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TOPIC: NATURAL HAZARDS

Volume I

Avalanches, Landslides, Multirisks, Earthquakes, Volcanoes

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EC CONTACT INFORMATION

Natural Hazards Projects

Denis PETER
DG Research
Environment and Climatic Systems Unit
Tel: +32.2.295.84.46
Fax: +32.2.299.57.55
Email : denis.peter@cec.eu.int

Infrastructure Projects

Cathy ECCLES
DG Research
Natural Resources Management and Services Unit
Tel: +32.2.299.46.95
Fax: +32.2.295.05.68
Email: Catherine.eccles@cec.eu.int

Gilles OLLIER
DG Research
Natural Resources Management and Services Unit
Tel: +32.2.295.66.30
Fax: +32.2.295.05.68
Email: gilles.ollier@cec.eu.int

Framework Programme 6 information

http://fp6.cordis.lu/fp6/calls.cfm
http://www.cordis.lu/fp6/find-doc.htm
http://www.cordis.lu/fp6/activities.htm
http://www.cordis.lu/sustdev/environment/home.html

DG Research Natural Disasters Web Portal

http://www.eu-medin.org

Volume I: Avalanches, Landslides, Multirisk, Earthquakes, Volcanoes
Volume II: Forest Fires, Floods, Technological Hazards, Multirisks

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AVALANCHE

NATURAL HAZARDS

CADZIE - Catastrophic Avalanches: Defense Structures and Zoning in Europe
EVG1-CT-1999-00009

Start date: 01/04/00 – End date: 01/04/03
Duration: 36 months
EC contribution: 689,599.00 €
EC contact: Maria Yeroyanni

Project Co-ordinator
Dr Mohamed Naaim
CEMAGREF
Water and Waste Disposal Engineering and Management dept.
Snow Avalanche and Torrent Control Research Unit
Rue de la Papeterie 2
FR – 38402 Saint Martin d'Hères
Tel : +33.4.76.76.27.22
Fax : +33.4.76.51.38.03
Email : mohamed.naaim@cemagref.fr
http://cadzie.grenoble.cemagref.fr/

PROJECT SUMMARY

Problems to be solved

The extreme avalanche winter of 1999 has made the European avalanche experts to rethink existing methods in order to calculate avalanche runout distance and prepare hazard maps. New methodologies, based on modern computer methods presently under development in all European countries, must be introduced in order to be able to manage the extreme avalanche periods better. The aim of this project is to understand the physical processes involved in dynamics of catastrophic avalanches and their interactions with defences structures

Scientific objectives and approach

The aim of this project is to improve catastrophic snow avalanche zoning by developing new methods which will complement the classical methods based on expert and historical analysis. The new numerical models will be integrated in G.I.S and a database concerning well-documented avalanche data will be built.
The macroscopic law of the interaction between avalanche flows and defence structures will be determined through laboratory physical scale-models and 3d numerical model experiments. The experiments will be carried out in laboratory-small scale models and also using refined numerical models. The numerical models including defence structures laws will be tested comparing their results to the available data from field. The obtained laws will be integrated in the avalanche numerical models. The database will be complemented with the available field data and major avalanche events which will be used to test the avalanche models including defence structures. New catastrophic avalanche risk mapping methods will be developed in order to improve the quality of avalanche zoning. Dissemination towards end users will be achieved through handbooks, trainings, demonstration and publications.

Expected impacts

The Alps are the single most popular tourist region in the world drawing 120 millions visitors per year. The expansion of existing communities and construction in new developed areas requires accurate and easily used tools for avalanche zoning. The knowledge developed within this project will allow the European market to design in an efficient and competitive way the defence structures and to optimise the investments.

Scientific partners

2	Mr Ulrik Domaas	Norwegian Geotechnical Institute P.O. Box 3930 Ulleval Stadion Sognsveien 72 NO – 0806 Oslo	Tel : +47.22.02.30.85 Fax : +47.22.23.04.48 Email : ud@ngi.no
3	Dr Tomas Johannesson	Icelandic Meteorological Office Department of Research and Processing Bústaõavegur 9 IS – 150 Reykjavik	Tel: +354.560.06.00 Fax: +354.552.81.21 Email: tj@vedur.is
4	Dr Perry Bartelt	Swiss Federal Institute of Snow and Avalanche Research Flüelastrasse 11 CH – 7260 Davos Dorf	Tel: +41.81.417.02.51 Fax: +41.81.417.01.10 Email: bartelt@slf.ch
5	Dr Karl Kleemayr	University of Agricultural Sciences-Vienna Institute of Torrent and Avalanche Control Peter Jordanstr. 82 AT – 1190 Vienna	Tel: +43.1.476.54.43.53 Fax: +43.1.476.54.43.90 Email: klee@edv1.boku.ac.at
6	Dr Peter Sampl	AVL List GmbH Advanced Simulation Technolgies Hans-List-Platz 1 AT – 8010 Graz	Tel: +43.316.787.439 Fax: +43.316.787.777 Email: peter.sampl@avl.com
7	Dr Horst Schaffhauser	FBVA Institut für Lawinen und Wildbachforschung Rennweg 1 – Hofburg AT – 6020 Innsbruck	Tel: +43.512.5739.33.51.02 Fax: +43.512.5739.33.52.50 Email: fbva.aiatr@magnet.at
8	Prof. Luigi Natale	University of Pavia Hydraullic and Environmental Engineering Department Via Ferrata, 1 IT – 27100 Pavia	Tel: +39.382.505.315 Fax: +39.382.505.589 Email: natale@unipv.it
9	Prof. Jean-Paul Vila	Institut National des Sciences Appliquées de Toulouse Département de Mathématiques Lab. Mathématiques pour l'Industrie & Physique Avenue de Rangueil 135 FR – 31077 Toulouse	Tel : +33.561.55.93.15 Fax : +33.561.55.93.20 Email : vila@gmm.insa-tlse.fr
10	Dr Francesco Sommavilla	ARPAV – Centro Valanghe di Arabba Passo Campolongo 122 IT – 32020 Arabba (BL)	Tel: +39.04.367.92.27 Fax: +39.04.367.93.19 Email: csydi@sunrise.it

NATURAL HAZARDS

SATSIE - Avalanche Studies and Model Validation in Europe
EVG1-CT-2002-00059

Start date: 01/10/02 – End date: 30/09/05
Duration: 36 months
EC contribution: 1,231,680.00 Euro
EC contact: Denis Peter

Project Co-ordinator
Dr Lied Karstein
Norwegian Geotechnical Institute
P.O. Box 3930 Ulleval Hageby, Sognsveien 72
NO - 0806 Oslo
Tel : +47.2202.30.00
Fax : +47.2223.04.48
Email : kl@ngi.no
http://www.leeds.ac.uk/satsie/

PROJECT SUMMARY

Problems to be solved

SATSIE will contribute to European economic development and to the EU policies aiming at sustainable development by creating tools for increasing public safety in avalanche-prone areas. An adequate level of avalanche safety is prerequisite to further development of the mountain regions as habitable areas, prime destinations of tourism, and the critical segments of some of the most important European traffic routes. It is vital to perform this work at a European scale in order to share know-how and make maximum use of the large cost of operating full-scale experimental sites.
Snow avalanches represent a rather serious problem in the Alps, in the Norwegian mountains, in several inhabited areas of Iceland, in the Pyrenees and in the mountain range near the Black Sea coast of Turkey. Winter tourism is an important and growing economic sector that is strongly susceptible to avalanche danger. Indeed, yearly about 20 million winter tourists contribute some 20-30 billion Euros to the Gross National Products of the Alpine countries. Transalpine traffic, which is still very vulnerable to avalanche danger, is of similar importance and directly or indirectly affects the majority of Europeans. Avalanche-induced damage may reach 1 billion Euros during a severe winter, not counting the loss of human lives.

Scientific objectives and approach

Land-use planning based on avalanche hazard maps and protection dams are two major approaches to long-term avalanche protection. Current avalanche flow models neglect key phenomena such as changes of flow regime and snow entrainment that may have substantial impact on the predicted pressures and runout distances. Similarly, the dimensioning of protection dams is still based on overly simplistic concepts and engineering intuition. The scientific focus of SATSIE is therefore on understanding the physical mechanisms that determine the flow regime, the snow entrainment rate and the interaction of avalanches with obstacles. To this end, laboratory and full-scale experiments with novel sensors-to be developed in the project-will be conducted at two chutes, at NGI's full-scale test site in western Norway (equipped with a retention dam) and at a deflecting dam in Ice- land. This knowledge will be used to develop and validate mathematical models of avalanche flow that take into account the rheological properties of avalanching snow as well as mass transfer between the snow cover and the flowing snow. The full-scale measurements will also be used to validate new models for avalanche-dam interaction from the EU project CADZIE, to be summarised in a handbook on protection dam design.

Expected impacts

By developing and disseminating physically sound numerical models for avalanche motion and handbooks on computer-assisted avalanche mapping and protection- dam design, SATSIE will improve the quality and accuracy of land-use planning in endangered areas and long-term avalanche protection in general. The concerted research, development and teaching effort of most European institutions engaged in avalanche research is expected to lead to a wide consensus on best practice in this field and to foster convergence of the different national standards for hazard-mapping procedures and avalanche safety. The development of affordable radar devices for monitoring the snow-cover evolution and avalanche motion will pave the road towards widespread use of alarm systems along endangered traffic routes.

Scientific partners

2	Dr Tómas Jóhannesson	Icelandic Meteorological Office Department of Research & Processing Bústaõavegur 9 Iceland - 150 Reykjavík	Tel: +354.522.60.00 Fax: +354.522.60.01 Email: tj@vedur.is
3	Dr Christopher Keylock	University of Leeds, School of Geography Woodhouse Lane UK - LS2 9JT Leeds	Tel: +44.113.343.33.07 Fax: +44.113.343.33.08 Email: c.keylock@geog.leeds.ac.uk
4	Dr Stuart Dalziel	The Chancellor, University of Cambridge Department of Applied Mathematics and Theoretical Physics Silver Street UK - CB3 9EW Cambridge	Tel: +44.1223.33.78.58 Fax: +44.1223.33.79.18 Email: s.dalziel@amtp.cam.ac.uk
5	Dr Lambert Rammer	Federal Forest Research Centre Austrian Institute for Avalanche and Torrent Research Rennweg 1 – Hofburg AT – 6020 Innsbruck	Tel: +43.512.573933.5105 Fax: +43.512.573933.5250 Email: lambert.rammer@uibk.ac.at
6	Prof. Otto Koudelka	Technical University of Graz Department of Communication and Wave Propagation Inffeldgasse 12 AT – 8010 Graz	Tel: +43.316.873.74.43 Fax: +43.316.46.36.97 Email: randeu@radar.tu-graz.ac.at
7	Prof. Mohamed Naaim	CEMAGREF Water and Waste disposal engineering and management department Rue de la Papeterie, 2 FR - 38402 St. Martin d'Hères	Tel : +33.4.7676.27.22 Fax: +33.4.7651.38.03 Email : mohamed.naalm@cemagref.fr
8	Prof. Luigi Natale	University of Pavia Hydraulic and Environmental Engineering Department Via Ferrata, 1 IT - 27100 Pavia	Tel: +39.328.505.315 Fax: +39.382.505.589 Email: natale@unipv.it
9	Dr Emma Suriñach	Universitat de Barcelona Departament de Geodinàmica i Geofísica Martí i Reixac, s/n ES – 08028 Barcelona	Tel: +34.93.402.13.86 Fax: +34.93.402.13.40 Email: emma@natura.geo.ub.es

LANDSLIDES

NATURAL HAZARDS

DAMOCLES – Debrisfall Assessment in Moutain Catchments for Local End-Users
EVG1-CT-1999-00007

Start date: 01/03/00 – End date: 28/02/03
Duration: 36 months
EC contribution: 857.500.00 €
EC contact: Maria Yeroyanni

Project Co-ordinator
Dr James Bathurst
University of Newcastle upon Tyne
Department of Civil Engineering
NE1 7RU Newcastle upon Tyne
United Kingdom
Tel: +44.191.222.63.33
Fax: +44.191.222.66.69
Email: j.c.bathurst@ncl.ac.uk
http://damocles.irpi.cnr.it/welcome.htm

PROJECT SUMMARY

Problems to be solved

Debris flows and rockfalls are a familiar hazard in European mountain areas and regularly cause loss of life, livelihood and property. Hazard assessment is therefore increasingly required in land use planning. However, there are no standard techniques and existing operational techniques are qualitative. DAMOCLES will therefore develop quantitative technologies for assessing the distribution of rapid slope failures and their hazard, for determining the physical impact of debris flows and, hence, for assessing the mitigating effects of torrent control works and land management.

Scientific objectives and approach

In order to achieve its goals the project integrates research-based model development with the involvement of local planning and civil protection authorities as data suppliers, advisors and recipients of the project results. Its objectives are:

1. Develop and apply three advanced models for hazard assessment, impact prediction and mitigation studies relevant at local to regional scales:
   a) A Geographical Information System (GIS) debris flow and rockfall hazard assessment model;
   b) A small basin (<10 km^2) debris flow impact model;
   c) A basin scale (<500km^2) landslide erosion and sediment yield model (SHETRAN).
   Models (b) and (c) will be integrated with (a).
2. Conduct field surveys and assemble databases in support of model development for one region in the Spanish Pyrenees and two in the Italian Alps. Identify debris flow process relationships for insertion in the models.
3. Transfer the technologies to end-users and make outcomes accessible through the public domain. Involve end-users in model applications, including assessment of possible future land use and climate change impacts.

Expected impacts

The project is aimed at improving the efficiency and reliability of decision-making in the development of European mountain areas, with implications for the quality of life of both mountain dwellers and lowland inhabitants. Its innovative aspects include: a quantitative approach; an emphasis on user-friendliness; the direct involvement of end-users; consideration of debris flow impacts at a range of scales; provision of new databases; and a proposal for a standard approach to hazard assessment and zonation.

Scientific partners

2	Prof. Giovanni Crosta	Università degli studi di Milano – Bicocca Dipartimento di Scienze Geologiche E Teotecnologie Via Emanueli 14 IT – 20126 Milano	Tel: +39.02.236.98.246 Fax: +39.02.706.38.261 Email: giovanni.crosta@unimi.it
3	Prof. Lucio Umbertini	Consiglio Nazionale delle Ricerche Istituto di Ricerca per la Protezione Idrogelogica nell'Italia Centrale Via della Madonna Alta, 126 IT – 06128 Perugia	Tel: +39.075.505.49.43 Fax: +39.075.505.13.25 Email: l.ubertini@irpi.pg.cnr.it
4	Prof. Mario Aristide Lenzi	Università degli studi di Padova Dipartimento territorio E Sistemi Agro-Forestali Via Romea – Agripolis IT - 35020 Padova	Tel: +39.049.827.26.75 Fax: +39.049.827.26.86
5	Mr. Tomas Fraile	Consejo Superior de Investigaciones Cientificas Istituto Pirenaico de Ecologia Avda. Montaña 177 ES – 50080 Zaragoza	Tel: +34.9158.55.000 Fax: +34.9141.13.077 Email: t.fraile@orgc.csic.es
6	Mr. Antonio Castellano	Instituto Technologico Geominero de España Geologic Department Rios Rosas 23 ES - 28003 Madrid	Tel: +34.1.349.59.35 Fax: +34.1.349.59.29

NATURAL HAZARDS

IMIRILAND - Impact of Large Landslides in the Mountain Environment: Identification and Mitigation of Risk

EVG1-CT-2000-00035

Start date: 01/03/01 – End date: 31/12/03
Duration: 34 months
EC contribution: 638,760.00 €
EC contact: Maria Yeroyanni

Project Co-ordinator
Dr Vincenzo Coccolo
Regione Piemonte, Direzione Servizi Tecnici di Prevenzione
Via Pisano 6
IT - 10152 Torino
Tel: +39.011.432.43.10
Fax: +39.011.432.33.60
Email: settore.20-3@regione.piemonte.it

PROJECT SUMMARY

Problems to be solved

Large landslides affect many mountain valleys in Europe. They are characterised by a low probability of evolution as a catastrophic event but can have very large direct and indirect impact on man, infrastructures and environment. This impact is becoming more and more dangerous due to the increasing tourism development and the construction of new roads and railways in mountainous areas. Methodologies for the identification and mitigation of risk are therefore a major issue.

As a matter of fact, many experiences during critical development of landslides have shown a lack of methodologies and above all a non-systematic approach of interpreted risks. Risk management is in practise accomplished by local and regional authorities only during the critical event in a necessarily improvised way. This "reactive" approach brings to negative consequences on the identification procedure. For instance, very expensive monitoring systems have been installed on several large landslides without any well-established methodology linking the interpretation of the measures and the understanding of deformation mechanisms to the practical questions concerning the management of the risk.

Furthermore, risk can extend well beyond local damage (for instance, risk of river damming which may induce major hydrological hazards: floods, inundation of sewage plants, loss of drinking water resources), so that it must be considered in a wide perspective

The countries involved in the consortium are aware of the importance of these problems as they have been working for several years on them; in particular the consortium involves some of the most scientifically advanced universities and research infrastructures dealing with natural hazard problems and also two end-users that have to face every day with practical land management problems.

On the basis of these considerations, the main aim of the project is to develop and disseminate organic methodologies, which could be a useful tool for decision-makers to plan actions for the identification and mitigation of the risk in European valleys.

Scientific objectives and approach

The project focuses on management of risk in the case of landslides, in its scientific, technical and land planning aspects, considering mainly phenomena of large magnitude, with a low probability of evolution as a catastrophic event, but which might have a large direct and indirect impact on man, infrastructure and environment.

Very large slope movements are quite often directly or indirectly implied in disasters (secondary slides or debris flows); therefore their early identification, which is not always easy, is essential to an adequate risk assessment of the zones involved. In this sense a multidisciplinary approach by specialists from different countries using specific methods (like tectonic analysis, photogrammetry, numerical analysis) in some well-monitored sites will improve the determination of the main landslide mechanisms and thus the assessment of the hazard level.

The main objectives are to:

1. get a review of hazard analysis methodologies and develop new techniques;
2. compare the reliability of hazard assessment in different situations according to various criteria
3. develop practical risk analysis methods considering direct and indirect potential damage;
4. apply the developed methods to real situations in different countries to show how they can be included in land planning procedures;
5. test the applicability of such approaches by a close interaction with administrators.

To achieve such objectives following phases are foreseen:

Phase 1: Data collection: some large landslides have been selected, where geological geomechanical and monitoring data are available and a complex risk situation exists.

Phase 2: Development of risk assessment methodology: in order to compare, in terms of landslides scenarios evolution, the results of different methodologies, the following approaches are considered:
a) field analysis,
b) mechanical modelling,
c) black box methods.
For each approach, new developments are envisaged and state of the art critical analysis of the methods and application to selected sites are foreseen. Vulnerability and risk analyses are also carried out.

Phase 3: Application to management: It relates to the application of developed methodologies to the management of endangered landslide zones. The actions are defined in relation to problem urgency, the legal frameworks and the powers of local and regional authorities the relevant economical conditions. A criterion for the definition of acceptable risk level will also be worked out.

Phase 4: Dissemination of risk management methodologies.

The IMIRILAND project is innovative because:

1. no previous experience has been achieved at a large scale to include the notion of actual risk in land planning;
2. no comparative analysis of different hazard prediction techniques has been carried out by multidisciplinary teams;
3. no application of risk assessment procedures to large landslide zones has been carried out considering quantitatively the potential damage and the cost of protective measures in a complete economic balance including direct and indirect costs;
4. no comparative assessment of the applicability of such techniques in different frame works has been done yet.

Other innovations of the project lie in the implication of end users (regional and national technical administrations) and in the application of such new methods to real cases, in which the administrative and legal aspects of the final results will be checked. It will thus ensure a practical control of the reliability and suitability of such techniques.
Finally, the project will include a special diffusion effort in order to avoid that the results remain at an academic level. The results will be disseminated to administrative and technical control offices which will have the opportunity to give their opinion in an essential "feed back" operation.

Expected impacts

The global and multidisciplinary approach that characterises the project itself represents the first important result for the entire consortium. As a matter of fact it will be experimented a new method of working at a European dimension, gathering different researchers, technicians and officials from different countries, making them face similar problems (natural hazard in mountain environment) in different contexts (from a socio-political point of view).
From the exploitation of all these experiences, a common way of carrying out and solving the problems that our project intends to study could derive.

Precisely, for university organisations, the project represents a very useful opportunity of developing new methodologies or applying existing ones to several real situations (so big amount of data would not be available outside the project), making a sort of test on their applicability and reliability. Furthermore it must be considered the opportunity of comparing methods and results a~ regards scientific and technical aspects. As far the other members of the consortium are concerned, which are also end-users, they have the opportunity of establishing a direct relationship with the academic world, in order to search together practical solutions for the problems they have to face as their institutional tasks.

Another important positive consequence would be the improvement in scientific and technical competencies of officials and public administrators working on territory. As in the project a specific work phase is dedicated to this aspect, the comparison among different approaches to similar phenomena within different legal frameworks will be very interesting and useful

Scientific partners

2	Prof. Claudio Scavia	Politecnico di Torino Dipartimento di Ingegneria Strutturale e Geotecnica Corso Duca degli Abruzzi 24 IT - 10129 Torino	Tel: +39.011.564.48.23 Fax: +39.011.564.48.99 Email: scavia@polito.it
3	Dr Riccardo Polino	Consiglio Nazionale delle Ricerche C.s. Geodinamica Catene Collisionali Via Accademia delle Scienze 5 IT - 10123 Torino	Tel: +39.011.530.652 Fax: +39.011.530.652 Email: r.polino@csg.to.cnr.it
4	Dr Jean-Louis Durville	Laboratoire Central des Ponts et Chaussées LCPC Boulevard Lefebvre 58 FR - 75732 Paris	Tel : +33.1.40.43.52.46 Fax : +33.1.40.43.65.16 Email : durville@lcpc.fr
5	Dr Pere Prat	Universitat Politècnica de Catalunya Enginyeria del Terreny Jordi Girona, 1-3 Mòdul D2, Campus Nord ES – 08034 Barcelona	Tel: +34.93.401.65.11 Fax: +34.93.401.72.51 Email: Pere.prat@upc.es
6	Prof. Ewald Tentschert	Technische Universitaet Wien Fakultaet fuer Bauingenieurwesen Institut fuer Ingenieurgeologie Karlsplatz 13 AT – 1040 Wien	Tel: +43.1.5880.120.310 Fax: +43.1.5880.120.399 Email: Tentschert@tuwien.ac.at
7	Dr Christophe Bonnard	Swiss Federal Institute of Technology of Lausanne Department of Civil Engineering Laboratory of Soil Mechanics CH – 1015 Lausanne	Tel: +41.21.693.23.12 Fax: +41.21.693.41.53 Email: Christophe.bonnard@epfl.ch

NATURAL HAZARDS

ALARM - Assessment of Landslide Risk and Mitigation in Mountain Areas
EVG1-CT-2001-00038

Start date: 01/12/01 – End date: 30/11/04
Duration: 36 months
EC contribution: 911,187.00 €
EC contact: Denis Peter

Project Co-ordinator
Dr Sandro Silvano
Consiglio Nazionale delle Ricerche
Istituto di Ricerca per la Protezione Idrogeologica
nei bacini dell'Italia Nord-Orientale
C. So Stati Uniti 4
IT – 35127 Padova
Tel: +39.049.829.58.03
Fax: +39.049.829.58.27
Email: s.silvano@irpi.pd.cnr.it
http://www.citimac.unican.es/Alarmproject/alarm.htm

PROJECT SUMMARY

Problems to be solved

Most of the scientists involved in landslide studies feel that landslide hazard is generally neglected, more emphasis being given to other types of hazards such as seismic and volcanic hazards. It has been estimated that every year about 225,000 lives are lost because of natural events in general, among which several mass movements causing many casualties. The fact that landslide hazard is usually underestimated is even more unfortunate, since slope movements are usually more easily predictable and manageable than earthquakes, volcanic eruptions or hurricanes. Actually there is a huge number of medium to small sized landslides which are so widespread that the related cost for human society is even higher than that of catastrophic events. The losses due to low-magnitude, high-frequency events is also generally increasing, especially in developing countries, because of human activity which, on the one hand, tends to increase landslide hazard (road cuts, quarries etc.) and, on the other hand, favours vulnerability situations. Therefore the problem to be solved will be the correct interpretation of landslide hazard and risk and than the optimisation of the interventions to be carried out in order to mitigate the loss of human lives and economic assets.

