



**ICSU**

International Council for Science

strengthening international science for the benefit of society

# Natural and human-induced environmental hazards

Report from the ICSU Scoping Group



**ICSU Scoping Group on  
Natural and Human-induced  
Environmental Hazards\***

**Report to the  
ICSU 28<sup>th</sup> General Assembly,  
Suzhou, China  
October 2005**

The ICSU 28<sup>th</sup> General Assembly decided that the name of the proposed programme be changed to “Natural and Human-Induced Hazards and Disasters”.



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## Summary

The frequency of recorded natural disasters rose markedly during the last century, from about 100 per decade up to 1940 to nearly 2800 per decade during the 1990s. Three-quarters of these disasters are triggered by weather-related events. Population growth in hazardous areas means that more and more people are at risk, and the increasing dependence of urban communities on complex infrastructure brings with it an increasing vulnerability to disruption. The 2002 World Summit on Sustainable Development highlighted the extent to which progress in development can be wiped out by natural disasters. The IPCC foresees that the severity of the impacts of extreme events will increase in concert with global warming.

So natural hazards and natural disasters are becoming more and more prominent. World leaders in a variety of fora are bringing the subject into the mainstream of political concern. This report outlines the possible scope of an ICSU initiative on natural and human-induced environmental hazards.

There is extensive research on individual hazards – how hazardous events are triggered, how to improve forecasting, how events unfold, how they cause damage, etc. We suggest that the greatest shortfall in current research activities lies not so much in scientific work itself as in research on how science is used to shape social and political decision-making in the context of hazards and disasters, and it is here that our proposal is principally focused.

This report recommends the appointment of a Planning Group to develop the details of an ICSU hazards initiative. The initiative should take the form of a programme of research aimed at strengthening international science to provide a firmer basis for policies to prevent natural hazards from becoming disasters. Such an objective will need:

- an international collaborative research programme lasting a decade or more;
- the combined insights of the natural, health, social and engineering sciences;
- engagement with populations living in hazardous areas, to understand better the social and cultural determinants of choice in the hazards context;
- engagement with policy-makers at regional, national and international level, to understand better the constraints on policy-making in the hazards context;
- the ability to accommodate both individual hazards and the interplay between hazards;
- a long-term perspective; and
- a focus on delivering new scientific insights for the primary customers: development agencies, humanitarian assistance agencies and governmental policy-makers.

This is an ambitious undertaking, in keeping with the importance and complexity of the subject. ICSU will need to work with appropriate partners to achieve its goals.





## Science and Natural Hazards – an ICSU Statement<sup>1</sup>

As the recent tragic events in the Indian Ocean have shown only too vividly once again, natural hazards (earthquakes, tsunamis, floods, hurricanes, landslides, tornadoes, volcanic eruptions, and other geophysical phenomena) are an integral component of life on Earth. These can have disastrous effects on vulnerable communities and ecosystems. Only by understanding how and where such hazards may occur, what causes them, what circumstances increase their severity, and what their impacts may be, will it prove possible to develop effective mitigation strategies. In practice, this requires addressing issues such as real-time monitoring and prediction, emergency preparedness, public education, post-disaster recovery, engineering, land use, and construction practices. Coordinated approaches involving scientists, engineers, policy makers, builders, investors, insurers, news media, educators, relief organizations, and the public are therefore essential if the devastating effects of natural hazards are to be reduced.

In order to reduce vulnerability to natural hazards, the International Council for Science strongly endorses the need for:

- fundamental research on the Earth system and its dynamics,
- integrated research on the impact of natural disasters on social and ecological systems,
- agreement on an international global observation framework for the collection, management and open sharing of data and information on natural hazards,
- mapping of the known exposures of human populations, resources and economic activities to multiple disasters,
- integrated models that combine geophysical, ecological, demographic and economic aspects of disaster scenarios,
- establishment of coordinated international detection and early warning systems,
- building of indigenous scientific and technical capacity in vulnerable regions to take advantage of existing knowledge and stimulate local innovation,
- development and evaluation of prevention and mitigation programs in the most risk-prone areas,
- dissemination of the relevant results to policy makers and the public, and
- a renewed focus on public education, particularly in vulnerable communities.

Science has contributed much to the understanding of natural hazards but, as recent events have shown, the natural environment remains dangerously unpredictable. Scientific knowledge and technologies are not always available when and where they are needed. A new strategic international and interdisciplinary approach to science is necessary to more fully exploit existing knowledge and identify and address the unknown. At the same time more effective strategies for mitigation of the effects of natural hazards need to be developed and deployed. Only when good science and policy making are effectively combined will the world become a safer place.

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<sup>1</sup>This statement is based on material from the American Geophysical Union (1996, 2000: [http://www.agu.org/sci\\_soc/policy/positions/naturalhaz.shtml](http://www.agu.org/sci_soc/policy/positions/naturalhaz.shtml)); the International Union of Geodesy and

Geophysics (Jan 2005: <http://www.mitp.ru/georisk/> or <http://www.iugg-georisk.org>); the ICSU Committee on Disaster Reduction ( 2002: [http://www.icsu.org/Gestion/img/ICSU\\_DOC\\_DOWNLOAD/210\\_DD\\_FILE\\_statem-NDR\\_Apr\\_02.pdf](http://www.icsu.org/Gestion/img/ICSU_DOC_DOWNLOAD/210_DD_FILE_statem-NDR_Apr_02.pdf)); and, the International Global Observing Strategy *ad hoc* Working Group on Geohazards (2002: <http://dup.esrin.esa.it/igos-geohazards/home.asp>). It also draws on some of the recommendations made in a letter from Lerner-Lam *et al* that was published in the Los Angeles Times on 30 December 2004 (<http://www.latimes.com/technology/la-oe-lerner30dec30,1,3003421,print.story?coll=1&ctrack=1&cset=true>).

The statement is endorsed the Executive Board of the International Council for Science (ICSU, January 2005). ICSU is a non-governmental organization representing a global membership that includes both National Scientific bodies (103 members) and International Scientific Unions (27 members). The Council is currently exploring the establishment of a new international interdisciplinary program on natural and man-made hazards. This will build on ongoing plans for the Year of Planet Earth, involving the Geo-Unions and UNESCO (<http://www.esfs.org/downloads.htm>).

# 1 Introduction

The ICSU Priority Area Assessment on Environment and its Relation to Sustainable Development (2003),<sup>1</sup> reviewing strategic options for future ICSU activities related to environmental research, proposed ‘Natural and human-induced hazards’ as one of four possible new fields of work. This field was also highlighted as an emerging scientific issue in the ICSU Foresight Analysis (2004).<sup>2</sup> ICSU has been involved, as an institutional partner, in preparing the Geohazards Theme<sup>3</sup> of the Integrated Global Observing Strategy Partnership, and has been active in a number of other initiatives related to scientific<sup>4</sup> aspects of natural hazards.

From a number of directions, then, the natural hazards theme has been coming to the fore as a possible candidate for a substantive ICSU initiative. The ICSU Executive Board therefore appointed a group to recommend the scope of a possible ICSU initiative in this area and report to the ICSU General Assembly. The membership of this Scoping Group, drawn from a wide range of natural and social science disciplines and institutional contexts, is given in Annex A. The Group’s terms of reference are given in Annex B.

