ICSU
International Council for Science

IUGG XXVth General Assembly
Melbourne, Australia – 29th June, 2011

U-02 Open Forum: Natural Hazards: from Risk to Opportunity by Partnership of Science and Society

Partnership of Science and Society: A great Challenge

Reiko Kuroda

ICSU Vice-President for External Relations
Professor of the University of Tokyo (Chemistry/Biology)
Head, Science Interpreter Training Program, The University of Tokyo

Natural catastrophes

Geophysical events:

earthquake, tsunami,
volcanic eruption

Meteorological events:

tropical storm, winter storm,
severe weather, hail, tornado,
local storms

Hydrological events:

flash flood, river flood, storm surge,
mass movement (landslide)

Climatological events:

heatwave, freeze, wildland fire, drought

Geophysical events:

Great East-Japan Earthquake

14:46 JST on Friday, 11 March 2011

Magnitude 9.0
Many aftershocks
7.4, 7.1 etc

Tsunami waves of up to 38.4 meters

15,471 deaths, and 7,472 people missing as well as over 125,000 buildings damaged or destroyed

Source: http://www.tsunami.pro/articles/133895/Damage-and-Effects

Soccer field in Minamisanriku

Adapted from ABC news

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Arahama, Sendai

© Google

Adapted from ABC news

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Natural catastrophes

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earthquake, tsunami,
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Cannot stop the incidence

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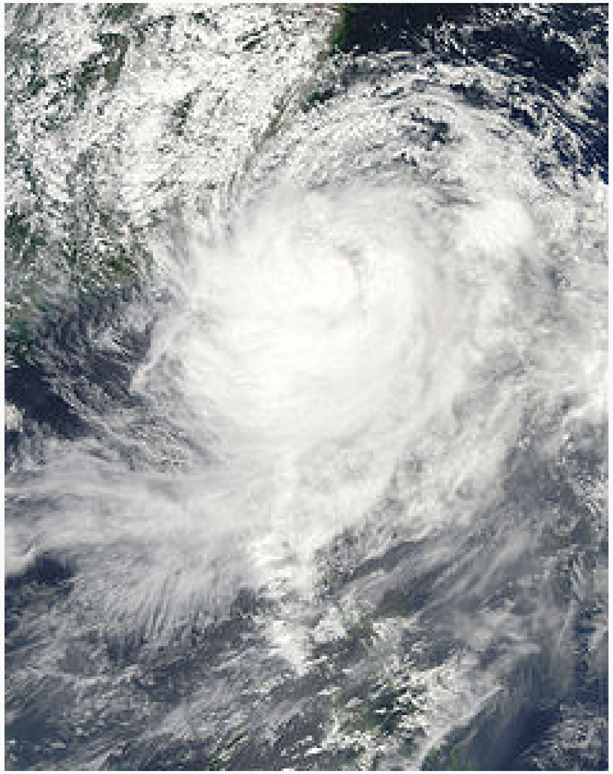
Typhoon Morakot (Kiko) Aug. 2009

Typhoon (JMA)

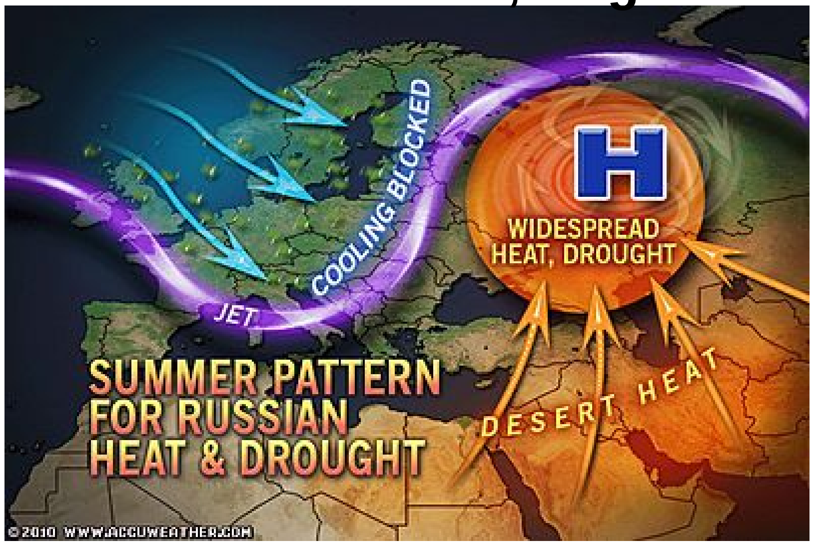
Category 2 typhoon (SSHS)



Typhoon Morakot near peak intensity.

Pakistan Flood, Aug.2010

Russian Heat wave, Aug.2010



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Shiao Lin village,Taiwan, drastic changes after typhoon Morakot.

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Natural?
Human-induced ?

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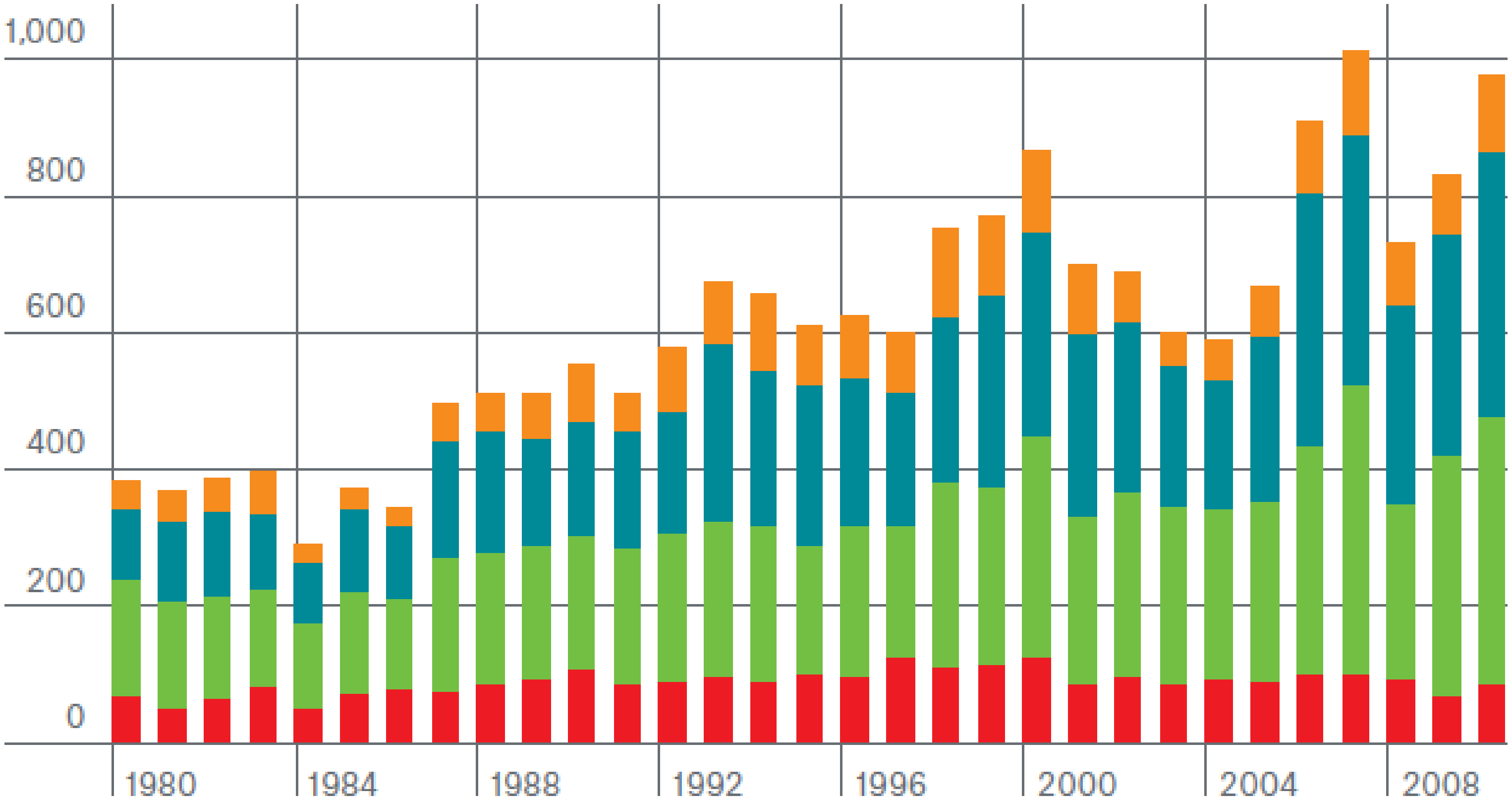
Number of natural catastrophes 1980-2010



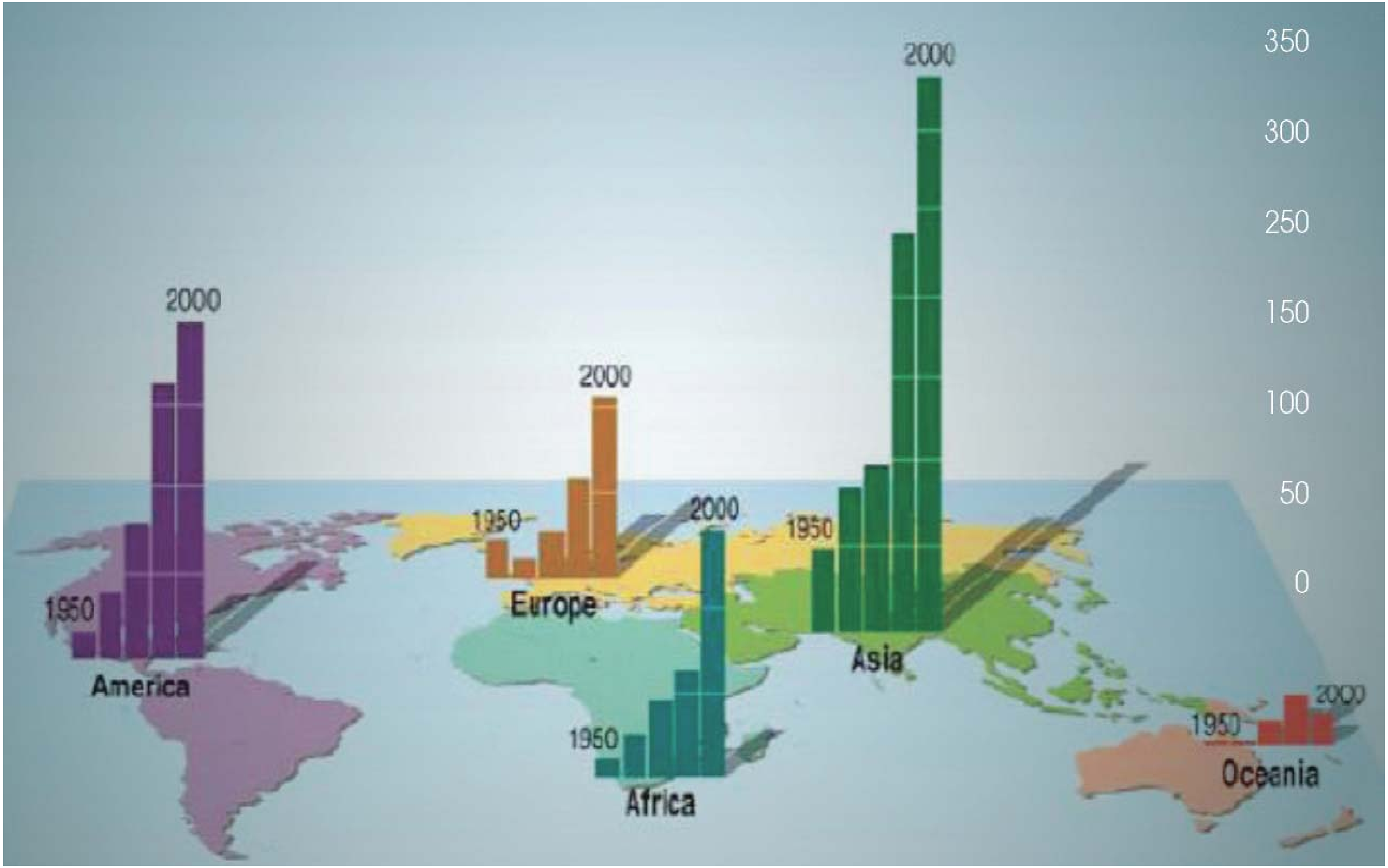
Geophysical events: Earthquake, volcanic eruption

Meteorological events: Tropical storm, winter storm, severe weather, hail, tornado, local storms

Hydrological events: Flash flood, river flood, storm surge mass movement (landslide)

Climatological events: Heatwave, freeze, wildland fire, drought

Major Floods Per Decade



Natural catastrophes

Geophysical events:
Earthquake, tsunami,
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Cannot stop the incidence

However, we can reduce the disaster

Meteorological events:
Tropical storm, winter storm,
severe weather, hail, tornado,
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Hydrological events:
Flash flood, river flood, storm
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Natural?
Human-induced ?