Scientific objectives and approach

This project aims to have progress done in prevention and mitigation of hydrogeological risks affecting inhabited areas, in EC counties, improving existing tools and methods, to bring others into focus to test their applicability with institutional users and, beyond, general public. Preliminary, an inventory of the national and regional laws, prescriptions and technical regulations, concerning the assessment and management of the morpho-hydro-geological hazard, vulnerability and risk, and of existing conceptual methods concerning hazard, vulnerability, value and related risk will be carried out. The second task will regard landslide hazard assessment at medium scale (1:25,000-1:10,000) for each study area. At first, the spatial distribution of landslide susceptibility will be assessed with innovative GIS

techniques adopting statistic-probabilistic approaches which will provide for a high degree of objectivity and reproducibility. Landslide frequency analysis will be undertaken in order to estimate return time of landslides.
Altogether, susceptibility and frequency will lead to maps assessing hazard zones in terms of probability (0-1) of occurrence. In three study areas, additional 1:5,000-1:2,000 working scale will be adopted for carrying out different hazard and magnitude scenarios, assessing hazard and magnitude complex landslides which, at present, cause major problems to urban development. The vulnerable elements falling into hazardous zones will be identified and expressed in a GIS on a scale 0-1 (no damage-total loss). Magnitude and vulnerability assessments, specific risk will be computed for each vulnerable element. Total risk will be represented into maps designed to satisfy laws and rules in force in the study areas, precise, reliable, credible by administrator authorities, clearly readable for the large public. The final task will consist in the identification of risk prevention and mitigation measures and in a proposal of measures to local administrators for the settlement of sustainable land-use zones, and spreading of results and methodology.

Expected impacts

We expect to develop and implement landslide loss-reduction strategies and engineering means, that would enable to reduce the likelihood of occurrence of damaging landslides and minimise their social and economic effects. To this purpose the Local Municipality of the test sites will be directly involved in the project and they should be the potential users of the project results. Nevertheless the methodology developed during the project could be used at National level by each partner.

Scientific partners

2	Prof. Antonio Brum Ferreira	Fundacao da Universidade de Lisboa Centro de Estudos Geograficos Facultade de Letras de Lisboa Alameda da Universidade PT – 1600-214 Lisboa	Tel: +351.21.796.54.69 Fax: +351.21.793.86.90 Email: ceg@mail.telepac.pt
3	Dr Euro Beinat	Vrije Universiteit Amsterdam Instituut voor Milleuvraagstukken De Boelelaan, 1115 NL – 1081 HV Amsterdam	Tel: +31.20.444.95.08 Fax: +31.20.444.95.53 Email: Euro.Beinat@ivm.vu.nl
4	Dr Wojciech Raczkowski	Polish Geological Institute Carpathian Branch Skrzatów Str. 1 PL – 31-560 Krakow	Tel: +48.12.411.38.22 Fax: +48.12.411.26.32 Email: wraczkow@pigok.com.pl
5	Dr Eugeniusz Gil	Institute of Geography and Spatial Organisation of the Polish Academy of Sciences 22 Sw. Jana Str. PL - 30-018 Krakow	Tel: +48.18.351.31.70 Fax: +48.18.351.31.70 Email: igszymbark@poczta.onet.pl
6	Dr Les Aw Zabuski	Institute of Hydro-Engineering of the Polish Academy of Sciences Department of Geotechnics KO Cierska Str. 7 PL - 80-953 GDA SK	Tel: +48.58.552.20.11 Fax: +48.58.552.42.11 Email: lechu@ibwpan.gda.pl
7	Dr José Ramon Diaz de Teran	Universidad de Cantabria Departamento de Ciencias de la Tierra y Fisica de la Materia Condensada Facultad de Ciencias Avenida de Los Castros s/n ES – 39005 Santander	Tel: +34.942.201.503 Fax: +34.942.201.402 Email: diazjr@unican.es

8	Dr Olivier Maquaire	CNRS Université Louis Pasteur Institut de Physique du Globe de Strasbourg Rue René Descartes, 5 FR - 67084 Strasbourg	Tel : +33.3.90.24.09.36 Fax : +33.3.90.24.09.00 Email : maquaire@equinoxe.u-strasbg.fr
9	Prof. Angelo Cavallin	Università degli Studi di Milano-Bicocca Dipartimento di Scienze dell'Ambiente e del Territorio Piazza della Scienza 1 IT - 20126 Milano	Tel: +39.02.6448.27.08 Fax: +39.02.6448.28.95 Email: angelo.cavallin@unimib.it
10	Prof. Mauro Soldati	Università degli Studi di Modena e Reggio Emilia Dipartimento di Scienze della Terra Largo S. Eufernia 19 IT - 41100 Modena	Tel: +39.059.205.58.42 Fax: +39.059.205.58.84 Email: soldati@unimo.it

NATURAL HAZARDS

LEWIS - Landslide Early-Warning Integrated System
EVG1-CT-2001-00055

Start date: 01/03/02 – End date: 28/02/05
Duration: 36 months
EC contribution: 1,498,181.00 €
EC contact: Denis Peter

Project Co-ordinator
Professor Luciano Guerriero
Università degli Studi di Bari, Dipartimento Interateneo di Fisica
Via Amendola, 173
IT – 70 126 Bari
Tel: +39.080.544.32.24
Fax: +39.080.544.32.24
Email: Luciano.Guerriero@ba.infn.it
http://www.kinoa.net/lewis/

PROJECT SUMMARY

Problems to be solved

The LEWIS project is focused on landslide warning, hazard assessment and mitigation, and therefore, directly contributes to the Community social objectives; quality of life and health and safety in Europe. Landslides kill people every year in Europe and also result in high socio-economic losses. Taking Italy as an example, between 1990 and 1999, 263 people were killed by landslides (CNR-IRPI database). The 1998 Samo-Quindici event alone killed 153 people. Catenacci (1992) estimated that at least 2447 lives were lost in the period 1945-1990. Historical landslide investigations (CNR-IRPI database) indicate that over 10,000 people died in landslide events in Italy in the last centuries.
Among the European countries, Italy has the highest number of deaths or missing people due to landslides, (and the highest expected yearly loss of life). However, despite this the landslide risk perception in Europe is still low. LEWIS could give a strong impulse to improve the landslide risk perception by integrating multidisciplinary expertise for solving the important strategic problem of landslide damage mitigation and prevention. In any case the results will represent a generic advancement in hazard analysis of landslide.

Scientific objectives and approach

The main objective of the LEWIS project is the development of a prototype landslide warning service to the citizen (trough the application of a methodology) based on the use of earth observation data. It will develop' an approach which increases and promotes the value of comparatively low-cost, wide-area satellite data as an input to the assessment of hazard and risk from ground movements. Through the integration of remotely sensed data with ground data it intends to detect significant surface changes which are taking place on landslide susceptible slopes.
Principal objectives are: a) validation of EO methods to detect and evaluate surface changes of features which are precursory indications of landslide; b) production of periodic warning maps of potential slope instability; c) design of a networked service of warning directly available to end-users.
Secondary objectives are: d) to integrate multidisciplinary research expertise in geological, physical and computing science for solving the important problem of landslide damage mitigation and prevention; e) to offer research training to young scientists involved in the project; f) to create new business opportunities for EO data by providing user-friendly products to administrative bodies involved in territorial management.

Expected impacts

LEWIS, through its emphasis on EO data for the detection of ground surface changes will provide a landslide warning system devoted to all users interested in monitoring and prevention of potential natural disasters such as Public Administrations, insurance companies and scientific centres. LEWIS will directly contributes to the planning process at each level through the realisation of data products which can be used locally and networked to all levels of end-user for appropriate decision making. In addition, the environmental data collection, collation, processing and dissemination over the internet for Southern Mediterranean countries directly addresses Community social concerns for improved information transfer and public awareness of natural hazards. It is envisaged that the research and data products based on EO processing from the LEWIS consortium will provide a better understanding of the surface changes which trigger ground movements and periodic warnings of surface change which might lead to areas of ground instability.

Scientific partners

2	Dr Palma Blonda	Consiglio Nazionale delle Ricerche Istituto Elabroazione segnali ed immagini Via Amendola 166/5 IT – 70 126 Bari	Tel: +39.080.548.16.12 Fax: +39.080.548.43.11
3	Prof. Vern Singhroy	Singhroy Canada Centre for Remote Sensing 588 Booth Street Canada - K1A OY7 Ottawa	Tel: +1.613.947.12.15 Fax: +1.613.947.13.85 Email: vern.singhroy@ccrs.nrcan.gc.ca
4	Prof. Maria Petrou	The University of Surrey Centre for Vision, Speech and Signal Processing UK - GU2 7XH Guildford	Tel: +44.1483.68.98.01 Fax: +44.1483.68.60.30 Email: m.petrou@surrey.ac.uk
5	Dr Janusz Wasowski	Consiglio Nazionale delle Ricerche Centro di Studi sulle Risorse Idriche e la Salvaguardia del Territorio c/o Politecnico di Bari Via E. Orabona, 4 IT – 70 125 Bari	Tel: +39.080.542.81.37 Fax: +39.080.556.79.44 Email: wasowski@area.ba.cnr.it
6	Dr Vincenzo Del Gaudio	Università degli Studi di Bari Osservatorio Sismologico Via E. Orabona 4 IT - 70125 Bari	Tel: +39.0805.44.22.79 Fax: +39.0805.44.26.25 Email: delga@geo.uniba.it
7	Dr Gerassimos Papadopoulos	National Observatory of Athens Institute of Geodynamics P.O. Box 20048 Lofos Nymfon EL - 11810 Thission, Athens	Tel: +30.1.349.01.65 Fax: +30.1.349.01.65
8	Dr Geraldine Fitoussi	SILOGIC Chemin des Sept Deniers, 78 FR – 31200 Toulouse	Tel : +33.5.611.35.300 Fax : +33.5.616.79.660 Email : geraldine.fitoussi@silogic.fr
9	Dr Maria Pappalepore	Planetek Italia SRL S.P. per Casamassima km. 3 IT – 70010 Valenzano Ba	Tel: +39.080.467.06.11 Fax: +39.080.467.06.10 Email: pappalepore@planetek.it
10	Dr Alain Arnaud	Altamira information Llacuna 162 ES – 08018 Barcelona	Tel: +34.93.401.98.82 Fax: +034.93.401.98.83 Email: alain.arnaud@altamira-information.com

11	Dr Oscar Corsico	Amministrazione Provinciale di Foggia Servizio Geologico Piazza XX Settembre 20 IT – 71100 Foggia	Tel: +39.0881.791.701 Fax: +39.0881.791.706 Email: labgeo.provfg@isnet.it
12	Dr Luigi Minenna	Regione Puglia Ufficio informatico e servizio cartografico Via Positano, 6 IT – 70121 Bari	Tel: +39.080.540.63.01 Fax: +39.080.540.63.29 Email: cartografico@regione.puglia.it
13	Dr Carlo Troisi	Regione Piemonte Direzione Servizi Tecnici di prevenzione Settore Progettazione Interventi Geotecnica Via Pisano, 6 IT - 10100 Torino	Tel: +39.011.433.497
14	Mr Vassilios Andriannakis	Earthquake Planning and Protection Organization Department of Seismotectonics Xanthou 32 EL - 154 51 Cholargos Athens	Tel: +30.1.672.52.33 Fax: +30.1.677.95.61

NATURAL HAZARDS

OASYS - Integrated Optimization of Landslide Alert Systems

EVG1-CT-2002-00061

Start date: 01/01/03 – End date: 31/12/05
Duration: 36 months
EC contribution: 1,104,495.00 €
EC contact: Denis Peter

Project Co-ordinator
Dr Helmut Wenzel
VCE Holding GmbH
Diesterweggasse 1
AT – 1140 Wien
Tel: +43.1.894.60.21
Fax: +43.1.894.61.70
Email: vce@atnet.at
http://www.vce.at/oasys/

PROJECT SUMMARY

Problems to be solved

Worldwide landslides are one of the major types of natural hazards killing or injuring a large number of individuals and creating very high costs every year. Between 1990 and 1999, for example, in Italy at least 263 people were killed due to landslide events. In the United States of America landslides are annually causing estimated 25 to 50 deaths and damages exceeding US$ 2 billion (USGS 2000 (1)). Figures for Asia, particular China, Africa and South America may easily exceed those for Europe and the US.

Besides direct costs landslides are also reason for even higher indirect costs like interruption of important infrastructure facilities or losses for the tourist industry etc. In future it is very likely that the damages caused by landslides will even increase as the hilly areas, where the majority of the landslides occur, are used by a growing number of tourists and intersected by increasingly powerful transnational networks. In addition many global climate change scenarios predict an increase in the probability for heavy rain, which is a primary trigger for landslides. This implies that there is urgent need for highly productive and reliable tools for landslide hazard management at an operational level.

Scientific objectives and approach

The objectives of the suggested project are the development of observation methods that allow:

- To detect potential landslides,
- An efficient and continuous observation of critical areas,
- The derivation of real time information about actual risks.

General concepts of the approach:

- Multidisciplinary: There will be a strong emphasis on the integration of different disciplines like geology, geodesy, geo-informatics, software engineering etc. Each working group should consist of members of several disciplines to assure a maximum of horizontal integration.

- Productivity: In order to gain acceptance by the practitioners it is necessary to develop highly productive methods that enable the user to acquire the necessary information he needs for a decision with a minimum of effort. This implies that remote sensing and information technology will play an important role.
- Vertical integration, multi scale approach and modularity: One target of the project is to provide the practitioner with support in all levels of his decision making process. Besides being lead through the whole process he should also be able to use only certain modules.

Expected impacts

Generally the project can be divided into three principal impacts:

- The first comprises the optimisation of early warning systems on a regional scale, where landslide prone areas are detected and classified.
- The second on a local scale active zones are detected and observation methods and devices are optimised for the specific case.
- The third area comprises all issues related with the transfer of information about possible hazards to the affected population. The aim of this information transfer is an increased awareness of the impending hazards and effective alerting in the case of a catastrophic event.

Scientific partners

2	Prof. Wolfgang Niemeier	Technische Universität Braunschweig Institut für Geodäsie und Photogrammetrie P.O. Box 3329 Gausstrasse 22 DE – 38106 Braunschweig	Tel: +49.531.391.74.73 Fax: +49.531.391.74.99 Email: w.niemeier@tu-bs.de
3	Prof. Heribert Kahment	Technische Universität Wien Institut für Geodäsie und Geophysik Gusshausstrasse 27-29 AT – 1040 Wien	Tel: +43.1.5880.112.840 Fax: +43.1.5880.112.894 Email: heribert.kahmen@tuwien.ac.at
4	Dr Gyula Mentes	Geodetic and Geophysical Research Institute of the Hungarian Academy of Sciences P.O. Box 5 Csatkai E. u. 6-8 HU – 9400 Sopron	Tel: +36.99.508.348 Fax: +36.99.508.355 Email: mentes@ggki.hu
5	Dr Barbara Theilen-Willige	Büro für Angewandte Geowissenscahftliche Fernerkennung Birkenweg 2 DE – 78333 Stockach	Tel: +49.7771.18.68 Fax: +49.7771.91.88.57 Email: Barbara.Theilen-Willige@surf24.de
6	Dr Klaus Chmelina	Geodata Ziviltechnikergesellschaft mbH Hans-Kudlich-Strasse 28 AT – 8700 Leoben	Tel: +43.1.7866.302.034 Fax: +43.1.786.302.050 Email: office@geodata.at
7	Dr Cui Zhengquan	Geological Bureau of China Bureau of Investigation and Survey, CJWRC Jiefang Road, 1155 China - 430010 Wuhan	Tel: +86.27.8282.95.12 Fax: +86.27.8282.95.05 Email: zongkj@cjw.com
8	Dr Antal Papp	National Directorate General for Disaster Management Hungarian Ministry of Interior P.O. Box 314 Mogyorodi 43 HU – 1903 Budapest	Tel: +36.1.469.42.89 Fax: +36.1.469.42.28 Email: hucivpro@elender.hu

9	Mr Christos Georganopoulos	Egnatia Odos S.A. P.O. Box 30 6km street EL – 57001 Thermi, Thessaloniki	Tel: +30.310.47.03.04 Email: cgeorg@egnatia.gr
10	Prof. Mario Panizza	Università degli Studi di Modena e Reggio Emilia Dipartimento di Scienze della Terra Largo S. Eufernia, 19 IT – 41100 Modena	Tel: +39.059.205.58.40 Fax: +39.059.205.58.87 Email: pit@unimo.it
11	Prof. Zhenglu Zhang	Wuhan Technical University School of Geodesy and Geomatics GPS Research Centre of Wuhan University Luoyu Road 129 China - 430079 Wuhan	Tel: +86.27.8787.15.09 Fax: +86.27.8786.85.71 Email: zzl623@wtusm.edu.cn
12	Prof. Paraskevas Savvaidis	Aristotle University of Thessaloniki Laboratori of Geodesy P.O. Box 465 University Campus EL – 54006 Thessaloniki	Tel: +30.310.995.724 Fax: +30.310.996.159 Email: psav@civil.auth.gr

MULTIRISKS

NATURAL HAZARDS

RETINA - Realistic Evaluation of Temporal Interactions of Natural Hazards
EVG1-CT-2001-00046

Start date: 01/02/02 – End date: 31/07/05
Duration: 42 months
EC contribution: 1,370,100.00 €
EC contact: Denis Peter

Project Co-ordinator
Mr Philippe Bardey
ACRI-ST
P.O. Box 234
Route du Pin Montard, 260
FR - 06904 Sophia-Antipolis
Tel : +33.492.96.75.00
Fax : +33.493.95.80.98
Email : prb@acri.fr
http://www.acri.fr/retina/

PROJECT SUMMARY

Problems to be solved

The RETINA project focuses on problems of Europe-wide interest concerning seismic risk, volcanic risk and landslide risk. Each of these natural hazards occurs in multiple member states, more than are included in the project, so the research will be applicable to the greater European community. However, the most important added value to the community is hazard mitigation since given the population density of Europe, when a major catastrophic event occurs in an individual member state, it will require mobilization of resources at a European scale.
Since Europe must ultimately absorb the consequences of major catastrophes in individual member states, Europe has an economic and social interest in verifying that hazard analysis for urban development and risk management adheres to norms set at the European level.
RETINA will define elevated risk situations, and attempt to determine thresholds, represented by coupled phenomena that may be observable over time scales of months to weeks, that provide a realistic possibility to prepare for interventions at a European scale if needed.

Scientific objectives and approach

The objective of RETINA is to support the implementation of new European scale risk management systems by civil defense participants in the project by developing models and technologies for understanding the mechanical coupling and temporal interactions between earthquakes, volcanoes and landslides. To achieve this goal, RETINA seeks to:

1. Recognize periods of elevated hazard by monitoring the temporal evolution of geodetic and seismic signals;
2. Locate areas of elevated hazard by mapping crustal deformation and identifying areas of rapid strain accumulation;
3. Identify from these maps areas where one event may trigger another;
4. Derive exploitable models for the physical mechanisms underlying correlated events;
5. Provide a component of hazard and risk assessment that is currently lacking, by re-evaluating the probability of hazardous events in time and space including the effects of triggering;
6. Share expertise and resources in risk management at the European level.

Expected Impacts

The expected results will be improved models and better understanding of the interaction of natural hazards. Coupled hazard catalogs and maps for target areas of the Alps, Iceland and Azores; modular automatic deformation monitoring systems using INSAR and CGPS; definition of realistic "elevated risk situations" with accompanying seismic, landslide and volcano hazard coupling models and documented case studies. The expected impact on existing and planned risk management operations in Europe will be a temporal component to risk assessment that will improve the capability of civil protection operations to respond quickly to emergencies.

