Hazards -

minimising risk, maximising awareness

Earth sciences for society

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Prospectus for a key theme of the International Year of Planet Earth

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What is this brochure for?

This brochure is a prospectus for one of the main scientific themes of the International Year of Planet Earth.

It describes, in terms accessible to the informed layperson, why the research that the Year hopes to support under this theme is of such vital importance to our understanding of the Earth System, and to society at large.

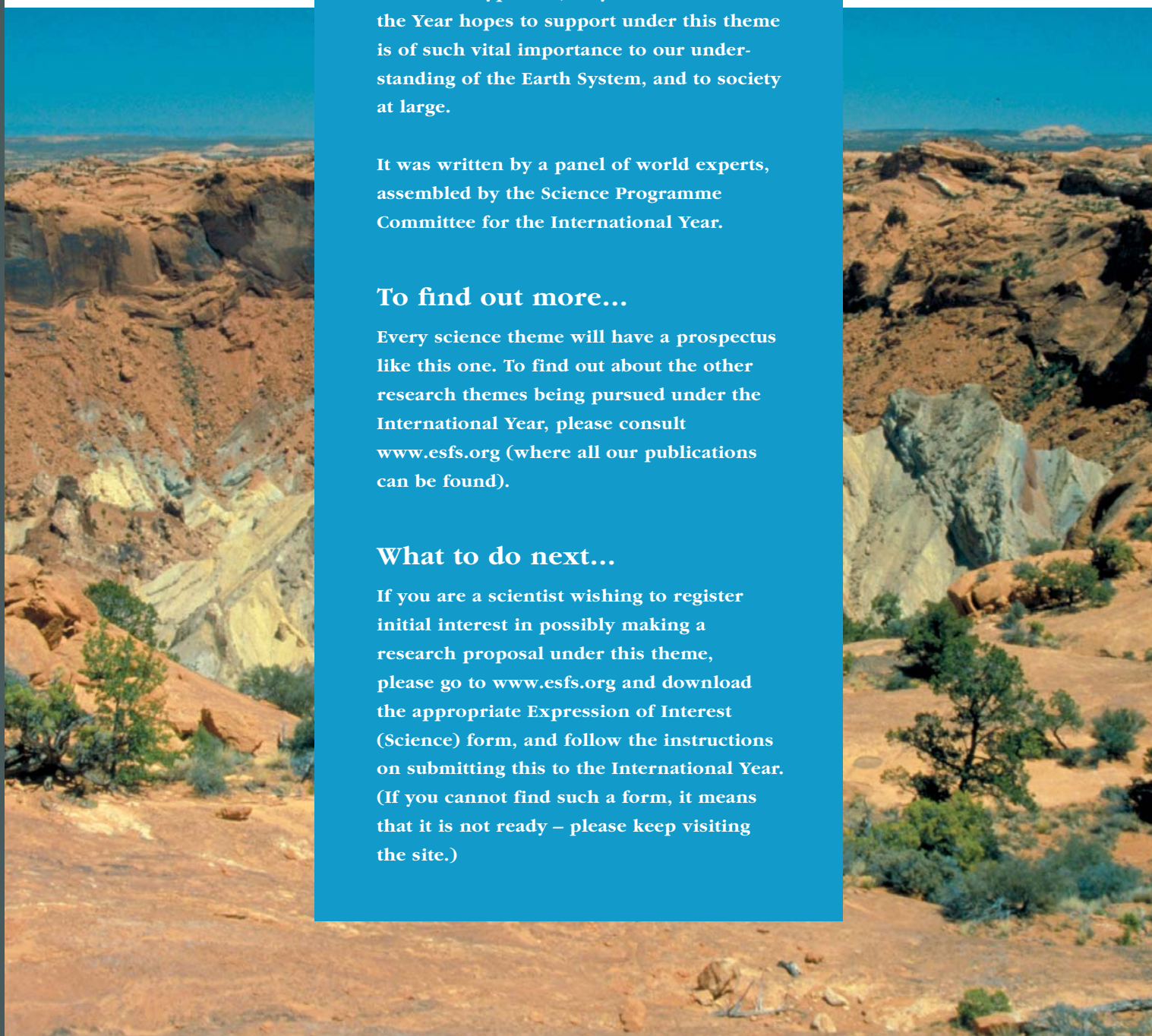
It was written by a panel of world experts, assembled by the Science Programme Committee for the International Year.

