

3.0 LARGE-SCALE OCEAN RESEARCH PROJECTS

- 3.1 Global Ocean Ecosystems Dynamics Project, **p. 3-1** *Burkill*
- 3.2 Global Ecology and Oceanography of Harmful Algal Blooms Program, **p. 3-14** *Hong*
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3.1 Scientific Steering Committee on Global Ocean Ecosystem Dynamics (GLOBEC)

(Joint with IGBP and IOC)

Terms of Reference:

- To oversee the implementation of the Global Ocean Ecosystem Dynamics project in accordance with the published Science and Implementation Plans;
- To develop a programme of Integration and Synthesis for GLOBEC for presentation to the sponsors and the larger scientific community;
- To recommend to the sponsoring organizations the necessary actions to be taken in accordance with the GLOBEC Science and Implementation Plans and to co-ordinate and manage the resulting activities;
- To collaborate, as appropriate, with other related global change projects and programs and planning activities, such as IMBER, LOICZ, WCRP, the IOC program on Ocean Science in relation to living resources (OSLR), and the Global Ocean Observing System;
- To establish appropriate data management policies to ensure sharing and preservation of the GLOBEC data set taking into account the related policies of the sponsors; and
- To report regularly to SCOR, IGBP and IOC and to other bodies such as WCRP, ICES and PICES, on the state of planning and accomplishments of GLOBEC.

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Ruben Escribano	CHILE	Jeffrey Runge	USA
Roger Harris	UK	Yasunori Sakurai	JAPAN
Eileen Hofmann	USA	Svein Sundby	NORWAY
James Hurrell	USA	Francisco Werner	USA

Executive Officer: Manuel Barange

Executive Committee Reporter: Peter Burkill

GLOBEC: Global Ocean Ecosystem Dynamics

Report of the SCOR/IOC/IGBP GLOBEC International Project for 2008/2009
to the SCOR Executive Committee Meeting. Beijing, P.R. China, 20-22 October 2009

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

1.1. GLOBEC-sponsored international symposia

- 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 Proceedings are in press with the following reference: *Progress in Oceanography*, vol. 83 (nos. 1-4), 2009, and contains approximately 45 papers.
- GLOBEC-FAO-EUROCEANS symposium on “Coping with global change in marine social-ecological systems”*. Rome, Italy, 8-11 July 2008. This symposium was 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). The proceedings of the symposium appear in two separate outlets: A commissioned book:

World Fisheries: A Social-ecological Analysis, to be published by Wiley-Blackwells, and a special issue in the journal *Marine Policy* (papers in the final stages of approval). Both publications are expected to appear in early 2010.

- *GLOBEC 3rd Open Science Meeting. Victoria, British Columbia, Canada, 22-26 June 2009.* The 3rd OSM was 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 GLOBEC OSM was planned to culminate the integration and synthesis activities of the international GLOBEC programme by 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. When the GLOBEC programme was being developed in the late 1980s the scientific view of the ocean was very different from what it is today—collaboration between oceanographers and fisheries scientists was limited, the major forcings on the ocean were seen to be climate variability (by oceanographers) and fishing (by fisheries scientists); and the Internet and email did not exist. Today, the marine world looks very different—satellites provide coverage of an array of ocean properties, huge amounts of data are instantly available over the Internet and the main drivers of change in marine ecosystems are realised to be climate, humans and their interactions. GLOBEC has played a large role in effecting these changes, as shown in the presentations at the OSM. The first two days of the conference were devoted to ten specific workshops:
 - Modelling ecosystems and ocean processes. Chairs: Enrique Curchitser, Alejandro Gallego, Michio Kishi and Emanuele Di Lorenzo
 - Comparisons of processes and climate impacts in sub-Arctic and Antarctic marine ecosystems. Chairs: Eileen Hofmann, George Hunt, Bernard A. Megrey, Eugene Murphy, Sei-ichi Saitoh and Hyoung-Chul Shin
 - Worldwide large-scale fluctuations of sardine and anchovy. Chairs: Jürgen Alheit, Salvador Lluch-Cota and Carl van der Lingen
 - Krill biology and ecology in the world’s oceans. Chairs: Angus Atkinson, Jaime Gómez-Guitérrez, Bettina Meyer and William Peterson
 - Biogeochemistry of the oceans in a changing climate. Chairs: Francis Chan and Debby Ianson
 - Continuous Plankton Recorder surveys of the global ocean. Chairs: Sonia Batten and Peter Burkill
 - Cod and climate change: the past, the present and future. Chairs: Øyvind Fiksen, Jeff Runge and Fritz Köster

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- Plankton phenology and life history in a changing climate: observation and modelling Chairs: Rubao Ji, Dave Mackas and Martin Edwards.
- Climate impact on ecosystem dynamics of marginal seas. Chairs: Yasunori Sakurai and Christian Möllmann
- Socio-economic dynamics and ecosystems, governance Implications. Chairs: Kathleen Miller and Anthony Charles
- There then followed three days of plenary sessions along the following themes:
 - GLOBEC achievements. Chairs: Manuel Barange and Ian Perry
 - Ecosystem structure, function and forcing. Chairs: Salvador Lluch-Cota, Yasunori Sakurai, George Hunt and Qisheng Tang
 - Ecosystem observation, modelling and prediction. Chairs: Harold Batchelder, Roger Harris and Dale Haidvogel
 - Workshops feedback. Chair: Manuel Barange
 - Ecosystem approach to management. Chairs: Dave Checkley, Keith Brander and Astrid Jarre
- Each of these sessions (except #4) consisted of a number of invited and contributed presentations, plus an adjacent poster session. Session 4 was devoted to providing feedback on the follow-ups to the workshops. In this context, GLOBEC intends to partially fund selected follow-up activities that contribute to the synthesis of the programme. The OSM was attended by more than 300 delegates from 34 countries. Thanks to the contribution of the sponsors (such as SCOR), the organisation was able to invite and offer financial support to 20 scientists from many countries including Peru, India, Lebanon and Namibia. The proceedings of the conference will be published in a special issue of *Progress in Oceanography* and edited by Manuel Barange (UK), Ian Perry (Canada), Eileen Hofmann (USA), Coleen Moloney (South Africa), Yasunori Sakurai (Japan) and Geir Ottersen (Norway). The Proceedings complement the GLOBEC synthesis book (“Marine ecosystems and global change”, Ed. By Barange et al., Oxford University Press, in press).
- 26-29 April 2010: Climate change effects on fish and fisheries: forecasting impacts, assessing ecosystems responses, and evaluating management strategies. Sendai, Japan. While this symposium is to take place after the official closure of the GLOBEC programme, it is listed in this report because it has emanated from the work conducted by GLOBEC programmes in different ocean basins. The symposium will provide a forum for scientists and policymakers to discuss the potential impacts of climate change on marine ecosystems and our uses of these ecosystems, and to consider the strategies that society can take to be prepared for anticipated impacts. Quantitative studies of the potential impact of climate change on fish and fisheries throughout the world will be featured. The symposium is co-sponsored by ICES, PICES and the FAO, and convened by Anne Hollowed (NOAA, USA), Manuel Barange (PML, UK), Harald Loeng (IMR, Norway),

Suam Kim (PKNU, Korea) and Sin-Ichi Ito (FRA, Japan). The list of sessions is as follows:

- Plenary Session 1 Forecasting impacts: from Climate to Fish. Ken Drinkwater (Norway), Harald Loeng (Norway) and Yasuhiro Yamanaka (Japan)
- Plenary Session 2 Forecasting impacts: from fish to markets. Co-convenors: Jacquelynn King (Canada) and Manuel Barange (United Kingdom)
- Plenary Session 3: Sustainable strategies in a warming climate. Co-convenors: Anne Hollowed (USA) and Michael Schirripa (USA)
- Parallel Session A1: Downscaling variables from global models. Co-convenors: Michael Foreman (Canada) and Jason Holt (United Kingdom)
- P. Session A2: Species-specific responses: changes in growth, reproductive success, mortality, spatial distribution, and adaptation. Co-convenors: Myron A. Peck (Germany) & Richard J. Beamish (Canada)
- P. Session B1: Assessing ecosystem responses: impacts on community structure, biodiversity, energy flow, and carrying capacity. Co-convenors: Akihiko Yatsu (Japan) and Thomas Okey (Canada)
- P. Session B2: Comparing responses to climate variability in nearshore, shelf and oceanic regions. Co-convenors: Jürgen Alheit (Germany) and Vladimir Radchenko (Russia)
- P. Session C1: Impacts on fisheries and coastal communities. Co-convenors: Keith Brander (United Kingdom) and Suam Kim (Korea)
- P. Session C2: Evaluating Human Responses, Management Strategies, and Economic Implications. Co-convenors: Jake Rice (Canada) and Kevren Cochrane (Italy)
- P. Session D1: Measuring uncertainty, identifying key unknowns and communicating risk. Co-convenors: Chairs: Franz Mueter and Carl O'Brien
- P. Session D2 Session: Contemporary and next generation climate and oceanographic models, technical advances and new approaches. Co-Convenors: Jonathan Hare (USA), Shin-Ichi Ito (Japan)

Additional information on this symposium is available at www.pices.int.

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:

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- ICES-GLOBEC Workshop on Cod and Future Climate Change. 16-17 June 2008, Copenhagen, Denmark. This was the 2008 annual workshop of the Cod and Climate Change programme of ICES and GLOBEC, which follows on the strategy of the CCC. The project will conclude at the end of 2009.
- GLOBEC-ESSAS 2008 Science Meeting. Halifax, Canada, 15-19 September 2008. A series of ESSAS workshops is planned in Halifax, Nova Scotia. The workshops included 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.
- 18-20 September 2008: GLOBEC synthesis book editors meeting. Halifax, Canada. This meeting was used to make final decisions regarding the structure and contents of the GLOBEC synthesis book, which is now in press (see below).
- PICES XVII Annual Meeting. Dalian, China, 23 October-2 November 2008. The meeting included the following GLOBEC sessions:
 - GLOBEC CCCC Topic Session - Marine system forecast models: Moving forward to the FUTURE.
 - GLOBEC ESSAS Workshop - Status of marine ecosystems in the sub-arctic and arctic seas - Preliminary results of IPY field monitoring in 2007 and 2008
 - GLOBEC CCCC - Climate scenarios for ecosystem modelling (II)
- 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. This workshop follows on a series of similar initiatives conducted over the last few years in the Americas, Africa, Asia and Europe under the banner of SPACC. A report of this meeting is still being prepared.
- 18-19 June 2009: ESSAS Annual Science Meeting. Seattle, Washington, USA. The annual ESSAS science meeting included three workshops and three working group sessions:
 - Gadoid-crustacean interactions in Sub Arctic Seas (Franz Mueter & Earl Dawe)
 - Advection and Its Effects in Sub-Arctic Ecosystems (Ken Drinkwater)
 - Comparisons of Approaches to End-to-End Modeling of Marine Ecosystems (Conveners: Bernard Megrey, Kenneth Rose, and Shin-Ichi Ito)
 - ESSAS Working Group 1 — Regional Climate Prediction
 - ESSAS Working Group 2 — Bio-Physical Coupling: Hotspots and Thresholds
 - ESSAS Working Group 3 — Modeling Ecosystem Response

- *CLIOTOP-WG3 Workshop: Inter-ocean comparisons of oceanic food webs. Sète, France, 6-10 July 2009.* This five-day workshop in Sète conducted analysis of stomach content data of a common subset of predators (especially tunas) from the Indian, Atlantic, and Pacific Oceans to examine similarities and differences in their trophic ecology in relation to differences in regional oceanography (Fig. 2). The approach, which has been applied recently by WG3 scientists during a one-day meeting in Hawaii to a combined data set covering three distinct regions in the Pacific Ocean, revealed a number of important differences suggesting that large-scale comparisons would be useful to interpret future responses to ocean warming. The workshop in Sète was designed to investigate how to incorporate food web data (both stomach and stable isotope data) from the three oceans into an interoperable database from which the global inter-oceanic comparative analysis will be based.
- *CLIOTOP-WG2 Workshop: Development of new electronic devices to monitor animal behaviour and physiology. Swansea, UK, 28-30 July 2009.* The primary purpose of the workshop is to identify how we might best proceed in order to be able to model the movement and incidence of space-dependent behaviours of oceanic top predators. The aspiration is to produce a strategy for studying top predator movement with a truly global perspective.
- *Summer colloquium: Ecosystems and climate: modelling and analysis of observed variability in marine ecosystems. Boulder, USA, 3-14 August 2009.* This colloquium will provide climate and marine ecosystem graduate students with a comprehensive introduction to issues surrounding the development of and hands-on experience with observational datasets and state-of-the-art marine ecosystem modeling approaches in the context of climate models, and the techniques of testing models versus existing datasets. An integrated approach to studying climate-ecosystem interactions is typically not offered in standard university courses; accordingly, the colloquium will provide unique and unprecedented opportunity to study and apply these research tools. As importantly, this colloquium will provide an opportunity for graduate students in the marine ecosystem, climate and climate impact sciences to collaborate. The Colloquium is co-funded by CLIVAR and GLOBEC, in collaboration with the NCAR advanced study programme organised by James Hurrell, Keith Lindsay and Joan Kleypas (NCAR), Dale Haidvogel (Rutgers University), Thomas Powell (University of CA, Berkeley) and Michael Alexander (NOAA, ESRL).
- *ICES Annual Science Conference. Berlin, Germany, 21-25 September 2009:* The programme includes two GLOBEC theme sessions on:
 - Climate impacts on marine fishes: discovering centennial patterns and disentangling current processes and
 - Advances in marine ecosystem research: what we have learned from GLOBEC and what we can carry forward in future climate related programs

In addition, GLOBEC has hosted/will host the following SSC/working group meetings in 2008/2009:

- 18-19 September 2008: GLOBEC-ESSAS SSC meeting, Halifax, Canada
- 17 and 20 June 2009: ESSAS Scientific Steering Committee meeting
Seattle, Washington, USA
- 20 September 2008: GLOBEC Executive meeting. Halifax, Canada
- 27 June 2009: GLOBEC Executive meeting. Victoria, Canada.
- 11-13 November 2009: GLOBEC SSC Meeting Plymouth, UK

More information is available on the GLOBEC Web site, 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 parallel, IGBP and SCOR appointed a Transition Task Team (TTT) to draft an addendum to the IMBER *Science Plan and Implementation Strategy* in preparation for the closure of GLOBEC. The TTT was an implementation of 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 2008. The 2nd meeting of the TTT is expected to take place in November/December 2008. The TTT prepared a comprehensive report on the areas of GLOBEC science that needed to be incorporated in a second phase of IMBER. Some of the existing GLOBEC regional initiatives have already agreed to continue under their new umbrella (CLIOTOP, ESSAS), others will not (CCC, CCCC), and others are still under negotiation (SPACC). The sixth GLOBEC regional programme (Southern Ocean GLOBEC) concluded last year and was followed by a new GLOBEC-IMBER programme (ICED). A number of national and multi-national initiatives are already shared between IMBER and GLOBEC, and this process is expected to continue in the final stages of GLOBEC.

2.2. Partnership for Climate, Fisheries and Aquaculture (PaFCA)

As a result of GLOBEC and other initiatives, 2009 saw the creation of this partnership, initially tasked with the objective of increasing the profile of fisheries and aquaculture issues in the political negotiations in the build up and during the Conference of Parties of the UN Framework

Convention for Climate Change, to take place in Copenhagen, Denmark, December 2009. In brief, the main steps of the Partnership have been

- the meeting of partners at FAO in March 2009 to establish a group strategy
- the draft of a Policy Brief to outline why fisheries should be included in the negotiations of the CoP
- the attendance of PaCFA representatives at key meetings in the build-up to the CoP to distribute the Policy Brief to national delegates and defend it (particularly Bonn, 10-14 August; Bangkok 28 Sep-9 October; Barcelona 2-6 November).
- The organisation of side events in Copenhagen (7-18 December) to act as a node of information and advice.

PaCFA includes currently the following organisations: FAO, UNEP, UNDP, GLOBEC, ICES, PICES, UNISDR, NACA, NACEE, OECD, OSPESCA, EBCD, SEAFDC, SPC, World Bank, WorldFish, and UNESCO-IOC. The creation and steering of PaCFA is a direct response of GLOBEC's engagement with policymakers and advisors, benefitting from the interest and commitment of a large number of interested parties. While the group is still ad hoc, it is likely to become increasingly formal, and is developing strong links with other ocean-oriented information groups, such as the Global Oceans Forum which is currently led by FAO and UNEP.

2.2. Publications

2007-2008 Special Issues and books

GLOBEC has produced in excess of 3,200 (>2,700 refereed) research papers since its implementation. In total, we have produced 26 special issues in peer-reviewed journals. For a full list go to <http://web.pml.ac.uk/globec/products/publications/chron/all/2007.htm> or follow links from www.globec.org

In 2008, the following special issues have been produced:

- 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 of 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.
- Batchelder, H.P and Kim, S. (Eds) 2008. Climate variability and ecosystem impacts on the North Pacific: a basin-scale synthesis. *Progress in Oceanography* 77(2-3): 83-258

The full list is available at http://web.pml.ac.uk/globec/products/publications/special/spec_list.htm.

