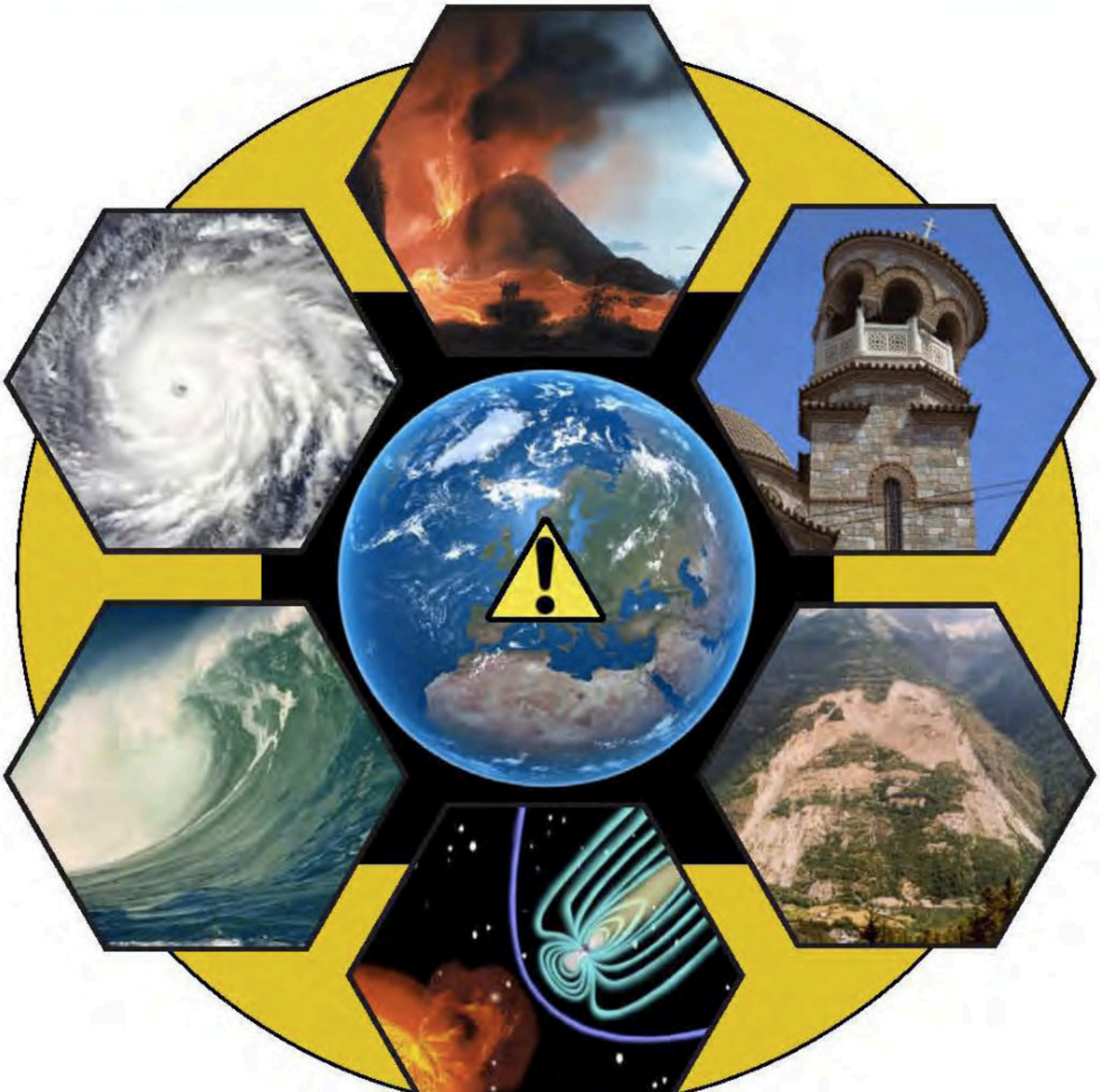
European Geosciences Union

Committee on Education



GIFT - 2013

Natural Hazards

Geosciences Information for Teachers Workshop

Vienna, Austria, 7-10 April 2013

Dear Teachers,

Welcome to the 11th GIFT workshop of the European Geosciences Union !

This year the workshop will unite 80 teachers from 18 different countries around the general theme « Natural Hazards».

Natural hazards are potential threats to humans that begin within and are transmitted through the Earth's natural environment, including the lithosphere, hydrosphere, atmosphere and biosphere. Examples of natural hazards include earthquakes, volcanoes, tsunamis, mass wasting, floods, climate (severe storms, strong winds, droughts) and wildfires. Natural hazards do not just originate on Earth, but can also be extra-terrestrial, such as asteroids potentially hitting the Earth, and solar storms.

Both the causes and results of natural hazards provide a dramatic intersection between the physical and social sciences. Many disasters that occur are a complex mix of natural events and human processes, including political, social and economic. Financial losses due to natural hazards, and the impact of disasters on society, have both increased dramatically over the last couple of decades. All spheres of society are now touched to some extent by natural hazards, whether they involve loss of lives and homes, an increasing strain on country/global resources (particularly acute for developing countries) or the more removed observation of disasters via public media.

Scientists, both physical and social, policy makers, reinsurance companies, disaster managers, and the public themselves, have different ways for understanding and studying natural hazards. These range from mathematical equations, computer models, laboratory experiments, and many kinds of ground-based and satellite data, to interviews, philosophical constructs, compilation of many kinds of social sciences data, and ultimately policy.

Here, in the two and a half days of the workshop we will have time to describe and discuss only some of the more topical natural hazards issues currently facing society via a number of presentations by worldwide known scientists present at the General Assembly of EGU. But we hope these will help you in transmitting these notions to your pupils and we also offer you a set of hands-on activities that, we hope, will soon be a standard in your schools!

Moreover, as in every GIFT Symposium, contributions by the attending teachers on particular "off-the-program" activities that they may have had in their classrooms are particularly welcomed, either as poster or oral presentations, even if their subject is not directly related to the theme of the workshop.

The GIFT workshop is sponsored not only by EGU, but also by several science organizations. We would like to continue to offer teachers the opportunity to attend GIFT and similar workshops, but this depends upon us being able to show our sponsors that teachers have used the new GIFT information and science didactics in their daily teaching, or as inspiration for new ways to teach science in their schools.
Therefore, we ask you **1.** to fill out the evaluation forms as soon as possible and send them back to us, **2**. make a presentation of your experiences at GIFT to a group of your teaching

colleagues sometime after you return from EGU, and **3**. send us reports and photographs about how you have used the GIFT information in your classrooms. We also encourage you to write reports on the GIFT workshop in publications specifically intended for géosciences teachers.

Information on past and future GIFT workshop is available on the EGU homepage. Look at http://www.egu.eu/media-outreach/gift/gift-workshops.html
where you can find the brochures (pdf) and also the slides of the different presentations givenat the GIFT workshops for the last 8 years. Beginning in 2009, we have also included web-TV presentations, which may be freely used in your classrooms.

We know that bringing together 80 teachers in Vienna is not enough to spread scientific information as widely as we would hope. For this reason, the EGU Committee on Education has inaugurated in 2012 an annual series of GIFT Distinguished Lectures (for the moment restricted to European countries), to be given by top scientists who have previously participated as speakers in GIFT workshops during the EGU General assemblies. These lectures are to be included in a well-organized educational event for high school science teachers, in which a minimum of one hundred teachers will attend. High school teachers, high school directors, educators for teachers are welcome to request a lecture, for which the EGU Committee on Education will cover the travel and subsistence costs of the speaker. Lecturers and topics should be selected among the ones given in the past 5 years in EGU General Assembly GIFT Workshops.

Even before we get « officially » started, you are in for our special yearly treat: our traditional visit to the Vienna Museum of Natural History on Sunday April 7, 2013 afternoon, a courtesy of Mathias Harzhauser and Herbert Summesberger. Following this visit, we'll have an ice-breaker reception in the beautiful Museum.

We are looking forward to meeting you in Vienna!

The Committee on Education
European Geosciences Union

Acknowledgements

The GIFT-2013 workshop has been organized by the Committee on Education of the European Geosciences Union. EGU has supported the major share of the expenses, but the workshop has also benefited of the generous help of:

The European Space Agency

Istituto Nazionale di Geofisica e Vulcanologia

The Research School for Teachers in Natural Hazards

Network of European Research Infrastructures for Earthquake Risk Assessment and Mitigation

The Associazione per la Geofisica « Licio Cernobori » in Trieste, Italy

The Institute of Geology and Geophysics, Chinese Academy of Sciences, China

Westermann Verlag, Braunschweig, Germany

National Science Foundation

William S. Goree Award

And we thank all the speakers who have contributed to this educational workshop and their institutions

European Geosciences Union
Committee on Education

CHAIR

Carlo Laj
Laboratoire des Sciences du Climat et de l'Environnement (LSCE)
Avenue de la Terrasse,
91198 Gif-sur-Yvette cedex, France
education@egu.eu
lajcarlo@gmail.com

MEMBERS

Eve Arnold
Department of Geological Sciences
Stockholm University
S106 91 Stockholm, Sweden
emarnold@geo.su.se

Jean-Luc Berenguer
Centre International de Valbonne
BP 97 - 06902 Sophia Antipolis cedex, France
berenguer@unice.fr

Friedrich Barnikel
Fachkoordinator für Geographie
Landeshauptstadt München ,
Germany
friedrich.barnikel@awg.musin.de

Anita Bokwa
Jagiellonian University
Institute of Geography and Spatial Management
7 Gronostajowa St.
PL-30-387 Cracow, Poland
anita.bokwa@uj.edu.pl

Angelo Camerlenghi
Istituto Nazionale di Oceanografia e di Geofisica Sperimentale OGS
Borgo Grotta Gigante 42/C
34010 Sgonico, Trieste, Italy
acamerlenghi@ogs.trieste.it

Francesca Cifelli
Dipartimento Scienze Geologiche
Università degli Studi Roma TRE
Largo San Leonardo Murialdo 1
00146 Roma, Italy
cifelli@uniroma3.it

Francesca Funiciello
Dipartimento Scienze Geologiche
Università degli Studi Roma TRE
Largo San Leonardo Murialdo 1
00146 Roma, Italy
ffunicie@uniroma3.it

Stephen A. Macko
Department of Environmental Sciences
University of Virginia
Charlottesville, VA 22903, USA
sam8f@virginia.edu

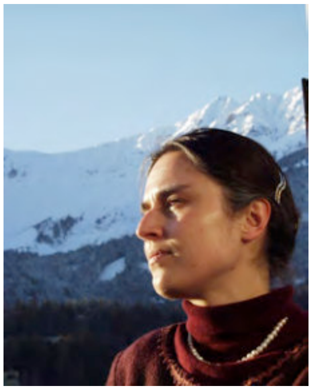
Phil Smith
Teacher Scientist Network (TSN)
John Innes Centre
Colney Lane
Norwich, NR4 7UH Great Britain
phil.smith@bbsrc.ac.uk

Annegret Schwarz
Gymnasium an der Stadtmauer,
Hospitalgasse 6,
55543 Bad Kreuznach,
Germany
aschwarz@stamaonline.de
Annegret.Schwarz@online.de

Herbert Summesberger
Natural History Museum
1010 Wien, Burgring 7
Austria
herbert.summesberger@ nhm-wien.ac.at

European Geosciences Union

Committee on Education



Anita Bokwa

Angelo Camerlenghi

Steve Macko

Francesca Cifelli

Eve Arnold

Carlo Laj

Annegret Schwarz

Friedrich Barnikel

Francesca Funiciello

Jean-Luc Berenguer

Phil Smith

Herbert Summesberger

Program

European Geosciences Union - General Assembly

GEOSCIENCE INFORMATION FOR TEACHERS (GIFT) WORKSHOP

Austria Center Vienna, 7-10 April 2013

Natural Hazards

Sunday April 7, 2013

16:30 - 18:30 **GUIDED TOUR OF THE VIENNA MUSEUM OF NATURAL HISTORY** and ice breaker reception
Herbert Summesberger and Mathias Harzhauser
Vienna Museum of Natural History

Monday April 8, 2013

08:30 - 08:45 **WELCOME !**
Günter Bloeschl
President of EGU

PRACTICAL INSTRUCTIONS FOR THE WORKSHOP
Carlo Laj
EGU Committee on Education

Chairperson: Carlo Laj

08:45 – 09:15 **HOW CAN WE DEFEND OURSELVES FROM THE HAZARDS OF NATURE IN THE MODERN SOCIETY?**
Stefano Tinti
University of Bologna,
Bologna, Italy

09:15 – 10:00 **UNDERSTANDING THE EARTHQUAKE GENERATION PROCESS: KEY RESULTS AND PRESENT GRAND CHALLENGES**
Massimo Cocco
Istituto Nazionale di Geofisica e Vulcanologia, Roma Italy.

10:00 – 10:30 COFFEE BREAK

Chairperson: Francesca Cifelli

10:30 – 11.15 **CONVERGENT MARGINS AND MEGA-EARTHQUAKES**
Francesca Funiciello
Università of Roma 3, Roma, Italy

11:15 – 11:45 **Marine Sediments in the Classroom**
Claudie Le Divenah & Aurélie Van Toer
Lycée E; de Breteuil, Montigny Le Bretonneux, France & Laboratoire des Sciences du Climat et de l'Environnement, Gif sur Yvette, France

11:45 – 12:00 **Instructions for the poster session EOS02**
Eve Arnold
University of Stockholm, Sweden

12:00 – 14:00 Lunch (sandwiches)

Chairperson: Phil Smith

14:00 –18:00 **Hands-on activities**
Jean-Luc Berenguer & François Tilquin
Centre International de Valbonne & Lycée Marie Curie Echirolles, France

Tuesday April 9, 2013

Chairperson: Francesca Funiciello

08:30 – 09:15 **Risk Assessment of Vesuvius Volcano**
Franco Barberi
Università Roma 3, Roma Italy

9:15 – 10:00 **Tsunami hazard assessment: what did we learn since 2004 and 2011?**
Hélène Hébert
CEA, DAM, DIF, DASE, Arpajon, France

10:00 – 10:30 Coffee Break

Chairperson: Friedrich Barnikel

10:30 – 11:15 **Triggered Landslide Events: Statistics, Implications and Road Network Interactions**
Bruce D. Malamud
King's College London, UK

11:15 – 12:00 **ESA Earth Observation programme and its applications to Natural Hazards**
Francesco Sarti
ESA/ESRIN, Frascati (Italy)

12:00 - 13:30 Lunch (sandwiches)

Chairperson: Friedrich Barnikel

13:30 - 14:15 **SUBMARINE GEOHAZARDS**
Angelo Camerlenghi
OGS, Istituto Nazionale di Oceanografia e Geofisica Sperimentale, Sgonico, Trieste, Italy

14.15 - 15.00 **THE EDUCATIONAL PROGRAMS OF THE EUROPEAN GEOSCIENCE UNION**
Carlo Laj
EGU Committee on Education

15:00- 15:30 COFFEE BREAK

Chairperson: Eve Arnold

15 :30 – 19 :00 **EOS2 – POSTER SESSION**

Wednesday April 10, 2013

Chairperson : Stephen Macko

09:00 – 9 :45 **SPACE WEATHER: STORMS FROM THE SUN**
Norma B. Crosby
Belgian Institute for Space Aeronomy

10:00 – 10:30 COFFEE BREAK

Chairperson : Annegret Schwarz

10 :30 – 11 :15 **INCREASE OF EXTREME EVENTS IN A WARMING WORLD**
Stefan Rahmstorf
Potsdam Institute for Climate Impact Research, Germany

11:15 – 12:00 **RISK MANAGEMENT OF NATURAL HAZARDS CHALLENGES FOR THE INSURANCE INDUSTRY**
Andreas Siebert
Munich Re Insurance Company

12:00 – 12:30 **CONCLUSIONS**
Carlo Laj

12:30 LUNCH (Sandwiches) and GOODBYE!

13:30 – 16:30 Optional! **EXCURSION: FLOOD PROTECTION IN VIENNA**
Limited to 30 teachers
Contact herbert.summesberger@NHM-WIEN.AC.at

Speakers

Prof. Stefano Tinti
Alma Mater Studiorum – University of Bologna
Email: stefano.tinti@unibo.it

Employment
Full Professor of Solid Earth Geophysics, Department of Physics and Astronomy, University of Bologna

Research Responsibilities

- **Coordinator** of the European project **TRANSFER** (Tsunami Risk ANd Strategies For the European Region) undertaken by a Consortium of 29 partners, which started in 2006 and ended in September 2009.
- **Coordinator** of the project **GITEC-TWO** (Genesis and Impact of Tsunamis on the European Coasts – Tsunami Warning and Observations) in the period 1996-1998.
- **Coordinator** of the project **GITEC** (Genesis and Impact of Tsunamis on the European Coasts) in the period 1992-1995.
-

Other Responsibilities

- **2011-present: President** of the **Natural Hazards Division of the EGU**
- **2005-2009: Chairman** of the **Intergovernmental Coordination Group for the North-East Atlantic, the Mediterranean and Connected Sea Tsunami Warning System (IOC/UNESCO)**
- **Member** of the **International Tsunami Commission** (IUGG) and in 1995-2003 **Vice-Chairman**
- **Vice-President** of the Tsunami Society (1991-1997)

Editorial Boards
Member of the **Editorial Board** of the journal **Natural Hazards and Earth System Sciences** (NHESS) open access journal of the European Geoscience Union and **Guest Editor** of several special issues of the same journal
2002- 2008 Editor-in-Chief of the journal **Physics and Chemistry of the Earth**, published by Pergamon Press.
Editor of the volume **Tsunamis in the World** published by **Kluwer Academic Publishers** in 1991.
Guest Editor of two special issues of the journal **Science of Tsunami Hazards** in 1988 and 1991.
Guest Editor of five special issues of the journal **Physics and Chemistry of the Earth** in 1996, 2001, 2003, 2005 and 2009.

Research Achievements
Expert on the strategies and methods to mitigate the impact of natural hazardous phenomena, with special interest on tsunamis and coastal inundation. Author of over 200 papers, of which more than 140 published in peer-reviewed journals and in international books. Research and operational experience in the Solid Earth Geophysics, in Seismology, as well as in Long Ocean Wave Dynamics, and in Systems of Early Warning.

