



A step change for Earth system research: Future Earth – research for global sustainability

Members of the Future Earth Transition Team present a new 10-year international initiative on integrated global environmental change research.

Human activities are altering the Earth system and impacting the environment at the local, regional and global scale in ways that, on one hand, threaten human well-being but, on the other hand, provide ample new opportunities for innovative sustainable development. Changes in the Earth's climate and loss of biodiversity are undermining poverty alleviation, as well as food, water, energy and human security. The challenge of achieving a transition to global sustainability is urgent given the potentially catastrophic and irreversible implications for human societies.

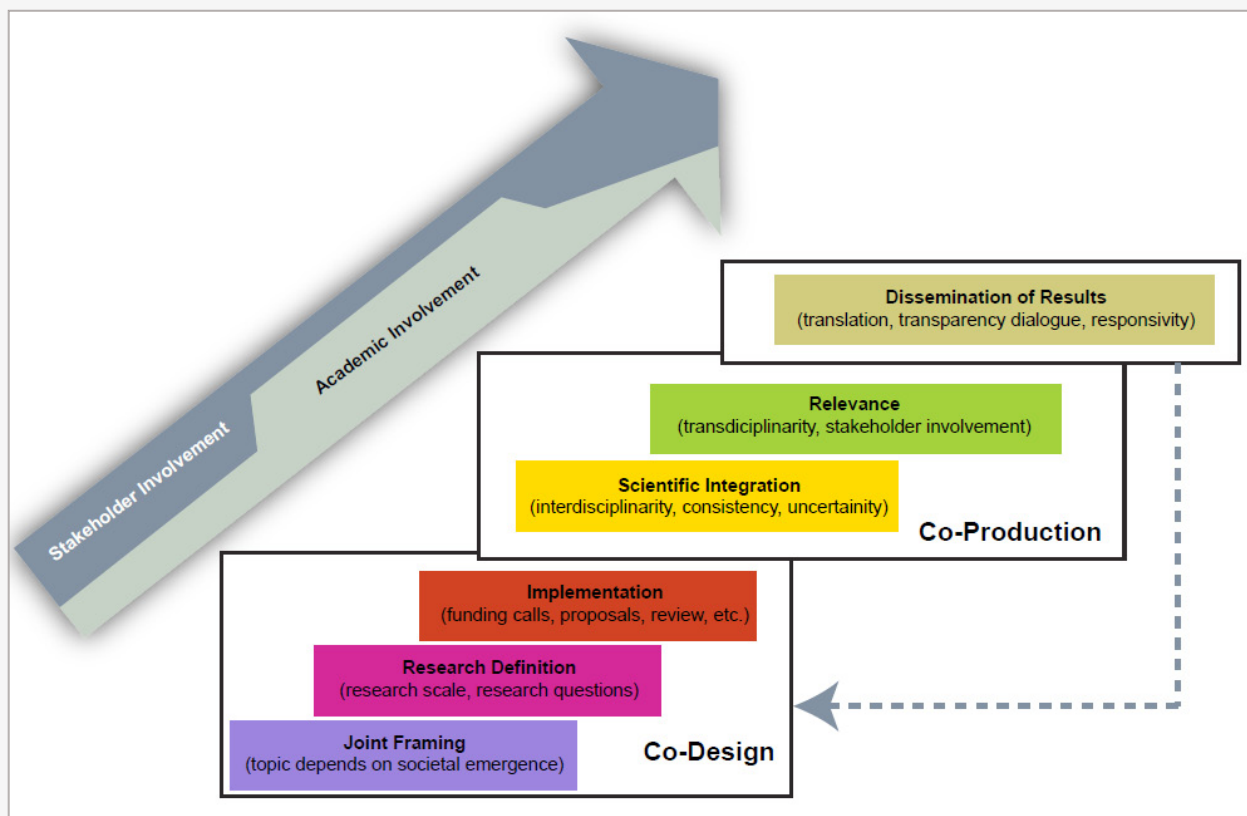
Future Earth is a 10-year international research programme which will provide the knowledge required for societies to face the challenges posed by global environmental change and to identify opportunities for a transition to global sustainability. It will support science of the highest quality, integrate the natural and social sciences, as well as engineering, the humanities and law. It will be co-designed and co-produced by academics, governments, business

and civil society, encompass bottom-up ideas from the wide scientific community, be solution-oriented, and inclusive of existing international Global Environmental Change projects and related national activities.

