Draft initial design report

17th April 2013

This report sets out the initial design of Future Earth, comprising a research framework and governance structure, preliminary reflections on communication and engagement, and capacity building and education strategies, and implementation guidelines.

This report was developed by the Future Earth Transition Team, a group of more than 30 researchers and experts from many countries and representative of the natural sciences, social sciences, and humanities, as well as from international organisations, research funders and business. Earlier drafts of its main sections have been circulated and presented for consultation in the process of designing Future Earth. Future Earth is expected to develop and evolve through a wider consultation process as the transition is made to its fully operational phase.

These recommendations suggest a direction for the Alliance of sponsors and the initial governance bodies of Future Earth to take the design and implementation forward.

The following document is an excerpt of the Future Earth Draft initial design report
Pages 29 to 32

Theme 1: Dynamic Planet

Observing, explaining, understanding, projecting earth, environmental and societal system trends, drivers and processes and their interactions as well as anticipating global thresholds and risks.

The Dynamic Planet research theme will provide the knowledge needed to understand observed and projected trends in the Earth system, including both natural and social components, variations and extremes, and interactions globally and regionally. It encompasses research questions and projects that seek to observe, monitor, explain, and model the state of the planet including its societies and the potential for abrupt and potentially irreversible changes. The Dynamic Planet research theme has a particular goal of providing the science base for reports and assessments of the state and trends of the planet and providing early warnings of extreme events, vulnerabilities, and thresholds.

The global change research community has a continuing role to contribute to knowledge about our changing planet – understanding how and why the planet is changing and forecasting likely futures. Working with other critical partners (such as United Nations and national data and information agencies) the research community provides observations, models, analyses and projections that help society and decision-makers understand past, present and future changes and interactions in global climate, air quality, ecosystems, watersheds, oceans, ice cover, and the natural and human drivers of environmental changes. The human drivers include production and consumption, land use, natural resource exploitation, population dynamics, trade, technology and urbanization, as well as the values and policies that influence these drivers.

Assessments such as the IPCC and the Millennium Ecosystem Assessment, the periodic Global Environment Outlook (GEO) reports from UNEP, the Global Biodiversity 3 Outlook (GBO-3, Pereira et al. 2010) and 4 of the Convention on Biological Diversity (GBO-4), and annual reports of organizations such as the World Bank, United Nations Development Programme (UNDP) and FAO make extensive use of such knowledge but also reveal important gaps in geographic and temporal observations, understanding

of system processes, and confidence in observations and projections. This knowledge also contributes to establishing and monitoring indicators and objectives such as the Millennium Development Goals (MDGs) and future Sustainable Development Goals. The information in assessment reports is widely used to build awareness about global environmental change, to provide future scenarios, to inform negotiations about environment and development, and to guide action on environmental issues. Global environmental change researchers have provided important forecasts and warnings of risks associated with extreme geophysical events, social vulnerabilities to environmental change, biodiversity loss, newly emerging risks (such as the ozone hole, ocean acidification, or infectious diseases), critical zones, and potential tipping points and thresholds. The risk that human activity will trigger rapid or irreversible changes in the Earth's key systems, highlights the need for more research to understand the risk of tipping points, and explain, map and predict vulnerability.

Future Earth will place a particular emphasis on research related to the development of early warning systems for abrupt and irreversible change that would be of use to decision makers, resource managers and business. Climate change is only one focus of such warning systems, which might also anticipate and warn of rapid changes in forest cover, ocean conditions, biodiversity, or water quality. A focus on vulnerability and resilience within this Future Earth theme is an excellent opportunity for the disaster risk reduction research community to come together with global environmental change researchers - especially those who focus on forecasting extreme events and anticipating thresholds with those who work on vulnerability and adaptation[7]. Historical analysis also offers important insights into past global environmental changes and their interactions with social systems and ecological regimes (e.g. Costanza et al 2012).

Although Future Earth focuses on research with an international scope, the shared challenges of particular places and regions are also a relevant priority. Some regions, people and ecosystems are more vulnerable than others to global environmental change because they are located in places where changes are most extreme, where biodiversity is the greatest, where populations are especially sensitive, concentrated or poorer, or where parts of the Earth system or local ecological systems are closer to thresholds. Global environmental change programmes have focused attention on particular regions and biomes that play important roles in the Earth system or are particularly vulnerable to environmental change. These include Monsoon Asia and the Arctic, Antarctic, Island and Mountain ecosystems, which are vulnerable to global warming (e.g. Hare et al 2011; Gurung et al 2012; Messerli 2012; www.mountainbiodiversity.org) — and are also important controls on the atmospheric and oceanic system. A biome of particular concern is the tropical forests, which exert an important influence on global and regional biogeochemical and hydrological cycles and are reservoirs of biodiversity and cultural diversity under pressures from agriculture, logging, mining and infrastructure (Malhi and Phillips

[7] For example, disaster risk reduction is a focus of the ICSU-ISSC-UN Integrated Research on Disaster Risk (IRDR) programme and climate risks and vulnerability are a focus of the Programme of Research on Climate Change Vulnerability, Impacts and Adaptation (PROVIA) with UNEP, UNESCO and WMO as partners (www.unep.org/provia).

