

ENHANS

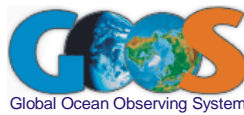


Extreme Natural Hazards and Societal Implications

FINAL REPORT



CO-SPONSORED BY



CONTENT

SUMMARY	4
INTRODUCTION	6
FOCUS ON LATIN AMERICA AND THE CARIBBEAN REGION	8
FOCUS ON AFRICA	11
FOCUS ON NORTH AMERICA AND EUROPE	15
FOCUS ON THE MIDDLE EAST	17
FOCUS ON ASIA AND THE PACIFIC REGION	19
FOCUS ON EDUCATION	26
FOCUS ON PREDICTABILITY	27
ENHANS PROJECT WEB-PAGE	29
APPENDICES	30

SUMMARY

The Project “Extreme Natural Hazards and Societal Implications – ENHANS” was an initiative of the International Union of Geodesy and Geophysics (IUGG) and received a grant of the International Council for Science (ICSU) in 2010. The ENHANS project was co-sponsored by the following project Partners: the American Geophysical Union (AGU), the International Geographical Union (IGU), the International Society for Photogrammetry and Remote Sensing (ISPRS), the International Union of Geological Sciences (IUGS), the International Union of Theoretical and Applied Mechanics (IUTAM), the Scientific Committee of the Program “Integrated Research on Disaster Risk” (IRDR), and the Global Ocean Observing System (GOOS) of IOC-UNESCO. The ICSU Regional Offices for Africa (ROA), Asia & the Pacific (ROAP), and Latin America and the Caribbean (ROLAC) have been involved in the relevant parts of the project providing links to the regions.

The principal goals of the ENHANS project have been

- (i) to improve understanding of critical phenomena associated with extreme natural events and to analyze impacts of the natural hazards on sustainable development of society;
- (ii) to promote studies on the prediction of extreme events reducing predictive uncertainty and on natural hazards mitigation; to bring the issues into political and economical policies;
- (iii) to disseminate knowledge and data on natural hazards for the advancement of research and education in general and especially in developing countries; and
- (iv) to establish links and networks with the international organizations involved in research on extreme natural hazards and their societal implications setting up a consortium of experts of ICSU Unions and several major intergovernmental and multi-national organizations involved in the project.

The goals of the ENHANS project have been achieved via scientific meetings and open forums bringing together research experts, decision makers, and disaster management, insurance agency and mass media practitioners. The project placed a special emphasis on the importance of research on extreme natural hazards and disaster risk mitigation in the most vulnerable regions of the world, particularly in Latin America and the Caribbean, in Africa, in the Middle East, in Asia, and the Pacific region.

The project contributed to and promoted the activities of the Partner organizations in natural hazard and disaster risk research, particularly it contributed to the implementation of the IRDR Programme. The project revealed the existing knowledge, potentials, and scientific expertise in the relevant topics of extreme natural hazards and disaster risk research in many regions of the world. The project events were held around the world focusing on extreme natural hazards and disaster risks in a particular region:

- Latin America and the Caribbean (Iguassu, Brazil, August 2010),
- North Africa (Cairo, Egypt, November 2010),
- North America and Europe (San Francisco, USA, December 2010);
- sub-Sahara Africa (Pretoria, South Africa, January 2011);
- the Middle East (Antalya, Turkey, May 2011), and
- Asia and the Pacific region (Melbourne, Australia, July 2011).

Moreover, the school (Trieste, Italy, October 2011) and scientific session (San Francisco, USA, December 2011) on predictability of extreme events have been the parts of the ENHANS project.



The ENHANS project concludes that a reduction of disaster risk can be reached through in-depth scientific research on disaster risks and through risk assessments. The ENHANS project calls for the following important actions:

1. to promote comprehensive holistic inter- and trans-disciplinary approaches to natural hazard and disaster risk research, which have to integrate knowledge from natural and social sciences, mathematics, engineering, disaster management, insurance sectors and other stakeholders dealing with disaster risk;
2. to help in networking existing regional scientific and educational centers with the aim to establish a regional center of excellence in disaster risk research (e.g., in sub-Saharan Africa);
3. to negotiate on setting up a process of assessing and synthesizing the policy-relevant results of peer-reviewed published research on the understanding of the natural phenomena and the social vulnerability associated with disasters; on the capability of predictive systems to disseminate timely and accurate information needed for policy and decision making; on methodologies and approaches for reducing vulnerability and increasing resilience of societies; and on the overall ability of societies to reduce risk (prevent, mitigate and prepare for the increasing impact of natural events). The assessment would contribute to enhance the knowledge of disaster risk at global, regional, and local levels and the awareness of the people living with risk.

The major scientific results of the ENHANS project have been broadcast via the project homepage (<http://www.ENHANS.org>), newsletters of U.N., international and national organizations, and Internet (as video presentations or as report presentations). The ENHANS project results will be summarized in the book to be published by the Cambridge University Press in 2013.

INTRODUCTION

The beginning of the XXIst century has been marked by a significant number of natural disasters, such as floods, severe storms, wildfires, hurricanes, earthquakes, landslides, volcanoes, and tsunamis. Extreme natural events cause devastation resulting in loss of human life, large environmental damage, and partial or total loss of infrastructure. The principal signature of such events is that their probability decreases rapidly with magnitude, but the damage caused increases rapidly, and so does the cost of protection against it. The recent catastrophic events (e.g. the 2004 Indian Ocean and the 2011 Great East Japan giant earthquake and devastating tsunami, earthquakes in Pakistan in 2005, China in 2008, Haiti in 2010, Katrina hurricane in USA in 2005, 2010 flooding in Pakistan) reminded us once again that there is a strong coupling between complex solid Earth, oceanic, and atmospheric processes. A holistic approach is required to understand the phenomena, to predict catastrophic events, and to mitigate natural disasters.

Humankind will never be able to prevent these occurrences of natural phenomena entirely. However, scientists are able to gain better understanding of the complex mechanisms of extreme natural events that cause the disasters and deliver their knowledge to disaster management agencies in order to be prepared to cope with such extreme events. Scientists need also a deeper understanding, based on work across disciplines, of all of the processes that are involved. They must be mindful of public concerns and the risk perceptions that underlie them. Communication between the groups of experts of various international organizations dealing with natural hazards and their activity in disaster risk reduction needs to be strengthened.

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The project was managed by IUGG and the *Steering Committee*:

Ron Abler, IGU President (USA)

Alice Abreu, ROLAC Executive Director (Brazil)

Orhan Altan, ISPRS President (Turkey)

Keith Alverson, GOOS Director (Kenya)

Peter Bobrowsky, IUGS Secretary General (Canada)

Jaime Fucugauchi, AGU International Secretary (Mexico)

Nordin Hasan, ROAP Executive Director (Malaysia)

Alik Ismail-Zadeh, IUGG Secretary General (Project Leader, Germany)

Edith Madela-Mntla, ROA Executive Director (South Africa)

Gordon McBean, Chair of the IRDR Scientific Committee (Canada)

Keith Moffatt, IUTAM Past President (UK)

FOCUS ON LATIN AMERICA AND THE CARIBBEAN REGION



The first ENHANS events took place at the Meeting of the Americas in Foz do Iguassu, Brazil, on 9-11 August 2010. The program of the events can be found in [Appendix 1](#).

1. Symposium “International Collaboration in Earth and Space Sciences: Present Status, Needs, and Future Perspectives”

The symposium organized by the American Geophysical Union (AGU) and International Union of Geodesy and Geophysics (IUGG) was aimed to present recent achievements in international collaboration and to discuss new opportunities, especially those related to Latin America and the Caribbean countries. *A. Ismail-Zadeh* (IUGG Secretary-General) delivered a talk on international cooperation in geophysics reviewing the history of IUGG and new trends in cooperation between geo-unions. *A. Abreu* (Director of the ICSU Regional Office for Latin America and the Caribbean) discussed the role of the ICSU Regional Office for Latin America and the Caribbean in developing research projects related to the region. Particularly she mentioned the fruitful research collaboration in area of understanding and managing risks associated with natural hazards. *G. Good* (Director of the Center for History of Physics at American Institute of Physics) discussed the past, current and future aspects of international cooperation in Latin America. *J. Hess* (Executive Director at Geological Society of America) spoke on the development of a global geosciences initiative as an outcome of the International Year of Planet Earth. *P. Leahy* (Executive Director of the American Geological Institute) discussed how to communicate geoscience information to the public and the professionals, and *J. Bradford* (Vice President of the Society of Exploration Geophysicists) talked on the role of scientific societies in international collaboration. *I. Wainer* (Member of the World Climate Research Program, WCRP) spoke on the international climate research programs developed by WCRP. *J. Fucugauchi* (AGU International Secretary) concluded the symposium discussing the role of international collaboration in promoting geosciences research and education in developing countries.

2. Symposium “Natural Hazards and Disaster Risk in Latin America and the Caribbean”

The symposium was the central event of the “Extreme Natural Hazards and Societal Implications – ENHANS” project sponsored by the International Council for Science (ICSU) and co-sponsored by several international and intergovernmental organizations. The symposium was convened by O. Cordona (Colombia), A. Ismail-Zadeh (Germany), and V. Kossobokov (Russia).

A. Lavell (Costa Rica) spoke on new multidisciplinary research programme of ICSU “Integrated Research on Disaster Risk” and discuss the content and significance of the programme when looking at concrete examples of the social construction of risk in the Latin

American and Caribbean region. T. Gibbs (Barbados) presented the paper on meteorological hazards and associated risks in the Caribbean. The talk was followed by the presentation “A scaling criterion to estimate and compare the volcanic hazard among different volcanoes” S. De La Cruz-Reyna (Mexico). O. Perez (Venezuela) spoke on earthquake activity and associated hazards in South America and the Caribbean and on socio-economic impact of severe earthquakes in these regions. I. Alcantara-Ayala (Mexico) discussed the anatomy of landslides disasters and presented case studies from Mexico and other South American countries. A. Soloviev (Russia) discussed problems in seismic hazard assessment and earthquake predictability, and V. Kossobokov (Russia/France) continued the discussion on predictability of extreme events presenting a paper “Natural Hazards At Extreme: Predictive Understanding Versus Complex Reality”. O. Cardona (Colombia) spoke on indicators of disaster risk and risk management in the Americas. F. Romanelli (Italy) presented scenarios-based seismic hazard assessment methodology and its implication to hazard evaluation in Valparaiso. H. Salmun (USA) discussed statistical prediction of storm surge in the New York Metropolitan area, and A. Rice (USA) spoke on multiple meteoroid impacts in Antarctica and implications for humanity.

Two oral sessions of the symposium was continued as a poster session of 25 papers.

3. Town Hall meeting: "Natural Hazards in Latin America and Caribbean (LAC): From Risk to Opportunity by Partnership of Science and Society"

The meeting addressed the following major topics: (i) how science (both natural and social) and society can form partnership for disaster reduction? (ii) how science and society partnership can convert natural disaster risk to opportunity? And (iii) what are the urgent issues of disaster risk in LAC cities and regions under intensifying natural and social pressure?



A. Lavell (Latin American Social Sciences Faculty – FLACSO and LA RED, Costa Rica; member of the ICSU Scientific Committee “Integrated Research on Disaster Risk” and ICSU Regional Office for LAC) spoke on increasing the salience of disaster risk management on the political agenda. Disaster Risk Management is still not of sufficient social and political salience given current and future predicted disaster trends and costs, and which climate change will probably add to. The talk will try to highlight why this may be so and what are the principle ways to place the theme more firmly on the political and social agenda.



K. Alverson (Director, Global Ocean Observing System, Intergovernmental Oceanographic Commission) spoke on the Global Ocean Observing System (GOOS) in Latin America and the Caribbean. The talk focused on the importance of sustained ocean observing systems be in place both to prevent and mitigate disasters, where possible, but also in order to rapidly bring observing assets to bear in post disaster relief efforts. Both natural coastal inundation hazards, such as storm surge and tsunamis, as well as anthropogenic hazards, such as oil spills, was discussed, focusing where possible on Latin America and the Caribbean, including the Gulf of Mexico.



P. Boccoardo (Director, ITHACA, Professor of Politecnico di Torino, Italy and Representative of the International Society for Photogrammetry and Remote Sensing) He discussed geomatics and disaster management in the case of the recent Haiti earthquake disaster. Presentation highlighted issues and challenges associated with emergencies related to natural disasters. Taking into account the last earthquake occurred in Haiti, data acquisition, processing and information extraction were presented when humanitarian response is involved.

Two panelists I. Alcantara-Ayala (Vice-President of the International Geographical Union) and M. McPhaden (President of the American Geophysical Union) mentioned how professional societies can assist in mitigation of natural hazards and disasters. The speakers and panelists answered questions of the attendees. The meeting's discussion was moderated by J.U. Fucugauchi (Mexico) and A. Ismail-Zadeh (Germany).

FOCUS ON AFRICA

The African legs of the ENHANS project took place in Cairo, Egypt on 1 November 2010 and in Pretoria, South Africa, from 17 to 20 January 2011.

The **mini-symposium on Extreme Natural Hazards and Climate Changes** was organized by the Egyptian Academy of Scientific Research and Technology. The Program of the event can be found in [Appendix 2](#).

Alik Ismail-Zadeh (KIT, Germany) introduced the ENHANS project and emphasized an importance of the integrated research on topics of natural and human-induced hazards and disasters. Tom Beer (CSIRO, Australia) discussed problems of environmental risk management related to climate change and geophysical hazards. Harsh Gupta (NGRI, India) presented the tsunami warning system built for the Indian Ocean. He also discussed the problem of induced seismicity. David Jackson (UCLA, USA) told about global earthquake forecasts and how they help to understand seismic hazard. Samir Riad (Cairo Univ., Egypt) discussed the climatic changes and their possible impacts in Egypt. After presentations round-table discussion took place.