In addition, at least another 4 special issues are in press (2 in *Progress in Oceanography*, one in *ICES J. Mar. Sci.* and one in the *J. Mar. Systems*).

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Three books were also published in 2008 or are in press:

- Barange, M., Field, J.G., Harris, R.H., Hofmann, E.E., Perry, R.I., Werner, C. 2010. *Marine ecosystems and Climate Change*. Oxford University Press, Oxford, UK (expected to be released in Feb 2010)
- Checkley, D. M., Jr., Alheit, J. A., Oozeki, Y., and Roy, C., eds. (2009). *Climate Change and Small Pelagic Fish*, Cambridge University Press, Cambridge, UK (released in August 2009)
- Ommer, R., I. Perry, P. Cury, K. Cochrane, eds. 2010. *World Fisheries: A Social-Ecological Analysis*. Wiley-Blackwells Fisheries and Aquatic Resources Book Series. (expected early 2010).

2008/9 GLOBEC Reports

In this reporting period we produced three GLOBEC reports:

- Hampton, I., M. Barange and N. Sweijd (Eds.) 2008. *Benguela Environment Fisheries Interaction and Training Programme (BENEFIT) Research Projects*. GLOBEC Report 25
- Murphy, E.J., R.D. Cavanagh, N.M. Johnston, K. Reid and E.E. Hofmann (Eds.) 2008. *Integrating Climate and Ecosystem Dynamics in the Southern Ocean (ICED): A Circumpolar Ecosystem Programme*. Science Plan and Implementation Strategy. GLOBEC Report No.26
- Wiebe, P.H., R.P. Harris, M.A. St. John, F.E. Werner, B. deYoung and P.Pepin (Eds.) 2009. *BASIN: Basin scale analysis, synthesis and integration. Science plan and implementation strategy*. GLOBEC Report No. 27

2.3. GLOBEC Synthesis book

The GLOBEC synthesis book “**Marine Ecosystems and Global Change**” will be published by Oxford University Press. The manuscript has been submitted and will be released in time for the February 2010 ASLO meeting. It is already available for pre-order at the OUP website. The book was put together by almost 100 contributors from 17 countries, and will be the most tangible and comprehensive synthesis of the work of the programme. The structure of the book is as follows:

Editors: Manuel Barange, John Field, Roger Harris, Eileen Hofmann, Ian Perry, Cisco Werner

- Preface
- Chapter 1. Introduction: Oceans in an Earth System – Manuel Barange et al.

Section 1. The changing ocean ecosystems

- Chapter 2. Climate forcing on marine ecosystems – Ken Drinwater et al.
- Chapter 3. Human impacts on marine ecosystems - Keith Brander et al.

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

- Chapter 4. Target species – Dian Gifford et al.

- Chapter 5. Physical-biological interactions: integration and modeling – Brad deYoung et al.
- Chapter 6. Dynamics of marine ecosystems: observation and experimentation – Roger Harris et al.
- Chapter 7. Dynamics of marine ecosystems: ecological processes – Coleen Moloney et al.

Section 3. The human dimensions of marine ecosystem change

- Chapter 8. Interactions between changes in marine ecosystems and human communities – Ian Perry et al.
- Chapter 9. Marine resources management in the face of change: from ecosystem science to ecosystem-based management – Manuel Barange et al.

Section 4. A way forward

- Chapter 10. Ocean ecosystem responses to future global change scenarios: a way forward – Sin-ichi Ito et al.
- Chapter 11. Marine ecosystems and global change: a synthesis – Eileen Hofmann et al.

For more details, follow <http://ukcatalogue.oup.com/product/9780199558025.do>

2.4. GLOBEC SSC 2008

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

Name	Gender	Country	Function
Dr Jürgen Alheit	M	Germany	Chair Focus 1, SPACC Exec
Dr Kevern Cochrane	M	Italy	SSC – FAO link
Prof Brad deYoung	M	Canada	Chair Focus 3
Dr Ruben Escribano	M	Chile	SSC
Dr Roger Harris	M	UK	Chair Focus 2
Prof Eileen Hofmann	F	USA	SSC, SO Chair
Dr James Hurrell	M	USA	SSC
Dr Astrid Jarre	F	Denmark	SSC
Dr Salvador Lluch-Cota	M	Mexico	SSC
Dr Olivier Maury	M	France	SSC
Dr Ian Perry	M	Canada	Chair, Focus 4 co-Chair
Dr David Runge	M	USA	SSC
Prof Yasunori Sakurai	M	Japan	SSC
Prof Svein Sundby	M	Norway	SSC
Prof Francisco Werner	M	USA	Past SSC Chair

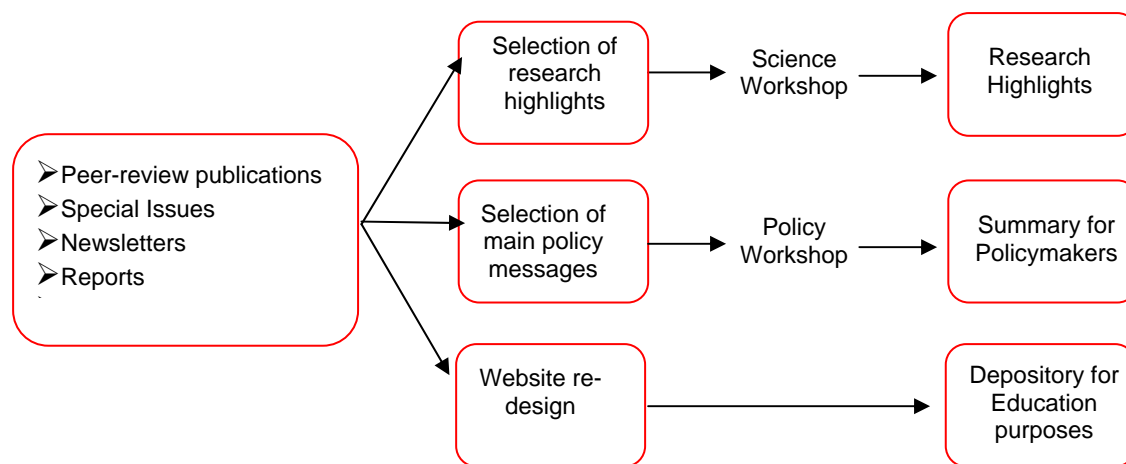
The SSC will complete its mandate at the end of December 2009, although some of the members will remain engaged in the final stages of the project (see below).

3. FINAL STEPS: Science Communication and IPO closure

3.1. Research Highlights and Summary for policymakers

In 2009, the GLOBEC IPO, in collaboration with ICES, PICES, FAO, SCOR, IGBP, DEFRA (UK) and DFO (Canada) put together a proposal for funding to the Natural Environment Research Council under their Knowledge Transfer calls to synthesise the results of GLOBEC (3,113 papers, 30 special issues, 5 synthesis books and the 33 GLOBEC Reports), to maximise its impact in policymaking, science management, advisory and educational arenas. The proposal involved producing a comprehensive Science Highlights document, a targeted Summary for Policymakers and a long-standing educationally oriented Web site that acts as a depository of GLOBEC's products. The work was to be coordinated between the Chair of GLOBEC, the International Project Office and a professional science communicator, and will benefit from the partnership established.

The proposal was intended (see diagram) to include two workshops with key scientists and policymakers.



Despite excellent reviews and a 4/5 overall score, the proposal was not funded. It is therefore unclear at this stage how much of the proposed work will be conducted, as it will depend on the savings from the 2009 budget. GLOBEC remains committed to producing the outputs outlined in the figure above, albeit with a limited level of funding (and thus possibly without the leading workshops).

While the above process was being completed, and as a result of conversations at the GLOBEC OSM meeting in Victoria, a "Digging into Data" proposal, titled "Constructing a Summary for Policymakers in a Web2.0 World: the GLOBEC legacy", was put together in collaboration with Canadian, USA and UK teams. The objective of the proposal is to use a range of resources in digital humanities computing, social networking technologies and computer-supported collaborative work environments, to develop a technology-enhanced process for constructing a summary for policymakers from the large body of literature created through GLOBEC. If

successful, this proposal will provide innovative ways of selecting summary conclusions, rather than relying on expert opinion alone.

Furthermore, also during the final OSM meeting, Elsevier proposed that GLOBEC publish a compendium of key GLOBEC research publications that have appeared throughout the duration of the programme, as a single volume. Such a product would complement the synthesis books, special issues, research highlights and summary for policymakers, in a way that would make GLOBEC unique in its final communication of its research. This offer, however, needs to be funded internally and thus needs to be discussed by the GLOBEC SSC in its final meeting.

3.2. Programme closure

The plans for the closure of GLOBEC remain as follows:

1. All science activities (with the exception of unexpected delays) to be completed by 31 December 2009
2. GLOBEC International Project Office to close at the end of March 2010
3. Steps to be taken during the period Jan.-March 2010:
 - a. Full financial reporting to sponsors
 - b. Preparation and dissemination of 2 packs of GLOBEC hardcopy documentation to three institutions with public access. Although yet to be decided these institutions would be in the UK, Africa and the Americas.
 - c. Uploading of as much documentation as possible to the GLOBEC Web site, and securing its access (if not its maintenance) for at least 10-years after closure.
4. Because some of the products of GLOBEC will only result in the final stages of the project (e.g., the GLOBEC Synthesis book is to be published in February 2010) or after its closure (e.g., Proceedings of the 3rd OSM not expected until the summer of 2010), a skeleton structure of the IPO will remain in place for final clean-up between March and July 2010.

A brief report on the programme's closure, and on the use of the SCOR-secured funds between August 2009 and the end of GLOBEC, will be included in the last report of GLOBEC to SCOR, which will be provided for the 2010 SCOR Annual Meeting.



PRESIDENT: Professor Wolfgang Fennel
SECRETARY: Professor Jorma Kuparinen
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RESOLUTION OF THE SCOR EXECUTIVE COMMITTEE (adopted 29 May 2009)

On the occasion of the Third Open Science Meeting of the Global Ocean Ecosystem Dynamics (GLOBEC) project, the Executive Committee of the Scientific Committee on Oceanic Research (SCOR) notes with great appreciation the successful conclusion of the project. SCOR is pleased to have been a co-sponsor of GLOBEC with the Intergovernmental Oceanographic Commission (IOC) since 1992 and with the International Geosphere-Biosphere Programme (IGBP) since 1995. The results presented at the open science meeting and published in many peer-reviewed articles over the life of GLOBEC demonstrate that GLOBEC has significantly improved our understanding of ocean ecosystems and key species, and how the climate and other factors (including humans) affect marine life.

Many individuals and organizations have been responsible for the great achievements of GLOBEC. The SCOR Executive Committee commends the chairs of the international GLOBEC Scientific Steering Committee (SSC): Brian Rothschild, Roger Harris, Cisco Werner, and Ian Perry, and all the committee members who selflessly volunteered their time and energy to implement the ambitious set of GLOBEC activities internationally. IPO duties were handled on a part-time basis by Elizabeth (Tidmarsh) Gross at the beginning of the project, but it is safe to say that the project did not reach its full potential until a fully staffed international project office, with Manuel Barange as the Executive Officer, was set up in 1999. Dr. Barange has served in an exemplary manner in guiding the day-to-day operations of the project, seeking funding for it, liaising with related organizations and projects, and maintaining continuity of project activities between SSC meetings. He managed the project with great vision, wisdom, and enthusiasm.

The SCOR Executive Committee thanks its sister organizations, IGBP and IOC, for their cooperation in overseeing the project. IGBP's participation in GLOBEC has helped integrate the project's activities and results into broader Earth system understanding. IOC's participation has helped link GLOBEC with the community of users of the research results generated by the project.

Finally, but not least, the SCOR Executive Committee thanks the many financial sponsors of GLOBEC, particularly the U.K. Natural Environment Research Council, the University of Plymouth, and the Plymouth Marine Laboratory for funding and hosting the GLOBEC IPO since 1999. IPOs are vital to the success of the large-scale ocean research projects and their support is a major commitment for a nation to undertake. SCOR also thanks other financial sponsors of international GLOBEC, particularly the U.S. National Science Foundation, for their significant financial support of the GLOBEC SSC and its subcommittees. SCOR thanks the many nations that funded national research and other activities that contributed to the success of the international project. GLOBEC has demonstrated once again that committed scientists and sponsors are vital ingredients to make a large field research project successful.



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7 July 2009

**3rd GLOBEC Open Science Meeting
22-26 June 2009, Victoria, British Columbia, Canada**

Dear Drs. Fennel and Urban;

On behalf of GLOBEC, the Global Ocean Ecosystem Dynamics program of IGBP, SCOR and IOC, I wish to thank SCOR for its support of our GLOBEC 3rd Open Science Meeting. As you well know, these meetings do not "just happen", and the financial, and other, support by SCOR was essential for making the meeting a success.

Outputs from the meeting will include a substantial volume of papers in a special issue of *Progress in Oceanography*, as well as papers from several of the workshops that are planned for other publications. The support of SCOR will continue to be acknowledged in these publications. In addition, we are planning a summary for policy-makers from the GLOBEC program, which will be prepared over the next 12 months.

Once again, many thanks for your participation and for the support of SCOR in making this 3rd (and final) GLOBEC Open Science Meeting a success!

Yours sincerely,

R. Ian Perry
Chair, GLOBEC

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A core project of the International Geosphere-Biosphere Programme, co-sponsored by the Scientific Committee on Oceanic Research (SCOR) and the Intergovernmental Oceanographic Commission of UNESCO (IOC)



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

(joint with IOC)

Terms of Reference:

The Scientific Steering Committee of the GEOHAB Programme will

1. Coordinate and manage GEOHAB Core Research Projects (CRPs) in accordance with the GEOHAB Science and Implementation Plans.
2. Identify gaps in knowledge required to execute CRPs, and encourage targeted research activities to fill those gaps.
3. Review progress on CRPs over time and initiate new CRPs in priority research areas.
4. Foster framework activities to facilitate implementation of GEOHAB, including dissemination and information tools.
5. Establish appropriate data management activities to ensure access to, sharing of, and preservation of GEOHAB data, taking into account the data policies of the sponsors.
6. Promote comparative and interdisciplinary research on harmful algal blooms by providing coordination and communication services to national and regional research groups, encouraging explicit affiliation with GEOHAB via the endorsement process.
7. Collaborate, as appropriate, with intergovernmental organizations and their subgroups (e.g., ICES, PICES, FANSA, ANCA, WESTPAC/HAB, HANA, NOWPAP), as well as related research projects (e.g., GLOBEC, LOICZ, IMBER) and observational systems such as the Global Ocean Observing System and its regional alliances.
8. Report regularly to SCOR, the IOC Intergovernmental Panel on Harmful Algal Blooms (IPHAB), and the global HAB research community on the state of planning and accomplishments of GEOHAB, through annual reports and, as appropriate, the GEOHAB Web site, a GEOHAB Newsletter, *Harmful Algal News*, special sessions at scientific meetings, and other venues.
9. Interact with agency sponsors to stimulate the support of GEOHAB implementation through various mechanisms (e.g., direct support of GEOHAB initiatives and integration of the GEOHAB approach in national programs).

Acronyms

ANCA = IOC HAB working group for Central America and Caribbean Sea

FANSA = IOC HAB working group for South America

HANA = IOC HAB working group for North Africa

GLOBEC = Global Ocean Ecosystem Dynamics project

ICES = International Council for the Exploration of the Seas

IMBER = Integrated Marine Biogeochemistry and Ecosystem Research project

IOC = Intergovernmental Oceanographic Commission

LOICZ = Land-Ocean Interactions in the Coastal Zone project

NOWPAP = UNEP Northwest Pacific Action Plan

PICES = North Pacific Marine Sciences Organization

SCOR = Scientific Committee on Oceanic Research

WESTPAC/HAB = IOC SubCommission for the Western Pacific HAB working group

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

ACTIVITIES 2008-2009

1. SSC Meeting: Galway, Ireland, June 2009

The GEOHAB SSC met in Galway, Ireland on 11-13 June 2009 and discussed all aspects of GEOHAB work. The meeting discussions included the following topics:

- Review of all the status of all GEOHAB Core Research Projects
- Planning for an Open Science Meeting on HABs in Benthic Environments
- Update on the GEOHAB Modeling Workshop
- Beginning discussions of plans for GEOHAB completion at the end of 2013
- Discussion of a potential joint activity with IOCCG
- Interactions with GOOS and the Intergovernmental Panel on Harmful Algal Blooms
- Updates on regional, national, and GEOHAB-endorsed projects
- Report from the SCOR Project Summit
- GEOHAB Web site and publications
- Representation at meetings
- SSC rotations

A summary of the meeting is available on the GEOHAB Web site (<http://iodeweb6.vliz.be/geohab/>).

2. Implementation of Core Research Projects

The GEOHAB *Implementation Plan*¹, 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 2008 SCOR General 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 special issue is almost completed. After that occurs, the group may plan a second open science meeting, on some specific aspect of HABs in upwelling systems.

