



ICSU

International Council for Science

strengthening international science for the benefit of society

ICSU and Climate Science: 1962 - 2006 and beyond

From GARP to IPCC

Celebrating 75 years: 1931-2006

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Catalysing international research to inform policy development

A key part of ICSU's mission is to plan and coordinate research, especially on topics that need collaboration between scientists in different disciplines and in different parts of the world. In many cases the outcomes of this research provide the basis for international policy development. To understand ICSU's role in bridging science and policy is to understand how a small organisation with extensive networks can have a big impact both on the progress of science and policy.

Typically, the first step in the development of a new ICSU programme is to bring the key international scientific experts together and secure the support of appropriate institutional partners. Depending on the topic of interest, an initial scoping activity may be required as a prelude to a more focused programme planning exercise. In this way ICSU, in consultation with the international scientific community, is able to define the framework for an international research programme, set the scientific priorities and establish quality benchmarks, whilst taking on board the relevant policy issues. Once a scientific framework is approved – normally involving formal endorsement by the General Assembly of ICSU, a scientific steering committee is established with appropriate representation to oversee implementation of the programme. At this stage a separate secretariat or programme office is normally set up, to support the long-term coordination and planning. In effect, ICSU develops and incubates a programme until it is mature enough to stand on its own.

While ICSU will often fund some or all of the programme incubation costs from its own resources, the cost of the actual research will be met by other sources, national as well as international. ICSU may help scientists raise funding from such sources, for example by ensuring that funding agencies are fully briefed on the objectives of the overall programme. Most importantly, ICSU maintains a long-term responsibility for ensuring the quality and strategic direction of the programme.

In the context of research collaboration, ICSU is effectively a bridge between the international scientific community, global governmental organisations and national funding agencies. Such a role is particularly valuable where a long-term scientific perspective has to be negotiated. The link with intergovernmental organizations, which is frequently manifest is co-sponsorship of programmes, ensures both that policy concerns are addressed in the research programmes and that the research outcomes are fed-back into the policy-making process.

The following brief outline of some of ICSU's contributions to the development of climate science illustrates how this approach to facilitating research collaboration to inform policy development works in practice.

Global atmosphere research (*the GARP*)

In 1962, following the successes of the 1957/58 International Geophysical Year, the UN General Assembly formally invited ICSU to work alongside the World Meteorological Organisation in developing a programme of research on atmospheric science. ICSU and WMO appointed a committee to plan what became the Global Atmosphere Research Programme (GARP), which was launched as a joint ICSU/WMO programme in 1967.

The Global Atmosphere Research Programme was important particularly for its early recognition of the new science that could be done with satellites for continuous, global observation of the Earth and with computers for modeling global atmosphere circulation. It produced some visionary collaborative experiments and results, notably the Atlantic Tropical Experiment. This delivered new insights into the ways in which tropical weather systems are organized and their links with the overall tropical circulation and with variations in surface temperature and other properties of the ocean. It led on to the highly successful 1979 Global Weather Experiment which laid the scientific foundation for redesign of the WMO's operational World Weather Watch.

As a result of these efforts the climate science agenda grew to the point where, in 1978, ICSU WMO and UNEP jointly organized an international workshop on climate issues, hosted by the International Institute for Applied System Analysis (IASA) in Vienna. This led to the first World Climate Conference in Geneva in 1979, sponsored by ICSU, WMO and other key partners. Here, 300 scientists from 50 countries considered the scientific evidence, and confirmed the long-term significance for global climate of atmospheric CO₂ levels, and the important role of the oceans in driving the natural variability of climate on seasonal to inter-annual timescales. This prompted ICSU and WMO to bring the Global Atmosphere Research Programme to a close in 1980 and in its place set up the World Climate Research Programme¹ (WCRP), with the broad objectives of determining how far climate can be predicted and the extent of human influence on climate.

World climate and problems of the environment (*the WCRP and SCOPE*)

The WCRP initiative intersected the work of the Scientific Committee on Problems of the Environment (SCOPE), which had been set up by ICSU in 1969. This is an interdisciplinary body of natural and social science expertise focused on global environmental issues, operating at the interface between science and political decision-making. SCOPE was closely involved in the workshop at IASA in 1978 and then, in 1986, it published a seminal report no.29, *The greenhouse effect, climatic change and ecosystems*. This was the first comprehensive international assessment of the environmental impact of atmospheric greenhouse gases. Its publication coincided with the Villach conference organized jointly by ICSU, WMO and UNEP, on how to reduce the scientific uncertainties regarding environmental change, on the nature of the international collaboration needed to do this, and on priorities for future research – including future directions for the WCRP. This conference made it clear that the Earth's climate was entering a period of rapid change with potentially far-reaching consequences.

