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SCOR Proceedings, Volume 41
REPORT OF THE 37th SCOR EXECUTIVE COMMITTEE MEETING

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37th SCOR EXECUTIVE COMMITTEE MEETING

Cairns Convention Centre
Cairns, Queensland, Australia

29 August – 1 September 2005

1.0 OPENING

1.1 Opening Remarks and Administrative Arrangements

Bjørn Sundby (Canada), the President of the Scientific Committee on Oceanic Research (SCOR), opened the meeting and welcomed participants. He extended SCOR's thanks to the Australian Academy of Sciences and two Nominated Members from Australia—Trevor McDougall and Terry Done—who helped arrange the meeting and the special session on coral reef science. This is the first SCOR annual meeting in Australia since the General Meeting in Hobart in 1986. Ed Urban, the SCOR Executive Director, described the administrative arrangements for the meeting. Sundby asked participants to introduce themselves.

1.2 Approval of the Agenda

Additions or modifications to the agenda as distributed may be suggested prior to approval of the final version. A new Item 1.7 was added to discuss the Nominating Committee for 2006 SCOR elections early in the meeting. The IOC presentation was brought forward to Tuesday to adapt to the speaker's schedule. The revised agenda was adopted.

1.3 Report of the SCOR President

Bjørn Sundby reported on his SCOR-related activities in his first year as SCOR President, since the SCOR General Meeting in September 2004. He noted that it has been quite a learning experience and that he took over an organization that is in great shape. Sundby gave his thanks to Past-Presidents Robert Duce (USA) and John Field (South Africa), and to Ed Urban and Elizabeth Gross (SCOR Finance Officer), for the good health of SCOR. He has no plans for significant changes in how SCOR operates.

Sundby represented SCOR at various meetings in the past year. They included the first open science meeting of the Surface Ocean – Lower Atmosphere Study (SOLAS) in Halifax in 2004. Sundby was impressed by the science being sponsored by SOLAS. In December, he attended a meeting in Paris of “ocean carbon stakeholders” to negotiate how responsibilities related to ocean carbon and research would be shared among SOLAS, the Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) project, and the International Ocean Carbon Coordination Project (IOCCP). While in Paris, Sundby and Urban met with Patricio

Bernal, the Intergovernmental Oceanographic Commission (IOC) Executive Secretary, and Thomas Rosswall, the International Council for Science (ICSU) Executive Director. In February, Sundby represented SCOR at the International Geosphere-Biosphere Programme Science Committee (IGBP-SC) meeting in Beijing, China. He gave a short presentation there about the SCOR/IOC symposium entitled “The Ocean in a High-CO₂ World.” (Two papers, from *EOS* and *Oceanography* magazine, were also passed out at the meeting.¹)

Sundby attend the IOC Assembly in Paris with Urban. He reported that it was interesting to see how a large intergovernmental organization works, and how this differs from a small non-governmental organization like SCOR. Sundby met with a variety of people attending the IOC Assembly. He noted that he has been in close contact with Urban all year and has gained a greater appreciation for the Secretariat and its work. Sundby’s personal priorities for his term as SCOR President are to (1) work on SCOR’s relationships with other organizations, (2) involve new nations in SCOR, (3) work on the visibility of SCOR and diversification of sources of funding, and (4) finally, continue to insist on high-quality science, which is SCOR’s major purpose.

1.4 Report of the SCOR Executive Director

Ed Urban offered his thanks to participants. He reported that SCOR is in good financial condition. He reiterated his concern that SCOR needs to decrease its dependence on U.S. funding sources. SCOR is making progress in new areas of ocean science, for example, the ocean acidification issue, which has become a hot topic internationally. Urban reported that he and others are working on several fronts to get new member nations in SCOR. These new nations would not add significantly to SCOR’s income, but would increase SCOR’s diversity and international participation. Several important publications have resulted from SCOR activities in the past year. Two high-visibility publications are the special issue of the *ICES Journal of Marine Sciences* that resulted from SCOR/IOC Working Group 119 on Quantitative Ecosystem Indicators for Fisheries Management² and the SCOR/IMAGES Working Group 113 review paper on paleoceanography of Asian monsoons.³

SCOR is working to expand its role as a catalyst to help major ocean research projects work together. There have been two meetings with this aim so far, with plans for a third one next year. SCOR’s capacity-building efforts continue, with new sources of funding being sought for the SCOR project on Regional Graduate Schools of Oceanography and Marine Environmental Sciences for regional planning meetings.

¹Cicerone et al. 2004. The Ocean in a High-CO₂ World. *Oceanography Magazine* 17(3):72-78 and Cicerone et al. 2004. The Ocean in a High CO₂ World. *EOS* 85:351, 353

²Daan et al. (eds.). 2005. Quantitative Ecosystem Indicators for Fisheries Management. *ICES Journal of Marine Science* 62:307-614.

³Wang, P. et al. 2005. Evolution and variability of the Asian monsoon system: State of the art and outstanding issues. *Quaternary Science Reviews* 24:595-629.

1.5 Appointment of an *Ad Hoc* Finance Committee

The SCOR Constitution requires that a Finance Committee be appointed at every SCOR meeting. It must consist of three members of SCOR who are not members of the Executive Committee. The Finance Committee reviews the administration of SCOR finances during the previous fiscal year and the current year, and proposes a budget for the following year's activities. The committee's report is given in Section 8.4. The SCOR Executive Committee approved Jorma Kuparinen (Finland) to chair the ad hoc Finance Committee, and other members included Adolfo Gracia Gasca (Mexico) and Mingyuan Zhu (China-Beijing). The committee was appointed prior to the meeting to allow them adequate time to prepare.

1.6 Appointment of an *Ad Hoc* Committee to Review the Disciplinary Balance of SCOR's Activities

The Executive Committee meeting in 1999 agreed that at future SCOR annual meetings, after the consideration of working group proposals has been completed, the disciplinary balance of SCOR groups should be assessed. Scientific gaps should be identified and communicated to national committees when the next request for working group proposals is sent. Laurent Labeyrie (France) continued to chair the committee and welcomed other volunteers, particularly with physical and biological expertise. The findings of the committee are presented in Section 8.5.

1.7 Nominating Committee for 2006 Election of SCOR Officers

Robert Duce introduced this agenda item. He noted that Julie Hall (New Zealand) will complete her allowed term as SCOR Secretary at the end of 2006 and thus cannot be re-elected. Two of the three SCOR Vice Presidents cannot be re-elected, although Victor Akulichev (Russia) can be re-elected if he is nominated again. The Nominating Committee is responsible for obtaining nominations from national SCOR Committees, according to a process agreed at the 1998 SCOR General Meeting and described on the SCOR Web site (see <http://www.jhu.edu/scor/constitution.htm>). The SCOR Past President is responsible to chair the committee. Duce stated that he would like the committee to include four members this time, to ensure disciplinary, gender, and geographic balance. He asked meeting participants interested in nominating members of the committee to contact him by noon on Wednesday of the meeting. Members of the Nominating Committee should not be candidates for election. The committee works by electronic mail between meetings.

2.0 WORKING GROUPS

2.1 Disbanded Working Groups

2.1.1 WG 78—Determination of Photosynthetic Pigments in Seawater

In 2004, SCOR approved the re-publishing of the book of this working group (entitled *Phytoplankton Pigments in Oceanography*), with a new preface. The book was published soon

after the 2005 SCOR Executive Committee Meeting. Interest also has been expressed in creating a new, revised edition of the book. Elizabeth Gross made a presentation about the plans for a second edition, which would be a relatively small document to augment the original book, with the original book provided in CD or DVD format. Bjørn Sundby asked whether SCOR should support this new edition and how it should be funded. Terry Healy (New Zealand) asked whether this should be an electronic publication. Ed Urban replied that it could be available in both formats. John Compton (South Africa) asked about the costs of the second edition. Gross responded that the costs are difficult to determine at this point and that a formula for cost sharing with UNESCO would need to be negotiated (if UNESCO Press publishes the book, as before). Sundby summarized that there seemed to be consensus to proceed with the idea. Strong leadership of the writing group, wide availability of the product, and adequate funding would need to be ensured. John Field suggested that there should be a single chair of the group. SCOR included funds in its 2006 budget for a group to meet to plan the book contents and estimate the costs to complete it.

2.1.2 SCOR/IUPAC WG 109—Biogeochemistry of Iron in Seawater

This group was disbanded in 2005 and the members were thanked for their service. The subgroup on intercomparisons recently published a paper in *Marine Chemistry*,⁴ which will be linked to the SCOR Web site. Annelies Pierrot-Bults (The Netherlands) presented a few PowerPoint slides about the subgroup's conclusions. This group carried out methodological comparisons in the lab and at sea, which showed much variability in the results of dissolved iron measurements. SCOR provided some additional funding to support a few meetings of the subgroup. The work of this subgroup led, in part, to a major U.S. National Science Foundation-supported cruise to work on intercalibration of dissolved iron measurements in 2004 on the R/V *Melville* (the SAFE cruise). The SCOR working group helped highlight the issue and this resulted in significant progress related to an important methodological problem. Robert Duce added that iron is so important in oceanic biogeochemical processes that it made sense to put extra effort into getting the measurements right. The early intercomparison results differed by an order of magnitude. The second exercise narrowed this variability significantly. Bjørn Sundby added that the R/V *Melville* cruise was extraordinary, as people worked at sea with their own equipment and methods for the intercomparison. Ralph Schneider (IMAGES) asked what is the next step. Sundby responded that GEOTRACES will use this effort as a model for other elements, as needed.

2.1.3 WG 114—Transport and Reaction in Permeable Marine Sediments

This group was disbanded and thanked for their service. Bjørn Sundby added that although this working group did not produce a written report, they have started a series of Gordon Research Conferences (GRCs) as their legacy. The second GRC on this topic will be held next year.

⁴Bowie, A.R. et al. 2005. A community-wide intercomparison exercise for the determination of dissolved iron in seawater. *Marine Chemistry* 98:81-99.

2.2 Current Working Groups

The Executive Committee Reporter for each working group presented an update on working group activities and progress since the 2004 SCOR meeting and made recommendations on actions to be taken. Meeting participants made preliminary recommendations, based on the progress of working groups and the merits of the requests, about whether funding should be provided for 2006 activities of working groups. The Finance Committee took into account these recommendations as it developed the 2006 SCOR budget, which was then subject to final approval by meeting participants.

2.2.1 WG 111—Coupling Winds, Waves and Currents in Coastal Models

Ilana Wainer (Brazil), the Executive Committee Reporter for the group, reported that the group is developing a book entitled *Coupled Coastal Wind-Wave-Current Dynamics*, which will be published by Cambridge University Press in 2006. Peter Craig (Australia) is leading the editorial work for the book. Wainer noted that the production of the book has been delayed, but that the manuscript is in Craig's hands. The group did not request funds from SCOR for 2006.

2.2.2 WG 115—Standards for the Survey and Analysis of Plankton

Annelies Pierrot-Bults, the Executive Committee Reporter for this group, reported that this working group plans to meet for its third and final time in May 2006 in Plymouth, UK, at the Sir Alistar Hardy Foundation for Ocean Sciences. This meeting will bring together the findings of the group in relation to its terms of reference and will provide recommendations on standards for the surveys and analyses of plankton. The group will publish its work in the *Journal of the Marine Biological Association UK*. The group has been delayed somewhat by the chairman's illness and retirement. The Web site is not as advanced as hoped. Graham Hosie (Australia) will be taking the lead on next year's meeting in Plymouth. This group has good links to WG 125 on Global Comparisons of Zooplankton Time Series and Pierrot-Bults recommended funding for the 2006 meeting, which was approved.

2.2.3 WG 116—Sediment Traps and ²³⁴Th Methods for Carbon Export Flux Determination

This working group held its final full meeting in April 2005 in Xiamen, China. The group is nearly finished with a synthesis paper on sediment traps to be published in *Progress in Oceanography*, with a summary in *EOS*. Group members have contributed to several papers in *Marine Chemistry*. Laurent Labeyrie, the Executive Committee Reporter for the group, noted that the group has been very active. The group was created in 1999, but was delayed by one year after its first meeting due to SCOR financial limitations in 2000. The group asked for a little extra funding to get reprints and color plates for the *Progress in Oceanography* paper and a last editorial meeting, which Labeyrie recommended be approved. (This request was approved.) In addition, it was suggested that the working group chair and/or Ed Urban try to make sure that the publications from the group are freely available on the Web in electronic form.

Labeyrie noted the general comments about SCOR working groups from Ken Buesseler in his report on WG 116: "I encourage SCOR to continue these activities, maintain adequate financial

support for WG participants, and add new WG initiatives as resources allow. The oceanographic community benefits in many ways from these efforts and thus SCOR staff, steering committee members and advisors, funding sources and importantly, all of the WG participants should be thanked for their contributions to this process.”

2.2.4 SCOR/IOC WG 119—Quantitative Ecosystem Indicators for Fisheries Management

A special issue of the *ICES Journal of Marine Science* was published in May 2005 from the symposium and was distributed by SCOR to libraries in developing countries. The working group chairs have proposed a small meeting to follow up on the results of their symposium. This meeting would be funded by a small amount of leftover registration fees (~US\$11,400) from the group’s symposium. John Field, the former Executive Committee reporter for the group, noted that he has been in correspondence with one of the working group co-chairs, and that they would like to convene a three-day workshop in 2006 to reconcile classical fisheries management methods (single stock assessments) and use of ecosystem indicators. This would allow them to make recommendations for conventional management of fisheries, while also using the indicator approach. The group would raise other money from Eur-Oceans, the North Pacific Marine Science Organization (PICES), the Global Ocean Ecosystem Dynamics (GLOBEC) project, and other potential sources. Approval is needed from IOC, the other main sponsor of the symposium, to use the funds in this way. Field recommended that SCOR continue WG 119 for another year, rather than setting up a totally new working group, as proposed. Birger Larsen (Denmark) commented that this was a very successful and important working group and that he supports use of registration funds for the follow-up workshop. Annelies Pierrot-Bults agreed and there was general agreement among meeting participants about granting the request for use of the left-over registration fees.

2.2.5 WG 120—Marine Phytoplankton and Global Climate Regulation: The *Phaeocystis* Species Cluster As Model

Julie Hall, the Executive Committee Reporter for this group, reported that this working group is going well and is convening a symposium in the week following the SCOR meeting (in the Netherlands) as their final meeting. The papers from the meeting will be published in a special issue of the journal *Biogeochemistry* in 2006. There was no request for 2006 funding from this group.

2.2.6 IAPSO/SCOR WG 121—Ocean Mixing

Victor Akulichev, the Executive Committee Reporter for this group, reported that this joint group of SCOR and the International Association for the Physical Sciences of the Ocean (IAPSO) is active and successful. The group held a successful conference in October 2004 in Victoria, B.C., Canada. Approximately 120 individuals attended the conference, which was supported by funds from the U.S. Office of Naval Research, the U.S. National Science Foundation, and registration fees. The group held its second meeting following the conference. The papers from the symposium will be published in a special issue of *Deep-Sea Research II*, anticipated to be published in March 2006.⁵ Three Associate Members were replaced in 2005 by

⁵ Muench, R.D. et al. (eds.). 2006. Ocean Mixing. Special issue of *Deep-Sea Research II* 53:1-245.

Sonya Legg (USA), Jennifer Mackinnon (USA), and Anne Marie Treguier (France), who each participated in the conference. The final meeting of the group will be held in conjunction with the 2007 International Union of Geodesy and Geophysics (IUGG) General Assembly, where they will organize a session. The group will propose a Gordon Research Conference (GRC) series on ocean mixing. SCOR meeting participants decided that the leftover registration fees from the group's symposium can be used for publication costs (e.g., to buy extra copies of the publication), if necessary.

2.2.7 SCOR/LOICZ WG 122—Estuarine Sediment Dynamics

Laurent Labeyrie, the Executive Committee Reporter for this group, reported that the group held its second meeting in Texel, Netherlands, in June 2005. The group is working well. It has developed a Web site, which is available at <http://www.criba.edu.ar/scorwg122>. The group will hold its final meeting in College Station, Texas, USA, in 2006. The group is planning an *EOS* paper and a special issue of the journal *Estuarine, Coastal and Shelf Sciences*. The group's request for funding for a meeting in 2006 was approved.

2.2.8 SCOR/IMAGES WG 123—Reconstruction of Past Ocean Circulation (PACE)

Laurent Labeyrie, Executive Committee Reporter for this group, reported that the group held a conference on their topic in Atlanta, Georgia, USA, in March 2005, bringing together physical oceanographers and paleoceanographers. Ten papers arising from this meeting will be published in a new electronic journal, *Geochemistry, Geophysics, and Geosystems (G3)*, of which Labeyrie is an editor. They want to hold their next meeting sometime in 2006 and Labeyrie recommended that funding for the meeting should be approved. The 2006 budget approved by meeting participants included the remaining SCOR funds for the group.

2.2.9 SCOR/IMAGES WG 124— Analyzing the Links Between Present Oceanic Processes and Paleo-Records (LINKS)

Ilana Wainer, the Executive Committee Reporter for this group, noted that this group was approved in 2003 and held a planning meeting in conjunction with the 8th International Conference on Paleoceanography in September 2004 in Biarritz, France. They will hold their second meeting at the fall American Geophysical Union meeting in San Francisco, California, USA, in December 2005.

Wainer was concerned that the group's report doesn't say enough about what it did at its first meeting or what it plans to do at its next meeting. Also, it is not clear that the Reporter and Associate Members are receiving all the communications about the working group. Laurent Labeyrie expressed similar concerns. Ed Urban responded that the Reporters are supposed to be copied on all emails to working group members. Bjørn Sundby recommended that the group should be asked where they stand in respect to their terms of reference. The funds for the second meeting should not be released until the situation is clarified. Julie Hall added that there has been no contact with IMBER as was proposed and as stated in the report. Ralph Schneider added that IMAGES also does not receive reports from this group. The IMAGES Executive Committee will decide what to do about this group in December; it may not have been active enough 1.5 years after being established. John Field suggested that December 2005 may be too

soon for the group to meet. Wainer responded that she would communicate these concerns to the group, specifically that SCOR needs more detailed information before funding any additional meetings.

2.2.10 WG 125—Global Comparisons of Zooplankton Time Series

Annelies Pierrot-Bults, the Executive Committee Reporter for this group, reported that the group has been established, after minor revisions to its terms of reference and membership, as requested in Venice. The Chair has been active in getting other support (i.e., from GLOBEC, PICES, and the International Council for the Exploration of the Seas [ICES]) to sponsor Associate Members. The first meeting of the group will take place in November 2005, and they group has requested funds for a meeting in 2006. Pierrot-Bults recommended that funding should be approved for the 2006 meeting, contingent on SCOR receiving a plan for the second meeting after its first meeting this year. The funding for the group's meeting in 2006 was approved, contingent on receiving detailed plans for it.

2.2.11 WG 126—Role of Viruses in Marine Ecosystems

Julie Hall, the Executive Committee Reporter for this group, introduced the discussion by reporting that this is a new working group, established at the SCOR meeting in Venice. Some membership decisions and modifications to the terms of reference have been made since Venice. The group has been active. Some of the members got together at the American Society of Limnology and Oceanography (ASLO) meeting in Santiago de Compostela, Spain, in June 2005 and organized a session there on "Viruses, Microbial Diversity and Ecosystem Function" that was well attended. (Because most group members were attending the ASLO meeting, there was no cost to SCOR.) The group asked for funding for a meeting in 2006, also in conjunction with an ASLO meeting. The members will have draft papers for a textbook on methods in marine virology ready to review by then. They are negotiating with ASLO to publish the textbook electronically. This would cost US\$20,000-30,000 for a completely open access book. The group is working on funding from an outside source (the Gordon and Betty Moore Foundation) for this publication. Group members also have prepared project proposals for the International Polar Year (IPY) and are planning a major symposium in 2008. Hall recommended funding for the June 2006 meeting. Ilana Wainer remarked that this is an exciting, cutting-edge topic, and Hall added that the textbook and other products should be useful to the community.

Following the discussion of current working groups, there was a more general discussion about the annual reports from working groups. Ed Urban summarized comments from the individual working group discussions, especially that working groups need more direction about what should be in their annual reports. He agreed to draft some guidelines. He also noted that it was good to see the groups moving faster, since SCOR's experience has shown that the more slowly a group operates, the less likely it is to complete its work successfully. Working groups should directed to give strong justifications for their requests to schedule meetings close together in time. Ilana Wainer asked that there also be a document on guidelines for Reporters, which should be given to the Reporters and the SCOR groups for which they are responsible, and

should also be on the SCOR Web site. Elizabeth Gross noted later that such a document exists and will be updated and distributed to Reporters.

2.3 New Working Group Proposals

Six working group proposals were received by the SCOR Secretariat and were distributed to national SCOR committees and others.

2.3.1 WG on Thermodynamics and Equation of State of Seawater (see Annex 3)

Mike MacCracken (IAMAS), the monitor for this proposal, opened the discussion with a summary of the purpose of the proposed group and comments from SCOR National Committees and others. The proposal is to update the equation of state of seawater, which has not been done since 1980 and which used methods that are now out of date. Also, problems with special applications of the existing equation of state are now recognized, such as for the polar oceans. The reviews of the proposal by SCOR National Committees were generally positive.

MacCracken had interacted with the proposed working group chair, Trevor McDougall, on the results of the reviews and asked a few ocean modelers for their independent input. All agreed that this is an important topic. Some scientists have updated their approach, but many have not, and there is no internationally accepted equation. A couple of reviewers commented on problems of pressure and temperature as the freezing point of seawater is approached.

MacCracken identified that there are perhaps too many members proposed from the United States. This problem can be resolved, according to McDougall, by shifting one of the proposed U.S. members from Full Member to Associate Member status. Roberto Purini (Italy) asked what influence a small improvement in the equation of state on global ocean circulation models would make. MacCracken responded that the climate modelers agree this will make a large difference. Shiro Imawaki (IAPSO) stated that IAPSO strongly supports the proposal and believes it is fundamental for almost all ocean studies. Annelies Pierrot-Bults stated that the Netherlands SCOR Committee agrees that this is a very good proposal. Their only concern is whether the proposed work can be done in only two workshops. Laurent Labeyrie reported that the French SCOR Committee agrees that this would be an excellent project. The Danish SCOR Committee also believes that this is an important topic for SCOR to handle, according to Birger Larsen. Toshitaka Gamo added that the Japanese SCOR Committee ranked this proposal very high and that knowing the equation of state at a range of temperatures is important. Mauricio Mata (Brazil) and Missy Feeley (USA) stated that this proposal received the highest rankings from the Brazilian and U.S. SCOR committees, respectively. John Compton (South Africa) reported that the South African SCOR Committee felt that this proposal was not as timely as others and is very specialized. However, the general consensus of meeting participants was that this group should be approved.

2.3.2 WG to Investigate Mesopelagic Fish Populations as Potential Fishery Stocks

Julie Hall, the monitor for this proposal, introduced it. The reviews were varied and rankings ranged from first to last among the six proposals, mostly at the lower end of the rankings, because the proposal is still seen as too regional and too focused on the Arabian Gulf. (The proposal was revised from a version reviewed at the 2004 SCOR meeting, but not approved.) It

is seen as too focused on fisheries exploitation and is likely to be beneficial to industry, which should, therefore, pay for it. Other reviewers thought that the project is important because it could provide scientific understanding before all mesopelagic stocks have been fished down. The references in the proposal are not recent and the members proposed are relatively senior. The membership seems to be focused on taxonomists rather than including experts on ecosystems and food webs. Ilana Wainer asked whether this is a timely subject and if the science would be cutting edge, as a SCOR project should be. Hall responded that new studies of the mesopelagic zone would be timely and would provide baseline data. Laurent Labeyrie expressed that the French SCOR Committee had similar comments on the seniority of the proposed members and the need to include other oceans. John Field reported that the South African SCOR Committee supports the proposal as one of its top two, but only if the terms of reference were adjusted to reflect ecology rather than taxonomy, and if the membership included a physical oceanographer and trophic modeler. Annelies Pierrot-Bults reported that the Netherlands SCOR Committee thinks that the proposal is improved since 2004. She commented that it is good that the proposal comes from a non-western perspective and that it is timely, as very little is known about non-commercial fisheries. She added that some taxonomy is needed, but not exclusively. The Netherlands SCOR Committee had some concerns about the suitability of the membership, but ranked the proposal high with these reservations. Julie Hall conveyed comments from the New Zealand SCOR Committee. They also noted that recent research is not cited and that there was no mention of acoustic techniques, which are a commonly used methodology. They also thought that the inclusion of molecular techniques is odd and asked if the Food and Agriculture Organization should be involved. Missy Feely reported that the U.S. SCOR Committee does not think this working group would be a good fit for SCOR; other organizations are more appropriate. The Brazilian SCOR Committee gave this proposal an intermediate ranking, with the main problem being its regional focus. Bjørn Sundby summarized that there is a great deal of sympathy for the proposal, but it would need extensive revisions to be suitable for SCOR, especially in terms of membership. Sundby was not sure what should be done, which led to an extended discussion. The conclusion was that this proposal would need major revisions to be acceptable, to the point that the resulting project would not resemble the proposed project and that the proponents should not be encouraged to submit the proposal again. Hall and Urban volunteered to formulate a response to the proponents.

2.3.3 WG on Hydrodynamic and Sediment Transport Model Prediction Performance Criteria

Terry Healy, one of the proponents of this working group, gave a presentation about the proposal. He reported that hydrodynamic models are now a common tool in oceanography and that model simulations are applied to a wide range of phenomena. For the coastal oceans there are many simulations, for example, for wave breaking, tidal currents, long-shore currents, wave-current interactions, pollution dispersal, and sediment transport. Healy stated that many new models have been developed in recent years, but that problems arise related to their performance, which depends on skill in setting boundary conditions, mathematical stability of the model, data quality, and other factors. He believes that there is a need for internationally

accepted standards for model performance. Healy showed some examples of models versus actual data, with big differences in values, illustrating the need for model performance standards. He reviewed the proposed terms of reference and the proposed membership of the group, which would include model developers and users, an empiricist, a meteorologist, a time-series statistician, and others. Output from the group would include a collation of possible model performance measures and possibly a conference. Healy summarized the positive and negative criticisms from reviewers, some of which were helpful, particularly related to co-sponsorship by the Land-Ocean Interactions in the Coastal Zone (LOICZ) and/or the Engineering Committee on Oceanic Resources (ECOR), and the potential addition of a tsunami modeler. He acknowledged that a more specific work plan is needed. He noted that not all SCOR working groups work well, but that the successful ones have strong leaders and he would be committed to being a strong leader for this group. In principle, all oceanographic models could be covered by the working group, but the proposal focused on coastal models because it is his area of expertise and because of the population pressures on the coastal zone. Healy believes that coastal models will be more and more important and that international standards for their performance are needed. Healy welcomed comments and membership suggestions.

Victor Akulichev asked whether the problem is regional or global. Healy replied that it is global. Bill Erb (IOC) related that at a recent meeting on tsunamis, IOC agreed to have a modeling workshop in Hyderabad in November 2005 to look at different available models and decide which ones are most appropriate for various applications (e.g., mitigation, risk assessment, etc.). He stated that bathymetry is missing in many important areas and that this is a big concern. Roberto Purini asked whether the terms of reference propose a new standard procedure or to review existing ones. Healy responded that there are some methods for “skill scores”, but most authors don’t use them and that the working group may come up with a new method. Ralph Schneider asked which statistical test would be used. He noted that there is no real research on what should be the measures for testing models and this is a much bigger problem than for coastal models only. Birger Larsen stated that there is intense commercial competition in this field. Healy responded that the commercial models are often used for pure research applications as well and that this makes it a SCOR issue. Admittedly, there is potential for examination of a huge range of disciplines’ models, but the proponents decided to focus just on coastal models.

After lunch, Laurent Labeyrie reviewed the comments on the proposal from national committees, working groups, and individuals. The reviewers thought that the working group’s proposed approach (including the statistical aspects) was too narrow a view of what is needed to evaluate models. Yet, the terms of reference are too broad. The membership is unbalanced. The activity has too much connection to commercial interests; one proposed co-chair and one member are involved with organizations that sell commercial models and SCOR needs to be careful about not advocating the use of one commercially available product over another. Roberto Purini added that there is no mention of how the results from other fields could be applied to this problem. For example, this problem has been dealt with in atmospheric physics, but there is no mention of how the approaches from that field might be applied to coastal

models. Annelies Pierrot-Bults added that the Netherlands SCOR Committee thought that the idea was not really well worked out and that the proposal was too narrow. John Compton stated that the South African SCOR Committee ranked this proposal low, because it was not well thought out and not well supported. They were wondering whether this idea is really appropriate for SCOR. They consider it more of a statistical or mathematical problem than an ocean research question and perhaps, as a result, out of the domain of SCOR expertise. Missy Feely added that there is a critical need to develop robust models, especially for use by countries without sophisticated modeling expertise. Better models need to be developed and guidelines for their application need to be set. Performance criteria alone do not get to the issues of developing robust models that will work in real situations. John Field added that the plan for the coastal Global Ocean Observing System (GOOS) includes a modeling analysis working group. He suggested that a working group on coastal modeling could help GOOS, and suggested the possibility of a SCOR/GOOS working group. The Brazilian SCOR Committee noted that the proposal is not very clearly written, especially in comparison to the other proposals. Ilana Wainer added that the commercial aspects are a problem, that this proposal doesn't feel scientific, and that there is a lack of overall strategy in the proposal. John Compton added that model comparisons are a more technical question that need sophisticated statistical approaches. Often, the robustness of the data sets aren't even known. The same model can give different results if it is set up differently. Before comparing different models, standards are needed on how to run them. Ilana Wainer added that you can't talk about performance measures if you don't do intercomparisons.

Laurent Labeyrie stated that the French SCOR Committee thinks that the intercomparison of coastal models is an important problem, but the proposal doesn't address the problem adequately through its terms of reference and membership. A specific problem is that the databases used to test the models are not considered in the proposal. There needs to be much more specificity about how the models will be tested. The proposal's approach is too narrow, with no inter-evaluation of existing models, or of forecasting versus nowcasting models. Bjørn Sundby summarized that the consensus is that there was not much enthusiasm for this proposal. Everyone agreed on the need for models as tools and that the models should be as good as possible. What is really needed is not an evaluation of existing models, but more guidelines for developing robust models. There is an underlying concern about using SCOR to provide a quality stamp for commercial firms to sell models. This is a risk that SCOR may not want to undertake.

Laurent Labeyrie added that Hurricane Katrina's advance on New Orleans demonstrates the importance of coastal hydrodynamics. There needs to be a really good understanding of how hydrodynamic models behave in coastal areas. The proposal would look at only a very small part of the problem. Mike MacCracken added that the potential for a connection to GOOS should be pushed. It may be that there is a need for setting standards, but he was not sure the case had been made. Commercial interests should probably support this activity through an independent entity, not necessarily SCOR. How can one discriminate between problems caused by the quality of the data set and those caused by the design of the model and its performance?

John Field added that the title of this proposal suggests sediment transport when the problem is much broader and they may be suggesting the wrong people to be involved. Birger Larsen added that engineers tend to have more expertise in sediment transport, and that this proposal is not talking about scientific models that are developed for scientific reasons. Labeyrie added that it should be clear that SCOR would be receptive to a proposal about development of models, but that this proposal is too narrow and outside SCOR's area of expertise. Bjørn Sundby stated that he didn't sense that the proposal should be supported and meeting participants confirmed that this was the consensus.

