October 23-24, 2002

Final Meeting of the U.S. JGOFS Scientific Steering Committee
Holiday Inn Select, Old Town Alexandria, Virginia

Attendees

SSC members: M. Abbott (chairman), R. Anderson, M.E. Carr, S. Doney, M. Follows, G. Jackson, K. Johnson, C. Lee, A. Michaels, W. Smith, R. Wanninkhof

Time-series programs: A. Knap, BATS; D. Karl, HOT

U.S. JGOFS Planning office: M. Bowles, K. Buesseler, C. Chandler, D. Glover, M. Zawoysky

Department of Energy: J. Summers

National Science Foundation: S. Metz, D. Rice, P. Taylor, J. Yoder

National Aeronautics and Space Administration: C. Trees

National Oceanic and Atmospheric Administration: M. Conkright

Guests: J. Kleypas, National Center for Atmospheric Research; E. Urban, Scientific Committee on Oceanic Research

Introduction

Chairman Mark Abbott welcomed members of the U.S. JGOFS Scientific Steering Committee (SSC), planning office staff and guests to the final meeting of the SSC and urged those attending to focus on the transition to future programs.

Antarctic Environment and Southern Ocean Process Study (AESOPS)

Bob Anderson reviewed both national and international activities in the Southern Ocean and noted that the third and final AESOPS special issue of *Deep-Sea Research II* is currently with the publisher. He picked three papers from this volume to discuss as examples of the first round of synthesis of Southern Ocean results. *DSR II* volumes are coming out of the various Brest symposia on the Southern Ocean as well. He also mentioned several iron-enrichment experiments (EisenEx, SOFEX) that have been conducted in the Southern Ocean during the transition from the JGOFS era.

Bob noted that there was much confusion about what is to be done for the regional and topical poster sessions to be held during the JGOFS Open Science Conference (OSC) in May 2003. Should contributions be encouraged, particularly of synthesis posters? Ken Buesseler agreed that this topic needed to be discussed. General discussion ensued on how to encourage international Southern Ocean synthesis, given the lack of JGOFS funds.

Synthesis and Modeling Project (SMP)

Scott Doney listed the final five SMP projects funded during FY 2002 and discussed the 2002 summer workshop, held in Woods Hole in July. Some 90 persons attended, including 18 students. Presentations included posters as well as talks.

Scott reviewed some of the highlights from four day-long sessions that focused on the Southern Ocean past and present, food webs, global-scale synthesis of the carbon cycle, and SMP goals and accomplishments. Participants have broadly addressed the first two goals set at the beginning of the SMP, he said, referring to global and regional mass balances and mechanistic controls on local carbon balances. The project is not as far along on extrapolation and prediction, he conceded.

John Dunne of Princeton University conducted an informal survey of opinions about the main contributions of JGOFS to ocean biogeochemical modeling. Among these contributions were high-quality data sets for model evaluation and enhanced interactions among field investigators and modelers. Major changes in thought since the SMP Implementation Plan was published include a growing appreciation of the role of biological complexity in ocean carbon cycling. The most pressing uncertainties in biogeochemical modeling include the role of remineralization and dissolution in the twilight zone, the role of the Southern Ocean and the ocean margins, and limitations on predictive capability.

Most of the 65 studies funded as part of the SMP are finished, Scott said. Only 26 are still active. The project comes to an end in 2004.

Turning to data management, Scott said that U.S. JGOFS data is currently available via two live access servers (LAS), one for gridded data and one for non-gridded data. In short order, the LAS site in Woods Hole will be serving both forms of data. Thanks to the valiant efforts of Joanie Kleypas, great advances in SMP data and code submission have taken place. Barriers to the submission of results include the reluctance of investigators to release models in progress, Scott said.

Cindy Lee asked about getting coastal data into the system. Modelers should say what data they

want, even if no funds are as yet available to collect and work with them, she said. Joanie said that some data sets have been sent to her. They present the same problems of differing units and formats that the U.S. JGOFS Data Management Office (DMO) has been wrestling with, she added.

Some SMP data are being submitted through the Global Ocean Data Analysis Project (GLODAP), which will handle quality control and so forth. Bob Key of Princeton University has spearheaded the assimilation and quality control of carbon data, Scott said.

SMP contributions include *DSR II* special issues, contributions to the Bergen volume, general science articles, community products such as the SMP LAS, synthesis and modeling advances that will help shape future field studies, and intercomparisons of current ecosystem models as part of the regional testbed project. The second SMP *DSR II* issue will be published in mid 2003, and a third volume of papers is planned. Efforts at education and outreach include an expanded web page with public curricula notes and a slide gallery. Workshops and summer school programs for graduate students and post-docs are under discussion.

