

AGU Natural Hazards Focus Group

Annual Report
15 November 2010 – 15 November 2011

INTRODUCTION

AGU Focus Group on Natural Hazards

- established in 2008 by the decision of the AGU Council and started its activity on 1 June 2009;
- fosters geophysical hazard studies - droughts, earthquakes, fires, floods, heat waves, landslides, space weather, storms, tsunamis, volcano eruptions, impact by near-Earth objects, and related events,
- establishes links between extreme natural hazards and dynamic processes on Earth and in space;
- focuses on real-time and long-term monitoring of Earth and Space active processes; quantitative natural-hazard modeling; studying predictability of natural extreme events;
- concentrates on the development of solid links between geophysical sciences and mathematical, engineering, and social sciences communities and users of knowledge concerning natural hazards;
- works in cooperation with and provides a bridge to similar efforts by the global programs of the International Union of Geodesy and Geophysics (IUGG), International Council for Science (ICSU), U.N. International Strategy for Disaster Reduction (UN-ISR), and other national, regional and international bodies.

Officers

Alik Ismail-Zadeh, Chair (Karlsruhe Institute of Technology, Germany)
Susan Cutter, Vice Chair (University of South Carolina, Columbia SC, USA)
Ilya Zaliapin, Secretary (University of Nevada, Reno, USA)

Executive Committee

Servando De la Cruz-Reyna (National Autonomous University of Mexico, Mexico)
Harsh Gupta (National Geophysical Research Institute, Hyderabad, India)
Kelly Klima (Graduate Student at Carnegie Mellon University, USA)
Yev Kontar (University of Illinois at Urbana-Champaign, USA)
Bruce Malamud (King's College London, UK)
Richard Murnane (Bermuda Institute of Ocean Sciences, UK)
Roger Pielke Sr. (CIRES and University of Colorado, Boulder, USA)
Vasily Titov (NOAA Center for Tsunami Research, Seattle, WA, USA)
Gezahegn Yirgu (Addis Ababa University, Ethiopia)

AGU Program Committee Members

Yev Kontar (University of Illinois at Urbana-Champaign, USA)

EOS Representative

Roger A. Pielke Sr. (CIRES and University of Colorado, Boulder, USA)

The Advisory Board

(comprised of experts in natural hazards and disaster risks appointed by AGU Sections)

- Susan Cutter, Chair, University of South Carolina, Columbia SC, USA (social aspect of natural hazards)
- Victor R. Baker, University of Arizona, Tucson (floods)
- Yehuda Bock, University of California, San Diego (geodetic applications and mitigation of natural hazards)
- Timothy Cohn, US Geological Survey and Johns Hopkins University (floods)
- Andy Freed, Purdue University, West Lafayette (earthquakes and volcanoes)
- Greg Holland, National Center for Atmospheric Research (NCAR), Boulder Colorado (hurricanes)
- Erkan Istanbuluoglu, University of Nebraska-Lincoln (landslides, wildfires)
- Upmanu Lall, Columbia University, New York (floods)
- Jian Lin, Woods Hole Oceanographic Institution, Woods Hole, MA (tsunami)
- James K. Mitchell, Rutgers University (s hazard mitigation and disaster management)
- Andrew V. Newman, Georgia Institute of Technology (geodetic applications and mitigation of natural hazards)
- Roger S. Pulwarty, National Oceanic and Atmospheric Administration, Boulder Colorado (droughts)
- Howard Singer, National Oceanic and Atmospheric Administration, Boulder Colorado (space weather)
- Amber J. Soja, NASA Langley Research Center, Hampton, VA (wildfires)
- Mary Lou Zoback, Risk Management Solutions, Newark, California (earthquakes)

