32 Minutes — October 5-7, 1999

U.S. JGOFS Scientific Steering Committee Meeting
East-West Center, University of Hawaii, Honolulu

Attendees

Scientific Steering Committee Members: M. Abbott (acting chairman), W. Berelson, S. Doney, M. Follows, D. Hansell, G. Jackson, K. Johnson, C. Lee, J. McCarthy, A. Michaels, J. Murray, P. Quay, W. Smith, R. Wanninkhof, J. Yoder

Time-series Programs: A. Knap, D. Steinberg, BATS; D. Hebel, D. Karl, L. Tupas, HOT

Planning Office: M. Bowles, K. Buesseler, C. Hammond

National Science Foundation: D. Rice, P. Taylor

NOAA: L. Dilling

NODC: M. Conkright

Guests: R. Bidigare, University of Hawaii; M. Landry, University of Hawaii

32.1 Introduction

David Karl welcomed U.S. JGOFS Scientific Steering Committee (SSC) members, planning office staff, government agency representatives and guests to the East-West Center on the Manoa campus of the University of Hawaii. Filling in for outgoing SSC chairman Hugh Ducklow, who could not attend, Mark Abbott led introductions all around and reviewed the schedule for the meeting. Draft minutes from the previous SSC meeting, held in March 1999 in Boulder, were accepted subject to any corrections that members might submit.

32.2 SSC Membership and Election of New Chairman

Ken Buesseler led a discussion of SSC size and membership. Members of the SSC whose terms end in 1999 are Dennis Hansell, Paul Quay, Doug Wallace, Tony Michaels and Rik Wanninkhof. Rik will continue as a member of the U.S. JGOFS Executive-Plus committee, representing the NOAA participants in the global survey of CO_2. Ken presented a proposal that only two members be elected to replace them, rather than more, and asked for comments on altering the size and composition of the committee. Will Berelson cautioned against trimming the size of the SSC to the point that it would be difficult to muster a quorum for meetings. Jim McCarthy mentioned the problems of disciplinary and geographic balance on

the committee. Tony Michaels observed that needs will change and that the problem of SSC membership should be revisited regularly. Mark suggested that the committee avoid making a hard and fast policy.

Ken then announced the results of the recently held election. Tony Michaels was reelected to another term, and Mary Elena Carr of the Jet Propulsion Laboratory, an expert in satellite biogeochemistry, was elected to the committee for a first term.

In answer to a question from Jim McCarthy, Mark listed a number of ongoing tasks for the SSC, including advice to the Synthesis and Modeling Project (SMP) and the time-series programs, oversight on the future of the growing U.S. JGOFS data set, and the creation of clear and coherent statements about JGOFS for a variety of audiences. Mark noted that governments and citizens expect more in the way of information from basic research that will support policymaking and resource management than they did when GOFS began more than a decade ago. He and Jim encouraged SSC members to consider a series of essays that would document the progress of JGOFS and provide a framework within which to pose new questions.

The next topic was the resignation of Chairman Ducklow, necessitated by his election as chairman of the international JGOFS SSC, and the selection of a new chairman. Noting that he had one nomination in hand, Ken asked SSC members how they wished to proceed. Jim observed that long involvement with the SSC was essential for a chairman. Other members noted that the Executive Committee had discussed the matter at length and had nominated Mark Abbott for the chairmanship. Some discussion followed on potential changes in the roles of the SSC and the Executive Committee as the program comes to an end. Cindy Lee suggested that the election be put off until the next day to give everyone a chance to talk, and SSC members agreed to do so.

32.3 Time-series Programs: BATS

Tony Knap, Debbie Steinberg and Dennis Hansell reported on Bermuda Atlantic Time-series Study (BATS) activities and recent results. The program has completed 196 cruises. Most BATS data through 12/98 are available electronically. Averaged underway data have been released for 1994 & 1995. IMET and CTD data have been processed up through the present. Getting data reports out in hard copy is a slow process, Tony said.

Tony listed current ancillary users of BATS cruises and services and urged all former and current ancillary researchers to send in data or information on data sets so that they can be linked to the BATS home page. He also presented a list of other projects underway around Bermuda, including an automated underwater vehicle, neutrally buoyant sediment traps, a buoy with a pCO_2 instrument on it and ongoing pCO_2 sensor development, the AEROCE tower, the Bermuda Testbed Mooring and a microbial observatory. BATS staff members are involved in a number of educational activities as well.

Debbie Steinberg gave a science presentation on planktonic community structure and biogeochemical cycling at the BATS station. Community structure has a significant effect on chemical cycles, particle transport and the sequestration of carbon, she said, showing data on seasonal and interannual changes in biomass and species abundance of both phytoplankton and zooplankton. It is important to look at species composition in zooplankton blooms, because this is what makes a difference in particle flux.

She went on to show that a huge rise in zooplankton biomass in June 1999 was due to a bloom of salps, a coastal species that is usually around only in low numbers, which is able to consume almost anything. Such salp blooms increase particulate organic carbon flux at times when high flux would not be expected. The take-home message is the importance of studying community structure and biogeochemical fluxes together in order to understand what mechanisms govern fluxes.

