NATURAL HAZARD PREVENTION AND MANAGEMENT IN THE WIDER BLACK SEA AREA: THE SciNetNatHaz PROJECT

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ABSTRACT

Natural hazards present Trans-boundary consequences, pose a serious problem to communities, form a roadblock to sustainable development and can lead to Natural Disasters when combined with vulnerability and insufficient capacity to reduce the potential chances of risk. The problem in the Black Sea area is widely recognized and a lot of effort has already been made towards Natural Disaster mitigation. A brief review of the already applied and ongoing research shows a lag in the implementation of methodologies at regional and local scales. Such methodologies can provide results that can be directly used to make decisions regarding preventive measures and to plan effective post-event management actions. Key-elements for an effective Natural Disaster mitigation are the Hazard Identification and the Risk Assessment, which, on a cross-border basis, can be effectively achieved by applied research and by technology transfer. The "SciNetNatHaz Prevention" Project presented, is partially funded by the EU and aims towards providing the means for a reliable and accurate hazard assessment regarding Earthquake, Landslide and Flood Hazards (ELFH) on regional and local scales, in the wider Black Sea area. The way to achieve that goal, includes the formation of a Scientific group to act as an initial contact point and to ensure applied research and technology transfer among partners from different countries through the investigation of problems such as the lack of reliable information, the lack of a "common ground" in terms of Methodologies and Procedures adapted and the lack of systematic hazard assessment. The project expected outcomes include guidelines for ELFH data acquisition and publishing, submission of proposals regarding methodologies to be commonly used in assessing each of the ELF Hazards by providing, at the same time, comparable results, and finally, the development of Hazard maps for selected pilot implementation areas in order to support planning preventive measures.

KEYWORDS: **Landslide, Flood, Earthquake, hazard assessment.**

1. Introduction

Natural Hazards especially in the form of Earthquakes, Landslides and Floods (ELF), pose a serious threat to societies all over the world and a block to sustainable development. They can lead to Natural Disasters when combined with insufficient capacity to reduce the Risk. The problem is widely recognized and a lot of effort has been spent on Disaster Mitigation which is the ongoing effort to reduce the impact disasters have on people and property. Because of the varying type of each of the natural hazards, there are different mitigation strategies for each one of them.

Disaster Mitigation as a management process can be divided into: pre-event measures; actions taken during and immediately following an event; and post-disaster measures, all classified into four basic stages: prevention, preparedness, response and recovery.

Key elements for Natural Disaster mitigation are the Hazard Identification and the Assessment of the Risk.

Pre-event measures are the most cost effective, provided that they are based on accurate and reliable Hazard Identification and Risk Assessment and the same stands for the rest of the Mitigation Process stages so it appears that Hazard Identification and Risk Assessment provide the background needed for an effective Natural Hazard Prevention (EU Commission, 2010).

Their great importance in all stages of Hazard Mitigation stages, poses the necessary requirements for their assessment. It must be based on: Accurate and Reliable Data; and scientifically proven (after being adapted to local conditions, tested and accepted) Methodologies.

These goals can be better achieved via Applied Research and Technology transfer.

2. Current Status regarding ELF Hazard Management in EU and in the Black Sea area

Natural Hazard mitigation is an ongoing effort of the international community supported by Research based on a number of activities and measures including the International Strategy for Disaster Reduction expressed by the Hyogo framework for Action 2005-2015 (Kobe World Conf. 2005), the International Council of Science-ICSU Natural and Human induced environmental hazards (2006-2012 plan) and the International year of Planet Earth (UNESCO) and the GEO-Group of Earth Observation – 10 year GEOSS implementation Plan). Hazard Mitigation involves actions towards three different axes: Legislation, Research, and Implementation.

As far as the problem is concerned, all involved parameters have been recognized by the European Union and various actions have been taken including establishing International Organizations and funding of research projects regarding Hazard Mitigation strategies.

Within the context of FP5 and FP6 programmes, a number of projects regarding Natural Hazard Mitigation were awarded. The attempt to investigate the flood issue, focused mostly on analyzing historical and real-time information on floods but still, it was recognized that work needed to be done in developing European databases, including extreme events and socio-economic consequences (European Commission. Research and Innovation, 2006). The potential priorities for future research included the study of phenomena as sediment/debris generation and propagation in extreme floods; probabilistic real-time risk forecasting of multi-hazard events; feasible extreme flood-management options; non-intrusive technologies to measure infrastructure defenses against floods and the performance of storm sewerage systems under intense rainfall or wave over-topping.

In the following years, FP7 as well as projects funded by other EU Bodies and financial Instruments (CORDIS, ENPI, IPA), focused at exactly on the aforementioned targets, providing valuable results on natural hazard mitigation and especially on flood forecasting, on hazard assessment methodologies and on the use

of new technologies for hazard assessment. During the years 2008-09, the EU Commission focused on enhancing disaster response capacity. From the outcome of the implemented projects, it is evident that there is a need for an integrated approach to disasters in a way that the full Natural Hazard mitigation cycle – prevention, preparedness, response, recovery – should be considered for any type of potential disaster, Natural or man-made. The proposed approach to Hazard mitigation suggests that Prevention is the primary target accompanied by impact assessment so that measures leading to effective preparedness and response can be planned (European Commission DG Environment, 2008). The specific objectives set by the EU Commission include actions into three axes: developing knowledge-based prevention policies; linking actors and policies throughout the disaster management cycle; and improving the effectiveness of existing financial and legislative instruments. The European Parliament's resolution of September 2010 provides support to the Commission's priorities: improved knowledge of the risks, improved coordination of all actors and effective and innovative financing. The "Staff Working Paper on Risk Assessment and Mapping Guidelines for Disaster Management" issued by the Commission (2010) suggests that risk assessments "*are crucial for enhancing disaster prevention and preparedness activities and contribute significantly to planning and capacity building*". The main aim of these guidelines, is to improve coherence among the risk assessment carried out in the EU Member States at national level, all stages of the hazard mitigation cycle and to make these risk assessments more comparable between Member States. This approach is expected to lead to greater transparency in terms of hazard related communication and will facilitate co-operation in efforts to prevent and mitigate shared risks, such as cross-border risks.