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. A draft of their report was presented and two SSC members volunteered to review it when completed (the review was going on as of August 2009).

¹ 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.

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, overlapping with the 2009 SCOR Executive Committee meeting and immediately after 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 was completed about one year ago and the SSC discussed the composition of a subcommittee for this CRP.

E. Open Science Meeting on HABs in Benthic Systems

The GEOHAB SSC budgeted funding for an open science meeting (OSM) on HABs in benthic systems, which would include algae that contribute to ciguatera, probably the most widespread of all algae-related poisonings. All SSC members recognize the importance of this issue. A potential chair was agreed upon and has accepted (Paul Bienfang, USA). The SSC is in the process of assembling a planning committee for the OSM, which will take place between May and September 2010, in Hawaii, so that the results can be reported out at the November 2010 international HAB meeting in Crete.

3. GEOHAB Modelling

GEOHAB held a workshop to help integrate modeling activities into GEOHAB CRPs and regional/national projects. The workshop was attended by about 80 participants and was held at the Martin Ryan Institute, National University of Ireland, Galway, Ireland on 15-19 June 2009. Information about the meeting is available at www.geohab-models.org. Funding was obtained from a variety of sources.

4. 2010 SSC Meeting

The 2010 SSC meeting may be held in conjunction with the OSM on HABs in Benthic Systems in Hawaii (?).

5. GEOHAB Asia

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 and will be reviewed by scientists in the region and GEOHAB SSC members.

6. International Programme Office [IPO]

The SSC and sponsors have concluded that with the difficulty in finding funding for a GEOHAB IPO and the fact that GEOHAB is beginning to wind down (see below), attempts to establish an IPO for the project would be stopped.

7. GEOHAB Sunset

SCOR and IOC agreed to close the GEOHAB program at the end of 2013, ten years from the publication of the GEOHAB Implementation Plan. Discussions were begun on what would be appropriate final products. At this time, ideas include a summary of program accomplishments for a broad audience and/or an update of the HABWATCH book on HAB-observing technologies.

3.3 Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) (joint with IGBP)

Terms of Reference:

- To develop a new IGBP/SCOR activity in ocean biogeochemistry and ecosystems within the IGBP II Vision for the next 10 years of ocean research. The new activity should be developed in harmony with the Global Ocean Ecosystem Dynamics (GLOBEC) project and be designed and implemented in close collaboration with GLOBEC.
- To revise the Draft Framework Report in Biological and Chemical Aspects of Global Change Research in the Oceans to form the intellectual basis for an Open Science Conference (planned for December 2002).
- To organise an Open Science Conference to generate new ideas for the development of the science and implementation of the Ocean Biogeochemistry and Ecosystems project.
- To use both the Framework Report and community input from the Open Science Conference to produce a Science Plan/Implementation Strategy for the new activity by the end of 2003.
- To cooperate with GLOBEC, the Land-Ocean Interactions in the Coastal Zone (LOICZ) project, the Surface Ocean-Lower Atmosphere Study (SOLAS), and other relevant projects and programmes in the development of the Science Plan/Implementation Strategy.

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Jean-Pierre Gattuso	FRANCE	Carol Robinson	UK
Nicolas Gruber	SWITZERLAND	Hiroaki Saito	JAPAN
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Arne Körtzinger	GERMANY		

Executive Committee Reporter: Bjørn Sundby

IGBP Liaison: Wendy Broadgate

Executive Officer: Sylvie Roy



Integrated Marine Biogeochemistry and Ecosystem Research

IMBER Annual Report to SCOR August 2009

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- *Being Efficient and Environmentally Responsible* (BEER) training workshop
- *Decadal Variations of the Ocean's Interior Carbon Cycle: Synthesis and Vulnerabilities* symposium
- *Analyses of End-to-end Food Webs and Biogeochemical Cycles* Summer School
- ICED Science Plan published
- Draft Science Plan and Implementation Strategy for SIBER
- GLOBEC-IMBER Transition Task Team Report
- Incorporation of the Regional Programmes CLIOTOP and ESSAS into IMBER
- Deep-Sea Research II: *Surface Ocean CO₂ Variability and Vulnerabilities*
- Workshop on developing IMBER research in the UK
- IMBER/SOLAS meeting for the French community

Working groups

IMBER has developed five working groups or task teams which are active in the development and implementation of IMBER.

1 IMBER/SOLAS Carbon (SIC!) Working Group

The joint IMBER/SOLAS Carbon Working Group has recently been restructured. The Chairs of the three sub-groups now report directly to the IMBER and SOLAS SSCs and work closely with the International Ocean Carbon Coordination Project (IOCCP). The Joint SOLAS/IMBER

Carbon Research Implementation Plan is available at
http://www.imber.info/products/Carbon_Plan_final.pdf.

Sub-group 1 (SG1) Surface Ocean System (Leader: Are Olsen, Norway)

SOLAS is currently developing new Terms of Reference for this sub-group. Are Olsen is replacing Nicolas Metzl as Chair of the group. The need for a surface CO₂ database was recognised at the SOLAS Open Science Conference in Xiamen, China in 2007 and activities of the group have focussed on achieving this. The SOCAT database will be released in late 2009. A *Deep-Sea Research II* special issue: *Surface Ocean CO₂ Variability and Vulnerabilities* was published in April 2009 (Vol 56, Nos. 8-10)
<http://www.sciencedirect.com/science/journal/09670645>

Sub-group 2 (SG2) Ocean Interior (Leader: Nicolas Gruber, Switzerland)

New Terms of Reference are currently being developed and membership of the group is to be increased. The group deals with inventory and observations, natural variability and transformation. Its aim is to determine the uptake, transport and storage of anthropogenic CO₂ on decadal timescales.

As part of the global synthesis SG2 organised the *Decadal Variations of the Ocean's Interior Carbon Cycle: Synthesis and Vulnerabilities* symposium at the Centro Stefano Franscini in Ancona (Switzerland) on 13-17 July 2009. Its aims were to synthesise ocean observations to obtain an estimate of oceanic uptake of anthropogenic CO₂ since the WOCE period and to identify changes in observation strategies.

Following the rationale that oxygen is very sensitive to global change, a pilot program—Oxywatch O₂ (putting oxygen sensors on Argo floats)—was developed. A White Paper was developed and Argo floats with O₂ sensors are currently being tested. A Community White Paper has been accepted for OceanObs'09, where the sub-group Chair, Niki Gruber, will deliver the keynote address.

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 Ocean and to form a consistent, quality-controlled data base for the Atlantic (including the Southern and Arctic ocean). The second quality control exercise was recently completed and the manuscript is soon to be submitted to *Earth System Science Data*.

Sub-group 3 (SG 3) Ocean Acidification (Leader: Jean-Pierre Gattuso, France)

The third IMBER/SOLAS Carbon Research sub-group on Ocean Acidification has recently been launched (August 2009) (http://www.imber.info/C_WG_SubGroup3.html).

The tasks of the group are to

1. coordinate international research efforts in ocean acidification, and
2. undertake synthesis activities in ocean acidification at the international level.

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The group's first meeting will identify and prioritise topics for immediate attention, with proposed deliverables and a plan to achieve them.

2 Continental Margins Task Team

The IMBER/LOICZ Continental Margins Task Team was developed to link the two projects at the continental margins. The current Task Team is co-chaired by Jack Middelburg (The Netherlands) and Nancy Rabalais (USA). The group organised 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 draft Continental Margins Science Plan that resulted from this conference has recently been submitted. A team from the IMBER and LOICZ SSCs has been tasked with finalising the document and developing a paper to guide the Continental Margins biogeochemistry and ecosystems research going forward. The team leader is Katja Philippart.

IMBER is currently in the process of establishing an IMBER project office in China which will take the lead for Continental Margins activities. The organisation of a dedicated Continental Margins IMBIZO is being considered.

3 Capacity Building Task Team

The Capacity Building group was set up at the start of IMBER to ensure that capacity building initiatives were included in all IMBER projects. Its mission is to assist developing countries to develop research initiatives and to provide involvement in IMBER activities and training for young and developing country scientists. 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. The task team is chaired by Jing Zhang. A capacity building strategy and implementation plan has been developed (http://www.imber.info/products/Capacity_Building_final.pdf). Membership of the task team is currently being reviewed and additional members from developing countries have been invited to join.

IMBER is represented on the SCOR Capacity Building Committee by Jing Zhang (see <http://www.scor-int.org/capacity.htm> for details), who is hosting a meeting of the committee in Shanghai immediately before the SCOR Executive Committee meeting.

The IMBER Capacity Building Task Team, with financial support from EUR-OCEANS, organised the *Analyses of end-to-end food webs and biogeochemical cycles* Summer School in Ankara, Turkey in August 2008 (http://www.imber.info/E2E_EcoModel_programme.html). Lectures, discussions, poster sessions and practical modelling training simulations provided the 21 participants (PhD students and Post-docs working with biogeochemical cycles and end-to-end food webs) with an overview of the methods and models that are available. Live web-broadcasting opened the presentations and discussions to participation by many more students and scientists around the world.

The Summer School has proved to be a successful capacity building exercise and consequently plans are well underway to hold the next one in August 2010 at the Institut Universitaire Européen de la Mer in Brest, France. The preliminary title is *Marine ecosystems in the context of climate change: dynamics and impacts*.

4 Data Management Task Team

The IMBER Data Management Committee (DMC) is currently chaired by Raymond Pollard (UK) with Alberto Piola (Argentina) replacing him at the end of the year. The DMC promotes a cooperative data management approach that includes involving experienced data management specialists from the start of a project, and also training young scientists in good data management procedures.

The DMC has produced a draft Data Management Policy and *The Benefits of Integrated Data Management* document. They are currently under review.

Prior to IMBIZO I in November 2008 in Miami (USA), the DMC held the *BEER - Being Efficient and Environmentally Responsible* training workshop, which highlighted the benefits of adding a data integration scientist to projects. Participants were given the opportunity to test some of the “recipes” for using data integration concepts and handling techniques in the IMBER Data Integration “Cookbook”. Very positive feedback was received regarding the “Cookbook” which has now been published.

The DMC have also set up a data management portal on the IMBER website and coordinated the development of a metadata portal which is hosted by GCMD.

5 End-to-end food web Task Team

The joint IMBER-GLOBEC End-to-end food web Task Team was co-chaired by Coleen Moloney (South Africa) and Mike St John (Germany). It has completed its mandate and produced draft manuscripts and was disbanded in 2008. One paper has been submitted to the DSR Special Issue from the IMBER IMBIZO and is currently under review. The other requires some revision. Coleen Moloney and Mike Roman co-chaired the *Ecological and Biogeochemical Interactions in End-to-end Food Webs* workshop at IMBIZO 1 which considered

- the relative impacts of change on material cycles through predator-prey interactions (top-down perspective), and
- the indices that should be used to describe material transfer from photosynthesis to fisheries (bottom-up perspective).

A new team is to be established to deal with end-to-end activities for IMBIZO II. It has been proposed that they organise a topic-focused mini-workshop a few months prior to the IMBIZO to do a comparative study which would provide a synthesis to feed into the IMBIZO.

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The End-to-end team was involved in the organisation of the Summer School on *Analyses of the interactions between end-to-end marine food webs and biogeochemical cycles*, which was held in Ankara, Turkey in August 2008.

Regional Projects

An IMBER/GLOBEC Transition Task Team (TTT) was appointed by SCOR and IGBP to recommend how IMBER should accommodate new developments in marine ecosystem research that need addressing post-GLOBEC. The Task Team met in Reading, UK from 30 July to 1 August and in Washington DC on 15-17 December 2008. The final TTT report will be published as an addendum to the *IMBER Science Plan* in September 2009.

After considering the Transition Team Report, the IMBER SSC decided to invite all continuing GLOBEC projects to become part of the IMBER project. To date, CLIOTOP and ESSAS have accepted this invitation.

Climate Impact on Top Oceanic Predators (CLIOTOP)

CLIOTOP was started as a regional programme under GLOBEC in 2005. It aims to provide a global comparison of the impact of climate variability (at various scales) and fishing on the structure and function of open ocean pelagic ecosystems and their top predator species, and from this to develop reliable predictive capacity. CLIOTOP is co-Chaired by Patrick Lehodey and Oliver Maury and there are five working groups. The Science Plan and Implementation Strategy were accepted by GLOBEC in 2005.

The CLIOTOP mid-term workshop [is planned for late 2009 and will involve IMBER SSC members](#).

Ecosystem Studies of Sub-Arctic Seas (ESSAS)

ESSAS was developed in conjunction with GLOBEC and EUR-OCEANS in 2005 and focuses on comparative studies of the impacts of climate variability on the productivity and sustainability of Sub-Arctic marine ecosystems. There are four working groups and several national and multi-national projects. The Science Plan and *Background to the Climatology, Physical Oceanography and Ecosystems of the Sub-arctic Seas* document were produced in 2005.

ESSAS and PICES co-sponsored the *Marine Ecosystem Model Inter-comparisons* workshop on 25 October 2008, in Dalian, China. The ESSAS Annual Science Meeting [was held in Seattle, Washington, USA on 18-19 June 2009](#).

Integrating Climate and Ecosystems Dynamics (ICED)

ICED is currently an IMBER/GLOBEC project with a partnership with EUR-OCEANS. It aims to determine the main control of Southern Ocean ecosystem dynamics and potential for feedbacks as part of the Earth system. Its Science Plan, which was accepted by both IMBER and GLOBEC, was published in 2008.

At the first ICED modelling workshop, held in April 2008, there was consensus that understanding of the structure of food webs at regional and circumpolar scales was needed to be able to improve the reliability of predictions of ecosystem dynamics in the Southern Ocean. This put the focus on Southern Ocean ecosystem modelling, with particular emphasis on cross-disciplinary studies. In June 2009, the *New Frontiers in Southern Ocean Biogeochemistry and Ecosystem Research* workshop was held at Princeton University in New Jersey, USA. It aimed to facilitate interaction between the physical, biogeochemical, and ecosystem research communities to develop research strategies to resolve current limitations, gaps and discrepancies in our understanding and prediction of the Southern Ocean ecosystems, biogeochemical cycles and carbon uptake.

To provide a central focus for fieldwork planning and coordination activities in the Southern Ocean, across all disciplines, for the next decade, ICED is developing a series of interactive maps representing Southern Ocean research

The first Southern Ocean Sentinel Workshop took place in April 2009 in Hobart, Australia, to consider how to measure, assess and provide early-warning of climate change impacts on the Southern Ocean and how these could be used to signal future impacts on marine and other ecosystems elsewhere in the world. The workshop proceedings, outcomes and a strategic plan will be published. The second Sentinel Workshop is planned for 2010.

Sustained Indian Ocean Biogeochemical and Ecological Research (SIBER)

SIBER is a developing regional program of IMBER that aims to understand climate change and anthropogenic forcing on biogeochemical cycles and ecosystems in the Indian Ocean. A planning workshop was held at NIO in Goa, India on 13-14 April 2009. The draft Science Plan and Implementation Strategy is currently being reviewed.

Endorsed Projects

IMBER now has 17 endorsed projects from 12 different countries. The following projects were endorsed by IMBER this past year.

BOUM Biogeochemistry from the Oligotrophic to the Ultra Oligotrophic Mediterranean Sea
Leading applicant: Thierry MOUTIN (France)

CAIBEX Shelf-ocean exchanges in the Canaries-Iberian Large Marine Ecosystem
Leading Applicants: Eric D. Barton and Javier Arístegui (Spain)

CROZEX CROZet Natural Iron Bloom and EXport Experiment
Leading applicant: Raymond Pollard (UK)

EPOCA European Project on Ocean Acidification
Leading applicant: Jean-Pierre Gattuso (France)

Fisheries Oceanography Project
Leading applicant: Matt Pinkerton (New Zealand)

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GENUS Geochemistry and Ecosystem Research in the Namibian Upwelling System

Leading Applicant: Kay Emeis (Germany)

MALINA What is the impact of the decrease in sea ice, increase in UV radiation, and permafrost thaw on microbial biodiversity and biogeochemical fluxes in the Arctic Ocean?

Leading applicant: Marcel Babin (France)

Oceans 2025 UK Strategic Marine Science Programme

Leading applicant: Phil Williamson (UK)

OMMIX Food-Web structure and carbon budget in a coastal area off Central Chile (36°S): Influence of mixotrophy and omnivory.

Leading applicant: Cristian A. Vargas (Chile)

POMAL Population Outbreak of Marine Life

Leading applicant: Hiroaki Saito (IMBER-Japan)

SACC An International Consortium for the Study of Oceanic Related Global and Climate Changes in South America

Leading applicant: Alberto Piola (Argentina)

OUTREACH ACTIVITIES

IMBER website

The IMBER website (<http://www.imber.info/>) is the project's main communication tool. In the interest of ensuring that information is kept up-to-date and to improve communication links, the website will be redesigned soon.

The IPO also developed and maintained several other activity-based websites, for example, for the CLIMECO workshop, IMBIZO 2008, E2E EcoModel Summer School, the IMBER data portal, and the IMBER/SOLAS French meeting. The website for IMBIZO 2010 is under construction. There are also plans to develop an Ocean Acidification website to support the activities and findings of the IMBER/SOLAS SG3.