2.3.4 WG on Natural and Human-Induced Hypoxia and Consequences for Coastal Areas (see Annex 4)

Robert Duce introduced the proposal by saying that most national SCOR committees ranked this proposal in the top three. Duce reviewed the terms of reference and summarized them by saying that the group would synthesize present knowledge and recommend future science and requirements for observing systems and modeling. The proposed membership seems good, with a good geographic distribution and expertise coverage. The proposed group would start in early 2006 in conjunction with one of two larger meetings. They would decide then whether a workshop would be a good idea to address their terms of reference. If approved, the group will approach the Scientific Committee on Problems of the Environment (SCOPE) for financial support. They have already contacted major programs to assess their interest and to establish interactions.

Annelies Pierrot-Bults stated that the Netherlands SCOR Committee is a bit concerned about the limited time frame and the ambitious terms of reference. Perhaps the proposal should focus a bit more. Overall, however, they favor the proposal and ranked it highly. Mike MacCracken noted that there is nothing in the proposal about atmospheric deposition and river hydrology that can lead to hypoxic events. Julie Hall noted that IMBER has had good interactions with the people developing the proposal, and SOLAS and LOICZ have responded positively; these other groups will bring in the aspects that MacCracken mentioned. Duce replied that it will be important to ensure formal liaisons with SOLAS, IMBER, and LOICZ. Hall responded that the link to LOICZ exists via Nancy Rabalais, who is a proposed working group member and member of the LOICZ SSC. Several members of the IMBER SSC are proposed members of the working group.

Birger Larsen reported that the Danish SCOR Committee thought that this was a good proposal, but not very well focused. Focus should be on coastal areas and on processes in relation to intermittent hypoxia and the recovery processes, but not broadened to include all general aspects of eutrophication and shelf-slope low oxygen zones. Laurent Labeyrie stated that the French SCOR Committee thought that the proposal needs to be more specific about the group's product and that it must be more focused to look at hypoxia. Missy Feely noted that there is a lot being done on hypoxia, and asked what made this working group unique. How does it fit other activities within and outside SCOR? Roberto Purini noted that mixing is a major mechanism related to hypoxia, yet is not mentioned in the proposal. Huasheng Hong reported on behalf of the Chinese (Beijing) SCOR Committee that this is a very important topic in China. The mechanisms and processes of hypoxia need more study, including the influence of

circulation changes, as well as the consequences of hypoxic events. Bjørn Sundby stated that he has a strong personal interest in hypoxia research. He believes that one new aspect in this proposal is the connection between the coastal zone and the open ocean.

Julie Hall reported that the New Zealand SCOR Committee felt this was a timely proposal. Ralph Schneider pointed out that ocean sediments that have undergone anoxic conditions are among the best archives, and that it would be useful to include some paleoceanographic aspects in this project. Jorma Kuparinen reported that the Finnish SCOR Committee would also like to see the group incorporate the paleoceanographic aspect of hypoxia; there are valuable records on climate change and variability and the inflow of water into the Baltic Sea. John Compton suggested that the synthesis portion of the group's work may be the key. If we ask for too much focus of the proposal, we may miss the important interdisciplinary approach. The Brazilian SCOR Committee also ranked this proposal very high, #2, and urged SCOR to support this group. Toshitaka Gamo added that the Japanese SCOR Committee agrees with this assessment. Bjørn Sundby summarized the comments so far. There is a lot of interest in this topic, but there are a variety of suggestions (some contradictory) for improving the proposal. The proposal is too focused, too broad, should focus on synthesis, past/future aspects of hypoxia, etc. Sundby requested that discussion focus on the areas where the reviewers differed in their opinions in order to determine the consensus on what changes should be made. For example, is it a good thing to ask for a synthesis or should we require them to be more focused? Laurent Labeyrie responded that perhaps there could be two subgroups. Compton thinks the proposal is precisely what is needed and they should be told to get on with it. The current literature is dispersed and there hasn't been a recent synthesis.

Adolfo Gracia commented that the topic is important and timely. The proposal takes an interdisciplinary approach, but the questions are not well defined. Clear expectations are needed. Bjørn Sundby asked whether the synthesis task is achievable. Julie Hall responded that a synthesis would be very valuable. Hall added that the second term of reference would be an important way of strengthening links to GOOS (see Annex 4). Robert Duce added that a synthesis of current understanding could move the field ahead. Sundby turned the meeting chair position to Julie Hall so he could express his personal opinion more freely. He noted that past studies of hypoxia have focused on effects and not the inputs from the land and the impacts of the open ocean. This is a new aspect.

Hall asked Duce for a summary of the discussion. Duce had mixed feelings, in that he thought the terms of reference were acceptable as they were, and was surprised by the suggestions about changing them. Meeting participants keep adding more topics for the group, which would make it less focused. Duce suggested postponing the decision so that he could synthesize the discussion and make a recommendation later. Having consulted with other participants, Duce later suggested that the second bullet in the first term of reference should be removed ("influence of the open ocean on the occurrence of coastal hypoxia") because it opens up such a wide range of issues that broaden the group too much. It would also be good to define the term "coastal ocean" in the proposal. Intermittent hypoxic events are especially important and should be emphasized. Finally, the word "predicting" should be removed from the last line of the abstract and replaced with "modeling" to be consistent with the terms of reference. The product

of the group needs to be clarified in the terms of reference. Julie Hall concluded that the group should be accepted as one of the new working groups to be funded, if finances permit and if the proposal is revised as suggested. Meeting participants agreed that this was the consensus.

2.3.5 WG on Deep Ocean Exchanges with the Shelf (DOES)

Victor Akulichev introduced this working group proposal and stated that he thinks it is worthy of SCOR support. Shiro Imawaki added that IAPSO strongly supports the proposal. Physical and chemical interactions at the shelf break between deep ocean circulation and shelf currents are very important. Preliminary discussions with potential sponsors indicate that the U.S. Office of Naval Research might be interested in funding the working group, if approved.

Roberto Purini began the comments from the national SCOR committees by remarking that there seems to be some confusion about time and space scales to be investigated and that the proposed activities are not focused enough. Laurent Labeyrie reported that the French SCOR Committee ranked this proposal as a low priority for funding because of several problems, including not enough European involvement and terms of reference that are too broad (e.g., numbers 3 and 4). Annelies Pierrot-Bults reported that the Netherlands SCOR Committee had similar reservations. Julie Hall added that the New Zealand SCOR Committee felt this is a timely proposal, but the link to biogeochemistry is not made through the proposed membership; they would need to add a chemical oceanographer. Robert Duce asked why IAPSO wants a SCOR group to oversee a program it already has established. The link between the IAPSO DOES project, IAPSO, and the proposed working group is very confusing. Ed Urban asked Shiro Imawaki to describe the DOES program; what is it doing? What would be the role of the working group? Bjørn Sundby stated that these relationships are very confusing; there is already a program in IAPSO, so it's not clear what a SCOR working group's role would be. Imawaki replied that the working group, if established, would take over the IAPSO DOES program. Imawaki clarified that the DOES project just started with a session in Cairns in the week before the SCOR meeting and is not an established program.

Bob Anderson (GEOTRACES) stated that the issue of exchange between the deep ocean and the continental shelf system is important for several reasons. For example, the idea of the continental shelf carbon pump is controversial because of uncertainties about the physical exchanges between the shelf and the open ocean. Similarly, GEOTRACES needs understanding of physics on continental margins to understand the global cycling of trace metals and isotopes.

Ed Urban stated that it would be useful to convey to the proponent how this proposal could be changed to help IAPSO make a better DOES project. Laurent Labeyrie responded that we need to send the message that the proposal needs to focus on shelf-break processes. Julie Hall added that we need to give the proponent other feedback, for example, that a tangible product must be identified. They need a multidisciplinary approach if we are encouraging them to come back to SCOR. Birger Larsen suggested that the proposal needs to add marine geology. Ilana Wainer responded that she agreed with much of what had been said, but that we might be sending a mixed message if we say that the proposal needs tightened terms of reference, but also needs to include a biologist, chemist, geologist, etc.

Bjørn Sundby summarized the discussions: the consensus is that the proposal is not ready for SCOR. There was discussion about the possibility that the proposal could be revised before next year's meeting, but the decision was made that it would be better for the proposal to be revised and re-submitted next year, if the proponents so desire. Julie Hall added that we need a clear understanding of the relationship of the proposed working group to DOES and that the proponent needs to discuss with IMBER, GEOTRACES, and other SCOR-sponsored projects their needs and how the working group could address them. Mike MacCracken stated that it appears the group will meet even without SCOR support. It would be useful to determine if the proponent wants to re-submit for consideration at the 2006 General Meeting or to proceed without SCOR support.

2.3.6 WG on Critical Bathymetric Studies

Laurent Labeyrie, the monitor for this proposal, reminded meeting participants that SCOR spent a lot of time on former WG 107 on Improved Global Bathymetry. The aim of this proposed working group is to identify the under-mapped areas of the global ocean's bathymetry. The reviewers' comments were all skeptical as to the feasibility of the project and the proposal was poorly ranked by all reviewers. The proponent is open to suggestions to improve the proposal. Victor Akulichev stated that the proponents may not need financial support from SCOR. Julie Hall noted that most countries won't release classified data on bathymetry in their EEZs. Since the key bathymetry for modeling is often within the EEZs, this working group would have trouble accessing those data. SCOR cannot tell countries what they should do in their EEZs. The U.S. SCOR Committee thought this was an important proposal and ranked it second overall. But, the U.S. committee wouldn't recommend funding it unless it were closely linked to existing efforts. Labeyrie noted that Walter Smith is the head of the General Bathymetric Chart of the Oceans (GEBCO) Subcommittee on Digital Bathymetry and they find problems with bathymetric data everywhere. He thinks that a SCOR working group would really encourage an international effort on this topic, although the proposal did not describe the output from the working group. Missy Feely responded that there may already be bathymetric data for some areas, but that it's not available to the public; perhaps a SCOR working group could encourage release of such data. Bjørn Sundby noted that the proposal suffers from being too open-ended. It's a noble cause, but what happens once the working group has completed its work? Who will implement the recommendations? Birger Larsen asked if we should just pass the proposal to IOC since Sundby reported so much interest in this topic at the IOC Assembly. Perhaps they could handle the topic more effectively than could SCOR. There was consensus not to establish a SCOR working group based on this proposal.

At the beginning of the second day of the meeting, Bjørn Sundby reiterated the decisions on working group proposals made on the first day. Two proposals were approved, and need to be ranked in case there isn't enough money for two new working groups to start in 2006. Sundby noted his impression that the Equation of State working group should have the highest priority and the Hypoxia working group should have second priority. Meeting participants agreed. Executive Committee members determined that, in the future, proponents of new working groups should not be allowed to present their proposals personally, as not all proponents can afford to do this.

3.0 LARGE-SCALE OCEAN RESEARCH PROJECTS

3.1 SCOR/IGBP/IOC Global Ocean Ecosystem Dynamics (GLOBEC) Project (see Annex 5)

John Field, a member of the GLOBEC SSC, presented a report prepared by Manuel Barange, the GLOBEC Executive Officer. Field reported that GLOBEC is very active. It has sponsored five major symposia and five workshops in 2004 and 2005. GLOBEC has approved two new regional activities:

- Climate Impacts on Oceanic Top Predators (CLIOTOP)—The CLIOTOP Science Plan has been published, a number of working group meetings have taken place, and a CLIOTOP SSC has been formed.
- Ecosystem Studies of Sub-Arctic Seas (ESSAS)—The ESSAS Science Plan has also been published and a steering committee has been appointed. ESSAS held a symposium entitled “Climate Variability and Sub-Arctic Marine Ecosystems”, in Victoria, Canada, on 17-19 May 2005, for which SCOR contributed travel funds. This workshop had 238 registrants from 16 countries. Following this symposium was an ESSAS Implementation Plan Workshop, attended by 88 participants.

GLOBEC’s official lifespan runs from 1999 through 2009. GLOBEC research continues, but the project has also begun its integration and synthesis (I&S) phase. Part of this process will be to identify research topics that GLOBEC will recommend that IMBER take up when the GLOBEC’s project is completed. Field reviewed the I&S activities and schedule. So far, this phase has achieved the following:

- A Regional Ocean Model System (ROMS) of North Atlantic and Arctic oceans has been developed
- An individual-based model (IBM) was created to answer the question “What happens to Arcto-Norwegian cod if thermohaline circulation slows down?” The IBM suggests that poor cod recruitment will result.
- The buoyancy of cod eggs has been studied. Different buoyancies of different sub-stocks create differences in the retention of eggs in the spawning area or advection of eggs out of the area, which has implications for recruitment.

In regard to GLOBEC SSC membership rotations, GLOBEC will send nominations to SCOR and other co-sponsors after the SCOR meeting. The first joint meeting of the GLOBEC and IMBER Executive Committees will take place later this year, at which the two projects will continue planning for joint activities.

3.2 SCOR/IOC Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) Program (see Annex 6)

Julie Hall, the Executive Committee Reporter for GEOHAB, reviewed the GEOHAB report in the background book. GEOHAB has embarked on a series of focused open science meetings (OSMs) to create research plans for its four Core Research Projects. Three have been held so far: (1) Harmful Algal Blooms (HABs) in Upwelling Systems (Lisbon, Portugal), (2) HABs in Fjords and Coastal Embayments (Viña del Mar, Chile), and HABs and Eutrophication (Baltimore, Maryland, USA). The research plan for the Upwelling project was published by IOC in March 2005, and the plans from the Fjords and Coastal Embayments, and Eutrophication meetings are in progress. The final open science meeting will be held on HABs and Stratification (December 2005 in Paris, France). The next GEOHAB SSC meeting will be held in Villefranche, France, early in 2006. The major focus of the meeting will be implementation of GEOHAB Core Research Projects. GEOHAB has been unable to secure funds for an IPO and this continues to be a major impediment to rapid development of the program. Three members of the SSC and the Chair will be rotating off at the end of 2005; the SSC is working on nominations to send to SCOR. Ed Urban added that the small OSMs have been a good way to focus on specific topics and to entrain a broader community of scientists in GEOHAB.

Ralph Schneider asked whether there have been contacts between these large programs and the paleoceanographic community. IMAGES could help provide this linkage. Ed Urban replied that GEOHAB has an interest in getting recent sediments for studies of dinoflagellate cysts versus changes in upwelling and other climate-related features, and IMAGES had expressed an interest in helping with this scientific question. SOLAS and IMBER SSCs include members with paleoceanographic expertise. Urban added that he will encourage SCOR projects through the *SCOR Newsletter* to consult with IMAGES when paleoceanographic expertise is needed.

3.3 SCOR/IGBP Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) Project (see Annex 7)

Julie Hall, the chair of the IMBER SSC, made a presentation about the project status and plans. The IMBER *Science Plan and Implementation Strategy* was approved by SCOR and IGBP, and published a few weeks before the SCOR meeting. Ed Urban pointed out that the cover of this document incorporates both IGBP and SCOR design elements, as befits a joint project, and he noted his appreciation for the work of the IGBP Secretariat communications staff to achieve this result. The IMBER SSC met in April 2005 in Shanghai, China, to discuss implementation activities.

Hall described IMBER's four themes and the key issues and questions in each theme:

- Theme 1—Interactions between biogeochemical cycles
- Theme 2—Sensitivity to global change

- Theme 3—Feedbacks to the Earth system
- Theme 4—Responses of society

In the implementation of IMBER, sustained long-term observations are a top priority. Other implementation approaches will include repeat hydrographic lines, field-based process studies, mesocosm experiments, lab experiments, and use of paleo-proxies.

IMBER has established an IPO in Brest, France, and has hired an Executive Officer for the IPO, Sylvie Roy. She started full-time work for IMBER just before the SCOR meeting. An advertisement has been circulated for a Deputy Executive Officer and a secretary has been hired.

National activities and planning have begun in China (with a newly funded GLOBEC-IMBER five-year program), Canada, Chile, Germany, France, India, Japan, New Zealand, the Netherlands, South Africa, the United Kingdom, and the United States. Regional activities related to IMBER include Eur-Oceans, CARBOOCEAN, ICED (Southern Ocean), and OECOS (SubArctic Pacific).

Later in 2005, IMBER will co-sponsor an ocean carbon working group meeting with SOLAS, and an end-to-end food web working group and joint Executive Committee meeting with GLOBEC. There are plans to form a Human Dimensions Working Group (Theme 4) and to convene a Continental Margins Open Science Meeting in 2006. IMBER plans to hold its first project-wide open science meeting in 2008.

3.4 SCOR/IGBP/WCRP/CACGP Surface Ocean – Lower Atmosphere Study (SOLAS) (see Annex 8)

Laurent Labeyrie, the Executive Committee Reporter for SOLAS, reviewed the SOLAS report. SOLAS hired an Executive Officer, Jeff Hare, for its IPO in 2005. SOLAS held its first open science meeting in Halifax, Nova Scotia, Canada, in October 2004 and has set the dates for its next OSM: March 2007 in Xiamen, China. Robert Anderson noted that GEOTRACES just held a meeting in Xiamen, that it is a nice place to meet, and that the local hosts are already working on preparations for the SOLAS OSM. The scientists at Xiamen University are excellent hosts.

SOLAS and IMBER have agreed to create a cooperative research activity related to ocean carbon and are in the process of forming a working group to guide the activity and to interact with IOCCP. Labeyrie stressed the need for the SOLAS SSC to add a new paleoceanographer among the membership replacements. Urban noted that the SOLAS IPO has two scientists and no administrative person. In order for SCOR to ensure appropriate financial management for SOLAS, it will be necessary for SCOR to continue managing SOLAS funds from Baltimore for now. Annelies Pierrot-Bults added that the Netherlands SCOR Committee is seeking funds to host a SOLAS SSC meeting in Amsterdam in 2006; they will have a national IMBER/SOLAS planning meeting at the same time.

3.5 SCOR GEOTRACES Planning Committee (see Annex 9)

Robert Duce, the Executive Committee Reporter for the developing GEOTRACES project, introduced the discussion on GEOTRACES by stating that approving new SCOR working groups and projects is the most important activity at SCOR meetings. He noted that SCOR has now received the draft *GEOTRACES Science Plan* for review and the question before this meeting was whether to approve GEOTRACES as a new SCOR project.

GEOTRACES has developed very quickly: it was only started in 2003. The first meeting of the GEOTRACES Planning Committee was held in June 2004. The first draft of the *GEOTRACES Science Plan* was finished at an editorial meeting in December 2004. This draft was then posted on the Web for community review. After the final draft was completed at a meeting of the Planning Committee in May 2005, it was submitted to SCOR for formal review.

Two GEOTRACES sub-committees are being set up on (1) standards and intercalibration and (2) data management. GEOTRACES has had good interfaces with other programs, including IMBER, SOLAS, and the two SCOR working groups related to paleoceanography (WGs 123 and 124). GEOTRACES activities are underway in Canada, China-Beijing, the Western Pacific region, India, Germany, Japan, Spain, France, the UK, and the United States. The U.S. National Science Foundation (NSF) is waiting to consider proposals for U.S. GEOTRACES until SCOR has approved the *GEOTRACES Science Plan*.

Duce reviewed the GEOTRACES mission statement: “To identify and quantify processes that control the distribution of key trace elements and isotopes in the ocean, and their sensitivity to changing environmental conditions, in order to elucidate sources of micronutrients, contaminant dispersal, and tracers of past and present ocean conditions.” Duce introduced one of the GEOTRACES co-chairs, Bob Anderson, to make a presentation about the project.

Anderson described the motivations for GEOTRACES. Trace elements and isotopes (TEIs) are clearly important for many aspects of ocean science, including the role of micronutrients in ocean biogeochemistry and their impacts on ecosystem structure and carbon cycle, and rates of carbon cycle processes. TEIs also serve as tracers of ocean processes, and the transport and fate of contaminants. They can be used as proxies to reconstruct past ocean conditions and to predict the ocean’s response to global change. The need for information on the concentrations, distributions, sources, and sinks of TEIs to understand these processes motivates GEOTRACES. It is timely to conduct a project like GEOTRACES now because (1) it has been 30 years since the most recent global program of marine chemistry (GEOSECS: Geochemical Ocean Section Study), (2) we now have an improved ability to sample the ocean without contamination, (3) analytical instruments are more sensitive than in the GEOSECS era, and (4) advances in modeling permit rates and fluxes to be derived from distributions. GEOTRACES has three organizing themes:

- Theme 1: Chemical fluxes and processes at ocean interfaces
- Theme 2: Internal cycling
- Theme 3: Development of proxies for past change

GEOTRACES will have three overlapping phases:

1. Preparation (planning, preparation and distribution of standards, intercalibration, modeling, data archiving protocols, test stations).
2. Core activity: series of sections to cover all major ocean basins (~12 - 15 sections, chosen to address a maximum number of processes, run by various countries, but with international representation).
3. Parallel and follow-up process studies (e.g., coastal work—estuaries, shelf processes, etc.—tied to ends of sections where possible). Process studies will exploit existing time-series stations, as well as exploiting natural temporal variability (e.g., ENSO) to establish sensitivity to changing environmental conditions. Process studies will also follow up on features discovered from the sections.

Key elements of the GEOTRACES strategy include (1) multi-tracer synergy (Boyle Principle: Measuring multiple TEIs with varying behavior will provide insights into processes not attainable from study of a single TEI) and (2) a section approach to identify processes. GEOTRACES is having some success in ship time proposals and in relation to its proposed work for IPY.

Robert Duce opened discussion about Anderson's presentation. Birger Larsen asked what GEOTRACES would do about measuring temporal variability. Robert Anderson answered that there is so little sampling to date that temporal variability cannot be assessed. There will be strong partnerships with physical oceanographers, who are beginning to understand the processes driving the seasonal variability of temperature and salinity in the deep sea. GEOTRACES must look at correlations between trace element concentrations and standard physical parameters.

John Compton asked how GEOTRACES will bring along those countries that don't have the capability to make trace element measurements. Anderson responded that GEOTRACES intends to conduct capacity building in a variety of ways, including making available berths on ships doing GEOTRACES work. The International Atomic Energy Agency (IAEA) is very interested in helping GEOTRACES with capacity building, through courses and other opportunities. Ilana Wainer stated that there are many GEOTRACES-related activities in Brazil. How can countries foster contacts and collaborations with GEOTRACES? The Joint Global Ocean Flux Study (JGOFS) came and went, and even though there were people doing related work in Brazil, they never became actively involved in JGOFS. How can GEOTRACES get information out to scientists in countries like Brazil that are doing isotope measurements and/or trace element studies? Anderson said that it would be very helpful to GEOTRACES if Wainer could send him names of interested Brazilians.

Moving on to the review of the *Science Plan*, Robert Duce noted that 9 individuals reviewed it, with comments received over the past 6 weeks. The co-chairs and planning group have responded to all comments. Duce read some of the reviewers' comments; all reviewers were very positive about GEOTRACES and its *Science Plan*. He also went over issues commented on by several reviewers. Duce thinks that GEOTRACES has responded to the reviews very well. Some changes will be incorporated into the *Science Plan*; others reviewers suggested changes would not improve the plan. The standardization and intercalibration exercises that GEOTRACES is undertaking are absolutely critical.

Duce proposed that SCOR should approve the *Science Plan* conditional on GEOTRACES satisfactorily incorporating changes to respond to the reviewers' comments. A few Executive Committee members will have to look at the final version of the plan. Duce will lead on the final review and Laurent Labeyrie volunteered to help. Bjørn Sundby stated SCOR must send a strong message that it wants to approve this plan and not wait another year. All that is left is fine tuning.

The meeting agreed to approve GEOTRACES as a new SCOR program. Once the *Science Plan* has been finalized, a GEOTRACES SSC will be established by the SCOR Executive Committee in consultation with the co-chairs of the GEOTRACES Planning Committee.

3.6 IGBP/IHDP Land-Ocean Interactions in the Coastal Zone (LOICZ) Project

LOICZ is sponsored by IGBP and the International Human Dimensions of Global Change Programme (IHDP), but not presently by SCOR. The 2002 SCOR General Meeting agreed to co-sponsor the elements of LOICZ related to coastal ocean science, pending development of financial support for LOICZ. SCOR has not yet been able to secure funds to assist LOICZ in a long-term way, but has provided travel grants for two LOICZ meetings. Julie Hall was appointed by SCOR to serve as the Reporter to SCOR for LOICZ, to make sure that LOICZ is covered in annual SCOR meetings. The LOICZ IPO is very busy as it prepares to change locations from the Netherlands to Germany. LOICZ II has a significant social science component, as shown in the *LOICZ II Science Plan* published earlier this year. LOICZ is working with SOLAS and IMBER on carbon issues, and IMBER and LOICZ will hold a joint OSM on continental margins if funding can be developed for it.

Bjørn Sundby concluded the discussions about SCOR-sponsored research projects by acknowledging that SCOR cannot promote new programs without considering the abilities of the international science community and the national funding agencies to support them. Laurent Labeyrie responded that communities generate programs because there is a scientific need. The main issue should be that SCOR should support good science. Ed Urban noted that SCOR has agreed with IGBP not to start new projects that overlap significantly with existing ones.

Ralph Schneider made a general comment that it is easy to write statements in science plans about needs for paleoceanographic activities, but this work would be more likely to be achieved

if the projects developed linkages to IMAGES. Ed Urban replied that this is one of the purposes of the project coordination meetings (see Section 4.3.2). He hopes that IMAGES would have direct contacts with relevant projects and would propose joint activities. Bjørn Sundby suggested that these concerns could be discussed in the *SCOR Electronic Newsletter*.

4.0 OCEAN CARBON AND OTHER ACTIVITIES

4.1 SCOR/IOC International Ocean Carbon Coordination Project

Ed Urban reported that SCOR and IOC convened an “Ocean Carbon Stakeholders Meeting” in Paris in December 2004 to determine what would be the best approach to replace the SCOR/IOC Advisory Panel on Ocean CO₂ and to create a structure that will encourage national contributions to SOLAS and IMBER ocean carbon research goals. The result of the meeting was the formalization of the SCOR/IOC International Ocean Carbon Coordination Project (IOCCP) and the creation of a SOLAS/IMBER ocean carbon research implementation group. The Scientific Steering Groups for both projects have been formed and will meet jointly annually and will work closely to coordinate ocean carbon research and observations worldwide. IOCCP will focus on observational issues, data, and other infrastructural issues. It now has a full-time postdoctoral fellow (funded by NSF) to work at IOC with Maria Hood. Urban presented the IOCCP membership. Initial activities of IOCCP include an IOCCP/CLIVAR Repeat Hydrography Workshop; a technical paper on underway measurement systems; an Ocean Carbon Directory on the IOC Web site (<http://ioc.unesco.org/ioccp/>); inventories and compilations for time-series stations, coastal observations, and process studies; and discussion of the development of a compiled uniform-format data set of global pCO₂.

The joint SOLAS/IMBER Ocean Carbon Research Implementation Group will coordinate international ocean carbon science activities. The group is just starting. Julie Hall added that this group is developing a joint plan for carbon research by the two projects, which will be posted on the projects’ Web sites soon (see http://www.imber.info/products/Carbon_Plan_final.pdf). IOCCP and the SOLAS/IMBER group will meet separately and together in September 2005 in Boulder, Colorado, USA at the Seventh International Carbon Dioxide Conference.

4.2 SCOR/IOC Symposium on The Ocean in a High-CO₂ World

Robert Duce introduced this item by stating that this was a highly successful symposium. The planning committee and symposium were chaired by Ralph Cicerone, now President of the U.S. National Academy of Sciences. The symposium provided input to a special report of the Intergovernmental Panel on Climate Change (IPCC) on Carbon Dioxide Capture and Storage. The Royal Society of London convened a group on ocean acidification (in part) as a result of the symposium.⁶ The meeting helped to raise the issue and concerns about ocean acidification as a result of increasing atmospheric CO₂ concentrations.

A special section of the *Journal of Geophysical Research—Oceans* will be published with 16 papers from the symposium later in 2005.⁷ IOC and SCOR have been discussing making the activity a continuing series of symposia. There was a general consensus that SCOR should maintain a leadership role in this issue and should work with IOC to hold another symposium in 2008. By that time projects like SOLAS and IMBER will be more mature and able to play an active role. John Compton suggested that the organizers should make a real effort to get a science journalist involved. In the 2004 symposium, there was concern that inviting journalists would impede the scientific discussions, particularly of the controversial idea of carbon sequestration in the ocean. But, now that the issue of ocean acidification is more visible, involvement of journalists could be beneficial.

4.3 Other Activities

4.3.1 The Global Iron Cycle

Robert Duce was the Executive Committee Reporter for an IGBP/SCOR “Fast-track Initiative” on the Global Iron Cycle. He reminded meeting participants that SCOR had been a supporting applicant for a proposal from IGBP to ICSU. The proposal was successful and the resulting meeting brought together experts on oceanic, atmospheric, and terrestrial aspects of the global iron cycle to document the current state of knowledge. The activity resulted in one synthesis paper for *Science*⁸ and several other more-focused papers that will be submitted to *Global Biogeochemical Cycles*.⁹

4.3.2 SCOR Meeting on Coordination of International Marine Research Projects

Laurent Labeyrie and Ed Urban gave an update on the SCOR Meeting on Coordination of International Marine Research Projects. SCOR obtained funding from the Alfred P. Sloan Foundation to convene a meeting of representatives of the major large-scale ocean research projects—SCOR-sponsored, SCOR-affiliated, and others. The meeting was held in Mestre, Italy, during the week before the 2004 General Meeting and was co-chaired by John Field and Laurent Labeyrie. Urban reviewed progress on the action items from the Mestre meeting:

- A review of SSC memberships shows that few SSCs share members with other SSCs, probably due to the time commitment of being involved in even a single SSC. A more practical approach may be to appoint liaisons among projects (or *ex officio* members) who would be copied on e-mails to the SSCs of the projects and invited to attend SSC meetings at their own expense.

⁶Royal Society (UK). 2005. Ocean acidification due to increasing atmospheric carbon dioxide. London

⁷Orr, J.C., S. Pantoja, and H.-O. Pörtner (eds.). 2005. The Ocean in a High-CO₂ World. Special section of *Journal of Geophysical Research—Oceans* 110.

⁸Jickells, T.D. et al. 2005. Global iron connections between desert dust, ocean biogeochemistry, and climate. *Science* 308:67-71.

⁹For example, Mahowald, N.M.; A.R. Baker, G. Bergametti, N. Brooks, R.A. Duce, T.D. Jickells, N. Kubilay, J.M. Prospero, and I. Tegen. 2005. Atmospheric global dust cycle and iron inputs to the ocean. *Global Biogeochem. Cycles*, Vol. 19, No. 4, GB4025.

- A e-mail list has been set up at JHU (OCEAN-PROJECTS) and is available for communication among the projects.
- SCOR did not locate funding for another meeting in 2005, but is beginning discussions with the Sloan Foundation about funding for a meeting in 2006.
- The Partnership for Observations of the Global Oceans (POGO) has been discussing the creation of a research cruise database; POGO and SCOR will convene a meeting later in 2005 on this topic. In the meantime, a page has been created on the SCOR Web site to provide links to project cruise information. Bill Erb noted that South Pacific Applied Geoscience Convention (SOPAC) also is setting up a research cruise database.
- The *Journal of Marine Systems* has invited Roy Lowry to produce an article on the data management meeting that SCOR and IGBP convened in Liverpool, UK, in 2003.
- SCOR will fund a participant in the review of the Ocean Integrated Global Observing Strategy (IGOS) theme and help as needed.