Participants of the mini-symposium, 1 November 2010, Cairo, Egypt

ENHANS Workshop in Pretoria, South Africa

The ENHANS International Workshop “Extreme Natural Hazards and Disaster Risk in Africa” (17-20 January 2011) provided an opportunity for the research community of the African countries and international experts to discuss and analyze major topics related to extreme natural events and disaster risk. The workshop served as a platform to establish links and networks between African experts with relevant international organizations.

The workshop was hosted by the Aon Benfield Natural Hazard Centre, University of Pretoria, and was based on invited presentations by African and foreign experts in natural hazards and disaster risk analysis. More than 40 delegates attended the workshop representing various international, inter-governmental, African, and other organizations. The Workshop's scientific program can be found at the workshop's web-page (<http://www.technoscene.co.za/hazardsws>) as well as in Appendix 3. The talk of the workshop participants can be downloaded from http://www.enhans.org/showcasing/workshop_jan2011.php



The Pretoria Workshop's participants

The Workshop's participants adopted the recommendation (see Appendix 4) to governments and funding institutions in cooperation with the relevant ICSU bodies, United Nations agencies and other international entities.

The workshop participants visited the Tswaing crater, an extreme event site associated with an asteroid, which hit the Earth some 200,000 years ago. Keith Moffatt, a workshop participant, wrote a poem about the tour (see Appendix 5)



During the Workshop field trip

The Pretoria workshop was highlighted in the *U.N. SPIDER Newsletter*:

"The Extreme Natural Hazards And Societal Implications (ENHANS) International Workshop on Extreme Natural Hazards and Disaster Risk in Africa was held in Pretoria, South Africa,

from 17 to 20 January 2011. The Workshop was hosted by the Aon Benfield Natural Hazard Centre, University of Pretoria, and sponsored by ENHANS/International Council for Science (ICSU), Global Ocean Observing System (GOOS), and the United Nations Educational, Scientific and Cultural Organization (UNESCO). Important goals of the ENHANS project are to improve the understanding of critical phenomena associated with extreme natural events and to analyze impacts of the natural hazards on sustainable development of society. Furthermore the project aims at establishing links and networks with the international organizations involved in research on extreme natural hazards and their societal implications by setting up a consortium of experts of ICSU Unions and several major intergovernmental and multi-national organizations. The Pretoria Workshop provided fruitful opportunities to the research community of the African countries and international experts, including representatives of the United Nations Economic Commission for Africa (UNECA), UNESCO/Intergovernmental Oceanographic Commission (IOC), and the United Nations International Strategy for Disaster Reduction (ISDR), to discuss and analyze major topics related to extreme natural events and disaster risk, and to establish links and networks between African experts in natural hazards and risk analysis with the relevant international organizations. UN-SPIDER supported the workshop programme committee, and Senior Expert Robert Backhaus gave an invited lecture on the UN-SPIDER Programme, highlighting the Programme's activities in Africa. As an outcome of the final discussion, a working group was established and mandated to prepare a formal recommendations document."

[http://www.un-spider.org/news-en/4847/2011-02-04t123100/un-spider-enhans-international-workshop-%E2%80%9Cextreme-natural-hazards-and,](http://www.un-spider.org/news-en/4847/2011-02-04t123100/un-spider-enhans-international-workshop-%E2%80%9Cextreme-natural-hazards-and)

in the *Insurance Journal*:

Aon Benfield announced that its Natural Hazard Centre in South Africa at the University of Pretoria has hosted the first "ENHANS International Workshop on Extreme Natural Hazards and Disaster Risk in Africa. "The event brought together Africa's leading global experts in natural hazards, disaster risk analysis and risk management, who will continue to pool their expertise to mitigate and manage the consequences of extreme natural hazards across the continent," said the bulletin. Professor Andrzej Kijko of the Aon Benfield Natural Hazard Centre noted: "Africa is a continent with enormous natural disaster risks. In comparison with developed countries such as Australia, Japan or the U.S. which are able to recover from natural disasters at a relatively quick pace, most of Africa's inhabitants are very poor and may lose everything when extreme natural hazards like floods, droughts or earthquakes occur." Dr. Keith Alverson, Director of the Global Ocean Observing System, added: "There is a growing need for more awareness from the government on the implications of extreme natural hazards for the African continent. Preventative disaster measures need to be monitored and the results regularly communicated to the authorities. For example, while water supplies are checked regularly for hygiene purposes, there is not as much emphasis on testing sprinkler systems to ensure they would work effectively in the event of a fire." Dr Alik Ismail-Zadeh, Leader of the Extreme Natural Hazards and Societal Implications (ENHANS) Project and Secretary-General of the International Union of Geodesy and Geophysics, pointed out that a natural disaster "should not be considered just as a natural phenomenon but as an extreme societal event affecting people and infrastructure. There are needs for integrated research and education on natural and human-induced environmental disaster risks. In response, a decade-long program – Integrated Research on Disaster Risks – has been recently developed by the International Council for Science together with the International Social Sciences Council and the United Nation's International Platform for Disaster Reduction.". Pieter Visser, Catastrophe Analyst for Aon Benfield Analytics in South Africa, indicated: "Research is crucial to understanding the risks facing Africa. Working with its academic partners, Aon Benfield Research uses our findings to improve catastrophe models and provide insurers, our clients, with the high quality information they need to assess risk and provide cover."

<http://www.insurancejournal.com/news/international/2011/02/03/183169.htm>

and in the *University of Pretoria, South Africa*:

ENHANS International Workshop aims to reduce disaster risk due to extreme natural hazards in Africa

“Africa is a continent with enormous natural disaster risks. In comparison with developed countries (like Australia, Japan or USA), which are able to recover from such disasters rather quickly, most of the inhabitants in Africa are very poor and may lose everything when extreme natural hazards like floods, droughts, or earthquakes occur,” explains Prof Andrzej Kijko. Prof Kijko is the Director of the Aon Benfield Natural Hazard Centre at the University of Pretoria and one of the organisers of the ENHANS International Workshop on Extreme Natural Hazards and Disaster Risk in Africa which took place from 17 to 20 January 2011. He emphasised that one of the main aims of this international workshop was to establish a network of African experts in natural hazards, disaster risk analysis and risk management, where the knowledge and expertise from all over the continent can be analysed and utilised to mitigate and manage the consequences of extreme natural hazards in Africa.

Dr Keith Alverson, Director of the Global Ocean Observing System (GOOS; <http://www.ioc-goos.org>), shared these sentiments. “There is a big need for more awareness from government’s side about the possibilities of extreme natural hazards and disaster risks for the African continent. We also need to be aware what the effects of natural hazards and disasters in Africa are on other parts of the world and vice versa. Furthermore the preventative disaster measures and centres need to be monitored and the results be communicated regularly to the respective authorities. For example, if one only needed to check and maintain your house’s water pipes to ensure the water sprinklers work when there is a fire, one would not check it as regularly as when you know the water pipes ensure your daily water for drinking and hygienic purposes. The same goes for the maintenance of preventative measures and central organisations to monitor these risks.”

“A natural disaster should not be considered just as a natural phenomenon, such as a flood, volcano or tsunami, but rather as an extreme societal event, because natural hazards become disasters when and where people and infrastructure exist. There are needs for integrated research and education on natural and human-induced environmental disaster risks. As a response to the needs, a decade-long program *Integrated Research on Disaster Risks* (IRDR) has been recently developed by the International Council for Science (ICSU) together with the International Social Sciences Council (ISSC) and the United Nation’s International Strategy for Disaster Reduction (UN-ISDR)”, tells Dr Alik Ismail-Zadeh, the Leader of the Extreme Natural Hazards and Societal Implications (ENHANS) Project and the Secretary-General of the International Union of Geodesy and Geophysics (IUGG; <http://www.iugg.org>). He stressed an importance of capacity building in the related fields in the African continent. “Africa needs perhaps to set up an institution dealing with capacity building and research on natural hazards and disaster risks. It can be a network of already existing research and educational centers or new structures in the African countries, coordinated by one of the network’s partners. The institution could provide lecture courses for African students and promote international collaboration on natural hazards and disaster risks in Africa.”

ICSU, IUGG and GOOS are the main co-sponsors of the Workshop. Read more on the activities of ENHANS and its partner organizations on <http://www.enhans.org>

<http://web.up.ac.za/default.asp?ipkCategoryID=3523&ArticleID=6252>

FOCUS ON NORTH AMERICA AND EUROPE



ENHANS Symposium “Natural Extreme Events: Modeling, Prediction and Mitigation” and related events

13-15 December 2010, San Francisco, USA

The symposium was a part of the activity in the framework of the ICSU project “Extreme Natural Hazards and Societal Implications – ENHANS”. The symposium consisted of three scientific sessions (the program of the session can be found in [Appendix 6](#)).

The first session of the symposium was a Union session (by invitation only) and attracted attention of more than 300 experts in various fields of extreme natural hazards. The session was focused mainly on North America and Europe. On behalf of Prof. *Surjalal Sharma* (University of Maryland, College Park, USA) and Prof. *Ilya Zaliapin* (University of Nevada, Reno, USA), co-organizers of the symposium, Prof. *Alik Ismail-Zadeh* (Karlsruhe Institute of Technology, Germany; Institut de Physique du Globe de Paris, France; and Russian Academy of Sciences, Moscow, Russia) welcomed the participants of the symposium and presented the ENHANS project as a trans-disciplinary and international cooperation between natural and social scientists, engineers, industry, and policy makers.

Prof. *Daniel Baker* (Director of the Laboratory for Atmospheric and Space Physics, Colorado University at Boulder) spoke on predictability and mitigating impacts of extreme space weather events. A storm surge, as a globally distributed risk, was a topic of the talk by Prof. Dr. *Hans von Storch* (Director of Institute for Coastal Research of the GKSS Research Centre in Geesthacht, Professor at the Meteorological Institute, University of Hamburg, Germany). Prof. *Upmanu Lall* (Director, Columbia Water Center, and Alan & Carol Silberstein Professor of Engineering of the Columbia University) explained why flooding was severe in 2010. He considered several case studies and discussed whether this is a coincidence or a predictable climate phenomenon and how to respond on this extremes. Prof. *Thomas Jordan* (Director of the Southern California Earthquake Center and the W. M. Keck Professor of Earth Sciences at the University of Southern California) spoke on new large-scale numerical simulations to forecast extreme earthquake ground motions, whereas Prof. *Steven Sparks* (Director of the Bristol Environmental Risk Research Centre, University of Bristol, UK) gave a talk on extreme volcanic eruptions and discussed their return period, impact and implications. Mr. *Rowan Douglas* (Chairman of the Willis Research Network, London, UK) spoke on how re/insurance and public science interact to manage risk of extreme events for societal benefit.

The next session of the Symposium was based on three invited talks and selected contributed presentations. The 2010 AGU Natural Hazards Focus Group Graduate Research Awardee Dr. *Ning Lin* (Massachusetts Institute of Technology, Cambridge) spoke on a hurricane risk

assessment related to wind damage and storm surge. Ms. *Kelly Klima* (Graduate Student, Carnegie Mellon University, Pittsburgh) spoke on tropical cyclones and presented her approach to a decision-analytic assessment of cyclone hazards. Extreme precipitation events in the European Alpine region was the topic of the talk by Dr. *Nauman Awan* (University of Graz, Austria). Prof. *John Rundle* (University of California, Davis) spoke on precursory activation and quiescence prior to major earthquakes. Prof. *Fausto Guzzetti* (University of Perugia, Italy) discussed landslide hazard, vulnerability and risk assessment and emphasized importance of methodology for risk assessment, its limits and challenges. Prof. *Kenji Satake* (University of Tokyo, Japan) spoke on tsunami modeling, forecast and warning. Dr. *Adam Smith* (National Oceanographic Atmospheric Administration, Asheville, USA) examined insurance loss return periods with extreme event intensity thresholds across the United States.

The poster session (20 papers) presented a variety of topics related to natural hazards, extreme events, theory, modeling, prediction and mitigation. The culminating event of the symposium was a keynote lecture on “Society's Growing Vulnerability to Natural Hazards and Implications for Geophysics Research” by Prof. *Julia Slings* (Chief Scientist, MetOffice, U.K.)

Mr. *Rowan Douglas* (Managing Director of Willis Analytics for Willis Re, the world's third largest insurance and re-insurance broker) delivered an invited talk “Natural Hazards Reshape Landscapes in Finance, Public Science & Policy” at the Reception of the AGU Natural Hazards Focus Group on Tuesday, 14 December. According to Douglas natural hazard modeling, married to risk, financial and economic modeling, created a new scientific and social organism – a rich and diverse community representing how nature, property and populations perform at the extremes. An urgent need and a common medium are uniting academic disciplines, industries, public/private sectors, and technology in a shared journey. This drives a powerful intellectual fusion, creativity and impact: the shock waves are breaking down the walls.

Dr. *Jane Rovins* (Executive Director of the International Program Office for Integrated Research on Disaster Risk, IRDR) attended the Executive Committee meeting of the AGU Natural Hazards Focus Group on 15 December and presented the IRDR Program to the Focus Group leadership. She explained the mission and vision of the program, its major activities, and welcomed active participation of the AGU scientists in the program.

FOCUS ON THE MIDDLE EAST

ENHAS Session “Natural Hazards and Disaster Risks in the Middle East Region”

7 May 2011, Antalya, Turkey

The special session focused on the Middle East natural hazards and disasters was organized and chaired by Alik Ismail-Zadeh. Jane Rovin, IRDR Executive Director, gave a talk on the ICSU-ISSC-UNISDR scientific program “Integrated Research on Disaster Risk” highlighting recent developments and preparation to the IRDR Conference in Beijing in 2011.

