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This report is available in pdf format at http://www.scor-int.org.

SCOR Proceedings, Volume 44
REPORT OF THE XXIXth SCOR GENERAL MEETING

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XXIXth SCOR GENERAL MEETING[1]

Woods Hole Oceanographic Institution
Woods Hole, Massachusetts, USA

22-24 October 2008

1.0 OPENING

1.1 Opening Remarks and Administrative Arrangements

The SCOR President, Bjørn Sundby, opened the meeting and welcomed participants. He stated that this meeting may less exciting than the SCOR 50th Anniversary Symposium held over the past two days, but it is just as important in its own way. Because of the large number of participants and the shortness of the meeting time, Sundby encouraged everyone to get to know each other during the planned social events. He started by recalling past members of SCOR who had died in the last year: Ed Goldberg, Fritz Schott, David Cushing, Mike Fasham, and Peter Killworth. A minute of silence was observed.

1.2 Approval of the Agenda

Bjørn Sundby reviewed the agenda. Additions or modifications to the agenda as distributed may be suggested prior to approval of the final version. Sundby added the topic of how to get more value out of working groups, which would be introduced later by John Compton.

1.3 Report of the President of SCOR

Bjørn Sundby briefly reviewed his activities since the SCOR Executive Committee Meeting in August 2007 in Bergen, Norway. He attended various meetings on behalf of SCOR, including the Executive Council of the Intergovernmental Oceanographic Commission (IOC), the meeting of the Scientific Committee of the International Geosphere-Biosphere Programme (IGBP), and the second symposium on The Ocean in a High-CO_2 World in Monaco. Sundby and Ed Urban were involved in editing the book with the Scientific Committee on Problems of the Environment (SCOPE) and the International Association for the Physical Sciences of the Oceans (IAPSO) on vulnerability of enclosed and semi-enclosed marine systems. Sundby stated that SCOR is in good health and is a strong organization.

[1] This Proceedings is based on extensive notes taken by Elizabeth Gross, which Ed Urban edited and supplemented with submitted documents and PowerPoint presentations from the meeting.

1.4 Report of SCOR Executive Director

Ed Urban reported on his activities since the 2007 SCOR meeting, and on the financial health of SCOR. Urban noted that he met with several national SCOR committees in the past year, which he considers a privilege and an opportunity to find out about their concerns. The SCOR President and Executive Director are always available to do this, depending on funding and travel plans. SCOR is healthy financially, with good support from the U.S. National Science Foundation (NSF) and other sources. Urban noted the need to diversify funding sources. SCOR is very "lean" in terms of staff compared with other organizations of the International Council for Science (ICSU) with one full-time staff member and two part-time: himself, Elizabeth Gross, and SCOR's new financial assistant, Lora Carter. (The Secretariat went almost two years without an assistant.) SCOR had several grants renewed and several new grants approved in the past year. Publications in the past year were listed in his written report. The SCOPE/IAPSO/SCOR book took up a lot of his time. It should be printed in the next few weeks by Island Press. SCOR's partnerships with many organizations are healthy; the symposium in Monaco is a good example of a cooperative activity; it was a great success and SCOR can take pride in it.

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 reviewed the administration of SCOR finances during the previous fiscal year and the current year, and proposed a budget for 2009 activities. The Committee will report to the meeting in Section 8.3. The committee for 2008 was composed of John Compton (Chair), Marie-Alexandrine Sicre, and Julie Hall.

1.6 *Ad hoc* Committee to Review the Disciplinary Balance of SCOR's Activities

The Executive Committee meeting in 1999 agreed that at future SCOR meetings, after the consideration of working group proposals is complete, the current 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 agreed to continue to chair this committee and Bjørn Sundby requested volunteers to join Labeyrie. Motoyoshi Ikeda, Robert Duce, and Peter Burkill helped. Laurent asked that one of them be prepared to carry on with this after he leaves the Executive Committee, and Peter Burkill agreed.

1.7 2008 Elections for SCOR Officers

Robert Duce reported on the work of the SCOR Nominating Committee, which he chaired in his capacity as Past President, and which also included Wajih Naqvi (India), Peter Haugan (Norway), and Carmen Morales (Chile). Duce described the election process, the current version

of which was approved at the 1998 SCOR General Meeting. Wolfgang Fennel (Germany) was elected as the new SCOR President (2008-2012). Peter Burkill (UK) and Huasheng Hong (China-Beijing) were renewed as Vice-Presidents (2008-2010) and Missy Feeley (USA) was elected as a new Vice-President, to replace Victor Akulichev (Russia). Bjørn Sundby congratulated the new officers. Although not an elected position, the SCOR Executive Committee is allowed to co-opt up to two members to improve the balance of the committee and/or to serve in a specific capacity. John Compton (South Africa) accepted an appointment (to replace Laurent Labeyrie of France), to help with SCOR outreach, to add geological/paleoceanography expertise, and to increase representation on the Executive Committee from the Southern Hemisphere. Venu Ittekkot agreed to continue as a co-opted member to lead SCOR capacity-building activities.

Duce introduced a proposed change to the election procedures to add word "gender" to items 2 and 4 in the procedures (see http://www.scor-int.org/constitution.htm). (Election procedures can only be modified at General Meetings.) Meeting participants approved.

2.0 WORKING GROUPS

2.1 Getting More Value From Working Groups

John Compton introduced this discussion. He referred to the South African magazine *Quest*, which brings science to general public. Compton asked how SCOR could reach a greater audience to develop an interest in science and its societal relevance. This was discussed when Bjørn Sundby and Ed Urban met with the South African SCOR Committee in Cape Town in May. Compton proposed that SCOR request its working groups to produce small (2-page?) pdf documents with images and text with wide appeal to educated non-scientists. These products would be submitted to SCOR and SCOR would finalize them for distribution. The documents should convey the excitement of science, perhaps in the context of global change. It might be necessary to enlist the help of a journalist or intern. While some working group titles might not seem too exciting to a general audience, every working group topic could be made relevant and interesting. These documents could include references and might be a teaching tool.

Bjørn Sundby stated that this is just a small extra step for a group that has worked for 3 or 4 years, and not too much extra to expect. He would like to see such a product included as the last term of reference for all SCOR working groups. Julie Hall responded that this idea fits with recommendations she made in the SCOR 50th Anniversary Symposium. But what is to be achieved? Three very different products have been mentioned: (1) information for the public, (2) teaching materials for K-12 schools, and (3) teaching materials for university levels. The last is easy for scientists accustomed to teaching. Specialists can help with public outreach, but it is very difficult to get materials into schools; this is a special skill and requires working with people

in the education systems. Hall has been active on such activities in New Zealand. What we are expecting needs to be clearly defined. Ed Urban suggested that a group should get together to discuss these ideas in greater detail after the SCOR Meeting and help design the parameters. He mentioned the example of the outreach to teachers in Monaco after the symposium on The Ocean in a High-CO_2 World. Mike MacCracken suggested another means of outreach: maybe each working group could have a public lecture videotaped and put on the Web, through "research TV" (see www.research-tv.com).[1] Sundby also mentioned the science summary for policymakers that Carol Turley presented in Monaco. Corina Brussaard suggested that SCOR start simple, using the SCOR Web site. It's not very inviting; a working group could introduce themselves much better. Perhaps, once a year SCOR could set aside money to create one brochure-like publication to feature a working group's results. Labeyrie responded that the SCOR office doesn't have the resources to do this. He continued by discussing how the Past Global Changes (PAGES) project has done outreach. Marta Estrada cautioned that SCOR must pay attention to questions of peer-review of lectures, rights to use images, etc. Wendy Broadgate agreed with Julie Halls' earlier comment that SCOR needs to be sure it knows who the audience is. The PAGES material is largely used by other scientists. Broadgate suggested the need for partnership with communicators. IGBP and IOC do have science communicators, who helped for the symposium in Monaco, but IGBP still is working on contacts with policymakers. The Reference Users Group (RUG) of the European Project on Ocean Acidification (EPOCA) is an advisory group to EPOCA and includes environmental, industry, policymaker, and other representatives, and is a good model for outreach.

Julie Hall added that another successful model is the Euro-OCEANS program and their partnership with the Oceanopolis Aquarium in Brest, which produces material and videos (they have one on acidification, she has used it in New Zealand). Bjørn Sundby noted that SCOPE gave a contract to a journalist to write a book on biodiversity (a popularized version of a SCOPE report); the journalist worked with the project scientists and did a very good job of producing an interesting book for non-specialists. There is a lot here to explore; should we form a group to work on this? Marta Estrada suggested that the group should look at things that are already available. Ed Urban mentioned an OSB activity that produces attractive booklets for the public (see http://dels.nas.edu/osb/). Bjørn Sundby proposed John Compton, himself, Julie Hall, Missy Feeley, and Kurt Hanselmann to form a group to discuss the topic and report back later in the meeting.

They reported back that the motivation/need is to

- communicate ocean sciences understandably
- introduce others to scientific thinking and reasoning

[1]Unfortunately, Research.TV has ceased posting of new features.

- better apply scientific knowledge
- to synthesize research outcomes across scientific boundaries
- to explain research results and their implications

The audience is the interested public at large, policy and decision makers, and at an early stage, to those who will become the next generation of ocean scientists. This includes high school students and teachers, undergraduate science students and those who never thought that oceanography could be interesting. SCOR is well placed to undertake this kind of outreach because SCOR has an international network of scientists and institutions representing a broad assembly of competences and many scientific fields. SCOR leads in ocean science, through its working groups and research projects on many issues that are of great economic and ecological importance. SCOR scientists come from countries with many different languages and have a responsibility to convey the results of research that is mostly publicly funded. Inspiration can be drawn from many sources, such as good internet sites and the experience of SCOR members.

What outreach materials should be placed on the SCOR Web site? Ideas include the following:

- science stories
- commented picture series
- ocean news and highlights
- discoveries
- useful numbers, dimensions
- animations
- instructive experiments
- interactive models
- videos
- cruises
- interviews
- podcasts
- short lectures
- Webinars
- www. links with “Google key words”
- useful references
- how it works (e.g. Argo floats)
- what oceanographers do
- how to become an oceanographer

How could/should SCOR do this?

- introduce an outreach contribution into terms of reference for each SCOR-supported working group and project (at minimum for University teaching)
- develop examples of type of materials
- contact chair persons of WG and projects and ask them
  - to motivate group members to collect materials and produce suitable contents
  - to assign an outreach reporter for meetings to produce outreach material
- establish contacts with those who have experience in science outreach, for example, University of Delaware and develop networks to assist in outreach activities
- create a home for the outreach pages as part of SCOR Web site and ensure links from other key sites

Once an instructive website with a few examples has been established, SCOR should explore private and public funding for specific outreach project components (e.g., from foundations). Ideas for outreach materials and methods can be exchanged at SCOR annual meetings, and working group and project meetings, and a specially designed strategy workshop at the Bellagio Center and other centers.

Catherine Jeandel noted that it will be a challenge to accomplish all these tasks, since the individuals on the group that met here are all very busy. Laurent Labeyrie added that this needs a dedicated person and would take a lot of time. Lawrence Mysak added that this is an excellent initiative. The media like controversy, but it is possible to present many scientific issues in an interesting and balanced way. Several individuals asked for a copy of the outreach PowerPoint presentation, so it will be placed on the SCOR General Meeting Web site (see www.scor-int.org/2008GM/SCOR_outreach.ppt). Julie Hall noted that this discussion had mostly focused on pushing out information, but we must also work on engaging with policy makers and resource managers. SCOR should develop a strategy for outreach, including this aspect, for the next meeting.

2.2 Disbanded Working Groups

2.2.1 WG 78—Determination of Photosynthetic Pigments in Seawater

Ed Urban reported that chapters of the book are still being completed and a suitable non-profit publisher is still being sought. So far, Cambridge University Press and Island Press have declined to publish the book.[1] Other non-profit publishers are being considered. Urban asked for suggestions of potential editors. It is important to ensure that the book is inexpensive and easily available.

[1]Cambridge University Press reversed its decision and will publish the book.

2.2.2 SCOR/IOC WG 119—Quantitative Ecosystems Indicators for Fisheries Management

Ed Urban reported that, in 2007, the SCOR Executive Committee approved that leftover registration fees from WG 119's symposium be used for a workshop on "Coping with global change in marine social-ecological systems". This workshop, held in Rome in June 2008, contributed to the objectives of both GLOBEC and IMBER. Ian Perry added that this workshop brought together natural and social scientists and the participants found the workshop valuable enough that other such events should be planned in the futures.

2.3 Current Working Groups

The Executive Committee Reporter for each working group presented an update on working group activities and progress, and made recommendations on actions to be taken. The Executive Committee made preliminary decisions, based on the progress of working groups and the merits of the requests, about whether funding should be provided for 2009 activities of working groups that request funds. The Finance Committee took into account the recommendations of the Executive Committee as it developed the 2009 SCOR budget, which was then subject to final approval by the meeting.

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

Lawrence Mysak reported that this group has been around for a long time, but seems to be back on track to complete its book early in 2009. The group's book is entitled *Coupled Coastal Wind-Wave-Current Dynamics*, which will be published by Cambridge University Press. One of the co-chairs, Chris Mooers, is taking responsibility for the book and is waiting for revisions to one chapter.

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

Annelies Pierrot-Bults reported that the group held its final meeting in May 2006 in Plymouth, UK at the Sir Alister Hardy Foundation for Ocean Sciences and group members planned a series of papers for a special issue of the *Journal of the Marine Biological Association of the U.K.* Unfortunately, only one of the papers has been completed as planned and the timeline has slipped. The Executive Committee recommended that the group be disbanded without a product, since no one is stepping forward to complete a product. Even so, the working group was not a waste of time and money, since WG 125 on Global Comparisons of Global Zooplankton Times Series has built upon it. Meeting participants approved disbanding the group.

2.3.3 SCOR/LOICZ/IAPSO WG 122—Estuarine Sediment Dynamics

Bjorn Sundby reported that the group met for its final time on 23-27 September 2007 at the University of Colorado, Boulder, Colorado, USA. The meeting concentrated on completed the Terms of References of the group and defining the publication of its findings in a special issue to *Coastal and Estuarine Science*. These publications are expected in 2009. Sundby recommended

that the group be maintained and encouraged to produce the special journal issue (a member, Wolanski, is an editor of the journal that will include the special issue. This approach was approved by meeting participants. Lawrence Mysak noted that IAPSO co-sponsorship was missing in some places in the group's report.

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

Laurent Labeyrie reported that the group met for the final time on 20–24 November 2006, in Delmenhorst, Germany. It is preparing a series of 5 manuscripts that mainly target understanding the changes in ocean productivity and the connection to the recorded signal at the seafloor. The papers are designed to review the present state of the art in modern ocean process studies and in paleoceanography as well as to give recommendations for future studies. The main goal of the international workshop was the discussion of these manuscripts to finalize them for publication in a peer-reviewed journal (potentially *Biogeosciences* or *Global Biogeochemical Cycles*). Labeyrie noted that the group has not yet achieved its final goal of the symposium volume. The co-chairs have requested a one-year extension with no funding. Labeyrie recommended that the group be extended, but that the leaders must be urged to get the papers out. Ralph Schneider added that IMAGES is also concerned that the group be urged to get the report out. IMAGES was a bit more negative and decided to disband the group. Ed Urban suggested that SCOR should ask the group to come up with a "Plan B" if the chair (Karin Lochte) does not have the time to finish the job. Bjørn Sundby proposed that the group be given one more year to finish their terms of reference and meeting participants agreed.

2.3.5 WG 125—Global Comparisons of Zooplankton Time Series

Annelies Pierrot-Bults reported that the group held its final meeting in May 2008 in Gijon, Spain, before the symposium on "Effects of Climate Change on the World's Oceans". During the symposium, the group presented one jointly authored summary paper in the symposium plenary session on "Impacts on Marine Ecosystems," and also held a one-day workshop session on zooplankton time series. Papers from the working group will be collected for a special issue of *Progress in Oceanography* (editor-in-chief Cisco Werner has given pre-approval for a special issue to appear in 2009, and Pierre Pepin has agreed to serve as "arms-length" guest editor for the issue). The NOAA National Marine Fisheries Service has committed funds to bring more participants (and data) into the process. A major activity of the group has been to encourage deposit of new data in the Copepod database (see http://wg125.net/). No more meetings are planned and Pierrot-Bults recommended keeping the working group active until their final publication appears. This recommendation was approved by meeting participants.

2.3.6 WG 126—Role of Viruses in Marine Ecosystems

Jorma Kuparinen reported that the group had a very productive meeting in Bergen, Norway in May 2007. The major outcome of the Bergen meeting was a multi-lab comparison of techniques. The group established some mesocosms at the Bergen facility and used them as samples (one

with nutrients added, one without), to produce communities of differing trophic status. Different counting techniques, different virus production techniques, and different molecular tools were compared. The group's book, tentatively entitled *Methods in Aquatic Viral Ecology* is expected to be ready for publication in 2009. To date, four of the chapters have been received and are undergoing peer review to ensure the highest quality. Completion is expected by January 2009. The group and a related group from EurOCEANS published a perspective for *Nature Reviews Microbiology*. Currently, the group is planning to hold its final meeting in 2009, most likely somewhere central to most of the members. The group did not meet in 2008 since they wanted to focus on work on their book. Ed Urban suggested that more information should be obtained about the group's plan for its 2009 meeting before funding is finally approved for it.

2.3.7 SCOR/IAPSO WG 127 on Thermodynamics and Equation of State of Seawater

Lawrence Mysak reported that the group held its final meeting on 7-13 September in Berlin in conjunction with the International Association of the Properties of Water and Seawater. There will be a joint session between the two groups. IOC will consider adopting the new standard at their 2009 General Assembly. Their "Saline Gibbs Function" has the blessing of the International Association of the Properties of Water and Steam. They have published 12 papers related to their group. The group is seeking endorsement of their work by IOC to recommend the adoption of new international equation of state of seawater. The work still to be done will require another two years, although no additional working group meetings will be needed. Mysak recommended approving the extension of the group.

The group has sought comments from the community on their plans. IOC is interested since they were involved in endorsing the first equation of state. Michael MacCracken asked whether the new equation of state gives different results if used in a model. Does it change the interpretation of observations? Should we encourage our activities to use it? Mysak responded that a poster by a young scientist (Andreas Klocker) who participated in the SCOR 50th Anniversary Symposium relates to this question. Andreas Klocker responded that he hasn't actually used the new equation of state, but he thinks it will make a big difference in some applications, especially in extreme conditions like high or low salinity. Wolfgang Fennel noted some situations in which the existing equation of state doesn't work so well. He also mentioned that the new one is being implemented in some models already, including those of the Geophysical Fluid Dynamics Laboratory.

2.3.8 WG 128 on Natural and Human-Induced Hypoxia and Consequences for Coastal Areas

Robert Duce reported that the group started in 2005 and has been very active and successful. Their link with LOICZ has been active and positive. The group met for the second time on 20-23 September 2007 in Shanghai, China, in conjunction with the IMBER/LOICZ Continental Margins Open Science Meeting, where they presented a special session. Most of the papers for their special issue (potentially for *Biogeosciences*) are underway and were discussed at the Shanghai meeting. The group postponed its 2008 meeting to 2009 because of a delay in

completion of the papers. The group has had some difficulty in locating a publication venue for their papers, because some are rather long review papers and the group members cannot afford to pay the page charges assessed by some journals. Most of the papers are in and the last two are expected within a month. Their first choice is *Biogeosciences*. The group has held two meetings and spent $30,000 of the $45,000 allotted. Should they be allowed to use some or all of their remaining funds towards publication costs, in lieu of a final meeting? Duce proposed that SCOR allow this option, but to leave the decision to the group. Meeting participants agreed.

2.3.9 SCOR/IAPSO WG 129 on Deep Ocean Exchanges with the Shelf

Lawrence Mysak reported that this group was formed out of the IUGG meeting in Perugia in 2007. They have prepared a good bibliography on their topic, available on the IAPSO and SCOR Web sites. The group recently convened a workshop in Cape Town, South Africa (on 6-8 October 2008) to contribute to fulfilling their terms of reference. The U.S. Office of Naval Research, IUGG, SCOR, and IAPSO contributed funds for this workshop. Papers from the workshop will be published in *Ocean Science*. Johan Rodhe (IAPSO Executive Secretary) reported on the Cape Town meeting and noted that we know very little about the quantitative nature of exchanges between the deep ocean and the shelf. The group's next meeting will be held in mid-2009, in conjunction with the IAPSO meeting in Montreal. Funding for developing country scientists from Africa came from SCOR, IUGG, and ONR; making such contacts in Africa can be difficult. No action was required.

2.3.10 SCOR WG 130 on Automatic Plankton Visual Identification

Peter Burkill noted that this group is using open source software for automatic plankton identification. The group met for the second time on 6-9 May in São Paolo, Brazil, with most of the meeting expenses funded by Petrobras. This meeting was focused on term of reference 3 ("To review existing practices and establish standards in the use of reference image data used for training automation machines and in training people."). Burkill had some concern about their interest in expanding to include lower taxonomic groups. Burkill's recommendation to continue the group was approved.

2.3.11 SCOR WG 131 on The Legacy of *in situ* Iron Enrichment: Data Compilation and Modeling

Robert Duce reported that the group has made good progress this year in compiling data from past iron-enrichment experiments, but the work of putting the data into an open access database is not yet completed. The group has requested additional funding for a post-doctoral fellow to work with the data center, as well as funding for a workshop on modeling the enrichment experiments. They also see approval for remaining WG members. (The co-chairs were only approved for the first phase of the group.) Duce noted that the Executive Committee had already discussed this group. It is a really important issue; the idea was to assemble data from all 13 iron enrichment experiments and make it available for modeling and other uses. Last year SCOR approved $7,000 for a post-doc to start assembling the data and the Biological and Chemical

Oceanography Data Management Office (BCO-DMO) at Woods Hole agreed to host the database. This has progressed quite well; all metadata and almost all the data are in for three experiments and part of the data and metadata are in for the other experiments. They hope to have it all in the next year. Now they want to move into modeling, starting with a meeting in early 2009 to get modelers to start looking at the data. The co-chairs have requested $10,000 to continue funding the post-doc, and "greater than $35,000 for their meeting", that is they are exceeding the normal funding of SCOR working groups, and putting all the funding into one meeting. Meeting participants were concerned that the data set won't be complete enough in January 2009 to have a modeling workshop, and there should be some interpretation of the data first.

Bjørn Sundby stated that the first step has been achieved, getting people to agree to share their data. Lucas Stal reminded participants that we faced the same issue last year; we need to wait until the database is complete. Catherine Jeandel stated that it is surprising that SCOR has agreed to pay a post-doc to do work like this. Why didn't one of the investigators come up with the funding for this? Wolfgang Fennel agreed with Duce that an assessment of the data is needed before the modelers start using it. Lawrence Mysak suggested that we should invite a new proposal once the data set is completed. They should complete the work we have paid them to do and then re-submit the proposal. Duce stated that SCOR should continue the funding for the post-doc. But, he didn't think a new proposal should be required, just a new plan for what they will do once the data set is available. Michael MacCracken added they need to get some modelers to have a preliminary look at the data set to make sure it's useable. The group should focus on some synthesis efforts related to the data set. Corina Brussaard asked if SCOR is really supporting a salary and whether it should continue to do so. Sundby responded that this was a very unusual working group from the beginning. At first they just wanted the influence of SCOR to get data contributed. Then they wanted money for the individual to do the work of the data assembly. The funding that SCOR has given is only a small portion of the funds needed for a full post-doc salary. Duce added that one of the strengths of SCOR is that it responds as needed to get important things done; this shouldn't be a precedent for supporting salaries, but the compilation of this data set might not have happened otherwise. Laurent Labeyrie added that SCOR shouldn't pay salaries in general, but iron is such an important issue and this job had to be done. Discussion continued on the SCOR decision in 2007; the group's first job was to get all the data together, and only then to proceed to other things. Sundby summarized the consensus that SCOR should continue to support the development of the database for one more year, but provide no support for a meeting or appointment of additional members to the working group until the co-chairs achieve this. Duce and MacCracken should write an appropriate letter to convey SCOR's decision to the co-chairs.

2.3.12 SCOR/LOICZ WG 132 on Land-based Nutrient Pollution and the Relationship to Harmful Algal Blooms in Coastal Marine Systems

Jorma Kuparinen reported that this group is being co-funded by the Institute of Oceanology of the Chinese Academy of Sciences and the Land-Ocean Interactions in the Coastal Zone project, with a small amount of funding added by SCOR. They made good progress on their work starting in mid-2008 and plan their second meeting in October 2009, in conjunction with the SCOR Executive Committee meeting and a GEOHAB open science meeting in Beijing, China. The group proposed some changes to clarify the group's terms of reference, which were approved by the Executive Committee. This group was approved in principle last year if funds could be found outside the SCOR budget. LOICZ agreed to some support and Chinese sources agreed to co-fund the group as a result of Urban's meeting with the China-Beijing SCOR Committee.

2.4 New Working Group Proposals

Seven working group proposals were received by the SCOR Secretariat. SCOR eventually was able to fund three new working groups to begin in 2009, because each of the three came with some co-funding. Bjorn Sundby proposed three categories for working group proposal discussions: (1) must fund, (2) could fund, and (3) do not fund.

2.4.1 Working Group on Evaluating the Ecological Status of the World's Fished Marine Ecosystems

Annelies Pierrot-Bults, the monitor for the proposal, stated that this group proposes to build on WG 119 on Quantitative Ecosystem Indicators for Fisheries Management to develop a suite of indicators. They proposed to look at 20 ecosystems. Is this too ambitious? FAO, ICES, and PICES were not mentioned in the proposal. Of the rankings received from SCOR national committees before the meeting, three were high, but the overall results were very variable. Many meeting participants thought the proposal was not very clear. Pierrot-Bults concluded that the project was more appropriate for institutions involved with fisheries research. Catherine Jeandel noted that the proposal was ranked #1 by the French SCOR Committee, especially in the context of renewable resources and for its strong emphasis on communication and outreach, building on WG 119. John Compton added that the South African SCOR Committee also ranked the proposal high and encouraged the move to an ecosystem approach to fisheries. They liked the international distribution and expertise of the proposed members. Lawrence Mysak added that the IAPSO Executive Committee ranked the proposal highly also. One concern they had was that the proposal did not include enough focus on the influence of climate change; they thought that the group needs more input from climate experts. Peter Burkill added that the UK SCOR Committee ranked the proposal first. It is timely because of its emphasis on ecosystems that are fished. However, there are too many Associate Members and they should add a member from Japan.

Michael MacCracken asked if there any indication that all these ecosystems are actually comparable: is it possible to develop a common set of indicators? Lucas Stal noted that the Netherlands SCOR Committee ranked this proposal as one of the lowest. This is not a typical SCOR issue and may already be handled by environmental non-governmental organizations. The proposal should pay more attention to the science; the proposal is not novel. Marta Estrada asked if more time should elapse between WG 119 and another working group on fisheries indicators. Julie Hall suggested that the proponents could look for other sources of funding. Missy Feely added that the U.S. SCOR Committee ranked this proposal #4. It is timely, but other sources of funding are probably more appropriate. The terms of reference are far too ambitious. John Volkmann added that the Australian SCOR Committee gave the proposal a middle ranking; the model discussed is a full ecosystem model. Wolfgang Fennel reported that the German SCOR Committee ranked the proposal last. The terms of reference are not specific enough. The science is not new or original enough. There is a big ongoing EU project on this topic. Perhaps they just want to use the SCOR label? Huasheng Hong reported that the China-Beijing SCOR Committee ranked the proposal low. It is too ambitious and the fisheries are too variable. Most full members are from temperate regions, with no input from tropical regions.

Bjørn Sundby summarized that this is not a "must fund" proposal. Annelies Pierrot-Bults recommended that it be ranked low by SCOR. Sundby asked if the proposal should be put into the "Do Not Fund" category. Hall responded that we should see if SCOR can help the proponents find funding, as the idea is timely, but it is not appropriate for SCOR.

2.4.2 OceanScope Working Group

Lawrence Mysak noted that this proposal is a result of Tom Rossby's presentation at the SCOR annual meeting in Bergen last year. The basic idea of the group is to put new ocean observation capabilities on merchant ships to get physical, biological and chemical data. Mysak reported that IAPSO is quite enthusiastic about the proposal. Then he received the national rankings. Four placed the proposal at #1; it came out second overall of the 7 proposals. Mysak then synthesized the comments and concerns of national committees and contacted Rossby. The national committees had 6 major concerns:

1. A need to involve the International Chamber of Shipping and others.
2. The membership is incomplete, especially in not having any members proposed from the Southern Hemisphere.
3. The terms of reference are too open-ended.
4. There was no mention of the Argo float program to map world ocean in a different way
5. There were concerns about data archiving
6. The project should see existing models, such as a Finnish program in the Baltic Sea.

Mysak consulted Rossby about these concerns and he responded. He is attempting to make contact with the International Chamber for Shipping. Rossby agreed about the membership needing completion; he wanted to see how the proposal fared. He intended this to be a 3-year

maximum working group, to develop an implementation plan to keep the program going. Data issues will be addressed to some degree; the implementation plan would be very specific about data management. The group's objectives are very different from that of a usual working group with regard to partnership with the merchant marine and use of alternatives to research vessels. Mysak stated that he was in a quandary about what to recommend. The proposal should go back to Rossby to make changes requested; there is a lot of interest and enthusiasm. We need something much more focused into a three-year window.

Peter Burkill added that the Sir Alister Hardy Foundation for Ocean Sciences (SAHFOS) has been running a volunteer shipping survey for a very long time. The UK SCOR Committee ranked the proposal tied for #1. The proposal represents a timely and new approach to yield observations at a high density that has not previously been achieved. It's timely, but needs to be tightened up. The final term of reference relating to a funding structure is absolutely crucial. Health and safety issues are becoming more and more important. How serious is the international shipping industry? We need a serious discussion with them. Robert Duce offered a general comment; we could give any of these proposals approval, making funding contingent upon some adjustments. Michael MacCracken noted that the VOS program was started before Argo floats were going everywhere. If this will be an expensive effort, they need to justify it with regard to the Argo system. "It would be nice to have" is not a good enough justification. Do ships actually go to the areas (e.g., high latitudes, tropical oceans) where we need more measurements? Perhaps the ships can measure variables that the Argo floats do not. MacCracken thought the proposal was far too general. We had a similar proposal last year and asked Rossby to focus it, for example, by specifying which sensors could best be adapted for VOS use, etc. Julie Hall added that the proposal has a lot of strengths, but there appears to be no direct link to GOOS. A lot of this work has been done by coastal GOOS and the Ocean Observations Panel for Climate (OOPC). The OceanObs'09 conference in September 2009 needs to be considered. There are no links proposed to the large projects, even if the names of some people from these projects are used in the proposal. Wolfgang Fennel responded that he had similar concerns. It will be very important to clarify the connection to GOOS.

Tom Rossby had extensive communication with Albert Fisher in GOOS; there is a big concern in the observation community that there needs to be coordination of multiple approaches to ship owners. Huasheng Hong reported that the China (Beijing) SCOR Committee thinks this activity is important, but that the proposal needs more focus. Bjørn Sundby stated that he suspected that GOOS would never fund this proposal because they don't have the money. If SCOR can play a role to get this going, to get the sensors, ships etc., we could make a big difference. Missy Feeley reported that the U.S. SCOR Committee rated the proposal highly as an exciting idea, although it needs more specificity, links to GOOS, etc. But it could really benefit from SCOR help. The working group could determine the feasibility of such a system. Feeley is a member of the GOOS Scientific Steering Committee and thought they would really welcome this kind of initiative. The data issues will need to be worked out.

Motoyoshi Ikeda thought that the proposal was a good try. The proponents need to contact the World Maritime University (of the UN): http://www.wmu.se/. Mike MacCracken came back to comment about GOOS relying on researchers for data. This is not correct; GOOS is operational. But, GOOS better have researchers associated with the use and analysis of data sets and keep researchers involved. Lucas Stal stated that this would be an excellent activity for SCOR to be involved with. His concern (and that of the Dutch SCOR Committee) is whether the group can achieve their terms of reference in a normal working group life time. Laurent Labeyrie added that this proposal is good and timely. They want to explore what kinds of tools are possible, not to launch a system. But, they have too large an objective and he suggested dropping the last two terms of reference. Luis Icochea noted there are existing merchant ships making these kinds of observations; these could be improved along the lines of this proposal. There are also research vessels, such as one from Peru, that make transects to Antarctica every year, and could be instrumented for new automated measurements. Gerold Siedler added that he has been involved in XBT lines on commercial ships, working with shipping agencies, etc. He thought that the group should focus on first two terms of reference. Argo float measurements are not in conflict with this. Zonal fronts and meridional circulation cannot be measured by floats and these features are now known to be important for biology. Repeat sections are also an important positive feature of this proposal. Siedler also suggested that the group needs a member from the Southern Hemisphere. Victor Akulichev suggested that someone from the Shirshov Institute should be involved, since they have regular transects through the Arctic Ocean. Sandor Mulsow added that the group should use what is available now. At the WG 132 (Land-based Nutrient Pollution and the Relationship to Harmful Algal Blooms in Coastal Marine Systems) meeting he learned about the North Sea ferries that are equipped to do observations. Claudio Giesecke suggested that the proposal is important to motivate observations where they don't yet exist, especially in the Southern Hemisphere, as already noted. John Volkman added that Australia has been doing this type of work for many years and the Australian SCOR Committee thinks the scope of membership is too narrow. However, the Australian committee strongly supports the group, focusing on what could be put on merchant ships and the problems involved with doing this.

Ed Urban pointed out that the third term of reference from the end is impossible. A working group could never resolve EEZ issues. Bjørn Sundby summarized. There was strong support for the working group, but the proposal needs to be improved. Mysak will write to Rossby with points from the discussion. IAPSO will co-sponsor. There was general agreement that this working group should go into the "must fund" category. We will work with Rossby to tighten the focus, develop the membership, and define the final product.

2.4.3 Working group on the Coral Triangle: The centre of maximum marine biodiversity

Peter Burkill introduced the proposal and noted that it had been modified since last year. There were issues relating to links to other coral reef activities, etc. Most rankings from national SCOR committees were middle to low; one committee found the proposal unacceptable. Burkill stated

that he thought the proponents made a good response to the request for revisions. The working group would involve countries not often associated with SCOR. The weakness is whether it should be more global than focused on a single region. The products are a bit ambiguous, but Burkill thought that the SCOR working group mechanism would be a good one for this type of activity.

Jorge Corredor noted that the U.S. SCOR Committee ranked this proposal lowest. They did not think that the proposal should be funded as it was. Its central flaw is lack of a scientific rationale for delineating the triangle. Issues of design of marine protected areas are fundamental. Venu Ittekkot noted that there are three existing programs addressing similar problems. Mike MacCracken had the same comments as last year; the proposal barely acknowledged impact of climate change and ocean acidification. (See sentences on first page.) Given the importance of ocean acidification, there should be an expert in this field on the group. Lucas Stal responded that the proposal is designed to define the baselines needed to detect change. MacCracken responded that they need to consider the parameters you need to measure to get the baseline, not only the questions of what are the different species and where they live. What about things like compensation depth, pH, etc. Lawrence Mysak stated that he thinks the proposal was improved, although the role of physical oceanographers and the deliverables are still vague. IAPSO ranked it low. Catherine Jeandel added that the French SCOR Committee had the same concerns and ranked the proposal lowest. Huasheng Hong added that the China (Beijing) SCOR Committee had the same opinion. John Volkmann added that the proposal to define an artificial boundary doesn't make much sense. But there are strong elements of capacity building in the proposal. If it were a research proposal it would not get funded. Venu Ittekkot suggested putting the proponents in touch with IOC Sub-commission on the Western Pacific and relevant Global Environment Facility projects, and also the Census of Marine Life. Bjørn Sundby summarized that it sounded like put it in the "do not fund" category. When all the proposals were discussed, there was agreement with this assessment.

2.4.4 Working Group on Global Patterns of Phytoplankton Dynamics in Coastal Ecosystems: Comparative Analysis of Time-Series Observations

Jorma Kuparinen introduced the proposal by stating the purpose of the group "to conduct a detailed comparison of phytoplankton time series with a view to detect patterns of change. This group would link thematically with SCOR/LOICZ WG 132 on Land-based Nutrient Pollution and the Relationship to Harmful Algal Blooms in Coastal Marine Systems. There is no other obvious international sponsor, besides SCOR. Its work would be analogous to the work of WG 125 on Global Comparisons of Zooplankton Time Series. The proposal presents a long list of ambitious goals, allocated to different working group members. Many countries ranked the proposal highly, but some expressed that the terms of reference need some clarifications. Some names were suggested by national SCOR committees. Kuparinen suggested that the group should be funded by SCOR.

