



JOINT GLOBAL OCEAN FLUX STUDY

A Core Project of the International Geosphere-Biosphere Programme

JGOFS REPORT No. 28

**ELEVENTH MEETING OF THE JGOFS SCIENTIFIC
STEERING COMMITTEE**

**TWELFTH MEETING OF THE JGOFS SCIENTIFIC
STEERING COMMITTEE**

SECOND MEETING OF THE NORTH PACIFIC TASK TEAM

NOVEMBER 1998

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**SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH
INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS**

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- No. 1 Report of the Second Session of the SCOR Committee for JGOFS. The Hague, September 1988
- No. 2 Report of the Third Session of the SCOR Committee for JGOFS. Honolulu, September 1989
- No. 3 Report of the JGOFS Pacific Planning Workshop. Honolulu, September 1989
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- No. 12 Report of the Second Meeting of the JGOFS North Atlantic Planning Group.
- No. 13 The Reports of JGOFS meetings held in Carqueiranne, France, September 1993: Eighth Meeting of the JGOFS Scientific Steering Committee; JGOFS Southern Ocean Planning Group - Report for 1992/93; Measurement of the Parameters of Photosynthesis - A Report from the JGOFS Photosynthesis Measurement Task Team. March 1994.
- No. 14 Biogeochemical Ocean-Atmosphere Transfers. A paper for JGOFS and IGAC by Ronald Prinn, Peter Liss and Patrick Buat-Ménard. March 1994.
- No. 15 Report of the JGOFS/LOICZ Task Team on Continental Margin Studies. April 1994.
- No. 16 Report of the Ninth Meeting of the JGOFS Scientific Steering Committee, Victoria, B.C. Canada, October 1994 and The Report of the JGOFS Southern Ocean Planning Group for 1993/94.
- No. 17 JGOFS Arabian Sea Process Study. March 1995
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- No. 22 Report on the International Workshop on Continental Shelf Fluxes of Carbon, Nitrogen and Phosphorus. 1996
- No. 23 One-Dimensional models of water column biogeochemistry. Report of a workshop held in Toulouse, France, November-December 1995. February 1997
- No. 24 Joint Global Ocean Flux Study: Publications, 1988-1996. October 1997.
- No. 25 JGOFS/LOICZ Workshop on Non-Conservative Fluxes in the Continental Margins, October 1997.
- No. 26 Report of the JGOFS/LOICZ Continental Margins Task Team Meeting, No 2, October 1997.
- No. 27 Parameters of photosynthesis: definitions, theory and interpretation of results. August 1998

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- The Joint Global Ocean Flux Study: Background, Goals, Organizations, and Next Steps. Report of the International Scientific Planning and Coordination Meeting for Global Ocean Flux Studies. Sponsored by SCOR. Held at ICSU Headquarters, Paris, February 17-19, 1987
- North Atlantic Planning Workshop. Paris, September 7-11, 1987
- SCOR Committee for the Joint Global Ocean Flux Study. Report of the First Session. Miami, January, 1988
- Report of the First Meeting of the JGOFS Pilot Study Cruise Coordinating Committee. Plymouth (UK), April, 1988
- Report of the JGOFS Working Group on Data Management. Bedford Institute of Oceanography, September, 1988

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Ms. Judith R. Stokke, Adm. Secretary
JGOFS International Project Office
Centre for Studies of Environment and Resources
University of Bergen
N-5020 Bergen, NORWAY

Tel: (+47) 55 58 42 46
Fax: (+47) 55 58 96 87
E-mail: jgofs@uib.no
URL: <http://ads.smr.uib.no/jgofs/jgofs.htm>

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JOINT GLOBAL OCEAN FLUX STUDY
Minutes of the
11th Scientific Steering Committee Meeting
18 - 22 April, 1996
Bad Münstereifel, Germany

**1. Welcome and
Introductions:**

JGOFS Chair, John G. Field, opened the 11th Meeting of the JGOFS Scientific Steering Committee at 08:30, 18 April 1996, which was held in conjunction with the IGBP Congress. He welcomed the members of the Committee, Chairs of the JGOFS Task Teams and Planning Groups, JGOFS guests from the Continental Margin Task Team, SC-IGBP Chair, and SCOR Executive Director. Field introduced the 5 newly appointed 1996 Committee Members along with the new JGOFS Executive Officer. The IGBP Secretariat officers rotated *ad hoc* among all SSC Committee meetings. Because of the Congress schedule, the Committee met all day Thursday and half days on Sunday and Monday.

Present

JGOFS Chair and Vice Chair: John G. Field; Liliane Merlivat

JGOFS Executive Members

Egil Sakshaug; James McCarthy; Roger Hanson(EO), Neil Swanberg (IGBP), Elizabeth Gross (SCOR)

JGOFS Scientific Steering Committee

Robert Moore, Alex Bychkov, S. Krishnaswami, Graham Shimmield, Kari Lochte, K. -K. Liu, Julie Hall, Bronte Tilbrook, Jürgen Willebrand

JGOFS Task Teams and Planning Groups (Chairs)

Roy Lowry (DMTT), Julian Priddle (SOPG), Michael Fasham (NAPG), Trevor Platt, (GS&MTT), Peter Burkill (IOPG)

IGBP Secretariat (Executive Officers)

Chris Rapley, Peter Liss, Risa Rosenberg, João Morais

JGOFS Guests

Jarl-Ove Strömberg (SCOR), Koji Terada (Japan NASDA), Andy Watson (IOC-CO₂ Panel), Roger Harris (GLOBEC-Ch.), Arthur Chen (CMTT Mbr), Isao Koike (SC-IGBP), Coleen Moloney (CMTT Mbr)

JGOFS SSC In Absentia:

Hugh Ducklow, André Morel, James Murray, Taro Takahashi

**2. Agreement on the 11th
SSC Agenda and Schedule**

The agenda for the 11th Meeting of the JGOFS Scientific Steering Committee with briefing items were circulated prior to the meeting. Schedule changes were announced: (1) the times for TT and PG Reports would depend on chairs' attendance due to their late arrival or early departure; (2) the closed Joint JGOFS-LOICZ CMTT Meeting would shift to Thursday afternoon; (3) the Committee would meet again on Sunday and Monday mornings to continue general business; (4) the Committee meeting would be adjourned at noon Monday; and (5) a brief Executive meeting would follow the Committee meeting. The agenda with noted changes was approved.

**3. Minutes of the 10th JGOFS
SSC Meeting from the
Villefranche JGOFS
Symposium**

Minutes of the 10th JGOFS Committee Meeting were not written because of the logistics of the Symposium, sharing of minutes by Ducklow and Gross, and hiatus in the JGOFS Core Project Office. Therefore, formal Minutes were neither prepared nor approved at the 11th Committee Meeting. However, Gross prepared a list of items that required Committee attention. It was determined that most items on the list would be dealt with during the course of the 11th Meeting.

Villefranche Symposium Synthesis Volume-Status.

Only 7 high quality manuscripts have received peer review (Volume Editors Field and Ducklow). About 5 manuscripts remain missing from the Symposium. Field reviewed the Symposium's presentations and identified gaps in the Synthesis Volume. Committee recommended that

symposium authors be reminded to submit their manuscripts by 30 June 1996. Field noted that additional manuscripts from JGOFS participants might be needed to round out the Symposium Synthesis Volume, so as to represent a good cross-section of JGOFS.

ACTION: Volume Editors need to notify authors that symposium manuscripts are due, 30 June 1996.

IGBP evaluation and recommendations.

On Monday, Field reviewed ICSU/IGFA/IGBP evaluation and recommendations. On the issue of collaboration with IGAC, JGOFS Committee agreed that tighter links and integration are needed with IGAC. JGOFS air-sea component can expand greatly with IGAC and thus enhance a better understanding of the mechanisms involved in CO₂ fluxes at the air-sea interface. Based on the discussion at the Oceans Session, Moore elaborated on IGAC needs for berthing space on JGOFS cruises in support of additional studies. The JGOFS Committee felt that they can help national committees to secure additional ships and ship time with "Letters of Support". Field noted that JGOFS CPO with Executive Approval can respond rather quickly in support of national requests.

Burkill expressed a concern that the Committee should be casting a bottom up approach rather than a top down approach. He argues that IGAC should be formally associated with JGOFS CO₂ interests. However, McCarthy noted that historically IGAC has never been interested in the CO₂ problem until recently, as they have been entrenched in other marine aerosols. IGAC has now a responsibility in this area and should become active in future JGOFS activities. In the past, IGAC has interfaced with JGOFS in the Arabian Sea Study and the North Atlantic Bloom Experiment.

ACTION: Field encouraged all Committee members to interface with IGAC activities and *vice versa*.

Shimmiel recommended that JGOFS respond directly to Professor Lal. The IGBP Review Committee made reasonable recommendations on the JGOFS science plan. For example, JGOFS should address deep ocean fluxes and continental margins to bring the JGOFS program into the mature phase. Although Field recognized the shortcomings of the program, as mentioned by the Review Committee, the problem lies at the national funding agencies in support of the JGOFS Science Plan for the international

program. For example, the National Science Foundation dropped the sediment work in the Arabian Sea program, which left a big hole in the international program. McCarthy mentioned that although Professor Lal emphasized five shortcomings, the synthesis and modelling phase of JGOFS is now the most critical phase to the overall success of JGOFS. We must eagerly seek continued funding for synthesis and modelling from our national sponsors beyond 1999. He asked if there are any plans to do this? If not, some thought should be given to this soon. This is the single most visible shortcoming in JGOFS.

4. Goals of the IGBP Congress-Introduction, Purpose and Arrangements

Field reviewed the goals of the IGBP Congress, including the Theme and Special Science Sessions. In the opening address of the Congress, IGBP requested that all Committees have representation at each Theme Session. Liss reiterated and emphasized that the operational goal for the Congress is to integrate Programme Elements in IGBP, and he encouraged JGOFS Committee to select representative(s) to each Theme Session and report back to the JGOFS Committee. For **IGBP and Total Earth System**, Field and Tilbrook will report on the session to the JGOFS Committee. For **Scaling**, which is mostly terrestrial, Field felt that there is a marine interest folded within the Scaling issue. No one seemed immediately interested, but Liss again emphasized that there must be Programme Element representation at each session to explore and establish commonality. Platt mentioned that Scaling applies to marine systems and that he would attend and report on the Scaling Session. For **Global Change and Food Supplies**, Field felt that this session was within the realm of GLOBEC (marine fisheries). Harris (GLOBEC Chairperson) agreed to represent JGOFS interests here with support from McCarthy. For **Closing of Carbon and Nitrogen Cycles**, McCarthy would report. For **Capacity Building and Global Change Science**, Lochte would report with support from Gross. The chairs (Field and Baut-Ménard) canceled the session on Terrestrial and Aquatic Ecosystem. For **Ice/Variability**, Krishnaswami would report. For **Ecological Buffering in Global Change**, Harris would report with support from Priddle. For **Database Management**, Lowry would report with support from Hanson and Hall.

Field discussed the organization of the upcoming Oceans Session. The Oceans Session would be arranged under five discussion areas with topic speakers. Field listed the 5 working areas, activities, speakers, and priorities. Liss felt that the topic area of ocean biogeochemical forcing is a two dimensional process and it would be best to say, "Ocean-Atmospheric forcing of biogeochemical cycling". In other working areas, Harris will address GLOBEC's "Physical Forcing of Biological Organization: Biodiversity and Dynamics" and GLOBEC collaboration with JGOFS synthesis and modelling. Platt will lead the presentation on "Modelling as a Synthesizing Activity" with GAIM reporting on their activities in Ocean Carbon Modelling. Several Committee members expressed concern if there are any plans to discuss the hierarchy of modelling activities. Field felt that this could be handled under "Modelling as a Synthesis Activity".

5. JGOFS Scientific Steering Committee Membership

Field introduced the recent concerns of the IGBP Secretariat over the size of SSC membership and their effectiveness. With decreasing budgets and increasing travel costs, IGBP Secretariat has proposed a new structure for Committee memberships along the lines of IGBP-SC. The IGBP-SC is composed of a small group of executive members, plus Chairs of all IGBP Core Projects and framework activities, Chairs of IHDP and WCRP, and Officers of IGBP. The JGOFS Committee presently stands at 17 members. With SSC invitations extended to Task Teams (8) and Planning Groups (4) Chairs, as proposed by IGBP, the Committee would expand to 21 in 1997. However, over the next few years, this number would decline to about 15. The disadvantage of this proposal is balancing national, gender, and discipline representation.

Liss opened discussion and emphasized IGBP position. Usually, Programme Element Executive Committee and the chairs from Task Teams and Planning Groups do most of the work on the Committee. Although the JGOFS Committee supports IGBP size reduction of Scientific Steering Committees, present balance among international members would be difficult, especially from developing nations, under the proposed plan. McCarthy noted that because JGOFS has a planned lifeline, JGOFS requires international participation for links to other national elements and discipline balance. McCarthy recommended that JGOFS should look seriously at the recommendations proposed by

IGBP, especially now when JGOFS has reached maturity with a focus on program integration, synthesis and modelling. Field agreed that the JGOFS community should support the importance of cross-linking with other National Committees and Programme Elements of IGBP.

Gross emphasized that with a basic Committee core of 5-6 executive members plus chairs (7) of the Task Teams and Planning Groups, a Committee membership would be made up of leaders and would conform to present IGBP policy of 12 Committee members per Programme Element. Field deferred further discussion of IGBP proposal until Monday when current membership, scheduled rotation, and 1997 Committee nominations would be addressed.

On Monday, Field continued with the discussion of the IGBP Committee reform. It still remains a problem as to how to proceed. He recommended that the reform could be phased in over the next three years. Liss agreed that Committee members could rotate off as scheduled with the aim of focusing on a smaller and effective Committee.

Five members are presently scheduled to rotate off this Committee, 31 December 1996. Although Committee members are rotating off, a few are presently focused JGOFS activity chairs. If the IGBP and SCOR approve a restructuring plan, they will be asked to remain on the Committee or until their leadership shifts or until the activity is disbanded. This year, the Committee Chair is also scheduled to rotate off the Committee and the present Executive Committee will recommend a new JGOFS Chair nominee to IGBP and SCOR for appointment. Nominations for JGOFS Chair are solicited from National Committees and Committee membership. Nominees must be or have been involved with the Scientific Steering Committee and/or a focused JGOFS activity. The incumbent Committee Chair usually decides the Executive Committee members from among the SSC in July.

ACTION: The Executive Committee to develop a SSC restructuring plan and to nominate a new SSC Chair and SSC member(s) to both sponsors for approval and appointment, respectively.

6. JGOFS International Project Office

Field briefed the Committee on his visit to Bergen and the new JGOFS Core Project Office. The new Executive Officer, Roger B. Hanson, established the office at the University of Bergen and appointed Judith Stokke as Administrative Secretary. The interviews of the candidates for

the Assistant Executive Officer are continuing. Hanson elaborated on the status of JGOFS Office staffing, the interviews of the AEO candidates, and office priorities for the coming years, 1997 and beyond. The Office received financial support from the Norwegian Research Council, the University of Bergen/Meltzer Foundation and office space in the Centre for Studies of Environment and Resources. In the coming year, the highest priorities for the Office will be to establish a JGOFS CPO Homepage with links to IGBP Secretariat, IGBP Programme Elements, national JGOFS Project Offices, national ocean data centers and/or JGOFS data centers.

7. Reports and Planned Activities from Task Teams and Planning Groups

North Atlantic Planning Group Report. Fasham reported that national funding is doubtful for a North Atlantic Ocean JGOFS program. At present, funding agencies in Canada and the US are redirecting their resources to other national programs. Details are provided in the NAPG report from the May 1995 meeting in Bergen, Norway. Lochte commented that the present North Atlantic situation is an excellent example where the funding of international projects separately and independently of national funding agencies would have been helpful. There is no shortage of U.S. scientific interest in the North Atlantic, said McCarthy, but rather the National Science Foundation is holding US-JGOFS to its original time frame for fieldwork, which runs through 1999. The US-JGOFS field program will close with the completion of the Southern Ocean. Nevertheless, there remains a strong scientific interest in completing the WOCE/JGOFS-CO₂ survey in the North Atlantic. The important issue here is in securing commitments from U.S. national funding agencies to finish the global ocean survey. As yet, there has been no commitment from the U.S. Department of Energy on funding the last North Atlantic WOCE/JGOFS-CO₂ line.

Gross asked about the possibility of UK institutions supporting JGOFS core measurements on other North Atlantic Ocean projects, so as to keep some UK-JGOFS groups together. As yet, there is no plan with this thought in the funding UK institutions, said Fasham. The Committee asked, "what value would these *ad hoc* core measurement be to JGOFS? Fasham said that *ad hoc* measurements would be very useful for future modelling efforts. Sakshaug felt that the highly

rated North Atlantic science proposal should be resubmitted to Brussels. However, there is the impression within the scientific community that the EC wants to develop technology, which makes this oceanography proposal unlikely, said Fasham. A modelling proposal, however, will be submitted to the EC soon. However, Brussels is difficult to pin down as to what they want. So, it's doubtful at best.

Fasham also said that other ongoing programs related to the North Atlantic Ocean will continue, e.g., WOCE CO₂ survey measurements, invitation of JGOFS modellers (e.g., Sarmiento) to GAIM workshops; assemble a global CO₂ database (IOC-CO₂ Panel, Andy Watson, chair). IMAGES is another program where PAGES (JGOFS) is developing plans in the North Atlantic, said Schimmiel.

Fasham asked the Committee for guidance on how the NAPG should proceed or complete its task. The NAPG is presently composed of seven members. McCarthy said that it was important to keep this group intact to help nations with synthesis issues and finding support. Therefore, the role of this group should shift to coordination, synthesis, and modelling. If the North Atlantic CO₂ measurements are not completed, it leaves a very large hole in our understanding of the North Atlantic Ocean. Willebrand also emphasized the importance of this group, as it will become more difficult to acquire support and funds to assemble data for modelling and synthesis. Lochte recommended that they resubmit the modelling component of the proposal to the EC and that the North Atlantic Ocean Synthesis must be the major task for the NAPG. Because of this urgency, NAPG requested a meeting for 3-4 people to develop new emphasis and goals for the NAPG. Field noted a Committee consensus to retain the NAPG and Fasham as the Chair, and to restructure the NAPG towards synthesis.

ACTION: Field asked Fasham to develop new goals and emphasis (Terms of Reference) for the North Atlantic Planning Group.

Synthesis and Modelling Task Team Report. Platt reported on the Toulouse Workshop that was arranged by G. Evans (Canada) and V. Garçon (France). A report was distributed on the JGOFS Modelling Workshop on 0- and 1-Dimensional Models of Upper Ocean Biogeochemistry. Participants from 9 countries submitted their models to be tested on system hardware with a common data set. From some initial simulations, parameters were extracted for comparison. Unfortunately, because of facility problems, only a few comparisons were conducted and for only one

site. From these limited comparison, the models appear to have problems. The outputs were not consistent between models.

Platt said that the workshop theme was a good idea for a small group directed to a broader group of people. The effort resulted in high level discussions, apart from the technical difficulties. Although the Toulouse Workshop was too exclusive with limited national participation, the SMTT could be tasked to help educate and train the next generation of ocean biogeochemical modellers. He recommends that JGOFS should take the lead to target JGOFS modelling interests, and then asked the Committee for advice.

Field felt that modelling workshops are of great importance. Swanberg asked if SMTT has communicated with GAIM and also inquired about the topic under the Oceans Session. Tilbrook felt that JGOFS efforts need stronger links with GAIM. Platt said that this will be developed, but JGOFS SMTT group is presently more versatile than GAIM. Platt also said that he represents JGOFS on GAIM issues. Field said that JGOFS will continue to work towards greater integration at the Oceans Session.

The Committee supported Platt's suggestions. Small groups of different modellers are the best way to arrange workshops, and at the same time it's great for capacity building and visibility for JGOFS. These workshops will also help biogeochemical modellers incorporate their models into large scale GAIM modelling programs. At the Programme Element level, CMTT is proposing parallel continental margin modelling workshops in Nigeria and again later in The Netherlands. Between LOICZ and JGOFS, there is good coordination of modelling efforts. Training future modellers within developing countries is very important, especially in the use of core measurement data.

ACTION: Field asked Platt to organize a JGOFS Synthesis and Modelling Workshop, Modelling Symposium, and a training course over the next three years.