In answer to questions, Debbie acknowledged that there was much less work at BATS than at the Hawaii Ocean Time-series (HOT) site on the smallest size classes of zooplankton, which are important for recycling of nutrients. Jim McCarthy suggested adding sampling of microzooplankton to the BATS measurements. Debbie agreed, noting that study of zooplankton in general was not part of the core measurement program at the time-series sites but that it should be.

Debbie's presentation was followed by a brief discussion about whether to revive the time-series oversight committee as a forum for reviewing what is and is not critical to putting together an effective long-term record from BATS and HOT. Further discussion was postponed until the agenda item on the future of the time-series programs came up.

Debbie then made a brief presentation on a project titled BATS in the Classroom: Using Oceanographic Data for Inquiry-based Learning. Its goal is to encourage schoolteachers to use real oceanographic data of all sorts in teaching mathematics and science, rather than focusing solely on "charismatic megafauna" (whales and the like) and coral reefs. The project is designed to help teachers meet National Science Education standards in the U.S.

Dennis Hansell followed with a discussion of the Sargasso Sea Ocean Observatory, also referred to as S_2O_2, which is intended to draw together a number of the research programs in the Sargasso Sea. Programs such as BATS, Hydrostation S, the Bermuda Bio-Optics Project, the testbed mooring, satellite and weather service observations, ships of opportunity, and eddy modeling studies will be part of S_2O_2. Noting the rich and varied data available for the Sargasso Sea, Dennis argued that bottom-up ocean observing programs such as this were more likely to be successful than ones organized from the top.

Bob Bidigare noted that an effort similar to S_2O_2 was taking place for the Pacific. Mark Abbott mentioned an atmospheric observatory that was being organized. The Sargasso Sea observatory is just getting started and has not yet attracted funding. Tony Knap, who is a panel head for the Global Ocean Observing System (GOOS), pointed out that all the elements essential to an ocean observing system were in place for this particular region. The problem is linking what is already available, he added.

The ocean observatory question is at bottom a data management question. Both Jim McCarthy and Margarita Conkright pointed out that JGOFS had been especially proficient in allocating funds to data management from the start and supporting it throughout. The JGOFS data set and data management system will be a significant legacy.

32.4 Time-series Programs: HOT

Having awarded acting chairman Mark Abbott a lei for his leadership in Hugh Ducklow's absence, Dave Karl presented an update on the Hawaii Ocean Time-series program (HOT). HOT has recently released all data collected from 1988 through 1998 on a CD-ROM, produced by Sharon DeCarlo and Fernando Santiago-Mandujano at the University of Hawaii.

Dave continued with a report on ships, cruises and moorings. RV *Moana Wave* was retired last year, and HOT is using the University of Hawaii's research vessel *Kaimikai-O-Kanaloa (KOK)* throughout the rest of 1999 and 2000. The ship is large and comfortable, but it has little free deck space, and the labs are not convenient for HOT use, Dave said. The university will receive a new AGOR-class ship in 2001.

During his review of sampling strategies and analyses, Dave pointed out that JGOFS had made a major contribution with the dissolved inorganic carbon (DIC) and alkalinity standards developed by Andrew Dickson and colleagues. He presented comparisons for various forms of primary production measurements and phosphorus cycle measurements and noted the differences that turned up. He discussed recent findings on distribution in the water column of species of Bacteria and two groups of Archaea. He also presented a comparison of chlorophyll measurements made by two different methods.

Dave then reviewed personnel changes in the HOT program and various ancillary studies. He also described cross-system comparisons that are underway for the phosphorus cycle between BATS and HOT and for carbon flux measurements between HOT and COLD, a study that is part of the Long-Term Ecological Research (LTER) program at Palmer Station in the Antarctic. Phosphorus is very low around the BATS station, compared to the HOT station; the question is why it should be so low in this part of the North Atlantic.

Bob Bidigare followed with a talk on mesoscale variations in chlorophyll and primary productivity in the subtropical North Pacific Ocean. He described work with a bio-optical model for estimating rates of primary production and comparisons between results of modeling simulations and those derived from satellite (CZCS and SeaWiFS) observations of ocean color. Measured and modeled primary production rates for the subtropical North Pacific are twice as high as values derived from CZCS data during the period 1978 to 1986, Bob said. If data from the study region around HOT Station ALOHA are representative of oligotrophic waters, rates of primary production may be significantly underestimated in current global estimates. Discussion ensued on the problems of measuring net versus gross production.

Bob next reported on two modeling projects that used remote-sensing observations, one to study phytoplankton biomass and productivity on the swordfishing grounds of the subtropical frontal zone, the

other to quantify the influence of cyclonic eddies on biomass, production rates and community structure downstream of the island of Hawaii.

32.5 Other Time-series Issues

Tony Knap introduced a request to hold a time-series data assimilation and synthesis meeting, perhaps in combination with an SSC meeting at Bermuda Biological Station for Research, and asked the views of the group on a possible meeting in early May. Scott Doney asked about the availability of funds for such a meeting and suggested that the idea be discussed in the context of other synthesis meetings planned for the year 2000. Mark agreed and asked for a prospectus for the meeting. Paul Quay endorsed the idea of focusing on the contributions and future of the time-series programs and stations.

