# ICSU-IGFA Review of the Earth System Science Partnership (ESSP)

ICSU
International Council for Science

## ICSU

Founded in 1931, the International Council for Science (ICSU) is a non-governmental organization with a global membership of national scientific bodies (114 Members, representing 134 countries) and international Scientific Unions (29 Members).

The Council is frequently called upon to speak on behalf of the global scientific community and to act as an advisor in matters ranging from scientific conduct to the environment. ICSU's activities focus on three areas: planning and coordinating research; science for policy; and strengthening the Universality of Science.

## IGFA

The International Group of Funding Agencies for Global Change Research (IGFA) is a cooperative organization of funding agencies that support scientific research on global change. IGFA fosters international coordination of research efforts through meetings, publications and dialogue at a senior level. It provides a forum for funding agencies to identify issues of mutual interest and to develop strategies that address these issues both nationally and internationally. IGFA cooperates with ICSU and associated agencies, and promotes interaction with the International Global Change Research Programmes.

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# Foreword

Scientific findings have shown that the Earth's environment is changing on all scales, from local to global, in large measure due to human activities. Much of the substantiating evidence has come from scientists who are active in the global environmental change programmes: DIVERSITAS (an international programme of biodiversity science), International Geosphere-Biosphere Programme (IGBP), International Human Dimensions Programme on Global Environmental Change (IHDP), and World Climate Research Programme (WCRP). ICSU is the only common sponsor of these four programmes and has a long tradition in the field of global environmental change research[1].

The four global environmental change programmes have come together under the banner of the Earth System Science Partnership (ESSP), which promotes international and interdisciplinary research in special focal areas (carbon, food, water and health). The ESSP was created after the programmes signed the Amsterdam Declaration on Global Change in 2001. The ESSP brings together researchers from diverse fields, and from across the globe, to undertake an integrated study of the Earth system: its structure and functioning, the changes occurring to the system, and the implications of those changes for global and regional sustainability.

In addition to sponsoring programmes, ICSU has a commitment to their periodic review. Indeed, the ICSU Strategic Plan 2006-2011 states: 'ICSU will conduct individual reviews of its global environmental change research programmes. Special attention will be given to the development of the Earth System Science Partnership (ESSP), which brings together the four programmes to address issues that are integral to sustainable development'. The ESSP Review was initiated by ICSU and the International Group of Funding Agencies for Global Change Research (IGFA) at the request of the global environmental change programmes. IGFA is a forum through which national agencies that fund research on global environmental change identify issues of mutual interest and ways to address these through national and, when appropriate, through coordinated international actions. This Review of the ESSP provides not only an assessment of the progress to date, but options and guidance for the future development of the partnership.

ICSU and IGFA have noted with interest that the ESSP Review Panel recommended a strengthened ESSP and that the partnership has already begun drafting a scientific strategy and is planning regular stakeholder dialogue, as recommended in the Review. In this report, several models for development were suggested along with a timeline for implementation. ICSU will monitor the overall development of the partnership, including governance.

IGBP and WCRP are currently being reviewed, while the IHDP Review was published in 2006 and the DIVERSITAS Review will start in 2010. Indeed, these are very busy times. Once the IGBP and WCRP reviews are finished, ICSU will consider organizing a high-level meeting to outline options for the needed framework for global environmental change research and its policy relevance. The landscape of environmental research is changing and many new opportunities are arising. ICSU and IGFA are looking forward to an exciting future for the Partnership and, more generally, for global environmental change research.

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Chair of ICSU's Committee
on Scientific Planning
and Review

Dawn Conway
Chair of the International Group
of Funding Agencies for Global
Change Research

[1] In 1979, ICSU co-sponsored the first World Climate Conference, which led to the establishment in 1980 of the WCRP with the World Meteorological Organization (WMO); in 1993 the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO) also became a co-sponsor. Based on the studies of the Scientific Committee on Problems of the Environment in the 1970s and early 1980s, the Council initiated the planning of the IGBP in 1986. The International Human Dimensions Programme on Global Environmental Change (IHDP) was established with the International Social Science Council (ISSC) in 1996, and the United Nations University UNU became a co-sponsor in 2007. DIVERSITAS was initially established in 1991 by the International Union of Biological Sciences (IUBS), SCOPE, and UNESCO. In 1996, ICSU joined as a co-sponsor.

# Executive summary

**The global environmental change community declared its commitment to meet the challenge of a changing Earth in the Amsterdam Declaration in 2001**. This declaration, which launched the Earth System Science Partnership (ESSP), is even more valid today than seven years ago. There is a clear need for an internationally coordinated and holistic approach to Earth system science that integrates natural and social sciences from regional to the global scale. In principle, the ESSP should be able to assume this role.

The International Council for Science (ICSU) *Strategic Plan 2006–2011* calls for reviews of the Global Environmental Change (GEC) programmes—DIVERSITAS, IGBP, IHDP and WCRP—with special attention to the ESSP. The timing of this Review, which was commissioned in 2007 by ICSU and the International Group of Funding Agencies for Global Change Research (IGFA), was motivated by a request from the GEC community in 2006 to assess the partnership as soon as possible. The purpose of the Review was to assess ESSP's science, governance, engagement with the wider community, capacity building, and resources in a forwarding-looking manner. The primary question the Review Panel addressed was: what do scientists, sponsors, and end-users get out of participating in and supporting the ESSP? For this Review, the Panel took a consultative, evidence-based approach. Dialogue with the ESSP, as well as input from ICSU, IGFA, and the wider community through questionnaires, interviews, a source Review, and comments on the draft report, informed the analysis of the Panel. The final report aims to provide ICSU and IGFA, as well as the ESSP, with guidance on options for the future.

Currently, the ESSP is sponsored by the GEC programmes. The ESSP is comprised of several components:

- Joint projects focusing on:
  - Carbon—Global Carbon Project (GCP)
  - Food—Global Environmental Change and Food Systems (GECAFS)
  - Water—Global Water System Project (GWSP)
  - Human health—Global Environmental Change and Human Health (GEC&HH)
- Capacity building in developing countries—SysTem for Analysis Research and Training (START)
- Monsoon Asia study—Monsoon Asia Integrated Regions Study (MAIRS)
- ESSP Open Science Conferences (OSCs)

The ESSP is governed by a Scientific Committee (SC) that was restructured recently with ICSU playing an important role. Hence, the timing of the Review coincides with major changes in governance.

**The conclusions of the Panel are summarized below.**

**The Panel notes that the partnership as a whole is still relatively unknown and even considered marginal**, despite several specific contributions from individual ESSP components. For the ESSP to evolve into an excellent partnership, its activities should be based on the following principles: carrying out cutting-edge science guided by a strategic vision; adding value through innovative interdisciplinary approaches; developing new methodologies; and creating new partnerships with the policy and development communities. Ultimately, ESSP's results should influence policy development.

To achieve this, the partnership must demonstrate strategic thinking in addressing global challenges that require coordinated action. The ESSP should marshal and channel global resources accordingly. The SC should ensure that the ESSP components collaborate more effectively to promote synergies across the GEC community and beyond. The priority setting process within the ESSP needs to be clarified. The partnership should analyse what are ESSP activities versus what activities could be done by one or two of the GEC programmes. In particular, the Panel recommends that the mandates, particularly between ESSP and IGBP, be differentiated as soon as possible.

**A strong scientific focus is necessary.** Scientific challenges for the ESSP to investigate include: How does the Earth system work (system behaviour)? What are the cost, benefits and unintended consequences of Earth system changes? How can the Earth system adapt and what is required to make these changes sustainable? The Panel made a conscious decision not to perform a detailed Review of the ESSP components. However, the Panel recommends that in the near future a full Review of the ESSP components be performed. This Review should focus on the science but also examine engagement with the wider community, including the participation of developing country scientists. Metrics, such as indictors, should be used to gauge the success of the ESSP.

**With respect to governance, the Panel believes that ESSP's structure should be driven by the scientific mandate with input from users.** The Panel observed that the new SC governance structure is an improvement over

the previous governance arrangement, because the ESSP needed to have an independent Chair—not directly linked to one of the programmes. However, having such a large committee (20 members) with double representation of the sponsoring programmes prompted the Panel to consider an alternative governance structure with a smaller strategic committee. In addition, the Panel recommends that ESSP's relationship with ICSU be formalized by having ICSU become a sponsor of the ESSP.

**Engagement with the wider community is critical.** New mechanisms will need to be put in place to ensure that consultations feed into informing the ESSP governance structure. One possible model would be to have a Davos-style week of meetings focused on GEC issues. Such a week might have an ESSP OSC, followed by a consultative forum, and then an ESSP governance meeting. The ESSP should pay attention to entraining regional inputs and engaging a wide audience, including the policy and development aid community.

**The ESSP should take a strategic and comprehensive approach to capacity building.** The Panel recognizes that capacity building is a matter for all countries and goes far beyond training courses. Capacity building throughout the ESSP needs to be better coordinated and carried out in a collaborative fashion. It should cover all aspects of the research process and be sensitive to regional priorities. Capacity building needs to be an integral part of the research programmes and projects.

The role of START in ESSP's overall capacity building effort must be clarified. START's mandate should be revised to allow it to play a greater role within the ESSP and the GEC community. In view of the transitions within START, there is an opportunity to redefine its role within the ESSP. In addition, the ESSP should explore new funding arrangements for capacity building activities.

**The Panel considers the current funding available to the ESSP to be insufficient to fulfil its mandate.** Securing additional funding is crucial to ensuring an enhanced impact of the ESSP. Finalizing a business and resource mobilization plan should be given high priority by the ESSP and should reflect the strategic directions of the ESSP. Careful attention to and clear articulation of priority setting in a consultative context will be critical. The further development of the ESSP, including resource mobilization, depends mainly on the ESSP Chair, who can champion the ESSP with the help of the SC and the support of the ESSP secretariat.

The ESSP, on behalf of the GEC research community, must promote more effectively the relevance and need of research to enable countries to respond to the challenges of GEC. Engagement with users should help to mobilize more financial resources. ESSP's scientific sponsors should clearly articulate to funders the role and function of the ESSP in helping to amplify the relevance and impact of the GEC programmes, to ensure that funders recognize and support the services that it provides. Since funders are increasingly asking for evidence of impact, the ESSP should take a lead for GEC science in establishing how impact and societal legacies would be evaluated, including how to measure the uptake of GEC products in education, public information, policy making and in various relevant industries, and at various scales, from regional to global.

**The Panel is convinced that the status quo will inevitably result in a progressive decline of the partnership, and thus, it recommends that the ESSP formulate as soon as possible a long-term vision of where it wants to be in 10 years time.** The ESSP must take an evolutionary approach towards implementing its long-term vision, which may entail the adoption of several or all of the models discussed in the report. For that reason, the Panel recommends that the ESSP advance towards a significant strengthening of its structure and activities over the coming five years. The Panel recommends that over the coming year the ESSP at least move towards an alliance model (a full description of the models is in the report). Over the next three years the ESSP should enhance the integration of capacity building, work to improve resources and enhance its dialogue with the policy and development community. By the end of 2012, the ESSP should have moved to a flagship model and the governance structure should evolve accordingly. The Panel recommends that the ESSP seriously considers the fusion model as a long-term option.

Finally, the Panel believes that society needs, and Earth system science deserves, a strong and forward-looking ESSP. There is a historic opportunity to realize the vision of an integrated Earth system approach to GEC and to mobilize the necessary support.

# 1. Setting the Stage

## 1.1 The Earth System Science Partnership

The concept of Earth system science gained recognition in the 1990s as the global environmental change (GEC) community increasingly realized that the complex and dynamic nature of the Earth required the incorporation of natural sciences and human dimensions, in order to provide a comprehensive understanding of issues, identify key challenges, and provide policy-relevant information to stakeholders. In 2001, at the first Global Change Open Science Conference in Amsterdam, the 1400 participants—from more than 100 countries—signed the *Amsterdam Declaration on Global Change* (Annex 1). The declaration called for strengthening the cooperation amongst the GEC programmes, for greater integration across disciplines, between both natural and social sciences and between GEC environment and development issues. It also called for greater collaboration across national boundaries and for intensified efforts to enable the full involvement of scientists from developing countries.

In response to the declaration, the four international ICSU-sponsored GEC programmes—DIVERSITAS (an integrated programme of biodiversity science), International Geosphere-Biosphere Programme (IGBP), International Human Dimensions Programme on Global Environmental Change (IHDP) and World Climate Research Programme (WCRP)—joined together to form the Earth System Science Partnership (ESSP).

The mandates of the ESSP and the GEC programmes are summarized in Table 1.

**Table 1: Mandates of the ESSP and the GEC Programmes**

| Organization | Mandate |
|---|---|
| ESSP | To bring together researchers from diverse fields, and from across the globe, to undertake an integrated study of the Earth system focusing on:<br>• its structure and functioning<br>• the changes occurring to the system<br>• the implications of those changes for global and regional sustainability. |
| DIVERSITAS | • To promote an integrative biodiversity science, linking biological, ecological and social disciplines in an effort to produce socially relevant new knowledge.<br>• To provide the scientific basis for the conservation and sustainable use of biodiversity. |
| IGBP | • To analyse the interactive physical, chemical and biological processes that define Earth system dynamics.<br>• The changes that are occurring in these dynamics.<br>• The role of human activities on these changes. |
| IHDP | To generate scientific knowledge on coupled human-environment systems, achieve comprehensive understanding of global environmental change processes and their consequences for sustainable development, and make contributions to explore:<br>• the anthropogenic drivers of global environmental change<br>• the impact of such change on human welfare<br>• societal responses to mitigate and adapt to global environmental change. |
| WCRP | To identify knowledge gaps, prioritize needs and lead world-class research into climate variability and climate change to meet end-user requirements and policy needs. The two overarching objectives of the WCRP are:<br>• to determine the predictability of climate<br>• to determine the effect of human activities on climate. |

The central activities of the ESSP are joint projects designed to address the GEC aspects of four critical issues for human well-being:

- The carbon cycle—Global Carbon Project (GCP)
- Food security—Global Environmental Change and Food Systems (GECAFS)
- Water resources—Global Water System Project (GWSP)
- Human health—Global Environmental Change and Human Health (GEC&HH).

The SysTem for Analysis Research, and Training (START), which builds capacity in developing countries, is also under the ESSP umbrella. While START predates the ESSP, it is now an integral part of ESSP's objectives and vision.

The ESSP is planning on developing a small set of Integrated Regional Studies (IRS), designed to contribute sound scientific understanding in support of sustainable development at the regional and local level. The first study is in Monsoon Asia (MAIRS), which was originally launched by START and remains relatively focused on downscaling climate processes. Also, the ESSP organized the 2006 Open Science Conference on Global Environmental Change: Regional Challenges, in Beijing, and another ESSP Open Science Conference is planned for ~2011. Table 2 presents a summary of the missions of the ESSP components.

**Table 2: Summary of the missions of the ESSP components**

| ESSP component | Acronym | Year launched (to finish) | Goal |
|---|---|---|---|
| Global Carbon Project | GCP | 2001 | To develop a complete picture of the global carbon cycle, including both its biophysical and human dimensions together with the interactions and feedbacks between them. |
| Global Environmental change and Food Systems | GECAFS | 2001 (2011) | To determine strategies to cope with the impacts of GEC on food systems and to assess the environmental and socioeconomic consequences of adaptive responses aimed at improving food security. |
| Global Water System Project | GWSP | 2005 | To answer the fundamental and multi-faceted question: How are humans changing the global water cycle, the associated biogeochemical cycles, and the biological components of the global water system, and, what are the social feedbacks arising from these changes? |
| Global Environmental Change and Human Health | GEC&HH | 2006 | • To identify and quantify health risks posed by GEC, now and in the reasonably foreseeable (scenario) future.<br>• To describe spatial (geographic, inter-population) and temporal differences in health risks, to better understand vulnerabilities and priorities for interventions.<br>• To develop adaptation strategies for reducing health risks, assess their cost-effectiveness, and communicate results (especially to decision makers). |
| SysTem for Analysis Research, and Training | START | 1992 | • To develop regional networks of collaboration of scientists and institutions in order to:<br>- conduct research on regional aspects of global change<br>- assess the causes and impacts of regional global change<br>- provide relevant information, to policy makers and governments, to assist in formulating adaptation strategies.<br>• To enhance scientific capacity in developing countries by strengthening and connecting existing institutions, by training global change scientists and by providing them with improved enhanced access to data, communication technology and research skills.<br>• To mobilize the resources required to augment existing global change scientific capabilities, infrastructure, and activities in developing countries. |
| Monsoon Asia Integrated Regional Study | MAIRS | 2006 | To understand to what extent human activities modulate the Asia monsoon climate and how the changed monsoon climate will impact further the social and economic development of Asia. |
| ESSP Open Science Conference | OSC | 2006 | To present progress in our understanding of the natural and social systems of GEC and to highlight the ESSP approach to the study of the Earth system. |

## 1.2 The Review

The Review of the ESSP was commissioned by the ICSU Committee on Scientific Planning and Review (CSPR) and IGFA, at the request of the GEC programmes that originally established the ESSP. At the same time, the ESSP itself is undergoing major changes in its governance structure and is starting a process to develop a business plan[2], a new vision, and new strategic research directions. Therefore the Panel, in consultation with CSPR and IGFA, decided not to undertake a traditional retrospective Review of ESSP achievements, but rather to conduct a Review focused on assisting the ESSP in identifying strategic options for its future development. The Review is thus carried out in the spirit of a consultative dialogue with the ESSP in its current transitional state; the goal of this Review is to provide the ESSP with guidance on options for the future.

The Terms of Reference (ToRs) for the Review (Annex 2) are in line with this approach, where the emphasis is placed on whether the ESSP is meeting its overall objectives and how the ESSP can evolve in the future, rather than focusing on a detailed assessment of the scientific, capacity building and outreach achievements of ESSP activities. The Review does not thereby evaluate the achievements of the individual joint projects of the ESSP, nor does it evaluate START separately.

The members of the Review Panel were appointed jointly by CSPR and IGFA. Their names and institutions are given in Annex 3.

## 1.3 Approach, methodology and timeframe

As a first step, the Chair and two members of the Review Panel, as well as the ESSP coordinator met at ICSU to discuss the ToRs, to organize information gathering for the first Review Panel meeting and to discuss the timing of the Review. At the first full Panel meeting in April 2007, it became clear that it would be difficult to assess a relatively young organization that was undergoing major changes in governance—a Scientific Committee (SC) replacing the previous GEC 'Chair and Directors' meetings. Methodologically, the Review Panel had to be alert to the ESSP transformative steps, to ensure the production of a coherent and concise report that would be responsive to the new developments in the partnership.

At this meeting it was agreed to:

- Take a consultative and evidence-based approach including: analysis of a source Review; written self-assessments from the ESSP community; interviews; standardized Panel interviews; and online questionnaires from both within the GEC community and from the wider community—ICSU family, IGFA membership, research partners and users. This Review would not be a traditional one; instead the Panel decided to be proactive and forward-looking, based on this interactive methodology
- Concentrate on ESSP's overall activities and not on a detailed analysis of the quality of the science in the individual projects
- Propose several scenarios to provide options for ESSP's development, in order to gauge the aspirations and commitment of the partnership.

The draft of the ESSP business plan was produced and forwarded to the Panel. The Review Panel analysed all the documentation in-line with the basic questions in the ToRs and the issues raised at the first meeting of the Review Panel.