Connecting research and responses to societal challenges

Future Earth will address issues critical to poverty alleviation and development such as food, water, energy and human security, governance, tipping points, economic implications of inaction and action, natural capital, technological transformations including a low-carbon economy, the sustainable use and conservation of biodiversity, lifestyles, ethics and values with an increased regional emphasis.

Future Earth provides an opportunity to refocus research priorities and open up new research frontiers co-designed by researchers and users. It will establish new ways to produce research in a



Steps and involvement of stakeholders in the co-design and co-production of scientific knowledge (Credit: Mauser et al., submitted to *Current Opinion in Environmental Sustainability*)

more integrated and solutions-oriented way. [Recent foresight exercises](#) on the challenges facing Earth system research and its funding converged on the need for a step change. More disciplines and knowledge fields need to be engaged, bringing both disciplinary and interdisciplinary excellence; the close collaboration with stakeholders across the public, private and voluntary sectors to encourage scientific innovation and address policy needs is essential.

At the Rio+20 Earth Summit last June, governments agreed to develop a set of Sustainable Development Goals (SDGs) that will integrate environment and development goals for all nations. Future Earth will provide the integrative environmental knowledge needed to underpin the SDGs and sustainable development more broadly. To produce relevant knowledge for action on these critical issues, Future Earth will build upon and integrate the existing Global Environment Change Programmes – the World Climate Research Programme (WCRP), the International Geosphere-Biosphere Programme (IGBP), the International Human Dimensions Programme (IHDP), Diversitas, and the Earth System Partnership (ESSP).

The research and other capacity building and outreach activities of Future Earth will be co-designed by the broad community of researchers in partnership with the users of knowledge, such as governments and business, to close the gap between environmental research and policies and practices (see figure on previous page). Researchers will be responsible for the scientific approaches, but the articulation of the research priorities and the final dissemination of results will be a joint responsibility. Future Earth will deliver a step-change in making the research more useful and accessible for decision-makers by, inter-alia, communicating uncertainty, developing useful tools for applying knowledge, respecting and including local/traditional knowledge and supporting innovation.

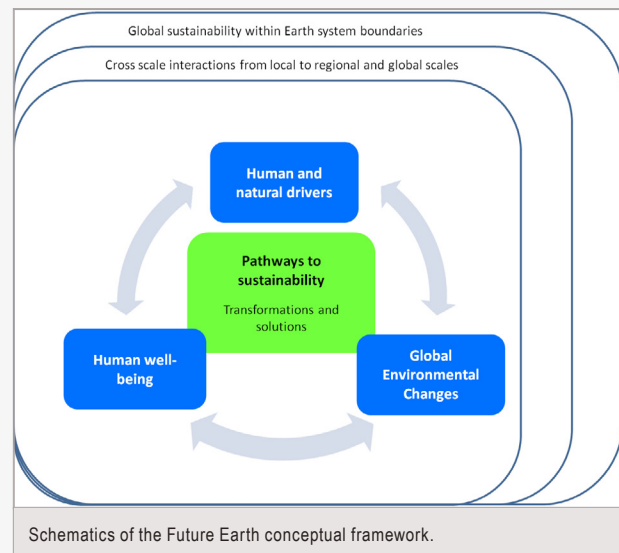
The conceptual framework

The conceptual framework for Future Earth (see figure above), which will guide the formulation of research themes and projects, recognises that humanity is an integral part of the dynamics and interactions of the Earth system. It also encompasses the cross-scale spatial and temporal dimensions of the social-environmental interactions and their implications for global sustainability.