The National Science Foundation (NSF) representatives were asked for their opinions. NSF continues to be interested in the time-series programs, Phil Taylor said. Noting the success of the time-series programs in obtaining renewed funding, Don Rice said that peer-reviewed opinion on what is needed for ocean biogeochemistry and marine ecology would be the main force controlling the longevity of the time-series programs after JGOFS. For the next few years, the question is what sort of structure should be developed to maintain not only the time-series programs but also data management and the planning office. Mark asked about support for the development of standards. Don said that NSF would continue to support this effort.

Phil pointed out the value of the long-term records already established and suggested that their preservation be a priority for SSC discussion. Jim McCarthy asked Scott how many Synthesis and Modeling Project (SMP) studies use time-series data. Many do, Scott said, but none focus on time-series data exclusively. He added that he wanted to see the focus on synthesis preserved in the planning for a time-series workshop.

In answer to questions about inviting representatives of other time-series programs, Tony said that doing so would change the nature of the meeting. Dave pointed out that the JGOFS meeting held recently in Taipei at which the South East Asia Time-Series (SEATS) program was launched was just such a meeting. Tony argued in favor of a data-assimilation meeting like the ones held after the completion of each of the various process studies. The meeting should include the ancillary investigators, he said.

32.6 Data Management: U.S. and International

Mark invited Christine Hammond and Margarita Conkright to speak on data management for both U.S. JGOFS and its international counterpart. Margarita will be taking over chairmanship of the JGOFS Data Management Task Team (DMTT) from Roy Lowry of the British Oceanographic Data Centre in the near future. She reviewed activities of the DMTT and asked SSC members what their concerns were.

The main goal of the DMTT is long-term stewardship of the JGOFS data, Margarita said. U.S. JGOFS is having fewer problems than most countries, she added, noting that Thomas Mitzka, the data manager for German JGOFS, has just resigned. In response to a question from Dave about quality control, she said that the DMTT assumes that the investigators take care of it. Scott asked about the availability of

data via the international web site. Is there a commitment to make data available? The French are actively working on their JGOFS database, Margarita said. But in Germany there is no requirement that investigators share their data, despite Mitzka's efforts. The first concern of the DMTT is getting data together; accessibility is second, she acknowledged.

Beatriz Baliño at the JGOFS International Planning Office is working on a metadata directory in which data sets are catalogued by country. The directory interchange formats (DIFs) being used come from the NOAA Global Change Master Directory (GCMD). In answer to a question about model data, Margarita said that no decision has been made yet at the international level.

Ken Buesseler asked what the U.S. National Oceanographic Data Center (NODC) is going to do for U.S. JGOFS, noting that ease of access and interfaces is not what NODC provides. Margarita said that NODC is committed to long-term archiving of data and that tools for access were not part of the center's work. Ken Johnson asked whether data requested from NODC would be available in JGOFS format or some other form. The answer was NODC format.

Chris Hammond provided an update on the activities of the U.S. JGOFS Data Management Office (DMO). Dave Schneider took responsibility for most of the work of the DMO during 1999 while Chris was serving as interim director of the Woods Hole Oceanographic Institution's Computer and Information Services.

She showed several data sets from Antarctic Environment and Southern Ocean Process Study (AESOPS) cruises that will be available via the U.S. JGOFS web site by the end of the month. A few are not in yet. Data sets that have not been through quality control are listed on the web site, but those interested in looking at them must contact the principal investigators directly.

Chris asked SSC members for their data management priorities, citing as an example the merging of data sets. During the field studies it made sense to list data sets by cruise number and investigator, she said, but that will change as data sets are merged. The point is to provide access via the parameter of interest. Both forms of access will continue to be available, she added.

In answer to a question about the needs of SMP investigators working with large data sets, Scott described work that Chris Sabine is undertaking on the CO_2 global survey data set with the Carbon Dioxide Information Analysis Center (CDIAC). He also noted that SMP project scientist Joanie Kleypas and Chris Hammond talk regularly.

George Jackson asked about the possibility of making data sets from other programs available via the U.S. JGOFS web site. The DMO can do so, Chris said, at the same time making it clear that they are not JGOFS material. Tony Michaels asked how much work it would be for the DMO to undertake such tasks. That depends on the shape the data are in. Walker Smith noted that the ROAVERRS (Research on Ocean-Atmosphere Variability and Ecosystem Response in the Ross Sea) program would be serving its own data; U.S. JGOFS will have links to ROAVERRS data via the home page. While expressing her willingness to work on or link to data sets JGOFS investigators identify and present, Chris suggested that

the DMO should not spend time chasing down data sets on its own.

Will Berelson asked about correcting errors in data sets that are already being served. Chris said that Dave would continue to make these corrections.

32.7 Planning and Data Management Office Budget

Ken Buesseler listed upcoming meetings and workshops and commented briefly on ones held during the previous summer. The AESOPS and SMP workshops in Keystone were both great successes from the budgetary as well as scientific perspective. Ken thanked Scott Doney and Joanie Kleypas, organizers of the SMP workshop, and Walker Smith and Bob Anderson, organizers of the AESOPS workshop, for their effective leadership. He also thanked Mark Abbott for providing some support for the AESOPS workshop from NASA funds and Mary Zawoysky and Dave Schneider from the planning and data management offices for their contributions to the smooth functioning of these workshops.