Scientific partners

2	Dr Kurt Feigl	CNRS Université Paul Sabatier (UPS) – Toulouse III UMR 5562 – Dynamique Terrestre et Planetaire Avenue E. Belin, 14 FR - 31400 Toulouse	Tel : +33.5.61.33.29.40 Fax : +33.5.61.33.29.00 Email : Kurt.Feigl@cnrs.fr
3	Dr Freysteinn Sigmundsson	Nordic Volcanological Institute Grensasvegur 50 IS - 108 Reykjavik	Tel : +354.893.46.07 Fax : +354.562.97.67 Email : fs@hi.is
4	Prof. João Luis Gaspar	Universidade dos Açores Centro de Vulcanologia e Avaliação de Riscos Geológicos Rua Mãe de Deus, Edifício do Complexo Científico, Bloco Sul, 3 Andar PT - 9501-801 Ponta Delgada	Tel : +296.650.147 Fax : +296.650.142 Email : jlgaspar@notes.uac.pt
5	Prof. Jean Virieux	CNRS Université de Nice Sophia-Antipolis Géosciences Azur UMR 6526 Rue Albert Einstein 250 FR - 06560 Valbonne	Tel : +33.4.92.94.26.51 Fax : +33.4.92.94.26.10 Email : viri@geoazur.unice.fr
6	Dr Niels Hovius	University of Cambridge Department of Earth Sciences Downing Street UK - CB2 3EQ Cambridge	Tel: +44.1223.333.453 Fax: +44.1223.333.450 Email: nhovius@esc.cam.ac.uk
7	Dr Ragnar Stefansson	Icelandic Meteorological Office Department of Geophysics Bustadavegur 9 IS - 150 Reykjavik	Tel : +354.522.60.00 Fax : +354.522.60.01 Email : ragnar@vedur.is
8	Dr António Cunha	Secretaria Regional da Habitação e Equipamento SRPCBA Vale de Linhares, S. Bento PT - 9700 Angra do Heroísmo	Tel: +295.40.14.11 Fax: +295.40.14.51 Email: antonio.cunha@azores.gov.pt
9	Dr Hjalmar Eysteinsson	National Energy Authority Geoscience Division Grensasvegur 9 IS - 108 Reykjavik	Tel : +354.569.60.00 Fax : +354.568.88.96 Email : he@isor.is
10	Mr Agust Gunnar Gylfason	National Commisioner of the Icelandic Police Skulagata 21 IS - 101 Reykjavik	Tel: +354.570.26.55 Fax: +354.562.26.65 Email: agust@rls.is

11	Mr Bernard Jannin	REMIFOR DDSIS Boulevard Maljournal, 87 FR - 83300 Draguignan	Tel : +33.4.94.60.37.00 Fax : +33.4.94.60.37.32 Email : remifor@wanadoo.fr
12	Mr Yves Guglielmi (now at CNRS Géosciences Azur, partner 5)	University of Franche-Comté Département de Géosciences Route de Gray 16 FR - Cedex 25030 Besançon	Tel : +33.4.92.94.26.71 Fax : +33. 4.92.94.26.10 Email : guglielmi@geoazur.unice.fr
13	Dr Christophe Delacourt	CNRS Université Claude Bernard Lyon 1 Laboratoire Sciences de la terre UMR 5570 Bâtiment Géode Rue Raphaël Dubois FR - 69622 Villeurbanne	Tel : 0472.44.84.90 Fax : 0472.44.85.93 Email : christophe.delacourt@univ-lyon1.fr
14	Dr Olivier Maquaire	Université Louis Pasteur Centre d'Etudes et de Recherche Eco-Géographiques UMR 7007 Rue de l'Argonne 3 FR - 67083 Strasbourg	Tel : +33.3.90.24.09.36 Fax : +33.3.90.24.09.00 Email : olivier.maquaire@eost.u-strasbg.fr

NATURAL HAZARDS

MAGMA - Prague Centre of Mathematical Geophysics, Meteorology and their Applications
EVG3-CT-2002-80006

Start date: 01/01/03 – End date: 31/12/05
Duration: 36 months
EC contribution: 399,740.00 €
EC contact: Tobias Fuchs/Denis Peter

Project Co-ordinator
Dr Jiri Zahradnik
Charles University in Prague
Faculty of Mathematics and Physics
Department of Geophysics
V. Holesovickach, 2
CZ – 18000 Prague
Tel: +420.2.2191.25.46
Fax: +420.2.2191.25.55
Email: jiri.zahradnik@mff.cuni.cz
http://karel.troja.mff.cuni.cz/magma/

PROJECT SUMMARY – SPECIFIC SUPPORT MEASURE

Problems to be solved

The project aims at increasing international recognition of geophysics and meteorology at the Charles University in Prague, and to finalise integration into the European Research Area. The Centre will be based on strong existing international co-operation (including EC and NATO projects, and third-party projects with major companies).

Scientific objectives and approach

The objective of Magma centre is to contribute to the European co-ordination of research and education in dynamic phenomena of the solid Earth and atmosphere by adopting unifying mathematical viewpoint and multidisciplinary approach. The main approach to achieve the objective is networking of European researchers by means of organising workshops, inviting distinguished lecturers, and hosting PhD students and post-doctoral researchers.

Expected impacts

The Centre will apply the research to European environmental problems such as climate change, pollution transport, earthquake hazard and the energy problems, such as the oil exploration.

NATURAL HAZARDS

NARAS – Natural Risks assessment harmonisation of procedures, quantification and information
SSPI-CT-2003-511264 (SSA)

Start date: 01/09/04 – End date: 31/08/06
Duration: 24 months
EC contribution: 240.000 €
EC contact: Denis Peter

Project Co-ordinator
Paolo Gasparini
Università di Napoli Federico II
Corso Umberto I, 40
IT - 80125 Napoli
Tel: +39.0817.68.51.25
Fax: +39.0817.68.51.44
Email: paolo.gasparini@na.infn.it

PROJECT SUMMARY

Mediterranean countries are subject to frequent and different natural catastrophes which pay a high toll in terms of economic loss and human life. Since some tens of years EU countries are trying to mitigate the effects of these events mainly by means of prevention. Scientific progress in natural risk assessment and mitigation has increased the capacity of public administration to cope with high risk deriving from volcanic and hydro-geological events, to use satellites for short term prediction of meteorological events and floods, to work out, refine and enforce seismic EUROCODE 8. Several research project have been supported by EU Framework Programs. In all these cases risk assessment and managing have been approached individually for each risk typology and, often, differently even for a same typology in different countries. The consequence has been that the deliverables produced for different types of hazard are often not comparable and different deliverables for the same hazard types are produced in different countries. The need of harmonisation of terms and procedures has been stressed out in different EU MEDIN and UN Workshops. The aim of this project is to contribute to harmonise the risk assessment procedures and indicate ways to quantitative evaluation of hazard and risk levels through a two years long programmed series of Workshops, seminars, meetings, formation and educational activities which involve scientists, administrators and insurance experts who have been actively working in risk assessment problems in the latest years. Regions of South Italy, Greece and France will be used as test cases. The project is divided into 4 WP, dealing with: (1) Dissemination, comparisons of results and harmonisation, (2) Risk evaluation for land, urban planning and emergency management, (3) Formation and education (4) Publication of results.

This project aims at contributing to this need by:

1. Disseminating and discussing the results obtained by EU funded projects, in order to make specialists of each area aware about the results attained by other areas' specialists;
2. Promoting harmonisation of scenarios and procedures of risk evaluation among different countries and among different types of natural risks and by a critical analysis of existing normative codes, such as EC8;

3. Stimulating the development of quantitative probabilistic methodologies of evaluation of risks and different emergency scenarios using improved stochastic methods;
4. Promoting information and education actions in the schools aimed at increasing consciousness of natural risks among young people.

Scientific partners

2	Prof. Aris Avdelas	Aristotle University of Thessaloniki University Campus GR – 541 24 Greece	Tel: +30.2310.99.57.84 Fax: +30.2310.99.56.42
3	Prof. Jean Virieux	Université de Nice-Sophia Antipolis 28 Avenue Valrose FR - 06103 Nice	Tel : +33.49.294.26.51 Fax : +33.49.294.26.10

NATURAL HAZARDS

FORESIGHT – Frequent Observation-driven Realistic Evaluation and Simulation of Interacting Geophysical Hazard Triggers

SSPI-CT-2003-511139 (STREP)

Start date: 01/09/04 – End date: 31/08/06
Duration: 24 months
EC contribution: 1.080.000 Euro
EC contact: Denis Peter

Project Co-ordinator
Olivia Lesne
ACRI-ST. S.A.S
260 route du Pin Montard
FR - 06904 Sophia Antipolis Cedex
Tel : +33.492.96.75.00
Fax : +33.492.96.71.17
Email : oli@acri-st.fr

PROJECT SUMMARY

The overarching scientific objective of FORESIGHT is to understand the mechanically coupled, interrelated processes leading to the hazardous activity associated with earthquakes, volcanoes, landslides and tsunamis.

To assess, mitigate and manage the risks posed by these hazards, existing and fresh data from multi-sensor surveillance networks and satellites will be combined within a time-dependent Geographic Information System (GIS).

To harmonise data and methodologies for understanding geophysical processes across Europe

FORESIGHT will focus on four natural laboratories: Iceland, Azores, Alps and Turkey. FORESIGHT, like its FP5 predecessor RETINA, will emphasise the mechanical coupling and temporal interactions between geophysical processes. FORESIGHT will apply advanced methods of GIS analysis to enhance physical models for calculating, predicting, and interpreting the consequences of such geophysical activity.

FORESIGHT will support the implementation of new European-scale risk management systems by civil defence participants in the project.

To achieve these goals, the FORESIGHT consortium seeks to:

1) Recognise times of increased geophysical activity by assimilating fresh data from existing sensors.

2) Locate areas of increased geophysical activity by mapping crustal deformation, seismicity, and other indicators.

3) Develop exploitable models for the physical mechanisms underlying correlated events.

4) Calculate stress fields to identify areas where one event may trigger another.

5) Identify times and areas of increased hazard, accounting for triggered events in conditional probabilities.

6) Introduce these time-dependent assessments of hazard into risk management systems.

7) Share expertise and resources in risk management at the European level.

As a result, FORESIGHT will help reduce the effects of natural disasters upon the citizens and infrastructure of Europe.

Scientific partners

2	Dr Kurt Feigl	Centre National de la Recherche Scientifique UMR 55562 – Terrestrial and Planetery Dynamics 3, rue Michel Ange FR – 75794 Paris	Tel : +33.5.61.33.29.40 Fax : +33.5.61.33.29.00
3	Dr Niels Hovius	The Chancellor, Master and Scholars of the University of Cambridge Department of Earth Sciences Downing Street UK – CB2 3EQ Cambridge	Tel: +44.1223.33.34.53 Fax: +44.1223.33.34.50 Email: nhovius@esc.cam.ac.uk
4	Ms. Solveig Thorvaldsdóttir	Sólveig Thorvaldsdóttir Vesturgata 35 IS - 101 Reykjavik	Tel: +354.89.81.194 Email: solveig@rainrace.com
5	Mr Grimur Bjornsson	Iceland Geosurvey Department of Geophysics Grensasvegur 9 IS – 108 Reykjavik	Tel: +354.528.15.00 Fax: +354.528.15.00 Email: grb@isor.is
6	Mr Agust Gunnar Gylfason	National Commissioner of the Icelandic Police Civil Protection Section Skulagata 21 IS – 101 Reykjavik	Tel: +354.570.25.00 Fax: +354.562.26.65 Email: agust@rls.is
7	Dr Freysteinn Sigmundsson	Nordic Volcanological Institute Askja, Sturlugata 7 IS – 101 Reykjavik	Tel: +354.893.46.07 Fax: +354.562.97.67 Email: fs@norvol.hi.is
8	Dr Ragnar Stefansson	Icelandic Meteorological Office Department of Physics Bustadavegur 9 IS – 150 Reykjavik	Tel: +354.522.60.00 Fax: +354.522.60.01 Email: ragnar@vedur.is
9	Dr Einarsson Páll	Science Institute, University of Iceland Dunhagi 3 IS – 107 Reykjavik	Tel: +354.525.48.16 Fax: +354.552.13.47 Email: palli@hi.is
10	Dr Gabriela Queiroz	Universidade dos Açores Rua da Mãe de Deus PT – 9501-801 Ponta Delgada	Tel: +351.296.65.31.47 Fax: +351.296.65.01.42 Email: gq@notes.uac.pt
11	Antonio Cunha	SRHE/SRPCBA Vale de Linhares, são Bento PT – 9700-854 Vale de Linhares	Tel: +351.295.401.400 Fax: +351.295.401.451 Email: srcpcba@mail.telepac.pt
12	Dr Anne-Marie Duval	Centre d'Etudes Techniques de l'Equipement Méditerranée Pôle d'activité d'Aix-en-Provence 30 Avenue Albert Einstein FR – 13791 Aix-en-Provenance	Tel : +33.49.200.81.67 Fax : +33.44.260.79.19 Email : anne-marie.duval@equipement.gouv.fr
13	Mr Bernard Jannin	REMIFOR 247 rue Jean Aicard FR – 83300 Draguignan	Tel : +33.49.450.12.75 Fax : +33.49.468.77.03 Email : contact@remifor.org
14	Dr Semih Ergintav	Türkiye Bilimsel ve Teknik Arastirma Kurumu Ataturk Bulvari 221, Kavaklidere Turkey – 06100 Ankara	Tel : +90.262.641.23.00 Fax : +90.262.641.23.09

15	Msc. Mahmut Bas	Istanbul Metropolitan Municipality Merter Turkey – 34010 Istanbul	Tel: +90.212.511.56.62 Fax: +90.212.511.47.01 Email: mbas@ibb.gov.fr

NATURAL HAZARDS

3HAZ CORINTH – A multidisciplinary approach for measuring, modelling and predicting their triggering modes and their effects

Proposal 004043 (STREP)

Start date: 01/10/2004 – End date: 30/09/2006
Duration: 24 months
EC contribution: 1.500.000 Euro
EC contact: Denis Peter

Project Co-ordinator
Dr Pascal Bernard
Institut de Physique du Globe de Paris
4, Place Jussieu
FR - 75252 Paris
Tel : +33.144.27.24.14
Fax : +33.144.27.38.94
Email : bernard@ipgp.jussieu.fr

PROJECT SUMMARY

The project will contribute to better measure, model, and predict the processes leading to earthquakes, landslides, submarine slides, and tsunamis, and their effect in terms of hazard. The target area is the rift of Corinth, well known for its exceptional activity with respect to these hazards. This work will focus on the western end of the rift, close to the cities of Patras and Aigion, where the risk is highest.

We will study the short term seismic hazard with methods involving seismology, geodesy, geophysics, and geochemistry. In addition to strong motion analysis and prediction, transient processes (seismic swarms, "silent" earthquakes, fluid transients) will be studied, for a better modelling of fault mechanics and earthquake preparation processes. In addition to the existing monitoring arrays and data base, specific new instrumentation will be built. Near-real time alarms systems for significant earthquakes will be developed and tested. For the long term seismic hazard, the seismic potential of active faults will be assessed on land and offshore.

For submarine slope failures, places of past and future potential slumps will be mapped, and complemented by marine sediment coring and dating on selected places. Scenarios of slope failure and of coseismic displacement of the sea floor will be the inputs for tsunami modelling. The latter will be implemented using the existing high resolution bathymetry for modelling of the wave run up. Early warning alarms will be developed and tested.

For landslides, the main objective is to monitor and model the perturbation of the sliding of a well documented active landslide, in response to ground shaking from local earthquakes. Continuous GPS, seismic and tilt monitoring, and repeated advanced geodesy, will quantify sliding rates and constrain first order models. The feasibility of alarm systems will be studied.

Scientific partners

Will be communicated in the next version of the catalogue

NATURAL HAZARDS

LESSLOSS – Risk Mitigation for Earthquakes and Landslides
GOCE-CT-2003-505448 (Integrated Project)

Start date: 01/09/04 – End date: 31/08/07
Duration: 36 months
EC contribution: 6.430.000 €
EC contact: Denis Peter

Project Co-ordinator
Professor Michele Calvi
Università degli Studi di Pavia
Dipartimento di Meccanica Strutturale
Via Ferrata 1
IT - 27100 Pavia
Tel: +39.0382.505.461
Fax: +39.0382.528.422
Email: gm.calvi@unipv.it

PROJECT SUMMARY

Earthquake and landslide risk is a public safety issue that requires appropriate mitigation measures and means to protect citizens, property, infrastructure and the built cultural heritage. Mitigating this risk requires integrated and coordinated action that embraces a wide range of organisations and disciplines. For this reason, the LESSLOSS IP is formulated by a large e number of European Centres of excellence in earthquake and geotechnical engineering integrating in the traditional fields of engineers and earth scientists some expertise of social scientists, economists, urban planners and information technologists.

The LESSLOSS project addresses natural disasters, risk and impact assessment, natural hazard monitoring, mapping and management strategies, improved disaster preparedness and mitigation, development of advanced methods for risk assessment, methods of appraising environmental quality and relevant pre-normative research.

In order for the multi-disciplinary S&T ingredients of the project to be tackled in an efficient and productive manner, the research programme has been split into three distinct areas: physical environment, urban areas and infrastructures. For each one of this areas four main types of transversal fields have been identified as fundamental and capable of producing permanent effects on risk mitigation:

1. instrumentation and monitoring,
2. methods and technologies to reduce vulnerability,
3. innovative approaches for design/assessment,
4. disaster scenarios and loss modelling.

Within this general framework, specific objectives will be pursued, such as the development of innovative methods and approaches to design and assessment of structures and earth slopes for both short and long term implementation, the development of advanced monitoring techniques and devices, and the development, manufacturing and testing of innovative isolating and dissipating seismic devices.

Scientific partners

Will be communicated in the next version of the catalogue

SEISMIC

NATURAL HAZARDS

SEISLINES - Age-Variant Seismic Structural Reliability Of Existing Underground Water Pipelines
EVG1-CT-1999-00005

Start date: 01/03/00 – End date: 31/08/02
Duration: 30 months
EC contribution: 651,700.00 €
EC contact: Maria Yeroyanni

Project Co-ordinator
Dr Dimitris Kalles
Computer Technology Institute
Research and Development Division
Applied Information Systems Unit
P.O. Box 1122
Riga Feraiou Street 61
EL – 26221 Patras
Tel: +30.61.625.148
Fax: +30.61.222.086
Email: kalles@cti.gr

PROJECT SUMMARY

Problems to be solved

Many underground water pipelines were built without adequate earthquake protection; they are old and may have been subjected to aggressive environmental stressors that have resulted in corrosion, settlement, soil erosion and caused their seismic structural resistance to decrease. Damages to those pipelines during earthquakes are unavoidable and losses can be substantial. Preventive mitigation by upgraping existing pipelines for seismic resistance is cost effective for failure critical ones. This work aims to assess the structural reliability of deteriorating underground water pipelines (especially the asbestos cement ones) and develop a decision-support system (DSS) for upgrading and keep them in service following a major earthquake.

Scientific objectives and approach

The objectives of the proposed research are: to develop a methodology for the quantitative assessment of deteriorating underground water pipelines. and implement
this methodology in the case of asbestos cement, concrete, ductile iron, steel, PVC and PE pipelines; to validate the predictive ability of the above methodology in laboratory simulated conditions and to produce a decision- support-system (DSS).
To test the validity of the above assessment of seismic resistance, intact corroded asbestos cement pipes will be subjected to seismic loads in laboratory experiments. The above will be translated into a software programme in the form of a DSS for the seismic upgrading of critical waterpipelines, in order to remain in service following an earthquake. Furthermore, the user friendliness, usefulness, accuracy of results of the proposed DSS , as well as the lifecycle costs of the main rehabilitation and replacement options for the above pipelines will be assessed.

Expected impacts

The proposed decision-support system (DSS) for upgrading water pipelines, if proved under experimental and field conditions could be very promising for the markets of seismic active countries of Southern Europe (there are about 6000 water utilities in the earthquake prone countries of EU), the Balkans, South America, Asia and Japan. This project will improve the competitiveness of the European industry on pipeline seismic upgrading, the post earthquake service condition and increase people's safety.

Scientific partners

2	Dr Vassilis Kallidromitis	Tecnic Consultino Engineers Via Panama 86a IT – 00198 Roma	Tel: +39.06.853.550.88 Fax: +39.06.853.550.96 Email: tecnic.spa@agora.stm.it
3	Prof. Costas Syrmakezis	National Technical University of Athens Institute of Structural Analysis and Aseismic Research Iroon Polytechniou 9 EL -15773 Athens	Tel: +30.1.772.15.90 Fax: +30.1.772.15.82 Email: isaarsyr@central.ntua.gr
4	Dr Günter Becker	RISA Sicherheitsanalysen GmbH Krumme Strasse 55 DE – 10627 Berlin	Tel: +49.30.315.70.60 Fax: +49.30.315.70.621 Email: Guenter.Becker@risa.de
5	Dr Paolo Negro	European Commission Institute for Systems, Informatics and Safety Via Enrico Fermi, 1 IT – 21020 Ispra	Tel: +39.0332.785.452 Fax: +39.0332.789.049 Email: Paolo.Negro@jrc.it
6	Dr Sotirios Pappas	Water and Sewerage Authority of Greater Volos Water Department Konstanta Street, 141 EL – 38221 Volos	Tel: +30.421.52927 Email: deyamb@volos-m.gr

NATURAL HAZARDS

SPIDER - Strands Prestressing for Internal Damping of Earthquake Response
EVG1-CT-1999-00013

Start date: 01/03/00 – End date: 30/08/02
Duration: 30 months
EC contribution: 295,700.00 €
EC contact: Maria Yeroyanni

Project Co-ordinator
Dr Mouloud Behloul
Bouygues Travaux Publics
Direction Scientifique
Avenue Eugene Freyssinet 1
Challenger – E15
FR – 78061 Saint Quentin en Yvelines
Tel : +33.1.30.60.47.81
Fax : +33.1.30.60.27.27
Email : m.behloul@bouygues-construction.com

PROJECT SUMMARY

Problems to be solved

Earthquake protection of buildings is of key importance. Retrofitting of a large amount of structures, not respecting the new regulations, is becoming an important market. The traditional methods require important additional strengthening inducing works at high costs. Dissemination of energy dissipation devices, is also limited. The objective is to overcome the limits of energy dissipation devices through coupling of a series of dampers and cables. Some promising preliminary studies have already been carried out.

Scientific objectives and approach

The technical key problem concerns the connections between the cable and the structure to be protected. Moreover, the following items must be addressed: architectural constraints, end-user needs, public authorities approval aspects. The project includes the development of prototypes and tests on full-scale mock-ups, full-scale mock-ups.). Laboratory tests and preliminary studies carried out by the damper manufacturer have shown the feasibility of the damper/cable system (DCS). The ambition is to limit the number of dampers needed to protect the structure against earthquakes. Identification of the requested DCS characteristics and the structural typologies for which the system is applicable. Design of the DCS components, and supply of DCS prototypes. Study of architectural issues related to the installation of DCS. Experimental analysis of the DCS prototypes and of full-scale structures equipped with them. Evaluation of the technical and economical benefits of the use of such devices. Design guidelines for the implementation of the semi-active and passive control technologies.

Expected impacts

The industrial results of this project – prototype innovative devices – for earthquake protection of structures at low costs, will contribute to the increase of European retrofitting market world-wide. In collaboration with construction companies, effective and economic solutions for the retrofitting of schools and hospitals will be proposed.