·HFA, ·IRDR, ·WDS
·A New Initiative on Earth System Research for Global Sustainability.
ICSU, ISSC, Belmont Forum, IGFA

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･*We can reduce the disaster risk of both natural and human-induced disasters*

Early warning system Science/ Technology/ Innovation
Build/promote a culture of disaster resilience

･*Human-induced disasters*

Determine how to anticipate, avoid, and manage disruptive global environmental change

･*Partnership of Science and Society*

Scientists with social literacy
Citizens with science literacy
Science interpreter/communicator linking the two

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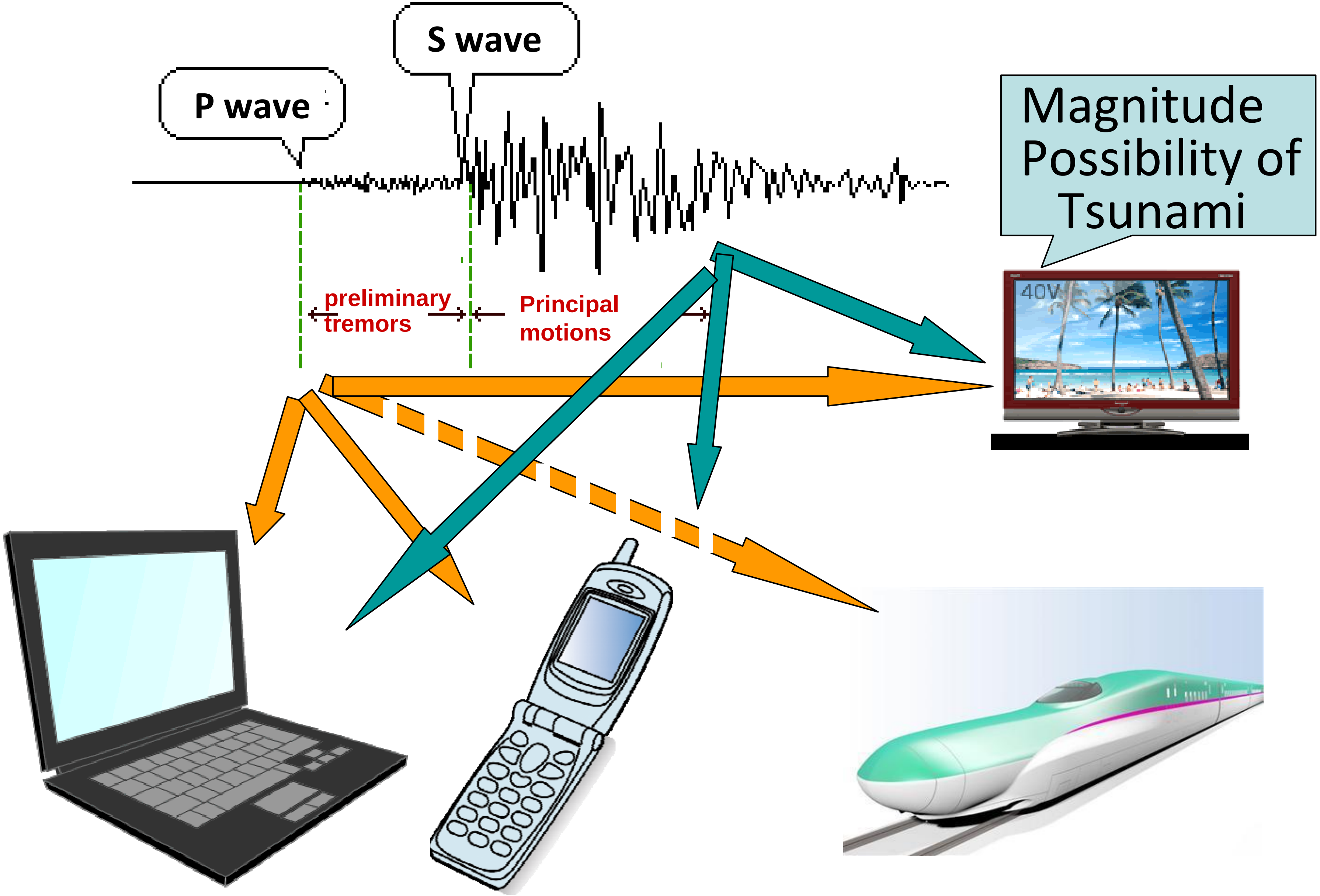
Well-developed early warning system of earthquake/tsunami in Japan



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緊急地震速報 翻訳/活用ソフト 東京大学地震研究所 - Google Chrome

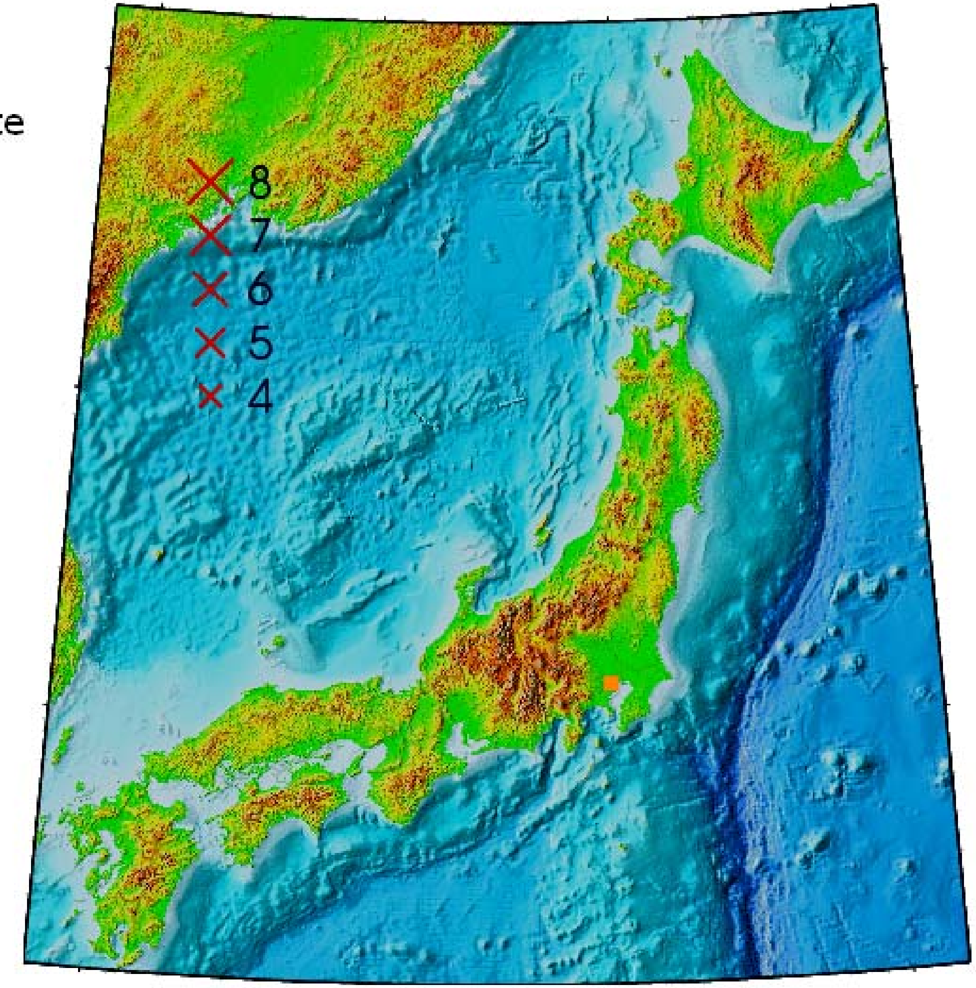
eew-komaba.eri.u-tokyo.ac.jp/komaba/ncmain.html

東京大学 地震研究所
Earthquake Research Institute

Expected magnitude ---

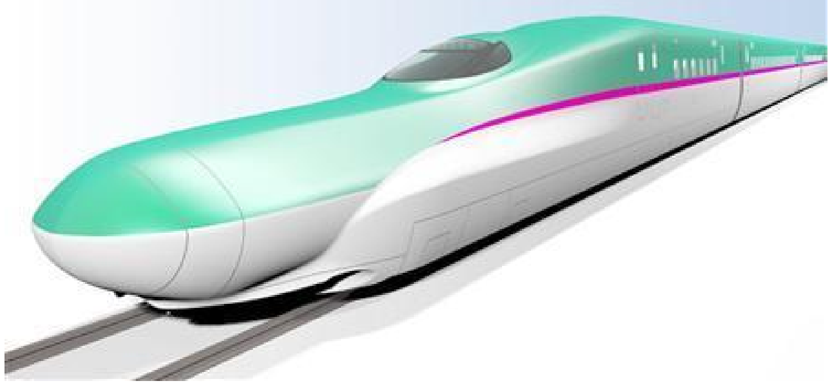
Principal motions comes --- Sec later

Time now	2011/6/20 16:46:52 27
Earthquake ID	-
Triggered time	
Longitude/latitude	E / N
depth	km
magnitude	
epicentre	



訓練の受信: **OFF** ON OFF 震度3未満 **SOUND: ON** ON OFF

Tohoku Shinkansen



27 Shinkansen trains were running in the earthquake-hit area at full speed at the moment of earthquake, but all automatically stopped safely (UrEDAS P-wave warning system developed by the JR Institute) and none ran off the tracks.