The calendar of upcoming meetings and workshops includes:

- Nov. 4-5, 1999: SMP workshop on modeling dynamics of equatorial Pacific ecosystem, Old Dominion University, Virginia
- April 13-17, 2000: JGOFS Open Science Conference, Bergen, Norway
- July 9-13, 2000: The Southern Ocean: Climatic Changes and the Cycle of Carbon, Brest, France
- July 10-14, 2000: SMP summer workshop, WHOI, Woods Hole

Other possibilities during 2000 include the time-series data assimilation and synthesis meeting discussed above, other AESOPS or SMP workshops, an international WOCE/JGOFS tracer flux meeting in the fall, and a meeting of the U.S. JGOFS "legacy" group. Ken noted the potential costs of sponsoring or participating in each of these. He asked the group to set priorities. Did U.S. JGOFS want to support a limited number of participants at both the Brest and the Bergen conferences, for example?

32.8 OCTET

Mark Abbott began the second day of the SSC meeting with an announcement of changes in the agenda and a brief review of the discussion on future directions at the SSC meeting last March in Boulder. He mentioned the letter from Hugh Ducklow to Don Rice on future research in ocean biogeochemistry and thanked the next speaker, Cindy Lee, for her leadership of the Ocean Carbon Working Group.

Cindy gave a short presentation on Ocean Carbon Transport, Exchanges and Transformations (OCTET), a new initiative for which the Ocean Carbon Working Group has put together a prospectus. OCTET proposes a multi-disciplinary approach to characterizing the biological, geochemical and physical

controls that govern the partitioning of organic and inorganic pools of carbon in the ocean and, therefore, the spatial and temporal variations in pCO_2 in the mixed layer. Its designers are working with the group that is putting together the Ecological Determinants of Ocean Carbon Cycling (EDOCC) initiative. Cindy also linked OCTET to some of the major questions asked in the recently released Carbon Cycle Science Plan (CCSP).

Modeling will play a central role in OCTET, she said. Modeling results will be used to inform field studies from the outset. The program as proposed takes advantage of modern measurement methods. The plan is to concentrate on the North Atlantic and the North Pacific in the short term.

Next steps are to hold a planning workshop, form a steering committee and elect a chairman. Don Rice has encouraged the working group to write a proposal for support of a workshop, possibly in March, which will discuss issues and set priorities, Cindy said. Under consideration is a plan to require each participant to write a short paper outlining priorities, she added, encouraging anyone who wanted to write such a paper to join in.

Addressing the "son of JGOFS" problem, Cindy noted that OCTET, EDOCC and the Surface Ocean Lower Atmosphere Study (SOLAS) all build on the legacy of JGOFS. All three proposed studies have attracted JGOFS participants. Some duplication of planning effort is inevitable, but the participants will work the problem out together.

Lisa Dilling asked whether the workshop would focus on processes important for the carbon cycle. Cindy replied that the focus will actually be on what questions we need to answer and how. George asked about the differences between JGOFS and OCTET; Cindy described the proposed study as much more concise and focused on the unanswered questions. A much higher level of interdisciplinary cooperation and interaction between modelers and field researchers exists than was true at the beginning of JGOFS, she added. Jim McCarthy agreed and reminded the group of the debate at the beginning of JGOFS over carbon as the "currency" of the project and the assumption that terrestrial and atmospheric scientists would not be much interested in JGOFS. There is much more public and political interest in the carbon cycle now, he added.

Paul suggested that the OCTET group present a summary of what has been learned in JGOFS as a means of differentiating between the two studies. Tony Michaels suggested instead a focus on what needs to be done next. Jim Yoder pointed out that the CCSP plan stresses interdisciplinary approaches to carbon questions and wondered whether the OCTET workshop could involve terrestrial and atmospheric scientists. Noting that it would be hard for a workshop with 30 to 40 participants to do everything, Cindy suggested that coordination with SOLAS would be a way of interacting with at least atmospheric scientists.

Scott suggested focus on the biogeochemical processes and controls that would have a major effect on carbon sequestration in the future. Cindy emphasized the ongoing importance of the questions that JGOFS has been wrestling with. We are not "the" CCSP ocean carbon group, she stressed, but just one of the groups working in that framework.

Lisa described interagency activities with regard to atmospheric research. The OCTET prospectus

has good words, she said, and NOAA would want to help support the scientific effort it describes but not the whole picture. The interagency group would like to establish a committee responsible for overseeing the entire agency effort on the carbon cycle. The agencies need to make sure that things do not fall off the table, she added.

Mark pointed out that the OCTET working group was asking the U.S. JGOFS SSC to help it focus and pin down topics. We must be able to answer the "why now?" question, he said. Mick Follows expressed concern that JGOFS not look as though it had failed to answer questions. He also asked whether there were groups similar to OCTET in the terrestrial and atmospheric science communities.

Others asked what OCTET would not include. Cindy pointed to sediments and deep waters as examples. The OCTET working group took earlier planning documents and pulled out a list of relevant issues. We have a good idea of the big questions, she said, but the approaches are wide open.

Don Rice observed that there were many more ocean biogeochemists now than there were before JGOFS. He considered it remarkable that there were only three initiatives coming out of the community rather than many more. "We have an internal and external mandate to relate what we do to the whole planetary system, to understand the ocean carbon cycle and to look at the underlying intercellular processes," he said, referring to all three of the current initiatives.

