FÉDÉRATION EUROPÉENNE DES GÉOLOGUES
EUROPEAN FEDERATION OF GEOLOGISTS
FEDERACIÓN EUROPEA DE GEÓLOGOS

European Federation of Geologists
13 Rue Jenner, B-1000 Brussels
Ph. +32-2-7887636
efgbrussels@tiscalinet.be

Geoscientific recommendations regarding natural hazards to be considered in the Seventh Framework Programme 2007 - 2013

Prepared by the Panel of Experts on Natural Hazards of the European Federation of Geologists

H. Ligtenberg (co-ordinator)

- March 2006 -

The European Federation of Geologists (EFG) established panels of experts to provide high quality response to the European Commission and Parliament. Recently, the EFG expert panel on natural hazards was approached to provide additional input to the Seventh Framework Programme, to be able to identify a strategic research agenda for the natural hazards sector. The official request and the full extract related to Environment research (*extract from Annex 1 Themes)* were studied and discussed within the expert panel. Feedback from the experts involved, approximately 40, are presented below. Aim was to provide recommendation headlines, without too much technical detail. More technical background information can be provided on request. We hope the contributions presented will be considered in the final version of the Seventh Framework Programme.

Key issue to keep in mind is that the better we understand the natural mechanisms and the behaviour and properties of the subsurface, the better we can set up mitigation measures that can ultimately lead to prevention and full preparedness to these threatening hazards. Significantly improving our understanding of all geological processes will therefore be of great benefit to the European society.

General issues to consider:

- Integration of different disciplines should be a driving force in research.
- Establish an improved European network of researchers working on the same issues; initiate closer collaboration. European Federation of Geologists can assist to build this European research network, using its extensive networks of geoscientists in (and outside) Europe.
- Connections with hazard and risk mapping are important in natural hazards research, because the society will then ‘directly’ benefit from the research for improved land use management.
- A lot of natural hazards research has already been done at national geological surveys, at research institutes, at universities, et cetera. The available results and techniques should be inventoried, collected and subsequently harmonised.
- Co-operation and integration with running research projects is recommended (e.g. ESA projects).
- Raise awareness and educate people.

European Federation of Geologists
13 Rue Jenner, B-1000 Brussels
Ph. +32-2-7887636
efgbrussels@tiscalinet.be

A - Key research needs on a specific hazard level

- **Research in slope stability.**

Land slides are a well-known natural hazard, occurring quite often in many parts of Europe and with devastating effects to people and infra-structure. Land slides mostly occur in deposits that are made up of fine sand, silt and clay. They are related to hydro-geological, geo-morphological and geo-structural conditions. Slope deformations commonly appear in connection with spring snowmelt and thawing of frozen ground, as well as during periods of intensive rain fall, leading to saturation of water and high water pressure in the ground. Land slides can also be related to poor land use management practices, such as deforestation in potential risk areas.

Many regions in Europe are vulnerable to slope deformations – landslides, rock falls, debris flows. General observations show an increasing number of landslide events and an extension of landslide occurrence into formerly stable areas For example, permafrost regions are slowly thawing, the cryospheric system of high altitudes starts to fall apart, with implications for rock fall, avalanches, land slides and so on. It has also implications for buildings anchored to previously solid (frozen) ground and for developing tourist and sporting activities in high mountain areas. Increasingly, landslides, outbursts of glacial lakes and flash debris flows are forming a threat to the European community.

The mechanism and triggering of landslides is influenced by many different factors (e.g. sediment type, slope angle, soil properties, water saturation, temperature, et cetera). Especially the interaction between the different parameters requires more research.

Additional research is required to gain improved insight in the quality and behaviour of slopes. Especially to improve our understanding of the effect that different parameter changes may have on slope stability.

Focus on:

- Improve understanding of mechanism and triggering of landslides.
- Gain improved insight in interaction of different parameters effecting landslides.
- Understanding influence of climate change on slope instability (e.g. increasing rain fall; permafrost thawing).
- Specific research in cryospheric systems and their effect on slope instabilities.
- Developing/improving early warning systems (geo-indicators) to detect slope instability at an early stage.
- Integration of different technologies and disciplines in slope stability research.
- Detailed integration with remote sensing, for example to use satellite monitoring techniques for ground motion (e.g. terrestrial laser scanning and interferometric single aperture radar (InSAR)).

The results of this research will ultimately lead to improved land use management, being able to take preventive or mitigation measures in regions vulnerable to landslides.

European Federation of Geologists
13 Rue Jenner, B-1000 Brussels
Ph. +32-2-7887636
efgbrussels@tiscalinet.be

- **Research in flooding**

Geology should be an integral part of flood prevention and protection. Flooding is often assumed to be a matter of weather forecasting, hydrology and civil engineering, but the valleys and catchments that focus floodwaters are also major geological systems. We should therefore be aware that geology plays a crucial role with respect to flooding.

