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ACCORD EUROPEEN ET MEDITERRANEEN
SUR LES RISQUES MAJEURS
(EUR-OPA)

EUROPEAN AND MEDITERRANEEN
MAJOR HAZARDS AGREEMENT
(EUR-OPA)

RESEAU DES CENTRES EURO-MEDITERRANEENS SPECIALISES DE L'ACCORD EUR-OPA RISQUES MAJEURS

ACTIVITES DEVELOPEES DANS LE CADRE DES PROGRAMMES COORDONNES POUR 2012-2013

NETWORK OF SPECIALISED EURO-MEDITERRANEAN CENTRES OF THE EUR-OPA MAJOR HAZARDS AGREEMENT

ACTIVITIES DEVELOPED WITHIN THE COORDINATED PROGRAMMES FOR 2012-2013

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1. USING INFORMATION TO SAVE LIVES AND HELP VICTIMS

1.A. Assessment of events and population alert

MULTI-SENSOR TECHNOLOGIES FOR EWS OF LANDSLIDES AND MAN-MADE STRUCTURES

TARGET COUNTRIES : France, Georgia, Italy

PARTNERS INVOLVED :

COORDINATING CENTRE : CERG Strasbourg, France

OTHER CENTRES: GHHD Tbilisi, Georgia,

OTHER PARTNERS : Delft University of Technology (TUD, T.A. Bogaard), National Research Council, Institute for the Dynamic of Environmental Processes (CNR-IDPA, S. Sterlacchini), National Research Council, Research Institute for Geo-Hydrogeological Protection (CNR-IRPI, S. Frigerio, L. Schenato), Centre National de la Recherche Scientifique, Institut de Physique du Globe de Strasbourg (CNRS-IPGS , J.-P. Malet), Restauration des Terrains de Montagne 04 (RTM, G. Guiter)

EXECUTIVE SUMMARY

The project explored the feasibility of the use of multi-sensor technologies as possible early-warning systems for landslides and man-made structures, and the integration of the information collected in a simple Decision Support System (DSS).

The applicability of different techniques for displacement and deformation monitoring of landslides and man-made structures were summarizes successively. The performance acoustic emissions (AE) monitoring and point cloud (LiDAR, stereo-photogrammetry from terrestrial or spaceborne platforms) monitoring were presented and some guidelines for the selection of the most appropriate technique for a specific monitoring problem.

The project targeted the review of innovative remote sensing techniques that have emerged during the last decade and which are potentially useful or even already operational for landslide monitoring. First, criteria are proposed to compare their capabilities and, second, guidelines for the selection of the most appropriate technique for monitoring different landslide types, displacement rates and environmental settings are provided. The guidelines are furnished to aid operational decision-making, and include information on the spatial resolution, accuracy and coverage, data and processing costs, and maturity of the method.

Based on the previous results, the implementation of a simple DSS to manage data flow of rain, groundwater and displacement time was presented series and on the development of a combined statistical-mechanical approach to predict changes in landslide displacement rates from observed changes in rainfall amounts. Finally, the calibration procedure has been performed on a daily basis by optimizing model performance over several sizes of time windows as the objective of the model application is to predict daily displacement from the rainfall time series.

OBJECTIVES OF THE PROJECT

Global objective for 2012-2013 :

The purpose of the project is to test the use of multi-sensor technologies as possible early-warning systems for landslides and man-made structures, and the integration of the information in a simple Decision Support System (DSS). The final aim is the provision of timely and effective information that allows individuals exposed to hazard to take appropriate actions to avoid or reduce their risk and prepare for effective response. The observation techniques used are displacement sensors (such as low-cost GPS and tiltmeters), hydrological sensors (pore water pressure, temperature) and strain sensors (FO technology, possibly seismometers) for which some of the observations are transmitted automatically (GSM, web-services, etc.). Not all sensors will be tested at all the monitored sites, but the fluxes of data will be integrated in a simple DSS that will allow to manage the data, propose some interactive graphs, identify some thresholds and prospective hazard scenarios that could be used for pre-alert and alert. Finally (not within the scope of this 2-year project), the possibility of linking the fluxes of observation data to people in charge of the decision-making in case of major disaster will be considered.

In this project, particular attention will be paid to some new possibilities available in the field of distributed monitoring systems of relevant parameters for landslide and man-made structures monitoring (such as large dams and bridges), and among them the distributed monitoring of temperature, strain and acoustic signals by FO cables. This novel technology appears stable, very accurate, and has the potential to measure several independent physical properties. However, the operative implementation and performance testing of such technique has not still been evaluated in a quantitative approach.

The objectives of the project are:

1) To assess the applicability and limitations of FO cable technology in landslide and man-made structures monitoring

based on both literature review and field experiments on relevant case studies in France, Georgia and Italy. Focus will be on the use of all physical variables that can be obtained using F0 (such as strain, temperature and acoustic signals) in order to provide timely and effective information on the dynamics of the structure.
2) To assess the use of arrays of multi-technique displacement sensors (tiltmeters, inclinometers, GPS, etc.) to monitor in real-time small ranges of displacement, on relevant case studies in France, Georgia and Italy.
3) To review the landslide and man-made structures EW systems already working in European countries in order to define to what extent multi-sensor technology can be incorporated in the EWs and what kind of added value can be provided.
4) To translate the observation and the analysed signals into a simple DSS able to visualize the data, identify some trends in the time series, and provide meaningful information usable to "foresee" a forthcoming possible catastrophic event.
The proposed activity associates three specialised centres (CERG, GHHD). The expertise of contributing academic partners (see above) guarantees the success of the research activities as they are already working closely together within European Projects. Co-funding to the research will be made available by each of the partners.
Specific yearly objectives :
2012 :
1) Analysis of the potential of FO cable technology for landslide monitoring (test site in France) through a 1 week field experiment.
2) Analysis of the potential of arrays of displacement sensors (tiltmeters, GPS, etc) with real-time data transmission for landslide monitoring (test site in France) and a large dam monitoring (test site in Georgia)
3) Development of a framework for a simple DSS system able to visualize the data, plot relevant information and identify trends and thresholds in the time series. Definition of the concept for the diagnostic.
2013 :
1) Analysis of the potential of FO cable technology for dam/bridge monitoring (test site in Luxemburg)
2) Consolidation of the data transmission equipment/procedure for real time monitoring in Georgia.
3) Creation of the DSS system, and implementation of all the data acquired, and test of the performance of the system.

EXPECTED RESULTS

2012 :
1) Organisation of a 2-days workshop to initiate the work
2) Literature review on FO cable technology and arrays of displacement sensors for landslide and man-made structures monitoring.
3) Field experiment to test FO cable technology at a landslide test site in France.
4) Implementation of tiltmeters and data transmission systems at the Georgia test site (large dam).
5) Framework/concept for the development of the simple DSS (specifications, visualization, etc).
2013 :
1) Organisation of a 2-days workshop to discuss the progress of the work
2) Field experiment to test FO cable technology at one landslide in France.
3) Consolidation of the arrays of equipment and data transmission system at the Georgia test site (large dam).
5) Development of the DSS prototype, integration of data and test of the system.
5) Diffusion of the results through joint publications

RESULTS OBTAINED PREVIOUSLY (if any)

The proposed activity will take advantages of previous results obtained within the activity of CERG members, on the test of FO technology for soil temperature monitoring on landslide (Krzeminska et al., in press) and in rivers (Westhoff et al., 2011) and on the use of arrays of GPS and extensometers on landslides with a near-real time data transmission (Malet et al., 2011) . It can take advantage of the CERG activity 'Real-Time Management of Emergency Phase in the aftermath of Natural Disasters ' which objective was to develop a beta-version of a DSS system able to manage data and communications.

References:
Krzeminska, D.M., Steele-Dunne, S., Bogaard, T.A., Rutten, M., Sailhac, P. Géraud, Y. 2011. High-resolution temperature observations to monitor soil thermal properties as a proxy for soil moisture condition in clay-shale landslide. Hydrological Processes, DOI: 10.1002/hyp.7980
Westhoff, M. C., T. A. Bogaard, and H. H. G. Savenije, 2011. Quantifying spatial and temporal discharge dynamics of an event in a first order stream, using Distributed Temperature Sensing, HESSD, Hydrol. Earth Syst. Sci., 15, 1945–1957, 2011. doi:10.5194/hess-15-1945-2011
Peters, E.T. J.-P. Malet, T.A. Bogaard (2010). Multi-sensor monitoring network for real-time landslide forecasts in early warning systems. Pp. 335-340. Proceeding conference on Mountain Risks: bringing science to society (Ed. J.-P Malet, T. Glade, N. Casagli). Florence 2010. ISBN 2-9518317-1-5
Malet, J.-P., Ulrich, P., Déprez, A., Masson, F., Lissak, C., Maquaire, O., 2011. Continuous monitoring and near-real time processing of GPS observations for landslide analysis: a methodological framework. In: Margottini, C., Canuti, P. Sassa, K. (Eds): Proceedings of the Second World Landslide Forum, 3-7 October 2011, Rome, Italy, Springer (to be published in 2012).
Co-funding 2012 :
- TUD: KultuRISKProject funded by the European Commission by the Seventh Framework Programme - co-funding provided: 2000 €.

- CNR-IDPA/IRPI: CHANGES project funded by the European Commission by the Seventh Framework Programme - co-funding provided: 2000 €.
- CNRS / RTM : La Valette DSS System funded bt DTT Alpes-de-Haute-Provence - co-funding provided: 2000 €.
Co-funding 2013:
- TUD: KultuRISKProject funded by the European Commission by the Seventh Framework Programme - co-funding provided: 1000 €.
- CNR-IDPA/IRPI: CHANGES project funded by the European Commission by the Seventh Framework Programme - co-funding provided: 2000 €.
- CNRS / RTM : La Valette DSS System funded bt DTT Alpes-de-Haute-Provence - co-funding provided: 1000 €.

RESULTS OBTAINED IN 2012

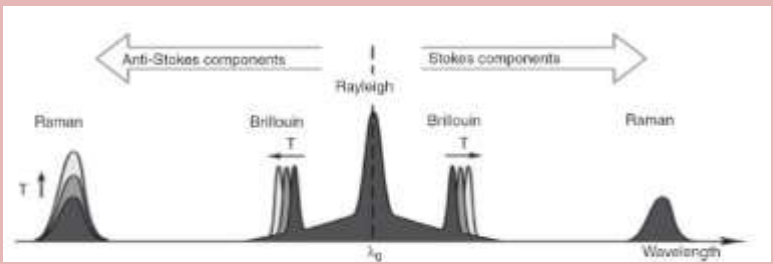
Work package 1 (prepared by CERG Strasbourg, France, TUD, CNRS, RTM*):*
Applicability and limitations of fiber optic cable technology for landslide and man-made structure monitoring
Associated deliverables:
1.1 Review on the use of FO cable technology for landslide and man-made structures monitoring (CERG)
1.2 Field experiment to test in practice the use of FO technology to monitor temperature, strains and acoustic signals on a landslide site in France (CERG)

Applications and limitations of fiber optic (FO) cable technology for landslide research

First, a thorough literature review was done to assess the applicability and limitations of FO cable technology. This review was focused but not limited to application in landslide research. Fiber optic cables have been developed in the telecommunication business to send large amounts of information over large distances with the speed of light. Because of the commercial application, production costs are relatively low. Using Fiber optics for measurements has several advantages: it is for instance immune to electromagnetic interference and can used in a wide range of applications; using Fiber optic cables as distributed measurement devices gives the opportunity to gain knowledge in different both engineering and science.
The review assessed the physical properties that can be measured and the physical background. The possibilities to measure physical phenomenon are abundant and before searching for new applications, it is important to know what is possible with Fiber optic cables. The table below shows the Fiber Optic technique and the physical property of light to measure.

Fiber Optic technique	What is measured
Amplitude modulated	Measuring the intensity losses of the light
Phase modulated	Measuring differences in phase of a lightwave
Polarization modulated	Measuring the total polarization of the light
frequency modulated	Measuring the changes in frequency of the light

The main form of application of Fiber Optic relates to the backscatter of light and the temperature (and strain) dependence of the backscatter wave forms (see figure below). Lastly, also the attenuation of energy is looked at as that influences the total range over which a Fiber Optic technique can be applied.



The different operational fiber optic measurement techniques are compared below.

Scattering	Rayleigh	Raman	Brillouin
Temp. sensitivity [% °C^{-1}]	0.54	0.8	0.01
Temp. range [°C]	5 to 110	0 to 70	-30 to 60
Accuracy [°C]	1	0.01[2]	1
Spatial resolution [m]	1	0.25[3]	3-5
Fiber length range [m]	170	1000	51000
Measurement time [s]	2.5	40	4
Strain [μm]	-	-	100

A full list of current applications is then reviewed, showing that applications are mainly concentrated in engineered structures (like dams) and for temperature monitoring in natural conditions. Limited applications are found that apply strain related measurements in natural conditions: the second year of the APO-funded project will focus on this.

Applications of multi-sensor technology for the hydrogeophysial monitoring of landslides

Introduction

Hydrogeophysics typically consists in the combination of hydrological and geophysical methods for a better understanding of hydrogeological systems. Among key petrophysical parameters that can provide time-lapse sections of the topsoil, we consider the electric conductivity for its sensitivity to soil water contents.

The study site is the Super-Sauze landslide (French Alps) largely documented and monitored since several years. Triggered in the 1960s, the landslide is representative of slope instabilities developed in clay-shales (Fig. 1a). Previous studies highlighted the importance of material rheology, bedrock geometry and changes in pore water pressures as controlling factors of the landslide kinematics. The latter is known to vary seasonally, with two rapid groundwater recharge episodes (spring and autumn) and a progressive drainage from June to April but the relation between water table levels and precipitations remain poorly understood (Malet, 2003).

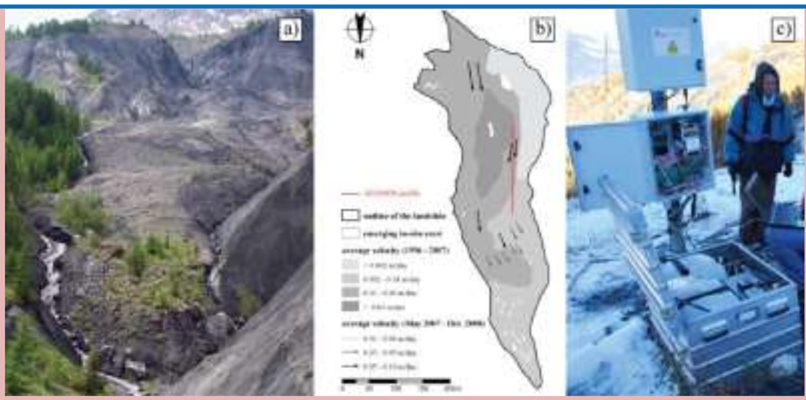
Recently, Travelletti et al. (2011) showed the possibility to monitor the hydrological response of a weathered clay-shale slope during a controlled rainfall experiment using time-lapse Electrical Resistivity Tomography (ERT). The high conductivity of the clayey soil generally results in poor resolution and sensitivity at depth. To avoid this problem, they used salt tracers and showed that it was possible to monitor water flows in the case of a simulated rainfall experiment, over short time periods.

In the present work, we consider a new electrical monitoring experiment at the Super-Sauze landslide dedicated to long period of monitoring (one year) under natural meteorological conditions. The monitoring is carried out along a profile located in the upper part of the landslide (Fig. 1b) within an area characterized by high displacement rates and several soil surface facies (with or without cracks, with different grain sizes and soil water conductivity). We present the experimental set up, and then show the first results in terms of electric resistivity but also streaming-potential (SP) and discuss about perspectives.

Setup of the GEOMON device on the Super-Sauze landslide

Contrary to most commercial systems that do not suit to permanent monitoring, the GEOMON4D resistivity monitoring system, developed by the Austrian Geological Survey (Vienna), was specifically designed for experiments needing high rate of data acquisition, records of full signal samples for noise detection, remote controlled management and automatic data transfer (Supper et al., 2002, 2003 & 2004). The device comprises 93 electrodes, separated in 24 injection and 69 potential electrodes. Their spacing, not regular, is 0.5, 1.0 or 2.0 m according to the cracking state of the topsoil for a total profile length of 113 m. 4300 quadripoles in a gradient array are acquired two times per day. SP measurements are also carried out every hour along the profile. The device is powered with a solar panel and an ethanol fuel cell (Fig. 1c) and the data are sent daily.

Wilkinson et al. (2010) show the importance of electrode movements in apparent resistivity measurement and propose to obtain displacement information directly from the resistivity data. Because our purpose is to monitor the underground water content through the electrical resistivity, we decided to monitor the electrode displacements independently. This is obtained by combining GPS campaign and time-lapse stereophotogrammetry. We equipped the 24 injection electrodes with 10 cm diameter white Styrofoam spheres on their top. Two high-resolution optical cameras were placed on stable crests nearby the profile; the cameras are spaced by 75 m and are able to monitor the displacement of the electrodes located 65 and 110 m downstream. The cameras are triggered every day at 12h, 14h and 16h so that the best picture (according to weather conditions and illumination) can be selected for the day. We monitor the electrode coordinate processing the pictures in four steps: (i) correction of the rigid camera movements (ii) detection of the white Styrofoam spheres centroïd plane coordinates based on a color detection algorithm (iii) correction of the lense distortion, and (iv) computation of the 3D global coordinate by stereo-restitution.



1. Multi-sensor instrumentation at the study site: a) Picture of the Super-Sauze landslide from 2006. b) Mean velocities and directions of horizontal displacements at the Super-Sauze landslide (modified from Amitrano et al., 2007). c) GEOMON4D device powered with a solar panel and an ethanol fuel cell.

The algorithm is tested on a period of one month in June 2012. During this period, we monitor the displacements of a permanent GPS antenna and show that the accuracy of the stereo-photogrammetry processing is 10 cm for the further electrode. Over this period, the profile had moved downhill between 50 cm and 76 cm. The obtained coordinate are then used in the ERT inversion.

In addition to the electrode displacements, other parameters are considered to correct possible effects on electrical resistivity changes as pointed by Travelletti et al (2011). Several hydrological sensors are set up along the profile to monitor soil temperature at several depths, groundwater conductivity, water temperature, and groundwater table level continuously at some places.

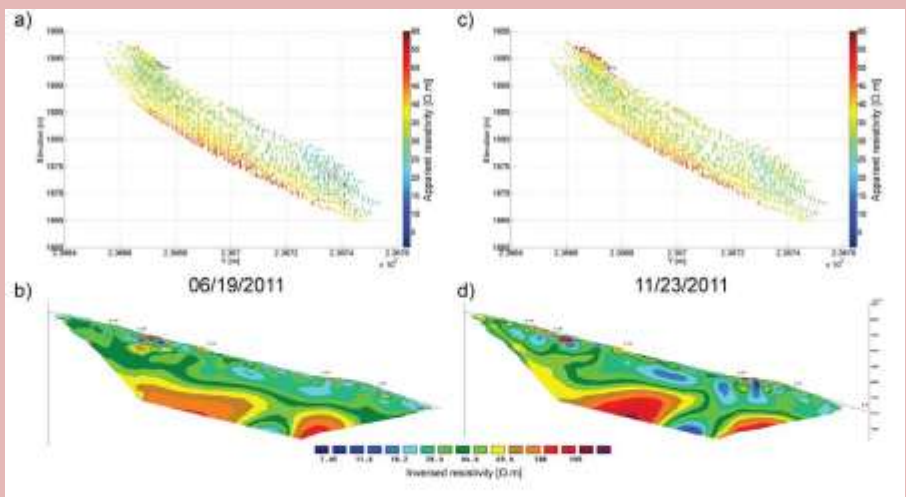
First results

They concern the electrical resistivity monitoring. Raw data are processed using three criteria:

- the measured voltage must be greater than 0.5 mV to ensure that the measure is not an ambient noise (e.g. magneto-telluric currents or sudden variations in streaming-potential);
- the error percentage between forward and reverse measurement must be lower than 15%, to ensure the good repeatability of the measurement;
- negative or null resistances are removed from the dataset.

This pre-processing permits to select 98% of the initial data to be inverted. The remaining 2% of the initial data is concentrated on a few quadripoles. Those low quality data appears to be more concentrated on dry periods an could be explained by a problem of contact between the electrodes and the ground due to shrinkage or swelling of the clay. This pre-processing allows verifying the coupling of the electrodes with the soil. Those problems can be periodically fixed when going back to the field.

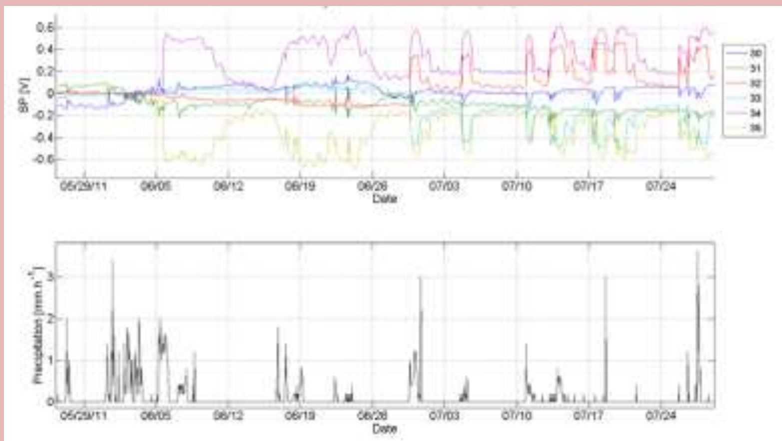
Among 500 slices, we show the results at two very contrasting days. The figure below shows two pseudo-sections and the corresponding inverted sections with RES2DINV. Both dataset have been inverted in five iterations with a misfit function lower than 5%.



Apparent and inversed resistivities at different dates. a) Apparent resistivity from the 19th June 2011. b) Inversed resistivity from the 19th June 2011. c) Apparent resistivity from the 23th November 2011. d) Inversed resistivity from the 23th November 2011.

Although the two datasets have been inverted separately and with the conventional parameters of RES2DINV, we observe resistivity differences mostly located in the landslide layer. This can be attributed to large changes in the soil

water content in the soil around the profile. More generally, apparent resistivity variations are noticeable during the six months of data. Some of them, for small quadripoles, are clear response to rainfall, and others show long wavelength variation. This first interpretation is done without consideration on the effect of temperature and groundwater conductivity that have to be considered when estimating actual water content from the resistivity.
Besides, the systems also provides the SP monitoring along the same profile; the figure belowshows a few dipoles. Although unpolarizable electrodes were not used, it seems by visual inspection that SP signals are stable enough and provides useful information. Indeed, their variations present different intensities, durations and are linked to some rainfall events (Fig. 3): a clear correlations is observed, for instance, on the 5th June 2011. Precise modelling of the SP do to the rainfall infiltration and groundwater flows would be necessary. Possibly, soil saturation plays a crucial role in these behaviors: Indeed, Allegre et al. (2012) has shown that coupling coefficient greatly depends on the water stauration, with smaller values at saturation than at lower saturation (at least in sand). Thus, SP data may provide important information on the infiltration that follows rainfall; both the observed time lag and the existence of non-appearance of SP response to rainfall could be related to the complex relation between rainfall and soil water content in the top soil.
SP monitoring from the 25th May to the 26th July 2011.a) SP voltage for 6 consecutive dipoles. b) Precipitation observed in the same period.



SP monitoring from the 25th May to the 26th July 2011.
a) SP voltage for 6 consecutive dipoles. b) Precipitation observed in the same period.

To monitor water flows in a clayey landslide, we monitor the electrical resistivity of the soil with time-lapse ERT technique. To allow a possible interpretation of the tomograms as groundwater content images, we also measured continuously the different parameters that affect apparent electrical resistivity (electrode movement, temperature and groundwater conductivity). The first results using the dataset of May-July 2011 show that apparent and inverted resistivities present low variations correlated with rainfall and large variations correlated with the increase of groundwater table. The GEOMON4D monitoring system also provides SP data which could be used to obtain information on the infiltration processes and the topsoil saturation. They could be used with the resistivity data to determine and classify the amplitude and durations of rainfalls which may lead to infiltration.

Work package 2 (prepared by GHHD Tbilisi, Georgia, CNRS*):*
Description:
Applicability and limitations of arrays of multi-sensor for the monitoring of landslide and man-made structures / Leader: GHHD
Associated deliverables:
D.2.1 Review on the use of displacement sensors for landslide and man-made structures monitoring (GHHD, CNRS)
D.2.2 1st stage implementation of the arrays of displacement sensors and telemetry at the Georgia test site, and pre-analysis of data (GHHD)

Modification of Loughborough University technique which is using acoustic sensor with gravel coating around waveguide

The goal of acoustic monitoring is to record acoustic signals generated by preliminary displacement of geologic formations before activation of the fast phase of landslides. The similar technique based on the recording of the acoustics generated by displacement in the gravel coating around acoustic sensor was earlier developed by Loughborough University team, but it demands drilling of relatively deep borehole down to the sliding surface. This procedure is quite expensive. Our objective was to develop a cost-effective version of the mentioned method. The idea is to use two sensitive acoustic probes grounded on different depths, one on the depth of several meters and other close to the day surface. The former probe is the basic and the role of latter one is to distinguish signals of surface origin, which in this case are considered as noise.

The probes are constructed from thick-wall stainless steel tube containing acoustic sensor (Fig.8). The length can be chosen according to the depth of investigation by screwing additional sections to the tube containing basic sensor. The length of these sections is 1.5 m; the maximal depth of probe is of the order of 4 m.
The upper part of the basic probe is manufactured as a cylinder rod with inclined cut. The precise finish of the cut surface guarantees good contact of acoustic sensor with probe tube. Investigation of various types of acoustic sensors in laboratory led to conclusion that for the frequency range of interest, i.e. frequencies generated by displacements in the gravel coating i.e. 5-25 KHz the best solution is the capacity capsule-microphone, glued with his sensitive membrane side to the surface of the upper end of the probe (Fig. 9b).
The whole electronic module, located in the upper part of the probe and consisting of capsule-microphone, filters and integrator schemes is seated into hermetic box to avoid environment impact. The hermetization of connection of electronic module to the probe tube is performed by the soft rubber in order to avoid damping and accordingly, decrease of acoustic signal amplitude (Fig.9c).
Electronic module consists of low-noise amplifier, buffer amplifiers of output for signal waveform A and precision peak-integrator and DC voltage output B for recording in the datalogger (Fig. 10 a,b). The integrator fixes in its memory the maximal value of obtained signal and after this the signal decays by the rate 5% per minute. Fixing on datalogger the readings with the sampling rate 1 per minute allow obtaining the necessary information on the variation of acoustic noise in the time domain.
Below is presented (Fig. 11) a real two-ray oscillogramm, where the acoustic burst arriving on the background of the ambient noise is visible as well as peak value of the signal from the output of the datalogger. It is evident that logger output fixes the peak output signal – the DC out B voltage increases rapidly according to the signal waveform out front.

A two-ray oscillogramm, where the acoustic burst arriving on the background of the ambient noise is visible as well as peak value of the signal from the output of the datalogger (clipped).

At present the system is tested in laboratory conditions.

Development of cost-effective telemetric system for real-time data communication from multi-sensor monitoring network to remote diagnostic centre

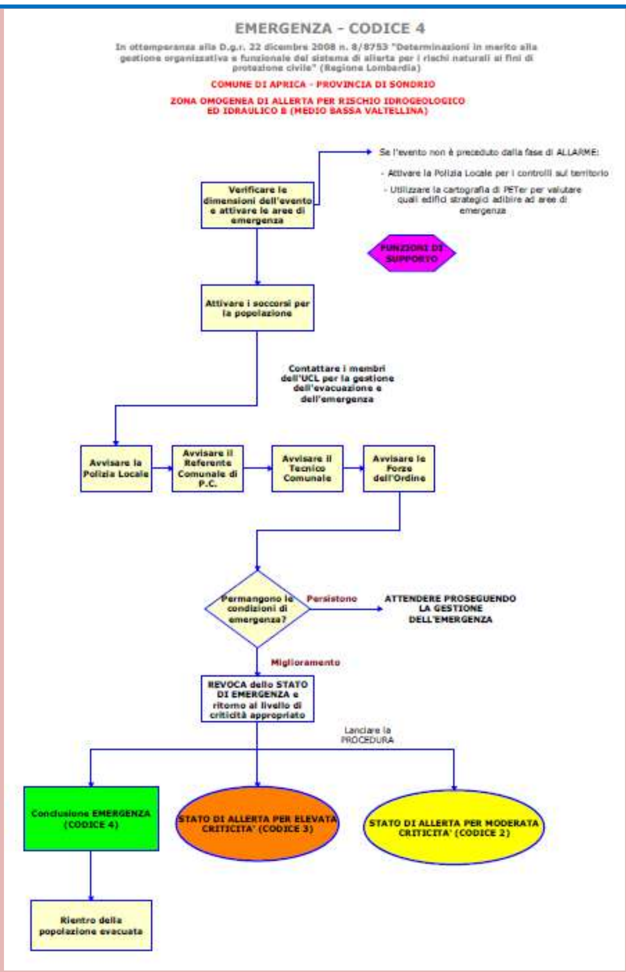
For the automation and telemetric data communication from multi-sensor monitoring network to remote diagnostic centre the GHHD and Institute of Geophysics prepared a technical project and the organization – "ALGO, ltd" was ordered to construct the real-time operating telemetric system. After laboratory testing the system was installed on the 360 m, 402 m and 475 m levels of the section 12 of the Enguri high arc dam for monitoring tiltmeter network data. The data acquisition and transmitting system (DAMWATCH) supports the collection of data in a form of an electronic data table and their transmission to the diagnostic center in Tbilisi for the further processing and analysis of the material. Though the system was developed for dam monitoring, it can be used for monitoring any dynamical system (constructions, bridges, landslide areas etc).
The system consists of several terminal controllers (in accordance to the quantity of points) and a central controller that is connected with the GSM/GPRS Modem (Fig. 8). The diagnostic center is equipped with a computer with a static IP address connected to Internet and supported by proper server programs. The number of the objects under monitoring and their geographic areas connected with one computer is limitless in the GSM/GPRS cover zones.
The terminal controller is a microprocessor with 3 similar inputs on the one hand and RS485 interface – on the other hand. The number of inputs may vary according to the tasks. The diagram of the figure 3 shows the controllers linked to a sensor that provide continuous measuring of the tilt X and Y components and the temperature T and their transformation into digital data. The terminal controllers are linked to the central controller by a RS485 bus-bar. The bus-bar is presented as a couple of overwound wires that are connected with all terminal and central controllers simultaneously. The permissible total length of the bus-bar is 1300 m. The maximal number of controllers connected to one bus-bar is 32.
The central controller receives information alternatively from the terminal controllers linked with the bus-bar, and then collects data in its memory and automatically transmits them by means of the modem in regular time intervals to the diagnostic center database. The transmitting time intervals are defined according to tasks and vary from one

minute to several days. An extraordinary transmission of data from the objects is possible as well. The transmission is fulfilled by means of GSM/GPRS service that is quite necessary for the monitoring processes.
The central controller in the data exchange process functions as FTP client by means of the GSM/GPRS modem, and the computer in the diagnostic center is supported by FTP server and a special utility that provides the input of the data received from the client into the database. The central controller is operated and configured by SMS directives from the research center.
The database records the arrival time and the ordinal number of the data. Moreover, it informs about presence or absence of electric power as for the central controller as well for each terminal controllers. In case of electric failure the controllers are fed from the local batteries. The memory size of the central controller is 262144 bytes. In case of 3 terminal controllers the average size needed by one datum is 105 bytes. Thus, in a minute data transmission regime the whole memory is sufficient to save information during 41 hours.
After processing the data we obtain information about the dam tilts in angle seconds or about its displacement against the dam axis according to the current technical and tectonic processes practically in real time – with delay depending on technical details. It is evident that the accurate data received in short time intervals from multi-sensor will give huge information about the technical state of the construction. There is no problem in applying this system for multi-sensor monitoring of landslides and debris-flows.

Work package 3 (prepared by CERG Strasbourg, France , CNR-IDPA, CNR-IRPI, CNRS):
Description:
Development of a simple DSS system to manage the dataflow and identify thresholds in the time series
Associated deliverables:
D.3.1. Review of existing DSS system used to manage data acquired on landslides and man-made structures (CERG, CNR-IDPA, CNR-IRPI, GHHD) - M+6
D.3.2. Guidelines for the development of a simple operational; DSS - Definition of functionalities (CERG, CNR-IDPA, CNR-IRPI, GHHD) - M+12

Translate of the observations and the analyzed signals into a simple DSS able to visualize the data

On the basis of past experience, the priority is to design and make available solutions easy to use. Starting from this assumption, the proposed system has been designed in order to improve the capacity of local authorities to cope with natural disaster preparedness and response activities by acknowledging some important demands, needs, and policies from the expected final users. The system architecture (in terms of functionalities and characteristics) is based on the outcomes of some user's requirements meetings in which the stakeholders have specified their desiderata. Specifically, during these meetings, the actors that will interact with the system have been identified and the roles they play specified. The actors comprise the various types of stakeholders, system administrators, information providers, experts and any other external programs and data sources which interact with the system.
To this end, some system prototypes have been defined and submitted to the stakeholders and potential actors for their feedback and refinement. Based on the outcomes of this first step, the system architecture has been defined, including all components and considering their interactions. The system hereafter described provides tools able to identify and prepare people in charge to take actions, define the activities to be performed, be aware of available resources and optimize the communication system for data transfer and sharing. In this way, the system can help to plan in advance response and rescue to disaster-related emergency anticipating, as far as possible, the demand for disaster relief operations. This will rely on the main requirements and actions expected for each phase of the emergency concerning different risk scenarios. The signals derived from FO cables will be the input to give the start of the procedure managed by the system that is able to activate a flow of response actions according to pre-defined thresholds and on the base of the legislative framework in charge in each country involved in this project.
The system has been designed and tested in a Consortium of Mountain Municipalities (Valtellina di Tirano, Central Alps, Northern Italy) that has been affected by natural disasters over the past years, experiencing significant losses. Nowadays, the system is in full operation at a municipal and inter-municipal level, continuously updated by local end-users and it is expected to significantly improve the capacity of the community to face the negative effects of prospective disasters by organizing the delivery of timely response, rescue, relief and assistance activities. It is expected that the same system will be operational in a short time at Barcelonnette municipality, the largest town in the Ubaye Valley, given that many work phases (hazard and risk scenario definition, inventory of elements at risk, list of strategic resources and structures available for response and rescue, collection of Laws and Decrees concerning Civil Protection matters, etc.) have already be accomplished.



Emergency workflow. A detail of the main procedural steps related to Code 4 – hydrogeological critical state "Emergency" (in compliance with the regulations in Lombardy Region) is represented. Four other workflows are available for hydrogeological risks: from Code 0 – hydrogeological critical state "Null" to Code 3 – hydrogeological critical state "High".

Dissemination of project results

Gance, J., Sailhac, P., Malet, J.-P., Supper, r., Jochum, B., Ottowitz, D., Grandjean, G. 2012. Electrical Monitoring of the Super-Sauze Landslide (French Alps). Near Surface Geoscience 2012 – 18th European Meeting of Environmental and Engineering Geophysics, Paris, France, 3-5 September 2012 [Poster presentation]

Bogaard, T.A., Wenker, K., Malet, J.-P. 2013. A search for applications of Fiber Optics in early warning systems for natural hazards. EGU 2013 General Assembly, Vienna, 7-13 April 2013.

RESULTS OBTAINED IN 2013

Working package 1 (prepared by CERG Strasbourg, France TUD, CNRS, RTM*):*

Description:

Applicability and limitations of FO cable technology for landslide and man-made structure monitoring

Leader: CERG

Associated deliverables:

D.1.3 Writing of a joint publication (CERG, TUD, CNRS, RTM) -M+24

The results are detailed in the following report:

- CERG-TUD_Report-FiberOptics-2012.pdf
- CERG-TUD_Report-FiberOptics-2013.pdf

A scientific publication will be written in Spring 2014 on the basis of the reports. A leaflet explaining the technique to the end users will be available for Spring 2014. A presentation of the results was already carried out in 2013 at the 8th IAG International Conference on Geomorphology: Bogaard, T.A. Wenkers, K., Malet, J.-P. *Can fiber optic technology be used in early warning systems for landslide initiation?* 8th IAG International Conference on Geomorphology ''« Geomorphology and Sustainability », 27-30 August 2013, Paris, France (poster presentation).

Work package 2 (prepared by GHHD Tbilisi, Georgia, CERG Strasbourg, France, CNRS):
Description:
Applicability and limitations of arrays of multi-sensor for the monitoring of landslide and man-made structures
Leader: GHHD
Associated deliverables:
D.2.3 2nd stage implementation of the arrays of displacement sensors and telemetry at the Georgia test site (GHHD) - M+18
D2.4 Analysis of data, and integration in the DSS system (GHHD, CERG, & CNRS) - M+21

The applicability of different techniques for displacement and deformation monitoring of landslides and man-made structures are summarizes successively. It presents successively the performance acoustic emissions (AE) monitoring and point cloud (LiDAR, stereo-photogrammetry from terrestrial or spaceborne platforms) monitoring and at the end some guidelines for the selection of the most appropriate technique for a specific monitoring problem.
The results are disseminated in the following manuscripts:

- Stumpf, A., Malet, J.-P., Allemand, P., Deseilligny, M.-P., Skupinski, G. (in review). Terrestrial multi-view photogrammetry for landslide monitoring, Journal of Geophysical Research. 48p.
- Stumpf, A., Malet, J.-P., Allemand, P. (in review). Stereo-photogrammetry and displacement monitoring with Pleiades VHR satellite images. Geophysical Research Letters, 12p.
- Stumpf, A., Malet, J.-P., Kerle, N., Michoud, C., Tofani, V., Segoni, S., Michoud, C., Jaboyedoff, M., Casagli, N. (submitted). Selecting appropriate remote sensing techniques for landslide monitoring: Review and selection criteria for users. Earth Science Reviews (accepted, in press).
- Raucoules, D., de Michele, M., Malet, J.-P., Ulrich, P. 2013. Time-variable 3D ground displacements from High-Resolution Synthetic Aperture Radar (SAR). Application to La Valette landslide (South French Alps). Remote Sensing of Environment, 139: 198-204.
- Gance, J., Malet, J.-P., Dewez, T., Travelletti, J. (accepted, in press). Detection and continuous tracking of moving objects for characterizing landslide displacements from terrestrial optical images. Engineering Geology, 20p.
- Travelletti, J., Malet, J.-P., Delacourt, C. (accepted, in press). Multi-date correlation of Terrestrial LaserScanning data for the characterization of landslide kinematics. Journal of Applied Earth Observation and Geoinformation (accepted, in press).

2.1 Performance of acoustic emission for landslide and man-made structure monitoring (GHHD)

Acoustic emissions (AE) carry information about location, intensity, and deformation mechanisms occurring in a material. Detecting AE generated by a developing shear surface within a slope is not an easy task. The goal of our study is registration and monitoring of landslide slow motion (creep) by recording the acoustic emission. For this goal we developed the special equipment (Fig. 2.1a). Plastic barrel is filled with a soil from the landslide, the in the center of which is a cylinder filled with gravel (mean diameter about 7 mm). In the center of gravel parcel a thick-wall stainless steel tube is placed, through which acoustic pulses aroused in the gravel are transmitted to the acoustic sensor and then to recording oscilloscope (Fig. 2.1c) . The deformation of the experimental set up is done with the help of a mechanical jack or pendulum strike. Continuous recording waveform and DC voltage was done using USB oscilloscope. One of the record fragments is shown on Fig. 2.1b.

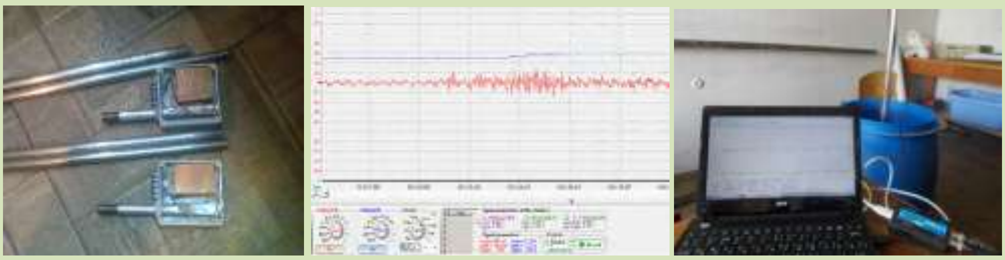


Figure 2.1. a) Acoustic sensor; b) AE registration accompanying, records of acoustic signal level and waveform using USB oscilloscope; x-axis is time in sec, y-axis is the acoustic signal intensity in volts, c) Landslide creep modeling barrel and monitoring equipment.

We also produced collision pendulum (4.57 kg iron core) to the barrel and calculated the force of impact. To calculate the force it is necessary to know the time of contact of the pendulum to the barrel. To measure the contact time piezo sensor was used. Recordings received by piezo sensor and acoustic sensor at the collision of the pendulum to the barrel are shown in Figure 2.2 a, b.

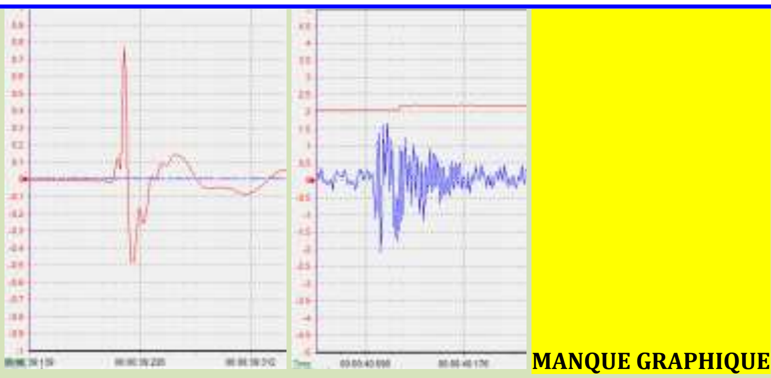


Figure 2.2. a) record on USB oscilloscope of acoustic signal generated during clash 54 cm length pendulum deviated by 50 cm using piezo sensor, b) Records of acoustic signal level and waveform generated during clash using USB oscilloscope; x-axis is time in sec, y-axis is the acoustic signal intensity in volts, c) Processing records of acoustic signal level increment (without constant component) generated during clash of 50 cm deviated pendulum (54 cm length)

Experiments were conducted for various intensities of pendulum impact (various deviations from equilibrium) and corresponding impact force F on the barrel was calculated using formula $F = p/t$, where p is pulse and t is the contact duration. If these results are compared with the pendulum impact forces on the barrel it can be concluded that the force exerted on the landslide body (in our experiments) should be no less than 80 N to clearly indicate the perturbation acoustic signal.

For the automation and telemetric data communication from landslide multi-sensor monitoring network to remote diagnostic centre the data acquisition and transmitting system (DAMWATCH) can be used. The GHHD and Institute of Geophysics prepared a technical project and the organization – "ALGO, ltd" was ordered to construct the real-time operating telemetric system. After laboratory testing the system was installed on the 360 m, 402 m and 475 m levels of the section 12 of the Enguri high arc dam for monitoring tiltmeter network data. The data acquisition and transmitting system (DAMWATCH) supports the collection of data in a form of an electronic data table and their transmission to the diagnostic center in Tbilisi for the further processing and analysis of the material. Though the system was developed for dam monitoring, it can be used for monitoring any dynamical system (constructions, bridges, landslide areas etc). The system consists of several terminal controllers (in accordance to the quantity of points) and a central controller that is connected with the GSM/GPRS Modem (Fig. 8). The diagnostic center is equipped with a computer with a static IP address connected to Internet and supported by proper server programs. The number of the objects under monitoring and their geographic areas connected with one computer is limitless in the GSM/GPRS cover zones. The approximate cost of the DAMWATCH system is 3000 €.

2.2 Performance of point cloud (LiDAR, stereo-photogrammetry) for landslide and man-made structure monitoring (CERG)

Correlation of terrestrial LiDAR point clouds for 3D displacement measurement

The potential of terrestrial LiDAR (TLS) for the monitoring of geomorphologic processes has been demonstrated in the last years, mainly for defining the structure of rocky slopes susceptible to rockfalls and rockslides (Abelan et al., 2009; Oppikofer et al., 2008) or characterizing the dynamics of ice glaciers (Avian et al., 2009) and landslides (Teza et al., 2008). Automatic matching algorithms applicable to TLS data have started to be developed because of their capability to fully exploit all the geometric information available in the point clouds. The approach is to find correspondences among typical features located in multi-temporal point clouds assuming that the tracked object has a constant geometry in time and/or a perfectly rigid behaviour.

Correlation techniques can be applied on repeated TLS point clouds in order to characterize the 3D displacement field. The hypothesis is that for objects scanned from a unique view point, simple 2D correlation functions can be applied on multi-date point clouds and yield the same range of accuracy than complex and time-consuming 3D surface matching algorithms (Teza et al., 2008). The processing chain has been developed on datasets acquired at the toe of the Super-Sauze landslide (Fig. 2.3a). A long-range terrestrial laser scanner Optech ILRIS-3D has been used for the monitoring (Travelletti et al., in press). Ten acquisitions were acquired between October 2007 and May 2010 at an average distance of 100 m from the landslide toe (Fig. 2.6a). A projective transformation is used to represent the entire geometrical information in a plan perpendicular to the viewing direction of the laser scan using the collinearity equations (Kraus and Waldhaüsel, 1994). The point density varies from 0.78 to 0.94 pt.pixels^{-1} with a relatively low standard deviation of 0.18 pt.pixel^{-1}. Because the correlation function gives better results where the input data contains regions of rapidly varying pixel information, the norm of the 2D gradient (in the direction u and v) of the line of sight is calculated for emphasizing the morphology of the landslide. The images are then converted in grey-scale values and are used as inputs for the image correlation (Fig. 2.3b).

Two acquisition periods (July–October 2008, July–October 2009) are presented (Fig. 2.4). For the period July–October 2008, displacements between 0.5 and 1.5 m are observed, corresponding to an average displacement rate of 0.6 to 1.7 cm.day^{-1}. The displacement field is heterogeneous. The largest displacements are detected in the front where the slope gradient increases. The detachment of a toe compartment is also highlighted in the front. During the period July-October 2009, the landslide displays a very different kinematics both in terms of magnitude and spatial distribution. Displacements are shorter and range from 0.1 m at the front to 0.6 m in the upper part, corresponding to an average displacement rate of 0.1 to 0.8 cm.day^{-1}. The accuracy on the determination of the displacement rates is estimated through comparisons with dGPS surveys on a series of benchmarks. A mean error and a standard deviation of 0.04 m and 0.03 m are determined

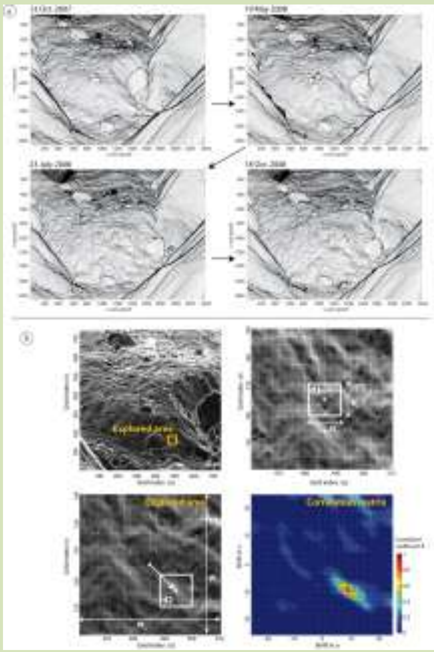


Figure 2.3. Image correlation applied on TLS point clouds at Super -Sauze lansdslide. (a) Images derived from the gradient calculation on a series of TLS point clouds for the period October 2007 – October 2008 at Super -Sauze. The morphology of the landslide toe is very well depicted and the progression of the landslide toe is highlighted. The grey -scale images are then correlated. (b). Principle of the image correlation applied to TLs point clouds. Top right: Grey -intensity value of the interrogation image and location of the explored area; Top left: Correlation window d1 of the reference image. Nu and Nv are the size of the correlation window; Bottom left: Explored area of size Wu and Wn of the interrogation image. The correlation window d2 is shifted in both direction u and v in the explored area, the correlation coefficient R between d1 and d2 is calculated for each grid shift. The location of the maximum correlation coefficient is a direct measurement of the displacement (white arrow) with respect to the origin of the correlation window d1; Bottom right: Values of the correlation coefficient R calculated for each grid shift. (adapted after Travelletti et al., in press).

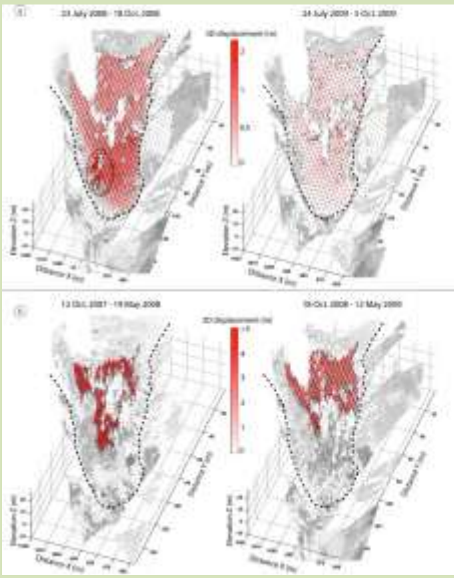


Figure 2.4. 3D displacement fields obtained by TLS measurements at Super -Sauze landslide for the acquisition periods of (a) July -October of the years 2008 and 2009, and (b) October–May of the years 2007 and 2008. The dashed circle indicates shallow slips at the front. The displacement maps are represented on their corresponding point clouds (intensity values).

(adapted after Travelletti et al., in press).

The method allows estimating the strain fields from the computed displacement fields in order to characterize possible strain localization and the material behavior in the damaging zone. Because the displacements are mainly in the horizontal plane, the strain fields are determined with the 2D Cauchy strain tensor E (Teza et al., 2008). The strain analysis allows discriminating mechanical units in extension, compression and affected by shearing (Fig. 2.5a, 2.5b). The upper part of the front is characterized by a succession of approximately parallel bands (width of 5 to 10 m) in compression and extension whose main orientation is perpendicular to the sliding direction (Fig. 2.8a). Except near the landslide boundary, the upper part is not affected by important shearing (Fig. 2.5b). The location of the compression and extension zone changes from 2008 to 2009, thus suggesting a possible displacement of these areas downslope. The consequence of this extension results in the development of tensile fissures identifiable in the field (Fig. 2.5c). The front is also affected by important shearing concentrated along the landslide boundary.
The high shear values in these sectors are confirmed by the presence of persistent shear fissures affecting the landslide material (Fig. 2.5c).

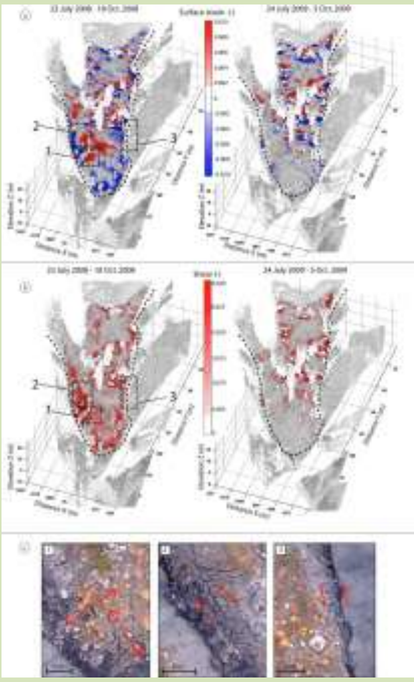


Figure 2.5. Strain field obtained by TLS measurements at Super-Sauze landslide. (a) Maps of the surface strain (a positive value means extension). (b) Maps of shear strain. The dashed squares refer to Fig. 2.7. The strain maps are draped on their corresponding point clouds (intensity values). (c) Mophological observations proving the deformation pattern quantified in the point clouds, with tensile fracture (1) and shear fracture (2, 3) observed at the front of the toe on an orthophotograph acquired in October 2008. (adapted after Travelletti et al., in press).

Time-lapse multi-view terrestrial stereo-photogrammetry for 3D displacement measurements and volume estimates

The costs of the equipment and the logistics of LiDAR surveys are, still currently, rather high and, therefore, acquisitions at high temporal resolution are not always feasible. Conventional photogrammetric techniques with metric and non-metric cameras are a frequently employed alternative for a wide range of applications but comprise high demands on the image acquisition geometry, ground control, processing software and the experience of the operator (Henry et al., 2002; Fryer et al., 2007).
Fallourd et al. (2010) and Travelletti et al. (2012a) have demonstrated that terrestrial time-lapse photography is a valuable tool for the monitoring of landslides and glaciers but multi-view photogrammetry has not yet been tested in this context. Great advances of the photogrammetry and computer-vision communities in pose-estimation and bundle-adjustment (Triggs et al., 2000; Hartley and Zisserman, 2004), camera self-calibration (Pollefeys et al., 1999) as well as feature-based and area-based image matching (Lowe, 2004; Pierrot-Deseilligny and Paparoditis, 2006; Furukawa and Ponce, 2010) have recently converged in a new class of photogrammetric algorithms and tools that enable more flexible 3D surface reconstruction from unordered non-metric image collections. They are summarized under the terms Structure-from-Motion (SfM); being the process of estimating camera parameters and sparse point-clouds, and Multi-View Stereo (MVS), which is the process of deriving dense surface models once the correspondence of multiple cameras has been established.

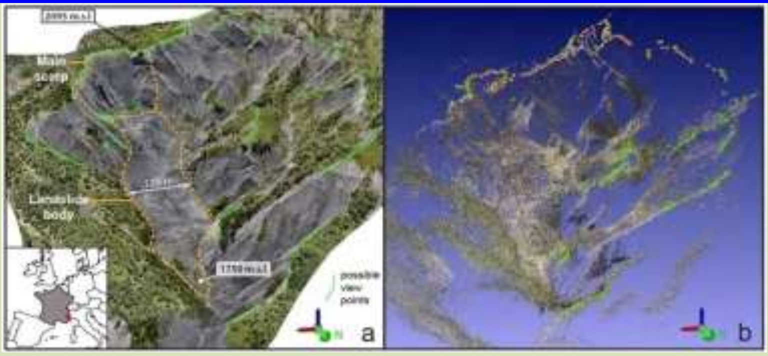


Figure 2.6. Image acquisition at Super-Sauze landslide for SfM-MVS processing. (a) Location and overview of the landslide with possible view points. (b) Exemplary reconstruction results (unscaled sparse point cloud, 18 July 2013) illustrating the camera acquisition protocol for the full scene reconstruction. Cameras positions are depicted by red/green icons. (adapted after Stumpf et al., submitted).

Many proposed approaches for SfM and MVS are now implemented in commercial softwares (AgiSoft PhotoScan, Pix4D, PhotoModeler Scanner, Trimble Inpho), web-based services (Photosynth, Autodesk 123D, Arc3D, Cubify Capture) as well as in open-source softwares (Snavely et al., 2008; Furukawa and Ponce, 2010; Rothermel et al., 2012). However, none of these resources allows the design of a nearly automated processing pipeline, with a complete control on the processing steps. We therefore investigated the possibility to propose a pipeline based on open source processing tools (Wu et al., 2011; Deseilligny et al., 2013) for the monitoring of active landslides (Stumpf et al., submitted).

Regular acquisitions of terrestrial photographs in a MVS setup have been carried out since October 2011 at regular intervals. A Nikon D700 camera has been used, the focus has been set to infinity, and care has been taken to obtain a good trade-off between sufficiently short exposure time and large depth of field (narrow aperture) during all acquisitions. Series of 300 to 400 photographs were taken for the 3D reconstruction at each campaign.

Apero-MicMac is an open-source code for multi-view image correlation (Deseilligny et al., 2013). The code comprises tools for tie-point extraction (Tapioca), pose-estimation, camera-calibration, bundle-adjustment (Apero; Deseilligny and Clery, 2011), dense-matching (MicMac) and georeferencing as well as tools dedicated to point cloud extraction, creation of masks and orthorectification. Several aspects of the algorithm are described in Deseilligny et al. (2013) and Stumpf et al. (submitted). The basic principle is to select one base image Ib and at least two matching images Im and the 3D object surface will be estimated as the depth relative to Ib. To evaluate the accuracy of the SfM-MVS pipeline, the results were compared against the corresponding terrestrial LiDAR scans (at 3 dates) and the mean-absolute error (MAE), the root-mean-squared error (RMSE) and the mean distance (MD) between the point clouds are reported. While MD does not reflect the accuracy of the 3D model, it was found to be a useful indicator for a potential bias after scaling and co-registration.

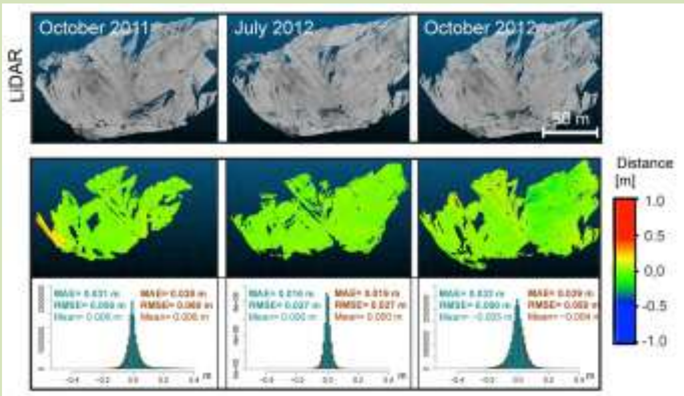


Figure 2.7. Comparison of the SfM-MVS pipeline Apero/MicMac (bottom) against terrestrial LiDAR scans (top) considered as reference for three dates. MAEs, RMSEs, and mean differences from two different point-cloud comparison methods are reported. (adapted after Stumpf et al., submitted)

The RMSEs of the obtained models (Fig. 2.7) were between 2.7 cm and 5.6 cm according to the dates. In this context it is worth noting that the uncertainty of the terrestrial LiDAR is within a range of 2-3 cm and at an RMSE of 2.7 cm it is, therefore, not possible to state with certainty if the LiDAR or the photogrammetric point cloud is more accurate, and we can thus consider stereo-photogrammetric techniques as an interesting alternative to terrestrial LiDAR surveys. The datasets allow quantifying and interpreting the landslide dynamics. The example of change detection between the photogrammetric models of October 2012 and July 2013 (282 days) is depicted in Figure 2.8. At an estimated co-registration error of 0.2 m, the minimum displacement that can be detected at 95% confidence is 0.4 m. The general change pattern indicates a strong displacement from the central part of the landslide (mainly negative distances) towards the lower part (mainly positive distances). Notable features include the retrogression of a translational failure in the middle part of the slope, lobes that displayed coherent downslope movement and a significant progression of the landslide front. Volumes released from two source areas at the main scarp are estimated at 260 m^3 and 3760 m^3.

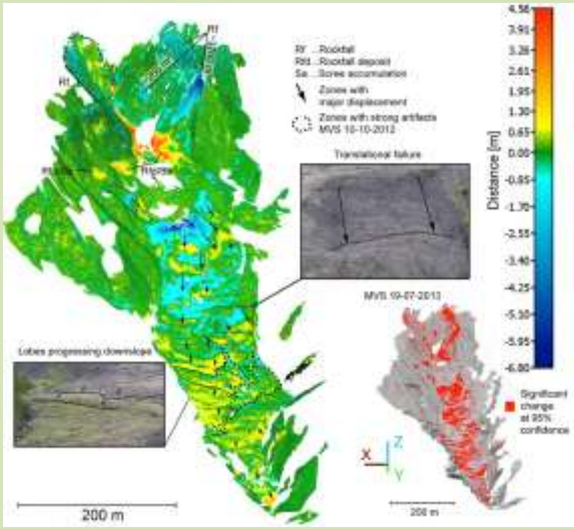


Figure 2.8. Analysis of multi-date photogrammetric models at Super-Sauze landslide. (a) Change detection results (10-Oct-2012 till 19-Jul-2013) for the full landslide, and their geomorphological interpretation. Vegetated areas were masked out for better visualization. Subsets of a terrestrial photograph show (b) the final state of a detected translational failure and (c) lobes that displayed coherent downslope movement. (adapted after Stumpf et al., submitted).

2D and 3D surface displacements from VHR (Very High Resolution) optical and SAR satellite imagery

While 2D displacement fields have been derived with terrestrial image correlation techniques (Travelletti et al., 2012a) and from derivates of terrestial LiDAR point clouds (Travelletti et al., submitted), the most commonly used sources for input data are currently airborne, spaceborne optical and SAR amplitude images. For long-term observations, archives of airborne photographs can be exploited and allowed for example the analysis of the historical evolution of La Clapière landslide over several decades (Casson et al., 2005). The displacement fields can also be exploited to derive further physical parameters on strain, geometry and rheology of a moving mass (Booth et al., 2013). Also Mackey et al. (2009) exploited time series of aerial photographs and reconstructed the movement of an active landslide over a period of more than 40 years. To measure of landslide displacements at shorter time intervals, several case studies have explored the use of VHR satellite images (Delacourt et al., 2004; Debella-Gilo and Kääb, 2012) but only from bi-temporal datasets and with metre accuracies. The need for GCPs is commonly considered as a bottleneck for the construction of longer time series from VHR satellite sensors.

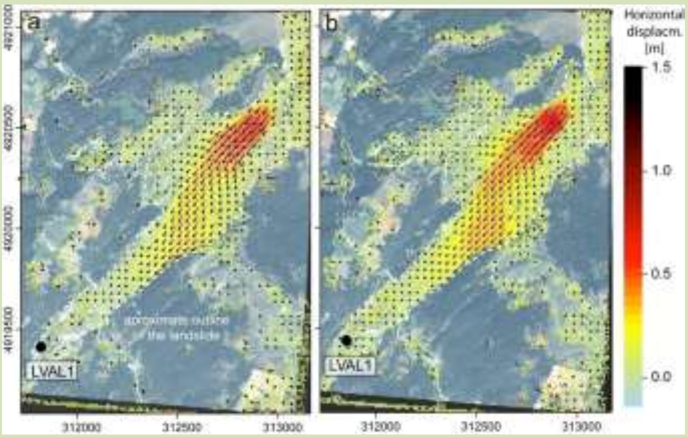


Figure 2.9. Displacement field of the La Valette landslide derived from Pléiades stereo-pairs between 07/08/2012 and 05/10/2012 using (a) 40 GCPs and (b) no GCPs. (adapted after Stumpf et al., in review).

In this context, the possible use of VHR satellite imagery has been evaluated through the correlation of series of Pléiades stereo-pairs (0.5m spatial resolution in Panchromatic mode) and TerraSAR-X (1 m spatial resolution) satellite image time series for the period 2010-2012. For the Pléiades evaluation, a particular focus was on the impact of minimal or missing ground control points (GCPs), and on the quality of the computed surface model. For the TerraSAR-X evaluation, the focus was on a first estimation of 3D displacements by combining information from the correlation of amplitude images along the Azimuth direction and from differential interferometry along the Line of Sight direction (Raucoules et al., 2013). In both cases, the accuracy of the extracted motion fields is compared with permanent GNSS stations.

For Pléiades, a processing chain comprising bundle adjustment, stereo-photogrammetric DSM extraction, and sub-pixel image correlation has been proposed (Stumpf et al., submitted). Figure 2.9 shows the displacement fields at La Valette landslide. The general pattern of movement shows higher displacements at the scarp (maximum of 0.65 m) and gradually decreasing displacements downslope. This pattern is consistent with field observations and previous remote sensing studies (Squarzoni et al., 2003; Travelletti et al., 2013). The results obtained with (Fig. 2.9a) or without (Fig. 2.9b) GCPs are, though not identical, indeed very similar. Slightly higher displacements in the central part of the landslide are observed without GCPs (Fig. 2.9b) but from visual comparison alone it is not obvious which of the two models provides the more accurate result TerraSAR-X allows measuring the displacement field in 3D and with high spatial details (Fig. 2.10a). The displacement rates exhibit temporal changes with higher displacements rates during the April-July period (up to about 20 m.yr-1) and lower displacement rates during the July-November period. The upper part globally has higher horizontal displacement rates between April and June 2010 than during the May-July period whereas the lower part seems to slightly accelerate between May and July. Further, the accuracy of the displacement rates measured from the TSX data is quantified through a comparison (at locations LVA1 and LVA2; Fig. 2.10a) with the displacements measured in-situ by permanent dual-frequency GNSS receivers. The GNSS observations (acquired at a frequency of 30s for 24h sessions) are processed daily using the GAMIT/GLOBK software. Figure 2.13b presents the GNSS displacement time series obtained for the period April-December 2010 and the corresponding amount of cumulated displacement measured from the TSX data. For the three components (Up, North, East), the accuracy of the TSX displacements is in the range of ± 12 cm for the North and East components and ± 8 cm for the Up component in comparison to the GNSS cumulated displacements.

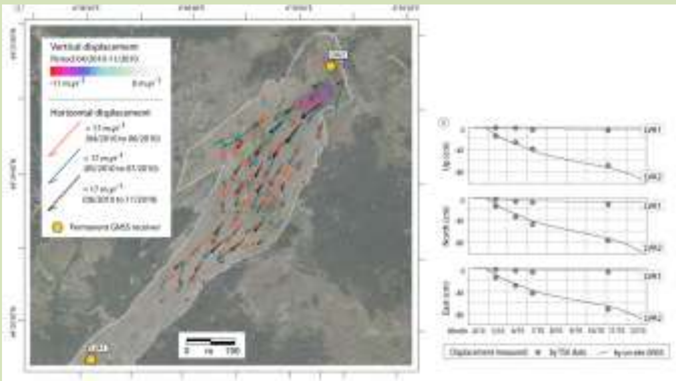


Figure 2.10. Displacement field of the La Valette estimated from TerraSAR-X images. (a) Cumulative 3D displacement map for the year 2010. Color represents the vertical displacements for the whole data set period, and arrows the horizontal displacement field per sub-period. (b) GNSS displacement time series at locations LVA1 (downslope) and LVA2 (upslope) for the period April-December 2010 and associated cumulated displacements measured in May, June, July and November 2010 by the TSX data for the three component of the displacement (Up, North, East).

2.3 Guidelines for the selection of the most appropriate technique for a specific monitoring problem (CERG)

This part of the project targeted the review of innovative remote sensing techniques that have emerged during the last decade and which are potentially useful or even already operational for landslide monitoring. First, criteria are proposed to compare their capabilities and, second, guidelines for the selection of the most appropriate technique for monitoring different landslide types, displacement rates and environmental settings are provided. The guidelines are furnished to aid operational decision‐making, and include information on the spatial resolution, accuracy and coverage, data and processing costs, and maturity of the method.

Guzzetti et al. (2012) have recently provided a detailed review of classical and innovative methods for regional landslide inventory mapping including remote sensing as well as field methods. Among many new valuable tools, they emphasized the use of VHR satellite images and LiDAR but also the great need for standards and thorough uncertainty analysis of the resulting maps. In earlier reviews, Metternicht et al. (2005) treated the use of remote sensing for landslide hazard assessment while van Westen et al. (2008) provided an overview of geospatial datasets for landslide risk assessment. A brief summary of remote sensing techniques for the analysis of landslide kinematics has also been provided by Delacourt et al. (2007) and Jaboyedoff et al. (2010) gave a detailed review of the application of LiDAR. In contrast to previous works, this work targets in particular technologies for landslide monitoring and details criteria that should be considered for the selection of the most appropriate techniques. The proposed criteria consider aspects of the landslide process (type, size, displacement rates, etc.), technological issues such as the measurement accuracy and the temporal resolution, as well as external factors such as financial constraints and risk management strategies. The article does not target to provide a comprehensive review of the immense body of literature on landslide monitoring but provides an overview of available techniques and the most recent innovations.

The outcome of this work is a set of inter-related graphs and rule sets that can be used by scientists and risk managers to obtain an overview of methods and technologies suitable for their particular needs.

Criteria to select the most appropriate remote sensing techniques

The choice of the most appropriate monitoring techniques is conditioned by a number of different factors.
Landslide-related criteria comprise the landslide type, size and expected displacement rates. External criteria include the configuration of the site, the surface conditions, financial and logistic constraints, the current risk management phase and the scientific objectives of the study. Technological criteria correspond to the capability of particular remote sensing techniques. Many of them are interrelated.
Technological criteria inherent to different monitoring techniques are the main focus of this review. The considered criteria are the measurement accuracy, measurement distances, ground sampling distances, spatial coverage, temporal resolution, quality of the obtained measurements, costs for data acquisition and processing, expected elaboration time, portability of the acquisition system and maturity of the technique. For each quantitative criteria, parameter values are provided where possible; otherwise, nominal scales are adopted for qualitative criteria such as the information content of the measurements and the portability of the system (Table 2.3.1.). Typical ranges are provided to represent the variability that results from different sensor systems, processing algorithms, noise, operator experience and other factors.

Table 2.3.1: Catalogue of evaluation criteria.

Technological criteria		
Criteria	**Scale range**	**Explanation**
Spatial coverage	Point, local (e.g. slope), regional	Typical scales at which the measurements are carried out
Information type	1D	One component of the displacement or change along a spatial axis or along the Line-Of-Sight (LOS) of the sensor
	2D	2D displacement (mostly horizontal components) at a point or spatially distributed 3D displacement field
	3D	3D displacement at a point or spatially distributed 3D displacement field
	Volume	Volumes and volume changes of the moving mass
	Surface features	Time and space evolution of surface features
Spatial resolution	mm to hm	Typical spacing of individual measurements
Temporal resolution	seconds to months	Typical time lag between individual measurements
Distance to target	m to km	Distances to target at which the measurement devicecan be employed. This category is not relevant forsatellite systems that operate in fixed orbital heights.
Measurement accuracy	mm to dm, mm3 to 10 m3 for volumes	Accuracy of the measured quantities such as displacement rates, volumes and the location of surface features
Operation mode	Continuous	Automatic measurements can be carried without human intervention for long time periods
	Campaigns	Measurements require regular human intervention and are thus typically carried at intervals of several days, weeks or months
Approximate elaboration time	minutes to month	Approximate time lag between the measurement of the system and the final results
Approximate costs	10 to 100.000 €	Typical costs including installation and operation ofthe system as well as the data processing
Technological maturity	Concept	Technical design and potential applications have been proposed
	Prototype	Working prototypes have been tested in a limited number of experiments
	Case-studies	Operating systems have been tested for landslide monitoring in the field for short time periods
	Commercial	Working systems and processing software are commercially available and have been tested on several landslides

		for long time periods.
	Mature	Potential and limitations of the technique are well understood and it has been applied in established monitoring programs
Landslide‐related factors		
Landslide type Surface displacement rates Monitoring scale	Not applicable	The technique is not useful for this particular category
	Probably not applicable	It is very unlikely that the technique is useful for this particular category, however exceptions may exist
	Applicable in few cases	The technique could be applicable but restrictions must be expected. Possible alternatives should be considered
	Suitable in many cases	The technique has been used in several case studies for the same landslide type/ displacement rate/ scale. Further criteria should be carefully checked before decision is made.
	Ideal in many cases	In many applications, this technique has provided excellent results for the same landslide type/displacement rate/scale

To assess landslide-related factors, all available knowledge about the movement patterns should be compiled and a number of criteria for the choice of the remote sensing technique should be considered.
Three landslide-related criteria can be distinguished. The scheme of Cruden and Varnes (1996) provides a process-based classification into fall, topple, rotational slide, translational slide, spreads and flows (Figure 2.3.1). Complex landslides types combine several of those movement patterns. Understanding the underlying mechanical processes is important to evaluate in which parts of the slope displacement as well as volume- and surface changes are likely to occur. The applied remote sensing technique should capture at least the main component of the change which typically concentrates in a certain direction. Particular robust techniques should be adopted if a loss of coherence of the moving mass is likely. Since the size and spatial distribution of the targeted landslides vary considerably, the scale of the study typically constitutes a trade-off between spatial coverage and detail. Most available ground-based techniques target local measurements, whereas spaceborne techniques cover large areas (PST-A, 2008; Cuenca et al., 2011; Cigna, 2012).
The expectable displacement rates are closely linked to the landslide type and constitute a further criterion. Possible displacement rates (Figure 2.3.1) vary by orders of magnitude ranging from a few millimeters per year to several meters per second (Cruden and Varnes, 1996) and, therefore, have a strong influence on the applicable technique and the choice of the observation frequency. Displacement rates often change over time and in response to rain, snowmelt or ground-shaking. The evolution of the slope movement (Figure 2.3.1) should be reviewed in order to obtain a reliable estimate of the range of possible velocities. For previously in-active or non-investigated areas where little historic information is available, inventory maps and susceptibility maps (e.g. spatial occurrence) need to be prepared in advance to guide the monitoring efforts. The applicability of different remote sensing techniques according to the landslide type, expected displacement rates and the monitoring scale is evaluated with a rating scale including “not applicable”, “probably not applicable”, “applicable in few cases”, “suitable in some cases” and “ideal in many cases”.

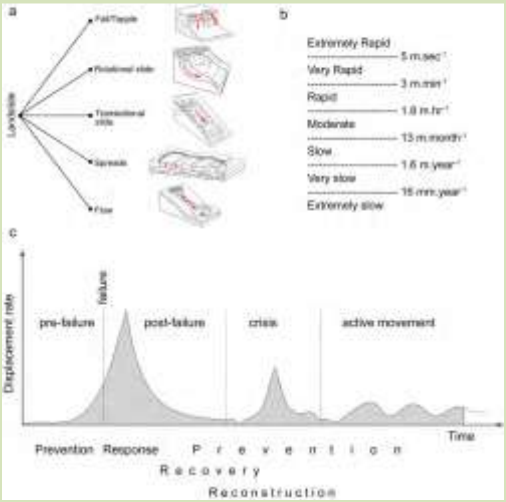


Figure 2.3.1. First order landslide classification according to (a) the type of movement and (b) the displacement rates (modified after Cruden and Varnes, 1996). Note that falls and topples are different failure mechanisms but are grouped together here since the site geometries and main component of the displacement vector are very similar. (c) Generalized phases of landslide activity (Vaunat and Leroueil, 2002) and typically corresponding risk management phases.

External factors are closely interlinked and include the site configurations, the surface conditions (vegetation, snow, and soil humidity), as well as financial and logistic constraints.
In practice, the current risk management strategy and the scientific objectives of the study play an important role. The classical risk management phases are prevention, response, recovery and reconstruction (Alexander, 2002) and in the context of landslide investigations they are closely related to different phases of activity (Figure 2.3.1). The usefulness of a technique for prevention (e.g. early warning) is governed by its capability to acquire measurements with high robustness, accuracy and temporal resolution, whereas during other management phases, criteria such as spatial coverage and instrument portability can gain greater importance. In practice financial and logistic constraints are probably the most crucial aspects when setting up and operating monitoring systems over longer time periods. The development of generally applicable scenarios for the use of remote sensing techniques in different risk scenarios would have to involve complex economic, political, organizational and ethical aspects and is beyond the scope of this article. However, costs, elaboration time and portability of different remote sensing techniques are assessed and provide criteria that can be confronted with the available resources.

Guidelines for the selection of the appropriate remote sensing techniques

This section provides a detailed evaluation of the proposed criteria that can be used as rule sets for the choice of the most appropriate technique for different monitoring scenarios.

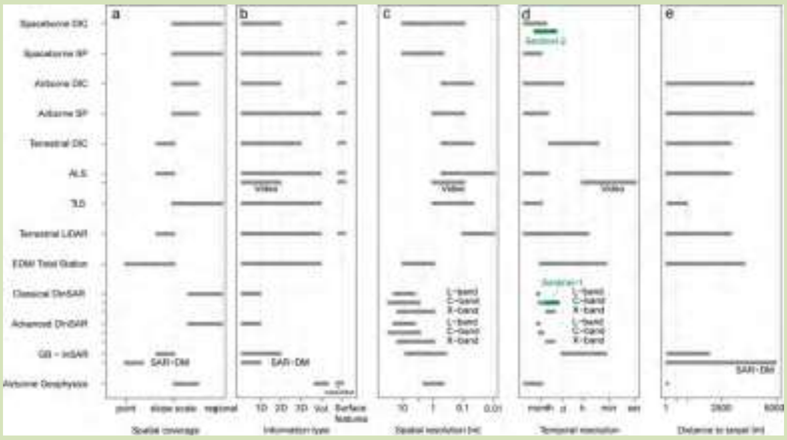


Figure 2.3.2. Capability of remote sensing techniques for landslide monitoring regarding (a) spatial coverage, (b) resulting information type, (c) spatial resolution, (d) temporal resolution and (e) distance to the target. Sub-categories such as SAR distance meter (SAR-DM) and different microwave bands are distinguished for criteria where their value range differs.

Most available remote sensing techniques for landslide monitoring can provide local and regional coverage and information about the 3D displacement and volume changes. A notable exception is spaceborne SAR interferometry [classical and advanced DInSAR] which only provides displacement measurements in the LOS direction (Figure 2.3.2a, b). The information that can be derived from airborne geophysics is unique in the sense that a detailed image of the subsurface structures, volumes and physical parameters can be obtained. Besides quantitative information (e.g. point clouds), LiDAR and optical remote sensing techniques also yield images of the surface that can be interpreted manually or semi‐automatically to observe diagnostic features at the surface (fissures, lobes, boulders, vegetation disturbance).
Ground‐based techniques yield higher spatial and temporal resolution for local monitoring. For a better interpretation of the spatial resolution (Figure 1 3c), it is important to consider that it refers to horizontal resolution for spaceborne DIC, spaceborne SP and airborne DIC, to the resolution in azimuth and range for SAR techniques, to the 3D points spacing for ALS, TLS and terrestrial SP and to 3D cell resolution for airborne geophysics. While the spatial and temporal resolutions (Figure 2.3.2c, d) for spaceborne systems are determined by the specifications of the sensor, the resolution of ground-based techniques is variable and only limited by the distance to the target (Figure 2.3.2e) and, eventually, the available resources for data transmission, storage and processing.
Among many relevant satellite missions which are planned or scheduled for the near future (ALOS-2, Cartosat-3, WorldView-3), the ESA Sentinel mission stands out since all captured images will be publicly available without charges (ESA-Copernicus, 2013) and because of its high temporal frequency. Sentinel-2 (scheduled for launch in late 2014) provides optical images with a maximum spatial resolution of 10 m and a repeat pass cycle of 5 days. A comparatively high co-registration accuracy of better than 0.3 pixel is foreseen (Drusch et al., 2012) yielding continuous time-series whose value for DIC monitoring of slow and moderate moving landslide should be explored (Figure 2.3.3a).
Regarding the measurement accuracy (Figure 2.3.3a), three main groups of remote sensing techniques can be distinguished. First, ground-based and spaceborne SAR as well as Total Station surveys can achieve measurements with only millimetric and sub-millimetric errors and are therefore especially valuable for the monitoring of small displacements. X-band SAR is currently one of the most accurate techniques, whereas the costs of the data and satellite scheduling are relatively high (Figure 1 4d). C-band SAR with the forthcoming Sentinel-1 (scheduled to be launched in early 2014) has the potential to yield sub‐millimetre accuracy (Rucci et al., 2012) at significantly reduced costs (Figure 1 4d). Second, ALS, TLS, and terrestrial and airborne (UAV) SP typically achieve centimetre and decimetre accuracy.

Third, accuracy of spaceborne DIC and spaceborne SP is usually not higher than several decimetres. Note that the accuracies refer to the measured quantities such as LOS displacements, heights, 3D point positions and 3D displacements and must be extrapolated to obtain derivates such as volumes. Airborne geophysics provides very precise measurements of resistivity, gamma and microwave radiation but the delineation of structural units can comprise uncertainties in the range of a few metres.

The possibility to operate a remote sensing technique continuously without significant intervention (Figure 2.3.3b) is conditioned by the capability of the sensor to provide continuous time-series and the availability of automatic processing chains. Due to short repeat-pass cycles and automated processing chains, spaceborne SAR systems qualify for continuous measurements. Also, ground-based systems including optical cameras, GB-InSAR and Total Stations can record data continuously over longer time periods (several months and even longer). Other systems for TLS and spaceborne SP can only be used for permanent or campaign surveys since issues such as the data volume and the required manual intervention in the processing chain do currently not allow automatic operation.

Figure 1 4c provides an overview of the approximate elaboration time which marks the time lag between the acquisition of the data and the completion of the final results. Since the elaboration time depends on the experience of the operator, the size of the dataset (e.g. number of SAR images, size of LiDAR point clouds), requirements of external data sources (e.g. GCPs) and the computational resources, only indicative ranges are provided. It shows that the analysis phase requires several days or weeks with most remote sensing techniques which limits their use for early warning. Automated Total Stations and GB‑InSAR, at the opposite, provide results already a few seconds or minutes after the measurement process and are frequently integrated into Earl-Warning Systems (Casagli et al., 2010; Cardellini and Osimani, 2013; Michoud et al., 2013).

The approximate costs of the technique (Figure 2.3.3d) include costs for the instrumental equipment, the processing software, the field installation and the required manpower. The costs were evaluated based on publicly available (in 2013) price lists of instruments and sensors, data providers and space agencies, inquiries at private companies and the experience of the partners within the SafeLand European project. In general, the costs represent the current state-of-the-art and are likely to reduce as new spaceborne, airborne and ground-based systems enter the market. Especially free data from the forthcoming Sentinel missions 1 & 2 will nullify the data costs for the acquisition of SAR images (Figure 2.3.3d). For historical analysis, techniques, (such as spaceborne SAR, spaceborne DIC and spaceborne SP can greatly benefit from large image archives that sometimes span over several decades (e.g. ERS-1/2, airborne photographs after 1945) and are available at low costs or even free of charge. For continuous monitoring with state‑of‑the‑art satellite systems (e.g. TerraSAR-X, Pleiades), costs are still relatively high especially if scheduled acquisitions are requested. This generally also applies for ALS surveys and airborne geophysical surveys. It is however important to note that those techniques are rather designed for regional applications (Figure 2.3.4) and are therefore relatively cost-efficient when price per area is concerned.

The expenses for the use of GB-InSAR, TLS and Total Stations are dominated by the costs of the hardware and leasing. Shared use among institutions and/or study areas is often appropriate for such systems.

UAVs and especially optical cameras can be considered as low-cost systems and entry-level models are already available for a few hundred EUR. Additional costs for terrestrial DIC and SP typically arise from fixed installations which require power supplies, data transmission systems and sometimes additional data loggers. The prices for high‑end civil UAVs easily exceed 10.000€ but can carry higher payloads that allow the integration of navigational systems and high quality SLR cameras reducing the need for GCPs and generally providing significantly more accurate results.

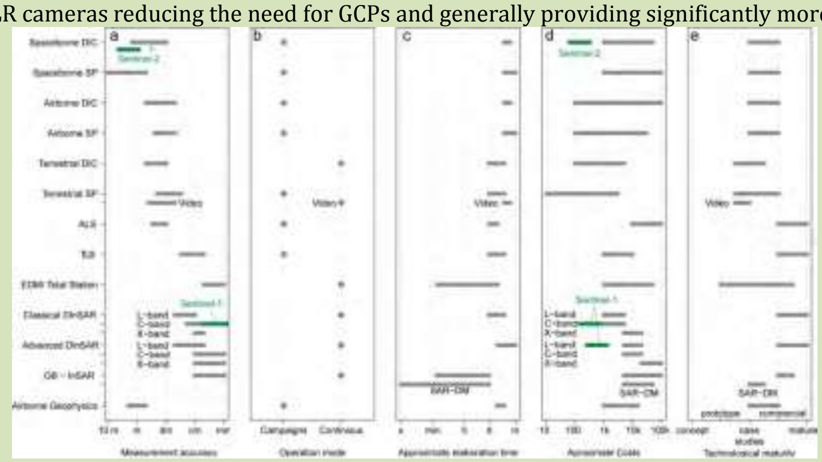


Figure 2.3.3. Capability of remote sensing techniques for landslide monitoring regarding (a) measurement accuracy, (b) operation mode, (c) approximate elaboration time, (d) approximate costs and (e) technological maturity. Sub‑categories such as SAR distance meter (SAR-DM) and different microwave bands are distinguished for criteria where there value range differs.

The applicability of remote sensing techniques to a particular landslide type (Figure 2.3.4) has to involve several aspects. Especially, the geometry of the measurement should be able to capture the principal component of the movement and the largest extension of the moving mass. Consequently many spaceborne and airborne techniques are for example less suitable for the monitoring of falls and topples (Figure 2.3.4a) since only a small fraction of the moving surface is visible from a quasi-vertical view point and the resolution and accuracy of the techniques are generally too low. On the contrary, spaceborne SAR and GB-InSAR, are very well adapted to measure very small displacement preceding falls and topples. In many cases, they are also suitable for the monitoring of rotational slides where the movement is distributed over various components (Figure 2.3.4b). It has been demonstrated that Classical DInSAR techniques can be used to detect and characterize also translational landslides (Nikolaeva et al., 2013) but the most important component of the movement along the slope is not very well depicted.

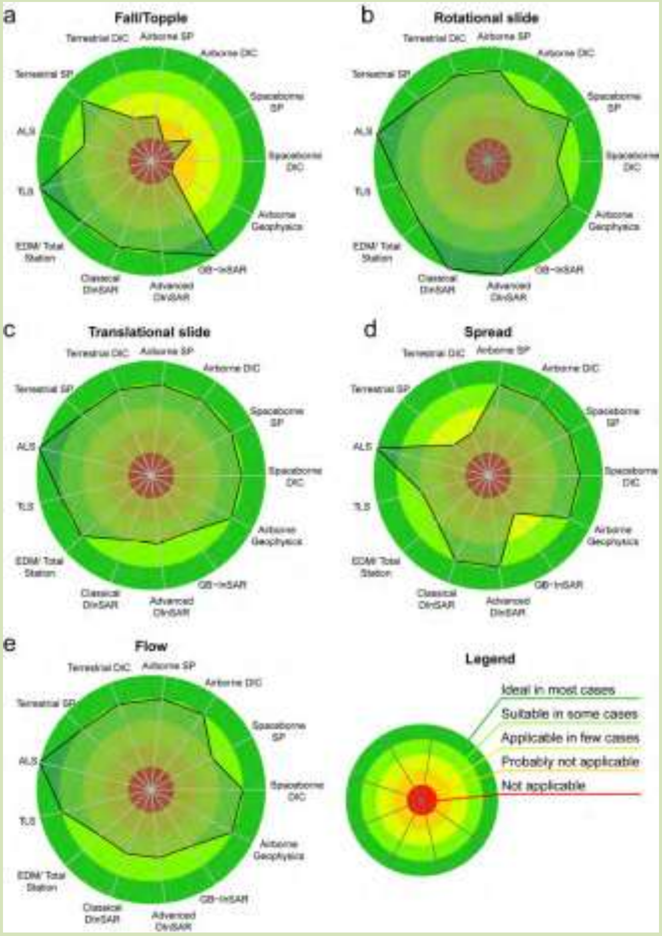


Figure 2.3.4: Suitability of remote sensing techniques for the monitoring of different landslide types including (a) falls and topples, (b) rotational slides, (c) translational slides, (d) spreads and (e) flows.

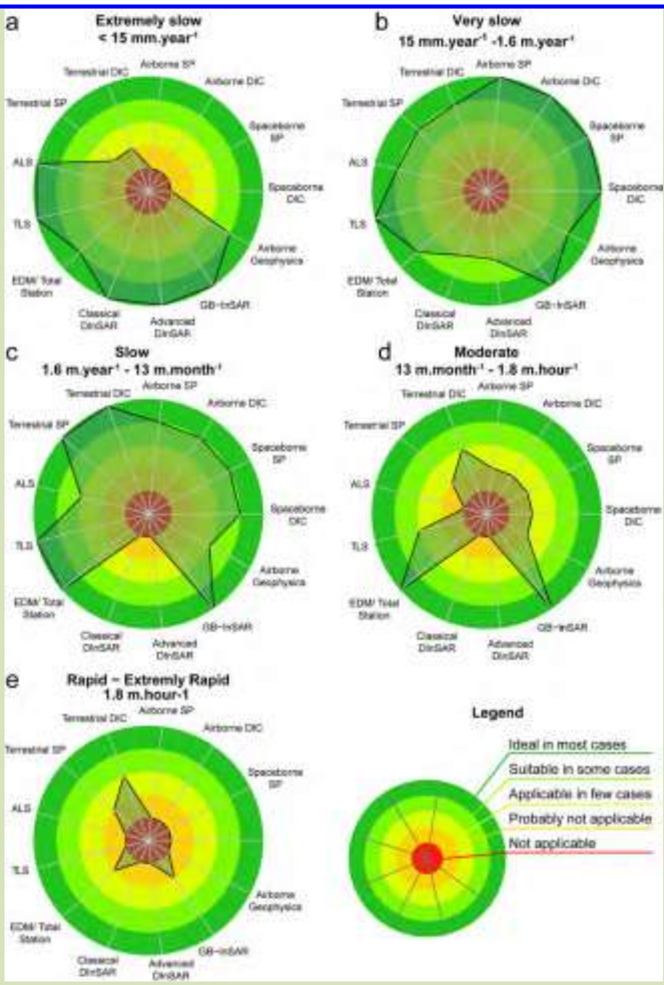


Figure 2.3.5: Suitability of remote sensing techniques for the monitoring of different displacement rates including (a) extremely slow, (b) very slow, (c) slow (d) moderate (e) rapid – extremely rapid.

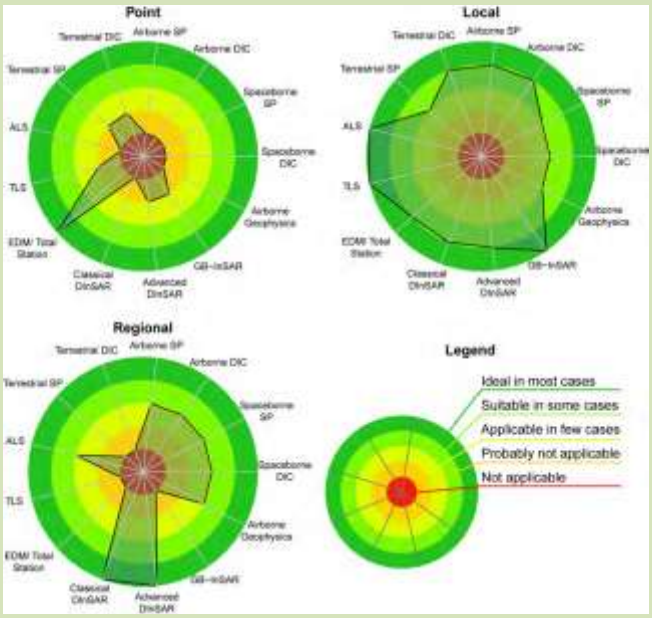


Figure 2.3.6: Suitability of remote sensing techniques for landslide monitoring for (a) point-wise surveys, at (b) local scale and (c) regional scale.

Different ground-based techniques are applicable to a variety of landslide types but their use is problematic for the monitoring of spreads (Figure 2.3.4d) which mainly occur in flat or low gradients terrains where it is typically difficult to obtain a near-vertical view on the surface. In this assessment, ALS is depicted as an ideal tool for most landslides

types since the high costs for frequent surveys are not considered at this point.
Translational and rotational slides display rather coherent displacement with little deformation, whereas flows and spreads typically comprise strong deformation of the moving mass along with significant changes of the surface. The latter can yield decorrelation when using SAR techniques, and to a lesser extent terrestrial and airborne DIC (Figure 2.3.4e).
The suitability of remote sensing techniques for different displacement rates (Figure 2.3.4), is mainly determined by their temporal resolution (Figure 1 3d) and the accuracy of the measurement (Figure 2.3.2a). In general, most available techniques can only be employed to measure extremely slow to slow movements (Figure 2.3.5a-c) but possible choices for moderate to extremely rapid velocity are limited (Figure 2.3.5d, e). Notable exceptions are GB-InSAR, robotized Total Stations, and terrestrial SP and DIC based on videos. It should be noted in this context that video-based SP and DIC are mature measurement techniques in experimental mechanics (Sutton et al., 2009) but are rarely used for landslide monitoring.
This must be attributed to the fact that rapid slope failures also exceed the reaction time for the installation of such specialized devices and hence rapid movements have in practice been rarely observed with dedicated cameras (Arattano and Marchi, 2000). The high measurement accuracies of SAR techniques make them particularly well adapted for the monitoring for extremely slow and very slow movements (Colesanti and Wasowski, 2006). Due to phase ambiguity and repeat pass cycles, spaceborne SAR systems cannot provided reliable measurement, at displacement rates exceeding ~1.5 m.year-1 (Figure 2.3.5a, b), whereas GB-InSAR systems have a much higher temporal resolution (several minutes) and are therefore applicable even for displacement rates up to several decimeters per hour (Figure 2.3.5d).
Figure 2.3.6a provides an overview of the suitability of the evaluated techniques for monitoring applications at different scales considering aspects such as spatial coverage (Figure 1 3a), measurement accuracy and costs (Figure 2.3.3a, e). Most techniques are dedicated for surveys at the local (or slope) scale (Figure 2.3.6b). Exceptions are EDMs, Total Stations and GB-InSAR which can be employed efficiently for point-wise observation (Figure 2.3.6a), and Spaceborne SAR techniques which have also been used for regional surveys (Figure 2.3.6c). Airborne DIC and SP, Airborne LiDAR as well as Spaceborne DIC and SP are applicable in some cases for monitoring at the regional scale (Figure 2.3.6c) but comprise disadvantages regarding costs and/or accuracy.

Work package 3 (prepared by CERG Strasbourg, France, CNR-IDPA, CNR-IRPI):
Description:
Development of a simple DSS system to manage the dataflow and identify thresholds in the time series
Associated deliverables:
D.3.3 Development of the DSS system (CERG, CNRS, CNR-IDPA) - M+18
D.3.4 Integration of all the data and test of the system to identify trends and thresholds (CERG, CNRS, RTM) - M+24
D.3.5 Writing of a joint publication (CERG, CNRS, CNR-IDPA) -M+24

This report presents the implementation of a simple DSS to manage data flow of rain, groundwater and displacement time series and on the development of a combined statistical-mechanical approach to predict changes in landslide displacement rates from observed changes in rainfall amounts.
The results are disseminated in the following manuscript: Bernardie, S., Desramaut, N., Malet, J.-P., Gourlay, M., Grandjean, G. (in review). *Prediction of changes in landslide rates induced by rainfall*. Landslides, 24p.

The DSS and forecasting platform FLAME
The forecasting tool associates a statistical impulse response (IR) model to simulate the changes in landslide rates by computing a transfer function between the input signal (e.g. rainfall) and the output signal (e.g. displacements) and a simple 1D mechanical (ME) model (e.g. visco-plastic rheology) to take into account changes in pore water pressures.
The models have been applied to forecast the displacement rates at the Super-Sauze landslide (South East France), one of the most active (with velocities from 0.002 to 0.4 $m.day^{-1}$) and instrumented clayey landslide in the European Alps. The performance of different combinations of models (IR model alone, ME model alone, and a combination of the IR and ME models) is evaluated against observed changes in pore water pressures and displacement rates at the study site. Results indicate that the three models are able to reproduce the displacement pattern in the general kinematic regime (succession of acceleration and deceleration phases); at the contrary, extreme kinematic regimes such as fluidization of part of the landslide mass are not being reproduced. The approach constitutes however a robust tool to predict changes in displacement rates from rainfall or groundwater time series.

Impulse Response model-IR
The impulse response model (IR) is derived from the TEMPO modeling approach (Pinault and Schomburgk, 2006), originally developed for the analysis of hydrogeological and hydrogeochemical time series. It allows to compute transfer functions between input and output data through signal processing, inversion and optimization techniques.
The IR model reproduces an output signal S using the convolution product of an input signal E by a transfer function G as described in Eq. 1) and illustrated in Figure 2.4.1. The convolution is based on impulse response functions.

$$S(n.dt)= G^* E(t) = \Sigma^{k}_{i=1} 1G(i.dt).E((n\ i\ 1).dt) \quad (1)$$

where n is the discretized interval time, and k is the order (length) of the impulse response.
Thus, when considering for instance a groundwater level as the output signal, and rain amounts as input signal, with a

daily discretized interval time, G(k) corresponds to the contribution of the rain of the day i-k+1 to the groundwater level of the day I, while G(1) corresponds to the contribution of the rain to the groundwater level at the same day.

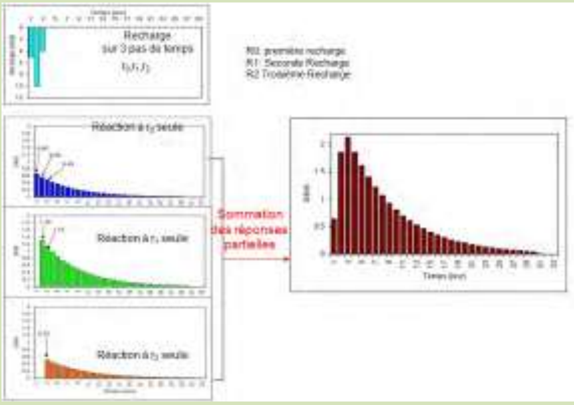


Figure 2.4.1.

In this work, the shape of the transfer functions is the convolution of a Gaussian function (e.g. representing the recharge of the water reservoir) by an exponential function (e.g; representing the discharge of the water reservoir; Eq. 2).

$I(t) = \exp(-\ln(2) * ((t-T)/D)^2) * \exp(-t * (\ln(2)/L)$ (2)

The three degrees of freedom to optimize are:

- T ≥ 0 : the position of the Gaussian (e.g. time delay between the recharge and the rainfall; in day);
- D > 0 : the width at middle height of the Gaussian (e.g. time duration of the phenomenon; in day);
- L : the half time duration of the drainage of the water reservoir (in day)

The transfer functions are normalized, considering a coefficient defined by the conservation law between inputs and outputs (Eq.3):

$c = (\Sigma S(t) / \Sigma E(t))$ (3)

The IR model is able to define the contribution between the rain amounts participating to either a fast response or a slow response of the system. Moreover, the model is able to integrate several types of input data (e.g. evapotranspiration, discharge rate of surface springs, snow meltwater), thus allowing to analyse the contribution of additional non-correlated entries to the model. To characterize the possible contribution of melting snow on the groundwater recharge, a simple degree-day model has been used to create time series of meltwater from rain and air temperature observations (Kustas, 1994). The model used in this work is based on simple parameters such as a critical temperature Tc (in °C) to characterize the quality of the rain (e.g. solid or liquid) and a coefficient a (in m.°C-1.day-1) which define the rate of snow melting (Eq. 4):

Potential snowmelt $= a \times (T(t) - T_c)$ if $T(t) > T_c$
Potential snowmelt = 0 if $T(t) < T_c$ (4)

Mechanical viscoplastic model -ME

A simple 1D mechanical model based on the theory of limiting equilibrium of soils and on a constitutive viscoplastic law is considered from Herrera et al. (2009). The model is constituted of two parts; the first part simulates the variations of pore water pressures, and the second part, simulates the deformation and displacement pattern of the mass. The model assumes a pre-existing slip surface (of constant thickness d and inclined at a constant slope α) above which an infinite mass of constant thickness h is sliding as a rigid body (Figure 2.4.2).

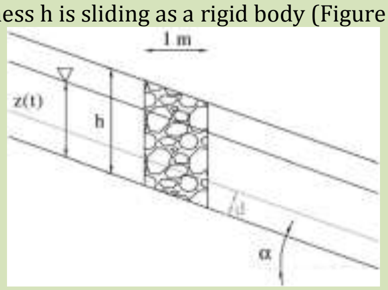


Figure 2.4.2. Schematic representation and parameters of the viscoplastic model

The daily effective rain amounts (e.g. rain and snowmelting water) are used as direct inputs; the dissipation of excess pore-fluid pressure in the saturated layer is computed using Terzaghi's one dimensional consolidation theory (Eq. 5):

$$ep_w(t) = ep_{w0} . e^{-t/T_v} \quad (5)$$

where ep_{w0} is the initial excess pore water pressure, and T_v is time factor controlling the dissipation time of the excess pore pressure (Eq. 6):

$$T_v = (4H^2) / (\pi^2 C_v) \quad (6)$$

where C_v is the consolidation coefficient.

The momentum equation over the slope direction is defined by Eq. 7:

$$\tau - [c + (\sigma_n - P_w(t).\tan \varphi] = m \,.\, a(t) + (\eta/d)\, v(t) \qquad (7)$$

where τ is the destabilizing shear stress; σ_n is the normal stress; φ is the material friction angle; c is the material cohesion; m is the mass of the landslide; η is the viscosity; d is the thickness of the shear zone; $P_w(t)$ is the pore water pressure as a function of time; a(t) is the acceleration as a function of time; and v(t) is the velocity as a function of time.

With the assumptions of a groundwater flow parallel to the slope surface, the pore water pressure is defined by Eq. 8:

$$p_w = z(t)\gamma_w \,.\, cos^2\alpha \qquad (8)$$

where z(t) is the position of the groundwater level and γ_w is the unit weight of water. Changes in groundwater level are supposed, in first instance, directly proportional to the effective rainfall intensity:

$$dz = I_{rainfall} / 1000n \qquad (9)$$

where $I_{rainfall}$ is the effective rainfall (in $mm.m^{-2}.day^{-1}$) and n is the material porosity.

The displacements are then computed by solving Equation (7) using functions to optimize some geometry parameters (h, d), and material properties (r, f, h, n, T_v).

Coupled statistical-mechanical (IR-ME) model

This model combines the IR and ME models. The IR model is used to simulate groundwater level from the rain and temperature observed time series; then the mechanical part of the ME model is used to compute the displacement rate of the landslide directly from the computed groundwater levels transformed in pore water pressures.

Application of the DSS and forecasting model to the dataset of the Super-Sauze landslide (France)

The Super-Sauze landslide is located in the French South Alps (Barcelonnette Basin) and is continuously active since its triggering. The landslide is typical of flow-type gravitational processes developed in Callovo-Oxfordian clay shales (e.g. called black marls in the region). In the mid 1960s, the upper part of the Sauze torrential catchment was affected by rock failures along pre-existing lithological and tectonic discontinuities. The failed material composed of rocky panels progressively transformed into a silty-sandy matrix integrating marly fragments of heterogeneous sizes through successive weathering cycles. From the 1970s until today, the landslide material is gradually filling the thalweg (Fig. 2.4.3). In 2007, the landslide extents over a distance of 920 m between an elevation of 2105 m at the scarp and 1740 m at the toe with an average width of 135 m and a average slope of 25°. The total volume is estimated at 560,000 m3 (Travelletti and Malet, 2012). From a hydrological and geotechnical viewpoint, the landslide is structured in two vertical units: the first unit (5 to 10 m thick) is a moderately stiff and semi-permeable material, while the second unit (with a maximum thickness of 10 m) is a stiff and impervious material (Malet and Maquaire, 2003). A slip surface of 5 to 10 cm thick is separating these two landslide units, as was evidenced from inclinometers measurements and observation of borehole samples (Malet and Maquaire, 2003). Detailed information on the hydrological and geomechanical properties of this low plasticity and intensely fissured reworked material can be found in Malet (2003). These two landslide units overlay a bedrock of intact clay-shales.

The landslide is part of the French Observatory on Landslide (omiv.unistra.fr) which aims at acquiring and distributing multi-parameter observations on different types of landslides through geomorphologic, geologic, hydrologic, geophysical and seismological long-term monitoring. In this context, the kinematics of the landslide is currently monitored by differential Global Positioning System (campaigns and permanent receivers), Terrestrial Laser Scanning (TLS) surveys, remote Very-High Resolution cameras and an extensometer (Travelletti and Malet, 2012).

