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STRIM pilot project: Space technologies and G.I.S. for seismic risk monitoring on active tectonic structures. Synergy in application of space technics and G.I.S. to aid seismic risk managers in decision making

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a. BRIEF DESCRIPTION OF THE PROJECT

Active tectonic structures and their elements, such as active seismic faults, are the main causes of seismic disasters in urban areas and is significant infrastructure (High Dams, Refineries etc). Seismic Hazard and Risk monitoring on these active structures requires operation of dense seismological geodetic (i.e. GPS) and other networks, which are very expensive and time-consuming in the context of emergency situations management. Remote sensing techniques can offer an alternative in Seismic Hazard Monitoring as less money and time consuming and having multiple use. These technics are very effective in detecting, delineating and describing active faults and their characteristics because of recognizing in satellite images through certain morphostructures caused by faulting. Information on active tectonic structures and monitoring results integrated into G.I.S. could be well utilized by earthquake engineers while designing infrastructures, as well as by seismic risk managers of all interested parts and at all levels of administration while decision making. Moreover, the application of space techniques enables complete fault systems to be analyzed and monitored without travel and boundary issues, which hold the operational possibilities of ground monitoring networks on States frontiers.

The aim of this pilot project is to organize a practical exercise aiming at testing the cooperating capabilities of five European Centers on tackling a specific problem that is applying Space Technologies and G.I.S. to monitor seismic risk on Active Tectonic Structures with the purpose to demonstrate the possibility of inputting processed space imagery to EDRIM Network in order to aid decision-making.

The European Centers involved are:

- European Center on Prevention and Forecasting of Earthquakes (Athens, Greece),
- European Center of New Technologies for the Management of Natural and Technological Major Hazards (Moscow, Russia),
- European Center for Seismic and Geomorphological Hazards (Strasbourg, France),
- European Center on Geodynamical Risks of High Dams (Tbilisi, Georgia),
- Associated European Center of Training and Information of Local and Regional Authorities (Baku, Azerbaijan).

The main objectives of the project are:

1. To define and describe the parameters of active tectonic structures and associated seismic faults for two seismically active areas with developed infrastructure and characterized by different geological history, for well understanding the difference or similarity of related seismic hazard and risk parameters.
2. To assess the seismic hazard parameters which could be recognized and monitored on the basis of space images processing and interpretation by using all the available remote sensing data, optical and radar, or combined images from different sensors .
3. To integrate into G.I.S. the results of space imagery interpretation as specific informative layers with scope to aid seismic risk monitoring in given region.

4. To exchange knowledge and to transfer technologies and skill-sets in the field of space imagery processing and interpretation and G.I.S. on the problem of Seismic Risk Monitoring on an international basis, among the Centers involved.
5. To prepare in a friendly for the non-specialist end-user form the processed space imagery which on the detection of active tectonic structures, seismic faults and seismic hazard parameters for input into the EDRIM network in order to aid decision making of seismic risk managers.

WORK CONTENT

Characteristics of main active faults, constituting active tectonic structures, have been recognized in satellite images through the related topographic and other features. To verify the results of image interpretation and to have the additional information about active faults parameters, field observations on these faults was conducted.

Informative layer on characteristics of active tectonic structures and associated seismic faults, as well as of seismic hazard parameters derived from space images, have been prepared and integrated into G.I.S. for assessment of possibilities of seismic risk monitoring on these structures using space technics.

For the purpose of the project, two test areas were selected: one in Greece and one in Azerbaijan. For the Greek test-site, the area of Heraklion prefecture, Central Crete was selected.

In order to carry out the project the following space earth observation and other ancillary data were used:

- SPOT XI, 4 bands (from visible to infrared), 20 m/pixel
- Digital Elevation Model (DEM), created from satellite SPOT PAN data, 20m/pixel
- Shaded relief map of the area, created from DEM, 20m/pixel
- Topographic maps scale 1:50,000
- Sismological data
- Tectonic information capture from already existing tectonic and neotectonic maps
- Results of field observations on neotectonic structures and their eventual affect on human infrastructures.

The space data and the thematic maps were georeferenced in the same projection system EGSA'87 (Hellenic Geodetic System). The combination and manipulation of the data were made in a G.I.S.

RESULTS AND CONCLUSIONS

The prospect results of this project could be summarized as following:

- The satellite imagery may be used in a fully understandable way in a system made for decision making by non-specialists on space technics matters.
- The best synergy of Earth Observation data and other related thematic maps as well as databases that describe the objects of the thematic maps was the main task we tried to achieve. In the project we used the best offered (spatial and spectral resolution) satellite multispectral data. An important progress should be achieved using the new very high-resolution data (IKONOS) which will expand the applications and the quantity and quality of the capture information. Regarding the descriptive information as databases, they should be analytical and often updated.
- Final products are displayed in a way that could be "readable" also by non-specialists, using the Geographic Information Systems, in this case ARC-VIEW s/w. Further effort should be on the technic of image processing and displaying the results, because the most simple image for the specialist is very difficult to be interpreted by the non-specialist. The problem becomes more difficult when not optical but radar data are to be used. More steps must be done on this matter.

- New commercial satellites are getting into orbit in the near future and the new space images are going to have better characteristics for processing and interpretation and finally to become more palpable. It is more mature nowadays to use new remote sensing technics such as SAR Interferometry, as they are getting more and more into operational projects.
- It is significant to overcome an endogenous, but very important obstacle of the project regarding the partnership between the involved European Centers that is the communication difficulties. Our experience on this matter points out that communication between the Centers needs improvement.

The results of the project are presented in the multimedia CD available in E.C.P.F.E.