It is already known that the properties and behaviour of soils are important factors in flooding. Extensive research has been done in e.g. the UK on 'run-off' response of soils. However, linkage between soil properties and aquifer properties of the geological substrate, which controls the behaviour of soils, is seldom mentioned. This linkage can either be indirect, where rock compositions influence the types of soil developed in the weathering profile, or direct, where natural or man-made drainage systems penetrate the soil layer and convey runoff straight to the geological substrate. To give one example, the response to significant rain fall will be completely different if the parent/soil system acts as a sponge or as a seal. In the latter, runoff conditions are enhanced and there will be a greater potential for damaging flash floods to occur. The importance of geology is emphasised in the case of regions prone to ground water flooding, which is caused by elevated water tables in rock sequences that give rise to karstic landscapes. In all, more research into geological ground conditions, and in particular the distribution and physical properties of rocks and superficial deposits, should take place. Research into fluvial processes occurring on floodplains should also be an essential geological input to the flooding problem; in conjunction with high-resolution topographic surveying, this can assist decisions about future land-management practises in vulnerable areas.

Special focus on flood plains and coastal plains that are heavily defended by engineered embankments (compare New Orleans scenario) should be considered. Additional attention may also be required to construction of flood defence systems. For example, it will be necessary to construct special types of foundations if flood defence systems are to be built on top of permeable and generally unconsolidated river bed deposits. The influence of subsidence on flood defences in mining areas is another important factor. Specific geological and geomorphologic studies will be necessary. In this respect, additional research may also be required to improve geophysical, engineering geological and geotechnical methods to quickly evaluate the quality of water defence systems and detect weak sections in dikes at an early stage.

Focus on:

- Research on geological ground conditions on flood plains and coastal plain areas that are mainly protected by man-made flood defence systems (incl. land subsidence (see below)).
- Hydrogeological research to improve our understanding run-off and water storage capacity/groundwater movements (also useful in water quality and scarcity problems).
- Improving geophysical, engineering geological and geotechnical methods to quickly evaluate the quality of flood defence systems.
- Improving our understanding of fluvial processes, and how they can influence the various options available to mitigate the effects of future flooding.

European Federation of Geologists
13 Rue Jenner, B-1000 Brussels
Ph. +32-2-7887636
efgbrussels@tiscalinet.be

- **Research in land subsidence**

Land subsidence in low lands, deltaic areas and undermined areas is a natural/artificial geological hazard with major consequences and increasing risk for bordering lands and cities. Consequences are damage to foundations of buildings, bridges, roads, et cetera. When this land subsidence is combined with the risk of foreseen sea-level rise, especially in floodplain and deltaic regions, this issue is of great concern for the near future. Research into the long-term sustainability of 'vulnerable' settlements is recommended. Many European cities are built on loosely consolidated substrates and are liable to 'sink' under their own weight, a situation that will be accentuated by sea-level rise and isostatic subsidence.

Regarding undermined areas, they may become a hazard to society, especially with changes in ground water conditions (in relation to climate change). Increasingly in Europe, long established mining industries are coming to the end of their life or are being abandoned on economic grounds. As a result, mine waters rise and causing fault reactivation, renewed subsidence and, when the mine waters reach the surface, pollution of rivers and other water courses, and possibly aquifers. The after effects of mining may not be regarded as 'natural' but these effects may take decades to manifest themselves, by which time the old mining industry has long gone and no-one is left to take responsibility.

With respect to land subsidence, it is also recommended to consider geohazards that are caused by material properties. These include collapsible soils such as loesses which are extensive in Eastern Europe but also encountered to the west; compressible soils – peat and soft alluvium and swelling and shrinking clays that are the most expensive geohazard in e.g. the UK because of their consequences for light structures such as houses. UK insurance industry loses around €600M a year. Similar losses take place elsewhere in Europe where Mesozoic and Tertiary clay formations are found.

Focus on:

- In general, research into long-term sustainability of vulnerable settlements with respect to land subsidence. Integrate with geological maps.
- Research in subsidence behaviour of the subsurface; consider special focus on regions with flood risk (especially low lands and deltaic areas), as well as collapsible soils, peat, swelling and shrinking clays.
- Research in monitoring land subsidence, possibly by using airborne laser or radar technology, especially in large urban areas at risk of inundation.
- Investigate preventive and mitigation measures to reduce the damage caused by natural and artificial land subsidence.

European Federation of Geologists
13 Rue Jenner, B-1000 Brussels
Ph. +32-2-7887636
efgbrussels@tiscalinet.be

B - Key research needs on a more horizontal level

- **Risk mapping**

Geological hazards should always be taken into account in land use planning, in order to mitigate the risk. Several European regions have already partly integrated hazard and risk maps in their land use management.

Flood risk mapping already receives quite a lot of attention in Europe. Experts through the European Federation of Geologists are involved in a European Commission working group on risk mapping, EXCIMAP, and a working group on land use management, both in relation to the preparations for a European Floods Directive.

Often regions are vulnerable to multiple hazards. These should be fully integrated in one hazard and risk mapping system.

Geological maps, often digitally available at geological surveys, should be fully incorporated in hazard maps. They contain information on the occurrence of weak soils (important in investigation of land subsidence and slope instability); locations of faults in the subsurface that are sensitive to earthquakes; they highlight regions with the distribution of alluvial deposits, crucial in determining zoning in flood risk maps; et cetera.

Geographical Information Systems are recommended to be used for hazard and risk mapping purposes, in combination with geostatistical analysis, to create multi-risk maps.

A special recommendation, often overlooked, is the mapping of old environmental loads and radioactive emanation activity (esp. Radon). These are geological hazards that can cause major health problems.