



IUGG Commission on Geophysical Risk and Sustainability

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## Annual Report

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The IUGG Commission on Geophysical Risk and Sustainability (IUGG GeoRisk Commission) established by the IUGG Bureau in August 2000 is dedicated (i) to promoting scientific studies applied to the reduction of risk from natural hazards in an increasingly urbanized world and sustainability and (ii) to reducing death and destruction from natural and technological hazards by providing hazards data and information to emergency managers, policy-makers, scientists and the general public in the most timely and effective manner as possible. This includes the integration of knowledge concerning environmental, social and economic processes. The fundamental scope of this Commission is to facilitate communications – between scientists via meetings, workshops and publications, as well as between scientists and decision makers, between scientists and the public, and between scientists and schools.

The GeoRisk Executives and Commissioners are:

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The GeoRisk Commission Executive was appointed by the IUGG Executive during the Executive Board meeting in August 2004 and took office at the Hyderabad GeoRisk Business meeting in December 2004.

## Scientific Meetings Organized by the Commission

### 1. Special Session on Mathematical Aspects of Geohazard Research, 5<sup>th</sup> June 2006, Sea of Galilee, Israel



Developments in mathematical science have significantly accelerated the progress in numerical modeling, data assimilation, and forecast-oriented research associated with atmospheric, oceanic, space, and solid Earth sciences, and this progress has a strong impact on geohazard research (such as cyclones, earthquakes, landslides, storms, tsunamis, and volcanic eruptions). Session on Mathematical Aspects of Geohazard Research was organized by the IUGG GeoRisk Commission and held at the IUGG Conference on Mathematical Geophysics, 5<sup>th</sup> June 2006, Ma'agan, Sea of Galilee, Israel.

The session was dedicated to Professor V. Keilis-Borok (KB), a distinguished mathematical geophysicist, a founder of the IUGG Committee on Mathematical Geophysics, and former IUGG President. In his welcoming speech Prof. U. Shamir, IUGG President, mentioned a leadership of KB in mathematical geophysics. F. Abramovici of Tel Aviv University described the scientific life of KB and his contribution to computational seismology and predictions of infrequent seismic events of large magnitudes.



The scientific session was focused on several topics:

- (i) non-linear dynamics of the lithosphere, predictions of extreme natural events and limitations of the predictability (V. Keilis-Borok, UCLA),
- (ii) mathematical descriptions of physical phenomena associated with geohazards (B. Malamud, King's College London, UK, and M. Ghil, ENS Paris, France),
- (iii) mathematical and numerical modeling of extreme natural events (E. Aharonov, Weizmann Institute of Science, Rehovot, Israel; A. Ismail-Zadeh, Karlsruhe University, Germany; and J. Zvelebil, Geological Survey, Prague, Czech Republic), and
- (iv) quantitative analysis and compilations of geophysical data related to geohazards (V. Gusiakov Institute of Computational Mathematics and Mathematical Geophysics, Russian Academy of Sciences, Novosibirsk, Russia; and S. Sobolev, GFZ-Potsdam, Germany).

#### Session Description

V. Keilis-Borok, EARTHQUAKES PREDICTION: “THE PARADOX OF WANT AMIDST PLENTY”

Four paradigms of earthquake prediction are established by modeling of complex systems; studies of fault networks dynamics; and exploratory data analysis of pattern recognition kind.

In terms of statistics the problem is formulated as predicting extreme point events, with predictor being an also discrete sequence of alarms. These paradigms along with the experiments in predicting-in-advance open new possibilities to enhance the prediction capability, by using the wealth of available but yet untapped data, models, and theories. He discussed specific possibilities of that kind and methods of linking earthquake prediction with earthquake preparedness. Finally, he demonstrated pilot applications of the findings reviewed to predicting other disasters.

#### B. Malamud: LANDSLIDES, EARTHQUAKES AND EROSION

A landslide event consists of single to tens of thousands of landslides associated with a trigger, such as an earthquake, sudden snowmelt, or extended precipitation. Using four well documented landslide events, from Italy, Guatemala and the USA, each with a different triggering mechanism, he showed that the frequency of landslide areas for all four are well approximated by the same three-parameter inverse-gamma distribution. For small areas this distribution has an exponential ‘roll-over’ and for medium and large landslide areas decays as a power-law with exponent  $-2.40$ . Implications of this distribution include: (i) a possibility to introduce a landslide-event magnitude scale based on the log of the total number of landslides associated with a trigger; (ii) if a landslide-event inventory is incomplete (smaller landslides not included), the partial inventory can be compared with our landslide probability distribution, and the corresponding landslide-event magnitude inferred; (iii) this technique can be applied to inventories of historical landslides, inferring the total number of landslides that occurred over geologic time, and how many of these have been erased by erosion, vegetation, and human activity; (iv) using Gutenberg–Richter frequency-magnitude statistics for regional seismicity, the intensity of seismicity in an area and the magnitude of the largest regional earthquakes can be related to erosion rates.

