

Future Earth: Research for global sustainability

A framework document

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A pressing challenge

Humanity is facing unprecedented global risks. We are observing more rapid and complex global interactions between social and environmental components of the Earth system and clear indications of significant shifts in climate, biodiversity, pollution loads and other critical factors. The evidence suggests that the Earth and its inhabitants have entered a new geological era - the Anthropocene - where the scale of human influence on the Earth system constitutes the dominant driving force of change at the planetary scale. The human impact on our planet may be so great that irreversible and abrupt changes to the Earth system could occur with serious impacts on economic development and human wellbeing (Crutzen 2002; Rockström et al., 2009; Steffen et al., 2007). Yet scientific research only partly understands these risks, how they will affect different regions, and how we might best respond to them. In an increasingly interconnected world, where people, goods and ideas move across vast distances, it is no longer possible to address problems such as poverty or access to water at community or national scales without considering the implications of global environmental change for economic, social and environmental sustainability. Governments, firms and citizens are increasingly recognizing that, even though global environmental change poses risks to prosperity and security, it also provides opportunities for innovation and secure livelihoods. Decisions are being made to respond to global environmental change from the household to the international level and researchers need to engage with policy makers and citizens if they wish their work to be of use in informing and evaluating these decisions.

Achieving a sustainable global society requires us not only to understand the processes that determine how the Earth system functions, and how drivers of lifestyles and models of progress function, but also how to manage and govern our activities to reach and maintain global sustainability. We need to achieve a global transition that goes beyond gradual incremental change, and which addresses major equity challenges in a world that hosts 7 billion of people - 4 billion of them living in poverty. With many people aspiring to live longer and increase their consumption, with the likelihood of an additional 2 billion people by 2050, and with some unavoidable global environmental changes already underway, societies face major challenges for adaptation and transformation.

Humanity does not have adequate answers as to how to safeguard prosperity and development in this new world of the Anthropocene. The most up to date Earth system research indicates that global sustainability is a prerequisite for human wellbeing in this new era. A new kind of research, co-produced with society and seamlessly integrating social and natural sciences, is now needed to support a transition to global sustainability, cutting across sectors and addressing key human development objectives, such as global food and water security, risk reduction, energy equity and security, poverty alleviation, and health. At the same time we still face major knowledge gaps about the global risks facing humanity and how the Earth system operates. A new research agenda is needed, that deepens our knowledge while integrating understanding and seeking transformative solutions. This agenda must focus on a comprehensive range of solutions and choices including science, technology, institutional, economic, and behavioural change for sustainable development and must be attentive to the needs of those who will use the research to make choices about responses to global environmental change. This new integrated research effort will need to be supported by new ways of conceptualizing human-environment interactions and by increased efforts in global observation systems – to monitor and understand biophysical and social changes occurring in the world – and research on Earth system dynamics, human dimensions of global change, and world development.

A new global endeavour to focus Earth system research on global sustainability is needed that integrates our understanding of the global risks facing humanity and that explores new opportunities for partnerships with the users of research, transformative change, innovation,

economic development and enhanced human security. The international research community has a universal responsibility to step up to this challenge. The **“Future Earth”** initiative, focused on **research for global sustainability** seeks to meet this challenge through new alliances of researchers, scientific organizations and research users who will join to co-design an integrated research agenda, foster new research programmes, coordinate research funding, and deliver knowledge for solutions to the global community.

Background to Future Earth

There is a long tradition of international global environmental change research generated by individual researchers, national scientific agendas and international global change research programmes such as those co-sponsored by the International Council for Science (ICSU), the International Social Science Council (ISSC), and UN agencies. These programmes have provided considerable evidence as to how and why the global environment is changing, the successes and failures in responding to these changes, and why a major transformation in research for global sustainability is urgently required.

Recent evaluations of the global environmental change research programmes of ICSU and its partners, while acknowledging the major scientific achievements so far, concluded that the challenges ahead require a major new and integrative initiative on Earth system research for global sustainability. Together with ISSC, ICSU undertook the Earth System Visioning, a broad consultative process which identified five priorities:

- (1) Forecasting: improve the usefulness of forecasts of future environmental conditions and their consequences for people
- (2) Observing: develop, enhance and integrate the observation systems needed to manage global and regional environmental change
- (3) Confining: determine how to anticipate, avoid and manage disruptive global environmental change
- (4) Responding: determine what institutional, economic and behavioural changes can enable effective steps toward global sustainability and
- (5) Innovating: encourage innovation (coupled with sound mechanisms for evaluation) in developing technological, policy, and social responses to achieve global sustainability (Figure 1) (Reid et al. (2010); ICSU report on the Grand Challenges, 2010).