BUSINESS MEETING

Wednesday, 15 December 2010, San Francisco

Attendance

Executive Committee: Alik Ismail-Zadeh (Chair), Ilya Zaliapin (Secretary), Kelly Klima (Member), Yev Kontar (Member), Corne Kreemer (Member), Rick Murnane (Member), Vasily Titov (Member). **Advisory Board:** Victor Baker (Atmospheric Sci.), Yehuda Bock (Geodesy), Upmanu Lall (Hydrology), Jian Lin (AB: Ocean Sci.), Andrew Newman (Geodesy), Roger Pulwarty (Atmospheric Sci.), Howard Singer (Space Weather), Mary Lou Zoback (Seismology.) **Guests:** Dalia Kirschbaum (AGU NH member), Jane Rovins (IRDR), Ramesh Singh (IUGG). **AGU staff:** Danica Williams. Apologies for absence were received from: Susan Cutter (Vice Chair), Servando De la Cruz-Reyna (Member), Harsh Gupta (Member), Bruce Malamud (Member), Roger Pielke Sr (Member), and Gezahegn Yirgu (Member).

Agenda Topics

1. General announcements, introduction of the meeting participants
2. Approval of Agenda
3. NH focus group teleconference
4. Report of the Chair (A. Ismail-Zadeh - AIZ). The report can be found in the Agenda Materials.
5. Report of the Secretary (I. Zaliapin). The report can be found in the Agenda Materials.
6. Outstanding Student Paper Awards – preliminary Report (K. Klima)
7. Report of the NH representative at the AGU Program Committee (Y. Kontar and C. Kremer)
8. Advisory Board for the AGU Natural Hazards Focus Group: Introduction / Terms of Reference

- 9. Integrated Research on Disaster Risk – a new International Program (Jane Rovins, Executive Director of the International Program Office)
- 10. AGU involvements in the ENHANS project
- 11. Other topics

Minutes of the business meeting can be downloaded from the NH Focus Group web-page:
http://www.agu.org/focus_group/NH/events/meetings/Minutes_Dec15_10.pdf



Participants of the Fall 2010 focus group business meeting.

Sit (left to right): J. Rovins, K. Klima, V. Baker, M. L. Zoback, A. Ismail-Zadeh, and V. Titov.
Stand (left to right): R. Pulwarty, H. Singer, U. Lall, R. Singh, Y. Bock, J. Lin, R. Murnane, Y. Kontar, A. Newman, C. Kreemer, and I. Zaliapin

NATURAL HAZARDS RESEARCH AT 2010 AGU FALL MEETING IN SAN FRANCISCO

The 2010 Fall AGU meeting will feature a range of sessions on Natural Hazards. The NH Program will run from Monday, 13 December till Friday, 17 December. It will include 331 oral talks and posters in 32 NH sessions that will cover various aspects of natural hazards, including hazard assessment techniques and mitigation strategies, data collection approaches, extreme events, interaction with government, policy and decision makers, as well as numerous case studies.

AWARD FOR GRADUATE RESEARCH

The AGU Natural Hazards Focus Group awards young scientists for outstanding contributions achieved during their Ph.D. research. The Graduate Research Award Committee consists of three distinguished experts in natural hazards: *Michael Ghil*, Chair (UCLA & Ecole Normale Supérieure, Paris, France), *Efi Foufoula-Georgiou* (University of Minnesota, Minneapolis, USA), and *Friedemann Wenzel* (Karlsruhe Institute of Technology).



The 2011 AGU Natural Hazards Focus Group Graduate Research Award went to **Dr. Valentin Gischig** (ETH Zurich, Switzerland). The award is given for his original research improving understanding of and mitigating hazards from unstable rock slope. The Award Committee has emphasized substantial creativity, originality, multi-disciplinarity and maturity of the work of the award recipient and recognized his potential to become a leader in the natural hazard field.

Dr. Valentin Gischig received his M.Sc. in Geophysics and Glaciology at ETH Zurich, Switzerland, in 2007. After a five month internship at Geoscience Australia, Canberra, in 2007, he started in a PhD project about rock slope instability in the Chair of Engineering Geology at ETH Zurich.