How can we defend ourselves from the hazards of Nature in the modern society?

Stefano Tinti
University of Bologna,
Bologna, Italy

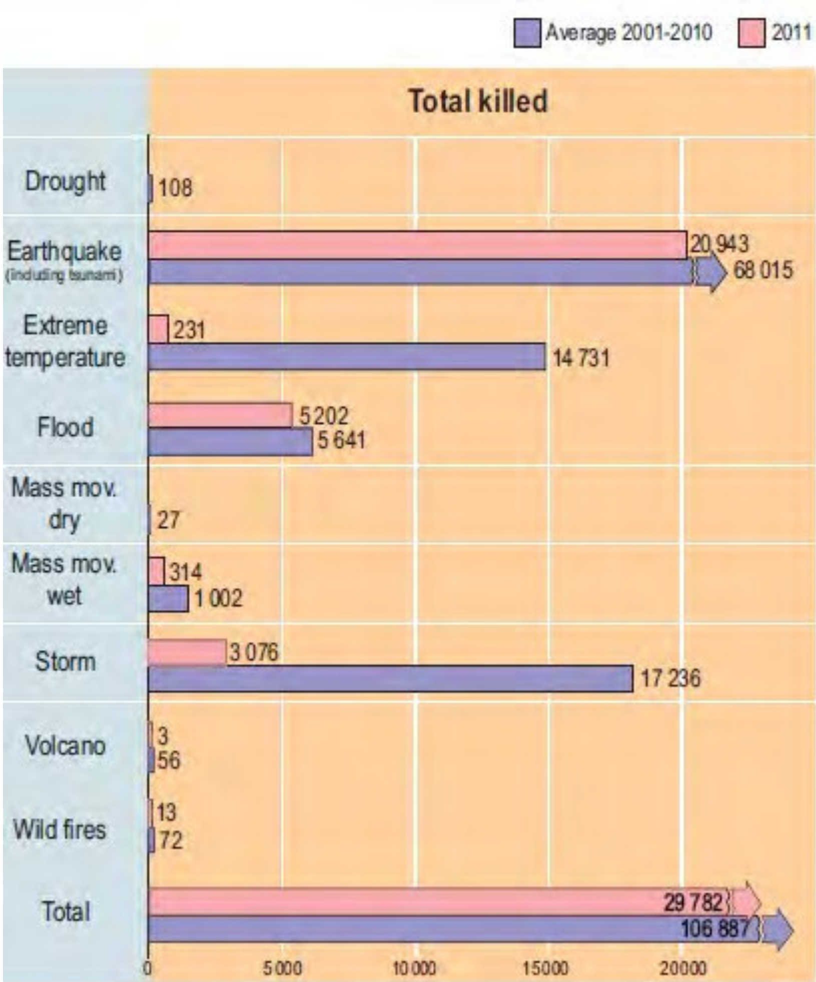
If we think of natural hazards, immediately our mind goes to dramatic images of earthquakes, floods, tsunamis, forest fires, landslides, hurricanes and typhoons, etc. that are conveyed to us by TV channels, by internet amateur or professional videos, or to reports of press agencies and newspapers with stories of destruction and fatalities.

One of the largest disasters of the last centuries in terms of the toll of human lives and of the extension of the area affected was the 26 December 2004 tsunami in the Indian Ocean that followed a mega-thrust 9.3 magnitude earthquake in the Sumatra trench: all the countries with coasts in the Indian Ocean were affected and the total number of fatalities was counted to be around 220-230 thousands, mostly from Sumatra (see e.g. Figure 1) and Thailand to the east of the source region, and from Sri Lanka and India to the west. One could say that it was the first natural catastrophe with global coverage of the media with news reaching all the parts of the word almost real-time, which raised an enormous world-wide impression.

Figure 1. Houses totally flattened by the 26 December 2004 tsunami in Banda Aceh, Sumatra. This was the area most hit by the waves. Aerial photo shot three weeks after the event. Credit: © Adek Berry—AFP/Getty Images

Data and statistics of major catastrophes can be found in many specialized data bases and open access web sites, populated and maintained by international organizations, research centers and universities. The UNISDR (United Nations International Strategy for Disaster Reduction) is one of the most important of such bodies having the institutional task of collecting data and of devising and disseminating strategies to reduce the impact of natural processes with large hazardous potential. In Figure 2 the number of fatalities due to natural disasters that occurred in 2011 is compared with the average of the previous 10-year period (2001-2010), separated by disaster type. It can be seen that the largest numbers are associated with earthquakes and tsunamis both in 2011 and in the previous decennium, and that floods, storms (more precisely hurricanes, typhoons, tropical storms) are the other most relevant causes of deaths.

Figure 2. Histograms with fatalities from natural disasters of 2011 vs. average yearly figures in



the interval 2001-2010. Here only disasters as severe as to affect heavily a country are considered. Notice that tsunamis are included in the category of the earthquakes. The total number of deaths in the decennium was more than 1 million and in 2011 slightly less than 30000 with most of the victim attributable to the 11 March 2011 Tohoku tsunami, affecting Japan (from “2011 Disasters in numbers”, a joint document of UNISDR, www.unisdr.org/, USAID, and CRED, www.cred.be/, published in www.preventionweb.net).

There are several indicators that can be used to quantify the effect of a great natural catastrophe. In addition to the number of lost human lives, the economic impact is one of the most significant parameters. Figure 3 provides the trend of the economic losses due to natural disasters in the last 30 years. It can be seen that it is steadily increasing, which could suggest that nature is becoming more and more aggressive against the human society, and we should start to posing questions about a possible increase of hazard (i.e. of the occurrence probability), an issue more related to the basic geophysical and geological processes, or about a possible increase of vulnerability, an issue more related to the development of the anthropic environment.

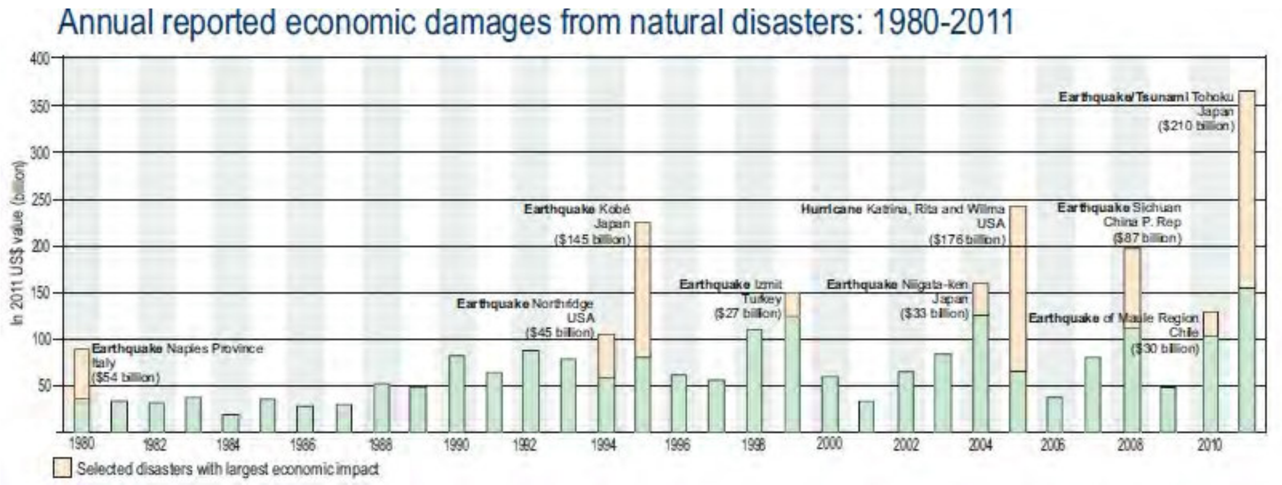


Figure 3. Histogram of the economic losses of the major natural disasters in the period 1980-2011. It may be seen that the last decade was much more affected than the first decade (1980-1989), and that most losses are due to the Kobe earthquake in 1995, the hurricane Katrina (2005) and the Tohoku earthquake and tsunami (2011), all affecting developed countries (USA and Japan) with strong economies (from "2011 Disasters in numbers", a joint document of UNISDR, www.unisdr.org/, USAID, and CRED, www.cred.be/, published in www.preventionweb.net).

We could pose the question in the following way: can we protect ourselves from natural hazards or are they unavoidable? We can even reformulate it in a slightly different way: are the society or societies of the XXI century strong enough to cope with natural hazards or are they vulnerable, even more vulnerable than the societies of the previous decades or centuries? And other related questions are: what are the best strategies to mitigate the impact of such hazardous phenomena? And what kind of contributions can researchers and teachers provide and what kind of role can they play if they like to be active factors of these counter-disaster strategies? These issues form the main skeleton of my speech, where considerations and suggestions to build sensible answers are provided.

Massimo Cocco

Senior Researcher, Seismologist
Istituto Nazionale di Geofisica e Vulcanologia (INGV)

Senior Researcher
Seismology and Tectonophysics Department, Roma 1

Academic record:
1984 - graduated in physics; Diploma Thesis in seismology at Faculty of Physics, University Roma 1 (La Sapienza).

Positions Held
1985-1987 Research fellowship at the Istituto Nazionale di Geofisica (ING), Rome.
1987-1991 Researcher at the Istituto Nazionale di Geofisica, Rome.
1991-1997 Associate Researcher at Istituto Nazionale di Geofisica, Rome.
1991-1993 Chief of the National Seismic Network managed by ING.
1995-1996 Professor of Seismology at the University of Bologna (temporary position).
1996-1998 Professor of Seismology at the University of Milan (1996-1997; 1997-1998)
(temporary position).
1998-2000 Professor of Seismology at the University of Rome III (1998-1999; 1999-2000)
(temporary position).
2001-2007 Director of the Department of Seismology and Tectonophysics at INGV
1997-present Senior Researcher at Istituto Nazionale di Geofisica, Rome

Research activities:
(1) Strong motion seismology;
(2) Earthquake physics;
(3) Seismic Monitoring and management of Research Infrastructures;
(4) Fault interaction and seismicity patterns;
(5) Seismic hazard and engineering seismology.

Teaching:
Faculty of Physics, University of Bologna, 1995-1996
Faculty of Earth Sciences, University of Milano, 1996-1998
Faculty of Geology, University of Rome III, 1999-2000
Rose School, University of Pavia, 2009
Supervisor of 18 Diploma Thesis and 8 PhD. Theses

Professional Associations:
Member of Seismological Society of America (1986-1999)
Member of American Geophysical Union
Member of European Geophysical Society
Member of the European Seismological Commission

Membership in scientific committees:

Member of the Scientific Council of the Istituto Nazionale di Geofisica 1999-2001
Member of the Commission for Development of Earth Science of CNR, comitato 05.
Member of the Commission for Monitoring of Volcanoes for the GNV of CNR
Member of the Scientific Council of the Gruppo Nazionale per la Difesa dai Terremoti (GNDT).
Member of the Commission of the Italian Civil Protection for the proposition of the Coordinated Research Framework Program of the National Group of Volcanology (GNV).
Member of the Commission of the Italian Civil Protection for the proposition of the Coordinated Research Framework Program of the Gruppo Nazionale Difesa dai Terremoti (GNDT).
Member of the Commission for Defending PhD. Thesis in Geophysics in Italy and France.
Member of the Board of Directors of INGV.
Member of the Scientific Council of the European Centre for Training and Research in Earthquake Engineering (EUCENTRE).
Member of the Executive Committee of the European Seismological Commission (ESC), sub-commission SC-C Physics of the Earthquake Sources.

Membership in editorial boards:

Associate Editor for Journal Geophysical Research, Solid Earth. (2002-2004)
Associate Editor for Journal of Seismolgy. (until 2008)
Associate Editor for Annali di Geofisica (now Annals of Geophysics).
Editor for Geophysical Journal International (until 2012)

Scientific Activity

Author of 105 papers on International Scientific Journals.
Invited lectures and seminars given during short visits and research stages in international institutions.
Presenting author of more than 150 comunications at scientific international meetings.
Editor of 2 special issues on Annali di Geofisica and Journal of Seismology.
Editor of 1 special issue on Journal of Geophysical Research.
Director of 4 schools and conferences in Solid Earth Geophysics in 1993, 1998, 2002, 2007.
Organizer of a European Science Fundation Conference in Earthquake Mechanics in 1999.

Coordinator and partners in numerous international Projects and national grants.
Presently coordination the EC Preparatory Phase Project: **EPOS European Plate Observing System, Project Coordinator**, (www.epos-eu.org), 2010-2014.

Understanding the earthquake generation process: key results and present grand challenges

Massimo Cocco
Istituto Nazionale di Geofisica e Vulcanologia, Roma Italy.

Earthquake science has made extraordinary progress in the last years promoted by high-quality data, high-precision observations, improved computational facilities and laboratory experiments. Despite these advances and an improved understanding of physical processes generating earthquakes, the grand challenge is nowadays to reconcile seismological measurements, geological observations and the key findings of laboratory experiments. Several different observations on natural and experimental faults indicate that many different physical processes control the earthquake preparation, initiation and the following dynamic rupture.

In my lecture I wish to present the results of original studies on recent earthquakes in order to discuss the complexity of the earthquake generation processes, the progress in understanding these processes and the difficulties in forecasting the spatio-temporal evolution. This in turn represents the progress and the problems in assessing the impact of earthquakes on society.

Among the several different large-magnitude earthquakes, I will pay particular attention to the 2009 L'Aquila main shock (6^{th} of April, M_w 6.1). This seismic event, despite its moderate magnitude, is an important study-case for earthquake science for many different reasons: (i) it is one of the best recorded normal faulting earthquake with a distinctive foreshock-aftershock sequence; (ii) it allowed the collection of an excellent multi-disciplinary near-source data set; (iii) despite its moderate magnitude, it revealed a surprising complexity of source processes, including an unusual rupture directivity; (iv) its impact on society and seismologists is unique.

As many other previous moderate and large magnitude events in Italy, this earthquake has left the scientific community and the involved stakeholders quite evident lessons concerning the necessary prevention actions, as well as the urgent need to train and educate the society to live in earthquake prone areas. These lessons should spur all the public authorities towards a better use of seismic hazard maps and available information concerning the vulnerability of the Italian territory, with particular attention to urban areas. These lessons demand for urgent initiatives to increase the resilience of the Italian society to natural hazards.

Unfortunately, these lessons are still unheard. The missed prediction and the claimed lack of adequate indications for evacuating the population immediately before the earthquake have focused the attention of the media and produced a misleading effect on public opinion. There was the presumption to undertake prevention actions in few days or hours without any existing plan for emergency management; there was the presumption to do in few days what it was not done in previous decades or years.

I will present and discuss this complex nucleation and rupture process for showing how different competing mechanisms control the initial stage of rupture and the dynamic rupture propagation and I will focus on the fact that seismologists provided all the scientific information necessary to undertake the prevention actions to reduce fatalities and mitigate the impact on society.

Francesca Funiciello
Laboratory of Experimental Tectonics (LET),
Dip. Scienze, Univ. "Roma TRE, Roma, Italy

website:http://host.uniroma3.it/dipartimenti/geologia/laboratori/let/index.php?page=home&lang=en
e-mail: ffunicie@uniroma3.it

EDUCATION/CAREER: **1997**: Master degree in Geological Sciences at La Sapienza Univ., Roma (Italy). **1998–1999**: CNR fellowship. **1999-2002**: Ph.D. in Geophysics ETH Zürich (Switzerland).**2003–2006**: Post-doc at the Dip Scienze Geologiche "Roma TRE" Univ. **2006** Winner of the European Young Investigator (EURYI) Award 2006 (European Science Foundation) with the project "Convergent margins and seismogenesis: defining the risk of great earthquakes by using statistical data and modelling". **2006- 2011**: Non-permanent researcher at the Dip Scienze Geologiche "Roma TRE" Univ. as EURYI Awardee. **2011-present**: Permanent researcher at the Dip Scienze Geologiche "Roma TRE" Univ.

RESEARCH INTERESTS
Topics: Dynamics of subduction zones; Convergent margins and seismogenesis; Mantle convection; Material Rheology; Outreach.
Methodologies: Laboratory modelling; Numerical modelling; Analysis of geological and geophysical data; Rheometry.

PEER REVIEWED PUBLICATIONS: 45, ISI-h index: 17 (July 2012)

NUMBER OF PRESENTATIONS AT MEETINGS: **National:**:6; **International**: 151; **Invited lectures/seminars**: 17

SERVICES: **a)** Referee of NSF (National Science Foundation, USA) and EC (European Commission) projects; **b)** referee of scientific journals: Tectonophysics, Earth Science Reviews, Geophysical Research Letters, Nature, Geology, G-cubed, Physics of the Earth and Planetary Interiors, Geophysical Journal International, Journal of Geophysical Research, Nature Geoscience **c)** Editor of a special volume 'Frontiers in Earth Sciences' edited by Springer; **d)** Topical Editor of Solid Earth (EGU journal); **e)** Editor of the special volume "Subduction Zones" in the journal Solid Earth; **f)** Organizer of Subduction Zones Conference 2007. Montpellier (France) 2-6 June 2007; **g)** Convener of EGU (European Geophysical Union) and AGU (American Geophysical Union) sessions; **h)** Collaboration to realize the scientific movie, "Face of Earth", produced by "The American Geological Institute", "Evergreen Films" and "Discovery Communication" for Discovery Channel. **i)** Italian responsible of Educational Committee of Education of the European Geosciences Union (EGU);

AWARDS: **a)** Winner of the European Young Investigator (EURYI) Award 2006 (European Science Foundation) with the project "Convergent margins and seismogenesis: defining the risk of great earthquakes by using statistical data and modelling". **b)** 2008 Editors' Citation for Excellence in Refereeing for Geophysical Research Letters**;** **c)** Burgen Scholar Award 2009 (Accademia Europaea) for the high value of her scientific results.

