GeoHazards in the International Year of Planet Earth

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Abstract

The year 2007 marks the fiftieth anniversary of the International Geophysical Year (IGY). The International Union of Geodesy and Geophysics (IUGG) will mark this anniversary – known as IGY+50 – at our quadrennial General Assembly in Italy. In addition, various other activities have been planned that include:

The eGY, or electronic Geophysical Year, being organised by the International Association of Geomagnetism and Aeronomy of IUGG.

(http://www.egy.org)

The IPY, or International Polar Year, established by the International Council of Science (ICSU)

(http://www.ipy.org/)

The IYPE, or International Year of Planet Earth, organised under the auspices of the International Union of Geological Sciences (IUGS) and UNESCO.

(http://www.yearofplanetearth.org/)

The IYPE has established ten major science themes including Hazards. The Hazards theme is centred around on the following key questions:

2.1. How have humans altered the geosphere, the biosphere and the landscape, thereby creating long-term changes detrimental to life and the environment and triggering certain hazards, while increasing societal vulnerability to geophysical (geological and hydrometeorological) hazards?

2.2. 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?

2.3. How do geophysical hazards compare relative to each other regarding current capabilities for monitoring, prediction and mitigation and what can be done in the short term to improve these statistics?

2.4. What barriers exist to the utilization of risk and vulnerability information by governments (and other entities) for risk and vulnerability reduction policies and planning (including mitigation) from each of the geophysical hazards?

Following the 26 December 2004 Indian Ocean Tsunami, and the UN World Conference on Disaster Reduction held in Kobe, Japan in January 2005, ICSU decided to establish a major research program and initiative on Natural and Human Induced Environmental Hazards and Disasters. The ICSU Regional Offices will, hopefully, play a major role in implementing the scientific and societal interactions that will be needed to implement the program.

Introduction

Geohazards and Georisks are topics that are international in scope, but often local in their effects. The knowledge and wisdom accumulated over time and in many different parts of the world can assist the research worker and the disaster manager to provide better information and to make better decisions. This paper sets out to explain some of the history of the international scientific rationale for this work and to describe the context within which future geohazards research of international scope is expected to be taken forward.

The International Geophysical Year and IGY+50

The International Geophysical Year (IGY)[1] ran from July 1957 to December 1958. The aim of the IGY was *...to observe geophysical phenomena and to secure data from all parts of the world; to conduct this effort on a coordinated basis by fields, and in space and time, so that results could be collated in a meaningful manner.*

The IGY was an immensely successful international collaboration that advanced international research and understanding in aurora and airglow, cosmic rays, geomagnetism, glaciology, gravity, ionospheric physics, longitude and latitude determination, meteorology, oceanography, rocketry, seismology and solar activity. The launch of the first artificial satellite, Sputnik, during the IGY gave both the event and the year immense public exposure and prestige.

The International Union of Geodesy and Geophysics intends to commemorate the fiftieth anniversary of the IGY with a co-ordinated sequence of events and activities under the label of IGY+50. These events include the XXIVth General Assembly of the IUGG, to be held from 2-13 July 2007 in Perugia, Italy with the theme Earth: Our Changing Planet.[2] To honour and commemorate the IGY there will be a special session organised at this assembly to report on and discuss the many accomplishments since the IGY and plans for international programs in the year 2007.

Major programs being planned include:

- International Polar Year
  http://www.ipy.org
  Sponsored by ICSU and WMO
- International Heliophysical Year
  http://ihy.gsfc.nasa.gov/
  Sponsored by NASA

[1] http://www.nas.edu/history/igy/

[2] http://www.iugg2007perugia.it/

- eGY
  http://www.egy.org/
  Sponsored by IUGG (IAGA)
- International Year of Planet Earth
  http://www.yearofplanetearth.org/
  Sponsored by IUGS and UNESCO

This article will focus on the Hazards initiative that is being organised as part of the International Year of Planet Earth, and related and ancillary activities.

International Year of Planet Earth[3]

On 22 December 2005 the 68th Plenary Session of the United Nations General Assembly declared 2008 to be the International Year of Planet Earth. It had originally been hoped to make 2007 (the IGY+50 year) the International Year of Planet Earth, but obtaining international agreement to such a designation took longer than originally envisaged.