The questionnaires were prepared by the members of the Review Panel; the questions addressed issues related to scientific aspects (including ESSP's mission), governance, policy impact, communication and resources. One questionnaire was developed for the ESSP community and another for the wider scientific community. The questionnaires, once approved by the Review Panel, were distributed to the key informants identified in each group (Annex 4). All of the key informants from the ESSP community responded to the questionnaire (Annex 5), but from the wider scientific community (Annex 6) only 24 responses were received from 207 invitations. These questionnaires were analysed and a summary of the finding was produced for each group. At the second Review Panel meeting, members reviewed both summaries and used them to draw out key issues to be raised during the joint session with the ESSP Scientific Committee.

[2] As of the publication of this report, the ESSP business plan is still in preparation. The Panel saw two versions of this plan in July and October 2007, but as there were no significant changes made in the later version, it is referred to here simply as the draft business plan.

Panel members conducted ten interviews with key-persons knowledgeable about the partnership. These interviews had a standardized structure, which also allowed for more general comments to be captured. Table 3 summarizes the information received and analysed by the Panel.

Regular exchange of views between the Panel members, and sharing of the interview results allowed for a common analysis, identifying key-issues and preliminary conclusions and recommendations, providing insight in the progress of the Review and identifying areas that needed extra attention.

To support the analysis, and in-line with the interactive methodology of the Review, it was decided that a consultative meeting between several members of the ESSP Review Panel, the ESSP sponsoring programmes, ICSU, the ESSP coordinator and the incoming ESSP SC Chair was needed. The meeting took place in Stockholm in August 2007 in conjunction with World Water Week. The second Review Panel meeting took place in Paris in conjunction with the first ESSP SC meeting. These meetings were important for promoting better understanding of the ESSP mission, operations and future developments. In addition, they allowed the Panel to discuss the key issues.

The Review Panel presented its preliminary report to the ESSP community for factual Review in mid-December 2007. The first draft of the Review was finished by the end of January and comments were received from the ICSU and IGFA communities by mid-February 2008. At the third and final meeting of the Review, at the end of February, the Panel revised the report based on consideration of the comments forwarded to the Panel. A summary of the ESSP Review Panel work plan is presented in Annex 7.

The Review addresses both short-term and long-term issues and recommendations. The Panel provides short- to medium-term (1–5 years) and long-term (~10 years) recommendations. This was done in the form of a set of scenarios for the ESSP, which include potential sequential pathways of development. The Panel considered it to be important for the ESSP to start seriously considering its long-term future, in order to enable strategic decisions to be taken over the short-term, to stem an ad hoc and arbitrary development of the partnership.

**Table 3: Summary of information received and analysed by the Review Panel**

| Item | Panel received and analysed |
|---|---|
| ESSP questionnaire | 12 responses/12 invitations |
| Wider community questionnaire | 24 responses/207 invitations |
| Standardized interviews with key informants | 10 interviews |
| Source material | • six self-assessments from the ESSP components four views, one from each of the sponsoring programmes<br>• a draft ESSP business plan<br>• annual reports and science plans of all the ESSP and GEC bodies. |

## 1.4 Future challenges and opportunities

The Amsterdam Declaration from 2001, which set the stage and rationale for the need of an Earth System Science Partnership (ESSP), is more valid today than seven years ago. The Declaration points out that 'a new system of global environmental science is required' that will 'integrate across disciplines, environment and development issues and the natural and social sciences; collaborate across national boundaries on the basis of shared and secure infrastructure; intensify efforts to enable the full involvement of developing country scientists; and employ the complementary strengths of nations and regions to build an efficient international system of global environmental science'.

Since Amsterdam, major changes have occurred in the social and economic landscape with regard to global environment change and sustainable development. Economic development in the developing world has had a significant impact on the environment. The World Summit on Sustainable Development (2002) focused attention on the need to integrate the three pillars of sustainable development: environmental, social and economic. The climate change agenda—through two Intergovernmental Panel on Climate Change (IPCC) assessments since the establishment of the ESSP—has risen to the top of the international political arena, culminating with the Nobel Peace Prize in 2007, awarded jointly to the IPCC and former US Vice-President Al Gore. The prize recognizes the potential impact of climate change on global security and the role of science assessments in communicating essential insights in causes, impacts and solutions. The ESSP has been and continues to be integral to

this process, particularly through the Global Carbon Project (GCP), START and the major scientific work of the WCRP and IGBP (and to a lesser extent IHDP). The UN Millennium Ecosystem Assessment (MA), which presented its findings in 2005, has contributed to raising broader awareness of the fundamental importance of biodiversity and ecosystem services for human well-being and sustainability. It also conveyed an evidence-based manifestation of the precarious situation for many of the key ecosystem services sustaining social and economic development. In addition, it considered the risks of unexpected and unprecedented cross-scale feedbacks, both in social and ecological systems, when degradation of ecosystems occurs at a global scale and interacts with changes in the climate system.

Twenty years after the Brundtland Commission, there is a growing realization that humanity is in the 'Anthropocene', which in the words of Nobel Prize laureate Paul Crutzen, is a period where humanity has become one of the major driving forces behind changes in the processes of the Earth system. In October 2007, German Chancellor Angela Merkel, took the initiative to gather 15 Nobel Prize laureates and a number of key representatives from research and policy, to address challenges for global sustainability. The *Potsdam Memorandum* produced from this major gathering, calls for urgent mobilization of human intelligence across natural and social sciences to support a necessary 'great transformation' of societies towards sustainable trajectories for the planet.

The origins of this call for global action in addressing sustainability challenges, not only come from a better understanding of the 'no-analogue' current state of the planet, related to the complexity and vulnerability of the Earth system; the call is also a result of the social drivers behind environmental change, particularly the precarious growth in social inequity on the planet. With three billion poor people in urgent need of rapidly improved social and economic development, and an expected demographic increase of 2.5–3.0 billion by 2050, on a planet that is increasingly showing signs of limits to its carrying capacity under the affluent lifestyles of the rich minority, the situation poses a new constraint and challenge in the quest for poverty alleviation, development, and ultimately, global justice.

Tipping points, both in the social and ecological systems, cannot be ruled out under current social and ecological drivers—globalization, consumption and production patterns, and global environment change.

Science is urgently needed to address how complex social-ecological interactions play out across scales, impacting the Earth system, and subsequently affecting local livelihood conditions among all world citizens. This affirms the call in the *Amsterdam Declaration* for a new inter- and trans-disciplinary science of the Earth system, which not only integrates social and environmental drivers and interactions across scales, but which also provides societies at large with knowledge relevant to governance and management. There is a sense of urgency around these challenges, particularly related to climate change and the risk of unforeseen acceleration of global warming due to positive feedbacks within the Earth system.

Politically, the implementation of the UN's Millennium Development Goals (MDGs) also requires an integrated scientific approach to GEC and its management, Global environmental changes, plus forthcoming global events addressing sustainable development—the final year of the Kyoto Protocol and a possible World Summit on Sustainable Development in 2012, and the year of Review of the MDGs in 2015—create both an urgency and unique window of opportunity to engage, promote and develop Earth system science.

## 1.5 The Report

The structure of this report responds to the topic headings identified in the ToRs: science; governance; engagement with users, communications, and policy impact; capacity building; and resources. In Section 2, observations and assessments are presented for the ESSP as a whole and for the areas identified in the ToR (science, governance, engagement with the wider community and capacity building). Possible models for the development of the ESSP, developed by the Panel, are described in Section 3. Section 4 summarizes the Panel's conclusions and recommendations on the topics that were discussed in Section 2.

The Panel agreed to use the following terminology throughout the Review:

- ESSP: the partnership as a whole, which is described in Section 1.1
- GEC (or parent) programmes: DIVERSITAS, IGBP, IHDP, and WCRP
- ESSP components: the joint projects—GCP, GECAFS, GWSP and GEC&HH—START, MAIRS and ESSP Open Science Conferences
- Earth system: the unified set of physical, chemical, biological and social components, processes and interactions that together determine the state and dynamics of the Earth, including its biota and its human occupants.
- Earth system science: the study of the Earth system, with an emphasis on observing, understanding and predicting global environmental changes involving interactions between land, atmosphere, water, ice, biosphere, societies, technologies and economies.

# 2. Observations and Assessments

## 2.1 General

### 2.1.1 General: observations

The ESSP was the response to a need to complement the existing discipline-based studies of global environmental conditions with a mechanism for an integrated study of the Earth system. The discipline-based activities of the international GEC programmes, which are aligned primarily along disciplinary axes, were a sound base upon which to build comprehensive initiatives directed to broad questions of regional and global scope. IGBP, IHDP and WCRP had already collaborated in the design of joint projects related to science and society.3 However, a more compressive approach was clearly needed. In response, in 2000, the Scientific Committee of the IGBP proposed a 'unified scientific effort' to focus the actions of the three programmes. The following mission statement was adopted following a meeting of the programmes' science committees:

> The IGBP, IHDP and WCRP will build on our existing understanding of the Earth system and its interactive human and non-human processes through time in order to:
>
> - Improve evaluation and understanding of current and future global change; and
> - Place on an increasingly firm scientific basis the challenge of sustaining the global environment for future human societies.

The principle underlying the statement was that the Earth is a single integrated system that life itself helps to control; and that a synthesis of research input from across the community is required in order to understand GEC and the Earth system. This concept was further developed and culminated a year later in the Amsterdam Declaration. Planning for some cross-cutting activities between IGBP, IHDP, and WCRP had been underway and the resultant projects—GCP and GECAFS—were launched in 2001 and assigned the ESSP label. This occurred without the ESSP being capable of providing much oversight concerning the development of these projects. The situation changed only marginally over the coming years due to an inactive governance structure. Consequently, the individual projects and components assumed leadership roles and acted relatively independently. The ESSP is currently under the sponsorship of the programmes and the aegis of ICSU, which incorporated the development of the ESSP in its Strategic Plan 2006–2011.

The information gathering exercises that the Panel conducted revealed several important issues. From the wider community questionnaire responses, it was clear that the ESSP is not widely known. Indeed, the most common response was that the respondent was only familiar with the ESSP name, but not with its components.

The questionnaires also revealed substantial differences regarding the possible future development of the ESSP, particularly among the different parent GEC programs. When the Review Panel surveyed the programmes on their views of the value added and future of the ESSP, the programmes' divergent responses included that the ESSP should 'avoid drifting away from parent programmes' (DIVERSITAS) to 'in 10 years we should have a single programme on GEC' (IGBP)—see Table 4. Another issue that came up several times was the need to include more young and developing country participants in ESSP activities.

Responses from both questionnaires ranked working with the development community as a high priority. For the GEC community, 82% said it was 'highly important' and another 18% said it was 'somewhat important' and for the wider community the highest ranking response was 'highly important' 39%).

[3] It should be noted that DIVERSITAS was not involved in these earlier efforts, because it was not formally launched in its current form until 2002.

**Table 4: Review Panel summary of Global Environmental Change Programmes: Evaluation of the value added and the future role of the ESSP**

| | ESSP's perceived value added | ESSP's future role/challenges |
|---|---|---|
| DIVERSITAS | • Recognizes that GEC is broader than climate change<br>• Does integrated science (four programmes) with joint projects<br>• Allows DIVERSITAS to interact with partners such as IGFA and CGIAR | • To fully integrate biodiversity into the Earth system analysis<br>• To raise biodiversity to the level of climate change<br>• To facilitate other collaborative activities besides the four programmes<br>• Concern about competition for the same resources<br>• Should set a clear vision for itself (strong secretariat)<br>• Avoid drifting away from parent programmes. |
| IGBP | • Helped START & MAIRS to be the first elements of a System for Global Environmental Science<br>• GCP, GWSP & GECAFS are helping us already to take an integrated approach | • Should clarify future interaction with four programmes<br>• Avoid resources being diverted from programme funds<br>• A new governance structure needed<br>• In 10 years we should have a single programme on GEC, it will help to set research priorities<br>• Use our understanding of coupled human-environmental systems as basis for assessments and communications of options, risks and vulnerabilities of future sustainable development of our planet |
| IHDP | • Should help us to foster improvements in our understanding of coupled human-natural systems that feature non-linear dynamics<br>• Should help address questions that can only be answered with contributions from many scientific communities | • Resources have been scarce; present a united front to enthuse funders (e.g. IGFA)<br>• The ESSP needs a new governance structure<br>• How to get credit to scientist in their home discipline for participating in ESSP projects?<br>• Process involved in developing the science plans for joint projects should be improved. (e.g. GEC&HH science plan lacks legitimacy in the eyes of the human dimensions community)<br>• Each of the joint projects should evaluate its contributions to knowledge of dynamics of coupled human-natural systems |
| WCRP | • Brings broader perspectives to address societal issues that could not be delivered by the four programmes alone<br>• Helpful to deliver climate information to meet the needs of society<br>• The joint projects and START have made good progress<br>• There are good examples of valuable linkages between WCRP and broader Earth system science<br>• WCRP has led the ESSP in strengthening the relationship with SBSTA* of the UNFCCC** | • Further strengthening linkages between the ESSP activities and the four programmes and between the programmes themselves<br>• The four programmes must continue their guidance of ESSP activities. New governance structure should provide better opportunity for this.<br>• Ensure that the ESSP does not operate as separate competing entity<br>• IGBP and WCRP are studying arguments for possible merger of the two programmes |

**SBSTA—Subsidiary Body for Scientific and Technological Advice*

***UNFCC—United Nations Framework Convention on Climate Change*

### 2.1.2 General: assessment

In the seven years since the Amsterdam Declaration, the ESSP has added some value. This has been provided by the ESSP's role as a coordinating mechanism, by its effectiveness in identifying gaps and opportunities, and by the complementarity of its mission and activities with those of the GEC research programmes. The Panel acknowledges the very valuable efforts of the ESSP to coordinate regional and global activities, to respond to the current unprecedented GEC. As stated in its mission, the ESSP has a unique mandate on regional issues, which it needs to exploit more fully. In addition to scientific efforts, creative thinking about regional consultations is needed. The Panel notes, however, that the primary example of adding value for the ESSP has been mainly limited to one OSC. It also observed the limited resources available to implement ESSP's broad mission, and the need for clear identification of the ESSP mission from the GEC programmes.

The development of the ESSP has to date been ad hoc, rather than strategic. It has not yet adequately demonstrated its ability to identify broad global issues and to marshal and channel the world's scientific resources to respond to them, nor have they been able to further the science sufficiently to provide substantial innovations that could not have been done under the parent programmes. In some cases the ESSP has been too reactive (e.g. biofuels); in others it has not acted on emerging issues such as GEC and poverty, nor put in place the coordinated activities needed to address them. A business as usual scenario for the ESSP would lead to a progressive decline in its effectiveness and is unsustainable. The Review Panel encourages a more strategic approach and development of guiding scientific principles to identify and address opportunities.

One of the reasons for the ad hoc nature of the ESSP and the differing views on the future direction of the ESSP has been that until recently the partnership has lacked the guidance and oversight of a Scientific Committee (see Section 2.3). The delay in establishing the group is regrettable and has inter alia likely limited the ESSP's ability to respond to policy requirements.

With respect to communication and outreach, the ESSP issued a statement from the ESSP Beijing Conference on Global Environmental Change which affirmed that the ESSP and the GEC programmes would:

> Take responsibility to mobilise knowledge for action, and provide society with the scientific information to better meet present and future needs within the context of sustainable development.

Even though the ESSP is aiming to urge governments to undertake actions to reduce the impact of human activities on the environment in order to ensure sustainable development, it has not always been able to realize its ambitions. Indeed, the application of information for policy development and adaptation is a key objective for the ESSP, but the tools for such communication and application require work.

The Panel hopes that the issues raised in this Review will be addressed by the ESSP SC in a timely manner.

## 2.2 Science

The ESSP states that its mission is: 'to undertake an integrated study of the Earth system: its structure and functioning, the changes occurring to the system, and the implications of those changes for global and regional sustainability'. From this statement, it is clear that the emphasis is on scientific investigation. A defining element of the grand challenges ESSP aims to address is their global scope and their interconnectedness; this requires that these challenges be approached through international collaboration and from an Earth system perspective, that is, a perspective in which the climate system, biogeochemical cycles, and humans and their economic and social systems, are all considered. The Review Panel focused its evaluation of the science at the 'partnership' level, that is, the Panel has not taken on a full scientific evaluation of the ESSP components: this remains to be done.

### 2.2.1 Science: observations

The four ESSP joint projects are all relatively young and in very different stages of development. While the carbon, water and food projects (GCP, GWSP, and GECAFS) have been in existence for a few years, the health project (GEC&HH) started only very recently.

Perhaps the most widely noticed scientific contribution of the ESSP has been two related papers by Raupach et al. (2007) and Canadell et al. (2007), both emerging from the GCP. In these two publications, the GCP undertook a rapid synthesis and dissemination of politically and societally relevant information about the global carbon cycle. They were first to show that the global emissions of fossil fuel CO2 have increased quite substantially in the last few years, with growth rates that are well above those of the last two decades. This has resulted in fossil fuel emission rates for the period post 2005 that are higher than those predicted by the most aggressive IPCC scenario. Raupach et al. (2007) analysed the drivers for this trend in detail and demonstrated that a major factor was the rapid economic expansion in Asia, particularly China. It also found a disturbing increase toward

a less carbon efficient economy also contributed to this trend. Canadell et al. showed that not only have the sources of CO2 increased more than expected, but that there might be a disconcerting weakening trend in the sink strengths of the ocean and the land.

Another important scientific contribution from the ESSP that likely will receive substantial attention is a recent study by Ericksen (in press) on food systems, emerging out of GECAFS. In this paper, Ericksen develops a conceptual framework for 'studying the interactions of food systems with GEC and evaluating the major societal outcomes affected by these interactions: food security, ecosystem services, and social welfare.' This paper will likely serve as a blueprint for the future development of GECAFS, as it addresses in a systematic manner interrelated issues such as the recent dramatic changes in the food production and distribution system, the rapid changes in the diets of humans and the emerging challenges from GEC. Overall, the goal is to develop food systems that are robust in the face of all these changes.

A third major research blueprint was published recently by the GWSP (Van Bers et al., 2007) on the basis of a recent joint workshop of The Integrated Assessment Society (TIAS) and the GWSP, that examined bridging scales and providing links to policy in the context of global assessments. In this collection of publications, a range of issues were presented, ranging from the role of land use in integrated water management, to the impacts of GEC on water and food security. The workshop report ends with a section on how the human dimension can be better integrated into, and represented in, global water assessments.

Besides published articles, the most important scientific contribution of the ESSP as a partnership was the organization of the 2006 ESSP Open Science Conference. This conference brought together more than 900 scientists from around the world to discuss issues around the core theme of Global Environmental Change: Regional Challenges. The conference was also used by START to organize a Young Scientists Conference, to enhance capacity building.

### 2.2.2 Science: assessment

The Panel notes that the mission statement of the ESSP is very similar to that of IGBP, that is: 'to analyse the interactive physical, chemical and biological processes that define Earth System dynamics—the changes that are occurring in these dynamics and the role of human activities on these changes'. Perhaps the only identifiable distinction is the greater emphasis on the role of humans in ESSP's mission.

The Panel's assessment of the scientific achievements is that on the whole the quality of the science is high. However, the science has confined itself to addressing a limited set of questions. The Panel has not been able to identify any achievement that came out of the ESSP as a whole. It is telling that only a few publications coming out of the components actually list an ESSP affiliation.

