

Chapter 6: Program Implementation and Critical Partnerships

Implementation Principles

Past experience with large-scale, multidisciplinary global change research programs has provided invaluable insights into principles for successful program implementation. During its deliberations, the authors of this report (the Carbon and Climate Working Group) and sponsoring agencies of the U.S. Global Change Research Program (USGCRP) identified many aspects of the successful Tropical Ocean–Global Atmosphere (TOGA) Program as possible models for the Carbon Cycle Science Plan. Many of the principles and strategies described in this chapter have their roots in the TOGA Program and are drawn from the experiences of Working Group members, sponsoring agency representatives, and community colleagues, including a 1996 National Research Council review of the TOGA Program (NRC 1996). Working Group deliberations and discussions at the August 1998 Carbon Cycle Science Planning Workshop identified the following key principles for program implementation.

Shared Scientific Vision

This plan represents the critical first step in any successful global change research program—the development of a shared program vision focused on clearly defined problems with identifiable deliverables of value to both the scientific community and the potential beneficiaries in the public and private sectors. Development of this shared vision should involve broad community participation in an open process, with programmatic flexibility to evolve continually as new scientific insights emerge, new technologies are developed, and new information needs are identified.

In this context, the Working Group felt it essential to provide a clear statement of scientific priorities for a focused Carbon Cycle Science Program, while recognizing the critical contributions of related national and international global change research programs. These programs also address such issues as ecosystem dynamics, land use/land cover change, climate variability and change, and atmospheric chemistry. The Carbon Cycle Science Program proposed here describes the essential elements of a program designed specifically to improve the quantitative characterization of past and present CO₂ sources and sinks; to develop models to predict future sources and sinks; and to provide a scientific basis for evaluating potential carbon sequestration strategies and for measuring net emissions from major regions of the world.

Shared Programmatic Responsibility

The National Research Council's review of the TOGA Program (NRC 1996) points to the importance of implementing this shared scientific vision through a dynamic, interactive partnership between the scientific community and responsible federal agencies. In this partnership, responsibility for program direction, implementation, and review is shared, and all partners commit to the programmatic discipline needed to implement the shared vision of the program. As seen in TOGA, commitment to a shared scientific vision requires that, once a Carbon Cycle Science Plan has been adopted, the federal agencies agree that resources will be secured and allocated in accordance with the plan. The scientific community must also accept an appropriate level of responsibility for setting priorities, sustaining relevant existing commitments, and making a compelling case for new resources.

As was the case in TOGA, the programmatic partnership proposed here requires a strong mechanism for interagency coordination to take inventory of individual agency assets and ongoing programs. Agencies must also agree on appropriate agency roles and responsibilities for implementing elements of the Carbon Cycle Science Program, based on the agencies' individual capabilities and missions. Resources can, and probably should, remain in individual agencies, provided that participating agencies agree to a single plan, a single committee for the program's scientific oversight and review, a unified proposal/program review process, and a single address for scientific community and public access to information about the program. When successfully implemented, this ensures that funding decisions reflect scientific merit and programmatic relevance and are essentially "independent" of agency boundaries. The program management structure proposed later in this chapter is based on this model of interagency coordination.

Program Integration

Like the TOGA Program, the Carbon Cycle Science Program necessitates an integrated approach, combining sustained measurements and data analysis and synthesis; targeted process studies and field research campaigns; organized modeling and prediction efforts; and information management. In addition to requiring good integration among these programmatic activities, a successful Carbon Cycle Science Program will require a

multidisciplinary approach. It is critical to integrate studies of atmospheric, oceanic, and terrestrial components of the carbon cycle, together with research on the human dimensions of carbon cycle changes.