IMBER Update

The electronic newsletter "*IMBER Update*" is published three times a year. The most recent edition was published in July 2009. Included in the newsletter are IMBER science highlights, reports of the activities of the IMBER working groups and IMBER endorsed and contributing projects, regional and national programme reports, and upcoming IMBER-related conferences and workshops. The IMBER Update can be downloaded at <http://www.imber.info/newsletters.html>.

eNews

The eNews bulletin is published monthly to circulate information about IMBER activities and

activities within the IMBER scientific network. Included in the publication are calls for funding, job opportunities, conferences and workshops.

IPO Report to SSC

As the SSC only meets once a year, every two months the IPO sends a report to IMBER SSC members to keep them up to date about IMBER activities and developments. This report includes 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.

Promotional Material

The IPO has promotional material that can be sent to meetings or conferences that IMBER representatives are attending or holding. The IMBER brochure and posters introduce the global scientific context of IMBER and present the four themes of the program. Information regarding how to get involved and how to contact the International Project Office (IPO) are also included. Both the brochure and poster can be downloaded from the IMBER website (<http://www.imber.info/useful-downloads.html>) and are available on request at the IPO. A new poster will be produced shortly, that will illustrate the direction that IMBER science is moving towards with the introduction of the new regional programmes that are being incorporated into the program.

The IPO recently updated a PowerPoint presentation about the structure and activities of IMBER which can be adapted by representatives for meetings and conferences.

Training

Summer School in Ankara

The IMBER/EUR-OCEANS *Analyses of End-to-end Marine Food Webs and Biogeochemical Cycles* Summer School was held at the Middle East Technical University, Ankara (Turkey) on 11-16 August 2008. The aim was to provide an overview of methods, models and approaches for analyzing the interactions between marine biogeochemical cycles and end-to-end food web studies. There were two topics: *Main processes controlling marine food webs* and *Advances in end-to-end food web modelling*. Theoretical lectures, practical workshops were given for each topic. Discussion and poster sessions were used to stimulate interaction amongst the students and also between students and the lecturers. Debates on hot topics pertinent to end-to-end ecosystem research were also organised.

INTERNATIONAL PROJECT OFFICE (IPO)

The IMBER IPO is located at the Institut Universitaire Européen de la Mer (IUEM) in Brest, France. There are currently three staff members at the IPO. Lisa Maddison replaced Sylvie Roy as Executive Officer in April 2009. Sophie Beauvais is the Deputy Executive Officer, and a new Administrative Assistant will be appointed soon.

The IPO is primarily responsible for carrying out IMBER SSC decisions, obtaining funding to support IMBER activities, providing support for the IMBER working groups and task teams,

providing administrative support for the program's activities, maintaining communication links both within and outside the program, and maintaining a data and information archive.

The IPO is funded by a French consortium comprising the University of Brest, IUEM, the Region of Brittany, Ifremer, the Conseil Général de Bretagne (Department authorities) and the City of Brest, Centre National de la Recherche Scientifique (CNRS), Institut de Recherche pour le Développement (IRD), Université de Bretagne Occidentale (UBO).

In 2008-2009, IMBER activities and the IPO received the following sponsorship:

- IGBP: support for the SSC meeting (\$16K annually);
- SCOR: support from NSF (\$50K annually, renewed until 2011);
- French Consortium: support for IPO salaries and running expenses (\$284K)

The French consortium agreed to provide further funding to hire additional staff members to support the increased workload of the IPO after April 2010 when the regional projects from GLOBEC become part of IMBER. A meeting will be organised shortly with the French consortium to discuss the way forward for the IMBER IPO in light of the recommendations of the GLOBEC/IMBER Transition Task team.

INTERACTIONS WITH OTHER PROJECTS AND PROGRAMMES

SOLAS

Joint SOLAS/IMBER Carbon Research group (SIC!): the joint IMBER and SOLAS carbon implementation group has been restructured (see section on IMBER/SOLAS Carbon Working Group above). The Chairs of the three sub-groups work closely with each other and also with the IOCCP (International Ocean Carbon Coordination Project).

The first IMBER/SOLAS French Meeting was held at the University Paris 7 on 22-23 June 2009 to inform the community about the marine science being undertaken by French IMBER and SOLAS scientists. The main objectives were to highlight the scientific questions common to IMBER and SOLAS and to develop new collaborations. The meeting was organized by Véronique Garçon (LEGOS, Toulouse), Jean-Pierre Gattuso (LOV, Villefranche/Mer), Cécile Guieu (LOV, Villefranche/Mer), Rémi Losno (LISA, Paris) and the IMBER International Project Office (IUEM, Brest) and financed by LEFE-CYBER. There were six sessions:

1. "Nutrients and marine ecosystems",
2. "Atmospheric aerosols",
3. "Anthropogenic carbon and acidification",
4. "Biogeochemical cycles and marine ecosystems",
5. "Transversal actions", and
6. "Trace gases and CO₂".

Sixty participants from 14 French laboratories and institutions attended. It gave PhD and young scientists the opportunity to present their work to the national marine science community. Some of the presentations are available at (http://www.imber.info/IMBER_SOLAS_Programme.html).

LOICZ

Joint IMBER/LOICZ Continental Margins Task Team (CMTT): acknowledging the amount of research in continental margins IMBER has suggested that the existing CMTT be disbanded and a new one established to conduct integration and synthesis activities to draw together the national and regional research. A team of eight members, jointly appointed and funded by IMBER and LOICZ, with a representative co-chair from each project is envisaged. The team will develop perspective or white papers to stimulate integration and synthesis activities. Several knowledge gaps have been identified, including carbon and nutrient budgets for shelf seas and the role of the “continental margin pump”, the differential role of physical processes in the exchange of water and biological properties between the coast and the open ocean, the effect of global warming on the occurrence and extension of low oxygen zones, and their effects on biogeochemistry, marine ecosystems and ecosystem services (e.g. fisheries yields) and basin-to-basin variation in food web structure and functioning.

The new CMTT will meet before the end of 2009 to develop plans for the first integration and synthesis activity, possibly a “Continental Margins IMBIZO” to be held early in 2011.

Carbon and Nutrient Fluxes in Continental Margins: A Global Synthesis, Edited by Kon-Ke Liu, Larry Atkinson, Renato Quiñones and Liana Talaue-McManus has been published by Springer Verlag in the IGBP Book Series on Global Change. The book provides perspectives on the role of continental margins in the Earth's biogeochemical system as well as highlights of biogeochemical functionality in representative regional settings. More than 150 experts contributed best estimates of carbon and nutrient fluxes in seven types of continental margins.

GLOBEC

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

CARBOOCEAN

A Memorandum of Understanding was signed between IMBER and CARBOOCEAN, an integrated project that aims to provide an accurate assessment of marine carbon sources and sinks with special emphasis on the Atlantic and Southern Oceans on a time scale of -200 to +200 years. All five of the core CARBOOCEAN themes contribute to IMBER's goals. For example, the North Atlantic surface ocean carbon observing system confirmed the decrease in uptake strength for anthropogenic CO₂ from the atmosphere in the late 1990s. The Southern Ocean sink has also weakened during the recent years. Among the modelling studies, an investigation on a quick transfer of anthropogenic CO₂ into deep oceanic areas close to deep water production locations show that the ocean acidification not only affects the surface ocean, but also has implications for deeper ocean areas. CARBOOCEAN has contributed to two data synthesis efforts for a global surface ocean pCO₂ data set of raw data (no climatology) and an Atlantic 3-D carbon database.

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CLIVAR

Climate Variability and Predictability (CLIVAR) is a core project of the World Climate Research Programme (WCRP), with a particular focus on the role of the ocean in climate variability and change. There are IMBER representatives on the relevant CLIVAR Panels. Following the successful ClimEco (Climate driving of marine ecosystem changes – training for young marine scientists) Workshop in Brest, France in April 2008, CLIVAR organised an NCAR Advanced Study Programme Workshop on “Marine ecosystems and climate - modelling and analysis of observed variability” in Boulder, Colorado, USA on 2-14 August 2009. CLIVAR, together with IOCCP and the joint SOLAS/IMBER Carbon Group, participates in the Global Ocean Ship-based Repeat Hydrographic Investigations Panel (GO_SHIP) which is developing a strategy for a sustained program of interdisciplinary repeat hydrography.

EUR-OCEANS

IMBER signed a Memorandum of Understanding with the EUR-OCEANS Network of Excellence and continues to maintain strong links with the self-funding EURO-OCEANS Consortium. The Consortium has allocated funding for the IMBER IMBIZO II in 2010.

GODAE

The IMBER-GODAE Task Team, established in June 2007 focused on three key areas:

- (1) How IMBER modellers can benefit from the data products and insight generated by GODAE,
- (2) How GODAE products can be improved from the perspective of IMBER modellers, and
- (3) How to improve ocean observation systems to observe ocean ecosystem and biogeochemistry better.

The Task Team produced a synthesis paper in 2008 that focused on the applications of GODAE products to ecosystem and biogeochemistry projects and identified what is required to integrate biogeochemistry and ecology into ocean data assimilation systems. The paper was presented at the final GODAE Symposium on 12-15 November 2008 in Nice, and has been submitted for publication. The Symposium proceedings can be viewed at (<http://www.godae.org/Invited-papers.html>). The meeting report was also published in IMBER Update n°12.

A White Paper about the future of GODAE was also presented at the Nice Symposium, providing the basis for an international program called GODAE Ocean-View (GOV) which will consolidate the long-term coordination and cooperation on ocean analysis and forecasting. The Marine Ecosystem Analysis and Prediction Task Team (MEAP-TT) is one of several GOV task teams that have been established and it is likely that the IMBER-GODAE Task Team will be dissolved and absorbed into the MEAP-TT.

PICES

The PICES interdisciplinary programme FUTURE, aims to forecast and understand the trends, uncertainty and responses of North Pacific marine ecosystems to climate change and human activities at basin-wide and regional scales. The FUTURE Science and Implementation Plan was published in May 2009 (see:

http://www.pices.int/members/scientific_programs/FUTURE/FUTURE_final_2008.pdf

FUTURE provides for collaboration between IMBER and PICES.

National activities

IMBER activities are underway in many different countries (e.g. Chile, China, France, Germany, India, Japan, Korea, New Zealand, Norway, Spain, Turkey, UK, and USA).

Some examples include

- **China:** the five-year IMBER-GLOBEC Marine Dynamics project is now in its third phase. The IMBER-GLOBEC community is very active and there are plans to open an IMBER-China office next year.
- **Japan:** IMBER-Japan, established under the Science Council of Japan is chaired by Hiroaki Saito. The Population Outbreak in Marine Life (POMAL) project is an IMBER project focusing on cruises investigating the integration of biogeochemical cycles. Two cruises are planned over the next three years. SUPRFISH AND STOPJELLY are also IMBER-related projects.
- **Korea:** Although there are no formal IMBER projects in Korea, about ten current projects could be IMBER-related. The next symposium of the GLOBEC committee (members from China, Korea and Japan) will be held in Korea and consideration will be given to transforming it into an IMBER-related group and establishing a Korean IMBER research project. The Chair of IMBER has been invited to attend this meeting.
- **France:** CYBER has submitted several proposals for IMBER-related projects. The SOLAS-IMBER meeting for the French community was held in June 2009 in Paris.
- **India:** SIBER recently organised a workshop where a national committee was established which could function as an IMBER committee.
- **Spain:** There are many IMBER-related activities in Spain. The most relevant are MALOSPINA – a five-year global circumnavigation exploration of global change and biodiversity of the oceans and SUMMER – a surface mixing modulation study. Two symposia were held recently: the *International Symposium on the Effects of Climate Change on the Worlds Oceans* and the *Eastern Boundary Upwelling Ecosystems Symposium*.
- **UK:** The process to develop IMBER-UK has started (see www.imber-uk.org). Several session reports relate to the IMBER themes. There has been an 11 million GBP call for proposals on Ocean Acidification. IMBER science in the Arctic is developing and several aspects in the Southern Ocean are linked through ICED.
- **USA:** Ocean Carbon and Biogeochemistry (OCB) is the U.S. contribution to IMBER.

FUTURE ACTIVITIES

- As part of the IMBER IMBIZO series, IMBIZO II is scheduled for September/October 2010. The meeting will be held in the Creteaquarium on the island of Crete in Greece. As with the previous IMBIZO, the meeting will consist of three interdisciplinary workshops held in parallel, plenary and poster sessions. Workshops will include oral presentations

showing current research and knowledge about each topic and discussion sessions to identify key questions to be addressed by IMBER. The workshops will be limited to 40 participants each and funding will be available for some scientists from developing countries to attend. Workshop outcomes will be reported as publications and synthesis papers in a peer reviewed journals.

- OceanObs09 Conference, 21-25 September 2009, Venice, Italy.
- PICES Eighteenth Annual Meeting: *Understanding ecosystem dynamics and pursuing ecosystem approaches to management*, Jeju, Korea (23 Oct-1 Nov 2009)
- AIMES OSC *Earth System Science: Climate, Global Change and People* 10-13 May 2010, Edinburgh, Scotland.
- Summer School Institut Universitaire Européen de la Mer, France August 2009)
- ICED SSC Meeting
- SIBER SSC Meeting in Perth, Australia March 2010

3.4 GEOTRACES

Terms of Reference:

- Organize national and international planning workshops as well as special sessions at international conferences to obtain community input on the design and implementation of GEOTRACES.
- Establish priorities for research on the sources, sinks, internal cycling, transport, speciation and fate of TEIs, and develop this information into an International Science Plan.
- Promote intercalibration of analytical methods, and the development of standard reference materials.
- Identify new instrumentation and related infrastructure that will help achieve GEOTRACES objectives.
- Define a policy for data management and sample archival.
- Forge scientific linkages with other research programs holding overlapping interests to create synergies where possible and avoid duplication of efforts. To the extent practical, this will involve cross-membership between the GEOTRACES Planning Group and the Planning Groups and Science Steering Committees of other programs.
- Interact with SCOR Working Groups that share common interests including, but not limited to, SCOR/IMAGES WG 123 on Reconstruction of Past Ocean Circulation (PACE) and SCOR/IMAGES WG 124 on Analyzing the Links Between Present Oceanic Processes and Paleo-Records (LINKS).

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Other Members

Per Andersson	SWEDEN	Chris Measures	USA
Hein de Baar	NETHERLANDS	Felipe Niencheski	BRAZIL
Philip Boyd	NEW ZEALAND	Kristin Orians	CANADA
Kenneth Bruland	USA	James Orr	MONACO
Minhan Dai	CHINA-Beijing	Carol Robinson	UK
Martin Frank	SWITZERLAND	Reiner Schlitzer	GERMANY
Toshitaka Gamo	JAPAN	Sunil Singh	INDIA
Catherine Jeandel	FRANCE	Michiel Rutgers	
Bill Jenkins	USA	van der Loeff	GERMANY
Pere Masque	SPAIN		

Alternate: Jing Zhang JAPAN

Executive Committee Reporter: Bjørn Sundby

GEOTRACES SCIENTIFIC STEERING COMMITTEE
ANNUAL REPORT TO SCOR 2008/2009
July 2009

SCOR Scientific Steering Committee for GEOTRACES

Co-Chairs

Robert F. Anderson, USA
Gideon M. Henderson, UK

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

Jing Zhang, Japan (alternate, Japan)

Members

Per Andersson, Sweden

Philip Boyd, New Zealand

Ken Bruland, USA

Minhai Dai, China

Hein de Baar, Netherlands

Martin Frank, Germany

Toshitaka Gamo, Japan

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 2008/2009

SSC meeting: The third meeting of the GEOTRACES SSC was held for three days (6-8 November 2008) in Toyama, Japan, hosted by Toyama University. This was attended by all but two of the SSC members. Jing Zhang, Japan, served as local host. The chair of the GEOTRACES Intercalibration Subcommittee (Greg Cutter) also attended, as did Ed Urban, representing SCOR. Ed Mawji (GEOTRACES Data Assembly Centre) and Juan Brown (British Oceanographic Data Centre) joined the SSC meeting and remained for the meeting of the Data Management Committee (see below).