The focus on food, carbon, water and health, addressed by both relevant natural and social sciences disciplines, is novel in the context of GEC science and the chosen interdisciplinary and transdisciplinary approach distinguishes these projects from corresponding activities within the parent programmes. Also the new regional project, MAIRS, has a strong scientific justification, as it allows for integration of scientific knowledge across a broad palette of approaches?from basic science to management. However, the scientific goals and approaches were defined within each project separately, with little coordination and synthesis across the ESSP, and they are mostly sectoral in nature and do not deal much with the management and policy dimensions of GEC. Although clearly distinct in their approaches, it is not entirely clear whether these four projects could not have existed within the parent GEC programmes. The four themes are well chosen, but are not encompassing, leading to possibly large gaps in the research agenda. For example, one area identified by the Panel as missing is attention to development and poverty alleviation in relation to GEC and the MDGs.

Such gaps are the result of the ESSP, until very recently, not having taken an assertive role in defining the research agenda, nor in ensuring strong linkages across its projects. The only major contribution of the ESSP over and above those of the joint projects has been the organization of the very successful Beijing Open Science Conference, which was judged to have had a substantial impact on the research community. Indeed, one of the major achievements of the ESSP and its components is its success in connecting the scientific community at large, especially in bringing together social and natural scientists. To what extent this will permanently change the scientific landscape, remains to be seen. Unfortunately, there is still a sense of imbalance, in that the Panel considers that the ESSP has been able to draw in the best natural scientists for most of the projects, while integration with social scientists has been achieved only partially (though much better than many of the parent programmes). The ESSP also has been somewhat less successful in engaging the non-scientific community, than the scientific community.

The gradual and fragmented approach to the definition of the major research questions within the ESSP has had its consequences. While the quality of the research undertaken in the individual components is good, the truly

grand challenges of Earth system science have so far only inadequately been addressed by the ESSP as a whole. In addition, there is an impression that the scientific goals and products of the individual components are not particularly well defined. The ambition to undertake basic and novel research has been overshadowed by a strong push towards policy, capacity building and outreach rather than being combined in an effective manner.

A brief scientific assessment of the four joint projects of the ESSP and MAIRS:

- **GCP** has been scientifically, perhaps, the most successful project to date, and also among the most visible in the scientific community. While the GCP has taken a more integrative approach than its closest parent, IGBP, the level of distinction is not large.
- **GECAFS** has been successful in developing new methodologies and adapting a more Earth system perspective on food systems, which is considered a major step in the right direction. These new ideas are just emerging, so it is too early to judge their longer-term impact.
- **GWSP** appears to have some novel approaches to water sciences, however still with only limited interdisciplinarity. As a result, it is not clearly distinguishable from its parents, IGBP and WCRP, and could well be an enhanced IGBP and/or WCRP activity
- **GEC&HH** is a very recent addition to the ESSP, but it seems to be developing quite slowly, compared to the other projects. Also, it remains to be seen if this project is being developed in consultation with relevant international bodies, including the World Health Organization.

MAIRS, which was launched in 2006, is too new to permit a proper assessment. Its initial science plan contains a broad inter- and transdisciplinary vision, which is consistent with the overarching goals of the ESSP. When a full scientific assessment is done, it should examine if this component is indeed a good blueprint for regionally-focused studies.

The overall level of scientific achievements of the ESSP and its components is limited in number and impact. In addition, the different components have chosen rather different routes for the dissemination of the results. For example, while the GCP selected a mix of scientific publications in high-impact journals and policy briefs, the GWSP chose the publication of books and workshop reports. The ESSP has not been actively engaged in research at the partnership level, so it is not surprising that the ESSP has a rather low scientific visibility, especially when compared to its scientific mandate.

The Panel judges this shortcoming to be mainly a result of the short duration of the existence of these components and the recognition that it takes many years to achieve broader-scale impacts?it is only seven years since the Amsterdam Declaration formally put the ESSP on the map and the majority of the components are less than five years old. In addition, it is very clear that the limited resources available to the partnership precluded it from becoming more active.

## 2.3 Governance

### 2.3.1 Governance: observations

Before 2007, the ESSP governance structure was viewed by most to be inadequate. Indeed, one of the main reasons given by the sponsoring programmes to Review the ESSP before IGBP, WCRP and DIVERSITAS—IHDP had been reviewed in 2006—was dissatisfaction with the previous governance structure[4]. The new governance arrangement, the ESSP SC, met for the first time in October 2007. The SC membership is composed of:

- the Chair, appointed by ICSU in consultation with the four programmes
- the four programme Chairs
- the four programme Directors
- one ICSU representative

[4] Before 2007 the ESSP was governed by annual meetings of the Chair and Directors of the GEC programmes, and the other ESSP components were invited as observers.

- the ESSP coordinator
- one representative of each joint project
- one START representative
- one representative of each Integrated Regional Study (IRS).

As there are currently four joint projects and one IRS, this brings the number of SC members to twenty.

The Panel observed that this new governance structure is an improvement over the previous arrangement and having an independent Chair positively changed the governance dynamic; however, having such a large committee with double representation of sponsoring programmes prompted the Panel to consider alternate governance structures.

### 2.3.2 Governance: assessment

Throughout the Review process, the Panel was reminded of the inherent competition between the programmes and the partnership. When the Panel suggested that there was a need for a significantly strengthened ESSP, the divergent visions of ESSP's future became more evident (see Table 4).

The SC governance structure is too large, and the mix of Chairs and Directors is a redundant arrangement. The current arrangement has the Directors of the ESSP components—joint projects, START and MAIRS—as full members of a committee which should be governing their actions. The Panel expects the governance arrangement to evolve with the ESSP.

## 2.4 Engagement with the wider community

In creating the ESSP, the parent GEC programmes sought to establish a mechanism that could help the GEC community increase the relevance of its research to society, increase the use of research findings in policy making and respond to issues identified by stakeholders. The GEC programmes stated that, among other objectives, the ESSP should undertake a 'vigorous effort to communicate the work on Earth system science to a number of target audiences: broader scientific community, policy makers, resource/environment managers, public' (Ingram et al., 2007). In this same paper, 'Envisioning Earth system science for societal needs: the development of joint projects and the Earth System Science Partnership', it states that one aim of the joint projects under the ESSP is to 'build a global environmental-change oriented research agenda of *direct relevance for societies* [emphasis added]'.

Here we analyse and assess three interrelated aspects of ESSP's performance to achieve these goals of increased relevance and use of findings:

- the engagement of intended users in defining ESSP activities
- the role of the ESSP in communicating its work, and that of other GEC programmes, to its audience
- the policy and wider impact of GEC research.

### 2.4.1 Engagement with the wider community: observations

#### 2.4.1.1 User engagement: observations

The engagement of an intended user audience can be one of the most effective means of ensuring the relevance of research for that audience and the use of research findings by that audience. Scientists themselves are one key user of the findings of GEC research and scientists have been the primary stakeholders directly engaged in developing science plans and in defining research questions within the GEC community. That said, the involvement of many researchers from the GEC community in international assessment processes such as the IPCC and the MA, which by definition involve very strong engagement with users, provides an important channel for communication of the needs of other users to the GEC scientific community. The goal in creating the ESSP was to provide a mechanism for more active engagement with other intended users of the findings of the GEC community, in particular decision makers.

The evidence available does not indicate that the ESSP's engagement with users has been significantly different from that which takes place through the parent programmes. In principle, one of the most important areas for user engagement in the ESSP is in the selection of research priorities. Until now, engaging intended users—outside of the scientific community—in the process of selecting ESSP priority areas and projects has been limited.

While the total number of respondents to the wider community questionnaire was limited (24), there were a variety of sectors represented: users of ESSP products from the scientific community; funders; users of ESSP products from the development aid sector; and the policy community. Based on the Review Panel's survey, scien-

tists are still viewed to be the most important audience for activities established under the ESSP, although international institutions and national governments also rank relatively high (with media, general public, private sector and local communities ranking far lower). In the Review Panel's survey of the wider community, only 17% of respondents indicated that they had been invited by the ESSP (or its component projects) to provide input or take part in a priority setting or planning process. The selection of joint projects appears to have been made with little structured interaction with users. Although, the selection of these projects was no doubt informed by researchers' understanding of issues that are likely to be very relevant to society and decision makers.

In contrast, users have been somewhat more engaged in the identification of research questions within projects. Respondents to the GEC questionnaire ranked 'scientific questions' most important in making decisions about the focus of ESSP activities (4.7 on a scale of 1 to 5), while 'user needs' ranked second most important (4.0). The GEC questionnaire identified 'workshops' as the most important method for interacting with users in setting priorities (4.8). However, this interaction in workshops does not appear to be in the context of any systematic effort to engage with users in defining priorities, except possibly in the case of GECAFS, which was unique in undertaking a two-year scoping phase to define researchable issues and to prepare proposals.

GECAFS and START are also unique in establishing partnerships outside of the GEC research community—for example, intergovernmental and nongovernmental organizations—and these partnerships will provide opportunities both for input into research needs and for more effective communication of findings.

#### 2.4.1.2 Communications: observations

The GEC community has historically relied upon scientific publications and scientific conferences as their primary means for communication with their intended primary audience (i.e. scientists). GEC research findings have also been communicated to a broader policy audience through the involvement of researchers in international assessments such as the IPCC and MA and presentations. Newsletters and occasional short policy briefs are sometimes made available on the GEC programme websites.

It is worth distinguishing the role of the ESSP in communicating information from its own activities, such as the joint projects, from its role in helping to strengthen the communication of GEC findings more generally. Like the parent programmes, the ESSP joint projects use scientific publications and the internet as significant communication mechanisms. In addition, the use of policy briefs ranks relatively high among mechanisms used for communication. Some of the individual ESSP components—such as GCP and START—have also undertaken briefings for policy makers including the UN's Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP) and Subsidiary Body for Scientific and Technological Advice (SBSTA).

The single highest ranked mechanism for communication used by the ESSP was 'conferences'. The ESSP sponsorship of the Open Science Conference plays a particularly important role in strengthening the communication of work from the entire GEC community to scientists and to policy makers. To date, the Open Science Conference appears to be the primary 'value added' component that the ESSP provides in the way of communications for the parent programmes. However, the programmes are beginning to turn to the ESSP to facilitate their input into policy processes. For example, the ESSP was asked to coordinate a presentation to the UNFCCC SBSTA on behalf of the GEC programmes.

#### 2.4.1.3 Policy impact: observations

There are three components of policy impact: science policy, development policy and overall policy (i.e. the wider political process). The ESSP probably has an easier entry point with the science and development communities, but the lack of a strategy on the broader scientific issues has meant that ESSP's impact on the overall science policy agenda has been limited. Given the many factors influencing policy and management decisions, it is possible only to make inferences regarding the likely policy impact of ESSP activities based on their policy relevance and visibility with policy makers and managers.

As mentioned in Section 1.5, much of the research of the GEC community is highly relevant to policy makers. Indeed, it formed the foundation of the four IPCC assessments, which contributed in turn to the shared Nobel Peace Prize to the IPCC in recognition of the important role it had played in stimulating action to address global climate change. Even more than its parent programmes, the intent in establishing the ESSP and its joint projects was to focus on policy relevant research, and certainly the topics of all four joint projects fit this description.

Among the ESSP activities, some products from the GCP have received significant media attention and are thus likely to have received attention from policy makers, while other projects and products are poorly known. Among the wider community surveyed, 30 per cent of respondents had never encountered information resulting from the ESSP or its component activities. The policy audience for different components of the ESSP differs

significantly but in no case does there appear to have been an explicit effort to define that audience and develop a strategy to ensure maximum use of research findings by that audience.

The ESSP appears to have had only limited success—primarily through GECAFS and START—in engaging the development community as an audience, despite the clear relevance of the food, water, and human health joint projects to development needs. The ESSP has not shown a systematic attempt to reach out and engage this audience, although it should be acknowledged that a session on the need to bridge GEC research and development was held at the ESSP Open Science Conference in Beijing in 2007. This session was a follow-up to the IGFA-ICSU hosted workshop on the interface between global environmental change and development-oriented research, held in Krusenberg, Sweden, in 2005. Thus, there is momentum for the ESSP to build on, in order to advance the scientific and policy links between GEC research and development challenges.

### 2.4.2 Engagement with the wider community: assessment

Scientists involved in both the parent GEC programmes and in the ESSP joint projects have played central roles in international assessments, such as the IPCC and the MA, as well as in assessments carried out by the Scientific Committee on Problems of the Environment (SCOPE). Because the focus of different assessments will naturally align with different programmatic elements within the GEC community, it is important that the ESSP not come to be a 'gatekeeper' in controlling access and input into such assessments. However, as part of its mandate to strengthen the impact of GEC research on policy and decision making, the ESSP has a critical role to play in both identifying scientific issues that could lend themselves to assessment processes and in catalyzing such assessment opportunities.

The Review Panel is not recommending that the ESSP seek to carry out scientific assessments itself. The most influential global assessments have three features in common: (a) a strong 'authorizing environment' providing legitimacy to the assessment and an engaged user audience; (b) a strong focus on user needs; and Iextremely high scientific credibility, typically achieved in part by an extensive peer Review process.

While the ESSP could in principle ensure the focus on user needs and the credibility of the assessment, it does not possess the type of authorizing environment that has been critical to the success of other assessments. Not all assessments necessarily need a strong authorizing environment; for example, assessments carried out by SCOPE have played important roles in informing policy makers. However, because of the mandate and track record of SCOPE, it is a more logical institution to carry out such 'science-driven' assessments than the ESSP.

Although the ESSP has taken steps to develop a set of GEC activities more directly relevant to society and to policy makers, the Review Panel does not believe that ESSP's activities are having any greater impact on policy making and decision making than its parent programmes. Nor does it appear to be significantly increasing the outreach or impact of findings of the parent programmes, except to some extent through the Open Science Conference (which primarily serves to increase the impact on the scientific community). Like the parent programmes, science priorities and research priorities within the ESSP are set largely by the scientific community itself, with limited interaction with the intended audience.

Overall, the primary mechanism for policy impact being utilized by the ESSP is that used by the parent programmes: independent development of priorities by scientists, and 'push' communication of findings through papers, briefs, and the internet.

For the ESSP to have the type of impact and relevance that it is seeking, it will need to adopt a very different style of work built strongly around the idea of fully engaging its intended user The ESSP needs to carefully define and target the users of the joint projects' results and to actively seek out and create opportunities to engage its intended audience in the conceptualization and design of projects and other activities. It also must significantly increase the scale and visibility of the 'push' component of its communications and, more importantly, seek out and create opportunities for dialogue with intended users about its findings.

We recognize that this type of active interaction with users and enhanced communication and outreach is a significant departure from the standard operating practices of the GEC community. Dedicated staff and a significant budget for communications, engagement and outreach are essential because most scientists do not have the time, interest, or expertise to engage in extensive dialogue with users or to develop outreach products and interact with the media and target audiences.

Given the strategic nature of the science questions being asked by the ESSP, the potential user audience for the ESSP is vast: scientists in other GEC programmes and projects; scientists outside the GEC system; policy makers; resource managers; educators; the media; and the general public. All have different information needs that the ESSP could help the projects and programmes understand. Indeed, the ESSP could lead an effort to take stock of the different types of users and uses to which the GEC programmes' products have already been put and draw

generic lessons and guidance to all GEC work. The Review Panel believes that the communications and policy engagement elements of the ESSP must not be limited to the activities of the ESSP but rather the ESSP should be strengthened to provide support and coordination to communication, engagement, and outreach of GEC results from the ESSP as well as from the parent programmes. This does not mean that it would replace the communications staff or funds within the parent programmes but it should have both staff and financial resources that could assist those programmes and it would play a role in coordinating outreach and engagement opportunities.

We do not believe that it is in the interest of the GEC community to attempt to raise the 'brand' visibility of the ESSP among the user community. The ESSP should serve as a mechanism for increasing the policy relevance and policy use of the entire GEC community, not as a standalone programme seeking to elevate its own brand identity. The GEC community is already a confusing arrangement of institutional structures and acronyms. There would be no value added to users in trying to understand how the ESSP is distinguished from the parent programmes.

Because of the significant diversity of user audiences across the GEC programmes and the ESSP joint projects, a users consultation forum would have to be an open, targeted event. In addition to the traditional GEC community, including representatives from scientific assessments, it should aim to attract policy makers, the development community, the media and funders.

## 2.5 Capacity building

The Panel adopted the concept of capacity building that is widely used now in development circles, namely 'approaches, strategies and methodologies used...to improve performance at the individual, organizational, network/sector or broader system level' (Bolger 2000). It is the view of the Panel, in light of this definition, that capacity building should be considered an integral part of all ESSP activities and not just the job of START.

### 2.5.1 Capacity building: observations

On the ESSP website, it states that 'each of the four global environmental change programmes organizes research activities and capacity-building initiatives, and helps establish scientific networks. The joint projects, MAIRS and START all have a strong suite of capacity building and networking elements to their activities.'

Capacity building has two dimensions in the ESSP context: making a special effort in developing countries to train people in a wider GEC perspective?that is, START's activities—and addressing a worldwide need to train young people. When analysing ESSP's capacity building activities, the Panel noted that two main observations deserve attention. The first is that the importance of capacity building is recognized throughout the ESSP community but is not given a commensurate place in the programme or project plans of the various entities. The second is that there is less agreement on: (a) who should do it; (b) what its scope should be; and (c) how it is best pursued.

Capacity building is such a broad concept that almost anything can be included. Respondents confirmed this by pointing to a wide range of examples of building capacity: Open Science Conferences; training workshops; courses; research projects; PhD education; participation in scientific assessments; and providing access to articles and scientific results. They also believed that capacity building should be carried out both independently and through START.

Some capacity building is carried out as part of all ESSP projects and GEC programmes; however, responses to the questionnaires sent to representatives of the principal programmes and projects in the GEC community (n=10) showed that capacity building gets more attention in the projects than in the programmes. For instance, in response to the questionnaire IHDP said that it considers capacity building to be only a 'minor component' of its ESSP activity.[5]

With regard to the importance attached to ESSP's capacity building activities (including those of START) in attracting the interest of young scientists and in fostering a new generation of scientists working in a more interdisciplinary research environment, close to half of the GEC respondents (START, DIVERSITAS, IHDP, MAIRS, WCRP) consider this to be 'somewhat important' while the other half (ESSP-SC, GCP, GECAFS, GWSP, OSC) consider them 'highly important'.

Two thirds of the respondents from the GEC community think that the impact of the ESSP in changing their organization's or their key-partner organizations' capacity for global environmental science has been, is, and will be 'somewhat important' while two respondents (ESSP-SC and GCP) answered 'highly important'. Only one respondent (WCRP) thought it would be 'of little importance'.

[5] However, after filling out the questionnaire, IHDP indicated that it expects its 'CapDev' to contribute significantly to ESSP capacity building, but it is not possible to judge at this point the impact of this initiative.

Our findings show that although capacity building is viewed as a core component of the ESSP and GEC programmes, START—at its own admission—and other activities in this area have had limited success, primarily due to this organization's limited resources. However, another important issue is that there is a lack of communication and recognition of START within the GEC community. Awareness of this problem has led IGBP to propose, in response to our questionnaire, a reorganization of START to make it more ambitious in terms of its scope and size.

### 2.5.2 Capacity building: assessment

With such a broad definition of capacity building, it is inevitable that it will be carried out by many agents in different forms. Other than broadly examining the activities of START, analysing the details of the capacity building examples given in the questionnaire (i.e. Open Science Conferences; training workshops; courses; research projects; PhD education; participation in scientific assessments; and providing access to articles and scientific results) was beyond the scope of this Review, and will have to be left to a more detailed Review of the ESSP components.

The Review Panel's main concern is that the organization that has been particularly identified to promote capacity building, that is START, be better integrated into the ESSP and the GEC programmes and projects. An interview respondent with experience from START lamented a 'silo mentality' and a lack of understanding among the GEC programmes on what START is all about. It is significant that capacity building does not feature in the ESSP business plan.