#### B. Malamud, RISK, ECOSYSTEMS AND ROBUST POWER-LAW SCALING OF WILDFIRES

Combining the timing, frequency and magnitude of all wildfires occurring in a given region is known as the ‘wildfire regime’. The quantification of wildfire regimes, the result of the complex interaction of multiple variables, is of particular interest to both ecologists and wildfire managers. One quantification method is determining the relationship between the frequency with which wildfires occur and the area they burn. A number of different frequency-area distributions have been suggested for wildfire regimes, with many recent wildfire studies showing a robust inverse power-law (heavy-tail) relationship. This distribution reduces the description of a wildfire regime to just two parameters, allowing comparisons between different regions. To illustrate this, Malamud presented a study for the USA that compares 18 regions, each with distinct climate, vegetation, and topography, using a data set consisting of 88,916 wildfires for the period 1970–2000. For the conterminous USA, he showed that (a) wildfires exhibit robust frequency-area power-law behavior in 18 different ecoregions and (b) wildfires in the eastern third of the USA have higher power-law exponents for anthropogenic vs. lightning ignition sources. He determined recurrence intervals for wildfires of a given burned area or larger for each ecoregion, allowing for the classification of wildfire regimes for probabilistic hazard estimation in the same vein as is now used for earthquakes. By examining wildfire statistics in a spatially and temporally explicit manner, resultant wildfire regime summary statistics and conclusions have been presented along with a probabilistic hazard assessment of wildfire risk at the ecoregion division level across the conterminous USA.

#### M. Ghil, COUPLING IN EARTH SYSTEMS: SOLIDS, FLUIDS AND ECONOMICS

Extreme events are a key manifestation of complex systems, such as the Earth system, and a major source of hazards in nature and society. Their economic and social consequences are a matter of enormous concern. Due to their rarity, extreme events have been hard to study and even harder to predict. Within the EU's Sixth Framework Programme (FP-6) and its initiative on "Tackling Complexity in Science," a highly interdisciplinary project on "Extreme Events: Causes and Consequences (E2-C2)" incorporates 17 different scientific institutions in 9 countries. He provided a sketch of some of E2-C2's unifying ideas and concentrated on the truly interactive nature of natural and economic hazards. Integrated assessment of economic and climatic changes associated with global warming is an exemplary area of interaction between the natural and socio-economic sciences. The UN's Intergovernmental Panel on Climate Change (IPCC) has divided, so far, the scientific issues among its three working groups: WGII has been providing scenarios of CO<sub>2</sub> emissions, WGI expected climate changes based on these scenarios, and WGII and III have dealt with the impacts of, adaptation to and mitigation of these changes. The macro-economic models used in these assessments have been essentially quasi-equilibrium models driven mainly by technological changes and other types of external forcing. E2-C2 considers instead a Non-Equilibrium Dynamic Model (NEDyM) and its two-way coupling to a simple climate model. NEDyM produces endogenous "business cycles" with realistic periods of 5–6 years and the characteristic saw-tooth shape of slow growth and rapid recessions, as well as chaotic behavior. When subjected to exogenous shocks, such as natural disasters, this model exhibits a larger response during expansions, when the shock amplifies pre-existing disequilibria, than during recessions, when the existence of unused resources helps damp the shock. Genuine economic dynamics can thus amplify or damp the effect of climatic and other natural disasters.

#### A. Ismail-Zadeh, CRUSTAL BLOCK-AND-FAULT DYNAMICS AND EARTHQUAKE MODELING IN THE TIBET PLATEAU AND HIMALAYANS

Earthquakes in the Tibetan plateau and Himalayans occur mainly in response to the crustal motion and stress localization associated with the Indian and Eurasian plate convergence. To understand the basic features of the crustal motion and seismicity in the region, we develop a mathematical and computational model of block-and-fault dynamics. The model domain is composed of six major upper crustal blocks separated by fault planes. These blocks are assumed to be perfectly rigid and move as a consequence of the Indian plate push. Deformations take place along the fault planes separating the blocks. The interaction of the blocks along the fault planes is visco-elastic as long as the ratio of the shear stress to the difference between the pore pressure and normal stress remains below a critical strength level. When the critical level is exceeded in some part of a fault plane, an earthquake (stress-drop) occurs causing also failures in adjacent parts of the fault plane. The stress-drop-affected parts of the fault plane enter in a state of creep immediately after the earthquake, and the creep lasts until the stress falls below a certain level. Numerical experiments were developed to analyze the earthquake flow, frequency-to-magnitude relationships, clustering and focal mechanisms of earthquakes, and fault slip rates in the model. Large events in the numerical experiments cluster mainly on the fault segments associated with the Himalayan Frontal Thrust as well as at some internal faults of the Tibetan plateau. The clustering of earthquakes on a given fault is a consequence of the dynamics of the regional fault system rather than that of the fault only. We show that variations in the relationship of magnitude to frequency of the events are associated with changes in the motion of the upper crustal blocks and depend on the rheological properties of fault plane zones. The focal mechanisms of model events are found to be consistent with that of earthquakes in the region. Variations in the rheological properties of fault plane zones and/or the lower crust influence displacement rates of the crustal blocks

and hence slip rates at the faults separating the blocks. This can explain the discrepancies in estimates of slip rates over short and long time scales at major faults in the region.

