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PROJECT REPORT: 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

Co-sponsored by

AGU, GOOS, ICSU, IGU, IRDR, ISPRS, IUGG, IUGS, IUTAM, UNESCO, UNISDR

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, President of the IUGG GeoRisk Commission and Vice Chair of IRDR) and Alik Ismail-Zadeh (Germany/Russia/France, Leader of the ENHANS project)

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

The Scientific Program of the events can be found in Annex 1.

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. **Dr. 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 **Dr. 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. Dr. 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.

Dr. 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. Dr. 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 **Dr. 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.

Dr. 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. Dr. 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. **Dr. 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. Dr. 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.

Dr. 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. **Dr. 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 **Dr. 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.

Dr. 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. **Dr. 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 m horizontal and > 1 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.

Dr. 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. Dr. 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.

Dr. 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, Dr. Keifer with her group constructed hydrographs for sites in Kesenuma, Oirase, Sendai, and Kamaishi.

Finally, **Dr. 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. **Dr. 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.

Dr. 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. **Dr. A. Ismail-Zadeh** and **Dr. Kuni Takeuchi** opened the forum. Dr. 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.

Dr. 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.

Dr. 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.

Dr. 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. Dr. Kuroda proposed to nurture scientists with social literacy and public with science literacy.

After the short introductions by the panelists, Dr. Ismail-Zadeh and Dr. K. 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>).

There seems to have been another natural disaster almost each week as recent earthquakes, tsunamis and volcanic eruptions have impacted on millions of people around the world. Scientists continually monitor the globe for seismic ripples but are we actually getting any better at predicting where, when and how big the next catastrophe will be? Four experts were speaking at the news briefing:

Dr. James Goff, Co-Director of the Australian Tsunami Research Centre and Natural Hazards Research Laboratory, University of New South Wales;

Dr. 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

Dr. Thomas Jordan, Director of the Southern California Earthquake Center and Professor of Earth Sciences at the University of Southern California;

Dr. 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/>

ANNEX 1: SCIENTIFIC PROGRAM

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