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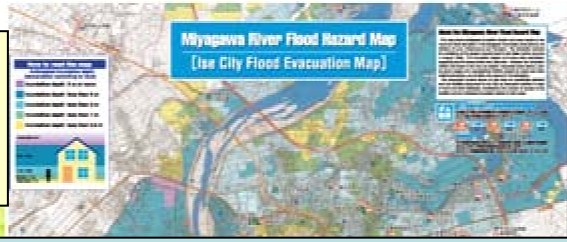
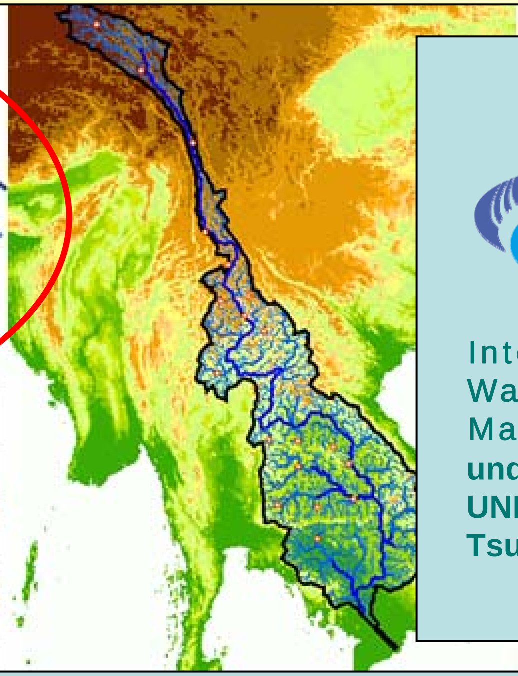
Advanced Technology for Early Warning & Hazard Mapping



IFAS

Integrated Flood Analysis System



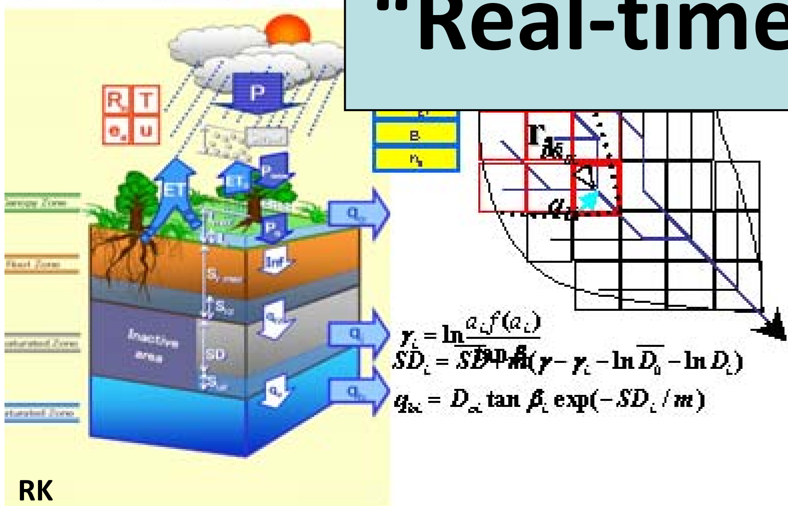
ICHARM

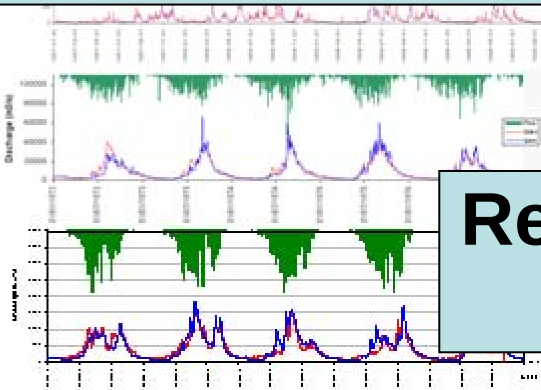
International Center for Water Hazard and Risk Management

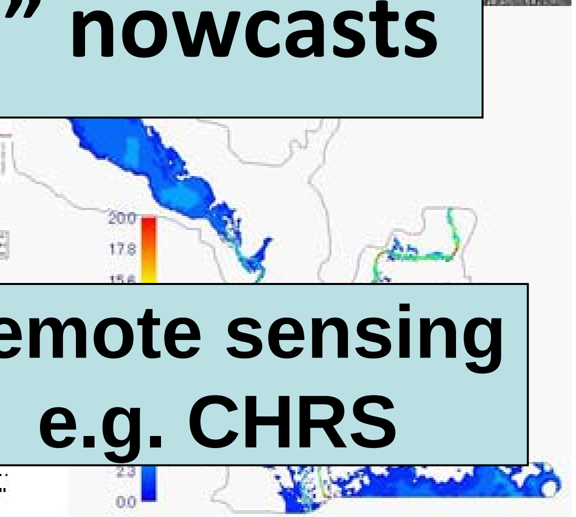
under the auspices of UNESCO hosted by PWRI, Tsukuba

United Nations Educational, Scientific and Cultural Organization

"Real-time" "worldwide" nowcasts







Remote sensing e.g. CHRS

Natural catastrophes

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→ ***However, we can reduce the risk***

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IRDR Integrated Research on Disaster Risk

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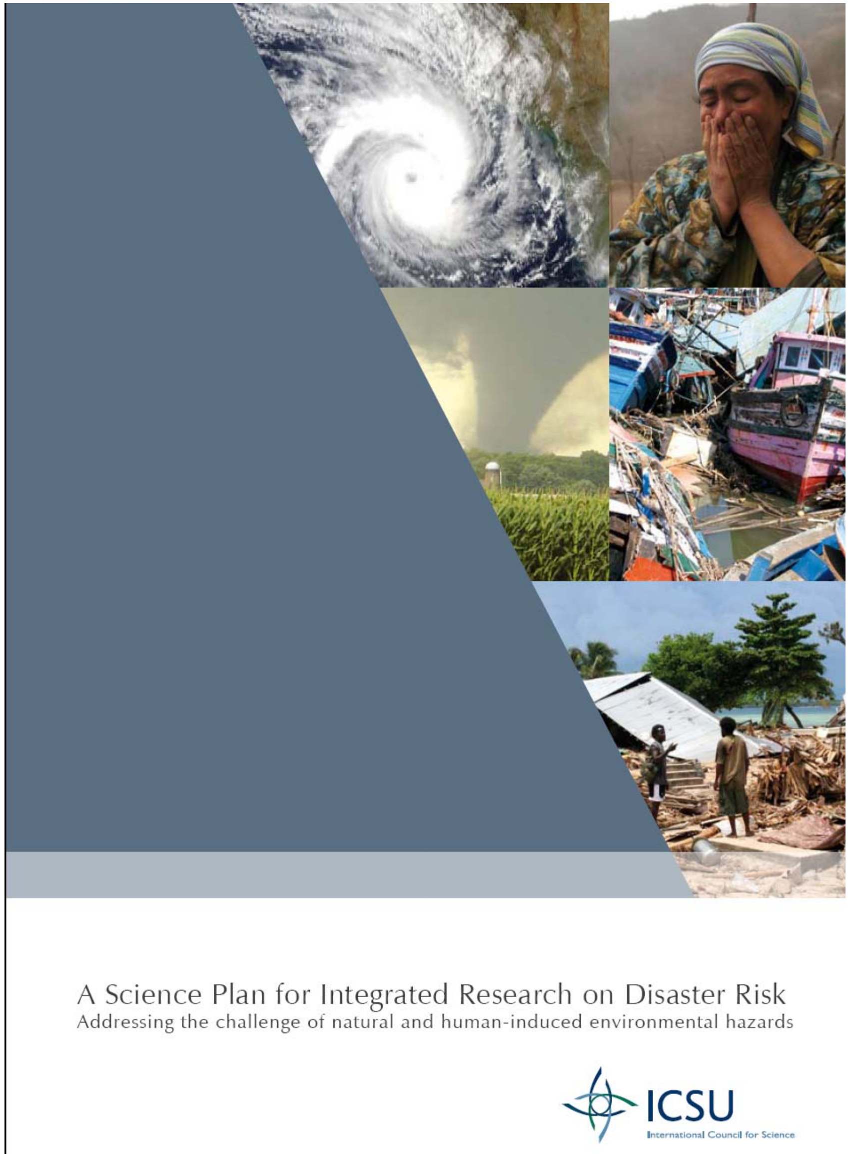

The IRDR programme addresses the impacts of disasters on regional and global scales and brings together the combined talents of the natural, socio-economic, health and engineering sciences from around the world.

IRDR will focus on hazards related to geophysical, oceanographic, climate and weather trigger events – and even space weather and impact by near-Earth objects.

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IRDR
Integrated Research on Disaster Risk

ICSU, ISDR (UN International Strategy for Disaster Reduction), ISSC (International Social Science Council)

IPO: at Center for Earth Observation and Digital Earth (CEODE), Beijing /CEO, Taipei dealing with a defined part

There are three major research objectives:

- to address the gaps in knowledge and methods for the effective identification of disaster risks;
- to better understand just how decisions can contribute to hazards becoming disasters – or reduce their effects; and,
- to develop knowledge-based actions that will reduce risk and curb losses.

ICSU International Council for Science

BELMONT FORUM

ISSC international social science council

IGFA International Group of Funding Agencies for Global Change Research

A New Initiative on Earth System Research for Global Sustainability

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Earth System Research for Global Sustainability: A New 10-Year Research Initiative

Societies need knowledge that will allow them to simultaneously reduce global environmental risks while also meeting economic development goals.

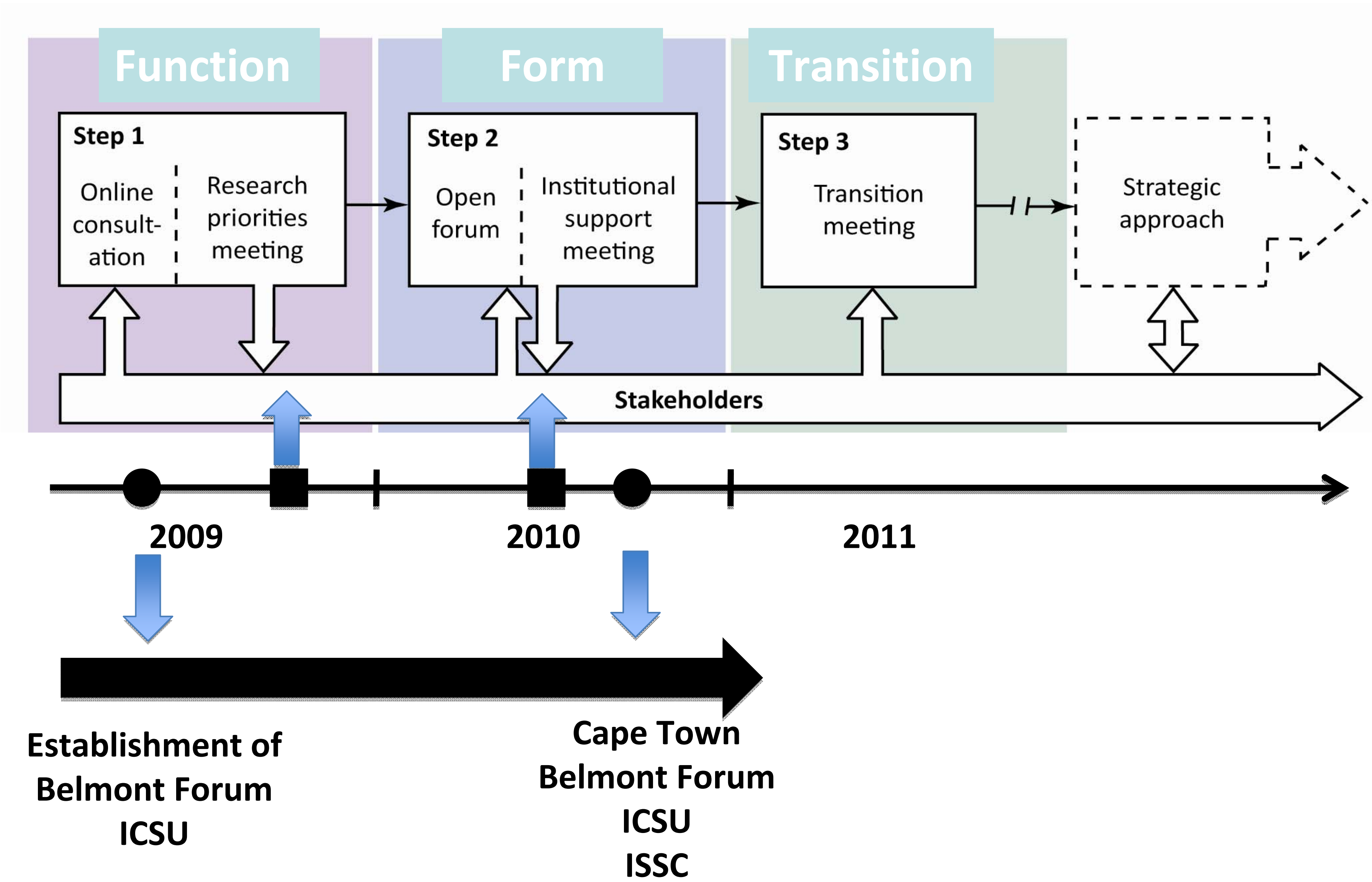
How can we advance science and technology, change human behavior, and influence political will to enable societies to meet targets for reductions in greenhouse gas emissions to avoid dangerous climate change?

