30 Minutes -- October 6 and 7, 1998
U.S. JGOFS Scientific Steering Committee Meeting
Woods Hole Oceanographic Institution, Woods Hole, MA

Attendees

Scientific Steering Committee Members: M. Abbott, R. Anderson, W. Berelson, S. Doney, H. Ducklow (chairman), P. Falkowski, D. Hansell, M. Landry, C. Lee, M. Lewis, J. McCarthy, D. McGillicuddy, A. Michaels, J. Murray, R. Najjar, P. Quay, W. Smith, D. Wallace, R. Wanninkhof, J. Yoder

Time-series programs: N. Bates, C. Carlson, D. Steinberg, BBSR; M. Landry, HOT
Planning Office: M. Bowles, C. Hammond, D. Schneider, M. Zawoysky
National Science Foundation: D. Rice
Guests: Wade McGillis, WHOI; Rob DeConto, NCAR; Chris Sabine, Princeton

30.1 Introduction

Chairman Hugh Ducklow welcomed steering committee members and guests to Woods Hole. He complimented Tony Knap and Dave Karl by noting that this was the first out of thirty SSC meetings to be held without either one or the other to represent the U.S. JGOFS time-series programs.

30.2 Arabian Sea Process Study

Walker Smith presented an Arabian Sea update on behalf of Sharon Smith, who was unable to attend the meeting. A special volume of *Deep-Sea Research* will be coming out soon with 21 articles, and a second volume is in the works.

An international workshop titled "Biogeochemistry of the Arabian Sea: Synthesis and Modelling" will take place in Bangalore, India, next January, followed by a course on biogeochemical modeling under the aegis of JGOFS. Trevor Platt, one of the organizers, has asked U.S. JGOFS for funds to support travel for U.S. scientists attending the workshop.

CTD data from the U.S. Arabian Sea study has been submitted for inclusion in a CD-ROM that the German JGOFS office is putting together. In answer to a question about submission of data to the U.S. office, Chris Hammond said that Arabian Sea data are all in except for a few data sets that take a long time to analyze. She noted that it was harder for her to be sure that all projects have submitted their data for the earlier process studies. Jim Murray acknowledged that not all EqPac data sets are in yet. Hugh asked Jim to contact the investigators involved to make sure that the last ones come in.

30.3 Committee Rotations

Steve Emerson has decided to step down as a member of the Executive Committee. Hugh Ducklow thanked him for three years of substantial service. Cindy Lee was reelected to the committee for a second term, and Mark Abbott was elected for a first term.

Mike Landry is rotating off the Scientific Steering Committee. Hugh thanked him for his help in a variety of areas. Dave Siegel was reelected to the SSC. Mick Follows of Massachusetts Institute of Technology and Ken Johnson of Moss Landing Marine Laboratory were elected to the SSC for the first time, and Eileen Hofmann of Old Dominion University is rejoining the committee after several years off.

30.4 Southern Ocean Process Study (AESOPS)

Bob Anderson began the AESOPS report with a summary and a map of the 11 cruises that comprised the Southern Ocean process study. Everything went well aboard both R/V *Roger Revelle* and RVIB *Nathaniel B. Palmer* considering the difficulties of working in that part of the world, Bob said, and Antarctic Support Associates (ASA) provided great support. The AESOPS cruises achieved a remarkable extension of seasonal coverage, which will prove very useful.

The AESOPS investigators got together at the University of Tennessee in Knoxville in June 1998 for their first data workshop, only two months after the end of the final cruise. Presentations began with overviews of the physics of the Ross Sea and the Antarctic Polar Frontal Zone (APFZ). Four investigators from other national JGOFS programs discussed their results as well. Bob judged the workshop to be a good start; he and Walker plan a similar format for the second and final workshop, which will be held next summer. The Knoxville workshop helped investigators to identify synthesis issues to work on and to decide which data sets would be helpful in each case.

Bob listed a number of important conclusions from the Knoxville meeting:

* Bloom follows stratification;
* Nitrate is dominant source of nitrogen;
* Iron limitation in Ross Sea and south of APF, silicate limitation north of APF;
* Low DOC concentrations;
* Low grazing of *Phaeocystis* and low grazing by microzooplankton in Ross Sea, higher levels of grazing in APF;
* Non-Redfieldian nutrient consumption;
* Iron influences uptake ratios of silicate and nitrate;
* Large but strongly seasonal flux, maximum in deep-water seasonal ice zone, not shelf or APF;
* Benthic flux ratio was 1:1 for alkalinity and total CO2, as is true elsewhere;
* Chlorophyll levels observed by SeaWiFS were greater than those observed by CZCS; AESOPS calibrations support CZCS offset;

* SeaWiFS and SeaSoar observations indicate that mesoscale variability is considerable and present everywhere in the study region.