SCIENTIFIC COLLABORATIONS: Dip. Idraulica, Univ."La Sapienza" Roma (Ita); INGV (Ita); Dip. Fisica, Univ. Urbino (Ita); ETH, Zurich (CH); Dep. of Earth and Planetary Sciences, Harvard Univ. (USA); Ecole Normale Superieure, Paris (Fra); Carleton Univ. (Can), Laboratoire de Dynamique de la Lithosphere Institut des Sciences de la Terre, de l'Environnement et de l'Espace de Montpellier (Fra); LMTG, Univ. P. Sabatier Toulouse (Fra); Univ. Pierre et Marie Curie (Paris 6), Paris (Fra); Laboratoire de Planétologie et Géodynamique de Nantes Nantes (Fra); Frankfurt Univ. (Ger); Univ. Durham (UK); Imperial College, London (UK); Ludwig-Maximilians Univ., München (Ger); Dep. of Earth Sciences, University of Utrecht (Ned); Univ. Politecnica de Madrid (Spa); Facultad de Ciencias Físicas, Univ. Complutense de Madrid (Spa); Institute of Food Science; Food Engineering, ETH, Zurich (CH), Univ. South California LA (USA); MIT (USA); Res. Center for Prediction of Earthquakes/Volcanic Eruptions, Tohoku Univ. (Jap); Dep. of Earth Science, Tohoku Univ. (Jap); Department of Earth Sciences, Carleton University, Ottawa (Can); Anton Paar (GER/ITA).

PROJECTS: Participant to 24 national/international granted projects, 5 as PI.

TEACHING HISTORY: Geodynamic course (spring semester 2012); advisor of 7 master students and 9 PhDs; Summer School "Thermal convection in complex fluids: from laboratory to mantle dynamics", LAB FAST Univ. Paris X, Orsay (Paris, Fra).

CONVERGENT MARGINS AND MEGA-EARTHQUAKES

Francesca Funiciello

Laboratoty of Experimental Tectonics, Dep. Geology,
Univ. "Roma TRE", L.S.L. Murialdo 1, 001546 Roma, Italy

Subduction zones are the site of the largest and most dangerous seismic events occurring on the Earth. The interface of converging plates represents major fault zones where the main fraction of the global seismicity is released. During the last decade – from the 2004 Sumatra earthquake to the 2011 Tohoku-oki earthquake- seismic mega-events have been apparently more frequent compared to the preceding three decades. The attention for these events has thus progressively increased, raising issues on their controlling factors that, if addressed, would have dramatic implications on the earthquake and tsunami risk assessment.

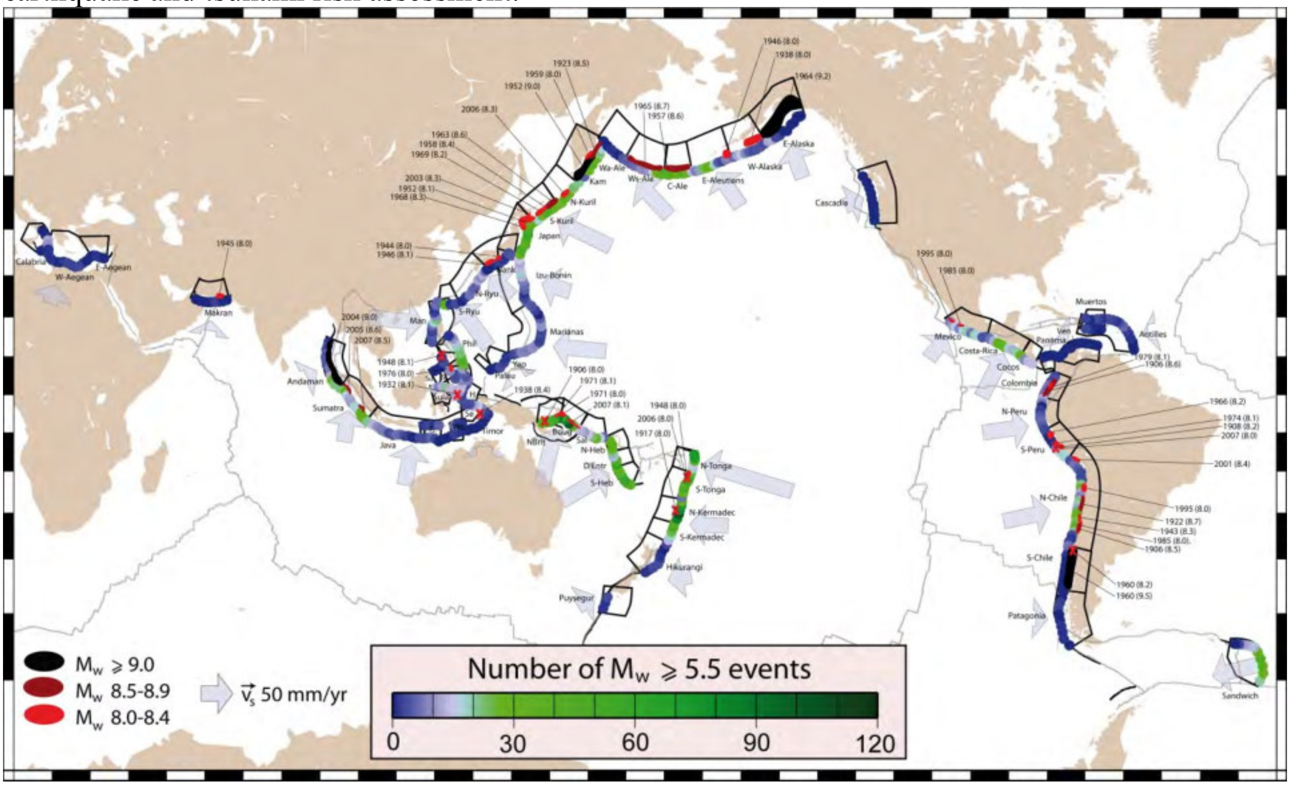


Figure 1: *Map of the subduction interface seismicity and trenches segmentation as in Heuret et al., 2011. The rupture area of the Mw ≥ 8.0 subduction interface events (1900-2007) is represented by red to black ellipses. The rupture areas are taken from McCann et al., [1979], Kanamori [1986], Schwartz et al. [1989], Byrne et al. [1992], Tichelaar and Ruff [1993], Johnson et al. [1994], Ishii et al. [2005], Fedotov et al. [2007], Ruppert et al. [2007], Bilek [2009]. The location of the events for which rupture area is not available is represented by a red cross. The number of Mw ≥ 5.5 subduction interface events (1976-2007) is represented for each 1° transect by a coloured dot. Subduction velocities [Heuret, 2005] are represented by blue arrows.*

Despite first order similarities between convergent margins, the distribution of interplate seismic activity on different subduction zones is considerably diverse: some regions are characterized by the occurrence of mega-earthquakes while others show only minor seismic activity, with moderate-sized events (Figure 1). Determining the causes of this variability is extremely challenging for both scientific and societal reasons. While essential features characterizing the behavior of the subduction thrust faults are known, it is still difficult to merge them in a single, comprehensive picture. This is mainly related to the lack of direct observables (i.e. subduction thrust faults are not readily accessible developing in the deeper crust, in the offshore domain) and to a short (i.e. limited to the last century) time-span of modern instrumental measurements. Piecing together 'snapshots' from different subduction zones can lead to the only possible unifying picture in which the crustal deformation seems to be controlled by both the short-term (years) elastic and long-term (decades and centuries) viscous behaviour of the mantle (Figure 2). Hence, the traditional "seismological" view of interplate seismicity based only on elastic models, such as coseismic deformation mirroring the interseismic phase, needs to be thoroughly revised.

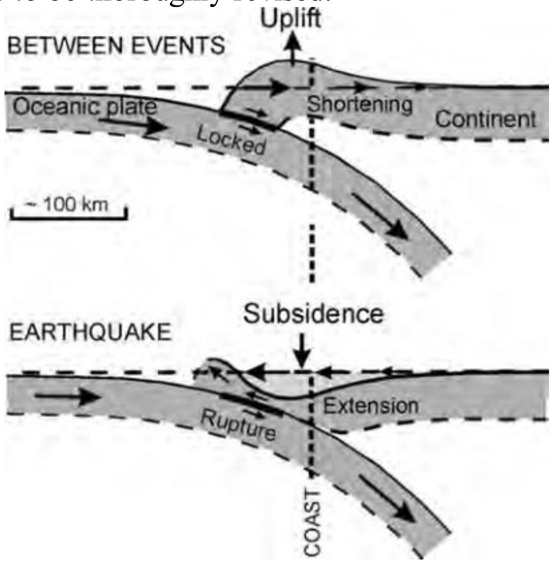


Figure 2: *Schematic diagram illustrating interseismic and coseismic deformation associated with a subduction thrust fault (drawn by R. Hyndman).*

This talk will focus on subduction megaearthquakes, emphasizing what is already known, what is still unknown and the new ideas are recently coming out, mainly thanks to the occurrence of the recent events (Sumatra, Chile, Tohoku-oki). We will first analyze the distribution of interplate events as respect to the plate tectonics picture, trying to merge the long-term engine of the system (i.e, the subduction) to the short-term observables (i.e., interplate earthquake). Afterward, an overview will be presented on behavior of the subduction thrust fault, with specific focus of what happened during the 2011 Tohoku-oki event. Finally, it will be highlighted how the future of this study requires an interdisciplinary and coordinated research effort. In particular, it will be shown how seismological and geological data can be successfully interpreted using modeling results. Modeling strategies – both numerical and analog - indeed represent invaluable tools to unravel the behavior of the subduction thrust fault, being able to bridge the gap between large- and short temporal and spatial scales (i.e. subduction scale vs. earthquake scale) and, in turn, to overcome the limitation related to the short time-span of modern instrumental measurements.

Claudie Le Divenah

Teacher in physics and chemistry
CLIL teacher in English
Lycée Emilie de Breteuil
Montigny le Bretonneux (FRANCE)

Email: cledivenah@gmail.com
School website: http://www.lyc-breteuil-montigny.ac-versailles.fr

Career: After the exam to be a teacher in 2004, I took position in my current school.

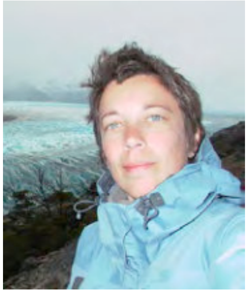
2012 Awarded at the GIFT symposium during the EGU, Vienna, Austria
A project on water and a different way to teach it

Education

1998-2003 Master of Engineering Chemistry, specialty Analyzing methods, Ecole Nationale Supérieure de Chimie de Rennes (ENSCR)

Mars – August 2003 : Research internship at the Marinbiologisk Laboratorium, Helsingør, **Danemark,** preparation and study of a 2D-pHmeter to analyze sediments.

May – August 2002 : Research internship at the IFREMER (French marine research institute) in Brest, France; Oceanographical mission to study black smokers on the East rift of the pacific ocean (next to Mexico) : autonomous pH metric measurements in extreme environment.



Aurélie Van Toer

Engineer at C.E.A. (Alternative Energies and Atomic Energy Commission)
Laboratoire des Sciences du Climat et de l'Environnement (L.S.C.E.)
Gif sur Yvette, France
Email: aurelie.vantoer@lsce.ipsl.fr
http://www.lsce.ipsl.fr /
http://www.lsce.ipsl.fr/Phocea/Pisp/index.php?nom=aurelie.vantoer

Career: **Since 2005, engineer at L.S.C.E.**

2004-2005 : Preparation of planktonic foraminifera samples for ^{14}C dating.

Education

2003-2004 : Research internship at EPOC, University Bordeaux 1. "Study of the recent sedimentation in the Gulf of Oman".

1997-2003 : Master of "Oceanic and Costal Environments and Palaeoenvironments", University of Bordeaux 1.
January-June 2003 : Research internship at EPOC, University Bordeaux 1. "Study of the palaeoclimatic variations of the Marine Isotopic Stage 11"

Technical skills

Micropalaeontology : Planktonic and benthic foraminifera
Sedimentology: grain-size measurements

Marine sediments in the classroom

Claudie Le Divenah and Aurélie Van Toer

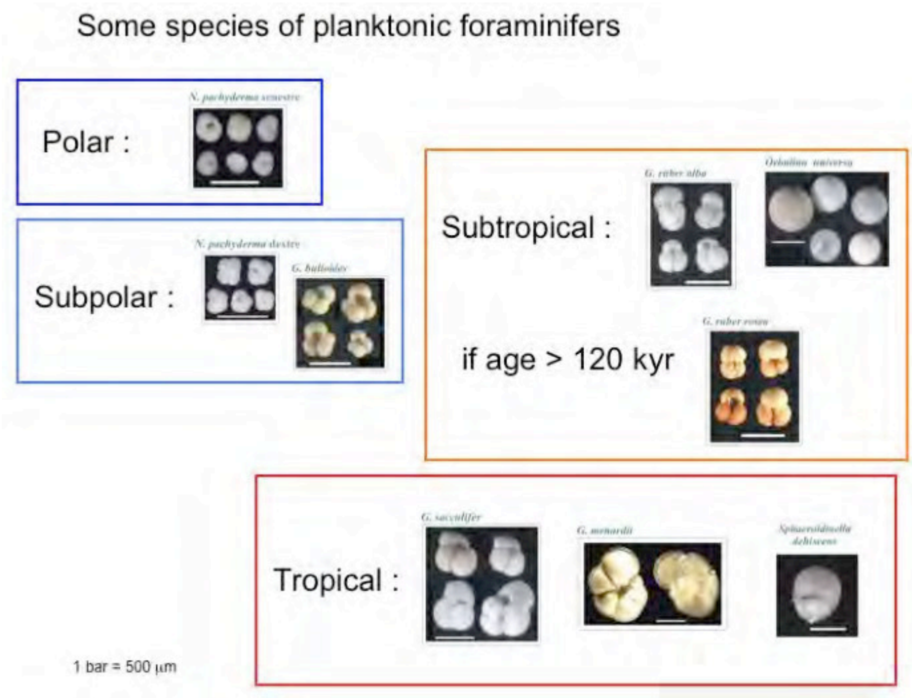
School program with EGU-IPEV-LSCE-Académie de Versailles

In the present context of global climatic change, studies of the past natural climate variability is critical for the knowledge of the Earth climate mechanism. One of the major climatic reservoirs is the ocean which covers more than 70% of the surface of the earth. It exchanges moisture and heat with the atmosphere and plays an important role in the climatic changes at different latitudes. The marine sediments are therefore archives of past oceanographic/climatic changes. These marine sediments are collected as long cores penetrating into the sediment and therefore giving access to the progressive climatic changes with time.

Marine sediments are classically composed of skeletons of micro-organisms and of the terrigenous fraction. The main micro-organisms used as tracers of paleoclimatic changes are foraminifera. Their species change with the properties of the water mass in which they live (in particular temperature and salinity). With the aim of showing the students in a classroom how to recognize these species and to reconstruct past oceanographic changes, part of the sediments taken during different cruises in different oceanic basins have been reserved for high school teachers.

We will present here the type of sediments available and the type of analysis/observations that can be made in a classroom. We will show how to perform the preparation of the samples and what are the possible observations through a binocular microscope. The students will then be able to extract information from their own observation about climate: its variations over time and through the differences between the areas of coring operations.

In order to allow this activity to be introduced into your class, a program of distribution of these marine sediments will be proposed and will be presented. A registration form will be given during this presentation. A limited number of proposals will be accepted and a report of their activity in the classroom will be mandatory a few months after the distribution of samples.



BERENGUER Jean-Luc
International School
Valbonne Sophia Antipolis, France

TILQUIN François
Lycée Marie CURIE
ECHIROLLES cedex
FRANCE

BERENGUER Jean-Luc

I currently teach biology and geology at International School in Valbonne Sophia Antipolis, on the French Riviera near Nice. In the past, I also worked in a few french schools in Canada, Germany and Portugal before coming back to France.

When not in the classroom, I'm a coordinator for an educational seismological network in France called 'sismometers at school'. Indead, working on seismometers in schools gives students (12-17 years old) more motivation and a better opportunity to focus on natural hazards knowledge as well as the use of real time databases.

I am member of the Committee of Education of EGU. I am also involved in the International Earth Science Olympiads in my country and I supervise, in my regional area, the teachers' training program in geosciences. It is the reason why I am working with scientists from Geoazur (CNRS) located in Sophia Antipolis in South of France.

I try to make my students or my colleagues realize how important more investigation, more field tools, more data use in science teaching are. I involve my students in field schoolwork and in network databases. I am really looking forward to bringing more authentic science to my students.

TILQUIN François

I am a biology and geology teacher in a high school near Grenoble. My students are 15 -18 years old.

I am the author of various teaching software and pedagogical applications: data acquisition with interface, simulations, numerical and analogical modeling in biology and geology.

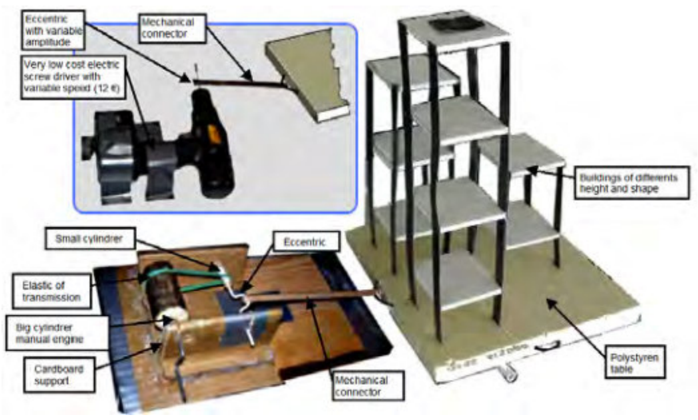
Even if it is more difficult, I always prefer that every pupil makes the manipulations by themselves, and test the hypothesis, than the professor makes the demonstration himself.

In France, we are lucky enough to have practical class with reduced number of students, and we dispose enough experimental material for the individual manipulations.

