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Geoscience, a tool for civil protection against floods

Intelligere, tueri noscendas - To understand, to identify and to protect

The geological science, the discipline of the dynamic changes which Earth has undergone and is undergoing, is always at the forefront of understanding the mechanisms of natural processes and events. Practitioners of geology, academics and professionals alike, offer their expertise to the society's benefit and provide one of the first lines of defence against natural disasters.

The European Federation of Geologists (EFG), the professional body that represents 25 national geological association members, is drawing the attention of policy makers at international, European, national, regional and local level to the paramount importance of geoscience in civil protection against natural hazards and especially floods, given the recent events in Germany, Belgium and France this June.

The recent European floods resulted in the loss of life for at least 12 people ¹ and 600 pupils were trapped in schools ² with the risk of losing lives. Fortunately, they were eventually brought to safety. Streets were submerged and the Louvre and Orsay museum were closed with several artwork moved to the top floors ¹. Damages to infrastructure from the floods and the landslides triggered by the rain are yet to be reported.

The flood cost is currently estimated at €600 million worth of damage with the potential to reach more than a billion euros ³. Previous floods of June 2013 led to €12 billion in economic losses across nine EU Member states ⁴. It is expected that the average annual economic loss due to flooding will be in the range of €23.5 billion by 2050, over five times the amount for the period 2000 to 2012 (€4.6 billion) ⁴.

The previous figures are indicative of the funds that are and will repeatedly be spent every year for the same reason without bringing the required result of safety. Furthermore, it prevents the release of funds for societal progress. These costs stress the resources of insurers, governments and society overall as there is also the pain for loss of life which may also be a valuable resource of family support.

These events once more emphasize the importance of focusing on reducing the risks from natural hazards. The increase in the number of natural disasters caused by floods during the last few decades underlines the importance of taking preventive and, where necessary, mitigation measures against natural hazards.

Flood disaster conditions are created by changes in land use and reckless building in vulnerable areas such as floodplains with subsequent failure to control flooding. Levee failures are extremely difficult to alleviate with disasters being even worse as usually there are no contingency plans for such cases ⁵. Floods damage human settlements, force evacuation, damage crops, strip farmland, wash away irrigation systems, result in erosion of land or make it otherwise unusable. Forced agricultural development has eliminated natural obstacles such as hedges, herbaceous ditches, trees and topographic raisings. A water volume which was taking significant time to reach a river or a stream is now arriving within a few hours period. Still, floodplains when properly managed can reduce flood risk and simultaneously improve water quality, recharge groundwater, support fish and wildlife and provide recreational tourism benefits ⁶.

Current policy concentrates on reaction to disasters, rather than taking preventive and mitigation measures. With climate change and the continuous increase of construction in hazard-prone areas, concentration on disaster reaction will lead to continuous increase in cost for the society. Investment in Disaster Risk Reduction (DRR) ^{7,8} saves lives during and after the disaster occurred and financially restricts the disaster cost ⁹ with high economic returns ⁸. Benefit-cost ratios of 4 and higher are documented in the literature ¹⁰ on prevention ¹¹. This approach supports a proactive risk reduction response instead of the traditional post disaster action.



DRR includes any activity that prevents or reduces the risk from damages caused by natural hazards like floods^{12,13} and is framed within information sharing and policy implementation under three pillars¹⁴ of action at which geosciences have an important contribution to offer at the different levels of spatial development planning, land use planning, natural hazards mapping and disaster preparedness emergency planning:

1. Risk Assessment.
2. Risk Reduction.
3. Risk Financing & Transfer.

Risk Assessment identifies hazards and provides information on exposures and vulnerabilities on the population and infrastructure. Risk Reduction is achieved with the installation of early warning systems and by implementing its core concept of Risk Prevention. The latter is based on land use planning, infrastructure development and maintenance, water resource management, agricultural planning, understanding the mechanisms of climate change, institutional coordination mechanisms, information and knowledge sharing.

The reduction of the disaster's financial impacts can be achieved by risk financing mechanisms such as insurance products¹⁵. Proper knowledge of geological conditions underlying the hazardous factors can help to quantify the associated risk and thus accurately calculate the insurance cost.