Although carbon to nitrogen ratios were right on the Redfield ratio, Bob said, nitrogen to phosphorus ratios were around 12 rather than the Redfield value of 16. Conversations with other investigators indicate that the same results are turning up from other parts of the Southern Ocean. South of the Polar Front, N to P ratios are around 12; north of the front, they are 15-16. The Si/N drawdown ratios differ as well, with molar consumption values around 2 north of the front and around 5 south of the front. These results indicate iron limitation south of the front and silicate limitation north.

Alkalinity levels were surprising, Bob said. Enough calcium carbonate is being produced even in the silica-rich region south of the APFZ to neutralize the acidity from the remineralization of organic matter. There is no detectable change in alkalinity as one goes down from the surface waters into the depths, he added.

AESOPS data are slowly making their way onto the web. All management data are in and are now being served by the U.S. JGOFS data management office, Bob said. This includes the trace-metal-clean rosette data collected aboard RVIB *Nathaniel B. Palmer*; rosette data from R/V *Roger Revelle* will be ready in a couple of months.

SSC members discussed the problem of making AESOPS data available to investigators funded under the U.S. JGOFS Synthesis and Modeling Program (SMP) as well as to investigators from other countries. The policy for AESOPS data has been the same as for data from other U.S. JGOFS process studies: a two-year moratorium on access to data for everyone except AESOPS investigators. Recognizing the importance of encouraging collaboration between AESOPS particpants and SMP investigators and other interested parties, the AESOPS coordinators have listed investigators, research topics and forthcoming papers on the U.S. JGOFS home page. The parameter spreadsheet generated at the AESOPS workshop is also available, and Chris Hammond is building a data inventory. The data from the site survey cruise is now two years old and thus available without restriction.

Hugh Ducklow noted that the SSC is responsible for setting policy and urged members to discuss it before making any announcements. Tony Michaels pointed out that NSF award letters require that data become available after two years. The current difficulty is the tight scheduling of AESOPS and the SMP. "I don't think we can change the two-year rule as a committee," he said.

What we should convey is where we need help; what are the most important outstanding questions that new proposers could tackle, Bob observed. The international program is preparing a report on these questions; U.S. JGOFS should direct attention to this report, he added.

The first round of AESOPS papers for publication in *Deep-Sea Research* are due in December. Some 26 are committed. The deadline for the next issue is July 1999. Bob and Walker have tentative commitments for 29 papers for that volume. Future events include a special Southern Ocean session that

will be held at the ASLO meeting in Santa Fe in February 1999 and a second AESOPS data workshop in Keystone, Colorado, in July 1999. A Gordon Conference to be held in Ventura in March 1999 will cover both polar regions. Iron limitation will be among the topics addressed.

A number of national programs were represented at the JGOFS Southern Ocean Planning Group meeting in Bremerhaven in September. This committee, like other JGOFS planning groups, is metamorphosing into a synthesis group, Bob said. Under the leadership of Uli Bathmann, this group will be putting together a report with themes and questions and summaries of of JGOFS findings from the Southern Ocean. The list of synthesis themes includes ocean biogeochemical regions, regional primary and new production, community structure and function, water column remineralization, air-sea CO2 exchange and ocean DIC distribution, feedback processes regulating production and exchange, continental margins, export production, deep-ocean fluxes, biogeochemical models and challenges for the future.

A basic question is whether biogeochemical processes and export fluxes are the same throughout the different regions of the Southern Ocean covered by the JGOFS programs of different nations. Each subsystem is extremely heterogeneous, Bob pointed out, despite the consistent physical forcing associated with the advance and retreat of the ice each year. French investigators found some of the lowest export fluxes in the world in the seasonal ice zone; U.S. JGOFS investigators found high export fluxes in the same zone in their region. The high biomass of the APF is a much more prominent feature in the Atlantic than in the Pacific.

Bob discussed five themes or topics in greater detail, attaching preliminary numbers to some of them. They were: net air-sea CO2 flux; the magnitude and variability of primary production, based on both measurements and modeling efforts; limitation by light, iron and silicate in HNLC regions; variation in principal export pathways, including grazing and aggregation and mass sedimentation, and variations in productivity and export flux between zones and sectors.

Bob also discussed plans for international iron experiments in the Southern Ocean. The planning and synthesis group continues to advocate intercalibration experiments. David Turner of University of Gothenberg is heading up an international iron working group under the auspices of SCOR.

Mark Abbott made a presentation next on the preliminary results from various sampling efforts in the APFZ. Noting the importance of mesoscale processes, he pointed out that the strong meanders associated with bottom topography and the smaller-scale instabilities associated with the convergent fronts had substantial effects on the biogeochemical characteristics of the region. These included enhanced chlorophyll concentrations downstream of the intersection of the circumpolar current with the rough topography and a plankton community that was not in equilibrium.

Mark presented data from optical moorings deployed for several months around 61°S, 170°W, drifters, and SeaWiFS and other satellite-mounted instruments. A decade of sea-surface temperature data from NASA/NOAA Pathfinder instrument shows interannual variations in the position of the polar front. The

SeaWiFS chlorophyll data does not seem to be out of line with the shipboard data, Mark said. All of the optical mooring records show similar patterns, including a great peak of chlorophyll over about 20 days in December.