To find out more...

Every science theme will have a prospectus like this one. To find out about the other research themes being pursued under the International Year, please consult www.esfs.org (where all our publications can be found).

What to do next...

If you are a scientist wishing to register initial interest in possibly making a research proposal under this theme, please go to www.esfs.org and download the appropriate Expression of Interest (Science) form, and follow the instructions on submitting this to the International Year. (If you cannot find such a form, it means that it is not ready – please keep visiting the site.)



Mother Earth can seem like an uncaring parent. The impact of geohazards (box) on our lives and economy is very great, and will never go away. Every year floods, tsunamis, severe storms, drought, wildfires, volcanoes, earthquakes, landslides and subsidence claim thousands of lives, injure thousands more, devastate homes and destroy livelihoods.

Damaged infrastructure and insurance premiums increase costs. Developed countries are sometimes affected, but mostly in financial terms. The human impact - injury and loss of life - is concentrated in the developing world. As the world's population increases, more people are going to live in hazardous areas and thus the impact grows.

Earth scientists need to take a multi-disciplinary approach and then interact with governments and other bodies to help them frame policies and plans that will raise public awareness, minimise hazards and reduce people's vulnerability to them.

In 2006 it will be 1000 years since a paroxysmal eruption of Mount Merapi, Indonesia, destroyed the Mataram Ancient culture in Central Java and surrounding areas, blocking the flow of the Progo river to form a large lake, burying the famous Borobudur temple, and damaging many others. A large part of Indonesia is located in a volcanic arc, providing a laboratory in which geologists can study these powerful agents of creation and destruction for the service and protection of the Indonesian people.

Austria and the Alps have an almost identical meaning for many, though from a geological perspective, some very varied rock types are involved in building the country's famous landscape. These range from crystalline basement rocks, changed by heat and pressure during different mountain-building episodes, to fossil-rich sedimentary sequences of Palaeozoic to Mesozoic eras, followed by much younger Paleogene to Neogene clastic sediments, laid down in the basins that formed in the forelands of the rising Alpine chain.

Each west-east trending unit is characterized by its specific history and tectonic evolution. Depending on the rocks that each unit contains, these are all more or less affected by landslides and other forms of "mass movement" that pose severe problems to local people, settlements and infrastructure. Having detailed geological maps helps to minimize these risks - the most demanding issue that the Geological Survey of Austria, and other surveys in their own countries around the world, are currently facing.

What are geohazards?

"Geohazard" is a term that includes geological hazards, like landslides and volcanoes, hydrometeorological hazards like floods and freak tides, and geophysical hazards like earthquakes. Any Earth process that poses risk to human life can be said to be a geohazard, ranging in scope from local events (such as small rockfalls) to global geophysical events that can threaten the existence of our entire species, like major asteroid impacts and supervolcanic eruptions.

What does the International Year's logo mean? The International Year is intended to bring together all scientists who study the Earth System. Thus, the solid Earth (lithosphere) is shown in red, the hydrosphere in dark blue, the biosphere in green and the atmosphere in light blue. The logo is based on an original designed for a similar initiative called Jahr der Geowissenschaften 2002 (Earth Sciences Year 2002) organised in Germany. The German Ministry of Education and Research presented the logo to the IUGS.