Science Minute: Interannual Variability in Nutrient Drawdown and Availability from Satellite Altimeter

Mary-Elena Carr gave a brief talk on satellite observations of interannual variations in nutrient drawdown and availability as a method of estimating oceanic new production. Changes in ocean heat storage, measured by the Topex/Poseidon altimeter, are inversely related to changes in nutrient storage. Her conclusions indicate that the global new production estimate from the altimeter (6.4 Gt C) is close to estimates derived from *in-situ* measurements, and that the estimate is within 5-10% of the climatological drawdown for phosphate, the nutrient addressed in her study.

Midwater Processes Workshop

George Jackson presented a report on the midwater processes workshop held last March in San Antonio, Texas. The meeting provided a useful opportunity for dialogue between modelers and field researchers and a chance to address the problem of scale, as well as demonstrating the need for a comprehensive study of the fate of particles that fall through the water column. A workshop report is available online, and articles on it have been published in *EOS* and in *U.S. JGOFS News*.

Iron Dynamics Workshop

Ken Johnson reported on the workshop on iron dynamics in the ocean carbon cycle, held at the Monterey Bay Aquarium Research Institute in June. Major recommendations of this workshop

include expanding the global database for iron, which is inadequate for initializing models and for identifying the processes that control iron distributions. External iron inputs must be characterized as well. A series of open-ocean iron fertilization experiments have demonstrated the positive role of iron in stimulating blooms, but the effects of iron levels on the termination of blooms and on carbon export are not well studied, Ken said.

NATO Advanced Study Institute

Mick Follows made a presentation on a NATO advanced study institute on the ocean carbon cycle and climate that was held in Ankara, Turkey, in August. The two-week intensive course for students attracted 90 participants from 22 countries. Among other activities, students explored JGOFS and WOCE data with Ocean Data View and worked on building ecological models with Simile. U.S. JGOFS funding provided partial support for six U.S. students and one lecturer.

JGOFS SSC Meeting

Bob Anderson reported on the penultimate JGOFS SSC meeting, which was held in Concepcion, Chile, in September. Funding for the upcoming JGOFS OSC was a major topic of discussion. Roger Hanson is trying to raise funds for scientists from eastern Europe, Asia, Africa and South America.

Bob reviewed the work of various JGOFS synthesis groups, focusing on the Global Synthesis Working Group (GSWG), its objectives and its recommendations for future research. This group may provide a transition to the next International Geosphere-Biosphere Programme (IGBP) oceans project (then OCEANS, now IMBER). He also talked about the future of the IGBP, which is pushing toward interdisciplinary science and regional studies rather than the study of specific processes. The IGBP has involved itself in an "earth system science partnership" with the World Climate Research Programme (WCRP), the International Human Dimensions Programme (IHDP) and Diversitas.

Asked about an IGBP carbon project that was launched in Durham two years ago, Bob said that this is being described as a "synthesis effort," not a research program. The problem of future oversight and coordination of ocean carbon studies, both organic and inorganic, stimulated considerable discussion at the JGOFS meeting, Bob said.

Planning Office Activities

Executive scientist Ken Buesseler presented a list of workshops that the planning office is supporting and noted considerable demand for publications such as the special issue of *Oceanography* and the U.S. JGOFS brochure. He reviewed the names and talks in the OSC

brochure and said that speakers have agreed to submit their talks to commentators ahead of time. Planners are expecting between 300 and 500 attendees.

Ken sought advice on picking students to support for travel to the OSC. Chuck Trees said that NASA is interested in encouraging young scientists and will be able to help.

Post-OSC activities will include newsletters through 2004, continued development of the U.S. JGOFS web site, SMP meetings during 2003 and 2004 and possibly another steering committee meeting. All agreed that the SSC could remain available to make decisions as needed without holding another meeting.

Materials collected by the planning and data management offices can be archived at Woods Hole Oceanographic Institution (WHOI). The list includes JGOFS reports, issues of U.S. JGOFS News, brochures and other publications. A selected set of letters and emails could be included as well. The web site could continue for a time in static form.

Ken also stressed the importance of taking advantage of the lessons learned during JGOFS in setting up planning and data management activities for future ocean carbon programs. Data management should be the responsibility of a centralized DMO that brings in data in a timely manner, conducts quality control procedures, facilitates data assimilation, and provides consistent information, metadata and methods, public access, a regularly updated user interface. A centralized planning office is essential for meeting support, cruise planning and organization, information via publications and coordination of outreach activities.

Data manager Cyndy Chandler emphasized the need for people to keep a web site up to date and effective. WHOI personnel can serve the web site in static form but cannot update it.

Southern Ocean Iron Experiment

Ken Johnson reviewed results from the SOFEX experiments carried out in different locations in the Southern Ocean earlier in 2002. The study involved three ships (RV *Melville*, RV *Revelle* and RVIB *Polar Star*), drifters and sites north and south of the polar front. Iron was released in two different patches and followed up over a period of weeks. Ken Buesseler followed with a brief discussion of the effort to determine whether iron fertilization enhanced carbon sequestration via sinking particles, the focus of efforts aboard the icebreaker *Polar Star*.