Jesse Ausubel (USA) stated that the Sloan Foundation would be willing to consider a proposal for a second meeting in 2006. Laurent Labeyrie stated that SCOR should convene a second meeting and John Field added that a meeting should be held every second year, in association with SCOR General Meetings, if possible. Urban responded that he will ensure that projects find such interproject coordination meetings useful before submitting a proposal to the Sloan Foundation. Labeyrie stated that last year GOOS was a major theme. There was some discussion about whether the IPY would be a good focus for the 2006 meeting. Field suggested that links between CLIVAR and other projects could be a theme. Urban added that he thinks there should be an emphasis on data management again; but, the point is to find out what the projects want to discuss and facilitate it for them, not direct them.

Colin Devey suggested getting someone from a World Data Center to come and make a presentation on data issues. Labeyrie noted that one data issue is that databases need to be more user friendly. Ralph Schneider stated that he is not sure that inviting data managers is useful, as they will just push their standard formats. We need to think about how to train the community to use the data. Devey replied that we need the data managers at the meeting, so the projects can tell them what they want. PANGAEA (Publishing Network for Geoscientific & Environmental Data) is hard to use and data managers need to get advice on how to make it easier to use. The consensus was that the meeting should focus on data again.

4.3.3 Panel on New Technologies for Observing Marine Life

Annelies Pierrot-Bults reported that the first meeting of the panel was held in Goa, India, in February 2005. The panel has established a Web site (www.scoml.org) and is working on improving interactions with Census of Marine Life (CoML) projects. There was a summary in the background book for the meeting.¹⁰ Last year the group was in transition from Working Group 118. The panel will meet next in Frankfurt in November 2005 at the CoML All Program Meeting. The Panel's challenge is to engage the CoML projects on technology issues. For example, the Barcode of Life effort will involve the panel in a CoML-wide activity. The Panel will meet in Kobe, Japan, in 2006 in conjunction with a meeting of the CoML Natural

¹⁰ Also available at <http://www.jhu.edu/scor/GoaMeetingReports.pdf>.

Geography In Shore Areas (NaGISA) project and a major ocean technology conference called Techno-Ocean 2006.

4.3.4 Activity Proposed by SOLAS and the International Nitrogen Initiative (INI)

The International Nitrogen Initiative (INI) is designed to develop a coordinated plan to understand nitrogen cycling for the world's continental regions and their coastal margins. INI has not, to date, pursued aspects of the global nitrogen cycle related to the open ocean. INI and SOLAS are jointly considering a review of the current understanding of the potential for changes in open ocean health due to human alteration of the marine nitrogen cycle. This is an issue of central importance to SOLAS, the subject of Activity 1.5 of the *SOLAS Science Plan and Implementation Strategy*. Robert Duce and Julie La Roche (Germany) will co-chair this activity to represent chemistry and biology, respectively. The INI/SOLAS review would be accomplished, in part, through a small workshop on this topic. Because neither SOLAS nor INI has adequate funds to support this activity, they requested \$15,000 from SCOR.

Robert Duce reported that the activity would be similar to the global iron cycle fast-track initiative in which SCOR participated with IGBP. The proposed new activity would bring 12 people together for about one week to produce a synthesis paper for a journal such as *Science* or *Nature*, as well as other more specific papers. The meeting would take place in about September 2006. Duce, La Roche, and Peter Liss (UK) will meet in Norwich, UK, in November 2005 to start planning the activity. SCOPE developed INI initially and it was later co-sponsored by IGBP, within the framework of its Fast-track Initiatives. The funding available from SCOPE and IGBP for the proposed activity is not clear. Bjørn Sundby stated that while the ocean's role in the global nitrogen cycle is a hot issue, he was not sure it would be timely to do a synthesis because so much research is going on right now. Duce clarified that, again, the situation is analogous to the iron situation, in which much research is underway, but it was timely to synthesize the progress to that point. Duce is concerned that 12 people may not be enough to cover this broad area of science. He added that the workshop group will be selected in November, and Duce and La Roche would like invitation suggestions from SCOR.

Sundby summarized the discussions among meeting participants, which indicated that the ocean's influence on the global nitrogen cycle is an appropriate "hot topic" for SCOR involvement, if the support from other potential co-sponsors can be ascertained and issues about group size can be clarified. If the above issues are addressed adequately, SCOR will allocate part of its discretionary funds and some developing country travel support for the meeting.

5.0 CAPACITY-BUILDING ACTIVITIES

5.1 Regional Graduate Schools of Oceanography and Marine Environmental Sciences (RGSO)

The Executive Committee formed a small committee at the 2002 General Meeting to determine how to proceed with this activity. This committee is co-chaired by John Field and Ilana Wainer,

and also includes Huasheng Hong (China-Beijing) and Manuwadi Hungspreugs (Thailand). Ed Urban has been working with individuals in the Southeast Asia region, including Hong, Hungspreugs, and Anond Snidvongs (Thailand) to try to develop support for a planning meeting in the region. Urban submitted a preproposal to the Asia-Pacific Network for Global Change Research (APN) for a Southeast Asian regional meeting, but was not encouraged to submit a full proposal because of the nature of the proposed meeting. SCOR has also begun discussions with Canadian sources about potential funding for regional workshops and implementation. The Canadian International Development Agency (CIDA) is a possible source of support. Ilana Wainer added that there is too much competition between institutions in South America and that a meeting is needed in the region to work this out. Brazil would like to host some RGSO activities.

John Field added that the African region has training courses through the Benguela Environment Fisheries Interaction and Training (BENEFIT) Programme. Other activities are taking place, but nothing under the SCOR umbrella yet, although they could be in the future. Ed Urban stated that the University of Concepción model has proven very successful for Chile, but needs to be modified for a regional graduate school, because it consists of centralized, non-rotating classes. SCOR is trying to obtain funding for four regional meetings. Mauricio Mata (Brazil) asked whether there had been any contacts with the Inter-American Institute for Global Change Research (IAI) for funding. Urban responded that he had checked the IAI requirements for proposals and this idea did not seem to fit their funding profile. Huasheng Hong described summer courses in China that rotate around different universities. John Compton stated that getting students on cruises is critical; as ships come through Cape Town, students from South Africa often get chances to do this. It would be useful to try to coordinate ship port calls with RGSO efforts in nearby universities. SOLAS Summer Schools have shipboard aspects and this approach could be encouraged through RGSO and other SCOR activities.

5.2 Partnership for Observations of the Global Ocean (POGO)/IOC/SCOR Visiting Fellowships for Oceanographic Observations

Five sets of fellowships have been awarded (13 each in 2001 and 2002, 9 in 2003, 12 in 2004, and 10 in 2005). The program sponsors have received good feedback about the value of the fellowships to the fellows and the hosts. Urban stated his surprise that there are not more applications each year; there were only 25 this year. Most applicants are from Latin America, India, China, and Russia. IOC has eliminated its funding for the fellowships, but the funds available should allow the program to continue. SCOR funding was approved for the fellowships for 2006, under the next agenda item.

5.3 NSF Travel Support for Developing Country Scientists

SCOR received a three-year renewal from the U.S. National Science Foundation (NSF) of its grant for these awards, at a level of \$75,000 per year from mid-2005 to mid-2008. The grants have been an important source of support for several SCOR-related activities in the past year, including

- POGO-IOC-SCOR Fellowships
- GEOHAB and LOICZ Open Science Meetings
- SCOR-relevant workshops at the PICES annual meeting
- the IAPSO Workshop on Forecasting in the Benguela Current System
- the XIth International Harmful Algal Bloom Conference
- the Bjerknes Centenary 2004 conference
- the 8th International Conference on Paleoceanography
- an InterRidge conference on back-arc basins
- the International GLOBEC Symposium on Climate Variability and Sub-Arctic Marine Ecosystems
- the Advances in Marine Ecosystem Modelling Research Conference
- the 2005 International Ocean Research Conference of The Oceanography Society,
- the first SOLAS Summer School
- the International Association of Geodesy (IAG)/IAPSO/International Association of Biological Oceanography (IABO) Assembly

Ed Urban explained how the grants are handled and recipients selected. Meeting organizers identify a list of potential recipients, which are reviewed by the SCOR Secretariat before the any recipients are notified, to ensure that the same individuals have not received other travel support from SCOR in the past two years.

During the discussion of SCOR finances on Thursday, Urban presented a list of requests and meeting participants agreed on which ones to fund and how much each meeting should receive. Requests for funding were approved for the following meetings:

- the PICES/GLOBEC Symposium on “Climate variability and ecosystem impacts on the North Pacific: A basin-scale synthesis”
- IGBP/SCOR Fast-Track Initiative on Atmospheric CO₂ and Ocean Biogeochemistry: Modern Observations and Past Experiences
- SOLAS/INI Review of Anthropogenic Nitrogen Impacts on the Open Ocean
- POGO-SCOR Visiting Fellowships for Oceanographic Observations
- Satellite Oceanography 2006
- 12th International HAB Conference
- workshop on “Oxygen minimum systems in the ocean: distribution, diversity and dynamics” (with SCOR 2006 General Meeting)
- PICES 15th Annual Meeting
- 2006 COSPAR Scientific Assembly
- AMT-Royal Society meeting on Atlantic Ocean Biogeochemistry and Biodiversity

The only stipulation beyond the normal requirements is that SCOR should require that the funding for the AMT meeting is conditional on providing some other educational opportunities for meeting participants from developing countries, beyond attending the one-day meeting planned.

5.4 SCOR Reports to Developing Country Libraries

Ed Urban reported that the SCOR Secretariat distributed two reports to developing country libraries since the 2004 SCOR meeting: the special issue of the *ICES Journal of Marine Science* from WG 119's symposium and the *IMBER Science Plan and Implementation Strategy*. SCOR sends copies of SCOR publications to 42 libraries in 30 developing countries. Two-thirds of the countries that receive the reports are not yet members of SCOR, so we are hoping that sending the reports also helps SCOR visibility and may encourage some new countries to join SCOR. Birger Larsen asked whether new libraries can be added to the list. Urban responded that a small number of additions is possible. As reiterated at this meeting, we need to work with publishers to get more SCOR reports available online.

5.5 ICSU Priority Area Assessment on Capacity Building

Ed Urban reported that the committee conducting the ICSU Priority Area Assessment on Capacity Building issued a draft report for review in March 2005. He provided comments to ICSU, but has not yet seen the final version, so he is not sure that ICSU incorporated the SCOR comments. Urban will send the final report to the Executive Committee, plus the RGSO group.¹¹

6.0 RELATIONS WITH INTERGOVERNMENTAL ORGANIZATIONS

6.1 Intergovernmental Oceanographic Commission (IOC)

Bjørn Sundby and Ed Urban attended the IOC Assembly in June 2005 to represent SCOR and made interventions related to the Intergovernmental Panel on Harmful Algal Blooms, the Intergovernmental Panel for GOOS, and IOCCP. Bill Erb, from the IOC office in Perth, Australia, made a presentation at the SCOR meeting about IOC activities. He expressed apologies from Patricio Bernal, the IOC Executive Secretary, who could not attend the meeting. Erb noted that IOC and SCOR have a long relationship, and IOC values the partnership. Erb described the IOC response to the 26 December 2004 tsunami in Indonesia and the Indian Ocean. IOC was asked by the UN to lead the UN response. The \$11million UN project has five parts:

1. Core system implementation – the observing array
2. Integrated risk knowledge
3. Public awareness and education
4. Community-level approaches
5. Project coordination

The biggest problem is getting tsunami warnings out to the potentially affected communities; it probably will take at least a decade to get warning systems in place. IOC has received US\$3.5

¹¹(see

http://www.icsu.org/Gestion/img/ICSU_DOC_DOWNLOAD/928_DD_FILE_ICSU_PAA_Cap_Building.pdf).

million for the observing component. Two intergovernmental coordination meetings have taken place so far to discuss capacity building and the core system observational network. Capacity building has focused on expert advisory missions and a startup training program. The core system observational network has focused on operation of an interim tsunami advisory information system and establishment of an operational sea-level network.

The first intergovernmental meeting recommended

- establishing an Intergovernmental Coordination Group (ICG/IOTWS) with IOC as the Secretariat;
- creating an international warning system, which will be a coordinated network of national systems;
- establishing the principle that warnings are the responsibility of countries. National Tsunami Warning centers need to be established;
- promoting data sharing; and
- establishing an interim tsunami advisory information service.

The second intergovernmental meeting resulted in the Mauritius Declaration, which (1) reaffirmed the commitment of nations, (2) acknowledged that nations are fully informed of, and agree with, the work plan, and (3) invited countries to assess requirements and capacity-building needs by July 2005, followed by development of national strategic plans. Donors attending the Mauritius meeting pledged support, including Finland, Belgium, Norway, Germany, and Italy.

National assessments are needed to inform stakeholders on the requirements (organizational, infrastructural, and human resources) for the establishment and operation of a tsunami warning and mitigation system; to assess the available resources; to promote the establishment of national coordination committees involving the widest possible group of stakeholders; and to identify capacity-building needs. The 18 national assessment reports will be submitted formally to each visited country and will be consolidated in a single document, which will identify similar requirements for capacity building at the regional and subregional levels. A meeting in December 2005 will design and adopt a capacity-building plan.

The IOC Assembly in June formally established the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning System. (The warning system will be part of GOOS.) Australia will host the secretariat in Perth. The office will look at other natural hazards as well, such as cyclones and storm surges. Other regions are building their own tsunami warning systems. The first meeting of the group was held in Perth and established four working groups:

- SWG 1: Seismic measurements, data collection, and exchange
- SWG 2: Sea level data collection and exchange, including deep-ocean tsunami detection instruments

- SWG 3: Tsunami hazard identification and characterisation, including modeling, prediction and scenario development
- SWG 4: The establishment of a system of interoperable operational centers

Michael MacCracken asked if the tsunami warning system would be able to detect asteroid impacts, which wouldn't have a seismic signature. John Compton asked if volcanic eruptions would be detected. Erb responded that they have considered these tsunami-generating events, plus slumps, but they are not yet included in the system. Yueh-Jiuan Glory Hsu (China-Taipei) asked if the Indian Ocean warning system would be similar to the Pacific Ocean system. Erb responded that the Pacific Ocean system has been operating for about 40 years and thus is transferring a lot of time-tested technology to the Indian Ocean System. Bjørn Sundby asked if scientific issues had been identified yet. Erb responded that they expect scientific issues to emerge from their working groups. Sundby offered scientific support from SCOR if it is needed.

6.1.1 Global Ocean Observing System (GOOS)

GOOS is sponsored by IOC, the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP). The GOOS Scientific Steering Committee also is cosponsored by ICSU. GOOS is planning implementation of its activities through GOOS Regional Alliances. John Field, chair of the GSSC, made a presentation about GOOS.

GOOS is a cooperation and coordination mechanism, building sustained, internationally coordinated observations of the ocean, a platform for the generation of oceanographic products and services, and a forum for interaction between research, operational, and user communities. (GOOS is implemented by nations.) GOOS is designed to

- monitor and better understand climate,
- improve weather and climate prediction,
- provide ocean forecasts,
- improve management of marine and coastal ecosystems and resources,
- mitigate damage from natural hazards and pollution,
- protect life and property on coasts and at sea, and
- support scientific research.

GOOS' open ocean observing system for climate is now more than 50% complete. The coastal ocean observing system strategy and implementation plans are now approved. Relevant components of GOOS are now made available for operational hazard warnings. There has been significant progress in building towards global coverage, as illustrated by the increases in deployment of Argo floats between 2003 and 2005.

The Global Ocean Data Assimilation Experiment (GODAE) is a pilot project for routine ocean forecasting. GODAE is currently providing modeling and technical support for the improvement of global and regional forecasts and analyses. Once a pilot project has done a successful demonstration, the Joint (WMO/IOC) Commission for Oceanography and Marine

Meteorology (JCOMM) takes over as the implementation mechanism for global GOOS. JCOMM is mainly concerned with the physical and meteorological aspects of GOOS. The role of JCOMM in coastal GOOS is not yet fully defined. Most of coastal GOOS will require regional alliances, setting priorities for each region.

The remaining challenges to GOOS include

- developing sustained and operational national ocean observing institutions;
- transitioning proven satellite and *in situ* pilot elements of GOOS to operational status, for example, Argo, satellite altimetry, and carbon measurements;
- tailoring ocean services, especially hazard warnings, to local cultural, social, and economic conditions;
- integrating GOOS within global efforts including the Global Earth Observing System of Systems (GEOSS) and the Integrated Global Observing Strategy (IGOS);
- filling the gaps in GOOS (50% of the planned *in situ* GOOS climate network),
- implementing observing systems in polar regions and the deep ocean (technology development will be necessary);
- increasing developing country participation (capacity building will be necessary);
- developing new observations of ocean biogeochemistry and ecology (including biodiversity and fisheries); and deployed a coastal GOOS system (implemented via GOOS Regional Alliances).

Field presented some information about GEOSS, which is an intergovernmental organization outside the UN system, and integrated through IGOS. GEOSS potentially can provide targeting of Earth observations for societal benefits, a wider base of data users and providers, enhanced sustainability of observing systems, enhanced compatibility across systems, and enhanced political and scientific interest in observing systems. GOOS is the ocean component of GEOSS.

Field reviewed the new terms of reference of the GOOS Scientific Steering Committee and the Intergovernmental GOOS Panel. They include changes recommended in the 2002-2003 review of GOOS, and recognize that GOOS is moving from planning to operations. The GOOS Coastal Panel is being dissolved and coastal GOOS will be represented on the GOOS SSC by coastal scientists. SCOR provides nominations for the GSSC on behalf of ICSU. Field reviewed the current membership and those rotating off the committee.

Robert Duce asked a question about chemistry in GOOS and how GOOS would relate to the UN Global Marine Assessment (GMA). Field replied that the connections between GOOS and GMA have not yet been discussed. Bjørn Sundby asked how gaps in GOOS coverage in polar regions will be filled. Field responded that such gaps will be filled by nations with interests in those regions. There will be a GOOS Arctic regional alliance. Ralph Schneider asked what kind of products can be expected from GOOS, and when. Field responded that the long-term aim is to provide products that users such as port authorities and shipping companies require; the scientific community is not the main client. Laurent Labeyrie asked what should be the

interaction between GOOS and SCOR? Are there possibilities for joint working groups? Field responded that SCOR provides scientific advice to GOOS and other parts of IOC. Mike MacCracken stated that he is concerned about the use of Mercator projections to show the distribution of instruments. Because this projection exaggerates high-latitude areas compared with low-latitude areas, it does not show real gaps in the observing network, especially in low latitudes. It is important to use equal area maps.

Bill Erb noted that ICSU funding for the GOOS SSC was cut off earlier this year and asked whether SCOR could help fill the void. In relation to other potential funding for GOOS, John Field added that the World Bank will only support coastal GOOS projects via funding for Large Marine Ecosystems. Bjørn Sundby stated that Ed Urban has tried to find funds for SCOR to contribute to GOOS, but GOOS is not seen as a research program, and agencies like NSF are not interested in providing funding. Could the GSSC help us by pointing out the parts of GOOS that are still in research phase so that we could use this to raise funding? Field replied that most of GOOS is still in research phase. SCOR has also been trying to help GOOS work more effectively with SCOR-sponsored and affiliated research projects. This process was started at the 2004 Project Coordination meeting. There needs to be more exchange of information about observations that are needed by the projects and what observations are planned by GOOS. This might be a way to help GOOS obtain research funding. Field replied that the GSSC requested project representation in its membership. Mike MacCracken asked whether GOOS is linked to IPY. Field replied that links are developing. Field reminded SCOR to provide nominations for the GSSC by 15 October 2005.

6.2 Other Intergovernmental Organizations

6.2.1 Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP)

GESAMP's sponsoring organizations (UN, UNEP, Food and Agriculture Organization [FAO], IOC, World Health Organization, WMO, International Maritime Organization, and IAEA) are developing a revised Memorandum of Understanding to implement the strategic vision for GESAMP. GESAMP has continued to participate in the development of a regular UN process for a Global Marine Assessment (GMA). Robert Duce reminded meeting participants about the external review of GESAMP that occurred several years ago. SCOR named two of the reviewers (Julie Hall and Seth Krishnaswami). A new strategic plan has been developed as a result of the review and has been accepted by GESAMP and all the 8 sponsoring agencies. GESAMP is being restructured and a new Memorandum of Understanding is being negotiated among the sponsors. Meanwhile, the GMA was developed with overlapping objectives and the future of GESAMP's periodic reviews of the health of the ocean is in doubt; some sponsors may decide to support GMA instead of GESAMP. GESAMP asked for advice from SCOR on relevant issues it might address. Bjørn Sundby suggested that GESAMP should be made aware of GEOTRACES.

6.2.2 North Pacific Marine Science Organization (PICES)

SCOR and PICES have cooperated in several activities in the past year, as described in the written PICES report. Victor Akulich, the SCOR liaison to PICES, reviewed the report. PICES' 14th Annual Meeting will be held in Vladivostok, Russia. Julie Hall added that PICES has had a very strong relationship with SCOR, especially with GLOBEC. They are now reaching out to IMBER and will have a strong role in this project. Meeting participants approved support for SCOR-relevant sessions at the PICES 15th Annual Meeting, as well as for a PICES-GLOBEC meeting. The SCOR support will be used for the participation of scientists from developing countries and countries with economies in transition.

7.0 RELATIONS WITH NON-GOVERNMENTAL ORGANIZATIONS

7.1 International Council for Science

Bjørn Sundby reminded everyone of the very positive ICSU review of SCOR, issued in 2003. He visited Thomas Rosswall, the ICSU Executive Director, last year. One issue that still needs to be discussed is the relationship among ICSU, SCOR, and GOOS. ICSU has withdrawn its financial support for the GOOS SSC. Perhaps SCOR, as the ICSU body with oceanographic expertise, should discuss with ICSU whether SCOR can play a stronger role in GOOS, on behalf of the ICSU community.

Michael McCracken was a member of the Advisory Committee for the ICSU Workshop on Comet/Asteroid Impacts and Human Society. The workshop was held in November/December 2004 in Santa Cruz de Tenerife, Canary Islands. MacCracken reported on his participation in the meeting. It featured a very diverse group of participants. A book of papers and a summary report are in preparation for ICSU. On another topic, MacCracken noted that the UN Commission on Sustainable Development meets next spring and has asked ICSU for some input and recommendations on key research issues. SCOR could make a contribution to ICSU's input.

SCOR was a supporting applicant for three proposals to ICSU this year: (1) Dynamics of semi-enclosed marine ecosystems: The integrated effects of changes in sediment and nutrient inputs from land (PACKMEDS, led by SCOPE and IAPSO), (2) Argo-Ed: A "window" on the global ocean, and (3) Geohazards: Extreme Natural Events and Societal Implications (*GENESIS*). SCOR did not submit any proposals as a lead applicant. The first proposal was funded by ICSU for \$50,000 and SCOPE, IAPSO, and SCOR will begin assembling the project committee later in 2005. There will be a planning meeting in Bremen in March 2006. The ICSU money will fund part of that meeting, but not much beyond that. There will be more to report next year. SCOR has not submitted a proposal to ICSU in the last several years, since there is less funding available. Accepted proposals are usually for societally relevant projects, and not as much on fundamental science.

SCOR nominated Kenji Satake (Japan) for the ICSU Scoping Group on Natural and Human Induced Environmental Hazards.

SCOR sent Geoff Brundrit (South Africa) to attend the First ICSU Regional Meeting for Africa in October 2004, to improve SCOR's outreach and contacts in Africa. Brundrit submitted a report to SCOR. The ICSU Regional Office for Africa has been established and SCOR will contact them for help in involving African scientists in SCOR activities in the future.

Urban directed meeting participants to the list in the meeting book of proposed projects for the International Polar Year coordinated by ICSU, and noted that there were several proposals for SCOR-related projects.

7.1.1 International Geosphere-Biosphere Program (IGBP)

Bjørn Sundby and Ed Urban attended the IGBP Science Committee meeting in Beijing, China, in February 2004 to represent SCOR. Julie Hall also attended at IGBP's expense as the IMBER SSC chair and Robert Duce attended as a new IGBP-SC member.

Wendy Broadgate from IGBP was unable to attend the SCOR meeting, but gave a PowerPoint presentation to Robert Duce. Duce reported first on the outcomes of the 2005 IGBP-SC meeting in Beijing. The IGBP-SC approved the science plans for IMBER, the International Global Atmospheric Chemistry (IGAC) project, LOICZ, the Integrated Land Ecosystem – Atmosphere Processes Study (iLEAPS), and the Global Land Project. They approved several new Fast-Track Initiatives, and reports were given about the development of the Analysis, Integration and Modelling of the Earth System (AIMES) project, the IGBP Science Plan, and a new goal and vision for IGBP.

The first three IGBP Fast-Track Initiatives (FTIs) were approved in 2003: (1) Global Iron Connections (with SCOR), (2) International Nitrogen Initiative (with SCOPE), and (3) the role of fires in the global environment. The Global Iron Connections Workshop in April 2004 resulted in a *Science* review paper and several other publications, as mentioned previously. New FTIs were approved in 2005 on (1) Ocean Acidification over time (with SCOR); (2) An Earth System Perspective on Sustainability: Research Challenges; and (3) State of the Earth in 2050.

Robert Duce led a discussion about the FTI on ocean acidification suggested by the Past Global Changes (PAGES) project at the IGBP-SC meeting. Duce summarized the concern from several individuals who participated at the IGBP-SC meeting that the proposal has been broadened recently. Laurent Labeyrie stated that he was disturbed about PAGES suggesting this activity without involvement from the International Marine Aspects of Global Changes (IMAGES) project. This FTI is an important project, but it is a matter of concern that IMAGES, which has a goal in this very area and is a project of PAGES, was not involved. If the proposed participants have already been contacted, it may be difficult to fix this problem. Julie Hall asked how this broadened FTI description affects the decision to have another symposium on The Ocean in a High-CO₂ World in 2008; we need to be careful to avoid having two competing initiatives. Ed Urban suggested that SCOR should make funding for this activity contingent on PAGES involving IMAGES and focusing on the paleoceanographic aspects of their topic. The current proposal is too broad to create an effective fast-track effort. Urban displayed the latest

version of the proposed scientific themes and questions, and there was discussion about which proposed issues are really focused on paleoceanography. Robert Duce commented that there are probably papers coming out from the 2004 High-CO₂ symposium that will address some of the proposed issues. The FTI is not very far along, although there is a lot of enthusiasm about it, from PAGES and elsewhere. SCOR needs to transmit comments to IGBP in time for their Officers' meeting on 18 September 2005.

Sundby suggested that interested individuals should talk during coffee and come up with a response. He later summarized the break discussion by saying that SCOR needs to send a message to IGBP expressing SCOR's concerns and proposing a course of action. Sundby thought that the letter should begin by expressing SCOR's surprise at the broadening of the proposal. The developments have diluted the original emphasis and the effort has grown to contain several large programs. For now, at least, the joint IGBP/SCOR effort should be focused on the original idea and other things should be postponed. Many of these points are already going to be covered as part of the now ongoing SCOR/IOC series of symposia on The Ocean in a High-CO₂ World. There should not be a perception that there is a vacuum and nothing is being done. SCOR must be sure that PAGES is aware of the symposium series and of the products of the first symposium. The emphasis of the IGBP/SCOR FTI should be narrowed to focus on the paleo-records of changing CO₂ in the ocean. Since this topic is one of IMAGES' priorities, the organizational issue of the lack of communication between IMAGES and PAGES must be resolved by involving IMAGES in the FTI somehow. At the same time, SCOR should praise the initiative. Laurent Labeyrie stated that Ralph Schneider will write independently to PAGES expressing surprise at their lack of IMAGES involvement. Details about the number of meetings to be supported should be resolved later.

7.1.2 World Climate Research Programme (WCRP)

WCRP is sponsored by IOC, WMO, and ICSU. It is co-sponsoring the SOLAS project. SCOR projects are working well with WCRP's Climate Variability and Prediction (CLIVAR) project, the part of WCRP most relevant to SCOR. SCOR provided funds to the CLIVAR IPO to help revise the World Ocean Circulation Experiment (WOCE) hydrographic manual in terms of carbon measurements, in cooperation with IOCCP. A meeting is planned for this activity later in 2005.

Mike MacCracken attended the WCRP Joint Scientific Committee (JSC) meeting in Ecuador in March and reported briefly about the meeting. The JSC received updates about the WCRP projects: CLIVAR, the Global Energy and Water Cycle Experiment (GEWEX), the Stratospheric Processes And their Role in Climate (SPARC) project, and the Climate and Cryosphere (CliC) project. There was much discussion about the Coordinated Observation and Prediction of the Earth System (COPES) activity, which is meant to integrate WCRP activities. Ilana Wainer is a new member of the WCRP JSC. WCRP is in the midst of planning "Global Environmental Change: Regional Challenges. An Earth System Science Partnership (ESSP) Open Science Conference", which will be held in Beijing in November 2006.

7.1.3 Scientific Committee on Antarctic Research (SCAR)

Julie Hall, the SCOR Liaison with SCAR, referred to the extensive SCAR report in the background book for the meeting. SCAR and SCOR co-sponsored a special session at the IAG/IAPSO/IABO meeting in Cairns, Australia, on the topic of integrated biological and physical oceanography in the Southern Ocean. The two organizations have also developed a joint Expert Group on Oceanography, which will meet for the first time at the Third International Conference on the Oceanography of the Ross Sea, which will take place in Venice, Italy, in October 2005. At present, the group is focused on physical oceanography, but there is a plan to improve the disciplinary balance over time. The activity seems to be going well, but SCOR needs to monitor the membership. Laurent Labeyrie reported that the French community is unhappy with the group composition, and there is no one from the paleoceanographic community on the group. Mike MacCracken suggested that SCAR should be interested in the new working group on the equation of state since it has a focus on the freezing point of water.

7.1.4 Scientific Committee on Problems of the Environment (SCOPE)

Annelies Pierrot-Bults represented SCOR at the February 2005 SCOPE General Assembly and is now a member of SCOPE's Executive Committee. SCOR will participate with SCOPE and IAPSO in the PACKMEDS activity. Pierrot-Bults also noted that SCOPE is interested in initiating an activity on the prevention and mitigation of extreme events in coastal zones, about which she will keep SCOR informed. SCOPE conducts two basic kinds of activities: (1) rapid assessments (1 year or less) and (2) longer-term programs (5-7 years). SCOPE has been working successfully with Island Press in the United States to get their reports published. Mike MacCracken reinforced the efficiency of the rapid assessment projects, having participated in a rapid assessment meeting on monsoons.

7.1.5 Engineering Committee on Oceanic Resources (ECOR)

ECOR is a Scientific Associate of ICSU. ECOR has appointed Ian Jones as their liaison to SCOR. Jones reported that ECOR's new constitution abandoned national committees and moved to individual and commercial memberships. ECOR has panels of engineers, working groups, and an annual symposium, and publishes *Ocean Engineering International*. ECOR WG-1 is called Carbon Storage in the Ocean. It will recognize other studies on the topic, will build on them, will focus on costs and relative risk, and will document "world best practice." ECOR asked SCOR to nominate a scientist to this group. Bjørn Sundby asked for proposals of names to forward to ECOR. John Field requested that ECOR nominate people for GOOS from the maritime industry.

7.2 Affiliated Organizations

7.2.1 International Association for Biological Oceanography (IABO)

Annelies Pierrot-Bults, the IABO President, reported that IABO had an Executive Committee meeting in Cairns just prior to the SCOR meeting and that she is still the IABO President. IABO is considering establishing an individual membership category. They will hold a joint

symposium with IAPSO in Perugia, Italy in 2007. IABO is also developing a close relationship with CoML. They held a successful symposium on variability in the Southern Ocean with SCAR, SCOR, and IAPSO at the IAG/IAPSO/IABO Assembly immediately prior to the SCOR meeting.