Rik Wanninkhof asked whether CCSP was the science plan that OCTET was going to follow. We are trying to work within the CCSP framework, but we are coming up with our own ideas, Cindy said. Jim Yoder and Jim McCarthy stressed the importance of choosing priorities that address large questions that motivate terrestrial and atmospheric scientists as well as oceanographers.

Cindy said that OCTET would make room for different methods and levels of studies. She and Scott agreed that it should not be composed entirely of large-scale process studies. The planners of each of the current initiatives need to listen to each other's reports before discussing how to go about carrying out studies, she added.

Information on the legacy of JGOFS would assist OCTET in moving beyond the scientific questions. "This is JGOFS's job," Cindy said. She thanked the SSC for giving her the kind of comments that the OCTET group needed to move forward on articulating and coordinating a plan.

32.9 EDOCC

Phil Taylor began his presentation on the Ecological Determinants of Ocean Carbon Cycling (EDOCC) initiative with a few words about the SMP workshop on functional groups, held at Rutgers in January 1999. This workshop focused on the importance of representing key functional groups of phytoplankton in biogeochemical models. Both the concepts discussed at this workshop and the second goal of the CCSP, which is to understand the mechanisms that regulate carbon cycling, have contributed to the planning of EDOCC, he said.

Phil characterized EDOCC as a "community discussion" designed to identify, understand and quantify the biological and ecological processes that are critical to our understanding and ability to make predictions about ocean carbon fluxes and their role in the global carbon cycle. It is critical, in the formulation of a new initiative, to see how our conceptual frameworks limit our understanding, he added. A critical question underlying EDOCC is whether progress in ocean carbon cycle and biogeochemical research is being compromised by lack of attention to specific biological and ecological processes and mechanisms.

HOT has provided a new paradigm by improving our understanding of the role of nitrogen fixation in upper ocean ecosystems, Phil said. As a result, we realize how important the organisms are. Is attention to the deeper ocean and the role of the Archaea going to do the same? Do we know the role of higher trophic levels in the cycling of materials, or are we avoiding the issue? The questions EDOCC is asking overlap with the questions of OCTET, he added, but some are different.

The question of coastal research stimulated considerable discussion. Noting that OCTET is staying at the open-ocean end of the coastal zone, Cindy asked whether the study of coastal systems is missing from global carbon planning. She suggested that EDOCC could be a major place for coastal studies. They would not be excluded from EDOCC, Phil said. Don reminded the group that coastal studies have been included among international JGOFS projects but have not been part of U.S. JGOFS. Others pointed out the critical role of ocean margins in the flux of iron into the ocean and the burial of carbon.

The EDOCC working group, headed by Doug Capone and Ricardo Letelier, is planning a workshop in March 2000. Debbie Steinberg asked that these planning workshops be advertised widely.

32.10 SOLAS

On behalf of Dennis McGillicuddy, who could not attend the SSC meeting, Scott presented a brief update on the Surface Ocean-Lower Atmosphere Study (SOLAS). This initiative has gained considerable momentum on the international level; planning is well underway for an open science conference in February 2000 in Kiel, Germany. Rik Wanninkhof will serve as chairman of the recently formed U.S. steering committee. Robert Duce and Richard Barber serve on the international committee. The U.S. committee will meet for the first time in December.

SOLAS was described in detail in a report to the SSC at its last meeting. The study addresses two main questions: the key interactions of marine biogeochemistry, atmosphere and climate, and how this system affects and is affected by past and future climate and environmental perturbations. The emphasis of the study is on the upper ocean and atmospheric boundary layer. Its organizers envision conducting perturbation experiments, coordinated atmosphere-ocean observations, and studies of response to natural disturbances. A unique aspect of SOLAS is its attempt to bring together two disparate scientific communities, Scott observed.

32.11 NOAA Update

Lisa Dilling introduced the SSC to NOAA's Global Carbon Cycle Project (GCC), which has

replaced the Ocean-Atmosphere Carbon Exchange Study (OACES). The goal of the project is to improve our ability to predict the fate of anthropogenic CO_2 and future atmospheric CO_2 concentrations. NOAA regards the GCC project as a long-term research strategy and a contribution to the U.S. Global Change Research Program. Its themes include global sinks and sources of CO_2, the northern hemisphere terrestrial sink, causes of variability in sinks and sources and future atmospheric CO_2 concentrations. Lisa showed the group the FY 2000 announcement for the project. Although NOAA wants to move forward during the next year, the agency also wants to link up with other initiatives, she said.

Lisa then gave the SSC an update on interagency efforts in Washington. She is a member of a broad interagency working group that meets regularly to discuss FY 2000 priorities and their fit with the goals outlined in the Carbon Cycle Science Plan (CCSP). That group is drafting an implementation plan from the agency perspective. The point is to avoid overlap, Lisa said. Thus the interagency group plans an inventory of what people are doing now to see where the gaps are and whether anyone is moving toward these gaps.

Various members asked about the focus of NOAA's research interests. The NOAA focus is on atmospheric and oceanic carbon cycles, not ocean ecosystems or components of the biological pump, Lisa said.