Figure 1: ICSU-ISSC Visioning Grand Challenges

At the same time, a coalition of major research funding agencies from around the world – the Belmont Forum – identified a challenge for the international scientific community to develop and deliver knowledge in support of national and international government action to mitigate and adapt to global and regional environmental change. The Belmont Challenge is for research to deliver knowledge needed for action to avoid and adapt to detrimental environmental change including extreme hazardous events. Belmont identified several critical activities including (1) assessments of risks, impacts and vulnerabilities, through regional and decadal-scale analysis and prediction (2) information on the state of the environment, through advanced observation systems (3) interaction of natural and social sciences (4) enhanced environmental information service providers to users and (5) effective international coordination mechanisms, with initial foci on

coastal vulnerability, freshwater security, ecosystem services, carbon budgets and the most vulnerable societies. They identified engagement with stakeholders as a high priority.

The convergence of thinking between the research community and the funders provides a promising basis for the new initiative in concluding that a new global integrated initiative is needed to answer the grand challenges of the quest for global sustainability now facing humanity. Both the ICSU-ISSC Visioning and the Belmont process recognize that major new investments are needed in synthesis of research, bridging across the sciences (natural and social), and linking science, policy and practice. They also see great needs for capacity development – particularly in the developing world - and in engaging stakeholders and communicating new insights to society. The 2-year Visioning process and the Belmont Forum process have generated a road map for a major transformation and expansion in research effort, motivated by the urgency to answer – for humanity and for those making decisions – critical questions for world development in the Anthropocene. The road map calls for a transformation in coordination and leadership in order to provide a globally coordinated ability for research to respond to societal needs, become more policy-relevant, and to raise – significantly – the ability to bridge research to policy and practice.

Box 1: The 'Future Earth' Alliance

Future Earth brings together an alliance of partners with long term interests and expertise in international research collaboration on environment, science and sustainability. The International Council for Science (ICSU) includes as members disciplinary unions as well as national members, and has focused on global environmental change through programmes such as World Climate Research Programme (WCRP), International Geosphere-Biosphere Programme (IGBP), International Human Dimensions Programme (IHDP), and DIVERSITAS, as well as focused efforts on climate, ocean and terrestrial observing systems, disaster risk reduction, ecosystems and oceans. The global environmental programmes also jointly created the Earth System Science Partnership (ESSP), and a range of joint and specific projects.

The alliance of natural and social sciences is also represented by the involvement of the International Social Science Council (ISSC), the primary international body representing the social, economic and behavioural sciences, including disciplines and professions such as law, economics, demography, sociology, geography, psychology, political science and anthropology.

The Alliance is further strengthened by the participation of the United Nations Environment Programme (UNEP), the United Nations Educational, Scientific and Cultural Organization (UNESCO), and the United Nations University (UNU), who bring research and monitoring programmes in climate, ecosystems, hazardous waste, governance, local knowledge, water, ecology and oceans. The World Meteorological Organization (WMO), with its resources and expertise in climate, Earth observations and weather, currently has observer status in the Alliance,

Very importantly, the Alliance includes funders in the form of the Belmont Forum, council of principals for the International Group of Funding Agencies for Global Change Research (IGFA), who work to enhance cooperation and coordination of funding for global environmental change research.

The Alliance is set to become a ground-breaking strategic partnership of the international research community, funders, operational service providers, and users of global environmental change science. It provides exciting opportunities to create and support a coordinated and cutting edge agenda for research, co-designed by scientists, funders and users of environmental knowledge. It aims at establishing a joint strategy to work together on common priorities that create and use the knowledge that societies need to adapt and mitigate to hazardous global environmental change. The Alliance will lever the capability generated over recent decades, embracing truly transdisciplinary goals that cannot be achieved by a single country, existing organisational structures or a single field.

