

U.S. JGOFS NEWS

JGOFS Not Over Yet: U.S. JGOFS Synthesis and Modeling Project Still Going Strong

by Scott C. Doney

The final JGOFS Open Science Conference, held last spring in Washington, D.C., was a fitting conclusion to a decade and a half of exciting international cooperation in ocean biogeochemical research. But JGOFS is not quite over yet. The U.S. JGOFS Synthesis and Modeling Project (SMP) is still going strong, exploring the implications of the JGOFS field data and developing improved models of the marine carbon cycle.

More than 70 U.S. and interna-

tional researchers and students got together at Woods Hole Oceanographic Institution (WHOI) in late July for the eighth annual SMP summer science workshop. Events included a series of plenary research presentations, posters from individual SMP groups, open discussion and, of course, the now-famous SMP clambake.

Several broad scientific themes emerged at the meeting. An overall goal of JGOFS is to understand how the marine carbon cycle might re-

spond to future climate change. But to have confidence in any projections of future behavior, we need to test our models against data from the past.

With 15 years' worth of data from the U.S. time-series stations near Hawaii and Bermuda, investigators such as Nicholas Bates of Bermuda Biological Station for Research are beginning to examine directly the effects of climate variability on

Continued on page 2



Participants in the 2003 SMP summer science workshop.

biogeochemical properties over interannual time-scales. Mick Follows of Massachusetts Institute of Technology, LuAnne Thompson of the University of Washington, Fei Chai of the University of Maine and others also reported on their efforts to develop basin-to global-scale numerical models that replicate the physical, biological and chemical variability in the ocean over the last several decades.

On geological time scales, paleoceanographic records can be used to investigate changes in the carbon cycle under the larger climate perturbations of the distant past. Olivier Marchal and Lloyd Keigwin of WHOI talked about our still cloudy understanding of abrupt climate change events in the past on scales of decades to centuries, which may tell us something about potential surprises in the future.

Robbie Toggweiler of the National Oceanic and Atmospheric Administration's Geophysical Fluid Dynamics Laboratory (GFDL) presented a new approach, involving changes in the wind-driven upwelling circulation in the Southern Ocean, to explaining the large changes observed in atmospheric carbon dioxide between glacial and interglacial periods.

Jorge Sarmiento of Princeton University and Anand Gnanadesikan of GFDL discussed new theories on how the large-scale ocean physical circulation controls nutrient resupply to the surface ocean and ocean carbon storage. Their work and that of many other SMP investigators will be enhanced by release of new global nutrient and carbon climatologies created by Robert Key, also of Princeton, and his colleagues.

With a little more than a year left to go in the SMP, workshop participants devoted considerable time to discussing ways to complete the ambitious science plan laid out in Dur-



Tammi Richardson, Texas A&M University, and Fei Chai, University of Maine, wait for dinner to be served at the SMP workshop clambake.

ham, New Hampshire, at the first SMP workshop back in 1996.

An effort is well underway to create a general numerical system for testing ecosystem models against data at various sites. The Regional Ecosystem Modeling Testbed Project, led by Marjorie Friedrichs of Old

Dominion University, held a workshop last spring at ODU (see article in this issue). The group plans another workshop some time next spring.

A second SMP volume of *Deep-Sea Research II* is at the printers. Workshop participants discussed plans for one or two more such special issues. A mix of integrative synthesis papers and standard research articles will be accepted for a third special issue beginning next spring.

Many of the synthetic data products and numerical simulations produced by SMP investigators are currently available online via the U.S. JGOFS web page (<http://usjgofs.whoi.edu/mzweb/data.html>), and more are being posted regularly. This resource will be maintained as long as possible online, and a subset will be preserved on digital video disks (DVDs) by the U.S. JGOFS Data Management Office.

A final SMP workshop is set for July 12-15, 2004, in Woods Hole. More information is available from Mary Zawoysky at the U.S. JGOFS Planning Office (mzawoysky@whoi.edu) or from Scott Doney (sdoney@whoi.edu).

U.S. JGOFS Publication Awards

Current and former members of the U.S. JGOFS Scientific Steering Committee and staff members from the U.S. JGOFS Planning and Data Management Office got together in Washington, D.C., during the JGOFS Open Science Conference in May to celebrate the successes of the program and to present publication awards to several U.S. JGOFS stalwarts.

David M. Karl of the University of Hawaii was honored for having contributed the greatest number of publications to the U.S. JGOFS total, some 30 altogether. Richard A. Feely of NOAA's Pacific Marine Environmental Laboratory received an award for authoring U.S. JGOFS Contribution #1. And Scott C. Doney of the Woods Hole Oceanographic Institution won a complete set of *Deep Sea Research II* volumes that were published as a result of JGOFS research over the last 15 years for submitting U.S. JGOFS Contribution #1,000.

SMP Regional Ecosystem Modeling Project Develops Testbeds For Model Comparisons

Among the goals of the U.S. JGOFS Synthesis and Modeling Project (SMP) is the development of a suite of models able to simulate accurately ocean properties and processes on a variety of temporal and spatial scales and to predict their response to changing environmental conditions. A related goal is to make effective use of the substantial, high-quality data sets amassed during the JGOFS field studies in the formulation and testing of these models against observations.

Although investigators have developed a number of models to simulate biogeochemical cycling in specific ocean regions, few quantitative comparisons have been carried out on how such models behave in general across a range of marine ecosystems. Participants in the SMP Regional Ecosystem Modeling Testbed Project are carrying out comparisons of a set of one-dimensional ecosystem models of varying complexity to ascertain which ecosystem structures and formulations are most robust and why.

Main objectives of this project are:

- to add to our mechanistic understanding of how and why euphotic zone production and the associated export of carbon vary among diverse ocean regions, and
- to accelerate the development of mechanistically-based ecosystem models that are capable of simultaneously describing the primary biogeochemical features of multiple ocean regions.

Principal investigator Marjorie Friedrichs of Old Dominion University (ODU) and her co-investigators have created a testing framework, consisting of a series of regional "testbeds" that contain data from U.S. JGOFS process studies and

time-series programs. Each testbed contains the physical fields required to force the models as well as biogeochemical data for evaluation or optimization and assimilation. Although work to date has focused primarily on testbeds in the equatorial Pacific and Arabian Sea, testbeds for the Southern Ocean and for the Hawaii Ocean Time-series (HOT) study and the Bermuda Atlantic Time-series Study (BATS) sites are also being developed. The goal is to create a community resource to facilitate both intra-site and inter-site model comparisons via a World Wide Web site that is under construction.

The testbed project also includes a series of workshops, the first of which was held last spring at the ODU Center for Coastal Physical Oceanography. Seventeen scientists attended (Table 1), making short presentations on their models and using the testbeds to compare and improve their simulations.

The goals of the workshop were to increase awareness of the similarities and differences among models currently in use, to compare simulations using a standard physical framework and identical validation data, to develop ways of characterizing the strengths and weaknesses of the different models, and to provide instruction on the use of the adjoint method for reducing model/data misfits. Results were presented in May at the JGOFS Open Science Conference in Washington, D.C.