John Compton stated that the South African SCOR Committee recommended the proposal highly, because it was timely and important to the community. South Africa has several long time series to contribute, especially on dinoflagellates. Compton noted that there was no input from IMBER, PICES, etc. [Note: PICES had submitted a letter of endorsement.] Julie Hall noted that IMBER was approached. She added that this working group has momentum and it is exciting. But, they should pull the data together first and they need to involve data specialists. Ed Urban noted that Todd O'Brien at NOAA (a member of WG 125) had offered to help with this. Catherine Jeandel reported that the French SCOR Committee liked the proposal also, but thought it might be too ambitious. They also recommended the addition of a data specialist. The group must ensure a standardized database useful to the community. Jeandel had some French names to suggest, if the proposal were funded. Marta Estrada (Spain) also thought the proposal was timely. The terms of reference are ambitious, but they have been copied directly from WG 125, which SCOR has funded. The membership is not diverse enough. Lawrence Mysak stated that IAPSO finds the proposal interesting from a climatic point of view; the membership needs someone with a climate interest. Mysak noted that it would be a coastal study, implying that there should be links with LOICZ. Jorma Kuparinen stated that the LOICZ contact could be through WG 132.

Jorge Corredor stated that the proposal was based in premise that phytoplankton are responsive to climate changes, potentially providing an early warning of change. The group recognizes the need for statistical help. One problem is the need for development of best practices for sampling; this should be done. The U.S. SCOR Committee ranked this proposal #1, if the working group agrees to store the data with existing data centers.

Peter Burkill reported that the UK SCOR Committee felt that the proposal was timely and relevant, but that it missed several things. Coastal oceans are threatened by many factors. The LOICZ coastal typology should be considered and the proposal did not take long-standing time series into account, such as CalCOFI and the Continuous Plankton Recorder. Is the proposal 5 years out of date? The North Sea figure in the proposal is wrongly interpreted. Mike MacCracken added that the proposal needs a statement about why this is significant for people, perhaps an opening paragraph about relevance. Annelies Pierrot-Bults added that IABO likes the proposal, but that ocean color expertise is needed. IABO also noted the absence of CalCOFI in the proposal. The need for a database specialist was addressed earlier in the discussion. There are problems with taxonomy. Marta Estrada cautioned against including satellite data, as this could make the activity too diffuse. John Volkman noted that Australia strongly supported this group.

Laurent Labeyrie agreed with many of the comments and agreed that data set intercomparisons could be useful. Huasheng Hong reported that the China-Beijing SCOR Committee thought this was an important proposal, but that it needs connections with GEOHAB program. Satellites give biomass information, but this proposal would give species information. It needs members from developing countries. This working group could have an important role in capacity building. Bjørn Sundby added that ocean color doesn't work well in coastal areas. Marta Estrada

recommended that the group be sure to use taxonomic names that don't cause confusion. Jorma Kuparinen mentioned very long time series in the Baltic Sea that would need to be included. Bjørn Sundby summarized that he heard a lot of support for this proposal, although Kuparinen would need to work with them to sharpen the terms of reference, address membership issues, etc.

After all the proposals had been discussed, decisions were made about which groups to fund. It was noted that this proposal is very specialized and that SCOR already has quite a few biology groups. The individuals are already working anyway, so it is not clear that SCOR needs to help. Lucas Stal suggested that the group should be low priority because it is not clear that they can assemble the necessary data. May others expressed that the availability of data could be a problem. However, John Volkman liked the time-series group best because they have already met and are addressing some data issues; they are likely to produce results. Ultimately, it was decided that this group should not be funded to start in 2009.

2.4.5 Working Group on Hydrothermal energy transfer and its impact on the ocean carbon cycles

Bjørn Sundby asked Jorma Kuparinen to take over as chair of the meeting as Sundby handled the proposal as the monitor. Sundby introduced the proposal by saying that there is a great deal of energy available around vents for the fixation of carbon. This group wants to determine the importance of chemosynthesis at mid-ocean ridges to the global carbon cycle, as well as the importance of the vents as a source of trace elements. The group's proposed terms of reference were reviewed. The proposal is really to lay the groundwork for future research. The tasks seem achievable and the time frame is appropriate. Sundby expressed that he thought this was a good topic for a SCOR working group and complementary to GEOTRACES. As Bob Anderson noted yesterday, GEOTRACES is reluctant to take samples at the seafloor because of issues of contamination of water-column samples. Sundby summarized the written comments from national committees. Some felt that the proposal did not provide an argument for the global importance of chemosynthesis to provide a sense of scale. There was some criticism of the proposed membership; even if only a few nations have the technology to study the vents, which should not constrain the selection of members from other countries. Sundby recommended that this proposal should be approved.

Colin Devey stated that he was happy to see interest in bottom of the ocean. Devey agreed with Sundby that the drive to go into deeper water is interesting more oceanographers in all disciplines. The shape of the seafloor and what it does to the overlying water is becoming more important. Here's another group encouraging SCOR to have some focus on the deep ocean. Devey strongly supported the proposal. Catherine Jeandel reported that the French SCOR Committee found the proposal interesting and likes the fact that it brings together various disciplines. They were not completely satisfied with the membership, because some of the proposed members are already over-committed. It will be important for the group to provide a rough estimate of the significance of vents to the global iron cycle. Lawrence Mysak reported that IAPSO found the proposal interesting also. One question that should be answered is whether

chemosynthesis produces an amount of biomass equivalent to photosynthesis, even a rough estimate. IAPSO was surprised that there was no carbon modeler proposed in the membership. IAPSO ranked the proposal low to middle. Lucas Stal reported that the Netherlands SCOR Committee liked the proposal and ranked it third. It is a good topic for a SCOR working group. However, they did wonder how the goals will be achieved. The proposal needs a more convincing plan of action. They also had some membership concerns. Jorge Corredor reported that the U.S. SCOR Committee ranked the proposal second. They would have like to have seen more preliminary estimates of the importance of vents in the carbon cycle. Are there other potential additional sources of funding? Peter Burkill reported that the UK SCOR committee ranked the proposal in the middle. They were unsure about the significance of vents to the global carbon cycle. Huasheng Hong added that the China-Beijing SCOR Committee had some questions about the modeling planned.

Kurt Hanselmann reported that the Swiss SCOR Committee ranked the proposal highly; the quantitative issues raised in the discussion just now are exactly the ones the group wants to address. Primary production due to vents should not be compared with photosynthetic production; this is not the issue. The system is interesting in its own right. Sundby responded that the system itself is so interesting that it deserves to be considered whether or not it impacts global cycles. Perhaps it was a strategic mistake to couch the proposal in these terms. The goal of developing models is a very important one.

Jorma Kuparinen summarized that there was a consensus that this was an exciting proposal in a new area of science. The proposal needs some work. Several questions arose: the membership need to be revised, links to the carbon cycle needs clarification, and a link to GEOTRACES needs to be developed. They need to explain the scales at which the processes might operate. With some refinement, the proposal should be considered for funding. Colin Devey responded that having seen the positive comments and heard at previous meetings how important it would be to get a seafloor topic in SCOR, it would be a shame not to accept it. Meeting participants agreed to start this group, with co-funding from the InterRidge project.

2.4.6 Working Group on Coupled climate-to-fish models for understanding mechanisms underlying low-frequency fluctuations in small pelagic fish

Mike MacCracken introduced the proposal. He had some good exchanges with the proponents. The purpose of the group would be to couple pelagic fish to physical system models for upwelling regions around the world. It would be helpful to first see if fish distributions and abundance can be represented in such models. They would use the Regional Ocean Modeling System (ROMS) for physical properties. The proposed membership advanced would be a strong team with representation from four upwelling regions and the relevant disciplines. MacCracken reviewed some of the questions raised in the reviews about the scope of the proposal and relevance to SCOR. Two countries ranked the proposal first, while others ranked it quite low. There were questions about their deliverables. They would ensure an updated database, an assessment of models and a scientific paper. There were also some questions as to whether this

was a job for a graduate student, rather than a working group. The proponents say there is a lot of synthesis to be done. There were other questions about links of the group to GLOBEC and IMBER, and the breadth of the tasks, whether the group should do more.

Ian Perry reported that he had not been contacted as Chair of GLOBEC about this proposal, but the Canadian SCOR Committee asked him to review it. As GLOBEC chair, he thinks the group would build on the accomplishments on SCOR WG 98 on Worldwide Large-scale Fluctuations of Sardine and Anchovy Populations; this proposal is a direct descendant of that group. The issue of understanding the drivers of sardine and anchovy fluctuations is still important. What drives alternating regimes is still a big question, especially in upwelling regions. The people involved are excellent and keen. However, there are some weaknesses in the underlying hypotheses. The McCall hypothesis relating to eddies was never written up formally. The behavioral hypothesis is very complex and the NEMURO model is not yet tested in upwelling systems. Perry was not sure whether NEMURO is the right model to test the proposed biological hypotheses. He thought this was a problem that needs to be resolved and SCOR is the right group to do it. But the proposal has some weaknesses and needs to be matured. Burkill added that the UK SCOR Committee likes the proposal, but identified two problems. Fisheries models are going more towards ecosystem-based models and this seems to be lacking in this proposal. Why put all your eggs in one basket to work with one model? Perry responded that it is true that the trend is to ecosystem approach, but in upwelling systems the ecosystem is much simpler, He thinks the NEMURO model is ecosystem-based. Perry added that this group should have a link to WG 125 on Global Comparisons of Zooplankton Time Series. Marta Estrada asked if there was a link to the former WG 98 and someone pointed out that there are some linking members. Ed Urban noted that the WG 98 publication is the single most cited paper from a SCOR working group.

Lawrence Mysak reported that IAPSO didn't rank this proposal as highly as the others. IAPSO raised several concerns. How will the circulation model be forced? Who is the expert on ecosystem modeling in the proposed working group? Ian Perry responded that the ROMS model is widely used and includes the physical forcing. Others agreed that ROMS is an excellent circulation model. Wolfgang Fennel added that the terms of reference are very inhomogeneous and that the development of a climate-to-fish model is overly ambitious. He thought it is too early to try to do this. Even the NEMURO model doesn't include predator-prey interactions. Lucas Stal added that the Dutch SCOR Committee thought this proposal was written like a research proposal and that it could be assigned to a couple of post-doctoral fellows, not a SCOR working group. Catherine Jeandel noted that the French SCOR Committee had exactly the same reaction and also noted the lack of a socio-economic specialist. The idea does not seem appropriate for a SCOR working group. Jorge Corredor reported that the U.S. SCOR Committee was concerned at the lack of model validation in this proposal; there is no proposal to use data to test the model.

Mike MacCracken stated that the need for a SCOR working group doesn't come across. How does it fit with other projects? Julie Hall noted that there had been no discussion of the

proponents with IMBER to date. The proposed group is closely related to SPACC and there have only been preliminary discussions between IMBER and SPACC. MacCracken added that they should build links to PICES. Perry agreed they should have run the proposal past GLOBEC, IMBER, PICES, etc. Perry asked whether it is worth coming back to with revisions. Mike MacCracken noted that Chile and Japan rated this proposal #1, so it is clearly important to them. Sundby summed up that this is not a "must fund" group. It was ultimately decided not to fund this proposal to begin in 2009.

2.4.7 Working Group on The Microbial Carbon Pump in the Ocean

Peter Burkill began the discussion of this proposal by stating one of the legacies of the Joint Global Ocean Flux Study (JGOFS) was the recognition of the importance of the microbial pump for export of carbon into the ocean interior. Huge questions remain about remineralization processes; there have been huge advances in understanding primary production processes, but we still know very little about heterotrophic pathways. Burkill reviewed the proposed terms of reference for this group. The proposal was ranked very highly by seven national SCOR committees that provided written comments, although three ranked it lowly. Burkill reviewed the negative comments to determine how the group would need to be changed before approval. Most criticisms were that the terms of reference are too vague and the proposal needs more oceanographic context; it needs involvement of physics relating to solubility pump, at least one organic chemist, and a microbial modeler. The proposal shows a lack of understanding of the processes of respiration. There is too much focus on dissolved organic carbon (DOC). The list of techniques is rather random. What is the link to the virus working group (#126)? There is insufficient capacity building included in the proposal.

Lawrence Mysak offered comments from IAPSO that some members ranked it highly, if it will shed light on carbon sequestration in the ocean. Mike MacCracken noted that there is no link to international carbon cycle programs. If this is such an important issue why aren't other groups already covering it? Julie Hall responded that the Global Carbon Project doesn't work at this level of detail and is very atmospherically and terrestrially based. There is no international project working on this issue. Hall added that this working group would make a significant contribution to IMBER interests; IMBER cannot work at this level of detail. Hall agreed with the issues raised by Burkill, but with some changes this could be an excellent working group. She mentioned expertise at the University of Concepcion on this topic. Lucas Stal noted that the Netherlands SCOR Committee ranked the proposal #1, with some concerns similar to Burkill's: the vague list of techniques, overlap with virus group, etc. Catherine Jeandel stated that the French SCOR Committee liked this proposal, but had some suggestions. The objectives need better definition. What are the real goals? To build a database? Or what? Are these achievable in three years? The group needs at least one member from a developing country. Marta Estrada added that this working group would help the disciplinary balance of SCOR, although the membership is too restricted to Western nations. Kurt Hanselmann added that the Swiss SCOR Committee ranked the proposal number #2. He added that it needs to link to techniques being used at the Monterey Bay Aquarium Research Institute (MBARI). It should not limit itself to

aerobic systems; the addition of anaerobic systems would involve developing countries. Marie-Alexandrine Sicre added that DOC is still poorly characterized and some techniques should be added. Jorge Corredor agreed that the proposal needs revision. Riitta Autio added that she knows the people involved in the proposal and they are highly qualified.

Peter Burkill summarized that he had not yet heard anyone who felt this proposal was not worthy of SCOR support. The issue is with the specific proposal as it stands. We need to work with the proponents to put it into a context more relevant to SCOR. The group is already working together well. The proposal needs to have the terms or reference changed to insert modelers, organic chemists, etc. Should we ask the proponents to resubmit a proposal next year or modify what was submitted so it can be started in 2009? There was agreement that the proposal could be approved for start in 2009, with revisions, and assuming co-funding from China.

2.5 General Discussion

Following individual discussions of each proposal, decisions were made about which groups would be funded to begin in 2009. There was general consensus not to fund the proposal on Evaluating the Ecological Status of the World's Fished Marine Ecosystems, the proposal on the Coral Triangle, or the proposal on Coupled climate-to-fish models for understanding mechanisms underlying low-frequency fluctuations in small pelagic fish, although it was agreed that the latter proposal might be revised and reconsidered in 2009. The four remaining proposals were listed by Bjørn Sundby:

OceanScope
Phytoplankton Time Series
Microbial Carbon Pump
Hydrothermal Effects on Carbon

Jorma Kuparinen reminded participants that the decisions should respect the need to maintain disciplinary balance among the groups and it may not be wise to fund two proposals related to the same discipline. Laurent Labeyrie agreed with this comment and noted that all the four proposals would need some modifications before being funded. He particularly liked that idea of funding the OceanScope proposal, since it had been a very long time since SCOR had a technology-oriented working group. Labeyrie continued regarding the Microbial Carbon Pump proposal that they are also working together anyway, so it would not slow them down if their funding was delayed for one year. In terms of the Hydrothermal Carbon proposal, it has been a long time since SCOR had a group in this field, and funding this proposal would establish better links with InterRidge. Lucas Stal stated that OceanScope proposal should be lower priority because of its doubtful feasibility. He would rank the Microbial Carbon Pump proposal first, followed by the Hydrothermal Carbon proposal. Lawrence Mysak stated that the technology aspects of OceanScope are important to SCOR and IAPSO, and IAPSO would like to cosponsor this proposal. He supported OceanScope first. He was undecided between the Hydrothermal Carbon and Microbial Carbon Pump proposals, leaning toward placing the Hydrothermal Carbon

proposal second. Ralph Schneider noted that there is a large European group active in the "deep sea frontier" and they are trying to get EU funding for the hydrothermal topic. SCOR should take this into account. Catherine Jeandel did not think OceanScope will produce anything original and the French SCOR Committee still thought it should be lowly ranked. They are interested in the two carbon-related proposals, the Microbial Carbon Pump and Hydrothermal Carbon. It is especially important that SCOR hasn't had a group on seafloor science for a long time. Missy Feeley reiterated that the Hydrothermal Carbon group is the top one for the U.S. SCOR Committee. The topic needs some facilitation to get people working together. The U.S. Committee ranked the OceanScope proposal second; if successful, it could really improve the use of the marine fleet. Peter Burkill stated that the top four proposals are all great, but that the Microbial Carbon Pump group should be asked to re-submit next year. Burkill would like to see OceanScope fast-tracked and Hydrothermal Carbon also approved. Robert Duce stated that it was hard to choose among the proposals. Should SCOR have two new groups with a carbon focus? But the carbon cycle is the most critical issue of our time, so he thought the Hydrothermal Carbon and Microbial Carbon Pump groups should be established. Marta Estrada noted that the Microbial group would incorporate new technology. Julie Hall added that the Microbial Carbon Pump proposal had some funding committed from China. Perhaps the OceanScope group could exploit links to GOOS for funding and IAPSO will contribute a little; perhaps three proposals could be funded? Jorma Kuparinen agreed that, with co-sponsoring, three groups might be funded. John Compton agreed that some creative funding would allow three proposals to be funded. The Microbial Carbon Pump group seems to be meeting already; maybe they would not need as much funding? John Volkman expressed his liking for the Phytoplankton Time Series group the best. There has already been a preliminary meeting and they are addressing some data issues; they are likely to produce results. The Microbial Carbon Pump proposal needs reworking. The Hydrothermal Carbon proposal should be second ranked.

Laurent Labeyrie asked if there is any chance of some funding from InterRidge for the Hydrothermal Carbon group. Colin Devey responded that he thought so and this could be verified quickly, as the InterRidge office is located at WHOI. Huasheng Hong emphasized the importance of microbial issues. Ed Urban confirmed that, with the co-funding available, SCOR should be able to fund the three co-funded groups. Bjørn Sundby concluded that the consensus was that the proposals for OceanScope, Microbial Carbon Pump and Hydrothermal Carbon would be funded, after some changes in terms of reference and membership. Catherine Jeandel reminded participants that the French SCOR Committee had membership concerns about the Microbial Carbon Pump group. Bjorn Sundby responded that the reporters would need to work with the chairs to make the changes requested. Lawrence Mysak asked how much co-sponsorship would cost? IAPSO could support the OceanScope group at about $5,000 per year. Colin Devey added that InterRidge could provide $3,000 per year for the Hydrothermal Carbon group.

3.0 LARGE-SCALE SCIENTIFIC PROGRAMS

3.1 SCOR/IGBP/IOC Global Ocean Ecosystems Dynamics (GLOBEC) Project

GLOBEC held its 2008 SSC meeting in Cape Town, South Africa in conjunction with the IGBP Congress. GLOBEC continues its integration and synthesis activities to work toward its completion at the end of 2009. GLOBEC and IMBER are working together on an activity on end-to-end food webs and the IMBER/GLOBEC Transition Task Team (TTT) met for the first time in July 2008 to identify aspects of GLOBEC that IMBER might take on after GLOBEC ends. The TTT will meet for the second and final time in December 2008, at the U.S. National Academy of Sciences in Washington. D.C. GLOBEC's synthesis book is well under way and will be completed by the time of GLOBEC's June 2009 final open science meeting. Peter Burkill, the Reporter for GLOBEC, introduced Ian Perry, the GLOBEC Chair. Burkill reviewed the goal of GLOBEC and congratulated the project for its successes. Ian Perry noted that this was perhaps his last opportunity to speak to SCOR for GLOBEC. He thanked SCOR for continued support over past 10 years.

Perry reviewed GLOBEC's goal and structure, as well as its accomplishments. Six symposia have been held by GLOBEC in the past 12 months. All of these were part of the move towards synthesis. They have had good collaborations with ICES and PICES in co-sponsoring a number of workshops, and regional and national symposia. GLOBEC is modeling its synthesis after the JGOFS synthesis. What will be the lasting legacy of GLOBEC? A synthesis book edited by Barange, Field, Harris, Hofmann, Perry and Werner; Perry reviewed the structure of the book. It will be submitted in late 2008 to Oxford University Press for publication in mid- to late 2009. GLOBEC's 3rd OSM will be held in June 2009. They are not referring to it as their "final" OSM because some GLOBEC activities will continue. The OSM will span 5 days, beginning with two days of workshops (12-14), then three days of plenary sessions, ending with a handover to IMBER. The concluding tasks will include production of a summary brochure of highlights and summary for policymakers, as well as the final SSC meeting in November 2009. GLOBEC has good links with IMBER. ICED, and CLIVAR. As to challenges, how will CLIOTOP and ESSAS be completed? They may migrate to IMBER, although this may not be appropriate for ESSAS. There is a funding challenge because the NSF grant to SCOR expires in August 2009, while GLOBEC won't end for several months after that. They are looking at alternative budgets depending on scenario. The funding shortfall, if the NSF funds are not renewed, would be about US$30,000.

Peter Burkill thanked Ian Perry for his presentation and noted that there were a few issues to resolve. One is the rotation of members of the GLOBEC SSC. In view of the fact that the project is ending, the SCOR Executive Committee thinks there is no point in bringing in new people. Burkill recommended no more rotations and meeting participants approved this recommendation. As to the expected funding shortfall, Burkill recommended that the Finance Committee consider the problem. SCOR will ask for the funding in the next NSF proposal. He

recommended to Perry that the U.S. members of the GLOBEC SSC contact their NSF program managers to urge final support for GLOBEC. (SCOR funding to projects is limited to what is provided by NSF.) The third issue is the continuity of science beyond GLOBEC. The IMBER/GLOBEC Transition Task Team (TTT) chaired by John Field is considering new science issues in marine ecosystem research. The TTT has had one meeting so far. They need to come up with firm mechanisms to facilitate the transition and will continue this dialogue at their next meeting in December. Julie Hall added that the TTT has requested community input. There is a draft report that the IMBER Executive Committee will discuss in detail. The initial response is positive and IMBER is prepared to absorb both CLIOTOP and ICED. It will be a challenge, especially to deal with larger predators. The proposed new members of the IMBER SSC reflect these new interests. Urban added that both IMBER and GLOBEC have done a good job in preparing for this transition, but he is concerned about the level of funding available to IMBER. To implement the recommendations of the TTT, new funding will be required, unless they set priorities. The sponsors cannot expect them to take on all the continuing projects from GLOBEC without new funds. Hall responded that IMBER is aware of this. They will be discussing with NSF and NERC, and have approached the French funding consortium also, for an additional person in the IPO after 2009. Perry added that the two main programs of concern are CLIOTOP and ESSAS, each of which has some funding of its own. Duce was also concerned about the funding issue and noted that SCOR and IGBP will review the TTT report in early 2009. The transition process is moving at a fairly fast rate. Wendy Broadgate added that the draft report will be posted on the Web before that for community comment. The comment period so far is more internal, in preparation for the December TTT meeting. Perry responded that SCOR could recommend more input. Bjørn Sundby stated that it seems that the only issue is money; scientific issues are not really at stake. This is healthy. Good ideas will be carried forward. Laurent Labeyrie asked if GLOBEC will produce educational materials, especially for fishermen, vis-a-vis top predators. Perry responded that there is a lot of confused information in the public realm, so perhaps GLOBEC could help clarify the situation. He will take this idea to the GLOBEC SSC; it is a good suggestion. The Executive Committee noted that the TTT should recommend what it feels is scientifically important and the Executive Committee thanks the TTT for its work.

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

GEOHAB continues to develop its Core Research Projects (CRPs). The research plan for the HABs in Stratified Systems is in press now. A new Asian GEOHAB activity is under development and a second meeting was held in Vietnam in January 2008. The next SSC meeting will be held in Galway, Ireland in June 2009, in conjunction with a GEOHAB Modeling Workshop (see https://www.confmanager.com/main.cfm?cid=1431). GEOHAB still needs an International Program Office. Huasheng Hong, the Executive Committee reporter, referred participants to the report in the meeting background book. She noted that GEOHAB is discussing a new CRP on benthic HABs, but are looking for a champion for it. The potential CRP on

benthic HABs, such as those that cause ciguatera, could be very important. GEOHAB is looking for funding for an OSM on this topic. The modeling workshop has good support. Wolfgang Fennel described plans for the modeling workshop. Urban added that the Asian GEOHAB project is another important activity. Regarding the need for an IPO; the project will probably never have an IPO, but Ed Urban and Henrik Enevoldsen (IOC) will continue to fill in. Julie Hall stated that a CRP on benthic HABs would provide a huge opportunity for capacity building. Ed Urban responded that there is a very active research center in Noumea, New Caledonia, but we really need a hero to move this CRP forward. Hall responded that the South Pacific Commission might be a good contact, as they are active on this topic. Kurt Hanselmann asked about the possibilities for an IPO in Denmark. Urban responded that Denmark is already funding an IOC HAB office in Copenhagen.

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

IMBER held a joint open science meeting with LOICZ on coastal margin science in Shanghai, China in Sept. 2007, and an implementation plan for cooperative science in coastal areas is being produced. The IMBER SSC met most recently in May 2008 in Cape Town, South Africa in conjunction with the IGBP Congress. IMBER will hold an open science meeting (Imbizo) in late 2008, with an innovative structure of parallel focused sessions. IMBER received commitments of renewed funding for its IPO through 2011 and is about to name a new Executive Officer. Robert Duce introduced the IMBER project and its chair, Julie Hall. Hall gave a complete overview of IMBER activities and closed with thanks for SCOR support, especially in relation to SCOR leasing the Conference Manager system, LDC travel support, financial training and advice. Catherine Jeandel stated that, in France, their policy is that all the projects are required to go through the data bank in Villefranche; is this happening in IMBER? It is being planned for GEOTRACES. Hall responded that she is not sure, but will find out. She knows that there has been a lot of effort to link IMBER with existing databases.

3.4 GEOTRACES Project

The GEOTRACES Scientific Steering Committee held its second meeting in Barcelona, Spain in November 2007. One of the two GEOTRACES intercalibration cruises (in the Atlantic Ocean) was conducted in mid-2008 and the second is scheduled for 2009. NSF and several European sources are co-funding the first full-time position for a GEOTRACES International Project Office in Toulouse, France and the position will be advertised by the end of 2008. The GEOTRACES SSC will meet next in Toyama, Japan in November 2008. The Japanese hosts are paying for the group's lodging and some other expenses. The first SSC rotations will take place in 2009. Robert Duce noted that GEOTRACES has been supported by SCOR from its start. Many countries are active. Duce introduced Bob Anderson, one of GEOTRACES' two co-chairs. Anderson gave a brief review of project. Its implementation phase is just beginning. Until now, most attention has been devoted to enabling activities, such as intercalibration and development

of standards; data protocols, management and archiving, and modeling. Three basin cruise planning workshops were held in 2007, as well as the first data-model synergy workshop. Anderson extended thanks to Ed Urban for his help, support and advice in getting GEOTRACES going. Anderson showed a map of proposed Pacific sections and gave the rationale for them. He did the same for the Atlantic and Indian ocean sections, especially reasons for revisions to U.S. Atlantic section to fulfill objectives and link to Cape Verde stations. GEOTRACES is participating in the International Polar Year (IPY) through cruises in Arctic and Antarctic regions. One Arctic cruise, on the *Polarstern*, more than doubled the worldwide measurements of deep water iron; we still know almost nothing about iron in the deep ocean. There is new information about a hydrothermal vent plume emitting dissolved iron from the Mid-Atlantic Ridge. So, GEOTRACES is partially a program of discovery. As GEOTRACES progresses, process studies will be designed to follow up on interesting results from the sections. In terms of data management, GEOTRACES decided to partner with an existing national oceanographic data center, the British Oceanographic Data Centre (BODC), to build on existing expertise. Ed Mawji was hired by BODC in June 2008 to serve as the GEOTRACES Data Liaison Officer. The IPO is not yet established, as some funds are available but not yet sufficient. Meanwhile, IPO functions are served by U.S. GEOTRACES Project Office, SCOR and SSC members. Capacity building will be essential to the success of the project. Many nations don't have the hardware for clean sampling. Most do have clean labs; it's the sampling technology that is the problem, and it's not just developing countries that face this problem. Proposals to set up a training center in Hawaii were declined.

Lawrence Mysak stated that he was very impressed with the project's progress and was wondering how the project manages without an IPO. Bob Anderson responded that deadlines help. Catherine Jeandel added that establishment of the IPO is urgent. SCOR has facilitated international transfer of funds. Anderson continued that he could not emphasize enough the importance of SCOR to help GEOTRACES happen. Ed Urban added that the SSC and its subgroups are dedicated and motivated. He asked Anderson to comment on aerosol sampling with SOLAS. Anderson responded that the activity has been slowed down due to an injury to the leader in Miami, but it still proceeded. Jeandel added that the intercalibration cruise in 2009 will be a new opportunity for those who missed the first chance to get samples. Anderson noted that when the intercalibration is completed, a methods manual will be published. At-sea training is vitally important for the clean sampling methods. Bjørn Sundby asked if there are any plans for sediment work in GEOTRACES. Anderson responded that this is a real problem; having sediments on the ship is a real concern to many scientists due to clean sampling issues. French and UK scientists are doing some sediment sampling, but U.S. scientists and others are not. Jeandel added that the Germans have developed a new corer, but cable time also is a big issue in deep ocean cruises. Anderson added that no one samples near bottom waters, so little is known about chemical gradients there to detect sources or sinks of trace elements near the sea bed. Toshi Gamo noted that the next GEOTRACES SSC meeting would be hosted in Japan in two weeks.

Venu Ittekkot asked why the proposals for capacity building were declined. Anderson answered that one international agency (Asia-Pacific Network for Global Change Research) wasn't interested in trace metal work; to them it is not clearly relevant to society. The other potential sponsor felt this wasn't an appropriate use of funds. Ed Urban added that the ship time needed for the training is very expensive, so this is a problem. He also thanked the Japanese SCOR Committee for local support for the upcoming GEOTRACES SSC meeting.

3.5 SCOR/IGBP/WCRP/CACGP Surface Ocean-Lower Atmosphere Study

Huasheng Hong introduced Peter Liss, former SOLAS SSC chair, just appointed as a Fellow of the Royal Society (UK) for his work on air-sea interactions. She also introduced the new SOLAS SSC chair, Doug Wallace. Wallace congratulated SCOR on its 50th Anniversary symposium and said that his presentation would focus on capacity building and some structural issues. SOLAS convened a joint session with IMBER for South African scientists in Cape Town after the IGBP Congress there. Wallace discussed the Tropical Eastern North Atlantic Time-Series Observatory (TENATSO) in the Cape Verde Islands. This is one of the dustiest places on Earth. They have established both atmospheric and oceanic time-series sites there. Wallace mentioned a POGO/SCOR operational oceanography fellow who was trained in Kiel to work on the site. This is an example of the great potential for capacity building at the TENATSO site, especially for West Africa. Wallace showed the SOLAS SSC list and the changes that had been approved by the SOLAS sponsors, as well as changes in IPO staffing. Wallace described two SOLAS events planned for 2009, the SOLAS Summer School and the Open Science Conference (November in Barcelona, Spain). He reviewed the goals of the summer school, which has a very good reputation. Wallace also reviewed the major items of the OSC program and the confirmed speakers. The SOLAS SSC will meet next in Washington, D.C. in March 2009. SOLAS has identified a series of future activities as part of SOLAS mid-term strategic planning:

- Surface ocean nutrient limitation and cycling
- Atmospheric deposition/dust effects on marine ecosystems
- Air-sea gas fluxes at Eastern boundary upwelling systems
- Sea ice as a habitat, reaction surface and barrier
- Marine aerosol formation
- Ship plumes
- Large-scale experiments for hypothesis testing

These are cross-cutting issues suitable for coordinated international research. Short papers are being prepared on each topic for discussion by the SSC and presentation to agency representatives at the SSC meeting in Washington.

Wallace raised some project-related issues:

- IPO support—they have a huge work load coming up with the OSC, new activities, etc.
- Carbon coordination with IMBER and IOCCP is very complicated.
- Emerging cooperation with GEOTRACES is very positive.

Huasheng Hong noted that SOLAS has built up a very good national network and provides a good model for capacity building. Peter Liss added that the Cape Verde observatory is a tremendous facility, devoted to air-sea exchange of chemicals. Early results, already reported in a *Nature* paper, show that marine emissions of molecules containing iodine lead to a breakdown of ozone, previously thought to occur only over seaweed beds. The NERC funding for the IPO ends in March 2010. Renewal is not assured, but the odds are good. Two full-time people are presently employed, and all funds from NERC are for salaries and fixed costs. There is a little support from SCOR and IGBP. The NSF grant is substantially less than for other projects. Wallace added that the Summer School is producing a SOLAS text book. The chapters are all in and the book will be published in time for the next Summer School. Michael MacCracken noted that he is working with scientists in Mexico who are also interested in dust coming across the Atlantic and they are establishing a mountain-top observatory in Mexico. Wallace responded that the dust issue is important to many countries because of its role in chemical inputs to the ocean, hurricane formation, etc., but the Mexicans will have to be careful not to do too much too fast. It has taken a lot of time and effort to get the Cape Verde station working well. Bjørn Sundby thanked Wallace for his presentation.

4.0 OCEAN CARBON AND OTHER ACTIVITIES

4.1 IOC/SCOR International Ocean Carbon Coordination Project (IOCCP)

Bjorn Sundby reported that IOCCP has continued to be very productive in the past year. NSF is funding one full-time and one part-time position at IOC for IOCCP and is providing activity funding through SCOR. IOCCP and PICES published a revised CO_2 methods handbook in 2008. The group's major activities for the coming year will be a panel to revise the WOCE/CLIVAR hydrography manual, a workshop on biogeochemical measurements at time-series stations, and an activity on standards for ocean acidification experiments. Maria Hood, the IOCCP director, will be moving to part-time status in 2009 and a search was underway for a full-time replacement for her. Sundby noted that this group is doing well after its role vis-a-vis other activities was clarified. Julie Hall added that there is a lot of interaction between IOCCP and the projects, in relation to activities of mutual interest. IOCCP is focused on observations and methods, and IMBER and SOLAS more on research.

4.2 SCOR-IOC-IAEA-IGBP Second Symposium on "The Ocean in a High-CO_2 World"

SCOR, IOC, the International Atomic Energy Agency (IAEA) and IGBP held the second symposium on The Ocean in a High-CO_2 World on 6-9 October 2008, at the Oceanography Museum in Monaco. The symposium attracted about 220 registrants, and included about 50 oral presentations and 110 posters. SCOR's Nominated Member for Monaco, Michel Boisson, and the Planning Committee chair, Jim Orr, were instrumental in raising additional funding for the symposium from local sources and capably handling many of the local logistics. IOC and IGBP helped with communications and interactions with the press. The Prince Albert II of Monaco Foundation provided funding for the symposium and Prince Albert II addressed the symposium on the final day. Robert Duce stated that he heard that the symposium was outstanding. Duce suggested postponing further discussion of the symposium until the afternoon session with the U.S. SCOR Committee.

4.3 Other Activities

4.3.1 Third SCOR Summit of International Marine Research Projects

Ed Urban reported that SCOR obtained funding from the Alfred P. Sloan Foundation to convene a third meeting of representatives of the major large-scale ocean research projects, both SCOR-sponsored and others. This series of summits started in 2004, thanks to Sloan Foundation funding. The first two summits were held in 2004 and 2006. The idea is to have the projects meet to discuss common issues like data management, capacity building, etc. Urban described plans for the 2009 summit. The meeting will be held at the University of Delaware, Newark, Delaware, USA on 30 March-1 April 2009. The major discussion items so far include data management/data publication/project data legacy, capacity building, observing technology/ocean biology observatories, project visibility/publicity, modeling, and interactions with intergovernmental organizations. Urban finished by noting that an activity from the 2006 summit, on data publication, held a meeting earlier in 2008 and presented a draft *EOS* article about the activity. Urban will convene a meeting with editors of ocean science journals in conjunction with the Fall American Geophysical Union Meeting in San Francisco. The SCOR Executive Committee appointed Wolfgang Fennel and Bjorn Sundby to serve as co-chairs of the meeting.