## 2 Natural Hazards and Disasters

### 2.1 Recent trends

The devastating effects of the 1995 Kobe earthquake in Japan, the December 2004 Indian Ocean tsunami and the August 2005 Hurricane Katrina in the United States are vivid reminders that natural disasters<sup>5</sup> are a global issue and can result in great loss of human lives, livelihoods and economic assets in both developed and developing countries. But while very large events are, fortunately, fairly rare, the frequency of recorded natural disasters has been rising rapidly. From about 100 per decade in the period 1900-1940, to 650 per decade in the 1960s and 2000 per decade in the 1980s, it reached almost 2800 per decade in the 1990s. Millions of people are killed, injured or displaced each year because of natural disasters, and property damage has been doubling about every seven years over the past 40 years.<sup>6</sup>

Though earthquakes and tsunamis can have horrific impacts, most disaster losses, whether measured in terms of the number of events (see Figure 1), the lives lost or material destruction, stem from extreme atmospheric events and weather-related natural hazards such as hurricanes, cyclones, other major storms, floods, landslides,

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[http://www.icsu.org/Gestion/img/ICSU\\_DOC\\_DOWNLOAD/58\\_DD\\_FILE\\_ICSU\\_PAA\\_REPORT.pdf](http://www.icsu.org/Gestion/img/ICSU_DOC_DOWNLOAD/58_DD_FILE_ICSU_PAA_REPORT.pdf)

<sup>2</sup> [http://www.icsu.org/Gestion/img/ICSU\\_DOC\\_DOWNLOAD/371\\_DD\\_FILE\\_Foresight\\_Analysis.pdf](http://www.icsu.org/Gestion/img/ICSU_DOC_DOWNLOAD/371_DD_FILE_Foresight_Analysis.pdf)

<sup>3</sup> <http://dup.esrin.esa.it/igos-geohazards/>

<sup>4</sup> For convenience, and unless otherwise specified, we use ‘science’ and ‘scientific’ to include the natural, health, engineering and social sciences.

<sup>5</sup> See Annex C for definitions of some of the technical terms used in discussing hazards and disasters.

<sup>6</sup> EM-DAT: The OFDA/CRED International Disaster Database <http://www.em-datnet.UCL> - Brussels, Belgium

wildfires and drought. <sup>7</sup> In the 1990s, about three-quarters (by number) of all natural disasters were triggered by weather-related events (Figure 2).

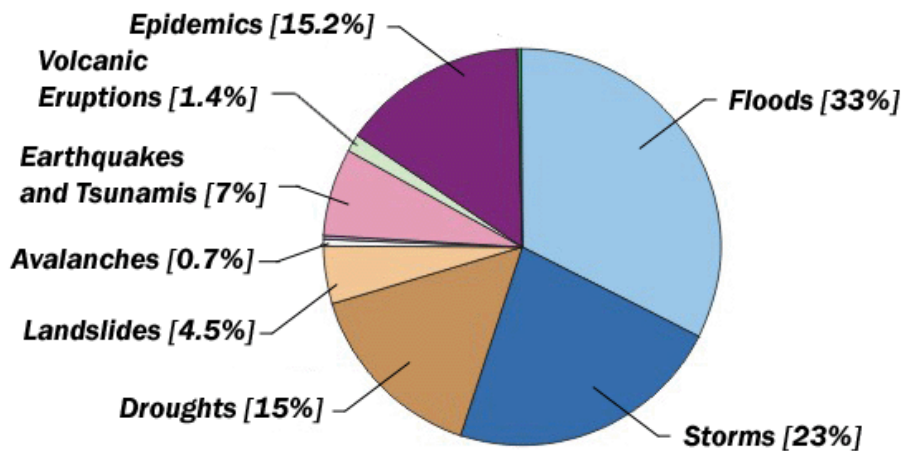


Figure 1. Natural disasters by triggering hazard averaged across the world, 1994 - 2003.

Source: EM-DAT: The OFDA/CRED International Disaster Database

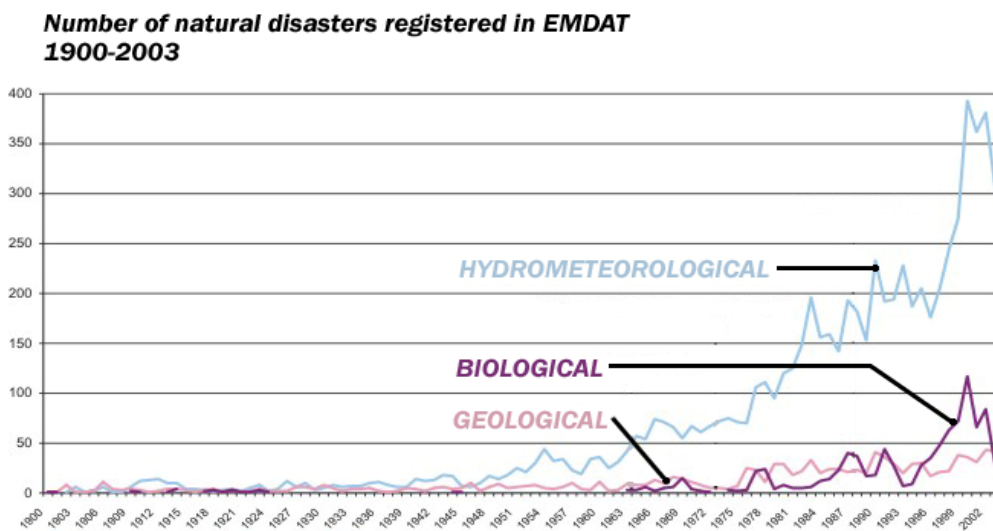


Figure 2. Trends in the frequency of natural disasters

Source: EM-DAT: The OFDA/CRED International Disaster Database

Natural disasters in 2004 are currently estimated to have caused economic losses totalling US\$140bn, the second highest annual total on record, and the costliest year ever for the international insurance industry (though the majority of these losses are

<sup>7</sup> Munich Reinsurance, 2005, *Annual Review: Natural Catastrophes 2004* [Available: <http://www.munichre.com>]; World Bank, 2005, *Natural Disaster Hotspots: A Global Risk Analysis*.

uninsured). This was twice the annual mean value over the past 10 years and second only to the record US\$179bn set in 1995. The economic losses in 2004 included US\$73bn in Asia, mainly due to earthquakes, and US\$63bn in North and South America, mainly due to windstorms.<sup>8</sup>

Around the globe, population growth in hazardous areas means more people and communities are at risk. In urban regions (and particularly in very large cities), the complex infrastructure systems that make life and economic activity possible by the same token increase the vulnerability of populations to disruptions caused by natural hazards. Human interventions in the environment can also increase vulnerability to natural hazards. Examples include changes in landcover that increase risks of landslides or flooding, destruction of mangroves that increases the susceptibility of coastal areas to storm damage, and emissions of pollutants and greenhouse gases into the atmosphere that can increase the frequency of extreme weather events.

Changes in the global climate have altered and will continue to alter the risk associated with natural hazards. As the Intergovernmental Panel on Climate Change noted in 2001:

*The vulnerability of human societies and natural systems to climate extremes is demonstrated by the damage, hardship, and death caused by events such as droughts, floods, heat waves, avalanches, and windstorms. While there are uncertainties attached to estimates of such changes, some extreme events are projected to increase in frequency and/or severity during the 21<sup>st</sup> century due to changes in the mean and/or variability of climate, so it can be expected that the severity of their impacts will also increase in concert with global warming.*<sup>9</sup>

## **2.2 Disaster management**

A natural disaster can be conceptualized as an extreme event in which a natural hazard interacts with individual and community exposure and vulnerabilities to trigger negative social and economic impacts on a scale that is beyond the coping capacity of the affected population.<sup>10</sup> From this perspective, natural disasters are not inevitable; positive decisions and actions can be taken to prevent or reduce hazard pressures, to minimize the vulnerability of people and property and thus to mitigate the negative consequences of hazard events. This is the basic premise of disaster management, which refers to the development and implementation of policies and practices designed to manage and reduce the impacts of hazard events.

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<sup>8</sup> *The WCDR News*, published by the Secretariat of the Hyogo Cooperative Committee for the World Conference on Disaster Reduction, No. 4, 21 January 2005.

<sup>9</sup> IPCC *Climate change 2001*, Synthesis Report, p107 (available from <http://www.ipcc.int>)

<sup>10</sup> See Alexander, D. 1997. 'The Study of Natural Disasters, 1977-1997: Some Reflections on a Changing Field of Knowledge,' *Disasters* 21(4): 284-304; McEntire, D.A. 2001. 'Triggering Agents, Vulnerabilities and Disaster Reduction: Towards a Holistic Paradigm,' *Disaster Prevention and Management* 10(3): 189-196; Paton, D. and D. Johnston. 2001, 'Disasters and Communities: Vulnerability, Resilience and Preparedness', *Disaster Prevention and Management* 10 (4): 270-277.