At the same time, how can we meet needs for food, water, 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

Earth System Visioning Process



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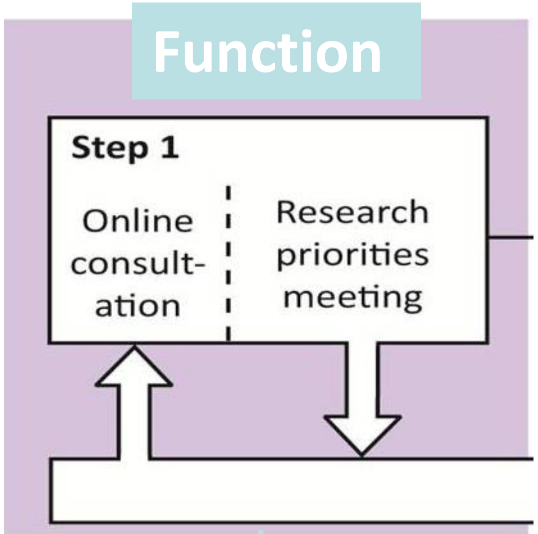
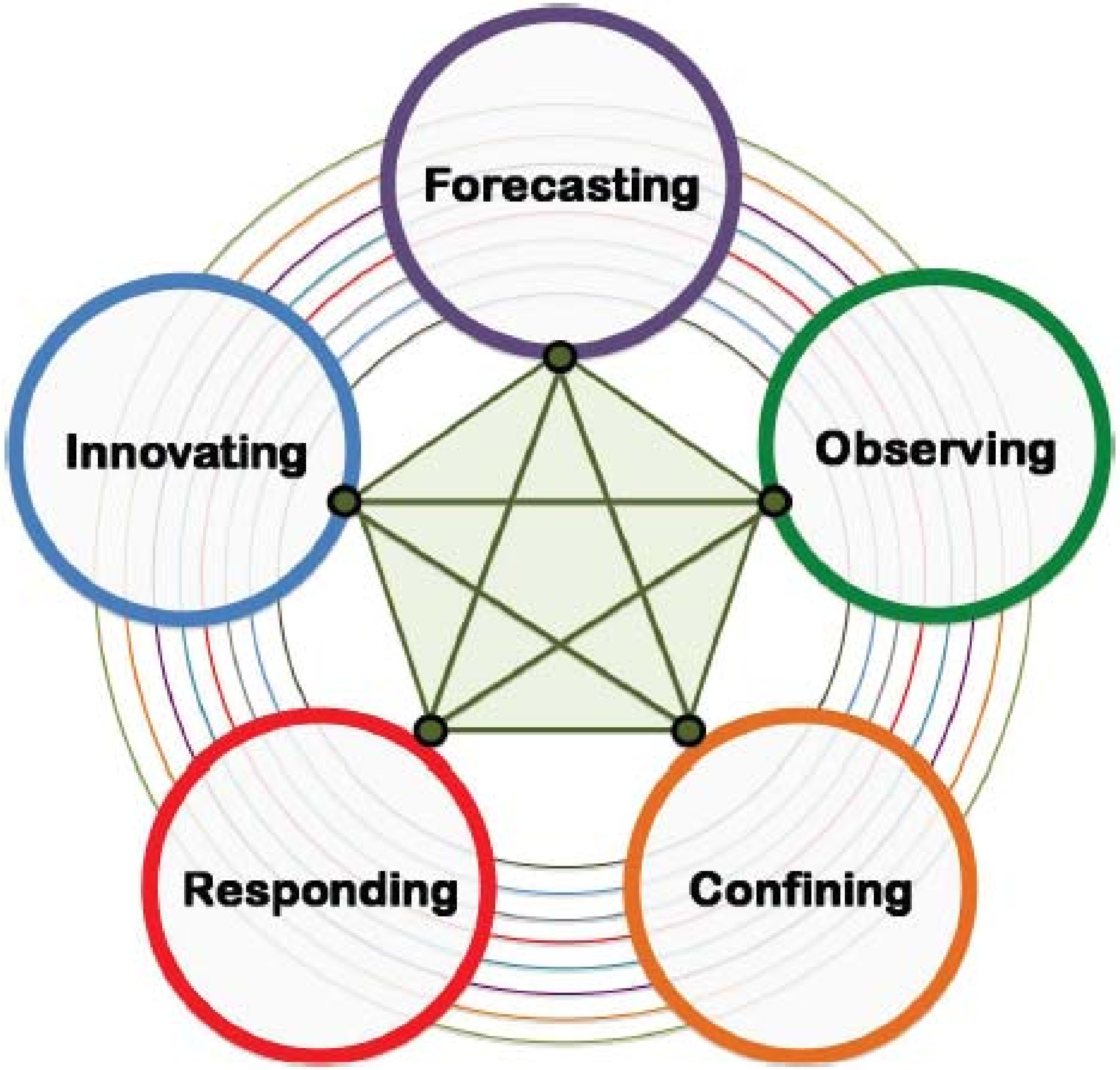
Visioning process: Step 1



- **5 Grand Challenges**
- Natural sciences, social sciences and humanities
- Disciplinary, interdisciplinary and transdisciplinary



“Grand Challenges”

a consensus list of the highest priorities for Earth system science that would remove critical barriers impeding progress toward sustainable development

1) *Improve the usefulness of forecasts of future environmental conditions and their consequences for people.*

2) *Develop, enhance, and integrate observation systems to manage global and regional environmental change.*

3) *Determine how to anticipate, avoid, and manage disruptive global environmental change.*

4) *Determine institutional, economic, and behavioral changes to enable effective steps toward global sustainability.*

5) *Encourage innovation (and mechanisms for evaluation) in technological, policy, and social responses to achieve global sustainability.*

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Grand Challenges: overarching goals

A two-fold research challenge:

- develop effective response strategies to ongoing global change
- deepen our knowledge of the functioning of the Earth system

New ways of doing research

- implement a more balanced mix of disciplinary, interdisciplinary, and transdisciplinary research
- actively involve stakeholders and decision-makers
- transition from research dominated by natural sciences to research involving the full range of sciences and humanities

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]

Tremendous progress has been made in understanding the functioning of the Earth system and, in particular, the impact of human actions (*1*). Although this knowledge can inform management of specific features of our world in transition, societies need knowledge that will allow them to simultaneously reduce global environmental risks while also meeting economic development goals. For example, how can we advance science and technology, change human behavior, and influence political will to enable societies to meet targets for reductions in greenhouse gas emissions to avoid dangerous climate change? At the same time, how can we meet needs for food, water, 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 (*5*), we focus here on an important dimension of this larger sustainability agenda: the need to broaden and deepen Earth system research to encompass the intersection of global environmental change and sustainable development.

[1]David and Lucile Packard Foundation, Los Altos, CA 94022, USA. [2]International Council for Science (ICSU), 75116 Paris, France. [3]International Social Science Council (ISSC), 75732 Paris, France. [4]National Research Foundation of South Africa, Pretoria, 0001, South Africa. [5]Indiana University, Bloomington, IN 47408, USA. [6]Stockholm Environment Institute, SE-106 91 Stockholm, Sweden. [7]Potsdam Institute for Climate Impact Research, 14473 Potsdam, Germany. [8]Environment and Natural Resources, International Development Research Centre, Ottawa K1G 3H9, Canada.

*Author for correspondence: wreid@packard.org

Grand Challenges

A great deal of collaborative international research on global environmental change is coordinated through four Global Environmental Change Research Programmes (*6*) and the Earth System Science Partnership. In light of the need for an overarching set of solution-focused and integrated research priorities for these institutions, the International Council for Science (ICSU) and the International Social Science Council (ISSC) carried out a consultative process to rethink the focus 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,

Determine how to anticipate, avoid, and

Published by AAAS

Earth System Science for Global Sustainability

The Grand Challenges

ISSC international social science council

ICSU International Council for Science

Reid *et al*. 2010 Science

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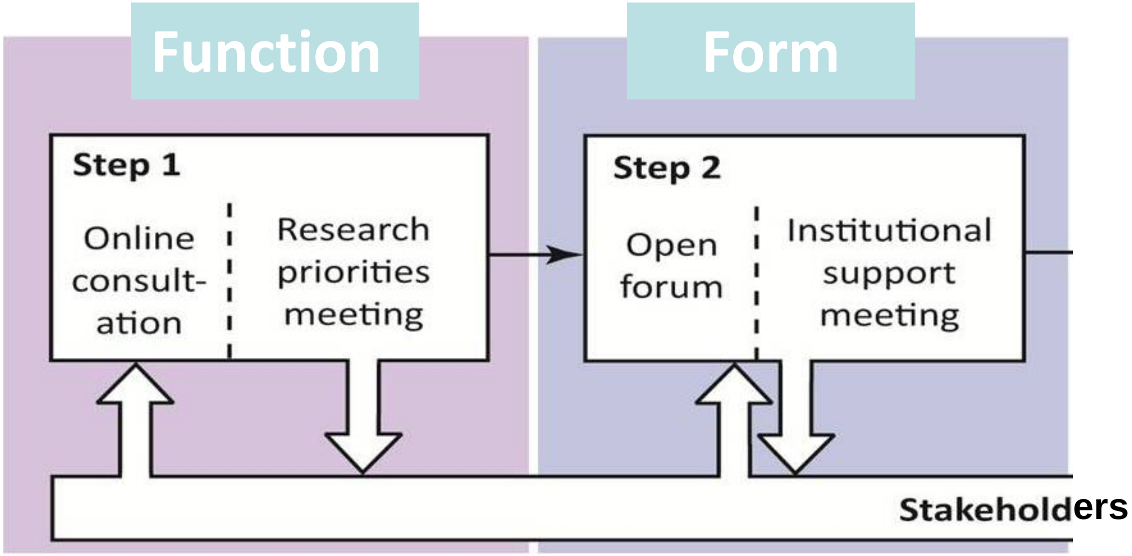
Visioning process: Step 2



- 5 Grand Challenges
- Natural sciences, social sciences and humanities
- Disciplinary, interdisciplinary and transdisciplinary