Mohsen Ghafory-Ashtiany (Tehran, Iran) presented a talk on the topic of natural hazard and risks in Iran and on the experience in risk reduction capacity building. To reduce and mitigate the unavoidable risk of natural hazard; scientists, engineers, government officials and the general public must all be involved in finding realistic, achievable and appropriate ways of applying scientific knowledge to everyday life. Only by capacity building and working together, a nation can mitigate the impact of natural hazards on human life and society, and solve the risk puzzle. The combination of factors that has made visible progress toward a seismically safe Iran, include good and timely response of scientific community to safety demands; the national decision for natural hazard risk reduction following the Manjil and Bam earthquakes, and excellent cooperation among the scientific communities of Iran. The undoubted success of Iran’s experience can be easily applied to the developing countries. Ghafory-Ashtiani showed that the main reason for high human, social and property losses in the past decades were due to vulnerability of the built environment, rapid growth of population, and incompatible urban development with respect to exposed hazard level. To ensure the sustainable development of Iran a multidisciplinary risk reduction strategy is required with the objective of saving human lives and resources. The capacity building in Iran was started with the establishment of the International Institute of Earthquake Engineering and Seismology (IIEES) in 1989 (before the Manjil earthquake) and continued by other related institutions. This capacity building initiative provided an excellent platform for answering the increasing demand for safety, development of the required disaster reduction program and providing the required know-how and expertise for hazard and risk mapping, vulnerability reduction and public awareness and preparedness. He discussed the Iran’s achievement in seismic risk reduction during the three main eras: before the Manjil Earthquake, post Manjil Earthquake era (1990-2003), and post Bam earthquake era (2003 - present).

Cuneyt Tuzun (Istanbul, Turkey) presented a new project EMME (Earthquake Model of Middle East Region) for assessment of hazards and risks. The Middle East region is located at the junction of major tectonic plates, namely the African, Arabian and Eurasian plates, resulting in very high tectonic activity. Some of the major earthquake disasters in human history occurred in the Middle East, affecting most countries in the region. Being one of the most seismically active regions of the world, Middle East, extending from Turkey to India, is also a key region in terms of urbanization, energy reserves and industrialization trend. The region under consideration involves world’s most populated capitals and cities with key economical importance such as Istanbul, Baghdad, Tehran, Jeddah, Riyadh, Cairo, Kabul, Karachi and Lahore. Tuzun told that the EMME project aims at the assessment of seismic hazard, the associated risk in terms of structural damages, casualties and economic losses and also at the evaluation of the effects of relevant mitigation measures in the Middle East region

in concert with the aims and tools of the Global Earthquake Model Project (GEM). EMME project encompasses several modules such as the Seismic Hazard Module, Risk Module, Socio- Economic Loss Module and the development of an IT infrastructure or platform for the integration and application of modules under consideration. The methodologies and software developments within the context of EMME will be compatible with GEM in order to enable the integration process.

Abdulaziz Al-Bassam (Riyadh, Saudi Arabia) presented various natural hazards in Saudi Arabia. The Kingdom of Saudi Arabia is quite prone to different kinds of natural hazards. The northwestern region of the Kingdom is prone to earthquakes and volcanic hazards, whereas the central and the western regions of the country are exposed to floods especially during events of heavy rainfall. Landslides are a common phenomenon in the inhabited mountainous regions in the southwest. Dust storms are quite common in the central and the eastern parts of the Kingdom. Different government agencies and various universities having been working on these issues, to mitigate these hazards and also educate the people. Due to the 2009 Jeddah flood disaster more emphasis is being given to tackle the problems related to hydrological hazards. Similar events like this have the potential to affect other major cities of the Kingdom.



Flooding in Jeddah, Saudi Arabia, 2011

Tarek Merabtene (Dubai, United Arab Emirates) spoke on flood risk management in the North Africa and the Middle East Region (MENA region). Magnitude and impact of climate change will increasingly take new catastrophic dimensions under the current paradigm shift of our cities if disaster risk management actions and appropriate disaster policies are further delayed. Governments in the MENA Region are aware that countries in the Middle East region are not an exception as translated by the recommendations made during the GCC summit in Kuwait 2010 to unifying efforts on issues related to climate change. In recent years, flash floods in many different countries of MENA region have caused loss of life, social disturbance of business and livelihood and large economical damages to private and public assets. The increasing frequency of floods in the region are clear indicators that urban flood management will have potential implications on the sustainable development of current and future urban infrastructures in the MENA region. Merabtene emphasized the institutional deficiencies behind the current situation and discussed various strategic measures in the direction of mainstreaming flood risk management high in the political agenda of MENA countries.

FOCUS ON ASIA AND THE PACIFIC REGION

The following ENHANS events took place on 29 June – 2 July 2011 at the XXV General Assembly of the International Union of Geodesy and Geophysics in Melbourne, Australia:



Union Symposium

GRAND CHALLENGES IN NATURAL HAZARDS RESEARCH AND RISK ANALYSIS

Union Symposium

EARTH ON THE EDGE - RECENT PACIFIC RIM DISASTERS

Open Forum

NATURAL HAZARDS: FROM RISK TO OPPORTUNITY BY PARTNERSHIP OF SCIENCE AND SOCIETY

Co-organized by

IUGG Commission on Geophysical Risk and Sustainability (GeoRisk Commission) and
Extreme Natural Hazards and Societal Implications (ENHANS) Project

The Program “Integrated Research on Disaster Risk (IRDR)” co-sponsored by ICSU, ISSC and UNISDR started 2009 aiming at curbing natural disaster losses by knowledge-based decision-making. It is only possible through the partnership between science and society by integrating natural and social sciences, engineering, economic and industrial activities, public administration, policy making etc. The Symposium will address major challenges in natural hazards research, risk analysis and ways for solutions. Open Forum will discuss how such integration is realized and natural disaster risk can be converted to opportunity.

Co-Conveners: Kuniyoshi Takeuchi (Japan) and Alik Ismail-Zadeh (Germany/Russia/France)

Co-Conveners: Tom Beer (Australia), David Boteler (Canada), Shigeko Haruyama (Japan), David Jackson (USA), Fumihiko Imamura (Japan), Vladimir Kossobokov (Russia), John LaBreque (USA), Uri Shamir (Israel), Ramesh Singh (India), Gerd Tetzlaff (Germany).

The Scientific Program of the events can be found in Appendix 8.

SYMPOSIUM “GRAND CHALLENGES IN NATURAL HAZARDS RESEARCH AND RISK ANALYSIS”

Each year thousands of people across Asia and the Pacific region are killed and many more affected due to floods, storms, earthquakes, drought, volcanoes and other such hazards. Hazards are only potentially damaging and the disasters occur when they impact on vulnerable communities, which are highly concentrated in poorer countries with weaker governance. **Gordon McBean** (*Research Chair, the Institute of Catastrophic Loss Reduction of the University of Western Ontario, Canada, and Chair of the ICSU-ISSC-UNISDR Program “Integrated Research on Disaster Risk- IRDR”*) introduced IRDR programme, which integrates research across hazards, natural, socio-economic, engineering and health sciences disciplines and geographical regions. The research will focus on the characterization of hazards, vulnerability and risk; effective decision making; and knowledge-based actions leading to major reductions in future impacts and loss of lives. “Forensic Investigations that will delve in greater depth into the root causes of disasters is one initial thrust. The second, Risk Interpretation and Action, will examine how human actions, conditions, decisions and culture, and how people choose, or feel they have no choice but, to live and work in areas at higher risk, change vulnerabilities and contribute to disasters”, according to Dr. McBean.

“Effective disaster risk reduction is founded on knowledge of the underlying risk”, mentioned **John Schneider** (*Group Leader “Risk and Impact Analysis Group” of Geoscience Australia*). While methods and tools for assessing risk from specific hazards or to individual assets are generally well developed, our ability to holistically assess risk to a community across a range of hazards and elements at risk remains limited. Developing a holistic view of risk requires interdisciplinary collaboration amongst a wide range of hazard scientists, engineers and social scientists, as well as engagement of a range of stakeholders. Schneider presented some of the challenges sampled from a range of applications addressing earthquake, tsunami, volcano, severe wind, flood, and sea-level rise from projects in Australia, Indonesia and the Philippines.

Soroosh Sorooshian (*Director of the Center for Hydrometeorology & Remote Sensing and Distinguished Professor of the University of California at Irvine, USA*) considers that capturing the spatial and temporal distribution precipitation in fine scales is critical to hydrologic, climatic, and ecological applications. Recent development of satellite remote sensing techniques provides a unique opportunity for better observation of precipitation from space and overcome some of the limitations of ground measurement. Sorooshian reviewed some of the recent developments in the development of satellite-based precipitation observation methodologies.

“High-resolution models are vital to project reliable and possible future changes in weather extremes such as tropical cyclone and heavy rainfall”, mentioned **Akio Kitoh** (*Director, Climate Research Department, Meteorological Research Institute at Tsukuba, and Professor of Kyoto University, Japan*). Unprecedented super high-resolution atmospheric models are being used for global warming projection. Projections on tropical cyclones reveal marked future increases in precipitation and surface wind velocity fields at inner-core region within 150 km from the tropical cyclone center, implying increase in disaster risk induced by tropical cyclones in the future. Information on the uncertainty of future projection is significant for any decision-making processes and for various application studies on disaster prevention.

Paul Linden (*Professor of the University of Cambridge, UK and ENHANS representative of the International Union of Theoretical and Applied Mechanics*) presented an ongoing scientific and engineering project to prevent flooding in Venice. The construction of the flood protection gates at the entrance to the Venice Lagoon and due to be commissioned in 2014 provides an unprecedented opportunity to manage the lagoon and its interaction with the Adriatic Sea. It also raises important questions about the scientific monitoring and decision-making process to enable the sustainable development of the lagoon and the historic city of Venice. Linden discussed the past and future monitoring and assessment of the physical and ecological states of the Venice Lagoon and described proposed structures for its management.

In the book “The Handbook of Disaster and Emergency Policies and Institutions” by Handmer and Dovers (Earthscan, 2007), a lack of previous focus on the policy and institutional aspects of disasters and emergencies is identified. **Stephen Dovers** (*Professor and Director of the Fenner School of Environment and Society, Australian National University in Canberra and ENHANS representative of the International Geographical Union*) discussed the increasing emergence of climate change as a major influence on thinking about disasters, and the lessons from recent events such as floods and cyclones in Australia. Dovers emphasized particularly the degree to which existing agendas of policy and institutional reform, and existing institutional capacities provide a basis for coping with what is likely to be a future punctuated by more and more serious disasters and emergencies.

John Eichelberger (*Program Coordinator for the Volcano Hazards Program at the U.S. Geological Survey – USGS, and ENHANS representative of the American Geophysical Union*) discussed how several observatories in the Pacific region monitor volcanoes and warn of impending or ongoing eruptions. Much of the real-time monitoring data are available to the public through observatory websites, and citizen reports on volcanic activity and ash falls are solicited. Close linkage between Russian and the Alaska observatories tracks ash threatening North Pacific air routes. A challenge is to maximize the societal benefit from this expanded hazard community. Indeed, accessibility of real-time data makes the concept of cloistered observatories outmoded. Observatories will still be dedicated to monitoring a limited number of volcanoes for their neighboring populations and will be the sole authoritative voice for hazard warnings, but must also become nodes for data and knowledge exchange for the larger scientific community. The Eyjafjallajökull eruption showed that such networking should be international in scope.

The recent Indian Ocean Tsunami (26 December 2004) was the most devastating in the world over the past 40 years. **Harsh Gupta** (*Panikkar Professor at the National Geophysical Research Institute, Hyderabad, India; President of the Asian Oceanic Geoscience Society, and the ENHANS representative of the ICSU Regional Office for Asia and the Pacific*) discussed how India planned for development of an integrated mitigation system for the tsunami and storm surges in the northern part of Indian Ocean region with an ultimate goal to save lives and property. The design of the system was based on end-to-end principle, involving (i) mean real time estimate of earthquake parameters, (ii) assessment whether a tsunami has been indeed generated through deployment of ocean bottom pressure sensors and tide gauges, (iii) numerical modeling for tsunami, storm surges with all associated data inputs, (iv) generation of coastal inundation and vulnerability maps, (v) development of Tsunami Warning Centre in Hyderabad, and (vi) capacity building, education, and training for all stakeholders.

“A proper management increases the situational awareness after a disaster happened, gives a better overview of available data (especially dynamic data), facilitates the access to a desired piece of information, and contributes to automatic data processing. Consequently the information can be used more efficient in the decision-making process”, as **Sisi Zlatanova** (*Professor, Delft University of Technology, The Netherlands and ENHANS representative of the International Society of Photogrammetry and Remote Sensing*) considers. Well-structured data can support cost-benefit analysis in post-disaster period, provide strong foundation for effective mitigation measures and improve the preparedness. The variety of approaches reveals the complexity of the problem. Emergency response is very much nationally and even locally (district) organized. Furthermore each country is prone to a specific set of hazards and organizes its management procedures according to the recognized vulnerability. Another complicating factor is the disaster type, which may require different data sets and procedures for management. Dr. Zlatanova analyzed the challenges in data management and presented some dynamic data models developed recently.

UNION SYMPOSIUM: EARTH ON THE EDGE - RECENT PACIFIC RIM DISASTERS

The symposium was dedicated to the recent disasters in the Pacific Rim region.

Kuniyoshi Takeuchi (*Director of the International Centre for Water Hazard and Risk Management, Tsukuba, Japan*) introduced the total picture of the Great East Japan Earthquake and Tsunami with the latest figures of damages. He said that it was a concatenation of events occurred from the earthquake to the tsunami and from the tsunami to nuclear meltdown. Impacts spread through supply chain of production materials from local to nation and from nation to the outer world. He also introduced the newly enacted Reconstruction Law and its basic policy. He emphasized that there should not be "beyond expectation" in disaster risk management however unexpected hazards are.

