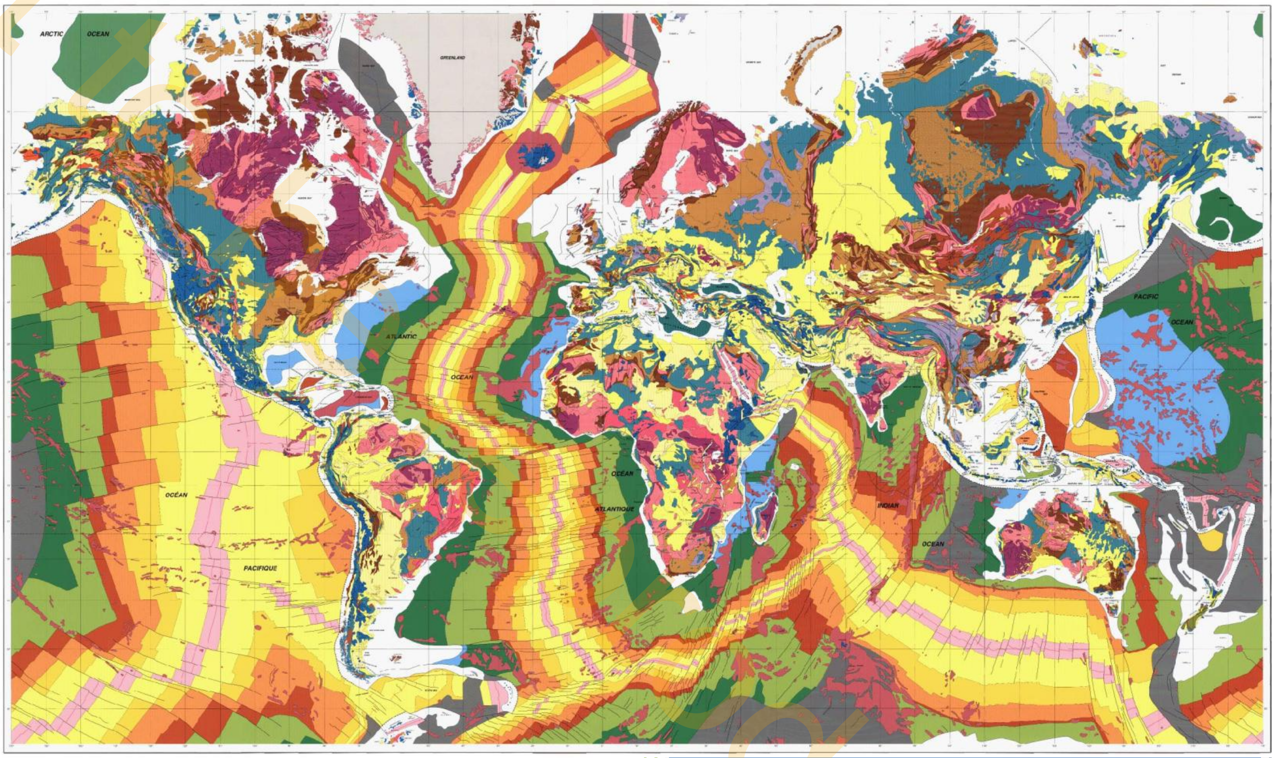
Towards a Global Geoscience Initiative (GGI)



DECEMBER 2012

Introduction

The Earth sciences community is highly fractured being dispersed among many competing geoscientific sub-disciplines. A consequence is that it fails to act together in coherently bringing together and promoting both the collective insights and understanding of Earth processes. This diminishes greatly the contribution geoscience can make to the understanding and resolution of a range of contemporary issues facing humankind.

A self elected group comprising Jack Hess (Geological Society of America), Pat Leahy (American Geosciences Institute), John Ludden (British Geological Survey) and Edmund Nickless (The Geological Society of London), has been working informally to assess if there is broad support within the global geosciences community for a major initiative (a so-called Global Geoscience Initiative). The aim of the GGI would be to focus the efforts of our community on a few major research thrusts in the geosciences that would have significant research potential and societal impact, provide a platform for global cooperation, be multidisciplinary, and catalyze the innovation and excitement of the geoscience community.

History

The origin of the GGI is the International Year of Planet Earth triennium. The IYPE has been justifiably praised for enhancing society's awareness of the significance and impact of the geosciences in the safety, health and welfare of humankind globally. The IYPE was sponsored by the International Union of Geological Sciences with significant support from UNESCO. IYPE was truly global in scope with more than 100 participating countries and groups, and through its outreach programme achieved much in raising public awareness and understanding.

As the triennium came to a close, the IYPE Board of Directors discussed remaining challenges facing the geosciences. It was widely recognized by the Board and the IYPE National Committees that one of the greatest shortcomings of IYPE was the lack of a robust scientific legacy. That was not an oversight but simply a strategic decision based on the limited funding resources available for the IYPE.

In response to that concern, a small group comprising Hess, Leahy, Ludden and Nickless (all former IYPE Board members), undertook to investigate the extent of interest and potential within the wider geoscience community for concerted action. In addition to establishing if such an endeavor had merit, the group wished to identify relevant potential research topics with broad community support. Because of the intended global nature of the effort, the group decided to convene a series of town hall meetings to engage with the geoscience community. A report of the kick off meeting is at Annex A.

Between 2009 and 2012, five town hall meetings were organized in conjunction with international meetings and symposia: GSA, Portland in 2009, AGU, San Francisco in 2009, EGU, Vienna in 2010, AGU Iguassu Falls, Brazil, Meeting of the Americas in 2010, with a concluding event at the

International Geological Congress in Brisbane, Australia, in August 2012. Summaries of these discussions are at Annex B.

All of the town hall meetings were usually addressed by three invited, active researchers, internationally recognized as leaders in their field. Each attracted significant participation. The selection of speakers drawn from all continents except Antarctica reflected a broad global perspective as well as disciplinary diversity in the geosciences. All presentations were followed by extensive discussion. Generally, discussion focused on the feasibility and desirability of pursuing a global initiative, reaction to potential topics and the role of the social sciences in adding value to the initiative.

Topics identified

Numerous topics were identified that should be considered as the GGI evolves. Speakers highlighted:

- Deltas, in particular living on these dynamic systems in the face of future sea-level rise with consequential loss of highly productive land area, salinisation of ground water and significant reduction of crop yields.
- Natural hazards including earthquake, tsunami, volcanic eruption, coastal erosion, landslide and subsidence.
- Developing energy and mineral resources with minimal adverse environmental impact.
- Water resources, in particular the importance of groundwater.
- Ecological concerns and the quality of life.

The driver with regard to many of these topics, in particular the need for a major research initiative, is increasing human population and its demands on the planet.

Outcomes, in no particular, order include:

- Growing global population is driving the demand for natural resources. The availability of energy, minerals and water are critical to quality of life, national security and economic development generally and, in particular, to emerging economies and less developed countries.
- There is a need for increased effort in the area of applied geoscience, such as the discovery and environmental impact of the extraction of energy, mineral and water resources, waste disposal, development of large-scale infrastructure and the use of the subsurface.
- The Global Earthquake Model (GEM) and the development of a Global Volcano Model (GVM) are seen as programmes that could be expanded globally to address earthquake hazard and resiliency as part of a broader research emphasis on natural hazards.
- There are particular challenges in communicating geoscience as demonstrated by public and government discussions of climate change science, but also in communicating the need to

better use the subsurface to sequester waste and for resource development. The complex interaction of humans with the natural world and resulting impact on our long-term climate and other issues is not clearly understood by the general public and policy makers. Although significant and high quality research has been conducted, the communication of these findings and impact has been marginalized by some articulate opinion-formers. Society is uncertain about the reliability of the evidence underpinning the science and their views on climate change are ambivalent.

- To be relevant it is crucial that GGI projects link to contemporary issues of societal concern. Several speakers highlighted the need for an initiative to focus on Africa, Latin America and the Caribbean, or Central Asia. This was further amplified through presentations on a South African programme entitled *Africa Alive Corridors* and '*Tethys'* a programme bridging Europe and Asia bringing together geoscience research with historical and social impacts. Both are good examples of engaging the public in the geosciences.

Conclusions

In summary the town hall meetings show:

i. There is grass roots interest in further exploring potential topics and organizing the effort in a more formal fashion under the auspices of an international organization. The town hall meetings recognized that stable funding and collaborative mechanisms are required if the GGI is to move to the next level of implementation. Formal endorsement by an internationally recognized body would ensure continuity of effort, broader participation, and credibility to the effort.

ii. Securing funding for the GGI is essential. An organization with stature in the geosciences is required to be able to:

   a. Attract the necessary funding and commitments by a global consortium of research funding agencies, not-for-profit organizations and industry;

   b. Promote and focus effort within the geosciences community, encouraging submission of project proposals against an agreed but limited series of themes to research funders.

Because of the global nature of the initiative, UNESCO, ICSU and its geounions, in particular IUGS, acting alone though preferably with the International Union of Geodesy and Geophysics, may be appropriate champions. ICSU along with a number of research funding agencies has formed The Belmont Forum and this mechanism may be an appropriate source of funding for the GGI. The Belmont Forum has a major emphasis on climate science linked with the social science of adaptation and mitigation. If the Belmont Forum initiative was expanded to include broader geoscience topics, the GGI would certainly be a vehicle for encouraging a stronger geoscience component to the Belmont Forum process. IUGS is an appropriate organization to promote the GGI to the Belmont Forum. A key next step is the adoption of the GGI process by the leadership of the IUGS and UNESCO.

iii. As a first step, the IUGS leadership should determine their interest and commitment. Then IUGS should seek UNESCO and ICSU support and buy-in. It would be desirable for IUGS to gain the support of its National Committees and appropriate scientific organizations globally, including other international geounions. The formation of a multinational steering committee may be necessary to refine the initial focus and scope of the effort.

iv. Over the next year, the IUGS Executive should

a. open discussions with the leadership of the Belmont Forum to determine their interest and willingness to more visibly promote the geosciences within the process;

b. and, report to National Committees.

Jack Hess, Executive Director, Geological Society of America
Edmund Nickless, Executive Secretary, Geological Society of London
John Ludden, Executive Director, British Geological Survey
Pat Leahy, Executive Director, American Geosciences Institute

05 December 2012

Annex A

TOWN HALL MEETING SUMMARIES

The Origins: Summary of the London Meeting

An informal group comprising John Ludden (chair) (BGS), Tom Beer (IUGG), Nic Bilham (GSL), Ed de Mulder (IYPE) (first part of the meeting), David Dent (IYPE Board), Wolfgang Eder (IYPE Board), Manual Grande (EGU), Jack Hess (GSA), Pat Leahy (AGI), Robert Missotten (UNESCO), Edmund Nickless (GSL) and Roland Oberhaensli (ILP) met on 16 July 2009 at the Geological Society of London, Burlington House, London

- to establish whether the concept of a global geoscience initiative is viable,
- to discuss institutional arrangements, and the roles and relationships of key organisations (including IYPE, whose activities will draw to a close in June 2010),
- to discuss how working science communities might be engaged, and
- to agree on next steps in the process.

In seeking to establish a global geoscience initiative, no new structures or institutions were identified as there are already suitable vehicles (UNESCO, the International Unions, etc). Support of these institutions will be invaluable. The continuing success of International Years depends on their being seen to have a distinct end, and a clear legacy, so IYPE (and the other years) should be used to lever support for the current initiative among existing institutions.

Institutional support from the International Unions and UNESCO is likely to be a key determinant of success. A repurposed IGCP was suggested as a possible institutional vehicle for the programme.

It was agreed that the theme(s) of the programme should be associated with clear societal goals. A useful starting point would be to consider the role of geoscience in delivering the 'Millennium Goals', at a global, national and regional level. Some broad trends in societal drivers for science are common to many countries, such as stimulating economic competitiveness, and living with environmental change – recognising these broader social agendas will help attract funding. A clear link between the science programme and societal goals will also help to sustain continuing outreach projects, and will help to show to those outside the community the vital role of Earth scientists in addressing the great challenges of the future.

While institutional support and some joined up international effort to give the project identity, stimulate new funding, etc, are essential, it was agreed that excellence in the science itself depends on allowing a more organic, 'bottom up' approach. A key challenge is to engage scientific communities, as well as funding bodies and other institutions, and to knit together these 'bottom up' and 'top down' elements. A programme which enables access to (possibly new) international infrastructure might be attractive in this respect.

The Earth sciences tend to be fragmented, and relatively restricted to disciplinary silos. The project must therefore be seen to be genuinely interdisciplinary, and will add real value if it is seen to help counter institutional as well as disciplinary fragmentation, so that there are fewer but stronger and more cohesive voices talking to outside audiences. In order to engage a truly global community, the project must not be seen as Euro-centric or colonialist.

It was suggested that the programme should not be 'global' simply in the sense of involving activity in many countries, and being globally organised, but should also involve global processes – this has been a strength of the oceanography community.

Although it was recognised that it was not the purpose of the meeting (or of the group) to fix on a theme (or themes) for an global science programme and pre-empt discussions later in the year, it was agreed that it would be helpful to generate some ideas, which might be a useful starting point for those discussions. A number of possible themes, often inter-related, were identified and discussed.

A possible model is to identify a broad overarching theme, such as landscape, which would span the ten year lifetime, say, of the programme, with three distinct successive three-year phases (an attractive timeframe for many funding bodies) addressing more focused topics, e.g. deltas. It was noted that most of the suggested themes inevitably involve climate change/environmental change, but as a driver rather than a research topic in its own right – which clearly locates them in a societal context. It was agreed that in the end, attractive and focused themes must be identified, rather than very diffuse subject areas such as energy or water.

The need to raise political support and awareness among funding bodies was recognised, but it was agreed that this should be left until after the third Town Hall Meeting at EGU, capitalising on the process which will have taken place at Town Hall Meetings at GSA and AGU, in gathering support raised in the global geoscience community.

The aims of the Town Hall Meetings are:

- to establish whether the concept of a global geoscience initiative is viable,
- to discuss institutional arrangements, and the roles and relationships of key organisations (including IYPE, whose activities will draw to a close in June 2010),
- to discuss how working science communities might be engaged, and
- to agree next steps in the process.

Annex B

Towards a Global Geoscience Initiative: Town Halls

Sponsors

American Geological Institute (AGI), British Geological Survey (BGS), Geological Society of America (GSA) and Geological Society of London (GSL)

Background

The activities associated with the International Year of Planet Earth (IYPE) will shortly come to an end. Looking back over the three years of IYPE, there have been many notable successes, particularly in its Outreach program.

Several members of the IYPE board, along with representatives of some other Earth science institutions, have started to explore whether there is scope to launch a global geoscience initiative, in response to the 'call to arms' embodied in the Tsukuba Declaration put forward by participants in IYPE and three other International Years — the International Polar Year, the Electronic Geophysical Year, and the International Heliophysical Year.

Such an initiative, while independent of IYPE and the other International Years, would constitute a fitting legacy, contributing to global scientific understanding and international capacity building, and complementing the outreach achievements of IYPE.

The vision of the group developing this proposal is that it should:

- be inclusive, and involve a geoscience community which is broad both in terms of discipline and nationality,
- have a clear socio-economic context, and global societal relevance,
- focus on a globally significant science theme, and preferably involve global processes, and
- attract the support of scientific communities, funding agencies, governments and other institutions in many countries, under the umbrella of UNESCO and the geoscientific International Unions.

While some initial thought has been given to how such an initiative might work, and to possible science themes, it will only be a success if it has the support and involvement of a broader community of Earth scientists. 'Town hall' meetings are therefore being held at the GSA Annual Meeting in Portland, Oregon (October 2009), at the AGU Fall Meeting in San Francisco, California (December 2009), and at the EGU Meeting in Vienna (May 2010). The proposal will also be discussed at the closing IYPE event in Lisbon (November 2009), and at events in other parts of the world over the coming months.

Edmund Nickless and P. Patrick Leahy

06 January 2010

GSA Town Hall Meeting: Tuesday 20 October 2009 at 6:00 pm – 7:30 pm, Oregon Convention Center, Room B116, Portland, Oregon

Chairs:

Edmund Nickless (Geological Society of London) and Jack Hess (Geological Society of America)

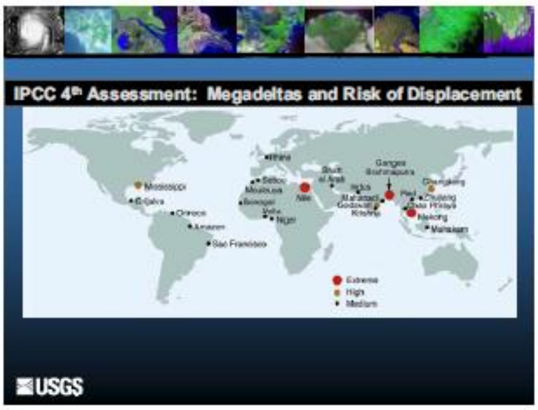
Speakers:

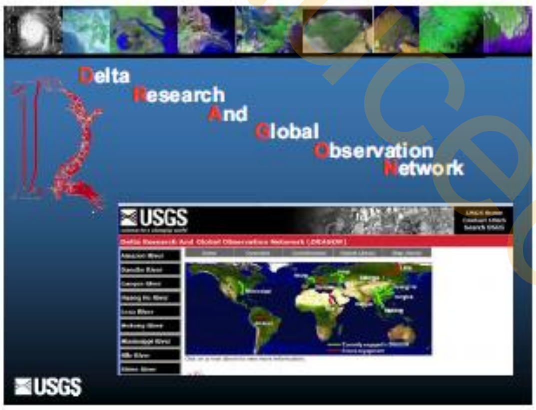
Suzette Kimball (Acting Director, US Geological Survey); Murray Hitzman (Charles F. Fogarty Professor of Economic Geology, Colorado School of Mines); John Ludden (Executive Director, British Geological Survey

Presentations:

Presentations can be viewed online at: http://www.agiweb.org/members/presentations/index.html

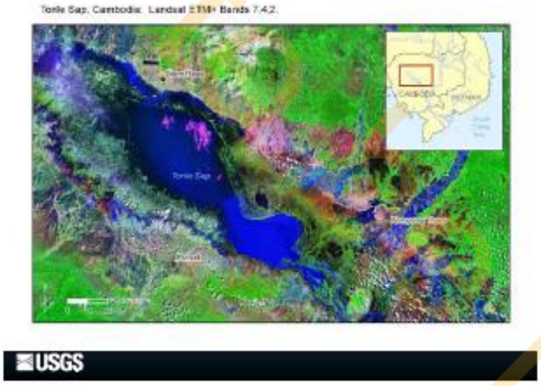
1) **Suzette Kimball (Acting Director, US Geological Survey) – There Be DRAGONs: Delta Science in the 21st Century**






Goals of the DRAGON Project
Create a community of practice
Share data, create models and visualization tools
Develop ecological forecasting models
Delta Research And Global Observation Network
USGS


THE WHITE HOUSE
Joint Statement Between the United States of America and the Socialist Republic of Vietnam
DRAGON Institute-Mekong
•To be established at Can Tho University, Vietnam.
•Joint statement issued by President Bush and Prime Minister Dung welcoming the DRAGON project in Vietnam.
•Secretary of Interior kicks off the DRAGON Institute in November 2008


Tonle Sap, Cambodia: Landsat ETM+ Bands 7,4,2.
USGS


Mekong Delta
Mississippi Delta


USGS
Delta Research And Global Observation Network (DRAGON)
RAGON
Latest News
DRAGON Expands with "Forecast Mekong"
DRAGON Asia Summit 2009: A Huge Success
USGS

2) **Murray Hitzman (Charles F. Fogarty Professor of Economic Geology, Colorado School of Mines) – *Critical Research Challenges in Natural Resource Geosciences for the Early 21st Century***

GSA Town Hall Meeting
Towards a Global Geoscience Initiative

Critical Research Challenges in Natural Resource Geosciences for the Early 21st Century

Murray W. Hitzman
Charles Fogarty Professor of Economic Geology
Colorado School of Mines

20 October 2009

Acknowledgements

- A number of individuals were contacted concerning the issue of grand challenges in natural resources geosciences – thanks to all! But especially —
  - *Mark Barton*
  - *Maeve Boland*
  - *Larry Cathles*
  - *Stephen Kesler*
  - *Donald Paul*
  - *Jeremy Richards*
  - *Steve Sonnenberg*
  - *Scott Tinker*
  - *Neil Williams*

2

Framing the Issue

- What is the overarching challenge facing humanity in the early 21st century?

Sustainable existence on planet Earth

(+ increased living standards for much of the world's population)

3

The Real Driver for the Challenge — Population Growth (human system)

2005		2030 estimates	
China	1.31	India	1.53
India	1.09	China	1.46
USA	0.29	USA	0.36
Indonesia	0.23	Indonesia	0.28
Brazil	0.22	Pakistan	0.23

Source: U.S. Census Bureau

4

Some strategic issues:
(intersections between human and earth systems)

- Growth of mega-cities and need for energy
- Restructuring of global capital and debt
- Renewable energy growth and land use
- U.S., China, coal, and carbon
- Coupling of IT and natural resources growth
- Unanticipated discoveries / technologies
- Unanticipated consequences

Framing the Issue — Natural Resources

- How do the natural resources geosciences relate to the global challenge?

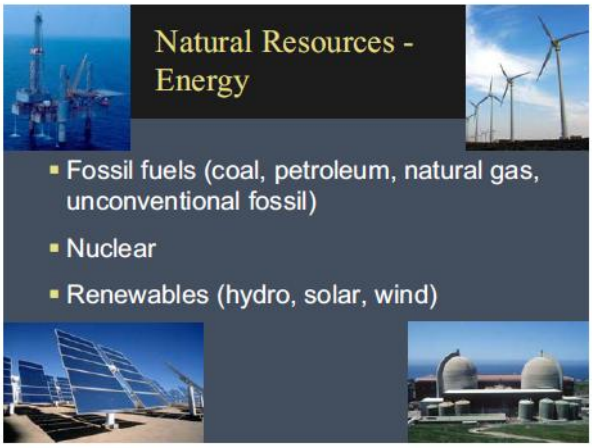
Energy

Water

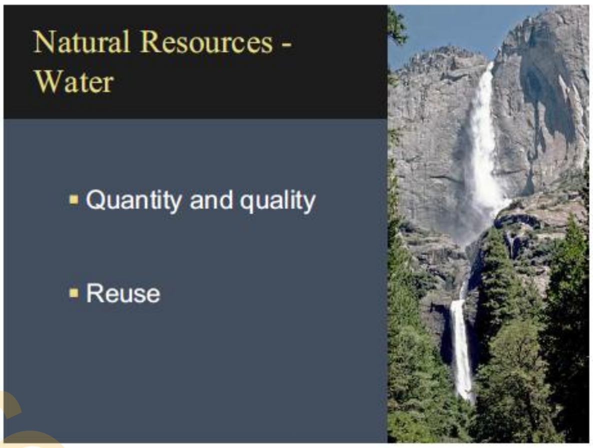
Earth Materials

Through the twin prisms of environmental sustainability and climate change

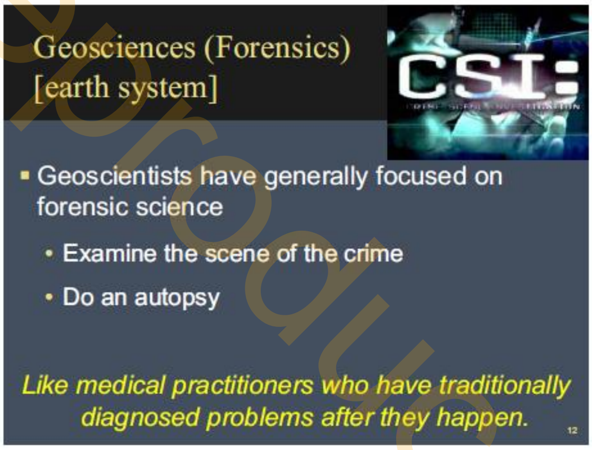

Natural Resource Issues Involve Complexity:
Science and Technology
+
Economics and Business
+
Society and Environment
+
Policy and Government


Natural Resources - Energy
Fossil fuels (coal, petroleum, natural gas, unconventional fossil)
Nuclear
Renewables (hydro, solar, wind)


Natural Resources - Energy
Production
Finding more
Producing and using what we have most efficiently
Environment – wastes
Solids
Gases
Liquids
Heat (lost energy)


Natural Resources - Water
Quantity and quality
Reuse


Natural Resources – Earth Materials
Production
Finding more
Using what we have most efficiently
Environmental impacts
Wastes
Land use
Energy


Geosciences (Forensics) [earth system]
CSI:
Geoscientists have generally focused on forensic science
Examine the scene of the crime
Do an autopsy
Like medical practitioners who have traditionally diagnosed problems after they happen.