#### J. Zvelebil, SOME APPLICATIONS OF NONLINEAR DYNAMICS IN ROCK FALL RISK ASSESSMENT AND EARLY WARNINGS

An unstable slope is a nonequilibrium, hierarchic system with complex interactions with environment. Phenomenological models of unstable slope dynamics have been developing parallel to the geomechanical approach since 70s of XXth century. Those, primarily empirically based models describe geometric features of plots of monitoring time series (TS) about deformation behavior of the unstable slopes. The models were successfully used to interpret the with regards to identification of landslide/rock fall danger and to time forecasting of occurrence of catastrophic event. Nevertheless, the boom of information technologies is overloading us by monitoring data. To support the use of computer techniques also to the TS interpretation, those phenomenological models should be expressed mathematically in more rigorous way. To beat the limitations of high dependency of those models on personal experience of an expert in naked-eye assessment of TS geometry, and of the inadequacy of current 'linear math' in their description, Zvelebil applied tools of Nonlinear Dynamics. Real TS data from unstable sandstone rock slopes in NW Bohemia were used in the study. The TS contain so far 'hidden' information about the dynamics of slope stability failure. This information cannot be found when using the current linearly based analytical methods. The occurrence of fractal patterns, which makes a qualitative difference between intrinsic slope movement dynamics of time series from the near-to-equilibrium and the far-from-equilibrium dynamical states of slope failure system, is an example of such 'hidden', diagnostically important indicator. It helps to identify the stage of immediate danger of rock fall occurrence, just in time to launch an efficient early warning.

#### V. Gusiakov (GeoRisk Commissioner), AN INTEGRATED TSUNAMI RESEARCH AND INFORMATION SYSTEM: APPLICATION FOR MAPPING OF TSUNAMI HAZARD

The Integrated Tsunami Research and Information System (ITRIS) for calculation and mapping of the tsunami hazard has been developed and is being maintained at the Novosibirsk Tsunami Laboratory as a joint project with the World Agency for Planetary Monitoring and Earthquake Risk Reduction (WAPMERR). The concept of the ITRIS is based on the integration of historical data, numerical models, processing and analyzing tools along with supporting mapping software. These components are embedded inside a specially developed GIS-type graphic shell for easy data retrieval, visualization and processing. The shell operates on Windows PC platforms with no additional co-located software required. The current version of the built-in tsunami database covers the period from 1628 B.C. to present time and contains more than 2250 entries in the event catalog and almost 9500 run-up heights. Another sub-sets of data include the global seismic catalog containing over 250 000 records, catalog of active volcanoes and impact structures, as well as some additional reference information related to the tsunami problem (directories of seismic and mareograph stations, gazetteer of the coastal populated places, selected bibliography). The set of the built-in numerical models includes a subroutine for fast calculation of Tsunami Travel Time (TTT) charts and numerical code for calculation of tsunami generation and propagation in an ocean with a real bathymetry within non-linear shallow water model. The approach to the long-term tsunami hazard assessment, implemented in the ITRIS software, is based on the statistical analysis of historical run-up observations. For a particular coastal area, this type of analysis can be interactively made using a special pop-up menu and dialog windows. The results can be immediately displayed on the screen in the form of hazard curves and evaluated by an expert. For areas that are not provided with sufficient number of historical data, another, so

called, scenario approach can be used. It is based on application of numerical models for calculation of synthetic tsunami catalog for pre-established set of earthquake models with parameters derived from analysis of seismotectonic features of the area under study.

### S. Sobolev, GPS-SHIELD CONCEPT FOR A LOCAL TSUNAMI EARLY WARNING SYSTEM

After the catastrophic Sumatran earthquake and tsunami of 2004, the great attention of the international community has been focused at the problem of early tsunami warning. Particularly, Germany has initiated and financed building of the tsunami early warning system for Indonesia leaded by the GeoforschungsZentrum in Potsdam. He presented a concept aiming to fast and precise characterization of the parameters of the subduction zone earthquake and associated tsunami. The subduction zone, which is potential source of tsunamigenic earthquakes is located directly in front of the Indonesian islands Sumatra and Java, with the trench only some 200-300 km west of the coast line. In this case, of so called local tsunami, when the distance from the source is of the same order or less than potential source size, the heterogeneities of the distribution of slip at a earthquake fault strongly effect the tsunami wave heights. Therefore, details of the slip distribution of the scale of 100 km (trench-parallel) and 20-50 km (trench-perpendicular) must be resolved for the early tsunami warning. Additional complexity is that the tsunami hits nearest coast only some 20 min after the earthquake. Using elasto-static numerical modeling combined with a non-linear inversion technique, Sobolev showed that the array of near real-time GPS stations of a specific design, using available islands between the trench and Sumatra, can be efficiently used for the determination of the source parameters and prediction of the tsunami wave heights during less that 10 min after the earthquake.

## **2. Symposium "Riding the storm: Can science keep us in the saddle?", 16<sup>th</sup> July 2006, EuroScience Open Forum, Munich, Germany**



The third joint symposium of the IUGG GeoRisk Commission and European Association for Promotion of Science and Technology was held in Munich, Germany, during the EuroScience Open Forum from July 15<sup>th</sup> to 19<sup>th</sup> 2006 (the first and second symposiums took place in Budapest, Hungary, 2002, and in Stockholm, Sweden, 2004).

### **Symposium Description**

Dr. A. Ismail-Zadeh opened the session and spoke on recent extreme natural events, which resulted in great humanitarian tragedies because of weak preventive disaster management. He considered several factors (natural, economical, political, awareness and preparedness) brought about the humanitarian tragedies of the early XXI century.