The International Year of Planet Earth is an initiative organised and promulgated by the International Union of Geological Sciences (IUGS) with the support of the Earth Science Division of the United National Educational, Scientific and Cultural Organisation (UNESCO). The concept has twelve Founding Partners and 26 Associate Partners that include all major international geoscientific and other relevant organisations. The list of partners may be found at:
http://www.yearofplanetearth.org/organisation.htm

The organisers of the International Year of Planet Earth (IUGS and UNESCO) sought proclamation of the International Year of Planet Earth by the General Assembly of the UN, which was accomplished on 22 December 2005.

The UN press release reads: "*By a draft on the International Year of Planet Earth, 2008, which the Committee approved without a vote on 11 November, the Assembly would declare 2008 the International Year of Planet Earth. It would also designate the United Nations Educational, Scientific and Cultural Organization (UNESCO) to organize activities to be undertaken during the Year, in collaboration with UNEP and other relevant United Nations bodies, the International Union of Geological Sciences and other Earth sciences societies and groups throughout the world. Also by that draft, the Assembly would encourage Member States, the United Nations system and other actors to use the Year to increase awareness of the importance of Earth sciences in achieving sustainable development and promoting local, national, regional and international action*" .

The Year's activities will span the three years 2007-2009.

A Science Programme Committee (SPC) was established in 2002. Eight science themes, all relevant to society, were selected in the autumn of 2003 from an original

[3] http://www.yearofplanetearth.org

slate of 22. A procedure was then initiated by which specialist Key Text Teams focused on specific questions within the themes to be addressed in the triennium, given that "tangible deliverables" are a binding condition for any such UN proclamation. Two extra science themes (*Soil* and *Life*) were subsequently added to the original eight.

The Science Themes are:

1. Groundwater – towards sustainable use
2. Earth & health – building a safer environment
3. Climate – the 'stone tape'
4. Resources – sustainable power for sustainable development
5. Megacities – going deeper building safer
6. Deep Earth – from crust to core
7. Ocean – abyss of time
8. Hazards –
   minimising risk, maximising awareness,
9. Soils – the living skin of the Earth
10. Life

Brochures have been published on all of the science themes. They are available as colour PDF downloads from the web site http://www.yearofplanetearth.org/downloads.htm. In fact there are twelve brochures available for download from this site. There is also a general brochure describing the overall concept of the Year of Planet Earth called *Planet Earth in our hands*, and a brochure on the outreach program.

The subtitle of the Outreach brochure is "bringing Earth sciences to everyone". The outreach program is intended to complement the science program and to have equal funds devoted to it. Both programs will operate in a "bottom-up" mode by seeking Expressions of Interest. Some of the activities being encouraged as part of the outreach program include photography competitions, the commissioning of special art and publication of books intended for the general public.

Implementation of the science programmes will closely resemble the International Geoscience Programme[4] (IGCP), which is also a joint IUGS/UNESCO Programme. This programme was previously known as the International Geological Correlation Programme. As is the case with the IGCP, the Year will operate essentially in a 'bottom-up' mode and will be run by a scientific board, composed of one Science Implementation Team (SIT) for each of the Themes.

These SITs will have up to 10 experts and thus be larger than the teams that wrote the key text theme brochures. They will have a wider geographical representation than IGCP's Scientific Board. They are presently in the process of being formed. Their main task being attraction and evaluation of Expressions of Interest in project development received from scientific groups around the world. Expression of Interest forms are available on the web site of the International Year of Planet Earth

[4] http://www.unesco.org/science/earth/igcp/index_igcp.html

(ww.yearofplanetearth.org) and anyone interested in registering either a science project or an outreach project is encouraged to fill in the form.

The web site also contains a prospectus and business plan that outlines the history and status of the International Year of Planet Earth, and seeks funding support for the science and outreach projects.

The organisation of the International Year of Planet Earth is being carried out at the international level through its Board of Officers. The International Year of Planet Earth also intends to form National Committees to carry out activities at the national level.

The Board of Officers suggests that that National Committees select science themes from the list of 10 themes developed for the International Year for implementation in their own countries and so to contribute to answer some of the key questions posed in the science brochures to assist national and international decision makers. In addition, National Committees may wish to propose science and outreach projects of a supranational level to be supported by the Board of Officers.