START could well exist without the ESSP, as it did from 1992 to 2001, but the Review Panel considers such an option strategically wrong. Instead, it proposes that START's role be clarified in relation to the various ESSP components. It should be brought closer into the ESSP family. The main emphasis has been on START; while there are positive aspects, START's mandate limits ESSP's view on capacity building. A comprehensive ESSP capacity building strategy is needed.

The scope of capacity building needs to be wide enough that it covers key aspects of the research process and its links to action, as suggested in Figure 1.

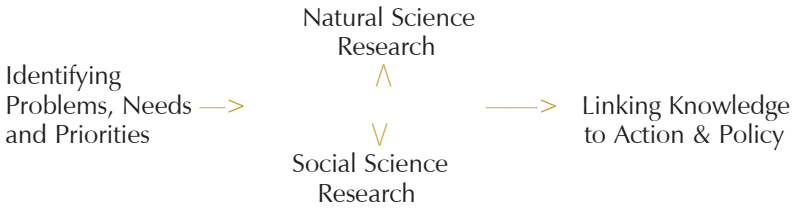


**Figure 1:** The research process and its links to action

START is well placed within the ESSP community and has extensive networks to allow it to play a more significant role in coordinating major capacity building initiatives. These activities should not be designed as general training programme for scientists from developing countries but be integral parts of the research programmes and projects within the broader GEC community. As such, they should be targeted towards activities that generally help enhance the profile of the ESSP and the GEC programmes—something that is not occurring today. This will require mobilization of additional funding.

Building capacity within research programmes and projects allows scientists in developed and developing countries to work together in ways that are mutually beneficial. Capacity building, therefore, should be pursued in this collaborative context. Institutional 'twinning' arrangements that allow research cooperation between senior and young scientists in developed and developing countries over some time constitute one way of doing it more effectively. Another, related method would be to establish a separate funding facility for new research projects within the GEC framework that contain a twinning arrangement for capacity building purposes.

## 2.6 Resources: business plan and effectiveness of resource mobilization

The ESSP is only now in the process of preparing a business plan and resource mobilization strategy; thus it is premature for the Review Panel to assess the effectiveness of the new business plan. Here we present our observations and assessment of the information available to the Review Panel with regard to the resource mobilization during the first few years of the ESSP and the draft business plan prepared by the ESSP.

### 2.6.1 Resources: observations

#### 2.6.1.1 Current resources

Resources for the ESSP include both the funding for the activities of the core and joint project secretariats (coordination funds) and funding for the research and project activities themselves (research funds). With respect to

the core secretariat funding, resources available to the ESSP include contributions from governments (USA, China-Taipei, The Netherlands, Austria, Norway, France, UK; making up 90% of the 2007 budget) and contributions from the four GEC programmes (10% of the 2007 budget). Overall, financial resources for the core functions of the secretariats have been extremely limited and often frozen at a constant level for several years (see Table 5).

**Table 5: Core secretariat funding for the ESSP and its components, as reported in the questionnaire**

| Secretariat | 2006 Annual Operating Budget (€) |
|---|---|
| ESSP | 118 000* |
| MAIRS | 120 000 |
| GECAFS | 270 000 |
| GCP | 280 000 |
| GWSP | 500 000* |
| START | 560 000 |

**Signifies 2007 operating budget.*

The available evidence suggests that despite support in principle for the goals of the ESSP, IGFA national funders are constrained in the resources that they have available to support the GEC secretariat and thus expansion of support for the ESSP secretariat would require a reduction in support for other programmes. Funding for the core secretariat function of the ESSP is currently in a precarious state with only one funder (The Netherlands) providing a long-term commitment of support for a portion of the budget.

The Panel did not undertake a comprehensive evaluation of the resources of the joint project activities carried out under the ESSP. For the four GEC research programmes, the bulk of funding for research and projects carried out under the GEC umbrella is provided directly to the researchers by national science funding agencies. An IGFA Resource Assessment undertaken in 1995 indicated that the funding for the GEC coordination, including the secretariats of the four programmes and their projects, accounted for only 0.5% of the overall funding (~US$2 billion for GEC research). In 2003, it was recommended that the funding for international coordination of GEC be increased to 1% of the total GEC research budget (ICSU, 2003). To place this number in context, the Consultative Group on International Agricultural Research (CGIAR), which has a similar system of coordination and research, reported in 2006 that their coordination costs were 1.6%—Systems Office and Committees, US$7.4 million; and research, US$458 million (CGIAR, 2006).

While the ESSP secretariat has funding needs of its own, the presence of the ESSP can potentially play a role in helping to mobilize resources for its projects and parent programmes. Our survey indicated that involvement as a part of the ESSP was moderately important for fundraising for several of the joint projects (GCP, GWSP, MAIRS, and START) but of relatively little importance for GECAFS. Involvement in the ESSP was seen to be of little or no importance for fundraising for IHDP, WCRP, and IGBP, but was highly important for DIVERSITAS.

Approaches to host national agencies for core and secretariat support were cited as highly important for many of the ESSP components (GCP, GECAFS, GWSP and START). A summary of the responses shows that several other mechanisms were seen as being effective for the individual components (see Table 6). With regard to interactions with IGFA, those who responded rated this as one of the least effective mechanisms of resource mobilization.

START and GECAFS are unique in the GEC community in that a large fraction of their financial resources are obtained from the development assistance community. While fundraising has always been a challenge for the ESSP activities, the situation appears likely to become still more difficult as bilateral funders are compelled to devote greater resources to the challenge of addressing the impacts of GEC and wrongly assume that there is now less need for scientific research to understand GEC. START is uniquely positioned to continue and to strengthen its efforts to make the case for the importance of capacity development in understanding and responding to GEC, using compelling examples of where their activities have made a difference.

| Table 6: Responses to the question 'For your organization what mechanisms have you used for resource mobilization?' | | | | | |
|---|---|---|---|---|---|
| | GCP | GECAFS | GWSP | MAIRS | START |
| Approaches to national agencies for core and secretariat support | 7 | 8 | 8 | | 7 |
| In kind support from home institutions | 8 | 3 | 5 | 6 | |
| Independently initiated project proposals to government donors | 4 | 6 | 7 | | 5 |
| Independently initiated project proposals to donors other than governments | 3 | 7 | 4 | | 8 |
| Responses to request for proposals from governments or other donors for science support | 6 | 4 | 6 | 7 | 1 |
| Responses to request for proposals from governments or other donors for development aid support | | 5 | 3 | | 6 |
| Interactions with IGFA | | 2 | 2 | | |

Note: Respondants ranked mechanisms in order of importance based on the amount of funds received, 1 = least important, 8 = most important. GEC&HH did not respond.

#### 2.6.1.2 Business plan

The ESSP draft business plan, which was provided at the request of the Review Panel, includes information on: *(a)* the rationale for the ESSP; *(b)* the ToRs for the partnership, Scientific Committee and coordinating office; *(c)* the scientific imperatives for the ESSP; and *(d)* a work plan and budget. In that regard, the draft includes some elements that would normally be found in a science strategy—*(a)* and *(c)*—and elements that would be found in a business plan—*(b)* and *(d)*.

As acknowledged by the ESSP Scientific Committee, the preparation of a full business plan was premature since there is not yet a broad agreement on the basic mission and objectives of the ESSP or on a science strategy. A business plan would ideally follow directly from a clear statement of the mission and objectives of the ESSP. It would identify: the assets—financial resources, human resources—needed to achieve those objectives; the processes and institutional arrangements required; the potential sources of support; the plan for mobilizing assets and building the processes and institutional arrangements; and the mechanism for monitoring progress and changing course based on the results of that monitoring. The current draft business plan does not contain many of these elements.

### 2.6.2 Resources: assessment

The ESSP Scientific Committee thought that one of the most important elements of the current draft business plan is the articulation of the desired 'value added' of an enhanced ESSP:

> An enhanced ESSP would be able to aid the international community in several important ways:
>
> - providing an authoritative source of GEC research results and understanding
> - coordinating and facilitating truly interdisciplinary research that links social and natural sciences in a wide international community
> - being a source for timely and regular input into international assessment and negotiation efforts
> - providing the international scientific infrastructure without which GEC would be much more difficult or impossible.

In practice, these responsibilities are not unique to the ESSP but are also shared by the parent programmes. The Review Panel believes that the added value of the ESSP is not in assuming these responsibilities itself but rather in strengthening the ability of the GEC research community to fulfil these responsibilities. The Panel recognizes the constraints facing the partnership, but considers a business plan essential for the ESSP's future.

The ESSP should add value to the GEC programmes' undertakings by:

- advancing integrated Earth system science
- reinforcing joint action among programmes on major global issues central to the GEC/ESSP mission
- enabling GEC programmes to speak and negotiate authoritatively on common concerns
- promoting efficient collective action on administrative matters among the programme secretariats to save time and money.

In addition the ESSP should add value to the GEC operations by:

- increasing the impact of research activities through joint action on key GEC themes, enabling complex problems to be tackled effectively through synergies
- identifying high priority opportunities to communicate GEC research findings to important user audience and facilitating work to communicate these results
- facilitating dialogue between IGFA and the GEC programmes
- enhancing networking between GEC programmes of the ESSP to strengthen the reputation of the whole GEC system.

Given its growing potential to add value to the GEC family of programmes, the ESSP is significantly under-funded. The low level of secretariat funding makes no sense from either the funder or science standpoint. Currently the staff across the ESSP is spending far too much time seeking multiple small grants for support.

There exists an untapped potential to use the more applied focus of the ESSP to increase the potential amount of funds available. However, the funds are most likely to come from government granting councils, departments and/or agencies. The ESSP will probably not expect that significant additional funds will be available from foundations or the private sector, without significant effort. A business plan, which should include a funding strategy, is essential but should follow from a clear priority setting mechanism, which will help articulate the mission and objectives of the ESSP. Moreover, the business plan should be developed in support of the ESSP science strategy.

There is a need for more consolidated GEC committees, to replace the more common arrangement of separate National Committees for each programme (WCRP is the notable exception), as the current arrangement is a significant barrier to adequate funding—especially for the ESSP.

# 3. Scenarios

## 3.1 The rationale

As pointed out in an earlier part of this Review, the Panel is of the opinion that the rationale for setting up the ESSP in 2001 has without doubt been strengthened further since the launch of the partnership. The importance of understanding the coupled social and ecological dimensions of GEC and how they influence development, from local to global scales, has grown drastically over the past five years. The scientific community increasingly recognizes the importance of interdisciplinary and transdisciplinary research in order to understand drivers of change and the critical need to focus on interactions between local and GEC processes. The policy arena has been rapidly engulfed by global environment change, through the climate change agenda and its links to management of terrestrial and aquatic ecosystems. Understanding the Earth system is now, more than ever, at the centre of international policy discussions and all signs are that it will continue to grow in importance.

The question is: how should the ESSP position itself in the short-, medium-, and long-term future in order to meet the growing need for relevant knowledge for society on global environment change? The partnership itself recognizes that the current structure of the ESSP is not well suited to achieve the objectives set up in 2001, and therefore much less so to meet growing demand for Earth system understanding in the future.

The draft ESSP business plan discusses the need for an 'enhanced' partnership (see Section 2.6.1.2). The Panel has comments and recommendations regarding this 'new' objective; they reflect the fact that the ESSP itself recognizes the need and opportunity to strengthen its ability to coordinate and execute interdisciplinary GEC research and moreover, to be a recognized knowledge platform, which can respond to demands for policy advice on GEC issues.

## 3.2 The current model and ongoing developments

It is not entirely clear what the partnership itself means with an 'enhanced ESSP', apart from a stronger ability to initiate thematic research projects (biofuels, carbon offsets, consumption issues are among cited examples), and being even more strongly connected to assessments and policy processes. The fundamental structure appears to be more or less unchanged.

The success of the ESSP joint projects—which have their own governance committees and funding—in combination with a weak coordinating centre for the partnership, has resulted in the Earth system science community being even more scattered among a broad variety of acronyms, rather than achieving a more coherent approach to Earth system science, which was the original intention. The effects are two-fold: a realization that the 'grand research questions' of the Earth system remain unanswered; and a growing, rather than diminishing, level of confusion among non-ESSP core stakeholders (e.g. the parent programmes IGBP, WCRP, DIVERSITAS and IHDP create the ESSP, which in turn launches GWSP, GECAFS, GCP, GEC&HH).

The Panel's conclusion therefore is that the current structure of the ESSP is not an option for the future—status quo will not enable the ESSP to continue to develop into the future. Instead, a clear long-term ESSP vision needs to be developed, including setting out an evolutionary pathway for the partnership; however, at the present time the ESSP should not concern itself too much with the mechanics of how the other programmes might collaborate. Indeed, collaboration should be openly encouraged as an organic organizational process that does not require management from the ESSP SC, as it is the role of the sponsors to examine the structural needs. However, in the future, the ESSP may well serve as an appropriate forum within which to discuss and act on, as necessary, the effects operationalizing institutional collaborations, and even possibly broker a merger of all the programmes into one body.

The recommendations in Section 4 should help frame the challenges to the GEC community, as well as the possible development scenarios in a broad context. The Panel notes that the reviews of WCRP and IGBP began in 2008 and the findings here should be of use.

## 3.3 Scientific considerations

There is clearly a growing need for Earth system research that can answer the key questions of the risks, challenges and opportunities facing humanity in the Anthropocene, especially given the projected demographic and economic growth. It is also increasingly understood that to answer these questions, a new generation of inter- and transdisciplinary research is required that bridges social and natural sciences, and addresses complex spatial and temporal interactions.

At the same time, such systems research of GEC, must build on disciplinary and fundamental research from both the social and natural sciences. We cannot understand how ecosystem crises and climate change affect our abi-

lity to attain the MDGs, unless we have a profound understanding of climate science, ecology and economics. It will be impossible to advance credible, evidence-based Earth system understanding without trustworthy observational data on processes and detailed functioning of systems of the Earth from local to global scales. The disciplinary parts that inform such comprehensive systems research must be strong so that they can support the strong, integrative Earth system science required in the ESSP. In other words, however far the ESSP develops in terms of programmatic synergies and mergers, its fundamental disciplinary building blocks must remain intact as a foundation for systems research that integrates societal and environmental dimensions.

## 3.4 Development considerations

A critical realization over the past 10 years, which was reflected in the launch of the ESSP in 2001, is the urgent need to make GEC research relevant for development and to help build the capacity for GEC research in developing countries. This is especially true when providing collaborative, focused research programmes to maximize 'learning by doing' and to fully include scientists from developed and developing countries. The need to bridge the gaps between the GEC research community and development research was addressed at the meeting in Krusenberg, which was organized by ICSU and IGFA. This was a first step in defining strategies to establish closer links between the understanding of the Earth system, global environment change, and how it affects vulnerabilities and resilience among local communities and societies in developing countries.

The Panel's view is that the challenge of making GEC research relevant for development efforts—in the North and the South—in itself will require closer integration between the GEC programmes in order to bridge the more physically based process research (i.e. systems understanding) with the research on the human dimension of global environment change. Moreover, the Panel is convinced that the fundamental questions of Earth system science are related to poverty, and development (including rapid economic development), and how these impact the natural factors affecting the Earth system. The ESSP needs to tap resources and promote an awareness of GEC issues in the wider community, and in particular in the development community. The envisaged collaboration between the ESSP and the CGIAR for the proposed Challenge Programme on Climate Change, Agriculture and Food Security may help integrate the GEC programmes on this important topic and may provide a bridge to the development agenda.

## 3.5 Financial considerations

According to the Panel, there is a vast discrepancy between the need for Earth system understanding to support governance and management for sustainable development, and the current funding for the GEC research programmes. The current operating budget for the ESSP secretariat—including its components—and the four GEC programmes, amounts to approximately €7 million per year. Even though this is only the core funding (i.e. the operational costs of the secretariats of the ESSP and the parent programmes; and does not include funding for specific research activities or projects of the GEC parent programmes), it remains a very small budget in relation to the research and policy support needs.

This said, the Panel has in its discussions with the current funding community for GEC research, encountered an almost uniform sentiment that it would be very difficult to envisage an increased funding envelope from the current sources. Even though not researched in detail, the Panel takes this seriously, and, as an indication that there is a high risk of the ESSP venturing into the future with the current organizational structure, which is perceived as unable to fully address the rapidly growing challenges of GEC and sustainability.

While there are constraints on current funding sources, the Panel believes that there is the possibility of new funding sources. To access these, the ESSP will need to be more strategic about its future and what it can deliver, so that a compelling case can be made for a significantly larger budget to address the research and policy needs.

When it has determined its vision, mission and strategy, the ESSP should endeavour to forge new and entrepreneurial partnerships both for financial and user needs. For example, the multi-lateral and bilateral development assistance community, non-government conservation organizations, and welfare assistance agencies are all paying greater attention to GEC as a challenge for human development and environmental conservation. The ESSP could use its expert knowledge and selectively work with key organizations, looking to have a regional impact, as they formulate their priorities and strategies. IGFA could assist by helping the ESSP make personal connections in relevant organizations and in promoting the importance, quality and value of GEC science.

## 3.6 Future models

The Panel recommends the ESSP formulate a long-term goal for the partnership, which should be communicated clearly inside and outside the community. The development trajectory for the advancement of the current ESSP to the goal would then be a progressive evolutionary development, with clear milestones and time-targets.

To support this important process within the ESSP, the Panel has elaborated four possible models. The basis for the models is that the ESSP is presently a loose system of components, each of which is itself a system of projects and activities, supported by secretariats and conducted by more formal 'bricks and mortar' organizations. The parts and the whole are supported by a wide range of funders. Some of these ESSP components are entirely independent of the staff and the host institutions that employ them.

The purpose of these models is to give the ESSP a set of future-oriented options, and also to share the Panel's advice on potential constraints and opportunities related to the more difficult options. The Panel also believes that the models could be implemented in a sequential manner, where the partnership evolves from incremental, but significant, organizational change to a model of major integration among the parent programmes of the ESSP.

The Panel has considered four future models for the ESSP:

1. **Status quo** model, where the ESSP essentially continues as a loose network of the four GEC programmes.
2. **Alliance** model, where a strategic business plan forms the basis for a common framework of operations for the four GEC programmes—a more formal system of systems, with negotiated and agreed delegations of certain functions and services to different parts of the alliance.
3. **Flagship** model, where a common facility is established, moving the partnership towards a shared programme, with the existing GEC programmes deeply invested—a more consolidated version of the alliance wherein much more centralized decision making occurs.
4. **Fusion** model, where the GEC programmes are merged into a Scientific Global Environmental Change Programme (e.g. Science on Humanity and the Earth System, SHE)—the most consolidated organizational structure with considerable centralized decision making, although still overseeing a system of research providers and interacting with a set of independent external funders and internal host institutions.

Figures 2a-d provide schematic illustrations of the four models while Table 7 summarizes the characteristics of each one.