7.2.2 International Association for Meteorology and Atmospheric Sciences (IAMAS)

Mike MacCracken, the IAMAS President, referred to his written report in the background book and provided updates to it. The IUGG General Assembly will be held in Perugia, Italy in July 2007, and IAMAS will have a meeting there. IAMAS and IAPSO are planning a joint meeting in Montreal in 2009. The IAMAS International Commission on Climate is seeking to link with IAPSO.

MacCracken made some brief comments about IUGG. He reported that it will establish an International Association of Cryospheric Sciences, its eighth association, at the Perugia meeting. This new association will build a link to SCAR as well. MacCracken asked whether this association should be involved in the SCAR/SCOR Group of Experts on Oceanography. He also inquired whether there is a link between WCRP's CliC and the SCAR/SCOR group. IUGG is participating with ICSU in outreach to Africa.

7.2.3 International Association for the Physical Sciences of the Oceans (IAPSO)

Shiro Imawaki, the IAPSO President, reported about IAPSO activities, particularly three that involved SCOR. SCOR and IAPSO are currently co-sponsoring WG 121 on Ocean Mixing, including a successful symposium on ocean mixing last year. Both organizations helped support the symposium on forecasting and data assimilation in the Benguela and comparable systems, which will result in an Elsevier publication. Finally, SCOR, IAPSO, SCAR, and IABO co-sponsored a session at the IAG/IAPSO/IABO Assembly during the week prior to the SCOR meeting.

Two working group proposals were generated by IAPSO and will be co-sponsored by SCOR and IAPSO, if (1) SCOR approves the proposals and (2) IAPSO can co-fund the groups or help raise funds from other sources.

A final document on IAPSO's future was distributed in Cairns, entitled "Physical Sciences of the Oceans in the 21st Century: Science and Enabling Strategies for the International Association for the Physical Sciences of the Oceans (IAPSO)." IAPSO is proposing to its members some changes in IAPSO administrative procedures.

7.3 Affiliated Programs

The benefit of continued affiliation of each affiliated program to SCOR is evaluated at each General Meeting. Reports are provided at Executive Committee meetings for information only. All of these programs were invited to send representatives to the project coordination meeting sponsored by SCOR in 2004. New guidelines, eliminating the former termination of affiliation to SCOR after 10 years, were transmitted to the affiliated programs.

7.3.1 Application for New Affiliated Program: InterMARGINS

Laurent Labeyrie presented information about InterMARGINS, which has applied for affiliation to SCOR. It is an international and interdisciplinary (although mostly geologic) initiative, concerned with all aspects of continental margin research, and has been active for several years. It is designed to encourage scientific and logistical coordination, with particular focus on problems that cannot be addressed as efficiently by nations or national institutions acting alone or in limited partnerships. The discussion exposed concern over the InterMARGINS fee structure and voting membership on their steering committee. Bjørn Sundby stated that SCOR needs to encourage InterMARGINS to lower the barriers to participation, especially by developing countries. Labeyrie offered to draft a response to InterMARGINS from SCOR. The consensus is that SCOR should give InterMARGINS affiliated status, pending clarification of the membership fee structure.

7.3.2 Census of Marine Life (CoML)

Annelies Pierrot-Bults reported that the Census of Marine Life is progressing rapidly and now has 14 field projects underway. SCOR's Panel on New Measurement Technologies for Observing Marine Life is a scientific advisor to the CoML projects. Pierrot-Bults introduced Jesse Ausubel, from the Alfred P. Sloan Foundation, who expressed his pleasure to be attending another SCOR meeting. Ausubel stated that the SCOR Panel on New Technologies for Observing Marine Life is very helpful for CoML.

Ausubel continued by reporting on the scientific progress in CoML. The first ideas for CoML go back to 1997, based on concerns about marine biodiversity and understanding what controls it. CoML began in 2000, conceived as a 10-year program, so it is at its mid-point. 2006-2008 will be the peak years for observations. The goal of CoML is to assess and explain the diversity, distribution and abundance of marine life, describing "the known, the unknown, and the unknowable." CoML is a program of both research and exploration. Knowledge gained from CoML could be applied to sustainable fisheries, marine protected areas (finding hotspots), habitat loss and pollution, environmental assessments, invasive species, endangered species, the UN Conventions on Biodiversity and Global Climate Change, and other uses. CoML is collaborating with SCOR, IABO, IOC, FAO, ICES, PICES, the Global Biogeographic Information Facility (GBIF), IGBP, GOOS, and POGO.

Ausubel reviewed CoML's development, schedule, and benchmarks over time. Two major legacies are envisioned: (1) contributions to the biological observations of GOOS and the Ocean Biogeographic Information System (OBIS). Both of these could contribute to the Global Marine Assessment, if it is developed. CoML has four components:

1. What did live in the oceans?
History of Marine Animal Populations (HMAP)
2. What does live in the oceans?
Ocean Realm Field Projects

3. What will live in the oceans?
Future of Marine Animal Populations (FMAP)
4. How to access and visualize data on living marine resources.
Ocean Biogeographic Information System (OBIS)

HMAP is built around case studies, to try to document the changes in marine animal populations over the past several hundred years.

The 14 CoML field projects are cooperative, international ocean-realm projects, which include

- **Nearshore** - Natural Geography In Shore Areas (NaGISA) and Coral Reef Ecosystems (CReefs)
- **Coastal** - Gulf of Maine Area Census (GOMA) and Pacific Ocean Shelf Tracking (POST)
- **Continental Margins** – Continental Margins Ecosystems (CoMargE)
- **Abyssal Plain** – Census of Diversity of Abyssal Marine Life (CeDAMar)
- **Active Geology** - Chemosynthetic Ecosystems (ChEss) and Census of Seamounts (CenSeam)
- **Deep Oceanic** - Mid-Atlantic Ridge Ecosystems (MAR-ECO)
- **Ice Oceans** - Arctic Ocean Diversity (ArcOD) and Census of Antarctic Marine Life (CAML)
- **Swimmers** - Tagging of Pacific Pelagics (TOPP)
- **Drifters** – Census of Marine Zooplankton (CMarZ)
- **Microbes** – International Census of Marine Microbes (ICOMM)

Ausubel showed examples of the results of underway projects. He also presented examples of new technology in use in projects, for example, ocean wave-guide acoustics, “coastal curtains” of acoustic receivers to detect the passage of tagged fish, and elephant seal bioprobes (one seal did 9000 temperature profiles in 6 months). Ausubel described various CoML expeditions. For example, a recent survey of the Arctic Ocean revealed far more marine life there than expected.

The FMAP project has been publishing papers on diversity and density of top predators over the past several years, including a recent paper in *Science* by Worm et al.¹² on predator diversity in the open ocean.

Finally, Ausubel described OBIS, which is a 21st Century informatics infrastructure for marine biodiversity. As of August 2005, OBIS served 6.1 millions records. OBIS priorities include rescuing and digitizing old data, capturing new data streams (e.g., GenBank), fostering on-line tools; easing data overlays with physical and geologic data; adding species information (genetic, images, sound); and encouraging education and outreach. Current activities of OBIS include

¹² Worm, B. et al. 2005. Global Patterns of Predator Diversity in the Open Oceans. *Science* 309:1365-1369.

- Data capture—acquiring more data and targeting data gaps
- Technical development—mapping, modeling, species name services, indexes, software tools; standards for data sharing; and metadata standards
- Management—creating regional nodes and linking them in a global network; hiring a Programme Manager; establishing intellectual property agreements; encouraging user monitoring to guide development; and developing a quality-control system.

The World Bank has invited CoML proposals from developing countries. The final challenge for CoML will be creating and/or encouraging visualization techniques to look at marine biodiversity data in new and useful ways.

Annelies Pierrot-Bults responded to Ausubel's presentation by stating that SCOR is fortunate to have an affiliated program such as CoML. Robert Duce stated that CoML's accomplishments and plans are very impressive. He asked what will happen after CoML officially ends in 2010. Ausubel answered that the legacy of CoML will be a data assimilation framework that will allow people to add data and ask new questions. Hopefully, CoML will lead to continuing funding for marine biodiversity observations and research. Mark Costello (CoML/OBIS) added that they are trying to build up a data citation index in order to encourage people to publish data.

Labeyrie asked about linking databases and whether they are looking at fossil records in sediments and so on, that is, past marine life. Ausubel answered that there is a historic (500 years) component in HMAP, but not a paleo-component, because this would make the program too large to be manageable.

7.3.3 International Antarctic Zone (iAnZone) Program

Ilana Wainer, the Executive Committee Reporter for iAnZone, reviewed its terms of reference and noted that it is an important program for IPY. iAnZone has been very active in the past year, developing the Synoptic Antarctic Shelf-Slope Interactions (SASSI) project, which was submitted as an IPY contribution. iAnZone also has the ANSLOPE (the Antarctic Slope project) and ISPOL-1 (the Ice Station Polarstern field program) projects ongoing. The next biennial iAnZone meeting will be held in Venice in October 2005 and SCOR approved developing country travel support in 2004 for an associated Ross Sea conference. iAnZone was requested to make a presentation at the SCOR Executive Committee meeting, but was unable to do so, due to its limited funding.

7.3.4 International Marine Global Changes Study (IMAGES)

Ralph Schneider made a presentation about IMAGES at the meeting. He started by stating the aims of IMAGES:

1. To quantify the role of ocean circulation in climate change
 - a. the time relationships between variability in different parts of the ocean-climate system,
 - b. the impact of perturbations in the freshwater cycle on ocean circulation, and

- c. the relative roles of high- and low-latitude processes in rapid climate change.
2. To quantify changes in the oceanic nutrient and carbon cycles
 - a. changes in deep-water carbon storage as a function of circulation,
 - b. changes in biological productivity related to new supply or redistribution of nutrients, and
 - c. implications for the net CO₂ flux into or out of surface waters.

Schneider then showed the past and planned IMAGES cruises, for which information is available on the IMAGES Web site (see <http://www.images-pages.org>). He described various IMAGES activities and scientific questions and results. Cores are limited to cruise participants for two years, then are available to other investigators. The cores are kept at the institutions of the principal investigators, rather than at a central repository.

Schneider identified two areas in which IMAGES and SCOR could work together. First, SCOR could help IMAGES build stronger links with GOOS and POGO. Second, a potential new SCOR/IMAGES working group could focus on modern teleconnections between the warm oceans and the Southern Ocean.

Strongly emerging topics for IMAGES are land-ocean linkages (as mitigated by human activities) indicated by dust and pollen in cores. IMAGES models give ideas about sea surface temperature and precipitation changes. This area of study will require major links to IMAGES, but also to LOICZ, SOLAS, IPCC, Paleoclimate Modelling Intercomparison Project (PMIP), Coupled Model Intercomparison Project (CMIP), and AIMES. SCOR could help establish these links, as well as helping to link IMAGES to programs that deal with pattern analysis from global-scale satellite or GOOS-type observations/products for ocean temperature, precipitation, and drought modes; river runoff and sediment load estimations; dust flux into the ocean and its composition; and hypoxia issues.

Ed Urban asked if IMAGES has links to LOICZ. Schneider responded that such links do not exist yet because IMAGES coring has been conducted further offshore than the locations of most LOICZ activity. Laurent Labeyrie speculated that the shelf will become more important for IMAGES in the future, in terms of studies of changes in human occupation and use of land areas, fish scale studies, and other issues of interest to LOICZ and other projects. Bob Anderson asked if IMAGES can help make PANGEA (and other databases) more user friendly. This question led to a discussion of data issues, especially inter-database compatibility and visualization.

7.3.5 InterRidge - International, Interdisciplinary Ridge Studies

SCOR provided support for travel of a developing country scientist to an InterRidge meeting in 2004. Colin Devey, a SCOR Nominated Member from Germany, is also the chair of InterRidge and gave an update about InterRidge activities. Devey described several major science activities that InterRidge has underway:

- Workshop on Indian Ocean ridges, Jan. 2005
- Workshop on observatories on the Mid-Atlantic Ridge and the implications of the establishment of Marine Protected Areas
- Transfer vent biology database to the CoML project, ChEss
- Cyprus Field School (science and community building)

The InterRidge Web site has been overhauled. InterRidge has established a “science writer at sea” program and berth exchanges on InterRidge cruises, to help students working on ridge research find empty berths on InterRidge cruises. InterRidge benefits from its affiliation with SCOR in several ways, including contacts to other international programs, funding for workshop participants from developing countries, and standardization of data archiving. Devey stated that InterRidge can help SCOR by providing important input to some SCOR activities, such as working groups and projects like GEOTRACES. InterRidge also provides an ocean floor component to SCOR and access to a community of 200+ scientists. InterRidge hopes to get funding from instrument companies to establish a fund to assist developing country scientists to travel to InterRidge workshops.

Devey’s presentation was followed by discussion of science outreach and public education and how SCOR can improve in these areas. Ed Urban replied that this is an important issue, but one that requires financial resources and skilled professionals. IGBP, which has an excellent communication capability, has about three people in their secretariat to handle communications, outreach and public education. SCOR could perhaps enlist working group chairs to handle outreach activities. Julie Hall noted that IGBP requires an outreach component in the science plans for new projects. Bjørn Sundby agreed that this is not a part-time activity on the side; it requires professionals. It is not something we can ask chairs to do. John Compton suggested that SCOR should investigate getting an intern from a journalism school to help. Annelies Pierrot-Bults commented that CoML is another organization that does communication well, with the help of professional journalists, and might provide ideas to SCOR.

7.3.6 International Ocean Colour Coordinating Group (IOCCG)

Julie Hall reported that IOCCG is making good progress on eliminating a backlog of project reports and will have a new chair, James Yoder (USA), at the end of 2005. It was suggested that a note should be sent to IOCCG expressing concern that nearly all of their current working groups are chaired by Americans.

7.4 Other Organizations

7.4.1 Partnership for Observation of the Global Ocean (POGO)

POGO exists to promote observations, improve scientific knowledge, interpret scientific results to policymakers, enhance public awareness of oceanic issues, and provide training and technology transfer. The most recent POGO meeting was held in Brest, France in late 2004. John Field represented SCOR at the meeting and gave SCOR an update about POGO at the

Cairns meeting. In addition to the POGO-IOC-SCOR Fellowship program described above, POGO is involved in a variety of other activities:

- Promote implementation of the Argo float program by encouraging POGO members to become more active in Argo, encourage deployment of Argo floats in undersampled regions (e.g., the Southern Ocean), promote use of Argo data in POGO institutions, encourage continued support for Argo, and encourage inclusion of Argo in GEOSS.
- Promote establishment of appropriate data archiving policies in POGO institutions. POGO will also include data issues as a new area for the POGO-IOC-SCOR Fellowships. POGO will also develop principles for sound data management.
- Promote capacity building in Southern Hemisphere developing countries and countries around the Indian Ocean, both areas of under-sampling and needing increased scientific understanding.
- Promote the inclusion of GOOS and other ocean measurements in the GEOSS process.
- Improve coordination of planned and actual cruises and databases to enhance awareness of opportunities, to improve cost-effectiveness and to improve data mining.

POGO has requested SCOR involvement in the GEOSS process and in creating a new database of research cruises. SCOR will be involved in the cruise database development to the extent that its resources allow. Ed Urban will represent SCOR at a planning meeting for the database in December 2005 in Silver Spring, Maryland, USA.

Field will attend the next POGO meeting in Hyderabad, India in January 2006 as the chair of the GOOS Scientific Steering Committee and offered to represent SCOR there also; his offer was accepted. Field will coordinate with Julie Hall, who is the SCOR Liaison to POGO.

8.0 ORGANIZATION AND FINANCE

8.1 2006 Election of SCOR Officers

The process for the 2006 election of SCOR Officers began at the Executive Committee meeting by seeking names for the Nominating Committee. The dates for the steps in the election process cannot be specified until the dates of the 2006 General Meeting in Chile are known. Robert Duce, the chair of the 2006 SCOR Nominating Committee by virtue of his position as Past-President of SCOR, noted that his request at the beginning of the meeting produced only two suggestions for members of the Nominating Committee so far. Bjørn Sundby replied that the Nominating Committee could not be finalized at the Cairns meeting, since not enough suggestions had been received. Sundby asked meeting participants for agreement that the committee can be finalized by the SCOR Executive Committee later and there was consensus that this was acceptable.

8.2 Membership

8.2.1 National Committees

Ed Urban met with the South African SCOR Committee in November 2004, and Bjørn Sundby and Urban met with the French SCOR Committee in June 2005, in conjunction with the IOC Assembly. Thailand has enquired about re-joining SCOR, and discussions have been held with individuals from other nations. The Executive Committee approved a procedure in 2003 to change the status of members not paying their dues to “Suspended Member”, with fewer benefits. At the end of 2004, Bangladesh was moved to suspended member status. The Philippines is also subject to a change in their status, since it has not paid dues in 2001-2004, although attempts have been made this year to reinstate The Philippines. Egypt is due to be placed in suspended member status at the end of 2005, if no dues payment is received.

Ed Urban noted new changes in Brazil’s Nominated Members, with Zelinda Leão and Mauricio Mata joining Ilana Wainer as the Nominated Members from Brazil. The Philippines is still trying to reactivate its committee and probably should be allowed another year. Egypt should probably be suspended, since we have lost contact with anyone there willing to pay the annual dues. Laurent Labeyrie stated that SCOR needs to make a special effort in Africa, and offered to provide some names of contacts in Algeria, Tunisia, and Morocco. One way to induce new African countries to join would be to have some other source pay their dues. Perhaps ICSU can help identify sources. John Field suggested using the Large Marine Ecosystems (LMEs) in Africa to get contacts into the national communities. Field and John Compton mentioned Angola and Mozambique as potential new SCOR members. Bjørn Sundby added that SCOR members should take advantage of personal contacts to promote national SCOR memberships. Also, he and Ed Urban will contact potential new countries at various meetings. Funding was approved to bring scientists from other parts of Latin America to the meeting on oxygen minimum zones in Concepción, Chile in 2006, which will be held in conjunction with the SCOR General Meeting and will make it possible for these individuals to interact with SCOR meeting participants. This will offer the possibility of recruiting other Latin American countries to SCOR.

8.3 Publications Arising from SCOR Activities

Ed Urban reported on publications arising from SCOR activities, from working groups, projects, and the SCOR Secretariat:

Publications from Working Groups and Major Projects—WG 113 published a paper in *Quaternary Science Reviews* and WG 119 published a special issue of the *ICES Journal of Marine Science*. GEOHAB published its *Research Plan on HABs in Upwelling Systems* and IMBER published its *Science Plan and Implementation Strategy* since the last SCOR meeting. Two publications resulted from the Symposium on The Ocean in a High-CO₂ World (see footnote 1) and one publication resulted from the IGBP/SCOR activity on the global iron cycle

(see footnote 3). GLOBEC published science plans for the ESSAS and CLIOTOP activities. Other publications from the projects are listed on their Web sites.

2004 SCOR Proceedings—The *Proceedings* of the 2004 SCOR General Meeting was printed and distributed in July 2005.

SCOR Brochure—The SCOR brochure is updated occasionally and given to potential sponsors, potential member nations, and others. The brochure is available in English, Spanish, and French.

SCOR Web site—The SCOR Web site is updated regularly and some new features were added in 2005, to make links to important information more obvious on the front page (via red boxes down the left-hand side of the home page), provide information about working groups in one location, and provide the opportunity for news from national SCOR committees. Urban asked for suggestions on other changes to the Web site.

SCOR Electronic Newsletter—A SCOR Electronic Newsletter was started late in 2004, to provide more frequent updates about SCOR activities between annual meetings. Three issues of the newsletter had been distributed by the time of the meeting. The SCOR Secretariat will plan to issue three newsletters each year. Several potential items for articles were noted earlier in the meeting, and Urban stated that he is interested in hearing other ideas. He wants to keep each issue of the Newsletter to 4 or 5 pages.

SCOR Poster—The SCOR poster is still available in A0 and A3 sizes.

8.4 Finances

The annual audit was completed in mid-July and Elizabeth Gross worked to prepare information for the auditors. The financial records and financial controls were found to follow accepted standards.

SCOR's grant from NSF for developing country travel was renewed and SCOR received the third year of its ongoing science grant from NSF. SCOR also received renewed funding for IOCCP and increased funding for GEOTRACES.

Jorma Kuparinen chaired the ad hoc Finance Committee, which also included Mingyuan Zhu and Adolfo Gracia. The committee reviewed the auditors' report and comments on 2004 finances. The auditors made management suggestions, which could help to improve SCOR practices. Ed Urban had responded to the auditors' suggestions and implemented many of the suggested practices. Urban provided the committee with charts of SCOR finances over time, which helped the financial review. The committee reviewed the 2004 finances, the revised budget of 2005 and the budget for 2006. There were no critical comments regarding SCOR's 2004 finances, based on the audit reports and reports from the SCOR Secretariat. At the 2003 meeting, it was recommended that SCOR maintain a reserve of US\$100,000; this was well met

in 2004. The committee recommended that the 2004 financial statements be approved.

The Finance Committee reviewed revisions to the 2005 budget. Some activities were more expensive than budgeted, but these were met with the increased income. Changes in the income resulted from new funds raised by the SCOR Secretariat for SCOR activities since the budget was approved at the Venice meeting. The committee recommended that the suggested changes to the 2005 budget be approved. The year-end reserve for 2005 is about US\$200,000, which is high compared to the recommendation given in 2003.

Urban explained the 2006 budget. The committee noted the small difference of half-time secretary expenses compared to a full-time secretary. The committee concluded that there is enough funding for two new working groups in 2006. The new working groups and other expenses accepted by the Cairns meeting will create a budget deficit of about US\$70,000 in 2006, but this is acceptable because of the large projected reserve at the end of 2005.

The committee recommended that dues for 2007 be increased by 1% for Category II, III, IV and V nations and that dues for Category I nations continue to be maintained at 2001 levels. The committee suggested Egypt to be suspended from the list of SCOR member nations due to long-term unpaid membership fees.

Bjørn Sundby thanked the Finance Committee for its work and requested comments. Ed Urban explained how the budget surplus got so large; if countries don't pay their dues on time, the Secretariat cuts back on expenses. SCOR received an extra US\$80,000 in past dues 2 years ago. Urban added that he always seeks external funding to replace the SCOR discretionary funds in the budgets. To the extent that he is successful, this decreases expenses below budgeted levels.

Elizabeth Gross presented the draft 2006 budget, which was approved by meeting participants. Urban showed charts of SCOR financial performance over time. Laurent Labeyrie asked about the funds for programs that do not go through SCOR—other countries are also paying for SCOR activities in the form of IPOs and such—we should try to get a more precise idea to show U.S. agencies that SCOR activities do receive a lot of support from other countries, even if the actual funding does not flow through SCOR.

8.5 The Disciplinary Balance Among SCOR Working Groups

Laurent Labeyrie has been following the issue of the disciplinary balance of SCOR groups for several years. He had input from several people during the meeting. There seems to be a good balance with the new groups approved. Labeyrie listed the groups by discipline. There is still no activity on benthic biology or about hard-rock geology in Earth sciences. The percentage of biology projects is a little high, about 40% of the current groups. Physical oceanography is about 20%, not including climate. Chemistry and geochemistry are at reasonable levels. Where can SCOR improve its disciplinary balance? Potential areas, in addition to those listed above, are physics/sedimentology/geochemistry, shelf-break processes and models, and instabilities

related to clathrate dissolution. Particularly useful would be interdisciplinary work focused on the shelf break. SCOR should encourage multidisciplinary approaches at the boundaries between existing large programs. There was an inconclusive discussion about whether SCOR Executive Committee members could help formalize working group proposals before submission, perhaps through letters of intent before proposals. Ed Urban proposed that he identify an Executive Committee member to work with proponents before proposals go to the national committees and others for review. Currently, Urban provides comments on the proposals, but an Executive Committee member is not assigned to each one until reviewers' comments are received.

Bjørn Sundby suggested that the concept of disciplinary balance is becoming obsolete because all SCOR activities are becoming multi-disciplinary. A suggestion was made to add more model working group proposals to the SCOR Web site. Urban commented that SCOR needs to be sure that the process remains bottom-up, with ideas for working groups being generated by the scientific community rather than having them suggested by the SCOR Executive Committee.

9.0 SCOR-RELATED MEETINGS

9.1 SCOR Annual Meetings

The Executive Committee considered potential locations in which to hold future meetings, particularly in nations that have not recently hosted annual meetings.

9.1.1 2005 Executive Committee Meeting – Cairns, Australia

Bjørn Sundby thanked the Australian SCOR Committee and Australian Academy of Sciences for hosting the meeting and helping with preparations.

9.1.2 2006 General Meeting – Concepción, Chile

The Chilean SCOR Committee has offered to host the 2006 General Meeting in Chile and SCOR accepted the offer in 2004. The Chilean SCOR Committee has begun to make preparations for the meeting, which will be held on 23-26 October 2006. Mario Caceres (Chile) noted that a formal invitation was sent by the President of the University of Concepción to SCOR. Caceres added that the university will be an ideal location for the meeting. Ed Urban responded that he met a few weeks before the SCOR meeting with the Chilean scientist who will be in charge of the meeting on oxygen minimum zones, Victor Gallardo. Carmen Morales will be the primary contact for logistics for the SCOR General Meeting.

9.1.3 2007 Executive Committee Meeting

Since the observation of SCOR's 50th anniversary in Woods Hole was shifted to 2008 in order to avoid conflicts with other events, a new location must be found for the 2007 meeting. A tentative invitation has been received from the Norwegian SCOR Committee to hold the 2007 Executive Committee Meeting in Bergen, Norway. (SCOR has never held an annual meeting in

Norway.) Bjørn Sundby noted that there will an IPY-related symposium in late August 2007 to which the SCOR meeting could be associated. A more formal invitation is in process.

9.1.4 2008 General Meeting—SCOR 50th Anniversary—Woods Hole, USA

The Executive Committee has agreed to hold the 2008 SCOR General Meeting in Woods Hole, Massachusetts, USA to celebrate SCOR's 50th Anniversary, since Woods Hole was the site of the first SCOR annual meeting, in 1957. Robert Duce reported on plans for the 50th Anniversary symposium, which would occur before or after the General Meeting. The symposium will be associated with a major CoML meeting, and both meetings may potentially receive Sloan funding. One idea is to use SCOR national committees to identify young scientists to be invited to the meeting. Ian Jones noted that he made an “oral history” with George Humphries, who was 2nd President of SCOR. This could/should be done with other SCOR Presidents. Ed Urban suggested that he could put a section in the *SCOR Newsletter* about the meeting to get national committees and others to start thinking about the meeting.

9.2 Other Meetings Sponsored by SCOR

Other SCOR-related meetings are listed on the SCOR Web site.

Bjørn Sundby closed the meeting, thanking Ed Urban and the SCOR Secretariat. Urban thanked Elizabeth Gross for taking notes and helping out in many other ways at the meeting.

ACRONYMS

AICI	Air-Ice Chemical Interactions (SOLAS and IGAC)
AIMES	Analysis, Integration and Modelling of the Earth System (IGBP)
APN	Asia Pacific Network for Global Change Research
ArcOD	Arctic Ocean Biodiversity (CoML)
AMT	Atlantic Meridional Transect (UK)
ASLO	American Society for Limnology and Oceanography
BENEFIT	Benguela Environment Fisheries Interaction and Training
CACGP	Commission on Atmospheric Chemistry and Global Pollution (IAMAS)
CAML	Census of Antarctic Marine Life (CoML)
CARBOOCEAN	Marine carbon sources and sinks assessment (EU Integrated Project)
CCC	Cod and Climate Change (ICES and GLOBEC)
CCCC	Climate Change and Carrying Capacity (PICES and GLOBEC)
CeDAMar	Census of Diversity of Abyssal Marine Life (CoML)
CenSeam	Census of Marine Life on Seamounts (CoML)
ChEss	Chemosynthetic Ecosystems project (CoML)
CIDA	Canadian International Development Agency
CLIOTOP	Climate Impacts on Ocean TOP Predators (GLOBEC)
CLIVAR	Climate Variability and Prediction project (WCRP)
CoMargE	Continental Margin Ecosystems (CoML)
CMarZ	Census of Marine Zooplankton (CoML)
CoML	Census of Marine Life
COPEs	Coordinated Observation and Prediction of the Earth System (WCRP)
CReefs	Coral Reef Ecosystems (CoML)
CRP	Core Research Project (GEOHAB)
DOES	Deep Ocean Exchanges with the Shelf
ECOR	Engineering Committee on Oceanic Resources
ENSO	El Niño-Southern Oscillation
ESSAS	Ecosystem Studies of Sub-Arctic Seas (GLOBEC)
ESSP	Earth System Science Partnership (IGBP, WCRP, IHDP, and DIVERSITAS)
EU	European Union
FAO	Food and Agriculture Organization (UN)
FMAP	Future of Marine Animal Populations (CoML)
FTI	Fast-Track Initiative (IGBP)
GEBCO	General Bathymetric Chart of the Oceans
GEF	Global Environment Facility
GenBank	The U.S. National Institutes of Health genetic sequence database, an annotated collection of all publicly available DNA sequences
GEOHAB	Global Ecology and Oceanography of Harmful Algal Blooms program (SCOR and IOC)
GEOSS	Global Earth Observing System of Systems

GEOTRACES	An international study of the global marine biogeochemical cycles of trace elements and their isotopes.
GESAMP	Group of Experts on the Scientific Aspects of Marine Environmental Protection (UN)
GLOBEC	Global Ocean Ecosystem Dynamics project (SCOR, IGBP, and IOC)
GMA	Global Marine Assessment *UN)
GODAE	Global Ocean Data Assimilation Experiment
GOOS	Global Ocean Observing System
GRC	Gordon Research Conference
HAB	harmful algal bloom
HMAP	History of Marine Animal Populations (CoML)
IABO	International Association of Biological Oceanography (IUBS)
IAEA	International Atomic Energy Agency
IAG	International Association of Geodesy (IUGG)
IAI	Inter-American Institute for Global Change Research
IAMAS	International Association of Meteorology and Atmospheric Sciences (IUGG)
iAnZone	International Antarctic Zone program
IAPSO	International Association for the Physical Sciences of the Oceans (IUGG)
ICED	Integrated analyses of circumpolar Climate interactions and Ecosystem Dynamics in the Southern Ocean
ICES	International Council for the Exploration of the Seas
ICoMM	International Census of Marine Microbes (CoML)
ICSU	International Council for Science
IGAC	International Global Atmospheric Chemistry project (IGBP and CACGP)
IGBP	International Geosphere-Biosphere Programme (ICSU)
IGOS	Integrated Global Observing Strategy
IHDP	International Human Dimensions of Global Change Programme (ICSU)
iLEAPS	Integrated Land Ecosystem – Atmosphere Processes Study
IMAGES	International Marine Global Changes Study (IGBP/PAGES)
IMBER	Integrated Marine Biogeochemistry and Ecosystem Research project (SCOR and IGBP)
IMP	Implementation Group (SOLAS)
INI	International Nitrogen Initiative
InterMARGINS	An international and interdisciplinary initiative concerned with all aspects of continental margin research.
InterRidge	An initiative for international cooperation in ridge-crest studies
IOC	Intergovernmental Oceanographic Commission (UNESCO)
IOCCG	International Ocean Colour Coordinating Group
IOCCP	International Ocean Carbon Coordination Project (IOC and SCOR)
IPCC	Intergovernmental Panel on Climate Change
IPO	international project office
IPY	International Polar Year
ISPOL-1	Ice Station Polarstern (iAnZone)
IUBS	International Union of Biological Sciences (ICSU)
IUGG	International Union of Geodesy and Geophysics (ICSU)
IUPAC	International Union of Pure and Applied Chemistry (ICSU)