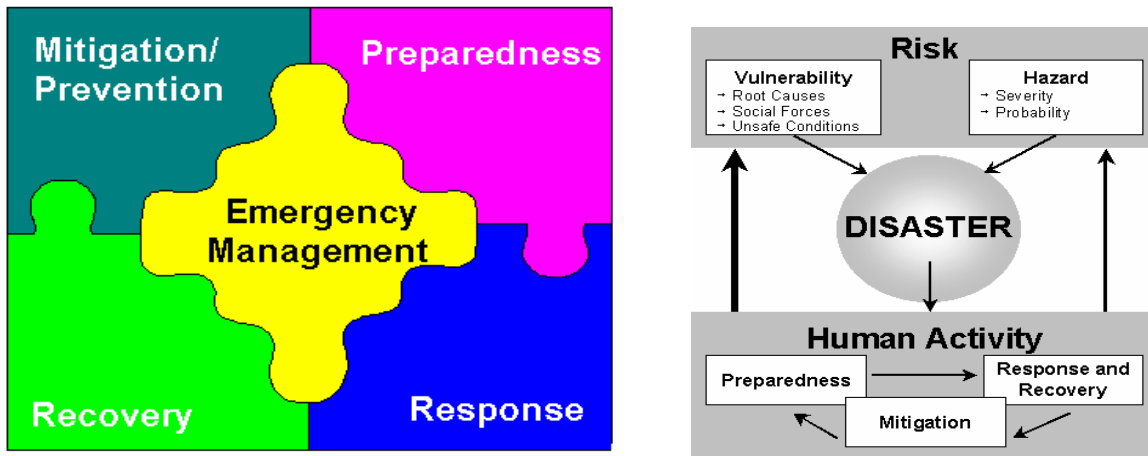


Figure 3. Disaster management

Disaster (or emergency) management has four interrelated elements: preparedness; response; recovery; and mitigation (ie reducing adverse consequences) (Figure 3).<sup>11</sup> There is growing recognition that the focus of disaster management must shift from response and recovery towards mitigation. This idea was central to the Yokohama Strategy (see section 5 below), which stated:

*The impact of natural disasters in terms of human and economic losses has risen in recent years, and society in general has become more vulnerable to natural disasters... Disaster response alone is not sufficient, as it yields only temporary results at a very high cost. We have followed this limited approach for too long... Prevention contributes to lasting improvement in safety and is essential to integrated disaster management.*<sup>12</sup>

These objectives were reiterated and expanded at the 2005 Hyogo Declaration (section 5 below), which stated:

*We recognize as well that a culture of disaster prevention and resilience, and associated pre-disaster strategies, which are sound investments, must be fostered at all levels, ranging from the individual to the international levels... We affirm that States have the primary responsibility to protect the people and property on their territory from hazards, and thus it is vital to give high priority to disaster risk reduction in national policy, consistent with their capacities and the resources available to them.*<sup>13</sup>

<sup>11</sup> Godschalk, D.R. 1991. 'Disaster Mitigation and Hazard Management', in *Emergency Management: Principles and Practice for Local Government*, ed. T.E. Drabek and G.J. Hoetmer. Washington, D.C.: International City Management Association: 131-159.

<sup>12</sup> United Nations International Strategy for Disaster Reduction (UNISDR). 1994. *Yokohama Strategy and Plan of Action for a Safer World: Guidelines for Natural Disaster Prevention, Preparedness and Mitigation*. World Conference on Natural Disaster Reduction, Yokohama, Japan, 23 May 1994 [Available: <http://www.undp.org>]

<sup>13</sup> United Nations International Strategy for Disaster Reduction (UNISDR). 2005. *Hyogo Declaration*. World Conference on Disaster Reduction, Kobe, Japan, 18-22 January 2005. [Available: <http://www.unisdr.org/wcdr/>]

In the context of natural disasters, mitigation includes actions to prevent or reduce losses associated with natural hazards. These actions might include: regulating land use to prevent inappropriate development in hazardous areas; enforcing minimum construction standards to ensure structures are resistant to extremes; installing structural controls to resist hazard pressures (*e.g.*, flood protection systems or reinforced concrete in earthquake zones); improving forecasting and warning systems in order to provide hazard information to citizens and advise them regarding an appropriate response strategy; and providing public education to help people undertake protective activities and to ensure that they know how to respond to hazard warnings.<sup>14</sup>

Losses from natural disasters are substantial and in some countries represent a major proportion of national GDP.<sup>15</sup> It is therefore important that hazard mitigation and risk management be integrated into the global change agenda and that all three be considered within the overall frameworks of sustainable development, poverty eradication and global security. An integrated approach to human development is needed.

### **3 The ICSU Community and Natural Hazards**

This section and the two that follow provide a brief summary of some of the main relevant scientific activities, respectively in the ICSU community, other international bodies and the UN system. The aim is to give a flavour of current work rather than to be comprehensive.<sup>16</sup>

#### **3.1 ICSU**

ICSU itself was an active participant in the UN-led International Decade for Natural Disaster Reduction (IDNDR, 1990-1999). It established a committee to oversee its own engagement with IDNDR and to advise ICSU members on harmonising their activities related to natural disasters. Associated projects included: drought assessment and famine (coordinated with IGU); reducing volcanic disaster (with IAVCEI); global seismic hazard assessment (with IASPEI and ILP); tropical cyclone disasters (with IUTAM and WMO); and engineering for disaster reduction (with WFEO). After the Decade, ICSU replaced its IDNDR committee with the Committee on Disaster Reduction, charged with representing ICSU in the UN's International Strategy for Disaster Reduction, the successor initiative to IDNDR (see 5.1 below).

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<sup>14</sup> Godschalk, D.R., T. Beatley, P. Berke, D. Brower and E.J. Kaiser, 1999. *Natural Hazard Mitigation*. Island Press, Washington.

<sup>15</sup> Handmer, J. 2003. 'Adaptive Capacity: What Does it Mean in the Context of Natural Hazards?', in *Climate Change, Adaptive Capacity and Development*, ed. J.B. Smith, R.J.T. Klein and S. Huq, London: Imperial College Press.

<sup>16</sup> The information given in sections 3 – 5 is based mainly on published sources. However, it has not been systematically checked with each organisation listed, and should therefore not be treated as a definitive statement of each organisation's activities.

## 3.2 CODATA

CODATA, the Committee on Data for Science and Technology, was established by ICSU in 1966. Never before has the role of scientific data been of such paramount importance to society as it is today. A simple example reflects this:- Immediately after the South Asian tsunami, critical data on elevation, population location and administrative boundaries could not be shared because of intellectual property and national security constraints. To address some of these issues, CODATA is exploring the feasibility of commencing a project on the “*Role of Science and Data in Disaster Risk Management*”.

## 3.3 Earth observation initiatives

ICSU is actively involved in a series of interlocking initiatives addressing various aspects of Earth observation. The overall objective relates to the global agenda for sustainable development and sound environmental management but, within this, there is a specific focus on natural hazards.

Since the early 1990s, ICSU and others have been co-sponsoring systematic global observing programmes for the oceans (*Global Ocean Observing System, GOOS* [1991]), the climate (*Global Climate Observing System, GCOS* [1992]), and the land (*Global Terrestrial Observing System, GTOS* [1996]). GCOS, GOOS and GTOS, together with ICSU itself and other organizations, are Partners in the *Integrated Global Observing Strategy (IGOS)*, established in 1998.

IGOS's role is to address strategic issues across all the main observing systems and to guide their priority-setting. IGOS has defined a number of Themes to facilitate the coherent definition and development of an overall strategy for observing selected fields of common interest among IGOS Partners. One of the ten Themes is Geohazards, ‘to respond to the scientific and operational geospatial information needs for the prediction and monitoring of geophysical hazards, namely earthquakes, volcanoes and land instability’. The Geohazards Theme was scoped in 2001, and a preliminary prospectus was published in April 2004. The Theme established its own funded secretariat in late 2004 and has its own website. A recent meeting to develop the prospectus concentrated on: scientific research priorities; observations and data needs; interoperability and other infrastructure needs; integration of data to generate information products; and capacity building. The overall aim is to bring together active practitioners from a range of geohazard disciplines and techniques in order to stimulate collaboration and identify priorities for earth observation. IGOS Geohazards sees its main target audiences as responsible civil authorities, scientists in monitoring and advisory agencies, and research scientists.