4.3.2 Panel on New Technologies for Observing Marine Life

Annelies Pierrot-Bults reported that the fourth meeting of this panel was held in Auckland, New Zealand in November 2007, in conjunction with the Census of Marine Life (CoML) All Program Meeting there. In October 2007, the Panel sponsored a special session on geolocation of electronic tags on marine organisms, at a major symposium on electronic tagging (see http://unh.edu/taggingsymposium/), and a report of the workshop has been published by CSIRO. The grant to the Panel concluded in June 2007, but the Sloan Foundation has allocated new

funding for the Panel for the coming three years. The Panel's primary task will be to create a CoML technology synthesis as part of the overall CoML synthesis, as the program comes to an end in 2010. The Panel will also oversee two cross-project synthesis activities on electronic tagging and will convene a meeting on ocean biology observatories in conjunction with OceanObs09 in Venice, Italy in September 2009.

4.3.3 SOLAS/INI Workshop on Anthropogenic Nitrogen Impacts on the Open Ocean

Mike MacCracken reported that the article that resulted from this meeting was published in *Science* in May 2008.[1] Bob Duce summarized the paper. Annelies Pierrot-Bults noted SCOPE involvement in this activity.

5.0 CAPACITY-BUILDING ACTIVITIES

5.1 SCOR Committee on Capacity Building

The committee met for the first time just prior to the SCOR 50th Anniversary Symposium, on 17-18 October to discuss several draft documents and develop a work plan for the coming year. The committee discussed the range of SCOR capacity-building activities and further elaborated the SCOR Visiting Scholars concept, which was approved by meeting participants to proceed.

5.2 Regional Graduate Networks of Oceanography

Venu Ittekkot reported that this activity is still unfunded, but the new Committee on Capacity Building discussed potential funding sources and how regional meetings could be used to explore the idea on a regional basis.

5.3 POGO-SCOR Visiting Fellowships for Oceanographic Observations

Eighty-four applications were received for this program in 2008. POGO and SCOR awarded 15 fellowships. It was agreed to provide continued funding for the program in 2009.

5.4 NSF Travel Support for Developing Country Scientists

SCOR received a three-year renewal of its grant from the U.S. National Science Foundation at a level of $75,000 per year. The grants have been an important source of support for several

[1] Duce, R.A., J. LaRoche, K. Altieri, K.R. Arrigo, A.R. Baker, D.G. Capone, S. Cornell, F. Dentener, J. Galloway, R.S. Ganeshram, R.J. Geider, T. Jickells, M.M. Kuypers, R. Langlois, P.S. Liss, S.M. Liu, J.J. Middelburg, C.M. Moore, S. Nickovic, A. Oschlies, T. Pedersen, J. Prospero, R. Schlitzer, S. Seitzinger, L.L. Sorensen, M. Uematsu, O. Ulloa, M. Voss, B. Ward, and L. Zamora. 2008. Impacts of Atmospheric Anthropogenic Nitrogen on the Open Ocean. *Science* 320:893; DOI: 10.1126/science.1150369.

SCOR-related meetings in the past year (see 2007 *SCOR Proceedings*). New requests were approved for several meetings and training activities: Humboldt Conference (South Africa), ASLO 2009 (France), GEOHAB Modeling Workshop (Ireland), Summer school on Automated plankton identification: State of the art, calibration and practice (UK), GLOBEC OSM III (Canada), IMBER Global Carbon Synthesis Symposium (Germany), IAPSO/SCOR Session on Ocean Mixing at Session IAMAS-IAPSO-IACS Assembly (Canada), SOLAS Summer School (France), PICES Summer School on "*Satellite Oceanography*" (Korea), SCOR-relevant sessions/workshops at PICES XVIII (Korea), and SOLAS Open Science Meeting (Spain).

5.5 SCOR Reports to Developing Country Libraries

The SCOR Secretariat distributed two reports to developing country libraries since the 2007 SCOR meeting: the *Guide to Best Practices for Ocean CO_2 Measurements* and the 2007 *SCOR Proceedings*.

6.0 RELATIONS WITH INTERGOVERNMENTAL ORGANIZATIONS

6.1 Intergovernmental Oceanographic Commission

Bjørn Sundby and Ed Urban attended the IOC Executive Council in June 2008 to represent SCOR. ICSU asked SCOR also to represent ICSU at the meeting. Sundby and Urban made several interventions at the meeting on behalf of SCOR and/or ICSU, related to IOC's "Future of IOC Document", IOC discussions on ocean fertilization, and on the Global Ocean Observing System. **[**SCOR and IOC cooperate on several different activities, as discussed in other sections**.** Sundby reminded participants that we heard from the IOC Chair (Javier Valladares) during the SCOR 50th Anniversary Symposium. Things are changing within the IOC leadership within the coming 1.5 years, with a new Chair, Secretary and head of the Science Sector. Sundby encouraged the new SCOR President to continue close interactions with IOC.

6.1.1 Global Ocean Observing System (GOOS)

Huasheng Hong reported that GOOS is working with the Global Earth Observation System of Systems (GEOSS) on implementing an ocean observation system and within the past year achieved the goal of 3,000 Argo floats. GOOS is promoting the Chlorophyll Global Integrated Network (ChloroGIN) project which aims to increase the in situ measurement of chlorophyll in the ocean and to combine these data with satellite-derived estimates. Hong noted the relevance of the OceanScope Working Group to GOOS, as well as the importance of the POGO Center of Excellence for Ocean Observations in Bermuda. GOOS is cosponsored by ICSU and that ICSU gives SCOR some responsibility for oversight of GOOS. SCOR will probably send someone to the next GOOS meeting. Also, the SCOR Technology Panel has links with GOOS, including tentative plans for a meeting at OceanObs'09.

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

SCOR and GESAMP collaborated in the past year on a position statement on ocean iron fertilization and an article was published in *EOS* to publicize the statement.[1] Robert Duce noted that GESAMP met most recently in Concepcion, Chile and that there are a couple of joint efforts between GESAMP and SCOR. Sandor Mulsow, a member of GESAMP, explained its structure. It is sponsored by 8 UN agencies. Experts act in individual capacity. GESAMP responds to requests from its member agencies for scientific reviews, analyses, and advice on thematic topics; scientific and technical guidance; and syntheses. GESAMP sets up working groups to respond to these requests. These are quite similar to SCOR working groups and are supported by a lead agency and cosponsor. Mulsow focused on GESAMP WG 38 on Atmospheric Input of Chemicals to the Ocean, which is co-sponsored by SCOR. He mentioned the SCOR/GESAMP statement on ocean fertilization. Bjørn Sundby asked about the furor within IOC over the statement. Mulsow insisted that GESAMP has the right to issue such statements, since they serve as an independent group of individual scientists advising their UN sponsors. Duce confirmed that IOC received the statement well in advance and had a chance to comment on it before it was published.

6.3 North Pacific Marine Science Organization (PICES)

PICES conducts several activities that are relevant to SCOR interests and that implement SCOR activities in the North Pacific region. The PICES annual meeting will occur in China overlapping with the SCOR meeting, so SCOR will not be sending a representative. Victor Akulichev noted that PICES was founded in 1992 and reviewed its membership. He presented the PICES report, adding some information about his institute's PICES-related activities, such as a cruise in conjunction with the University of Alaska.

7.0 RELATIONS WITH NON-GOVERNMENTAL ORGANIZATIONS

7.1 International Council for Science

ICSU has continued its development of regional offices in Africa, Asia, and Latin America, and the Arab Region. ICSU has designated SCOR its representative at IOC annual meetings. Bjørn Sundby noted that ICSU now formally recognizes that SCOR as the responsible ICSU body for the ocean. This is a subtle, but important, change, especially in relation to IOC and GOOS. This

[1]Urban, E., and F. Haag. 2008. Organizations Urge Caution on Ocean Fertilization Experiments. *EOS: Transactions of the American Geophysical Union* 89(19):179.

is very encouraging. Sundby advised Wolfgang Fennel to maintain a good relationship with ICSU.

7.1.1 International Geosphere-Biosphere Program (IGBP)

Bjørn Sundby and Ed Urban attended the IGBP Science Committee meeting in Cape Town, South Africa in May 2008 to represent SCOR. SCOR and IGBP staff members have ongoing discussions in relation to co-sponsored projects. Robert Duce introduced Wendy Broadgate, a Deputy Executive Director for IGBP. Broadgate reported that IGBP's vision is to provide scientific knowledge to improve the sustainability of the living Earth. The program focuses on interactions among biological, chemical and physical processes and human systems. Broadgate presented a chart of the overall IGBP program and noted the marine projects, most of which are co-sponsored by SCOR. Sybil Seitzinger is the new IGBP Executive Director. Broadgate noted that IGBP was a new co-sponsor of the symposia on The Ocean in a High-CO_2 World. She showed Jim Orr's animation of the Southern Ocean becoming corrosive by 2100. Models do very badly in the Arctic, margins, enclosed areas and upwelling areas. These are sensitive areas where we really need more understanding. 70% of cold water corals will be in corrosive waters by 2100 if atmospheric CO_2 concentrations follow the IPCC "business as usual" scenario. The combined impacts of ocean acidification and warming mean that the largest changes may occur in the Arctic Ocean. For example, reduced pteropod calcification is predicted and these marine mollusks are an important food for salmon. Broadgate listed the products from the Monaco symposium:

- press releases,
- a media fact sheet to be published in *IGBP Newsletter*,
- the *Research Priorities Report*,
- an *Oceanography* magazine article,
- and a *Summary for Policymakers*.

An IGBP Congress was held in Cape Town, South Africa in May 2008. A review of IGBP is being conducted by ICSU and the International Group of Funding Agencies (IGFA) for global change research. It has been more than a decade since last the ICSU review of IGBP and the program has changed a lot since then. IGBP Fast-track Initiatives (FTIs) are similar to SCOR working groups. Two were done in the past with SCOR: (1) global iron connections and (2) ocean acidification over time. The PAGES office is planning some follow up on the latter FTI and ocean acidification is included in the new PAGES science plan. They would like to set up a paleo-ocean acidification group. 2009 will mark the beginning of the IGBP mid-term synthesis. The next IGBP Open Science Conference will be held in 2012, but there will be no more congresses.

Robert Duce noted that 2009 will be a very active year for IGBP, with a new director, responding to the ICSU/IGFA review, the mid-term synthesis, etc. The SCOR President and

Executive Director typically attend SC-IGBP meetings and someone from IGBP, usually Wendy, attends the SCOR annual meeting. Our interactions are very positive. Mysak asked about IGBP interactions with WCRP. Broadgate responded that both participate in the Earth System Science Partnership and this has helped the two programs develop a very close relationship and a lot of joint projects in recent years. There was discussion of a merger with WCRP, but it's not going to happen due to the intergovernmental nature of some WCRP sponsors. Ed Urban noted that SCOR needs to be careful to avoid conflicts in 2012 between IGBP Open Science Meeting and the next Symposium on The Ocean in a High-CO_2 World. Urban also asked that IGBP avoid expensive locations for its open science meeting; the past two congresses really hurt the budgets of our joint projects.

7.1.2 World Climate Research Programme (WCRP)

WCRP is co-sponsoring the SOLAS project and SCOR projects are working well with CLIVAR, the part of WCRP most relevant to SCOR. CLIVAR, IMBER, and GLOBEC conducted the CLIMECO training workshop in April 2008. CLIVAR will participate in the 2009 SCOR Project Summit. Michael MacCracken reported that WCRP continues to be very active. The program is also under review by ICSU and IGFA this year. SCOR projects work most closely with CLIVAR, for example, in the CLIMECO workshop with IMBER and GLOBEC.

7.1.3 Scientific Committee on Antarctic Research (SCAR)

Jorma Kuparinen reported that SCOR and SCOR have three major areas of overlapping interests: (1) iAnZone, (2) the International Bathymetric Chart of the Southern Ocean, and (3) the SCAR/SCOR Expert Group on Oceanography. The major activity of the Expert Group is development of a plan for a Southern Ocean Observing System (SOOS). The Expert Group is co-chaired by Steve Rintoul (Australia) and Eileen Hoffman (USA). SOOS is focused on the need for sustained observations in the Southern Ocean, what observations are required to meet research and operational needs, etc. SCOR contributes up to $10,000 annually for the Expert Group. Julie Hall added that she is a member of the group and she feels it is making good progress. The draft SOOS document is very multi-disciplinary and has a lot of potential. It is very science-focused, since major users of data in the Southern Ocean region are scientists.

7.1.4 Scientific Committee on Problems of the Environment (SCOPE)

SCOR's major cooperative activity with SCOPE (and IAPSO) in the past two years has been the PACKMEDS project, which resulted in the book entitled *Watersheds, Bays and Bounded Seas.*[1] SCOR played a major role (through Ed Urban and Bjørn Sundby) in the book's review and editing. Annelies Pierrot-Bults reported that SCOPE has had serious financial problems for the past two years, with projects ending and overhead funds lapsing. ICSU has just decided to sever

[1]Urban, E.R. Jr., B. Sundby, P. Malanotte-Rizzoli, and J. Mellilo (eds.). 2009. "Watersheds, Bays, and Bounded Seas: The Science and Management of Semi-Enclosed Marine Systems", Island Press. Washington, D.C.

links with SCOPE, two years from now. Ed Urban added that SCOPE has had trouble since the creation of other organizations within ICSU and outside with overlapping mandates.

7.2 Affiliated Organizations

7.2.1 International Association for Biological Oceanography (IABO)

Annelies Pierrot-Bults reported that most IABO activities are related to CoML and carried out by her and the IABO Vice-President, since that is their interests. IABO has little money and is looking for a new President. IABO will cosponsor a session at the next IAPSO meeting in Montreal. This is Pierrot-Bults' last SCOR meeting; she has been involved in SCOR in some capacity since 1980. She recalled the encouragement of Henry Charnock. Ed Urban thanked Pierrot-Bults for her service in various capacities for SCOR. Lawrence Mysak noted that IABO is under the International Union of Biological Sciences (IUBS) of ICSU as IAPSO is under ICSU's International Union of Geodesy and Geophysics. IUGG. IUGG gives IAPSO a little funding. He sees the problem as a lack of support from IUBS. Annelies answered that this is true; IABO receives no financial support from any other organizations. Also, IABO is only as active as its officers. This has been a problem under her and others. Bjørn Sundby asked if IABO is ever reviewed and Pierrot-Bults answered "no." Jesse Ausubel commented that the value and functions of IABO might be a good topic for the SCOR Project Summit.

7.2.2 International Association for Meteorology and Atmospheric Sciences (IAMAS)

Mike MacCracken, as IAMAS past-president, continues as IUGG/IAMAS liaison to SCOR. MacCracken described IAMAS activities. The key IAMAS activities over the past year have been (1) planning for the joint IAMAS/IAPSO/IACS scientific symposium to be held in Montreal, Canada from 19-29 July 2009; (2) assumption of office by the new officers of IAMAS; (3) following up after the IUGG General Assembly in Perugia in July 2007; (4) liaison of IAMAS representatives with other organizations; (5) improving communication via the Web and newsletters; and (6) the activities of the IAMAS commissions.

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

SCOR and IAPSO are currently co-sponsoring WG 122 on Estuarine Sediment Dynamics (with LOICZ), WG 127 on Thermodynamics and Equation of State of Seawater, and WG 129 on Deep Ocean Exchanges with the Shelf. Lawrence Mysak noted that their 2009 meeting in Montreal (MOCA - Meteorology - Oceans - Cryosphere Assembly) is their big concern right now. The meeting will feature 55 symposia of which will be 21 joint among different organizations. Mike MacCracken is organizing a session on geoengineering. There is a new IAPSO brochure and Web site, thanks to Johan Rodhe.

7.3 Affiliated Programs

The benefit of continued affiliation to SCOR is evaluated at each General Meeting. Affiliated programs were invited to send representatives to the project summit sponsored by SCOR in 2009. SCOR is using the project summits to help (among other benefits) the affiliated projects interact with other large-scale ocean research projects; there is no other forum for this interaction to take place.

7.3.1 Census of Marine Life (CoML)

In 2010, this international research program will release its first report on the status of knowledge of marine biodiversity. To meet this deadline, CoML has begun implementing plans for integration, synthesis, and visualization of marine biodiversity information, as well as the management needs to achieve them. This information is actively being collected by the 14 CoML Ocean Realm Field Projects and three cross-cutting initiatives in historical studies (HMAP – History of Marine Animal Populations), modeling and prediction (FMAP – Future of Marine Animal Populations), and data management and accessibility (OBIS – Ocean Biogeographic Information System). CoML will hold a synthesis meeting in Long Beach, California, USA in February 2009 and a final conference in London in 2010. Peter Burkill introduced Victor Gallardo, Fred Grassle, and Jesse Ausubel of CoML. Burkill noted that we heard during the previous day of the meeting about the SCOR Technology Panel that is advising CoML. Ed Urban is participating in the Science Council 2020 to advise CoML on its future.

Jesse Ausubel made a presentation about CoML, first providing examples of CoML discoveries. He noted that much progress had been made since his most recent presentation in 2005 at SCOR's annual meeting in Chile. CoML was initiated in 2000 and has a sunset in 2010. Its objective is to assess and explain the diversity, distribution, and abundance of marine life—the known, the unknown and, unknowable. CoML is a global collaboration and Ausubel presented a map of national and regional activities. It is a program of both research and applications, with a focus on marine biodiversity. The program's point of entry are species, requiring that it gets the taxonomy right. The grand challenge questions of CoML are what did, does, and will live in the ocean? The program will have two great legacies: (1) contributions to GOOS for observing marine life and (2) its database, the Ocean Biogeographic Information System (OBIS). Ausubel presented slides of examples of history of human exploitation of marine resources. CoML has 14 ocean international ocean realm field projects. Some new developments in relation to these include

- Tagging to understand continental shelf migrations. The initial test area is in the NE Pacific Ocean. The vision is to expand to a global ocean tracking network. Tagged salmon smolts were tracked 2500 km from Fraser and Columbia Rivers to Alaska.
- Integration with Encyclopedia of Life (EOL)—this is a fast growing project to create a Web page for every species.
- Fish TV - shelf ecosystem-scale monitoring of populations by Ocean Acoustic Remote

Sensing. This technique can cover very large areas on continental shelves. 200 million herring were observed in one school on Georges Bank. 4 or 5 of these systems could cover the entire North Atlantic Ocean.

- Long-distance tracking of larger, wide-ranging organisms, such as bluefin tuna commuting between Los Angeles and Tokyo, and loggerhead turtles from California to Indonesia.
- International Census of Marine Microbes is conducting global sampling, in 1700 locations. 2007 results showed unexpected microbial diversity: 60,000 bacterial species in a liter of seawater. They developed the concept of the "rare biosphere", an enormous number of rare species that may adapt to changing conditions, such as ocean acidification or climate change. Visualization is important in the microbe project synthesis, such as use of "microbial skylines" - visual characterization of microbial population diversity.
- CoML has active cooperation with GEO and GOOS and has been active with POGO to encourage inclusion of CoML technologies in GOOS.
- OBIS provides a 21st Century informatics infrastructure for marine biodiversity, but how will it continue after the Census? IOC requested a detailed plan for how it and IODE can help.

Major challenges for CoML will be synthesis and resources for future work, although no major effort has faltered for lack of resources. The total investment in CoML is about $650M, of which the Sloan Foundation provided about $60M. Ausubel concluded his presentation by showing footage from the new film, "Oceans" by Galatee, for release at the CoML Finale in October 2010.

Many participants expressed appreciation for Ausubel's presentation. Laurent Labeyrie expressed his concern that the fish detection technology advanced through CoML will get to industry and help fishermen to wipe out remaining fish. He suggested that the results not be available in real time. Jesse Ausubel responded that there is also concern about vents and information from Census being used by the undersea mining industry. The community doesn't yet appreciate the responsibilities that will come with the acquisition of these new technologies. It was agreed that CoML affiliation with SCOR should continue.

7.3.2 International Antarctic Zone (iAnZone) Program

iAnZone last met in conjunction with the Polar Dynamics meeting in Bergen in August 2007, and made an extended presentation at the SCOR Executive Committee meeting there. Jorma Kuparinen noted that their next meeting is in Montreal at MOCA-09. It was agreed that iAnZone's affiliation with SCOR should continue.

7.3.3 International Marine Global Changes Study (IMAGES)

SCOR and IMAGES are currently co-sponsoring WG 124 on Analyzing the Links Between Present Oceanic Processes and Paleo-Records. Ralph noted that IMAGES comprises the marine PAGES community, evolved from SCOR/PAGES WG 100. Schneider described the IMAGES

structure and mission. In terms of administration, IMAGES has a full-time data manager and a one-quarter time assistant director. IMAGES cruises in 2008 include the following:

- Project RETRO - Response of tropical Atlantic Surface and Intermediate Waters to Changes in the Atlantic Meridional Overturning Circulation.
- AMOCINT - Atlantic Meridional Overturning Circulation during Interglacials

Inactive and completed IMAGES working are disbanded, including the joint group WG 123 with SCOR.

IMAGES has been going for 12 years now and project leaders knows of the finite life of SCOR activities. Eighty PhDs have resulted from the program, but renewal is always a good thing. They would like to enhance their collaboration with IGBP-PAGES and renew the IMAGES Science Plan, along the lines of "IMAGES(2): Into a new decade of IMAGES research". They would also like to strengthen IMAGES-SCOR links (e.g., new joint working groups, links to other SCOR programs like IMBER). They would like to use new platforms, not only the *Marion Dufresne*. Woods Hole Oceanographic Institution is performing the first sea trials for a new 30m-long Calypso coring system on the RV *Knorr*. A meeting will be held in Spring 2009 to discuss a new IMAGES science plan. They are looking for a new host for the IPO, perhaps at Southampton. Laurent Labeyrie added that he thinks it is time to plan in detail for the renewal of IMAGES. He would like to see a major scientific congress at this point. The energy for leadership in IMAGES has run down, but there is still a lot of enthusiasm coming up from the community. Labeyrie discussed the need for a move to "modern oceanography" in this field: new instruments, new collaborations. We need a much better understanding of ocean variability for the last few thousand years. Maybe there should be a whole new identity for IMAGES, which should be discussed with IGBP, SCOR, and WCRP/CLIVAR. Wendy Broadgate asked about the interaction of IMAGES with PAGES. Has IMAGES had any role in the production of the new science plan for PAGES that is coming out soon? Schneider responded that there have been regular meetings with PAGES and a lot of IMAGES contributions to last PAGES OSM in Beijing. But a lot of IMAGES objectives have now been channeled into PAGES. The emphasis internationally (IPCC, etc) is changing towards future climate change, mitigation, etc., with less support for studies of past change. Mike MacCracken noted that the most recent IPCC Assessment had, for the first time, a whole chapter on paleoclimate and he expects that there will be more interest in paleoclimate, not less. Sandor Mulsow added that he participated in the recent IMAGES cruise off Chile. They recovered extremely high resolution cores for the first time, near the face of a glacier, including one 39m-long core. Chile is just getting involved in IMAGES. He urged that an international program keep going in some form. Labeyrie proposed a high-level SCOR-IGBP meeting to discuss the future of IMAGES. Catherine Jeandel noted that the *Marion Dufresne* is getting old. She is involved in discussions in France about this problem and needs help to maintain support for the ship and asked interested individuals to get in touch with her. It was agreed that IMAGES' affiliation with SCOR should continue.

7.3.4 InterRidge - International, Interdisciplinary Ridge Studies

InterRidge has an active program of working groups and scientific meetings, as well as significant education and outreach activities. The project's focus is on science projects that no country can accomplish alone. Laurent Labeyrie introduced the discussion by noting that InterRidge became affiliated with SCOR 12 years ago. He was pleased to see their involvement in the new working group proposal. Jian Lin, one of the two InterRidge co-chairs, reported in the project. He discussed new directions and activities of InterRidge and its relationship with the CoML project ChEss. Ridge systems host distinctive species assemblages in different oceans and perhaps specific biogeographic types can be defined. There is increasing pressure for mining of massive sulfide deposits in ridge zones, which would impact fragile deep-sea ecosystems. Thirty nations or regions are now part of InterRidge and China has become a principal member. Lin described funding of the program office at Woods Hole. Both SCOR and InterRidge benefit from the project's affiliation with SCOR, though links with GEOTRACES, SCOR working groups, InterRidge working groups, the CoML ChEss project, etc.

Labeyrie thanked Lin and stated that a few years ago SCOR was concerned that InterRidge would be only for rich countries; clearly this is not the case. A lot of capacity building is conducted by the project. He is very concerned about the potential of mining. Sandor Mulsow is President of one of the International Sea Bed Authority commissions and stated there are already 8 mining companies with concessions for deep sea mining. Mining issues are very serious. SCOR agreed to continue the affiliation of InterRidge.

7.3.5 International Ocean Colour Coordinating Group (IOCCG)

Several monographs are in progress by IOCCG scientific working groups and 6 have been published in the IOCCG Report series so far, on various aspects of ocean color technology and its applications. Seven other scientific working groups are in various stages of progress. Jorma Kuparinen reported that this group has been affiliated with SCOR since 1997. Six working groups are active now; a couple are having trouble and may be closed. One new one is under consideration. Jim Yoder, the Chair of IOCCG for 1.5 more years, reported on the activity and praised the work Venetia Stuart, the Executive Scientist for the project. They are interested in water-leaving radiance, calculations of ocean productivity, particulate carbon, suspended sediments, etc. SCOR agreed to continue IOCCG's affiliation.

7.3.6 Application for a new Affiliation: A New Program on Ocean Mixing

This request arises out of former the former IAPSO/SCOR WG 121 on Ocean Mixing. Ed Urban explained that this request reflects a desire to develop a mechanism to keep a loose structure for occasional meetings, somewhat like iAnZone. Laurent Labeyrie suggested that the group be asked to broaden its membership geographically. Michael MacCracken suggested that SCOR could use its travel grant to send people from developing countries to meetings of this group. The requested affiliation was approved.

7.4 Other Organizations

7.4.1 Partnership for Observation of the Global Ocean (POGO)

The 2008 POGO meeting will be held in Concepcion, Chile in January 2009. POGO and SCOR are participating together on the POGO-SCOR Visiting Fellowships for Oceanographic Observations and on developing new capacity-building activities. POGO devotes much effort to capacity building and to ocean input to the Global Earth Observing System of Systems (GEOSS). Robert Duce introduced the discussion. The biggest joint effort is the POGO-SCOR Visiting Fellowships for Oceanographic Observations. The visiting professorship program has concluded, although has several other capacity-building activities ongoing. The Nippon Foundation-POGO Centre of Excellence in Observational Oceanography is now established at the Bermuda Institute of Oceanography. Its proximity to the Bermuda Atlantic Time Series (BATS) and other time-series stations was an important consideration. Ed attended the most recent POGO meeting in Bermuda. The January 2009 meeting in Bermuda was the best attended yet. They try to collectively influence the evolution of the ocean observation systems.

7.4.2 Arctic Ocean Sciences Board (AOSB)

The AOSB re-established contact with SCOR in 2007 and is interested in expanding its role in the global ocean programs and will be looking to new linkages with various international marine science organizations such as SCOR and GOOS. AOSB will merge with the International Arctic Science Committee in the coming year.

8.0 ORGANIZATION AND FINANCE

8.1 Membership

8.1.1 National Committees

Bjørn Sundby and Ed Urban met with the South African SCOR Committee in May 2008 and with the French SCOR Committee in June 2008, in conjunction with other meetings. Ed Urban also met with the China (Beijing) and U.S. SCOR committees since the last annual SCOR meeting. He has been told Korea is interested in coming back into SCOR. Urban introduced Alexandra Gogou from Greece, who is going to take information about SCOR home. Spain, thanks to Marta Estrada, has increased its membership level.

8.2 Publications Arising from SCOR Activities

Publications from Working Groups and Major Projects—Major publications from SCOR activities produced since the 2007 SCOR meeting include the following:

Guide to Best Practices for Ocean CO_2 Measurements—The International Ocean Carbon Coordination Project (an IOC/SCOR activity), North Pacific Marine Sciences Organization (PICES), and U.S. Department of Energy collaborated to update this manual. It contains the most up-to-date information available on the chemistry of CO_2 in seawater and the methods for determining carbon system parameters. Copies were sent to the SCOR list of libraries in developing countries and countries with economies in transition. Others wishing to obtain copies of this document should contact Alex Kozyr (kozyra@ornl.gov).

SCOR/IAPSO WG 127: Millero, F.J., R. Feistel, D.G. Wright, and T.J. McDougall. 2008. The composition of Standard Seawater and the definition of the Reference-Composition Salinity Scale. *Deep Sea Research, Part I* 55:50-72.

SOLAS/INI Workshop: R.A. Duce, J. LaRoche, K. Altieri, K.R. Arrigo, A.R. Baker, D.G. Capone, S. Cornell, F. Dentener, J. Galloway, R.S. Ganeshram, R.J. Geider, T. Jickells, M.M. Kuypers, R. Langlois, P.S. Liss, S.M. Liu, J.J. Middelburg, C.M. Moore, S. Nickovic, A. Oschlies, T. Pedersen, J. Prospero, R. Schlitzer, S. Seitzinger, L.L. Sorensen, M. Uematsu, O. Ulloa, M. Voss, B. Ward, L. Zamora. 2008. Impacts of Atmospheric Anthropogenic Nitrogen on the Open Ocean. *Science* **320**:893-897;DOI: 10.1126/science.1150369

SCOR Panel on New Technologies for Observing Marine Life: Evans, K., and G. Arnold. 2008 *Report on a geolocation methods workshop convened by the SCOR Panel on New Technologies for Observing Marine Life, 5-6 October 2007*. San Sebastián, Spain.

SCOR/GESAMP on Deliberate Nutrient Additions to the Ocean: Urban, E**.,** and F. Haag. 2008. Organizations Urge Caution on Ocean Fertilization Experiments. *EOS: Transactions of the American Geophysical Union* 89(19):179.

SCOPE/IAPSO/SCOR PACKMEDS Project: Urban, E.R. Jr., B. Sundby, P. Malanotte-Rizzoli, and J. Mellilo (eds.). 2008. *Watersheds, Bays, and Bounded Seas: The Science and Management of Semi-Enclosed Marine Systems.* In press.

Urban, E., S. Sathyendranath, and J. de Leeuw. New Database of Research Cruises, Submitted to *EOS.* In review.

2007 *SCOR Proceedings*—The *Proceedings* will be printed and distributed in September or October 2007.

SCOR Web site—The SCOR Web site is updated and checked for dead links regularly. Ed Urban hopes to revise the Web site in the coming year.

SCOR Newsletter—The SCOR Electronic Newsletter was started late in 2004, to provide more frequent updates about SCOR activities between annual meetings. Eleven issues have been

distributed so far. (All are available on the SCOR Web site.) The SCOR Secretariat will issue three newsletters each year. The SCOR Secretariat improved the layout and design of the Newsletter in 2007 and will continue to have it printed in hard copy occasionally for limited distribution.

8.3 Finances

The annual audit was competed in May. Elizabeth Gross worked to prepare information for the auditors. The financial records and financial controls were found to follow accepted standards. SCOR received the following new or renewal grants since the 2007 SCOR meeting:

- Renewal of NSF grant for travel of scientists from developing countries to ocean science meetings
- Supplemental funding to SCOR's science grant from NSF, for the GEOTRACES Data Management Office and International Project Office, and for GLOBEC and IMBER open science conferences
- Funding from the U.S. Office of Naval Research for the workshop of SCOR/IAPSO WG 129 on Deep Ocean Exchanges with the Shelf
- Agreement by the Land-Ocean Interactions in the Coastal Zone to co-fund SCOR/LOICZ WG 132 on Land-based Nutrient Pollution and the Relationship to Harmful Algal Blooms in Coastal Marine Systems
- Agreement from the Institute of Oceanology of the Chinese Academy of Sciences to co-fund LOICZ/SCOR WG 132 on Land-based Nutrient Pollution and the Relationship to Harmful Algal Blooms in Coastal Marine Systems
- Renewal of the grant from the Alfred P. Sloan Foundation for the SCOR Panel on New Technologies for Observing Marine Life

Julie Hall reported for the Finance Committee (John Compton, chair, Marie-Alexandrine Sicre and Julie Hall), since John Compton had to leave early. The 2007 audit found no problems. The 2007 net assets were US$197,000, not reduced as recommended in Bergen, but the committee recommended approval of the 2007 financial statement, which the meeting did approve. In the revised budget for 2008 discretionary funds, there is a projected reduction in costs, but also projected assets of $179,000, a decrease consistent with recommendations of previous finance committees. The revisions to 2008 budget were approved. Considering the 2009 draft budget, net assets are projected to decrease again to about $146,000, again consistent with previous recommendations. This includes a 5% dues increase approved in 2007. Funding for three new working groups includes the co-funding by IAPSO, Chinese sources, and InterRidge. The Finance Committee is comfortable with the proposed budget and recommends its acceptance. The 2009 budget was approved by meeting participants. The Finance Committee recommended a

5% increase in SCOR dues for 2010, which was also approved.[1] Another financial issue for discussion is the $8,000 allocated for publication; about half is for the *SCOR Proceedings*. Do we really need to produce a hard copy of this document every year? Could those funds be used for other outreach activities if we went to electronic publication of the *Proceedings*? There was general agreement with this idea, as the *Proceedings* is a rather old-style document. Hall ended her presentation by noting that Ed Urban and Elizabeth Gross put a lot of effort into looking after finances, which made the Finance Committee's job easy.

8.4 The Disciplinary Balance among SCOR Working Groups

Laurent Labeyrie led the disciplinary balance activity for the final time. Peter Burkill agreed to take over from Labeyrie. For 2009 working group proposals, meeting participants agreed to encourage approaches which includes climate change, ecosystem impact and human impact for next IPCC assessment:

- Sea level changes and impacts
- Ocean dynamic and heat transfers
- Ocean dynamic and carbon cycle
- Human health and disaster impacts
- integrated modeling ecosystems-ocean dynamic and biogeochemistry

9.0 SCOR-RELATED MEETINGS

9.1 SCOR Annual Meetings

Meeting participants will consider potential locations in which to hold future meetings, particularly in nations that have not recently hosted annual meetings.

9.1.1 2008 General Meeting – Woods Hole, Massachusetts, USA

Bjørn Sundby thanked the U.S. SCOR Committee, and the Marine Biological Laboratory and Woods Hole Oceanographic Institution for their hospitality in hosting both the SCOR 50th Anniversary Symposium and the 2008 General Meeting.

9.1.2 2009 Executive Committee Meeting – Beijing, China

The SCOR Executive Committee agreed in 2007 to accept the offer from the Chinese SCOR Committee to hold the 2009 SCOR Executive Committee meeting in China. Huasheng Hong presented information about the Beijing meeting venue.

[1]This was later decreased to a 3% increase because of the global financial crises.

9.1.3 2010 General Meeting

The SCOR Executive Committee has accepted an offer from the French SCOR Committee to hold the 2010 General Meeting in Toulouse, France.

9.2 Gifts of Appreciation

Ed Urban distributed gifts to retiring Executive Committee members. He especially thanked Laurent Labeyrie for his work on the SCOR 50th Anniversary Symposium. Labeyrie responded that Robert Duce initiated the idea and Urban did a lot of the hard work. Urban noted that Duce was probably not expecting a gift, but he had put in four more years of hard work as Past President. Duce noted that this was the end of 14 years on the SCOR Executive Committee, as the IAMAS President, SCOR President, and SCOR Past President. Bjørn Sundby thanked Urban for four years of close work together, sharing meals, traveling together, leading the PACKMEDS book, etc. Sundby added that it had been a great honor to be President of SCOR—the people make all the difference.