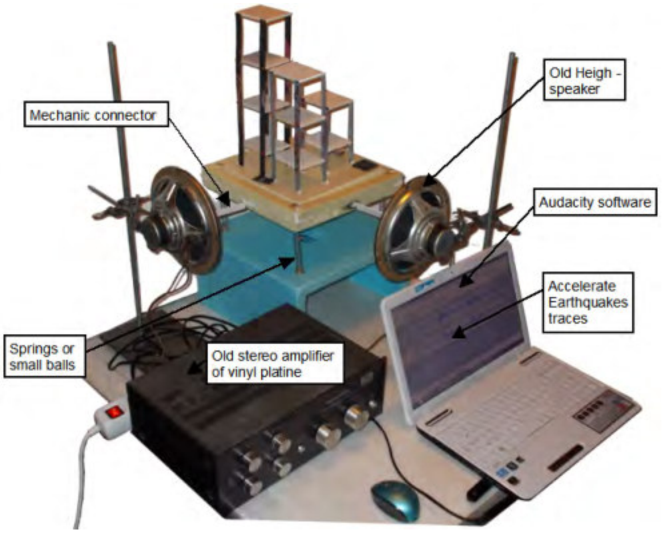
Every time it is possible, I try to adapt scientific experiments to the class, with some simplifications, and with the advice of the searchers who are always very interested by this transfer of their knowledge. It is a very interesting goal of teaching.

PEDAGOGICAL SHAKE TABLES : simple study of BUILDING'S resonance and earthquake resistance in the classroom. (francois.tilquin@ac-grenoble.fr)

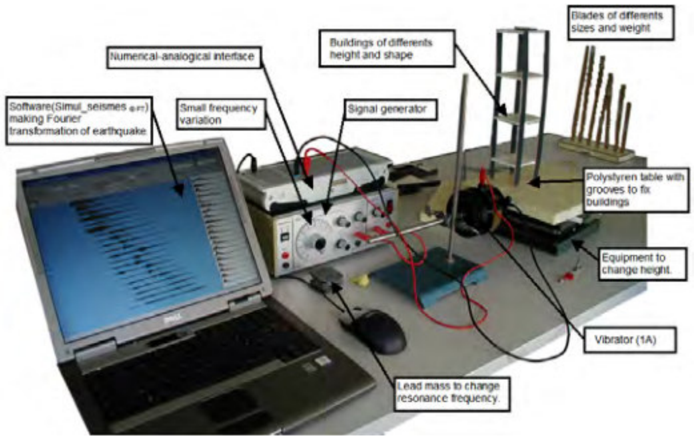
These experiments simulate seismic vibrations on very simple plastic buildings, more or less good built, with or without bearing walls or fundations, chaining or not, put on rolling fundations.
It is possible to study resonance of differents various height buildings, resonance of the ground as alluvions valley, in using differents vibrations systems.
It simulates also ground's liquefaction with vibrations applied on a bac containing some wet sand and a heavy building above. The system shows main problems of earthquakes, and solutions to protect against it.



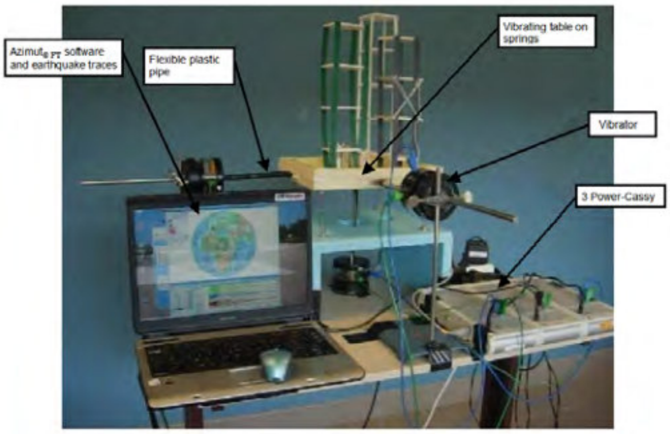
The lower cost shake table (from 0 € to 12 €): only sinusoïde vibrations



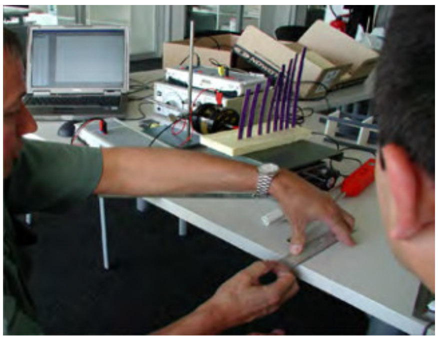
The shake table built with an old stereo equipment (sinusoïde and earthquakes traces).



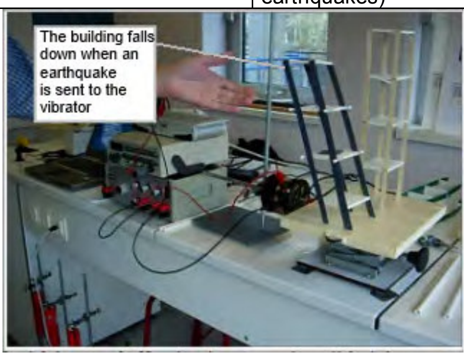
The first peagogical shake table presented at Science on stage nov. 2005 (sinusoïde and earthquakes)



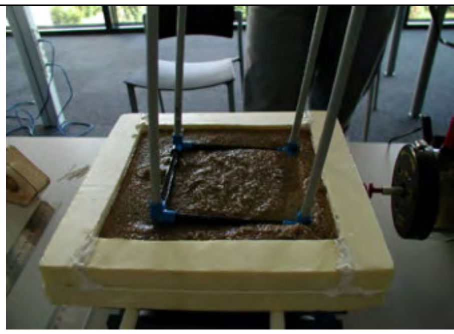
The 3D pedagogical shake table (sinusoïde and earthquakes)



Studying the resonance with rule and microphone



Falling down of the building.



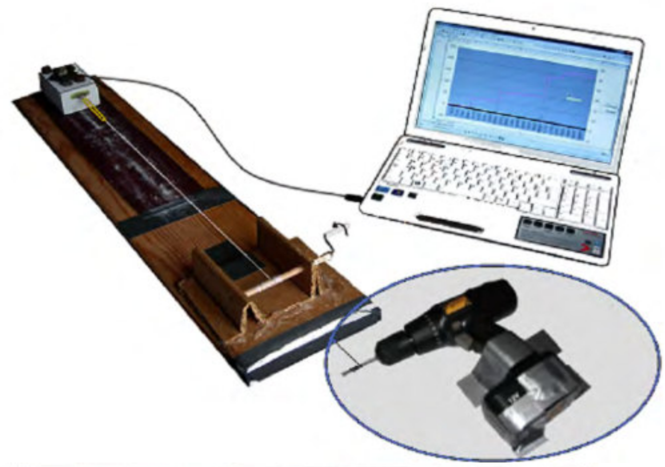
Ground liquefaction

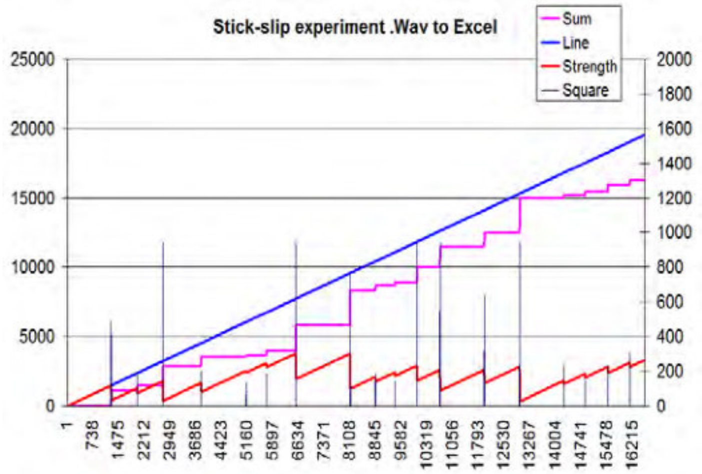
http://www.ac-grenoble.fr/webcurie/sismo/web_patin

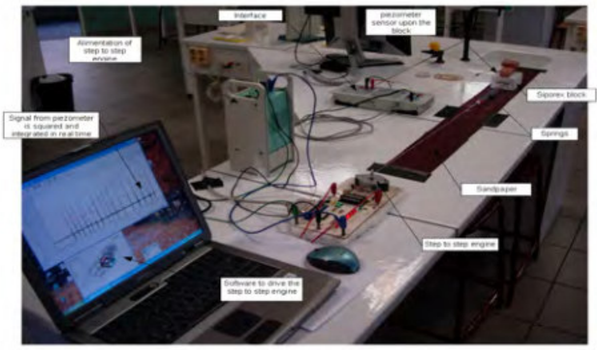
Scientists which help us: François Thouvenot (LGIT), Julien Frechet (CNRS Strasbourg), Françoise Courboulex (CNRS Nice)

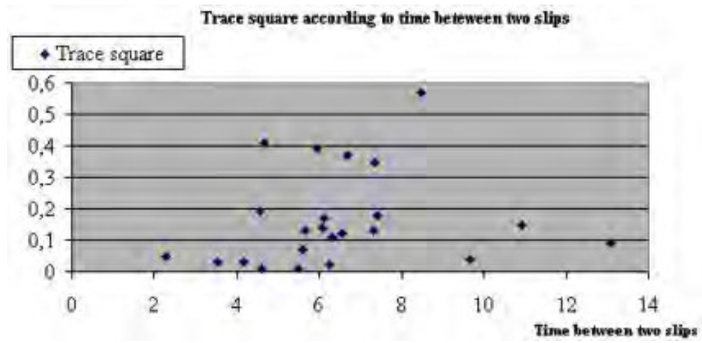
SPRING-SLIDER BLOCK MODEL experiment in classroom
Is it possible to predict earthquakes ?

This classical experiment in earth science is possible in classroom after simplification: only one block, and one spring. The material consist in a block of cellular concrete, a very low cost electric perforator-screw-driver (12 €), or manual crank, a computer with sound card to record signal from the piezometer and the Audacity software to record or read sounds. You need also Excel or Openoffice and the free software **Sismo-logic**© FT 2012 wich set Audacity correct parameters automatically, and converts .wav files into excel file, with following calculations: square of signal (Energy), somme of it, regression line to have the energy spent by the engine, and evaluate strength.
It is also possible to use two piezometric sensors, one for the block, and the other for the sudent, who hits it when he supposes the block is going to slip.
This experiment can be simplified at most by locating, with a pencil, the various positions of the block.



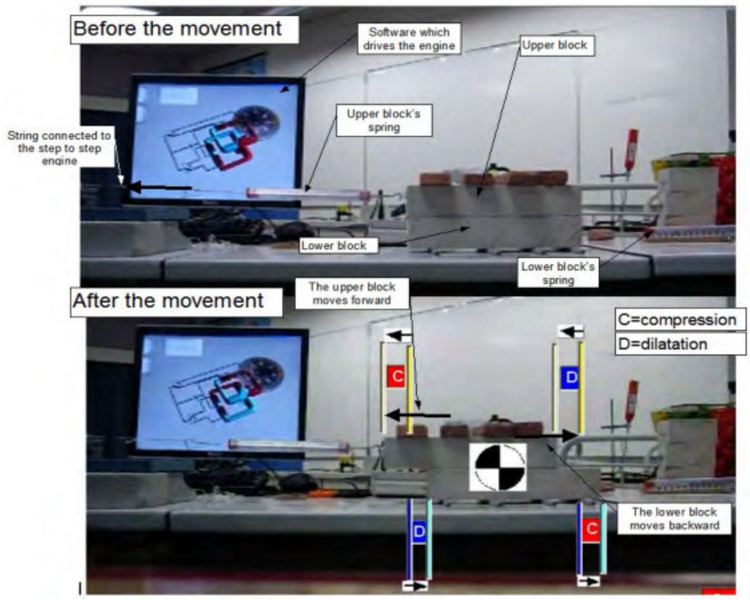






Differents other Excel treatements shows that there is no visible correlations between the magnitude and the time between 2 slippings, or no real visible regularity of sliping.

Movements on both sides of a fault
We also do a very similar experiment with 2 springs and 2 blocks, one upon the other to understand a little better, fault mechanism.
The upper block is pulled by the step to step engine until the rupture: the 2 blocks move in an opposite way (pull by the 2 springs) and make a compression in front of the movement and a depression behind it. It helps to understand the constraints ellipsoïd representation. A little freeware allows to understand that it exists 2 hypothesis about the fault direction when the ellipsoïd constraints representation is done.



http://www.ac-grenoble.fr/webcurie/sismo/web_patin

AZIMUT© FT 12/2011 **free software**

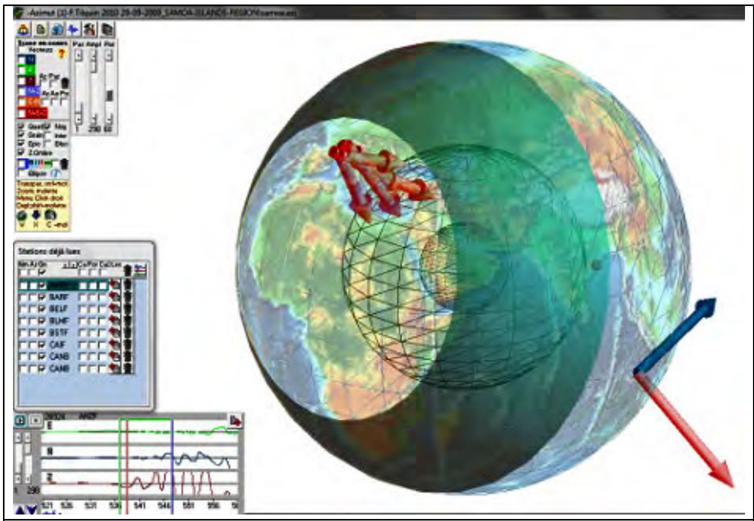
(Lycée Marie Curie- Echirolles Académie de GRENOBLE)

Goals: The software shows the 3D ground movments from the 3 components earthquake stations. The software shows ground speed vector, P, S and L waves, and the vector extremity with small balls. Epicenter can be found also with tools wich uses the vector extremity and the user decides the best direction.

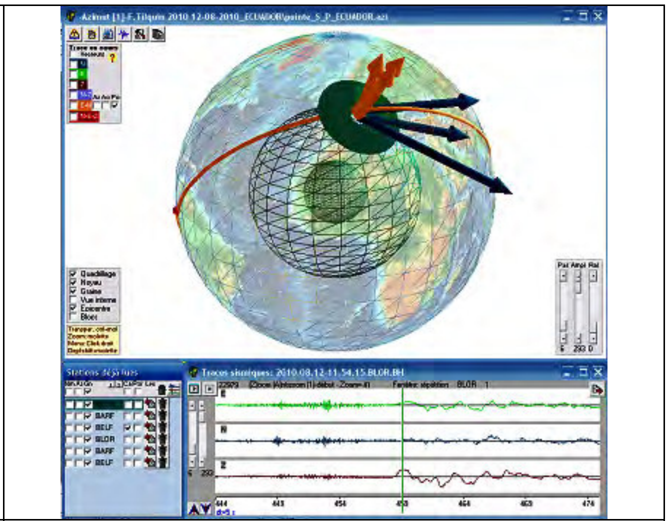
Why do japan earthquake pushed us, althow japan went on the pacific ocean for few meters?

Samoa eathquake pull us: why?

This software is also able to record movements of USB accelerometer and is able to drive 1-3 Cassy interface(s) for a shake table.

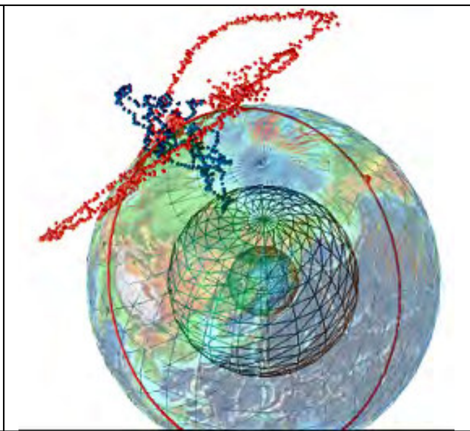


First ground movement: temporary depression (Samoa)

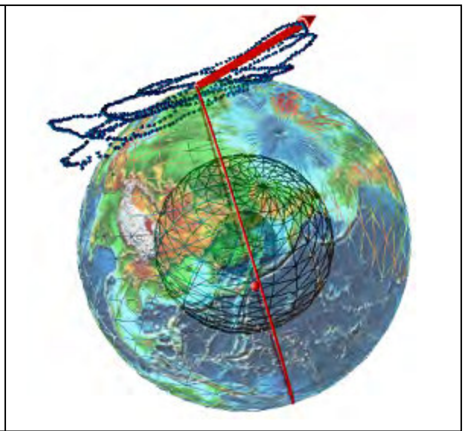


Perpendicularity of P-wave and S-wave. 1st arc pointed.

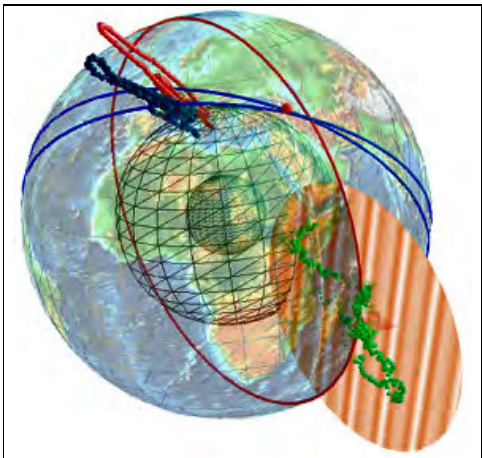
Azimut and ground compression movement : Japon (1st arc)



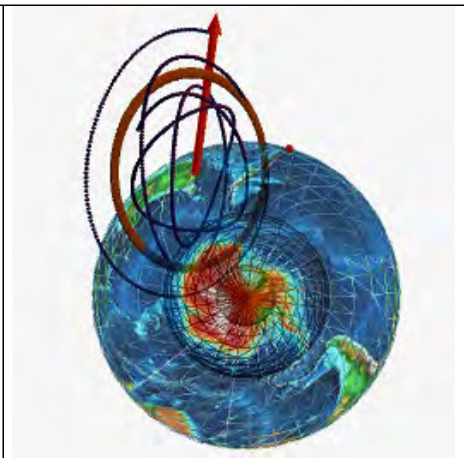
Perpendicularity of P-S waves (Vector extremity during few sec)



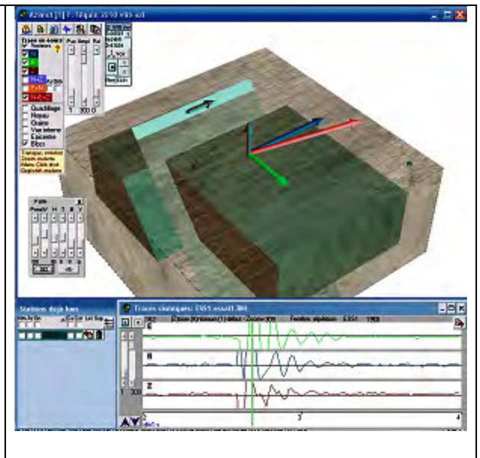
Love wave :S-wave horizontal and perpendiculary to azimut.