The role of Earth scientists

Living in an often turbulent and unpredictable public environment, Earth scientists can contribute to decision-making through a risk management framework designed to examine technical and social issues related to sustainability. This means:

- anticipating human-induced and natural risks through widespread consultation
- determining concerns by using risk assessment techniques for various potential future emergencies
- identifying consequences by systematic cataloguing of hazards
- making calculations about potential future situations using appropriate computer models
- evaluating the certainties, uncertainties, and probabilities involved in calculating vulnerability and exposure of people to risk
- comparing the risks against pre-determined criteria to assess the need for further action
- determining and acting on available options to control, mitigate and adapt to the risk
- communicating the results to those who need to know
- setting up monitoring systems to collect, assimilate and archive data relevant to the determination of sustainability and risk, now and in the future
- integrating knowledge and understanding from all relevant disciplines to enable society to review the sustainability and risks of proposed policies and plans.

scientific methods hold out the promise of an improved science of risk

Though rational scientific methods hold out the promise of an improved science of risk and sustainability, scientists must not forget that public policy will always be heavily influenced by the public and political agenda of the day. This means that implementing risk management (so as to achieve a sustainable means of living with an ever-present hazard) can be achieved only through interaction of theory and practice.

The Budapest Manifesto

The Budapest Manifesto of 2002 attempted to find a generic framework, suitable for a multi-disciplinary approach, in which both physical and social scientists can deal with issues of risk, vulnerability and sustainability. The full text may be found at http://www.iugg.org/budapest.pdf This research prospectus draws extensively on its operational sections.

Many great civilizations have collapsed for a variety of reasons

Alphabet soup

In much of what follows, we refer to a great many scientific bodies with long complicated names. For the sake of brevity this means using their acronyms. Researchers will be familiar with these, but for those who are not, here is a list.

CDR	Committee for Disaster Reduction (of ICSU)
CRED	Centre for the Epidemiology of Disasters
ESPROMUD	Earth Surface Processes, Materials Use and Urban Development
IAEG	International Association for Engineering Geology and the Environment
ICL	International Consortium on Landslides
ICSU	International Council of Science
IGBP	International Geosphere-Biosphere Programme
IGCP	International Geoscience Programme
IGOS	Integrated Global Observing System
IGU	International Geographical Union
IHDP	International Human Dimensions Programme
INQUA	International Union for Quaternary Research
ISDR	International Strategy for Disaster Reduction
ISPRS	International Society of Photogrammetry and Remote Sensing
IT	Industrial Transformation
IUGG	International Union of Geodesy and Geophysics
IUGS	International Union of Geological Sciences
IUSS	International Union of Soil Science
LUCC	Land Use and Land Cover Change
SCOPE	Scientific Committee on Problems of the Environment
UN	United Nations
UN-ISDR	United Nations International Strategy for Disaster Reduction
UNESCO	United Nations Educational Scientific and Cultural Organization
USA	United States of America
USGS	United States Geological Survey
WCDR	World Conference on Disaster Reduction

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Hazards - four key questions

1. How have humans altered the geosphere, the biosphere and the landscape, thereby helping to trigger certain hazards and increasing societal vulnerability to them?

This question focuses on land use and development patterns (e.g. building on steep slopes, unstable ground, floodplains, etc.) and the unsustainable growth of megacities (see Prospectus 7 in this series) in hazard-prone areas. It also examines some of the cultural differences in development patterns.

To a certain extent, the background information needed to address these questions is being examined as part of a number of projects in the International Geoscience Programme (IGCP) of IUGS and UNESCO, and the International Geosphere Biosphere Program (IGBP) of ICSU. IGCP projects such as Landslide Hazard Assessment and Cultural Heritage (#425) and Environmental Catastrophes (#490) exemplify the new directions of societally relevant geoscience research for the Earth science community. Projects such as the SCOPE project ESPROMUD, the IGBP project Land-Use Land Cover Change (LUCC) project, and the IHDP project on Industrial Transformation (IT) examine human alterations to the biosphere, but do so within the context of urban change, or global warming and climate change, rather than within the context of societal vulnerability to natural hazards.