The *Group on Earth Observations (GEO)* is an inter-governmental initiative launched in July 2003 in response to the WSSD commitment to develop comprehensive, coordinated and sustained Earth observation. At the 3<sup>rd</sup> Earth Observation Summit in February 2005, a



10-year implementation plan (starting January 2006) for the *Global Earth Observation System of Systems (GEOSS)* was approved. It defines nine societal benefits, of which the first is 'Reducing loss of life and property from natural and human-induced disasters'. The plan then sets out activities on 2, 6 and 10 year timeframes for each of the defined benefits. Its overarching vision for disasters is 'to further enhance coordination among operational observing systems with global coverage. These need to be capable of supporting effective disaster warnings, responses and recovery ... collaborative framework to permit free exchange and efficient use of data, together with support for continuity of operations for all essential systems.'

### **3.4 IGU**

The International Geographical Union has Commissions on 34 varied topics including: hazards and risks; land degradation and desertification; land cover and land use change; and population and vulnerability. The Commission on hazards and risks takes as its starting point that disasters arise from interactions between natural phenomena and societal conditions, and therefore focuses particularly on vulnerability of ecosystems, societies and individuals. It aims to carry out comparative international geographical studies that will contribute to the creation of an interdisciplinary language of hazards, risks and vulnerability.

The *International Association for Engineering Geology and the Environment*, an affiliate of the IGU, has established a committee on landslides and engineered slopes, whose objectives include the development and application of the relevant science and engineering expertise.

### **3.5 ILP**

The International Lithosphere Programme, established by ICSU in 1980 at the request of IUGG and IUGS, includes:

- the *Global Earthquake Potential* project (to produce a reliable estimate of earthquake potential valid throughout the world that would be useful as a source model for seismic hazard calculations);
- the *Global Seismic Hazard Assessment Program* (launched in 1992 by ILP and ICSU in the context of IDNDR to create a global seismic hazard map based on advanced methods in probabilistic seismic hazard assessments, and completed in 1998); and
- the *Earthquakes and Megacities Initiative* (aimed at creating a network of large metropolises exposed to the threat of earthquakes so that they can share their experiences and coordinate their activities in order to increase capacity for disaster preparedness, response and recovery. Themes include evaluation of seismic exposure, impact on society, economic consequences, preparedness and emergency response capabilities.)

### **3.6 ISPRS**

The International Society for Photogrammetry and Remote Sensing has two working groups specifically focused on disaster monitoring, mitigation and damage assessment. Spatial Data Integration for Emergency Services is concerned with the generation of vulnerability and hazard zone maps for various types of disaster, integrating remotely sensed data observation and communication strategies with enhanced predictive modeling capabilities for disaster management. Hazards, Disasters and Health is concerned with applying remote sensing data products to public health and other environmentally-induced events that may affect people. Other ISPRS Working Groups deal with topics of relevance to natural and human induced environmental hazards, such as rapid delivery of geospatial data to disaster areas and the application of Earth observation data to a variety of problems.

ISPRS also works with the UN Office of Outer Space Affairs Disaster Management International Space Coordination entity (DIMISCO).

### **3.7 IUGG**

The International Union of Geodesy and Geophysics established the *Commission on Geophysical Risk and Sustainability (Georisk)* in 2000. Its projects include a series of symposia (four to date) on geohazards, risks and sustainable development in cities, intended both to explore scientific issues and to raise awareness among policy-makers; and production of a 'webcyclopedia' of urban risk and sustainability giving ordered information analysed by city, hazard and risk. Participants in a NATO Advanced Workshop in June 2002 organised jointly by Georisk and Euroscience agreed the *Budapest Manifesto*,<sup>17</sup> which stressed the need for scientists to work with local communities in evaluating risk from natural hazards and ways to respond to risk. These principles were included in the proposed research agenda for the Hazards theme of the IUGS/UNESCO International Year of Planet Earth (3.11 below).

*IASPEI (International Association of Seismology and Physics of the Earth's Interior)*, one of the IUGG Associations, has current commissions on a range of earthquake issues relevant mainly to scientific aspects of the theme of natural hazards. *IAVCEI (International Association of Volcanology and Chemistry of the Earth's Interior)*, another IUGG Association, is the primary international focus for research in volcanology and related disciplines and efforts to mitigate volcanic disasters. Among its active commissions are those on cities and volcanoes (to provide a linkage between the volcanology community and emergency managers, and to promote applied research involving the collaboration of physical and social scientists and city officials); mitigation of volcanic disasters (focused on the preparation of hazard maps as a tool for designing monitoring systems, emergency plans and socio-economic development strategies for a given region); and the international volcanic health hazard network (to produce and disseminate protocols and volcanic health hazard information to volcano observatories, scientists, governments, emergency managers, health practitioners and the general public).

IASPEI and IAVCEI have a joint working group on Subduction zones located in developing countries, which is planning a workshop on earthquake and volcanic hazard

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<sup>17</sup> <http://www.iugg.org/budapest.pdf>

mitigation at the IASPEI General Assembly in October 2005. That Assembly will also see workshops on Tsunamis: case studies, warning system and hazard assessment, and Effects of earthquakes on megacities.

### **3.8 IUGS**

The International Union of Geological Sciences 'Commission on Geological Sciences for Environmental Management (GEMS) is the main group within the Union that deals with urban hazards. IUGS and UNESCO collaborate as partners in the International Consortium on Landslides (ICL, 4.2 below), the International Geoscience Programme (IGCP), IGOS (3.3 above), the International Lithosphere Program (ILP, 3.5 above) and the GeoIndicators Initiative. Several IUGS Affiliated Organisations (International Association of Engineering Geology and the Environment (IAEG), International Association of Geomorphologists (IAG), International Society of Soil Mechanics and Geotechnical Engineering (ISSMGE) and the International Society for Rock Mechanics (ISRM) also have interests relevant to hazards issues.

The Executive of seven GeoUnions of ICSU – IUGG, IUGS, IUSS, IGU, INQUA, IAU and ISPRS – collaborate on a number of issues, including natural hazards. The GeoUnions Science Initiative in this area has been working closely with the International Year of the Planet Earth team to develop the key research questions (see 3.11 below).

### **3.9 PSA**

The Pacific Science Association, a regional, non-governmental organization that seeks to advance science and technology in support of sustainable development in the Asia-Pacific, is establishing a task force on natural disaster reduction.

### **3.10 Tsunami statements**

ICSU itself, IUGG, IUGS, and the IGOS Geohazards Working Group each issued statements in response to the December 2004 Indian Ocean Tsunami, identifying urgent and long-term needs, and stressing the importance of bringing good science to bear effectively on policy-making.<sup>18</sup>

### **3.11 International Year of the Planet Earth**

The IUGS, IGU, ILP, INQUA, IUGG, IUSS, UNESCO and others are promoting the *International Year of Planet Earth*. The Year is expected to be declared late in 2005 by the United Nations, and is planned to run 2007 - 2009, with the subtitle *Earth sciences for*

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<sup>18</sup> [http://www.icsu.org/3\\_mediacentre/INSIGHT\\_SI\\_01\\_2005.html](http://www.icsu.org/3_mediacentre/INSIGHT_SI_01_2005.html)

*society*. IYPE aims to sponsor multidisciplinary international research within a number of societally relevant, broadly based themes, and to raise awareness among decision-makers and the public of the importance of Earth sciences to society at large. One of the themes is hazards, under which four broad, overlapping research questions have been identified:

- How have humans altered the geosphere, the biosphere and the landscape, thereby promoting and/or triggering certain hazards and increasing societal vulnerability to geohazards?
- What technologies and methodologies are required to assess the vulnerability of people and places to hazards and how might these be used at a variety of spatial scales?
- How does our current ability to monitor, predict and mitigate vary from one geohazard to another? What methodologies and new technologies can improve such capabilities, and so help civil protection locally and globally?
- What are the barriers, for each geohazard, that prevent governments (and other entities) from using risk and vulnerability information to create policies and plans to reduce both?