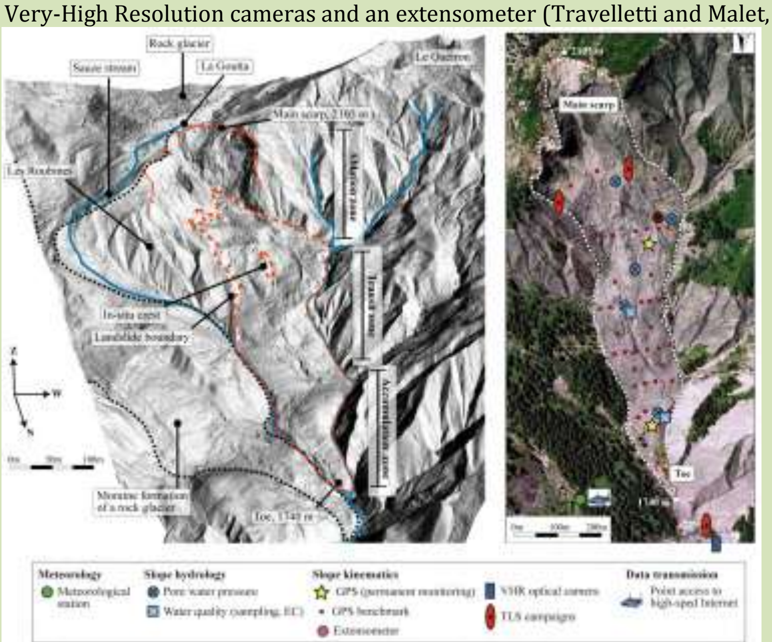


Figure 2.4.3. The Super-Sauze Landslide Observatory: landscape represented on a airborne LiDAR point clouds (left) and position of the monitoring systems (right).

Work package 4 (prepared by CERG Strasbourg, France*)*:
Description:
Application of the methodology: model calibration and performance evaluation
Associated deliverables:
D.4.3

The objective of the model application is to predict daily displacement from the rainfall time series. Therefore, the calibration procedure has been performed on a daily basis by optimizing model performance over several sizes of time windows. The used optimization algorithm is the SQP method (Sequential Quadratic Programming) which is adapted to the optimation of non-linear dynamic systems.
Several parameters have to be optimized with this procedure:

- for the IR model, the parameters T, D and L are optimized for each input of the model. Moreover, the contribution of the input components, as well as the coefficient c, defined by the conservation law between inputs and outputs, are also optimized. Finally, the length of the Impulse Response is also optimized. So in the case of three input data (rainfall, snow, and spring water discharge, as will be defined later), twelve parameters are optimized.
- for the ME model, the choice of the parameters to be optimized depends on the knowledge of the parameters for the specific site. For instance in the case of Super-Sauze landslide, six parameters are optimized f, r, h, n, T_v and h and the other parameters are fixed.
- for the IR-ME model, the same parameters than for the IR model are optimized, including also the Zmax (highest observed groundwater level from the last recharge), and the adequate parameters of the mechanical part of the ME model), so in this case f, r, h and h.

The performance of the model is evaluated with the Nash and RMSE (Root Mean Square Error) statistical criteria. The IR model provides variable but generally good accuracy, with Nash values ranging from 0.07 to 0.96, and RMSE values from 5.7 10^{-4} to 1.10^{-2} $m.day^{-1}$. The mean value of RMSE is $4.3.10^{-3}$ $m.day^{-1}$ and the mean value of Nash is 0.5 which indicate a good quality model. Various tests have been conducted to improve this model by integrating derived additional input data such as evapotranspiration, the delay due to snowmelt, the rain typology (liquid/solid) and the discharge of uphill and lateral springs. The most accurate model is the one considering two distinct impulse responses (e.g. one for the rainfall, one for the snow) and integrating the contribution of a spring bringing an equivalent of water fluxes of 10 $mm.day^{-1}$.
The ME model and the IR-ME model also provide good results with, respectively, a mean Nash value of 0.2 and a mean RMSE value of 5.6 10^{-3} $m.day^{-1}$; and a mean Nash value of 0.23 and a mean RMSE value of 5.4 10^{-3} $m.day^{-1}$.
We observe that the cumulated displacement computed by the three models fit the observed data with a very good accuracy (Figure 2.4.4). The IR and the IR-ME models reproduce more precisely the local variations of displacements. With these validations, the three models can be applied to the site, with very good accuracy.

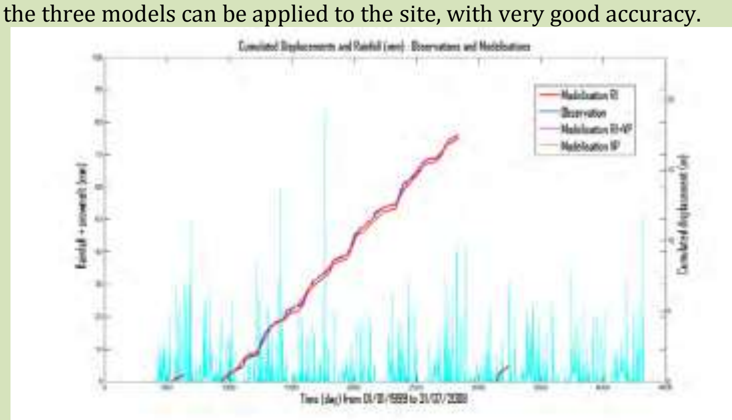


Figure 2.4.4. Observed and computed cumulated displacements.

The capability to predict the complex displacement pattern (acceleration, deceleration) of landslide is an important issue for early-warning. Most of the current alarm systems are based on simple criteria, such as cumulated precipitation thresholds, which can provide false alarms and make therefore them unreliable for people.
A methodology has been tested to combined meteorological observations and mechanical models to simulate the kinematics of landslides in their normal regime. The three proposed models demonstrated their capability to reproduce the landslide movements. Further applications to other test sites are scheduled in 2014.

SURVIVING DISASTERS: A POCKET GUIDE FOR CITIZENS

TARGET COUNTRIES : Algeria, Azerbaijan, Belgium, Bulgaria, Cyprus, France, Georgia, Germany, Greece, San Marino, Luxemburg, Italy, Malta, Armenia, Moldova, Ukraine, Morocco, Portugal, Romania, Russian Federation, France, Former Yugoslav Republic of Macedonia, Spain, Turkey

PARTNERS INVOLVED :

COORDINATING CENTRE : CEMEC San Marino

OTHER CENTRES: TESEC Kiev, Ukraine; GHHD Tbilisi, Georgia; ECRM Yerevan, Armenia ; CUEBC Ravello, Italy

EXECUTIVE SUMMARY

To provide useful information to properly deal with different possible emergencies in order to protect people and safeguard things and environment, a booklet of 38 pages has been produced with the following table of contents:

- What to do and what not to do in case of emergency
- Know how to use the emergency services
- How to correctly deal with different types of emergency
- Basic principles of emergency situations
- Information and useful contacts in case of emergency

It is now available in pdf format for download to any smartphone in 7 languages: English, French, Russian, Italian, Armenian, Georgian and Arabic.

OBJECTIVES OF THE PROJECT

Global objective for 2012-2013 :
Produce and circulate an handbook on emergencies including basic vital information about the main natural and technological hazards
Specific yearly objectives:
2012 :
Publishing English and French versions on the BeSafeNet web site.
2013 :
Publishing multilingual version on the BeSafeNet web site.

EXPECTED RESULTS

2012 :
Publishing English and French versions on the BeSafeNet web site
2013 :
Publishing multilingual version on the BeSafeNet web site.

RESULTS OBTAINED IN 2012

Work package 1 (prepared by CEMEC, TESEC):
Description:
Hazards list definition and Task 1 action plan

The set of hazards already addressed is:
1.1 Urban Fires
1.2 Bushfires
1.3 Earthquake
1.4 Landslides
1.5 Slips
1.6 Floods
1.7 Toxic Gases Incidents and Leaks
1.8 CBRN events
Tsunami, Hurricanes and tornadoes, Extreme cold and Extreme heat will be dealt with in 2013.

TESEC

Being aware of possible natural and technological risks is vital for general population potentially involved in disasters. Although public awareness initiatives about disasters and major risks have been carried out in several countries, knowledge about safety measures, first aid and prevention is still lacking or insufficient. In addition, information material currently available has been produced by local agencies and institutions without taking into account additional and different expertise provided at an international level.
The SurvDis project will produce and circulate a handbook on emergencies including basic vital information about the main natural and technological hazards.
In 2012 the local knowledge (civil protection, civil defence) about already existing handbooks and guidelines has been collected and analysed. Proposals for English version have been prepared.

Work package 2 (prepared by CEMEC, GHHD):
Description:
Gathering local knowledge

Active discussions have been carried out among participating centers both by e-mail and face-to-face.
Participating centers have agreed about three major points:

- Basic information and advices for population in case of disaster can be shared among different European countries.
- Further (more detailed) information and advices for population in case of disaster must be tailored on local realities, laws and legislations.
- Both basic and detailed information for population must be provided in general terms and should not be considered as alternative or substitution of local procedures and protocols.

GHHD
Georgia is prone to all catastrophes, characteristic for mountainous countries (1-12). In the last two decades occurred the following large-scale natural disasters: avalanches in North Georgia, landslides in a mountainous Achara and Racha, flash floods, hurricanes and drought in the West and East Georgia, Racha earthquake of 1991 and Tbilisi Earthquake of 2002. These phenomena are very special both from ecological and from social-economical points of view. By the index of disaster risk obtained by UNDP, Georgia relates to the countries with medium and high level risk. So the natural disasters in Georgia have to be considered as a standing negative factor for the development process of the country. Such approach implies necessity of more active actions to reduce the risk of natural disasters by all possible means at each level to maintain the sustainable economic development of the country.
It is known that Georgia experienced significant losses, due to following natural hazards: earthquakes, landslides, debris flows, avalanches, floods and flashfloods, hurricanes, droughts, hail storms.
Average annual economic losses in Georgia: 84% of economic losses come from EQ-s (Push, 2004).
During the soviet time, some handbooks and guidelines, prepared by Institute of Geophysics, Seismic Survey of Georgia and Emergency Department of Ministry of Internal Affairs, were issued in Georgia. Significant errors in economic loss assessment by some sources have been discovered.
Earthquakes.
Earthquakes are the most destructive natural events in Georgia. The total economic losses from earthquakes in 1990-2010 years are of the order of 10 billion USD (not 350 USD as erroneously is assessed in (6)). The map of probabilistic seismic hazards for territory of Georgia (for the 2% probability of exceedance in 50 years), accepted as an official document in national building codes is shown in Fig. 3. It is evident that almost whole Georgia, including capital city Tbilisi is prone to Intensity shaking I = 8 and almost 50% - to Intensity I = 9 , which means that population should have a basic knowledge on surviving in case of strong EQ.
Landslides, debris flows
Up to now around 53,000 landslide phenomena and around 3,000 mudflows susceptible water channels and processes have been recorded in the territory of Georgia, where around 3,000 settlement units are considered to be at substantial risk of hazards. Since 1968 he human loss due to these geological disasters exceeded 1000. From 1995 to 2010 occur 5700 landslide events, which caused 39 human losses; corresponding numbers for mudflow events in the same time period are 2016 and 49. The total economic losses from both landslides and mudflows in this period amounts to 650 USD. Fig. 4, 5 present landslide and mudflow hazard for Georgia (http://drm.cenn.org).
Floods and flashfloods
The territory of Georgia is characterized by floods and flash floods (Fig. 7). In total, from 1995 t0 2010 there were documented 164 floods/flashfloods which caused 270 million USD losses and 24 casualities.
Hurricanes
A map of observed hurricanes in Georgia is presented.
Droughts
In Georgia, drought damages arid, semi-arid and semi-humid lands as the phase of increased consumption of water by plants does not coincide with the phase of increased precipitation. Major recurrence of droughts is observed during July-August in Eastern Georgia, while in western Georgia the same happens during April-May. Days are deemed droughty when the precipitation is less than 5 mm, the relative humidity is less than 30% and the average temperature is more than 25°C. The quality of aridity has been defined on the basis of the difference between the precipitation and water-consumption by plants and the index of humidity within the plant vegetation period (April-September) (NEA).
Hail Storms

In Georgia, hailstorms are observed on a seasonal basis throughout the entire territory of the country. Their intensity and frequency is extremely high in Eastern Georgia. From 5 to 15 cases of this event are annually recorded in Georgia, as a result of which, from 0.7% to 8.0% of agricultural land is destroyed. The years of 1983, 1987, 1993 and 1997 have been notable for the extreme frequency and intensity of hailstorms. According to incomplete data, the damage to the Country caused by hailstorms over the last 13 years exceeds GEL 140 million.

SOS-phones, which you need in case of emergency in Georgia (country code +995 32)

(Fire emergency)	011
Police	022
Ambulance	- 033
Gas emergency	04
Emergency Management Department, Ministry of Internal Affairs	2411852
Water emergency	2931111
Geological disaster department, Ministry of Environment	2439547
Seismic monitoring centre	2390091

Work package 3 (prepared by CEMEC, ECRM):
Description:
Designing EUR-OPA knowledge

Active discussions have been carried out among participating centers both by e-mail and face-to-face. It has been outlined that a booklet on emergencies preparedness and management is not a news, generally speaking; nevertheless, The "Surviving disasters: a pocket guide for citizens" booklet is the EUR-OPA message and version.
Significant discussions have been carried out among participating Centers and other EUR-OPA centers as well about the appropriate ways to circulate and promote the booklet. It has been agreed to implement an electronic version of the booklet accessible by smartphones and tablets. This will allow people to know local procedures in case of disaster when travelling in Europe.

ECRM
ECRM has prepared some relevant information materials, addressing awareness raising of the population about possible natural and man- made risks. There were created information materials, containing some brief information about the most devastating natural events typical of Armenia, the Southern Caucasus region, as well as of other countries, representing partner-centres of the present Project, however alongside with other country-members of the EUR-OPA Agreement. This brief information concerns such natural events as: earthquakes, floods, landslides, mudflows, avalanches, storms, and hurricanes in line with man-made hazards such as: accidents with the involvement of chemical substances and nuclear hazard. At the same time there were designed more detailed information materials, concerning calamities being the most devastating for Armenia, such as: earthquakes, floods, chemical and radiological (nuclear) accidents.
Being more precise, the drafts of these more detailed information materials were developed by support of the EUR-OPA Major Hazards Agreement within the pilot Project: "National and Municipal Campaigns on informing and warning the population at central and municipal levels about emergencies".
In 2012 from a pilot Project there were selected, further worked out and updated three additional information Modules (brochures), assigned for the municipalities at special risks: one for the municipalities at possible radiological risk; second for the municipalities, in whose territories some hazardous substances are being produced, utilized or stored; third one for the municipalities located in flood prone vicinities (with reservoirs adjacent to an inundation area), and at last also an information Module, assigned for the municipalities situated in earthquake prone areas.
Value, usefulness and possibility for these information materials to be used at both: further working on a final variant of the joint Project: "Surviving disasters: a pocket guide for the citizens" (SurvDis), as well as while preparing, on its basis, a pocket guide for Armenia, are based on the facts that:

- information, contained in them, in full corresponds to the aim, objectives and expected results of the SurvDis project;
- these materials have been created by given the both: specifics of Armenia and rich international experience, accumulated by different countries.

These information materials have been collected through involvement of some information sources, concerning:

- hazards of natural, man-made and other nature present in the Republic, its regions and areas, where the citizens live as well as hazards typical of other partner-countries;
- the degree of vulnerability of communities and level of risks, that communities are exposed to;
- likely specific disaster scenarios ;
- mechanisms and tools, used to inform and warn the population about disasters;
- how to prepare beforehand for a likely disaster and to act adequately in times of a specific disaster;
- behavior patterns when informed and warned about an impending disaster (in the preventive phase) and at the actual emergency situation (in the acute phase), as well as how to proceed in a recovery phase.

At this stage, the Project coordinating Centre CEMEC has sent us an English version of the above draft " Surviving disasters: a pocket guide for the citizens" (SurvDis). At present we are translating it Armenian, with further comparing it with the relevant information materials created in ECRM and available in the Republic of Armenia in the above area, will make some proposals in order to develop a final draft Project, as well to prepare, drawn on its basis, a "Pocket Guide for Armenia". Simultaneously we have submitted to the CEMEC the "BRIEF INFORMATION on information materials for AWARENESS RAISING OF THE POPULATION about possible natural and man-made risks" created by ECRM in 2012 within the framework of the Project "Surviving disasters: a pocket guide for citizens".

Work package 4 (prepared by CEMEC, CUEBC):
Description:
Implementing English and French electronic version

The Graphic Layout of the booklet has included simple comics and vignettes which visually reinforce the concepts included in the text.
The European University Centre for Cultural Heritage has been involved in CEMEC San Marino in the production of the booklet "Surviving Distaters: a pocket guide for citizens - Surviving Disaster pocket guide for citizens - Sopravvivere allle catastrofi: a vademecum per i cittadini" by ensuring the French translation by Centre staff and the revision of the text by a person whose mother tongue is French.
The English and French versions have been presented during the Meeting of the Directors of Centers held in Paris on December 4 and 5. Simplicity, immediacy, originality, legibility of the booklet have been outlined and appreciated. Several Centers have provided availability for translation in more European Languages (Arabic, Portuguese, Spanish).

RESULTS OBTAINED IN 2013

Working package 1 (prepared by CEMEC, ECRM, TESEC, CUEBC, GHHD)*:*
Description:
Collecting partners able and willing to translate in their own native language
Associated deliverables:

Based on the previous year comments, CEMEC produced a final version in English and diffused it to partner centres for translation in local languages and incorporation of possible national specificities

GHHD prepared the Georgian version and included emergency phone number specific for Georgia.
ECRM translated the final version in English in Armenian and inserted corrections by given the specifics organizations and services of the Disaster Risk Reduction and Response system of the Republic of Armenia, as well as with comparing it with the relevant information materials, created in ECRM and available in Armenia in above area.
TESEC developed the Russian version that was disseminated for discussion and proposals have been collected. Based on national data, additionnal proposals for the English version have also been prepared and provided to CEMEC.
CUEBC translated in Arabic the final version in English for its possible diffusion in some member states (Morocco, Algeria, Lebanon).

Work package 2 (prepared by CEMEC, TESEC, ECRM, CUEBC, GHHD)*:*
Description:
Implementing multilingual electronic versions
Associated deliverables:

Thanks to the collaboration of all the associated centres, the following linguistic versions of the booklet have been produced and are available as pdf files:

- English
- French

- Russian
- Italian
- Armenian
- Georgian
- Arabic

GHHD
The final Georgian version has being printed (200 copies).

ECRM
The final Armenian version received from CEMEC will be published, distibuted and used for awareness raising of the population. Based on that common “Pocket Guide”, the ECRM plans to develop a more extended Armenian version giving more information and educational material it developed previously.

Work package 3 (prepared by CEMEC)*:*
Description:
Publishing multilingual versions on the BeSafeNet web site
Associated deliverables:

Due to the revision of the content of the Besafenet website, the publication on the website was delayed.

1.B. Networking between governments

PROPOSAL OF A REGIONAL AGREEMENT ON FIRE MANAGEMENT TRANSBOUNDARY COOPERATION

TARGET COUNTRIES : CoE and UNECE Member States

PARTNERS INVOLVED :

COORDINATING CENTRE : GFMC Freiburg, Germany

OTHER CENTRES: ECFF Athens, Greece

OTHER PARTNERS : Regional Fire Monitoring Center (RFMC), Skopje, Former Yugoslav Republic of Macedonia

EXECUTIVE SUMMARY

The UNECE/FAO regional Forum has been held and brought together member states and specialists, which recommended, as a result of careful and multi-year preparation and cooperation, among other, that an international mechanism for enhancing fire management capacities of countries in need to be established.

The main outcome of the preparatory work for the Forum, namely the"White Paper on the State of Wildfires and Fire Management in Forests and other Vegetation Resources in the UNECE Region", has been published under the title "Vegetation Fires and Global Change" by Kessel Publishing House: the table of contents is available at http://www.forstbuch.de/GoldammerVegetationFires_1_11.PDF .

OBJECTIVES OF THE PROJECT

Global objective for 2012-2013 :

In 2010-2011 first suggestions have been developed by fire management experts from CoE and UNECE member states to develop a proposal for "Regional Agreement on Cross-Boundary Cooperation in Fire Management". This proposal has to be seen under the light of changes of land use, climate and socio-economic conditions in the past decade in the member States of the region, which have resulted in an increasing vulnerability of forests and open landscapes, including actively managed or abandoned agricultural and pasture lands, as well as wetlands / pit lands ecosystems. At the same time an increasing vulnerability of society to become affected by fires burning at the interface of urban and other residential areas is noted. Air pollution generated by wildfires is an increasing problem for human health and security in many UNECE member states. In order to meet the increasing threats of wildfires CoE / UNECE member states need to address the challenges arising from the consequences of changing environmental, climate and socio-economic conditions on forests. Public policies affecting forest fires need to be reviewed and adapted to changing and changed environmental and socio-economic conditions. International cooperation in fire management offers solutions to exchange expertise and enhance effectiveness of international collaboration during emergency situations. Together with the UNECE Forestry and Timber Section (Geneva) and the UNECE / FAO Team of Specialists on Forest Fire (which is chaired by GFMC) a Forum will be prepared and convened in Geneva in which Team members and delegates from governments will discuss and agree on a proposal for an agreement.

Specific yearly objectives :

2012:

Continuation of the preparatory process, which was initiated in 2010-11. Some selected delegates from member countries will meet at GFMC in 2012 in the frame of the Joint Meetings of the Global Wildland Fire Network / UNISDR Wildland Fire Advisory Group. ECFF and RFMC staff to work for short periods at GFMC to support preparatory process.

2013:

The Forum "Cross-Boundary Cooperation in Fire Management" will be held and followed up.

EXPECTED RESULTS

2012:

Advisory support by fire management experts from the region will be solicited at the Meeting in Freiburg (GFMC) in June/July 2012.

2013:

The Forum "Cross-Boundary Cooperation in Fire Management" has been held and resulted in a proposal on a voluntary agreement, which may become a voluntary or a legal agreement, or a chapter to a convention.

RESULTS OBTAINED PREVIOUSLY (if any)

Various meetings have been held by GFMC in 2010-2011 to solicit statements, proposals, etc. towards developing a regional agreement. A questionnaire has been drafted to be circulated to CoE / UNECE member states in preparation of the Forum.

RESULTS OBTAINED IN 2012

Work package 1 (prepared by GFMC, ECFF, RFMC):
Description:
Preparing / organizing (with the support of . ECFF and RFMC) the different steps in convening the Forum in 2013 at the UN in Geneva. Additional fire management experts from Council of Europe / UNECE member states will also be called in (Former Yugoslav Republic of Macedonia, Russia, Ukraine), as well as three or four experts from South Asia, Central America and Africa where regional strategies for fire management are in place or developed.
Associated deliverables:
Recommendation of the consultation to be forwarded to UNECE for the next steps of preparing the Forum.

The Global Fire Monitoring Center (GFMC) continued to prepare the concept for the development of a regional voluntary or legal agreement on transboundary cooperation in fire management, a multi-year endeavor.
The activities concentrated on the final preparation for the project "UNECE-FAO / CoE Regional Forum on Cross-boundary Fire Management" which is aiming at the development for a proposal for a "Regional Agreement on Cross-boundary Cooperation in Fire Management in the UNECE Region", to be associated with EUR-OPA agreement, UNISDR and OSCE.
This proposal has to be seen under the light of changes of land use, climate and socio-economic conditions in the past decade in the member States of the region, which have resulted in an increasing vulnerability of forests and open landscapes, including actively managed or abandoned agricultural and pasture lands, as well as wetlands / peatland ecosystems. At the same time an increasing vulnerability of society to become affected by fires burning at the interface of urban and other residential areas is noted. Air pollution generated by wildfires is an increasing problem for human health and security in many UNECE member states.
In order to meet the increasing threats of wildfires CoE / UNECE member states need to address the challenges arising from the consequences of changing environmental, climate and socio-economic conditions on forests. Public policies affecting forest fires need to be reviewed and adapted to changing and changed environmental and socio-economic conditions. International cooperation in fire management offers solutions to exchange expertise and enhance effectiveness of international collaboration during emergency situations. Together with the UNECE Forestry and Timber Section (Geneva) and the UNECE / FAO Team of Specialists on Forest Fire (which is chaired by GFMC) a Forum will be prepared and convened in Geneva in which Team members and delegates from governments will discuss and agree on a proposal for an agreement.
In June 2012, in conjunction with the biennial meeting of the UNISDR Wildland Fire Advisory Group, the GFMC invited experts from the Council of Europe member states as well as additional resource persons experienced in the development of border-crossing agreements for cooperation in fire management from outside Europe, to finalize the proposal for the Forum and the development of the agreement.
A revised proposal has been formulated now by the delegates and submitted, through the UNECE/FAO Timber Section, Geneva, to the Government of Germany. Based on the comments by the German GIZ (on behalf of the Federal Ministry for Agriculture) another revision of the proposal and financial matrix is underway in November 2012.
The project objectives include:
1. Prepare an in-depth analysis of:
- the key factors determining contemporary and expected future forest fire problems in the UNECE region, e.g. those that are newly arising from changes in land use, socioeconomical conditions and climate and which are threatening sustainable forest management;
- the state of current and need for future public policies to address the underlying causes of fire problems in the region
2. Development of guidelines for international cooperation in fire management (ground, aerial)
3. Representatives of UNECE / CoE member states to discuss the analysis and the draft guidelines in a Forum and to develop recommendations for national action and international response, e.g. for a regional agreement on cross-boundary cooperation in fire management.
4. Representatives of other regions to provide expertise in developing formal and informal bilateral and multilateral agreements on transboundary cooperation in fire management.
The Government of Germany has indicated in October 2012 to provide up to ca. € 370,000 for this project for implementation between January 2013 and June 2014.
While the report of the CoE-sponsored meeting in Freiburg is not yet ready, one of the major outputs was the discussion, modification and endorsement of the draft paper "Integrating the Management of Wildfire-related Risks in Rural Land and Forest Management Legislation and Policies" discussed and in its draft version endorsed by the WFAG meeting (Annex I). This paper has been submitted to FAO Committee on Forestry (COFO), the governing body of the FAO Forestry Department, in September 2012.
As pointed out in the proposal for this 2012 activity, in 2010-2011 first suggestions have been developed by fire management experts from CoE and UNECE member states to develop a proposal for "Regional Agreement on Cross-Boundary Cooperation in Fire Management".
The decision to postpone "UNECE-FAO / CoE Regional Forum on Cross-boundary Fire Management" to 2013 brought a delay of the political process but has not slowed down the preparatory work. With the submission of the revised financing proposal by UNECE to the German Government for preparing and organizing the Forum in Geneva or Krasnoyarsk (Russian Federation) in November 2013, there is a progress towards implementation of the plans

developed since 2010. Once again, the interim financing of the dedicated work through the Administrative Arrangement by EUR-OPA was important and instrumental in order to further develop this process was successful in 2012.

Embedding the UNECE / CoE activities and Forum in the global context
It is clearly envisaged to utilize the upcoming Forum to take the lead globally in the development of a regional agreement and to embed this activity in the global development that is facilitated by GFMC. Besides inviting representatives from other regions (cf. bullet 4 on top) it is now considered to call for an attached 1-day International Wildland fire Summit.
To prepare the Summit a dedicated Special Event is now requested to be held at the GPDRR in Geneva, May 2013. This Special event, tentatively entitled "Strengthening Cooperation of the United Nations and International Organizations in Wildland Fire Management" would follow the first informal UN Interagency Meeting on Cooperation in Fire Management, which was held 29 June 2012 at the United Nations Geneva and preceded the WFAG meeting in Freiburg (CoE was invited but had to apologize; the Secretary General of the EUR-OPA had provided a letter [dated 27 June 2012] to the meeting in which he proposed that the 2013 Forum would become a global character [cf. separate Attachment 01]). For the preparation of the Special Event the GFMC has reviewed the role of UN agencies and international organizations in the field of fire management (cf. separate Attachment 02, CoE / EUR-OPA activities mentioned in several contexts and in detail in section 3.2. [p. 19]).
At this event the "UN White Paper on Vegetation Fires and Global Change", which is now in its final stage of preparation, will be presented publicly.
This White Paper, for which the UNISDR Wildland Fire Advisory Group (WFAG) members contributed significantly, will be published by Springer (Dordrecht, Netherlands) in late 2012 or early 2013, and represent a contribution of WFAG to the UN and the international community.

Work package 2 (prepared by GFMC):
Description:
Provision of seed funding to establish the REEFM in a room at the National University of Life and Environmental Sciences of Ukraine (Kiev), basic renovation, furniture and IT (PCs, internet connection).

In order to support and facilitate the dialogue with Eastern European countries, at the same time by strengthening the overall capacity of regional fire monitoring and policy support in Eastern Europe, a small nucleus for the establishment of a Regional Eastern European Fire Monitoring Center (REEFMC) was proposed to be established at the National University of Life and Environmental Sciences of Ukraine (Kiev, Ukraine). The Center would follow the successful example of the building the Regional Fire Monitoring Center in SE Europe / Caucasus (Skopje, Former Yugoslav Republic of Macedonia) through EUR-OPA funding in 2010.
Parts of the 2012 budget were used to prepare the designated leader of the REEFMC, Prof. Dr. Sergiy Zibtsev, to familiarize himself with the administrative and conceptual environment of the UN and international organizations. A modest contribution of 1225 Euro has been made available to the National University of Life and Environmental Sciences of Ukraine to set up a special space for the REEFMC (by investing in infrastructure).
The establishment of the REEFMC fuelled the discussion about the need and prospects of establishing similar Centers in other regions of the world. The request by South Africa and the ongoing work to build a Regional Fire Monitoring Center for Central Asia (in Mongolia) was the reason to develop a paper on the roles and mandates of Regional Fire Monitoring Centers, following the examples of the EUR-OPA-sponsored Centers in SE Europe and Eastern Europe.

RESULTS OBTAINED IN 2013

Working package 1 (prepared by GFMC*):*
Description:
The three Centers will work together in the organization / realization of the Forum and the follow up. All travel costs covered by this project will be administered by GFMC.
Associated deliverables:
Forum has been held and report delivered to Council of Europe and UNECE.

The Forum was implemented as planned thanks to the additional financial support of the Government of Germany.
It was attended by 50 participants from the following countries/organizations:

- 26 delegates from 22 UNECE member states;
- 8 delegates from 4 countries outside UNECE (Africa, South America, Central America, South Asia and Northeast Asia);
- 4 delegates from 4 multilateral / international organizations (ASEAN, SADC, OSCE, CoE EUR-OPA Secretariat);
- 4 delegates from 4 international and national development organizations and NGOs;
- 8 delegates from 5 UN specialized agencies, programmes and secretariats (UNECE, UNFAO, UNOCHA/UNEP, UNECE LRTAP Convention Secretariat).

A number of preparatory documents had been submitted to the participants ahead of the Forum: the Draft "White Paper on the State of Wildfires and Fire Management in Forests and other Vegetation Resources in the UNECE Region" was one of the documents.

The Forum was opened by the statements i.a.w. the final agenda. The Forum Chair welcomed the opening remarks by the Executive Secretariat of the European and Mediterranean Major Hazards Agreement (EUR-OPA) of the Council of Europe, and expressed the appreciation of the GFMC that the EUR-OPA Secretariat had financed the preparatory meetings of the Forum between 2010 and 2012.

The Forum Papers, which had been distributed to the attendees before the Forum, were presented by main authors or rapporteurs of Working Groups:

- Study on the contemporary and expected future forest fire issues in the UNECE region, with reference to "White Paper on Vegetation Fires and Global Change" (Johann G. Goldammer, GFMC)
- Preliminary evaluation of the questionnaire (Peter W. Sheldon, GFMC)
- Proposal of the International Working Group on Cooperation in Wildfire Preparedness and Response (IWG-CWPR): "Building Resilience of Nations and Communities within the UNECE Region to Wildfire Emergencies and Disasters" (Mark Jones, Member, IWG-CWPR, UK)
- Proposal by the International Fire Aviation Working Group (IFAWG): Adoption of "Voluntary Guidelines for Fire Aviation" (Richard Alder, Chair, IFAWG, Australia)
- Draft "White Paper on the State of Wildfires and Fire Management in Forests and other Vegetation Resources in the UNECE Region" (Johann G. Goldammer).

A special presentation was given by the Head of the Secretariat of the UNECE Convention on Long-Range Transboundary Air Pollution (CLRTAP), Ms. Albena Karadjova. The Secretariat confirmed the significance of agricultural burning on generation and long-range and cross-border transport of air pollutants and their impacts on the environment and human health.

All discussions of the Forum Reports were held in the plenary and a draft Forum Statement was prepared. It was agreed that a final version would be developed in the week after the Forum, by circulation of the final draft of the end of the Day 2 (29 November 2013) for comments. In the following week a number of comments were incorporated in the final draft.

The official report and the recommendations of the Forum were finalized on 5 December 2013 and published on the website of the UNECE/FAO Team of Specialists on Forest Fire.

In summary, the Forum essentially recommended (some abbreviations of extracted items):

- The cross-boundary effects of wildfires require jurisdictions at all levels to cooperate in fire management and to define collective solutions.
- While prime emphasis should be given to cooperation in fire management between jurisdictions sharing common borders, the long-range consequences of fire emissions are calling for strengthening existing and, if necessary, developing additional protocols addressing the reduction of adverse consequences of wildfire at international level.
- Calling for the development of a voluntary regulatory institutional and policy framework aimed at building resilience of nations and communities within the UNECE region.
- Any recommended measures in building resilience of nations and communities to wildfire require an holistic approach to integrated fire management and wildfire risk reduction.
- Proposes to establish an International Wildfire Support Mechanism (IWSM) for the UNECE Region and globally, that will assist nations to improve their capacity and resilience to wildfire
- Recommends that UNECE member states adopt in principle the Draft Fire Aviation Guidelines and support their continued development.
- Considering the increasing impacts and damages of fire on the one side, and the required investments in building fire management capacities at global level on the other side, the option should be explored of whether a strengthened mechanism should evolve from the currently existing voluntary framework to a more formalized framework under the auspices of and support by the United Nations taking into consideration, and supportive of, bilateral and regional frameworks.
- The Global Wildland Fire Network over the past decade has been promoting fire management and networking which is appropriate to continue and expand its role as the overarching framework at the global level to host a new, strengthened global mechanism of cooperation in fire management. This framework

should ensure that voluntary initiatives and the wealth of experience of individual, national, regional and international actors be utilized and shared.

- It is proposed to explore options to establish a UN Secretariat mandated with the implementation of a global fire management programme that should have a key role in facilitating the free and open global transfer of knowledge.
- The UNECE/FAO Team of Specialists on Forest Fire to jointly prepare a set of possible organizational scenarios that will ensure that the successful work it has carried out so far will not be interrupted, creating a vacuum, but will rather go global with a new mandate and a different setup. Based on these scenarios the leader of the Team will approach and seek the interest of UN organizations. The results of the consultation could be discussed at a team of specialists meeting to be organized before July 2014.

What are the implications for the follow-up of the Forum? The Forum, which convened technical fire management specialists (representatives of administrations responsible for fire management and academia), had a character of a consultation, which came up with a set of recommendations directed to the UNECE Member States, policy makers, international organizations and the UN system.

The discussion at the Forum revealed a strong consent that the fire problems within the UNECE Region and globally are increasing and that emphasis should be given to address the global fire problem at cross-sectoral level from national to global and solutions for international concerted and coordinated action to be identified.

In brief: The ToS Leader (head of GFMC) has been tasked to follow up and identify solutions. Details of procedures will be elaborated during January / February 2014 by the UNECE/FAO Forestry and Timber Section and GFMC.

Altogether, the UNECE/FAO Regional Forum on Cross-boundary Fire Management has been held, but the most important process is still ahead in 2014.

2. USING KNOWLEDGE TO REDUCE VULNERABILITY

2.A. Knowledge diffusion

GUIDELINES FOR THE DEFENSE OF RURAL POPULATIONS, SETTLEMENTS AND OTHER ASSETS AGAINST WILDFIRES AND SMOKE POLLUTION

TARGET COUNTRIES : All member countries

PARTNERS INVOLVED :

COORDINATING CENTRE : ECFF Athens, Greece

OTHER CENTRES: GFMC Freiburg, Germany

OTHER PARTNERS : Regional Fire Monitoring Center (RFMC), Skopje, Former Yugoslav Republic of Macedonia

EXECUTIVE SUMMARY

The first ever produced guidelines aiming at enhancing capacities for the "Defense of Rural Populations, Settlements and other Assets Against Wildfires and Smoke Pollution" are a product that can be easily understood by local decision makers and end users, by translating the globally available comprehensive scientific and technical knowledge to understandable language and action.

The guidelines are divided into three sections:
Part 1: Guidelines for Local Authorities

- Background and rationale
- Some facts about Wildfire Threats
- Wildfire preparedness

Part 2: Guidelines for Local Population

- Introduction
- Are your House and your Family at Risk?
- Preparing your property
- Widfire emergency

Part 3: Fire Management Training Materials for Rural Fire Services and Local Communities and Local Communities based on EuroFire Standards

The draft document is currently available in English and Greek.

OBJECTIVES OF THE PROJECT

Global objective for 2012-2013 :
Collaborative work between the 3 Centers will result in the development and first publication (ENG) of "Guidelines for Defense of Rural Populations, Settlements and other Assets Against Wildfires". This project will address the wildfire threats of rural settlements (villages, towns, scattered farmsteads) and other rural assets (agricultural fields / crops, infrastructures and other values at risk), which in some regions of Europe / Mediterranean are increasingly endangered by wildfires due to rural exodus, weakening of rural work force and self-protection ability, and increasing wildfire hazard on abandoned lands. Vice-versa, increasing industrialization and concentration of populations in some areas exert a high pressure on natural resources for land use change, which is reflected by the high frequency of arson and 'unknown'-cause fires in the wildlands. The intermix of human settlements with natural ecosystems in many places create severe wildland / urban interface fire problems, which have become a major issue of political debate and confrontation. The Guidelines will be designed to provide information to local inhabitants (incl. farmers, community leaders / mayors, local fire service units, volunteer fire-fighters and village defence committees) with state-of-the-art information on wildfire damage prevention measures, and defense of wildfires threatening settlements and rural assets. Furthermore, the guidelines will provide information to the residents how to apply all fire safety regulations for their house (clearing vegetation, provide extra sources of water, use appropriate building materials, etc.) and to protect the communities against the adverse effects of vegetation fire smoke pollution on human health and security. Also, the issue of unexploded ordnance (UXO) will be addressed since many forest sites and non-forest lands in SE Europe and the Balkan region are contaminated by land mines and unexploded ordnance (UXO) stemming from recent conflicts. The relevance of the expected outcomes will be high for all CIS member states.
Specific yearly objectives :
2012 :
Collection of materials to be processed for the development of guidelines, bringing fire experts from SE Europe together in a regional workshop, co-organized by the 3 centers.

2013 :
Production of guidelines, with a second final workshop in the region

EXPECTED RESULTS

2012 :
State-of-the-art material collected; expert inputs by Workshop I are solicited.

2013 :
Final product of Guidelines (ENG) will be reviewed by experts from Greece, Former Yugoslav Republic of Macedonia, Russia, Bulgaria, Turkey, and from specialists from other countries, including one or several invited specialists from North America (t.b.d.) (Workshop II). The Guidelines will be accompanied by a homeowner checklist ("How to make your home forest fire safe") and by a 10-minutes video presenting home & health protection guidelines. The Guidelines will also be accompanied by an example of a map of distribution of UXO and land mines (wherever exist), and instructions about precautionary measures and to how to respond during the wildfires.

RESULTS OBTAINED PREVIOUSLY (if any)

General expertise available. Mediterranean: Aristotelion University, Thessaloniki, Greece. Eastern Europe / EECCA: Specific human health threats by fire smoke emissions have been addressed by ECFF. Community-Based Fire Managment: GFMC expertise from countries worldwide. Cooperation between state agencies and civil society organizations including volunteers: RFMC.

RESULTS OBTAINED IN 2012

Work package 1 (prepared by ECFF, GFMC, RFMC):
Description:
Development of the guidelines
Associated deliverables:
State of the art draft material

The development of the Guidelines is a collaborative project between the Global Fire Monitoring Center (GFMC) with and through its associated Regional Southeast Europe / Caucasus Fire Monitoring Center (RFMC) and the European Center for Forest Fires (ECFF). The Guidelines will address the wildfire threats of rural settlements (villages, towns, scattered farmsteads) and other rural assets (agricultural fields / crops, infrastructures and other values at risk), which in some regions of Europe / Mediterranean are increasingly endangered by wildfires due to rural exodus, weakening of rural work force and self-protection ability, and increasing wildfire hazard on abandoned lands. Viceversa, increasing industrialization and concentration of populations in some areas exert a high pressure on natural resources for land use change, which is reflected by the high frequency of arson and 'unknown'-cause fires in the wildlands. The intermix of human settlements with natural ecosystems in many places create severe wildland / urban interface fire problems, which have become a major issue of political debate and confrontation. The Guidelines will be designed to provide information to local inhabitants (incl. farmers, community leaders / mayors, local fire service units, volunteer firefighters and village defense committees) with state-of-the-art information on wildfire damage prevention measures, and defense of wildfires threatening settlements and rural assets.

Furthermore, the guidelines will provide information to the residents how to apply all fire safety regulations for their house (clearing vegetation, provide extra sources of water, use appropriate building materials, etc.) and to protect the communities against the adverse effects of vegetation fire smoke pollution on human health and security. Also, the issue of unexploded ordnance (UXO) will be addressed since many forest sites and non-forest lands in SE Europe and the Balkan region are contaminated by land mines and unexploded ordnance (UXO) stemming from recent conflicts. The relevance of the expected outcomes will be high for all CIS member states. Detailed background and rationale for the project "Guidelines for Defense of Rural Populations, Settlements and other Assets Against Wildfires", which will provide guidance and assistance to rural populations to defend their assets and ensure security of people against wildfires are provided in ANNEX I.

The development of the Guidelines is a 2-years project. In the first year the field work and other preparatory work have been terminated. The RFMC started with collection of all available data, documents, reports etc. in the region (in regards of the Guidelines). The same was done in the other centers, partners in the project. For that purpose but also

for other activities in the frame of the project, a technical person was engaged - Ljubomir Netkov (forestry engineer). There was a need for harmonization of the next steps for the organization of the first workshop. The first meeting of the centers was held in Freiburg from 30 June to 1 July 2012, in the frame of the UNISDR Global Wildland Fire Network / Wildland Fire Advisory Group Meeting 2012 (the meeting was an activity devoted to the preparation of the "UNECE Forum on Transboundary Cooperation in Fire Management", to be held in Geneva, late 2013. The duties were splitted among the centers and the place for the first workshop was determined - Skopje.
In order to get much more precise data for the circumstances in Former Yugoslav Republic of Macedonia, a short field trip was organized. The region of the National Park "Pelister" (in the region of the border with Greece) was visited. It is very specific area with large number of UXO from I World War, forest fires, villages under threat of fires etc. Very valuable information was collected especially through contacts with the local population.

Work package 2 (prepared by ECFF, GFMC, RFMC):
Description:
Regional workshop(I) of SE Europe forest fire experts (Skopje, Former Yugoslav Republic of Macedonia)
Associated deliverables:
Report on the results of Workshop (I)

At a workshop held in Skopje (Former Yugoslav Republic of Macedonia) at the RFMC on 9 November 2012, the preparatory work was evaluated and as main results the concept of the Guidelines were drafted and the duties for the next period were shared. Because the Guidelines could be used in the large region of Council of Europe Member States, we decided to invite other specialists in this area to contribute with their work and improve the Guidelines. The Final number of the participants was 9, from the follow countries: Greece, Germany, Turkey, Serbia, Ukraine and Former Yugoslav Republic of Macedonia. In the last moment participation of the representative from Russia was canceled even if he had contributed remotely.

Between September and October 2012 an opportunity developed to possibly create synergies with a Greek Foundation to cooperate in the project. Following the devastating wildfire affecting ecosystems, land-use systems and livelihood of rural inhabitants of Chios Island (Greece) in August 2012 and the subsequent Congress "Our Response to the Fires – Working together for a better Chios", initiated and organized by the "Maria Tsakos Foundation – International Center of Maritime Research and Tradition N.G.O." (Greece), under the auspices of the Minister of Mercantile Marine and the Aegean and in co-operation with the Chios Municipality and Regional Unit (15-16 October 2012), the GFMC has proposed "Maria Tsakos Foundation" to consider cooperative efforts in testing the concept of the Guidelines on Chios Island and to eventually co-organize the public presentation of the Guidelines in Athens (Greece) in 2013.
The proposed cooperation and possible co-financing of some activities of the Guideline Project in 2013 by the "Maria Tsakos Foundation" is not yet finally agreed upon at the time of writing this report. On 11 December 2012 the "Maria Tsakos Foundation" sent a message that only limited cooperation is possible due to the restrictions by the Charter of the Foundation. However, the CEO of the Foundation offered to act as "intermediary" between our project work and the public authorities in Greece. It is not yet clear at this stage of the Foundation will provide the co-financing and logistical support as indicated at an earlier stage.

RESULTS OBTAINED IN 2013

Working package 1 (prepared by ECFF, GFMC, RFMC):
Description:
Workshop II: Guidelines will be reviewed by experts from Greece, Former Yugoslav Republic of Macedonia, Russia, Bulgaria, Turkey, and from specialists from other countries (Athens, Greece).
Associated deliverables:
Report on the results of the Workshop II.

The development of the Guidelines is a collaborative project between the Global Fire Monitoring Center (GFMC) with and through its associated Regional Southeast Europe / Caucasus Fire Monitoring Center (RFMC) and the European

Center for Forest Fires (ECFF). The Guidelines address the wildfire threats of rural settlements (villages, towns, scattered farmsteads) and other rural assets (agricultural fields / crops, infrastructures and other values at risk), which in some regions of Europe/Mediterranean are increasingly endangered by wildfires due to rural exodus, weakening of rural work force and self-protection ability, and increasing wildfire hazard on abandoned lands. Vice-versa, increasing industrialization and concentration of populations in some areas exert a high pressure on natural resources for land use change, which is reflected by the high frequency of arson and 'unknown'-cause fires in the wildlands. The intermix of human settlements with natural ecosystems in many places create severe wildland / urban interface fire problems, which have become a major issue of political debate and confrontation. The Guidelines will be designed to provide information to local inhabitants (incl. farmers, community leaders / mayors, local fire service units, volunteer firefighters and village defense committees) with state-of-the-art information on wildfire damage prevention measures, and defense of wildfires threatening settlements and rural assets. Furthermore, the guidelines will provide information to the residents how to apply all fire safety regulations for their house (clearing vegetation, provide extra sources of water, use appropriate building materials, etc.) and to protect the communities against the adverse effects of vegetation fire smoke pollution on human health and security. Also, the issue of unexploded ordnance (UXO) will be addressed since many forest sites and non-forest lands in SE Europe and the Balkan region are contaminated by land mines and unexploded ordnance (UXO) stemming from recent conflicts. The special problem of disabled / handicapped people and wildfire safety (notably evacuations) is addressed.

The year 2013 was devoted in writing and illustrating the guidelines. In the beginning field research was implemented on Chios Island, Greece. For that purpose, the Global Fire Monitoring Center (GFMC) together with and financed by the "Maria Tsakos Foundation" organized a field campaign between 25 and 28 February 2013 to investigate and report on local population behavior and fire community safety. This investigation involved interviews with 118 local residents in fire affected areas.
Interviews were conducted in eleven major fire affected villages. Interviews were semi-structured in format and followed an interview guide which invited local residents to describe:

- Their preparedness for a wildfire prior to 18 August 2012
- Information and warnings received from local authorities about the predicted fire danger weather and fires on the day
- How they became aware of the fire, what they did, if they defended, how they defended; if they left: when?
- Their experience during past wildfires (prior to August 2012) in the area
- Their experience in using fire and on voluntarism

Furthermore, the interviewers evaluated 4 proposed pictures for the guidelines illustration purposes. This assisted the selection of "style" of developing the illustrations for the guidelines. The unpublished, internat technical field research report is provided Attachment 8.

A first technical meeting was held in Thessaloniki, Greece, 9-10 March 2013, in which a first review of the guidelines was undertaken. This was followed by a second technical workshop in Athens, Greece, 13-14 May 2013, combined with a political "Round Table on Fire Management". Contracts for contributing authors and both workshops could be financed by the Administrative Arrangement. The "Maria Tsakos Foundation" contributed by paying for the meeting venue in Athens (Evgenideio Conference Center, Athens) including catering.

Work package 2 (prepared by ECFF, GFMC, RFMC):
Description:
Guidelines development with a homeowner checklist (How to make your home forest fire safe and protect the health of inhabitants against smoke pollution), and a 10 minutes video presenting home protection guidelines. The Guidelines will also be accompanied by an example of a map of distribution of UXO and land mines (wherever exist), and instructions about general precautionary measures and how to respond during the wildfires.
Associated deliverables:
Final guidelines (including DVD + Map)

The guidelines are divided into three sections:

- Part 1: Guidelines for Local Authorities
  - Background and rationale
  - Some facts about Wildfire Threats
  - Wildfire preparedness
- Part 2: Guidelines for Local Population
  - Introduction
  - Are your House and your Family at Risk?
  - Preparing your property
  - Widfire emergency
- Part 3: Fire Management Training Materials for Rural Fire Services and Local Communities and Local Communities based on EuroFire Standards

The English version of the Guidelines is actually not the final product for application and consequently the Guidelines shall not yet be published in full length digitally. A pilot print version of the Guidelines has been published with Parts I and II in English and in Greek, for demonstration and delivery to the Annual meeting of the Directors of the European and Mediterranean Centres of the EUR-OPA Major Hazards Agreement Meeting (EUR-OPA) in Strasbourg, France, 25-26 November 2013.

Since the guidelines are targeted to be used by local administration and individual farmers/land managers in SE Europe and the greater neighborhood of Eastern Europe, Caucasus and Central Asia, the production of local language versions of the guidelines (including the translation of the EuroFire Competency Standards and Training Materials for wildland fire fighting and management). The printing of a set of guidelines corresponding to the separated Parts I, II, and III is considered as they have different target groups (local administrations; individual farmers; trainees of professional, voluntary and village defense firefighters).

REAL-TIME TELEMETRIC MONITORING/EARLY WARNING SYSTEMS OF LARGE ENGINEERING CONSTRUCTIONS WITH TIME SERIES LINEAR/NONLINEAR DYNAMICS PROCESSING TOOLBOX

TARGET COUNTRIES: Georgia, Morocco, Russia, Turkey, Bulgaria, Former Yugoslav Republic of Macedonia.

PARTNERS INVOLVED :

COORDINATING CENTRE : GHHD Tbilisi, Georgia

OTHER CENTRES: ECNTRM Moscow, Russian Federation , ECILS Skopje, Former Yugoslav Republic of Macedonia , CEPRIS Rabat, Morocco , ECRP Sofia, Bulgaria

OTHER PARTNERS : AFEM, Ankara, Turkey

EXECUTIVE SUMMARY

The DAMWATCH system was installed and is running now without serious disruptions, monitoring tilts in the body of the Large Enguri Arc Dam (Georgia) with given rate (1 /min, 1/10 min). The results are regularly presented to and used by decision-makers - Direction of the Enguri Dam for assessment of the safety of object.
The detail information on the DAMWATCH system (hardware, software and manual) has been distributed by GHHD to other participating centres (ECRP, CEPRIS, ECNTRM, ECILS) in October 2012 and were asked to present the object appropriate for monitoring and assess possibility of implementing DAMWATCH system on the selected object in their countries. Bulgaria and the Former Yugoslav Republic of Macedonia proposed a candidate for the experimentation while the Russian Federation informed that the country uses its own systems of monitoring and early warning system.
In 2013, the centres involved in the project had to consider the program of processing monitoring data DAMTOOL. Only Bulgaria expressed finally an interest in implementing the DAMWATCH system in one of its dams but due to the strategic aspect of dams, the actual implementation turned out to be very difficult.
Through that concrete example, the project showed that even if technically feasible, the application of scientific work in actual dams is very dependent on the willingness of national authorities to implement them and the issue of the associated cost of such implementation in a larger scale is also crucial.

OBJECTIVES OF THE PROJECT

Global objective for 2012-2013 :
The safety of large engineering objects (dams, etc.) depends not only on the quality of design and construction but also on the proper maintenance during exploitation and systematic monitoring of construction's condition. Accordingly, development of cost-effective real-time telemetric monitoring/early warning systems of large engineering constructions using network of tiltmeters, strainmeters and other sensors and toolbox of linear/nonlinear dynamics processing methods of monitoring time series for systematic control of construction's stability is the main objective of the project.

Specific yearly objectives :

2012 :
Development of cost-effective scheme of collecting real-time information on time-dependent strains /tilts from sensors and transmitting by Internet to the diagnostic centre and its realization. Testing of real-time telemetric monitoring/early warning systems at Enguri Dam International Test Area (EDITA) using the network of sensors. Distribution of developed technology to cooperating centres and collection of the data on large engineering constructions in their countries, which need monitoring systems. Permanent acquisition of analog signal measurements from sensors (tiltmeters, strainmeters, vibrometers) and finding, whether the latter ones are representative for the main characteristics of construction's mechanical behavior. Creation of long enough data bases of tilts, strains and low-frequency vibrations for linear/nonlinear analysis. Creation and development of the 3d static mathematical model of construction taking into account: geometric parameters; construction material properties, geologic conditions of foundation; operation loads of different origin. Comparative analysis of measured and predicted (by deterministic model-FEM, linear and nonlinear forecasting) data sets in order to derive the main statistical and dynamical features of construction's behavior patterns and to ensure appropriate decision making. Collection of information on selected objects (Large dams) in partner countries and the monitoring systems installed in these objects. Development of plans of cost-effective systems of monitoring automatization and telemetry at selected objects (dams) in partner countries.

2013 :
Compilation of data-base of recordings of sensors (tiltmeters, strainmeters, vibrometers) at EDITA and the selected objects in partner countries for an year 2013. Selection/development of data analysis linear (frequency, time-frequency, singular value decomposition, autocorrelation first zero crossing variation, etc.) and nonlinear (phase space

structure, phase trajectory evolution, noise reduction, memory, long range correlation testing, etc.) methods, appropriate for measured tilt, strain, vibration meter data sets during one year load-unload cycle in order to establish construction response to water load. Selection of appropriate to the targeted problem linear (autoregressive) and nonlinear (based on topology of reconstructed attractor) forecasting methods and creation of special diagnostic toolbox for analysis of tilt/strain time series.

EXPECTED RESULTS

2012 :

Design of scheme of collecting real-time information on strains /tilts from sensors and transmitting by Internet to the diagnostic centre. Installation of real-time telemetric monitoring/early warning system at the Enguri Dam International Test Area using the network of tiltmeters and strainmeters and testing its reliability. Data base on monitoring systems in partner countries. Distribution of the scheme to partner centres and testing its applicability to selected objects (dams) in their countries. 3d static mathematical model of construction (Enguri Dam) taking into account: geometric parameters; construction material properties, geologic conditions of foundation; operation loads of different origin.

2013 :

Data-bases of recordings of sensors (tilts, strains) at EDITA and selected objects (Large dams) in partner countries. Processing of these data by the special diagnostic toolkit. Establishment of patterns of time-dependence of tilt and strains at stable state and defining of general signs of closeness to the critical situation for static and dynamic approaches.

RESULTS OBTAINED PREVIOUSLY (if any)

First steps in planning real-time telemetric monitoring/early warning systems of large engineering constructions in Georgia

References

1. M. Bartsh , A. Schiess Zamara, K.Steiger. 2011. Continuous dam monitoring: an essential basisfor reliable back-analysis. The International Journal on Hydropower & Dams. v.18, 51-56.

2. T. Chelidze, T. Matcharashvili, V. Abashidze, M. Kalabegashvili. 2011. Real time telemetric monitoring system of large dams (DAMWATCH): the case of the Enguri Dam International Test area. Proceedings of Symposium "Dams and Reservoirs under Changing Challenges", 29 May-3 June, 2011, Lucerne, Switzerland (electronic version).

3.V. Levtchouk, J. Alberto, E. Gaziev. 2000. Informational support system for diagnosis and prediction of dam's behavior. Geoecology and Computers. Yufin (Ed). Rotterdam, pp.309-314.

4. Automated dam monitoring systems. 2000. Bulletin 118. International Commission on Large Dams. Paris.

RESULTS OBTAINED IN 2012

Work package 1 (prepared by GHHD):

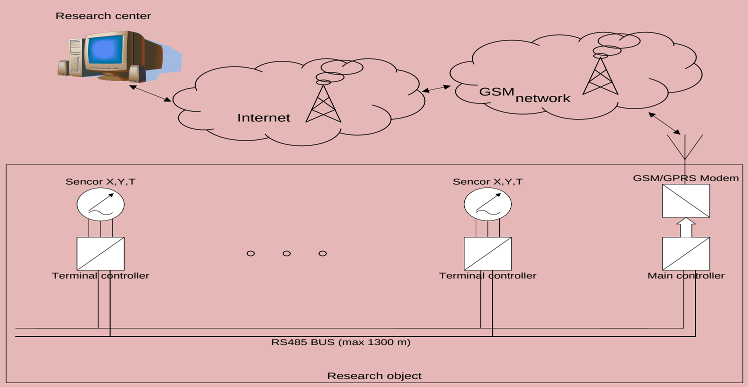
Description:

Development of cost-effective scheme of collecting real-time information on time-dependent strains /tilts from sensors and transmitting by Internet to the diagnostic centre and its realization. Testing of real-time telemetric monitoring/early warning systems at Enguri Dam International Test Area (EDITA) using the network of sensors. Distribution of developed technology to cooperating centres and collection of the data on large engineering constructions in their countries, which need monitoring. Permanent acquisition of analog signal measurements from sensors (tiltmeters, strainmeters, vibrometers) and finding, whether the latter ones are representative for the main characteristics of construction's mechanical behavior. Creation of long enough databases of tilts, strains and low-frequency vibrations for linear/nonlinear analysis.

Cost-effective scheme of telemetric collecting real-time information on time-dependent strains /tilts from sensors and transmitting by Internet to the diagnostic centre and its realization. Testing of real-time telemetric monitoring/early warning systems at Enguri Dam International Test Area (EDITA) using the network of sensors. Distribution of developed technology to cooperating centres and collection of the data on large engineering constructions in their countries, which need monitoring and installed monitoring systems. Permanent acquisition of analog signal measurements from sensors (tiltmeters, strainmeters, vibrometers) and finding, whether the latter ones are representative for the main characteristics of construction's mechanical behavior. Creation of long enough data bases of tilts, strains and low-frequency vibrations for linear/nonlinear analysis.

Deliverables:

The created system for large engineering constructions' monitoring data acquisition – DAMWATCH described in detail has been distributed to participating centres 12 October 2012.



The data acquisition system (Fig. 1.1) is a hardware and software suite for collecting data that are acquired by monitoring using sensors located at remote sites for their subsequent processing and analysis in a (research) diagnostic center. GSM/GPRS and SMS services rendered by all GSM service providers are employed as a communication tools. This is the most cost-effective way of communication for this kind of survey lacking the direct wiring path or access to the Internet.

Basic features of the system

Quantity of the monitoring devices (sensors) linked to the Research Center:	practically unlimited
Geographical range of separation of monitoring devices:	limited by GSM/GPRS coverage only
Quantity of sensors per object:	30
Maximum distance between the sensors:	1300 m.
Maximum sample rate:	1 sample per minute
Maximum amount of stored data:	262144 bytes
Running time of the master controller in lack of a power line:	48 h.
Running time of the terminal controller in lack of a power line:	48 h.
The cable used as RS485 bus:	UTP CAT5
Necessity of routine service:	not applicable

Requirements imposed to the computer operating as an FTP server at the Research Center:

- Without any special hardware requirements – any office WINDOWS PC having access to the Internet can be used without any restriction imposed to its basic functionality.
- Explicitly defined LAN IP address.
- Installed Software of the FTP server.
- Exclusion on FTP port in a WINDOWS firewall.

LAN requirements at the ResearchCenter

- Permanent access to the Internet
- Static IP address on the WAN side.
- Router with NAT function – routing the FTP port to the LAN IP address of a computer used as FTP server.

Approximate cost of the system without sensors

Approximate cost of the master controller:	1600 USD
Approximate cost of the terminal controller:	990 USD
Operational overheads:	at most 100 USD a year

[determined by the tariff of a GSM communication service provider per unit of transmitted data through the GPRS and SMS channels as well as by the operation mode (combination of parameters Qc, Tacq, and Qs - see below) and frequency of use of SMS messages]

Research Center EQP

At the Research Center, a computer permanently connected to the Internet with a static IP address and installed FTP Server software is operating, that enables to gather the acquired data in an EXCEL spreadsheet.

Terminal controllers

On an object undergoing the research, “terminal controllers” are installed, the number of which corresponds to that of sensor points. The terminal controllers (see the diagram in Fig. 2) are provided with two 18 bit ΔΣ analog-to-digital converter (ADC) units (U3) supplied by the company MICROCHIP, whereto high accuracy tiltmeters of model 701-2 supplied by the company APPLIED GEOMECHANICS, which enable to measure X and Y components of tectonic transports, are connected. The terminal controllers are built on the basis of 8-bit microcontrollers supplied by the company ATMEL, product line ATMEGA (U5), and programmed with a software specially developed to fulfill the given task. Under the control of the microcontroller, ADC performs every minute conversion of signals obtained from the tiltmeter outputs. The converted data are read by the microcontroller one-by-one from each ADC by means of a multiplexer. Moreover, the microcontroller reads the temperature value from a respective output of the tiltmeter by means of an integrated 10-bit successive-approximation ADC and performs voltage availability control in a power line. All read data are stored in the temporary storage of the microcontroller. On the other hand, the microcontrollers are provided with RS485 (U7) drivers supplied by company MAXIM, to be connected to

RS485 bus made in the form of a twisted pair of wires. An unique number is assigned in the programming phase to each terminal controller on the bus. The terminal controllers are provided with LEDs (U4) for detecting the measurement processes locally and voltage availability in the power line, and a slot (U6) for connecting a LCD alphanumeric display capable of displaying all measured real time data. The terminal controllers are powered by AC current line of 220B/50Hz by means of a transformer power source (U1). In addition, they are provided with a rechargeable battery 12B/1.2AH operating in a buffer mode and constantly recharged by a charging circuit with voltage stabilization and current limitation whenever the voltage is available in the power line. The microcontrollers are powered with a DC voltage source of 5 V from a voltage stabilizer (U2).

Master controller

All terminal controllers are united by means of the RS485 bus in a common network controlled by a "master controller" (see the diagram in Fig. 3). The master controller is likewise built on the basis of a 8-bit microcontroller supplied by the company ATMEL, product line ATMEGA (U5), programmed by corresponding software specially developed to fulfill the given task. The master controller is connected to the above mentioned RS485 bus by means of RS485 (U7) driver supplied by the company MAXIM. It is provided with a non-volatile memory (U6) built on the basis of 4 chips supplied by the company ATMEL, each having 65536 bytes of memory, i.e. 262144 bytes of memory amount in total, as well as a GSM/GPRS modem (U4) supporting TCP/IP stack and FTP protocol on the basis of a module Q2406 supplied by the company WAVECOM, also being connected to the common RS485 bus by means of the RS485 (U7) driver. The present solution enables to employ a relatively low-cost microcontroller with a single (merely) integrated UART. The master controller is powered by AC mains 220V/50Hz by means of a power supply unit (U1) equipped with a transformer. Besides, it is provided with a floating battery 12V/1.2AH constantly recharged with a constant-voltage and limit current charging circuit (U1) whenever the voltage is available in the power line. The microcontroller is powered by constant voltage 5 V from a stabilizer (U2). The modem is powered by constant voltage 3.9 V from a stabilizer (U3).

System operation

The master controller interrogates all terminal controllers connected to the RS485 bus in a successive order with predetermined periodicity (see below the parameter Tacq). In accordance with the specification, 32 devices are allowed to be connected to a single RS485 bus and the maximum length of the bus is limited to the value of 1300 meters. The system renders sufficiently manifold possibilities to employ systems built in the same manner. The terminal controllers are interrogated through their unique numbers assigned thereto at the programming stage. Having received the request on its own number, each terminal controller transmits current data – X and Y components of the tilts, temperature at the sensor point and information on availability of supply-line voltage, from its temporary memory to the bus. The data are exchanged in ASCII format on the bus. Having received the data, the master controller adds serial number of reading, time and date read on a timer and information on availability of supply-line voltage thereto and stores them in the form of a text string in a non-volatile memory. The master controller uses a timer as a clock that is integrated in the modem provided with an additional lithium-ion cell to retain the capability of time reading in lack of power supply. Having acquired the predetermined amount of data (see the parameter Qs below), the master controller establishes communication with a computer at the Research Center via the modem, and according to FTP protocol, creates in the hard disk memory a text file with the data having been stored in the non-volatile memory at that moment. Thereafter, the master controller cleans up the non-volatile memory and starts to acquire new portion of data. Such method – storing the data in a non-volatile memory and transmitting them to the Research Center batchwise, enables to save expenses imposed by billing systems of mobile communication service providers on service (protocol) data that are inevitably communicated in both directions in the course of establishment/completion of GPRS communication and opening/closing of FTP session so as to enhance useful traffic. Moreover, it enables to avoid data losses in case of short-term service disturbances in GSM network or on the Internet. Such being the case, in the instance where the master controller fails to establish communication with the Research Center computer, it resets the modem and retries to accomplish transfer. If the problem persists, it tries again in 30 minutes.

The non-volatile memory storage space allows to store 262144 alphanumeric characters, which means that in case of, for example, 7 terminal controllers on the bus (full record of one reading makes up 207 characters), and of maximal reading rate – 1 reading per minute – corresponds to 21 hours of data acquisition duration, and thus the loss of data can be avoided even in the case of long-term disturbances in communication systems.

The master controller makes access to the FTP server via the Research Center computer as FTP client with assigned USERNAME and PASSWORD, according to the preliminarily created account in the FTP server clients list. Number of such accounts for a single FTP server is virtually unlimited to link a single computer with infinite number of similar remote data acquisition systems throughout GSM/GPRS coverage area.

The software of the master controller provides for possible management and changing of some parameters remotely via a SMS massage or a call that can be sent to the controllers from a certain mobile numbers. If the received SMS massage contains a command that is valid for the controller, and if it has been sent from an acknowledged number, it responds in accordance with the received command and sends a response to the same number in the form of a SMS report. In addition, the master controller sends on some its own messages in case of certain events.

The master controller supports the following commands:

Info	SMS	requesting the SMS reply containing data on the state and current parameters;
Set	SMS	setting the system parameters;
Nums	SMS	setting the numbers of the mobile phones wherefrom the SMS is received by the controller;
Res	SMS	forcible restarting of the controller and modem (the accumulated data are maintained);
Clr	SMS	cleaning the non-volatile memory;
call	CALL	requesting non-scheduled data transmission;

Example of Command Info

Having received this command, the controller responds with the following type of SMS message:

Info
16.01.12 22:23:15;Y;2458;E00;00;41h;100%;
6;10:00;18:00;10;
7;53;
217.147.238.81;21;UN;PWD;
+995599XXXXXX;+995577XXXXXX;+995593XXXXXX;

The fields of the given message are separated by the symbol ";" (semicolon) and have the following content:

Info	title that determines the cause of the given message
16.01.12 22:23:15	date and time of the message transmission (according to an internal timer)
Y	availability of power to the master controller
2458	total amount of transmitted readings
E00;00	latest error code
41h	available storage amount in hours at a given moment
100%	percentage of the free available storage amount at a given moment
6	Tacq (see the description of the command Set)
10:00	Tm (see the description of the command Set)
18:00	Te (see the description of the command Set)
10	Qs (see the description of the command Set)
7	Qc (see the description of the command Set)
53	Msms (see the description of the command Set)
217.147.238.81	IPftp (see the description of the command Set)
21	PORTftp (see the description of the command Set)
UN	UNftp (see the description of the command Set)
PWD	PWDftp (see the description of the command Set)
+995599XXXXXX	N1 (see the description of the command Nums)
+995577XXXXXX	N2 (see the description of the command Nums)
+995593XXXXXX	N3 (see the description of the command Nums)

Command Set

The non-volatile memory of the microcontroller stores the data defining its operation mode, which can be received remotely via SMS commands. The list of these parameters is given below:

Tacq - terminal controllers polling timeslot in minutes;
Tm - working day starting time – hh:mm (see the operation algorithm description below);
Te - working day ending time – hh:mm (see the operation algorithm description below);
Qs - amount of data after acquiring of which the controller has to send them to the Research Center;
Qc - quantity of the terminal controllers;
Msms - Mask of some parameters. Transmitted in the form of hexadecimal numerical symbols corresponding to one byte. Values of the bits of this number are given below:

MSb 7 - redundancy
6 - 0 – SMS induced by an event is always sent to the first number
1 - SMS induced by an event is always sent to the number wherefrom the latest SMS has been received
5 - 0 - GSM service provider MAGTICOM
1 - GSM service provider GEOCELL
4 - 1 - everyday congestion of the modem and controller
3 1 - messages "FTP err" are allowed (failure at opening the FTP session)
2 - 1 - messages "Power" are allowed (loss/restoring the main power line)
1 - 1 - messages "Start" are allowed (start/restart of the controller in the event of power supply/disturbances or errors)
LSb 0 - 1 - messages "FLASH err"are allowed (errors at accessing to the non-volatile memory of data)

IPftp - WAN IP address of the FTP server at the Research center;
PORTftp - FTP port number;
UNftp - USERNAME at FTP server for a given object;
PWDftp - PASSWORD at FTP server for a given object;

Example of command Set sent in the form of SMS message:
Set6;10:00;18:00;10;7;53;217.147.238.81;21;UN;PWD; -
after execution of which the following parameters are established:

Terminal controllers sampling rate in minutes: - 6 minutes
Working day start time: - 10:00
Working day end time: - 17:00
Amount of readings after collecting of which the controller has to send them to the Research Center: - 10
Number of the terminal controllers: - 7
Mask: - 53

SMS events are sent to the number wherefrom the latest SMS has been received;
GSM service provider MAGTICOM;
everyday restart of the modem and controller allowed;
messages “Start” allowed;
messages "FLASH err" allowed.

WAN IP address of the FTP server at the Research Center: - 217.147.238.81
FTP port number: - 21
USERNAME at FTP server for a given object: - UN
PASSWORD at FTP server for a given object; - PWD
and the controller responds with the following message:
Set
16.01.12 22:23:15;Y;2458;E00;00;41h;100%;
6;10:00;18:00;10;
7;53;
217.147.238.81;21;UN;PWD;
+995599XXXXXX;+995577XXXXXX;+995593XXXXXX;
After this command, the master controller will read data from the terminal controllers every 6 minutes (Tacq), and will transmit to the Research Center the chunk of data consisting of 10 latest readings (Qs), i.e. the data will be sent once in an hour – 10 latest readings at once. The entire non-volatile memory is sufficient for storing the data for 211 hours.

Command Nums

3 mobile phone numbers are also stored in the non-volatile memory of the microcontroller, through which SMS messages are received by the controller:
N1 - Number of the first mobile phone wherefrom the SMS is received by the controller;
N2 - Number of the second mobile phone wherefrom the SMS is received by the controller;
N3 - Number of the third mobile phone wherefrom the SMS is received by the controller;
An example of command Nums is given below:
Nums995599XXXXXX;+995577XXXXXX;+995593XXXXXX; - after execution of which the following numbers are established:
Number of the first mobile phone wherefrom the SMS is received by the controller: - +995599XXXXXX
Number of the second mobile phone wherefrom the SMS is received by the controller: - +995577XXXXXX
Number of the third mobile phone wherefrom the SMS is received by the controller: - +995593XXXXXX
and the controller responds with the following message:
Set
16.01.12 22:23:15;Y;2458;E00;00;41h;100%;
6;10:00;18:00;10;
7;53;
217.147.238.81;21;UN;PWD;
+995599XXXXXX;+995577XXXXXX;+995593XXXXXX;

SMS messages induced by events

The master controller can send unsolicited SMS messages in case of certain events depending on the value of the parameter Msms. On all occasions, the SMS contents are similar to the case with the command Info, except for the title, which can be as follows:
Start - start/restart of the controller occurred due to the power supply/disturbances or errors;
Power - loss or occurrence of line supply;
FTP err - transmission of the data to the server failed;
FL err - error occurred at accessing to the non-volatile memory;
Mem crit - non-volatile memory is filled to capacity – 90% (can occur in three cases if the controller fails to transmit the data to the server for a long while).

The master controller operation algorithm

The master controller polls the terminal controllers and reads the data in timeslots Tacq, adds a serial number of reading, time and date read on a timer integrated in the modem, and information on availability of supply-line voltage thereto and stores them in the form of a text string in a non-volatile memory. Whenever the number of the readings stored in the non-volatile memory reaches the value defined by the parameter Qs, the controller checks the current time, and in case it falls within the working day (>Tm and <Te), starts to establish connection with the server to transmit the data. Such organization of the operation mode envisioning the working hours of the Research Center allows to keep the server computer switched off outside of working hours if not necessary (the data received in non-working hours never can be handled by the personnel in the Research Center until the next working day) and, thereby, to save electric power and computer resources. In case of successful transmission of all data, the controller releases the non-volatile memory and starts to acquire new data in the same mode.
In case of failure or loss of connection with the server that leads to the failure of transmitting the complete data, the master controller restarts the modem and microprocessor in an attempt to establish the connection once again. In case of repeated failure, an SMS message with a title "FTP err" (if it is allowed by the parameter Msms) will be sent, and the attempt will be repeated in 30 minutes (if the shorter time is not defined by the combination of parameters Tacq and Qs). Meanwhile, it keeps acquiring the data from the terminal controllers and stores them in the non-volatile memory. This will be repeated until the end of the working day.
If for a long time the controller fails to send the data and the non-volatile memory is filled to capacity – 90%, the controller sends the message "Mem crit" and reattempts to send the data notwithstanding the working hours. The attempts will be repeated two times every 30 minutes after restarting the modem and microprocessor.
This process will run over and over again until successful transmission of the data and filling the memory completely. In the later case, the memory is cleaned, the data are lost and the process continues to run in ordinary way.
Correction of time in the integrated timer is performed automatically after each sent SMS, using the time of read from Delivery

Report SMS containing the true time from the SMS service center.

2. Possible alternative realizations of the system

In case where the objects that undergo research allow to use the Internet connection, the master controller can be built by use of an Ethernet controller instead of a GSM/GPRS modem to allow lowering the operation costs due to the lower costs of data transmission and receiving readings in practically real time without the need of the non-volatile memory.
If the specificity of the parameters measured on an object that undergoes the monitoring requires the higher reading rate, the circuitry and software of the master and terminal controllers can be built in such a manner as to allow 1 reading per second. However, the amount of the non-volatile memory must be larger in this case. This problem can be solved by adapting the master controller in a manner as to allow using SD card as a non-volatile memory and, thereby, increasing the memory amount up to several gigabytes.
In the present realization, the system reads the data from sensors having analog outputs. Any sensors (other than aforementioned) having analog outputs within the range of +/-14,3V can be used as well. Moreover, the system can be modified so as to be adapted to sensors having any other types of outputs, e.g. with sensors having a current output and various digital protocols.
It should be noted that the aforementioned modifications of the system and its components will affect (increase) the cost of the software and hardware

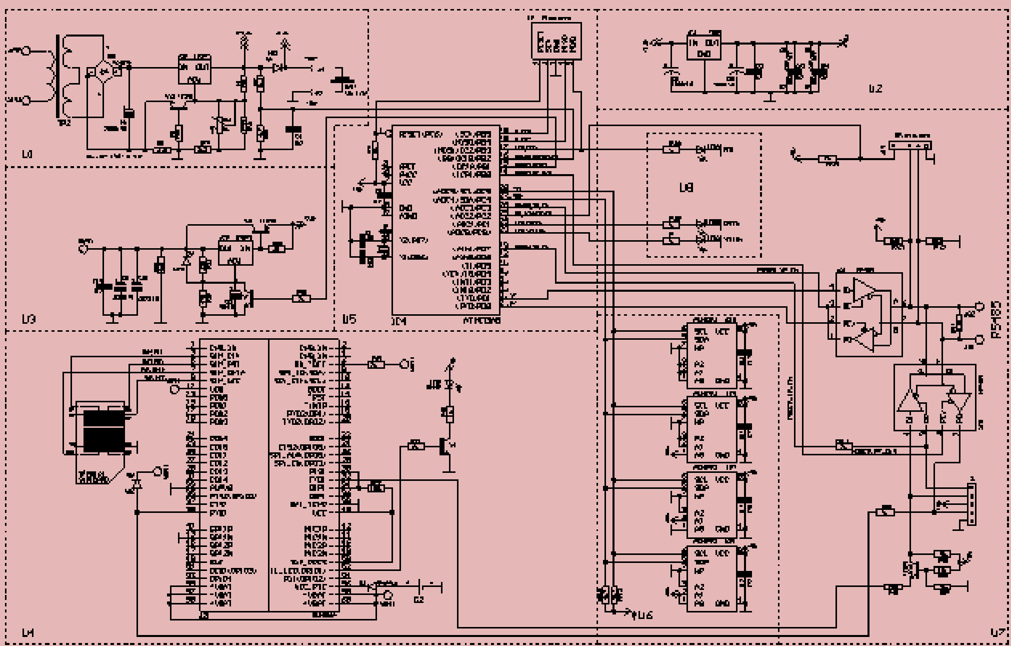


Fig.1.1

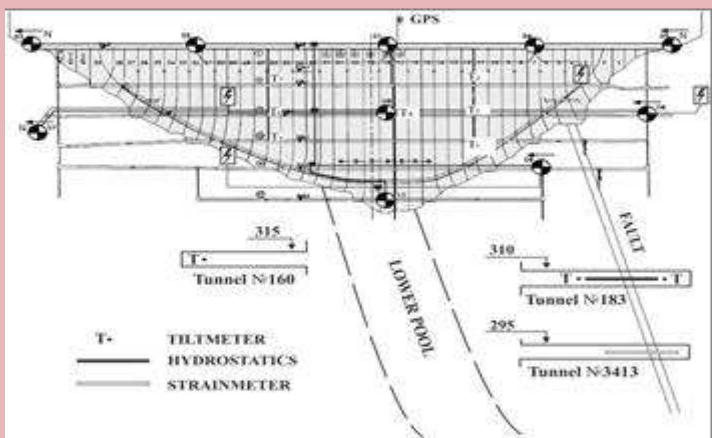


Fig.2.1. Scheme of monitoring network at EDITA, numbers show location of accelerometers and T - location of tiltmeters (downstream view).

Permanent acquisition of analog signal measurements from sensors (tiltmeters, strainmeters, vibrometers) and finding, whether the latter ones are representative for the main characteristics of construction's mechanical behavior. Creation of long enough data bases of tilts, strains and low-frequency vibrations for linear/nonlinear analysis.
Scheme of monitoring network at EDITA, is shown in Fig.2.1: numbers show location of accelerometers and T - location of

tiltmeters (downstream view). The data from 7 tiltmeters located in the body of the dam are regularly transferred by the system DAMWATC to the diadnostic centre. The typical electronic table of data is presented below. The long enough data base (almost two years long) has been compiled.

Date	Time	X1	Y1	T1	X2	Y2	T2	X3	Y3	T3
08.04.10	0:00:01	0.00	0.00	12.4	0.00	0.00	12.7	0.00	0.00	13.7
08.04.10	0:01:00	-0.01	0.00	12.4	0.00	0.00	12.7	0.41	0.33	13.7
08.04.10	0:02:00	0.00	0.01	12.4	-0.03	-0.01	12.7	0.00	-0.05	13.7
08.04.10	0:03:00	0.00	0.01	12.4	-0.03	-0.01	12.7	0.18	-0.08	13.7
08.04.10	0:04:01	-0.03	0.00	12.4	-0.05	-0.01	12.7	0.55	0.14	13.7
08.04.10	0:05:00	-0.01	0.00	12.4	-0.01	-0.02	12.7	0.43	0.06	13.7
08.04.10	0:06:01	0.00	0.01	12.4	-0.01	-0.01	12.7	0.02	0.01	13.7
08.04.10	0:07:01	0.02	0.01	12.4	-0.03	-0.01	12.7	0.62	0.08	13.7
08.04.10	0:08:01	0.01	0.00	12.4	-0.03	-0.01	12.7	1.09	0.36	13.7
08.04.10	0:09:00	0.01	-0.01	12.4	-0.05	-0.03	12.7	0.45	0.09	13.7
08.04.10	0:10:01	0.00	0.00	12.4	-0.04	-0.02	12.7	0.57	0.12	13.7
08.04.10	0:11:00	0.01	0.01	12.4	-0.04	-0.01	12.7	0.13	-0.05	13.7
08.04.10	0:12:01	0.00	0.00	12.4	-0.02	-0.01	12.7	0.81	-0.05	13.7
08.04.10	0:13:00	0.01	0.00	12.4	0.00	0.00	12.7	0.11	-0.13	13.7
08.04.10	0:14:01	0.01	0.01	12.4	-0.02	-0.01	12.7	0.42	-0.01	13.7

3. Creation and development of the 3rd static mathematical model of construction taking into account: geometric parameters; construction material properties, geologic conditions of foundation; operation loads of different origin. Comparative analysis of measured and predicted (by deterministic model-FEM, linear and nonlinear forecasting) data sets in order to derive the main statistical and dynamical features of construction's behavior patterns and to ensure appropriate decision making.

During to the project 3 goals were accomplishment.1. Creation of "Enguri arch dam–foundation" system FEM model; 2. Retrospective analysis of dam deformation dynamics at various loading conditions; comparison of measured and FEM data; 3. Definition of the range of significant departures of dam dynamical characteristics from FEM-predicted, which will signal damage and approaching the pre-failure state;

Creation of "Arch dam - foundation" finite element model

By use of topographical map the following was determined: - levels of characterizing points of foundation shape;- parameters of dam abutment.

The 3D model of system "Dam-foundation" has been developed. The foundation model takes into consideration homogeneity areas manly represented by 4 layers areas according the geological cross sections. The dam calculating scheme's vertical lines are created according the arch dam structure cantilevers including gaps. The horizontal lines orientated towered the boundaries of constriction concreting blocks (Fig. 3.1).

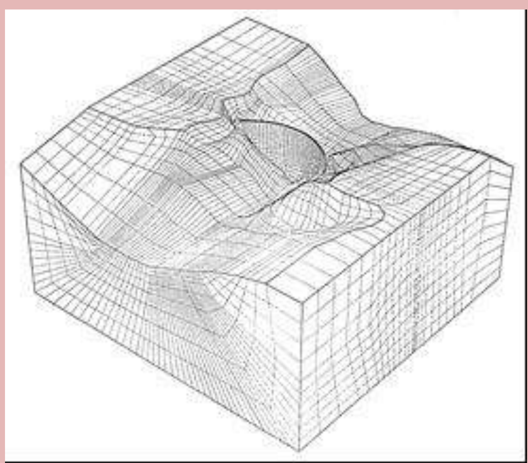


Fig. 3.1. Enguri "dam-foundation" 3D model.

In general, FEM calculations agree with observations of monitoring network on lower levels of the dam, but there are some problems at higher (closest to top) levels, where observed values exceed theoretical assessments for critical strains. At the same time the dam performs normally without any serious visual damage. This means that theoretical model should be re-considered.

Work package 2 (prepared by ECNTRM, ECILS, CEPRIS, ECRP):

Collection and exchange of information on the dam monitoring system for their respective country; selection of the dam to develop there real-time monitoring complex and complex of linear/nonlinear dynamics data processing methods for construction diagnostics;

Information on the dam monitoring system in for their respective country; selection of the dam to develop there real-time

monitoring; assimilation of complex of linear/nonlinear dynamics data processing methods for construction diagnostics;
Deliverables:

Bulgaria

ECPR collected the information concerning dams in Bulgaria. They are managed mainly by four ministries:

- The Ministry of Economy, Energy and Tourism: 43 dams of the National Electricity Company;
- The Ministry of Agriculture and Food (Irrigation systems);
- The Ministry of Environment and Water;
- Ministry of Regional Development and Public Works.

These ministries issue a Regulation on the terms and conditions for implementation of the technical operation of the dam walls and installations. This regulation determines the main parameters of the dam walls monitoring system in Bulgaria.
Classification of the dam walls and the related installations:

1. Depending on the type of the construction:

- Gravitational – dam walls of concrete or embankment;
- Counterforce – massive and multi-arch;
- Arch.

2. Depending on the construction materials and the technology of construction:

- Concrete – massive of conventional concrete or rolled concrete, massive lightened, massive – counterforce type "Nötzli" and arch;
- Embankment – earth, stone and mixed;
- Masonry;
- Inwash.

Large dam walls are determined depending on their summarized parameters – height, length along the top, volume of the water storage, in accordance with the classification of the International Commission on large Dams (ICOLD).
The classification of the dam walls and the related installations depending on the consequences in case of a failure and/or destruction is performed in accordance with the "Norms on Design of Hydrotechnical Installations" in Bulgaria.
The Water Act indicates a list of 52 complex and important dams, monitored by the Ministry of Environment and Water.
The dam walls and the related installations are categorized in accordance with the Territory Organization Act. The requirements for assurance of their security are determined in the project for operation and maintenance and the operating instructions. The person implementing the technical operation provides periodical assessment of the risk of compromising or destruction of the dam walls and the related installations depending on:
1. The updated hydrological information;
2. The changes in the seismological information;
3. The changes in the quality of the foundation, the construction materials and the construction;
4. The changes as a result of anthropogenic activity;
5. The results from the measurements and assessment of the operation of the Instrumentation Systems /IS/.
The risk during operation of dam walls and the related installations is determined by:

- The likelihood of occurrence of natural disasters;
- The specific topographic and geological conditions and the construction of the installations;
- The specific human activity.

The security under the conditions of operation is assessed through monitoring and control of indicators for:

- Their constructive security;
- Their technological security;
- Their impact on the environment.

The constructive security is the ability of the dam walls and the related installations and their foundation to retain:

- General local strength, carrying capacity;
- General resistance;
- Filtration resistance;
- Cracking resistance;
- Hardness;
- Fatigue effect strength;
- Frost resistance;
- Corrosion resistance;
- Wearing resistance;
- Temperature resistance;
- Bio-corrosion resistance.

The technological security is the ability to perform their main functions according to indicators for:

- Geometrical conformity with the design (dam wall ridge altitude, highest altitude of the anti-filtration device, water level altitude, head, slopes, permeability, etc.);
- Conformity with the properties of the materials (strength, water-tightness, head gradients, filtration coefficient);
- Technological term of operation.

The indicators for constructive and technological security and for preservation of the environment are determined in the project documentation:

- The person implementing the technical operation monitors for the occurrence of qualitative and quantitative signs of

deviation from the indicators in the project for operation and maintenance and the operating instructions;
- The parameters controlled within the period of operation are compared to the design and forecast values obtained on the grounds of data from previous monitoring and measurements.

The assessment of the security of dam walls and the related installations includes:
- Updating of the classification of the installation;
- Analysis of the results from the inspections of the technical state;
- Analysis of the results of the operation of the Instrumentation Systems and the database from the monitoring;
- Assessment of the methods for monitoring and control;
- Assessment of the operating instructions;
- Assessment of the results from the performance of periodic inspections of the state of all types of equipment;
- Assessment of the results from inspections of the readiness of action groups according to the emergency plan and simulation of an emergency situation;
- Assessment of results from inspections of the compliance with the directions from previous analyses of the security;
- Drawing up of conclusions and recommendations.

An emergency plan for action in case of extreme and emergency situations is developed. The activities on realization of the meteorological and hydrological monitoring are performed in observation of the requirements of the International Organization for Standardization and the World Meteorological Organization.

Technical monitoring during operation of the dam walls and the related installations

The technical monitoring provides information for assessment of the security of the dam walls and the related installations with the possibility for simultaneous identification of potential dangers. For each dam wall and the related installations equipped with Instrumentation Systems there is a separate database with measurements, which is maintained and periodically updated. For interrelated events the database contains synchronized measurements from the technical, meteorological and hydrological monitoring.

The technical monitoring /the observations and measurements, their analysis and assessment/ covers the dam wall and the related installations, the geological foundation and the coasts in the areas of effect in the upper and lower section.

The observations and measurements related to the technical monitoring of dam walls and the related installations are:
- Obligatory;
- Periodic and constant;
- Simultaneous during observations and measurements of interrelated events;
- Comparable by time, hour and place.

The Instrumentation System (IS) is executed on the grounds of a design, an integral part of the project.

The organization of the observations and measurements provides:
- The measurements of the processes and events occurring, as foreseen in the project for operation;
- The possibility for simultaneous measurement of a specific event with at least two devices from the IS;
- The possibility for a reliable assessment of the measured processes and events;
- Gathering of information for an overall assessment of the state of the dam walls and the related installations.

The observations and measurements are performed in accordance with the program for technical control on three levels:
- Visual control – determined by place and time;
- Operative measurements in specific points;
- Full measurements of all monitored points according to the IS project and the operating instructions.

The measurements of newly constructed dam walls and the related installations are direct and remote, without or with a Central Measurement Station. In the case of old dam walls, when possible, the IS is gradually connected to the Central Measurement Station.

The technical monitoring of concrete dam walls includes observations and measurements of:
- The water level in the water storage;
- Filling of the water storage with deposits;
- Horizontal and vertical shifting;
- Reciprocal shifting between wall and foundation;
- Development of cracks in the wall;
- State of the joints;
- Water raise and pressure;
- Change in the quality of the concrete and the foundation;
- Filtration and leaks through, under and around the wall;
- Turbidity and chemical composition of the filtrated water;
- Deformations and tensions in the body of the wall;
- Deformations of the foundation;
- Temperature of the concrete, the water and the air;
- Seismic impacts.

The technical monitoring of dam walls from local materials includes observations and measurements of:
- The water level in the water storage;
- Filling of the water storage with deposits;
- Water back pressure;
- Filtration under and around the wall;

- Filtration through the body of the wall;
- Turbidity and chemical composition of the filtrated water;
- Position of the depression surface;
- Steam /hydrodynamic/ pressure;
- Horizontal and vertical shifting;
- Change in the quality of the embankment and the foundation;
- Deformations and disruption of the solidity of concrete installations to the wall;
- Deformations and tensions in the embankment;
- Seismic impacts.

The periodicity of observations and measurements is indicated in the program for technical control in accordance with:

- The category of the installation;
- The dynamics of the water level in the dam;
- Occurrence of an extraordinary event.

If there are no other directions, observations and measurements with IS are performed no less than:

- Once every three months for large dam walls;
- Once every six months for small dam walls.

In the case of new dam walls the measurements are performed in accordance with a special schedule.

The volume, type, form and manner of documentation of the results from the measurements are determined in the project for operation and maintenance of the IS. All observations and reports are recorded in the respective journal /form/ prior to and after the primary processing performed by the operating group. The results of all observations and reports, as well as their primary processing performed by the operating group, are recorded in the existing database and on paper.

Potential object of study

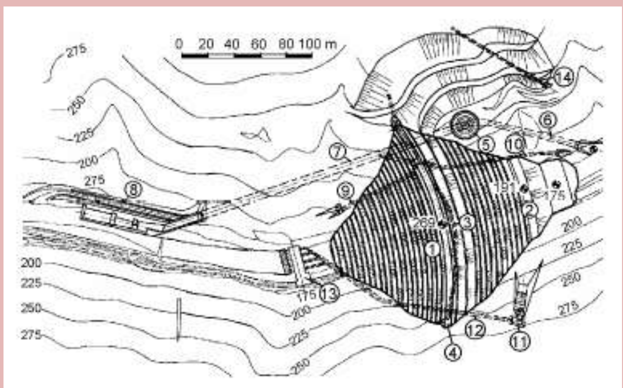
CHAIRA DAM in Bulgaria has been officially proposed by :

BASIC DATA	
Location	Rila Mountains
Built on	Chairska River
Water catchment area, square km	18,6
Mean annual inflow, cub. m/s	1985-1988
Use	electricity generation
Water masses regulation	daily by reversible pressure tunnel - Yadenitsa Dam
WATER STORAGE	
Total storage, mln. cub. m	5,60
Usable storage, mln. cub. m	4,20
Max. water level, m	1261,30
Max. operational water level, m	1260,0
DAM	
Type	concrete, gravity dam
Waterproof component	grout curtain
Height from foundation, m	85,0
Crest length, m	305,0
Crest level, m	1263,0

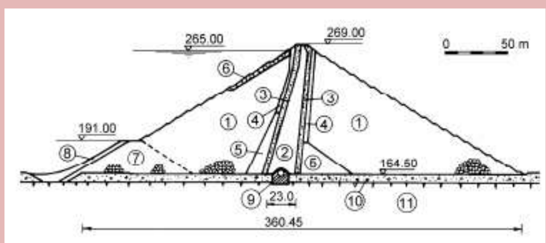
Former Yugoslav Republic of Macedonia

ECILS studied the suggested technology and is interested in the implementation. Potential object is not selected yet but two alternatives dams has been preselected by ECILS:

Dam: Tikveš
Structural height: 113.5m
Type: Earth-rock dam (E-R)
River: Crna Reka
Constructed: 1968

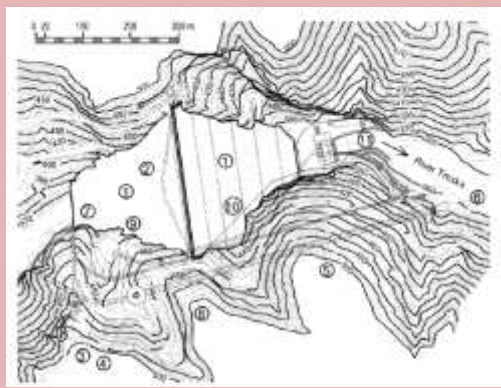


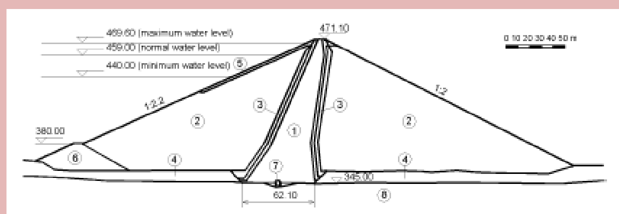
(1) Dam body; (2) upstream cofferdam; (3) layout if the grout curtain; (4) dam crest axis; (5) spillway shaft; (6) diversion tunnel; (7) spillway tunnel; (8) stilling basin; (9) access gallery; (10) bottom outlet; (11) intake structure; (12) head-race tunnel; (13) power house; (14) irrigation tunnel



(1) Rockfill; (2) clay core; (3) filter layer I; (4) filter layer II; (5) stone chippings; (6) coarse stones; (7) cofferdam of rockfill; (8) clay screen of cofferdam; (9) concrete block with a grouting gallery; (10) river sediment; (11) rock foundation

Dam: Kozjak
Structural height: 126m
Type: Earth-rock dam (E-R)
River: Treska
Constructed: 2004





(1) Rockfill; (2) clay core; (3) filter layer I; (4) filter layer II; (5) stone chippings; (6) coarse stones; (7) cofferdam of rockfill; (8) clay screen of cofferdam; (9) concrete block with a grouting gallery; (10) river sediment; (11) rock foundation

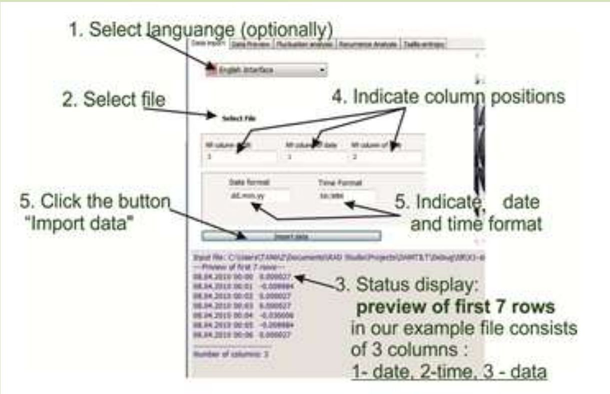
Morocco
CEPRIS studied the suggested technology and is interested in the implementation. Potential object is not selected yet.

Russian Federation
ECNTRM studied the technology suggested by GHHD and decided that Russia has its own technology for monitoring engineering objects and it is not interested in the project.

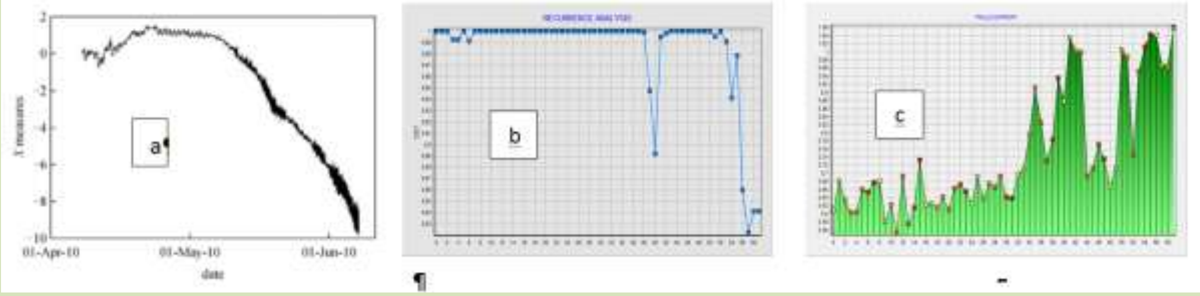
RESULTS OBTAINED IN 2013

Working package 1 (prepared by GHHD, ECNTRM, ECILS, ECRP, CEPRIS):
Description:
GHHD: Compilation of data-base of recordings of sensors (tiltmeters, strainmeters, vibrometers) at EDITA and the selected objects in partner countries for an year 2013. Selection/development of data analysis linear (frequency, time-frequency, singular value decomposition, autocorrelation first zero crossing variation, etc.) and nonlinear (phase space structure, phase trajectory evolution, noise reduction, memory, long range correlation testing, etc.) methods, appropriate for measured tilt, strain, vibration meter data sets during one year load-unload cycle in order to establish construction response to water load. Selection of appropriate to the targeted problem linear (autoregressive) and nonlinear (based on topology of reconstructed attractor) forecasting methods and creation of special diagnostic toolbox for analysis of tilt/strain time series.
ECNTRM: compilation of monitoring data base on selected object; assimilation of special of linear/nonlinear dynamics diagnostic toolbox for analysis of monitoring time series and application to selected dam to develop criteria of stable functioning of construction
ECILS: compilation of monitoring data base on selected object; assimilation of special of linear/nonlinear dynamics diagnostic toolbox for analysis of monitoring time series and application to selected dam to develop criteria of stable functioning of construction
ECRP: compilation of monitoring data base on selected object; assimilation of special of linear/nonlinear dynamics diagnostic toolbox for analysis of monitoring time series and application to selected dam to develop criteria of stable functioning of construction
CEPRIS: compilation of monitoring data base on selected object; assimilation of special of linear/nonlinear dynamics diagnostic toolbox for analysis of monitoring time series and application to selected dam to develop criteria of stable functioning of construction
Associated deliverables:

As comparison of the tilt data for varying reservoir load show deviations from (static) theoretical model of dam deformation computed by finite element method. In this case according to instructions, it is necessary to carry out repeated diagnostics of construction. At the same time it is evident that dam is operating normally, which means that the theoretical model needs corrections. Uncertainity of static model and long time (years) needed for new design safety assessment calls for developing new more efficient and operative methods using dynamic approach to analysis of monitoring data, namely low frequency vibrations.
Corresponding package for linear/nonlinear analysis of dynamic changes in monitoring time series (DAMTOOL) has been developed by GHHD. DAMTOOL is a program intended for visual estimate, processing and analyzing the data of large engineering constructions' (dams, bridges etc) tilt measurements. It can be used also for analysis of any monitoring time series (strains, stresses, etc). The program has 5 tabs (Data import, Data preview, Fluctuation analysis, Recurrent analysis, Tsallis Entropy) –see Fig. below.



The Figures below (a, b,c) show clearly that the suggested program singles out the sections of tilt data, where anomalous vibration due to big volume of water discharged through the dam outlet takes place.



Results of calculations by DAMTOOL using Recurrence Quantification Analysis or RQA (%DET - % of determinism) for the tilt time series from April 2010 to June 2010: (a) Original tilt time series; (b) RQA%DET (% of determinism); (c) Tsallis entropy Note high values of DET during regular regime, which point to highly correlated regime and strong deviations due to geotechnical impact – addition of high frequency component due to intensive discharge of water through dam outlet in 12.05–22.05.2010 and 01.06–11.06.2010 time intervals

The detail manual of DAMTOOL has been distributed between participating centres in May 2013.

The paper based on the project's result has been presented at the International Conference: Dams and reservoirs under changing challenges, ICOLD 79th ANNUAL MEETING. May 29 - June 3, 2011, Lucerne, Switzerland and published in the International Journal: Frontiers of Structural Civil Engineering: T. Chelidze et al, 2013. *Real time monitoring for analysis of dam stability: Potential of nonlinear elasticity and nonlinear dynamics approaches*. Front. Struct. Civ. Eng. 2013, Vol. 7, 188-205 DOI: 10.1007/s11709-013-0199-5 as well as in many high-impact journals.

ECRP

The following activities have been performed in 2013:

- Realization of regular meetings with the chief engineer "Topolnica", which were determined with aims:
    - Real control situation of the Dam
    - Technical equipment for control
    - Communication possibilities in region;
- Realization of different tasks for control and communication from Dam "Topolnica";
- Realization of communication by INTERNET from Dam "Topolnica";

In this project, difficulties were caused by secrecy issues as water projects (such as dams) usually fall into the category of special surveillance by the State Agency for National Security. Work and research conducted at such facilities fall thus under a special regime and it explains why the project in 2013 has to changed the initially proposed dam to conduct it for another dam, implying again a lot of preparatory work during 2013.
In Bulgaria, in recent years several major floods with many casualties were due to the destruction of dams but only earth - bulk type. The reasons for the destruction of these walls are mainly their unclear property rights and their poor technical condition. Interest was thus focused on these earthworks and walls, ignoring somehow large concrete dams as they are considered safe. Of course there was a strong control on the later and secrecy was increased, which in turn complicated and delayed the work on this project.