Continental Margin Task Team Report: Joint JGOFS and LOICZ SSC Meeting (Closed). On Thursday afternoon, both Committees convened for the first CMTT Report. Field and Edgardo Gomez (LOICZ SSC Chair) co-chaired the meeting. After general SSC introductions, Hall reported on the "CMTT Terms of Reference" and Smith (LOICZ SSC) reported on "CMTT Recommendations", i.e., workshops for fall 1996 in Nigeria and then again in The Netherlands for 1997. The first workshop will consist of presentations from four coastal margins: East

China Sea, Chile-Peru Shelf, North Sea, and the Gulf of Guinea. The purpose of the workshop is to provide a better understanding of fluxes between continental margins and the Open Ocean. Hall agreed to organize this workshop, which will be hosted by Nigeria. From the first workshop, a follow up workshop will be planned for synthesis, which will be hosted by The Netherlands LOICZ Office.

Committees expressed concerns about core measurement protocols. CMTT coordinators affirmed that LOICZ and JGOFS guidelines and protocols will be followed for CMTT projects. Other concerns focused on how water circulation and fluxes will be addressed and the difficulty of developing budgets across shelves. Smith and Hall agreed that the water budget varies with site selection, and that modelling efforts require careful attention. Developing carbon budgets on continental shelves, the Workshop will need to focus at the interface between both systems, as the budgets of continental shelves are quite different from those in estuaries. Eventually, CMTT Workshop efforts should move towards 3-D models.

Both Committees approved CMTT Recommendation on the "first Workshop in Nigeria. Swanberg asked the co-chairs, who would fund the first workshop? Field and Gomez agreed that first workshop would be supported jointly.

ACTION: CMTT should proceed immediately with the organization of the Nigerian CMTT Workshop (fall 1996). Initial Workshop plans were developed during the Congress and are annexed here for the record.

Hall then presented the "Guidelines for Designating Joint JGOFS/LOICZ CMTT Projects". Project designations would be made on a case by case basis and would remain flexible because of the heterogeneous environments. In JGOFS interests, oceanographers would direct JGOFS research interests at the ocean-shelf margins. Project leaders would also receive direction (advise) from the CMTT and their National Committees. JGOFS and LOICZ Executive Officers would be kept informed and receive relevant information on projects designated by CMTT.

JGOFS Committee expressed some concern over the document language that designated projects as JGOFS beyond the year 1999. CMTT had discussed and recognized the discontinuity in the time lines for JGOFS and LOICZ. However, not all National JGOFS Programs are winding down in 1999. Gomez also expressed concerns over

program interests of designated projects and funding projects to completion. The CMTT realized that these were legitimate concerns, which explains why the guidelines were structured loosely.

Swanberg raised a concern about JGOFS and LOICZ interfacing on the designation of CMTT projects. Lochte recommended that the workshop participants review these guidelines and revise them in Nigeria. The CMTT agreed with this recommendation. Field summarized the comments of both Committees and thanked the CMTT for their efforts. Field and Gomez approved CMTT Workshop recommendation. The “first” workshop on Continental Margins will be held in Lagos, Nigeria.

ACTION: JGOFS and LOICZ CP Officers were tasked with arranging support for the Nigerian Continental Margin Workshop.

Field asked if there were any other joint efforts or projects that needed consideration by the Joint JGOFS-LOICZ Scientific Steering Committees at this time. Pedersen from PAGES asked for time to promote IMAGES to the JGOFS and LOICZ Committees. He identified areas of commonality and encouraged stronger linkage and communication between programs. Field concurred with Pedersen and noted the Oceans Session for further discussion.

Photosynthesis Measurements Task Team-Final Report. Sakshaug reported on the revised PMTT Final Report. Committee praised the report but expressed concerns over the use of the unpublished symbols (e.g., “E” for Irradiance) in place of the accepted symbol “I” for measuring light absorption and quantum yield of photosynthesis in marine phytoplankton. A change in the use of symbols would create confusion within the community. Therefore, the Committee recommended that the PMTT address the need of revising the report to conform to the published parameters.

ACTION: Field asked the PMTT to discuss the use of new symbols and submit revised Final Report to JGOFS for SSC approval for publication as JGOFS Report.

ACTION: Field asked JGOFS EO to distribute the revised Final Report to JGOFS Executives and the previous readers for comment.

Remaining tasks of the PMTT: (1) liaise with other Task Teams, in particular the “Remote Sensing” and “Synthesis and Modelling”, on

scaling problems, (2) evaluate further the non-interfering methods, (3) address Gross, Net, and DOC production as a function of incubation time, i.e., What is it that we measure? and (4) how does one interpret the differences, i.e., the pros and cons of O₂ vs. ¹³C vs. ¹⁴C methods. Sakshaug requested a Task Team Meeting (or mini-symposium with 5-6 additional participants) in 1997 to address task #3 and #4. The site initially proposed was Spitzbergen.

ACTION: The Committee approved PMTT request to organize a small symposium to complete the tasks outlined above.

Sediment Trap Technology Report. On Thursday afternoon, Field asked Moore to review Gardner’s report on “Sediment Trap Technology and Sampling in Surface Waters” and report to the Committee. On Sunday morning, Field briefed the members on the background and asked for advise on publication as a JGOFS Report. Moore felt that the document lacked quantification and style for a JGOFS Report. In addition, the report appeared argumentative to the Committee. The Committee felt that the report is certainly useful and recommended possibly a Committee Report or wider distribution. Because the report came from the SSC in Villefranche, Gross suggested that it be annexed to 10th SSC Minutes or publish it as a Scientific Steering Committee Report.

Initially, funding agencies asked JGOFS to discuss the reliability of shallow sediment traps. In this regards, the discussion on sediments trap was quite good and the section on major recommendations was the most important section. It is too late for JGOFS to follow up on the recommendations, as the field program comes to a close over the next three years. However, there are important items here for future ocean studies. Willebrand and McCarthy mentioned that the outside community needs to follow up on these recommendations and issues, and develop new techniques for upper ocean sediment traps. Lochte also felt that the report should direct its recommendations to the general oceanographic community, not just the JGOFS Committee.

The Committee agreed that this should be one of JGOFS legacies to oceanography, especially as oceanographers move towards shallow waters. However, it must be made clear that deep traps are good and provide needed links to other programmes, e.g., PAGES. Therefore, the Committee recommended that Gardner focus on the upper water column problems and include a section on, for example, scientific value of sediment traps.

Field summarized the Committee's views. The report would be useful to National Committees and oceanographic community if revised in the form for a JGOFS Report or even the Symposium Synthesis Volume. However, many of the recommendations will be very difficult to accomplish, especially for JGOFS, as they are not simple and would require additional field experimentation (i.e., ship time).

ACTION: Field will contact Gardner about revising the document for a JGOFS Report, as discussed above by the Committee.

Time Series Report. Gerold Wefer, TSTT Chair, was not present. Gross noted that the TSTT was disbanded earlier. Field then informed the Committee about the implementation plan for time series stations within GOOS, which would be at no cost to JGOFS. This is expected to occur within the year. Merlivat questioned the future support for JGOFS Time Series Stations. McCarthy mentioned that the U.S. funding agency has a ten-year commitment to BATS and HOTS (1989-1999) and future funding of these stations beyond 1999 is under review.

ACTION: none

Southern Ocean Planning Group Report. Julian Priddle, SOPG Chair, distributed copies of the JGOFS Southern Ocean Regional Study and briefed the Committee on the Brest Symposium (September 1995). Research gaps in Southern Ocean research included: (1) winter CO₂ measurements to assess interannual variations, (2) iron limitation studies, as well as silicate limitation studies, to examine the HNLC paradox, (3) ocean and atmospheric measurements (physical forcing) to evaluate oceanic blooms, (4) instrumentation development to describe physical field at scales of biological processes, and (5) ultraviolet radiation measurements to assess its impact on biogeochemical processes. Recommendations included: (1) establish national programs other than JGOFS to assess the impact of UV radiation on community biodiversity, (2) develop schemes to identify biogeochemical provinces and key biotic systems, (3) develop research linkage with SCAR GLOCHANT at the marginal ice zone, (4) develop protocols and algorithms for using Southern Ocean satellite data, (5) identify proxies for past and contemporary processes, and (6) initiate synthesis and modelling.

Merlivat expressed concerns over the Southern Ocean CO₂ data sets and whether the region is a CO₂ sink. Tilbrook confirmed carbon dioxide

results on the Southern Ocean and that it functions as a CO₂ sink. Watson mentioned that the present confusion is over the data sets used to estimate carbon flux. Tilbrook informed the Committee that there are better estimates now and that the Southern Ocean may be a bigger CO₂ sink than once thought.

Strömberg mentioned that the Southern Ocean-GLOBEC will soon need support from SO-JGOFS modelling activities and urged future JGOFS cooperation. The Committee confirmed JGOFS cooperation in GLOBEC Modelling activities. Platt requested ideas or themes for an international Southern Ocean modelling workshop or symposium. On the CO₂ sink issue, he cautioned the Committee that the high latitude sink number is an average (number) and that it should not be used for modelling or budgets.

Tilbrook asked about SO-JGOFS interaction with other programs, e.g., SCAR. The Committee was told that there should be SCAR-JGOFS projects in the future. Other questions: Field asked about the membership size of the Planning Group and for how long the group planned to meet. The SOPG is composed of twelve members. Priddle recommends maintaining the group as formed. They plan to meet on average once a year or less frequently. Field thanked Priddle and the group for their efforts in preparing the Southern Ocean Report. Although the SOPG is still active, Field reminded the Committee that the SOPG may need to be disbanded or restructured when they completes their Terms of Reference.

ACTION: Possible meeting is planned for 1997.

Indian Ocean Planning Group Report. Peter Burkill, present IOPG Chair, informed the Committee that an IOPG Report will be submitted later (CPO received it May 1996). The current phase of the Process Study has been completed, which represents the largest JGOFS field program with ships from France, Germany, India, Netherlands, Pakistan, UK, and the U.S. The field studies also included calibration exercises using comparable data sets. Several scientific milestones were mentioned, e.g., National and International Science Meetings and a Remote Sensing Training Course in India. Presently, the program has produced several cruise reports, publications, and national data sets on CD-ROM from Holland, Germany and UK. The program has also contributed substantially to the capacity building in the region, e.g., various training programs, at a cost of over \$2.5 million USD, excluding intangibles. Future plans include the Final Field Phase of the Process Study, which is scheduled for August 1996, the proposed

synthesis meeting (1997), and presentation of Indian Ocean cruise results at The Oceanography Society (Amsterdam, July 1996) and American Society of Limnology and Oceanography (San Diego, February 1998). Future issues will focus on data merging and integration, as well as synthesis and modelling.

IOPG recommends: (1) the JGOFS CPO/AEO develop a cruise inventory of all National Indian Ocean Programs by early 1997, (2) the Indian Ocean database be assembled on CD-ROM, (3) the IOPG be disbanded after the final Process Study cruise or restructured towards synthesis and modelling, and (4) an Indian Ocean Synthesis Meeting in late 1997.

Recommendation: Burkill requested that JGOFS write a letter expressing our appreciation to Bernt Zeitzchel, past IOPG Chair, for his efforts in the organization, planning and implementation of the Indian Ocean Process Study (Arabian Sea).

Recommendation: Burkill request that the CPO/AEO develop an inventory and a database for the IO Process Study, and assemble the inventory and database on CD-ROM with DMTT assistance.

Lowry (DMTT Chair) supported IOPG recommendation on the CPO/AEO to develop a cruise inventory of all national IO programs. Platt addressed synthesis and modelling, and asked how IOPG plans to get it done and/or thoughts as how it will be tackled in other groups. IOPG plans to interface with SMITT on these topics.

Data Management Task Team Report. Lowry, DMTT Chair, distributed copies of a draft proposal for the German JGOFS Arabian Sea CTD CD-ROM development. The earliest time possible for the next DMTT meeting would be fall 1996. Several achievements have occurred since the Villefranche Meeting: (1) BODC has been resourced to electronically publish all the data from the UK-JGOFS Arabesque Arabian Sea cruises, (2) a proposal for the construction of EUMELI data set on CD-ROM has been prepared, (3) the appointment of Thomas Mitzka at IFM, Kiel has been approved, and (4) documentation of the German Indian Ocean operations and development of Indian Ocean data sets on CD-ROM is underway. Zeitzchel has been very keen on developing the German JGOFS Arabian Sea data sets on CD-ROM. This draft proposal is the first step. He also reminded the Committee of the DMTT recommendations from the Villefranche Meeting.

Recommendation: The next CPO/EO should provide an inventory of all JGOFS cruises and data, including the Indian Ocean, the Equatorial Pacific, the Southern Ocean, and the North Atlantic Bloom Experiment.

Recommendation: The CPO/EO should make this inventory available through the World Wide Web.

Recommendation: The CPO/EO should provide resource support to those involved in the construction and documentation of JGOFS data sets and metadata.

McCarthy emphasized the importance of Mitzka in the German JGOFS program and the need for someone at this time to work on the international JGOFS data sets. Field added that Ulf Lie (Norway) is willing to help support the funding for a Database Manager. Lowry felt that he would like to appoint a person for exactly that purpose and have that person located at Bergen. He emphasized that we need to have something to show soon, and would like a recommendation from the JGOFS Committee to facilitate this appointment.

ACTION: Field to write a letter of support for the need of an international JGOFS Database Manager at the Core Project Office.

Remote Sensing Task Team Report: Yoder, RSTT Chair, was unable to attend this Committee Meeting. The Task Team is presently inactive as a Final Report was approved at the Villefranche meeting. Gross confirmed that the RSTT Report has been completed and is ready for publication as a JGOFS Report.

ACTION: JGOFS CPO/EO to proceed with the publication of the RSTT Final Report on Remote Sensing in the JGOFS Program.

North Pacific Ocean-Report on Activities: Koike (SC-IGBP) along with Bychkov reported on JGOFS related activities in the North Pacific Ocean. Koike began with a brief description of the North Pacific study area, mentioning the expanse of the region, site of intermediate water formation, contribution to CO₂ exchange and atmospheric carbon input, the strong chemical gradients from west to east, and the supply of atmospheric iron in the region. Japan's activities in the Northwest Pacific include the support of the long-term record being collected at Station Papa, collaboration with

Canadian Northeast Pacific JGOFS program, involvement in North Pacific WOCE survey from 1977-99, support of the time-series program in the Northwest Pacific until year 2000, and collection of oceanographic data along a cruise line between Japan and the United States. Future plans are to continue these studies as to better understand the influence of Global Climate Change on biogeochemical processes in the Northwest Pacific Ocean.

Bychkov reported on Russia's interests in the North Pacific Ocean. Current programs include the international North Pacific Ocean-Climate Program and the International Consortium on the Sea of Okhotsk. Other interests include the ocean circulation of the eastern Asia marginal seas, the formation of Pacific Ocean Intermediate Water, and the ocean's biological carbon pump. In the Sea of Okhotsk, Bychkov presented a few overhead views on the biological-physical carbon pump and ocean CO₂ data. The presentation indicated a very interesting study area of possibly important carbon exchange.

Bychkov requested advise about their plans to form a JGOFS planning group for the North Pacific Ocean. The Committee supported the idea on the formation of a North Pacific Planning Group. However, some Committee members thought that the area suggested was too far north for Intermediate Water formation, which likely occurs between 30° and 40°N. A short discussion followed on the location of a North Pacific site; e.g. CO₂ saturation values and possible CO₂ sink in the proposed area. Watson says that there are now new numbers on the sink question, which suggest a very weak sink. Bomb C¹⁴ data from 30° and 40°N would be helpful in this biogeochemical province. Others felt that methane carbon is an issue and most relevant in North Pacific, since denitrification is very important in the region. Recent results suggested that the eastern and western boundaries are quite different with regards to methane carbon flux.

Field restated Bychkov and Koike's proposal to organize a North Pacific-planning group. McCarthy asked about the Terms of Reference for the North Pacific group and how this one would evolve relative to other Terms of References. Although JGOFS status nears completion, North Pacific group could take advantage of ongoing programs and provide support to their National Committees. Koike acknowledges the importance of this recognition, especially in Japan.

ACTION: Field asked Koike and Bychkov to draft Terms of Reference for the North Pacific group for discussion. Merlivat and Chen offered to advise the writing of the Terms of Reference.

Synthesis and Modelling Task Team Report.

Platt, SMTT chair, addressed the SMTT proposal to organize a JGOFS Modelling Symposium, Workshop, and Course. The JGOFS Modelling Workshop would bring together six participants for 5-10 working days to develop protocols and algorithms by which frozen boundaries of biogeochemical provinces can be made elastic and defined in real time. The Test Ocean will be the North Atlantic. The location (tentatively late 1997) remains undetermined. Workshop participants would produce protocols, algorithms, and manuscripts.

Platt also proposed a JGOFS Modelling Symposium. It is needed to advance synthesis functions. The symposium would bring together fifty observationalists and theoreticians for about five days in 1997 to discuss a suite of critical issues and themes. Themes suggested: (1) export of particulate and/or dissolved organic carbon, (2) remineralization of organic matter, (3) production paradox in HNLC regions, or (4) coupling JGOFS biogeochemical models to earth systems models. The format would be lectures and discussion, posters, computing demonstrations, and possibly model output.

Platt also proposed a training course on "JGOFS Modelling of Ocean Biogeochemistry" in early 1998. The course would expose modelling methods and scope of modelling ocean biogeochemistry to ocean scientists from non-industrialize countries and hopefully to a broader range of individuals than the existing community of JGOFS modellers. Fifty participants are being planned for lectures and demonstrations during 10 working days (minimum). The location will be outside of normal range of countries with expertise in modelling. Lecturers and demonstrations are sought for the course for out reach and capacity building.

ACTION: The Committee supported SMTT proposal to organize a workshop, a symposium and a course with a focus on JGOFS synthesis and modelling, out reach, and capacity building.

Priddle asked if the Toulouse Workshop results would be made available. Platt mentioned that Geoff Evans should have a detailed Toulouse Modelling Report available shortly for JGOFS.

8. Reports from Other JGOFS Related Meetings (1995 and 1996):

Carbon Dioxide Panel Meeting Report (Puerto Rico). Watson reported on the Ocean CO₂ Panel meeting, which was held in Puerto Rico, January 1996. The highlights included modelling studies using Global Circulation Models, time-series studies, and new technologies in marine chemistry. Watson noted that the IOC-CO₂ Panel felt that at this time, there is a complete and full global ocean pCO₂ data set. The problem is obtaining access to ocean pCO₂ data. This was alarming news to many Committee members. For example, McCarthy asked if seasonal and interannual data exist for all ocean regions. In the North Atlantic, there is an excellent WOCE database and for other regions, said Watson. McCarthy then noted that interannual pCO₂ variability in the ocean has never been a major responsibility of WOCE. In the U.S., CO₂ measurements are still needed and US-JGOFS has recommended the completion of the WOCE/JGOFS cruises in the North Atlantic. JGOFS scientists in the U.S. and Europe are deeply concerned about finishing the North Atlantic WOCE/JGOFS CO₂ lines. Their position contradicts a full global ocean pCO₂ data set. If what the IOC-CO₂ Panel says about the CO₂ database is correct, then it could seriously jeopardize present ocean CO₂ proposals, those projects presently supported to continue CO₂ measurements as well as the WOCE/JGOFS surveys in the North Atlantic Ocean.

In regards to data access problems, McCarthy noted that in the U.S., this isn't a problem. JGOFS, for example, has a data policy agreement, which is leveraged by the funding agencies. Watson said that this is generally the case in Europe as well. The access problem is with the depositories of non-JGOFS data sets, which are of concern to the IOC-CO₂ Panel. Field asked if the CO₂ Panel has a directory of where ocean pCO₂ databases reside? There are about 50 institutions in that directory, said Watson.

This year, Brewer, Brown, Maier-Reimer and Platt will rotate off the SCOR (JGOFS)/IOC-CO₂ Panel and the new members will be F. Joos (Switzerland) and Douglas Wallace (USA). Merlivat remains a member on the 1997 IOC-CO₂ Panel.

ACTION: none

Data Management DIS Workshop (Toulouse). No one represented JGOFS at this meeting in

February 1996. Swanberg noted that Ducklow planned to attend but an Antarctic cruise prevented him from going, and Hanson just arrived at the CPO in Bergen. Lowry recommended that the next JGOFS CPO/AEO represents DMTT on data management issues and attends the next DIS Workshop.