Before the workshop, participants were provided with the testbed framework, which includes Fortran routines for physical ocean processes. Also provided were time-series data on mixed-layer depths, vertical and horizontal advection and solar radiation, initial conditions and bio-

geochemical properties, including chlorophyll *a*, zooplankton biomass, nitrate, primary production and sinking particle flux.

Participants in the workshop were responsible for inserting their ecosystem model subroutines into the testbed framework and providing model output. Friedrichs synthesized the results and presented the model comparisons for discussion.

The workshop also included a tutorial on the use of the adjoint method for one-dimensional ecosystem models. Participants were able to use on-site computational facilities to develop adjoint code for their

Continued on page 15

Table 1: Regional Testbed Workshop Participants

| |
|---|
| Marjorie Friedrichs , Old Dominion University (ODU) |
| Larry Anderson , Woods Hole Oceanographic Institution (WHOI) |
| Robert Armstrong , State University of New York, Stonybrook |
| Fei Chai , University of Maine |
| James Christian , University of Victoria, Canada |
| Bob Daniels , Virginia Institute of Marine Science |
| Scott Doney , WHOI |
| John Dunne , NOAA Geophysical Fluid Dynamics Laboratory |
| Jeff Dusenberry , WHOI |
| Katja Fennel , Rutgers University |
| Raleigh Hood , Horn Point Environmental Laboratory |
| John Klinck , ODU |
| Dennis McGillicuddy , WHOI |
| J. Keith Moore , University of California, Irvine |
| Ragu Murtugudde , University of Maryland |
| Yvette Spitz , Oregon State University |
| Jerry Wiggert , ODU |

U.S. JGOFS Data Management Office Still Hard At Work

by Cynthia L. Chandler

As U.S. JGOFS draws to a close, the staff of the Data Management Office (DMO) is making progress on several tasks. These include publishing a final data report, improving the Live Access Server interface and collecting the remainder of the data generated by the Synthesis and Modeling Project (SMP).

Volume 1 of the U.S. JGOFS final data report was published on CD-ROM last spring, and copies were first distributed to participants in the JGOFS Open Science Conference in Washington, D.C., in May. This volume contains all of the data collected between 1989 and 1998 during the U.S. JGOFS process studies in the North Atlantic, the equatorial Pacific, the Arabian Sea and the Southern Ocean. We plan to publish data from other components of U.S. JGOFS in future volumes.

Those interested in getting access

to the CD-ROM data report information can use either a web browser or JGView, a fully documented Java application written for use with the data report files and included on the CD-ROM. JGView can help locate data of interest. It can also be used to select subsets of data in accordance with the user's criteria, and it offers the option to export the selected data in a variety of formats, including Ocean Data View (ODV) and MATLAB. In addition, JGView can be used for access to the large merged CTD and bottle data products assembled by the DMO and included in volume 1 of the final data report.

After the JGOFS Open Science Conference, the DMO collected PowerPoint files for all the conference presentations. These files, along with smaller PDF versions, are available via the U.S. JGOFS web site ([http://usjgofs.whoi.edu/osc2003/](http://usjgofs.whoi.edu/osc2003/talks.html)

[talks.html](http://usjgofs.whoi.edu/osc2003/talks.html)). A complete description of the conference program and abstracts of all posters presented are also available. During the first four months following the conference, the U.S. JGOFS web server received nearly 3,000 requests from 403 locations to view presentation files.

In June, we installed a new version of the SMP Live Access Server (LAS) interface. The new version (LAS v6.1) includes several new features that greatly improve this web-based interface as a means of getting access to the SMP data collection. Data sets available via the SMP LAS web page (<http://usjgofs.whoi.edu/las/servlets/dataset>) are now grouped together to facilitate access. Other new features include support for multi-variable selection, gridded and in-situ data comparison, additional views (property-property, depth horizon, cruise tracks, overplots) and the ability to select groups of variables for download. We plan another SMP LAS upgrade before the end of 2003.

The DMO has purchased a new machine, which will replace our current data server. The DMO expects to have the new server online by the end of November. In addition to providing sufficient storage space for the products of the SMP, the new server should make possible an improvement in the speed with which information is returned to users of the SMP LAS interface.

We have received several new data sets that are not being served via the LAS. All SMP data are available via the SMP home page (<http://usjgofs.whoi.edu/mzweb/data.html>). Peter Verity of Skidaway Institute of Oceanography has



Continued on page 8

SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH



JOINT GLOBAL OCEAN FLUX STUDY

Final Conference Celebrates Completion Of JGOFS, Previews Future Studies In Ocean Biogeochemistry

by Margaret C. Bowles

A celebratory atmosphere prevailed as 332 scientists and students from 32 countries got together in Washington, D.C., in early May to mark the conclusion of the Joint Global Ocean Flux Study (JGOFS) and to assess both its accomplishments and the future course of research in ocean ecology and biogeochemistry.

Over the years since it was launched in 1987, JGOFS has sponsored a series of symposia to measure the advance of scientific knowledge against the questions the study was designed to address. The final open science conference (OSC), "A Sea of Change: JGOFS

Accomplishments and the Future of Ocean Biogeochemistry," was held May 5-8 at the U.S. National Academies facility, site of the first international JGOFS symposium on the North Atlantic Bloom Experiment (NABE) in 1990.

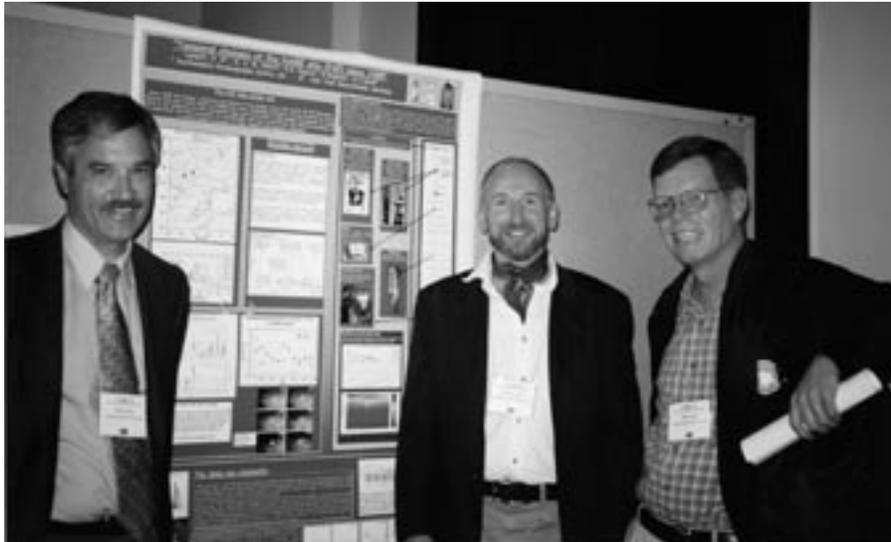
Deborah Steinberg of the Virginia Institute of Marine Science (VIMS), U.S., served as chairman of

the scientific program committee for the conference. Other members of her committee were Véronique Garçon of the Centre National de la Recherche Scientifique, France; Peter Haugan, University of Bergen, Norway; David Karl, University of Hawaii, U.S.; Kon-Kee Liu, National Taiwan University, Taiwan, and

beth Gross, Scientific Committee on Oceanic Research (SCOR), and Ken Buesseler, Margaret Bowles and Mary Zawoysky of the U.S. JGOFS Planning Office at Woods Hole Oceanographic Institution (WHOI).