The web site of the International Year indicates that National Committees exist in Malaysia and Australia. In the case of Australia, the National Committee of Earth Sciences of the Australian Academy of Science has agreed to act as the interim National Committee of the International Year of Planet Earth, and has organised a workshop in Melbourne on 19 October 2006 to inaugurate the Australian component of the International Year.

The GeoUnions Initiative

Six of the unions that comprise the International Council of Science (ICSU) have agreed to advance certain selected areas of geoscience. The unions involved are

- IAU - International Astronomical Union
- IGU – International Geographical Union
- INQUA - International Union for Quaternary Research
- ISPRS – International Society of Photogrammetry and Remote Sensing
- IUGG – International Union of Geodesy and Geophysics
- IUGS – International Union of Geological Sciences
- IUSS – International Union of Soil Science.

The GeoUnions prepared a list of areas for a joint science program. These areas were:

- Cities and Megacities
- Desertification
- Groundwater
- Health
- Hazards
- Polar

plus

- Geo-Sciences in Africa

This list has similarities to the science themes of the Planet Earth though they are not identical. The Hazards theme was included in both programs, and there was a degree of overlap in the two committees, as shown in Table 1.

Table 1 – Membership of IYPE and GeoUnions Hazards Committees

IYPE Hazards: **Science Implementation Team**	**GeoUnions Hazards Team with Alternate Members in parentheses**
Tom Beer (Chair, Australia)	Tom Beer (Chair, IUGG) {Alik Ismail-Zadeh (IUGG)}
Peter Bobrowsky (Canada)	Peter Bobrowsky (IUGS)
Stuart Marsh (UK)	Piero Boccardo (ISPRS)
Susan Cutter (USA)	Susan Cutter (USA)
Marcello Pagliai (Italy)	Rob Fitzpatrick (IUSS) {Marcello Pagliai (IUSS)}
R.K. Chadha (India)	
Dr Zhongliang Wu (China)	
Dr Seree Supharatid (Thailand)	

In practice the two committees worked together to produce the Hazards theme brochure that may be downloaded from: http://www.yearofplanetearth.org/downloads.htm .

GeoUnions Initiative – Joint Science Program: Hazards

The joint committees working on the Hazards Theme noted that the Budapest Manifesto on Risk Science and Sustainability[5] provided a generic framework suitable for environmental risk management across a variety of disciplines. Details of the manifesto may be found in Beer and Ismail-Zadeh (2003). It can be summarised by the following list of items that need to be examined:

[5] www.iugg.org/budapest.pdf

- Consultation
- Concerns
- Consequences
- Calculations
- Certainties, uncertainties, probabilities
- Comparing against pre-determined criteria
- Control, mitigate and adapt
- Communicate
- Monitor
- Review