As it therefore appears, the European Parliament and Council has set, as the fore-most priorities, the ones related to hazard prevention, risk assessment and risk mapping by improving existing sources of information on disasters.

Those priorities foreseen by the EU Parliament and Council for the next years include: a programme of best practices, leading to EU guidelines on minimum standards for disaster prevention (2012); Overview of the major risks the EU may face in the future (2012); and the European Commission in cooperation with UNISDR and OECD (2013) to support this governance tool as part of the EU cooperation in disaster risk management (Council of the European Union, 2009).

2.1.Policies-International Agreements

The significance of the Natural Hazard mitigation problem has for long been recognized by the European Union and this great interest has been transformed into a series of EU Strategies, Actions and Directives targeting at Hazard Mitigation. These include but are not limited to:

- The soil thematic strategy [SEC(2006)620] & [SEC(2006)1165] and the proposal for an EU Directive [COM(2006) 232] [http://ec.europa.eu/environment/soil/three_en.htm] set the framework for soil erosion and landslide hazard identification and prevention.
- The **Directive 2007/60/EC** of the **European Parliament** and of the Council of 23 October 2007 on the assessment and management of flood risks, which is under implementation in all EU countries.
- The Report of the "**Committee of Energy, Research and Technology**" on the establishment of a European research area and regional planning measures for

protection against earthquakes. European Parliament, session documents, DOC_EN\RR\244\244682, 31 January 1994.

- The **Commission of the European Community** (1975): Harmonization on structural design codes & technical specifications: **Eurocode 8** [http://europa.eu.int/comm/enterprise/ construction/internal/guidpap/l.htm]. These "EUROCODES" intend to provide a set of rules for the design of buildings and civil engineering construction in order to effectively reduce earthquake hazard.
- The **Convention on the Protection and Use of Transboundary Watercourses and International Lakes** (Water Convention) (1996) led to forming Capacity building activities like the "**Task Force on Flood Prevention and Protection**" which in turn led to the adoption of the "Guidelines on Sustainable Flood Prevention" at the second session of the Meeting of the Parties to the Convention in 2000. As a follow up to that action, the Guidelines which were complemented by the **Model Provisions on Transboundary Flood Management**, adopted in 2006, led to Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks.
- In 2006, the mandate of the Task Force on Flood Prevention and Protection was broadened to take into account the climate change perspective. The "Task Force on Flood Prevention and Protection" was renamed to "**Task Force on Water and Climate**". Moreover the Convention's work programme for 2007–2009 on flood management mostly focused on exchanging experiences and knowledge between EU and non-EU countries. The Convention's **Guidelines on Sustainable Flood Prevention** as well as the subsequent Model Provisions on Transboundary Flood Management, provide specific guidance to support transboundary cooperation on flood management.
- There's also the **Hyogo framework for Action 2005-2015**: "Building the resilience of nations and communities to disasters", which was established under the United Nations Office for Disaster Risk Reduction (UNISDR). In the framework is clearly stated that: "There is now international acknowledgement, that efforts to reduce disaster risks must be systematically integrated into policies, plans and programmes for sustainable development and poverty reduction, and supported through bilateral, regional and international cooperation, including partnerships. Sustainable development, poverty reduction, good governance and disaster risk reduction". The priorities for Action (2005-2015) aim at: i) Ensuring that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation. ii) Identifying, assessing and monitoring disaster risks and enhancing early warning. iii) Using knowledge, innovation and education to build a culture of safety and resilience at all levels. iv) Reducing the underlying risk factors. v) Strengthening disaster preparedness for effective response at all levels.

2.2.Research-Major Networks

As far as the Research and Implementation are concerned, a lot of effort has already been spent with very positive results by the EU and by individual countries. An indicative list of EU projects includes:

- The **Directorate General for Research & Innovation** [http://ec.europa.eu/research/index.cfm?pg=dg] which has funded more that 50 research Projects on Earthquake Hazard mitigation since 1987.
- the establishment of the **EUR-OPA Major Hazards Agreement** which is a platform for co-operation in the area of major natural and technological disasters

between the rest of Europe and the South of the Mediterranean. The main objectives of the EUR-OPA Major Hazards Agreement are to reinforce and to promote co-operation between Member States in a multidisciplinary context to ensure better prevention, protection against risks and better preparation in the event of major natural or technological disasters. The Web site [http://www.coe.int/t/dg4/majorhazards/centres/presentation /ispu_en.asp] provides a wealth of information and documents regarding multiple hazard mitigation issues.

- The **European Advisory Evaluation Committee for Earthquake Prediction (EAECEP)** June 10, 1994 was created by the Committee of Ministers of the Council of Europe, with the duty to provide advice on the earthquake predictions put forward by various scientists.
- The **European Warning (Alarm) System** [http://www.coe.int/T/DG4/MajorHazards/alertes/default_en.asp] which was established to support information and cooperation between the Member States of the Agreement and a State hit by a disaster. It mainly focuses on earthquakes of a magnitude higher than 6 on the Richter scale, although it can be used for other types of disasters. As part of this system, the Euro-Mediterranean Seismological Center (CSEM/EMSC) collects and disseminates in real time, information regarding the location of the epicentre and the magnitude of any occurring earthquake. They also investigate the needs of the countries hit by earthquakes about potential assistance needed.
- Several Projects (more than 50) funded by the "**Community Research and Development Information Society (CORDIS)**" under different calls (programmes), that target on Climatology, Natural disasters and Risk assessment and reduction.
- The establishment of the **Joint Research Centre (JRC)** [http://ec.europa.eu/dgs/jrc/]. Mission of the JRC is to provide to stakeholders, scientific and technical support for the conception, development, implementation and monitoring of European Union (EU) policies. JRC consists of several Institutes and acts as a reference centre of science and technology for the EU, covering risk and management issues regarding man-made and natural hazards including floods, landslides and earthquakes.
- The **European Flood Alert System** and the cooperation between Austria and the Czech Republic on the Morava River basin.
- Existing international framework agreements such as the **UNECE Water Convention** and the European Union (EU) Directives (e.g. the Floods Directive) should be implemented and enforced
- **The Associated Programme on Flood Management (APFM)** of the World Meteorological Organization (**WMO**) which provides important support tools for countries for implementing an integrated approach to flood management. and the Helpdesk for Integrated Flood Management [www.floodmanagement.info]
- The **European Flood Alert System** and those provided by **the European Exchange Circle on Flood Forecasting** (EXCIFF)
- The **European Exchange Circle on Flood Mapping (EXCIMAP)**
- The **European Flood Awareness System (EFAS)** http://www.efas.eu/
- The **Flood Mitigation) Action** [http://databases.eucc-d.de/plugins/projectsdb/project.php?show=288] concerning best practices (e.g. related to land-use planning) for flood plain management involving participants from all the EU Member States and associated countries.