Agency Reports: National Science Foundation

Jim Yoder began the NSF agency report with a discussion of plans for the development of an integrated carbon cycle research fund that he hopes will involve other agencies and possibly other

nations. He mentioned two key committees involved in this effort, the Ocean Carbon Cycle Research (OCCR) planning group headed by Cindy Lee and the Carbon Cycle Science Program (CCSP) Ocean Interim Implementation Group headed by Scott Doney. The NSF has to have a clear hypthesis-driven role in the national effort to address carbon questions, Jim said. The effort to put together a new pot of money for carbon cycle research is entirely separate from the NSF biocomplexity program, which has funded some interesting ocean proposals.

Mark asked about future support for program planning and data management, and Cindy reminded the group of the previous discussion about the absence of coastal data from an ocean data system. Another question raised and discussed was whether a new large-scale program would focus on anthropogenic carbon as well as on the natural carbon cycle. Jim acknowledged the need to address this question but did not have an answer at that moment.

National Aeronautics and Space Administration

Chuck Trees spoke on behalf of NASA. He and several other managers are trying for new funds for a coastal mission for carbon cycle research. He also described remote-sensing instruments that are currently in the pipeline and their contribution to the collection of coastal data, both terrestrial and aquatic. NASA is moving toward coastal research because of the administration's North American carbon program, he said.

Mark asked about the status of SeaWiFS. NASA has found an extra $1.1 million and has proposed one more year to Orbimage, Chuck said, noting that there will be a data crunch next November as the MODIS instruments try to absorb all the ocean color work. NASA is committed to maintaining a quality remote-sensing data record and hopes to move the SeaWiFS and SIMBIOS people into the MODIS program.

National Oceanic and Atmospheric Administration

Rik Wanninkhof represented NOAA in the absence of ocean carbon program officer Kathy Tedesco. He discussed a number of topics, including reorganization, new managers, organizational separation of observations and research, and research themes. A new global carbon cycle announcement will be split between ocean research and observations, he said.

The CO_2/CLIVAR repeat hydrography program is being supported under ocean observations, Rik noted. Cruises are underway for this program, which receives support from both NSF and NOAA. An underway pCO_2 workshop took place in Miami in October with the goal of designing a community-based system, he added.

Surface Ocean-Lower Atmosphere Study

Turning to SOLAS, Rik described the international summer school in Corsica that is planned for next July. Its purpose is to expose graduate students and young scientists to recent developments and methods in the study of interactions and feedbacks between biogeochemistry and physics in the ocean and atmosphere. Rik also listed U.S. SOLAS focus areas, the status of the program and plans for the near future.

Ocean Carbon Cycle Research report

Cindy Lee provided an update on the activities of the OCCR committee since the last SSC meeting a year ago. She stressed the importance of workshops as a mechanism for getting people together to address complex questions, pointing out that only one of the initiatives that received support under the last NSF announcement of opportunity had done so (RIOMAR). She also observed that continued discussions made it apparent that an NSF committee was not the right entity to plan a multi-agency effort. The future role of the OCCR committee is yet to be determined, she said, mentioning serveral possibilities.

CCSP Oceans report

Scott Doney, head of the CCSP Ocean Interim Implementation Group (CCSP Oceans), explained the origin, composition and functioning of this committee. It is currently preparing an ocean implementation plan for the U.S. Carbon Cycle Scientific Steering Committee and the Interagency Working Group. Scott listed the guidelines for this project, noting that there are important biogeochemical questions that will not be addressed under CCSP.

The focus of the CCSP is on the integration of ocean, atmosphere and terrestrial carbon system research. Five overarching questions are: the ocean anthropogenic CO_2 inventory, the magnitude and variability of the air-sea CO_2 flux, feedback mechanisms and climate sensitivities for ocean carbon storage, marine ecosystem response to climate and global change, and the scientific basis for mitigations studies.

After Scott's presentation, discussion ensued about the role of the OCCR committee, as an NSF committee, in this larger, multi-agency effort. A component of the discussion was how to fold hypothesis-driven science into CCSP, at least for oceans.

JGOFS Data Management

Margarita Conkright of NOAA brought the SSC up to date on efforts to preserve JGOFS data on

the international level and to make sure that data management is an integral part of planning for future large programs. The World Data Center in Germany (WDC-MARE) is putting the international data into a common format on a voluntary basis, using the German system called Pangaea, and the data will be archived at WDC Oceanography. Given the diversity of data collection methods, the metadata will be particularly important, and data sets will not be merged, Margarita said.