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?

This question addresses the complexity involved in integrating measurements of physical and social phenomena as well as the development of comparative indices at various spatial scales. This is difficult to do well, and suitable models are yet to be developed. The IGU Commission on Hazards and Risks (C-12) focuses on societal vulnerability to natural hazards and is developing generalised indices of vulnerability.

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Who is behind the International Year?

Initiated by the International Union of Geological Sciences (IUGS) in 2001, the proposed International Year of Planet Earth was immediately endorsed by UNESCO's Earth Science Division, and later by the joint UNESCO-IUGS International Geoscience Programme (IGCP).

The main aim of the International Year - to demonstrate the great potential of the Earth sciences to lay the foundations of a safer, healthier and wealthier society - explains the Year's subtitle: Earth sciences for society.

hazard issues are coming to the forefront in influencing political decisions

3. 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?

These questions address the role of the natural sciences in providing the background information for public policy and government decision-making.

The questions are partly being addressed through the Geohazards Theme of the Integrated Global Observing Strategy (IGOS). The report of this theme (see **http://dup.esrin.esa.it/igos-geohazards/pdf/igos_report.zip**) points out that citizens need to know a hazard's location, timing, extent, likely behaviour, and duration. The Geohazards IGOS will reduce the data gaps, between what is known and what needs to be known, by aiming to improve hazard inventories, maps and monitoring tools available to monitoring and advisory agencies. Equally prominent multilateral efforts include the information provided by the Centre for the Epidemiology of Disasters (CRED) at **http://www.cred.be/** and the hazards database managed by the International Research Institute for Climate Prediction at **http://iri.columbia.edu/**.

National positions regarding such hazard issues are also coming to the forefront in influencing political decisions and addressing public needs directly. These are exemplified by two recent North American reports, one in Canada (*An Assessment of Natural Hazards and Disasters in Canada: A Report for Decision Makers and Practitioners* at **http://www.crhnet.ca/**) and one in the USA (USGS Circular 1244: *National Landslide Hazards Mitigation Strategy - A Framework for Loss Reduction* at **http://pubs.usgs.gov/circ/c1244/**). *The Spatial Hazards Events and Losses Database for the United States* was recently released at **http://sheldus.org/**. This provides forty years of hazard event and loss data, at the county scale, for the whole of the USA.

Science programme

A panel of 20 eminent geoscientists from all parts of the world decided on a list of nine broad science themes - Groundwater, Hazards, Earth & Health, Climate, Resources, Megacities, Deep Earth, Ocean, and Soils.

The next step is to identify substantive science topics with clear deliverables within each broad theme. A 'key-text' team has now been set up for each, tasked with working out an Action Plan. Each team will produce a text that will be published as a theme prospectus like this one.

A series of Implementation Groups will then be created to set the work under the nine programmes in motion. Every effort will be made to involve specialists from countries with particular interest in (and need for) these programmes.

For more information - www.esfs.org

4. 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?

This question addresses the role of science in public policy decision-making, including the way issues of risk and uncertainty, data quality and quantity, influence who uses information, what information is used, and the purpose for which it is used.

To a certain extent this question is addressed (peripherally) in the United Nations Inter-Agency Secretariat International Strategy for Disaster Reduction (UN-ISDR). The UN-ISDR has released the 2004 version of its report *Living with Risk: a global review of disaster reduction initiatives*, which includes information on hazard assessment and awareness. UN-ISDR has also been a key player in organising the World Conference on Disaster Reduction (**http://www.unisdr.org/eng/wcdr/wcdr-index.htm** , Kobe, Japan 2005) as a prominent meeting of governments, policy analysts and decision makers.