He finished his PhD thesis in May 2011 with the thesis title: '*Kinematics and failure mechanisms of the Randa rock slope instability (Switzerland)*', which was supervised by Dr. Jeffrey R. Moore, Dr. Florian Amann, Dr. Keith F. Evans and Prof. Simon Loew. Since October 2011, Valentin Gischig will be a postdoc in the Swiss Seismological Service, ETH Zurich, and will work in a project related to induced seismicity in enhanced geothermal systems. Dr. Gischig published 5 papers and submitted 4 papers for publications in peer-reviewed journals. He was nominated for the award by Prof. Simon Loew.

2010 OUTSTANDING STUDENT PAPER AWARD

The NH Focus Group executives appointed a committee to search for the outstanding student papers to be presented at the 2010 AGU Fall Meeting. The Committee evaluated 76 student presentations at the Fall Meeting. The final decision was made on the basis of the score information and comments submitted by the judges. The following students have been selected to be awarded:

- 1) Shi Sim (University of California at San Diego);
- 2) Kelly Klima (Carnegie Mellon University); and
- 3) Daniele McKay (University of Oregon).

AGU NATURAL HAZARDS INDEX TERMS

The Executive Committee of the Focus Group developed the Natural Hazards Index Terms, which are placed in the AGU Index Terms. This will assist AGU members in choosing proper terms to refer in abstract of their papers.

FOCUS GROUP GILBERT F. WHITE DISTINGUISHED LECTURE AWARD PROPOSAL

The Executive Committee of the Natural Hazards (NH) Focus Group decided that outstanding scholarship in the field of NH and risk assessment based on a sustained record of contributions and accomplishments should be recognized. Dr. Gilbert F. White was one of the leading XXth century scholars in the field of natural hazards, and the NH Focus Group would be pleased if AGU decides to name the lecture as "Gilbert F. White Distinguished Lecture". A proposal prepared by S. Cutter was considered by the Executive Committee of the AGU Natural Hazards Focus Group at its

business meeting on 18 December 2009 in San Francisco and was approved unanimously. The proposal was submitted to the AGU Honors and Recognition Committee for review. The AGU Council approved the Award at its meeting on 18-19 August 2011 in Washington.

NH FOCUS GROUP PROJECT



The AGU Natural Hazards Focus Group participates in the ENHANS Project. The principal goals of the ENHANS project are (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 prediction of extreme events reducing predictive uncertainty and on natural hazards mitigation; to bring the issues into the 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 ENHANS are achieved via scientific meetings and open forums bringing together research experts, decision makers, and disaster management, insurance agency and mass media practitioners. The project places a special emphasis on 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 sub-Saharan Africa, and in Asia and the Pacific region. Further information: <http://www.enhans.org/>

ENHANS SYMPOSIUM “NATURAL EXTREME EVENTS: MODELING, PREDICTION AND MITIGATION”

This ENHANS symposium was held at the 2010 AGU Fall Meeting on 13-14 December. 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 Surjalal Sharma (University of Maryland, College Park, USA) and Ilya Zaliapin (University of Nevada, Reno, USA), co-organizers of the symposium, Alik Ismail-Zadeh (Karlsruhe Institute of Technology, Germany) 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.

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 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). 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. 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 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. 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 Ning Lin (Massachusetts Institute of Technology, Cambridge) spoke on a hurricane risk assessment related to wind damage and storm surge. 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 Nauman Awan (University of Graz, Austria). John Rundle (University of California, Davis) spoke on precursory activation and quiescence prior to major earthquakes. 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. Kenji Satake (University of Tokyo, Japan) spoke on tsunami modeling, forecast and warning. 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 was a keynote lecture on “Society's Growing Vulnerability to Natural Hazards and Implications for Geophysics Research” by Julia Slingo (Chief Scientist, MetOffice, U.K.)

ENHANS WORKSHOP “EXTREME NATURAL HAZARDS AND DISASTER RISK IN 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. The Workshop’s scientific program can be found at the workshop’s web-page: <http://www.technoscene.co.za/hazardsws>.



The Pretoria Workshop's participants

The Workshop's participants adopted the recommendation to governments and funding institutions in cooperation with the relevant ICSU bodies, United Nations agencies and other international entities (see Annex 1).