NATURAL HAZARDS

CORSEIS - An Integrated Study of Seismic Hazard Assessment in the Area of Aigion, Gulf of Corinth, Greece

EVG1-CT-1999-00002

Start date: 01/04/00 – End date: 31/07/02
Duration: 28 months
EC contribution: 662,000.00 €
EC contact: Maria Yeroyanni

Project Co-ordinator
Dr Pascal Bernard
IPGP
Département de Sismologie
Place Jussieu, 4
FR – 75252 Paris
Tel : +33.1.44.27.24.14
Fax : +33.1.44.27.38.94
Email : bernard@ipgp.jussieu.fr
http://www.corinth-rift-lab.org/index_en.html

PROJECT SUMMARY

Problems to be solved

The aim of the project is to contribute to improve observational, experimental and theoretical methodologies for seismic hazard assessment. The work will focus in the highly seismic Aigion area, Gulf of Corinth, Greece. Tectonic studies with geomorphology, trenching, and coring in quaternary sediments, associated with dating, will provide information of long and mid term deformation and rupture sequences of the major faults. Continuous GPS will bring space and time variability of the strain field. Borehole and surface high dynamic accelerometers in soft soil sites will allow the study of non-linear effects. Continuous geophysical (strain, tilt, pore water pressure,) and geochemical monitoring will detect crustal transients, to be analysed together with seismicity.

Scientific objectives and approach

The tectonic studies consist of a detailed geomorphological survey of the area, trenching on the two major fault scarps and dating of the rupture episodes, drilling at shallow depth (tens of meters) for dating of quaternary sediments. Long term subsistence and uplift, as well as time series of rupture, will be analysed. The source seismological studies consist of deploying broadband surface accelerometers on rock sites, installing an array of shallow borehole velocimeters (100-150 m), and installing deep borehole high dynamic accelerometers (400 m and 100 m).
For the engineering seismology and earthquake engineering studies, shallow boreholes drilled in soft soils will be equipped with high dynamic accelerometers. In situ and laboratory dynamic tests will be performed to define soil profile with a detailed description of the dynamic soil properties. Finally, a buried structure will be instrumented with a few accelerometers. Experimental and theoretical analysis of non-linear behaviour of soils will be achieved. The data mostly telemeters via phone line, will be processed and stored in several databases. It will be available on request after validation and first publications. Catalogues of seismicity will be available. Effects of surface geology and of soft behaviour will be quantified. Models of crustal processes and fault mechanics, sequences of paleoearthquakes, as well as long and short-term slip on the two major faults will be published.

Expected impacts

The project will allow defining better methodologies in the whole chain of the seismic hazard assessment process. The resulting increase of expertise in Europe will allow better advising and collaboration with the end-users (Electricité de France, International Agency of Nuclear Energy and Nuclear Waste) for practical applications. It will in particular provide reliable design values for the Eurocode 8, based on strong data and taking into account non-linear behaviour of soils.

Scientific partners

2	Dr Daniela Pantosti	Istituto Nazionale di Geofisica U.O. SFIT – Active Tectonics and Paleoseismicity Via di Vigna Murata 605 IT – 00143 Roma	Tel: +39.06.5186.04.83 Fax: +39.06.504.11.81 Email: pantosti@ingrm.it
3	Prof. Konstantinos Makropoulos	National and Kapodistrian University of Athens Department of Geophysics Seismological Laboratory Panepistimioupolis, Zografou EL – 157 84 Athens	Tel: +30.1.724.74.45 Fax: +30.1.724.32.17 Email: kmacrop@geol.uoa.gr
4	Mrs Kyriazis Pitilakis	Aristotle University Thessaloniki Civil Engineering Laboratory of Soil Mechanics and Foundation Engineering P.O. Box 450 University Campus EL – 54006 Thessaloniki	Tel: +30.31.996.745 Fax: +30.31.200.392 Email: research@rc.auth.gr
5	Prof. Harilaos Billiris	National Technical University of Athens Higher Geodesy Laboratory Dionysos Satellite Observatory Heroon Polytechniou 9 EL – 157 80 Zographos – Athens	Tel: +30.1.772.26.69 Fax: +30.1.772.26.70 Email: Billiris@central.ntua.gr
6	Dr Catherine Berge-Thierry	Institut de Protection et Sureté Nucléaire Berssin/Sergd/dpre/ipsn P.O. Box 6 FR – Cedex 92265 Fontenay aux Roses	Tel : +33.1.46.54.86.71 Fax : +33.1.46.54.81.30 Email : catherine.berge@ipsn.fr
7	Dr Iain Stewart	Brunel University Department of Geography and Earth Sciences Kingston Lane UK – UB8 3PH Uxbridge, Middlesex	Tel: +44.1895.203.215 Fax: +44.1895.203.217 Email: Iain.stewat@brunel.ac.uk
8	Dr Hélène Lyon-Caen	Ecole Normale Supérieure Département T.A.O. E.N.S. Rue Lhomond, 24 FR – 75231 Paris Cedex 5	Tel : +33.1.44.32.22.05 Fax : +33.1.44.32.22.00 Email : Helene.Lyon-Caen@ens.fr

NATURAL HAZARDS

SPACE - Semi-active Passive Control of the Dynamic Behaviour of Structures subjected to Earthquake, wind and vibration

EVG1-CT-1999-00016

Start date: 01/04/00 – 31/03/03
Duration: 36 months
EC contribution: 1,673,000.00 €
EC contact: Maria Yeroyanni

Project Co-ordinator
Dr Christian Braun
Maurer Soehne GmbH & Co. KG
Brueckenausruestung
Frankfurter Ring, 193
DE - 80807 Muenchen
Tel: +49.89.3239.42.68
Fax: +49.89.3239.43.06
Email: braun@muchn.maurer-soehne.de

PROJECT SUMMARY

Problems to be solved

The proper functioning of industrial equipment and provision of safe working environment require techniques to reduce the effects of earthquakes, wind and traffic-induced vibrations on structures. Present technologies applied - isolation and passive energy dissipation - have limitations. The aim of this project is the development of innovative systems for reducing the effects of seismic induced vibrations. Based on the performance needs of various types of structures & industrial plants, selected in the project, such innovative devices will be designed, manufactured and tested.

Scientific objectives and approach

The objectives of the project are to develop: 1)semi-active vibration control system using hydraulic dampers based on magneto-rheological smart fluid; 2) floor isolation system operating in 3 directions; 3) 3D floor isolation system incorporating the semi-active dampers developed. Prototype devices will be developed, manufactured and widely tested also incorporated in mock-up structures. The project will consist in the following phases: - Definition of structures for the application of semi-active and passive devices - Development of semi-active control system - Numerical models of the devices, of the structures and mock-ups and dynamic analyses -Characterisation tests of devices, structures and mock-ups - Evaluation of technical and economical benefits - User Manual (design procedures for the implementation of the semi-active control and for passive technologies).

Expected impacts

The protection of transport infrastructure, industrial plants and strategic buildings from earthquake damage is of paramount importance, particularly to Southern areas of the European Union. Countries situated in earthquake-prone areas, for instance California (USA), Japan and New Zealand are actively engaged in the development of novel techniques and devices for the earthquake protection of structures. As a result of this project, the development of seismic devices will open the possibility of increased exports for manufacturers of both the devices and that of

seismically protected sensitive equipment, while the structures provided with the innovative devices will suffer no significant earthquake damage. This possibility will result in: a) much greater safety in the event of an earthquake b) less damage to the historical environment c) avoidance of demolition and reconstruction after an earthquake d) improved possibility of siting industrial work places close to housing.

Scientific partners

2	Mr Joern Seitz	Bilfinger & Berger Bauaktiengesellschaft Service Center Technik Carl-Reiss-Platz 1-5 DE – 68165 Mannheim	Tel: 49.621.459.25.06 Fax: +49.621.459.28.33 Email: jsei@sct.bub.de
3	Mr Gilles Moresco	Thomson Marconi Sonar SAS Route des Dolines 525 FR – 06903 Sophia Antipolis Cedex	Tel : +33.4.929.64.585 Fax : +33.4.929.64.208 Email : gilles.moresco@tms.thomson-csf.com
4	Prof. Ann-Christine Albertsson	Kungliga Tekniska Hoegskolan Institutionen foer Polymerteknologi Teknikringen 58 SE – 10044 Stockholm	Tel : +46.8.790.82.74 Fax : +46.8.100.775 Email : aila@polymer.kth.se
5	Dr Roberto Roascio	ISMES S.p.a. Structural Engineering Area Via Pastrengo 9 IT – 24068 Seriate	Tel: +39.035.307.200 Fax: +39.035.302.999 Email: info@ismes.it
6	Dr Renzo Tavoni	ENEA Dipartimento Energia Divisione Sistemi Energetici Ecosostenibili Via Martiri di Monte Sole 4 IT – 40129 Bologna	Tel: +39.051.609.85.11 Fax: +39.051.609.86.88 Email: tavoni@bologna.enea.it
7	Mrs Gabriella Giuseppetti	ENEL S.p.A. Hydraulic & Structural Centre Via Pozzobonelli 6 IT – 20162 Milano	Tel : +39.02.722.43.544 Fax : +39.02.722.43.550 Email : giuseppetti@pis.enel.it
8	Prof. Vieri Quilici	UNIROMA 3 Dipartimento di Progettazione e Scienze dell'Architettura Via della Madonna dei Monti 40 IT – 00184 Rome	Tel: +39.6.48.15.694 Fax: +39.6.48.18.625 Email: serino@uniroma3.it
9	Dr Alan Roberts	Tun Abdul Razak Research Centre Brickendon Lane, Brickendonbury UK - SG13 8NL Hertford	Tel: +44.1992.584.966 Fax: +44.1992.554.837 Email: Roberts@tarrc.tcom.co.uk

NATURAL HAZARDS

PRESAP - Towards Practical, Real-Time Estimation of Spatial Aftershock Probabilities: a Feasibility Study in Earthquake Hazard

EVG1-CT-1999-00001

Start date: 01/06/00 – End date: 30/09/03
Duration: 40 months
EC contribution: 495,100.00 €
EC contact: Maria Yeroyanni

Project Co-ordinator
Dr John McCloskey
University of Ulster
School of Environmental Studies
Cromore Road
UK - BT52 1SA Coleraine
Tel: +44.1265.324.769
Fax : +44.1265.324.911
Email : j.mccloskey@ulst.ac.uk

PROJECT SUMMARY

Problems to be solved

While it is now widely accepted that the goal of deterministic earthquake prediction will not be attainable in the short or medium time, this does not preclude the estimation of seismic hazard and how it might vary in space and time. Recent advances in the modelling of stress perturbations as the result of a large earthquake account for the spatial distribution of aftershocks in terms of triggering by the mainshock.

Scientific objectives and approach

This project aims to assess the possibility of using these modelling techniques in a particular context on two fronts so that they might be used in the hours to tens of days following an earthquake to assist in seismic crisis management. Firstly, the project will examine in detail the scientific feasibility of the technique in terms of its ability to forward model the aftershock sequences of several recorded and synthetic earthquakes and secondly it will test the ability to use this forward modelling in a practically useful way.

Expected Impacts

This project has the potential to significantly contribute to a major advance in earthquake hazard mitigation, predicting risk hazards in near real-time. This tool would provide a firm basis for civil protection agencies to make decisions that directly affect health (e.g. when to allow people to return to their homes following an earthquake).

Scientific partners

2	Prof. Jiri Zahradnik	Charles University Faculty of Mathematics and Physics Department of Geophysics V. Holesovickach 2 CZ – 18000 Prague	Tel: +420.2.2191.25.46 Fax: +420.2.2191.25.55 Email: jz@karel.troja.mff.cuni.cz
3	Mr Vasileios Andrianakis	Earthquake Planning and Protection Organisation Xanthou 32 EL - 154 51 Athens	Tel: +30.1.67.28.000 Fax: +30.1.67.79.561 Email: eppoeng@hol.gr
4	Dr Massimo Cocco	Istituto Nazionale di Geofiscica Via di Vigma Murata 605 IT – 00143 Roma	Tel: +39.06.518.60.401 Fax: +39.06.504.11.81 Email: cocco@ing750.ingrm
5	Prof. Geoffrey King	Institut de Physique du Globe de Paris B.P. 89 Place Jussieu 4 FR – 75252 Paris	Tel : +33.1.442.724.39 Fax : +33.1.442.724.40 Email : king@ipgp.jussieu.fr
6	Dr Oona Scotti	Institut de Protection et Sureté Nucléaire Berssin/Sergd/Dpre B.P. 6 FR – Cedex 92265 Fontenay aux Roses	Tel : +33.1.46.548.647 Fax : +33.1.46.548.130 Email : oona.scotti@ipsn.fr
7	Dr George Stavrakakis	National Observatory of Athens Institute of Geodynamics P.O. Box 20048 Lofos Nymfon EL - 118 10 Athens	Tel: +30.1.349.01.95 Fax: +30.1.349.01.80 Email: g.stav@egelados.gein.noa.gr

CITY OF TOMORROW

RISK-UE – An advanced approach to earthquake risk scenarios with applications to different European towns

EVK4-CT-2000-00014

Start date: 01/02/01 – End date: 30/09/04
Duration: 44 months
EC contribution: 1,625,378.00 Euro
EC contact: Adèle Lydon

Project Co-ordinator
Dr Pierre Mouroux
BRGM
Amenagement et Risques Naturels
Avenue Claude Guillemin 3
FR - 45060 Orleans
Tel : +33.4911.774.74
Fax : +33.1911.774.75
Email : p.mouroux@brgm.fr
http://www.risk-ue.net/

PROJECT SUMMARY

Problems to be solved

Decision makers in earthquake-prone cities need concrete figures of the possible impact of seismic event. RISK-UE will develop a general and modular methodology for creating earthquake-risk scenarios that concentrates on the distinctive features of European towns, including both current and historical buildings. It will be based on seismic-hazard assessment, a systematic inventory and typology of the elements at risk and an analysis of their relative value and vulnerability, in order to identify the weak points of urban systems. The resulting scenarios will give concrete figures of direct and indirect damage of possible earthquakes. With the participation of urban council representatives, the methodology will then be applied to seven selected cities from the EU and Eastern Europe for its adaptation and validation. A European cities network for seismic-risk reduction will be created during a final symposium.

Scientific partners

2	Prof. Adriano De Maio	Dipartimento di Ingegneria Strutturale Politecnico of Milan Piazza Leonardo da Vinci 32 IT - 20133 Milano	
3	Prof. Guiba Tziampiri	Laboratory of Soil Mechanics and Foundation Engineering Department of Civil Engineering School of Technology Organisation: Aristoteleio Panepistimio Thessalonikis, University Campus PO Box 450 Greece - 54006 Thessaloniki	

4	Prof. Eugenio Onate	Centre Internacional de Metodos Numerics en Ingenyeria S/N Gran Capitan S/N, Campus Norte Upc Edificio C1 ES - 08034 Barcelona	
5	Prof. Petre Patrut	Technical University of Civil Engineering 124 Lacul Tei Boulevard, Buc 38 72302 Bucharest Romania	
6	Prof. Kosta Talaganov	Section on Risk and Disaster Management Institut of Earthquake Engineering and Engineering Seismology University 'St. Cyril and Methodius' Salvador Aljende Str. 73 91000 Skopje Macedonia	
7	Mr Carlos Amieiro	Direccio de Serveis de Proteccio Civil Ayuntamiento de Barcelona ES - 08071 Barcelona	
8	Mr Gheorghe Tomoiala	Direction of Seismic Risk Reduction Organisation: Ministry of Public Works and Land Planning Apolodor Nr. 1770661 Bucharest Romania	
9	Ivan Gechev	Investment and Supervision Department Organisation: Municipality of Sofia Moskovska Street N°33 1000 Sofia Bulgaria	
10	Marc Lafaurie	Direction de L'environnement Mairie De Nice, 2 Rue Saint Francois De Paule FR - 06364 Nice	
11	Ivan Jolevski	Museum and Gallery Institute for Protection of Cultural Heritage and Natural Rarities Kliment Ohridski, Bb, 7000 Bitola Macedonia	
12	Dr Anton Bojadjiev	Risk Engineering Ltd, 34, Totleben Boul.1606 Sofia, Bulgaria	
13	Ziatko Tomski	Office of The Principal City Architect Municipality Of Bitola, Kiril I Metodij, 6, 7000 Bitola, Macedonia	
14	Prof. Umberto Scapagnini	Centro Storico, Publica Incolumita e Sicurezza Sismica Direzione Gestione del Territorio Comune di Catania Via G. Verdi, 31 IT - 95100 Catania	

15	Prof. Ludmil Tzenov	Seismic Mechanics Central Laboratory for Seismic Mechanics and Earthquake Engineering Bulgarian Academy of Science Bonchev Block 3 1113 Sofia Bulgaria	
16	Mr Jaume Mirando	Unitat de Geologia Institut Cartografic de Catalunya, Parc de Montjuic ES - 08038 Barcelona	
17	Prof. Giovanni Solari	Department of Structural and Geotechnical Engineering: Universita degli Studi di Genova Via Montallegro 1 IT - 16145 Genova	
18	Dr Bertrand Grellet	Geologie Tectonique Environnement et Risques 3 Rue Jean Monnet 3 FR - 34830 Clapiers	
19	Prof. Katsambalos, Konstantinos	Organization for the Master Plan and Environmental Protection of Thessaloniki 105, Vas. Olgas Str. EL - 546 43 Thessaloniki	

NATURAL HAZARDS

S.A.F.E – Slow Active faults in Europe Assessing fundamental input for seismic risk in regions of low Seismicity

EVG1-CT-2000-00023

Start date: 01/02/01 – End date: 30/04/04
Duration: 39 months
EC contribution: 970,231.00 €
EC contact: Denis Peter

Project Co-ordinator
Dr Michel Sébrier
Université Paris-Sud
Orsayterre – UMR 8616, Bâtiment 509
FR – 91405 Orsay
Tel: +33.1.691.56.140
Fax: +33.1.601.91.446
Email: sebrier@geol.u-psud.fr
http://www.aramis-research.ch/e/14485.html

PROJECT SUMMARY

Problems to be solved

Seismically active western European regions are generally characterised by low-hazard but high-risk, due to the concentration of human and material properties with high-vulnerability. Detecting tectonic deformations, which may lead to destructive earthquakes in such areas, requires innovative research strategies that suit western European climate, slowly deforming fault, and heavily human-modified areas. This project is aiming at identifying and characterising active faults in low- seismicity regions.

Scientific objectives and approach

This project will establish conceptual methodologies in key regions of Western Europe that explain the behaviour of slow active faults through diagnostic criteria. It will develop an expert system, which may be used as a standard in the future to diagnose the existence and seismogenic potential of slow active faults. The objectives are to: (1) Extend geologic investigations of fault activity beyond the Holocene; (2) Develop an expert system combining diverse lines of geologic evidence in order to diagnose the existence and seismogenic potential of slow active faults; (3) Delineate and characterise high seismic risk areas of Western Europe, either from historical evidence or from geological evidence; (4) Demonstrate and discuss the impact of the project's results on risk assessment through a case study in a pilot area characterised by several urban concentrations. European test areas include tectonic domains with low-level of seismicity or with major historical earthquakes (Provence; Upper-Lower Rhine grabens; Po plain, Southern Spain and Catalan coast). The main expected results are: Modelling of seismic catalogs; Seismotectonic in extensional and compressional settings; Geophysical methodology for fault identification; Analysis of landscape response to faulting; Expert System for diagnosing slow active faults; Table of studied fault and associate parameters.

Expected Impacts

While the strategies for risk mitigation in high seismicity areas of the globe are quite established, the decisions to be made in the western European countries where seismicity is infrequent are diversified. The main findings of this project will contribute to the realistic assessment of seismic risk in the given region (e.g. decisions about the exact location of hazardous industries nuclear and chemical plants and use planning). Potential end-users are decision-makers, insurance companies and engineering companies.

Scientific partners

2	Dr Gianluca Valensise	Istituto Nazionale di Geofísica U.O. SFIT Active Tectonics and Paleoseismicity Via di Vigna Murata 605 IT – 00143 Roma	Tel: +39.06.518.604.85 Fax: +39.06.504.11.81 Email: valensise@ingrm.it
3	Dr Thierry Camelbeeck	Royal Observatory of Belgium Département 1 – Systèmes de Référence et Géodynamique Avenue Circulaire, 3 BE - 1180 Bruxelles	Tel: +32.2.373.02.52 Fax: +32.2.373.03.39 Email: thierry.camelbeeck@oma.be
4	Dr Denis Jongmans	Université de Liège Laboratoire de Géologie de l'Ingénieur Bâtiment B19 BE – 4000 Liège	Tel : 32.4.366.20.35 Fax : 32.4.366.28.17 Email : djongmans@ulg.ac.be
5	Dr Mustapha Meghraoui	Université Louis Pasteur Institut de Physique du Globe, Section « Faille Active et Paléosismologie » Rue René Descartes 5 FR - 67084 Strasbourg	Tel : +33.3.88.60.60.57 Fax : +33.3.88.61.67.47 Email : Mustapha@eost.u-strasbg.fr
6	Dr Thierry Winter	Bureau de Recherches Géologiques et Minières Service « Land Use Planning and Natural Hazards » B.P. 6009 Avenue Claude Guillemin FR – 45060 Orléans Cedex 2	Tel : +33.2.3864.33.01 Fax : +33.2.3864.33.99 Email : t.winter@brgm.fr
7	Prof. Manfred Strecker	Universitaet Potsdam Institut fuer Geowissenschaften P.O. Box 601553 DE – 14415 Potsdam	Tel: +49.331.977.52.61 Fax: +49.331.977.50.60 Email: strecker@persius.rz.uni-potsdam.de
8	Prof. Pere Santanach	Universitat de Barcelona Departament de Geodinàmica i Geofisica Martí i Franquès, s/n ES – 08028 Barcelona	Tel: +34.93.402.13.76 Fax: +34.93.402.13.40 Email: santanach@antura.geo.ub.es
9	Dr Kuvvet Atakan	University of Bergen Department of Solid Earth Physics Allégt. 41 NO – 5007 Bergen	Tel: +47.555.83.413 Fax: +47.555.89.669 Email: kuvvet.atakan@ifjf.uib.no
10	Prof. Domenico Giardini	Swiss Federal Institute of Technology Swiss Seismological Service Institute of Geophysics ETH ETH Hoenggerberg CH – 8093 Zurich	Tel: +41.1.633.26.10 Fax: +41.1.633.10.65 Email: giardini@seismo.ifg.ethz.ch
11	Prof. Mostafa Zouine	Ecole Normale Supérieure Département des Sciences de la Terre ENS Takaddoum P.O. Box 5118 Avenue Oued Akreuch Maroc – Rabat	Tel: +212.76.80.425 Fax: +212.77.50.047 Email: zouine.ens@yahoo.fr

CITY OF TOMORROW

SAFEFLOOR – Low risk and totally recyclable structural buildings
EVK4-CT-2000-00020

Start date: 01/02/01 – End date: 30/09/04
Duration: 44 months
EC contribution: 1,553,740.00 Euro
EC contact: Adèle Lydon

Project Co-ordinator
Dr Juan Manuel Mieres
Necso Entrecanales Cubiertas – R&D Dept.
Avda. Europa 18 Alcobendas
ES - 28108 Madrid
Tel: +34.9166.331.60
Fax: +34.9166.328.37
Email: jmieres@nesco.es

PROJECT SUMMARY

Problems to be solved

- A high percentage of victims and people injured during and after earthquake disaster is due to the heavy structural elements necessary to be removed during the rescue operations. To cut down response time by 15% will reduce the injured during earthquake. If we do not provide a lighter and easy disassembling design the victims due to the traditional dead load of the building will be maintained.
- A great number of accidents which occur in the Construction Sector (the most important industrial activity in urban areas) derive from the need to transport heavy loads in site areas. To cut down loads in site area by 70% during structural works will reduce the current figures of victims in construction accidents.
- Lack of rationality within the construction process. The final product of this project will permit a major rationality in the construction of building and a reduction of the construction period. Consequently the high environmental impact in urban areas due to the construction activity will be also reduced.