Natural Resource Issues Involve Complexity:
Science and Technology
+
Economics and Business
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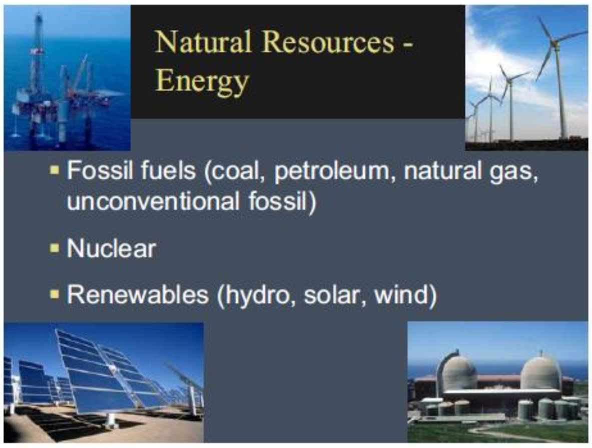
Society and Environment
+
Policy and Government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Natural Resources - Energy
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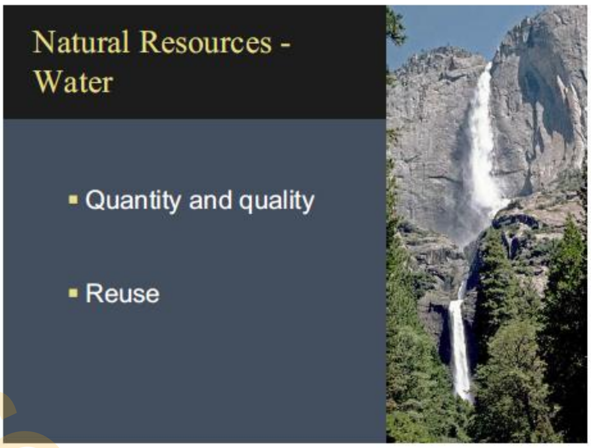
Heat (lost energy)
9


Natural Resources - Water
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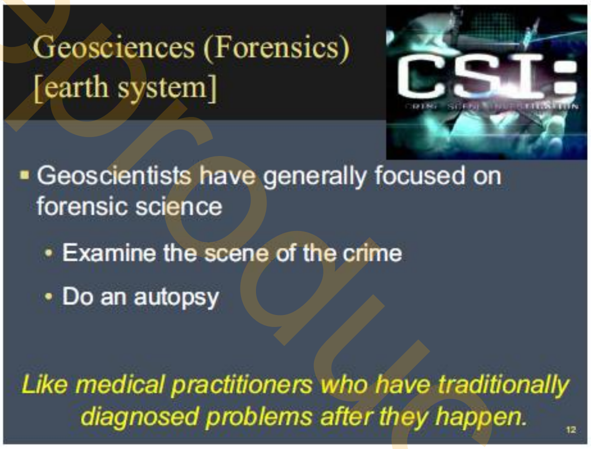
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Predictive Geosciences [earth + human systems]

Like medicine, we must move toward predictive and integrative geology.

But see how challenging it can be – current health care debate!

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Framing the Issue — Natural Resources

What unique skills do geoscientists bring to the table?

UNDERSTANDING THE EARTH SYSTEM & SCALE & TIME

But we have less expertise integrating earth and human systems

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Natural Resource Implications - SCALE Trillion is the magic number*

- Trillion gallons of fuel consumed per year
- Half a trillion gallons of water withdrawn per day in US
- Trillion watts of U.S. power generation capacity
- Trillion barrels of oil consumed in the last 125 years
- Two trillion pounds of sand & gravel consumed in US / year
- Three trillion pounds of copper consumed in the last decade
- Trillion tons of coal reserves
- More than $20 trillion in capital needed in 25 years for energy

Even for geoscientists, the scale of earth-human system issues is enormous!

* Modified from Donald Paul, William Keck Chair of Energy, USC

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Natural Resource Implications - SCALE "1% matters" — examples in energy

- Adding 1% to global oil reserves requires about $200 billion in exploration and production investment.
- U.S. ethanol production is about 1% of total global liquids production.
- Installing 10 GW of solar PV in the US would add 1% to total electric capacity.
- 2.5 million electric vehicles would displace 1% of US fuel demand (100,000 bbl/day).

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Natural Resource Implications - SCALE

- Enhanced Geothermal (EGS)
  - How to manipulate and control both subsurface heat and seismicity *(crustal scale)*
- Fluid / gas movement
  - How to understand and manipulate materials at the *nano-scale* in geological environments.

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Natural Resource Implications – TIME hundreds to millions of years

- Most individuals think seriously in terms of one to three generations (~150 years).
- Natural resource issues (earth + human systems) must be considered in 100's to 1000's of years.
  - Peak oil
  - Peak coal
  - Nuclear waste disposal
  - Aquifer recharge
- Geoscientists must routinely think in millions of years.

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Natural Resource Implications – TIME

- Energy — natural gas, coal to liquids, oil shale, algal biofuels
  - Fracturing — pump from the source rock
  - In-situ creation of new liquids and gases
  - Genetic modification of algal materials and processes

Speed up geologic time!

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Natural Resource Implications - TIME

- Earth materials
  - In-situ leaching (chemical, biological)
  - Co-produce metals from geothermal
  - Tap active sea-floor hydrothermal vents

Hasten geochemical processes

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Natural Resource Implications - TIME

- Environment — carbon capture and sequestration (CCS)
  - Utilize and create subsurface reservoirs
  - Innovative ways to tie up CO_2

Create or manipulate subsurface permeability and reaction processes at geologically meaningful scales

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Complexity, scale, and time: Natural Resources

Past, present, and future always co-exist.

Energy
Water
Environment

Earth System
Resources
Knowledge
+
Human System
Technology
Values
=
Sustainable Existence

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Natural Resources: Research Challenges — Overarching Themes

- How to better understand and engineer fluids (of all types) in the subsurface
  - *Energy (oil and gas; hydrothermal fluids)*
  - *Water*
  - *Environmental (CO_2)*

Predictive Geo-engineering

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Natural Resources: Research Challenges — Predictive Geoengineering

- At all scales and through time.
- Utilize natural test sites (e.g. Earthscope) and human manipulated test sites (oil fields, major aquifers – Ogallala, etc.)
  - Field geology (traditional mapping)
  - Laboratory (empirical analysis)
  - Remote sensing (geophysics)
- Synthesis and predictive studies and tests

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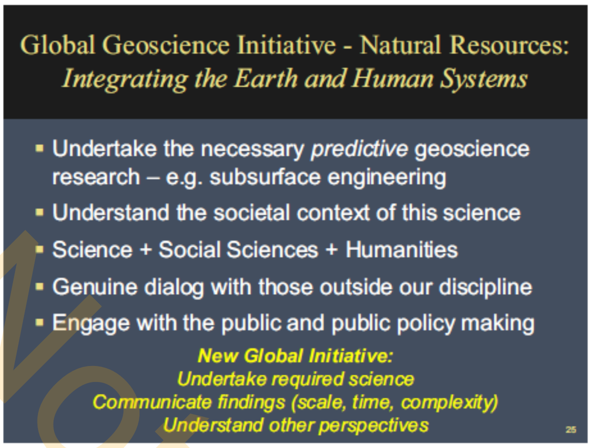
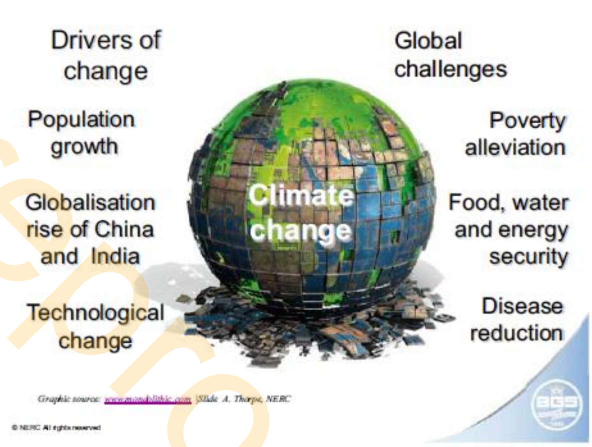
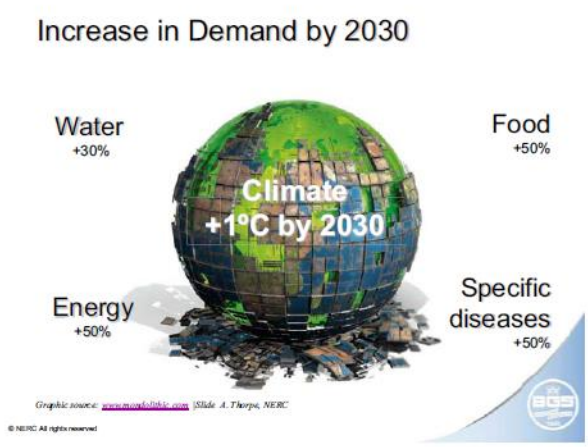
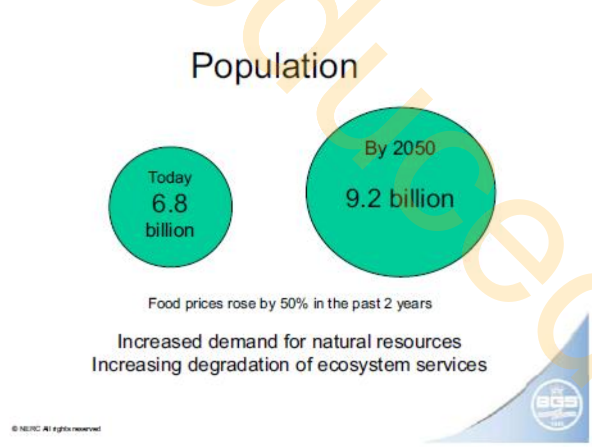
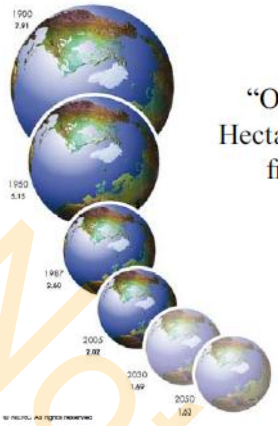


3) **John Ludden (Executive Director, British Geological Survey) – *Applied Geosciences for Planet Earth***







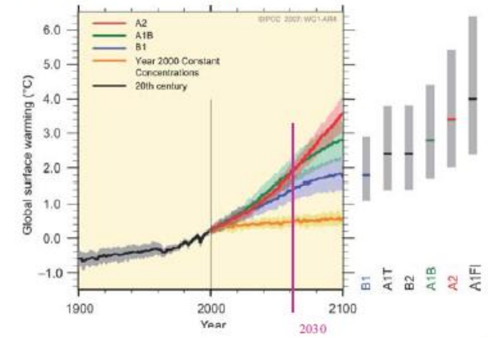


GEO-4 2007
"Our Shrinking Earth"
Hectares of land per person
from 1900 to 2050:
7.9 to 1.6*

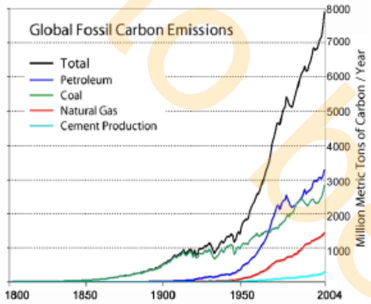
* = 128m x 128m = 4 acres

|Slide A. Thorpe, NERC

Projections of global warming

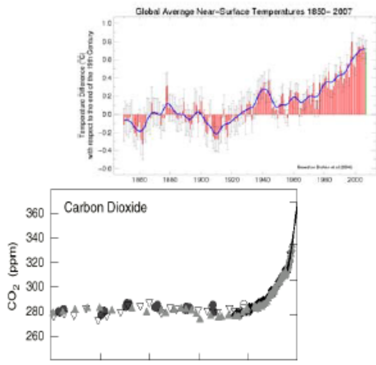


Global fossil carbon emissions



(US Department of Energy)

Climate trends and CO2 concentrations



Energy

~60% of CO2 comes from energy production

•World energy demand >50% increase by 2030

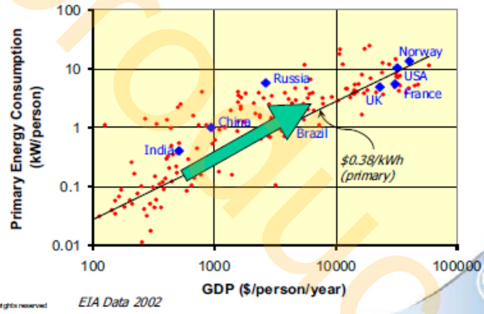
•China and India will account for half the increase

•The Mix will remain coal and gas, nuclear and renewables

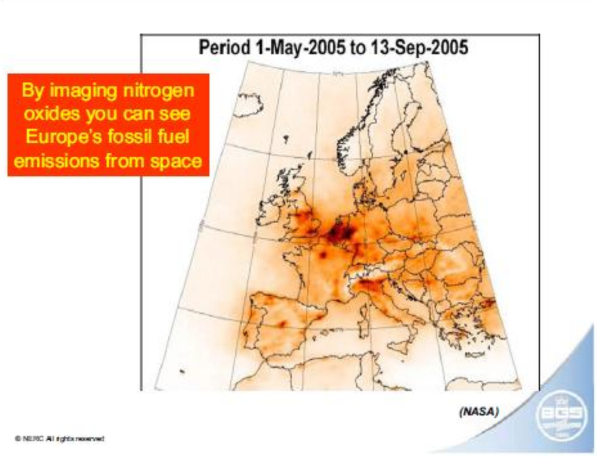
•One quarter of humanity has no access to electricity

•One third rely on traditional biomass for cooking and heating

Energy, Wealth, Economic Growth



EIA Data 2002


Period 1-May-2005 to 13-Sep-2005
By imaging nitrogen oxides you can see Europe's fossil fuel emissions from space
(NASA)
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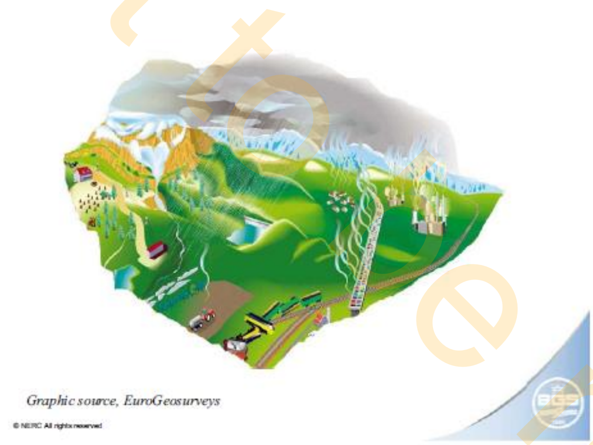
Graphic source, EuroGeosurveys
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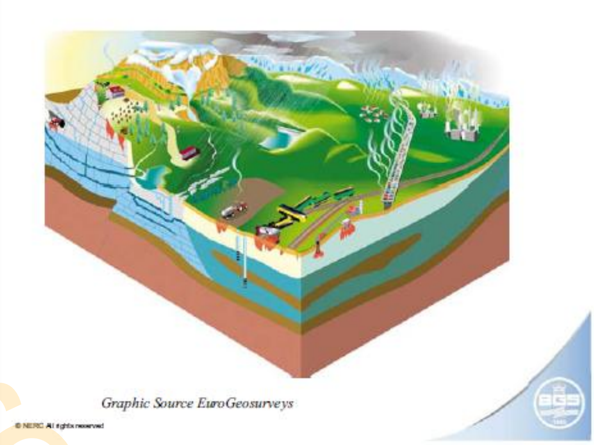
Graphic Source EuroGeosurveys
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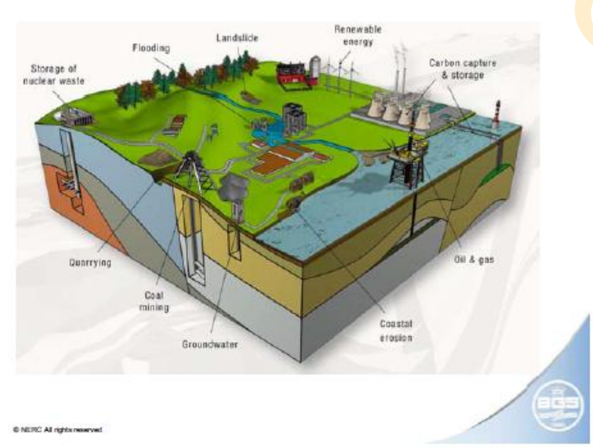
Storage of nuclear waste
Flooding
Landslide
Renewable energy
Carbon capture & storage
Quarrying
Coal mining
Groundwater
Coastal erosion
Oil & gas
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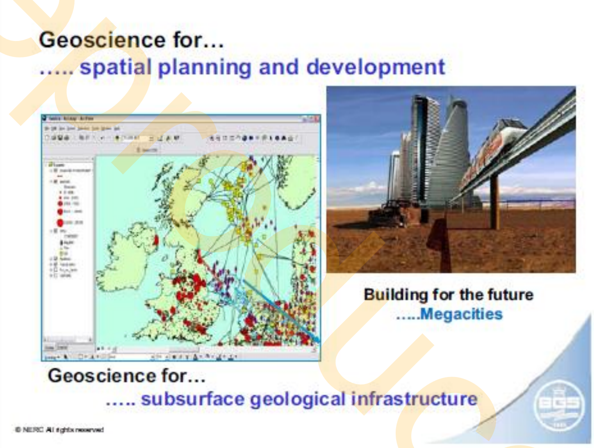
Geoscience for…
….. spatial planning and development
Building for the future
…..Megacities
Geoscience for…
….. subsurface geological infrastructure
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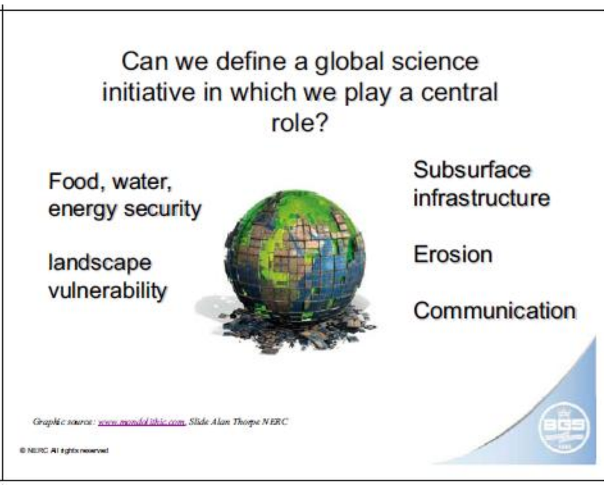


Discussion

In an hour long discussion following the three presentations, during which approximately 20 people were present representing a cross section of employment sectors and age, no one said that we should not be pursuing this initiative.

Points made include:

- Globally the challenge is the interface of food, water, and energy security.
- Is there a global geoscientific project which would command public interest?
- The challenge is adapting to and mitigating environmental change in a resource poor future coupled with sustainability.
- How can the geosciences be brought into the development of policy and to the attention of government?
- Prediction depends on integrated science.
- We will need to work with social scientists in communicating the message and in identifying socially acceptable action.
- Hazards attract attention but what is the excitement in earth observation? 3-D modelling of the Earth through time provides a challenge of scale – kilometres to nanometres.
- Remote sensing techniques can be linked to monitoring and sustainability.
- Can this initiative be grouped around 'spaceship earth' – a journey or 'mission earth' – make the earth a better place to live on. What are the indicators of quality? Reference this and say for example – "This is the best place for this desired human activity".
- In terms of status how do we move away from conspicuous consumption as an indicator? What is the role of the citizen – can we identify a topic which is engaging – citizen science as an observer, reporter of change?

- On oceans and atmosphere, what has been done and what remains to do? Food, water and energy security will be pressing topics over the next forty years. What do the public understand about long-term sustainability?
- Potential focus of an initiative might be fluids in the subsurface or the use of the geosphere.

Specific issues are:

- Population growth,
- Communication,
- Difficulties of getting academics aligned in their priorities,
- Initiating measures of public engagement, and
- Involving the public in observational experiments – citizen science.

Edmund Nickless and P. Patrick Leahy

06 January 2010

AGU Town Hall Meeting: Thursday 17 December 2009 at 7:00 pm – 8:00 pm, Moscone West, Room 2004, San Francisco, California

Chairs:

Edmund Nickless (Geological Society of London) and Pat Leahy (American Geological Institute)

Speakers:

Donald J. Depaolo, (Director, Earth Sciences Division, University of California/Lawrence Berkeley National Laboratory); Mark D. Zoback, (Benjamin M. Page Professor of Earth Science and Professor of Geophysics, Stanford University); Marcia K. McNutt, (Director, US Geological Survey)

Presentations:

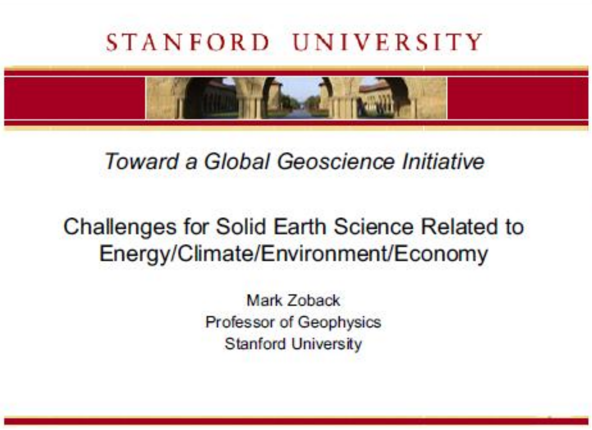
Presentations can be viewed online at: http://www.agiweb.org/members/presentations/index.html

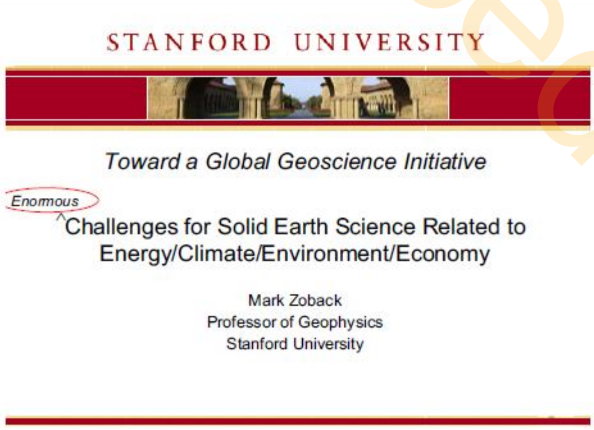
1) ***Donald J. Depaolo, (Director, Earth Sciences Division, University of California/Lawrence Berkeley National Laboratory) – The Grand Research Questions in the Solid-Earth Science***

Dr. Depaolo summarized a report from a review group of the US National Research Council which he had chaired. His presentation discussed ten research questions that need to be addressed by the geoscience community and covered topics as diverse as the origin of Earth to climate dynamics. The presentation provided an outstanding overview of major research questions all of which are certainly global in nature.

2) ***Mark D. Zoback, (Benjamin M. Page Professor of Earth Science and Professor of Geophysics, Stanford University) – Scientific Challenges Related to Energy and the Environment***

The major thrust of Dr. Zoback's presentation dealt with maintaining the demand for energy while at the same time reducing climate change specifically carbon emissions. He presented an analysis of what could be expected if the energy mix changed relative to carbon capture and storage, the migration to an increase in natural gas and nuclear power, and practical view of the geologic, societal and economic constraints to these changes.