The OSC was sponsored and supported by the U.S. National Science Foundation, the National Oceanic

and Atmospheric Administration, the National Aeronautics and Space Administration, the U.S. Office of Naval Research, the International Geosphere-Biosphere Programme (IGBP), the Scientific Committee on Oceanic Research (SCOR), the Research Council of Norway and the Ocean Studies Board of the



Vernon Asper, University of Southern Mississippi (left), Richard Lampitt, Southampton Oceanography Centre, and Walker Smith, Virginia Institute of Marine Science, at OSC poster session.

Bronte Tilbrook, CSIRO Marine Research, Australia.

The local committee charged with the organization of the symposium comprised U.S. JGOFS Scientific Steering Committee (SSC) chair Mark Abbott, Oregon State University; JGOFS SSC chair Hugh Ducklow, VIMS; Roger Hanson, JGOFS International Planning Office, Bergen; Eliza-

U.S. National Academy of Sciences. Support for international travel also came from the Global Change System for Analysis, Research and Training, the Inter-American Institute for Global Change Research, and the Asia-Pacific Network for Global Change Research.

JGOFS contributions and glimpses into the future emerged from pre-

sentations at the conference. Plenary sessions with keynote speakers and commentators addressed a series of broad topics, including ocean color observations from space, air-sea fluxes of carbon dioxide (CO₂), ocean carbon transport and storage, ecosystem community structure and dynamics, ocean margins and benthic processes, the paleoceanographic perspective, data assimilation and modeling, iron limitation, particle export flux, and new technologies for biogeochemical observations.

Other talks explored JGOFS history, links between JGOFS and other major ocean programs past and present, ocean biogeochemistry in the context of earth system science, and future ventures in ocean biogeochemistry.

Poster sessions were organized by region as well as topic. The former included the North Atlantic, equatorial Pacific, North Pacific, Arabian Sea, Southern Ocean and ocean margins. The latter included CO₂, ocean color, plankton community structure, euphotic zone production and export, the mesopelagic zone, the deep ocean and seafloor, paleoceanography, time-series studies, and global synthesis and modeling.

An article on the OSC by Steinberg, Ducklow, Buesseler and Bowles in the 7 October issue of *EOS* (84: 4) highlights a few of the large-scale questions that JGOFS has tackled in its quest for a better understanding of the ocean's role in the global carbon cycle and likely responses to changing climate conditions:

- How much carbon is taken up and stored in various regions of the ocean, and how might this change in the future?
- What role do foodweb structure and biological processes play in the partitioning of carbon into different pools?
- How does carbon get from the surface waters to the deep ocean and

seafloor, where it can be sequestered for millennia to eons?

Plenary talks and posters at the OSC addressed these and many other topics and suggested directions for future research, stimulating lively discussions among participants.

Carbon Uptake And Storage

Data amassed during the JGOFS survey and previous ocean studies indicate a globally integrated net CO₂ flux into the ocean of roughly 2.1 petagrams of carbon per year. This flux varies greatly from one region to another; the largest uptake occurs in the North Atlantic and Southern Ocean, whereas the equatorial regions, particularly in the Pacific, show a substantial net release of carbon into the atmosphere.

In his talk on carbon storage, Nicolas Gruber of the University of California at Los Angeles pointed out that the ocean is the largest sink for anthropogenic CO₂ at present, taking up more than one-third of total emissions from human activities. But uptake and long-term storage are different issues. For example, most of the anthropogenic carbon that is taken up in the Southern Ocean is not stored there but transported northward instead, he said.

Gruber also noted that modeling studies suggest the possibility of positive feedback with atmospheric warming, reducing the ocean's capacity to take up CO₂. Talks by Corinne Le Quéré of the Max-Planck Institut für Biogeochemie and Jorge Sarmiento of Princeton University reviewed the contributions of JGOFS observations toward efforts to model the interactions of climate and ocean and to predict the effects of changes in climate.

JGOFS field studies in the tropics and subtropics, described in talks by Nicholas Bates of Bermuda Biological Station for Research and Richard Feely of the NOAA Pacific Marine

Environmental Laboratory, have demonstrated links between changes in large-scale climate patterns, such as the North Atlantic Oscillation and the El Niño-Southern Oscillation, and variations in the exchange of CO₂ between the ocean and atmosphere.

Although the continental margins were not a focus of JGOFS investigations, a number of speakers discussed the importance of their role in ocean CO₂ uptake, a critical issue for future study. Liana Talaue-McManus of the University of Miami stressed the importance of observing the effects of human activities in coastal watersheds for understanding the role of coastal regions in ocean biogeochemical cycles, a point revisited by Berrien Moore of the University of New Hampshire in his talk on ocean biogeochemistry in the earth system.

Both Rick Jahnke of Skidaway Institute of Oceanography, who spoke about benthic processes, and Thomas Pedersen of the University of British Columbia, who presented a paleoceanographic perspective on JGOFS questions, provided further evidence of the distinctive role of the continental margins in element fluxes in the ocean.

Role Of Biology In Ocean Carbon Flux

JGOFS process and time-series studies showed that plankton foodweb structure and dynamics have significant effects on the size and partitioning of the ocean carbon flux among organic and inorganic, dissolved and particulate forms, results noted in talks by Anthony Michaels of the University of Southern California and David Karl of the University of Hawaii. Phytoplankton size classes differ greatly in their contribution to surface blooms and to the timing and volume of material exported from the surface

ocean to the mesopelagic zone and deeper waters.

As Steinberg noted in her comments, zooplankton measurements showed that although larger species add variability and dominate the export of material from the euphotic zone, the microzooplankton provide the background that ultimately dominates the cycling of carbon and other elements through the water column. Both Steinberg and Karl pointed out that JGOFS studies also documented the overall domination of ocean biomass and flux by microbes, including autotrophic pico- and nanoplankton, *Archaea*, *Bacteria* and protozoan grazers.

New discoveries about the role of element limitation on phytoplankton growth and abundance emerged from a number of studies, described by Hein DeBaar of the Royal Netherlands Institute for Sea Research. Open-ocean experiments, reviewed in a talk by Philip Boyd of the University of Otago, tested the hypothesis that iron limits phytoplankton growth and abundance in regions with sufficient supplies of nitrogen and phosphorus.