ACRONYMS

AABP	anoxygenic photosynthetic bacteria
ACCENT	Atmospheric Composition Change European Network of Excellence
ADCP	acoustic Doppler current profiler
ADOES	Asian Dust and Ocean Ecosystems
AGU	American Geophysical Union
ANTARES	
APN	Asia Pacific Network for Global Change Research
AMT	Atlantic Meridional Transect (UK)
AOSB	Arctic Ocean Sciences Board
ASLO	American Society for Limnology and Oceanography
BELSPO	Belgian Federal Science Policy
BENEFIT	Benguela Environment Fisheries Interaction and Training
BODC	British Oceanographic Data Centre
CACGP	Commission on Atmospheric Chemistry and Global Pollution (IAMAS)
CalCOFI	California Cooperative Oceanic Fisheries Investigations
CARBOOCEAN	Marine carbon sources and sinks assessment (EU Integrated Project)
CARD-FISH	Catalysed Reported Deposition Fluorescence *in situ* Hybridization
CARINA	CARbon dioxide In the North Atlantic project
CASIX	Centre of Excellence for the Observation of Air-Sea Interactions and Fluxes (UK)
CCC	Cod and Climate Change (ICES and GLOBEC)
CCCC	Climate Change and Carrying Capacity (PICES and GLOBEC)
CDIAC	Carbon Dioxide Information Analysis Center (US)
CDOM	colored dissolved organic matter
ChEss	Biogeography of Chemosynthetic Ecosystems project (CoML)
ChloroGIN	Chlorophyll Global Integrated Network
CliC	Climate in the Cryosphere (WCRP)
CLIMECO	Climate driving of marine ecosystem changes (CLIVAR, GLOBEC, IMBER)
CLIOTOP	Climate Impacts on Ocean TOp Predators (GLOBEC)
CLIVAR	Climate Variability and Prediction project (WCRP)
CNRS	Centre national de la recherche scientifique (France)
CODiM	Comparison of Oceanic Dimethylsulfide Models
CoML	Census of Marine Life
COPAS	Centro de Investigación Oceanográfica en el Pacifico Sur-Oriental (Chile)
COST	European Cooperation in the Field of Science and Technical Research
CRP	Core Research Project (GEOHAB)
CSIC	Institut de Ciencies del Mar (Spain)
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australia)
CYBER	CYcles Biogéochimiques, Ecosystèmes et Resources (France)
DFO	Department of Fisheries and Oceans (DFO)
DLO	data liaison officer
DMC	data management committee
DMS	dimethylsulfide
DMS(P)	dimethylsulfide/dimethylsulfoniopropionate
DOC	dissolved organic carbon

DOM	dissolved organic matter
DYFAMED	***DY***namique des ***F***lux ***A***tmosphériques en ***MED***iterranée
EGU	European Geophysical Union
ESSAS	Ecosystem Studies of Sub-Arctic Seas (GLOBEC)
ESF	European Science Foundation
EU	European Union
EUROCEANS	European Network of Excellence for Ocean Ecosystem Analysis
FAO	Food and Agriculture Organization (UN)
FCM	
FMAP	Future of Marine Animal Populations (CoML)
FP	Framework Programme (EU)
FUTURE	**F**orecasting and **U**nderstanding **T**rends, **U**ncertainty and **R**esponses of North Pacific Marine **E**cosystems (PICES)
GCP	Global Carbon Project
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)
GOOS	Global Ocean Observing System
GO_SHIP	Global Ocean Ship-based Hydrographic Investigations Panel
HAB	harmful algal bloom
HItT	Halogens in the Troposphere (SOLAS and IGAC)
HMAP	History of Marine Animal Populations (CoML)
HPLC	high-performance liquid chromatography
IABO	International Association of Biological Oceanography (IUBS)
IAEA	International Atomic Energy Agency
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
ICSU	International Council for Science
IFREMER	Institut français de recherche pour l'exploitation de la mer (French Research Institute for Exploitation of the Sea)
IGAC	International Global Atmospheric Chemistry project (IGBP and CACGP)
IGBP	International Geosphere-Biosphere Programme (ICSU)
IGFA	International Group of Funding Agencies for Global Change Research
IHDP	International Human Dimensions of Global Change Programme (ICSU)
IMAGES	International Marine Global Changes Study (IGBP/PAGES)
IMBER	Integrated Marine Biogeochemistry and Ecosystem Research project (SCOR and IGBP)
IMO	International Maritime Organization
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)
IODP	Integrated Ocean Drilling Program
IPCC	Intergovernmental Panel on Climate Change
IPO	international project office
IPY	International Polar Year
IR	InterRidge
IRD	Institut de Recherche pour le Développement (France)
ISME	International Symposium for Microbial Ecology
ISSN	International Standard Serial Number
IUBS	International Union of Biological Sciences (ICSU)
IUEM	Institut Universitaire Européen de la Mer
IUGG	International Union of Geodesy and Geophysics (ICSU)
JGOFS	Joint Global Ocean Flux Study (SCOR and IGBP)
KORDI	Korean Ocean Research and Development Institute
LDOC	labile dissolved organic carbon
LDEO	Lamont-Doherty Earth Observatory (US)
LEFE	Fluid Envelopes and Environment project
LINKS	WG 124 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)
LORECS	Long-term Observation and Research of the East China Sea (China-Taipei)
MAP	Marine Aerosol Production (Ireland)
MAPHiNS	Marine Multi-Phase Halogen Chemistry and its Coupling to Nitrogen and Sulfur Cycles
MEAD	Marine Effects of Atmospheric Deposition (EU)
MEPS	*Marine Ecology Progress Series*
Micro-FISH	Microautoradiography and Fluorescent In Situ Hybridization
MOST	Ministry of Science and Technology (China-Beijing)
NASA	National Aeronautics and Space Administration (US)
NERC	Natural Environmental Research Council (UK)
NIWA	National Institute of Water & Atmospheric Research Ltd. (New Zealand)
NM	Nominated Member (SCOR)
NOAA	National Oceanic and Atmospheric Administration (US)
NOC	National Oceanography Centre (UK)
NSF	National Science Foundation (US)
NSFC	National Natural Science Foundation of China
OASIS	Ocean-Atmosphere-Sea Ice-Snow project
OBIS	Ocean Biogeographic Information System (CoML)
OceanSITES	a worldwide system of long-term, deepwater reference stations
OM	organic matter
OOMPH	Organics over the Ocean Modifying Particles in both Hemispheres
ORION	Ocean Research Interactive Observatory Network
OSC	open science conference
OSM	open science meeting

OSSE	observing system simulation experiment
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)
PARAFAC	fluorescence spectroscopy and parallel factor analysis
PICES	North Pacific Marine Science Organization
PLoS	Public Library of Science
POC	particulate organic carbon
POGO	Partnership for Observations of the Global Oceans
POTES	Pressure effects On marine prokaryoTES
PROOF	French acronym for biogeochemical processes in the ocean and fluxes
RDOC	refractory dissolved organic carbon
SCAR	Scientific Committee on Antarctic Research (ICSU)
SCOPE	Scientific Committee on Problems of the Environment (ICSU)
SCOR	Scientific Committee on Oceanic Research (ICSU)
SEARCH	Study of Arctic Change
SEATS	South East Asia Time-Series Station (China-Taipei)
SIBER	Sustained Indian Ocean Biogeochemical and Ecological Research
SIC	SOLAS/IMBER Carbon Research Implementation group
SO	Southern Ocean
SOCAT	Surface Ocean CO_2 Atlas
SOCOVV	Surface Ocean CO_2: Variability and Vulnerability meeting
SOLAS	Surface Ocean-Lower Atmosphere Study (SCOR, IGBP, WCRP, and CACGP)
SOPRAN	Surface Ocean Processes in the Anthropocene (Germany)
SPACC	Small Pelagic fish and Climate Change project (GLOBEC)
SPE-DOM	solid-phase extraction of dissolved organic matter
SP/IS	Science Plan/Implementation Strategy
SSC	scientific steering committee
SSG	scientific steering group
SWEET	Straight Watch on the Environment and Ecosystem with Telemetry (China-Taipei)
TEIs	trace elements and isotopes
TIREM	Time Series Observation-Based Infrared Epifluorescence Microscopy
TTT	Transition Task Team (GLOBEC, IMBER)
UBO	Université de Bretagne Occidentale
UEA	University of East Anglia (UK)
ULB	Université Libre de Bruxelles
UNESCO	United Nations Educational, Scientific, and Cultural Organization
UPS	uninterrupted power supply
USP	University of São Paulo (Brazil)
VAMOS	Variability of American Monsoon Systems (CLIVAR)
VOCALS	VAMOS Ocean Cloud Atmosphere Land Study
WCRP	World Climate Research Programme (WMO, IOC, and ICSU)
WG	working group

WHOI	Woods Hole Oceanographic Institution (US)
WMO	World Meteorological Organization
W-PASS	Western Pacific Air-Sea Interaction Study
XBT	expendable bathythermograph

Annex 1 - AGENDA

1.0 OPENING

1.1	Opening Remarks and Administrative Arrangements	*Sundby, Urban*
1.2	Approval of the Agenda	*Sundby*
1.3	Report of the President of SCOR	*Sundby*
1.4	Report of SCOR Executive Director	*Urban*
1.5	Appointment of an *ad hoc* Finance Committee	*Sundby*
1.6	*Ad hoc* Committee to Review the Disciplinary Balance of SCOR's Activities	*Sundby*
1.7	2008 Elections for SCOR Officers	*Duce*

2.0 WORKING GROUPS

2.1	Disbanded Working Groups		
	2.1.1	WG 78—Determination of Photosynthetic Pigments in Seawater	*Urban*
	2.1.2	SCOR/IOC WG 119—Quantitative Ecosystems Indicators for Fisheries Management	*Urban*
2.2	Current Working Groups		
	2.2.1	WG 111—Coupling Winds, Waves and Currents in Coastal Models	*Mysak*
	2.2.2	WG 115—Standards for the Survey and Analysis of Plankton	*Pierrot-Bults*
	2.2.3	SCOR/LOICZ/IAPSO WG 122—Estuarine Sediment Dynamics	*Sundby*
	2.2.4	SCOR/IMAGES WG 124— Analyzing the Links Between Present Oceanic Processes and Paleo-records (LINKS)	*Labeyrie*
	2.2.5	WG 125—Global Comparisons of Zooplankton Time Series	*Pierrot-Bults*
	2.2.6	WG 126—Role of Viruses in Marine Ecosystems	*Kuparinen*
	2.2.7	SCOR/IAPSO WG 127 on Thermodynamics and Equation of State of Seawater	*Mysak*
	2.2.8	WG 128 on Natural and Human-Induced Hypoxia and Consequences for Coastal Areas	*Duce*
	2.2.9	SCOR/IAPSO WG 129 on Deep Ocean Exchanges with the Shelf	*Mysak*
	2.2.10	SCOR WG 130 on Automatic Plankton Visual Identification	*Burkill*
	2.2.11	SCOR WG 131 on The Legacy of in situ Iron Enrichment: Data Compilation and Modeling	*Duce*
	2.2.10	SCOR/LOICZ WG 132 on Land-based Nutrient Pollution and the Relationship to Harmful Algal Blooms in Coastal Marine Systems	*Kuparinen*
2.3	New Working Group Proposals		
	2.3.1	Working Group on Evaluating the Ecological Status of the World's Fished Marine Ecosystems	*Pierrot-Bults*
	2.3.2	OceanScope Working Group	*Mysak*
	2.3.3	Working group on the Coral Triangle: The centre of maximum marine biodiversity	*Burkill*
	2.3.4	Working Group on Global Patterns of Phytoplankton Dynamics in Coastal Ecosystems: Comparative Analysis of Time-Series Observations	*Kuparinen*
	2.3.5	Working Group on Hydrothermal energy transfer and its impact on the	
	2.3.6	Working Group on Coupled climate-to-fish models for understanding mechanisms underlying low-frequency fluctuations in small pelagic fish	*MacCracken*
	2.3.7	Working Group on The Microbial Carbon Pump in the Ocean	*Burkill*

3.0 LARGE-SCALE SCIENTIFIC PROGRAMS

3.1	SCOR/IGBP/IOC Global Ocean Ecosystems Dynamics (GLOBEC) Project	*Burkill*
3.2	SCOR/IOC Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) Program	*Hong*

3.3	SCOR/IGBP Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) Project	*Duce*
3.4	GEOTRACES Project	*Duce*
3.5	SCOR/IGBP/WCRP/CACGP Surface Ocean-Lower Atmosphere Study	*Hong*

4.0 OCEAN CARBON AND OTHER ACTIVITIES

4.1	IOC/SCOR International Ocean Carbon Coordination Project (IOCCP)	*Sundby, Urban*
4.2	SCOR-IOC International Symposium on "The Ocean in a High-CO_2 World"	*Duce*
4.3	Other Activities	
4.3.1	Third SCOR Summit of International Marine Research Projects	*Urban*
4.3.2	Panel on New Technologies for Observing Marine Life	*Pierrot-Bults*
4.3.3	SOLAS/INI Workshop on Anthropogenic Nitrogen Impacts on the Open Ocean	*MacCracken*

5.0 CAPACITY-BUILDING ACTIVITIES

5.1	SCOR Committee on Capacity Building	*Ittekkot*
5.1.1	Regional Graduate Schools of Oceanography and Marine Environmental Sciences	*Ittekkot*
5.1.2	POGO-SCOR Visiting Fellowships for Oceanographic Observations	*Urban*
5.1.3	NSF Travel Support for Developing Country Scientists	*Urban*
5.1.4	SCOR Reports to Developing Country Libraries	*Urban*

6.0 RELATIONS WITH INTERGOVERNMENTAL ORGANIZATIONS

6.1	Intergovernmental Oceanographic Commission	*Sundby*
6.1.1	Global Ocean Observing System (GOOS)	*Hong*
6.2	Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP)	*Mulsow, Duce*
6.3	North Pacific Marine Science Organization (PICES)	*Akulichev*

7.0 RELATIONS WITH NON-GOVERNMENTAL ORGANIZATIONS

7.1	International Council for Science	*Sundby, Urban*
7.1.1	International Geosphere-Biosphere Program (IGBP)	*Duce, Sundby*
7.1.2	World Climate Research Programme (WCRP)	*MacCracken*
7.1.3	Scientific Committee on Antarctic Research (SCAR)	*Kuparinen*
7.1.4	Scientific Committee on Problems of the Environment (SCOPE)	
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)	*Mysak*
7.3	Affiliated Programs	
7.3.1	Census of Marine Life (CoML)	*Burkill, Ausubel, Gallardo*
7.3.2	International Antarctic Zone (iAnZone) Program	*Kuparinen*
7.3.3	International Marine Global Changes Study (IMAGES)	*Labeyrie*
7.3.4	InterRidge - International, Interdisciplinary Ridge Studies	*Labeyrie*
7.3.5	International Ocean Colour Coordinating Group (IOCCG)	*Kuparinen*
7.4	Other Organizations	
7.4.1	Partnership for Observation of the Global Ocean (POGO)	*Duce*
7.4.2	Arctic Ocean Sciences Board (AOSB)	*Kuparinen*

8.0 ORGANIZATION AND FINANCE

8.1	Membership	
	8.1.1 National Committees	*Duce, Urban*
8.2	Publications Arising from SCOR Activities	*Urban*
8.3	Finances	*Finance Committee, Urban, Gross*
8.4	The Disciplinary Balance among SCOR Working Groups	*Disciplinary Balance Committee*

9.0 SCOR-RELATED MEETINGS

9.1	SCOR Annual Meetings	
	9.1.1 2008 General Meeting – Woods Hole, Massachusetts, USA	*Sundby*
	9.1.2 2009 Executive Committee Meeting – Beijing, China	*Sundby*
	9.1.3 2010 General Meeting	*Sundby*
9.2	Other meetings of interest to SCOR	*Urban*

Annex 2 – Participants

XXIXth SCOR GENERAL MEETING
Woods Hole Oceanographic Institution
Woods Hole, Massachusetts, USA
22-24 October 2008

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OSB = member of the Ocean Studies Board, the U.S. SCOR Committee

YS = Young scientist

Annex 3 - Proposal for a SCOR/IAPSO OceanScope Working Group

Summary

This proposal outlines a new paradigm for the systematic and sustained observation of the ocean by working in close collaboration with the merchant marine industry. The overall objective will be to establish a global network of ocean observation platforms on selected commercial ships. The aim will be to encourage the maintenance, expansion and integration of existing volunteer observing ship programs (e.g. CPR, pCO_2, ADCP, and XBT) while developing in parallel VOS initiatives that use sophisticated new technology, with real time data streams and data analysis facilities. The proposed SCOR working group will be unique as it will bring together ocean scientists with experience of VOS programs, engineers, instrumentation experts, economists, shipping company representatives and senior merchant marine officers as committee members and associate members of the working group. A developing partnership with the merchant marine will be mutually advantageous as observations reported in real time will be used to enhance ocean forecasting services for the shipping industry on the one hand, and to improve our understanding of the ocean's structure and variability for weather and climate studies on the other.

The oceans cover over 70% of our planet and the merchant marine has a presence on the high seas second to none covering millions of miles each year. In contrast research vessel tracks cover a fraction of this distance and rarely repeat their tracks. Freighters, tankers and cruise ships traverse all major oceans on a regular basis, some on well-defined schedules for 'just in time' delivery. Analogous to satellites probing the earth's atmosphere and ocean surface, merchant marine vessels could serve as 'orbiting' platforms for monitoring the interior of the ocean. We do this already to a limited extent, but rather inefficiently because most of the tools available to us were developed for use on research vessels, not for long-term unattended service. But experience has shown that such programs are possible, and with today's technical know-how the opportunity to make a quantum leap in the observation of the ocean is not only a realistic ambition but an extremely cost effective way to obtain the data sets so critically needed to address the challenges posed to society by global environmental change.

The development of an integrated approach to the monitoring of the global ocean is central to the proposal with as a primary goal the construction of a plan of action to implement the concept. Focusing on four interlocking themes: **ORGANIZATION**, **OBSERVATION**, **COMMUNICATION**, and **INTEGRATION** the working group (with the assistance of other experts) will:

1. address and prioritize the scientific challenges that can be best addressed by an integrated VOS program,
2. outline, and promote appropriate and necessary sensor, instrument and software development,
3. develop an institutional framework that enhances the links between the merchant marine and ocean observation communities including ongoing VOS and SOOP programs, and
4. identify and develop an integrated framework for data management and distribution.

To ensure sustained interest and follow-through, a SCOR working group with its international participation, well-defined terms of reference and ability to maintain focus for several years will form an ideal framework to achieve these objectives. Initial responses to the ideas presented above from contacts at IOC and other international links have been positive.

The Marine Environment

The extensive regions of the ocean interior continue – despite their enormous climate and biochemical importance - to be extremely difficult to probe and monitor on a regular basis due to the high cost of research vessels and fixed moorings, and hence the very low density of marine measurements, especially in horizontal dimensions. This stands in complete contrast to the extraordinary ability of satellites to provide frequent and detailed views of the space-time evolution of the surface of the ocean, including temperature,

color, roughness and elevation. However, these systems sample only the surface. It has been said many times before that we know less about the ocean interior than we do of the moon! Oceanographers have sampled and studied the oceans from research vessels for well over a century, but our knowledge of how the ocean behaves over a very wide range of space and time scales remains very poor. How do currents vary in time, shift in position, how much mass and heat do they transport, how do basic biogeochemical processes and biological space/time distributions differ between ocean basins and regional seas - all questions of enormous importance to our understanding of the atmosphere-ocean system that regulates our climate.

Our inability to sample and resolve fields in the horizontal continues to be a major challenge in oceanography. All the more so given that the very energetic mesoscale eddy field not only serves to maintain mean distributions in the ocean, but also to expel gradients to the perimeters of homogenized regions where strong physical and biochemical contrasts develop. Thus mixing can create uniform regions on the one hand (the standard view of eddy processes) yet create strong contrasts on the other. But we know very little about the latter due to the lack of high-resolution subsurface sampling techniques. To take but one example, we still know surprisingly little about zooplankton and myctophid distributions except in a very few areas of the open ocean. We also see growing (and surprising) evidence that the shape of the ocean bottom can play a significant role in constraining ocean currents, not merely at depth but also in the upper ocean. Measuring ocean currents, temperature, and a wide suite of biochemical properties concurrently at high resolution in the horizontal remains a fundamental challenge.

Background

For more than a century officers of the merchant marine have - as part of their watch at sea - sent in weather reports on a regular basis. These observations of air and sea surface temperature, barometric pressure, winds and sea surface conditions have been of enormous importance to the forecasting services of neighboring countries. Further, the archives of these marine observations have formed the basis for much of what we know about the climate of the seas including the enormously important early charts of prevailing winds and ocean currents (e.g. Maury, 1855). But these early observations were largely limited to the ocean surface. Some 80 years later, starting in 1931, Alistair Hardy began a remarkable program to monitor plankton variability by arranging for freighters and ferries to tow Continuous Plankton Recorders on regular routes on a monthly basis (www.SAHFOS.ac.uk). These repeat tows along selected routes have allowed researchers to construct an accurate measure of biomass and various species in the surface waters and how they vary spatially, seasonally and over longer periods of time. A little later in the century mechanical bathythermographs were developed allowing observers to obtain upper ocean profiles of temperature from ships underway. This was followed by the development of the Expendable Bathythermograph (XBT) in the 1960s (e.g. Baker, 1981) that made it possible to develop an understanding of low-frequency variability in the ocean down to the depth of the main thermocline (e.g. Molinari, 2004). And more recently yet, a few commercial vessels have been equipped with Acoustic Doppler Current Profilers (ADCP) to measure and monitor upper ocean currents and their variability, e.g. across the Kuroshio (Hanawa et al., 1996) and the Gulf Stream (Rossby et al., 2005 and Beal et al., 2008). Similar repeat sections have been operated since the mid-1960s (but mostly later) and are now coordinated as part of the International Ocean Carbon Coordination Project (IOCCP) (See CAVASSOO website below.)

Repeat sampling along designated lines confers a tremendous advantage because patterns of change and their magnitudes can be identified and quantified with unparalleled accuracy. These above examples from volunteer observing ships (VOS) indicate the enormous potential of merchant marine vessels for probing the ocean water column on a regular schedule. Discussions that took place at a well-attended session on VOS-based observations held at the 2008 AGU Ocean Sciences Meeting highlighted an increased interest in working with the merchant marine, while at the same time noting the difficulties and challenges in doing so. Research vessels cannot in any way provide a comparable service.

The above encouraging examples notwithstanding, the use of merchant marine vessels to observe the oceans synoptically is far from achieving its considerable potential. One can summarize the reasons for this in a few words: lack of suitable instruments and access to ship platforms, each checkmating the other in a catch-22 loop. In terms of physical measurements temperature profilers are not optimized for merchant ships, so XBTs are used. In most cases their deployment requires a technician to be in attendance, greatly increasing the cost of measurement. Widespread use of VOS has been discouraged by these high costs plus the challenge of accessing merchant ships on regular routes in selected regions of the world. In consequence there has been little effort to develop an automated technique for profiling temperature. ADCPs, although they work reasonably well on their own, are not designed for the 'industrial' environment of freighters. More precisely, the ADCPs at present need considerable protection with industrial-strength uninterruptible power supplies (UPS). It is possible to build ruggedized instrumentation, but this won't happen until a broader demand for such equipment develops. A number of vessels were equipped with 'Ferry-boxes' as part of an EU project (http://www.ferrybox.org/) that included e.g. thermosalinographs, fluorometers for chlorophyll and other instruments to measure, turbidity, oxygen, nutrients and pCO2 with real-time transmission of raw data via satellite. Some of these ships are still operating with research funds, but the program has not moved into operational mode now that the funding for the original project has stopped. The Ferry Box project provided useful information about surface water properties, but the equipment was expensive to install and maintain and generally required regular technical support. Finally, a substantial planning effort and installation cost in dry dock had to be covered for each vessel with little economy of scale or sharing.

The Concept

We propose a fresh start that addresses the need to develop sensors and systems that are optimized for the rigorous environment of routine operation on merchant ships, suitably packaged and easily maintained. To employ an obvious analogy, the atmosphere and ocean surface is probed on a routine and systematic basis with highly reliable instruments developed for satellite application; the same approach should be possible for the sub-surface ocean using ships as 'satellite' platforms. With fresh thinking, and taking full advantage of the possibilities offered by modern technology, a much-improved coverage of the ocean interior can be achieved for a comparatively small additional expense. Just to give a hint at what might be possible, with instruments mounted in the hull one could measure a wide range of physical, biological and chemical properties. Some techniques exist today; others would require considerable development. Much as is done today for remote sensing satellites we need to let loose our creative instincts and engineering skills to develop the instrumentation that could take full advantage of these ocean platforms. Instruments topside would measure a wide range of atmospheric properties providing ground-truth to satellite-based remote sensing systems. As experience grows expectations and requirements will evolve (precipitation being an obvious example). All measurements would be forwarded to a central unit, which would handle shipboard data archiving as well as all communications between ship and shore. Communications will work both ways: ship-to-shore (near-) real time transmission of data for post-processing and distribution, and shore-to-ship for system performance analyses and corrective action as required. But, as with satellites, a very high level of hardware reliability and software robustness must be built into these systems so that they can provide unattended operation over periods of months to years. We offer the following vision statement:

"In partnership with the merchant marine shipping industry develop an integrated approach to the observation of the global ocean on regular and sustained basis. This effort, which might be called 'OceanScope' - to give it a name - will equip commercial ships with instrumentation to automatically measure and report on currents and the physical, chemical and biological state of the water column throughout the water-covered planet. These data will in time become a fundamental resource for studies of the climate and health of our planet."

Proposal

The above concepts are all feasible, but cannot be implemented on a one-by-one basis, they beg for concerted action. Furthermore, all partner countries in SCOR share a common interest in the ocean, for reasons of commerce, optimal ship routing, fisheries, defense, and on the longer time scale the ocean's role in climate. The SCOR approach to resolving issues of common interest seems eminently well suited to the issues posed above. We propose to establish a SCOR working group to develop the concept of a merchant marine-based global observing system of the ocean interior. The working group would bring together experts from science, technology, and the marine industry to develop an entirely new paradigm for working with the merchant marine that incorporates and builds on the past and ongoing experience of current practitioners. Rather than thinking in terms of volunteer observing ships, a very modest concept, we propose a pro-active or purposeful approach, namely the development of new technologies and new modes of cooperation with the merchant marine. A fundamental point should be emphasized here. Experience has shown that the operators of merchant ships are receptive to the presence of ocean and atmosphere observing instrumentation onboard their vessels. They see this as providing a service that will provide feedback to their own benefit as well as, in many cases, giving green credentials. Ship operators invariably only require that the equipment makes no demands on their costs, insurance, time, people or operations. This is where the analogy with orbiting satellites comes in: satellite-borne instrumentation has been designed, optimized and tested for these platforms before they fly so that they can and will perform without any need for hands-on human intervention. The working group will identify suitable scientific objectives and translate these into what might be called 'mission' requirements. The group will be tasked with identifying mechanisms for stimulating the development of 'mission-proof' instrumentation as well as exploring and documenting necessary communications requirements and developing parameters for selecting vessels to be equipped (vessel type, route, hull shape, etc). And, perhaps most important of all, to develop a flexible, easy-to-implement international infrastructure for cooperation between existing and new VOS programs with the merchant marine and the institutions responsible for the instrumentation. The first goal of the working group will be to produce a Development Plan and a procedure for its implementation. This work will take some time, and in order to provide the plan with both support and supervision it is recommended that the working group be active for at least three years or until such time that an operational structure has been implemented that can assume these oversight and management responsibilities.

Issues and Organization

At this stage we propose that the SCOR working group be organized around four central themes, organization, observation, communication and integration. The first refers to developing appropriate frameworks for collaboration between the maritime industry and the marine research communities, the second to the development and implementation of observational programs, the third to shore-based supervision of shipboard systems, and data transfer, distribution and archiving and the fourth to the integration of the proposed development with existing ocean observing programs into a global collaborative system that contributes to the Global Ocean Observing System (GOOS). Each of these areas spans a wide-range and overlapping set of issues. The following subheadings: scientific requirements, instrumentation, networking, platforms and institutional links show how intimately they are linked.

1. *Scientific requirements:* Under this heading the working group will review emerging scientific questions in relation to our present observational skill. For example, what aspects of the ocean interior do scientists think are the most important issues for which more information is required? The intention will be to focus upon the desirability of particular measurements, sensors and technologies rather than their current availability. Historically, scalar or state variables have occupied center stage as researchers have endeavored to characterize the present state of the ocean. However, vector information has much to offer as changes in currents and property fluxes can help presage future changes in state – variations in currents and state tend to be out of phase with the former leading the latter. And recent advances in modeling have shown that assimilating deep velocity profiles using Kalman filtering or 4D methods can be just as fruitful as assimilating temperature or salinity. To meet future scientific and operational forecasting needs, it may be essential to reach below the main thermocline to resolve the weakly-sheared deep velocity field. Measuring currents at great depth is technically possible today but will

require some development to become operational. Experience has taught us that long-term averages of Eulerian time series of currents do not settle down due to the red nature of the velocity spectrum. Eulerian current measurements also suffer from topographic biases. Averaging currents across space gets around both sources of uncertainty so that degrees of freedom accumulate far more rapidly.

Repeat sampling at suitably high-resolution of such biological parameters as upper ocean phytoplankton and mid and upper ocean zooplankton is essential to characterize their temporal and spatial variability. High resolution species data for these taxa are virtually restricted to the near surface northern North Atlantic sampled by the CPR. Given the stress that is being put on marine living resources by commercial fisheries in concert with climate change, there is a need to routinely measure biomass distribution in a wide range of size classes along selected routes. This information is needed to predict shifts in community composition that may profoundly affect the availability of the living marine resources constituting a major fraction of the protein diets in many nations as well as providing information on the changing composition of the plankton that is so crucial for understanding the carbon cycle. Just as the towed plankton recorder opened the window to surface plankton distributions and documented population shifts related to environmental changes, acoustic techniques might be able to do the same for the entire water column. This is just a brief hint of what could be done.

A supplementary need for improved information on the changing role of biota in the biological pump by use of new and existing technologies is noted. The processes involved in the biological pump and its variability are poorly understood on a regional, never mind global scale, and quantifying its role is crucial to an improved understanding of oceanic uptake of CO2. The information provided will be invaluable to modelers and for validation of satellite remote sensing products.

2. *Instrumentation:* Here we address the state of the technology from the perspective of merchant marine-based applications (i.e. robustness and reliability) and explore avenues for future development. Focusing again on currents, what technologies might be available for their measurement at depth - even if at low vertical resolution? What techniques might be developed to monitor thermocline biomass variability? Can we develop low cost (recall that unit cost is a very steep inverse function of numbers) probes of temperature, conductivity, oxygen, ..., that telemeter their data back acoustically to a dedicated hydrophone in the hull of the ship? With the entire circuitry for a probe on a single silicon wafer production costs could be reduced enormously. In addition to this one-way data transfer from expendable probes, ships can also serve as acoustic modems to receive and retransmit underwater instrumentation in their vicinity.

3. *Networking:* Several issues need to be addressed here. First, communication within a vessel. This could be done through Ethernet communications between instrument sites and the bridge or wireless through a series of transmitters distributed throughout the ship. These solutions are much easier to accomplish during the original construction. Second, communication with the outside world. Here, Iridium and Inmarsat will go a long way towards system monitoring and low-bandwidth data transfer with high data rates reserved for when a vessel arrives in port. A choice or balance between the two band-width options might be possible depending upon priorities. Large shipping companies most probably have standard communications methodologies already in place for vessel tracking, routing and data transfer, but if not, the option to promote this capability in conjunction with data messaging may be attractive to them. Communication issues also may involve shipboard data processing at various levels of detail, inclusion of data description and identification (metadata) and shipboard data archival and retrieval. Much has been done in this area in the satellite community, and further relevant technology will be available as a result of the nascent U.S. NSF-sponsored Ocean Research Interactive Observatories Network (ORION) program.

4. *Platforms:* This topic would include a review of vessel designs and an evaluation of the advantages and disadvantages of different hull forms. In so far as acoustic observations of the water column from the

vessel is concerned, a major requirement will be to identify vessel hull types that are relatively free of bubble sweep-down, including measures that might be employed to ameliorate this limitation. What comparatively inexpensive preparations might be built into a vessel during construction in anticipation of use? Here we have in mind features such as reserved hull plate areas for very low-profile external sensors, standard sea-chests with cofferdams to accommodate expected hull-mounted instrumentation, seawater plumbing connections in anticipation of flow through surface water analysis equipment and cable channels and pass-throughs for interior wiring (electrical and fiber-optic). At construction time these costs are very modest but as retrofits they can become prohibitive. Vessels with particular silhouettes may be advantageous for some kinds of meteorological measurements requiring "clean" air and air flow. Consideration may also need to be given to superstructure arrangements and access for sensors requiring a clear view of the skies and options for fitting gyro-stabilized platforms for stable horizon requirements. The overarching consideration is that standardized procedures, technologies and approaches need to be developed to facilitate easy installation, removal and (when necessary) servicing, and to take advantages of economies of scale to enable the establishment of a large-scale integrated network of instrumented commercial vessels.

5. *Institutional:* This is a large and important topic with many subtopics. Institutional links are needed between research, government and international agencies charged with ocean and climate monitoring and the maritime industry. Almost certainly this will require a program office that searches for, develops and provides a liaison between appropriate ship operators and the scientific community. Second, development of formal arrangements or letters of understanding between the parties to avoid misunderstandings and/or subsequent confusion. It is understood that vessel operators may at any time shift vessels from one route to another for commercial reasons, but with proper lines of communications it may be possible to anticipate or minimize the impact of such changes in operation. For example, given adequate warning (and stand-by response capability) even underwater hardware can be removed by scuba divers without a dry-dock. Conversely the same capability would permit equipment installation to take advantage of newly available commercial routes and opportunities. Third, given justifiably heightened security concerns it will be important for the scientists and technicians to prepare in advance. Obtaining prior clearance (and documentation) to enter port facilities has become the rule rather than the exception. Fourth, it will be important to educate both communities (scientific and industrial) of the operational, personnel and logistical needs of the other. A key to success will be recognizing and honoring each other's needs and concerns.

Summary of Activities <u>Mode of Operation of the Working Group</u>

	Organization	**Observation**	**Communication**
Scientific requirements	User community; real-time forecasting/ climate studies	Type of parameter; scalar/ vector; air/water; accuracy; sampling frequency	Real-time/ delayed/ distribution networks
Satellite validation	Remote sensing de-velopers/ users/ tech. designers/developers	Atmosph/oceanic spectral parameters, chlorophyll fluorescence, currents	Real-time/ delayed/ processed products

Instrumentation	Developers/ users/ partnerships	Type of sensors/ atmosph/ oceanic/ acoustic/ optic/ towed systems	Development/ evaluation/ testing
Networking	Shipboard/ ship-to-shore/user communities/ GTS?	Data collection/ software/ pre-wire ships at construction time	Transmission/ software
Platforms	Designers/ users/ vessel owners	Type of observable topside/ hull-based/ towed	Design and approval process
Institutional links	Merchant marine/ science/ go's/ regulatory	Shipboard activities	Establish formal lines of communication

Most of the work outlined above can 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 and a second one after roughly a year. It is envisaged that at the first of these meetings the specific issues listed above will be developed through pre-prepared presentations and discussions. Lead writers will be nominated to draft section contributions for a Development Plan in collaboration with others as appropriate. This work will be reported and discussed at the second meeting of the working group. At this second meeting the members will be in a better position to determine the time scale for completing any remaining tasks, including a possible role in the supervision of the development and implementation of the recommendations in the Development Plan.

The Working Group

The proposed SCOR working group would include experts in all the areas addressed above. A key to success will be to find people who have the time and interest to contribute in a practical way to the objectives of the working group. We note that the response to discussions outlining the basic plans of the proposal, held with a wide cross section of ocean science researchers, representatives of the instrumentation, communication and maritime industries and more recently attendees at the JCOMM/SOT-IV meeting in Geneva (April 2007), have been strikingly positive. Additional voluntary or independently aided contributors to the meetings of the Working Group, or by correspondence will be sought with, where appropriate, nominations from international organizations such as IAPSO, IOC, ICES, PICES, POGO, GEO and of course SCOR. If possible, funding will also be obtained to enable an environmental economist to participate in the working group meetings. In advance of each meeting, the basic agenda for the discussions, time and venue will be advertised to enable participation of additional experts with relevant experience from countries adjacent to the meeting venue. Funds will also be sought, independently of SCOR, to enable participation of representatives from developing countries and some young scientists/engineers.

Full Members

- Prof H. Thomas Rossby (GSO/URI, USA) - Chair Physical Oceanography and technology
- Prof Philip C. Reid (U. Plymouth, SAHFOS, UK) – Co-Chair Marine Biology and Fisheries
- Int'l Chamber of Shipping Industry expert

- Dr David Hydes (NOC, SOTON, UK) VOS technologies
- Mr. Markku Kanerva (DeltaMarin, Finland) Naval architect
- Prof. Fred Soons (Utrecht Univ.) Marine Law
- Prof. Doug Wallace (GEOMAR, U. Kiel, Germany) Ocean carbon
- Prof. Rod Zika (U. Miami) Chemistry, instrumentation
- TBD Passive optics
- TBD Active optics/bioacoustics/communication?