Epicenter determination with 3 azimuts of P-wave during 10 s.



Ellipticity of Rayleigh wave (P-wave perpendic with surface and azimutal)



Acquisition of trace from a USB accelerometer.

Scientists Pierre-Yves BARD (*Searcher IFSTTAR*), Michel CARA (*CNRS BCSF Strasbourg*), Françoise COURBOULEX (*CNRS UMR Geoazur, Valbonne*), François THOUVENOT (*CNRS LGIT Grenoble*).

Download software : http://www.ac-grenoble.fr/webcurie/sismo/web_patin

Prof. Franco Barberi

University of Roma 3
Roma, Italy

Professor of volcanology first at the University of Pisa and then at the University of Roma Tre, retired since 2010. He has been the founder and president of the Italian Geodynamics Project and of the Italian National Group of Volcanology, Vice-President of the International Association of Volcanology and Chemistry of the Earth Interior (IAVCEI), chairman of the IAVCEI Commission for the Mitigation of Volcanic Disaster, chairman of the ESF Project on European Laboratory Volcanoes, chairman of the Volcanic Risk Section of the High-Risk Commission of the Italian Civil Protection, Editor of the Bulletin of Volcanology. He has been also deputy-minister for Civil Protection in the Italian government.

He carried out researches on volcanic hazards at all Italian active volcanoes and on many other volcanoes in Central and South America, East Africa and Indonesia. He also participated to many exploration projects on geothermal energy. He is author or co-author of more than 200 scientific paper mostly published in international journals.

He received the Wager prize of IAVCEI, the Sasakawa-UNDRO Price, the Soloviev Medal of the European Geophysical Society for his researches on volcanology and on mitigation of natural hazards.

Risk assessment of Vesuvius volcano

Franco Barberi

Department of Geological Sciences, University of Rome Tre, Italy

Since 1944 Vesuvius volcano is in a quiescent state whose duration cannot be assessed. On the basis of the past activity of the volcano, a sub-Plinian event, similar to that occurred in 1631, has been selected as a likely reference eruption for the Vesuvius preparedness plan for the protection of the exposed people. Main hazards are related to: pre-eruption earthquakes, ash fallout, pyroclastic flows, lahar. The risk associated to each of these phenomena has been evaluated by combining hazard data (e.g. earthquake magnitude and depth; eruption column height, discharged ash mass, dominant wind direction; extension of pyroclastic flows and lahar) with vulnerability of the exposed buildings. Results are impressive. Earthquakes of the pre-eruption unrest phase may cause the total or partial collapse of up to 16,000 buildings, with hundreds of deaths, thousands of injured people, and up to 80,000 homeless (data from Plinivus Center, University of Naples). In addition the ruins of collapsed buildings may compromise the practicability of most escape roads to be used for the evacuation of the population most exposed to pyroclastic flows. Ash fallout from a 18 km height eruption column with total discharged mass of $5x10^{11}$kg, may cause tens of thousands of roof collapses, involving up to 410,000 people according to the wind direction, which unfortunately cannot be assessed in advance. The zone exposed to pyroclastic flows, where the probability of survival is very low and should then be totally evacuated before the eruption onset, includes 18 municipalities with 550,000 residents. Additional thousands of people are exposed to lahar risk. With such a severe risk scenario, the emergency management of a Vesuvius eruptive crisis appears very difficult and would require a close cooperation among local and national authorities, permanent education and training of the exposed population and the urgent promotion of structural risk reduction interventions (e.g. reduction of seismic vulnerability of buildings at least along the evacuation paths; roof reinforcement in the zones most exposed to ash fallout).

Hélène Hébert
Laboratoire de Détection et de Géophysique
Département Analyse Surveillance Environnement
CEA
91297 Arpajon Cedex
FRANCE

helene.hebert@cea.fr

Position
since 1999: tsunami scientist in CEA, France.

Education
1994: Engineering degree in Geophysics (EOST, Strasbourg) – Monitoring of mining induced seismicity in France
1998: PhD in Geophysics (IPGP, Paris) – Geophysical imagery of a fossil and a nascent oceanic spreading ridge (Gulf of Aden and NE Indian Ocean)
2012: HDR (*Habilitation à Diriger des Recherches*) in Geophysics (Université Paris Diderot) – Numerical modeling of tsunamis, from hazard assessment towards operational issues

Activities
My first interests in geosciences (PhD) dealt with the study of seafloor spreading ridges on young (Gulf of Aden) and fossil spreading structures (Wharton Basin, NE Indian Ocean).
During a postoctoral stay in CEA I began to work on tsunami modeling, a matter that requires to handle seismological and bathymetric data. Since then I have been working as a research engineer in CEA on tsunami hazard, first in French Polynesia, especially on the Marquesas Islands that are particularly exposed to trans-Pacific tsunamis, and more recently on the Mediterranean and Atlantic context. Today, since July 2012, my institute CEA is in charge of the French Tsunami Warning Center established close to Paris, and as such, receives and processes real-time seismic and sea level data in order to disseminate warning messages to French authorities, in less than 15 minutes once a tsunamigenic earthquake has occurred.
In this context, I am involved in engineering activites (assessment of tsunami hazard for coastal facilities) as well as fundamental studies (discussion on historical and recent earthquakes using tsunami data). Our modeling codes have recently been adapted towards operational warning for the western Mediterranean Sea.

Recent scientific publications
Allgeyer, S., C. Daubord, **H. Hébert**, A. Loevenbruck, F. Schindelé, R. Madariaga, Could a 1755-like tsunami reach the French Atlantic coastline? accepted in *Pure and applied Geophysics*.
Hébert, H., D. Reymond, Y. Krien, J. Vergoz, F. Schindelé, J. Roger et A. Loevenbruck : The 15 August 2007 Peru earthquake and tsunami: influence of the source characteristics on the tsunami heights, Pure and Applied Geophysics, 166, 1-22, 2009.
Hébert, H., P.-E. Burg, S. Allgeyer, R. Binet, F. Lavigne et F. Schindelé, The 17 July 2006 tsunami in Java (Indonesia) studied from satellite imagery and numerical modelling, accepted in *Geophysical Journal International*.
Labbé, M., C. Donnadieu, C. Daubord, et **H. Hébert,** Refined numerical modeling of the 1979 tsunami in Nice (French Riviera): comparison with coastal data, Journal of Geophysical Research, 117, F01008, doi:10.1029/2011JF001964, 2012.
Roger, J., M.A. Baptista, A. Sahal, F. Accary, S. Allgeyer, **H. Hébert**, The transoceanic 1755 Lisbon tsunami in Martinique, Pure and Applied Geophysics, 168, 1015-1031, 2011a.
Roger, J., **H. Hébert** , J.-C. Ruegg, et P. Briole, The El Asnam October 10th, 1980 inland earthquake: a new hypothesis of tsunami generation, *Geophysical Journal International*, 185, 1135-1146, 2011b.

Tsunami hazard assessment: what did we learn since 2004 and 2011?
EGU 2013 GIFT workshop

Hélène Hébert
CEA, DAM, DIF, DASE
Arpajon, FRANCE
helene.hebert@cea.fr

The perception of the tsunami phenomenon has considerably grown since the last catastrophes in the Indian and Pacific oceans. But since the 1960's, tsunami scientists had already developed various techniques to study processes and hazards related to tsunamis. One of the preferred tools is the numerical modeling, able to provide elements to understand the source mechanisms, the propagation of waves, and to improve risk prevention.

The most devastating tsunamis, able to provoke great damage at far distances from their source, are related to the largest submarine earthquakes, those occurring at subduction zones (as in 2004 and 2011). Tsunamis related to landslide sources (e.g. volcanoes, submarine landslides) are devastating close to the source, but their shorter wavelengths (compared to tsunamis related to earthquakes) do not imply comparable damage at distances.

The modeling methods allow accounting for the coseismic deformation of the large earthquakes generating tsunamis, with the help of commonly used elastic dislocations models. Then the propagation of the tsunami waves is modelled through a non linear finite difference method solving the hydrodynamic equations under a shallow water assumption. The method takes into account several levels of imbricated bathymetric grids to focus on the studied site and to ensure a proper model of the shoaling effect (**Figure 1**). Eventually inundations are modeled onshore, provided fine topographic data are available. Various applications will be shown, either in the Pacific Ocean (French Polynesia), the Indian Ocean or in the Euro-Mediterranean region.

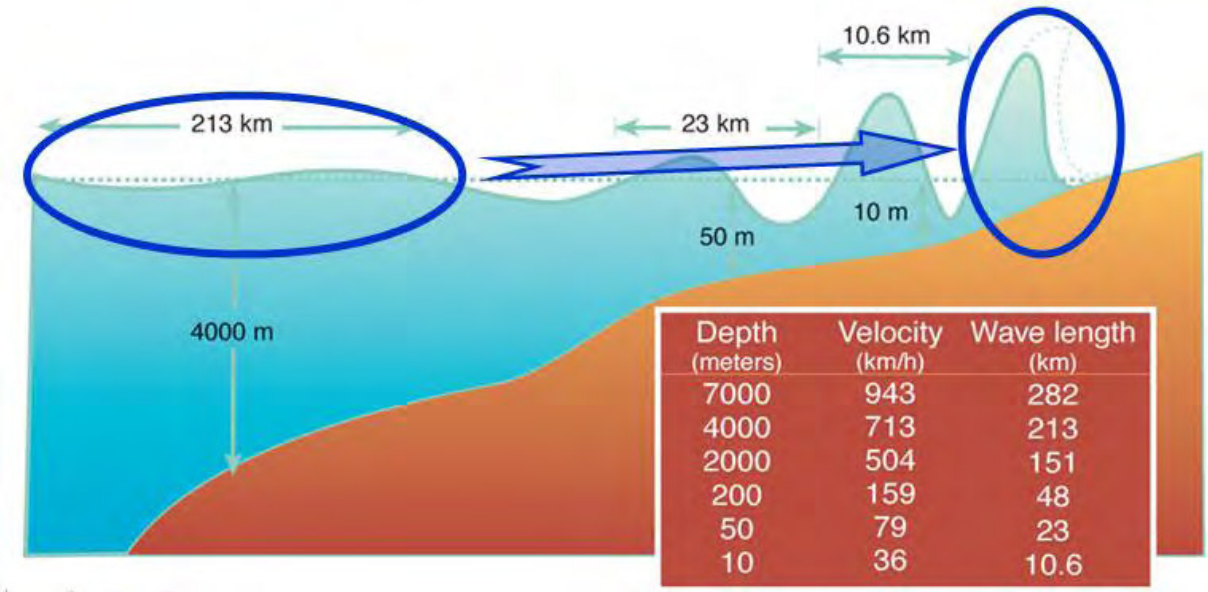


Figure 1: The shoaling effect for tsunamis: the decrease of the celerity implies the increase of water heights, leading to the actual tsunami amplification onshore

French Polynesia is located at a central location in the Pacific Ocean, where several large transoceanic tsunamis occur several times each century (1946, 1957, 1960, 2011 ..), usually after large earthquakes on the ring of fire. Depending on the coastal configurations, the impact of these tsunamis varies a lot. In Tahiti, an island surrounded by a limited lagoon and a small coral reef, the historical impacts are moderate, but sometimes with large inundation zones as in 1960. In the Marquesas Islands, more than 2000 km northeast to Tahiti, the high islands consist of old volcanic structures without any coral reef, and submarine slopes are smoother, favouring more substantial tsunami amplifications. Indeed, several bays and harbours in the Marquesas have been heavily inundated in 1946 and 1960, the latter causing 2 casualties in Hiva Oa. Tsunami modeling results allow developing Risk Prevention Plans, which are complementary to Tsunami Warning Systems in place since the 1960's in the Pacific Ocean, and in Tahiti in particular,

A classical result of the modeling is to display the maximum water heights spread over the ocean, highlighting the areas at risk, which are theoretically located in the perpendicular direction to the origin fault (example of the 2011 Tohoku tsunami, **Figure 2**).

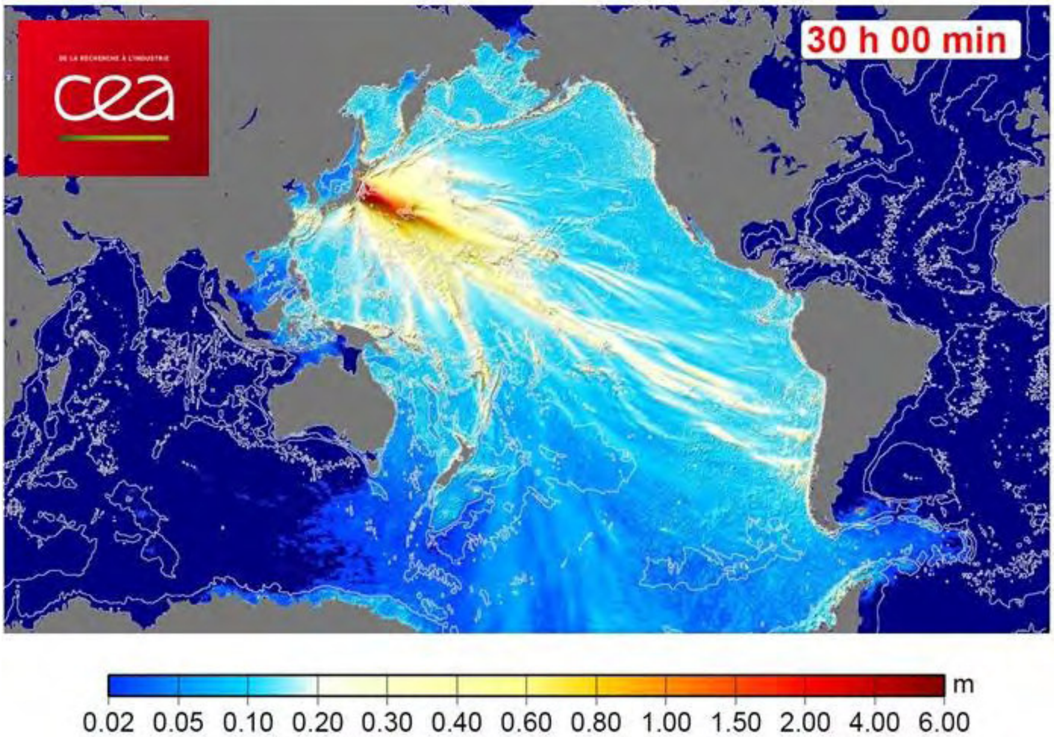


Figure 2: Maximum water heights spread over the Pacific Ocean after the 2011 Tohoku tsunami

The onshore computed inundation levels also depend on several source parameters (the earthquake magnitude and focal mechanism mostly), that must be accounted for in the frame of a real-time alert system. This early seismological assessment is a key part of any warning system, which relies, first, on seismological networks, second, on the sea level measurements to process possible tsunami signals, and third, on automatic systems to disseminate warning messages. Since the 2004 tsunami, an international effort, under the auspices of IOC/Unesco has put forward the necessity of warning systems in all the oceans that were deprived of. This also includes the Euro-Mediterranean area where historical events are well known, from the 1755 Lisbon earthquake and tsunami in the NE Atlantic Ocean (**Figure 3**), to large tsunamis having occurred in the Hellenic Trench (e.g. 365 in Crete). The French Tsunami Warning Center (CENALT) has been operating since July 2012 and is responsible, for French authorities, for the tsunami watch in the western Mediterranean and North-eastern Atlantic. In the international cooperation set up for the NEAMTWS (NE Atlantic and Mediterranean Tsunami Warning System), this center is also a candidate Tsunami Watch Provider to disseminate international messages to any state which applies to the service.

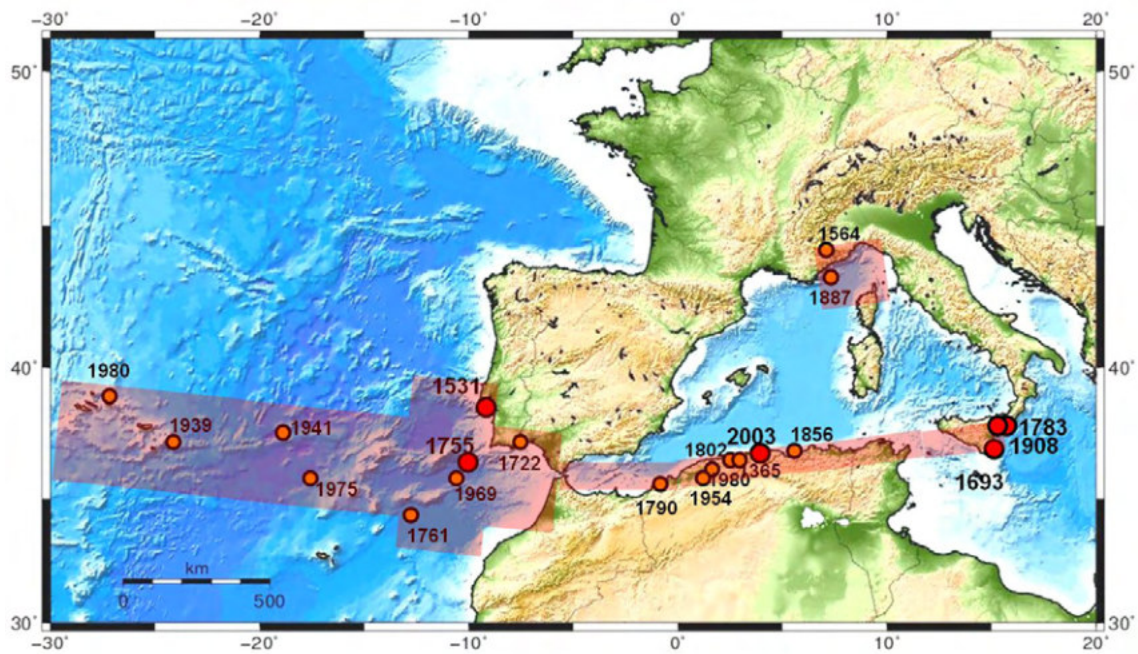


Figure 3: Historical tsunamis in the western Mediterranean and NE Atlantic Ocean, including the famous 1755 Lisbon tsunami, and the recent 2003 Boumerdès event.