JCOMM	Joint Commission for Oceanography and Marine Meteorology (WMO/IOC)
JGOFS	Joint Global Ocean Flux Study (SCOR and IGBP)
LINKS	WG on Analyzing the Links Between Present Oceanic Processes and Paleo-Records (SCOR and IMAGES)
LOICZ	Land-Ocean Interactions in the Coastal Zone project (IGBP and IHDP)
LME	large marine ecosystem
MAR-ECO	Mid-Atlantic Ridge project (CoML)
NaGISA	Natural Geography In Shore Areas project (CoML)
NASA	National Aeronautics and Space Administration (USA)
NERC	Natural Environmental Research Council (UK)
NIWA	National Institute of Water & Atmospheric Research Ltd. (New Zealand)
NOAA	National Oceanic and Atmospheric Administration (USA)
NSF	National Science Foundation (USA)
OASIS	Ocean-Atmosphere-Sea Ice-Snow project
OBIS	Ocean Biogeographic Information System (CoML)
OECS	Ecodynamics Comparison in the Oceanic Subarctic Pacific
OFCCP	Oceanic Fisheries and Climate Change Project
OSM	open science meeting
PACE	WG on Reconstruction of Past Ocean Circulation (SCOR and IMAGES)
PACKMEDS	Dynamics of semi-enclosed marine systems: the integrated effects of changes in sediment and nutrient input from land (SCOPE, IAPSO, and SCOR)
PAGES	Past Global Changes project (IGBP)
PANGAEA	Publishing Network for Geoscientific and Environmental Data
PICES	North Pacific Marine Science Organization
PML	Plymouth Marine Laboratory (UK)
POGO	Partnership for Observations of the Global Oceans
RGSO	Regional Graduate Schools of Oceanography
SAGE	SOLAS-ANZ Dual Tracer Gas Exchange Experiment
SCAR	Scientific Committee on Antarctic Research (ICSU)
SCOPE	Scientific Committee on Problems of the Environment (ICSU)
SCOR	Scientific Committee on Oceanic Research (ICSU)
SERIES	Subarctic Ecosystem Response to Iron Enrichment Study (SOLAS)
SOLAS	Surface Ocean-Lower Atmosphere Study (SCOR, IGBP, WCRP, and CACGP)
SOPAC	South Pacific Applied Geoscience Convention
SPACC	Small Pelagic fish and Climate Change project (GLOBEC)
SP/IS	Science Plan/Implementation Strategy
SSC	scientific steering committee
TEIs	trace elements and isotopes
TOPP	Tagging of Pacific Pelagics (CoML)

UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific, and Cultural Organization
WCRP	World Climate Research Programme (WMO, IOC, and ICSU)
WG	working group
WMO	World Meteorological Organization
WOCE	World Ocean Circulation Experiment (WCRP)

Annex 1

Agenda

1.0 OPENING

- | | | |
|-----|---|----------------------|
| 1.1 | Opening Remarks and Administrative Arrangements | <i>Sundby, Urban</i> |
| 1.2 | Approval of the Agenda | <i>Sundby</i> |
| 1.3 | Report of the SCOR President | <i>Sundby</i> |
| 1.4 | Report of the SCOR Executive Director | <i>Urban</i> |
| 1.5 | Appointment of an <i>ad hoc</i> Finance Committee | <i>Sundby</i> |
| 1.6 | Appointment of an <i>ad hoc</i> Committee to Review the Disciplinary Balance of SCOR's Activities | <i>Sundby</i> |

2.0 WORKING GROUPS

- | | | |
|--------|--|----------------------|
| 2.1 | Disbanded Working Groups | |
| 2.1.1 | WG 78—Determination of Photosynthetic Pigments in Seawater | <i>Gross</i> |
| 2.1.2 | WG 109—Biogeochemistry of Iron in Seawater | |
| 2.1.3 | WG 114—Transport and Reaction in Permeable Marine Sediments | |
| 2.2 | Current Working Groups | |
| 2.2.1 | WG 111—Coupling Winds, Waves and Currents in Coastal Models | <i>Wainer</i> |
| 2.2.2 | WG 115—Standards for the Survey and Analysis of Plankton | <i>Pierrot-Bults</i> |
| 2.2.3 | WG 116—Sediment Traps and ²³⁴ Th Methods for Carbon Export Flux Determination | <i>Labeyrie</i> |
| 2.2.4 | WG 119—Quantitative Ecosystems Indicators for Fisheries Management | <i>Field</i> |
| 2.2.5 | WG 120—Marine Phytoplankton and Global Climate Regulation: The <i>Phaeocystis</i> Species Cluster As Model | <i>Hall</i> |
| 2.2.6 | WG 121—Ocean Mixing | <i>Akulichev</i> |
| 2.2.7 | WG 122—Estuarine Sediment Dynamics | <i>Labeyrie</i> |
| 2.2.8 | WG 123—Reconstruction of Past Ocean Circulation (PACE) | <i>Labeyrie</i> |
| 2.2.9 | WG 124—Analyzing the Links Between Present Oceanic Processes and Paleo-records (LINKS) | <i>Wainer</i> |
| 2.2.10 | WG 125—Global Comparisons of Zooplankton Time Series | <i>Pierrot-Bults</i> |
| 2.2.11 | WG 126—Role of Viruses in Marine Ecosystems | <i>Hall</i> |
| 2.3 | New Working Group Proposals | |
| 2.3.1 | WG on Thermodynamics and Equation of State of Seawater | <i>MacCracken</i> |
| 2.3.2 | WG to Investigate Mesopelagic Fish Populations as Potential Fishery Stocks | <i>Hall</i> |

- 2.3.3 WG on Hydrodynamic and Sediment Transport Model Prediction
Performance Criteria *Healy, Labeyrie*
- 2.3.4 WG on Natural and Human-Induced Hypoxia and Consequences for
Coastal Areas *Duce*
- 2.3.5 WG on Deep Ocean Exchanges with the Shelf *Akulichev*
- 2.3.6 WG on Critical Bathymetric Studies *Labeyrie*

3.0 LARGE-SCALE SCIENTIFIC PROGRAMS

- 3.1 SCOR/IGBP/IOC Global Ocean Ecosystems Dynamics (GLOBEC)
Project *Field, Sundby*
- 3.2 SCOR/IOC Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB)
Program *Hall*
- 3.3 SCOR/IGBP Integrated Marine Biogeochemistry and Ecosystem Research (IMBER)
Project *Hall, Duce*
- 3.4 GEOTRACES Planning Committee *Anderson, Duce*
- 3.5 SCOR/IGBP/WCRP/CACGP Surface Ocean-Lower Atmosphere Study *Labeyrie*
- 3.6 Land Interactions in the Coastal Zone (LOICZ) Project *Hall*

4.0 OCEAN CARBON AND OTHER ACTIVITIES

- 4.1 International Ocean Carbon Coordination Project *Urban*
- 4.2 SCOR-IOC International Symposium on “The Ocean in a High-CO₂ World” *Duce*
- 4.3 Other Activities
 - 4.3.1 The Global Iron Cycle *Duce*
 - 4.3.2 SCOR Meeting on Coordination of International Marine Research
Projects *Labeyrie, Urban*
 - 4.3.3 Panel on New Technologies for Observing Marine Life *Pierrot-Bults*
 - 4.3.4 Activity Proposed by the SOLAS and the International Nitrogen
Initiative (INI) *Duce*

5.0 CAPACITY-BUILDING ACTIVITIES

- 5.1 Regional Graduate Schools of Oceanography and Marine Environmental
Sciences *Wainer*
- 5.2 POGO-SCOR Visiting Fellowships for Oceanographic Observations *Urban*
- 5.3 NSF Travel Support for Developing Country Scientists *Urban*
- 5.4 SCOR Reports to Developing Country Libraries *Urban*
- 5.5 ICSU Priority Area Assessment on Capacity Building *Urban*

6.0 RELATIONS WITH INTERGOVERNMENTAL ORGANIZATIONS

- 6.1 Intergovernmental Oceanographic Commission *Erb, Sundby, Urban*
- 6.1.1 Global Ocean Observing System (GOOS) *Field, Hall*
- 6.2 Other Intergovernmental Organizations
- 6.2.1 Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) *Duce*
- 6.2.2 North Pacific Marine Science Organization (PICES) *Akulichev, Urban*

7.0 RELATIONS WITH NON-GOVERNMENTAL ORGANIZATIONS

- 7.1 International Council for Science *Sundby, Urban*
- 7.1.1 International Geosphere-Biosphere Program (IGBP) *Duce*
- 7.1.2 World Climate Research Programme (WCRP) *MacCracken, Wainer*
- 7.1.3 Scientific Committee on Antarctic Research (SCAR) *Hall*
- 7.1.4 Scientific Committee on Problems of the Environment (SCOPE) *Pierrot-Bults*
- 7.1.5 Engineering Committee on Ocean Resources (ECOR) *Jones*
- 7.2 Affiliated Organizations
- 7.2.1 International Association for Biological Oceanography (IABO) *Pierrot-Bults*
- 7.2.2 International Association for Meteorology and Atmospheric Sciences (IAMAS) *MacCracken*
- 7.2.3 International Association for the Physical Sciences of the Oceans (IAPSO) *Imawaki*
- 7.3 Affiliated Programs
- 7.3.1 Applications for New Affiliated Programs *Sundby, Labeyrie*
- 7.3.2 Census of Marine Life (CoML) *Pierrot-Bults*
- 7.3.3 International Antarctic Zone (iAnZone) Program *Wainer*
- 7.3.4 International Marine Global Changes Study (IMAGES) *Schneider, Labeyrie*
- 7.3.5 InterRidge - International, Interdisciplinary Ridge Studies *Devey, Labeyrie*
- 7.3.6 International Ocean Colour Coordinating Group (IOCCG) *Sundby*
- 7.4 Other Organizations
- 7.4.1 Partnership for Observation of the Global Ocean (POGO) *Field, Hall*

8.0 ORGANIZATION AND FINANCE

- 8.1 2006 Election of SCOR Officers *Duce*
- 8.2 Membership
- 8.2.1 National Committees *Duce, Urban*
- 8.3 Publications Arising from SCOR Activities *Urban*
- 8.4 Finances *Kuparinen, Urban, Gross*
- 8.5 The Disciplinary Balance among SCOR Working Groups *Labeyrie*

9.0 SCOR-RELATED MEETINGS

- 9.1 SCOR Annual Meetings
 - 9.1.1 2005 Executive Committee Meeting – Cairns, Australia *Sundby*
 - 9.1.2 2006 General Meeting – Concepción, Chile *Caceres, Sundby*
 - 9.1.3 2007 Executive Committee Meeting *Sundby*
 - 9.1.4 2008 General Meeting -- SCOR 50th Anniversary— Woods Hole, USA *Sundby*
- 9.2 Other meetings of interest to SCOR *Urban*

10.0 OTHER BUSINESS

Annex 2

Meeting Participants

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Annex 3

Proposal for an IAPSO/SCOR Working Group on the Thermodynamics and Equation of State of Seawater

Background

Defining the equation of state of seawater is fundamental to many activities concerned with observing the physical state of the oceans and representing ocean processes in numerical models. The work of the Joint (IOC/SCOR) Panel on Oceanographic Tables and Standards (JPOTS) during the 1970s and 1980s provided the world with a much-needed way to determine the salinity and density of seawater much more accurately than had been previously possible. The equation of state needed to do this is presently defined in algorithms published by Fofonoff and Millard (1983).

Since the mid-1980s there has been little formal study of these issues and yet there have been advances that point to a need to revisit the work initiated by JPOTS.

Timeliness and relevance

The International Equation of State is written in terms of the 1968 temperature scale. Virtually all new high precision ocean measurements are now made in the 1990 temperature scale. A growing group of scientists are unaware of the 1990 change, and may therefore wrongly employ the equation of state without taking into account the temperature conversion. In addition the 1990/1968 conversion is done with an approximate linear formula, deemed to be “adequate” for oceanographic purposes, but is not rigorously precise. Ocean modelling has made great advances driven by increased computing power, by improved physical understanding and by the need to better represent the oceans in climate models. Scientists who run global ocean models are keen to have an accurate equation of state and they need their equation of state to be expressed as a function of potential temperature rather than in terms of in situ temperature. Recent work by McDougall et al. (2003) and Jackett et al. (2005) has provided ocean modellers with such an algorithm based on Feistel and Hagen (1995) and Feistel (2003). In this way, the modern thermodynamic research of Feistel has made its way into ocean modelling, but this work has not yet been adopted by the observational oceanographic community.

The known thermodynamic quantities for which accurate measurements exist have now been incorporated into a Gibbs function for seawater (Feistel, 1993; Feistel and Hagen, 1995; and Feistel, 2003). The most recent study in this series, namely Feistel (2003), abbreviated below as F03, has carefully documented the known accuracy of each type of thermodynamic measurement. This work seems to represent the limit of accuracy that is available at this time to determine density and other properties of seawater. The relevance of this finding to the wider oceanographic community should be addressed.

While the bulk of research has applied to the range of temperature and salinities typical of the open ocean, its relevance to areas of extreme high and low temperature and salinity as well as of nonstandard sea salt composition should be considered.

The case for SCOR sponsorship of the WG

SCOR has a long history of support of activities in this and related areas. Relevant past SCOR Working Groups that have studied related topics include

WG 4	Physical Properties of Sea Water
WG 6	Chemical Oceanography
WG 10	Oceanographic Tables and Standards (reconstituted as the Joint Panel on Oceanographic Tables and Standards (JPOTS))
WG 49	Mathematical Modelling of Oceanic Processes
WG 51	The Acquisition, Calibration, and Analysis of CTD data
WG 77	Laboratory Tests Related to Basic Physical Measurements at Sea

WG 102 Comparative Salinity and Density of the Atlantic and Pacific Ocean Basins
WG 121 Ocean Mixing

This working group would continue that long association. Its co-sponsorship by IAPSO and the support for the working group expressed by IOC provides a link to the foundation laid by the JPOTS panel.

Its subject matter matches the physical emphasis expressed in SCOR's call for new WG proposals.

While the topics to be addressed by this WG may appear esoteric, they have applications and relevance to a wide range of modelling, observational and practical issues. (e.g., parameterisation of mixing in models, the calculation of density from temperature/salinity/pressure observations, and the physics and chemistry of substances such as liquefied CO₂ placed in the deep ocean.

In view of this wide relevance, the activities of the WG may be able to attract financial support other than that available from SCOR.

Terms of Reference

- (1) To examine the results of recent research in ocean thermodynamics with a view to recommending a change to the internationally recommended algorithms for evaluating density and related quantities (including enthalpy, entropy and potential temperature). Such recommendations would take into account the reformulation of the International Temperature Scale (ITS-90). (This work is elaborated in the priority 1 issues listed below)
- (2) To examine the most accurate recent knowledge of the freezing temperature of seawater, the calculation of dissolved oxygen, and the behaviour of seawater at high salinity.
- (3) To examine the feasibility of using simple functions of three-dimensional space to take account of the spatially varying concentrations of alkalinity, total carbon dioxide, calcium and silica place on the determination of density in the ocean.
- (4) To extend these concepts to a wider range of physical/chemical issues of relevance to the internal working of the ocean and of its interaction with the atmosphere and to present and potential future observational techniques.
- (5) To write a set of related recommendations on the above topics in the form of a report to SCOR/IAPSO and a review or series of reviews to be published in the scientific literature.

Detailed explanation of the proposed remit for the Working Group

The WG will produce new "official" thermodynamic quantities of seawater (including the equation of state), taking into account recent developments in ocean thermodynamics and the reformulation of the International Temperature Scale (ITS-90).

The working group's main thrust would be to evaluate the recent Gibbs function that has been published by Feistel (2003), to decide on the limits of its accuracy, to weigh up its accuracy vis-à-vis the presently used international equation of state, with a view to recommending a change to the internationally recommended algorithms for evaluating density and related quantities (including enthalpy, entropy and potential temperature).

The following is a more detailed list of issues that would fall within the Terms of Reference of the proposed working group and that would be the focus of the WG. These have been separated into priority groups indicating the order in which they might be addressed.

Items in the first two priority categories should be achievable by the proposed Working Group within a time frame of two years.

Priority 1 issues:

- 1.1 Adopt the recent IAPWS-95¹³ international scientific pure water standard (Wagner and Pruß, 2002) as the freshwater reference system for modern seawater thermodynamics.
- 1.2 Update all oceanic algorithms so that they are written in terms of the ITS-90 temperature scale and provide practical conversion algorithms between old and new parameters.
- 1.3 Examine F03's Gibbs function and the quantities that are derived from it and establish error estimates for the maximum errors that might arise from its oceanographic use.
- 1.4 Consider recommendations for chemical potential, specific entropy, enthalpy, internal energy or free enthalpy (Gibbs energy) of seawater, which were not part of the JPOTS standards, including the arbitrary reference state definitions.
- 1.5 Examine the accuracy of potential temperature that is determined by equating entropy based on F03's Gibbs function.
- 1.6 Examine the benefits of using potential enthalpy (or conservative temperature) as an oceanographic variable to represent "heat content" in oceanography, in particular, the potential enthalpy that is found from F03's Gibbs function.
- 1.7 Recommend the most accurate algorithms for the freezing temperature of seawater for pressures up to 3000db.

Priority 2 issues:

- 2.1 Recommend the most accurate algorithms for saturated vapour pressure over seawater.
- 2.2 Examine whether modern data warrant a new algorithm for calculation of oxygen.
- 2.3 Examine the impact of air saturation on seawater properties.
- 2.4 Examine whether it might be possible to further increase the accuracy of the determination of density and other thermodynamic properties by a focused effort at collecting a limited number of extra data sets (e.g., data on the temperature of maximum density or on density below 0°C (Caldwell 1978))
- 2.5 Reconsider the practically widespread use of "dbar/db", "ml/l" or "psu" as units and recommend definitions and formula symbols for density anomaly, specific entropy, specific Gibbs energy, specific internal energy, sound speed, isothermal and adiabatic compressibility, or isothermal and adiabatic haline contraction coefficient.
- 2.6 Examine the possibility of optical determination of spatial and temporal distributions of density anomalies by using a refractive index sensor attached to standard CTD probes.
- 2.7 Write a set of related recommendations in the form of a review to be published in the scientific literature.

In addition to these tasks, there is a further set of issues (listed below) that should be addressed in order to progress this field even further. It is not clear at this time whether these issues are amenable to neat algorithmic solutions, and so it seems appropriate that the Working Group be asked to report back to SCOR after 12 months whether these issues seem amenable to further study by a Working Group or whether these issues, while being worthy research questions, are not close to yielding recommendations for changing the practice of oceanographers.

Priority 3 issues:

Examine the limits that the varying concentrations of alkalinity, total carbon dioxide and silica place on the determination of density in the ocean, and to examine whether a simple function of three-dimensional space might be used as a correction for some of this effect for the present ocean (Brewer and Bradshaw, 1975; Millero, 2000).

Examine the present knowledge of the ratio of absolute salinity to practical salinity and to determine whether it might be possible to construct a simple function of three-dimensional space to provide an estimate of this ratio for the present ocean.

¹³ IAPWS - International Association for the Properties of Water and Steam (<http://www.iapws.org/>)

Issue a recommendation on how standard formulas should be applied to waters with known density anomalies like the Baltic Sea.

Examine the possibility of a recommendation for artificial standard seawater chemical composition as reference for future models, theoretical work, or alternative measurement technologies, including recommended IUPAC¹⁴ values for fundamental physical constants and atomic weights.

Examine the need for extending all the existing formulas to higher salinities/temperatures as already done up to salinities of 50 for conductivity and density.

Examine the possibility of a unified thermodynamic treatment of cold high-salinity seawater, ice, and sea ice (Herut et al., 1990; Feistel and Hagen, 1998; Marion et al., 1999; Feistel and Wagner, 2005)

Write a set of related recommendations in the form of a review to be published in the scientific literature.

Mode of Operation of the Working Group

As reported above, the priority 1 and 2 tasks should be able to be achieved by the Working Group over a two-year period, with two face-to-face meetings, one in the early months of the group's formation, in early 2006, and one after twelve or fifteen months of existence.

It is envisaged that at the first of these meetings the specific issues listed as priority 1 should be discussed and work be assigned to individual members (in collaboration with other members and non-members) to be performed out of session. This work would be reported and discussed at the second session. At the second meeting the Working Group would be in a better position to see if some or all of the priority 2 and 3 tasks could be fruitfully tackled by this or another Working Group, and if so, on what timescale.

In general, the work of this group would involve a small group of specialist participants, with intersessional targeted work having to be performed at their home institutions. Progress reports would be written and sent out to other experts for comment.

References

- Brewer, P G and A Bradshaw, 1975: The effect of the non-ideal composition of sea water on salinity and density. *J. Mar. Res.*, **33**, 157-175.
- Caldwell, D.R., 1978: The maximum density points of pure and saline water. *Deep-Sea Res.*, **25**, 175-181.
- Feistel, R., 1993: Equilibrium thermodynamics of seawater revisited. *Prog. in Oceanogr.*, **31**, 101-179.
- Feistel, R., 2003: A new extended Gibbs thermodynamic potential of seawater. *Prog. in Oceanogr.*, **58**, 43-114.
- Feistel, R. and E. Hagen, 1995: On the GIBBS thermodynamic potential of seawater. *Prog. In Oceanogr.*, **36**, 249-327.
- Feistel, R. and E. Hagen, 1998: A Gibbs thermodynamic potential of sea ice. *Cold Regions Sci. Technol.*, **28**, 83-142.
- Feistel, R. and W. Wagner, 2005: High-pressure thermodynamic Gibbs functions of ice and sea ice. *J. Mar. Res.*, **63**, 95-139.
- Fofonoff, N. P., 1985: Physical properties of seawater: A new salinity scale and equation of state for seawater. *J. Geophys. Res.*, **90**, 3332-3342.
- Fofonoff, N. P. and R. C. Millard, 1983: Algorithms for computation of fundamental properties of seawater. *UNESCO Technical Papers in Marine Science*, **44**, UNESCO, 53pp.
- Herut, B., A. Starinsky, A. Katz and A. Bein, 1990: The role of seawater freezing in the formation of subsurface brines, *Geochim. Cosmochim. Acta* **54**, 13-21.
- Jackett, D. R., T. J. McDougall, R. Feistel, D. G. Wright S. and M. Griffies, 2005: Updated algorithms for density, potential temperature, conservative temperature and freezing temperature of seawater. submitted to *Journal of Atmospheric and Oceanic Technology*,
- Marion, G.M., R.E. Farren, and A.J. Komrowski, 1999: Alternative pathways for seawater freezing. *Cold Regions Sci. Technol.* **29**, 259-266.

¹⁴IUPAC- International Union of Pure and Applied Chemistry (<http://www.iupac.org/>)

- McDougall, T.J., D.R. Jackett, D.G. Wright and R. Feistel, 2003: Accurate and computationally efficient algorithms for potential temperature and density of seawater. *J. Atmos. Oceanic Technol.*, **20**, 730-741.
- Millero, F.J., 2000: Effect of changes in the composition of seawater on the density-salinity relationship, *Deep-Sea Res. I*, **47**, 1583-1590.
- Wagner, W. and A. Pruß, 2002: The IAPWS formulation 1995 for the thermodynamic properties of ordinary water substance for general and scientific use. *J. Phys. Chem. Ref. Data*, **31**, 387-535.

Annex 4

Proposal for Working Group on Natural and Human-Induced Hypoxia and Consequences for Coastal Areas

Abstract

There is accumulating evidence and growing concern that low oxygen (i.e., hypoxic) conditions are proliferating in marine coastal environments worldwide. Coastal hypoxia has major ecological and biogeochemical consequences that are poorly understood and often studied in isolation from other conditions. The intensity, duration and frequency of coastal hypoxia are changing due to human-induced alteration of coastal ecosystems (e.g., enhanced delivery of nutrients and/or organic matter) and changes in oceanographic conditions potentially related to global warming, climate variability and ocean circulation patterns. Recent work suggests that hypoxia induces changes in ecology and biogeochemistry that are strongly coupled and linked with the adjacent land and open ocean. Hypoxia can be either intermittent or permanent, with different consequences for various organisms and key biogeochemical processes. The integration of existing knowledge on the biogeochemical and ecological processes related to intermittent hypoxia is central to this working group. This group will collect and synthesize the available data on coastal hypoxia and produce a state-of-the-science report that (1) summarizes the mechanisms governing coastal hypoxia, (2) documents the ecological and biogeochemical consequences, (3) identifies the gaps in our understanding and (4) evaluates the requirements for observing and predicting hypoxia events and their impacts.

Rationale

Events of low oxygen can cause serious problems in coastal areas of the world. These problems include changes in populations of marine organisms such as large-scale mortality, as well as changes in species distributions, changes in biodiversity, physiological stress, and other sublethal effects, such as reduced growth and reproduction (Service, 2004). Tourism can be negatively affected by dead organisms and unpleasant smells. Hypoxic events are increasing in intensity and frequency worldwide (Rabalais and Turner, 2001) and the public is becoming increasingly aware of the events and their impacts (Boesch, 2004; Ferber, 2004). Hypoxic events are not only be caused by nutrient and organic matter inputs from land areas, but also by natural intrusions of sub-surface oceanic low-oxygen waters (Grantham et al., 2004), and/or by stimulation from up-welled nutrients, such as in Benguela and California upwelling systems. It is important to synthesize existing knowledge about the causes and effects of hypoxia in coastal areas, and to recommend research, observation strategies, and modeling activities that can enable better understanding and prediction of hypoxic events to make adaptation and/or mitigation possible.

A SCOR working group is the best mechanism to ensure a coordinated international scientific effort on the issue of coastal hypoxia. The scientific rationale for this working group comes from the benefits that could be gained by bringing together biologists, chemists, and physicists to identify common features and differences in governing mechanisms among hypoxic systems in different coastal settings worldwide. The results of this working group would contribute to several SCOR and IGBP large-scale ocean research projects, and to national, regional, and international coastal observing systems.

Scientific Background

We do not provide a complete background on coastal hypoxia and consequences on biogeochemical cycles and marine ecology. Rather, we summarize those issues that have motivated the organization of the working group, that is, increasing hypoxia problems in the coastal ocean, and their impacts on the functioning of ecosystems and biogeochemical cycles.

Hypoxia in coastal waters is governed by physical and biogeochemical processes. Enhanced delivery of nutrients and organic matter to coastal waters may generate hypoxia in certain settings (e.g., strong surface stratification and long water residence time). Upwelling of subsurface oceanic waters that have low oxygen content and subsequent warming may also cause zones of hypoxia. Upwelled nutrients along

western boundaries result in enhanced productivity and subsequent accumulation of carbon and oxygen deficiency. The combined effect of natural upwelling of low oxygen oceanic water and enhanced availability of nutrients and organic matter may accelerate and intensify coastal hypoxia.

Hypoxia in a variety of coastal environments is now believed to be a major barrier to the sustainability of ecosystems (cf. Naqvi et al., 2000; Breitburg, 2002). There are several potential causes of hypoxia in the coastal ocean, including (1) increase in land-source input of organic materials and nutrients with limited circulation and vertical mixing, for example, off large river mouths and adjacent continental shelf areas; (2) climate-induced change (e.g., monsoon) in coastal oxygen depletion, and (3) intrusion of deep oxygen-depleted waters in near-coastal areas, through upwelling and changes in coastal circulation.

Although the occurrence of hypoxic events may not necessarily be induced by human activities, the existing knowledge indicates that anthropogenic perturbations can be an important factor in the occurrence of coastal hypoxia. Land-based human activities have been shown to greatly increase the riverine influx of nutrients world-wide and modify ratios between nutrient species, for example, N/P and N/Si (Turner et al., 2003). Loading and composition of organic materials from terrestrial sources can also be modified by human activities in the watersheds. For instance, the construction of dams and/or reservoirs not only affects the freshwater discharge, and hence stratification of the receiving water bodies, but also dissolved silicate can be trapped, resulting in highly modified N/Si and P/Si ratios. Deforestation and land erosion can have dramatic effects on coastal water quality. Other major pathways of nutrient inputs to the coastal environment include atmospheric deposition and discharge of groundwater. Another important influence of human activity is from marine aquaculture, which in some coastal regions (e.g., Asia) can have dramatic impacts on the nutrient load in coastal waters.

A growing body of evidence suggests that interannual-to-interdecadal variability in ocean biology is linked to large-scale fluctuations (e.g., El Niño/Southern Oscillation, Pacific Decadal Oscillation, North Atlantic Oscillation) through direct or indirect pathways of ocean circulation.

The net impacts of large-scale ocean current systems and associated biogeochemical conditions on the structure and dynamics of coastal ecosystems in general and coastal hypoxia, in particular, however, remain poorly resolved. Understanding the linkages between open-ocean climate (Keeling and Garcia, 2002) and the frequency, duration and intensity of coastal hypoxia events is critical for open coastal regions since they support a major proportion of the world's fisheries and marine biodiversity, and are a focus of chemical transformations of globally important elements. For example, the intrusion of anomalously strong inflow of subarctic water into the California Current System led to unprecedented development of severe inner-shelf hypoxia and resultant mass mortality of fish and invertebrates in summer 2002 (Grantham et al., 2004). Gilbert et al. (2005) present evidence of a long-term decline of oxygen in the St. Lawrence Estuary (Canada) from intrusions of oxygen-poor oceanic water. How and to what extent the above mentioned mechanisms function in different climatic and oceanographic settings have profound effects on the transition from oxygen-rich to hypoxic conditions and vice versa.

Low oxygen conditions have major consequences for biogeochemical cycles and the diversity and functioning of biological communities. Some hypoxic systems have been studied extensively, but an integrated view is lacking and there is limited understanding of the interactions between biogeochemical cycles and their dynamics. Hypoxia can alter the relative importance of nitrate removal pathways (e.g., denitrification, ammonium regeneration and anaerobic ammonium oxidation) and induce formation and emission of nitrous oxide, a radiatively active greenhouse gas. Oxygen conditions determine the retention and regeneration of phosphorus in sediments; regeneration increases under anoxic conditions and burial increases under oxic conditions. Many trace element cycles, including those of essential trace nutrients, are governed by oxygen availability. For example, iron regeneration is lowest under fully oxic and permanent anoxic conditions, and highest under low oxygen or alternating oxic-anoxic conditions. Iron released from coastal sediments becomes available for coastal plankton communities and, after cross-shelf transport, also for open ocean communities. Hypoxic conditions on shelf ecosystems could thus stimulate

primary production in the adjacent open ocean by enhanced trace metal remobilization (e.g., through iron release) and along-isopycnal transfer.

The effect of hypoxia on marine benthic metazoans has been relatively well studied in terms of the number and biomass of animals (Levin, 2003) and the differential tolerance of benthic organisms towards low oxygen conditions. However, the consequences of these community changes on the interactions between metazoans and bacteria and functional diversity aspects, as well as their impact on nutrient regeneration and cycling, have been addressed only occasionally; there is a clear need for synthesizing the available data. Animals that are mobile can move away from hypoxic areas, but sessile organisms cannot relocate and experience physiological stress and may die, depending on the intensity, frequency, and duration of hypoxic events. If metazoans disappear from sediments, sulphide may reach the sediment-water interface (and even escape into the water column) and sulphide-intolerant organisms will not settle on or survive in the sediments. In extreme local cases, hydrogen sulphide has entered the water column and escaped to the atmosphere (e.g., Weeks et al., 2002). Within the shelf sediments of the Humboldt Current system, extended periods of hypoxia favor high biomass development in the form of mats of the giant sulphide bacterium *Thioploca* (Gallardo, 1977), which can link the benthos to modified water column food webs. Within the water column, low oxygen water causes changes in distribution of fish spawning (e.g., Black Sea anchovy), in the magnitude of recruitment (Baltic cod), and in available habitat of pelagic and demersal species, increasing exposure to predation and other causes of mortality (e.g., Namibian hake). Extreme cases of hypoxia in surface waters can result from harmful algal blooms, resulting in mass mortality of water column (marine) organisms (e.g., Li et al., 2002).