ACTION: Field asked Hanson and/or the new AEO to represent JGOFS at future DIS Data Management Workshops.

European JGOFS Marine Remote Sensing. Field informed the Committee of ERSCO activities (e.g., funding for the European Remote Sensing Co-ordinating Office) and the purpose of the Toulouse meeting in March 1996. ERSCO recommendations: JGOFS to write a supporting letter to NASDA and urge coordination with JRC, JGOFS supports activities beyond the local area coverage to data management system, and JGOFS propose workshops on ocean color sensors.

The Committee supported ERSCO proposal and a person to run the Co-ordinating Office for one year, and they recommended that the office be supported out of their project funds. Field described a funding discrepancy here. He believed that MAST money was initially denied for this proposal. But, then money came through for the Office and now they must use it in the best possible way. Following discussion, the Committee supported ERSCO first and second recommendations.

ACTION: Field would write a Letter of Support for the development of regional satellite databases and copy IGBP-DIS.

The third recommendation, e.g., a Workshop, is generally given to JGOFS Task Teams with approval from the Committee. The Committee felt that this recommendation was too vague and needed development (i.e., a proposal). ERSCO should first get the satellite databases in place before submitting a Workshop proposal.

No ACTION: Committee deferred the last recommendation to next year 1997, pending the establishment of ERSCO and the development of regional satellite databases.

GOOS/OOPC Meeting (Miami 1996). Field deferred the report on GOOS/OOPC (see Time Series Task Team under Section 9 (below).

9. Status of JGOFS Task Teams and Planning Groups

The Committee recommended that the “North Pacific Group” should be formed to coordinate JGOFS activities in the North Pacific Ocean. During the open discussion, the Committee also recommended that Bychkov form a task team and that this team is called the **North Pacific Task Team**.

It was proposed that the **Benthic Flux Task Team** be disbanded and that future business be handled under CMTT. Lochte questioned whether Deep Ocean business should be CMTT responsibility. She proposed a joint task team with PAGES. Schimmield agrees that JGOFS needs to address issues below the mix layer. Field felt that this was an excellent mechanism to interact with PAGES. Committee recommended that Lochte and Schimmield co-chair the Task Team and develop links with PAGES/IMAGES. Schimmield and Lochte later agreed that Schimmield will Chair and Lochte will co-Chair. Schimmield also proposed a name change for the Task Team and recommended “Deep Ocean Flux Task Team”. Committee approved the name changed from Benthic Flux Task Team to **Deep Ocean Flux Task Team**.

The **Time Series Task Team** was disbanded earlier and the Committee agreed not to reform Time Series Task Team but to incorporate its activities into GOOS/OOPC (Bermuda 1996). The Executive Committee will handle such activities with GOOS/OOPC in the future.

The **BOAT Task Team** is a joint activity with IGAC, but it needs a committee. Field appointed Tilbrook to be JGOFS liaison with IGAC. The Committee supported the development of BOATTT activities, especially in the North Pacific and North Atlantic Oceans. At present, funding is not looking good in the North Atlantic and links with the North Atlantic Planning Group are encouraged. Tilbrook felt that JGOFS needs to identify people in marine gaseous and to ask if they are interested. Lochte felt that she could suggest people and help Tilbrook establish these inter-programme links. IGAC key people are Nick Owens and Peter Liss.

The **Remote Sensing Task Team** has turned in their Final Report, but there are still other issues/business for the RSTT, e.g., ERSCO/ISPR Group and their interaction with Photosynthesis Measurement Task Team. Further action on the RSTT is deferred to next year 1997.

The **Photosynthesis Measurement Task Team** is planning a mini-symposium in 1997, which would be composed of task team members plus

seven guests. McCarthy felt that LOICZ needed to be involved. Sakshaug agreed. The 1997 PMTT would be modify and changes would be submitted to the Executive Committee for approval.

The **Data Management Task Team** is clearly needed as we move towards data synthesis, involvement of the Assistant EO in Data Management, and the possibility of funding an International Database Manager. Lowry felt that such plans are developing in the UK. Sakshaug suggested industrial funds for a Data Management Assistant.

The **Global Synthesis and Modelling Task Team** has several out-year activities planned. McCarthy emphasized that it is very important to provide encouragement of Toulouse Meeting organizers to finish their report. The community needs the report and the product needs to be shared. It was initially planned to publish in the open literature, and now it is expected to be a JGOFS Report with the software to run these models.

The **Continental Margin Task Team** has been established and future workshops are being planned. Hall indicated a positive response from LOICZ for the Nigerian Workshop.

The **IOC-CO₂ Panel** activities will require Merlivat to continue and sit ex-officio on the next JGOFS SSC. Merlivat remains a member on the IOC-CO₂ Panel.

The **North Atlantic Planning Group** will continue with basically the same core members with possible new members from other countries and IGAC.

The **Equatorial Pacific Planning Group** must report soon. McCarthy is not aware of any activity. Murray chairs the group and is largely U.S. based. Field recommended that EqPac coordinate with NPTT. Koike supported the coordination.

The **Southern Ocean Planning Group** is nearing its final phase in the field. Priddle will continue to chair and review their role in JGOFS.

The **Indian Ocean Planning Group** will shift their focus from the field to a synthesis mode next year. An Indian Ocean Synthesis Meeting is planned in 1997.

The **North Pacific Task Team** submitted a draft of their Terms of Reference and a discussion followed. In general, the TOR will required reorganization and revision. There were still questions about the geography/location of the North Pacific site, an area north of 40°N. The Committee felt that NPTT should not assign a specific area or region for political reasons. Other questions addressed the important process of nitrogen fixation in the North Pacific. Although nitrogen fixation is covered in other programs,

Lockte felt that it should be specifically stated in the TOR. McCarthy would also have liked more details, e.g., host organization, etc. There were other editorial and syntax concerns over the submitted TOR.

ACTION: Field asked Bychkov to act as NPTT Chair and to coordinate the writing and organization of the NPTT Terms of Reference. Bychkov will then submit the Terms of Reference and names of potential members of the NPTT to the Executive Committee for approval.

10. JGOFS Liaisons with IGBP and other International Programmes:

- **GAIM-** Fasham is JGOFS liaise with GAIM. GAIM and JGOFS Modeling Groups will interface with a small technical group. Presently, Program Elements lack two way communication and they must start nesting models.
- **START-**Hall and Moloney through the Continental Margins Task Team presently links JGOFS with START, e.g., CMTT (JGOFS/LOICZ) Workshop in Nigeria. START has asked JGOFS/SCOR for liaise to develop an oceanic program. There are oceanic issues here where the potential for interaction is extensive.
- **DIS-**Lowry noted that JGOFS EO and AEO will be JGOFS liaise with DIS. DIS has a working partnership with NASA in developing remote sensing databases.
- **GLOBEC-**Strömberg is JGOFS liaise. Strong links are developing with SO-GLOBEC through programme modellers.
- **CMTT-**Hall links JGOFS with LOICZ in Continental Margins
- **PAGES-**Shimmield links JGOFS with PAGES/IMAGES in deep ocean fluxes.
- **IGAC-**Tilbrook links JGOFS with IGAC via Nick Owens and Peter Liss.
- **GCTE-**JGOFS has interests in GCTE Transects.
- **BAHC-**JGOFS has minimal contact with BAHC.
- **LUCC-** Programme links with JGOFS through CMTT
- **WOCE-**Willebrand links JGOFS with WOCE.
- **WCRP-** WCRP is a potential parent of SOLAS
- **SCAR-** Priddle links JGOFS with SCAR.
- **IASC-**Sakshaug links JGOFS with IASC.

- **GOOS-**Field links JGOFS with GOOS and McCarthy links JGOFS with JGOOS.

11. Other JGOFS Business

Canadian JGOFS Programme. Field asked Moore and Platt to speak to the Canadian request for a JGOFS Letter of Support for CJGOFS. After a discussion of the Canadian request, the Committee unanimously supported the CJGOFS Program.

ACTION: Moore will draft a letter for JGOFS support of the CJGOFS Program for Field. Field to write to Bruce Johnson, Director of CJGOFS.

12. Future Committee Meetings

The International Geosphere-Biosphere Programme holds its Annual SC Meetings in February-March, followed by an Officers' Meeting in the fall. This may change in the near future, as a recommendation is now developing around the possibility of a biennial IGBP Congress. Other recommendations include linking JGOFS Scientific Steering Committee meetings with national and international science meetings or combine two or more Program Elements for joint SSC meetings, e.g., the Joint JGOFS-LOICZ SSC Meeting on continental margins.

The JGOFS Committee offered several site suggestions for their 1997 Meeting, e.g., The Netherlands at the time of the LOICZ Open Science Meeting (late 1997), Scotland at the site for JGOFS Modelling Symposium (location and time TBD), Cape Town (South Africa), and Williamsburg (USA). In selecting the next site, primary consideration is first the science and then the timetable of the Committee. Other suggestions offered to the Committee included the Arabian Sea Synthesis Meeting (TBD) and Task Team Workshops. Committee favored holding the next Committee meeting with the LOICZ Open Science Meeting or with a JGOFS Modelling Symposium. The problem here is logistic for fifty or more Symposium participants plus twenty Committee members.

ACTION: The Committee approved to hold the next Scientific Steering Committee meeting with the JGOFS Modelling and Synthesis Symposium, Argyll, Scotland (Spring 1997). Dates to be determined by the Symposium Organizers.

The next JGOFS Executive Committee Meeting is planned for Bergen, Norway (September 1997).

Dates to be determined at the Executive Meeting following the Committee meeting. McCarthy noted that the US-JGOFS Committee has scheduled its meeting at this time.

13. Closing Remarks

Field thanked Committee members, Task Team Leaders, and Planning Group Chairs for their help and cooperation, which made his task easier. He also thanked the out going Committee members, guests and participants for their contributions and special activities. Strömberg congratulated the Committee on being the most successful group to date and acknowledged Field's leadership for this success. Field noted his appreciation for the support he received from the Core Project Office and his gratitude for financial support from SCOR on financing the additional travel expenses for JGOFS guests. The 11th Scientific Steering Committee JGOFS Meeting was adjourned at 10:00, 22 April 1996.

14. Executive Committee Meeting Notes

A brief Executive Committee Meeting followed the Committee Meeting. The short agenda included (1) discussion of candidates for the Assistant Executive Officer for the Core Project Office, (2) the North Pacific Task Team, and (3) the next Executive Committee Meeting. After a discussion of candidates for the CPO **Assistant Executive Officer**, the Executive Committee approved the appointment of Beatriz Baliño.

ACTION: Field asked Hanson to offer the Assistant Executive Officer position to Beatriz Baliño.

The Terms of Reference for the **North Pacific Task Team** were further discussed. McCarthy expressed concerns over the Terms of Reference for NPPT. JGOFS must be very careful with these TOR, in particular the scope, the reorganization of the terms, the document language, how it is going to happen, who is responsible (name or responsible government or non-governmental body), selection of task team members, and host country. Executives mentioned the possibility of Steve Emmerson and EQPAC participation on the Task Team.

ACTION: Field asked McCarthy to assist and advise Bychkov and Koike in drafting the NPPT TOR for circulation to the Executives for approval.

The timing of the next **JGOFS Executive Committee Meeting** was discussed. Because of various meetings planned between August and October 1996, not all Executives would be able to attend the next Meeting. The Executives agreed on the 12-13 September 1996 in Bergen. The attendance for this meeting will be Field, Merlivat, Sakshaug, Hanson, and CPO staff. Only McCarthy would be unable to attend. Invitations would be extended to IGBP and SCOR, but it is unlikely that either sponsor would attend.

ACTION: Executive Committee asked Hanson to arrange the next Executive Committee Meeting at the University of Bergen, 12-13 September 1996.

The JGOFS Executive Committee Meeting was adjourned at 1230, 22 April 1996.

JOINT GLOBAL OCEAN FLUX STUDY

Minutes of the 12th Scientific Steering Committee Meeting

17-19 May, 1997
Dunstaffnage Marine Laboratory
Oban, Scotland

Welcome

The JGOFS Chair, John G. Field, opened the 12th Meeting of the JGOFS Scientific Steering Committee, which was held at the Dunstaffnage Marine Laboratory in Oban, Scotland, at 09:00 on May 17, 1997. He welcomed members of the Committee, Chairs of the Task Teams and Planning Groups, Chris Rapley, Director of IGBP, and Elizabeth Gross, SCOR Executive Director. A special welcome went to the new SSC member from Japan, Professor Toshiro Saino and to the National Committee Chair from China-Taipei, Professor Ching-Ling Wei. A special word of appreciation went to Graham Shimmield for his efforts on behalf of the IPO office and for his help with the organisation and arrangements of the SSC Meeting and the International JGOFS Modelling Symposium.

Present

John Field (Chair, RSA), Egil Sakshaug (NO), Karin Lochte (GER), James Murray (USA), Alexander Bychkov (RUS), Kon-Kee Liu (ROC), André Morel (FR), Toshiro Saino (JAP), Graham Shimmield (UK), Taro Takahashi (USA), Jürgen Willebrand (GER), Roy Lowry (UK), Julie Hall (NZ), Peter Burkill (UK), James Yoder (USA), Trevor Platt (CAN), Julian Priddle (UK), Elizabeth Gross (SCOR), Chris Rapley (IGBP), Roger Hanson (Executive Officer), Beatriz Baliño (Assistant Executive Officer), Judith Stokke (Administrative Secretary), and Ching-Ling Wei (China-Taipei).

Apologies. Hugh Ducklow (Vice Chair, USA), Bronte Tilbrook (AUS), Andrew Watson (UK) and Mike Fasham (UK).

2. Meeting Objectives, Adoption of Agenda and Timetable

Field requested that all Task Team Chairs look carefully at their groups and assess its efficiency. If a group is not performing, perhaps a solution would be to disband or reorganise it. Proposed

Terms of Reference and membership suggestions for a new or reorganised group should always be sent to Executive Committee for review and approval. Another matter of importance is the budget. All Chairs should carefully consider the expenses involved in holding meetings and keep these to a minimum. All chairs must present requests before the end of September 1997 in order to be included for consideration for next year's budget.

The 1997 SSC agenda with briefing items, which was circulated before the meeting needed only minor changes in the timetable. IGBP's contribution was moved up from Monday the 19th to Sunday the 18th. The agenda with noted changes was approved.

3. Old Business

1996 SSC Meeting Minutes. Minutes of the 11th JGOFS Committee Meeting, which were circulated prior to the meeting, were gone through page by page with the following comments and changes: Pg. 1--NASDA (corrected spelling). Pg. 7--Regarding the Synthesis and Modelling Task Team Report: the wording was too negative. Suggested change: Workshop was successful but should be assessed to find out how to utilise what was learned there and implement this in a setting with a larger group of people. Pg. 9 -- Photosynthesis Measurements Task Team. Rewording to: The site initially proposed was Spitzbergen. Should read: The site initially proposed was Longyearbyen. Pg.18--WCRP is the potential parent of SOLAS. Minutes of the 11th Meeting of the Scientific Steering Committee with above changes were approved.

1996 Executive Committee Meeting Minutes. At the Executive Committee meeting, members discussed writing an article on "JGOFS Legacy to Ocean Science: Achievements in Understanding Ocean Biogeochemistry". This is still perhaps an issue, which should have been included in the agenda for the present SSC meeting. There was general agreement to

discuss this later in the meeting. The Minutes of the JGOFS Executive Committee Meeting in Bergen, Norway 12-13 September 1996 were accepted.

Cambridge University Press-IGBP Book Series. Field informed the members on the progress, which has been made in the forthcoming publication. The current volume was developed from keynote papers presented at the First JGOFS International Scientific Symposium held at Villefranche-sur-Mer, France, in May 1995. The goal of the book is to give an overview of JGOFS science and its achievements to date. The editors: Field, Ducklow, and Hanson modified, reviewed and revised manuscripts, and they expect a copy to go to the publisher sometime in the fall--hopefully no later than October.

Discussion about the contents of the book focused on Chapter Five involving the ICSU/IGFA Evaluation. Field mentioned that this chapter might be an edited version of the Panels recommendations, which takes on the essence from JGOFS own perception of the evaluation. There was a concern mentioned about the publishing of this semi-confidential report. Hanson commented that the report had already been released in various forms (see for example, SCOR Proceedings, Volume 31, 1996) and therefore its contents would not be new or surprising for most. Takahashi recommended changing the title to "Future Perspectives in JGOFS". Rapley suggested that there would be added value in the synopsis if there was some focus towards the mechanism, as well as the science, of JGOFS. These are issues, which the editors must address.

ACTION: The editors will carefully weigh comments on whether this material belongs, or in what form, to compliment the scientific presentations in this book.

JGOFS Response to ICSU-IGFA Evaluation. Field and Hanson have written JGOFS response to the report for IGBP, but not made public beyond that. Therefore, there were several suggestions to open possible channels of communication. Field suggested that JGOFS response to the evaluations could be accessed on the JGOFS homepage and/or published in the US JGOFS News and/or IGBP Newsletter in an informative form.

ACTION: Field asked Hanson and Baliño to develop a JGOFS release to community on the homepage.

4. JGOFS Scientific Steering Committee: Membership

When IGBP Secretariat provided an option for Core Projects to streamline their SSC memberships at the IGBP Congress, the response of the JGOFS SSC was immediately supportive. The Executive Committee therefore responded with a plan for restructuring the JGOFS SSC (Bergen, September 1996). Initially, there were some procedural problems because of the speed by which the JGOFS EXEC submitted their reorganisation plan to IGBP and SCOR for approval. It seemed that SCOR approved one proposal while IGBP approved another version of the "same" proposed reorganisation. After little discussion, the 1997 SSC adopted the IGBP interpretation of the reorganisation that provides greater flexibility within JGOFS activities.

New wording for JGOFS SSC Membership: (1) There will be a core of up to six "at-large" SSC members from whom the JGOFS Chair will be drawn. The remainder of the SSC will consist of the chairs of current task teams and planning groups, which will be disbanded as soon as they have completed their terms of reference. It is expected that the number of such groups will decline as JGOFS enters its synthesis phase. Chairs of the Task Teams and Planning Groups are *ex officio* members of the SSC. (2)

The new SSC structure will be phased in by natural rotation of present SSC-members reaching the end of their 3-year terms. Future rotation of SSC membership will be achieved by staggered rotation to maintain some continuity. Members will be appointed for 3-year terms, which may be renewed once. (3) The SSC shall nominate a chair for appointment by SCOR and IGBP. The chair with a vice-chair along with 2-3 at-large members of the SSC will form an Executive Committee, which will oversee the day-to-day business of JGOFS and the IPO. The Executive Committee will conduct most business by e-mail, and will normally meet once annually in addition to the SSC meeting. Its decisions and actions shall be reported to the SSC. (4) The task team concerned and appointed by the JGOFS Executive Committee nominates task Team and Planning Group chairs. They will normally be appointed for a term of three years, with a maximum of two terms unless there are exceptional circumstances. This is aimed at rotating the SSC membership and promoting vigorous groups.

Representatives from IGBP and SCOR agreed that it was not necessary to identify a vice-chair for approval by the sponsors. Rapley mentioned that once the Executive Committee approves function leaders or chairs, IGBP requests at the beginning of each calendar year a list of all SSC “at-large” members and any others needed for its business that year. IGBP will reimburse costs for only those members who are on this list.

ACTION: The IPO will send a list of 1998 Function Leaders to IGBP at the beginning of each year.

Field reviewed the 1998 Rotation plan. There are presently eight “at-large” members, four will rotate off at end of the

year and two should be replaced, resulting in six SSC “at-large” members in 1998.

ACTION: Field appealed to everyone at the meeting to come forward with nominations for the 1998 SSC.

JGOFS nominations must be completed by 5th September for the next IGBP Officer’s meeting in October. Therefore, JGOFS members will have to make their nominations via email with deadline at the end of June for SSC “at-large” members.

Field mentioned that he must be replaced before the end of the year with hand-over taking place at the Executive Meeting in October. Ducklow will not be able to consider a nomination. It is desirable that the next JGOFS Chairperson has some experience in SSC activities.