The Great Off Tohoku earthquake occurred on 11 March 2011 off the Pacific coast of northern Honshu (Tohoku) was the latest in size (magnitude 9.0) and caused the worst tsunami disaster in Japan's history. **Kenji Satake** (*Professor at the Earthquake Research Institute, University of Tokyo, Japan*) mentioned that this giant earthquake was a plate boundary rupture along the Japan trench, where interplate earthquakes ($M < 8$) occurred with a few decades interval and the probability of next one in the next 30 years was forecasted as $>80\%$. The March earthquake was however much larger than forecast. The GPS network recorded large co-seismic displacements ($> 5\text{m}$ horizontal and $> 1\text{m}$ subsidence), and the tsunami inundation was several kilometers. The fault rupture was about 400 km long, while the aftershocks extended nearly 500 km long, including three $M > 7$ events within an hour of the main shock. Similarly large earthquake and tsunami in AD 869 (called the Jogan earthquake) was recorded in a Japanese historical document, which mentioned a thousand casualties and kilometers of tsunami inundation. Recent studies have clarified that the Jogan and older tsunami deposits were distributed several kilometers from the present coast with recurrence intervals of several hundreds to thousand years.

Fumi Imamura (*Professor at the Disaster Control Research Center, Tohoku University, Japan*) mentioned that the Great East Japan earthquake took more than 27,000 lives. Several types of tsunami impact are reported, among them, inundation in a large area, destructive force destroying houses, buildings, infrastructures, road, and railways, and change of topography due to the erosion and deposition. Although the observation system of tsunami

was heavily damaged along the coast, some available data recorded by the tidal gages, GPS buoy one, and deep sea pressure sensors. The extent of affected area is quite large and still limitations and difficulties of ground survey exist. Imamura reported the results of field surveys as well as satellite image analysis with ground truth data, to obtain the data of the tsunami and its disaster, and identify extent of tsunami inundation and land use change. The distribution of tsunami run-up heights measured along the coast were ranging from 7 to 15 m in Sendai and Fukushima with a simple beach geometry and 10 to 30 m in Sanriku with the complex geometry of the Rias coast.

Susan Kiefer (*Professor of the University of Illinois, USA*) discussed how the tsunami waves changed their dynamic features. As the tsunami approached and then flowed onto the shore of northern Honshu, the character of the waves changed several times. Deep-water waves changed to multiple shallow water waves as the tsunami approached shore. When these waves encountered coastal cities, they broke into individual hydraulic streams channelized by the infrastructure. From videos posted on the WWW, Keifer with her group constructed hydrographs for sites in Kesenuma, Oirase, Sendai, and Kamaishi.

Finally, **Kojiro Irikura** (*Professor of the Aichi Institute of Technology, Japan*) discussed how the huge tsunami generated by the Great East Japan earthquake led to the accidents at the nuclear reactors. When the earthquake happened, all of reactor-units at four nearby plants were automatically shut down and began to be cooled by cooling systems until they were attacked by big tsunami waves. All units at the Onagawa and the Tokai-No. 2 Nuclear Power Plants got out of troubles because the heights of tsunami waves were lower than the altitudes of the plant sites. However, the Fukushima-No.1 and the Fukushima-No.2 plants were damaged by big tsunami waves, because the tsunami heights were much higher the altitudes of the plant sites. At the Fukushima No.1 plant, external electric powers were stopped, water-tanks were broken, and further all of the independents power generation systems were broken. At the Fukushima No.2 Plant, some of the independents power generation systems were not broken because they were put at a little high ground, then the cooling systems at the Fukushima No. 2 Plant were soon recovered. The severe accidents at the Fukushima No. 1 Plant were caused to deficiency of multifaceted protective mechanisms, not only the tsunami.

The deadly and damaging Christchurch Earthquake of 22 February 2011 is part of the Canterbury earthquake sequence started by the Mw 7.1 Darfield Earthquake in September 2010. **Kevin Furlong** (*Professor at Penn State, USA*) showed that this sequence occurred on previously unrecognized fault(s) and significantly distant from the main components of the plate boundary system through South Island, New Zealand. The initial rupture of the September event and subsequent aftershocks have delineated a linear (nearly east-west in orientation) trend extending over 80 km from the foothills of the Southern Alps to the Pacific coast, east of the city of Christchurch. Understanding the relationships among fault segments, regional geologic structure, and crustal stresses associated with regional plate interactions is key to placing these events into a context that allows us to apply lesson learned elsewhere.

Neville Nicholls (*Professor at Monash University, Melbourne, Australia*) discussed the role of the climate and weather in the January 2011 Brisbane floods, and the potential role of climate/weather forecasts in avoiding or reducing flood damage. Since the last major floods in the Brisbane River (1974) there have been major advances in the detail, timeliness, delivery, and quality of weather and climate predictions on all these time-scales. On some time-scales weather and climate forecasts were not even available for previous floods. The skill of forecasts on the synoptic time-scale has improved dramatically over the past few decades. The

models used to make projections on climate change timescales have become more complex than those available in the early 1970s, and the likely consequences of global warming are now better appreciated.



Speakers of the ENHANS events in Melbourne continue a round-table discussion during a dinner.
Sit (left to right): R. Kuroda, A. Kitoh, K. Takeuchi, A. Ismail-Zadeh, J. Eichelberger, and J. Schneider.
Stand (left to right): P. Linden, S. Sorooshian, G. McBean, and H. Gupta

OPEN FORUM: NATURAL HAZARDS: FROM RISK TO OPPORTUNITY BY PARTNERSHIP OF SCIENCE AND SOCIETY

The Open Forum attracted attention not only the participants of the IUGG General Assembly but also representatives of media. **A. Ismail-Zadeh** and **Kuni Takeuchi** opened the forum. Ismail-Zadeh introduced the project “Extreme Natural Events and Societal Implications” as trans-disciplinary and international efforts of natural and social scientists, engineers, insurance industry, international organizations, policy makers and media to deals with extreme events and disaster risks. International Strategy for Disaster Reduction.

Salvano Briceno (former Director of UNISDR) welcomed the participants in his video message (<http://www.youtube.com/watch?v=pN8Xka29SzQ&feature=email>) and presented key issues related to disaster risk reduction and mitigation.

Tom Beer (*Research Program Leader at the Centre for Australian Weather and Climate Research, CSIRO, Australia; and IUGG President*) presented several challenges in natural hazards research and risk analysis especially those related to climate change.

Reiko Kuroda (*Professor of the University of Tokyo, Japan, and Vice President of the International Council for Science*) talked about partnership of science and society. She mentioned that during the last decade or so, science itself had changed: it became inter- and trans-disciplinary and more competitive. Meanwhile international collaboration through mega-projects became inevitable part of research. The most profound change for science,

however, has been its stronger interdependence with society. The outcome of science and technology very quickly spreads into our everyday life and can change and has changed socio-economic structures and our way of thinking dramatically. Kuroda proposed to nurture scientists with social literacy and public with science literacy.

After the short introductions by the panelists, Ismail-Zadeh and Takeuchi moderated the forum and discussions on the topics related to natural hazards, extreme events, disaster risk and link between science and society.

ONLINE BRIEFING: PREDICTING NATURAL DISASTERS FROM A SHAKING EARTH

The online science news briefing was held on 4 July 2011 and was organized by the Australian Science Media Centre (<http://www.aussmc.org>). Four experts were speaking at the news briefing:

- **James Goff**, Co-Director of the Australian Tsunami Research Centre and Natural Hazards Research Laboratory, University of New South Wales;
- **Alik Ismail-Zadeh**, Scientific Leader of “Computational Geodynamics” at the International Institute of Earthquake Prediction Theory and Mathematical Geophysics, Russian Academy of Sciences, Moscow; Senior Research Scientist at the Geophysical Institute, Karlsruhe Institute of Technology, Germany; and Professor at the Institut de Physique du Globe de Paris, France
- **Thomas Jordan**, Director of the Southern California Earthquake Center and Professor of Earth Sciences at the University of Southern California;
- **Brian Kennett**, Chair of the Australian Academy of Science Committee on Earth Science and Professor of Seismology at the Research School of Earth Sciences, Australian National University in Canberra;

The briefing addressed the following questions:

- Can anyone really predict earthquakes, tsunamis and volcanic eruptions? If not, why not and will we ever be able to?
- Knowing the epicenter of a shake only seems to be part of the problem, can we say how much damage they will cause?
- Australia has been affected before, how likely are we to see another earthquake or tsunami?
- Can we be forewarned enough to organize mass evacuations days in advance? Or to accurately predict that an event will happen in a few years’ time?

The briefing can be listened at the web-page of the Australian Science Media Centre: <http://www.aussmc.org/2011/07/online-briefing-predicting-natural-disasters-from-a-shaking-earth/>

FOCUS ON EDUCATION



Trieste, Italy, 26 September to 8 October 2011

ADVANCED SCHOOL

UNDERSTANDING PREDICTION OF EARTHQUAKES AND OTHER EXTREME EVENTS IN COMPLEX SYSTEMS

The need for a scientifically literate populace is increasingly recognized as critical in many countries, as they face the consequences of increasing population pressures, limited resources and environmental degradation. Basic science literacy, coupled with scientific “ways of knowing – namely drawing conclusions based on observation, experiment and analysis – provides citizens with the tools needed for rational debate and sound decision-making based on scientific knowledge” (from the 2011 report of the ICSU Ad-hoc Review Panel on Science Education). Geoscience education and particularly education on extreme natural events and disaster risk is profoundly important for basic science literacy of the population living at risk. Moreover, a special attention should be given to economically less-developed countries.

The Advanced School on Understanding Prediction of Earthquakes and other Extreme Events in Complex Systems held on 26 September to 8 October 2011 in the Abdus Salam International Centre for Theoretical Physics in Trieste, Italy, covered a wide range of the recent developments in the field of natural and socio-economic extreme hazards and disaster risks. During two weeks school, prominent experts delivered lectures and gave seminars to earlier career scientists mostly from developing countries. The list of the lectures could be found at the web: http://cdsagenda5.ictp.trieste.it/pdf_display.php?ida=a10170



Participants of the Advanced School at the poster session

FOCUS ON PREDICTABILITY



AGU FALL MEETING 2011

San Francisco, California, USA | 5-9 December

ENHANS Sessions 5-6 December 2011

UNION SESSION “PREDICTING EXTREME EVENTS IN NATURAL AND SOCIO-ECONOMIC SYSTEMS”

Natural and socio-economic disasters pose an intolerable threat to society. The most damaging and least understood in this realm are so-called extreme events. In different contexts these events are also called critical transitions, disasters, or catastrophes. The multidisciplinary research of the last decades reveals surprising similarity and structural universality in development of extreme events in systems of diverse origin.

The Union Session “Predicting Extreme Events in Natural and Socio-Economic Systems”, dedicated to V. Keilis-Borok, a distinguished scientist who greatly contributed to research on predictability of extremes in natural and socio-economic systems, reviewed the state-of-the-art in predictability and outlined directions for future research in the science of forecasting extreme events.

The Session’s co-organizers: *Andrei Gabrielov* (Purdue University, West Lafayette, USA), *Alik Ismail-Zadeh* (Karlsruhe Institute of Technology, Germany), *Donald Turcotte* (University of California, Davis, USA), and *Ilya Zaliapin* (University of Nevada, Reno, USA)

The invited speakers covered a wide spectrum of research on predictability:

- Earthquake Forecasting Based on Seismicity by *Donald L. Turcotte* (University of California, Davis, USA)
- Predictability of extremes in non-linear hierarchically organized systems by *Vladimir G. Kossobokov and Alexandre Soloviev* (Russian Academy of Sciences, Moscow, Russia)
- Earthquake prediction in Japan and natural time analysis of seismicity by *Seiya Uyeda* (Japan Academy of Sciences, Tokyo, Japan) and *Panayiotis Varotsos* (University of Athens, Greece)
- Scaling Laws, Earthquakes, Chaos and Predictions by *Claude J. Allègre, Jean-Louis Le Mouél and Clement Narteau* (Institut de Physique du Globe de Paris, France)
- Tracking Earthquake Cascades by *Thomas H. Jordan* (University of South California, Los Angeles, USA)
- Prediction of Induced Earthquakes and Deep Scientific Drilling at Koyna, India by *Harsh K. Gupta* (National Geophysical Research Institute, Hyderabad, India)
- Extreme events and their economic consequences by *Michael Ghil* (École Normale Supérieure, Paris, France)

- Using pattern recognition as a method for predicting extreme events in natural and socio-economic systems by *Michael Intriligator (UCLA, USA)*

The Union Session was videotaped and available for viewing at:

<http://sites.agu.org/fallmeeting/scientific-program/sessions-on-demand-6-december/>

NATURAL HAZARDS SESSION

“GREAT DISASTERS OF THE XXI CENTURY: THE LESSONS WE LEARNED”

Humans face natural hazards at different scales in time and space. The first decade of the century has been marked by a significant number of natural disasters, such as floods (e.g., in Europe, Pakistan, Australia); Katrina hurricane; cyclone Nargis; Kashmir, Sichuan, and Haiti large earthquakes; Sumatra and Tohoku great earthquakes and tsunamis; wildfires (e.g., in Australia, California, Russia). The session will overview the disaster cases, address major challenges in natural hazards and risk research, and try to answer the questions: What are the lessons scientists learned from the recent disasters? When do natural hazards turn to become disasters? How to integrate the knowledge from natural and social sciences to mitigate disasters?