In his concluding talk on JGOFS accomplishments and new challenges, Karl reviewed data from time-series studies in oligotrophic ocean gyres that show a long-term shift in the ratio of nitrogen to phosphorus in particulate matter. These data suggest a link between the warmer, calmer conditions that accompany a high frequency of El Niño events and the growth of nitrogen-fixing cyanobacteria, he said.

Transport To Sea Floor

The quest to understand how carbon gets from the ocean surface to the seafloor sediments produced a number of lessons for JGOFS scientists. Just as it is insufficient to rely

solely on satellite data on pigments as a measure of surface productivity, Buesseler noted in his talk, so too is it insufficient to rely solely on particulate organic material collected in sediment traps at various depths as a measure of ocean export flux.

A significant discovery during the



Keynote speaker Carol M. Browner, left, and OSC program committee chair Deborah Steinberg.

JGOFS era is the importance of dissolved organic carbon (DOC), which comprises 20% of the total ocean export flux on the global scale. Although processes governing DOC formation, export, decomposition and geographic distribution are not well understood, it is interesting to note that the cycling and export of carbon south of the Antarctic Polar Front is dominated by particle fluxes, Ducklow said. Almost no carbon is exported in the form of DOC in that region.

JGOFS field and modeling studies have yielded insights into the importance of the inorganic fractions

of the particle flux. In their talks, Richard Lampitt of Southampton Oceanography Centre and Michaels described the inorganic "ballast" that protects organic material from decomposition in the water column and affects the rate and extent of particle sedimentation and remineralization. Foodweb structure and windborne materials have an impact on the formation and effects of this ballast.

Lessons Learned

In their introductory remarks, Ducklow and Abbott both noted that JGOFS was global in scope, multinational and interdisciplinary from the beginning and predictive in its aspirations, essential for a study designed to tackle big and complex questions. Both Abbott and Andreas Oschlies of the Institut für Meereskunde, Kiel, stressed the importance of the integration of disciplines - including remote sensing, biology, geochemistry, physics and modeling - to the success of JGOFS.

Another lesson of JGOFS is the importance of improving methods of measurement and establishing common standards that permit effective comparison of results, a point that Buesseler stressed in his talk. Measurements of both DOC and dissolved inorganic carbon (DIC) benefited by the development of reliable seawater standards, and advances in trace-metal-free sampling techniques made it possible to carry out effective iron-enrichment experiments in the open ocean.

Tommy Dickey of the University of California at Santa Barbara described improvements in remote sensing technology, autonomous underwater vehicles and sensors for long-term deployment on buoys that advanced biogeochemical research during the JGOFS era.

From the beginning, JGOFS

planners committed resources to developing an open, accessible and comprehensive data base. Many participants in the conference cited the value of program-wide data management as one of the most important lessons JGOFS can offer future studies. Reiner Schlitzer of the Alfred-Wegener-Institut in Bremerhaven emphasized the value of the huge JGOFS and WOCE data sets in his discussion of inverse modeling.

Another lesson learned is the importance of determining temporal and spatial scales relevant to particular questions, an issue explored by both Oschlies and Dennis McGillicuddy of WHOI. Long-term studies and the development of continuously recording instruments have made it possible to capture small and mesoscale events in time and space that have a disproportionate effect on variability in ocean properties.

In their reflections on the antecedents and early history of JGOFS, Peter Brewer of the Monterey Bay Aquarium Research Institute and James McCarthy of Harvard University touched on the extraordinary efforts of committed scientists and agency managers in the early 1980s,

the parental role of SCOR and later IGBP, and a variety of things that JGOFS got right from the start—the establishment of project planning offices, the commitment to data management, interaction with other major programs, and international cooperation.

Education And Policy

With support from NASA, minority students participating in the Minorities Striving and Pursuing Higher Degrees Of Success Program attended conference talks and worked with mentors from a variety of countries to improve their understanding of environmental issues and relevant research questions. OSC planners also encouraged student participation in the conference by offering a series of awards for outstanding posters (see accompanying box).

The Smithsonian National Museum of Natural History was the venue for the OSC keynote lecture the evening of May 7. Former Environmental Protection Agency administrator Carol M. Browner discussed the role of scientists in the formulation of governmental climate policies.

Conference participants and guests enjoyed a reception in the museum's rotunda and a chance to see some of its best-known galleries afterwards.

The conference concluded with an address by Margaret Leinen of the NSF. An early participant herself at both the national and the international levels, Leinen applauded JGOFS for its broad goals and focused vision, for successfully intertwining observations and experiments with modeling, for its cooperation with other major ocean programs, and for the effectiveness of its data management system, which she described as a model for future programs to follow.

JGOFS took time for both modeling and synthesis, Leinen observed, concluding that no other large program has so purposefully engaged in synthesis.

Rather than publishing conference proceedings, organizers of the final JGOFS OSC are making available the plenary presentations themselves as well as the poster abstracts for broad educational and scientific use. The talks can be downloaded in either pdf or html format or in Powerpoint from the U.S. JGOFS web site (<http://usjgofs.whoi.edu/osc2003/talks.html>).

OSC Best Student Poster Awards

Day One: Seung-Hyun Son, University of New Hampshire, "Decadal and interannual variations in the Yellow and East China seas revealed by satellite ocean color data (1979-2002)"

Day Two: Cecelia Sheridan, University of Hawaii, "A synthesis of Hawaii Ocean Time-series (HOT) mesozooplankton data from 1994-2002: Temporal variability and contribution to elemental budgets"

Day Three: Astrid Schnetzer, University of Southern California, "The impact of diel vertical migration on surface export of particulate organic matter and cycling of energy in the mesopelagic zone"

Topics Related To Physical Oceanography: Marie-Hélène Radenac, LEGOS, Université Paul Sabatier, "Nitrate distribution in the equatorial Pacific during the 1997 El Niño: Biological processes vs. vertical and horizontal physical processes"

Topics Related To Microbial Ecology: Matthew Church, Virginia Institute of Marine Science, "Light-enhanced bacterial production at Station ALOHA in the oligotrophic North Pacific Ocean"

Data Management—Cont. from page 4

submitted the Ocean Margins Program (OMP) data set, which has been reformatted and is being served by the JGOFS Database Management System. We are currently working with Susumu Honjo, Roger François and Steven Manganini of Woods Hole Oceanographic Institution (WHOI), who have put together a synthesis of global sediment trap data, and we expect to make this data set available before the end of 2003.

Contributions To The JGOFS Legacy: Final Data and Information Management Activities

by Bernard Avril

As JGOFS draws to a close, the members of the JGOFS Data Management Task Team (DMTT) and the staff of the International Project Office (IPO) have been working hard to ensure that the extensive data sets amassed during a decade and a half of field studies around the world are preserved for future reference and that the lessons of JGOFS benefit future programs.

JGOFS Data Sets: Volumes I & II

A first volume of JGOFS data is now available on digital video disk (DVD), and a second volume is in the works.