- The **International Consortium on Landslides (ICL)**, which is an international non-governmental scientific organization supported by UNESCO, UN/ISDR, FAO, WMO and intergovernmental programmes. ICL promotes and coordinates collaborative research and expertise, as well as capacity building, on landslide risk reduction.
- The **European Centre on Geomorphological Hazards (CERG)**, a specialized research network of the Council of Europe's EUR-OPA Major Hazards Agreement co-operation platform. CERG promotes international scientific cooperation and training on prevention of geomorphological and geohydrological hazards and risks, especially landslides, gravitational flows and floods.

A lot of projects have been and are also funded by the European Neighbourhood and Partnership instrument (ENPI) including Inter-regional Projects (INTERREG, Black Sea basin JOP 2007-13).

2.3.Research and Implementation

An interesting proposal which covers all potential Disasters is the **CRISHOPE** regional reference model. It is a theoretical concept that proposes a regional process of planning and continuous improvement through dialogue, exchange of experience and practical cooperation on early recovery and consequence management in the aftermath of natural and man-made disasters. Basic axes include 1) the Development and implementation of effective and transparent legislation for disaster relief, early recovery and disaster risk reduction, 2) the Development of effective and transparent national strategies, policies, and capabilities, as well as operational and management arrangements to build resilience to disasters, and increase adaptation to ongoing demographic change and climate change/variability, 3) the Enhancement of the involvement and the role of non-institutional actors, including civil society, private companies, the media, local communities and individual citizens, in disaster relief and early recovery, 4) the Development and contribution to institutional and/or non-institutional arrangements in the Greater Black Sea Area ensuring effective transnational assistance, information and experience exchanges, and cooperation on disaster relief, early recovery and disaster risk reduction, at both bilateral and multilateral level.

2.3.1. Earthquakes

Earthquakes are a major natural hazard especially for the southern part of Europe including Mediterranean and Black Sea countries. The EU has recognized the importance of the seismic risk mitigation and has actively supported the EU countries by legislating and by funding projects which led to significant scientific and technological achievements. The problem which still remains is the cross-border cooperation issue which is common among efforts to mitigate any of the Natural Hazards.

Some of the already implemented Earthquake Research projects include but are not limited to:

- **LESSLOSS**: The project worked to improve risk mitigation for earthquakes and landslides. In particular, improved tools for landslide monitoring, earthquake-resistant design methods and innovative approaches for predicting landslides were developed, together with ways to stabilize landslide-prone areas and anti-seismic devices.

- **SAFER**: The primary aim of SAFER is to develop tools that can be used by disaster management authorities for effective earthquake early warning in Europe.
- **SEAHELLARC**: SEAHELLARC's goal is to establish a real-time on/offshore network for simultaneous seismic and tsunami observations in the coastal zones of western Peloponnese.
- **TRANSFER**: The project main goal is to contribute to our understanding of tsunami processes in the Euro-Mediterranean region, to the tsunami hazard and risk assessment and to identifying the best strategies for reduction of tsunami risk.
- **NERIES** is working at networking the European seismic networks, improving access to data, allowing access to specific seismic infrastructures and pursuing targeted research developing the next generation of tools for improved service and data analysis.
- **Turkey Earthquake and Flood Recovery Project- TEFER:** The purpose of the project is to investigate the Turkish Black Sea coast area in respect to floods and landslides and to develop a flood management programme to reduce or eliminate long-term risk and damage to people and their property. In the West Black Sea Flood Region the priority is laid on engineered flood defence works, mainly in the form of channel improvements.

A future goal could be the development of policies to enhance cross-border cooperation in respect to Earthquake Hazard Mitigation strategies (including Prevention and Management). To achieve this goal, policy-making is essential at governmental level in order to legislate accordingly to each of the participating countries. Co-operation with international organizations, technology transfer (for instance: improvement of rescue methods, develop new technologies to help reduce the impact disaster have on life & property) and land use planning. The Earthquake Hazard identification in all those issues plays an important role, so it has to be assessed by the use of common-widely accepted-reliable and accurate methodologies and supported by equally reliable and accurate data.

Earthquake Hazard should be assessed nor only as an estimation of the ground motion parameters (i.e., PGA, PGV etc) but as an assessment of the impact the ground motion has, on the ground itself in terms of geotechnical hazards caused. Potential Hazard maps including liquefaction, lateral displacement and ground settlement maps can be created and used to effectively make decisions about taking preventive measures needed to avoid the problem, about potential Land Uses, about construction related legislation and also to raise public awareness.

2.3.2. Floods

Most EU countries have already started preparing the Flood Management plans according to the 2007/60/EC Directive. At this point, all countries have completed the Preliminary Flood Risk Assessment (Art. 4&5, deadline reporting 22.3.2012) [http://ec.europa.eu/environment/water/flood_risk/timetable.htm] and are proceeding to the next stage which is the “Flood Hazard & Flood Risk Maps” (Art. 6, deadline reporting 22.3.2014).

