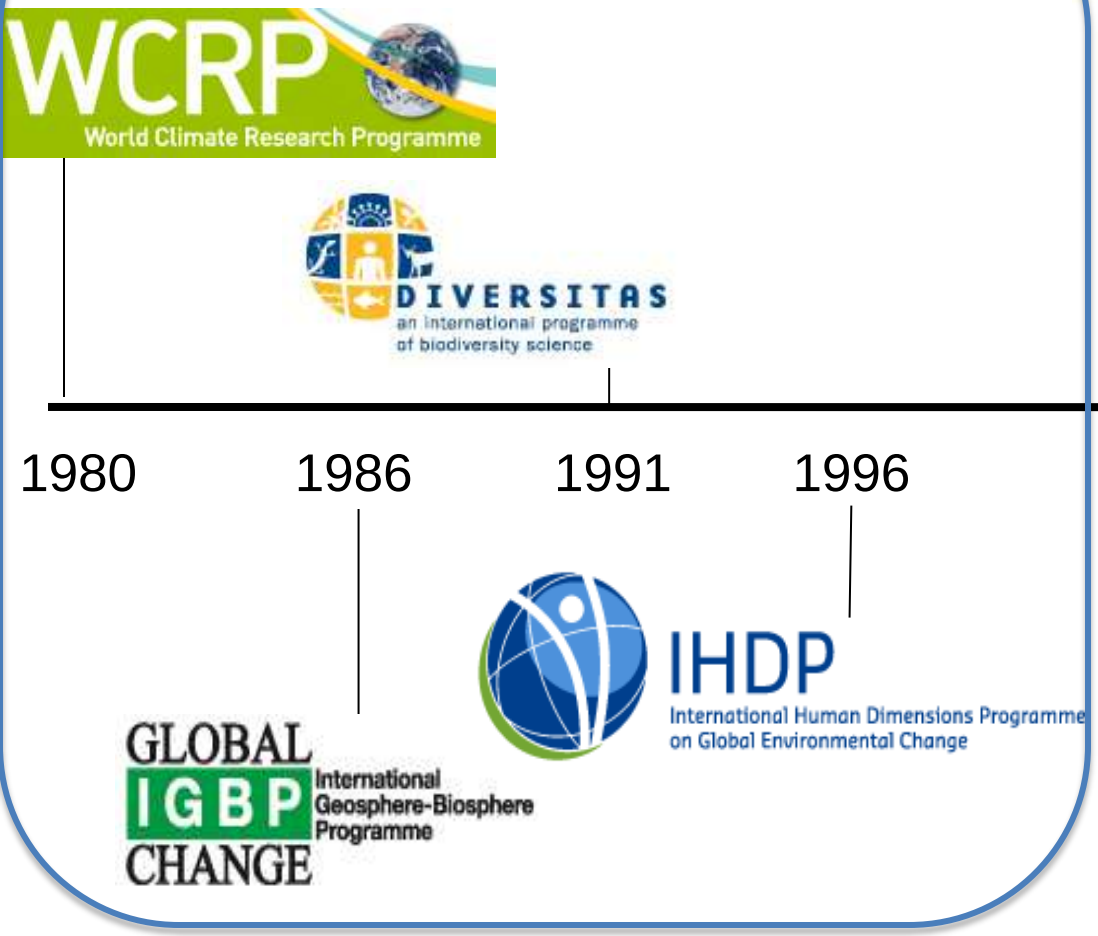
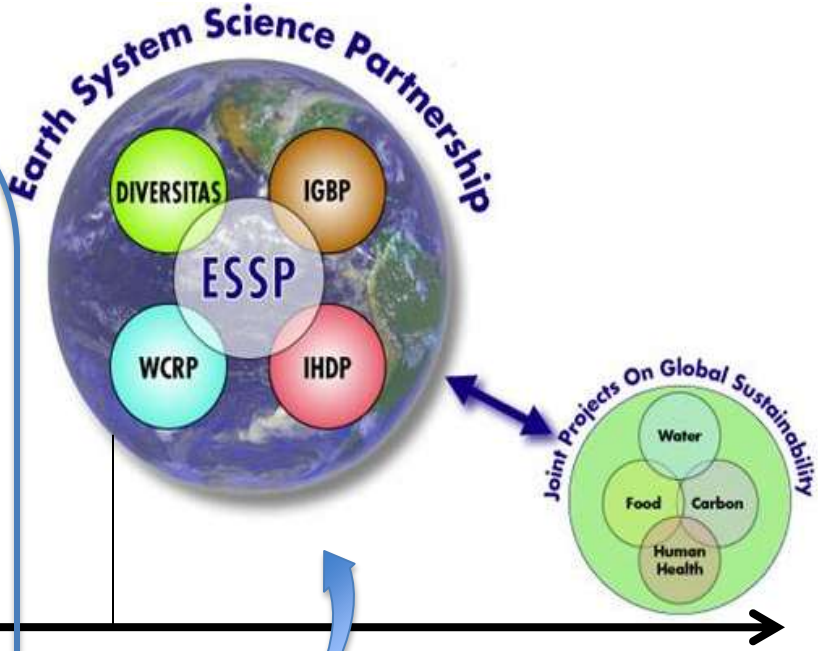
GEC research: a long, successful history