Ecological and biogeochemical responses to decreasing oxygen concentrations can be fast, for example, die-off of seagrasses and benthic animals. The reverse is often not the case when oxic conditions return. The recovery of benthic communities may take years to decades. This differential response to decreasing and increasing oxygen (i.e., hysteresis) may result in alternative quasi-stable states or benthic regime shifts.

A number of observing systems are in the planning stages for coastal areas, as documented by the Coastal Ocean Observations Panel of the Global Ocean Observing System (GOOS), which has identified hypoxia as one of the issues of interest for coastal observations. There is a need for improved technology for observations, for example, through utilization of a range of sensors, not only for oxygen, but also sensors of nutrients and micro-nutrients important in generating hypoxia, as well as sensors of the biogeochemical and biological impacts of hypoxia. New technological developments have recently enabled scientists to routinely monitor oxygen concentrations remotely and transmit data in real time (Körtzinger et al., 2004). These developments offer ample opportunities to begin the task of monitoring changes in the ocean's oxygen regime, as well as other measurements important for understanding the causes and consequences of hypoxia. It is timely to have a coordinated examination of the requirements for such systems, in terms of detecting and predicting hypoxic events and their consequences. The placement of sensors and their use in detection and prediction of hypoxic events is being carried out in various locations. Guidelines are needed for time and space scales for future placement and use of observing systems.

Model simulations are necessary to assess the sensitivity of oxygen budgets to variations in anthropogenic nutrient load from freshwater influx, water column properties and cross-shelf exchanges, variations in climate, and critical scales of forcing. The models designed to simulate temporal changes of oxygen in response to variations in climate and anthropogenic loading have involved various levels of complexity, from simple nutrient-oxygen models (e.g., Justic et al., 2003) to more sophisticated models with various levels of food-web complexity (e.g., Park et al., 1996) and biogeochemical cycles (e.g., Oguz et al., 2000). An interdisciplinary modeling approach involving coupled physical and biogeochemical processes as well as local and open-ocean forcing is required for more accurate predictions of hypoxia events and for more deterministic understanding of their causes and effects. The latter issue is important in understanding global biogeochemical cycles, an active topic in oceanographic studies from tropical to high latitudes.

Terms of Reference (as revised following the SCOR meeting)

The working group will conduct its work by pursuing the following term of reference:

1. Synthesize the state of the science and make recommendations for future research related to the following topics:
 - prevalence and spatio-temporal variability of natural and human-induced coastal hypoxia, particularly intermittent hypoxic events;
 - retrospective examination of the effects of hypoxia on the biogeochemistry and ecology of coastal marine systems, particularly the role of daily to inter-decadal variability; and
 - non-linearity (e.g., asymmetric influence) in effects of the formation of, and recovery of coastal ecosystems from, hypoxic events;
2. Determine the requirements for observing hypoxic events and their impacts in coastal systems;
3. Identify requirements for modeling coastal hypoxia and its impacts; and
4. Document the work of the group in a special issue of a peer-reviewed journal or a book by a major publisher.

Working Group Membership

The work proposed in this document would be carried out by a group of ten Full Members and 11 Associate Members (more Associate Members may be nominated at the first working group meeting). The proposed list of members would ensure wide geographic coverage and includes expertise in biological, chemical, and physical oceanography, marine biology and fishery, and modeling.

Working Group Activities

If approved, the working group would organize its first meeting in early to mid-2006, potentially in conjunction with the Ocean Sciences Meeting (February) or the annual European Geophysical Union meeting (late April). At its first meeting, working group members will make short presentations about their scientific activities, followed by (1) agreement on how they will fulfill their terms of reference (who will do what), (2) discussion of whether they will require a workshop to fulfill the terms of reference and produce their publication, (3) discussion of potential funding sources for a workshop, if needed, and (4) detailed planning related to the workshop and/or publication. If a workshop is planned, it will be held in late 2007 or early 2008, followed by the second meeting of the working group. The final meeting of the group will be held in 2009, to complete their publication.

The Scientific Committee on Problems of the Environment (SCOPE) will be approached about co-sponsoring the working group, as they have interest in this topic. The activities of this group could be useful for many global ocean research projects, including GEOHAB, GEOTRACES, GLOBEC, IMBER, LOICZ, and SOLAS. Therefore, the working group will ensure that mutually beneficial links are established with other global ocean projects.

References

- Boesch, D.F. (2004) The Gulf of Mexico's dead zone. *Science* 306:975.
- Breitburg, D. (2002) Effects of hypoxia, and the balance between hypoxia and enrichments, on coastal fishes and fisheries. *Estuaries* 25:767-781.
- Gallardo, V.A. (1977) Large benthic microbial communities in sulfide biota under Peru–Chile subsurface countercurrent. *Nature* 268:331–332.
- Ferber, D. (2004) Dead zone fix not a dead issue. *Science* 305:1557.
- Gilbert, D., B. Sundby, C. Gobeil, A. Mucci and G.-H. Tremblay (2005) A seventy-two year record of diminishing deep-water oxygen in the St. Lawrence estuary: The northwest Atlantic connection. *Limnol. Oceanogr.* 50:1654–1666.
- Grantham, B.A., F. Chan, K.J. Nielsen, D.S. Fox, J.A. Barth, A. Huyer, J. Lubchenco and B.A. Menge (2004) Upwelling-driven nearshore hypoxia signals ecosystem and oceanographic changes in the northeast Pacific. *Nature* 429:749-754.
- Justic, D., N.N. Rabalais and R.E. Turner (2003) Simulated responses of the Gulf of Mexico hypoxia to variations in climate and anthropogenic nutrient loading. *J. Mar. Syst.* 42:115-126.

- Keeling, R.F. and H.E. Garcia (2002) The change in oceanic O₂ inventory associated with recent global warming. *Proc. Nat. Acad. Sci.* 99:7848-7853.
- Körtzinger, A., J. Schimanski, U. Send and D. Wallace (2004) The ocean takes a depth breath. *Science* 306:1337.
- Levin, L.A. (2003) Oxygen minimum zone benthos: adaptation and community response to hypoxia. *Ocean. Mar. Biol. Ann. Rev.* 41:1-45.
- Li, D.J., J. Zhang, D.J. Huang, Y. Wu and J. Liang (2002) Oxygen depletion off the Changjiang (Yangtze River) Estuary. *Sci. China* 45:1137-1146.
- Naqvi, S.W.A., D.A. Jayakumar, P.V. Narvekar, H. Naik, V.S. Sarma, W. D'Souza, T. Joseph and M.D. George (2000) Increased marine production of N₂O due to intensifying anoxia on the Indian continental shelf. *Nature* 408:346-349.
- Oguz, T., H. Ducklow and P. Malanotte-Rizzoli (2000) Modelling distinct vertical biogeochemical structure of the Black Sea: Dynamic coupling of oxic, suboxic and anoxic layers. *Global Biogeochem. Cycles* 14:1331-1352.
- Park, K., A.K. Kuo and B.J. Neilson (1996) A numerical model study of hypoxia in the tidal Rappahannock River of Chesapeake Bay. *Est. Coast. Shelf Sci.* 42:563-581.
- Rabalais, N.N. and R.E. Turner (2001) Commonality and the future. In *Coastal Hypoxia Consequences for Living Resources and Ecosystems*, Eds: N.N. Rabalais and R.E. Turner, American Geophysical Union, *Coastal and Estuarine Studies* 58:451-454.
- Service, R. (2004) New dead zone off Oregon Coast hints at sea change in currents. *Science* 305:1099.
- Turner, R.E., N.N. Rabalais, D. Justic and Q. Dortch (2003) Global patterns of dissolved N, P and Si in large rivers. *Biogeochemistry* 64:297-317.
- Weeks, S.J., B. Currie, A. Bakun (2002) Satellite imaging: Massive emissions of toxic gas in the Atlantic. *Nature* 415:493-494.

Annex 5

Report of the SCOR/IOC/IGBP GLOBEC International Project for 2004/2005
to the SCOR Executive Committee. Cairns, Australia, 29 August-1 September 2005

Manuel Barange, Director GLOBEC International Project Office
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1. RECENT PROGRESS: Symposia and Workshops

1.1. GLOBEC-sponsored symposia

- **GLOBEC/PICES CCCC synthesis sessions at PICES XIII, 15-24 October 2004, Honolulu, USA**

Four synthesis sessions for this regional activity were included in the programme of the PICES XIII meeting, on the following topics:

- a) "The impacts of large-scale climate change on North Pacific ecosystems",
- b) "Modelling approaches that integrate multiple spatial scales and trophic levels between shelf and open oceans",
- c) "The seasonal cycle of plankton production in continental shelf waters around the Pacific Rim" and
- d) "Linking open ocean and coastal ecosystems".

- **EUR-OCEANS Symposium, 14-16 April 2005. Paris, France.**

EUR-OCEANS is a "Network of Excellence" funded by the European Commission, aimed at coordinating the delivery of GLOBEC and IMBER science at European level. The network gathers more than 60 research institutes and universities from 25 countries. The overall scientific objective of EUR-OCEANS is to develop models for assessing and forecasting the impacts of climate and anthropogenic forcing on food-web dynamics (structure, functioning, diversity and stability) of pelagic ecosystems in the open ocean. The first open meeting of EUR-OCEANS took place in April 2005, bringing together over 150 scientists. The GLOBEC IPO coordinates a work package on "Transfer of knowledge to socio-economic users", and sits on the EUR-OCEANS Scientific Steering Committee. Recent activities of the network also include

- a) Co-sponsoring (with NSF) a GLOBEC-inspired workshop on the impact of basin-scale oceanographic and climate-related processes on the dynamics of plankton and fish populations in the North Atlantic Ocean. The ultimate objective of the workshop was to set up a North Atlantic research initiative named BASINS. The workshop was held in Iceland in March 2005, and was attended by about 50 scientists from Europe and North America.
- b) Sponsoring a North Sea modelling workshop following the AMEMR symposium (see below), in Plymouth in June 2005.
- c) Sponsoring a session at the ICES Annual Science Conference in Aberdeen in September 2005, on the application of the Ecosystem Approach to Marine Resources.

- **GLOBEC symposium on Climate Variability and Sub-Arctic Marine Ecosystems, Victoria, Canada, May 16-20, 2005**

Part of GLOBEC's integration and synthesis effort will be through regional symposia, taking the role previously delivered through Open Science Meetings. This meeting was also used to launch the GLOBEC-ESSAS (Ecosystem Studies of Sub-Arctic Seas) regional programme. The symposium was held at the Victoria Conference Centre, and received financial support from GLOBEC, NSF, SCOR, North Pacific Research Board, NOAA Arctic, NOAA Alaskan Fisheries Science Centre, PICES, and Fisheries and Oceans Canada. The symposium was attended by 240 delegates. Two days of the symposium were devoted to plan the global implementation of ESSAS, and the U.S. implementation of BEST (Bering

Ecosystems Study), the main US-ESSAS project. The Proceedings will be published as a quadruple issue of *Progress in Oceanography*. The co-chairs of ESSAS, Ken Drinkwater (Norway) and George Hunt (USA) co-convened the symposium. The GLOBEC IPO manned the Secretariat, with substantial support from PICES as the local host. The main sessions of this symposium were

- a) Regional Focus Session (Barents/Norwegian, Iceland/Greenland, Labrador/Gulf of St. Lawrence/Hudson Bay, Bering Sea, Sea of Okhotsk, Oyashio)
- b) Physical Forcing and Biological Response in the Water Column
- c) Climate Warming Impacts on Trophic Coupling
- d) Disciplinary parallel sessions (Physics and Chemistry; Primary Production; Secondary Production; Fish, Shellfish, Marine Birds and Mammals)
- e) Climate Change and the Structure of Ecosystems: The Potential for Trophic Cascades
- f) Recent Changes in Ecosystem Structure or Function
- g) Implications of Climate-forced Change for Management and Social Institutions

Prof. R.T. Barber (Duke Univ., USA) delivered the invited keynote speech, on “How will ocean warming in the next 50 years affect sub-Arctic marine ecosystems”. Prof. V. Smetacek (AWI, Germany) provided a symposium summary. Some of the presentations and the full programme of talks are available at www.globec.org.

- **PML AMEMR (Advances in marine ecosystem modelling research) Symposium, Plymouth, UK, 27-29 June 2005**

This international symposium is being convened by the Plymouth Marine Laboratory as a forum for presentation and discussion of all aspects of model-based marine ecosystem research, encompassing numerical, conceptual, mathematical and statistical approaches. AMEMR is supported by GLOBEC. Sessions and post-symposium workshops are being designed to further GLOBEC’s Focus 3 (Modelling) objectives.

- **GLOBEC/PICES CCCC synthesis sessions at PICES XIV, Vladivostok, Russia, September 29-October 9 2005:**

The GLOBEC-PICES CCCC regional programme is organising four sessions to be run during PICES XIV:

- a) 1-day topic session on “The comparative response of differing life history strategists to climate shifts”. Co-convenors: Hyung-Ku Kang (Korea) and Gordon A. McFarlane (Canada)
- b) ½-day topic session on “Modeling climate and fishing impacts on fish recruitment”. Co-convenors: Jacob Schweigert (Canada) and Yury I. Zuenko (Russia)
- c) ½-day topic session on “Modeling and iron biogeochemistry: How far apart are we?”. Co-convenors: Fei Chai (USA) and Jun Nishioka (Japan)
- d) 1-day workshop on “Filling the gaps in the PICES North Pacific Ecosystem Status Report”. Co-convenors: Vyacheslav B. Lobanov (Russia), Phillip R. Mundy (USA), R. Ian Perry (Canada) and Sei-Ichi Saitoh (Japan)

- **PICES/ GLOBEC Symposium on Climate variability and ecosystem impacts on the North Atlantic. Honolulu, USA, 19-21 April 2006.**

This symposium is designed to continue the programme of GLOBEC symposia along regional lines by synthesising the knowledge acquired as part of the PICES-GLOBEC Climate Change and Carrying Capacity in the North Pacific (CCCC). The programme of the symposium is being drafted by the steering committee, chaired by Dr Harold Batchelder (USA) and Prof. Suam Kim (Korea). The themes are

- a) Regime shifts, especially examination of the ocean and ecosystem responses to known strong, infrequent changes in the North Pacific Ocean, such as those that occurred in 1977, 1989, and 1998;
- b) Ecosystem productivity and structural responses to physical forcing, with an emphasis on shorter than inter-decadal time scales and interannual (El Niño-La Niña), seasonal and event scales; and

- c) Pan-Pacific comparisons, with an emphasis on comparisons of similar species or processes from multiple coastal ecosystems and of open ocean-coastal linkages and climate connections.

The Proceedings are to be published as a special volume of *Progress in Oceanography*. The GLOBEC Scientific Steering Committee will meet in Honolulu in 2006, to facilitate their engagement in the symposium.

1.2. GLOBEC workshops

- **GLOBEC-SPACC workshop on the “The economic implications of climate change-driven changes in pelagic fish stocks”, Portsmouth, UK, September 2004.**

Small pelagic fish species (anchovy, sardine, herring, capelin, etc.) fluctuate significantly on short and long time scales. The focus of the workshop was on the economic implications of these fluctuations. Papers will include both backward-looking papers, analyzing how people have coped with major resource displacements, and papers that are theoretical or forward looking, describing likely implications of climatic variations and how these could or should be dealt with. Twenty-four participants attended (most of them funded through NOAA, GLOBEC and SCOR). A collection of 12 articles have been selected, reviewed and accepted in a book in the series “*New Horizons in Environmental Economics*” by Edward Elgar in 2005. The editors of the book are R. Hannesson, M. Barange and S. Herrick.

- **Japan/Korea/China annual GLOBEC Symposium. 27-29 November. Hangzhou, China**

The 2nd Japan/Korea/China annual symposium gathered 62 scientists, and consisted of 25 oral presentations and 27 posters. The symposium continued the tradition of these three national GLOBEC programmes to coordinate their research and contribute to GLOBEC’s overall synthesis. The two areas of focus in this year’s meeting were

- a) ecosystem structure and food-web trophodynamics, and
- b) physical-biological processes and models.

The next tri-national meeting will take place in Japan in 2007.

- **GLOBEC-CLIOTOP planning workshops for Working Groups 2, 4 and 5. Hawaii, 1-3 December 2004.**

CLIOTOP is a new regional GLOBEC activity synthesising the ecology of ecosystem top predators (see below). CLIOTOP is organised in a number of working groups. Working groups 2 (Physiology, behaviour and distribution), 4 (Synthesis and modelling) and 5 (Socio-economic aspects and management strategies) met in parallel to define their work plans, timelines and milestones; identify people and projects to implement the proposed activities; identify future projects; and define synthesis plans and interactions with other WGs. CLIOTOP is planning a major OSM in Mexico in 2006.

- **GLOBEC/ICES CCC-WGZE Workshop on the Impact of Zooplankton on Cod Abundance and Production. Copenhagen, Denmark, 7-9 June 2005.**

This workshop will (a) determine the zooplankton species in the diets of cod, their temporal and spatial changes; (b) determine the variability in zooplankton populations and their relationships to cod; (c) examine the vital rates of zooplankton that are relevant to cod life histories; (d) determine how the timing of zooplankton production and spatial dynamics of nauplii relates to the spawning, distribution and survival of early stages of cod; (e) establish the links between zooplankton and later stages of cod; and (f) study long-term changes in phenology, abundance and size composition of zooplankton and possible consequences for cod. An ICES Cooperative Report is expected from this workshop.

- **GLOBEC-IOC Study Group on Ecosystem Regime Shifts. Rome, June 2005 and TBA, Fall 2005.**

This study group has been set up to write a review paper that would exemplify the process of identifying and detecting regime shifts, and applying the knowledge to management and governance of marine resources. The product would be used to design observational systems that would operationalise the process. This small group will meet twice in 2005, leading to a major paper in 2006. The group is co-funded by IOC, PICES and GLOBEC.

- **GLOBEC-SPACC workshop on "Image analysis to count and identify zooplankton", San Sebastian, Spain, 1-3 November 2005.**

To understand fish biomass fluctuations we need appropriate biological information on the prey field. The difficulty is to extract the information from the thousands of samples collected routinely. However, new systems based on image analysis have become available, allowing quick counting and sizing of the zooplankton. The workshop is intended to evaluate these new systems and provide feedback for the manufacturers. The final objective is to have a network of laboratories using the same approach to count and identify zooplankton. A group publication is expected.

- **GLOBEC-SPACC workshop on "Fluctuations of sardines and anchovies and impact on coastal fishing communities", Tokyo, Japan, 14-17 November 2005.**

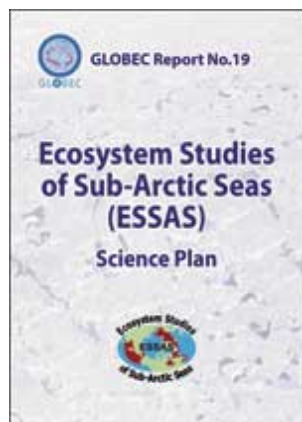
This workshop will be used to fit the NEMURO-FISH ecosystem model (an NPZ model with compartments for pelagic fish) to data from several areas that have large populations of anchovy and sardine, with the objective to ascertain if the replacement between both species could be explained as driven by decadal-scale climate variability that permeates through the food web. The workshop is a GLOBEC Focus 4 and SPACC activity, and funding is provided by APN, IAI, Japanese Fisheries Agency, PICES and GLOBEC.

In addition, GLOBEC conducted meetings of their Focus 1 working group (Hawaii, USA, 23-24 October 2004), Focus 2 working group (Rhode Island, USA, 18-20 July 2004) and Focus 3 working group (Bergen, Norway, 9-10 May 2004). In 2005, meetings of the following working groups are planned and funded: Focus 4 (Sidney, Canada, August 2005), Focus 2 (Dartington, UK, September 2005), and Focus 3 (Aberdeen, UK, September 2005). More information is available on the GLOBEC Web site.

2. RECENT DEVELOPMENTS AND PUBLICATIONS

2.1. GLOBEC-ESSAS

The GLOBEC Executive Committee approved a new regional programme on the impacts of climate variability and change on marine sub-arctic ecosystems, in October 2004. The approval was the



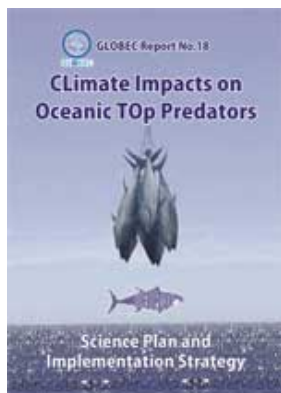
culmination of a process that included the appointment by GLOBEC of a committee to draft a Science Plan (funding provided by NSF and the Norwegian Research Council), the anonymous review process by independent scientists, and the revision of the science plan as a result. The Plan is now available via the GLOBEC IPO (GLOBEC Report 19), and downloadable from the GLOBEC Web site. An appendix to the Science Plan (GLOBEC Report 20), with reviews of the climatology, physical oceanography and ecosystem considerations of Sub-Arctic Seas, is also available in hard copy and as a download.

The goal of ESSAS (Ecosystem Studies of Sub-Arctic Systems) is to compare, quantify, understand, and thereby predict the impact of climate variability on the productivity and sustainability of sub-arctic marine ecosystems, from phytoplankton to whales and birds. The main field regions are the Bering Sea, Sea of Okhotsk, Oyashio Current, Barents Sea, the Newfoundland-Labrador Shelf and the West Greenland shelf, all of which experience seasonal ice cover. ESSAS initiated its activities with a

symposium and planning implementation workshop in Victoria, Canada. A preliminary Scientific Steering Committee for ESSAS has been appointed, and met in Victoria as well for the first time.

2.2. GLOBEC-CLIOTOP

GLOBEC has also approved a new pan-equatorial research activity named CLIOTOP (Climate Impacts on Oceanic Top Predators). The objective of CLIOTOP is to organize a large-scale world-wide comparative effort aimed at identifying the impact of both climate variability (at various scales) and fishing on the structure and function of open-ocean pelagic ecosystems and their top predator species by elucidating the key processes involved in open-ocean ecosystem functioning. CLIOTOP will focus on populations of tunas, sharks and other large predators, and the ecosystem that sustain them. A science plan has been published (GLOBEC Report 18), following a review process identical to that set up for the approval of the ESSAS Science Plan. CLIOTOP initiated activities with a set of workshops in Hawaii in December 2004 (see above), and plan a kick-off conference for 2006.



2.3. Publications

The GLOBEC publication list can be interactively searched at www.globec.org. Since 2000 the list includes a total of 1,123 publications (943 refereed, 180 non-refereed). This is an underestimate of the total publications of GLOBEC researchers, as they have to be logged in the Web site by the authors themselves and have to acknowledge their contribution to GLOBEC in the article. The real figure is likely to be at least an order of magnitude higher. The following are special issues of GLOBEC and IPO publications printed in 2004/2005:

1. **Barange, M., Nykjaer, L. (Eds.)** 2004. ENVIFISH: Investigating environmental causes of pelagic fisheries variability in the SE Atlantic. *Progr. Oceanogr.* 59:177-337.
2. **Hofmann, E.E., P.H. Wiebe, D.P. Costa and J.J. Torres (Eds.)**. 2004. Integrated ecosystem studies of western Antarctic Peninsula continental shelf waters and related southern ocean regions. *Deep-Sea Res.* 51:1921-2344.
3. **Stenseth, N.C., G. Ottersen, J.W. Hurrell and A. Belgrano (Eds.)** 2004. *Marine Ecosystems and Climate Variation*. Oxford: Oxford University Press.
4. **Valdes, L., R. Harris, T. Ikeda, S. McKinnell and T. Peterson (Eds.)** 2004. The role of zooplankton in Global Ecosystem Dynamics: comparative studies from the world's oceans. ICES J. Mar. Sci. Symposia 220. *ICES J Mar. Sci.* 61:441-737.
5. **Ashby, D.M. (ed.)**. 2004. *Update of the Report on the GLOBEC National, Multinational and Regional Programme Activities, 2004*. GLOBEC Special Contribution No. 7, 194 pp.
6. *GLOBEC Newsletter 10.1. April 2004*
7. *GLOBEC Newsletter 10.2. October 2004*
8. *GLOBEC Newsletter 11.2. April 2005*

Two GLOBEC Reports are currently in press.

2.4. GLOBEC IPO

We are delighted to inform SCOR that a bid to renew the GLOBEC IPO for a further 5 years (March 2005-March 2010) has been approved by the UK's Natural Environment Research Council and the Plymouth Marine Laboratory. The IPO was established at the Plymouth Marine Laboratory (PML) in 1998, and this support ensures the Office will remain at PML. The renewal will carry the IPO until the completion of GLOBEC, providing for staff salaries, overheads, T&S and other IPO costs. This is a final

IPO request, as GLOBEC will formally conclude its science activities in December 2009, after which a 3-month wind-up of the IPO is envisaged.

As part of our involvement in the European network of Excellence EUR-OCEANS, the IPO will grow with an additional project officer to deliver the expected contributions from the IPO. The position is expected to be filled during the summer months.

In the short term, however, the IPO will have an important staff shortage, as Ms. Lotty Ireland will be on maternity leave until January 2006.

2.5. Integration and Synthesis plans

GLOBEC is embarking on an integration and synthesis (I+S) phase that will lead the programme to its conclusion in December 2009. The GLOBEC SSC has developed a blueprint document to set up the goals, milestones and pathways to this I+S. The document can be downloaded from a section of the GLOBEC Web page devoted to I+S. In this section of the Web page, I+S activities can be proposed online, and the community has the opportunity of requesting information on specific I+S outputs as and when they become available. Much of GLOBEC's I+S will take the form of regional symposia, and the following are already in diverse stages of planning:

- 1- ICES/GLOBEC The influence of Climate change on North Atlantic fish stocks, Bergen, Norway. May 2004. **COMPLETED**
- 2- GLOBEC Climate variability and sub-arctic marine ecosystems. Victoria, Canada, 16-20 May 2005 **COMPLETED**
- 3- PICES/GLOBEC Climate Change and Ecosystem impacts in the North Pacific, Honolulu, USA, 19-21 April 2006.
- 4- GLOBEC CLIOTOP 1st OSM. La Paz, Mexico. 2006.
- 5- PICES/ICES/GLOBEC 5th Zooplankton Production Symposium. Hiroshima, Japan, June 2007
- 6- GLOBEC Focus 4 Symposium "Natural and Human system implications of large-scale changes in marine systems". 2007
- 7- Final GLOBEC Open Science Meeting, 2009

For more details, follow the links to Integration and Synthesis plans in www.globec.org.

3. RESEARCH HIGHLIGHTS

The GLOBEC IPO produces an annual research highlights brochure, which is available for download from the GLOBEC Web site. Because this year the SCOR annual meeting is held earlier than it is customary this brochure is not yet available. However, the following are specific highlights extracted from the GLOBEC-Norway programme, which was the subject of a special GLOBEC Newsletter in April 2005.

ROMS model for the North Atlantic and Arctic Oceans – W. Paul Budgell.

A Regional Ocean Modelling System coupled to a thermo-dynamic sea ice model has been developed to simulate the conditions in the North Atlantic and Arctic oceans for the period 1980-2004. The model horizontal resolution is 20km in the study area and 30km in the wider North Atlantic. The forcing fields are daily mean surface heat and momentum fluxes from NCAR/NCEP data sets, and the outputs are used by other GLOBEC-Norway research projects.

What happens with the Arcto-Norwegian cod if the thermohaline circulation slows down? – F. Vikebo, S. Sundby, B. Adlandsvik, O.H. Ottera.

A reduction in the thermohaline circulation might have strong impacts in the Northeast Atlantic ecosystem. A ROMS circulation model forced by a simulated reduction of the thermohaline circulation was coupled to an IBM of cod early life stages to investigate the effects of the reduction. The main results are a reduction of the influx into the Barents Sea, in favour of increased flow west of Spitsbergen Island, a southward and westward shift in the distribution of early stages of cod on the narrow shelves of Norway

and away from the Barents Sea (see figure below) and a reduction in growth and therefore poorer year classes.

Buoyancy of eggs of Norwegian coastal cod from different areas of the coast – E.K. Stenevik, S. Sundby.

It is believed that Arctic and coastal cod form two different stocks genetically differentiated. One of the hypotheses in support of stock differentiation between cod populations is related to the ability to be retained in specific areas. Measuring the buoyancy of cod eggs from different locations along the Norwegian coast (see figure) shows that cod eggs in the northernmost region (Porsanger) were more buoyant and widely distributed in the water column, while the eggs from other areas peaked at depth (30-50m) and were substantially heavier. The implication is that northerly eggs have a higher probability of being advected, while other populations would be retained more successfully. The results have implications for individual-based modelling of young stages of cod in Norwegian waters.

More highlights of GLOBEC-Norway are available in the *GLOBEC Newsletter* 11.1, available from the GLOBEC IPO or downloadable from www.globec.org.

4. GLOBEC SSC 2005

The membership of the GLOBEC SSC is shown in the Table below.

Name	Gender	Country	Function	Term end
Dr Jürgen Alheit	M	Germany	Chair Focus 1, SPACC Exec	(Ex-Officio)
Dr Ruben Escribano	M	Chile	SSC	1 st term 2007
Prof John Field	M	South Africa	SSC	1 st term 2004
Dr Roger Harris	M	UK	SSC Past-Chair, Focus 2	(Ex-Officio)
Prof Eileen Hofmann	F	USA	SSC, SO Chair	(Ex-Officio)
Dr James W. Hurrell	M	USA	SSC	1 st term 2007
Dr Patrick Lehodey	M	N. Caledonia	SSC, Focus 4	2 nd term 2005
Prof Rosemary Ommer	F	Canada	SSC, Focus 4 co-Chair	2 nd term 2005
Dr Geir Ottersen	M	Norway	SSC, CCC Co-Chair	2 nd term 2005
Dr Ian Perry	M	Canada	Focus 4 co-Chair	(Ex-Officio)
Dr David Runge	M	USA	SSC	1 st term 2005
Prof Marten Scheffer	M	Netherlands	SSC	1 st term 2007
Prof Qisheng Tang	M	China	SSC	1 st term 2005
Prof Francisco Werner	M	USA	SSC Chair, Focus 3	1 st term as Chair 2005

At the end of 2005 four members complete their second term (Lehodey, Ommer, Ottersen, Werner). The latter is eligible for a further term as Chair. The GLOBEC SSC will soon be designing a strategy to fill the vacancies in light of the synthesis phase of GLOBEC.