The first DVD, titled "International JGOFS Data Collection, 1988-2000. Volume 1: Discrete Datasets," was distributed to participants in the final JGOFS Open Science Conference in Washington, D.C., in May and afterwards, in response to requests. It contains all JGOFS data products available by the end of March 2003 from Australia, Canada, France, Germany, India, Japan, The Netherlands, New Zealand, Norway, Pakistan, Spain, United Kingdom and United States. It also includes 10 major data sets never previously released to a broad audience.

A second volume is planned for 2004. JGOFS representatives are working with members of the Pangaea team at the World Data Centre for Marine Environmental Sciences (WDC-MARE) in Bremen, Germany, towards the goal of making all JGOFS data and metadata available through the WDC system. Articles in previous newsletters have described the Pangaea information system and the team's interaction with JGOFS (*U.S. JGOFS News* 11:4,

pp 18-19; 12:2, pp 12-13).

The Pangaea team plans to publish the second JGOFS DVD, to be titled "International JGOFS Data Collection, Volume 2: Integrated Datasets," next year. All data sets in this new volume will be accessible in a common file and data format through the Pangaea interface. They will be organised by country, project, cruise and data set for each parameter.

Since the first JGOFS DVD was released, several additional data sets are being gathered for this new product, and the team at the WDC-MARE has been compiling and harmonizing JGOFS data sets with its Pangaea system. Roughly 38,000 entries are available so far. National JGOFS data sets from the countries listed above are accessible via the Pangaea web site (www.pangaea.de/PangaVista?query=@JGOFS_countryname).

The DMTT and IPO will continue to work with the Pangaea team until JGOFS comes to an end in December and later on a voluntary basis in order to help produce and edit the second DVD volume.

Lessons Learned: Recommendations For Future Programs

As another component of the JGOFS legacy, a set of "lessons learned," observations and recommendations for the future, has been assembled with the aim of promoting the rapid dissemination of marine data and information and their long-term preservation and accessibility (www.uib.no/jgofs/D_I_M/d_i_m.html).

Past DMTT chair Roy Lowry and the IPO assistant executive officer Bernard Avril organized and led the

Oceanographic Data and Information Management session at the International Geosphere-Biosphere Programme (IGBP) Congress held in Banff, Canada, last June. Discussions indicated that after the experiences gained by JGOFS and other major ocean studies, future marine projects and initiatives would benefit greatly from the following actions:

- Establishment of data and information management units at the outset of each program;
 - Development of distributed, scalable data management;
 - Adoption of standards to facilitate intercomparison and transmission of data and information among independent sources and structures;
 - Utilisation of existing infrastructure with additional resources to address the needs of international rather than national specifications and standards;
 - Provision of services and data access that match the needs of scientists;
 - Provision of data through alternative media, such as CD-ROMs, for those without Internet access;
 - Development of close working relationships among data managers and scientists and the provision of "end-to-end" management and tools for getting access to data sets.
- Participants in this session put together a set of recommendations for large-scale ocean research projects currently in the planning phase (www.igbp.kva.se/congress/wgppts/B2_Lowry.pdf). They suggested that:
- Projects should establish data policies at the outset with particular focus on questions such as data

Continued on page 12

Final SSC & Executive Committee Meetings Review JGOFS Accomplishments And Future Activities As International Project Nears End

by Roger B. Hanson and Bernard Avril

The JGOFS Scientific Steering Committee (SSC) held its last meeting on May 4, the day before the start of the final JGOFS Open Science Conference (OSC) at the U.S. National Academy of Sciences in Washington, D.C. Chairman Hugh Ducklow welcomed attendees and reminisced briefly about the small but willing band of writers who met in the same room a decade and a half ago to put together the JGOFS science plan under the leadership of Michael Fasham of Southampton Oceanography Centre, United Kingdom. He also observed that current international political and health concerns had prevented the attendance of several SSC members and regretted their absence.

Turning to JGOFS achievements, Ducklow announced the publication of *Ocean Biogeochemistry: The Role of the Ocean Carbon Cycle in Global Change*, edited by Fasham and published by Springer-Verlag in the International Geosphere-Biosphere Programme (IGBP) science series. The rest of the one-day meeting was devoted to final reports from synthesis and working groups, task teams and sponsors, with accolades for the leaders of these groups for their substantial contributions.

The Data Management Task Team (DMTT) reported on another major milestone, the release of the first DVD volume of JGOFS data sets, which was distributed to all SSC members and conference partici-

pants. The DMTT report stressed the importance of having a credible data and information management plan and funds from the very start of a major international project such as JGOFS (see accompanying article by Avril in this issue on data management activities and the JGOFS legacy). SSC members urged an extension and standardization of core parameters, in particular those of the carbon dioxide (CO₂) system, before the next major ocean field program begins. The SSC thanked DMTT

results from their use.

Reiner Schlitzer, chairman of the GSWG, Patrick Monfray, co-chairman with James Orr of the joint JGOFS/Global Analysis, Interpretation and Modelling (GAIM) Task Team (JGTT), and Nicolas Hoepffner have completed their report on the successful and productive modelling workshop held in Ispra, Italy, in June 2002. Hard copies of this report, JGOFS Report No. 38, are available from the International Project Office (IPO) in Bergen, and a pdf version is available via the

JGOFS web site. The SSC acknowledged Schlitzer's dedicated leadership of the GWSG and for production of the workshop report. A small North Atlantic Synthesis Group (NASG) meeting took place in January 2003 to complete terms of reference, review current activities and prepare synthesis contributions to the OSC. NASG chairman Véronique Garçon noted that the Atlantic Meridional Transect (AMT) programme con-



Former JGOFS SSC chairmen John Field, left, Trevor Platt, Bernt Zeitzschel, and current chairman Hugh Ducklow

chairman Margarita Conkright and her predecessors for their leadership and for contributing the international DVD to the JGOFS legacy.

The Global Synthesis Working Group (GSWG) cancelled plans for a meeting to conduct comparisons of model approaches and performances because several carbon model intercomparisons are already underway in the United States and Europe. The SSC briefly discussed the need for objective evaluation of models before publication of

continues, and that several members of the NASG are currently involved in the preparation of the EUROCEANS programme. She expressed her thanks for SSC support for NASG activities, and the committee, in turn, thanked her for her efforts.

A strong international presence continues in the Arabian Sea region as activities are being planned by scientists in Germany, India, the United Kingdom and the United States. The Indian Ocean Synthesis Group (IOSG) is now preparing a

Courtesy of JGOFS IPO

regional synthesis book on the Arabian Sea Process Study. Publication is expected in late 2004. The SSC noted the accomplishments of IOSG chairman Sharon Smith as guest editor of multiple *Deep-Sea Research II* volumes on the Arabian Sea and credited the successes of the Indian Ocean synthesis to her enthusiasm and strong leadership.

The current activities of the Equatorial Pacific Synthesis Group (EPSG) are now taking place under the aegis of various Japanese institutions, the U.S. JGOFS Synthesis and Modeling Project, and the French PROOF Modélisation. A *Deep-Sea Research II* special issue and a *Journal of Geophysical Research* special section on equatorial Pacific synthesis were published in 2002 and 2003. The SSC thanked Robert Le Borgne for taking over leadership of the EPSG in 1999 and credited much of its success with synthesis to his effort and dedication.