We have approached several groups in China, Japan and Korea for participation in the working group.

Associate Members

- TBD IAPSO representative
- Prof. Peter Ortner (Univ. Miami) Biological Oceanography and Technology
- Dr. C. Flagg (SUNY, Stony Brook Univ.) Physical Oceanography
- Dr. J. Churnside (NOAA, Boulder) Active optics
- TBD (JCOMMOPS, Paris, France) Marine operations, communications
- Dr. Gwyn Griffiths (NOC, SOTON, UK) marine technology, bioacoustics
- Dr. Rik Wanninkhof (NOAA) Global Ocean Carbon Budget
- Dr Joaquim Goes (Bigelow Laboratory) Remote sensing expert
- Marine technology experts

Other members and areas of expertise will be sought as plans continue to develop.

We should mention here a few companies that have been actively supporting sustained ocean observation:

- Maersk Line (Copenhagen, Denmark)
- The Brittany Ferries (Roscoff, France)
- The DFDS Tor Line (Copenhagen, Denmark)
- P&O Ferries (Dover, U.K.)
- The Royal Arctic Line (Nuuk, Greenland)
- The Bermuda Container Line (Hamilton, Bermuda)
- Royal Caribbean Cruise Line (Miami, Fl, USA)
- The China Navigation Company (Hong Kong, China)
- The Smyril Line (Torshavn, Faroes)

We also have contact with several shipping companies and marine activities, including:

- Wallenius Marine AB (Stockholm, Sweden)
- Neste Shipping Oy (Keilaranta, Finland)
- Skaugen Marine Construction (Skaugen, Shanghai, China)
- V.Ships Leisure S.A.M. (Monaco)
- Color Line Marine (Sandefjord, Norway)
- Teekay Shipping (Vancouver, BC, Canada)
- Höegh Autoliners (Oslo, Norway)

Suggested Terms of Reference

The overall objective will be to develop an integrated plan for systematic observation from merchant marine vessels. To achieve this means addressing and resolving issues of which the list below includes some of the major ones mentioned in the text. Of course, once the working group convenes, it should begin with a review of the ToRs and approve/modify them as appropriate.

- Identify ocean observation and scientific needs in terms of parameters and locations
- Identify and prioritize marine routes for sustained ocean observation
- Classify and identify merchant vessel types suitable for sustained observation
- Identify technologies that can enhance vessel capability for ocean observation
- Identify and prioritize instrument needs to meet *future* mission requirements
- Identify and develop procedures (hardware and software) to meet communication needs
- Develop procedures and algorithms for managing data flow, handling, and archival
- Develop information and advisory links with the scientific and government communities for input and feedback
- Identify and resolve EEZ questions, including data ownership, release and sharing
- Design a structure – an Ocean Space Center – to coordinate and implement a merchant-marine based ocean observation program. This would ab initio be conceived as a standalone 'center' to avoid the complications of embedding (and/or losing) its needs in a larger existing structure. But, once the exercise has been completed, it might either be merged into or designed with strong ties to existing ocean observing systems.
- Identify and develop procedures for creating the funding structure to start up and sustain the proposed merchant-marine ocean observation program.

Timeline (assuming a once/year meeting schedule)

Year 1:

- Review and adjust as necessary the TOR
- Produce three year work/action plan for the Working Group
- Complete tasks as defined at first meeting
- Begin discussion and conceptual design of Ocean Space Center
- Review OSC paradigm in relation to existing ocean observing systems
- Explore funding sources/structures
- Develop a website for the Working Group

Year 2:

- Issue first interim report
- Develop and review as necessary the Work Plan for years 2 and 3.
- Complete a proposal for the Ocean Space Center.
- Develop funding (Prepare and submit proposals to government agencies using interim report)

Year 3:

- Issue final report
- Complete and submit a series of papers a special edition of a journal or book.
- Revise – as appropriate – proposal for Ocean Space Center.
- Explore further funding sources. It is hoped by this stage that some initial funding will be in place to start program. If this is the case, start-up of Ocean Space Center, initial funding to industry for instrument and software development.
- Review and decide what structures will need to be put in place to carry forward the deliberations

and plans of the Working Group into the future.

In Summary

There is little doubt that a partnership between the International Oceanographic Community and the merchant marine fleet to equip an appropriate set of vessels to systematically and repeatedly probe the ocean interior at high resolution both horizontally and vertically will have a fundamental impact on our knowledge and understanding of the marine environment and ocean interior. The time is right. First, activities by various groups have clearly shown that partnerships between vessel operators and the scientific community can work well, in many cases over decades. Second, experience from both marine and satellite-based technologies show that systems can be developed for long-term reliable operation, an essential requirement for autonomous operation on merchant marine vessels, and third, (if we ever doubted it), the oceans play a fundamental role in regulating and modulating our climate. The richness of circulation patterns in the ocean and their time scales of overturning imply a continuous spectrum of variability. The best way to understand how the ocean responds to and impacts our climate is through accurate measurement. The ocean scientific community and merchant marine, working together in partnership, with the help of the SCOR Working Group proposed here will provide the means of helping to make the ideas presented in this proposal a reality.

Web Sites

Sir Alistair Hardy Foundation for Ocean Science

www.SAHFOS.ac.uk

CO2 program: http://tracer.env.uea.ac.uk/e072/publications/first_annual_rep.pdf

Worldwide Merchant Marine Fleet http://www.cia.gov/cia/publications/factbook/fields/2108.html

Information on present volunteer observing ship programs

www.bom.gov.au/jcomm/vos/vos.html

Two academic programs:

http://www.rsmas.miami.edu/rccl/ http://www.po.gso.uri.edu/rafos/research/ole/index.html

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Annex 4 - Proposal for SCOR Working Group on Hydrothermal Energy Transfer and its Impact on the Ocean Carbon Cycles

Summary

The importance of hydrothermal energy transfer to the biosphere through chemosynthetic primary production has long been recognized. Initially, this was only considered to occur at discrete, isolated, hydrothermally active hotspots around the global ridge crest and to have minor impact on the global ocean carbon cycles. But recent results suggest that this assumption may not be correct. We now know that hydrothermal venting can be widespread throughout all oceans, along the entire thermohaline conveyor, and that both the local fixation of carbon and the export of bio-limiting nutrients to the broader ocean may be much greater than previously recognized. For too long, fragmentation of our understanding of bio-geochemical interactions in hydrothermal systems has prevented any quantitative estimation of hydrothermally driven primary production. Now, however, recent advances in molecular methods as well as *in situ* and *in vivo* experimentation provide us with new opportunities for a coordinated, integrating effort in which interdisciplinary approaches and modelling can be brought to bear. Consequently, we believe that it is very timely to plan a revised consideration of the diverse pathways of biomass generation driven by hydrothermal processes and the potential contribution that they may make to the global ocean carbon cycle.

Terms of reference

The objective of the proposed SCOR WG is to bring together an interdisciplinary group of marine scientists, ranging from geochemists to biologists to modellers, with three key goals:

- to **synthesize** current knowledge of chemical substrates, mechanisms and rates of chemosynthetic carbon fixation at hydrothermal systems as well as the transfer of phytoplankton-limiting micronutrients from these systems to the open ocean.
- to **integrate** these findings into conceptual models of energy transfer and carbon cycling through hydrothermal systems which would lead to quantification of primary production in view of a future assessment of the contribution of these systems to the global-ocean carbon cycle.
- to **identify critical gaps** in current knowledge and proposing a strategy for future field, laboratory, experimental and/or theoretical studies to bridge these gaps and better constrain the impact of deep-sea hydrothermal systems on ocean carbon cycles.

Objectives and Timeliness

Our approach will focus on the mechanisms and rates of chemosynthetic carbon fixation in the subsurface, at the seafloor, and in the overlying water column of hydrothermal systems, as well as appraising the extent of iron/nutrient transfer to the global ocean. Such an interdisciplinary and integrative approach is now timely because 1) the recent discovery of widespread hydrothermal venting indicates that such systems may be more important to ocean budgets than previously assumed, 2) the recent developments of deep-sea *in situ* instrumentation and molecular biological techniques provide new methods for investigating the energy transfer pathways used to fix inorganic carbon at hydrothermal vents, 3) we can develop integrative models that will explore critical limits to current knowledge and generate preliminary quantitative estimates of primary production from hydrothermal activity. The ultimate goal will be to identify an integrated body of new research that needs to be conducted, to bridge gaps in our current knowledge and allow us to better constrain the role of hydrothermal venting in global-scale ocean carbon cycling.

Scientific background and rationale

A huge amount of energy (~1 TW of heat-flow and approximately 10^{14} kJ available from hydrothermal fluids for biomass production per year) is delivered from the geosphere to the ocean at mid-ocean ridges. Magmatic and tectonic processes drive hydrothermal circulation which leads to both the extraction of some chemical constituents from seawater into altered oceanic crust as well as the export of heat and crustal elements from beneath the seafloor into the overlying water column (see review by German and Von Damm, 2003).

At any site where hydrothermal circulation brings reduced components from the Earth's interior into contact with oxidising (electron acceptor-rich) seawater, chemical disequilibria arise; from these, energy can be gained by microbes to fix inorganic carbon into biomass. This microbial process is termed *chemosynthesis*. Wherever large fluxes of thermogenic methane are supplied to the seafloor, methane could also constitute a significant carbon source for chemosynthesis. At hydrothermal vents, chemosynthetic primary producers fuel large animal communities with standing crops as high as those of the most productive ecosystems on Earth. Many vent invertebrates and microbial communities on the seafloor display exceptionally fast growth and high production rates for organic biopolymers (Gaill et al. 1997, Taylor et al., 1999; Girguis and Childress, 2006).

Chemosynthetic primary production is now known from a wide range of submarine geotectonic settings, such as mid-ocean ridges, intraplate volcanoes, forearcs, backarc basins, submarine arc volcanoes, and ridge flanks. Additionally, hydrothermally derived dissolved and particulate material has the potential to sustain chemosynthetic carbon fixation in hydrothermal plumes as they disperse through the water column, tens or even hundreds of kilometres away from vent sites (Bach et al. 2006).

Even at sites remote from spreading axes and thermal vents, chemosynthesis is now recognized to play an important role wherever oxidized seawater comes into contact with cooling oceanic crust (Edwards et al., 2005; Santelli et al., 2008).

Despite its potential relevance to ocean-wide ecosystems and the ocean carbon cycle, the quantitative importance of hydrothermally driven carbon fixation and its biogeochemical implications has been largely overlooked. In addition to the potential importance of *chemosynthetic* primary production, recent studies have revealed that vent-derived compounds, such as organic iron complexes, could have residence times in the water column that are longer than originally predicted (Statham et al., 2005; Bennett et al., 2008) such that this vent-derived iron may even impact upon *photosynthetic* primary production in the upper ocean.

In the last decade, the widespread use of molecular techniques and the development of *in situ* and *in vivo* experimental approaches have provided important clues to the pathways involved in carbon fixation or nutrient export, improving our understanding, at the molecular level *and* at the micro-habitat scale, of the interactions between microbes and the chemical environment. Our challenge, now, is to integrate these discoveries at the systems level to provide a mechanistic basis for modelling hydrothermally driven primary production.

Proposed work and products

We propose a coordinated effort that will provide the framework to assess the contributions of submarine hydrothermal venting to the ocean carbon cycles and which will be documented through review papers in a special issue of a peer-review journal or a book. Specifically, we plan to: *i)* synthesize current knowledge on carbon cycling in the different components of hydrothermal systems and integrate these findings into conceptual models; *ii)* use these models to quantify hydrothermal primary production and assess the contribution of hydrothermal systems to the ocean carbon cycles; and *iii)* identify the key novel investigations needed to better constrain these models.

We will achieve this by bringing together key marine biologists, biogeochemists and modellers with a range of field, laboratory, experimental and theoretical expertise to ensure a thorough integration of the current state of the art that can be captured into robust conceptual models. There is no doubt that even this activity, in isolation, would already be enough to stimulate the development of a wealth of original international and interdisciplinary efforts. What we also expect to achieve in the proposed Working Group, however, is to use the resulting numerical models to obtain first-order quantification of the carbon flux through hydrothermal systems on the global-ocean scale. Finally, by testing the sensitivity of this model, we will identify key gaps in our current knowledge. From this knowledge base the WG will then be in a position to recommend which aspects of deep-sea hydrothermal ecosystems are most in need of concerted future studies to better constrain their global oceanic significance.

Timeline of the group's activities

The working group will meet three times over a four-year period. To ease travel and equilibrate costs for members (including associated members), meetings will be organised in Asia, Europe and the USA. We will also combine

these meeting with international conferences of interest to the WG participants, such as the regular AGU, ALSO and EGU meetings held in North America & Europe.

At the first meeting we will finalize the agreed agenda and timeline for the WG activities as a whole and organise our discussions into multidisciplinary sub-groups dedicated to the seafloor, sub-seafloor and water column compartments of the hydrothermal system.

At the second meeting we will set up an outline and time schedule for the publication of a special issue or monograph on the role of deep sea hydrothermalism on global ocean carbon cycles. Candidate journals for this special issue include *Limnology and Oceanography*, *PLoS*, *Deep-Sea Research* and *Biogeosciences*.

The third meeting will identify and plan new interdisciplinary initiatives which would benefit from SCOR support for a large-scale international programme of deep-ocean research. Combined with the third meeting we will organise a workshop (seeking sponsorship from, among others, SCOR, InterRidge and national programs) on chemosynthetic primary productivity and mechanisms of CO_2-fixation. Such a meeting would allow many more scientists, including from developing countries *and* from a wider spectrum of the marine sciences to participate in, benefit from, and contribute to, our initiative.

Why a SCOR Working Group?

While international coordination already exists for both the multidisciplinary study of mid-ocean ridges as a whole (InterRidge), chemosynthetic ecosystems' biogeography and biodiversity (ChEss program, Census of Marine Life), and for some aspects of the deep-biosphere research (IODP), this is the first time that an integrative interdisciplinary effort has been focussed upon the impact of hydrothermalism on the global carbon cycle. We are convinced that a dedicated SCOR working group would provide the most efficient vehicle to achieve this goal, by providing an ideal context for cross-cutting discussions between scientists from different disciplines and research areas on this focussed issue.

Within SCOR, we will benefit from the complementary expertise of other SCOR groups and panels of experts dealing with the issues of carbon biogeochemistry, energy transfer in marine ecosystems and trace element cycling in the oceans. Favouring collaborations between scientists from largely separated communities, approval of this SCOR WG would help provide the basis for a new field of research at the interface between the mid-ocean ridge and open-ocean science domains. Including an established ocean carbon cycling modeller in our group is just one action we propose to help facilitate the development of this interaction. We do not expect to achieve full integration within the lifetime of the WG but to educate our own community on how to prepare to integrate more fully with other global-scale ocean programs.

In addition, much can be gained from our proposed integrative effort for the definition and coordination of future interdisciplinary projects. Simultaneously, newly discovered vent sites, with highly heterogeneous chemistries, provide natural laboratories in which to investigate modes of carbon fixation in a variety of environmental and/or biological settings (Takai et al. 2006). Given the inherent difficulties in gaining access to the deep seafloor, as well as the large facilities and state-of-the-art instrumentation required for the work envisaged (both in the deep-sea and in the laboratory), our community will need strong international leadership and collaboration. Focussing our efforts through the auspices of a SCOR working group presents the ideal opportunity to help this proceed in a timely fashion and bring our efforts to the wider global ocean science community's attention.

We are expecting that this integrative and coordination effort will be encouraged by national agencies and international organisations through complementary funding. Furthermore, an increased emphasis is put on integration and synthesis in the final phase of the US Ridge2000 NSF programme and efforts directed on interdisciplinary model conception and testing are explicitly recommended. It can therefore be expected that proposals related with the activity of this SCOR WG may benefit from NSF support.

Relevance to other SCOR activities

There are obvious links between our program and other SCOR programs. In terms of current activity we are relevant to, but different from, both InterRidge and the Census of Marine Life ChEss program. There are also clear links with

the new GEOTRACES initiative, particularly in terms of understanding the export from hydrothermal systems of trace elements and isotopes that play key roles in global ocean – e.g., Fe as a bio-limiting micronutrient. As currently conceived, however, the scope and ambitions of GEOTRACES (in particular, a long section extending across the south Pacific from the East Pacific Rise) will need to focus upon ocean chemistry with little opportunity to expand the emphasis to include microbiology and *bio*geochemical cycling. On a much larger scale, where our group would differ from all of InterRidge, CoML and GEOTRACES is that we would focus on ocean-scale carbon cycling. From that perspective, our group represents a natural "dark energy" complement to past and present SCOR programs focussing on *photosynthetically* driven carbon cycling, primary productivity and ecosystem functioning, such as JGOFS and IMBER. We will keep InterRidge, ChEss, GEOTRACES, IMBER and other relevant programs informed of the group's activities.

Composition of the group

Only a few nations to date possess major oceanographic fleets and technologies suitable to access hydrothermal environments at great depths: the composition of the core membership of our proposed WG reflects this (N. America: 3; Europe: 4; Asia: 3). By contrast, our gender balance is much more even (Female: 5; Male: 5) and an effort will be made to associate, wherever possible, more scientists from developing countries which have recently joined the group of nations conducting ridge-research programmes.

Full Members

1. Nadine Le Bris (IFREMER, FR) (co-chair)
2. Chris R. German (WHOI, USA), (co-chair)
3. Wolfgang Bach (Uni. Bremen, Germany)
4. Loka Bharathi (National Institute of Oceanography, Goa, India)
5. Nicole Dubilier (Max Planck Institute-Marine microbiology, Bremen, Germany)
6. Katrina Edwards (U. South Cal., USA)
7. Peter Girguis (Harvard Univ., USA)
8. Xiqiu Han (2nd Institute of Oceanography, SOA, Hangzhou, China)
9. Louis Legendre (LOV-UPMC-Paris 6, Villefranche, France)
10. Ken Takai (JAMSTEC, Japan)

Associate Members

We identified here key scientists whose expertise is required for the WG, for whom funding will be seek from other sources. More associated members, particularly from emerging countries, will be proposed at the first working group meeting.

1. Françoise Gaill (CNRS, Paris, France)
2. Julie Huber (Marine Biology Laboratory, Woods Hole, USA)
3. Stefan Sievert (WHOI, USA)
4. Margaret K. Tivey (WHOI, USA)
5. Andreas Thurnherr (U. Columbia, USA)

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Annex 5 - Proposal for SCOR Working Group on The Microbial Carbon Pump in the Ocean

Abstract

The utilization of labile dissolved organic carbon (DOC) and production of refractory DOC by heterotrophic prokaryotes can shape the chemical composition of organic carbon and thereby influence the residence time of carbon in the ocean. This process is analogous to the better-known "biological pump". To better understand the microbial processing of carbon and its possible impacts on oceanic carbon sequestration, microbiologists and biogeochemists need to work together to bridge the fields of microbial ecology and organic biogeochemistry. This working group (WG) will document the state of the art in microbial processing of organic carbon and acquire new insights through analyzing the available data on microbial biomass, production and diversity along with dissolved organic matter (DOM) data from a variety of marine environments. The goal of the WG is to identify priority scientific questions and the corresponding technical needs, and establish or standardize protocols for the observations of key microbial and DOM parameters, to advance interdisciplinary research on the microbial carbon pump in the ocean.

Rationale

The "biological pump", a key mechanism for atmospheric CO2 fixation by the ocean, is based on particulate organic carbon (POC) transport from the surface to the deep ocean and burial in seafloor sediments. Recent studies have revealed that dissolved organic carbon (DOC) may also be a potential mechanism for carbon sequestration in the ocean. Besides the known physical and chemical processes transporting DOC from surface to deep sea, biological processes play a central role in DOC dynamics. Labile DOC (LDOC) can be utilized by heterotrophic prokaryotes and then transported to higher trophic levels through the "microbial loop" (Azam et al., 1983), consequently forming sinking POC. Refractory DOC (RDOC), either left or produced by microbial processes, can remain in the water without returning to the atmosphere for up to thousands of years (Bauer et al., 1992). In contrast to the "sinking biological pump", RDOC does not sink, and can be coined "non-sinking biological pump" (Jiao, 2006). Since DOC is the largest organic carbon pool in the ocean, and RDOC is the majority of total DOC, the non-sinking biological pump is one of the keys in understanding the carbon sink of the ocean. As a major pathway to generate RDOC, microbial processes have been identified (Ogawa et al., 2001; Kawasaki and Benner, 2006). This RDOC production process can also be coined "microbial pump" (Jiao et al., 2007; Jiao et al., 2008). Although this new research line is beginning to emerge, studies on the non-sinking microbial pump are still in its infancy compared with the well-documented sinking POC-based biological pump. Detailed information about interactions between microbial processes and organic carbon is required. Scientists from different disciplines need to work together on the interdisciplinary scientific questions and protocols to measure these newly recognized processes and parameters. A SCOR working group on the microbial carbon pump would be the best forum to bring together outstanding scientists from marine microbial ecology and biogeochemistry, bridging the gaps between different disciplines. Such a WG will not only benefit the members in addressing scientific and technical aspects of the problem, but also benefit the general fields of biological and chemical oceanography, and global biogeochemical modeling, by producing new angles of view, new concepts, and new methods.

Scientific Background

The ocean acts as a global buffer system mitigating increases of anthropogenic CO2. The known biological mechanism is the "biological pump", which is responsible for the transfer of particulate organic carbon (POC) from the surface to deep waters and even to the sediment, and thus can hinder carbon from returning to the atmosphere for hundreds and even thousands of years. In addition to the "sinking particle"-based biological pump, recent studies have revealed that dissolved organic carbon (DOC) is another potential mechanism that needs to be studied regarding carbon cycling in the ocean. The DOC pool in the ocean is estimated to be 700 Gt (Ogawa and Tanoue, 2003), the second largest carbon reservoir in the ocean and approximately equivalent to the carbon stock of atmospheric CO2 (~750 Gt) or terrestrial biomass (~600 Gt) (Hedges, 1992). However, DOC consists of a plethora of different compounds with different availability to microbial degradation. Total DOC can be roughly divided into LDOC that is readily utilized by heterotrophic microorganisms and RDOC that is resistant to biological decomposition. DOC does not sink except for the portion adsorbed to sinking particles. The fate of much of the LDOC is to be taken up by heterotrophic prokaryotes and transformed into particulate organic carbon (POC) through microbial loop and then transported to upper trophic levels (Azam et al., 1983). However, RDOC will stay in water until being further

decomposed by non-biological processes, like photochemical degradation (Benner and Biddanda, 1998). Approximately 650 Gt of the DOC in the ocean is RDOC (Ogawa and Tanoue, 2003) accounting for the majority of marine DOC (more than 90%). Compared with inorganic carbon storage, RDOC is much less sensitive to environmental changes, and there are no chemical equilibrium limitations for increase of RODC in the water. With a turnover time of about 4000-6000 years (Bauer et al., 1992), RDOC is the most persistent carbon form and could be one of the keys to the understanding of carbon sequestration in the ocean. Although the precise mechanism for generation of RDOC is still unclear, microbial processes are known to play an important role in generating RDOC (Kawasaki and Benner, 2006). Microbial activities pump a fraction of the available organic carbon pool from low-concentration bioactive LDOC pool to the high-concentration RDOC pool, a process coined "microbial pump" (Jiao, 2006). There are at least two major consequences of microbial pump processes. First, it pumps organic carbon from low concentrations to high concentrations and keeps the organic carbon in the ocean for a longer time. Second, the microbial pump shapes the chemical composition of DOC and alters the ratio of carbon to other elements, such as nitrogen and phosphorus. Stoichiometric analyses of marine organic matter have shown that the C:N:P ratio of RDOM (3511:202:1) is quite different from LDOM (199:20:1) and POM (106:16:1) (Hopkinson Jr and Vallion, 2005). That means that the microbial pump sequesters more carbon relative to nitrogen and phosphorus from the active organic matter pool into inert organic matter. In contrast to the biological pump accomplished by sinking particles, the microbial pump is a "non-sinking biological pump". Quantification of the relative importance of the two paths is mandatory for a better understanding of the mechanisms controlling carbon cycling and sequestration of CO2 by the ocean.

Two major disciplines are involved in studying the microbial carbon pump: microbial ecology and organic biogeochemistry. In the past few years, substantial progress has been made in both of these fields. Some new techniques have been introduced:

- Micro-FISH (Microautoradiography and Fluorescent In Situ Hybridization) for simultaneous observation of abundance and carbon uptake rate of major bacterial groups (Cottrell and Kirchman, 2003), addressing "who are out there and what they are doing" simultaneously.
- CARD-FISH (Catalysed Reported Deposition Fluorescence *in situ* Hybridization) and rolling circle PCR-FISH for in situ identification of environmental microbes and for simultaneous detection of mRNA and rRNA in environmental bacteria, thereby linking the identification of single cells to the expression of particular functional genes (Pernthaler and Amann, 2004).
- Micro-CARD-FISH (Microautoradiography and Catalyzed Reporter Deposition Fluorescence *in situ* Hybridization Combined with Microautoradiography) for determination of specific carbon metabolism of different functional groups of bacteria. Applications to meso- and bathypelagic realm of the ocean have revealed that archaea play a significant role in deep sea carbon cycling (Herndl et al., 2005).
- TIREM (Time Series Observation-Based Infrared Epifluorescence Microscopy) for accurate quantification of aerobic anoxygenic photosynthetic bacteria (AAPB) (Jiao et al., 2006), resulting recognition of distinct global distribution pattern of AAPB against theoretical speculations (Jiao et al., 2007) and consequently evoking further studies on the role of AAPB in energy flow and carbon cycling in the surface ocean.
- HTC (DOC), HPAEC-PAD (amino Sugars) to document chemical dynamics of marine DOM when exposed to microbial transformation (Benner and Opsahl, 2001; Benner and Kaiser, 2003)
- HPAEC-PAD (neutral sugars), HPLC (amino acids) to profile bioreactivity of marine DOM (Amon et al., 2001) (Sempéré and Kawamura, 1996; Sempéré et al., 2003; Sempéré and Kawamura, 2003).
- Fluorescence spectroscopy and parallel factor analysis (PARAFAC) for the detection of optically active component of marine Chromophoric DOM (CDOM) (Stedmon et al.,2003)
- SPE-DOM (solid-phase extraction of dissolved organic matter) for extraction of DOM in seawater (Dittmar et al., 2008).

A perfect combination of technique development and scientific theory can be found in the case of the "Microbial Loop" and microscale interactions of bacteria with organic matter and its influence on carbon export flux in the ocean (Azam and Worden, 2004).

In spite of the above achievements, there are still great needs for interdisciplinary interactions between scientists studying microbial processes and organic carbon cycling. New theories and concepts could be generated and validated through exchange and interactions between scientists from different disciplines and new techniques could be worked out or standardized for comparable observations. A SCOR working group would bring together scientists with the expertise required to address the newly merged scientific questions, and to work out protocols for measurement of the newly recognized processes and parameters.

Relevance to Other Activities of SCOR or Other International Organization

SCOR has a long history of support of research in ocean carbon cycling. Relevant past SCOR Working Groups that are related to the present one include

WG 62: Carbon Budget of the Ocean;
WG 79: Variations in Carbon Dioxide and the Carbon Cycle
WG 116: Sediment Trap and ^{234}Th Methods for Carbon Export Flux Determination

WGs 62 and 79 worked on CO2 budgets and dynamics and WG116 worked on sinking POC-based biological pump. The outputs of these WGs provide an important basis for the proposed WG on the microbial carbon pump. The proposed WG will extend the topic of carbon cycling and deepen our understanding of the mechanisms. Another distinct feature of the proposed WG is the interdisciplinary interactions among scientists from microbial ecology and biogeochemistry, which will bridge the gaps between different fields that hinder progress on this topic, and will hopefully bring breakthroughs in new angles of view, new concepts, and new methods.

Terms of Reference

- Summarize representative microbial data on biomass, production and diversity as well and DOC data along environmental gradients, establish the current state of knowledge and identify essential scientific questions regarding the role of microbial processing in carbon cycling in the ocean;
- Assess the available techniques for quantifying functional groups of prokaryotes and different types of DOC, document state-of-the-art techniques and parameters addressing microbial processing of organic carbon, and establish/standardize key protocols for the essential observation/measurements;
- Convene International Workshop(s) and publish a special volume in an internationally recognized peer-reviewed journal, or a protocol book (practical handbook) by a major publisher on measurements of the key parameters related to microbial processing of carbon in the ocean.
- Make recommendations for future research related to the microbial carbon pump in the ocean, toward development of a large-scale interdisciplinary research project.

Working Group Membership

Full Members

Nianzhi Jiao (China) – Co-Chair – Marine Microbial ecology
Farooq Azam (USA) – Co-Chair –Microbial Oceanography
Gerhard J. Herndl (Netherlands) – Microbial Oceanography
Ronald Benner (USA) – Marine Biogeochemistry
Bernhard Fuchs (Germany) – Molecular Microbiology
Colin Stedmon (Denmark) –Marine biogeochemistry
Michal Koblizek (Czech) –Marine microbial ecology
Susan Ziegler (Canada)–Marine biogeochemistry
Ingrid Obernosterer (France) – Marine microbial ecology
Gerhard Kattner (Germany) –Marine Biogeochemistry

Associate Members

David L. Kirchman (USA) – Marine Microbial ecology
Simon Meinhard (Germany) – Marine Microbiology
Feng Chen (USA) – Marine Virus and Molecular Ecology
Richard Sempéré (France) – Marine Biogeochemistry
Tron Frede Thingstad (Norway)- Microbial ecology
Danyun Ou (China) – Marine Microbial Ecology
Steven W. Wilhelm (USA) – Virus Ecology
Paul Harrison (Canada) – Phytoplankton Ecology
Rainer Amon (USA) – Marine Biogeochemistry
Sang-Jin Kim (Korea) –Microbiology and Genomics
Nagappa Ramaiah (India) – Microbiology and Marine Ecosystem
Carol Robinson (UK) Marine microbiology

Key items to examine and corresponding members

- The following issues would fall within the Terms of Reference of the proposed working group and would be the focus of the WG. （Necessary sampling for methodological intercalibrations and field observations will be carried out with samples from a cruise to the West Pacific Warm Pool supported by the Ministry of Science and Technology of China (MOST) and the National Natural Science Foundation of China (NSFC) (see "Operation Mode and Timeline" item 4 and 5 ）

1. Discrimination and quantification of functional microbial groups

- Flow Cytometry recognition, sorting, and enumeration of functional microbial groups on board and in lab (Jiao)
- Time-series observation-based infrared epifluorescence microscopy (TIREM) analysis of aerobic anoxygenic photosynthetic bacteria (AAPB) (Jiao)
- Catalyzed reported deposition fluorescence in situ hybridization (CARD-FISH) for discrimination of functional microbial groups and the application of Nano-SIMS (Fuchs/Herndl)
- *in situ* dual fluorescence monitoring of bacterial chlorophyll and chlorophyll (Koblizek)

2. DOC analysis methodology
    - Solid-phase extraction of dissolved organic matter (SPE-DOM) from seawater, especially from the deep sea (Kattner)
    - DOC composition bioassay method-sugars, dicarboxylic acids, amino acids (Obernosterer)
    - CDOM extraction, measurement and indications (Stedmon)

3. Contribution of bacteria to the marine DOM transformation
    - Bacterial colonization and enzyme action affect aggregation potential with consequences for carbon export flux (Azam)
    - Shaping of marine DOM composition under exposure to microbial transformation (Sempéré/Obernosterer)
    - Bioreactivity of marine DOM to natural microbial community (Benner)

4. Carbon metabolism of functional groups of microorganisms
    - Microautoradiography and fluorescent in situ hybridization (Micro-FISH) for simultaneous observation of abundance and carbon uptake rate of major bacterial groups (Kirchman)
    - Archaeal carbon fixation, Micro-CARD-FISH for determination of specific carbon metabolism of different functional groups of bacteria (Herndl)

- Stable isotopes in combination with microbial assay studies toward the role and fate of marine and terrestrially derived DOM in the ocean (Ziegler).
- Virus-host interaction and the role of virus in the ocean carbon cycle (Chen)
- Selective use of carbon sources by functional groups of prokaryotes as seen from Biolog bioassay (Ou /Jiao) and by Nano-SIMS (Fuchs)
- Bacterial utilization of phytoplankton exudation as carbon or energy source (Harrison/Jiao)

Prospective Products:

1. A few review papers by the whole group or subgroups on the following topics
   a. Microbial pumping process of carbon in the ocean
   b. DOC (including CDOM) measurements
   c. Carbon metabolism of functional groups of microorganism

2. A handbook of practical protocols for observation of marine microorganisms and microbial processing of carbon in the ocean. The following items should be included:
   a. Flow cytometry analysis and sorting
   b. Specialized/modified epifluorescence microscopy
   c. Atomic force microscopy
   d. Fluorescence probing techniques (Micro-CARD-FISH, Card-FISH)
   e. Isotopic tracing techniques
   f. Functional gene probing
   g. DOC extraction approaches
   h. Bioassay on microbial shaping of DOM composition
   i. Bioassay on microbial carbon utilization spectrum
   j. Bioreactivity of environmental DOM to natural microbial community
   k. Interaction between phytoplankton and bacterioplankton (carbon/electron donor test)
   l. Virus-Host interaction system (carbon lysis bioassay)
   m. Bacterial colonization/aggregation test system
   n. Carbon metabolism at community and functional groups (Micro-CARD-FISH)
   o. Application of genomics and proteomics to microbial carbon use

3. A special volumes of a major international peer-reviewed journal for papers presented at the WG workshop(s). (The group will decide at its second meeting whether or not to develop a workshop with its final meeting).

Operation Mode and Timeline of the Working Group

1. Since its initiation last year, interactions among the potential members at individual level has been going well, and **a group of interest has been gradually formed naturally,** Continuing discussions are taking place this year:

- Exchange ideas between potential members at individual level by emails (Jan.-Apr. 2008);
- Partial group discussion and planning at the 10th International Estuarine Biogeochemistry Symposium (Xiamen, May 18-22, 2008);
- Partial group discussion among prospective members at ASLO meeting (Canada, June 8-13, 2008) and AOGS meeting (Korea, June 16-20, 2008);
- Partial group study at summer school in Xiamen and Qingdao, China (July 8-22, 2008).
- Partial group members meet in Xiamen for preparation of ISME-12 round table session (see 2) (China, Aug 7-11, 2008).

2. A **round table session** as **a pilot WG meeting at the ISME-12 conference** (International Symposium for Microbial Ecology) (Australia, 2008.8.12-17) has been approved officially by the ISME-12: Four WG members are invited speakers: Farooq Azam (USA), Nianzhi Jiao (China), Gerhard Herndl (The Netherland), and Feng Chen (USA).
3. Partial group members meet at the "Xiamen Ocean Festival" (Nov. 2-8, 2008) for exchange and preparation of

sampling on a cruise to the West Pacific Warm Pool (see 4).

4. **Cruise opportunity** will be provided by Chinese research projects for necessary field sampling and methodological intercalibrations. The most recent one will be a 30-day cruise along environmental gradients from the Yangtze River estuary to the Kuroshio Currents and the West Pacific Warm Pool (so called "the engine of climate changes") which will be carried out from November to December,2008. Once-a-year oceanic cruises to the Pacific and Indian Oceans (R/V Ocean No.1, 3800 ton) are another opportunities (Participation of scientists outside China need to go through official formalities for approval).
5. **Support from inside China**. The idea of this SCOR WG was approved and recommended by the Chinese SCOR Committee at the last annual meeting (Suzhou, Sept. 15-26, 2007). The NSFC and the State Key Lab for Marine Environmental Science will provide partial financial support (200K-300K RMB) for the WG related academic activities and WG meeting/workshops held in China.
6. **The first official WG meeting**, will be taking place in Xiamen, China in early 2009. A detailed WG four-year work plan will be made in accordance with the assignments of the above-listed missions to each member. Face-to-face interactions between members with microbiology and biogeochemistry expertise would take place on the hot topics regarding the role of microbial processes in carbon cycling in the ocean. A review paper will be initiated during this meeting.
7. **The second official WG meeting** will be held approximately one year after the first one targeting on examination of implementation of the assignments and problems-solving toward the planed outputs. The group will decide at this meeting whether or not to develop a **workshop** with the final meeting for a special volume of a major international peer-reviewed journal.
8. **The final meeting** will be convened in the last year (early 2012) to complete the group's work.