ENHANS SESSION "NATURAL HAZARDS AND DISASTER RISKS IN THE MIDDLE EAST REGION"

This ENHANS session was held on 7 May 2011 in Antalya, Turkey during the International Conference on "Geo-Information for Disaster Management" and chaired by Alik Ismail-Zadeh and Kuniyoshi Takeuchi (International Center for Water Hazard and Risk Management under the auspices of UNESCO, Tsukuba, Japan). The focus of this session was on the Middle East Region. 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.



Flooding in Jeddah, Saudi Arabia, 2011



Earthquake disaster in Jerusalem, 1927

The following speakers gave an invited talk:

- 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*
- Mustafa Erdik (Turkey, Bogazici University, Istanbul, Turkey), Cuneyt Tuzun, Domenico Giardini, Karin Sesetyan: *A Regional Program of GEM: Earthquake Model of Middle East*
- 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.*

ENHANS SYMPOSIA “NATURAL HAZARDS AND DISASTER RISKS IN ASIA AND THE PACIFIC REGION”

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.

The Union Symposium “Grand Challenges in Natural Hazard Research and Risk Analysis” and the Open Forum “Natural Hazards: From Risk to Opportunity by Partnership of Science and Society” were held on 29 June-2 July 2011 at the XXV IUGG General Assembly in Melbourne, Australia. The Symposia addressed major challenges in natural hazards research, disaster risk analysis and ways for solutions. The Open Forum discussed how natural disaster risk could be converted to opportunity. The following distinguished experts in natural hazards, extreme events, disaster risk analysis as well as representatives of various organizations dealing with relevant problems delivered talks are the symposium:

- Tom Beer, Centre for Australian Weather and Climate Research, CSIRO, Australia (IUGG President)
- Salvano Briceno, U.N. International Strategy for Disaster Reduction
- Stephen Dovers, Fenner School of Environment and Society, Australian National University, Canberra, Australia
- John Eichelberger, Volcano Hazards Program, USGS
- Kevin Furlong, Penn State, USA
- Harsh Gupta, National Geophysical Research Institute, Hyderabad, India (President of the Asian Oceanic Geoscience Society; ICSU Regional Office for Asia and the Pacific)
- Fumi Imamura, Disaster Control Research Center, Tohoku University, Japan
- Kojiro Irikura, Aichi Institute of Technology, Japan
- Susan Kiefer, University of Illinois, USA
- Akio Kitoh, Meteorological Research Institute at Tsukuba, and Kyoto University, Japan
- Reiko Kuroda, University of Tokyo, Japan (Vice President of the International Council for Science)
- Paul Linden, University of Cambridge, UK

- Gordon McBean, Institute of Catastrophic Loss Reduction, University of Western Ontario, Canada (Chair of the ICSU-ISSC-UNISDR Program “Integrated Research on Disaster Risk-IRDR”)
- Neville Nicholls, Monash University, Melbourne, Australia
- Kenji Satake, University of Tokyo, Japan
- John Schneider, Risk and Impact Analysis Group, Geoscience Australia
- Soroosh Sorooshian, University of California at Irvine, USA
- Kuniyoshi Takeuchi, International Centre for Water Hazard and Risk Management, Tsukuba, Japan
- Sisi Zlatanova, Delft University of Technology, The Netherlands



The ENHANS 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

FOCUS GROUP’S WEB PAGE

The Focus Group Web page moved to its permanent site at http://www.agu.org/focus_group/NH/. The page contains the information on the latest news related to natural hazards and disasters, on the activities of the Focus Group, FG executives, meetings, conferences, links to relevant organizations dealing with natural hazards. The group e-mail is: nathazards@gmail.com.

NATURAL HAZARDS GROUP NEWSLETTERS

The Focus Group newsletters were published electronically and broadcast to the AGU members twice for the reported period. The Newsletters are available at web: http://www.agu.org/focus_group/NH/about/newsletters/

Alik Ismail-Zadeh, Chair, AGU Natural Hazards Focus Group

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.