The importance of community interaction and participation was also stressed in the ICSU position statement on *Natural Disaster Reduction: Safer Sustainable Communities - making decisions about risk* (**http://www.iugg.org/ICSUposition.pdf**)

this question will tie in with

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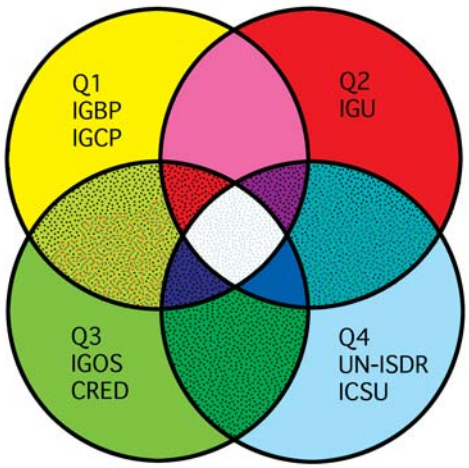
of the geoscience unions

Summary of research agenda

The four key questions are shown here diagrammatically. The diagram demonstrates the fact that these questions are interrelated. It also indicates that any International Year strategy that seeks to answer these four questions will need to integrate closely with the existing and future planned work of many of the research bodies already mentioned above, including IGCP, IGBP, IGOS, UNESCO, and UN-ISDR. It also indicates that a key area of concern requiring action by a consortium of the geoscience unions (IUGG, IUGS, IGU, IUSS and ISPRS) relates to Question 2 above.

Concentrating on this question will tie in with the existing and ongoing programmes of the geoscience unions and their affiliates, namely:

- IUGG (Commission on Geophysical Risk and Sustainability, called the GeoRisk Commission **http://www.mitp.ru/georisk/**)
- IUGS (Commission on Geological Sciences for Environmental Planning, called Cogeoenvironment **http://www.sgu.se/hotell/cogeo/index.htm**)
- 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 **http://cgi.ensmp.fr:88/iaeg/**
- ICL (International Consortium on Landslides **http://icl.dpri.kyoto-u.ac.jp/**)
- IGU (Commission on Hazards and Risks, C-12 **http://www.giub.uni-bonn.de/gidi/igu-c12/**)



humans have altered the geosphere,

biosphere and the landscape,

helping to trigger hazards

Future potential International Year activities

Webcyclopedia of Geohazards

Prototype at: **http://www.mitp.ru/georisk/webcyclopedia/index.html**

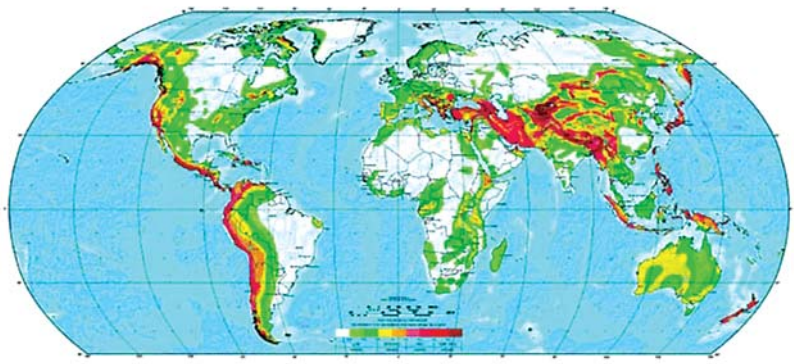
The Webcyclopedia project exists to supply a web-based encyclopaedia of hydrometeorological, geological and geophysical risks and hazards. It deals with both the geographical, physical and human aspects of natural risks and hazards. Started on a volunteer basis by the GeoRisk Commission, this project requires considerable updating, revision and new information to become a future key source of information. Responsibility to maintain the site demands a "champion" who will recruit broader geographical coverage, wider thematic topics and technical peer review. The form of such material could be varied, ranging from the traditional scientific paper through to interactive hazard maps, real-time data, models of phenomena, or merely hyperlinks to other sites providing information on the topic.

Postdoctoral research

Funding should be made available to establish an international network of five postdoctoral researchers (one in each continent) appointed to examine Question 2 above.