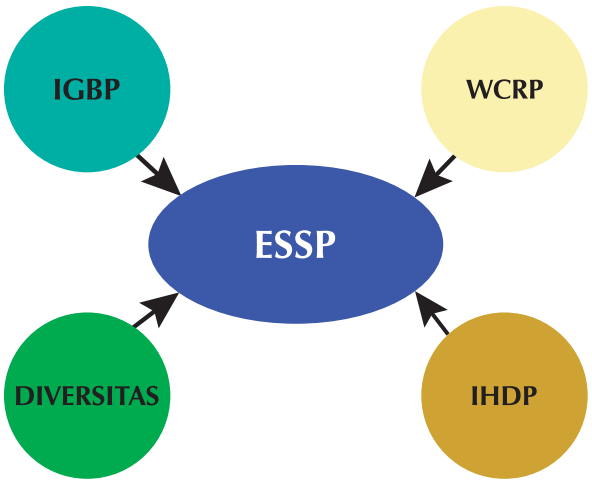


**Figure 2a:** Schematic illustration of the status quo model

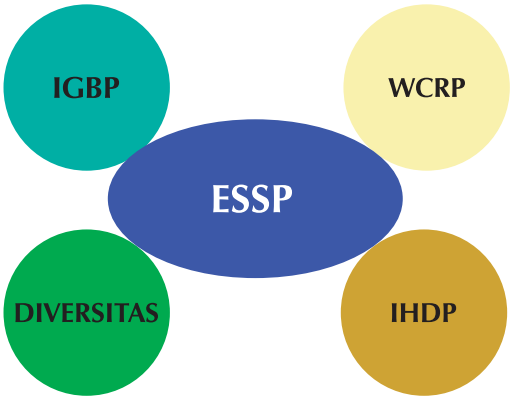


**Figure 2b:** Schematic illustration of the alliance model

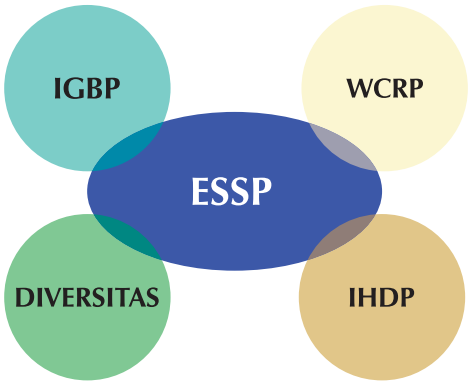


**Figure 2c:** Schematic illustration of the flagship model

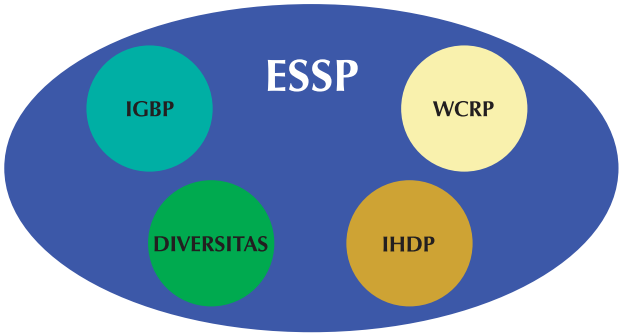


**Figure 2d:** Schematic illustration of the fusion model

**Table 7: Characteristics of the four models**

| | Information sharing | resource sharing | joint action | |
|---|---|---|---|---|
| | **Status quo** | **Alliance** | **Flagship** | **Fusion** |
| **Funds** | Minimal ESSP funds from the four parent programmes | Increased ESSP funds from the four parent programmes | Larger common pot | Shared |
| **Structure** | Loose coordination | Regularized coordination | Strong coordination | Integrated |
| **Infrastructure** | Existing | Largely autonomous | Partially common | Integrated |
| **Intellectual capital** | Existing | Largely autonomous | Partially common | Integrated |
| **Governance** | Weak SC | Strengthened SC | More integrated structure | Completely integrated structure |
| **Plans** | Stay the course | Common business plan | • Common plans and budget with respect to ESSP<br>• Share a vision but not a mission | • One overarching science plan and one budget<br>• Share a vision and mission |

### 3.6.1 Status quo model

In this model, the ESSP continues to operate in its current form. The partnership forms an umbrella for the independent GEC programmes, with the capacity to organize Open Science Conferences and coordinate joint project initiatives among different constellations of collaborations among the programmes. The GEC programmes essentially contribute information to the centre, which consists of a small coordinating office. This relatively loose network model gives the individual GEC programmes a clearing-house for information, and a (so far) successful platform for scientific conferences. It would continue to function as a vehicle for the initiation of joint thematic project activities, even though it is doubtful whether the ESSP umbrella really plays—and particularly will be able to continue to play—a decisive role in the successful launch of joint projects among the GEC programmes.

The Panel's conclusion is that this status quo model translates into a sunset model for the ESSP. Without a strengthened capacity and mandate for the core of the partnership to more profoundly share data and knowledge, integrate social and natural science, advance the science-policy dialogue and the GEC-development agenda, the partnership is probably on an unavoidable course of gradual and persistent decline. The Panel does not see a status quo model as an option for the ESSP, and we conclude that the ESSP leadership agrees with this assessment, which is manifested in the current efforts to develop an ESSP business plan, a strategic research plan, and the ongoing discussions of the mandate and operational implications of an 'enhanced ESSP'.

### 3.6.2 Alliance model

The alliance model—which the Panel believes is the progression currently being discussed within the partnership—entails a significant strengthening of the core functions of the coordinating office, and the development and implementation of a joint business plan and research strategy.

In this model, the GEC programmes continue to operate largely independently, with their own infrastructure and management arrangements. The emphasis in the alliance model is on strengthening the coordinating function, through a much stronger coordinating office—including a probable expansion from the current one person secretariat to three or four people, with an executive officer, a research coordinator, an outreach and capacity building coordinator, and, potentially, an administrative person. In the alliance model, collaboration across the four GEC programmes is intensified, addressing issues including: sharing of research information and comparative datasets; joint communications and policy dialogue activities; as well as actively developing partnership-wide research initiatives and common funding strategies. The governance structure of the partnership is strengthened further under the alliance model, where the partnership, while receiving increased resource support from the GEC programmes, maintains a definite measure of governance autonomy.

### 3.6.3 Flagship model

Under a flagship model, the partnership evolves into a joint facility or programme, where the GEC programmes remain as independent programmatic entities, but all coordination and management is pooled under one entity, with (in due course) a consolidated secretariat. Under this model, the coordinating function of the ESSP 'programme' is strong, and the GEC programmes contribute parts of their respective infrastructure and intellectual capital in order to streamline and improve the performance of the overall venture.

The flagship entity becomes the place where all Earth system science activities—for example, research, conferences, communications, policy dialogues and capacity building—are planned and operationalized. Certain activities, such as outreach, communications and capacity building, would be entirely pooled under the joint facility or programme. Under a flagship model, all GEC programmes share a common vision. Each GEC programme continues to develop its own mission statement and strategic objectives.

Governance under a flagship model would become more integrated across the GEC programmes. Key areas—such as, strategic research planning, capacity building and outreach—would be governed under one common 'flagship' committee across all GEC programmes, while thematic areas of focus within the GEC programmes would continue to be governed by separate committees. When transitioning to a flagship model, the current institutional setup might be altered (e.g. a merger between two GEC programmes). Clearly, this model is an important step in the evolution of the ESSP, but not an endpoint in itself.

### 3.6.4 Fusion model

In the longer term, the flagship model could only exist if it had a complementary feature (a common facility), and the next step would be a fusion model. The Panel is not suggesting that the ESSP must pass through all four models. Indeed, leapfrogging could also be envisioned (e.g. from an alliance to a fusion model).

Important motivating factors in an evolution towards a fusion model would potentially be: the formulation of key GEC research questions to be answered (e.g. over the next 10 years); and/or setting up the objective of developing an integrated Earth system modelling capability, which would incorporate both process-interactions and human dimensions. Such 'end goals' would complement a common vision with a tangible 'cross-programmatic' objective.

Under the ESSP fusion model, DIVERSITAS, IGBP, IHDP, and WCRP converge to one common Earth System Science Programme. The fusion programme shares a common vision and mission, and develops a joint strategic research plan and operates a joint budget. Furthermore, strong links should be institutionalized with the development community, especially with its research components, such as the CGIAR.

Funds are shared, as well as structures and intellectual capital. The new programme develops one business plan and is governed by one body. The research plan focuses both on the large social-ecological research questions to be answered under a truly inter-disciplinary GEC programme, and the more targeted 'disciplinary' research questions emanating from the current GEC programme areas. However, more targeted research would be prioritized, designed and implemented—with broader Earth system research in mind—in order to make sure that all component research feeds directly into the broader Earth System Science Programme.

All funding would be channelled through the new fused programme, which should facilitate donor interactions, while placing a large responsibility on leadership, management and administration at the core of the programme.

## 3.7 Timeframe and urgency

Developing a business plan and long-term priority setting are extremely important exercises for the ESSP and they should not be lost in the day-to-day work. Based on this vision, the partnership can plan a road-map over the coming years, defining milestones along the way towards achieving its goals.

In the short-term, an alliance model should be envisioned. Over the next three years, the ESSP should enhance the integration of capacity building, work to improve resources and enhance its dialogue with the policy and development community. In addition, the ESSP is well advised to anticipate coming major international events, as discussed in Section 1.4, and position itself accordingly. For example, 2012 (ten years after the World Summit on Sustainable Development) could serve as a milestone and rallying point.

Over the next five years, the ESSP should move to a flagship model and the governance structure should evolve accordingly.

The key driving forces currently influencing the partnership are:

1. growing realization of the importance of GEC for sustainable development
2. reluctance to significantly increase funding support to the GEC research community
3. weakness of the current model to deliver results in the originally envisioned way
4. current ongoing work within the partnership to gradually strengthen the partnership.

Given these forces, the Panel recommends that the partnership advances in a decisive fashion away from the current model, towards a significant strengthening of the ESSP. Priorities and funding must be mobilized otherwise the ESSP will be caught in a withering model.

## 3.8 Networking

With a couple of notable exceptions, the ESSP overall has suffered from an inward looking approach to research. The ESSP is strongly encouraged to foster new partnerships. A process needs to be put in place to create coherence and priority setting within the ESSP networking efforts. Consultation within the ESSP and outsider partners, including the development aid community, needs to be established to develop and carry out its long-term vision. The models presented here are focused entirely on future options for the internal structure of the partnership. It is of course also possible to change or complement the model with new ways of engaging with knowledge institutions around the world. For example, discussions have been held within the ESSP, strengthening the partnership through affiliation with key institutions willing to function as executing hubs for key areas of research within the partnership or programmes. The Panel believes this is an interesting avenue to explore, which may not only strengthen the ESSP, but also increase its ability to raise funds for GEC research and development work.

# 4. Conclusions and recommendations

## 4.1 Key principles

For the ESSP to evolve into an excellence partnership its activities should be based on the following principles:

- carrying out cutting-edge science guided by a strategic vision
- adding value via innovative interdisciplinary approaches
- developing new coordinated methodologies
- creating new partnerships with the policy and development communities.

Forming the core of a partnership, the ESSP should strive to convey the need for serious study of the Earth system and to truly integrate social scientists in the study of the impacts of GEC. The components must be encouraged to collaborate more intensely, to ensure synergies across the GEC community and with the development community, for their common effectiveness and impact. The policy and development community partnerships should be structured to respect the scientific knowledge of the GEC community and ensure it is applied in policy development.

If the ESSP is to fulfil its original mandate, it must ensure its activities: build on a solid base of science and on the added value it brings (e.g. interdisciplinarity); are relevant to global and/or broad regional concerns; and are policy relevant. The ESSP can also add new, coordinated scientific methodologies and facilitate the adoption and use of common research protocols where appropriate.

The ESSP must invest in strategic thinking in the identification of global issues requiring coordinated action, and channel global resources to respond to them—in so doing it could be informed by the growing evidence of impacts (e.g. from Working Group II of the *IPCC Fourth Assessment Report*).

The partnership is encouraged to use its Scientific Committee to full advantage in defining its activities and identifying best practices for transfer and uptake of results by policy and decision makers.

## 4.2 Science

As noted earlier, the Panel made a conscious decision not to perform a detailed Review of the ESSP components. However, the Panel recommends that in the near future a Review of the ESSP components should be performed. This Review should focus on the science but also examine engagement with the wider community. Metrics such as indicators should be considered to gauge ESSP's success. The engagement issue should include an assessment of the inclusion of developing country scientists.

A strong scientific focus is necessary for the partnership. This is especially the case since there seems to be an impression among decision makers that the scientific challenges associated with GEC are largely resolved, and that the main remaining challenge is one of communicating the results and implementing the required changes in the socioeconomic system. This would be a clear misconception, as the scientific understanding of many GEC challenges is rather weak to virtually non-existent. There is a clear need for focused research on GEC problems and the ESSP is in an excellent position to address them.

The priority setting process within the ESSP needs to be clarified. The Panel recommends a more consultative process in order to set the agenda for the ESSP as well as to ensure consistency and linkages between, and among, the individual components. The priority setting should be done with due attention to complementarity with the GEC programs and the added-value. The ESSP should think strategically about what an ESSP activity is, versus, an activity that could be done by (one or two of) the GEC programmes. In particular, the Panel recommends that the mandates be differentiated as soon as possible, particularly between ESSP and IGBP (see Table 1). Currently their mandates are so similar that ambiguity and even structural problem result.

Within a continuum between strong disciplinarity and interdisciplinarity on one axis, and basic science versus applied science on the other axis, the Panel envisions the ESSP to occupy the inter-disciplinarity and applied science corner. Within a continuum of communication between broadcasting and dialogue with users on one axis, and big science (requiring large infrastructure to support it) versus grand science (required to tackle the grand challenges of society) on the other axis, the Panel envisions the ESSP to take the dialogue and grand science corner. Therefore, the challenge for the ESSP is to simultaneously tackle the grand challenges of GEC and to seek dialogue with stakeholders and users.

What are the grand challenges of GEC? Answering this question is almost a grand challenge in itself. A good starting point is the requirement that a particular type of environmental change has global impacts. This impact can

emerge simply from the sheer magnitude of the sum of many little changes (e.g. application of industrially fixed nitrogen), and/or through the global-scale action of these changes (e.g. changes in atmospheric composition). Rather than prescribing the exact grand challenge questions, the Panel has outlined areas that should be addressed:

- **How does the Earth system work? (system behaviour)**

  The development of an understanding of the behaviour of the Earth system that underlies and/or is affected by GEC is a condition sine qua non for the development of strategies for addressing these changes. Particular questions that need to be addressed are: How has the Earth system behaved in the past? What are its current trends? How will it behave in the future? How sensitive is the Earth system to changes? Is the Earth system linear, or does it tend to dampen or magnify external perturbations? What are its internal (unforced) dynamics? Are there thresholds and points of no return?

- **What are the cost, benefits and unintended consequences of Earth system changes? (development objective)**

  Addressing GEC nearly always requires a trade-off of different objectives, as many of these changes arise as a consequence of a particular set of activities with a certain benefit. Therefore, the adaptation of solutions comes at a certain cost, which needs to be understood as much as the costs of the impact, to ensure that the underlying environmental problem is addressed.

- **How can the Earth system be changed and what is required to make these changes sustainable? (governance)**

  The understanding of the socioeconomic and political factors that determine whether changes to a particular Earth system—or return to the unperturbed situation—are sustainable, is crucial for ensuring that particular solutions have a long-lasting effect. These factors include treaties, stewardship, global versus local decision making and the information basis.

A related overarching question is:

- **What kind of observations and tools are needed to document Global Environmental Changes?**

  Recognition of GEC critically depends on the availability of observations that unambiguously demonstrate that a problem exists and requires action. Observational systems need to be developed that recognize trends and changes early and permit documentation of these changes reliably through time. The Panel recognizes the urgent need for the implementation of platforms for global Earth observations, such as terrestrial observations and the benefit of the involvement of the ESSP in these initiatives.

The Panel considered several questions that have a particularly strong human-climate-biogeochemical flavour. Below are several examples of such questions, the order of which is not prioritized.

- What is the role of land-use change for present, past, and future evolution of Earth? Elements for possible consideration include: carbon storage, food production, water cycle, climate (including albedo), human societies and migration.
- What is the impact of the massive global alteration of nutrient cycles on the natural and human environment?
- How much warming (climate change) is acceptable, that is, avoids dangerous interference with the climate system?
- How can we stabilize the concentration of atmospheric greenhouse gases?
- What is the role of humans in the global system? Why and how have humans escaped their natural controls and begun to develop their own controls? Elements for possible consideration include: resources, technology, planetary stewardship, determining the ecological footprint, study of trends in different regions, syndromes, and examples of best practices in law, technology, and institutions.
- How can the vicious circle of environmental change, resource scarcity, poverty and poor health be overcome?
- What determines successful responses to environmental problems? Capacities? Adaptability?
- Should we undertake manmade geophysical experiments (geomanipulation) to overcome anthropogenic climate change?

Comparison of these specific questions as well as of the fundamental questions reveals only a partial overlap with the existing structure and activities of the ESSP. Whether or not these questions and programmes can be matched using a matrix structure is open for discussion and needs to be investigated. Another issue to be considered is whether there are obvious GEC issues that are currently not addressed by the programmes —for example, issues around poverty alleviation, working more closely with the development community, and security.

## 4.3 Governance

The Panel believes that while the ESSP governance structure should be driven by the scientific mandate, there should be broad consultation with users. New mechanisms will need to be put in place to ensure that consultations feed into informing the ESSP governance structure. One possible model would be to have a Davos-style week of meetings focused on GEC issues—for example, an ESSP OSC, followed by a consultative forum and then an ESSP governance meeting. Such an arrangement should allow for more participatory practices to emerge. When implementing such an approach, the ESSP should pay attention to entraining regional inputs and engaging a wide audience, including the development aid community.

The ESSP mandate will also be determined by which ESSP model is chosen. Again, the input of users should be considered when considering the long-term ESSP evolution. If the ESSP is to be significantly strengthened, which is the proposal of the Panel, the governance structure should be streamlined accordingly. The recommendation of the Panel would be for a Strategic Committee to replace the current Scientific Committee. This new committee would be composed of four 'external' members (including the ESSP Chair, who would head the Strategic Committee) and the Chairs of the GEC programmes. Ex officio members to this Strategic Committee would be the ESSP coordinator and an ICSU representative—at the discretion of the Chair of the, ESSP the Chairs of the ESSP components could be invited for specific agenda items. Regular communication among the Strategic Committee members would be needed to guide the development of the ESSP between annual meetings. In addition to the Strategic Committee, a Management Committee— composed of the Directors the GEC programmes and the ESSP components, and the ESSP coordinator—could meet before the Strategic Committee meeting in order to ensure proper coordination. The ToRs and other operational details of the Strategic Committee and the Management Committee should be drafted as an early priority to clarify and establish the respective governance roles of each committee and their relationship to each other, the ESSP secretariat and the GEC programmes. To summarize, the recommendation is for a Strategic Committee (eight regular members, plus two ex officio members) to replace the current Scientific Committee.

In addition, the Panel recommends that ESSP's relationship with ICSU be formalized, by having ICSU become a sponsor of the ESSP. Of course, other sponsoring organizations could be added later, if needed.

## 4.4 Engagement with the wider community

The ESSP's major role here is to communicate Earth system science issues to a wide variety of user communities in order to enable the translation of scientific considerations into policy and action. Its communication objective should be to elevate and expand the use of Earth system science by decision makers in order to have a more significant impact.

The Review Panel recommends that:

**4.4.1** The ESSP establish a clear objective to increase the use of GEC research findings in decision making by helping to increase the policy relevance of research conducted in the parent programmes and the joint projects and by strengthening the ability of the GEC community to communicate and interact with decision makers.

**4.4.2** The ESSP should take full advantage of mechanisms that already exist for engagement with user audiences, such as the 'dialogues' that take place between scientists and policy makers in the context of assessment processes (e.g. IPCC and the MA). In addition, the ESSP should create opportunities for structured interactions with intended users in such contexts as:

- meetings of scientific bodies at international conventions
- annual meeting of the CGIAR
- World Economic Forum
- Commission on Sustainable Development
- annual meeting of the World Business Council on Sustainable Development
- Earth Summit + 20.