5. Task Teams

Data Management Task Team (Lowry).
Meeting Information. The DMTT met at BODC in January 27-28, 1997. DMTT members: Roy Lowry (Chair, England), Christine Hammond (USA), Thomas Mitzka (Germany), Graham Glenn (Canada), Jaswant Sarupria (India), and Koji Kambara (Japan), who could not attend. Other invited participants were Dr. Peter Burkill (UK), who is the Chair of the Indian Ocean Planning Group and Dr. Beatriz Baliño (Assistant Executive Officer) from JGOFS IPO.

Recommendation: Lowry notified the SSC that the DMTT recommends the development of a JGOFS Data Index (JDI), a centralised index to the data collected during JGOFS field programme. The JDI will be a parameter-temporal-space index, implemented under a commercial RDBMS (relational database management system). The design of the database will be the responsibility of the DMTT. The database will be physically located at the IPO and is Baliño’s responsibility for loading data and maintenance. The development of a JDI interface

will require a special programmer. In the future, the JDI will supersede the cruise inventory

CD ROM Products. The preparation of the Arabian CTD CD-ROM, containing data from the Indian Ocean north of the Equator, is well underway and its release is expected by May 1998. Data from most participating countries is readily available while the permission to use the US data is under negotiation. Approval for inclusion of these data is to be discussed at the US-JGOFS SSC meeting in June 1997. In addition, the US and German WOCE have collected major data sets in the area and it will be desirable to include them in the CD-ROM. Jürgen Willebrand advised Lowry to write a formal letter to Dr. John Gould at WOCE IPO to get access to WOCE data.

ACTION: Lowry will write to John Gould at WOCE IPO to access WOCE data in the Arabian Sea

Recommendation: Lowry expressed the need for funds for the final production and distribution of the CD-ROM within JGOFS community. Field and Gross agreed that funds will be available for this purpose. The CD-ROM will be advertised on the IGBP homepage, in the US JGOFS News, and on the International JGOFS homepage.

Review of Terms of Reference (TOR) and Membership. The TOR were modified to reflect the higher profile role of the IPO in JGOFS data management.

Recommendation: Lowry recommended approval of the Japanese nomination of Takeharu Miyake of JODC as a replacement for Kambara. The SSC concurred with the replacement.

Lowry also proposed to nominate a French JGOFS data expert to the DMTT this year. André Morel agreed with this initiative and suggested a couple additional names. It was also noted that there is a need for CO₂ expertise on the DMTT.

ACTION: Field asked Lowry to proceed and nominate a French representative with knowledge of CO₂ databases.

Lowry mentioned the value of having data users and field scientists at DMTT meetings and requested financial support to invite 1 to 2 representatives from countries holding major data sets to attend future DMTT meetings. Field agreed that these funds could be justified. He emphasised that budget requests of this sort as well as any other, should be reported to the IPO as soon as possible.

Data Management at the IPO. Lowry suggested that John Hughes from BODC could undertake the development of the JDI interface. An EU proposal in support of a training position for Hughes will be submitted June 15. JGOFS IPO is negotiating office and hardware/software facilities for Hughes with its hosting centre in Bergen. Platt and Rapley suggested IGBP and JGOFS/SCOR to write recommendation letters to the EU for this position. The IGBP letter will be drafted by Lowry to be signed by Rapley. Likewise, Gross/Field will write a letter on behalf of JGOFS/SCOR. Whereas, it **was also** raised that outside pressure from international committees might be viewed negatively rather than having a positive effect.

ACTION: Lowry offered to investigate whether lobbying by JGOFS, IGBP and SCOR would be helpful, and if necessary, IGBP and SCOR/JGOFS would write letters of recommendation in support of Hughes' proposal to the EU.

Long-term archiving of JGOFS data. At the IGBP-DIS/WDC workshop in Boulder, Colorado, April 1997, Lowry arranged some plans with Sidney Levitus, Director of the World Data Centre for Oceanography, for the future long-term archiving of JGOFS data.

Recommendation: Lowry notified the SSC that the DMTT recommends Baliño from IPO to liaise with IGBP-DIS. The SSC concurred with the recommendation.

Final comments. Platt and Rapley thanked Lowry for his work and personal efforts for the JGOFS DMTT.

Remote Sensing Task Team (Yoder)

Yoder talked of solving data availability problems. NASA will have many new data available by the end of the year. The future looks promising in that space agencies are continuing their commitment of gathering Remote Sensing data. Software is also being developed which makes data gathering and image processing more easily available over the network.

Due to new technology in satellite ocean-colour sensors there will be a major amount of data available to JGOFS in the next 5 years. Selected global satellite missions are already generating much data, such as simulations of ocean circulation that may be of interest to JGOFS, especially in biogeochemical modelling. The software is being developed and distributed to handle these type of data.

An International Ocean-Colour Co-ordinating Group (IOCCG) has been set up. The focus of this international advisory group is to advise the research community in the co-ordination and development of this important new data stream and to promote community user involvement. SCOR and CEOS are partner organisations.

Recommendation: Yoder proposed to disband the RSTT and to develop a tighter link to IOCCG since there is already JGOFS involvement in this group. IOCCG wants liaisons with JGOFS and IGBP.

It was suggested that Saino could act as a contact for JGOFS and report to SSC. André Morel expressed his reluctance to disband the Task Team because RSTT is more than ocean colour and very important for the future. Rapley supported the suggestion that a SSC member should be nominated to be the link between the RSTT and IOCCG. It was suggested then that a contact should be appointed to function as a link with the ocean colour group (Yoder?). Yoder stated that the RSTT would not call for another meeting unless necessary and that the

membership should be reviewed at the next SSC meeting.

Photosynthesis Measurements Task Team (Sakshaug)

Sakshaug reported on the manuscript for photosynthesis measurements with emphasis on ¹⁴Carbon. The PMTT report is to be published in the Journal of Plankton Research, divided into two papers: the first is on theory and results (which was submitted in Feb'97 with revision in late June), and second paper will be drafted on the protocols.

There will be a protocol discussion at the next PMTT meeting, which will take place in Longyearbyen, August 1997. A total of 10 participants plus 3 guests is expected. The agenda will include discussions of gross *versus* net photosynthesis measurements and the question of how to complete the second part for publication so that it will make a complete protocol. This will be the final product of the PMTT and its last meeting.

Recommendation: After this last activity, the Task Team would disband.

Sakshaug inquired about the future activities related to LOICZ and GLOBEC. Hall will flag this matter in her report later.

IOC- CO₂ Panel: (Watson/Takahashi)

Reference was made to Watson's panel report that pointed out that although there is considerable CO₂ data available, there is still a problem with sharing or merging it in a global database. The problem centres on those that possesses or holds exclusive right to CO₂ data sets. Takahashi felt that the resolution of this would require more resources and that there will probably be more information to share after the next IOC-CO₂ meeting this June in Germany.

On the issue of data set complexities, Takahashi also mentioned that because US CDIAC shares its resources with US JGOFS and WOCE Global pCO₂ database, some Principal Investigators are reluctant to submit their data. This is probably, in part, due to the methodological aspects of CO₂

measurements, a technique under development, which means that the quality of some of the data varies. PIs are not willing to let their data be mixed with what they may feel to be inferior quality data. Therefore, they argue that this data should be kept with the PIs or the cruise.

To alleviate this problem, Takahashi proposed that those who submit data will become co-authors of the scientific papers where their data are integrated with others and that submitted data will not be released until the paper is published. After that, the data will be made available on the PMEL (Pacific Marine Environmental Laboratory from NOAA) homepage. In order to extend the existing global CO₂ databases, Takahashi recommends that links be made with the other planning groups for the Equatorial Pacific, Indian Ocean and Southern Ocean.

Takahashi felt that a policy decision among space agencies affects the authorship of CO₂ data sets. They have decided that principal investigators have no jurisdiction over merged data sets, although they have put considerable effort into their data sets. Lowry commented that the information technology is here and that authors' names can be easily linked to their specific data sets.

Priddle posed a question of whether there are research areas (e.g., missing data sets) that need to be addressed in future JGOFS and/or ocean programs. Most obvious information gap occurs in high latitude regions during the winter, e.g., the Southern Ocean and northwest North Pacific Ocean.

Global Synthesis and Modelling Task Team (Platt)

Platt reported on the Toulouse workshop (One-Dimensional Models of Water Column Biogeochemistry). The JGOFS Report No. 23 (February 1997) was distributed earlier. The workshop had 20-26 participants (plus 5 guests), and it functioned as an *ad hoc* meeting for the SMTT.

Recommendation of Future activity: Platt notified the SSC that there are plans for a modelling training course. The purpose is to enlarge the group of people who are capable of discussing the type of work done in Toulouse, which was rather restrictive. Platt proposed that these efforts should continue and that they include

biogeochemists from developing countries who may not have had opportunities to develop modelling skills. Although the course has not been announced yet, there has been a high interest judged by the amount of inquiries received (by Platt). The course will have a number of co-ordinating instructors. Funding is expected to be supplied by a number of sponsoring agencies. It should be held in a developing country, and India was suggested.

Upcoming IOCCG Workshop: Platt notified the SSC that a small number of people will gather to deal with technical problems in modelling related to the use of ocean colour remote sensing. The plan is to hold the workshop in Chile, November 1997).

In response to Liu's question, Platt informed the SSC that there are no links presently between the SMTT and the CMTT.

Platt announced that The International JGOFS Modelling Symposium immediately follows the SSC meeting. The Symposium Organising Committee anticipates 85 registered attendees, 45 papers and 25 posters. The results will be reported later.

North Pacific Task Team (Bychkov and Saino)

Bychkov discussed changes in the Terms of Reference (TOR) for the NPTT. The team decided to delete the specific reference to activities and to replace them with ones that are more general.

Recommendation of new Task Team

Membership: Bychkov proposed the addition of three new members: Dr. Stephen Riser (USA, physical oceanographer); Dr. Steve Emerson (USA, chemical oceanographer); and Dr. Nianzhi Jiao (China, to replace Prof. Lu, deceased). Present members are: Bychkov (Russia), Saino (Japan), Frost (USA), Chen (China-Taipei), Denman (Canada) and Kim (Korea)

Draft of the report on research programs.

Research is being organised on a regional basis. The report will be finished during the second meeting of the NPTT in October 1997 (Pusan, Korea) and a copy will be submitted to the 1998 SSC.

NPTT main goal. To encourage Pacific Rim nations to launch long-term time-series stations (like PAPA) in the NW North Pacific. Japan is

ready to do this and it is anticipated that Japan will play an important role in the organisation of the time-series research.

Contacts with other organisations. Bychkov expressed the need to keep a close relationship with other organisations, especially PICES.

Recommendation: Bychkov proposed that the NPTT hold its 2nd meeting (workshop) with PICES (GLOBEC) in Pusan, Korea (October 1997). Bychkov and Saino request JGOFS to provide financial support for Drs. Chen, Jiao, Emerson and Feely to participate at this meeting. Feely, non-NPTT member, would be an invited guest of the NPTT and is essential for the purpose of this workshop. PICES plans to cover costs of other NPTT members to the workshop.

Saino's reports on JGOFS Japanese activities. The Japanese field programme will run between 1988 and 2000 while the synthesis phase will continue beyond 2000.

NW Pacific Ocean Time-Series Station. Japan is interested in establishing an ocean time-series station. Its location is under evaluation, although there is a site of interest at 43N and 155E. A proposal for the time plan and fieldwork is being discussed. Several ship operations have already agreed to work in the area from spring to fall but there is still a lack of ships to cover the winter months. Saino asked JAMSTEC (Japan Marine Science and Technology Center) for ship time to cover the winter months. Saino is waiting for a reply.

Liu asked if Japan is going to launch sub-tropical studies, and Saino said that it is not a high priority. Lochte expressed concern about the coverage of the entire North Pacific regarding biogeochemical cycles in the region. For example, such data from the western North Pacific is scarce compared to North Atlantic. In addition, the western North Pacific's warm pool has a much higher bacterial production than the North Atlantic. JGOFS needs a thorough assessment of carbon cycle in North Pacific. Questions were also raised about the adoption of JGOFS core measurement protocols and whether there will be Data Management accessibility. Saino assured the SSC that these concerns have been addressed by the NPTT and will be dealt with appropriately.

Yoder stated that HOT (Hawaiian Ocean Time-Series Station) is addressing this problem of coverage, in the sub-tropical gyre of the

Equatorial Pacific. Also that a new Institute is under development at the initiative of the University of Hawaii and Alaska. Other comments: JGOFS in particular NPTT should be careful about extending the time-line beyond year 2004. Field reminded the group that the North Pacific studies were launched rather late so that the SSC cannot be too harsh on the NPTT about extending their time schedule beyond that stipulated.

Lochte offered her support for this expansion of the NPTT by two members, because the NPTT has the largest task to accomplish, and it is a logical step to take. Regarding the question about Dr. Jiao nomination, Field asked if Beijing is planning North Pacific activities that need co-ordinating. If this is the case, the nomination of Jiao is justified. Gross said that the Chinese SCOR Committee had considered Jiao's nomination. In addition, Hall commented that there has been a big initiative in the China Sea. She foresees that this could mean that China-Beijing will be an important player in the region. Field agreed and the SSC approved the appointment of Jiao, Emerson and Riser to the NPTT.

ACTIONS: (1) NPTT should clearly define their activities and ensure that these activities are completed either within JGOFS lifetime or in a reasonable time frame; (2) Fair national representation should be taken into account (e.g. developing countries, including gender and disciplines); and (3) SSC appoints Emerson (USA), Riser (USA), and Jiao (China-Beijing) to the NPTT.

ACTION: Field asked Hanson to determine if JGOFS funds are available to support this 1997 request and to get back with Bychkov and Saino. Funds might be 'borrowed' from other Task Team activities.

Continental Margins Task Team (Hall)

The JGOFS/LOICZ CMTT project looks at the discrepancies of what reaches the continental margin and what leaves to the open ocean. In Lagos, CMTT Workshop synthesised some of the current knowledge of non-conservative fluxes in continental margins. One product of Workshop was the JGOFS Report #22: Report on the international workshop on continental shelf fluxes of carbon, nitrogen and phosphorus. The next workshop is

planned for Texel, October 1997. The organisers plan to publish the proceedings in a peer-reviewed journal.

CMTT Membership: Hall announced a possible change in membership for 1998. There will be recommendations coming from the CMTT Meeting in Texel. At the next SSC meeting, Hall felt that the SSC should address the issue of whether to involve GLOBEC in the future CMTT activities. Rapley mentioned that there is a confusion among IGBP projects, e.g. BAHC, on how to deal with players in horizontal flux systems. If a workshop is to be held, then representatives of these core projects should participate or be invited. He encouraged more interaction and communication between JGOFS/LOICZ CMTT and other IGBP projects, such as BAHC and GLOBEC.

Along these same lines of thought, Gross offered information on some recent SCOR activity in coastal systems, i.e., groundwater input to the coast. It is becoming clear that groundwater input is a very important source of water, perhaps more than rivers, she said, and that SCOR has received a proposal. The proposal came from the Russian and US SCOR Committees together with LOICZ to form a working group to address this process. Shimmiel also informed the group that EU has received a proposal to study the runoff from the Siberian area into the Arctic.

Liu commented that he has been having problems linking the CMTT homepage to other continental margin homepages, like OMEX.

ACTION: Lowry, a member of the OMEX SSC, will put the CMTT into contact with OMEX through Hall.

Lochte cautioned against diversifying the CMTT tasks with all its related programs. The CMTT should continue focusing on the main goal and be selective in their links to other programs. Both Hall and Liu acknowledged this concern.

Deep Ocean Flux Task Team (Shimmiel and Lochte)

Establishing a DOFTT. Shimmiel reports that plans are underway to establish a joint JGOFS/PAGES Task Team, which will be composed of three JGOFS and three PAGES members. Regarding a question about national representation, Shimmiel was informed to consider the representation on IMAGES (International Marine Global Change Study), and

ODP (Ocean Drilling Program) Committees in forming the task team. Shimmiel recommended that DOFTT hold its first meeting in early 1998 to draft terms of reference of DOFTT, draft implementation plan for approval, develop timetable for implementation, as well as prepare plans for its first workshop on Deep Ocean Fluxes in conjunction with ADEPD (summer 1998). The DOFTT objectives and products will link strongly to PAGES, GAIM and IMAGES (a PAGES/SCOR project). IMAGES links present-day ocean fluxes to paleo-oceanographic records. Emphasis will be placed on data synthesis and modelling (e.g. ADEPD). Travel funds will be requested for three JGOFS participants and three PAGES participants for the DOFTT meeting next year.

ACTION: Regarding DOFTT appointments, Shimmiel must seek approval of DMTT members from the JGOFS Executive Committee (EXECOM). For full consideration, the EXECOM requires the names (plus alternatives), scientific disciplines, nationalities and institution addresses of all DOFTT nominees. Information should be sent to the International Project Office.

Lochte reported on ADEPD (Atlantic Deep-Ocean Project Database)

6. Planning Groups

North Atlantic Planning Group (Fasham)

From a written statement, Fasham proposed that the NAPG be replaced with the NA Synthesis Working Group (NASWG). One option suggested was to place this group under the SMTT for a global perspective. The TOR should be redefined and the number of members reduced. Fasham is willing to lead this group and act as the link with SMTT. An overall discussion and coordination with the other Planning Groups will be discussed later.

Recommendation: Fasham proposes a NAPG meeting in late 1997 to discuss reorganisation and to develop TOR for the NASWG (meeting approved last year).

Equatorial Pacific Planning Group (Murray)

Murray mentioned that this group has not met since he took the leadership (1996). Most work has been completed with the exception of some joint Japanese-Canadian cruises. Two special issues of the journal *Deep Sea Research* (Volumes 42 and 43) have been devoted to the results from

this process study. A 3rd special issue is coming out soon (Volume 44). The US Synthesis and Modelling Plan will be used for data synthesis of the US Equatorial Pacific Process Study. He suggests that the group plans to meet next year and bring the Equatorial Pacific Process Study to a closure. He suggests that Equatorial Pacific group should be reformed into a Synthesis Working Group and the membership of the group should be changed accordingly.

Recommendation: Murray notified the SSC that he proposes to plan an EqPAC meeting in early 1998 and to suggest a refocusing of the group towards synthesis issues.

Indian Ocean Planning Group (Burkill)

According to Burkill, no formal meeting of the IOPG had taken place since 1995. Scientific milestones include the completion of the fieldwork in the Arabian Sea, the publication of two, possibly three, special issues of Deep-Sea Research and CD-ROMs of Indian Ocean research. CDs are now available that include a set of biogeochemistry data from The Netherlands Program, a planned set of CTD data from the Germany Program, and a planned set of biogeochemistry data from the UK Program.

Recommendation: The Indian Ocean project is almost finished with its fieldwork and Burkill presented a proposal to replace the group with a Synthesis Group. He plans to disband the Planning Group by July 1997 (which is the time of the last cruise). The data from this project should go through a proper data managing process. This would require that the PIs collaborate to ensure the availability of data on a timely basis.

Recommendation: Burkill suggested holding the next scientific meeting in India (1999). Platt suggested that this meeting could be co-ordinated with the training course that the SMTT is planning at about that time (1998). This would give a better chance for financial support, in addition to demonstrating JGOFS' concern for training and development issues.

Recommendation: Burkill notified the SSC that plans are underway to assemble an IO Arabian Sea Synthesis Meeting in Plymouth (January

1998) and the first meeting of the IO Synthesis Working Group in Paris (June 1998)

Southern Ocean Planning Group (Priddle)

Priddle informed the group about the progress of the Southern Ocean Planning Group towards completing the fieldwork and synthesis. To date, three special issues of Deep-Sea Research have been published and another in preparation. While the last official meeting was in Brest 1995, part of the group has met in March 1997 to discuss the next stages of synthesis. Following the JGOFS Modelling Symposium in Oban, the group will meet to discuss: cataloguing data from SO-JGOFS and other activities, refining the definition of biogeochemical provinces within the Southern Ocean, and developing system-specific models.

Recommendation: Priddle requested funding for several workshops that would address scientific and synthesis issues of each of the major Antarctic subsystems.

ACTION: Field asked Priddle to send requests for 1998 activities to IPO.

Synthesis plans. JGOFS fieldwork in the Southern Ocean will continue during the synthesis phase. Therefore, it is anticipated that the transition of the SOPG to analysis and synthesis must retain links with ongoing programmes, including *in situ* iron-fertilisation experiments. A strategy for developing a regional approach to analysis and synthesis was outlined by Priddle. JGOFS was asked to fund workshops to produce up-to-date descriptions of biogeochemical provinces in the Southern Ocean, based on advances made in by SO JGOFS studies.