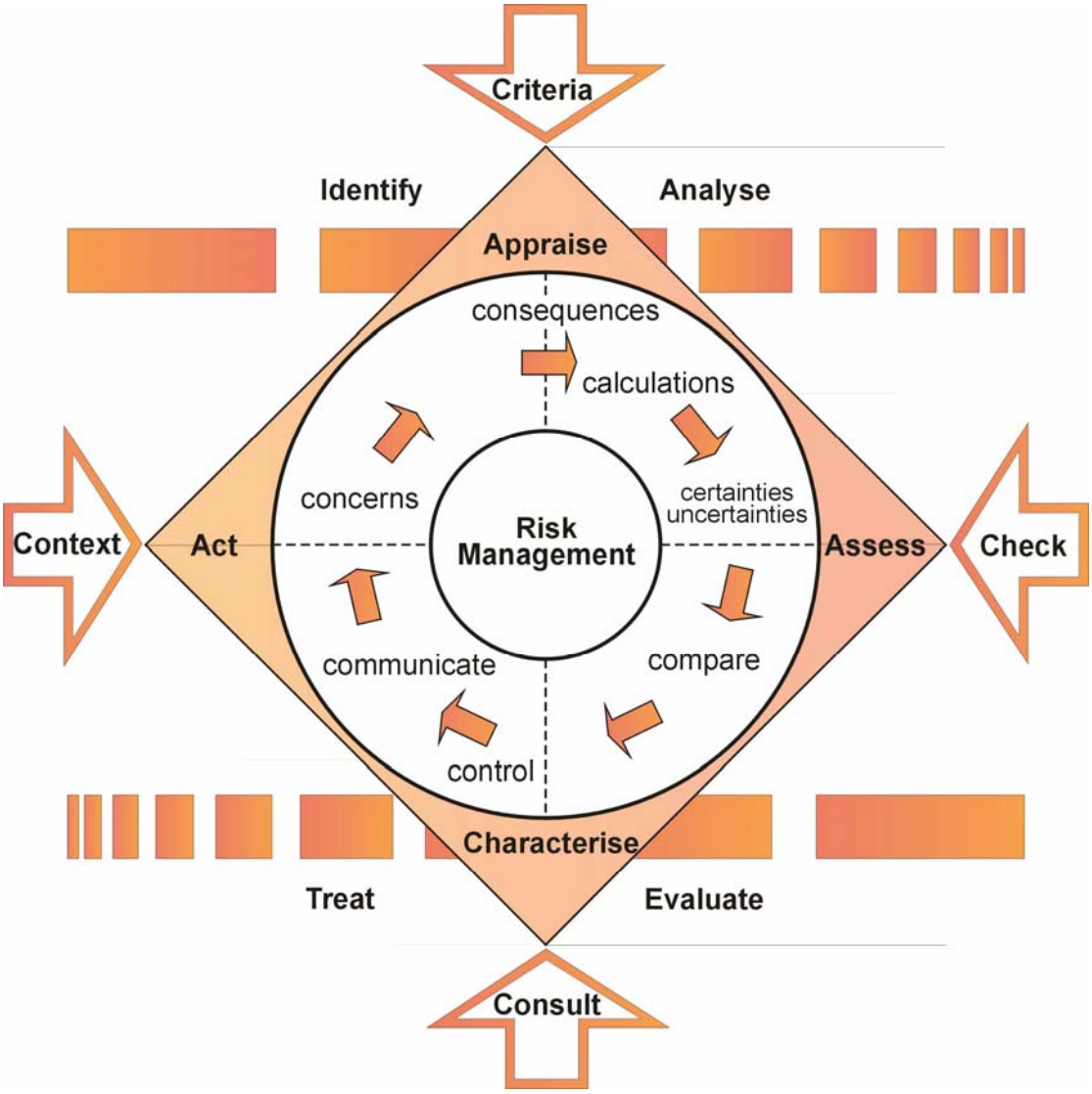

Figure 1 – Diagrammatic representation of the steps involved in the Budapest Manifesto. The steps themselves are shown by arrows within the circle. The inner circle, with the words Risk Management, indicates that all of the words in the diagram refer to various aspects of risk management.

A diagrammatic representation of the manifesto is shown in Figure 1, in which the Monitor and Review stages have been replaced by the word "Check". The diagram divides the steps of the Budapest Manifesto into those that are overarching, such as consultation, monitoring and review, and those that are core. The seven core steps are shown within a circle, with each step marked by an arrow to denote the order in which a risk management exercise needs to be carried out. The overarching concepts are shown within arrows outside the main diagram. In addition to the two from the Budapest Manifesto, Figure 1 has added "context" and "criteria".

The first step in risk management is always to establish the context in which to operate. In addition, there need to be pre-determined criteria (which are sometimes called thresholds) for the risk analyst to compare the calculated risks against. We treat both of these as overarching concepts.

The words: identify, analyse, treat, evaluate; which lie outside of the diamond are the names that the Australian and New Zealand Standard on Risk Management (AS/NZS 4360) (Standards Australia, 2004) ascribes to the four quadrants of the circle. Risk evaluation, for example, is shown in the bottom right quadrant and consists of comparison of the calculated risk against pre-determined criteria.

The words within the vertices of the diamond refer to two quadrants of the circle. Risk appraisal consists of identification and analysis. Risk assessment is risk analysis and risk evaluation.

Key Research Questions

The committees dealing with the Hazards Theme identified four key research questions:

Key Question 1

- How have humans altered the geosphere, the biosphere and the landscape, thereby creating long-term changes detrimental to life and the environment and triggering certain hazards, while increasing societal vulnerability to geo-hazards?