A work permit (but with certain limitations) was obtained but we could not pass information out largely, negating partially the interest of our work since the main idea is to use the Internet. After lengthy discussions, it was stated that the information can be conveyed only to the principal's office in Sofia, which further complicate the work of the computer specialist. Once we finally got permission to work on Topolnica dam, it appeared that there are in place only geodesic controls, meaning that you have to use a temporary Tiltmeter only for our project and it further reduced the available time to build it up, collect information and draw conclusions. Based on data collected from Tiltmeter gone. Limited to it to realize the main goal of the joint project namely to convey information on the internet and only to the principal's office. Initially working only dam itself in very poor conditions - mountain, distance from settlements, and the wall was only security. The main problem was the poor quality of electricity (the voltage change) as we were forced to interrupt work several times for a long time due to lack of electricity at all: a mobile unit was not affordable due to the small budget available.
ECRP benefited from the services of a very good computer and programming specialist for attracted great interest as there are great prospects for the development in the near future. He developed the method for receiving and sending information supplied by Tiltmeter. Originally developed program didn't work and needed its improvement. After refinement of the program, the signal is received but with interruptions: thinking initially that the cause was just in the program while the reason was in the Tiltmeter, a month was lost. During the operation of the dam, an electric shock damaged the computer and the monitor: computer was repaired but the monitor had to be replaced. Only in late September, we were able to pass on a sustainable and long- time signal from the instrument to the principal's office in Sofia, completing the main task of the project.
If the project continue in some form in the next programming period and an opportunity to purchase Tiltmeter to be put on the wall will always be able to build a database and to draw conclusions and to respond to emergency situations

based on information from this device. Of course, due to the limitations of secrecy that information will be analyzed and discussed only by specialists within this organizational structure.
Achievement of the project that was first located Tiltmeter of this dam, which showed the leadership that quality and continuous monitoring can be done from a distance.

Some serious problems need however to be addressed in the future development of such kind of project.

- The main weakness of the project is the very small budget, which cannot generate interest in professionals and those who have an interest then they cannot be detained because they usually hire from outside the system. If the budget allowed to purchase at least one appliance that can be deployed and then remain constant for the dam, the effect would be much larger, more importantly, that device itself is not very expensive. The effect would be and that would be required leadership to continue these measurements and create a database.
- Installation of the device and the settings are time consuming and require specialized equipment for installation, which cannot be achieved with this budget.
- It requires concerted action in assembly activities, the presence of an officer more than 8 hours a day, which is an additional difficulty, because the site is remote and should provide subsistence and hotel on that person.
- It is impossible to sign a formal agreement to install and provide permanent equipment on the dam project and write the conditions under which it will be used and how to access and provide the information.
- Internet connection is slow because as the site is remote from population centers, a mobile connection was used. Providing high-speed Internet for research is necessary in the long term development of the project.
- The realization of such a project is very difficult and highly in many different directions in its implementation it comes down to the inability for the degree of secrecy. Always face in dealing with this problem with discomfort that we created of professionals and managers as they feared for their jobs even though we had an official permit.
- On the other hand European Commission projects realized so far in this area usually have significant budgets and was surprised that we have such a tight budget, do not even believe in a sense also interfere with work especially in the beginning.
- Main interest in Bulgaria, however, is directed at the control of small earth-fill dams, which have a large number of locations throughout the territory of the country and create great dangers often accompanied with many casualties: the establishment of a permanent monitoring system of these small dams is a major challenge.

2.B. Risk mapping and vulnerability

PAN-EUROPEAN AND NATION-WIDE LANDSLIDE SUSCEPTIBILITY ASSESSMENT

TARGET COUNTRIES : Europe continental level with focus regional sites in Portugal, Romania and the Caucasus

PARTNERS INVOLVED :

COORDINATING CENTRE : CERG Strasbourg, France

OTHER CENTRES: GHHD Tbilisi, Georgia , ECBR Bucharest, Romania , ISPU Florival, Belgium ,

OTHER PARTNERS : University of Strasbourg (UdS, J.-P. Malet, A. Puissant), University of Lisbon (ULISBOA, J.-L. Zêzere), University of Caen (O. Maquaire), IGRA (M. Micu), Technical University of Catalonia (UPC, J. Corominas), Joint Research Centre (JRC, J. Hervàs, M. Van Den Eeckhaut), German Geological Survey (BGR, A. Günther), National Research Council, Research Institute for Hydrogeological Protection (CNR-IRPI, P. Reichenbach)

EXECUTIVE SUMMARY

After a discussion on national landslide susceptibility assessments, different methods for evaluating the performance of the assessments and access to data, several trials to validate the first European Landslide Susceptibility Map ELSUS 1000 (available at http://eusoils.jrc.ec.europa.eu/library/ESDAC/Index.html) have been realized. The aim of ELSUS 1000 is solely the representation of the propensity of the terrain to generate landslides at the European scale. It does not attempt to provide information on the temporal frequency of landslide susceptibility, or the delineation of hazardous areas using information on dynamic spatial landslide triggering data. Therefore, we selected only very reduced static (or quasi-static) environmental information from available pan-European datasets for susceptibility modelling.

The proposed methodology for generic continental-level landslide susceptibility assessment appears superior to previous approaches, because it quantitatively incorporates landslide density information while allows for incorporating expert-knowledge to account for quality, bias and spatial gaps in the data used. Additionally, the proposed susceptibility levels are defined by the class-specific proportions of landslides. This has a clear advantage in the definition of susceptibility levels because they directly refer to the proportions of landslides occurring in particular spatial susceptibility classes.

So far, no attempt has been made to use climatic and/or physiographic zonings over Europe for small-scale landslide susceptibility mapping, although several European or global climate, geomorphological or landscape classification maps exist. A proposal for a climate-physiographic terrain delineation in terms of landslides for the European territory covering 27 member states plus the Balkan countries, Norway and Switzerland was also presented and susceptibility modelling was performed individually for each climato-physiographic zone.

In order to validate and improve the performance of ELSUS 1000, typologically-differentiated national scale maps were created for Georgia, Romania and France as pilot study cases. Finally, a survey (available at: http://www.ispu.eu/ls/) on Risk Assessment Methodologies developed for landslide management from an operational point of view for the different Member States of Council of Europe was launched to evaluate the current situation of the available landslides RAMs per country in terms of input data, model, scale and final product.

OBJECTIVES OF THE PROJECT

Global objective for 2012-2013 :

In the framework of the European Soil Thematic Strategy, a project to map landslide susceptibility at the scale of Europe (i.e.1:1 Million) was suggested in 2007 by the Soil Information Working Group (SIWG) of the European Soil Bureau Network (ESBN). The methodology consists of identifying the potential areas subject to generic landslide types by expert knowledge using available thematic and environmental data. The choice of the 1:1 M scale allows the use of harmonized data sets for all Member States as input to the susceptibility model.

Within this context and with support of the International Programme on Landslides (IPL), the German Geological Survey (BGR), the National Research Council, Research Institute for Hydrogeological Protection (CNR-IRPI) and the EUR-OPA Major Hazards Agreement, the Landslide Expert Group of JRC, among which 3 CERG members, proposed a preliminary heuristic assessment exploiting a reduced set of landslide conditioning factors derived from common pan-European data sources for the whole of the European Union and adjacent countries (Hervàs et al., 2007). Evaluation of the susceptibility estimates with national-level landslide inventory data from France, Great Britain and Italy suggests that zoning of Europe according to e.g. morphology and climate and preparation of individual models for each of these zones could give more reliable results (Günther et al., 2011; Malet et al., submitted).

The objectives of the project are:
1) To refine the preliminary assessment at the Pan-European scale by estimating three independent maps per landslide type (e.g. slides, falls and flows) and propose a methodology to combine the three independent maps in one unique compound landslide susceptibility map; the susceptibility modelling will be carried out by comparing a spatial multi-criteria approach (SMCE) and a fully data oriented statistical approach (logistic regression). This objective is being carried out as part of the Landslide Expert Group of JRC;
2) To propose nation-wide assessments of landslide susceptibility for three countries (Portugal, Georgia and Romania) by compiling national landslide inventories and using a statistical modelling approach (logistic regression) on a series of environmental factors on data with higher resolution than for the Pan European map. A method to integrate information on landslide triggers (rain, earthquake) in the analysis will be proposed and tested in Georgia, Portugal and Romania (possibly the use of meteorological information derived from remote-sensing imagery will be used);
3) To analyse (through a dedicated online questionnaire) the different methods of assessment (Landslide Risk Assessment Model; LRAM) and the categories of maps used in practice by the European Countries in their regulation for landslide susceptibility, hazard and risk mapping, and identify the pro & cons of each methodology.

The Project has a European dimension and a significant impact within the activities of the "European and Mediterranean Major Hazards Agreement" since it involves four specialised centres (CERG, GHHD, ECBR, ISPU). The expertise of the academic partners (see above) guarantees the success of the research activities, as some of them (JRC-BGR-UdS-CNR) are already working closely together within the 'Landslide Expert Group'. Co-funding to the research will be made available by each of the partners.

Specific yearly objectives :

2012 :

1a) Update of the actual landslide European inventory (focus on location and landslide type) with data from Portugal, Georgia and Romania in order to complement a database in construction within the Landslide Expert Group (CERG, GHHD, ECBR, BGR, JRC, IGRA).
1b) Test of the methodologies for susceptibility mapping per main landslide type (slide, flow and fall) at 1:1 M scale using SMCE and logistic regression models at the Pan-European scale, and evaluation of the performance of the modeling (CERG, BGR, UdS, CNR, JRC, UPC).
1c) Collection and organisation of relevant data for the national and regional assessments in Portugal, Georgia and Romania (CERG, GGHD, ECBR, IGRA)
1d) Set up of the "Landslide Risk Assessment Model, LRAM" survey and launch of the questionnaire on the internet (ISPU, CERG).

2013 :

2a) Production of the national and regional susceptibility maps for Portugal, Romania and Georgia, and comparisons with the Pan-European map (CERG, GGHD, BGR, UdS, IGRA, CNR, JRC, UPC).
2b) Analysis of the response to the survey, and production of a synthetic report with the pro/cons of the methods used in each country (ISPU, CERG)
2c) Diffusion of the results through joint publications

EXPECTED RESULTS

2012 :

1) Organisation of a 2-days workshop in France (Strasbourg) to define the working methods and present the data already available
2) Organisation of a landslide inventory database (for scientific purpose) with indication on landslide location and landslide type at the European scale, and for Portugal, Georgia and Romania (the database will not be transferred).
3) Oranisation of a database of environmental factors (geology, slope, land cover, rain) for Portugal, Georgia and Romania
4) Test of the performance of the statistical models at the Pan-European scale.
5) Diffusion of the on-line internet questionnaire on LRAMs on the ISPU website, and identification of target people in each country.

2013 :

1) Organisation of a 2-days workshop in Portugal (Lisbon) to discuss the progress of the work
2) Production and diffusion of the European susceptibility maps per landslide types.
3) Test of the performance of the statistical models at the national and regional scales for Portugal, Georgia and Romania, and integration of triggering factors (rain, earthquake acceleration map) in the model. Set up of the methodology.
4) Analysis of the survey, and production of a synthetic report on the advantages and limitations of the different methods used in each country.
5) Diffusion of the results through joint publications

RESULTS OBTAINED PREVIOUSLY (if any)

The proposed susceptibility assessment obtained for France in 2011 for three landslide types (falls, flows, slides) and based on slope angle, lithology and land cover will be 1) extended by testing more robust statistical techniques, 2) tested on country-side data sets available for Portugal, Spain and Belgium, 3) and later applied to the European scale using the climate-physiographic regions suggested by Günther et al. (2011).

References:

Günther, A., Van Den Eeckhaut, M., Reichenbach, P., Hervás, J., Malet, J.-P., Foster, C., Guzzetti, F. (2011). New

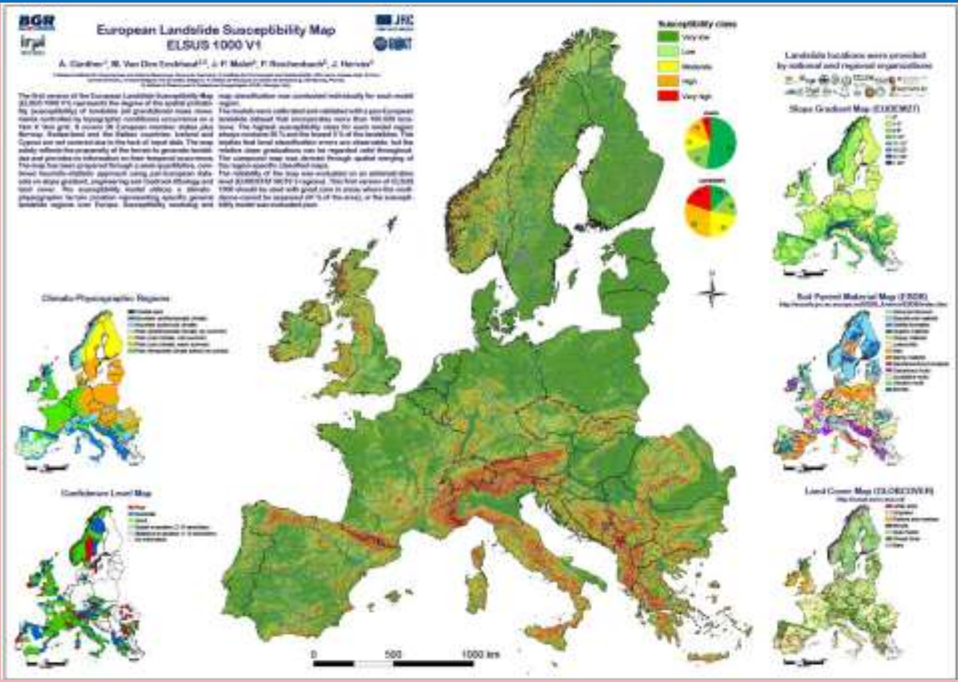
developments in harmonized landslide susceptibility mapping over Europe in the framework of the European Soil Thematic Strategy. In: Margottini, C., Canuti, P. Sassa, K. (Eds): Proceedings of the Second World Landslide Forum, 3-7 October 2011, Rome, Italy, Springer (to be published in 2012).
Hervás, J. (Ed.), 2007. Guidelines for Mapping Areas at Risk of Landslides in Europe. Proc. Experts Meeting, JRC, Ispra, Italy, 23-24 October 2007. JRC Report EUR 23093 EN, Office for Official Publications of the European Communities, Luxembourg, 53 pp.
Landslide Expert Group: http://eusoils.jrc.ec.europa.eu/library/themes/Landslides/
Malet, J.-P., Puissant, A., Mathieu, A., Van Den Eeckhaut, M., Fressard, M. (submitted). Landslide susceptibility assessment at 1:1M scale for France. Landslides, 15p. (submitted in July 2011).
Co-funding 2012:
- UdS: ChangingRISKS Project funded by the European Commission by the Seventh Framework Programme - Instrument ERA-NET CIRCLE - co-funding provided: 3000 €.
- JRC: Landslide Expert Group - co-funding provided: 1000 €
- ULISBOA: DISASTER - GIS Project funded by the Portuguese Foundation for Science and Technology - co-funding provided: 2000€
Co-funding 2013:
- UdS: ChangingRISKS Project funded by the European Commission by the Seventh Framework Programme - Instrument ERA-NET CIRCLE - co-funding provided: 1000 €.
- JRC: Landslide Expert Group - co-funding provided: 1000 €
- ULISBOA: DISASTER - GIS Project funded by the Portuguese Foundation for Science and Technology - co-funding provided: 2000€

RESULTS OBTAINED IN 2012

Work package 1 (prepared by CERG, GHHD, ECBR):
Description:
Refined Pan-European Landslide Susceptibility Map / Leader: CERG
Associated deliverables:
D.1.1 Update of the actual landslide European inventory of the Landslide Expert Group (CERG) - M+6
D.1.2 Spatial multi-criteria model (CERG) -M+9
D.1.3 Statistical (logistic regression) model (CER*G) -M+12*

Discussion on the methodology to progress in the European Landslide Susceptibility mapping of Europe according to landslide typology

In 2012, the main objective was to discuss on the methodology among a group of experts. A meeting has been organized in October 2012 in Berlin (hosted by BGR) where national landslide susceptibility assessments, different methods for evaluating the performance of the assessments, and access to data were discussed.
The time schedule and all presentations of the meeting can be found on the CERG website at: www.cerg.eu
Further to this meeting, several trials to validate the version 1 of the landslide susceptibility map of Europe have been realized, and the work will be presented at the forthcoming EGU 2013 Conference.



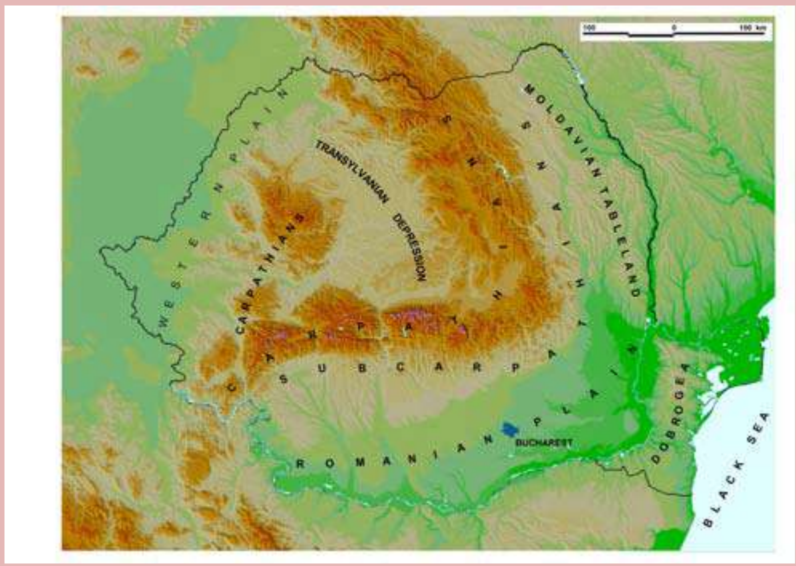
Different to previous continental and global scale landslide susceptibility studies, we start with collecting more than 102,000 landslides in 22 European countries. These landslides are heterogeneously distributed over Europe, but are indispensable for the evaluation and classification of Pan-European datasets that can be used as spatial predictors for landslide susceptibility, and the validation of respective assessments. We further attempted a subdivision of the European territory into seven different climato-physiographic zones by combining morphometric and climatic constraints for terrain differentiation, and additionally defining coastal areas as a 1km inland from the coastline. Landslide susceptibility modelling was performed for the individual model zones involving heuristic spatial multicriteria evaluations, and validated with the inventory data using receiver operating characteristics. The reliability of the resulting susceptibility map ELSUS 1000 Version 1 was examined on an administrative terrain unit level in areas with landslide information. The ELSUS 1000 was further evaluated through comparisons with available national and regional landslide susceptibility maps. These evaluations suggest that although the first version of ELSUS 1000 is capable for a correct synoptic prediction of landslide susceptibility in the majority of the area, it needs further improvement in terms of data used. These should also consider differentiated susceptibility evaluations with respect to different landslide types. ELSUS 1000 Version 1 can be downloaded together with auxiliary data from the European Soil Data Centre (ESDAC) hosted at JRC.

Work package 2 (prepared by GHHD, ECBR, CERG*):*
Description:
National assessments of Landslide Susceptibility for three countries / Leader: GHHD
Associated deliverables:
D.2.1 Collection of inventory data and predisposing factors data for the three countries (Georgia: GHHD; Romania: ECBR; Portugal: CERG) - M+6
D.2.2 Organisation of the database for the three countries - M+9
D.2.3. Collection of triggering factors for the three countries - M+12
D.2.4. Statistical model for Portugal (CERG) - M+12

Nation-wide assessment of landslides: focus on Romania

In 2012, the project focused on creating a status of nation-scale landslide susceptibility mapping for Romania, and on preparing the data and maps needed for the analysis.

A brief overview on landslide typology in Romania
Romania represents one of Europe's main landslide hotspots. More than 2/3 of its territory corresponds to mountainous, hilly and tableland units (Fig.1) that are prone to a wide variety of landslides, which are triggered mainly by precipitation but also by earthquakes. Vrancea seismic area represents an intra-continental collision area, generating sub-crustal (90-150 km deep) earthquakes which may affect along a NE-SW direction a large European space extended from Ukraine to Bulgaria.
The complexity of landslide forms and processes is induced by the litho-structural parameters of the main relief units, by the climate characteristics (shifting from the more humid, Atlantic, in the western half to a continental one, marked by temperature and precipitation contrasts and extreme events in the east) and the long-lasting inhabitation.

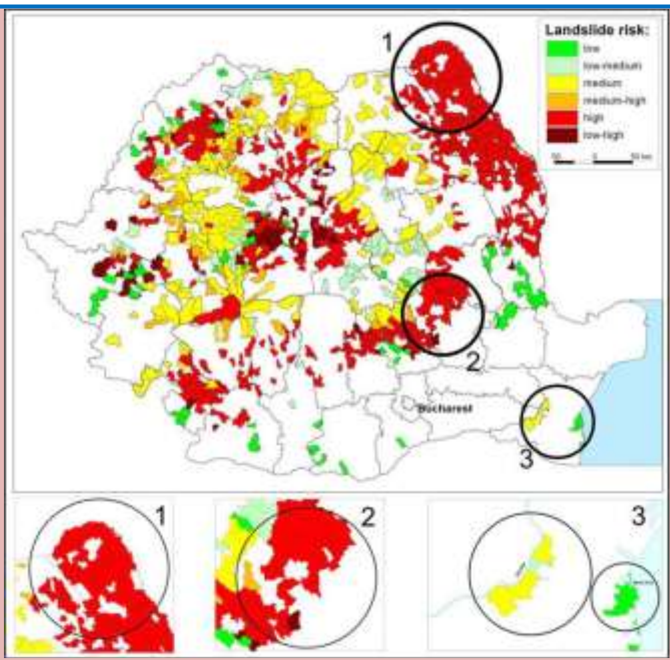


The main relief units of Romania

Throughout Romania's territory, several areas are showing an increased landslide occurrence (from both first time failures and reactivations points of view) potential: the Flysch Carpathians, the Subcarpathians, the Moldavian Tableland and the Transylvanian depression. The Flysch Carpathians represents mainly the outer-facing third of the Eastern and Curvature sector, and especially due to lithology (alternations of thin or thick, unconsolidated to well-cemented sandstone packages with schistose marls and clays) they are characterized by high magnitude/low frequency deep-seated complex (alternation of translational and rotational sectors) debris and rock slides (the majority being considered reactivation of dormant, periglaciar landslide deposits). Their triggering framework involves quite often spring showers overlapping snowmelt. The loose lithology of the Subcarpathians (molasse deposits of clays, marls, sands and gravels in a very heterogeneous disposition of intensely folded and faulted strata) is also the main responsible for the wide variety of low magnitude but high frequency landslides: shallow and medium seated earth and debris slides, earth flows, rarely debris flows, triggered by heavy summer rainfalls, long-lasting autumn showers or thaw processes in early spring. The homocline relief build up on young (Neogene) sediments that forms the Transylvanian and Moldavian Tablelands is marked mainly by shallow and medium-seated earth slides and by complex (sometimes related to spreads) deep-seated slides called in Transylvania glimee. An update of landslide articles (and available data) in Romania is made by Balteanu et.all (2010) and within Loczy et.all (2012).

Landslide hazard and risk, legislative framework

From commune (local) to county (regional) and national level, the risk-related landslide issues are taken into consideration by several authorities, each one having specific attributions. At commune level, the Local Committee for Emergency Situations (organized by each municipality) issues post-failure documentations on damages-causing landslides to the next level, which is the County Inspectorate for Emergency Situations. Their preparedness/post-failure interventions are integrated within a county plan for landslide risk reduction measurements, which is discussed inside the County Committee for Emergency Situations, an institution that includes also the heads of County Prefecture and County Council. The County Council is responsible for developing the county landslide risk map, mandatory for the County Territorial Arrangement Plan. The main national institution that integrates such studies is the General Inspectorate for Emergency Situations, which works with other ministries in developing national-scale preparedness or intervention documentations.



NUTS 5 (communes) distribution of landslide risk in Romania (LG 575/2001)

The legislative framework is based on several laws (LG 575/2001, LG 124/1995, HGR 382/2003, HGR 447/2003, GT-019-98) which are regulating the procedures meant to develop landslide risk maps and to implement them into territorial planning procedures. The suggested method is a qualitative one, based on an expert judgment of the weights of several criteria: lithology, geomorphic, structural, hydrological and climatic, hydrogeology, seismicity, silviculture, human. Within the legislative framework there are some gaps, dealing with both form and fund issues. Besides an old conceptual and methodological framework (with obvious problems in explaining and applying the differences among susceptibility, hazard and risk), the subjectivity and uncertainty of the proposed method is increased by elusive expressions like "main valleys, reaching maturity stage, with young tributaries" or "slopes with average heights and average-high steepness" which are used as ranking criteria for landslide favorability classes. In the mean time, the legislation does not make any recommendations concerning a scale-methodology dependency.
The law 575/2001 makes a hierarchy of 987 communes and towns showing differenced landslide risk levels. Besides the bizarre distribution of risk classes (Fig.2, medallion 1 and 2), which shows high values all across the Moldavian plain, overestimating the intensity of the phenomenon compared with the Subcarpathians, one may notice also, sometimes, the complete absence of landslide risk inside high risk areas. The list also contains information about potential Danube lateral erosion and sea cliff undermining (Fig.2, medallion 3) Adding to that the fact that a lot of communes in the Subcarpathians showing indeed a high risk (Catina, Chiliile, Chiojdu, Odaile: CHANGES FP7) are curiously excluded from the hierarchy, the representativity of such a map is reduced to a rather general overview, and should be compared with other existing maps (Balteanu et.all, 2010) in order to built a proper confidence map.

Nation-wide assessment of landslides: focus on Georgia

1. Collection and organisation of relevant data for the national and regional assessments in Georgia:
Elevation data - DTM (Digital Terrain Model)
Relief slope's database
Hydrological data
Engineering Geology map of Georgia
The active fault system of Georgia
Land use
Landslide database
2. Test of the methodologies for susceptibility mapping per main landslide type (slide, flow and fall) at 1:1 M scale using SMCE and logistic regression models at the Pan-European scale, and evaluation of the performance of the modelling.
3. Set up of the "Landslide Risk Assessment Model, LRAM" survey and launch of the questionnaire on the internet.
Report structure:
In the Introduction (chapter 1) the overall description of the problem and its significance is discussed.
In the second chapter the main goals, objective and sub objectives are represented
The next chapter shows the short description of the available dataset.
The methodologies and application for the territory of Georgia is shown in the chapter N4.
The full report has been given to coordinating Centre, CERG.

Work package 3 (prepared by ISPU, CERG):
Description:
Analysis of the Landslide Risk Assessment Models used for mapping in the CoE members states
Associated deliverables:
D.3.1. Workshop of 1 day in Brussels to define the scope of the survey (CERG & ISPU) - M+6
D.3.2. On-line (web-based) creation of the survey (ISPU) - M+9
D.3.3.Diffusion of the survey to identified persons - M+10

The workshop was cancelled as it finally appeared as not necessary. Unfortunately, the survey was received only in December and it was technically not possible to transform in a web-based survey in 2012.

RESULTS OBTAINED IN 2013

Working package 1 (prepared by CERG, GHHD, ECBR):
Description:
Refined Pan-European Landslide Susceptibility Map / Leader: CERG
Associated deliverables:
D.1.4 Test of the performance of the model - quality control (CERG) - M+18
D.1.5 Writing of a joint point publication (CERG) -M+24

This part of the work has been mainly completed in 2012 and has resulted in the release of the first European Landslide Susceptibility Map ELSUS 1000 available on the ESDAC ---European Soil Portal:
http://eusoils.jrc.ec.europa.eu/library/ESDAC/Index.html
The methodology and the results are explained in the manuscript:
Gunter, A., Van Den Eeckhaut, M., Malet, J.P., Reichenbach, P., Hervas, J. - *Climato-physiographical differentiated Pan-European landslide susceptibility assessment using spatial multicriteria evaluation and transnational landslide information* (submitted to Geomorphology, July 2013).

This report briefly describes the landslide data collected and presents an attempt for a climate-physiographic terrain delineation in terms of landslides for the European territory covering 27 member states plus the Balkan countries, Norway and Switzerland. Then, the data used for landslide susceptibility mapping is described.

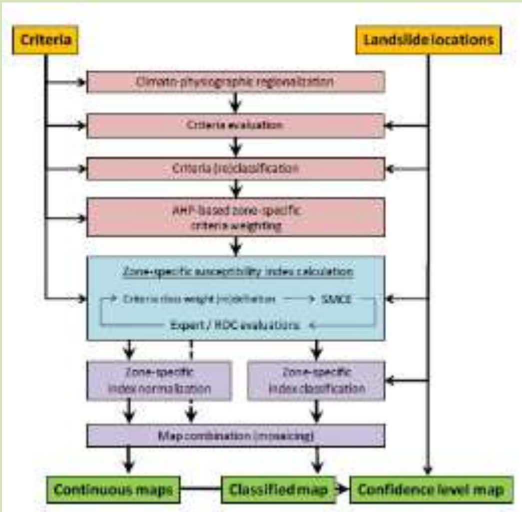


Figure 2.1.1. Pan-European Landslide susceptibility assessment workflow

A methodological framework for susceptibility modelling is presented that builds on a heuristic spatial multi--criteria evaluation (SMCE) scheme allowing for semi-quantitative indexing of grid cells according to landslide susceptibility. In this evaluation process, the spatial criteria used for susceptibility evaluation (e.g., terrain gradient, lithology and land cover) are first evaluated for their relative importance in predicting landslides using model zone-specific analytical hierarchical processes (AHP`s, Saaty, 1983).
Individual criteria class weights are then assigned through an iterative process starting from frequency ratios of landslide distributions over the parameter classes that are altered by expert knowledge and the analysis of receiver operating characteristics (ROC). Next, we present the resulting model-zone specific susceptibility maps and approaches to combine them into one classified landslide susceptibility map. We then discuss an approach to produce a confidence level map based on common European administrative mapping units (NUTS 3), and compare the ELSUS 1000 with available European, national and regional susceptibility maps. We conclude this contribution with a critical

discussion on version 1 of the ELSUS 1000 and future approaches for improvements. The methodology is described in Figure 2.1.1.

Landslide information

For this study, a pioneering attempt has been undertaken to gather basic spatial information of landslides over the European territory, i.e. landslide location points. Although for many European countries regional or national landslide inventories and maps provided by different institutions are available with different degrees of completeness and information (Dikau et al., 1996 and Van Den Eeckhaut and Hervás, 2012), so far no attempt has been made to make use of these data for continental landslide zonings at small spatial scales (1:1 M). We collected location information on landslide events on national and regional levels throughout Europe from inventories, literature, published map sources, and through Google Earth imagery (Table 1). Due to the heterogeneity of the sources, we compiled all projected locations into one database, regardless of type, date, or size of the events because it was not possible to acquire this information throughout all sources for this study. Thus, our collected inventory consisting of more than 100,000 entries solely reflects point information on where landslides occurred in the past. However, it is not possible to estimate the completeness of the gathered inventory. The quality of the location information can only be estimated relatively in such that points picked from scanned map sources and databases incorporating only locations of nearby settlements are attributed as "low" quality, inventories partly or exclusively built from historical data are attributed as "medium" quality, and data that largely consist of mapped information are ranked as "good" (Table 1). However, it has to be stated that also in most of the national-level inventories ranked as "good" the accuracy varies significantly, because these data incorporate both historical information without exact coordinates and mapped locations.

National-level data					
Country	n	Provider	Source	Quality	Access
Norway	32886	NGU	Inventory DB	good	Restricted
France	17935	BRGM	Inventory DB	good	Open
United Kingdom	15897	BGS	Inventory DB	good	Restricted
Italy	15499	CNR	Inventory DB	good	Open
Czech Republic	9257	CGS	Inventory DB	good	Restricted
Greece	2321	IGME	Inventory DB	medium	Restricted
Slovenia	1234	GeoZS	Published map	low	Open
Spain	973	JRC	Literature and published maps	good	Restricted
Austria	654	BGA	Overview DB	good	Restricted
Sweden	543	SGI	Inventory DB	good	Restricted
Bulgaria	419	BAS	Published map	low	Open
Hungary	342	BMFH	Inventory DB	low	Restricted
Albania	309	AGS	Inventory DB	medium	Restricted
Switzerland	284	BAFU	Overview DB	good	Restricted
Portugal	162	IGOT	Inventory DB	medium	Restricted
Ireland	157	GSI	Inventory DB	good	Restricted
Romania	77	JRC	GoogleEarth™	good	Restricted
Denmark	39	JRC	GoogleEarth™	good	Restricted
Regional-level data					
Region	n	Provider	Source	Quality	Access
Bavaria (Germany)	2222	LFU	Inventory DB	good	Restricted
Flanders (Belgium)	291	LNE	Inventory DB	good	Restricted
Mecklenburg-Vorpommern (Germany)	75	LUNG	Inventory DB	good	Restricted
Saxony (Germany)	73	LFULG	Inventory DB	good	Restricted

Table 2.1.1. Landslide data collected for this study. "Quality" only refers to relative average accuracy of location information, not completeness of the inventory

The spatial distribution of the landslide information is shown in Fig. 2, where the numbers of events or landslide-affected 1 km^2 grid cells are attributed to EUROSTAT NUTS ("Nomenclature des unites territoriales statistiques" - Nomenclature of territorial units for statistics) level 3 administrative terrain units.
It can be inferred that many areas throughout Europe known to be affected by landslides entirely lack information for this study (e.g., parts of Germany, Finland, Poland, the Baltic States, Slovakia, parts of the Balkan states, and parts of the Iberian Peninsula). Additionally, in many areas that are known to be highly landslide-prone the compiled information must be regarded insufficient (e.g., extensive parts of the Alps and the Carpathians). Moreover, a bias in the inventory information exists since locations of small-scale events in well-recorded landslide prone areas are highly numerous in analysis mapping units (1 km^2 grid cells), and therefore make comparisons across high hazardous terrains additionally problematic (Fig. 2A).
Considering the above, we do not use landslide numbers per terrain units for our susceptibility assessment. Instead, we computed a binary 1 km2 raster to delineate landslide-affected grid cells (in the following: "landslide pixels2, LSP) against unaffected ones (Fig. 2B). This procedure allows some degree of harmonization across terrains with

comparable landslide intensity. In summary, the landslide data gathered for this study can be considered sufficient to obtain a signal for susceptibility criteria evaluation and susceptibility model calibration and validation, but permits data-driven modelling attempts (see below).

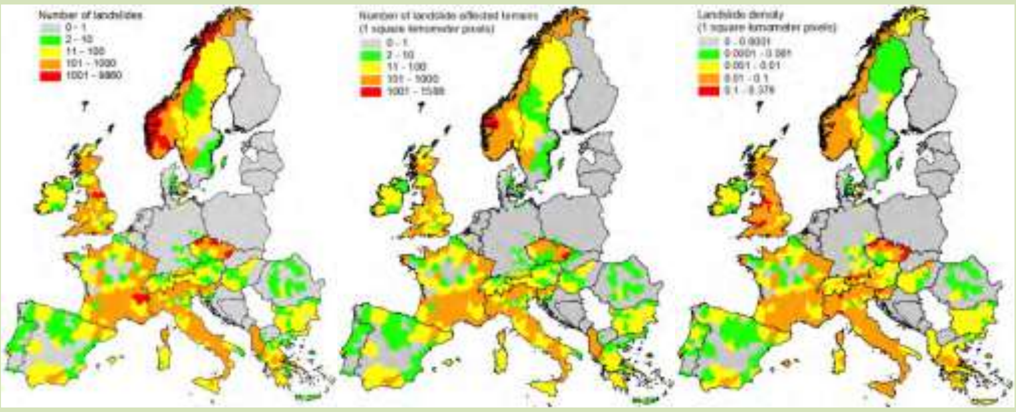


Figure 2.1.2. Distribution of landslide information per NUTS 3 administrative units used in this study. A) Number of collected landslides, B) Number of landslide-affected 1 km2 grid cells, C) Grid cell (1km2) landslide density

1.2 Climato‐physiographic model regions

Small-scale synoptic landslide zoning over physiographic and climatic complex terrains like Europe prove difficult since different landslide conditioning factors exert specific control on landslide susceptibility, depending on their climato-physiographic setting (Van Den Eeckhaut et al., 2012, Günther et al., 2013 and Malet et al., in press). So far, no attempt has been made to use climatic and/or physiographic zonings over Europe for small-scale landslide susceptibility mapping, although several European or global climate, geomorphological or landscape classification maps exist, e.g. LANMAP2 (Mücher et al., 2010), Landform Classification by Drăguţ and Eisank (2012), climato-physiographic regions from the Soil Regions Map of Europe (Hartwich et al., 2009). The main constraint withholding geomorphologists to produce individual models for different climato-physiographic zones was probably the fear of the presence of boundary effects along the different zones in the final landslide susceptibility map. Examination of available European climato-physiographic classification maps reveal that they can not straightforwardly be used for landslide zonings since they do not delineate sloping areas in mountainous terrains sufficiently against those in non-mountainous areas.

In this study, we combined a simple physiographic landscape classification with a common global climatic delineation. Following an approach proposed by Malet et al. (in press) and Günther et al. (2013), we subdivided the topography of the study area into three classes: “Plains”, “Mountains” and “Coasts” (Fig. 3A). For this, the Nordregio (2004) mountain classification was applied to the GTOPO30 global elevation model (USGS, 1996), a global digital elevation model (DEM) with horizontal grid spacing of 30 arc seconds (approximately 1 km). The Nordregio (2004) scheme allows differentiating between mountain and plain areas using a refinement of the global geomorphological division developed by the UNEP‐World Conservation Monitoring Centre, which is based on elevation and slope criteria and follows the principle that the threshold for rough topography increases as the altitude decreases. Similar to the original version of this regionalisation we excluded isolated mountainous areas less than 5 km2 and included non-mountainous areas within mountain ranges. For cleaning these isolated areas eCognitio DeveloperTM was used. In contrast to the original subdivision we did not approximate the mountain areas to municipal boundaries. After extraction of mountain and plain areas, a 1 km buffer was defined around the coasts to delineate the coastal areas (Fig. 3C). This seems important since coastal landslides and their controlling/triggering characteristics are not comparable to inland phenomena (Malet et al., in press).

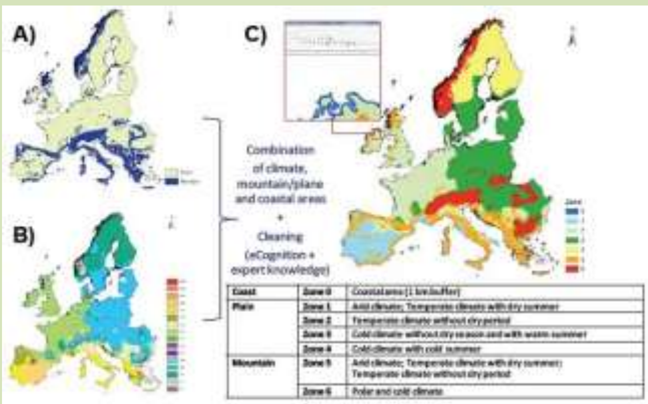


Figure 2.1.3. Production of 7 climato physiogeographic regions (C) by combining (A) Nordregio (2004) mountain

classification with (B) Köppen climate classification

For climatic differentiation, the global Köppen climate classification (Fig. 3B, Peel et al., 2007) was used. The data is available as a global grid with a 5 X 5 km resolution. The 16 Köppen-Geiger classes present in the study area (Fig. 3B) were aggregated to seven climatic classes and cross-cut with the physiographic zonation (Fig. 3C). Small isolated areas resulting from the combination were again removed with eCognitionTM. This resulted in seven climato-physiographic regions (Fig. 3C): coastal zones, plains with arid and temperate climate with dry summer, plains with temperate climate without dry period, plains with cold climate without dry season and with warm summer, plains with cold climate with cold summer, mountains with arid, temperate climate, and mountains with polar and cold climate.
When examining the terrain differentiation shown in Fig. 3C, it can be inferred that the delineated zones display individual characteristics in terms of the spatial distribution of important geofactors and climatic attributes controlling landslide predisposition. Even though especially elevation and precipitation show a high degree of intercorrelation, this evidences the usefulness of the applied regionalization scheme in terms of landslides. For the susceptibility modelling described below, each of the zones was treated independently.

1.3 Environmental susceptibility criteria

The aim of ELSUS 1000 is solely the representation of the propensity of the terrain to generate landslides at the European scale. It does not attempt to provide information on the temporal frequency of landslide susceptibility, or the delineation of hazardous areas using information on dynamic spatial landslide triggering data. Therefore, we selected only very reduced static (or quasi-static) environmental information from available pan-European datasets for susceptibility modelling. According to the specifications for continental-level landslide susceptibility evaluations formulated by the European Landslide Expert Group, these consist of slope gradient, soil/bedrock lithology and land cover (Hervás et al., 2007 and Günther et al., 2013). More dynamic environmental data that may be used for general spatial landslide hazard zoning (e.g., soil moisture, precipitation, seismicity) were rejected since they reveal a higher temporal dependence than the three parameters used and therefore should be considered in a future stage to produce hazard scenario maps based on ELSUS 1000. Other DEM derivatives commonly used for landslide susceptibility modelling like elevation, aspect, plan-or profile curvature were also not considered, analogous to complex terrain parameters as e.g. topographic wetness indices, because they are mostly attributed to susceptibility for specific types of landslides. Moreover, as demonstrated by previous studies, slope gradient is by far the most important parameter to predict general landslide susceptibility at the continental scale (Van Den Eeckhaut et al., 2012 and Günther et al., 2013) and therefore any terrain parameter utilizing slope would pose risk on overfitting of the model.

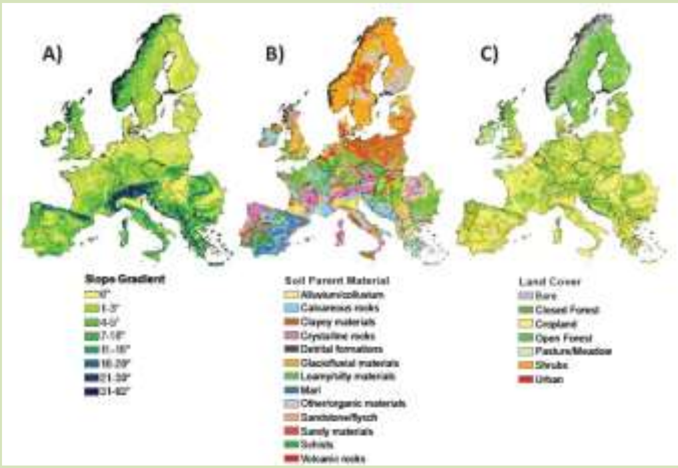


Figure 2.1.4. Input criteria maps produced for landslide zoning in Europe: (A) Slope Gradient map, (B) Soil Parent Material map, (C) Land Cover map

Information on slope gradient (Fig. 4A) was derived from the EU 27 DEM provided by BGR (Reuter, 2009). This dataset was produced with SRTM 90 data and Russian topographic contour lines and hydrologically corrected and harmonized using standard GIS tools. It has a resolution of 100 m and was clipped to VMAP 1000 coastlines for our analyses. EU 27 DEM is of better use for deriving classified information on slope gradient than lower resolution data (e.g., GTOPO 30 used before for climate-physiographic regionalization) since it reflects local slope gradient conditions much better. Similar to Günther at al. (2013), information on soil/bedrock lithology was obtained from the European Soil Database (ESDB, Heinike et al., 1998 and Panagos et al., 2012). The soil mapping unit attribute "dominant parent material" at level 2 comprises 41 classes of soil parent material which can be interpreted to reflect surficial lithologies of both consolidated and unconsolidated materials (Fig. 4B). As for now, this dataset must be considered the only available digital coverage providing harmonized information on surface lithology at an acceptable resolution over Europe. Alternative data as e.g. the International Geological Map of Europe at scale 1:5 Mil. (IGME 5000, Asch, 2005) is of very limited use for landslide susceptibility assessments since it is a solid geology map that does not provide information on characteristics and occurrences of unconsolidated geologic materials. For land cover, the global land cover data

GLOBCOVER from ESA was used. This dataset has a 300 m resolution and was selected against alternative data (e.g. PELCOM, CORINE) because it has a higher resolution than the first and renders information on the whole study area (in contrast to the second).

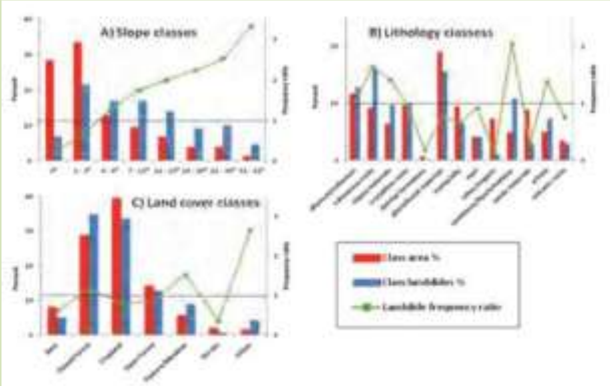


Figure 2.1.5. Histograms showing area density, landslide density and frequency ratios of the different classes extracted from (A) Slope Gradient map, (B) Soil Parent Material map, (C) Land Cover map

The three input data were classified (slope gradient) or further aggregated (lithology, land cover) using basic frequency statistics from the landslide inventory (Fig. 5). The aim here was to produce classified maps where the criteria classes are not too small in size and not too large in number, and covered by sufficient LSP to use the signal of the landslides for susceptibility modelling (see below). Susceptibility modelling in this study was carried out solely using categorical data. Even though the slope gradient data may also be used as a continuous input criterion, we chose also classification of this data to better overcome inaccuracies of the location information, also resulting from projecting the data.

The slope parameter was classified by plotting the number of LSP over the integer of the slope gradient and then manually selecting class breaks which best represent the shape of the curve (Fig. 5A). It is obvious that gently sloping terrains (two lowest classes in Fig. 5A) contain more than 60% of the area but less than 30% of the landslides, therefore resulting in frequency ratios (FR) below 1. For the rest of the classes FR are gradually increasing with the highest class covering only a relatively small portion of the study area (1.4%). The 41 soil parent material classes of the SDBE at level 2 were further aggregated into 13 lithology classes (Fig. 5B). The smallest class is the "detrital formations" class that was not possible to semantically merge with other bigger classes. The two largest lithology classes "alluvium/colluvium" and "glaciofluvial materials" are also highest in LSP occupations resulting in FR values around 1. Some small lithology classes like "sandstone/flysch/molasse" or "schists" exhibit high FR values in contrast to "sandy materials", "other/organic" or "detrital formations" with very low values. For land cover, "bare" and "shrubs" are relatively small classes with low FR values. The class "urban" is the smallest class but has more than 4% of the landslide pixels, resulting in a very high FR value. This is due to the fact that landslides close to built up areas are better recorded than landslides in more remote places and that landslide locations of historical catalogues are attached to the closest villages.

1.4 Landslide susceptibility modelling

Although the landslide information collected for this study provides a spatial overview of landslide occurrences in Europe, it is highly incomplete and heterogeneous. Therefore, data-driven statistical modelling techniques for landslide susceptibility evaluation based on this inventory are problematic. Moreover, an irresolvable bias in the landslide data exists that over-or underestimates specific criteria classes in terms of landslide frequency ratios. Considering the above, we adopted a heuristic evaluation scheme (SMCE), quantified through an AHP (Saaty, 1983) for landslide susceptibility evaluation. This assessment follows an approach discussed by Malet et al. (in revision) for small-scale landslide zoning and allows both the incorporation of landslide information and expert knowledge into the assessment.

SMCE-based evaluations are widely used in landslide susceptibility assessments at small and medium spatial scales over large territories with incomplete or even lacking landslide information (e.g., Barredo et al., 2000, Castellanos Abella and van Westen, 2008, Yalcin, 2008 and Günther et al., 2013).

Table 2. Parameter weight assignment based on AHP for the three physiographic regions

Coasts	Slope	Lithology	Land cover	Weight	CR
Slope	1			0.75	-
Lithology	6	1		0.25	
Land cover	-	-	-	-	
Plains					
Slope	1			0.64	0,03
Lithology	6	1		0.26	
Land cover	7	6	1	0.10	
Mountains					
Slope	1			0.58	0,98
Lithology	6	1		0.28	
Land cover	6	6	1	0.13	

In the SMCE, encoded in the ILWIS software, first the parameter weights attributed to landslide susceptibility are established in an AHP through pairwise comparisons (Saaty, 1980) of the tree criteria slope gradient, lithology and land cover for the three different physiographic regions coasts, mountains, and plains. Pairwise comparisons are found highly suitable in this study since the hierarchical structure of the criteria (in the order slope, lithology, and land cover) can easily be a-priori defined for generic small-scale assessments. In the pairwise comparison, a value between 9 ("extremely more important than") to 1 ("equally important as") can be assigned to each pair of parameters in a comparison matrix by rating rows against columns (Table 2). The weights computed through the pairwise comparisons can be evaluated through a consistency ratio (CR) that indicates the probability of the decision matrix to be generated randomly (Saaty, 1980 and Saaty and Vargas, 1984). Matrices with CR greater than 0.1 may be re-evaluated. In our assessment, we used only two criteria (slope and lithology) to evaluate landslide susceptibility for the coastal areas (model zone 0) since no evidence in landslide frequency over the land cover classes was found here. We assigned a lower relative importance of slope vs. land cover for the plain physiographic regions than for the mountains since lithology was found to have more control on landslide susceptibility here. Although this significantly increases the CR value of the comparison matrix for mountains, all obtained CR values are below the critical threshold (CR = 0.1, Table 2).
The next step in the SMCE is the assignment of parameter class weights, which were in this study allocated directly. As a basis, the frequency ratios of LSP over the parameter classes were used for a hierarchical ordering. The normalized frequency ratios were then modified by expert knowledge to account for over-or underestimated values based on parameter class sizes and landslide distributions (see below). A susceptibility index map was then produced through a weighted linear summation of the parameter- and parameter class weights (Voogd, 1983). Further tuning of the parameter class weights was conducted through trial-and-error runs combined with ROC evaluations to produce a map satisfying both expert knowledge and landslide signal.
In Fig. 6 the final parameter class weights (listed in Table 3) together with their differences to the initial landslide frequency ratios are shown. It can be seen that weights attributed to slope classes were mainly tuned in model zones 2, 3 and 4 (plain units with sparse and/or highly localized landslide information).
Zone 4 contains extensive areas without landslide information and a huge proportion of flat terrains; therefore initial weights resulting from normalized frequency ratios obtained for the small two highest slope classes seem overestimated and needed reduction. In turn, the initial weight of slope class 5 (11-15°, Fig. 6A) was increased to achieve an increase of the weight values of the slope classes coinciding with the other plain model zones. In zone 1 (also containing very sparse landslide information), the highest (very small) slope class is not occupied by landslides, therefore a weight value similar to that of the second highest class has to be established, resulting in lowering of other slope classes. In general, slope class weights for model zones 5 and 6 were only very slightly tuned for harmonization amongst the zones and do not show a steep increase in weight values compared to the plain model zones. This is because both sizes and LSP occurrences of the slope classes are distributed relatively evenly in the mountainous model zones 5 and 6, e.g. landslides are frequent in many different slope settings throughout mountainous terrains.
Similar to the slope classes, weights attributed to lithology classes (Fig. 6B) required modifications from the initial frequency ratios in the plain model zones 3 and 4 because of sparse and localized landslide information. In model zone 4, landslide information apparently clusters in the very small "alluvium/colluvium" class and is completely lacking in the much larger class "clayey materials". Reducing the weight of the first class required an increase of the other lithology classes here through trial-and-error runs of the model to receive an acceptable result. Model zone 3 displays extreme clustering of landslides in the relatively small classes "schists", "marls" and "detrital formations" which need weight adjustment in order to not bias the resulting susceptibility image too much. Weight decreases are here again compensated by increase in weights of other classes to achieve a model result both satisfying expert knowledge and landslide information.
A general bias in the initial weights obtained from frequency ratios for the land cover classes exists throughout all model zones (except for model zone 2 showing the best information on landslide distribution) in the "urban" class (Fig. 6C). This class is overestimated because landslides are causing most damages (including fatalities) here, and are most frequently recorded in landslide databases.
Further, historical location information on landslides is in many inventories often attributed to the next nearby settlements. In this instance, parameter class weights have to be reduced and compensated through the increase of other parameter classes by expert knowledge and trial-and-error model runs to retrieve a susceptibility estimate that is not biased too much.

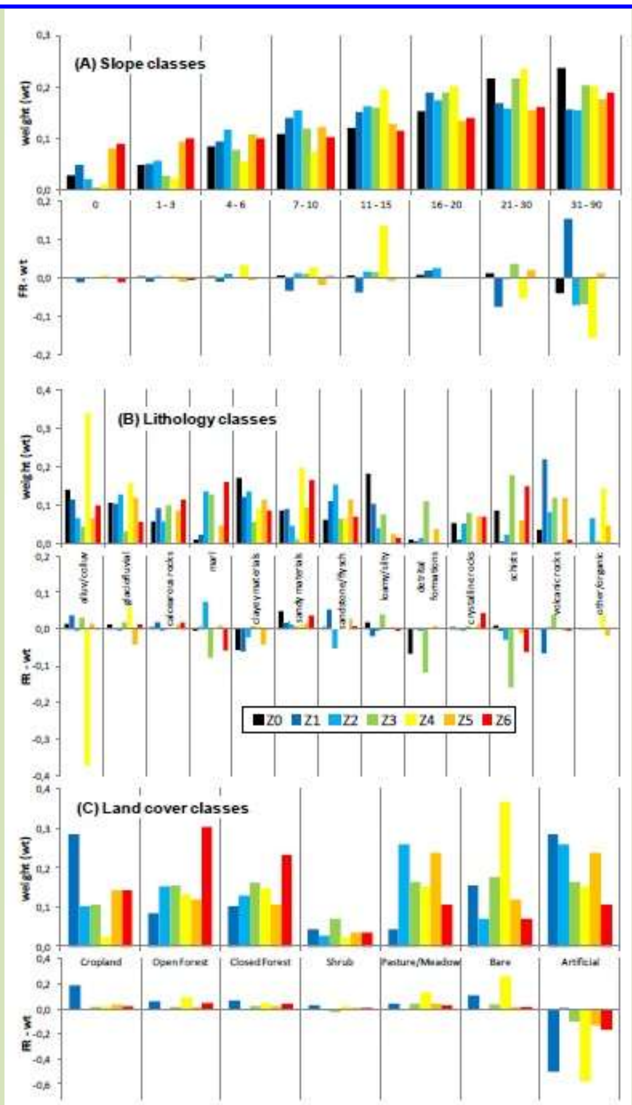


Figure 2.1.6. Histograms showing expert-corrected parameter class weights and differences to initial parameter class frequency ratios resulting from expert tuning for the seven climato-physiographic zones

1.5. Landslide susceptibility map

Susceptibility modelling was performed individually for each climato-physiographic zone. The zone-specific SMCE models result in continuous susceptibility index (SI) maps for each zone. In order to prepare a combined susceptibility map for the whole area, the zone-specific SI grids could not be straightforwardly merged since this results in significant zone border effects because SI is separately computed for each zone. Normalization of SI for each model zone reduces the border effects significantly, but produces incompatible susceptibility estimates from model zone to model zone. Given the above, we decided to individually classify each zone-specific susceptibility map separately and subsequently produce a mosaic over the whole study area with the classified maps.

Classification of the zone-specific susceptibility index maps was done using the landslide data. We used five susceptibility classes with labels as commonly used in small-scale landslide susceptibility mapping (e.g., Guzzetti et al., 2006, Van Den Eeckhaut et al., 2012 and Günther et al., 2013): “Very low”, “Low”, “Moderate”, “High”, and “Very High”. It was decided to attribute the highest susceptibility class exclusively for the physiographic regions “Mountains” (zones 5 and 6, see Fig. 3) and “Coasts” (zone 0, see Fig. 3) because landslide intensity in these terrains must be expected significantly higher than in any of the “Plain” areas (zones 1 – 4, see Fig. 3). In the highest susceptibility class for each model zone (“Very High” in “Mountains” and “Coasts, “High” in “Plains”), 50% of landslide-affected pixels (LSP) are located, whereas in the lowest susceptibility classes (“Very low” in “Plains”, “Low” and “Very low” in “Mountains” and “Coasts” respectively) less than 10% LSP occur. We acknowledge that map landslide susceptibility classification is a non-trivial task and still no general rules for this in terms of class numbers, characteristics and specifications are established (Guzzetti et al., 1996). To introduce a classification-scheme that is as transparent as possible, we rely on landslide class density here although our landslide sample is biased and incomplete. Despite local class inconsistencies, we think the classification proposed here is feasible to delineate landslide susceptibility at the continental scale and can be best transported to end users.

The final classified susceptibility map resulting from the spatial combination of the zone-specific maps is shown in Fig. 7. At its very small synoptic scale printed here, the map broadly resembles susceptibility patterns as also indicated by former assessments (e.g., Van Den Eeckhaut et al., 2012 and Günther et al., 2013). However, important differences exist especially in non-mountainous areas where our map shows a much more differentiated pattern when compared to previous assessments since calibrated with much more landslide information. Correct susceptibility evaluations of coastal zones remain problematic since the input criteria are not uniformly attached to the same coastline data. However, our model is the first that attempts to delineate coastal landslide susceptibility at the continental scale and can therefore also be considered superior to other evaluations.

Although the chosen susceptibility classification shows some local inconsistencies mainly resulting from deficits in the "lithology" criterion (see Section 4), our map classifies 6% of the territory as of "very high" susceptibility to landslides including 20% of the total LSP (Fig. 8). These areas, which are mostly located along the major European mountain ranges but also in non-Alpine environments and along specific coastal portions, are heavily affected by landslides. In turn, 70% of the study area shows "very low" or "low" landslide susceptibility where 28% (mostly isolated) LSP are recorded in the databases used for this study (Fig. 8). In these terrains, landslides are not expected to cause problems and the areas may not be evaluated in more detail for landslide susceptibility. "Moderate" and "high" landslide susceptibility is indicated in Fig. 8 for terrains containing 52% of LSP. In these areas, landslides can be expected to occur frequently in specific regions, while others may not be affected to a similar degree. These terrains need to be evaluated at larger scales using more robust susceptibility modelling than that applied at the continental scale.

In Fig. 8, the relative area proportions of the susceptibility classes in the specific model zones are shown. It can be observed that in "mountain" regions (model zones 5 and 6) areas classified as of "very high" susceptibility are obviously much larger than in the other physiographic regions. Comparison between zone 5 and 6 in Fig. 9A indicates that generally landslide susceptibility is slightly higher in the southern mountainous regions. In the "Plain" model zones (1 -4, Fig. 9B), in turn, the majority of the area is attributed to "very low" rep. "Low" landslide susceptibility. When comparing the zones, it can be observed that significantly fewer terrains are assigned to "very low" landslide susceptibility in model zone 2. This may be attributed due to the specific climatic conditions in this zone leading to more intense weathering of susceptible lithologies being more prone to landslides here. The coastal areas have not been further differentiated in terms of climatic conditions for this study, and therefore model zone 0 renders a synoptic overview of landslide susceptibility area percentages along coastlines over Europe.

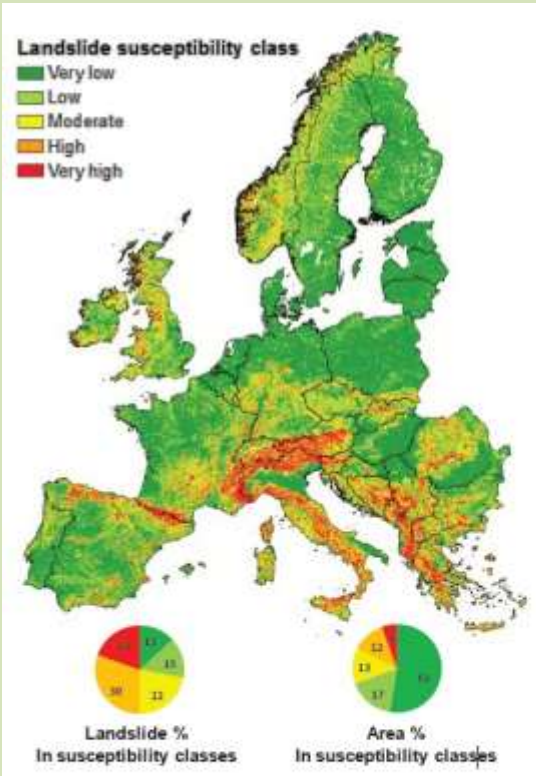


Figure 2.1.7. Classified Pan-European landslide susceptibility map (ELSUS1000)

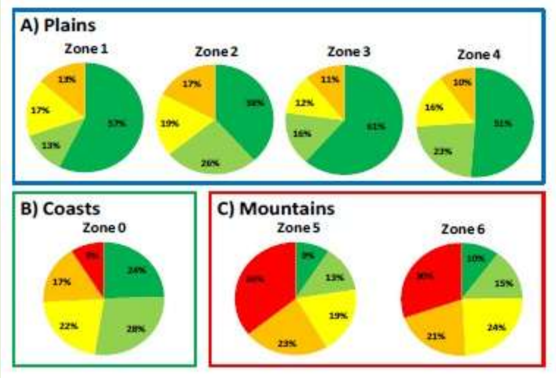


Figure 2.1.8. Pie charts showing spatial distribution of the susceptibility classes over the seven climato -physiographic regions

1.6. Further work: landslide inventories and map validation

Our proposed methodology for generic continental-level landslide susceptibility assessment superior to previous approaches, because it quantitatively incorporates landslide density information while allows for incorporating expert-knowledge to account for quality, bias and spatial gaps in the data used. Additionally, the proposed susceptibility levels are obtained through ROC evaluations and therefore are defined by the class-specific proportions of landslides. This has a clear advantage in the definition of susceptibility levels because they directly refer to the proportions of landslides occurring in particular spatial susceptibility classes.

In its current stage of development, ELSUS 1000 Version 1 has limitations to correctly predict landslide susceptibility in many regions mainly due to the incompleteness of landslide information (44% of the area without LSP data, Fig. 2), and deficits of the "lithology" layer as discussed above. Although the incorporation of better data can be suspected to improve the current stage of the evaluation, the main prerequisite for an advancement of ELSUS 1000 would be the incorporation of more landslide data in areas not or only very sparsely covered by the inventory. It can be suspected that in the context of European spatial data infrastructure initiatives (e.g., INSPIRE Directive, EC, 2007) and the further development of modern data dissemination and storage technologies (mobile apps, crowd sourcing etc.), the amount of accessible actual landslide information will increase. However, in landslide prone areas of Europe identified by ELSUS 1000 the compilation of historical landslide archives is highly important because they are indispensable for the evaluation of landslide hazard and risk.

We further conclude that small-scale continental susceptibility maps should always be accompanied by spatial information reflecting its regional reliability. The confidence level evaluation proposed here provides a clue for identification of areas where more landslide information must be gathered to improve the analysis, or where the susceptibility model fails despite of the availability of landslide data. In its further development, confidence level maps attached to ELSUS can be suspected to look more optimistic, but terrains of low confidence will most probably persist due to local landslide conditions not captured by the susceptibility criteria used, or irresolvable deficits in thematic information. Therefore, a reliability evaluation should always be part of any continental landslide susceptibility evaluation.

Landslide susceptibility assessments provide the basis for the spatial evaluation of landslide hazard and risk. A pragmatic spatial assessment of generic landslide hazard can be achieved when combining ELSUS 1000 with spatial information on dynamic factors mainly attributed to landslide triggering, that is precipitation and seismicity (Jaedicke et al., 2012). Although pan-European datasets (WORLDCLIM, ref.) and seismicity (peak ground acceleration from GSHAP, ref.) are available and may be combined with the ELSUS information in the future, we conclude at this stage that these factors should be evaluated in the framework of landslide typology specific evaluations and used for spatial hazard assessments of individual landslide types.

Work package 2 (prepared by GHHD, ECBR, CERG):
Description:
National assessments of Landslide Susceptibility for three countries / Leader: GHHD
Associated deliverables:
D.2.5 Statistical model for Georgia (GHHD & CERG) - M+14
D.2.6 Statistical model for Romania (ECBR & CERG) - M+14
D.2.7 Methodology to integrate dynamic factors in the analysis (CERG & GHHD) - M+18
D.2.8 Statistical model integrating triggering factors for the three countries (CERG & GHHD) - M+24

In order to validate and improve the performance of ELSUS 1000, typologically-differentiated national scale maps were created for Georgia, Romania and France as pilot study cases.

The methodology and the results are disseminated for the French case study in the manuscript:

Malet, J.-P., Puissant, A., Mathieu, A., van den Eeckhaut, M., Fressard, M. (in review). *Landslide susceptibility assessment at 1:1M scale for France*. Geomorphology, 15p.

For Romania and Georgia, the results will be published in a scientific journal in 2014.

2.1. Landslide Susceptibility Map for Georgia (GHHD, CERG)

The creation of the first landslide susceptibility map for Georgia was undertaken by T. Tsamalachvili and T. Chelidze, with the following steps:

1. The current dataset of different types of landslides have been checked out and reworked from duplicates and uncertainties.
2. Additional landslide databases have been derived from the geological maps of the Georgia (digitized) and finally the catalog for slide (1978 records), flow (1158) and fall (234) events have been produced using above mentioned datasets.
3. Subsequent, using GIS analysis for the DTM of Georgia two geomorphological types of the landscape: mountains and lowland have been derived using GIS technologies.
1. The three factor maps have been selected from the existing factor maps dataset:
   a) Lithology – derived from the Engendering geological map (initially 54 classes have been reworked into 8 classes),
   b) Land use – from the Terra MODIS image (originally 16 classes have been regrouped into 7 classes)
   c) Slope obtained from DTM (Aster) have been reclassified into 8 classes.

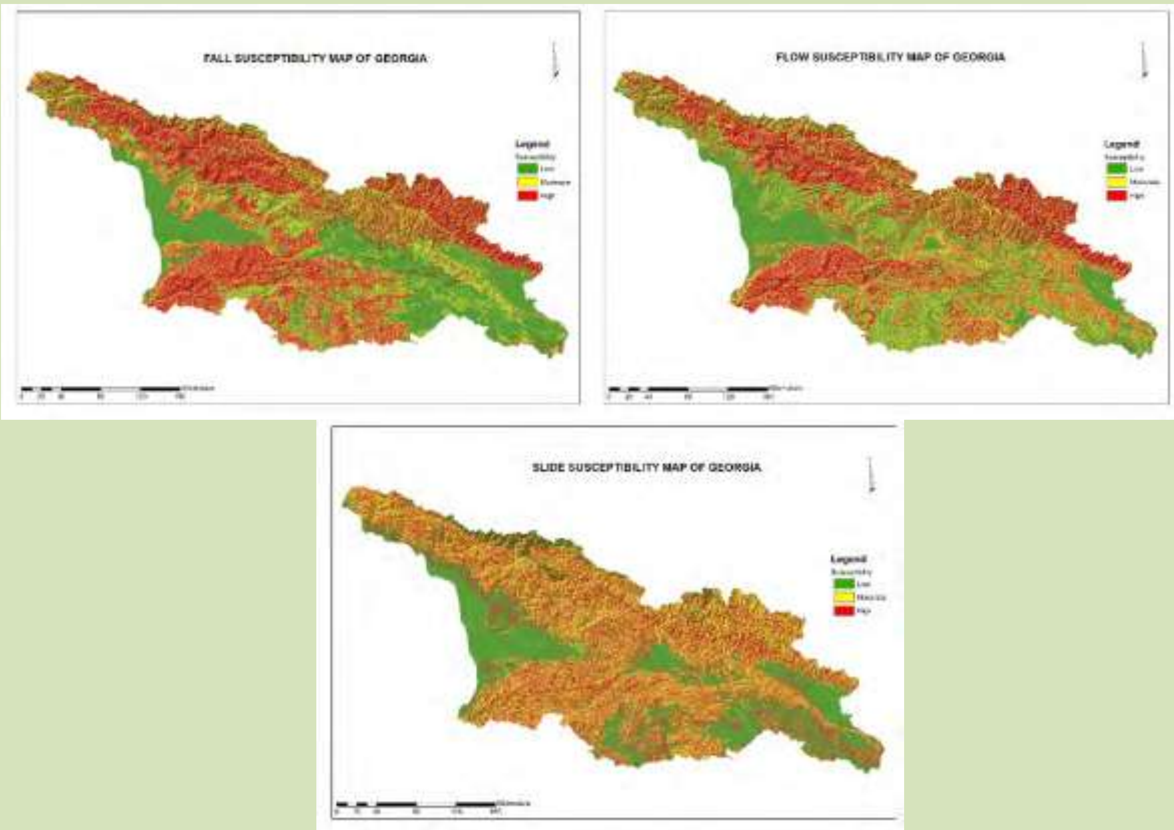


Figure 2.2.1. Typologically-differentiated landslide susceptibility maps for Georgia.

Statistical analyses have been carried out in order to determine dependences between the landslide amount and different factor maps classes for the mountain and lowland topographic units. The rasterized dataset have been exported into the ILWIS software; Then logical trees have been generated for three types of mass movements (slide, flow, fall) designed for lowland and mountain regions separately. Next have been weighting the factor maps classes and factor maps themselves and the slide, flow and fall susceptibility maps have been generated (Fig. 2.1).
Using the susceptibility degree matrix (Table 2.1) the final landslide susceptibility map has been produced using slide susceptibility, fall susceptibility and flow susceptibility maps, which are shown in Figure 2.1.

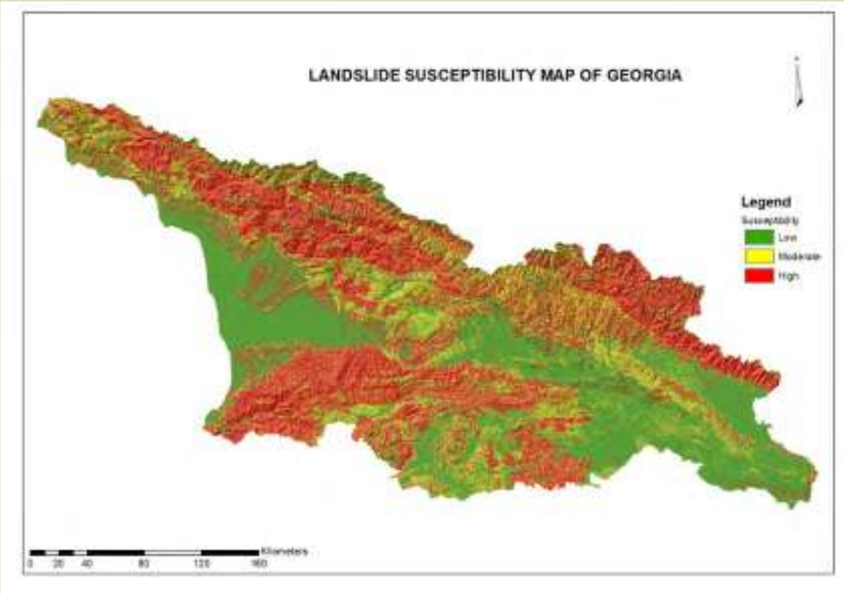
	High	Medium	Low
High	High	High	Moderate
Medium	High	Moderate	Low
Low	Moderate	Low	Low

Table 2.2.1: Combination of susceptibility classes

The amount of the slide, flow and fall events have been calculated for each susceptibility classes which is represented in Table 2.2.

	Recorded events per susceptibility classes	%		Recorded events per susceptibility classes	%		Recorded events per susceptibility classes	%
Slide	1977		Flow	1160		Fall	236	
High	755	38	High	614	53	High	124	53
Moderate	756	38	Moderate	398	34	Moderate	66	28
Low	462	23	Low	146	24	Low	46	19

Table 2.2.2. Percentage of recorded events par landslide susceptibility classes.



2.2. Landslide Susceptibility Map for Romania

For Romania, the objective of the work is to propose a first national inventory-based landslide susceptibility assessment, as a basis for the upcoming ELSUS 1000 V2 continental map. The task was undertaken by a group of researchers (M. Micu, IGAR-Academy of Sciences, C. Mărgărint, I. Şandric, Z. Chiţu and C. Simota).
Romania's territory consists out of quasi-concentrical disposition of relief units. The Transylvanian Tableland in the middle is surrounded by the Carpathian Mountains, that are bordered towards the exterior by altitudinal-decreasing units of the Subcarpathian hills and pericarpathian tablelands. The plane areas of the exterior are showing a quasi-null landslide presence.
The landslide inventory consists of 27.900 cases (including three main categories, slides, flows, falls) that were compiled throughout the year 2013 (Fig.2.3). The sources were various: 2,100 cases used in PhD theses (University of Bucharest), 9,800 gathered within Iaşi University, 3,000 obtained within CHANGES FP7 Project. The rest of 13,000 (including 200 literature‐based) were based on aerial and satellite images (Google Earth, BingMaps) interpretation and on the topographic map of Romania 1:25,000, 1984 edition.

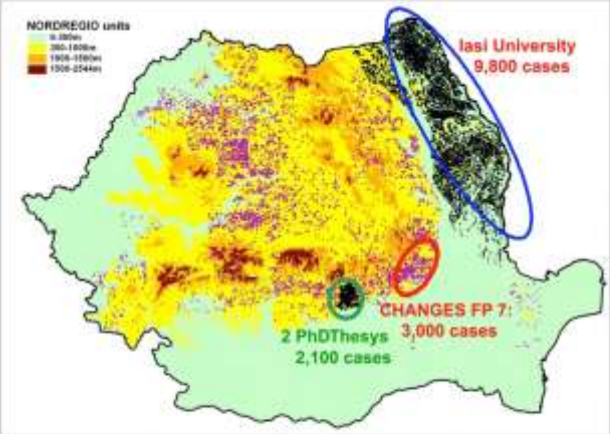


Figure 2.3. Landslide inventory for Romania.

In order to perform the analysis, three conditional factors were taken into consideration (Fig.2.4):

(i) geology
(based on 1:200,000 maps published by the Geological Institute of Romania; initial classification was having 240 classes, which were reduced to only 8: predominantly fine material formations – alluvial, colluvial and Aeolian deposits; predominantly clayey and marly formations; predominantly clayey and marly formations with sandstone intercalations; predominantly loose flysch formations of low cohesive sandstone alternating with marls and clays; predominantly cohesive flysch formations including cemented conglomerates and volcano deposits; predominantly limestones and dolostones; metamorphic formations; igneous formations);

(ii) slope (derived out of a 100x100 m SRTM DEM; classified into 8 classes: 0-2°, 2-5°, 5-10°, 10-15°, 15-20°, 20-30°, 30-40°, >40°),

(iii) land-cover (based on CORINE LandCover2006; classified into 9 classes: artificial surfaces, arable land, permanent crops, pastures, heterogeneous agricultural areas, forests, shrubs and/or herbaceous vegetation association, bare rocks with little/no vegetation, wetlands).

The methodological approach was based on three steps:

(i) classify conditional factors;
(ii) weighting first-and-second-order derivates;
(iii) spatial multi-criteria evaluation (performed in ILWIS3.6).

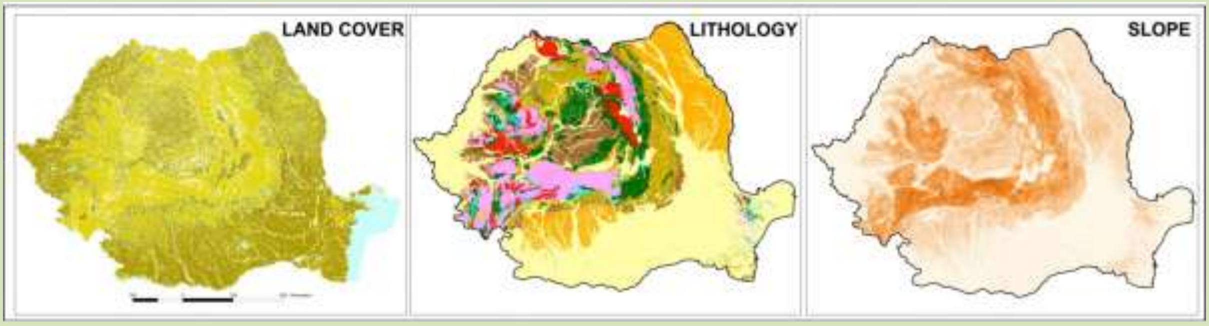


Figure 2.2.4. Conditional factors maps for Romania.

Following the SMCE approach, three susceptibility maps (Fig. 2.5) (expressed by values ranging from 0=very low to 1=very high) to slides, flows and falls. The slide susceptibility map (values between 0 and 0.8) outlines the Moldavian, Getic and Transylvanian Tablelands alongside the flysch Carpathians and the Subcarpathian chain as the regions most prone to mud and debris-slides. Rock-slide phenomenon is showing a low frequency but high magnitude pattern and characterize especially the more cohesive (Cretaceous) and less cohesive (Palaeogene) Eastern and Curvature flysch Carpathians. The model''s overestimation across the Moldavian Tableland and in the high part of the Southern Carpathians reflects the high density of landslides within the inventory. Falls susceptibility map (values from 0 to 0.5) reflects also the number of cases spread across the high sectors of the Carpathian chain in form of rock-falls that are characterizing mainly the areas above 1800-2000 m. Below this altitude, the rock-falls are developing within limestone or dolostone units (like the Western Carpathians and some parts of the Southern Carpathians) and their altitude drops down to some 500-600 m in the Danube Gorges. The flows susceptibility map (values between 0 and 0.5) individualizes two different frameworks: on one hand, the regions of the Eastern and Curvature flysch Carpathians and Subcarpathians, characterized by medium and high frequency mud-flows while on the other hand, the high sectors of the Northern, Eastern and Southern Carpathians are marked by the dense presence of debris-flows.

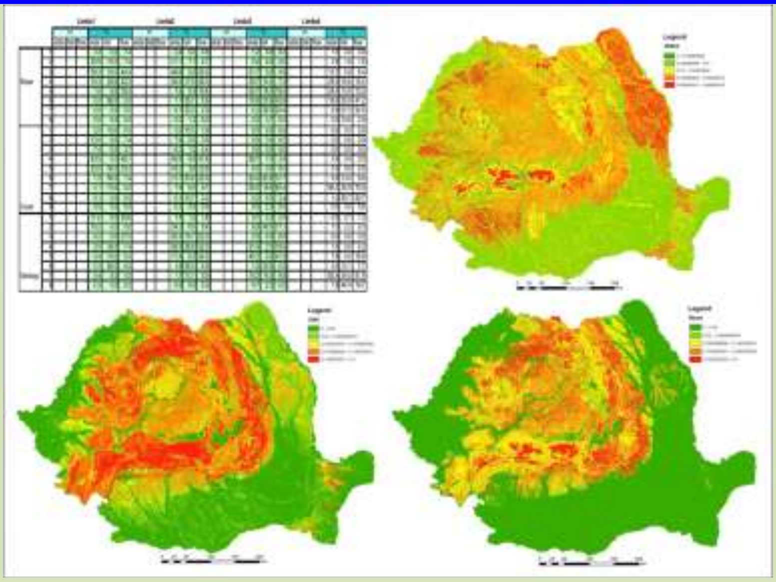


Figure 2.2.5. Landslide susceptibility maps for Romania (in table, the weights of second-order derivates)

The three landslide (slide, fall, flow) maps are outlining the correlation between the major morphostructural units and different susceptibility classes: the medium and high Carpathians, built mainly on metamorphic and igneous rock formations (sometimes on limestone and dolostones) presents the highest susceptibility to (rock/debris) falls and (debris) flows; the low Carpathians, consisting of more or less cohesive flysch formations are very prone to (mud/debris) slides, while the Subcarpathian hills and the extended homocline or hilly tablelands shows high susceptibility to (mud/debris) slides and (mud) flows. Besides their importance within European (ELSUS 1000 V2) framework, the obtained maps are representing an important step for prioritizing areas in which more detailed studies, at a larger scale, should follow up.

2.3. Landslide Susceptibility Map for France

For France, the proposed assessment is based on slope angle, lithology and land cover, but the input data sets are different in terms of usable scale, pixel resolution and taxonomy (Table 2.3).

Table 2.2.3. Landslide conditioning factors used in the differentiated Tier 1 susceptibility model for France. The number of classes corresponds to the reclassification of the original thematic variables.

Factors	Source	Date	Usable scale	Resolution	Number of classes used in the analysis
Slope gradient	IGN DEM (BD-Alti®)	2008	1:100,000	50 m	13 (5° interval)
Soil parent material	BRGM geological map (BD-Million-Geol), 6th Edition	2005	1:1M	50 m	24
Land cover	Corine Land Cover -France	2005	1:100,000	50 m	10

The slope gradient map, derived from the French topographic database (BD-Alti®) with a spatial resolution of 50 m, is subdivided in13 classes of 5° interval. The soil parent material map is derived from the geological database of the Bureau de Recherche Géologiques et Minières (BRGM) at 1:1M scale. The original map is classified in 24 classes, representative of the main geological units observed in terms of lithology, structure and age. The land cover map is derived from the Corine Land Cover (CLC) data set available for Europe. The database is obtained by a joint analysis of Landsat ETM+ and SPOT XS imagery. Only objects with an area larger than 25 ha are represented and Level 1 (10 classes) of the CLC database is used for the analysis. A detailed description of the input data and its accuracy is available in Malet et al. (subm.). For input data pre-processing, the spatial and semantic consistency of all thematic data have been controlled, and the data was rasterized to a grid cell size of 50 m corresponding to the resolution of the DEM.

The French landslide inventory (BDMvT) provided by the BRGM, the Laboratoire des Ponts et Chaussées (LCPC) and the Restauration des Terrain en Montagne (RTM) is used to validate the susceptibility model. This inventory records several characteristics (i.e. type, location, date, state of activity and damage) of the observed landslides but is incomplete and has a low or unknown spatial accuracy in some regions. The landslide types in this study are slides (e.g. rotational and translational slides affecting soils, cohesive sediments and hard rocks), flows (e.g. mudflows, earthflows, debris flows and debris avalanches affecting soils, cohesive sediments and hard rocks) and falls (e.g. rockfalls and topples observed in hard rock). Criterion standardisation, weighting and combination of the input data were accomplished by means of a Spatial Multi-Criteria Evaluation (SMCE) method (Figueira et al., 2005). The theoretical background is based on the Analytic Hierarchy Process (AHP) which uses a tree-shaped structure to organize the thematic variables (e.g. the conditioning factors), and to associate a weighting factor to each class of variables (Figure

5). The methodological framework is based on the approach proposed by Malet et al. (2009) and is structured in several steps (Figure 5):

1. Division of France in three physiographic sub-units. Mountain areas and plain areas are distinguished using the Nordregio (2004) criteria, while the coastal areas are defined by using a 1 km-buffer along the coastline;
2. Classification of landslides into three different types (i.e. slides, flows and falls);
3. Transformation of the input data (Table 2.3) in Boolean values for each data class, and a standardization of the criteria (in red in Figure 2.6B);
4. Definition of the weights attributed to each conditioning factor and to each factor class. Similar to the European Tier 1, the AHP pairwise comparison method has been used for the three conditioning factors. More importance was given to the slope gradient (0.58), then to the lithology (0.28) and finally to the land cover (0.13). The weighting procedure of the variable classes has been performed by using the landslide frequency in each variable class for each landslide type and for the three sub-units, and then ranking the classes from more to less prone to landslides.
5. The preparation of several susceptibility maps (with a resolution of 50 m) for each landslide type by slicing the modeled variables in four class according to natural breaks in the cumulated distribution; e.g. very low, low, moderate and high). The susceptibility maps of the three landslide types obtained for the plain, mountain and coastal sub-units are combined in one susceptibility map. In the association procedure, the final susceptibility class attributed to a grid cell is the highest susceptibility class observed in that grid cell in the individual susceptibility maps.

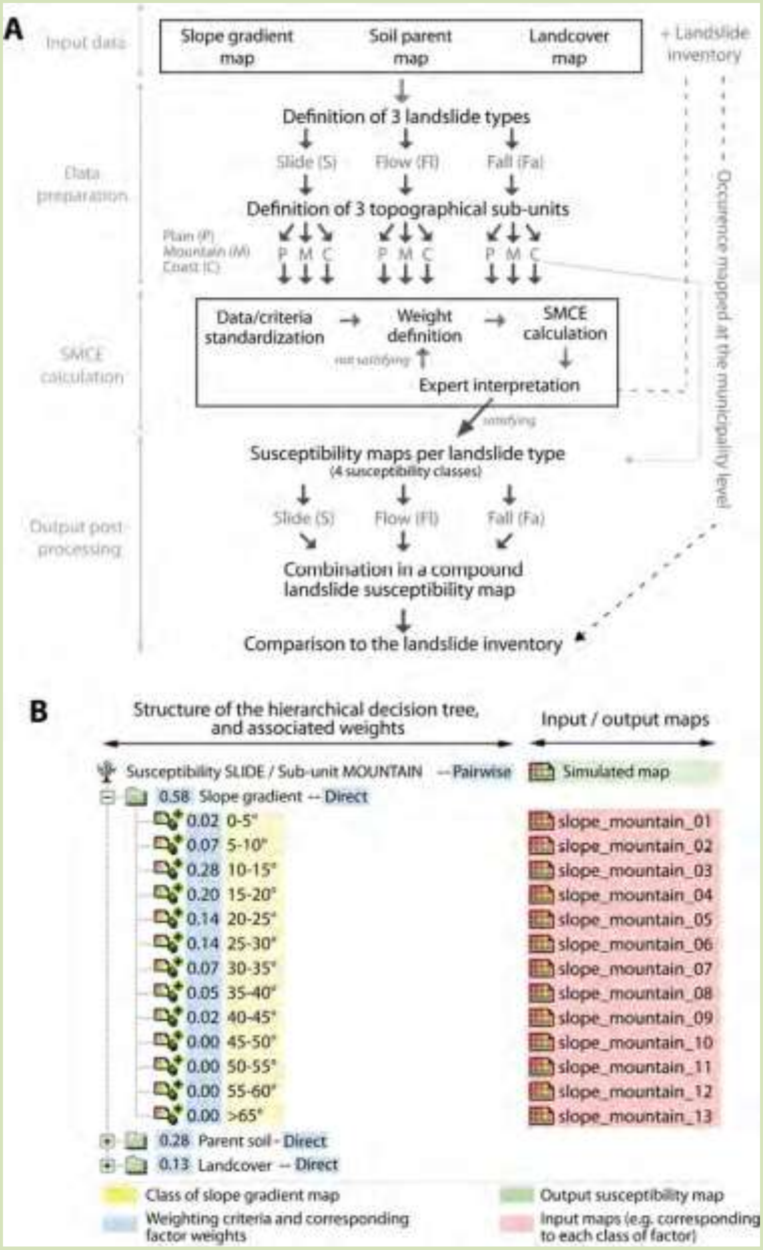


Figure 2.2.6. Spatial Multi-Criteria Evaluation used for the differentiated Tier 1 landslide susceptibility assessment in

France: (A) Methodological framework, and (B) Example of the decision tree used for the SMCE calculations in ILWIS (S: slide, Fl: flow, Ra: rock fall, P: plain sub-unit, M: mountain sub-unit, C: coast sub-unit).

The compound landslide susceptibility map presented in Figure 2.7A is obtained through combination of the three maps calculated for slides, flows and falls (Fig. 2.7B) using the association procedure detailed in Figure 2.7C.

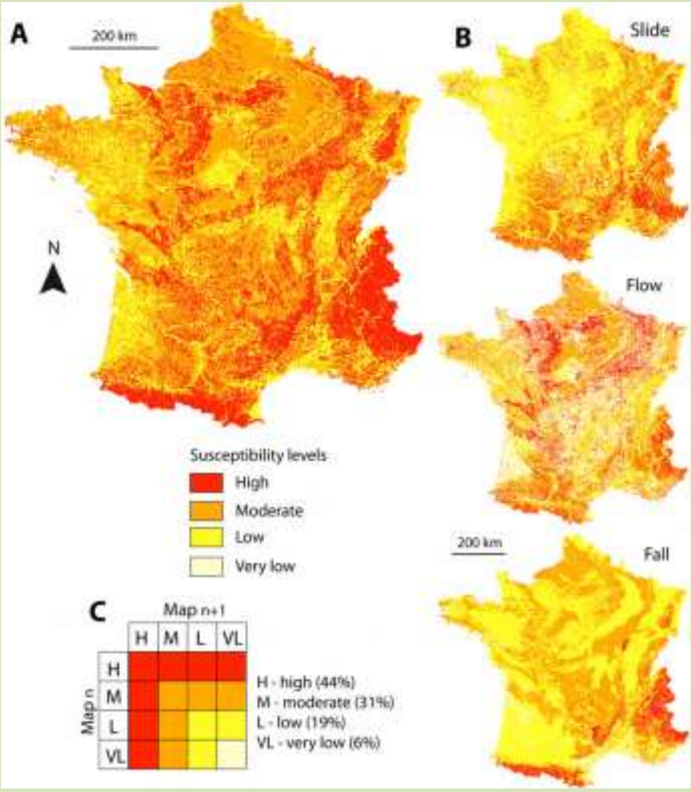


Figure 2.2.7. Differentiated Tier 1 assessment over France. (A) Compound landslide susceptibility map. (B) Susceptibility maps obtained for each landslide type (e.g. slide, flow and fall). (C) Criteria used in the association method to prepare the compound susceptibility map.

The distribution of the susceptibility classes (Fig. 2.8) was calculated for the plain and mountain sub-units (the coastal sub-unit is not indicated as it covers only 0.15% of the French territory).

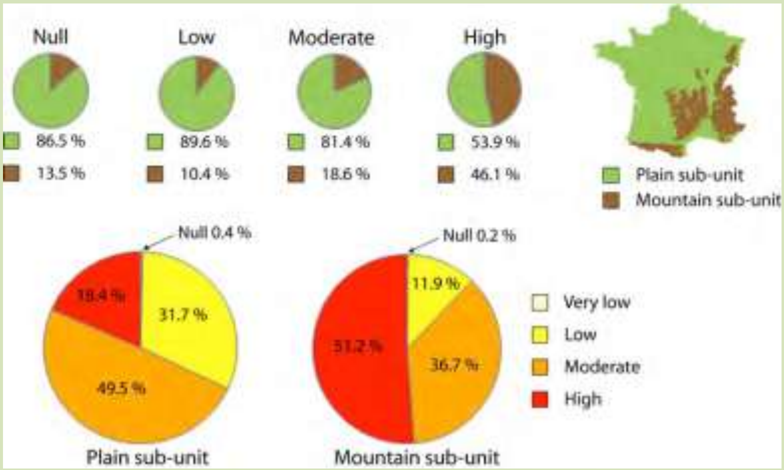


Figure 2.2.8. Distribution of susceptibility classes of compound map for the plain and mountain sub-units.

The association procedure used to combine the slide, flow and fall susceptibility maps gives higher possibilities of presence for the high and moderate susceptibility classes. Almost 44% and 31% of the territory are respectively classified with a high and moderate susceptibility, whereas only 19% and 6% are classified with a low and null susceptibility. This association has been used in order to consider the precautionary principle implemented in the French regulatory law for natural hazard and risk assessment and for the creation of the Risk Prevention Plans -PPR (MATE/METL, 1999).

The highest susceptibility areas identified with the SMCE technique (Figure 6) are in accordance with the main landslide-prone areas identified by the pan-European susceptibility map (Figure 3). According to the recommendations for a harmonised approach for landslide susceptibility assessment at the European scale (Hervás et al., 2007), a basic distinction between susceptible and non susceptible areas has been performed to identify the areas which could be further analysed through a detailed Tier 2 approach. In this study, only the highest susceptibility areas have been chosen because they provide a reliable overview of the main areas known to be prone to landslides. The agreement between modelled susceptibility and landslides reported in the BDMvT is illustrated in Figure 8, where the compound landslide susceptibility map is compared with a map showing municipalities affected by at least one landslide whatever its type.

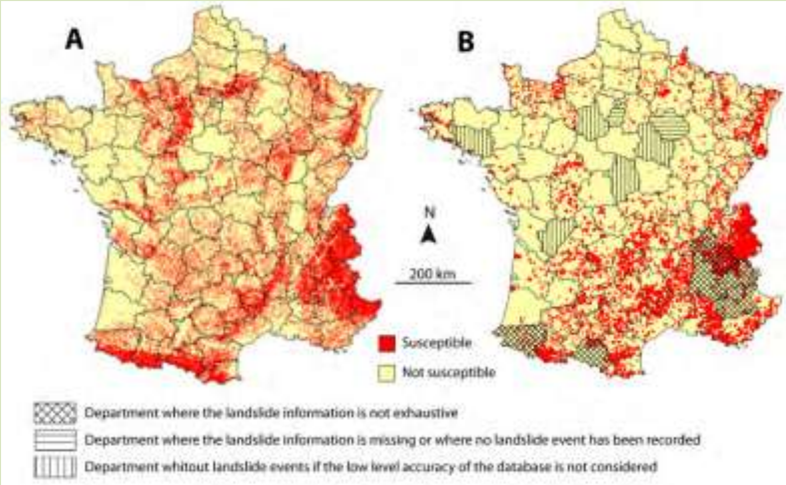


Figure 2.2.9. Evaluation of the differentiated Tier 1 susceptibility assessment in France: (A) Compound landslide susceptibility map classified in susceptible and non susceptible areas. (B) Representation of municipalities (red dots) affected by at least one landslide event.

Figure 2.9 indicates that many municipalities affected by landslide events in the past are well predicted by the susceptibility model. However, for several departments, the susceptibility model highlights more possibility of landslides than the recorded events. This may be explained by:

i. The low accuracy of the BDMvT database in some departments (highlighted with dashed lines in Figure 8B), especially in terms of exact landslide location and correct definition of landslide type. This is particularly true for some departments located in the mountain areas which are known to be landslide prone but where detailed information is missing;
ii. The criteria used in the association rule for the combination of the individual slide, flow and fall susceptibility maps in the compound landslide susceptibility map, which prioritize the highest susceptibility class observed for each grid cell;
iii. The generalization of the input data in generic classes which does not allow predicting correctly local environmental conditions.

A more detailed validation, including quantitative comparisons with other published local and regional susceptibility maps is provided in Malet et al. (subm.).

This study highlights some improvements which should be included in the Tier 1 approach for a pan‑European landslide susceptibility assessment. The territory sub-division in physiographic sub-units, the reclassification of the conditioning factors in more than five classes and the preparation of separate susceptibility maps for slides, flows and falls should improve the pan-European model performance since it takes into account different local susceptibility conditions for each landslide type.

Work package 3 (prepared by ISPU, CERG):
Description:
Analysis of the Landslide Risk Assessment Models used for mapping in the CoE members states
Associated deliverables:
D.3.4 Analysis of the questionnaire's response (ISPU) M+14
D.3.5 Synthetic report on the advantages and limitations of each LAMs per country (ISPU & CERG) - M+9
D.3.6.Publication of the results on-line at the ISPU website - M+24

The CERG (European Centre on Geomorphological and Seismological Hazards; Strasbourg, France), the GHHD (European Centre on Geodynamical Hazards of High Dam; Tbilissi, Georgia) and the ISPU (Institut Supérieur de Planification d''Urgence, Bruxelles, Belgique), with the support of the JRC (Joint Research Centre of the European Commission; Ispra, Italy) and the BGR (Federal Institute for Geosciences and Natural Resources; Hannover, Germany) are conducting a survey on the availability and characteristics of Risk Assessment Methodologies (RAMs) developed for landslide management from an operational point of view for the different Member States of Council of Europe.

The objective of this survey (lauched in November 2013) is to evaluate the current situation of the available landslides RAMs per country in terms of input data, model, scale and final product. The survey is not reproduced in this report. It is available at: http://www.ispu.eu/ls/.
The results will be analysed in 2014.

Figure 3.3.1. Access to the Landslide RAMs questionnaire on ISPU website. (http://www.ispu.eu/ls/)

SEISMIC PROTECTION OF MONUMENTS

TARGET COUNTRIES : GREECE, ITALY, ARMENIA

PARTNERS INVOLVED :

COORDINATING CENTRE : ECPFE Athens, Greece

OTHER CENTRES: CUEBC Ravello, Italy , ECRM Yerevan, Armenia

OTHER PARTNERS : EUROPEAN COUNCIL OF CIVIL ENGINEERS

EXECUTIVE SUMMARY

The preparation of a regulatory document for the design of structural interventions in monuments in earthquake prone areas was produced based on based on relevant documents already developed in Greece (by EPPO and ECPFE in collaboration with the Ministry of Culture) and in Italy (by the Ministry of Cultural Heritage and Activities). The final document, available at http://ecpfe.oasp.gr/sites/default/files/files/pantazopoulou.pdf, reviews the available tools for assessment as well as their respective limitations, points that were discussed with the other partner centres in a final workshop in December 2013.

For that occasion, Armenian experts elaborated the "Preliminary scale of seismic Intensity based on analyses of damages of the Armenian churches" as a first attempt of drawing up a special macro-seismic scale for an estimation of intensity of strong earthquakes in the territory of Armenian was made for the time. Italian experts also produced a study on "The force of vernacular: Seismic-proof technologies, typologies and artisan know how in the historical built-up environment in the Amalfi Coast, Italy", showing that in historical built up area of Amalfi, numerous elements have played the dual function of stabilizing from both earthquakes and floods, leading to a careful selection of each single element on the territory in relation to the altitude of construction and soil characteristics.

OBJECTIVES OF THE PROJECT

Global objective for 2012-2013 :

The main objective of the proposal will be the preparation of a "Regulatory document for the design of structural interventions in monuments in earthquake prone areas". The proposed action is aiming at: a) a better understanding of the main issues in selecting the level of seismic actions used in the design of structural interventions of monuments, and b) demonstrating the necessity and elaborating the contents of a Regulatory Document on aseismic design of structural interventions in monuments. The preparation of this document will be based on relevant documents already developed in Greece (by EPPO and ECPFE in collaboration with the Ministry of Culture) and in Italy (by the Ministry of Cultural Heritage and Activities).To this end an international working committee composed by experts from selected European Centers specialized in the above topic will be established with the aim to prepare the relevant document. The present action is proposed in the framework of the issues of special concern "Cultural Heritage and Risk" of the Committee of Permanent Correspondents for 2012-2013 biennium.

Specific yearly objectives :

2012:

A first Draft of the document in English language will be prepared

2013:

Finalization of the draft, including case studies (one case study per partner), to better illustrate its application. Dissemination of the goals achieved.

EXPECTED RESULTS

2012:

A workshop of the Committee members will be held in one of the three capitals of the members (Athens, Ravello, Yerevan) to initiate the preparation of the document.

2013:

A Seminar will be held at the end of 2013 including Case Studies concerning the applicability of the Document in one of the three capitals of the members (Athens, Ravello, Yerevan) to disseminate the goals achieved.

RESULTS OBTAINED PREVIOUSLY (if any)

The preparation of this document will be based on relevant documents already developed in Greece, in the framework of 2011 ECPFE' s Activities (by EPPO and ECPFE in collaboration with the Ministry of Culture) and in Italy (by the Ministry of Cultural Heritage and Activities). Results obtained by ECPFE and EPPO:

1.A two-day international meeting was organized in Athens by EPPO and ECPFE in 2006 and in 2009, concerning the Seismic protection of Monuments.

2. Two Seminars on the same topic were also organized by EPPO and ECPFE in Athens and in Thessaloniki in 2010 and in 2011 respectively.
3. A first document was elaborated on the proposed topic by EPPO - ECPFE in collaboration with the Hellenic Ministry of Culture and Tourism. This document constitutes a basis for further development by the Committee proposed to be established with the participation of experts from the CUEBC, ECRM and EUROPEAN COUNCIL OF CIVIL ENGINEERS.

RESULTS OBTAINED IN 2012

Work package 1 (prepared by ECPFE Athens, Greece, ECRM Yerevan, Armenia, CUEBC Ravello, Italy)
Description:
The formation of a scientific committee deployed by distinguished scientists nominated by the European Centers (ECPFE, CUEBC, ECRM) and other Competent Authorities with main goal the syntax of a first draft of a Regulatory document for the design of structural interventions in monuments in Earthquake prone areas.
The document will include the following :
Definition of the main issues affecting the selection of seismic actions: contradicting Principles (monumental and social values as well as performance requirements), need for classification of monuments in various categories and definition of the importance level of each category, definition of visibility levels and acceptable damage levels. Elaboration of specific proposals for the selection of the value of seismic actions, which will be based on an optimization process taking into account also its eventual consequences on monumental values, as well as on human lives, costs and technical performances. Brief elaboration of the contents of the Regulatory Document on aseismic design of structural interventions on monuments.
The members of the Scientific Committee will communicate via internet facilities
At the end of 2012 , a Workshop will be held in Athens, Ravello or Yerevan so as to present the relevant work
Associated deliverables:
A draft of the document in English

ECPFE
A biministerial (Ministry of Culture deployed by EPPO& the Ministry of Culture) Scientific Committee was nominated to implement the Activity and it was composed by:
- ECPFE Athens, Greece: K.Stylianidis, S.Dritsos, N.Papadopoulos, L.Pelli, Th.Tassios, E.Vintzilaiou, F.Karadoni, A.Miltiadou
- CUEBEC Ravello, Italy: F.Ferrigni
- ECRM Yerevan, Armenia: S.Badaylan
- European Council of Civil Engineers: T. Tankut

A draft of the document in English is already available

CUEBC
The research was based on the recovery of data which emphasize the level of studies on local seismic cultures, and in particular the new methodological approach for this type of study. We did a thematic bibliographical review, through which most significant elements for the advancement of studies on the subject were collected. Theoretical knowledge were crossed with case studies conducted over the years with this new methodology.
In order to assess the need to implement protocols for identifying elements of the Local Seismic Culture and to disseminate knowledge in areas with minor seismic intensity, but with similar elements relating to old buildings, the study of the urban structure of Atrani (Amalfi Coast) was done. Data relating to the historical centre was collected. We started from the bottom of the valley to move first on the east side and then to the West side, trying to make, where possible, horizontally following the curves of altitude. From each copy was recovered photographic documentation and the cartographical positioning was performed.
The findings highlight the need to apply in priority to seismic zones the protocols already prepared following the "Ravello" approach and accompanying this activity with training for technicians.

RESULTS OBTAINED IN 2013

Working package 1 (prepared by ECPFE, CUEBC, ECRM):
Description:
Elaboration of Case studies so as to check the applicability of the Document. Finalization of the Document
The members of the Scientific Committee will communicate via internet facilities.
At the end of 2013, a Seminar will be held in Athens, Ravello or Yerevan so as to present the relevant work.
Associated deliverables:
The final Document

Its main task was the compilation and the legalization of an Official Regulatory Document concerning the Structural

Interventions as well as the Protection of our Cultural Heritage , based on this Document
The Syntax of a common Regulatory Document for the design of Structural Intervention in Monuments in Earthquake Prone Areas, based on previous work elaborated by EPPO & ECPFE, was developed and the dissemination of the Goals should be achieved through:

- Production of Printed Material
- Organization of a Seminar at the end of 2013
- Publishing the Outcome in ECPFE's website

Elaboration of the Report " STATE OF THE ART REPORT FOR THE ANALYSIS METHODS FOR UNREINFORCED MASONRY HERITAGE STRUCTURES AND MONUMENTS" by S. J. Pantazopoulou, PhD Professor of Structural Engineering

Summary
The proliferation of new materials and structural systems in urban construction highlight by contrast the heritage buildings of the past, conveying the signature of evolution of human achievement in architecture and engineering. These older structures comprise mostly unreinforced load-bearing masonry construction (URM), dating anywhere from antiquity to the 19th and early 20th Century. Ageing and being exposed to the elements, heritage buildings may be in various states of disrepair or degradation of the constituent materials. Disintegration of the essential components that secured in the original system continuity, resilience and robustness places the future of this cultural treasure at risk: response to a potential earthquake at some unknown moment in the years to come is unpredictable and the ensuing consequences in terms of cultural loss that a structural failure would entail are articulated without words in the picture of the failed L'Aquila dome

Failure of monument after the 2009 L'Aquila Earthquake (S. Maria di Paganica)

Of course not all heritage structures are of equal significance. There is a great range of structures listed as monuments of cultural heritage not only in terms of their comparative value as historical samples of human achievement but also in terms of their structural complexity and size, the risk to human life effected by a potential collapse and their role in defining the ambiance and character of the urban space where they may belong. Thus, in complete analogy of the urgency of the condition, the risk and the overall significance of the structure, its seismic assessment may involve a range of analysis procedures that may vary in terms of complexity of implementation and modeling, computational demand and degree of simplification of the actual circumstance. In all cases the objective includes estimation of demands within an acceptable level of confidence and quantification of the resistances and mechanisms of behavior of the structure in question, so as to establish the anticipated performance in the event of a seismic hazard scenario but also in order to guide rehabilitation and strengthening strategies.
State of the art report with the objective to illustrate the available tools at the disposal of the assessor, also highlighting the limitations and difficulties of the underlying modeling approaches. It is always tempting to extend from the well documented field of seismic assessment of reinforced concrete where volumes on performance based methods based on nonlinear models and analyses have been authored. But a note of caution is in order: extending current nonlinear analysis practices for seismic assessment of heritage buildings is neither straightforward, nor wise in most cases: in contrast with conventional frame structures, they are characterized by distributed stiffness and mass and poor diaphragm action. Interventions are often restricted by international treaties for non-invasiveness and reversibility of the intervention - given the practical requirements for the buildings' intended reuse.
Poor understanding of the mechanics of masonry and the inherent brittleness of the material further compound the uncertainties in analytical methods used today for seismic assessment and rehabilitation.