The Session’s co-organizers: *Alik Ismail-Zadeh* (Karlsruhe Institute of Technology, Germany), *Upmanu Lall* (Columbia University, New York, USA), *Jane Rovins* (IRDR International Program Office, Beijing, China), and *Vasily Titov* (National Oceanic and Atmospheric Administration, Seattle, USA)

The Session’s speakers presented the following papers:

- Extreme Geophysical and Weather Related Disasters in the First Decade of the XXI Century - How do the Patterns of these Two Groups of Perils Differ? by *Peter Höppe; Eberhard Faust; Mark Bove (Munich Re, Germany-USA)*
- IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation by *Christopher Field (Stanford University, USA) et al.*
- Integrated Assessment of Risk Reduction for Coastal Cities by *Gordon McBean (University of Western Ontario, Canada)*
- Errors in Expected Human Losses Due to Incorrect Seismic Hazard Estimates by *Max Wyss (World Agency of Planetary Monitoring and Earthquake Risk Reduction, Geneva, Switzerland)*
- Unforecasted earthquake and forgotten tsunamis: Lessons from 2011 Tohoku event by *Kenji Satake (Earthquake Research Institute, Tokyo, Japan)*
- Ironic Effects of the Destructive Tsunami on Public Risk Judgment by *Satoko Oki and Kazuya Nakayachi (University of Tokyo, Japan)*

ENHANS PROJECT WEB-PAGE

[HTTP://WWW.ENHANS.ORG](http://www.enhans.org)



Extreme Natural Hazards and Societal Implications (ENHANS)

- About ENHANS
 - Introduction
 - Goals
 - Steering Committee
- Showcasing
- Partners
- IRDR
- Funding
- Contact Us

Welcome to ENHANS

While we cannot prevent natural phenomena such as earthquake and cyclones, we can limit their consequences (*UN Global Assessment Report on Disaster Risk Reduction*, 17 May 2009).

Humans face natural hazards on different scales in time and space. Geological, hydrometeorological and geophysical hazards affect human life and health as well as having a dramatic impact on sustainable development of society. They are a pending danger for vulnerable lifelines and infrastructure such as water supply and reservoirs, pipelines, and power plants. Developed countries are affected, but the impact is disproportionate within the developing world. **Extreme natural events** can change the life and economic development of developing nations within minutes and throw them back for decades.



- About ENHANS
- Showcasing
 - Focus on Latin America
 - Focus on North America and Europe
 - Focus on Africa
 - Focus on the Middle East
 - Focus on Asia
 - Focus on education
 - Focus on predictability
- Partners
- IRDR
- Funding
- Contact Us

Project Events

Major scientific and outreach events of the ENHANS project will be

1. **Symposium** "Natural Hazards and Disaster Risk in Latin America and the Caribbean" and associated events at the Joint Meeting of Americas (9-11 August 2010, Foz do Iguassu, Brazil);
2. **Mini-symposium** "Natural Hazards and Climate Changes" at the Egyptian Academy of Scientific Research and Technology (1 November 2010, Cairo, Egypt);
3. **Symposium** "Extreme Natural Events: Modeling, Prediction and Mitigation" at the AGU Fall meeting (12-17 December 2010, San Francisco, USA)
4. **Workshop** "Extreme Natural Hazards and Disaster Risk in Africa" (17-20 January 2011, Pretoria, South Africa);
5. **Mini-symposium** "Natural Hazards and Disaster Risks in the Middle East Region" at the conference "[Geoinformation for Disaster Management](#)" (3-8 May 2011, Antalya, Turkey);
6. **Symposium** "Grand Challenges in Natural Hazards Research and Risk Analysis" and the **Open Forum** on Natural Hazards at the XXV IUGG General Assembly (29 June – 2 July 2011, Melbourne, Australia).
7. **Advanced School** "Understanding and Prediction of Earthquakes and other Extreme Events in Complex Systems" at the Abdus Salam International Centre for Theoretical Physics (26 September – 8 October 2011, Trieste, Italy)
8. **Union sessions** "Predicting Extreme Events in Natural and Socio-Economic Systems: State-of-the-Art and Emerging Possibilities" and **Natural Hazards session** "Great Disasters of the XXI Century: the Lessons We Learned" at the AGU Fall Meeting (5-6 December 2011, San Francisco, USA)

APPENDICES

**APPENDIX 1:
FOCUS ON LATIN AMERICA AND THE CARIBBEAN REGION**

ENHANS Events Program

*2010 The Meeting of the Americas
8–12 August 2010
Convention Center, Av. Olímpio Rafagnin, 2357
Foz do Iguacu - PR, 85862–210, Brazil*

Monday, 9 August 2010

U12A. International Collaboration in Earth and Space Sciences: Present Status, Needs, and Future Perspectives I

10:30-10:45 AM

U12A-01. International Cooperation in Geophysics for Benefit of Society
A. Ismail-Zadeh; T. Beer

10:45-11:00 AM

U12A-02. The ICSU Regional Office for Latin America and the Caribbean: a new opportunity for collaboration in Understanding and Managing Risk Associated with Natural Hazards (*Invited*)
A. Abreu

11:00-11:15 AM

U12A-03. Carnegie Institution Geophysicists in South America, 1905 to the IGY: Changing Meanings of International Science
G. A. Good

11:15-11:30 AM

U12A-04. Development of a global geosciences initiative (*Invited*)
J. W. Hess; E. Nickless

11:30-11:45 AM

U12A-05. Effective Communication of Geoscience Information to the Public and the Profession - Using a Federation Approach (*Invited*)
P. Leahy

11:45-12:00 AM

U12A-06. The Role of Scientific Societies in International Collaboration: One View from the Society of Exploration Geophysicists (*Invited*) *J. H. Bradford*

12:00-12:15 PM

U12A-07. The World Climate Research Program (WCRP) (*Invited*)
I. Wainer; A. J. Busalacchi; G. R. Asrar

12:15-12:30 PM

U12A-09. Geosciences Research and Education in Developing Countries – Role of International Collaboration

J. U. Fucugauchi

U13B. Natural Hazards and Disaster Risk in Latin America and the Caribbean

2:00-2:15 PM

Introduction: *Extreme Natural Hazards and Societal Implications* - Alik Ismail-Zadeh, Omar Cardona, Jaime Fucugauchi, Ilya Zaliapin

2:15-2:30 PM

U13B-01. The International Council for Science -ICSU- Multidisciplinary Research Programme on Risk and Disaster: Content and Significance Looking at Concrete Examples of the Social Construction of Risk in the Latin American and Caribbean Region (*Invited*)

A. M. Lavell; O. D. Cardona

2:30-2:45 PM

U13B-02. Meteorological Hazards and Associated Risks in the Caribbean (*Invited*)

T. Gibbs

2:45-3:00 PM

U13B-03. Risk factors associated with urban floods in Latin America (*Invited*)

J. C. Bertoni

3:00-3:15 PM

U13B-04. A scaling criterion to estimate and compare the volcanic hazard among different volcanoes (*Invited*)

S. De La Cruz-Reyna; A. T. Mendoza-Rosas

3:15-3:30 PM

U13B-05. An Overview of the Earthquake Activity and Associated Hazards in South-America and the Caribbean and the Socio-Economic Impact of Severe Earthquakes in These Regions (*Invited*)

O. J. Perez

3:30-3:45 PM

U13B-06. The anatomy of landslides disasters – an insight (*Invited*)

I. Alcantara-Ayala

3:45-4:00 PM

U13B-08. Seismic Hazard and Earthquake Predictability

A. Soloviev; V. G. Kossobokov

4:30 PM-6:30 PM

NH14A. Natural Hazards of the Americas in Focus of Geosciences

4:30-4:45 PM

NH14A-01. Natural Hazards At Extreme: Predictive Understanding Versus Complex Reality

V. G. Kossobokov

4:45-5:00 PM

NH14A-02. Indicators of Disaster Risk and Risk Management in the Americas: Updated Assessment 2010

O. D. Cardona; M. L. Carreño

5:00-5:15 PM

NH14A-03. Seismic Hazard in Americas in Revision by Unified Scaling Law for Earthquakes (*Invited*)

A. K. Nekrasova

5:15-5:30 PM

NH14A-04. Scenarios Based Earthquake Hazard Assessment (*Invited*)

F. Romanelli; A. Peresan; F. Vaccari; G. F. Panza

5:30-5:45 PM

NH14A-05. Hazard evaluation in Valparaiso: the MAR VASTO Project

F. Romanelli

5:45-6:00 PM

NH14A-06. Integrated Urban Flood Management in Latin America (*Invited*)

C. E. Tucci

6:00-6:15 PM

NH14A-07. Statistical prediction of storm surge in the New York Metropolitan area

H. Salmun; A. M. Molod; K. Wisniewska; F. Buonaiuto

6:15-6:30 PM

NH14A-08. Multiple meteoroid impacts in Antarctica and the mid-Brunhes Event/MIS 11 Stage:if there's a connection,what are the implications for humanity?

A. R. Rice; J. Weihaupt; F. van der Hoeven

Tuesday, August 10, 2010

12:45 PM- 13:45 PM, Room Salao Iguacu I

Town Hall meeting:

"Natural Hazards in Latin America and Caribbean (NHLAC): From Risk to Opportunity by Partnership of Science and Society"

Moderators:

Jaime Urrutia Fucugauchi (Mexico) and Alik Ismail-Zadeh (Germany/Russia)

The Town Hall meeting will address the following topics:

- (i) How science (both natural and social) and society can form partnership for disaster reduction?

- (ii) How science and society partnership can convert natural disaster risk to opportunity?
- (iii) What are the urgent issues of disaster risk in LAC cities and regions under intensifying natural and social pressure?

Scientists, public managers, policy makers and other stakeholders will be invited to present solutions to the problems, to indicate the potential barriers and break-throughs.

Speakers: Keith ALVERSON

Affiliation: Director, Global Ocean Observing System, Intergovernmental Oceanographic Commission of UNESCO

Title: Global Ocean Observing System in Latin America and the Caribbean

Summary: The talk will focus on the importance of sustained ocean observing systems be in place both to prevent and mitigate disasters, where possible, but also in order to rapidly bring observing assets to bear in post disaster relief efforts. Both natural coastal inundation hazards, such as storm surge and tsunami, as well as anthropogenic hazards, such as oil spills, will be discussed, focusing where possible on Latin America and the Caribbean, including the Gulf of Mexico. In the context of global sea-level rise, the presentation will probe the interface between physical and social sciences in order to clearly distinguish between patterns of climatic and environmental change, and patterns of risk and vulnerability.

Speaker: Allan LAVELL

Affiliation: Latin American Social Sciences Faculty – FLACSO and LA RED, Costa Rica (ICSU Regional Office for LAC Rep)

Title: Increasing the Salience of Disaster Risk Management on the Political Agenda

Summary: Disaster Risk Management is still not of sufficient social and political salience given current and future predicted disaster trends and costs, and which climate change will probably add to. The talk will try to highlight why this may be so and what are the principle ways to place the theme more firmly on the political and social agenda.

Speaker: Piero BOCCARDO

Affiliation: Director, ITHACA/Politecnico di Torino, Italy (ISPRS Rep)

Title: Geomatics and disaster management: Haiti emergency

Summary: Presentation highlights issues and challenges associated with emergencies related to natural disasters. Taking into account the last earthquake occurred in Haiti, data acquisition, processing and information extraction are presented when humanitarian response is involved. Milestones gained and issues to be approached are also introduced, with the aim to set up effective procedures suitable for technologic assistance to early impact and reconstruction phases.

Panelists:

I. Alcantara-Ayala (Mexico), IGU Vice-President

M. McPhaden (USA), AGU President

2:00 PM-6:30 PM, Rafain Expocenter II-III Exhibit Hall

NH23A. Natural Hazards of the Americas in Focus of Geosciences. Posters

NH23A-01. Earthquakes and Possible Relationship with Solar Cycles M. D. Tavares

NH23A-02. A Declustering Method for Seismicity using the Thirumalai-Mountain Metric N. Cho; K. F. Tiampo; W. Klein; J. B. Rundle

NH23A-03. Disaster monitoring for the Abruzzo earthquake in Italy (April 2009) with ALOS/PALSAR observations N. Kawano

NH23A-04. Assessment of the Potential of Scale Formation and Corrosivity of Tap Water Resources and the Network Distribution System in Shiraz, South Iran M. Dehghani

NH23A-05. A case study of the extreme weather event in southern South America: The 2008 – 2009 drought. M. N. Nuñez; A. E. Fernández; H. H. Ciappesoni; A. Rolla

NH23A-06. Holocene giant collapses in the Aconcagua Park. S. M. Moreiras

NH23A-07. Natural hazards as an eco-geo-social phenomenon J. Kelmelis

NH23A-08. Mechanical-mathematical modeling of landslides processes V. Svalova

NH23A-09. The Location Capability of a Local Seismograph Array, Doppler Determination of Rupture Directions, and Tectonic Activity on the Agua Blanca Fault of NW Baja California, Mexico F. A. Nava Pichardo; J. Acosta; J. Frez

NH23A-10. A Statistical Method for a Simple Assessment of the Volcanic Hazard A. Mendoza-Rosas; S. De La Cruz-Reyna

NH23A-11. Low frequency seismic events at Ceboruco Volcano, México. M. C. Rodriguez-Uribe; J. J. Sanchez; F. J. Nunez-Cornu; E. Trejo; C. Suarez-Plascencia

NH23A-12. Study of the Seismic Source of 2005 Vulcanian Explosions at Colima Volcano F. J. Nunez-Cornu; C. Suarez-Plascencia; E. Trejo

NH23A-13. Developing of a wireless sensor network to monitor and quantify debris flows from Cotopaxi and Tungurahua volcanoes P. D. Marcillo; F. Vasconez; M. E. Vaca

NH23B. Societal Impacts of Monsoon Variability in the Americas Posters

NH23B-01. Caribbean Sea Tropical Cyclone occurrences in the last six decades and their impacts in Central America and the Caribbean Islands (*Invited*) E. J. Alfaro

NH23B-02. Creating dynamically downscaled seasonal climate forecast and climate change projection information for the North American Monsoon region suitable for decision making purposes C. L. Castro; F. Dominguez; H. Chang

NH23B-03. Hydrologic Extremes in a changing climate: how much information can regional climate models provide? F. Dominguez; X. Zhang; C. L. Castro; H. Chang; D. P. Lettenmaier