An Alliance was formed to co-design a new 10-year initiative - recognising the need for a deeper integration between disciplines and bodies of knowledge (natural, social, economic, health, engineering, and humanities) as well as for a major improvement in the ability for science to provide outcomes that respond to needs in society (Box 1).

The Alliance consists of researchers, funders of global change research, and services providers, including ICSU, ISSC, the Belmont Forum, the United Nations Educational, Scientific and Cultural Organization (UNESCO), the United Nations Environment Programme (UNEP), and the United Nations University (UNU). A Transition Team was established by the Alliance in 2011 to lead the planning of the new initiative, that will be presented at the Planet Under Pressure conference in March 2012, launched at the Science, Technology and Innovation Forum associated with the Rio+20 Earth Summit in June 2012, and operational in 2013. In December 2011, the Transition Team and the Alliance adopted “Future Earth – Research for Sustainability” as the name for the new initiative, with the short form - “Future Earth” - to be used.

Goal and objectives of Future Earth

In a world where research has provided evidence of the urgent need for a rapid transition to global sustainability, and can contribute options for a successful transition, Future Earth has the overarching strategic goal to *develop the knowledge for responding effectively to the risks and opportunities of global environmental change and for supporting transformation towards global sustainability*. The intent is to deliver at global and regional scales the knowledge that societies require to effectively address global change while meeting economic and social goals.

The means by which Future Earth will contribute to this overarching goal is through a major global 10 year initiative of international scientific collaboration on Earth system research, with the specific objectives to:

- coordinate and focus international research to engage with stakeholders to address the grand challenges arising from the ICSU-ISSC Visioning and Belmont Forum processes in order to use human and financial resources efficiently;
- build on and continue successful international collaborative projects that are addressing critical global environmental change problems which require broad international collaboration on Earth system research;
- engage a new generation of diverse researchers from all regions in the social, economic, natural, health, humanities, and engineering sciences, and foster their engagement with stakeholders so as to ensure the future use and success of research efforts;
- strategically engage a variety of stakeholders in the pursuit of solutions to growing problems of global environmental change and sustainable development;
- foster a major transformation not only in scientific endeavour, but also in bridging science-policy-practice, research in support of development and human possibilities, service provisioning, communications, and capacity development;
- provide a strengthened global platform and regional nodes for initiatives on science and research in support of global sustainability and an enhanced ability for collaborative efforts in synthesis, assessments and observations.

Institutional design elements

The strategy for Future Earth, informed by the ICSU-ISSC Visioning and Belmont challenges, assumes that the initiative will be governed by one overarching structure advised by a

full range of scientists and stakeholders, and guided by a comprehensive conceptual research framework and set of research questions that generate scientific enthusiasm and societal engagement. Future Earth will:

- develop a strengthened global coordination through a unified institutional framework at the top, in order to provide the best possible support for multiple initiatives and self-organised scientific endeavours among researchers across the world. The research within Future Earth will include disciplinary, inter-disciplinary, and transdisciplinary efforts in the area of Earth systems research. It will build on a combined strategy that (1) supports ongoing and new disciplinary research, and (2) initiates and supports mega-themes of integrated global change research.
- provide a new architecture for the international coordination of Earth system research under ICSU and its partners, which will include all current global environmental change research programmes and bodies¹ (WCRP, IGBP, IHDP, DIVERSITAS and the joint ESSP) and will be open to other ICSU initiatives such as Integrated Research on Disaster Risk (IRDR) and Ecosystem Change & Society (PECS). This is likely to include the integration of several of the existing global environmental change programmes.
- build on the ongoing research projects coordinated under the existing ICSU (co-) sponsored global environmental change programmes, and provide a wider global platform for strategic research collaboration and engagement with users of research that attracts scientists from around the world, and which supports initiatives from research groups and institutions. Future Earth will establish close partnerships with other initiatives by co-sponsors and partners (such as the UNEP ProVia² initiative) in order to assure complementarities and synergies.
- pay particular attention to engaging the users of research early in the development of research programmes, for example by including stakeholders in advisory committees, and also seek to ramp up the research community's understanding and practices of working with business, governments, non profit organizations and communities to identify research priorities and seek solutions to global environmental challenges. This responsiveness is increasingly demanded of and by the funders of research including taxpayers, foundations, and the private sector.
- provide leadership by embedding sustainability strategically not only into the new organisation's vision and mission, but also in all phases of the planning, operations, project development, funding, meetings, research and other activities. By having best practices in sustainability embedded in all phases, Future Earth can also more credibly help develop new paradigms, standards and policy.
- require a transformational increase in funding, both flexible institutional funding and competitive research funding, to provide the ability to take strategic global research initiatives, generate policy relevant syntheses and assessments, and to support communication, and capacity building, in order to achieve success and fulfil its promise.