One of the researchers should be located within the Earth Science Division of UNESCO in Paris or the UN-ISDR office in Geneva to ensure contact and influence upon decision makers at the highest level. Topics to be addressed may include an examination of comparative indices at various spatial scales as well as frameworks and models for the assessment of vulnerability and responsibility for integrating physical and social phenomena.

GLOBAL SEISMIC HAZARD MAP



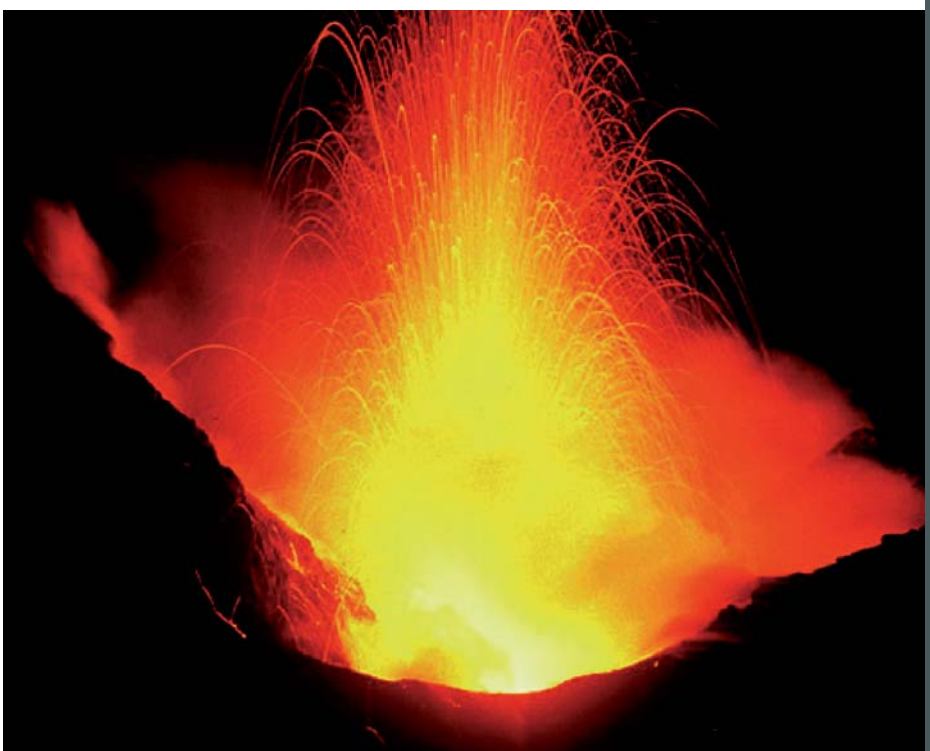
Development of a research programme

A key component of the Hazards theme will be the development of a research programme through networking. Two types of networking are needed:

- within the geoscience unions and their many affiliates designed to address Question 2 above
- with researchers within IGCP, IGOS, IGBP, ISDR, CDR (and many others) involved in seeking answers to Questions 1, 3 and 4. A programme of attendance at key conferences and meetings from 2004 through 2007 will need to be planned. Some relevant meetings being planned at the time of writing include:

World Conference on Disaster Reduction (WCDR)
(**http://www.unisdr.org/eng/wcdr/wcdr-index.htm**)
Kobe, Japan, in January 18-22, 2005. UN-organised meeting of governments.