STANFORD UNIVERSITY

Toward a Global Geoscience Initiative

Important

Challenges for Solid Earth Science Related to Energy/Climate/Environment/Economy

Mark Zoback
Professor of Geophysics
Stanford University

STANFORD UNIVERSITY

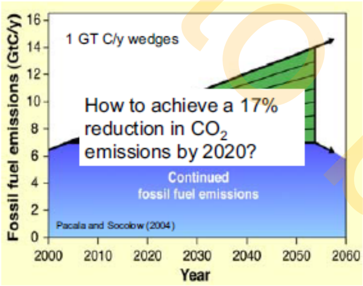
Toward a Global Geoscience Initiative

Immediate

Challenges for Solid Earth Science Related to Energy/Climate/Environment/Economy

Mark Zoback
Professor of Geophysics
Stanford University

Strategies for Stabilizing CO_2 Emissions by Mid-Century



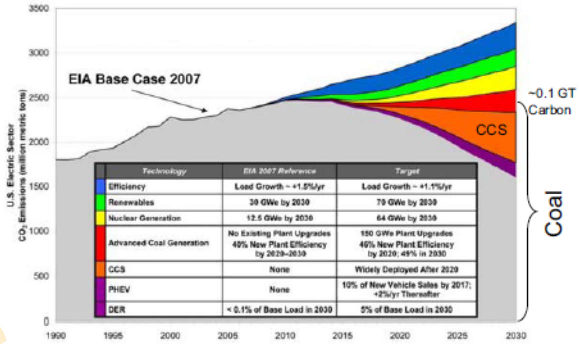
Potential Wedge #6 - CO_2 Capture and Storage (CCS) from coal baseload power generation

Potential Wedge #9 - Use Nuclear to replace coal baseload power

Potential Wedge #5 - Use Gas to replace coal baseload power

To contribute to stabilization of atmospheric greenhouse gas, each wedge must operate at a scale of ~ 1 GT C/y

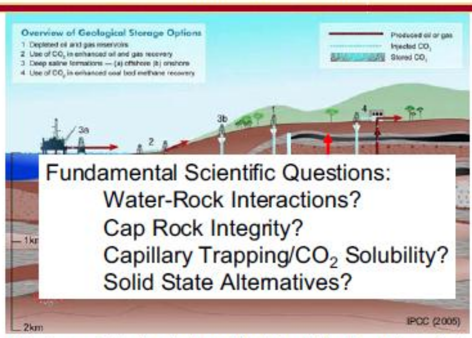
Coal/Nuclear/CCS Scenario



Technology	EIA 2007 Reference	Target
Efficiency	Load Growth ~ +1.5%/yr	Load Growth ~ +1.1%/yr
Renewables	30 GWe by 2030	70 GWe by 2030
Nuclear Generation	12.5 GWe by 2030	64 GWe by 2030
Advanced Coal Generation	No Existing Plant Upgrades 40% New Plant Efficiency by 2020–2030	150 GWe Plant Upgrades 46% New Plant Efficiency by 2020; 49% in 2030
CCS	None	Widely Deployed After 2020
PHEV	None	10% of New Vehicle Sales by 2017; +2%/yr Thereafter
DER	< 0.1% of Base Load in 2030	5% of Base Load in 2030

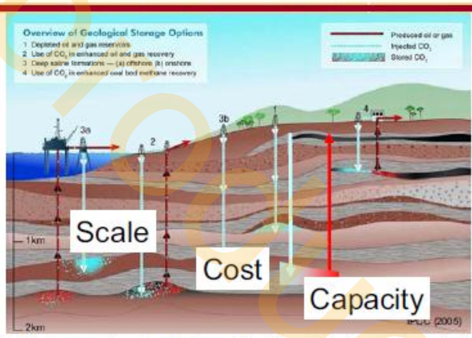
Source: EPRI, The Power to Reduce CO_2 Emissions, 2007

CO_2 Capture and Storage



If CO_2 Sequestration is going to contribute to stabilization of atmospheric greenhouse gas, it must operate at a scale of ~ 1 GT C/y

CO_2 Capture and Storage

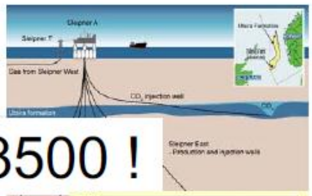


If CO_2 Sequestration is going to contribute to stabilization of atmospheric greenhouse gas, it must operate at a scale of ~ 1 GT C/y

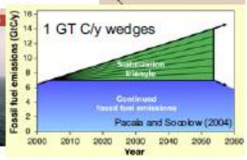
Mass of CO_2 in CCS ≈ Oil Production

Why Not Just Do It?

- 1996 to present
- 1 Mt CO_2 injection/yr
- Seismic monitoring



X 3500 !



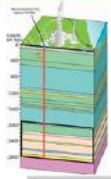
Capacity and Cost?

AEP Mountaineer Project: New Haven, WV

NY Times Sept. 21, 2009

Current Plans to Inject 100 ktons/y for 2-5 years

AEP Mountaineer Project: New Haven, WV



183 Coal burning plants in Ohio River Valley (emitting 700 Megatons of CO_2/year)

AEP Mountaineer CO_2 Emissions ~7 Mton/year limited to ~ 35 kton/year per injection zone - 200 injection zones required!

Lucier and Zoback (2008)

Cost

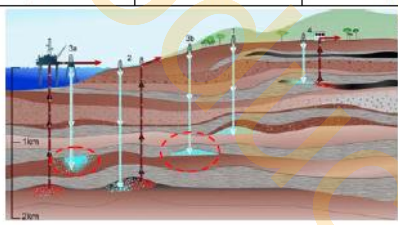
- Energy penalty: 10 to 30%
- Cost
  - \$50 to \$100/tonne CO_2 for the n^{th} plant
  - Significantly more for the 1st plants (\$150 to \$250/tonne CO_2)
  - Cost of electricity generation: 50 to 100% increase
- Uncertain reliability

Courtesy Sally Benson

Revisiting Overly Optimistic World Wide Capacity Estimates

Reservoir Type	Lower Estimate of Global Storage Capacity ($GtCO_2$)	Upper Estimate of Global Storage Capacity ($GtCO_2$)
Oil and gas fields	675	900
Coal seams (ECBM)	3–15	200
Saline aquifers	1000	~ 10,000

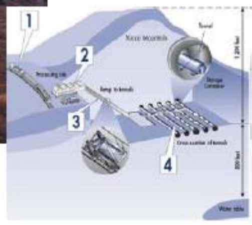
IPCC, 2005



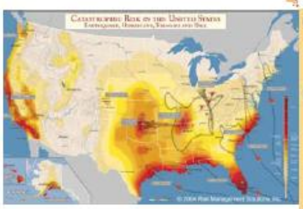
50 New Nuclear Power Plants by 2030?

Licensing Will be a Formidable Task that Will Take Effort and Time

Waste Disposal After Yucca Mountain?



Surface Waste Storage and Other Natural Hazards



Fuel Switching to Reduce CO_2 Emissions

Natural Gas Produces Half the CO_2 per BTU

Current Gas Power Electrical Generation Capacity 400 GW

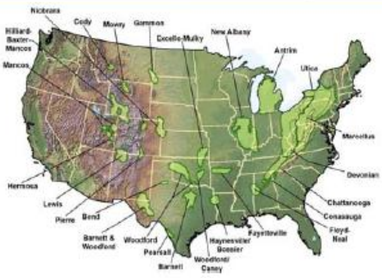
Current Average Utilization ~20%

To Meet CO_2 Reduction Targets for 2020, Need to Increase Utilization of Existing Plants to ~40%

(Could Also Replace Oldest and Least Efficient Coal Plants with Combined-Cycle Gas Plants)

Combined-Cycle Gas Plant

Unconventional Gas Resources

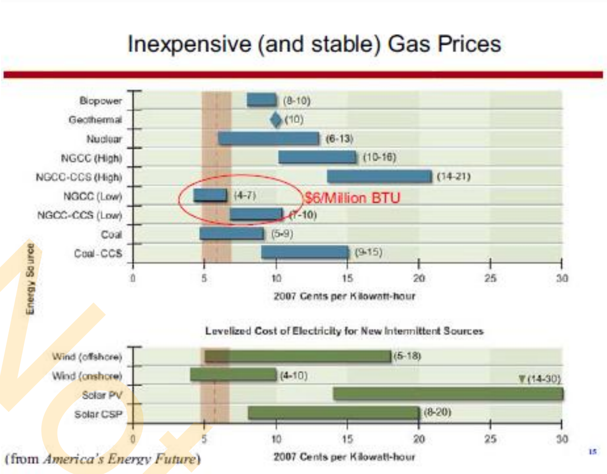


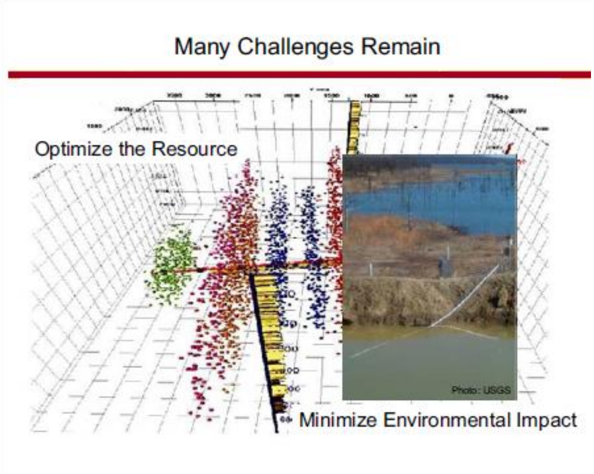
2009 Estimates of Gas Resources Over 2000 TCF
~100 Years at Current Consumption

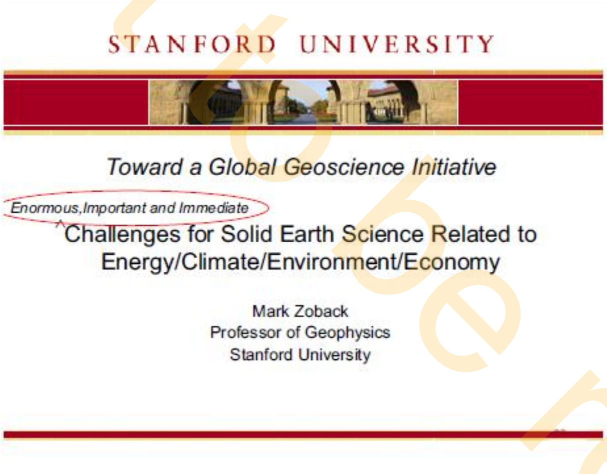
Global Potential for Shale Gas

World Total: 32,560 tcf
roughly 300 years of supply

MITei
MIT Energy Initiative

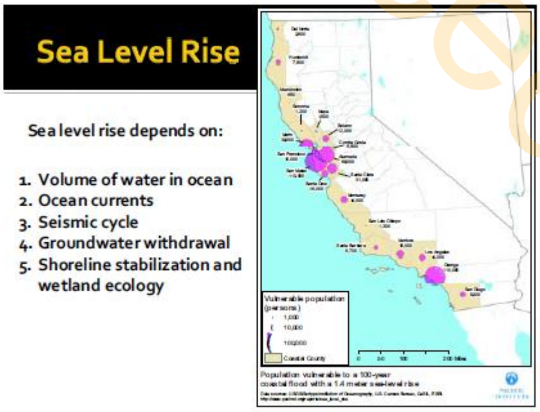


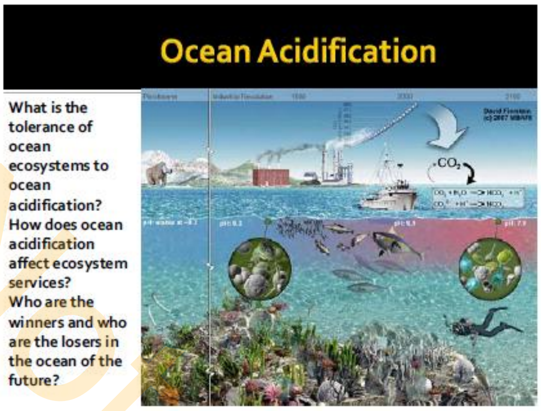


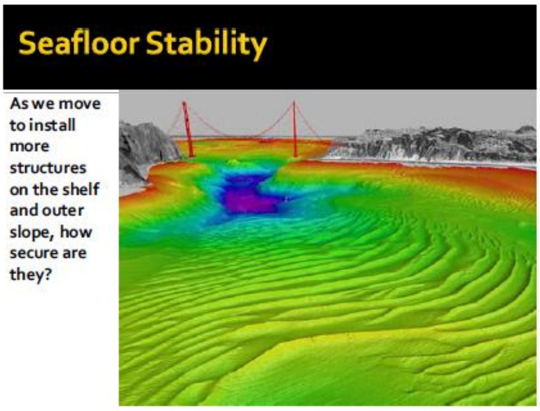


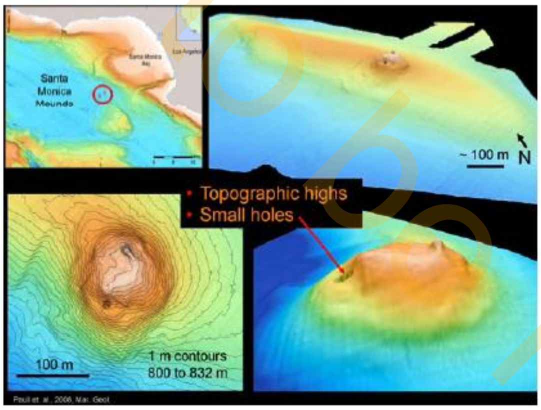
3) Marcia K. McNutt, (Director, US Geological Survey) – Challenges and Opportunities for Research in the Oceans

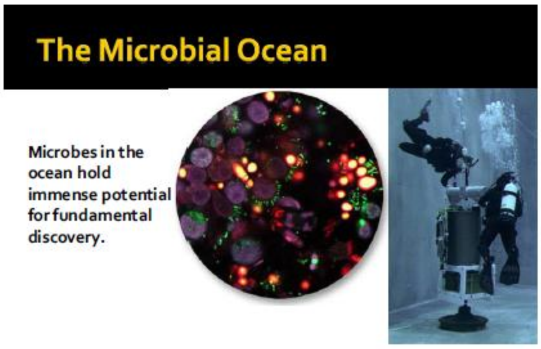
Dr. McNutt highlighted some the issues and challenges associated with developing infrastructure and the stability in near-shore environments, sea-level rise associated with both climate change and other causes, the potential impacts of ocean acidification, and the opportunities for scientific breakthroughs associated with microbial communities in the oceans.











Discussion

The presentations were followed by an open discussion of potential global geoscience initiatives that included topical areas as well as issues associated with the conduct of global research efforts. A concern was that the geoscience community is fractured but what we understand about Earth history and processes is highly relevant to the resolution of a number of issues facing society. The challenge was to identify a topic or topics that would command the broad support of the geoscience community, be multidisciplinary and link with other scientific disciplines. The audience of about two dozen individuals represented an array of interests and included a number of individuals representing the international perspective.

In a wide ranging discussion the following main points were made:

- Should a global initiative should be promoted along outstanding scientific questions or aligned with major societal issues?
- Does the initiative need to be global in scope of observation or can global teams of scientists work together in an appropriate setting? A topical subject is carbon sequestration. Currently

research efforts are thought to be fragmented. Perhaps a global effort would be desirable given the magnitude of the effort that is needed and given the diversity of geologic environments globally?

- Open data access was identified as an impediment that must be overcome to ensure global cooperation.
- One commentator identified the pace of change relative to research agendas as a concern. Global geoscience institutions may not be nimble enough to set priorities quickly and to implement and encourage global cooperation.
- The engagement of younger geoscientists was identified as a challenge. The recent Young-Earth Scientists Congress was seen as a fledging effort to address this concern.
- There was concern that we are not using technology (e.g. Web 2, Web3, etc.) effectively to encourage global allegiances or to broaden the dialogue concerning geoscience initiatives.
- One individual noted that the quality of leadership dialogue at the Copenhagen Climate Summit demonstrated the need for greater effort by geoscientists to educate and inform the public more effectively. Given this continuing challenge, the prospects of developing a robust global geoscience initiative may be in doubt or at best difficult. Another suggestion was that a global information portal for the geosciences is needed. Such an effort would enhance a better dialogue between the geoscience community and the public.
- In moving forward there was an urgent need to improve dialogue with the public, identifying issues of concern with the geoscientific community providing perspective.

As a final discussion point, the audience was asked if anyone thought the idea of a global geoscience initiative was a bad idea. All thought the concept worthy of further and broader exploration though the issue of how to bring this initiative to closure is problematic.

Edmund Nickless and P. Patrick Leahy

06 January 2010

EGU Town Hall Meeting: Tuesday 4 May 2010 at 5:30 pm – 7:00 pm, Austria Center Vienna, Room D, Vienna, Austria

The third in a series on Town Hall meetings was held at the European Geoscience Union's (EGU) AGM in Vienna on the 4th May 2010. The focus of the meeting was to discuss the topic that has been framed in various ways over the past year at GSA 2009, Fall AGU, 2009: "Do we need? How can we create? What should be a global geosciences initiative?"

This followed on from a movement spawned from the International Year of Planet Earth (IYPE) in which the board felt that the final year of IYPE could provide an opportunity for Earth scientists to crystallise the concept of "Global Geosciences Initiatives". Such initiatives would offer an opportunity across the planet for Earth scientists to address challenging pressing problems and would build a sense of community behind science initiatives that could then be funded through national international agencies.

Speakers:
Maarten de Wit (University of Cape Town); Slides prepared by Rui Pinho (GEM); Robert Missotten (UNESCO)

Presentations:
Presentations can be viewed online at: http://www.agiweb.org/members/presentations/index.html

1) ***Maarten de Wit (University of Cape Town) – Africa Alive Corrridors***

A network of 21 selected corridors across the length and breadth of Africa spell out its autobiography. Each, a belt of territory some 1-3,000 km in length and 50km in width, tells a chapter in the epic 4-billion-year story, and each draws the people of the region into co-curatorship.
The project invites all 900,000 Africans into interpreting and promoting the story of their continent. It is about the synergy between Africa and her people, past, present and future. In merging with the story of their continent and her people, all her people, gain dignity from the soul of the land—as they incorporate the prodigious diversity of all other species of life.
These corridors cover geological, economical and social issues of Africa and are focused on key targets. They offer an outstanding opportunity to focus science initiatives on world-class problems, to include the broader aspects of science and to reach out to young earth scientists in schools.
This project has considerable momentum in Africa and globally including through UNESCO and IYPE, and given the need to underpin the development of Africa science this was seen as a prime opportunity for global Earth science.

Africa Alive Corridors 'Townhall Meeting' - EGU, Vienna, May, 2010

Journeys through Africa's autobiography with everyone a stakeholder

Maarten de Wit - AEON, University of Cape Town, South Africa – maarten.dewit@uct.ac.za

Africa Alive Corridors

Journeys through Africa's autobiography with everyone a stakeholder

Africa, the world's heritage colossus

Africa is the heritage colossus amongst the continents of the world. It is here that we emerged step-by-step from the primate world over the past 10-million years, and from here—as *Homo sapiens*—that we colonised the world. All 7-billion humans alive today are one close-knit family, born on African soil less than 200,000 years ago. It is here that our earliest cultures, languages and technologies arose.

Africa is the geological hotspot of the world. The largest, best-preserved fragment of the Earth's earliest emerging continents, along with the earliest known life forms (micro-organisms), are found here. And the most prodigious mineral deposits anywhere are preserved here.

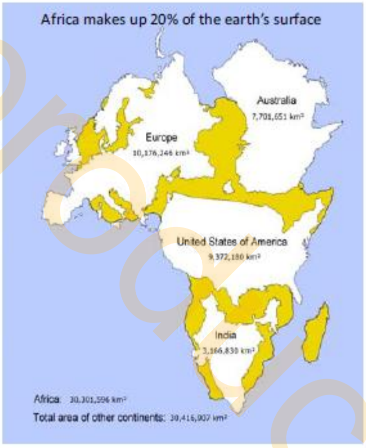
Africa is the biological hotspot of the world. The world's top terrestrial plant (Cape Fynbos) and animal biodiversity hotspots (tropical Africa) occur here. Of all the continents of our planet, only Africa still supports intact ecosystems with their diverse megafauna (herbivores and carnivores).

- **International Africa, by its people for its people**
- The people of Africa join in telling the autobiography of their continent. Together they write and celebrate their epic 4-billion-year story along 20 'Heritage Corridors'. The corridors—averaging 2,000 to 3,000 km in length—criss-cross the continent taking in all 53 nations (including Madagascar).
-
- Heritage Corridors are international, with most linking three or more countries. They embrace two tightly related concepts. Each is a chapter in the African autobiography: archived in its rocks, minerals, fossils, extant plants and animals, archaeological and historical sites, and its living pulsating cities and rural communities. And each is a focus for international, holistic, sustainable management by all for the enrichment of all.

- **But, place of greatest human suffering**
- In spite of standing unparalleled atop Earth's heritage podium, Africa's people suffer the greatest spectrum of ills anywhere. Considering the UN Millennium Goals, addressing poverty, hunger, education etc, Africans are in the deepest grip of suffering. This is the most astonishing irony!

The size of Africa alone tells of the enormous task that lies ahead…

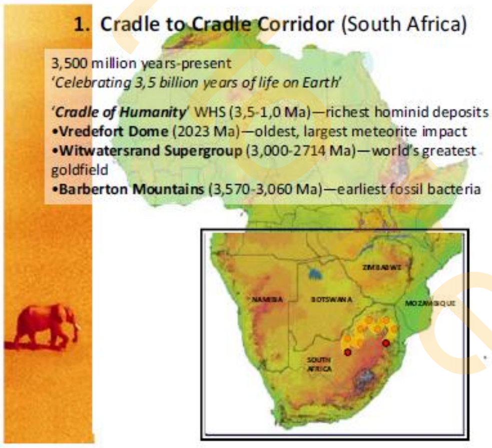
…..are we ready for this?

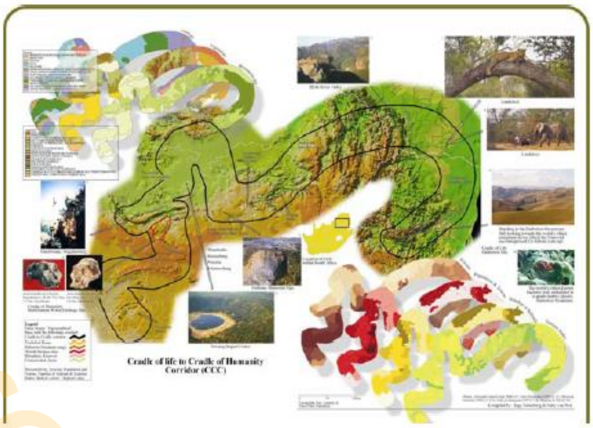


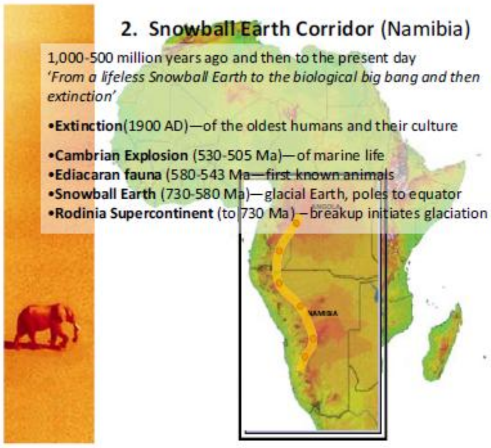
The 20 Heritage Corridors

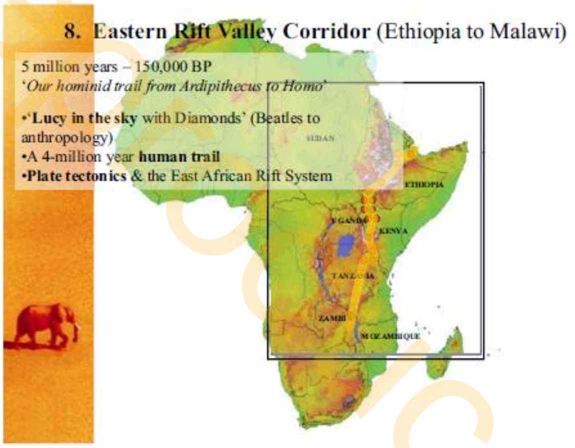
Here follows a selection of four of 20 proposed corridors to give a sense of their international character and of their unmatched place in the unfolding story of Africa, indeed of the Earth.