  10% of noise disturbs produced in the site.
  20% dust contamination.
  20% of traffic disturbs.
  25% of labour accident risk
  15% of works period.

Scientific objectives and approach

- Through the use of composite materials and high strength concrete, integrating the finish pavements we aim to develop a totally new and technologically advanced light structural element. During the project we will pursue the following objectives:
- To develop a construction procedure that allows the structure to be quickly assembled and disassembled by stages.
- To reduce the building square meter cost, in terms of foundations, structure and indoor pavements. To integrate the finished pavement into the structural floor member.
- To optimise the materials to lower the structural floor dead load down to 80 Kg/m2 (a reduction of the
- 70% regarding the actual products)

- To optimise the combination of high strength concrete and composite materials (carbon fibre and Aramida), using prestressing techniques)
- To develop a calibrated software programme to help designers calculate the building structure

Expected impacts

In the consortium the construction partner is interesting to solve these problems in order to improve the productivity, the quality, the safety and security in sites, as well as the environmental impact of the construction activity.
The composite materials industry is interesting to solve some problems linked to the application of these materials in the construction sector and regarding the design, the calculation and the construction
process.
The universities and research institutes involved in this project want to look deeply into the durability, recycling and seismic behaviour of composite structures.
The rescue organisations are interested in developing new structural system more suitable to facilitate the rescue operation.
If the consortium can resolve these problems we will provide to the society a low risk structural element, we will improve the productivity of the construction industry, and the European composite material technology will surpass the levels already existed in EEUU or Japan.
As a result of the weight of the construction materials being reduced, the plant and equipment used during said construction shall be lighter and quieter. Because the items to be moved shall be lighter, construction rates shall be higher and construction periods shall be cut down. The impact upon the urban environment "The City of Tomorrow" can be summarised as follows:

- A 10% reduction in the level of noise caused by the construction of buildings in the towns.
- A 20% reduction in truck traffic (for material transportation purposes), with respect to current traffic.
- As a result of the overall weight of the building being reduced and consequently the loads transmitted to the ground being lighter, it shall be possible to build on grounds currently considered unsuitable and located in the outskirts of towns. A more rational utilisation of the ground available in the big cities

Scientific partners

2	Ebby G. Shahidi	The Advanced Composite Group –ACG Research & Department Delves Road Heanor Gate Industrial Estate, Heanor UK - Derbys DE75 7SJ	
3	Eugenio Gutierrez	JAC European Comission IT – Ispra	
4	Antonio Miravete	University of Zaragoza Dept. of Mechanical Engineering Maria de Luna 3 ES - 50015 Zaragoza	
5	Thanasis Triantafillou	University of Patras Dept. of Civil Eng. Structures Division GR - 26500 Patras	
6	Roko Zarnic	Civil Engineering Institute ZRMK Dimiceva 12 p.p. 2554.1001 Ljubljana, Slovenia	
7	Konstantin Meskouris	Aachen Technical University Mies-van-der-Rohe-Strasse 1 DE - 52056 Aachen	

NATURAL HAZARDS

SESAME – Site Effects Assessment Using Ambient Excitations

EVG1-CT-2000-00026

Start date: 01/05/01 – End date: 31/10/04
Duration: 42 months
EC contribution: 889,648.00 €
EC contact: Maria Yeroyanni

Project Co-ordinator
Dr Pierre-Yves Bard
Université Joseph Fourier/Grenoble I
Lab. De Géophysique Interne & Tectonophysique
Rue de la Piscine 1381
FR – 38041 Grenoble
Tel : +33.4.76.82.80.61
Fax : +33.4.76.82.81.01
Email : bard@obs.ujf-grenoble.fr
http://sesame-fp5.obs.ujf-grenoble.fr/index.htm

PROJECT SUMMARY

Problems to be solved

After recent earthquakes, a priori estimations of site effects became a major challenge for an efficient mitigation of seismic risk. Unfortunately, the few methods known as reliable systematically appear as far too expensive for local and national authorities, especially in moderate seismicity countries or in developing countries. There is therefore a drastic need for reliable, low cost techniques. The objectives of the present proposal are to investigate the reliability of two techniques born in Japan using ambient noise recordings: the very simple H/V technique ("Nakamura"), and the more advanced array technique. They offer many advantages, especially in urban areas, and their use (perhaps misuse) is rapidly spreading world-wide; but their physical basis and actual relevancy for site effect estimates has never reached a scientific agreement. This project gathers experts in seismology, engineering geology, surface geophysics, data processing, numerical modelling and earthquake engineering, to tackle these methods under different viewpoints, understand their physical basis, assess their actual meaning in view of site effect estimation, and propose user guidelines and processing software to ensure a correct use, and thus improve significantly the mitigation tools..

Scientific objectives and approach

The work will consist of 4 main, complementary tasks. On the upstream side, the project will try and fill the gap concerning the understanding of the real nature of noise, especially in urban areas. On the technical side, series of investigations will be carried out to clearly identify the key points in each of these techniques and their reliability, and to clearly assess the conditions under which they have to be performed: experimental conditions for the measurements, and processing techniques as well. Finally, on the downstream side, after - hopefully - having shown that these techniques do provide useful information when applied with care, we want to offer a framework for reliable measurements by proposing user guidelines that could form the basis for a quality label.

The scientific work will thus be separated into a total of 12 work-packages, three for each main task:

- H/V technique : experimental aspects for warranting the stability and reproducibility of measurements, investigations on the various data processing alternatives and choice of the most robust ones, and finally

experimental assessment of the meaning of this ratio by a thorough comparison with instrumentally measured site effects, or damage distribution in several recent earthquakes.

- Array measurement technique : experimental aspects for an optimal adaptation of the instrumental characteristics and layout to the site under study, analysis of several multitrace signal processing techniques (f-k, spatial autocorrelation) and implementation of a robust software, and improvements in the inversion of velocity profiles with an optimum use of a priori information.
- Physical background and numerical modelling for cross-checks with observed data: data analysis at several sites to identify the composition of noise wavefield (nature, proportion and origin of surface and body waves) in urban areas, development and validation of numerical models (FD) with random surface sources, and numerical analysis of the H/V and array techniques on noise synthetics, and finally cross checking of observations, numerical simulations, and known structure and site effects for a few well-known test-sites.

Finally, organisation of the dissemination of the scientific knowledge and technical know-how through special workshops and special issue in an international journal, redaction of user guidelines and realisation of a CD-ROM with validated processing software for the H/V technique to be advertised in international committees.

Expected Impacts

The main outcome will be a clear, solid assessment of the meaning of these methods, and recommendations as to their practical implementation. This will materialize through user guidelines for each technique, to be discussed in specialized committees of international bodies (joint IAEE/IASPEI working group on effects of surface geology), and thus widely disseminated, in order to provide the basis for a quality label.
The consequences will be two-fold: on one side, their wide dissemination will hopefully prevent misuses, wrong microzonation maps and misleading earthquake safety feelings. On the other side, for countries which till now have been reluctant to use them, it will offer a validated, simple, low-cost tool to contribute in systematic, first-level evaluations of seismic risk in urban areas.

Scientific partners

2	Martin Koller	Résonance Ingénieurs-Conseils SA 21 rue Jacques Grosselin CH – 1227 Carouge (GE)	Tel : +41.22.301.02.53 Fax : +41.22.301.02.70 Email : martin.koller@resonance.ch
3	Frank Scherbaum	Institut für Geowissenschaften Universität Potsdam P.O. Box 601553 DE - 14415 Potsdam	Tel: +49.33.1977.52.57 Fax: +49.33.1977.50.60 Email: fs@geo.uni-potsdam.de
4	Denis Jongmans	Université de Liège Laboratoire de Géologie de l'Ingénieur	
5	Kuvvet Atakan	University of Bergen Institute of Solid Earth Physics Allegt. 41 NO – 5007 Bergen	Tel: +47.55.58.34.13 Fax: +47.55.58.96.69 Email: kuvvet.atakan@ifjf.uib.no
6	Donat Fäh	Swiss Seismological Service Institute of Geophysics	Email: faeh@sismo.ifg.etzh.ch
7	Nikos Theodulidis	Institute of Engineering Seismology and Earthquake Engineering P.O. Box 53 EL – 55102 Finikas, Thessaloniki	Tel: +30.31.47.60.81 Fax: +30.31.47.60.85 Email: ntheo@quake.itsak.gr
8	Paula Teves-Costa	Centro de Geofisica da Universidade de Lisboa	Tel: +351.217.500.814
9	Antonio Rovelli	Istituto Nazionale di Geofisica Via di Vigna Murata 605 IT – 00143 Roma	Tel: +39.6.5186.0427 Email: ptcosta@fc.ul.pt

10	Alberto Marcellini	Consiglio Nazionale delle Ricerche	Email : marcel@daphne.irrs.mi.cnr.it
11	Peter Moczo	Slovak Academy of Sciences Geophysical Institute Dubravska cesta 9 Slovakia – 84228 Bratislava	Tel: +421.7.5941.0608 Fax: +421.7.5941.0626 Email geofpemo@savba.sk
12	Anne-Marie Duval	CETE Méditerranée – Equipe de recherché "Risque sismique" 56 bvd Stalingrad FR – 06359 Nice cedex 4	Tel : +33.492.00.81.67 Fax : +33.442.60.79.19 Email : anne-marie.duval@equipement.gouv.fr

NATURAL HAZARDS

EUROSEIS-RISK - Seismic Hazard Assessment, Site Effects and Soil Structure Interaction Studies in an Instrumented Basin

EVG1-CT-2001-00040

Start date: 01/01/02 – End date: 31/12/04
Duration: 36 months
EC contribution: 1,465,968.00 €
EC contact: Denis Peter

Project Co-ordinator
Professor Kyriazis Pitilakis
Aristotle University of Thessaloniki
Civil Engineering Department
Laboratory of Soil Mechanics and Foundation Engineering
P.O. Box 450
EL – 54006 Thessaloniki
Tel: +30.31.995.693
Fax: +30.31.995.619
Email: pitilakis@evripos.civil.auth.gr
http://euroseis.civil.auth.gr/index.htm

PROJECT SUMMARY

Problems to be solved

The core of the proposed research activities which will be performed in an existing test site is fivefold: (a) to conduct experimental and theoretical research for understanding the physics of ground motion variations due to ID/2D/3D site effects for engineering applications, (b) to validate, improve and develop methods, models and tools for ground motion variations, SSI effects, hazard assessment and risk mitigation (c) to enhance the earthquake resistance of ordinary R/C buildings and bridges, (d) to contribute to the ongoing elaboration of the new generation of Eurocode 8 in terms of site specific response spectra, soil amplification, and SSI phenomena as well as (e) to create a database of high quality and well constrained data, easily accessed from European and International researches through Internet that may be used not only for validation and/or improvement of existing methods but also for the development of new approaches in many aspects of earthquake engineering.

Scientific objectives and approach

The Work Programme of EUROSEIS-RISK is broken down into six (6) Work Packages:

- W.P. 01: Performance of complementary geophysical, geotechnical and geotechnical surveys to provide a well defined 3D description of the basin.
- W.P .02: Monitoring of the seismicity of the area. Performance of seismological studies related to focal mechanism, attenuation and wayefield. Creation of earthquake catalogue. Seismic hazard assessment.
- W.P.03: Investigation of the use of micro tremors for soil and site characterisation. Development of innovative technique for monitoring transient and permanent ground deformations.
- W.P. 04: Extension of the free field ground motion network. Experimental and theoretical ground motion research studies on ID/2D/3D site effects analysis, complex basin effects, soil non-linearities, liquefaction and spatial variation of ground motion. Validation and improvement of existing models and tools to estimate ground motion and development of advanced new ones.

- W.P.05: Study on the structural behaviour and SSI effects both in the elastic and inelastic range through forced vibration tests and actual earthquake excitations of model structure-foundation-soil systems. Application and validation of rehabilitation techniques.
- W.P.06: Critical evaluation of the results in terms data, methods, tools and obtained know-how towards seismic risk mitigation. Data dissemination and investigation of possible code implications. Creation of a complete database, joint publications, establishment of an International Network of Experts and Users and organisation of a Workshop.

All the above components constitute well-specified and interconnected activities, contributing to the final target, which is the performance of an extensive research scheme on several fields of earthquake engineering, engineering seismology and seismology, supported by field experiments in a well- established test site, in order to contribute to seismic risk mitigation.

Expected impacts

An extensive set of code-oriented experimental and theoretical studies in several state-of-the-art engineering topics validated with high quality data both of which will continuously enrich a multi- layer database accessible via Internet. Millestones: Accomplishment of necessary adjustments of the existing facilities by the end of 6 months. Accomplishment of the scheduled research scheme by the end of3rd year. Establishment of a Network of Users and experts and organisation of a Workshop.

Scientific partners

2	Prof. George Manos	Aristotle University of Thessaloniki Civil Engineering Department Laboratory of Strenght of Materials Aristotle University Campus EL – 54006 Thessaloniki	Tel: +30.31.99.57.07 Fax: +30.31.99.57.67 Email: gcmanos@civil.auth.gr
3	Prof. Panagiotis Hatzidimitriou	Aristotle University of Thessaloniki Faculty of Sciences, School of Geology University Campus EL – 54006 Thessaloniki	Tel: 30.31.998.505 Fax: 30.31.998.528 Email: takis@lemnos.ego.auth.gr
4	Dr Nikolaos Theodulidis	Institute of Engineering Seismology and Earthquake Engineering Georgikis Scholis Str. 46 EL – 55102 Thessaloniki	Tel: +30.31.47.60.81 Fax: +30.31.47.60.85 Email: ntheo@itsak.gr
5	Dr Pierre-Yves Bard	Laboratoire Central des Ponts et Chaussées MSRGI – LGIT Rue de la Piscine 1381 FR – 38041 Grenoble	Tel : +33.476.82.80.61 Fax : +33.476.82.81.01 Email : Pierre-Yves.Bard@obs.ujf-grenoble.fr
7	Prof. Konstantin Meskouris	Aachen University of Technology LBB Mies-van-der-Rohe-Str. 1 DE – 52074 Aachen	Tel: +49.241.805.088 Fax: +49.241.8888.303 Email: kmeskou@baustatik.rwth-aachen.de
8	Dr Antoni Rocca	Institut Cartografic de Catalunya Parc de Montjüic s/n ES - 08038 Barcelona	Tel : +34.93.567.15.00 Fax : +34.93.567.15.67 Email : roca@icc.es
9	Prof. Peter Suhadolc	Università degli Studi di Trieste Dipartimento di Scienze della Terra Via Weiss 1 IT – 34127 Trieste	Tel: +39.040.676.21.11 Fax: +39.040.676.21.11 Email: suhadolc@dst.univ.trieste.it

10	Dr Kazuyoshi Kudo	University of Tokyo Earthquake Research Institute Division of Disaster Mitigation Science 1-1-1, Yayoi, Bunkyo-ku JP – 113-0032 Tokyo	Tel: +81.3.5841.82.51 Fax: +81.3.5841.58.09 Email: kudo@eri.u-tokyo.ac.jp
11	Prof. Peter Moczo	Comenius University Faculty of Mathematics, Physics and Informatics Department of Geophysics Mlynska Dolina F1 SK - 842 48 Bratislava	Tel: +421.7.6029.53.27 Fax: +421.7.6542.59.82 Email: moczo@fmph.uniba.sk
12	Dr Vito Renda	Joint Research Centre of the European Commission Institute for Systems, Informatics and Safety European Laboratory for Structural Assessment Via E. Fermi, 1 IT - 21020 Ispra	Tel: +39.0332.78.90.21 Fax: +39.0332.78.56.45 Email: vito.renda@jrc.it

NATURAL HAZARDS

EMICES - European-Mediterranean Infrastructure Co-ordination for Earthquake Seismology
EVK2-CT-2001-80002

Start date: 01/05/02 – End date: 30/04/04
Duration: 24 months
EC contribution: 69,855.00 €
EC contact: Denis Peter

Project Co-ordinator
Dr Torild van Eck
Royal Netherlands Meteorological Institute, KNMI
P.O. Box 201, Wilhelminalaan 10
NL – 3730 AE De Bilt
Tel: +31.30.220.67.80
Fax: +31.30.220.13.64
Email: vaneck@knmi.nl
http://orfeus.knmi.nl/emices/

PROJECT SUMMARY

The consortium will organise three European workshops to co-ordinate on-going European efforts in earthquake data management and exchange. The immediate goal is to engage more observatories and researchers from Europe and the Mediterranean area in existing initiatives, notably EC-project MEREDIAN (EVRI-CT2000-40007) and EPSI (EVRI-CT2000-40006). Another goal is to co-ordinate a large number of both regional and global on-going initiatives with regard to earthquake data. The workshops are to be organised in Barcelona (Spain), Athens (Greece) and Nicosia (Cyprus). Each of the workshops emphasises a specific issue.

Our objectives for the three workshops are:

- Co-ordinate and improve real-time waveform data exchange within Europe.
- Co-ordinate different initiatives for Internet software development to facilitate earthquake data exchange and earthquake information distribution in Europe.
- Plan and co-ordinate rapid exchange of earthquake data within Europe and the Mediterranean Area.

The workshops are essential in co-ordinating existing rapid international developments in management and exchange of earthquake data and to initialise new activities.

Scientific partners

2	Dr Rémy Bossu	European-Mediterranean Seismological Centre c/o CEA/DASE P.O. Box 12 FR – 91680 Bruyeres-le-Chatel	Tel: +33.1.69.26.78.14 Fax: +33.1.69.26.70.00 Email: riviere@emsc-csem.org
3	Dr Josep Vila	Institut d'Estudis Catalans Laboratori d'Estudis Geofisics "Eduard Fontsere" Carme, 47	Tel: +34.9.340.211.99 Fax: +34.9.340.211.33 Email: jvila@am.ub.es

		ES – 08001 Barcelona	
4	Dr Nicholas Voulgaris	University of Athens Department of Geophysics Panepistimioupolis, Zografou EL - 157 84 Athens	Tel: +30.1.7274.431 Fax: 30.1.7274.787 Email: voulgaris@geol.uoa.gr
5	Mr Kyriakos Solomi	Min. of Agr. Res. And Environment Geological Survey Department Seismology Section Lefkonos 1 1415 Nicosia Cyprus	Tel: +357.2.309.265 Fax: 357.2.316.873 Email: Gsd@cytanet.com.cy

NATURAL HAZARDS

INDEPTH - Development of Innovative Devices for Seismic Protection of Petrochemical Facilities
EVG1-CT-2002-00065

Start date: 01/09/02 – End date 31/08/05
Duration: 36 months
EC contribution: 1,242,200.00 €
EC contact: Denis Peter

Project Co-ordinator
Mr Fabrizio Gatti
Enel. Hydro - Business Unit ISMES
Via Pastrengo, 9
IT – 24068 Seriate
Tel: +39.035.537.76.23
Fax: +39.035.537.79.99
Email: gatti.fabriziog@enel.it
http://indepth.boku.ac.at/sitemap.php

PROJECT SUMMARY

Problems to be solved

The consequences of earthquake damage to petrochemical facilities can strongly impact the surrounding areas and population, due to the toxic products release to atmosphere, soil, groundwater or body of water, the vapor clouds, the direct and indirect economic losses. The most recent example is the Tupras oil refinery fire during the Kocaeli Earthquake, Turkey (1999), which has presented all these typologies of impact.
The project is aimed to improve the earthquake resistance of existing and new structures at petrochemical facilities, in particular of tanks, recognized to be amongst the most critical equipment, through the development of new methods and technologies in the field of seismic isolation. The team involved in the Project, representing industrial research centres, industrial consulting firms, universities and end users, considers that the development of the aforementioned devices gives the possibility to successfully mitigate some consequences of earthquake damages in those plants.

Scientific objectives and approach

The major scientific gaps in using seismic isolation systems at petrochemical facilities, are namely the presence of variably mass equipment, the lack of low cost isolators and the problem of the high displacements of isolated systems. The great variation of the level of the liquid in tanks, decreases the performances of potential isolation systems, normally designed to be totally effective for only one mass value. The classical seismic isolators, based on a layout of alternate sheets of metal and rubber, are quite expensive and this has limited their use in general to landmark commercial/historic buildings and bridges. The application of any isolation system reduces the transmitted forces but increases the level of displacement in the isolated structures. This effect is especially critical for petrochemical facility structures, which are linked each other by interconnected piping, ductwork, etc., which can be strongly overstressed. The proposed project is therefore focused on the development of a seismic protection system for liquid-filled structures (cylindrical and spherical tanks), with new isolators (mass-independent, fibre-reinforced, low-cost and light-weight). The displacements resulting from the use of such isolation systems at the interconnected piping will be compensated for through the use of flexible piping couplings and joints. The components and the overall system will be designed, manufactured, tested in full scale, and installed on reduced scale mock ups which will be fully shaking table tested. Specific problems relevant to effects of the fluid-soil-structure interaction (FSSI) on the seismic behaviour of structures fitted with such systems will also be studied.

Expected impacts

The main expected impact of the development of this project is the development and the manufacturing of demonstrators of an integrated system base on new concept seismic isolators and flexible joints for accompanying interconnected piping, conceived by taking into account the specific needs of variable-mass cylindrical tanks/spheres, recognized as some of the most critical components (for their potentially dangerous contents and by their inherent seismic vulnerability) in a petrochemical facility. This development will be completed by a quantification of the technical and economic benefits of such devices, including consideration of the need form protection from fire and chemical attack due to the highly aggressive and corrosive operating environments and by the preparation of guidelines for selection of proper isolation and/or energy dissipating devices.