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Annex 6 - Global Ocean Ecosystem Dynamics (GLOBEC) Project

GLOBEC: Global Ocean Ecosystem Dynamics

Report of the SCOR/IOC/IGBP GLOBEC International Project for 2007/ 2008
to the SCOR General Meeting. Woods Hole, Mass., USA, 22-24 October 2008

Manuel Barange, Director GLOBEC International Project Office
Plymouth Marine Laboratory, UK, **m.barange@pml.ac.uk**

1. RECENT PROGRESS: Symposia and Workshops

1.1. GLOBEC-sponsored international symposia

- **GLOBEC/PICES/ICES 4th International Zooplankton Production Symposium: human and climate forcing of zooplankton populations.** Hiroshima, Japan, 28 May-1 June 2007. Zooplankton research is central to GLOBEC, and for this reason GLOBEC has been a sponsor of this series of symposia for some time. The 4th IZPS followed on the very successful 3rd IZPS held in Gijon, Spain, May 2003, also co-sponsored with ICES and PICES. The symposium was attended by 334 participants from 46 countries, who contributed 141 oral and 250 poster presentations. There will be two special issues from the symposium, one in the ICES Journal of Marine Science 65(3), 2008, covering most of the contributions presented, and one in Deep-Sea Research II on "Krill biology and ecology", resulting from Workshop #3. SCOR supported three developing country scientists to the meeting.
- **GLOBEC CLIOTOP 1st Symposium "Climate Impacts on Oceanic Top Predators".** La Paz, Mexico, 3-7 December 2007. The first CLIOTOP symposium focused on implementing the synthesis objectives of CLIOTOP following from three years of intensive workshops. The symposium had a special interest in presenting comparative studies between regions or species and papers dealing with an integrated approach, combining observation/experiments and modelling. SCOR was a co-sponsor of this symposium through support of developing country scientists. The symposium sessions were attended by almost 200 scientists delivering 93 oral and 73 poster presentations.
- **GLOBEC-IMBER-SOLAS-EUROCEANS symposium on "Dynamics of Eastern Boundary Upwelling Ecosystems: integrative and comparative approaches".** Las Palmas, Spain, 2-6 June 2008. This was the first symposium co-sponsored by all three SCOR marine projects, receiving generous support from SCOR to developing country scientists. The symposium considered most aspects of the dynamics, structure and functioning of the four major eastern boundary upwelling ecosystems linked to the Benguela, California, Canary (African Canary and Iberian Peninsula) and Humboldt Current systems. These aspects include climate and ocean dynamics, climate change, physics of the ocean and atmosphere, biogeochemistry, ecosystem production, ecology (including behavioural ecology), food-web structure and dynamics, trophic interactions, fisheries assessment and management. The symposium was convened by Pierre Fréon, IRD (France), Javier Aristegui, ULPGC (Spain) and Manuel Barange, PML (UK) and was a clear success. More than 350 scientists attended the symposium, with very even representation from each of the four regions. The symposium website is www.upwelling-symposium.org. Approximately 40 papers are expected to be published in Progress in Oceanography.
- **ICES/PICES/IOC symposium on "Effects of climate change on the world's oceans".** Gijón, Spain, 19-23 June 2008 (co-sponsored by GLOBEC and WCRP). The symposium had its origins in the high scientific and social relevance to assess the consequences of climate change on the world's oceans and on our poor understanding of the sensitivity and adaptability of natural and managed ecosystems to climate change. The symposium focused on the major issues of climate change that affect the ocean: oceanic circulation, climate modelling, cycling of carbon and other elements, acidification, oligotrophy, changes in species distributions and migratory routes, sea-level rise, coastal erosion, etc. For more information visit

http://www.pices.int/meetings/international_symposia/2008_symposia/Climate_change/climate_background_3.aspx.

- **GLOBEC-FAO-EUROCEANS symposium on "Coping with global change in marine social-ecological systems".** Rome, Italy, 8-11 July 2008. This symposium is the culmination of the GLOBEC Focus 4 working group activity. It was highly successful, and was attended by more than 200 scientists from both natural and social science disciplines. Social-ecological systems have marine (including physical-biological sub-systems) and human (including cultural, management, economic, and socio-political sub-systems) components which are highly inter-connected and interactive. The central goals of this symposium were to share experiences across disciplines and to identify key next steps and common elements and approaches that promote resilience of marine social-ecological systems in the face of global changes. The meeting was convened by Ian Perry (Fisheries & Oceans Canada, Nanaimo, Canada), Rosemary Ommer (University of Victoria, Victoria, Canada) and Philippe Cury (IRD/CRH, Sète, France). For more information visit www.peopleandfish.org.
- **ICES-GLOBEC symposium "Linking Herring: linking biology, ecology and status of populations in the context of changing environments".** Galway, Ireland, 26-29 August 2008. This symposium is intended to provide the ultimate link to our understanding of herring populations in the Atlantic and Pacific oceans. The conveners are Maurice Clarke (Ireland), Mark Dickey-Collas (The Netherlands) and Aril Slotte (Norway). Scientific Steering committee members include Emma Hatfield (UK), Doug Hay (Canada), Richard Nash (Norway), Deirdre Brophy (Ireland) and Øyvind Fiksen (Norway). The meeting has the following planned sessions:

    1. Herring in the middle - the trophic and ecological interactions and impacts of herring - Andrew Bakun (USA)
    2. Managing change - management and exploitation of herring in a dynamic environment, within the context of long-term change - Martin Pastoors (The Netherlands)
    3. Variable production - particularly the role of reproduction, recruitment and life history strategies
    4. Population integrity - the rigidity of stocks and the drivers of migration
    5. Counting herring - qualitative and quantitative estimation of herring and its application - John Simmonds (UK)
    6. Advances in herring biology- Audrey Geffen (Norway)

The symposium website is http://www.linkingherring.com/.

- **GLOBEC 3rd Open Science Meeting.** Victoria, British Columbia, Canada, 22-26 June 2009. The 3rd OSM is entitled "Marine ecosystems: from function to prediction" to focus the meeting toward the overall objective of GLOBEC of "providing a new mechanistic understanding of the functioning of the marine ecosystem, in order to develop predictive capabilities and propose a framework for the management of marine ecosystems in the era of global change". This meeting will provide a unique forum for scientists from the 29 countries involved in GLOBEC to offer their conclusions. A more detailed description of this meeting is available in section 2 below. A request for funding support to SCOR is included in Annex 1.

1.2 GLOBEC workshops, regional and national symposia

The following is a collection of GLOBEC-sponsored workshops and national/regional meetings hosted during the reporting period or planned for the forthcoming year:

- **PICES XVI Annual Meeting.** Victoria, Canada, 26 October-4 November 2007. The meeting included the following GLOBEC/PICES CCC sessions:

    1. Towards ecosystem-based management: recent developments and successes in multi-species modeling;
    2. Fisheries interactions and local ecology; and
    3. Operational forecasts of oceans and ecosystems

as well as a pre-symposium workshop on "Climate scenarios for ecosystem modelling.

- **GLOBEC-BENEFIT synthesis symposium.** Swakopmund, Namibia, 19-21 November 2007. BENEFIT, one of the most successful capacity building efforts of GLOBEC, was completed in December 2007. A special GLOBEC Report with scientific highlights, history of the project and appraisal of its achievements by its advisory panel, will be published before the end of 2008.
- **GLOBEC Germany Symposium.** 14-15 November 2007**.** Hamburg, Germany. This symposium concluded the activities of this successful GLOBEC national programme.
- **3rd Japan-Korea-China GLOBEC symposium.** Hakodate, Japan, 13-15 December 2007. The 3rd regional symposium provided new information and a forum for discussion regarding new research findings of the national GLOBEC programmes in this region. Particular topics of interest were ecosystem structure and environmental factors, food web tropho-dynamics, physical-biological processes and models, climate change, regime shifts, bottom-up and top-down control of marine ecosystems, and ecosystem-based management. How to integrate GLOBEC and the Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) project after 2009 were discussed at the symposium.
- **GLOBEC-ESSAS 2008 Science Meeting.** Halifax, Canada, 15-19 September 2008. A series of ESSAS workshops is planned in Halifax, Nova Scotia. The workshops will include a follow-up 1-day session on predicting future climates in the ESSAS regions, a 1-day workshop devoted to presentations and discussions from the 2008 Science meeting in Hakodate, a half-day session on advective processes and a 1-day workshop on assessing the best approaches to using models for comparing the ESSAS regions and their responses to climate change.
- **GLOBEC Synthesis book Editors meeting.** Halifax, Canada, 18-19 September 2008. This meeting will be used to complete the editing of the GLOBEC synthesis book, to be submitted to Oxford University Press in October 2008, to appear in time for the GLOBEC 3rd OSM in June 2009.
- **2nd GLOBEC QUEST_Fish PI meeting.** UK, 14-15 October 2008. QUEST_Fish is a programme affiliated to GLOBEC that attempts to use climate change and ecosystem predictions to estimate the potential for fish production in the future, and the socio-economic consequences of these. For more information visit http://web.pml.ac.uk/quest-fish/default.htm.
- **PICES XVII Annual Meeting.** Dalian, China, 23 October-2 November 2008. The meeting includes the following GLOBEC sessions:

    1. GLOBEC CCCC Topic Session - Marine system forecast models: Moving forward to the FUTURE.
    2. GLOBEC ESSAS Workshop - Status of marine ecosystems in the sub-arctic and arctic seas - Preliminary results of IPY field monitoring in 2007 and 2008
    3. GLOBEC CCCC - Climate scenarios for ecosystem modelling (II)
    4. GLOBEC CCCC/ESSAS Workshop – Marine ecosystem model inter-comparisons

- **GLOBEC/ICES/PICES workshop on changes in distribution and abundance of clupeiform small pelagic fish in relation to climate variability.** Kiel, Germany, 3-7 November 2008.

In addition, GLOBEC has hosted/will host the following SSC/working group meetings in 2006/2007:

- 8-9 October 2007: GLOBEC-IMBER Executive Committees Meeting. Brest, France
- 5-6 May 2008: GLOBEC SSC meeting. Cape Town, South Africa
- 7-9 May 2008:Sessions at the IGBP Congress convened or contributed to by GLOBEC, Cape Town, South Africa
- End-to-end food webs in marine ecosystems
- Biogeochemistry and food web interactions along continental margins: Forcings and feedbacks of the carbon cycle in land-atmosphere-ocean Systems
- Social-Ecological Systems Analysis in a Changing Earth System
- Climate Influences and Biological Controls in High-Latitude Marine Ecosystems
- 10-12 June 2008: GLOBEC-CLIOTOP SSC meeting. Plymouth, UK

- 18-19 September 2008: GLOBEC-ESSAS SSC meeting, Halifax, Canada
- 20 September 2008: GLOBEC Executive meeting. Halifax, Canada

More information is available on the GLOBEC website, including minutes of GLOBEC SSC meetings.

2. RECENT DEVELOPMENTS AND PUBLICATIONS

2.1. Links with IMBER and future developments beyond 2010

GLOBEC is closing down in December 2009, at which point the continuing activities and outstanding scientific questions are anticipated to be taken up by IMBER. To that effect the GLOBEC and IMBER Executive Committees have been meeting together annually to advance common activities and develop the necessary synergy. In addition, the projects' Scientific Steering Committees met recently in Cape Town, South Africa, with identical objectives. A number of common activities have since been developed:

- GLOBEC-IMBER End to End Food web Task Team – Currently this activity is led exclusively by IMBER.
- Integrated Analyses of Circumpolar Climate Interactions and Ecosystem Dynamics in the Southern Ocean (ICED) – A science plan for this new regional activity is ready for publication.
- Chinese GLOBEC/IMBER programme – A mature activity developed from the 1st and 2nd phases of GLOBEC China.
- CLIMECO training workshop (http://www.imber.info/CLIMECO_home.html) – An IMBER-GLOBEC-CLIVAR effort to increase the interactions between physical climate science and marine biogeochemistry/ecosystems communities with focus on impacts of climate variability on the marine environment; to foster cooperation between physical climate scientists and marine scientists; and to take stock of IPCC 4AR results, ocean/atmosphere reanalysis data, and observational data where relevant for impacts on the marine environment. CLIMECO was held in Brest in April 2008.
- The GLOBEC-IMBER-SOLAS symposium on Eastern Boundary Upwelling Ecosystems, held in Las Palmas, June 2008 and reported above.
- EUR-OCEANS Network of Excellence

In addition, IGBP and SCOR appointed a Transition Task Team (TTT) that will draft an addendum to the IMBER Science Plan and Implementation Strategy in preparation for the closure of GLOBEC. The TTT will implement the agreement of the sponsors of both GLOBEC and IMBER (IGBP, SCOR) to merge both projects into a single ocean research project in the IGBP structure. The first meeting of the TTT was organized by GLOBEC (and co-sponsored by SCOR) and held in Reading, UK, 30 July – 1 August 2998. The 2nd meeting of the TTT is expected to take place in November/December 2008.

2.2. Publications

2007-2008 Special Issues and books

- Michael J. Dagg, Roger Harris, Sin-ichi Uye, Luis Valdes (Eds.) 2008. 4th International Zooplankton Production Symposium: Human and Climate forcing of Zooplankton Populations. ICES Journal Marine Science 65(3): 277-495.
- Eileen E. Hofmann, Peter H. Wiebe, Daniel P. Costa and Joseph J. Torres (Eds.) 2008. Dynamics of plankton, krill and predators in relation to environmental features of the western Antarctic Peninsula and related areas: SO GLOBEC Part II. Deep-Sea Research II 55(3-4): 269-558.
- George L. Hunt Jr., Kenneth Drinkwater, Stewart M. McKinnell and David L. Mackas (Eds.) 2007. Effects of Climate Variability on Sub-Arctic Marine Ecosystems - A GLOBEC Symposium, GLOBEC-ESSAS Symposium on "Effects of climate variability on sub-arctic marine ecosystems". Deep-Sea Research II 54(23-26): 2453-2970.
- Fidel Echevarría, Jose Luis Acuña, Santiago Hernández León, Enric Saiz, A. Miguel P. Santos and Manuel Barange (Eds.) 2007. Ecological functioning of the Iberian seas: a synthesis of GLOBEC research in Spain and Portugal. Progress in Oceanography 74(2-3), 95-422.

- Qisheng Tang, Jilan Su, Michio J. Kishi and Im Sang Oh (Eds) 2007. Selected papers from the Second China-Japan-Korea GLOBEC Symposium on the Ecosystem Structure, Food Web Trophodynamics and Physical-biological Processes in the Northwest Pacific, Second China-Japan-Korea Joint GLOBEC Symposium, 2004 Journal of Marine Systems 67(3-4): 203-322.
- Michio J. Kishi, Bernard A. Megrey, Shin-ichi Ito and Francisco E. Werner (Eds.) 2007. Special Issue on NEMURO (North Pacific Ecosystem Model for Understanding Regional Oceanography) and NEMURO.FISH (NEMURO for Including Saury and Herring) - Modelling of North Pacific Marine Ecosystems. Ecological Modelling 202(1-2): 1-224, 2007.
- H.P Batchelder and S. Kim. (Eds) 2008. Climate variability and ecosystem impacts on the North Pacific: a basin-scale synthesis. Progress in Oceanography 77(2-3): 83-258

In total GLOBEC has produced 26 special issues, and at least three additional issues are currently in press. The whole list is available at http://web.pml.ac.uk/globec/products/publications/special/spec_list.htm.

2007/8 GLOBEC Reports

- P.H. Wiebe, R.P. Harris, M.A. St. John, F.E. Werner and B. de Young. (Eds.). 2007. BASIN. Basin-scale Analysis, Synthesis, and INtegration. GLOBEC Report 23 and U.S. GLOBEC Report 20. 1-56pp.
- Robert J. Olson and Jock W. Young (Eds.). 2007. The role of squid in open ocean ecosystems. Report of a GLOBEC-CLIOTOP/PFRP workshop, 16-17 November 2006, Honolulu, Hawaii, USA. GLOBEC Report 24: vi, 94pp.
- ICES-GLOBEC-EUROCEANS 2007. Report of the Workshop on the Integration of Environmental Information into Fisheries Management Strategies and Advice (WKEFA). Copenhagen, Denmark (18-22 June 2007). J. Simmonds and M. Barange (Eds.) ICES Advisory Committee on Fishery Management. ICES CM 2007/ACFM:25 (http://www.eur-oceans.eu/training_and_outreach/wp9/)

2007/8 Publications

(for full list go to http://web.pml.ac.uk/globec/products/publications/chron/all/2007.htm or follow links from www.globec.org)

GLOBEC has produced a total of 3,113 (2,668 refereed) research papers since its implementation. The rate of publications per year has dropped in the last 2-3 years (64 publications in 2008 versus 300-400 per year in the period 2000-2005). We believed that this reflects delays in logging publications through the GLOBEC website facility and an increasing reliance on the IPO staff to identify and log publications.

2.3. GLOBEC Synthesis book

The GLOBEC synthesis book "**Global Change and Marine Ecosystems"** will be published by Oxford University Press. It is intended to be available in time for the 3rd GLOBEC OSM (see below) in June 2009. Currently, all but two papers have been reviewed and are in final stages of completion. The remaining chapters will be reviewed shortly. The draft structure of the book is as follows:

Editors: Manuel Barange, John Field, Roger Harris, Eileen Hofmann, Ian Perry, Cisco Werner (alphabetical order at this stage)

- Preface
- Introduction – Manuel Barange et al.

Section 1. The changing ocean ecosystems

- 1.1 Climate forcing on marine ecosystems – Ken Drinkwater et al.
- 1.2 Human impacts on marine ecosystems - Keith Brander et al.

Section 2. Advances in understanding the structure and dynamics of marine ecosystems

- 2.1. Dynamics of marine ecosystems: physical processes – Brad de Young et al.
- 2.2. Dynamics of marine ecosystems: ecological processes – Coleen Moloney et al.
- 2.3. Dynamics of marine ecosystems: observation and experimentation – Roger Harris et al.

- 2.4. Dynamics of marine ecosystems: integration and modelling – Cisco Werner et al.

Section 3. The human dimensions of marine ecosystem change

- 3.1 Interactions between changes in marine ecosystems and human communities – Ian Perry et al.
- 3.2 Management of marine resources in the face of change – Manuel Barange et al.

Section 4. A way forward

- 4.1 Ocean ecosystem responses to future global change scenarios: a way forward – Sin-ichi Ito et al.
- 4.2. Ocean ecosystem responses: a synthesis – Eileen Hofmann et al.

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

2.4. GLOBEC 3rd Open Science Meeting

GLOBEC will be holding its 3rd and final open science meeting in Victoria, BC, Canada, 22-26 June 2009. This conference will culminate the integration and synthesis activities of the international GLOBEC Programme, ten years after its launch as an IGBP-SCOR-IOC activity. The 3rd OSM is entitled "**Marine ecosystems: from function to prediction"** to focus the meeting towards the overall objective of GLOBEC of "providing a new mechanistic understanding of the functioning of the marine ecosystem, in order to develop predictive capabilities and propose a framework for the management of marine ecosystems in the era of global change".

The conveners of the meeting are Ian Perry (DFO, Canada), Manuel Barange (PML, UK) and Eileen Hofmann (Old Dominion University, USA). The Steering Committee of the meeting includes: J. Alheit (Germany), H. Batchelder (USA), K. Brander (Denmark), W. Broadgate (Sweden), D. Checkley (USA), D. Haidvogel (USA), J. Hall (New Zealand), R. Harris (UK), G. Hunt (USA), A. Jarre (South Africa), S. Lluch-Cota (Mexico), O. Maury (France), Y. Sakurai (Japan), S. Sundby (Norway), Q. Tang (China), E. Urban (USA) and F. Werner (USA).

The conference will comprise of workshops/theme sessions, plenary and poster sessions:

22-23 June 2009 - The first two days will be devoted to topical workshops/theme sessions. The GLOBEC community is currently being consulted to identify relevant topics, and a final selection will be made in September 2008.

24-26 June 2009 - Three days of plenary sessions will follow, along five themes:

1. GLOBEC achievements
2. Ecosystem structure, function and forcing
3. Ecosystem observation, modelling and prediction
4. Ecosystem approach to management
5. Marine ecosystem science: into the future

A poster session will also be included, and a commercial fair is under consideration.
The website for the conference is https://www.confmanager.com/main.cfm?cid=1345&nid=10031, and it can also be accessed directly from the GLOBEC website www.globec.org.

2.5. GLOBEC SSC 2008

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 Kevern Cochrane	M	Italy	SSC – FAO link	1st term 2008
Prof Brad de Young	M	Canada	Chair Focus 3	1st term 2009
Dr Ruben Escribano	M	Chile	SSC	2st term 2010
Dr Roger Harris	M	UK	Chair Focus 2	(Ex-Officio)
Prof Eileen Hofmann	F	USA	SSC, SO Chair	(Ex-Officio)

Dr James Hurrell	M	USA	SSC	2nd term 2010
Dr Astrid Jarre	F	Denmark	SSC	1st term 2008
Dr Daniel Lluch-Cota	M	Mexico	SSC	1st term 2008
Dr Olivier Maury	M	France	SSC	1st term 2008
Dr Ian Perry	M	Canada	Chair, Focus 4 co-Chair	1st chair term 2010
Dr Jeffrey Runge	M	USA	SSC	2st term 2008
Prof Yasunori Sakurai	M	Japan	SSC	1st term 2008
Prof Svein Sundby	M	Norway	SSC	2st term 2008
Prof Francisco Werner	M	USA	Past SSC Chair	(Ex-Officio)

Several members of the SSC complete their first (Cochrane, Jarre, Lluch-Cota, Maury, Sakurai) or second terms (Runge, Sundby) in 2008. However, given that GLOBEC concludes in December 2009 it is requested that all their memberships be extended for a year, as it would be disruptive to bring new members at this stage.

Annex 7 - Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) Program

Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) Program

ACTIVITIES 2007-2008

1. SSC Meeting: Annapolis, Maryland, April 2008

The GEOHAB SSC met in Annapolis, Maryland (USA) on 9-11 April 2008 and discussed all aspects of GEOHAB work. The meeting discussions included the potential for a new CRP on benthic algae, briefings on U.S. HAB programs, interactions with other projects, plans for a GEOHAB modelling workshop (see below), HAB observations and GEOHAB-GOOS cooperation, regional and national activities related to GEOHAB, communications and finances. A public outreach session was held one afternoon, attended by state scientists and managers who are responsible for HAB research and management in the Chesapeake Bay and some marine policy fellows working for the U.S. Congress.

2. Implementation of Core Research Projects

The GEOHAB *Implementation Plan*[8], published in November 2003, 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 has been the primary GEOHAB activity since the 2007 SCOR Executive Committee Meeting.

A. Core Research Project: HABs in Upwelling Systems

This sub-group is chaired by Grant Pitcher (South Africa). Group members are writing papers to be published in the journal *Progress in Oceanography* to synthesize previous research related to their topic, to serve as a foundation for new comparative research on HABs in upwelling systems. The group met in Sept. 2007 to complete the special issue and plan activities for the coming year, and will hold an opportunistic meeting in conjunction with the 13th International Conference on Harmful Algae in November 2008 in Hong Kong.

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

This sub-group is co-chaired by Allan Cembella (Germany) and Leonardo Guzmán (Chile). Their Open Science Meeting took place in Viña del Mar, Chile on 26-29 April 2004. The report from the meeting is still in preparation. There was discussion at the meeting about how to complete the report and the draft text was received from Cembella.

C. Core Research Project: HABs and Eutrophication

The sub-group on HABs and Eutrophication is chaired by Patricia Glibert (USA). The research plan for this CRP was published in 2006. The group is planning a 2nd GEOHAB Open Science Meeting on HABs and Eutrophication in Beijing, China, in conjunction with the 2009 SCOR Executive Committee meeting and the second meeting of SCOR/LOICZ WG 132 on Land-based Nutrient Pollution and the Relationship to Harmful Algal Blooms in Coastal Marine Systems.

D. Core Research Project: HABs and Stratification

The sub-group on HABs and Stratification is chaired by Patrick Gentien (France). The report from this meeting is under review now and is expected to be completed by the time of the 13th International Conference on Harmful Algae in November 2008 in Hong Kong.

The GEOHAB SSC discussed the possibility of starting a new CRP on benthic systems, which would include algae that contribute to ciguatera, probably the most widespread of all algae-related poisonings. All SSC

[8]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.

members recognize the importance of this issue, but it is not obvious who would be the appropriate champion for the activity and whether GEOHAB can afford to fund another CRP.

3. GEOHAB Modelling

GEOHAB is planning a workshop to help integrate modeling activities into GEOHAB CRPs and regional/national projects. The workshop will be open to any interested students and scientists, but the number of participants will be limited by the size of the meeting space. The workshop will be held at the Martin Ryan Institute, National University of Ireland, Galway, Ireland on 15-19 June 2009. Inexpensive accommodations will be available on campus for students. The organizing committee for the workshop is chaired by Dennis McGillicuddy (USA); other members include Wolfgang Fennel (Germany), Marcel Babin (France), Marina Levy (France), Peter Franks (USA), Icarus Allen (UK), and Ken Furuya (Japan). CRP chairs Patrick Gentien, Grant Pitcher, Pat Glibert, and Allan Cembella have also participated in the planning. Information about the meeting is available at www.geohab-models.org.

Objectives

The objectives for the meeting will be to

- stimulate modeling activity in GEOHAB Core Research Projects (CRPs);
- entrain researchers at all levels (students, postdocs, faculty, etc.) into HAB modeling;
- facilitate dialog between model developers and HAB researchers involved in process studies through joint training sessions;
- improve understanding of HAB processes through linkage of models, *in situ* observations, and remote sensing;
- foster linkage between HAB modeling and the broader community of biogeochemical, ecosystem, and population dynamics modeling;
- highlight species-specific aspects intrinsic to HAB modeling: autecology, behavior, species interactions, toxin production, etc.;
- improve capabilities for prediction of HABs and quantitative assessment of their skill;
- encourage the use of advanced data assimilation techniques in HAB modeling;
- encourage the use of observing system simulation experiments (OSSEs) in array design;
- improve forecast products and their dissemination to maximize their benefit to the user community; and
- develop a written glossary for terminology.

Structure

The workshop will consist of four connected elements:

1. Plenary talks comprised of (a) invited reviews on HAB modeling and other relevant approaches (ecosystem modeling, population dynamics modeling), and (b) contributed talks on models and observations in support of the CRPs.
2. Dialogue seminars given by HAB observationalists and modelers. Specific modeling needs of the CRPs will be identified; implementation plans will be developed, utilizing existing modeling infrastructure where practical, and identifying needs for additional model development where gaps exist.
3. Tutorials and training on model design and application of models (geared toward students involved in CRPs).
4. Student mentoring.

Product

A set of peer-reviewed contributions will published in a special issue of a suitable journal, such as *Journal of Marine Systems* or perhaps an open-access journal. The tentative title of the special issue is *Modeling biophysical interactions in harmful algal blooms: processes and methods.*

4. 13th International Conference on Harmful Algae

This conference will be held in Hong Kong in November 2008 and the GEOHAB SSC has had a special session on the global ecology and oceanography of harmful algal blooms approved. GEOHAB will plan a variety of activities associated with the meeting to publicize GEOHAB and involve more members of the international HAB science community in GEOHAB. These international meetings have been excellent venues to disseminate information about GEOHAB, including reports.

5. SSC Meeting: Galway, Ireland on 11-13 June 2009

This meeting will review the progress on GEOHAB activities and will precede the GEOHAB Modeling Workshop.

6. Asian GEOHAB

A meeting focused on GEOHAB-related research in Asia was held in conjunction with the 2007 SSC meeting in Tokyo, Japan. It was concluded that formation of an Asian GEOHAB collaboration would be beneficial for research in this region. A second meeting was held in Vietnam in January 2008. A Science Plan is being developed for GEOHAB research in Asia.

7. 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 *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. Until the GEOHAB IPO is established, the co-sponsors of GEOHAB are responsible for sharing IPO duties, as one of their many tasks. This situation is unsatisfactory for the long-term progress and success of the programme.

Annex 8 – Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) Project

Integrated Marine Biogeochemistry and Ecosystem Research

IMBER Annual Report to SCOR August 2008

Contents:

Major Activities and Achievements

Working groups
Five working groups or task teams have been formed and are active in the development and implementation of IMBER.

IMBER/SOLAS Carbon Working Group
IMBER and SOLAS have established a joint carbon implementation group (SIC!). The group is now chaired by Truls Johannessen (Norway) and works closely with the International Ocean Carbon Coordination Panel (IOCCP). Three sub-groups have been formed to move forward the implementation of the carbon research. A Joint SOLAS/IMBER Carbon Research implementation plan has been published electronically (February 2006) (http://www.imber.info/products/Carbon Plan final.pdf) and is currently being revised. A SIC! Group meeting is being planned for October 2008, in conjunction with the Ocean in High CO_2 Symposium in Monaco.

WG1 Surface Ocean System (SOS) (leader: Nicolas Metzl (France))
This year, the activities of the SIC-SOS group were focussed on decisions taken at the Surface Ocean CO_2: Variability and Vulnerability (SOCOVV) meeting last year in Paris. A *Deep-Sea Research* special issue is in preparation with thirteen papers now accepted for publication, including new CO_2 climatology, CO_2 variability and decadal changes, coastal regions, instruments, modelling, ecosystems variability and vulnerability. Two meetings of the Surface Ocean CO_2 Atlas (SOCAT) group were held this year, the first one evaluated the actuality of the global and regional synthesis and discussed on the quality control. The goals of the second meeting were to reach international agreement on 2nd-level quality-control procedures, to identify approaches for gridding and interpolation, to identify major science issues at basin and global scale, and to develop a short report for distribution to all relevant networks. This is done in close collaboration with IOCCP, CARBOOCEAN, CDIAC and with all contributors of surface pCO_2 data.

WG2 Ocean Interior (leader: Nicolas Gruber (Switzerland))
This group covers inventory and observations, natural variability, transformation, designing a strategy for leverage for the ARGO program, and interaction with modelling. They have developed the initiative "*The Oxygen-Argo Program (ARGO-O_2)*.

This group also prepared a FP7 proposal entitled "*Towards Global Observatories for Oxygen Depletion (OXYWATCH O_2)*". The proposed project would be 3-year project starting in 2009 and includes 15 partner organizations. The work packages themes are Coordination and Management, Oxygen Sensor Technology Development, Oxygen Float Pilot Study, Coastal Oxygen Glider Study, Atmospheric Oxygen Study, Synthesis, Modelling and Prediction, Outreach, Dissemination and Communication.

Another activity related to this sub-group is the CARbon dioxide In the North Atlantic *(CARINA).* CARINA was started in June 1999 with the objective to collect carbon-relevant data sets in the North Atlantic and form a consistent, quality-controlled database for the Atlantic Ocean (including the Southern Ocean and the Arctic). Regional working groups were formed during a meeting held in Iceland: North Atlantic (leader: Toste Tanhua), Arctic Mediterranean Seas (leader: Are Olsen) and Southern Ocean (leader: Mario Hoppema). The group is now finalising the synthesis analysis, and the publication of the product online is expected late 2008.

Finally, the Interior Ocean group has been allocated funds from the ESF Conference Program to organise a Global Carbon Synthesis Symposium. The title of the symposium is *Decadal Variations of the Ocean's Interior Carbon Cycle: Synthesis and Vulnerabilities.* This symposium will be held at the Centro Stefano Franscini in Ancona (Switzerland) on July 13-17, 2009.

WG3 Carbon cycle climate sensitivities and feedbacks
Subgroup 3 is focused on understanding the climate feedbacks to the ocean, but is not yet active. This subgroup will play a role in coordination and synthesis of ocean acidification research. One proposed theme for this group is the impact of pH and its effects on biogeochemical cycles and ecosystems.

Global Ocean Ship-based Hydrographic Investigations Panel (GO_SHIP)
The Global Ocean Ship-based Hydrographic Investigations Panel (GO_SHIP) was formed in 2007. This group brings together interests from physical hydrography, carbon, biogeochemistry, Argo, OceanSITES, and other users and collectors of hydrographic data, to develop guidelines and advice for the development of a globally coordinated network of sustained ship-based hydrographic sections that will become an integral component of the ocean observing system. The approved membership of the group is Masao Fukasawa (JAMSTEC), Bernadette Sloyan (CSIRO), Greg Johnson (NOAA PMEL), Niki Gruber (ETHZ), Chris Sabine (NOAA PMEL), and Arne Koertzinger / Toste Tanhua (IFM-GEOMAR). The terms of reference for the group include

1. To develop the scientific justification and general strategy for a ship-based repeat hydrography network, building on existing programs and future plans, that will constitute the core global network, post-CLIVAR;
2. To develop guidelines for a single global information and data center for ship-based repeat hydrography; and
3. To review and provide guidance on the need to update the WOCE hydrographic manual, including a review and update of data quality control issues.

The group held its first meeting during the PICES 16th Annual Meeting, November 1-2, 2007 in Victoria. The group is developing a "blueprint" for a coordinated network of ship-based repeat hydrography that will be circulated widely for consultation and consensus on the way forward.

Continental Margins Task Team
LOICZ and IMBER have formed a joint IMBER/LOICZ Continental Margins Task Team. The task team consists of 10 members and is co-chaired by Jack Middelburg (The Netherlands) and Nancy Rabalais (USA). The group organized a Continental Margins Open Science Conference at the East China Normal University in Shanghai on 17-21 September 2007 (https://www.confmanager.com/main.cfm?cid=792). The aims of the Conference were to estimate the relative importance of changing forcings (global, local, and human) and to determine how much of the changes in shelf ecosystems can be attributed to the respective forcings. Invited speakers delivered keynote presentations at the beginning of the sessions. This was followed by high-standard

oral and poster presentations, with discussion session wrapping up each session. A total of 110 scientists from 25 countries attended this conference. The major outcome was the identification of research foci for the development of an implementation plan of collaborative research efforts on continental margin biogeochemistry and ecosystems, its responses to global changes and its feedback effects on the Earth System and human society. Oral and poster sessions were instrumental in highlighting the new findings and new directions in continental margins research. A meeting report was published in *EOS* (Kelly-Gerreyn et al., see publication section). A list of IMBER and LOICZ themes have been identified that include sources and sinks of CO_2, coupled model of ecosystems and biogeochemistry for continental margins, coupling of element cycles, regeneration, modeling of coupled ocean-seafloor systems, and ocean-shelf exchange. The task team is preparing a draft Science Plan and Implementation Strategy for IMBER and LOICZ continental margins biogeochemistry and ecosystems research.

Capacity Building Task Team

The IMBER Capacity Building Task Team is now chaired by Jing Zhang. This group has developed a capacity building strategy and implementation plan for IMBER to guide capacity building issues (http://www.imber.info/products/Capacity_Building_final.pdf). One objective of the strategy is to enhance research capabilities in developing countries, especially those geographically close to interesting biogeochemical/ecosystem provinces. Another objective is to enhance research capabilities globally in those IMBER activities that have few practitioners but are crucial for optimal implementation of the *IMBER Science Plan and Implementation Strategy*. IMBER is represented on the SCOR Committee on Capacity Building where by Jing Zhang (please visit http://www.scor-int.org/capacity.htm for details).

IMBER is organizing (in collaboration with EUR-OCEANS) a Summer School on End to end Food Webs in Ankara, Turkey, on 11-16 August 2008. Prof. Temel Oguz, a member of the Capacity Building Task Team, is the organizer of this Summer School. The IMBER IPO supported the organizers and prepared a website (http://www.imber.info/E2E_EcoModel_programme.html). Participants will be PhD students and young post-docs working with biogeochemical cycles and end to end food webs. Confirmed lecturers are Icarus Allen (UK), Temel Oguz (Turkey), Mike St. John (Germany), and Jing Zhang (China). The programme consists of lectures, discussions, practical work/experiments and poster sessions. The formal lectures will be webcast live and will allow scientists around the world hear the lectures and ask questions.

Data Management Committee

The IMBER Data Management Committee (DMC) met in Victoria (Canada) on June 10-11, 2007. It is chaired by Raymond Pollard (UK). The DMC recommended promoting a cooperative data management approach. This implies

- to involve data specialists from the start,
- to strongly recommend that a person with data management experience be appointed, delegated or hired to serve as the Project Data Specialist
- to train young scientists to conduct this task (useful on their CVs, educate them to do DM better) and
- to promote “carrots” rather than “sticks” (e.g., facilitating).