SSC discussions were wide ranging. The meeting began with a review of national efforts and of GEOTRACES cruises carried out as part of the International Polar Year. Publicizing information about GEOTRACES and providing information in a format appropriate for users is important as the program enters its period of main field activity. Production of a GEOTRACES brochure and upgrading the Web site are therefore a priority. The SSC set guidelines for the brochure, but will defer action on the Web site until the IPO is staffed (see below). In addition to

relationships with other programmes, major issues for discussion included measurement intercalibration, data management, ocean modelling, and criteria for GEOTRACES participation. Topics that received special emphasis include:

- International Project Office (IPO) - funding is in place to hire an executive officer to staff the IPO in Toulouse. Funds will cover salary and expenses for two years. Catherine Jeandel will represent GEOTRACES in developing a contract with Laboratoire d'Etudes en Geophysique et océanographie Spatiale (LEGOS), the host institution. As there is no national or institutional sponsor of the entire cost of the IPO, it is vital that all nations participating in GEOTRACES seek contributions to sustain the office.
- 2008 Intercalibration cruise - Greg Cutter reported on preliminary results from the first GEOTRACES intercalibration cruise, held in June and July 2008, between Bermuda and Norfolk, Virginia. Of note is the finding that the sampling rosette designed specifically for U.S. GEOTRACES was shown to collect water samples free of contamination for metals such as iron, lead, zinc and mercury. The ability to sample the water column rapidly and without contamination represents a vital technological advance that will enable GEOTRACES to measure trace element distributions at high spatial resolution on a global scale. Other nations are now developing clean sampling systems based on this design. Several hundred seawater samples from SAFE and GEOTRACES have been archived to use as working standards during future cruises.
- Data Management - The SSC heard a report from Ed Mawji, the GEOTRACES Data Liaison Officer, on steps being taken to establish the GEOTRACES Data Assembly Centre at BODC. The role of GDAC includes
 1. Establish a global database of GEOTRACES parameters
 2. Provide guidance on metadata requirements

The next SSC meeting is scheduled for 4-6 November 2009 in Washington, D.C. Ed Urban and Lora Carter are overseeing local arrangements. The GEOTRACES Data Management Committee will meet on 7 November.

Arctic Ocean Basin Workshop in 2009

A workshop to set research priorities and plan the implementation of GEOTRACES science in the Arctic Ocean was held on 8-10 June 2009, at the Hanse Institute for Advanced Study, Delmenhorst, Germany. This workshop followed the precedent of the three successful international workshops held in 2007 to set priorities for the three major ocean basins – Pacific, Atlantic, and Indian.

Information about the Arctic workshop was publicized on the GEOTRACES Web site. Travel subsidies were provided for many participants with support from SCOR, from the European COST Action (see below), and from a variety of national sources. During the meeting workshop participants identified the key regions and research questions for the Arctic basin, and discussed opportunities for international collaboration to address the goals laid out in the *GEOTRACES*

Science Plan. International collaboration will be necessary due to the difficult logistics involved when working in the Arctic Ocean.

The Arctic Ocean workshop report will be published on the GEOTRACES Web site. It is intended mainly for use by national and regional planning groups for implementing GEOTRACES cruises. The SSC will extract material from these reports to prepare an overview document to be disseminated more widely.

Measurement Intercalibration during the GEOTRACES programme

There was early recognition during the planning of GEOTRACES that intercalibration of measurements between laboratories would be critical to the success of the program. To that end, intercalibration, along with data management, has been one of the two primary “enabling” activities since the establishment of the GEOTRACES program. To date, GEOTRACES has completed two major intercalibration cruises:

- 1) 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
- 2) 6-30 May 2009: sampling mainly at the SAFE station in the eastern subtropical North Pacific Ocean, but also in the Santa Barbara Basin, off the west coast of the United States. Samples were collected at the SAFE site to test the collection and analysis of samples for a broad spectrum of dissolved and particulate trace elements and isotopes. Samples were collected in the Santa Barbara Basin to test analytical methods used under low-oxygen conditions to measure the chemical speciation of redox-sensitive trace elements.

Results from the first intercalibration cruise were presented and discussed at a workshop (13-14 December 2008; San Francisco, USA) attended by about 45 persons. Team leaders compared results from participating labs worldwide, both in terms of different classes of trace elements and isotopes and in terms of different sampling techniques.

In general, results from different sampling systems were found to be in agreement. For many of the trace elements, inter-lab agreement was good as well, although some problems were identified. However, agreement was poorer than expected for some of the radioisotope measurements. These results led to the design of new tests to be conducted during the second intercalibration cruise (May 2009). Results from that cruise are not yet available.

A final workshop (March 2010, Norfolk, USA) will synthesize results from the intercalibration activities and begin preparation of a “Best Practices Manual” documenting lessons learned from the intercalibration and making recommendations to facilitate acquisition of reliable data on future GEOTRACES cruises. The manual will be completed by the GEOTRACES Standards and Intercalibration Committee (Greg Cutter, Chair) and made available via the GEOTRACES Web site.

Data Management for GEOTRACES

The Data Management Committee, co-chaired by Chris Measures and Reiner Schlitzer, met immediately following the SSC meeting on 9 - 10 November in Toyama, Japan. Progress in establishing the international GEOTRACES Data Assembly Centre in the UK was reviewed, and priorities for future activities of the centre were developed. Currently the GDAC is operating under two years of funding provided in equal amounts by the UK NERC and by the US NSF. 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.

During the past year, Ed Mawji (GEOTRACES Data Liaison Officer) has set up a Web page (<http://www.bodc.ac.uk/geotraces/>), established metadata requirements for GEOTRACES cruises, contacted cruise leaders to submit metadata, designed an interface for submission of data and metadata, contacted representatives of national data centres to establish protocols for data transfer, and initiated a Web site with information about GEOTRACES cruises. Most recently, he has started to request data from the principal investigators who participated in GEOTRACES IPY cruises.

Modeling in GEOTRACES

Building on the success of the first GEOTRACES international data-model synergy workshop in 2007, the SSC initiated plans for a second workshop, to be chaired by Jean-Claude Dutay (Venue: École Normale Supérieure, Paris, France; 7 - 10 December 2009). Additional information is posted on the GEOTRACES Web site: http://www.geotraces.org/PW2009_Data_Model_Synergy.html.

Links with other programmes

GEOTRACES remains committed to maintaining strong links to other relevant programmes. During the past year members of the GEOTRACES SSC have held discussions with Doug Wallace, Chair of the SOLAS SSC, to explore opportunities for collaboration. GEOTRACES and SOLAS are both interested in the supply of iron and other micronutrients that are essential for marine organisms, as well as in the biological response to variability in the supply of these micronutrients. In support of that interest, GEOTRACES is considering opportunities to make a limited suite of measurements aboard section cruises that would characterize biological parameters related to organism physiology and their sensitivity to micronutrient limitation. This initiative has been labelled bioGEOTRACES. Meanwhile, SOLAS has identified a related topic "Atmospheric control of nutrient cycling and primary production in the Surface Ocean" as a focus activity for its future research. This is one of the themes to be highlighted at the SOLAS Open Science Conference in Barcelona. Ideally, SOLAS and GEOTRACES would join forces to plan a process study that exploits information gained about micronutrient supply from the GEOTRACES sections to test new hypotheses concerning ecosystem response to varying

micronutrient availability. At this time, individuals are being sought who would take the lead on organizing such an effort.

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 have met with discouraging responses. At this time, Chris Measures continues to lead an effort to seek alternative sources of funding for the training activity. The major sticking point is the need to pay for ship time.

GEOTRACES also seeks to build communities of marine biogeochemists within individual nations to expand the network of scientists contributing toward GEOTRACES goals. Toward that end, the Indian Ocean basin-planning workshop was held in India in 2007 to help organize Indian scientists with interests in the marine biogeochemistry of trace elements and their isotopes. It was rewarding, therefore, when the government of India Ministry of Earth Sciences announced its intentions in mid-2009 to support an Indian national GEOTRACES program (see national report from India).

In May 2009, SSC members Chris Measures and Bob Anderson visited university and government labs in Korea to assist in organizing a Korean GEOTRACES program (see national report from Korea).

GEOTRACES anticipates holding an East Asian regional planning workshop in early 2010. Workshop organizers (Minhan Dai, China, and Jing Zhang, Japan) have offered to hold that workshop in Korea if doing so will enhance the visibility of Korean GEOTRACES organizing efforts and help secure funding for a Korean GEOTRACES program.

International Project Office

The principal activity during the past year involved developing a legal contract with the hosting institution. This proved to be a time-consuming effort. The GEOTRACES SSC wishes to thank Ed Urban for his valuable assistance in completing the contract. The GEOTRACES Executive Officer position was advertised in early July, 2009. It is hoped that the executive officer will be hired and in place by the time of the next GEOTRACES SSC meeting (November 2009). A search committee consisting of Ed Urban (SCOR), Gideon Henderson and Bob Anderson (SSC co-Chairs), and Catherine Jeandel (local IPO supervisor) will review the applications and interview finalists for the position, on 7 September.

Other Activities

GEOTRACES Co-Chairs Henderson and Anderson attended the SCOR 50th Anniversary Symposium (The Changing Ocean: From Past to Future) and the 2008 SCOR General Meeting in Woods Hole, Massachusetts, USA, on 20-24 October 2008.

Anderson also participated in the Third SCOR Summit of International Marine Research Projects (Newark, Delaware, USA; 30 March-1 April 2009).

European GEOTRACES activities are supported by COST Action ES0801: The ocean chemistry of bioactive trace elements and paleoclimate proxies. This COST Action directly supports the International GEOTRACES Programme, but extends beyond that programme to cover all marine trace-metal research in the COST region. Supported activities include cruise planning, intercalibration, data management and training. For more information, see <http://costaction.earth.ox.ac.uk/>.

GEOTRACES-related sessions at international conferences

GEOTRACES research goals are regularly promoted through special sessions at international conferences. Highlights during the past year include:

Goldschmidt 2009 - Challenges to Our Volatile Planet

21-26 June; Davos, Switzerland

Theme 14: Ocean Chemistry Past and Present - Sessions:

- 14a: Present-Day Ocean Chemistry and Biogeochemical Cycling of Elements and Metals
- 14b: New Developments in Marine Geochemical and Isotopic Proxies
- 14c: Past Ocean Circulation
- 14d: Ocean-Lithosphere Exchange and Fluid-Rock Interaction

ASLO Aquatic Sciences Meeting 2009

25-30 January; Nice, France

- 009. Progress in the application of short-lived radionuclides as tracers of particle cycling and export in the ocean
- 016. Aquatic biogeochemistry as only skin deep: Trace element exchange, meta-stable speciation and reactions at interfaces
- 081. Biological transformations of trace metals
- 097. Chemical speciation of metals in waters and its dynamics
- 099. IPY-GEOTRACES: Trace Elements and Isotopes in Polar Oceans

Looking forward, two special sessions at the Ocean Sciences meeting (22-26 February 2010; Portland, Oregon) will highlight results pertaining to trace elements and their isotopes:

- CO07: GEOTRACES in the International Polar Year, and
- CO09: Getting the Right Number: Precision and Accuracy in Chemical Oceanography.

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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.

National Reports

Australia

Summary of Australian GEOTRACES activities in the period July 2008-June 2009:

- Metadata and cruise reports from IPY-GEOTRACES projects *SIPEX*, *SAZ-Sense* and *SR3* submitted to Edward Mawji at BODC in the United Kingdom
- IPY-GEOTRACES voyages (*SIPEX*, *SAZ-Sense* and *SR3*) -- analyses and interpretation ongoing, publication outputs listed below
- SS01/2010 voyage planning underway for international interdisciplinary study of the macro- / micro-nutrient gradients and biogeochemistry in the Tasman Sea (Jan/Feb 2010); looking for endorsement as a GEOTRACES process study (PI: Christel Hassler)
- Australian Government funds new oceanographic research vessel; looking to be operational 2012/13. Requests from Bowie/Butler for vessel to conform to GEOTRACES “standards”
- Proposal submitted to Australian Marine National facility for shiptime in May/June 2011 for joint Australian-NZ GEOTRACES two-ship voyage along line P06 (~30°S) east of Australia (153°E to 160°W) (PI: Andrew Bowie)
- Australia joins European Union COST Action ES0801 for GEOTRACES (“The ocean chemistry of bioactive trace elements and paleoclimate proxies”) as non-COST international participant (National representative: Andrew Bowie)

Outputs from IPY-GEOTRACES activities involving Australian researchers:

Journal articles:

- Bowie A.R., Lannuzel D., Remenyi T.A., Wagener T., Lam P., Boyd P.W., Guieu C., Townsend A.T., Trull T.W., 2009. Different processes structure biogeochemical iron budgets in the subantarctic and polar Southern Ocean south of Australia during summer. *Global Biogeochemical Cycles*, accepted subject to minor revision
- Lannuzel D., Schoemann V., Pasquer B., van der Merwe P., Bowie A.R., 2009. What controls the distribution of dissolved iron in Antarctic sea ice? Spatial, seasonal and inter-annual variability. *Journal of Geophysical Research - Biogeosciences*, accepted subject to major revision
- van der Merwe P., Lannuzel D., Mancuso Nichols C.A., Meiners K., Heil P., Norman L., Thomas D., Bowie A.R., 2009. Biogeochemical observations during the winter-spring transition in East Antarctic sea ice: evidence of iron and exopolysaccharide controls. *Marine Chemistry*, accepted subject to minor revision
- Lannuzel D., Remenyi T., Lam P., Townsend A., Ibanami E., Butler E., Wagener T., Schoemann V., Bowie A.R., 2009. Distributions of dissolved and particulate iron in the sub-Antarctic and polar frontal Southern Ocean (Australian sector). *Deep-Sea Research II*, accepted subject to minor revision

- Ibisani E.B., Hunter K.A., Sander S., Boyd P.W., Bowie A.R., 2009. Vertical distributions of iron-(III) complexing ligands in the Southern Ocean, Deep-Sea Research II, accepted subject to minor revision

Conference presentations:

- Bowie A., Lannuzel D., Remenyi T., Wagener T., Lam P., Boyd P., Guieu C., Townsend A., Trull T.W., Griffiths B., SAZ-Sense Team, 2009. Different processes drive biogeochemical iron budgets in the subantarctic and polar Southern Ocean. 2nd International Forum on the Sub-Antarctic (IFSA), Environmental Change in the Sub-Antarctic, Hobart, Australia, 26-27 April
- Trull T.W., Bowie A.R., Boyd P., Cassar N., Davidson A., Griffiths F.B., Rintoul S.R., Thomson P., Tilbrook B., Wright S., SAZ-Sense team, 2009. The Australian SAZ-Sense Study of the sensitivity of the Sub-Antarctic zone to Climate Change, 2nd International Forum on the Sub-Antarctic (IFSA), Environmental Change in the Sub-Antarctic, Hobart, Australia, 26-27 April
- Bowie A., Lannuzel D., Remenyi T., Wagener T., Lam P., Boyd P., Guieu C., Townsend A., Trull T.W., Griffiths B., SAZ-Sense Team, 2009. Different processes drive biogeochemical iron budgets in the subantarctic and polar Southern Ocean. Gordon Research Conference: Polar Marine Science - Beyond IPY: Crossing Boundaries, Lucca, Italy, March 15-20
- Bowie A.R., Boye M., de Baar H., Bathmann U., Cardinal D., Murphy E., Treguer P., 2009. An overview of the biogeochemical features of the Southern Ocean during the International Polar Year. Gordon Research Conference: Polar Marine Science - Beyond IPY: Crossing Boundaries, Lucca, Italy, March 15-20
- Boye M., de Baar H., Bowie A.R., Masque P., Dehairs F., Rutgers van der Loeff M., Butler E., Tovar-Sanchez A., Croot P., Nishioka J., 2009. GEOTRACES in the International Polar Year: an overview. ASLO 2009 Aquatic Sciences Meeting, Nice (France), January 25-30
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- C.S. Hassler, V. Schoemann, E. Alasonati, C. Mancuso-Nichols, V.I. Slaveykova, E.C.V. Butler, 2009. Are sugars the key to ubiquitous control of oceanic iron limitation? Gordon Research Conference on Polar Marine Science. 'Beyond IPY: Crossing Boundaries', Lucca (Barga), Italy.
- V. Schoemann, C.S. Hassler, I. Dumont, F. Masson, A. Bowie, D. Lannuzel, J.T.M. de Jong, and S. Becquevort, 2008. Control of organic ligands on Fe bioavailability, carbon production and export. European Network of Excellence for Ocean Ecosystems Analysis (EUR-OCEAN) Workshop "Controls on organic carbon export and twilight zone mineralisation". Brussels, Belgium.
- C.S. Hassler and V. Schoemann, 2008. Iron bioavailability and primary productivity to model phytoplankton of the Southern Ocean. European Network of Excellence for Ocean Ecosystems Analysis (EUR-OCEAN) Workshop "Controls on organic carbon export and twilight zone mineralisation". Brussels, Belgium.
- C.S. Hassler, and V. Schoemann, 2008. On the role of organically bound iron in controlling iron bioavailability to model phytoplankton of the Southern Ocean. European Network of Excellence for Ocean Ecosystems Analysis (EUR-OCEAN) Workshop "Iron biogeochemistry across marine systems at changing times". Gothenburg, Sweden.
- V. Schoemann, C.S. Hassler, I. Dumont, F. Masson, A. Bowie, D. Lannuzel, J.T.M. de Jong, and S. Becquevort, 2008. European Network of Excellence for Ocean Ecosystems Analysis (EUR-OCEAN) Workshop "Iron biogeochemistry across marine systems at changing times". Gothenburg, Sweden.

Other publications:

- E.C.V. Butler, and A.R. Bowie, 2008. Tracing elements in the ocean. Australian Antarctic Magazine, (14): 20.
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Prepared by: Andrew Bowie (Antarctic Climate & Ecosystems CRC)
Ed Butler (CSIRO Marine & Atmospheric Research)

Brazil

Workshop:

State of Knowledge on Southwestern Atlantic Ocean Margin Processes (16-21 Nov).