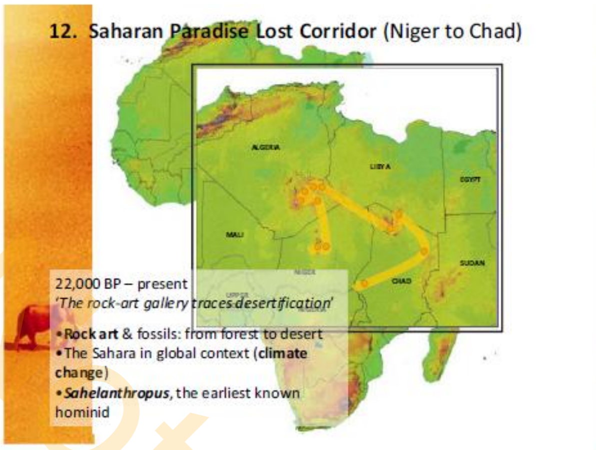
- **Prime Heritage Nodes**
- Each corridor includes 20 prime heritage nodes (World Heritage Sites, Biosphere Reserves, biodiversity hotspots, Geoparks etc): pages in the chapters of the African story. The nodes might be seen as a string of pearls, each a priceless treasure.

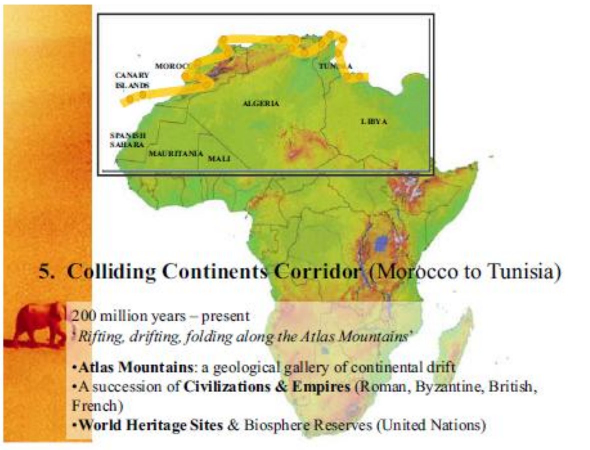


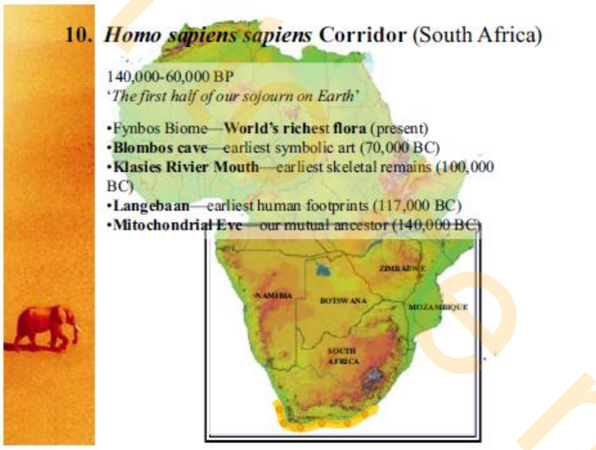







12. Saharan Paradise Lost Corridor (Niger to Chad)
ALGERIA
LIBYA
EGYPT
MALI
SUDAN
CHAD
22,000 BP – present
'The rock-art gallery traces desertification'
•Rock art & fossils: from forest to desert
•The Sahara in global context (climate change)
•Sahelanthropus, the earliest known hominid


CANARY ISLANDS
ALGERIA
LIBYA
SPANISH SAHARA
MAURITANIA
MALI
5. Colliding Continents Corridor (Morocco to Tunisia)
200 million years – present
'Rifting, drifting, folding along the Atlas Mountains'
•Atlas Mountains: a geological gallery of continental drift
•A succession of Civilizations & Empires (Roman, Byzantine, British, French)
•World Heritage Sites & Biosphere Reserves (United Nations)


10. Homo sapiens sapiens Corridor (South Africa)
140,000-60,000 BP
'The first half of our sojourn on Earth'
•Fynbos Biome—World's richest flora (present)
•Blombos cave—earliest symbolic art (70,000 BC)
•Klasies Rivier Mouth—earliest skeletal remains (100,000 BC)
•Langebaan—earliest human footprints (117,000 BC)
•Mitochondrial Eve—our mutual ancestor (140,000 BC)
ZIMBABWE
NAMIBIA
BOTSWANA
MOZAMBIQUE
SOUTH AFRICA


AEON's Imizila – finding a new way forward
IMIZILA AFRICA ALIVE
Earth Alive!
AEON has developed a new strategic board game - Imizila - for sustainable development along 21 geo-bio-cultural corridors across Africa (Africa Alive Corridors program). Imizila ('finding a new way forward') consists of a holistic set of 101 strategies aimed at stimulating debate seeking this path into a safer, kinder future. Teams of scholars—together with parents, teachers and others—play the game at workshops and at home. Imizila seeks togetherness; Ubuntu!
Imizila was introduced to the Africa-wide community in Arusha, Tanzania, at the Africa launch of IYPE (International Year of Planet Earth), in April 2008. The director of AEON and two AEON associate members took 10 young learners from South Africa to play the board game during the IYPE Africa discussions. The 10 selected South African learners met and challenged 10 Tanzanian counterparts in an exploratory IYPE competition. The game drew lots of attention, including participation by H.E. Mr Jakaya Mrisho Kikwete, President of Tanzania, and is presently being adopted, through AAC by UNESCO for further development


Africa Alive Corridors [strategic game] live-competition Arusha

What since Lisbon?

Corridor Themes – experience a unique chapter of Africa's Autobiography

- Timelines & time capsules
- Continent Adrift
- Rock-systems and Landscapes
- Fossils and the deep history of life
- Flora, fauna, biodiversity & ecosystems
- Our human roots
- Culture and spirituality
- Climate change, footprints and 6th extinction
- Mega-hazards and their impacts

Corridor Content

- Each corridor has a team assigned
  - Script Team
    - Story and timelines
    - Specific themed focus
  - Production Team
    - Creating usable content
    - Graphic design
    - Outputs include timeline assets, posters, cards and themed booklets
  - Post Production Choreography Team
    - Real adventures & survival tours -Tourism Content Packages; DVD & virtual tours

Corridor Packs - Cards

- Tells the story of each corridor
- Collectors Cards – high quality
- Game Play possibilities

Tourism Options – Self Drive

- Content is collated and moulded for use by tourists
- Loaded onto GPS based navigator (e.g. Garmin Nuvi).
- Advantages:
  - Delivery of information specific to current location
  - Data storage capacity can provide audio, video and photo streams (no need to download)
  - GPS device is a guide, giving tourists options of destinations and plotting their course for them and signposts:
    - Tourism services
    - Attractions
    - Accommodation
    - Experienced guides
    - Experts
    - Local flavour

Card Examples

Custom Collectors Box

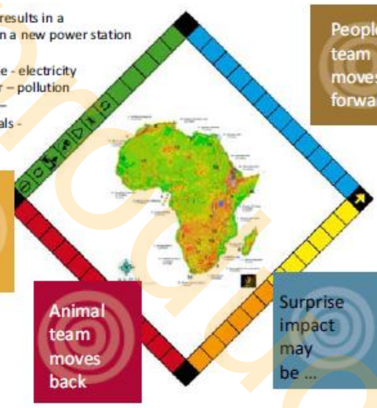
Lid Design

The Game

- Easy to play - Fast and Fun
- Can be played on a board
- Can be played on a field
- Can be played by a few at home
- Can be played by an entire school
- Can be played at a conference
- Can be played virtualized - web and mobile
- Contains the best of the current Imizila
- Corridors can compete with each other...

1. Challenge results in a team putting in a new power station
1. Impact
   - People - electricity
   - Water – pollution
   - Birds –
   - Animals -

People team moves forward

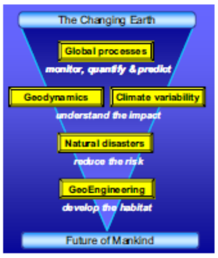


Water team moves back

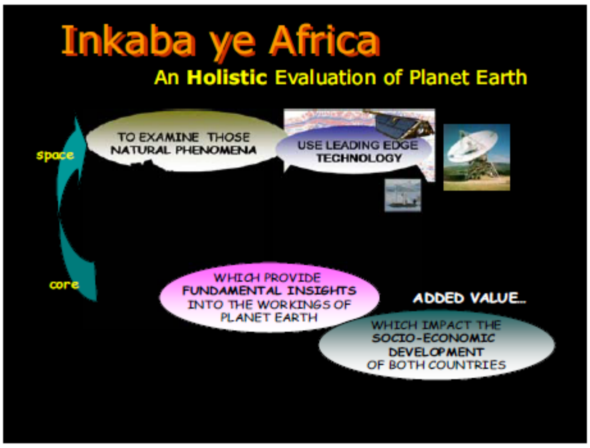
Animal team moves back

Surprise impact may be ...

Geosystem: the changing Earth

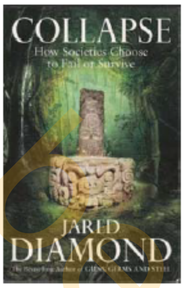


A brave new world



Jared Diamond identified what he considered to be the 12 most serious environmental problems facing past (and future) societies, problems that often have led to the collapse of historical societies:

1) Loss of habitat and ecosystem services,
2) Overfishing,
3) Loss of biodiversity,
4) Soil erosion and degradation,
5) Energy limits,
6) Freshwater limits,
7) Photosynthetic capacity limits,
8) Toxic chemicals,
9) Alien species introductions,
10) Climate change,
11) Population growth, and
12) Human consumption levels.



More importantly, Diamond, and several other authors before him emphasized that **the interplay of multiple factors is almost always more critical than any single factor. Systems that lose resilience are vulnerable to shocks from several sources.**

In a full world context, what is "the economy" and what is it for?

Gund Institute for Ecological Economics, University of Vermont

2nd most cited article in the last 10 years in the Ecology/Environment area according to the ISI Web of Science.

NATURE |VOL 387 | 15 MAY 1997 253

Article

The value of the world's ecosystem services and natural capital

Robert Costanza, Ralph d'Arge, Rudolf de Groot, Stephen Farber, Monica Grasso, Bruce Hannon, Karin Limburg, Shahid Naeem, Robert V. O'Neill, Jose Paruelo, Robert G. Raskin, Paul Sutton & Marjan van den Belt

The services of ecological systems and the natural capital stocks that produce them are critical to the functioning of the Earth's life-support system. They contribute to human welfare, both directly and indirectly, and therefore represent part of the total economic value of the planet. We have estimated the current economic value of 17 ecosystem services for 16 biomes, based on published studies and a few original calculations. For the entire biosphere, the value (most of which is outside the market) is estimated to be in the range of US$16–54 trillion ($10^{12}$) per year, with an average of US$33trillion per year. Because of the nature of the uncertainties, this must be considered a minimum estimate. Global gross national product total is around US$18 trillion per year.

Ecosystem services are the benefits humans derive from ecosystem functioning

ECOSYSTEM SERVICES	ECOSYSTEM FUNCTIONS
Gas regulation	Regulation of atmospheric chemical composition.
Climate regulation	Regulation of global temperature, precipitation, and other biologically mediated climatic processes at global, regional, or local levels.
Disturbance regulation	Capacitance, damping and integrity of ecosystem response to environmental fluctuations.
Water regulation	Regulation of hydrological flows.
Water supply	Storage and retention of water.
Erosion control and sediment retention	Retention of soil within an ecosystem.
Soil formation	Soil formation processes.
Nutrient cycling	Storage, internal cycling, processing, and acquisition of nutrients.
Waste treatment	Recovery of mobile nutrients and removal or breakdown of excess or xenic nutrients and compounds.
Pollination	Movement of floral gametes.
Biological control	Trophic-dynamic regulations of populations.
Refugia	Habitat for resident and transient populations.
Food production	That portion of gross primary production extractable as food.
Raw materials	That portion of gross primary production extractable as raw materials.
Genetic resources	Sources of unique biological materials and products.
Recreation	Providing opportunities for recreational activities.
Cultural	Providing opportunities for non-commercial uses.

From: Costanza, R. R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, S. Naeem, K. Limburg, J. Paruelo, R.V. O'Neill, R. Raskin, P. Sutton, and M. van den Belt. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387:253-260

2) ***Slides prepared by Rui Pinho (GEM) – The GEM Project: Towards a Global Earthquake Model***

GEM is a public/private partnership initiated and approved by the Global Science Forum of the Organisation for Economic Co-operation and Development (OECD-GSF). GEM aims to establish a uniform, independent standard to calculate and communicate earthquake risk worldwide. With committed backing from academia, governments, and industry, GEM will contribute to achieving profound, lasting reductions in earthquake risk worldwide.

GEM will be a critical instrument to support decisions and actions that help to reduce earthquake losses worldwide. All who face risk, from homeowners to governments, need accurate and transparent risk information before they will take mitigating action. By providing the information in a manner that is understandable to all users, GEM aims to raise awareness, lead to adoption and enforcement of building codes, promote seismic mitigation, and stimulate insurance use.

GEM will be the first global, open and dynamic model for seismic risk assessment at a national and regional scale, and aims to achieve broad scientific participation and independence. It will be conducted in three integrated modules: Hazard, Risk, and Socio-Economic Impact.

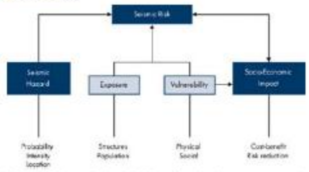
GLOBAL INVOLVEMENT

The construction of the Global Earthquake Model is a cooperative public-private endeavour, and GEM is therefore structured as a partnership among country governments (f.e. Singapore, Switzerland and Italy), private organisations, research institutions, international organisations f.e. World Bank, UN/ISDR, UNESCO, OECD) global risk initiatives, NGOs and individuals.

Experts and institutions across the entire globe are involved in GEM

BUILDING GEM

The GEM scientific framework serves as the underlying basis for constructing the model, and is organised in three principal integrated modules:



- The **hazard module** will calculate harmonised probabilities of earthquake occurrence and resulting shaking at any given location.
- The **risk module** will calculate damage and direct losses resulting from this damage such as fatalities, injuries and cost of repair. Damage due to strong ground shaking is calculated by combining building vulnerability, population vulnerability and exposure. GEM will furthermore develop remote-sensing and crowd-data collection techniques to classify, monitor and regularly update building inventory and thus regional vulnerability.
- The **socio-economic impact module** will provide tools and indices to both estimate and communicate the impact from earthquakes on the economy and society; in particular on indirect losses. For example the impact on a company's revenue, on budgets, or on poverty. The module will allow for calculations of scenarios that enable cost/benefit analysis of mitigating actions, such as systematic building strengthening, and facilitate insurance and alternative risk transfer.

BUILDING GEM

It will take five years to build the first working global earthquake model and its accompanying software and tools. The work started in 2009 and at the end of 2013 the first version of a truly global and comprehensive earthquake model will be presented. The global earthquake model is constructed by means of various 'building blocks'. These components together ensure that a uniform and independent standard for global earthquake risk assessment will be established:

GEM1: A pilot project [1.1.2009-31.3.2010] to develop the initial model infrastructure and GEM's first preliminary products.

Global Components: The scientific modules of GEM that are developed at a global scale to provide standards, models, tools and data. Addressed by international consortia that respond to Requests for Proposals (RfPs) released periodically by the Scientific Board.

Regional Programmes: Independent projects that sign a cooperation agreement with GEM, agreeing to trial and test the standards and software from the global components, providing necessary feedback and data.

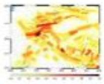
Executive Committee: Includes experts in hazard, risk, socio-economic impact, and IT. Coordinate the integration of output from the global components and regional programmes into the model.

GEM Model Facility: Assembles and maintains global and regional data, provides capability to compute, analyse and communicate global seismic hazard, risk and socio-economic impact estimates.

RESULTS

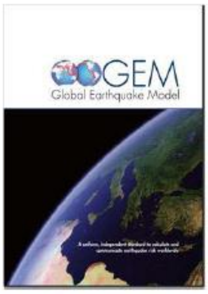
Promising progress has been made over the course of one year, due to the active participation and efforts of the entire GEM community:

- In June 2010 a blueprint of **GEM's Computational Infrastructure** (the OpenGEM system) will be ready, as well as preliminary (state-of-the-art) global hazard and risk maps, plus several exemplificative risk applications. Furthermore a worldwide inventory of existing regional hazard models and a number of global databases for risk will become available, and the results of a user needs assessment [see also next slide].
- The **Global Components** will establish a common set of definitions, standards, quality criteria and formats for the compilation of databases that are input to the model, and a first global compilation of relevant data. The work for the **Hazard Global Components** will start soon, proposals can be handed in until 18 March 2010 for the **Risk Global Components** and the roadmap for the **Socio-Economic Impact Global Components** will undergo public commenting in the spring of 2010.
- Several **Regional Programmes** have started (Europe, East Mediterranean/Middle East) and others are being defined at the moment in Africa, South America, South, South East, Central and North East Asia, to ensure that uniform standards are created, that detailed data goes into the model, that experts from all over the world are involved and that local capacity is built.



- The **GEM Model Infrastructure** is put in place as we speak. It is the organisational structure that brings together the technical input from GEM's Global Components and Regional Programmes with the IT capacity of GEM's Model Facility (MF), coordinated by the Executive Committee (a component of the GEM Secretariat) in order to develop an open source, dynamic, uniform, Global Earthquake Model.

FURTHER INFORMATION



GEM Outreach Meeting 2010 [1-4 June]
Interactive demonstrations and presentations of GEM's first products as proof-of-concept; overview of all the components that comprise GEM.

Website
www.globalquakemodel.org

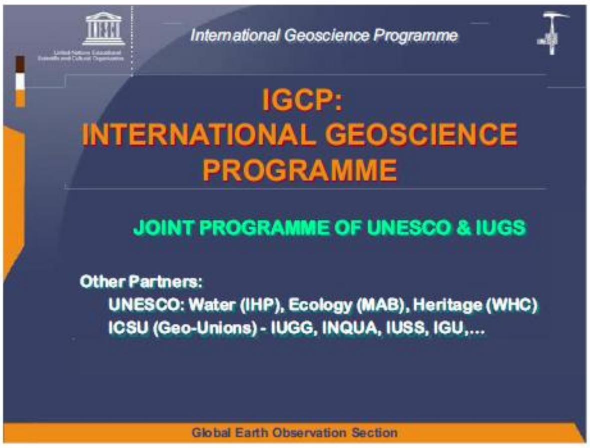
Booklet
- Available from website and in paper
- Updated version available from June 2010

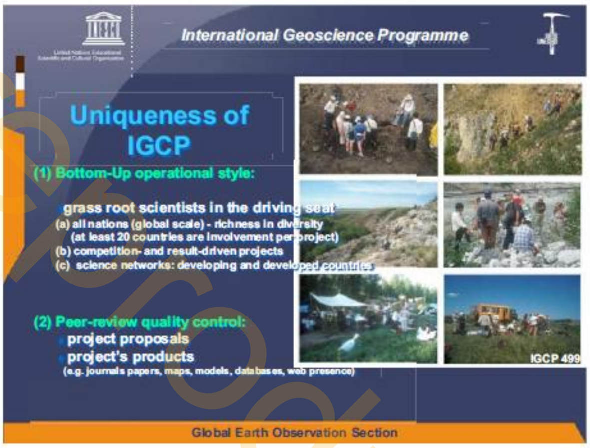
Bi-monthly e-Newsletter
Register online

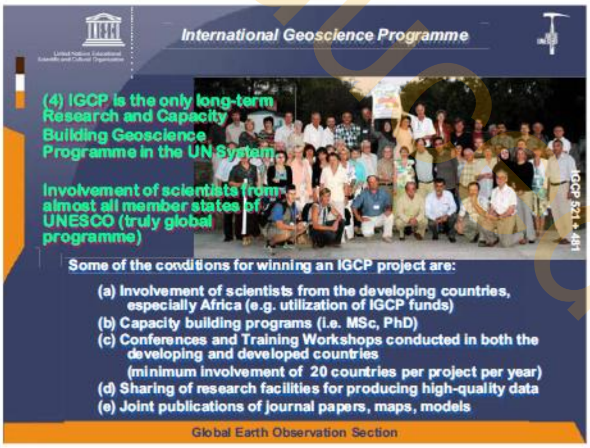
3) *Robert Missotten (UNESCO) – The UNESCO Earth science initiatives*

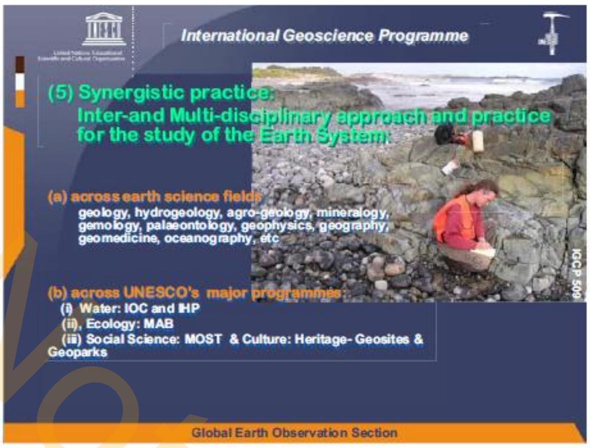
This involved a presentation of how UNESCO was focusing its science delivery through a more effective organisation and prioritisation of its science programme and the general evolution towards an international platform for development of global Earth sciences.

The talk from UNESCO provided an important focus for the discussion on what should be the next steps in the preparation and delivery of a Global Earth Science Initiative.