**4.4.3** The ESSP should add staff capacity (at least two professionals) and significant financial resources (ideally at least €300 000 per year beyond staff costs). This would enable the ESSP to substantially elevate the level of dialogue between user audiences and the GEC community, and to substantially increase the communication of GEC results to audiences outside of the scientific community.

**4.4.4** The ESSP should clearly articulate to funders the role and function of the ESSP in helping to amplify the relevance and impact of the GEC programmes, to ensure that funders recognize and support the services that it provides. The Panel also recommends that IGFA take a proactive role vis-à-vis the ESSP, particular with a request to clarify the relative roles of IGBP and ESSP.

## 4.5 Capacity building

The ESSP has indicated a commitment to capacity building, yet, as with the engagement of the wider community (see section 4.4), this element deserves strengthening. More specifically the Review Panel recommends:

**4.5.1** The ESSP should take a strategic approach to capacity building. The Panel recognizes that capacity building is a matter for all countries and goes far beyond training courses. Capacity building throughout the ESSP needs to be better coordinated and carried out in a collaborative fashion. It should be broad enough to cover all aspects of the research process, yet sensitive to regional priorities. These activities need to be an integral part of the research programmes and projects, rather than catering broadly to training needs in developing countries.

**4.5.2** The role of START in the overall ESSP capacity building effort must be clarified. START's mandate should be revised to allow it to play a greater role within the ESSP and the GEC community. In view of the transitions within START, there is an opportunity to redefine the role of this component within ESSP's capacity building effort. In addition, the ESSP should explore new funding arrangements (inter alia an IFS-START small grants programme).

**4.5.3** The Panel recommends that the partnership should promote arrangements, such as twinning between institutions in various parts of the world. This would help build capacity sustainably within the ESSP community. The creation of a special funding facility for research that is built around such twinning arrangements should be considered as a way of stimulating attention to new and emerging issues within the overall GEC frame of reference. Young scientists, especially from developing countries, need to have the opportunity to work side by side with senior scientists; this should be a criterion for approving research in such a funding facility.

**4.5.4** Consideration should be given to how ESSP's capacity building activities can strengthen national or regional organizations of scientists. Replicating the Open Science Conference concept at smaller meetings at national or regional levels may be one way of linking the ESSP closer to individual science communities.

**4.5.5** Distance-learning tools, web tools, and other education material should be produced and used in capacity building, allowing for a low-cost expansion of users of GEC products in collaborations with appropriate agencies, such as international development organizations.

## 4.6 Resources: business plan and effectiveness of resource mobilization

The Panel considers that the current funding available to the ESSP is insufficient to fulfil its mandate. A business and resource mobilization plan should be given high priority by the ESSP, subject to the strategic directions of the ESSP. Careful attention to, and clear articulation of, the priority setting process will be critical. Further development of the ESSP, including resource mobilization, depends on the ESSP Chair, who can champion the ESSP with the help of the SC and the support of the ESSP secretariat. Securing additional funding is crucial to ensuring an enhanced impact of the ESSP, regardless of which model it evolves into. The Panel has the following recommendations for the ESSP, GEC funders, and scientists:

### To the ESSP:

**4.6.1** The ESSP, on behalf of the GEC research community, must aggressively market the relevance and need of research to enable countries to respond to the challenges of GEC. The issues must be repositioned. Just as countries understand that investment in some areas of science and technology are key for their long-term economic growth, so too they must be convinced that investment in GEC research is essential for national economic, social and security considerations. The ESSP should formulate, with the GEC programmes, and with the help of outreach professionals, the 'big messages' coming from the GEC programmes, as they relate to Earth system science.

**4.6.2** Greater effort to engage users and to address scientific questions relevant to their needs (in particular: what to do about GEC?) can help to mobilize more financial resources. This orientation toward policy relevant research does not place the science in a 'consulting' mode (a fear expressed by some members of the Scientific Committee). Selection of research areas can still be curiosity-driven, but this mechanism allows both scientists and funders to better identify those areas of curiosity-driven research that are more relevant to the grand challenges facing society today. The ESSP, in collaboration with the programmes, should consider maintaining central information on how the science of the GEC programmes is being used in science, policies, and practices.

**4.6.3** The ESSP needs to finalize its business plan as soon as possible. This should include a clear presentation of the budget. Ideally, the budget should list the amount of monetary and "in-kind" support it receives. IGFA has advised the ESSP secretariat to indicate what funds are absolutely essential for coordination versus what is desired (e.g., for offsetting carbon emissions).

### To funding agencies:

**4.6.4** The Panel noted that there is a mismatch between expectations of what IGFA should do and what the IGFA members can actually do. Clearly additional funding is needed. The Panel recommends that IGFA act as a facilitator to stimulate innovative creative coalitions to mobilize new resource streams and involve new partners.

**4.6.5** All countries need the results of the GEC programmes and the value-added work of the ESSP to capture the synergies and enhance outreach. To achieve its value-added, the ESSP needs core funding for the secretariat services and to enable GEC collective strategic thinking.

**4.6.6** The Panel strongly recommends that countries consider establishing single GEC National Committees (involving both scientists and users) responsible for the entire set of GEC programmes (thus including the ESSP) rather than individual committees for each GEC programme and yet another committee for the ESSP.

**4.6.7** IGFA should carry out another GEC Resource Assessment which would include programme, partnership and project funding for coordination and total research funding. Such an assessment should be carried out at regular intervals.

### To scientists:

4.6.8 Scientists themselves are not advocating enough within their countries for international science and should press harder for this type of funding. While ideally the overall level of GEC funding should increase, in the absence of that, scientists should advocate for more international GEC funding (even if at some loss to national science funding).

## 4.7 Pathways to the future

The four models in Section 3.7 were provided to aid the ESSP to reflect carefully on the long-term development of the partnership. These models can be treated in two ways. One is to see them as options that the ESSP and its parent programmes each consider for the future, without a commitment to any one of the GEC programmes. The other is to treat them as a road map towards closer integration between the GEC programmes. The speed with which the ESSP might be able to move from one model to the next would be a function of the partnership's ability to overcome existing barriers to integration.

The Panel recommends that the ESSP formulate a long-term vision of where it wants to be in 10 years. It recommends the ESSP take an evolutionary path towards its long-term vision, which may entail the adoption of several or all of the steps suggested here.

It is for the ESSP itself to formulate its long-term vision. The ESSP components should perform a similar exercise. The Panel is convinced that a status quo model will inevitably result in a progressive decline of the partnership. For that reason, the Panel recommends that the partnership advance in a decisive fashion away from the current model, towards a significant strengthening of the ESSP over the coming five years. The Panel recommends that the ESSP at least move towards an alliance model over the coming year. Over the next three years the ESSP should enhance the integration of capacity building, work to improve resources, and enhance its dialogue with the policy and development communities. Over the next five years, the ESSP should move to a flagship model and the governance structure should evolve accordingly. The Panel recommends that the ESSP seriously consider a fusion model as a long-term option. The ESSP should, as soon as possible, initiate a strategic consultative process to explore its long-term evolution.

To conclude, the Review Panel firmly believes that the subject of Earth system science deserves a strong and forward-looking ESSP. Currently, the staffing and funding situations are too weak to give the ESSP a true leading role. Too often the partnership is unknown or considered marginal. The scientific and policy communities, as well as the ESSP, are encouraged to reach out to all important communities, policy makers, academics of all disciplines, non-governmental and educational organizations, to bring to their attention the importance of an integrated Earth system approach to global environmental change.

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# Annexes

# Annex 1: The Amsterdam Declaration on Global Change

The scientific communities of four international global change research programmes—the International Geosphere-Biosphere Programme (IGBP), the International Human Dimensions Programme on Global Environmental Change (IHDP), the World Climate Research Programme (WCRP) and the international biodiversity programme DIVERSITAS—recognise that, in addition to the threat of significant climate change, there is growing concern over the ever-increasing human modification of other aspects of the global environment and the consequent implications for human well-being. Basic goods and services supplied by the planetary life support system, such as food, water, clean air and an environment conducive to human health, are being affected increasingly by global change.

Research carried out over the past decade under the auspices of the four programmes to address these concerns has shown that:

- The Earth System behaves as a single, self-regulating system comprised of physical, chemical, biological and human components. The interactions and feedbacks between the component parts are complex and exhibit multi-scale temporal and spatial variability. The understanding of the natural dynamics of the Earth System has advanced greatly in recent years and provides a sound basis for evaluating the effects and consequences of human-driven change.
- Human activities are significantly influencing Earth's environment in many ways in addition to greenhouse gas emissions and climate change. Anthropogenic changes to Earth's land surface, oceans, coasts and atmosphere and to biological diversity, the water cycle and biogeochemical cycles are clearly identifiable beyond natural variability. They are equal to some of the great forces of nature in their extent and impact. Many are accelerating. Global change is real and is happening now.
- Global change cannot be understood in terms of a simple cause-effect paradigm. Human-driven changes cause multiple effects that cascade through the Earth System in complex ways. These effects interact with each other and with local- and regional-scale changes in multidimensional patterns that are difficult to understand and even more difficult to predict. Surprises abound.
- Earth System dynamics are characterised by critical thresholds and abrupt changes. Human activities could inadvertently trigger such changes with severe consequences for Earth's environment and inhabitants. The Earth System has operated in different states over the last half million years, with abrupt transitions (a decade or less) sometimes occurring between them. Human activities have the potential to switch the Earth System to alternative modes of operation that may prove irreversible and less hospitable to humans and other life. The probability of a human-driven abrupt change in Earth's environment has yet to be quantified but is not negligible.
- In terms of some key environmental parameters, the Earth System has moved well outside the range of the natural variability exhibited over the last half million years at least. The nature of changes now occurring simultaneously in the Earth System, their magnitudes and rates of change are unprecedented. The Earth is currently operating in a no-analogue state.

On this basis the international global change programmes urge governments, public and private institutions and people of the world to agree that:

- An ethical framework for global stewardship and strategies for Earth System management are urgently needed. The accelerating human transformation of the Earth's environment is not sustainable. Therefore, the business-as-usual way of dealing with the Earth System is not an option. It has to be replaced – as soon as possible – by deliberate strategies of good management that sustain the Earth's environment while meeting social and economic development objectives.
- A new system of global environmental science is required. This is beginning to evolve from complementary approaches of the international global change research programmes and needs strengthening and further development. It will draw strongly on the existing and expanding disciplinary base of global change science; integrate across disciplines, environment and development issues and the natural and social sciences; collaborate across national boundaries on the basis of shared and secure infrastructure; intensify efforts to enable the full involvement of developing country scientists; and employ the complementary strengths of nations and regions to build an efficient international system of global environmental science.

The global change programmes are committed to working closely with other sectors of society and across all nations and cultures to meet the challenge of a changing Earth. New partnerships are forming among university,

industrial and governmental research institutions. Dialogues are increasing between the scientific community and policymakers at a number of levels. Action is required to formalise, consolidate and strengthen the initiatives being developed. The common goal must be to develop the essential knowledge base needed to respond effectively and quickly to the great challenge of global change.

| Berrien Moore III | Arild Underdal | Peter Lemke | Michel Loreau |
|---|---|---|---|
| Chair, IGBP | Chair, IHDP | Chair, WCRP Co-Chair | DIVERSITAS |

Challenges of a Changing Earth: Global Change Open Science Conference Amsterdam, The Netherlands 13 July 2001.

# Annex 2: Terms of Reference

**International Council for Science (ICSU) –**
**International Group of Funding Agencies for Global Change Research (IGFA)**
**Review of the Earth System Science Partnership (ESSP)**

## Preamble

ICSU is a sponsor of the four global environmental change programmes: the World Climate Research Programme (WCRP; together with WMO and IOC), the International Geosphere-Biosphere Programme (IGBP), the International Human Dimensions Programme on Global Environmental Change (IHDP; together with ISSC) and DIVERSITAS—an International Programme on Biodiversity Science (together with UNESCO, SCOPE and IUBS).

In 2001 at the first Global Change Open Science Conference in Amsterdam the 1400 participants (from more than 100 countries) signed the *Amsterdam Declaration on Global Change*. The declaration called for strengthening the cooperation amongst the global environmental research programmes, for greater integration across disciplines, environment and development issues and the natural and social science. It also called for greater collaboration across national boundaries and for intensified efforts to enable the full involvement of scientists from developing countries.

In response to the declaration, DIVERSITAS, IGBP, IHDP, and WCRP joined together to form the Earth System Science Partnership (ESSP). The ESSP brings together researchers from diverse fields, and from across the globe, to undertake an integrated study of the Earth system:

- its structure and functioning
- the changes occurring to the system
- the implications of those changes for global sustainability.

The interactions and feedbacks between the component parts of the Earth system exhibit multi-scale temporal and spatial variability. Understanding of the system's natural dynamics has advanced greatly in recent years, and now provides a sound basis for evaluating the effects and consequences of human-driven change.

General reviews of the ICSU global environmental change research programmes, as well as the global observing systems and all other relevant ICSU Interdisciplinary Bodies and Joint Initiatives, were conducted in 2002–03 within the Priority Area Assessment on *Environment in Relation to Sustainable Developmen*t as a component of the development of an *ICSU Strategic Plan 2006–2011*.

A specific Review of the Global Environmental Change Research Programmes is specifically called for in the *Strategic Plan 2006–2011*:

> ICSU will conduct individual reviews of its global environmental change research programmes. Special attention will be given to the development of the Earth System Science Partnership, which brings together the four programmes to address issues that are integral to sustainable development. The links between this partnership and other ICSU Interdisciplinary Bodies and Members will be considered as part of these reviews.

### Review of the Global Environmental Change Research Programmes in 2007–09

The four Global Environmental Change Research Programmes have been reviewed in the past:

- DIVERSITAS, a management Review by IGFA in 2003
- IGBP in 1987, 1991 and 1996
- IHDP in 2005
- WCRP in 1995.

ICSU will Review DIVERSITAS, IGBP, WCRP and ESSP in 2007–09 through the appointment of individual Review Panels. ICSU has suggested to the International Group of Funding Agencies for Global Change Research (IGFA) that reviews be conducted by the two organizations jointly. In addition, other co-sponsors must also be involved in the reviews for DIVERSITAS (IUBS, SCOPE and UNESCO) and WCRP (IOC/UNESCO and WMO).

The reviews should be both reflective and forward-looking. They should evaluate past performance of the programmes, Review operational structures and assess future plans. The reviews will thus help guide the scientific research, which is vital for advancing our understanding of the functioning of Planet Earth. Such understanding is essential if we are to predict future trends in the development of the Earth as a system.

Research findings underpin many international assessments such as the Intergovernmental Panel on Climate Change (IPCC), the Millennium Ecosystem Assessment (MA) and the planned biodiversity assessment (IMoSEB). Through such assessments, scientific research is supporting several global conventions such as the UN Convention on Climate Change (FCCC), the UN Convention on Biodiversity (CBD) and the UN Convention to Combat Desertification (CCD). Thus, global change research provides excellent examples of policy relevant science.

The WCRP has existed since 1980, IGBP since 1987, DIVERSITAS in its current form since 2002, and IHDP in its current form since 1996. During this period, the world has changed and political interest is today primarily on other issues than reducing the scientific uncertainties in relation to global change processes. The interest within the policy community has, for example, shifted to the Millennium Development Goals and the outcomes of the World Summit on Sustainable Development. The discussion currently centres on how research could help to alleviate poverty.

The ESSP has taken on the challenge of truly integrating natural and social sciences around common research questions and educating a new generation of scientists to address complex issues outside of disciplinary research structures. In doing so, it is hoped that a new generation of scientists can be trained to tackle complex, multidisciplinary issues.

IGFA and ICSU have identified the need to more effectively bring the global change community together with the development community. Thus, a conference was organized in 2005 that brought the two communities together to discuss common interest and possibilities for increased collaboration. Reference is made to the presentation by Sara Farley at the IGFA Annual Meeting 2005 on 'Rethinking Global Change and Development Research' and sessions during the ESSP Open Science Conference (November 2006). A major challenge for ESSP will be to try to build bridges between the global change and development communities.

## Terms of Reference

ICSU and IGFA will conduct a Review of the ESSP, through the appointment of a Review Panel, to address issues that are integral to sustainable development and to build the science structure necessary to investigate coupled human-environmental systems. The components of ESSP are Joint Projects (currently addressing food, water, health and carbon), Integrated Regional Studies (currently MAIRS) and the Global Change System for Analysis, Research and Training (START).

The Review will focus on both internal and external interactions. The major questions to be considered by the Review are given below. The overriding objective should be to evaluate the extent to which the character of ESSP adds value to its priority areas of research and the national programmes that contribute to them.

**The primary question that the Review should answer is: What do scientists, sponsors and the end-users get out of participating in and supporting the ESSP that they could not get from participation in the individual Programmes (DIVERSITAS, IGBP, IHDP, WCRP)?**

Additional questions to be considered are listed below. In addressing the questions, the Review should go beyond providing simple 'yes' or 'no' answers and give the reasons for conclusions reached and, where appropriate, recommendations for improvement.

### 1. Scientific aspects

1.1 Is the scientific mandate of ESSP clearly stated, is it distinct from the mandates of the four sponsoring programmes, and, if so, how?

1.2 Has the existence of ESSP added significant new approaches and components that could not have been part of the four programmes?

1.3 How were the topics for Joint Projects developed and what strategic considerations were used to set priorities?

1.4 Do the scientific and implementation plans developed by the ESSP components (Joint Projects, Integrated Regional Studies and START) address key issues perceived as priorities by the scientific community?

1.5 Does the ESSP seek to achieve balance between natural and social sciences and, if so, what is the nature of this balance and is it appropriate?

1.6 Do the Joint Projects seek to achieve balance between global and regional approaches and, if so, what is the nature of this balance and is it appropriate?

1.7 The need to link global change and development research has been discussed. Has ESSP, or its components, developed in such a way that it could provide a platform for involving both the global change and development communities?

1.8 Do the ESSP Joint Projects, Integrated Regional Study and START receive input and benefit from the four Programmes?

1.9 Does the ESSP plan for syntheses and integration of results from its components, both within ESSP and with the four Programmes?

**2. Policy relevance**

2.1 Do the ESSP Joint Projects, Integrated Regional Study (MAIRS) and START address issues perceived as priorities by the policy communities? How have they interacted with the assessment and policy communities? Is it necessary to strengthen the policy relevance of the research and, if so, how?

2.2 Has ESSP developed a strategy for ensuring that its components are relevant to the Millennium Development Goals and Science for Sustainable Development? Has such relevance been clearly demonstrated to the user communities? Have the policy and other stakeholder communities made attempts to engage ESSP?

2.3 Is a specific forum necessary to enable ESSP and policy, as well as other stakeholder, communities to have a closer ongoing dialogue and, if so, what might such a forum be?

**3. Organization and governance**

3.1 The four programmes are currently discussing substantive changes in the governance of ESSP. Does the proposed governance structure ensure appropriate mechanisms for priority setting and efficient coordination?

3.2 Has the ESSP made efforts to ensure long-term financial stability of its planning and coordination activities and, if so, have these efforts been effective? Has ESSP been important in fund-raising for the components?

**4. Visibility and communication**

4.1 Do the ESSP's visibility and communication efforts stimulate the international science, development and donor communities to contribute to the ESSP and are the various stakeholders cognizant of its activities?

4.2 Does ESSP involve the scientific communities in all parts of the world and, if so, to what extent?

**5. Capacity building**

5.1 Have ESSP components been able to attract the interest of young scientists and to foster a new generation of scientists working in a more interdisciplinary research environment?