Scientific Guidance and Review

Experience with numerous global change research programs has demonstrated the importance of establishing clear procedures for scientific guidance and review of the Carbon Cycle Science Program from the outset. In the case of TOGA, an NRC panel (under the auspices of the Climate Research Committee of the Board on Atmospheric Sciences and Climate) provided a source of ongoing scientific guidance and review throughout the program's lifetime. The Working Group recommends separating the scientific guidance and review processes in a structure that draws from both the TOGA experience and the World Ocean Circulation Experiment (WOCE) and the Joint Global Ocean Flux Study (JGOFS) experiences. We recommend that an independent Scientific Steering Committee be responsible for scientific guidance. (The formation and composition of this committee is addressed in the section on proposed management structure below.) In addition, the Working Group recommends a periodic (e.g., every three to five years) external review of the Carbon Cycle Science Program. The Working Group suggests that the NRC Committee on Global Change Research is an appropriate body to oversee the conduct of these periodic reviews of issues related to scientific quality, relevance, accomplishments, future plans, and program implementation.

Links to International Programs

As the TOGA Program demonstrated, establishing strong ties to the related scientific efforts of other countries and formal international research programs (the World Climate Research Program in the case of TOGA) can yield significant benefits; it represents another key principle for successful implementation of the Carbon Cycle Science Program. The case for international collaboration is even stronger for carbon cycle research in light of the ongoing efforts of the Intergovernmental Panel on Climate Change and current national and international deliberations related to the United Nations Framework Convention on Climate Change. Establishing and sustaining effective links with related international programs is described in further detail below under "Critical Partnerships."

Access to Data and Communication of Research Results

Achieving the goals described in this plan requires a culture of open exchange of observations and associated data products, research findings, and model results. In part, this

requirement calls for a new level of collaboration among scientists engaged in modeling, measurement programs, and field research. In this context, the Working Group notes that early and continuous investment in data-model integration and synthesis is essential to providing a full understanding of past, present, and future carbon cycle behavior. A commitment to easy and open access also implies greater responsibilities for information management strategy to ensure timely provision of data, research findings, and model results; to assimilate/integrate observations and data from different platforms, instruments, and field campaigns; to adhere to appropriate standards, protocols, and guidelines; and to provide metadata critical to the analysis from numerous individual scientists and participating institutions. The continuation of support for any research group under this plan will depend on the timely and complete availability of data and models generated.

Experience with other multidisciplinary, global change research programs like WOCE and TOGA highlights the technical challenges and opportunities associated with open access and exchange within the scientific community. The Carbon Cycle Science Program described in this plan, however, places an additional burden of responsibility on the scientific community and sponsoring agencies: effective communication of research results to intended users such as businesses, communities, land management agencies, and government officials. The U.S. Global Change Research Program uses the term "assessment" when describing such an organized effort to convey scientific results to potential beneficiaries in useful forms and to establish a continuing, interactive dialogue with those users. Current national and international discussions relating to the Framework Convention on Climate Change highlight the importance of sustaining a dialogue that provides government and private sector decision makers with reliable, quantitative information on the sources and sinks of carbon dioxide, both present and future. One element of this dialogue will involve scientific support for formal assessment programs such as the work of the Intergovernmental Panel on Climate Change. In addition, participants in the Carbon Cycle Science Program should, from the beginning, plan an organized program of communication, outreach, and education that supports the understanding and dissemination of new scientific insights and research results to interested parties in and beyond the scientific community.

Proposed Program Management Structure

With these principles in mind, the Working Group recommends establishment of a collaborative management structure for the Carbon Cycle Science Program as depicted in Figure 6.1.

This tripartite management structure reflects the shared responsibilities of the scientific community and the spon-