## **4 Scientific Aspects of Natural Hazards in the UN System**

### **4.1 International Strategy for Disaster Reduction**

ISDR was established in UN Office for the Coordination of Humanitarian Affairs as the successor initiative to IDNDR. Its four primary functions are: policy and strategy; advocacy; information and networks; and partnerships for applications. Its policy framework is set by the Yokohama Strategy (see Section 6 below) and by the 'Geneva statement' *A Safer World in the 21st Century: Risk and Disaster Reduction*, emanating from the final IDNDR forum in July 1999. One of the overarching themes of the framework is to locate the goal of reducing vulnerability to natural disasters within the context of sustainable development strategies.

The main current ISDR projects concern climate change and disaster risk reduction (chaired by UNDP and WMO), disaster reduction in Africa (chaired by the African Union and NEPAD), and the January 2005 World Conference on Disaster Reduction (core ISDR secretariat). Completed projects dealt with climate and disasters, early warning systems, wildland fires, and risk, vulnerability and disaster impact assessment. ISDR is working with WMO on a new survey of early warning systems, ahead of a major conference scheduled for Bonn in March 2006.

ISDR published a major survey, *Living with risk: a global review of disaster reduction initiatives*, in 2004. This includes an annex outlining activities of all parts of the UN system involved in disaster risk reduction.

### **4.2 United Nations Environment Programme**

UNEP has a strong focus on the interplay between environmental issues and natural disasters. In its various initiatives responding to the Indian Ocean tsunami, for example, it has stressed the need to respect environmental requirements during reconstruction and has documented the role of mangroves and coral reefs in protecting some parts of Sri Lanka from the worst effects of the tsunami. It is surveying the environmental consequences throughout the affected region and offering practical assistance in the reconstruction efforts.

More generally, UNEP is active in assessing the impact of deforestation and other practices on vulnerability to natural disasters. Its Global Environment Outlook project, initiated in response to Agenda 21, has delivered systematic scientific assessments of vulnerability to natural disasters for many regions of the world.

UNEP, the UN Office for the Coordination of Humanitarian Affairs and the Global Fire Monitoring Center are mandated to coordinate action to combat large international forest fire emergencies. The GFMC, established at Freiburg in 1998, monitors, forecasts and archives information on vegetation fires at global level. It is a designated activity of ISDR (5.1 above).

UNEP has established a finance initiative to work with a range of financial institutions throughout the world on interactions between environmental and financial performance. This includes detailed assessment of the financial aspects of natural disasters.

### **4.3 UNESCO**

UNESCO is involved in numerous programmes related to aspects of hazards, including its own natural hazards programme in the earth sciences and collaborative initiatives such as: the IYPE (3.11` above); an international flood initiative to be located at a new Centre for Water Hazard and Risk Management at Tsukuba (with WMO, the UN University, ISDR and IAHS); a coalition on education to integrate disaster reduction education into school programmes and to make school buildings safer; and an initiative on disaster management planning in megacities. On tsunamis, UNESCO is concentrating on mitigation (through the IOC's work on early warning), educational recovery, restoring biological and cultural diversity, and integrated water management.

During the Kobe Conference (section 6 below), UNESCO organized sessions on education for sustainable development, cultural heritage risk management, floods and landslides, and tsunami mitigation and early warning in the Indian Ocean. It also published a report of 93 case studies on good practice in disaster reduction.

### **4.4 Intergovernmental Oceanographic Commission of UNESCO**

UNESCO's IOC established the International Tsunami Information Center in Hawaii in 1965 to carry out a range of tsunami warning activities for all Pacific Ocean countries. IOC also established the Global Ocean Observing System (see 3.3 above), in 1991, which

it sponsors jointly with WMO, UNEP and ICSU. In recent years disaster mitigation has also become a priority objective for the analysis of GOOS data.

IOC is now committed to putting in place a tsunami early warning system in the Indian Ocean by 2007, in cooperation with WMO and ISDR.

#### **4.5 World Meteorological Organisation**

WMO sees natural hazards as core business, both because of the value of short- and medium-term weather forecasting in helping communities to anticipate and deal with weather-related hazards (a large proportion of all natural hazards), and because climate change is predicted to increase the number of extreme weather events. It launched, in 2004, a Natural Disaster Prevention and Mitigation Programme to link itself more effectively into disaster work, including ISDR. The main emphasis is on information, communication and capacity building, and increasing awareness among the public and decision-makers about the causes and consequences of natural hazards.

WMO's unique historical databases are used to quantify the intensity and frequency of natural events, to characterize the potential damage of extreme events and to predict damage. WMO stresses the need for stronger, more coordinated activities among government leaders, risk managers in both public and private sectors, national, regional and international organisations and the scientific community, in order to support proactive strategies for natural disaster risk reduction.

#### **4.6 World Summit on Sustainable Development**

At the WSSD, ICSU played an important part in putting science on the Summit agenda by co-representing the scientific and technical community and playing a key role in helping to organize the Forum on Science, Technology and Innovation for Sustainable Development. Government leaders at the WSSD adopted a Summit Plan of Implementation as part of the strategy to meet the Millennium Development Goals.<sup>19</sup> They stated the need for an 'integrated, multi-hazard, inclusive approach to address vulnerability, risk assessment and disaster management, including prevention, mitigation, preparedness, response and recovery'. In the same document, they also called for proper financial support for the ISDR, and put forward a series of more specific proposals concerned mainly with S&T capacity building and the applications of science that were later to be picked up at the Kobe Conference and promoted in the Hyogo Framework.

The Implementation Plan drew strong connections between international development and natural hazards, and called for action:

*37. An integrated, multi-hazard, inclusive approach to address vulnerability, risk assessment and disaster management, including prevention, mitigation,*

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<sup>19</sup> Report of the World Summit for Sustainable Development, Johannesburg, South Africa, 26 August-4 September 2002 A/CONF.199/20\* [Available: <http://www.un.org>]

*preparedness, response and recovery, is an essential element of a safer world in the twenty-first century. Actions are required at all levels to:*

- (a) Strengthen the role of the International Strategy for Disaster Reduction and encourage the international community to provide the necessary financial resources to its Trust Fund;*
- (e) Improve techniques and methodologies for assessing the effects of climate change, and encourage the continuing assessment of those adverse effects by the Intergovernmental Panel on Climate Change;*
- (h) Develop and strengthen early warning systems and information networks in disaster management, consistent with the International Strategy for Disaster Reduction;*
- (j) Promote cooperation for the prevention and mitigation of, preparedness for, response to and recovery from major technological and other disasters with an adverse impact on the environment in order to enhance the capabilities of affected countries to cope with such situations.*

## **5 The Policy Response**

Natural disasters are now attracting the attention of world leaders as a major issue needing collective attention. For example, a report for the UK Prime Minister in June 2005 urged that ‘governments and international bodies prioritise national capacity building for hazard risk management’,<sup>20</sup> and an American Government report at the same time highlighted six ‘grand challenges for disaster reduction’.<sup>21</sup> The participants at the July 2005 Gleneagles G8 Summit stated: ‘*We believe that the aim of the international community should be to reduce the vulnerability to the threat of disasters.*’ They identified several priority strategies for disaster risk reduction, including early warning systems (for as many hazards as possible), natural hazard risk assessments and improving the humanitarian relief system.

The main recent forum for the international policy response, however, has been the World Conference on Disaster Reduction. This was organised by ISDR and held in Kobe on 18-22 January 2005. It followed the earlier 1994 World Conference in Yokohama. The Yokohama Conference had inter alia provided a platform for the mid-term review of IDNDR and had generated the *Strategy and Plan of Action for a Safer World*, and a set of ten principles concerning governance, risk identification, knowledge management, reducing underlying risk factors, preparedness, and mechanisms for implementing policies.