A brief list of major EU funded projects related to Flood Hazard management can be found at the JRC web site:
[http://ec.europa.eu/environment/water/flood_risk/links.htm#researchlinks]

Additionaly, important projects on flood Hazard assessment & management include:

- **The RIBAMOD (River Basin Modelling, Management and flood mitigation)**. The project "*will promote understanding of technical and policy issues in flood management, will examine how advanced modeling should support planning, design, operation and maintenance of flood defence systems and will identify methods and procedures for sustainable development, management and use of the river and its catchment".*
- **EFFS - European Flood Forecasting System. Aims at "***the development of a prototype pan-european flood forecasting system with a forecasting lead-time between 4 to 10 days ahead (the so-called medium range).The system provides daily information on potential floods for large rivers in Europe. The EFFS is set to be used as a pre-warning tool for water authorities that have a warning system for 0-3 days ahead already in place. The system can also provide flood warnings for basins that presently do not have an operational warning system. The prototype has been tested and validated in semi-operational mode on the* ***river*** *Rhine".*
- **FLOODMAN - Near real time flood forecasting, warning and management system based on satellite radar images, hydrological and hydraulic models and in-situ data. "***The project develops, demonstrates, and validates an information system for cost effective flood forecasting and management using EO data, in particular space borne SAR data. The prototype system will provide near real time information on the flood event, better flood predictions, and improve best practices for management of rivers and their catchments, including hydropower production planning".*
- **SPHERE – Systematic, Palaeoflood and Historical Data for the improvement of flood Risk Estimation. The scientific objectives of the Projects include:**
  "*1) To generate new scientific frameworks and technical tools for integrating data on extreme floods using multidisciplinary risk assessment methods. This new approach complements hydrologic modeling efforts by applying historical information and palaeoflood hydrology methods together with statistical and hydrological procedures to specifically increase data on the largest storm/floods over time spans which range from decades to millennia. 2) To provide a new methodology to estimate the frequency of the highest risk floods and transfer the resulting tools to end-users and decision makers of different technical and administrative levels. To provide a methodological guide for climatic/flood data collection and temporal analysis. 3) To improve the understanding of the climatic forcing conditions related to the formation of extreme floods in the short and long-term (10-103 years). 4) To suggest strategies for improving public awareness and flood risk education with regard to extreme flood events."*
- **The CRUE ERA-NET** project which "*aims to introduce structure within the area of* ***European Flood Research*** *by improving co-ordination between national programmes. The vision for the CRUE ERA-NET action on flooding is to develop strategic integration of research at the national funding and policy development levels within Europe to provide knowledge and understanding for the sustainable management of flood risks*."
- The **DANUBE FLOODRISK** Project within the Southeast Europe Transnational Cooperation Programme which focuses "*on the most cost-effective measures for flood risk reduction: risk assessment, risk mapping, involvement of stakeholders, risk reduction by adequate spatial planning*".
- The Project **"RIVERCROSS - Cross-border cooperation on flood basin River Evros / Maritza / Meric ",** includes partners from the Netherlands, Germany, Poland and Greece, and emphasizes the exchange of experience on transboundary

water management, analysis of factors determine the success or failure of the CBC this field and produce proposals for improvements and new methodologies.

- The Project "**Observation of quantitative and qualitative characteristics of rivers Erythropotamos**, **Ardas and Evros Region Eastern Macedonia and Thrace**", in the framework of the Community Initiative INTERREG IIIA / PHARE CBC GREECE-BULGARIA, implemented by the Department of Water Supply Directorate of Public Works, Region of Eastern Macedonia and Thrace, and funded by the European Regional Development Fund (ERDF) and by 75% National Funds 25%. The Project aims at creating a **flood forecasting system** to enhance defense against floods, to implementing key measures for the gradual incorporation of and compliance to the EC Directive 2000/60/EC and to designing a common approach between Greece and Bulgaria in order to achieve the common goals.
- **FLOODSite – Integrated Flood Risk Analysis and Management Methodologies. "***The FLOODsite project covers the physical, environmental, ecological and socio-economic aspects of floods from rivers, estuaries and the sea. The project is arranged into seven themes covering: 1) Risk analysis – hazard sources, pathways and vulnerability of receptors. 2) Risk management – pre-flood measures and flood emergency management. 3) Technological integration – decision support and uncertainty. 4) Pilot applications – for river, estuary and coastal sites. 5) Training and knowledge uptake – guidance for professionals, public information and educational material. 6) Networking, review and assessment. 7) Co-ordination and management."*
- **Regional Strategy for Disaster Prevention. CivPro**. It's a Regional Initiative Project financed by the European Programme for Interregional Cooperation INTERREG IVC.
- The "**FLINKMAN**" project [http://www.flinkman-project.eu/]. The basic scope of the project is the "development" of a suitable framework through the preparation of a flood management plan to ensure consistent and effective link, at each stage of the chain prevention - Readiness - Response - Recovery of floods. Moreover the project aims at: i) Developing supportive tools, based on Information Technologies (IT), which will promote the collection, evaluation and exchange of best practices. ii) Upgrading the current status of Civil Protection Units and iii) promoting international cooperation among the competent bodies in Europe.
- The Project SEE/A/118/2.2/X: **Practical Use of MONITORing in Natural Disaster Management – Project "MONITOR II"** [http://www.monitor2.org/index.php?option=com_content&view=frontpage&Itemid=1&ac45af24dc0db8131d6d3647bf3df4c7=b2a7a35180c18b667673e65384bc7324]. Scope of the Project is to improve communication among Disaster Management Experts. This is going to be achieved, according to the project, by improving communication and accelerating the flow of information between risk experts, local stakeholders and civil protection services. Requirements include the harmonization of procedures, methodologies and standards.
- **Project FLAPP – Flood Prevention in Border Areas**: Common approach on the cross-border management of floods. INTERREG III. Implementation period: Jan 2005-Aug 2007. The Project was about the integrated river basin management in cross-border areas. Aspect of the project include: flood prevention via construction and land use planning measures, sustainable management of river basins, disaster

management, cross-border cooperation for a holistic approach on flood management issues, raising public awareness on flood management issues.