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The full report is downloadable at the ECPFE website: http://ecpfe.oasp.gr/sites/default/files/files/pantazopoulou.pdf

Workshop & Seminar : "Seismic Protection of Monuments", 2 December 2013

The European Center of Prevention and Forecasting of Earthquakes (ECPFE) and the Earthquake Planning and Protection Organization (EPPO) of Greece with the contribution of the European Center of Ravello (CUEBC) , the European Center of Armenia (ECRM) and the European Council of Civil Engineers (ECCE), took the initiative to organize a Workshop on "Seismic Protection of Monuments in the framework of the ECPFE's Activities 2012-2013".
The Workshop-Seminar was carried out in Athens, 2 December 2013. A field trip to Dafni Monastery took place on 3 December 2013. Distinguished Greek and foreign Scientists participated in the Workshop.
The thematic topics of the Workshop-Seminar were:

1. Classification of importance of Monuments and acceptable damage levels
2. Basic data influencing the design (architectural, historical and Structural documentation, Monitoring of seismic behaviour, etc.)
3. Methods of Analysis for Assessment of bearing capacity and the design of Structural Interventions,
4. Estimation of Resistances of critical regions before and after Interventions,
5. Selection of Design Seismic Actions for the redesign,
6. Criteria for the selection of the most appropriate scheme of Structural Interventions: Monumentic values/optimum interventions
7. Case studies
8. Existing National Regulatory documents for the aseismic design of structural interventions in Monuments.

The abstracts, programme and proceedings of the Workshop are available on the ECPFE website page: http://ecpfe.oasp.gr/en/node/109

ECRM
The preparation of the above Regulatory document was supposed to be based on the relevant documents, already created in Greece and Italy. The Armenian experts in 2013 elaborated the "Preliminary scale of seismic Intensity based on analyses of damages of the Armenian churches". An attempt of drawing up a special macro-seismic scale for an estimation of intensity of strong earthquakes in the territory of Armenian was made for the first time.

The new micro-seismic scale for an estimation of intensity of strong earthquakes can serve one of the bases for legislative regulation of the structural interventions to and seismic protection of monuments. The method of drawing up a special macro-seismic scale can be successfully impended by any concerned states including Greece and Italy.
By taking into account the direct link of the above work to the joint Project: "Seismic Protection of Monuments" and considering this work as a contribution made by Armenian experts into joint Project, about which has been said above, together with interest it may arise in Greece and Italy, as well as importance of the "Regulatory Document", the brief description of the basic elements of the above work: "Preliminary scale of seismic Intensity based on analyses of damages of the Armenian churches" was presented during the Seminar: "Seismic protection of monuments" (Athens, 2-3 December, 2013).
After receiving the English version of the "Draft FRAMEWORK REGULATORY DOCUMENT for structural interventions to and seismic protection of MONUMENTS" from the Project Coordinating Centre: ECPFE, Athens (in October, 2013), it was translated from English into Armenian by professional translators, due to its diverse consents and some specific terminology it contain, and presented to the relevant experts for analyses of the Document, comparing it with the Provisions of the Armenian Legislation in the above field (being analyzed by ECRM in 2012 within the Project) and development of relevant suggestions, aimed to it updating and preparing the Armenian version of "Regulatory Document". If necessary the Armenian version of Draft "Regulatory Document" may be sent to the Secretariat.
After receiving from the Project Coordinating Centre: ECPFE, Athens the final version of the "Draft FRAMEWORK REGULATORY DOCUMENT for structural interventions to and seismic protection of MONUMENTS", worked out by given the results of the above Seminar (Athens, 2-3 December, 2013), in the Republic of Armenia will start developing on its basis the Armenian version of the "Regulatory Document", by taking into account the specifics of the institutional and legislative systems of the Republic of Armenia.

CUEBC

A research on "The force of vernacular: Seismic-proof technologies, typologies and artisan know how in the historical built-up environment in the Amalfi Coast, Italy" was produced by the CUEBC as contribution to that project and presented at the December workshop.
The analysis of the historical built up area of Amalfi shows that numerous elements have played the dual function of stabilizing from both earth tremors and floods. This dual role has led to a careful selection of each single element on the territory in relation to the altitude of construction and soil characteristics.
Among the most commonly antiseismic elements there are:

- buttresses
- contrast arches between two buildings;
- vaults between two buildings, which are not contemporary to one or another building, built on the public
- street to get additional rooms on the upper floors;
- external stairs and balconies irregularly made (so that they narrow streets only at certain points);
- tie rods and chains, mostly metallic, sometimes wooden.

These structures are not evenly present throughout the territory, but have a higher frequency in the centres of lower altimeter elevation, i.e. those built in the valleys created by the streams. This different distribution does suggest a different intensity of the damage, and a consequent typical amplification in alluvial soils5.
The purpose of the research is to determine which structural features have given a better seismic support and ground stability over the centuries to the elements mentioned above. From the analysis of the single buildings, we noted that the "empirical" knowledge of the seismic shocks dynamics was on the basis of the two elements that contribute to the effectiveness of these structures: the craft technique and the materials used.
Considering the information and the evidence collected, the Amalfi Coast vernacular architecture items are not only the stone walls (dry-stone or with binder), thicker than required in order to withstand vertical loads (thickness also made necessary by the arrangement of stones chaining), but also the pushing structures. The mechanical characteristics of these structures, resulting from the careful choice of the materials and the intelligent assembly techniques, make them very deformable. They are particularly effective, therefore, to "metabolize" the seismic energy. A feature that is well known to the local artisans.
The artisan knowledge on the Amalfi Coast is therefore a real heritage that can contribute to draft a user manual not only to integrate the operational guidelines on the monuments, which have much in common with the features of the coastal historic buildings, but also to the re-appropriation of a proper relationship with the land and the reduction of seismic risk in each municipality.

ASSESSMENT OF INTERVENTIONS IN EARTHQUAKE PRONE AREAS

TARGET COUNTRIES: Greece, Bulgaria, Romania

PARTNERS INVOLVED:

COORDINATING CENTRE : ECPFE Greece

OTHER CENTRES: ECRP Sofia, Bulgaria , ECBR Bucharest, Romania

OTHER PARTNERS : EUROPEAN COUNCIL OF CIVIL ENGINEERS

EXECUTIVE SUMMARY

Based on an important preparatory work by the relevant Scientific Committee, a common document for the Assessment and Interventions on Reinforced Concrete and Masonry Buildings, According to Eurocode 8-Part 3 has been finalized. A Workshop on « Implementation of the EC8-p3- Assessment and Interventions on buildings in Earthquake prone areas» was carried out in Athens, on 12th April 2013, with the contribution of ECRP Sofia, Bulgaria and ECBR Bucharest, Romania. In the Workshop participated distinguished Greek and foreign Scientists to exchange experience and opinions, to present Case Studies as well as proposals for further amelioration of the Code.

OBJECTIVES OF THE PROJECT

Global objective for 2012-2013 :

The main objective of the proposal, belonging to the line of action: "Reduction of the Vulnerability ", will be the preparation of a document concerning Assessment and Interventions on Reinforced Concrete and Masonry Buildings. The document will take into account the Part 3 of the Eurocode 8, elaborating specific objects and facilitating its implementation. It will be complementary to EC8 Part3 and non-contradictory. Specific Case Studies will be included in the document in order to facilitate its application .To this end an international working committee composed by experts from selected European Centers specialized in the above topics will be established with the aim to prepare the relevant document. The Committee will work using mainly internet facilities, as only one or two meetings/workshops of the Committee per year may be envisaged. At the end of the second year a seminar will be held in order to disseminate the goals achieved.

Specific yearly objectives :

2012:

Collecting and sharing information on experience in Greece, Bulgaria and Romania and identification of issues that may cause differences in large scale practical application of EC 8 part 3 in each partner country.

2013:

Identification of needed changes in EC 8 part 3 and national regulations and proposing anticipated preparative in order to fulfill needs of coverage in conjunction with needs of safety and vulnerability data, coping with the European requirements.

EXPECTED RESULTS

2012 :

State of the art of experience concerning the post-earthquake assessments and interventions in partner countries-

2013:

The specific of buildings stock and needs of vulnerability reduction in each partner country- the degree of detailing needed in interventions and/or strengthening design, in different stages of work

RESULTS OBTAINED PREVIOUSLY (if any)

Romania has adopted in the last years several national laws requesting and supporting the identification and the strengthening of buildings vulnerable to earthquakes (Law OG No. 20/1994, revised) as well as the upgrading of thermal comfort of buildings. The existing building stock in Romania and in many countries of Europe has various age, comfort and structural safety and reliability. The change of occupancy of buildings during the building lifespan, the cumulative structural damage produced by natural hazards and the upgrading of knowledge, standards and materials used for design of buildings and their technical equipment make the rehabilitation of buildings a major challenge for contemporary society in Europe. Since 2007 it was enforced the new Code P100-1 for seismic design. A new Romanian Methodology MEE 003-2007 for post-earthquake emergency investigation of safety of buildings and framework solutions of intervention, was enforced in 2007 by the Ministry of Regional Development and Tourism; the draft was coordinated by INCERC in collaboration with UTCB, IPCT and NCSRR. The enforcement of EC 8 part 3, as National Annex SR EN 1998-3: 2005 /NA 2009 raised some issues of correlation with the National Code P100-1 and with the new Romanian code P 100-3/2008 for seismic assessment of existing buildings. Thus, there is a need of a concerted approach, at least among S-E European countries.

RESULTS OBTAINED IN 2012

Work package 1 (prepared by ECPFE, ECRP, ECBR):
Description:
The formation of a scientific committee deployed by distinguished scientists nominated by the European Centers (ECPFE, ECRP, ECBR) and other Competent Authorities with main goal the syntax of a first draft of a document concerning Assessment and Interventions on Reinforced Concrete and Masonry Buildings for the design of structural interventions in Earthquake prone areas. The document will be complementary to EC8-part 3.
The members of the Scientific Committee will communicate via internet facilities.
At the end of 2012, a Workshop will be held in Athens, Sofia or Bucharest so as to present the relevant common work.
Associated deliverables:
ECPFE : A draft of the document in English.
ECBR: presenting the Romanian experience on post-earthquake investigations to derive observed vulnerability data, as they were carried out after March 4, 1977 earthquake; outline of the new Romanian Methodology MEE 003-2007 for post-earthquake emergency investigation of safety of buildings and framework solutions of intervention, enforced in 2007 and correlations with EC 8 part 3 needs of data.
ECRP:

ECPFE
A workshop on «Assessment of interventions in Earthquake Prone Areas» was scheduled for the end of 2012 in Athens, in order to disseminate the above work among distinguished Scientists from other European Centers, who will also deliver relevant presentations. The workshop has to be postponed to the beginning of 2013 (probably in March), due to the following reasons:

a) Better organization among the partners of the Section «Reduction of the vulnerability» and invitation of experts from Europe, taking into account that the end of the year is always a rather «heavy» period for most academicians;

b) Wider participation (of speakers as well as of engineers), since by mid December a Workshop on «Seismic Protection of Monuments» was already scheduled.

The working Group (nominated by E.C.P.F.E. in collaboration with EPPO) who produced in 2011 the five first chapters of a non-contradictory complementary document (in Greek and in English) to elaborate specific objects and facilitate the implantation of EC8-Part 3, has produced in 2012 the draft of chapters 6 to 11 of that document "Code of Interventions (KAN. EPE), final harmonized Text" in English, namely:
Chapter 6: BASIC BEHAVIOUR MODELS
Chapter 7: ASSESSMENT OF BEHAVIOUR OF STRUCTURAL ELEMENTS
Chapter 8: DESIGN OF INTERVENTIONS
Chapter 9: SAFETY VERIFICATIONS
Chapter 10: REQUIRED CONTENTS OF THE DESIGN
Chapter 11: CONSTRUCTION – QUALITY ASSURANCE - MAINTENANCE

ECRP
The main objective of the planned activities will be the preparation of a "Regulatory document for the design of structural monuments in earthquake prone areas". The preparation of the above Regulatory document was supposed to be based on the relevant documents, already created in Greece and Italy. In particular, a first document (elaborated on the proposed topic by EPPO-ECPFE in collaboration with the Hellenic Ministry of Culture and Tourism) constitutes a basis of further development of the Scientific Committee proposed to be established with the participation of experts from the Project Coordinating Centre and Partner Centres. As proposed by the Coordinating Centre, ECRM has submitted candidatures from Armenia to the Project International Scientific Committee and began to assemble a working group from relevant specialists. Awaiting an English version of the above draft "Regulatory document", ECRM in 2012 within the Project has carried out researches addressing two directions.
In the first direction, an array of analyses were conducted of the existing legislative and regulatory documents of the Republic of Armenia dealing with seismicity and seismic resistance of constructions in general, as well as the availability in the above mentioned documents of the elements, concerning structural interventions in monuments in earthquake prone areas, in particular.
In the second direction, some comparative analyses were conducted of comparing the legislation of the Republic of Armenia with that of the European Union in the field of Civil Protection and Disaster Risk Reduction , in general, from a point of view of clarifying the coincidences and discrepancies existed in approaches to their formation; specifying some fundamental structural and contents related discrepancies in legislation and proposing the ways towards harmonization of the legislation of Armenia and that of the European Union in the above field.
Our work would have become more effective had we got an extended summary in English of the "Draft framework Regulatory Document for structural intervention to and seismic protection of monuments", which is called to serve a basis for our common work, or would have allowed to make at least a first step towards it, in case we have received a short "Annotation" in English of the mentioned document. At receiving of the above documents, we will immediately start translating them from English into Armenian and to continue target work with the involvement of the experts from Armenia on analyses of the documents, comparing them with the Provisions of the Armenian Legislation in the

above field being analyzed by ECRM in 2012 within the Project, and development of relevant suggestions.

ECBR
...

RESULTS OBTAINED IN 2013

Working package 1 (prepared by ECPFE, ECRP, ECBR)
Description:
Elaboration of Case Studies so as to check the applicability of the document
Finalization of the Document.
At the end of 2013, a Seminar will be held in Athens, Sofia or Bucharest so as to present the goals achieved.
Associated deliverables:
ECBR: comparisons between the requirements of Romanian code P 100-3/2008 for seismic assessment of existing buildings and EC 8-part 3, vs. EC 8 requirements for newly designed buildings. case studies in using analytical assessments and calibrating them with field inspections and measurements of dynamic characteristics of buildings made of concrete and masonry and according with different codes, as to derive vulnerability patterns
ECRP:

The Committee for the implementation of the Activity was composed by:
- ECPFE Athens, Greece: K.Stylianidis, N.Papadopoulos, L.Pelli, Th.Tassios, S.Dritsos, A.Kappos, M.Fardis, M.Chronopoulos
- ECRP Sofia, Bulgaria: K.Kolev , V.Petkov
- ECBR Bucharest, Romania: S.Georgescu, I.Craifaleanu

CODE OF STRUCTURAL INTERVENTIONS 2012: FINAL HARMONIZED TEXT WITH EC8-Part 3

A common Document for the Assessment and Interventions on Reinforced Concrete and Masonry Buildings, According to Eurocode 8-Part 3 has been finalized by the Relevant Scientific Committee (Th.Tassios, S.Dritsos,A.Kappos,M.Fardis, M.Chronopoulos)

Preamble
The significant need for a normative text for the Design of structural interventions had been long recognized: in a relatively new sector of science and technology, the methods of design are not yet settled – therefore the Designer undertakes a disproportionately big responsibility when adopting a specific design logic or a specific calculation method or, even, a specific technique of repair and strengthening. But also the economy and safety of structures is not always catered for properly. Therefore, we have the well-founded hope that the present 5th (and final) text of the Code of Interventions on existing buildings will be particularly useful for Engineers and for society in general.
On the other hand, the very same reasons that necessitate the introduction of such a Code, also make its compilation more difficult; precisely because of the recent growth of the particular scientific and technical sector, the relevant research has not, on all occasions, been completed, or (more often) adequate international consensus has not yet been reached on the relevant problems. Therefore, the choice of methods and the harmonization of the approach to matters that were followed in this Code are subject to criticism. Besides, it is not a coincidence that among National Codes, no relevant texts are readily available in international literature on such matters. The introduction of the first edition of EC8 in 1994 paved the way, going even further with the final text of EC8 in 2004 and 2005. But even the relevant part of EC8 does not offer the thoroughness that daily practical applications require. FEMA's far more well-wrought normative texts (USA) cover mainly general principles and analysis only. In the framework of this reality, the present Text of the Greek Code of Interventions that is introduced attempts to cover an even wider spectrum of needs of engineering practice.
The 1st Draft of this Code had been submitted for peer review to a 23-member Committee of Consultants, consisting of the following distinguished Greek Engineers (March 2004). Additionally to oral comments, the Authoring Committee also received comments in writing from Consultants. All comments and remarks were taken into consideration, and were answered in writing to each Consultant.
The 2nd Draft of the Code was drawn up taking into consideration the aforementioned comments and remarks, as well as developments in international literature and research financed by OASP in the meantime. This 2nd Draft was checked once more (June 2006 to July 2007) by 9 esteemed Structural Design Offices. These Offices volunteered to carry out their studies aiming to investigate the general applicability of the Draft of the Code. The studies involved specific examples of buildings prepared by the Authoring Committee.
The 3rd final Draft of the Code was drawn up taking into consideration the conclusions and comments that resulted from the aforementioned studies, and after problems were solved and corresponding answers were given. This Draft, before its final configuration as a National Standard, was put to public consultation until the end of 2009.
The final (4th) version of the National Standard (September 2010) was drawn up taking into consideration the conclusions that resulted from the public consultation as well as the most recent remarks and observations of the Members of the Authoring Committee.

The present harmonised final Text (5th) resulted after the necessary interventions so that the 4th text is compliant with the Eurocodes system .

A final observation concerns the search of an optimal synthesis between the adversative requirements which we usually have from a Code; it needs to be complete, scientifically collegiate, safe, economic, and legally consistent – but is also needs to be as simple as possible and promptly applicable. In the past few years, significant progress has been made in our Country towards this direction – as opposed to the previous generation of Codes.

More specifically, for the subject of the present Code there are at least two reasons which lead to an (inevitable) additional "complexity":

1. Here, we do not deal with a new structure to which, through our Design, we lend the desirable attributes (as dictated by modern science and engineering practice), but rather with an existing structure, the various behaviors of which should first be comprehended, and subsequently modified. That is to say, double the difficulty.
2. In the field of interventions, apart from the behaviour of additional materials and elements that will be used, we also must study the intended behaviour of interfaces between existing and new materials or elements. Again, double work.

If indeed it is taken into account that the relevant scientific knowledge has not yet been completely incorporated in the curriculum of our academic Faculties, the Code of structural interventions also undertakes an additional role of a more analytical presentation of the subject. The sum of all the above hindrances could easily create the impression of "unnecessary" complexity. However, the nature of the subject does not allow further simplification of the Code, without the danger of it degrading to a recipe-like approach. The Authoring Committee has drawn up relevant justification notes and literature references for the major Chapters of the Code.

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The full document is available at http://ecpfe.oasp.gr/sites/default/files/files/ΚΑΝΕΠΕ_EN2013_FINAL.pdf

Workshop : « Implementation of the EC8-p3- Assessment And Interventions on buildings in Earthquake prone areas»
The Workshop was carried out in Athens , on 12th April 2013, with the contribution of ECRP Sofia, Bulgaria and ECBR Bucharest, Romania. In the Workshop participated distinguished Greek and foreign Scientists.
The main aim of the Workshop was to exchange experience and opinions, to present Case Studies as well as proposals for further amelioration of the Code.
The programme, abstracts and proceedings of the Workshop are available at: http://ecpfe.oasp.gr/en/node/107

1. The harmonized Intervention Code according to EC8-Part 3
4. Elaboration of intervention code-part1 (http://ecpfe.oasp.gr/sites/default/files/files/ΚΑΝΕΠΕ_EN2013_FINAL.pdf)
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ECRP

Of all Structural Eurocodes in Bulgarian civil practice is an ongoing process – since the beginning of 2012th to the end of 2013th, both local civil engineering codes and Eurocodes are applicable in design practice. In fact, it is hard to call it joint application because the two systems of codes are completely different and a designer either uses the Bulgarian codes or the Eurocodes. When the objective is assessment and retrofitting of existing buildings, though, there is no choice, because Eurocode 8 Part 3 Assessment and retrofitting of buildings (BDS EN1998-3:2005) is in fact the first specific civil design code of such kind in Bulgaria.
At the same time, there is an ongoing program, which main purpose is renovation and rehabilitation of the existing residential buildings in the country. Prior to the renovation, an assessment should be carried out by licensed professionals including structural designers. And on the bases of the report, retrofit activities should be prescribed. As for the financial support of such activities, there is a specific renovation program, co-financed by the European Union, but its main purpose is energy efficiency and the buildings should be structurally safe in order to be approved for renovation activities. Recently, the government has stated its intentions to change the financed activities by including strengthening of buildings' structures. Also, until now, the state programs were concentrated mainly on specific type of buildings, made by prefabricated reinforced concrete elements (Large Panel System buildings). That's mostly due to the fact, that roughly 50% of all apartments in Bulgarian cities are situated in such buildings. Furthermore, many of these buildings are built at the late 60s and early 70s, and their service life expectancy is around 50-60 years, which means that in the near future many such structures should be rehabilitated if the government doesn't want hundreds of thousands of people to be left homeless.
Even though Large Panel System buildings' retrofitting is important, there are other typical structures in Bulgarian civil practice. Such examples are buildings, where masonry is used as primary structural material, buildings with unfilled frames (masonry infill as primary structural material together with concrete or steel beams and frames, surrounding the masonry - braced masonry walls), and buildings with masonry-infill's as secondary (non-structural) material (usually the primary structure is made of reinforced concrete shear walls, RC frames or combination of shear walls and RC frames). Such buildings are more or less the other 50% of all buildings in Bulgarian cities and almost all

houses in small towns and villages. Problems, concerning their proper structural assessment are well known and some of the facts are mentioned below.
The following activities have been performed in 2013 by the European Centre for Risk Prevention (ECRP), Sofia within the implementation of the project “Assessment of interventions in earthquake prone areas”:

- Managing in Bulgaria the discussions related to the implementation of EC 8 – Part 3 with the participation of specialists and students from the Universities and interested instructions;
- Presentation of the results of the discussion and the present situation of the problems in Bulgaria during the seminar held in Athens (Greece) on 2013;
- Proposals for changes and additions to EC 8 – Part 3 concerning Bulgaria together with other organizations which resulted prolongation of the term of its implementation with minimum one year;
- Planning of future activities in the same field aiming to continue the discussion of this matter and implementation of this specific condition for Bulgaria and the Balkan region.

UNDERSTANDING AND QUANTIFICATION OF NATURAL HAZARDS

TARGET COUNTRIES: All interested member countries, Japan, Democratic Republic of the Congo and Rwanda

PARTNERS INVOLVED:

COORDINATING CENTRE: ECGS Walferdange, Luxemburg

OTHER CENTRES:

OTHER PARTNERS : GFZ German Research Centre for Geosciences in Potsdam, Germany, Royal Museum for Central Africa (Tervuren, Belgium), Musée national d'histoire naturelle Mnhn (Luxembourg)

EXECUTIVE SUMMARY

The research programme Understanding and quantification of natural hazards led at the European Center for Geodynamics and Seismology (ECGS) during the period 2012-2013 aimed at improving our scientific knowledge on a range of fundamental research problems in natural hazard assessment, in accordance with ECGS's fields of expertise. The project was therefore structured into three work packages.

The first of these dealt with the question how much of the variability observed in earthquake ground motions on regional scale can be associated with variability of the source characteristics of the earthquakes. This is a question of extraordinary importance for seismic hazard assessment, since systematic regional variations of source radiation could be potentially taken into account in the derivation of ground motion prediction equations and thus allow for a reduction of their variability. As a study region for this work package, we selected Japan, since the wealth of high-quality ground motion observations freely available there is unrivalled throughout the World. The results of these efforts were presented at several conferences and also recently published in high-impact, peer-reviewedscientific literature (Oth, 2013).

In the second work package, we worked towards the installation of a seismic network providing observations throughout the entire Luxembourgish territory, since up untilrecently, the only available seismic station in Luxembourg was the one installed in the Walferdange Underground Laboratory for Geodynamics. In order to be able to gain insights into potential small-scale seismic activity and to respond to public enquiries, it is essential to close this observational gap.

Finally, the third work package aimed at the processing of seismological field data that were collected during a field mission to the summit of Nyiragongo volcano, located in the bordering region of the Democratic Republic of the Congo (DRC) and Rwanda. This highly active volcano threatens the nearby city of Goma, which counts more than 1 million inhabitants. During a field mission in September 2011, scientists of the National Museum for Natural History (Mnhn, Luxembourg), the Royal Museum for Central Africa (Mrac, Belgium) and ECGS collected a unique multi-parameter dataset at the volcano's summit in an endeavour to better understand the dynamics of its permanent lava lake. In particular, seismic data were collected using three broadband seismometers, and this dataset was analysed in the framework of this research programme. Preliminary results were presented in a poster at the AVCOR-2013 meeting ("Active Volcanism and Continental Rifting") that was held in Rwanda on November 12-15th 2013 (De Gelder et al., 2013).

OBJECTIVES OF THE PROJECT

Global objective for 2012-2013:

During the past few years, ECGS has contributed to the aims of the EUR-OPA Major Hazards agreement as outlined in the guidelines for the programme of activities 2012-2013 [AP/CAT 2011(21)] through a range of research and education activities. These included, among others, research activities aiming at a better understanding of the physical characteristics of earthquake ground motions (the latter being the fundamental prerequisite for adequate seismic hazard assessment, which in turn represents the basis for risk assessment and vulnerability reduction), the improvement of earthquake early warning systems (based on an in-depth investigation of the Istanbul earthquake early warning system), research aiming at monitoring ground deformations using state-of-the art space borne or ground based methods (e.g. for volcano monitoring, natural or man made ground subsidence…), as well as several specialised workshops dealing with topics such as induced seismicity (ECGS-FKPE workshop 2010). These and other projects were carried out in collaboration with high-profile academic partners worldwide.

Specific yearly objectives:

2012:

In the framework of the 2012-2013 programme of activities of the EUR-OPA Major Hazards agreement, ECGS intends to continue and extend these research activities aiming at a better understanding and quantification of natural hazards in the Euro-Mediterranean region, but also on a global scale.

Indeed, ECGS is strongly involved in the processing of Japanese earthquake strong motion data, and in the coming two years, one aspect on which we will concentrate is the study of the implications of the massive M 9 earthquake that occurred on 11 March 2011. This is the first time that such a wealth of near-source strong motion data have been recorded from such a mega thrust earthquake, and thus the results obtained from the study of the near-source strong ground motions generated by this earthquake are of particular interest also for other regions threatened by the potential occurrence of mega thrust earthquakes. Besides the study of this particular earthquake, we will also work on the analysis of the variability of earthquake ground motions, an issue of utmost significance for seismic hazard calculations worldwide. These research activities will be carried out in close collaboration with scientists from the GFZ German Research Centre for Geosciences in Potsdam, Germany.

Besides these aspects of fundamental earthquake ground motions research, ECGS is also currently investing its efforts in developing a permanent seismic network for Luxembourg and the Great Region around (i.e. Luxembourg and neighbouring regions of Belgium, France and Germany), an infrastructure that was so far missing. With these efforts, we intend to close the gap of missing seismological recordings in the Grand Duchy and collect the necessary data to contribute to a significantly improved assessment of the seismic hazard in the area.

Furthermore, ECGS will also remain deeply involved in the study of volcanic hazards and ground deformation mainly in Africa and in the Great Region. For instance, in close collaboration with the Museum for Natural History of Luxembourg and the Royal Museum for Central Africa (Tervuren, Belgium) as well as European universities from Belgium, France and Italy, we study the Virunga Volcanic Province (VVP) at the bordering region of the Democratic Republic of the Congo and Rwanda. Two of the most actives volcanoes of Africa (Nyiragongo and Nyamulagira) indeed lie in the VVP and threaten the > 1 million inhabitants of the city of Goma and neighbouring urban areas and villages. In particular, the volcano-tectonic risk is extremely high in Goma as shown by the recent 2002 Nyiragongo eruption that destroyed 10% of the city, a city where the population doubled over the last 10 years. Similarly, methods developed for the study and the monitoring of that region were also successfully applied to other volcanic and tectonic areas such as in Tanzania, Cape Verde, and South Kivu as well as in the Great Region. This allowed to address in previous studies important questions such as whether the occurrence of recent seismic sequences in the East African rift were of purely tectonic origin or whether there was any magma involved (which has important impact in hazard assessment), as well as bringing fundamental information about the continental rifting process itself.. Applying these methods developed on the African targets and new methods developed recently by a postdoctoral fellow at ECGS, we also detected long-term subsidence related to the mining activity in Luxembourg and the Great Region.

The large datasets of satellite Radar images owned at ECGS (acquires since the nineties over active tectonic regions in Africa and over Luxembourg and surrounding areas) and the necessary computing facilities and processing tools, as well as various ancillary data or equipment to complement these remote sensing studies (GPS, tiltmeters, gravimeters, etc.) provide us with outstanding tools for conducting fundamental research and hazard assessment-oriented research.

In the years 2012-2013, further studies will be carried out, in particular with the aim of gaining insights into the magmatic system of Nyiragongo volcano. As a first step towards this goal, a field mission was carried out in September 2011, providing an invaluable dataset to tackle this issue

2013:

see above

EXPECTED RESULTS

2012:

see above

2013:

see above

RESULTS OBTAINED IN 2012

Work package 1 (prepared by ECGS):

Description:

Fundamental seismological research on ground motion prediction equations and ground motion variability

Associated deliverables:

A better understanding of how earthquake ground motions are generated and how their variability can be treated in seismic hazard assessment

During the year 2012, significant progress has been made in the project “Understanding and quantification of natural hazards”, led at the European Center for Geodynamics and Seismology. The year was in particular marked by the work on ground motion and source parameter variability of earthquakes in Japan, and the workshop Earthquake source physics on various scales, which was organized by ECGS with cofounding from the EUR-OPA Major Hazards Agreement, and relates directly to the research carried out at ECGS.

In 2012, we carried out a study on the regional variability of earthquake source parameters (such as stress drop and released seismic energy) in Japan, starting from the earlier results of Oth et al. (Geophysical Research Letters, 37, 19304, 2010), who had analyzed the average source scaling behavior (i.e., how earthquake source parameters scale with earthquake size) in Japan. The more detailed analysis of the regional variations of these parameters revealed very interesting insights. First of all, crustal earthquakes in the northern part of Japan’s largest island Honshu exhibit very low stress drops and released energy per unit moment, while the contrary is the case for the island of Kyushu in

southernmost Japan. Compared to the distribution of quaternary volcanoes (i.e., the volcanic arc of Japan) and heat flow measurements throughout the country, there is a striking relationship between the latter and the source parameters of earthquakes. In the volcanic areas, where the crust is obviously warmer, stress drops are very small. When compared to other geophysical parameters, such as strain rate determined from GPS measurements or the focal mechanisms, the relation of the source parameters to heat flow seems to be the most robust, indicating that most likely, the thermal strength of the crust is the main determining factor for how much energy is radiated by an earthquake.
Furthermore, there are also clear regional variations in the scaling, and not only in the absolute stress drop values. These are currently under further investigation, and we are currently in the process of preparing a publication on this work.

Work package 2 (prepared by ECGS):
Description:
Establishment of permanent seismic network in Luxembourg
Associated deliverables:
Operating seismic network covering the entirety of the Luxembourgish territory by the end of 2013

Progress was also made concerning the establishment of a seismic network in Luxembourg. A temporary network of 6 seismic stations is already up and running, in cooperation with the Karlsruhe Institute of Technology (KIT). ECGS has purchased 6 seismic sensors that are currently in the process of being deployed. The first three of these are deployed in the framework of a project funded by the National Research Fund of Luxembourg (FNR), with the aim of using seismological measurements to make estimations of bedload transport in rivers (project BEDLOAD). While these stations are primarily destined to serve this project for the coming 1-2 years, they will nevertheless also provide earthquake registrations, since they are measuring continuously. The other 3 stations will be deployed in Luxembourg for seismological monitoring purposes, in addition to the permanent station in the Walferdange Underground Laboratory for Geodynamics (WULG) and the six stations already present. This network provides the first dataset of continuous seismic recordings covering the entirety of the Luxembourgish territory.

Work package 3 (prepared by ECGS):
Description:
Processing of the field mission data acquired on Nyiragongo Volcano in September 2011
Associated deliverables:
Improved understanding of the dynamics of the Nyiragongo lava lake

The work on the field mission data acquired on a field mission on Nyiragongo volcano in September 2011 has started and will be continued throughout the coming year.

RESULTS OBTAINED IN 2013

Working package 1 (prepared by ECGS)*:*
Description:
Associated deliverables:

Work package 1: Fundamental seismological research on ground motion prediction equations and ground motion variability

During the past decades, compelling evidence has been provided that the rupture dynamics of the seismic source process must span an extraordinarily wide range, from slow earthquakes to super-shear ruptures. One of the most important characteristics of the earthquake source process is the amount of stress released on the fault, often referred to as stress drop. Stress drop estimates have proven to be highly variable, covering about three orders of magnitude (mostly the range 0.1 – 50 MPa), and the question as to what causes this variability could thus far only be speculated upon. Besides this high degree of variability, there is still a partially vigorous debate going on in the scientific community whether stress drop depends on earthquake size or not. At the same time, these questions are however of great importance for ground motion prediction, since the models and methods used for this purpose generally require an estimate of stress drop (linked to radiated energy via a given source model) as input parameter, and the amount of energy released by an earthquake naturally is a determining factor for the ground shaking recorded in its vicinity.
In order to obtain new insights that might help to clarify these issues, stress drop variations of nearly 4,000 earthquakes that occurred throughout Japan from May 1996 to October 2011 were studied (Figure 1).

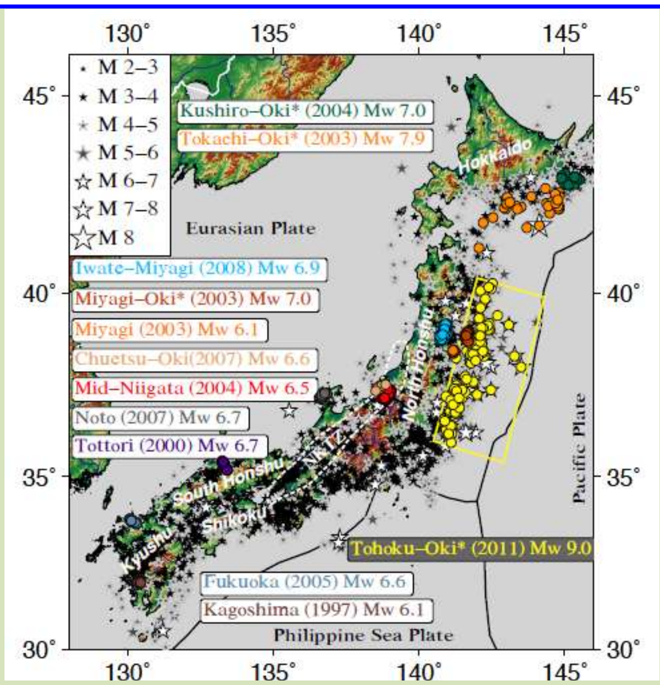


Figure 1: Epicenters of earthquakes used. Earthquake sequences are color-coded in relation to mainshock name. Sequences marked with an asterisk are classified as subcrustal. The yellow rectangle indicates the assumed fault model of the Tohoku-Oki mainshock.

These earthquakes ranged in magnitude (MW) from 2.7 to 7.9 and including events from 12 particular major sequences. This uniformly processed dataset allowed for a robust quantification not only of potential systematic lateral stress release variations on the scale of the Japanese archipelago, but also of the stress drop scaling with earthquake size on the local scale of individual earthquake sequences, and its variability throughout the country. Combined with the availability of reliable information on other important parameters, such as focal mechanisms, b values, heat flow and geodetic strain rates in Japan, this dataset therefore provided unique conditions in the quest for the causes underlying earthquake stress release variations.

In order to derive the source spectra of the earthquakes, from which stress drop can then be estimated, a non-parametric spectral inversion technique originally published by Castro et al. (1990) and further refined by Oth et al. (2011) was applied. For further technical details, the interested reader is referred to Oth et al. (2011), Oth (2013) and references therein. The resulting stress drop estimates were then investigated for their variability throughout Japan and their relation to other parameters characterizing the seismic source, such as focal mechanism or depth.

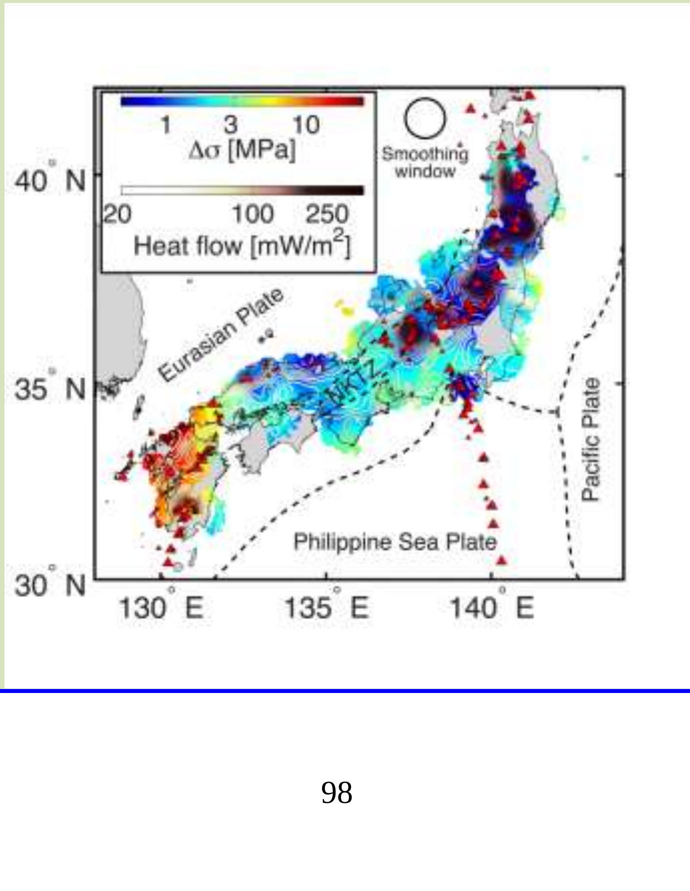


Figure 2: Direct comparison of crustal earthquake lateral stress drop (color-filled areas in background) with heat flow variations (color-coded contour lines in foreground), spatially smoothed over an area of 50 km radius surrounding each grid point of 0.1° by 0.1° grid. Note the excellent spatial correlation between the low stress drop and high heat flow regions, in particular in Honshu. Quaternary volcanoes are shown as red triangles.

Figure 2 shows, as a comparison, the lateral variations of crustal earthquake (depth shallower than 30 km) stress drops and the lateral heat flow variations in Japan (Tanaka et al., 2004). The stress drops of crustal earthquakes depict clear systematic lateral variations, which show a distinct correlation with heat flow variations and the presence of quaternary volcanoes, in particular in Honshu. In Kyushu (southwestern Japan), the correlation is not that clear, yet still indicatively present, even though at generally increased stress drop level.
In addition, we could show that the variability of stress drop on local scale (i.e., the spatial scale of an individual earthquake sequence, see Figure 1) is smaller by a factor of 2 to 3 as compared with the overall stress release variability in Japan. This conclusions has strong implications for ground motion prediction, since it means that taking into account the systematic lateral variations of stress release allows for a significant reduction of the stress release variability for ground motion prediction at local scale. Subduction zone earthquakes (mostly offshore eastern Japan), in contrast, show highest stress drops in regions of strongest coupling of the subduction interface, and further details on this extensive study can be found in Oth (2013).
In a second step, we also started to work towards a direct application of these results on ground motion prediction equations, which is still work in progress with our partners at the GFZ German Research Centre for Geosciences. Such predictive models are usually required in the computation of seismic hazard maps, and they generally show large variability (both of aleatory and epistemic nature). This variability, in turn, is highly problematic especially when computing the seismic hazard at long return periods. The intention of this work is to use the extensive information gained by the spectral inversions described above (for site, path and particularly also source effects) to potentially help in reducing the standard deviation of these relations.

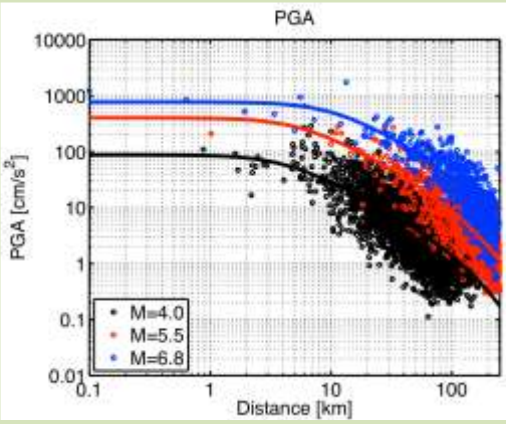


Figure 3: Example for ground motion regression model (continuous lines) and its fit to the observations (open circles, for three different magnitudes). The plot shows the results for peak ground acceleration (PGA).

For this purpose, we calculated regression models defining a ground motion prediction equation in Japan (Figure 3) and proceeded to a residual analysis. This was done for peak ground acceleration (PGA) and a range of response spectral ordinates.

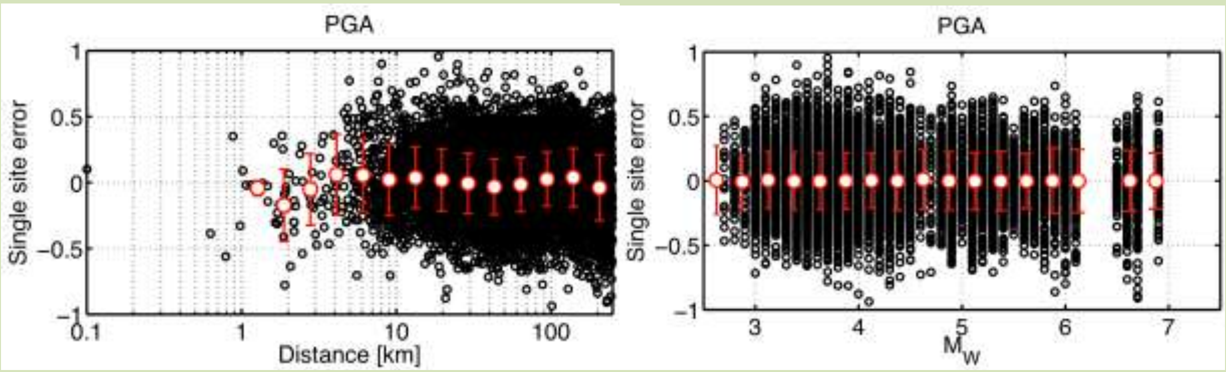


Figure 4: Residual analysis after correction for between-event and site-to-site error components (i.e., within-event, single site error term). Note that the residuals do not show and significant correlation with distance (left) or magnitude (right).

As can be seen in Figure 4, the residuals do not show any specific trends with magnitude or distance of the events, showing that the ground motion model is on average a good representation of the observations. We then separated the residuals into their between-events (variability in ground motion due to the consideration of different earthquakes) and within-event components (variability in ground motion within the recordings of a given earthquake). The latter was then further separated into the site-to-site (variability due to the consideration of many different recording sites) and single-site (variability within the recordings at a given recording site) variability components, following the method of Chen and Tsai (2002).

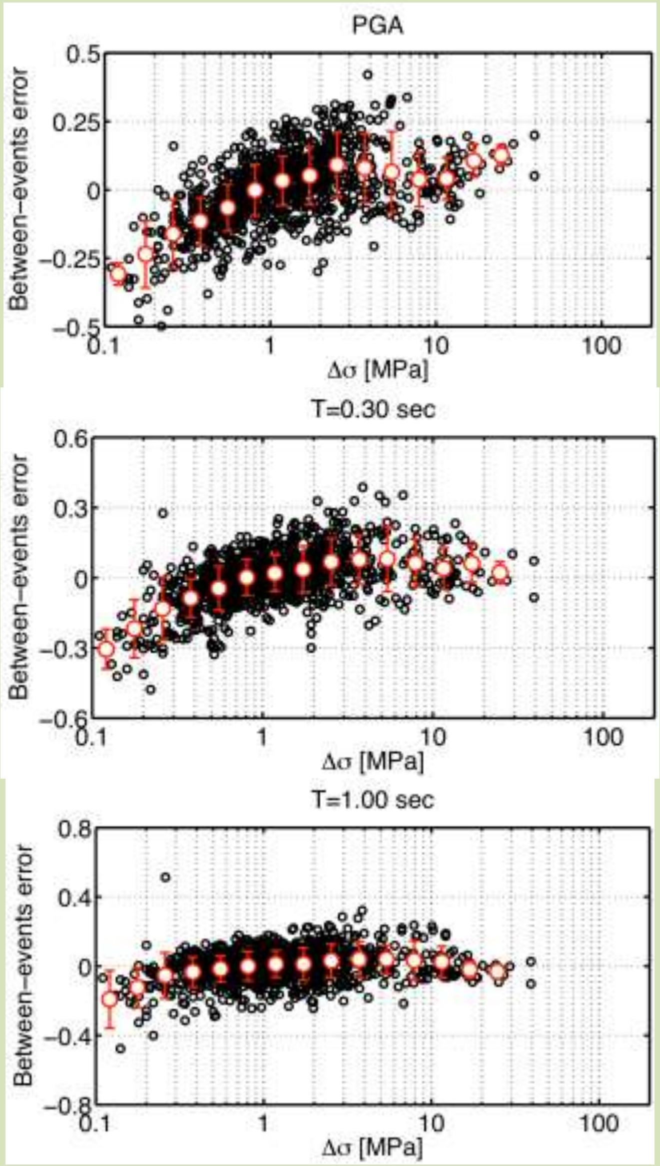


Figure 5: Between-events error term (i.e., the average residual of all observations from a specific earthquake from the prediction by the ground motion model) versus earthquake stress drop (see also Figure 2) for a range of periods. Note that at short periods, a correlation between the two quantities is apparent.

Figure 5 shows for instance the correlation of the between-events error terms with stress drop as determined in the study above (Oth, 2013). Note the significant correlation at short periods (PGA and 0.3 sec), while at long periods the correlation gets lost. This is a good example for how for instance stress drop might be a useful parameter in the endeavour to reduce the variability, and further studies along this direction are on going.

Work package 2: Establishment of permanent seismic network in Luxembourg

Luxembourg is generally considered to be a region of low seismic hazard, as it is located well within the Eurasian Plate, far away from its boundaries. Yet, while the Luxembourgish territory indeed does not show significant present-day or historical seismicity, this is not the case for regions as close as 100 – 150 km from the Grand Duchy. For instance, the Roermond earthquake in 1992, which took place close to the border of the Netherlands and Germany and had a magnitude of 5.4, was also widely felt in Luxembourg. On 14 February 2011, a magnitude 4.4 earthquake took place in the region of Koblenz (Nassau), and caused widespread concern in Luxembourg as well, as it could be felt remarkably well throughout the country. However, Luxembourg does not dispose of a country-wide, permanent, high-quality seismic monitoring network (only three permanent stations), making it difficult to adequately react to public enquiries and to carry out fundamental research activities, for instance on ground motion attenuation from earthquakes in the Lower Rhine embayment or site amplification studies.

In order to remedy this situation, ECGS has started an instrumentation programme in order to achieve a homogeneous, high-quality broadband seismic network throughout the country. As a first step, six temporary stations were installed in collaboration with Karlsruhe Institute of Technology (KIT) beginning in December 2009, five of which are still in operation at this date. Since then, ECGS has also acquired a set of seven broadband instruments (Güralp CMG-3EPSC 60 sec sensors) whose installation is currently on going. One of these stations has been co-financed by the EUR-OPA Major Hazards Agreement in the framework of this research programme.

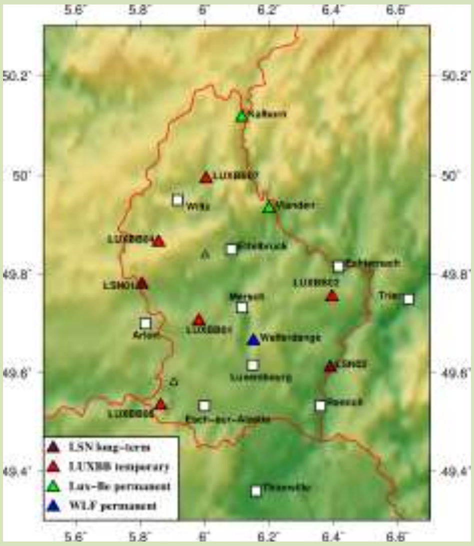


Figure 6: Current status of the Luxembourg seismic network. At present, 10 stations are operational: one permanent station in Walferdange, blue; two permanent stations jointly operated with ROB, green; five temporary stations operated in collaboration with KIT, red; and two long-term stations that are intended to be turned into permanent installations. The two small grey triangles indicate previous occupied sites (not in operation anymore).

Figure 6 shows the current status of the Luxembourg seismic network. One permanent, high quality station is installed in the Walferdange Underground Laboratory for Geodynamics (Streckeisen STS2, operated in collaboration with the GFZ German Research Centre for Geosciences), which serves as a reference station. Two further permanent shortperiod stations are operated in collaboration with the Royal Observatory of Belgium in Vianden and Kalborn. Finally, as mentioned above, five temporary broadband stations are operated in collaboration with KIT, and so far, two of the ECGS stations have been installed in a long-term, (semi-) permanent setting. In the immediate vicinity of station LSN01, further two ECGS stations are currently in temporary operation in the framework of another research project (BEDLOAD, funded by the National Research Fund, Luxembourg).
It should be noted however that, due to limited funding resources and manpower, the installation of all stations in a high-quality, permanent setting, including all necessary realtime capabilities, will still require some time. We will therefore first install the sensors in the best possible way taking into account the currently available resources and upgrade them in a step-by-step approach to fully permanent installations.
An example for a recording from the recently installed seismic stations is shown in Figure 7 (teleseismic event recorded at station LSN02 in Wormeldange).

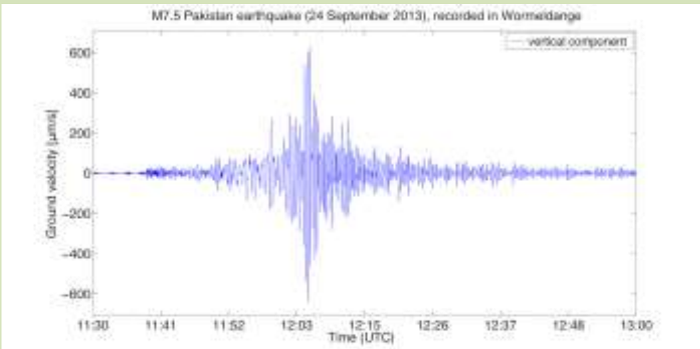


Figure 7: Example recording of a teleseismic earthquake (MW 7.5, Pakistan earthquake on 24 September 2013), at station LSN02 (Wormeldange), vertical component.

Work package 3: Processing of the field mission data acquired on Nyigragongo volcano in September 2011

The Nyiragongo volcano, located in the Virunga Volcanic Province in the bordering region of the Democratic Republic of the Congo (DRC) and Rwanda, is one of the most active volcanoes in Africa and is characterized by the largest permanent lava lake of any volcano worldwide (Figure 1). Nyiragongo poses a serious threat to the local population, in particular to the city of Goma, located in its immediate vicinity. The silica-undersaturated lava in the volcano is highly fluid (Tazieff, 1977), and two major flank eruptions in 1977 and 2002 completely drained the lava lake, feeding >10km-long flows that destroyed nearby villages and a part of the city of Goma within hours.
In order to better understand the dynamics of the magmatic system, in particular of the lava lake, scientists of the National Museum for Natural History (Mnhn, Luxembourg), the Royal Museum for Central Africa (Mrac, Belgium) and ECGS carried out a scientific expedition to the summit of Nyiragongo and collected field data of various types, among which seven days of continuous measurements with three broadband seismic stations. These data have been analyzed in the framework of a student internship (De Gelder, 2013, three months duration) at ECGS in order to gain insights into typical seismic signals emitted by the volcano.

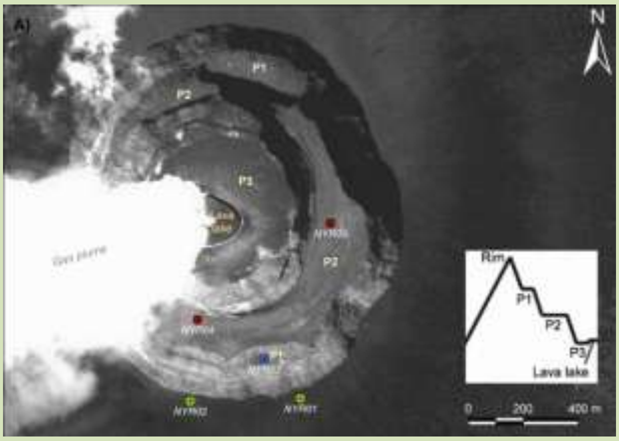


Figure 8: Top view of Nyiragongo's crater. Green/blue/red bullets indicate the seismic stations installed at the Rim, on platform 1 (P1) and platform 2 (P2) respectively. Inset: schematic crosssection with the three platforms (P1-3).

Figure 8 shows the setting of the seismic stations within the crater of Nyiragongo. The crater is composed of a series of platforms (denoted here by P1-P3) formed by slabs of solidified lava from previous eruptions. The three stations were successively installed on the rim (NYR01 and NYR02), on platform P1 (NYR03) and on platform P2 (NYR04 and NYR05). In total, continuous seismic recordings were obtained over a period of seven days, and the records of the different stations show partial temporal overlap (stations NYR01 & NYR02 with NYR03, respectively stations NYR04 & NYR05 with NYR03).
The sensors used were three Güralp CMG-3EPSC (60 sec – 100 Hz), and in order to achieve an as stable installation as possible in this difficult environment, the instruments were buried at approximately one meter depth, resting on a slab of flat rock. The obtained signals were then analysed with a range of standard techniques in seismic signal processing, including the calculation of spectrograms (Figure 9), power spectral densities (Figure 10, following McNamara and Buland, 2004), or S-transforms for optimal timefrequency resolution when dealing with short transient signals (Figure 11, Stockwell et al., 1996).

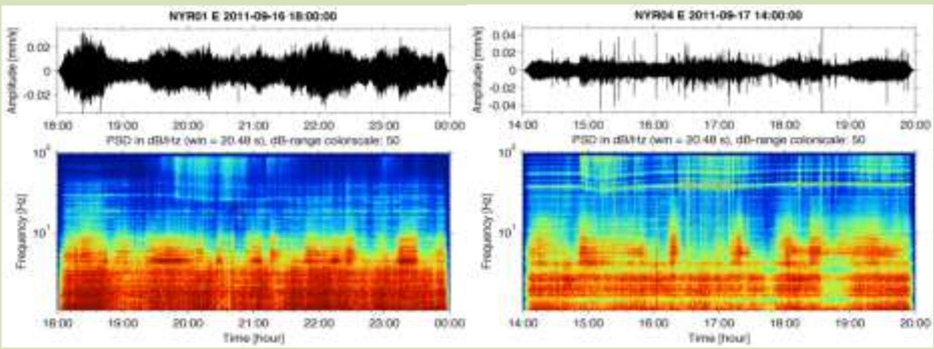


Figure 9: Seismograms (top) and spectrograms (bottom) of EW component at locations NYR01 (left) and NYR04 (right), respectively. The records show 6 hours of data acquired on two different days. The amplitude in the spectrograms ranges from -160 to -110 dB (blue to red).

The following observations could be made when analysing the spectrograms and power spectral densities (PSDs) of the signals:

- Low-frequency tremor (below ~1 Hz) is continuously occurring, with similar PSD amplitudes on the horizontal and vertical components at all 5 locations and distinct peaks at 0.2 Hz, 0.55 Hz and 1 Hz (Figure 10, black arrows).
- Tremor in the dominantly excited frequency range 1-4.5 Hz persists ~95% of the time and has highest power in the horizontal components. Overall, power is highest at locations NYR01 and NYR02 and lowest in NYR03 in this frequency range.
- Nearly continuous narrow bands of significant energy at higher frequencies (up to 100 Hz) are also visible (see for instance Figure 9). Some of these bands are present at multiple sites, while some are characteristic to a given station. Above ~30-40 Hz, these bands show not only amplitude but also frequency modulation during periods of strongest high-frequency excitation (Figure 9), and are strongest on platform P2.
- Tremor activity with most energy between 4.5-10 Hz – with slightly higher frequencies on the platform P2 – persists ~50% of the time, causing this frequency band to appear more diffuse in the PSD probability density functions (Figure 10, red arrow). Horizontal and vertical components show similar power level.
- In NYR04 and NYR05 continuous signal strength is observed in the frequency range of ~10-40 Hz, with highest power in the vertical component.

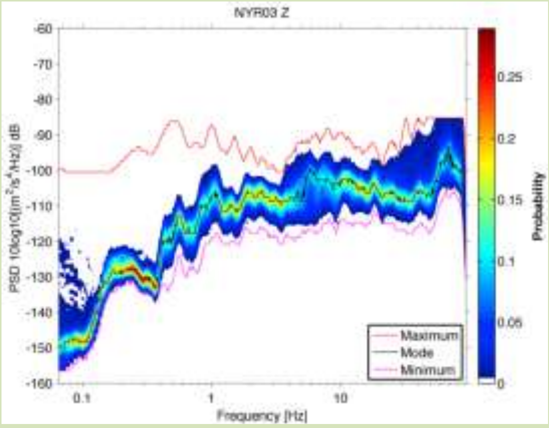


Figure 10: Power spectral density (as probability density function representation) for the vertical component of station NYR03, based on statistical averages of power spectral densities calculated for 10 min windows over the entire recording period. Note the distinct peaks at 0.2, 0.55 and 1 Hz (black arrows). Red arrow: intermittent tremor at 4.5-10Hz.

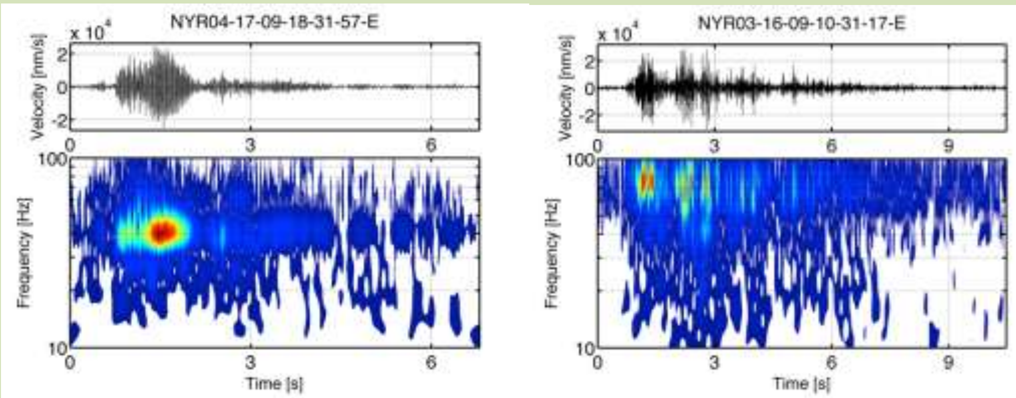


Figure 11: Two examples for typically observed high-frequency, transient signals (left at station NYR04, right at station NYR03). Top: seismogram. Bottom: S-transform of signal.

In addition, several types of short, transient signals were observable, the most characteristic consisting in highly localized (in the time-frequency plane), high frequency signals of only a few seconds duration (Figure 11). Overall, this study provided valuable insights in the seismo-volcanic signals that are characteristic to Nyiragongo volcano, and these observations will guide the development of further studies and field missions.

Dissemination of results (publications and conference presentations)

Oth, A. (2013). On the characteristics of earthquake stress release variations in Japan. Earth Planet. Sci. Lett., 377-378, 132-141, doi: 10.1016/j.epsl.2013.06.037.

Oth, A., and D. Bindi (2013). Stress drop variations and their relevance for ground motion prediction: case study of Japan. Eos Trans. AGU, 94 , Fall Meet. Suppl., Abstract S51F-01.

De Gelder, G.I.N.O., A. Oth, N. d'Oreye, B. Smets, G. Mavonga, N. Mashagiro, F. Kervyn and GVO team (2013). Volcanic tremors and transients: 7 days of seismic recordings at Nyiragongo Volcano summit (Democratic Republic of Congo). Active Volcanism & Continental Rifting (AVCOR) workshop with special focus on the Kivu rift zone.

Oth, A. (2012). Stress drop and scaling variations in Japan: what is the driving mechanism? ECGS workshop 2012, Luxembourg.
Oth, A. (2012). Lateral stress drop variations and the Tohoku aftershocks in the context of earthquake source characteristics in Japan. ESC 33rd General Assembly, Moscow, Russia.
Oth, A. (2012). Lateral stress drop variations and the Tohoku aftershocks in the context of earthquake source characteristics in Japan. SSA Annual Meeting, San Diego, USA.

References

Castro, R.R., Anderson, J.G., and Singh, S.K., 1990. Site response, attenuation and source spectra of S waves along the Guerrero, Mexico, subduction zone. Bull. Seismol. Soc. Am. 80, 1481-1503.
Chen, Y.-H., and Tsai, C.-C.P. (2002). A New Method for Estimation of the Attenuation Relationship with Variance Components. Bull. Seismol. Soc. Am. 92, 1984-1991, doi:10.1785/0120010205.
De Gelder, G.I.N.O. (2013). Volcanic tremor and transients: 7 days of seismic recordings at Nyiragongo Volcano summit, unpublished internship report, University of Utrecht, The Netherlands.
McNamara, D.E., and Buland, R.P. (2004). Ambient noise levels in the continental United States. Bull. Seismol. Soc. Am. 94, 1517-1527.
Oth, A. (2013). On the characteristics of earthquake stress release variations in Japan. Earth Planet. Sci. Lett., 377-378, 132-141, doi: 10.1016/j.epsl.2013.06.037.
Oth, A., Bindi, D., Parolai, S., and Di Giacomo, D. (2011). Spectral Analysis of K-NET and KiK-net Data in Japan, Part II: On Attenuation Characteristics, Source Spectra, and Site Response of Borehole and Surface Stations. Bull. Seismol. Soc. Am. 101, 667-687, doi:10.1785/0120100135.
Stockwell, R.G., Mansinha, L., and Lowe, R.P. (1996). Localization of the complex spectrum: the S transform. IEEE Transactions on Signal Processing 44, 998-1001.
Tanaka, A., Yamano, M., Yano, Y., and Sasada, M. (2004). Geothermal gradient and heat flow data in and around Japan (I): Appraisal of heat flow from geothermal gradient data. Earth Planets Space 56, 1191-1194.
Tazieff H. (1977): An exceptional eruption: Mt. Niragongo, Jan. 10th, 1977. Bull. Volcanologique, Vol. 40 (3), 189-200.

RISK AND VULNERABILITY MAPS FOR SELECTED COASTLINES IN MALTA & TURKEY WITH REGARD TO TSUNAMIS & SLR

TARGET COUNTRIES : Euro-Mediterranean countries

PARTNERS INVOLVED :

COORDINATING CENTRE : ICoD La Valletta, Malta

OTHER CENTRES:

OTHER PARTNERS : Middle East Technical University (METU), Turkey

EXECUTIVE SUMMARY

In the light of the previous years' studies, additional tsunami scenarios were performed ans the results obtained from NAMI-DANCE Tsunami Modeling software are prepared. The two sources, Algerian-Tunisian and Eastern Sicily - Southern Tyrrhenian sources, are selected and the results are observed in the coasts of Maltese Islands based on the previous studies performed in the same area. The Eastern Sicily-Southern Tyrrenian source has more important results compared the Algerian-Tunisian fault. The results of the possible tsunamis generated by these two sources and their maximum flow depth inland, maximum wave height, first wave propagation graphs are drawn on Surfer and Grapher softwares. Algerian-Tunisian source does not pose a threat for Maltese Islands due primarily to the settlement side facing inside and due secondarily to the distance between the source and its location. On the other hand, Eastern Sicily and Southern Tyrrhenian source has more impacts compared to Algerian-Tunisian fault system. Even in the second scenario, the maximum wave height is not larger than 1 meter.

The indicator based model developed by the Middle East Technical University (METU) will help decision makers and authorities to take decisions in order to prevent the coasts from being defeated and sometimes losing against the sea level rise scenarios. It can be used for all regions in the world in order to create a database and a vulnerability map after a cumulative and detailed study.

Turkey, with a 8333km of coastline is absolutely under threat against sea level rise scenarios due to its geological location. The vulnerability assessment is focused on Fethiye Bay since the bay is very close to the center of settlements of Fethiye people. The vulnerability is investigated especially for this central region due to the people living around.

The study performed is based on two main categories; physical and human based parameters. Impacts are based on physical and human influence parameters can be classified into five different categories. Coastal Erosion, Flooding due to Storm Surge, Inundation, Salt Water Intrusion to Groundwater Resources, Salt Water Intrusion to River/Estuary. Outside of the bay towards Mediterranean Sea, high cliffs with very steep slopes can be observed that no settlement is formed in those areas due to the difficulty of constructing transportation facilities onto such a steep sloped geography. Thus, the suburban zones around Fethiye are not considered in the vulnerability model.

The main parameters played important role in the vulnerability of Fethiye is tidal range, proximity to coast. The least important ones are the significant wave height which is not high (0.4m) and the depth to groundwater level above sea which is larger than 2 meters. All parameters for each impact are tabled and mentioned in Case Study part above.

Sea water intrusion is really harmful especially for agricultural areas. Since the economy is based on agriculture and stockbreeding at a large scale, in addition to tourism in Fethiye, sea level rise scenarios are vital to be investigated. Since the region is not ready to such a scenario, a very coordinated adoptation study must be performed. An adoptation process might be painful to get used to it but it's inevitable. On the other hand, if the policy makers and decision takers can come to an agreement on common issues, Fethiye would be able to prepare for a possible sea level rise scenario.

Being an island poses a serious threat and increases the vulnerability to both sea level rise and tsunami (IPCC, 2007). Since people do not have an alternative place to escape or shelter, Maltese Islands should also be well-prepared.

For the future studies, vulnerability database both for tsunami and for sea level rise scenarios may be enlargen considering other coastal regions having economical and sociological importances. Furthermore, additional parameters may be added enrich the content and extent of the study.

OBJECTIVES OF THE PROJECT

Global objective for 2012:
Identification and mitigation of risk and vulnerability to Sea Level Rise and Tsunamis for selected low lying coastal areas in the Maltese islands and Turkey.

Specific yearly objectives :

2012:
3-year project conclusion (see expected results)

EXPECTED RESULTS

2012:

- Development of Risk / Vulnerability maps.
- Comparison of the scenario solutions and computational results.
- GIS based inundation mapping.
- Producing vulnerability risk maps under the conditions of tsunami and sea level results.

RESULTS OBTAINED PREVIOUSLY (if any)

2010: Identification of historical events, selection of study areas from Turkey and Malta subject to possible effects of tsunamis, collection of necessary data (near-shore bathymetry and topography, distribution of coastal and marine structures and their characteristics, wind, wave and sea level data), public surveys, processing of data and database development for the computational tools.

2011: Development of regional / local scenarios (e.g. forecasted climate change impact on Sea Level Rise and possible tsunami events, downscaling from global to regional to local scenarios); Correlation of Mediterranean regional history of tsunamis to local vulnerability, wind and wave climate studies for selected sites, wave transformation studies, tsunami simulations and computations of the near shore tsunami parameters at selected sites, development of database for the vulnerability risk maps.

RESULTS OBTAINED IN 2012

Work package 1 (prepared by ICoD, Middle East Technical University):
Description:
Development of Risk / Vulnerability maps.
Associated deliverables: see above

Work package 2 (prepared by ICoD, Middle East Technical University):
Description:
Comparison of the scenario solutions and computational results.
Associated deliverables: see above

Work package 3 (prepared by ICoD, Middle East Technical University):
Description:
GIS based inundation mapping
Associated deliverables: see above

Work package 4 (prepared by ICoD, Middle East Technical University):
Description:
Producing vulnerability risk maps under the conditions of tsunami and sea level results .
Associated deliverables: see above

Selected sites for vulnerability assessment

The selected sites are Fethiye Bay in Turkey and Grand Harbour and Salina Bay in Maltese Islands. Previous assessments for Gocek, Bodrum and Goksu regions of Turkey and selected sites in Maltese Islands can be found in the previous years' progress reports of this project.

Malta

With a 315km2 surface area and 137km shoreline, Malta has a considerable population of 380.000 people, especially located on east coasts of the island. The east part of the island has low-lying coastal areas starting from 11.3° whereas the western coasts have steeper slopes up to 1.15° (Figure 1).

Due to the being low-elevated area with a very mild slope, the impact of physical parameters seems to be much greater in this low-lying marsh land in Salina Bay (Caruana, 2012).

Due to being an industrial and recreational region, Grand Harbour, where there exists low-lying inlet and a drowned valley system, is protected by seawalls, jetties and breakwaters. Urban development, engineering works and various forms of physical changes to the coastline have endangered Grand Harbour (Caruana, 2012).

Turkey

Fethiye region (Figure 2), the district of Mugla City is placed in the southwestern part of Turkey. Population in the city center is 68285 while in nearby provinces is around 110000 according to 2009 population census. Fethiye has a surface area of 2686km2 (District Governship of Fethiye, 2008).. Settlements are common in the vicinity of the bay area with slope values between 0˚ - 10˚. Outside of the bay towards Mediterranean Sea, high cliffs with very steep slopes can be observed where there exists no settlement (Figure 2).

Vulnerability Studies

Tsunami

In 1693 and in 1908, two destructive earthquakes and tsunamis occurred in the Southern Tyrrhenian and Eastern Sicily source. However, the most devastating one was Eastern Sicily earthquake with an approximate magnitude of 9 (Mw=9) and a tsunami event resulted in 60000 casualties occurred (M.A. Gutscher, 2006). This source is towards eastern and northeastern coasts of Malta having a more low-lying slope characteristics. Additionally, in the past, around Algeria-Tunisia source zone, there were several different earthquake phenomenas which generated tsunami thereafter (Tinti S., 2005). In the past, the last destructive seismic event occurred on May 21, 2003 with a Mw=6.8 earthquake located on east of Algiers (Bounif et al., 2004). More than 2000 people were killed, 11.000 injured and 200.000 became homeless (Yelles et al., 2004).

The past events showed that eastern coasts of Malta as a whole are more prone to inundation after possible tsunami scenarios. Since it is a low-lying coastal area and most of the population has settled down around the eastern coasts of the island. Thus, it is essential to determine the vulnerability of Maltese Islands to possible future tsunami events.

Working with scenarios is a very beneficial technique for determination and evaluation of tsunami hazard and risk for any given region, and it is a simple starting point for tsunami mitigation, preparedness and sustainable coastal zone development (Tinti S. et al, 2005).

In the light of the past events, the impact of a set of tsunamis occurring after an earthquake generated by two of the major fault zones of the Mediterranean Sea was modeled and its probable effects were analyzed on different coasts of Maltese Islands as a part of this project. The impacts of these two scenarios were simulated on NAMI-DANCE 5.9 Tsunami Modelling Program (METU, 2011) and the results were discussed.

Sea level rise

Turkey as a potential country for tourism with its cultural and natural heritage has important coastlines. From the economical and sociological point of view, some important coasts of Turkey need to be investigated in terms of a detailed vulnerability assessment.

All these reasons mentioned above create a strong need of a vulnerability assessment study considering the impacts of sea level rise for each region. Decision makers can use the maps created by all vulnerability assessment studies in order to prepare action plans and adopt policies against the actions posing a threat (De Brujin and Klijn, 2009).

The model used in this study is based on Ozyurt, 2007. A coastal vulnerability matrix is prepared with the corresponding indicators of impacts of sea level rise. The impacts are categorized into five classes; (i) Coastal Erosion, (ii) Flooding due to Storm Surge, (iii) Inundation, (iv) Salt Water Intrusion to Groundwater Resources, (v) Salt Water Intrusion to River/Estuary. The results of the matrix and coastal vulnerability index (CVI) value will help decision makers to take decision and make policies for the adaptation measures against sea level rise.

For each impact, different parameters of both physical and human influence will be indicative (Table 1).

Physical Parameters
Rate of Sea Level rise
Geomorphology
Coastal Slope
Wave Climate
Sediment Budget
Tide Range
Proximity to coast (groundwater)
Type of aquifer
Hydraulic Conductivity
Depth to water table above sea
River depth at downstream
Discharge
Storm surge height

Table 1: Physical and Human Based Parameters used in the model (Ozyurt, 2007)

Human Influence Parameters
Reduction of Sediment Supply
River Flow Regulation
Engineered Frontage
Natural Protection Degradation
Coastal Protection Structures
Land Use
Groundwater Resource Abstraction

In order to contribute to the vulnerability assessment works and broaden the scope of the sea level rise based vulnerability studies conducted by METU OERC, Fethiye is selected as a second pilot region to be evaluated in terms of its vulnerability to sea level rise.

Results

Vulnerability Score of Fethiye (Turkey)

Turkey, with a 8333km of coastline is under threat of sea level rise due to its geological location. Although this threat of most of the coastline is not as serious as the countries neighboring the ocean. Nevertheless, low-lying coastal lines and having tidal range less than 0.5 m pose danger against sea level rise since these features increase the possibility of sea water intrusion to groundwater resources. The vulnerability assessment is focused on Fethiye Bay since the bay is very close to the center of settlements of Fethiye people. The vulnerability is investigated especially for this central region of the bay due to the high population density. The model study performed is based on two main categories; physical and human based parameters and the impacts are classified into five different categories as Coastal Erosion, Flooding due to Storm Surge, Inundation, Salt Water Intrusion to Groundwater Resources, Salt Water Intrusion to River/Estuary. Each impact related to various parameters different than each other is investigated for Fethiye like the previous study areas of Göcek, Amasra and Göksu (Ozyurt G, Ergin A.,2009). Settlements in Fethiye are common in the vicinity of the bay area with slope values between 0˚-10˚ corresponds to a low-lying zone. Outside of the bay towards Mediterranean Sea, high cliffs with very steep slopes can be observed that no settlement is formed in those areas due to the difficulty of constructing transportation facilities onto such a steep sloped geography. Thus, the suburban zones around Fethiye are not considered in the vulnerability model.

Sea water intrusion is really harmful especially for agricultural areas. Economy is based on agriculture and stockbreeding at a large scale, in addition to tourism. 55% of total population is interested in agriculture with a total agricultural area of 64.395 ha (Fethiye District Governship).

The main parameters played important role in the vulnerability of Fethiye are tidal range, and proximity to coast. Having a tidal range value of 0.15m for Mediterranean coastslines are really sensitive to sea level rise since the adoptation process against sea water intrusion hasn't been witnessed in these areas yet. In other words, since the tidal range all the year round fluctuates between -0.5m and 0.5m, the region is not ready and needs of an adoptation process for such a rise. Such an adoptation process might be long that stakeholders should be concentrated well. For all these characteristics of Fethiye, Table 11 indicates all parameters both physical and human based with their corresponding vulnerability scores .

In the light of these parameters, Fethiye Bay has a vulnerability score of approximately 3.2 which corresponds to a moderate range.

Vulnerability Score of Salina Bay and Grand Harbour (Malta)

The modeling results obtained from Caruana (2012) indicates that Salina Bay is vulnerable to flooding and coastal erosion with a score of 3.4 and 3.0 respectively (Table 13). As a geological feature, outcrops can be also found in Salina Bay. Studies show that Salina Bay is vulnerable to sea level rise with an overall vulnerability score of almost 3.67 indicating its moderate vulnerability range but much more than other moderate ones (Caruana, 2012).

As one of the low-lying bays, Salina Bay is in danger of having a reduction in area through inundation. The grand Harbour area is moderately vulnerable to coastal flooding due to storm surge and its few pockets of low lying rock are liable to be eroded and inundated. Salina Bay is also moderately vulnerable to coastal erosion (Caruana, 2012).

Lack of natural protection degradation increases the vulnerability of Salina Bay. Urban development through boat houses and accompanying facilities along the coast has contributed by their presence to increase flooding and coastal erosion. Modeling results represent Salina bay as vulnerable to flooding and coastal erosion with the following scores of 3.0 and 3.4, respectively corresponding to moderate vulnerability. Although the impact of human pressure is considerable, the impact of physical parameters is much greater in this low-lying marsh land by predisposing the area to a moderate vulnerability to natural hazards. The physical parameters form the 42% of the whole part whereas the human based parameters form nearly 58% in Salina Bay (Caruana, 2012).

Urban development, engineering works and various forms of physical changes to the coastline have endangered Grand Harbour, limiting its coping ability in the event of natural hazards and subjecting it to a high vulnerability of coastal flooding. Having low-lying inlet and a drowned valley system makes the Grand Harbour vulnerable to flooding and inundation. Total vulnerability index of 3.4 corresponds to moderate vulnerability range for Grand Harbour (Table 14). However, anthropogenic pressure is overwhelming by changing most parameters from moderate to high vulnerability. Due to being an industrial and recreational region, Grand Harbour is protected by seawalls, jetties and breakwaters which can mitigate its vulnerability to inundation and flooding due to storm surge and erosion. The Grand Harbour area is moderately vulnerable to coastal flooding due to storm surge and its few pockets of low lying rock are liable to be eroded and inundated. The overall vulnerability score of 3.4 for the Grand Harbour is assessed as moderately vulnerable to the impact of sea level rise. The physical parameters form the 44.4% of the whole part whereas the human based parameters form nearly 55.6% in Salina Bay (Caruana, 2012).

2.C. Impact of climate change and environment issues

COUPLING TERRESTRIAL AND MARINE DATASETS FOR COASTAL HAZARD ASSESSMENT AND RISK REDUCTION IN CHANGING ENVIRONMENTS

TARGET COUNTRIES: Euro-Mediterranean countries

PARTNERS INVOLVED:

COORDINATING CENTRE : ICoD La Valletta, Malta

OTHER CENTRES: CERG Strasbourg, France

OTHER PARTNERS : Università di Modena e Reggio Emilia (UNIMORE, Italy), Université de Caen Basse-Normandie (UNICAEN, France), Consiglio Nazionale delle Ricerche: Istituto di Scienze Marine (ISM, Bologna, Italy); CNR-IRPI (Padua, Italy)

EXECUTIVE SUMMARY

The research outputs are expected to provide a significant opportunity for scientific discussion regarding the integration of terrestrial and marine data in the context of coastal hazard assessment in the Maltese archipelago and relevant outputs to be compared with those of the Normandy case study.

The research team has also tried to identify strategies to involve and sensitize technical and administrative staff from public institutions responsible for the protection of the environment, as well as academic staff, towards aspects of landslide hazard and risk. For this purpose meetings have been organized in Malta with public institutions and stakeholders.

The next research steps may include detailed hazard mapping, with special reference to landslides and coastal erosion, taking into account issues related to climate change (sea-level, more frequent extreme meteorological events etc.); In addition, it would be crucial to verify whether it is possible to perform landslide monitoring offshore (on the seafloor) by means of innovative techniques.

OBJECTIVES OF THE PROJECT

Preliminary note:

The global objectives of this activity fit in priority within the line of action "2.C - Impact of climate change and environment" and secondarily within the line of action "2.B Risk mapping and vulnerability".

Background:

Coastal hazards are a topical issue nowadays which involves scientists and stakeholders trying to define the best procedures to face risks and increase community resilience, either reducing natural hazards or diminishing vulnerability. Coastal environments are particularly sensitive and susceptible to relevant damages in case of both sudden events (e.g., tsunamis, landslides, storm surges) and long-term processes (e.g., sea-level changes).

Coastal instability phenomena which cause heavy socio-economic consequences and fatalities have increased significantly in recent years due to global changes, which determine more frequent extreme meteorological events, and progressive urbanisation of coastal areas, especially in developing countries. Furthermore, if coastlines are located in tectonically active areas, such as the Mediterranean Sea, the situation can be even more problematic.

The study areas are the Normandy coast (France) and the coasts of the Island of Malta, which show different morphoclimatic and tectonic setting, but which have been and are at present affected by significant changes in sea level since the Last Glacial Maximum, when the sea level was some 120 metres lower than present. Previous research carried out in the frame of the "Coastline at risk" project has shown that several landslides along the coastlines of Normandy and Malta are extending well below the sea level.

The Projects involves two specialised centres, CERG and ICoD. The expertise of the academic partners (see above) guarantees the success of the research activities. Co-funding to the research will be made available by each of the partners.

Global objectives 2012 - 2013:

• Delivering an original contribution and new directives for risk reduction in coastal areas taking into account historical and possible future climate changes based on the outputs of the CERG 2009 - 11 Project "Coastlines at Risk: methods for multi-hazards assessment".

• In the absence of documented research aiming at a joint knowledge of 'land and sea' environments and related risks, this project aims to develop a multidisciplinary methodological approach which is capable to integrate terrestrial and marine datasets.

• Focusing on two study areas where significant data have been collected within the "Coastline at Risk" Project with respect to terrestrial processes and related risks. Special emphasis will be devoted to landslides, taking also into consideration the influence of climate change and coastal erosion on sea-level rise, as possible conditioning factors.
• Application of a multidisciplinary geomorphological, engineering-geological and geophysical approach to recognise landforms which are presently under the sea level, but which were not in very recent geological periods and which may be still active (e.g., faults, landslide accumulations, sand bars).
• A better understanding of landslide kinematics through generation of knowledge of their submarine spatial and temporal development. This knowledge would of course enable to provide a more comprehensive picture of landslide hazard conditions.
• Generation of information and knowledge related to risk reduction through pilot studies, with the possibility of extending the methodology to other European coastal areas, improving their environmental resilience.
• The Projects is intended to have a European dimension and a significant impact within the activities of the "European and Mediterranean Major Hazards Agreement".

Specific yearly objectives :

2012 :

1) Integration and coupling of existing terrestrial and submarine datasets;
2) Outline of marine level variations since the LGM;
3) Acquiring new data on submarine landforms and processes along the Normandy and Malta coastlines selecting pilot-areas where to conduct multi-beam surveys;
4) Continue the monitoring of coastal processes initiated within the "Coastline at risk" Project.

2013 :

1) Integration of newly acquired data (terrestrial and submarine) with the existing ones;
2) Propose a temporal reconstruction of the evolution of the study areas, with particular emphasis on creating maps when the sea levels was below the actual one;
3) Outline a methodology for hazard assessment taking into account climate and sea level changes (thus also focusing on terrestrial and submarine information).
4) Monitoring of coastal processes.

EXPECTED RESULTS

2012 :

Definition and assessment of the relationships between terrestrial and submarine morphological features in relation to landslide processes.

2013 :

1) Improvement of existing hazard maps taking into account issues related to climate change (sea-level, more frequent extreme meteorological events etc.);
2) Acquisition of necessary knowledge to define methods to perform landslide monitoring offshore (on the seafloor);
3) Definition of protocols which can be used in other coastal environments for risk reduction and resilience improvement.

The expected results could be used by others to prepare a guideline on climate change impact and integrate in the BE-SAFE-NET website

RESULTS OBTAINED PREVIOUSLY (if any)

The proposing partners have obtained significant results which can be functional to the development of the present Project within the CERG 2009-11 Project "Coastline at risk: methods for multi-hazard assessment".

RESULTS OBTAINED IN 2012

Study sites in Normandy coast

Along the Normandy coast, the research focuses on landslides and storm surges: the landslides studied are falls in hard rocks (cliff falls, debris fall and boulder and rock falls) and slides in soft rocks.

Location of the main processes in the study sites in Normandy

Two selecting pilot areas are:

The Villerville-Cricqueboeuf Landslides (Lower Normandy Coast, France).

The 12 km long Pays d'Auge coast in lower Normandy is periodically affected by rotational and translational landslide since several centuries. These landslides occurred in marly formations covered by chalks and quaternary deposits. In January 1982, major landslides have caused several damages (roads, destroyed houses). The affected slopes are the Cirque des Graves at the West of the city of Villerville and the Fosses du Macre at the East of the city of Cricqueboeuf.

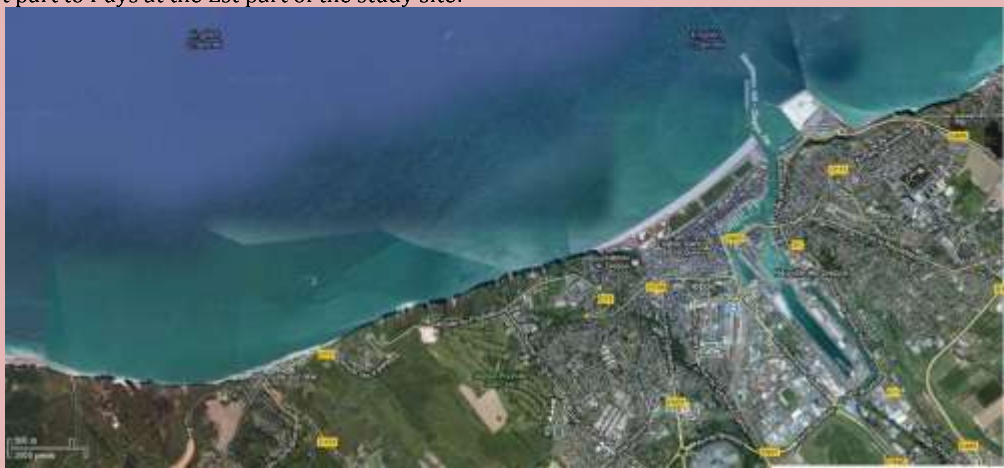
Aerial view of the Villerville-Cricqueboeuf landslide in Lower Normandy

The Pays d'Auge Plateau is bordered on the North by high cliffs of up to 140 m. The topography and geology of the cliffs are various. The main scarp is composed of Cenomanian chalk overlying glauconitic sands. Below, a thick layer of marls is on top of the sandy limestone of Hennequeville which shapes the cliff toe and constitutes a reef flat between Trouville and the Pointe du Heurt. Below the scarp, the slope is more gentle and composed of an accumulation of thick superficial heterogeneous materials (blocks and debris of chalk and flints, loamy sands). These formations have been placed during the Upper Pleistocene period. For coastal risk assessment, the main issues are focused on:

- reconstruction of the long term evolution of the instable slopes;
- definition of the morphology and internal structure of the landslides;
- integration of terrestrial and marine datasets,
- study of the relationship between the predisposal and triggering factors (i.e. the influence of climate change and coastal erosion on sea-level rise),
- definition of the dynamic of the active landslides and the different threshold in order to define a specific 'Landslide Early Warning System'.

Hard rock cliff in Upper Normandy

The other selecting pilot area is located in Upper Normandy along the hard rock cliff subjected to landslides (cliff falls, debris fall and boulder and rock falls) and storm surges, in each part of Dieppe arbour from Cap d'Ailly (Varengeville) at the west part to Puys at the Est part of the study site:



Selecting pilot area in Upper Normandy in each part of Dieppe harbour from Cap d'Ailly (Varengeville) to Puys (Est part).

For coastal hazard assessment, three issues coupling terrestrial and submarine datasets are requiring for:

- definition of the production of debris (flint) from cliff erosion which feeding intertidal sedimentary stock, gravel beach,
- definition of infratidal sandy inputs on gravel beach, which participate to the functioning of these accumulation,
- definition of the impacts of harbor jetty on infratidal sedimentary drift (onshore-off shore and longshore drift).

Study sites in Maltese coast

During this year of research, the existing terrestrial and submarine datasets have been collected through a bibliographic and archive research.

A multidisciplinary approach to integrate and couple terrestrial and submarine datasets has been defined, which foresees contributions from geomorphology, marine geology, geophysics and engineering geology.
The newly acquired submarine data (see specific following section) and the elaboration of a detailed DTM of the seafloor along the north-west coast of the Island of Malta, has enabled to outline for the first time the submerged landforms of this stretch of coast. A first attempt to compare terrestrial and submarine landforms has been performed with the aim of producing, during the second year of research, a comprehensive geomorphological map capable to illustrate terrestrial and submarine landforms in the same sheet, which could serve as a useful tool for hazard assessment.

Work package 1 (prepared by CERG, IcoD, Università di Modena e Reggio Emilia, Université de Caen Basse-Normandie, Consiglio Nazionale delle Ricerche: Istituto di Scienze Marine; CNR-IRPI):
Description:
Integration and coupling of existing terrestrial and submarine datasets;
Associated deliverables:

Normandy case study
For the two sites, all existing terrestrial and submarine datasets have been integrate in a GIS platform (Arcgis 10). The main efforts have been focused in the research and the integration of the submarine datasets (bathymetric characteristics, sedimentary characteristics of sea floor (Figure 3), beach's sedimentary stock evolution on the beaches and at the cliffs foot). This information is very important especially to assess the sandy exchanges between near shore zone and sub-aerial beach.
Several maps, DTM (Digital Terrain Model) at the different scales and resolutions, meteorological data and hydrodynamic conditions (wave climate, tide regime, storm sea level …) have been collected from the bibliography and previous researches. Also, historical census events allow to know (1) the types of atmospheric circulation, (2) meteorological conditions (thresholds), and (3) flood extension.
The quality and the density of information are very diverse for the test sites. In example, for the Villerville-Cricqueboeuf landslides, the bathymetric data are relatively low and incomplete. A multibeam sonar survey has been carried out by the SHOM (French Hydrographic Office) but the area covered by the survey stopped at the West part of the Villerville town. At the East part, only information provided by the submarine paper map is available (Figure 4).

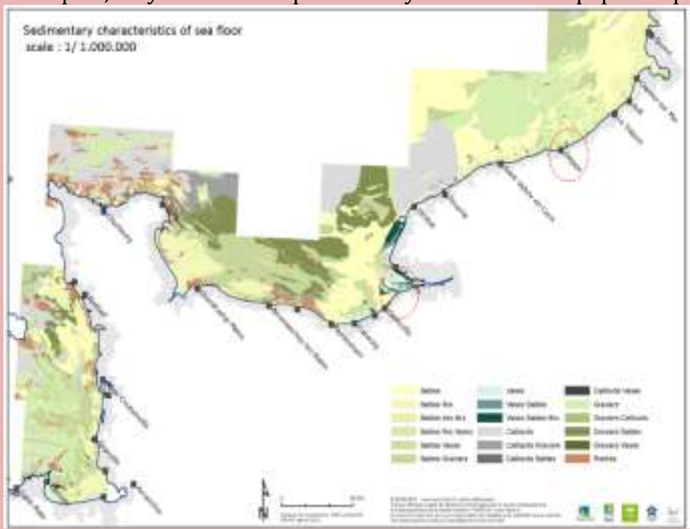


Figure 3. *Sedimentary characteristics of sea floor of the Channel at the scale of 1/1.000.000. (from SHOM, 2011)*

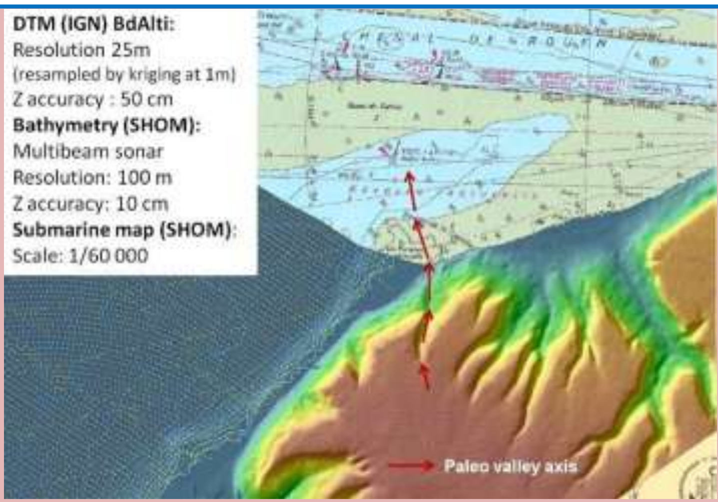
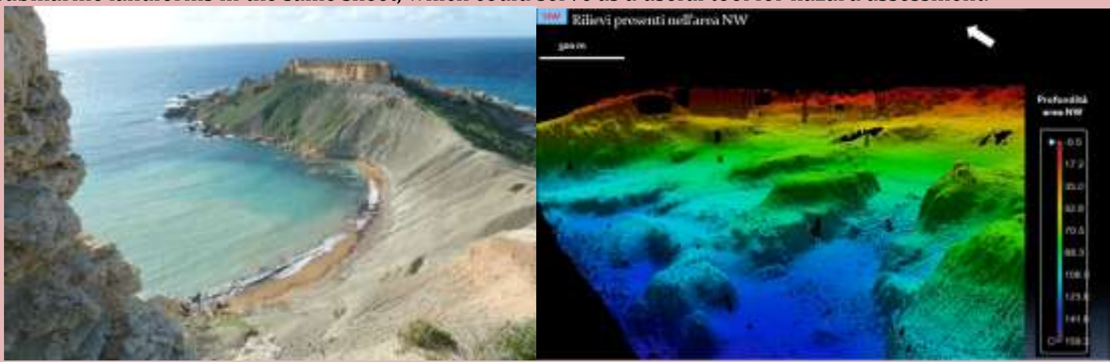


Figure 4. *Example of merged different submarine and terrestrial datasets under the GIS platform for the Villerville-Cricqueboeuf landslides test site.*

Malta case study

The newly acquired submarine data and the elaboration of a detailed DTM of the seafloor along the north-west coast of the Island of Malta, has enabled to outline for the first time the submerged landforms of this stretch of coast (see figure below). A first attempt to compare terrestrial and submarine landforms has been performed with the aim of producing, during the second year of research, a comprehensive geomorphological map capable to illustrate terrestrial and submarine landforms in the same sheet, which could serve as a useful tool for hazard assessment.



Comparison of emerged and submerged structural landforms susceptible to landsliding along the NW coast of Malta

Work package 2 (prepared by CERG, IcoD, Università di Modena e Reggio Emilia, Université de Caen Basse-Normandie, Consiglio Nazionale delle Ricerche: Istituto di Scienze Marine; CNR-IRPI):

Description:

Outline of marine level variations since the LGM for selected coastal areas in Normandy and Malta;

Associated deliverables:

Normandy case study

An outline of sea-level variations since the Last Glacial Maximum (LGM) has been produced based on literature and recent researches (Figure 5). This has to contributed to reconstitute the general environmental conditions since Wurm period (- 30 000 year BP, maximum of Wurm), in the Channel, with periglacial conditions, and the estimated positions of sea level for several dates with a lower sea level ca. 130 metres lower than today.

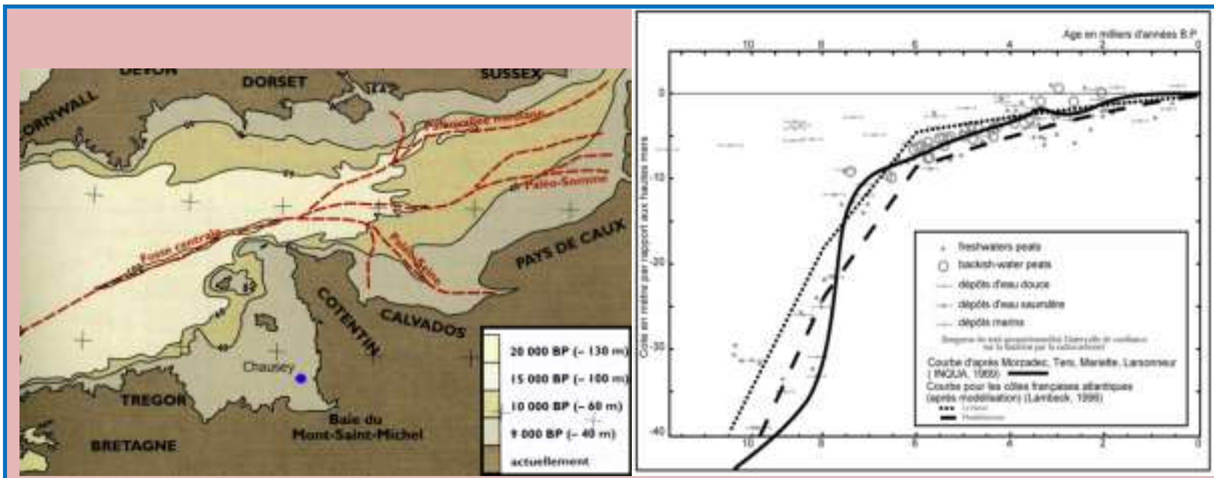


Figure 5. *Position of the shore (level) since the Wurm period (left image) and Curves of relative sea level rise during the Holocene for the N-W of France (right from Morzadec et al., 1969 & Lambeck, 1996).*

During the Holocene (last 10 000 years), after intensive increase of the sea level (between 10 000 to 8 000 year BP) with a rate of 6-7 cm per year, the rate decreased with a value of 3-4 cm per year, and at 5 000 year BP, the sea level reached more or less the actual sea level. It is not really well observed on Figure 5 (right), because the curve is an average for the N-W of France for tidal range different than tidal range observed in study sites (the Channel is a macrotidal and megatidal sea and it is very difficult to determine precisely the sea level). But for the Lower Norman study site, our observations and measures conducted during this project allowed to determine the position of the low tide cliff (at the altitude of -1 m NGF) which is the limit of the reef flat. This would correspond to the position of the shoreline at 6000-5000 year BP located at a distance of 290-330 m in front of the actual shoreline (Figure 6 & Figure 7).

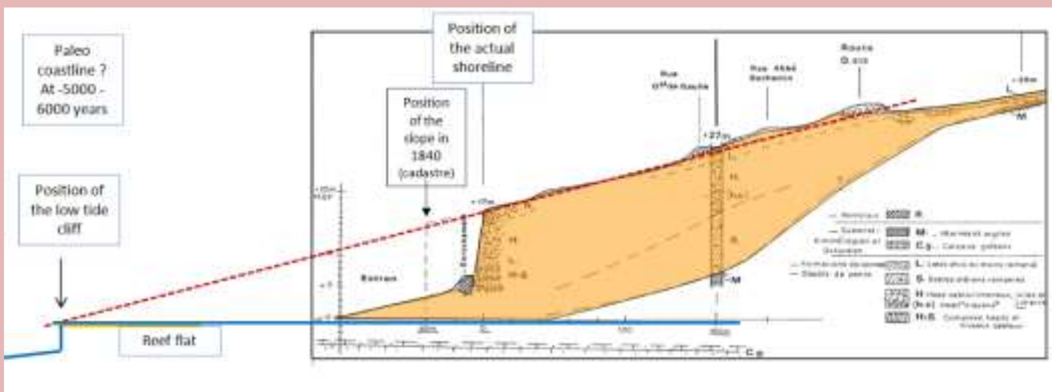


Figure 6: *Cross section of the paleo-valley fulfilled by colluvial-alluvial materials and different position of the shoreline during the last 6000 years at Villerville town, France*

Figure 7: *Position of the shoreline at 5000-6000 years BP in front of the Villerville-Cricquebeouf slope, France.*

The progressive sea erosion during the last 6000 years reach a value of 300 m: the rate of erosion is approx. 5 cm per year for this sea level. But for the future, we have to take into account the relative sea level evolution. On the base of monthly and annual mean sea level measured between 1950 to 2011 at the Dieppe harbor and Le Havre harbor located close to the study sites, the rate of Sea Level Rise (SLR) is respectively 0.53mm per year and 0.18 mm per year since 1960's (Figure 8).

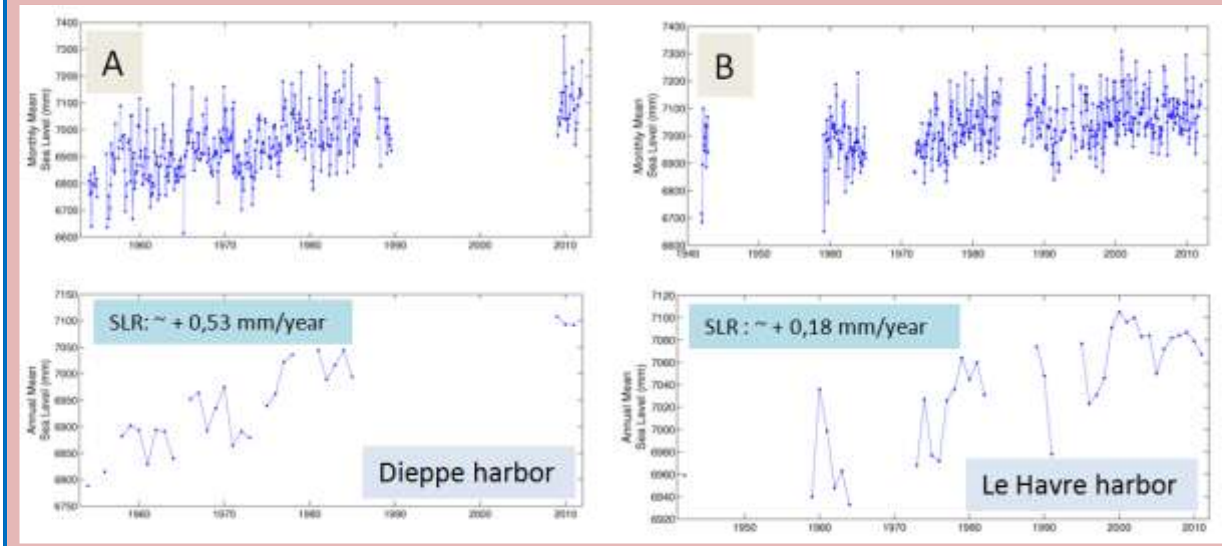


Figure 8: *Monthly and annual mean sea level measured and rate of Sea Level Rise (SLR) between 1950 to 2011 for the Dieppe harbor (A) and Le Havre harbor (B) (from Pirazzoli et al., 2002 and PSMSL, 2011).*

Malta case study

Based on recent literature (Lambeck et al., 2011; Carroll et al., 2012; Furlani et al., 2012; Marriner et al., 2012), an outline of sea-level variations since the Last Glacial Maximum (LGM) has been produced. This has contributed to confirm the hypothesis that the large-scale landslides located along the north-west coast of Malta were triggered in different morpho-climatic conditions, which foresaw more humid conditions and a sea level ca. 130 metres lower than today (Figs. 2 and 3). This means that the onset of the numerous block slides at present observable along the coast probably affected valley slopes rather than coastline areas. The progressive increase of the sea level during the Holocene would have then caused the partial submersion of the lower parts of the landslide accumulations.