In the North Pacific, Japanese researchers have recently launched the Subarctic Pacific Iron Experiment for Ecosystem Dynamics Study (SEEDS). In 2004, the Japan Oceanographic Data Center will release a CD-ROM containing JGOFS North Pacific data sets. Later in the year, the North Pacific Synthesis Group (NPSG) expects to publish a special issue in *Journal of Oceanography*. The SSC thanked Alexander Bychkov and Toshiro Saino for their leadership in JGOFS North Pacific activities.

The accomplishments of Southern Ocean Synthesis Group (SOSG) have been well covered in several *Deep Sea Research II* volumes over the years as well as at the JGOFS Southern Ocean symposium held in July 2000. JGOFS investigators have made major contributions toward clarifying the host of unknowns surrounding the biogeochemical and ecological functioning of the Southern Ocean. The SSC thanked

chairman Paul Tréguer and past chairman Uli Bathmann for their leadership of the SOSG synthesis.

Progress on the Continental Margins Task Team (CMTT) IGBP book at Springer-Verlag continues. Lead editor is Kon-Kee Liu; co-editors are Larry Atkinson, Renato Quiñones and Liana Talaue-McManus. Publication is expected in late 2004. The SSC noted that the strong efforts of the CMTT in recent years have greatly advanced our knowledge of the processes at the ocean boundary. The committee thanked Quiñones and extended their appreciation to Liu and the CMTT.

The accomplishments of the Ocean Carbon-cycle Model Intercomparison Project (OCMIP) were communicated to the SSC through the JGOFS-GAIM Task Team (JGTT), led by Patrick Monfray from JGOFS and James Orr from GAIM. The European Union has recently approved funds for the Northern Ocean Carbon Exchange Study (NOCES), a collaborative effort in OCMIP-3 that involves researchers from Belgium, France, Germany, Norway and United Kingdom. NOCES will be the first ocean model intercomparison to focus on interannual-to-decadal variability, to use multiple ocean carbon-cycle models to simulate decadal variability, to focus on associated mechanisms, and to include an inverse atmospheric modeling component.

Members of the SSC are active in the second phase of the IGBP and support plans for a new international ocean programme, sponsored by IGBP and the Scientific Committee on Oceanic Research (SCOR). The new programme, titled Integrated Marine Biochemistry and Ecosystem Research (IMBER), evolved from earlier IGBP-supported planning for OCEANS. Monfray presented a report on the questions to be addressed in IMBER, including a new

focus on the mesopelagic layer and special emphasis on continental margins and high-latitude regions.

Many JGOFS participants are also involved in the Surface Ocean-Lower Atmospheric Study (SOLAS), a joint venture of IGBP, SCOR, the World Climate Research Programme (WCRP) and the Commission for Atmospheric Chemistry and Global Pollution (CACGP). SOLAS organizers are looking for members for their working groups in several areas, including modelling and data management.

LOICZ continues into the second phase of the IGBP with the addition of a theme on socioeconomics, linked to the International Human Dimensions Programme (IHDP), and a theme on the fate and transformation of materials on continental shelves, co-sponsored by SCOR.

Planning for the future of the International Ocean Carbon Coordination Project (IOCCP), jointly sponsored by SCOR, the joint SCOR-Intergovernmental Oceanographic Commission (IOC) CO₂ Panel and the joint Earth System Science Partners (ESSP) Global Carbon Project, is well underway. Next year SCOR and IOC plan to host a symposium titled "Oceans in a High CO₂ World," which will tackle issues such as purposeful sequestration of CO₂ in the ocean, sequestration policy, research needs, protocols and standards.

Measurement of ocean colour has been essential to JGOFS goals since the beginning of the study. Data continue to flow from the SeaWiFS ocean-colour sensor, and discussions are underway about continuing that flow until data sets from newer sensors are accessible to all. An unofficial "Future of SeaWiFS" web site has been set up to survey the degree of community support, both in the US and elsewhere, for continuing SeaWiFS observa-

tions (http://www.ccpo.odu.edu/orca/SeaWiFS/Future_of_SeaWiFS.html). Ducklow thanked International Ocean Colour Coordinating Group (IOCCG) chairman Trevor Platt for his report on satellites and sensors and for his long service to JGOFS.

A global ocean time-series observational system is now under development, linking carbon and biogeochemical observations as a new pilot project under the Ocean Observation Panel for Climate (OOPC). This project, co-sponsored by the Partnership for Observation of the Global Ocean (POGO) and by the Climate Variability and Prediction Programme (CLIVAR), would be focused on testing and evaluating operating systems and data delivery mechanisms as well as developing standards and formats for data exchange. The SSC thanked Peter Haugan for his report on OOPC and

for maintaining a JGOFS link with various other ocean observing initiatives and projects.

JGOFS Exec Holds Last Meeting

Members of the Executive Committee got together in Bergen in late September to tie up loose ends and survey the JGOFS landscape. Several items remain on the calendar, including an upcoming NPSG meeting in Nagoya, Japan, an Indian Ocean special issue editors' meeting in Miami, US, and publication of the final list of JGOFS peer-reviewed publications. A final revision of the JGOFS Core Parameters List is underway as well.

Committee members discussed the possibility of putting together a JGOFS history that would be a part of its legacy to ocean science. SSC chairman Hugh Ducklow offered to lead and supervise the effort. National JGOFS leaders will be asked for comments on the development

of JGOFS in their respective countries. IGBP is encouraging the JGOFS leadership to put together a full issue of the *Global Change News Letter* as well.

The executive committee and IPO staff offered their particular gratitude and appreciation to the "unsung heroes" of JGOFS in Norway, in particular Ulf Lie and Truls Johannessen of the University of Bergen and Kirsten Broch-Mathisen of the Research Council of Norway. Without their efforts to bring the JGOFS IPO to Bergen and their staunch support thereafter, JGOFS could not have achieved all that it has.

The "sunset" date for the IPO is approaching at the end of December, and efforts are underway to transfer and archive JGOFS and IPO holdings and documents in libraries in the US and Norway, to World Data Centres and to future ocean programmes under IGBP and SCOR.

JGOFS Legacy—from page 9

sharing within the project and with those outside, data quality and standards, and long-term stewardship of data sets.

- Projects should dedicate resources to the development of an international project meta-database, in conformity with appropriate international data standards, as a means of facilitating integration and exchange of information.

- Projects should establish a data management working group, such as the JGOFS DMTT or the World Ocean Circulation Experiment (WOCE) Data Products Committee, that comprises both data managers and scientists.

- Scientific contributions should address questions of data management in a credible and adaptable manner. They should be motivated by and accountable to the scientific objectives of the project. They

should contribute to capacity building, if appropriate, and should promote the concept of data sets as important scientific products that can be cited.