- **Flood warning system establishment in Arda river basin for minimising the risk in the cross border area** (**ARDAFORECAST**). Greece-Bulgaria 2007-2013, Investing in our Future. Project start: 20 Mar. 2012; End: 19 Mar. 2014. [http://arda.hydro.bg/index.php]. The Project's expected outputs include the establishment of hydro meteorological information system, the development of GIS database, the improvement of the density and frequency of the hydro-meteorological observation network through, the installation of additional automatic stations, a flood warning system operation manual, a set of hot points, a set of alert threshold for each hot points, a set of warning procedures, WEB based tools for information exchange and access of decision makers, stakeholders and large public to all the necessary data and forecasts.
- Project **FLoods and fIre Risk assessment – FLIRE**. The aim of the LIFE + FLIRE is the combinatorial and effective assessment and management of flood and fire risks using cutting-edge tools and technologies, taking into account the issues of prevention, adaptation and interaction. FLIRE includes the development of the following tools and actions: Management Tool of Meteorological Information (WIMT) that takes short term forecast, taking into account local conditions, and classifies the weather as favorable for potential flood or fire risk. A tool for the assessment and management of flood risk in nearly real time, which will include components for river basin modeling, urban modeling and a Flood Early Warning System. This tool takes the WIMT information on flood hazards and activates the corresponding early warning systems (EWS).
- **FLOODRELIEF: REaL-tImE Flood Decision Support System Integrating Hydrological, Meteorological and Remote Sensing Technologies.** *"The main objective of FLOODRELIEF is to address the limitations of current flood predictions by developing and demonstrating a new generation of flood forecasting methodologies which will advance present capabilities and accuracies and making the results more readily accessible both to flood managers and those threatened by floods. This is achieved by exploiting and integrating different sources of forecast information, including improved hydrological and meteorological model systems and databases, radar, advanced data assimilation procedures and uncertainty estimation, into real-time flood management decision support tool designed to meet the needs of regional flood forecasting authorities."* *http://www.eugris.info/DisplayProject.asp?P=4598*
- **ECOFLOOD: Towards Natural Flood Reduction Strategies. "***The long-term objective of the Ecoflood project is to stimulate creation of floodplains that both protect the environment against floods and provide opportunities for restoration and development of highly valuable ecosystems. This requires an integrated vision. However, there is a knowledge gap between research fields, and scientific output is often not appropriate for stakeholders. EcoFlood contributes to this long-term objective by compiling comprehensive guidelines for creation of natural flood defenses based on the present information. The guidelines will contain: a) scientific knowledge on wet and terrestrial floodplain ecosystems, b) practical problems that obstruct stakeholders in creating natural flood defenses, c) scientific gaps and insecurities. Gathering this information is the main deliverable of a scientific conference, a stakeholder workshop and a thinktank meeting. The various relevant research fields will be integrated in the Ecoflood project."* **http://levis.sggw.waw.pl/ecoflood/**

- **ACTIF: Achieving Technology Innovation in Flood Forecasting. "***ACTIF will actively consolidate and disseminate Fifth Framework research advances in Flood Forecasting through three scientific meetings and preparation of best European practice guidance. The ACTIF partners will compile best practice guides on three topics where significant research advances have been made in recent years and also on cataloguing specific data sets of long-term value to the research community. Thus ACTIF will facilitate the uptake by end-users of European research advances in flood forecasting, warning and dissemination."* [http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/scho0606bkys-e-e.pdf]
- **VULMIN – Flood vulnerability of localities and the environment under the global modification.** Aim of this project is to evaluate the vulnerability of the potential flood-affected systems (human settlements, the communication network, arable lands etc.) in relation to their physical conditions and to social, economic and political contexts.
- **Integrated Management of the Danube ("Danube WATER integrated management").** The project aims to increase the capacity of border control cooperation and Romania - Bulgaria in terms of quality monitoring of environmental factors on the Danube and grounding joint response to emergencies (droughts, floods, pollution, contamination).
- **Plan for Preventing Flood protection and mitigation**. Scope of the project is to develop plan of prevention, protection and flood mitigation in the hydrographic area Dobrogea Litoral. These maps can be used to support decision making regarding flood hazard mitigation.
- **DESWAT project (**Destructive Water Abatement and Control of Water Disasters) The Destructive Waters, or DESWAT, program is an initiative of the Romania Ministry of Environment and Water Management (MMGA) to improve the water management authority National Administration Apele Romane (ANAR)'s flood monitoring capacity, as well as to improve its National Institute of Hydrology and Water Management flood modeling and prediction capabilities.
- **ROMANIAN FLASH FLOOD GUIDANCE (RO_FFG):** "*The objective of this technology transfer project is to design, develop and test the components of an operational flash flood guidance system for Romania. There are radar rainfall estimates for the area and a number of real time on-site precipitation sensors which would be used to provide input to the system. The flash flood guidance system will be implemented by HRC at the National Institute for Hydrology and Water Management (NIHWM) in Bucharest."*
- **HYDRATE Project: "***The **HYDRATE** objective is to improve the scientific basis of flash flood forecasting by extending the understanding of past flash flood events, advancing and harmonising a European-wide innovative flash flood observation strategy and developing a coherent set of technologies and tools for effective early warning systems."*

2.3.3. Landslides

Ongoing EU projects have examined the relationships between rainfall, land use, land cover and the event of slope failure and extensive erosion. Climate change impact on landslide occurrence is also being investigated. The final scope is to develop methodologies that can predict the occurrence and impact of landslides. European guidelines for relict landslides recognition have been prepared in order to support

decisions about land-use planning. New technologies as Remote Sensing (RS) and GIS are widely applied to assess landslides susceptibility through the evaluation of geological, hydrogeological and morphometric parameters affecting slope stability. Various modeling methods have been proposed in order to assess the landslide hazard in a more reliable and accurate way.