The conceptual framework illustrates the fundamental interconnections between natural and human drivers of change, the resulting environmental changes and their implications for human wellbeing within the Earth system boundaries. These interactions take place across a range of time and spatial scales, and are bounded by the limits of what the Earth system can provide. This fundamental, holistic, understanding is the basis for the identification of transformative pathways and solutions for global sustainability.

The initial research themes

The conceptual framework guides Future Earth research towards addressing key research challenges, expressed as a set of three broad and integrated research themes:



Dynamic Planet

Understanding how planet Earth is changing due to natural phenomena and human activities through intensified and novel research on mapping, understanding and projecting global change processes and interactions between social and environmental changes across scales. The Future Earth research emphasis will be on observing, explaining, understanding, projecting Earth environmental and societal trends, drivers and processes and their interactions, anticipating global thresholds and risks.

Global Development

Providing the knowledge for sustainable, secure and fair stewardship of food, water, biodiversity, health, energy, materials and other ecosystem functions and services. The emphasis of Future Earth research will be on determining the impacts of human activities and environmental change on human well-being, people and societies through integrated social-environmental research and the identification of sustainable solutions.

Transformations toward Sustainability

Understanding transformation processes and options, assessing how these relate to human values, emerging technologies, and economic development pathways, and evaluating strategies for governing and managing the global environment across sectors and scales. The emphasis of Future Earth research will be on solution-oriented science that enables societal transitions to global sustainability, such as how to anticipate, avoid and manage global environmental change through research on transformative pathways and scenarios, innovation pathways, and what institutional, economic, social, technological and behavioural changes can enable effective steps towards global sustainability and how these changes might best be implemented.

These research themes will be the main organisational units for Future Earth research and they will build on the success of existing Global Environmental Change (GEC) programmes and projects.

Cross-cutting capabilities

Addressing the proposed integrated research themes will depend on core capabilities such as observing networks, high performance computing, Earth system models, data management systems and research infrastructures. These capabilities are essential to advance the science of global environmental change and translate it into useful knowledge for decision making and sustainable development. Many of these capabilities lie beyond the boundaries of the Future Earth initiative, residing in national and international observing systems, modelling centres, training programmes, and disciplines. It will be important that Future Earth works in partnership with the providers of these capabilities for mutual benefit.

Education and capacity building

Future Earth will partner with programmes and networks that already work in the educational sector to ensure rapid dissemination of research findings and support science education at all levels. Targeted audiences will include primary, secondary and tertiary education and engagement with youth through social networks. Approaches will include online education, engagement with media, science and technology centres, and use of existing GEC research programmes that support graduate and post-graduate education.

Future Earth has identified capacity building as a basic principle of all its activities and will develop a multi-tiered exercise in scientific capacity building, with both explicit capacity building activities and capacity building that occurs as a by-product of its many activities. Future Earth's dedicated capacity building activities will include generating a strong international network of scientists committed to international interdisciplinary and trans-disciplinary research, with a particular focus on early-career scientists, and the development of institutional capacity, including developing functional regional nodes and international networks.

The governance structure

The Science and Technology Alliance for Global Sustainability is responsible for establishing Future Earth and will promote and support its development as its scientific sponsors. Its members are the International Council for Science (ICSU), the International Social Science Council (ISSC), the Belmont Forum, the United Nations Educational, Scientific, and Cultural Organization (UNESCO), the United Nations Environment Programme (UNEP), the United Nations University (UNU), and the World Meteorological Organization (WMO) in an observer capacity.

The governance structure of Future Earth embraces the concept of co-design. It involves a Governing Council responsible for setting the strategic direction of the programme supported by co-equal engagement and science committees. The science committee will provide scientific guidance, ensuring quality of the research and suggest new projects. The engagement committee will provide leadership and strategic guidance on involving stakeholders throughout the entire research chain from co-design to dissemination and ensure that Future Earth produces the knowledge that society

Town Hall Meeting on Future Earth at the EGU 2013 General Assembly

On Tuesday 9 April 2013 from 19:00 to 20:00 (room B6), the EGU will host a town hall meeting to present and discuss Future Earth.