¹ In 1993 the International Oceanographic Commission (IOC) of UNESCO joined as a co-sponsor of WCRP, reflecting the importance of the oceans in determining climate.

After the Villach conference,² its three organisers jointly appointed the Advisory Group on Greenhouse Gases, which produced a number of reports on the policy implications of the emerging science. WMO and UNEP (both intergovernmental bodies) then entrenched climate science in the policy agenda by establishing, in 1988, the IPCC (Intergovernmental Panel on Climate Change) to take stock of the emerging science at government level and examine options for responding to human-induced climate change.

WCRP meanwhile established a ground-breaking programme of collaborative research, which has produced some major advances in climate science. Notable achievements include establishing the physical basis for understanding and predicting El Niño events, and improved climate models through improved understanding of key climate processes, comprehensive field measurements and the development of regional and global observational climatic data sets.

Impact of the biosphere (*the IGBP*)

Through these successive research and assessment initiatives, then, ICSU was hugely influential in establishing the international research agenda on climate science. Initially, this meant climate as driven by 'physical' forces. However, partly as a result of work carried out under the auspices of ICSU's Scientific Committee on Problems of the Environment, it was recognized that an adequate account of climate science could not be derived from such a base alone, and that interactions with the biosphere play an important role. This perspective was discussed at several ICSU meetings, and the 1983 General Assembly appointed a planning group to make detailed proposals for how ICSU could respond. In 1986, the ICSU General Assembly approved the launch of the International Geosphere Biosphere Programme (IGBP).

IGBP addresses the Earth as a system of globally interacting phenomena, and seeks to understand the physical, chemical and biological processes that regulate this system, changes occurring to these processes and the role of human activities in these changes. The focus is on developing common international frameworks and an agreed agenda for collaborative research, by facilitating research networks, by promoting standardized methodologies, and by undertaking analysis, synthesis and integration activities on broad Earth system themes. Some 200 scientists from all parts of the world are directly involved in planning and implementing IGBP activities, and over 10 000 scientists take part in IGBP projects.

Major scientific outcomes from this work include an improved understanding of the important role that biology plays in controlling the Earth's environment and the strong interactions among biological, physical and chemical processes; recognition that the Earth system is characterized by critical thresholds and abrupt changes that can be inadvertently triggered by human activities; and evidence that the Earth system has recently moved outside the range of natural variability, with unprecedented magnitudes and rates of change.

Influencing policy (*the IPCC*)

The various ICSU initiatives during the 1980s were crucial in establishing greenhouse gases as an object of national and international policy. In a sequel to the successful 1979 Conference that led to the creation of WCRP, ICSU and WMO sponsored a second World Climate Conference in Geneva in October 1990. That Conference was a further milestone in the recognition of the reality of climate change. It received the First Assessment Report from the Intergovernmental Panel on

² In addition to prompting the creation of the IPCC, the Villach conference was an important input to the thinking of the highly influential 1987 Brundtland report *Our common future*.

Climate Change (IPCC), produced under great time pressure, and paved the way for the UN Framework Convention on Climate Change and the 1992 Rio 'Earth Summit' on Environment and Development (where 154 States signed the UN Framework Convention). It also exposed the difficulties in getting political agreement on how to deal with the problems highlighted by science.

Over the past decade, the priorities of the WCRP have been greatly influenced by the policy issues and research gaps being identified in IPCC analyses. The WCRP Strategic Framework for 2005 – 2015 maintains this practice with a commitment that future WCRP results will 'feed directly into major scientific assessments such as the reports of IPCC', and that WCRP will 'continue to be a major contributor to providing the scientific basis' for future IPCC assessments.

An independent review of WCRP for ICSU in 1994 concluded that 'both the WCRP and IGBP must be seen as the main mechanisms by which the scientific community is mobilized to provide improved understanding of the behaviour of the climate system'. The review argued further that 'it must be much more strongly recognized and publicized that the major foundation of the natural science assessments of IPCC is the collaborative work of many scientists and countries through the WCRP and IGBP'.

Funding for Global Environmental Change Research

IGBP and WCRP are two of the four major ICSU programmes of international collaborative research on particular aspects of global change that together constitute the Earth System Science Partnership. The other two programmes address issues related to biodiversity (DIVERSITAS) and to the human dimensions of global environmental change (IHDP).