Mark noted that the meanders in the APFZ are intense in the spring and early summer and weaken as stratification increases. His instruments detected a strong bloom at the polar front in December, the formation of which appeared to be related to stratification. The end of the bloom appeared to be associated with depletion of silica. There was also a strong bloom at the south ACC (Antarctic Circumpolar Current) front that persisted throughout the season without any evidence of silicate limitation.

30.5 CO2 Survey

Doug Wallace began the presentation on the status of the global CO2 survey with a comprehensive map that showed cruises carried out by other national JGOFS programs as well as the U.S. ones supported by DOE and NOAA. Crossover analyses of data taken at same stations during different cruises are currently underway for both the Indian Ocean and the Pacific. All water-column data (U.S.) will be submitted to CDIAC by December 1998. Data reporting and release are ongoing. Alex Kozyr at CDIAC has funding through 2000 for the management of the CO2 data set.

Availability of the WOCE data sets continues to pose a problem, as these data are necessary for a full data report on the DOE-supported portion of the CO2 survey. Chris Sabine noted that the hydrographic data available at the end of each of the WOCE cruises is good enough for most CO2 survey purposes. Alex Kozyr is able to get that data from the relevant investigators.

The crossover analyses of total CO2 and alkalinity are complete for the Indian Ocean. Dick Feely has recently completed a report on DIC in the Pacific that makes use of both U.S. and Canadian data. Analysis of Atlantic stations has not started yet.

Funds are becoming available for the synthesis of CO2 survey data. NOAA and DOE recently issued a joint announcement of opportunity; each agency is making $600,000 available. The proposals are currently under review. Doug also mentioned two upcoming synthesis workshops, a CLIVAR/AIMS tracer workshop in Bremen in February and an ocean carbon transport workshop in either Germany or Spain in late 1999.

Other national programs are continuing to support field studies in the Atlantic focused on the ocean carbonate system. Germany is carrying out sections in the Laborador and Irminger seas and perhaps along 40°S. France has a large controlled-volume experiment in the northeast Atlantic (Laurent Memery). The Netherlands is planning cruises along 48°N and 58°N. The Scandinavian countries are continuing to work in the Greenland, Iceland, Norwegian and Barents seas. Spain continues to support its ESTOC/CANIGO field program in the eastern central Atlantic.

Following Doug's review, Chris Sabine presented a science talk on recent efforts to use CO2 survey data to estimate anthropogenic CO2 levels in the ocean. The first basin-wide estimates of CO2 of anthropogenic origin were made in the Indian Ocean using the delta C* technique described by Nicholas Gruber in a 1996 article in *Global Biogeochemical Cycles*. This method involves estimating the anthropogenic component of total CO2 in the ocean by subtracting changes in total carbon that result from biological activity and the carbon in water equilibrated to a 280 ppm atmospheric CO2 level.

Chris showed vertically integrated anthropogenic CO2 inventories for the Atlantic and Indian oceans based on measurements and on modeling. He pointed out that the highest levels of anthropogenic CO2 stored in the southern Atlantic and Indian oceans occur in the region of the subtropical convergence.

Chris also reviewed some of the potential uses for global carbon data in the development and improvement of models. These include three-dimensional carbon distributions, decadal-scale changes in the CO2 inventory, a total anthropogenic CO2 inventory, property to property relationships between CO2 and other tracers such as bomb 14C, and preindustrial carbon distributions. The Ocean Carbon Model Intercomparison Project (OCMIP), for example, is making comparisons of survey data and modeling results from the Princeton OBM to determine preindustrial total CO2 levels in various ocean regions.

CO2 survey presentations continued in the afternoon. Rik Wanninkhof and guest speaker Wade McGillis discussed two recent studies that involved the measurement of the air/sea flux of CO2 and other gases. Rik showed some results from GAS EX-98, a multidisciplinary process study in the North Atlantic. The goal of this study, funded by NOAA and several other agencies in the U.S. and Canada, was to improve estimates of air/sea CO2 fluxes. It was carried out aboard R/V *Ron Brown* in an eddy near the old North Atlantic Bloom Experiment site (42°N, 20°W). Participants looked at the mass balances of CO2 and other gases from a variety of perspectives, using a variety of methods. These included a tracer (SF6), drifters and instruments on a shipboard tower and boom. Emphasis was on getting the environmental forcing correct, Rik said.

Wade presented data from a 1997 CoOP cruise on R/V *Oceanus* that was carried out south and east of Cape Cod and Long Island. The CoOP project made use of a small catamaran with a variety of samplers on it. Wade talked about making a gas transfer coefficient. The problems are measuring gas transfer velocity versus wind speed and the effect of surfactants on gas transfer velocity. He pointed out that direct air-sea gas flux estimates require that one measure variability of fluxes on the same time and space scales as variability in the physical forces that affect these fluxes.