Bruce D. Malamud

Department of Geography

King’s College

London, Great Britain

Bruce D. Malamud (PhD) is a Reader in Natural & Environmental Hazards. His main research and publication areas include wildfires, floods, earthquakes, landslides & heavy-metal contamination of water, crops and soil. Underlying subthemes of his research include time-series analyses, risk, and the comparison of models with data in the broad environmental sciences. He has over 50 peer-review journal articles, conference proceedings and chapters in books, including 1st author publications in *Earth and Planetary Science Letters*, *Earth Surface Processes and Landforms*, *Journal of Geophysical Research*, *Proceedings of National Academy of Sciences*, and *Science*. Currently there are >2,200 citations to his publications. He has been PI on ESA, NERC, EPSRC, and EC grants, served as chief editor of Nonlinear Processes in Geophysics, President of the Natural Hazards Division of the European Geosciences Union (EGU), Chair of the EGU General Assembly 2010 and 2011 Programme Committee, and member of the NERC peer-review college.

TRIGGERED LANDSLIDE EVENTS: STATISTICS, IMPLICATIONS AND ROAD NETWORK INTERACTIONS

Bruce D. Malamud
Department of Geography, King's College London, UK

Landslides are the movement downslope of material, such as soil, rocks and debris. The area of landslides range from m^2 to km^2 and the velocity they travel from slow (mm/year) to very fast (e.g., as fast as 80 km/hr for debris flows). Landslides are generally associated with a trigger, such as an earthquake, a rapid snowmelt or a large storm. In the hours to days following the trigger, anywhere from a single landslide up to many thousands can be generated. We call this a triggered landslide event, which is what will be examined in this talk. Four examples of landslides triggered by a snow-melt event (rapid temperature increase) that occurred in central Italy during January 1997 are given in **Figure 1**.

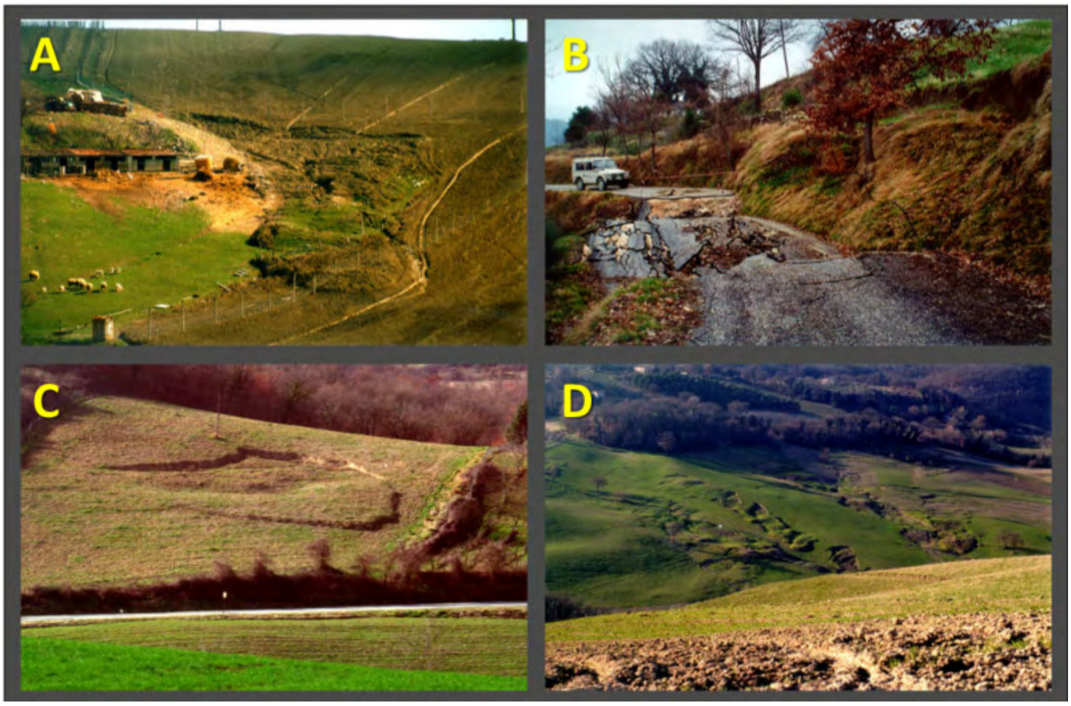


Figure 1. Four examples of landslides triggered by the January 1997 rapid snow-melting in Umbria. (A) To the right of the buildings can be seen a deep-seated slide (slump earth flow) of about 50 m × 180 m. (B) In the foreground, cutting across the paved road, can be seen part of a deep-seated slide (rotational) of about 30 m × 100 m. (C) On the slope can be seen a shallow slide (soil slip) of about 40 m × 40 m. (D) In the middle can be seen deep-seated slides (complex), with the largest (on the left) extending about 100 m × 250 m. Figure from Guzzetti et al. (2002).

Triggered landslide event inventories are the compilation, through air photos, remote sensing, and/or ground work, of the location and area of landslides that have occurred as a result of a trigger. An example of a landslide event inventory for the Umbria Snowmelt event in 1997 (over 4,000 landslides) is given in **Figure 2**.

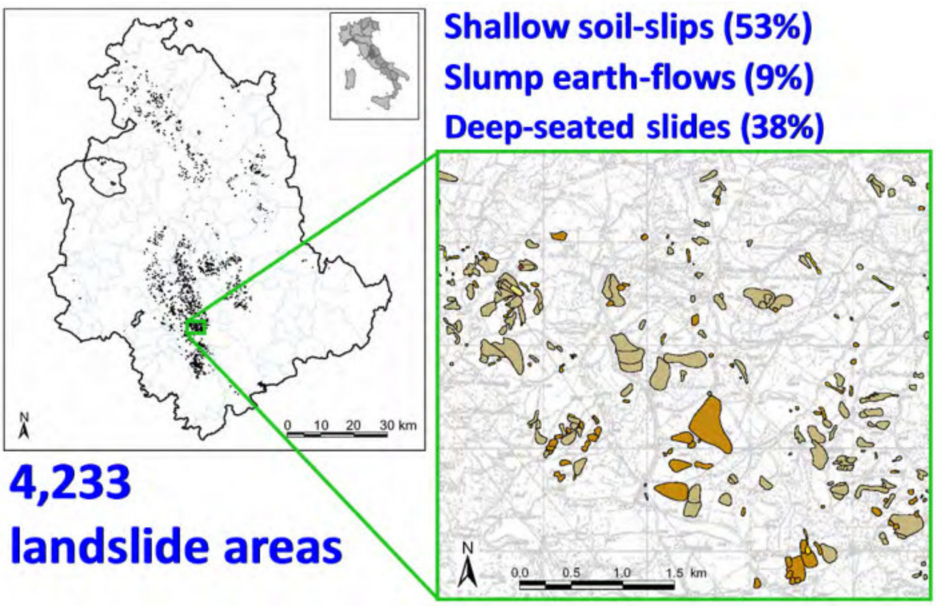


Figure 2. Spatial distribution of Umbria landslides triggered by rapid snow-melt in January 1997. (Left) Shown is the spatial location of 4233 landslides identified through the interpretation of 1:20 000 aerial photographs fown 3 months after the event. These aerial photographs, supplemented by field surveys, resulted in mapping being carried out at a scale of 1:10 000. (Right) An example of the results of detailed mapping of landslides. Figure from Guzzetti et al. (2002).

In addition to the Umbria Snowmelt event, we will examine two other triggered event inventories here (see **Figure 3**): (i) over 11,000 landslides areas triggered by a 1994 earthquake in California, and (ii) about 9,500 landslides triggered by heavy rainfall in Guatemala as the result of Hurricane Mitch in 1998.

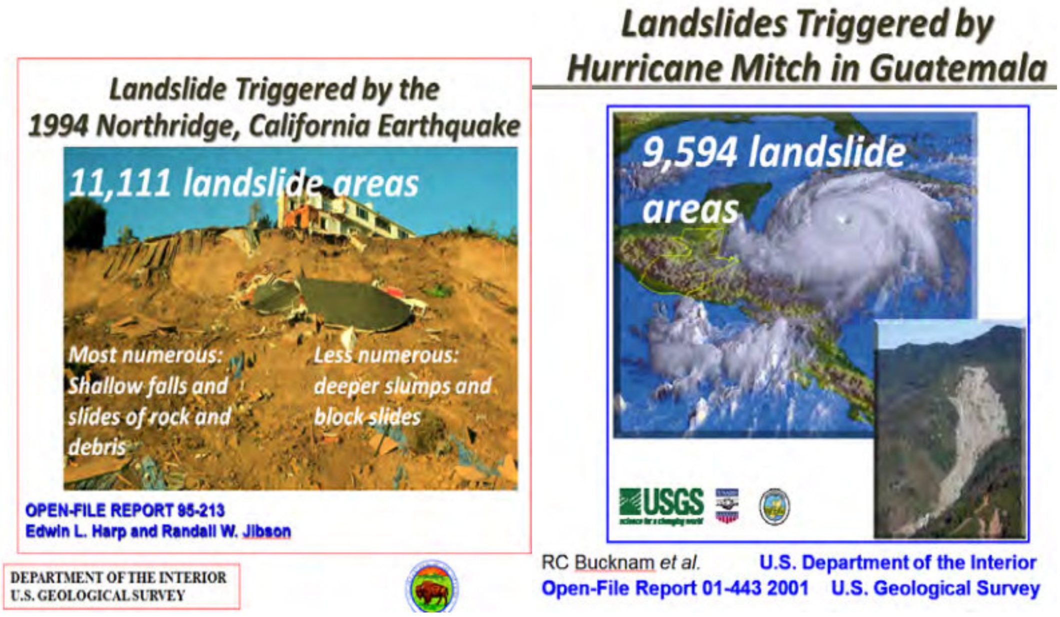


Figure 3. Two other triggered event landslide inventories considered in this paper: (Left) Northridge earthquake (California) triggered landslides in 1994. (Right) Hurricane Mitch (Guatemala) triggered landslides in 1998.

There are many ways to study natural hazard processes (in this case, landslides), including examining them spatially, what happens to them temporally, the physical processes involved, the policy actors surrounding them, and issues such as communications. Here we examine what we can learn by examining the ***statistical population*** of the landslide areas or volumes in a triggered landslide event, i.e. what is the relative numbers of small, medium, large, and very large landslides that occur in the event. The probability of the distributions for these three triggered event inventories is given in **Figure 4**.

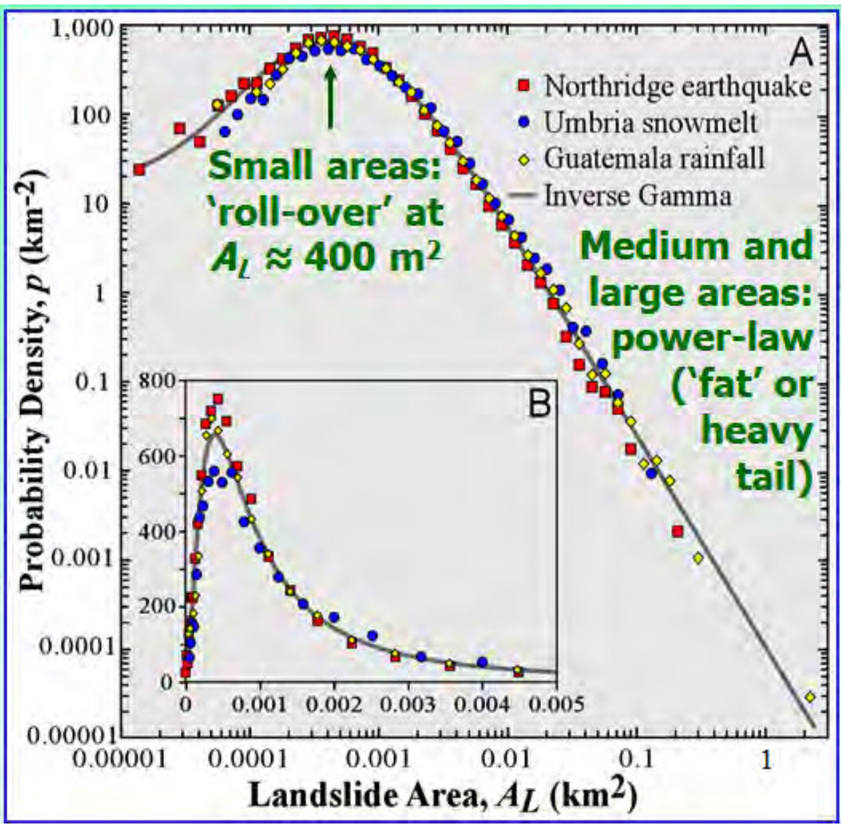


Figure 4. Dependence of landslide probability densities p on landslide area A_L, for three landslide inventories discussed in this talk: January 1994 Northridge earthquake in California, USA; January 1997 snowmelt event in the Umbria region of Italy; heavy rainfall from Hurricane Mitch in Guatemala in late October and early November 1998. Probability densities are given on logarithmic axes (A) and linear axes (B). Also included is the proposed landslide probability distribution. This is the best fit to the three landslide inventories of the three-parameter inverse-gamma distribution, which is an exponential distribution for small landslide areas and a power-law for medium and large areas. Figure from Malamud et al. (2004).

There are a number of implications of having the 'same' general probability distribution for triggered landslide event areas, including:

- Average landslide area in a triggered event will be the same.
- We can determine the total area of landslides in a triggered event from total number of landslides.
- We can make estimates of erosion due to triggered event.
- A quick 'Assessment' of triggered landslide numbers can be made by using largest areas.
- One can use this statistical distribution to explore, via a computer grid-based model, the probability of landslides interacting with road networks (see **Figure 5**).

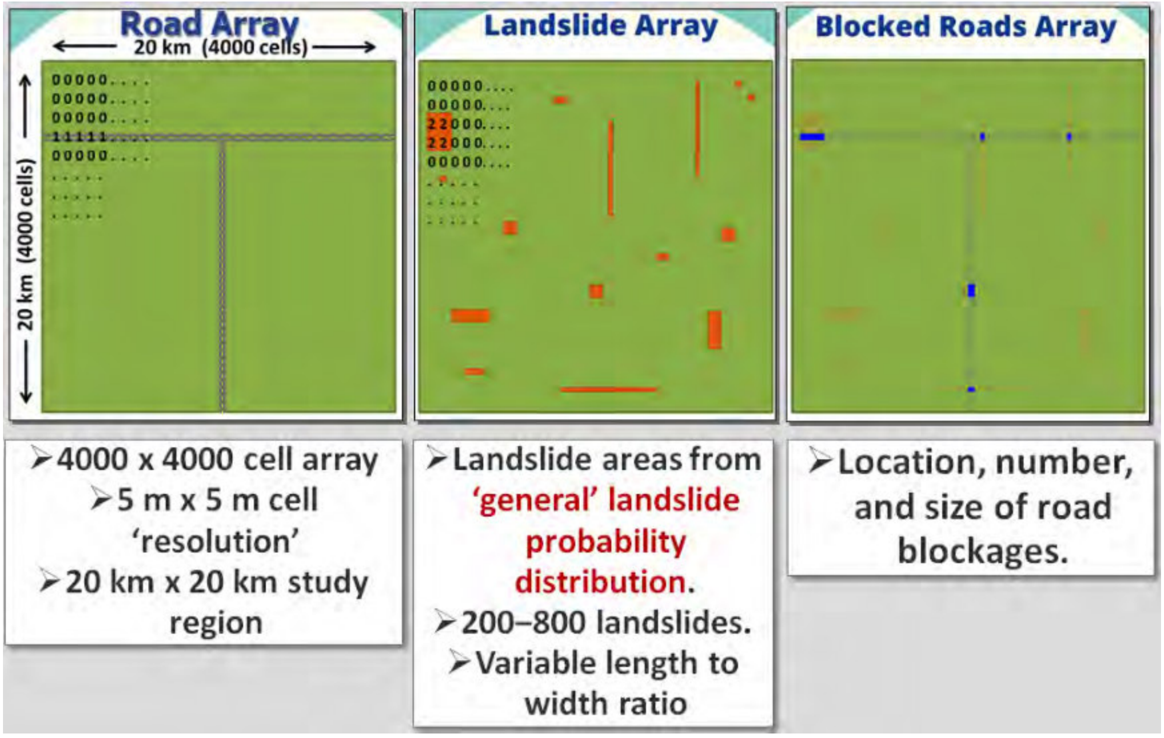


Figure 5. *Example of a computer generated model, where landslides are 'randomly' chosen from the statistical probability distribution shown in Figure 4, and 'randomly' dropped on a grid that includes roads. The number of 'road blocks' are then calculated, and the model run thousands of times. Knowing the average number of road blocks will help Civil Protection Agencies have an idea of the potential impact of future landslide invents on road network infrastructures. Figure courtesy of Faith Taylor, King's College London.*

Ultimately, through these implications and models, it is hoped that a better understanding of the landslide frequency-areas involved in past triggered landslide events can help hazard managers in their risk assessments for the future.

References Cited

Guzzetti F, Malamud BD, Turcotte DL and Reichenbach P (2002) Power-law correlations of landslide areas in central Italy: *Earth and Planetary Science Letters*, **195(3–4)**:169–183, 10.1016/S0012-821X(01)00589-1.

Malamud BD, Turcotte DL, Guzzetti F and Reichenbach P (2004) Landslide inventories and their statistical properties: *Earth Surface Processes and Landforms*, **29(6)**:687–711, doi: 10.1002/esp.1064.