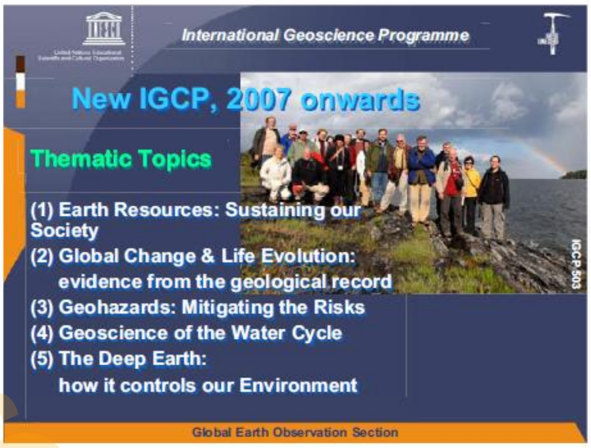




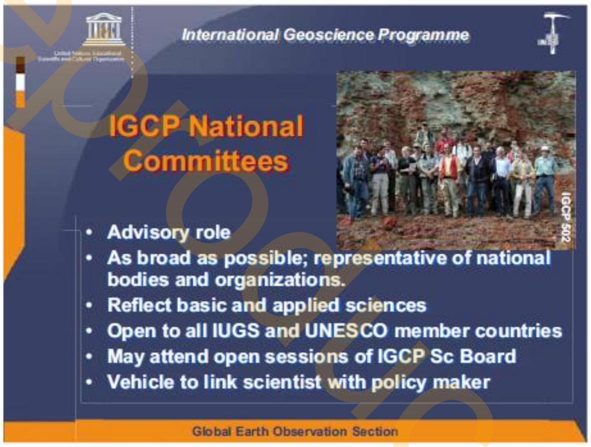

International Geoscience Programme
(5) Synergistic practice:
Inter-and Multi-disciplinary approach and practice for the study of the Earth System:
(a) across earth science fields
geology, hydrogeology, agro-geology, mineralogy, gemology, palaeontology, geophysics, geography, geomedicine, oceanography, etc
(b) across UNESCO's major programmes:
(i) Water: IOC and IHP
(ii), Ecology: MAB
(iii) Social Science: MOST & Culture: Heritage- Geosites & Geoparks
IGCP 509
Global Earth Observation Section


International Geoscience Programme
(5) Synergistic practice (cont)
(c) Landslides and Debris Flows (Global Programme), partners are:
IGCP 425- Landslide Hazards Assessment and Cultural Heritage
UNESCO's Cultural Heritage Division, IUGS
Japan (International Consortium on Landslides)
(d) Global Geochemical Database, IGCP & ICSU (Geo-Unions, e.g. INQUA, IUSS, IGU) & EU Envir Ag
(e) IGCP projects 404 & 459 on Carbon Cycle and Hydrology in the palaeo-terrestrial environment: IGCP and ICSU (Geo-Unions)
Climate, Environmental & Biodiversity Changes
(f) Creation of a International Research Center on Karst, Guilin, China as UNESCO Cat 2 institute
Global Earth Observation Section

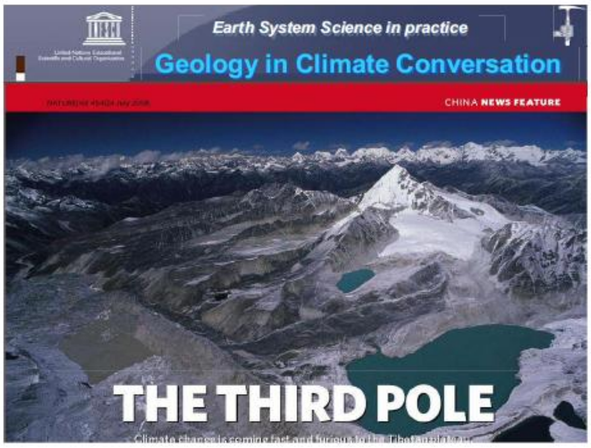

International Geoscience Programme
IGCP & the Developing World: long-term partnership
IGCP 490
Recorded Tangible Benefits for the African Countries and Other Developing Countries:
(1) Capacity Building
(2) Databases
(3) Development of new Earth Resources-large& small-scale operations
(4) Solving of Societal Problems- poverty reduction
(5) Science for the Development of national policies and economic growth plans
(6) African Diaspora: Involvement in IGCP projects
Global Earth Observation Section

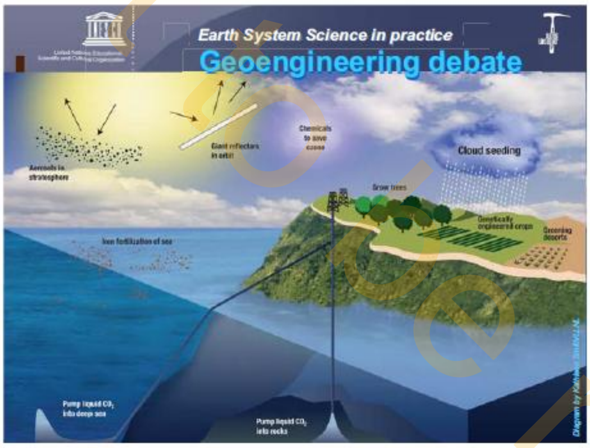

International Geoscience Programme
New IGCP, 2007 onwards
Thematic Topics
(1) Earth Resources: Sustaining our Society
(2) Global Change & Life Evolution: evidence from the geological record
(3) Geohazards: Mitigating the Risks
(4) Geoscience of the Water Cycle
(5) The Deep Earth: how it controls our Environment
IGCP 503
Global Earth Observation Section


International Geoscience Programme
Mandate and Functions of the IGCP Scientific Board
• Evaluate project proposals
• Quality assessment of projects in progress and finishing up
• 50 specialized individuals charged with technical reviews
• Chairperson, Theme Leaders within thematic clusters (members rotate every two years).
IGCP 470
Global Earth Observation Section


International Geoscience Programme
IGCP National Committees
• Advisory role
• As broad as possible; representative of national bodies and organizations.
• Reflect basic and applied sciences
• Open to all IUGS and UNESCO member countries
• May attend open sessions of IGCP Sc Board
• Vehicle to link scientist with policy maker
IGCP 502
Global Earth Observation Section

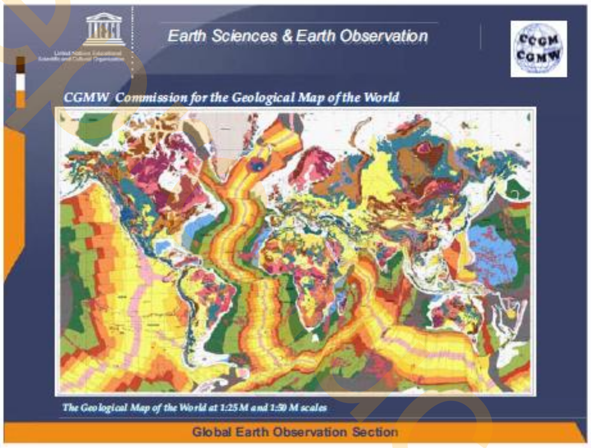

International Geoscience Programme
European IGCP Meeting
at the
Celebration of the 35th Anniversary
of the
Spanish IGCP National Committee
Caravaca, 15-18 September 2010
www.ugr.es/~mlamolda/congresos/geoevents/
Global Earth Observation Section


Earth System Science in practice
Geology in Climate Conversation
CHINA NEWS FEATURE
THE THIRD POLE

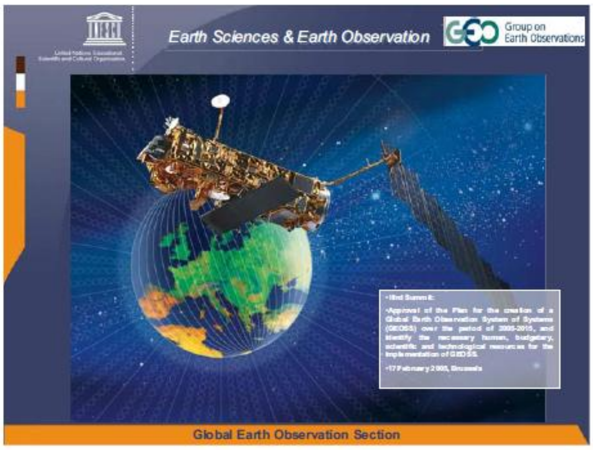

Earth System Science in practice
Geoengineering debate
Cloud seeding

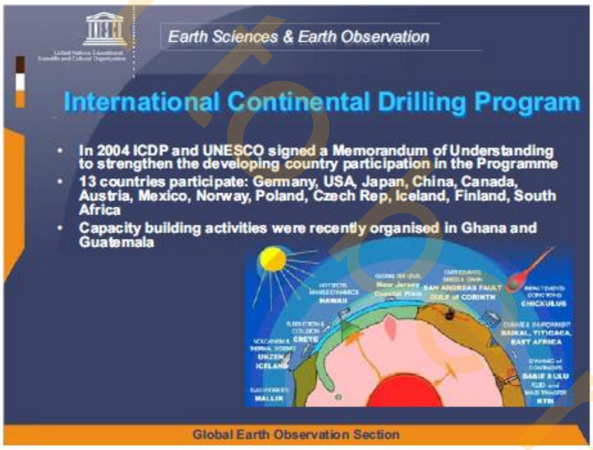

International Geoscience Programme
Joint Global Initiatives
Global Earth Observation Section

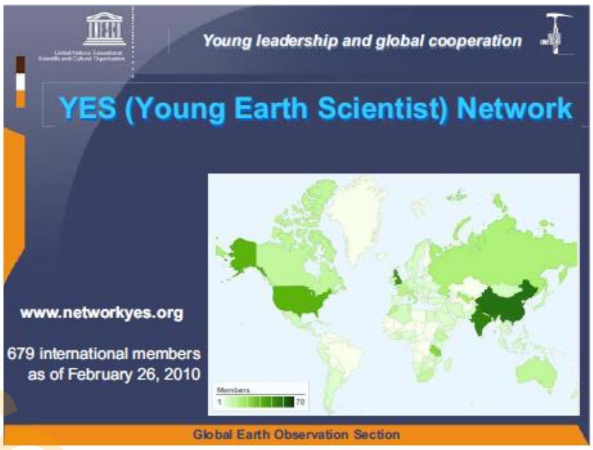

International Conference
TRANSBOUNDARY
AQUIFERS
Challenges and new directions
First announcement and Call for abstracts
6–8 December 2010
UNESCO, Paris (France)
Convened by
UNESCO IHP and IGCP Programmes,
IAH and UNEP


Earth Sciences & Earth Observation
CGMW Commission for the Geological Map of the World
The Geological Map of the World at 1:25 M and 1:50 M scales
Global Earth Observation Section


ONE-GEOLOGY PROJECT
A proposal to develop a global interoperable digital geological map data at 1:1 million scale as part of the IYPE
Global Earth Observation Section


Earth Sciences & Earth Observation
Group on Earth Observations
Global Earth Observation Section


Earth Sciences & Earth Observation
International Continental Drilling Program
• In 2004 ICDP and UNESCO signed a Memorandum of Understanding to strengthen the developing country participation in the Programme
• 13 countries participate: Germany, USA, Japan, China, Canada, Austria, Mexico, Norway, Poland, Czech Rep, Iceland, Finland, South Africa
• Capacity building activities were recently organised in Ghana and Guatemala
Global Earth Observation Section


Young leadership and global cooperation
YES (Young Earth Scientist) Network
www.networkyes.org
679 international members as of February 26, 2010
Global Earth Observation Section


International Education Partnerships
Earth science education initiative in Africa.
A New UNESCO Initiative
To support the development of the next generation of earth scientists in Africa who are equipped with the necessary tools, networks and perspectives to apply sound science to solving and benefiting from the challenges and opportunities of sustainable development.
Global Earth Observation Section


Earth Sciences & Earth Observation
GLOBAL GEOPARKS NETWORK
Preservation
Education
Development
Global Earth Observation Section

Discussion

Those attending the meeting included working Earth scientists, funding organisations, national associations and a large group from the YES (Young Earth Scientists) network.

- All think that the concept is worth pursuing
- The YES network intend to focus their attention on pushing this initiative within their structure
- Specifically the Africa Alive Corridor initiative was strongly supported and the thought was that this could be extended to other corridors on other continents or to continuations of the African Corridors to the adjacent continents
- UNESCO proposes to ensure that the development of the next generation of Earth scientists in Africa who are equipped with the necessary tools, networks and perspectives to apply sound science to solving and benefiting from the challenges and opportunities of sustainable development
- The underlying question at this and all other Townhall meetings has been:
    - How do we take this to the next step?
    - How do we find funding?
    - How do we continue to build momentum?
- The fact that UNESCO was represented was important as they have been instrumental in encouraging the fora to discuss a global initiative. UNESCO specifically asked those involved in the initiative to summarise that current level of support and define the scope and deliverable of a Global Geoscience Initiative. It was agreed that a draft paper summarising the steps taken, views expressed and identifying a number of possible themes which had attracted support at the various Townhall meetings would be prepared and widely circulated before being presented to UNESCO by the fall 2010.

John Ludden, Director of the British Geological Survey

16 July 2010

AGU Meeting of the Americas: Wednesday 11 August 2010, Iguassu Falls, Brazil

The fourth and final town hall meeting to discuss the desirability of a Global Geoscience Initiative was held at the American Geophysical Union (AGU) Meeting of the Americas, Foz do Iguassu, Brazil, on August 11, 2010. This meeting was sponsored by The Geological Society of America (GSA), The American Geological Institute (AGI), The Geological Society of London (GSL), and The British Geological Survey (BGS). The four town hall meetings were conducted under the auspices of the International Year of Planet Earth (IYPE) with support from UNESCO and the International Union of the Geological Sciences.

Speakers:

Michael McPhaden (American Geophysical Union); Alberto Riccardi (International Union of the Geological Sciences); Jaime Urrutia Fucugauchi (The World Academy of Science (TWAS), Mexico Chapter)

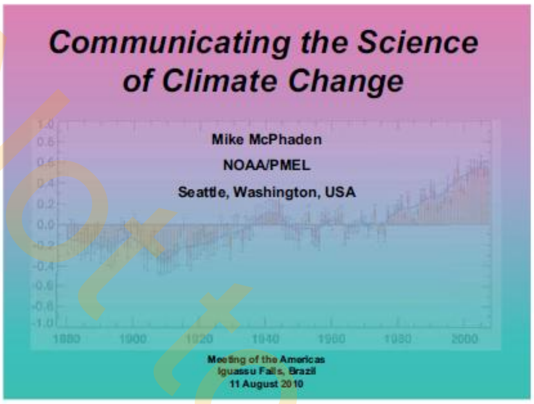
Presentations:

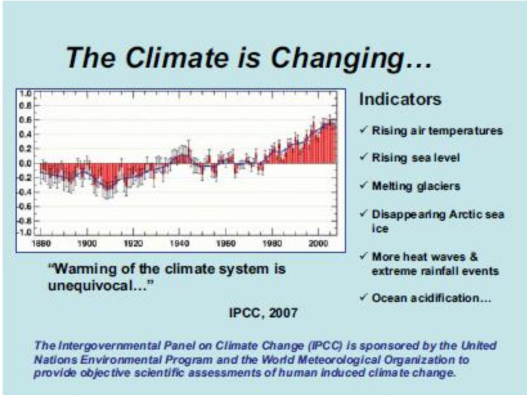
Presentations can be viewed online at: http://www.agiweb.org/members/presentations/index.html

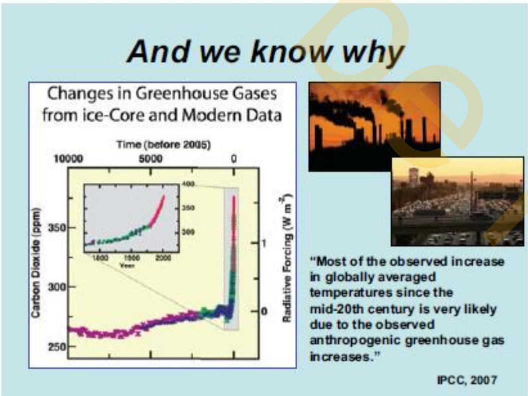
1) ***Michael McPhaden (American Geophysical Union) – Communicating the Science of Climatic Change***

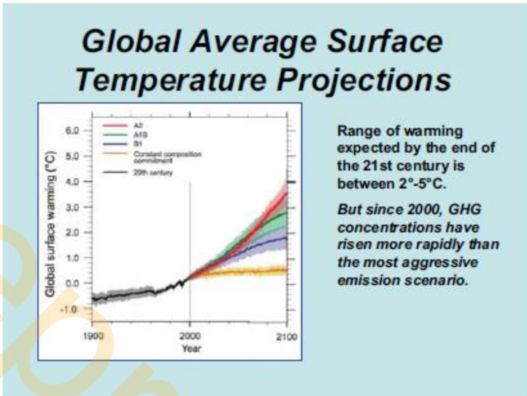
Michael McPhaden, President of the American Geophysical Union presented "Communicating the Science of Climatic Change." Dr. McPhaden pointed out that there are several grand challenges facing society in the 21st century that include not only climate change but also issues such as energy availability, sustainability, food security, infrastructure needs, division of wealth, and biodiversity. He emphasized that the findings of the Intergovernmental Panel on Climate Change stating that the warming of the climate are unequivocal. He reiterated the findings that the warming is carbon dioxide driven, pointed out a 2-5 degree Celsius warming is expected in the next century, recognized that sensitivity and the many feedback mechanisms are poorly understood but research is focused on reducing this uncertainty. Dr. McPhaden pointed out that although the scientific community is almost universally (96%)in agreement with the findings, only about 60 percent of the general public are in agreement with the findings. Recent polls show that this percentage is declining.

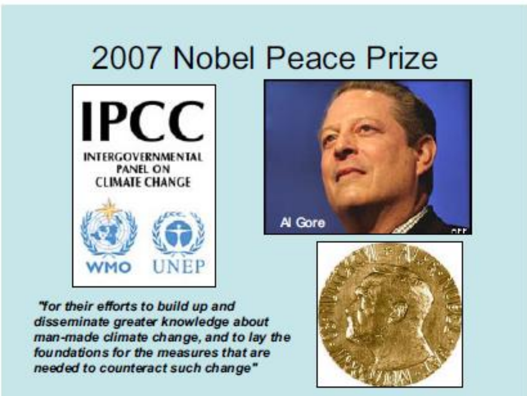
Dr. McPhaden identified several barriers to acceptance of the IPCC results including for example, complexity and uncertainty, economic costs of social change, and media portrayals. The challenge before the geoscience community is to communicate with the public more effectively in light of the various barriers. He mentioned the importance of the communication role of various professional and scientific societies in educating the public and policymakers especially in the context of climate change. He also pointed out that the use of scientists in the media, such as weatherman may be a key aspect of any communication effort. These individuals enjoy public trust but often are not fully informed concerning the science and in fact, about 27 percent of weathermen don't believe that there is global warming and 1/3 of those polled don't think there is consensus among the scientific community. Dr. McPhaden clearly made the case for the need for stronger science leadership in societal issues and the need to communicate the reality of situations and potential consequences of human actions or non-action.

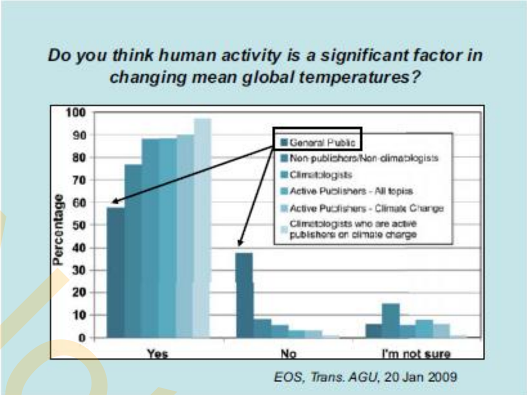


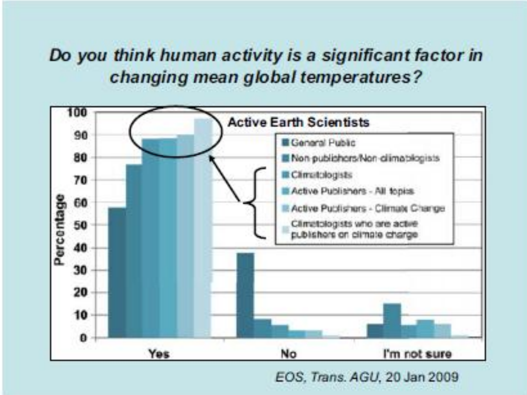









Do you think human activity is a significant factor in changing mean global temperatures?
Percentage
General Public
Non-publishers/Non-climatologists
Climatologists
Active Publishers - All topics
Active Publishers - Climate Change
Climatologists who are active publishers on climate change
Yes
No
I'm not sure
EOS, Trans. AGU, 20 Jan 2009


Do you think human activity is a significant factor in changing mean global temperatures?
Active Earth Scientists
Percentage
General Public
Non-publishers/Non-climatologists
Climatologists
Active Publishers - All topics
Active Publishers - Climate Change
Climatologists who are active publishers on climate change
Yes
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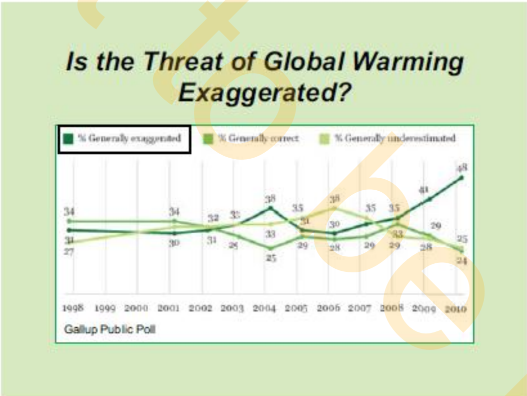
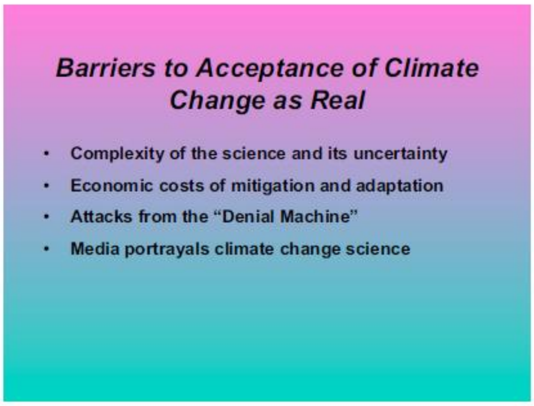
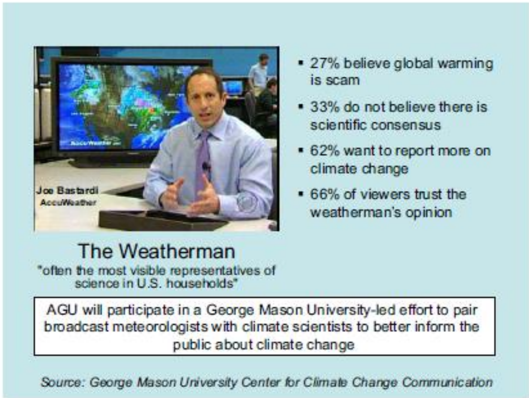

Is the Threat of Global Warming Exaggerated?
% Generally exaggerated
% Generally correct
% Generally underestimated
1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010
Gallup Public Poll


Barriers to Acceptance of Climate Change as Real
Complexity of the science and its uncertainty
Economic costs of mitigation and adaptation
Attacks from the "Denial Machine"
Media portrayals climate change science


THE BRIDGE TRAGEDY • MURDOCH'S WAR PLAN
Newsweek
Global Warming Is A Hoax.*
* Or so claim well-funded naysayers who still reject the overwhelming evidence of climate change. Inside the denial machine. By Sharon Begley


AGU
NEW AGU Strategic Plan
Approved by AGU Council 7 June 2010
Vision Statement
AGU galvanizes a community of Earth and space scientists that collaboratively advances and communicates science and its power to ensure a sustainable future.

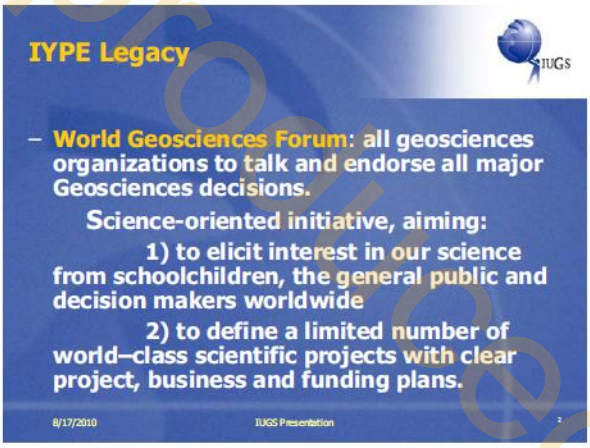


2) Alberto Riccardi (International Union of the Geological Sciences) – Global Research Initiatives and Something Else

The second presentation was by Prof. Alberto Riccardi, President, International Union of the Geological Sciences (IUGS). His presentation was entitled "Global Research Initiatives and Something Else." Prof. Riccardi discussed the legacy of IYPE and its numerous accomplishments. He pointed out that in addition to IYPE, the Electronic Geophysical Year (eGY), the International Heliophysical Year, and the International Polar Year (IPY) also took place providing the geosciences an opportunity to collaborate. These international years led to the World Geosciences Forum held in Japan and resulted in the development of the Tsukuba Declaration encouraging a continuation of geoscience efforts in the both research and outreach. Prof. Riccardi emphasized the importance of the geoscience community eliciting interest in it efforts, the need to define a limited number of world-class projects that would have significant societal impact. Certainly, climate change and its impacts would be of significance. However, Prof. Riccardi also pointed out that water issues should also be considered and that these efforts should include issues associated with water development as well as education and capacity building internationally.

He encouraged the geoscience community to consider the both long-term aspects, such as political, social, and economic commitment to solution and short-term aspects such as effective collaboration mechanisms to the long term success of the geosciences contributing to societal issues. He also pointed out needs for success such as stronger development of interdisciplinary capacity and international cooperation. Prof. Riccardi also identified some tools that can be used to affect change including the various geounions of the International Council of Science (ICSU). He pointed out that professional and scientific societies like AGU, GSA, AGI and many others have a role to play though their memberships and influence on the geounions.

Prof. Riccardi stated that some potential solutions to the geoscience community working in concert may be strategic mergers, improved coordination and structural alignments, and a unified strategic plan for the geounions. The scope of coordination should include research initiatives, priorities and agendas, geoinformation and education (the OneGeology project, and the Earth Science Education Initiative in Africa were given as good examples), and the global geoscience workforce (such as the UNESCO, IUGS, and AGI workforce project).