Appendix 1. GLOBEC National, Multinational and Regional Programmes

National

Country	Duration	Name-code	Funding	Contact
Brazil	1998-2002	DEPROAS	Conselho Nacional de Desenvolvimento Cientifico e Tecnológico	B. M. de Castro
Canada	1996-1999	GLOBEC Canada	Natural Sciences and Engineering Research Council, Fisheries and Oceans Canada	B. de Young
Chile	1997-ongoing	FONDAP-COPAS	Chilean National Commission for Science and Technology	R. Escribano
China	1997-ongoing	China GLOBEC	National Natural Science Foundation of China, Ministry of Science and Technology	Q. Tang
France	1999-ongoing	PNEC	Call for proposals, funded for 1 year. Proposals can be resubmitted each year. Mean duration ~4 years.	F. Carlotti
Germany	2000- ongoing	GLOBEC Germany	Federal Ministry for Education, Science, Research and Technology plus participating institutions	J. Alheit
Italy	2000- ongoing	SINAPSI	Ministero dell'Università e della Ricerca Scientifica e Tecnologica	M. Zavatarelli
Japan	1997- ongoing	Japan GLOBEC	One project funded by Japanese Government, others seem to be institute/university funded	Y. Sakurai
Korea		Korea GLOBEC	Korea Science and Engineering Foundation, Ministry of Maritime Affairs and Fisheries, NFR&D Institute	I. Sang Oh
Mexico	1997- ongoing	IMECOCAL	Consejo Nacional de Ciencia y Tecnología, IAI	T. Baumgartner
Netherlands	1993-2002	Several	Various loosely affiliated projects, various funding agencies	M. Bars
Norway	1993-2001 2003-2006	MARE COGNITUM ECOBIE, CLIMAR, ADAPT	EU funding, Norwegian Research Council, Norwegian Institutes and Institute of Marine Research	W. Mille/ S. Sundby
Portugal	1999- ongoing	GLOBEC Portugal	Portuguese Foundation for Science and Technology, IPIMAR	M. Santos
Peru	2004- ongoing	GLOBEC-IMARPE	Instituto del Mar del Peru (IMARPE)	R. Guevara
Spain	2001- ongoing	GLOBEC Spain	Ministerio de Ciencia, IEO, CSIC, CYCIT, etc.	F. Echevarria
Turkey	1997- ongoing	Black Sea GLOBEC	Turkish scientific and technical research council (TUBITAK)	T. Oguz
Ukraine	1997- 2004	Ukraine GLOBEC	INTAS, UK DETR Darwin Initiative + others	V. Zaika
UK	2000-2005	Marine Productivity (largest)	NERC Thematic money – individual projects by proposal	P. Williamson
USA	1994- ongoing	US GLOBEC	NSF and NOAA – individual projects by submitted proposals	D. Haidvogel

Multi-National and Regional

Start Year	Countries	Funding	Contact
1997-2007	BENEFIT : South Africa, Namibia, Angola, Norway, Germany	Norwegian and German donor agencies, Governments of Angola, Namibia, South Africa	N. Sweijd
2000-2003	LIFECO : Norway, Germany, UK, Denmark	EU FP 5	M. St John
1996-1999	TASC : Norway, UK, Denmark, Iceland, Germany, France, ICES	EU MAST	K. Tande
1999-2001	ENVIFISH : EU countries, Angola, Namibia, South Africa	EU INCO	L. Nykjaer
1997-2000	VIBES : France, South Africa	IRD (ORSTOM)	P. Freon
2001-ongoing	IDYLE1 and 2 : France, South Africa, Namibia, Chile, Peru	IRD (ORSTOM)	P. Freon
2002-2005	NATFISH : Norway, Morocco, Mauritania, Senegal, Italy	EU INCO	L. Nykjaer
2001-ongoing	OFCCP : USA, N. Caledonia, Mexico, Australia, France, N. Zealand, Japan, IATTC	National funding agencies of participating countries, GEF	P. Lehodey
Start Year	Countries	Funding	Contact
1993-ongoing	SPACC : Spain, France, Germany, Japan, Chile, Peru, Senegal, Mauritania, Portugal, USA, Mexico, and others	National, GLOBEC	D. Checkley and C. Roy
1993-2009	CCC : ICES countries	National, ICES	G. Ottersen and K. Drinkwater
Ongoing-2009	CCCC : Japan, China, Korea, Russia, Canada, USA	National, PICES	S. Kim and H. Batchelder
Ongoing	SO GLOBEC : USA, Australia, UK, Germany, IWC, and others.	National	E. Hofmann
2005-ongoing	ESSAS	National, GLOBEC	G. Hunt
2005-ongoing	CLIOTOP	National, GLOBEC	O. Maury and P. Lehodey

Annex 6

Global Ecology and Oceanography of Harmful Algal Blooms

ACTIVITIES 2004-2005

1. Implementation of Core Research Projects

The GEOHAB *Implementation Plan*, published in November 2003 (GEOHAB. 2003. *Global Ecology and Oceanography of Harmful Algal Blooms, Implementation Plan*. P. Gentien, G. Pitcher, A. Cembella and P. Glibert (eds.), SCOR and IOC, Baltimore and Paris, 36 pp), specified the formation of Core Research Projects (CRPs) related to four ecosystem types—upwelling systems, fjords and coastal embayments, eutrophic systems, and stratified systems. Initiation of these CRPs through focused Open Science Meetings has been the primary GEOHAB activity during 2004-2005.

A. Core Research Project: HABs in Upwelling Systems

A report of the Open Science Meeting on HABs in Upwelling Systems, hosted at the Instituto Nacional de Investigação Agrária e das Pescas (INIAP-IPIMAR), in Lisbon, Portugal on 17-20 November 2003, has been completed and published (GEOHAB 2005. *Global Ecology and Oceanography of Harmful Algal Blooms, GEOHAB Core Research Project: HABs in Upwelling Systems*. G. Pitcher, T. Moita, V. Trainer, R. Kudela, P. Figueiras, T. Probyn (Eds.) IOC and SCOR, Paris and Baltimore. 82 pp).

The Open Science Meeting served to identify interested participants and research regions and to bring together the international community to design core research. The meeting report provides a general overview of HABs in the designated upwelling systems (California Current System, Iberian Upwelling System and Benguela Upwelling System) and details 8 high-priority research activities to be addressed in understanding the ecology and oceanography of HABs in upwelling systems. Our understanding of and ability to predict HABs in upwelling systems over the next 5-10 years may reflect the extent to which the above questions are answered. Much of the content of the Open Science Meeting report was included in a paper published in *Oceanography* (Kudela, R, G Pitcher, T Probyn, F Figueiras, M Moita and V Trainer. 2005. Harmful algal blooms in coastal upwelling systems. *Oceanography* 18(2):184-197).

A GEOHAB Core Research Project Committee [Grant Pitcher – South Africa, Teresa Moita – Portugal, Francisco Figueiras – Spain, Raphael Kudela – USA, Trevor Probyn – South Africa, Vera Trainer – USA, Sonia Sanchez - Peru] is responsible for implementation. In accordance with the GEOHAB strategy this committee is required to encourage comparative research projects, to address the key questions identified in the CRP report. Committee members are therefore required to play a leading role within their region in establishing comparative projects. Involvement may include generating interest within the research community, disseminating information, submitting proposals and securing funding, coordinating and actively participating in projects and possibly data sharing. Two members of the CRP Committee are members of the international GEOHAB SSC, to ensure a strong linkage between the Committee and the SSC. It is intended that much of the work of the CRP Committee will be conducted by means of the GEOHAB Web site and through the establishment of a CRP mailing list. Periodic meetings of the Committee may be organized and combined with GEOHAB SSC meetings, for example, in conjunction with the next GEOHAB SSC meeting (see below).

An invitation to participate in the Core Research Project: HABs in Upwelling Systems has recently been sent to all participants of the Open Science Meeting.

B. Core Research Project: HABs in Fjords and Coastal Embayments

The Open Science Meeting on Harmful Algal Blooms in Fjords and Coastal Embayments took place in Viña del Mar, Chile from 26-29 April 2004 under the co-direction of Allan Cembella (Alfred Wegener Institute, Germany) and Leonardo Guzmán (IFOP, Chile). The objectives of this meeting were fourfold: (1) to introduce the GEOHAB Core Research approach to the international community; (2) to foster the development of national and international

links to GEOHAB, specifically to Core Research; (3) to review and assess existing knowledge and future prospects for research on HABs in coastal embayments, and (4) to initiate the development of an action plan for implementation of the Core Research on coastal embayments. An international panel of experts participated as the Core Research Project Co-ordinating Committee to plan the research agenda, in conjunction with several key members of the GEOHAB SSC.

The OSM was open to any participant from any part of the world; however, strong participation from Latin America was particularly noteworthy. More than 60 participants attended at least part of the meeting, which featured 11 key lectures, more than 25 posters presented by participants, and an extensive and lively discussion and question periods following each theme. To stimulate maximal scientific interaction, all posters were presented orally, several times in rotation.

The programme was opened with short welcome addresses from Chilean dignitaries, including representatives of the Comité Oceanográfico Nacional of Chile, the SCOR Secretariat and the IOC HAB Programme Communication Centre in Copenhagen. After the conclusion of the plenary key lectures, theme break-out groups were formed to discuss comparative approaches and integration of physical versus biological and chemical factors, and the incorporation of hydrodynamic and ecosystem models into this research framework. A series of recommendations and considerations emerged from these theme groups, such as the importance of physical constraints in determining hydrodynamics and species outcomes in coastal embayments and the significance of benthic-pelagic coupling. The critical importance of water residence time was also noted.

On the day following the completion of the open meeting, the co-convenors met with the GEOHAB Chairman, the international Core Project Coordinating committee, and representatives of the GEOHAB SSC to plan the research agenda and to prepare the forthcoming summary report. Specific issues addressed included (1) identification of processes and mechanisms that must be studied in such ecosystems to define HAB dynamics; (2) determination of the most important questions and working hypotheses; (3) consideration of opportunities, differences and commonalities to be addressed in studies of coastal embayments; (4) discussion of potential field study sites where research could be implemented; and (5) possibilities and constraints for national and international funding support for research initiatives. This information will be incorporated into a detailed OSM report to be delivered within the next few months.

At the request of participants, it was decided to include short summaries of the poster presentations in the OSM report. Plenary speakers were also invited to prepare a manuscript based upon their presentations, subject to peer review and publication in a special GEOHAB edition of the Elsevier journal *Harmful Algae*. The practical implementation of Core Research activities in coastal embayments is in an advanced planning stage and actual field work is anticipated in 2005.

C. Core Research Project: HABs and Eutrophication

The Open Science Meeting on HABs and Eutrophication was held on 7-10 March 2005 in Baltimore, Maryland, USA, under the leadership of Patricia Glibert, assisted by a Steering Committee of D. Anderson (USA), E. Granéli (Sweden), M. Zhou (China), J.I. Allen (UK) and M. Burford (Australia). As with the previous Open Science Meetings, this meeting served to obtain community input for the development of a detailed research plan for the Core Research Project – Harmful Algal Blooms in Eutrophied Systems. The plan is presently being drafted by the Steering Committee based on the input of the approximately 120 participants at the meeting. The programme incorporated sessions on trends in eutrophication and HABs; physiology and ecology of HABs with respect to nutrients; the GEOHAB programme and other initiatives; comparative studies and international programmes on HABs in eutrophic areas; macronutrient interactions with other factors controlling HABs; new challenges and methodologies; modelling of nutrients and HABs; and GEOHAB implementation.

D. Core Research Project: HABs and Stratification

The fourth Open Science Meeting, on HABs and Stratification, is scheduled for 5-8 December 2005, at the UNESCO Headquarters in Paris, France, under the leadership of Patrick Gentien. This meeting is designed to bring experts together to review the state of knowledge of the physical and chemical processes related to stratification, and their interaction with microscopic algae. As profiling techniques have improved, persistent and spatially

coherent plankton patches have been described at scales smaller than those of standard sampling. These patches are recurrent in coastal systems and their study is essential to understanding the development of HABs. The meeting will address topics relating to the physical processes relevant to stratification, the maintenance of HAB populations in thin layers, the selection of assemblages by different turbulent regimes, the influence of phytoplankton communities on small-scale physical properties, the implications for sampling, monitoring and operational oceanography, and the required detection systems.

2. Targeted Research

The Scientific Steering Committee has approved establishment of two task teams to develop Targeted Research relating to Modelling Studies and Observation Systems and Instrumentation. Membership will be developed in close cooperation with the chairs of the CRP committees and should eventually include members from each CRP committee.

A. Modelling Studies

A Task Team chaired by Wolfgang Fennel, and including SSC members Marcel Babin and Dennis McGillicuddy will be formed during the course of 2005. Its Terms of Reference are as follows:

- Advise on the development, application, and dissemination of models within GEOHAB CRPs.
- Organize a GEOHAB Modelling Workshop, focusing on model inter-comparisons, by the end of 2006, after the completion of all Open Science Meeting reports. Modellers involved in the CRPs will be encouraged to participate and to demonstrate the use of their models.
- Conduct an annual assessment of the success of GEOHAB in modelling and prediction and report to the SSC.
- Specify targeted modelling research.

B. Observation Systems and Instrumentation

A Task Team chaired by Marcel Babin, and including SSC member Patrick Gentien, will be formed during the course of 2005. Its Terms of Reference are as follows:

- Assist and advise on the use of sensors and systems in the CRPs.
- Identify the needs for new developments and promote inter-comparison of instruments.
- Conduct periodic evaluation of recent technological and methodological developments.

Two Targeted Research proposals with international participation were endorsed by the GEOHAB SSC during the course of 2005:

- ALEXARRAY – Genetic Regulation of Bloom Formation in the Toxic Marine Dinoflagellate *Alexandrium tamarense*.
- SEED: Life cycle transformations among HAB species, and the environmental and physiological factors that regulate them.

3. SCOR Meeting on Coordination of International Marine Projects

Supported by the Sloan Foundation, this meeting took place from 23-24 September 2004 in Mestre, Italy. It served to bring together representatives of the major international ocean research and observation projects and programs to discuss common opportunities, issues and problems. Meeting participants included representatives from virtually all international marine research projects and programmes (CLIVAR, CoML, DIVERSITAS, GEOHAB, GLOBEC, iAnZone, IMAGES, InterRidge, IMBER, LOICZ, and SOLAS). Profs. John Field and Laurent Labeyrie convened the meeting on behalf of the SCOR Executive Committee. The meeting agenda included several specific topics determined in advance to be important inter-project issues, including data management, interactions of projects with the Global Ocean Observing System (GOOS), project coordination in the area of Southern Ocean research and participation in the International Polar Year, project needs for time-series stations, and future project contributions to global environmental assessments. GEOHAB was represented at the meeting by Grant Pitcher and Henrik Enevoldsen. Discussions on the interactions with GOOS were of particular importance to GEOHAB. Mechanisms to improve the way in which GEOHAB and other programmes integrate with GOOS were addressed.

Measurements required from GOOS by GEOHAB and the potential for data from GEOHAB to enter GOOS data streams were considered. Information and recommendations relating to the meeting are available on the activity Web page (see www.jhu.edu/scor/ProjCoord.htm).

4. XI International Conference on Harmful Algae

A GEOHAB display was constructed at the XI International Conference on Harmful Algae held in Cape Town, South Africa, from 14-19 November 2004, to promote the strategy, mission and achievements of GEOHAB. The display served primarily to distribute the *GEOHAB Implementation Plan*.

5. SSC Meeting: Cape Town, South Africa, 2004

A Scientific Steering Committee meeting was held on 21-23 November 2004 following the XI International Conference on Harmful Algae in Cape Town, South Africa. The focus of this meeting was on the Core Research Projects and their implementation and future management, the development of targeted research projects (specifically those related to modelling and observation systems), data management, the development of standard measurement protocols within GEOHAB, and the establishment of an International Programme Office.

6. Special Issue of *Oceanography*

A special issue of *Oceanography* (Vol. 18, No. 2, June 2005) devoted to the ecology and oceanography of Harmful Algal Blooms was edited by Scientific Steering Committee members P. Glibert and G. Pitcher. The issue gave extensive coverage to GEOHAB and the Core Research Projects, and other international programmes on harmful algae. Several of the papers were written by present and past members of the Scientific Steering Committee, such as

- Glibert, PM, DM Anderson, P Gentien, E Graneli and K Sellner. The global, complex phenomena of harmful algal blooms.
- Anderson, DM, GC Pitcher and M Estrada. The comparative “systems” approach to HAB research.
- Cembella, AD, DA Ibarra, J Diogene and E Dahl. Harmful algal blooms and their assessment in fjords and coastal embayments.
- Gentien, P, P Donoghay, H Yamazaki, R Raine, B Reguera and T Osborne. Harmful algal blooms in stratified environments.
- Kudela, R, G Pitcher, T Probyn, F Figueiras, M Moita and V Trainer. Harmful algal blooms in coastal upwelling systems.
- Glibert, PM, S Seitzinger, CA Heil, JM Burkholder, MW Parrow, LA Codispoti and V Kelly. The role of eutrophication in the global proliferation of harmful algal blooms: New perspectives and new approaches.
- Babin, M, JJ Cullen, CS Roesler, PL Donaghay, GJ Doucette, M Kahru, MR Lewis, CA Scholin, ME Sieracki and HM Sosik. New approaches and technologies for observing harmful algal blooms.

7. ASLO meeting 2005

Two Special Sessions were organized by the GEOHAB Scientific Steering Committee to promote GEOHAB at the ASLO meeting in Santiago de Compostela, Spain, from the 19-24 June 2005. Both sessions will be chaired by members of the Scientific Steering Committee.

- Session SS 43: Eutrophication and Harmful Algal Blooms
Co-chaired by P. Glibert and E. Graneli.
- Session SS52: Comparative Ecosystem Studies of Harmful Algal Blooms
Co-chaired by G. Pitcher, P. Gentien and A. Cembella.

The GEOHAB approach of international co-operative research on HABs in ecosystem types sharing common features were emphasized in these sessions with presentations relating to all four Core Research Projects.

8. International Programme Office [IPO]

GEOHAB, SCOR and IOC continue to seek the establishment of an International Programme Office to help implement, co-ordinate and manage GEOHAB resources in accordance with the approved international *GEOHAB Science Plan* and *GEOHAB Implementation Plan*. IOC and SCOR seek a commitment to host the IPO for GEOHAB with basic operational funds of US\$200,000 per year. For support of the Executive Officer and Administrative Assistant, IOC and SCOR seek international funds from national funding agencies for a period of no less than 3 years and preferably at least 5 years. IPOs are established by the project SSCs to relieve the Scientific Steering Committees of the day-to-day responsibility of handling the administrative and logistical aspects of the programmes. The IPO serves as the programme secretariat and works with the SSC and co-sponsors in implementing the programme and raising funds for its international coordination, planning and framework activities. The transition from the programme planning phase to programme implementation and establishment of an IPO is an important step that makes it possible for programmes to be implemented more quickly and comprehensively. Until the GEOHAB IPO is established, the co-sponsors of GEOHAB are responsible for overseeing programme progress, as one of their many tasks. Despite recent consideration of the location of the IPO in Norway, China, United Kingdom and Germany, none of these options have materialized. This situation is unsatisfactory for the long-term success of the programme.

9. SSC Meeting: Villefranche, France 2006

The next SSC meeting is tentatively scheduled for January/February 2006 in Villefranche, France. The focus of this meeting will be on the implementation of Core Research Projects.

10. GEOHAB Finances

Income	2004	2005
Carry-over from previous year (NSF grant)		\$15,485.04
NOAA (through SCOR)		\$24,000.00
NSF (through SCOR)	\$40,574.00	\$30,000.00
IOC	\$18,000.00	\$20,000.00
IFREMER		\$5,000.00
SCOR Support for LDC Travel	\$1,674.78	\$5,000.00
Other sources (YSI, DNR, CRC)		\$2,500.00
Registration Fees	\$2,525	\$17,500.00
Total	\$62,773.78	\$119,485.04
Expenses		
Publications (formatting, printing, mailing)	\$5,626.67	
Advertising	\$545.00	
SCOR Administrative Expenses	\$189.42	
IOC Expenses (airfares)	\$18,000.00	
SSC Meeting 1	\$11,739.20	\$25,000.00
HABs in Upwelling Systems	\$363.13	
HABs in Fjords and Coastal Embayments	\$13,793.15	
HABs in Stratified Systems		\$35,000.00
HABs in Eutrophified Systems		\$56,365.22
Total	\$50,256.57	\$116,365.22
Remaining	\$12,517.21	\$3,119.82

Annex 7

IMBER: Integrated Marine Biogeochemistry and Ecosystem Research

Report 2004/2005

Submitted by Julie Hall, IMBER Chair

On behalf of the IMBER Scientific Steering Committee

Contents

IMBER Science Plan and Implementation Strategy

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Development of the IMBER Science Plan and Implementation Strategy (SP/IS)

The IMBER *Science Plan and Implementation Strategy* was approved by both SCOR and IGBP earlier this year. The plan is being printed and will be distributed to more than fifteen hundred scientists and funding agency staff and has been made available electronically on the IMBER Web site (www.imber.info).

SSC Meetings

An IMBER SSC Executive meeting was held in December 2004, hosted by Denise Hansell at the Rosenstiel School of Marine and Atmospheric Sciences, University of Miami. This meeting focused on editing the IMBER *Science Plan and Implementation Strategy* to address the reviewers' comments and the immediate needs for the implementation of the IMBER project.

The second IMBER SSC meeting was hosted by Jing Zhang at the East China Normal University in Shanghai, China in April. This meeting focused on developing more detailed plans for the implementation of IMBER and developing a promotional strategy for the project.

International Project Office

The IMBER IPO will be funded for the next three years by a consortium of French agencies (Centre National de la Recherche Scientifique [CNRS], Institut de Recherche pour le Développement [IRD], the Université de Bretagne Occidentale and the Brittany Region.) and will be based at Institut Universitaire Européen de la Mer (IUEM) in Brest, France. The office will open in late August 2005 and will be staffed by the Executive Officer, a Deputy Executive Officer and an Administrative Assistant.

The Executive Officer position was advertised in early January 2005, and we received more than 30 applicants for the position. Eight candidates were short listed for the position and four were interviewed. In April, Dr. Sylvie Roy was appointed and will take up the position in late August. Sylvie is currently based in the Canadian SOLAS office. We are looking forward to welcoming Sylvie to the IMBER project.

Development of IMBER Research

There are a significant number of countries currently developing IMBER activities. Several countries, including India and China, have funding proposals submitted; others such as Japan and the Netherlands have formed committees to take IMBER initiatives forward, and others, such as Germany and Canada, are working toward developing funding proposals for future research. In other countries (i.e., France, England, New Zealand, Chile, South Africa) there are already significant research activities being undertaken that are closely aligned with the IMBER project goals and we are working with these researchers to ensure close links

to the IMBER project. In the United States a town meeting was held at the American Society of Limnology and Oceanography meeting in February to introduce the IMBER project to the marine science community.

There are a number of regional activities developing. ICED (Integrated analyses of Circumpolar Climate interactions and Ecosystem Dynamics in the Southern Ocean) had a planning meeting in May to develop a Science Plan for a joint IMBER/GLOBEC activity in the Southern Ocean. There are also two European initiatives that are closely aligned with IMBER. These are EUR-OCEANS, which is a European Union-funded Network of Excellence and CARBOCEANS, which is an EU-funded Integrated Project focused on the marine carbon cycle. A close association between IMBER and EUR-OCEANS is developing, which will be facilitated by the co-location of their IPOs at IUEM in Brest.

Implementation of IMBER

At the recent SSC meeting a more detailed plan was developed for the implementation of the IMBER project. This will involve setting up a number of working groups to take forward sections of IMBER research. A joint IMBER/SOLAS working group has already been formed to develop a joint implementation plan for the two projects on marine carbon research. This plan will be published electronically later this year. Another important working group will be an End-to-End Food Webs Working Group that will be jointly developed between IMBER and GLOBEC. This group will be developing plans for taking forward both experimental and modeling approaches of end-to-end food web studies. A small data management working group will be formed once the Deputy Executive Officer has been appointed and will be responsible for developing IMBER's data management policy and plans. These will be implemented in close collaboration with several other marine research projects. A small capacity-building working group has also been formed and has been charged with developing a capacity-building policy for IMBER that can be used by all the working groups in their planning.

Acknowledgements

I would like to thank Ed Urban, Wendy Broadgate and Claire Hamilton for their excellent support of the IMBER project and Bill Young and John Bellamy for their work in preparing the IMBER *Science Plan and Implementation Strategy* for publication. Special thanks must also go to Plymouth Marine Laboratory for supporting the Interim IMBER International Project Office in 2004/05.

IMBER Budget

Income	2004	2005	2006
SCOR - NSF (IMBER)	\$48,951	\$60,061	\$50,000
SCOR - NSF (Carbon Coordination)		\$4,000	\$2,000
SCOR - NSF (Travel Grants)		?	?
SCOR Carry-over from Previous Year	\$0	\$0	\$9,547
IGBP to SCOR	\$18,480	\$20,000	\$20,000
IGBP directly for Gorick figure	\$1,520		
PML	£13900	£11100	
			150000 euros
IPO (France)			
Proposals for Specific Activities			
National Contributions to international SSC Activities?			
National Hosting of Meetings?			
Total Income	\$68,951	\$84,061	\$81,547
Expenses			
Representation at other meetings	\$3,603	\$12,000	\$12,000
Interviews for EO Position		\$5,275	
Website costs		\$216	
Gorick Figure		\$1,250	
Other SCOR Admin	\$351		
NIWA Expenses		\$1,011	
PML Expenses	£13900	£11100	
			150000 euros
IPO (France)			
SP/IS Editorial Meeting	\$5,219		
SSC Meeting	\$29,344	19,162.37	\$25,000
SSC Executive Committee Meeting	\$15,741	\$12,000	\$12,000
SP/IS		\$4,600	
Brochures		\$1,000	
Joint SOLAS-IMBER-LOICZ Ocean Carbon Group	\$13,101	\$10,000	\$10,000
Data Management Subcommittee		\$0	
End-to-end Food Webs Working Group		\$8,000	\$8,000
			seek funding
Send people to EUR-OCEANS meeting			
Planning Meeting for T2 (I1)			
Planning Meeting for T2 (I3)			\$10,000
		seek funding	seek funding
Continental Margins Open Science Meeting		seek funding	seek funding
		seek funding	seek funding
Human Dimensions Working Group		seek funding	seek funding
Total Expenses	\$67,359	\$74,514	\$77,000
Remaining Balance	\$1,592	\$9,547	\$4,547

Annex 8

SOLAS International Project Office

Annual Report to SCOR 2004/2005

SOLAS Implementation Plans

The Surface Ocean – Lower Atmosphere Studies (SOLAS) Science Plan and Implementation Strategy was published on the Web and in hardcopy in late 2003 to early 2004, and this posting marked the start-up phase of SOLAS.

The next critical stage of the program was undertaken in mid- to late 2004, with meetings of three Implementation Groups (IMPs) representing the three foci of SOLAS:

Focus 1: Biogeochemical Interactions and Feedbacks between Ocean and Atmosphere

Focus 2: Exchange Processes at the Air-Sea Interface and the Role of Transport and Transformation in the Atmospheric and Oceanic Boundary Layers

Focus 3: Air-Sea Flux of CO₂ and Other Long-Lived Radiatively Active Gases

It is of significant importance that the Implementation Plan for Focus 3 has been developed jointly with scientists from the Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) project. As of May 2005, the Focus Groups have successfully developed the three Implementation Plans, and these are under review by the SOLAS Scientific Steering Committee (SSC). After the review process is complete, the text of the Implementation Plans will be available on the Web and the IMPs will move into action to execute the science.

SOLAS Scientific Steering Committee

The SOLAS SSC met in Tokyo, Japan, for two and one-half days near the end of May 2005. After this meeting adjourned, the SSC members were invited to participate in the Asian SOLAS meeting for the remainder of the week.

Original membership of the SSC (2001-2003):

Peter Liss (Chair, UK), Microlayer/Air-Sea Overview

Ilana Wainer (Brazil), Ocean Boundary Layer Physics

Peter Schlosser (USA), Air-Sea Exchange (WCRP member)

Bill Miller (Canada), Marine/Atmospheric Photochemistry

Katherine Richardson (Denmark), Biological Oceanography

Phil Boyd (New Zealand), Marine Biogeochemistry

Truls Johannessen (Norway), Ocean Carbon

Doug Wallace (Germany), Air-Sea Exchange of Greenhouse Gases

Patricia Matrai (Vice-Chair, USA), Air-Sea Sulfur Exchange

Ulrich Platt (Germany), Air-Sea Halogen Exchange

Barry Huebert (USA), Atmospheric Aerosols

Mitsuo Uematsu (Japan), Atmospheric Aerosols

Elsa Cortijo (France), Palaeo Studies

Ken Denman (Canada), Biogeochemical Modeling (WCRP member)

Dileep Kumar (India), Coastal Studies

Gerbrand Komen (Netherlands), Atmospheric Boundary Layer

Tim Jickells (UK), Air-Sea Exchange of Nutrients

Changes to the membership of the SSC:

Jan 2004:	Departed -	Ilana Wainer, Brazil, Ocean Boundary Layer Physics
	Replacement-	Wade McGillis, USA, Ocean Boundary Layer Physics
	Departed -	Katherine Richardson, Denmark, Biological Oceanography
	Replacement-	Osvaldo Ulloa, Chile, Biological Oceanography Christiane Lancelot, Belgium, Biological Oceanography
Jan 2005:	Departed -	Phil Boyd, New Zealand, Marine Biogeochemistry
	Replacement-	Shigenobu Takeda, Japan, Marine Biogeochemistry
	Departed -	Gerbrand Komen, Netherlands, Atmos. Boundary Layer
	Replacement-	Gerrit DeLeeuw, Netherlands, Atmos. Boundary Layer
Jan 2006:	Departed -	Dileep Kumar, India, Coastal Studies
	Replacement-	Guang-Yu Shi, China, Coastal Studies
	Departed -	Elsa Cortijo, France, Palaeo Studies
	Replacement-	Isabel Cacho Lascorz, Spain, Palaeo Studies
	Departed -	Peter Schlosser, USA, Air-Sea Exchange (WCRP member)
	Replacement-	Sergey Gulev, Russia, Air-Sea Exchange (WCRP member)

SOLAS International Project Office

With the establishment of the SOLAS International Project Office (IPO), funded for 5 years by the U.K. National Environmental Research Council (NERC) and housed at the University of East Anglia in Norwich, SOLAS coordination and networking is moving forward rapidly.

The IPO has undergone significant changes over the latter months of the reporting period. As of June 1, Casey Ryan has resigned his post as Officer of the IPO in order to pursue graduate studies, and Dr. Jeffrey Hare has been appointed as Executive Officer (EO) of the IPO. Jeff comes to the office from the University of Colorado, where he worked for nearly 10 years as a research marine micrometeorologist in the NOAA Environmental Technology Laboratory in Boulder.

In March 2005, Ms. Emilie Breviere of the Centre de Calcul Recherché et Réseau Jussieu (CCR) at the University of Pierre and Marie Curie in Paris, was appointed as IPO Project Officer. She begins her work in the IPO on September 1 and will receive her PhD in marine CO₂ research shortly thereafter.

Dr. Martin Johnson and Dr. Susanne Kadner of the School of Environmental Sciences at UEA have been working in the IPO for the last several months of the reporting year, diligently maintaining the office structure during the significant personnel changes. In addition, Martin and Susa are performing the administrative tasks for the 2005 SOLAS Summer School.

National Networks

Many countries have SOLAS activities in the planning stages, but research activities are already taking place in many countries. Some highlights are presented below.

- Australia – Much SOLAS-related research is happening within the country (at CSIRO, ACECRC, etc), and collaborations with scientists from New Zealand are frequent. Activity within the nation should accelerate if the proposed Australia-based joint Land-Ocean Interaction in the Coastal Zone (LOICZ)/SOLAS office is realized.