¹ Four major global environmental change programmes, all (co)sponsored by ICSU, operate in the planning and coordination of international global environmental change research: DIVERSITAS: An International Programme on Biodiversity Science; International Geosphere-Biosphere Programme (IGBP); International Human Dimensions Programme on Global Environmental Change (IHDP); World Climate Research Programme (WCRP). In 2001, they created the Earth System Science Partnership (ESSP) to develop common activities.

² Programme of Research on Climate Change Vulnerability, Impacts and Adaptation.

Transition Team activities

The Transition Team, formed in June 2011, includes members from around the world of the scientific community, major research organizations and funders, and the private sector, with experience in academia, government, international agencies and non-governmental organizations and with a wide variety of disciplinary backgrounds. Many members have close familiarity with existing global environmental change programmes but each member of the team is asked to contribute as an independent expert rather than the representative of any particular programme or project. The team is supported by observers that include representatives from the existing ICSU global environmental change programmes. The Transition Team has organized his members in three working groups: (1) Research strategy; (2) Institutional design; and (3) Education / Communication / Interaction with stakeholders. The team is staffed by a joint ICSU-Belmont secretariat and has an Executive Group responsible for the overall process that includes the co-chairs of the Transition Team, members of the Alliance, and one or two representatives of each working group. The Executive Group meets in monthly teleconferences and the Transition Team has scheduled in person meetings in June and Dec 2011, March 2012 and November 2012.

Box 2: Transition Team - Terms of Reference

The Transition Team Terms of Reference set out the following tasks over an 18 month lifetime:

1. Develop a research strategy for the initiative drawing on the outputs of the ICSU Visioning process, the Belmont forum White Paper and the strategies of the other main partners in the Alliance to set out the critical research challenges, the required thematic priorities and capabilities, desired outcomes, impacts and success measures, and how progress will be evaluated.
2. Identify gaps in the partnership, and then reach out to potential partners to encourage them to join the initiative and secure the necessary high-level commitment from governments, business and civil society.
3. Find ways to build on existing capability and investments including the greater and more effective integration of GEC programmes.
4. Identify mechanisms for funding and models for delivery focussing on open, flexible approaches, including processes and mechanisms that would allow the scientific community to move forward faster and deliver more effective research, network design and development including possible regional 'nodes' for the network, and examining options for knowledge management systems, that would enable cost-effective interaction and information exchange across the network and beyond to broad research user and provider stakeholder groups.
5. Facilitate the design of a research and implementation plan for the first three years of the Initiative, setting out the early phase priority areas and a specific action plan with a small number of priority areas/directions as an initial step as well as a communication strategy.
6. Make recommendations for the governance of the initiative.

Criteria guiding the Transition Team process

The work of the Transition Team is guided by criteria outlined in the terms of reference (Box 2), which have been refined in discussions among the team and the Alliance partners. These include:

- a focus on research that requires international collaboration to be successful
- a unified research framework as a goal
- continuation of the successful and respected existing international collaborative global change projects with the intention of including them within the umbrella of the new initiative with access to new financial resources, institutional support and links to policy
- research that can provide early warnings of global environmental risks, identify strategies to respond to them and can help define new opportunities for growth and livelihoods
- research that seeks to provide solutions and transition pathways, ranging from economics to behavioural change and governance
- creation of partnerships between research, organizations, policy and practice to deliver knowledge that is useful to decision makers, responds to development priorities, and can be easily explained to citizens
- research that is co-designed by the partners represented in the Alliance, bringing together natural, social, human and applied/professional/engineering sciences for consultation and input
- an open and flexible process, to allow partners to contribute as widely as possible, providing a coordination platform of research and funding at the international level, without challenging individual partners' decision-making autonomy, and managing conflicts of interest.
- attention to strong regional nodes, geographic and gender balance, capacity building and collaboration.

