

# Towards Future Earth: evolution or revolution?

During its three decades of existence, the International Geosphere-Biosphere Programme (IGBP) built research networks, facilitated synthesis and enhanced capacity around the world. Its trajectory may offer some pointers for Future Earth as it charts its own course.

Earlier this year we spent a lot of time in the archives of the Royal Swedish Academy of Sciences – a fascinating, if somewhat cramped, place in the basement of this 18th century building. Among other things, we were making sure that valuable documents, some dating to the years prior to IGBP’s founding, were in good shape. It proved hard to resist being drawn into the letters, faxes, reports and newsletters that traced the origin and early evolution of IGBP. Naturally, it set us thinking about Future Earth and the course it will chart during the coming decade. The early IGBP was somewhat different from Future Earth, but its more recent phase can certainly be viewed as a stepping-stone for the new initiative.

IGBP was set up in 1986 with an ambitious goal of “providing the information we need to assess the future of the Earth in the next 100 years”<sup>1</sup>. The programme was to gain a fuller understanding of the Earth as an interconnected whole. It would focus on such aspects as biogeochemical cycles, which were not being looked at by existing programmes or activities. There seems to have been an explicit desire to go beyond disciplinary confines: indeed, the word

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“transdisciplinary” pops up on the very first page of the first report that can be attributed to IGBP<sup>1</sup>. Early documents also make it clear that the programme was not about knowledge for knowledge’s sake but about informing decisions and policies.

Nothing quite like IGBP had been in operation in the mid-1980s and the anticipated level of international scientific coordination and collaboration was, in some respects, unprecedented. Below we trace some of the key institutional developments during the programme’s lifetime. The picture that emerges is of an adaptable and flexible organisation that did not hesitate to change in the face of changing scientific and societal realities.

## From Amsterdam to London

The decade between 1990 and 2000 witnessed the setting up and maturing of several core projects that addressed almost all dimensions of the physical Earth system. National committees were set up in many countries around the world. The Secretariat in Stockholm became a well-oiled unit for coordination and communication. More and more satellite data were being generated, major scientific

cruises and expeditions were being undertaken: for example, the Joint Global Ocean Flux Study organised cruises in all the major ocean basins. Computing power was increasing and the Internet had begun revolutionising communication. All of this translated into significant knowledge production at the project as well as programme level.

In many ways, IGBP’s trajectory is also that of the refinement and further evolution of the concept of the Earth system. Various components were described in more and more detail, and the interactions among these were elucidated. There was growing recognition of feedbacks, thresholds and rapid, or sudden, irreversible changes. Before IGBP came into existence, much of the research on climate had tended to focus on its physical aspects. IGBP’s projects focused explicitly on how life – terrestrial and marine ecosystems – interacted with the physical and chemical systems.

By the late 1990s the scientific leadership became keenly aware of the need for a programme-wide synthesis to complement project-level syntheses that had already begun. At the same time, the community was also beginning to have a greater



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appreciation of the degree to which humans had altered and were continuing to alter their environment – in fact, humans were an integral component of the Earth system as a whole. Indeed, the Anthropocene concept – first introduced by Paul Crutzen and Eugene Stoermer in the *Global Change Newsletter*<sup>2</sup> – featured prominently in the programme-wide synthesis, which sought to quantify it by means of the now-iconic Great Acceleration graphs.

The Global Change Open Science Conference, held in Amsterdam in 2001 and jointly organised by IGBP, the International Human Dimensions Programme on Global Environmental Change (IHDP) and the World Climate Research Programme (WCRP), marked the beginning of a new era for IGBP. The conference highlighted the research of the programmes as well as the emerging outcomes of IGBP’s first synthesis. It also explored the pathway that Earth-system science would take in the following decade. The conference is perhaps best remembered for the “Amsterdam Declaration”, which stated unequivocally that anthropogenic forces were “equal to some of the great forces of nature in their extent and impact”<sup>3</sup>. Furthermore, the declaration calls for “an ethical

Earth-system science entered a new phase in 2001, when the four major global-change programmes came together. The communities belonging to three of the programmes will now work under the Future Earth umbrella.

**Understanding the Anthropocene required a more integrated approach.**

framework for global stewardship and strategies for Earth system management”. All of these developments culminated in a desire on IGBP’s part to create an “integrated Earth System Science programme”<sup>4</sup>. This would eventually culminate in the launch of the Earth System Science Partnership (ESSP) made up of IGBP, WCRP, IHDP and DIVERSITAS. The formation of ESSP meant that carbon, water, food security and health would now be looked at by projects sponsored jointly by the four programmes.