Dr. F. Wenzel (Universität Karlsruhe, Germany) presented the talk on extreme events that disrupts civil life, social systems, regional stability, etc. Recent events that have been counted into this category are the 26. December 2004 tsunami in SE-Asia, the August 2005 hurricane Katrina in the Gulf of Mexico, but also the August 2002 1000 year floods in Germany, Austria and Czech Republic. Their occurrence raise fundamental questions such as: To what degree can we 'understand' them? Are these events predictable? What have phenomenological

different events in common? Is our vulnerability to Extreme Events growing? What controls the vulnerability? Can Extreme Events be tamed or managed? Can we protect ourselves? To what extent, what is the prize? In terms of natural disasters extreme events are understood as extreme risks for society, which grows – independent of the extreme natural event – by increasing exposure of people and values and increasing vulnerability of society. It is difficult to prepare societies for extremely rare events. However, Wenzel considers that scientists need to improve earth system monitoring and the capacity for early warning. On this basis more realistic statements on forthcoming extreme events and their impact are conceivable and can be used as input for public safety policy.

Dr. H. Moderassi (IGOS-Geohazards Initiative, Orleans, France) spoke on the need for information on the current state of the Earth System. The effects of a growing population and an increasing economic development has led to public and political awareness of the human and economic significance of the changes in the environment. The international scientific community is now collaborating at a global scale to better understand and monitor the current state of the Earth and its environment and to predict its evolution. An effective monitoring of our planet on a global scale requires a multi-disciplinary and multi-national co-operation.

Dr. V. Kossobokov (Russian Academy of Sciences, Moscow, Russia) spoke on quantitative earthquake predictions. He mentioned that earthquake prediction is widely recognized as one of the global challenging problems facing the mankind in the 21st century. The recent scientific advances in understanding the hierarchical nature of the lithosphere and its dynamics did result the design of reproducible earthquake prediction technique. The real-time experimental testing aimed at prediction of the largest earthquakes worldwide from 1992 to the present proved statistically a possibility of practical earthquake forecasting although of an accuracy of 1-5 years and 5-10 times the anticipated source dimension. He discussed how to use earthquake prediction of limited accuracy to the benefit of population living in seismic regions, as well as feasible perspectives of developing a new generation of earthquake prediction technique of higher accuracy.

Dr. A. Smolka (Munich Reinsurance, Germany) spoke on risk management from an insurance perspective. The growing loss burden from natural disasters requires a cooperative effort from all parties involved in order to mitigate and reduce the losses from future events. An approach to managing the risk emanating from natural disasters is introduced. Under the heading of “risk partnership”, the roles played by the persons and entities affected, the financial sector and the state, are described from an international perspective based on actual business practice. The potential role of the insurance sector in risk mitigation is addressed specifically, and some examples of private/public partnerships are presented. The specific challenge posed by extreme natural events is discussed from an insurance perspective, and along the lines of the approach to more common hazards.

Dr. J. Paterson (University of Aberdeen, UK) discussed the relation between disaster risk management and governance. As the UNDP notes in its 2004 report, *Reducing Disaster Risk: A Challenge for Development*, ‘today we live with the accumulated risk of past development pathways’. In other words, all else equal, the magnitude of an earthquake or of a hurricane is a given, but the impact of such an event varies according to decisions taken regarding settlement location, land use planning, building design, and so on. It is not surprising, then, that the same organization in drawing conclusions from its survey of disaster and development and in making recommendations states that ‘Most fundamental is the role of governance at all scales from the local to the global’. Where political power lies and how it is exercised can accordingly make a significant difference to the impact of a natural disaster. Science is a key component in the human response to natural hazards, but it can only fulfill its

potential in this regard if it is married to appropriate governance structures. He examined some of the principal themes in the sometimes fraught relationship between science and politics and considers whether there are legal instruments that could assist in cementing and guiding that relationship in the field of disaster risk management.

The symposium was followed by a press-briefing where more than 30 representatives of European media agencies were present.

## **Scientific Meetings Endorsed by the Commission**

### **The 3rd International Conference on Early Warning: From Concept to Action**

The third International Conference on Early Warning: From Concept to Action was held from 27-29 March 2006 in Bonn, Germany. The conference addressed a broad community comprising scientists, national and international governmental and non-governmental bodies. Two major forums comprised the Conference: “Projects Forum” and “Scientific and Technical Forum”. The Conference Program included three main topics: “Multi-hazard Approaches”, “Mega-Events”, and “People, Politics and Economics”. 33 scientific and technical presentations were selected from more than 200 submissions, which highlighted the current state of early warning systems. The IUGG GeoRisk Commission's contribution was to shape the scientific and technical programs of the Conference participating in the International Advisory Board (H. Gupta) and the Program Committee (G. Tetzlaff, Secretary General of the IUGG GeoRisk Commission) and delivering scientific presentations (R. Singh, Vice-President of the Commission).

## **Invited Sessions and Lectures**

### **1. IOC/UNESCO International Workshop on Post-Disaster Assessment and Monitoring of Changes in Coastal, Ocean, and Human Systems in the Indian Ocean and Asian Waters**

Dr. E. Kontar, GeoRisk Commissioner, was invited to organize a Science Session on the Ocean Data, Observations, Disaster Warning and Risk Reduction during the IOC/UNESCO International Workshop on Post-Disaster Assessment and Monitoring of Changes in Coastal, Ocean, and Human Systems in the Indian Ocean and Asian Waters, Phuket, Thailand, February 20-24, 2006.