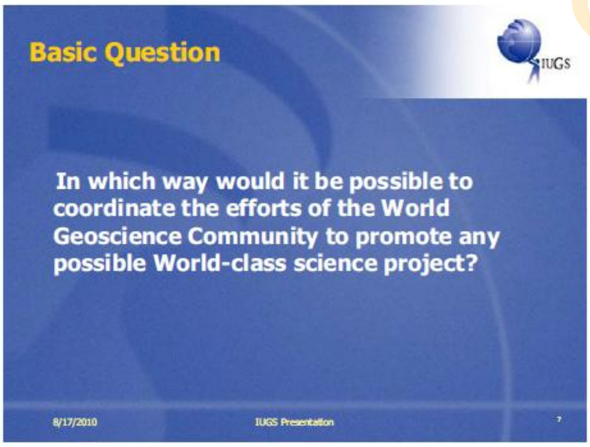



World Class Science Projects
IUGS
Constrains: need to address research issues of direct relevance to society, e.g.:
relationship to environment (climate, urban planning, etc.)
strategic resources (water, oil, etc.).
8/17/2010
IUGS Presentation


Other issues to be considered
IUGS
Differences
in development
in education and capacity building
8/17/2010
IUGS Presentation

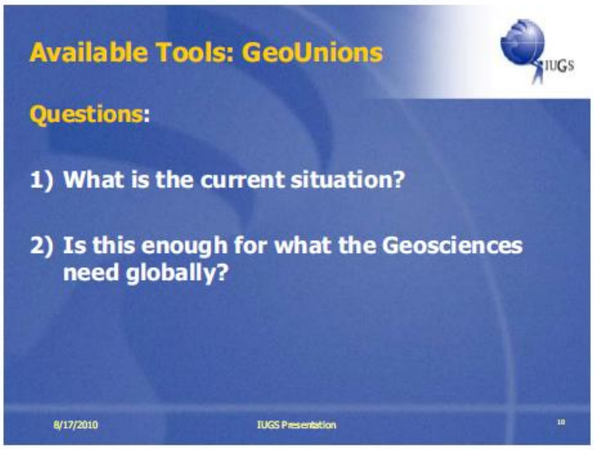

Work on different Visions
IUGS
Long term: projects for a homogeneous (politically, socially, and economically) World.
Short term: projects adapted to different circumstances (collaborative strategy).
8/17/2010
IUGS Presentation

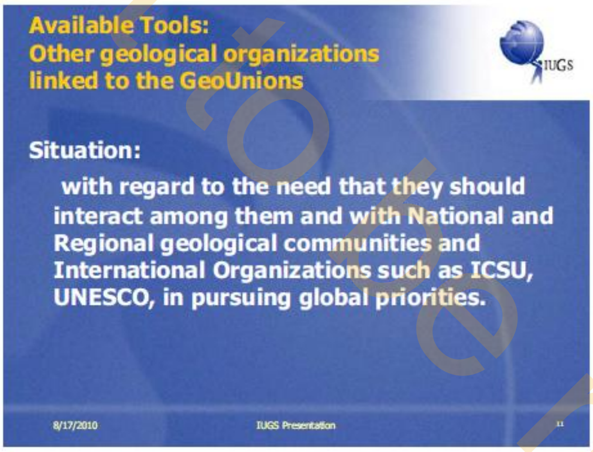

Needed
IUGS
Interdisciplinary approaches
International cooperation
Evidence-based decision-making (national and international)
Sharing of scientific knowledge
i.e. "something else"
8/17/2010
IUGS Presentation


Basic Question
IUGS
In which way would it be possible to coordinate the efforts of the World Geoscience Community to promote any possible World-class science project?
8/17/2010
IUGS Presentation


Available Tools
IUGS
1) GeoUnions (ICSU)
2) Other international geological organizations linked to the GeoUnions
8/17/2010
IUGS Presentation


Available Tools: GeoUnions
IUGS
Intl. Astronomical Union (IAU)
Intl. Geographical Union (IGU)
Intl. U. for Quaternary Research (INQUA)
Intl. Soc. for Phtogrammetry and Remote Sensing (ISPRS)
Intl. U. of Geodesy and Geophysics (IUGG)
Intl. U. of Geological Sciences (IUGS)
Intl. U. of Soil Sciences (IUSS)
Intl. U. of Radio Science (IURS)
8/17/2010
IUGS Presentation
9

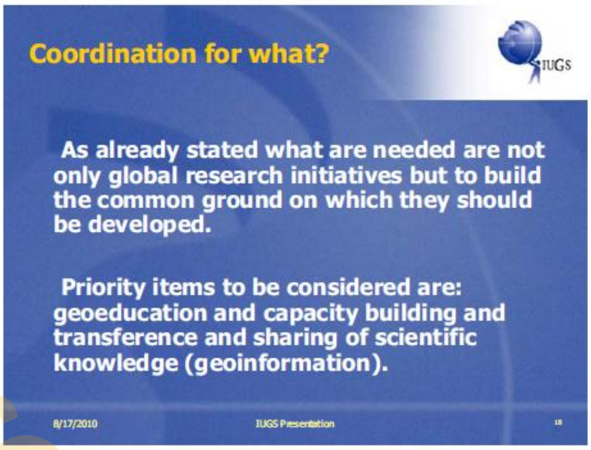

Available Tools: GeoUnions
IUGS
Questions:
1) What is the current situation?
2) Is this enough for what the Geosciences need globally?
8/17/2010
IUGS Presentation
10

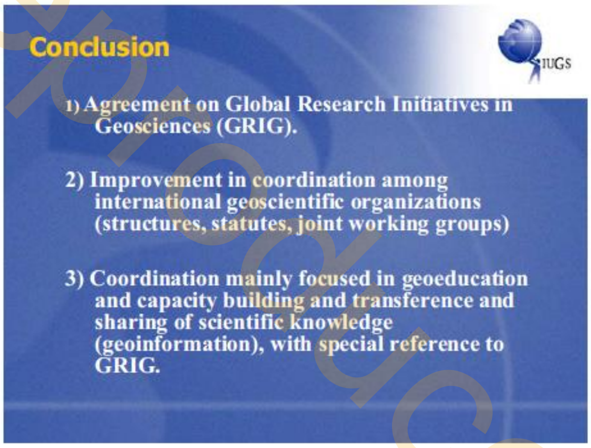

Available Tools:
Other geological organizations linked to the GeoUnions
IUGS
Situation:
with regard to the need that they should interact among them and with National and Regional geological communities and International Organizations such as ICSU, UNESCO, in pursuing global priorities.
8/17/2010
IUGS Presentation
11


Available Tools:
Other geological organizations
IUGS
Differences in scope and size
Activities often overlap
Communication among them and with other international bodies is not usually the best.
8/17/2010
IUGS Presentation
12


Available Tools:
international organizations
IUGS
Problems of interaction
Duplication of efforts
Officers of the governing bodies change periodically, work ad-honorem, and come from different institutions and backgrounds
Absence of permanent executive staff
Result: difficulties in long term planning and effective management.
8/17/2010
IUGS Presentation
13


Available Tools: other organizations (e.g. AAPG, AGI, AGU, GSA, GSL)
IUGS
Permanent executive management
International projection
In origin and top leadership not really international.
8/17/2010
IUGS Presentation
14





3) Jaime Urrutia Fucugauchi (The World Academy of Science (TWAS), Mexico Chapter) – Latin American and Caribbean S & T Cooperation Agency: A Proposal

The third presentation was made by Dr. Jaime Urrutia Fucugauchi, representing The World Academy of Science (TWAS), Mexico Chapter. His presentation was entitled "Latin American and Caribbean S & T Cooperation Agency: A Proposal." Dr. Fucugauchi argued that a science and technology agency should be formed to increase investment in science, especially the geosciences. He referred to the UNESCO science report which stated that investment in research and development (R&D) in Latin

America and the Caribbean is very small relative to the GDP of the region. Furthermore, Brazil, Mexico and Argentina account for more than 85 percent of the investment in R&D. There are many challenges facing the region including limited numbers of scientists, ‘south-south’ collaboration and the need for funding.

Dr. Fucugauchi noted that a Latin American and Caribbean government cooperating agency has been proposed in the past but it has never been implemented but the opportunity for change may be present. There are a number of models that have merit for consideration including some of the S&T organizations formed in the European Union (all Europe research councils and funding agencies). He cited the formation of the Sao Paulo Research Foundation as a vehicle for increased funding in R&D with an accompanying improvement in economic growth.

Joint Assembly 2010 Iguassu Falls, Brazil 8-13 August

Town Hall

International Geosciences Initiative

Sponsored by Geological Society of America, American Geological Institute, Geological Society of London, and British Geological Survey

"Latin American and Caribbean S&T Cooperation Agency – A Proposal"

Jaime Urrutia Fucugauchi
TWAS Mexico Chapter

UNESCO 2005 Science Report, April 2006

The world is globalizing and Latin America is not even getting it together’. Attempts at intra-regional integration have faced persistent ‘obstacles connected with development problems and political and financial instability. The report also points to ‘untapped potential in Latin America and the Caribbean for the horizontal transfer of knowledge and technologies under mutually advantageous conditions’.

Latin America and the Caribbean continue to account for just a fraction of world expenditure on R&D and this share appears to have slipped between 1997 and 2002 (from 3.1% to 2.6% - compared to a 7.6% share of world GDP). According to the UNESCO 2005 Science Report, just three countries - Brazil, Mexico and Argentina - contribute 85% of the total.

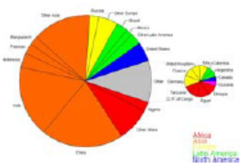
Of the US$ 21.7 billion spent on GERD in Latin America and the Caribbean in 2002, Brazil contributed US$ 13.1 billion, Mexico US$ 3.5 billion and Argentina US$ 1.6 billion. Brazil is the only country in the region to devote 1% of GDP to R&D, the R&D effort of Argentina and Mexico amounting to just 0.4% and 0.3% of GDP.

Regional Cooperation in Latin America and the Caribbean

Science policy makers and the research community should realize that, if the region is to advance and increase its presence on the international scene, they require to pull together, and that this entails strengthening intra-regional ties.

UNESCO Science Report, April 2006

Latin America and the Caribbean represents 8.6% of the world population but just 2.5% of the world's scientists.
In the region, on average, there are 261 researchers per million population There are 715 in Argentina, 315 in Brazil and 217 in Mexico.
This compares with 2982 in France, 3209 in Germany, 4374 in the USA and 5085 in Japan.



Latin American and Caribbean Science and Technology

- Small, isolated academic communities
- Inadequate infrastructure
- Few large, long-term programs
- Dependence on programs, projects, directives from groups in industralized nations
- Few collaboration projects with the region
- Economic, social and political problems
- Most student programs directed to industrialized nations
- Few academic exchange programs with the region
- Relatively few groups and individuals with international status
- Brain drain
- Poor telecommunication facilities
- Low-speed internet
- Few if any regional S&T funding agencies

Latin American and Caribben Science and Technology

- Small, isolated, poorly-financed national societies
- Lack of coordination among Governmental Science Agencies
- Lack of cooperation in Science and Technology among countries in the region
- Lack of communication and academic exchange
- Lack of science and technology as state-policies in most countries
- Lack of long-term S&T programs and even visions
- Lack of national S&T infrastructures
- Un-fullfilled dreams of Latin American integration and a successful Latin American scientific community
- Un-promising future

International Collaboration North-North, North-South and South-South

International Collaboration – Papers ISI	1981	1985	2000	2007
International Collaboration Papers (Co-authors from two or more countries)	5.7%	7.3%	18.4%	21.9%
Developed Countries Collaborative Papers	6.0 %		20.4%	
Developing Countries Collaborative Papers	15.1%		30.8%	
Collaboration Among Developed Countries	80.9%		75.1%	
(From Total Number of Papers) Collaboration Developed/Developing Countries			28.9%	
Collaboration Among Developing Countries			1.9%	
Number International Collaboration Papers			107,637	

Over the 20 years under analysis, international collaboration in science and technology has increased. One indicator of this process is the rise in papers co-signed by authors from different countries. The share of world papers with authors in two or more countries has more than tripled between 1981 and 2000, from 5.7% to 18.4%. The proportion of publications from authors in developed countries co-signed with authors in other countries has risen more than three times from 6.0% to 20.4% between 1981 and 2000, and in developing countries the share of collaborative papers doubled from 15.1% to 30.8%. Of the total 107,637 internationally collaborative papers in 2000, 74.0% were collaborations between scientists in different developed countries ("North-North"8), 24.5% collaborations between authors in developed and developing countries ("North-South"), and only 1.6% between scientists in different developing countries ("South-South"). From the total number of papers by authors in developing countries, 28.9% were written in collaboration with authors in developed countries ("South-North") and 1.9% with scientists in other developing countries ("South-South"). "South-North" collaboration represents therefore 93.7% of total collaboration involving developing country authors. On the other hand, developed countries Collaborate mainly between themselves: 75.1% of their collaborative papers were written with authors in other developed countries in 2000, down from 80.9% of papers in "North-North" collaboration in 1981.

Ongoing and past efforts

- Government Programs

-International Collaboration Programs
- Increased Involvment/Participation International Projects
- Increased collaboration with Industrilized Nations
- Support Laboratory Infrastructure
- Equipments/Instrument Donnations

- Student Support Programs
- Student Travel Grants
- Student Project Grants
- Postgraduate Fellowships
- Instrumental Networks

- Academic Exchange Programs
- Postdoctoral fellowships
- Postgraduate fellwoships

- Education Programs

- North-South Collaboration Projects
-

-South-South Collaboration Projects
-

Needs for Collaboration in Science and Technology in Latin America and Caribbe

-Coordination of programs, activities and policies in a regional context
- Increased funding
- Top high-quality laboratory infrastructure
- Frontier science projects
- Frontier technologies
- Science academic mobility
- New research centers

Alternatives, options, actions?

Proposal

Creation of the

Latin American and Caribbean Intergovernmental Cooperation Agency in Science and Technology

Advisory body for science and technology to assist the Latin American and Caribbean governments with the implementation of cooperation strategies and coordination of regional research and development policies.

Latin American and Caribbean Research Council

Intergovernmental research council and funding body for science and technology

Latin American and Caribbean Science and Technology Foundation

Independent, non-governmental, non-profit organization that facilitates cooperation and collaboration in research and development

erc
European Research Council

The European Research Council (ERC) is the first European funding body set up to support investigator-driven frontier research.
Its main aim is to stimulate scientific excellence by supporting and encouraging the very best, truly creative scientists, scholars and engineers to be adventurous and take risks in their research. The scientists are encouraged to go beyond established frontiers of knowledge and the boundaries of disciplines.
The ERC complements other funding activities in Europe such as those of the national research funding agencies, and is a flagship component of the 'Ideas Programme' of the European Union's Seventh Research Framework Programme (FP7).

The ERC aims to:
- support the best of the best scientific efforts in Europe across all fields of science, scholarship and engineering.
- promote wholly investigator-driven, or 'bottom-up' frontier research.
encourage the work of the established and next generation of independent top research leaders in Europe.
- reward innovative proposals by placing emphasis on the quality of the idea rather than the research area.
- harness the diversity of European research talent and channel funds into the most promising or distinguished researchers.
- raise the status and visibility of European frontier research and the very best researchers of today and tomorrow.
- put excellence at the heart of European Research

European Cooperation in Science and Technology - COST

COST is an intergovernmental framework for European Cooperation in Science and Technology, allowing the coordination of nationally-funded research on a European level. COST contributes to reducing the fragmentation in European research investments and opening the European Research Area to cooperation worldwide.

The goal of COST is to ensure that Europe holds a strong position in the field of scientific and technical research for peaceful purposes, by increasing European cooperation and interaction in this field. This research initiative makes it possible for the various national facilities, institutes, universities and private industry to work jointly on a wide range of Research and Development (R&D) activities. COST – together with EUREKA and the EU framework programmes – is one of the three pillars of joint European research initiatives. These three complementary structures have differing areas of research.

Setting Science Agendas
The ESF provides a common platform for its Member Organisations in order to:
- Advance European research
-Explore new directions for research at the European level

Through its activities, the ESF serves the needs of the European research community in a global context.

The **European Science Foundation** (ESF) is an association of 79 member organisations devoted to scientific research in 30 European countries. It is an independent, non-governmental, non-profit organisation that facilitates cooperation and collaboration in European research and development, European science policy and science strategy. It was established in 1974. The ESF offices are in Strasbourg, France (headquarters), and in Brussels and Ostend, Belgium.
The ESF Member Organisations are research-performing and research-funding organisations, academies and learned societies across Europe. Together they represent an annual funding of about €25 billion.
The ESF provides a platform for foresighting and research networking on a European and global scale to the ESF member organisations. According to its mission and strategic plan, the European Science Foundation runs foresighting programmes in science, programmes to enhance science synergy (i.e.: research networking programmes and collaborative research projects for European scientists) and activities dedicated to science management (such as providing administrative services to independent scientific committees and other organisations).

Latin American and Caribbean Intergovernmental Cooperation Agency in Science and Technology

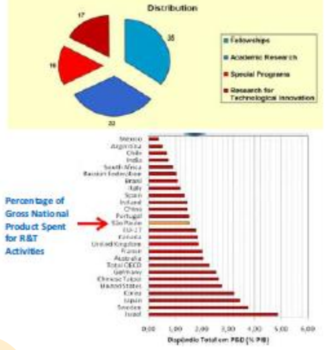
Latin American and Caribbean Research Council

Latin American and Caribbean Science and Technology Foundation

Are these proposals realistic?

The São Paulo Research Foundation, FAPESP

- 2009 budget: ~ US$ 420 million

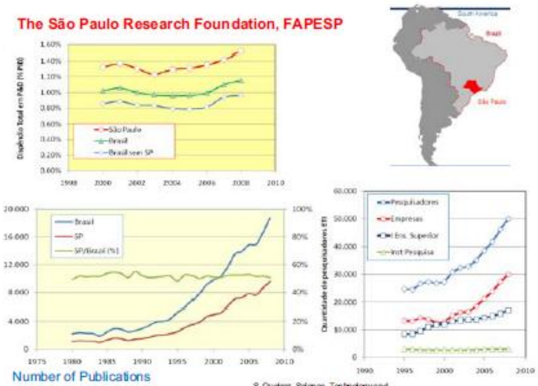


1989: New State of São Paulo Constitution –Article 271 –

"The State shall grant no less than one percent of its total tax revenues to the Foundation for the Support of Research in the State of São Paulo, as a revenue to be privately managed by said foundation, to be applied in scientific and technological development"

S. Queiroz, Science, Technology and Innovation in the State of Sao Paulo

The São Paulo Research Foundation, FAPESP



Number of Publications

S. Queiroz, Science, Technology and Innovation in the State of Sao Paulo

UK-Brazil International Conference
"Frontiers of Science"

August 2010
Royal Society – Sao Paulo Cooperation Agreement
Royal Society 350 year Anniversary

Thanks!
Muito Obrigado
Muchas Gracias
Merci

Discussion

The discussion that followed the presentations focused on enhancing the credibility of science. The question posed was "How does geoscience address ideological challenges and outright lies in an effective manner?". Dr. McPhaden said the recent AGU editorial in the Wall Street Journal that addressed concerns raised about bias in the peer review systems is a good example of proactive approaches the geoscience community must use to inform the public. Effective, clear, concise, and accurate communication of geoscience must be a critical element of any global geoscience initiatives.

Dr. Fucugauchi was asked why he thought the Latin American and Caribbean S&T was appropriate at this time. He pointed out that several countries are already working collaboratively. Dr. Fucugauchi believes that the political desire to establish more effective mechanisms for S&T currently exists and that there is now recognition of need for an independent S&T agency among political leaders in the region.

Prof. Riccardi was asked to prioritize the next steps he outlined for the global geoscience community. He replied that a common strategy for the geounions that are part of ICSU is critical in defining a clear path forward.

P. Patrick Leahy and John Hess

1 September 2010

34th International Geological Congress: Wednesday 8 August 2012, Brisbane, Australia

Organizers:
Edmund Nickless, John Ludden, Pat Leahy and Jack Hess

Discussants:
Provided by Young Earth Scientists (YES) Network

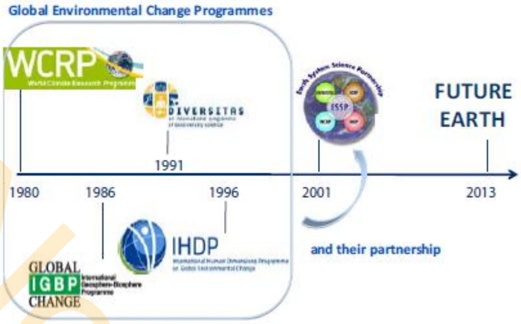
Speakers:
Dr. John Ludden (Executive Director, British Geological Survey); Dr. Suzette Kimball (Deputy Director, U.S. Geological Survey); Dr. Chris Pigram (CEO Geoscience Australia); Dr. Yao Yupeng (National Natural Science Foundation of China); Dr. Mike Sandiford (School of Earth Sciences, University of Melbourne)

Presentations:
Presentations can be viewed online at: http://www.agiweb.org/members/presentations/index.html

1) ***Dr. John Ludden (Executive Director, British Geological Survey) – Future Earth: Research for Global Sustainability***

John Ludden's presentation discussed the Belmont Forum and the Future Earth initiative.

Future Earth: building from the GEC programmes



3

Some of the challenges we face

- Feeding 9 billion people within sustainable planetary boundaries
- Valuing and protecting nature's services and biodiversity
- Adapting to a warmer and more urban world
- Transitioning to low carbon societies
- Providing income and innovation opportunities through transformations to global sustainability
- Reducing disaster risks
- Aligning governance with stewardship

4

Future Earth

To provide the knowledge required for societies in the world to face risks posed by global environmental change and to seize opportunities in a transition to global sustainability

Future Earth: can we answer ...

How and why the global environment is changing, what are likely future changes, what the implications are for human wellbeing and other species, what choices can be made to reduce harmful risks and vulnerabilities and enhance resilience, and how this knowledge can support decisions and sustainable development?

The challenges of global environmental change and sustainable development require some new approaches which are:

- *More international*
- *More interdisciplinary*
- *More collaborative*
- *Co-designed with users, funders…*
- *More responsive to society and grand challenges of sustainability*
- *Builds on the success of current international research programmes*

7

The Transition Team

17 individual capacity members, 12 ex-officio (ICSU, ISSC, Belmont Forum, UNESCO, UNU, UNEP) and Global Environmental Change Programme Directors

Transition Team deliverables

- An initial research framework
- An institutional design
- A strategy for outreach, education, stakeholder engagement
- A name for the initiative

Organizing Future Earth research

A conceptual framework

A number of "integrated research" themes:

- thematic areas in which interdisciplinary research will be carried out
- a number of key research questions under each theme
- populated by existing/new projects

10

	Future Earth: Proposed Integrated Research Themes
1	**A Changing Planet**: Understanding earth, ecological and societal system trends, drivers, processes, and projections
2	**Resources for development and wellbeing**: ensuring the sustainable provision of food, water, health and ecosystem services
3	**Low Carbon Societies**: Linking Climate Change, Energy and the Economy
4	**Living with the Sea**: Oceans, coasts and blue societies
5	**Reducing the risk of catastrophes**: Global thresholds and disaster risk reduction
6	**Pivotal places**: Cities, regions, and critical biomes
7	**Global Responses**: Managing change and governing the environment
8	**Transformative Pathways**: Fundamental changes for a Sustainable, Inclusive and Prosperous Future Earth
9	Other themes to be proposed by the scientific community…..

11

Living with the sea: oceans, coasts and blue societies - Example research questions

- What might adaptive management strategies contribute to resilient coastal zones?
- How much and what kind of food will the oceans provide to future societies?
- What is the capacity of the ocean to take up CO_2?
- How to govern sustainable fisheries?
- How do land-use and open ocean changes influence coastal habitats and marine biodiversity?
- What are the regional impacts of sea level rise and their interaction with coastal use and protection?