International Geosphere-Biosphere Programme

Ed Urban discussed the new Scientific Committee on Oceanic Research (SCOR)/IGBP project called OCEANS (now IMBER). Overlapping the "oceans" box in the new IGBP scheme are existing programs such as SOLAS, LOICZ and GLOBEC. Julie Hall from New Zealand and Patrick Monfray from France are chairing the OCEANS transition team. An OCEANS open science conference will be held in Paris in January 2003 with invited presentations, poster sessions and working groups; Ed listed topics and speakers and encouraged a good turnout from U.S. JGOFS participants.

The center of gravity of the new project will be in ocean biogeochemistry with links to GLOBEC, Ed said. It will focus on little-known components of the food web, such as viruses, and on the mesopelagic zone as well as on "hot spots" and "choke points," including deep water formation, ENSO triggering and the instability of Antarctic ice sheets.

Other upcoming meetings and activities include the Ocean Carbon Coordination Project, a collaboration between the SCOR/IOC panel on CO_2 and the IGBP, which will hold a workshop after the Paris OCEANS conference. Later in 2003, there will be an international symposium on the scientific issues involved in ocean carbon sequestration, which will produce a special issue of *DSR II*.

U.S. JGOFS Data Management Office report

Cyndy Chandler introduced her report on DMO activities with a review of the status of data from various U.S. JGOFS field studies and the current set of priorities. These include a data inventory, merged data products, a final media set of CD-ROMs, software development and the SMP data.

Data submission is nearly complete, Cyndy said, although a few AESOPS investigators have yet to turn in their data. The production of merged data products has been hampered by these late submissions. Cyndy has also created a parameter dictionary with all renamed parameters noted.

Cyndy asked SSC members whether she should attempt to generate a database for EqPac trace-metal bottle data, a task that would take a fair amount of work. The consensus seemed to be that

this was worth doing.

The SMP LAS and J-LAS will be combined, and the LAS version 6 will be installed at the DMO in January 2003. Key improvements in the new version are a richer metadata interface, data subselection capability, multi-variable support, gridded versus *in-situ* differencing, and additional products and views. The NOAA Pacific Marine Environmental Laboratory has assigned Joe McLean to support the serving of SMP data.

Volumes 1 and 2 of the U.S. JGOFS data set will be available on CD-ROM by the open science conference in May. They will include process study and merged data, a web browser interface, general U.S. JGOFS documentation and a citation for use in publications. Cyndy asked about the audience for this CD-ROM. The consensus among SSC members was that the target audience was JGOFS scientists rather than the public. Dave Glover noted the importance of including a reference list and very clear information on how to use the U.S. JGOFS data for future scientific audiences. Advance versions of the CD-ROM will be sent to SSC members in January.

Time-series Programs: HOT

Noting that the epitaph on his tombstone will say "how much time do I have?", Mark introduced Dave Karl's HOT presentation. Dave announced the arrival of research vessel *Kilo Moana*, the new SWATH vessel delivered to Honolulu in September. She will be used for most new HOT cruises. He then reviewed the status of a number of HOT and ancillary projects, staff changes and plans for the future. Data report number 12 is now online, with 13 and 14 to follow soon.

In his "science second," Dave discussed advancing knowledge about the relationship between carbon export and factors such as primary productivity, community structure, nutrient loading and stochastic physical processes. Nitrogen fixation ecosystems, such as have developed in the North Pacific gyre over the last decade and a half, may be able to export more carbon to the benthos than nitrate-based systems, he observed.

Time-series Programs: BATS

Tony Knap reviewed the status of the BATS program and ancillary projects and expressed his hope that efforts to bring ancillary data sets into the BATS database would prove fruitful.

Ken Buesseler asked about making time-series data available for the upcoming open science conference. Time-series data are not included in the forthcoming CD-ROM, he noted, urging the publication of new time-series data products. Long-term archiving of time-series data is also an issue that needs to be addressed. Mark thanked Dave and Tony for their presentations and noted the contributions of HOT and BATS to the nurturing of young scientists who have moved on into

research, teaching and administrative positions.

On To The Future

The meeting concluded with a discussion of the transition to future ocean biogeochemistry programs. Scott's committee has a clear charge; Cindy's less so, Mark observed. Cindy cited as critical issues the integration of modeling with experimental design and commitment to data management from the beginning of future programs. George raised the question of institutionalizing interactions between modelers and field researchers.

Responding to concerns about the creation of an international oceans program without U.S. participation, Bob urged those present to go to Paris for the OCEANS open science conference and provide guidance. Further discussion revealed that many SSC members do, in fact, intend to particpate in that conference. Scott will urge participation from the members of the CCSP committee. Rik observed that written input into the document that is to emerge would be even more important than attending the meeting.

Toasts and reminiscences over champagne brought the final SSC gathering to a festive close.