### **2. OECD Global Science Forum Workshop on Earthquake Science and its Contribution to Society, 1–2 June 2006, Potsdam, Germany**

The main purposes of the OECD GSF workshop have been to

- Examine recent advances and trends in earthquake science and consider how best to exploit those to the benefit of society;
- Explore the opportunities for new and/or enhanced international co-operation in the field of earthquake sciences in connection with their contribution to society; and
- Prepare a concise policy-level document that will highlight recent understanding in the field of earthquake science, with findings and recommendations for action by governments, funding agencies, international organizations and the scientific community.

Each workshop session consisted of a keynote talk and subsequent discussion: (1) Earthquake Processes (keynote speaker: A. Hasegawa, Tohoku University, Japan); (2) Hazard Assessment (keynote speaker: S. Wiemer, ETH Zürich, Switzerland); (3) Data Issue (keynote speaker: T. Ahern, IRIS Data Management Center, USA); (4) Rapid Earthquake Information (keynote speaker: M. Erdik, Bogazici University, Turkey); and (5) From Science to Application (keynote speaker: A. Ismail-Zadeh, Geophysical Institute, Karlsruhe University, Germany).

Discussions resulted in a draft of the workshop recommendations, which should be discussed in some detail later before a presentation of the recommendations to the OECD member countries. Two representatives of the IUGG GeoRisk Commission (A. Ismail-Zadeh and Z. Wu) and IASPEI President (R. Engdahl) attended the Workshop.

### **3. 11<sup>th</sup> International Symposium on Natural and Human Induced Hazards and 2<sup>nd</sup> Workshop on Earthquake Prediction**

Dr. E. Kontar was invited to convene a Science Session on Earthquakes and Earthquake Prediction and deliver a lecture entitled: "Seawater - Groundwater Interactions in Tsunami Affected Areas, Solutions and Applications" during the 11<sup>th</sup> International Symposium on Natural and Human Induced Hazards and 2<sup>nd</sup> Workshop on Earthquake Prediction organized by the Natural Hazards Society (NHS) and European Seismological Commission, Patras, Greece, June 22-25, 2006. E. Kontar was elected to be a Representative-at-Large at the Natural Hazards Society's Council.

### **4. 36th COSPAR Scientific Assembly**

Dr. R. Singh attended the 36th COSPAR Scientific Assembly held in Beijing, China, 16-23 July 2006 and chaired a Session on Natural Hazards. He also gave an invited talk on "Complimentary nature of land, ocean and atmospheric parameters associated with coastal earthquakes".

### **5. General Assembly of the Asian Seismological Commission and Symposium "Earthquake and Tsunami Disaster Preparedness and Mitigation", Bangkok, Thailand, 7-10 November 2006.**

The Asia-Pacific region suffers continuously from earthquake disasters. Seismological research plays an important role in the sustainable development of economy and society in this region. Characterized by its diversity of regional geology and unique tectonic features - continental collision zone, subduction zone, intra-plate seismicity, and tsunami-generated earthquakes, among others, Asia-Pacific region is also one of the hot spots not only in global seismology but also in a board perspective of Earth science.

The tenth General Assembly of the ASC and Symposium "Earthquake and Tsunami Disaster Preparedness and Mitigation" was held in Bangkok, Thailand, from 7 to 10 November 2006. Dr. Harsh Gupta served as a Chairman of the Scientific Committee of the meeting. Three of six invited key-note lectures were presented by the IUGG GeoRisk Commissioners: (1) INDIA'S INITIATIVE IN MITIGATION OF TSUNAMIS AND STORM SURGES by H. Gupta; (2) THE GREAT TANGSHAN EARTHQUAKE: THIRTY YEARS AFTER by Z. Wu, and (3) EXTREME SEISMIC EVENTS: FROM SCIENCE TO PREVENTIVE DISASTER MANAGEMENT by A. Ismail-Zadeh.

The Open Forum on scientific, political, economic and social aspects of seismic protection and security (chaired by H. Gupta) addressed the social and economic aspects of earthquake hazard and risk reduction and preventive measures that need to be taken so that in the future the hazard from such events could be reduced.

## **6. International Conference on Global Change, Islamabad, Pakistan, 13-17 November 2006.**

The Muzzafarabad (Pakistan) earthquake of 8 October 2005 was one of most devastating recent seismic events with estimated 80,000 human lives and huge economic losses. Immediately after the tragic event the Pakistan Government decided to develop earthquake science and education. As a result of this effort, the International Conference on Global Change (where two main topics were considered: earthquake science and climate change) was held in Islamabad, Pakistan from November 13 to 17, 2006. The Conference was organized by the National Centre for Physics at Islamabad, Pakistan, and The Abdus Salam International Centre for Theoretical Physics at Trieste, Italy. Two GeoRisk Commissioners, Dr. V. Kossobokov and Dr. A. Ismail-Zadeh, were invited to the Conference. The topics of their presentations were earthquake prediction and stress and earthquake modeling, respectively.

The Conference was followed by round table discussion with Dr. Ahmad, Special Adviser to the Prime Minister of Pakistan. He announced that the Center for Earthquake Study had been recently founded in Islamabad. Also he mentioned that the Government considers to set up an International Scientific Council on Earthquake Science at the Pakistan Government to promote the activity in earthquake research and education in Pakistan. A. Ismail-Zadeh and V. Kossobokov were invited to serve for the Council.