Scientific partners

2	Dr Alfred Strauss	University of Applied Science Institute of Structural Engineering Peter Jordan Street 82 AT – 1190 Vienna	Tel: +43.1.47654.52.54 Fax: +43.1.47654.52.99 Email: alfred.strauss@boku.ac.at
3	Dr Massimo Forni	ENEA PROT – PREV Via Martiri di Monte Sole, 4 IT – 40129 Bologna	Tel: +39.051.609.85.54 Fax: +39.051.609.85.44 Email: forni@bologna.enea.it
4	Dr Samuele Infanti	FIP Industriale S.p.A. Research and Development Department Via Scapacchiò, 41 IT – 35030 Selvazzano Dentro (Padova)	Tel: +39.049.822.55.11 Fax: +39.049.638.567 Email: infanti.fip@fip-group.it
5	Dr Marti Joaquin	Principia Ingenieros Consultores S.A. Velazquez 94 ES - 28006 Madrid	Tel: +34.91209.14.82 Fax: +34.91575.10.26 Email: marti@principia.es
6	Mr Paul Summers	MMI Engineering Limited 5/7 Grosvenor Court, Foregate Street UK - CH1 1HG Chester	Tel: +44.7885.651.021 Fax: +44.1244.405.566 Email: psummers@mmiengineering.com
7	Prof. Dimitris Karabalis	University of Patras Department of Civil Engineering EL – 26500 Patras	Tel: +30.610.996.218 Fax: +30.610.997.812
8	Mr Stelios Triantafillou	Hellenic Petroleum S.A. Aspropyrgos Refinery Maintannance Division 17th Km National Road Athens-Patras EL – 19300 Aspropygros	Tel: +30.10.553.31.90 Fax: +30.10.557.09.90 Email: striantafillou@hellenic-petroleum.gr
9	Mr Helmut Novak	IWKA BKT GmbH P.O. Box 1162 Lorenzstrasse DE – 76288 Stutensee	Tel: +49.724499.323 Fax: +49.724499.223 Email: Helmut.novak@iwka-bkt.de

NATURAL HAZARDS

VAST-IMAGE - Development of Variable Stiffness Seismic Isolators and Vibration Mitigation Dampers Based on Magnetically Controlled Elastomers

EVG1-CT-2002-00063

Start date: 01/09/02 – End date: 31/08/05
Duration: 36 months
EC contribution: 1,307,119.00 €
EC contact: Denis Peter

Project Co-ordinator
Dr Renzo Medeot
Maurer Söhne GmbH & Co. KG
Frankfurter Ring 193
DE - 80807 Muenchen
Tel: +49.89.32394.341
Fax: +49.89.32394.306
Email: medeot@mchn.maurer-soehne.de

PROJECT SUMMARY

Some areas in Europe are subject to seismic risk and the protection of traI1Sport infrastructures, industrial plants and strategic buildings from earthquake damage is vitally important to them.
This Project addresses the solution of socio-economic problems connected with seismic risk and thus intends to safeguard life and limb, health, property and public welfare and thus respond to several social needs, such as assuring safety by improving the reliability of structures and safeguarding employment in seismic areas, maintaining in operation energy production plants during the emergency phase following an earthquake, minimising the risk of major economic dislocation etc.

The scope of the project is to solve the above problems tI1rough the development of:
1. an improved smart elastomer whose stiffness is controlled by means of a magnetic field;
2. semi-active seismic isolators.

Social benefits will consist of much lower risk (due to significantly reduced probability of damage or failure), better emergency management and first aid (due to the availability of strategic buildings and infrastructures), calm of the population (due to the consciousness of living in and be surrounded by seismically safe structures), assuring safety by improving the reliability of structures (hospital, museums, plants, etc) located in seismic prone area.
The advantages of introducing a new type of seismic isolation, as proposed in this Project, are three-fold.
On one hand, specially in the more seismically active areas, these concepts may allow achieving the desired safety objectives at a lower cost. While strengthening becomes more expensive as the demand increases, the probable costs of isolation remain unchanged or slightly increase.
There is therefore a potential economic advantage, which is compounded with the time and cost savings achieved if some degree of design standardisation follows as a consequence. However, the most important advantage is that conventional strengthening often is based on a criterion of "collapse avoidance" as opposed to "avoidance of discontinuity".
In addition to the above, the project also proposes a secondary objective, which is that of mitigating the impact of ground borne vibrations. In this way, it responds to the societal need to improve the quality of life of the residential and

working people by means of an optimal control of the vibration induced by traffic and other causes. This will be achieved through the development of a semi-active variable stiffness damper.

Scientific partners

2	Prof. Bengt Stenberg	Kungl Tekniska Högskolan Department of Polymer Technology Teknikringen 56 – 58 SE - 10044 Stockholm	Tel: +46.8.790.82.69 Fax: +46.8.100.775 Email: stenberg@polymer.kth.se
3	Prof. Matej Fischinger	University of Ljubljana Institute of Structural Engineering, earthquake Engineering and Construction IT P.O. Box 3422 Jamova Street, 2 SI - 1001 Ljubljana	Tel: +386.1.476.85.93 Fax: +386.1.425.06.93 Email: matej.fischniger@ikpir.fgg.uni-lj.si
4	Dr Karl-Hartmut Müller	Leibniz Institute for Solid Sate and Materials Research Dresden Institute of Metallic Materials P.O. Box 27 00 16 Helmholtzstrasse 20 DE - 01069 Dresden	Tel: +49.351.4659.527 Fax: +4.351.4659.537 Email: khm@ifw-dresden.de
5	Mr Fabrizio Gatti	ENEL. HYDRO S.p.A Business Unit ISMES Via Pastrengo, 9 IT - 24068 Seriate	Tel: +39.035.531.76.23 Fax: +39.035.537.79.99 Email: gatti.fabriziog@enel.it
6	Dr Massimo Forni	ENEA PROT – PREV Via Martiri di Monte Sole 4 IT - 40129 Bologna	Tel: +39.051.609.85.54 Fax: +39.051.609.85.44 Email: forni@bologna.enea.it
7	Dr Keith Fuller	TARRC Brickendon Lane, Brickendonbury UK - SG13 8NL Hertford	Tel: +44.1992.58.49.66 Fax: +44.1992.55.48.37 Email: kfuller@tarrc.co.uk

NATURAL HAZARDS

QUAKER - Fault-rupture and strong-shaking effects on the safety of composite foundations and pipeline systems: quantification and reduction of seismic risk through the application of advanced geotechnical engineering techniques.

EVG1-CT-2002-00064

Start date: 01/11/02 – End date: 31/10/05
Duration: 36 months
EC contribution: 848,276.00 Euro
EC contact: Denis Peter

Project Co-ordinator
Professor Michael Davies
University of Dundee
Department of civil engineering
Nethergate
DD1 4HN Dundee
United Kingdom
Tel: +44.1382.348.327
Fax: +44.1382.348.327
Email: m.c.r.davies@dundee.ac.uk
http://www.dundee.ac.uk/civileng/quaker/partners.htm

PROJECT SUMMARY

Problems to be solved

QUAKER will reduce both the loss of life and the high economic cost resulting from the failure of buildings and lifeline services during earthquakes by contributing to their improved seismic design. Dissemination of QUAKER findings and their implementation in new design codes will ensure that both new infrastructure and infrastructure retrofitted in the future is better able to withstand large earthquakes. Thus, QUAKER will reduce the loss of life, injuries and homelessness caused by earthquakes, and the long-term economic disruption caused by such events.

Scientific objectives and approach

A primary aim of the research is to gain a greater understanding of the effects of earthquake loading on soil and structure/lifeline systems by the application of advanced geotechnical engineering techniques, viz. geotechnical centrifuge modelling and non-linear numerical analysis. In particular, the consortium will study in detail two of the major unresolved issues in foundation dynamics, both relating to large ground movements occurring during strong earthquakes. These are the behaviour of infrastructure (i) very close to fault-rupture and (ii) during strong shaking. This will be done using a combination of research techniques: field assessment, physical model testing, advanced numerical modelling, and synthesis of the results obtained from these different approaches. The findings will be used to produce improved practical design methods. Dissemination of these is a primary objective of the QUAKER project. This process will be facilitated by the inclusion of two end-users in the consortium and by the formation of a Project Steering Group (membership of which will include a range of end-users) to advise on the progress and direction of the research. Furthermore, the findings of the QUAKER programme will be disseminated at an end-users workshop to be held at the end of the project. Key international academics and engineers working in the field of earthquake engineering will also be invited to attend the workshop.

Expected impacts

QUAKER will (i) improve understanding of the behaviour of soil and structural systems in strong earthquakes, (ii) produce high quality experimental and field data, (iii) examine existing design methods in light of new data, (iv) develop appropriate methods of analysis, (v) provide and disseminate practical engineering design recommendations, and (vi) inform the development of design codes. The design codes will be used in the future for both the design of new infrastructure and for strengthening existing structures, and so this will reduce the risk from future earthquakes.

Scientific partners

2	Dr Alain Pecker	Geodynamique et Structure Rue des Blains, 157 FR - 92220 Bagneux	Tel : +33.1.466.500.11 Fax : +33.1.466.558.54 Email : alain.pecker@geodynamique.com
3	Prof. George Gazetas	National Technical University of Athens Civil Engineering Department Geotechnical Engineering Section Heroon Polytechniou 9 GR - 157 80 Athens	Tel: +30.10.772.34.28 Fax: +30.10.772.34.35 Email: gazetas@compulink.gr
4	Prof. Ezio Faccioli	Studio Geogecnico Italiano Via Ripamonti, 89 IT - 20139 Milano	Tel: +39.02.239.94.337 Fax: +39.02.239.94.220 Email: faccioli@stru.polimi.it
5	Dr Jacques Garnier	Laboratoire Central des Ponts et Chaussées Division Reconnaissance et Mécanique des Sols B.P. 4129 FR - 44341 Bougeunais Cedex	Tel: +33.2.40.84.58.19 Fax: +33.2.40.84.59.97 Email: Jacques.Garnier@Icpc.fr

NATURAL HAZARDS

GEODEV - Centre on Geophysical Methods and Observations for Sustainable Development
EVK2-CT-2002-80005

Start date: 01/12/02 – End date: 30/11/05
Duration: 36 months
EC contribution: 315,410.00 €
EC contact: Tobias Fuchs/Denis Peter

Project Co-ordinator
Prof. Zdzislaw Kaczmarek
Institute of Geophysics of the Polish Academy of Sciences
Ks. Janusza 64
PL – 01-452 Warsaw
Tel: +48.22.691.58.51
Fax: +48.22.691.59.15
Email: kaczmar@igf.edu.pl

PROJECT SUMMARY

Problems to be solved

The goal of this project is to establish mechanisms and infrastructure promotion full integration of the research performed at the Institute of Geophysics of the Polish Academy of Sciences and other Polish research institutions into the European Research Area (ERA). On the eve of enlargement of the European Union, expansion of ERA to include the newly associated states (NAS) of Central and Eastern Europe is inevitable. Research institutions in NAS countries offer a considerable wealth of expertise and experience in areas vital to increased versatility and effectiveness of European research. However, they often lack sufficiently developed infrastructure and financial support. The GEODEV Centre of the Institute of Geophysics is one of the leading Polish research institutions in the area of environmental and geophysical sciences. Failure to develop closer links with its European counterparts may result in isolation of Polish environmental research from the ERA mainstream. Success of GEODEV will enable the Centre to "*better put its capabilities at the service of economic and social needs of" Poland and other NFAS countries, in conformity with the interest of the Union as a whole*"

Scientific objectives and approach

The general goal of the proposal is to strengthen links between those research teams from the Institute of Geophysics, which are involved in environmentally oriented studies, and their colleagues working on similar research problems in other European countries. Areas of core competencies of GEODEV, in which it can offer new knowledge, innovative methods and technologies include:

- assessment and monitoring of risk threats caused by geophysical hazards, such as earthquakes or floods,
- geomagnetic and deep seismic soundings as a method of identifying potential alternative energy sources,
- integrative flood risk assessment and modelling of pollution transport, and d) long-term sampling of stratospheric ozone.

Specific objectives of the project are:

1. To facilitate the exchange of scientific knowledge and experience (through workshops and conferences) among GEODEV scientists and researchers from other EU and NAS institutions in the areas of core competencies of the Centre;
2. To increase the skill level and broaden the horizons of young researchers at the Institute by training fellowships abroad;
3. To establish and/or improve links between GEODEV Centre and other leading European research institutions through a science visitor exchange programme;
4. To increase GEODEV's involvement in ERA through networking by joint instrument calibration/data validation workshops and through twinning agreements with institutions in Hungary and Austria;
5. To disseminate project results among audiences outside the field of scientific research.

Expected impacts

The main expected result of the project is increased co-operation between the Centre and its European partners resulting in full integration of the Centre's research into ERA and its effective participation in 6FP large-scale RTD projects. Potential users of the deliverables of this AM project and subsequent research projects, other than the general research community, include policy-making and government body officials in Poland and other countries (e.g. Ministry of Environment), water resource management institutions and the mining industry.

NATURAL HAZARDS

OPTSDET - Novel Optical Devices and Techniques for Seismic Activity Detection and Measurement
EVG1-CT-2002-00062

Start date: 01/12/02 – End date: 30/11/05
Duration: 36 months
EC contribution: 494,779.00 €
EC contact: Denis Peter

Project Co-ordinator
Dr Emil Smeu
University "Politehnica" of Bucharest
Physics Department
Research Center for Applied Physics
Laser Metrology Laboratory
Spl. Independenti 313
RO – 77206 Bucharest
Tel: +40.21.402.91.02
Fax: +40.21.402.91.20
Email: emil_smeu@physics.pub.ro

PROJECT SUMMARY

Problems to be solved

Earthquakes affect extended territories with devastating effects that do not stop at regional or national boundaries. Over a million villages, towns, and cities are placed in earthquake-prone areas in the world, therefore, it is important to improve the overall process for undertaking risk assessment and management at national, regional, state, provincial and local scales. Harmonization of Eastern and Western Europe in terms of safety compliance requires joint efforts of European laboratories to complete the investigation cycle: seismic motion measurement – realistic seismic input modelling – seismic risk assessment – seismic risk reduction by prevention of damages.

The problem of the **urban** earthquake risk management is of extreme interest for public, government officials, and business leaders. Due to the rapid urban growth the earthquakes affect today larger sectors of the population and o the infrastructure. In the Carpatho-Balkan Region for instance, the buildings are more vulnerable and the local resources to manage rare events such as earthquakes are poor. Therefore, support and expertise from laboratories and centres in the European Community could contribute to better handling of earthquake prevention and emergency management in urban areas exposed to seismic risk. These are the reasons for the existence of the thematic priority "The fight against major natural and technological hazards" (EESD-2000-7.1) in the EU-funded research programme "Energy, environment and sustainable development" (EESD-2000). The mentioned thematic priority specifically contains point 1.1 – "Seismic Risks".

Scientific objectives and approach

So far, **all** the seismic survey/measurement instrumentation is based on electro-**mechanical** sensors. These sensors and the dedicated electronics have several drawbacks, which are well known by the people who deploy them and use the delivered data. The present contract aims to design/manufacture/test and implement new types of seismic sensors (broadband) based on optical principles. The dynamic ranges and resolution of these sensors will allow improvement in

the sensitivity and accuracy of the ground motion recordings. Such sensors may in the future complement the existing complex mechanical sensors and eventually replace them altogether. Multiplexing techniques will be also developed to remotely monitor many optical seismic sensors. The optical link has the advantage of lower interference noise in comparison with the actual electrical links between existing (electro-mechanical) sensors.

Expected impacts

The consortium will design/manufacture/test optical geophones and accelerometers. Additionally, the possibility of monitoring minute tilts of high buildings in earthquake areas will be evaluated as a new sensitive method. To this goal, an auto-calibrated optical sensor to measure the distance changes between tow high buildings will be constructed and evaluated in the field. The new sensors in single or multiple sensor topologies will provide advanced tools for measurement of the soil motion due to earthquakes, readily transferable to other interested European countries. The most appropriate sensor configuration will be implemented into the National Seismic Networks belonging to one country (Romania), possibly two (Romania and Finland). It is hoped that the data delivered by these sensors will represent more accurately and with a better resolution the seismic activity within the surveyed areas, compared with those delivered by the classical existing instruments.

Scientific partners

2	Dr Mircea Radulian	National Institute of Research and Development for Earth Physics Romanian Seismic Network Calugareni, 12 RO – 077125 Bucharest	Tel: +40.21.493.01.18 Fax: +40.21.493.00.52 Email: Mircea@infp.ro
3	Dr Adrian Podoleanu	University of Kent School of Physical Sciences Giles Lane UK – CT2 7NR Canterbury	Tel: +44.1227.823.272 Fax: +44.1227.827.558 Email: a.g.h.podoleanu@ukc.ac.uk

NATURAL HAZARDS

RELIEF - Large Earthquake Faulting and Implications for the Seismic Hazard Assessment in Europe: The Izmit-Duzce earthquake sequence of August-November 1999

EVG1-CT-2002-00069

Start date: 01/12/02 – End date: 30/11/05
Duration: 36 months
EC contribution: 810,051.00 Euro
EC contact: Denis Peter

Project Co-ordinator
Professor Mustapha Meghraoui
CNRS – Institut de Physique du Globe de Strasbourg, UMR 7516
Rue René Descartes, 5
67084 Strasbourg
France
Tel : +33.3.902.401.11
Fax : +33.3.902.401.25
Email : mustapha@eost.u-strasbg.fr
http://www.ingv.it/paleo/RELIEF/

PROJECT SUMMARY

Problems to be solved

Two large earthquakes (Mw 7.4 and 7.1) have struck western Turkey, east of Marmara Sea, in 17 August and 12 November 1999. Recurrent seismic waves devastated the area and induced huge damage with about 30.000 victims, 50.000 injured and up to 35 billions Euro of losses. The occurrence of such an earthquake sequence is unique in the recent times, and highlights the problem of applying our present earthquake models to the socio-economic problem of seismic-hazard mitigation in urban areas. To mitigate the disastrous effects of future earthquakes in Europe, a better understanding of the entire earthquake process including its effects on the society (loss of human lives and property), is needed.
The RELIEF project focuses on the epicentral zone of the 17 August and 12 November 1999 earthquake sequence south-east of Istanbul and near the Sea of Marmara in western Turkey. The area is an ideal natural laboratory site because a large number of studies have been undertaken over the few past decades. Even if some seismic hazard problems will not be resolved, a direct benefit to the EU is the transfer of results, experience and expertise acquired in the natural laboratory to case studies across the EU.

Scientific objectives and approach

Specific target areas of the study are the surface rupture zones of the two main shocks, and the severely affected environs of Lake Sapanca, the Gulf of Izmit and the area of the Sea of Marmara. Our aim is to investigate each fault segment associated with historical earthquakes in the Izmit-Duzce and the Marmara Sea region.
Most recent seismic hazard scenarios in Turkey are standard probabilistic hazard assessment based on simplified seismotectonic sources which were defined as area zones based on the general tectonic framework and the seismic catalogue. However, previous analyses of earthquake hazard in this region suffers from the lack of integration between: 1) the existing knowledge of the faulting (fault mapping, paleoseismology and related seismicity with characteristic earthquake, physical dimensions with maximum capable earthquake, elapsed time, recurrence interval), 2) the local site effects and 3) design and construction practices. We consider that the Izmit-Duzce earthquakes provide a wealth of new information related to disciplines interested in seismic hazard problems. Our approach is based on a close interaction

between the active tectonics and paleoseismology, seismology, geotechnical and civil engineering research communities. We also need to explore alternative ways of integrating the numerous data, and understand the deficiency of our previous methods of seismic-hazard assessment in the earthquake areas.

Expected impact

The recognition, dating and size of paleoearthquakes along faults, integrated catalogue of Holocene earthquakes and recurrence interval, models of seismic fault behaviour and maps of seismic hazard scenarios are among the concrete deliverables in RELIEF. Among the important implications for the EU policy in seismic risk mitigation is the ongoing implementation of EuroCode-8. The accurate ground-shaking maps produced in this study will provide to potential users the means to correlate damage and shaking and to benchmark the modem European building code against a real earthquake, as a crucial test toward the calibration of the EuroCode-8. Scientific results of RELIEF will provide new opportunities to the participating institutions in their educational and public- awareness missions.

Scientific partners

2	Dr Daniela Antosti	Istituto Nazionale di Geofisica e Vulcanologia Sismologia e Tettonofisica Department U.F. Tettonica Attiva e Strutture Sismogenetiche Via di Vigna Murata, 605 IT - 00143 Roma	Tel: +39.065.186.483 Fax: +39.065.186.05.07 Email: pantosti@ingv.it
3	Dr Iain Stewart	Brunel University Department of Geography and Earth Physics Kingston Lane UB8 3PH, Uxbridge, Middlesex United Kingdom	Tel : +44.189.520.32.15 Fax : +44.189.520.32.17 Email : iain.stewart@brunel.ac.uk
4	Prof. Domenico Giardini	Swiss Federal Institute of Technology Institute of Geophysics ETH Hoenggerberg CH - 8093 Zurich	Tel: +41.163.32.610 Fax: +41163.21.237 Email: giardini@seismo.ifg.ethz.ch
5	Dr Serdar Akyuz	Istanbul Technical University Faculty of Mine, Department of Geology ITU Madden Facultesi 80626 Istanbul Turkey	Tel: +90.212.285.61.56 Fax: +90.212.285.62.10 Email: serdar@itu.edu.tr
6	Prof. Kuvvet Atakan	University of Bergen Institute of Solid Earth Physics P.O. Box 7800 NO – 5007 Bergen	Tel: +47.555.83.413 Fax: +47.555.89.669 Email: kuvvet.atakan@ifjf.uib.no

NATURAL HAZARDS

PREPARED - Application of practical experience gained from two recent large earthquakes in the South Iceland seimic zone in the context of earthquake prediction research to develop technology for improving preparedness and mitigating risk

EVG1-CT-2002-00073

Start date: 01/02/03 – End date: 31/01/05
Duration: 24 months
EC contribution: 1,117,618.00 €
EC contact: Denis Peter

Project Co-ordinator
Dr Ragnar Stefansson/Bardi Thorkelsson
Icelandic Meteorological Office
Department of Geophysics
Bustadavegur 9
Iceland - 150 Reykjavik
Tel: +354.522.60.00
Fax: +354.522.60.01
Email: bardi@vedur.is
http://hraun.vedur.is/ja/prepared/

PROJECT SUMMARY

Problems to be solved

The project aims at preparedness towards earthquake hazards and to mitigate seismic risk. It aims towards technology to assess what earthquake effects may occur and where. It aims to use observed earthquake forerunners and crustal changes to develop methods for earthquake warnings on a long-term and short-term basis. By fast evaluation of the impacts of earthquake hazard, before or after its onset, it helps to prepare necessary and effective rescue actions. It develops close relationship with an early warning and information system, the National Civil Defence of Iceland, and the test area for PREPARED, for testing and application of its methods.
The objective is to develop methodology which can be applied to mitigate risks anywhere. Understanding what ground motions can be expected at various places in populated areas is socially and economically significant. To understand where the faults rupture the surface and when, is of huge significance in any earthquake prone country.