four Global Environmental Change Programmes





and their partnership

all co-sponsored by ICSU

The need for an even more coordinated approach

Common recommendations from ICSU/IGFA reviews of GEC Programmes (2006-2009):

- Priority setting
- Effectiveness
- Integrated research framework

"*There is a clear need for an internationally coordinated and holistic approach to Earth system science that integrates natural and social sciences from regional to the global scale*." (ESSP review)

Why a new initiative?

Need for a unified strategic framework to:

- deepen our understanding of the Earth system
- deliver solutions to sustainability challenges, at regional to global scale

An Initiative arising from Visioning and Belmont efforts

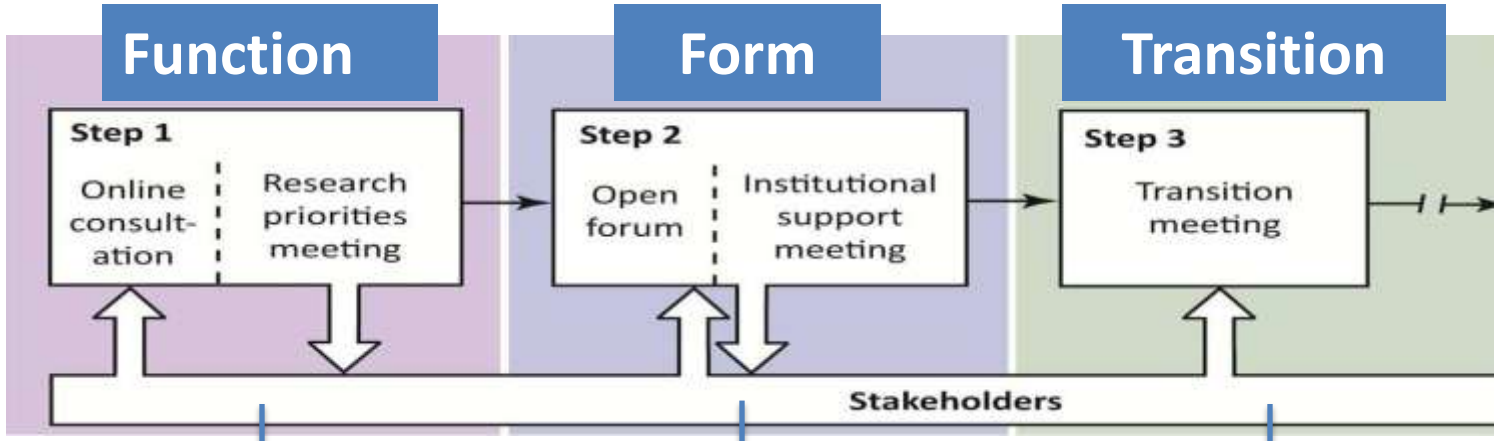
Earth System Visioning (2009-2011)

- mandated by the ICSU General Assembly in 2008
- to outline options for an **overall framework for global environmental change research**
- established in cooperation with ISSC

Belmont Forum

- a high-level body of main funders of environmental change research
- established in 2009
- to **catalyze delivery of the environmental science-derived solutions that society needs**