Key Question 2

- 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?

Key Question 3

- How do geo-hazards compare relative to each other regarding current capabilities for monitoring, prediction and mitigation and what methodologies and new technologies can improve such capabilities to help civil protection at local and global scales?

Key Question 4

- What are the barriers to the utilization of risk and vulnerability information by governments (and other entities) for risk and vulnerability reduction policies and planning (including mitigation) from each of the geo-hazards?

The committees also examined many of the organisations and programs undertaking research work to examine these four questions. This is diagrammatically illustrated in Figure 2 where the four key questions are depicted as overlapping circles.

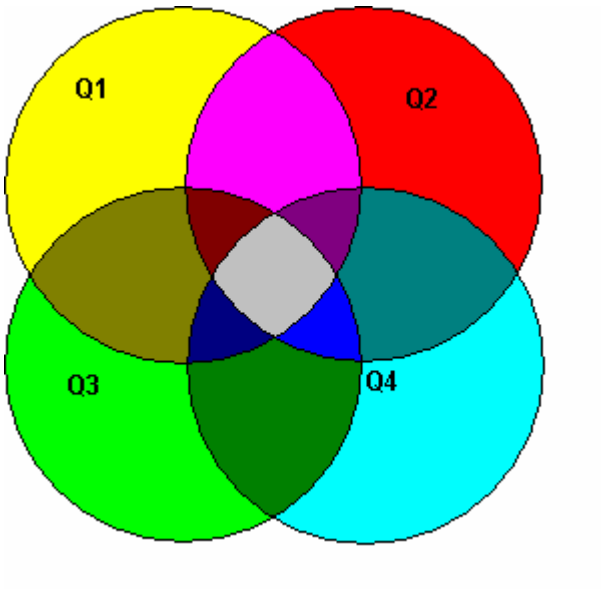

Figure 2: Diagram being used to indicate the four key research questions associated with the scientific study of natural hazards and their inter-relationships. Some of the agencies and organisations that are presently investigating the questions are described in the text.

Some of the international institutions or organisations working to examine these questions are as follows:

Question 1 is being examined by the International Geosphere Biosphere Program (IGBP) and the International Geoscience Programme of UNESCO (IGCP, because it was previously known as the International Geological Correlation Program). Question 2 is being examined by the International Geographical Union (IGU), amongst others. Question 3 is being examined by the International Global Observing Strategy, and especially by the Hazards Theme of IGOS (Marsh et al., 2004). Question 4 is being examined by the UN International Strategy for Disaster Reduction, and – as elaborated below – by the International Council for Science.

The sections above are the "real meat". Is there a way of providing 1-2 examples of topics within each question, so it becomes more concrete?

On the basis of the organisations and their work, the conclusion reached by the GeoUnions committee and the International Year of Planet Earth committee was that the key question most amenable to scientific investigation is Question 2, which is designed to investigate methods to quantify vulnerability at different spatial scales.

Certain groups and committees associated with international associations are already undertaking ancillary work that is intended to investigate various aspects of vulnerability. Some of these groups are:

- IUGG (Commission on Geophysical Risk and Sustainability, called the GeoRisk Commission)(http://www.iugg-georisk.org)
- IUGS (Commission on Geosience for Environmental Management) (http://www.lestari.ukm.my/iugsgem/)
- INQUA (Projects of the International Union for Quaternary Research) (http://www.inqua.tcd.ie/)
- IAEG (Several commissions and working groups of the International Association for Engineering Geology and the Environment, which is affiliated with IUGS) (http://www.iaeg.info/)
- ICL (International Consortium on Landslides) (http://icl.dpri.kyoto-u.ac.jp/)
- IGU (Commission on Hazards and Risks) (http://www.igu-net.org/uk/what_is_igu/commissions.html)

World Conference on Disaster Reduction[6]

The United Nations International Strategy for Natural Disaster Reduction (UN-ISDR) was set up after the Yokohama Conference of 1994 to progress the resolutions involved in the Yokohama Strategy[7]. To mark ten years of the UN-ISDR, and to commemorate the tenth anniversary of the Great Kobe Earthquake of 1995, , the UN-ISDR organised the World Conference on Disaster Reduction (WCDR) in Kobe from 18-22 January 2005. This event occurred just three weeks after the Indian Ocean Tsunami of 26 December 2004. The IUGG issued a statement [8] that was presented at WCDR. IUGG also collaborated with ICSU to organise a meeting to determine how to progress the GeoUnions initiative, and to determine how ICSU can facilitate the process.