Field stated that JGOFS should be able to accommodate different Planning Group approaches from fieldwork to synthesis as timelines and memberships during this transition phase will certainly differ.

(Executive Officer's note: Future planning for the Southern Ocean regional study was addressed by the SOPG meeting after the modelling symposium. A series of recommendations were then forwarded to the International Project Office for consideration at the October 1997 Executive Committee meeting. These recommendations included items relating to the regional synthesis mentioned above, and presented terms of reference for the group.)

ACTION: Lowry asked the SOPG to send all the information about cruises and data location to the IPO, so that the DMTT can keep track of things. Priddle agreed.

Gross proposed that the SOPG get in contact with GLOBEC for a liaison meeting. This group is preparing to start its fieldwork in the Antarctic soon. Later JGOFS cruises could perhaps go under the GLOBEC shield. Priddle agreed.

7. Science Presentation and Discussion

IOC-CO₂ Panel (Takahashi)

Takahashi reported on the ocean CO₂ database. He is also preparing an article that will include CO₂ data sets gathered. In order to encourage PIs to submit their data, he will include them as authors of that article.

JGOFS Synthesis Plan (Platt)

Platt mentioned that in phasing in synthesis and modelling activities, a spectrum of models exist for people. Platt suggested that the SMTT would like to be kept informed about what these groups are planning by copying emails to Platt or Fasham. Lochte felt that it might be beneficial if an implementation plan was developed for each regional synthesis group. Field suggested that members from Synthesis and Modelling Task Team could join in on divergent synthesis styles proposed by the Planning Groups to help them phase into synthesis activities.

JGOFS Legacy (Field)

There is a need to focus public attention upon JGOFS activities and achievements. Field asked for comments on how to produce a popular article. One could use the WOCE Newsletter and Global Change NewsLetter as models. There is a need to justify the money spent on scientific work. Lochte suggested a working group to look at the situation. Willebrand postulated that the Villefranche Volume should

reflect JGOFS direction and perhaps societal interests. He mentioned that there is a change of attitudes in the scientific community that seems to recognise the need for better links between science outputs and the needs of society in general. In addition, young scientists seem to need direction. State of art, past and present, in the synthesis book would be useful for scientists. Hanson asked for highlights in different areas to help shape the article. This process can sharpen the perspective and provide informative material used in the Symposium Book.

JGOFS 5-year plan (field)

Field, Ducklow and Hanson are currently sketching out a timeline, and Field will seek volunteers to help in drafting a detailed 5-year plan for the JGOFS Program. This article is suggested to be appended to the Villefranche book.

8. JGOFS International Project Office: Reporting Activities

Hanson highlighted some of the major activities occurring in the Office over the past year: IGFA Resource and Requirement Assessment activities, Data Management Developments, IGBP Book Series progress and 1997 budget concerns.

IGFA Resource Assessment (Rapley):

Rapley talked about the background for the International Group of Funding Agencies, which did a resource assessment for Global Change Research. The exercise involved looking at how much money was being spent annually and what research was being pursued in the IGBP program.

Data Management issues (Baliño): The JGOFS IPO homepage was implemented early last year. Highlights: The JGOFS Cruise Inventory is now implemented on the web site. It contains a lists of JGOFS cruises and JGOFS related cruises since the start of the fieldwork in 1986. The inventory holds 654 cruises as of May 1997. Baliño is now

linking each cruise to its data. There is rather good coverage for the Atlantic Ocean. About 67% of the cruises in the inventory have been linked; less links in the other ocean basins, e.g. Pacific: 30%; Indian Ocean: 19% and Southern Ocean: 2%. JGOFS Protocols (Report # 19) were implemented on the homepage because of high demand from users. The document can be browsed and downloaded through the internet. For those that do not have access to the web, the IPO can distribute the document on a floppy disk or as a hard copy.

The publication list for JGOFS (Report # 18) is being updated. It contains ca. 1200 references at this time. Baliño asked chairs of Planning Groups and Task Teams, and National Committee Chairs to ensure that references be sent to the IPO.

JGOFS posters on research program and science are being planned and will be produced with updated versions over time. In addition, another poster will be produced with information about JGOFS data management policy, models and products. Baliño will present this poster at the Ocean Data Management Symposium, which will be held in Dublin, October 1997.

Stokke covered pertinent administrative issues.

9. JGOFS related meetings

IGBP-DIS/WDC Boulder Workshop (Lowry)

Purpose of the workshop was to map links between IGBP core projects and the World Data Center (WDC). For JGOFS, the Centre of interest is the WDC-A for both oceanographic data, CO₂ data at CDIAC (Carbon dioxide Information and Analysis Centre) and JGOFS benthos data (Paleoclimatology). Lowry negotiated (mentioned before) with the Director of this centre, Mr. Sidney Levitus, the long-term archiving of JGOFS data sets. This workshop also gave insight into the activities of IGBP-DIS in that they work with large data sets, which originate from satellite. They are helping scientists to use these data sets. Several outcomes occurred from the workshop. Participants proposed to adopt the standard Directory Interchange Format (DIF) when it concerns metadata. Lowry proposed to implement DIF to major JGOFS data sets, such as a DIF for BODC, NODC, etc. They also proposed to build a dedicated search engine to help locate IGBP data on the web (Günther is doing this now). Because of this workshop, the WDCs will be better linked with IGBP core projects.

OOPC Workshop (Field)

Field attended the second meeting of the Ocean Observing Panel on Climate (OOPC) which defined its objectives. Field noted that there were few carbon-experts represented on the panel.

IAI-Time Series Workshop (Chile)

A recommendation from the workshop emphasises a need for greater co-operation between Time-Series Stations in Chile and Hawaii. Organisers of the IAI workshop plan to develop these links in a Phase 2 IAI proposal under an umbrella common to both time-series stations with an aim towards synthesis. Recently, a proposal was submitted to develop data links among Pacific Ocean time-series stations and to establish a time-series station near Easter Island.

GAIM Activities (Rapley)

Rapley remarked that there are four different GAIM models. With GAIM's reorganisation towards co-operation on regional projects and integration with Core Projects and International Project Offices, they hope to develop a new approach and greater collaboration.

ICES Activities (Field)

With an invitation from ICES, a few JGOFS participants (Fasham (UK), Zeitzschel (GER), Field (RSA), Noji (NOR), and Marra (USA)) attended the Annual Science Meeting in Iceland last October 1996 and presented papers on lessons learned from international global ocean programs (WOCE and JGOFS) in the North Atlantic.

10. IGBP Core projects and Other Activities

The Future of Ocean Biogeochemistry after JGOFS

Field reported on the SOLAS proposal that was presented to IGBP and SCOR for review. It was determined that another meeting would be needed to consider this proposal. Field mentioned that the proposal required a main question (hypothesis) to connect the sub-hypotheses. Other reviewers noted that SOLAS was mainly a biogeochemical project and would require more balance.

SCOR and IGBP think that with the phasing of JGOFS fieldwork into synthesis and modelling, what may come after JGOFS has to be timed very carefully. Rapley says that IGBP core projects will all end according to their planned timelines and that the IGBP Secretariat will finalise its policy on ending its core projects soon.

Murray stated that one should not wait until JGOFS is over to present its continuation. Something should be already presented (SOLAS is a trial), so that the one will smooth into the other. Platt expressed concerns about SOLAS being prepared with almost no representation from JGOFS SSC. Field agrees that somebody from JGOFS should be in the SOLAS group and that JGOFS should contribute to its implementation plan. Platt suggested that a rather small group meet informally to discuss the future of JGOFS. There must be some initiative from within the SSC group.

Recommendation: Field suggested that a subgroup from the SSC be formed to treat this topic and asked the Executive Committee to see the formation of this group. Field said that the SOLAS committee does not exist anymore since they finished the proposal. He suggests that a new one should be formed to review the whole thing.

Field mentioned that the SOLAS acronym is being used for a maritime commission called Saving of Lives at Sea (SOLAS). A possible alternative acronym for proposed project is SOLAF (Surface Ocean Layer and Atmospheric Feedbacks).

Lochte suggested that this subgroup be charged with the synthesis of JGOFS achievements in the planned volume from the Villefranche Symposium. It should also highlight the open questions and pressing topics to be addressed by SOLAF. There should be JGOFS representatives on the SOLAF planning group to present these views. Lochte also suggests that this group should synthesise JGOFS achievements, write down the questions that JGOFS has raised, and present this information to the next SOLAF meeting. This would be JGOFS contribution to SOLAF. Field agreed. Platt commented that JGOFS legacy should be a protocol to watch ocean changes due to climatic changes, which is economically effected. JGOFS goal of watching the ocean to observe indications in structure and function change should remain. The SOLAF 2nd point does not reach this goal. Lochte felt that this project might be linked to GOOS.

GLOBEC (Gross)

Gross briefly reviewed progress in the planning and implementation of the SCOR/IGBP/IOC Global Ocean Ecosystem Dynamics (GLOBEC) program since the last meeting of the JGOFS SSC. This is being carried out under the Chairmanship of Dr. Roger Harris (UK), who had given a detailed GLOBEC science presentation to that meeting. Most importantly, the GLOBEC SSC has been reconstituted since the decision of IGBP to adopt GLOBEC as a Core Project, and this new SSC held its first meeting in Baltimore in November 1996. This meeting approved the final version of the international GLOBEC Science Plan which has now been published as IGBP Report 40 and GLOBEC Report No. 9. The GLOBEC SSC will meet in Plymouth in June 1997 and will devote much of its attention over the coming months to the completion of an international Implementation Plan. An advanced draft of such a plan will be presented at the first GLOBEC Open Science Meeting in Paris in March 1998. Lastly, GLOBEC does not yet have an International Project Office and this lack is seriously hampering the development of the program. A bid for UK support of an IPO failed recently, although other possibilities are being explored.

PAGES (Shimmiel updates)

The NAUSICCA-IMAGES II, a part of the IMAGES programme, is working on two essential areas: (i) the South African Region and (ii) Southeastern Atlantic Upwelling System. With the main objective of recovering giant piston cores of sediment from these areas, the NAUSICCA-IMAGES II cruise took place aboard the French R/V Marion Duffresne between La Réunion (20 September 1996) and La Réunion (25 October 1996). Representatives from seven countries participated in this cruise. Based on what has been tentatively evaluated onboard, sediments of a maximum age of Early Pleistocene were retrieved from the Saldanha Slope near Cape Town. More generally in the Benguella Upwelling System, especially off Lüderitz and Walvis Bay, sedimentary records show high sedimentation rates, up to over 15 cm/ky, which will enable the team to work to time-resolution of even less than 7y/cm.

LUCC/JGOFS Activities (Hall)

Hall mentioned that links through CMTT and LOICZ have not been established yet. Rapley stated that an Implementation Plan is being drafted, and JGOFS should make early contact.

START/JGOFS Activities (Hall and Platt)

Hall along with Coleen Moloney plans to develop an oceanic program with START. It will be done, but nothing concrete yet. Platt mentioned that he drafted a proposal requesting help from START with a SMTT workshop (India, 1998?).

IGBP Secretariat (Rapley)

Rapley gave a brief update on the status of the IGBP. The Programme is maintaining its high reputation with the developing world. For example, Vietnam recently established the 75th IGBP National Committee, and it is working to create an Indonesia-Chinese regional network consisting of Vietnam, Laos, Cambodia, Myanmar and Thailand. Taiwan is keen to provide secondments to IPOs. The possibility is being actively explored.

There is continuing pressure for the Programme to deliver "goods and services of value to society" in addition to front-ranking science. A new joint project with WCRP and IHDP on "Climate Variability Prediction and Agriculture in Monsoon Asia" is a specific response. GCTE's Synthesis exercise is also seen as very helpful in this respect.

Accreditation continues to be a problem. All IGBP participants are urged to ensure acknowledgement of IGBP's role and support in associated science output. Several recent important IGBP-related publications omitted to mention IGBP.

The SC meeting in Norwich was very productive. The entire Programme was reviewed, and was, largely, judged to be making excellent progress. Changes to the GCTE and PAGES Implementation Plans (IP) were approved. START IP was presented and approved. BAHG and GAIM are reviewing and updating their IPs. LUCC and GLOBEC are in the process of developing their IPs. GAIM is reviewing its organisational structure with a view to expanding its remit to include a wider range of activities, including certain types of "Inter Project, e.g., a proposed project with JGOFS on carbon model intercomparisons".

Liu suggested making contact with GAIM. In Vietnam, there was a committee recently formed that resulted in an Indo-Chinese network. JGOFS should take advantage of this development.

A three-year fixed cycle of IGBP meetings has been adopted with SACs and

Congresses scheduled 18 months apart (SAC in November or December of year 1, Congress in April or May of year 3). The SC-IGBP will meet in late February, SSCs (other than Congress years) in the March or June timeframe, IPOs in late summer or early autumn, and SC-Officers in early October.

SAC V will be held in Nairobi from the 1st to the 8th December this year. It will start with a two-day Policy Forum, followed by a one-day review of the IGBP, a one-day set of SAC discussions, a half-day National Committees session, and a two-day science Symposium entitled "Living with Global Change in Africa". ("Editor's Note": SAC V was cancelled (September 1997) and rescheduled. The new date is 1-7 September 1998 in Nairobi, Kenya)

Recent publications include the 1997 Directory, and the GLOBEC Science Plan. It is intended to produce a draft of the IGBP 1999-2003 Five-year plan for consideration at SAC V. A draft contents list was circulated in November 96, but more details will be provided by the Secretariat shortly.

11. Other International Programs

SCAR/GLOCHANT (Priddle)

Priddle reported that this group has been restructured to provide a forum for all SCAR, IGBP and WCRP global change programmes with Antarctic interests. Southern Ocean interannual variability has been proposed as a focus for collaboration between SCOR, SCAR and other bodies involved in oceanographic studies in the region.

IASC/Bering (BESIS) and Barents (BASIS) Seas Impact Study (Sakshaug)

Sakshaug mentioned a BESIS/BASIS Modelling meeting that showed large-scale modelling activities. These are interesting programs with links to both GLOBEC and JGOFS.

JGOOS (Hall)

Hall mentioned that JGOOS held a workshop earlier in the year to review the content and focus for a coastal component for GOOS. A JGOOS Coastal Panel will be formed soon. JGOOS wants

more involvement of users with interests in the identification and review of remote technologies.

CRP/CLIVAR (Willebrand)

Willebrand mentioned that WCRP/CLIVAR (Climate Variability and Predictability) was initiated by the Joint Scientific Committee of the WCRP and has three foci. The first focus (CLIVAR-GOALS) addresses ENSO, monsoon-interaction and seasonal predictability; second focus (CLIVAR-DECCEN) addresses decadal and centennial natural climate variability; and third focus (CLIVAR-ACC) addresses modelling of anthropogenically induced climate change.

CEOS (Platt)

Platt reported on the activities of CEOS. A small group within CEOS has designated 6 projects, which will demonstrate usefulness of Remote Sensing, Long-term Time-series, and Ocean Colour.

WOCE (Willebrand)

Willebrand mentioned that the observational phase of WOCE is scheduled to end this year. The analysis, interpretation and modelling phases will continue for another 4 years. However, national funding for the analysis phase has been problematic in many countries.

then noted the three significant JGOFS phases that paralleled its three leaders.

Field announced the 12th Meeting of the Scientific Steering Committee adjourned at 18.00 on the 19th of May 1997.

12. Other JGOFS Business

There were several places suggested for the next SSC meeting. Field proposed the next meeting be in Cape Town, South Africa, since it will be the end of his term as Chairman. An alternative place would be in Bergen, concatenate with the Data Management and Synthesis Workshop. It was also suggested that Task Teams could hold joint meeting with GLOBEC Open Science Meeting in March 1998. This period is a bit early for the SSC, as April or May are usually the months when the SSC meet.

Field then thanked those members rotating off SSC this year. They are K.-K. Liu, André Morel, Taro Takahashi, Karin Lochte and Graham Shimmield. Rapley offered a special thanks to all those rotating off for their service on the SSC. Their personal efforts are greatly appreciated. Gross also noted that this was the 10th year Anniversary of JGOFS since it began in 1987, and

Minutes of the JGOFS NORTH PACIFIC TASK TEAM Meeting

Pusan, Korea, 16 & 19 October 1997

Present

Members: Alexander Bychkov (Co-chair), Toshiro Saino (Co-chair), Chen-Tung Chen, Ken Denman, Steve Emerson, Bruce Frost, Nianzhi Jiao and Kyung-Ryul Kim;

Guests: Robert Bidigare (ALOHA, USA), Robin Brown (TCODE/PICES, Canada), Richard Feely (PMEL/NOAA, USA), Howard Freeland (POC/PICES, Canada), Paul Harrison (PAPA, Canada), Masashi Kusakabe (JAMSTEC, Japan), Allen Macklin (AFSC/NOAA, USA), Yukihiro Nojiri (KNOT, Japan), Ian Perry (CCCC/PICES, Canada), Sei-Ichi Saitoh (OCTS/ADEOS, Japan), Nobuo Suginoara (SAGE, Japan), Bruce Taft (WG9/PICES, USA), Shizuo Tsunogai (Japan, invited scientific presentation)

Welcome & Opening remarks

Dr. A. Bychkov opened the meeting on Thursday, 16 October, at 0900, and welcomed NPTT members and guests who had taken time to join the meeting. He directed a special thanks to the JGOFS IPO and North Pacific Marine Science Organization (PICES) for the sponsorship, and to Korean colleagues for the efforts they had put into organising the meeting.

Dr. Bychkov outlined the objectives of the meeting (to review the present status of ongoing and future national and international programs related to JGOFS, to identify areas for cooperative efforts in the North Pacific and adjacent marginal seas, to discuss mechanisms for coordinating field program, and plan NPTT activities for 1997-1998) and significant issues for discussion. He reviewed the agenda, circulated prior to the meeting, and asked for changes and additions. Absent from the meeting were Drs. T. Yoshida (JMA) and S. Riser (Univ. Washington) who had sent visuals to Dr. Bychkov. Drs. K.-R. Kim and C.-T. Chen would not arrive until the late afternoon, requiring that their presentations be rescheduled. After the recommended changes were incorporated, the agenda was approved (Appendix 1). Dr. Ken Denman was appointed as a rapporteur.

Dr. Bychkov briefly reviewed the history of the JGOFS NPTT and provided a Task Team progress

report. The JGOFS SSC made a decision to set up the NPTT in April 1996 (Bad-Munster-eifel, Germany), recognizing the lack of JGOFS process studies in the subarctic North Pacific, a region of significance as a sink for anthropogenic carbon dioxide. In September 1996, the JGOFS Executive Committee (Bergen, Norway) approved the Terms or Reference and appointed 7 members to the new Task Team. The first NPTT meeting was held in November 1996 in conjunction with the International Symposium on Biogeochemical Processes in the North Pacific (Mutsu, Japan), thanks to the efforts of Prof. Shizuo Tsunogai and generous sponsorship from the Japan Marine Science Foundation. At the meeting the Terms of Reference were revised and changes to the TOR and membership of the NPTT were recommended. In May 1997, the JGOFS SSC (Oban, Scotland) approved the suggested changes and appointed 3 new requested members for the Task Team. The SSC also tasked the NPTT with developing a *Summary of scientific JGOFS-related programs in the North Pacific* for submission to the SSC at its next annual meeting scheduled for May 1998. Dr. Bychkov announced that joint efforts of the NPTT and Japanese JGOFS resulted in the approval of the *Kyodo North Pacific Ocean Time Series (KNOT)* station in the western North Pacific (44°N, 155°E) (Fig. 1a) by

the Science and Technology Agency of Japan, and this is, undoubtedly, the major achievement since the first NPTT meeting.

Summary of presentations

The following is a summary of the reports of the various speakers with the titles listed in the agenda. The summary emphasizes points relevant to the planning and activities of the NPTT.