5.2 To what degree has START been instrumental in developing capacity for scientists in developing countries to participate in ESSP? Has this effort been successful and, if so, are there any lessons to be drawn from this? Should the Joint Projects and Integrated Regional Studies capacity-building activities be done in cooperation with START or independently, or both? If both, what activities are appropriate for START and what can the Joint Projects and Integrated Regional Studies do better themselves?

**6. Resources**

6.1 Recent information received from national and international funding agencies indicate that they are facing constraints on their budgets for global change research and for its planning and cooperation. Have planning, cooperation, and implementation of the ESSP been impacted by limited funding and, if so, what has the impact of such limitations been and what might such impacts be in the future?

6.2 Are the transaction costs of planning and coordination of ESSP reasonable?

6.3 Has the funding community been receptive to the transaction costs of increased coordination and multidisciplinarity in the ESSP activities that are in addition to the transaction costs of the four Programmes and its Core Projects?

## The Review process

During the first meeting, the Panel will agree on the conduct of the Review, the information necessary to perform the Review and the division of work. The Panel should also decide on the balance between Review of ESSP relative to its component parts. It may be necessary to design an interview/questionnaire process for collection of views of ESSP leadership, Joint Projects, Regional Studies and START as well as individual participating scientists. The policy relevance should be assessed through interviews/questionnaires with representatives of various international assessments, UN framework conventions, relevant UN organizations and others (e.g. ICSU bodies) with an interest in the results of ESSP.

At its second meeting, the panel would Review the collected material and prepare a first draft of its report. This draft would then be circulated to ESSP and its components and the four programmes with the opportunity for them to provide factual corrections and comments. During a teleconference, the panel would Review the comments received, and decide on how the report should be amended before circulating the second version of the report to a wider audience (i.e. including ICSU bodies and IGFA members).

The final assessment report would be finalized at the panel's third and last meeting and shortly thereafter submitted to ICSU and IGFA.

The Review Panel will be assisted by Dr Leah Goldfarb, ICSU Science Officer, Environment and Sustainable Development.

# Annex 3: Membership of the ESSP Review Panel

Lidia Brito
Department of Forestry
Universidade Eduardo Mondlane
Maputo
Mozambique

Adrian Fernandez Bremauntz
National Institute of Ecology
Secretariat of Environment
Mexico City
Mexico

Louise O. Fresco (Chair)
University of Amsterdam
The Netherlands

Nicolas Gruber
Institute of Biogeochemistry & Pollutant Dynamics
Dept.of Environmental Sciences
Zürich
Switzerland

Göran Hydén
Department of Political Science
University of Florida
Gainesville
USA

Walter Reid
Conservation and Science Program
The David and Lucile Packard Foundation
Los Altos
USA

Johan Rockström
Stockholm Environment Institute
Stockholm
Sweden

Meryl Williams
Aspley, Queensland
Australia

**CSPR,** *Ex Officio*
Hans Joachim Schellnhuber
Potsdam Institute for Climate Impact
Potsdam
Germany

**IGFA** *Ex Officio*
Dawn Conway
Canadian Foundation for Climate and Atmospheric Sciences (CFCAS)
Canada

# Annex 4: Key persons and institutions inside and outside of ESSP

| Organization | Name | Title (mid-2007) |
|---|---|---|
| **Inside ESSP** | | |
| DIVERSITAS | Michel Loreau | Chair, Scientific Committee |
| DIVERSITAS | Anne Larigauderie | Executive Director, Secretariat |
| IGBP | Carlos Nobre | Chair, Scientific Committee |
| IGBP | Kevin Noone | Executive Director, Secretariat |
| IGBP | João Morais | Deputy Director, Social Sciences |
| IHDP | Oran Young | Chair, Scientific Committee |
| IHDP | Andreas Rechkemmer | Executive Director, Secretariat |
| WCRP | John Church | Chair, Joint Scientific Committee |
| WCRP | Ann Henderson-Sellers | Director, Joint Planning Staff |
| GCP | Mike Raupach | Co-Chair, Scientific Steering Committee |
| GCP | Anand Patwardhan | Co-Chair, Scientific Steering Committee |
| GCP | Pep Canadell | Executive Director, Global Carbon Project – International Project Office, Canberra, Australia |
| GCP | Shobhakar Dhakal | Executive Director, Global Carbon Project – International Project Office, Tsukuba, Japan |
| GECAFS | Diana Liverman | Chair, Scientific Advisory Committee |
| GECAFS | John Ingram | Executive Officer, International Project Office |
| GWSP | Joe Alcamo | Co-Chair, Scientific Steering Committee |
| GWSP | Charles Vörösmarty | Co-Chair, Scientific Steering Committee |
| GWSP | Lydia Gates | Executive Officer, International Project Office |
| GEC&HH | Tony McMichael | Co-Chair, Planning Team |
| GEC&HH | Ulisses Confalonieri | Co-Chair, Planning Team |
| START | Gordon McBean | Co-Chair, Scientific Committee |
| START | Graeme Pearman | Co-Chair, Scientific Committee |
| START | Roland Fuchs | Director, Secretariat |
| START | Hassan Virji | Deputy Director |
| MAIRS | Congbin Fu | Chair, Scientific Steering Committee |
| MAIRS | Frits Penning de Vries | Executive Director, International Programme Office |
| **Key Players in ESSP Evolution** | | |
| | Berrien Moore | Ex-IGBP Chair, Scientific Committee |
| | Will Steffen | Ex-IGBP Executive Director |
| | Arild Underdal | Ex-IHDP Chair, Scientific Committee |
| | Jill Jaeger | Ex-IHDP Executive Director |
| | Peter Lemke | Ex-Chair, WCRP JSC |

| Outside ESSP proper | | |
|---|---|---|
| **Personal Capacity** | | |
| | Corell, Robert | Global Change Director of the Heinz Center. Previously, Assistant Director for Geosciences at NSF where for over 12 years he had oversight for the GEC programmes. |
| | Dubois, Jacques | Swiss Re; Private Sector |
| | Lenton, Roberto | Executive Director, International Research Institute for Climate Prediction (Columbia University) |
| | Marks, John | ESF Director of Science and Strategy |
| | Moss, Richard | Director of the Climate Change Program, UN Foundation |
| | Sachs, Jeffrey D. | Director, Earth Institute at Columbia University |
| | Watson, Robert | Chair, ICSU PAA on Environment in Relation to Sustainable Development; Chief Scientist & Senior Advisor for Natural Resource Management, World Bank; Co-Chair International Assessment of Agricultural S&T for Development |
| **UN & related agencies** | | |
| CGIAR | Anne-Marie Izac | Chief Alliance Officer |
| CSD | DiSano, JoAnne | Director, Division for Sustainable Development (DESA) |
| FAO | Wulf Killmann<br>Alexander Mueller | Director of FAO Forest Products and Economics Division<br>Assistant Director-General |
| GEF | Barbut, Monique | CEO & Chairperson |
| UNEP | Steiner, Achim | Executive Director |
| UNESCO | Ederlen, Walter | ADG for Natural Sciences |
| UNESCO | Szöllösi-Nagy, A. | Director, Division of Water Sciences |
| WHO | Chan, Margaret | Director General |
| WHO | Corvalan, Carlos | Department of Protection of the Human Environment |
| UN/WHO | Nabarro, David | Senior UN System Coordinator for Avian and Human Influenza |
| WHO | Carlos Corvalan | Coordinator and Scientific Expert Department for the Protection of the Human Environment |
| WMO | Michel Jarraud | Secretary-General |
| **Conventions** | | |
| CBD | Djoghlaf, Ahmed | Executive Secretary |
| CBD | Mulongoy, Kalemani | Principal Officer, Scientific, Technical & Technological Matters |
| UNFCCC | de Boer, Yvo | Executive Secretary |
| **Development Agencies** | | |
| DFID | Conway, Gordon | Chief Scientist |
| DFID | Anderson, Simon | Research Manager |
| IIED | Toulmin, Camilla | Director |
| IIED | Huq, Saleemul | Director Climate Change Programmes |
| SIDA | Ohlsson, Eva | Head, Division of Natural Sciences |
| USAID | Kosnik, Chris | Sustainable Agriculture & Natural Resource Management Advisor |

| NGOs | | |
|---|---|---|
| IFS | Stahl, Michael | Executive Director |
| ISSC | Hernes, Gudmund<br>Hackmann, Heidi | President<br>Secretary General |
| IUCN | Marton-Lefèvre, Julia | Director General |
| SEI | Banuri, Tariq | Director of the Asia Centre of the Stockholm Environment Institute |

# Annex 5: GEC questionnaire and summary of responses[6]

All of the GEC bodies we contacted (i.e. DIVERSITAS, ESSP SC, GCP, GECAFS, GEC&HH, GWSP, IGBP, IHDP, MAIRS, ESSP secretariat, START, WCRP) responded to the questionnaire.

Note: If an organization is not listed, it did not respond to that question.

| # | Question | | |
|---|---|---|---|
| 1–3 | These dealt with the identity of the respondents. | | |
| 4 | **How familiar are you with the ESSP mission and, if you are familiar with it, do you agree with it?** | | |
| S | All were quite familiar with it and agreed with the mission. | | |
| 5 | **To what extent has the existence of ESSP added significant new approaches, components, or ways of doing research that could not have been part of the four Programmes?** | | |
| | Large extent | DIVERSITAS, GCP, GECAFS, IHDP | |
| | Moderate extent | ESSP SC, GWSP, IGBP, MAIRS, START, WCRP | |
| 6 | **Give two or three examples of ESSP features that led to new approaches, components or new ways of doing research.** | | |
| | Most of the responses cited research on coupled human-ecological systems, and gave the joint projects and IRS as examples. | | |
| 7 | **Have ESSP activities contributed to efforts to achieve sustainable development and/or to address the Millennium Development Goals? Please provide one or two examples.** | | |
| S | The answers were varied but GECAFS was the most cited example (by DIVERSITAS, GECAFS, IHDP, WCRP). Other responses included GCP, START initiatives (CLIMAG, AIACC, and their Advanced Institutes), and GWSP. | | |
| 8 | **For your ESSP activity, provide the percentage of involvement of individuals from: (the total should sum to 100)** | | |
| | | | **ESSP SC** |
| | Natural sciences | 54 | 60 |
| | Social sciences | 34 | 30 |
| | Users (policymakers, farmers, managers, etc.) | 12 | 10 |
| 9 | **Describe the regional and global characteristics of your ESSP activity. How was the balance between global and regional approaches chosen?** | | |
| S | The ESSP components with regional approaches are: MAIRS, START, GECAFS, GCP, GWSP. | | |

[6] The following questionnaire directions were given: 'Unless otherwise specified, the following questions refer to ESSP as a whole. Several questions stipulate that they refer only to a component of ESSP (these are worded in terms of 'your ESSP activity', 'your organization' or 'your ESSP governance structure'; for these questions, the GEC Programme should answer in terms of the ESSP as a whole. For example in question 11, the GEC Programmes should respond to the question: For ESSP as a whole, provide the percentage of involvement of individuals from different sectors. As you will note several of the questions are open ended; for these we are looking for concise responses. If you care to expand on any of your answers, there is space available at the end of this questionnaire.'

| | | | | | | |
|---|---|---|---|---|---|---|
| 10 | **For your ESSP activity, please rank the following mechanisms, which have been used to deliver results, in terms of how successful have they been. [scale : least to most important]** | | | | | |
| | **answer options** | **fourth in importance** | **third in importance** | **second in importance** | **most in importance** | **Rating Average** |
| | open science conference | 1 | 1 | 3 | 3 | 3.0 |
| | publications | 0 | 3 | 3 | 2 | 2.9 |
| | other | 2 | 1 | 1 | 3 | 2.7 |
| | interaction with decision-maker | 3 | 2 | 1 | 0 | 1.7 |
| S | Meetings such as the Open Science Conferences (OSCs) and workshops were considered to be the most important mechanism for delivering results. The OSCs were followed by publications, interactions with decision-makers, general communications efforts [including websites], and contributions to science assessments. | | | | | |
| 11 | **In what ways has your ESSP activity benefited from the four Global Environmental Change Programmes?** | | | | | |
| S | The most common response was that the ESSP components benefit via access to GEC experts and with respect to general information exchange. | | | | | |
| 12 | **What is the approximate percentage regional proportion of scientists involved in your ESSP activity? The total should sum to 100.** | | | | | |
| | Europe | | | | 25 | |
| | North America (excluding Mexico) | | | | 21 | |
| | Eastern Asia | | | | 13 | |
| | South Asia | | | | 12 | |
| | Latin America (including Central America and Mexico) | | | | 10 | |
| | Sub-Saharan Africa | | | | 8 | |
| | Australia and New Zealand | | | | 6 | |
| | Oceania (excluding Australia and New Zealand) | | | | 2 | |
| | Central Asia | | | | 2 | |
| | North Africa and Middle East | | | | 2 | |
| 13 | **How important is it now or will it be in the next five years for your organization to work with the development community?** | | | | | |
| | somewhat important | | 18% | GEC&HH, MAIRS | | |
| | highly important | | 82% | DIVERSITAS, ESSP SC, GCP, GECAFS, GWSP, IGBP, IHDP , START, WCRP | | |
| 14 | **For your ESSP activity, who are your major partner organizations within and outside of ICSU?** | | | | | |
| S | Most of the respondents (GCP, GECAFS, MAIRS, OSC, START, WCRP) cited research centres (regional research centres, national agencies, and universities) as partners. Institutions that were cited by several respondents were: UNESCO (DIVERSITAS, GWSP, IHDP), WMO (GECAFS, GWSP, WCRP), IPCC/UNFCCC (GCP, GWSP, START), UNU (IHDP, START), IGFA (DIVERSITAS, START). Other partner organizations cited were: APN, CBD, CGIAR, the European Commission's FP6, FAO, GEOSS, Global Environment Center (based in Malaysia), Global River Sustainability Project, IAI, International Permafrost Association, ISSC, MA, the Integrated Assessment Society, UNEP, WHO, and WRI. | | | | | |

| 15 | **Rank on a scale of 1 to 5 the influence of each of the following in making decisions about the focus of your ESSP activity.** | | |
|---|---|---|---|
| | | | **Relative ranking** |
| | Most important | Scientific questions | 4.7 |
| | Second in importance | User needs | 4.0 |
| | third in importance | Capacity of the key participants | 2.8 |
| | fourth in importance | Sources of financial support | 2.4 |
| | fifth in importance | Other: | 2.0 |
| | other: | 'Relevance to development agenda, interdisciplinary, engagement of SSC members, momentum in between meetings.' | |
| 16 | **Rank in order of importance the user audience for your ESSP activity?** | | |
| | | | **Relative Rating** |
| | most important | Scientific community | 6.7 |
| | | International institutions | 5.4 |
| | | National governments | 4.9 |
| | | Media | 3.3 |
| | | General public | 2.6 |
| | | Private sector | 2.6 |
| | least important | Local communities/farmers/etc. | 1.9 |
| 17 | **Which of the following methods were used to interact with users to set priorities for your ESSP activity? Please rank in order of importance.** | | |
| | | **Rating Average** | |
| | Workshops | 4.8 | most important |
| | 'Other' | 4.0 | E.g., GEC programme director conf calls, consultations among Executive Committee members and SSC, current policy development process (not published yet), email interactions. |
| | Published guidance or policy documents | 3.6 | |
| | One-on-one discussions | 3.3 | |
| | Surveys | 1.8 | least important |
| 18 | **To what extent have intended users approached your ESSP activity for input or interaction?** | | |
| | no users have approached us, | 0% | |
| | 0-20 % of the users identified in question 16 have approached us | 20% | GEC&HH, GWSP |
| | 20-40% of the users | 40% | GCP, GECAFS, ESSP SC, MAIRS |
| | 40-60 % of the users | 20% | IHDP, START |
| | 60-80 % of the users | 10% | DIVERSITAS |
| | 80-100 % of the users | 10% | OSC |

| | | | |
|---|---|---|---|
| 19 | **Do you expect this to change over the next 1-5 years?** | | |
| S | Most organizations hoped to increase the interaction with users through outreach or interaction with decision-makers. | | |
| 20 | **How could engagement with users be enhanced?** | | |
| S | Policy briefs were cited the most frequently (by DIVERSITAS, GCP, GWSP, IHDP). Not surprisingly, increased resources were mentioned (DIVERSITAS, GECAFS, GWSP, START). Other suggestions included general communication products (books, etc) and seeking out those who are not currently in the ESSP network (OSC). | | |
| 21 | **To what extent has the ESSP enhanced the visibility of and attention to the work of the Global Environmental Change Programmes?** | | |
| | ESSP has not enhanced the visibility of the GEC Programmes | 8% | START |
| | to a small extent | 25% | GECAFS, ESSP SC, IHDP |
| | to a moderate extent | 50% | GEC&HH, GWSP, IGBP, IHDP, OSC, WCRP |
| | to a large extent | 17% | DIVERSITAS, GCP |
| 22 | **Other than scientific publications, what mechanisms does the ESSP use for raising visibility and improving communications?** | | |
| | Conferences | most important | 6.3 |
| | Internet-based information or outreach | | 6.1 |
| | Policy briefs | | 4.3 |
| | Contributing to assessments | | 4.0 |
| | Op eds, press releases and other popular media outlets | | 3.6 |
| | Communication through sponsoring institutions | | 3.6 |
| | Advocacy activities (direct interaction with users and decision-makers) | least important | 2.8 |
| 23 | **Other than scientific publications, what mechanisms should (rather than does, as in the previous question) the ESSP use for raising visibility and improving communications?** | | |
| | Policy briefs | most important | 6.2 |
| | Other: (see below) | | 5.0 |
| | Advocacy activities (direct interaction with users and decision-makers) | | 4.8 |
| | Op eds, press releases and other popular media outlets | | 4.7 |
| | Internet-based information or outreach | | 4.5 |
| | Conferences | | 4.1 |
| | Communication through sponsoring institutions | least important | 2.9 |
| | Other:<br>- High level articles<br>- Interactions with development community<br>- Media<br>- 'We had an ESSP OSC communications team that developed the media campaign. Press releases were issued and interviews with the media were conducted. We should, however, have worked on a special issue in a major scientific journal highlighting some of the key themes that came out of the conference. Conference outputs were (in my opinion) poor - although several parallel session participants may have went on to write in journals and prepared project proposals that we do not know about.' (OSC) | | |