30.6 Time-series Programs: HOT

Mike Landry presented the HOT report for Dave Karl, who was unable to attend the meeting. He noted that the U.S. JGOFS core program is funded through August 2001, although at a reduced level. The WOCE core program is funded until 2001 as well. Several new ancillary programs are getting underway. Mike mentioned studies of N2O dynamics, DON cycling and radioisotopes. Other new projects are out

for review.

R/V *Moana Wave* will handle all HOT cruises through June 1999, and R/V *Kaimiki-O-Kanaloa* will cover the rest of the year. The HALE ALOHA mooring is functioning successfully and providing a platform for a wide variety of sensors. The University of Hawaii is in line for a ship to replace R/V *Moana Wave*. R/V *Kilomoana,* a 170-foot SWATH vessel designed by Lockheed-Martin, will be launched in 2001 and begin service in February 2002.

Investigators hope to hold a HOT 100 science symposium next March or April in conjunction with a U. S. JGOFS SSC meeting in Honolulu. Data report 9 is now out, and data report 10 will be the last to be made available in hard copy. Subsequent ones will be available electronically. Two time-series volumes will be coming out in *Deep-Sea Research* in the near future. Editors are Siegel, Karl and Michaels.

Continuing the tradition established by Dave, Mike presented a "science minute" on investigations of the role and functioning of Archaea in the North Pacific Gyre ecosystem. Dave Karl and Markus Karner of UH and Ed DeLong of MBARI are developing a new fluorescence in-situ hybridization polynucleotide probe as part of this investigation. Although *Bacteria* are more important in the processing of carbon in surface waters, the *Archaea* become more important below the euphotic zone, especially below 250 meters, Mike noted.

30.7 Time-series Programs: BATS

Debbie Steinberg presented an update on the BATS program on behalf of Tony Knap, who was unable to attend the meeting. BATS has logged a total of 175 cruises, 120 of them for core measurements. BATS data are available via the web through January 1997 for most parameters, she said. The data report for cruises 61-72 is available in hard copy, and future reports will be available electronically. The BATS methods manual #4 is out but not on the web.

Debbie listed current ancillary projects that take advantage of the BATS time-share technician program. She mentioned several projects that use AUTOSUB-1, an autonomous underwater vehicle from the Southampton Oceanography Centre that is currently in Bermuda. BATS personnel are also participating in a number of educational programs associated with BBSR.

A time-series meeting in Taiwan in March 1999 will focus on studies in the South China Sea. BATS investigators hope to organize another symposium in Bermuda as well.

Marlon Lewis complimented both the HOT and the BATS data systems, noting that it was easy to retrieve data on a given parameter from a given time and place from these systems. Jim McCarthy agreed, noting that the time-series data sets would be one of the greatest legacies of JGOFS. Cindy Lee reminded SSC members that Chris Hammond needed feedback from investigators to help her organize data sets in ways that would be useful to them.

Debbie then gave a brief talk on the role of zooplankton migration in element cycling at the BATS site. She showed how the diurnal vertical movements of zooplankton increase the export of dissolved carbon and nitrogen into the deeper waters.

Nick Bates followed with a review of what BATS investigators have learned about the temporal and spatial variability in CO2 levels in the waters around the BATS site. He focused particularly on the role of transient physical events such as hurricanes in altering the seasonal cycle of CO2 flux between the ocean and the atmosphere and on long-term trends in CO2 concentrations in the upper ocean at BATS.

30.8 Synthesis and Modeling Program (SMP)

Scott Doney launched his presentation on the SMP with a review of the calendar. The first SMP planning meeting was held in August 1996, and the first round of proposals was submitted the following June (1997). The second summer workshop was held the following month in Snowbird; the focus of that meeting was on time-series studies.

The first meeting for investigators funded to do SMP projects was held in May 1998 in Boulder. The third summer workshop, held in Durham in July 1998, focused on ocean biogeochemical responses to climate change. The second round of SMP proposals was submitted for the annual NSF deadline in August. Proposals in subsequent years will be due in time for this deadline.

Scott proposes to hold a principal investigators' meeting in the spring of 1999 if sufficient funds are available. The fourth summer workshop will be held in Keystone, Colorado, July 12-16, 1999. The second international JGOFS Science Conference will take place in Bergen April 13-18, 2000.

Bob Anderson asked whether NSF had requested relevance reviews, which were required for the process studies. Not with the first round of proposals, Scott replied. Jim Yoder observed that the NASA review panel for the first set of proposals had considered the question of relevance to JGOFS goals.

Scott reported next on the Durham workshop. The focus was on how the ocean biology and biogeochemistry might respond to changes in physical phenomena such as dust, temperature, stratification or circulation. He listed the plenary talks and poster sessions as well as working group topics. Participants were asked to concentrate on what the U.S. JGOFS SMP could do over the next five years to improve our understanding in a variety of areas. A report on this workshop is due out later this fall.

To illustrate his points, Scott showed an IPCC figure depicting confidence levels associated with the effects of radiative forcing on greenhouse gases and aerosols. He introduced the NCAR climate system model and discussed some of the difficulties in linking components in coupled models. He went on to describe several modeling simulations, one an intercomparison among 11 different models that attempted to reconstruct changes in atmospheric variables and temperature from the 1840's to the present. He also showed Jorge's figures of two simulations, one with biology and solubility pumps, one

with solubility alone.