Although considerable research has been carried out on the Southwestern Atlantic Ocean Margin, there has been little integration of results across disciplines and the few recent summaries of research that have been published do not take into account more recent scientific findings in the region.

The purpose of the Montevideo's workshop is to bring together scientists from Brazil, Uruguay, Argentina and the United States to assess the state of knowledge on ocean margin processes of the Southwestern Atlantic Ocean. The goal is to develop a summary of the present understanding of physical and biogeochemical processes operating in this region and how they are linked and to identify major areas of uncertainty. The anticipated outcomes of the workshop are: 1) to initiate the pursuit of cooperative research projects/programs in the region that articulate with more

global research agendas and 2) to enhance North-South American, and regional-national collaborations.

Multidisciplinary syntheses of research in this region will not only benefit regional researchers in planning future efforts, but will also serve the wider marine research community by providing a better overview of the state of knowledge of this important ocean region.

Scientific activities:

1. We have realized the first observations of naturally occurring geochemical tracers (^{222}Rn , ^{223}Ra , ^{224}Ra) in the coastal waters as proxies of SGD into the Albardão shelf, extremely Southern Brazil, close to the Uruguayan borders. Coastal seawater and shallow beach groundwater (<4m deep) were sampled in January 2007 and September 2008. Groundwater samples were collected with a stainless steel drive-point piezometer system (“Retract-a-Tip” from AMS[®]). For measuring ^{222}Rn ($t_{1/2} = 3.8$ days), we used a portable, continuous radon-in-air monitor modified for radon-in-water (Rad-7, Durrige Company) deployed on a rubber boat in the surf zone. Radium sampling was carried out by passing large volumes of water (~20 L for groundwater; ~200 L for surface waters) through a “Mn fiber” adsorber. Activities of ^{223}Ra ($t_{1/2} = 11.4$ days) and ^{224}Ra ($t_{1/2} = 3.7$ days) were then measured on a delayed coincidence counter.

Offshore radium transects indicated a nearshore groundwater source. Given the environmental conditions of the southern Brazilian continental shelf (e.g., wavy, open shoreline), radium may provide more consistent information than radon, as it is difficult to estimate the influence of waves on radon atmospheric evasion.

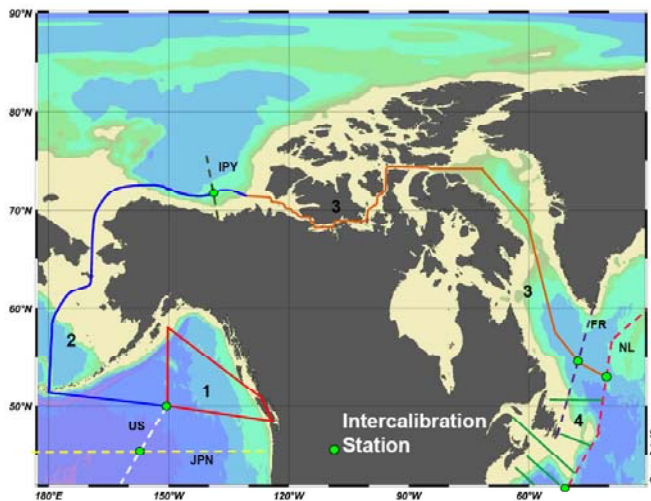
2. We are in contact with Brazilian Navy to conduct three transects (from the coast up to the shelf break) in between latitude 26° - 33° S, to analyze macronutrients and isotopes. This is a joint project involving the Navy, IEAPM (Instituto de Estudos Almirante Paulo Moreira) and IRD/CNEN (Instituto de Radioproteção e Dosimetria/Comissão Nacional de Energia Nuclear). It is scheduled for 2009. The scientists involved took part in the the *Ubatuba, Brazil* SGD assessment intercomparison that was held in 2005.

Canada

The Canadian GEOTRACES IPY cruise in the Arctic Ocean was delayed until 27 August - 15 September 2009. It is anticipated that all key GEOTRACES parameters will be measured, with the possible exception of aerosols. The cruise track is shown below.



The Canadian GEOTRACES community is also looking forward to collaborating with other nations in a larger study of the Arctic Ocean.



Tentative plan for a Canadian GEOTRACES NSERC Strategic Network.

China

GEOTRACES Activities in China
An annual report for 2008-2009
July 15, 2009
By China-GEOTRACES Working Group

1. Activities:

- a. Participation to the international GEOTRACES activities- inter-comparison:
 - Xiamen University: Th, Ra, Pb and Po
 - East China Normal University (Jinzhou Du): U, Ra.
 - Ocean University of China (Jingling Ren): Al and As
- b. Attendance in the International Polar Year-GEOTRACES program
- c. Continue to explore the possibility of a trace metal sampling/analysis training workshop with Chris Measures
- d. “973” Carbon project—part of China-GEOTRACES has been accommodated in this project and there is the first cruise to Chinese Marginal Seas between July-September, 2009
- e. Planning of a 3rd Asian-GEOTRACES workshop, with the exploration of a Korean host
- f. Start to plan a GEOTRACES process cruise in Pacific in 2011

2. Products:

- a. Preliminary results from GEOTRACES inter-calibration exercise are available. Details not shown.
- b. Supported by the Alexander von Humboldt Foundation and BMBF, the cooperation between Xiamen University and Alfred-Wegener Institute of Polar and Marine Research in the POC export studies in the Arctic Ocean and the Southern Ocean has led to two submitted manuscripts of Cai et al., 2009 (JGR-Oceans) and Rutgers van der Loeff et al., 2009 (DSR II). The major findings are the very low POC export in the central Arctic Ocean (Figure not shown) and that simultaneous determinations of ²³⁴Th is crucial for understanding the geochemical behaviors of other particle reactive elements, like Mn and Fe (Figure not shown).

3. Promotion of GEOTRACES in China:

- a. China-GEOTRACES theme has been in the NSFC key project proposal call in 2009 on “Ocean response to terrestrial input in western Pacific and its marginal seas--A biogeochemistry study of trace elements and their isotopes”. We are trying to extend this same proposal call in 2010.
- b. Capacity building on trace metals start to accumulate

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- a couple of “clean” systems will be tested for underway and stationary trace metal sampling in an upcoming cruise to South China Sea in July-September 2009
- We have shown capacity to measure Fe isotopes in suspended particulate material collected in the South China Sea, a largest marginal sea in the West Pacific.

France

The French GEOTRACES held a planning workshop attended by 30 participants (representing roughly 50 interested people). Scientists from Belgium and Spain participated as well, reflecting anticipated international collaboration.

GEOTRACES-France confirms its plan to carry out a section along the "OVIDE" North Atlantic track (between France and Greenland) in 2014 (Catherine Jeandel, lead investigator). GEOTRACES-France is also considering an Indian Ocean action (Keops II) and probable section (at least from La Reunion to Kerguelen, both led by Stephane Blain, possibly as early as 2012). A pre-proposal has been submitted to test the willingness of the French scientific committees to support such an operation. Finally, plans are being initiated for a Mediterranean GEOTRACES action under the direction of C Guieu.

GEOTRACES-France has ordered a clean rosette with the cable and 12 bottles. It is anticipated that the winch will be purchased in the next year.

Germany

Many activities were related to the GEOTRACES IPY expeditions with RV *Polarstern* to the central Arctic (July-Oct, 2007) and to the Atlantic sector of the Southern Ocean (ZERO and DRAKE, Febr-Apr, 2008):

Post-cruise workshops of these IPY *Polarstern* expeditions took place:

- Antarctic expedition ZERO and DRAKE: ANT XXIV/3 (AWI, Bremerhaven, September 2008)
- Arctic expedition ARK XXII/2 (AWI, Bremerhaven, June 2009)

Results based on GEOTRACES-related work on these IPY expeditions were presented at international conferences (ASLO-Nice; Goldschmidt-Davos) and led to the submission of a first set of publications.

In addition to the three basin workshops organized in 2007, an international Arctic Cruise Planning workshop was held in Delmenhorst 8-10 June 2009 (http://www.geotraces.org/PW2009_ArcticCruise.html) to discuss and coordinate future GEOTRACES activities in the Arctic.

Directly after the Delmenhorst meeting a cruise preparation meeting for a German RV *Meteor* GEOTRACES expedition to the tropical Atlantic (Meteor M81/1, February 2010 Las Palmas – Port of Spain (Trinidad and Tobago), chief scientist Martin Frank) was held on June 10.

India

Indian GEOTRACES Report Sunil Kumar Singh

After the successful organisation of GEOTRACES Indian Basin Planning workshop at Goa during October 2007, further interaction among Indian scientists resulted in concurrence to submit a combined proposal under GEOTRACES (India) to the Ministry of Earth Sciences (MoES) to get funding and required facilities to study trace elements and isotopes (TEIs) in Indian and Southern oceans. In the beginning of 2009, nine proposals dealing with biogeochemistry of TEIs in Indian Ocean from various institutions in India were put together. These proposals plan to study the various aspects of biogeochemistry of TEIs, such as their sources-sinks, water column distribution, inter-oceanic exchange, etc. As the coordinator of this programme, I presented these proposals to MoES in a meeting chaired by the secretary, MoES in middle of April 2009. Immediately after the talk, the secretary announced the formation of GEOTRACES (India) and assured us all the financial and logistical helps including the ship timing for this programme. He also agreed to provide necessary funding for acquiring a clean sampling system including the clean van and other instruments under GEOTRACES (India) programme. We hope to start the acquisition process for the clean sampling system and other instruments in late September 2009.

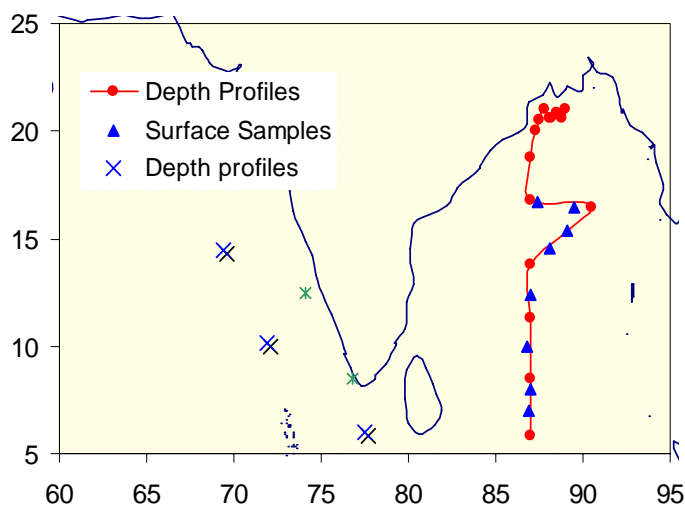


Fig. 1: Cruise track and sampling location in BoB and AS



Fig. 2: Cruise track in Southern Ocean

As has been discussed earlier, we had initiated some work related to GEOTRACES by studying U, Mo, Re and Ba distribution in the Bay of Bengal and Arabian Sea. During November 2008, we arranged a 25-day cruise in the Arabian Sea (AS) and the Bay of Bengal (BoB) to collect seawater samples from various depth profiles (Fig. 1). Further, we participated in the Southern

Ocean cruise Akademik Boris Petrov, Cruise # 35 during February 12 to April 14, 2009 and seawater samples were collected along the cruise track shown in Fig. 2

The samples from BoB have been analysed for Ba, U, Re and Mo and some of the initial results given in Fig. 3.

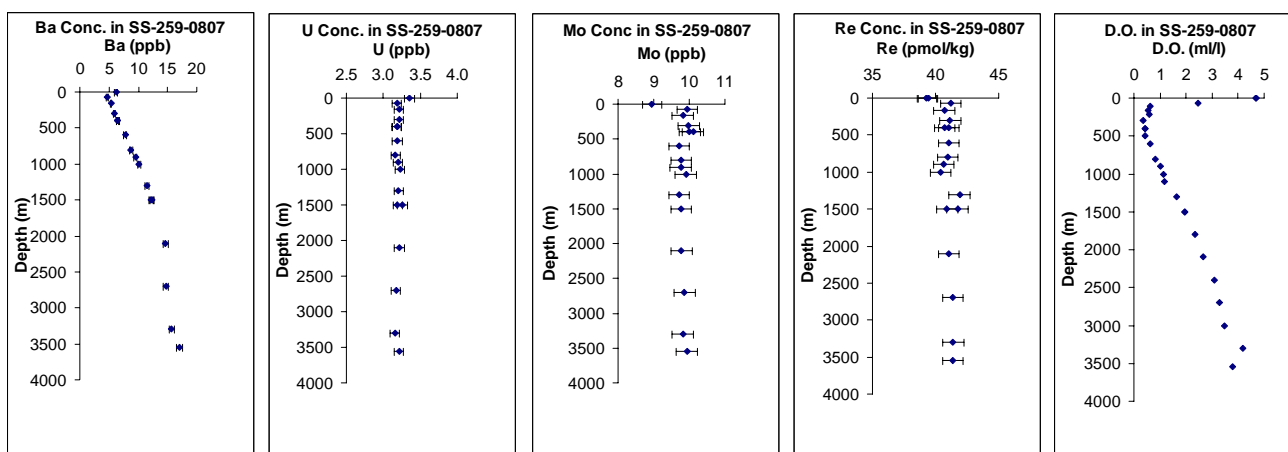


Fig. 3: Ba, U, Mo, Re and D.O. concentrations in the Bay of Bengal

Japan

Major GEOTRACES-related activities in Japan during the past year are as follows:

1) Publication of two special sections in *Journal of Oceanography* (Oceanographical Society of Japan) Vol. 64 (Nos. 2 and 3) on GEOTRACES-related studies in the east Asia. Vol. 64(2) was published in April 2008, which contains 11 papers including Preface by W.S. Broecker and R.F. Anderson and Introduction by the guest editors (J. Zhang, T. Gamo, M. Dai, C-T. A. Chen, and Y. Sohrin), and Vol. 64(3) was published in June 2008, which contains 7 papers. Titles and abstracts of these papers have been uploaded in the TERRAPUB Web site (<http://www.terrapub.co.jp/journals/JO/index.html>).

2) Participation in the intercalibration cruise in June. Two young researchers from Japan took part in the U.S. GEOTRACES intercalibration cruise Leg. 1 from Norfolk to Bermuda (from 8 to 27 June 2008) as observers. During the cruise, Dr. Hajime Obata (ORI, U. Tokyo) and Dr. Kazuhiro Norisuye (ICR, Kyoto Univ.) used Niskin-X samplers for clean water sampling, and showed that the samplers are clean enough for contamination-prone trace metals, like Zn and Hg.

3) Although many of the Japanese geotraces as well as some foreign geotraces had been actively preparing for the GEOTRACES Indian Ocean cruise scheduled in December 2008 to January 2009, the cruise was postponed to the next year (November and December 2009) due to unusual increase of oil prices.

4) A five-year proposal of a new grant-in-aid (totally \$14M) for GEOTRACES studies in Japan was submitted to the Government in April 2008, but it was not approved. A revised proposal was again submitted in December 2008.

GEOTRACES-Japan will begin its first major ocean section cruise in November 2009, covering a meridional transect in the western Indian Ocean.

Korea

- Planning project for a Korea GEOTRACES Program (K-GEOTRACES) were funded and started from November 2008.
- The scientific committees and working groups (Intercalibration and TEI research) have been formed to develop a K-GEOTRACES in Feb. 2009.
- K-GEOTRACES Planning Committees hosted Dr. Bob Anderson (co-chair of international GEOTRACES program), LDEO, and Dr. Chris Measures, University of Hawaii to get comments and recommendations in developing a Korean GEOTRACES program (K-GEOTRACES) in May 2009 (referred the photo below).
- We organized the open science meeting of interested scientists for launching a K-GEOTRACES program at the bi-annual meeting of Korean Society of Oceanography in May 2009.
- The working groups are planning to get together to prepare a national implementation plan and priority goals for a K-GEOTRACES program and Korean oceanographic community in Aug. 2009.



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Dr. Bob Anderson introduced the overview of international GEOTRACE program during the open science meeting at Korea in May 2009.

Netherlands

Netherlands activities focused on continued analysis of samples, and interpretation of results generated during International Polar Year cruises.

Arctic Polarstern cruise July-October 2007

Datasets for Fe, Mn, Al, high-accuracy nutrients; samples collected for Ag (to be analyzed with Eric Achterberg), and Cu, Cd, Ni, Zn (to be analyzed with Bill Landing).

Most other GEOTRACES sampling for Ba, REE and radioisotopes was done by the German team of Michiel Rutgers van der Loeff.

Manuscript on Al is ready and awaiting few minor corrections before submitting to *Marine Chemistry*.

Antarctic Polarstern cruise February-April 2008

Datasets for Fe, Mn, Al, high-accuracy nutrients; samples collected for Ag (to be analyzed with Eric Achterberg), and Cu, Cd, Ni, Zn (to be analyzed with Bill Landing).

most other GEOTRACES sampling for Ba, REE and radioisotopes was done by the German team of Michiel Rutgers van der Loeff.