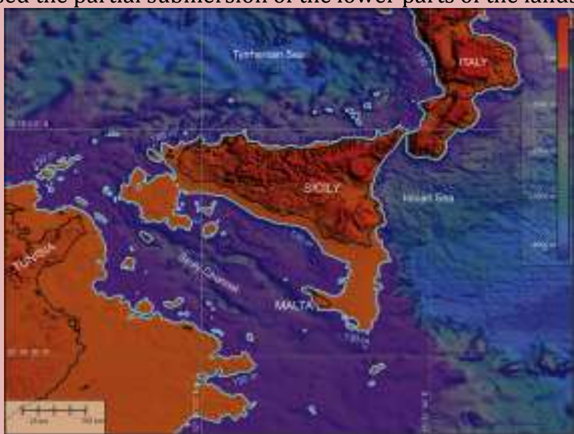


Fig. 2 – Paleogeography of the Central Mediterranean Sea during the LGM (sea level ca. 130 m below present level; after Furlani et al., 2012)

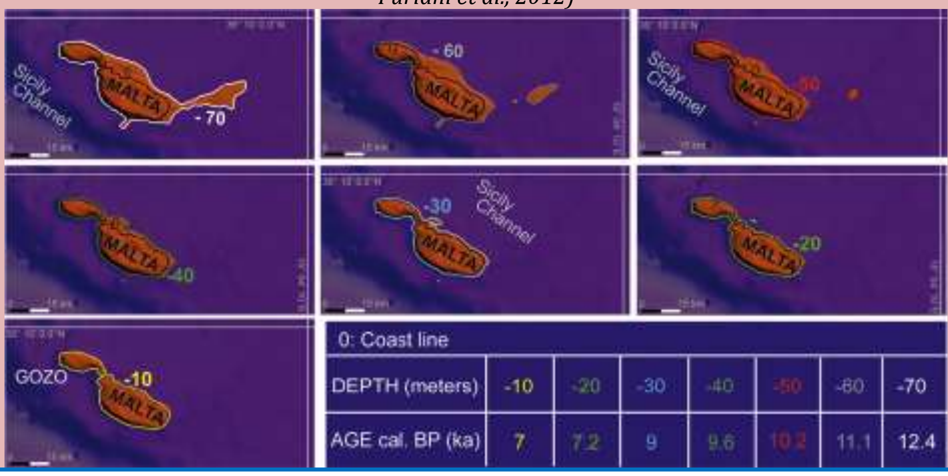
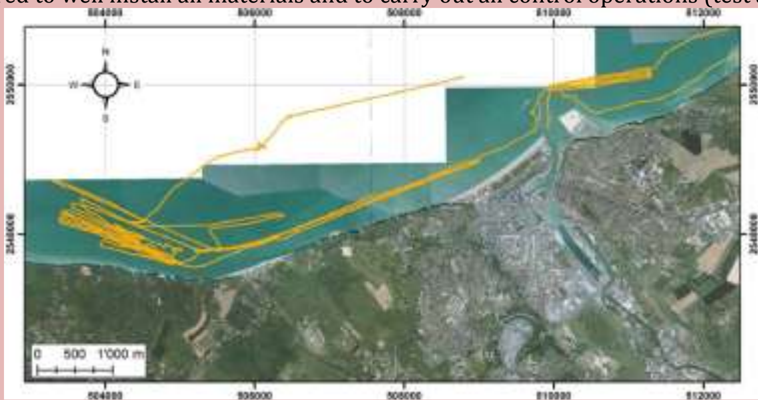


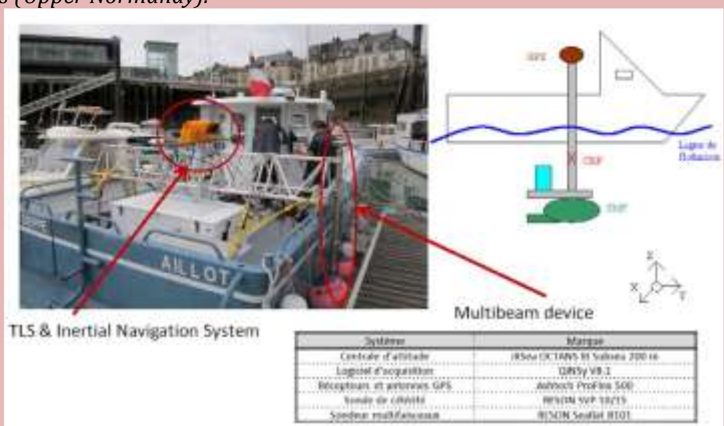
Fig. 3 - Palaeoshorlines during the post-glacial sea-level rise, from 12,400 to 7000 years ago; after Furlani et al., 2012

Work package 3 (prepared by CERG, IcoD, Università di Modena e Reggio Emilia, Université de Caen Basse-Normandie, Consiglio Nazionale delle Ricerche: Istituto di Scienze Marine; CNR-IRPI):
Description:
Multi-beam survey of selected Normandy and Malta coasts.
Associated deliverables:

Normandy case study
The selecting pilot area is located in Upper Normandy along the hard rock cliff subjected to landslides (cliff falls, debris fall and boulder and rock falls) and storm surges, in each part of Dieppe arbour from Cap d'Ailly (Pourville) at the west part to Puys at the East part of the study site.
For coastal hazard assessment, three issues coupling terrestrial and submarine datasets are requiring for:
• definition of the production of debris (flint) from cliff erosion which feeding intertidal sedimentary stock, gravel beach,
• definition of infratidal sandy inputs on gravel beach, which participate to the functioning of these accumulation,
• definition of the impacts of harbor jetty on infratidal sedimentary drift (onshore-off shore and longshore drift).
The different devices (MLS coupling with Multibeam) were installed on the boat:
• 1. Mobile Laser Scanning (MLS) is using the same principles than aerial devices. It is constituted by 2 GNSS (GPS) antennas in order to localize the laser source, 1 Inertial Measurement Unit (gyroscope to orientate the Line of Sight of the laser) and 1 TLS (Terrestrial Laser scan) that produces laser pulses and records the time of flight. Also, by this way, we could well know the laser's position, orientation and time of flight, and obtain spatial registration of points (cloud points).
• 2. Multibeam: Bathymetric measurements were acquired by the multibeam sounder high-resolution SeaBat 8101 manufacturer RESON. This system operates at frequency 240 kHz. The geometry of emission and reception antennas to get an opening angle (of the beam) transverse and longitudinal 1.5 by 1.5 ° °, and therefore a beam footprint well resolved on the bottom of the sea. The multibeam is also
associated with GPS antenna and to attitude station OCTANS Subsea manufactured by iXSea which is used to compensate the movement of the boat and provide the vessel's heading.
• One full day is required to well install all materials and to carry out all control operations (test and calibration).

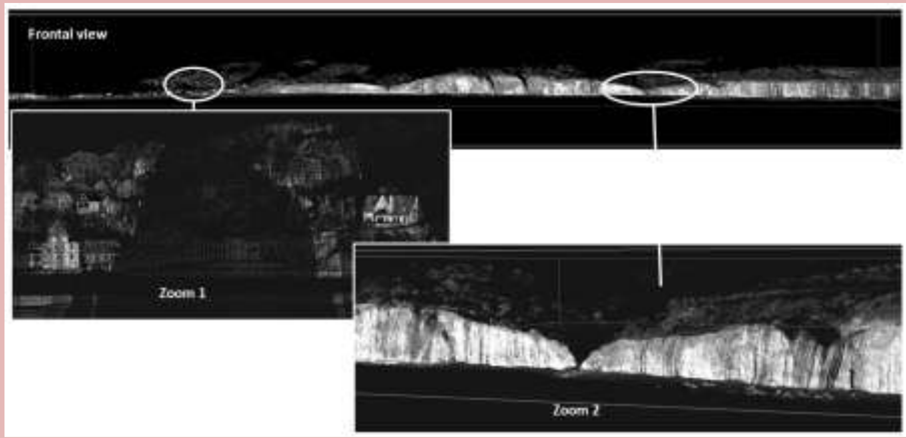


Example of vessel trajectory during bathymetry and MLS acquisitions for one single day in September 2012 from Cap d'Ailly (Pourville) to Puys (Upper Normandy).



General view of the different devices (MLS coupling with Multibeam) installed on the boat for simultaneous survey (September, 2012). (by R. Cancouet, E. Augereau, C. Delacourt, IUEM-DO, Brest).
First results:
Once all instruments set up on board, topographic and bathymetric measurements can be done quickly. If weather conditions is good (not too windy and rainy), we could obtain information on approx two linear km per hour.

For the MLS (Figure xx.3), on the example of frontal view, we obtained a very good general aspect of the landforms. In high density areas (Zoom 1), the resolution is better than 10 cm (cf. house). The morphological parameters (Zoom 2) can be well observed, even on intertidal areas. Surfaces processes, such as collapse talus, can be observed and quantified in few seconds.



Cloud points obtained by MLS (Mobile Laser Scan) from Dieppe to Pourville (Upper Normandy, September 2012) (by C. Michoud, D. Carrea, M.-H. Derron, M. Jaboyedoff, UniL CRET)

For the multibeam survey, the preliminary results allow to well observe the bathymetry with a very good resolution (around 20 cm): In example, an important accumulation of blocks on the lower shore platform is well detected at the cape d'Ailly. These blocks of sandstone are in relation with the retreat of the cliff by large old rock falls (the blocks are arranged in the shape of crown or curved belt); also, near the jetty of Dieppe, an important sandy accumulation progress towards the tip of the jetty.

Malta case study

In the frame of this project a new marine survey along the north-west coast of the Island of Malta was commissioned to AquaBioTech Limited, which performed it in May 2012. It consisted of a Multi Beam and a Sub Bottom Profiler survey to obtain a high resolution bathymetry of the shallow water and to assess the internal structure of the submarine landslides. An inteferometric echosounder Swathplus was used which is made up by two transducers with a frequency of 117 kHz that can reach a depth of 350 m.

The survey carried out has investigated an area of about 7.5 km in length (north/south orientation) and a maximum distance from the shore of 1.6 km in width (east/west orientation). Preference has been be given to shallower areas, close to the coastline to better support the integration of terrestrial and marine datasets. The survey area extends from the south point of Cirkewwa to Ras il-Pellegrin point as seen on the map (Figs. 4 and 5).

The detailed bathymetry, achieved by means of analysis carried out in collaboration with CNRISMAR, has provided useful information on the seafloor morphology, including submerged landslide accumulations. The elaboration enabled the production of a DTM of the seafloor of the investigated area with a resolution of 2 m and a vertical exaggeration of 5x (Fig. 5). Worth of note are the profiles achieved for Anchor Bay, where extensive landslide monitoring is ongoing. The observation of the first metres under the seafloor enable to identify buried collapsed blocks related to the landslides affecting the north side of the bay.

Work package 4 (prepared by CERG, ICoD, Università di Modena e Reggio Emilia)

Description:

Monitoring of coastal processes initiated within the "Coastline at risk" Project.

Associated deliverables:

Normandy case study

As regards the Norman case study in France, the APO-CERG Project "Coastline at risk" focused on coastal instability phenomena occurring on the Lower Normandy where large active landslide occur in the Villerville-Cricqueboeuf municipalities (see description above). Monitoring of coastal landslides has been continued in the frame of this project. Several monitoring campaigns have carried out during 2012, in order to measure the superficial displacements, the water table variations and the climatic conditions. The results' analysis shows that the landslides continue to be active and show horizontal and vertical displacements in agreement with trend of movement shown during the last years of observation.

Maltese case study

As regards the Maltese case study, the APO-CERG Project "Coastline at risk" focused on coastal instability phenomena occurring on the north-western stretch of the Island of Malta where widespread active lateral spreading and block sliding occur due to the presence of rock masses showing different lithological and geomechanical characteristics (Soldati et al., 2011; Devoto et al., 2012). Integrated research methods and techniques were applied with special reference to mapping and monitoring of coastal instability phenomena along the coastlines (Mantovani et al., 2012).

Monitoring of coastal landslides has been continued and strengthen along the north-west coastline of Malta, at Il-

Prajjet (Anchor Bay) and Ghajn Tuffieha Bay (Fig. 6). Monitoring techniques include GPS, consisting in 2 reference stations and more than 20 benchmarks spread all over the unstable areas and wire extensometers which have shown that rock spreading phenomena are active with local displacements up to a few centimetres per year. In order to guarantee the repetitiveness of the surveys, this project is meant to continue the GPS measurements. Moreover, this has been accompanied by the installation of wire extensometers to monitor in continuous the displacements along the most active fractures. Additional benchmarks have been placed along the selected fractures and the first measures have been made manually by means of a wire extensometer.
Two monitoring campaigns have carried out during 2012, in April and November. The results' analysis shows that the landslides continue to be active and show horizontal and vertical displacements in agreement with trend of movement shown during the last years of observation. The total displacements recorded at the Anchor Bay site are shown in Fig. 7.

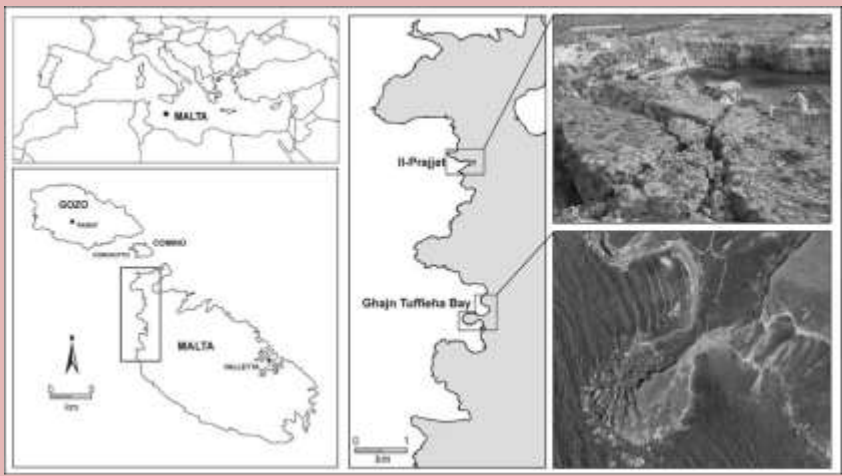


Fig. 6 - Location of the landslide monitoring sites along the NW coast of Malta

Fig. 7 – Displacements measured at the monitoring site of Anchor Bay, NW coast of Malta

RESULTS OBTAINED IN 2013

Working package 1 (prepared by CERG, IcoD, Università di Modena e Reggio Emilia, Université de Caen Basse-Normandie, Consiglio Nazionale delle Ricerche: Istituto di Scienze Marine; CNR-IRPI):
Description:
Improvement of existing hazard maps taking into account issues related to climate change (sea-level, more frequent extreme meteorological events etc.);
Associated deliverables:

Work package 2 (prepared by CERG, IcoD, Università di Modena e Reggio Emilia, Université de Caen Basse-Normandie, Consiglio Nazionale delle Ricerche: Istituto di Scienze Marine; CNR-IRPI):
Description:
Acquisition of necessary knowledge to define methods to perform landslide monitoring offshore (on the seafloor);
Associated deliverables:

Work package 3 (prepared by CERG, IcoD, Università di Modena e Reggio Emilia, Université de Caen Basse-Normandie, Consiglio Nazionale delle Ricerche: Istituto di Scienze Marine; CNR-IRPI):
Description:
Definition of protocols which can be utilised in other coastal environments for risk reduction and resilience improvement.
Associated deliverables:

Work package 4 (prepared by CERG, ICoD, Università di Modena e Reggio Emilia):
Description:
Monitoring of coastal processes.
Associated deliverables:

A. Maltese coastal area

Achievement of new data on submarine landforms and processes along the Maltese coastlines

In the frame of this project a new marine survey along the north-west coast of the Island of Malta was commissioned to AquaBioTech Limited, which performed it in May 2012. It consisted of a Multi Beam and a Sub Bottom Profiler survey to obtain a high resolution bathymetry of the shallow water and to assess the internal structure of the submarine landslides. An interferometric echosounder Swathplus was used which is made up by two transducers with a frequency of 117 kHz that can reach a depth of 350 m.

The survey carried out has investigated an area of about 7.5 km in length (north/south orientation) and a maximum distance from the shore of 1.6 km in width (east/west orientation). Preference has been be given to shallower areas, close to the coastline to better support the integration of terrestrial and marine datasets. The survey area extends from the south point of Cirkewwa to Ras il-Pellegrin point as seen on the map (Figs. 4 and 5).

The detailed bathymetry, achieved by means of analysis carried out in collaboration with CNR-ISMAR, has provided useful information on the seafloor morphology, including submerged landslide accumulations. The elaboration enabled the production of a DTM of the seafloor of the investigated area with a resolution of 2 m and a vertical exaggeration of 5x (Fig. 5). Worth of note are the profiles achieved for Anchor Bay, where extensive landslide monitoring is ongoing. The observation of the first metres under the seafloor enable to identify buried collapsed blocks related to the landslides affecting the north side of the bay.

Fig. 4 – Coordinates of the marine survey area along the NW coast of Malta

Long WGS84	Lat WGS84
14°18’40.0490’’	35°54’15.7742’’
14°18’37.9081’’	35°58’22.3723’’
14°20’47.2283’’	35°58’23.0960’’
14°20’49.2576’’	35°54’16.4961’’
14°18’40.0490’’	35°54’15.7742’’

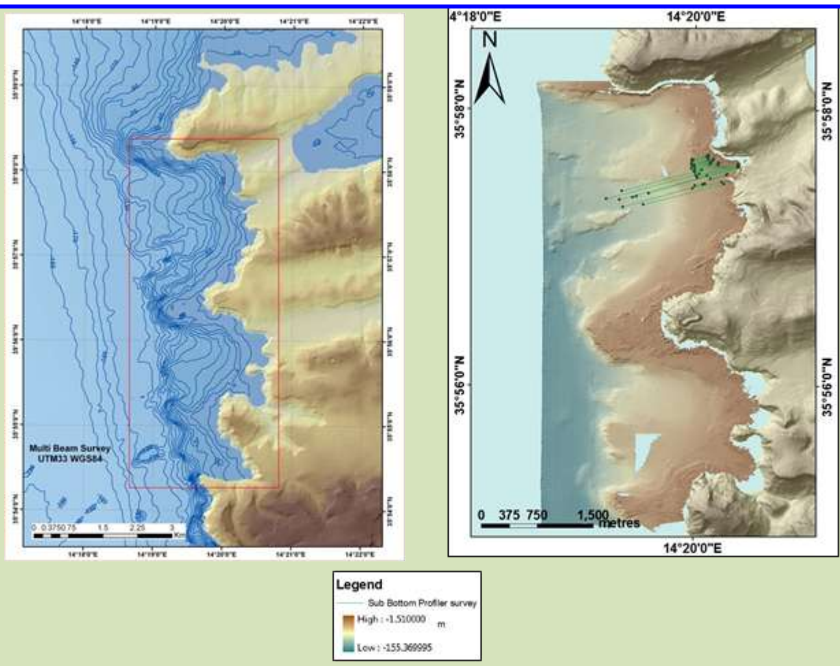


Fig. 5 – Extension of the marine survey area (left) and DTM of emerged and submerged areas along the NW coast of the Island of Malta (right)

The AquaBioTech Group provided also a LiDAR-derived DTM of the northern area of the Island of Malta. The dataset comprises both land and seafloor on the north-western coast of Malta (from Ras il Pelegrin to the south to Marfa Ridge to the north), the north-eastern coast of the Island (from Qawra to the south to Marfa Ridge to the north) and the northern area (including Comino Channel). The device used to acquire the data is the airborne bathymetric LiDAR HawkEye II, which is characterized by a density ranging from 1.7x1.7 m to 3.5x3.5 m. The DTM obtained has a resolution of 1 m and no vertical exaggeration. The data reach the elevation of 150 m and the depth of 52 m. These data permitted to better analyse the topography, especially the landslide accumulations, both submerged and emerged.

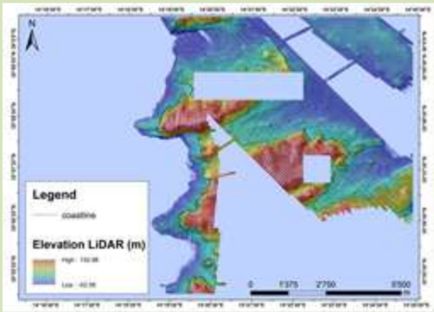


Fig. 6 – DTM derived from the LiDAR data

Analyses carried out on the datasets

A morphometric analysis of the LiDAR and the bathymetric data together was performed calculating aspect, slope, standard deviation of the slope, profile and planform curvature. A detailed study was carried out on the landslide accumulations extracting the crests of the blocks and calculating the density of the blocks for both the emerged and submerged landslides. The analyses confirmed that the larger extension of the submerged blocks accumulations than the terrestrial ones. The submarine landslides also showed a preferential orientation W-E, well notable in the sites of Anchor Bay and Badja Ridge. Through the extraction of the crests of the blocks, it was noticed that the single blocks do not show a preferential orientation, but they seem to be randomly distributed. Moreover the density map shows a higher density of blocks in the submarine landslides than in the terrestrial accumulations.

A visual interpretation of the backscatter data acquired during the bathymetric survey was performed and improved using the Focal Statistics tool of ArcGIS 10.1. This is to infer the kind of sediment coverage discriminating between rock substrate, coarse and fine sediment. Through this analysis, it was confirmed that the landslide accumulations are made up of large rocky blocks in a finer matrix. It was also possible to identify rock outcrops downslope the continental shelf, while the majority of the area surveyed is covered by medium to fine sediment. Based on these results future objectives are to validate these hypotheses taking samples from the seafloor and to define which geological formations could be found under the recent sediment coverage.

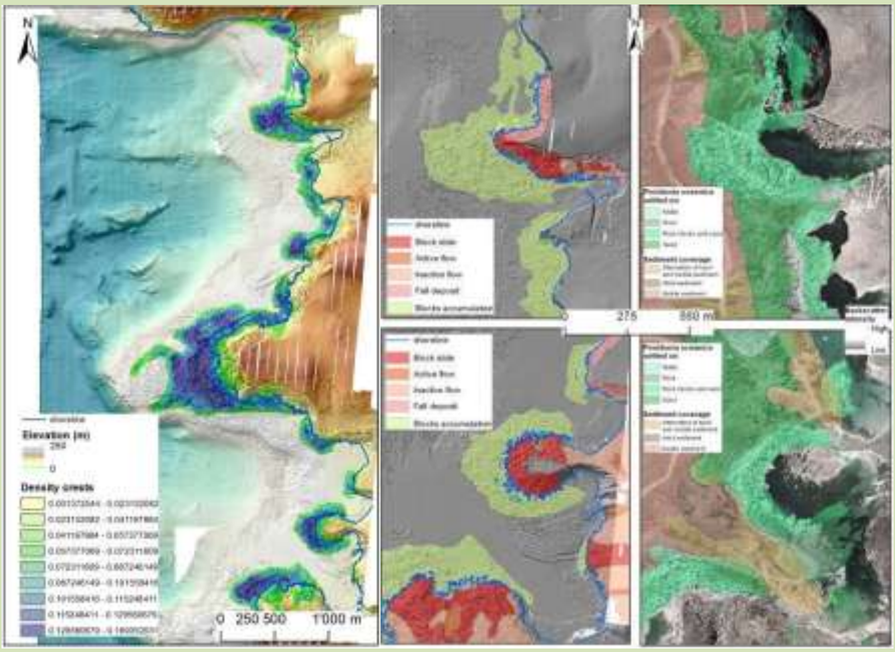


Fig. 7 – Density of blocks in the terrestrial and marine landslides (left). Maps of landslide distribution at Anchor Bay and Il-Qarraba (centre) and interpretation of backscatter data at Anchor Bay and Il-Qarraba (right).

Monitoring of hazardous coastal processes

Two monitoring campaigns have carried out during 2012 and two during 2013, in April/May and November. The results' analysis shows that the landslides continue to be active and show horizontal and vertical displacements in agreement with trend of movement shown during the last years of observation. The total displacements recorded at the Anchor Bay site are shown in Fig. 9.

Fig. 9 – Displacements measured at the monitoring site of Anchor Bay, NW coast of Malta. Arrows refer to planar displacements and circles to vertical displacements measured between 2006 and 2013.

B. French coastal area

The selecting pilot area is located in Upper Normandy along the hard rock cliff subjected to landslides (cliff falls, debris fall and boulder and rock falls) and storm surges, in each part of Dieppe arbour from Cap d'Ailly (Pourville) at the west part to Puys at the East part of the study site (Figure 3.1).

Figure 3.1 Location of the different survey campaigns carried out along the coast in September 2012 and September 2013 from Cap d'Ailly (Pourville) to Puys (Upper Normandy).

Achievement of new data on submarine landforms and processes along the Upper Norman coastline

In September 2012, a coupling MLS (Mobile Laser Scanning) and bathymetry (multibeam) campaign was carried out in order to acquire simultaneous new data on submarine and subaerial landforms. The main objective was to verify the feasibility and to estimate the accuracy of this type of coupling survey in an 'open' sea, like the Channel (previously, MLS coupling with multibeam was applied only on the artificial reservoir and along the coast of protected and closed sea in Norway).

In September 2013, a second simultaneous MLS (Mobile Laser Scanning) and TLS (Terrestrial Laser Scanning) campaign was carried out in order to acquire new data on subaerial landforms. The main objectives were: to compare the data acquired by MLS and TLS in the same zones, in order to define their respective resolution and repeatability; to verify if the MLS method could become a reliable and rapid technique for regularly monitor the cliff dynamic; to define the protocols which can be used in other coastal environments for hazard assessment.

The different devices (MLS coupling or not with Multibeam) installed on the boat have been detailed in the 2012 report. This year for this second campaign, we have used the same materials and the same boat. After installation of the materials and control operations (test and calibration), we have acquired topographic information on approx two linear km per hour. During two days and following the tide and weather constraints, a total of approx 40 linear km has been collected.

Results:

Once all instruments set up on board, topographic and bathymetric measurements can be done quickly. If weather conditions is good (not too windy and rainy), we could obtain information on approx two linear km per hour (Fig. 18).

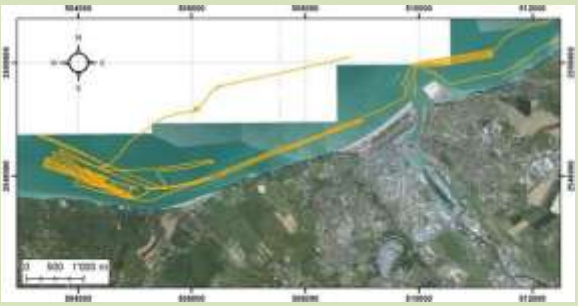


Fig. 18 - Example of vessel trajectory during bathymetry and MLS acquisitions for one single day in September 2012 from Cap d'Ailly (Varengeville) to Puys (Upper Normandy) (by R. Cancouet, E. Augereau, C. Delacourt, IUEM-DO, Brest).

For the multibeam survey, the results allow to well observe the bathymetry with a very high resolution (around 20 cm): In example, an important accumulation of blocks on the lower shore platform is well detected at the cape d'Ailly (Fig. 19). These blocks of sandstone are in relation with the retreat of the cliff by large old rock falls (the blocks are arranged in the shape of crown or curved belt); also, near the jetty of Dieppe, an important sandy accumulation progress towards the tip of the jetty.

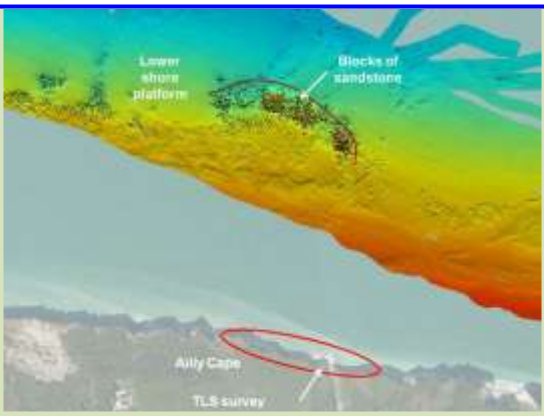


Fig. 19 - Bathymetry in front of the Ailly Cape obtained by multibeam sounder high-resolution in September 2012 (by R. Cancouet, E. Augereau, C. Delacourt, IUEM-DO, Brest)

For the MLS survey (Fig. 19), on the example of frontal view, we obtained a very good general aspect of the landforms. In high density areas (Zoom 1), the resolution is better than 10 cm (cf. house). The morphological parameters (Zoom 2) can be well observed, even on intertidal areas. Surfaces processes, such as collapse talus, can be observed and quantified in few seconds (Michoud et al., 2013b).

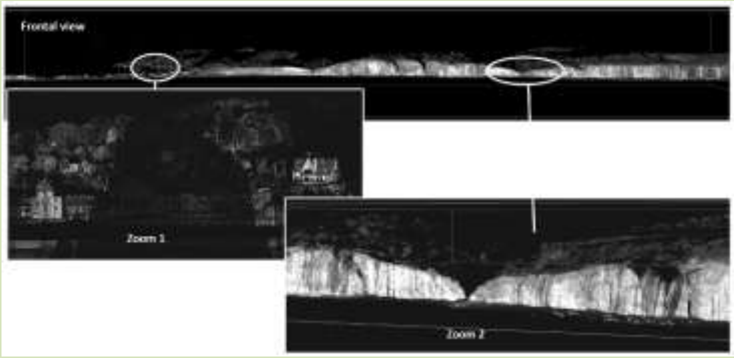


Fig. 19 - Cloud points obtained by MLS (Mobile Laser Scan) from Dieppe to Pourville (Upper Normandy, September 2012) (by C. Michoud, D. Carrea, M.-H. Derron, M. Jaboyedoff, UniL CRET)

In September 2013, the MLS survey confirm that we could obtain a very good general aspect of the landforms with a range of resolution from less than 10 cm in the high density areas to approx. 10-20 cm in the other areas. The morphological parameters can be well observed, even on intertidal zone (Flintstones, caves). Surfaces processes, such as chalk fall (Zoom) can be well observed and quantified in few seconds (Fig. 20). Also, the density of points obtained by MLS is mostly better than pre-existing DEM25 available dataset (Fig. 21).

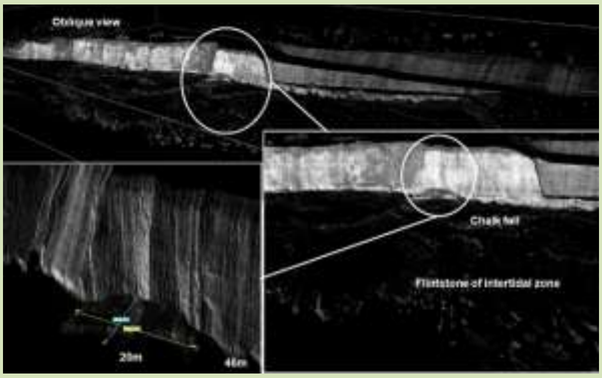


Fig. 20 - Cloud points obtained by MLS (Mobile Laser Scan) in front of Puys (North of Dieppe Upper Normandy) (by C. Michoud, D. Carrea, M.-H. Derron, M. Jaboyedoff, UniL CRET)

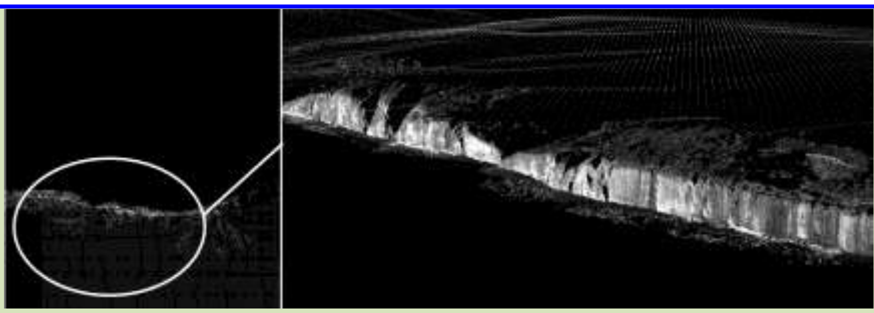


Fig. 21 - Cloud points obtained by MLS (Mobile Laser Scan) vs DEM25 cloud points available in front of Pourville-Petit Ailly, Upper Normandy) (by C. Michoud, D. Carrea, M.-H. Derron, M. Jaboyedoff, UniL CRET)

The MLS survey confirm that we could obtain a very good general aspect of the landforms with a range of resolution from less than 10 cm in the high density areas to approx. 10-20 cm in the other areas. The morphological parameters can be well observed, even on intertidal zone (Flintstones, caves). Surfaces processes, such as chalk fall (Zoom) can be well observed and quantified in few seconds. Also, the density of points obtained by MLS is mostly better than pre-existing DEM25 available dataset (Figure 20).

In conclusion, MLS devices are able to quickly scan long shoreline with a resolution up to about 10 cm. The precision of the acquired data is relatively small enough to investigate on geomorphological features of coastal cliffs at the low-cost financial effort (Michoud et al., 2013a). MLS also are producing complementary dataset. MLS will be use in addition of the ALS (aerial laser scan) survey mainly for the steep and vertical cliffs areas due to the vertical line of sight during ALS acquisitions. MLS survey appears like a reliable and rapid technique for regularly monitor the cliff dynamic. But at the high spatial and temporal scale, the processes have to be observing with the TLS (Terrestrial Laser Scan). Also, by the way, we could now define the protocols which can be used in other coastal environments for hazard assessment.

To observe the production of scree which could be in significant proportion (approximately 10%) of the ablation, a site of active cliff (Petit Ailly) was surveyed by TLS every 4-5 months during 28 months (2010-2013). After data processing (georeferencing point cloud, cleaning point cloud, meshing and interpolation to have DEMs), the differential error margin of results is about ±0.03 m for a TLS located at 80 m from the studied cliff face (Fig. 22). This work highlights that (Fig. 23):

- Ablation rate in context of active cliff (Petit Ailly) has a regressive dynamic of 0.24 m/y,
- Active cliffs have mass movements and scree production. The latter one is responsible for 25% of the total ablation, and the rest is due to mass movements,
- Ablation mainly occurs during winter.

Fig. 22 - TLS (Terrestrial Laser Scan) survey at Puys and Petit Ailly, Upper Normandy

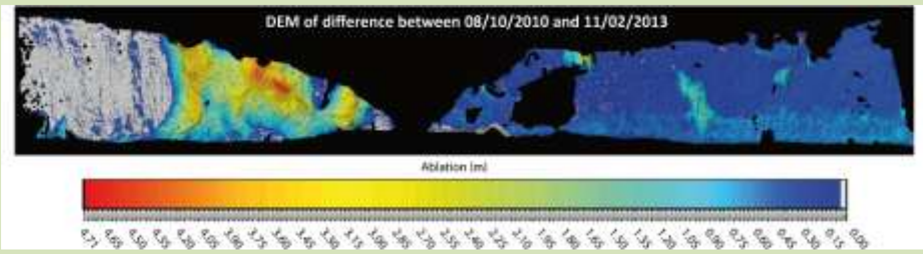


Fig. 23 - Evolution of the cliff front obtained by TLS (Terrestrial Laser Scan) from 8 October 2010 to 11 February 2013, Petit Ailly, Upper Normandy) (from Letortu, 2013)

Monitoring of hazardous coastal processes

As regards the Norman case study in France, the APO-CERG Project "Coastline at risk" focused on coastal instability phenomena occurring on the Lower Normandy where large active landslide occur in the Villerville-Cricqueboeuf municipalities (see description above). Monitoring of coastal landslides has been continued in the frame of this project. Several monitoring campaigns have carried out during 2012 and 2013, in order to measure the superficial displacements, the water table variations and the climatic conditions. The results' analysis shows that the landslides continue to be active and show horizontal and vertical displacements in agreement with trend of movement shown during the last years of observation.

Analysis of the Danestal piezometer allows defining two significant piezometric thresholds, for respectively, a seasonal acceleration of low amplitude (threshold at -10.3 m in depth) and a large acceleration of high amplitude (threshold at 13 m in depth). Consequently in-situ observations suggest that a change of +2.65 m of the groundwater level is necessary to trigger a major acceleration (Fig. 24).

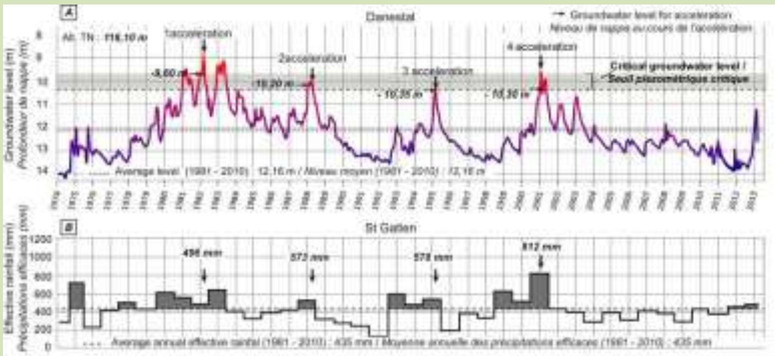


Fig. 24 – Relation between groundwater level variations at Danestal piezometer and effective rainfall between at St Gatien between 1974 and 2013. A: Groundwater level at Danestal piezometer since 1974; B: Excessive rainfall compared to the mean annual effective rainfall at Saint Gatien station. (Lissak et al., accepted).

The Cirque des Graves landslide is a typical example of slow-moving and deep-seated landslide developed in vulnerable area. The multiscalar (spatial and temporal) analysis makes it possible to estimate a piezometric level of the Cirque des Graves landslide reactivation. The hydrological analysis based on historical data and field surveys highlights the spatial distribution, the temporal variability of the landslide kinematic and the complexity of the landslide dynamic linked to the hydro-meteorological conditions. The landslide is characterized by minor accelerations in winter season associated to hydro-meteorological regular conditions. But brutal accelerations associated to excessive rainfall periods can trigger too. Thus, the assessment of the temporal occurrence of the landslide is complex because of the temporal heterogeneities of the landslide dynamic. Statistical methods are generally suggested to investigate the temporal occurrence of landslides by probability. For the moment a semi-quantitative approach can be carry out through field surveys. The use of permanent sensors with millimetric resolutions helped to quantify very low movements (mm) which are imperceptible by traditional geodetic measurements. However the installation at several points of sustainable permanent GNSS receivers with a daily transmission of data is still expensive. It is therefore necessary to implant receivers at strategic points, representative of the whole behavior of the landslide (Lissak et al, accepted).

The combination of repeated campaigns and permanent monitoring was necessary to: 1) highlight the regressive dynamic of the landslide, 2) evaluate the spatial and temporal heterogeneity of the displacement rates, 3) to divide the landslide into several compartments affected by a time lag for displacements and 4) to evaluate the effect of groundwater fluctuations on the velocity pattern, 5) to define piezometric threshold for landslide reaction. Two significant piezometric thresholds can be defined: a regional piezometric threshold (-10.35 m) based on historical data (long-term/low resolution) of the four major accelerations occurring between 1982 and 2001, and a local piezometric threshold (-3.50 m) based on field surveys (short-term/high resolution) for minor accelerations recorded between 2009 and 2013.

Temporal reconstruction of the evolution of the study area

In Upper Normandy, for quantitative risk assessment (QRA), it is very important to assess the value and the speed of the historical retreat of the cliff. Also an adapted specific approach has been developed based on the lost area between successive coastlines (Letortu, 2013). This approach has the advantage to follow the retreat in a spatially continuous way. Retreat rates can be calculated over 42 years (1966-2008) from Antifer cape to Le Treport (110 km) with this approach. The average retreat rate between Antifer cape and Le Treport is estimated at 0.15 m/y (± 0.03 m/y) over the period 1966-2008 (Fig. 25).

Fig. 25 - Approach based on the lost area (surface model) between successive coastlines (Letortu, 2013)

In addition, an inventory of geomorphological markers (whitish scars visible on the cliff top and on foreshore, visible on aerial photographs between 1939 to 2008) has the advantage to provide some elements about (1) possible changes in time and space, intensity or the frequency of these events, (2) the retreat rhythm of falls (since that successive falls are observed exactly at the same place). Information can also bring information useful for management (Fig. 26).

Fig. 26 - Position of the different coastline for different scenarios (Letortu, 2013)

Improvement of existing hazard maps

In lower Normandy, for the Villerville and Cricqueboeuf landslides (Fig. 10), according to the past event analysis, we can suppose that the limit of the active zone will enlarge at the next event (Fig.27).

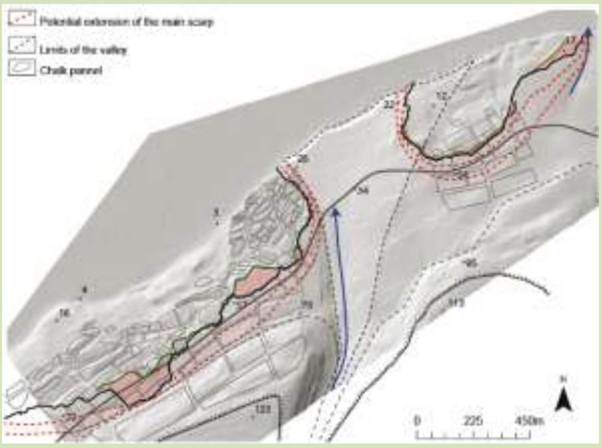


Fig.27 - Long term potential extension of the landslides (Maquaire et al., 2013)

The position of the major scarp is defined according to two scenarios based on: internal structure of the slope, landslide kinematics, triggering factors, landslide mitigation. In the future we can suppose a regularization of the scarp. This extension is limited on lateral parts by the paleo-valley between the landslides (see above Fig. 14 & 15). It will progress until the toe of the plateau and probably join the Hennequeville landslide which is separated by the Cirque des Graves landslide by a small valley (Maquaire et al, 2013).

Consequently, three degrees of hazard have been determinate (high, moderate, low) according to two scenarios based on knowledge of the morphostructure (Fig.28):

G3 - High hazard: Active landslide with opened cracks, counterslope and poorly drained areas (ponds, wetlands), steep slope (> 25/30 °). Geology: chalk panels and blocks, galuconitic sands and marls, slope deposits. Extension of the active zone taking into account the fracturing and competence of the major chalk pannels.
G2 - Moderate hazard: No indice of activity; Moderate to low slope. Geology: same as G3. Second scenario of the probable extension (behind G3). G1 - Low hazard: area mainly corresponds to the paleo-valley that is stable. No activity (no instability indice); Gentle to low slope. Same geological conditions as G2 or colluvial-alluvial formations with porous materials (paleo-valley).
G0 - No hazard: No slope, flat topography (plateau).

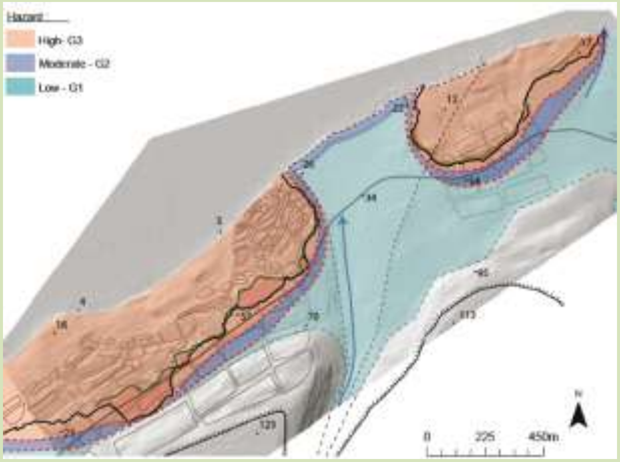


Fig. 28 - Landslide hazard zoning proposed for the area around the Cirque des Graves and the Fosses du Macre landslides (Maquaire et al., 2013)

NEW GLOBAL CLIMATE CHALLENGES AS A RESULT OF INCREASED DEVELOPMENT OF THE ARCTIC TERRITORY

TARGET COUNTRIES : This activity has global significance because of the correlation between the Arctic development and climate change and is aimed at defining complex security measures in the region to provide safety of people not only living there but the citizens of any country appeared to be at the territory for business or tourism. North sea route opens new prospects for increased rate of human activity. And this demands creation of resilience potential.

PARTNERS INVOLVED :

COORDINATING CENTRE : ECNTRM Moscow, Russian Federation

OTHER CENTRES:

OTHER PARTNERS : Institute of Arctic and Antarctic in Saint Petersburg

EXECUTIVE SUMMARY

Given analysis brought us to the conclusion that special safety provision measures are needed for the Arctic conditions that will include:

- creation of the system of monitoring and forecasting the appearance and dynamics of development of dangerous geophysical, geological, meteorological, hydrological, ecological and socio-economic phenomena and processes;
- creation of alerting system for informing the population of the Northern territories about the emergencies, using modern information technologies and means of communication;
- development of the emergency response forces, including mobile, considering new threats to the Northern territories, the specificity of the territories in order to improve response activity efficiency in emergency situations, improvement of the system of their location, composition and equipment;
- providing the rescue forces duty along the Northern sea route for the improvement of search and rescue activity;
- development of special rescue technologies and special rescue and fire fighting equipment and devices capable to operate in Arctic conditions.

Our specified findings and conclusions were presented to the Emercom of Russia headquarters and were used in the report of the Emercom of Russia Deputy Minister at the International Conference "The Issues of Emergency Management in the Arctic. Oil Spills Prevention and Response" which was held in the city of Naryan-Mar, Russian Federation, August 20-22 , 2013.

Our proposals were also included in the Conference recommendations, which were sent to the Russian Federal executive bodies, major ministries, business management of the companies working in the area, scientific and research institutions.

OBJECTIVES OF THE PROJECT

Global objective for 2012-2013 :

Guidelines and recommendations on global security measures in the Arctic.

Specific yearly objectives :

2012 :

The Arctic is an area of potential large-scale economic activities of production, processing and transportation of mineral raw materials conducted in a sensitive environment. Considerable risks of emergencies exist due to the natural and technical character of these activities. The situation becomes even more serious in the conditions of the climate change because the region is climate influencing.

The project is aimed at preparing the survey on the correlation between increased Arctic development and climate change. The research activity aimed at increasing the level of understanding the problem.

This issue is planed to be discussed at the Workshop "Emergencies preparedness and response in the Arctic" which is to be held in the city of Norilsk, Russian Federation, August 22-25, 2012.

2013 :

•To conduct natural and technogenic risks assessment.
•To indentify vulnerability.
•Elaborate specific proposals how to prepare for new opportunities and challenges as a result of a changing Arctic.
•To increase awareness among the general public as well as governments of the
Arctic and its importance, not only regionally but globally.

EXPECTED RESULTS

2012 : Analyses of the correlation between increased Arctic development and climate change
2013 : Finalizing the survey adding the analytical results and proposals

RESULTS OBTAINED IN 2012

Work package 1 (prepared by ECNTRM, Russian Federation):
Description:
Together with the academic scientists specializing on the problems of the Artic collect and analyze the appropriate information and prepare the survey. To share the knowledge with the decision-making people and business community.
Associated deliverables:

THE ARCTIC AND WORLD CLIMATE
The Arctic plays a significant role in the global climate system mainly because it acts like an "air conditioner" in formation of the weather not only in the Northern hemisphere but worldwide through heat exchange, ocean water currents and carbon cycling. Thus, apart from significant effects of the Arctic, change in the Arctic cryosphere will affect in many ways the entire globe. Such feedbacks have far-reaching implications on the global climate system, sea level, and population outside Arctic. Besides, the Arctic is economically linked to the entire globe and increased access and activities may have effects locally and within the
global context.
Shifts in Arctic sea ice and increased heating will warm the lower atmosphere in the Arctic. This change will affect weather at lower latitudes, particularly in winter. Recent „outbreaks. of cold Arctic air masses over lower latitudes particularly in Eurasia appear to have resulted from weakening of the „polar vortex. which typically traps cold Arctic air near the pole. This variability may reflect an early shift toward altered Arctic, and perhaps northern hemispheric, climatic patterns.
In parallel with the lessening of the temperature gradient between the Arctic and more southerly latitudes, the capacity for northward transport of contaminants is reduced, and thus accumulation in southerly areas is likely to increase. Also, it is very likely that the stores of legacy contaminants within the Arctic are being mobilized by cryospheric degradation. Their release from ice, snow, permafrost, glaciers and ice caps and subsequent re-entry into ecosystems appears to be occurring.

INHABITANTS AND ECONOMIC DEVELOPMENT
The Arctic region occupies 11% of the global surface area. Demographic estimates vary due to Arctic geographical extent and seasonal migration. Population figures vary between 4 million and 9.9 million depending on the geographical definition. Estimation of indigenous population ranges from 400 000 to approximately 1.3 million. Seasonal variation due to work-related migration is particularly applicable in the Russian Federation, which accounts for roughly 75% of all Arctic inhabitants.
The Arctic is characterized by a dispersed settlement pattern with few large cities. About one-third of Arctic residents live in settlements with a population size of less than 5000 and one tenth of the Arctic population lives in one of the five largest cities. The Arctic region is an exporter of raw materials and energy and an importer of final goods and services.
Since their arrival in the Arctic, the indigenous peoples have lived from the renewable resources of the sea (fish, marine mammals), the land (land mammals, birds, berries), and freshwaters (fish). Although not considered in official Arctic gross regional product (GRP) assessments, the contributions from commercial and subsistence fishing, hunting, and herding activities are documented as playing a significant role in the mixed cash-subsistence economies.
The GRP is a measure of the total value of goods and services in a given territory. Comparing the contributions from the primary sector (exploitation of natural resources), the secondary sector (manufacturing and construction), and the tertiary sector (public and private services) to GRP, as well as to the overall Arctic GDP, the tertiary sector is the most dominant. Only in Arctic Russia is the primary sector more dominant. This means that, apart from the Russian Arctic, public services such as education, health, and social work account for a significant part of all economic activities. The largest economies in the Arctic belong to Alaska (United States) and Russia, mainly due to mining and gas- petroleum activity.
Regions where more traditional subsistence activities, such as hunting and fishing, play a more dominant role (e.g., Greenland and northern Canada) have much lower GRP. Similarly, reindeer herding in Russia and Scandinavia is of substantial importance to the livelihoods and lifestyles of reindeer herders but does not contribute greatly to GRP in these regions.
The abundance of renewable and non-renewable resources and the generated share of GDP, varies from region to region. For many Arctic indigenous peoples, the cryosphere is fundamental to their cultures and identities. The cryosphere has traditionally been used as a platform for travelling, and for livelihood activities such as herding, hunting, and fishing. The cryosphere also plays a fundamental role in the life and work of non-indigenous residents, through non-renewable resource extraction; hunting, fishing and recreational activities; and extensive use of seasonal ice roads across wet tundra, rivers, and lakes. These roads provide key transportation routes for relatively inexpensive transport of heavy equipment, foodstuffs, and other supplies for residents and industry. Accessibility afforded by these

roads reduces the cost of living in the North.
Arctic residents rely on their extensive traditional and local knowledge, and on their observations of the environment and weather when making decisions on: when, where, and how to build, travel, or harvest. The documentation and incorporation of traditional and local knowledge is currently central to research on community adaptation to climate change.

PERMAFROST IMPACT ON THE INFRASTRUCTURE

Most settlements in the Arctic are relatively small communities and the majority are located on the coast where permafrost is commonly present. With the expansion of resources development the Arctic population is set to increase, especially in northern Russia where large cities with over 100 000 inhabitants are located in permafrost areas.
Most developments in the Arctic have taken place with an awareness of current permafrost conditions, but projected climate-driven changes in permafrost are likely to affect these and future developments beyond current planning and engineering provisions and can pose a significant challenge to infrastructure, environment, and health in the Arctic.
Coastal Arctic regions have concentrations of industrial facilities associated with oil and gas such as the Pechora Basin in Russia. Damage to pipelines may have dramatic environmental effects, especially when oil or gas is released at the coast or at sea. About 500 pipeline failures are registered annually along the 350 000-km network of pipelines in western Siberia. Over 20% are probably due to deformations and weakening of foundations induced by permafrost thaw.
Infrastructure includes physical facilities with permanent foundations or the essential elements of a community. It includes schools, hospitals, various types of buildings and structures, and facilities such as roads, railways, airports, harbors, power stations, communication systems, and power, water, and sewage lines. Infrastructure forms the basis for local, regional, and national communication and for economic.

SEA ICE AND COASTAL INFRASTRUCTURE

Sea ice is a significant factor influencing the coastal situation. It can both prevent and cause erosion of coast and infrastructure, and plays an important role as a regulating element in coastal sediment dynamics. Sea ice protects the coast from the erosive action of storms and preserves the thermal state of subsea permafrost, the coastal erosion rates along the Arctic coast have increased over the past 30 years. Low-lying coastal plains, which are not tectonically active, are especially vulnerable to coastal erosion. Although rocky coasts predominate in the European and western Russian Arctic and in parts of the Canadian Arctic Archipelago, human settlements are often associated with stony sectors of the coast because these provide more suitable locations for human activities.
Coastal erosion rates vary considerably between and within regions and over time, and erosion presents a significant problem for communities, infrastructure of various types, cultural heritage sites, and in some cases protective coastal landforms. The complex interactions between declining sea ice and other consequences of climate change (rising sea level, shifting river discharges, run-off, altered sedimentation rates in coastal areas, permafrost degradation) will increasingly affect Arctic coasts, coastal infrastructure and coastal marine ecosystems and potentially human resource use. Major forcing parameters are waves, currents and water levels, and, especially for the Arctic, sea surface temperature, salinity, decreasing sea ice and increasing open water fetch, ground temperatures, and excess ground-ice content. With sea ice forming later in the season, the coast is more exposed to a projected increased number of autumn storms, and to storms with longer fetch. Even a small increase in the intensity of storms and coastal surges is likely to increase infrastructure substantial damage and costs. In addition, a decrease in landfast ice increasingly exposes coastal permafrost to wave action and increased temperatures, leading to thaw. This can have serious consequences for existing infrastructure (e.g., structures or buildings depending on ice-bonded surface for strength could be at risk over the decadal time scale). Although new coastal permafrost may form when sea ice freezes to newly aggraded sediments, it is likely that this permafrost will be unstable because of increased temperatures of the seabed. Rising ground temperatures will increase seasonal thaw depth and enhance coastal erosion processes.
Other hazards involve ice ride-up, ice pile-up and the formation of near shore pressure ridges, primarily as a result of wind action, which may provide a mechanism for near shore scour and landward sediment transport. While the effects are often superficial, they include an example of damaging ride-up of 0.4 m of ice that knocked a lighthouse off its foundation and destroyed standing infrastructure on fishing harbor pier.
Because of the highly episodic and rare occurrence of damaging ice motion, such as ice ride-up and pile-up, little effort has been devoted to mitigate and forecast such hazards and many communities where damage has occurred may not have anticipated the event before it happened. While engineering solutions are available for shore protection, these measures may address one problem but create another by altering the dynamics of erosion and deposition processes.

HUMAN ACTIVITY AND COASTAL CHANGES

Substantial increase of human activity in the Arctic region may impact sea ice which can be considered as a social-ecological system with a variety of processes coupling the physical, biological, and social components. Reduction in sea ice will lead to increased accessibility in the Arctic and, thus, affect in various directions the sea-ice services derived from the ice cover.
Local effects have often been examined in greater detail in the context of environmental impact statements that are part of proposed industrial development in Arctic regions. At the local level, feedbacks are mostly expected in the context of modifications of the coastline that are conducive to enhanced entrainment of sediments into sea ice. Both seasonal ice formation and ice melt at the local and regional level are strongly impacted by the influx of freshwater from terrestrial runoff. Moreover, large-scale river discharge and potential modifications, such as through damming of

large rivers can impact stratification and hence impact ice production rates. River discharge was affected by human activities in several areas of the Arctic and dams or water withdrawal for irrigation may significantly change river discharge and thereby have significant impacts on the sea-ice regime.

Modification of freshwater discharge and its impact on ice formation could promote enhanced ice formation in the Arctic with impacts that might reverberate at the global level if, for example, discharge from the large Siberian rivers was reduced substantially.

The distribution of shoals and shallow areas is also a key constraint in stabilizing the land fast ice cover. Hence, coastal development such as dredging of harbors or other areas to mitigate the effects of coastal retreat, or the construction of artificial gravel or ice islands in the context of offshore oil and gas development, can have major impacts on the ice cover in the coastal zone. It may also greatly reduce primary production in the sea ice by increasing the amount of sediment entrained into sea ice, either through enhanced resuspension as a direct or indirect result of offshore activities or through reduction in ice stability enhancing sediment entrainment in a mobile coastal ice environment. While these impacts are only likely to be important on a very confined, local scale in the immediate vicinity of coastal development sites, they can significantly affect use of the ice cover at this scale, both by industry and by coastal communities.

While local effects such as coastal change and river discharge affect land fast ice, human emissions of greenhouse gases, dust and black carbon may result in further reductions in albedo affecting the ice cover on a much wider scale. Hydrocarbon exploration, production and transportation cause considerable emissions to air and are important variables in regional Arctic emission inventories of greenhouse gases used in climate scenarios. The geographic location of emissions of $CO2$ has no impact on the warming potential. For particles (black carbon) on the other hand, the location of the emissions is important and increased activity in the Arctic results in an increase in local emissions, with concurrent effects on the surface albedo. Sea-ice retreat will also lead to a shift in patterns and timing of shipping and icebreaker activity. There will be a general increase in ship traffic in new areas, and Arctic marine shipping may adversely impact sea ice through operational discharges and emissions and navigation impacts on sea ice.

However, it is possible that changing ice type sand a reduced ice-cover season will limit icebreaking needs. With activities in the Arctic increasing and adding to global impacts on sea ice, feedback effects are likely to play an increasingly important role in the further reduction of sea ice, especially on the local-scale at the Arctic coasts.

OTHER ASPECTS OF CHANGE

Apart from cryospheric changes there also many other factors that shape vulnerability and adaptation to changes in Arctic communities and sectors. Such factors include resource accessibility, allocation, and extraction policies; limited economic opportunities and markets; access constraints; demographics; attitudes and perceptions of change; bidirectional local-to-global linkages; infrastructure; threats to cultural identity and well-being; transfer of local and traditional knowledge; economic and livelihood flexibility; and enabling institutions. These aspects are rarely independent of each other and frequently combine across scales and sectors. In many cases, socio-economic changes are likely to have greater immediate significance than cryospheric changes, which in turn will affect the ability to adapt.

Increased industrial activity challenges migration and grazing on traditional pastures, leading to areas of unused and underused grazing areas. Avoidance of certain reindeer pastures can lead to a reduction in optimal range use, leading to complications with herding, increased costs, and reduced production.

Another example is the projected increase in tourism. While there are potential economic benefits for local communities from increased tourism, such an increase may also negatively affect those communities. Given international pressure for sustainable management of wildlife, indigenous communities that depend on hunting, for example, polar bears (for tourism or subsistence) may have to adopt alternative livelihood. Further expansion of tourist seasons may result in extended use of infrastructure and longer duration of employment and income benefits. Human activities can greatly amplify the effects of climatic variability and change on Arctic societies.

ARCTIC REGION AND GLOBAL WORLD

Arctic cryosphere is closely linked to the rest of the world. These linkages include physical (e.g., Arctic climate system feedbacks globally), chemical (e.g., pollutant transport to the Arctic), biological (e.g., migratory biota and ecosystem connections), and social (e.g., tourism, resource extraction, management, politics).

Global climate changes are influencing on the Arctic cryosphere; at the same time these changes will in turn respond to far-reaching subsequent effects of global consequence.

The cold Arctic region typically acts as a sink for heat, greenhouse gases, particulate aerosols, and contaminants and performs fundamental regulatory functions for global climate systems. Degraded cryospheric components will increasingly act less so with highly uncertain consequences; however, hemispheric and global scale effects are likely. In some cases, these will be responses to Arctic change that affect the globe (i.e., simple outputs), whereas in others they will constitute feedback effects which may further alter global processes (e.g., climate system change, weather pattern change, shifting from sink to source for some greenhouse gases, possibly both $CO2$ and methane). Such changes are very likely to affect human society beyond the Arctic.

Cumulative effects with consequences for society on a broader scale include the feedback from changing snow conditions and surface albedo and the release of methane by thawing terrestrial and sub-sea permafrost to the climate system leading to accelerated global warming. Such amplification needs to be included when developing mitigation efforts and in updated models projecting future climate change. In contrast, the increased period of open water on lakes and increased growing season for vegetation will lead to increased evaporation and transpiration, drying of the landscape, and a negative feedback to climate, especially when combined with drainage of tundra water bodies fostered by permafrost degradation, although the balance between these two processes is highly uncertain.

Changes in the Arctic cryosphere coupled with other climate-driven changes have hemispheric and global-scale social effects, which may include the following:

- Enhanced ice outflow (icebergs and ice export) leading to shipping hazards in the North Atlantic.
- Alteration of ocean and river heat and freshwater transport to Arctic environments and alteration of oceanic circulation patterns, affecting ecosystems and impacting fisheries and hunting activities.
- Alteration of the structure and functional relationships within and services received from terrestrial, freshwater, and marine Arctic and sub-Arctic ecosystems, including possible loss of iconic species and altered biodiversity.
- Increased activities in the Arctic leading to increased risk of pollution and increased shipping bringing noise pollution and ballast water that contains contaminants and invasive species.
- Uptake of pollutants via microorganisms into the Arctic food web (e.g., fisheries) that have local and global health impacts.
- Economic opportunities that may provide impetus to national and global economies but must be developed in a sustainable manner.
- Significant contribution to global sea level rise and thus follow-on effects for low-lying coastal regions throughout the world.

CLIMATE CHANGE AND MARINE ASPECTS

Climate change may result in the fluctuation of sea level at local and global scales and represents one of the more serious consequences of climate change, mostly due to the scale of potential effects. Possible rise of sea level is a complex phenomenon resulting from many factors. Climate change affects sea level primarily through water mass changes and through density changes due to changes in temperature and salinity. Global sea levels are also affected by mass losses from non-Arctic glaciers and the Antarctic ice masses. Present mass losses from Arctic glaciers and the Greenland Ice Sheet contribute a total increase of 1.3 mm per year to the rise in global mean sea level. Increasing contributions from the Greenland Ice Sheet and other Arctic glaciers have occurred since 1995. Contributions from other sources (Antarctic Ice Sheet, non-Arctic glaciers) are added to these.

High regional variation in sea-level rise will result from concurrent changes in other factors that include gravity fields, ocean temperatures, freshening, tidal effects and local isostatic rebound or subsidence of land. Rates will also differ, thus impacts may be highly regionalized and realized over varying time scales.

Mean sea-level rise increases possibilities of coastal flooding, erosion, infrastructure damage, environmental impacts on ecosystems, and saltwater intrusions into groundwater. Such effects may be accompanied or exacerbated by local additional effects. Ultimate global effects realized at the century scale and beyond include significant inundation of low-lying coasts and possibly complete submergence of small islands in some areas of the globe, although growth of coral atolls may offset this to some degree.

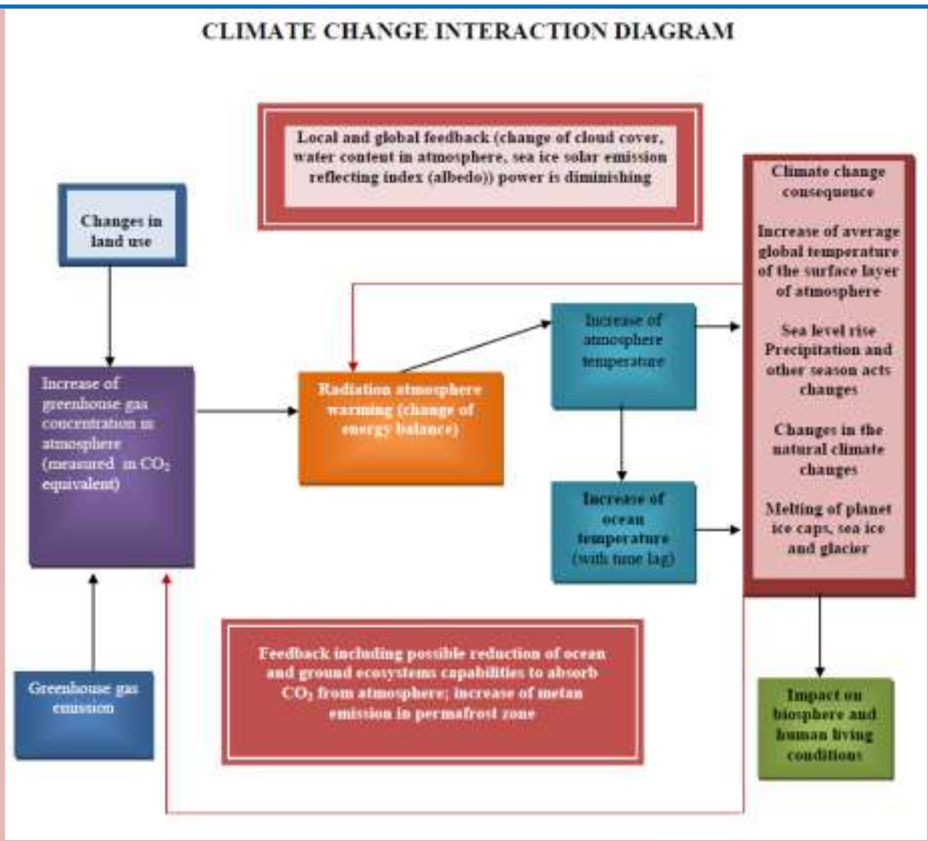
Ocean circulation is a global phenomenon by which heat and water are transported between the polar and equatorial regions. This circulation is powered in part by density differences among water masses due to differences in temperature and salinity. Inflows to the Arctic resulting from this phenomenon consist of surface (lower salinity, warmer) waters entering from the Pacific via the Bering Strait, and surface (warmer) waters entering from the North Atlantic.

These inflows are counterbalanced by the outflow of Arctic waters primarily through the Canadian Archipelago and along eastern Greenland, mostly as lower salinity, cold and freshened surface flows. Additional deeper outflows of Arctic Ocean water (high salinity, cold) occur in the northeastern area of the Atlantic. The North Atlantic thus has several mixing zones where warm surface currents from the south interact with cold surface and sub-surface currents originating from the north.

Several changes in the Arctic cryosphere are anticipated to increase freshwater inputs to the Arctic Ocean, thus reducing its salinity (at least in surface waters). These include: increased direct precipitation, possibly increased inputs of low salinity Pacific waters, increased runoff from large Arctic rivers, reduction of ice stores on land, and degradation of perennial sea ice. The increased input of freshwater will have local effects within the Arctic primarily on coastal shelves, many of which are largely associated with increased stratification.

FEEDBACKS AND IMPLICATIONS

The atmosphere, ocean, and individual components are the major factors affecting the Arctic cryosphere. Many aspects of Arctic climate change are simple responses to a driving force, for example, higher (or lower) air temperatures will alter the ice balance in a particular area. Other changes may involve a feedback whereby a change in one component of the system drives a change in another, which ultimately induces additional change in the original component. Such feedbacks can be positive (i.e., induced change reinforces and exacerbates the original change), whereas others can be negative (i.e., induced change dampens, cancels or reverses the original change).



Feedbacks are important because they may alter rates of change, magnitudes of change, or even directions of change. Owing to their unpredictable effects and their variable scales (spatial and temporal) of operation, feedbacks also add to the uncertainties of outcomes especially for higher-order consequences of climate and cryospheric change.

Work package 2 (prepared by ECNTRM, Russian Federation):
Description:
Organize the workshop “Emergencies, preparedness and response in the Arctic” with the participation of representatives from high level legislation, Russian State government bodies, Ministries, Coastguard of Russian Federation, state-private companies, scientific community, local government bodies and search and rescue detachments.
Associated deliverables: Discuss the issue and collect proposals and recommendations for the survey

Russian Federation hosted a 2-days conference on “Emergencies preparedness and response in the Arctic” in the city of Norilsk, Russian Federation on August 23-25, 2012.
Conference participants were more than 90 representatives from different institutions of the Russian Federation: Emercom of Russia, Ministry of Transport of the Russian Federation, Russian Federation Coast Guard Directorate, Federal security service, research institutes, Administration of Krasnoyarsk region and business community of the Russian Federation.
Among foreign delegates were the representatives of USA, Canada, Norway, Denmark and Finland.

There were three plenary sessions:

- Emergency situations in the Arctic. Preparedness and response;
- Economic development of the Arctic regions and the industrial development security problems including mining works security provision.

- Transport security in the Arctic.

More than 20 presentations were made stating the importance of the issues because the number of emergencies and the complexities of emergencies in the Arctic will increase in the near future as a result of continuing climate change and increased development in the Arctic.

Delegates called for the new researches in all the spheres of emergencies preparedness and response both scientific and technological for arctic conditions, shearing the knowledge; implementation of the modern systems of emergencies monitoring and management in the Arctic.

It was acknowledged that the amount of means and forces in the Arctic aimed at protection of people and territories, search and rescue, oil and other hazardous liquid substances spills elimination is not adequate.

Shortage of response forces in some states and necessity of search-and-rescue activity coordination of different countries necessitates strengthening of international collaboration.

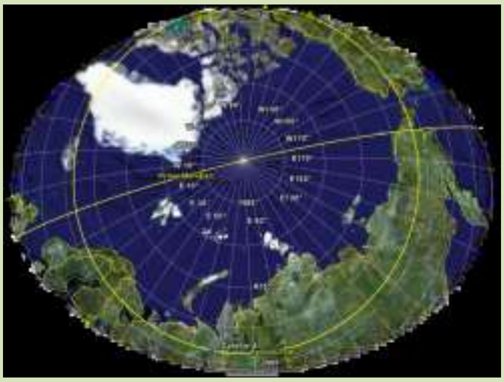
As an important step in response improvement Russian Federation is working at the program of establishing Complex Search and Rescue Centers in the Arctic region of the Russian Federation The purpose of establishing a system of Complex Search and Rescue centers is to provide comprehensive operational assistance to persons in distress in the Arctic regions of the Russian Federation, along the Northern Sea Route and in the adjacent territories of foreign states in accordance with international agreements.

RESULTS OBTAINED IN 2013

Working package 1 (prepared by ECNTRM):
Description:
Identify the main future issues related
Associated deliverables:

INTRODUCTION

The aim of the work is to increase the knowledge base and facilitate its use; to enhance existing efforts to understand causal linkages across all aspects of the Arctic system, both among cryospheric components and between the cryosphere and other components of the Arctic system; to provide broad information on commercial activities in the Arctic that pose a risk to the Arctic environment, stress the responsibilities regarding emergency prevention, preparedness and response programs and activities. There was done the risks assessment of cryospheric changes for ecological and human systems in the Arctic across all relevant scales to allow effective planning and remediation, identify shortfalls in design or approaches presently in place to address future changes in the cryosphere. There is given analyses of environment and risk interactions which should promote risk perception by people and societies and will raise political attention to risk governance. Risk mapping was presented.



NATURAL DISASTERS OF THE ARCTIC ZONE

The main types of natural disasters in the Arctic include: shore erosion; bottom ice gouging, lithodynamic and permafrost processes especially dangerous in coastal areas; physical and chemical processes with outburst of free gas, especially in fossil cryosoloic areas; geodynamic processes mostly dangerous in earthquake zones of magnitudes 6-8 or more; ravine erosion and slope movement; thermal erosion, thermokarst, gas hydrates, ice formations.

Global climate change and the growth of anthropogenic impact on the northern nature will lead to:

- increase of frequency and magnitude of floods, including the catastrophic that can cause emergency situations, including technogenic;
- increase of frequency and strength of hurricanes and tornadoes caused by the large gradient of temperatures that may lead to the growth of the number of emergency situations of natural and technogenic character;
- degradation, drying of forests and large areas of pastures due to the increase of the average surface temperature of the soil that can further on lead to massive forest fires, increasing the duration of fire hazard conditions in most of the northern territories;
- accelerated melting of the mountains snow, glaciers, polar ice will stimulate the raising of the world ocean

level and will lead to the flooding of large coastal areas, and considering the actual shore destruction, all this can lead to a breach of the infrastructure of the settlements located not only on the coast, but in some cases at a considerable distance inland;
- increased melting of discontinuous permafrost zone will lead to the growth of such dangerous processes as landslides on melting slopes, surface subsidence due to the soil compaction, the weakening of the foundations of buildings and structures, and as a result to emergency situations of technogenic character.

Widespread strengthening of abrasion process poses direct threat to already-built industrial and civilian shore objects. Design and construction of new facilities and particularly objects of extraction, storage and transportation of hydrocarbons requires consideration of the coastal dynamics as one of the most important factor in ensuring geoecological security. An important role in the system plays the human activity that can enhance or slow down and stop abrasion.

SEA ICE IMPACT

Another not less significant problem is the influence of ice formations on the seabed and the banks. Sea ice and icebergs as zonal implication of high-latitude position of the majority of Russian seas play an important role in the dynamics of the coastal shelf zone. Ice exaration belongs to the category of the most dangerous natural processes. According to the definition exaration is destructive mechanical effect of ice to the covering surface connected with the ice dynamics, its mobility, ice rubble and pileup grounded ice hummocks formation under the influence of meteorological factors and elevation of coastal zone.

To find the best option and thus reduce the risks of emergency situations is currently the most urgent task of the science and practice. It becomes more complicated by the fact that as a result of decrease of the ice cover of the Arctic seas caused by the climate change, there will be the change in the intensity of the direct impacts of sea ice on the banks and bottom, including thrusts of ice to the shore and the ice exaration of sea bottom. Ice season duration will decrease, however, ice dynamics will activate increasing porosity of ice and therefore impact of drifting ice on the seabed.

METHANE AND SOLID HYDRATES

Seabed stores huge amount of methane in the form of solid hydrates. Constant companion and a source of methane hydrates formation is so called free gas, which is under their resources. This gas may be under high pressure, which may lead to sharp emission of gas on the border of the layer. Such heterogeneity is a big threat to the stability of the seabed in case of extraction of gas from the hydrate layer.

There are real conditions of accumulation and existence of gas hydrates in the rocks below the seabed up to the 200 m depth in the Shtokman field area. In the process of deposits development warm gas going through the housing pipe increases the temperature of the surrounding materials. This leads to a change of a phase condition of water and gas in hydrate intervals around the well.

TECHNOGENIC EMERGENCIES RISKS

The main technogenic emergencies in the Arctic zone of the Russian Federation are linked with the following risks:
- risk of oil spill (leakage from onshore and offshore pipelines, accidents with oil tankers, accidents at oil terminals during loading and unloading of oil);
- risk of accidents in life-supporting systems of public utilities in the cities and villages of the Arctic zone (gas supply, power supply, water supply, heating);
- risk of accidents of the constructions build in fossil cryosoloic areas, due to the observed warming in the Arctic zone;
- risks of industrial accidents, including radiation-dangerous objects;
- shipwrecks.

Should be emphasized close relationship of man-made risks with changing hydrometeorological conditions and climate in the Arctic.

NECESSITY OF RISK ASSESSMENT

“Varandey oil export terminal” is the basic facility for export of oil extracted in Timan-Pechora oil and gas province. Study of existing development experience of “Varandey” showed that insufficient consideration of the permafrost conditions may cause adverse geological changes, lead to the destruction of the economic infrastructure.

It is necessary to develop and adopt proactive measures to monitor the state of fossil cryosoloic areas and stability of engineering structures. New constructions in this area should be designed taking into account the fossil cryosoloic

areas that have relatively complicated structure: sheeted ice coming close to the village of Varandey.
Today a great number of residential and commercial buildings are deformed (up to destruction) as a result of intensive retreat of coast due to permafrost thawing. Collapse threat is hanging over the offshore oil storage, airport and a number of other buildings.

SPILLS CAUSES AND CONSEQUENCES
The main causes of spills, both small and large, are damaged pipelines in handling operations and accidents (collision, stranding) of tankers. In the near future these may be added by the accidents at the drilling platforms and pipelines supplying oil to oil terminals (ice and wave load, accidents and falling of the helicopters onto the platform, gush, accidents during loading of tankers, under water pipelines rupture).
Behavior of oil in cold Arctic seas, especially in ice conditions, considerably differs from it's behavior in oil spill in other regions of the world. Different scenarios for oil spills proposed for Arctic conditions indicate that any oil spill always ends up on the shore. In Arctic conditions, this means that it is almost impossible to remove the oil if it reaches the shore, therefore, it is extremely important that the strategy preparedness for oil spill response (OSR) rely primarily on in-situ burning and dispersion in the open sea.

There are no sufficient developments in the world practice on the arrangement of deposits of the Arctic shelf. Hydrocarbon production is planned in the areas characterized by low temperatures, hurricane winds (more than 30 m/s), the height of waves up to 27 m, fast glaciations. In some parts of the shelf planned for oil and gas extraction one and a half meter ice and icebergs of more than 1 million tons are drifting more than 200 days a year.
Production of hydrocarbons in the area of the Arctic seas requires creation of complex unique engineering structures, including extraction, transportation and processing of hydrocarbons, as well as technical and servicing vessels, capable of long-term reliable operation in the conditions of polar marine climate.

POTENTIALLY DANGEROUS OBJECTS
On the territory of the Far North regions there are several thousands of potentially dangerous objects: stores of explosive and chemical materials, the spent nuclear fuel storage, buried waste containers, time-expired nuclear submarines, nuclear reactors on land and sea vessels, oil storage tanks, objects of nuclear power, oil and gas pipelines and others.
This concentration of potentially hazardous objects requires increased control measures.
There are about 1000 of radioisotope thermoelectric generators (RTGs) in Russia, most of them are used as an element of power light beacons in the Arctic zone. All existing RTGs reached the end of the term and should be utilized.
RTGs were fixed 30 years ago, when the threat of terrorism was not considered and in addition the RTGs were not made vandal protected. The existing system of RTGs treatment does not allow to provide physical protection for these devices, and the situation may be classified as an accident of uncared storage of hazardous sources. Therefore generators require immediate evacuation.
The most typical emergency situations for the Northern regions are the accidents on the objects of communal power engineering, networks of heat, gas and water supply pipelines. In most Northern regions of the Russian Federation the housing fund is in poor condition which also creates an additional threat to the security of the population.

GEOECOLOGICAL CONSEQUENCES OF CRYOSPHERE DEGRADATION
With the global warming the dangerous geoecological consequences of cryosphere degradation will be unavoidable.

As a result, there may be massive deformation of buildings and structures constructed without consideration of climatic warming. Many facts indicate that in recent decades the destructive impact of cryogenic processes on objects of infrastructure in the permafrost areas has intensified. According to the published data each year thousands of failures and accidents happen on the oil and gas pipelines in Western Siberia. About 21% of all recorded accidents are caused by mechanical impacts, including those related to the loss of stability of the bases and deformation of the supports.

Field-geological survey of oil and gas complex in Yamalo-Nenets Autonomous Okrug, Nenets Autonomous Okrug and other regions of permafrost indicate that thawing zones often arise around the mining and exploration wells. This leads to subsidence of soil and formation of craters in the estuary zone affecting the stability of wells and the pumping unit.

In addition to the fuel and energy complex facilities, there are numerous examples of violations of integrity and destruction of residential and industrial buildings due to the reduction of carrying capacity of permafrost and various forms of thermokarst.

More than 75% of all buildings and structures in permafrost area in such cities as Magadan, Anadyr, Yakutsk, Mirny, Norilsk, Igarka, Nadym, Vorkuta were constructed and operated on the principle of preservation of the frozen status of the bases soils. The lower the temperature of the permafrost the more is freezing power and thus bigger bearing capacity of foundations. In case of degradation of permafrost and increase of the soil temperature, there will be dramatic decrease of bearing capacity of foundations, but because of the load of facilities remain the same, the objects will be deformed.

Today almost 60% of all buildings and structures in Igarka, Dickson, actually 100% in the settlements of Taimyr, about 40% in Vorkuta are deformed. Deformation of oil, gas and product pipelines, as well as various enterprises (especially chemical and metallurgical) can lead to enormous emissions of pollutants into the environment.

The largest enterprises possessing potential radiation danger are Kola and Bilibino nuclear power stations. Besides there are objects of the Ministry of defense of Russia, which require constant attention and monitoring.

In general, all processes of possible man-made accidents and disasters in the Arctic in low temperature conditions considering the climatic conditions have very serious specific features that should be considered in the legislative and practical activities of the legislative and Executive authorities, rescue organizations, business divisions.

NORTH SEA ROUTE NAVIGATION

In addition to stationary objects the sources of emergencies in the Arctic zone could be transport communications and especially the North sea route. Severe ice and climate conditions complicate the work of water transport, reduce its effectiveness, cause significant risks compared to the shipping in temperate latitudes.

Specificity of navigation on the Northern sea route, which is determined by natural conditions, seasonal transport, limited depth on the sailing routes and water area cause need of using costly icebreakers, specialized transport vessels, means of scientific, operational and hydrographic support. The growing importance and scale of production requires the improvement of transport service of these territories. When navigating in ice, there are particularly dangerous phenomena for navigation such as encounter with icebergs, ice drift with a speed of more than two knots that can exceed the speed of the ship and may cause it much trouble. The third phenomenon is the special power of compression, which reaches its maximum of 3 points, and specific ship's hull loading reaches 400 tons/sq. m. But even the vessels of reinforced ice class actually withstand the loading only within 370-380 tons/sq. m, because the designers are always trying to reduce the weight characteristics of the vessel, and this reduces the maximum strength of the shell plating set. Traffic volume growth along the Northern sea route is connected mainly with the development of oil and gas fields. The main directions of marine export of oil and gas from these fields will be Europe and USA. Planned volume of export of hydrocarbon raw materials from the region in 2015 will amount from 30 to 60 million tons a year. All this will require the use of significant transport fleet for sailing in ice conditions and the risk of shipwrecks will increase.

ECOLOGIC RISKS

Main ecologic risks in the Arctic zone of Russia are connected with the following factors:

- increase of pollution and degradation of environmental components in the conditions of increasing anthropogenic pressure; • accumulation of waste;
- high risks of natural resources development; • global climatic changes and their influence on the area of permafrost;
- hazardous weather, ice and other natural processes dynamics increase the risk and damage caused by these processes.

Main factors of impact (point) pollution and anthropogenic changes in Arctic natural complexes are:

- pollution of atmosphere air, water and soil with specific harmful substances from the enterprises of metallurgical and pulp-and-paper industry, power engineering facilities;
- accumulation of large amounts of industrial and domestic waste;
- contamination of soil and other components of the natural environment from the enterprises of oil and gas;
- storage of spent resource submarines with nuclear power installations.

The most significant sources of pollution of the Arctic on the territory of the Russian Federation are the mining and metallurgical plants in the cities of Norilsk, Monchegorsk and Nickel, as well as Archangelsk and Solombala pulp and paper enterprises, oil and gas complexes in the Nenets and Yamalo-Nenets Autonomous districts, North fleet objects, transport and fishing fleets, as well as discharges of untreated wastewater. Water area of the Kola Bay with the sea commercial and fishing ports, bases of the Northern fleet and the border guards, 6 large shipyards and 8 cities in the coastal zone is facing serious environmental impact. As a result of fishing, commercial, nuclear, military fleets and other water users activities there are practically no undisturbed ecosystems along the Kola Bay coast. In the recent years the problem of danger to the navigation in the Kola Bay caused by the sunken ships is particularly acute, and it is connected with stepping-up of the activity on transportation and transshipment of oil products through the Kola Bay. Shipping and first of all of large-capacity tankers has increased.

2.D. High level courses on risk issues

TRAINING ON CLIMATIC RISKS MANAGEMENT

DURATION : ☐ 2012 ☐ 2013 ☒ 2012 – 2013

LINE OF ACTION: 2.D. High-level courses on risk issues

TITLE OF THE PROJECT: Training on Climatic Risks Management (floods, draughts, storms, desertification)

TARGET COUNTRIES: Countries affected by climatic risks

PARTNERS INVOLVED:

COORDINATING CENTRE : CRSTRA Biskra, Algeria

OTHER CENTRES: ECRM Yerevan, Armenia , CUEBC Ravello, Italy

OTHER PARTNERS : Université de Blida, Université de Constantine, Université de Biskra, Université de Batna, Université de Rouen, Institut Français de Formation de Formateurs Risques Majeurs et Protection de L'environnement, Agence Spatiale Algérienne, Institut des Haute Formation de Recherche Météorologique Oran.

EXECUTIVE SUMMARY

L'expérience menée à travers le deux cycles (2012 et 2013) de formation intensive, les échanges avec les formateurs et les apprenants nous ont orienté vers une démarche visant l'ancrage d'une méthodologie scientifique de prévention et de gestion des risques en consacrant une formation par risque, ce qui permettra une analyse plus fine du risque et l'apprentissage de méthodes, d'outils et surtout leur application réelle au niveau du terrain comme suite à donner au projet (mettre la connaissance au service de la gestion des risques)

OBJECTIVES OF THE PROJECT

Global objective for 2012-2013 :
Réduction de la vulnérabilité des établissements humains et des écosystèmes
Specific yearly objectives :
2012 :
Cours sur la compréhension des changements climatiques et des risques climatiques.
-Maitrise des outils d'analyse et d'évaluation (SIG, cartographie, géostatistique, télédétection, expérimentation, identification, prospection, modélisation)
-Travaux d'application
-Etude de cas concrets et analyse de quelques situations vécues
-Montage des systèmes de veille et d'alerte précoces
Il convient de préciser que cette formation portera plus sur des aspects pratiques et prend en charge les impacts des risques climatiques sur les écosystèmes dans leur dimension physique, biologique et socio-économique.
2013 :
Reproduire le cycle de formation par les bénéficiaires en 2013

EXPECTED RESULTS

2012 :
Formation d'un groupe de 25 à 30 personnes dans les risques climatiques devant reproduire la formation au bénéfice d'un 2ème groupe de formateurs en 2013 avec un objectif à long terme
2013 :
Pérenniser la formation sur les risques climatiques en ciblant selon les besoins des partenaires socio-économiques (Protection civile, Education, Bâtiment, Agriculture, Hydraulique, . . .) ce qui est en adéquation d'une part avec nos activités dans le cadre de l'accord:
-Education (Be Safe Net);
-Groupes Législation (recherche/gestion des risques);
-Veille phénologiques par rapport aux changements climatiques (dimension participation des populations concernées);
et d'autre part avec les missions du Centre qui concerne essentiellement les risques climatiques.

RESULTS OBTAINED PREVIOUSLY (if any)

Le CRSTRA a organisé un cours International sur les inondations et les crues en 2005, dispensés à l'intention des universitaires (enseignants, chercheurs et étudiants).

Le CRSTRA a aussi organisé un Atelier International de formation sur les catastrophes naturelles et les risques majeurs, en 2009, et dont ont bénéficié des acteurs et des techniciens exerçant en régions arides et semi arides et impliqués dans la gestion des catastrophes (notamment le corps de la protection civile, des climatologues, des hydrauliciens et des agronomes). En outre, l'ouvrage qui en résulte est un outil utile aussi bien pour les scientifiques que les praticiens sur terrain. Une large diffusion est en cours à l'échelle nationale et internationale.
L'Atelier Sécheresse et stratégie d'adaptation aux changements climatiques a permis de mettre l'accent sur les zones les plus vulnérables au Méditerranée, ce qui a conduit à la mise en place d'un système de veille phénologique par rapport au changement climatique en milieu Oasien abritant les ressources naturelles utiles, et des savoirs faire locaux ancestraux. (en matière d'Hydraulique, d'Agriculture, d'Habitation . . .).
Une fiche de suivi a été élaborée, traduite en plusieurs langues (Arabe, Anglais, Français) pour faciliter son renseignement par les partenaires socio-économiques (les agriculteurs étant impliqués pleinement à l'atelier méthodologique en novembre 2011) et lancée en Février 2012 selon un transect Nord-Sud.

RESULTS OBTAINED IN 2012

Work package 1 (prepared by CRSTRA):
Description:
Définition de la formation de 25 à 30 personnes dans le domaine des Risques Climatiques.
Diffusion et promotion de la formation sur les risques climatiques
Associated deliverables:
Programme de formation (programme et liste des intervenants)

Horaire	11 Novembre	12 Novembre	13 Novembre	14 Novembre	15 Novembre
8.00-10.00	Accueil des participants + inscription **Ouverture officielle**	Etude de cas des pluies exceptionnelles de 1969 sur Biskra et ses environ s **MATARI A *(IHFR Oran)***	Désertification des parcours pastoraux. Sensibilité/vulnérabilité et indications d'alerte. **AIDOUD A. *(Uni Reine France)***	Risques Incendies de Forêt en Méditerranée. Expérience algérienne **ABBAS M. *(D. G Forêts Alger)***	Le quantificateur multidirectionnel du sable en transit éolien. Réalisation et Exploitation. **MESSEN N. *(CRSTRA/CRNB)*** Collecteur d'aérosols pour un environnement tropical. **MESSEN N. *(CRSTRA/CRNB)*** Film Documentaire
10.30-12.00	Problématique des changements climatiques **BOUCHEREF D. *(ONM Alger)***	Prévisions climatiques **BOUCHEREF D. *(ONM Alger)***		Caractéristiques des inondations et leurs conséquences sur l'aménagement du territoire **BENAZZOUZ M.T. *(Uni. Constantine/CRSTRA)***	**Clôture Officielle**
14.00-15.30	Les Risques Climatiques **BOUCHEREF D. *(ONM Alger)***	Présentation/démonstration sur matériel météorologique **BOUCHEREF D. *(ONM Alger)***	Impact des changements climatiques sur la biodiversité Postures et gestion du risque d'extinction des taxons/étude de cas. **BELHAMRA M. *(Uni. Biskra/CRSTRA)***	Maitrise et économie de l'énergie dans le bâtiment et impact sur le phénomène des changements climatiques. **MAOUDJ Y. *(CNERIB Alger)***	
15.30-17.00	Impact des sécheresses sur les	Sécheresses climatologiques et		Préparation et sensibilisation des	

	productions agricoles **HALITIM A.** ***(Uni. Batna)***	météorologiques **MATARI A** ***(IHFR Oran)***		populations aux Risques Climatiques : cas Pratiques : Inondation / Sécheresse **BOULAASSEL A.** ***(INRAA Alger)***	

Work package 2 (prepared by CRSTRA, ECRM):
Description:
Cours international intensif « Gestion des risques climatiques » d'une durée de 7 jours de formation
Associated deliverables:
Programme de formation, documentation, préparation des formations.

Le CRSTRA a organisé un cours international intensif sur la gestion des risques climatiques du 11 au 15 Novembre 2012 dont l'ouverture officielle a été assurée par Monsieur le Secrétaire Exécutif de l'Accord.

LE CARREFOUR D'ALGÉRIE / MERCREDI 14 NOVEMBRE 2012
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Centre-Est 09

Gestion des risques climatiques majeurs

De nombreux pays méditerranéens, parmi lesquels l'Algérie sont, actuellement, confrontés à divers risques climatiques majeurs liés au réchauffement climatique, avec à la clé des conséquences néfastes d'abord sur l'environnement, ensuite sur les populations et enfin sur les activités socio-économiques de ces pays. «C'est dans le but d'appréhender la problématique de la réduction de la vulnérabilité des écosystèmes et de la protection du patrimoine humain des pays du pourtour méditerranéen que le Centre de Recherche Scientifique et Technique sur les Régions Arides (CRSTRA) de Biskra que je dirige, a initié, 4 jours durant, à partir du 11 /11/ 2012 un Cours International intitulé «Gestion des risques climatiques /stratégie d'adaptation» avec la collaboration de l'instance internationale European and Mediterranean Major Hazards Agreement (EUR-OPA Risques Majeurs), a confié à la presse Dr Fattoum Lakhdari l'organisatrice de ce colloque. Pour sa part, M Eladio Fernandez-Galiano, le secrétaire exécutif de l'Accord EUR-OPA s'est félicité dans l'allocution inaugurale de ce cours, de la participation active de l'Algérie à ces travaux. Il précisera en outre que l'Accord EUR-OPA créé en 1986 est une plateforme de coopération qui réunit 25 états. Sa grande force a été de mettre les représentants de ces pays autour d'une même table, pour des échanges profitables à tous, non seulement pour les pays de l'Union Européenne, mais aussi pour ceux de l'Europe de l'Est et du Maghreb. Toujours à propos de cet accord M Eladio nous confiera qu'il a pour objectif prioritaire d'améliorer la prévention des risques majeurs et qu'il favorise, tout en essayant d'intégrer au mieux les compétences des autorités locales, la mise en œuvre de plans de prévention et de réseaux de coopération sur de nombreux thèmes. Enfin l'accord assiste également les services nationaux de protection civile en matière de préparation à la gestion de crises. Cette série de cours donnés par d'éminents spécialistes étrangers et algériens visent, entre autres, à former, une trentaine de cadres de la protection civile, des hydrauliciens, des ingénieurs forestiers, des météorologistes et autres scientifiques algériens, à l'analyse des risques majeurs, à leur cartographie et partant, à la maîtrise de leurs impacts sur l'environnement. «C'est à partir d'études de cas concrets et de quelques situations vécues et répertoriées à l'instar de la canicule insupportable qui a sévi cette été dans notre pays avec comme corollaire une hyper consommation d'énergie électrique et les délestages et autres coupures de courant décidés pour éviter le black-out total que le centre de recherche s'est impliqué dans la lutte contre les effets dévastateurs du réchauffement climatique», nous a précisé la directrice du CRSTRA de Biskra. Elle ajoutera que la problématique du climat telle qu'elle se pose aujourd'hui interpelle les chercheurs du CRSTRA sur 3 domaines essentiels à la vie à savoir: l'eau, l'énergie et surtout la sécurité alimentaire . Ce qui nécessite une amélioration des compétences de nos cadres, via la formation et l'échange d'expériences avec les sommités internationales que nous avons invitées à notre colloque».

EL OKBI

Ce cours a été ouvert à tous les partenaires (en tant que candidat ou formateurs) impliqués dans la gestion du risque majeur et les catastrophes naturelles (Protection Civile, hydraulique, forêts, Mines, Environnement, Urbanisme, Chemin de Fer ….), aux pays membres de l'Accord et aux chercheurs CRSTRA affiliés aux équipes « Risques Majeurs » (Inondation, Surveillances de la désertification, Ensablement, Changements Climatiques). Il convient de signaler l'adhésion des Centres spécialisés du réseau EUR-OPA : CUEBC - Centre Européen universitaire sur les biens culturels Ravello, Italie et ECRM - Centre Européen inter-régional scientifique de formation sur la gestion des risques majeurs Arménie.

Compte tenu des objectifs fixés par rapport à cette activité, le cours est assuré par des formateurs venant aussi de différents secteurs et ayant la double casquette (académique et pratique du terrain), ce qui a permis de faire bénéficier les candidats sur les différents volets relatifs à la question du risque climatique à savoir :

- Etat des connaissances en climatologies/météorologie (tendances, prévisions) soutenu par une démonstration pratique sur station météorologique automatique placée à cet effet et une documentation météorologique illustrant les prévisions météorologiques du jour et du mois (bulletin météo-spécial).
- Les sécheresses et leurs impacts sur les systèmes de production agricole.
- La désertification indices de sensibilité et d'alerte précoce.
- Les feux de forêts en méditerranée en s'appuyant sur l'expérience Algérienne.
- L'ensablement et sa quantification soutenue par une présentation de quantificateur spécifique aux sables mobiles mis au point dans le cadre d'un projet CRSTRA-CNRNB et d'un quantificateur pour les particules aérosols notamment les polluants tels que les pesticides.
- Un film documentaire dédié au risque désertification ensablement vient appuyer cette problématique.

- Les aspects énergétiques sont traités surtout par rapport à l'habitat et les économies potentielles en matière d'énergie à ce niveau.
- Enfin, un cours éminemment didactique traite la ou les manières d'aborder une population pour la sensibiliser sur ces questions de risques en mettant l'accent sur l'intérêt d'impliquer tous les partenaires à travers des exemples pertinents.

Par ailleurs, il convient de signaler que chaque séance est suivie d'un débat sous forme de (question/réponse) entre candidats et formateurs.

Démonstration sur Station Météorologique par groupe

Comme prévu au programme, la clôture officielle est assurée (à 11 heures) par la Directrice du Centre et le président du Conseil Scientifique après remerciement de l'ensemble des participants ayant contribué à ce cours et distribution des attestations aux candidats ainsi qu'aux formateurs.
Il faut noter que le cours a coïncidé avec des événements extrêmes (inondations) à l'Ouest et au Centre de l'Algérie ainsi que d'autres pays du pourtour méditerranéen.

Cf. tableau 1 ci-joint des participants.

RESULTS OBTAINED IN 2013

Working package 1 (prepared by CRSTRA):
Description:
Formation de 25 à 30 personnes dans le domaine des Risques Climatiques
Associated deliverables:
Programme de formation (programme et liste des participants)

Horaire	03/11/2013	04/11/2013	05/11/2013	06/11/2013	07/11/2013
8.00-9.00	Accueil des participants et inscription	Sécheresses climatologiques et météorologiques **MATARI A. *(IHFR/ Oran)***	Désertification des parcours pastoraux. Sensibilité/vulnérabilité et indications d'alerte. **AIDOUD A. *(Université de Rennes/ France)***	Risques Incendies de Forêt en Méditerranée (expérience algérienne) **ABBAS M. *(DG Forêts/ Alger)***	Collecteur d'aérosols pour un environnement tropical. **MESSEN N. *(CRSTRA/ CRNB)***
9.00-10.00	**Ouverture officielle**	Impact des sécheresses sur les productions agricoles. **BOULASSEL A. *(INRAA/ Bejaia)***	Caractéristiques des inondations et leurs conséquences sur l'aménagement du territoire **BENAZZOUZ M.T. *(Univ. Constantine/ CRSTRA)***	Maitrise et économie de l'énergie dans le bâtiment et impact sur le phénomène des changements climatiques. **AFRA H. *(CNERIB/ Alger)***	Film Documentaire
10.30-12.00	Les risques climatiques **BENSALAH N. *(ONM/ Biskra)***				**Clôture Officielle**
14.00-15.30	Pluies exceptionnelles (cas d'une région Saharienne, cas d'une région littorale) **MATARI A *(IHFR/ Oran)***	Présentation/démonstration sur matériel météorologique **BENSALAH N. *(ONM/ Biskra)***	Impact des changements climatiques sur la biodiversité Postures et gestion du risque d'extinction des taxons/étude de cas.	Le quantificateur multidirectionnel du sable en transit éolien. Réalisation et Exploitation. **MESSEN N. *(CRSTRA/ CRNB)***	

			BELHAMRA M. ***(Uni. Biskra/ CRSTRA)***		
15.30-17.00	Assurances et catastrophes naturelles **R. NUSSBAUM (Mission Risques Naturels/ France)**		Stratégie de lutte contre le fléau acridien en Algérie **BENSAAD H.** ***(INPV/ Alger)***	Préparation et sensibilisation des populations aux Risques Climatiques : cas Pratiques : Inondation / Sécheresse **BOULAASSEL A.** ***(INRAA/ Alger)***	

Work package 2 (prepared by CRSTRA, CUEBC):
Description:
Diffusion et promotion de la formation sur les risques climatiques
Associated deliverables:

Afin d'élargir les retombées de ce projet en matière de renforcement des capacités locales, nous avons œuvré en coordination avec les Autorités locales (Monsieur le Wali de Biskra) afin de faire bénéficier deux cadres et/ou acteurs de terrain impliqués dans la gestion des risques et des catastrophes naturelles de chacune des wilayates implantées en régions arides et semi arides (Tamanrasset, Tébessa, El oued, Illizi, Ouargla, Djelfa, Nâama, M'sila, Tindouf, Saida, Batna, Alger, Jijel) et issus de différentes structures (Protection Civile, Forêts, HCDS, DSA, Hydraulique, Travaux Publics, Environnement, etc.) afin de constituer un groupe pluridisciplinaire et multisectoriel avec présence de deux apprenants Italiens du CUEBC de Ravello d'Italie (partenaire du projet) ainsi qu'une dizaine de chercheurs du CRSTRA affiliés aux équipes liées à la thématique et n'ayant pas bénéficié du 1er cycle tenu en 2012.

Work package 3 (prepared by CRSTRA, ECRM):
Description:
Cours international intensif « Gestion des risques climatiques » d'une durée de 5 jours de formation
Associated deliverables:
Programme de formation-documentation-préparation des formations

Un deuxième cycle du Cours International sur la Gestion des Risques Climatiques et les Stratégies d'Adaptation a été organisé à Biskra du 03 au 07 Novembre 2013. au profit d'un 2ème groupe de 36 participants composé de:

- Partenaires socio-économiques impliqués dans la gestion des risques majeurs et des catastrophes.
- Chercheurs du CRSTRA chargé de l'élaboration d'outils d'aide à la décision en matière de prévention et de gestion des risques majeurs.
- Candidats venant des pays membres de l'Accord Euro-méditerranéen (Italie). (cf. Bilan ci-dessous).

Il s'agit d'un cours intensif privilégiant les aspects pratiques et l'échange des expériences du terrain et par conséquent le nombre d'apprenants a été limité à une trentaine avec l'objectif annoncé dès l'ouverture du cours que chaque bénéficiaire doit relayer les acquis dans son entourage professionnel et social (formation de formateurs).
Les séances se sont déroulées sous forme interactive entre formateurs et candidats avec une après-midi consacrée à une démonstration sur matériel météorologique au niveau de l'Office National de Météorologie à l'aéroport de Biskra où les autorités civiles et militaires nous ont facilité la programmation de cette application.

Il convient d'indiquer que le cours a été enrichi par rapport au 1er cycle en 2012 du fait de :

- la prise en charge d'un risque potentiel pour l'Algérie et par d'autres pays de la région: le risque acridien et la stratégie de lutte
- l'étude de la question des assurances comme voie susceptible d'atténuer les arrières effets des catastrophes (cours assuré par un représentant de la mission des risques naturels de France).

Un autre élément nouveau est l'évaluation de la formation par les candidats eux-mêmes sur fiches anonymes avant l'attribution des attestations de participation et le clôture de la formation. Ce dépouillement des fiches en question a donné le constat suivant :

- Aspects pratiques à privilégier + stratégie par région ciblée,
- Application et utilisation des stratégies ?
- Secteur santé à associer
- Reproduire le cours
- Faire participer des écoliers, clubs scientifiques et associations environnementales pour le volet sensibilisation
- Prévoir plus qu'une semaine pour une telle formation
- Prendre chaque risque majeur à part et lui consacrer une formation
- Accorder un temps aux manipulations d'outils SIG/Télédétection, statistiques.
- Penser à la mise en place d'un projet piloté sur la gestion des risques climatiques.