October 16, 1997

JGOFS-related activities in the subarctic Pacific and marginal seas

Dr. S. Tsunogai (Hokkaido University, Japan) introduced a term "*the potential anthropogenic CO₂ sink capacity*", defined as the expected amount of CO₂ absorbed by seawater when all the nutrients contained

are transformed to the organic matter. The amount of preformed PO_4 in the N. Pacific is greater than that in the N. Atlantic, making the potential chemical capacity for uptake of anthropogenic CO_2 in the N. Pacific greater than commonly known. He presented new estimates of the potential capacity of the N. Pacific by considering four processes:

- (1) the formation of the North Pacific Intermediate Water in the northwestern North Pacific occupying the layer down to about 1000 m with a residence time of a few tens to one hundred years;
- (2) the continental shelf pump providing the dense water which contains more total carbonate and supplying it to the subsurface layer of the open ocean;
- (3) the gas exchange process in the high latitudes where the gas transfer velocity, being accelerated by bubbles, is larger than that accepted at present by the majority of scientists in this field;
- (4) the abundant silica controlling the ecosystem by producing larger particles sinking into the abyssal with higher speeds and larger organic-C/carbonate-C ratios in the western North Pacific.

All these processes indicate the peculiar and important role of the North Pacific, especially its western part, as the anthropogenic CO_2 sink, and seem to be overlooked or underestimated by the present modellers giving smaller values for the oceanic CO_2 uptake.

Providing comments to this presentation Dr. S. Emerson mentioned that the physical potential may be limiting because of the absence of deep convection in the N. Pacific beyond that associated with the North Pacific Intermediate Water formation.

B. Frost (Univ. Washington, USA) reviewed the US plans for JGOFS synthesis and modelling in the N. Pacific. He had expected a funding decision by now on the first round of activities, but that decision has been delayed pending decisions on next year's federal budget. His presentation was thus based on planning information contained in the US JGOFS Newsletter Vol. 7 (3, 4), Vol. 8 (3) and at US JGOFS home page (<http://www1.whoi.edu/jgofs.htm>). The US JGOFS program consisted of the following elements:

- the CO_2 survey
- time series studies
- process studies in the N. Atlantic, the Equatorial Pacific, the Arabian Sea, and currently the Southern Ocean
- synthesis and modelling to describe the role of oceanic

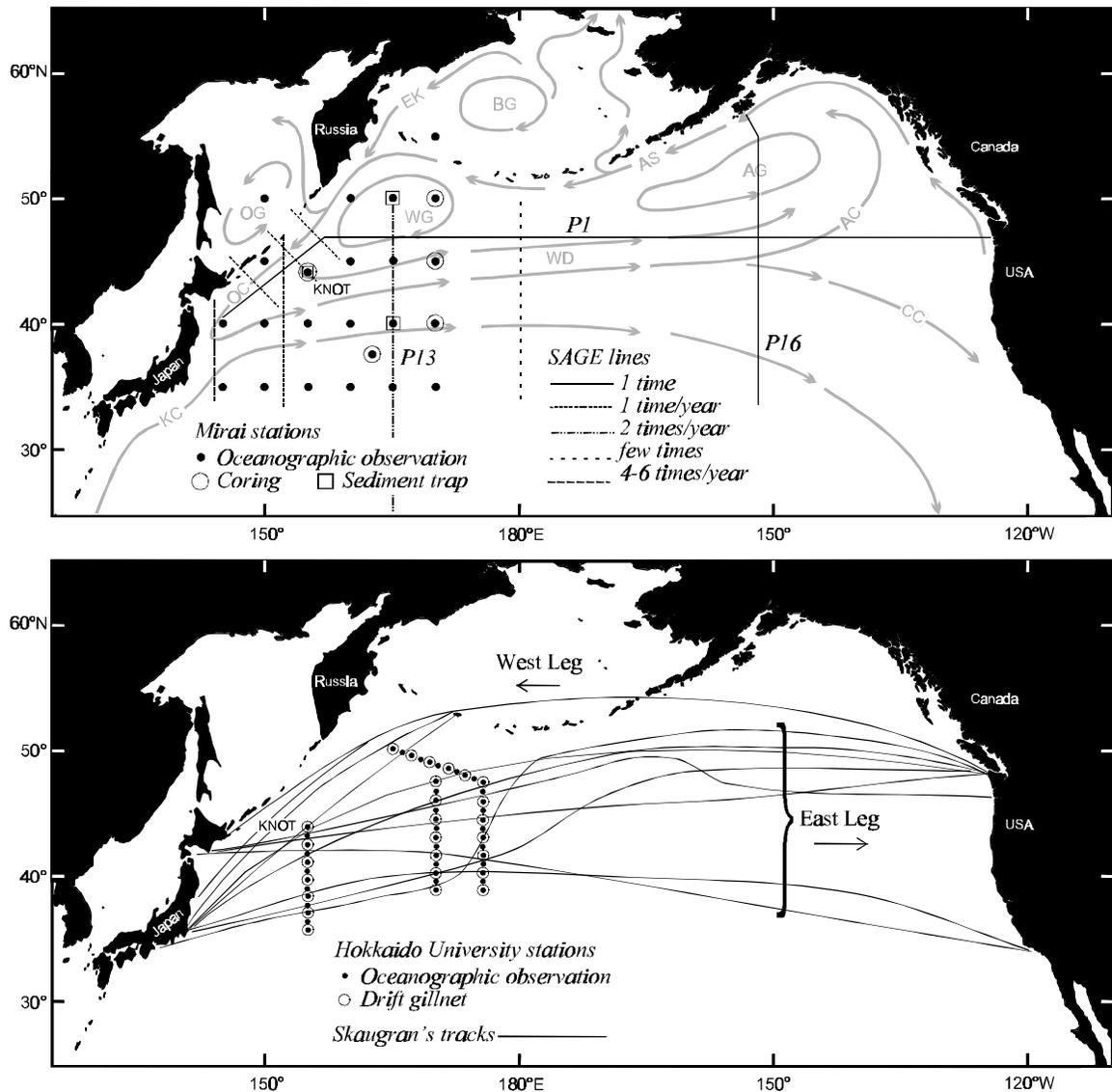


Figure 1. Japanese North Pacific Study: Cruises and stations.

processes in the global carbon cycle
 - satellite color analysis
 - data management

- global and regional mass balances
 - mechanistic controls of local C mass balances
 - extrapolation and prediction.

Two synthesis and modelling workshops have been held: in August 1996 where an implementation plan was drafted (published in February 1997), and in July 1997 which focussed on modelling time series observations. The US synthesis and modelling phase is designed to support the two main JGOFS goals, to understand the oceanic carbon cycle and to develop the capability to predict future change in the oceanic carbon cycle, and will focus on 3 areas:

Subarctic Pacific

Dr. Y. Nojiri (National Institute for Environmental Studies, Japan) reviewed progress on the Japan/Canada monitoring program carried out aboard the merchant ship *Skaugran*. This 5-year project commenced in March 1995 and consists of repeated east/westward transects (8-9 round trips per year with 6 weeks intervals) between Japan to North America. The ship route from Vancouver

to Japan is the great circle route crossing the Gulf of Alaska, the southern Bering Sea and the western subarctic Pacific, whereas that from Japan to North America fluctuates in a latitudinal band between 35°N and 52°N, according to the port of destination (Fig. 1b) The project's goals are (1) to monitor the spatial and temporal variations of sea surface delta fCO₂ and related meteorological and biogeochemical parameters in the northern N. Pacific and (2) to understand factors controlling the atmosphere/ocean CO₂ exchange in this region. Partial pressure of CO₂ in the air and seawater, temperature, salinity, chl.-a fluorescence are monitored continuously and logged in computer. Samples for nutrients, dissolved inorganic carbon, alkalinity, pigments, aerosols, calcium, selenium, etc. are taken every six hours. The *Skaugran* program is funded under the Agreement on Cooperation in Science and Technology between the Government of Japan and Canada, and principal investigators are Dr. Yukihiro Nojiri from the National Institute for Environmental Studies (Japan) and Dr. C.S. Wong from the Institute of Ocean Sciences (Canada).

Dr. Nojiri presented results from repeated transects and annual time series from several regions. About 20 round trips have been made between March 1995 and September 1997. In the northwestern subarctic Pacific, clear seasonality in delta fCO₂ (fCO₂ in sea – fCO₂ in air) was observed, showing low delta fCO₂ from May to December and high delta fCO₂ from January to April. In the Bering Sea, delta fCO₂ minimum in summer and maximum in winter were revealed. The largest peak to peak amplitude in delta fCO₂ was recorded in western region of the Gulf of Alaska, where extraordinary low fCO₂ of 220 μatm was found in the 5 degree longitude zonal average in June 1995. In the middle of the Gulf of Alaska, the seasonal variation in delta fCO₂ was very small. The two and a half year

integration of the fCO₂ data and on board recorded wind velocity suggested the net CO₂ sink of 0.3 GtC/y in the latitudinal zone north of 35°N. However, the data include uncertainty, especially due to the incomplete seasonal coverage in the low latitude zone (35-40°N°).

Dr. M. Kusakabe (JAMSTEC, Japan) presented a Japan Marine Science and Technology Center research plan on *Biogeochemical study of the northern North Pacific and its adjacent seas*. Major goals of this study are (1) to assess the spatial and temporal variations of the atmosphere/ocean CO₂ flux and vertical particulate biogenic fluxes; (2) to understand mechanisms controlling the biological pump and its role in the carbon cycle; (3) to clarify transport processes of dissolved materials in conjunction with the intermediate water formation; and (4) to determine the past changes in the oceanic environment from the records in sediments. Observations include deployment of sediment traps at three or more stations and repeated CTD and sampling lines (Fig. 1a). Analysis are planning in the following areas: *air-sea interaction* (continuous pCO₂, TCO₂, bottle pH, carbonate species, meteorological parameters and gas exchange coefficients), *biological activity* (primary production, 13C isotopes, chlorophyll, trace metals (Fe, Cu, etc) in seawater and air); *material transport* (dissolved and particulate matter from the sediment traps, 14C in seawater, radioisotopes: 234Th (particles), 226Ra (mixing), 228Ra (terrestrial)); and *paleoceanography* (sedimentation rates from C and O isotopes, biomarkers in sediments for organic matter, and T and S from O isotopes).

The new research vessel *Mirai* (means *Future* in Japanese), capable for winter operations in the high latitude (length of 130 m, gross tonnage of 8600 tons, service speed of 16 knots and capacity for 28 researchers and 18 technicians), will be used for the field campaign. Completed in October 1997, she will go through a year of test shakedown cruises and will undertake her first biogeochemical cruise in October 1998. Beginning in 1999, at least two months a year of ship time will be allocated to this study, which is expected to last a minimum of five years. From 1998 the program will be open to

Japanese scientists from universities and national research institutes and limited opportunities for foreign scientists, especially those from institutions with cooperative agreement with JAMSTEC.

Dr. S.I. Saitoh (Hokkaido University, Japan) reviewed activities with satellite remote sensing of ocean color in the subarctic N. Pacific, emphasizing the importance to gather sea-truth data simultaneously with satellite observations to develop and validate bio-optical algorithms from this area. His group is comparing color series with *in situ* sampling from four sites in the western N. Pacific. The OCTS (Ocean Color and Temperature Scanner) on ADEOS was launched in August 17, 1996 and provided 8 months of images, but died in June 1997. The US SeaWiFS (Sea-viewing Wide Field-of-view Sensor) on SeaSTAR which was launched August 1, 1997 for monitoring the marine environment, especially primary production, in the subarctic North Pacific Ocean. Hokkaido University started receiving and archiving SeaWiFS images for the western N. Pacific on 29 September 1997. Dr. Saitoh presented some results on temporal and spatial variability of phytoplankton pigment concentration in the Japan and Okhotsk Seas, using the CZCS (Coastal Zone Color Scanner) monthly mean data sets. Future missions include MODIS (MODerate resolution Imaging Spectroradiometer) on EOS-AM in 1998 and GLI (Global Imager) on ADEOS-2 in 1999. They also plan to start in 1998 a cruise, repeated each year for 5 years, along a track over the N. Pacific reaching Seattle.

Dr. T. Yoshida (Japanese Meteorological Agency) provided information presented by Dr. A. Bychkov. The JMA's objective is to monitor the state of the ocean and understand the mechanisms responsible for oceanic variability on various time scales, with an emphasis on greenhouse gases. The JMA has been making a variety of observations from hourly at the tidal and meteorological stations to seasonal and annual onboard research vessels. These oceanographic activities are carried out in the Climate and Marine Department of JMA Headquarters in Tokyo, at four Marine Observatories in Hakodate, Kobe, Nagasaki and Maizuru and at the

Meteorological Research Institute (MRI) in Tsukuba. The Agency also operates the WMO World Data Centre for Greenhouse Gases (WDCGC), which collects and analyses greenhouse gas data in the world.

To contribute to the understanding of the roles of the western N. Pacific in the climate system oceanographic observations along 137°E from near the equator (3°N) to the Japanese coast (33°N) has been performed on a routine basis since 1967 in winter and 1972 in summer. Measurements of oceanic and atmospheric CO₂ along this line, started in 1981. In 1989, the JMA initiated operational monitoring of greenhouse gases (carbon dioxide, methane, chlorofluorocarbons and nitrous oxide) in the marine air and sea surface water, and in 1992, the observation of these gases was extended to deep layers of the oceans. In 1994, to estimate the accumulation of carbon dioxide in the oceans, the JMA started observing organic substances (dissolved organic carbon and dissolved organic nitrogen) in seawater. In 1996 the Agency commenced making measurements (including greenhouse gases monitoring) along 165°E, from 50°N to 7°S, and carried them out twice, in April-June and in October-December. The JMA is planning CO₂/greenhouse gases observation along lines 144°E, 147°E, and 152°E as a part of the Subarctic Gyre Experiment (SAGE), which has been started in 1997. Besides the north-south lines in the western North Pacific, observations are conducted four times a year along five lines which traverse major ocean currents in the seas adjacent to Japan. The JMA also operates three moored ocean (meteorological and oceanographic observations) data buoys in the Japan Sea, East China Sea and south of Japan. Data are reported to JMA via GMS and distributed to the world community through the Global Telecommunication System (GTS).

Some results on spatial pCO₂ variations along 137°E and 165°E and temporal pCO₂ variations along 137°E were presented. Dr. K. Denman mentioned that the reported increase in oceanic pCO₂ along 137°E, at a rate of 1.8 μatm/yr north of 15°N and 0.65 μatm/yr south of 15°N is comparable with 2.0 μatm/yr growth along the outer half of line P (C.S. Wong, Canada, personal communication). This presentation followed by a discussion on the JMA involvement in the North Pacific Process Study and NPTT activities.

Bering Sea

A. Macklin (Alaska Fisheries Science Center, NOAA, U.S.A) described two Bering Sea research projects funded by the U.S. National Oceanic and Atmospheric Administration (NOAA) Coastal Ocean Program. The projects are Bering Sea Fisheries-Oceanography Coordinated Investigations (BS FOCI) and Southeast Bering Sea Carrying Capacity (SEBSCC). They are of interest to the JGOFS community primarily for their monitoring and modeling components that provide information on physical oceanography and meteorology, abundance and distribution of nutrients, primary and secondary productivity.

The BS FOCI, 7-year program completed 30 September 1997, had a Walleye Pollock focus with moorings giving vertical profiles of ADCP currents and chlorophyll absorption. Major findings, resulted from analysis of satellite altimetry, trajectories from over 100 satellite-tracked drift buoys, development of a circulation model, and atmospheric studies, include variability in forcing from the N. Pacific, identification of a new current, the North Aleutian Slope Flow, and detection of mesoscale features such as eddies that are important to transport and shelf/slope exchange. S. Bollens (WHOI) developed a coupled 1D physical biological model that, consistent with observations, indicated zooplankton over the continental slope would starve and required onshore transport for survival. Several technological achievements by the project, such as *in situ* chlorophyll absorption meters for use on moorings and modified equatorial surface moorings with standard meteorological and at-depth oceanographic sensors, biological sensors for chlorophyll and photosynthetically active radiation, and ADCP for ocean velocity and zooplankton abundance estimates, are of interest to JGOFS. A summary of FOCI will appear in the upcoming PICES volume on the Bering Sea and is available through the FOCI Home Page at <http://www.pmel.noaa.gov/foci/>.

The SEBSCC program will focus on the role of juvenile pollock in the slope/shelf ecosystem and will have an ecosystem, management orientation. The six-year project (1996-2001) is jointly managed by the University of Alaska, the Alaska Fisheries Science Center, and the Pacific Marine Environmental Laboratory. Researches relevant to JGOFS include monitoring from biophysical platforms in conjunction with measurements of nutrients, primary and secondary productivity, isotopic and biomarker composition of sinking organic matter from sediment traps, and a coring component. Further information can be found on the NOAA Bering Sea/North Pacific home page (<http://www.pmel.noaa.gov/bering/>), and a data inventory for the Bering Sea is being developed with PICES.

Okhotsk Sea

Dr. S. Riser (Univ. of Washington, USA) provided Dr. A. Bychkov with a summary of international cooperative studies in the Sea of Okhotsk. Because of harsh environmental conditions and political limitations, the Okhotsk Sea has traditionally been a difficult venue for research by non-Russian scientists. In recent years this situation has improved somewhat, and there is hope that further international cooperative research programs will take place in the near future. Two JGOFS-related expeditions were carried out recently. In 1994 a Russia-Canada WOCE cruise completed 35 stations along an abbreviated line P1 and in 1995 a Russia – USA cruise completed 184 CTD stations in the Sea of Okhotsk. Both of these cooperative ventures were highly successful and provided new scientific results concerning the Okhotsk Sea as well as fostering a spirit of international cooperation.

A number of cooperative ventures in the Okhotsk Sea are now underway and continuing. As examples, (1) the Hokkaido University has cooperated with Russian colleagues in recent years to continue to maintain a meteorological station on Sakhalin Island; (2) a number of Japanese scientists from the Hokkaido Central Fisheries Experimental Station and

their Russian colleagues from the Sakhalin Research Institute of Fisheries and Oceanography have continued to carry out a cooperative study of the flow through Soya (La Perouse) strait.

Plans are presently being made for a 3-year joint Russian-Japanese-US cooperative study of the Okhotsk Sea beginning in the summer of 1998 and involving scientists from the Hokkaido University and JAMSTEC (Japan), Far-Eastern Regional Hydrometeorological Research Institute and Pacific Oceanological Institute (Russia), and University of Washington and Scripps Institute of Oceanography (USA). Proposals for this program have been written and submitted in all three countries, and funding from the Science and Technology Agency of Japan was granted, and approval from two other governments is now awaited.

Project goals: (i) to Okhotsk Sea in the region east of Sakhalin Island and north of the Kurile Islands, and the region in and around Bussol' Strait; determine the characteristics of dense water formed in the Okhotsk Sea in winter and its connection to NPIW; (ii) to examine the pathway between dense water formation regions in the north of the Okhotsk Sea and the Kurile Straits and North Pacific in the south; (iii) to quantify the nature of the exchange between the Okhotsk Sea and North Pacific. Observations include:

1. 3 current meter and 4 pressure gauge moorings in Bussol' Strait, to be deployed in summer of 1998 to be recovered in the summers of 1999 and 2000
2. current meter moorings in the East Sakhalin Current between 46°N and 54°N, to be deployed in summer of 1998 and recovered in summer of 1999
3. CTD and chemical surveys with core JGOFS measurements in the vicinity of the Bussol'

Strait and north between 1000 m isobath and Sakhalin Island in the summers of 1998 and 1999

4. sediment core sampling along Sakhalin Island in summer of 1998
5. meteorological observations using weather balloons along Sakhalin Island in summer of 1998.

Japan/East Sea

Dr. A. Bychkov (PICES) reviewed the Circulation Research of the East Asian Marginal Seas (CREAMS) program started in 1993 as a joint venue between Japan, Korea and Russia involving scientists from the Seoul National University and KORDI (Korea); Research Institute for Applied Mechanics, Kyushu University (Japan); and Far-Eastern Regional Hydrometeorological Research Institute (Russia).. CREAMS-I was completed in 1997 and followed by CREAMS-II beginning in 1998 for another 5 years. An intensive observation program including simultaneous multi-ship surveys and deployment of current meters, surface drifters, PALACE floats and moorings in the entire Japan/East Sea is planned in 1999-2000. Primary contacts are Dr. Kuh Kim (kuhkim@ocean.snu.ac.kr), Dr. Masaki Takematsu (i79493a@kyu-cc.cc.kyushu-u.ac.jp) and Dr. Yuri Volkov (hydromet@online.ru)

Project Goals are

1. to understand the circulation of cold water in the Japan/East Sea (JES) and the dynamics of the path of the Tsushima Current;
2. to clarify the structure of the deep waters and meso-scale variations of properties and currents;
3. to relate the interior properties of the JES to the boundary conditions;

4. to forecast short- and long-term changes of the JES environment.