## **Web-page of the Commission and Webcyclopedia**

The web-page of the Commission is updated recently: <http://www.iugg-georisk.org> (webmaster is Mr. D. Krupsky). The web-site presents news on the life of the Commission. The webcyclopedia at: <http://www.iugg-georisk.org/webcyclopedia/index.html> continues to collate information. The presentations, given at several meetings organized by the Commission during 2006 or at meetings where Commissioners delivered invited talks, will be incorporated into the Webcyclopedia.

## **GEO Programme**

On the request of ICSU Executive Director, IUGG GeoRisk Commission proposed ICSU to consider project *Development of the New Approaches to Coastal Zone Hazard Observation and Warning Systems and suggested* as a possible contribution to the implementation of the GEO Programme Task DI-06-01: Encourage in-situ and space agencies to (i) systematically record data over coastal regions subject to tsunami risk, and (ii) archive data in a form easily accessible to all countries.

## **International Centre for Water Hazard and Risk Management**

Dr. K. Takeuchi, Vice-President of the IUGG GeoRisk Commission, has been appointed as the Founding Director of the International Centre for Water Hazard and Risk Management (ICHARM), inaugurated under the auspices of UNESCO on 6 March 2006. The Centre is an outcome of the Third World Water Forum in Kyoto in 2002 and is hosted by the Public Works Research Institute in Tsukuba, Japan. The goal of the Centre is to provide practicable strategies to localities, regions, and nations to manage the risk of water-related disasters including floods, drought, landslide, debris flow, storm surge, tsunamis, and water contamination. For example, ICHARM will develop inundation models and distribute them to countries to help forecast and mitigate damage, and will train researchers from developing countries to create flood-hazard maps. IUGG GeoRisk Commission will establish a tight link with the Centre. For more detail see web-page: <http://www.icharm.pwri.go.jp>.

### **Business meetings**

#### 1. T. Beer and A. Ismail-Zadeh met in Paris.

Tom Beer, IUGG Vice-President, visited Paris to attend the first meeting of the ICSU Planning Group on Natural and Human Induced Environmental Hazards and Disasters. On June 19 and 21 TB met with A. Ismail-Zadeh (AIZ), the President of the IUGG GeoRisk Commission, who has been working in the Institute of Physics of the Earth in Paris. AIZ summarized the recent CMG meeting in Israel that he attended earlier in June, and the plans for the next GeoRisk Commission activity – the Euroscience Open Forum in Munich on 16 July 2006. Also they discussed two proposals for subsequent meetings. One is a joint meeting with the Earthquakes and Megacities Initiative (EMI) to be held in Manila (?). The second proposal, for a meeting in Kenya, is focused more on coastal hazards. TB introduced AIZ to Pauline Dube from Botswana, a member of the ICSU Planning Group, and suggested that it may be possible to widen the scope of a Kenyan meeting to include the Hazards in Africa focus of the ICSU Regional Office for Africa (and thus also tie in with the GeoScience in Africa initiative of the GeoUnions). AIZ contacted Dr. G. Mulugeta, Chairman of the African Scoping Group on Natural and Human-Induced Hazards and Disasters, regarding collaboration in organization of a conference on geohazards in Africa.

#### 2. Business meeting at the IGOS-GeoHazards Secretariat in Paris.

On Monday 19 October, TB and AIZ met with H. Modaressi, S. Hosford and G. Le Cozannet of the IGOS GeoHazards Bureau. The Bureau is jointly supported for the September 2004 to September 2007 period by BRGM (the French Bureau of Research in Geophysics and Mining) and the European Space Agency. The IGOS GeoHazards Bureau has two projects over this period: (1) GeoHazData, which comprises a metadata editor and listing of GeoHazards data; and (2) GeoHazNet, which aims to develop a community of practice in the area. The IGOS GeoHazards Bureau offered in January 2005 to act as the Secretariat for the GeoUnions Hazards Initiative. This offer continues to stand but in discussing its practical implications it became apparent that there is insufficient formal administrative structure for the GeoUnions Initiative so that it is not clear with whom (or with what entity) such an agreement needs to be concluded.

#### 3. Science Symposium and Reception in honor of the ICSU 75th Anniversary, 4 July 2006.

On behalf of IUGG, AIZ attended the Science Symposium organized by the French Academy of Sciences in Grande Salle des Seances, Academie des Sciences in Paris. The symposium

started with three welcome speeches by Edouard Brezin, President of the French Academy, Goverdhan Mehta, ICSU President, and Francois Goulard, Deputy Minister for Higher Education and Research. The welcome speeches were followed by lectures on topics of biodiversity, sustainability and marine fisheries, research in Africa, languages and communications. The last speech was given by Gilles de Robien, French Minister for National Education, Higher Education and Research who specially arrived to the closure of the Symposium. The symposium was followed by a reception in the Mairie de Paris. The Reception was opened by Madam Maniele Auffray, Deputy to the Mayor of Paris, Prof. G. Mehta, ICSU President, Mr. K. Matsuura, Director General of UNESCO, and Mr. M. Jarraud, WMO Secretary-General.