Conceptual framework for an integrated platform

One of the key tasks of the Transition Team is to develop the conceptual framework for an integrated platform that links major research traditions with critical policy and human development concerns and can be used to identify priority research questions for Future Earth.

At the December 2011 meeting of the Transition Team, a conceptual framework was developed, in part, from the ICSU Visioning and Belmont Challenge, but also from key projects within ICSU and other Alliance partners and from major human development goals and concerns. Within the framework, three nested models were developed (Figure 2), centered on global environmental change and the social, political, economical transformations needed to realize a sustainable future. The first provides a simple conceptual model of global environmental change, its drivers, the responses to it, and its impacts on human wellbeing (Figure 3). The second provides a map of the core intellectual concerns of the global environmental change research community (Figure 4). The third encompasses the most critical human development concerns – the issues that people and society care about that are affected by global environmental change and where decisions might be informed by responsive research (Figure 5).

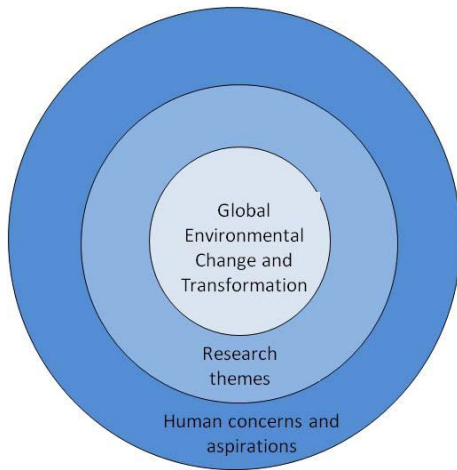


Figure 2: Nested conceptual framework



Figure 3: GEC and transformation

The simple conceptual model of the process of global environmental change begins with a set of drivers of change including both natural forcing factors such as the sun and volcanic eruptions and socioeconomic forcings such as changes in economics, demographics, technology, culture and politics. These underlying forces are manifest in more direct activities such as changes in land use, resource management, and energy use that drive changes in the Earth system. The global environmental issues of concern include interconnected changes in climate, water, biodiversity, air quality, oceans, and soil quality. These in turn have impacts on human well-being through access to basic needs for food, water and energy as well as integrated conditions of livelihoods, health, values, wealth, security, and empowerment. As humans respond to the risks and opportunities to human well being posed by global environmental change they make decisions that alter the driving forces of the Earth and human-environment system.

The Transition Team's intellectual mapping of global environmental change research (Figure 4) is intended to encompass the main activities of many existing programmes and to include a broad and integrated range of social science and engineering research themes. The question mark indicates that we do not intend this to be a definitive map at this stage in the transition to the Future Earth research agenda.