32.12 NSF Update

Phil Taylor spoke briefly about the biocomplexity initiative at NSF, which involves many of the directorates. The focus of Phase I is on processes related to microbes and the environment. This phase, still unfinished, was funded with $28 million. So far five projects have been approved, including one on nitrogen fixation in the ocean. Phase II will be funded with up to $50 million and will have a wide-open environmental focus but without the microbial requirement.

Don Rice spoke next on the state of progress toward addressing the second goal of the CCSP, which is to quantify and understand the uptake of anthropogenic CO_2 in the ocean. He presented a list of needs:

1. developing technology for CO_2 measurements on various platforms

2. acquiring broad-based and long-term measurements of the air-sea flux of CO_2 to improve both our knowledge of ocean sinks and sources and our ability to model them

3. synthesizing results from recent surveys and conducting ongoing ocean inventory and tracer measurements to allow full ocean coverage every 10 to 15 years

4. developing and carrying out process studies, modeling and synthesis, including manipulation experiments, large-scale tracer releases and direct measurements of air-sea fluxes

5. developing remote-sensing capabilities for monitoring physical and biological properties.

Don noted the importance of retaining corporate memory at the agencies, especially with regard to ongoing efforts to inventory ocean parameters. He also complimented Lisa Dilling for her pivotal role in linking the Global Change Research Program efforts of the interagency working group.

Don then reviewed current NSF budget projections for fiscal years 2000, 2001 and 2002. SMP support is expected to continue through these years, declining from the FY 2000 projection of $3.5 million. HOT and BATS support is expected to stay at a constant level through these years, as will support for the planning and data management office, the development of standards and the small subvention for the Global Analysis, Interpretation and Modelling (GAIM) program.

Some 22 proposals were submitted in response to the SMP announcement of opportunity for FY 2000, as compared to 33 and 36 in the two previous years. They provide good coverage for all SMP areas of interest except trace metals, Don said. Nine dealt with export production, four with sediments, and four with the air-sea exchange of inorganic carbon. No proposal dealt exclusively with one process-study region.

Fiscal year 2002 will be the last year for U.S. JGOFS, although the international program will continue until 2004, possibly 2005. Don urged SSC members to think carefully about what might be needed in the last SMP proposals and to work with the international program.

Don expressed his view that the time-series stations and programs would survive beyond 2002 and the formal end of U.S. JGOFS. He urged the SSC to think about the long-term role of the planning and data management office as well. "What needs to be done before the lights go out?" he said. Funding could possibly continue for the time-series programs, the office, the standards and GAIM for a couple more years. Support for the last rounds of SMP awards will also continue past the end of U.S. JGOFS. Workshops for OCTET and other initiatives will be supported from other sources of funds entirely, he added.

All of the funds that have disappeared from U.S. JGOFS budgets in the last few years have stayed in the NSF Ocean Sciences budget for carbon cycle research, Don said. Thus some $2.5 million is budgeted for this purpose for FY 2000 and more for years after that. The timing is good for medium-size and smaller studies at the moment, during an interval between big programs, he noted, citing iron, mesoscale physics, nutrients and primary productivity among topics of possible studies. NSF Ocean Sciences is working with NOAA on the gas exchange (GasEx) study as well. In addition to the global change allocation that has gone to JGOFS, Geosciences has put in for $2 million more. Thus some $12 million total is expected to be available for FY 2001 and FY 2002.

In answer to a question about how fast a new program, such as OCTET, could get going, Don observed that he and Phil would be delighted to have a program to promote by 2003. In order for that to happen, he would have to have something in hand a year from now.

Lisa noted the high visibility of global change questions right now and the time it takes to work budgets up through various levels. She will start 2002 planning this winter. She has implementation funds already in the next budget that she needs to spend wisely. She added that the agencies are pleased to hear the scientific community speaking with a common voice.

Jim Yoder reported that Margaret Leinen has been chosen as the next associate director for Geosciences. She will need to hear about these things, he said. Mark expressed his hope that the SSC would come out of the meeting with a plan for writing about the purposes and accomplishments of U.S. JGOFS and their links to critical carbon cycle questions.

32.13 Election of New Chairman

Jim McCarthy nominated Mark Abbott to serve as the next chairman of the U.S. JGOFS SSC; Jim Murray seconded the nomination. No other nominations were put forth. The committee chose Mark unanimously to serve as chairman, retroactively from Oct. 1, 1999 on. Cindy Lee pointed out that the Executive Committee would need a new member. Nominations will be solicited from the SSC, and voting will be carried out by email. Hugh Ducklow is now chairman emeritus. After this discussion, Ken Buesseler called Mark in to the room as the committee applauded him.

32.14 Variability in Production in Equatorial Pacific

Jim Murray presented the third science talk of the meeting on variability in new production in the equatorial Pacific. This variability is about 10 times that of primary production, a finding that was not expected at the beginning of the Equatorial Pacific Process Study (EqPac) in 1991. Jim and his colleagues looked at data from nine cruises, including FLUPAC and Zonal Flux Study cruises as well as EpPac, to see how variability in new production was related to various euphotic zone properties. Their analysis showed that variability in nitrate, ammonium, primary production (chlorophyll) and temperature explain 80% of the variability in new production over a wide set of hydrographic conditions.