#### 4. Business meeting with A. Gvishiani of CODATA.

On July 10<sup>th</sup> 2006, AIZ met Prof. A. Gvishiani, Vice President of ICSU CODATA, to discuss a possible cooperation between IUGG GeoRisk Commission and ICSU CODATA. A. Gvishiani appreciated the GeoRisk Commission proposal on the development of webcyclopedia of Natural Hazards and Risk together with CODATA. He suggested the Commission to submit a proposal on webcyclopedia for the next CODATA call for proposals to get some funding for the project. Meanwhile, both IUGG and CODATA should look for extra funds for the webcyclopedia.

A. Gvishiani informed AIZ that IUGG is not a member of CODATA and suggested to delegate somebody from IUGG to CODATA. AIZ informed J. Joselyn, IUGG Secretary General, on this suggestion, and she contacted immediately the CODATA Secretariat and proposed Charlie Barton, IAGA President, to represent IUGG as an observer at the CODATA General Assembly held in October 2006 in Beijing.

### **Commission Proposals funded**

1. The Commission proposal put forward by A. Ismail-Zadeh to organize a symposium on extreme natural events during the EuroScience Open Forum in Munich, 15-19 July 2006 received funding from IUGG (\$1,500).
2. The Commission proposal put forward by A. Ismail-Zadeh to organize a workshop on natural and human-induced hazards and disasters in Africa, to be held in Kampala, Uganda, August 2007, received funding from IUGG (\$2,000).

### **Nominations for the IUGG Bureau**

Three of the GeoRisk Commissioners are nominated for the IUGG Bureau: Tom Beer as President; Harsh Gupta as Vice-President; and Alik Ismail-Zadeh as Secretary General.

### **Publications**

- Ell, R., Riding the storm: can science keep us in the saddle? ESOE Newsletter, No. 10, Feature article, 24.05.2006 ([http://www.esof2006.org/blog\\_article.php4?ID=24&what=Feature](http://www.esof2006.org/blog_article.php4?ID=24&what=Feature))
- Gupta, H., Mega –Tsunami of 26th December 2004: Indian Initiative for Early Warning system and Mitigation of Oceanogenic Hazards, *Episodes*, Vol. 28, No.1, 2-5, 2005.
- Ismail-Zadeh, A. T. (Ed.) *Recent Geodynamics, Georisk and Sustainable Development in the Black Sea to Caspian Sea Region*, American Institute of Physics Conference Proceedings, vol. 825, Melville, New York, 2006. 162 p.

- Ismail-Zadeh, A. T., and T. Beer (Eds.) *Georisk: Interactions between Science and Society*, special issue of *Natural Hazards*, Springer, in press, 2007.
- Singh, R. (Ed.), *Sumatra Tsunami and Earthquake*, special issue of the *International Journal of Remote Sensing* (Taylor and Francis), 2007.

## **Planned Activity for 2007**

### **1. IUGG GeoRisk Commission Business Meeting**

The last business meeting of the Commission was held in Hyderabad (India) in December 2004. The next business meeting is considered to be held in Perugia at the IUGG GA, July 2007. The President, Secretary General and Treasurer will report on the activity between December 2004 and June 2007. Based on the reports and discussions, we should recommend to the IUGG Executive that the Commission will continue its activity. Another item of the business meeting is the composition of the Commission for the next 4 years.

### **2. Union Symposia at the IUGG Perugia General Assembly**

The IUGG GeoRisk Commission will organize two Union Symposia at the IUGG General Assembly in Perugia, Italy, 2-13 July, 2007.

#### ***US007: High-Performance Computations in Geosciences***

Since recent years computation has been playing an increasingly important role in the understanding of the nature of the complex Earth system, especially catastrophic extreme events emerging from the system. Developments in computational science and technology has significantly accelerated the progress in data assimilation, modeling, and forecast/prediction-oriented simulations associated with various branches of Earth sciences such as atmospheric, oceanic, space, and Solid Earth sciences. This development has a strong impact to the studies of geohazards and risks such as cyclones, earthquakes, landslides, storms, tsunamis, and volcanic eruptions and shows significant potentials to be applied to serve the sustainable development of society. To reflect up-to-date developments in this direction, to identify the new frontiers and important scientific/technique problems in this developing field, and to foster new opportunities for inter-disciplinary cooperation, this session aims to focus on (but not limited to) the following topics: 1) Computer simulation in geosciences, its physical significance, and observational constraints; 2) Web-based grid computation and parallel computation applied to geosciences; 3) Data assimilation, data analysis, and data mining in geosciences; visualization in geosciences and analysis of high-dimensional data; 4) Forecast/prediction of hazards and risks based on high performance computation and its engineering application; limitation on the predictability of hazards and risks, and related engineering countermeasures; 5) Physics of complex systems and its computational implementation; 6) Development and sharing of software for the simulation and visualization in geosciences: from traditional individual-based approach to modern network-based approach. Invited and contributed papers will be presented in the session.