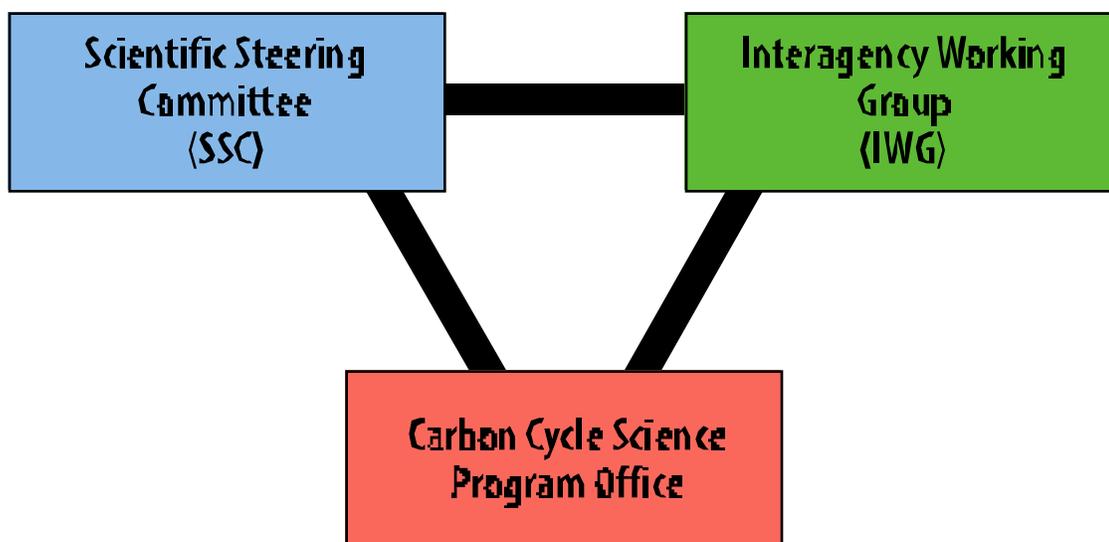


Figure 6.1 Carbon Cycle Science Program management structure.

soring federal agencies, and provides a mechanism to coordinate their contributions. While each component of the management structure has primary responsibility for different elements of the program, success requires that these management components work in unison, interacting on a day-to-day basis, exchanging information freely and openly, and jointly resolving critical issues and problems. The program will stand only if all three “legs” are balanced, strong and positioned to support their special responsibilities.

Responsibility for continuous scientific guidance would be provided by a Scientific Steering Committee (SSC) comprised of an expert panel actively engaged in various aspects of carbon cycle science. Individual members of the SSC would be selected by the sponsoring federal agencies in consultation with the scientific community and other interested parties. The NRC, through the Committee on Global Change Research, could be a source of nominations and/or review of a membership slate for the proposed SSC. Members of the steering committee should have a vested interest in the success of the program, and therefore, committee membership should likely include funded participants in the Carbon Cycle Science Program. Membership should reflect both individual disciplinary/programmatic expertise and the special challenges posed by the integrated nature of the program described in this plan. In addition, consideration should be given to including individuals who represent potential beneficiaries of the program in government, the private sector, and public interest groups.

Working with their colleagues in the sponsoring federal agencies, the SSC would have primary responsibility for ensuring that the detailed implementation of the Carbon Cycle Science Program follows directly from the scientific

goals and programmatic objectives described in the plan. The SSC would achieve this by continually evaluating progress; by reviewing priorities and revising plans as needed to reflect new scientific insights, technology, and information needs; by evaluating proposals for major adjustments to measurement, field research, and modeling projects, ensuring a strong scientific review process for individual projects; and by periodically submitting the Carbon and Climate Science Program to rigorous review by an outside body. The Working Group recommends that the sponsoring federal agencies look to the NRC’s Committee on Global Change Research to organize periodic (e.g., every three to five years) outside reviews of the Carbon Cycle Science Program.

An Interagency Working Group (IWG) comprised of agencies contributing resources to support the Carbon Cycle Science Program would have responsibility for interagency coordination and program management. The IWG would have primary responsibility for identifying and sustaining relevant existing commitments and securing appropriate resources for new activities in support of the program. As for the TOGA Program, the IWG for the Carbon Cycle Science Program should be comprised of program managers with the responsibility and authority to commit resources in support of the program. The IWG should have access to the scientific expertise residing in individual agencies, and IWG members should have the responsibility of ensuring that their agency assets—fiscal, human, and capital—are brought to bear appropriately in support of the program. In addition to their responsibilities for communication within and among the participating scientific agencies, IWG members will also be responsible for ensuring that program results are incorporated appropriately into federal policy formulation and mission agency

decision making. Similarly, as public servants, members of the IWG have a special responsibility for communicating the results of the Carbon Cycle Science Program to interested parties in the public and private sector.