The main priorities for this year are

- complete data policies and Web guides
- contact each IMBER project to encourage development of their data management policy
- develop the IMBER data web pages
- contact the GCMD

The data management committee is organizing a workshop entitled “*BEER - Being Efficient and Environmentally Responsible*” to be held before the IMBER IMBIZO on Sunday, November 9 in Miami (USA). This workshop and discussion will present the benefits of adding a Data Integration Scientist to all projects, and will introduce the various data integration and handling techniques illustrated in the IMBER Data Integration

Cookbook. Scientists of all experience levels are invited to participate in this workshop and contribute to the discussion. Confirmed lecturers are Raymond Pollard, Todd O'Brien (NOAA) and Gwen Moncoiffe (BODC).

Human Dimension
IMBER is exploring a collaborative approach with other IGBP core projects to bring together natural and social science communities to develop the issues and questions for Theme 4 in the IMBER SP/IS. Julie Hall met with the Chair of IHDP (Oran Young) who encouraged IMBER to build on the activities of GLOBEC and LOICZ rather than start a new activity. IMBER was a co-sponsor of a GLOBEC Focus 4 (Human Impacts) workshop that was held in Rome (Italy) on July 8-11, 2008.

End to end Food Web Task Team
The End to end food web Task Team, a joint activity with GLOBEC, was co-chaired by Coleen Moloney (South Africa) and Mike St. John (Germany). The group prepared two papers. The first one was a review paper focused on the concept for end to end food web research submitted to *Trends in Ecology and Evolution* (St. John et al.). The Task Team also prepared a longer paper (Moloney et al.) for publication in *Ecosystems.* This second manuscript captures much of the detailed discussion from the meeting of the Task Team in December 2005 in Hamburg, and attempts to provide a framework for future end-to-end food web research. As a result of the discussions from this group, further end to end activities are being lead by IMBER.

CLIOTOP Symposium: IMBER sponsored Coleen Moloney to attend the first CLIOTOP Symposium (La Paz, Mexico, December 3-7, 2007). The symposium aimed to stimulate international scientific collaboration among researchers studying the responses of oceanic top predators to climate variability and change and to intensive fishing pressure. One of the interesting topics was the link between oceanic mesoscale features and the movements and distributions of top predators, often linked to "hot spots" and high-use areas. Links to climate change were also elaborated in a number of presentations, highlighting the advantages of using highly mobile top predators to integrate ecological signals in the ocean. Publications emanating from the symposium will be assembled in a special issue of *Progress in Oceanography*.

The End to End Task Team is involved with in the organisation of the Summer School on "Analyses of the interactions between end to end marine food webs and biogeochemical cycles", to be held in Turkey.

Coleen Moloney, Mike St. John and Astrid Jarre organised a topic session on *End to end food webs in marine ecosystems* during the IGBP Congress in Cape Town on May 8, 2008. The format of the session consisted of three 20-minute presentations, followed by an hour of structured discussion. The presentations were

- Bridging gaps by weaving marine food webs from end to end (Coleen L. Moloney, South Africa)
- Looking at the end-to-end food web through copepod *Neocalanus* (Hiroaki Saito, Japan)
- Benguela food webs in relation to global change (Lynne J. Shannon, South Africa)

Coleen Moloney and Mike Roman are co-chairing one of the three IMBER IMBIZO workshops on *Ecological and Biogeochemical Interactions in End to End Food Webs*. (https://www.confmanager.com/main.cfm?cid=1185&nid=8821). A plenary speaker (Hiroaki Saito, Japan) will introduce the workshop topic to the IMBIZO. The workshop will be considering two perspectives:

- material cycles related to high trophic level species - what are the relative impacts of change on material cycles through predator-prey interactions (looking from the top down)?
- transformations of elements linked to low trophic level species - what indices should be used to describe material transfer from photosynthesis to fisheries (looking from the bottom up)?

Regional Projects
Integrating Climate and Ecosystems Dynamics (ICED)
ICED is a new international multidisciplinary initiative launched in response to the increasing need to develop

integrated circumpolar analyses of Southern Ocean (SO) climate and ecosystem dynamics (http://www.iced.ac.uk/). ICED has been developed in conjunction with GLOBEC and EUR-OCEANS. ICED submitted a Science Plan and Implementation Strategy, which was reviewed jointly by IMBER and GLOBEC in 2007. This document was approved by the joint GLOBEC and IMBER SSCs and will be published later this year. A list of SSC members was proposed and also reviewed by the joint SSCs. Recommendations for gender and geographical balances were forwarded to the ICED Interim Steering Committee.

ICED held their first ICED model development workshop on April 16-18, 2008 at CCPO/ODU in Norfolk, Virginia, USA. Approximately 30 participants working in biogeochemical modeling, food web, fisheries and physical modeling attended the workshop. The meeting structure consisted of plenary presentations and breakout groups. The workshop was aimed at initiating the process of developing a basis for generating models of circumpolar SO ecosystems. The focus was put on SO food web models (structure of SO food webs and SO food web response to climate change). Further products from the workshop will be a workshop report, GLOBEC/IMBER newsletter articles, and an overview paper on SO food webs for peer-reviewed journals such as *Marine Ecology Progress Series* (MEPS).

Sustained Indian Ocean Biogeochemical and Ecological Research (SIBER)
A second workshop was convened by Raleigh Hood and Wajih Naqvi at the National Institute of Oceanography (NIO) on 27-30 November 2007, to write the SIBER Science Plan. As SIBER is designed to be a regional initiative under the auspices of IMBER and GOOS, IMBER has been actively involved in its planning. Brief presentations by all participants were followed by working group and plenary discussions. The following six major themes have been identified, keeping in view the unique features of the Indian Ocean biogeochemistry and ecosystem dynamics:

(1) Boundary current dynamics, interactions and impacts;
(2) Equatorial circulation and Indonesian Throughflow, including climate and circulation phenomena such as MJO, IOD, Wyrtki Jets, etc.;
(3) Controls and fate of primary production in the Indian Ocean, including marginal seas;
(4) Biogeochemical differences between the Arabian Sea and Bay of Bengal;
(5) Global change and anthropogenic impacts; and
(6) Role of higher trophic levels in ecological processes and biogeochemical cycles.

The different working groups have been assigned tasks for preparing a detailed Science Plan and Implementation Strategy. The objective of the writing team is to submit the plan for review at the IMBER Executive Committee meeting in November 2008.

North Pacific Marine Science Organization (PICES)
PICES is developing a new interdisciplinary programme named **F**orecasting and **U**nderstanding **T**rends, **U**ncertainty and **R**esponses of North Pacific Marine **E**cosystems (FUTURE). The vision of FUTURE is to understand and forecast responses of North Pacific marine ecosystems to climate change and human activities at basin-wide and regional scales, and to broadly communicate this scientific information to members, governments, resource managers, stakeholders and the public. During the last annual meeting in Victoria (Oct. 2007), an open forum on FUTURE were held and comments on the science plan were received from the PICES community. There are many overlaps in the science plan between FUTURE and IMBER, for example, studying the mechanisms underlying ecosystem response to natural and anthropogenic forcing, developing effective ways to communicate complexity to policy makers, resource managers, and society, etc. The new FUTURES project is a natural and appropriate venue for collaboration between IMBER and PICES. The importance of the collaboration with external projects such as IMBER was accepted by the workshop attendees. The science plan of FUTURE was approved by the PICES Governing Council early this year (http://www.pices.int/members/scientific_programs/FUTURE/FUTURE_final_2008.pdf).

New Endorsed Projects

An Early Warning System Using Seabirds to Detect Ecosystem Change in the High and Low Arctic, leading applicant: William Montevecchi (funding 2007-2009)

Marine resources are vital to many northern communities. Climate changes that have been underway for several decades are influencing marine life in Arctic waters. These changes will affect resource use and traditional harvesting practices and will present challenges as well as opportunities. Information on ongoing change in marine ecosystems is important in planning for future adaptation.

Biological responses to climate change can be expected to be most evident near the limits of species ranges where physiological tolerances are most challenged. The research focuses on top seabird predators in High and Low Arctic Canadian regions linked through the Labrador Current in the North Atlantic. It will capture "downstream" (Labrador Current) influences of High Arctic changes and variability. Changes in the biology of seabirds have already been noted (altered breeding times, deterioration in nutrition and chick condition) with dietary changes involving switches from ice-associated and polar fish to Low Arctic species.

Diving and surface-feeding seabirds (murres, fulmars, gannets, storm-petrels) will be studied when foraging over regional scales during summer and when migrating throughout the High and Low Arctic during fall, winter and spring. The project will use previous surveys of seabird diets throughout Nunavut and Newfoundland and Labrador during the 1970s and 1980s to assess changes that have occurred in High and Low Arctic marine food webs and to establish a current baseline against which future change can be assessed. (Contact: mont@mun.ca)

Pressure effects On marine prokaryoTES (POTES), leading applicant: Christian Tamburini (funding: 2005-2008)

The POTES program (Pressure effects On marine prokaryoTES) project concerns the role of marine micro-organisms in the mineralization of particulate (POM) and dissolved (DOM) organic matter and on the regeneration of biogenic compounds (silicates, carbonates) in the meso- and bathypelagic zones of the ocean. Currently, most of the information regarding these processes comes from the epipelagic zone and/or does not take into account the effect of increasing pressure with depth. Yet, it is essential to integrate effects of hydrostatic pressure forcing (as well as the associated decrease in temperature) when studying oceanic organic matter (OM) mineralization. POTES participants have not only a thorough knowledge but also the required equipment (hyperbaric bottles and samplers, sinking particles simulator) developed in collaboration with a private society (Métro-Mesures SA) that make it one of the leading international laboratories on hyperbaric topics. The major aim of the POTES project is to determine the effect of pressure on prokaryote community structure and on their activities related to the OM transformation and mineralization, using an innovative dual approach based on both laboratory experiments and in situ studies (ANTARES and DYFAMED sites, Northwestern Mediterranean Sea). Due to the high inputs of anthropogenic OM in the ocean (through wind inputs, rainfall, maritime transport, used waters), we will focus on the fate of both biogenic and anthropogenic OM. In this context, petroleum hydrocarbons will be considered as a model, as their fate in the meso- and bathypelagic zones remains unknown. The proposed experiments specifically allow us to characterize and quantify the effects of an increase in hydrostatic pressure and a decrease in temperature on:

(i) The processes of OM mineralization (transformation of POC into DOC, hydrocarbon biodegradation, respiration) and on the regeneration of biogenic compounds (silicates, carbonates) in intermediary and deep oceanic waters;
(ii) The structural ((phylo)genetic) and functional (activities) dynamics of prokaryotic communities;
(iii) The flux of POM in the water column and the kinetic of particle transformation in the mesopelagic zone ; these information will be incorporated into a model describing the transformation of particles by micro-organisms in the entire water column.

(website:www.com.univ-mrs.fr/LMGEM/potes) (Contact: tamburini@univmed.fr)

Outreach activities

IMBER website
The IMBER IPO insures that the IMBER website (www.imber.info) is always up to date and is the major communication tool for IMBER. This year the IMBER web site was visited 15,600 times over a period of 12 months. The number of visits has doubled since last year. A curve of the number of visit per day over the last two years showed peaks of hits generally following announcements for IMBER activities. The National Contact page http://www.imber.info/national_activities.html and a portal for highlighting the activities of the Joint Carbon Research Group have been developed.

The IMBER website is also used to advertisement small meetings and conferences that don't require the use of a registration package. A very good example this year is the webpage developed for the CLIMECO Training for young scientists (http://www.imber.info/CLIMECO_home.html). All information regarding the event are communicated through those pages. We have developed a similar page for the IMBER Summer School planned for August 11-16 in Ankara, Turkey.

IMBER update
Ten issues of the electronic newsletter *"IMBER update"* were published since 2005, including the latest in July 2008. The newsletter includes IMBER science highlights, reports from the activities of the IMBER working groups, summaries from IMBER-endorsed and contributing projects, reports from regional and national programmes, and a list of the upcoming IMBER related conferences and workshops. In 2007, the format of the *IMBER update* was modified to be easily readable online. All issues are downloadable from the IMBER website, http://www.imber.info/newsletters.html.

eNews
Considering the growing number of requests for circulation of information regarding activities happening in the IMBER scientific network, the IMBER IPO started in April 2007 the publication of a monthly eNews bulletin. This publication includes a list of upcoming IMBER activities, funding calls, job opportunities, conferences and workshops.

IPO Report to SSC
In an effort to keep the IMBER SSC aware of the development of IMBER activities throughout the year, and not only at SSC meetings, the IMBER IPO started to circulate an IPO report to IMBER SSC members and sponsors. This document reports on IPO activities, news from the IMBER working groups, IMBER meetings, workshops and conferences, IMBER contributing, regional and national projects, sponsored activities, communication and interactions with our sponsors.

Brochure and Poster
An IMBER brochure and a poster are available as a communication tool to promote the IMBER program. They introduce the global scientific context of IMBER and present the four themes of the program, with a special focus on the major questions of Theme 2, which is the heart of IMBER. Information regarding how to get involved and how to contact the International Project Office (IPO) are also included. Both the brochure and poster are downloadable from the IMBER website (www.IMBER.info/useful-downloads.html) and available on request at the IPO.

Training
CLIMECO
IMBER, CLIVAR, GLOBEC and EUR-OCEANS jointly organised training for young scientists entitled "Climate-driven ecosystem changes" on April 21-24, 2008. The motivation came from the need to make the connection between climate and ocean scientists to better understand the sensitivity of the ocean to climate change. The goals were to bring together young marine scientists working on biogeochemistry and ecosystems research (grad students, postdocs) with climate scientists and upscale the climate drivers of ocean processes that are relevant for impact on the marine environment. We received 190 applications from young marine scientists

and the selection of the 30 candidates was a challenge. The numerous applications have allowed us to choose a group of high-level science PhD and post-docs and lead us to expect a productive training.

The CLIMECO training workshop was a combination of scientific plenary sessions on defined themes followed by discussions and "hands-on" sessions where young scientists with a marine biogeochemistry/ecosystems background learned how to use climate data. This included sourcing relevant data, scrutinising its quality and knowing how to make use of it. Eight invited lecturers presented plenary sessions on the following topics:

- Ocean physics, patterns of climate variability and biogeochemical cycles
- The contribution of the ocean observing system to investigate ocean variability
- Modelling ocean circulation and variability
- Combining ocean observations and circulation models
- Patterns of climate variability and change forcing the ocean
- From Physics to Fish and bioclimate feedbacks
- Physical ocean processes upwelling, mixing, surface forcing, nutrients and fish
- Future changes in the atmosphere - ocean system
- Marine ecosystems lecture

Due to the interest shown in the CLIMECO Training for Young Scientists, a live webcast of the plenary lectures throughout the week using the EUROCEANS Web Conference tool were provided. All candidates were asked to prepare a poster presenting their research. A poster session was held on the first day during the icebreaker and the posters stayed up for the duration of the workshop to allow exchange between workshop participants and the local students and scientists. Outcomes from the training will include a meeting report, articles in IMBER, CLIVAR and GLOBEC newsletters, and a public outreach film (collaboration with Oceanopolis). All PowerPoint lectures are available from the IMBER website.

Summer School in Ankara

IMBER is organising with EUR-OCEANS a summer school entitled *Analyses of end to end marine food webs and biogeochemical cycles* that will be held at the Middle East Technical University, Ankara (Turkey) on August 11-16, 2008. The summer school aims to provide participants with an overview of methods, models and approaches for analyzing the interactions between marine biogeochemical cycles and end to end food webs studies. It will introduce to participants recent research foci on the interactions of end to end marine food webs and biogeochemical cycles to better understand and predict changes in marine ecosystems. The summer school will be organized around two lectures series on *Main processes controlling marine food webs* and *Advances in end-to-end food web modelling*. For each topic, a combination of theoretical lectures and practical workshops will be given. The discussion and poster sessions will be organized to stimulate interactions among student and also between students and the lecturers. The organizers are also planning debates on hot topics pertinent to end-to-end ecosystem research and participants presentations. Lecturers will be Icarus Allen, Temel Oguz, Mike St. John, and Jing Zhang. Further information can be found on the summer school website: http://www.imber.info/E2E_EcoModel_home.html.

International Project Office (IPO)

The IMBER IPO is located in Brest, France at the Institut Universitaire Européen de la Mer. The IPO is funded by Centre National de la Recherche Scientifique (CNRS), Institut de Recherche pour le Développement (IRD), Université de Bretagne Occidentale (UBO) and the Brittany Region. The IPO is primarily responsible for carrying out the decisions of the Scientific Steering Committee, searching for funding to support the program's activities, providing support to the different working groups and task teams, providing administrative support for the program's activities, maintaining communication inside and outside the program, and maintaining a data and information archive.

In 2007-2008, IMBER's activities and international office were sponsored by

- IGBP: support for SSC meeting (16K USD; yearly);
- SCOR: and support from NSF (50K USD; 2006-2009) and occasional support for developing country scientist to participate in IMBER-related meetings;
- CNRS: support for activities and travel (32K USD; 2006-2008), for salary (80K USD, 2006-2008);
- IRD: support for salary (33K USD, 2006-2008);
- Region of Brittany: support for salary (22K USD, 2006-2008);
- University of Brest (UBO and IUEM: support for rooms and stationary costs (10K USD, 2006-2008), plus in kind support.

Discussion started with the current funders of the IPO regarding the refunding of the IPO for 2008-2011. A meeting to bring together funders, the IMBER Executive and sponsor representatives was planned in conjunction with the IMBER Executive meeting in early October 2007. A second meeting was held in Paris on April 14, 2008 to finalise the supporting agreements from the French consortium. Funding for the IMBER IPO was renewed for 2008-2011 for the three full-time positions. For this new cycle, the IPO sponsors will include the University of Brest, IUEM, the region of Brittany, CNRS, IRD, Ifremer, the Conseil Général de Bretagne (Department authorities) and the City of Brest. During a meeting with the French consortium, a two-phase approach was proposed for the IMBER IPO for the next 3 years (2008-2011): from July 2008 until March 2010, as the GLOBEC IPO is scheduled to close in March 2010, and from April 2010 until July 2011. In response to this proposed way forward, the French consortium agreed to find further funding for hiring two more staff to support the increased workload of the IPO after April 2010. The French consortium decided to hold another meeting in April 2009 to discuss a proposed way forward for the IPO from the GLOBEC/IMBER Transition Task Team.

Interactions with other projects and programmes

SOLAS

Joint SOLAS/IMBER Carbon Research group: IMBER and SOLAS have established a joint carbon implementation group. The group is chaired by Truls Johannessen (Norway) and works closely with the IOCCP (International Ocean Carbon Coordination Panel). (See section on IMBER/SOLAS Carbon Working Group).

LOICZ

Joint IMBER/LOICZ Continental Margins task team: LOICZ and IMBER have formed a joint LOICZ/IMBER Continental Margin Task Team. The task team consists of 10 members and is co-chaired by Jack Middelburg (The Netherlands) and Nancy Rabalais (USA). The team organized a Joint Continental Margins Open Science Conference that was held at the East China Normal University in Shanghai in 17-21 September 2007, (https://www.confmanager.com/main.cfm?cid=792). (See section on Continental Margins Task Team).

GLOBEC

Joint IMBER/GLOBEC End- to-end task team: See section on End to end food web Task Team.

IMBER/GLOBEC Transition Team

The sponsors of both GLOBEC and IMBER (IGBP, SCOR) have agreed that preparations should be made for a single ocean research project in the IGBP structure after 2009. The *IMBER Science Plan and Implementation Strategy* was written for a 10-year lifetime and will need an addendum to address the results of the GLOBEC programme, new scientific findings in the IMBER programme and projects within GLOBEC that will continue past 2009. A Transition Task Team (TTT) has been appointed jointly by SCOR and IGBP and tasked with the preparation of this addendum to the *IMBER Science Plan and Implementation Strategy* that will define the additional science to be included in the IMBER project after the conclusion of GLOBEC. In preparing this supplement to the *IMBER Science Plan and Implementation Strategy* the Task Team will consider:

- New developments in marine ecosystem science,
- Key new scientific questions arising from GLOBEC,
- Scientific results of IMBER to date,
- Projects currently within GLOBEC that are planned to continue after 2009.

The Transition Task Team may include recommendations for mechanisms to facilitate the transition, including representation in programmatic structures.

The timetable for this activity will be as follows:

- Nov 2007-April 2008: discussion/drafting within TTT by email
- July 2008: first meeting of TTT in Plymouth (UK)
- Sept 2008: report on activities to IGBP and SCOR Officers
- Dec 2008: 2nd meeting of the TTT with input from the Execs
- Jan-Feb 2009: public posting of draft (e.g., on websites)
- May 2009: presentation at GLOBEC OSC
- Jun-Jul 2009: final touches based on OSC and other comments
- Aug 2009: review by IGBP and SCOR
- Sep 2009: presentation of final report to GLOBEC, IMBER, IGBP and SCOR
- Oct 2009 Discussion/Approval by the IGBP and SCOR officers

The first meeting of this group will be held on 30 July to 1 August 2008 (3 days) at the University of Reading, UK.

CLIVAR
IMBER, CLIVAR, GLOBEC and EUR-OCEANS organized jointly on April 21-24, 2008 a training for young scientists entitle “Climate driven ecosystems changes”. (See section on training and CLIMECO.)

EUR-OCEANS
IMBER co-sponsors with EUR-OCEANS activities focused on marine biogeochemical and ecosystem research including:

- End-to-End food webs task team activities;
- International Symposium on “Parameterization of trophic Interactions in Ecosystem Modelling” , (March 2007);
- ICED, joint international multidisciplinary initiative launched in response to the increasing need to develop integrated circumpolar analyses of Southern Ocean climate and ecosystem dynamics.
- Climate driving of marine ecosystem changes…*Training for young marine scientist* (CLIMECO), April 21-24, 2008;
- Summer School on *Analyses of end to end marine food webs and biogeochemical cycles* at the Middle East Technical University, Ankara (Turkey) on August 11-16, 2008;
- End to end fob web workshop at the IMBER IMBIZO in Miami (USA) on November 9-13, 2008.

CARBOOCEAN
CARBOOCEAN is a European integrated project that aims at an accurate scientific assessment of the marine carbon sources and sinks with special emphasis on the Atlantic and Southern Oceans on a time scale -200 to +200 years from now. A Memorandum of Understanding was signed between IMBER and CARBOOCEAN and discussions are underway to develop joint activities.

GODAE
A joint IMBER/GODAE task team was formed and held a workshop in Paris on June 12-13, 2007. The aims of this workshop were to review the present biogeochemistry and ecosystem development within GODAE systems and related issues, to identify common interests between IMBER and GODAE, to evaluate real time datasets and assimilation schemes required for biogeochemistry and ecosystem applications and to provide a report to IMBER and GODAE useful for further actions. As an outcome of this workshop, the group is developing an implementation document for future joint activities.

National activities
IMBER activities are starting in many countries (e.g. Chile, P.R. China, Finland, France, Germany, India, Italy, Japan, Netherlands, New Zealand, Norway, Spain, Taiwan, Turkey, UK, USA). China has 5 years of funding IMBER/GLOBEC programme and will be hosting the Second Large Marine Ecosystems Conference; IMBER-JAPAN was established under the Science Council of Japan, chaired by Hiroaki Saito. A North West Pacific cruise has been funded for Summer 2008. France has funded the CYBER programme "CYcles Biogéochimiques, Ecosystèmes et Resources". Spain has many projects and activities that are closely related to IMBER goals and will contribute significantly. In the United Kingdom, the Oceans 2025 programme (a partnership of seven leading UK marine centres) aims to improve understanding of how the ocean behaves, how it is changing, and what this means for society. There are nine science themes within Oceans 2025 (www.ocean2025.org), of which most are relevant to IMBER.

Future Activities

IMBER IMBIZO 2008
IMBIZO is a Zulu word that means “gathering” or “meeting”. IMBER will conduct a series of IMBIZOs over the next decade, with the first gathering planned for November 9 -13, 2008 in Miami, Florida. (http://www.imber.info/IMBIZO.html).

The first IMBER IMBIZO will consist of three interdisciplinary workshops, held in parallel, that will facilitate interactions among scientists from a range of disciplines to discuss current knowledge and future research directions in biogeochemical cycles and ecosystems: *End-to-end Food Webs, Mesopelagic*, and *Bathypelagic*. Each workshop will include oral presentations to showcase the current state of knowledge in each area and discussion sessions to identify key science questions to be addressed as part of IMBER over the next 10 years. Through the gathering, the workshops will meet jointly for plenary, poster and reporting sessions. To facilitate effective discussion, each workshop will be limited to 40 participants. Some funding will be available for scientists from developing countries to attend. Each participant is also encouraged to present one poster on their research area. The posters will be up for the duration of the IMBIZO. The knowledge advanced at the workshops will be reported as publications and synthesis papers in peer-reviewed journals.

The confirmed invited speakers for the end to end, mesopelagic and bathypelagic workshop are Hiroaki Saito (Japan), Richard Lampitt (UK)and David Karl (USA), respectively.

IMBER/ EUR-OCEANS Summer School: *Analyses of end to end marine food webs and biogeochemical cycles* (Ankara, Turkey, August 11-16, 2008)

BEER: *Data integration training* (Miami, November 9, 2008)
Invited speaker: Todd O’Brien (NOAA, Marine Ecosystems Division, USA) and Gwenaelle Moncoiffé (British Oceanographic Data Center, Liverpool, UK)

This IMBER Data Management Committee-sponsored workshop and discussion will present the benefits of adding a Data Integration Scientist to any project, and will introduce the various data integration and handling techniques illustrated in the IMBER Data Integration Cookbook. Scientists of all experience levels are invited to participate in this workshop and contribute to the discussion. Further information about the Miami IMBIZO and draft programs for each workshop can be found on the IMBIZO website

((http://www.imber.info/IMBIZO.html).

Global synthesis Symposium 2009
Decadal variations of the ocean's interior carbon cycle: synthesis and vulnerabilities (Centro Stefano Franscini in Ascona, Switzerland, July 13-17, 2009). (See section on WG2 Ocean Interior (leader: Nicolas Gruber, Switzerland)

IMBER-sponsored meetings

- Joint meeting of the SIC group with the IOCCP SSG next to the Ocean in a High-CO_2 World symposium (October 2008)
- PICES XVII Annual Meeting (Dalian, China, Oct. 23 - Nov.2, 2008) IMBER topic session entitled "End to End food webs: Impacts of a Changing Ocean"
- ICED first Scientific Steering Committee meeting (late 2008)
- Transition Task Team: Second meeting (Brest, December 2008)
- Second GO_SHIP meeting (early 2009)
- ICED Workshop on biogeochemical modelling and ecosystem links (early 2009)
- Summer School in Brest (Institut Universitaire Européenne de la Mer, August 2009)
- IMBER IMBIZO 2010

Annex 9 - Surface Ocean–Lower Atmosphere Study (SOLAS)
(joint with IGBP, WCRP, and CACGP)

SOLAS International Project Office
Annual Report to SCOR 2007/2008

Jeffrey Hare Executive Officer jeff.hare@uea.ac.uk
Emily Breviere Project Officer e.breviere@uea.ac.uk (on assignment to IGBP)

SOLAS International Project Office, School of Environmental Sciences
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02 July 2008

SOLAS Scientific Steering Committee (SSC)
The SOLAS SSC met in Xiamen, China in March 2007 (prior to the SOLAS Open Science Meeting) and again in May 2008 in Cape Town, South Africa (during the IGBP Congress).

The membership of the SOLAS SSC for 2008:

Doug Wallace, M, Germany, Greenhouse gases, Air-sea exchange
Isabel Cacho Lascorz, F, France, Palaeo Studies
Gerrit de Leeuw, M, Netherlands, Atmos. Boundary Layer
Veronique Garcon, F, France, Ecosys. dynamics, biogeochemistry
Sergey Gulev, M, Russia, Air-Sea Exchange (sponsored by WCRP)
Barry Huebert, M, USA, Atmospheric Aerosols
Truls Johannessen, M, Norway, Ocean Carbon
David Kieber, M, USA, Photochemistry
Nilgun Kubilay, F, Turkey, Air-Sea Exchange of Nutrients and Long-Range Transport
Christiane Lancelot, F, Belgium, Biological Oceanography
Cliff Law, M, New Zealand, Trace gas exchange and nutrients
Wade McGillis, M, USA, Ocean Boundary Layer Physics (sponsored by WCRP)
Eric Saltzman, M, USA, Atm. chemistry, aerosol and halogens
Guang-Yu Shi, M, China, Coastal Studies
Jacqueline Stefels, F, Netherlands, DMS and sulfur cycles
Shigenobu Takeda, M, Japan, Marine Biogeochemistry
Osvaldo Ulloa, M, Chile, Biological Oceanography
Roland von Glasow, M, UK, Halogens, modeling, chemistry

New members are being considered by the four co-sponsors for terms starting in 2009.

SOLAS International Project Office
The SOLAS International Project Office (IPO) is housed at the University of East Anglia (UEA) in Norwich, UK, with five-year funding by the UK Natural Environment Research Council (NERC). Funding for the operation of the IPO in Norwich expires in March 2010. Plans are being formulated for future placement and funding of the IPO.

Dr. Jeff Hare is the Executive Officer (EO) of the IPO, and Dr. Emily Breviere is the IPO Project Officer (PO). From November 2007 until August 2008, Dr. Breviere is serving a secondment at the IGBP as Deputy Director. Ms. Georgia Bayliss-Brown, who received a BS in Environmental Sciences (specialty in Meteorology) from UEA, works as a Research Assistant in the IPO.

In November 2006, Dr. Tom Bell was appointed as SOLAS Project Integrator. Dr. Bell received his PhD in Environmental Sciences from UEA in 2006, and his role is to act as the facilitator for the community to have access to project databases and for the development of global air-sea flux fields.

In mid-August 2008, Dr. Hare will step down from the IPO, and Dr. Breviere will assume the post of Executive Officer. The search for a new Project Officer position is currently underway.

National Networks

A number of nations have SOLAS research programs or projects in the planning stages, but research is active in many countries. Some highlights are presented below.

- **Australia** –SOLAS-related research occurs at academic institutions and government laboratories (CSIRO), and collaborations with scientists from New Zealand are frequent. The Australian National Representative is Dr. Jill Cainey (Cape Grim Observatory), and she was an invited speaker at the SOLAS Open Science Meeting in Xiamen, China.
- **Belgium** – The Belgian Federal Science Policy (BELSPO) generously contributed funds to permit a half-time Secretariat for IMP1 over a 2-year period beginning January 2005, and Dr. Veronique Schoemann (from the Université Libre de Bruxelles) filled that role. Unfortunately, a proposal to renew the funding for this position has been declined. In December 2006, ULB organized and hosted the Comparison of Oceanic Dimethylsulfide Models (CODiM) workshop, which brought together 20 scientists for intercomparison of 1-D and 3-D DMS models. The results of this synthesis are still under development, and plans are being made for another workshop in a few years. The Belgian National Representative for SOLAS is Christiane Lancelot (ULB), and she is also a member of the SOLAS SSC.
- **Brazil** – The Brazilian National Representative is Amauri Pereira de Oliveira (USP), although communications with the IPO have been minimal.
- **Canada** – The C-SOLAS program was the first funded national program within SOLAS, and their five-year funding cycle (including extensions) ended in mid-2007. The C-SOLAS network has produced an incredible number of refereed publications from the 5-year funding cycle. Ongoing work within the network includes contributions to the International Polar Year effort. The National Representative for SOLAS in Canada is Maurice Levasseur (University of Laval) who was an invited speaker at the 2007 SOLAS Open Science Meeting.
- **Chile** – SOLAS research is conducted at the COPAS (Centro de Investigación Oceanográfica en el Pacifico Sur-Oriental) institute in Concepción, with academic institutions also contributing. There are plans underway to coordinate SOLAS research with the upcoming CLIVAR Variability of American Monsoon Systems (VAMOS) Ocean-Cloud-Atmosphere-Land Study (VOCALS) field intensive in October 2008, and this collaboration involves significant participation by Chilean SOLAS researchers. Osvaldo Ulloa (Universidad de Concepcion) is the SOLAS National Representative and is a member of the SOLAS SSC.
- **China** (**Beijing**) – China SOLAS obtained more than US$1 million to conduct SOLAS research from 2003 to 2007, networking with neighboring countries (China-Taipei, Korea, Japan, etc) has increased, and the national scientists look forward to more progress in international cooperation across the Asian network. 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 CO_2 fluxes between the air and sea, and effect of these fluxes on cloud and radiative budgets. Cruises have been executed in the Yellow Sea and in the South China Sea. Chinese and Japanese scientists are leading an effort to establish the Asian Dust and Ocean Ecosystems (ADOES) project participants into a SOLAS Task Team, with a total of three workshops held over the past 4 years. China hosted the International SOLAS Open Science Meeting in Xiamen (6-9 March 2007). Guang-Yu Shi (Institute of Atmospheric

Physics) is the National Representative to SOLAS, a member of the SOLAS SSC, and was the Chair of the Organizing Committee for the 2007 SOLAS Open Science Meeting in China.

- **China** (**Taipei**) – National scientists continue to participate in three major SOLAS activities: Long-term Observation and Research of the East China Sea (LORECS; the 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 Straight Watch on the Environment and Ecosystem with Telemetry (SWEET), and 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). Wu-Ting Tsai (National Central University) was an invited speaker at the 2007 SOLAS Open Science Meeting and is the National Representative for SOLAS.
- **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. An around-the-world cruise campaign was conducted from August 2006 until April 2007 (GALATHEA) to measure surface concentrations and fluxes of carbon dioxide. Lise Lotte Sorensen (Riso National Laboratory) was an invited speaker at the 2007 SOLAS Open Science Meeting in China and is the SOLAS National Representative in Denmark.
- **France** –French scientists are very active in SOLAS-related research, and the French program originally operated under the moniker of PROOF (acronym for biogeochemical processes in the ocean and fluxes). A new 'umbrella' for research within the SOLAS remit has been established: LEFE (Fluid Envelopes and Environment). This program includes projects on atmospheric chemistry (CHAT), biogeochemical cycles (CYBER), climate variability on a global scale (EVE), and interactions and dynamics of the ocean and atmosphere (IDAO). SOLAS-France plans a national meeting in September 2007. Remi Losno (LISA) and Veronique Garcon (SSC Member) are the SOLAS National Representatives. Dr. Garcon was an invited speaker at the 2007 SOLAS Open Science Meeting in Xiamen.
- **Germany** – D-SOLAS scientists are very active in the SOLAS research regimes, combining institutional (Max Planck Institutes) and university researchers. The SOLAS effort in Germany operates under the recently funded (6.5m EUR over 5 years) SOPRAN (Surface Ocean Processes in the Anthropocene). SOPRAN includes 12 institutions, 43 investigators, and has four main foci: interphase transfer at the air-sea interface, effect of anthropogenic CO_2 on marine ecosystems and sea-air flux of gases, production and emission of radiatively and chemically active gases in the tropics, and the oceanic response to dust deposition. 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. In addition, collaborations have been developed for Cape Verde with researchers in the USA. An atmospheric-related SOLAS proposal will soon be submitted to national funding agencies, and this program is called the Marine Multi-Phase Halogen Chemistry and its Coupling to Nitrogen and Sulfur Cycles (MAPHiNS). Doug Wallace (IfM-GEOMAR, Kiel) is one of the German National Representatives and has been named as new Chair of the International SOLAS SSC. He was also an invited speaker at the 2007 SOLAS Open Science Meeting in China. The other National Representative is Uli Platt (University of Heidelberg).
- **India** – SOLAS and IMBER collaborate strongly in India, but resources within the nation are limited. Interest areas include oxygen dynamics in the upper ocean, halocarbon fluxes, and time-series measurements of biogeochemical species. The Indians have established a new time-series station in the coastal Bay of Bengal, and this project is funded for the next 3 years. Dileep Kumar (NIO, Goa) is the SOLAS National Representative and is a former member of the SOLAS SSC.
- **Ireland** – A small number of scientists are working on SOLAS-related research within the nation, and a planning and coordinating meeting was held in Galway in November 2006. Irish scientists led the 2006 experimental effort for Marine Aerosol Production (MAP), which was funded by the European Commission. Brian Ward (Galway) is the SOLAS National Representative.