Projects already implemented in the EU countries, regarding landslide hazard mitigation include (but are not limited to):

- **GALAHAD,** focused on landslides, avalanches and glaciers -related hazard mitigation, through the development of advanced monitoring techniques and the improvement of forecasting methods and tools, with the aim of developing innovative and fundamental functionalities of remote monitoring techniques.
- **IRASMOS,** reviewed, evaluated and extended methodological tools for hazard and risk assessment of extremely rapid mass movements.
- **SafeLAND,** aims at developing "*generic quantitative risk assessment and management tools and strategies for landslides at local, regional, European and societal scales and establish the baseline for the risk associated with landslides in Europe, to improve our ability to forecast landslide hazard and detect hazard and risk zones."* SafeLAND has completed in 2013.

3. Conclusions

A review of EU actions related to Earthquake, Landslide and Flood Hazards Prevention and Management; which covered 22 EU guidelines and Directives, Programmes and Organizations established, and more than 40 Research Projects funded, shows that there has been an great interest by the EU regarding the mitigation of ELF Hazards.

As it appears, most of Research projects carried out so far, cover riverine floods in terms of flood hazard assessment and early warning, while a couple of them cover the part of data and methodologies homogenization. The implementation of those projects has led to the identification of Riverine Flood Hazard in large rivers of Europe and of the Black Sea area including Evros/Marica and Danube rivers. Solutions for the riverine problems have been proposed in most cases and even early warning systems have been developed.

The problems which still remain are related to information gaps, comparability of assessment results, lack of comprehensive overview in certain types of hazards and problems in dealing with cross-border issues.

The unavailability of required data, is a twofold issue: either there are no accessible data at all or the available data do not cover the entire required range (in terms of standards, inconsistencies in measurements, time-series etc) or finally, the available data are not comparable due to the different way data are recorded, processed or even coded by different researchers. Only a two of the research projects examined or have attempted to set up guidelines for data homogenization within their wider aims, but this issue still remains unresolved.

Another problem is the different methodological approaches used to assess the ELF Hazards. They lead to non-comparable results and this problem is widely spread as different methodologies are often used by researchers even within the same country.

Having said the above, the achievement of a consensus among the scientific community regarding data and methodologies used to assess ELF Hazards is of great importance because it will help create a large network of potential partners with the

same scope: to tackle ELF Hazards. Moreover, it will give them the means to communicate transparently regarding related scientific problems.
Management strategies should also be homogenized as fully as possible. Hazard Management must follow all steps of the risk management cycle: preparedness -being the most cost-effective stage, response, recovery and reconditioning of the management system. Cross-border cooperation is necessary at every step because it will greatly help to effectively tackle the problem for the greater benefit of all partners. Early warning systems installed in upstream countries can save lives and reduce economic losses. Moreover, cooperation helps to enlarge the number of available solutions and also to strengthen the knowledge and information base shared between partners. Widening the geographical area considered in planning on a "river basin" basis, offers the ability to select the more cost-effective mitigation strategies. The problems that arise when considering cross-border cooperation in flood hazard mitigation are usually connected to: lack of a legal framework for cooperation, lack of capacity and resources, lack of trust, insufficient data, differing institutional structures, lack of political will and lack of public awareness and participation. There is a need to address those problems.
One more problem that has not been fully addressed is the flash flood issue. Flash floods are typical in Mediterranean countries. These sudden and violent phenomena cause heavy damage and losses and are the most frequent type of flooding in the central and especially the southern part of the Black Sea area. The problem with modeling these types of floods is that water courses that cause flooding are usually ephemeral with very little or not at all water during most of the year and the respective watersheds are usually of limited extent and with a steep morphology so, this type of flooding has to be addressed by implementing research on a local scale.
Most of the aforementioned problems have also been recognized by the European Commission (Clark, 2012).
To sum up, cross-border cooperation, homogenization of methodologies used to assess ELF Hazards, easy or free access to reliable and accurate homogenized data needed to apply those methodologies, and reliable hazard maps on a local scale are needed in order to effectively design prevention measures, to plan an effective management strategy and finally to raise public awareness, in order to convert the public from part of the problem to a partner for the solution.

4. The Project "A Scientific Network for Earthquake, Landslide & Flood Hazard Prevention" - SciNetNatHaz

4.1. Details about the Project

The Project with the acronym "SciNetNatHaz" aims at contributing to solving the aforementioned problems, of a closer cooperation among the scientific community, the homogenization of methodologies used to assess ELF Hazards, the initiation of the procedure towards freely accessible and usable data, and sample-pilot implementations of hazard assessment on local scales which lead to designing of preventive measures. Basic project details are:

Programme: Black Sea Basin Joint Operational Programme
Priority 2: Sharing resources and competencies for environmental protection and conservation

Measure 2.1.: Strengthening the joint knowledge and information base needed to address common challenges in the environmental protection of river and maritime systems
Duration: 24 months
Total Budget (ENPI + IPA): 1.053.000,00
Total Grand (ENPI + IPA): 947 700,00
Start - End Dates: 01.05.2013 - 30.04.2015

4.2. Scope of The Project

Scope of the project is to achieve a strong regional partnership and cooperation by the Development of a Scientific Network for the establishment a scientific consensus, in order to setup common strategies and natural hazard prevention methods. The Scientific Network members will work together sharing competencies and resources to address Earthquake, Landslide and Flood Hazards which do have Trans - boundary consequences both on the economy and on the environment.