Scientific objectives and approach

During a decade Iceland has been a European test area for earthquake prediction research. The reasons are high earth activity, other favourable natural conditions and the availability of high level geophysical monitoring systems. Most significant here were the Nordic SIL-project (1988-1995) and the EC-funded PRENLAB-projects (1996-2000).
It was like a test for the research efforts when two Ms=6.6 earthquakes stroke South Iceland in June 2000. The warnings and information which were issued showed the significance of the earthquake prediction research. The data which were collected are significant for better warnings and information service in the future.
It is a special objective of the project to make use of the valuable observations that were made before, during and after these earthquakes, to develop methods and understanding for better hazard assessments and warnings in the future.
This is done through multidisciplinary, multinational scientific approach. The project continues and proceeds from the basic results of the earlier earthquake prediction research projects.

Expected impacts

The main expected results of the project are end user products for enhanced hazard assessment and for issuing information and warnings which are significant for mitigating seismic risk.
In the test area, the products will be applied and tested through the Icelandic early warning and civil defence infrastructure. The results will also be distributed through the participants which come from 8 European countries to the other countries, as well as through the dissemination mechanisms of EC.
Besides end user results, directly applicable for hazard assessment and warnings, new knowledge and understanding will be disseminated to the European scientific community and to the world through the participants and through open reporting.

Scientific partners

2	Prof. Reynir Bödvarsson	Uppsala University Department of Earth Sciences Villavägen 16 SE - 752 36 Uppsala	Tel: +46.18.471.23.78 Fax: +46.18.501.110 Email: Rb@geofys.uu.se
3	Prof. Stuart Crampin	The University of Edinburgh Geology & Geophysics West Mains Road, King's Buildings UK - EH9 3JW Edinburgh	Tel : +44.131.650.49.08 Fax : +44.131.668.31.84 Email : Scrampin@ed.ac.uk
4	Dr Thora Arnadottir	Nordic Volcanological Institute Grensasvegur 50 IS - 108 Reykjavik	Tel : +354.525.44.88 Fax : +354.562.97.67 Email : thora@norvol.hi.is
5	Prof. Agust Gudmundsson	University of Bergen Department of Geology P.O. Box 7800 Realfagbygget Allégt. 41 NO – 5007 Bergen	Tel : +47.55.58.35.21 Fax : +47.55.58.94.16 Email : agust.gudmundsson@geol.uib.no
6	Prof. Páll Einarsson	University of Iceland Science Institute, Geophysics Division Hofsvallagata 53 IS - 107 Reykjavik	Tel : +354.525.48.16 Fax : +354.552.13.47 Email : palli@raunvis.hi.is
7	Dr Françoise Bergerat	Université Pierre et Marie Curie Fédération de Recherche 32 – CEPAGE Laboratoire de Tectonique Place Jussieu 4 FR – 75252 Paris	Tel : +33.1.44.27.34.43 Fax : +33.1.44.27.50.85 Email : Bergerat@lgs.jussieu.fr
8	Prof. Maurizio Bonafede	Università di Bologna Dipartimento di Fisica Viale Carlo Berti-Pichat 8 IT – 40127 Bologna	Tel : +39.051.209.50.17 Fax : +39.051.209.50.58 Email : bonafede@ibogfs.df.unibo.it
9	Prof. Frank Roth	GeoForschungs Zentrum Potsdam Solid Earth Physics and Disaster Research Earthquakes and Volcanism Section P.O. Box 60 07 01 Telegraphenberg DE - 14473 Potsdam	Tel : +49.331.288.12.10 Fax : +49.331.288.12.04 Email : Roth@gfz-potsdam.de

10	Dr Kurt Feigl	CNRS Université Paul Sabatier – Toulouse III Dynamique Terrestre et Planétaire UMR 5562 Avenue Edouard Belin 14 FR - 31400 Toulouse	Tel : +33.5.61.33.29.40 Fax : +33.5.61.33.29.00 Email : Kurt.feigl@cnes.fr
11	Prof. Peter Suhadolc	Università degli Studi di Trieste Dipartimento di Scienze della Terra Seismology Group Via Weiss, 4 IT – 34127 Trieste	Tel: +39.040.558.21.22 Fax: +39.040.558.21.11 Email: suhadolc@dst.units.it
12	Dr Christian Goltz	Christian-Albrechts Universität zu Kiel Institut fuer Geowissenschaften Abt. Geophysik Olshausenstr. 40 DE – 24098 Kiel	Tel : +49.431.880.38.81 Fax : +49.431.880.15.60
13	Prof. Max Wyss	World Agency of Planetary Monitoring and Earthquake Risk Reduction Route de Malagnou 36A CH - 1208 Geneve	Tel: +41.79.749.48.94 Fax: +41.22.735.20.50 Email: author@maxwyss.com
14	Prof. R. Sigbjoernsson	University of Iceland Engineering Research Institute Earthquake Engineering Research Centre Austurvegur 2a IS – 800 Selfoss	Tel : +354.525.41.41 Fax : +354.525.41.40 Email : Ragnar.Sigbjornsson@hi.is

VOLCANO

NATURAL HAZARDS

MULTIMO - Multi-disciplinary Monitoring, Modelling and Forecasting of Volcanic Hazard
EVG1-CT-2000-00021

Start date: 01/02/01 – End date: 31/01/04
Duration: 36 months
EC contribution: 1,211,154.00 €
EC contact: Denis Peter

Project Co-ordinator
Dr Jürgen Neuberg
University of Leeds
School of Earth Sciences
Woodhouse Lane
UK – LS2 9JT Leeds
Tel: +44.113.233.67.69
Fax: +44.113.233.52.59
Email: j.neuberg@earth.leeds.ac.uk
http://earth.leeds.ac.uk/~aj/Multimo/

PROJECT SUMMARY

Problems to be solved

This project will measure key properties of magmas that control eruption dynamics, develop advanced models of magma flows from magma chambers to the surface and link these to the major observables of earthquakes, ground deformation, gas fluxes and extrusion rates and eruptive styles. Geostatistical methods will be applied to analyse time series of integrated data and compared with the predictions of dynamical models to improve the reliability of forecasts.

Scientific objectives and approach

The objective of this project is to improve the ability of vocalnologists to forecast volcanic activity using monitoring methods, advanced physical models and geostatistical techniques. It will develop a multi-parameter monitoring station to collect integrated data of seismic activity, ground deformation, gas emissions and other parameters. MULTIMO aims to produce new data on critical properties of magma and to develop physical models, which explicitly predict data that are monitored during volcanic eruptions teams. It aims finally to develop approaches on how to best apply and use scientific information. The main expected results are:
development of a geostatistical package tested on real and synthetic data for forecasting of volcanic events, and dissemination of the integrated monitoring, modelling and forecasting results to end users.

Expected results

This project will produce a multi-parameter monitoring strategy and a prototype of a volcanic surveillance station with a multi-sensor berehole set-up, which can be marketed with ample opportunity for applications on volcanoes world-wide. This includes volcanoes monitored by observatories but also volcanoes in remote areas, which pose a serious threat to civil aviation. The project will benefit from the technical knowledge of highly specialised companies, while these companies obtain information regarding the scientific requirements of the product.

Scientific partners

2	Dr Valérie Cayol	Università Blaise Pascal Laboratoire Magmas et Volcans, UMR 6524 Rue Kessler 5 FR – 63038 Clermont-Ferrand Cedex	Tel : +33.4.73.34.67.63 Fax : +33.4.73.34.67.44 Email : V.Cayol@opgc.univ-bpclermont.fr
3	Dr Clive Oppenheimer	University of Cambridge Department of Geography Downing Place UK - CB2 3EN Cambridge	Tel: +44.1223.33.93.82 Fax: +44.1223.33.33.92 Email: co200@cam.ac.uk
4	Dr Antoni M. Correig	University of Barcelona Department of Astronomy and Meteorology Martí I Franquès, 1 ES – 08028 Barcelona	Tel: +34.93.402.11.99 Fax: +34.93.402.11.33 Email: Ton.correig@am.ub.es
5	Prof. Robert Sparks	University of Bristol Department of Earth Sciences Wills Memorial Building UK – BS8 1RJ Bristol	Tel: +44.1179.545.419 Fax: +44.1179.253.385
6	Prof. Donald Dingwell	Ludwig Maximilians Universitaet Muenchen Institut fuer Mineralogie, Petrologie und Geochemie Theresienstrasse 41/III DE – 80333 Muenchen	Tel: +49.89.2394.42.50 Fax: +49.89.2394.41.76 Email: Dingwell@petro1.min.uni-muenchen.de
7	Dr Oded Navon	The Hebrew University of Jerusalem Institute of Earth Sciences, Faculty of Science Givat Ram Campus 91904 Jerusalem Israel	Tel: +972.2.658.55.49 Fax: +972.2.566.25.81 Email: oded@vms.huji.ac.il
8	Dr Roberto Carniel	Università degli Studi di Udine Dipartimento di Georisorse e Territorio Via Cotonificio 114 IT – 33100 Udine	Tel: +39.0432.55.87.49 Fax: +39.0432.55.87.00 Email: carniel@dgt.uniud.it
9	Dr Susanna Falsaperla	Istituto Internazionale di Vulcanologia Piazza Roma 2 IT – 95123 Catania	Tel: +39.095.44.80.84 Fax: +39.095.43.58.01 Email: Susanna@iiv.ct.cnr.it

NATURAL HAZARDS

VOLCALERT - Innovative Techniques for Forecasting Volcanic Eruptions
EVG1-CT-2001-00047

Start date: 01/12/01 – End date: 31/01/04
Duration: 26 months
EC contribution: 647,884.00 €
EC contact: Denis Peter

Project Co-ordinator
Dr Christopher Kilburn
University College London, Department of Geological Sciences
Gower Street
UK – WC1E 6BT London
Tel: +44.20.7679.71.94
Fax: +44.20.7388.76.14
Email: c.kilburn@ucl.ac.uk

PROJECT SUMMARY

Project VOLCALERT will investigate innovative practical techniques for forecasting eruptions and for effectively communicating these forecasts to non-specialists. Key aims are (1) to develop physical models of edifice fracture and the opening of new magmatic pathways to the surface, (2) to investigate the role of aquifers in enhancing the stress field produced by intruding magma, (3) to design objective, quantitative methodologies for issuing short-term eruption forecasts, and (4) to identify optimum procedures for communicating forecasts to civil authorities and the emergency services. The results will be disseminated to groups responsible for coordinating emergency responses during volcanic crises.

Central to reducing volcanic risk is the ability to estimate when a given volcano is most likely to erupt. It is precisely the difficulty in quantifying eruption forecasts that remains an outstanding problem in applied volcanology. As populations increase around active volcanoes, it is essential to develop objective and quantitative methods for making short-term eruption forecasts.

Seismicity and ground deformation are the precursory phenomena most frequently detected before a volcanic eruption. They occur as Earth's crust is distorted by magma pushing its way to the surface, and the final approach to eruption is commonly preceded by accelerating rates in both phenomena. Combined field, theoretical and laboratory studies will investigate the controls on these accelerating trends, focusing on the rates at which a volcanic edifice fractures to open a new pathway for magma ascent. The implications of fracturing models for additional precursors, such as rates of gas release, will also be considered. Analytical and numerical fracturing models will quantify the limits for which precursor accelerations will (1) lead to an eruption or (2) decay without eruption. The stresses imposed by intruding magma, and their modification by aquifers, will be modelled by dedicated numerical codes. Statistical evaluations will identify the type of precursory signal best suited for forecasting, and will test the robustness of the signal and the uncertainty associated with its forecasts. Established group profiling methods will investigate how decision makers perceive eruption forecasts and use the results to design guidelines for the effective communication of eruption warnings from volcanologists to those coordinating the emergency response. All studies will focus on four test volcanoes: Campi Flegrei and Vesuvius (in Italy), Piton de La Fournaise on Reunion Island (France) and Soufriere Hills on Montserrat (UK). If applicable, supplementary studies will also be conducted on Etna in Sicily. The combined results will be synthesised in the form of best-practice methodologies for making and issuing short-term eruption forecasts.

Scientific partners

2	Prof. Giuseppe De Natale	Osservatorio Vesuviano Via Diocleziano 328 IT – 80124 Napoli	Tel: +39.081.61.03.14 Fax: +39.081.61.08.351 Email: pino@ov.ingv.it
3	Prof. Torsten Dahm	Universitaet Hamburg Institut fuer Geophysik Bundesstr. 55 DE – 20146 Hamburg	Tel: +49.40.42838.29.80 Fax: +49.40.42838.54.41 Email: dahm@dkrz.de
4	Prof. Ian Main	The University of Edinburgh Department of Geology and Geophysics Kings Buildings, West Mains Road UK – EH9 3JW Edinburgh	Tel: +44.131.650.49.11 Fax: +44.131.668.31.84 Email: Ian.main@ed.ac.uk

INFRASTRUCTURE

E-RUPTIONS – A Satellite Telecommunication and Internet-Based Seismic Monitoring System for Volcanic Eurption Forecasting and Risk Managment

EVR1-CT-2001-40021

Start date: 01/04/02 – End date: 31/03/05
Duration: 36 months
EC contribution: 1,993,995 Euro
EC contact: Gilles Ollier

Project Co-ordinator
Dr Clifford Banninger
Joanneum Research Institute for Digital Image Processing
Wastiangasse 6
AT – 8010 Graz
Tel: +43.316.876.1730
Fax: +43.316.876.1720
Email: Clifford.banninger@joanneum.at
http://www.e-ruption.info/

PROJECT SUMMARY

Problems to be solved

The EU, through the issue of *Council Decisions 98/22/EC* and *1999/847/EC,* has set forth its aims in the field of civil protection. These aims relate to the detection and study of the causes of natural or technological disasters; to the protection of the environment, people and property in the event such disasters; and to improve the preparedness and response of those involved in civil protection in Member States, by the developing and adapting of new technologies to meet requirements of civil protection and support co-operation between Member States. The improvement in volcanic disaster forecasting, planning, management and response to reduce risks to the environment and local population in volcanic regions addresses these aims.

Although there is empirical evidence to suggest that there is a relationship between the type of earthquake and volcanic activity, there is insufficient understanding and reliable data to be able to determine the precise nature of the relationship. Seismic and other information pertinent to the understanding of volcanic eruptions is not generally collected, nor commonly made available outside the local monitoring area. There is a need, therefore, to establish a quantitative relationship between the dynamic behaviour of magmatic and hydro-geothermal systems and the nature and occurrence of the related seismicity, not only to improve the accuracy of predicting volcanic eruptions, but also to be able to provide information on their potential in a timely and reliable manner.
Because most active volcanoes are situated in remote or difficult to access parts of the world, facilities are rarely available to assess the likelihood of a volcanic eruption and provide advanced warning to the local population. The establishment of a seismo-volcanic monitoring system linking volcanic sites to fully equipped and staffed volcanic observatories in real-time would be able to provide the necessary early warning of an ending eruption.

Scientific objectives and approach

The principle objective of ***e-Ruption*** is to design and develop a prototype Internet and telecommunication-based seismic monitoring and early warning system for improved prediction of volcanic eruptions. ***e-Ruption*** will investigate the type and nature of volcanic seismicity that are precursors to an impending eruption and will assess

their significance in terms of eruption potential through theoretical and applied seismo-volcanological research and the use of advanced information and communication technology.

Expected impacts

E-uption is foreseen as a potential major contributor to the decision-making process of environmental and civil protection agencies. **E-Ruption** will allow rapid collecting, processing, analysing and distributing of relevant data and information in an up-to-date and timely manner on the threat and risk associated with volcanic events to the environment and society and to help them better assess the different protection schemes and options for reducing risks.

Scientific partners

2	Alexander Nischelwitzer	Technikum Joanneum Alte Poststrasse 152 AT – 8020 Graz	Tel: +43.316.5453.8516 Fax: +43.316.5453.8501 Email: alexander.nischelwitzer@fh-joanneum
3	Jim Hogg	Geosoft Ltd. 2 Blenheim Court UK – LS2 9AE Leeds	Tel : +44.113.234.4000 Fax : +44.113.246.5071 Email : sales@graticule.com
4	Gilberto Saccorotti	Osservatorio Vesuviano Via Diocleziano 328 IT - 80124 Napoli	Tel: +39.081.6108.327 Fax: +39.081.6108.351 Email: Gilberto@ov.ingv.it
5	Lavinia Ciucci	Advanced Computer Systems S.p.A. Via della Bufalotta, 378 IT – 00141 Roma	Tel: +39.06.8709.0965 Fax: +39.06.8720.1502 Email: i.ciucci@acsys.it
6	Paolo Gasparini	Università di Napoli "Federico II" Dipartimento di Scienze Fisiche Complesso Universitario di Monte S. Angelo Via Cintia IT - 80126 Napoli	Tel: +39.081.676.819 Fax: +39.081.676.346 Email: paolo.gasparini@na.infn.it
7	Bruno Palazzo	Università degli Studi di Salerno Facolotà di Ingegneria Dipartimento di Ingegneria Civile Via Ponte Don Melillo IT – 84084 Fisciano	Tel: +39.089.964.109 Fax: +39.089.964.045 Email: palazzo@unisa.it
8	Jesus Ibanez	Universidad de Granada Insituto Andaluz de Geofisica Campus de Granada ES – 18071 Granada	Tel : +34.958.248.910 Fax : +34.958.160.907 Email : jibanez@ugr.es
9	Alicia Garcia	Consejo Superior de Investiigiones Cientificas Museo Nacional de Ciencia Naturales Departamento de Volcanologia Jose Gutierrez Abascal, 2 ES – 28006 Madrid	Tel : +34.91.336.0469 Fax : +34.91.564.4740 Email : aliciag@mncn.csic.es

10	Maria Jose Blanco	Centro Geofisico de Canarias Instituto Geografico Nacional C/La Marina 20 ES – 38001 Santa Cruz de Tenerife	Tel: +34.92.228.9054 Fax: +34.92.224.3017 Email: mblanco@ign.es
11	Nicolau Wallenstein	Universidade dos Acores Departamento de Geociencias Rua de S. Gonçalo Apartado 1422 PT - 9501-801 Ponta Delgada	Tel: +351.296.650.143 Fax: +351.296.650.141 Email: nw@alf.uac.pt
12	Dimitris Panagiotopoulos	Aristotle University of Thessaloniki Faculty of Science School of Geology Department of Geophysics	Tel: +30.31.998.487 Fax: +30.31.998.528 Email: panagiot@geo.auth.gr
13	Jean-Robert Grasso	Université Joseph Fourier Grenoble Laboratoire de Geophysique Interne et Tectonophysique 1381 rue de la Piscine FR – 38041 Grenoble	Tel : +33.4.76.828.032 Fax : +33.4.76.828.101 Email : jean-robert.grasso@obs.ujf-grenoble.fr
14	Chris Bean	University College Dublin Department of Geology Belfield Dublin 4 Ireland	Tel: +353.1.706.2140 Fax: +353.1.283.7733 Email: chris.bean@ucd.ie

NATURAL HAZARDS

PEFIRVES – Publication of the edited final report of the project ENV4-CT-98-0698 "TomoVes"
EVK2-CT-2001-80003

Start date: 01/06/02 – End date: 30/11/02
Duration: 6 months
EC contribution: 17,840.00 Euro
EC contact: Maria Yeroyanni

Project Co-ordinator
Professor Paolo Gasparini
Università degli Studi di Napoli "Federico II"
Dipartimento di Scienze Fisiche
Complesso Universitario di Monte S. Angelo, Via Cintia
IT - 80126 Napoli
Tel: +39.081.67.68.19
Fax: +39.081.67.63.46
Email: paolo.gasparini@na.infn.it

PROJECT SUMMARY

This proposal is a contribution to the information activity and to the transfer of technologies. The objective is the publication of the edited final report of TomoVes Project (ENV4-CT -980698). This project aimed at determining a 3D model of the structure of specific support measures and the underlying upper crust. It allowed to infer the possible magma reservoir of the volcano. A work package of computional tools applied for seismic imaging of complex structure, using the whole information contained in seismograms has been developed. The results have been (or are going to be) published in several scientific journals. We believe that worth gathering all the information and know-how developed in the project in a single publication has a great scientific worth and is a powerful means for the transfer of technologies useful in geophysical study and in different research fields.

The complexity of the structures, the high environmental noise and the irregular topography required to develop and to implement new numerical methods for the processing of seismic data, suitable for highly heterogeneous structures and therefore exportable to other volcanic area or for industrial exploration s. A single publication of the project's results will contribute to the dissemination of information and to transfer of technologies.

The unitary discussion on the results will give a most complete information on:
- the utilisation of the whole information contained in 3C recordings in order to improve the resolution of the inferred images;
- the use of different seismic phases to retrieve seismic integrated models;
- the use of different standard and newly developed computing from linearized to truly non-linear tomography, migration, synthetic modelling.

The publication (Editors: P. Gasparini, P. Capuano, J. Virieux, A. Zollo) will follow the TomoVes project organisation, using its subdivision in four tasks, harmonising the results obtained by each of them and ting in evidence the deliverables produced, enhancing their relation to the transfer of technologies.
Firstly, we describe the creation of the data archive and of a database with a friendly user interface. Secondly, we describe the development and implementation of methods and codes for data interpretation in 1D and 2D geometry;

the construction of seismic velocity model of Mt. Vesuvius and underlying upper crust; the development of 2D seismic velocity model of intermediate and deep crust under Mt. Vesuvius.
Then, we present the development and implementation of methods and codes for seismic velocity attenuation 3D models; the inferences about intermediate and deep crustal velocity models and integration of seismic models with other geophysical, geological and petrologic data, including volcanological interpretation. Finally, we summarise the results obtained on the volcanic-sedimentary upper layers, the high velocity body under Mt. Vesuvius, the Mesozoic carbonate basement, the UPI intermediate and deep crust. We summarise also the methodology and codes developed for seismic data analysis for highly heterogeneous structures and therefore exportable to other volcanic area or industrial exploration aims.