The cost of running all four of these global change programmes – i.e. secretariats, scientific steering committees, integration activities, publications etc – is about 10 million USD p.a., funded mainly by contributions from ICSU Members, by earmarked grants and (for WCRP) by the WMO. This compares with a conservative estimate of 2 billion USD for annual expenditure on directly related research, a leverage ratio of 1:200.

Earth observation (*GCOS to GEOSS*)

Another of the outcomes of the Second World Climate Conference in 1990 was the recommendation to establish a Global Climate Observing System (GCOS). This echoed ICSU's early recognition in the Global Atmosphere Research Programme of the potential of satellite technology for scientific research. ICSU, WMO and the Intergovernmental Oceanographic Commission convened a workshop in January 1991 to consider the details, and then signed an agreement in October 1991.³ The agreement specified the broad objectives of the Global Climate Observing System; established a Joint Scientific and Technical Committee, appointed collectively by the sponsors and with staff based at WMO, to guide its development; and provided for financial contributions from the sponsors to cover planning activities (as opposed to the costs of actually making, storing and interpreting observations).

This was followed by the creation of analogous global observing systems concentrating on oceans (1993) and on land (1996), both sponsored by ICSU, WMO and other UN bodies. Since 1998 the three observing systems have been coordinating their activities through an Integrated Global Observing Strategy which guides their priority-setting. This also provides a mechanism for

³ A further agreement was signed also by UNEP in February 1992.

them to work with the Committee on Earth Observation Satellites, which encompasses many of the world's government agencies responsible for civil Earth observation satellite programmes and agencies that receive and process data acquired remotely from space.

The observing systems stimulate and coordinate observations by national or international organizations; they do not perform the observations themselves. An example of this coordination is the Argo system, which is a broad-scale global array of nationally deployed temperature/salinity ocean profiling floats. When fully operational, there will be 3000 uniformly spaced Argo floats recording data that will be used for ocean and coupled forecast models, data assimilation and dynamic model testing. The observing systems also identify the minimum needs for an effective international programme of measurements, and respond to requests on how effectively to implement a programme.

Since 2003, ICSU has played another important role in representing the international science community in a new inter-governmental initiative to develop a Global Earth Observation System of Systems (GEOSS). This has included, for example, taking the lead in identifying needs and exploring mechanisms for the collection of global socio-economic data, which are essential for research on the human dimensions of environmental change and sustainable development. ICSU has been invited to co-chair the GEO Science and Technology Committee, together with Germany and South Africa.

The future (*ESSP and beyond*)

WCRP, IGBP and the Global Observing Systems represent only a part of ICSU's commitment to research on global environmental change. This includes two other major interdisciplinary programmes on biodiversity (DIVERSITAS) and the human dimensions of climate change (IHDP). The four programmes work closely together under the auspices of the Earth Systems Science Partnership (ESSP) and have developed joint projects addressing key policy areas (carbon, food, water and human health). All of these activities were subject to a strategic assessment in 2003⁴ that confirmed their continuing importance in providing new scientific knowledge to increase our understanding of environmental change and how to mitigate its effects in the future.

Strategic Goal, 2006 - 2011

Environment – to ensure a more coordinated and inclusive approach to research on the environment such that the necessary high-quality scientific evidence is made available to policy-makers; and to develop new international programmes in key areas
[ICSU Strategic Plan, 2006-2011]

Conclusion

ICSU, then, has played a pivotal role in the development of climate science at the international level, providing mechanisms to orient and complement research going on at the national level. In the last three decades, climate science has demanded international collaboration among researchers on an unprecedented scale, coupled with collaboration at the inter-governmental level and, at times, collaboration between civilian and military interests. ICSU's contribution has been crucial to defining the scientific issues that needed to be addressed, achieving consensus about research priorities and facilitating the various collaborations that have underpinned the

⁴ Environment and its relation to sustainable development: Report of the CSPR Assessment Panel (ICSU, 2003) 62pp

research. Without ICSU's efforts, there would have been little science for the IPCC to assess and thus no established foundation on which to conduct the crucial public debate about global warming. ICSU will continue to play a leading role in providing the scientific evidence to inform this debate in the future.



ICSU

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ICSU Mission Statement

In order to strengthen international science for the benefit of society, ICSU mobilizes the knowledge and resources of the international science community to:

- Identify and address major issues of importance to science and society.
- Facilitate interaction amongst scientists across all disciplines and from all countries.
- Promote the participation of all scientists—regardless of race, citizenship, language, political stance, or gender—in the international scientific endeavour.
- Provide independent, authoritative advice to stimulate constructive dialogue between the scientific community and governments, civil society, and the private sector.

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