The Scientific Committee on Oceanic Research (SCOR) and the IGBP are sponsoring a follow-up meeting on data and information management for marine research projects in Liverpool, UK, in early December. The purpose of the meeting is to produce a common strategy for managing and sharing marine data and information among IGBP and SCOR projects, drawing upon the experiences of JGOFS, WOCE and other large-scale international projects (www.jhu.edu/~scor/DataMgmt.htm).

JGOFS Web Site

The JGOFS Internet site (www.uib.no/jgofs/jgofs.html) will be actively managed until the end of December. Afterwards, it will be

maintained "as is" for at least a year at its current address. It will also be reproduced in the form of a CD-ROM to be distributed to all former and present JGOFS Scientific Steering Committee members and JGOFS sponsors. A limited number of CD-ROMs will be available for distribution to others on a first-come, first-served basis.

JGOFS Publication List

The final list of JGOFS peer-reviewed publications will soon be posted on the JGOFS web site.

All comments and requests for the JGOFS International Data Collection DVD volumes, the Legacy and Advancement for Data and Information Management document, the JGOFS web site CD-ROM, or the JGOFS publication list should be sent to Bernard Avril (Bernard.Avril@jgofs.uib.no) at the JGOFS IPO.

IMBER: The Way Forward

by Julie Hall and Claire Hamilton

A new international study with a focus on marine ecosystems and biochemistry is emerging under the sponsorship of the International Geosphere-Biosphere Programme (IGBP) and the Scientific Committee on Oceanic Research (SCOR). Formerly known as OCEANS, Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) will be part of the second phase of the IGBP.

The goals of IMBER are:

- To develop a quantitative and predictive understanding of marine biogeochemical cycles, ecosystems and their interactions in response to global change;
- To identify key feedbacks from the marine system to other parts of the earth system;
- To promote scientific analysis of possible adaptive and mitigative strategies to address the predicted effects of global change on the marine system.

The draft of the IMBER Science Plan and Implementation Strategy is available via the IGBP web site (<http://www.igbp.kva.se/obe/recentupdates.html>). Its creators hope to complete work on it in early December and to submit it to IGBP and SCOR before the end of the year. The document will be reviewed for approval during the first quarter of 2004. After approval, IGBP and SCOR will form an IMBER International Scientific Steering Committee to guide the implementation of the new study.

IMBER will seek to foster an interdisciplinary approach toward four basic research themes and the priori-



Integrated Marine Biogeochemistry and Ecosystem Research

ties that have been identified under each of them.

The first of these themes is “key processes.” What key marine biogeochemical cycles and ecosystem processes and interactions will be affected by global change? Issues to be considered under the theme of key processes are:

- Sources and sinks in marine biogeochemical cycles and the ways in which these affect macro- and micronutrient stoichiometry;
- Relationships among the biodiversity, structure, functioning and stability of marine food webs;
- Interactions between biogeochemical cycles and the structure, functioning and dynamics of marine food webs.

The second theme is “sensitivity to global change.” How will key marine biogeochemical cycles, ecosystems and their interactions respond to global change? Issues are:

- Effects of climate-induced changes in circulation, ventilation and stratification on marine biogeochemical cycles and ecosystems;
- Response of marine biogeochemical cycles, ecosystems and their interactions to increases in atmospheric carbon dioxide (CO₂) of anthropogenic origin and changing pH;
- Response of marine biogeo-

chemical cycles, ecosystems and their interactions to changes in the fluxes of macro- and micronutrients from the land and atmosphere into the ocean.

A third theme is “feedbacks to the earth system.” What are the present and future capacities of the ocean to regulate atmospheric composition and solar penetration into the surface waters? Focus will be on

these issues:

- Oceanic regulation of the concentration of CO₂ in the atmosphere;
- Feedbacks from the ecosystem to the nitrogen and sulphur cycles;
- Direct ecosystem feedbacks to ocean physics and climate with regard to solar heat penetration and the physical structure of the upper ocean.

The final theme of IMBER will be “responses of society.” What are the relationships among marine biogeochemical cycles, ecosystems and human society? Focal issues are:

- Effects of human lifestyles on the state of the ocean;
- Mitigative and adaptive policies that could reduce the impact of global change on society.

IMBER will focus on the themes and issues outlined above in four key domains of the ocean: the euphotic zone, the mesopelagic layer, the continental margins and the high-latitude oceans. Its participants are expected to develop collaborative studies that will draw on the expertise of other projects and programmes to avoid unnecessary duplication and ensure an interdisciplinary approach.

Continued on page 15

SOLAS Holds First International Summer School

by Wade McGillis and Rik Wanninkhof

More than 70 students from 20 nations attended the first summer school of the Surface Ocean- Lower Atmosphere Study (SOLAS), held on the French island of Corsica from late June to mid July. The purpose of this course was to introduce graduate students and young researchers to different components of SOLAS, a joint project of the International Geosphere-Biosphere

Programme (IGBP), the Scientific Committee on Oceanic Research (SCOR), the World Climate Research Programme (WCRP) and the Commission on Atmospheric Chemistry and Global Pollution (CACGP).

Students met at the Institut d'Études Scientifiques de Cargèse, an idyllic meeting place overlooking the Mediterranean Sea. The course used a multidisciplinary theoretical

framework, practical exercises and laboratory experiments to create an intensive learning environment. It also provided an opportunity for young researchers interested in SOLAS science to meet one another and to interact with lecturers currently investigating a number of important global issues.

Lectures covered such topics as the global carbon cycle, biogeo-

Table 1: SOLAS Summer School Scientific Steering Committee

Corinne Le Quéré, Max-Planck-Institut für Biogeochemie, Germany
 Peter Liss, University of East Anglia, UK
 Véronique Garçon, Laboratoire d'Études en Géophysique et Océanographie Spatiales, France
 Wade McGillis, Woods Hole Oceanographic Institution, US
 Bill Miller, Dalhousie University, Canada
 Ulrich Platt, University of Heidelberg, Germany
 Mits Uematsu, University of Tokyo, Japan
 Rik Wanninkhof, NOAA Atlantic Oceanographic and Meteorological Laboratory, US