Scientific partners

2	Dr Massimo Forni	ENEA Divisione Sistemi Energetici Ecosostenibili Unità Analisis e Progettazione Sísmica Via Martiri di Monte Sole 4 IT – 40129 Bologna	Tel: +39.051.609.85.54 Fax: +39.051.609.86.44 Email: forni@bologna.enea.it
3	Dr Maurizio Zola	ISMES SPA Structural Engineering Area Via Pastrengo 9 IT – 24068 Seriate	Tel: +39.035.307.613 Fax: +39.035.302.999 Email: mzola@ismes.it
4	Dr Eric Costes	JARRET Avenue des Grésillons 198 FR – 92602 Asnières	Tel : +33.1.46.88.46.20 Fax : +33.1.47.90.03.57 Email : contact@jarret.fr
5	Prof. Stefano Sorace	Università degli Studi di Udine Dipartimento di Ingegneria Civile Via delle Scienze 208 IT – 33100 Udine	Tel: +39.432.558.056 Fax: +39.432.558.052 Email: stefano.sorace@dic.uniud.it
6	Prof. Julio Appleton	A2P Consult, Estudos e Projectos, Lda. Av. De Roma, 12, 3° DTO PT – 1000 – 265 Lisboa	Tel: +351.1.847.14.36 Fax: +351.1.848.40.49 Email: a2p@ip.pt
7	Dr Hans Rudolf Ganz		Tel : +33.1.30.12.09.30 Fax : +33.1.30.48.94.94 Email : hrganz@vst-mgt.com

NATURAL HAZARDS

DORSIVA - Development of Optical Remote Sensing Instruments for Volcanological Applications
EVG1-CT-2002-00060

Start date: 01/10/02 – End date: 30/09/05
Duration: 36 months
EC contribution: 786,640.00
EC contact: Denis Peter

Project Co-ordonator
Dr Bo Galle
Chalmers University of Technology
Department of Radio and Space Science
41296 Gothenburg
Sweden
Tel: +46.31.772.56.54
Fax: +46.31.772.18.84
Email: bo.galle@rss.chalmers.se

PROJECT SUMMARY

Problems to be solved

Volcanic gas emission significantly contributes to the global budget of several atmospheric gases and has a strong local and regional effect on environment and health. Measurements of volcanic gas emissions yield vital information on magmatic conditions and processes and provide valuable data for volcanic hazard assessment and risk mitigation. However, the presently available instrumentation for volcanic gas emission monitoring are based on outdated technology and provide data with low accuracy and time resolution at a relatively high cost.
This project aims to develop robust and reliable optical remote sensing instruments and measurement strategies for surveillance of volcanic emissions of SO_2, halogen species and possibly CO_2, with high time resolution and affordable cost, and to test and demonstrate their use in field experiments at Soufriere Hills volcano, Montserrat and Etna, Italy.

Scientific objectives and approach

Spectroscopic methods allow remote non-invasive quantitative multi-component observations. Building on recent advances in passive remote sensing techniques, new monitoring capabilities for remote and automated measurement of volcanic gas fluxes by various novel techniques including tomographic approaches will be developed.
Five different types of volcanic emission monitoring instruments will be designed and constructed in the project. All instruments are based on absorption spectroscopy (UV and IR) and use two different sources of radiation: scattered or direct Sunlight. Also two principally different measurement strategies will be developed: active measurements from mobile platforms, and automatic long-term measurements using static remotely located systems.
Subsequently the different systems will be extensively tested, inter-compared and validated, and dedicated software and operation procedures for their specific applications will be developed. The necessary plume height and wind speed at plume height will be obtained by models as well as directly by measurement methods, both to be developed in this project.
The applicability of the different instruments and measurement strategies will be demonstrated in two field-campaigns at the volcanoes Soufriere Hills (Montserrat) and Etna (Sicily).

Expected impacts

The expected outcome of the project is prototypes of novel optical remote sensing instruments for measurements of volcanic gas composition and emission, and measurement strategies for the optimal use of these instruments. In addition to demonstrating the applicability of the methods, the field-campaigns will also provide a valuable dataset for the composition, temporal and dynamical behaviour of the gas emissions from the selected campaign sites, of value for other ongoing research and monitoring activities.

Scientific partners

2	Prof. Ulrich Platt	Universität Heidelberg Institut für Umweltphysik Im Neuenheimer Feld 229 DE - 69120 Heidelberg	Tel: +49.6221.54.63.50 Email: uplatt@iup.uni-heidelberg.de
3	Dr Clive Oppenheimer	Chancellors Masters and Scholars of the University of Cambridge Department of Geography Downing Place UK - CB2 3EN Cambridge	Tel : +44.1223.71.97.12 Fax : +44.1223.33.33.92 Email : clive.oppenheimer@geog.cam.ac.uk
4	Dr Millan Millan	CEAM Parque Tecnológico C/Charles R. Darwin, 14 ES - 46980 Paterna (Valência)	Tel : +34.96.131.82.27 Fax : +34.96.131.82.190 Email : millan@ceam.es
5	Prof. Lucio Alonso	Universidad del País Vasco Departamento de Ingeniería Química y Medio Ambiente Escuela Superior de Ingenieros de Bilbao Alameda de Urquijo S/N ES - 48013 Bilbao	Tel: +34.94.601.41.01 Fax: +34.94.601.41.79 Email: iapalall@bi.ehu.es
6	Prof. Deliang Chen	Goteborg University Department of Earth Sciences Guldhedsgatan 5A SE - 405 30 Goeteborg	Tel : +46.31.773.48.13 Fax : +46.31.773.19.86 Email : Deliang@gvc.gu.se

INFRASTRUCTURE

EXPLORIS – Explosive Eruption Risk and Decision Support for EU Populations Threatened by Volcanoes
EVR1-CT-2002-40026

Start date: 01/12/02 – End date: 30/11/05
Duration: 36 months
EC contribution: 1,976,358.00 Euro
EC contact: Cathy Eccles

Project Co-ordinator
Dr Neri Augusto
Consiglio Nazionale delle Richerche
Istituto di Geoscienze e Georisorse
Via S. Maria 53
IT – 56126 Pisa
Tel: +39.050.84.72.73
Fax: +39.050.50.06.75
Email: neri@dst.unipi.it
Web: http://exploris.pi.ingv.it/non_conf/description/index.html

PROJECT SUMMARY

Problems to be solved

In the last few decades the population worldwide has become concentrated in large conurbations at high risk from volcanic disasters. The most serious hazards are represented by the occurrence of pyroclastic flows and tephra fallout at European cities on explosive volcanoes and volcanic islands. Whatever the policy to mitigate such a huge risk might be, quantification of risk in association with a ra11ge of eruption scenarios, their impact, and mitigation are the fundamental priorities. This project addresses these critical issues by advancing critical scientific and technological facilities (e.g. simulation codes, vulnerability databases, and risk protocols) needed in volcanic risk assessment and mitigation. The project also aims to apply the facilities to those European volcanoes at high risk (Vesuvius, Italy; Soufriere, France; Sete Cidades, Portugal; Teide, Spain) so that they become a technology platform for exploitation at volcanoes throughout the world capable of supporting officials in deciding development and planning priorities as well as decision making in volcanic crises.

Scientific objectives and approach

The main objective of the project consists in the quantitative analysis of explosive eruption risk in densely populated EU regions and the evaluation of the likely effectiveness of possible mitigation measures (such as land-use planning, engineering interventions in buildings, emergency planning and community preparedness) through the development of volcanic risk facilities -such as supercomputer simulation models, vulnerability databases, and probabilistic risk assessment protocols -and their application to high-risk European volcanoes. The specific objectives we plan to achieve are: 1) Define quantitative volcanological scenarios for the most dangerous European volcanoes, 2) Develop massively parallel supercomputer models for the simulation of pyroclastic flow and fallout dispersal in 3D, 3) Develop vulnerability databases for buildings, infrastructures, and inhabitants, 4) Quantify the potential impact of the eruptive events, 5) Define potential mitigation measures, 6) Develop and apply probabilistic risk assessment protocols, and 7) Transfer the project findings to civil protection authorities in order to provide policy-relevant information. The approach adopted aims at gathering and combining knowledge deriving from different fields in order to provide a

strategic multidisciplinary set of expertises. Competence in field volcanology, geology, physical modelling, applied mathematics, fluid-dynamics, computer science, engineering, architecture, medicine, and risk analysis are all involved in the project, representing a unique opportunity to improve European capabilities to undertake the complex task of volcanic risk management.

Expected impacts

3D simulation codes, vulnerability databases, and probabilistic risk assessment protocols are concrete volcanic risk facilities, delivered by the project, that can be easily applied to other volcanic regions. Therefore, a possible exploitation of project results will consist in the application of the facilities developed to other high-risk volcanoes worldwide. The project also contributes directly to improve the quality of life of millions of people in high-risk European regions through the establishing of safer life conditions. In particular, the assessment of volcanic risk on a probabilistic basis, as well as the identification of possible mitigation measures, will certainly help in the definition of a mitigation policy aimed at the reduction of risk for cities on volcanoes and volcanic islands.

Scientific partners

2	Dr Giovanni Erbacci	CINECA High Performance Systems Division Via Manganelli 6/3 IT – 40033 Casalecchio di Reno (Bologna)	Tel: +39.51.617.14.11 Fax: +39.51.613.21.98 Email: g.erbacci@cineca.it
3	Dr Giovanni Macedonio	Istituto Nazionale di Geofisica e Vulcanologia Osservatorio Vesuviano Via Diocleziano, 328 IT – 80124 Napoli	Tel: +39.081.610.83.35 Fax: +39.081.610.08.11 Email: macedon@ov.ingv.it
4	Mr Stephen Kellaher	The Cancellor and Masters and Scholars of the University of Cambridge Dept. of Public Health & Primary Care Institute of Public Health Robinson Way UK – CB2 2SR Cambridge	Tel: +44.1223.76.51.93 Fax: +44.1223.33.29.88 Email: Stephen.kellaher@rsd.cam.ac.uk
5	Prof. Guglielmo Trupiano	Università deglli Studi di Napoli "Federico II" Centro di Ricerca Interdipartimentale L.U.P.T Via Toledo, 402 IT - 80134 Napoli	Tel: +39.081.552.10.11 Fax: +39.081.551.34.95 Email: trupiano@unina.it
6	Mr Stephen Mortimer	University of Luton Dept of Computing & Information Systems Park Square UK – LU1 3JU Luton	Tel: +44.1582.48.90.11 Fax: +44.1582.48.92.12
7	Dr Willy Aspinall	Aspinall & Associates Woodside Close, 5 UK – HP9 1JQ Beaconsfield	Tel: +44.1494.67.27.46 Fax: +44.1494.67.12.39 Email: willy@aspinall.demon.co.uk
8	Mr Jose Carlos Rubio	Consejo Superior de Investigaciones Cientificas Institute of Earth Sciences "Jaume Almera" Lluis Sole Sabaris s/n ES – 08028 Barcelona	Tel: +34.915.855.000 Fax: +34.914.113.077
9	Dr Georges Boudon	Institut de Physique du Globe de Paris Observatoires Volcanologiques 4 Place Jussieu B 89 FR – 75252 Paris	Tel : +33.1.44.27.24.00 Fax : +33.1.44.27.24.01 Email : boudon@ipgp.jussieu.fr

10	Prof. João Gaspar	Universidade Dos Açores Centro de Vulcanologia e Avaliação de Riscos Geológicos Rua da Mãe de Deus, Edifício Complexo Cientifico, Bloco Sul, 3° Andar PT – 9501-801 Ponta Delgada	Tel: +351.296.650.147 Fax: +351.296.650.142 Email: jlgaspar@notes.uac.pt
11	Dr Derek Elsworth	Penn State University Department of Geosciences Volcanology Research Group 334 Deike Building 16802-2712 University Park, Pennsylvania United States	Tel: +1.814.865.7659 Email: elsworth@psu.edu

NATURAL HAZARDS

ERUPT - Processes and Timescales of Magma Evolution in Volcanic Systems
EVG1-CT-2002-00058

Start date: 01/01/03 – End date: 31/12/05
Duration: 36 months
EC contribution: 1,302,124.00 Euro
EC contact: Denis Peter

Project Co-ordinator
Professor Jon Davidson
The University of Durham
Department of Geological Sciences
South Road
DH1 3LE Durham
United Kingdom
Tel: +44.191.374.25.28
Fax: +44.191.374.25.10
Email: j.p.davidson@durham.ac.uk
http://www.dur.ac.uk/erupt.geolsci/

PROJECT SUMMARY

Problems to be solved

Within Europe there are several active volcanic systems which pose a significant hazard to human life, property and economic success. The volcanoes of Vesuvius and Campi Flegrei near Naples in particular represent a significant threat to the welfare of over half a million people. Beyond immediate risk, environmental degradation over both long and short term follows the deposition of volcanic materials over the land surface, and the injection of gases into the atmosphere. Our current ability to forecast the timing, sizes and effects of volcanic eruptions is very poor. We aim to improve this significantly.
Our objective in **ERUPT** is to work at a European level to provide new methodologies to relate the characteristics of volcanic rocks to the conditions leading to their eruption.

Scientific objectives and approach

The explosivity and size of eruption in the context of the geographical environment (topography, climate, population distribution) determines the risk posed to life and property.
Important questions concerning eruptions – how big? what type (how violent or explosive)? how frequent? can be addressed by examining the record contained within rocks erupted from a volcano, or frozen beneath it. The underlying principle of the work is to determine the conditions and timescales of magma storage in volcanic systems. The approach uses novel technological advances that allow us to undertake geochemical analyses at the scale of the components that constitute a volcanic rock. These data will be integrated with experimental data, textural data and field constraints and should enable us to estimate the rate at which magma differentiates, the conditions (pressure, temperature, volatile content) of magma storage and the architecture, in terms of relative volumes, of the magma storage system. These factors all affect the potential "risk" associated with a given eruption.

Expected impacts

ERUPT will provide constraints on the processes which determine the character of a volcanic eruption, and the timescales over which these processes operate.
ERUPT will provide techniques for geochemical analysis at the sub-millimetre scale.
ERUPT will deliver an improved understanding of specific European volcanic systems – Vesuvius, Campi Flegrei, Stromboli and Teide – and communicate this to the appropriate civil authorities responsible for taking decisions in response to an eruption threat.

Scientific partners

2	Prof. Lorella Francalanci	Universita degli Studi di Firenze Dipartimento di Scienza della Terra Via G. La Pira 4 IT - 50121 Firenze	Tel: +39.055.275.75.02 Fax: +39.055.290.312 Email: lorella@unifi.it
3	Prof. Gerhard Wörner	Geoscience Center Göettingen Division Geochemistry Goldschmidtstr. 1 DE - 37077 Göettingen	Tel: +49.551.393.972 Fax: +49.551.393.982 Email: Gwoerne@gwdg.de
4	Prof. Giovanni Orsi	Istituto Nazionale di Geofisica E Vulcanologia Osservatorio Vesuviano Via Drocleziano 328 IT - 80124 Naples	Tel: +39.081.610.83.43 Fax: +39.081.610.83.44 Email: orsi@ov.ingv.it
5	Prof. Marjorie Wilson	University of Leeds School of Earth Sciences Woodhouse Lane LS2 9JT Leeds United Kingdom	Tel: +44.113.343.52.36 Fax: +44.113.343.52.36 Email: M.Hamilton@adm.leeds.ac.uk
6	Prof. Joan Marti	Consejo Superior de Investigaciones Cientificas Institute of Earth Sciences "Jaume Almera" Liuis Sole I Sabaris ES - 08026 Barcelona	Tel: +34.934.095.410 Fax: +34.934.110.012 Email: joan.marti@ija.csic.es
7	Dr J. Stephen Daly	Dublin University, College Dublin Department of Geology Belfield IRL – Dublin	Tel: +353.171.623.27 Fax: +353.128.377.33

EARTH OBSERVATION

NATURAL HAZARDS

MUSCL – Monitoring Urban Subsidence, Cavities and Landslides by Remote sensing

EVG1-CT1999-00008

Start date: 01/03/00 – End date: 31/08/02
Duration: 30 months
EC contribution: 452,598.00 Euro
EC contact: Michel Schouppe

Project Co-ordinator
Dr Helmut Rott
University of Innsbruck
Institute for Meteorology and Geophysics
Innrain 52
AT – 6020 Innsbruck
Tel : +43.512.507.5455
Fax : +43.512.507.2924
Email: helmut.rott@uibk.ac.at or m.a.mcerlean@durham.ac.uk

PROJECT SUMMARY

Problems to be solved

The project MUSCL addresses one of the strategic goals of the 5th framework programme, the fight against major natural and technological hazards. In particular the project is aimed at contributing to the fight against natural hazards, which result from mass movements of unstable mountain slopes and excavations in urban areas. An urgent need exists for widely applicable methods to obtain quantitative data on mass wasting that are required for the assessment and mitigation of the hazards. In the project new techniques, based on Earth observation from space, are developed and validated to improve the detection of hazard zones and to advance the understanding of mass wasting processes.

Scientific objectives and approach

In order to advance the assessment and monitoring of hazards from landslides and buried cavities and to improve the understanding of mass wasting phenomena, advanced remote sensing techniques are introduced. The new information source is space-borne radar interferometry, which allows the measurement of surface displacement at the millimetre to centimetre scale over extended areas. The data sources are radar images of the European Remote Sensing satellites ERS-1 and ERS-2. The interferometric analysis methods will be optimised for the mapping of small displacements in different geological and environmental settings. The information content and application potential of the interferometric products will be validated at selected test sites in the Alpine and Mediterranean region in synergy with optical remote sensing data and with ground-based observations such as seismic profiles and point-based geodetic measurements. The test sites include deep-seated landslides, areas of building collapse related to buried cavities, and subsidence in urban areas due to changes of ground water level. The remote sensing products are integrated with conventional observations to characterise the subsidence and landslide phenomena and to develop methods for synergistic use. The capabilities and constraints of the different methods are assessed and tools for the operational use in risk management are elaborated.

Expected impacts

An integrative system for the detection of hazard zones and the monitoring of precursors to failure due to mass wasting phenomena is developed based on remote sensing and conventional information sources. These developments are guided by the needs of customers, mainly geotechnical companies and regional authorities responsible for hazard management. The project results will provide an improved, objective decision basis for the assessment and warning of geological hazards. The social and economic impact of improved measures for hazard prevention is high in regions which are exposed to landslide hazards and underground instabilities, such as specific zones of the Alpine and Mediterranean regions. In addition, the project contributes to the advancement of the European capacity in Earth observation technologies, enhancing the competitiveness of the Earth observation service providers on the global market. Methods are developed for generating new products from Earth observation data which can be exploited for operational services in geological hazard monitoring and related application areas.

Scientific partners

2	Fabio Rocca	Politecnico of Milan Department of Electronics and Information Sciences Piazza Leonardo da Vinci 32 IT – 20133 Milano	Tel : +39.02.2399.3573 Fax : +39.02.2399.3413 Email : rocca@elet.polimi.it
3	Alfredo Mazzotti	University of Milan Department of Earth Sciences – Geophysics Via Cicognara 7 IT – 20129 Milano	Tel: +39.02.503.18477 Fax: +39.02.503.18489 Email: alfredo.mazzotti@unimi.it
4	Dario Tarchi	Institute for the Protection and Security of the Citizen Humanitarian Security Unit EC Joint Research Centre Via Fermi 1 - TP 441 IT - 21020 Ispra	Tel: +39.0332.785143 Fax: +39.0332.785772 Email: dario.tarchi@jrc.it
5	Hans Rudolf Keusen	GEOTEST AG Birkenstrasse 15 CH – 3052 Zollikofen	Tel: +41.31.910.0101 Fax: +41.31.910.0100

OTHER INFRASTRUCTURE PROJECTS

(Details of projects related to Natural Hazards will be given in the next version)

Deep Geodynamic Laboratory - Gulf of Corinth (DGLab-Corinth EVR1-CT2000-40005). (Gilles Ollier)
This project concerns the development of a European seismic hazard research facility articulated around an in situ laboratory. It includes deep boreholes intersecting active faults and designed for obtaining data on the physics of earthquakes and on fault mechanisms as well as on seismic wave propagation in order to improve present earthquake hazards mitigation procedures. Particular emphasis will be placed on documenting the role of fluids on fault behavior and the role of earthquakes faulting on regional hydrogeology. The site is located in the Gulf of Corinth.

Internet-Site for European Strong-Motion Data (ISESD EVR1-CT1999-40008) (Gilles Ollier)
The objectives of the project are to establish a freely accessible European Internet platform of reliable strong-motion databank and associated database of seismological parameters of earthquakes in the greater European area, by installing a central site in London with mirror sites covering northern Europe from Reykjavik, Central Europe from Trieste, and the Mediterranean region from Thessaloniki. Through the Internet based platform the project will provide European end-users, engineers and scientists alike, with high quality strong-motion and associated seismological data from past and future earthquakes in the European area for design purpose and fulfil a need for upgrading technology in Europe.

Developing Stress-Monitoring Sites and Infrastructures for Forecasting Earthquakes (SMSITES EVR1-CT1999-40002) (Gilles Ollier).
The proposal is to develop a SMS (Stress Monitoring Site) in a seismic gap in Northern Iceland, where an M=7 earthquake is expected, and where, by chance, there are three wells with almost optimum SMS-geometry. Seismic shear-waves generated in a deeper well will be recorded in two shallower wells in directions monitoring the effects of the build up of stress before earthquakes. The times and magnitudes when stresses reach critical levels and an earthquake occurs can be forecast. Monitoring stress at SMSs is believed to be an important advance towards mitigating seismic hazard at any earthquake-vulnerable location in Europe and elsewhere.

Volcanic Activity Monitoring System in Tenerife (Canary Islands) - Implementing a Geophysical Radon Detector Array (Gilles Ollier)
(TeRn EVR1-CT1999-40010) will contribute to, test, demonstrate and establish a monitoring system related to potential volcanic disasters, by using radon to track the gas transport from depth within a large activity volcanic edifice. An experimental 3D array of continuous monitoring stations (CMS) for measurement of radon will be placed at surfaced localities, in subsurface galleries, and at Teide volcano. Chemical and isotopic composition of gas associated with the radon anomalies will be investigated. The CMS's will be integrated into a local telephone based network, controlled from a central laboratory facility.

Developing existing earthquake data infrastructures towards a Mediterranean-European Rapid Earthquake Data Information and Archiving Network (Gilles Ollier)
(MEREDIAN EVR1-CT2000-40007). This proposal aims at coordinating national initiatives towards a Mediterranean-European Rapid Earthquake Data Archive and Information Network (MEREDIAN) by improving the existing European infrastructure. The goal is to provide access to close-to-real-time and archived earthquake wave from data from most stations within Europe and the Mediterranean area for basic research, basic earthquake information for hazard mitigation and public information.

Earthquake Parameters and Standardized Information for a European Mediterranean Bulletin (EPSI EVR1-CT2000-40006) (Gilles Ollier).
The objectives are to establish homogeneous procedures for computing earthquakes parameters, and produce a European seismic bulletin. A unified formula for computing the magnitude of earthquakes occurring in Europe will be proposed. Improved cross-border data exchange and unified propagation model will contribute to enhance event locations in border regions. The results of this research will be incorporated, along with other upgrades, in a software allowing the fusion of tens of seismic bulletins to produce a European-Mediterranean bulletin on a regular basis. Finally, all data results gathered over the course of the project, as well as the European-Mediterranean bulletin will be available to the public through the EMSC web site and autoDRM.