4.3. Specific Objectives

1. Setup common terminology, methodologies and strategies for ELFH prevention.
2. Built a WebGIS platform will support decision making and will also provide data and information to the scientific community interested in Earthquake, Landslide and Flood Hazards (ELFH), thus promoting research and innovation regarding natural hazard's prevention and preparedness in the Black Sea area.
3. Implement finally selected (developed or adapted) methodologies to assess hazards on a regional scale and on local scale in selected locations.
4. Provide training with open seminars and workshops

4.3. Anticipated/Expected Results

1. Cross boundary cooperation in preventing ELFH,
2. Cross border know-how and expertise transfer.
3. Data, methodologies and strategies used harmonization,
4. A WebGIS platform with a geodatabase that will be freely accessed,
5. Education and Training

4.4.The Partnership

The partners contributing to the Project's implementation are listed in the following table.

	Technological Educational Institute of Kentriki Makedonia, Hellas	ENPI Beneficiary Lead Partner
	IPA: Kandilli Observatory & Earthquake Research Institute (KOERI), Bogazici University, Istanbul, Turkey	IPA Beneficiary
	Democritus University of Thrace, Civil Engineering Department, Anatoliki Makedonia & Thraki, Hellas	Partner 1
	Institute of Engineering Seismology & Earthquake Engineering, Earthquake Planning & Protection Organization, Kentriki Makedonia, Hellas	Partner 2

	"Prof. Assen Zlatarov" University of Burgas, Yugoiztochen, Bulgaria	Partner 3
	Ovidius University of Constanta, Sud-Est, Romania	Partner 4
	"Dr. Ghitu" Institute of Electronic Engineering & Nanotechnologies, Academy of Sciences, Chisinau, Moldova	Partner 5
	Environmental Academy of Sciences, Black Sea Branch, Odessa, Ukraine	Partner 6

4.5. Logical Framework

1. At a first stage, the current status of all aspects of Hazard Mitigation stages will be assessed: EU directives, National legislation, state-of-practice etc.
2. Data collection will follow in order to try to create an initial database which will be updated and populated with more data as the project implementation progresses. It must be noted that, data requirements and the selection of the methodological approaches which are going to be used for each of the ELF hazards, are interlinked procedures so the data collection is in fact, a dynamic procedure continuously changing until the end of the pilot implementations. Needless to say that, data homogenization is essential for the implementation of the finally selected methodologies by all partners so data will be homogenized and respective metadata files created according to the INSPIRE directive.
3. A review of available methodologies regarding ELF Hazards will follow and methodologies will be selected to be proposed for use and implemented. Parameters taken into consideration for the final selection of methodologies include reliability, accuracy, customizability/adaptation to local conditions and data requirements as compared to readily available data.
4. Earthquake hazard maps will be produced for the pilot implementation areas. These maps are going to be used for geotechnical hazards assessment in order to outline areas prone to liquefaction, settlement, lateral displacements and landslides; that is, all geotechnical hazards triggered by earthquakes. Geotechnical Hazard maps provide valuable information and support decision making regarding preventive measures, land use planning and can also help in designing Hazard mitigation actions.
5. Flash Flood Hazard maps of the implementation areas will be created at regional scales in order to locate flood hot spots and then, flood hazard will be assessed in local scale where the inundation area and the depth of inundation will be calculated. Repeated flash flood hazard assessments using preventive measures will be performed in order to finally estimate the preventive measures needed to channel the flood downstream and to protect valuable assets. The pilot implementation area for flash flood hazard assessment is the area of Serres, Greece where similar events have taken place in the past, causing serious damage in the city.
5. Landslide hazard considering both earthquakes and precipitation as triggering factors will be assessed, at regional and in local scales and preventive measures will be proposed.

6. Tools will be created in order to help stakeholders use the methodologies. Manuals containing step-by-step procedures and open source GIS software will enable everybody interested to be involved in ELF Hazard assessment. Seminars will provide the basics for communication and cooperation among the partners and stakeholders.
7. All collected and produced data will be freely available to the community via a WebGIS platform created for that purpose.

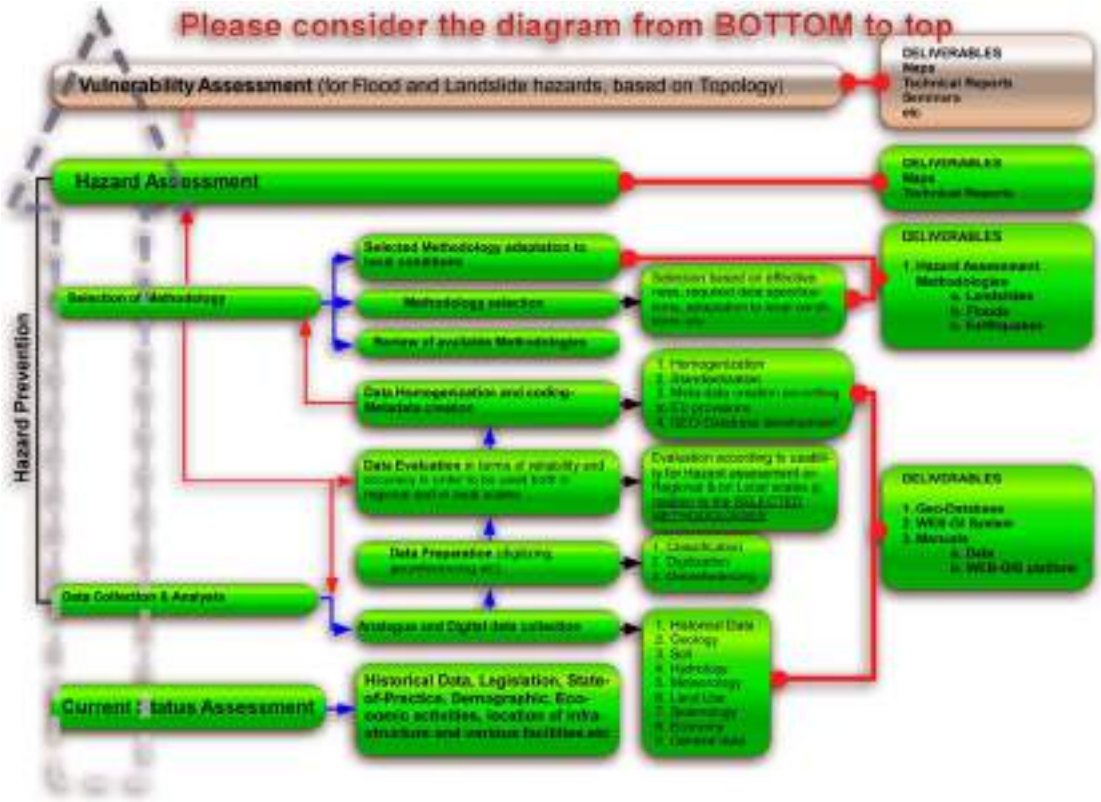

Fig.1. Representation of the Project's implementation scheme. Starting actions are at the bottom and the project evolves upwards.