CLIMATE CHANGE AND CULTURAL HERITAGE

PAYS VISES: Tout les pays

PARTENAIRES IMPLIQUES:

CENTRE COORDINATEUR : CUEBC, Ravello, Italie

AUTRES CENTRES: C.R.S.T.R.A, Biskra, Algérie

AUTRES PARTENAIRES : Université de Cergy-Pontoise (France), Centre de Recherche et Restauration des Musées de France (Palais du Louvre)

EXECUTIVE SUMMARY

Le *changement climatique* n'est qu'un des aspects du *changement global* qui affecte notre planète depuis plus de deux siècles. Ce changement résulte de l'action de l'Homme sur son environnement, au point même que la création d'une nouvelle époque géologique, l'Anthropocène, a été proposée, tant l'Homme a modifié la Planète depuis qu'il a su en utiliser à grande échelle les ressources énergétiques.
Ce changement global affecte non seulement le système Terre, y compris le climat, mais aussi la Société elle-même à grande échelle, par le biais de sa population et de son utilisation des ressources matérielles et énergétiques.
Le patrimoine culturel est concerné par le changement climatique non seulement du fait de l'évolution lente des paramètres climatiques et de pollution (température, humidité de l'air, pluie, vent, gaz à effet de serre...) et, en zone littorale, de la montée du niveau des océans. Il pourrait de plus être affecté par l'augmentation du nombre et de l'intensité d'évènements dévastateurs, violents et relativement brefs, tels que les tempêtes, les ouragans, les inondations, les canicules, les sécheresses, le gel...

Le succès persistant de ces cours tient à :
- l'originalité et la nouveauté du sujet : dérèglement climatique et patrimoine culturel ;
- la qualité du corps enseignant international (italien, anglais, tchèque, maltais et français) ;
- la qualité des étudiants sélectionnés parmi un grand nombre de candidats ;
- la prise en charge des frais de transport et de séjour des professeurs par le CUEBC ;
- enfin, l'attribution de bourses aux étudiants par le Conseil de l'Europe.

OBJECTIFS DU PROJET

Objectif global pour 2012-2013:
Exposé des connaissances actuelles sur les impacts du changement climatique et du changement global sur le patrimoine culturel bâti (monuments, musées, bibliothèques, archives et réserves), sur les villes et le tourisme urbain, par une approche scientifique, politique, technique, économique et managériale.
Objectifs spécifiques :
2012:
Les points suivants seront détaillés: modèles climatiques et nouveaux scénarios du GIECC, climatologie du patrimoine, impacts sur le patrimoine bâti et les villes, utilisation raisonnée de l'énergie, impact du tourisme sur les sites du patrimoine mondial.
2013:
idem

RESULTATS ESPERES

2012:
Formation de haut niveau sur cette thématique pour des étudiants en sciences, urbanisme, ingénierie, architecture, conservation du patrimoine.
2013:
Idem

RESULTATS OBTENUS PRECEDEMMENT (si pertinent)

Le Conseil de l'Europe a participé à l'organisation et au financement de 4 manifestations importantes entre 2009 et 2011 sur la même thématique :
1- Un Colloque international « Climate Change and Cultural Heritage » tenu à Ravello du 14 au 16 mai 2009. Il a réuni 42 participants de 17 pays et organismes internationaux.
2- Un 1er Cours de niveau Master-Doctorat « Vulnerability of Cultural Heritage to Climate Change » tenu à Strasbourg du 7 au 11 septembre 2009. Il a réuni 36 étudiants de 13 pays et 17 professeurs de 7 pays.

Ces deux premières manifestations ont donné lieu à l'édition des Actes du Colloque et des Textes des Cours en un volume de 201 p. illustrées : « Climate Change and Cultural Heritage » (R.-A. Lefèvre and C. Sabbioni, ed., Edipuglia, Publ., Bari).
3- Un 2ème Cours de niveau Master-Doctorat « Management and Protection of Cultural Heritage facing Climate Change » tenu du 4 au 9 octobre 2010 à Ravello. Il a réuni 22 étudiants de 7 pays et 16 professeurs de 8 pays.
4- Un 3ème cours de niveau Master-Doctorat "Climate Change, Cultural Heritage and Risk. Energy, Mobility and Access" donné du 3 au 7 octobre 2011 à Ravello pour 24 étudiants de 8 pays par 13 professeurs de 4 pays.

RESULTS OBTAINED IN 2012

Work package 1 (prepared by CUEBC):
Description:
Training planning (contacts with the lecturers, distribution of lectures, etc) - C all for application, announcement
Associated deliverables:
Programme of the course and list of applicants

September 2012	Monday 10	Tuesday 11	Wednesday 12	Thursday 13	Friday 14
9.30-10.45	- Welcome adress *M. Lavandier/M. Menu, C2RMF* - Introduction *C. Sabbioni, co-Director of the Course, CNR-Bologna, Italy* *E. Apicella, Secretary General, CUEBC, Ravello, Italy* *B. Menendez, Cergy-Pontoise University* -From Climate Change to Global Change *R.A. Lefèvre*	-Global Change and Heritage Climatology *A. Bonazza*	-Climate Change and Indoor Environments *D. Camuffo*	-Energy requirements of indoor heritage *A. Bernardi*	-The risk of flooding in Paris and the museums storages *S. Colinart* *-Closing of the Course. Certificate of Attendance* *E. Fernandez-Galiano, Council of Europe, Strasbourg*
11.00-12.15	- Impact of Climate Change on Built Heritage and Urban Landscape, *C. Sabbioni*	-Salts Climatology applied to Built Cultural Heritage, *B. Menendez*	-Impact of Global Change on Urban Heritage *M. Cassar*	-Energy-Natural resources, trends and opportunities *C. Iwaszkiewicz*	-11.00-13.00: Visit of the C2RMF Laboratory
14.00-15.15	-Climate modelling and uncertainties *M. Déqué*	-"Climate Myths" (Practical exercise) *M. Cassar* *C. Sabbioni* *A. Bonazza*	-Managing climate risks *F. Lakhdari*	- A material in a Changing Environment: Glass and Stained Glass *A. Ionescu*	-Cruise on the Seine: the UNESCO List in Paris.
15.30-17.00	-Presentation of the practical exercise "Climate Myths" *C. Sabbioni* *A. Bonazza*		-Managing tourism pressure on World Heritage *M. Rossler*	-Built Heritage and Museums Collections facing Climate Change *E. Doehne*	

Liste des intervenants:
Eugenia APICELLA, European University Centre for Cultural Heritage, Ravello, Italy
Adriana BERNARDI, ISAC-CNR Padova, Italy
Alessandra BONAZZA, Institute of Atmospheric Sciences and Climate (ISAC) of the Italian National Research Council

(CNR) , Bologna-Italy
Dario CAMUFFO, ISAC-CNR Padova, Italy
May CASSAR, Director Centre for Sustainable Heritage, University College London (UCL) , UK
Michel DEQUE, Météo-France-CNRM
Eric DOEHNE, Université Cergy-Pontoise, France
Eladio FERNANDEZ-GALIANO, EUR-OPA Major Hazards Agreement, Council of Europe, Strasbourg, France
Casimir IWASZKIEWICZ, RES Inbuilt, Kings Langley-UK
Fattoum LAKHDARI, Scientific and Technical Research Centre on Arid Regions, Biskra-Algeria
Roger-Alexandre LEFEVRE, Professeur émérite à l'Université Paris XII, France
Cristina SABBIONI, Institute of Atmospheric Sciences and Climate (ISAC) of the Italian National Research Council (CNR) , Bologna-Italy

Work package 2 (prepared by CUEBC, CRSTRA):
Description:
A 5-days course will be held in Paris at Université de Cergy-Pointoise
Associated deliverables:
Training course - documentation (Powerpoint) prepared by lecturers.

Les changements globaux dans la société affectent le patrimoine culturel par le biais de l'urbanisation massive, du tourisme, culturel ou de masse, par l'utilisation des matériaux, par la raréfaction des ressources en eau, par la pollution de ces eaux et par celle de l'air.
Ces problématiques étaient au programme du cours doctoral européen organisé conjointement par le Centre Universitaire Européen pour les Biens Culturels, par l'Accord sur les Risques Majeurs du Conseil de l'Europe et par l'Université de Cergy-Pontoise, du 10 au 14 septembre 2012, au Centre de Recherche et de Restauration des Musées de France, dans le Palais du Louvre. Il a réuni 35 étudiants de 9 pays devant 14 professeurs de 6 pays.

Un premier groupe de cours a concerné les aspects purement scientifiques des changements climatique et global: modèles climatiques, climatologie du patrimoine (avec un exercice pratique concernant des villes "mythiques", c'est-à-dire théoriques, situées dans des contextes variés), impacts sur le patrimoine urbain bâti (dont l'action des sels sur les milieux poreux et celle du climat et de la pollution sur le verre et les vitraux), impacts sur le patrimoine intérieur (musées, bibliothèques, collections, archives…). Un second groupe de cours a traité des problèmes d'utilisation de l'énergie pour le chauffage, l'éclairage et la climatisation des mêmes environnements culturels intérieurs. Un accent spécial a été mis sur la pression qu'exerce le tourisme sur le patrimoine mondial.

Enfin, profitant de ce que le lieu du cours, le Palais du Louvre, est au cœur de la partie de Paris inscrite sur la Liste du Patrimoine mondial de l'UNESCO, les risques potentiels que font courir les inondations de la Seine aux nombreux monuments et aux nombreux musées (surtout leurs réserves) ont été évalués, ainsi que les stratégies élaborées pour leur sauvegarde.

Le secrétariat du CUEBC, déplacé par l'occasion à Paris, a assuré l'organisation matérielle et le bon déroulement de ce cours, ainsi que la fourniture à chacun des participants des présentations faites par les professeurs.
Il est certain qu'en plus de l'intérêt, de l'actualité du thème et de la qualité de ce cours, l'attribution de bourses par le Conseil de l'Europe, jointe à la contribution financière du CUEBC et à quelle de l'Université Cergy-Pontoise, a été pour beaucoup dans le succès rencontré auprès des jeunes étudiants de nationalités très diverses.

Liste des participants:
Alexander ALEXANDROV, Bulgarian Academy of Sciencs
Tanya ALEXANDROVA, University of Plovdid, Bulgaria
Riccardo BERRIOLA, Soprintendenza Speciale per i beni Archeologici di Napoli e Pompei
Umberto CICCARELLI, Rimini, Italia
Mara D'AVINO, Somma Vesuviana, Napoli
Mélanie DENECKER, Universitè de Cergy Pontoise, France
Maria Concetta DI TUCCIO, University of Milano - CNR-ISAC, Padova, Italy
Monica DI TULLIO, Soprintendenza Speciale per i beni Archeologici di Napoli e Pompei
Alessandra FIASCO, University of Bologna
Stefania GATTO, Napoli, Italia
Josep GRAU-BOVE', London, UK
Vigen HARUTYUNYAN, Wester Survey for Seismic Protection RA; Yerevan State University, Armenia
Vardan HAYRAPETYAN, Wester Survey for Seismic Protection, Ministry of Emergency Situations of the Republic of Armenia
Varsik HAYRAPETYAN, Yerevan State University
Angela LUPPINO, Soprintendenza Speciale per i beni Archeologici di Napoli e Pompei
Irene NATALI, ISAC-CNR
Ivana OSWALDOVA, Faculty of Mechanical Engineering, Czech Technical University in Prague)
Lala RAHMANOVA, Baku - Oxford School

Mandana SAHEB, LISA, UPEC
Dimitra-Makrina SALMANIDOU, Aristotle University of Thessaloniki
Silvia SAVINI, University of Torino
Olga SHASHKINA, Ministry of Environment Protection of Republic of Georgia
Paolo SIANO, Paris, France
Sonya SPASOVA, State University of Library Studies and Information Technologies, Sofia, Bulgaria
Emma TURVEY, University of Lincon, UK
Giovanna VISINTIN, AlmaMater Studiorium, Faculty of mathematical, Bologna, Ita
Nadya VLADIMIROVA, State University of Library Studies and Information Technologies, Sofia, Bulgaria
Gillian WALKER, The University of Reading
Gergana ZAEMDZHIKOVA, Bulgarian Academy of sciences – Forest research institute, Sofia, Bulgaria

Work package 3 (prepared by CUEBC, CRSTRA):
Description:
Promotion and dissemination of results
Associated deliverables:
Newspapers and on-line articles - online publication of proceedings

L'ensemble des présentations ont été transmises au Secrétariat Exécutif.

RESULTS OBTAINED IN 2013

Working package 1 (prepared by CUEBC):
Description:
Training planning (contacts with the lecturers, distribution of lectures, etc) - Call for application, announcement
Associated deliverables:
Programme of the course and List of applicants

	Monday 7 October	Tuesday 8 October	Wednesday 9 October
9.30-10.45	Introduction *C. Sabbioni, co-Director of the Course* The future impact of changing climate and pollution on slow degradation of monuments in contrast to extreme events *R.-A. Lefèvre, Director of the Course*	Impact of Climate Change on Indoor Cultural Heritage *D. Camuffo*	Adaptation strategies for Built Cultural Heritage *M. Drdacky*
11.00-12.15	Climate Change and Heritage Climatology *A. Bonazza*	Impact of Global Change on Urban Cultural Heritage *C. Iwaszkiewicz*	Adaptation strategies for archaeological sites *J. Cassar*
14.00-15.15	Case Study: The Italian National Adaptation Plan to Climate Change *C. Sabbioni*	"Climate of Mythic Cities" (Practical exercise) *A. Bonazza* *C. Iwaszkiewicz* *C. Sabbioni*	Energy supply, resource and distribution *C. Iwaszkiewicz*

Liste des intervenants:
Alfonso ANDRIA, European University Centre for Cultural Heritage, Ravello, Italy
Alessandra BONAZZA, Institute of Atmospheric Sciences and Climate (ISAC) of the Italian National Research Council (CNR) , Bologna-Italy
Dario CAMUFFO, ISAC-CNR Padova, Italy
JoAnn CASSAR, University of Malta, Malta
Milos DRDACKY, ITAM, Prague, Czech Republic
Casimir IWASZKIEWICZ, RES Inbuilt, Kings Langley-UK
Roger-Alexandre LEFEVRE, Professeur émérite à l'Université Paris XII, France
Rémy PRUD'HOMME, Professeur émérite à University Paris XII, France
Cristina SABBIONI, Institute of Atmospheric Sciences and Climate (ISAC) of the Italian National Research Council (CNR) , Bologna-Italy

Work package 2 (prepared by CUEBC, CRSTRA):
Description:
A 5-days course to be held in Ravello
Associated deliverables:

Training course - documentation (Powerpoint) prepared by lecturers

Il s'agissait, depuis 1993, du 21ème cours de la série « Sciences et Matériaux du Patrimoine Culturel » dispensés par le CUEBC de Ravello et, parmi ceux-ci, du 6ème depuis 2007, consacré aux risques du changement climatique pour le patrimoine culturel. La durée de ce cours a été ramenée à 3 jours, contre 5 traditionnellement, ce qui en a renforcé la densité et la concentration des étudiants.

Ce cours, donné intégralement en anglais, a rassemblé 25 étudiants sélectionnés parmi une soixantaine de candidats. L'origine géographique de ces étudiants était variée : Turquie : 1 ; République Tchèque : 1 ; France : 1 ; Chine : 1 ; Israël : 1 ; Royaume-Uni :1 ; Algérie : 2 ; Italie : 17. Le nombre prépondérant d'étudiants italiens s'explique par leur proximité géographique et aussi par le traditionnel grand intérêt de l'Italie pour le patrimoine culturel, en particulier au niveau universitaire. Grâce au soutien financier du Conseil de l'Europe, ont été attribuées des bourses aux étudiants, dont deux avaient été réservées aux étudiants algériens dans le cadre de la coopération avec le Centre de Recherche Scientifique et Technique sur les Régions Arides de Biskra (CRSTRA).

Liste des participants:
Gülsen AKGÜNDÜZ, Dokuz Eylul University, Izmir, Turkey
Piergiorgio ALOISE, University of Calabria, Rende, Italy
Marta CAROSELLI, University of Modena and Reggio Emila
Chiara CARUSO, Rome, Italy
Marta CASTI, University of Cagliari, Italy
Annalisa CATALDI, University of Trento, Italy
Chiara CIANTELLI, CNR-ISAC, Bologna, Italy
Valeria COMITE, University of Catania, Italy
Marianna D'ANGIOLO, University of Naples "Federico II", Italy
Gilda FERRANDINO, University of Naples L'Orientale, Italy
Marine GAY, CNRS - UMR 8220 , Ivry-Sur-Seine, France
Mohamed Tahar HANAFI, CRSTRA – Biskra, Algeria
Eva LUPO, University of Roma "La Sapienza", Italy
Paula Jimena MATIZ-LOPEZ, IMT, Lucca, Italy
Abdel Halim MGHEZZI, CRSTRA – Biskra, Algeria
Klara NEDVEDOVA, ITAM AS CR , Praha, Czech Republic
Luca PICIULLO, University of Salerno, Italy
Laura PIERANTONI, Politechnic of Milano, Italy
Michela RICCA, University of Calabria, Rende, Cosenza, Italy
Rachel SINGER, Bezalel Academy of Art and Design, Jerusalem, Israel,
Raffaella STRIANI, University of Salento, Lecce, Italy
Lorenzo TEODONIO, University of Tor Vergata, Roma, Italy
Chrysoula THOUA, University College London, London, United Kingdom
Fosca TORTORELLI, II University of Naples, Aversa, Italy
Yi Qing ZOU, Cultural Heritage Conservation Center, Tsinghua University,

Work package 3 (prepared by CUEBC):
Description:
Reports
Associated deliverables:
Financial statement and scientific report

Le thème du cours, focalisé sur les risques liés au changement climatique pour les biens culturels, attire aussi des étudiants intéressés par ce sujet très nouveau qui n'est pas encore enseigné au niveau académique. En ce sens, le CUEBC continue de jouer son rôle d'avant-garde dans l'enseignement de haut niveau relatif au patrimoine culturel, après avoir été longtemps à l'avant-garde pour les risques liés à la pollution atmosphérique.

Après une longue et chaleureuse allocution de bienvenue prononcée par le sénateur Alfonso Andria, président du CUEBC, le cours introductif donné par R.-A. Lefèvre, professeur émérite à l'Université Paris-Est Créteil et directeur du cours, avait pour thème The future impact of changing climate and pollution on slow degradation of monuments.
A.Bonazza, chercheur à l'Institut des Sciences de l'Atmosphère et du Climat (ISAC) du CNR à Bologne a ensuite parlé sur Climate Change and Heritage Climatology, suivie de C. Sabbioni, directrice du même Institut et co-directrice du cours, sur Case Study: The Italian National Adaptation Plan to Climate Change.
D. Camuffo, directeur de recherche émérite à l'ISAC-CNR de Padoue, a ensuite traité de Impact of Climate Change on Indoor Cultural Heritage, suivi de C. Iwaszkiewicz, directeur de RES Inbuilt, Kings Langley-UK, sur Impact of Global Change on Urban Cultural Heritage, de M. Drdacky, directeur de l'Institut de Mécanique Théorique et Appliquée de l'Académie Tchèque des Sciences à Prague, sur Adaptation strategies for Built Cultural Heritage et de J. Cassar, de l'Université de Malte, sur Adaptation strategies for archaeological sites.
C. Iwaszkiewicz a ensuite exposé la problématique de Energy supply, resource and distribution, et R. Prud'homme,

professeur émérite à l'Université Paris Est Créteil, celle de l' Impact of the inscription on the World Heritage List.
Tous ces exposés théoriques ont été complétés par un exercice pratique intitulé Climate of Mythic Cities dirigé par A. Bonazza, C. Iwaszkiewicz et C. Sabbioni, à la fin duquel les étudiants, divisés en 4 groupes de travail, ont présenté oralement leurs propositions de solutions appliquées à ces cités mythiques en matière de risques liés au climat et à la pollution.

Work package 4 (prepared by CUEBC, CRSTRA):
Description:
Promotion and dissemination of results
Associated deliverables:
Newspapers and on-line articles - online publication of proceedings

L'ensemble des présentations ont été transmises au Secrétariat Exécutif.

3. PLACING PEOPLE AT THE HEART OF DISASTER RISK REDUCTION

3.A. Policy studies

ANALYSIS OF THE LOCAL AUTHORITIES INVOLMENT IN MAJOR HAZARDS MANAGEMENT

DUREE : ☐ 2012 ☐ 2013 ☒ 2012 – 2013

LIGNE D'ACTION: 3.A. Etudes concernant les politiques

TITRE DU PROJET: Analyse de l'implication des autorités locales dans la gestion des risques majeurs

PAYS VISES: Algérie, Arménie, Azerbaïdjan, Belgique, Chypre, Croatie, Grèce, France, Luxembourg, Monaco, Maroc, …

PARTENAIRES IMPLIQUES :

CENTRE COORDINATEUR : ISPU Florival, Belgium

AUTRES CENTRES: CRSTRA Biskra, Algeria , ECRM Yerevan, Armenia , ECMHT Baku, Azerbaijan ,

AUTRES PARTENAIRES : Service public Fédéral Intérieur, DG Centre de Crise

EXECUTIVE SUMMARY

Du fait que les contacts avec de nouveaux pays ne se sont pas concretisé, l'implémentation du projet s'est limitée à mettre en ligne les contributions déjà reçues les années précédentes sur le site www.ispu.eu et de retravailler le document d'analyse de ces contributions qui a donc le statut de rapport final du projet.

OBJECTIFS DU PROJET

Objectif global pour 2012-2013 :
Renforcer la complémentarité des actions nationales, régionales et locales dans la réduction des risques de catastrophes
Objectifs spécifiques :
2012:
Elargir l'enquête à d'autres pays, actualiser les résultats antérieurs et échanger les bonnes pratiques (activité continue).
2013:
Organiser un atelier.

RESULTATS ESPERES

2012 :
Nouvelles contributions (au minimum l'Azerbaïdjan et le Maroc+ Bonnes pratiques).
2013 :
Atelier d'analyse.

RESULTATS OBTENUS PRECEDEMMENT (si pertinent)

Site www.ispu.eu met en ligne les résultats de l'enquête par questionnaire menée auprès de 9 pays, les bonnes pratiques identifiées ainsi que les différents documents de travail. Le site permet également de remplir en ligne le questionnaire d'enquête ainsi que la fiche "bonnes pratiques". Trois ateliers ont également été organisés.

RESULTS OBTAINED IN 2012

Work package 1 (prepared by ISPU)*:*
Description:
Analyse des nouvelles contributions.
Livrables associés:
Identification de bonnes pratiques additionnelles.

Les contacts avec divers pays ne s'étant pas matérialisé, l'analyse de nouvelles contributions n'a pas été possible.

Work package 2 (prepared by ISPU)*:*
Description:
Actualisation des données collectées.

Livrables associés:
Site web actualisé.

Pour les même raisons, il n'y a pas eu d'actualisation.

RESULTS OBTAINED IN 2013

Work package 1 (prepared by ISPU)*:*
Description:
Atelier.
Livrables associés:
Rapport final.

Les contacts avec divers pays ne s'étant pas matérialisé, la tenue de l'atelier n'a pas été possible.

3.B. Awareness initiatives

BE SAFE NET. PROTECT YOURSELF BY HAZARD

TARGET COUNTRIES: Global

PARTNERS INVOLVED:

COORDINATING CENTRE : BE-SAFE-NET Nicosia, Cyprus

OTHER CENTRES: CERG Strasbourg, France , ICoD La Valletta, Malta, TESEC Kiev, Ukraine)

OTHER PARTNERS: The following Centres contributed to the implementation of sections of Be Safe Net: AFEM - European Natural Disasters Training Centre (Ankara, Turkey), CUEBC - European University for the Cultural Heritage (Ravello, Italy), CRSTRA - Scientific and Technical Research Centre on Arid Regions (Biskra, Algeria), ECRP - European Centre for Risk Prevention (Sofia, Bulgaria), GHHD - European Centre on Geodynamical Risks of High Dams (Tbilisi, Georgia)

EXECUTIVE SUMMARY

After a long process of material collection involving many specialized Centres, the website official launch of the BE-SAFE-NET (organized around a set of twelve question and answers of the several kind of hazards) took place during the 25th Anniversary of the EUR-OPA Major Hazards Agreement, which has been held on 26-27/04/2012. The dissemination of the BE-SAFE-NET Project consisted also in the distribution of a 22 pages leaflet on BE-SAFE-NET Project (Alexandrou et al., 2012).
To develop the actual consultation of the BE-SAFE-NET website by the public, the Editorial Board explored the idea of holding an online competition based on its content as a way to motivate potential users. The general lines of such online competition were discussed in 2013 and the need of more uniformized presentation (in terms of quantity and detail for various hazards) emerged as a preliminary step, implying a redrafting of the actual available material in English and its consequent translation in all available languages (English, French, Italian, Russian, Greek) in 2014.

OBJECTIVES OF THE PROJECT

Global objective for 2012-2013 :
Be Safe Net project was created under the umbrella of Europa Major Hazard Agreement of Council of Europe (27 mainly Euro-Mediterranean Countries).
The Be Safe Net initiative wishes to achieve three main goals:
1. Promote a culture of safety among a new generation of people
• Raising awareness on implications of their actions and their way of thinking on emergency
• Replacing fear with a culture of preparedness
2. Disseminate knowledge to multilingual societies
• Create a common knowledge base of best experience
• Disseminate it in several languages to benefit a wider society
3. Become a interactive tool
• Open our website to other users and organisations for their benefit and comments
• Enrich its content by contributions based on external experiences
The target is general public especially for the school teachers and students.
The global objectives for 2012-13 are:
1) The website launch during EUR-OPA 25th Anniversary (April, May 2012).
2) To Promote the web-site through the following activities:
-2a) in the "short term" (for the launching), Editorial board will design a leaflet;
-2b) in the "medium term", the editorial board + secretariat will design set of Posters for distribution to Ministries of Education/Civil Protection departments for subsequent circulation in secondary schools (e.g. travelling exhibits);
-2c) in the "long-term", the Editorial Board suggests the setting up of an ‘on-line based Olympiad’ which will test the knowledge gained from theBeSafeNet website. This will reflect the effectiveness of the website in terms of awareness raising, promoting a culture of safety, disseminating knowledge to a multi lingual society, and acting as an interactive tool.
Specific objectives :
2012 :
1) The website launch during EUR-OPA 25th Anniversary (April - May 2012) will concern into the launch of the general section and of the first level of the twelve question answers of the several kind of hazards.

2) The implementation of a leaflet on BE Safe Net Project and web-site.
3) to start to design set of Posters for distribution to Ministries of Education/Civil Protection departments for subsequent circulation in secondary schools
4) to start the organisation of an 'on-line based Olympiad' among teachers from different countries. The teachers will be asked to answer a questionaire based on the material of the website. To organize this Olympiad competition will be usefull the experience gained by the Editorial Board in the partecipation to the International Earth Science Olympiad (IESO 2011) held in Modena (Italy) in September 2011.
2013 :
1) to finish to design set of Posters for distribution to Ministries of Education / Civil Protection departments for their circulation in secondary schools.
2) the setting up of the 'on-line based Olympiad' which will test the knowledge gained from the BeSafeNet website.

EXPECTED RESULTS

2012 :
Completion of the web-site in a minimum of 5 main languages (English, Italian, French, Greek and Russian). To develope the knowledge of the Be Safe Net at least at an European Level.
2013 :
To reach the aim of the website which is to become an educational tool in the hands of teachers, focusing at risk prevention, preparedness, immediate reaction and rehabilitation.

RESULTS OBTAINED PREVIOUSLY (if any)

The first Be Safe Net website (still available at http://www.besafenet.org/main/default.aspx?tabid=9) has been deeply modified in the contents as well as in the look. The changes have been carried out following decisions taken in occasion of meetings held in Strasbourg (2006), Cyprus (2007 and 2009), Ravello (2008), Lisbon (2008), Malta (2010), Modena (2010), Paris (2011) and Kiev (2011). The new website is available at www.besafenet.net. It has been presented at the International Conference Mountain Risks: Bringing Science to Society held in Firenze (Italy) from 24 to 26 November 2010 and at the 5th edition of the International Earth Science Olympiad (IESO 2011), for secondary school students, held in Modena (Italy) from 5 to 14 September 2011. To the IESO 2001 attended 115 students and 97 mentors/teachers/observers coming from 34 countries from all over the world.

RESULTS OBTAINED IN 2012

Work package 1 (prepared by Besafenet, ICoD, CERG, TESEC)*:*
Description:
Website launching in as many languages during EUR-OPA 25th Anniversary with all the completed material. Web-site promotion through the implementation of a leaflet and of a set of Poster for distribution to Ministries of Education / Civil Protection departments for subsequent circulation in secondary schools.
Associated deliverables:
Availability of 5 languages (English, Italian, French, Greek and Russian) versions. Leaflet of information for diffusion among potentially interested entities.

The dissemination of the BE-SAFE-NET Project in 2012 consisted in the website launch, made by the Editorial Board members, during the EUR-OPA 25th Anniversary Major Hazards Agreement, which has been held on 26-27/04/2012 at the headquarters of Council of Europe in STRASBOURG.
The launch did concern into an oral presentation of the general section and of the first level of the twelve question and answers of the several kind of hazards and in the distribution of a 22 pages leaflet on BE-SAFE-NET Project (Alexandrou et al., 2012).

Front page of the leaflet on "BE-SAFE-NET" Project

The leaflet, written in the five languages of the website, contains a synthetic description of the “goals” and the “objectives”, of the "Natural" and "Technological" hazards and of the authors of the Project.
In 2012 leaflet of website has been developed and presented for the meeting of EUR-OPA Permanent correspondents.
The key information of website has been translated from English to Russian and published on website.

ALEXANDROU A., GEROSIMOU G., PAPADOPOULOS M., CASTALDINI D., MICALLEF A., POYARKOV V. & PLA F. (2012) - Be Safe Net. www.Besafenet.net. EUR OPA Major Hazards Agreement. Council of Europe. European Centre for Disaster Awareness with the use of internet, Nicosia, Cyprus, 22 pp.

Work package 2 (prepared by CERG, TESEC, ICoD)*:*
Description:
Assessment and resetting of the existing Natural Hazards and Technological Hazards material and search contributors for the first level material on hazards not yet completed who had been just hidden from the site.
Associated deliverables:
Revised versions of the existing material and addition of new contributions.

According to the decision of the Editorial Board members, the BE-SAFE-NET website was modified and, after another recent relooking, nowadays the hazards are classified in two main categories: "Natural" and "Technological". In particular, the Natural hazards are distinguished in Geological (Volcanic Eruptions, Earthquakes, Tsunamis, and Landslides) and Hydro-Meteorological hazards (Floods, Drought and Desertification, Avalanches, Hurricanes, Storm Surges and Sea Level Rise). The "Technological" hazards are subdivided into Chemical Emergency, Radiological Emergency and Dam Failure. Moreover the “introductory” page of each hazard has been translated in Italian, French and Russian; the greek translation has to be done for some of the Natural hazards.

Work package 3 (prepared by Besafenet, ICoD, CERG, TESEC)*:*
Description:
Define procedures for the setting up of an ‘on-line based Olympiad’ which will test the knowledge gained from theBeSafeNet website.
Associated deliverables:
Draft of the questions and of the organizational needs of the event.

A further way for the dissemination of the “BE-SAFE-NET” Project will be the organization of an ‘on-line based Olympiad’ among teachers from different countries. The teachers should be asked to answer a questionnaire based on the material of the BE-SAFE-NET website. At the Paris meeting in December, the general structure of the Olympiad and the preparatory work (in particular the technical requirements) were discussed and adopted.

Work package 4 (prepared by Besafenet, ICoD)*:*
Description:
Two meetings (one in Cyprus and one in Malta) to discuss and manage the activities.
Associated deliverables:
Content of the brochure and edition of new material submitted.

The Editorial Board of the BE-SAFE-NET Project had a first meeting in Paphos (Cyprus) on 28-29/03/2012 in order to evaluate the existing material of the BE-SAFE-NET website and to prepare a printed leaflet for the launching of the Project in occasion of the 25th Anniversary of the EUR-OPA.
A second meeting of the Editorial Board members was held on 6-7/12/2012 in Paris during which the 2013 project activity was discussed and planned. The 2013 activity will concern some technical issues, the improvement of English texts of some natural hazards, the translation in each contributor language (Italian, French, Russian and Greek) of the first level of the 12 Questions and Anwers, the introduction of new hazards and the definition of concrete procedures for the organisation of an ‘on-line based Olympiad’. The 2013 ongoing activity will be examined in occasion of two meetings which will be held in Strasbourg, or Kiev (first week of June 2013) and Paris (first week of December 2013)

RESULTS OBTAINED IN 2013

Work package 1 (prepared by Besafenet, ICoD, CERG, TESEC)*:*
Description:
Finish the implementation of the set of Poster and their distribution to Ministries of Education/Civil Protection departments for subsequent circulation in secondary schools
Associated deliverables:
Posters.

The 2013 meeting highlighted the need to create a specific event related to Besafenet to foster its promotion among Education and Civil Protection departments. The planned communication plan based will be delayed to 2014 to include in it the launch of the online Olympiad in 2015.

Work package 2 (prepared by Besafenet, ICoD, CERG, TESEC)*:*
Description:
The setting up of an 'on-line based Olympiad' which will test the knowledge gained from theBeSafeNet website. Addressed to teachers of secondary schools, it will give awards to the winners in occasion of a ceremony which will be held in Cyprus.
Associated deliverables:
Preparation plan of the Olympiad and the award ceremony.

In occasion of the Kiev Meeting, the Be Safe Net editorial board confirmed the interest of an electronic competition to promote the use of the website by teachers. Concerning the language(s) to be used, it is necessary to have the material in all five languages (English, French, Russian, Italian and Greek) but the competition will take place only In English avoid misunderstandings related to language.
The board decided to restrict participation to schools of the member states of the Agreement and decided to organize jointly an individual and a class competition, with prizes for both to be defined (i.e. tablet for individual winner, grant for books for class winner, …). That requires defining a specific formula for the selection of a team winner and also specific criteria for selecting only one winner in case of ties.
In order to ensure that only students participate, registration must be channelled through schools and the promotion of the Olympiad must be done at school level. It is planned to launch the registration in October 2014 and organize the competition in spring 2015.
In order to ensure a good level of participation, an attractive announcement is required: an official letter send to authorities to promote the participation; a poster and a leaflet; a special page of Website both on Besafenet and Agreement website (deadline March)
The board suggested involving the Permanent Correspondents in order to mobilize a critical mass of participants: they can liaise with their national Education Ministry to diffuse the information among schools. To reach the local level, the cooperation with other entities can be explored: UNESCO has already an international network of schools and the Congress of Local and Regional Authorities can help in a possible involvement of Mayors.
An organizational constraint is the accessibility of participants to local computing resources: the competition has to take place in free time as not enough computers at school are available during working days and participation from home has to be avoided.
The format of the competition will be a set of multiple choice questions (covering all hazards) selected randomly over a set of predefined Q&A to be produced well in advance (deadline: end of March 2014)
On the longer term, the board suggested to use the Q&A structure as a tool for training also professional people and not only students.

Home page of the "BE-SAFE-NET" Project web site (http://www.besafenet.net/)

Work package 3 (prepared by Besafenet, ICoD, CERG, TESEC)*:*
Description:
Two meetings (one in Kiev and one in Paris) to discuss and manage the activities.
Associated deliverables:
Final version of Olympiad procedures.

The 2013 activity did concern some technical issues, the improvement of English texts of some natural hazards, the translation in each contributor language (Italian, French, Russian and Greek) of the first level of the 12 Questions and Anwers, the introduction of new hazards and the definition of concrete procedures for the organisation of an 'on-line based Olympiad'.

Only one meeting of the BE-SAFE-NET Project Editorial Board was was held on 10-11 september 2013 in Kiev (Ukraine) to mainly discuss the actual implementation of the online Olympiad and the necessary adjustments in the Besafenet content associated to the competition.
The following general decision were taken:

- The final English Version needs to be finished before the translation to the other languages as any change by one member implies a revision of all translations.
- In case the editors wish to add new material, it must be written only in English and included only as 2^{nd} level questions (not to be translated for the moment). Such new material should also be marked with a specific "New!" label to keep track of the need of translation for it.
- For the moment not to translate to new languages the existing material.
- The Cyprus Centre will ask for the content of each section in electronic version as it will facilitate the translation.
- To improve English versions of floods, volcanoes, earthquake, tsunamis / dam failure, drought
- To translate in all languages the finalized hazards: avalanches, landslides, hurricanes, sea level rise,nuclear hazard, chemical hazard.

EDUCATIONAL MATERIALS TO RAISE AWARENESS AND IMPROVE PREPAREDNESS TO DISASTERS

TARGET COUNTRIES: Armenia, the Southern Caucasian and neighboring states, other concerned member-states of the Council of Europe's EUR-OPA Major Hazards Agreement , other countries

PARTNERS INVOLVED:

COORDINATING CENTRE : ECRM Yerevan, Armenia

OTHER CENTRES

OTHER PARTNERS : .

EXECUTIVE SUMMARY

A set of educational material, aiming to raise awareness and preparedness to disasters in particular in schools and other educational institutions, were prepared:

- The final version of the methodology for teaching the course “Basic knowledge on safe life activities in extreme situations” was completed in Russian.
- The final version of “Special Tests to assess safety of schools and other educational institutions” was completed in English to serve as basis for each pilot school of “Plans and Guidelines” to increase safety.
- A final version of the “Extreme psychology” brochure (27 pages) was completed in Russian to improve psychological abilities to face disasters.
- Pilot versions of universal teaching material “First Aid Manual (Atlas)" (69 pages) and a “Memorandum first aid pocket book" (26 pages) were completed in Russian to widely diffuse basic knowledge on first aid administration.

OBJECTIVES OF THE PROJECT

Global objective for 2012-2013 :
Developing of additional educational materials, aimed to raise awareness and improve preparedness to disasters and their pilot adoption in schools and other educational institutions
Specific yearly objectives :
2012 :
1. Creation of the “Basic knowledge on safe life activities in extreme situations” pilot Manual for schools and other academic institutions.
Development of a final version of the” Methodology” for teaching the course :” “Basic knowledge on safe life activities in extreme situations” for public school teachers drawn on the outcomes of the round table discussions and feedback from the specialists of the Refresher Training Faculty of the State Crisis Management Academy in Armenia
2. Selection of pilot schools . Duplication and dissemination of a preliminary vaient of the “Special Tests assigned for school administration, teachers and students' parents to assess safety of schools and other educational establishments " for selected schools for comments, questions and proposals from specialists, school administration, teachers and students' parents with an aim to use these “Special Tests” in line with the General Recommendations as a basis for more and better studying and further development of the Tests and Recommendations, assigned for each particular pilot school, by given its specifics and location characteristics.
Preparation of a final version of the "Special Tests assigned for school administration, teachers and students' parents to assess safety of schools and other educational establishments".
Submission of the final English version of the "Special Tests" as a contribution to implement of the corresponding Section of "Be Safe Net".
3. Presentation of an preliminary version of the “Extreme psychology” brochure created by ECRM for further discussions and feedback from the specialists.
The brochure will present some psychological aspects for survival in emergencies. This brochure is mainly targeted towards cultivating in people, especially children, some personal performances required to successfully combat critical situations: raising faith and developing skills, enabling the maximum use of opportunities in times of a temporal lack of help in order to overcome any severe handicaps and emergency related dangers.
It also can serve a manual, assigned for the use of teachers, students and their parents, rescuers, peacekeepers, volunteers, involved into rendering first psychological aid in communities; as well as for the specialists, engaged into emergency response, for all those who wish to improve their psychological abilities in order to survive in emergencies
4. Presentation of a preliminary variant of a universal teaching “First Aid Manual” and a "Memorandum first aid pocket book" created by ECRM for further discussions and feedback from the specialists of the State Crisis Management Academy

2013 :
1. Creation of final version of the "Basic knowledge on safe life activities in extreme situations" pilot Manual for schools and other academic institutions
Offering courses of lectures, organization of a round table discussion and seminars with the involvement of the specialists from the Refresher Training Faculty of the State Crisis Management Academy" , in order to bring the meaning of the key provisions and fundamentals of the "Methodology" for teaching of the above course: "Basic knowledge on safe life activities in extreme situations" to the sense of the staff, administration authorities , school principals, Heads of the Civil Protection and Emergency Chairs of the Higher academic institutions.
2. Preparation of particular Tests and Recommendations, assigned for each defined pilot school as well designing "Plans and Guidelines" on increasing security of school institutions; primarily actions undertaken in a case of a specific emergency incident, brawn on the basic Tests and General Recommendations developed under methodological support provided by ECRM and the State Crisis Management Academy with the involvement of some relevant security structures within local and territorial governance.
3.Preparation of a final version of the "Extreme psychology" brochure for publishing , based on the results of the held discussions and feedback received from the specialists.
Submition of the final English version of the "Extreme Psychology" as a contribution to implement of the corresponding Section of "Be Safe Net".
4.Preparation of a final version of a universal teaching "First Aid Manual and a "Memorandum first aid pocket book for publishing drawn on the discussions outcomes and feedback from the specialists"

EXPECTED RESULTS

2012 :
1. Preliminary version of the "Basic knowledge on safe life activities in extreme situations" pilot Manual for schools and other educational institutions.
A final version of the" Methodology" for teaching the course:" "Basic knowledge on safe life activities in extreme situations" for public school teachers. "
2. A final version of the "Special Tests, assigned for school administration, teachers and students' parents to assess safety of schools and other educational institutions".
Submission of the final English version of the "Special Tests" as a contribution to implement of the corresponding Section of "Be Safe Net".
3. Preliminary version of the "Extreme psychology" brochure.
Feedback from the specialists for preparing a final version of the "Extreme psychology" brochure.
4. Preliminary versions of a universal teaching "First Aid Manual" and "Memorandum first aid pocket book"
Feedback from the specialists for preparing a final version of a universal teaching "First Aid Manual and a "Memorandum first aid pocket book"
2013 :
1.Final version of the "Basic knowledge on safe life activities in extreme situations" pilot Manual for schools and other educational institutions
Bringing the meaning of the key provisions and fundamentals of the "Methodology" for teaching drawn on the above pilot "Manual" to the sense of the public school teachers
2. Particular Tests and Recommendations, assigned for each defined pilot school.
"Plans and Guidelines" on increasing security of school institutions; primarily actions undertaken in a case of a specific emergency incident.
3.A final version of the "Extreme psychology" brochure
Submission of the final English version of the "Extreme Psychology" as a contribution to implement of the corresponding Section of "Be Safe Net".
4. A final version of a universal teaching "First Aid Manual" and a "Memorandum first aid pocket book"

RESULTS OBTAINED PREVIOUSLY (if any)

RESULTS OBTAINED IN 2012

Work package 1 (prepared by ECRM):
Description:
Creation of the "Basic knowledge on safe life activities in extreme situations" pilot Manual for schools and other academic institutions. Development of a final version of the" Methodology" for teaching the course :" "Basic knowledge on safe life activities in extreme situations" for public school teachers drawn on the outcomes of the round table discussions and feedback from the specialists of the Refresher Training Faculty of the State Crisis Management Academy in Armenia.
Associated deliverables:
A final version of the Methodology for teaching the course "Basic knowledge on safe life activities in extreme situations" for public school teachers

A draft version of the "Basic knowledge on safe life activities basis in extreme situations", as a pilot "Manual" for schools and other educational institutions;
A final version of the universal "Methodology" for teaching the course "Basic knowledge on safe life activities basis in

extreme situations" for public school teachers.
There is a need to note here, that there are an array of educational training manuals, addressing the above venue that contain the brief methodological guidelines on teaching the particular course, partially included into the "Introduction" of the correspondent concrete (local) courses. However, a "Methodology", as a universal scientific educational manual on teaching the above wide spectrum course in general, aimed to offer fundamental retraining to teachers, doesn't exist and our universal "Methodology" is called to fill that gap.

Work package 2 (prepared by ECRM):
Description:
Selection of pilot schools. Duplication and dissemination of a preliminary variant of the "Special Tests assigned for school administration, teachers and students' parents to assess safety of schools and other educational establishments" for selected schools for comments, questions and proposals from specialists, school administration, teachers and students' parents with an aim to use these "Special Tests" in line with the General Recommendations as a basis for more and better studying and further development of the Tests and Recommendations, assigned for each particular pilot school, by given its specifics and location characteristics.
Preparation of a final version of the "Special Tests assigned for school administration, teachers and students' parents to assess safety of schools and other educational establishments". Submission of the final English version of the "Special Tests" as a contribution to implement of the corresponding Section of "Be Safe Net".
Associated deliverables:
A final version of the "Special Tests assigned for school administration, teachers and students' parents to assess safety of schools and other educational establishments".

A final version of the "Special tests assigned for school administration, teachers and students' parents to assess safety of schools and other educational institutions" was prepared and the final version in English was submitted to the EUR-OPA Secretariat also as a contribution if a need may arise in a corresponding section of "Be Safe Net".
Among the 40 Tests for school administration and teachers cited below, tests 1-8 addressing the first, second and third directions in the developed basic Tests need to be specially highlighted. Tests 9-18 are assigned to assess a preparedness level of school staff to respond adequately in case of a particular disaster, endangering the school. Test 19-27 enable to assess a state of an inner school organizational progress of ensuring safety and reducing vulnerability. 12 Tests, quoted within the framework of Clause 28, refer to the assessment of a progress of practical teaching and training organized in the school with an aim to improve school preparedness to prevent and liquidate hazards that could arise in the school itself, as well as to update and strengthen school staff skills to act adequately in emergencies.
Among the 12 Tests for the student's parents, tests 1-3 intend to assess a level of awareness of the student's parents, concerning the provision of safety and preparedness of the school to respond to disasters and also to assess a level of preparedness of the parents themselves to act rationally in case of an emergency in the school. Tests 4-12 intend to assess a level of awareness of the student's parents concerning the knowledge that the children have acquired on safe survival basis, and also to assess a level of parents' preparedness to recognize risks of involving children into extreme situations.

Work package 3 (prepared by ECRM):
Description:
Presentation of an preliminary version of the "Extreme psychology" brochure created by ECRM for further discussions and feedback from the specialists.
The brochure will present some psychological aspects for survival in emergencies. This brochure is mainly targeted towards cultivating in people, especially children, some personal performances required to successfully combat critical situations: raising faith and developing skills, enabling the maximum use of opportunities in times of a temporal lack of help in order to overcome any severe handicaps and emergency related dangers.
It also can serve a manual, assigned for the use of teachers, students and their parents, rescuers, peacekeepers, volunteers, involved into rendering first psychological aid in communities; as well as for the specialists, engaged into emergency response, for all those who wish to improve their psychological abilities in order to survive in emergencies.
Associated deliverables:
Preliminary version of the "Extreme psychology" brochure. Feedback from the specialists for preparing a final version of the "Extreme psychology" brochure.

A draft version of the "Extreme psychology" brochure was prepared. Drawn on the feedback from the specialists, a final version of the "Extreme psychology" brochure will be prepared. The brochure will present some psychological aspects for survival in emergencies. The main aim of the brochure is to cultivate in people, especially children some personal performances required to successfully combat critical situations: raising faith and developing skills enabling the rescuers, peacekeepers, volunteers involved into rendering fist psychological help in communities, as well as for the specialists, engaged into emergency response, for all those who wish to improve the psychological abilities in order to survive in emergencies.

Work package 4 (prepared by ECRM):
Description:
Presentation of a universal teaching "First Aid Manual" and a "Memorandum first aid pocket book" created in ECRM for

further discussions and feed back from the specialists of the State Crisis Management Academy.
Associated deliverables:
Preliminary versions of a universal teaching tool "First Aid Manual" and "Memorandum first aid pocket book". Feedback from the specialists for preparing a final version of a universal teaching "First Aid Manual and a "Memorandum first aid pocket book
Acknowledgement with a draft version of the above educational materials, created by ECRM, holding round table discussions, preparation by specialists from the State Crisis Management Academy" of a feedback aimed to their updating, involvement into preparation of their final versions

Draft versions of a universal teaching "First Aid Manual" and a "Memorandum first aid pocket book" were prepared. Drawn on the feedback from the specialists, final versions of both will be prepared.

RESULTS OBTAINED IN 2013

Working package 1 (prepared by ECRM):
Description:
Creation of final version of the "Basic knowledge on safe life activities in extreme situations" pilot Manual for schools and other academic institutions
Offering courses of lectures, organization of a round table discussion and seminars with the involvement of the specialists from the Refresher Training Faculty of the State Crisis Management Academy" , in order to bring the meaning of the key provisions and fundamentals of the "Methodology" for teaching of the above course :"Basic knowledge on safe life activities in extreme situations" to the sense of the staff, administration authorities , school principals, Heads of the Civil Protection and Emergency Chairs of the Higher academic institutions.
Submission of the final English version of the "Methodology" as a contribution to implement of the corresponding Section of "Be Safe Net".
Associated deliverables:
Preliminary version of the "Basic knowledge on safe life activities in extreme situations" pilot Manual for schools and other educational institutions. Final version of the Methodology for teaching the course "Basic knowledge on safe life activities in extreme situations" for public school teachers.

A final updated version of the universal "Methodology" for teaching the course: "Basic knowledge on safe life activities basis" for public school teachers (26 pages) in Russian and further will be prepared an English variant of the "Methodology".
There is a need to note here , that there are an array of educational training manuals, addressing the above venue that contain the brief methodological guidelines on teaching the particular course, partially included into the "Introduction" of the correspondent concrete (local) courses. However, a "Methodology", as a universal scientific educational manual on teaching the above wide spectrum course in general, aimed to offer fundamental retraining to teachers, doesn't exist. Our universal "Methodology" is called to fill this gap.

Work package 2 (prepared by ECRM):
Description:
Preparation of particular Tests and Recommendations, assigned for each defined pilot school as well designing "Plans and Guidelines" on increasing security of school institutions; primarily actions undertaken in a case of a specific emergency incident, brawn on the basic Tests and General Recommendations developed under methodological support provided by ECRM and the State Crisis Management Academy with the involvement of some relevant security structures within local and territorial governance.
Associated deliverables:
Particular Tests and Recommendations, assigned for each defined pilot school. "Plans and Guidelines" on increasing security of school institutions; primarily actions undertaken in a case of a specific emergency incident.

A final updated version of the "Special tests assigned for school administration, teachers and students' parents to assess safety of schools and other educational institutions" in English was completed.
These "Special Tests", designed for school administration and teaching staff and the Tests and Recommendations designed for parents are suggested as one of the effective mechanisms in ensuring their preparedness to recognize and reduce disaster risks, enabling to provide adequate response to any locally experienced emergency.
The aim of the Tests for school administration and teachers is to identify the level to which their educational institution is ready to eliminate natural, man-made and other disaster risks and to respond to disasters.
The Tests for parents enable them to highlight levels of a culture of safety, as well as of the parent's preparedness to recognize a hazard and undertake preventive measures to reduce risk of involving children into extreme situations and also to act rationally if an emergency incident occurred.
The Tests' outcomes can serve a basis for designing Recommendations on reducing vulnerability of schools, improving preparedness of the school staff to act adequately in a particular disaster and to review and upgrade the disaster preparedness Plans, as well as to prepare parents to recognize a hazard and undertake preventive measures to reduce risks for children.

Work package 3 (prepared by ECRM):
Description:
Preparation of a final version of the "Extreme psychology" brochure for publishing, based on the results of the held discussions and feedback received from the specialists. Submission of the final English version of the "Extreme Psychology" as a contribution to implement of the corresponding Section of "Be Safe Net".
Associated deliverables:
A final version of the "Extreme psychology" brochure. Submission of the final English version of the "Extreme Psychology" as a contribution to implement of the corresponding Section of "Be Safe Net".

A pilot version of the "Extreme psychology" brochure in Russian (on 27 pages) is enclosed to this "Brief Presentation of 2013 activities".
The brochure presents some psychological aspects for survival in emergencies. The main aim of the brochure is to cultivate in people, especially children some personal performances required to successfully combat critical situations : raising faith and developing skills enabling the rescuers, peacekeepers, volunteers involved into rendering fist psychological help in communities , as well as for the specialists, engaged into emergency response, for all those who wish to improve the psychological abilities in order to survive in emergencies.
In 2014-2015 it is supposed with involvement of partner-centres drawn on their proposals and comments on above brochure to develop an updated universal document in English and Russian: "EXTREME PSYCHOLOGY", whose main target is:

- to serve an universal Manual on training in cultivating an emotional- will self -regulation method in vast layers of the population, including school children, students as well as rescuers ,volunteers and other specialists.
- to format and cultivate in people (rescuers, adults, young generation, children) the skills of retaining self-control .
- to teach by giving correct assessment of the ongoing and mustering skills to make adequate decisions which is realistic only if this condition is met.

The brochure will present some psychological aspects towards survival in emergencies. It is manly targeted to cultivating in people, especially children, some personal performances required to successfully combat critical situations; raising faith and developing skills enabling the maximum use of opportunities in times of a temporal lack of help in order to overcome any severe handicaps and emergency related dangers.
It also can serve a manual assigned to the use of teachers, students and their parents, rescuers, peacekeepers, volunteers involved into intervention of a first psychological aid in communities; as well as for specialists engaged into emergency response; far all those who wish to improve their psychological abilities in order to survive in emergencies

Work package 4 (prepared by ECRM):
Description:
Preparation of a final version of a universal teaching "First Aid Manual and a "Memorandum first aid pocket book for publishing drawn on the discussions outcomes and feedback from the specialists".
Associated deliverables:
A final version of a universal teaching "First Aid Manual" and a "Memorandum first aid pocket book"
Offering courses of lectures, organization of a round table discussion and seminars with the involvement of the specialists from the Refresher Training Faculty of the State Crisis Management Academy" in order to bring the meaning of the key provisions and fundamentals of the methodological and educational materials to the sense of the potential teachers, running training courses, drawn on these materials .
Selection of pilot schools, engagement into the development of the "Plans and Guidelines on increasing security of school institutions and primarily actions, undertaken in a case of a specific emergency incident"
Running some relevant training programmes and organization of activities, aimed to be prepared, in the established order, to make correspondent decisions about adoption of the above teaching courses, drawn on the pilot educational materials, into the school and other educational institutions' curriculum.

Pilot versions in Russian of an teaching "First Aid Manual (Atlas)" (on 69 pages) and universal "Memorandum First Aid Pocket Book" (on 26 pages). The pilot version in Russian of a universal "Memorandum First Aid Pocket Book" (on 26 pages), as well as the "CONTENT" (on 3 pages) of the teaching "First Aid Manual (Atlas)" are enclosed to this "Brief Presentation of 2013 activities". The pilot version in Russian of the teaching "First Aid Manual (Atlas)" itself consists of 69 pages and contains many pictures. If needed it also can be delivered in addition.
In 2014-2015 it is supposed with involvement of partner-centres drawn on their proposals and comments on the pilot version of the above universal "Memorandum First Aid Pocket Book" and teaching "First Aid Manual (Atlas)" to develop an updated universal document in English and Russian "MEMORANDUM FIRST AID POCKET GUIDE", whose main target is to serve as a:

- manual for vast layers of the population (including students, school children and housewives, rescuers, volunteers…) as a brief summary comfortable for studying and regular consolidation of gained knowledge and skills on administering first aid,
- normative document which will provide insurance in actions while showing first aid with strictly defined

spectrum of competence and abilities of a man, his rights and duties, consequence in decision making and further actions,

– "crib", containing some elements of urgent search for the required information (a " brief guidebook" regards this manual for prompt orientation and finding the needed section).

Eventually, the "MEMORANDUM FIRST AID POCKET GUIDE " is called to promote the dissemination of knowledge and mustering the basic skills on administering first aid by general population of the countries, represented in the EUR-OPA Agreement.

It will enable people- the witnesses of the extreme situation to do all possible in order to avoid the death of casualties on the scene as well as to reduce the number of dead outcomes before the rescuers and specialized medical personnel arrive.

NUCLEAR HAZARD. CHERNOBYL AND FUKUSHIMA: LESSONS FOR PUBLIC AWARENESS

TARGET COUNTRIES : Armenia, Azerbaijan, Belgium, Bulgaria, Georgia, Moldova, Morocco, Russia, San-Marino, Turkey, Ukraine

PARTNERS INVOLVED :

COORDINATING CENTRE : TESEC Kiev, Ukraine

OTHER CENTRES: ECRM Yerevan, Armenia , CEMEC San Marino , ISPU Florival, Belgium , CEPRIS Rabat, Morocco

OTHER PARTNERS : Azerbaijan, Georgia, Moldova, Bulgaria,

Russia, Turkey, UNESCO, IAEA, UNDP

EXECUTIVE SUMMARY

After a large discussion with experts from all participant countries, the booklet "Basic Knowledge of Nuclear Hazards: Lessons from Chernobyl and Fukushima" was finalized in English. It covers the main aspects of radiological hazard, clarifying the various types of radiation, the potential sources of a radiological accident and the real threats associated to them as well as the necessary actions for prevention, preparedness and response in case of nuclear emergency.
It was translated by the partner Centres in several languages (Russian, Italian, Armenian, Bulgarian, Romanian, Azeri and Arabic) and already diffused in some of the countries to a wider public.

OBJECTIVES OF THE PROJECT

Global objective for 2012-2013 :
Better public awareness on nuclear and radiological hazard
Specific yearly objectives :
2012 :
Developing of first draft of Booklet BASIC KNOWLEDGE OF NUCLEAR HAZARDS: LESSONS FROM CHERNOBYL AND FUKUSHIMA in English and Russian; translate Booklet in national languages; distribute to national institutions (national authorities, public organization, communities, schools, etc.) for comments, questions and proposals from different categories of public: journalists, decision makers, teachers, students, and others ; editing of Booklet on national level; sending to TESEC for compilation and merging of proposals from different countries; organizing national Workshops for discussion of final texts.
2013 :
Developing of final text in 12 languages; publishing Booklets in national languages and English; distribute it on national and international levels; organizing of national training course for teacher and promotion of Booklet on national and international levels

EXPECTED RESULTS

2012 :
Draft of Booklet BASIC KNOWLEDGE OF NUCLEAR HAZARDS: LESSONS FROM CHERNOBYL AND FUKUSHIMA in 12 languages, with contribution of journalists, decision makers, teachers, students, and others; discussion of Booklet on national levels in 11 countries
2013 :
Booklet BASIC KNOWLEDGE OF NUCLEAR HAZARDS: LESSONS FROM CHERNOBYL AND FUKUSHIMA in 12 languages, with contribution of journalists, decision makers, teachers, students, and others; dissemination of Booklets in 11 countries, training course for teachers in 11 countries

RESULTS OBTAINED PREVIOUSLY (if any)

The primary text of Booklet BASIC KNOWLEDGE OF NUCLEAR HAZARDS: LESSONS FROM CHERNOBYL AND FUKUSHIMA in English has been prepared and discussed on international meetings, seminars and workshops

RESULTS OBTAINED IN 2012

Work package 1 (prepared by TESEC)*:*
Description:
Develop first draft of Booklet BASIC KNOWLEDGE OF NUCLEAR HAZARDS: LESSONS FROM CHERNOBYL AND FUKUSHIMA in English and Russian, distribute it to partners, coordination of project

Associated deliverables:
The revised draft of Booklet in English and Russian

In the meeting of held in Strasbourg on the 14th of April 2011, after a presentation on “Nuclear Hazard - Chernobyl and Fukushima lessons concerning population awareness” and following the proposal of the Belgian representative, The Permanent correspondents authorised TESEC to develop a booklet on “Basic Knowledge of Nuclear Hazards: Lessons from Chernobyl and Fukushima” which will be understandable for teachers, journalists, decision makers, etc.
A first draft of Booklet was presented on the 4th of November 2011 at a meeting with various international organization (UNDP, UNESCO, IAEA, Parliamentary Assembly the Council of Europe, EUR-OPA Executive Secretariat) and member states representatives (Université du Luxemburg) and some French professional organizations (Institute of Nuclear and Radiation Safety; Direction Générale de la Sécurité civile et de la Gestion des Crises; Paris Fire Department). The necessity of such Booklet, its technical aspects and the adequacy of the material presented has been discussed and all representatives underline that such Booklet is needed to better inform general public (such teachers, journalists, decision maker) on nature of nuclear and radiological risk and that its content is sufficient for understanding the nature of nuclear hazards.
Taking account of the remarks of the participants, and in particular that not all types of reactors have containment and that some case studies of radiological accidents have to be presented, a revised draft of Booklet (both in English and in Russian) was prepared in January 2012 and widely distributed to many countries for comments and proposals from different categories of population (teachers, journalists, decision maker, students, etc.).

Work package 2 (prepared by TESEC, ECRM, ISPU, CEMEC, centres in Azerbaijan, Georgia, Moldova, Bulgaria, Morocco, Turkey):
Description:
Translate Booklet in national languages and to distribute it to national institutions (national authorities, public organization, communities, schools, etc.)
Associated deliverables:
Draft of Booklet in 12 languages, with contribution of journalists, decision makers, teachers, students and others

The booklet was translated into the national languages of Armenia, Azerbaijan, Bulgaria, Georgia, Moldova, Russia, San-Marino and Morocco.
The Booklet was translated into Armenian **(ՄԻՋՈՒԿԱՅԻՆ ՎՏԱՆԳԻ ՎԵՐԱԲԵՐՅԱԼ ՀԻՄԱՆԱԿԱՆ ԳԻՏԵԼԻՔՆԵՐԸ ՉԵՌՆՈԲԻԼԻ ԵՎ ՖՈՒԿՈՒՍԻՄԱՅԻ ԴԱՍԵՐԸ)** by highly qualified professionals in this area and disseminated for feedback to correspondent national institutions.
The booklet has been translated into Azerbaijani (**NÜVƏ TƏHLÜKƏSI HAQQINDA ƏSAS BILIKLƏR: ÇERNOBIL VƏ FUKUSIMANIN DƏRSLƏRI**) and has been sent to 20 organizations,ministries and 5 corresponding specialists.
The Russian version of the booklet has been translated into Georgian (**ძირითადი ცოდნა ბირთვული საფრთხეების შესახებ: ჩერნობილისა და ფუკუშიმას გაკვეთილები**) and suggested for wide circle of scientists, school teachers, students, NGO-s etc. Many remarks and suggestion have been received and introduced into initial version.
The Chisinau Centre has translated the booklet into the official language (**CUNOŞTINŢE DE BAZĂ DESPRE PERICOLUL NUCLEAR: LECŢIILE CERNOBÎLULUI ŞI FUKUSHIMEI**) and has distributed it to different social strata, experts from different fields, decision-making authorities, student environment, pupils, etc. for identifying constructive proposals able to contribute to book’s quality improvement and availability.
The San Marino Centre staff produced the translation of the book in Italian (**CONOSCENZE DI BASE SUL RISCHIO NUCLEARE: QUELLO CHE ABBIAMO IMPARATO DA CHERNOBYL AND FUKUSHIMA**). It was not only a “passive” translation job as specific and knowledge based competencies on nuclear sciences were needed.
The Rabat Centre has also prepared an Arabic version (من تشيرنوبيل و فوكوشيما المعارف الأساسية للخطر النووي الدروس المستفادة) of the booklet.

Work package 3 (prepared by TESEC, ECRM, ISPU, CEMEC, centres in Azerbaijan, Georgia, Moldova, Bulgaria, Morocco, Turkey):
Description:
Organize national workshops for discussion of national texts and collection of comments, questions and proposals from different categories of public (journalists, decision makers, teachers, students, and others) at national level, sending them to TESEC for compilation and merging of proposals from different countries.
Associated deliverables:
National and international comments and proposals to final version of Booklet in 12 languages, with contribution of journalists, decision makers, teachers, students, and others.

The TESEC received comments and proposals from Ukraine, Armenia, Azerbaijan, Bulgaria, Georgia, Moldova, Russia, San-Marino, Turkey and USA.
All counterparts underlined that:
1. people need such book
2. Book is understandable for the majority of people
There were also some proposals to correct the text:

- To change symbols of elements to names
- To shift some tables to Attachments
- To add more about radioactive waste
- To add about different types of reactors
- More details about causes of Chernobyl accident
- To shift to attachment some details about structure of matter
- To add about decontamination
- To add more examples of radiological accidents

Some proposals will be reflected in the corrected text and published in TESEC website http://www.tesec-int.org/English1.htm

Armenia

The existence of a Nuclear Power Plant in the country explains a great interest of Armenian partners to participate in the the Project in order to benefit from valuable international practices by the other states participating and of course by the Coordinating centre, TESEC. Different stakeholders (Head and specialists of the Protection of population Department of the Ministry of Emergency Situations, the specialist in charge of the Armenian Nuclear Power Plant , the IAEA national expert , teachers and students of the State Academy of Crisis Management, journalists, etc.) provided comments, suggestions and questions concerning the booklet. A part of comments was prepared, drawn on the results of discussions held with relevant groups of users, in particular, the students attending the Refresher Course for senior staff and specialists, organized by the State Crisis Management Academy.
All the comments and proposals received were discussed with their authors in order to clarify them before sending to TESEC for compilation and merging with proposals made by other countries. ECRM also prepared more detailed proposals and comments drawn on the detailed analyses of the Booklet, which were also send to TESEC.
It must also be pointed out that some other work addressing the above venue are carried out in Armenia and some relevant developments and rather interesting experiences to share with other partners have been collected. In particular, ECRM is developing a “Manual for the population on how to act when a radiation pollution is real or seems imminent: priorities for action”, with some of the clauses of its final variant in English (available in 2013) can serve as additional material to the “Booklet”, in particular for sections 8 and 9.

Azerbaidjan

A round table on the topic was held on September 24, 2012 after collecting all responses of the result of discussion and classification of opinions,suggestions, comments and sortcomings by the special commision of experts. The well-known experts and scholars on radiation problems were invited to take part in the discussion. The round table was opened by the Director of the Center H.Ocaqov. He clarified why the EUR-OPA Major Hazards Agreement of the Council pays special attention to this problem. He also noted that the nuclear danger in the background of events happening in the atom objects has increased and that some countries make serious efforts to produce atomic weapons. In such situation, it is necessary that population especially in areas close to nuclear power stations must be ready to struggle and defence. Then he said his opinion to the result of discussions. He noted the majority of participants have highly appreciated efforts of EUR-OPA for financing and Kiev Center for preparation of such important book.
A number of opinions, amendments and additions to the booklet “Nuclear Hazard. Chernobyl and Fukushima: Lessons for public awareness” were proposed by the specialists of the Ministry of Emergency Situations of Azerbaijan Republic, Academy of Ministry of Emergency Situations, Azerbaijan National Aviation Academy, Institute of Geography of the National Academy of Sciences, Agency of Radiation, Isotopes Training Center , Institute of Radiation Problems of the National Academy of Sciences that participated in the discussions. All these proposals and additions were sent to the author of the booklet.

Moldova

The ECMNR collected several reviews from various social categories attesting the importance of the booklet and various concrete proposals to make the book more explicit, more interesting were sent to the Coordinating Centre TESEC.
The ECMNR also organized and held a Scientific and Practical Conference on the topic “LESSONS FROM CHERNOBYL AND FUKUSHIMA”on 28th of November 2012 within ”Alexei Mateevici” Pedagogical College from Chisinau. The main goal of the conference was to determine priorities and tools for improving population training, information and defense against the nuclear hazards. This is going to be achieved by the promotion of the best European practices of measure planning in risk situations, of successful cooperation between state authorities, local public administration authorities, NGOs, the general public, following the early information procedure, the iodine prophylaxis and other defense measures.
The participants in the conference (representatives of the Civil Protection and Exceptional Situations Service, local public administration authorities, medical practitioners and other decision-making authorities, didactical staff, students) have discussed and analyzed the content of the booklet.
The rapporteurs have mentioned that practical measures oriented towards the minimization of consequences related to the life and health of the human being and of the environment must be prepared according to the best international practices. The Chernobyl and Fukushima catastrophes have shown that this type of accidents does not recognize any state boundaries. In this regard, an effective solidarity ready to react anytime is needed.
The participants in the conference recommend:

1. To publish and distribute the booklet as soon as possible.

2. To organize training courses for family physicians on the topic Medicine of Radioactive Accidents.
3. To organize the preparation of the most modern and advanced materials for educational institutions and to train the didactical staff for teaching lessons on the "Radiation Hazard" in educational institutions.

RESULTS OBTAINED IN 2013

Working package 1 (prepared by TESEC):
Description:
Compilation and merging of final proposals and comments from different countries and international organizations, developing final text in English and Russian.
Associated deliverables:
Final text in English and Russian

The final version of the Booklet: "BASIC KNOWLEDGE OF NUCLEAR HAZARDS; LESSONS LEARNT FROM CHERNOBYL AND FUKUSHIMA" in English and Russian was timely submitted to all partner Centres by TESEC, the Project Coordinating Centre.

ISPU

In the course of its participation in the network of the 27 specialised centres of the Council of Europe's EUR-OPA Major Hazards Agreement, the Higher Institute of Emergency Planning (ISPU) has worked together on several occasions with the Ukrainian centre, the European Centre of Technological Safety (TESEC). This centre, set up to share the lessons learned from the Chernobyl disaster at international level, has been running a programme of activities for several years, aimed at strengthening the protection of communities against nuclear and radiological hazards.
In 2008, the TESEC organised a workshop in Kyiv, the objective being to share best European practices that can help strengthen protection for communities living close to a nuclear power station. The TESEC then started up a programme of activities running over several years, focusing on information for communities living near a nuclear power station. A draft information pack was compiled, bringing together some basic information on radioactivity, its health effects and means of protection against it. The idea is to strengthen trust among members of the public by providing neutral and verifiable information on the risk to which they are exposed, so that they will more easily understand and accept the protective action decided on by the authorities in an emergency situation.
After receiving comments on the information pack from several Belgian experts (in the fields of radiology, nuclear emergency planning and crisis communication), the ISPU has decided to pass these on to the EUR-OPA Agreement and TESEC, in the form of a "Guide" which might serve as a general framework for anyone tasked with providing information to a community living or working near a nuclear power station.
The ISPU welcomes the important work carried out by the TESEC specialised centre and encourages it to pursue its efforts to improve protection for communities living in the vicinity of nuclear power stations.

The approach is based on the following observation: The Chernobyl and Fukushima disasters sadly highlighted hesitancy, slow response and a lack of transparency regarding the seriousness of the situation and the management of the event. There is a danger that the precedents set in those cases could give rise to mistrust of official information issued in the event of a new disaster: the public might not follow the authorities' recommendations. Accordingly, the objective is to provide the public with a certain minimum of basic knowledge. As a result, when faced with an emergency situation, the community concerned could better evaluate the risks, understand the protective action decided upon and follow the recommendations made to it by the authorities via the official media.
Initially, the TESEC is planning to circulate its folder to various experts, authorities, teachers, journalists etc, in order to gather comments and useful suggestions.

The base information proposed in the pack relates to:

- radioactivity, its different sources, how it is detected and its effects on health;
- accidents, illustrated by the accidents at Three Mile Island, Chernobyl, Goiania and Fukushima
- the consequences of a release
- the persons exposed
- the factors determining the zone at risk such as the intensity of the release, weather conditions (wind direction and speed, atmospheric stability, rainfall), etc
- the protective action that can be taken in the event of an accident

Work package 2 (prepared by TESEC, ECRM, ISPU, CEMEC, centres in Azerbaijan, Georgia, Moldova, Bulgaria, Morocco, Turkey)*:*
Description:
To develop final texts in 10 languages.
Associated deliverables:
Final versions of Booklet in 12 languages, with contribution of journalists, decision makers, teachers, students, and others.

The final booklet is currently available in 8 languages:

- English
- Russian
- Italian
- Armenian
- Bulgarian
- Romanian
- Azeri
- Arabic

ECRM
The final variant of the Booklet was translated and edited into Armenian by highly qualified professionals in this area. The Armenian version of the Booklet was sent to the TESEC, Kiev - the Coordinating Centre of the Project. It will be copied and will serve as information - educational material for different categories of the public. The Booklet will also serve as educational material (Manual), used in relevant educational institutions of Armenia, in particular to train students attending the Refresher Course for senior staff and specialists, organized by the State Crisis Management Academy under the Ministry of Emergency Situations.
A great interest and readiness of ECRM and other Armenian partners in general to participate in the above Project was caused, primarily, by the availability of the Armenian Nuclear Power Plant in the country, as well as by those great significance and actuality that the Project under development has and, of course, by those valuable international practices that were gained by the Project state-members, namely, by the Coordinating centre: TESEC, Kiev, Ukraine. At the same time in Armenia, including in ECRM, some big work addressing the above venue was being carried out and some relevant developments and rather interesting experiences have been accumulated, that can be willingly shared with our “Partners”.
That is why ECRM has included not only activities in the framework of the Project in general, but also activities being fulfilled by ECRM in supplement to the Project, which results are to be applied in Armenia and also used for exchange of experience with “Partner-Centres”, which will only promote the enriching of the Project itself.
ECRM developed a pilot version of the “Manual for the population on how to act when a radiation pollution is real or seems imminent (priorities for action)”. Some clauses of the “Manual” can serve a supplemental material to the above “Booklet”, in the first turn, to its sections 8 and 9. A final variant of the ”Manual” in English and Russian will be completed soon.

Work package 3 (prepared by TESEC, ECRM, ISPU, CEMEC, centres in Azerbaijan, Georgia, Moldova, Bulgaria, Morocco, Turkey)*:*
Description:
Publishing of final version of Booklet in 12 languages, with contribution of journalists, decision makers, teachers, students, and others.
Associated deliverables:
Booklets in 12 languages.

In 2013, the English, Azeri, Romanian and Georgian versions were printed.

Work package 4 (prepared by TESEC, ECRM, ISPU, CEMEC, centres in Azerbaijan, Georgia, Moldova, Bulgaria, Morocco, Turkey)*:*
Description:
Dissemination of Booklets in 11 countries, organizing of training course for teachers in 11 countries
Associated deliverables:
Better public awareness on nuclear and radiological hazard in 11 countries.

The dissemination of the printed material took place in a few countries. The organization of training courses was however delayed to 2014 in order to clearly define its geographical scope and content and is subject to the willingness of concerned countries to host it as well as the availability of trainers. The principle of three pilot courses (one in English, one in Russian and one in Arabic) was retained for 2014.

ECRP

European Centre jointly with the Civil Protection organized under the leadership of Governor meeting with the participation of mayors and directors of schools of 30 km. zone of the plant " Kozloduy " . At the time of the meeting was presented the brochure " Basic knowledge of radiation hazards: lessons from Chernobyl and Fukushima." Were discussed methods of training based on this book for different age groups? It was agreed to be held sessions in certain classes without an open class because these classes in Bulgarian schools conducted by class teachers. It was decided during the year some elements of the book are presented in the classes in Physics and Biology.
There were classes in schools by 30 km area with students in 7th, 8th and 9th grade.
Our first impression is that the book is interesting to the public by 30 km area and it was decided the next year to make a bid for enhanced edition for it to reach every family.

The following activities have been performed in 2013 by the European Centre for Risk Prevention (ECRP), Sofia within the implementation of the project "Nuclear Hazard. Chernobyl and Fucushima: Lessons for Public Awareness":

- Translation of the finally text of the booklet into Bulgarian language;
- Editing of the booklet in 200 pieces ;
- Preparation for supply of the booklet in 30 km zone of Nuclear station of Kozlloduy and organization and realization of lessons in School.

COASTAL AREAS MANAGEMENT AGAINST SEISMIC AND TSUNAMI RISKS: SOCIO-ECONOMICAL IMPACT

TARGET COUNTRIES: Portugal, Morocco and Agreement countries ith coastal areas

PARTNERS INVOLVED:

COORDINATING CENTRE : CERU Lisbon, Portugal

OTHER CENTRES: CEPRIS Rabat, Morocco,

OTHER PARTNERS : IDL, PORTUGAL

EXECUTIVE SUMMARY

Le CERU (Centro Europeu de Riscos Urbanos, Lisbonne) et le CEPRIS (Centre Euro-méditerranéen pour l'Évaluation et la Prévention du Risques Sismique, Rabat), ont proposé un projet scientifique sur «la gestion des zones côtières face aux risques sismique et de tsunami qui concerne deux villes au Portugal (Cascais et Lagos) et deux villes au Maroc (Tanger et M'Dieq). A côté des études scientifiques pour une meilleure connaissance du risque, il vise à la sensibilisation des autorités et du public (notamment les jeunes) en vue d'augmenter la résilience de la population. L'originalité de ce projet, réside dans la participation des autorités (Mairies, Provinces) et est soutenue par la protection civile des deux pays.

A travers un séminaire itinérant qui a démarré à Cascais (Portugal) en juin 2012, s'est déplacé vers Tanger puis M'Dieq au Maroc en mai 2013 pour s'achever à Lagos au Portugal en septembre de la même année. Ce séminaire itinérant organisé sur les deux années 2012-2013 à travers les villes portugaises et marocaines programmées, constituait des étapes clés pour la présentation de l'état d'avancement des actions communes entreprises dans le cadre de ce projet pilote. Une bonne partie des institutions invitées a pris part aux travaux de ce séminaire: autorités centrales, régionales et locales, Protection Civile, agences urbaines, architecte et urbaniste, ONGs, presse locale, Investisseurs, experts, universitaires et système éducatif. Le projet VULRESADA a procédé en plusieurs étapes aussi bien importantes que complémentaires pour atteindre ses objectifs, et notamment la promotion du projet au niveau des autorités centrales et régionales de plusieurs départements ministériels, dont la protection civile et le système éducatif. Dans une seconde étape, l'équipe du projet a procédé à l'acquisition de données analogiques et numériques les plus détaillées: données hydrographiques, topographiques, bathymétriques, photos aériennes et ortho-photos des villes.

A travers des enquêtes de terrain, un inventaire des différentes constructions situées le long de la côte des villes a été dressé. Ces enquêtes ont été suivies par la réalisation d'une classification des bâtiments selon leurs matériaux de construction et leurs nombres d'étages. Ces enquêtes se sont par la suite poursuivies, avec l'aide des autorités compétentes, pour l'examen des infrastructures portuaires et les différents ouvrages de protection de la mer. Cette opération a été menée en concertation avec les autorités des villes étudiées. Ces autorités ont accordé un intérêt manifeste à ce genre d'études.

Suite à ces deux missions, une opération de digitalisation des différentes constructions situées le long de la côte sur des photographies aériennes d'un grand détail et de classification des bâtiments. Egalement, une compilation de toutes les données acquises (altimétrie, cours d'eau permanents, cours d'eau temporaires, tracé des pentes, canaux de drainage et bathymétrie détaillée), a été réalisée dans le but de générer de nouveaux modèles numérique de terrain.

Les traitements des données ont été réalisés sur le programme COMCOT-Lx (Cornel Multigrid Coupled Tsunami Model) du Portugal afin de simuler la genèse, la propagation et l'inondation de l'onde tsunamigénique qui pourrait être générée par une faille active située dans le golfe de Cadix. Les résultats ont permis l'établissement de cartes d'inondation probable pour trois villes du projet Lagos, Cascais et Tanger. Les résultats sur la quatrième ville (M'Dieq au Maroc) sont en cours de traitement.

Les connaissances scientifiques dans ce domaine ont porté jusqu'à présent principalement sur l'évaluation des aléas visant l'atténuation des risques. Les travaux scientifiques du projet VULRESADA ont abouti à de nouvelles connaissances présentées notamment sous forme pratique (cartes d'inondations probables) pour l'utilisation par les différents intervenants et notamment pour les opérations de sensibilisation.

Les opérations de recherche menées par le Projet VULRESADA ont été suivies par les autorités et par les responsables du système Educatif qui ont manifesté leur intérêt d'intégrer les connaissances sur les risques sismiques et de tsunami dans leurs activités scolaires et para-scolaire en collaboration avec les centres spécialisés de l'Accord: le CERU et le CEPRIS.

OBJECTIVES OF THE PROJECT

Global objective for 2012-2013 :

• Mise en forme des connaissances scientifiques des aléas pour les besoins de prévention, en intégrant les composantes prise de décision, éducation et sensibilisation;
• Développement de modèles numériques pour la génération du tsunami, la propagation et l'amplification côtière;
• Préparation de cartes d'inondation pour les zones sélectionnées pour comprendre des effets possibles sur ces régions;
• En utilisant le modèle de la vulnérabilité, les catastrophes enregistrées, l'identification de leurs caractéristiques et de la capacité à récupérer des individus en relation avec le concept de résilience, nous serons en mesure de démontrer la variation géographique de la composante sociale de la vulnérabilité ainsi que le spectre des causes relatives ;
• Publication de manuels et de dépliants.

Specific yearly objectives:

2012 :

2013 :

WP 1 : Séminaire : Présentation de l'Etat d'avancement des travaux et planification des travaux pour la seconde année
WP 2 : Plans d'action pour améliorer l'adaptation des villes aux aléas géologique, sismique et tsunamique.
WP 3 : Diffusion des résultats de l'étude et les présenter sous forme pratiques à l'utilisation pour engager les parties prenantes dans la prise de décisions
WP 4 : Séminaire itinérant de présentation publique des résultats du Projet

EXPECTED RESULTS

2012:

Sensibilisation et lancement du Projet auprès de la communauté scientifique, des autorités et de la population cible.
Synthèses géosciences: Tavaux scientifiques multidisciplinaires relatifs au Projet.

2013:

Engager la coopération avec les autorités locales pour des campagnes d'information et éducation publique. Engager la coopération avec les autorités locales et régionales pour développer des plans d'adaptation des villes aux aléa sismique et de tsunami et pour réduire les risques associés. Publication de dépliants.

RESULTS OBTAINED PREVIOUSLY (if any)

Il y a déjà quelques années que l'IDL (Université de Lisbonne) collabore avec le CNRST au sujet d'études de tsunami. Deux thèses de doctorat ont été présentées à l'Université de Ibn Tofail (Maroc) avec la co-supervision d'un chercheur du Portugal:
Omira, Rachid (2010) "Modelling tsunami impact in NW Marocco and SW Iberia"
Kaabouben, Fatima (2010) "L'impact des tsunamis sur les côtes du Maroc"

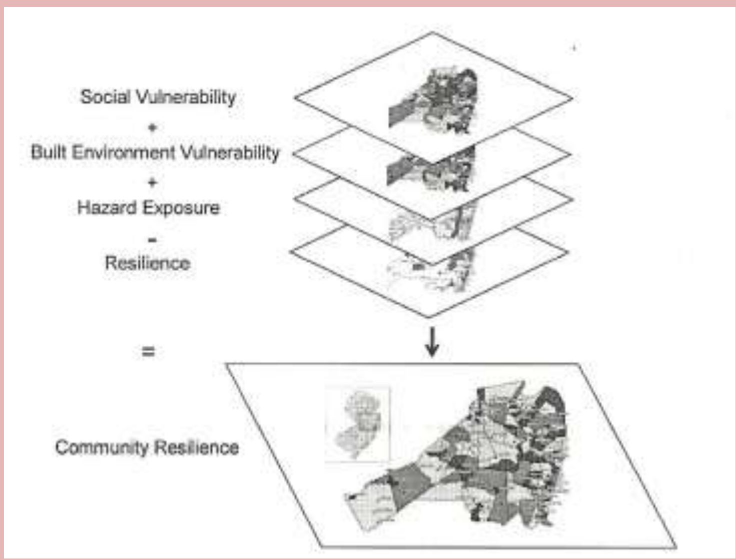
RESULTS OBTAINED IN 2012

Work package 1 (prepared by CERU, CEPRIS)
Description:
Présentation du programme de travail pour les deux centres, méthodologies et approches des participants ;
Adoption d'une approche commune pour l'évaluation de la vulnérabilité ;
Lancement des travaux autour des quatre villes.
Elaboration de Brochure du Projet
Proposition du lieu : Cascais ou Lagos (Portugal)
Frais d'organisation pour le CERU
Prise en charge des Intervenants du Maroc
Livrables associés:
Rapport sur les principales décisions prises pendant le séminaire. Draft de la brochure du projet

The kick-off meeting of the project (Vulresada Seminar) took place in Cascais (Portugal), from 18 to 20 of June 2012, with the support of Cascais Municipality. During this seminar the main objectives of the VULRESADA project were addressed and the major issues discussed. The seminar was attended by 20 persons among researchers (geophysics, geologists, engineers, sociologists, etc.), officers and stakeholders that have an active role in the many aspects of risk mitigation in costal zones, 17 from Portugal and 3 from Morocco. The Portuguese participants belong to 7 different institutions from Lisbon, Coimbra, Cascais and Lagos, and the Moroccan participants belong to the CEPRIS (2) and the University Mohamed V – Rabat (1). Twenty-five presentations were performed (10 from Morocco and 15 from Portugal), according to the established program.
Portugal and Morocco share a common source of destructive earthquakes and tsunamis: the Gulf of Cadiz, where the 1st November 1755 event was generated. The state-of-art from the evaluation of the seismic hazard and tsunami hazard for both countries was presented and discussed. The methodologies and the approaches proposed by both participants concerning the estimation of the building and infrastructure vulnerability, as well as the social vulnerability were presented.
The use of geographic information systems (GIS), with all associated tools, on the management of natural risks and aid to decision, the actual operational technologies of information, the vulnerability and resilience of the physical

phenomena and social factors, and the urban and heritage vulnerability of the historical centres were also discussed.
The seminar ended with the discussion on the way to implement this project in the 4 selected towns: Cascais and Lagos (Portugal), Tanger and M'Dieq (Morroco)
During this first year of the project the main objective was to compile all the available information, to analyse it and to get complementary information, in order to perform the necessary geophysical studies concerning mainly tsunami impact (inundation maps). Vulnerability studies (urban, heritage and social) were also initiated, as well as contact with the local authorities in order to get their support on the field experiments and for the purposes of prevention, education and awareness of the local population.
A first draft of the project brochure was prepared.

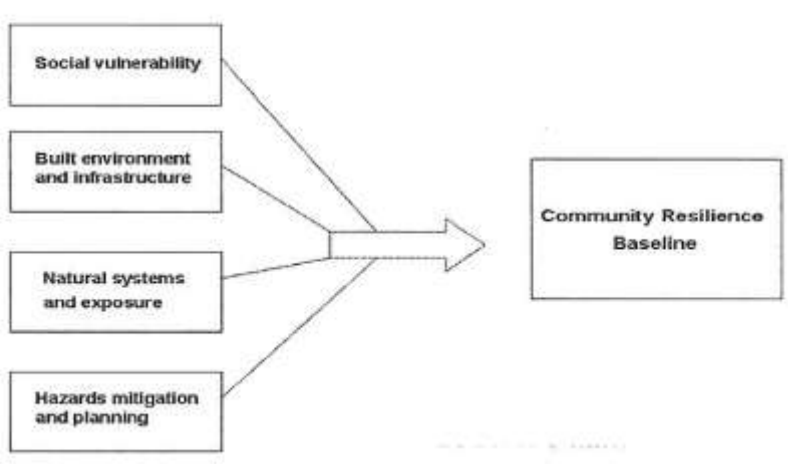
Vulnerability and resilience methodology
Understanding resilience as the capacity of socio-ecological systems to support disturbances and reorganize, the relationship between resilience and planning is very relevant. The development of a set of core indicators that measure social vulnerability is the key to the improvement of resilience and sustainability of coastal communities. The development of coastal resilience indicators is in its infancy and at present is no standard methodology or framework for conducting baseline assessments of resilience.
The identification of metrics and standards for measuring resilience is still a challenge. This project aims at exploring the replication of a methodology developed in Hazard and Vulnerability Research Institute (HVRI), University of South Carolina - USA for a set of indicators to measure characteristics of community based on their potential resilience. By setting the basic conditions, it becomes possible to monitor changes in resilience from time to time in certain locations, allowing a comparison between different places. We will apply the model as a proof test for two Portuguese coastal cities: Lagos and Cascais. The impacts of natural disasters within this region are widespread and vary extensively: different natural hazards can be identified to these cities but this project only concerns the characterization of geological hazards taking into consideration past occurrences and the probability of future events due to the regional geologic and geophysical conditions.
Cutter and colleagues (Hazard and Vulnerability Research Institute - HVRI, University of South Carolina) using the model of disaster places (DROP model – Disaster Resilience of Place), suggests that social vulnerability is a multidimensional concept that helps to identify those characteristics and experiences of communities (and individuals) that allow them to respond and recover from natural disasters, and in this sense it is not disconnected from the concept of resilience:



Community resilience

Since it is often difficult to measure resilience in absolute terms, we use a comparative approach and employ variables as proxies for resilience. Two considerations for variable selection:
1) justification based on the extent literature on its relevance to resilience; and
2) availability of consistent quality data from national data sources.

The DROP model presented the relationship between vulnerability and resilience in a manner that is theoretically grounded and amenable to empirical testing.
There are four key set metrics that are necessary to build profile or baseline of community resilience:



Community resilience baseline(from Susan L. Cutter, Urban Paper for the Urban Coast Institute, s.d.)

DROP framework explicitly focused on antecedent conditions, specifically those related to inherent resilience.
Disaster impacts may be reduced through improved social and organizational factors such as increased wealth, the widespread provision of disaster insurance, the improvement of social networks, increased community engagement and participation, and the local understanding of risk as well as through improvements in resilience within natural systems.
There is consensus within the research community that resilience is a multifaceted concept, which includes social, economic, institutional, infrastructural, ecological, and community elements.
Based on these findings, our index comprises these subcomponents that were then further defined for analytic and comparative purposes. The systematic development of such locally-based vulnerability assessments provides the basic understanding of the risk and its likely impacts and is the starting point.
Once we know where and how communities are vulnerable, strategies for improving their resilience can be targeted more effectively.
It would be of great interest to use and test the DROP model in Cascais and Lagos to provide an approach for establishing a hazard resilience measurement baseline that could serve as a benchmark for monitoring progress towards disaster reduction.
To achieve these objectives, it is necessary to develop a methodology for historical reconstruction of socio-demographic variables used for the Census. Thus, it is necessary to monitor changes in levels of social vulnerability (total) and dimensions that contribute to it (longitudinal analysis).
In addition, the analysis should be planned for the future, using analog data to develop realistic scenarios for the future of social vulnerabilities to reduce the risk. This methodology may also be useful to compare the levels of vulnerability of several coastal (and urban) areas elsewhere.

Work package 2 (prepared by CERU, CEPRIS):
Description:
• Analyse exhaustive de la nature géologique et topographique des quatre sites dans le contexte géodynamique régional ;
• Évaluation de l'aléa tsunami : localisation des principales sources sismiques tsunamigènes relatives aux quatre villes. Elaboration d'études de scénario et d'aléa tsunami ;
• Analyse/détermination de la bathymétrie des 4 villes
• Cartes d'inondation ;
• Evaluation de l'extension urbaine actuelle et de la vulnérabilité des infrastructures urbaines et sociales présentes sur les sites face aux tsunamis;
• Elaboration des cartes de vulnérabilité sous format SIG ;
• Présentation de la situation aux institutions nationales et locales dans les domaines de l'urbanisme, de l'aménagement d'infrastructures, et de la prévention des désastres naturels.
Livrables associés:
Rapport des activités avec les principaux résultats: cartographies géologique, cartes d'inondation et cartes de vulnérabilité pour les 4 villes

As the state of research progress is not the same in the two countries, different actions were undertaken to develop and implement the project in the four towns. Detailed description can be found in the technical report of both Centres.
Cascais

- Geological analysis in the context of the geodynamic environment
- Evaluation of tsunami risk – definition of the main tsunami sources
- Elaboration of tsunami scenarios and estimation of potential inundation maps

Lagos

- Revision of the geologic and geophysical studies performed some years ago

- Revision of the tsunami risk and the inundation maps performed for some selected scenarios

Tanger

- Acquisition of numeric data concerning the topography and hydrography
- Acquisition of numeric orthophotomaps and aerial photos
- Acquisition of recent bathymetric data with 10cm of resolution
- Elaboration of a new digital terrain model (DTM)
- Building surveys on the coastal areas and inside the two port zones
- Building digitalization and preliminary classification

For M'Dieq no field survey was performed up to now, but the project was already promoted by the local and regional authorities.

All the work was developed in collaboration and with the support of the municipalities of the four towns.

Collaboration between the two Centres, concerning tsunami propagation and elaboration of inundation maps, was performed in terms of a short stage of one Moroccan researcher in Portugal (Instituto Dom Luiz – IDL collaboration)

RESULTS OBTAINED IN 2013

Working package 1 (prepared by CERU, CEPRIS):

Description:

Organisation de Séminaire pour la présentation de l'Etat d'Avancement des travaux à Tanger (Maroc): Frais d'organisation pour le CEPRIS. Prise en charge des Intervenants du Portugal.

Livrables associés:

Rapport sur l´Etat d'avancement des travaux

Relevé de conclusions du séminaire itinérant Tanger – M'Dieq 28-30 mai 2013

A l'issue des travaux de ce séminaire itinérant entre Tanger et M'Dieq, une table ronde a été organisée pour débattre de l'évolution des travaux dans le cadre du projet VULRESADA, sur la gestion des risques sismique et de tsunamis pour les quatre villes (Cascais et Lagos) au Portugal et (Tanger et M'Dieq) au Maroc. A travers plusieurs sessions d'exposés et de visites sur les terrains organisées par la Protection Civile de Tanger et M'Dieq pour permettre aux participants d'examiner le niveau d'organisation et les équipements de ses Unités Mobiles Spécialisées dans les opérations de secours lors d'un séisme ou d'un feu de forêt.

Cette table ronde a été modérée par le Professeur Abdallah EL HAMMOUMI de la Faculté des Sciences de Rabat.

Quelques lignes directrices de cette table ronde ont été proposés dans le programme du séminaire, en guise d'amorcer les discussions entres experts, autorités chargés de la gestion du risque et utilisateurs finaux, en relation avec les objectifs du projet : Vulnérabilité et résilience des phénomènes physiques et facteurs sociaux :

- stratégie des informations délivrées aux institutions nationales dans les domaines de l'urbanisme, de l'aménagement, de l'infrastructure et des préventions des désastres naturels ;
- coopération avec les autorités responsables de l'aménagement, du développement et de la protection ;
- proposition de méthodologie de recensement pour l'évolution des variables sociodémographiques ;
- recommandations pour surveiller les changements des niveaux de la vulnérabilité ;
- campagnes d'information publique et d'éducation ;
- comportement civique des populations lors des opérations de gestion des catastrophes par les autorités

Les discussions ont porté dans un premier temps sur les modélisations des phénomènes physiques inhérents aux risques. Des experts ont mis l'accent sur la nécessité d'exprimer le degré de fiabilité et la limite de validité des modèles proposés par les scientifiques. Ces derniers ont reconnu la nécessité de communiquer et collaborer ensemble pour apporter les informations pertinentes pour la gestion d'un tel ou tel risque.

Concernant le risque de tsunami, il a commencé à susciter l'intérêt des communautés et des intervenants que tout récemment. Il s'avère que durant la haute saison, les plages les plus prisées connaissent une influence très poussée des estivants. Les effectifs pouvant être évalués à des centaines de milliers de personnes par jour, augmentant considérablement la vulnérabilité des zones touristiques vis-à-vis du phénomène tsunami. La plus part des ces estivants n'ont aucune conscience d'un risque majeur tel qu'un tsunami.

Aucune organisation de Protection Civile ne peut disposer des effectifs pour faire face à ce genre de situation. Il est évident que la gestion des zones côtières en cas de risque de tsunami ne repose alors que sur une approche complexe et multivariable, nécessitant plusieurs intervenants pouvant se rallier aux efforts de la Protection Civile à différent étapes de la gestion des zones côtières.

Les discussions ont concerné les moyens et l'organisation de la protection civile marocaine au niveau de la région. A ce propos des précisions ont été communiquées aux participants :

- A l'échelle du Royaume, et depuis l'an 2000, la Protection Civile a adopté une organisation selon un schéma directeur d'analyse et de couverture des risques (SDACR) qui a permis de mettre en place 16 Commandements régionaux dotés chacun d'Unité de Secours mobile spécialisée en plus de l'Unité Mobile Nationale d'Intervention ainsi que le recrutement de médecins spécialisés en médecine des catastrophes pour assurer les interventions d'urgences.

En plus, le schéma a permis la réalisation de 215 centres de secours opérationnels et de six dépôts ministériels dotés de matériels pour abriter les sinistrés ;

- En ce qui concerne la Préfecture de M'Dieq, l'Unité Mobile de la Protection Civile au niveau de M'Dieq, considérée comme une unité pilote, est destinée à la lutte contre les feux de forêt vu que la région est entourée d'un couvert végétal important ;
- Les unités mobiles ont été utilisées avec l'efficacité escomptée notamment lors du tremblement de terre qu'a connu la région d'Al Hoceima en 2004.

Communications des informations scientifiques aux autorités :

A côté de la communication de l'alerte sismique et la sismicité d'une région donnée de façon régulière, il est nécessaire de procéder périodiquement et de façon précise à la communication des informations scientifiques et techniques aux autorités politiques, relatives à d'actualisation de l'évaluation de l'aléa sismique sur une période de 5 à 10 ans selon la sismicité de chaque région. Cette actualisation de l'aléa sismique repose tout d'abord sur la révision de la magnitude des séismes les plus significatifs puisque cette révision affecte directement l'évaluation de l'aléa sismique. Cette révision permet enfin de compte la production de catalogue sismique uniforme et une meilleure révision du code de construction parasismique.

A côté de la révision de ces données sismiques, les études des sols de chaque région sont capitales pour une meilleure planification des tissus urbains. Ces études constituent une étape primordiale dans la prévention des risques.

Evaluation de la résilience des villes ciblées

Sur l'évaluation de la résilience des villes ciblées, les experts portugais et marocains ont discuté les méthodologies adoptées par les deux équipes. La réalisation de recensement basé sur des enquêtes sur l'âge, le niveau d'instruction et le lieu d'habitation de la population constitue une base importance pour l'évaluation de cette résilience. Ces enquêtes de base devrait être complétées par des enquêtes : ménage, revenu et sur la personne qui draine le revenu.

L'expérience portugaise dans l'évaluation de la résilience à travers les variables : âge, niveau d'étude et typologie d'habitation est très intéressante. Malgré qu'il est n'est pas possible de trouver une réponse universelle de la résilience, il est cependant possible de se mettre d'accord sur la façon d'utiliser les statistiques après avoir adopté une méthodologie commune pour les villes cibles (questions utilisées dans le recensement).

Pour aboutir à des conclusions valables et applicables, les deux équipes devraient arrêter des variables qui permettent d'aboutir aux mêmes objectifs : Consensus sur variables utilisées, et réfléchir maintenant sur la proposition et l'adoption d'un indice de vulnérabilité. Il serait judicieux de suivre l'évolution de la cartographie de cet indice de vulnérabilité et de procéder à l'actualisation périodique.

La réalisation de plans de prévention passe par l'utilisation de la densité de la population sur les zones côtières étudiées, à côté des structures présentes et la nature de la réponse du sol aux risques sismique et de tsunami.

Sensibilisations à différents niveaux

Sur la sensibilisation du citoyen, une culture scientifique en matière de risques sismique et de tsunami doit être assurée auprès des jeunes à des moins jeunes. Cette communication devra se faire sur la base d'exposés et d'expositions, de table ronde, de dépliant, afin d'assurer une vulgarisation des connaissances scientifiques au niveau du grand public. Ceci permettra une meilleure réactivité des populations lors de l'occurrence d'événement sismique significatif et d'augmenter la résilience des populations des villes ciblées.

Comportement civique

- Il est nécessaire d'apprendre au citoyen les pratiques et comportement qui permettent de minimiser les risques ;
- Apprendre au citoyen des gestes simples pour lui permettre de se prendre en charge avant l'arrivées des secoures ;
- Apprendre des gestes simples mais efficaces pour assister des handicapés qui dépendent d'autres personnes.

La description détaillée du contenu du séminaire est présenté dans le rapport du WP4.

Work package 2 (prepared by CERU, CEPRIS):

Description:

- Evaluation de l'extension urbaine actuelle et de la vulnérabilité des immeubles présents sur les sites face aux séismes;
- Campagnes d'information publique et d'éducation à lancer au niveau local ;

Identification comparative des caractéristiques sociodémographiques des lieux d'étude, qui contribuent à l'identification de la vulnérabilité sociale, inhérente au risque. Ainsi que l'identification des facteurs de protection et résilience des populations des lieux d'étude.

- Développer une méthodologie de reconstruction historique des variables sociodémographiques utilisées pour les recensements.
- Surveiller les changements des niveaux de vulnérabilité sociale (totale) ainsi que les dimensions qui contribuent pour cela (analyse longitudinale).
- Caractérisation du Patrimoine (typologies/co-existantes, des systèmes structurelles altimétrie/volume ; états de préservation/détection des fragilités des immeubles traditionnels ; usage) exposé aux séismes

Livrables associés:

Rapport sur les activités développées et principaux résultats

Méthodologie pour une Intérvention dans les Immeubles Dégradés

Cet étude s'intègre dans les tâches de gestion de la récemment instituée Zone de Réhabilitation Urbaine de la Ville de Lagos, voulant surtout disponibiliser à l'Éntité de Gestion une base de données actualisée sur la situation du Patrimoine dans la zone d'intervention, envisageant sa réhabilitation, à travers l'établissement d'une méthodologie d'approche.

Cette base de données sera fondamental pour une éventuelle mise en oeuvre de programmes de financement et permet soutenir d'une façon plus éfficace les interventions des privés, notamment vers l'usufruit des avantages fiscaux consacrées dans la Loi.
L'étude poursuit les tâches démarrées en 2010 sur la politique fiscal municipal pour le centre historique de la ville de Lagos, dans la présupposition que la fiscalité peut constituer un instrument au service de la réhabilitation. Son dévéloppement, s'intègre dans le travail élaboré dans le cadre du Projet VULRESADA « Gestion des Zones Côtières Face aux Risques Sismique et de Tsunami: Impact Socio-économique », mettant l'accent dans l'évaluation de la vulnérabilité, résilience et adaptation des villes de Cascais et Lagos au Portugal et M'Dieq et Tanger au Maroc, et comptant sur la participation et soutien des respectives entités locales.
La participation de Lagos dans ce projet poursuit l'élaboration de "l'Étude de Risque Sismique dans le Centre Historique de Lagos", aussi sur la responsabilitée du CERU en colaboration avec l'Instituto de Ciências da Terra e do Espaço, l'Instituto Geofísico do Infante D. Luís da Universidade de Lisboa, l'Instituto Superior de Engenharia de Lisboa et la Mairie de Lagos.
La méthodologie vise à établir un critère d'intervention dans le Patrimoine dégradé, hiérarchisant les intérventions en 3 niveaux de priorités, permettant à tout moment mettre en oeuvre une action globale dans ce champ dans le térritoire de la ZRU.
Par ailleurs, les éléments élaborés seront intégrés dans le Programme Stratégique de Réhabilitation Urbaine, aprouvé par l'Instituto da Habitação e Reabilitação Urbana lors de l'institution de la ZRU, conjointement avec les autres études que la ZRU élabore à présent (Étude Global, Étude du Modèle de Financement, Étude des Unités d'Intervention et élaboration des respectifs Projets ancre).

VULNÉRABILITÉ SOCIALE

Objectifs généraux
En utilisant le modèle de la vulnérabilité catastrophes-lieux on suggère l'identification des caractéristiques des lieus et individus qui leur permettent de réagir et de se remettre de désastres naturels, qui ne sont pas déconnectés du concept de résilience (capacité à récupérer). Ces caractéristiques doive démontrer non seulement la variation géographique de la component social de la vulnérabilité, ainsi que le spectre des causes de la même.
Objectifs atteints
A été développé avec l'aide d'un collègue de la Statistique (NIST-USA) une nouvelle méthode qui permet la construction d'un indice de vulnérabilité sociale et ainsi accéder a des dimensions de la résilience lorsque cela est appliqué.
Le modèle a été testé (en ce qui concerne la vulnérabilité) à Cascais et Lagos (deux villes côtières, au Portugal), pour certaines des variables démographiques tirées du dernier recensement au Portugal.
A été lancé la question d'une reconstruction historique de variables sociodémographiques utilisées pour le recensement au Portugal. Autant que possible à atteindre pour la caractérisation des vulnérabilités visage, à savoir les phénomènes naturels.