| | | | |
|---|---|---|---|
| 24 | **Including START, to what extent do you judge ESSP capacity building activities to be effective in attracting the interest of young scientists and in fostering a new generation of scientists working in a more interdisciplinary research environment?** | | |
| | not important | 0% | START |
| | of little importance | 9% | IGBP |
| | somewhat important | 45.5% | DIVERSITAS, IHDP, MAIRS, START, WCRP |
| | highly important | 45.5% | ESSP SC, GCP, GECAFS, GWSP, Open Science Conference |
| 25 | **Including START, to what extent do you judge ESSP has had, is having or will have (in the next 5 years) an impact in changing your organization's or key partner organizations' capacity for global environmental science?** | | |
| | not important | 0% | |
| | of little importance | 10% | WCRP |
| | somewhat important | 70% | DIVERSITAS, IGBP, IHDP, GECAFS, GWSP, MAIRS, START |
| | highly important | 20% | ESSP SC, GCP |
| 26 | **Please provide explain your answer to the question above.** | | |
| | Most respondents thought that START and other initiatives have had only limited success. START states that the current resources are insufficient for the task at hand. | | |
| 27 | **Should the Joint Projects and Integrated Regional Studies capacity building activities be done: in cooperation with START or independently or both?** | | |
| | in cooperation with START | 27 % | ESSP SC, GCP, WCRP |
| | independently | 0.00% | |
| | both | 73% | DIVERSITAS, IGBP, IHDP, GECAFS, GEC&HH, GWSP, MAIRS, START |
| 28 | **Excluding START, to what extent do you judge capacity building to be part of your ESSP activity? (Rank from 1 - 4)** | | |
| | 1 = this is a minor component | 11.1% | IHDP |
| | 2 | 22.2% | DIVERSITAS, ESSP SC |
| | 3 | 22.2% | GCP, GWSP |
| | 4 = this is a major component | 44.4% | GECAFS, GEC&HH, MAIRS, OSC |
| 29 | **What are these activities?** | | |
| | - Funds for training workshops, courses, projects, PhDs, OSC (DIVERSITAS, GECAFS,GEC&HH, GWSP, MAIRS) | | |
| | - Individuals seeking out scientific results e.g., articles, web (DIVERSITAS, IHDP) | | |
| | - Inclusion in the assessment process (GEC&HH) | | |
| | - National committees in developing countries (DIVERSITAS) | | |
| 30 | **What is your annual operating budget in Euros for 2006?** | | |
| | €118 000 (2007) | ESSP Secretariat | |
| | €120 000 | MAIRS | |
| | €270 000 | GECAFS | |
| | €280 000 | GCP | |
| | €500 000 (2007) | GWSP | |
| | €600 000 | DIVERSITAS | |
| | €785 000 | START | |
| | €1 200 000 | IHDP | |
| | €1 500 000 | IGBP | |
| | €1 600 000 | WCRP | |

| | | | |
|---|---|---|---|
| 31 | **In terms of fundraising for your activity, how important has it been that you are part of the ESSP?** | | |
| | not important | 10% | IGBP |
| | of little importance | 30% | IHDP, GECAFS, WCRP |
| | moderately important | 50% | ESSP SC, GCP, GWSP, MAIRS, START |
| | highly important | 10% | DIVERSITAS |

| | | |
|---|---|---|
| 32 | **For your organization what mechanisms have you used for resource mobilization (rank in order of importance based on the amount of funds received)?** | |
| | 6.4 | -Approaches to national agencies for core and secretariat support |
| | 5.8 | -Independently initiated project proposals to government donors |
| | 5.3 | -Independently initiated project proposals to other donors |
| | 5.0 | -In kind support from home institutions |
| | 4.9 | -Responses to request for proposals from governments or other donors (science support) |
| | 4.3 | -Interactions with IGFA |
| | 3.8 | -Responses to request for proposals from governments or other donors (development aid support) |
| | Other: | annual appeals to IOC and WMO (WCRP) |

| | | | |
|---|---|---|---|
| 33 | **Do you perceive the mechanisms for planning and coordination within ESSP to be more or less effective than other international GEC Programmes? (Rate from 1 -6)** | | |
| | 1 = not nearly as effective | 27% | GCP, START, WCRP |
| | 2 | 46% | DIVERSITAS, ESSP SC, IHDP, GECAFS, MAIRS |
| | 3 | 9% | IGBP |
| | 4 | 9% | GWSP |
| | 5 | 0% | |
| | 6 = much more effective | 9% | GEC&HH |
| 34 | **How much synergy do you see across the ESSP components?** | | |
| | no synergy | 0% | |
| | very little synergy | 25% | GECAFS, IHDP, WCRP |
| | a low-moderate level of synergy | 25% | DIVERSITAS, GEC&HH, START |
| | a moderate-high level of synergy | 33.3% | IGBP, GCP, GWSP, MAIRS |
| | a significant amount of synergy, which has remained constant in time | 8.3% | ESSP SC |
| | a lot of synergy and this is increasing with time | 8.3% | OSC/ESSP coordinator |

| | | |
|---|---|---|
| 35 | **For your ESSP governance structure (e.g., SSC), provide the percentage of involvement of individuals from different sectors. Total should sum to 100.** | |
| | Natural sciences | 54 |
| | Social sciences | 38 |
| | Users (policymakers, farmers, managers, etc.) | 8 |

| | | | |
|---|---|---|---|
| 36 | **What is the approximate percentage regional proportion of scientists involved in your ESSP governance structure? The total should sum to 100.** | | |
| | Europe | 28 | NB: It is a bit difficult to objectively characterize the ESSP SC regional composition, because there are a fair number of ex-officio seats that can be occupied by several different individuals. |
| | North America (excluding Mexico) | 18 | |
| | Eastern Asia | 15 | |
| | South Asia | 10 | |
| | Sub-Saharan Africa | 10 | |
| | Latin America (including Central America and Mexico) | 9 | |
| | Australia and New Zealand | 5 | |
| | Oceania (excluding Australia and New Zealand) | 2 | |
| | North Africa and Middle East | 2 | |
| | Central Asia | 1 | |
| 37 | **Do you have any final comments regarding the questions above or remarks? If expanding upon a question from above, please refer to its number.** | | |
| | Several pages of comments were received. Two select comments:, 'an integrated GEC 'roadmap' is needed' (IGBP), 'A mechanism of secure funding is needed (GWSP)'. | | |

# Annex 6: Wider community questionnaire and summary of responses

Over 200 'wider community' questionnaire invites were sent out, and 24 responses were received. One of the reasons that the response rate was so low was probably lack of familiarity with the ESSP. Boxes with an 'S' summarize the received responses.

| | | | | |
|---|---|---|---|---|
| 4 | **Would you identify yourself as a** | | | |
| | **answer options** | **Abbreviation** | **Response Percent** | **Response percentage for the ICSU family** |
| | 8 Union Members (ICSU) | Union | 33.3% | 28% |
| | 6 National Members (ICSU) | NM | 25.0% | 5% |
| | 4 Interdisciplinary Body (ICSU) | IB | 16.7% | 14% |
| | 2 Users of ESSP products from the science sector, responding in a personal capacity | User (S) | 8.3% | |
| | 2 Funders from the science sector (IGFA) | Funder | 8.3% | |
| | 1 User of ESSP products from development aid sector | User (D) | 4.2% | |
| | 1 Policy-maker | PM | 4.2% | |
| | User of ESSP products from another sector | | 0% | |
| | Funder from the development aid sector | | 0% | |
| | Funder from another sector | | 0% | |
| | Other | | 0% | |
| | 24 Total | | 100% | |
| 5 | **How familiar are you with ESSP or any of its projects or activities? Rate from 1-5.** | | | |
| | 1 = not familiar with the ESSP | | 8.3% | 2 Unions |
| | 2 = familiar with the name of ESSP, but not its sub-activities | | 29.2% | 4 Unions, 1 NM, 1 User (D), 1 User (S) |
| | 3 = familiar with the name of ESSP, and 1-2 of its projects/components | | 25.0% | 1 IB, 1 NM, 1 Union, 2 Funders, 1 U (S) |
| | 4 = familiar with the name of ESSP, and 3-4 of its projects/ components | | 33.3% | 3 IB, 3 NM, 1 Union, 1 PM |
| | 5 = highly familiar with most of the ESSP activities | | 4.2% | 1 NM |
| | total | | 100% | 24 |
| 6 | **The current ESSP mission is to bring 'together researchers from diverse fields, and from across the globe, to undertake an integrated study of the Earth System: its structure and functioning; the changes occurring to the System; the implications of those changes for global sustainability.' The ESSP states that 'a new system of global environmental science is required to compile the essential knowledge base and develop sustainable strategies for our Earth in the face of global change.' What do you think of the current mission? What should the goals of ESSP should be?** | | | |
| S | A common message was the need to strengthen the science-policy dialog, and explicitly state this in the mission. (E.g., ESSP should explicitly develop science-based strategies that would help policymakers.) In conjunction with this ESSP should strengthen its communication component. Many questioned how the ESSP could actually take on the rather ambitious, and even vague, goal of 'an integrated study of the Earth system'. They pointed out that ESSP's activities are rather targeted than truly integrative. The competition with the GEC programme funding was mentioned several times. Several mentioned the need to also work closely with other components of the ICSU family. | | | |

| | | | |
|---|---|---|---|
| 7 | **To what extent do you agree with the ESSP goals? (Rate from 1-6, where 1 = I don't agree and 6 = I agree completely)** | | |
| | **answer options** | **Response Percent** | |
| | Don't agree | 0% | |
| | 2 | 0% | |
| | 3 | 0% | |
| | 4 | 13% | 1 IB, 1 Union, 1 PM |
| | 5 | 48% | 2 IB, 4 NM, 4 Unions, 1 PM |
| | Agree completely | 39% | 1 IB, 2 NM, 3 Unions, 2 Funders, 1 User (S) |
| | | 100% | 23 |
| 8 | **How often have you received or come across information resulting from ESSP or its component activities? (Rate from 1-6, where 1 = I have never received such material and 6 = I receive such information regularly)** | | |
| | **answer options** | **Response Percent** | |
| | Never received such material | 29% | 1 IB, 1 NM, 4 Unions, 1 User (D) |
| | 2 | 13% | 1 IB, 1 Union, 1 User (S) |
| | 3 | 21% | 1 NM, 1 Union, 1 Funder, 1 PM, 1 User (S) |
| | 4 | 21% | 3 NM, 2 Unions |
| | 5 | 13% | 2 IB, 1 Funder |
| | receive information regularly | 4% | 1 NM |
| | Total | 100% | 24 |
| 9 | **Have ESSP findings or information influenced your decisions, programmes, or activities? Please describe and provide examples. If you have not used ESSP findings and information to date, do you foresee that ESSP outputs will be useful to you in the future? If so, when (approximately) and how?** | | |
| S | In the wider community, many confounded ESSP with the four programmes. When responding to the question of how they used ESSP findings, respondents were more likely to cite using finding from the GEC programmes (15 times) rather than the ESSP components (eight times). Of the ESSP components mentioned, results from the more established joint projects (i.e., GCP, GECAFS, and GWSP) were cited along with a general reference to an IRS (Integrated Regional Study), while there was no mention of START or GEC&HH, the latter being relatively new. | | |
| 10 | **Have you been invited by ESSP or its components projects to provide input or take part in a priority setting or planning processes?** | | |
| | **answer options** | **Response Percent** | |
| | yes | 17% | 2 NM, 1 Union, 1 Funder |
| | no | 83% | 3 IB, 4 NM, 7 Union, 1 Funder, 1 PM, 1 User (D), 2 User (S) |
| | Total | 100% | 24 |
| 11 | **Have you ever contacted ESSP to provide suggestions regarding their priority setting or research directions?** | | |
| | **answer options** | **Response Percent** | |
| | yes | 21% | 1 IB, 2 NM, 2 Funders |
| | no | 79% | 3 IB, 4 NM, 8 Unions, 1 PM, 1 User (D), 2 User (S) |
| | Total | 100% | 24 |
| S | Most respondents had not contacted ESSP; however, there did seem to be good communication with at least two of ICSU's National Members. | | |

| | |
|---|---|
| 12 | **What could ESSP do to better meet the needs of your organization (in terms of either research topics or forms of outreach and communications)?** |
| S | ICSU's IBs and Unions suggested specific sectorial areas (e.g., data, biology, marine science) to work on commonly, while the National Members focused on communication and dissemination of results. Interestingly, one funder said 'funding agencies should collaborate to secure a steady funding of ESSP.' |
| 13 | **What do you perceive the successes of ESSP to be?** |
| S | Several of the success mentioned, were the Open Science Conferences, building a network of high-level interdisciplinary scientists, and the GCP. Potential future successes such as: results from more IRS, databases, and advice on adaptation. |

| | | | | |
|---|---|---|---|---|
| 14 | **In the next five years, how important is or will it be for you (or your organization) to work with the development community? (Rate from 1-6, where 1 = not important and 6 = highly important)** | | | |
| | **answer options** | **Response Percent** | | |
| | not important | 4% | 1 Union | |
| | 2 | 13% | 1 IB, 1 PM, 1 User (S) | |
| | 3 | 4% | 1 Union | |
| | 4 | 26% | 2 NM, 4, Unions | |
| | 5 | 13% | 1 IB, 1 Union, 1 User (S) | |
| | highly important | 39% | 1 IB, 2 NM, 3 Unions, 2 Funders, 1 User (D) | |
| | Total | 100% | | |
| S | Most, but not all the respondents, plan to work with the development community in the future. | | | |
| 15 | **Would you recommend increased financial support for ESSP in comparison to other Global Environmental Change research activities?** | | | |
| | **answer options** | **Response Percent** | | |
| | yes | 50% | 4 NM, 2 Union, 2 Funders, 1 PM, 1 User (D) | |
| | no | 50% | 3 IB, 1 NM, 4 Union, 2 User (S) | |
| 16 | **Do you have any final comments regarding the questions above or remarks? If expanding upon a question from above, please refer to its number.** | | | |
| S | Improving communication was cited as a priority (e.g., 'ESSP is still not well known, except by its components. The word ESSP, even for many people involved in WCRP; IGBP, Diversitas or IHDP, does not represent anything. A way to make it more visible is thru communication activities'). | | | |

# Annex 7: The ESSP Review Panel work plan

| Date | Item | Comments |
|---|---|---|
| **2007** | | |
| 18-19 January | Preparatory Meeting in Paris | |
| February - March | | Collection of material:<br>- List of key institutions and people inside ESSP<br>- List of key institutions and people outside of ESSP (decision makers, Convention secretariats, funders, development aid community)<br>- ESSP historical document (incl. key points from Amsterdam Declaration, evolution of the ESSP, views on ESSP, linkages with the policy community)<br>- Calendar of key meetings (to be circulated before the first meeting)<br>- Sources Review: overview of existing ESSP documents<br>- Other materials: project science plans/frameworks… |
| 12 February | ESSP components asked to submit self-assessments by 31 March | Questions:<br>- What is your organization doing?<br>- Where is your organization going in the next 5 years?<br>- Your assessment of ESSP? Where would you see its future role? |
| 22 February | GEC programmes asked to submit ESSP assessments by 6 April | Questions:<br>-Your assessment of ESSP?<br>-Where would you see its future role? |
| 19 March | Mailing | ICSU Family, and relevant organizations informed of the Review. All were given the web link to the Review and the email address to submit comments. |
| 22 March | Received document | ESSP Historical Document: 'Envisioning Earth System Science for Societal Needs: The development of Joint Projects and the ESSP'. |
| 26 – 27 April | **Meeting 1** in Paris | Outcomes: Scoping of the task, development of scenarios, and drafting of online questionnaires. |
| May – October | Panel Interviews | Panel members to consult with key actors/institutions using the questionnaire. |
| 14 May | Deadline | Panel to comment on the report outline which is posted on the password protected site. |
| 22 May | Deadline | ESSP Business Plan to be received. It was received 22 June. |
| 28 May | Deadline | Panellists to look over the Meeting 1 notes and examine the questionnaires the notes for possible gaps. |
| Late May | Activation of the online questionnaires | Deadline for the GEC community: 1 July. Deadline for the wider community: 17 July. Actual deadline: end of July. |
| 17 Aug | Consultative meeting in Stockholm. Panel members to meet with several key people in ESSP's leadership in Stockholm | Several Panel members met with members of the several members of the ESSP governance structure. |

| Date | Item | Comments |
|---|---|---|
| **24-25 October** | **Meeting 2** in Paris<br>½ day joint meeting with ESSP Scientific Committee | Outcomes: Review of the questionnaires, interviews and Joint session. Development of outline report and writing assignments. Draft recommendations discussed. |
| Early December | Report mailed to ESSP | Draft report to be circulated first to ESSP to correct factual errors. |
| **2008** | | |
| 14 January | Deadline | Comments from ESSP due back. |
| 28 January | Report mailed to ICSU and IFGA | The report will be circulated to the ICSU family and outside organizations. |
| 15 February | Deadline | Comments from ICSU and IGFA due back. |
| 27-28 February | **Meeting 3** in Paris | Objective: Finalize the report. |
| 7 April | Deadline | Submission of the final report to ICSU's Committee on Planning and Review & IGFA. |
| 28-29 April | CSPR meeting | Review considered by the CSPR |
| 23-24 May | ICSU's Executive Board Meeting | Decision to publish the report. |
| 20-24 October | ICSU's General Assembly | Presentation of the ESSP Review by the Chair of the Panel to the ICSU family in Maputo. |

# Annex 8: Acronyms and abbreviations

| | |
|---|---|
| ADG | Assistant Director General |
| AIACC | Assessment of Impacts of and Adapations to Climate Change |
| APN | Asia-Pacific Network for Global Change Research |
| CBD | Convention on Biological Diversity |
| CCD | Convention to Combat Desertification |
| CEO | Chief Executive Officer |
| CGIAR | Consultative Group on International Agricultural Research |
| CLIMAG | Climate Prediction and Agriculture |
| CoP | Conference of the Parties |
| CSD | Commission on Sustainable Development |
| CSPR | Committee on Scientific Planning and Review |
| DESA | United Nations Department of Economic and Social Affairs |
| DFID | UK Department for International Development |
| DIVERSITAS | An international programme of biodiversity science |
| ESF | European Science Foundation |
| ESSP | Earth System Science Partnership |
| EU | European Union |
| FAO | Food and Agriculture Organization |
| FP | Framework Programme |
| GCP | Global Carbon Project |
| GEC | Global Environmental Change |
| GECAFS | Global Environmental Change and Food Systems |
| GEC&HH | Global Environmental Change and Human Health |
| GEF | Global Environment Facility |
| GEOSS | Global Earth Observation System of Systems |
| GWSP | Global Water System Project |
| IAI | Inter-American Institute for Global Change Research |
| IB | Interdisciplinary Bodies |
| ICSU | International Council for Science |
| IFS | International Foundation for Science |
| IGBP | International Geosphere Biosphere Programme |
| IGFA | International Group of Funding Agencies for Global Change Research |
| IHDP | International Human Dimensions Programme on Global Environmental Change |
| IIED | International Institute for Environment and Development |
| IMoSEB | International Mechanism of Scientific Expertise on Biodiversity |

| | |
|---|---|
| IOC | International Oceanographic Commission |
| IPCC | Intergovernmental Panel on Climate Change |
| IPO | International Programme Office |
| IRS | Integrated Regional Studies |
| ISSC | International Social Science Council |
| IUBS | International Union of Biological Sciences |
| IUCN | World Conservation Union |
| JSC | Joint Scientific Committee |
| MA | Millennium Ecosystem Assessment |
| MAIRS | Monsoon Asia Integrated Regional Study |
| MDG | Millennium Development Goals |
| NGO | Non Governmental Organization |
| NM | National Member |
| NSF | National Science Foundation |
| OSC | Open Science Conference |
| PAA | Priority Area Assessment |
| S&T | Science and Technology |
| SBSTA | Subsidiary Body for Scientific and Technological Advice of the UNFCCC |
| SC | Scientific Committee |
| SCOPE | Scientific Committee on Problems of the Environment |
| SEI | Stockholm Environment Institute |
| SIDA | Swedish International Development Cooperation Agency |
| SSC | Scientific Steering Committee |
| START | SysTem for Analysis, Research, and Training |
| TIAS | The Integrated Assessment Society |
| ToR | Terms of Reference |
| UNCED | UN Conference on Environment and Development |
| UNEP | United National Environment Programme |
| UNESCO | United Nations Educational Scientific and Cultural Organization |
| UNFCCC | United Nations Framework Convention on Climate Change |
| UNU | United Nations University |
| USAID | United States Agency for International Development |
| WCRP | World Climate Research Programme |
| WHO | World Health Organization |
| WMO | World Meteorological Organization |
| WRI | World Resources Institute |

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