NH23B-04. Statistical Analysis and Verification of Dynamically Downscaled Seasonal Forecast for the Summer North American Monsoon Region H. Chang; C. L. Castro; B. Ciancarelli

NH23B-05. The Amazon Drought of the Century in 1926 also Impacted Acre State, southwestern Amazonia, Brazil. R. Tavares; I. F. Brown

NH23B-06. Scenario-based Assessment Vulnerability of the Midwest Regional Economy to Monsoon Variability and Changing Climate J. O. Adegoke; S. E. Hasan; T. Willoughby; J. Ware

NH23B-07. Sonora Si- or No? The investigation of stakeholders' discourses that make a state hydrological project (im)possible in a NW Mexican state. N. A. Cortez; I. Minjarez; C. M. Minjarez

NH23C. TSUNAMIS ON THE PACIFIC AND ATLANTIC COASTS OF AMERICA I POSTERS

NH23C-01. Post-event Tsunami Data with focus on the 27 February 2010 Chile Earthquake K. J. Stroker; G. Mungov; P. K. Dunbar

NH23C-03. Historical and Prehistorical Evidence of Large Earthquakes and Tsunamis at the Pacific Coast of Mexico – Guerrero. M. Ramirez-Herrera; M. Lagos; I. Hutchinson

NH23C-04. Study of earthquake october 9, 1995 and the tsunami at Jalisco coast E. Trejo-Gómez; M. Ortiz-Figueroa; F. J. Nunez-Cornu; J. Sanchez; A. Gomez; M. C. Rodriguez-Uribe

NH23C-06. Tsunami Monitoring, Response Criteria and Dissemination for Puerto Rico and US and British Virgin Islands L. Soto-Cordero; V. Huerfano; G. Baez-Sanchez

NH23C-07. Consideration of far-field sources in tsunami hazard assessment in the West Indies: lessons from the 1755 and 1761 events. J. Roger; F. Accary

NH23C-08. Tsunamis generated by 3D granular landslides F. Mohammed; H. M. Fritz

APPENDIX 2: FOCUS ON NORTH AFRICA

Egyptian Academy of Scientific Research and Technology, Cairo, Egypt

Program

Monday, 1 November 2010

Moderator: Attia Ashour (Egypt) and Tom Beer (Australia)

Time	Speaker	Title
9:30 – 9:55	Tom Beer (Australia)	Environmental Risk Management, Climate Changes and Geophysical Hazards
9:55 – 10:20	Harsh Gupta (India)	Tsunami Warning for the Indian Ocean
10:20 – 10:45	Alik Ismail-Zadeh (Germany / Russia)	Extreme Natural Hazards and Social Implications
10:45 – 11:10	Samir Riad (Egypt)	Climatic Changes and their Possible Impacts in Egypt and in North Africa
<i>Break</i>		
11:40 – 12:05	Chen Yun-Tai (China)	Fast Determination of Earthquake Source Rupture Process with Application to Earthquake Emergency Response
12:05 – 12:30	David Jackson (USA)	Global Earthquake Forecasts
<i>Panel Discussion</i>		

APPENDIX 3: FOCUS ON SUB-SAHARA AFRICA

ENHANS International Workshop on Extreme Natural Hazards and Disaster Risk in Africa

17 - 20 January 2011
Protea Hotel Manor, Hatfield, Pretoria, South Africa

Hosted by the Aon Benfield Natural Hazard Centre, University of Pretoria, South Africa

P R O G R A M

Monday, 17 January

08:00-09:00 Workshop registration

Chair: **A. Kijko**

09:00-09:15 **E. Madela-Mntla** (ICSU ROA, South Africa)
Welcome from the International Council for Science Regional Office for Africa

09:15-09:30 **A. Kijko** (Aon Benfield Natural Hazard Centre, University of Pretoria, South Africa)
Welcome from the Aon Benfield Natural Hazard Centre

09:30-10:00 **A. Ismail-Zadeh** (International Union of Geodesy and Geophysics, Karlsruhe, Germany)
Extreme Natural Hazards and Societal Implication: an ICSU project

10:00-10:30 **J. Rovins** (Integrated Research on Disaster Risk IPO, Beijing, China)
Integrated Disaster Risk: From Research to Practice

10:30-11:00 Coffee break

Chair: **V. Gusiakov**

11:00-11:30 **A. Enow** (ICSU Regional Office for Africa, Pretoria, South Africa)
Addressing the Challenges of Hazards and Disasters in Africa: ICSU ROA strategy

11:30-12:00 **C. Vogel** (University of the Witwatersrand, Johannesburg, South Africa)
Forin or Farout? Exploring Multiple Drivers of Disaster Risks in Southern Africa

12:00-12:30 **R. Pinho** (GEM Foundation, Pavia, Italy)
The Global Earthquake Model (GEM) - Uniform and Open Standards to Calculate and Communicate Earthquake Risk

12:30-13:00 **P. Löw** (Geo Risks Research, Munich Reinsurance, Munich, Germany)
Hitting the Poor – Impact of Natural Catastrophes in Economies at Various Stages of Development

13:00-14:00 Lunch

Chairs: **A. Ismail-Zadeh**

14:00-14:30 **R. Backhaus** (UN-SPIDER, Bonn, Germany)
Natural Disasters and Space Technology Application: How UN-SPIDER Bridges the Gap

14:30-15:00 **M. Faye** (UNEC for Africa, Addis Ababa, Ethiopia)
Space-based Solutions for Disaster Management and Emergency Response for Africa

15:00-15:30 **E. Khamala** (RCMRD - Regional Center for Mapping of Resources for Development, Kenya)
Early Warning Systems in Eastern and Southern Africa: The Role of RCMRD

15:30-16:00 **S. Briceño** (UN-ISDR, Geneva, Switzerland)
The International Strategy for Disaster Reduction and the Hyogo Framework for Action (2005-2015): Essential Tools for Meeting the Challenges of Extreme Events and Climate Change

Moderators: **S. Briceño, J. Rovins**

16:00-17:00 Discussion: *Disaster Risk Reduction and Mitigation in Africa: Current State and Perspectives.*

18:00 Welcoming cocktail

Tuesday, 18 January

Chair: **R. Durrheim**

09:00-09:30 **K. Moffatt** (University of Cambridge, United Kingdom)
Fluid Dynamics and Geophysics of Environmental Hazards

09:30-10:00 **V. K. Gusiakov** (Russian Academy of Sciences, Novosibirsk, Russia)
Tsunami Impact on the African Coast: Historical Cases and Future Hazard Assessment

10:00-10:30 **I. Zaliapin** (University of Nevada, Reno, USA)
Hierarchical Network Approach to Modeling Extreme Events

10:30-11:00 Coffee Break

Chair: D. Benouar

11:00-11:30 **A. Kijko** (University of Pretoria, Pretoria, South Africa)
“Black Swan” events – events beyond the realm of expectations

11:30-12:00 **A. Ismail-Zadeh** (Karlsruhe Institute of Technology, Germany)
Extreme Seismic Events: From Modeling and Prediction to Preventive Disaster Management

12:00-12:30 **G. Yirgu Abegaz** (Addis Ababa University, Ethiopia)
Recent Eruptions in the Afar Rift: Hazards in the Making

12:30-13:00 **G. Papadopoulos** (National Observatory of Athens, Greece)
Large Earthquakes and Tsunamis in the Mediterranean Segment of North Africa

13:00-14:00 Lunch

Chair: A. Abdel Hady

14:00-14:30 **A. Diongue-Niang** (Senegal Meteorological Agency, Dakar Senegal)
THORPEX-Africa and the High-Impact Weather Information System

14:30-15:00 **B. Morel** (University of Reunion, Saint-Denis, Reunion)
Analysis of the 1997 Floods over East and Central Africa

15:00-15:30 **A. Abdel Hady** (Cairo University, Giza, Egypt)
Climate Change Hazard and the River Nile

15:30-16:00 **M. Majodina** (South Africa Weather Service, Pretoria, South Africa)
Socio-Economic Impacts of Meteorological Phenomena in Africa

Moderators: A. Diongue-Niang, A. Ismail-Zadeh

16:00-17:00 Discussion: *Modelling, Prediction and Mitigation of Natural Extreme Hazard and Capacity Building in Africa*

Wednesday, 19 January

07:30-13:00 Guided Tour to Tswaing crater site

13:00-14:00 Lunch

Chair: A. Abel

14:00-14:30 **K. Alverson** (GOOS, IOC Ocean Observations and Services Section, UNESCO, Paris, France)
The Role for Sustained, Global Ocean Observations in Preventing and Mitigating Disasters

14:30-15:00 **A. Abel** (Université d'Abomey Calavi, Cotonou, Benin)

Analysis of Human Issues Affecting Flood Disasters in West Africa

15:00-15:30 **I. A. Elshinnawy** (Coastal Research Institute, Alexandria, Egypt)
Vulnerability to Climate Changes and Adaptation Assessment for Coastal Zones of Egypt

15:30-16:00 **J. N. Kabubi** (Kenya Meteorological Department, Nairobi, Kenya)
Extreme Hydro-Meteorological Hazards in the Greater Horn of Africa (GHA): Challenges and Opportunities

Moderators: **I. A. Elshinnawy, K. Alverson**

16:00-17:00 Discussion: *Marine and Coastal Hazards in Africa: Risk Assessment and Impact Mitigation*

19:00-22:00 Workshop's Dinner

Thursday, 20 January

Chair: **C. J. H. Hartnady**

09:00-09:30 **C. J. H. Hartnady** (Umvoto, Muizenberg, South Africa)
Earthquake and Tsunami Impacts on South Africa

09:30-10:00 **D. Benouar** (USTHB, Alger, Algeria)
A Collaborative Programme in Capacity Development in Disaster Risk Reduction – Through African Universities

10:00-10:30 **T. M. Randrianalijaona** (University of Antananarivo, Madagascar)
Madagascar: Coping with Disaster Risk and the Role of Capacity Building Programs

10:30-11:00 **O. A. Ediang** (Nigerian Meteorological Agency, Oshodi Lagos, Nigeria)
Application of Remote Sensing in Disaster Management and Security Along the Coastline of Nigeria

11:00-11:30 Coffee break

Discussion Leaders: **A. Ismail-Zadeh, A. Kijko**

11:30-13:00 General Discussion and Workshop Conclusion

APPENDIX 4:

THE ENHANS INTERNATIONAL WORKSHOP RECOMMENDATION

Pretoria, South Africa, 20 January 2011

*The following recommendation is made by attendees of
the International Workshop “Extreme Natural Hazards and Disaster Risks in Africa”.*

Whereas, natural hazards are an integral component of life in the African continent, and floods, droughts, earthquakes, tsunamis, landslides, and other extreme natural events hit Africa on a regular basis resulting in tragic loss of life and property due to tremendous vulnerability of the African countries to extreme hazards;

The ENHANS International Workshop “Extreme Natural Hazards and Disaster Risks in Africa”

Acknowledging the long-standing and ongoing contributions of
the American Geophysical Union (AGU);
the Global Oceanic Observing System (GOOS) of the Intergovernmental Oceanographic Commission (IOC) of UNESCO;
the International Council of Science (ICSU) including its Regional Office for Africa;
the ICSU/ISDR/ISSC International Programme Integrated Research on Disaster Risks (IRDR);
the International Geographical Union (IGU);
the International Society for Photogrammetry and Remote Sensing (ISPRS);
the International Union of Geodesy and Geophysics (IUGG);
the International Union of Geological Sciences (IUGS);
the International Union of Theoretical and Applied Mechanics (IUTAM);
the Observing System Research and Predictability Experiment (THORPEX) of the World Meteorological Organization (WMO);
the United Nations Environment Programme (UNEP)
the United Nations International Strategy for Disaster Reduction (UNISDR);
the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER); and
other United Nations, intergovernmental, international and national organizations dealing with natural hazards and disaster risks;

Recalling the relevant recommendations of the World Conference on Disaster Reduction in Kobe, Hyogo, Japan, 2005, in particular the Hyogo Framework for Action (2005-2015): Building the Resilience of Nations and Communities to Disasters (HFA);

Noting the valuable contributions to and intensive discussion during the Workshop;

Recognizing that:

- (1) vulnerability of Africa is high and growing, and therefore, it is of crucial importance to reduce it for the safety and security of Africa;
- (2) an extreme natural event can trigger major socio-economic disorder or even conflicts in the countries of the African continent that may have an impact of global significances;

- (3) agricultural based African countries are highly dependent on climatic conditions, and there is a need to reduce the dependence (e.g. on rainfalls);
- (4) marine and coastal hazard vulnerability reduction requires observational infrastructure;
- (5) a lack of scientific data, their scattering and quality, access to data, and data exchange are major problems of research on natural hazards and disaster risks and in disaster risk reduction and management;
- (6) better education of students in Africa going through higher education on integrated research (like the PeriPeriU project) as well as of policy makers on disaster risk reduction is required;
- (7) better and more systematic use of the media would help promote risk reduction;
- (8) enhanced collaboration among natural, social, and health scientists and engineers in Africa could contribute to reduction of adverse effects of natural hazards;
- (9) closer and more active links among science, policy makers and end-users in operational disaster management bodies in Africa is essential for ensuring effective risk and vulnerability reduction;

Emphasizing that:

- (1) The social and economic impacts of disasters usually exceed, by several orders of magnitude, the cost of risk reduction (prevention, mitigation and preparedness);
- (2) Existing technology for satellite observations, real-time geophysical and environmental monitoring, and natural hazard forecasting models could prevent loss of life in Africa due to the disastrous events if their predictions are timely prepared and delivered and warnings were heeded by the disaster management and other relevant authorities;
- (3) For an improved management of disaster relief efforts, adequate scientific knowledge, existing technology and data could provide regional rescue agencies (national disaster management, civil defense or civil protection managers) immediate quantitative estimates of the occurrence, extent and severity of the disaster as well as data on impacts to be further utilized in recovery and risk reduction efforts;