- Belgium – The Belgian Federal Science Policy (BELSPO) has generously contributed funds to allow Dr. Veronique Schoemann to act half-time as the Secretariat for IMP1 over a 2-year period beginning January 2005. This agency has also provided funding for 2 years for 13 research groups within the nation to consolidate SOLAS research activities by setting up a Cluster. The funding will establish a communications office at the Université Libre de Bruxelles (ULB), establish a database management strategy, help to coordinate modeling efforts, and assist in the set up of a national Web site. In May 2005, the 37th Liege Colloquium on Ocean Dynamics focused on Gas Transfer at Water Surfaces (relevant to SOLAS Focus 2) and was hosted by Dr. Alberto Borges of the Université Liege. The Sea Ice Biogeochemistry in a Climate Change Perspective (SIBCLIM) project, headed by scientists at ULB, took part in the Ice Station Polarstern (ISPOL) experiment in the Weddell Sea during Nov. 2004-Jan. 2005 and conducted measurements of Fe, CO₂, and DMS in association with biological activity. In the near future, ULB will organize and host a 2006 DMS modeling workshop (SOLAS Focus 1), a SOLAS-related expression of intent has been submitted for the International Polar Year (IPY), and a call for proposals from the BELSPO 3rd Scientific Plan for Sustainable Development will be answered by making use of the SOLAS-BE Cluster.
- Brazil – There are four major experimental efforts listed on the SOLAS-BR Web site. These are (1) FluTuA – Turbulent Fluxes over the Tropical Atlantic, (2) Numerical Study of the Surface Fluxes in the South Atlantic, (3) Sea Waves and Coastal Monitoring at Sao Paulo State, and (4) Global Scale Studies of Oceanic Fluxes using Remote Sensing.
- Canada – The C-SOLAS program is one of the first funded national programs within SOLAS, and their five-year funding cycle is now wrapping up. Beginning immediately after the Feb. 2000 Open Science Meeting in Damp, Germany, the Canadians quickly developed their national program, obtained funding for a five-year period, and began the scientific effort. The science program is structured into three inter-related themes: (1) Biogeochemical interactions and feedbacks between oceans and atmosphere (DMS-climate connection, halogen-climate connection, carbon-climate connection, iron-climate connection), (2) Exchange processes at the air-sea interface, and (3) Integration and modeling. C-SOLAS has developed a network of 43 researchers from 9 universities, 22 government researchers, 2 industrial partners, and (most significantly) over 30 graduate students. For the field phase of the work, a series of cruises was planned and conducted (SERIES and SABINA) and a mooring was placed in the vicinity of Ocean Station Papa in the Northeast Pacific Ocean. Over 20 refereed publications have resulted from this work. At the present time, the C-SOLAS network is working to secure funding to continue work after the mid-2005 end of the 5-year funding period. The main Canadian funding agency (NSERC) has placed a temporary moratorium on longer-term (5-year) funding for network projects, but the CFCAS foundation initiated a call for proposals for work on the Arctic climate. The C-SOLAS network held a national open science conference and planning meeting to take advantage of this opportunity, and they have drafted a proposal addressing impacts and feedbacks of biogeochemical trace gases on Arctic climate. This project links appropriately with the International Polar Year (IPY), and the proposal will be submitted near the end of 2005.
- Chile – SOLAS-related research within this nation is conducted under the umbrella of the COPAS (Centro de Investigación Oceanográfica en el Pacífico Sur-Oriental) institute in Concepción, and a number of scientists are conducting SOLAS research within the institution. There are plans underway to coordinate SOLAS research with the upcoming CLIVAR Variability of American Monsoon Systems (VAMOS) Ocean Cloud Atmosphere Land Study (VOCALS) intensive field program in October 2007, and this collaboration involves significant participation by Chilean SOLAS researchers.
- China (Beijing) – China SOLAS has made significant strides over the past few years. So far, Chinese scientists have received over US\$1 million to conduct SOLAS research in 2003 to 2007, and networking with national neighbors (China-Taipei, Korea, Japan, etc.) has increased, and national scientists look forward to more progress in international cooperation across the Asian network. An Asian-SOLAS meeting was conducted in May 2005 in Tokyo, coincident with the SOLAS SSC meeting. Scientists from India, Japan, China (Beijing), China (Taipei), and Korea made presentations at the meeting. The Chinese are

focused on the effects of dust and marine primary productivity, nitrogen loading in coastal waters and marginal seas, processes controlling mass and energy exchange at the air-sea interface, variability of CO₂ fluxes between the air and sea, and the effect of these fluxes on cloud and radiative budgets. Cruises are planned in the Yellow Sea in 2005 and 2006 and in the South China Sea in 2006. Finally, China will host the next International SOLAS Open Science Conference in Xiamen, March 6-9, 2007.

- China (Taipei) – National scientists continue to participate in three major SOLAS activities: (1) Long-term Observation and Research of the East China Sea (LORECS, whose goal is to investigate the biogeochemical processes in the East China Sea that lead to uptake of carbon dioxide and to detect changes due to the damming of the Yangtze River), the (2) Straight Watch on the Environment and Ecosystem with Telemetry (SWEET), and (3) the South East Asia Time-Series Station (SEATS; a long-term buoy deployment in the South China Sea to understand upper ocean dynamics and variability of biogeochemical fluxes).
- Denmark – The Danish SOLAS team was involved in the EU-funded Marine Effects of Atmospheric Deposition (MEAD) project, which investigated the effects of nitrogen deposition on coastal water biogeochemistry. There are plans to gain national funding to continue the work with the Danish SOLAS community. Further studies are also planned for investigation of the air-sea exchange of aerosols, toward making improvement to existing parameterizations. The SOLAS network is particularly adept at obtaining funds for European cooperative projects (EU funding) and will pursue more money for SOLAS-relevant research within the EU Sixth Framework programme.
- France – Although France has not yet consolidated their SOLAS research efforts into a national network, a meeting is scheduled in Paris in September 2005 to create SOLAS-Fr. French scientists are very active in SOLAS-related research, so the assembly of a national network is important for the international effort. In the past, the French program operated under the moniker of PROOF (acronym for biogeochemical processes in the ocean and fluxes). This program had three main themes: (1) interaction between climatic changes and biogeochemical cycles through the ocean/atmosphere interface, (2) effects of climate change and natural variability on the functional structure of marine ecosystems and on biogeochemical cycles, and (3) calibration of palaeo-proxies in the ocean. Eight national SOLAS projects were sponsored by PROOF: ACTION (quantifying seasonal and interannual variations of the air-sea carbon dioxide flux in the Mediterranean Sea), BIOSOPE (biogeochemical and optical properties of trophic regimes in the South East Pacific Gyre during the austral summer), FLEMENCO₂ (estimation of regional air-sea fluxes of carbon dioxide), KEOPS (prediction and response of the Southern Ocean to climate change), OCEVAR (interactions between climate variability and marine biogeochemical cycles on a global scale), POMME (understanding subduction mechanisms in the northeast Atlantic), UVECO (effect of UV radiation on bacterial and phytoplanktonic communities), DYFAMED (long time-series measurement station with addition of carbon dioxide and other fluxes). Most of these programs are ongoing, but the addition of the SOLAS-Fr umbrella should create a more effective national network.
- Germany – German scientists are quite active in SOLAS research, combining institutional (the Max Planck Institutes) and university researchers. The D-SOLAS effort has focused on dust deposition, iron chemistry in aerosols and the sea, biogeochemistry, sulfur and halogen-chemical transformations in the atmosphere, and the air-sea fluxes of nitrogen and carbon compounds. Some efforts have been placed into developing the network, and a proposal was submitted to the national science agency in 2004. The D-SOLAS network is now planning a major proposal submission for a program called Surface Ocean Processes in the Anthropocene (SOPRAN) to their national funding agency. The SOPRAN project has four main foci: (1) interphase transfer at the air-sea interface, (2) effect of anthropogenic CO₂ on marine ecosystems and sea-air flux of gases, (3) production and emission of radiatively and chemically active gases in the tropics, and (4) the oceanic response to dust deposition. Significantly, D-SOLAS has teamed up with UK-SOLAS to plan the development of a unique atmospheric (UK) and oceanic (D) observatory in the Cape Verde Islands. Cruises and aircraft flights funded by each nation in the vicinity of the observatory are also planned, making optimal use of the facility and the continuous data set.

- India – In late 2003, a meeting was held in Pune to coordinate SOLAS and IMBER projects. Although resources are limited, a total of 10 project proposals were submitted to the national science foundation in mid-2004. The proposals were strongly collaborative in nature from institutional and university scientists, and focused on IMBER and SOLAS research areas.
- Ireland – A number of researchers are working on SOLAS-related research within the nation, and a planning and coordinating meeting was held in Galway during April 2005.
- Japan – Significant progress in the SOLAS-Jp network was demonstrated during the mid-2005 Asian SOLAS Workshop, held coincident with the Tokyo meeting of the SOLAS SSC. Research results were presented from the two Sub-Arctic Ocean Enrichment and Ecosystem Dynamics Study (SEEDS) iron enrichment cruises, measurements of bromomethanes and radical molecules in the atmosphere, time-series measurements, modeling of ecosystems, and results from the Studies on Antarctic Ocean and Global Environment (STAGE) experiment. The goals of the SEEDS experiments were to evaluate the iron enrichment as a way of carbon dioxide sequestration and to evaluate the effects of iron enrichment to marine ecosystems, while STAGE is a 5-year series of cruises into Antarctic waters which is in its final year of funding. An international symposium on the SEEDS experiment is scheduled for mid-October 2005. Other SOLAS activities include the Variability of Marine Aerosol Properties (VMAP) program, which seeks to exploit natural and man-made releases of sulfur compounds for studies of nutrient enrichment, and the Subtropical Nitrogen Fixation Flux Study (SNIFFS) which is due to occur from May to August 2006 in the subtropical North Pacific Ocean. SOLAS-Jp is currently working to develop strong proposals for funding over the next 3-5 years.
- Korea – There are SOLAS activities within the nation, much of it occurring at the Korean Ocean Research and Development Institute (KORDI). In addition, university researchers are working on controlled biogas transfer experiments, biogeochemical cycling, and other SOLAS research areas.
- Netherlands – The SOLAS network in the Netherlands held a well-attended workshop in 2001, and the universities and government laboratories in the nation have a tradition of strong science in SOLAS research areas and have been successful at developing international projects funded by the EU. Experimental studies were conducted, such as the Carbon Uptake in the Southern Ocean (CARUSO) project, which was granted approximately €1M by the EU and sought to understand the impact of iron and light on the uptake of CO₂. The EU project (€2.5M) Iron Resources and Oceanic Nutrients Advancement of Global Environmental Simulations (IRONAGES) was a series of cruises with the intent of making improvement to biogeochemical cycling with 12 participating institutions. Other EU experimental programs were conducted, such as LUMINY (investigation of bubble plumes in a wind wave chamber) and the Atmospheric Nitrogen Inputs in the Coastal Environment (ANICE) project.
- New Zealand – Following on the successful FeCycle experiment in 2003, national funding was acquired for the Spring 2004 SOLAS Air-Sea Gas Exchange Experiment (SAGE). Scientists from New Zealand, Australia, the United States, Canada, and the United Kingdom participated in this experiment to investigate the biological response to iron enrichment and gas transfer with a dual-tracer injection. From this experiment, the New Zealand network has gained strength and is led by scientists from the National Institute for Water and Atmospheric Research. Future NZ-SOLAS research includes investigations of event-based dust storms from Australia, and they plan to follow up on the two previous cruise expeditions with more perturbation and natural event investigations.
- Norway – Norwegian SOLAS at present does not have direct national funding for SOLAS science, but several activities are underway within the country. The Norwegians have been successful in obtaining EU funds for their SOLAS-related research, including work toward long term measurements of natural carbon dioxide variability in the North Atlantic Ocean (EU-CAVASSOO, which includes scientists from the United Kingdom, Germany, France, Spain, and Norway). Norwegian SOLAS scientists are involved in

investigations of the cycling of bioreactive gases between the air and sea, mesocosm perturbation experiments, coupled 3-d modeling, etc.

- Russian Federation – There are several research units within the Russian Federation that have long traditions in the investigation of physical and biogeochemical processes in the upper ocean and lower atmosphere. Development of the Russian national SOLAS research programme has been coordinated with the planning for the National Federal World Ocean Programme for 2003-2007. A national climate program exists, and SOLAS-related studies here include atmospheric anthropogenic gases and chemical components of the Earth climate. The national network has not fully developed, although many researchers are working within SOLAS fields.
- Spain – Specific funding for SOLAS research is not available at the national level, but a working group has been established within the general structure of IGBP-Spain. Spanish scientists work on quantification of air-sea carbon dioxide exchange and the marine biotic effects on this flux, the investigation of links between DMS and climate, the deposition of inorganic and organic compounds and marine productivity and respiration in oligotrophic environments. A number of Spanish graduate students attended the SOLAS Summer School 2003 (and more will attend the Summer School in 2005), and some of their research was presented at the Spring 2005 Gas Transfer at Water Surfaces colloquium in Liege, Belgium.
- United Kingdom – The UK-SOLAS programme has been developed in close cooperation with the Atlantic Meridional Transect project (north-south transects through the eastern Atlantic from 2002-2006) and the Centre of Excellence for the observation of air-sea interactions and fluxes (CASIX, funded from 2002-2007). The National Environmental Research Council (NERC) programme UK-SOLAS was initiated in early 2004 with £11M over 5 years. Recently, eleven Round One projects were selected for funding, and a planning workshop was held in Exeter in July 2005. Projects include an investigation of dust deposition impacts on microbiota, DMSP and glycine betaine impact on DMS and NH_3 production, global aerosol modeling, the role of algal bacteria in DMS fluxes, dust outflow and deposition, the role of bacterioneuston in air-sea fluxes, oxygenated volatile organic compound fluxes, the impact of coastal upwelling on air-sea gas fluxes, sea spray and whitecap studies, deep ocean gas exchange, and high-wind carbon dioxide flux measurements. A subsequent call for proposals for research in halogen dynamics in the surface ocean and lower atmosphere has been tendered. Funding has also been approved for the installation of SOLAS atmospheric sampling station in Cape Verde, and D-SOLAS will be coordinating some of their activities around this station as well. NERC has also generously provided funding for the SOLAS-IPO over a 5-year period beginning in 2004.
- United States – The U.S. program is in the initial stages of science and implementation plan development, site selection for the national project office, and network solidification. It is hoped that the network development will accelerate and that funding can be secured from a consortium of the National Science Foundation (NSF), the National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautics and Space Administration (NASA). As a scientifically powerful, relatively well-funded nation, a healthy US-SOLAS program is of fundamental importance to the continued success of the international effort.

Other Activities

The first SOLAS Summer School was organized by Corinne Le Quéré and Véronique Garçon in June 2003. 75 students and 24 lecturers attended and we received very positive feedback. The IPO and national contributing scientists have successfully acquired funding to conduct the 2005 SOLAS Summer School (also in Corsica), and plans are underway to continue through 2007. The Summer School is highly successful, and represents one of the real highlights of International SOLAS, as development of the next generation of SOLAS scientists is of high priority within the program.

The First SOLAS Open Science Conference was held in Halifax, Nova Scotia, Canada on October 13-16, 2004. This meeting of all international science contributors was organized by the Canadian SOLAS Secretariat and provided a

unique forum for networking. Twenty plenary lectures and more than 175 posters were presented, and the meeting was attended by over 250 scientists and students from 24 countries. The next Open Science Conference is planned for March 2007 in Xiamen, China and is being organized by the local hosts.

The Task Team on Organic Aerosols (IGAC/SOLAS/iLEAPS) met in Hyytiälä, Finland in May 2004 to define the outstanding scientific questions related to halogen chemistry in the troposphere and to develop a network of interested scientists and coordinating activities. A report will be circulated soon.

The Task Team on Halogens in the Troposphere (HitT; SOLAS/IGAC) also held its first meeting in May 2004. A full report has been developed and will be distributed shortly.

The Atmosphere-Ice Chemical Interactions (AICI) Task Team is under development.

The Ocean-Atmosphere-Sea Ice-Snow (OASIS) project has been endorsed by SOLAS. This large international project has links with the International Study of Arctic Change (international SEARCH) and may be complemented by the work of the Climate in the Cryosphere (CliC) Arctic Panel. The International Polar Year (IPY; March 2007 - March 2009) should provide a platform for OASIS, HitT and many other areas of SOLAS.

In conjunction with the International Nitrogen Initiative (INI), SOLAS has endorsed a review of anthropogenic nitrogen impacts on the open ocean. This review will generate a published paper explaining the state of the science and the outstanding scientific issues which must be addressed. A workshop is being planned for the near future.

The Iron Fast Track Initiative meeting was held at the University of East Anglia in April 2004 with 20 participants. The meeting was sponsored by an ICSU grant with additional support from SCOR for 3 developing country participants. The results of the meeting formed the basis of one published review paper (Jickells et al., 2005 *Science*, v308, p67-71) and two submitted papers (An et al. and Mahowald et al.) to *Global Biogeochemical Cycles*. A fourth paper is in preparation and an article also appeared in the Spring 2005 *IGBP Newsletter*.

A SOLAS-initiated meeting to review the results of the various large-scale iron enrichment experiments will take place in Wellington, New Zealand on Oct 30-Nov 4, 2005. This meeting will include 20 scientists representing all major experiments, plus experts in various other aspects of ocean iron biogeochemistry. The aim of the meeting is to synthesize the results of the eleven enrichment experiments, along with results from natural iron addition systems such as island plumes.

Capacity Building and Inclusion of LDC scientists

The main capacity-building activity of SOLAS is the biennial SOLAS Summer School. 10 young scientists from developing countries attended the 2003 school, supported by the IOC and SCOR. The SOLAS IPO is developing the lectures from the summer school into an online learning tool. Currently, the presentations are available on the summer school Web site, but these will be expanded into an online reference. These will be sent on CD to all those who applied for the summer school, and to anyone else who requests a CD. It will also be available on the Web. The IPO will also provide free hard copies or CDs of the *SOLAS Science Plan and Implementation Strategy* to anyone who requests one. There was made available approximately ~\$30k (US) for young scientists from developing countries to attend the 2004 SOLAS Open Science Conference in Halifax, generously provided by SCOR, the Asia Pacific Network (APN), and the Inter-American Institute for Global Change Research (IAI).

Jeffrey Hare
Executive Officer, SOLAS International Project Office
July 2005

Annex 9

GEOTRACES PLANNING GROUP ANNUAL REPORT TO SCOR 2004/2005 May 2005

Development of Science Plan for GEOTRACES

The primary goal of GEOTRACES SCOR planning group activity over the past year has been to set the priorities for the programme and to incorporate these into a cogent and comprehensive Science Plan. A draft of the *Science Plan* was completed in February 2005 and posted for public comment on the Web (at <http://www.ldeo.columbia.edu/res/pi/geotraces/index.html>). Comments were received from more than 40 people. These were uniformly positive, and suggested a number of areas where the plan could be further strengthened. Suggestions have now been discussed and incorporated (see below) and a complete version of the *Science Plan* is now ready for review.

Meetings

- Oxford, UK (June 2004): This first full SCOR Planning Group meeting outlined the structure of the *Science Plan* and commenced the work of writing it. Individual members of the Planning Group were tasked with writing subsections of the plan following this meeting.
- Boston, USA (December 2004): A subgroup of the SCOR Planning Group (10 people) met to discuss the first complete draft of the *Science Plan* and comments on this plan from members of the Planning Group. Changes to the structure and content were initiated at Boston and completed following this meeting.
- Vienna, Austria (May 2005): The second full SCOR Planning Group meeting responded to comments from the wider ocean geochemical community with a thorough revision of the *Science Plan*. This meeting also set up Standardisation and Data Management Sub-Committees, discussed other enabling activities, and planned overall implementation of the programme.

Establishment of Sub-committees

In the first instance, two subcommittees are considered essential to the realisation of GEOTRACES goals:

- i) *Standardisation and Intercalibration*: Just as WOCE and JGOFS found that standards were essential to measurement of carbon system parameters, well-constrained standards are essential to accurate measurement of trace elements and isotopes. This will ensure that data can be compared readily among different laboratories, and among different oceanographic regions.
- ii) *Data Management*: Robust storage of all GEOTRACES data and its rapid retrieval will clearly be important to achieve full use of new data, and to maximize rewards from the programme.

The reasons for establishment of these sub-committees are discussed fully in the *GEOTRACES Science Plan*. Both issues are of major importance and require significant work, so that a subcommittee is required for each task.

Future Issues

The GEOTRACES Planning Group is looking forward to the SCOR review of the *Science Plan* and to addressing the comments received from reviewers. We are aware that we will need to move to an SSC and establish an IPO in the near future. These issues are of higher priority now that the *Science Plan* is ready for review.

Links with Other Programmes

Throughout the planning of GEOTRACES we have maintained close linkages to other programmes in order to maintain synergies and to avoid replication. Major links have been established with

- SOLAS, is represented on the GEOTRACES planning group by Tim Jickells. SOLAS has also been asked for and provided input on a draft of the *Science Plan*.

- *IMBER*. Raymond Pollard is a member of both the GEOTRACES Planning Group and the IMBER SSC. Gideon Henderson is co-chair of the GEOTRACES Planning Group and attended the 2004 IMBER Meeting (Plymouth, August 2004). IMBER has also been asked for and provided input on a draft of the *Science Plan*.
- *Two SCOR/IMAGES working groups* (PACE, #123; LINKS, #124) are represented on the GEOTRACES Planning Group (by Jess Adkins and Roger Francois, respectively).

All members of the Planning Group named above attended the Vienna meeting and contributed to revision of the Science Plan.

We also have established less formal links with other programmes including IMAGES, CLIVAR, and InterRidge.

Developments at national and international levels

National Planning activities/workshops:

	Date	activity	Info:
Canada:	7-9 June 2005	just after SOLAS workshop, forum to discuss: <ul style="list-style-type: none"> - Canadian contribution to GEOTRACES - mesh with Canadian SOLAS/IMBER - GEOTRACES-related Canadian contributions to IPY - setting up a "C-GEOTRACES Network" in 2006 	Roger Francois UBC
China-Beijing	August 2005	Regional workshop on GEOTRACES Xiamen	Minhan Dai Xiamen University
Western Pacific		Proposal to the U.S. NSF requesting funds to expand the national GEOTRACES planning workshop in China to become a western Pacific regional planning workshop. Contacts in Korea, Hong Kong, Taiwan, Japan and Australia who have expressed interest in participating.	Yan Zheng and Bob Anderson, LDEO
India		discussions about developing an institute or a national plan for GEOTRACES-related research	S. Krishnaswami, PRL
Germany	Jan., May, Oct. 2004	submission of a priority program to the German Funding agency DFG	Michiel Rutgers van der Loeff, AWI
Japan	May 2005	GEOTRACES Subcommittee set up under the National Committee for SCOR Members: Y. Sano, H. Ogawa, H. Amakawa, H. Obata, S. Takeda, Y. Kumamoto, Y. Sohrin, M. Yamada, M. Minagawa, Y. Yamanaka, H. Kawahata, Y. Kato, J. Zhang, T. Gamo	Toshi Gamo ORI - Tokyo
Spain		Proposal for pilot project in Atlantic Ocean / Drake Passage	Pere Masqué UAB
France		Informal workshops to discuss on the "margin" topic. proposed (pre-) GEOTRACES cruises: BONUS (IPY, G Sarthou) and PRIMO (Peru-Chile Margin and OMZ, Y. Dupenhoat)	Catherine Jeandel LEGOS

The International Polar Year (IPY):

IPY 2007-2008 provides an opportunity for a major joint effort in polar research. Out of 901 Expressions of Intent (EOI) submitted to the IPY Planning committee (www.ipy.org), seven were related to GEOTRACES. These tracer studies will be performed in coordination with a wide range of interdisciplinary studies. Related oceanographic programs are iAOOS for the Arctic and CASO for the Antarctic. The coordination structure is presently under discussion.

Acronym	title	PI	Country
	<i>Bipolar</i>		
GEOTRACES Umbrella	GEOTRACES: An international study of the biogeochemical cycles of trace elements in the Arctic and Southern Oceans	Anderson	USA
	<i>Antarctic</i>		
U.S. GEOTRACES	U.S. GEOTRACES: Biogeochemical cycles of trace elements in the SW Pacific Sector of the Southern Ocean	Anderson	USA
MACS 07-08	Micronutrients in Antarctic coastal seawaters — determinants of primary production	Butler	Australia
BONUS	Biogeochemistry of the southern Ocean: interactions between NUtrients, dynamics, and ecosystem Structure	Sarthou	France
ZERO&DRAKE	ZERO&DRAKE: Synoptic transects of trace elements and their isotopes in the AntArctic Ocean. A contribution to the international GEOTRACES program	De Baar	The Netherlands
	<i>Arctic</i>		
Arctic GEOTRACES	Synoptic transects of trace elements and their isotopes in the Arctic Ocean. A contribution to the international GEOTRACES program	Rutgers van der Loeff	Germany
Canadian GEOTRACES	Canadian GEOTRACES in the Arctic	François	Canada

GEOTRACES: Spreading the word

We have strived to engage the wider research community through special sessions at a number of conferences, and by publication of two articles in relevant newsletters.

Conferences:

- Special session at European Geosciences Union, Vienna (April 2005), “*Cycling of trace elements and their isotopes in the oceans*”. Convened by M. Rutgers van der Loeff, C. Jeandel, G. Henderson, M. Frank.
- Special plenary session at the International Ocean Research Conference, sponsored by The Oceanography Society and UNESCO's Intergovernmental Oceanographic Commission, Paris (June 6-10, 2005), “*Biogeochemical Cycles of Trace Elements and Implications for Marine Ecosystems*”. Convened by R.F. Anderson (GEOTRACES) and T.D. Jickells (SOLAS).

Publications:

- “GEOTRACES gathers speed”, R.F. Anderson, G.M. Henderson, *Global Change Newsletter IGBP*, No. 60 December 2004
- “New International Study to Focus on Trace Elements and Isotopes in The Ocean”, R.F. Anderson, G.M. Henderson, *U.S. JGOFS Newsletter*, November 2004.

Acknowledgements

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Budget for GEOTRACES

	2004	2005	2006
Carry-over		\$28,508	-\$1,130
<u>Income</u>			
SCOR	\$11,989		
NSF	\$6,492	\$29,167	\$50,000
LDEO (Boston Meeting)	airfare/meals		
Total Income	\$18,481	\$57,675	\$48,870
<u>Expenses</u>			
Publications		\$10,000	
Oxford Meeting	\$16,391		
Boston-LDEO	airfare/meals		
Boston-SCOR	\$2,091		
Vienna Meeting		\$26,805	
2006 SSC Meeting			\$25,000
DM Comm. Meeting		\$10,000	\$10,000
Std/Protocol Meeting		\$12,000	\$12,000
Total Expenses	\$18,482	\$58,805	\$47,000
Balance	-\$1	-\$1,130	\$1,870

Annex 10
Post-Audit Financial Statement for 2004

Income	Disc. Funds	Grants & Contracts	Total
Membership (less arrears)	255,000		255,000
APN grant for SOLAS		20,000	20,000
FAO support for WG 119 symposium		10,000	10,000
IGBP contribution for IMBER and SOLAS		21,126	21,126
IRD support for WG 119 symposium		10,537	10,537
Marine Minerals Service re WG 111 (used in 2004)		6,996	6,996
NSF Grant / Travel Awards	10,000	61,857	71,857
NSF Grant / Science Activities	74,048	264,091	338,139
NSF Grant / GLOBEC ESSAS		2,003	2,003
NSF Grant / Ocean Carbon Observations		31,010	31,010
NSF Grant / WG 121 Conference		25,000	25,000
NOAA Support for WG 119		19,729	19,729
Norwegian Research Council for High-CO2 Symposium		15,000	15,000
ONR Grant / WG 121 Conference		15,000	15,000
Sloan Foundation for WG 118 and Proj. Coord. Meeting	6,000	49,710	55,710
Registration fees (less credit card fees):		50316	50316
Miscellaneous and Interest Income	1,409		1,409
Total Income	346,457	602,375	948,832
Expenses			
WG 109 - Iron in Seawater	3		3
WG 111 - Coastal Models	20	6,996	7,016
WG 112 - Submarine Groundwater Discharges	105		105
WG 113 - Asian Monsoons	36		36
WG 115 - Plankton Surveys	52		52
WG 116 - Sediment Traps & 234Th Methods	10,894		10,894
WG 118 - Technologies for Census		14,710	14,710
WG 119 - Quantitative Indicators Symposium		65,073	65,073
WG 120 - Phaeocystis	801		801
WG 121 - Deep-Ocean Mixing	1,030	56,713	57,743
WG122 -Sediment Retention (half from LOICZ)	8,453		8,453
WG 123 (PACE)	2,122		2,122
WG 124 (LINKS)	2,336		2,336
GEOTRACES Planning Group	15,210	6,492	21,702
Ocean Carbon Coordination	106	44,835	44,941
JGOFS	287		287
GLOBEC		70,568	70,568
GEOHAB	10,574	24,889	35,463
SOLAS	15,000	96,253	111,253
IMBER		67,431	67,431
Travel Awards	10,000	61,857	71,857
Ocean Carbon Sequestration	3,640	51,559	55,198
Data Management	1,570		1,570
Project Coordination Meeting	4,266	35,000	39,266
Technologies for Census (Panel)	6,000	-	6,000
Representation	19,566		19,566
Publications	10,387		10,387
Advertising	1,090		1,090
Annual Meeting	30,357		30,357
Salaries and Benefits	122,524		122,524
less project income for salaries	(16,000)		(16,000)
Outside Services	14,789		14,789
Communications	4,935		4,935
Office Equipment	2,370		2,370
Audit and Accounting Services	7,625		7,625
JHU overhead charges	18,811		18,811
Bank Charges	521	-	521
Miscellaneous, office supplies,	4,080		4,080
Total Expenses	313,558	602,375	915,933
Beginning Unrestricted Net Assets	178,200		
Income - Expenses (Discretionary Accounts)	32,899		
Ending Unrestricted Net Assets	211,098		

Annex 11

SCOR-Sponsored Meetings (2005-2007)

2005

February 14-16	Panel on New Technologies for Observing Marine Life	Goa, India
March 7-11	GEOHAB OSM on HABs and Eutrophication	Baltimore, Maryland, USA
March 20-23	SCOR/IMAGES WG 123 Workshop on Past Ocean Circulation	Atlanta, Georgia, USA
April 18-21	WG 116 on Sediment Trap and Th-234 Methods for Carbon Export Flux Determination	Xiamen, China
April 18-22	IMBER Scientific Steering Committee Meeting	Shanghai, China
May 1-3	GEOTRACES Planning Committee	Vienna, Austria
May 30-June 1	SOLAS Scientific Steering Committee	Tokyo, Japan
June 1-3	GLOBEC Scientific Steering Committee Meeting	Rome, Italy
June 20	WG 126 on Role of Viruses in Marine Ecosystems	Santiago de Compostela, Spain
June 23-25	WG 122 on Mechanisms of Sediment Retention in Estuaries	Texel, The Netherlands
August 29-September 1	SCOR Executive Committee Meeting	Cairns, Queensland, Australia
30 August - September 4	WG 120 Conference on <i>Phaeocystis</i> : Major Link in the Biogeochemical Cycling of Climate-Relevant Elements	Haren, The Netherlands
November 7-9	WG 125 on Global Comparisons of Zooplankton Time Series	Silver Spring, Maryland, USA
5-8 December	GEOHAB OSM on Harmful Algal Blooms and Stratification	Paris, France
December	WG 124 on Analyzing the Links Between Present Oceanic Processes and Paleo-records	San Francisco, California, USA

2006

April	WG 125 on Global Comparisons of Zooplankton Time Series	Honolulu, Hawaii, USA
18-19 May	WG 115 on Standards for the Survey and Analysis of Plankton	Plymouth, UK
June	WG 126 on Role of Viruses in Marine Ecosystems	Victoria, B.C., Canada

2007

6-9 March	SOLAS Science 2007	Xiamen, China
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