Work package 3 (prepared by CERU, CEPRIS):
Description:
• Coopération avec les autorités nationales et locales responsables pour l'aménagement et le développement des quatre sites ;
• Organisation d'événements locaux et régionaux de validation et de dissémination des résultats de l'étude.
• Établissement des normes génériques pour assurer la résilience des éléments du Patrimoine.
Livrables associés:
Manuels et dépliants publiés. Rapport sur les principales conclusions du projet

During the VULRESADA project, several information actions and events were developed in Cascais and Lagos in order to increase the resilience of the population. Also, in Morocco, several awareness actions were performed in Tangier and M'Dieq. Municipal Civil Protection services, the Cities Councils, as well as secondary schools were involved in these actions.

Actions developed in Cascais county

In the aim of the Vulresada project, the Municipality of Cascais, through the Municipal Civil Protection Service, participated in the following actions:
- Monitoring the work developed under the studies of seismic and tsunamis risks in Cascais;
- Implementation of the interim results in the production of risk cartography - susceptibility and risk maps;
- Presentation of the results obtained in the two previously mentioned studies and also those related to coastal hazards in the III Conference of Civil Protection in Cascais, on the 4th Meeting of Municipal Civil Protection Services and on various other seminars;
- Dissemination of results in awareness raising, training and targeted to audiences , including schools and parish councils various public information;
- Incorporation of the results into municipal plans: Master Plan and Detailed Plan for Carcavelos South;
- Preparation of Municipal Emergency Plan for Civil Protection of Cascais; Supporting the First Seminar of

Vulresada Project 18 to June 20, 2012, in Casa Santa Maria, in Cascais.

Actions developed in the Secondary School Gil Eanes (Lagos)

Two years ago, the Secondary School Gil Eanes (Lagos) presented a proposal to be developed by the students of Electrotechnics branch:

- The importance of sustainable development (analysis of the dynamics of the power systems together with the environmental and economic components of energy)
- The need for adequate and updated training and information strategy in all sectors of education
- The strong determination in relation to the resurgence of scientific research in all areas where negative impacts can arise, in the medium and long term, in a global world and the “storm” of climate change ...

Coastal risks, the development of intense weather events, the risks associated with the rise of the mean sea level, the seismic and tsunami risks in the western Algarve region should be mandatorily included in the extended observation systems and integrated into national networks of planetary observation, making use of the current technologies of information and data management and transmission.
The use of renewable energies arises naturally in the same context of observation of meteorological elements and catastrophic geological phenomena (Professor Luis Mendes Victor, former Director of Institute of Meteorology and of the Geophysical Institute of Infante D. Luiz and President of CERU).
A NOSSA ALEGRE CASINHA (“Our Joyful Little House”), a 50 m2 masonry project, aims to create in the Gil Eanes Secondary School space, the production of clean electricity and thermal energy (hot water use and house heating), through the use of photovoltaic and thermal solar systems combined with the latest technologies in the areas of energy and ITED (telecommunications infrastructures in buildings), and a system of rainwater recovery in the coverage of the house; the installation of a meteorological station and a seismograph that will be connected to the sectors of Meteorology and Seismology is also part of this project.
Eleven sponsors have joined this project that obtained also the support of Ciência Viva (Live Science program), after sending it to the Minister of Education for the acquisition of the Meteorological Station and the seismograph.
To launch the project several sessions were held with Professors Luis Mendes Victor (the seismic hazard and tsunami), Jorge Maia Alves (sustainable energy), Miguel Centeno Brito (solar photovoltaic systems), and Eng. Guilherme Carrilho da Graça (the bio-climatic building).
We wanted to awareness audiences, ie, students in this school, people in the municipality of Lagos and neighboring counties, and all municipalities in the country and their communities for individual or collective use of renewable energy, and for the seismic and tsunami risk in the western Algarve region, using up the existing qualitative treatment of information and its transmission technologies for insertion in the national collective.

Actions developed in Morocco (Tangier and M’Dieq)
Some of the actions developed in Morocco were presented during the seminars (see report WP4).

Leaflets

At the end of VULRESADA project, three leaflets were produced. For Cascais and Lagos, a Portuguese version was first produced. An English version is already done for Lagos and English and French versions are being prepared for Cascais. For Tangier, a first draft was produced.

Work package 4 (prepared by CERU Lisbon, Portugal, CEPRIS Rabat, Morocco):
Description:
Séminaire itinérant de présentation publique des résultats du Projet entre les 4 villes (Portugal et Maroc)
Livrables associés:
Rapport sur les séminaires présentés autour des 4 villes

Le premier séminaire, organisé à Cascais (Portugal) avec le support de la Mairie de Cascais, a constitué le démarrage du projet. Dans ce séminaire, l’état de connaissances relatif aux 4 villes a été présenté : la sismicité, l’aléa sismique et de tsunami, la géophysique, l’urbanisme et l’état des immeubles, ainsi que les aspects sociodémographiques. Les

différentes techniques utilisées par les chercheurs et techniciens du Maroc et du Portugal, pour aborder les thématiques ciblées, ont été présentées. Les deux équipes, portugaise et marocaine ont arrêté la planification des travaux à développer pour le projet.
Dans tous les séminaires, les autorités locales (protection civile et politiciens) ont été invitées, d'une part pour animer et participer aux discussions, mais aussi pour soutenir le projet, suivre son état d'avancement et participer aux actions à développer.
Par ailleurs, et en marge de la tenue de tous les séminaires dans les quatre villes, des visites d'étude sur des sites ont été organisées. Les participants à ces séminaires ont eu l'occasion de s'enquérir des dispositifs ou des systèmes aussi importants et aussi sensibles pour la gestion des problèmes en relation avec le risque sismique et de tsunami.
La seconde étape de ce séminaire itinérant a eu lieu entre Tanger et M'Dieq (Maroc).
L'état d'avancement des travaux a été présenté. Dans ce séminaire la présence des autorités locales a été très remarquable, avec la participation de la Protection Civile de Tanger et de M'Dieq, l'Agence Urbaine de Tanger et de Tétouan, et aussi des experts des Universités locales.
La troisième étape de ce séminaire a eu lieu à Lagos (Portugal), avec le support de la Mairie de Lagos. Dans cette dernière étape du séminaire itinérant, les résultats du projet ont été présentés. Aussi, l'équipe du projet et ses partenaires dans le deux pays ont discuté l'avenir des études développées jusqu'à présent. Ces discussions ont porté également sur quelques études qui ne sont pas encore finalisés. Les membres de l'équipe du projet sont mis d'accord sur le fait qu'il faut continuer à travailler sur les thématiques non encore achevées et sur l'opportunité de poursuivre les actions porteuses a développer dans un nouveau projet en 2014-15.
Les rapports sur le résumé des étapes de Cascais et Tanger-M'Dieq ont été déjà présentés dans d'autres WP. Cependant, il est jugé opportun de compiler l'information diffusée dans le séminaire itinérant en présentant ici les résumés de plusieurs communications exposées lors des trois étapes du séminaire itinérant du projet VULRESADA.

EARTHQUAKE PREPAREDNESS OF SCHOOL STUDENTS AND POPULATION USING SCIENTIFIC KNOWLEDGE FOR PUBLIC MULTIMEDIA INFORMATION

TARGET COUNTRIES: ROMANIA, R. MOLDOVA, UKRAINE, BULGARIA

PARTNERS INVOLVED:

COORDINATING CENTRE : ECBR Bucharest, Romania

OTHER CENTRES: ECMNR Chisinau, Moldova , ECRP Sofia, Bulgaria , TESEC Kiev, Ukraine

OTHER PARTNERS : ECPFE Athens, BE-SAFE-NET Cyprus

EXECUTIVE SUMMARY

The Centres gathered information on the past impact of Vrancea earthquakes in their respectives countries and identified the associated educational material available in each country concerning such earthquakes. Unfortunately, no common educational material, based on the individually collected information, was developed and consequently the expected dissemination among school students and population was not possible.

OBJECTIVES OF THE PROJECT

Global objective for 2012-2013:
Dissemination of earthquake preparedness knowledge for school students and population using public multimedia information in areas shaken by vrancea, romania, intermediate seismogenic source.

Specific yearly objectives:

2012:
Gathering knowledge on specific damage and vulnerability of buildings after past great Vrancea earthquakes and lessons for earthquake protection of students and citizens. Comparison with the experience of Greece and Cyprus.

2013:
Study of contents and dissemination means required for earthquake preparedness and education materials, to take into account the local conditions of each country affected by Vrancea source and validation according to experience of Greece and Cyprus.

EXPECTED RESULTS

2012:
Reports about damage and vulnerability of buildings and population in Romania, Moldova, Ukraine and Bulgaria

2013:
Preparation of materials for earthquake education od students and citizens, to be posted on websites of EUR-OPA Specialized Centers of partner countries and dissemination of other materials. Evaluation and improvement based on experience of Greece and Cyprus.

RESULTS OBTAINED PREVIOUSLY (if any)

Research and dissemination activities in support of rehabilitation programs, earthquake education seminars and courses in Romania, R. Moldova, Bulgaria and Ukraine

RESULTS OBTAINED IN 2012

Work package 1 (prepared by ECBR, ECMNR, ECRP, TESEC)*:*
Description:
Organize a working committee with experts from partner countries and set-up a content for a preliminary report on the scientific, technical and management issues and tasks of each center. The Committee works by INTERNET.
Associated deliverables:
D1-Committee tasks and content of a report with scientific, technical and management issues.
D2 Kick-off Meeting of all partners at ECBR Bucharest to discuss the tasks

The Committee was constituted but no kick-off Meeting of all partners took place in 2012 as, due to internal problems, the ECBR was unable to sign the administrative arrangement and to receive the agreed financial support.

Work package 2 (prepared by ECBR, ECMNR, ECRP, TESEC):
Description:
Gathering data on specific damage and vulnerability of buildings after past great Vrancea earthquakes and lessons for

earthquake protection of students and citizens in Romania, R. Moldova, Bulgaria and Ukraine.
Associated deliverables:
Report with scientific, technical and management issues from Romania, R. Moldova, Bulgaria and Ukraine.

ECBR

Romania is a country that is periodically subject to destructive earthquakes. The seismic hazard of Romania is dominated by the Vrancea intermediate depth earthquakes in south-east of the country, located at the Carpathian arc bend, that affect with high intensities ca. 50% of the territory and very large areas in neighbouring countries, at each strong event. Under such circumstances, Romania, proved an extended vulnerability of some urban categories of structures, was struck in the last 52 years, by four strong earthquakes, the most documented being that of 4 March 1977 (Vrancea, M=7.2) with a large influence on the efforts of the country to development.
The strong earthquakes generated by the Vrancea zone have affected in the past not only Romania, but also the present teritories of Republic of Moldova, northern Bulgaria and south-western Ukraine. The total area influenced by Vrancea earthquakes is of about 300 000 km2, with over 25 million people living in the affected areas (Georgescu, 2002; Craifaleanu, 2013).
The crustal seismogenic zones are characterized by less intense activity and by reduced focal depths, caused by intracrustal fractures, such that their importance is rather local, but, nevertheless, some of them can generate locally very high intensities related only to intracrustal fractures, with a strong tendency of concentration in several zones.
The prevention and mitigation of earthquake disasters include a wide range of activities in the following main fields: assessment of seismic hazard, design of earthquake-resistant buildings, structures, equipments and lifelines, strucrural retrofitting, training and education, measures for intervention before and after earthquake, according to a system of laws. The implementation of different programmes for prevention and mitigation of earthquake disasters pointed out the necessity to promote international exchange and the sharing of information and experience.

Seismic Hazard, Risk, Losses and Human Response in Romania

The November 10, 1940 Vrancea earthquake had a magnitude MG-R = 7.4 (converted at present as Mw = 7.6-7.7) caused a heavier damage in counties and towns near the epicentral area, as: Panciu, Focsani, Galaţi, Barlad, Brăila, Buzau, Valeni, upon the buildings made of masonry, adobe, wattle and daub and timber; the damage was widespread in all Moldova region, especially towards Iasi. The earthquake struck seriously the Moldova and Bessarabia regions, some are presently in Moldova Republic. The damage was largely to masonry buildings. It caused significant damage in Bucharest, where the 12-storey Carlton block, the tallest reinforced concrete building in the city, collapsed entirely. Bucharest shared 23.6% of the dead and injured relative to the total, mainly due to the collapse of the Carlton high-rise apartment building. (Georgescu and Pomonis, 2007, 2008, 2010).
The engineers concern for earthquake resistant structures design was triggered mostly by the impact of the 1940 earthquake, that led to a first regulation of the Ministry of Public Works for earthquake resistant design (1942). A first seismic zoning map was endorsed in 1952. Provisional codes were applied from 1950 to 1963. After 1950, the check against lateral forces become systematic, but only in 1963 the first aseismic design code was endorsed.
On March 4, 1977, a Vrancea earthquake of magnitude MG-R=7.2 (Mw=7.5) caused damage to a large area and to a variety of buildings. During the March 4, 1977 earthquake, the Bucharest City-capital of Romania was a natural testing laboratory of the new tall buildings, in an area of at least VIII degrees (MSK intensity); the positive effect of aseismic design was obvious. The INCERC studies after 1977 (Sandi, 1985; Balan et al, 1982) have shown that the heaviest consequences on old buildings have been recorded in Bucharest, where 27 apartment buildings located in the central area have collapsed, totally or partially. It is worth of remarking that most of them had been heavily affected by the 1940 earthquake, but neglected. It was recorded the partial collapse of 3 buildings erected after 1960 and damages to others. It is relevant the INCERC seismic record of March 4, 1977 that pointed out, for the first time, the spectral content of long period seismic motions of Vrancea earthquakes, the duration, the number of cycles and values of actual accelerations, with important effects of overloading upon flexible structures.
According to data at hand [World Bank, 1978], out of the over US $ 2 billion losses, about US $ 1.42 billion were in construction field (buildings, water supply system), out of which buildings valued US $ 1.03 billion. The property loss represented some 5% of GNP or 1.63% of National Wealth. Bucharest concentrated 70% of losses, US $ 1.4 billion respectively. The total reported losses account for US$ 2.048 billion (US$ 1.683 billion in direct losses and US$ 0.3647 billion in production losses). The analysis of the 1977 earthquake losses was made again in 1992 and resulted in a property loss of 5% of GNP or 1.63% of National Wealth (Georgescu, 2002; Georgescu and Pomonis, 2007, 2008).

Studies on seismic vulnerability
After 1977 disaster, a survey of damage distribution was organized in Bucharest under the auspices of the National Council of Science and Technology (Sandi, 1985; Balan et al, 1982, Sandi et al 2007). More than 18.000 buildings of the City of Bucharest were investigated according to a methodology derived on the basis of the MSK-scale methodology. The surveyed buildings were categorized according to two criteria: structural system and fundamental natural period.
The basic result of the survey was represented by the statistical damage spectra derived for 1 km x 1 km squares of Bucharest, for each of the structural systems considered. The processing of data made it possible to compile maps of macro-seismic intensities related to some definite intervals of periods of oscillation. Thus, the first basic data on vulnerability at hand were obtained on the basis of this postearthquake survey. The survey made it possible to derive statistical damage spectra for several sub-areas of the city (Bălan & al., 1982). These latter results were processed

additionally, leading to vulnerability functions expressed in terms of conditional damage distributions, presented by Dr. Sandi in an EAEE Working Group Report, prepared for the 8-th European Conference of Earthquake Engineering (Sandi & al., 1986). The vulnerability functions referred to were related to eight categories of buildings.
Another special survey of damage distribution was performed in Bucharest under the auspices of ICCPDC - The Central Institute for Research, Design and Guidance in Civil Engineering within about one year after the earthquake (Sandi, 1985; Balan et al, 1982). The study was carried out by a staff of the Design Institute of Bucharest and INCERC (Building Research Institute). It referred to over 800 buildings built according to several standardized design solutions. It was possible, for any types to which more than 100 buildings pertained, to measure the fundamental natural periods for three directions (oscillations in the longitudinal plane, oscillations in the transverse plane, oscillations of overall torsion), using the ambient vibration technique. At the same time, the statistical distribution of damage was investigated and correlations with the location and with the azimuthal orientation were derived.
Since the 1977 Vrancea earthquake, the seismic design code passed through several revisions based on the recorded local seismic data. Most important editions are those issued in 1992, 1996, 2006 and 2012. In 2008, this code included new provisions on existing buildings. This new provisions are in line with those provided by the Eurocode 8 and the Japonese and USA codes. New zoning maps and standards were endorsed in 1963, 1978 and 1991, following the events of 1977, 1986 and 1990-1991.
In order start the large-scale risk mitigation, the Government Decisions no. 644/1990 and 709/1991, the new aseismic design codes P.100/1991, 1992 introduced the obligation to evaluate and eventually to rehabilitate the existing buildings according to a set of criteria, with some public financing. The earthquakes of 1990 triggered some momentum and on this background, starting with 1991, the new seismic design codes P100 - 1991, revised 1992 and 1997, introduced in chapters 11 and 12 the obligation to evaluate and put in classes of risk, if required, to rehabilitate the existing buildings according to a set of criteria, with some public financing. Buildings of first class of risk are labeled with a red dot. This policy led to important technical, social, legal and financial demands, whose consequences proved the difficulty of this necessary approach. Later on, the effort continued for the harmonization of Romanian and European Earthquake Design Codes.
The Romanian code for the seismic assessment of existing buildings, P100-3/2008, in force, includes several notions and concepts from its European homologue, EN 1998-3:2005 (Eurocode 8, part 3). The main part of the P100-3 code, including annexes, totals over 350 pages, while the examples and comments add a supplement of almost 290 pages. Even though it is focalized on the assessment of existing buildings, P100-3 also provides a substantial informative annex, conceived as a guideline for seismic rehabilitation. This policy led to important technical, social, legal and financial demands whose consequences proved the difficulty of this necessary approach.

Vulnerability of buildings
The category which presents an obvious interest for earthquake vulnerability assessments is that of 80,600 tall buildings, out of which 6,864 buildings (8.5%) were built before 1944, 42,689 buildings (52.9%) were built between 1945 and 1980 and 31,047 buildings (38.6%), were built between 1981 and January 1992. According to available data, the structural systems are represented by rein¬forced concrete frames and shear walls (27.64%), masonry with concrete floors (14.52%), masonry with wooden floors (21.82%), wood (10.33%), adobe and paddle work (25.68%). The reinforced concrete high rise structures have been used mostly in urban centers, while masonry, wood and earthen buildings are still dominant in old districts of towns and in villages. The available vulnerability data emphasize higher collapse probabilities for various exposure periods affecting the pre-1940 categories of buildings. Other building categories, infrastructures and lifelines may also present disaster potentials.
Vulnerability of Bucharest buildings
Concerning the elements at risk, Bucharest has 16.4% of the total urban population (or 9% of the country's population), with over 2 million inhabitants and ca. 107,600 buildings with almost 800,000 apartments (1992 census). Over 88% of the buildings had GF….GF+1 stories (94,952 buildings, out of which 48,731 erected before 1945), 7,259 reinforced concrete buildings, 27,428 masonry, stone, or local materials, with reinforced concrete floors. In terms of the number of buildings, ca. 50% represents the pre-code generation, but only 300-500 of them, 0.3-0.5% of total, represents buildings higher than 6-7 stories.
Pre - 1940 (1944) high-rise buildings, made of gravitational reinforced concrete skeleton, with masonry infill are the highest factor of risk in Bucharest. These skeleton buildings and later on many frame buildings (erected until 1977) were designed to resist very low code forces as compared with those considered for rigid buildings, proving lack of ductility and too large allowable drifts; many soft-story structures proved to be weak to the action of long-period motions.
The family of "code structures"(1945-1977) includes ca. 40% of total number; from these, a group of 1,750 structures representing 1.5% of total, includes buildings with over 9 stories. The central area has an agglomeration of neoclassical and high-rise reinforced concrete pre-1940 buildings. New structures include a large number of new, standardized and precast buildings, designed to resist earthquakes, while districts with one-story buildings co-exist with new ones.

Secondary vulnerability (of inhabitants).
Some limited data on mortality and morbidity during Vrancea earthquakes are available; such data can be useful for life insurance, if related to earthquake risks, and we can assume an overall correlation with the vulnerability of buildings, as follows:

- a quite reduced vulnerability for occupants of traditional, low-rise, individual houses, (except some buildings, in epicentral areas);
- a low vulnerability for occupants in some reinforced concrete rigid structures designed according to the code

after 1963, with major improvements after 1977;

- a higher vulnerability for the occupants of high-rise, flexible and/or soft story reinforced concrete buildings, especially in those erected before 1940.

The National System for Emergency Situations Management

According to the Emergency Ordinance no. 21/2004, the National System for Emergency Situations Management is composed by:

a) Emergency Situations Committees;
b) General Inspectorate for Emergency Situations;
c) Professional Emergency Services;
d) Operative centres for emergency situations;
e) Action commander.

The committees for emergency situations will be organized on levels, as follows:

a) National Committee for Emergency Situations;
b) Ministerial committees and other central public institution's committees for
c) emergency situations;
d) Bucharest Municipal committee for emergency situations;
e) County committees for emergency situations;
f) Local committees for emergency situations.

The National Committee for Emergency Situations, organized under the Ministry of Interior, and the ministerial committees for emergency situations are responsible for application of the disaster risk reduction policy at national level.

The national strategy for civil protection drafted, discussed and approved by the Supreme Council for Country Defense, outlines the strategic direction in order to fulfil the fundamental objective established by the National security strategy and the Government's Program.

According to the Emergency Ordinance 21/15.04.2004, the national authority responsible with the multi-sectorial co-ordination will be the National Committee for Emergency Situations through General Inspectorate for Emergency Situations (IGSU). The minister of interior under the prime minister co-ordination manages national Committee for Emergency Situations. The National Committee is an interministerial body, comprising decision factor makers and specialized experts in emergency situations management.

The main priorities concerning the risk reduction are the floods, earthquakes, dangerous meteorological phenomena and technological disasters.

National Programme for Public Earthquake Education and Training

The national or international experience shows that for any earthquake disaster management programme, the public awareness, information dissemination, and the training and education of personnel represent the basic ingredients of success. The process of training and education for living and working in seismic zones requires a continuous improvement and transfer of knowledge between researchers, practitioners, public officials and population, under the form of special programmes, at local, national and international levels.

The general public needs training for awareness and preparedness; civil engineers, architects and seismologists as well as other engineers need to understand earthquake resistant design codes and the socio-economic consequences of disasters; and the policy makers need to know how their decisions and actions will affect the vulnerability of the community and the associated earthquake risk.

Community-level and professional-level training and education can have an immediate effect on earthquake disaster preparedness. In this respect, the specific target audience can be identified by the individual countries for priority training. In addition to these target audience levels, the private, voluntary or non-governmental organizations could constitute a parallel audience that could use training for earthquake disaster management. Training should be targeted to their senior personnel and field staff.

The population response, at social scale, following the past earthquakes may be synthesized as follows :

- 1940: panic, rumours and mystic beliefs in the 2nd World war wake;
- 1977: good public response; prompt and strong official and international emergency management, but gradually the regime and mass media coverage turned to overestimate the personal contribution of the country leader;
- 1986: the "forgotten earthquake" with officially neglected damage; rumours, followed by some later panic, after a subsequent earthquake in Bulgaria (December, 1986), in absence of any official consideration of the circumstances;
- 1990: panic, traffic jams, rumours, fear, false predictions. The mass media having now full freedom, but no experience, dispatched some fearful information. There was a combination of emotional and political stresses in that period in Romania, feeding the panic;
- 1991: fear, local panic, rumours. The fear was especially noted in the Banloc and Voiteg areas, due to the numerous strong aftershocks associated with the main shocks of 12 July and 2 December, respectively.

The questionnaire survey has shown that the experience of past earthquakes from 1940 to 1990 is reflected in the behaviour of citizens that passed through such events, since they are being aware of hazards and risks and for instance do not run out in the stairways at onset of waves. But in some other cases, some basic information was not available and the 1940 and 1977 experience proved to be too remote, forgotten or not fully transferred to the others in the

absence of a permanent education.
Regarding the rumours and false predictions, it is necessary to remark their large diversity and the negative influence on the public. These are generally determined by the lack of scientific knowledge about the causes of earthquakes, seismic zonation and earthquake prediction. The reaction of the Romanian specialists (seismologists, geologists and earthquake engineers) to these rumours was prompt, providing a correct information (newspapers, conferences, TV) of population, concerning the earthquake occurrence, aftershock activity and earthquake prediction.
Taking into account the high level of seismic hazard in Romania, immediately after the 1990 earthquakes, the Ministry of Public Works, promoted a Government Decision and INCERC elaborated a programme for public earthquake preparedness. All the activities required to avoid or to reduce, in case of earthquake, the life losses, excessive injuries, panic and disorganization of economic and social life, the emotional stress, the rumour effects, were suggested within this framework by Georgescu [Georgescu, 1991, 1992; Vataman and Georgescu, 1992].
The programme for public education was directed to be achieved through:

- activities of general education, providing basic knowledge, experience, essential safety and behaviour rules for living in seismic zones, including coherent public information;
- activities of specific education, adequate for different age and socio-professional categories living in different environment and built conditions, in urban and rural zones.

The education shall be gradual, permanent and using reliable, official backed sources.
Starting from seismological, engineering and sociological studies, since 1991, INCERC and PRODOMUS S.A., developed the following materials in Romania:

- posters and illustrated folders including essential safety rules and behaviour recommendations for the incidence of an earthquake;
- booklets detailing the seismic effects which are likely to produce casualties in buildings, built environments and settlements, schools, etc.;
- earthquake preparedness manuals (practical guides), for people, children and school staff, as well as for different categories of professions and population at risk;
- short documentary films, available as video products, presenting the main earthquake safety and preparedness rules.

Due to the priority resulting from past disasters, the urban hazards were firstly addressed. The posters recommend rules as:

- "In case of earthquake, keep calm, stay where you are, do not use the stairways or elevators" ;
- "In case of earthquake, do not use the stairway" ;
- "In case of earthquake, keep away from buildings" .

The pictures referred to the 1977 earthquake.
The posters for general use include:

- 10 rules of safety and behaviour;
- 10 rules of safety inside apartments or houses (securing furniture and appliances) and outside (non-structural members, chimneys, ornaments etc.).
- single rules on stickers, for children preparedness, as "In case of earthquake, protect yourself under a table, desk, doorway".

The first poster for rural zones became necessary after the Banloc/Banat earthquake of 12 July 1991. The inhabitants of damaged villages were advised as follows:
"We are living in a seismic zone. For your life safety:

- Do not proceed to unauthorized repair works, observe the mayor's office specialists' advice;
- Do not demolish damaged houses without the mayor's office specialists' advice;
- Do not build new houses, until the plans and erection permits are approved by the mayor's office;
- Do not live into the damaged houses if there is a life danger warning posted on by the mayor's office".

The poster combined educational and legal issues.
The booklets includes commented rules, relating occupants, buildings and contents, as:

- general rules of earthquake protection;
- family use rules in situational descriptions (home, school, work, downtown, travel, crowded places);
- simple earthquake engineering knowledge combined with safety and behaviour rules (before, during and after shaking).

The earthquake preparedness manual (Practical Guide) includes the following topics:

- knowledge on seismology, types of buildings and lessons from past damage in earthquakes in Romania;
- explanation about the importance of inspecting, maintaining, checking and repairing/strengthening buildings, legal issues to be observed;
- possible typical sensations and behaviour of humans in earthquakes, especially in high-rise buildings;
- commented rules of safety, self control, survival and behaviour, for seismic events during day and night, cold or warm season etc.

At more than 20 years from the first release in the National Program, in this process of direct action or empowerment in earthquake information-education, some gaps are easily identifiable:

- seismic risk reduction has a physical / engineering component, as well as a social / human one, but they are not in a full relationship of a mutual support;
- some owners that are living in weak and vulnerable buildings are passive in reducing seismic risk; the issue of convincing more owners of Bucharest apartments at risk to sign a contract for strengthening is rather difficult and some Romanian institutions are not fully prepared for the social communication of that kind;

- although many earthquake educational materials for the population have been financed and developed, the implementation of these materials is a difficult process, and mass-media plays in many cases a negative role, providing mostly catastrophic views;
- the legal basis for recommending information sources for earthquake education of the population, is a duty only for some public institutions (Civil Protection);
- reactions of the authorities and professionals are usually only a response to critical events or mass-media warnings;
- there are no specific institutional structures to provide earthquake education as a long term, scientific and diversified activity, with financial, material and professional human resources; when available, resources are not sufficient to disseminate the required amount of educational materials /documentation;
- there is a relatively low participation of teachers and permanent staff in schools in this process, to explain the scientific and technical issues; a limited knowledge of school students about basic data and some details of the hazards to which they may be exposed;
- some lawyers and court judges are confused in their decisions concerning the balance between private property apartments inviolability and risk reduction needs in condominiums;
- staff of public institutions is not educated for specific tasks, as to protect their assets and to have a role in communication with citizens if an earthquake strikes during office hours.

Reducing seismic risk of existing buildings

In order to improve the legal backing on this issue, a Government Ordinance on Existing Buildings Risk Reduction (Ordinance no. 20/ 1994) was adopted. The main legal gain of the Ordinance is the statement concerning the " national interest " represented by the activities related to the safety of the existing buildings stock, which led to a set of duties for the ministries as well as duties for public and private owners of constructions. Evaluation of residential buildings resistance was provided for free, while for design and strengthening works the owner may receive a bank credit at 5% interest up to 20 years; the apartment owners in buildings of first class of risk, with an income under the country average, may receive full subsidies. Some thousands of evaluation reports and preliminary strengthening projects were already drafted, but the works are costly and delayed because the owners are still reluctant to apply for loans under the clauses of mortgaging their property until the return of debts.

Presently in Romania is enforced a National Program for seismic risk reduction (O. G. 20 /1994), correlated with Eurocode 8 provisions, regional and European needs, and a National Program for thermal and energy rehabilitation of buildings, but they are conditioned only in order to intervene on buildings that are not at seismic risk. In Romania, the problem of funding seismic strengthening is legally and financially solved since 1994, but the key issue is that of relationship between the funding provided by MDRAP and actual management of seismic strengthening projects which is done by local authorities. Over 120 buildings of first class risk were documented and few strengthening projects are accomplished, but many are still waiting for rehabilitation works, depending upon their owners decision.

However, the response of owners to programs of strengthening was slow, therefore the number of buildings that were strehnthened is relatively reduced in comparison with the number of buildings ranked in seismic risk classes. Therefore it is necessary a new legal approach based on public danger and interest, to convince or to strongly mandate owners to accept works of strengthening, especially in urban areas with old and vulnerable high-rise buildings.

It is important to remark that the situation of buildings rehabilitation in Romania evolved and the situation is as follows:

- there is a contradiction is between the remarkable knowledge about the seismic risk and the attitude of owners of apartments in high-rise vulnerable buildings – they do not cooperate enough for strengthening; however, residents explained their reasons of reluctance and suggested many improvements to the legal framework. [Georgescu, Tojo et al., 2004].
- since adoption of the Law O. G. 20 /1994 there are steps of decisions with a chain of communication to the owners, these must be treated with other tools than purely administrative ones;
- it is obvious that formal legal aspects of bidding, contracting and surveying are a source of delays. Some owners are afraid of apartment mortgaging, many are rather old, low-income, absentees or just do not want to de disturbed by evacuation and noisy works; other owners and even some lawyers and court judges were confused in their decisions concerning the balance between private property apartments inviolability and risk reduction needs in condominiums;
- since 2003, the concerned ministry for constructions / urban planning / development (currently named MDRAP) promoted improvements of the Law OG 20/1994, as buildings that represent a first class of risk with criteria of public danger and require compulsory strengthening were to be subjected to urgent City Mayor Decision. This may become a Court ruling against bad-will owners who obstruct strengthening works. Other legal penalties are addressed to employees and/or owners for delay of decisions, or deadlines of 2 years for design and 2 years for works. But the pace of works is still too slow.
- mass-media showed a contradictory behaviour. They wrote papers with a lot of criticism to authorities and sometimes to engineers for the slow pace of rehabilitation, but on the other hand they published numerous unreliable seismic predictions, that are misleading for citizens' behavior.

Georgescu (2005) made an attempt to look into the nature of seismic risk perception in Romania, using local seismic setting and engineering arguments, starting from Sandmans' approach. The present situation in Romania, and especially in Bucharest is a crisis situation that may become an emergency situation in case a strong earthquake struck. At the first glance, some specific issues show a rather strange social behaviour of individuals / owners in Romania:

- the owners show apathy, they do not react for having their property at risk, labelled as "public danger"; it

seems that the Sandmans' statement about the apathy as a natural state of mankind is entirely true for Romania;
- the buyers apathy is reflected in market prices such apartments, still get good prices;
- the media vehiculates a false question, i.e. "when the Big One will struck" and not "How buildings at risk will survive" at that quake. Some kind of "outrage" is present, but not as a vehicle of decision to solve the risks.

Some of the Sandman's risk categories can be evaluated in Romania as follows (Georgescu, 2005):
- Ownership is voluntary, and it includes the risk, but some people do not want to change home at third age; seismic risk is known, looks natural, became familiar, as nothing happened since 30 years, and some complacency resulted after so many years since the last disaster.
- In Bucharest all remember the 1977 disaster, but the risk of having bank troubles with a loan is more dreadful; the seismic risk is dreaded in speeches, is both chronic and catastrophic, but that means for some people that there in any solution.
- The vulnerability is known, strengthening looks complicated, but everyone may find excuses to let decision for tomorrow.
- The situation is unfair, but seems to be caused by others, many years ago, damage was done by the earthquake. During communist regime the ownership and risk decision was upon the State, that is likely to be blamed.
- Apparently few may have in mind the morality of exposure and the fate of family or of the inheritors in case of collapse.

Conclusions about the needs of earthquake preparedness of school students and population using scientific knowledge for public multimedia information

Seismic conditions in Romania are dominated by strong earthquakes of intermediate depth in the Vrancea source, with several areas having crustal earthquake sources, mostly in Banat geographical area, which affect buildings of a small height. The present situation of seismic risk in Romania, and especially in Bucharest, is a crisis situation that may become an emergency situation should a strong earthquake strike. The risk perception and communication are on the edge and other tools are necessary to convince people about the true determinants of their life safety.

There is a need to rise public awareness of people living in buildings at risk, as well as of children / students and teachers in some schools in the central area of Bucharest, to organize seminars and to publish materials, using the best European and international knowledge at hand, under Romanian conditions.

ECMNR

For project fulfillment for the period of the year 2012 we laid stress on:
- short-term objectives ;
- promotion of the project involving Centres (more frequently CSLT Sofia, Bulgaria) and other central and local authorities from the Republic of Moldova;
- development of a policy of active communication

During activity fulfillment, taking into account the common aim, we have carried out these activities in a way that would allow us collecting as many as possible ideas, ensuring communication and an exchange of experience in this respect as to scientific and technical information about hazards and vulnerability, the identification of solutions for improving society's survivability against earthquakes.

In this respect, the selected information related to risk mitigation has been analyzed and developed with the participation of the scientists from this field, of the experts and of the central and local decision-making authorities.

In result of the earthquakes with the epicentrum in Vrancea in 1977, 1986 and 1990 and with the amplitude of 9 on the Richter scale the most affected buildings were those from Chisinau. We contributed to risk area identification and map elaboration according to the mutual consent of the municipal authorities. We worked upon concrete proposals and measures for mitigating the vulnerability of these areas of risk. In result of the polls made at different social levels, we found out that both the population and the persons in charge had scanty knowledge about this. In regard thereto, we sensitized the improvement of comprehension of the seismic risk by people and society, pursuing the aim of focusing the political attention on risk control. We proceeded to training improvement through a correct and attentive examination of the social and ethical aspects, paying attention to the vulnerable population from Chisinau and from the republic. With this object in mind, we organized and fulfilled training courses related to risk management within university classes for students. Considering the fact that we planned to use the knowledge with the aim of mitigating vulnerability, we proceeded to gathering information and to carrying out a round table. We should mention that Centre's initiatives sensitized both municipal authorities and a great part of the public opinion.

The Centre gathered as well information connected to the effects and damages provoked to the Republic of Moldova in the past by the earthquakes from Vrancea region.

The Centre has investigated the reports on the damages caused to the Republic of Moldova by the earthquakes from Vrancea region in the past and the current state of knowledge, training classes and needs concerning population's preparedness to an earthquake as well.

Round Table: ANTI-RISK EDUCATION IN THE EVENT OF AN EARTHQUAKE

Chisinau, Moldova, 26-27 December 2012

The round table was fulfilled with the aim of performing the project *„Earthquake preparedness of school students+population using scientific knowledge for public multimedia information in areas shaken by Vrancea, Romania, intermediate seismogenic source (case studies on buildings in Moldova, Ukraine, Bulgaria)"* regarding the promotion of the earthquake risk prevention culture and the application of anti-risk education activities in schools. The earthquakes with the epicentrum in Vrancea are still a situation of risk. The analysis of the earthquakes from 1977, 1986 and 1990 with the amplitude of 9 on the Richter scale, with the epicentrum in Vrancea, shows that they destroyed in a catastrophic way the buildings form Chisinau. In this regard, Centre's contribution made it possible for the local public authorities and scientific institutions to make common efforts for mitigating the seismic risk in Chisinau city.
Alexandru Boldesco, Chief Engineer of the General Department of Architecture, Urbanism and Land Relations of Chisinau Municipal Council, who was present at the round table, mentioned that the concept of a durable development determines a permanent reassessment of the relation between the human being and nature and asserted that the solidarity between generations is the only viable option for a long-term development.
For implementing this concept at a local level, the following researches have been developed through the common efforts of Chisinau Municipal Council, Chisinau City Hall, General Department of Architecture, Urbanism and Land Relations of Chisinau Municipal Council in collaboration with the Institute of Geology and Seismology at the Academy of Sciences of Moldova and the European Centre for Mitigation of Natural Risks:

1. Feasibility Study: „ Elaboration of engineering and technical protection measures for increasing seismic security of building territories and sites from Chisinau Municipium" (under the action of penetration of water into the basement and seismic actions)
The territory of Chisinau city has at present the total area of about 130.0 km^2, the maximal length of about 14 km., width -12 km. Chisinau is situated in the meadow of Bic River, on its left and right banks. The maximum pluvial precipitations with the probability of 1% attain 220 mm per day. The city is located on a territory with complicated geological and hydrogeological conditions and is in **the range of coverage of Vrancea seismic region.** The dwelling stock constitutes about 14,0 mln. m ^{2} (about 70% from country's stock). The most intensive building period was from 1966 up to 1989. For instance, at the end of the 80's, residential houses/blocks with the area of about 400 thousand m^2 (total area) were put in commission yearly.
This building dynamics had a negative influence on the natural and geological environment in result of the deterioration of the natural equilibrium of groundwater and of the conditions of its circulation. The greatest part of flooded territories from 1966 up to 2020 (forecasted year) amounts to 1803,1 ha. The period from 1966 until 1985 is the most intensive building period and represents 72,5% of the surface of flooded territories. The maximum increase in Botanica Sector constitutes 704,6 ha (39,1%), and the minimum increase is in Centru Sector - 174,5 ha (9,6%), where the built-up areas were minimal, fact confirmed by the priority thesis of anthropogenic loads for the flooding processes of the urban built-up territories and of the need for forecasting and engineering preparation of territories for their distribution for building aims.

The increase of flooded territories (groundwater level up to 5,0 m), ha			Total
1966-1985	1986-2002	2002-2020	
1308,3 (72,5%)	408,2 (22,7%)	86,2 (4,8%)	1803,1 (100%)

We have made an extensive analysis within the abovementioned study as to the area of the territory of the city that was flooded in the period from 1965 up to 2002. We have elaborated the groundwater pattern and the forecast of groundwater level dynamics up to 2020.
We have developed the groundwater pattern for Chisinau city and we have made the evolution forecast for 2020, which can present an insignificant increase, and namely 0,42-0,65 m or 2,3-3,6 cm per year; in general, the statistical interval of groundwater level rise "F" changes from 0,0 up to 1 m in 15 years. The temporary and local flooding can happen only within the boundaries of small territories during the creation of a temporary horizon, especially when there are intensive precipitations. We have made the geotechnical zonation of the territory. The outlined geotechnical regions differ according to their composition and properties of the quaternary soils, as well as according to the presence of some unfavourable factors as landslips, etc. We have developed a modern database describing the geologic and hydrogeologic environment of Chisinau city. The database contains information about 2376 wells drilled in the territory of Chisinau city recently. For the operational administration of the database, we have developed the "GEOTECH" program.
On the grounds of the results of a complex analysis and of the generalization of geological, geotechnical, instrumental and calculation data, we have developed the seismic microzonation map of the territory Chisinau city at a scale of 1:10000 for an area of 122,3 sq.km. depending on the value of the forecasted seismic oscillation intensity, the studied territory being divided in two areas: of 7 and 8 degrees MSK, and namely:
The 8-degree area constitutes 37% (45,3 km) out of the total area of the city.
The 7-degree area constitutes 63%, being associated with territories having a level of more than 80-120 m.
The seismically unfavourable sectors for buildings are indicated as well on the seismic microzonation map of Chisinau city. The study concerning the seismic microzonation of the territory of Chisinau city was fulfilled through the common efforts of Chisinau Municipal Council, Chisinau City Hall, General Department of Architecture, Urbanism and Land Relations, the Institute of Geology and Seismology and the European Centre for Mitigation of Natural Risks.

2. The development and monitoring of the geological and geotechnical database of Chisinau city.
As shown before by the feasibility study „Elaboration of engineering and technical protection measures for increasing seismic security of building territories and sites from Chisinau Municipium" (under the action of penetration of water

into the basement and seismic actions), information about 2376 wells was introduced in the database.
Within the abovementioned study, the database that had been created previously was considerably developed. Currently, this database contains data about circa 12 thousand wells and all this information is processed through Geotech program. The geological database of Chisinau city with a set of special maps represents already the data that are necessary for the development of design works in the field of urbanism and land improvements; this database allows creating a modern geotechnical service and continuous monitoring. The operation of this service has other social and economic effects, too.
As a result of the efforts made for the initiation and fulfilment of the abovementioned projects, the elaboration and approval of new normative acts in the building field was possible:
- "Geophysics of hazardous natural processes"
- Safety technique of the territory, buildings and structures against hazardous geological processes. General information
- Buildings in seismic areas. General guidance
This study contains as well the compartment "**Seismic risk assessment of the territory of Chisinau city**".
This kind of project was developed for the first time in Chisinau city.

The roundtable participants laid stress on the decreased competency level of the population, including that of the didactic staff as to the safety rules and organization of urgent actions for saving and protecting children in the event of an earthquake. Currently, the popularization of knowledge about the nature of the earthquakes and the provision with methodical support for didactic staff training and for skill development for the creation of an appropriate behaviour during an earthquake and in the period that follows it have a particular importance.
The subject ANTI-RISK EDUCATION IN THE EVENT OF AN EARTHQUAKE excited a vivid interest during the roundtable at which representatives of the central public administration, of the preschool, school, university and academic environment took part (41 participants). debates, the exchange of opinions and analysis, the following objectives were fulfilled and proposed:

- The development of an active communication policy.
- The promotion of the seismic risk prevention culture by implementing educational activities on seismic risk management in schools.
- To disseminate knowledge about the nature of earthquakes and to provide methodical support for didactic staff training and development of skills for the creation of an appropriate behavior in situations of seismic risk.

In result of a thorough analysis and exchange of views, the following conclusions took shape:

1. It is appropriate to improve the comprehension of the seismic risk by pupils, students and the society as a whole in order to focus the political attention on its management, too.
2. The inclusion of anti-stress skills and of an appropriate behaviour in the event of an earthquake as an optional or extracurricular subject.
3. Introducing an educational unit within the Faculty of Psychology and Education Sciences, at the State University of Moldova, the graduates of which could then go into schools to inform and prepare children and didactic staff.
4. The collaboration between psychologists and experts of the Service of Civil Protection and Exceptional Situations in order to improve the psychological methods of prevention and mitigation of earthquake consequences.
5. To contribute to the development of an active communication policy between European states regarding the preparation of students and people who use scientific knowledge about earthquakes in the shaken areas from Vrancea.
6. To contribute to changing population and especially teachers' attitude towards the need to know and create correct behavioral skills of automated type: before earthquake, during and after the earthquake and the combination with child-centered education.
7. To organize trainings in educational institutions, drawing contests, information, national and international competitions, to organize exhibitions about earthquakes and encouraging participants more frequently.
8. As well, in result of the debates, it was concluded that the introduction of new subjects in the school curriculum is not appropriate because the school program is overloaded, but new objectives and skills might be introduced in other subjects related to the Education for a Healthy Lifestyle, Civil Protection, Safety Management in Emergencies, Life Skills, and especially within educative classes. Practical lessons and periodic seminars for teachers with the organization of simulations can be organized in collaboration with the Civil Protection Department.

The roundtable participants considered that this type of work with the financial support of the Council of Europe is especially useful, important and efficient and they supported unanimously:
1. Making suggestions for conducting studies in the field of highly qualified didactic staff training for natural risk management.
2. The popularization of the safety rules in case of earthquakes.
3. The development of conceptual reference points concerning the education strategy in the field of protection against earthquakes in educational institutions.
4. The development of educational principles in the field of protection in the event of earthquakes:

- The adjustment of anti-risk education to pupil's personality.
- Carrying out the educational process against the background of the collaboration relations between the pupil and the teacher.

- The timely transparency and notification of all the persons concerned (pupils, parents, teachers, students, technical staff, etc.) concerning the seismic risks.
- The use of different strategies and technologies concerning the development of an appropriate behaviour to pupils, students, teachers, technical staff in the event of an earthquake.
- The creation of a behavioural skill of automated type: before the earthquake, during the earthquake and immediately after the earthquake.

The roundtable participants have highly appreciated this activity organized by the European Centre for Mitigation of Natural Risks, qualifying it as a successful and efficient one, having a long-term effect in the mobilization and bringing together of the persons interested in opening up, participating and collaborating in the field of seismic risk prevention culture.

TESEC

In the western areas of Ukraine (from the XVII centuries up to our time) earthquakes are generally characterised by the depths of fires (h) 2-10 km and magnitudes (M) <5.5. Due to the small depth these earthquakes cause local vibrations of soil surfaces with intensity of 7-7.5 points. The same vibrations are felt in Zakarpattya due to the earthquakes deeper (h=35 km) and bigger in size (M=6.8) with fires located in Romania (Pishkolz) at the distance of about 60 km from the Ukrainian borders. In Prykarpattya the biggest authentically described earthquake took place in 1875 near the region Velyki Mosty (in the Lvov region). It was characterised by the magnitude M=5.3, fire's depth of h=19 km and was felt in the epicentral zone with the intensity of 6 points.

A considerable part of the Ukrainian territory is under influence of the undercrust earthquakes, which take place in the Vranch zone in Romania (area of the joint between the Eastern and Southern Carpathians). Fires of the earthquakes, which are capable to become the reason of macroseismic manifestations on the territory of Ukraine, are located in the mantle at depths ranging from 80 to 190 km. Maximum magnitudes of earthquakes in this zone reached 7.6 points. Due to the big depths and magnitudes, earthquakes of the Vranch zone become apperent on the huge territory: from the South of Greece to the North of Finland.

On the epicentres' map the earthquakes' fires in the Vranch zone are presented since XI century with magnitudes over 3.5 points. Isoseists of the strongest earthquakes in the Vranch zone are reliably established for the last two centuries. For the construction of isoseists the published materials were used, and for the earthquakes of 1977-1990 - authors' data.

Seismicity of the Crimean-Black Sea region is defined by the epicentres of the earthquakes located in the water area of the Black sea, near the Southern coast of Crimea which are characterised by the highest indicators throughout the Ukrainian territory: magnitudes up to 6.8. On the epicentres' map the Crimean earthquakes are presented with magnitudes, exceeding 2.0, during supervision period between the I century BC up to the present time. On the flat part of Crimea and the Sea of Azov fires of earthquakes with magnitudes over 1.0 are shown.

It is possible to consider the delta of Danube as separate seismic area. Here throughout the historical times earthquakes with maximum magnitude of about 7 points took place, which together with Vranch earthquakes' zone represent serious danger to the territory of Odessa region.

In the central part of Ukraine, in particular within the Ukrainian board, for the last centuries only several earthquakes with small depths (5-10 km) and low magnitudes (M = 3) were authentically fixed. These earthquakes had local character of seismic influence. The strongest earthquake in the Eastern part of Ukraine is considered to be the one in 1913 near Kupyansk (magnitude 3.5, local vibrations with the intensity up to 5-6 points). In the western part of Ukraine, near urban village Mykulynzi in the Ternopil region, earthquake with magnitude of 4 took place on January 3rd, 2002, and had intensity of 6 points in the epicentre with 7 points' effects on the weakened soils. Heretofore the specified territory had indicator of 5 points.

In Ukraine the national network of seismic supervision was created, with 18 seismic and 14 complex geophysical stations. The oldest is the seismic station "Lviv" which was founded in 1899. Digital seismic station "Kiev" was created in 1994 and it is a part of the Global seismic network.

The knowledge on specific damage and vulnerability of buildings in Ukraine after past great Vrancea earthquakes has been collected.

ECPR

After the destructive earthquake in Southern Bulgaria on 14th and 18th April 1928 the next 50 years are relatively quiet with regard to seismic activity. This creates the impression that the seismic danger has disappeared and it is no longer necessary to spend resources in this regard. Even in 1975 scientists started to research the foreign experience in a neighboring country for reduction by 30% of the steel consumption in reinforced concrete construction.

In this atmosphere of relief on March 4, 1977 comes the destructive earthquake with epicenter Vrancea, Romania. The earthquake causes a mass psychological impact on the population in Bulgaria, especially the citizens of the town of Svishtov who have witnessed how just in a few seconds an eight-storey residential flat rotates around its axis and with a terrible bang goes down, covered in clouds of dust (more than 100 people died). Mass psychosis of fear and insecurity spreads around many towns in Southern Bulgaria and in Sofia.

A Central Scientific-Technical Committee was immediately founded with the task to document and research the earthquake. The committee publishes a preliminary report on the destructions and damages in Romania and Bulgaria. A complex target program was developed for long-term fundamental and applied surveys in the field of seismotectonics, engineering geology, hydrogeology, seismology, seismic mechanics and anti-seismic construction and

the related socially-economical problems. The Bulgarian Academy of Sciences developed a program on seismology and anti-seismic construction, which was to be implemented by 1990. The program was not realized.
The earthquakes in Vrancea and later in Velingrad were followed by urgent tasks for the construction of a network of seismic stations for signalization in case of earthquakes.

1. Tectonics, engineering geology and hydrogeology

After the 1977 earthquake the sector of geo-tectonics at the Geological Institute of the Bulgarian Academy of Sciences and the Geological-Geographical Faculty of the Sofia University, together with the specialists from the sector of engineering geology and hydrogeology at the Geological Institute of the Bulgarian Academy of Sciences, examined the connection of the seismic effects with the geological composition of Northern Bulgaria.

Brief data about the effect of center Vrancea in Bulgaria until March 4, 1977.

The most significant manifestations of the Vrancea center regularly affect the territory of our country. Almost in every case there are strips of maximum seismic impact with orientation SW – NE. One of them, the steeper direction, is within the range 30-45º (direction Tvarditsa), and the other one is with orientation approximately 70º (direction Yablanitsa). The strips in these directions are well differentiated in Northern Bulgaria. The depth of the earthquake-shaken layers of the upper mantle does not affect the selection of one of the abovementioned directions. During the earthquake from March 4, 1977 in North-Eastern Bulgaria there were also several not wide zones of more substantial damages on the buildings in orientation SE (120º).

By intensity of the earthquake impact of the Vrancea center, documented values close to the values from March 4, 1977 were achieved on November 10, 1940 with the strongest (VIII degree) impact by Forel-Mercalli in Nikopol and VII-VIII degree in Svishtov and Tetovo. Significant VII degree effects were noted along the entire Danube coast from Silistra to Vidin, to the south of Nikopol, Svishtov, Ruse, in the districts of Razgrad and Tarnovo. Weaker, but still significant is the VI degree impact in G. Oryahovitsa, Pleven, Mihaylovgrad, Shipka, the district of Kazanlak, Dalboki (district of Stara Zagora), Starosel (district of Plovdiv) and Letnitsa (district of Godech). Effects of V degree (as per Forel-Mercalli) were noted in Sevlievo, Tvarditsa, between Kazanlak and Karlovo, Koprivshtitsa, Hisar, St. Zagora, Septemvri, Brezovo (district of Plovdiv), Velingrad, Hvoyna, Devin, Ihtiman, Vakarel, Novoseltsi, Sofia, Cherni Vrah, Musala, Dragalevtsi, Pancherevo, Breznik, St. Dimitrov, Razlog, Yakoruda. The abovementioned increased values are probably the result of remobilization of seismic lines in relation to fault disruptions in a northeastern and southwestern direction, as well as in lines with sub-meridian orientation.

1.1. Seismotectonics conclusions

The deformations of the terrain and of the constructions caused by the 1977 earthquake are allocated too unevenly on the area of Northern Bulgaria. Besides in the Danube region, there are also damages far to the south of it. They form strips with various widths, mainly with elongation to SW and SE. Thus, for example, significant effects are characteristics even for the village of Polski Senovets, which is located to the north of Gorna Oryahovitsa, for Razgrad and the district of Razgrad, for the villages Chernolik, Bradvari, Dulovo, etc., each of them located at least dozens of kilometers to the south of the Danube coast. In several cases under analogous engineering-geological and hydrogeological conditions in the same or in different settlements the seismic effects are not the same. With almost the same type of buildings and relatively identical quality of performance it should be assumed that in the allocation of the seismic energy there was a tectonic factor – mainly the fault structures. Together with the southwestern and the southeastern direction in the allocation of the density of the flow of seismic energy, there are also strips with maximum intensities with sub-equatorial orientation. These directions and especially the first two are directions with the largest saturation of faults in the regmatic network of Northern Bulgaria. The southeastern (Berkovsko) direction is particularly characteristic of North-Eastern Bulgaria, where it is represented by several first-rate faults established by a geophysical method. The southwestern direction is covered mainly by the so called Tvardishka fault system (35-45º). But as a whole in our country, as well as in the plan of the entire Southeastern Europe, the isoseistic map of the quake from March 4, 1977 marks a clear elongation with orientation WSW, i.e. along the so called Yablanitsa direction.

The preliminary work map of the more significant disruptions in Northern Bulgaria there is a series of strips with SE direction. One of them is too wide and long and is followed along the line Tutrakan – Tolbuhin – Balchik (110º). Here we should note the disruptions on the terrain and the buildings, which however are not the same along the entire length of the strip. The seismic impacts sharply decrease from NW to SE. According to information from the population here the initial impact was felt, as if coming from NE. The strip Tutrakan – Balchik is largely covered by the hidden fault Tolbuhin – Dulovo, which in the foundation of the Moesia platform runs into the demarcating zone between the North Bulgarian protuberance and the Tutrakan depression. In the eastern part of the strip, more exactly to the east of the place, where it crosses the Tolbuhin sub-meridian fault, the earthquake impact weakens relatively quickly. A certain shielding role of this fault can be assumed. In the limits of this strip there were seismic lines noted on March 31, 1901, on November 8, 1911 and on August 9, 1912.

To the southeast of the Tutrakan – Balchik strip and almost parallel to it is the Vetovo – Razgrad strip (130-140º). It is relatively shorter, with quite similar degree of destruction, and it's relatively straightforward. The deformations in it are significant. According to information from the population, a strong rocking was felt there in direction NNE – SSW. This strip coincides too well with a depth fault along the foundation, as well as with a photo lineament 140º. This strip has been activated numerous times during other quakes – on September 13, 1903 and during the Razgrad earthquakes from 1913 and 1942.

Further to the southwest there is the next strip between the village of G. Ablanovo and the village of Opaka (120-130º). It is also marked well on the grounds of solid damages of the buildings. They are particularly severe in the crossing of the strip with another northeaster strip – the G. Ablanovo strip. This is in the region of Dve Mogili and the villages Ekzarh Yosif, G. Ablanovo and Trastenik. Within the limits of Dve Mogili there are strips of substantially damages

construction sites, which are with the direction of the strip between G. Ablanovo and Opaka. This strip also covers well a fault established in depth with the same orientation. Only its southeastern outskirts coincide with the analogously oriented seismic line in relation to the Razgrad quakes from 1942.
Next is the Yantra strip (150-160º). It is formed along the lower stream of the Yantra River from its mouth up to Gara Byala. The deformations caused by the earthquake to areas of the terrain with various sizes and to the settlements lead to the conclusion that there is a possible hidden fault with direction towards 150º, which contributed to the transmission of more significant seismic energy. Here there are many manifestations of sand volcanism in the mixed terrace of the Danube River and the Yantra River.
Further to the west there are the Osam (150-160º) and the Gulyantsi – Brashlqnsko (approximately 160º) strips. The first one is along the lower stream of the Osam River. In a series of settlements the damages from the quake are somewhat allocated in girdles with various width, which are identical to the orientation of the strip. In these areas it is assumed that there is a fault with similar orientation. The second strip is mapped according to scarce information, within a very limited length. It is the shortest of all NW – SE strips.
A series of strips with increased disruptions are with SW direction. They are characteristic mainly of the western and partly the middle part of Northern Bulgaria. It refers to the directions, which in a general aspect coincide with the overall elongation of the flow of diffusion of the seismic energy, which is characteristic of the impact of the Vrancea center. There are several such strips: G. Ablanovsko strip (30-40º) in the district of Ruse, coinciding at least partially with the Danube fault and the quite representative wide and long photo lineament bundle G. Ablanovo; the Vitsko strip (approximately 40º), which is covered by the famous Etropole line in these areas; the Koshavo-Vidin strip (45º), well folded in with the Oltensko crypto-fault line. All three strips mark increased seismic impacts. It is characteristic that they are monitored even further in the limits of the country, and in specific cases (for example the Vitsko strip) they even reach Middle Bulgaria.
There are also strips in WSW direction. They lie mainly in the middle part of Bulgaria. The Marten – Tutrakan strip (approximately 80º) is near the Danube coast. Its presence can be related to a fault, for which there is information from the decryption of cosmic photographs.
Besides the abovementioned main strips with directions SW and SE, there are also some secondary strips with sub-equatorial and sub-meridian orientation. Amongst them noteworthy is the sub-equatorial Danube strip. It is monitored from Oryahovo and Nikopol, through Svishtov to the east, up to Dve Mogili. Here there are severe damages of the buildings in the settlements (for example in Svishtov, the village of Krivina), often in areas with analogous direction to the strip, but also an entire series of newly formed cracks and faults with predominant sub-equatorial direction. Many of them are related to landslides activated along the coast. With regard to its orientation and location the Danube strip is well covered by a hidden fault line.
Another sub-equatorial strip with more limited linear dimensions is the Ruse – Tetovo strip. It is highly likely that it is conditioned by a fault with the same orientation, for which there is information in the section Chervena Voda – Tetovo. It is possible that it is also related to the line, which coincides with the strip and which manifested during the quake in Northeastern Bulgaria in 1940.
The Popintsi - Dulovo strip has sub-meridian orientation. It is quite wide and the damages in it are substantial. On Bulgarian territory we do not have information about such a fault, but in Romania there is an analogous one, which could spread south to the Danube River.
The presence of significant seismic impacts in Bulgaria, quite close to the most significant ones in Romania, shows that in the Moesia platform there are substantial fault lines, which contribute to the absorption of the flow of seismic energy. This, of course, is contributed mainly by the fault structures in NE direction. However, it is worth noting that in the western half of Northern Bulgaria, where the density of such oriented fault lines is greater, the impact of the Vrancea quake is relatively weaker than in its eastern half, where, on the contrary, the fault lines with NW direction are predominant. The reasons for these differences in the seismic impact should probably be searched for elsewhere. It is possible that the tectonic behavior of the North Bulgarian protuberance, which - still raising nowadays - is in the course of a process of tectonic disintegration, has a decisive role. Furthermore, the relatively weakened seismic impact to the west of the Iskar River could be viewed as a result of the tectonic behavior of the Lom depression, which is an area of sustainable sinking and respectively loading with a thick platform superstructure (up to 10-12 km).
In the end we will pay attention to several sections with limited area from Northern Bulgaria, where the damages are relatively greater. In most cases they coincide with the position of fault junctions, i.e. they are located in such areas, where established fault lines cross. Such are the Gulyantsi junction, the Somovit – Nikopol junction, the Novgrad junction, the Dve Mogili junction and the Sredna Kula junction, located at the crossings of faults with sub-equatorial and diagonal direction. Other junctions, such as the Razgrad and the Opaka junctions, lie on crossings of diagonal faults, and the Chernolika junction is located on crossings of diagonal and sub-meridian faults.

1.2. Engineering-geological conditions and their impact of the effects of the earthquake.

The 1977 earthquake, which caused severe damages on the territory of Romania, also affected the central parts of Northern Bulgaria. Here we summarize the performed observations and researches of the impact of the engineering-geological conditions on the effects of this earthquake. Together with the confirmation of known regularities and the establishment of new ones, there are results and facts, which are difficult to explain at this stage and need additional examinations.
The earthquake was one of the deepest earthquakes on the globe in 1977. It was registered by all seismic stations in the world. According to data from the International Seismology Center it was registered by 560 seismic stations within the range of epicentral distances 0 – 157º. The earthquake caused great material damages in Romania and on the territories of Bulgaria and Moldova. The seismic movement of the ground caused by the earthquake is characterized by an unusual allocation of the intensities. There is a certain tendency of focusing around the macro epicenter and islands

of high intensity at large distances from the central area.
Felt in the epicentral area – northwest from Foksani, and in the area of the Romanian capital at VIII degree, the earthquake created effects close to the ones caused by the maximum intensity in the district of Iasi (Northern Romania), in a wide area around the macro-seismic epicenter and in Southern Romania (district of Craiova) and a not small area along the Danube coast, covering regions from Romania, as well as from Northern Bulgaria. The field of high intensities (VIII and VII – VIII degree) is non-symmetric and torn. The cover of the discrete fields of intensity VII – VIII degree is obviously drawn in direction northeast – southwest, outlined convincingly by the isoline at VII degree. We should note the considerably weaker fading of the intensity from the macro epicenter to the southwest. This effect is coordinated with the main direction of the tearing in the center. The steep sinking of the plain of tearing to the northwest most probably conditions the non-symmetric allocation in direction northwest-southeast towards the epicenter of the field of intensity VII degree. In the areas with intensity not lower than VII degree, as expected, the effect from the central process is too dim. In the overall macro-seismic field there is unevenness – faster, followed by slower fading of the intensity between subsequent isolines. It is difficult to reach a quality conclusion about the course of fading of the intensity under V degree – a significant gradient to the southwest, south, southeast, relatively smaller to the northwest and north, and minimal to the northeast from the epicenter.

2. Seismology

The center in the region of Vrancea has the following significant peculiarities: relatively large depth (80 – 120 km) of the strong earthquakes with magnitude M => 7; large area of the macro-seismic impact; approximate constancy of the interval between two strong earthquakes; specificity in the azimuth allocation of the density of the flow of seismic energy; relative long-period transmission of seismic waves, etc.
The seismic impact of the 1977 earthquake on our territory is assessed on the grounds of an analysis of the effects in the towns and villages, information on which is gathered through inquiries and personal observations.
From March 5 to March 11, 1977 there was a macro-seismic survey in 106 settlements in the middle and eastern part of Northern Bulgaria by a group of seismologists – collaborators of the Geophysical Institute at the Bulgarian Academy of Sciences. They visited places, where the earthquake had caused an impact of at least V – VI degree in the form of residual effect on the buildings, which allows for increasing the objectivity of the assessment. The inclusion of several other settlements with manifestations, characteristic of lower intensities, constitutes an exception.
Upon the impact of VI degree most of the residents have gone out of their homes, there are cracks in the plaster, single demolished and 10-20% cracked chimneys, and seldom there are cracks in the walls between windows. In Shabla some very old and worn out houses have become uninhabitable, in Balchik there are very few damaged architectural decorations, and in Kochmar – isolated chimneys shifted to the east or with chipped-off parts.
Upon intensity of VI – VIII degree the observations show 40-50% damaged and a lot of fallen chimneys (masoned with mud and seldom with cement), isolated cracks in the carrying walls of brick houses, cracks and shifts of bricks around beams above windows and doors. In Gorsko Slivovo there were also demolished parts of walls in old houses, in Milkovitsa mainly the northwestern walls were damaged, and in Byala Voda there were cracks in the carrying southern and southwestern walls. The northwestern region of Gigen looked more affected than the southeastern and the damages were mainly in the southeastern walls. In Slivo Pole there were horizontal cracks under roofs, which had occurred due to the weight of the top slabs. In the walls of buildings in Dekov there were opened old cracks – an indicator of unfavorable padding; the new cracks were mainly in the southeastern walls. The damages in the northwestern and the southeastern walls of the buildings were caused by the highly-energetic transverse wave, while in Byala Voda and Dekov they were caused by more high-speed transverse waves.
The consequences from quakes VII degree were over 50% damages chimneys, multiple cracks around the openings in walls, broken eaves, in many old houses there were severe disruptions and damages in the carrying parts and some demolished filler walls, and in residential flats – only internal disruptions. In Dolni Vit there were vertical cracks almost along the entire height of the buildings and around the corners. In Levski approximately 30 houses with wooden beams had damages in the carrying construction, and in the 4-5-floor massive flats the most damaged were the second floors. In Gorna Oryahovitsa there were third-degree damages in 8 residential flats, all with stores on the ground floor; heavy damages were observed in 14 public buildings. In Lyubenovo there were cracks mainly in southern and southeastern walls (again the impact of the transverse wave). In Barin there was a different impact on the buildings located along the eastern-southeastern and along the western-northwestern slope of the gully. In Brest in the semi-massive one- and two-floor buildings as a result of old sagging of the foundation there were slanting and vertical cracks from the windows to the roofs.
The information received from the municipality of Oryahovo contained the following figures (added to the conclusions from the survey, they gave the impact in the town an assessment of VII – VII degree): total cracked buildings or only with fallen chimneys – approximately 700; completely uninhabitable due to damages in the carrying construction – 138. In old and newer semi-massive houses there were severely cracked and even demolished walls, with predominant cracks in the eastern corners.
The reference made on March 9 in the district gave information about the affected buildings in the district of Razgrad – 76 agricultural buildings, 26 schools (3 unusable and 23 for light repairs), 34 kindergartens (3 unusable, 23 for major repairs and 8 for light repairs), 208 residential buildings (48 completely demolished, 160 uninhabitable), 1600 buildings damaged in various degrees. In Razgrad approximately 166 buildings with various designations are uninhabitable, and 750 are affected in various degrees. Seriously damaged were some industrial and public buildings: MOK D. Blagoev – damaged roof (factory No 1), demolished building and partially demolished washing line, damaged hearing grid (factory No 2), damaged boiler (factory No 5), and severely damaged rope line. The cooling installation in the poultry slaughterhouse was damaged. The second floor of the spare parts factory was sagging. The antibiotics

factory there was a damaged steam pipe and a damaged boiler. In the veterinary clinic – a monolithic two-floor building, completed 4 years ago and located to the north of the town, the southern corner was chipped-off (the cross-beam was 5 m away from the corner) and the building was cracked under the first floor slab. The county hospital had three buildings subject to demolition, as well as a four-floor building with two additional floors (from which 190 hospital beds were removed). Under the weight of the additional floors in the lower two floors all integrated pipes were damaged, and the wide vertical cracks in the walls were continuing to spread open. The kindergarten located 300 m away from the county hospital was first dimensioned for small rooms, but later the intermediate walls were taken down. The ceiling of the ground floor had an old crack across the entire slab, and due to the earthquake the external walls had separated. Completed only three months ago, the children's institution in quarter Buzludzha had a cracked corner and a cracked wall. The bus station had a cracked under-roof blind wall and a cracked staircase. In quarter Buzludzha, built-up with brick two-floor houses, there were external cracks mainly between the openings in southern and southwest-

3. Impact of the earthquake on the buildings and installations

In order to analyze the deformed and stressed state of a construction during an earthquake, it is necessary to:

1) know the nature, power and duration of the seismic impact for the site in question;
2) know the geometric, strength and deformation characteristics of the construction in question;
3) use sufficiently accurate methods for examination of the response of the constructive systems in a non-elastic stage upon a specific seismic impact.

At this stage of development of the scientific examinations these three conditions have not yet found a simple and complete solution due to their extreme complexity. Each of these conditions is related to a series of prerequisites, assumptions and simplifications with the purpose of obtaining a final solution with the available scarce information about the earthquake, its impact on the construction and the methods for examination. The adoption of one or another method of examination amongst the popular ones up to now depends on the available information about the earthquake and the construction.

The proposed analysis of the damages and destruction in the buildings from the 1977 earthquake uses methods with the necessary experimental data, recordings and the observed deformations in the constructions. On account of the use of methods, which do not offer a simple solution, often times several methods are applied, in order to assess their reliability. Where possible, the calculated characteristics are compared to the experimental data and recordings, which are accepted as criteria for assessment of the obtained results.

The main factors, which the impact of the earthquake on the buildings and installations depends on, are: the mechanism of the earthquake and the nature of the generated seismic waves; the dynamic and spectral characteristics of the seismic waves (accelerations, velocities, shifts, predominant frequencies (periods), response spectrums, spectral density, etc.); the geological conditions from the epicenter to the site in question, the local engineering-geological and hydrogeological conditions, the relation of the dynamic characteristics of the buildings and installations and the characteristics of the received seismic waves; the resistance capacity of the buildings and installations and their capacity to re-allocate the forces between the carrying elements with development of non-elastic deformations, smaller than the limit ones, etc.

The specific mechanism of the earthquake in Vrancea generates seismic waves with comparatively not high seismic accelerations, but large shifts with predominant period 1 to 2,5 s. The analysis of the behavior of buildings and installations upon seismic impacts must take into consideration that for the low and hard buildings with periods of inherent oscillations up to 0,4 s, determinative are the dimensions of the seismic accelerations and the high frequencies (low periods) of the seismic waves. For averagely flexible buildings with periods up to 1,0 s determinative are the velocities of the seismic waves, and for the flexible and tall buildings and installations – the shifts in the foundation and the periods of the seismic waves over 1 s.

3.1. Impact of the earthquake of the buildings and installations of the territory of Bulgaria

3.1.1. Residential and public buildings

Masonry constructions. The masonry constructions, particularly the ones built more than 50 years ago without security against earthquakes, are characterized by a low resistance capacity to earthquake impacts. This type of buildings are usually built with wooden floor and roof constructions with a weak connection of the wooden beams with the brick masonry. The non-homogeneity of the floor constructions, their low hardness and the poor connection with the walls does not allow for re-allocation of the seismic forces between the walls. The brittleness of the brick masonry and its breaking down upon alternating loading prevent the masonry constructions from developing substantial non-elastic deformations and re-allocating the forces between the carrying elements.

Despite these disadvantages of the masonry constructions, they did not suffer serious damages during the earthquake in Vrancea mainly because of its specific spectral composition. As mentioned above, the earthquake manifested on our territory with long-period waves – T over 1 s. The masonry buildings are with period from 0,1 to 0,25 s and the earthquake had a weak impact on them Thus for example the two-floor brick building in Svishtov, located 100 m away from the completely demolished hostel of the factory "Sviloza", did not suffer serious damages despite the poor state of the building prior to the earthquake. Other similar buildings also have minimal damages. Even the single-floor building in the village of Batin, built of stone masonry and sun-dried bricks masoned with a mud solution, suffered less damages than a series of reinforced concrete buildings with a higher period of inherent oscillations. While the churches with stone and brick masonry were destroyed in mass numbers during the Plovdiv earthquakes, the church of one of the villages near Danube has more significant damages mainly in the bell tower, which has a higher period of inherent oscillations.

Some masonry buildings, for example in the village of Ekzarh Yosifovo and elsewhere, have significant destruction despite the low period of the buildings. In these cases we should note that the local geological conditions amplify the short-period seismic waves, on account of which the earthquake Vrancea from March 4, 1977 also demolished masonry buildings. Over 160 masonry single-floor buildings in Nikopol were severely damaged not only because of amplification of the short-period seismic waves, but also because of the extremely poor construction – sub-dried bricks, masoned with mud solution without connection between the brick walls at the corners, poor connection of the roof wooden constructions and the sun-dried brick walls, etc.

The masonry constructions usually serve as benchmark for determining the intensity of the earthquakes. The Vrancea earthquake, due to its specific mechanism, is an exception to this rule – it spared a large number of old masonry buildings, but inflicted more serious damages to the flexible buildings with higher periods.

The power of the seismic impact in Svishtov can be assessed by the more detailed analysis of the destruction in some of the larger masonry buildings.

District court. The building has two floors, with carrying brick walls 50 cm think on the first floor and 38 cm on the second. The foundations are made of stone masonry. The floor constructions are made of wooden beams, which do not establish a good connection between the walls. The roof construction is classic, wooden with cover of roof-tiles on mud over a plank liner.

The destruction on the façade walls is mainly in the beams above the windows, performed as arches. In this case the destruction is also in the area of the openings as a result of development of vertical shearing stresses. The destruction in the interior of the building is significantly greater as a result of the poor connection between the wooden floor constructions and the brick masonry. The lack of steel anchoring parts is the reason for more severe destruction.

Due to the impossibility for reconstruction, the building was demolished.

Reinforced concrete monolithic frame buildings. A large part of this type of buildings demonstrated good behavior during the 1977 earthquake. In regions with increased seismic activity, adverse engineering-geological conditions, a combination of inexpedient architectural and constructive decisions and mainly due to the poor quality of performance of the construction works, some buildings suffered substantial damages and destruction.

The reasons for the adverse response of some of the monolithic frame buildings during the earthquake can be systemized, as follows:

1. The seismic activity of some regions manifested in a higher degree as foreseen in the operative maps for seismic division into districts. This refers particularly to regions, which were envisaged in the maps with intensity VI degree, but actually manifested with activity up to VII and VIII degree. In these regions the buildings have not been calculated for impact of seismic forces, however experience shows that buildings, which were properly designed and performed in good quality, can withstand earthquakes of VII and partially VIII degree.
2. The lack of micro-seismic survey in responsible buildings and installations, as well as the failure to consider the local geological and hydrological conditions.
3. Low quality of performance of the construction works, contaminated additive materials, unsorted concrete and strengths, which have not reached the design strengths, frozen concrete during work in winter conditions. Poorly performed reinforcement works, insufficient anchoring of the reinforcement, incorrect bending, congesting of the reinforcement, lack of concrete cover, lack of stirrups, often congested or separated without reason.
4. Incorrect architectural-planning decisions with complicated forms, non-symmetric planning, removal of brick walls in ground floors, poor solutions for anti-earthquake joints, etc. led to unfavorable consequences for this type of buildings.
5. Constructively the buildings are not secured against earthquakes (they have not been calculated for this), and in some cases no constructive undertakings have been conducted for horizontal loading. In some of the cases an inexpedient constructive solution has been adopted, which decreases the horizontal carrying capacity of the buildings. In many cases the recommendations for constructive measures for buildings in regions with VII or higher degree of seismicity have not been observed.
6. Unfavorable construction of flexible buildings over weak soils, often with high ground water.

The 1977 earthquake also caused significant damages in monolithic frame buildings. The damages can be systematized depending on the constructive elements, in which they have manifested.

a) Damages in the brick walls. In many cases they are non-constructive – cracking of the plaster with oriented and non-oriented directions, and its coming off the walls. Another group of damages in the walls is the manifestation of cracks along the entire thickness of the brick masonry. There are horizontal cracks in the brick walls under the beams and on the floor, which means a disruption of the connection with the brick wall, and vertical cracks between the wall and the column. In most cases there are simultaneous horizontal and vertical cracks. These damages in the walls are characteristic of buildings without a monolithic connection between the brick walls and the reinforced concrete frame, which is characteristic of the system with lift-slabs. When the brick walls have monolithic connection with the frame construction, there are cases of single or crossed diagonal destructive cracks.
b) Damages in the columns. Usually they are in the junction column – beam and beam – column, or in the upper and lower end of the columns. They constitute crushing of the concrete in the pressure zone, especially in the case of poor quality unsorted concrete with insufficient strength, falling or dragging of the longitudinal reinforcement, lack of or insufficient stirrups – separated or performed in poor quality.
c) Damages in the beams. Usually they are in the junction beam – column. They constitute crushing of the pressure zone of the concrete due to poor execution, unsorted state or insufficient strength, congested, drawn-out or dragging reinforcement, insufficient or poorly executed stirrups, in most cases separated.

d) General damages and destruction in buildings. When the deformation joints between the blocks are not well constructed or their place is not properly envisaged, damages occur around them. There are damages in the foundations – cracking of the soil around them. In several cases, where all of the abovementioned adverse conditions are combined under poor engineering-geological conditions and increased seismic intensity, entire buildings are destroyed.

Damages in residential and public buildings. A residential flat in quarter 188 in Svishtov, designed in 1966 by the District Design Organization – V. Tarnovo, invested by ONS – Svishtov, has a monolithic frame reinforced concrete construction, based on single foundations over loess. The flat consists of a basement, stores with clear height of 6 m and 9 residential floors with 36 apartments. In plan the building consists of 2 separate rectangular bodies connected with a common staircase cell. The staircase flights are anchored in the two bodies, and the short sides of the staircase cell are fully glazed. The building has a flexible first floor due to the presence of stores, as a result of which the hardness of the floor is very low compared to the others.

A characteristic feature of the frame construction is the shifting by half a floor of the floor constructions of both bodies of the building, and the connection between them is realized only through the platforms of the staircase cell. The carrying frame of the individual bodies consists of 18 columns placed at not big distances, connected with beams in two directions. Most of the columns are rectangular with dimensions from 25x25 to 40x50 cm. Only three columns are circular. The beams are 25x12 cm wide and comparatively low heights. All columns are on separate foundations, some of which overlap. The round walls in the basement of the building are performed as concrete continuous walls, 35 cm thick.

The non-symmetric connection of the two bodies of the building through the staircase cell causes non-coinciding of the tracks of the resultants of the horizontal wind and earthquake forces, acting on the two bodies. On account of this there are torsion moments in a horizontal direction with particularly adverse consequences upon non-synchronous oscillation of both bodies. The connection of the columns at the staircase cell with the slabs in the middle of the floor height is also not favorable.

Large-panel buildings. The large-panel construction takes up a substantial place in the overall volume of residential construction in seismic regions. On the grounds of the features of this constructive system, some experimental data and the experience from the 1977 earthquake we have reached the conclusion that the use of this type of construction in seismic regions is completely justified. This constructive system survived the seismic impact from March 4, 1977 in comparatively the best state. The surveyed constructions are residential flats, which had cracks and insignificant damages along the connecting joints. We will track the state of the large-panel construction only in Northern Bulgaria and Sofia, since the data about Southern Bulgaria is scarce or completely lacking.

In the residential complexes Tsarevets and Mladost in Svishtov there are large-panel buildings. The panels are made in the home-construction factory in V. Tarnovo according to the nomenclature for construction in regions with seismicity of VIII degree. The inspection and the conversations with the inhabitants show that the buildings have survived the earthquake in a good condition.

The eight-floor flats in Ruse in general have no serious damages. An exception is flat Vezhen with the following defects: cracks in the deformation joint up to 0,5 mm along the façade, vertical cracks on the northern blind wall between the two panels from the second to the fourth floor. In the panels of the zero cycle and the treenail connections there are no cracks. On all floors of the fourth entrance there are slight cracks along the ceilings between the wall and floor panels in the entrance halls, slight cracks between the staircase flights and the staircase platforms.

In the county of Silistra there is no information about damages except for the 8-floor flat Druzhba in Silistra, where there are superficial cracks in the connections between the panels and above the doors.

In the county of Tolbuhin only in some of the large-panel buildings there are insignificant hairline cracks above openings (windows and doors).

In the county of Vratsa the large-panel buildings have not been calculated against earthquake impacts, and the connections between the individual wall panels are performed by welding two iron rods with Ø16. In one of the sites additional horizontal rods are used for connections between the two panels from the zero cycle and the first floor. Performed in this way the connection is not able to withstand the shearing and torsion forces. Such poor quality performance of the connections is found in many sites in the country.

The experimental hysteresis loops of tested connections between floor and wall panels show that this type of connection has great resistance capacity and capacity to absorb energy, as well as to admit non-elastic deformation to a certain extent. Its incorrect performance however eliminates this good possibility for increased carrying capacity.

A large-panel residential flat in Kozloduy (No. 33), as well as others in Oryahovo (residential flat Dunav), have received horizontal cracks between the individual wall panels and in some of the treenails. There are also cracks in the panels above doors and windows.

The performed inspection of 9 sites in the county of Vidin shows that 6 are in operation and 3 are under construction. The sites in operation are according to the nomenclature of Glavproekt. In isolated places on the first floors there are cracks along the monolith concrete at the treenails and along the ground coat at horizontal and vertical joints. There are chimneys detached from the panels and faience tiles detached from the chimneys in the service rooms. The sites under construction are 8-floor according to nomenclature Bn-IV-VIII, H = 2.80 m. They have cracks along the ground coat at vertical and horizontal joints. The chimneys, which are of siphon type, were masoned prior to the earthquake, but have not been plastered and fastened to the ceilings, and as a result they have been demolished, whereas the plastered ones have detached with a gap of 0,5 cm from the panels. There are also cracks on the connections at the staircase flights and the floor panels at the treenails on the first floors. Cracks on walls and floor panels as a result of the earthquake have not been ascertained.

In the first experimental large-panel building in Sofia (192 N. Tsankov Str.), built in 1958, there are no cracks or damages. The performed inspection of the first residential complex with large-panel buildings "Tolstoy" shows that the panels prepared on site have no cracks or damages, except for slight cracks in the staircases. In some buildings there are slight cracks in the places of the connections.

The good behavior of the large-panel construction during the 1977 earthquake led to the idea of serial panel construction with increased number of floors. This however should not happen without the necessary experimental examinations of reinforced connections and treenails, as well as natural examinations following an approved program in 2 – 3 test buildings.

Buildings with lift-slabs (LS). Immediately after the earthquake specialists from the Bulgarian Academy of Sciences visited the affected regions. They surveyed buildings executed with the LS method, and here we note the sites, which have received the most severe defects. The buildings are divided in to two groups. The first group includes the buildings in towns and settlements, which according to the Rules of construction in earthquake regions of 1964 are in non-seismic regions and have not been calculated against earthquakes (Svishtov, Dulovo, Dve Mogili, Pleven, Ruse, Sevlievo, Knezha, Kozloduy, etc.).

The seismic intensity in Svishtov is up to VII and partially up to VIII degree. To the east of the completely demolished 11-floor monolithic building there is a complex of four 8-floor and five 5-floor buildings with LS. The distance of these flats to the demolished buildings is from 100 to 500 m.

The 8-floor buildings have a reinforced concrete staircase cell executed with a creeping casing. The floors are shifted in height at 1/2 floor in both ends of the staircase flights. The reinforced concrete slabs do not cover the staircase, but are pushed against it. The buildings have not been calculated for earthquake impacts.

One of the 8-floor flats has severely cracked 25-centimeter exterior joints, opened by several centimeters, along the diagonal of the barrier walls. Some of the bricks, mainly of effective ceramics (fours), are completely demolished. The reinforced concrete cell has horizontal cracks under the platforms (where the technological joints of the creeping casing were probably located), as well as cracked beams above the doors of the cell. There is no disruption of the connection column – slab. A substantial part of the energy of the earthquake impact was absorbed by the 25-centimeter brick walls between the columns, which have served as vertical discs. The joints between the slabs and the staircase cell have hairline cracks. One of the facades has cracks going through the console formation of the slabs. The frame of the building is not damaged. The staircase cell is fit for operation. Such cracks, but with smaller sizes and less in number, can be found in another 8-floor building. The other three buildings have survived the earthquake without significant damages.

At approximately 100 m from the demolished monolithic building there is an 8-floor building under construction. Its architectural-planning solution is similar to the other 8-floor buildings. The entrances of the apartments are from the two platforms of the staircase. The construction has a reinforced concrete cell executed with a creeping casing and reinforced concrete discs between the columns.

3.1.2. Technological equipment

The security of the technological equipment during earthquakes constitutes a serious problem in view of the normal operation of the large-scale industrial enterprises (TPP, NPP, chemical plants, etc.). The damage and destruction of steam, gas and electricity plants can lead to fires, explosions and poisonings.

As a result of incorrect connection of the steam boilers with the carrying construction in some TPP the freight elevator shafts at the boilers are demolished. The adjacent reinforced concrete columns of the carrying construction are also damaged.

The earthquake inflicted severe damages to the equipment of the electricity substations. In substation Moesia, G. Oryahovitsa, Ruse-Center, Alfatar, Tutrakan, Ruse-1 and Svishtov there are broken isolators for voltage 110 and 220 kV, and cathode drain lines. One transformer in substation Moesia has turned around due to insufficient anchoring, and another one in substation Polski Trambesh has tilted and damaged the adjacent installations.

The earthquake has not inflicted any damages to distribution lines of all voltage ratings, as well as in the cable power lines. This is explained by the great elasticity of the distribution lines and the good dimensioning of the top of the columns. Damages are inflicted only to the high voltage grids. In most cases there are torn conductors due to mechanical tension and sometimes due to short circuit caused by their asynchronous swinging.

4. Social and mental consequences from the earthquake

4.1. Behavior of the population

The 1977 earthquake had an effect on a very large ground area. The strong seismic effect inflicted quite a lot of material and moral damages. They attract the interest of specialists and become the reason for a search for means of preservation of the modern material and spiritual culture of mankind against future earthquakes. While the damages in the field of material culture are subject to restoration, reconstruction and renovation, the damages in the field of human mentality are hard to heal and still not too well examined. The atmosphere of insecurity established after the earthquake showed that anti-seismic preparation in our country was not conducted, regardless of the fact that Bulgaria is located in one of the active seismic girdles of the Earth.

Since during the earthquake the seismic devices in Bulgaria have gone out of order, the earthquake is practically left without a "seismic biography" in the annals of the scientific specialists. Its power and destructive effect in the material and spiritual field can be judged by practical observations, conclusions and summarizations on the grounds of the collected oral and written information from the population, as well as the opinions of specialists who have visited the affected places in the country.

The interviews with workers and specialists from NPP Kozloduy and the town on March 8, 1977 show the conscientious, even heroic behavior of the on-duty teams during the earthquake.

An opinion of one of the engineers: "There was no panic in the plant. But it's good that we forget about these natural disasters! Otherwise we would live with the terrible memories, when the ground was shaking." One of the workers shared: "We felt a very strong quake. We pulled ourselves together after the shaking, we ran outside, we left the women and children on the street and ran towards NPP. Our coast is on a rock. We were shaking together with the ground, but it's good that the plant and the nuclear reactor did not suffer damages. I think that if the three buildings in Svishtov had not gone down, the damages from the earthquake everywhere in the country would have been similar, without human lives lost."

The people have calmed down after the disaster they experienced. They talk with concern about NPP, where they work. The main equipment of the plant is in a stable condition. The reactor and the pipelines are in a good working condition. The rescue works are also running well, the state of the citizens of Kozloduy and the workers at the plant is getting better. The damages inflicted on the residential buildings and the industrial plants in the town and the county are being repaired. The chimney of the plant has a deviation of approximately 2,60 m along the ellipse. Only a few minutes after the beginning of the quake all people were back at their workstations. The on-duty teams, which did not leave their workstations at all, ensured the stable operation of the devices and did not deprive the country of lighting and energy in this critical moment.

An opinion of the chief engineer of NPP: "The behavior of the on-duty teams during the quake was really heroic. These are people who overcame the initial fear of the unexpected disaster, did not run outside, but stayed at the electronic panels and continued their work in the interest of the order, which was needed in this situation."

Liliya G. Furlinska from the Production-Technical department shared: "After the quake we arrived at the plant. Those who were on duty had turned off one of the reactors and the other one was intentionally left on, in order to provide electricity and lighting in the country. During the next half hour absolutely all Bulgarian and Russian specialists arrived at their workstations."

Vladimir Berov, senior engineer, operator of the reactor: "I was on duty on Friday night. I've been working here since 1972. I was sitting and suddenly I felt as if I was kicked in the back. Then I felt a very strong earthquake. During the next few seconds the four workers on duty in the room waited to see if the ground will continue to shake. My thought was – I hope we can save some of the equipment! I am responsible for the reactor and its operation!"

Ivan Petrashev: "I was the on-duty engineer that night. When the quake began, I decided that the instructions say – if we cannot control the reactor, we must stop it."

A collective opinion of residents of Kozloduy (March 7, 1977): "During the quake due to the fear we were united. But after some time these feelings will fade away. It is very important what place in this process will be taken by the leader – as an authority, a personality and a public figure. During disasters people need a leader to give them courage, to unite them and to show them how to overcome the disaster."

On March 7 eng. Yanka Yankova from department "Construction and Architecture" of ONS – Svishtov shared: "The restoration of the material damages caused by the earthquake requires a lot of funds. All residents living in flats built according to the lift-slab method have moved out. The chairman of ONS issued an order against the dissemination of harmful rumors. The horror personally for me was greater when I realized that there are demolished flats around us and that we could have been among the deceased."

In the center of Svishtov there are posters – a call to fight against the harmful rumor that on March 7 as a result of a failure in the pipeline network of the chemical plant "Sviloza" a poisonous gas has been released and is nearing the town. The residents are in panic – this leads to a mass withdrawal of over 3000 people beyond the limits of the town. There are injured and distressed people.

According to the opinion of witnesses passing through a hostel of the chemical plant on March 4, 1977 at about 21:23 hrs it began to turn around its axis, it sunk and then was demolished. The evening of March 7, when we visited the place, the clearing was still ongoing. It was expected that the next day there would be many victims found, because only the ruins of the lowest floors were left, where most of the running people had reached.

4.2. Mentality in the moments of the quake.

The effect of the earthquake on the mentality of the people is not comparable to any material damages. It is too difficult to determine the amplitude of the mental manifestations in the conditions of the earthquake and especially after it. The question arises – why during an earthquake, which sometimes may not occur even once in the lifetime of a person, the horror of death is greater than its everyday presence in road accidents, which only for a few months take the lives of much more people than in an earthquake, and it's interesting why in the moment of the quake a person reacts decisively and quickly regardless of the surprise of the disaster, in order to save the life of his relatives and his own life, and after the fading of the natural disaster some of the people are obsessed with feelings of doom, anxiety and insecurity. How long do these psychological phenomena leave a mark in the soul of a person, is he protected from the surprise of a new psychological intervention, from the consequences of the mental distress suffered during the quake? What is the interaction of the personality and of the social groups in their behavior during and after the extreme situation?

The general thing in the behavior of an individual person and of a group of people during an earthquake is that the personality falls under the impact of strong and unexpected irritants, with regard to which there is no gathered experience. The unclear, unusual, tense psychological situation, filled with horror, uncertainty and fear of death, causes a total influence on the person. Not everyone could orientate properly, take a decision and find the successful outcome of the disaster. In such a dramatic situation, in which nature unexpectedly attacks the personality, there is a verification of the specific social roles, a revaluation of the values. The situation, which arises upon an earthquake, is most significant in an existential sense for the person – for a brief period of time, surprisingly and dramatically the personality can be attacked by various disasters, death being the greatest among them. The earthquake as a mental notion in the soul of a person is sometimes even scarier than in reality. In this case nature plays the role of a powerful, unknown and monstrous extreme, in the clutches of which the human life loses its meaning. The only means of fighting

against this feeling is the overall experience of the person, the scientific knowledge and the social experience.
The common mental stress in our country after the quake on March 4, 1977 is also due to the fact that after 1928 there is a relatively quiet period with regard to the seismicity of the region. The shock was incredibly powerful in the affected areas around the Danube River, where the earthquake has occurred at VII and VIII degree as per the MSK scale, and particularly in regions with demolished buildings and victims. The reason for this shock objectively are the considerable movements of the earth, the big deformations and movements of the buildings, the occurrence of rumbling, creaking, alarming sounds and roll, the observed shining in the atmosphere, the interruption of the electricity, the lightings from short circuits in the grid, the falling of heavy objects, the difficulty to retain balance, the outburst of fires, the cracking of walls, the falling of chimneys, etc. The people, who at this moment were on the higher floors, have experienced the quake in a more severe psychological degree. These people (particularly in the new complexes) get the illusion that the buildings are shaking with amplitude of about 1 m. The instinct for self-preservation and protection of the kids forces the people to go out in their underwear, barefoot, others take their cars and go outside of town, others start walking towards their villas or stop near the field. In public places (cinema, theater, holiday halls) the sense of responsibility towards yourself has contributed to the establishment of a calmer atmosphere for quick evacuation without panic.
The earthquake brings up questions related to the pathopsychology of a man. The quake inflicts transitory changes in the human brain and consciousness, on account of which we can talk about the onset of stress. Such moments are marked by the question of the power of the human will, the freedom to act, the overcoming of external and internal obstacles, which have occurred suddenly. This is a significant problem for the personal, as well as for the collective will and for the interaction between them. The tragedy brings out the respect in people, but this is passing respect. In Svishtov most of the victims were found on the stairs, while they were running. The mass multi-floor construction, the alienation of the man from the earth causes a progression of the fear. During an earthquake the fear is all-consuming and thus practically uncontrollable. It is in the basis of all mental phenomena related to the moment of the earthquake and after it – the fear before the unknown. All other phenomena in the soul of every individual person and of the social groups related to the earthquake depend on the mutual relation of the fear and the will of the person. Since the earthquake is over in just a few seconds, people are not able to make sense of the event, to gather experience in the struggle with it and to take a decision. Therefore the idea of the disaster comes after, when the actual danger has passed. The idea of the disaster is usually an illusion, greatly exaggerated, close to the dimensions of science fiction. The tragedy has passed through the mentality of all people and therefore it is common, but everyone wants to be understood, heard and calmed by the others. That's why the personal problem of the stress becomes public. Through the pathological idea of the disaster people are relieved of the horror they have experienced, they allocate their fear, their anxieties and their insecurity to the others. The duration of this process depends of the personal characteristics of the individual people. The more sensitive ones need more time, and the people with a more rational mind undertake the line of stable behavior in a shorter period of time.
After such a natural shock the mentality does not change in an obvious manner for a long period of time, because the upbringing, the intelligence and the culture play a decisive role. The tragedy fades away, but the idea of the instincts manifested during the earthquake remains alive for a long time. As the disaster is mass and individual, so the reassessment of the values is mass and individual. The reassessment of the values is the closest phenomenon, which occurs after the stress fades away. The experience from the twenty or thirty seconds of the earthquake is equal in power to hundreds of read pages and hundreds of days lived. There arises a pseudo-new idea of the meaning of life, of its purposes. Under the effect of the natural shock and the feat of the unknown (the fear of this event happening again) the personality tries to cope with negative emotions, which underline the senselessness of human life and the helplessness before nature.
4.3. Personal behavior in the common misfortune
Reflection in the consciousness. Upon the perception of the earthquake for every person there are common mental regularities acting through the common property of each living matter – sensuousness. Through the sensuousness the external energy of the earthquake has become a fact for the consciousness. Regardless of whether the earthquake has been perceived by different people in a different manner – some perceive it first with their hearing organs, others have first felt the shaking of the ground or the floor under their feet, others have observed the falling of objects or the vibrations of the walls, etc. Sometimes the first impressions of the disaster are "underground rumbling", "a sense of sinking", "passing of waves through the streets", "blue light", etc. The reflection of the earthquake is a prejudiced, subjective reflection of a specific person. For example a villager from Gorna Studena, county of Veliko Tarnovo, tells this story: "As if a big tractor was ploughing outside. At first I thought that it is passing through the street. Then the ground under my feet started to shake. I called my wife and we ran to the courtyard. I was telling her – get away from there, it's an earthquake! I lost balance and fell to the ground. At this moment the chimney of the house also fell." A four-year-old girl in the embrace of her grandmother cried: "Granny, are we dying?" Therefore it is necessary to consider the specific satiation of perception of the earthquake. The main question, which people were asking after the earthquake on March 4, was: "Where were you during the earthquake?" The question is not a random one, because on the grounds of the known activity from the human experience the personality is trying to orientate in the arising extreme situation. A group of viewers in a dark cinema hall are telling this story: "Somebody shouted "What is this?", and we all listened. Suddenly the people in the hall started to look around. There were exclamations "Something is happening!" and we all jumped out of our chairs." In the moment of the earthquake the personality is looking for a symptom of definiteness, which could give information on what is happening. Two young people in the street are asking the questions: "Who is playing with the trees? Who is playing with the house?"
The next mental stage of perception of the reception of a signal, some information about the natural disaster, which depends on the specific occupation of the personality in that moment. A 24-year-old man is relating: "Suddenly the

house started shaking, the windows started banging. I thought that someone is banging outside, but then the house started rocking. In the next moment I noticed that the chandelier was swinging, the walls were moving and the pictures started falling down one by one. I heard a whizzing from the outside, as if airplanes were passing by." After the reception of information about the disaster the personality comes out of the state of indefiniteness and starts to make unusual ascertainments about the disaster. For the specific situation everything is particular – the rumble, the noise, the loss of balance, the squeaking of the panels, the walls, the falling of objects. In the situation of the earthquake the bearers of the same information have different characteristics – from the slight shaking of the bed to the demolition of an entire residential flat. The final answer of the question "What is this?" in the moment of the earthquake is a complex intellectual activity of the personality. After the person experiences and assesses the situation, he asks the question "What should I do?" in the onset disaster. The extreme of the earthquake determines a very high intellectual and emotional tension in the course of the time needed to take a decision. The moment of assessment, which the fateful decision depends on, determines the behavior after that. Many people "do not know", "ask themselves" or "do not remember" how they found themselves amongst a group of running people. These cases can be explained by the great power of the energetic impact of the quake and the minimum term for taking a deliberate decision.

The behavior. As one of the most unexpected and unusual in its complexity and power irritants the earthquakes brings the nervous system of the personality to the ultimate level of excitation. Increased sensitivity accompanies the person for a long time after the disaster has faded. Any noise similar to the banging of windows, the cracking of walls or the noise of an airplane, the slightest loss of balance is enough to bring the nervous system in a state of anxiousness and excitation. Another peculiarity of the need to transfer information, sometimes even false information, which creates panic. For example the situation of mass panic, which spread in Svishtov on March 7 in relation to the false rumor about the release of a poisonous gas from the chemical plant. The information about the false danger spreads with a lightning speed. Random residents warn by phone kindergartens, hospitals, schools. Random drivers alarm the neighboring villages and the region around Svishtov. This is not an ordinary need for communication; this is a need of very complex social dimensions – the sense of duty, of responsibility to the family, to the public. The amplitudes of response during this extreme situation are too complicated – from the fear and horror to the heroism, from the complete desperation to the mobilization of the will of the personality.

The human actions during the earthquake are multiform, but nevertheless they have common characteristics, which are the most widespread and therefore the most impressive for the human behavior. The quake in the labyrinths of mentality assumes very interesting and varied reflections. The personality in a non-standard situation – the choice of behavior, the taking of a decision and the actions during the natural extreme – create a basis for psychological variety, for stimulation of the moral values, for reassessment of life. Not for nothing some of the people inquired told that this was a "man-quake", not an earthquake. Therefore during the quake there were individual and group forms of behavior with great variety. Adequate is that, which corresponds to the requirements, established by the extreme situation before the personality or before the group of people. The inadequate behavior is related to passive, panic characteristics, in some cases unexplainable even by the person who performs them.

It is not a coincidence that panic together with fear is the most characteristic moment in the behavior of the personality or the group of people during natural disasters. It is not always the most widespread phenomenon, but it is the most impressively related to the experienced horror. The mass panic during the quake was too weak compared to the panic created just after the disaster (the rumor of a poisonous gas in Svishtov). During the disaster there are almost no registered cases of breaking-up of interpersonal relations.

The mental states of anxious tension are very favorable for the lightning spreading of rumors and panic. In this situation the mass media plays a very important role, the value of its authenticity and the range of its influence increase. During the quake and six months after that the most current and valued information was related to the earthquake. The panic stress states cover people in an instant, they spread with a lightning speed and sometimes there are even cases of self-suggestion of false danger. An employee of the Ministry of Interior – Svishtov stated: "Most of the people were holding a handkerchief in front of their noses, because they thought they smelled gas. But on this date the wind was blowing in the other direction of the plant and none of the residents noticed that. Many people requested first aid because they thought they were gassed…" The case of the mass panic in Svishtov on March 7 is related mostly with the illusory perception of the situation. The mass panic during an earthquake poses a series of problems related to the regulation of the behavior of groups of people under the conditions of a critical situation and the period of its fading.

During the earthquake on March 4 the adaptive, adequate behavior was the most observed. Its description includes the following elements: "I saw a movement, I heard noises, I felt shaking, I understood what was happening, I quickly went outside." In these cases there is hardly any horror or fear, because most of the people have had previous experience (mainly older people who have memories from previous earthquakes).

One of the most stable and mass reactions during the quake is the initiative behavior. The initiative person first identifies the disaster amongst the overall silence, which not always expresses misunderstanding, but rather fear and horror; he calls for action, coordinated, instructs, commands, and when necessary, intervenes physically. The greatest manifestations of initiative behavior are related to immediate rendering of help during the quake and after it, sometimes with the risk of your own health and security. These cases are widespread and present the personality not only as emotionally stable, but most of all as a socialistic personality with a high sense of responsibility.

Dominating mental states of the spirit. They are directly dependant on the degree of tension and the domination of one or another component of the critical situation. One of the characteristic manifestations during and after the earthquake is the disorganization of the personality. Here's the story of a man who lives in the immediate vicinity of one of the completely demolished residential flats in Svishtov: "I live on the sixth floor, I was standing at the window and saw the sinking of the adjacent flat into the ground. I immediately understood what was happening, I took the kids and decided to go out of the apartment. At this moment my neighbors from the opposite apartment tried to grab my kids by force. After I defended myself, they still managed to grab something – my coat, and immediately ran outside.” The mass fear is a predominant mental reaction amongst people during the quake. The strong phase of fear dominates: “I could not move”; “I was running without direction”; “I was afraid of a second earthquake”, etc. The elimination of this state from the spirit of the person takes a short or a longer period of time. Hours after the quake people were still sharing that they felt as if the ground beneath them was shaking. Sometimes the fear effect transforms into anger and aggressiveness – pushing away the people who are trying to calm you down, not believing that the danger has passed. The apprehension is a dominating mental state for the individual person, as well as for a group of people after the fading of the quake. Despite the scientific forecasts that the quake will not be repeated, the dissemination of the rumor that on March 11 there will be another earthquake was accepted as true. On March 11 in the evening the streets of some towns were again filled with people who feared a second earthquake.