Visioning: a three-year consultative process



2009

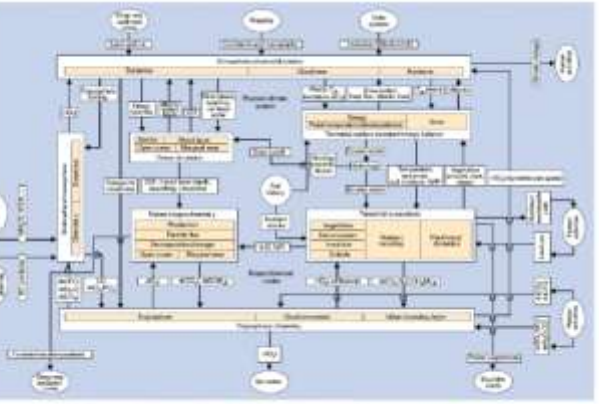
2011

- Five Grand Challenges
- Integration across disciplines
- A new way of doing research

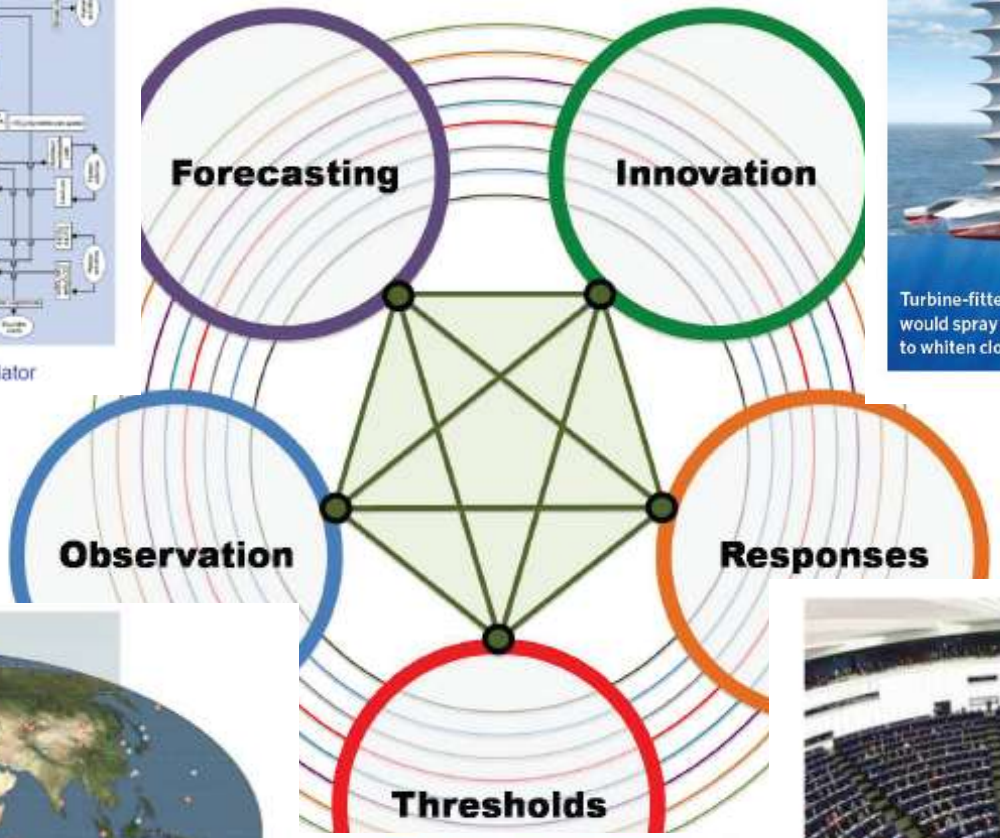
- Business as usual is not an option
- Need an overarching structure

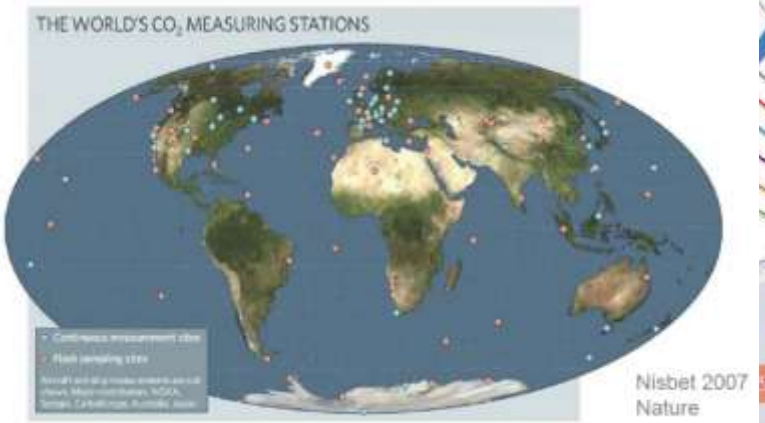
- A Joint Integrated Strategy under unified framework
- Strategically integrating GECs and other structures