- Business as usual is not an option

- Need a unified structure

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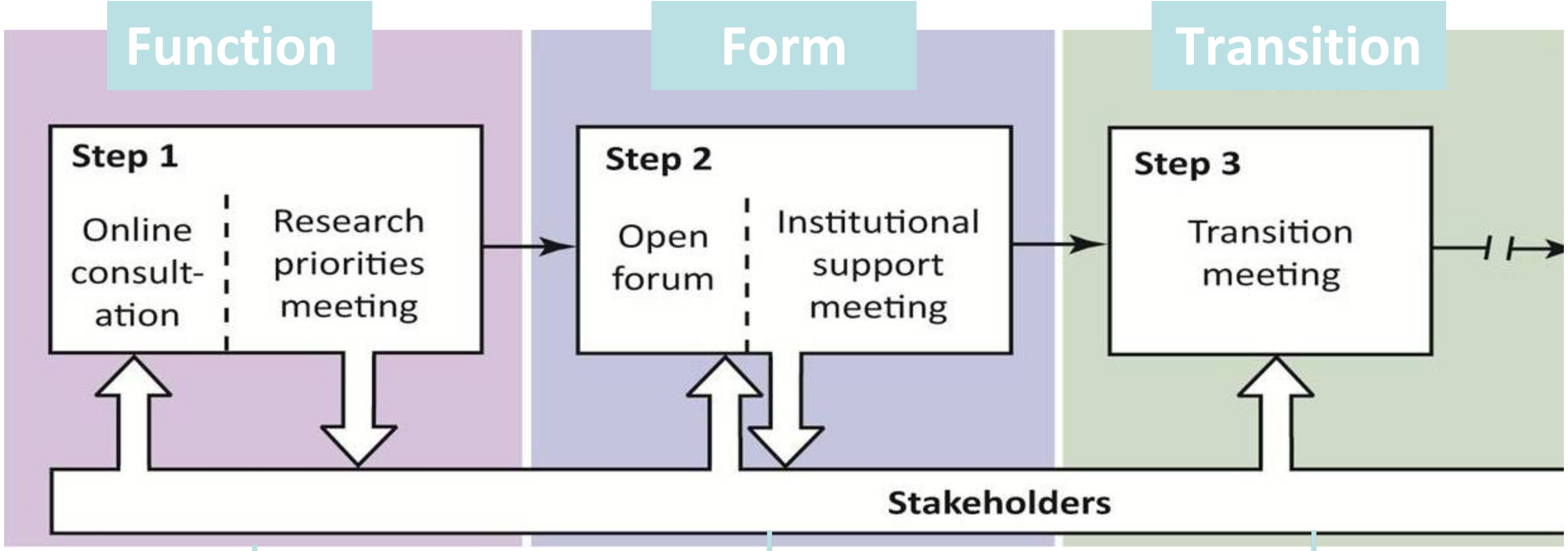
Visioning process: Step 3



- 5 Grand Challenges
- Natural sciences, social sciences and humanities
- Disciplinary, interdisciplinary and transdisciplinary

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

- New Joint Integrated Strategy governed under unified framework
- Aiming at strategically integrating GECs, ESSP and other structures

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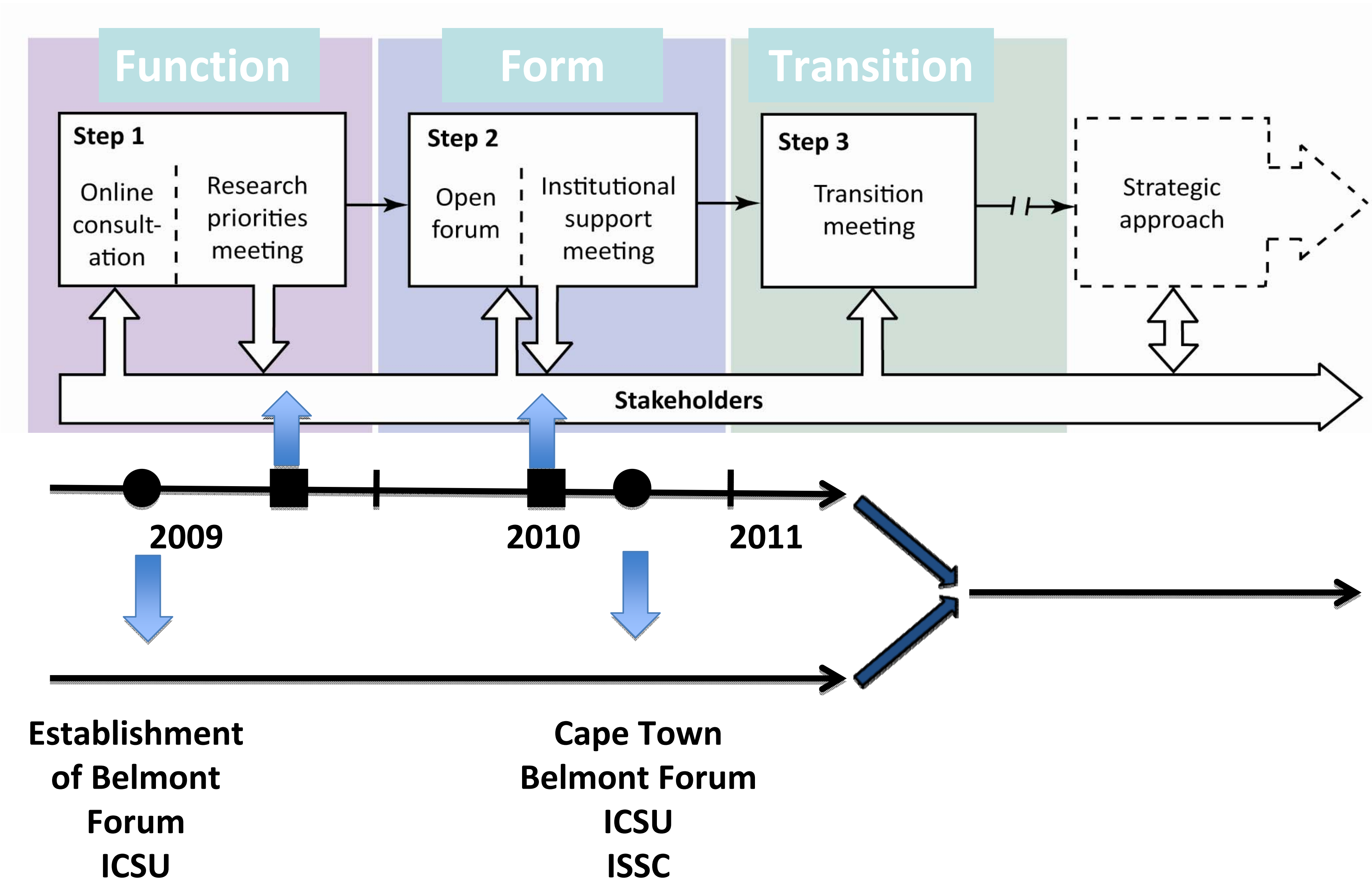
Visioning and Belmont Forum: convergence



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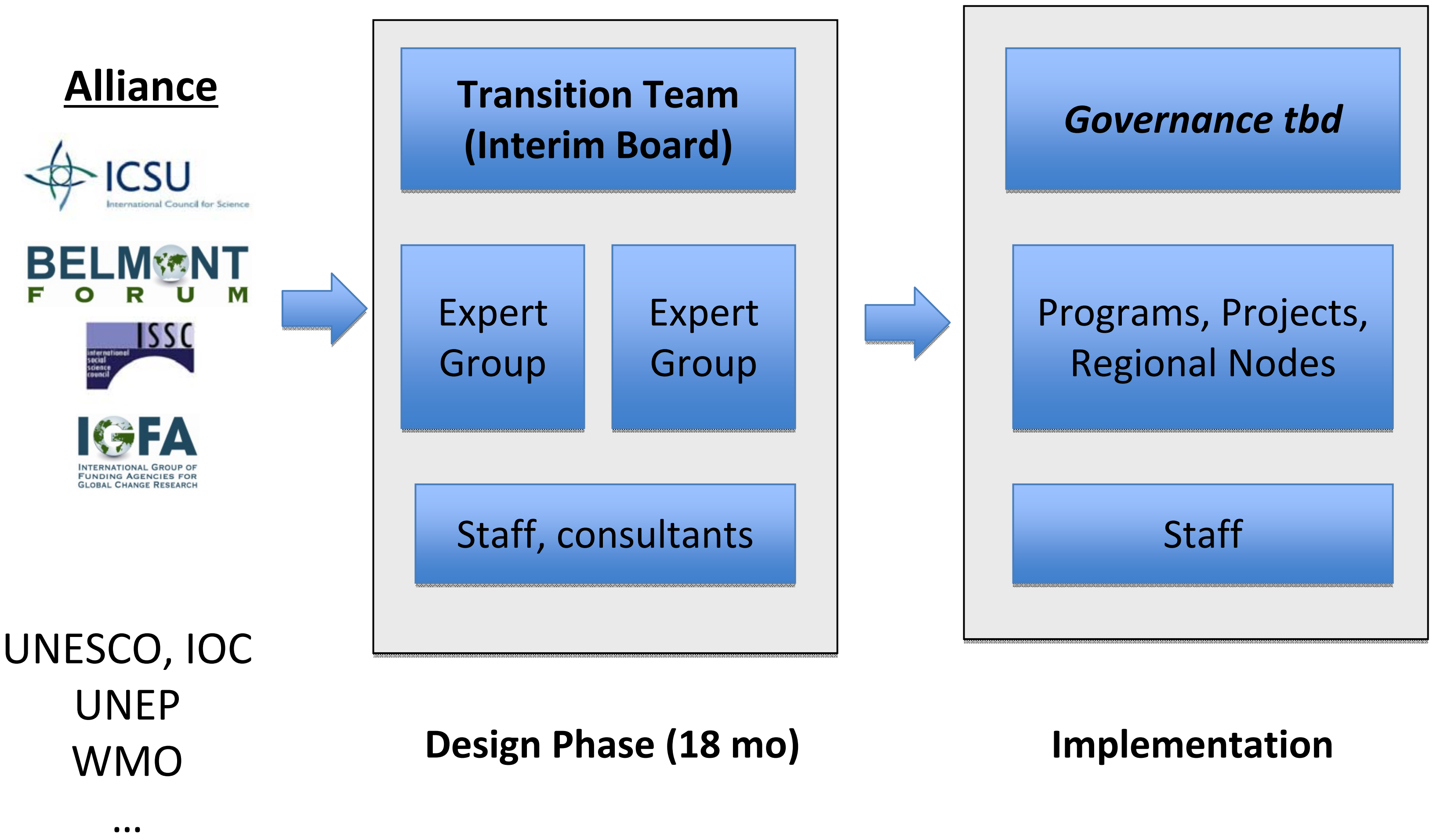
Initiative goals

- **Deliver knowledge to respond to global change**
  - Effectively bridge the science – policy divide at global and regional scales, enabling science to be more readily applied in service of society.
- **Address the grand challenges**
  - Better science (regional, new disciplines, etc.)
  - Mobilize more research support for existing needs, while also expanding support for new needs identified in the Grand Challenges.
- **Engage a new generation of researchers**
  - Broaden the base of scientists involved in the global change research network and enable it to better reflect the expertise, priorities and passions of young researchers