IGBP research during the 2000s responded to the growing recognition that humans were the prime driver of change on the planet. Understanding the Anthropocene required a more integrated approach to the Earth system and thus greater emphasis on interdisciplinarity. This interdisciplinarity was reflected both within a core project as well as in increased interaction among core projects. The human dimensions were brought in more explicitly and there was greater engagement with stakeholders. Climate became a more prominent component of many core projects’ scientific agendas and there was greater interaction with the Intergovernmental Panel on Climate Change (IPCC) and the United Nations Framework Convention on Climate Change (UNFCCC).

In 2009, the International Council for Science (ICSU) and the International Group of Funding Agencies (IGFA) published their review of IGBP<sup>5</sup>. The review team, while acknowledging the programme’s significant contributions to science and policy, recommended

that IGBP maximise its impacts on science, policy and practice. The team emphasised that “in setting future scientific priorities within IGBP-related activities, finding solutions to practical problems must feature much more strongly than IGBP has hitherto been mandated”.

The review also alluded to the increasingly more complex landscape of global-environmental-change research. Noting the “increasingly unwieldy and confusing arrangements among the Programmes, and between them and ESSP”, the review team stated that “most people contributing evidence to this review do not believe that there should be four GEC [Global Environmental Change] Programmes with independent planning a decade from now”. Soon after the review ICSU initiated a process of “Earth system visioning”. The goal was to develop a ten-year effort to address challenges in global sustainability research.

IGBP revised its vision in response to the review: since around 2010, sustainability in the Anthropocene has taken on a larger role in framing its science and activities. It has continued to study Earth-system processes, but with an emphasis on the applicability and relevance of this knowledge. It called on the UN to take a more integrated view of its over 500 international treaties and conventions that address the environment<sup>6</sup>. It invested substantially on communication and the science-policy interface, targeting processes such as Rio+20, the Convention on Biological Diversity (CBD) and the Sustainable Development Goals, in addition to the ongoing emphasis on the UNFCCC and IPCC. It produced numerous policy briefs<sup>7,8</sup> and, in particular, helped to raise the profile of ocean acidification in policy arenas via conferences, and

through engagement in the International Ocean Acidification Reference Users Group (iOA RUG). It has worked closely with the Global Carbon Project to ensure that the findings of its annual carbon budget are communicated as widely as possible.

IGBP had also begun to focus on sustainability around this time and it recognised the need to create a new, more integrated community of natural and social scientists as well as various stakeholders. In 2010, IGBP launched a synthesis on specific topics identified by IGBP's scientific committee with input from key stakeholders, including other international research programmes and IPCC. The synthesis sought to involve scientists from many disciplines as well as policymakers and other stakeholders. This led to, for example, greater emphasis on exploring the links between air pollution and climate<sup>9</sup>; a review on the ecosystem impacts of geoengineering<sup>10</sup>; and an assessment of the socioeconomic consequences of, and responses to, global environmental change in least developed countries<sup>11</sup>.

In 2010 IGBP initiated the planning of the second major global-change conference, Planet Under Pressure. This conference – which involved the three other global-change programmes as well as ICSU itself – was the largest gathering of scientists and others interested in global change. The IGBP Secretariat, along with its partners, made an unprecedented effort to bring together diverse communities of scientists, policymakers and practitioners from across the world for the conference, which was held in London in 2012. This community would provide the nucleus for Future Earth, the new initiative on global sustainability that was the outcome of ICSU's visioning process. As with the Amsterdam

Conference, Planet Under Pressure also led to a declaration – the State of the Planet Declaration. The conference raised some difficult questions too, particularly for traditional Earth-system scientists, which were summarised by the late Mike Raupach in his article for the *Global Change* magazine<sup>12</sup>. Raupach called for a path ahead that combines “the need for wide engagement with a continuing commitment to reason”.

### Towards Future Earth

The original goals of IGBP remain at least as valid today as they were three decades ago. However, much has changed in the world and in our understanding of it since IGBP launched. In the early days of IGBP, Earth-system science took centre stage: it evolved from a focus on individual elements to a focus on interconnections. The intervening years have brought to the fore the concept of the Anthropocene and, with it, the recognition of a radically altered human-environment relationship. The Anthropocene lens brings forth the interconnections among various social and ecological processes.

The present calls for an even closer interaction among various disciplines and with stakeholders than IGBP was able to accomplish. It also calls for a new way of doing, communicating and using science. This, in part, provides the rationale for Future Earth. During the past few years IGBP and its projects have made a conscious effort to deepen engagement with social scientists. The projects have also revised their science plans to address the growing emphasis on policy relevance, stakeholder engagement and co-design and co-production. Most projects are thus set to bring their communities under the Future Earth umbrella. It remains to

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be seen how existing, focused research communities such as IGBP's core projects are able to buy into and adapt to the new model.

IGBP's longevity and success can be attributed, among other things, to its visionary leadership, dedicated community, bottom-up organising and capacity to adapt its scientific and institutional agenda to changing circumstances. IGBP's history – via its excellent archives as well as the experience of its foot soldiers – will be available to guide Future Earth as it gathers steam. ■

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