To explore the causes of the unexplained variability, they developed a coupled nitrogen-iron mass balance model that addresses the controls on new production. They found that there was an excellent match between new production, surface nitrate and the dominant physical forces in operation at the time data were collected. Thus they concluded that Kelvin and tropical instability waves control the amount of nutrients available in the euphotic zone and therefore much of the variability in new production in the region.

32.15 Synthesis and Modeling Project (SMP)

Scott Doney presented a report on the activities of the SMP. The total number of SMP projects funded so far is 41, and the total number of individuals participating as principal or co-principal investigators is 91. At Don's request, SMP participants and SSC members provided guidance on the text of the FY 2000 announcement of opportunity. Recommended topics were synthesis of production, mid- to deep-water processes, controls on production of calcium carbonate and silicate and their transportation and remineralization, biogeochemical effects of the cycling of trace metals, spatial and temporal extrapolations from one scale to another, global ecosystem simulations, and synthesis and modeling focusing on regions such as the Arabian Sea, the Southern Ocean, the North Atlantic, the ocean margins, and U.S. and international time-series sites.

Scott noted that the basin and global synthesis group had 14 projects, covering every parameter of the global survey of CO_2. "That is one task we will probably have done by the next round of proposals," he said.

The 1999 principal investigators meeting took place in Keystone in July, and three workshops were held as well, one on functional groups, one on OCMIP and one on nitrogen fixation. Eileen Hofmann will be host to an equatorial Pacific SMP workshop in November. An SMP session will take place at the ASLO/AGU meeting in January as well. SMP will be well represented at the JGOFS Open Science Conference in Bergen in April. And finally, the 2000 summer meeting will be held in July in Woods Hole. There is discussion of an international WOCE/JGOFS tracer flux meeting in the fall, but it will not be held under JGOFS auspices in any event.

Tony Michaels spoke next about the SMP nitrogen (N_2) fixation workshop, held in September at the Wrigley Laboratory in California. Organizers were Douglas Capone and Raleigh Hood. Its goal was to bring together modelers interested in incorporating N_2 fixation into their models with researchers familiar with the ecology and physiology of N_2 fixation.

Evidence is accumulating that the flux of new nitrogen attributable to N_2 fixation is large, Tony said. But there are a number of questions. How do diazotrophs get phosphorus, for example? The evidence of iron limitation on N_2 fixation is inconclusive as yet. Direct evidence of N_2 fixation by diazotrophs other than *Trichodesmium* is not yet available.

The workshop produced a number of recommendations. One was to find a way to measure the biomass and fixation rates of other diazotrophs in the field. Another was to develop means of measuring phosphorus uptake and utilization in diazotrophs. Recommendations for modeling activities include mimicking carbon flux associated with N_2 fixation to determine patterns of export and improving ecosystem and physiological modeling of diazotrophs to guide the interaction of modelers and observationalists in future research.

Will Berelson asked about other trace metals beside iron. What do fixers need? Mark asked about sampling options. Tony noted that researchers interested in N_2 fixation hope that *Trichodesmium* blooms

can be seen by satellite instruments, but remote sensing would only cover surface manifestations, in any event.

Scott returned to the floor to review the eight SMP working groups, the data sets they are working with and their relationships with each other. Project scientist Joanie Kleypas is actively working on the SMP web site, which now offers access to preprints. Anyone wishing to post a preprint should contact Joanie.

Next topic was the management of SMP data. Goals are to provide public access to SMP results, to give investigators access to key data sets for SMP research, and to work with the data management office on model-data infrastructure. "Model data" encompasses a broad range of numerical and synthetic scientific data products developed under the SMP. The big problem is how to move beyond small data sets to the unique requirements of large model-data sets, Scott said.

SMP model-data products include large-scale synthesized data such as biogeochemical distributions and fluxes, carbon system parameters and biological fluxes as well as modeled data. The products are currently available via the SMP web site, which has links to servers such as the one at CDIAC.

Scott described the Distributed Oceanographic Data System (DODS), which is a distributed system like the original JGOFS one. The problem with this kind of approach, Chris Hammond pointed out, is that users must have servers that they leave on all the time. Most people do not want to use it, she said. The question for SMP investigators is whether they want data available on individual servers or at a central location, such as CDIAC or the data management office.

Scott also reported on the Ocean Carbon-cycle Model Intercomparison Project (OCMIP). The goal of this project is to improve capability of predicting the evolution of ocean uptake and storage of CO_2 through coordinated comparisons and evaluation of global marine carbon-cycle models. The second phase of OCMIP includes more than a dozen modeling groups in the U.S., Europe and Japan. Scott presented examples of the comparisons OCMIP participants are undertaking among modeling efforts as well as with data collected during field studies.

Mark asked about the likelihood of further support for SMP activities from NASA. Don Rice will talk with John Marra, who has replaced Janet Campbell as program officer.

32.16 Workshops and Travel Budget

Ken Buesseler presented a preliminary planning-office budget for workshops and meetings in 2000. He proposed spending $20,000 apiece for travel funds for investigators attending the Brest and Bergen meetings, He allocated $50,000 to the proposed time-series workshop and roughly $100,000 for the SMP summer workshop. The amount remaining for other workshops and the "legacy" publications was on the order of $50,000.