Governance



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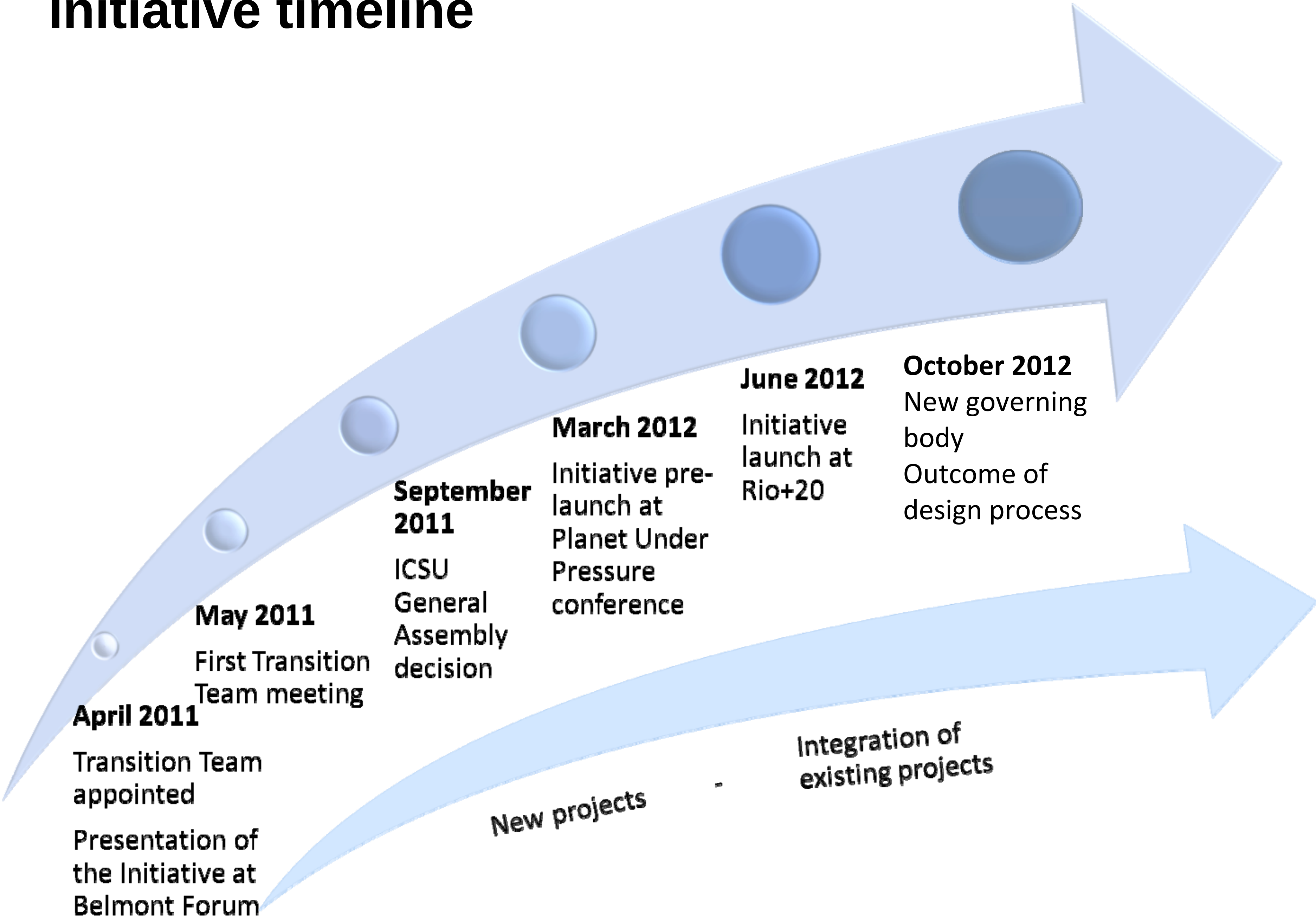
Elements of the design process

- Analysis of existing research
- Initiative Design
  - Input of expertise about other private sector and public sector research networks
  - Consultation with stakeholders
  - Development of the organizational model and governance arrangements
  - Identification of enabling processes (M&E, fundraising, knowledge management)
  - Selection of regional nodes
  - Development of business plan
  - Approval by sponsors and funders

Initiative timeline



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Early warning system **Science/ Technology/ Innovation**
Build/promote a culture of disaster resilience

·Human-induced disasters

Determine how to anticipate, avoid, and manage disruptive global environmental change

·Partnership of Science and Society

Scientists with social literacy
Citizens with science literacy
Science interpreter/communicator linking the two

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Advanced Science and technology
life science, information science, material science etc.

Big Changes in Socioeconomic Structure:

Big changes like the tectonic shifts have occurred in USA in 1990s by micro-processors, the internet and biotechnology, and spread throughout the world, as it is easy to cross the border in the flattened world

Era of Globalization, Knowledge Society, Knowledge Specialization, Knowledge Competition

Science in Society

- **Conflict between rapid progress of science and society**
- **Lights and shadows of science**

  Science has revealed mysteries and created new knowledge, which made our life rich, however, it may change the structure of society, ethics, and values, and destroy the ecosystem and environment.
- **Segmentation of both S&T and society to become black boxes**

  -Causes failure and accidents

  -Low public interests in sciences

  -Less excitement and loss of awe and appreciation for life

  -Spread pseudoscience

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Science in Society

- **Individuals have to make their own judgments in society**
- **S&T policy making with public participation**

Should S&T be more progressed?
applied to the society?
e.g. nuclear power, GMO, Tissue engineering

General public with science literacy
and
Scientist with social literacy are required

Interactive communication between scientists/engineers and the society is important.

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ASAHI EVENING NEWS 30.6.96

FORMULAS FOR THE FUTURE/ *Reiko Kuroda*

What it takes to bridge gap between science and life

Special to Asahi Shimbun

The 20th century has been a century of science. Scientific and technological progress has made possible what was previously deemed impossible and revealed unimaginable cause-and-effect relationships.

Humankind, ever yearning to fly, has conquered the air and can travel faster than sound. Satellites allow us to monitor the Earth from space and facilitate global telephone communications.

Computers benefit a wide range of human activities—from complicated calculations for research and data analysis to mundane day-to-day matters such as reserving seats on bullet trains.

Thanks to the Internet, e-mail and fax machines, people can rapidly exchange information around the world.

Household electronic appliances such as the microwave oven have made people's lives easier.

Human ingenuity has produced substances with desirable properties that

- **Asahi Shimbun**
- **Asahi Evening News, 30 June, 1996**

made to produce human insulin for treating diabetes.

These examples show the undoubted benefits of scientific and technological progress.

At the same time, this progress has brought serious problems. The stability of plastics and chlorofluorocarbons (CFCs) added to the problems of pollution. A higher standard of living has its drawbacks—greater energy consumption and a sharp increase in population. Thus, the existence and activities of humankind are beginning to impose a burden on the environment.

Science invariably brings both pluses and minuses to humankind. There is

ASAHI SHIMBUN

Reiko Kuroda

sometimes daunting task of deciding

technology that operate both at the individual and community levels and on a global scale? How can we make judgments that deal with them—judgments based on scientific knowledge and an informed viewpoint—without yielding to emotions and empty arguments?

Interpreters needed

What is needed is high-quality information linking science with society. We must use such information to guide our actions. Depending on the circumstances, we may become the source of such information ourselves.

Unfortunately, the format of published scientific

Create 21, Asahi

convey it to a wider audience. They are also liable to overlook the social significance of their research.

This calls for "scientific interpreters," experts who can explain the results of cutting-edge research and its social significance to the general public (as for the social significance, explain it to the scientists, as well).

Beyond merely explaining technical terms, these scientific analysts and commentators should identify problems and indicate the likely direction of future progress. They should serve as a bridge between science and life.

First, they should relay the excitement and interest of science. Instead of sensationalizing the negative aspects of science or its potential to improve material existence, they should communicate the wonders of biology, the quantum world and the enduring enigma of the universe.

Capable of scientific thinking

The public should be made aware that science has unraveled few of the mysteries of the universe and of life itself—systems that have taken billions of years to form and are still evolving—and that the creative efforts of science will be essential for the future well-being of humankind.

For the role of interpreters, I should like people who can appreciate that even trivial conclusions can often only be reached after the concentrated efforts of many scientists. I expect them to appreciate that it can be difficult for scientists to give simple explanations for their results because they need to take into account many parameters including experimental conditions, the state of the subjects and margins of error.

Moreover, it should be realized that scientists are fascinated by exceptions

fined and determined—in essence they should be capable of scientific thinking.

Of course, our interpreters should not rely solely on science as the basis for their opinion. In a poignant comment, the nonfiction science writer Kunio Yanagida said: "Besides the biological aspect, there is a spiritual side to death, because the dying are leaving behind people with whom they have shared their lives."

The interpreter's role must be filled by those who combine a deep understanding of science, the human mind and society with an ability to communicate. Even now, there are writers, commentators, scientists and journalists who are actively discharging this role.

As we enter the 21st century, the pace of scientific and technological advance will be accelerated further and we shall have ever more need of such talented individuals.

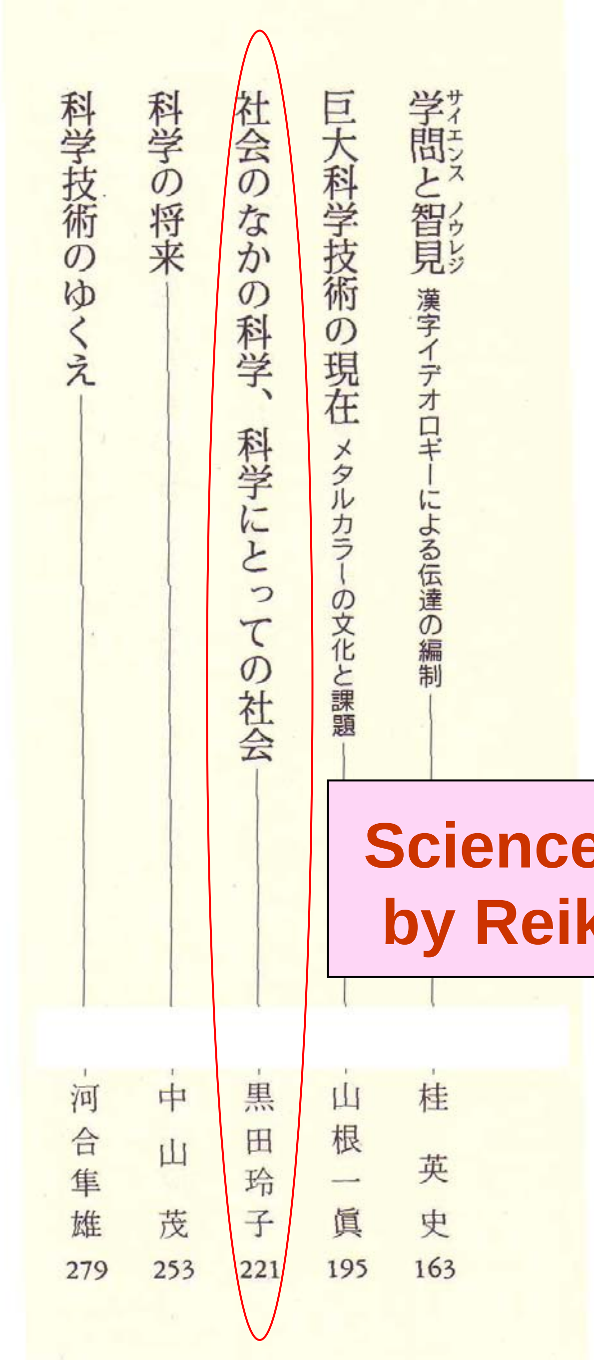
By inclination, scientists are driven by intellectual curiosity. Their prime objective is to perform research that unlocks the secrets of nature. However, they also have an obligation to society to explain the meaning of their research.