One of the prime objectives of Kobe was to review and update Yokohama. The policy context for this was the impact of natural disasters on sustainable development (highlighted at, eg, the 2002 Johannesburg Summit – see 4.6 above) and on the Millennium Development Goals. The strong message that emerged was that consideration of natural hazards must permeate all thinking about development. The review (written before the Indian Ocean tsunami) noted that developing countries accounted for just 11%

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<sup>20</sup> DTI, *The role of science in physical natural hazard assessment: report to the UK Government by the Natural Hazard Working Group* (HMSO, 2005)

<sup>21</sup> National Science and Technology Council, *Grand challenges for disaster reduction* (2005)

of populations exposed to natural hazards but 53% of hazard-related deaths, and stressed the disproportionate vulnerability of such countries.

The review also noted that, ‘in contrast to the earlier emphasis on largely scientific and technical approaches ... to mitigate the effects of natural hazards on national populations, considerable progress is evident in the expanded and more inclusive focus on the social dimensions and multi-sectoral interests of human vulnerability.’ It identified 22 ‘gaps and challenges’, which were mostly social or political but also included ‘pursuing research agendas that bring together multiple disciplines and professional interests, feeding into decision-making processes and leading to the implementation of disaster reduction at all levels’.

The Kobe conference was organized by ISDR over a period of one year, but of course took place less than a month after the Indian Ocean tsunami and therefore attracted massive publicity. In addition to the Yokohama review and a statement on the tsunami, the two main formal outputs were the *Hyogo Declaration* and the *Hyogo framework for action 2005 – 2015: building the resilience of nations and communities to disasters*. The latter in particular is now in large measure setting the disaster agenda, at least within the UN system.

In the Hyogo Declaration, world leaders stated:

*We are deeply concerned that communities continue to experience excessive losses of precious human lives and valuable property as well as serious injuries and major displacements due to various disasters worldwide.’*<sup>22</sup>

They highlighted the ‘intrinsic relationship between disaster reduction, sustainable development and poverty eradication’ and the importance of involving all stakeholders, including the private sector and the scientific community. They urged concrete implementation of the Framework and called for the development of specific indicators to track progress on reducing the risk of disasters.

The Hyogo Framework is structured around the broad themes of the Yokohama principles and the gaps and challenges identified in the Yokohama review, and also picks up relevant parts of the Johannesburg Summit agenda. It reiterates the view that primary responsibility lies at national level. A major issue is therefore how international bodies can engage effectively with national policy-makers; multi-sectoral ‘national platforms’ (mechanisms for bringing together all stakeholders at national level) are seen as crucial here. An integrated, multi-hazard approach is promoted. The need to stress the disaster reduction dimension in a wide range of policies is stressed throughout, and is associated with the need to invest considerably in advocacy to get policy-makers to take the message seriously. The five high-level priorities for the Framework are thus to:

- a) ensure that disaster risk reduction is a national and local priority with a strong institutional basis for implementation;
- b) identify, assess and monitor disaster risks and enhance early warning;
- c) use knowledge, innovation and education to build a culture of safety and resilience at all levels;

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<sup>22</sup> Hyogo Declaration, World Conference on Disaster Reduction, Kobe, Hyogo, Japan 18-22 January 2005.



- d) reduce the underlying risk factors;
- e) strengthen disaster preparedness for effective response at all levels.

The Framework identifies more detailed activities under each of these five headings. They include:

- develop indicators of disaster risk and vulnerability at national and sub-national scales that will enable decision-makers to assess the impact of disasters on social, economic and environmental conditions;
- develop early warning systems that are people centered ... promote the application of in situ and space-based earth observations;
- support the development and sustainability of the infrastructure and scientific, technological, technical and institutional capacities needed to research ... natural and related hazards, vulnerabilities and disaster impacts ... and to assess vulnerabilities to, and the impact of, geological, weather, water and climate-related hazards;
- promote and improve dialogue and cooperation among scientific communities and practitioners working on disaster risk reduction ... including the socio-economic dimensions;
- promote the use, application and affordability of recent information, communication and space-based technologies;
- develop improved methods for predictive multi-risk assessments and socio-economic cost-benefit analysis of risk reduction actions at all levels;
- encourage the sustainable use and management of ecosystems, including through better land-use planning and development activities to reduce risk and vulnerabilities;
- incorporate disaster risk assessments into urban and rural planning ... in particular with regard to mountain and coastal flood plain areas;
- promote the integration of risk reduction associated with existing climate variability and future climate change into strategies for the reduction of disaster risk and adaptation to climate change; and
- integrate disaster risk reduction planning into the health sector.

The May 2005 meeting of the ISDR Task Force revised and approved a ‘roadmap’ document (now called *Strategic directions for the ISDR system to assist the implementation of the Hyogo Framework ...*) taking this agenda forward. ISDR sees its own role as having four broad elements:

- i. supporting the implementation of the Hyogo Framework at national and regional level, working especially with national platforms and appropriate regional groupings;
- ii. guiding and mainstreaming the Framework in planning and programming within the UN system;
- iii. promoting awareness and advocacy, directly and indirectly; and
- iv. monitoring and reporting on progress with implementation (a working group on indicators is already under way).

## 6 Options for ICSU

In the light of an analysis of needs and current activities related to the scientific aspects of natural and human-induced environmental hazards, the Scoping Group has reached conclusions about how ICSU, with its particular characteristics, can most effectively contribute to preventing hazards from turning into disasters. This section

sets out our views on what ICSU could do, and Section 7 makes a formal recommendation to proceed to the next step in establishing an ICSU hazards programme.

## **6.1 Scope**

Our terms of reference /Annex B) define the scope of our work as:

*natural and human-induced environmental hazards, to include naturally occurring events such as earthquakes and volcanic eruptions, and events such as floods and landslides that may be the unintended consequences of human activity. It should cover both phenomena within the subject matter of the geosciences and phenomena with broadly ecological dimensions. Warfare and associated activities fall outside the scope. In general, the focus is on events that are manifested over relatively short periods, rather than gradually evolving phenomena such as climate change.*

We agree that an ICSU initiative should focus on short-term episodic events occurring naturally,<sup>23</sup> which can have both short-term and long-term consequences. We recognise, however, that many such events have a long gestation period (e.g., centuries or more for a volcanic eruption, or generations of inappropriate practice before a major flood). So we recommend that the proposed ICSU initiative (see below) should encompass also the impacts of climate change, land-use change and other long-term phenomena that can alter the characteristics of a given hazard and, indeed, the potential for disaster. Further, we recognize that research in related fields, such as on the impacts of industrial disasters, warfare and issues for refugees, can provide information highly relevant in the context of natural disasters.

## **6.2 Gaps in the international research effort**

Our terms of reference require us:

*to identify significant gaps in the international research effort on scientific aspects of natural and human-induced environmental hazards, and in particular to identify any areas where lack of interdisciplinary cohesion and interaction may be impeding progress.*

Our survey of recent and current work within and beyond the ICSU community indicates that there is clearly a good deal of activity already under way. We see gaps in the provision of systematised data and information, and in some public health aspects of disasters. The most significant research gaps, however, particularly in terms of interdisciplinary cohesion, are to be found at the intersection of natural science with social and political issues. Examples include: how knowledge about hazards is put to use, eg in land use planning and other spheres of public policy; the impact of environmental degradation on the vulnerability of affected communities; how the

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<sup>23</sup> The phrase ‘occurring naturally’ is intended to include human-induced events (natural events exacerbated by human activities) and to exclude, for example, industrial disasters and warfare.

public perceives natural hazards and risks and makes decisions in conditions of uncertainty, and how disaster victims in different cultural contexts perceive the nature and consequences of their losses; and how various human behaviours affect the vulnerability of communities.

Working towards the reduction of natural hazard impacts requires an enhanced understanding of local vulnerabilities as well as coping capacities. Applying knowledge generated at the local level is vital to successful strategies for dealing with disasters.

Further, much current research is conducted along disciplinary lines and is not sufficiently integrated with other research or connected with potential users. Hazards have been considered as individual, isolated phenomena and much of the analysis has had a retrospective, rather than forward-looking, view.