One of the IWG's most important initial tasks will be identifying existing agency assets (human, programmatic, and fiscal) and agreeing on individual agency roles and responsibilities in implementing the shared scientific vision described in this plan. Agency responsibilities for the Carbon Cycle Science Program should properly reflect agency missions, expertise, and experience. By way of example, discussions during the August 1998 Workshop on Carbon Cycle Science highlighted the following potential roles for individual agencies. The National Science Foundation would continue its tradition of support for critical long-term field studies and laboratory experiments to illuminate key processes for carbon cycle and Earth system modeling, and seek funding for exploratory research by individual investigators representing a variety of viewpoints and approaches. Operational mission agencies such as the National Oceanic and Atmospheric Administration, U.S. Geological Survey, and U.S. Department of Energy might play critical roles in supporting sustained measurements and integrated, predictive modeling projects. Resource management agencies such as the Department of Interior, Department of Energy, and the Department of Agriculture might assume primary responsibility for examining the roles of terrestrial reservoirs for carbon dioxide and the impacts of human activities on terrestrial ecosystems. The National Aeronautics and Space Administration might provide the lead in applications of space-based, remote-sensing techniques and technologies for carbon cycle science. None of these responsibilities would be exclusive, but some identification of appropriate, individual agency roles will be essential to successful implementation of an integrated inter-agency program.

Once the sponsoring federal agencies and the scientific community have adopted a shared scientific vision for the program and reached agreement on individual agencies' roles, the IWG would be responsible for overseeing the joint implementation of the Carbon Cycle Science Program on behalf of the participating federal agencies. We would like to emphasize that joint implementation does not necessarily require pooling of resources or the designation of a single "lead agency." However, it does require a joint commitment and adherence to the shared scientific vision (as described in the Carbon Cycle Science Plan) and to a primary source of scientific advice (the SSC described above); to the implementation of a consistent and unified approach to proposal and program review processes; and to the provision of a clear point of contact for and source of information on the Carbon Cycle Science Program. In addition, the IWG would likely constitute the primary liaison between the carbon cycle

science community and government policy officials and resource management agencies in the federal government.

Managing the day-to-day implementation of this partnership between the scientific community and the sponsoring federal agencies would be the responsibility of a Carbon Cycle Science Program Office. Responsibility for this component of the program management structure could, as in the case of TOGA, reside within a federal agency or, as in the WOCE program, be assigned through a competitive process to a qualified scientific institution outside the government. As envisioned by this Working Group, the function of the Carbon Cycle Science Program Office should not require establishing a large bureaucracy or the expenditure of a significant level of resources. Some investment of resources (human and fiscal) will be required, however, to ensure that the Program Office can effectively provide the programmatic and institutional "glue" to sustain the critical interaction between the scientific community and federal agencies responsible for implementation of the program. The Carbon Cycle Science Program Office staff should have appropriate levels of scientific and programmatic expertise (e.g., a Ph.D. or equivalent experience).

Specific responsibilities of the Program Office would include providing a programwide point of contact and source of information on program direction, activities, status, and accomplishments; providing programwide liaison with the National Research Council's Committee on Global Change Research and other relevant scientific organizations and research programs; serving as primary liaison for the U.S. program with relevant international scientific programs; supporting the day-to-day aspects of program implementation, assisting in program development, resource management, and program evaluation efforts; and providing secretariat services for both the SSC and the IWG.

Critical Partnerships

Successful implementation of the Carbon Cycle Science Program described in this plan will require the creation and maintenance of a number of critical partnerships. First and foremost, the program should represent a dynamic and innovative partnership between the scientific community and the sponsoring agencies in the federal government. The proposed management structure described above reflects this partnership and a shared responsibility for ensuring scientific quality and programmatic relevance, setting priorities, adhering to plans, securing required resources, and interpreting and disseminating the scientific and information products that emerge from the Carbon Cycle Science Program.