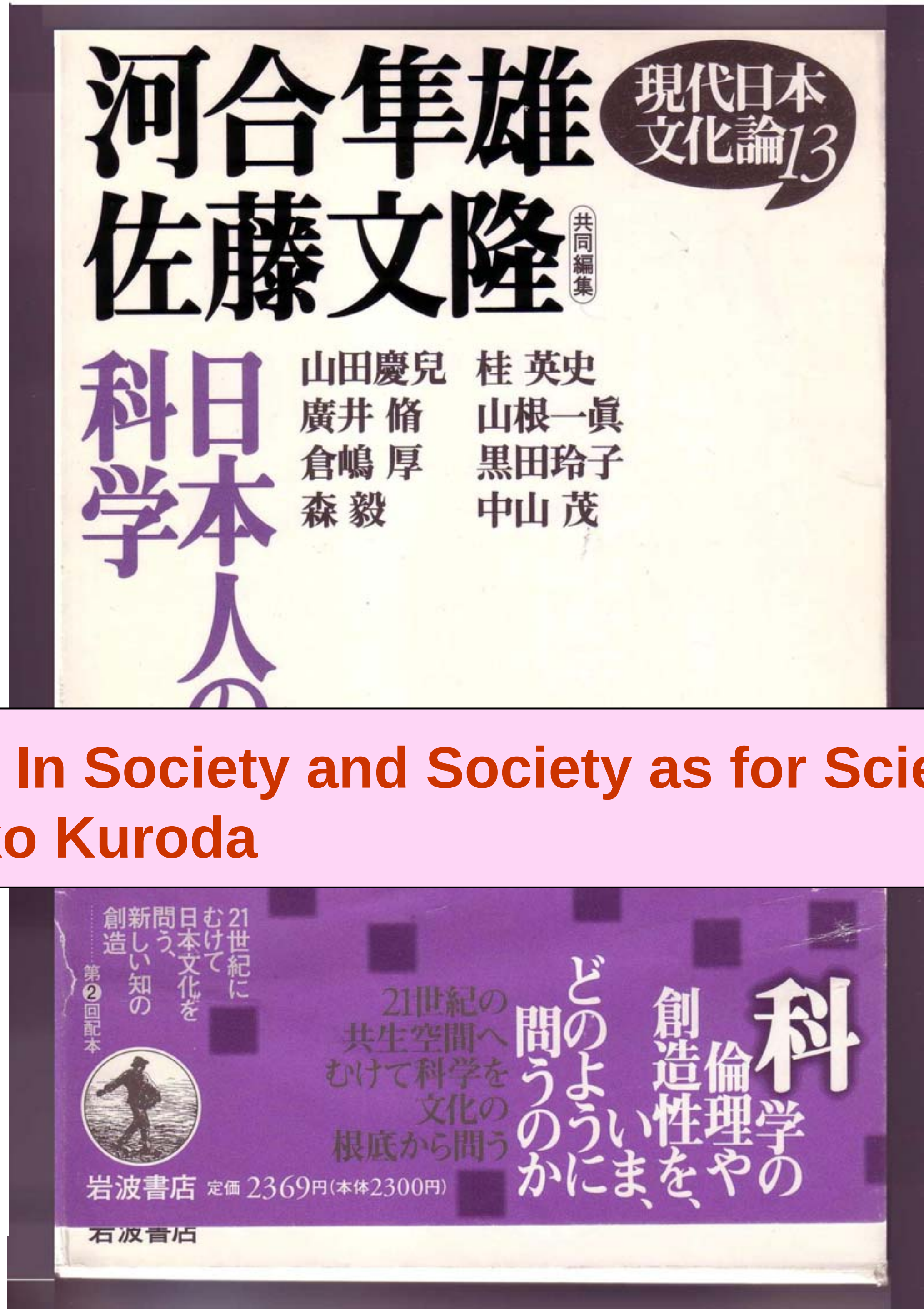
This follows not only because they receive research funding from public agencies, but because the consequences of their research either directly or indirectly, positively or negatively, has a big impact on society.

In Western universities, good science textbooks are often the work of frontline scientists. For 170 years since the time of Michael Faraday, Friday discourses and Christmas lectures at the British Royal Institution have been occasions for the most celebrated scientists of the day to address lay audiences including children "to amuse and entertain, as well as educate, edify and above all, inspire."

Linking science and humanities

In Japan, too, the social significance of science, the duties of scientists and the importance of scientific education should become matters for scientists themselves to discuss. Scientists





1996年

Science In Society and Society as for Science
by Reiko Kuroda

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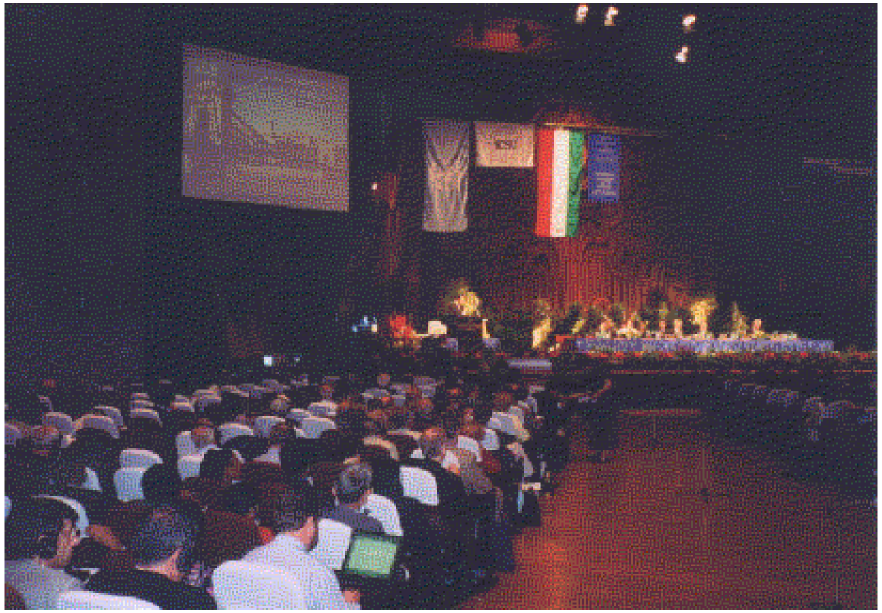
ICSU · UNESCO · The Hungary Academy of Sciences



Word Conference on Science

Budapest

1999

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Science for the Twenty-first Century
A New Commitment

Budapest, Hungary, 26 June–1 July 1999

World Conference on Science

UNESCO

ICSU

La science pour le XXI[e] siècle
un nouvel engagement

Conférence mondiale sur la science

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DECLARATION ON SCIENCE
AND THE USE OF SCIENTIFIC KNOWLEDGE

Text adopted by the World Conference on Science
1 July 1999. Definitive version

Preamble

1. Science for knowledge; knowledge for progress
2. Science for peace
3. Science for development
4. Science in society and science for society

Science interpretation/communication

- Discussions cannot be made
  without basic scientific knowledge.
- Emotional and biased information often misleads people.

- Scientific way of thinking must be learnt.
- Science interpreters can stimulate interactive communication between scientists and the society.

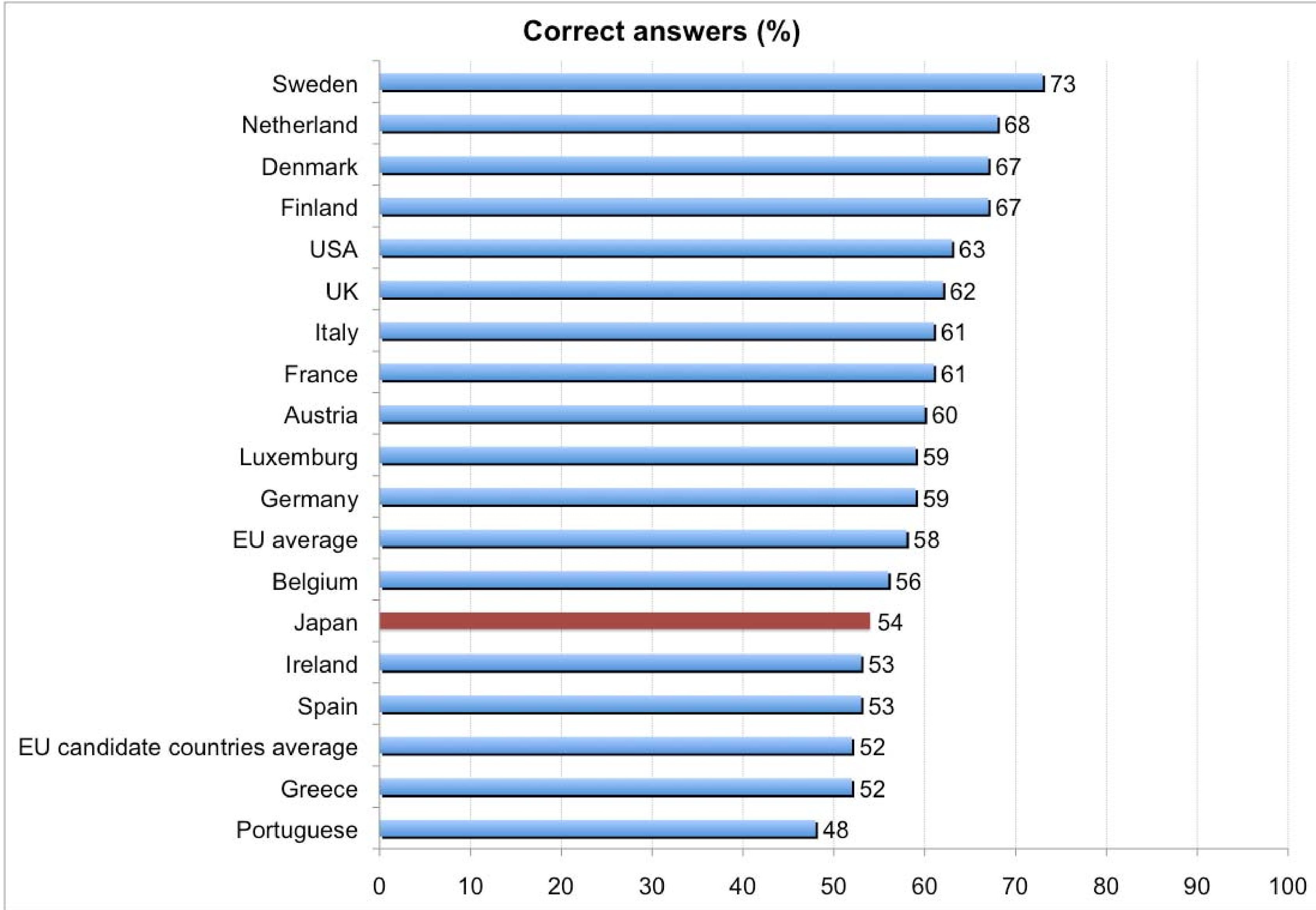
Before public participate in S&T policy making process…

Basic Knowledge of science

Can you answer correctly?

1. The center of the Earth is very hot.
2. All radioactivity is man-made.
3. Oxygen for our breath is made by plant.
4. It is the father's gene that decides whether the baby is a boy or a girl.
5. Lasers work by focusing sound waves.
6. Electrons are smaller than atoms.
7. Antibiotics kill viruses as well as bacteria.
8. The continents on which we live have been moving their location for millions of years and will continue to move in the future.
9. Human beings, as we know them today, developed from earlier species of animals.
10. Very early humans lived with dinosaurs.
11. Radiation-contaminated milk is safe when it is boiled.