Francesco Sarti
PhD, Scientific Coordinator of the Education
and Training Activities
Directorate of Earth Observation Programmes
ESA/ESRIN
V.Galileo Galilei, C.P. 64
00044 Frascati (Italy)

After his Master Degree in Electrical Engineering at the University of Rome *La Sapienza*, he was hired in 1990 at the Operation
Center of the European Space Agency in Germany (ESA/ESOC) in the area of mission analysis and orbit control manoeuvre optimization. He then moved to precise orbit determination and to orbit and attitude control and continued his career at ESA/ESTEC in The Netherlands.

He moved to Toulouse, France, in 1997, where he got a Post-graduate Master in Applied Remote Sensing and Image Processing followed by a PhD on the subject of optical-radar remote sensing for the monitoring of surface deformation (University of Toulouse *Paul Sabatier*). In France, he was first employed by CESBIO (1998) and later by CNES (1999-2001), working as a Project Manager for the *International Charter on Space and Major Disasters*, conducting R&D activities for remote sensing applications to disaster management and natural risk monitoring, interferometric monitoring of several seismic areas and providing training courses in Earth Observation.

After a short period at Italian Space Agency (2001) as a technical interface ASI-CNES for the cooperation COSMO-SkyMed / Pléiades, he joined ESA/ESRIN, in Italy, working in Earth Observation applications; since 2007, he coordinates the Education and Training Activities in Earth Observation.

In his spare time (unfortunately not much) he enjoys painting, playing piano and open-air sport like swimming and kayaking.

ESA Earth Observation programme and its applications to Natural Hazards

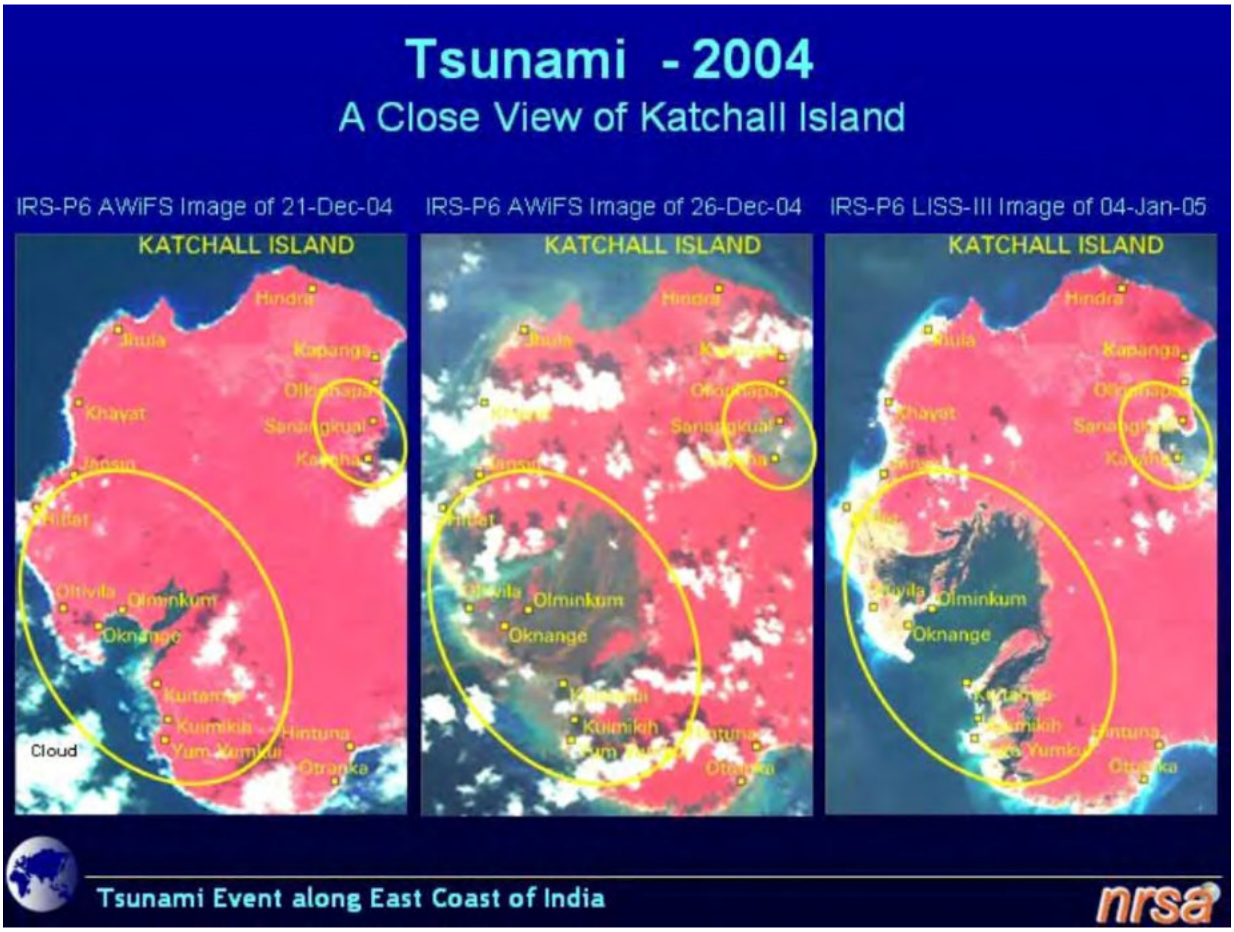
Francesco Sarti
Directorate of Earth Observation Programmes
ESA/ESRIN
Frascati (Italy)

Through its Earth Observation (EO) Programme, ESA undertakes a wide variety of projects related to the application of EO for the monitoring of natural hazards. These include operational services for rapid mapping and post disaster relief, as well as research and demonstration projects on the use of EO techniques for natural hazard monitoring.

In 1999, ESA and the French Space Agency CNES initiated the ***International Charter "Space and Major Disasters".*** The International Charter aims to provide a unified system of space data acquisition and delivery to those affected by natural or man-made disasters worldwide. Soon after the signing of the Charter by ESA and CNES, other space agencies became members. To date, 14 organisations are Charter members. The member agencies put at the disposal of the Charter their satellite resources. The Charter therefore benefits from a growing number of satellites that increase the revisit frequency and the choice of sensor for spectral and spatial resolution. Data from these sensors are processed, merged and interpreted in a variety of ways to extract the best possible information on the effects of a given disaster. One of the advantages of using Earth Observation satellites for disaster mapping is that ground-based information in the region affected is often difficult to generate otherwise because the infrastructure on ground, needed to generate the information might be destroyed or damaged by the disaster. Furthermore, satellites are the most effective means for synoptic viewing for disaster response on an emergency and priority basis. The Charter products are delivered to users on the ground with fast turnaround and at no cost. Value-adding and extraction of information from satellite data is generously sponsored by the individual Charter members. However, the Charter covers only the response phase of a disaster, on a best effort basis, whereas the later recovery and rehabilitation efforts are excluded by this mechanism.

Floods have been the most commonly covered disaster, representing roughly 50% of the Charter requests received. Typically, the main feature of the products is based on deriving flooded surfaces, either from the nature of the spectral response of these surfaces, and/or by comparison with the reference imagery predating the disaster. Typically, the flood vectors are presented as final products in GIS layers. More recently, with the advent of high-resolution SARs (metric resolution), new products showing changing water depths of inundated areas have been created.

The massive Asian tsunami of 26 December 2004 remains the biggest disaster covered by the Charter in its entire history. It was extensively covered by means of three separate Charter activations and by a combined use of optical and radar satellites, including imagery procured from high-resolution commercial satellites. Image products comprised extracts of satellite imagery, space maps on various scales, 'before-and-after' images, damage maps and 3D overview videos.



In the case of volcanic eruptions, the volcanic cloud often hampers observation of the crater and the surface topography during the eruption - therefore radar backscattering properties of the ground features can be exploited to delineate the different types of volcanic deposits. A good example of the use of SAR imagery for this disaster type comes from the Charter coverage of the Iceland volcanic eruption that halted air traffic over much of Europe in April–May 2010.

For fires, thermal and optical sensors from space constitute the core Charter capability for monitoring this disaster type. The coverage of forest fires in British Columbia (Canada) in August 2003, which affected some urban areas also, were adequately covered with SPOT, and products in various forms were delivered to show both the burning foyers as well as the burnt surfaces. Large scale burnt area mapping of the 2009 Greek fires was carried out with satellite sensors.

One of the greatest earthquake events for which the Charter was activated includes the devastating Kashmir (Pakistan/India) earthquake of 8 October 2005. The main data requirement was high resolution imagery to detect damage to towns and villages, roads, communication lines and other infrastructure. Given the hilly nature of the terrain, there was a particular concern about the landslide damage. Fine mode radar data and very high resolution (VHR) optical data were requested. Topographic map updates were prepared for logistical support and damage assessment purposes. In the case of an earlier Algerian earthquake in May 2003, optical satellite imagery (SPOT) helped in locating the evacuation and temporary refuge sites. Since these earthquake events, the Charter has obtained regular access to commercial VHR imagery, and earthquake damage assessment techniques have improved. The very large amount of VHR data that was obtained for the Haiti earthquake in January 2010 was analysed applying some new methods for recognising the degree of damage to buildings in the Port-au-Prince area.

For Hurricanes, the Charter is activated as soon as an ocean storm attains hurricane strength and the landfall is imminent, which was the case with Katrina. Twenty-five space maps were produced covering the New Orleans flooded surfaces, Biloxi and the surrounding areas, and the coastal islands south of Mobile. These maps were provided in addition to raw radar imagery showing the extent of flooded areas. Some good quality value added products showing different types of damage (flooding, oil spill due to damaged rigs, debris flow and other infrastructural damage) were produced and made available to the authorities concerned.

Very similar to the Charter is ***SAFER***, one of the services of GMES (Global Monitoring for Environment and Security). GMES develops services dedicated to a systematic monitoring and forecasting of the state of the Earth's subsystems. It collects data from multiple sources (earth observation satellites and in situ sensors such as ground stations, airborne and sea-borne sensors), processes these data and provides users (mainly policymakers and public authorities) with reliable and up-to-date information through services. Six thematic areas are developed: marine, land, atmosphere, emergency, security and climate change. The pre-operational GMES emergency management service, SAFER, reinforces the European capacity to respond to emergency situations such as fires, floods, earthquakes, volcanic eruptions, landslides or humanitarian crisis. It functions very much like the Charter, in that EO data is processed to produce disaster mapping products, which are delivered to users.

While the Charter and SAFER are predominantly for immediate disaster mapping, the GMES "***Respond***" service provides EO data in support to recovery, rehabilitation and reconstruction activities. The objective of Respond is to reinforce Europe's capacity to respond to emergency situations caused by the weather such as storms, fire and floods, geophysical hazards such as earthquakes, tsunamis, volcanic eruptions, landslides and subsidence, and environmental disasters resulting from human activity such as oil spills, and humanitarian disasters.

Another activity of ESA in the application of EO for natural hazards is in the development of a service for landslide monitoring. Ground Instabilities are among the most widespread geological hazards on Earth. Thousands of deaths and injuries, and enormous economic loss are regrettable evidences of worldwide slope instabilities. The necessity to identify and monitor slope movement is of paramount importance to reduce the socio-economic toll that every year is paid in developing as well as in developed countries. Several projects funded by ESA have investigated the feasibility and the operational applicability of spaceborne imagery to respond to the needs of governmental institutions that have a mandate in landslide prevention. These include the ***SLAM*** projects (Service for Landslide Monitoring), which are aimed at developing an end-to-end service chain for the provision of Slope Instability products.

The 1997 Kyoto Convention revealed to the general public that industrial and agricultural emissions of carbon dioxide, methane and other Greenhouse gases threaten to change the climate rapidly. The Baveno Manifesto reflected the European concerns for Global Environment Monitoring by space as a component of the Kyoto Convention implementation. In response to these, ESA developed the first ever multi-year ***Global Fire Atlas***. Remote sensing data from the ERS-2 ATSR-2 (Along Track Scanning Radiometer) allows to monitor agricultural fires and wildfires distribution at global scale and in Near Real Time. All Hot Spots (including gas flares) with a temperature higher than 312 k at night are precisely localised (better that 1km).

There is a growing international awareness about the importance of the epidemiology of diseases and it is recognized that improved up-to date information of the environment, in which infectious diseases occur, will help epidemiologists to study, understand and predict threats to human health. Within the scope of the ESA Project "***Epidemio***", satellites provide additional sources of data on epidemics. The scope of Epidemio is to demonstrate and use the potential of EO for a new service which supplies new types of environmental information for epidemiology. Satellites open up new opportunities to predict and help combat epidemic outbreaks, as well as join the hunt for the origin of pathogens. The scope of this project is to test and demonstrate the potential of EO for a new service which supplies new and improved types of information including: urban maps, digital elevation maps, maps of water bodies, vegetation maps, land cover maps, historical maps, land surface temperature maps and a service for monitoring wind-blown Sahelian dust. This information can contribute to the better management and mitigation of outbreaks of diseases.

Through its activities in Earth Observation, ESA contributes to the monitoring of a wide range of disasters worldwide at all phases of the event cycle, including risk analysis and forecasting (e.g. in the case of SLAM and Epidemio), immediate disaster mapping (in the case of the International Charter and SAFER), and post disaster recovery, rehabilitation and reconstruction (in the case of Respond). Continued availability of Earth Observation data is a prerequisite for the continuity of crisis mapping and disaster mitigation services in the long term. The upcoming Sentinel missions will provide essential rapid multisensor coverage over potential disaster-stricken areas.

Angelo Camerlenghi
OGS Istituto Nazionale di Oceanografia e di Geofisica Sperimentale
Borgo Grotta Gigante 42/C
34010 Sgonico, Trieste
Italy

Telephone: 00390402140447
E-mail: acamerlenghi@ogs.trieste.it

Present Position
Director, OGS Research Section 'Geophysics'.

Previous Positions:
ICREA Research Professor, University of Barcelona, 2004-2012;
Researcher, OGS, 1992-2004;
Fullbright Fellow, Texas A&M University, College Station, Texas, 1986-1988

Education
- Laurea, Geology, University of Milano, 1984;
- Master of Sciences, Geological Oceanography, Texas A&M University, 1988;
- Doctorate, Earth Sciences, University of Milano, 1991.

Research Interest
- Geology and geophysics of continental margins, with special focus on polar depositional systems and sedimentary processes;
- Petro-physical aspects of sedimentary successions affecting the stability of submarine slopes and related geohazards;
- Geological setting and distribution of natural gas hydrates within the marine environment.

Teaching experience
- Contract Professor, Marine Geology, University of Milano, 1997-1998;
- Lecturer, Geosciences, International Maritime Academy di Trieste, 1999;
- Associate Professor, Fluids in Marine Sediments, University of Barcelona (Master Level), 2007-2011;
- Contract Professor, Marine Geology, University of Trieste, 2012-present.

Bibliometry
115 scientific articles published, 85 of which listed in SCOPUS. Hirsch index (H = 24). Total citations: 1444.

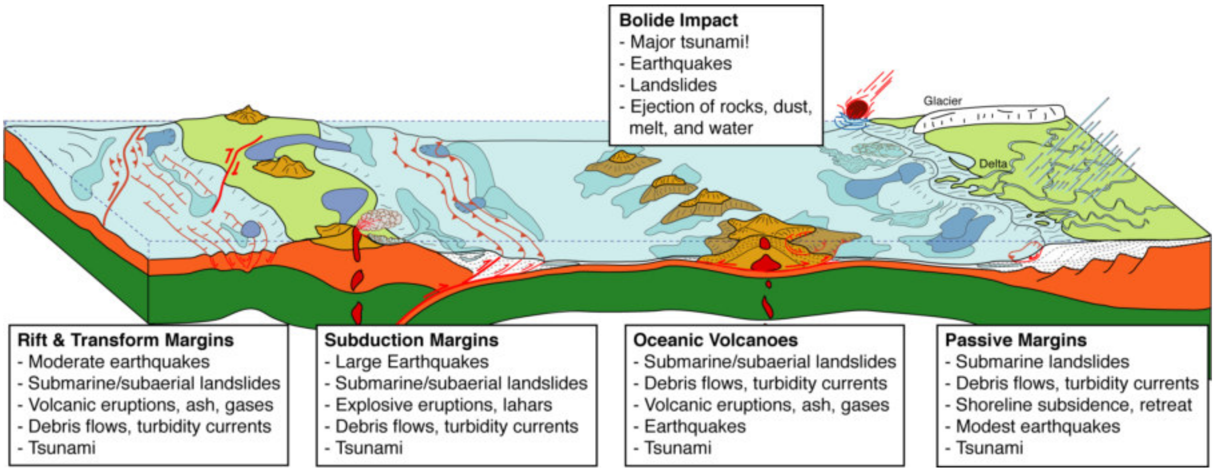
I pursue a multidisciplinary approach to the problems addressed in my research. I privilege group work in which the role of individuals is properly recognized in the technological, experimental, theoretical and intellectual aspects. I like to dedicate a significant part of my time to the dissemination of science among non-specialists, and to teaching.

Submarine geohazards

Angelo Camerlenghi
OGS Istituto Nazionale di Oceanografia e di Geofisica Sperimentale
Sgonico, Trieste, Italy
acamerlenghi@ogs.trieste.it

Submarine geohazards are some of the most devastating natural events in terms of lives lost and economic impacts. According to scientific literatures, they are identified in earthquakes, landslides, volcanic flank collapses, volcanic eruptions, the tsunamis that these generate, gas emissions, bolide impacts.

Geohazards are therefore geological events and processes that in highly vulnerable areas produce a situation of risk to population, to infrastructures, and to the environment. In one word: to Society.