Tony Knap reviewed the purposes, products, format and participants of the proposed time-series

workshop. Rik suggested seeking multiagency support, possibly from the Intergovernmental Oceanographic Commission (IOC). Dave stressed the need for such a workshop as a means of stimulating interdisciplinary cooperation.

Walker raised the question of another AESOPS meeting, which he argued was particularly necessary for the investigators who participated in the Antarctic Polar Frontal Zone (APFZ) cruises. They were less able to benefit from the first AESOPS workshop in Knoxville in 1998 than the Ross Sea investigators because their cruises ended later, he pointed out. He proposed a workshop in the spring of 2000, possibly for the APFZ investigators only, possibly including some SMP investigators as well.

Mark introduced the question of producing publications on the legacy of U.S. JGOFS. He proposed to initiate an email discussion of topics among the leaders of the SMP, process studies and time-series programs. Scott noted that WOCE had produced such a publication, focusing on major achievements in physical oceanography during the WOCE era. Ken Buesseler and Mark agreed to work on this issue.

32.17 HOT-DOGS

After the second session, Lance Fujieki from the University of Hawaii made a presentation on the HOT Data Organization and Graphical System (HOT-DOGS) for SSC members and guests. He described the history of the data system and the various ways in which those interested could work with it.

32.18 Neutrally Buoyant Sediment Traps

Ken Buesseler opened the final session of the SSC meeting with a presentation of the development of a neutrally buoyant sediment trap as a new tool for measuring the particulate flux in the water column. He reviewed the history of oceanographic knowledge about export flux of organic materials and the evolution of sediment traps as a tool for measuring it, noting the difference in results between trap and thorium-234 methods of measuring the flux.

Data from the equatorial Pacific show better agreement between thorium results and those obtained with indented rotating sphere (IRS) traps, which exclude swimmers, than between thorium and particle interceptor traps (PITS) trap results. Swimmers can represent up to 50% of the materials in trap samples, Ken said. Swimmers represent one of two major problems for traps; the other is the horizontal movement of materials.

Ken then introduced the neutrally buoyant sediment trap (NSBT) that Jim Price and Jim Valdes are developing at WHOI for upper ocean flux studies. The team has modified a neutrally buoyant drifter to collect sinking particles. Work is underway with Debbie Steinberg, Tony Michaels and Ken to test the device. Swimmer fluxes are much lower than those collected in PITS traps, Ken reported, and the NSBT traps seem to be selectively collecting different material, sorting based on sinking speed. He will be working on calibrating the NSBTs with thorium measurements and helping to develop a "user-friendly" version of the trap with a wide buoyancy range.

32.19 AESOPS

Walker informed the group that a total of 19 papers had been submitted to Deep-Sea Research and are now under review. The deadline is March 1 for the next Southern Ocean issue, and some 22 papers have been promised. Commenting briefly on trap and thorium data from the Ross Sea, he noted that fluxes appear to be uncoupled from productivity and are dominated by a large number of pterapods, collected in the winter. The export flux in the polar frontal zone is more complicated, he said. Considerable interannual variation in phytoplankton taxa occurs in both regions.

Much effort has gone into looking at opal production and the silica-iron relationship in the polar frontal zone, Walker said. Opal production is two to five times greater than could be predicted from previous studies. Now these rates are being found by other studies as well.

Meetings coming up include sessions at the ASLO/AGU meeting, the Brest symposium, and an international polynya workshop in Quebec next year. Walker agreed to ask Polly Penhale about the possibility of Office of Polar Programs funds for the Brest symposium.

Ken Johnson noted that AESOPS and ROAVERRS covered gaps for each other. The data sets are complementary, a great help to both programs. Those involved are working on making both data sets available to participants in both programs. Mark asked about doing comparisons with researchers involved in the Palmer LTER. Dave said that some were going on, but that the focus of that program was more ecological.

32.20 Other Business

Mark asked SSC members about the allocation of the limited funds available for upcoming meetings. Should they be used to support students or principal investigators? Cindy argued that the data workshops were more important to support. Mark asked Tony Knap and Dave Karl to put together a prospectus on the proposed time-series workshop for the planning office.

Turning to priorities for the remaining years, Mark noted the need to do a new planning office budget and to think about planning and data management needs. He asked Scott to think carefully about future SMP announcements of opportunity. The total amount of money available will probably not change, he said. He also suggested that the members think about transition in the SSC itself during the final years.

In the interests of putting together some good writing on the legacies of U.S. JGOFS, Mark and Ken will solicit "JGOFS greatest hits" from all those involved in the program. Publication possibilities vary; one would be a series of articles in the newsletter.

Mark also raised the question of another review of the time-series programs. He and Jim McCarthy suggested that an assessment and a look forward would prove invaluable for the transition out of JGOFS. Mark and Ken will look at previous review groups and try to tap SSC members to carry out this

assessment.

Mark brought the meeting to a close with thanks to Dave, Lance, Luis Tupas, Lisa Lum and all the other HOT staff members for their splendid hospitality. He also thanked Hugh Ducklow for his leadership and expressed his hope that he himself would lead the SSC into the right sunset. "The quality of the people is why I agreed to take on this job," Mark concluded.