Plan for the U.S.A. participation in the program was adopted recently by the Office of Naval Research.

Dr. S. Riser (U. Washington, USA) provided A. Bychkov with an update of US plans for participation in the CREAMS program. Proposals for the US CREAMS were submitted in July 1997 and funded programs were announced in October 1997. The Office of Naval Research (USA) allocated about \$12M spread out over 5 years and 12 scientific projects. The US CREAMS Project Office headed by Dr. Stephen Riser will be organized at the Univ. of Washington campus. List of US-CREAMS projects include

- (1) Satellite characterization of bio-optical and thermal variability in the JES (Bob Arnone, Naval Research Lab.);
- (2) Atmospheric forcing and its spatial variability over the JES (Bob Beardsley, WHOI);
- (3) The upper-layer circulation of the JES: historical data analysis (Amy Bower, WHOI);
- (4) Studies of the physical and biological processes in the JES using coupled numerical models (Carol-Anne Clayson, Purdue Univ.);
- (5) Glider surveys of the JES circulation (Chariles Eriksen, Univ. of Washington);
- (6) JES dynamics using numerical models with 1/8 to 1/64 degree (Harley Hurlburt, Naval Research Lab.);
- (7) Physical and optical structures in the upper ocean of the JES (Craig Lee, University of Washington, and Kenneth Brink, WHOI);
- (8) Optical properties as tracers of water mass structure and circulation patterns in the JES (Greg Mitchell, SIO);
- (9) Modeling support for CREAMS: oceanic and atmospheric mesoscale circulation and marine ecosystem simulations of the JES (Christopher Mooers and Shuyi Chen, Univ. of Miami);
- (10) Wind forcing of currents in the JES (Peter Niiler, SIO);
- (11) Observations of upper ocean hydrography and currents in the JES using PALACE floats (Stephen Riser, Univ. of Washington);
- (12) Hydrographic measurements in support of JES circulation, ventilation, and frontal process studies (Lynne Talley, SIO);

- (13) Shallow and deep current variability in the southwestern JES (Randy Watts and Mark Wimbush, Univ. of Rhode Island);

Dr. K.R. Kim (Seoul National University, Korea) reviewed results to date from the Circulation Research of East Asian Marginal Seas (CREAMS) program. They have found high $p\text{CO}_2$ – high nutrient correlations, indicative of biological production affecting $p\text{CO}_2$ concentrations. Calculations of annual cycles in $p\text{CO}_2$ were presented for 3 cases: (i) solubility effects of changes in SST only, (ii) inclusion of air-sea gas transfers, and (iii) inclusion of the biological pump. Some areas along the transects were deeply undersaturated with respect to atmospheric $p\text{CO}_2$ concentrations. CFC-11 profiles showed penetration all the way to the bottom.

Dr. C.-T. Chen (National Sun Yat-Sen University, China-Taipei) presented progress on determining stagnation of the Japan/East Sea deep water, work done cooperatively with A. Bychkov and K.R. Kim. It has been known for some time that there exist decade scale changes in the Japan/East Sea water properties. For the first time this fact was mentioned by Gamo and Horibe while they examined Japanese data collected during 1969-1984. Authors have extended the period of observations in both directions by adding a few joint Russian cruises with Taiwanese (KEEP-MASS, 1992), US (University of Washington, 1995), Japanese (Environmental Agency, 1995) and Korean (CREAMS, 1996) colleagues and, in an attempt to see how far this trend could be followed backwards, historical Russian data from the beginning of 50's. An 0.07°C increase in the potential temperature below 2000 m is observed from 1950 to 1996, but temperature scales have been changed. A deepening of the oxygen minimum layer from less than 1000 m in the late 60's to below 1500 m in 1996, and a decrease in the oxygen concentrations of the JSBW by $20 \mu\text{mol/kg}$ for the same period were reported. Observations suggest that the depth of the oxygen minimum layer and the oxygen concentration in the bottom

layer have been continuously decreasing since the 1950's. In addition it is quite certain that the thickness of the adiabatic Bottom Water has decreased by more than 1500 m for the same period. The phosphate concentrations in the bottom layer have been increasing by approximately 0.4 $\mu\text{mol/kg}$ from 1950's. Identifiable long-term changes were also found for silicate and normalized total alkalinity. To determine if these changes are real stations from the Sea of Okhotsk, occupied on the same cruises, were examined. No systematic trends are observed, indicating that the observed trends in the deep Japan/East Sea are real, and this stagnation started at least as early as 1950 and is continuing. It has been reported that the Japan/East Sea was anoxic during the last glacial period and did not become oxic until early in Holocene. If stagnation continues with the current speed, the Japan/East Sea could become anoxic below 2000 m between 180 and 530 years from now. There are indications that interdecadal variability of the Japan Sea water properties resulted from changes in deep/bottom water ventilation, possibly because winter storms have been less severe. Some speculations were proposed on what is the cause for these changes: a natural variation/oscillation or a special phenomenon reflected global changes in regional scale?

East China Sea

Dr. S. Tsunogai (Hokkaido University, Japan) presented results obtained under MASFLEX, a joint China – Japan study in the East China Sea. Along a transect from Okinawa to the mouth of the Yangtze River, the coastal region is highly undersaturated ($\sim 60 \mu\text{atm}$) in March, and slightly oversaturated in August. Observations indicated the following

mechanism for the absorption of atmospheric CO_2 : (i) surface water cooling, induced by the heat loss, produces denser water and accelerates the absorption of CO_2 in the shelf zone; (ii) organic particles are decomposed on the shallow bottom, making bottom water rich in dissolved inorganic carbonate; (iii) isopycnal mixing transports the carbonate from the coastal sea into the subsurface layer of the open oceans. A new term, Continental Shelf Pump, was proposed for this mechanism. The continental shelf pump accounts for the net oceanic uptake of carbon dioxide of 1 Gt C/yr, if the world continental shelf zone absorbs the atmospheric CO_2 with a rate observed in the East China Sea ($40 \text{ gC m}^{-1} \text{ y}^{-1}$).

Dr. C.T. Chen (National Sun Yat-Sen University, China-Taipei) reviewed activities and results of the Kuroshio Edge Exchange Processes (KEEP) project. This multidisciplinary study of the biogeochemical cycle of carbon and associated elements in the East China Sea has provided an extensive database for the area and discovered many important phenomena since its inception in 1989. The program was initiated and supported by the National Science Council, because it was not known what supported such productive fisheries in low nutrient waters. The KEEP project has completed two phases (KEEP-I and KEEP-II) which lasted for 5 and 3 years, respectively, and is now in the third phase (KEEP-III). Initially there were 30-40 principal investigators, now 12. It is still the main JGOFS related project in China-Taipei.

Observations include almost monthly sections for standard hydrographic variables, pH, Alk, TCO_2 , heavy metals and aerosol fluxes, and pCO_2 when possible. They discovered a nearly permanent upwelling eddy off the north east corner of Taiwan on the inner boundary of the Kuroshio, with horizontal currents often reaching 70-80 cm/s. The eddy was observable down to 200 m, and is responsible for a nitrate influx to the East China Sea shelf from the Kuroshio intermediate water at depths of ~ 600 m. Budget calculations for the area indicate that even for phosphate, rivers supply less than 10% of the influx to the East China Sea, the majority coming from upwelling from the deep Kuroshio. Comparative studies indicate that shelf drainage of waters in the Sea of Okhotsk and the Bering Sea takes excess CO_2 into the interior of the open ocean, but

there is trapping of deep waters in the Sea of Japan, the East China and South China Seas.

KEEP III (1997-2000) has goals:

- to determine the water budget of the East China Sea
- to determine the export flux of carbon
- to determine inventories and spatial distributions of key elements
- to quantify the lateral export flux in the South Okinawa Trough
- to quantify food chain dynamics

Participants of the KEEP-III are organized into three major groups: particulate plume transport, euphotic zone dynamics, and benthic dynamics. The particulate plume group concentrates on the southern Okinawa Trough. The investigators will deploy sediment traps and collect large-volume seawater samples for the determination of trace metals and particle-reactive radionuclides. More accurate material transport through the southern Okinawa Trough may be estimated from these measurements together with direct measurements of current velocities. The euphotic zone group will design biogeochemical cruises to sample the diverse biological and chemical regimes in the shelf and slope region of the East China Sea. Inventories of and exchange rates among the different components of the lower food chain will be estimated in order to delineate the role of biological processes in the carbon cycle in the East China Sea. The benthic group will collect cores from the East China Sea and the Taiwan Strait. The sedimentation rates and sediment mixing rates in these areas will be determined from the distribution of multiple tracers (^{210}Pb , $^{239,240}\text{Pu}$, ^{137}Cs etc.) in these cores. The information may then be used for estimating the removal of carbon by burial in the carbon budgets.

The publications and data originated from the KEEP project can be found at our web site (<http://keep.oc.ntu.edu.tw>) and in the forthcoming special issue of Continental Shelf Research.

Dr. N. Jiao (Institute of Oceanology, China-Beijing) described JGOFS activities in China started in 1991. Fourteen institutions from the Chinese Academy of Sciences (CAS), the National Education Committee (NEC), and the State Ocean Administration Bureau (SOA) are involved in JGOFS activities, thus forming the largest scientific program in the history of marine science in China both in terms of funding and duration. The major sponsor for JGOFS projects is the National Natural Science Foundation of China (NSFC).

Specific topics studied in the CN-JGOFS projects include circulation and water mass activities, vertical and horizontal fluxes of inorganic and organic matters, transport and transformation of carbon and other materials, sedimentary properties of different particles and evolutionary patterns of their consequences; estimation of the budget of carbon dioxide and other green house gases, estimation of the capability of carbon fixation; nutrients dynamics and their controlling mechanism; distribution of phytoplankton pigments, cell abundance, zooplankton biomass and non-living particulate organic matter; population interactions among different organisms, biomass spectra and their roles in the marine food web and carbon fluxes; biological production processes and their controlling mechanisms; and physical linkages for primary and secondary productivity; in addition, the application of remote sensing to ocean flux, and physical-biological coupling and modelling.

The main geographical location for CN-JGOFS studies is the East China Sea with special focuses on some particular areas such as the estuary of Yangtze River, the cold eddy, Kuroshio Current and Okinawa Trough. Other sites include the Yellow Sea, Bohai Sea, Taiwan Strait and South China Sea.

A few JGOFS projects were accomplished recently or are under way:

- (1) Margin Flux in the East China Sea (MFLECS) – Chinese input to the joint

program with Japan on the Material Flux in the East China Sea (MAFLECS) (1992-1995);

- (2) Processes of biological production in the estuary of Changjiang River and adjacent waters (1993-1995);
- (3) Studies on the fluxes of carbon and associated biogenic elements in the Taiwan Strait (1993-1996);
- (4) The exchange of water and nutrients between shelf and the Kuroshio in the East China Sea (1994-1996);
- (5) Key Processes of Ocean Flux in the East China Sea (POFLECS) (1996-1999).

The major results from the completed CN-JGOFS projects include:

- (i) The East China Sea serves as a sink for CO₂ with 7.2 million tons of carbon absorbed annually by the ocean
- (ii) Phytoplankton plays a key role in vertical flux of carbon in the East China Sea
- (iii) Fine materials are transported from Yangtze River mouth to the Okinawa Trough mainly by vertical circulation driven by the winter monsoon
- (iv) Particulate material transported to the Okinawa Trough is about 10-15 million tons each year

A new 4-year program on Biogeochemical processes of biogenic elements in the Taiwan Strait was started in January 1997 as the NSFC project (contact Dr. Huasheng Hong, hshong@xmu.edu.cn) and two programs were proposed to begin later this year: (i) Land-Ocean interactions near the Yangtze river mouth (1998-2001) supported by the NSFC; and (ii) Land-Ocean interactions in China Seas and their impacts on marine environment (1997-2000) supported by the CAS

International collaborations are actively being carried out at both the project level and the level of scientists-exchange for many projects.

October 19, 1997

Time-series observations in the North Pacific

Dr. R. Feely (Pacific Marine Environmental Lab/NOAA, USA) described the oceanic CO₂

program of NOAA, whose goal is to understand the role of oceanic sources and sinks in determining atmospheric CO₂ concentrations. He reviewed the CO₂ intercomparison work. The Quality Assurance Project consists of: four major efforts:

- (1) distribution and daily shipboard analyses of reference materials (dissolved inorganic carbon throughout the project, and alkalinity and pH during the last 2 years) directed by Dr. A. Dickson of SIO;
- (2) laboratory intercomparisons of fCO₂ methodology by Dr. A. Dickson of SIO;
- (3) collection of replicate samples and shore-based analyses by Dr. C. Keeling of SIO; and
- (4) intercomparisons of samples collected at intersection points along the cruise tracks (NOAA: PMEL and GFDL groups) directed by Dr. R. Feely of PMEL.

In the Pacific Ocean, surface-to-bottom CO₂ system parameter measurements were conducted on all of the WHP survey cruises. In all, 11 laboratories from 4 countries participated on 13 basinwide surveys of the Pacific. Eight of eleven laboratories provided data for intercomparison. Intercomparison was made for salinity, temperature, oxygen, dissolved inorganic carbon (DIC), total alkalinity (TAlk), and CO₂ fugacity (fCO₂). For the majority of cruises, there is excellent agreement amongst the various laboratories for DIC and TAlk. In general, DIC differences are <3.0 umol/kg and TAlk differences are <5.0 umol/kg in deep water. For fCO₂, the agreement varies quite widely from one cruise to another, from < 5 uatm to more than 25 uatm. Data and results of the study can be accessed at the PMEL web site: (http://pmel.noaa.gov/co2/oaces_doe/home.html). Proposal was made that the broad-based international cooperation in CO₂ quality assurance be continued for as long as large-scale field programs in the North Pacific are maintained. Recommendations concerning quality assurance and comparison of scientific results appear at the end of this report (Appendix 2).

Feely also briefly presented results for data assimilation/evaluation studies using a GFDL ocean general circulation model that interpolates to fill in pixels with missing data, which shows the N. Pacific to be a major sink for anthropogenic CO₂ of order 0.5-0.6 Gt C/y. Comparisons of vertical profiles of excess CO₂ (based on a modified version of Chen et al. 1981) with profiles of freons shows that the patterns of column burdens agree over large scales.

HOT Station

Dr. R. Bidegare (University of Hawaii, USA) reviewed the goals and elements of the JGOFS program before describing the Hawaiian Ocean Time Series (HOTS) program conducted at station ALOHA (22.75°N 158°W) in 4800 m of water north of Hawaii. Oligotrophic gyres make up 40% of the ocean surface area and cannot be ignored in an inventory of ocean-atmosphere CO₂ exchange. Hence the USA also operates a sister time series program: the Bermuda Atlantic Time Series (BATS) at 31.50°N 64.10°W.

HOTS commenced in 1988 with a comprehensive set of observations conducted on a 5-day cruise at least once per month. There is a WOCE standard CTD-rosette cast, drifting sediment traps are deployed for ~72 h each cruise and since 1992 there have been moored sediment traps. To date there have been 100 cruises. Data can be obtained in hard copy, as floppy disks, from NODC, by email, ftp, fax or telephone, or from the following web sites <http://hahana.soest.hawaii.edu> and <http://www.bbsr.edu>. On the HOTS web site there are data plotting routines, a field and laboratory protocols manual, and a publications list.

Scientific results from HOT have often been contrary to expected results. Primary productivity is higher than expected from the low nitrate concentrations, primary (PP) and export (XP) production do not fall on the Eppley-Peterson curve (higher PP often results in lower XP), late summer events result in intact diatoms (with internal N-fixing symbionts) sinking to the sea floor, half the nitrate in the euphotic zone comes from oxidation of ammonium, N₂ fixation organisms 'leak' ammonium as

well as nitrate, and there is decoupling of C, N and P from Redfield ratios and accumulation of DOM. There is considerable vertical structure in nitrate+nitrite at previously undetectable concentrations less than 10 nM. Six high nitrate 'events' would have been missed without the time series sampling. During ENSO events, a shallower mixed layer apparently contains the same amount of Fe and fixed N, resulting in greater nitrate utilization and eventual phosphate limitation. Fe concentrations of 1.0-1.5 nM/kg are not limiting.

Dr. S. Emerson (Univ. Washington, USA) reviewed recent work on the new fixation of CO₂ from 3 years of observations at HOTS (results of this study are in press in *Nature*). The flux of biologically produced organic carbon from the euphotic zone of the ocean to deep waters below--the biological pump--is one of the important controls on atmospheric CO₂. Accurate determination of this flux is critical to understanding and being able to predict future changes in the oceanic carbon cycle. Since there are no standards against which environmental fluxes can be determined, an accuracy was accessed by comparing results from three independent experimental approaches for measuring the net annual export of organic carbon in the subtropical North Pacific Ocean at U. S. JGOFS time series station near Hawaii.

The net biological production of oxygen determined from the mass balances of dissolved oxygen, nitrogen, and argon during three one year periods yields an equivalent carbon export of 2.7 ± 1.7 moles C m⁻² yr⁻¹. Net biological carbon production determined by mass balances of dissolved inorganic carbon (DIC) and DIC δ¹³C over a two year period is 1.6 ± 0.9 moles C m⁻² yr⁻¹. Finally, measurements of the particulate and dissolved organic carbon fluxes yield an export of 2.0 ± 0.9 moles C m⁻² yr⁻¹. Uncertainties of these fluxes were determined by a Monte Carlo method that compounds the error estimates of the individual terms of the mass balances. Given the uncertainties, these fluxes are not significantly different and establish the attainable experimental accuracy to be roughly ±50%. If 2.0 moles C m⁻² yr⁻¹ is typical of the subtropical ocean, then this vast region which is 60% of the ocean area, is responsible for a biological pump of 5-6 Gt C yr⁻¹. Assuming that recent model-derived estimates of the global ocean carbon pump (10-11 Gt yr⁻¹) are

correct, then the subtropical oceans, often considered a biologic desert, account for up to half of the global-ocean biological organic carbon pump.

The most serious problem associated with interpreting these relatively large export production values in the subtropical oceans is identifying the source of nutrients to the euphotic zone. It has long been known that isopycnals with measurable inorganic nutrients are several hundred meters below the euphotic zone in the subtropical Pacific. However, continuous measurements of oxygen and nitrogen gas on a mooring at the time series station indicate that during the first half of 1997 there was a period of enhanced oxygen production when an eddy or front passed through the area. The period of excess oxygen saturation was associated with shoaling of the isopycnals and color change indicating enhanced productivity. These observations can only be obtained only by continuous measurements from moorings and may indicate that nutrients are transported to the euphotic zone of the subtropical ocean by intermittent vertical pumping associated with eddies or fronts. This hypothesis will be investigated by continuing the mooring studies.

PAPA Station

Dr. P. Harrison (Univ. of British Columbia, Canada) described studies at ocean weather station Papa (50°N 145°W), where a weatherships operated from the early 1950's until 1981, and research cruises have been conducted 3-4 times a year since then. Dr. C.S. Wong has carried out CO₂-related measurements since the 1970s. The US-Canada SUPER project was performed between 1984 and 1987, but it was John Martin's hypothesis that the micronutrient iron limits primary production in the eastern subarctic Pacific that motivated the Canadian JGOFS program along line P and at station P. For the past 5 years, Phase I and II of CJGOFS has made 13 cruises along Line P to Stn P during late winter (Feb/Mar), late spring (May/June), and late summer (Aug/Sept). The advances include, the first winter cruises, extensive documentation of Fe

limitation, size-fractionated nitrogen uptake and primary productivity, extensive urea measurements and uptake and hence a recalculation of the f-ratio, extensive analysis of microzooplankton, heterotrophic bacteria, bacterial respiration, virus abundance, mid-water studies on the microbial loop, and new modelling efforts.