In order to improve our predictive capability, Scott said, we have to develop a hierarchy of mechanistic numerical models, historical analogues of climate change, and long-term ocean monitoring. He noted that many people were uncomfortable with the current crude GCM's and preferred to work on smaller-scale models that represented nature more accurately. The consensus of the workshop was that we are still very uncertain about our predictions but that we have at least identified the key processes over the last five years. We know more about where the uncertainties are.

An important problem for the SMP is how to bring currently funded investigators into the summer workshops and how to get them to work together on common issues, Scott noted. His objectives for future workshops include more direct involvement of SMP investigators,closer ties between them and SMP goals and the synthesis of JGOFS data, and leveraging of the synthesis of data from the global CO2 survey and SeaWiFS. Separation of the summer workshops from the PI meetings remains an open question.

The tentative topic for the summer 1999 workshop is "The Large-Scale Ocean Carbon Cycle: Observational and Modeling Perspectives." The summer 2000 workshop will focus on Southern Ocean biogeochemistry. Workshop products will include collections of papers and data and model compilations that can be distributed via the U.S. JGOFS home page. Bob Anderson pointed out that the third international Southern Ocean workshop will be held in Brest July 9-13, 2000. In the interest of encouraging links, he suggested that the SMP workshop be held afterwards.

Scott presented a draft outline for the summer 1999 workshop in Keystone. Topics will include:

basin-to-global-scale carbon budgets and fluxes,
air/sea CO2 and O2 fluxes,
primary production and export,
seasonal inorganic carbon distributions and anthropogenic carbon inventories, horizontal transport of inorganic carbon, DOM, oxygen and nitrogen,
subsurface remineralization,
sediment mineralization rates.

He hopes to bring together satellite experts from the EOS project, biogeochemical experts from JGOFS, and GCM modelers.

The next topic was the PI meeting in Boulder in May. The main accomplishment was the creation of working groups, Scott said. They are:

community synthesis and modeling
global-scale biogeochemistry
continental margins

large-scale data sets
satellite biogeochemistry
nitrogen fixation
regional testbeds

Scott reported considerable interest in Europe in developing model test beds, especially in the North Atlantic, and in putting JGOFS data together with earlier data sets to create gridded fields. Mark Abbott and Cindy Lee both cautioned that getting historical data sets is not as much of a problem as understanding how they were collected and for what purposes. Both emphasized the need for cooperation between those who made the measurements and those who wish to use them for modeling purposes. Paul Quay mentioned the risks of using gridded data sets without knowing the assumptions about the original data and the algorithms used to create the gridded data set. Scott observed that these points led to the larger question of how the SSC and the SMP coordinators provide guidance to NSF managers.

Noting that the scientific community needs advice and guidance on SMP needs and priorities as much as NSF does, Don Rice urged members to use the U.S. JGOFS web site. "Say where synthesis is now and what types of things are missing. Say objectively and clearly what you want. We will be directing people to the web site to learn things that they would find useful in developing a proposal," he said. A list of the scientific gaps in the current SMP program is posted on the web, Scott said. It includes biogeochemical functional processes such as denitrification, calcification, dissolution and silica cycling.

Sharing information via the U.S. JGOFS web site is a good way to provide guidance without overstepping bounds, members agreed. Scott asked for help with SMP needs from the whole SSC. Don said that, if all goes as planned, there will be four more SMP announcements of opportunity: 1999, 2000, 2001, 2002. These will become ever more curtailed as time goes on, he added.

30.9 SMP Data Management Issues

Rob DeConto and Chris Hammond made a presentation next on data management matters associated with the SMP. Rob, who is assisting Scott Doney with SMP tasks, began by reviewing the history of the draft model-data policy that is included in the handbook for the SSC meeting. The goals of the policy are to encourage scientific replication of modeling results, to ensure timely public access to SMP model data and comparisons between models, and to create an infrastructure for the development of a community model. The writers of the policy borrowed heavily from the U.S. JGOFS policy for observational and experimental data as well as from the policies established by GLOBEC and CoOP. They posted a draft on the U.S. JGOFS web site and asked for comments.

The process of evaluation produced two significant revisions to the policy, Rob said. The proprietary period for access to data was reduced from two to one year, and the data will be served from the DMO rather than from investigators' own workstations.

Rob defined model data as encompassing a broad range of numerical and synthetic data products, including numerical model code, forcing and results. He presented the most recent draft of the SMP model-data policy and said that oversight would be provided by the U.S. JGOFS SSC with the advice of the SMP coordinators. The policy is based on voluntary exchange of data for the benefit of both the SMP investigators and the larger scientific community and encourages two-way exchange between modelers and field researchers. It specifies that model data should be made available to other investigators no later than the time of publication and earlier if possible. Data will be available only to other SMP investigators for a period of one year.