The various negative mental states are also characteristic of the post-critical situation. Anxiety, which transitions into increased contact between the people as a peculiar form of relief of internal stress. The mass behavior in the various cases shows that the interpersonal relations in the period after the earthquake were extremely dynamic. The earthquake was a reason and topic of discussion – you could talk to anybody, knock on every door, in a private home or in a public institution. As a clearly expressed socially-psychological phenomenon the anxiety was the most widespread dominant in the state of the individual person and of the masses. The anxiety was defense against the last attacks of the experienced fear. The common disaster had monopoly over the feelings of the people who were facing the danger. Philosophic concepts were dominating the conversations about the perception of the event. Some of these summarizing opinions are: “I still cannot believe that a person can be so helpless. I am 20 years old and just now I understood the value of life. I feel an unusual goodness inside me. I started to look inside myself. Now I understand that I should not pay attention to the small problems and conflicts”, etc.

The mental state of mass grief was too clearly distinguished. The death and misfortune, which overtook us during the earthquake, are too different from the death by illness, old age or car accident. The natural disaster is perceived as a chance, uncontrollable by humans and therefore the death caused by it is perceived as unfair, especially for the children. The equal possibility for everyone to be among the dead also causes strongly negative mental states.

As a form of danger, which comes very unexpectedly, the quake “unmasked” the spirit of the individual personality or of the mass mentality. In the ordinary, everyday life a person can mask some of his negative qualities. This however is very difficult in extreme situations, as was the earthquake. In such situations the instinct for self-preservation acts first and the personality sometimes does things it should not be doing (chaotic and disorderly action), and in other cases it acts in the most reasonable and expedient manner. In this sense the earthquake can be viewed as one of the most certain, truthful and deep indicators for examination of the unmasked human spirit. After such a violent natural experiment the strong personalities rethink the experience, and quickly go back to their normal life. From a psychological point of view the effect of the earthquake on the spirit also has a positive effect – a reason for regulation, mastering your personal behavior, tempering the character and the strength of the will.

4.4. Intimate behavior in the common misfortune

The intimacy of every person includes the relation to the deeply personal, valuable and known things. In this sense the earthquake from March 4, 1977 can be defined as a monstrous intervention in the deepest, most intimate layers of the mentality of a person. The strongest impact was on the marital-family relations.

More than 85% of the people examined in Svishtov indicated the saving of the children as the first reaction during the disaster. A tragic confirmation of this is the pose of the bodies of the fathers who were found in the ruins of the two demolished residential flats in Svishtov. The bodies of the parents were disfigured, while the bodies of the children – comparatively preserved. Particularly tragic is the case with M.P. who died while covering his child with his body, while it was sleeping in bed. A series of signs (still wet and matted hair and body covered by dust) show that the father has run from the bathroom, in order to save his child.

The love towards our children and our readiness to sacrifice ourselves in the event of a natural disaster are marked very strongly. Moreover – the known fetishizaiton of children’s things found in the ruins (toys, clothes, shoes) has a shocking effect on most of the people present at the clearing of the demolished flats in Svishtov. Usually the mothers identify the body of the child the quickest with external expressions of mental emotions, the fathers try not to show their feeling of tragedy, but their state is usually accompanied by the tense and dramatic silence, which sometimes ends with feeling unwell or fainting.

The intimate relation of the children towards the parents during the disaster is also a mental feature of the experienced tragedy. A series of cases of intimate relation between parents and children uncover an extremely complex spectrum of moral and mental manifestations of the personality of our contemporary. The symbolic place occupied by the children in the life of their parents is so deep and strong that the loss of your own life loses ground to the idea of losing the life of the children.

The self-sacrifice of the parents, the particular feeling of guilt when they have been away from their children during the disaster, and the self-approval of the parental personality are interrelated mental phenomena in the intimate spectrum of the experiences of the parents. A series of examples during the earthquake prove that the actual value of the loving relation towards the children, towards the friends, towards the people who have been affected by the accident is the striving for hope, wellbeing, and happiness for those who we love. In essence love is always a positive and active motive of the human mentality. It manifests not only as a desire, but also as readiness, and often as self-sacrifice for the people closest to us. Therefore in the night after the earthquake there were mass manifestations of risk for your own life directed mainly at the good of the people. Exceptional examples of this behavior, a combination between the human and the official duty, with bright humane feelings were observed everywhere in the country, particularly in Svishtov. The behavior of the employees of the Ministry of Interior, Civil Defense, the municipality and especially the behavior of the medical personnel of the district hospital in Svishtov was led by high moral and ethical motives. In the first minutes after the earthquake an Operative Staff is established, which constantly, day and night struggles and coordinates the operations on rescuing the victims. One of the bulletins of the Operative Staff says: "Without being called, all medical personnel arrived at the hospital. Only five were missing – they were buried under the ruins."

Besides between parents and children, strong mental feelings of affection, love, self-sacrifice were manifested between the spouses during the disaster. In one of those cases a father, the only survivor of a family of four, develops a severe mental reaction with a marked tendency towards suicide. Particularly tragic are those cases of unbearable grief when the marital relations in a family have been normal. And in cases of marital depressions and conflicts the quake affects the stability or the final break-up between man and woman. The loss of the wide, with who the man has been in unbearable relations, many times subjected to experiments for living together and with several divorce cases, causes the man to feel an incredible feeling of guilt and manifestation of a guilty conscience for the unhappy marital life before the disaster. The man is mentally broken by the loss of his wife.

The psychology of intimate relations during a disaster also includes the relations between grown-up sons and daughters and elderly parents. In the first hours after the quake the telephone network in the country was flooded by an information wave – children were interested how their parents were feeling; they wanted to hear their voices. The telephone network was overloaded and was unable to overcome the communication boom related to the thesis "I want to hear their voice, this means they are alive and well!" But there are also cases of negative relation towards elderly people – while running to the outside some of them were forgotten in the homes.

During the earthquake and after it the people represented a very large family with identical thoughts and feelings, and readiness for mutual support. But in the conditions after the earthquake the social measure between the moral duty, conscience and honor in several cases was overtaken by a certain form of fanaticism.

But the predominant positive manifestations and behavior during the disaster of individual persons or of groups of people show the social maturity and the moral responsibility of the personality of a socialistic type.

The earthquake was also a strong indicator of manifestations of negative nature, of primitive, amoral conduct. The most significant mark of these manifestations related to unceremonious selfishness was the marauding. Therefore the analysis of the conditions and the opportunity for marauding during a mass disaster are an important indicator of the moral of a society. The level of their manifestation is a very important social criterion for moral purity of the people. Therefore the reaction of the residents in Svishtov to the individual cases of marauding in the night after the earthquake is too symptomatic and characteristic. On the background of the mass suffering the public was ready to lynch, to get physical with the marauders. Only thanks to the call for discipline on behalf of the employees of the Ministry of Interior the marauders were saved from public judgment and physical retribution.

4.5. Mental phenomena after the disaster

The connection between the physical characteristics of the earthquake and the scales of its mental consequences is obvious. The mental stress in the post-critical situation is caused and maintained by the objective consequences of the natural shock that affected a wide range of values in the personal and public life. Usually the number of the victims or the amount of destruction could not characterize the actual destructive power of the earthquake. In the situation of the earthquake the tragedy of the victims is perceived much more strongly because it is the result of an inevitable, sudden, uncontrollable natural disaster. The experience in the moment of the earthquake leaves reflections and accumulation of mental shock in the mentality after the disaster. The fading of the mental stress takes a much longer period, sometimes months, even years. Some people shared their feeling that "mankind is dying". The mental stress during the quake is characterized by high emotional amplitude, but in a mental aspect its power is greatly reduced.

Under the effect of the realized fear the mental ideas of the disaster and the memory of the earthquake in the post-critical situation a process of inadequate and unstable behavior develops, which often changes its characteristics – from strong emotional expression to depression, indifference, grief. In such a state a person is demoralized, expecting a new unknown danger of an earthquake. The memory of the disaster clears up, takes up a predominant part of the conscientious action, the relations with other people are subjected to the total topic "do you remember how it was, I don't feel like doing anything, what's the point now!" The tension after the earthquake is a permanent mental state up to the moment when the personality gradually starts to lose interest in its own memories, insinuations and ideas of the disaster. A woman at the age of 25 shared: "I live in constant terror and this is preventing me from thinking normally during the whole day."

The extremely powerful stress agents of the quake determinate in the post-critical situation mainly through the ideas in the mind of the person. He begins to search, to orientate towards the physical and social parameters of the living environment. A woman at the age of 36 says: "Now I think that in the town, with its tall buildings, the chances for survival upon a new earthquake are very small." A person may think that the flat, where he lives, is too tall, the stairs are too narrow, when the tram passes by the walls start to shake, etc. The people felt a mass desire to live "closer to the ground". Under the effect of the fearful tension a series of conditions of the environment, where a person lives, become symbols of a new danger. "I feel terror every time I have to go home on the sixth floor" – says a middle-aged woman.

In the post-critical situation there is a particularly strong feeling of anxious expectation. It is a result of the shifted and incorrect assessment of the objective reality in the mind of a person. The roles of fantasy and insinuation prevail. A person does not fear reality anymore, he fears the expected dangers of the future in hyperbolized fantastical images. A woman at the age of 32 shared: "I frequently imagined how the town would look like after a strong earthquake. Sometimes I even dream of this picture and after that I feel depressed the whole day." The fear is shifted by the immediate danger in the moment of the disaster towards the threat of the unknown nature of the future. The fear transitions into anxiety with regard to the perspectives, which arise on the grounds of the fantasy and the insinuation from the experienced event. Particularly characteristic in these cases is the decreased critical attitude of thinking, as a result of which there is a serious vacuum in the actual assessments and choices of behavior of the person. In the situation of anxiety the papers published a certain amount of information about small earthquakes in various countries near Bulgaria – Greece, Turkey, Iran, etc. In other cases this information would have been perceived as something normal, but then the comments were that "something is going to happen!".

After the disaster the personality enriches and rationalizes itself and its life much more deeply and forms a new behavior for protection of its values. The anxiety in many cases becomes the reason for searching of an exit from the critical situation. Furthermore, the state of the post-critical situation broadens the range of personal experiences. The changes in relations between people, the created mental vacuum in the minds of the person, the lack of personal experience in emergency situations are reasons for dissemination of various rumors.

The rumor is a phenomenon, which includes in itself complex mental components. It may become the reason for panic behavior and negative human manifestations. They also constitute an interest for the social psychology, because in the conditions of an extreme situation and especially after it they could overtake the function of the official sources of information, to decrease the "conjuncture" of the communications and the sense of trust towards the media. The rumor is most of all a piece of news which must fill the mental vacuum in the mind of the person after the quake, and as a fabrication it disorganizes the social life, maintains the fearful tension.

Rumors can be various, but during the quake they were predominantly two types – some ascertained what had happened, others forecasted what could happen in the future. For example: "The entire town of Svishtov is destroyed! On March 11 there will be another earthquake – exactly at 9:20 hrs!" The first type of rumors "supplement" the content of the emotional experience, the second type of rumors amplify the anxiety, the sense of doom. The rumor is started by somebody, supplemented by various carriers and is designated for mass consumption. The rumor does not have a specific author, but it is always presented as coming from a specific source.

In the conditions of information "hunger" in the post-critical situation many people directed their interests exactly towards the topic of earthquakes. Our newspapers and magazines published a series of materials in this field. The Bulgarian television also presented some information. But the overall impression was that the mass media covered the matters, which interested the people in the country, in a restrained manner and sometimes with great delay. Therefore in post-critical situations the problem for regulation of the social behavior is particularly serious. The personal and social responsibility of the individual person and of the community in such a situation enhances its role. A good example of high virtue in such cases is the assumption of personal responsibility and risk without looking for social recognition. Such an example is the struggle for saving the lives of D.L. buried beneath the ruins in Svishtov – more than ten hours eng. Velchev, corporal Kazanov and private Todorov were working under a concrete slab, which could crumble over them at any moment.

4.6. Conclusions

The mass media played a very important role for the mental state of the population during and after the earthquake. The disadvantage of this information was that it gave hastened conclusions and incorrect statements. The tragedy of entire countries was concisely suppressed and the mass heroism manifested on that day was announced just as a campaign, without personification of the participants. If the press and the television had competent and timely reports, information from the place of the event, photographs from the restorative works, interviews and opinions of more specialists, the "anti-seismic" feeling among the people would have been more stable despite the stress after the quake.

It is not impossible to be surprised again by analogous or similar natural disasters in the future. Therefore it is necessary to think about preparation, information and training of the population. At every spontaneous natural disaster the citizens need to remain calm, not to panic and to act with organization. Upon feeling the first signs of the earthquake the citizens must not leave the building in panic, but rather stay in the safest place, which is presumed to be near one of the interior walls of the construction or in an interior corridor, away from windows and exterior walls. After the passing of the first quake, all heaters, lighting fixtures, television sets and gas installations must be switched off; just take the most important things and personal documents and immediately leave the buildings. The home must be locked, the exit should be through the stairs (not the elevator) and the people must go to a safe distance away from the buildings. You must avoid standing under power lines, tram and trolley lines, and the movement should be along the middle of the streets. People in public places (cinemas, theaters, saloons) must remain calm and leave the buildings without panic. Priority must be given to the women and children. Specialists – physicians, engineers, workers, materially liable persons and others, who are on duty, must leave their workstations only upon instruction. During the earthquake the personal vehicles must not be left on the road lane, in order not to congest the road arteries. After the fading of the earthquake the return to the workstations and the homes may resume only after an announcement by the competent bodies. In order to prevent epidemics water from water sources can be consumed after permission from the competent bodies. The entry in buildings must be done with extreme care due to the danger of collapsing. Do not go in with torches, lanterns or lit cigarettes in gasified buildings. After the fading of the disaster the citizens should inform their relatives of their state.

The most important thing is to remain calm and to manifest the necessary moral and life qualities of the citizens and the control bodies, in order to prevent the direct, as well as the consequential damages from the spontaneous natural disasters.

Special thought could be given to the organization of joint courses or groups in qualification for anti-seismic preparation of the citizens. The public organizations in our country together with Civil Protection and other bodies are bound to undertake the necessary measures for that. The 1977 earthquake must be used for overall information activity amongst the community, for establishment of "anti-seismic confidence" and education of the people, in order to manifest greater stability of the mind and enhanced readiness in case of future earthquakes.

5. Earthquake training of the students and the population in Bulgaria

Since the main goal of the project is the dissemination of earthquake training amongst the students and the population,

it is expedient to present data about the state in this field in Bulgaria and the connection with the 1977 earthquake. The previous sections indicate the impact of the earthquake with epicenter Vrancea from March 3, 1997 on the territory of Bulgaria and the effect it had on thecrisis management system, and particularly on risk prevention training.
Until 1977 the Bulgarian schools did not offer training in prevention of natural and technological risks. There was only training for military times – protection against nuclear weapons. The subject was called "Primary military training" and had regular classes in 2nd, 3rd, 4th, 8th, 9th and 10th grade. The teachers were officers from the army reserve. After the 1977 earthquake, the programs included classes in natural risks prevention in 4th, 8th and 9th grade. The preparation of population was implemented by workplace and residence following a special program of Civil Defense, which in practice was not implemented at all and was just accounted for.
Later the European Center in Sofia conducted an international survey and it turned out that there was hardly any experience in the field of training at school level in the other countries, with the exception of West Germany. On account of that Bulgaria was following the path of the regular classes, traditional for the Bulgarian education. Textbooks and materials in Bulgaria and from abroad were scarce. People had to develop everything independently and, of course, it was based on military practice.
Immediately after the 1977 earthquake the Council of Ministers of Bulgaria established a Permanent Committee on population protection in case of disasters and failures with the task to eliminate the consequences. This was a new original form of extraordinary situations management, which had the purpose of unify all efforts – state, civil of science and culture. Such committees were later established in all "socialistic countries" and USSR and it was also transferred to California. Now similar structures (with different names) exist in almost all European countries.
The map of seismic division into districts in Bulgaria was immediately improved, which led to a change in the design, construction and control for almost the entire territory of the country.
Immediately after the 1977 earthquake, the Permanent Committee activated promptly and then maintained constantly all activities in Bulgaria related to the population protection and prevention: several political decisions were taken with regard to the implementation of protection training of population. Together with the introduction of the respective classes in the schools and with the purpose of covering the entire population with the training in the municipalities in 1978, people started to establish "Training centers on risk prevention", which were constantly operational and some of these centers still exist. This is an expedient form of preparation of the population, especially in districts, which could be affected by an Vrancea earthquakes.
After the initial stress due to the earthquake, enthusiasm gradually started to fade as prevention activities are very expensive. Only 10 years after the 1977 earthquake, after another destructive earthquake in 1986 in Strazhitsa, many of the activities started in 1977 were promoted. At that time almost every major municipality had a Training Center for risk prevention, specialized depending on the existing danger in the district.
The 1977 and 1986 earthquakes generated serious changes in the of anti-seismic construction rules in Bulgaria. The quality control of construction works was improved. This construction was actually tested and successfully passed the inspection in several districts after the earthquake in Pernik in June, 2012. After this last earthquake, people concluded that the combination between good anti-seismic construction and good earthquake training leads to a significant decrease in losses, especially human ones. Therefore our work and the results of this project are extremely important because it can summarize all good practices and disseminate them in the region.
Immediately after the major political changes in Bulgaria (1989), and based on the 1977 earthquake experience, Bulgarian schools introduced in 1992 a new subject "Protection in case of disasters" from 1st to 10th grade (in 47 classes) who also included classes in earthquake training and was later thematically enriched and modified. It should be noted that Russia started its training in this field mainly based on the Bulgarian experience in schools but now Russia is far ahead of us and can provide good practices.
Based on the 1977 earthquake experience, the European Centre for Risk Prevention Training at School Level (CSLT) was established in 1997 in Sofia as a EUR-OPA Agreement Centre, antecessor of today's European Center for Risk Prevention (ECRP). At that time Italy, France and Spain were against the establishment of such center with such tasks as they considered that such training was not necessary and resulted from a the totalitarian way of thinking.
The European Centre for Risk Prevention Training at School Level (CSLT) most significant international activities of this center were:
1997 Sofia – International Conference on "Training in the field of Risk Sciences at School Level" with the participation of 14 countries and 3 international organizations;
1998 Plovdiv – Second European Conference "Risk Prevention Education at School and Pre-school Level" with the participation of 14 countries and 2 international organizations;
2000 Sofia – "School communities and risk management" with the participation of 12 countries;
2000 International Workshop "Safety of Education Process and at the Workplace in the school building";
2002 Sofia – Work meeting "Risk Prevention Education at School Level" (Bulgaria, Italy, Cyprus) launches the project "BESAFENET";
2003 Sofia – Seminar "Disaster Awareness with the use internet" creates BeSafeNet center in Cyprus.
From 1997 to 2004 it conducted many activities within the former program FORM-OSE, with which it summarized the entire experience of the member-countries of EUR-OPA in the field of training at school level; the best practices were also summarized, which initiated the training in risk prevention at school and pre-school level in Europe, which up to that moment was not accepted.
The abovementioned information aims at indicating that within the agreement a lot of work has been done in the field of "culture of prevention against risks", but that work is scattered across the different centers:
- a set of 10 textbooks published in Russia;
- a series of games issued by the Ministry of Interior of Spain;

- a pedagogical briefcase of the Ministry of Environment of France;
- the practice of annual national campaigns in Finland;
- rendering first aid, including by children, in San Marino, Armenia, Bulgaria;
- the results of the EUR-OPA project MODEM-Risks based on the implementation of the concept "Campus Virtuel";
- the development by French Institute IFFO-RME and CERP of preventive measures in case of an earthquake and the introduction of two pedagogical means of primary and secondary education and of a training module based on the adapted model of the French National Plan for aid in a school building in case of a major disaster.

Based on this experience, the possible end result of this project can be the development of a national campaign (specific for every country affected by Vrancea earthquakes: Romania, Bulgaria, Moldova, Ukraine, as well as Greece and Cyprus) who can include the following package:

- General brief leaflet about the consequences of the earthquakes with epicenter Vrancea and their impact in the affected countries, rules of conduct and action in case of an earthquake (the initial text of this leaflet can be developed by the center in Bucharest based on the summaries from 2012 and in 2013 the text can be sent for opinions of students, journalists and specialists, after which it will be disseminated through the European Centers in each country – just like the work that the center in Kiev is doing now with regard to radiation);
- Directions for the use of BeSafenet in its part about earthquakes;
- Directions and pedagogical advices for the use of children's training simulators for earthquakes (Romania);
- Development of a scenario for radio transmission about the earthquakes in Vrancea and the impact in other countries with educational elements and inclusion of the opinions of people from affected regions in the respective country – with the option to use this scenario in each of the affected countries;
- Optional use of parts of the textbook "Earthquake Safety Programs for Schools" of the state of California (USA), issued by FEMA, with compulsory mentioning of the manners of fastening of furniture and other objects at home in the regions endangered by earthquakes, etc.;
- Summary and translation of various lessons and lectures on prevention of the risk of an earthquake for various age groups – from kindergarten to 10th grade;
- Explanatory material for the Training Centers for risk prevention in the Bulgarian municipalities.

The abovementioned example of a package is of course open for discussion and may be clarified in the course of our work. Based on our work now within the framework of this project, the European Center in Bucharest can make a list of the most important multimedia materials existing in the field of prevention of a Vrancea earthquake. Further thought can be given to holding a festival of films on the subject of prevention of such earthquake.

Used literature:

- Vrancea earthquake in 1977. It's after effects in the people's republic of Bulgaria , Publishing House of the Bulgarian Academy of Sciences, Sofia 1983
- Conclusions of European Activities of EUR-OPA
- Training-methodical teacher's guide on protection and self-defense in case of disasters, failures and catastrophes

RESULTS OBTAINED IN 2013

Working package 1 (prepared by ECBR):

Description:

Study of contents and dissemination means required for earthquake preparedness and education materials, to take into account the local conditions of Romania and comparison with experience of Greece and Cyprus.

Associated deliverables:

D 1 - Materials for earthquake education od students and citizens, to be posted on website of ECBR and dissemination of other materials.

D 2- Seminar with partners at ECBR Bucharest, validation and improvement according to experience of Greece and Cyprus.

Presently, in Romania, URBAN-INCERC, elaborated earthquake education materials by INCERC Bucharest Branch and ECBR contributed to the public transfer of knowledge for earthquake preparedness. Existing materials are:

- Website "INFORISX"-INCERC, the first website of a research institute with information on seismic risk and preparedness in Romania, with content entirely provided by scientific professionals in the field, was developed. The website, which is presently online and well-received by the public, is planned to be extended, revised and improved in the near future. The 4 booklets for earthquake education in schools, for 4 age and classes, endorsed officialy by ministers order, and available on line at INCERC Branch site. These booklets benefited of knowledge from Japan, in the framework of the JICA-NCSRR Project on Seismic Risk Reduction, 2002-2008. (Georgescu et al 2004, 2007).
- An English version of the website and these materials will be finalized in 2013, in the framework of the activities of the European Center for Building Rehabilitation, located in the premises of URBAN-INCERC, operated in the framework of the EUR-OPA Major Hazards Agreement network of European centers. It is important that we cannot vehiculate any kind of rules and all thse recommendations were carefully evaluated before endorsement and release.

ECBR and URBAN-INCERC staff accumulated a wide expertise in analysis of earthquake impacts on the physical and social fabric, in order to recommend the most reliable measures of protection. However, in the recent years, ECBR activities were mainly directed towards convincing urban owners of apartments to strengthening of high-rise reinforced concrete buildings of Bucharest, built before 1940 Vrancea earthquake, and labelled for seismic risk. Recently it became alarming that some very old low-rise masonry buildings of the historical center of Bucharest entered in touristic use and have a high degree of occupancy, although they are in precarious state.

It is well known the contradiction between the remarkable knowledge about the seismic risk and the attitude of owners - postponement of strengthening. But other social categories were identified also as important actors and factors in increasing or reducing seismic risk.

ECBR consider that there is a need of a more specialized approach, with new brochures, posters, video cassettes and spots including recommendations for earthquake preparedness and behaviour in case of tremor. For example, in earthquake protection of institutions, a number of aspects related to the disaster prevention measures must be evaluated, the earthquake response/reaction and recovery measures shall be conceived and solved.

Every citizen must show that he/she, as an employee or client of a public institution, is aware of the risk he/she is exposed to in case of a major earthquake, being able to answer to a number of questions related to the environment he/she might be at a particular time/ job place (thematic questionnaires). The availability of reliable publications on earthquake protection of the population in the public institutions shall be a part of the communication with the citizens and the mass-media.

In this respect, we must address two situations:

- areas exposed to Vrancea (subcrustal) earthquakes;
- areas exposed to crustal (shallow) earthquakes

Situation of areas exposed to Vrancea (subcrustal) earthquakes

Seismic conditions of Romania are dominated by strong earthquakes of intermediate depth in the Vrancea source. The existing buildings in Romania are affected by subcrustal earthquakes because their specific spectral composition is a reason of affecting the high structures. Although the 1940 and 1977 earthquakes were so damaging, it is difficult to judge the extent of public perception's contribution seismic risk mitigation attained to-date. In Bucharest, some hundreds of buildings have been rated as first class risk and tagged with a "Red Dot" warning at the building's entrance, out of which some 120 buildings are high-rise, but only a handful of these were strengthened.
The seismic risk perception in Romania is biased, because:

- The myth of Bucharest as the city at highest risk in Europe is not associated with a proper risk reduction strategy. The issue is understood mainly as a consequence of Vrancea proximity and not as a result of buildings vulnerability.
- Most owners of „High-risk buildings" seem passive to the legal request to provide strengthening, because of disturbances and financial implications, while market prices for apartments in such buildings are still convenient;
- The authorities make limited use of scenario studies for better preparedness;
- Recent earthquake damage experience is not sufficiently used in people's education for preparedness, instead media often host guests that spread cataclysmic views on earthquake risk not based on true-scientific facts;
- Some scientists and media are promoting the myth that a mass escape is feasible seconds before the earthquake waves arrive in Bucharest using the early warning system, but without considering the specific preparedness;
- Reversely, the officials and even some scientists feel „the duty" to calm-down people, although many are trully at risk.

There is a confusion between the recently devised NIEP system of early warning with some 30 seconds advance and the earthquake predictions claimed by various clarevoyants and pseudo-scientists. There are extensive media coverage of false predictions about the timing and effects of a coming great earthquake, as seismological issues, although difficult to be understood, are more attractive than engineering exaplanations.

In 2012, some false predictions about a "Big One", triggered by some small Vrancea earthquakes continued to cause public concern, while mass-media exacerbated the stress and rumors when conveying unreliable news about an imminent great earthquake. Such false predictions are propagated by low-standard media and thus attention has been focused on when would the next big event would happen, instead of what would be the consequences of such an event if we did little for risk mitigation.

Situation of areas exposed to crustal (shallow) earthquakes

The rationale for a new ECBR project, to cover also crustal earthquakes, is based on the recent crisis, covering a different situation. Starting with September 2013, a special crisis situation occurred in Galati County area, near

epicentral Vrancea source, where a swarm of small and shallow (crustal) earthquakes disturbed the life of several villages. The area tectonic basement has some well-known major faults, but country people and media suspected the local oil wells as a cause. In 2013 some floods affected the same villages. Since the number of small shocks reached over 300, and some Vrancea intermediate depth earthquakes occurred randomly, the crisis increased, but local authorities were not able to manage the social concern.
The prime minister and the minister of education asked a scientific survey. Specialized institutions, including URBAN-INCERC and ECBR studied the geotechnical parameters and damage patterns of buildings in villages Izvoarele and Schela. It was concluded that a small local fault was a reason of shocks, while the local ground conditions amplified the motions, but not with large damage. In November the swarm tended to decrease and eventually cease. This kind of swarm was a first case in recent history.
It was obvious that media coverage was a main reason of aggravating the crisis, because of debates about wrong defined issues and citizens need more correct information and education about natural hazards. Some TV interviews and seismic motion demonstrations with building models in ECBR Seismolab in in October and November 2013 contributed to a better information and education transmitted to population.
The crisis situation of Galati County has shown us that the scientist and authorities must address the earthquake protection not only for great shocks, but also for crustal shallow sources. We must address our materials for simple people, as well as for educated ones, but with due care about TV and newspapers that are feeding a kind of social unrest, misinterpreting the proper information.
However, later on the Vrancea source is producing small quakes around magnitude 3, keeping some fear in the minds of neighbour areas and in half of Romania. Thus, it is necessary to have both type of seismic sources as ECBR targets.
In this respect, URBAN-INCERC and ECBR started a cooperation with IGSU-General Inspectorate for Emergency Situations to make TV clips for earthquake preparedness and response.

Work package 2 (prepared by ECMNR*):*
Description:
D 1 -Study of contents and dissemination means required for earthquake preparedness and education materials, to take into account the local conditions of Moldova and comparison with experience of Greece and Cyprus.
Associated deliverables:
Materials for earthquake education od students and citizens, to be posted on website of ECMNR and dissemination of other materials

ECMR

Taking into account the common aim, we have carried out these activities in a way that would allow us collecting as many as possible ideas, ensuring communication and an exchange of experience in this respect as to scientific and technical information about hazards and vulnerability, the identification of solutions for improving society's survivability against earthquakes. In this respect, the selected information related to risk mitigation has been analyzed and developed with the participation of the scientists from this field from the Academy of Sciences of Moldova, of the experts and of the central and local decision-making authorities.

As a result of the earthquakes with the epicentrum in Vrancea in 1977, 1986 and 1990 and with the amplitude of 9 on the Richter scale, the most affected buildings were those from Chisinau. We contributed to risk area identification and map elaboration according to the mutual consent of the municipal authorities.
We worked upon concrete proposals and measures for mitigating the vulnerability of these areas of risk. In result of the polls made at different social levels, we found out that both the population and the persons in charge had scanty knowledge about this. In regard thereto, we sensitized the improvement of comprehension of the seismic risk by people and society, pursuing the aim of focusing the political attention on risk control.
We proceeded to training improvement through a correct and attentive examination of the social and ethical aspects, paying attention to the vulnerable population from Chisinau and from the republic. With this object in mind, we organized and fulfilled training courses related to risk management within university classes for students. Considering the fact that we planned to use the knowledge with the aim of mitigating vulnerability, we proceeded to gathering information and to carrying out a round table.
The Centre gathered as well information connected to the effects and damages provoked to the Republic of Moldova in the past by the earthquakes from Vrancea region.

We should mention that Centre's initiatives sensitized both municipal authorities and a great part of the public opinion, incited as well by the earthquake of the 6th of October 2013. The 4-rate earthquake that took place at 4.00 AM on the 6th of October 2013, which was more intensely perceived on the axis Vrancea-Chisinau confirmed indicatorily the actuality, need and correctness of the topic chosen by the Secretariat, i.e. „Earthquake preparedness of school students + population using scientific knowledge for public multimedia information in areas shaken by Vrancea, Romania, intermediate seismogenic source (case studies on buildings in Moldova, Ukraine, Bulgaria)". The earthquake that occurred at 4:37 AM on the 6th of October 2013, in Vrancea region, had a force of 5,5 points on Richter scale and happened at a depth of 134 km, being perceived more in Focsani and Panciu regions. The earthquake from this morning was perceived both in Chisinau and Bucharest. This fact surprised us and summoned us up for making a highly in-depth research of Vrancea earthquake evolution and behaviour.

The earthquake from 1940, which occurred at a deeper depth, destroyed down to the ground one of the most important cities from Vrancea, Panciu. Only a statue remained then from the old city, which was landowners, lessees, traders and money lenders' home, the one built in the memory of the soldiers that died during the First World War.
The earthquake from 1940 that happened at 3:39AM on the 10th of November, with the epicentrum in Vrancea region, had a magnitude of 7, 4 points on Richter scale. Its effects were devastating in the central and southern part of Moldova, but Muntenia was affected as well. 1.000 people died and 4.000 people were injured then, according to the records. The earthquake was felt both in Chisinau and Bucharest, were about 300 people died, most of them when the Carlton building, a 12-floored structure made of steel concrete, which was very modern at that time, got crashed. Other buildings from the capital had been as well deteriorated. After the earthquake, the General Association of Engineers in Romania started a detailed research of the earthquake effects on buildings made of steel concrete.
During the investigation, we came up to the conclusion that, especially as to the earthquakes from Vrancea region, the depth is important.
The tectonic movements from Vrancea do not affect only that region in particular. It is even possible, depending on the depth where the earthquakes happen, that they have a lesser intensity there, and the tragedies happen in other places. Gheorghe Marmureanu, the Director of the Institute of Physics of the Earth made an explanation, in March 2007, for a wide material on earthquakes published in Jurnalul Național(National Newspaper) :"Vrancea disposes of interesting particularities: up to the depth of 110 kilometers, the energy is directed towards Bucharest and Sofia, as in 1977. If the earthquake happens at a depth that exceeds 130 kilometers, the energy is directed towards Chisinau and Moscow, as it happened in 1940, with devastating effects in Focsani, Panciu and in other localities from Moldova",
The earthquake from 1940 occurred at a depth of H=133 km. It destroyed Panciu city completely and it was perceived even in Moscow. Marmureanu explains: "The axis on which the intensity of that earthquake was greater includes Vrancea, Chisinau and reaches even Moscow. The superficial earthquakes happen only in places where there are faults. Only deep earthquakes happen at our place. Richter scale gets blocked at the rate of 8, 41, that's why we use other scales for making measurements as well".
We came up to the conclusion that the irresponsible attitude of authorities in seismic risk management under all its aspects, especially the fact that the lessons learnt from the preceding earthquakes have been forgotten, made many victims.

Up to 1977, people talked less and less about the disaster from 1940. Marmureanu said: "The 4th of March 1977 was a day that made a great surprise for everybody. All of us have forgotten about the earthquake, because the last one happened in 1940. It has been decided even to reduce the force calculated for buildings. Bucharest was designed for the intensity of 8 point five (I=VIII 1/2) and it was reduced to VII in 1970s. All this was done to save steel and concrete. People's House is the most safe building from Romania from this point of view, because it was designed for an intensity of 9 points (I=IX). The magnitude (M) expresses the energy released in the focal point", the expert explains as well. In this way, we found out that all the buildings that were built before 1963 are less safe because the first standard of anti-seismic designing came into existence that year.
On the 4th of March 1977, at 09:22 PM, the earthquake that devastated both Bucharest and Chisinau began. Almost 30% from the territory of Romania and Moldova was strongly affected. Immense material damages were recorded especially in the central and southern region of Romania and of the Republic of Moldova. The earthquake was perceived from Sicily up to Moscow and Leningrad and, as well, in the South, up to Greece. The magnitude amounted to 7,2 points. 1.570 people died. The Romanians lost then beloved artists as Doina Badea, Toma Caragiu and Alexandru Bocanet.
Gheorghe Marmureanu explains the reasons why the earthquakes with the epicentrum in Vrancea are atypical, as they don't occur in result of the movement of some faults. "Let's imagine what will happen if we have a column and if we compress it. Vrancea is this column. The great earthquake happens in the moment when the energy reaches a critical condition, and Vrancea is at the confluence of two tectonic blocks. There are no faults there. We don't have a tectonic type as the one from Turkey or Bulgaria".
The disaster from 1977 was the subject of discussions for a longer period of time, because it was closer to our times, and the damages provoked were greater. It affected a great part from Bucharest and Chisinau; it destroyed buildings and made many people die. Marmureanu added: "Devastating earthquakes have been recorded in Vrancea from the Roman Empire. The most well-known were the ones from 1940 and 1977. Earthquakes occur every second in the world, but only those with a magnitude that exceeds 7,01 points are catastrophic. Thenceforth, Vrancea is extremely dangerous".People talk less about the damages provoked by the earthquake in cities as Giurgiu, Zimnicea or Alexandria in 1977. That earthquake affected less Vrancea during that period, which was the region where it occurred, and it had a greater intensity on the axis Bucharest-Sofia. The expert explains: "If an earthquake occurs in Vrancea, its magnitude is the same in all the regions of the country, while its intensity (I) shows how the earthquake is perceived in different places. The Mercalli scale has 12 points and an intensity of I=VII, which shows that chimneys can fall down the roofs, fissures can appear in the walls, destructive elements can come into existence, windows can be broken out, etc. If the magnitude is of MGR=7,2, as on the 4th of March 1977, while the intensity in Bucharest and Chisinau was of I=IX 1/2 , in Focsani it amounted only to VI-VII, and in Cluj only to II".

Since 2007, people have spoken about a possible devastating earthquake, which would correspond to a repeatability of about 40 years of such types of seisms.
One cannot determine yet the depth at which an earthquake will happen. Instead, an earthquake early warning system

was built in real time. In 32 seconds it can block the methane gas, elevators, operation rooms from hospitals, trains, big computers containing important data, etc. It represents an automated technical system designed for industrial units but it was indirectly designed for people as well. During an earthquake of more than VII points of Richter scale everything gets turned off: electricity, phones, computers, etc. This system was awarded the Great European Prize on the 22nd of March 2006 in Vienna.

The Centre has investigated the reports on the damages caused to the Republic of Moldova by the earthquakes from Vrancea region in the past and the current state of knowledge, training classes and needs concerning population's preparedness to an earthquake as well.

Workshop ANTI-RISK EDUCATION IN CASE OF EARTHQUAKE (Chisinau, Moldova, 30 – 31st of October 2013)

The earthquake that took place at 4.00 AM on the 6th of October 2013, which was more intensely perceived on the axis Vrancea-Chisinau confirmed indicatorily the actuality, need and appropriateness of gathering information and supporting a workshop with the aim of fulfilling the project regarding the promotion of the earthquake risk prevention culture and the application of anti-risk education activities in schools. In order to protect oneself from an earthquake, one must be informed about earthquakes and must know how to behave in this regard. As we have already mentioned, the earthquakes with the epicentrum in Vrancea are still a situation of risk.
The surveys fulfilled by the Centre in educational institutions and among the population show us that most people, including the didactic staff, show a decreased competence and even ignorance in relation to the safety rules and organization of urgent actions concerning children saving and protection in case of earthquake. Actually, the popularization of the knowledge on the character of earthquakes and methodical support granting in training the didactic staff and developing skills of creating a due behaviour in risk situations has a great importance.
The subject matter of the anti-risk education in case of earthquake developed a vivid interest within the workshop and at which took part representatives from the central public administration, from the preschool, school, university and academic environment (20 participants).
The roundtable participants laid stress on the decreased competency level of the population, including that of the didactic staff as to the safety rules and organization of urgent actions for saving and protecting children in the event of an earthquake. Currently, the popularization of knowledge about the nature of the earthquakes and the provision with methodical support for didactic staff training and for skill development for the creation of an appropriate behaviour during an earthquake and in the period that follows it have a particular importance.
The exchange of opinions between the representatives of the Service of Civil Protection and Exceptional Situations and the scientists from the university and academic field was very fruitful, and we can especially mention those of the Faculty of Psychology and Education Sciences under the direction of Mr. Vladimir Gutu, University Professor, Faculty's Dean, State University of Moldova.
During the debates, the exchange of opinions and analysis, the following objectives were fulfilled and proposed:

- The development of a wide information and active communication policy.
- The promotion of the seismic risk prevention culture by implementing educational activities on seismic risk management in schools.
- To disseminate knowledge about the nature of earthquakes and to provide methodical support for didactic staff training and to develop skills for the creation of an appropriate behaviour in situations of seismic risk.

For the fulfilment of the objectives, some questionnaires have been filled in, mentioning the achievements and the concrete proposals on the implementation of the educational activities concerning the mitigation of the seismic risk in schools and the development of educational principles in the field of the protection and promotion of the earthquake risk prevention culture.
The workshop participants considered as well that it was appropriate to get together at a roundtable where, following the conclusions and suggestions made during the workshop, they could develop a set of recommendations that must be taken into account obligatorily in case of an earthquake.

Roundtable : ANTI-RISK EDUCATION IN CASE OF EARTHQUAKE (Chisinau, Moldova, 19th of December 2013)

Following the proposals of the workshop held on the 30 – 31st of October 2013, the European Centre for Mitigation of Natural Risks organized a roundtable where it developed guidance on the efficient training of pupils and teachers, able to improve the management of earthquake prevention, preparation to and response. In this regard, during the works, new educational principles, general objectives and directions concerning the promotion of the culture of seismic risk prevention have been identified. The subject matter of the roundtable organized on the19th of December 2013 incited a captivating discussion between those 15 representatives of the central public administration from the preschool, school, university and academic environment.
The moderator of this activity was Prof. Anatolie Bantus, the Director of the Centre, who presented the European Centre for Mitigation of Natural Risks of the Open Partial Major Hazards Agreement EUR-OPA of the Council of Europe; he thanked to all the roundtable participants and informed them about the objective points in view.
The opinions of the experts and scientists from the pedagogy and psychology field contributed to the statement of the following conclusions:

1. To contribute to changing population and especially didactic staff' attitude towards the need to know and

create behavioural skills of automated type: before the earthquake, during the earthquake and after the earthquake and the combination with child-centred education.

2. More frequent visits of the experts of the Service of Civil Protection and Exceptional Situations in educational institutions, who shall ensure trainings, drawing contests, information, national and international competitions, organization of exhibitions on the relevant topic and awarding prizes for encouraging the participants thereto.
3. As well, in result of the debates, it was concluded that the introduction of new subjects in the school curriculum is not appropriate because the school program is overloaded, but new objectives and skills might be introduced in other subjects related to the Education for a Healthy Lifestyle, Civil Protection, Safety Management in Emergencies, Life Skills, and especially within educative classes. Practical lessons and periodic seminars for the didactic staff with the organization of simulations can be organized in collaboration with the Civil Protection Department.

The roundtable participants came up to the conclusion that earthquakes cannot be forecasted, that's why people are taken aback and have the tendency to become panic-stricken.

In this context, the roundtable participants recommend to all the people, wherever they would be, to keep calm first of all and to find a safe shelter.

Here are some recommendations that should be taken into account in case of earthquake:

- Stay in the building during the earthquake. Stay under the doorframe or under a concrete beam. Don't try to go outside or to the balcony.
- Those who live in a block of flats must know that, in such situations, they mustn't go outside.
- If the earthquake surprises you while you are on the stairs, run to the nearest floor. If you are in an elevator, stop it. Get out of it as soon as possible and find a safe shelter.
- The drivers must keep calm indispensably.
- If you are driving a car, stop it into a safe place far from bridges, viaducts, buildings and stay in the car. After the earthquake, don't get out of the car if you see some electrical cables that have fallen down.
- The people who are outside during the earthquake must find a shelter far from windows, blocks, bridges, electrical cables and pillars.

The workshop participants have highly appreciated this activity organized by the European Centre for Mitigation of Natural Risks, qualifying it as a successful and efficient one, having a long-term effect in the mobilization and bringing together of the persons interested in opening up, participating, communicating and collaborating in the field of seismic risk prevention culture and in implementing anti-risk education activities in schools.

The roundtable participants stated the contribution of the Centre in the discussed fields and supports the fact that the European Centre for Mitigation of Natural Risks of EUR-OPA Major Hazards Agreement of the Council of Europe must maintain its position of a centre for education, communication, cooperation, prevention, training and response to major disasters.

Work package 3 (prepared by ECRP):

Description:

D 1 -Study of contents and dissemination means required for earthquake preparedness and education materials, to take into account the local conditions of Bulgaria and comparison with experience of Greece and Cyprus.

Associated deliverables:

Materials for earthquake education od students and citizens, to be posted on website of ECRP and dissemination of other materials

During 2013, a discussion on training on the prevention of risks to the school level took place as a result of which many initiatives in this area were taken. Despite the increased number of natural disasters occurred, the emergency training at the school level has to be implemented mainly through school forms. The process of inclusion of this topic in other core subjects in schools for different age groups is very slow and limited.

Especially on the issues of protection of individual earthquake, classes are very small. Complex exercises are developed involving the protection of several natural and technological risks: classes about protections against earthquakes are accompanied by protection from flood, landslide and more.

ECRP, jointly with the New Bulgarian University, organized and held an International Conference "Ten Years education Security at the New Bulgarian University: status and prospects of education in a dynamic and unpredictable environment." Organizing and conducting training on the prevention of risks of school level cannot be done in isolation from other types of training in the field of risk prevention. During the conference, experts from the Balkans presented various research studies on the prevention of risks in the education system and the media.

In Bulgaria, different institutions seek to conduct training on the prevention of risks to the school level: the Ministry of the Interior / Fire Guard, Civil Protection/ Ministry of Environment and Water, the Ministry of Defense, the Bulgarian Red Cross and many other organizations. With so many players who do not coordinate their actions and everyone pointing out their own problems as the most important, it is understandable that the results are not very good (with the possible exception of environmentalists). In the event of a disaster such as earthquake or flooding, problems can become important in a short time if people do not usually follow specific training on prevention of risks at school and pre-school level.

A summary of the study materials (and its translation in English) for different risks and classification of materials used in the school for protection during an earthquake has thus been performed in 2013 by the ECRP.

Risk Prevention Training at Bulgarian School (2,5,8 and 10 grades) - Earthquake

2nd grade
Topic: Behavior and actions of the pupil in case of earthquake.

Purpose of the session: Familiarizing the pupils with the rules for behavior and action in case of earthquakes.
Method: Recital with practical implementation.
Place: the classroom.
Duration: one academic hour

Studied issues:
1. Behavior rules and actions in case of earthquake;
2. Practical implementation of the behavior rules

Academic materials required: fragments of video-movies, pictures, drawings and others, demonstrating the behavior and actions of people during earthquakes.

Methodology:
The teacher should study in advance the specifics of the area, in terms of seismic characteristics, to establish the most safe places within the school premises.
The session should start with fragments from video-movies (showing of photos, drawings) describing the behavior of people during earthquakes. The teacher announces the general behavior rules and actions before, during and after the earthquake, and after than implements them together with the pupils. In case the pupils make any mistakes, he moves to make the corrections necessary.

Content and course of the session
The earthquake is one of the most dangerous natural disasters. Its duration is not long, but the consequences of strong earthquakes are more severe than other natural disasters. The territory of our country falls under the influence of nine external earthquake destruction zones and three domestic seismic areas, where earthquakes ranging from IV to IX magnitude according the Richter scale are possible to originate. More than 6 million people live in that area and a partial or complete destruction of 30% of the buildings is possible.

1. Rules for behavior and actions during earthquakes

Annually there are about 1 million earthquakes worldwide. 1-2 of them are catastrophic (magnitude exceeding 8), 15-20 of them are severely destructive (magnitude exceeding 7) and 100-150 are destructive (magnitude exceeding 6.5) according the Richter scale.
Irrespectively of the fact that a man is 25 times less likely to die from an earthquake than as a result a car accident, the very occurrence is so sudden and so demonstrating the complete helplessness of the man before the forces of nature.
What should the pupil do prior to the occurrence of an earthquake:
- to acquaint himself with the seismic status of the residential location he lives in;
- to have good knowledge of the building where he lives or studies, and to know the safest places in it (next to internal walls, under sturdy furniture, etc.)
- to prepare in advance certain essentials and valuable objects;
- knowledge where/how to shut down electricity, water and gas.

When the first quake occurs:
- the person must not leave the residence, school or public establishment'
- a location that provides maximum possible safety against the crumble – under the door frame, near to an interior wall or pillar, under a sturdy table or bed, next to an internal corridor.
- In case the person's residence is located on a lower floor and it is possible to leave the residence in up to 10 seconds, that is acceptable to do, but at the expense of certain risks;
- staircases and elevators must not be used;
- if in vehicle, one should stop movement and wait for the danger to pass.

PLEASE NOTE: the maximal destructive force of the seismic disaster lasts for an average 10 seconds, and the duration of the quakes rarely exceeds one minute. Do not panic – it is a poor choice. Use the humorous advice of the New Zealand doctor Barry Wills: "Stay calm and count to 40. After you finish counting it no longer matters what you do".

What do we do after the first quake passes?
- immediately shut down any heating and warming devices, lights, TVs, any gas-based and kitchen appliances;
- follow the information transmitted through the Bulgarian National Radio;
- take the most essential items and personal documents and immediately leave the premises;

- apply first aid to anyone who needs it;
- lock the residence;
- get down using only the staircase, do not use the elevator, give priority to mothers with children and older people;
- when getting out of the building, move away from them to a distance at least equaling their height;
- do not stand under electrical, tramway or trolleybus grids;
- move through the middle of the street or the park alleys;
- If possible do not use personal transportation means;
- Do not use the phone, be patient – others will be needing it more.

After the passing of the earthquake the following will be necessary:
- Move back the children in the school or residence only after a message has been communicated by the competent authorities through the Bulgarian National Radio or the local radio-nod, stating that the danger has passed; rules must be strictly observed;
- If they cannot be moved back to school or inside the premises, find a way for them to call their parents that they are alive and well;
- Returning to a school or home must be done only after the building has been carefully checked for danger of crumbling;
- Do not light fires, irrespective of whether it is day or night.
- Keep strong personal hygiene, do not consume water from non-checked sources due to danger of epidemic.

2. Practical implementation of the behavior rules.
The teacher recreates a different situation (when feeling the first quake, after the passing of the first quake, etc.) with the pupils and trains their reactions.

5th grade
Topic: Earthquake – what should the pupil know in order to protect him/herself.

Purpose of the session: To acquaint the pupils with the natural disaster called earthquake and with the rules for behavior and actions at the time of its occurrence.
Method: Narrative.
Location: the classroom
Duration: one academic hour
Academic topics:
1. Earthquake – essence of the event;
2. Actions to be undertaken during earthquake;
3. Behavior and reactions during earthquake;
4. Behavior and reactions after the passing of the immediate danger.
Materials: video-movies, plans of the seismic areas of the Republic of Bulgaria

Methodology:
During the preparation for the session the teacher is to examine the seismic area plans and to establish the area of his current location.
During the first session the teacher will familiarize the pupils with the essence of the earthquake phenomena and with the Medvedev–Sponheuer–Karnik twelve grade scale (MSK-64).
During the second session emphasis should be placed on the characteristics of the seismic situation in the respective location where the children live and study.
In the course of the following academic topics the teacher is to acquaint pupils with the general behavior rules during earthquake.

Content and course of the session.
1. Earthquake - nature of the disaster.
Annually more than 1 million earthquakes occur, 1-2 of them are catastrophic, 10 – destructive, and about 100 are damaging.
The earthquakes result from the geological activity of the planet Earth. This activity is expressed in volcanic activity, mountain-forming processes, subsidence, and risings of the earth crust.
Earlier it was believed that all earthquakes result only from the earth crust. However it is now known, that the origin of most earthquakes is located inside the mantle, the depth of which is around 2900 km and is in solid state. The tensions that occur inside the mantle as a result of the existing massive pressures or as a result of underground explosions, cause the earth movements. Elastic seismic waves propagate outwards the hypocenter in every direction. The surface seismic waves propagate outwards from the epicenter along the earth surface.
The earthquakes usually hit large areas (zones). In case of strong earthquakes the integrity of the soil is damaged, buildings and equipment are damaged, communication and energy grids are disrupted (water conduits, sewer systems, power supply, etc.), human casualties are caused.
As a general rule the earthquake is accompanied by sounds as if rock blocks are breaking, and at certain distance away

from the origin of the sounds they resemble thundering echoes or explosive humming. When the earthquake happens under the water it causes massive waves – tsunami. The history knows of tsunamis exceeding 60 meters height, that caused massive destructions to the mainland.
As a physical process the earthquake represents the disruption of the integrity of the earth layers, accompanied by the release of mechanical energy, noting that a mere 1-2% of this energy are converted to energy for seismic waves. The movements and vibrations of the earth layers as a consequence of the elastic earthquake waves are called earthquake.
For the purpose of assessment of the intensity of the earthquake two scales are generally used – the macro-seismic scale of Medvedev–Sponheuer–Karnik (MSK-64) and the Richter magnitude scale.
According the MSK-64 the specific intensity levels are assessed on the grounds of specific criteria: human behavior, movement of objects, residual deformation of the earth surface and change of the underground- and ground waters. The MSK-64 scale is divided into 12 degrees:
I-st degree. Not perceptible. Not felt by humans.
II-nd degree. Hardly perceptible. Felt only by individuals at rest, especially on higher floors.
III-rd degree. Very weak, partially perceptible. The earthquake is felt only by some people indoors, and by people resting outdoors. The shake-up is similar to the one felt when a car starts moving.
IV-th degree: Felt by the majority of the population. The quake is felt by most people indoors, by some people outdoors. Some may wake from sleep. Windows, doors and kitchen appliances start shaking and ringing. The furniture shakes. Floors and walls crackle. Hanging objects swing.
V-th degree: Waking. Felt indoors by most, outdoors by few. A few people are frightened and run outdoors. Many sleeping people awake. Hanging objects swing considerably, some objects overturn or change place. Doors and windows swing open or shut. The shaking resembles a hit caused by the fall of a heavy object indoors.
VI-th degree: Frightening. All sleeping people wake up and run outdoors driven by fear. Felt by most indoors and by many outdoors. A few persons lose their balance, the chandeliers swing, wall clocks with pendulums stop, the trees shake strongly, pictures fall from walls, dishes fall of the shelves. Buildings made of adobe, round stone, bricks and panel building show small cracks in the coating, small fragments of the coating fall off, cracks in the chimneys.
VII-th degree: Damage to buildings. General anxiety, objects are falling down, waves are formed in the water basins and the water becomes turbid. The debit of the springs changes. The wells change water level. Buildings with reinforced constructions and wooden houses receive small cracks in their coating and small fragments thereof start falling. Buildings made of fire brick, panel buildings, buildings with supporting structures receive minor cracks in the walls, chimneys and parts thereof may fall. Stone and adobe buildings suffer heavy damage such as large wall cracks and crumbling of the chimneys.
VIII-th degree: Destruction of buildings. Panic and chaos take reign. Small tree branches start breaking off. Parts of the hanging lighting fixtures are damaged. Minor crumbles of steep earth areas and roadways. Cracks start appearing in the soil. The debit and level of the water sources changes shifts multiple times. Buildings with reinforced structure and wooden houses suffer minor wall cracks, chimneys and parts thereof may crumble. Lots of the rural buildings made of adobe and stone suffer splits of the stone foundations, part of the buildings crumble.
IX-th degree: General damage to buildings. The animals run, yowl, etc. Water often withdraws from the mold earth, sand and silt can be observed. The cracks in the soil can reach 10 cm in width. Earth layers slide. Springs appear and disappear. In some cases railroad tracks twist. Monuments and statues fall. Buildings with reinforced structure and wooden houses suffer large wall cracks, the chimneys crumble. Buildings made of firebrick, panel buildings, and buildings with supporting structure suffer damage, part of the buildings crumble. Some adobe- and stone- structures crumble completely.
X-th degree: General destruction of buildings. Cracks in the soil sometimes up to 1 meter wide. Landslides fall. New lakes are formed. Buildings with reinforced structure and wooden houses suffer – parts of the buildings crumble, walls collapse. Lots of the support structure buildings, panel buildings and brick-made buildings are completely destroyed, almost all rural buildings made of adobe or stone are completely destroyed. Serious damage to dikes, embankments, dams, severe damage to bridges.
XI-th degree: Destructive. Large changes to the earth surface take place, large cracks – gaps. Multiple land and rock masses crumble. Heavy damage is suffered by even the buildings that are most well constructed.
XII-th degree: changes the landscape. All buildings are destroyed. The land surface suffers serious changes. Waterfalls are formed, the rivers change their beds.

The Richter magnitude scale features 9 degrees and the different magnitudes give an approximate assessment of the total energy released by the hypocenter under the form of elastic waves. On the grounds of experimental data the correlation relations for transformations (connection) between degrees of intensity and magnitude, are established.
The territory of our country falls under the influence of nine exterior earthquake hypocenters and three domestic seismic areas where earthquakes are possible to occur, ranging from 4th to 9th Richter scale. These areas contain 90% of the living centers with more than 6 million population and a partial or complete destruction of the buildings is possible to occur there.
12 seismic stations have bee constructed on the territory of Bulgaria which establish the depth, location, epicenter and time of start of the earthquake.
Of largest interest for us are the destructive earthquakes in Bulgaria. In the course of the last hundred years the strongest among them are:

- on September 18th 1858 a strong earthquake of IX-th degree of intensity hit Sofia and cause multiple destructions and casualties.

- In 1901 a earthquake with magnitude 7.2 and epicenter 10 km east of the cape of Kaliakra shook Northeastern Bulgaria. The quake was felt in some northern seaside areas with intensity of IX-th degree (depending on the depth, earthquakes with identical magnitude can have different manifestations on the surface, and, conversely, earthquakes with different surface manifestations can have different magnitude.
- On April 4th 1904 in the Struma valley occurred the strongest earthquake in Bulgaria, which is also one of the strongest in Europe. Its magnitude was 7.8.
- On April 14th 1913 a strong earthquake destroyed Gorna Oryahovitsa and several villages in proximity. Its intensity was of IX-X degree.
- Two catastrophic earthquakes occurred on April 14th and 18th 1928 in the Upper Thracian Plain. The epicenters were near Chirpan with intensity of IX-th degree and near village Popovitsa, Plovdiv district – degree X-th.
- On March 4th 1978 – an earthquake with epicenter near the mountain of Vranchea, Romania was felt in the entire Bulgaria, mostly – in Svishtov.
- On December 7th 1986 – earthquake in Strazhitsa.

2. *Actions prior the earthquake*

Irrespective of the fact that it is 25 times less likely to die during an earthquake than to a car accident, the very occurrence is so sudden and demonstrating the complete human helplessness before the forces of nature, that the fear caused affects in the long tern both the psychological and sometimes physiological state of people. The loss of stability even for a short while strongly upsets and confuses people.

What to do prior the earthquake in order to reduce the risk of injury and to minimize the damage:

- to acquaint oneself with the seismic situation around the living center we reside at;
- careful examination of the building;
- heavy furniture and cupboards must be well fixed and heavy objects must not be placed on the upper shelves.
- The beds and places for rest must not be located to exterior walls and no heavy non-fixed objects should be in proximity;
- Essential supplies and valuable objects must be prepared in advance.

3. *Behavior and actions during an earthquake*

A characteristic trait of the human behavior during earthquake is the panic and fear. Therefore, just like in any critical situation, the most important thing is to overcome that state.

Any further reaction depends on the location where the earthquake has caught us.

If we are at home, the best thing is to stand under the frame of a door, next to an internal wall or pillar, under a sturdy table or high bed.

For people who live on the lower floors who can leave the house in approximately 10 seconds it is acceptable to go outdoors. The greatest danger in such moment comes from falling objects and crumbling walls, and time to leave the premises can be less than 10 seconds.

We will be most "lucky" if the quake finds us in the street. It is sufficient to move to middle of the street or to move away from the near buildings at a distance at least equal to their height. Attention must be paid for any torn or falling power cables, lamps or street lighting, balconies or chimneys.

The greatest danger lies in the panic and running about pointlessly.

If we are in a transport vehicle it is best to stop in an open area and wait inside the vehicle for the quake to pass. The same rule applies when we are in a tramway, train or other public transport.

4. *Behavior and actions after the immediate danger has passed.*

After the first quake has passed, the premises are to be left in the fastest way possible, and all electrical- and gas-appliances must be turned off. Water-supply should be switched off. Lighting matchstick or candle is not recommended.

- Calling an emergency phone is not recommended. If the line is overloaded with calls it may result in the delay in passing important information.
- The most valuable personal effects and documents are to be taken before leaving the building, using the staircase is obligatory.
- Walking barefoot may prove dangerous. Using the elevator is not allowed.
- When outdoors stand away from buildings at a distance equal to at least their height.
- Avoid using personal vehicles so that no obstruction is posed to the vehicles of Fire Fighting Service, police, emergency medical services, etc.
- Even if you have forgotten something important or valuable home, do not rush to retrieve it.
- Returning to the buildings must only be done after a message has been transmitted by the competent authorities stating that the danger has passed.
- In school the pupils are to follow the instructions of the teacher who is currently with them.

The experience gained during the last destructive earthquakes in our county showed that in the days after the earthquake the most important things are unity and mutual help between people. They contribute for optimism, safety and can really help for a faster normalization of the situation.

8 grade

Rules for behavior and reactions of the pupils in case of disasters, breakdowns and catastrophes

Natural disasters, breakdowns and catastrophes can be caused by earthquakes, earthslides, deluges, floods, thunderstorms, snowstorms, icing, industrial breakdowns. Many of the disasters, breakdowns and catastrophes cannot be averted, but the advance preparation of the pupils for the cases of their possible occurrence may lead to prevention or decrease of the consequences thereof.
Each pupil must be prepared with knowledge and skills to help him survive in emergency situations.
In order to preserve the life and health of the personnel of the school establishments, every school or service unit of the Ministry of Education and Science there is a prepared and approved school Plan for action in case of disasters, breakdowns and catastrophes (see Appendix 1 to Chapter "Protection against disasters, breakdowns and catastrophes" and Appendix 1, 2 and 3 to Chapter "Fire and Emergency Safety").
Knowledge of the character of the disasters and rules for reaction should they occur, can provide reliable protection and save human lives.

1. Earthquake

1.1 Essence of the earthquake

The earthquake is a natural disaster that cannot be predicted. Its duration is not long, but the consequences can be severe. In order to prevent the loss of human life and serious material losses, the state authorities are to undertake measures related to the anti-seismic construction, adherence to the construction regulations, ability to provide adequate reaction and handling the consequences. One must not forget, however, that our appropriate reactions can be life-saving.

1.1.1. Physical explanation

The earthquakes result from the sudden release of energy accumulated in the bowels of the earth. The hypocenter is the point of the earth crust or mantle where the destruction process starts. The "point" on the earth's surface located directly above the hypocenter, is called epicenter.

1.1.2. Strength and energy of the earthquake

The strength of the earthquake is assessed mainly through two indicators, different in their physical nature: seismic intensity and magnitude.
The seismic activity is connected with the effects of the earthquake on the earth's surface. It is an important indicator, also applied in construction. The seismic activity is established on the grounds of scales that describe the macro-effects of the earthquakes, and namely:

- how people felt the earthquake;
- what was the damage done and/or destruction to buildings;
- what were the effects inflicted on the terrain, etc.

There are macro-seismic scales that measure the intensity of the earthquakes through:

- 7 degrees (the Japanese scale)
- 10 degrees (the old European scales)
- 12 degrees.

The most widely used are the 12-grade scale of Mercalli – Kankani – Sieberg (in Europe), the modified Mercalli scale (in America), the scale of Medvedev-Sponheuer-Karnik (Eastern Europe and in our country) – also known as MSK-64.
The magnitude assesses the energy at the source of the earthquake, and not its impact on soil, buildings and equipment.

1.1.3. Danger of earthquake in our country.

Bulgaria falls into the active seismic area of the Mediterranean sea.
The Carpathian seismic area also exercises substantial effect.
Based on historical data the country has often suffered strong and destructive earthquakes. One of the earliest ones happened in I-st century BC, destroying the city of Kavarna and annihilating the area in proximity. Seismologists believe its intensity was X-th degree.
In 543 another earthquake occurred, with approximate intensity of IX-th degree, in the area of city Balchik when the sea flooded the mainland. In the same area, in November 1444 the ancient historian informs that the "cities were completely destroyed and rivers changed their beds".
The most dangerous seismic areas in our country are the Kresna-, Plovdiv-, Sofia- and Gornaoryahovitsa zones.

1.1.4. Predictive seismic zoning of Bulgaria for a 1000 year period.

The most dangerous seismic areas in our country are the Kresna-, Plovdiv-, Sofia- and Gornaoryahovitsa zones.
The predictive seismic zoning indicates the strength and force of the expected quakes (their impact on the earth's surface).
The Shabla seismic area encompasses the entire Southern Dobrudzha. The strongest earthquake in that zone occurred on March 31st 1901 with a magnitude of M = 7.2, intensity – X-th degree, and hypocenter depth of 14 km. The epicenter was located 10 km south of the cape of Kaliakra.
The Razgrad-Shumen seismic area is known for the earthquake that occurred on August 23rd 1942, with intensity of VII-th degree. The epicenter was located in the outskirts of Razgrad and the depth of the hypocenter was approximately 7 km.
The strongest earthquake occurred the Gorna Oryahovitsa – Tarnovo was on April 14th 1913 with a magnitude of M = 7.0 and intensity of IX-X degree, hypocenter depth of about 15 km.
The Tundzha seismic area includes the bed of the Tundzha river. The city of Yambol is located within the said zone. On

February 15th 1909 the city suffered an earthquake of magnitude M = 5.9 and VIII-th degree of intensity, hypocenter depth approximately 6.5 km.
The seismic area of river Maritza is one of the largest seismic areas in the country. This area includes a large part of the Thracian valley. Destructive earthquakes occurred there in 1818 and 1859, but the ones that are the most known happened in 1928. The first destructive earthquake happened on April 14th 1928, with magnitude of M = 6.8, IX-th degree intensity, hypocenter depth of approximately 9 km and epicenter located in the outskirts of city Chirpan, i.e., at 180 km from Sofia. The most considerable consequences from that earthquake are:

- destruction of almost all buildings located in the cities of Chirpan and Parvomay.
- strong deformations and faults in the earth crust;
- changes in the debit of wells and springs;
- deformations of railroad tracks, huge damage to telegraph and phone lines, etc.

On April 18th 1928 the seismographs in Sofia recorded the beginning of an even stronger earthquake with epicenter in the village of Popovitsa, i.e., at about 150 km from Sofia. The magnitude of the said earthquake was M = 7.0, its intensity was IX-th – X-th degree, the depth of the hypocenter – about 16 km. This resulted in the destruction of 1/3 of Plovdiv, substantial deformations of the earth crust, the population left severely shocked.
The Southwestern or Rhodope seismic area comprises the valleys of the Mesta and Struma rivers. Quoting the seismologists: "The strongest earthquake in our country during the 20th century, as well as one of the strongest in Europe, occurred on April 4th 1904 in the Struma valley, with epicenter located in the Kresna ravine". The magnitude was equal to M = 7.8, intensity degree of X, hypocenter depth of 18 km.
The Sofia seismic zone comprises the Sofia Field and the neighboring mountainous areas. In 1858 Sofia suffered an earthquake with intensity of degree IX-X.
The purpose of the above seismic information about Bulgaria is to demonstrate that the seismic danger is a reality for Bulgaria, and one that it is unacceptable to neglect.
1.1.5. Collateral damage
The earthquakes present danger not only by directly causing damage and destruction to buildings and equipment, but also by disrupting the main infrastructure systems – electricity, heating, gas-supply, water supply, sewer systems, phone lines and communications, railroads, seaports, airports.
Following an especially severe earthquake the water from the water supply grid can be contaminated and unsuitable for consumption.
Another very dangerous collateral effect are fires, often on a large scale, caused by appliances that were not switched off, short circuits in the power grid, damaged industrial installations, affected fuel storages, etc.
After the earthquake fire-fighting activities are obstructed, and the smoke and possible poisonous gases present significant threat to the populace. It is of great importance to appropriately organize the fire-fighting activities in order to reduce the fires and to find open locations that have good access to fresh air.
Collateral effects such as floods or mud slides can be caused by the damage and destruction inflicted on the large artificial water facilities (dams, tailings, dikes, channels) located in proximity to the living centers.
In case any similar danger exists people should not assemble in low lands or terrains that are susceptible to be flooded.
Dangerous toxic contaminations can be caused by damaged chemical, metallurgic or other facilities or their storage facilities. Moving away as soon as possible from such facilities is mandatory. The danger of epidemic outbreaks also looms high, due to disruption of the sanitary and hygienic services for the populace.
Very strong quakes can cause "liquefaction" of the soil, movement of land slides, wide and long cracks, shifting and earth slumps, falling of rocks, mud volcanism, avalanches. Do not drive through unchecked roads, that may lead to dangerous consequences.
Another negative consequence of the earthquake is the occurrence of marauding and theft in the affected areas. Collective vigilance is required and as well as timely address to the protection forces.
Mass-spread panic is also dangerous. It can be avoided, if the correct individual and collective effort is made to adhere to the above said instructions.
It is necessary to remember that during any difficult situation, priority care should be given to children, the sick, the wounded, the old and people with disabilities.
1.1.6. Rules for safe behavior
a/ Behavior rules during a seismically inactive period:
During a seismically inactive period it is necessary to:

- store in an easy to reach spot at home: a flashlight, handbag for documents and particularly valuable items, first aid kit, whistle, one warm piece of garment for everyone, food and water reserve;
- fix well the furniture and not place large, easy-to-fall objects at high places;
- know in advance the safest hiding places for each member of the family. Please remember that the balconies, exterior walls, staircases and elevators are the most dangerous ones.

b/ rules for behavior when feeling the first quake:
When feeling the first quake it is necessary:

- not to leave the premises, school or building where the pupils are located, unless such exit can be implemented within 10 seconds.
- take position at the safest places possible in the building- under the door frame, next to an interior wall, pillar, under a sturdy table or bed.
- Keep calm and refrain from leaving the building by elevators or stairs while the quake lasts;
- Stay away from buildings and transmission cables after leaving the building.

- If the quake catches you while inside a vehicle, stop in an open safe location and wait.
- Wait for the end of the quake in case the citizens are caught in a public transport vehicle.

c/ rules for behavior after the first quake passes:

After the passing of the first quake it is necessary to:

- shut down electricity, gas and water;
- take any baggage prepared in advance, and swiftly leave the building;
- Use the stairs and not the elevator;
- Give priority to mothers with children and older people;
- After leaving the building stay away at a distance equal to at least the height of closest building;
- not stand under transmission cables, electrical-, tramway or trolleybus cables;
- give first aid to any casualties;
- mark any locations where there are people buried underneath the rubble and help them, if possible;
- follow the information transmitted through the Bulgarian national radio and local radio-stations.
- Comply with the instructions of the Civil Protection Authorities and keep the public order.

10 grade

ACTION PLAN IN CASE OF STRONG EARTHQUAKES IN SCHOOL

1. Existence of any objects in proximity, which, in case of earthquake, would cause secondary damage.
2. Bodies and forces they are interacting with.
3. Order for action of the Permanent Commission.

After the passing of the quake /approximately 60 seconds/, the Permanent Commission will act as follows:

3.1. Organizes the surveillance for establishing the situation at the school /kindergarten, servicing unit/ - casualties, cracks, destructions, fires, damage to the communication and energy system and others, and sets the routes for leading the pupils /children/ out;

3.2. Organizing the lead-out of the pupils /children/ immediately after the first quake /approximately 60 seconds/ to the designated location / specify location/

3.3. Organizes any first aid for any casualties and their transportation to hospital establishments.

3.4. Checks for missing children /pupils/ among those that were led out. In case any are missing, organizes the search for them in the building;

3.5. Makes the reports to the Permanent Municipal Commission for Protection of the Population Against Disasters and Accidents and maintains constant communication with the on-duty officer of the Municipal Safety Council for obtainment of aid and instructions.

3.6. Sets the locations and routes for transportation.

3.7. Actions after leaving the destruction zone.

3.8. Locates and notifies the parents of any pupils /children/ who have suffered injury.

3.9. Locates and arranges for shelter for any pupils /children/ whose families have suffered injury.

Work package 4 (prepared by TESEC):

Description:

D 1 -Study of contents and dissemination means required for earthquake preparedness and education materials, to take into account the local conditions of Ukraine and comparison with experience of Greece and Cyprus.

Associated deliverables:

Materials for earthquake education od students and citizens, to be posted on website of TESEC and dissemination of other materials

The public perception of earthquake risk in Ukraine has been analysed.

Seismic regions area of Ukraine is about 120 thousand of square kilometres, or about 20% of all territory. The earthquake intensity arranged from 6 to 9 points on the MSK-64 scale. About 10.9 millions people live in earthquake-prone areas or about 22% of the total population of the country, including in the areas of the 6-point seismic activity — 7.98 million (15.5%), 7-point — 2.16 million (4 , 2%), 8-9-point — 0.79 million (1.5%).

Some important aspects of earthquake risk perception have been analysed.

In light of the events in Japan, many Ukrainians in horror wondering whether there will be anything like this in our country. It is obvious that Ukraine is not a tsunami threat, but in terms of the probability of an earthquake, how it is high?

Messages from Japan, really disturbing, but the consequences of these events are impossible to predict. They combined both natural and man-made events. According to UNESCO on the globe are victims of earthquakes each year from 15 to 30 thousand people, material loss is more than U.S. $ 400 million a year. Geography and the number of natural disasters tend to increase every year. Looking at the chart, we see clearly that the process of increasing the number of accidents for the period from 1975 to 2010.

The seismic areas of Ukraine are: Crimea, part of Odessa and Chernovtsy regions, Lvov, Ivano-Frankivsk and Ternopil region, located in the zone of the Carpathian earthquakes and Kirovohrad and Vinnitsa regions and part of the Donbas region.

Impulses which force can occur in these regions? Current data on seismic zones of varying intensity cover Crimea (6-9 points), Carpathian (7 points), Chernivtsi (6-7 points), Vinnitsa (6 points), Kirovograd (6 points), Lviv (6 points)

Odessa (6-9 points), Ternopil (6 points), Khmelnytsky (6 points) of Ukraine. Most threatening in its consequences for Ukraine is the region Vrancea area, Crimea and Transcarpathian seismic zone. Strong earthquake last occurred here in 1927, 1940, 1977, 1986 and 1990.

Can the Ukraine without the tragic consequences of the earthquake to survive the future? The fact is that modern construction in seismic areas is complicated by the presence of geological hazards (floods, landslides, tornadoes, karsts, etc.). On the territory of Kievan Rus and the Ukraine over the past 900 years there have been over 30 major earthquakes. Strong earthquakes in the Crimea in 1927 caused damage of about 70% of all buildings in Yalta. In zone 8-point effects were five cities of the Crimea. Photo clearly illustrates some of the effects of this earthquake in Yalta and Sevastopol. In the area of Alushta observed tsunami wave heights from 0.3 m to 1 m Russian seismologists have mapped the tsunami on the Black Sea. Carpathian earthquakes occurring in Vrancea Mountains are felt over a large area and extend for hundreds of kilometers from the epicentre. They occur at sharp bend the arc of the Eastern Carpathians and the general seismic situation in Moldova and western Ukraine. The strong influence of the Romanian earthquake in Ukraine recorded in the annals of history, references, and earthquakes in various catalogs and instrumental observations in 1091, 1170, 1230, 1443, 1446, 1471, 1701, 1790, 1802, 1838, 1893, 1908, 1912, 1927, 1940, 1977, 1986, and 1990. Earthquakes of this area have been the cause of significant destruction of buildings and structures in Moldova and Ukraine. The strongest earthquakes of Vrancea area has been reported in the Ukraine with the intensity of predominantly 5-6. The exception to this trend was the earthquake in October 26, 1802, which was observed in Odessa and Chernovtsy with intensity up to 7 points. As for the capital: whether its residents feel subterranean impulses and persevere if Kiev facilities. Previously, it was customary to assume that the most vulnerable old buildings and what can we say about the new buildings, which have recently been built in Kiev shock? And it will stand Kiev dam? In high-rise buildings in Kiev, which cater to the perception of seismic forces 6 points, as well as in buildings with over 9 floors, fluctuates a lot, but it should do without damage. Of course, this will lead to the manifestation of a sense of danger in people (especially on the upper floors of buildings), panic, ringing of bells in churches. In Kiev, did not observe an earthquake above 5 points, so with the Kiev dam will not be destroy because of that. Seismic scale determines the effects of the 5-point earthquake as follows: "In the room — there is a majority of people. Individuals — scared and ran out into the street. Hanging items — ranging, porcelain — ringing. Doors and windows — open. Animals — show concern. In buildings of adobe and rubble damage (pitting sealant hairline cracks in masonry joints). "But in Kiev these buildings cannot be found. General seismic zoning map of the territory of Ukraine, which are designed for all residential, public and industrial buildings — SRF 2004 "A", developed by the Institute of Geophysics of NAS of Ukraine and the Crimean council of experts to assess the seismic hazard and earthquake prediction, it is included in the Standards of Ukraine.

General seismic zoning map of the territory of Ukraine, which are designed for all residential, public and industrial buildings — SRF 2004 "A", developed by the Institute of Geophysics of NAS of Ukraine and the Crimean council of experts to assess the seismic hazard and earthquake prediction, it is included in the Standards of Ukraine.

The most exciting question discussed everywhere, will the Ukrainian nuclear power plants survived the earthquake without consequences? For Ukrainian nuclear power plants, including the Chernobyl nuclear power plant, the maximum possible intensity of earthquakes is less than 6 points on the MSK-64 scale.

From the point of view of science, is it possible to predict and somehow anticipate the approach of the earthquake? From the point of view of science, we cannot predict an earthquake. In America, in California, where the seismic active San Andreas Fault, the area is full of hundreds of seismic sensors, which record progress of the crust. There was no case to predictions were realized. Given the importance of the problem in Ukraine, the Interdepartmental Committee on Scientific and Technological Safety under the National Council of Security and Defence of the President of Ukraine in April 3, 2008 and May 19, 2009 considered the "Status of seismic security and development problems of earthquake engineering in Ukraine." The Commission noted the growth of negative degradation technical state construction projects in Ukraine and increased wear and tear of fixed assets in different sectors of the economy and encouraged the Cabinet of Ministers of Ukraine to ensure the development of concepts and programs "Protecting people and buildings from seismic hazard", a list of dangerous objects and housing and public facilities, a National Engineering and seismic service of Ukraine in the Ministry of Regional Development and Construction of Ukraine, in accordance with its logistics and staffing. We also give specific recommendations to the Ministry of Regional Development and Construction of Ukraine, the National Academy of Sciences of Ukraine, the Ministry of Ukraine of Emergencies and Affairs of Population Protection from the Consequences of the Chernobyl disaster, the Ministry of Education and Science of Ukraine and other state agencies that have to do with the problem of providing earthquake resistance of buildings and structures Despite the fact that you cannot predict an earthquake, in seismically active regions, it will happen. In the design and construction of buildings should be responsible to comply with the requirements of the Standards for design in seismic areas, carry out advocacy of the population — how to behave during an earthquake and after the earthquake, but not limited measures of recovery.

3.C. Ethic and social values

DEVELOPMENT OF INFORMATION-EDUCATIONAL MATERIALS ON AWARENESS AND PREPAREDNESS TO AN EARTHQUAKE AND ON RULES OF BEHAVIOR FOR PEOPLE WITH DISABILITIES

DURATION : ☐ 2012 ☐ 2013 ☒ 2012 – 2013

LINE OF ACTION: 3.D. Ethic and social values

TITLE OF THE PROJECT: Development of information-educational materials on awareness and preparedness to an earthquake and on rules of behavior for people with disabilities, especially children

TARGET COUNTRIES: Armenia, the Southern Caucasian and neighboring states, other concerned member-states of the Council of Europe's EUR-OPA Major Hazards Agreement , other countries

PARTNERS INVOLVED:

COORDINATING CENTRE : ECRM Yerevan, Armenia

OTHER CENTRES

OTHER PARTNERS : "Republic Children's Rehabilitation Centre" (Yerevan, Armenia), the Disaster Medicine Department of the Ministry of Emergency Situations of Armenia

EXECUTIVE SUMMARY

The pilot version in English of the "Manual on preparedness and behavior rules for people with disabilities, especially children, if an earthquake is real or seems imminent" was and was updated focusing on how to develop an Individual Plan, enabling to be prepared for disasters for people with disabilities, a Family Plan, Neighborhood Plan, Plan for Institution, where people with disabilities work or study and, particularly, Plan for Specialized Institution, where the people with disabilities, especially children, are given care".

The "Manual" is designed for three categories of people with disabilities, namely:

- People with impaired mobility
- People who are blind or have impaired vision
- People who are deaf or have impaired hearing

A specific document "Plan for a specialized institution where the people with disabilities, especially children, are given care" was also developed and a new information-educational document "Awareness-raising of the people with disabilities (preparedness and rules of behavior) as an integral part of disaster preparedness and response" was produced in 2013.

OBJECTIVES OF THE PROJECT

Global objective for 2012-2013:

Development of information-educational materials, aimed to raise awareness and improve preparedness to an earthquake of administration and personnel of specialized educational and other types institutions, where the children with disabilities are provided care as well to prepare the children themselves and their family members to act adequately in a case of the earthquake and following it.

Specific yearly objectives:

2012:

Acknowledgement of administration and personnel (physicians, teachers, all those who are involved into administering care to the children with disabilities) of the "Republican Children's Rehabilitation Centre" with the contents and key provisions of the "Manual on preparedness and behavior rules for people with disabilities , especially children, if an earthquake is real or seems imminent(the priorities for action)", developed by ECRM in 2011. Bringing the meaning of the "Manual" to the sense of the children with disabilities, given care in the above institution alongside with their family members.

In order to identify some approaches and venues, while creating a more detailed information-educational materials, drawn on the above "Manual" and assigned for the specialized education and other types institutions, where the children with disabilities are provided care, to consider and jointly analyze within this aspect the specifics of the "Republican Children's Rehabilitation Centre".

Based on the collected and discussed proposals to develop a final version of the above "Manual" with a focus on a section: " Plan for a specialized institution, where the people with disabilities, especially children, are given care".

Submission of the final English version of the "Manual on preparedness and behavior rules for people with disabilities, especially children, if an earthquake is real or seems imminent" as a contribution to implement of the corresponding Section of "Be Safe Net".
2013:
By factoring the results of analyses of specifics and the discussed proposals to create Basic Provisions for more detailed information –educational materials, assigned for specialized and other types institutions, where the children with disabilities are cared (the case of the "Republican Children's Rehabilitation Centre")
To develop information –educational materials ("Manual" or/and "Plan for action") on awareness and preparedness raising to an earthquake, assigned for the specialized and other types institutions where the children with disabilities are cared, as well on behavior rules for the children with disabilities, when an earthquake is real or seems imminent.
Organization of a training course for administration and personnel of specialized educational and other types institutions, where the children with disabilities are given care.

EXPECTED RESULTS

2012 :
A final English variant of the "Manual on preparedness and behavior rules for people with disabilities, especially children, if an earthquake is real or seems imminent (the priorities for action)".
Submission of the final English version of the "Manual on preparedness and behavior rules for people with disabilities, especially children, if an earthquake is real or seems imminent" as a contribution to implement of the corresponding Section of "Be Safe Net".
2013 :
"Manual"(or/and "Plan for action") on awareness and preparedness raising to an earthquake, assigned for the specialized and other types institutions where the children with disabilities are cared, as well on behavior rules for the children with disabilities, when an earthquake is real or seems imminent
Training course for administration and personnel of specialized educational and other types institutions, where the children with disabilities are provided care.

RESULTS OBTAINED PREVIOUSLY (if any)

The "Methodology and Plan for action, aiming to develop and hold of National and Municipal "Campaigns" on informing and warning the population about emergencies at central and municipal levels" has been developed.
Within a Project on the "National and Municipal Campaigns... the below information materials (including for the most vulnerable people) were developed :

- The basic (national) information materials for the population assigned for distribution in each family (the priorities for action to be undertaken by the population when warned on an imminent disaster or in case of disasters, which are likely to occur in Armenia)
- The information materials assigned for municipalities under special risks (one for the municipalities at a likelihood of a radiological risk; another for the municipalities in whose territories some hazardous substances are being produced, used or stored and the third one for the municipalities, located in flood-prone vicinities adjacent to high pressure dams;
- "Manual for the population on how to act when an earthquake is real or seems imminent" (the priorities for actions to be undertaken by the population.

From an information kit assigned for the most vulnerable population, as it has already been mentioned, as an initial step there was created a "Manual on preparedness and behavior rules for people with disabilities, if an earthquake is real or seems imminent".

RESULTS OBTAINED IN 2012

Work package 1 (prepared by ECRM)*:*
Description:
Acknowledgement of administration and personnel (physicians, teachers, all those who are involved into administering care to the children with disabilities) of the "Republican Children's Rehabilitation Centre" with the contents and key provisions of the "Manual on preparedness and behavior rules for people with disabilities, especially children, if an earthquake is real or seems imminent (the priorities for action)", developed by ECRM and updated in 2011. Bringing the meaning of the "Manual" to the sense of the children with disabilities, cared in the above institution alongside with their family members.
Associated deliverables:
Study by the Republican Children's Rehabilitation Centre's administration and personnel of the above "Manual", developed in 2011 by ECRM; participation of a feedback jointly with ECRM experts and drafting of proposals to improve it by given the specifics of the "Republican Children's Rehabilitation Centre".

By analyzing the information concerning the specifics of the Republican Children's Rehabilitation Centre in Yerevan, the creation of more detailed information materials assigned for specialized institutions where children with disabilities are treated requires taking into account:

- The basic venues of activities performed by such specialized institutions
- Knowledge of contingent of the cared children; their mustering of skills in every day live and a kind of social-psychological work delivered to them
- Basic principle and approaches applied to rehabilitate these children with an aim to prepare them to act

independently in every day circumstances

- Composition and qualification of rehabilitation team assembled for each child: physicians (including rehabilitation physician , psychologist and ect.) , teachers, rehabilitation nurseries
- An extent and a form of the engagement of parents and family members of the treated children into the rehabilitation team
- Basic construction performances of a specialized establishment where these children live, are taught and given rehabilitation courses
- Practice of giving integrated teaching and rehabilitation courses when the treated disabled childrenstudy andhave an access to the institutional facilities together with their healthy class mates (for instance, an integration kinder garden model)
- Type of a given care, applied rehabilitation and teaching methods :
- round- the -clock in - patient, day in- patient and out- patient treatment options
- Availability of plans on interaction with enterprises, organizations, academic institutions etc., located in the close proximity) regards the likelihood of showing prime assistance to the most vulnerable children (children with disabilities) in case of a disaster.

Work package 2 (prepared by ECRM)*:*
Description:
In order to identify some approaches and venues, while creating a more detailed information-educational materials, drawn on the above "Manual" and assigned for the specialized education and other types institutions, where the children with disabilities are provided care, to consider and jointly analyze within this aspect the specifics of the "Republican Children's Rehabilitation Centre".
Associated deliverables:
The analyses results , the specifics of the "Republican Children's Rehabilitation Centre"

During creation of the above "Manual" also the provisions of the underlying basic international documents, addressing the above venue were taken into account:

- The " Standard Rules on the equalization of opportunities for people with disabilities' (adopted by the UN's General Assembly in the Appendix to Resolution 48/96 of 20 December 1993)
- Recommendation Rec (2006) 5 of the Committee of Ministers to member-states of the Council of Europe "Action Plan to promote the rights and full participation of people with disabilities in a society: improving the quality of life of people with disabilities in Europe 2006-2015" (adopted by the Committee of Ministers on 5 April 2006 at the 961-st meeting of the Minister's Deputies")

Simultaneously to eliminate some shortcomings in the text of the Standard Rules, concerning the restricted access to education, information and warning (awareness raising) and relevant public services by people with disabilities of all ages regards the observation of their rights and the provision of equal opportunities to meeting their needs in the field of disaster risk reduction and reducing vulnerability, the protection of life and health against emergencies, there have been designed some suggestions to supplement the "Standard Rules" text.

Work package 3 (prepared by ECRM)*:*
Description:
Based on the collected and discussed proposals to develop a final version of the "Manual" with a focus on a section: "Plan for a specialized institution, where the people with disabilities, especially children, are given care"
Associated deliverables:
A final version of the "Manual on preparedness and behavior rules for people with disabilities, especially children, if an earthquake is real or seems imminent" with a focus on a section: "Plan for a specialized institution, where the people with disabilities, especially children, are given care"

Based on the collected and discussed proposals, there was created a final version of the above "Manual" with a focus on a section: "Plan for a specialized institution where the people with disabilities, especially children, are given care".
The "Manual" is designed for three categories of people with disabilities, especially children:

- People with impaired mobility
- People who are blind or have impaired vision and
- People who are deaf or have impaired hearing

At the same time the "Manual" is assigned also to their family members, guidance, neighbors, administration and staff of the specialized educational and other types of institutions, where they are provided care.
The final version in English of the above "Manual" has been submitted to the EUR-OPA Secretariat.

Work package 4 (prepared by ECRM):
Description:
Submission of the final English version of the "Manual on preparedness and behavior rules for people with disabilities, especially children, if an earthquake is real or seems imminent" as a contribution to implement of the corresponding Section of "Be Safe Net".
Associated deliverables:
Implementation of the corresponding Section of "Be Safe Net"

The final version in English is submitted as a contribution to implement (if a need may arise for) a corresponding section in the "Be Safe Net" website.

RESULTS OBTAINED IN 2013

Working package 1 (prepared by ECRM)*:*
Description:
By factoring the results of analyses of specifics and the discussed proposals to create Basic Provisions for the above more detailed information –educational materials, assigned for specialized and other types institutions, where the children with disabilities are cared (the case of the "Republican Children's Rehabilitation Centre").
Associated deliverables:
Basic Provisions for the above more detailed information –educational materials, assigned for specialized and other types institutions, where the children with disabilities are cared (the case of the "Republican Children's Rehabilitation Centre")

In 2013 the pilot version in English of the "Manual on preparedness and behavior rules for people with disabilities, especially children, if an earthquake is real or seems imminent" has updated with a partial focus on how to develop an Individual Plan, enabling to be prepared for disasters for people with disabilities, a Family Plan, Neighborhood Plan, Plan for Institution, where people with disabilities work or study and, particularly, Plan for Specialized Institution, where the people with disabilities, especially children, are given care".
The "Manual" is designed for three categories of people with disabilities, especially children:

- People with impaired mobility
- People who are blind or have impaired vision
- People who are deaf or have impaired hearing

At the same time the "Manual" is assigned also to their family members, guidance, neighbors, administration and staff of the institutions, where people with disabilities work or study, administration and personal of the specialized educational and other types of institutions, where they are provided care.

Working package 2 (prepared by ECRM)*:*
Description:
To develop information –educational materials ("Manual" or/and "Plan for action") on awareness and preparedness raising to an earthquake, assigned for the specialized and other types institutions where the children with disabilities are cared, as well on behavior rules for the children with disabilities, when an earthquake is real or seems imminent
Associated deliverables:
"Manual"(or/and "Plan for action") on awareness and preparedness raising to an earthquake, assigned for the specialized and other types institutions where the children with disabilities are cared, as well on behavior rules for the children with disabilities, when an earthquake is real or seems imminent

ECRM developed a new information-educational document "Awareness raising of the people with disabilities (preparedness and rules of behavior) as an integral part of disaster preparedness and response", the basic elements of which were shortly presented during the "Including People with Disabilities in Disaster Preparedness and Response", organized by the EUR-OPA Agreement on 22-23 October 2013.
Taking account of the EUR-OPA Agreement Recommendation on the "Inclusion of people with disabilities in disaster preparedness and response", adopted at the 64th Meeting of the Committee of Permanent Correspondents on 24-25 October 2013, and the key ideas of the report on "Including People with Disabilities in Disaster Preparedness and Response" and the "Guidelines for the Treatment of People with Disabilities during Emergencies, Crisis and Disaster situations"(prepared by David Alexander and Silvio Sagramola for the EUR-OPA Agreement), will imply an update of the above mentioned two documents will be necessary.
Based on those documents, more detailed recommendations and proposals should be designed on the development of:

- A family Plan
- A neighborhood Plan
- A Plan for the institution where the people with disabilities work or study
- A Plan for specialized institutions where the people with disabilities, especially children are provided care
- Integration of these Plans into Municipal Plans on disaster risk reduction and emergency response

That new research will take into account the long-term initiative implemented by the Ministry of Emergency Saturations of the Republic of Armenia (under support of the Armenian Government) on involving people with disabilities (people with impaired mobility at a first stage) into the Ministry system as, primarily, employees of the Crisis Management Centre.

Working package 3 (prepared by ECRM)*:*
Description:
Organization of a training course for administration and personnel of specialized educational and other types

institutions, where the children with disabilities are provided care
Associated deliverables:
Training course for administration and personnel of specialized educational and other types institutions, where the children with disabilities are provided care

Due to the necessary revision of reference documents, no training course was organized in 2013.

PREPARING COMMUNITY TO EMERGENCY SITUATIONS THROUGH RISK CULTURE AND SUSTAINABILITY

TARGET COUNTRIES : Turkey, Russian Federation, Kazakhstan

PARTNERS INVOLVED :

COORDINATING CENTRE : *ECMHT Baku, Azerbaijan*

OTHER CENTRES:

OTHER PARTNERS : *Scientific-Research Institute of the Ministry of Ecology and Natural Resources, Academy of Emergency Situations, Seismological Service Center of Azerbaijan National Academy of Sciences of Azerbaijan, Azerbaijan Architecture and Construction University, "Fovgal" Association*

EXECUTIVE SUMMARY

The Scientific-practical conference "Increasing sustainability in the most affected regions by natural disasters, preparation the community to the emergency situations and increasing risk culture among the population" (Baku, 12-13 November 2012) noticed the importance of evaluation of the human factor as reason of the damage resulting from emergency situations but it also stressed the minimization of human losses resulting of natural disasters. Some proposals were put forward to adopt necessary measures in that direction:

- Analysis of destruction left behind during emergency situations shows that most of it occurs mainly due to the human factor. Not taking into account probable natural disasters, not redeeming construction rules, disruption of regulatory rules in construction and use of water, gas, heating, and ventilation systems is unfortunately common in the activity of corresponding organizations: state control on these fields is important.
- The importance of involvement of municipalities, private business owners, farmers, businessmen was highlighted and its legalization by appropriate state orders encouraged. The non-recognized reconstruction of individual and social buildings at the expenses of the state and the associated spending on it avoids achieving the insurance of individual properties (widely used abroad) as well as the liability of organizations or persons responsible for sustainability of the facilities for public buildings destruction.
- Failure to comply with safety regulations leads to damages and losses (even human) during emergency situations. It requires an increased attention to the development of the preparation of population to emergency situations and their protection. Short-term training courses must be organized to train people in regions, free guide books must be prepared and diffused and mass-media (especially TV programs) must be used.
- The links between global climate changes and emergency situations in lectures and speeches were largely discussed. The involvement of qualified scientists and relevant scientific research institutes for a detailed study of the main reasons of these events and the allocation of sufficient resources to that study were stressed.

OBJECTIVES OF THE PROJECT

Global objective for 2012-2013 :

Intensified activity of the communities against emergency situations according to Hyogo program.

Specific objectives :

2012:

EXPECTED RESULTS

2012: *To prevent and liquidate the results of the emergency situations that intensified year by year, to intensify responsibility of the population, local institutions and communities.*

ASSOCIATED ACTIVITIES

2012: *International scientific-practical conference "Increasing sustainability in the most affected regions by natural disasters, preparation the community to the emergency situations and increasing risk culture among the population".*

RESULTS OBTAINED PREVIOUSLY (if any)

The report of the previous International scientific-practical conference was submitted to the Agreement on November 23, 2011.

RESULTS OBTAINED IN 2012

I. "Round table" (May 10, 2012) with the organizers of the project and experts and scholars of this sphere

During the meeting, the preparation of scientific-practical conference was discussed:

- Collection of necessary information related to the conference, specifying the conference hall for the plenary session and sections of the conference, preparation of technical equipment and organization of services to participants;
- Selection and confirmation of the plenary lectures and lecturers;
- Determination of the direction of sections and section's leaders;
- Approval of the preparation and publication of conference materials;
- Implementation of the conference through a committee (5 members) chaired by ECMHT director, prof. H.O.Ojagov.

Work rules of scientific-practical conference: Plenary reports of conference from 10:00 to 16:00 on November 13; Section meetings on November 13, from 10:00 to 16:00.

Plenary reports:

1. Prof. H.O. Ojagov, Director of the Center: "The role of management and development of disaster risk reduction"
2. Prof. G. Yetirmishli – Director of Seismological Service Center of Azerbaijan National Academy of Sciences of Azerbaijan: "The increase of seismic activity and its features"
3. Prof. N. Babakhanov – Chief of the Department of Geography, Baku State University : "Development of the risk culture and preparation of communities to possible natural disasters"

Plenary meeting of scientific-practical conference "Increasing sustainability in the most affected regions by natural disasters, preparation the community to the emergency situations and increasing risk culture among the population" (12-13 November 2012)

The meeting was opened by H.Ojagov who noted that increasing major hazards are the product of world civilization. Beginning from last century, this process had taken such a scale that the organization of the analysis of these reasons and the struggle against it internationally in each country became reality and demand of our time. Massive need for a quiet life, healthy food, pure water, clean air and clear sky are increased in social concerns day by day not only in the largest industrial centers but in the remote mountain villages too. There is no country in the world that will not face emergency situations and human losses from time to time.

The Republic of Azerbaijan is not an exception as the country is surrounded by Greater and Lesser Caucasus and considered to be the most complex regions of the world according to the intensity of the endogenous or exogenous situations. Almost the whole area of Azerbaijan is a very active seismic area. Earthquakes of magnitude 7-9, large-scale landslides, heavy streams, floods, volcanoes, etc. cover a wide range of areas in our republic and cause great harm to the economy and losses of people. The intensity of the emergency situations is increasing year by year according to global climate change.

An increasing of seismic activity, its duration, and dramatically expanding of the coverage of it, incredibly high scale of economic damages have caused serious trouble in the country during the last decades, especially in 2012 .Taking into account we have invited well-known scientists and specialists in these areas, the representatives of the relevant ministries and other government agencies . The aim is to discuss and analyze the situations together with the reasons which depend on the nature and direct us, to elaborate appropriate recommendations, to eliminate our shortcomings in against to emergency situations, instructing of the people and to define our opportunities to prevent all these.

In the report of prof. G. Yetirmishli, the director of Seismological Service Center of Azerbaijan National Academy of Sciences of Azerbaijan was noted that an increase of seismic activity on Earth is connected with globalization in the world and he added that the human factor plays an important role in global climate changes.

The seismic processes in the world differ with the covering of wide areas. For example, the earthquake measuring 7.0 on the Richter scale, occurred in Agdash region ,on June 4, 2009 was covered large area - Oguz, Gabala, Kurdamir, Zardab, Goychay, Ujar and Yevlakh regions (6 magnitude) and 5.0-magnitude covered the cities of Ganja and Mingechevir.

The earthquake occurred on May 7, 2012 started from Zagatala, north-west region of Azerbaijan and covered Balakan, Gakh, Sheki, Tovuz, Ismayilli and Gabala regions with various intervals and was lasted more than 10 days. Residential houses, social facilities and a number of schools damaged as a result of the earthquake. Only in Zagatala region over 500 residential buildings were destroyed, 5807 houses and 166 social facilities seriously damaged and suffered heavy losses in the neighborhood of Balaken and Gakh regions. Only for people who have lost its properties in Zagatala, 20 million manats (€) were allocated for the construction and rehabilitation of buildings in there.

Such earthquakes covering an area of 100 km are the abnormal events of globalization. The main reason of the destruction scale of earthquakes is the human factor. There is no need to apply experience of the world to compare. It is enough to look at the results of the earthquake occurred of same magnitude (7.0 magnitude) in Baku in 2012. There were no serious damages and no losses, only cracks in some of the old buildings.

The reporter noted that 9 seismic stations and one geophysical station was installed in the Zagatala region to determine seismic process and to evaluate the changes of the intensity state of geomagnetic fields. These systems are the most advanced devices made in the USA. The exact observed information transferred to Seismological Service Center of Azerbaijan in Baku within few seconds.

At the conference, it was noted that, importance of evaluation of the human factor should not be forgotten as the reasons of the damage besides occurrence reasons of the emergency situations. The human factor can be divided into 2 parts.

i. Human nature: the general development of society as a result of the rapid increase in world population and the urbanization, global climate change, etc.

ii. Neglected in our daily life, negligence: not taking into account the sustainability of buildings and facilities during construction, not paying attention to the rules of normal use of land and water, not taken preventive measures against natural disasters and so on.

Neron Babakhanov, the professor of the Geography Department of Baku State University gave a critical analysis of natural disasters and struggle against them in our country and in the world in recent years. He was noted that the human factor plays great role in occurrence of floods, streams, landslides, forest- field fires, especially in large-scale destruction.

In this case, the anomalous warming in 2010, at the same time strong floods and landslides as a result of heavy rains in the mountainous areas, overflow of the country's largest rivers Kur and Araz basin committed an unprecedented destruction.

In conclusion, southern areas of Kura River ,especially in Sabirabat, Saatli, Imishli, Salyan districts, the areas where Kura receives with the Araz river was a great destruction dozens of towns, villages remained under the water,7500 families become homeless and lost all their properties.

Large-scale floods, landslides and soil flooding caused major losses of the population and inflict damages to the economy of the country. It is impossible to determine the exact extent of this damage.

It is enough one fact that 100 million state funds were spent for the restoration of the destructions in the large areas, construction of new settlements and providing people who lost all their properties with all residential means, foods and water. This process is still going on.

Following natural events happened in the country on decades, scientist came to the conclusion that such claims can be expressed in compact form:

1. Not taken into account suspected natural events on the construction of the building and all other construction work.
2. Indifferent attitude to the necessary preventive measures in disaster zones.
3. The lack of strict control on the implementation of rules centralized by the government on use of the soil, water, forests and selection of settlements

Scientific-practical conference materials were systematized, edited and published. Books (conference materials) after publishing will be first distributed to the emergency commissions and municipal organizations of the more affected regions by natural disasters.

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On 13 November 2012, the scientific-practical conference continued its work on the 4 sections from10:00 to 16:00

Sections and section leaders

I Section - "Improvement of the management of disaster risk reduction"

Chair of the Section: senior lecturer G.Hacımatov

II Section - “Preparation to the suspected natural disasters- improvement of the risk culture"

Chair of the Section: senior lecturer Sh. Danyalov

III Section - “ Migration of population from destroyed places as the result of natural disaster to hazardous areas as the permanent residences”

Head of the Section : the expert of the Ministry of Emergency Situations, K. Bagirov

18 representatives took part in discussions on the reports and a recommendation was unanimously adopted.

Recommendation of the scientific-practical conference

Strengthening material and potential base of the struggle system with emergency situations in our country the last decade, an exemplary observation and timely warning organization, reconstruction of Seismological Service Center of Azerbaijan National Science Academy in accordance with modern technical standards, measures, such as widening The Ministry of Ecology and Natural Resources’ metrological center network, starting from the peaks and covering all the territory was highly appreciated by the participants. They noticed minimization of human loss as a result of natural disasters and appropriate offers put forward for realization of necessary measures in this direction:

- Analysis of destruction left behind during emergency situations shows that, the great deal of them occurs mainly due to the human factor. Not taking into account probable natural disasters, not redeeming construction rules, disruption of regulatory rules in construction and use of water, gas, heating, and ventilation systems became common in activity of corresponding organizations. Participants noticed importance of state control on this field.
- The state care to the struggle against intensified natural disasters year by year was highly appreciated. They noticed the importance of involvement of municipalities, private business owners, farmers, business people to the struggle and its legalization by appropriate state orders. One of the points of concern was the non-recognized reconstruction of individual and social buildings at the expense of the state collapsed during the emergency situations and spending millions of manat on it. Although we expressed our comments during our scientific-practical conference last year, the situation remains th same. 20 million has been allocated from the president’s reserve fund for reconstruction and removal the results of the Zaqatala earthquake in May of 2012. If continue so we will not be able to achieve insurance of individual properties widely used in the world practice, liability of organizations or persons responsible for sustainability of the facilities for public buildings destruction.
- One of the most important and discussed problem in the conference was the preparation of population to the struggle against the emergency situations and protection from them. Failure to comply with safety regulations brings to damages and losses during emergency situations even human losses. All this requires an increased attention to the development of preparation population to the safety. For this purpose short-term

training courses must be organized to train people in regions, free guide books must be prepared and spread, mass media, especially opportunities of TV programs must be used. The active participation of Academy of MES and "Emergency" Association must be noticed especially.

- There were large discussions around the links between global climate changes and emergency situations in lectures and speeches. The involvement of qualified scientists and relevant scientific research institutes for detailed study of the main reasons of these events, and was stressed the allocation of sufficient resources effectiveness to this area.