Moreover, more trace metals research by team of Peter Croot, Kiel, Germany

Results from the zero meridian for Fe, Al, Mn and Fe speciation & colloids will appear in a special issue DSR II for this cruise.

During all the above cruises, SAFe samples were used as standards and results for Fe, Al and Mn were submitted to SAFe data coordinator Ken Bruland. There is excellent agreement between several labs for Fe, also for the few labs for Al and Mn.

Hein de Baar co-chaired with Marie Boye (France) an IPY GEOTRACES session at the ASLO meeting in January 2009 in Nice. Some 22 abstracts were received.

A Netherlands GEOTRACES cruise has been approved to conduct the West Atlantic Ocean section in 2010 and 2011. We are now looking into all the logistics etc. to first come up with a ship time plan (which months we will use for each of these 4 sections)

New Zealand

The following activities have been conducted over the last 12 months:

- a) The first GEOTRACES process study – an interdisciplinary study of trace metal cycling and budgets during a spring bloom event in high-iron waters east of New Zealand.
- b) Ongoing ship-of-opportunity sampling for aerosol iron between Japan and New Zealand, Australia and New Zealand, and Tasmania and East Antarctica.
- c) Planning and co-ordination with Australian colleagues of a joint GEOTRACES survey voyage from N Queensland to Tahiti (i.e., Western portion of the WOCE P06 zonal section).

The process study took place in September 2008, and involved 31 scientists from New Zealand, Australia, USA and Canada. We successfully captured the onset and development of the spring bloom, and were able to sample in a quasi-Lagrangian mode by locating the centre of an almost stationary eddy. The voyage had a strong physics component to underpin the daily sampling of trace metals using both specialised clean rosettes and particle pumps. Samples were taken for a wide range of chemical (such as redox speciation, metal isotopes, electrochemistry) and biological (uptake and recycling of metals, trace metal content of individual cells and organisms) processes. A voyage data workshop will take place in Wellington in December 2009, and we will liaise closely with GEOTRACES data management in both the UK (BODC) and U.S. (BCO-DMO). Samples for both dissolved and particulates have been archived from the voyage and will be available to other GEOTRACES labs for inter-comparison.

Three meridional transects (17 aerosol samples per transect) were sampled between Japan and New Zealand in the last 12 months. These samples are analysed at UEA (UK) by the Jickells/Baker group to enable the inter-comparison between Atlantic (AMT) and Pacific transects. Due to ship logistics only one transect was sampled between Tasmania and E Antarctica in 2008/9, as was the case for the Melbourne/Auckland zonal section.

New Zealand has secured 26 days' shiptime for one of the legs (SE of New Caledonia) of the joint Australian/New Zealand survey. We contributed to the writing of the Australian shiptime proposal and hope to be able to confirm voyage dates in the next six months.

Sweden**Report on GEOTRACES related activities in Sweden during 2008**

Swedish GEOTRACES activities during 2008 include participation in planning activities for GEOTRACES projects in both the Arctic and Antarctic regions. During 2008 also one major expedition with GEOTRACES-related work was conducted in the East Siberian Sea.

Planning work related to GEOTRACES

The Swedish icebreaker *Oden* is rented by NSF on a five-year contract with the main task to clear a channel for resupply operations into the US McMurdo base in Antarctica. The agreement

also includes approximately 20 dedicated science days each year in conjunction with ice-breaking service. At a joint Swedish-U.S. workshop outside Stockholm in February 10-13, 2008 about 50 Swedish and U.S. scientists and science administrators discussed the capabilities of the vessel and possible scientific usage. The discussion included projects related to the GEOTRACES programme. A report from the workshop is available at NSF and Swedish Science Council (VR) and can be downloaded from http://www.vr.se/download/18.72e6b52e1211cd0bba880006699/Oden_workshop_report08.pdf

During 2008, Sweden also joined the COST action ES0801 “The ocean chemistry of bioactive trace elements and paleoclimate proxies”, which directly support the international GEOTRACES programme. Most of the Scandinavian countries are involved in the ES0801 action and an increased interest in the GEOTRACES programme from all countries have been noticed during latter part of 2008 and early 2009. A workshop for trace metal work in the Baltic Sea is currently being planned by the Finnish community. This is a very positive development for the GEOTRACES programme in Scandinavia.

A workshop, supported by COST action ES0801 on GEOTRACES project planning in the Arctic Ocean, Bering Sea and the Nordic Seas took place in Delmenhorst, Germany, during 8-9 June 2009. The workshop included 4 Swedish participants.

Expedition work related to GEOTRACES

Scientists from the Swedish Museum of Natural History, Stockholm University and Luleå Technical University took part in the analyses of samples collected during the GEOTRACES intercalibration cruises 2008-2009.

The International Siberian Shelf Study 2008 (ISSS-08) was a “GEOTRACES-compliant” cruise and a major IPY ship-based programme along the entire Eurasian-Arctic continental shelf with combined biogeochemical and geophysical observations (see Fig 1). The work was conducted from the Russian research vessel *R/V Yakov Smirnitsky* during 15 Aug. to 25 Sept.

ISSS-2008

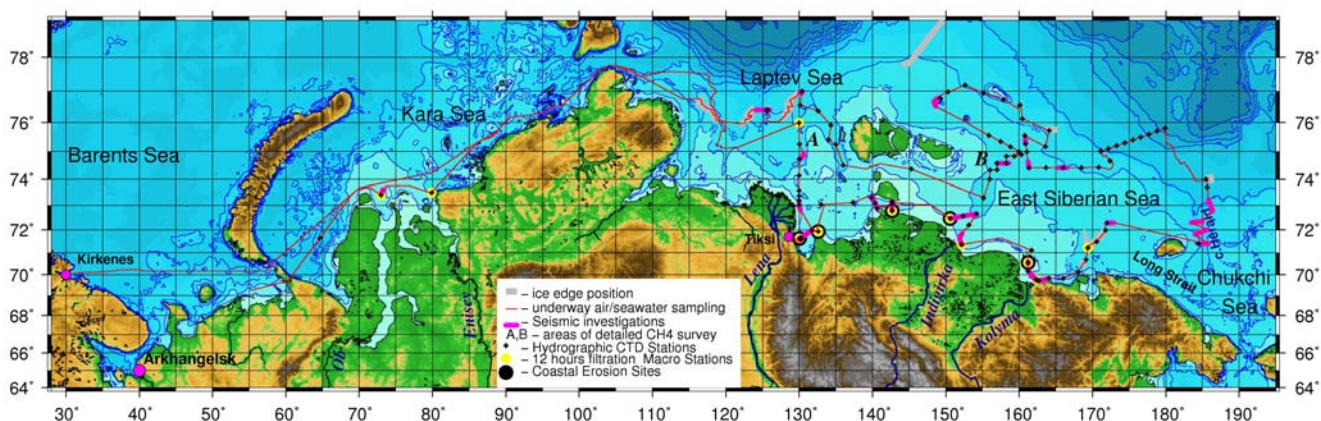


Fig. 1. The transect of the ISSS-08 starting and ending in Kirkenes, Norway. More than 130 stations for CTD and water sampling, 100 sediment coring sites, and 4 coastal erosion sites were investigated.

Planned analyses of collected air, seawater, eroding soil and sediment material include molecular and isotopic biomarker composition, as well as trace element and isotope characterizations following the protocol launched for GEOTRACES work during IPY.

A more detailed report on ISSS-08 with participants and scientific programmes can be found in the journal EOS <http://www.agu.org/journals/eo/eo0917/2009EO170001.pdf#anchor> and supplementary information http://www.agu.org/eos_elec/2009/gustafsson_90_17.html

Per Andersson/

Stockholm 21 July, 2009

UK and EU Cost Action

UK-GEOTRACES

1. South Atlantic Zonal GEOTRACES Section

Funding has been secured from the UK funding agency NERC for the A10 GEOTRACES Section along 40°S from Cape Town to Montevideo in a proposal led by Gideon Henderson (Oxford); Rachel Mills (Southampton); Richard Pancost (Bristol); and Ros Rickaby (Oxford). That proposal also provides funding for the paleoproxy measurements suggested in the GEOTRACES Science Plan. A second proposal has recently been submitted to fund an extensive set of trace metal measurements, which would complete the GEOTRACES key

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parameters and establish a formal UK-GEOTRACES programme. The cruise is likely to take place in November 2010.

2. Tropical Atlantic Zig-Zag GEOTRACES Section

Funding has also recently been secured from NERC for the A06 GEOTRACES Section under the Saharan dust plume in the north tropical Atlantic via a proposal led by Eric Achterberg (Southampton) and Maeve Lohan (Plymouth). That proposal includes funding for a large number of the GEOTRACES key parameters. The cruise is likely to take place sometime in 2011.

3. Data Management

The UK hosts the GEOTRACES International Data Assembly Centre at the British Oceanographic Data Centre in Liverpool. Ed Mawji co-ordinates data management efforts for the programme. See <http://www.bodc.ac.uk/geotraces/> for details.

GEOTRACES COST Action

An ESF-funded “COST Action” helps to co-ordinate GEOTRACES activities across Europe. Eighteen countries have signed up for the Action and are represented on its Management Committee (Belgium, Croatia, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, United Kingdom). Four working groups have oversight of Cruise Planning; Intercalibration; Data Management; and Training. The Action provides funding for short-exchange visits for scientists travelling from one European country to another to conduct GEOTRACES-related science. It has also contributed to the costs and organisation of the recent GEOTRACES Arctic Workshop (8-10 June 2009, Germany) and will do likewise for the forthcoming 2nd Data-Modelling Synergy workshop (7-10 December 2009, France). Future open meetings are planned to discuss GEOTRACES Activities in the Mediterranean and the Baltic. Full details of the Action can be found at: <http://costaction.earth.ox.ac.uk/>

USA

U.S. GEOTRACES scientists have been involved in the following activities during the past year.

1) Intercalibration: Both GEOTRACES intercalibration cruises (June-July, 2008, Bermuda to Norfolk; 6-30 May 2009, Honolulu to San Diego) took place aboard the U.S. Research Vessel *Knorr*. U.S. GEOTRACES hosted the international Intercalibration workshop in San Francisco (13-14 December 2009).

2) Planning Workshops: A Planning and Implementation workshop was held in Woods Hole (22-24 September 2008) to develop a strategic plan for the first U.S. GEOTRACES section, tentatively planned for late 2010 from Woods Hole to Lisbon. A second Planning and Implementation workshop (1-3 October 2008; Los Angeles) developed preliminary plans for the

second and third U.S. GEOTRACES sections, tentatively in the Pacific Ocean. One section runs from Alaska to Tahiti and the other from Tahiti to Peru.

The report from the Atlantic workshop was quickly revised to produce an implementation plan, which is available via the Web:

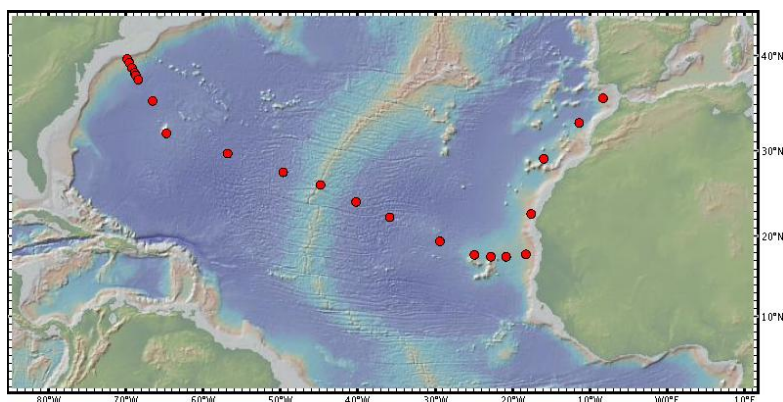
<http://www.who.edu/files/whoiserver.do?id=46083&pt=2&p=52929>, or at

http://www.geotraces.org/documents/US_GEOTRACES_Atlantic_Impln_23Dec08c_46083.pdf.

The Pacific workshop report is also available via the web at http://www.geotraces.org/documents/US_GEOTRACES_Pacific_Report_Jun09.pdf.

3) The U.S. GEOTRACES SSC met 3-4 June 2009 at the NSF. Among other topics covered, the U.S. SSC decided that the Tahiti to Peru section would take place before the Alaska to Tahiti section if the two sections could not be run consecutively. A long-range goal is to link the U.S. section from Tahiti to Peru with the combined Australia-New Zealand section running eastward from Northern Australia to produce a complete quasi-zonal section across the southern tropical Pacific Ocean.

4) Proposals from individual scientists seeking to participate in the U.S. GEOTRACES zonal section crossing the North Atlantic were submitted to a NSF deadline 15 February 2009. A complete count is unavailable, but approximately 20 to 25 proposals were submitted. At the time of this report, funding decisions are still being made concerning those proposals. A small number of additional proposals will be submitted to NSF for a deadline on 15 August 2009. It is anticipated that all GEOTRACES key parameters will be measured on the North Atlantic section. Representatives from each of the funded projects will create a final section plan at a cruise planning meeting in March 2010. The cruise dates are not yet set, but the cruise is anticipated to begin sometime between August and November 2010.



Station locations along the US GEOTRACES North Atlantic cruise track (US GEOTRACES North Atlantic Implementation Plan). Red dots represent stations where full water column sampling is anticipated. Final station locations will be determined by funded investigators at a pre-cruise meeting.

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

Terms of Reference:

- To develop the Surface Ocean - Lower Atmosphere Study (SOLAS) Science Plan and an Implementation Strategy, in accordance with guidance of the sponsoring organisations.
- To oversee the development of SOLAS in accordance with its Science Plan/Implementation Strategy.
- To collaborate, as appropriate, with other related projects of IGBP, WCRP, SCOR and CACGP and related projects and programmes (e.g., IHDP, DIVERSITAS, IOC and the Global Ocean Observing System (GOOS), etc.)
- To establish appropriate data management policies to ensure access to, sharing of, and preservation of SOLAS data, taking into account policies of the sponsors.
- To report regularly to SCOR, IGBP, WCRP and CACGP on the state of planning and accomplishments of SOLAS.
- The SOLAS SSC, its subsidiary groups and International Project Office shall operate in accordance with the operating procedures for IGBP Projects and as required by other co-sponsors.

Chair:

Douglas W.R. Wallace
Forschungsbereich Marine Biogeochemie
IFM-GEROMAR
Leibniz-Institut für Meereswissenschaften
an der Universität Kiel

Düsternbrooker Weg 20
24105 Kiel, Germany
Tel. 0431-600-4200
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Members:

Gerrit de Leeuw	NETHERLANDS	Peter Liss (past chair)	UK
Veronique Garçon	FRANCE	Wade McGillis	USA
Sergey Gulev	RUSSIA	Shigenobu Takeda	JAPAN
Barry Huebert	USA	Eric Saltzman	USA
Truls Johannessen	NORWAY	Guang-Yu Shi	CHINA-Beijing
David Kieber	USA	Jacqueline Stefels	NETHERLANDS
Nilgun Kubilay	TURKEY	Oswaldo Ulloa	CHILE
Christiane Lancelot	BELGIUM	Roland Von Glasow	UK
Isabel Cacho Lascorz	FRANCE		
Cliff Law	NEW ZEALAND		

Executive Committee Reporter: Huasheng Hong

IGBP Liaison: Wendy Broadgate

Executive Officer: Emily Breviere

Annual Report from SOLAS to SCOR. Aug 2008- July 2009

Version of 23 July 2009 by Dr Emily Breviere

SOLAS International Project Office (IPO)

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).

Currently, Dr. Emily Brévière is the Executive Officer (EO) of the IPO (since Aug. 2008), Georgia Bayliss-Brown is the IPO Project Officer (PO) (since Oct. 2008), and Hannah Mossman is IPO Research Assistant, 3 days a week (from Feb. to Aug. 2009). In Sept. 2009, Georgia Bayliss-Brown will step down from the IPO. The search for the Project Officer position is currently underway.

Funding for the operation of the IPO in Norwich expires in March 2010. Plans are being formulated for future plans for placement and funding of the IPO.

SOLAS Scientific Steering Committee (SSC)

The SOLAS SSC met in Washington, D.C., USA, in March 2009.