The Working Group believes that implementation of the program described in this plan would benefit significantly from efforts to build sustained partnerships

between federal laboratories and the extramural research community, leveraging the special capabilities and expertise of those partners. For example, partnership in the design, development, testing, and deployment of measurement systems could help address a number of issues facing the scientific community today. This partnership could ensure an appropriate mix of researchers aware of the scientific requirements, and engineers and technicians familiar with system capabilities; and facilitate the exchange of ideas and experience among groups working on the development of systems to meet similar needs. In short, it could create an environment of creative synergy rather than simply duplicate effort. The Carbon Cycle Science Program envisioned in this plan provides a framework for creative new partnerships among various disciplines and programmatic areas of expertise—such as individuals involved in measurements, modeling, and process research—within the scientific community. Similarly, innovative partnerships among supporting federal agencies should bring individual agency assets and expertise to bear on a shared program in complementary ways that build on existing capabilities, leverage limited resources, avoid duplication, and produce new opportunities for scientific progress.

The global nature of the carbon cycle and the international context of current policy deliberations related to CO₂ and other greenhouse gases highlight the critical need for international collaboration in carbon cycle investigations. As has been the case in the past, a strong U.S. program can serve as a catalyst for similar programs in other countries and provide a focal point for international coordination. Such multinational collaboration offers opportunities to leverage resources and take advantage of comparable methodologies and joint projects. Early collaboration with Canada, for example, could produce significant benefits for proposed investigations of the North American terrestrial sink. Similarly, investigations of ocean sources and sinks in the Pacific will benefit from international collaboration in much the same way that TOGA's investigations of El Niño benefited from the contributions of partners around the Pacific Basin and throughout the world.

As has also been seen in programs like TOGA, WOCE, and JGOFS, one particularly beneficial approach to international partnerships involves the development and implementation of strong U.S. contributions to established international global change research programs. The Carbon Cycle Science Program should establish strong ties to the World Climate Research Program (particularly the CLIVAR Program), the Global Energy Water Cycle Experiment (GEWEX), the International Geosphere-Biosphere Programme (IGBP, particularly JGOFS, GAIM, and IGAC), and the International Human Dimensions of Global Change Program (particularly the Land Use/Land Cover Change project being implemented jointly with

IGBP). In addition, the sustained measurement components of the program described in this plan could provide substantial contributions to emerging global observing programs such as the Global Climate Observing System (GCOS), the Global Ocean Observing System (GOOS), and the Global Terrestrial Observing System (GTOS). Conversely, these emerging multinational endeavors could leverage resources (such as space- and ground-based observational platforms); develop and demonstrate new technologies; and provide a global, Earth system context for carbon cycle measurements emphasizing large-scale ecosystem dynamics and carbon cycle interactions with variability and change in the climate system.

Finally, the Working Group believes that the Carbon Cycle Science Program described here would benefit from an early and sustained partnership with the private sector. Some of the program's goals—notably, providing a scientific basis for evaluating potential carbon sequestration strategies and measuring net emissions at a regional scale—should be of interest and value to businesses involved in the energy sector, resource use and management (e.g., forestry), and agriculture, for example. Private sector expertise and assets in technology R&D could accelerate the development and demonstration of critical new measurement technologies. Scientists interested in the design, development, testing and deployment of measurement systems face a number of obstacles today, and this Working Group believes that innovative partnerships among federal laboratories, universities, and the private sector (in the U.S. and abroad) would be mutually beneficial. Investments in the development of new systems should be supplemented with resources to make use of commercially available measurement systems in the field. Decisions to support the development of new systems should represent a commitment of the time and resources required to take new instrumentation from concept to reality. Early involvement of the private sector in this process could help ensure a smooth transition from limited experimental prototype to commercially available (and affordable) technology to support broad community needs.

Joint implementation of carbon cycle measurement programs and collaborative development of integrated modeling and assessment capabilities could result in early progress, with direct benefits to the scientific community, public policy officials, and private sector interests directly affected by carbon cycle and climate policies. The Working Group was unable to engage in detailed discussion of the character of such a public-private partnership in carbon cycle research during this initial planning phase. But we strongly encourage a thorough exploration of the challenges and opportunities of partnership with the private sector as an early implementation task.