### **6.3 Interface between science and policy-making**

The terms of reference require us:

*to consider possible shortcomings in the way that national and international policy-makers are making use of the relevant scientific knowledge (in its broadest sense) when devising policy initiatives intended to reduce the likelihood or minimise the impact of an environmental hazard.*

We have found ample evidence to suggest that policy-makers may at times act in ignorance or disregard of the relevant scientific information and thereby significantly exacerbate damage resulting from natural hazards. Examples include: removal of mangrove swamps from vulnerable coastlines; failure to take account of foreseeable volcanic or seismic risks; land use practices that augment risks from floods, landslides or wildfires; failure to make best use of satellite data and to support networked early warning systems; failure to invest in prevention; and financial incentives that encourage short-term, localised benefits at the expense of longer-term requirements.

Research is needed on how to translate research findings into policies that are effective in minimising the human and economic costs of hazards.

Today, most national and international investments related to disasters occur after a hazard event - in response and recovery - whereas relatively little investment has been made in mitigation or prevention. Research is also required to ascertain the real costs and benefits associated with pre-disaster investments (a calculation that will vary in different societies and cultures); to better understand the dynamics of the political decision-making process in this area, and to identify best practices for hazard risk reduction which can be used as models for others. The Budapest Manifesto<sup>24</sup> provides an initial framework for such research and the interaction between science and policy-making.

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<sup>24</sup> See ref 17.

A further requirement is to improve linkage between national and international initiatives, which is central for the successful implementation of research insights. In addition to the transfer of information to policy-makers, there is need to focus on the provision of information and guidance to the end-users and to operational programmes.

#### **6.4 Proposal for an ICSU hazards programme**

Our analysis suggests that research is needed on how to translate research findings about natural hazards and human behaviour into policies that are effective in minimising the human and economic costs of hazards. Such research needs a multidisciplinary approach focused on the needs of identified customers.

This conclusion is reinforced by ICSU's January 2005 statement on the Indian Ocean Tsunami (3.10 above), which identified a number of research needs, some relevant to ICSU itself in the current context:

- *integrated research on the impact of natural disasters on social and ecological systems;*
- *agreement on an international global observation framework for the collection, management and open sharing of data and information on natural hazards;*
- *mapping of the known exposures of human populations, resources and economic activities to multiple disasters;*
- *integrated models that combine geophysical, ecological, demographic and economic aspects of disaster scenarios;*
- *building of indigenous scientific and technical capacity in vulnerable regions to take advantage of existing knowledge and stimulate local innovation;*
- *dissemination of the relevant results to policy makers and the public.*<sup>25</sup>

Our conclusion is also consistent with the Kobe review of the Yokohama strategy (section 6 above), with its focus on 'pursuing research agendas that bring together multiple disciplines and professional interests, feeding into decision-making processes and leading to the implementation of disaster reduction at all levels'. The message was reiterated in the June 2005 report to the UK Prime Minister (section 6 above):

*It appears that scientific knowledge is often poorly applied to disaster risk management policies and practices: ..... there is an urgent need to improve the integration of scientific knowledge of physical natural hazards into the management of early warning. Robust communication lines between the scientific community and decision-makers must be established.*

And our conclusion ties in directly to one of the research issues planned for the International Year of Planet Earth (3.11 above), and specifically addressed to both ICSU and ISDR: 'What are the barriers, for each geohazard, that prevent governments (and other entities) from using risk and vulnerability information to create policies and plans to reduce both?'<sup>26</sup> Also relevant to our conclusion are the 2002 *Budapest*

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<sup>25</sup> See reference 17 for the full statement.

<sup>26</sup> IYPE, *Hazards – minimising risk, maximizing awareness* (November 2004). See also <http://www.esfe.org>

*Manifesto*, which stressed the need for scientists to work with local communities in evaluating risk from natural hazards and ways to respond to risk, and the 2002 WSSD Implementation Plan, with its stress on ‘an integrated, multi-hazard, inclusive approach to address vulnerability, risk assessment and disaster management’.

The coordinated research needed to understand and reduce the risk associated with natural and human-induced environmental hazards plays to ICSU’s inherent strengths: multi-disciplinarity, global scope, access to the full range of relevant scientific expertise, access to key policy-makers. The nature of the subject challenges ICSU to develop these strengths by working more closely with the social sciences and by recognising the contribution that non-specialists can make to science-based policy discussions. Furthermore, it provides a mechanism for ICSU to exercise leadership in an area of intense public, as well as scientific, interest and importance.

In short, the issue is important, there is work to be done, and ICSU is suited to do it. We therefore endorse the recommendations of the PAA on environment and the Foresight analysis (section 1 above) that ICSU should develop an initiative on hazards. The initiative should be centred primarily on the goal of reducing the adverse consequences of natural and human-induced environmental hazards, by strengthening international science to provide a firmer basis for preventing natural hazards from becoming disasters and for reducing the risk associated with extreme natural events. The programme should provide the scientific basis for the reduction of the adverse risks and consequences of natural and human-induced environmental hazards.

Our analysis has made it clear that such a goal requires the combined insights of the natural, health, social and engineering sciences and requires a joint engagement in the policy process to lead to effective action. As ICSU’s traditional strengths lie most readily in the natural sciences, this will require ICSU to develop its collaborative mechanisms and broaden its disciplinary repertoire – as it has already done very successfully in, for example, the International Human Dimensions Programme on Global Environmental Change (IHDP). By extending beyond ICSU’s traditional natural science focus to foster collaborative research with health and social sciences, the initiative will help to bridge the apparent research gap between the health and social science aspects of hazards.

This initiative should take the form of a research programme on the relevant scientific issues and their implications for policy and practical implementation. There should be a strong component linking the scientific advances to the end-user communities.

We are proposing a programme that could last a decade or more. Working with suitable partners, ICSU’s role would be to define broad research priorities, to provide international coordination and planning, to engage with the end-users, to engage with suitable funding agencies, to bring potential collaborators together and to generally act as an assurance of scientific quality. The research itself would be funded from other sources: ICSU’s financial contribution would be limited to some of the costs of these planning and coordinating functions.

The programme should focus on the relevant scientific needs of three primary customers: development agencies; humanitarian assistance agencies (including UN

bodies and NGOs); and governmental policy-makers at local, regional and national level.

The programme should adopt a multi-hazard approach, recognising that communities may be exposed to more than one hazard, that hazards can interact, and that strategies for dealing with one hazard must take account of other hazards likely to arise. It needs to have a number of interacting components dealing with such matters as:

- inventories giving systematic information about the nature and scale of hazards and disasters (including their characteristics, assessment of their likelihood, prediction potential);
- vulnerability and exposure; their consequences for people (including a full range of public health and economic issues), physical infrastructure and the natural environment; and approaches to reducing vulnerability by structural (dykes, fortified buildings, ...) and non-structural (planning laws, codes, ...) means so that the community is more resilient;
- public policy, and socio-economic cost/benefit analysis of investments in preparedness and mitigation as against response and recovery;
- communication and public education, human responses, including risk communications and understanding how individuals, communities, governments and multinational agencies factor risk into decision-making and development of policy.

From this basis, specific research topics might include some or all of the following:

- environmental approaches to mitigation (eg how infrastructure systems and natural barriers such as mangrove swamps, coral reefs, watershed forests and natural floodplains can be designed and maintained to be resilient and to mitigate hazard pressures) and, conversely, the environmental and ecological impacts of natural disasters;
- how hazard information can most effectively be conveyed to policy-makers, to vulnerable groups and to individuals, and how they respond when they have it;
- the costs and benefits of investing in mitigation in anticipation of future hazard events;
- the political, social and economic barriers to effective management of hazards and disasters;
- physical and psychosocial health aspects of natural disasters;
- the factors that determine individual and community vulnerability to hazard pressures;
- how global and local environmental change might affect the vulnerability of affected communities to hazards and disasters.