Crosscutting capabilities

- *Observing systems*
- *Data systems*
- *Earth system models*
- *Theory development*
- *Synthesis and assessments*
- *Capacity development and education*
- *Communication and the science-policy interface*

13

Future Earth: next steps

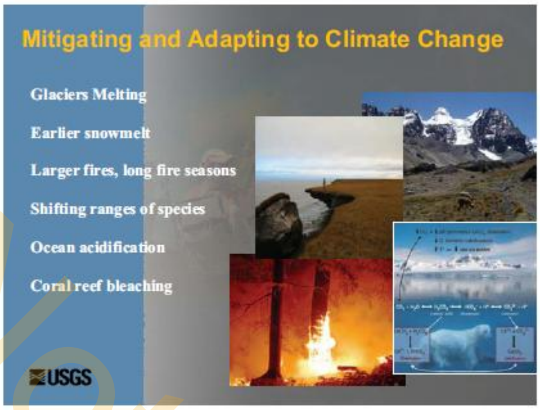
- Early actions
  - Launch – PuP and Rio+20
  - Belmont Collaborative Research Actions on coasts and water
  - ISSC transformations to sustainability project
- Consultations – second half 2012
  - Research Framework
  - Projects and programmes
  - Regional perspectives

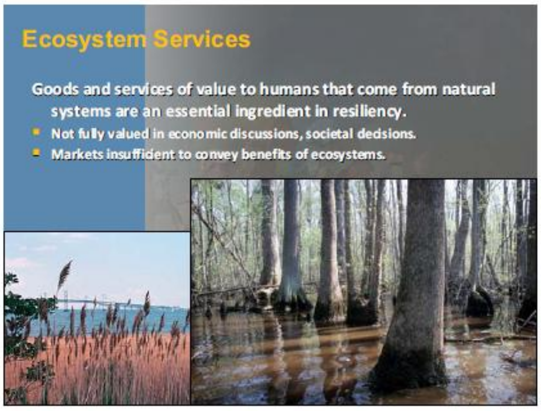
14

2) Dr. Suzette Kimball (Deputy Director, U.S. Geological Survey) – A Geosciences Vision for the United States

Suzette Kimball presented USA activities that we can take on as a global community including

- ecosystem resilience,
- climate variability and long term weather patterns,
- ecosystem services,
- critical materials where and how they are distributed,
- water issues on a global scale,
- global assessment Earthquakes
- global perspective of risk multidisciplinary efforts Primo
- pacific islands resilience
- vulnerability of coastal environments
- mega deltas and deltas
- workforce next generation of science African focus.

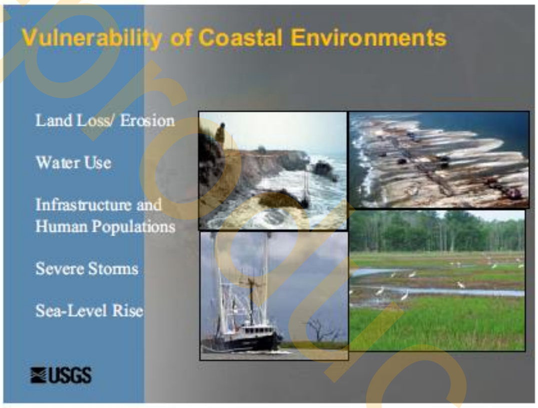

Mitigating and Adapting to Climate Change
Glaciers Melting
Earlier snowmelt
Larger fires, long fire seasons
Shifting ranges of species
Ocean acidification
Coral reef bleaching
USGS

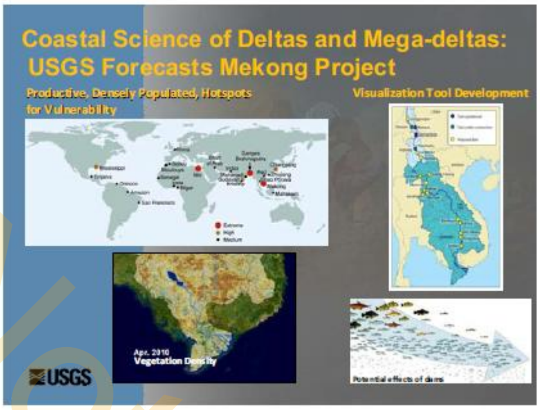

Ecosystem Services
Goods and services of value to humans that come from natural systems are an essential ingredient in resiliency.
Not fully valued in economic discussions, societal decisions.
Markets insufficient to convey benefits of ecosystems.


Strategic Thinking On Critical Minerals – A Global Perspective
Evaluate the methodology for assessments of undiscovered resources
Improve understanding of global materials flow and recycling
Legislators rely on accurate mineral information presented in economic context to address national mineral needs.
Expertise and technology for processing minerals are just as vital as access to minerals.
USGS


Addressing the Nation's Water Challenges: WaterSmart Initiative
Groundwater recharge and storage
Improved water use estimates, particularly for thermoelectric/irrigation (next slide)
Ecological flows
Estimates of streamflow at ungaged sites
Evapotranspiration
Assessments in areas with significant competition
Seamless database housing water-availability indicators
USGS


Natural Hazards Risk Reduction: Bringing Science and Communities Together
ARkSTORM
The Great Southern California ShakeOut
SCEC
USGS


Vulnerability of Coastal Environments
Land Loss/ Erosion
Water Use
Infrastructure and Human Populations
Severe Storms
Sea-Level Rise
USGS



3) Dr. Chris Pigram (CEO Geoscience Australia) – Priorities for Geoscience in Australia

Chris Pigram discussed global geoscience issues from the Australian perspective including:

- megathrust earthquakes
- disaster risk reduction
- palaeo tsunami – 10 Year International paleotsumami program
- Intraplate continental deformation.

Australian Government
Geoscience Australia

MEGATHRUST EARTHQUAKES

Tsunami risk

John Schneider and Phil Cummins

APPLYING GEOSCIENCE TO AUSTRALIA'S MOST IMPORTANT CHALLENGES

The 2004 Indian Ocean Tsunami: One of the most Lethal Natural Disasters in Human History

Total Deaths: 227,898

From Tsunami Evaluation Coalition Synthesis Report (2006)

GEOSCIENCE AUSTRALIA

The 2011 Tohoku Earthquake and Tsunami: The Most Costly Natural Disaster in Recorded History

GEOSCIENCE AUSTRALIA

Why Was the Death Toll so High?

Inadequate Preparedness.

2004 IOT: No one had foreseen the potential for a large tsunami, especially one of such massive scale. Hence, Sumatra and the Indian Ocean at large had not even considered tsunami mitigation measures.

2011 Tohoku: Although Japan was thought to be well prepared for tsunamis, the size of the 2011 event turned out to be far larger than anyone had expected. Hence, even the seemingly impressive tsunami mitigation measures were, in the end, inadequate.

GEOSCIENCE AUSTRALIA

Is Preparedness a Serious Component of Response/Recovery?

For the IOT, the tsunami Evaluation Coalition Synthesis Report (2006) documents the effectiveness - and lack thereof - of the international humanitarian response. It noted:

- "It is notable that disaster risk reduction (DRR) and preparedness, though demonstrably cost-efficient and effective if correctly undertaken, receive only a small portion of international aid."
- "Despite advances in early warning systems, the tsunami response has rarely enhanced local preparedness or significantly reduced longer term vulnerability."

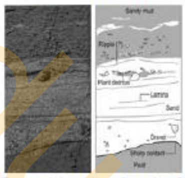
Preparedness was only a very small fraction of the response/recovery effort, and was largely directed at warning systems and public awareness in areas already impacted by the tsunami.

GEOSCIENCE AUSTRALIA

Tsunami Preparedness is Underpinned by Geology – i.e., Paleotsunami Studies

- Only paleotsunami studies can extend knowledge beyond the historical record to cover the long return periods of the largest events
- For both IOT and Tohoku, paleotsunami studies revealed evidence for recurrence of large events similar to those that caused the modern disasters

2004 IOT along with prehistoric tsunami deposits in pit off Thai coast (Jankaew et al., 2008)



Tsunami deposit attributed to 869 Jogan tsunami, in core collected near Sendai (Sawai et al., 2008)

GEOSCIENCE AUSTRALIA

The Real Killer: Local Tsunamis

Satellite images of the city of Banda Aceh, pop. 400,000, before (left) and after (right) it was devastated by the 2004 Indian Ocean Tsunami (images courtesy NASA).

A large, local tsunami can arrive within minutes, devastating coastal areas even several km from the coast. Such tsunamis are responsible for the massive death tolls in recent events. Large coastal cities in the Indian and Pacific Oceans that could experience such tsunamis include:

Chittagong, Bangladesh	Karachi, Pakistan	Nuku'alofa, Tonga
Padang, Indonesia	Kaosiung, Taiwan	Cilacap, Indonesia
Cebu City, Philippines	Seattle, USA	Concepcion, Chile

GEOSCIENCE AUSTRALIA — 34th IGC – GGI presentation

An International Paleotsunami Program for Tsunami Disaster Reduction

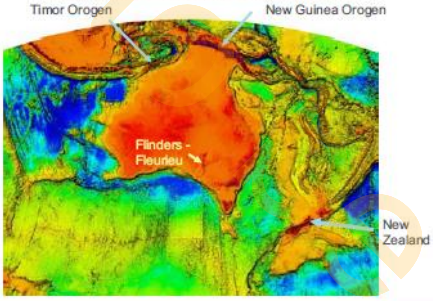
Should be focused on subduction zones with large coastal populations that have yet to experience a major tsunami disaster (e.g. Makran, Arakan, SW Pacific).

Unlike the 'quick technological fix' promised by warning systems, the commitment should be for a long term, basic science program spanning at least a decade.

Capacity building should be a major part of the program, along with outreach to the disaster management community to ensure uptake of results.

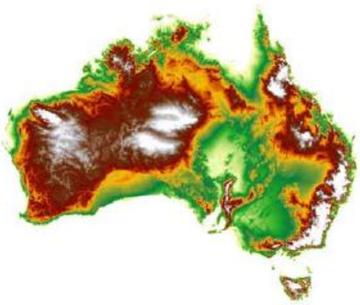
GEOSCIENCE AUSTRALIA — 34th IGC – GGI presentation

Intraplate continental deformation



GEOSCIENCE AUSTRALIA — 34th IGC – GGI presentation

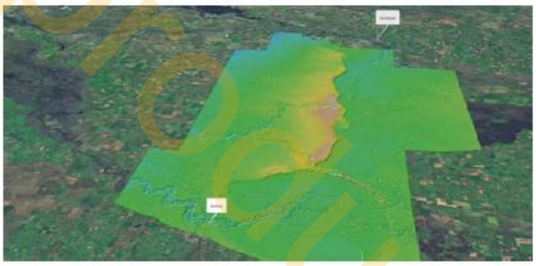
Digital Elevation Model



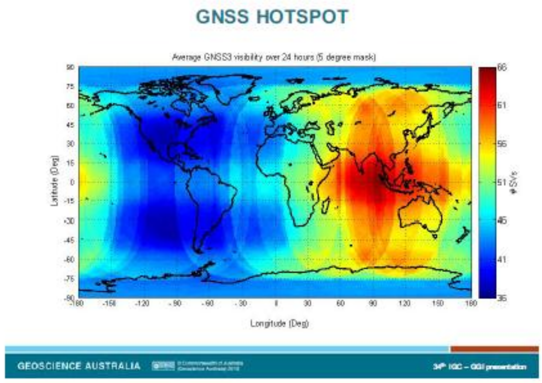
GEOSCIENCE AUSTRALIA — 34th IGC – GGI presentation

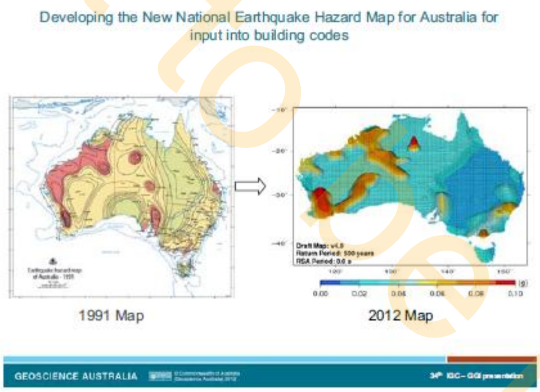
The Cadell Scarp

GEOSCIENCE AUSTRALIA — 34th IGC – GGI presentation



GEOSCIENCE AUSTRALIA — 34th IGC – GGI presentation





Two ideas for consideration:

1. An international Paleotsunami program
2. An intraplate processes program
   – building 4d understanding of how continents deform

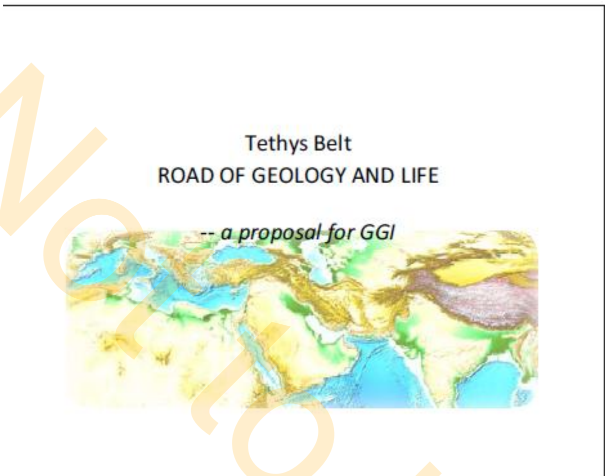
GEOSCIENCE AUSTRALIA

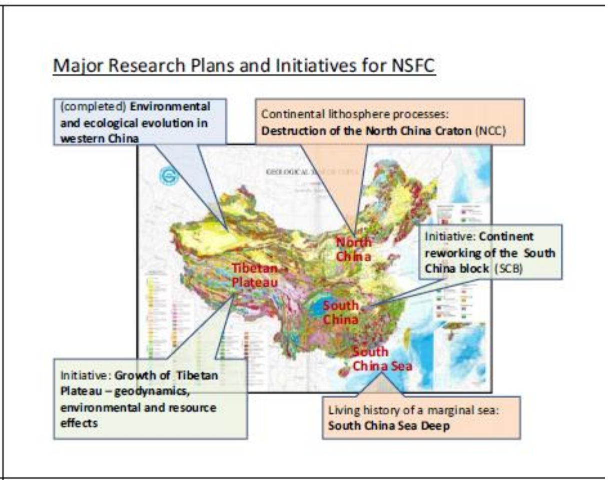
4) Dr. Yao Yupeng (National Natural Science Foundation of China) – Tethys Belt: ROAD OF GEOLOGY AND LIFE -- a proposal for GGI

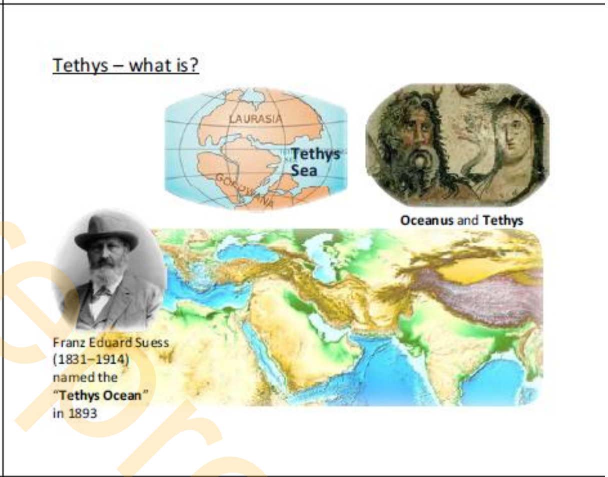
Yao Yupeng proposed a GGI program focused on the Tethys Belt: Road of Geology and Life. The program could involve 50 Countries. Scientific Themes include:

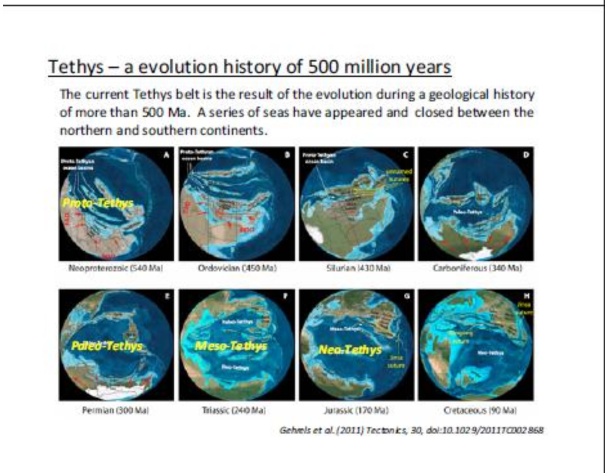
- Continental Dynamics
- Environment
- Biodiversity

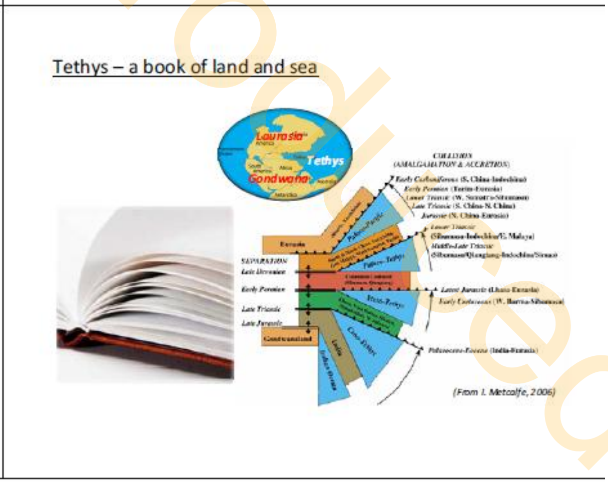
- Civilization and Society
- Natural Hazards
- Resources











Tethys – a cradle for geology

……

Ophiolite (*Brongniart , 1821*)
Alpine type orogenic belt (*Steinmann, 1906*)
UHP metamorphism / continental subduction (*Chopin & Smith, 1984*)
……

Continental collision between Eurasia and India

Work of M. Mattauer (1928-2009)
(Cartoon from ZQ Xu et al., 2011)

Tethys – the viewpoints of Chinese geologists

- Tectonic zone **dominating** the evolution of the China continent blocks over geological history
- Natural **connection** between Asia and Europe, Northern Africa, even America
- Tectonic zone with close relationship with the forming of utilizable **resource** and habitable **environment**

Scientific Themes

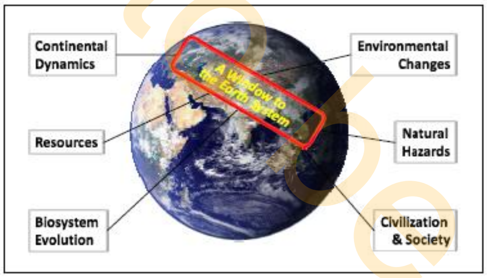
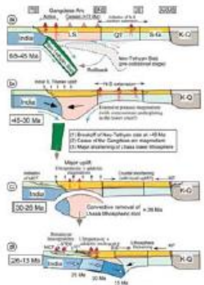


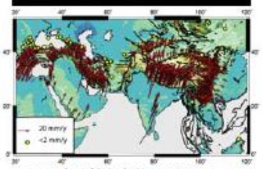
Photo from NASA website

THEME 1. Natural Laboratory for **Continental Dynamics**

- Structure and evolution of the continents and oceans
- Mechanism of uplifting and collapsing of the plateaus



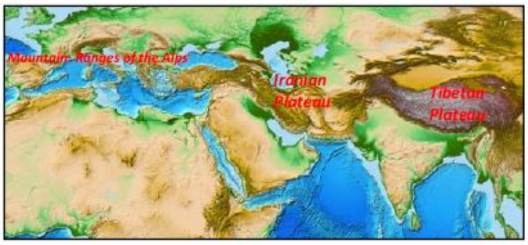
Stages of Tibetan plateau evolution
(Chung et al., 2005)



Topography and GPS velocities *(Hatzfeld & Molnar, 2010)*

THEME 1. Natural Laboratory for **Continental Dynamics**

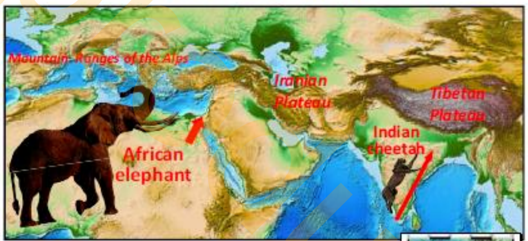
Correlation of the orogenic belt

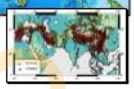


Continental collision --> plateau, or mountain range?

THEME 1. Natural Laboratory for **Continental Dynamics**

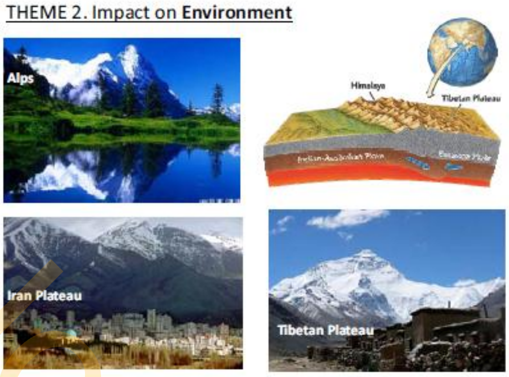
The difference of the moving **speed** (convergence rate)





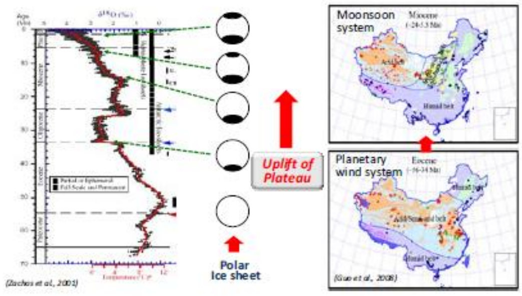
- more effective thickening of the crust/lithosphere in S. Tibet
- northward underthrusting of the Indian continental lithosphere
- providing support that holds up the plateau's high topography

THEME 2. Impact on **Environment**



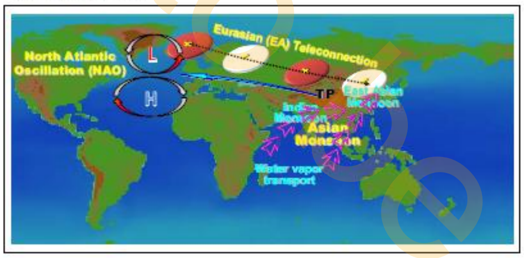
THEME 2. Impact on **Environment**

Formation of the polar ice-sheets, onsets of the monsoon-dominated climate and inland deserts in Asia are among the most prominent climate effects.



THEME 2. Impact on **Environment**

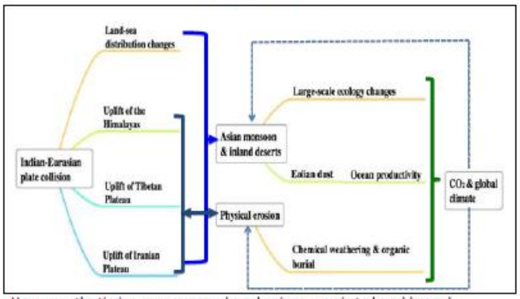
Modern surface conditions of Tibetan Plateau modulate monsoons and other climate components.



(Wu et al., 2012)

THEME 2. Impact on **Environment**

A summarized conceptual model of environmental changes related to the Tethys evolution

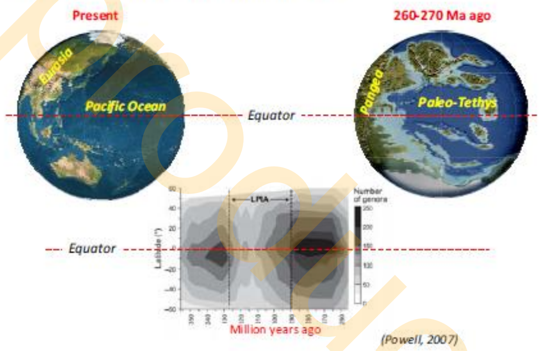


However, the timing, processes and mechanisms remain to be addressed.

THEME 3. Heritage of the **Biodiversity**

The distribution pattern of land and sea, the landscape of the continents and geological activities are predominant factors on the evolution of life and biodiversity.

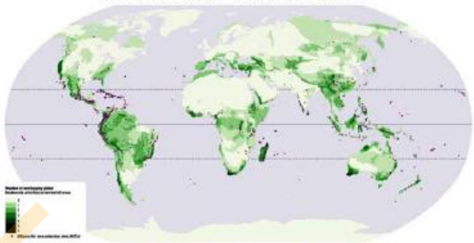
THEME 3. Heritage of the **Biodiversity**



(Powell, 2007)

THEME 3. Heritage of the **Biodiversity**

GLOBAL BIODIVERSITY PRIORITY SCHEMES



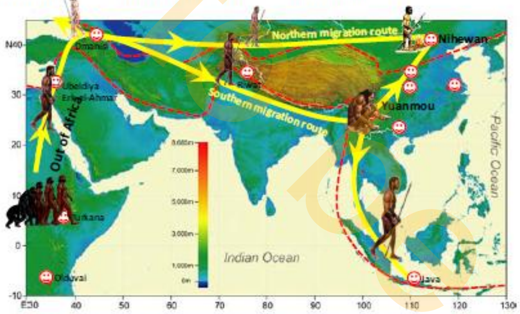
Tethys region is still one of the world centers of terrestrial biodiversity at present.