Recommends to governments and funding institutions in cooperation with the relevant ICSU bodies, United Nations agencies and other international entities, that:

- (1) the African Centre for Natural **H**azards, **D**isaster Risk Analysis and **M**anagement (ACHADEME), a network of already existing research and educational centers or new institutions in the African countries, coordinated by one of the network's partners, be set up in order to:
 - (i) improve understanding of natural phenomena and human, social, economic and ecological vulnerabilities associated with disasters and develop predictive modeling capability;
 - (ii) enhance the quality of the African PhD programmes to benefit students and earlier career specialists dealing with natural hazards and disaster risks through lecture and diploma courses;
 - (iii) exchange knowledge and experience via research workshops, advanced schools, and networking of African scientists and experts in disaster risk management;
 - (iv) integrate and provide free-access diverse data streams; and
 - (v) promote international collaboration on natural hazards and disaster risks in Africa and with other regions of the world ;
- (2) Education and capacity building at all levels on natural hazards, disaster risk reduction (prevention, mitigation and preparedness) and post-disaster recovery

should become a priority topic of the national disaster risk reduction policies of African countries;

- (3) Disaster risk management and climate adaptation centers be established in African countries in order to:
 - (i) catalogue, monitor and continuously update information on the population and infrastructure at risk and other hazard-relevant data;
 - (ii) monitor land, water, sea and atmospheric processes, and their interaction, in relation to all kinds of natural hazards that can occur,
 - (iii) assist emergency response agencies during disasters by providing timely information; and
 - (iv) facilitate regional and international cooperation and coordination;
- (4) As an essential part of a strategy for risk reduction, more infrastructure for reservoir holding and irrigation during dry seasons needs to be developed in the African regions affected by repeated threats of droughts and floods;
- (5) An efficient collaboration be encouraged between natural and social scientists and engineers, health professionals as well as with mass-media and policy-makers;
- (6) Insurance industry be more actively developed and involved in disaster reduction efforts;
- (7) A partnership be promoted between the corporate industries and the scientific community towards establishing observation systems to enhance the application of geosciences in disaster risk reduction;
- (8) A joint statement of the African national academies related to science education on natural hazards and disaster risks in Africa be issued;
- (9) the ICSU Regional Office for Africa, with input from ICSU Scientific Unions and UN agencies, to facilitate and coordinate action on the science policy interface related to disaster risk mitigation in Africa; and

Resolves to promote fundamental research of the Earth systems, natural hazards, and natural and human-induced environmental disaster risks in Africa in order to improve monitoring and prediction of extreme natural hazards for the benefit of the society. Namely,

- (1) To develop and to maintain an African seismic network combining local seismic networks, to monitor earthquake activity and deformation, and to intensify studies on quantitative predictions of large seismic events;
- (2) To concentrate on studies of volcanoes combining the monitoring of gas flux, crustal deformation, volcano seismicity, gravity, electromagnetic and radioactivity anomalies with theoretical and numerical modeling;
- (3) To improve research capabilities of African national meteorological services to forecast hydro-meteorological hazards;
- (4) To develop specific research methodologies dealing with incomplete and scattered data sets (specifically important for Africa);
- (5) To use vast GOOS dataset operating in Africa to monitor and forecast natural hazards associated interaction of land, ocean and atmosphere (e.g., earthquakes, tsunami, landslides);
- (6) In collaboration with the ICSU World Data System and ICSU Regional Office for Africa, to develop a network of African data centers and services to collect and index fundamental datasets, to document the datasets by creating metadata, to create data standards and data charters among many others.

APPENDIX 5:

BLACK SWAN ON FIRST LOOKING INTO THE TSWAING METEORITE CRATER

BY KEITH MOFFATT



In single file we climbed the narrow trail,
Through bramble thicket to the crater's rim.
Where warming sun cast shadows on the brim,
And bathed the bushveld scrub and scattered shale.

Concealed beneath the gently waving grass,
By saline lake, the haunt of duck and plover,
Lay snakes and lizards in the rain-soaked clover,
On diaplectic quartz and feldspar glass.

In prehistoric stone-age time of yore,
At hypersonic speed a chondrite fell
On thunderstruck impala and gazelle,
And vaporized upon the forest floor,

Black swans are not so rare, I heard you say!
Beware! One may befall this very day!

APPENDIX 6:

PROGRAM OF THE ENHANS EVENTS AT THE 2010 AGU FALL MEETING, SAN FRANCISCO, USA

Session Title: U13B. Extreme Natural Events: Modeling, Prediction, and Mitigation	
Conveners Alik Ismail-Zadeh, Ilya Zaliapin, A Surjalal Sharma	
Location: MS-104 (Moscone South)	
Start time: Monday, December 13 - 1:50 PM	
U13B-01. Predicting and mitigating impacts of extreme space weather (<i>Invited</i>). <u>D. N. Baker</u>	1:55 PM
U13B-02. Storm surges – a globally distributed risk, and the case of Hamburg (<i>Invited</i>). <u>H. von Storch</u>	2:13 PM
U13B-03. 2010: Why is it flooding everywhere this year? Coincidence or a predictable climate phenomenon, and how can we respond? (<i>Invited</i>). <u>U. Lall</u>	2:31 PM
U13B-04. From M8 to CyberShake: Using Large-Scale Numerical Simulations to Forecast Earthquake Ground Motions (<i>Invited</i>). <u>T. H. Jordan et al.</u>	2:46 PM
U13B-05. Extreme Volcanic Eruptions: return periods, impact and implications (<i>Invited</i>). <u>R. S. Sparks</u>	3:04 PM
U13B-06. Connecting Capital and Catastrophe in a Modeled World - How re/insurance and public science interact to manage risk for societal benefit (<i>Invited</i>). <u>R. Douglas</u>	3:22 PM

Session Title: NH14A. Extreme Natural Events: Modeling, Prediction, and Mitigation	
Conveners Alik Ismail-Zadeh, Ilya Zaliapin, A Surjalal Sharma	
Location: MW-3022 (Moscone West)	
Start time: Monday, December 13 - 4:00 PM	
NH14A-01. Hurricane Risk Assessment: Wind Damage and Storm Surge (<i>Invited</i>). <u>N. Lin</u> ; <u>E. H. Vanmarcke</u> ; <u>K. Emanuel</u>	4:00 PM
NH14A-02. Does It Make Sense to Modify Tropical Cyclones? A Decision-Analytic Assessment. <u>K. Klima</u> ; <u>M. G. Morgan</u> ; <u>I. Grossmann</u>	4:20 PM
NH14A-03. Extreme precipitation events: Comparative evaluation of high resolution regional climate models in European Alpine region. <u>N. K. Awan</u> ; <u>A. Gobiet</u> ; <u>M. Suklitsch</u>	4:35 PM
NH14A-04. Precursory Activation and Quiescence Prior to Major Earthquakes. <u>J. B. Rundle</u> ; <u>J. R. Holliday</u> ; <u>D. L. Turcotte</u> ; <u>K. F. Tiampo</u> ; <u>W. Klein</u> ; <u>W. Graves</u>	4:50 PM
NH14A-05. Landslide hazard, vulnerability and risk assessment: methods, limits and challenges (<i>Invited</i>). <u>F. Guzzetti</u>	5:05 PM
NH14A-06. Tsunami Modeling. Forecast and Warning (<i>Invited</i>). <u>K. Satake</u>	5:25 PM

NH14A-07. Examining Insurance Loss Return Periods with Extreme Event Intensity Thresholds across the US: 1980-2010. A. B. Smith

5:45 PM

Session Title: U15A. Frontiers of Geophysics: Society's Growing Vulnerability to Natural Hazards and Implications for Geophysics Research

Convener: Catherine L Johnson

Location: MS-103 (Moscone South)

Start time: Monday, December 13 - 6:30 PM

U15A-01. Society's Growing Vulnerability to Natural Hazards and Implications for Geophysics Research (*Invited*). J. Slings

POSTER PRESENTATIONS

Session Title: NH11A. Extreme Natural Events: Modeling, Prediction, and Mitigation. Posters

Conveners Alik Ismail-Zadeh, Ilya Zaliapin, A Surjalal Sharma

Location: MS-Poster Hall (Moscone South)

Start time: Monday, December 13 - 8:00 AM

NH11A-1102. Study of Impact of Groundwater Cascading on Bio-Geochemical Parameters of Lake Michigan . Y. A. Kontar; A. Stumpf

NH11A-1103. Scenario-based extreme seismic hazard and risk assessment for the Baku city (Azerbaijan). A. Ismail-Zadeh; G. Babayev; J. Le Mouel

NH11A-1104. Understanding Earthquake Hazard & Disaster in Himalaya - A Perspective on Earthquake Forecast in Himalayan Region of South Central Tibet. D. Shanker; . Paudyal; H. Singh

NH11A-1105. Investigating the Seismic Response of a Large Rock Slope Instability (Randa, VS). J. R. Moore; J. Burjánek; V. S. Gischig; S. Loew; D. Faeh

NH11A-1106. Application of New Liquefaction Hazard Mapping Techniques to the Sacramento-San Joaquin Delta. C. R. Real; K. L. Knudsen; M. O. Woods

NH11A-1107. NATURAL HAZARDS AT THE OTHER EXTREME: AN APPARENTLY SEASONAL HAZARD AT TAIHAPE LANDSLIDE, NEW ZEALAND. M. J. McSaveney; C. Massey

NH11A-1108. The costal landslide from analogue experiments: perspectives and limitation. C. Del Ventisette; T. Nolesini; S. Moretti; R. Fanti

NH11A-1109. SUDDEN MORPHOMETRIC CHANGES INDUCED BY DIFFUSE MASS WASTING PROCESSES. S. Moretti; N. Casagli; F. Catani; A. Battistini; F. Raspini

NH11A-1110. Solidification of Suspended Sediments with Two Characteristic Grain Sizes. G. Zarski; R. I. Borja

NH11A-1111. A potential submarine landslide tsunami in South China Sea. Z. Huang; Y.

Zhang; A. D. Switzer

NH11A-1112. Nonlinear analytical solution for landslide generated tsunamis. B. Aydin; U. Kanoglu; C. Synolakis

NH11A-1113. GIS-based multi-criteria analysis for the evaluation of subsidence in coal mine. J. Suh; Y. Choi; H. Park; H. Kwon; S. Yoon; W. Go

NH11A-1114. Interagency Operating Plan for Pacific Northwest Volcanic Ash Events. J. M. Osiensky; S. Birch

NH11A-1115. Statistical Approach to Detection of Strombolian Activity in Satellite Data. A. K. Worden; J. Dehn; M. Ripepe; A. J. Harris

NH11A-1116. Time series analysis to identify thermal precursors and develop forecasting algorithms: case studies from Bezymianny, Shiveluch, Kliuchevskoi and Karymsky. S. M. van Manen; J. Dehn; S. Blake

NH11A-1117. Data-Based Comparison of Frequency Analysis Approaches: Methodological Framework and Application to Rainfall / Runoff Data in France.. M. Lang; B. Renard; K. Kochanek; E. Sauquet; F. Garavaglia ; E. Paquet ; J. Soubeyroux ; S. Jourdain ; J. Veyssiere ; F. Borch ; L. Neppel ; K. Najib ; P. Arnaud ; Y. Aubert ; A. Auffray

NH11A-1118. Predictability and predictive ability of severe rainfall events over Italy. L. Molini; A. Parodi; N. Rebora; G. Craig; F. Siccardi

NH11A-1119. Reducing New Orleans Residential Flood Risk in an Uncertain Future Using Non-Structural Risk Mitigation. J. R. Fischbach; D. Groves; D. Johnson

NH11A-1120. A comparative analysis of MODIS based spectral indices for drought monitoring over fire prone vegetation types. G. Caccamo; L. A. Chisholm; R. Bradstock; M. L. Puotinen

NH11A-1121. Localized Modeling of Storm Surge Effects on Civil Infrastructure using ADCIRC. J. S. Simon; J. Baugh

NH11A-1122. Los Alamos Radiation Hydrocode Models of Asteroid Mitigation by a Subsurface Explosion. R. Weaver; C. S. Plesko; W. Dearholt

APPENDIX 7:

PROGRAM OF THE ENHANS SESSION

“Natural Hazards and Disaster Risks in the Middle East Region”

7 May 2011, Antalya, Turkey

Chair

Alik Ismail-Zadeh, Karlsruhe Institute of Technology, Germany; Institut de Physique du Globe de Paris, France; Russian Academy of Sciences, Moscow, Russia;

Scope

Today a single extreme natural event in the Middle East may take up to a hundred thousand lives; result in material damage up to billions of dollars, and cause a chain reaction including economic depression, ecological catastrophe, significant damage to a megacity, and disruption of the military balance in the region. The scientific session as a part of the ICSU project “Extreme Natural Events and Societal Implications” (<http://www.enhans.org>) will provide an opportunity to discuss and to analyse topics related to extreme natural events and disaster risk management in the Middle East region and to present methodologies and technologies suitable for hazard and risk analysis and disaster management.