#### *Principal Conveners:*

Alik Ismail-Zadeh, Geophysical Institute, University of Karlsruhe, GERMANY

Zhongliang Wu, College of Earth Sciences, Graduate School of the Chinese Academy of Sciences, Beijing, CHINA

#### *Co-Conveners:*

Slava Gusiakov, Institute of Computational Mathematics and Mathematical Geophysics,  
Russian Academy of Sciences, Novosibirsk, RUSSIA

John Rundle, Center for Computational Science and Engineering and Engineering University  
of California, Davis, USA

#### *Invited Speakers*

H.-P. BUNGE (Munich University, Germany) “*High-Performance Computations in Mantle Dynamics*”

M. GHIL (Ecole Normale Supérieure, Paris, France) “*Modeling of Atmospheric Processes*”

G. GLATZMAIER (University of California at Santa Cruz, USA) “*Three-dimensional Simulations of Volcanic Eruptions*”

G. PANZA (University of Trieste, Italy) “*Modeling and Prediction-oriented Simulations of Hazards Bridging to Engineering*”

Tetsuya SATO (The Earth Simulator Center, Yokohama, Japan) “*Fostering the Simulation Culture*”

Yaolin SHI (Chinese Academy of Sciences, Beijing, China) “*Computational Geodynamics and Its Applications*”

Vasily TITOV (National Center for Tsunami Research, Seattle, USA) “*Tsunami Modeling*”

Jeroen TROMP (California Institute of Technology, USA) “*Adjoint Methods in Computational Seismology*”

#### ***US012: Early Warning of Natural Hazards***

Satellite remote sensing has proved to be a very important tool in mapping of the damages related to natural hazards in recent years. Numerous sensors onboard satellites have capability of providing information about land, ocean and atmosphere. Natural hazards (Earthquakes, Volcanoes, Tsunami, Landslides, Floods, Cyclones/hurricanes, Subsidence, Harmful algal blooms, Erosion, Cloud bursts, Snow avalanches, Oil spills, Dust storms, Coastal erosion, Droughts, Desertifications) occur on land or ocean; atmosphere provides linkage, it is now strongly believed that these natural hazards provide strong coupling between land-ocean-atmosphere-ionosphere. The session will discuss applications of Remote Sensing in mapping, monitoring and early warning of various Natural Hazards. Invited and contributed papers should be presented in the session

#### *Convener*

R. Singh, Indian Institute of Technology, Kanpur INDIA

#### *Co-Conveners*

D. Tang, Chinese Academy of Sciences, Guangzhou, CHINA

M. Buchroithner, University of Dresden, GERMANY

V. Sgrigna, University of Rome Tre, ITALY

### **3. Workshop on geohazards in Africa, Kampala, Uganda, August 2007**

A purpose of the workshop “Natural and Human-induced hazards and disasters in Africa” is to promote networking between the various organizations and groups working in the field of natural hazards in Africa. This workshop is organized by the African Scoping Group on Natural and Human-Induced Hazards and Disasters, ICSU Regional Office for Africa (ICSU ROA) in the co-operation with the IUGG GeoRisk Commission. At present, ICSU ROA is spearheading efforts to mobilize the African and international scientific community to take a proactive approach on natural and human-induced disaster in Africa and interacts with governments and other bodies to help frame policies that will raise public awareness,

minimize hazards and reduce people's vulnerability to them. In addition the workshop will assess the need for developing educational materials on hazards and prompt cooperation for new initiatives in the region. In this respect, ICSU ROA will facilitate and work as an umbrella organization to bring together the Geounions and other international organizations to ensure that existing and new scientific knowledge is used to develop improved hazard mitigation strategies. Another aim is to facilitate participation in the Hazards team of the United Nations proclaimed International Year of Planet Earth (IYPE) in 2008.

### **3. IUGG-AOGS Session on Strategy of Reducing Predictive Uncertainty of Geophysical Hazards, Bangkok, Thailand, 30 July – 4 August 2007**

An IUGG-AOGS joint session "Strategy of Reducing Predictive Uncertainty of Geophysical Hazards" will be organized during the Asia Pacific Geophysical Society (AOGS) Annual Convention to be held in Bangkok, Thailand from 30 July to 4 August 2007. Co-conveners are K. Takeuchi, H. Gupta, T. Beer, and Z. Wu.

*Session Scope:* Reduction of uncertainty in prediction is a common objective of all geoscientific disciplines. Advanced observations, simulation, nonlinear mathematics, catastrophic theory, super computers, satellites etc. are the common technology available, yet waiting for break through for new generation prediction accuracy. The session brings scientific strategies of uncertainty reduction from different disciplines and compares them to find the possibility of better collaboration and joint work. It focuses on super-hazards such as 1991 Pinatubo eruption, 1998 China Floods, 2004 Indian Ocean Tsunami, 2005 Hurricane Katrina, 2005 Pakistan Earthquake as they are so destructive and badly need, if ever possible, prediction for survival. This session is organized jointly by IUGG GeoRisk Commission and AOGS and contributes the Hazards Theme of the International Year of Planet Earth and the UN-ISDR activities for Hyogo Framework for Action.

### **4. Cooperation with IGOS-Geohazards Team**

The Commission considers (i) to evaluate possibilities of synergies with 2008 IGOS-Geohazard Workshop; and (ii) to evaluate possibilities for cooperation on the project "Webcyclopedia of Natural Hazards, Risks and Sustainability".

### **5. Cooperation with ICL**

The Commission considers to establish a close link with the International Consortium for Landslides (<http://icl.dpri.kyoto-u.ac.jp>). Dr. A. Ismail-Zadeh will attend the International Symposium on Landslide Risk Analysis and Sustainable Disaster Management to be held in UNU, Tokyo, Japan, 22-25 January 2007.