(UNEP-WCMC, 2008)

THEME 4. Habitation for **Civilization and Society**

Along the Tethys belt also distribute great diversity of cultures and civilizations.

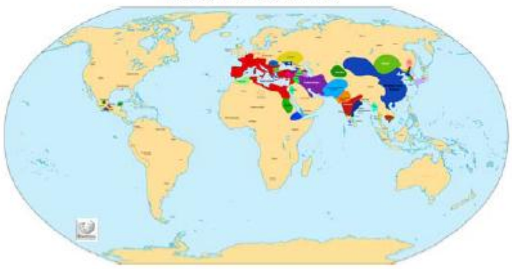
THEME 4. Habitation for **Civilization and Society**



After out-of-Africa, early human migrated across the Tethys zone along the N or S routes, which were obviously determined by environmental and topographic conditions.

THEME 4. Habitation for **Civilization and Society**

The world in the 1st Centuray



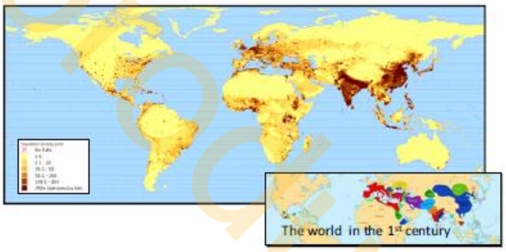
The world's ancient civilizations thrived along the Tethys belt.

THEME 4. Habitation for **Civilization and Society**

The silk road: historical link between the West and the East

THEME 4. Habitation for **Civilization and Society**

The world population density in the 21st Century



Today, the circum-Tethys region feeds 70% population of the world.
It's obviously a region vulnerable to hazard and environmental change.

(from Gridded Population of the World Project, Columbia University)

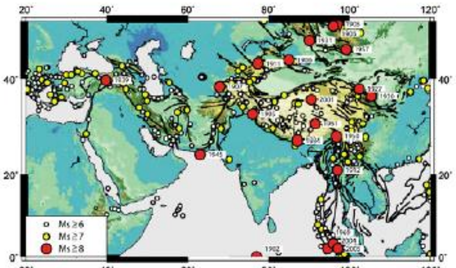
THEME 5. Menace of **Natural Hazards**

Due to the strong geological activities, the Tethys belt is also a "hazard zone".

Beichuan, China: relics of a city ruined by the **Wenchuan earthquake in 2008**

Pompei, Italy: relics of a city ruined by the **Vesuvius volcano eruption in 79 AD**

THEME 5. Menace of **Natural Hazards**

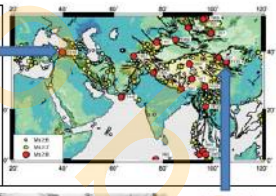


Significant earthquakes between 1900 and 2005

(Hatzfeld & Molnar, 2010)

THEME 5. Menace of **Natural Hazards**

The **1939 Erzincan earthquake**, of 8.2 on the Richter scale, killed ca **33,000 people**. The city was entirely abandoned.



The **1920 Haiyuan earthquake** of magnitude 8.5 destroyed the whole area, killed over **200,000 people**.

Continental Earthquakes

THEME 5. Menace of **Natural Hazards**

Major active volcanoes in the Tethys belt

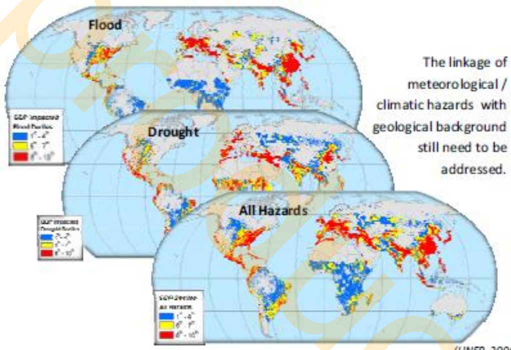
THEME 5. Menace of **Natural Hazards**

Santorini volcano exploded in 1613 BC, led to the **decline of Minoan civilization**.

Karakatau volcano, exploded in 1883, killed about **50,000 lives**. Volcanic dusts caused **global cooling** up to 0.3-0.6 degrees.

Densely Populated

THEME 5. Menace of **Natural Hazards**



The linkage of meteorological / climatic hazards with geological background still need to be addressed.

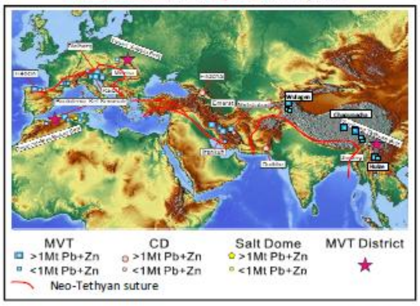
(UNEP, 2006)

THEME 6. Origin of Utilizable **Resource**

The Tethys belt is rich in many kinds of natural resource, particularly, petroleum and ore deposits. It's also the source of the major rivers on the Eurasia continent.

THEME 6. Origin of Utilizable **Resource**

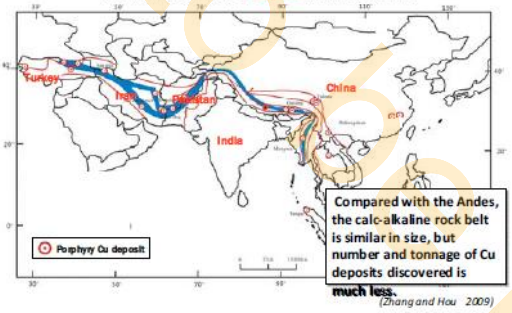
Sediment-hosted Pb-Zn **deposits** in Tethys belt



(Modified from Leach, 2011)

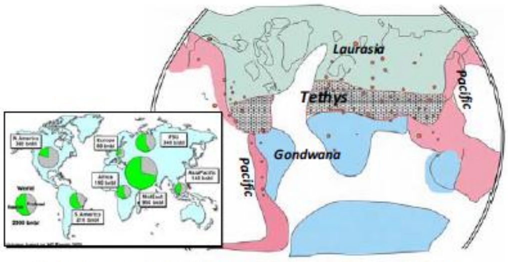
THEME 6. Origin of Utilizable **Resource**

Miocene high-K calc-alkaline **magmatic** rock belt and associated porphyritic Cu **deposits** in the Tethys belt



(Zhang and Hou 2009)

THEME 6. Origin of Utilizable **Resource**



With a surface area of only 17%, the Tethys domain contains 68% of the oil & gas reserves in the four domains.

Opportunities and Actions

- Abundant scientific themes cover broad fields of geoscience
- Direct link to the welfare of broad societies and a huge community

Projects supported by the funding agencies in many countries

Opportunities and Actions

US **NSF** and **NSFC** collaborative project (2010 - 2014)
Growth of the Tibetan Plateau environmental impacts with global significance
US NSF budget: 5 M USD (continued)
China NSFC budget: 5 M CNY + 20 M CNY (approved this year)

Opportunities and Actions

DFG priority project collaborating with China **NSFC** & **CAS**
SPP 1372: **Tibetan Plateau: Formation - Climate - Ecosystems (TiP)**
Budget: 14 M Euro (2008 -2014)

Opportunities and Actions

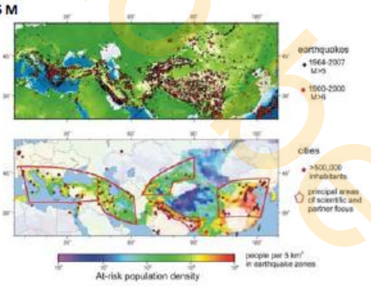
BMBF Program, Germany
Central Asia and Tibet– Monsoon dynamics and Geo-ecosystems
The investigations on the **interdisciplinary** projects are carried out in **international cooperation**.

Thematic areas:

1) Young geodynamics – climate - humans
2) Geo-ecosystems – human impact and climate change
3) Monsoon dynamics: driving factors and internal coupling

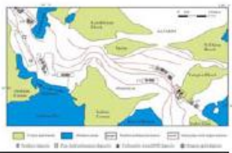
Opportunities and Actions

UK: **NERC** Project (2012 – 2017)
Collaborating with China, Greece, India, Iran, Italy, Kazakhstan, Kyrgyzstan and Turkey
Earthquake without frontiers: A partnership for increasing resilience to the seismic hazard in the continent
Budget: £ 3.5 M



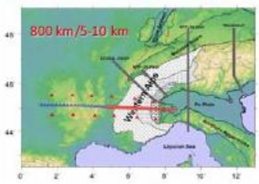
Opportunities and Actions

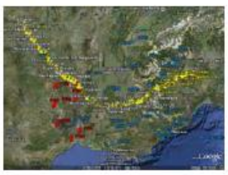
International Geoscience Programme (**IGCP**) sponsored by **UNESCO** & **IUGS**
IGCP/SIDA-600: **Metallogenesis of Collisional Orogens** (2011 - 2014)
Collaboration of 8 countries, 60 researchers



Opportunities and Actions

Cooperation of **research groups** from **China, France** & **Italy**
Geophysical collaborative observation (2011-2013)

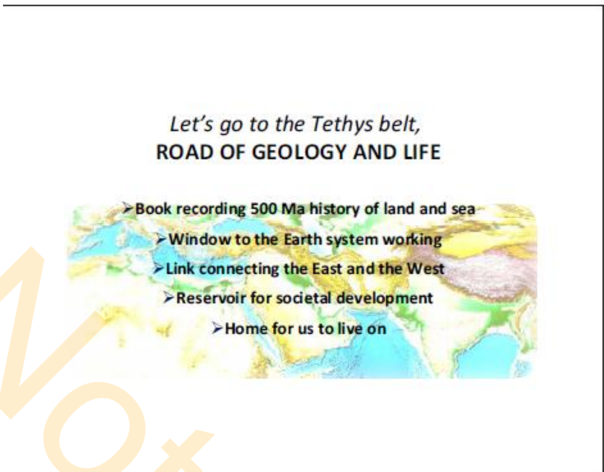


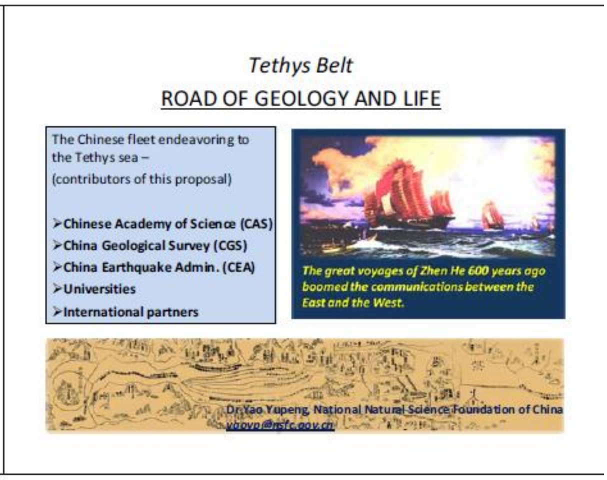


Opportunities and Actions

Advantages for GGI

- **Projects by funding agencies and international organizations**
- **Societal needs, from hazard mitigation to resource exploration**
- **Nations of different scientific & developing levels**

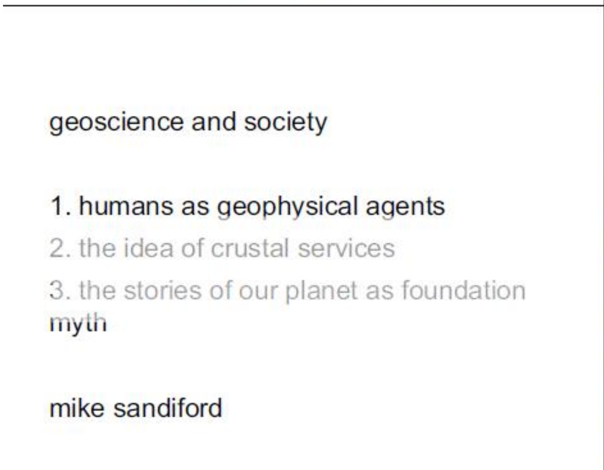


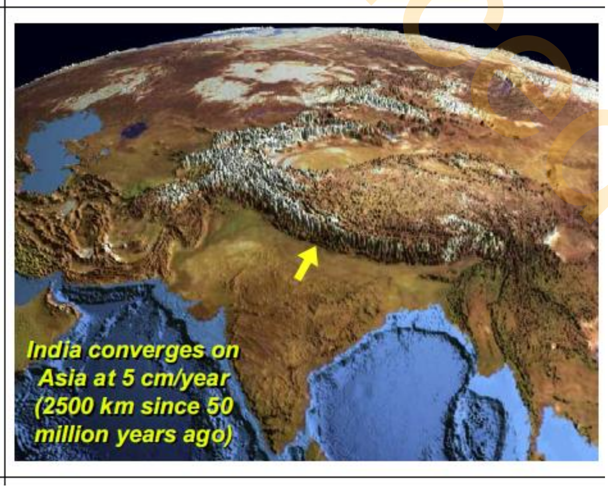


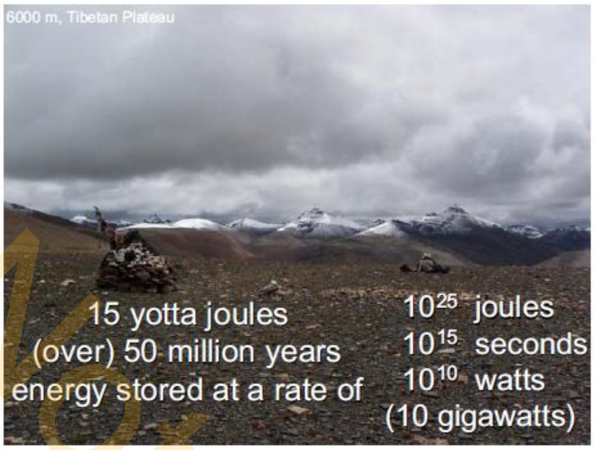
5) Dr. Mike Sandiford (School of Earth Sciences, University of Melbourne) – Geoscience and Society

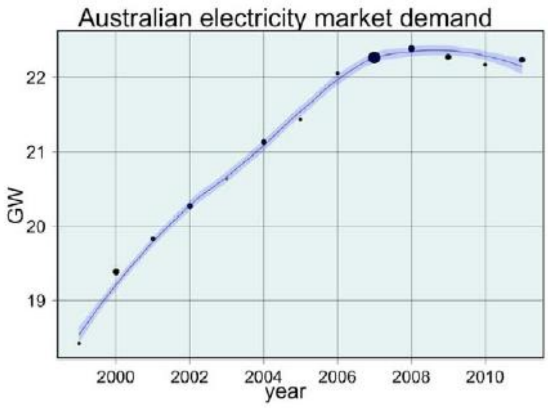
Mike Sandiford discussed geoscience and society and the geophysical scale of the planet.

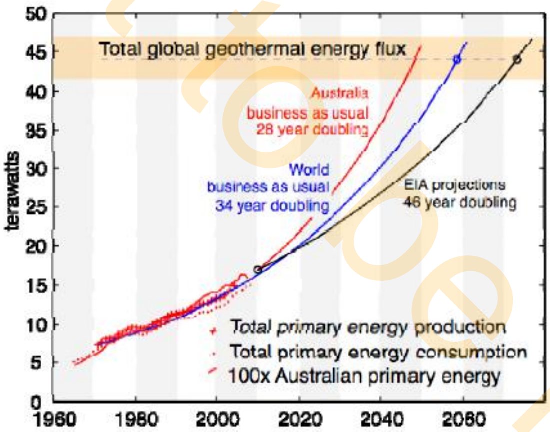
- Humans as geophysical agenda
- The idea of crustal services
- The story of our planet as foundation myth

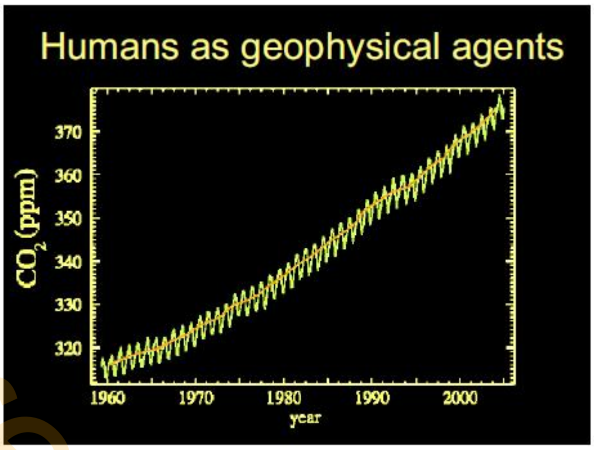




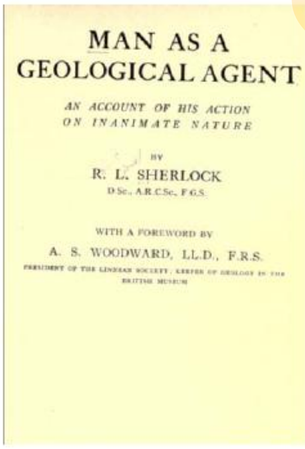








"Most interesting of all, perhaps, is the question whether man, by his prodigious combustion of coal …, is producing more carbonic acid [CO2] than can be eliminated by ordinary natural processes. If this production is excessive, the result eventually may be an unwelcome change in his atmospheric surroundings." Foreword to "Man as a geological agent", 1922.


MAN AS A
GEOLOGICAL AGENT

AN ACCOUNT OF HIS ACTION
ON INANIMATE NATURE

BY
R. L. SHERLOCK
D.Sc., A.R.C.Sc., F.G.S.

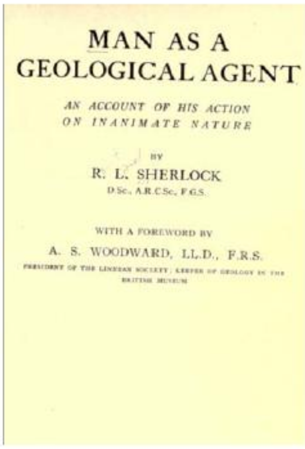
WITH A FOREWORD BY
A. S. WOODWARD, LL.D., F.R.S.

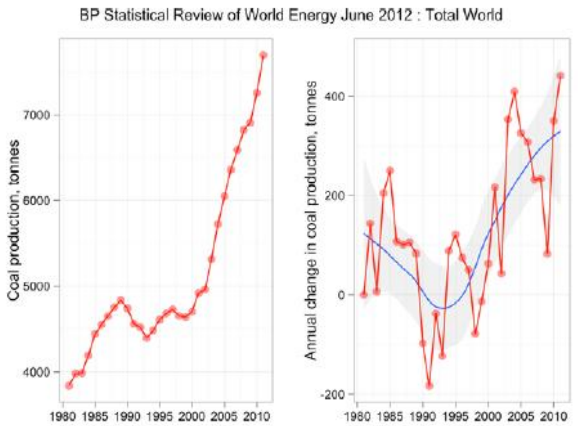
geoscience and society

1. humans as geophysical agents
2. the idea of crustal services
3. the stories of our planet as foundation myth

mike sandiford

“Man … may be approaching a stage when he should pause to consider whether his use and alteration of the crust of the earth itself are for future as well as for present advantage.“
Foreword to “Man as a geological agent”, 1922.





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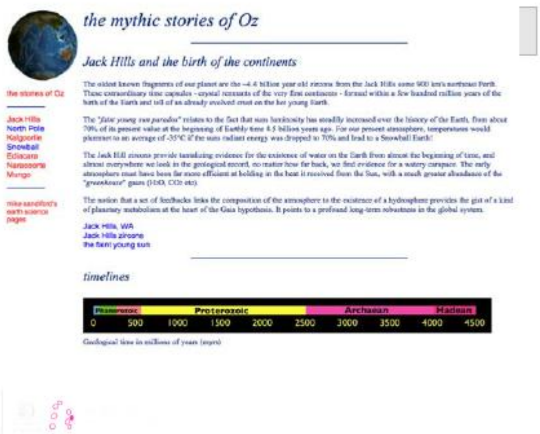

Breakout Groups

Each group’s responses to the Belmont Forum Question:

“What are the three critical geosciences topical priorities that should be included in the GGI and Belmont Forum agenda and given the strategy developed by the Forum, how can social science be integrated effectively into the research design to ensure relevance to decision makers?”

i) Group 1 (led by Michelle Cooper, YES network member)

a. Water

Water with a particular focus on groundwater, the most neglected aspect of the water cycle. It is important to understand more about the connectivity of groundwater and other water cycle components as until recently they have been looked at as separate systems. Groundwater can have a significant impact on ecosystems. The goal should be to increase the focus on groundwater and develop a detailed integrated model.

The role of geology in the water cycle is less recognised and there is scope to improve research and increase community understanding. There is a lot of potential to progress knowledge through research projects and collaboration.

It is possible for example to apply 'new' techniques such as those used in mineral exploration to better map and understand groundwater and water systems. A good understanding of the system is needed in order to recognise changes.

Water relates to communities, economics and is vital for all life. It will be important to work with social scientists to communicate the science and to consider the psychology behind implementation/communication. The question of human need versus ecosystem need will have to be addressed.

b. Coastal Vulnerability

Although the Belmont Forum is already investigating this topic, this group felt that there is a role for geoscientists to bring together and communicate the role of geology/geoscience in the area of coastal vulnerability. The Belmont Forum would have the ability to draw together researchers, organizations and communities to make research into this topic more global and less 'individual study area' focused. Social science would need to be incorporated into the program to ensure community 'buy-in'.

c. Energy

Geoscientists should play a bigger role in communicating the geoscience and 'background' of climate science. Geoscience has a large role to play in the area of developing and promoting alternate energy sources and pollution mitigation (e.g. carbon capture and storage).

d) The group also discussed:

- Urban Development and the Subsurface: Particular emphasis could be placed on the subsurface, 'the invisible element'.
- Intraplate Deformation: The group discussed this topic but felt it might be better suited to collaboration between geosurveys.
- Geohazards: The group felt that this topic was already receiving a lot of attention and that there is already substantial international cooperation

ii) Group 2 (Led by Gabriela Perlingeiro YES Network member)

a. Mining Waste Contamination

How mining has been affecting humans health in regards to its wastes? For example, how do mining wastes cause cancer in people that live nearby mines? How are the soils in these regions affected? Does it also contaminate food production in such areas?

b. Cities on Deltas

Seventy percent of the world's population lives around or on deltas. We do not fully understand how they work. Perhaps we could focus on research in the Asia region (as pointed out in the last talk given by the Chinese).

c. Regional Small Hazards

Rather than paying attention to global scale events, there is the necessity of studying small-scale disasters that affect small communities.

iii) Group 3 (Led by Amel Yes Network member)

b. Natural hazards:

The group posed the following question: How can geologists be more effective in spreading awareness and help government mitigate natural hazards consequences? It is known that geologists tend to be reached for by the public and governments almost exclusively when natural disasters occur; they're then asked for explanations and also responsibility of spreading awareness and assessing risks. Geological hazards are usually unpredictible. However, geologists play a key role to help governments mitigate their risks.

The idea suggested is to create a "field" organization (e.g. under the name of "Geologists of the World", analogically to "Médecins sans frontières") whose aim is to be active in the zones with potential risk and whose activities will be centered on spreading awareness among populations about geological hazards in their regions, help governments setting mitigation plans and be present in disastered areas to explain the geological aspects and assess future risks.

c. Geologists and Society:

The role of social sciences in the geologists work is crutial sometimes when it comes to dealing with topics like natural disasters. Although it can seem a difficult match, but geologists can work with social scientists in order to get closer to the public and spread the maximum of awareness about the geological aspects that surround them in their area of living, and which can affect them directly or indirectly.

It would even more ideal, if geologists could be formed to have a social scientist profile, through special formations and trainings. This would not only help them to reach directly the society, but also to be more effective and powerful in the decision making area.

To improve also the image of geologists, there is a need of more positivity when dealing with geological implications in societal aspects; as Earth gives "services" to the humanity, there are some side effects for these services, and geologists need to use this balance to incorporate this science with all its aspects into sustainable development.