2004; Gardner et al 2010). Deltas are another critical zone (Foufoula-Georgiou et al 2011). Cities are another important area for research on the dynamics of global environmental change (e.g. Seto and Sanchez 2010; Seto and Satterthwaite 2010; Seitzinger et al. 2012).

What types of research questions and projects might the Dynamic Planet research theme address? The Future Earth Transition Team identified the following over-arching questions to illustrate potential research priorities that can be addressed by current, updated or new collaborative international efforts:

- What approaches, theories, and models allow us to explain the functioning of Earth and socio-ecological systems, understand the interactions between these mechanisms, and identify the role of feedbacks and evolution within these systems?
- What are the states and trends of key environmental components such as climate, soils, the cryosphere, biogeochemistry, biological diversity, air quality, freshwater, and oceans, and in the human drivers of change, such as population, consumption, land and sea use, and technology. How do these relate to the states and dynamics in the social foundations of sustainable development, including well-being, equality, health, education, human security? How and why do these vary across time, space, and social context?
- What changes are predicted under the most likely scenarios of natural and social driving forces and Earth, social and biological system responses?
- What are the risks of rapid or irreversible changes, of crossing regional to global thresholds and planetary boundaries and inducing tipping points and social-environmental crises due to global environmental change?
- What can be understood and anticipated about the condition and future for critical zones and biomes such as coasts, tropical forests, arid zones or polar regions?
- What kind of integrated global and regional observing systems and data infrastructures are needed to document and model the coupled earth system and the anthropogenic drivers and impacts of change? Can we develop reliable monitoring systems, models and information systems and services that anticipate and provide early warnings of large scale and rapid change?

Many projects within the existing global environmental change programmes bring together observations and models to monitor and predict how key aspects of the Earth system are changing. Future Earth hopes to draw on and add value to these existing international projects (e.g. Analysis, Integration and Modelling of the Earth System – AIMES, Past Global Changes – PAGES, Climate Variability and

Predictability - CLIVAR, Global Energy and Water Exchanges Project - GEWEX, Stratospheric Processes And their Role in Climate - SPARC, Climate and Cryosphere - CliC, Global Carbon Project - GCP, bioGENESIS, bioDISCOVERY). These projects focus on key sectors – such as oceans, climate, carbon, biodiversity, or land – or critical zones such as coasts, mountains, or the Arctic. Others come together around input into key assessments such as IPCC and IPBES.

In addition to measuring change, some ongoing projects analyse the human driving forces of change including demography, consumption, industry and land use. However, integrated monitoring and modelling remains a challenge, especially with regards to including the full range of biological and social processes and cross scale dynamics. Responding to Future Earth those projects that use case studies and local analysis to understand Earth and social system dynamics could collaborate in initiatives that allow for rigorous comparative methods, identification of common drivers and feedbacks, and identification of distinctive regional patterns and problems. Future Earth also recognizes the importance of research agendas that have emerged from regional initiatives (e.g. the Inter-American Institute for global change research, the Asia-Pacific Network for Global Change Research, START) that seek to understand and forecast phenomena of particular regional concern – such as the state and fate of critical ecosystems and watersheds, the dynamics of the monsoon or El Niño Southern Oscillation, the degradation of soils, or rapid urbanisation.

There is a critical need for basic science to underpin this theme especially if we are to move towards prediction and informed management. Accurately observing and modelling our dynamic planet relies on the fundamental Earth, biological and social science undertaken by global environmental change projects and their partners. For example, an understanding of genetics and evolution is of practical importance in predicting how biodiversity will respond to rapid environmental change (Hendry et al 2010, Candry et al 2010). A comprehensive assessment of regional air quality and atmospheric composition is important to understanding health and climate at a variety of scales (Monks et al, 2009), linked biosphere-atmosphere models based on ecological studies across a range of vegetation types are needed to understand the biotic positive or negative feedbacks on anthropogenic climate change (Arneth et al 2010). Scientific evidence of human impact on ocean environments has led to calls for improved understanding of ocean systems and their significance to the Earth and social system (Halpern et al 2008). The fundamental geophysical, biological and social research needed to understand the dynamics of the planet must remain an essential component of Future Earth.

In summary, the Dynamic Planet research theme brings together existing strengths of global environmental change researchers, and other stakeholders, in continuing and new efforts to understand, document and anticipate how the Earth system and its socio-ecological interactions are changing and recommits the research community to communicate this knowledge to the full range of stakeholders.