Figure 4: Research themes of global environmental change research

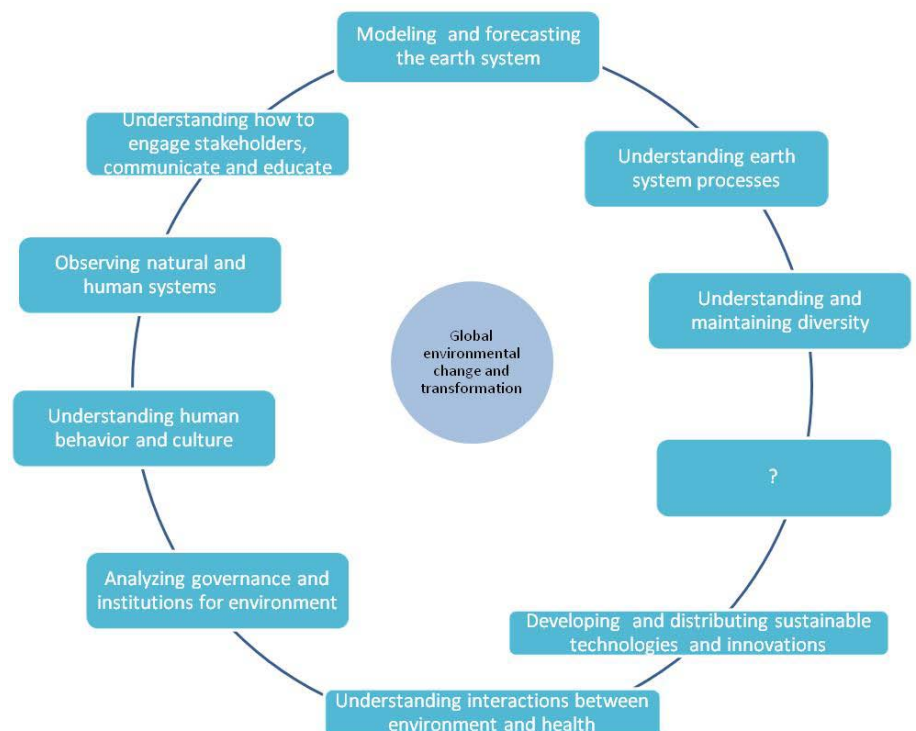


Figure 5 places global environmental change and its research concerns within the issues that people care about and which are usually the focus of decisions and policy makers.

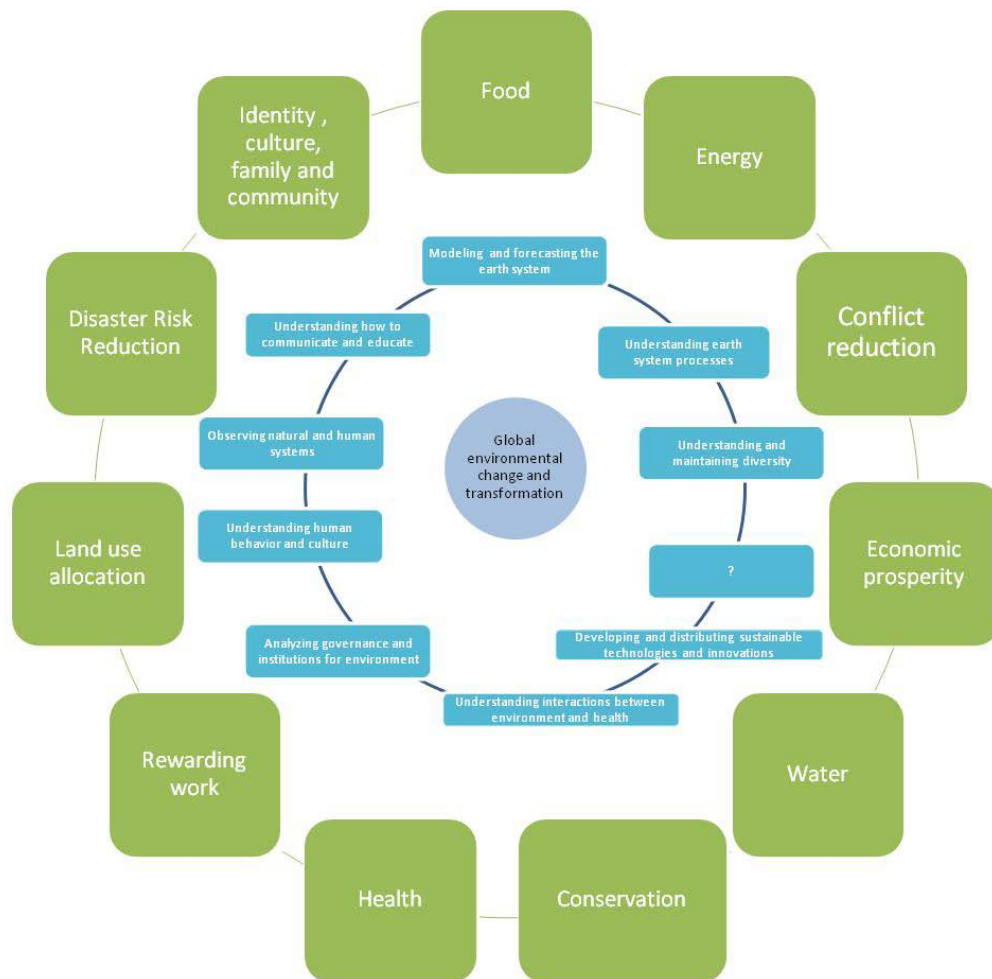


Figure 5: Human concerns and aspirations that interact with global environmental change

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