## **7 Recommendations**

We therefore recommend that:

- 1) ICSU initiates planning for an international natural and human-induced environmental hazards programme as outlined above;

- 2) a planning committee be established, with individual experts covering a wide range of natural, health and social science disciplines, as soon as possible, in the expectation that it completes its work within 15 – 18 months of the General Assembly; and
- 3) appropriate UN and other multinational agencies be consulted in the establishment of the planning committee and in the development of the programme.

Among the issues that the planning committee will need to consider, we would draw attention to the following:

- identification of appropriate partners at both planning and implementation stages;
- clear definition of how the new hazards programme will complement (ie interact with, but not duplicate) existing ICSU programmes such as WCRP, IGBP, IHDP and other current work, especially ISDR;
- clear definition of how the new hazards programme will complement work going on at Union level;
- how to achieve effective interaction between international activities that have a variety of sponsors – ICSU, UN agencies, multinational consortia;
- how to prioritise the research areas identified and how to promote ways of addressing them;
- approaches to managing extensive multidisciplinary collaboration and to integrating insights from a wide range of disciplines during the course of the programme;
- how to access and benefit from the experience and concerns of individuals most directly affected by some of the environmental hazards under consideration (the ‘science in society’ dimension);
- the need to engage with the target customers early in the exercise.

As has been noted, there are substantial activities, mainly in the natural and engineering sciences, for this programme to build upon. It is important that these activities be maintained and that mutual links with the proposed ICSU programme are strong.

## **Annex A: Membership of the Scoping Group**

The ICSU Executive Board would like to express its warm appreciation to the members of the Scoping Group. The members were acting in a personal capacity.

Gordon McBean (Chairman)	Institute for Catastrophic Loss Reduction University of Western Ontario, Canada
Edward Barbier	Department of Economics and Finance University of Wyoming, USA
Tom Beer	CSIRO Environmental Risk Network Aspendale, Australia
Chien-Jen Chen	Graduate Institute of Epidemiology National Taiwan University, Taipei, Taiwan
Robert Chen	Center for International Earth Science Information Network, Columbia University, USA
J. Richard Eiser	Department of Psychology University of Sheffield, UK
Katherine C. Ewel	Wetland ecology; recently retired from: USDA Forest Service, Hawaii, USA
Nila Kapor-Stanulovic	Human development and mental health University of Novi Sad, Serbia
Hans Kienholz	Department of Geography University of Berne, Switzerland
Robert Missotten	Division of Ecological and Earth Sciences UNESCO, France
Daniel Murdiyarso	Center for International Forestry Research Bogor, Indonesia
Coleen Vogel	Geography and Environmental Studies University of Witwatersrand, South Africa
Peter Collins	Secretariat
<b>Observer (invited by the Chair)</b>	
Peter Bobrowsky	Geological Survey of Canada



Ottawa, Canada

## **Annex B: Terms of Reference for the Scoping Group**

Taking into account relevant past and on-going activities both within and beyond the ICSU family:

1. to identify significant gaps in the international research effort on scientific aspects of natural and human-induced environmental hazards, and in particular to identify any areas where lack of interdisciplinary cohesion and interaction may be impeding progress;
2. to consider possible shortcomings in the way that national and international policy-makers are making use of the relevant scientific knowledge (in its broadest sense) when devising policy initiatives intended to reduce the likelihood or minimise the impact of an environmental hazard;
3. to make recommendations about the scope for a possible multi-disciplinary ICSU initiative in relation to (1) and/or (2). These recommendations should include an analysis of the potential customers for such an initiative (eg policy-makers whom it is intended to influence), and the partners with whom ICSU might work. They should also include suggestions about how the initiative might achieve greater impact by drawing on the experience and concerns of those most directly affected by some of the environmental hazards under consideration; and
4. to report to the General Assembly, via the Executive Board, in October 2005.

The Scoping Group should interpret 'natural and human-induced environmental hazards' to include naturally occurring events such as earthquakes and volcanic eruptions, and events such as floods and landslides that may be the unintended consequences of human activity. It should cover both phenomena within the subject matter of the geosciences and phenomena with broadly ecological dimensions. Warfare and associated activities fall outside the scope. In general, the focus is on events that are manifested over relatively short periods, rather than gradually evolving phenomena such as climate change. Within these parameters, the Group should focus on the areas on which it judges it most useful to devote its efforts.

## **Annex C: Definition of Terms (taken from the ISDR terminology)**

Disaster	A serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources. A disaster is a function of the risk process. It results from the combination of hazards, conditions of vulnerability and insufficient capacity or measures to reduce the potential negative consequences of risk.
Disaster risk management	The systematic process of using administrative decisions, organization, operational skills and capacities to implement policies, strategies and coping capacities of the society and communities to lessen the impacts of natural hazards and related environmental and technological disasters. This comprises all forms of activities, including structural and non-structural measures to avoid (prevention) or to limit (mitigation and preparedness) adverse effects of hazards.
Hazard	A potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation
Mitigation	Structural and non-structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation and technological hazards
Preparedness	Activities and measures taken in advance to ensure effective response to the impact of hazards, including the issuance of timely and effective early warnings and the temporary evacuation of people and property from threatened locations
Recovery	Decisions and actions taken after a disaster with a view to restoring or improving the pre-disaster living conditions of the stricken community, while encouraging and facilitating necessary adjustments to reduce disaster risk
Response	The provision of assistance or intervention during or immediately after a disaster to meet the life preservation and basic subsistence needs of those people affected. It can be of an immediate, short-term, or protracted duration
Risk	The probability of harmful consequences, or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human-induced hazards and vulnerable conditions

Vulnerability      The conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards

## **Annex D: Acronyms and Abbreviations**

CODATA	Committee on Data for Science and Technology
CRED	Center for Research on the Epidemiology of Disasters
FAO	Food and Agriculture Organisation
GCOS	Global Climate Observing System
GDP	Gross Domestic Product
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GFMC	Global Fire Monitoring Center
GOOS	Global Ocean Observing System
GTOS	Global Terrestrial Observing System
IAHS	International Association of Hydrological Sciences
IASPEI	International Association of Seismology and Physics of the Earth's Interior
IAVCEI	International Association of Volcanology and Chemistry of the Earth's Interior
ICL	International Consortium on Landslides
ICSU	International Council for Science
IDNDR	International Decade for Natural Disaster Reduction
IFRC	International Federation of Red Cross and Red Crescent Societies
IGBP	International Geosphere-Biosphere Programme
IGCP	International Geoscience Programme (formerly International Geological Correlation Programme)
IGOS	Integrated Global Observing Strategy
IGU	International Geographical Union
IHDP	International Human Dimensions Programme on Global Environmental Change
IIASA	International Institute for Applied Systems Analysis
ILP	International Lithosphere Programme
INQUA	International Union for Quaternary Research
IOC	International Oceanographic Commission
IPCC	Intergovernmental Panel on Climate Change
ISDR	International Strategy for Disaster Reduction
ISPRS	International Society for Photogrammetry and Remote Sensing
IUCN	World Conservation Union (formerly International Union for the Conservation of Nature)
IUGG	International Union of Geodesy and Geophysics
IUGS	International Union of Geological Sciences
IUSS	International Union of Soil Science
IUTAM	International Union of Theoretical and Applied Mechanics
IYPE	International Year of the Planet Earth
NEPAD	New Partnership for Africa's Development
PAA	Priority Area Assessment
PSA	Pacific Science Association
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WCRP	World Climate Research Programme

WFEO	World Federation of Engineering Organisations
WFP	World Food Programme
WHO	World Health Organisation
WMO	World Meteorological Association
WSSD	World Summit on Sustainable Development





# ICSU

International Council for Science

## ICSU Mission Statement

In order to strengthen international science for the benefit of society, ICSU mobilizes the knowledge and resources of the international science community to:

- Identify and address major issues of importance to science and society.
- Facilitate interaction amongst scientists across all disciplines and from all countries.
- Promote the participation of all scientists—regardless of race, citizenship, language, political stance, or gender—in the international scientific endeavour.
- Provide independent, authoritative advice to stimulate constructive dialogue between the scientific community and governments, civil society, and the private sector.

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