The aim of all this is to encourage sharing at preliminary stages among SMP PI's rather than waiting until papers are actually published, Scott said. An investigator should submit information to the U.S. JGOFS data management office (DMO) when he or she is ready to write a paper on a modeling exercise. When the paper is accepted, the data should be made available to the rest of the community. The problem is figuring out when you call a modeling project "done," he pointed out.

Discussion ensued on the similarity or otherwise between models and code and field data and methods. Mark pointed out that a fundamental change is occurring in science in the ways in which data are published and results gotten out. NSF is promoting communication and interaction, he said. Dennis McGillicuddy observed that the results of modeling exercises are not much use without the methods and that SMP participants would do the community a great service if they could come up with a good way to help people navigate through the stuff available.

Cindy urged members to separate the issue of encouraging sharing within the program from that of protecting investigators' results for a time from the outside world. Scott agreed that the program needs to have something on paper to prod people who don't "cough up" and to make everyone feel protected. Hugh Ducklow suggested that SSC members look at the model-data policy and try to reach a consensus on ratifying it after the lunch break. He noted that the spirit of the policy is to promote cooperation within the program and to offer a period of protection from the outside.

Rob pointed out that the policy would be implemented by the DMO, which would set up a system with passwords. Investigators would be responsible for the quality and accuracy of their data and for editing large data sets. The archive would include source code, protocols and boundary conditions.

Rob also gave a brief description of a JGOFS data management and synthesis meeting that he and Chris had attended in Bergen during September. Attending were JGOFS data management task team (DMTT) members from Germany, United Kingdom, Canada, France, Japan, India, United States and Australia, as well as international project office (IPO) staff members. A number of scientists interested in JGOFS synthesis also attended. The immediate needs recognized on the international level include regional model-data test beds, a standard model-data policy, better international communication, and consideration of synthesis and modeling needs on the part of data managers. Long-term and large-scale data sets were listed as well but appeared to be less of a priority for the international group, Rob said.

Chris began her talk by noting that the U.S. JGOFS data management office needs to have some way of knowing who is allowed to get access to SMP results and when. She also needs to know how to judge when model data can be moved from restricted to open access. She then reviewed the availability of data from the JGOFS programs of other nationalities and offered her help and her contacts to those who want to get access to these data sets.

India has amassed JGOFS data at a national center in Goa but does not release data from inside its exclusive economic zone (EEZ). Jaswant Sarupria, a member of the DMTT, oversees this center.

JGOFS France has a web site and makes data from the equatorial Pacific and the North Atlantic available online. More data sets are available via data manager Marie-Paule Labaied. The national data center is in Villefranche-sur-Mer.

Data from the Japanese JGOFS program are stored in the national ocean data center (JODC) in Tokyo, but lack of continuity and changing job responsibilities make it hard to get access to data, Chris said. The JODC has a web site, and data sets are available on CD-ROM. Contact person is Takeharu Miyake.

The German JGOFS data management office in Kiel is funded through 2000. Thomas Mitzka is the manager. There is a web site and metadata online but no data as yet. Data are being sent to the World Data Centre (WDC) and directory interchange formats (DIFs) are registered at NOAA's Global Change Master Directory (GCMD).

The data of JGOFS Canada are stored in a national data bank. Requests should be made to Graham Glenn of the Marine Environmental Data Service. They are probably available on CD-ROM.

Roy Lowry of the British Oceanographic Data Centre is the person to contact for access to U.K. JGOFS data sets. Some are available on CD-ROM. The data have been collected in one place and are available but not via the World Wide Web.

Few data sets from other countries are as easily accessible as those of U.S. JGOFS, Chris said, although the French are coming along. The rest of the national programs have had to contend with lots of political pressure in the absence of strong national policies on sharing. Thus data managers have focused on storing data rather than on making it readily available. Beatriz Baliño at the JGOFS IPO in Bergen is maintaining an inventory of cruises, organized by location, date, chief scientist, parameters measured and so forth. The next goal of the JGOFS Data Management Task Team (DMTT) is to put out a parameter-level inventory, a task that is stalled at the moment for a variety of reasons. JGOFS data managers are also focusing on developing a directory interchange format (DIF) or compatible formats as standards for metadata structure.

JGOFS data managers, DMTT chairman Roy Lowry in particular, are concerned that the data set be cared for properly in the long run, Chris said. Activities supporting this goal are the creation of the online cruise inventory, agreements about DIFs, archiving data on CD-ROMs in each country, and an

agreement that WDC-A be the site for long-term storage of JGOFS data.

JGOFS SSC chairman Michael Fasham would like to see all JGOFS data available via the web and organized so that one could select a location and get access to all data available for that location. Chris Sabine noted that NOAA has developed a system called "ferret" that is basically what Mike wants. Tony Michaels asked whether it would be possible to take data from the CD-ROMs of other national JGOFS programs and convert them to web access. Chris Hammond said that she thought there would be no problem doing so.