There have been apparent increases in primary production over 30 years from measurements made by McAllister, Wong, and Welschmeyer, but Harrison's measurements tend to be in the middle overlapping with those of Wong. Essentially no winter measurements had been made, so the JGOFS program conducted a series of winter cruises each February, and added a new emphasis on mid-water column transformations of organic matter. Most chlorophyll is in the 0.2- 5 µm fraction, and using the McCarthy relative preference index, Harrison and coworkers have shown that phytoplankton take up first ammonium, then urea, then nitrate, with the f-ratio being ~0.25 through all seasons (ignoring urea uptake would increase the f-ratio by 36%). The CJGOFS work has confirmed Fe limitation, with Fe-addition to containers stimulating growth in the >18 µm fraction. LaRoche succeeded in demonstrating that flavodoxin acts as a biomarker for Fe-limitation.

There have been isolated high chl values in the 10m samples from Stn. P, and silica data from Wong show dramatic draw down in late summer 1972, 1976 and 1979, corresponding with the lowest values for summer nitrates, indicating blooms of silicaflagellates or diatoms. To try to observe these events, C-JGOFS employed a mooring with a fluorometer, PAR sensor, current meter and pressure sensor all at 30 m. A hypothesis of atmospheric deposition of bioavailable Fe, either from the Gobi Desert, or Alaska has yet to be proven or disproven. Future work is required on (1) Fe, low light, PP interactions in winter to try to explain an

isolated observation of long coils of a Chaetoseros diatom on a February cruise, (2) the sources of iron, and (3) factors controlling bacterial productivity and mesozooplankton herbivory/omnivory.

Dr. K. Denman (Institute of Ocean Sciences/DFO, Canada) reviewed climate-related observations being conducted by IOS. There are a number of projects with JGOFS-related components under the Program on Ocean Climate Study in the northeastern Pacific, such as *Air-Sea exchange of climatologically important variables* (Dr. D. M. Farmer, farmer@ios.bc.ca); *Water circulation and nutrient supply in the northeast Pacific Ocean* (Dr. H. J. Freeland, hjfree@ios.bc.ca); *Oceanic uptake of fossil-fuel CO₂: tracers, modeling, sediment traps* (Dr. C. S. Wong, cswong@ios.bc.ca); *Oceanic DMS* (Dr. C. S. Wong, cswong@ios.bc.ca); *Plankton Process Studies* (Dr. D. L. Mackas, mackas@ios.bc.ca); *Alaska Gyre Zooplankton* (Dr. D. L. Mackas, mackas@ios.bc.ca);

All these all projects have funding from DFO and some of them have additional source for financial support. Field observations for this program include:

- (1) extensive ship-board CTD, chemical and biological surveys with JGOFS core measurements along line P (three 4 weeks cruises a year (winter, spring and fall) on the R/V Tully); high seas salmon cruises on the R/V Ricker are planned to be used to expand spatial coverage of the Gulf of Alaska;
- (2) long-term sediment traps observations at line P: single depth moorings at stations P4 (800 m) P12 (2800 m), P16 (3000 m) and P20 (3400 m), and 3 depths mooring at station Papa (200 m, 1000 m and 3800 m),
- (3) long-term automatic observations in the mixed layer at station Papa: bio-optical mooring to collect temperature, salinity, PAR and fluorescence data, bubble entertainment (acoustically)

and currents, and mooring with upward looking acoustic transponder to record zooplankton migration;

DFO has conducted daily sampling for surface temperature and salinity at a number of lighthouses along the Pacific coast of Canada, in some cases since 1934, providing a well-resolved average annual cycle to determine anomalous conditions. Currently, a strong ENSO event appears to be developing, and monthly mean sea surface temperatures at Amphitrite Point and Langara Island lighthouses for September 1997 were the warmest temperatures ever recorded at these sites (>60 years of observations). Surface nitrate concentrations in summer for the continuous El Niño conditions observed in 1990-95 showed increased depletion along the inner half of line P from year to year, reflecting lower winter concentrations during the same period. Long term series for POC and POC from sediment traps moored by CS Wong at a depth of 3800 m at station P show annual cycles and interannual variation, as do surface nitrate concentrations. Freon 11 profiles show increasing depth penetration over the same period, and recent dimethylsulphide (DMS) profiles show a strong annual cycle in the surface 50 m.

KNOT Station

Dr. T. Saino (Nagoya University, Japan) described the Japanese JGOFS North Pacific Process Study (NPPS) by first presenting the Japanese JGOFS organization:

- National Committee for JGOFS (N. Handa)
- NP Planning Group was established in July 1995 and reorganized to NP Steering Committee in December 1997 (T. Saino)
- Time series working group established December 1997 (Y. Nojiri)
- Data management advisory group (T. Saino) and Data management office (N. Bada, JODC)

The Japanese NPPS will consist of the following:

- KNOT time series station
- Extensive surveys: SAGE, Skaugran, etc (2 years 1999-2000)
- Intensive survey on Mirai, etc (1999-2000)
- Remote sensing – OCTS, SeaWiFS, etc
- Synthesis and Modelling (Dr. M. Kishi)
- Time series data management

He reviewed recent progress in Japanese JGOFS and described the different roles of

JODC and the newly established Marine Information Research Center (Prof. Y. Nagata), which is currently translating the JGOFS Protocols Manual to Japanese, to be published by JODC.

Dr. N. Suginothara (University of Tokyo, Japan) outlined the Subarctic Gyre Experiment (SAGE) program, an important element of the Japanese North Pacific Process Study. This 5-year WOCE-type multi-agency program, started in April 1997, is funded by the Science and Technology Agency of Japan. Primary contact is Nobuo Suginothara of the Center of Climate System Research, University of Tokyo (nobuo@ccsr.u-tokyo.ac.jp).

The western subarctic Pacific may be an appreciable sink of atmospheric CO₂ due to the North Pacific Intermediate Water (NPIW) formation, the JMA/MRI OGCM predicts warming in the subarctic Pacific, the subarctic gyre experiences one of the largest interannual variations globally, and the zone 40°N – 50°N is not well observed, especially in winter (WOCE statistics) – all motivation for this study. Dr Suginothara showed that the NPIW can usually be tracked as a salinity minimum, near the $\sigma_{\theta} = 26.8$ ‘neutral’ surface, which suggests that there should be a resulting thermohaline circulation.

The SAGE major goal is to understand the relationship between the subarctic gyre system and climate change. The objectives are (i) to estimate formation rates of water masses, especially for the NPIW; and (ii) to clarify distribution processes and their long-term variability. The program has four core projects: (CP1) Observational studies of the structure and variability of the subarctic gyre; (CP2) Research on the interaction between subarctic and subtropical circulation; (CP3) Observational studies on the behaviour of carbon dioxide the behavior of CO₂ in the subarctic circulation system; and (CP4) Numerical modelling of the subarctic circulation, including seasonal variability. Field observations include the deployment of surface (ARGOS) and mid-depth (ALACE) drifters and intensified one-time and repeated transects with sampling by CTD, current profilers (ADCP) and bathythermographs (XBT) and some of the JGOFS core

measurements. The lines 47°N (P1), 152°W (P16N) and 180°E will be occupied once during the program; the line 152°E and three lines from the Okhotsle Sea to the subpolar Pacific – once a year; the line 165°E – two times a year; and the line 144°E – 4-6 times a year (Fig. 1a)

Dr. Y. Nojiri (National Institute for Environmental Studies, Japan) outlined the plans for the *Kyodo North Pacific Ocean Time Series (KNOT)* station in the western North Pacific. Joint efforts of the NPTT and Japanese JGOFS resulted in new CREST (Core Research for Evolution Science and Technology) funding, provided by he Science and Technology Agency of Japan, to support the *KNOT*. The site, located at the southwestern margin of the subarctic gyre at 44°N and 155°E, just outside the Russian EEZ, is 4 days travel from Tokyo and 2 days travel from Hokkaido (Fig. 1a). The scientific theme for this study is CO₂ uptake and its relationship to biological activity in the seasonally variable ocean.

The KNOT funding for the period 1998-2000 is insufficient to cover all ship costs, thus requiring cooperative use of research ships of opportunity from already funded programs (*Kyodo* means cooperative). Research vessels from JAMSTEC, Hokkaido University, University of Tokyo, Tokai University and the National Institute for Resources and Environment will participate in the program. Observations will start in June 1998, and the period until the August 2000 is the intense phase of KNOT time series. Seven visits (30-54 hours) and one visit (up to 1 week) are expected in 1998, seven visits and two stays – in 1999, and seven visits and one stay – in 2000. In addition to CTD sampling and JGOFS core measurements, plans include deployment of moored sediment traps at depths of 1, 3 and 5 km, a shallow optical buoy and free-drifting sediment traps. Field work will be forewarned by CO₂ intercalibration experiment and the start-up KNOT workshop organized in March 1998 at the National Institute for Environmental Studies, Tsukuba (contact person is Yukihiko Nojiri (nojiri@nies.go.jp)). Observations at *KNOT* will be supplemented by long-term data on the

interannual variability of the vertical water structure, seasonal changes in CO₂ exchange, and mixed-layer depth from Hokkaido University and M/S Skaugran cruise tracks. It is known from the Skaugran results, that station *KNOT* absorbs CO₂ in the summer until December and probably outgases CO₂ during the winter.

Discussion on task teams planned activities

Coordination of JGOFS-related studies in the North Pacific

Bychkov presented the JGOFS timelines for Field Programs, Analysis and Interpretation, and Data Synthesis from the IJGOFS IPO in Bergen. N. Pacific 'opportunity' cruises are scheduled not to extend beyond 2001, although A. Chen said that KEEP will continue for 10 years, regardless of affiliation with JGOFS. Some programs within Japanese North Pacific Process Study as well as CREAMS-II are scheduled to 2002.

Most of the discussion focused on the time series stations – how to build them into the timeline, how to recommend the importance of their joint continuation, etc. A yearly bridging funding for HOT has been requested while a proposal for LTER (Long Term Ecosystem Research) funding (of order 10 years) is prepared and reviewed. Station P is funded only yearly, but the plan is to continue base sampling indefinitely into the future. *KNOT* funding is guaranteed only until 2000. From experience at the existing time-series locations it is obvious, that oceanographic insight and discoveries increase with the length of the studies. Moreover, insights about the oceanography of the north Pacific derived from each station enhance interpretation of results from the others. This led to the recommendation on preparing a letter on the importance of the joint continuation of all three time-series in

the North Pacific after JGOFS field programs come to end at around the turn of the century, such that scientists can use to search for continued funding within their own countries. Decision was made that Drs. Bychkov, Saino, Emerson and Denman will prepare a Statement recommending to continue studies at stations PAPA and ALOHA and to extend a lifetime of the Kyodo North Pacific Time Series (*KNOT*) site in the western North Pacific. The Statement should be sent to the appropriate agencies in Canada, Japan, and U.S.A.

Dr. R. Feely offered the following recommendations (supported by other NPTT members) regarding continued CO₂ surveys:

Quality Assurance

- encourage and support the development and distribution of reference materials for CO₂ and nutrients;
- encourage and support international participation in laboratory and field intercomparison studies;
- encourage and support open distribution and discussion of field intercomparison results;

Scientific Results

- support open discussion and debate about the various methods for calculating anthropogenic CO₂ from measurements;
- support open discussion and debate about data / model comparisons;
- encourage and support international cooperation in data synthesis

Relations with other Programs/ Organizations

Relations with other organizations/ programs were revised; a special emphasis was made on closer interaction with the North Pacific Marine Science Organization (PICES). Dr. A. Bychkov informed briefly on the main goals and structure of PICES and outlined cooperative opportunities with this organization. The following proposals for the PICES Science Board were generated:

- (i) To recommend PICES to establish a new Working Group on CO₂ in the North Pacific.

Dr. Tsunogai proposed a draft of Terms of Reference for the Working Group. The draft circulated to the NPTT members for recommendations on the second day of this workshop. Minor changes were suggested and Drs. Bychkov and Tsunogai were requested to bring this issue to the meeting of PICES POC (Physical Oceanography and Climate) Committee.

- (ii) To include in the program of the PICES Seventh Annual Meeting (October 1998, Fairbanks, USA); a joint PICES-JGOFS session on "Carbon Cycle in the North Pacific

Drs. Denman and Tsunogai were requested to bring this issue to the meetings of PICES BIO (Biological Oceanography) and POC Committees.

- (iii) To name an observer to the Implementation Panel for PICES-GLOBEC CCCC (Climate Change and Carrying Capacity) Program by the NPTT and vice versa; Dr. B. Frost was named responsible for these contacts.

Drs. Bychkov and Ian Perry (Co-chairman of PICES MODEL Task Team and member of the EC/IP) summarized a considerable overlap between many JGOFS-NPTT and PICES-CCCC objectives and activities, as well as differences in the approaches of this two bodies. They expressed a feeling that both JGOFS and PICES are interested in close communication and linkages between two

groups, and suggested that to facilitate collaboration NPTT and PICES CCCC should have an observer from the other party.

Dr. A. Chen reviewed the state of the Joint LOICZ/JGOFS Continental Margins Task Team (CMTT). At the last meeting (Texel, Netherlands, October) only the JGOFS members attended. The associated workshop to carry out material budgets for selected shelf regions was attended by 20 scientists. The most complete budget study has been carried out for the East China Sea – for fresh water, C, P, N, Alk., C and P budgets were consistent within 10%.

He stated that marginal seas are frequently severely undersaturated with respect to CO₂, mainly because of the high primary productivity supported by upwelling. Subsequently marginal seas are a large CO₂ sink. Very preliminary analysis based on limited data in the Sea of Okhotsk, Bering Sea, Japan/East Sea, East China Sea and South China Sea gives an uptake rate of 0.8 Gt C/y when extrapolated to the global marginal seas. The Sea of Okhotsk deserves particular attention because it not only absorbs CO₂, but it also transports CO₂ to the North Pacific Intermediate Water. This means that the Sea of Okhotsk acts as a conveyor belt, or a pump, for the North Pacific Ocean. With the above information, it comes naturally that the North Pacific marginal seas are ideal places for collaboration between the CMTT and the NPTT.

Dr. K. Denman (member of the GOOS SSCC and NPTT) described briefly a recent progress in planning for the Global Ocean Observing System (GOOS). JGOFS should be in the position to recommend monitoring for detection of changes in the ocean carbon system. Currently, a GOOS pilot project (NEARGOOS) is being operated by the Japanese Meteorological Agency.

Dr. Bychkov mentioned that PICES and GOOS are trying to establish a more close contact. Many PICES participants are already involved in GOOS bodies (Drs. K. Denman, W. Wooster etc) and programs (NEAR-GOOS activity in Japan). At the POC Topic session last year two talks were presented on NEAR-GOOS activity. Prof. Keisuke Taira (ORI, University of Tokyo) was invited to give a talk on "Activities towards NEAR-GOOS at Japanese universities" and Dr. Takashi Yoshida reported on "Present status on NEAR-GOOS real-time database at the Japan Meteorological Agency". Dr. Warren Wooster (ex-officio chairman of PICES) was requested to serve as co-chairman for the Living Marine

Resources Panel of GOOS. He is planning to attend the LMR-GOOS meeting in March and is going to bring PICES strategy to the attention of the Panel and propose a pilot or demonstration project that might appropriately be developed in the North Pacific.

JGOFS NPTT Home Page

Dr. T. Saino presented plans to have a JGOFS NPTT home page: a test page was completed in August 1997, but it is not open yet because of the time required to translate from Japanese to English. He reviewed the structure of the test page and expressed his appreciation to JGOFS IPO for her assistance and cooperation. Views were presented on whether cruise plans and reports should be included, but apparently JODC currently lists regional cruises of Korea, Japan and China. R. Feely mentioned that the CO₂ intercomparison studies could be included via pointers. The following proposal were made:

- (i) Japan should “host” the NPTT Home Page in conjunction with Japan JGOFS/NPPS pages; location is not too important (possibilities are JAMSTEC, Nagoya University or National Institute for Environmental Studies).
- (ii) NPTT Home Page content should include:
 - * Terms of reference, composition, progress reports, upcoming events, etc;
 - * List of JGOFS projects with project description, area of operation, name of the final archival center and contact information for PIs;
 - * Major field programs/activities including proposed cruises, long-term moorings, etc;
 - * Inventory of completed cruises/field operations (as per JGOFS IPO);

- * List of publications relevant to NPTT, including methodologies, analysis of historical data, recent results;
- * Links to other data sources relevant to JGOFS NPTT (possible examples are: PMEL, IOS, JODC/MIRC, US JGOFS, JGOFS IPO, PICES);

Assistance of NPTT members will be required as assemble and maintain/update information.

Publications

With regard to NPTT publications

- (i) To introduce NPTT activities and plan for North Pacific Process Studies to a broader JGOFS scientific community, Drs. Bychkov and Saino have agreed to write an article on NPTT activities for the international section of the U.S. JGOFS News.
- (ii) A decision to compile a *Summary of scientific JGOFS-related programs in the North Pacific* was made at the first NPTT meeting in November 1996 (Mutsu, Japan). Co-chairs prepared a draft of the *Summary* reviewed at second NPTT meeting. It was recommended to include in the *Summary* plans for field studies in the North Pacific and its marginal seas presented at the meeting. Once a format is decided on, Bychkov will request input from country members by early February for a final draft by the end of April

Future meetings

Representatives of PICES invited NPTT to hold a 3rd meeting immediately prior to the PICES Seventh Annual Meeting (Fairbanks, USA) in October 1998. This should allow saving some funds as PICES will be able to cover travel expenses for a few NPTT members. Besides, this will

provide an opportunity for NPTT members to attend a proposed PICES-JGOFS session one-day session on *Carbon cycle in the North Pacific Ocean* and have a joint meeting with PICES Working Group on CO₂ in the North Pacific (if both proposals are accepted by PICES). Members of the Task Team were supportive, but the final decision will be made after consultation with JGOFS IPO. A possible alternative is to organize the meeting in conjunction with the 2nd International Symposium on CO₂ in the Oceans planned for January 1999 in Tsukuba (Japan).

New PICES WG on CO₂ in N. Pacific (terms of reference)
JGOFS co-sponsorship of CO₂ session for PICES-VII
PICES CCCC and JGOFS NPTT
PICES “flag” to receive permission for cooperative research in EEZ
LOICZ/CMTT
GOOS

- (ii) *JGOFS NPTT Home Page:*
Page contents (terms of reference, composition, reports, upcoming events)
Page location: on Japanese JGOFS or JGOFS International Home Page?
- (iii) *Data management and data exchange:*
JGOFS Data Management for the North Pacific
Coordination with JGOFS IPO and DMTT
Relations with the existing Data Bases and Inventories
Migration to permanent archives

October 19

Time Series Observations in the North Pacific

08:30-08:50 R. Feely (PMEL/NOAA, USA)
Intercomparison of CO₂ system parameters from DOE/NOAA/NSF WOCE Global CO₂ survey in the North Pacific

HOT Station

08:50-09:20 R. Bidigare (University of Hawaii, USA)
The Hawaii Ocean Time-series (HOT) Program: past, present and future

09:20-09:40 Dr. S. Emerson (University of Washington, USA)
US JGOFS Hawaii time-series: recent results from biogeochemical mooring and future plans

PAPA Station

09:40-10:10 P. Harrison (University of British Columbia, Canada)
Food chain dynamics in the northeastern subarctic Pacific: An overview of the progress in the last five years in the CJGOFS Program

10:10-10:30 K. Denman (Institute of Ocean Sciences, Canada)
Canadian JGOFS/Climate work in the northeastern Pacific

Coffee Break (10:30-10:50)

Western Subarctic Pacific Station (KNOT)

10:50-11:10 T. Saino (Nagoya University, Japan)
Japanese JGOFS activities in the northwestern Pacific

11:10-11:40 Y. Nojiri (National Institute for Environmental Studies, Japan)
Plan for the station KNOT time-series observations in the western North Pacific: Intensive phase in 1998-2000

11:40-12:00 N. Suginoara (University of Tokyo, Japan)
JGOFS Activities within SAGE (Subarctic Gyre Experiment) Program

Lunch (12:00-13:20)

Discussion on Task Team planned activities

- 13:20-17:30
- (i) *JGOFS Timelines*
 - (ii) *Goals and problems of JGOFS Process Studies in the marginal seas*
 - (iii) *Goals and problems of JGOFS N. Pacific Process Studies*
 - (iv) *Coordination of JGOFS time-series observations in the North Pacific*
 - (v) *Publications*
- Summary of JGOFS-related national and international programs in the N. Pacific region
Paper for JGOFS Newsletter

(vi) *Future meetings*