International Comparison of Scientific Literacy



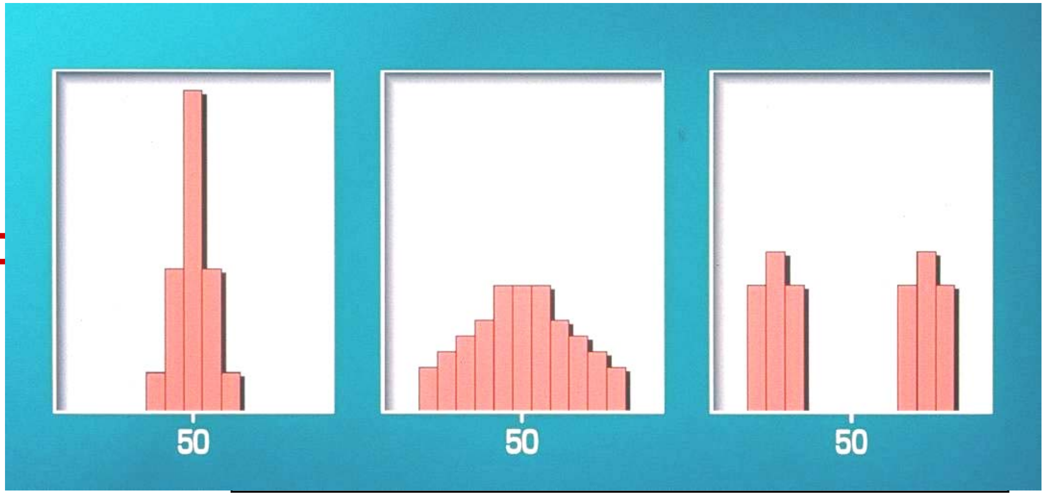
NSF 'Science and Engineering Indicators2002'
European Commission 'Eurobarometer55.2', 'Candidate Countries Eurobarometer 2002.2'
NISTEP 'Public Survey on S&T 2001'

RK

Modern Society Requires Decisions by Individuals

Learn scientific way of thinking and nature of science
to live wisely with science

- Average
- Distribution
- What is "Simulation" "F
- Risk and benefit
- Science expands gray
- 3 characteristics of materials



Physical, Chemical and Social Characteristics

- Quantitative understanding
- Non-exist cannot be proven

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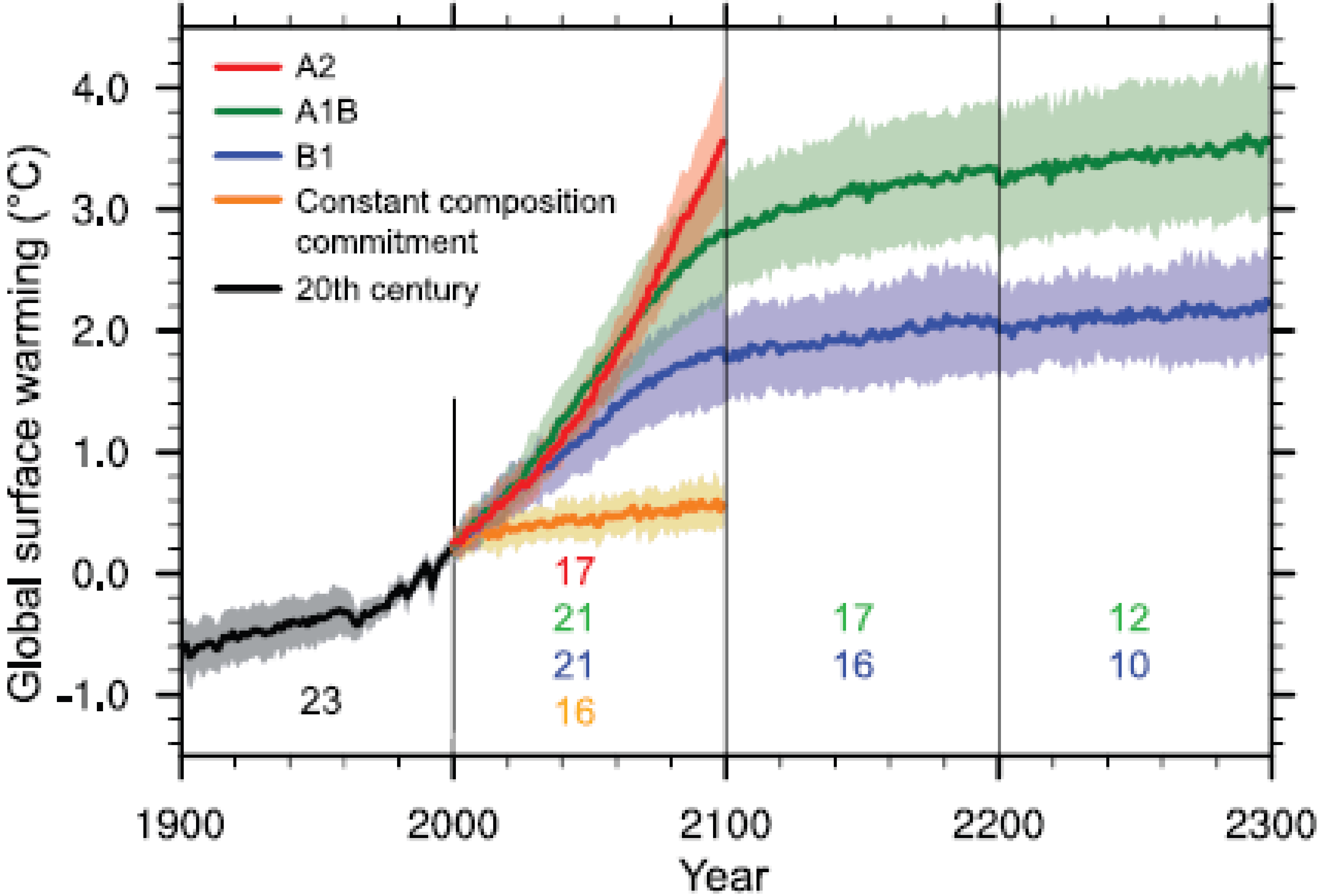

Multi-model means of surface warming (relative to 1980–1999) the scenarios A2, A1B and B1, shown as continuations of the 20th-century simulation.

RK
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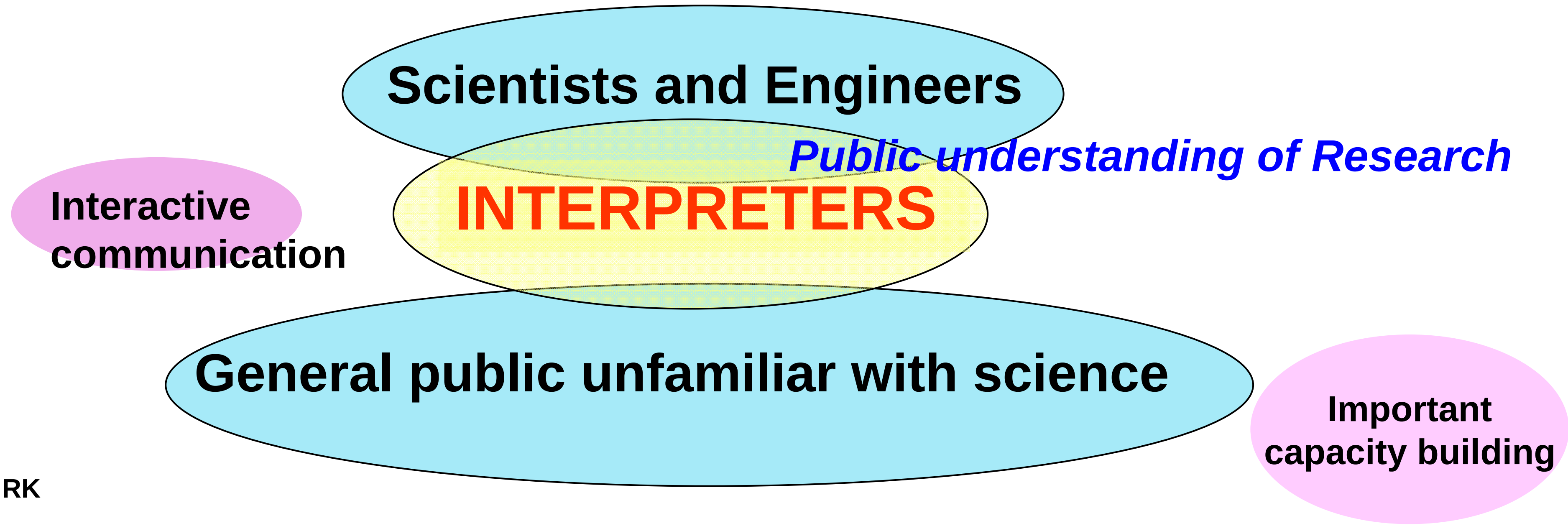
Global Climate Projections Gerald A. Meehl (USA), Thomas F. Stocker (Switzerland) et al

Role of Science Interpreters

•Connecting between scientists in various research fields and lay people

•Establishing interactive communication between science and real life

- •promoting social interests in sciences
- •Indicating social influences caused by sciences



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The University of Tokyo: *Science Interpreter Training Program* *since 2005*

Key Features of SITP

Highly concentrated small-group education (approx. 10 students/year):

Sending SITP graduates, as *catalysts* who disseminate spirits and skills of science interpretation, to various fields of society

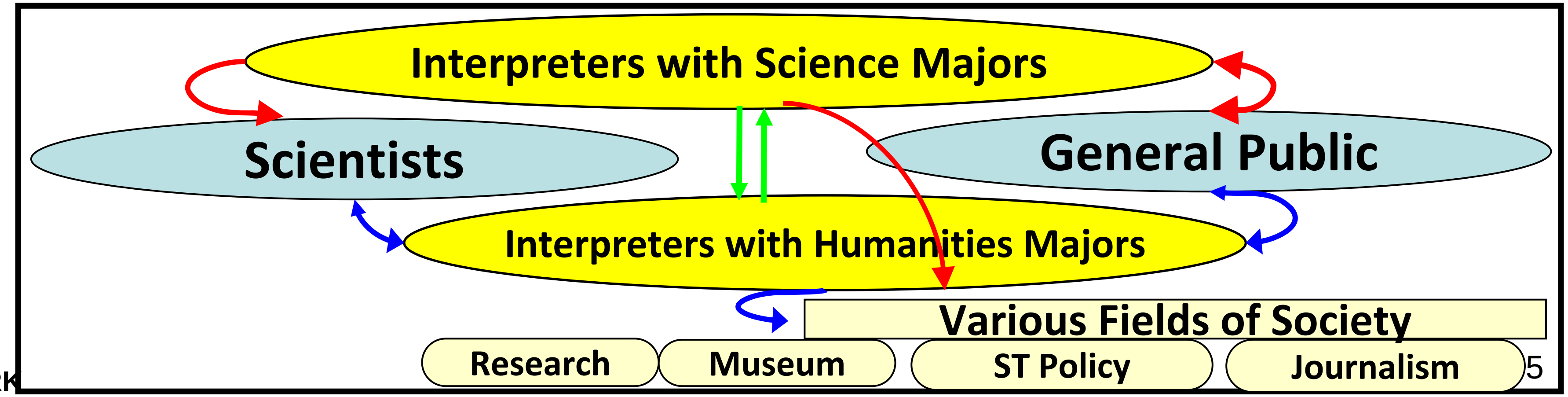
University-wide minor program for graduate students:

-Opens for graduate students with various majors both sciences and humanities

-Develops human resources who have solid expertise on their majors with minds and skills as a science interpreter as well as a leader of society

-Interactions between faculty members and students with different academic backgrounds

-SITP graduates plays important roles in various fields of society, such as R&D, ST policies, and Journalism



•The University of Tokyo: *Science Interpreter Training Program*

Target: All postgraduate students in the University of Tokyo
(including science and humanities major students)
Focusing on the interactions between students (and teachers)
Sub-major program: Interpreters based on their own major subjects
Curriculum: Designed for selected small class to develop cadre of the society

KEYWORD

What to Communicate,
How to Communicate

IUGG XXVth General Assembly

Thank you for your attention

http://www.icsu.org/

http://science-interpreter.c.u-tokyo.ac.jp