International Council of Science (ICSU)

ICSU, for a long period of time, had an active Committee on Disaster Reduction that, for example, in 2002 issued a statement on Natural Disaster Reduction titled *Safer Sustainable Communities: Making Better Decisions about Risk*.[9] Following a review

[6] http://www.unisdr.org/wcdr/
[7] http://www.unisdr.org/eng/about_isdr/bd-yokohama-strat-eng.htm
[8] http://www.iugg.org/tsunamiresolution05.pdf
[9] http://www.iugg.org/ICSUposition.pdf

of ICSU programs, the Panel for Priority Area Assessment for the Environment recommended that a new research program be established on Natural and Human Induced Disasters[10]. Following the Indian Ocean Tsunami, ICSU also issued a statement[11] and started the process to establish a research program that is presently known as Natural and Human-Induced Environmental Hazards and Disasters. This follows the recommendation of the ICSU Strategic Plan for 2006-2011 that recommends the establishment of two research programs – the International Polar Year and the program on Natural and Human Induced Hazards.

Following on the joint ICSU-GeoUnions meeting at the WCDR in Kobe, an ICSU Scoping Group on Natural and Human-induced Hazards was established. This scoping group reported to the ICSU General Assembly in October 2005[12], which widened the remit of the study to Natural and Human-induced Environmental Hazards and Disasters. The ICSU General Assembly also agreed to the establishment of a Planning Group to chart the way forward.

ICSU has also decided to open Regional Offices. During 2006, regional offices for Africa, Latin America & the Caribbean, and Asia & the Pacific were inaugurated, and there are plans for a regional office in the Arab Region. The existence of these regional offices and their regional committees provides a mechanism for ICSU to implement their forthcoming programs.

Discussion and Conclusion

This document has reported on the procedures that are being implemented to prepare for, and to organise, large-scale scientific programs. Such organisational and preparatory work is needed to enhance and promote scientific work that shall eventually lead to publication in the scientific literature and in scientific journals such as *Natural Hazards*.

This review has concentrated on the work, plans and initiatives of various committees. Once the initial planning work has concluded then it is to be hoped that there will be many opportunities for individual scientists to take part in the ongoing work by linking their own research into the international effort through participation at planning meetings, engagement in the research programs that, hopefully, will eventuate, and presentation of relevant research at key scientific conferences.

Figure 3 provides a diagrammatic representation of the three major international initiatives that incorporate a scientific component to examine hazards. The international auspicing bodies are shown in rectangles at the top. The programs that they are running are depicted as ellipses. The International Year of Planet Earth, to the left of the Figure, runs both an Outreach Program and a Science Program. The GeoUnions Initiative and the ICSU Program primarily concentrate on science.

[10] http://www.icsu.org/1_icsuinscience/ENVI_Paa_1.html

[11] http://www.icsu.org/3_mediacentre/INSIGHT_SI_01_2005.html
[12] http://www.icsu.org/5_abouticsu/STRUCT_Comm_Adhoc.html

Figure 3 illustrates that both the GeoUnions and proposed ICSU program are likely to benefit by utilising the Outreach Program of the International Year of Planet Earth. The Figure also illustrates that each program has a natural geographic niche. The GeoUnions Initiative is at a local scale, the International Year of Planet Earth intends to set up a national scale structure, whereas ICSU provides a regional scale structure.