- **Japan** – SOLAS in Japan recently received a boost with the successful funding of the Western Pacific Air-Sea Interaction Study (W-PASS).This award amounts to about US$ 9 million over 5 years to understand primary production in the Western Pacific, to determine how the marine ecological system will respond to changing atmospheric composition, to determine how production and emission of biogenic gases will affect the composition of the atmosphere, and to evaluate the contribution of marine biogenic gases to global warming. Mitsuo Uematsu (University of Tokyo) is the SOLAS National Representative and is a former member of the SOLAS SSC. Shigenobu Takeda is a member of the SOLAS SSC and has been named Vice-Chair.
- **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 (mesocosm) biogas transfer experiments, biogeochemical cycling, and other SOLAS research areas. Sung Yang (Gwangju University) is the SOLAS National Representative, although communication with the IPO has been minimal.
- **Netherlands** – 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. SOLAS research is in the fields of air-sea exchange of aerosols, DMS, CO_2 and momentum fluxes. Several institutions work on the EU-integrated project CARBOOCEAN. Recent years have seen more emphasis on IMBER-related research. During the 2006 SOLAS SSC meeting in Amsterdam, the Netherlands SOLAS/IMBER/GEOTRACES network held a well-attended one-day workshop in which the SSC was invited to participate. Jacqueline Stefels (University of Groningen) is an SSC Member and is the National Representative.
- **New Zealand** –A cruise was conducted in March 2006 to investigate the nitrogen cycle in the subtropical waters off NW New Zealand. 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. Phil Boyd (NIWA) is the SOLAS National Representative.
- **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. 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. through CARBOOCEAN, which is endorsed by SOLAS and is housed at the University of Bergen. Abdirahman Omar (Bjerknes Centre) is the SOLAS National Representative.
- **Russian Federation** –A national climate program exists, and SOLAS-related studies here include atmospheric anthropogenic gases and chemical components of the Earth climate. Sergey Gulev (Russian Academy of Sciences) is a member of the SOLAS SSC and is the SOLAS National Representative.
- **Southern Africa –** Immediately after the 2008 IGBP Congress in Cape Town, a group of committed national scientists held a joint SOLAS/IMBER workshop to communicate and coordinate a regional network in southern Africa. A number of talks were provided by members of the SSCs of the projects, and the local scientists demonstrated some of the impressive work being conducted within the SOLAS and IMBER interest areas. Discussions resulted in the incorporation of the regional network, and Dr. Carl Palmer was appointed as Representative.
- **Spain** – A SOLAS Committee has been established and includes 7 leaders within the Spanish community. Specific funding for SOLAS research is not coordinated at the agency level, but air-sea interaction is a national research priority. 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. Rafel Simo (CSIC in Barcelona) is the

SOLAS National Representative, and the 2009 SOLAS Open Science meeting will be held in Barcelona during the month of November.

- **United Kingdom** - The UK-SOLAS programme has been developed in close cooperation with the Atlantic Meridional Transect project (AMT) and the Centre of Excellence for the Observation of Air-Sea Interactions and Fluxes (CASIX). The Natural Environmental Research Council (NERC) programme UK-SOLAS was initiated in early 2004 with $21M over 5 years. The first annual meeting was held in July 2006 in Manchester, and the next annual meeting is scheduled for August in Leeds. Funding has also been approved for the installation of a SOLAS atmospheric sampling station in Cape Verde, and German 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. The National Representative for SOLAS in the UK is Phil Williamson (UEA).
- **United States** – US-SOLAS has published a Science Implementation Strategy with four foci:

    1. Quantification of biogeochemical interactions and feedbacks between the ocean and atmosphere,
    2. Understanding the exchange processes at the air-sea interface and the role of transport and transformation in the atmospheric and oceanic boundary layers,
    3. Characterization of air-sea fluxes of CO_2 and other long-lived radiatively active gases, and
    4. Promoting enabling technologies, outreach, and data management.

    Funding for US-SOLAS is expected to come from the 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. Wade McGillis (LDEO) is the SOLAS National Representative from the USA.
- **Europe** – SOLAS research is very strong across the continent, with more than 40% of the SOLAS research community residing in Europe. The IPO administers the networking funds for a COST Action to create flux data products from ongoing SOLAS data collection. This COST Action (number 735) has held one meeting of the working groups, and will work closely with the SOLAS Project Integrator to accomplish its goals. CARBOOCEAN, a European Union Integrated Project that seeks accurate scientific assessment of marine carbon sources and sinks over space and time, has been endorsed by SOLAS. The Marine Aerosol Production (MAP) campaign (see Ireland) and the Organics over the Ocean Modifying Particles in both Hemispheres (OOMPH) project are SOLAS efforts funded through European Union.

Other Activities

SOLAS International Summer School—Corinne Le Quere (UK), Veronique Garcon (France), and the IPO are responsible for the planning and operation of the Summer School, which is held biennially at the Institut d'Etudes Scientifiques de Cargese in Corsica, France. About 15-20 lecturers provide instruction on all aspects of SOLAS science, and this year there are plans to include discussions about publication of research and on the ethics of scientific endeavors. The site in Cargese provides a unique environment for the Summer School, with academic classrooms, laboratory facilities, and a nearby port. Collaborators within France have been able to secure a research vessel for ship-based practical workshops during the Summer School. The 1st SOLAS International Summer School was held in July 2003, with 72 students in attendance. The 2nd Summer School was held in September 2005 with 73 participants, and the most recent (3rd) Summer School was held on 22 October–3 November 2007. Plans are being formulated for the 4th Summer School in 2009. The Summer School is highly successful, as self-evaluations from the students and lecturers have shown. The atmosphere is ideal for interaction between students and lecturers, and

this capacity building is felt by SOLAS to be of fundamental importance to the long-term legacy of the project. There are plans to develop the lectures from the 2007 School into a textbook for SOLAS.

Open Science Meeting—Prior to the official establishment of SOLAS within the IGBP structure, an Open Science Meeting (OSM) was held in Damp, Germany in the spring of 2001. This conference provided the foundation for the SOLAS Science Plan and Implementation Strategy. The 2004 SOLAS OSM was held in Halifax, Nova Scotia Canada, on 13-16 October. The SOLAS SSC made a subsequent decision to follow the format of the Halifax meeting for future OSMs. The unique opportunities to network and establish collaborations are felt to be incredibly useful.

The 2007 SOLAS OSM was held on 6-9 March in Xiamen, China and was organized by local hosts at the University of Xiamen and the IPO. This OSM included a relatively small number of plenary talks (20), long poster sessions (posters were on display over the duration of the conference), and afternoon discussion and synthesis sessions on topics determined to be of importance by the community. The conference was attended by 235 scientists from about 30 nations of the world.

The 2009 SOLAS OSM will be held in Barcelona, Spain during the month of November. Plans are being developed for an exciting and rewarding experience for all participants.

Other Activities—A SOLAS-initiated meeting to review the results of the various large-scale iron enrichment experiments took place in Wellington, New Zealand on 30 Oct. 30-4 Nov. 4, 2005. This meeting included 21 scientists from 9 nations representing all major iron enrichment experiments, along with experts in various other aspects of ocean iron biogeochemistry. The aim of the meeting was to synthesize the results of the many enrichment experiments (natural and artificial). SCOR and the SOLAS IPO committed funding for the meeting. One of the most significant and discrete scientific developments for SOLAS within the past twelve months is the publication of the synthesis resulting from this meeting (Science article by Boyd et al., 2007).

The SOLAS SSC is concerned about the plans by some corporate interests to conduct large-scale iron fertilization of the ocean surface in the guise of 'carbon offsetting'. In response to this, the SSC has developed a position statement. "Large-scale fertilisation of the ocean is being actively promoted by various commercial organisations as a strategy to reduce atmospheric CO_2 levels. However the current scientific evidence indicates that this will not significantly increase carbon transfer into the deep ocean or lower atmospheric CO_2. Furthermore there may be negative impacts of iron fertilization including dissolved oxygen depletion, altered trace gas emissions that affect climate and air quality, changes in biodiversity, and decreased productivity in other oceanic regions. It is then critical and essential that robust and independent scientific verification is undertaken before large-scale fertilisation is considered. Given our present lack of knowledge, the judgement of the SOLAS SSC is that ocean fertilisation will be ineffective and potentially deleterious, and should not be used as a strategy for offsetting CO_2 emissions."

SOLAS also co-sponsored (along with PICES) the participation of a concerned scientist (Dr. Fei Chai of the University of Maine) to attend the London Dumping Convention meeting of the International Maritime Organization (IMO) in Guayaquil, Ecuador in May 2008.

In November 2006, 30 scientists from a dozen nations met at the University of East Anglia for a workshop on the "Anthropogenic Nitrogen Impacts on the Open Ocean". Nitrogen is deposited to the ocean via atmospheric and riverine inputs, but the impact of increased atmospheric nitrogen loading has not been discussed coherently within the scientific community. These concerns led SCOR, SOLAS, NOAA, the International Nitrogen Initiative (INI), and the European Science Foundation (ESF) to sponsor this four-day workshop. The output of the workshop was the publication in early 2008 of a paper in the journal *Science* (Duce et al, 2008: "Impacts of atmospheric anthropogenic nitrogen on the open ocean", *Science*, Vol. 320, no 4878, pp 893-897).

Along with the International Oceanic Carbon Coordination Project (IOCCP), the Global Carbon Project (GCP), and IMBER, SOLAS co-sponsored the April 2007 workshop in Paris on "Surface Ocean CO_2 Variability and Vulnerabilities". More than 100 scientists from 20 nations met in Paris to review the current knowledge base and develop deeper international collaboration to resolve the variability and processes governing ocean surface carbon

dioxide. The workshop included a number of breakout working group meetings on topics of value to the ocean carbon community, a discussion on observing systems, and the development of a cross-basin synthesis of surface ocean carbon observations. The organizing committee is currently working on a summary report of the meeting which will include recommendations for further research and networking within the community. SOLAS continues to be directly involved in other IOCCP-coordinated efforts, including the Surface Ocean CO_2 Atlas (SOCAT) and the Global Ocean Ship-based Hydrographic Investigations Panel (GO_SHIP).

SOLAS has also led the development of the Asian Dust and Ocean EcoSystem (ADOES) consortium of scientists who are interested in the response of the ocean surface biogeochemical system to inputs of masses of dust from the Asian plateau (see China above). Two ADOES workshops were held, in 2005 and 2006, and plans are underway to consolidate the participants into a research initiative.

SOLAS scientists also participated in South American dust transport workshop in Puerto Madryn, Argentina in October 2007. Dust coming off Patagonia is expected to have an impact on the biogeochemistry of the Southern Ocean, and this workshop was developed to begin the coordination of a scientific focus in this area.

In December 2006, SOLAS sponsored a workshop for the Comparison of Oceanic Dimethylsulfide Models (CODiM) in Brussels. This workshop is a continuation of discussions held during the 2004 SOLAS Open Science Meeting in Halifax, and seeks to conduct a systematic comparison of DMS ecosystem models against common data sets to spur improvements and indicate future observations to better constrain the dynamics of DMS systems. The CODiM exercise consists of two complementary initiatives: a comparison of different 1D DMS-ecosystem models with data sets from 3 different identified ocean sites and a task to compare global mechanistically based 3-D DMS models against a database of DMS(P) measurements. A paper authored by the entire scientific assembly has been submitted to *Geophysical Research Letters*, entitled "A first appraisal of ocean DMS models and prospects for their use in climate models", and two detailed articles will be produced on 1D and 3D model inter-comparisons.

SOLAS has close relationships with three other IGBP Core Projects. With the Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) project, SOLAS has developed a Joint Carbon Implementation Plan (SOLAS IMP3). With the International Global Atmospheric Chemistry (IGAC) project, SOLAS has joint projects on tropospheric halogens, polar research, and others. SOLAS is developing relationships with the Land-Ocean Interactions in the Coastal Zone (LOICZ) project, including activities to investigate air-sea fluxes of gases in nearshore regions and a collaborative effort (including IGAC) on MegaCities.

The Task Team on Halogens in the Troposphere (HitT), which is co-sponsored by SOLAS and IGAC, developed a whitepaper on the state of the science and strategies for future investigation. This document is available on the SOLAS website (http://www.solas-int.org).

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 (SEARCH) and may be complemented by the work of the Climate in the Cryosphere (CliC) Arctic Panel.

Joint IMBER/SOLAS special sessions have been conducted at the 2005, 2006 and 2007 EGU General Assemblies in Vienna.

SOLAS has been asked to partner with the CLIVAR VOCALS (Variability of the American Monsoon System Ocean-Cloud-Atmosphere-Land Study) program, to provide information about surface biogeochemical links and interfacial exchange that contributes to the development and persistence of unique stratus clouds (http://www.eol.ucar.edu/projects/vocals/). Current plans call for an October 2008 cruise with the possible participation of two research vessels.

SOLAS has developed a network in Southern Africa, and a joint meeting was held in coordination with IMBER and the SOLAS SSC in May in Cape Town after the IGBP Congress. The initiation of this network began during the 2006 IGAC/CACGP/WMO Conference on Atmospheric Chemistry at the Interfaces in Cape Town, and a

subsequent meeting of interested scientists was held in Cape Town in March 2007.

In late 2006, SOLAS was provided networking funds from the European Coordination in the field of Scientific and Technical Research office (COST) for a dedicated 'Action' which seeks to develop global air-sea flux data sets of gases and aerosols. This effort has resulted in coordinated efforts for DMS (coordinated by Drs. Rafel Simo of CSIC Barcelona and Tom Bell of UEA), halocarbons (coordinated by Drs. Jim Butler of NOAA and Birgit Quack of IFM-GEOMAR, and included a February 2008 meeting in London), flux parameterizations (coordinated by Drs. Jeff Hare of UEA and David Woolf of Thurso and included a workshop in February 2008 in Norwich), dust transport and characterization (coordinated by Drs. Alex Baker and Tom Bell, both of UEA), CO_2 (coordinated across various channels, including IOCCP and CARBOOCEAN), and others. This five-year project will provide a platform for dedicated closely focused efforts on developing flux data sets of great value to SOLAS.

Significant effort has been devoted to the development of the Tropical Eastern North Atlantic Time-Series Observatory (TENATSO) off the Cape Verde Islands. Funding for the oceanic observatory comes from the German government under the Surface Ocean Processes in the Anthropocene (SOPRAN) project and the atmospheric observatory is sponsored by UK-SOLAS; there is significant participation by U.S.-funded scientists. It is anticipated that significant scientific effort will be developed around this unique site, as the biogeochemistry and geographic location provide a significant natural laboratory for short-, medium, and long-term observation of responses. In addition, significant effort has been expended to develop the local scientific expertise to run the ocean observation program, and this capacity development will provide a long-term legacy for the observatories.

Capacity Building and Inclusion of Developing Country scientists

The primary capacity-building activity of SOLAS is the biennial SOLAS International Summer School. To run the SOLAS International Summer School, we rely on the generous support of SCOR, the Asia Pacific Network for Global Change Research (APN), the North Pacific Science Organization (PICES), the Atmospheric Composition Change European Network of Excellence (ACCENT), and national funding agencies. SOLAS is grateful for the support from these programs. In 2007, more than 15 young developing world scientists were accepted into the SOLAS Summer School.

The SOLAS IPO is developing the lectures from the summer school into an online learning tool and to develop a SOLAS textbook. 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 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 them.

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Dr. Emily Breviere, Project Officer (e.breviere@uea.ac.uk)

Annex 10 – GEOTRACES Project

GEOTRACES PLANNING GROUP
ANNUAL REPORT TO SCOR
July 2008

SCOR Scientific Steering Committee for GEOTRACES

Co-Chairs
Robert F. Anderson, USA
Gideon M. Henderson, UK

Members
Per Andersson, Sweden
Philip Boyd, New Zealand
Ken Bruland, USA
Minhai Dai, China
Hein de Baar, Netherlands
Martin Frank, Germany
Toshitaka Gamo, Japan (Alternate: Jing Zhang)
Catherine Jeandel, France
William Jenkins, USA
Pere Masque, Spain
Chris Measures, USA
Felipe Niencheski, Brazil
Kristin Orians, Canada
James Orr, France
Carol Robinson, UK
Michiel Rutgers van der Loeff, Germany
Reiner Schlitzer, Germany
Sunil Kumar Singh, India

The SSC membership (listed above) contains representatives of 13 different countries, with diverse expertise including marine biogeochemistry of carbon and nutrients; trace elements and isotopes as proxies for past climate conditions; land-sea fluxes of trace elements/sediment-water interactions; trace element effects on organisms; hydrothermal fluxes of trace elements; tracers of ocean circulation; tracers of contaminant transport; controls on distribution and speciation of trace elements; and ocean modelling.

SCOR-supported meetings during 2007/2008

SSC meeting: The second meeting of the GEOTRACES SSC was held for three days (6-8 November 2007) in Barcelona, Spain, hosted by CMIMA – Centre Mediterrani d'Investigacions Marine i Ambientals. This meeting was attended by all but one of the SSC members along with one alternate (Jing Zhang, Japan, complementing Toshi Gamo). The chair of the GEOTRACES Intercalibration Subcommittee (Greg Cutter) also attended, as did Ed Urban, representing SCOR.

SSC discussions were wide ranging. In addition to relationships with other programmes, major issues for discussion included measurement intercalibration, data management, ocean modelling, criteria for GEOTRACES participation, and reports of national activities. Topics that received special emphasis included

- International Project office - potential locations and funding strategy
- Intercalibration cruise - sampling systems; strategies for collecting and distributing samples
- Data Management - The SSC endorsed the proposal of the Data Management Committee (see below) to host the GEOTRACES International data Management Office at the British Oceanographic Data Centre, and to hire a Data Liaison Officer as rapidly as possible. The first priority for the DLO will be to define metadata standards and policy for GEOTRACES.
- Basin Workshop Reports - The SSC reviewed the reports from each basin workshop (see below) and made recommendations for revisions and final editing. Once the reports are completed, the SSC will take responsibility for developing an overview document that extracts the highlights from

the basin workshop reports and presents a view of the global plan for GEOTRACES in a format suitable for non-specialists.

The next SSC meeting is scheduled for 6-8 November 2008 in Toyama, Japan. Jing Zhang will serve as the local host.

Ocean Basin Workshops in 2007: Three international workshops were held in 2007 to set research priorities and plan the implementation of GEOTRACES science in each of the major ocean basins – Pacific, Atlantic, and Indian (note: initial work on the high-latitude oceans has been planned under International Polar Year (IPY), as detailed below). These workshops were held in the following locations:

- Honolulu, Hawaii, USA. 26-29 June 2007 – Pacific Ocean
- Oxford, UK, 10-13 September 2007 – Atlantic Ocean
- Goa, India, 24-26 October 2007 – Indian Ocean

Information about these workshops was publicized on the GEOTRACES website. Each meeting was open to interested participants, and each was attended by between 50 and 60 scientists with interests in GEOTRACES-related research in the relevant ocean basin. Travel subsidies were provided for many participants with support from SCOR and from a variety of national sources. At each meeting, workshop participants identified the key regions and research questions for that basin, and planned ocean sections (and to some extent process studies) to address the goals laid out in the *GEOTRACES Science Plan*. A draft report on each Basin Workshop was reviewed by the SSC at its meeting in November 2007 (see above), and modifications were made based on SSC recommendations. The revised reports were completed in February 2008, at which time it was pointed out that GEOTRACES should follow SCOR policy of obtaining permission from publishers for reproducing published figures in workshop reports. The process of securing permission has been underway since February and at the time of this writing (31 July 2008) all but one permission has been secured. In some cases it has taken a substantial amount of time to locate the origin of figures used in the basin workshop reports.

The basin reports will be published on the GEOTRACES web site, and are intended mainly for use by national and regional planning groups for implementing GEOTRACES cruises. As noted above, the SSC will extract material from these reports to prepare an overview document to be disseminated more widely.

Modelling and GEOTRACES: A fourth workshop held during 2007 addressed the role of modelling in the GEOTRACES program. This workshop was held at the Hanse Wissenschaftskolleg, Delmenhorst, Germany on 6-8 September 2007 and was hosted by Reiner Schlitzer (Alfred Wegener Institute, Germany) and Jim Orr (IAEA, Monaco). The workshop was attended by 53 participants from 7 countries with a good mix of modellers and observationalists, including several modelling groups new to GEOTRACES. Speakers reviewed the present state of models of trace elements and isotopes (TEIs) in the marine environment and discussed promising new modelling approaches and projects in the light of recent advances in our understanding of TEI cycles and the expected increase in quality and quantity of TEI observations during GEOTRACES. The workshop initiated a dialog that will facilitate interaction between modelers and observationalists on a number of issues, and came to two general conclusions relevant to the planning and implementation of GEOTRACES sections:

1. For complex TEIs the models are probably not yet good enough to guide the sampling design for GEOTRACES sections; and
2. There is no particular advantage of following WOCE/CLIVAR lines, and GEOTRACES scientists should be free to select the sampling strategy that best addresses geochemical issues.

Participants agreed that there is a particular value in workshops like this because it helps keep modelers on track looking at real-life problems. That is, observationalists are closest to the cutting-edge questions, so interaction between modelers and observationalists can help steer modeling toward the most pressing problems. Now is the time to be steering the modelers, rather than trying to engage the modelers long after the data are collected. The workshop also provided cross fertilization among modelers. There were very different types of models

represented, from 1-D complex biogeochemistry models to high-resolution models (e.g., ECCO) that assimilate many types of data to improve ocean circulation.

Workshop participants recommended that it would be good to have a repeat workshop in 2 years, and eventually have annual model-data workshops. A potential theme for the next workshop would be to examine preliminary results from GEOTRACES IPY cruises.

Measurement Intercalibration during the GEOTRACES programme

There was early recognition during the planning of GEOTRACES that intercalibration of measurements among laboratories would be critical to the success of the program. To that end, a major activity for GEOTRACES during the past year was an intercalibration cruise (8 June - 12 July 2008; sampling mainly at the Bermuda Atlantic Time Series Station, but also in continental slope waters near the east coast of the United States). Some of the principal activities, objectives and findings of the cruise include

- A variety of water-sampling systems was tested for contamination of trace metals that are known to be particularly prone to contamination. Analyses conducted at sea showed that the new GO-Flo rosette constructed for U.S. GEOTRACES collected samples that are uncontaminated with Fe, Zn and Hg, as determined by comparison with individual GO-Flo bottles hung on a Kevlar wire. This is particularly valuable for Hg because it means that the contaminant metal of greatest societal concern can be measured routinely on GEOTRACES cruises.
- A variety of filter types and pore sizes were tested to identify artefacts (e.g., contamination; absorption of dissolved TEIs) and to establish filter types and filtration protocols that are suitable for GEOTRACES cruises.
- Two types of *in situ* filtration systems were used, and samples of particulate material at the same locations were collected by filtering water from GO-Flo bottles to establish (a) if the two strategies (bottles and pumps) for collecting particulate TEIs can be used interchangeably, and (b) if either in situ pumping system experienced detectable contamination or other artefacts.
- Thousands of samples were recovered during the cruise for distribution to labs worldwide. Sample distribution and the comparison of results is being handled by 15 self-organized groups representing key GEOTRACES TEIs as well as selected additional trace elements and isotopes.

Results from the intercalibration will be assessed at a workshop to be held in San Francisco immediately prior to the Fall AGU meeting. A priority for the workshop is to identify problems based on results from the first intercalibration cruise, and to recommend solutions that can be implemented and tested during a second intercalibration cruise, tentatively set for May 2009. The second cruise will be held in the eastern North Pacific Ocean.

Data Management for GEOTRACES

The Data Management Committee, chaired by Chris Measures and Reiner Schlitzer, met immediately following the Modelling workshop on 8 September in Delmenhorst, Germany to plan initiation of Data Management procedures. There it was decided to establish an international GEOTRACES Data Management Office in the UK affiliated with the British Oceanographic Data Centre (BODC). Requests to the UK NERC and to the US NSF resulted in each agency committing resources to cover one-half of the funds needed to support a data management officer at BODC for a period of two years. A search to fill this position led to the hiring of Dr. Ed Mawji in June 2008.

It is anticipated that future support for the GEOTRACES Data Management Office will be provided via a national subscription policy. Each nation that carries out a GEOTRACES cruise is expected to include in the overall cruise budget a request for data management funds. The precise level of funding expected from each cruise remains to be established by the Data Management Committee.

Links with other programmes

GEOTRACES remains committed to maintaining strong links to other relevant programmes. Martin Frank (SSC member) attended the IMAGES SSC meeting in Shanghai (September 2007). Bob Anderson (co-chair) attended the SSC meetings of IMBER and SOLAS associated with the IGBP Congress in Cape Town (May 2008). Informal discussions have taken place between European members of the GEOTRACES SSC and European members of the SOLAS SSC to explore overlapping interests in seeking a call within the EU FP7.

Capacity Building

It became evident during the basin planning workshops that many nations with scientists interested in GEOTRACES lack the experience and expertise to collect and process seawater samples free of contamination of certain trace elements. Consequently, it was decided that a training workshop that included the collection and processing of samples at sea would be a valuable capacity building activity for GEOTRACES. Chris Measures (University of Hawaii) volunteered to take the lead in seeking support for the workshop, and to host the workshop in Hawaii. However, despite intense enthusiasm among GEOTRACES SSC members for this capacity building effort, initial requests for support (to the Asia Pacific Network and to the U.S. NSF) have met with discouraging responses. At this time, the leaders of this effort are searching for alternative sources of funding for the workshop.

International Project Office

After considering several possibilities, the SSC selected Toulouse, France, to be the site of the IPO. At the time of this report, the SSC is exploring mechanisms to fund the IPO. As soon as sufficient funds are committed, an IPO Executive Officer will be hired. Until then, Catherine Jeandel (SSC member) is leading the effort to secure facilities and local support in Toulouse for the IPO.

National Reports

Australia: Australian scientists mounted a joint CASO/GEOTRACES IPY cruise in March/April 2008 onboard the *Aurora Australis* along the Repeat WOCE SR3 line from Tasmania to Antarctica. Australian participants included scientists from the Antarctic Climate & Ecosystems CRC, CSIRO Marine & Atmospheric Research, University of Tasmania, and the Australian National University. International collaborators included scientists from several French institutions (IFREMER (La Seyne-sur-mer), LOV (Villefranche-sur-mer), and LPCE (Paris)). A total of 27 stations were sampled to a depth of 1000m (one degree of spatial resolution) using a trace metal-clean sampling system on loan from NIWA (New Zealand). Deeper samples were collected at 7 stations using a standard CD rosette modified to reduce contamination. Quality control tests show no evidence for contamination of Fe or Hg.

Canada: Canadian plans for a GEOTRACES IPY cruise in the Arctic Ocean have been deferred from 2008 to 2009. A benefit of delaying the cruise is that a ship with better lab facilities will be provided.

China (Beijing): The China-GEOTRACES working group has been formally acknowledged by the government of China. It is hoped that this will help generate funding calls specifically relevant to GEOTRACES.

France: An IPY cruise aboard the *Marion Dufresne* (8 Feb – 24 March 2008) sampled along a cruise track running southwest from Cape Town to 57°S. The sampling program included 77 hydro stations, 6 "Large" stations (hydro plus GO-Flo), and 5 "Super" stations, including hydro, GO-Flo, in situ pumps, and coring. Repeat stations were occupied by both the *Polarstern* and the *Marion Dufresne* for intercalibration.

Germany/Netherlands: Two major IPY cruises were held during the past year aboard the *Polarstern*. Each cruise was led by scientists from Germany and the Netherlands, with additional participants from other nations. The Arctic cruise (SPACE) sampled 105 hydrostations, with 43 stations for sampling TEIs. This cruise involved the first routine deployment of the TITAN trace-metal clean sampling system. Preliminary results show evidence for trace metal fluxes associated with hydrothermal venting on the Gakkel Ridge. The Antarctic cruise (Zero and Drake; 6 February-16 April 2008) transited from South Africa to Antarctic, across the Weddell Sea, and then north to South America. As in the Arctic, evidence for hydrothermal venting from the mid-ocean ridge was evident in dissolved trace metal profiles.

Japan: A major Japanese GEOTRACES expedition in the Indian Ocean, originally scheduled to begin in late 2008, has been deferred by approximately one year due to escalating fuel costs.

Sweden: An IPY cruise program aboard leased Russian vessels is underway at the time of the writing of this

report.
UK: Proposals were submitted to NERC requesting support for two GEOTRACES sections. One (South Atlantic zonal section) was designated for funding whereas the other (equatorial Atlantic) was declined. It is anticipated that the equatorial Atlantic proposal will be revised and resubmitted.
USA: U.S. GEOTRACES activities during the past year have focused on the intercalibration effort described above. In addition, the U.S. GEOTRACES SSC met in May 2008, at which time they reviewed all of the sections in the basin planning reports identified as being led, or potentially led, by the United States. From among these, the U.S. SSC selected two (one each in the Atlantic and Pacific Oceans) as having priority for earliest development. Implementation workshops to design section cruise plans will be held 22-24 September 2008 (Woods Hole, Atlantic section) and 1-3 October 2008 (Los Angeles, Pacific section). The workshops are open to all interested scientists, although funds for travel support are limited.

The above represent the most significant national developments, but GEOTRACES activities have also taken place in a number of other countries including Brazil, India, New Zealand, and Spain.

GEOTRACES sessions at international conferences

A special session entitled "GEOTRACES/trace element distributions/cycling in the oceans" was held at the 2008 Goldschmidt Conference, Vancouver, Canada, 13 - 18 July 2008. Session 15a: Conveners: Roger Francois, Catherine Jeandel

Acknowledgements
We offer our special thanks to Ed Urban, who continues to provide tremendous support and valuable advice to the planning of the GEOTRACES programme.

Annex 11 – Post-Audit Financial Statement for 2007

	Actual		
	Discretionary	**Flow-through**	**Total**
INCOME			
Membership Dues	265,561		265,561
Interest Income	8,028		8,028
Miscellaneous Discretionary Inc	551		551
NSF Science Grant	56,174	279,391	335,566
NSF Grant for Travel Program		94,016	94,016
NOAA Grant for WG 125		2,241	2,241
NASA Grant for IOCCG		67,780	67,780
APN Grants for SOLAS		20,000	20,000
GLOBEC Miscellaneous Funds		331	331
IGBP Contribution/IMBER		16,000	16,000
IGBP Contribution/SOLAS		20,000	20,000
IMBER Miscellaneous Income		260	260
LOICZ funds for WG 122		7,500	7,500
LOICZ funds for IMBER OSM		18,628	18,628
Misc Income for Pigment Book			
Sloan Grant - Ocean Tech. Panel		44,828	44,828
Sloan Grant - Project Coordination		1,655	1,655
SOLAS Miscellaneous Income		17,410	17,410
Registration Fees			
IMBER/LOICZ Registration Fees		11,328	11,328
GLOBEC/CLIOTOP		18,964	18,964
GEOHAB OSM Fees	(600)		(600)
SOLAS OSM		36,304	36,304
TOTAL INCOME	**329,714**	**656,637**	**986,351**
EXPENSES			
WORKING GROUPS			
WG 121 - Ocean Mixing	1,437		1,437
WG 122 - Estuarine Sediments	3,056	7,500	10,556
WG 124 - LINKS	3,573		3,573
WG 125 - Zooplankton Time Ser	-	2,241	2,241
WG 126 - Viruses	9,279		9,279
WG 127 - Seawater	14,876		14,876
WG 128 - Hypoxia	10,288		10,288
WG 129 - Deep Ocean Exchanges	9,174		9,174
WG 130 - Plankton Identification	12,277		12,277
PROGRAMS			
GEOHAB	(45)	11,891	11,846
GEOTRACES	18	70,773	70,792
GLOBEC	(306)	65,711	65,405
IMBER	(60)	122,627	122,566
SOLAS	2,561	116,549	119,110
MISC. PROGRAMS			
IOCCP - Carbon Activities		40,079	40,079
Sloan Ocean Technology Panel	547	44,828	45,375
SCOR-SCAR Joint Activities	10,705		10,705
Ocean Acidification	4,089	10,987	15,077
Pigment Book			

Sloan Project Coordination Meeting			1,655	1,655
IGBP/SCOR CO2 (2006)		(4,783)		(4,783)
PACKMEDS		3,357		3,357
Travel Grant Program			94,016	94,016
Capacity Building - Other		1,182		1,182
NASA funds sent to IOCCG			67,780	67,780
TOTAL SCIENTIFIC EXPENSES		17,266	646,896	664,162
ADMINISTRATIVE EXPENSES				
Executive Director - salary		88,856		88,856
Fringe Benefits		29,767		29,767
Finance Officer		33,176		33,176
Less Salaries Charged to Projects		(5,000)		(5,000)
Audit and Accounting Services		11,869		11,869
Representational Travel		15,252		15,252
Meeting Management Expenses		1,740		1,740
Bank charges and fees		719		719
Publications & Publicity		7,773		7,773
IPO staff meetings		3,166		3,166
General Meetings		2,371		2,371
Executive Committee Meetings		19,041		19,041
Insurance		815		815
Secretariat move		1,704		1,704
University overhead charges		13,422		13,422
Postage, Telephone and Internet		2,940		2,940
Office Equipment		2,554		2,554
Miscellaneous Admin Exp		5,433		5,433
Climate Care Fund		181		181
TOTAL ADMINISTRATIVE EXPESNES		235,781		235,781
TOTAL EXPENSES		**253,048**	**646,896**	**899,943**
NET INCOME		**76,667**	**9,741**	**86,408**

CASH BALANCE, JAN 1 2007	**184,706**	
NET CHANGE IN CASH BALANCE	**12,708**	**see audit**
LESS COMMITMENTS		
CASH BALANCE, DEC 31 2007	**197,414**	**see audit**

Annex 12 – SCOR-Related Meetings (2007-2009)

2007

4-10 September	WG 127 on Thermodynamics and Equation of State of Seawater	Berlin, Germany
6-8 September	GEOTRACES Data-Model Synergy Workshop	Delmenhorst, Germany
10-13 September	GEOTRACES Atlantic Basin Cruise Planning Meeting	Oxford, UK
17-21 September	IMBER/LOICZ Continental Margins Open Science Meeting	Shanghai, China
20-23 September	WG 128 on Natural and Human-Induced Hypoxia and Consequences for Coastal Areas	Shanghai, China
23-25 September	SCOR/LOICZ Sediment Retention in Estuaries (WG 122) Workshop	Boulder, Colorado, USA
1-3 October	SCAR/SCOR Expert Group on Oceanography Southern Ocean Observing System Workshop	Bremen, Germany
24-26 October	GEOTRACES Indian Ocean Cruise Planning Meeting	Goa, India
6-8 November	GEOTRACES SSC	Barcelona, Spain
12-16 November	CoML All Projects Meeting and SCOR Panel on New Technologies for Observing Marine Life	Auckland, New Zealand
26-30 November	GEOHAB Core Research Project on Upwelling Systems	Vigo, Spain

2008

9-12 April	GEOHAB SSC Meeting	Annapolis, Maryland, USA
May	WG 125 on Global Comparisons of Zooplankton Time Series	Gijón, Spain
5-6 May	GLOBEC SSC Meeting IMBER SSC Meeting SOLAS SSC Meeting	Cape Town, South Africa
6-9 May	WG 130 on Automatic Plankton Visual Identification	São Paolo, Brazil
17-19 June	SCOR/IODE Workshop on Data Publishing	Oostende, Belgium
28-31 July	WG 132 on Land-based Nutrient Pollution and the Relationship to Harmful Algal Blooms in Coastal Marine Systems	Geesthacht, Germany

7-13 September	WG 127 on Thermodynamics and Equation of State of Seawater	Berlin, Germany
6-8 October	Second Symposium on the Ocean in a High-CO_2 World	Monte Carlo, Monaco
6-8 October	SCOR/IAPSO WG 129 Workshop on Deep Ocean Exchanges with the Shelf	Cape Town, South Africa
20-21 October	SCOR 50th Anniversary Symposium	Woods Hole, Massachusetts, USA
22-24 October	SCOR General Meeting	Woods Hole, Massachusetts, USA
6-11 November	GEOTRACES SSC and Data Management Committee	Toyama, Japan
10-13 November	IMBER Imbizo	Miami, Florida, USA

2009

30 March-1 April	Third SCOR Project Summit	Newark, Delaware, USA
11-13 June	GEOHAB SSC	Galway, Ireland
15-19 June	GEOHAB Modeling Workshop	Galway, Ireland
22-26 June	GLOBEC 3rd Open Science Meeting	Victoria, B.C., Canada
November	SOLAS Open Science Meeting	Barcelona, Spain