Geohazards in oceanic basins (Morgan et al., 2008)

This lecture will focus on one of the most widespread phenomena in the oceanic environment: sediment mass transport through submarine landslides. Gravitational instability of marine sediments produces submarine landslides that are the cause of 20% of the known tsunamis on earth. Among geohazards tsunamis are the ones that can produce disastrous effects on population and structures and environment in a very short time with little warnings. In a small ocean basin like the Mediterranean the effects of tsunamis can show up in a matter of minutes on highly populated coastal zone. Although the preconditioning factors for submarine slope failure are generally known, the actual trigger mechanism that generates a submarine landslide is not known. It is often referred to ground shaking in very general terms. Most likely, submarine landslides are generated by the build-up of pore pressure due to gas migration and or dissociation of gas hydrates, or a combination of preconditioning factors that lead to a situation of weak static equilibrium between acting and resisting forces. Earthquakes may become the ultimate triggers of important events the understanding of which is possible only through in-depth analyses of the geological evolution of the sedimentary basin.
Case studies will be illustrated from the Mediterranean Basin and Polar continental margins.

Morgan, J., Silver, E., Camerlenghi, A., Dugan, B., Kirby, S., Shipp, C., and Suyehiro, K., 2009. Addressing Geohazards Through Ocean Drilling. *Scientific Drilling*, 7, 25-30. doi:10.2204/iodp.sd.7.01.2009

Carlo Laj
Laboratoire des Sciences du Climat et de l'Environnement
Gif-sur-Yvette Cedex,
France

Telephone : (33) 1 6982 3538
E-mail : Carlo.Laj@lsce.ipsl.fr

Education:

Secondary school in Italy and the USA (American Field Service Exchange Student.)
University studies at the University of Paris, PhD in Solid State Physics.

Research Interests:

After my PhD I spent a few years working with critical phenomena (scattering of laser light by critical fluids) then moved into the field of geophysics.

My main interests in this new field has always been linked to the magnetic properties of sediments and igneous rocks (paleomagnetism), used with several objectives: geodynamical reconstructions (particularly in the Eastern Mediterranean and the Andean Cordillera), reconstruction of the history of the Earth's magnetic field (including the morphology of field reversals) and more recently reconstructions of environmental and climatic changes on a global scale.

I have published about 200 articles in international scientific journals and a few general public articles in different journals.

Fellow of the American Geophysical Union (AGU).

Educational activities:

Chairman, Education Committee of the European Geosciences Union
Participant to different National and International Education Committees
Union Service Award for creating the the Committee on Education of EGU
Excellence in Geophysical Education Award of the American Geophysical Union

This picture was taken in the Taoist Temple in Beijing : according to the chinese astrological calendar, I was born in a « Year of the Rabbit » !

The educational activities of the European Geosciences Union

Carlo Laj
Chairman, EGU Committee on Education
Laboratoire des Sciences du Climat et de l'Environnement (CEA-CNRS-UVSQ)
Gif-sur-Yvette, France
Carlo.Laj@lsce.ipsl.fr, education@egu.eu

Founded in 2002 when EGU itself was founded, the Committee on Education of EGU has progressively developed programs and educational materials mainly aimed at secondary school teachers and pupils.
One of the main program is the annual Geosciences Information for Teachers (GIFT) Workshop organized in connection with the Annual General Assembly of the Union. This 3 days workshop typically reunites 80-85 teachers from about 20 different countries in Vienna.
The initial GIFT workshop model at the General Assembly has grown into a multi-faceted educational outreach effort that now includes distinguished lecturers, video-conferences and power-point presentations of GIFT lectures that can be downloaded for classroom use. This effort has resulted in many exchanges and networking between the group post-GIFT, which bodes well for pan-European and worldwide links in the future.
Also, in the 10 years of existence GIFT Workshops have built a library of digital material that any teacher, not only those who have participated in the workshops, can use with their pupils in the classroom:
- Presentations of all invited speakers are available for download, free from copyrights, as pdf files.
- Selected lectures have been video-recorded and mounted on-line for use in the classroom.
The GIFT library will now have 23 on-line presentations. In addition, interviews, extra videos and photographic collections are available to teachers to illustrate the initiative to their colleagues and students.
Other more recent activities include the "Teachers at Sea" program and the GIFT workshops associated with each Alexander von Humboldt topical conferences.
As for the Vienna GIFT workshops, all the presentations are available on line
Including some of the video presented on different occasions.
All the above-mentioned material is available at: http://www.egu.eu/media-outreach/gift/gift-workshops.html
In my presentation I will highlight the different activities of the CoE, and give examples on how the on-line material can be used in the classrooms as well as for first or second year University students.

Dr. Eng. Norma B. Crosby
Belgian Institute for Space Aeronomy
Ringlaan-3-Avenue Circulaire
B-1180 Brussels, Belgium

Email: Norma.Crosby@aeronomie.be
Website: http://www.aeronomie.be/

Education
1993-96 : Ph.D. Thesis in Astrophysics and Space Technology, Univ. of Paris 7, France
1992 : Summer Session Programme, International Space Univ., Japan
1982-88 : Master of Science in Chemical Engineering, Technical University of Denmark, Denmark

Professional Positions
2002-present : Research Scientist, Belgian Institute for Space Aeronomy, Brussels, Belgium
2000-02 : Research Fellow, UCL Mullard Space Science Laboratory, England
1999-00 : Assistant Director, Summer Session Programme, International Space Univ., France
1998-99 : Research Fellow, ESA ESTEC, The Netherlands
1997-98 : Post-doctoral Researcher, CNRS LPCE, France
1991-92 : Research Scientist, NASA Goddard Space Flight Center, Maryland, U.S.A.
1988-89 : Technical Writer, Radiometer Medical A/S, Denmark

Professional Activities
- Project Coordinator, EU FP7 COMESEP (Coronal Mass Ejections and Solar Energetic Particles: forecasting the space weather impact) Project (2011 - present)
- Team Leader, EU FP7 ARISE (Atmospheric dynamics Research InfraStructure in Europe) Project (2012 - present)
- Project Manager and Team Leader, ESA SEPEM (Solar Energetic Particle Environment Modelling) Project (2007 - 2012)
- Team Leader, International Space Science Institute International Team “The Earth’s Radiation Belts: Physical Processes and Dynamic Modeling” (2010 - present)
- Team Member, International Space Science Institute International Team “Self-Organized Criticality and Turbulence” (2012- present)
- ESA Network of Technical Competencies for Space Environments and their Effects, Belgian Representative and Member (Steering Board and Working Group)
- ESA Space Weather Working Team, Chair (2009 - 2012)
- EGU, Solar-Terrestrial Sciences Division, Division President (2011 - present)
- Editorial Board Member of “Space Weather: The International Journal of Research and Applications”, “Sun and Geospace: The International Journal of Research and Applications”
- Reviewer for professional journals (JASTP, ADGEO, GRL, COSPAR Advances in Space Research, Surveys of Geophysics, Space Weather: The International Journal of Research and Applications, Europhysics Letters, etc.)

Norma B. Crosby has twenty years of experience in space environment analysis and her main field of work concerns space weather related issues, specifically solar energetic particle events, statistical analyses on space plasma data, and extreme events. During her career she has acquired an interdisciplinary space background in science, engineering and administration. She has authored and co-authored over 30 publications in professional journals and is the author of several book chapters. In parallel she has given lectures on space weather related issues at various “summer-schools”, held in Italy, Turkey, Austria and Russia, for graduate and post-graduate students. Furthermore, she is active in education and public outreach activities; this includes promoting space weather in educational institutions at all levels, as well as raising and maintaining awareness of space weather effects among engineers, managers, and policy makers.

Space Weather: Storms from the Sun

Norma B. Crosby

Belgian Institute for Space Aeronomy

Throughout recorded history, society has been affected by extreme weather such as droughts, floods, ice storms, blizzards, hurricanes and tornadoes. Modern society became vulnerable to a new type of extreme weather around the 19^{th} century. This weather, observed as severe disturbances of the upper atmosphere and the near-Earth space environment is driven by the Sun's magnetic activity. It would later be coined space weather. In simple terms space weather can be defined as how solar activity can have unwanted effects on technological systems and human activity, be it in near-Earth space or on Earth's surface. The local space weather is a function of our location in the Solar System, the behavior of the Sun, and the nature of Earth's magnetic field and atmosphere. Thus, any planet will have its own local space weather defined by its local star, the planet's location in its star system and the conditions on the planet.

Storms from space and their interaction with Earth's magnetosphere. Courtesy of the International Solar-Terrestrial Physics Program and NASA.

To be able to characterize and define the changing space weather one must first understand the phenomena themselves that create this environment. The Sun has a well-known approximate eleven year cycle which can be observed in its sunspot number. Long-term behavior of the solar cycle is termed space climate, whereas it is the short-term variations on hours, days, to the approximate 27-day rotation period of the Sun where one speaks about space weather. The solar corona is a very dynamic region and the source of many eruptive phenomena related to magnetic energy releases in a large range of spatial and temporal scales.

During solar maximum the activity on the Sun increases and phenomena such as solar flares and coronal mass ejections (CMEs) occur. The latter can create major disturbances in the interplanetary medium and can trigger severe geomagnetic storms when they collide with the Earth's magnetosphere. Solar energetic particle (SEP) events are associated with solar flares and/or shock waves generated by CMEs. Even at solar minimum there are physical phenomena to worry about. Galactic cosmic rays (GCRs) originate from outside the heliosphere and when the Sun is less active the GCR background increases. In summary, like the weather on Earth, the space weather too is defined by many factors.

Source/ Credits: Space Environment Center, Boulder, CO, National Oceanic and Atmospheric Administration, U.S. Dept. of Commerce.

Since the early 1800's, all aspects of our technology have been affected by severe solar disturbances beginning with telegraph outages during 1850-1900, radio disruptions between 1910-1960, and satellite outrages and failures since the start of the Space Age.

Satellite systems that modern society depends on for communications and navigation systems are susceptible to the space weather. In extreme circumstances space weather can even pose problems to technical systems situated on the Earth (e.g. electrical power transmission systems, oil and gas pipelines). For human space exploration space weather is also of concern, as there are solar phenomena that can affect human health.

Space weather is an interdisciplinary subject covering scientific, technological, economic and environmental issues. It includes research (data analysis and modeling), forecasting and mitigation techniques, as well as hazard assessment. In summary, the subject is a merging of many topics ranging from space science, nuclear physics, aerospace engineering, space medicine to space law. This is why it is an ideal subject for educational purposes.

This talk will introduce space weather from an historical point-of-view. Thereafter the various issues that constitute the global space weather scenario, such as the physical phenomena that define the space weather, as well as space weather effects on technology and biological systems, will be presented. Furthermore, the importance in understanding, mitigating the effects of and forecasting the space weather will be highlighted. Historical case studies such as the March 1989 geomagnetic storm, the August 1972 SEP event and the recent extended solar minimum will be presented. It will be discussed why they have become well-known case studies. The talk will conclude with examples of hands-on exercises to complement the material presented.

Stefan Rahmstorf

Potsdam Institute for
Climat Impact Research,
Potsdam, Germany
rahmstorf@ozean-klima.de

After studying physics at the Universities of Ulm and Konstanz and physical oceanography at the University of Wales (Bangor) Stefan Rahmstorf completed a thesis on general relativity theory. He then moved to New Zealand and obtained his PhD in oceanography at Victoria University of Wellington in 1990. His PhD work included a number of research cruises in the South Pacific.

After this he worked as a scientist at the New Zealand Oceanographic Institute, at the Institute of Marine Science in Kiel and since 1996 at the Potsdam Institute for Climate Impact Research. His work there focuses on the role of the oceans in climate change.

In 1999 Rahmstorf was awarded the $ 1 million Centennial Fellowship Award of the US-based James S. McDonnell foundation. Since 2000 he teaches Physics of the Oceans as a professor at Potsdam University. Rahmstorf is a member of the Academia Europaea and of the German Advisory Council on Global Change (WBGU). He was also one of the lead authors of the 4th Assessment Report of the IPCC. In 2007 he became an Honorary Fellow of the University of Wales and in 2010 a Fellow of the American Geophysical Union.

He has published over 80 scientific papers (20 of which in the leading journals Nature, Science and PNAS) and co-authored four books. Available in English is Our Threatened Oceans (2009, with Katherine Richardson) and The Climate Crisis (2010, with David Archer).

Rahmstorf is co-founder of two climate science blogs, RealClimate and KlimaLounge, and a frequent commenter on climate issues in the media. He is also a sought-after speaker for public lectures on climate science.

Increase of extreme events in a warming world

Stefan Rahmstorf
Potsdam Institute for Climate Impact Research

Since the start of the industrial age, the carbon dioxide content of the atmosphere has risen to the by far highest value of the last million years. At the same time, global average surface temperatures have increased by 0.8 °C. This warming is continuing unabated: 2010 was the hottest year on record, together with 2005, since global measurements began more than 130 years ago.

The ice cover on the Arctic Ocean is shrinking rapidly and has reached a record low value in September 2012. The huge ice sheets both in Greenland and Antarctica are losing mass at an increasing rate, as satellite data show. This contributes to the accelerating rise of sea levels: they rose at a rate of one centimeter per decade at the beginning of the 20th Century, but already at over three centimeters per decade over the past twenty years.

The last decade has witnessed a sequence of unprecedented weather extremes (Coumou and Rahmstorf 2012), including the 2010 Russian heat wave, the flooding in Pakistan that same year, or the 2012 summer heat wave in the US. This ostensibly large number of recent extreme weather events has triggered intensive discussions, both in- and outside the scientific community, on whether they are related to global warming.

The lecture will review the evidence and argue that for some types of extreme — notably heatwaves, but also precipitation extremes — there is now strong evidence linking specific events or an increase in their numbers to the human influence on climate. For other types of extreme, such as storms, the available evidence is less conclusive, but based on observed trends and basic physical concepts it is nevertheless plausible to expect an increase.

Data analysis by Hansen et al. (2012) shows that the fraction of the Earth's land surface affected by extreme heat has increased dramatically, from around 0.1 to 0.2 percent in the 1950s to 1970s, to around 10 percent in recent years. Coumou et al. (2013) have shown that, worldwide, the number of local record-breaking monthly temperature extremes is now on average five times larger than expected in a climate with no long-term warming. This implies that on average there is an 80 % chance that a new monthly heat record is due to climatic change.

Large regional differences exist in the number of observed records. Summertime records, which are associated with prolonged heat waves, increased by more than a factor of ten in some continental regions including parts of Europe, Africa, southern Asia and Amazonia. Overall, these high record numbers are quantitatively consistent with those expected for the observed climatic warming trend with added stationary white noise. Strong El Niño years see additional records superimposed on the expected long-term rise.

Under a medium global warming scenario, by the 2040s the number of monthly heat records globally can be expected to be more than 12 times as high as in a climate with no long-term warming.

References

Coumou, D., and S. Rahmstorf, 2012: A decade of weather extremes. *Nature Clim. Change*, **2,** 491-496.

Coumou, D., A. Robinson, and S. Rahmstorf, 2013: Global increase in record-breaking monthly-mean temperatures. *Clim. Change*.

Hansen, J., M. Sato, and R. Ruedy, 2012: Perception of climate change. *Proceedings of the National Academy of Sciences of the United States of America*, **109,** E2415-E2423.

Dipl-Geograph
Andreas Siebert

Munich Reinsurance Company
Head Geospatial Solutions
Tel: +49 (89) 3891-5292
Fax: +49 (89) 3891-75292
Mail: asiebert@munichre.com

Andreas spent his early career in the geo-consultant industry as expert for Geographical Information Systems (GIS) and remote sensing applications working in various parts of the world. He subsequently pursued an spatial information and analysis specialisation, and in particular the development and installation of GIS, GPS and mapping tools in different institutions and international organisations.
A geographer by initial profession, he has longstanding interests in natural risks and risk assessment.

Since 1995 he is a member of Munich Re´s Geo Risks Research Team. His main interest has been the development of solutions and services to assist insurance underwriters and risk experts to manage their exposure to natural and man-made catastrophes by combining insurance information with (geo)scientific data.

Since 2004 he is heading the Geospatial Solutions Department in Munich Re, which is today part of Corporate Underwriting.

In many lectures and articles in the geoscience and insurance community he is stressing the benefit of geospatial and mapping solutions in the management of natural hazards.

In 2009 he starts to lecture “Risk management – Focussing global NatCat risks” at the University of Deggendorf.

In 2011 his team was a finalist of the Geo Business Award presented by the German Ministry of Economy for the NATHAN Risk Suite, a global geo-based risk assessment tool.

Risk Management of Natural Hazards – Challenges for the Insurance Industry

Andreas Siebert
Head Geospatial Solutions at Munich Reinsurance Company, Munich

The use of geoinformation is becoming increasingly common in the insurance industry and it has established a foothold more quickly than was expected a few years ago. This lecture deals with the latest geoinformation applications, solutions and trends.

It all began with a printed World Map of Natural Hazards in 1978. Today geoinformation technology is connected to the internet, provides real-time risk analysis and can be directly linked to individual workflows.

In the last few years, geoinformation systems have established themselves in the insurance industry. Initially, these systems were largely used by reinsurers and modelling firms in the handling of property insurance risks. Today, geo-based solutions are used for a much broader spectrum, including primary insurers. Geomarketing is a good example. By using geoinformation technology, regional business potential can be more easily identified, sales structures optimised and products and rates more precisely adjusted to the actual risk situations. Property insurance is one of the areas where Munich Re uses geointelligence: local industrial accidents or regional earthquakes are linked to the geographic distribution of the insurer’s portfolio to model specific loss expectation figures. These enhanced risk models ensure accurate risk assessment and claims management.

However, the full potential of this geographical knowledge can only be realised if the applications are linked to work processes. This has been made possible by the internet. Browser-based geo tools in particular enable underwriters and risk managers to use the systems at their workstations without incurring major installation costs. Applications are still used primarily to visualise and identify risk locations, portfolios and loss zones – i.e. for geocoding and hazard lookups. Geoprocessing is required if the task involves real-time geographical or even historic portfolio-data analysis. Here, data and information do not have to be stored on individual company computers, since the maps, satellite images, damage-zone, height and statistical data of an external provider can be readily accessed from a company's own applications with an online connection. The user “composes” an up-to-date knowledge map according to topic and objective.

A natural hazard analysis tool for many risk management requirements is a Munich Re development, called Risk Mapper, a web-based cutting-edge technology.
The Risk Mapper can be used for disaster modelling, risk identification and even loss prevention. Based on the lessons learned from the floods in Thailand 2011 or hurricane Sandy in 2012 the lecturer demonstrates how the industry is improving the risk transparency.