4.6. Progress

Ten Project actions have been successfully completed (30/12/2013) covering Project coordination issues, the "current status assessment" in terms of ELF Hazard related legislation and state-of-practice in the participant's countries as well as data collection and processing and a review of the most recent bibliography regarding available ELF Hazard assessment methodologies.

The Project has been presented in the Final Stakeholder's Meeting of the Project RiskLIDES, in three International Conferences and there are two additional publications in scientific journals related to it.

Currently, deliverables are being finalized and progress is made towards the implementation of the next Actions.

5. Discussion

The SciNetNatHaz Project aims at exactly the points that seem to be missing in order to effectively assess Earthquake, Landslide and Flood Hazards on regional and local scales, with methodologies which provide reliable and accurate results and can be widely accepted and applied. Among the project's scopes is the homogenization of data which must be accompanied with metadata formatted according to the INSPIRE proposed regulations. Potential problems are the lack of ELF Hazard inventories, the lack of a systematic data collection, the reluctance of well established organizations to accept adapting/modifying methodologies they are already using to new standards. Dissemination of the project's outcomes including documentation of methodologies, freely accessible data, implementation guides for the methodologies, step-by-step-tutorials and open source GIS tools are expected to broaden the group of potential participants in ELF hazard assessment in the Black Sea area.

5.1. More Information about the SciNetNatHaz Project

Web site: http://www.scinetnathaz.net/
FaceBook: https://www.facebook.com/scinetnathaz.scinetnathaz?fref=ts
Twitter: https://twitter.com/SciNetNatHaz
YouTube: http://www.youtube.com/user/SciNetNatHaz

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1. 2007/60/EC Directive implementation: Preliminary Flood Risk Assessment *http://ec.europa.eu/environment/water/flood_risk/timetable.htm*
2. ACTIF: Achieving Technology Innovation in Flood Forecasting: *http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/scho0606bkys-e-e.pdf*
3. Business Case for Disaster Risk Reduction: *http://www.preventionweb.net/english/hyogo/gar/2013/en/home/download.html*
4. Commission of the European Community (1975): *http://europa.eu.int/comm/enterprise/ construction/internal/guidpap/l.htm*
5. Council of Europe: European and Mediterranean Major Hazards Agreement
6. *http://www.coe.int/t/dg4/majorhazards/ressources/pub/default_en.asp*
7. DANUBE FLOODRISK project : *http://www.danube-floodrisk.eu/2009/11/about/*
8. DESWAT project. Early Warning System for Romania from Lockheed Martin: *http://www.solutionsforwater.org/wp-content/uploads/2012/01/DESWAT-Project.pdf*
9. Directorate General for Research & Innovation *http://ec.europa.eu/research/index.cfm?pg=dg*
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11. ECOFLOOD: Towards Natural Flood Reduction Strategies. *http://levis.sggw.waw.pl/ecoflood/*
12. European Alarm System *http://www.coe.int/T/DG4/MajorHazards/alertes/ default_en.asp*
13. European Commission- Research & Innovation: http://ec.europa.eu/research/environment/newsanddoc/article_3249_en.htm
14. **European Commission, Humanitarian Aid & Civil Protection: Prevention**
15. http://ec.europa.eu/echo/policies/prevention_preparedness/prevention_en.htm
16. European Laboratory for Structural Assessment (ELSA) *http://elsa.jrc.ec.europa.eu/*
17. EUR-OPA Major Hazards Agreement *http://www.coe.int/t/dg4/majorhazards/centres/presentation /ispu_en.asp*
18. European Flood Awareness System –EFAS. *http://www.efas.eu/*
19. FLOODRELIEF: REaL-tImE Flood Decision Support System Integrating Hydrological, Meteorological and Remote Sensing Technologies. *http://www.eugris.info/DisplayProject.asp?P=4598*
20. Global Assessment Report on Disaster Risk Reduction 2013: From Shared Risk to Shared Value: the Global Disaster Alert & Coordination System *http://vosocc.unocha.org/*
21. HYDRATE: *http://www.hydrate.tesaf.unipd.it/index.asp?sezione=ProjectOverview&SubSez=ProjectOverview*
22. Joint Research Centre (JRC) *http://ec.europa.eu/dgs/jrc/*

23. Practical Use of MONITORing in Natural Disaster Management – Project “MONITOR II” *http://www.monitor2.org/index.php?option=com_content&view=frontpage&Itemid=1&ac45af24dc0db8131d6d3647bf3df4c7=b2a7a35180c18b667673e65384bc7324*
24. The Prevention Web: Serving the Information needs of the Disaster Reduction Community. *http://www.preventionweb.net/english/*
25. River basin modelling, management and flood mitigation: *http://databases.eucc-d.de/plugins/projectsdb/project.php?show=288*
26. Romanian Flash Flood Guidance system -ROFFG *http://www.boku.ac.at/diebodenkultur/volltexte/sondernummern/band-64/heft-3-4/matreata.pdf*
27. UN-HABITAT : RDMU (Risk and Disaster Management Unit): *http://www.unhabitat.org/programmes/rdmu*
28. UNDAC (United Nations Disaster Assessment and Coordination): *http://www.unocha.org/what-we-do/coordination-tools/undac/overview*