This discussion will address international coordination of research and funding; co-designing research with funders, scientists, and users; and the role of science in bridging policy and practice.

More information to come on the [conference website](#) and [ICSU's webpage](#).

needs. An Executive Secretariat which will perform the day-to-day management of Future Earth, ensuring the coordination across themes, projects and regions.

Current GEC programmes have national committees that ensure that these initiatives are strategically linked with national research communities and priorities. These national committees will be asked to play a vital role in implementing Future Earth at the national level, and should be encouraged to work together on a regional basis. They need to be encouraged to transition away from being programme-specific and assist in the development of Future Earth communities.

Towards a funding strategy

Future Earth will require innovative funding mechanisms and increased coordination to secure the enhanced levels of funding needed for the continuation of current GEC activities as well as new activities. This will require the strengthening of funding bases for disciplinary and trans-disciplinary research and coordination activities. The Alliance will work with the Governing Council and Executive Director to secure new and enhanced sources of funding. Already, the Belmont Forum has launched in 2012 a new open and flexible process to support international collaborative research actions through annual multi-lateral calls to support environmental research. In addition, members of the Belmont Forum and the Informal Group of Funding Agencies (IGFA), who have been very supportive of GEC activities, will need to proactively engage with funders at national and regional levels, including non-traditional government funding agencies, as well as reach out to foundations and the private sector.

Towards a new model of communications and engagement

Future Earth will position itself as a lead provider of independent, impartial and innovative research for global sustainability. It will provide a vibrant, dynamic platform that encourages dialogue, accelerates knowledge exchange, and fosters innovation. Future Earth will develop a comprehensive and flexible communications strategy to engage all relevant stakeholders at the local to global level, by combining the traditional top-down expert information sharing approach with a demand-driven approach based on stakeholder needs.

*Robert Watson, Martin Visbeck and Steven Wilson
On behalf of the [Future Earth Transition Team](#)*

Helping scientists and policymakers work together

An American example

Writing from the other side of the Atlantic, the American Meteorological Society Policy Program team introduces their project and describes their efforts in strengthening the connection between public policy and Earth system science.

In the heart of downtown Washington, DC, nestled between the White House and Capitol Hill, stands the headquarters building for the American Association for the Advancement of Science (AAAS). On the fourth floor you can find a group whose vision is to benefit society by building bridges between the science and policy communities: the [American Meteorological Society \(AMS\) Policy Program](#).

The Program is a division of the Boston-based scientific and professional society that promotes the development of the atmospheric and related oceanic and hydrologic sciences and the advancement of their professional applications. With a membership of 14,000 professionals, students, and weather enthusiasts, AMS publishes eleven peer-reviewed journals, sponsors more than 12 conferences annually, and offers numerous programmes and services.

In America's capital city, the AMS Policy Program promotes informed and thoughtful decision-making through analysis, communication, creative problem solving, research, and activities that enhance working relationships between policymakers and scientists.

Core principles

Program staff believe public policy advances the interests of society most effectively when grounded in the best available knowledge and understanding. According to them, there is room for

improvement for scientists to become more effective at conveying their knowledge beyond the scientific community and recognising how value judgments and perspectives that lay outside their areas of expertise also affect policy. Members of the Program also help ensure that policy makers are armed with best available scientific understanding so they can more effectively account for competing economic, ethical, and philosophical concerns that influence policy choices. The Policy Program strives to provide policy-relevant options and analysis that are unbiased and non-prescriptive.

The Policy Program's effectiveness routinely depends on collaborations and partnerships with a wide range of groups, including those who share its vision and those who hold different views. The Program's staff aims to establish strong collaborations and partnerships in pursuit of using Earth science for societal benefit. To the maximum extent possible, they focus on partnerships that are collaborative, solution-oriented, inclusive, and that transcend disciplinary boundaries.