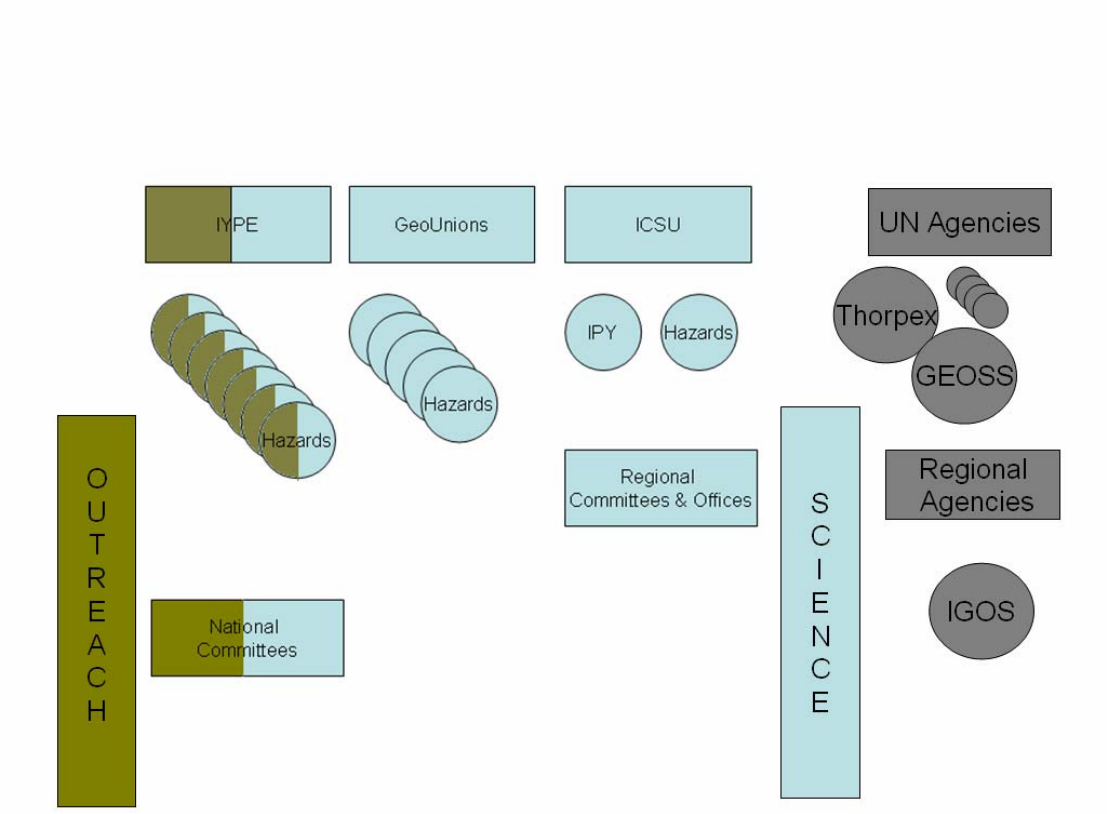

Figure 3 Diagrammatic representation of the three major international initiatives that incorporate a scientific component to examine hazards.

Figure 3 also illustrates the possibilities for linkages with the programs being run by international agencies such as UNESCO, WMO and the UN-ISDR. There are a number of existing or planned international programs that will have a hazards component embedded within them – or will enhance tools that would be useful for hazards research. For example, Thorpex, a program being planned by the WMO, will focus on extreme meteorological events. The Global Earth Observation System of Systems (GEOSS) is expected to provide observational tools with which to improve hazard and vulnerability assessments.

The International Year of Planet Earth already has strong links with UNESCO. The Hazards Science Implementation Team has started preliminary dialogue with the UN-ISDR to examine the possibility of a joint meeting in 2008 to examine the inter-relationships between the four key questions given above, and the Hyogo Framework for Action[13].

At the regional level, the GeoUnions co-operate with the IGOS GeoHazards Bureau[14], which is a joint initiative of the European Space Agency and the BRGM, the French Geoscience Research Organisation. This initiative intends to respond to the scientific and operational geospatial information needs for the prediction and monitoring of geophysical hazards, namely earthquakes, volcanoes and land instability.

Thus the mechanisms are in place for future collaboration between the various international and multi-national hazards initiatives to collaborate, to share information, and to undertake joint activities. We can look forward to a future where those undertaking work on hazards will think global, talk regional, and act local.

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[13] http://www.unisdr.org/wcdr/intergover/official-doc/L-docs/Hyogo-framework-for-action-english.pdf
[14] http://www.brgm.fr/brgm//Fichiers/IGOSGB_PBEO_Oct2005_lite.pdf