30.10 Carbon and Climate

After lunch Jim McCarthy and Scott Doney spoke about the evolution of a new and more integrated focus on the global carbon cycle and the formation of the Climate and Carbon Working Group. The threat to the U.S. JGOFS global CO2 survey that surfaced several years ago gave impetus to a growing awareness of the need to integrate oceanic, terrestrial and atmospheric investigations of carbon fluxes, Jim said. Furthermore, the signing of the Kyoto Protocol last year increased the visibility of carbon cycle questions.

Interest in how carbon is being stored and how this might change in the future has been heightened by the work of Pacala and Sarmiento on sinks and sources in North America, Jim continued. The realization is growing that one cannot address the question of terrestrial sinks and sources without looking at the ocean as well. Jorge has taken the lead and pulled together a group of about 15 persons that has met several times over the last year. The agencies are interested in seeing scientists work together in an interdisciplinary way, and they are willing to work together as well, he added.

Scott discussed the Carbon and Climate Workshop, held in Westminster, Colorado, during August under the aegis of the working group organized by Jorge. The objective was to develop broad goals for U.S. carbon-cycle research over the next decades to be supported as a coordinated, interagency activity. The motivation for pursuing this goal was that many key programs in carbon cycle research cut across disciplinary boundaries and agency responsibilities; the current system hampers progress. There were two focusing hypotheses: there is at present a large terrestrial sink for anthropogenic carbon in the Northern Hemisphere, the mechanism for which is not known; on decadal to centennial time scales the oceans will increase their fraction of anthropogenic carbon uptake with the rate being modulated by interactions between the climate and ocean circulation, biology and chemistry. The current terrestrial sinks cannot continue indefinitely, Scott said.

Scott presented a quick review of the results of the meeting, including scientific goals, plenary presentations and working groups, and ideas for implementation. The latter included a terrestrial flux tower network, expanded atmospheric flux network and inverse modeling, a completion of the global survey of CO2 in the ocean with the Pacific meridional lines, long-term monitoring of ocean DIC evolution over time, a basin-scale experiment with air-sea pCO2 measurements, meridional transport lines and assimilation modeling, and ongoing interaction between modelers and data collectors. This

workshop was U.S. only, not international.

Jim Yoder, also a member of the working group, noted that a report had circulated before the workshop with an ocean section that workshop participants used as input. He pointed out that the outline produced by the workshop does not reflect the report that proceeded it as much as he would have expected. It has three major elements that do not include a specific reference to process studies as a method of investigating ocean phenomena. Should it do so?

Considerable discussion ensued on the question of how specific the game plan proposed by the workshop should be and how important it might be to advocate specific reference to process studies and to biological processes in the ocean. Paul Falkowski noted that terrestrial scientists at times divide the world into the atmosphere, the ocean and the biosphere; a division that fails to recognize that 48% of global productivity takes place in the oceans. He expressed his frustration with a focus on carbon in vacuo and urged that the game plan acknowledge the links between the carbon cycle and other biogeochemical cycles. Cindy observed that monitoring phenomena yields information about concentrations, but only process studies can produce data about rates.

Scott pointed out that the carbon and climate program is intended to be a supplement to existing programs and that NSF already funds process studies. Asked for his input, Don Rice said that the emphasis at this point should be on developing the superstructure of the program and interagency cooperation. NSF will continue to be responsible for funding community-generated process studies, but other agencies and parts of the program must fall into place. Scott promised to take the concerns expressed by the committee back to the carbon and climate working group.

30.11 Budget Matters

Don Rice began his presentation by itemizing some remarkable events that have occurred this year. These include the Kyoto Protocol, the completion of budgeting for the U.S. Global Change Research Program, the Carbon and Climate Workshop, the GEO-2000 planning process at NSF organized by Corell, the Major Ocean Programs report, an intra-OCE review of funding and support for mid-size programs, and NRC's pathways report, which excoriated a "sister agency" for dropping the ball on a major ocean project. "It's a new show now," Don said.

He presented budget projections for the fiscal years 1998 through 2000. AESOPS funding comes to an end in 1999; BATS and HOT, the only ongoing field programs, continue with somewhat reduced budgets through 2000. The SMP received roughly $1.4 million from NSF OCE for FY 1998 and a little over $2 million from NASA. For FY 1999, the corresponding figures are $4.7 million and $2 million. NSF OCE is projected to provide $4.8 million for FY 2000. Modest levels of support continue for standards development (CO_2 survey) and for IGBP-GAIM and SCOR, and both OCE and NASA will provide funding for the planning office and data management office through FY 2000.

Don observed that he was much less worried now about U.S. JGOFS investigators working on the

question of the next ocean biogeochemistry program. "Times have changed," he said. Interest is rising in Congress and in the administration in following up on global carbon cycle questions. The FY 2000 planning budget contains $2 million for global carbon cycling work. Don has been asked to write about NSF's contribution to this interagency effort at the level of process research. This money is probably seed money, Don said. Carbon is the "common currency" for the Global Climate Research Program, he added, but there is definitely room for new themes.