What we do

The AMS Policy Program (APP) is taking steps to ensure that current and future scientists are prepared to handle weather and climate policy issues that directly affect our safety, health, economy, environment, and national security. Public policy impacts the Earth system (i.e., climate change, air quality), shapes our sensitivity to weather, climate, water and the near-space environment (i.e., electricity deregulation, land use), and can either enhance or constrain the utility and value of Earth system science information (i.e., managing watersheds). Policy can also affect the viability of these



The 2012 Summer Policy Colloquium participants, as part of the 10-day curriculum, visited Capitol Hill to meet Congressional staffers and learn how they assist in the policy process.

sciences (i.e., budgets, data sharing, education, immigration policy, public-private partnerships).

From the local to the federal level, US policymakers confront daily and long-term decisions on scientific issues. The AMS Policy Program (APP) helps them keep abreast of advances in Earth system science, as they relate to public health and safety, national security, the economy and the environment.

APP is working to build the field of policy research with respect to Earth system science and services, in several ways. First, the Policy Study Series is an important tool for the development of policy analyses with respect to major challenges facing society. However, that body of policy analysis by itself will not cover all facets of this subject. The APP is therefore working to build the capacity of the field of policy research as a whole, by educating Congress about areas in need of additional research, rather than only performing the needed research in-house.

To truly make an impact, however, the APP communicates developments involving the Program to the media, AMS members and the scientific community, to ensure that the group's ideas, policies, and goals are implemented through stakeholders, decision makers and the general public.

Summer Policy Colloquium

As part of its mission to prepare scientists to engage the policy process, every June the AMS Policy Program holds its [Summer Policy Colloquium](#), a training programme that brings a select group of students, faculty, mid-level managers and scientists to Washington, DC for an intense, 10-day immersion in policy. The Colloquium, which began in 2001, provides an overview of policy basics and how decisions are made governing the course and future of Earth system science. Participants gain knowledge about the policy process and training to engage in science policy effectively and responsibly.

Participants have the opportunity to interact with US federal officials, Congressional staffers, and others who make policy decisions. This activity helps participants build skills, experience and contacts they can use throughout their careers to understand and influence the

policy process. The participants can gauge their aptitude for and interest in the challenges of matching Earth and atmospheric science to societal priorities and scientific programme leadership.

To date, the Colloquium has more than 400 alumni, who are moving up into leadership and policy-level positions. The alumni continue to network at the AMS Annual Meeting, through collaborations, and will be benefiting the field as a whole.

The 2013 Summer Policy Colloquium will be held in Washington, DC, June 2–11. Earth and atmospheric scientists from academia, government and the private sector will have access to high-level US Executive Branch and Congressional decision makers. Participants learn from leaders in the federal agencies and Executive Office of the President, Congressional staff members from both major US political parties and other leaders engaged in the policy process. They also build a network of contacts and resources that will help them engage in science policy. The Colloquium also includes visits to Capitol Hill, hands-on workshops, and case studies of current issues in the earth and atmospheric sciences. For example, the 2013 Colloquium will cover the federal budget process, communicating research to non-scientific audiences, government affairs for the university, federal government and private sector, and the different roles of the scientist when engaging in the policy process.

Registration is open to all those interested, regardless of country of citizenship. Financial assistance is available from the National Science Foundation (NSF). To be eligible for NSF support, students, postdoctoral fellows and faculty must be currently affiliated with a US institution or university and be AMS (student) members, or applicants. To submit an application, visit the [Colloquium website](#). This site also includes agendas from previous years and details on the application process. The deadline to register is Sunday, March 31, 2013. Participation is limited to 50 individuals.

Prospective applicants may contact Caitlin Buzzas at cbuzzas@ametsoc.org with questions about the AMS Summer Policy Colloquium. For general inquiries about the AMS Policy Program, please contact Dr William H. Hooke at hooke@ametsoc.org.

Ellen Klicka

On behalf of the AMS Policy Program team

The Open Access Journals of the European Geosciences Union