Lecturers and Topics

Peter Liss, University of East Anglia, UK: Introduction to SOLAS
 Manuel Gloor, Max-Planck-Institut für Biogeochemie, Germany: Greenhouse gases and climate change
 Ric Williams, University of Liverpool, UK: Introduction to oceanography
 Eric Saltzman, University of California at Irvine, US: Introduction to marine atmospheric chemistry
 Fortunat Joos, Climate and Environmental Physics, Switzerland: Global carbon cycle
 Osvaldo Ulloa, University of Concepción, Chile: Marine ecology
 Rik Wanninkhof, NOAA Atlantic Oceanographic and Meteorological Laboratory, US: Gas exchange
 Ray Najjar, Pennsylvania State University, US: Biogeochemical cycling
 Mary-Elena Carr, Jet Propulsion Laboratory, US: Remote sensing
 Andreas Oschlies, Institut für Meereskunde, Germany: Data assimilation
 Catherine Jeandel, Laboratoire d'Études en Géophysique et Océanographie Spatiales, France:
 Macronutrient cycles
 Philip Boyd, University of Otago, New Zealand: Iron cycle
 Carlos Duarte, Instituto Mediterraneo de Estudios Avanzados, Spain: Marine ecology
 Wade McGillis, Woods Hole Oceanographic Institution, US: Gas exchange
 Gill Malin, University of East Anglia, UK: DMS and global sulfur cycle
 Ulrich Platt, University of Heidelberg, Germany: Marine particles
 Jos Lelieveld, Max-Planck-Institut für Chemie, Germany: Gas phase reactions
 Ina Tegen, Max-Planck-Institut für Biogeochemie, Germany: Atmospheric sources of nutrients
 Jason Holt, Proudman Oceanographic Laboratory, UK: Physical processes in the coastal zone
 Leticia Cotrim da Cunha, Max-Planck-Institut für Biogeochemie, Germany: Biogeochemical processes in the coastal zone
 Tom Pedersen, University of British Columbia, Canada: Paleo research
 Nick Bates, Bermuda Biological Station for Research, Bermuda: Time series

chemical modeling, gas exchange, physical and biogeochemical processes in the coastal zone, data assimilation and marine ecology. Practical workshops included a research cruise near Cargèse, laboratory experiments, computer modeling, meteorological observations and instruction in giving talks and posters. The experience culminated in student presentations on a variety of research topics.

The quality and enthusiasm of the students, selected from an applicant pool of more than 270, was impressive. Probing questions during the presentations and interactions kept the lecturers on their toes. Lecture topics focused on broad overviews of the large-scale processes that control the distribution of the compounds relevant to climate in the surface ocean and lower atmosphere.

Lectures in early morning and late afternoon alternated with practical lessons and student presentations. The practical lessons gave students exposure to ongoing research activities in the program. Groups of 10 participants each went on three-

hour research cruises aboard the French research ship N/O *Thetys II*, which included CTD casts, net tows and species enumeration using on-board microscopes.

Air-sea surface processes and flux measurement systems shipped over from Woods Hole Oceanographic Institution exposed students to the state-of-the art studies of heat, momentum and gas exchange. Another lesson covered basic modeling tools and their applications. In addition, all students participated in communication sessions where they prepared and practiced concise presentations based on the research they had performed at their home institution.

Students gave oral presentations before the entire school in the second week. Each student used techniques learned at the practical sessions to provide a articulate and concise overview of his or her work. All students also presented posters, which were displayed at sessions held in the school courtyard.

The program's organizers and lecturers, many of whom have spent

the last several years organizing SOLAS, found tremendous satisfaction in working with students from around the world with strong interests in the effects of climate and global change on the ocean and atmosphere. The great success of the school owes much to the tireless efforts of the organizer, Corinne Le Quéré of the Max-Planck Institut für Biogeochemie, Jena, Germany, and her committee (Table 1).

Travel costs for United States students, organizers and lecturers were covered by generous grants from the National Science Foundation, the National Aeronautics and Space Administration, the National Oceanic and Atmospheric Administration and the Office of Naval Research. Details of the summer school can be found on its web site (<http://www.uea.ac.uk/env/solas/summerschool>).

SOLAS may hold another summer-school session in 2005. Information on this project as well as other aspects of SOLAS, including its science plan, is available via our web site (<http://www.solas-int.org>).

IMBER—From page 13

A close collaborative relationship between IMBER and Global Ocean Ecosystem Dynamics (GLOBEC), an ongoing IGBP core project, is particularly important to ensure that a fully integrated biogeochemical and ecosystems approach is undertaken to the entire food web. The goal is to achieve a full integration of the two research communities after 2009, when GLOBEC comes to an end.

Collaborative associations are also planned with other IGBP projects, including the Surface Ocean-Lower Atmosphere Study (SOLAS), Land-Ocean Interactions in the Coastal Zone (LOICZ) and Past

Global Changes (PAGES), as well as the Climate Variability and Prediction (CLIVAR) programme, DIVERSITAS, the International Human Dimensions Programme (IHDP), Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB), the Global Carbon Project (GCP), the Global Ocean Observing System (GOOS) and GEOTRACES.

(Editor's note: Julie Hall, a scientist at the National Institute of Water and Atmospheric Research in Hamilton, New Zealand, is chairman of the IMBER Transition Team and will be chairman of the IMBER Scientific Steering Committee. Claire Hamilton is serving as research assistant to the team.)

Testbeds—From page 3

particular models or to revise them to enhance performance relative to other simulations presented.

Workshop results reported at the summer SMP investigators' workshop indicate that simple (four component) ecosystem models work nearly as well as the most complex models when they are optimized for a single site. Complex models have an advantage, however, when models are optimized for two very different ecosystems simultaneously. Another finding noted was that changes in physical fields produce far greater changes in plankton distributions than do changes in ecosystem model complexity.

12-15 July: U.S. JGOFS Synthesis and Modeling Project final workshop, Woods Hole Oceanographic Institution, Woods Hole. Contact: Scott Doney, WHOI (sdoney@whoi.edu).



U.S. JGOFS News

Published by the U.S. JGOFS Scientific Steering Committee

Editor: Margaret C. Bowles

Designer: Jeannine M. Pires

U.S. JGOFS News reports on U.S. contributions to the Joint Global Ocean Flux Study (JGOFS) of the Scientific Committee on Oceanic Research (SCOR), a permanent committee of the International Council of Scientific Unions (ICSU). JGOFS is a core project of the International Geosphere-Biosphere Programme (IGBP).

We welcome your comments and contributions for publication.

To obtain a free subscription, write to:

Mary Zawoysky
U.S. JGOFS Planning Office, MS #43
Woods Hole Oceanographic Institution
Woods Hole MA 02543-1047 U.S.A.
(508) 289-2834

Getting Access to U.S. JGOFS Data and Information

Information on the U.S. JGOFS program and access to all U.S. JGOFS data can be obtained through the U.S. JGOFS Home Page on the World Wide Web:

<http://usjgofs.whoi.edu/>

Inquiries may be addressed to the U.S. JGOFS data management office via electronic mail to dmomail@whoi.edu or by phone to Cyndy Chandler (508-289-2765).

Data from U.S. JGOFS process study cruises are available through the U.S. JGOFS data management system at the Web site above.

Data from the U.S. JGOFS time-series programs are also available via the World Wide Web at the following sites:

HOT <http://hahana.soest.hawaii.edu/hot/hot-dogs/interface.html>

BATS <http://www.bbsr.edu/ctd>

Data from the Survey of Carbon Dioxide in the Oceans are available from the Carbon Dioxide Information Analysis Center at <http://cdiac.esd.ornl.gov/oceans/home.html>

JGOFS Final Open Science Conference report

See page 5

U.S. JGOFS

U.S. Planning Office at Woods Hole Oceanographic Institution
Woods Hole, MA 02543-1047



Address service requested

Nonprofit organization

U.S. POSTAGE

PAID

Permit No. 46

Woods Hole, MA 02543