Don next addressed the question of the disposal of major equipment items from the U.S. JGOFS field programs. OCE and OPP signed an agreement that AESOPS seagoing equipment would be funded 50/50 and that it would be divided between the U.S. Antarctic Program and JGOFS at the end of the field program. OPP has requested certain items; the list is in the briefing book. Don asked members of the SSC to comment on the disposal of equipment to the Exec so that the Exec could convey general recommendations to NSF. Items are most likely to remain with investigators, but grantee institutions must agree that property be available to other qualified scientists. Don asked that recommendations be made to him by the end of the year.

30.12 Other Items

After a brief break, Scott took the floor again to talk briefly about data assimilation activities. Recommendations are being drafted for an ocean research synthesis and modeling program (ORSMP). A report will come out shortly from the 1997 and 1998 meetings. WOCE will be putting out electronic atlases; Scott was not sure whether carbon measurements will be included in these. He also presented a list of ongoing WOCE synthesis activities.

Hugh Ducklow introduced two other agenda items. First was a new executive scientist for the U.S. JGOFS Planning and Implementation Office. Since Hugh Livingston's departure, Mike Bacon has stood in as executive scientist. Ken Buesseler has expressed an interest, and WHOI has identified him as its choice to serve as the next executive scientist. NSF's view is that WHOI holds the planning office grant and can fill planning office positions when they are vacated. The Exec considers Ken an ideal choice, Duck said, asking the SSC for opinions. The consensus of the group was that Ken would be a fine choice.

The second item was the next SSC meeting. A proposal currently on the table is to hold it in Honolulu in March or April in conjunction with a HOT 100 symposium. Hugh expressed a preference for early March and suggested that the following one be held in Bermuda. He also suggested that the next meeting devote lots of time to issues raised by Don and others about the surge of interest in carbon and climate issues.

Rob DeConto brought the SSC back to the question of a model-data policy. He proposed that the investigator-only phase of access to data extend either to the end date of the proposal or to publication of results, whichever comes first. The DMO will maintain access for an additional three years, he said. SMP investigators sponsored by agencies other than NSF should comply with U.S. JGOFS model data

policies. Anyone who wants to be in the SMP will have to submit data and code to the DMO. Hugh asked for and received SSC agreement on the revised model-data policy.

Chris Sabine asked how outsiders could become involved in SMP program. Bob Anderson noted that AESOPS participants put enough information on the web so that those interested could go to individual investigators. Marlon asked about the impact of SMP output on the DMO. Were there enough funds in the budget to cover the management of these huge data sets? After a brief discussion about next summer's SMP workshop, SSC members agreed with the overall concept and encouraged Scott and his committee to go ahead with the planning.

30.13 Future Ocean Biogeochemical Programs

Jim Murray gave a brief review of the activities so far of an ad-hoc committee on Future Ocean Biogeochemical Programs. This group made a presentation to the Ocean Studies Board, sponsored a discussion at the Ocean Sciences meeting in February 1998 and published an article in EOS. In the meantime, other efforts have arisen, Jim said, including the carbon and climate working group, various NSF division review groups, and the Major Ocean Programs (MOP) Committee, headed by Rana Fine.

The MOP committee wrote a report titled "Science at Sea," which is now available. This report notes that NSF funding for focused, interdisciplinary programs has grown while disciplinary funded has stayed level for years. Success at obtaining funding has been higher for scientists applying for support within focused programs, but Jim pointed out that a high level of self-selection occurs before proposals are submitted to the MOPs. MOPs awards tend to be half again to twice as large as other awards. Although the report urged that the NSF core programs be kept healthy, it strongly endorsed goal-oriented, finite major ocean programs.

Bob Anderson brought the meeting to a close with a "Southern Hemisphere synthesis minute." One of the great things that JGOFS has produced is information about ecosystem structures in large biogeochemical provinces, he observed, but we do not have a good sense about how they will respond to changes in atmospheric parameters.

Bob proposed a modeling-first strategy, suggesting that the next program incorporate knowledge of ecosystem structure and relevant parameters gained during JGOFS into models of the response of biogeochemical systems and carbon fluxes to changes in atmospheric organizations in order to predict response to global warming. Field programs should be designed that involve multiple remote-sensing technologies together with shipboard measurements of key parameter fields at critical times to test the model predictions of response to changing atmospheric indices. The "where, when and how" questions should be determined in community workshops.

How do systems respond to changes in atmospheric forcing? Bob showed graphs provided by Will Berelson of rates of rain of organic carbon, calcium carbonate and opal in relation to sea surface temperature anomalies, citing them as evidence of response of carbon fluxes to atmospheric changes. Do

the modeling and then design field programs that focus on the response, he said. Hugh expressed his intention to solicit ideas like the ones Bob proposed for discussion at the next meeting.

The SSC meeting concluded with a brief discussion of budgeting for workshops and meetings. Mary Zawoysky pointed out that the office is just starting a new three-year budget that includes the DMO and planning office within one budget. Various members expressed a desire for a mechanism that allows funds for meetings that emerge from the evolution of the program.

The meeting was adjourned at 4:50 P.M.