Therefore the EFG recommends to:

1) **Integrate geology into future European Directives and national legislation**

EFG calls for the consideration of the amendment to the SEVESO III Directive, the SEA Directive, the EIA Directive and by the inclusion of the Critical Infrastructures Directive the need for defining and mapping natural hazards a priori to the eventual permitting or embedded into the licensing process.

In member states the generation of hazard maps for planning purposes to control construction in vulnerable areas, should be integrated into national, regional and local legislation as a prerequisite for decision makers in spatial development and land-use planning. Where legal framework for land use and control laws exist, authorities should always ensure their compliance¹⁶.

2) **Educate society to improve the understanding of and response to natural hazards**

Many natural disasters are compounded by inappropriate human actions or decisions. Raising public awareness and increasing the knowledge of geological sciences will assist disaster management teams and rescue operations to better understand the situation and avoid further escalation of the problems. Better insight in the geological sciences will lead to improved policy-making with respect to adopting the best preventive and mitigation measures against natural hazards.

3) **Develop and install early warning systems (geo-indicators) in areas at risk**

The EFG calls for a European unified hazard monitoring system, integrating already available warning systems with the use of geo-indicators, geological and geotechnical data. Furthermore, EFG recommends further research to improve these monitoring and early-warning systems and to effectively adapt them to European needs.

The above suggestions must be realized with special funds from the European Union. The final effect of such a coordinated approach would be effective know-how, expertise and experience sharing, and substantial reduction of costs on a European-wide level while minimising redundant efforts.

To provide a consistent and universal understanding of natural events a standard European system is recommended with the same hazard, risk levels and information. This is especially relevant when considering that a significant portion of the EU Community budget is allocated to the aftermath management of such major cases resulting from natural catastrophic events.

Such a harmonised information base and assessment/scoring system would assure EU taxpayers and decision makers that the allocation of these funds is justified and spent on a consensual base. Furthermore, harmonisation provides the incentive for professionals to freely move and offer their expertise to different European Union member states.

4) **Open access to the scientific data**

Disaster risk reduction requires an all-of-society engagement and partnership this can be greatly achieved by the implementation of transparency and access to data⁵³. The European Union through its digital agenda for Europe¹⁷ strongly encourages the development of a pan-European digital service infrastructure for open data with a view of providing multi-lingual access to data published by public administrations at all levels of government in Europe.



Making maps of flood plains and general geological data easily accessible would make developers and property owners more aware of the risks—and more motivated to build appropriately ¹¹.

The EFG recommends the amendment of the INSPIRE Directive with provision to promote the release in digital form of high-resolution topographic maps, near coast bathymetry, geological, environmental and geotechnical maps, remote sensing data, geophysical data, including data for the early warning systems as open data freely available for distribution and use to the general public. It is highly anticipated that data dissemination will greatly reduce risk from natural hazards as it will assist the technical professionals to design and construct safer infrastructure projects at reduced cost. Furthermore, and equally important, it will provide in depth information to the public and stakeholders.

5) **European coordination project**

Research project on the geological knowledge and dissemination. Furthermore, investigation on countries with strong legislation background in areas of natural hazards and how a good preventive policy has avoided major disasters and reduced economic losses.

The group of experts on Natural Hazards of the European Federation of Geologists is available to provide all necessary information and to make recommendations from a geological perspective, so that it will lead to a significant reduction of negative effects caused by natural disasters.

About EFG: The European Federation of Geologists is a non-governmental organisation that was established in 1980 and includes today 25 national association members. EFG is a professional organisation whose main aims are to contribute to a safer and more sustainable use of the natural environment, to protect and inform the public and to promote a more responsible exploitation of natural resources. EFG's members are national associations whose principal objectives are based in similar aims. The guidelines to achieve these aims are the promotion of excellence in the application of geology and the creation of public awareness of the importance of geoscience for the society.

About the EFG Panel of Experts on Natural Hazards: The group has been established in March 2003, in relation to EC initiatives on Civil Protection, DG Environment, and has since then provided many contributions to the EC.

Pavlos Tyrologou, the coordinator of this Panel of Experts, is Chartered Geologist and holder of EurGeol title in the field of Engineering and Environmental Geology. He is member of the Technical Committee in Engineering Practice of Risk Assessment and Management of the International Society for Soil Mechanics and Geotechnical Engineering and acts as focal point for the E.F.G. in the working group for the European flood directive.

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