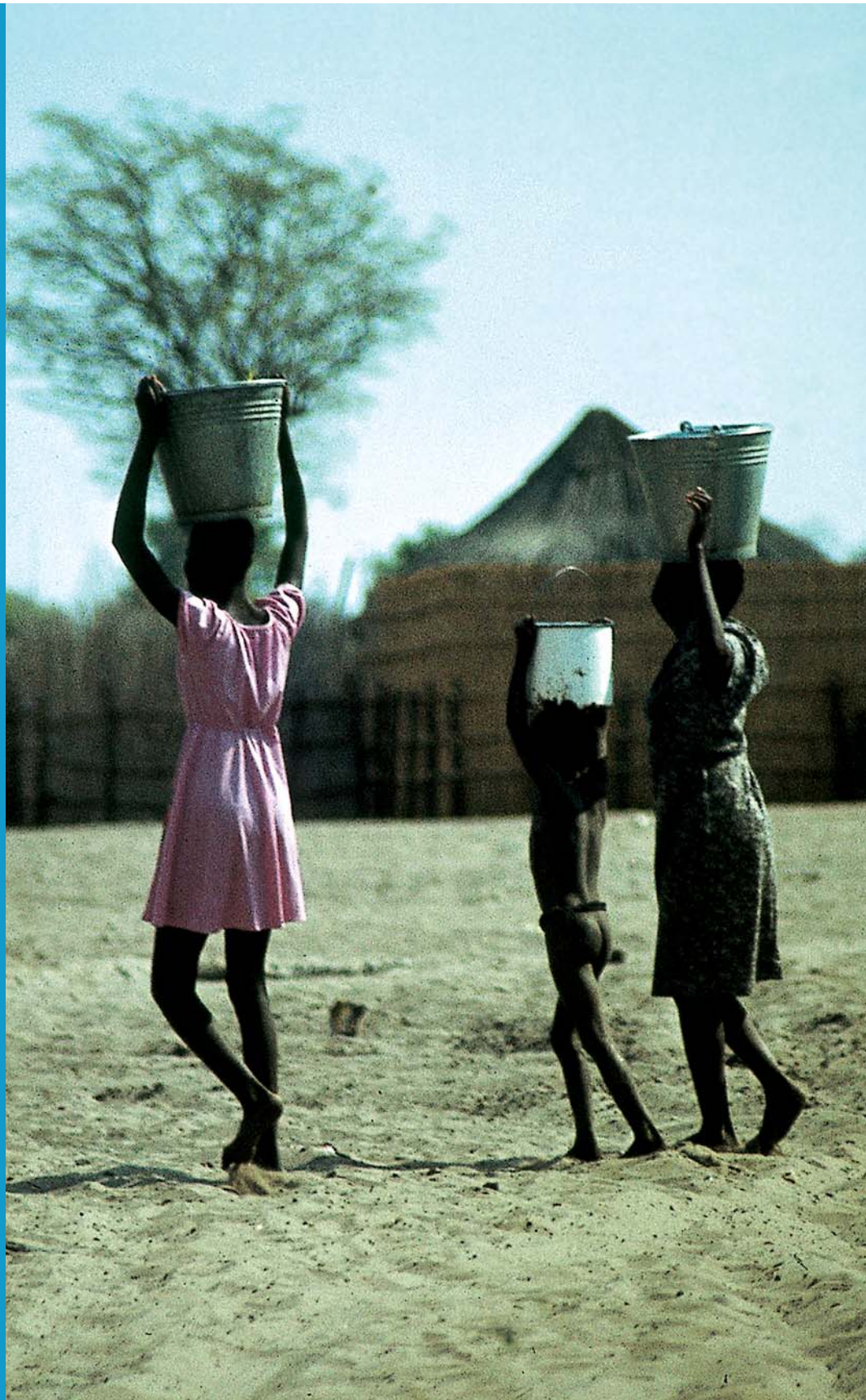
The First Symposium on Geo-Information for Disaster Management
(**http://www.gdmc.nl/gi4dm/**) Delft, Netherlands, March 21-23, 2005



Only one Earth

The human race needs its planet. We depend on it completely, because we evolved from it, remain forever part of it, and can exist only by courtesy of the self-sustaining Earth System.

The more we learn, the more we understand that we must nurture the Earth as we would our children, for their sake.



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IUGS
International Union of Geological Sciences

UNESCO
United Nations Educational Scientific and Cultural Organisation

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