Visioning: the five Grand Challenges



"Wiring diagram" (1985) → Earth System Simulator





Nisbet 2007 Nature

Earth Governance

after Lenton et al. 2008

Grand Challenges: publications

POLICYFORUM

ENVIRONMENT AND DEVELOPMENT

Earth System Science for Global Sustainability: Grand Challenges

W. V. Reid,[1]* D. Chen,[2] L. Goldfarb,[2] H. Hackmann,[3] Y. T. Lee,[2] K. Mokhele,[4] E. Ostrom,[5] K. Raivio,[2] J. Rockström,[6] H. J. Schellnhuber,[7] A. Whyte[8]

improved health and human security, and enhanced energy security? Can this be done while also meeting the United Nations Millennium Development Goals of eradicating extreme poverty and hunger and ensuring ecosystem integrity?

Answering these questions will require reorientation toward new research that better allows science and society to address the needs of decision-makers and citizens at global, regional, national, and local scales (*2*). We will have to meet a twofold challenge: (i) develop strategies to respond to ongoing global change while meeting development goals and (ii) deepen knowledge of the functioning of the Earth system and its critical thresholds (*3*). Promoting sustainable development requires research on a wide range of social, economic, cultural, institutional, and environmental issues (*4*). Given that sustainable development is no longer possible without addressing interactions with global change dynamics (*3*), we focus here on an important dimension of this larger sustainability agenda: the need to broaden and

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and framework of Earth system research (*7*, *8*). Efforts were made to obtain balanced input from developed and developing country experts, young and senior scientists, social and natural sciences, and both researchers and those using the findings of research. This process resulted in five "Grand Challenges" (listed below in italics), a consensus list of the highest priorities for Earth system science that would remove critical barriers impeding progress toward sustainable development (*9*). The challenges meet four criteria: (i) scientific importance, (ii) need for global coordination, (iii) relevance to decision-makers, and (iv) leverage (i.e., would help address multiple problems). For each grand challenge, several important research questions are identified as answerable within a decade.

Improve the usefulness of forecasts of future environmental conditions and their consequences for people. We need to develop what amounts to an enhanced Earth system simulator to improve our ability to anticipate impacts of a given set of human actions or conditions on global and regional climate and on biological, geochemical, and hydrological systems on seasonal to decadal time scales. Most current efforts to build state-of-the-art whole-Earth system models depart from sophisticated geophysical kernels (coupled atmosphere-ocean models based on exact dynamical equations like Navier-Stokes) that are to be complemented by equally powerful tools (once they become available) representing other parts of the planetary makeup. But,

Published by AAAS

Earth System Science for Global Sustainability

The Grand Challenges

ISSC

ICSU

International Council for Science

Reid *et al.* 2010 Science

The Belmont Challenge

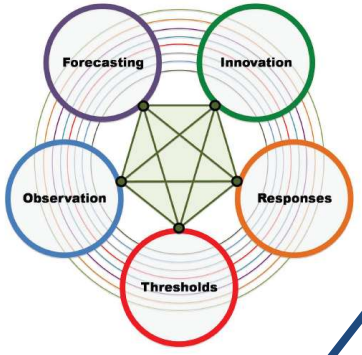
To deliver knowledge needed for action to mitigate and adapt to detrimental environmental change and extreme hazardous events.

This requires:

- Assessments of risks, impacts and vulnerabilities, through regional and decadal analysis and prediction
- Information on the state of the environment, through advanced observing systems
- Interaction of natural and social sciences
- Enhanced environmental information service provision to users
- Effective international coordination mechanisms.

Convergence of strategies for a long-term partnership

ICSU – ISSC
Visioning



Cape Town
meeting
Dec 2010

Seeking stronger
partnership

Belmont
Forum