INVITED SPEAKERS

- **Jane Rovins**, IRDR IPO, Beijing, China: Integrated Research on Disaster Risk: A New International Programme
- **Mohsen Ghafory-Ashtiani**, International Institute of Earthquake Engineering and Seismology, Tehran, Iran: *Risk of Natural Hazard in Iran and Experience on Risk Reduction Capacity Building*
- **Cuneyt Tuzun**, Mustafa Erdik, Domenico Giardini, Karin Sesetyan, Bogazici University, Istanbul, Turkey; ETH Zurich, Switzerland: *A Regional Program of GEM: Earthquake Model of Middle East (EMME)*
- **Abdulaziz Al-Bassam**, King Saud University, Riyadh, Saudi Arabia: *Natural Hazards in Saudi Arabia*
- **Tarek Merabtene**, University of Sharjah, Dubai, United Arab Emirates: *Flood Risk Management in the Middle East: Challenges and Opportunities*

APPENDIX 8:

PROGRAM OF THE ENHANS EVENTS IN MELBOURNE, AUSTRALIA

29 JUNE 2011

Session 1

Chairperson: K. Takeuchi

- 08:30 The Grand Challenges of Integrated Research on Disaster Risk
G. McBean,
- 09:00 Natural Hazard Risk Assessment in the Australasian Region:
Informing Disaster Risk Reduction and Building Community Resilience
J. Schneider, J. Sexton
- 09:30 Satellite-based remote sensing estimation of precipitation for
early warning systems: Strengths and Limitations
S. Sorooshian

10:00-10:30 **Coffee / Tea**

Session 2

Chairpersons: D. Jackson & K. Takeuchi

- 10:30 High Resolution 20-km Mesh Global Climate Model and
Projected Hydro-meteorological Extremes in the Future
A. Kitoh
- 11:00 Sustainability of the Venice Lagoon in the face of climate change
P. Linden, C. Nasci
- 11:30 Disaster policy and climate change: how much more of the same?
S. Dovers, J. Handmer

12:00-13:30 **Lunch**

Session 3

Chairpersons: A. Ismail-Zadeh & V. Kossobokov

- 13:30 Mitigating Volcanic Risk in the United States and Adjacent Pacific Region
J. Eichelberger
- 14:00 India's Tsunami Warning System: A Success Story
H. Gupta
- 14:30 Challenges in Data management during disasters
S. Zlatanova

Session 4: Poster session (15:00-16:30)

Chairpersons: V. Kossobokov & G. Tetzlaff

- Natural Hazards in Mega City of Jakarta (Indonesia)
H.Z. Abidin, I. Gumilar, H. Andreas, Y.E. Pohan & Y. Fukuda.

A Cyberinfrastructure Tool to Support the Response to Extreme Events: The Tungurahua Volcano Community Mitigation Case Study

J. Bajo & C. Renschler.

A national early warning system for rainfall-induced landslides in Italy

F. Guzzetti, M. Rossi, S. Peruccacci, M.T. Brunetti, I. Marchesini, et al.

Risk to the population posed by different natural hazards in Italy

F. Guzzetti, P. Salvati, C. Bianchi & M. Rossi.

Mechanisms of rain-induced landslide events of 2008 in hills of Chittagong City of Bangladesh

Y.A. Khan

Addressing Geophysical Hazards through Continuously Operating GPS Observational Network and Integrated Ocean Drilling Program

Y. Kontar

Seismic Hazard Predictability

V. Kossobokov & A. Nekrasova.

Coseismic displacement waveforms from high-rate GPS data: a comparison of two methodologies applied to the Tohoku-oki earthquake

A. Mazzoni, M. Crespi, G. Colosimo, M. Branzanti, H. Dragert, et al.

Artificial Neural Networks Modelling For Landslides Hazard Zonation In A Part Of The Himalaya.

L. Nwankwo & P. Champati-ray

Time-dependent ground shaking scenarios: an operational approach

A. Peresan, G.F. Panza, F. Vaccari & F. Romanelli.

Integrated Natural Resources and Extreme Events Management: Decision Support Tools for More Resilient Communities

C. Renschler

Session 5: Open Forum

Moderators: A. Ismail-Zadeh & K. Takeuchi

16:30 Introduction: Extreme Natural Events and Societal Implications

A. Ismail-Zadeh, ENHANS Project Leader

16:40 International Strategy for Disaster Reduction

S. Briceno, Past Director, UNISDR

16:50 Climate Change and Geophysical Hazards

T. Beer, IUGG President

17:00 Partnership of Science and Society: A Grand Challenge

R. Kuroda, ICSU Vice President

17:15 General Discussion

2 JULY 2011

Session 6

Chairpersons: K. Takeuchi & R. Singh

13:30 Chain Reactions Happened in Great East Japan Earthquake and Tsunami

K. Takeuchi

13:45 The Great Off Tohoku Earthquake of 11 March 2011

K. Satake

- 14:15 Tsunami disaster and impact due to the 2011 Tohoku earthquake
F. Imamura
- 14:45 Flow regime transformations in the March 11, 2011 tsunami,
Northern Honshu, Japan
S. Kieffer, J. Colberg, J. Flowers

Session 7: Poster Session (15:00-16:30)

Chairpersons: A. Ismail-Zadeh & T. Beer

Kamchatkian Subterranean Electric Operative Forerunners of Catastrophic Earthquake with M9, occurred close to Honshu Island 2011/03/11

V. Bobrovsky

The Maule earthquake in Chile, February 27, 2010 (Invited Poster Presentation)

H. Drewes, S. Barrientos, L. Sánchez & R. Maturana

Numerical modelling to assess the impact of recent tsunamis on groundwater quality and identification of remedial measures

L. Elango & C. Sivakumar

Analysis of Korea Peninsular Displacements from Sendai-Oki Earthquake using Global Navigation Satellite System

J. Ha, M.B. Heo, K. Nam & E. Sim

ALOS/PALSAR Images of the 2011 Tohoku Earthquake (II): Deformation Associated with the Induced Activities

M. Hashimoto, Y. Takada, Y. Fukushima, T. Ozawa & M. Furuya

The 2011 Tohoku earthquake slip distribution: joint inversion of GPS and ocean bottom pressure sensor data

A. Hooper, W. Simons, J. Pietrzak, R. Riva & M. Naeije

Relation between the interplate coupling distribution before and the slip at the time of the 2011 East Japan Earthquake (Mw 9.0)

R. Ikuta, S. Shimada & M. Satomura

Precursors of the Tohoku earthquake (M=9) – what was the trigger?

P. Kalenda & L. Neumann

Tracing of travelling of stress-deformation waves after the Tohoku earthquake

P. Kalenda, K. Holub, J. Rusajova & L. Neumann

Strong Motion Characteristics of the Off Pacific Coast, Tohoku, Japan Earthquake of March 11, 2011 in Terms of the Damage Potential to Buildings

H. Kawase, S. Matsushima & B. Baoyintu

Why March 2011 Tohoku earthquake, such a catastrophic event has been missed?

I. Kerimov & S. Kerimov

2011 Megathrust earthquake in Japan revealed existence of two types of great earthquakes

J. Koyama, K. Yoshizawa, K. Yomogida & M. Tsuzuki

Japan Seismic Catastrophe 11 of March 2011. Long-term prediction by microseismic noise properties

A. Lyubushin

Co- and post-seismic deformation of the Mw9.0 2011 Off-Tohoku Earthquake and strain accumulation observed by GEONET

T. Nishimura, S. Ozawa, H. Suito, T. Kobayashi & M. Tobita

ALOS/PALSAR Images of the 2011 Tohoku Earthquake (I): Coseismic deformations and Tsunami affected area

T. Ozawa, Y. Fukushima, S. Okuyama, Y. Takada & M. Hashimoto

Crustal Deformation Associated with the 2011 Off the Pacific Coast of Tohoku Earthquake (M9.0)

T. Sagiya, T. Ito, T. Watanabe & K. Ozawa

2011 Mw 9.0 Sendai-Oki Earthquake Coseismic Deformation and Tsunami Observed by Space Geodetic Sensors

C. Shum, C. Ji, Z. Lu, F. Simon & L. Wang

2010 Mw 8.8 Great Maule Earthquake Coseismic Slip Constrained by GRACE

L. Wang, C.K. Shum, F. Simons, A. Tassara & C. Ji

Possible effects of the 2011 Tohoku earthquake on activity at Shinmoe-dake volcano, southwest Japan: Insights from strain data measured in vaults

K. Yamazaki, M. Teraishi, S. Komatsu, Y. Sonoda & Y. Kano

Session 8:

Chairpersons: A. Ismail-Zadeh & V. Kossobokov

16:30 Accidents at Fukushima No.1 Nuclear Power Plant caused by the 2011 Tohoku earthquake

K. Irikura

17:00 Tectonic Context and Implications of the Canterbury, New Zealand Earthquake Sequence

K.P. Furlong, G.P.Hayes, M.Quigley, H.Benz.

17:30 Weather & Climate Prediction and the Brisbane 2011 Floods

N. Nicholls

APPENDIX 9:

PROGRAM OF THE ENHANS EVENTS AT THE 2011 AGU FALL MEETING, SAN FRANCISCO, USA

NH SESSION:

GREAT DISASTERS OF THE XXI CENTURY: THE LESSONS WE LEARNED

Monday, 5 December

10:20 AM - 10:25 AM Introduction

10:25 AM - 10:45 AM

NH12A-01. Extreme Geophysical and Weather Related Disasters in the First Decade of the XXI Century - How do the Patterns of these Two Groups of Perils Differ? *(Invited)*

Peter Hoeppe; Eberhard Faust; Mark Bove

10:45 AM - 11:05 AM

NH12A-02. IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation *(Invited)*

Christopher B. Field; Thomas F. Stocker; Vicente R. Barros; Dahe Qin; Kristie L. Ebi; Pauline

M. Midgley

11:05 AM - 11:25 AM

NH12A-03. Integrated Assessment of Risk Reduction for Coastal Cities *(Invited)*

Gordon McBean

11:25 AM - 11:40 AM

NH12A-04. Errors in Expected Human Losses Due to Incorrect Seismic Hazard Estimates

Max Wyss; Anastasia Nekrasova; Vladimir G. Kossobokov

11:40 AM - 12:00 PM

NH12A-05. Unforecasted earthquake and forgotten tsunamis: Lessons from 2011 Tohoku event

(Invited)

Kenji Satake

12:00 PM - 12:15 PM

NH12A-06. Ironic Effects of the Destructive Tsunami on Public Risk Judgment

Satoko Oki; Kazuya Nakayachi

12:15 PM - 12:20 PM Conclusion

NH SESSION:

GREAT DISASTERS OF THE XXI CENTURY: THE LESSONS WE LEARNED - POSTERS

1:40 PM - 6:00 PM

NH13C-1384. Analysis of XXI century disasters in the National Geophysical Data Center historical natural hazard event databases

Paula K. Dunbar; Heather L. McCullough

NH13C-1385. U.S. Interagency Response Plans for Volcanic Ash and Other Volcanic Hazards

Jeffrey M. Osiensky; Scott Birch; Duane Carpenter

NH13C-1386. Spatial Analysis of the Level of Exposure to Seismic Hazards of Health Facilities in Mexico City, Mexico

Sonia Moran; David A. Novelo-Casanova

NH13C-1387. Creating Probabilistic Multi-Peril Hazard Maps

James R. Holliday; Nelson A. Page; John B. Rundle

NH13C-1388. Cross correlation between seismicity and reservoir water level changes in the Koyna – Warna region, India

Ramana V. D.; J. P. Kumar; Rajender K. Chadha

NH13C-1389. Detection of Volcanic Dust by AERONET Sun-Photometers: Puyehue-Cordon Volcano, Chile June 2011

Santo V. Salinas Cortijo; Soo Chin Liew

NH13C-1390. Flood Identification from Satellite Images Using Artificial Neural Networks

Li-Chiu Chang; I-Feng Kao; Kuo-Kung Shih

NH13C-1391. Analysis of Tropical Cyclone Tracks in the North Indian Ocean

Anand Patwardhan; Mukta Paliwal; M. Mohapatra

NH13C-1392. Evaluation of coseismic and gravitational tsunami hazards in intraplate shelf seas: sensitivity modeling of the Dover Strait 1580 marine event.

Jean ROGER; Yanni Gunnell; Pascal Ray

NH13C-1393. Assessment of Drought Severity Techniques - A Historical Perspective

Umed S. Panu; Taylor Crinklaw

NH13C-1394. Poroelastic Coupling of the Zipingpu Reservoir and the 2008 Mw7.9 Wenchuan Earthquake, China.

Wei Tao; Timothy Masterlark; Zhengkang Shen; Erika Ronchin

NH13C-1395. The 2011 Tohoku-Oki Earthquake and Tsunami: Lessons learned from the evacuation response along the Ibaraki coastline

Yu Tabayashi; Frank H. Ling; Makoto Tamura; Nobuo Mimura; Kiyotake Ajima; Makoto Takahashi

NH13C-1396. COORDINATING POST-TSUNAMI FIELD SURVEYS IN THE US
*Laura S. Kong; Chris Chiesa; Paula K. Dunbar; Jesie Huart; Kevin Richards; Mike Shulters;
Adam Stein; Gen Tamura; Rick I. Wilson; Edward Young*

UNION SESSION:

**PREDICTING EXTREME EVENTS IN NATURAL AND SOCIOECONOMIC SYSTEMS:
STATE-OF-THE-ART AND EMERGING POSSIBILITIES**

Tuesday, 6 December

1:40 PM - 1:55 PM U23C-01. Earthquake Forecasting Based on Seismicity *Donald L. Turcotte*

1:55 PM - 2:10 PM U23C-02. Predictability of extremes in non-linear hierarchically organized systems *Vladimir G. Kossobokov; Alexandre Soloviev*

2:10 PM - 2:25 PM U23C-03. Earthquake prediction in Japan and natural time analysis of seismicity *Seiya Uyeda; Panayiotis Varotsos*

2:25 PM - 2:40 PM U23C-04. Scaling Laws, Earthquakes, Chaos and Predictions *Claude J. Allègre; Jean-Louis Le Mouel; Clement Narteau*

2:40 PM - 2:55 PM U23C-05. Tracking Earthquake Cascades *Thomas H. Jordan*

2:55 PM - 3:10 PM U23C-06. Deep Scientific Drilling at Koyna, India *Harsh K. Gupta*

3:10 PM - 3:25 PM U23C-07. Extreme events and their economic consequences *Michael Ghil*

3:25 PM - 3:40 PM U23C-08. Using pattern recognition as a method for predicting extreme events in natural and socio-economic systems *Michael Intriligator*