The current membership of the SSC:

Name	Gender	Country	Expertise
Isabel Cacho Lascorz	F	Spain	Paleoceanography
Min-Han Dai	M	China	Ocean coastal Carbon
Gerrit de Leeuw	M	Finland	Atmospheric boundary layer
Veronique Garcon	F	France	Biogeochemical models
Cecile Guieu	F	France	Marine ecosystems
Sergey Gulev (WCRP)	M	Russia	Air-sea physical interaction
David Kieber	M	USA	Photochemistry
Nilgun Kubilay	F	Turkey	Atmospheric transport
Cliff Law	M	New Zealand	Air-sea exchange / nutrients
Wade McGillis (WCRP)	M	USA	Ocean boundary layer
Patricia Quinn	F	USA	Aerosols / atm chemistry
Eric Saltzman	M	USA	Aerosol chemistry
Guang-Yu Shi	M	China	Atmospheric transport coast
Rafel Simo	M	Spain	Biogeochemical cycles
Jacqueline Stefels	F	Netherlands	Sulfur cycle
Shigenobu Takeda	M	Japan	Nutrient biogeochemistry

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(Vice Chair)			
Roland von Glasow	M	UK	Halogens
Doug Wallace (Chair)	M	Germany	Carbon, air-sea overview

Jan 2010: To Depart - Wade McGillis, M, USA, ocean boundary layer (WCRP member)
 To Depart - Gerrit De Leeuw, M, Finland, atmospheric boundary layer
 To Depart - Shigenobu Takeda, M, Japan, nutrient biogeochemistry

SOLAS National Networks

Twenty six nations are part of the SOLAS network. Each has a representative and/or a coordinator:

Australia: Michael Grose
Belgium: Christian Lancelot
Brazil: Amauri Pereira de Oliveira
Canada: Maurice Levasseur
Chile: Giovanni Daneri
China: Guang-Yu Shi
Denmark: Soren Larsen
France: Remi Losno
Germany: Doug Wallace and Ulrich Platt
India: Dileep Kumar
Ireland: Brian Ward
Italy: Maurizio Ribera d'Alcala
Finland: Gerrit de Leeuw
Japan: Mitsuo Uematsu
Korea: Kitack Lee
Netherlands: Jacqueline Stefels
New Zealand: Phil Boyd
Norway: Abdirahman Omar
Russia: Sergey Gulev
Spain: Rafel Simo
Southern Africa: Carl Palmer
Sweden: Katarina Abrahamsson
Taiwan: Gwo-Ching Gong, Wu-Ting Tsai and Kon-Kee Liu
Turkey: Baris Saglihoglu
UK: Phil Williamson
USA: Wade McGillis

Several nations have SOLAS research programs or projects in the planning stages, but research is active in many countries. For the first time in Jan. 2009, the national representatives of the SOLAS nations were asked to fill in a template form to report on the various types of SOLAS activities in their countries that took place in the calendar year 2008. These reports are available

on the SOLAS Web site. From now on, they will be asked to fill in this form annually. Some highlights are reported below.

Belgium

Research projects in which Belgian scientists carried out SOLAS-related activities include

- BELSPO: Assessing the sensitivity of the Southern Ocean's Biological Pump to Climate Change BELCANTO
- BELSPO: Role of Pelagic cAlcification and export of CarbonatE production in climate change PEACE
- FRFC: “Biogéochimie des glaces de mer dans les océans polaires: implications sur les échanges de gaz à effet climatique et les variations climatiques d'origine naturelle ou anthropique ». Belgian contribution to the IPY
- EU IP: Towards an integrated marine Carbon sources and sinks assessment CARBO-OCEAN
- EU IP: Southern European Seas: Assessing and Modelling Ecosystem changes SESAME

Brazil

In 2008, the SOLAS Brazil has been consolidated with three projects:

1. FluTuA : Turbulent Fluxes over the Tropical Atlantic. Coordinator: Jacyra Soares. Air-Sea Interaction Group. Institute of Astronomy, Geophysics and Atmospheric Sciences University of São Paulo, São Paulo, Brazil.
2. Study of the Atmospheric Boundary Layer in the Region of Brasil-Malvinas Confluence. Coordinator: Marcelo Dourado. Centre for Ocean Studies. Federal University of Paraná, Pontal do Sul, PR, Brazil.
3. Sea Waves and Coastal Monitoring at São Paulo State Valdir Innocentini. Coordinator: Valdir Innocentini. CPTEC/INPE.

Canada

The goal of the Arctic SOLAS program is to explore the interactions between sea ice, water circulation, marine microbiological activity and emissions of these gases from the ocean to the Arctic atmosphere. Two key questions are (1) How will the increased flow of Pacific waters through the Canadian Archipelago affect the dynamics of climate-active gases in the ocean, and (2) How will these gases be affected by a reduction of sea-ice cover, and increased areas of open water? These questions are being addressed during two expeditions on the Canadian research ice-breaker *Amundsen* as part of the International Polar Year. The expeditions took place during the fall of 2007 and 2008. The key preliminary findings from the 2008 cruise are

- The 2008 SOLAS transect from Resolute to Greenland effectively captured the transition from Pacific-derived waters exiting the Arctic via Lancaster Sound and the Atlantic-derived waters moving north along the Greenland coast. The strong and deep depletion of silicate near the mouth of Lancaster Sound indicates a hotspot of diatom production which could have a direct effect on the production of biogenic trace gases.

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- Major progress was made on our understanding of the dynamics of DMS production in the Arctic. Our incubation experiments with radio-labelled ^{35}S -DMSP revealed low but detectable bacterial DMSP uptake and DMS production during both cruises. In 2008, DMS production was linearly related to the bacterial DMSP uptake rate which, in turn, was positively correlated with the availability of dissolved DMSP. These results suggest that DMS bacterial production at these high latitudes and time of the year are limited by the availability of substrate, not temperature. In that context, future increases in primary productivity due to climate warming as predicted by most models should lead to an increase in DMS production and ventilation with a potential cooling effect (negative feedback) on climate.
- Significant concentrations of nitrous oxide (N_2O) were detected for the first time at the bottom of annual ice in the Beaufort Sea. This represents a new source of greenhouse gas (GHG) in the Arctic which is not taken into account in current Arctic climate models. The data collected as part of this project will allow estimating the magnitude and potential importance of this source of GHG.
- Our results show important inter-annual variations in atmospheric dimethylsulfide (DMS) concentrations during the fall period. Average atmospheric DMS concentrations in September 2008 were approximately twice those in October 2007. Preliminary results from aerosol and SO_2 samples suggest a significant proportion of atmospheric S products are derived from biogenic DMS oxidation. The composition of the submicron-sized Arctic aerosol during the Fall period has sizable fractions of both organics and sulphate present, and there are very few new particle nucleation events occurring.

China (Beijing)

- A four-year China-SOLAS project funded through NSF-China ended in 2008 (The budget was RMB 8 M). Various workshops towards an effort of synthesis were organized in 2008. The project focuses on the coupling of biogeochemical and physical processes between surface ocean and lower atmosphere over two contrasting marginal seas: the Yellow Sea and the South China Sea.
- A new SOLAS-relevant research program has been funded through the National Basic Research Program (“973” program) on “Carbon cycling in China Seas – budget, controls and ocean acidification (CHOICE-C)” with a budget of about 18 million RMB for 2009-2010. The “973” program is one of the most competitive basic research programs in China. The present project focuses on the carbon budget, controls, ecological response and future changes in coastal ocean systems. There will be many SOLAS-related activities with CHOICE-C program

China (Taipei)

There are three SOLAS-relevant research projects in Taiwan:

1. Long-term Observation and Research of the East China Sea (LORECS),
2. South-East Asia Time-series Study (SEATS), and
3. Atmospheric Forcing on Ocean Biogeochemistry (AFOBi). The new initiative, AFOBi, is focused on how the exchanges of momentum, energy and matter across the air-sea interface may affect the biogeochemistry of the ocean. The AFOBi (Contact: Professor George T.F. Wong) project is a multidisciplinary multi-institutional project involving a

dozen or so of principal investigators from several institutions: the AS-RCEC, the NTU-DAS, the Institute of Oceanography, National Taiwan University, and the University of California, Davis. The main focus of the project is on how the exchanges of momentum, energy and matter across the air-sea interface may affect the biogeochemistry of the oceans. The project is supported by the Academia Sinica and has started to receive funding since 2008. A network of aerosol sampling stations have been set up at several locations around Taiwan Island, at the Tungsha Island in the remote South China Sea, at Kinmen Island adjacent to the Chinese Mainland and at Xiamen, China to examine the chemical and physical characteristics of Asian dusts and how they may have been modified during transport.

France

French SOLAS activities are funded by CNRS/INSU through the LEFE program (Fluid envelopes and environment), by ANR (National Agency for Research), by IPEV (Institut Paul Emile Victor), but also by CNES and other funding institutions (IRD, CEA, etc...) and universities. A more extensive and complete view of French SOLAS activities will be achieved at the meeting planned in June 2009, including a special joint meeting of the French IMBER and SOLAS communities, on June 22-23, 2009 at University Paris Diderot in Paris. The "state of the art" of the French SOLAS activities will be described in detail.

Ireland

- Funding of the proposal "Development of a Greenhouse Gas Ocean-Atmosphere Flux Sensor with MEMS-based Photoacoustic Technology". This grant was funded under the US-Ireland Partnership Programme. (Ward, NUIG)
- The 4th SOLAS-IE workshop was held at NUI, Galway in December 2008. There were 9 presentations from researchers at Irish universities and government agencies. (Ward, NUIG)

Japan

- STAGE (Studies on the Antarctic Ocean and Global Environment) program. Oceanographic observations were carried out in January 2008 onboard RT/V *Umitakamaru* (Tokyo University of Marine Science and Technology) and in February 2008 onboard R/V *Hakuho-maru* (JAMSTEC) in the Indian sector of the Southern Ocean as a part of STAGE program.
- W-PASS (Western Pacific Air-Sea Interaction Study) program
 - July 29–September 18, 2008: SPEEDS (Subarctic Pacific Experiment for Ecosystem Dynamics Study) Cruise by R/V *Hakuho-Maru* (KH-08-2: SOLAS/IMBER joint cruise): Northwestern North Pacific. We found phytoplankton bloom patches of various stages with age and determined differences among composition of marine biogases from age of the patches.
 - October 13–November 10, 2008: R/V *Mirai* Cruise (MR08-04, 05): Equatorial and Northwestern North Pacific eddy-covariance flux measurements have been carried out during cruises from Japan to the equatorial and subarctic regions by R/V *Mirai* during the summer and fall of 2008.
 - December 12, 2008: Workshop on the biological responses to typhoon passing in the subtropical Pacific and its marginal seas. Faculty of Agriculture, The

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University of Tokyo, Convener: Atsushi Tsuda

- January 15–March 30, 2009: R/V *Mirai* Cruise (MR08-06): Western North Pacific, Central Pacific, Eastern South Pacific. ATOFMS Aerosol. Time-of-Flight Mass Spectrometer was set up below the bow hold of the ship as well as various atmospheric sampling equipments on the compass deck from Japan to Chile.

New Zealand

NZ SOLAS SAGE *Deep-Sea Res II* Special Issue – 10 papers (submitted and in press)
Collaborative New Zealand-Australia SOLAS-GEOTRACES activities include a trace metals/biogeochemistry research voyage in Tasman Sea (2010) and a two-ship transect of S.W. Pacific (2010-2011).

Norway

- Training workshop “The Fundamentals of carbon biogeochemistry” for students and researchers involved in ocean acidification research. 24-27 February 2009, Bjerknes Centre for Climate Research, University of Bergen, Norway. Sponsored by the EU projects EPOCA and CARBOOCEAN and the IOCCP.
- SOCAT database: Initial data base with more than 2100 cruises and > 7 million surface CO₂ measurements was produced and distributed to SOCAT scientists. Final product will be released in late 2009.

Russian Federation

“Global air-sea gas exchanges and their climate relevance” subproject is approved by the National Ministry of Education and Science as a part of the Federal Research “World Ocean” programme (funding is expected to be started in June 2009).

Southern Africa

- South African Symposium of Atmospheric Sciences, September 30–October 1, 2008
- At the annual South African Symposium of Atmospheric Sciences (SASAS), Dr. Carl Palmer presented on the formation of the Southern African SOLAS network and the international project.
- Investigations of phytoplankton production were undertaken during research cruises to the southeast coast (November 2008, Mossel Bay-Port St Johns) and the west coast (February 2009, Cape Town-Orange River). Experimental work included photosynthesis-irradiance experiments using both ¹⁴C labelling and fast repetition rate fluorometry, measurements of pigments by liquid chromatography and phytoplankton absorption by integrating sphere spectrophotometry. Preliminary results indicated high primary production in patches on the west coast and low production in upwelled water near the coast, while production on the southeast coastal shelf was generally lower than on the west coast. Pigment indices revealed that diatoms tended to dominate the high productivity patches and upwelling zones, with a high proportion of Chl a in the pigment pool. Mixed communities of small flagellates, diatoms and dinoflagellates were generally observed in lower biomass waters.

Turkey

- Southern European Seas: Assessing and Modelling Ecosystem change (SESAME) project. Currently Turkish research vessel R/V *Bilim's* cruises are ongoing as part of SESAME project under FP6 of EC. During the oceanographic cruise in Mediterranean Sea, the Aegean Sea, the Sea of Marmara and the Black Sea aerosol samples have been collecting.
- IMS-METU has an atmospheric sample collection tower located at the campus of IMS-METU, which is located of the Turkish coast of the eastern Mediterranean. Aerosol and rain samples are collected on the tower to perform nutrient (nitrate, ammonium, phosphate, silicate) analyses since 1999.
- Climatic Importance of Aerosols above the Eastern Mediterranean Area: A comprehensive study was conducted of the chemical and optical aerosol characteristics, of their interrelation, for the eastern Mediterranean (Turkish Scientific and Technical Research Council – TUBITAK, 105Y368). This is a region where the direct radiative forcing by anthropogenic and natural aerosols is expected to be much larger than average, and for which model calculations suggested that anthropogenic sulphate levels and their direct radiative effects are very pronounced. At sites in Crete (Greece) and in Erdemli (Turkey) long-term measurements have been performed of (a) the chemical and optical characteristics of the boundary layer (in situ) aerosol, (b) the column-integrated optical depth, and (c) aerosol size distribution. The various data sets obtained have been interrelated to each other to assess to what extent the ground-level in situ aerosol characteristics are representative for, are related to, or can be used for the prediction of the chemical and optical aerosol properties in the entire vertical column.
- Evaluation of the seawater solubility of Fe in the Eastern Mediterranean Aerosol Project started in September 2007 (NATO collaborative Linkage Grant, CLG – Ref 982862). Study aims to develop and test a novel approach to determine the seawater solubility of aerosol Fe and solid-state speciation of Fe in (i) the Eastern Mediterranean marine aerosol (range of aerosol population types, ranging from human input-dominated to Saharan dust-dominated populations) at three contrasting sites (ii) changing seawater solubility and solid state speciation of Fe (and other trace metals) during the transport of intense Saharan dust events and to define the change in chemical composition (major, minor and water soluble constituents) of the marine aerosol during the passage of intense Saharan dust events over the Levantine Basin of the Eastern Mediterranean.
- megaCITY-Zoom for the Environment: The main objectives of CityZen project (megaCITY-Zoom for the Environment, FP7 IP) are to quantify and understand current air pollution distribution and development in and around megacities/hot spot regions, estimate the future impact from emission changes (with a focus on the effect of rapid growth in the population of megacities/hot spots), estimate how megacities/hot spots influence climate change, develop tools to estimate interactions between different spatial scales (megacities to global) and bring the scientific results and methods developed and applied during the course of the project to semi-operational use with those consortium partners that on a more permanent basis provide technical underpinning of policy work.

United Kingdom

- The NERC-funded UK SOLAS directed programme (involving ~30 projects) is now nearing completion, with data analysis, interpretation and initial publications covering a

very wide range of activities. Two research cruises were planned for 2008, but one of these was re-scheduled to 2009. The final UK SOLAS research cruise (previously scheduled for both 2006 and 2008), took place in 2009: Discovery 338 (15 Apr – 27 May, Tenerife/Tenerife). Led by Carol Robinson, UEA, it studied the impact of coastal upwelling on air-sea exchange of climatically important gases (ICON project). Involvement of several other UK SOLAS projects are involved, with close links with Theme 2 (biogeochemistry) of the Oceans 2025 programme.

- The 2008 UK SOLAS Annual Science Meeting was held at the Solent University Conference Centre, Southampton, 6-8 October. There were 56 participants, 30 oral presentations and 13 posters.
- The ASM was followed by the 9th meeting of the UK SOLAS Steering Committee, chaired by Howard Cattle.
- The 2008 Challenger Conference (Bangor, 8-11 Sep) included sessions on “Oceans, atmosphere and biogeochemistry”. These featured 20 oral presentations and 9 posters arising from UK SOLAS studies.
- Most UK SOLAS science projects will be completed by late 2009/early 2010. NERC support for data management and programme coordination will, however, continue in 2010, and the scientific effort is expected to be maintained through a broader range of funding sources. The 2009 UK SOLAS Annual Science Meeting is scheduled for September, and a ‘programme finale’ meeting is planned for early 2010. Strong national links with IMBER have been developed.

SOLAS Mid-term Strategy

The Science Plan and Implementation Strategy (SP&IS) was approved by sponsors in 2004, and forms the foundation of the SOLAS programme. However, during a decade-long research programme, emphases shift and implementation approaches may need to be adapted.

The SOLAS Scientific Steering Committee (SSC) recently identified a set of research topics and issues relevant to SOLAS that are both topical and require international coordination to make progress. These topics are now described in a set of white papers, listed below, which have the goal to stimulate research and cooperation at the international level. These papers were presented in draft form to U.S. program managers from five funding agencies (NOAA, NASA, NSF, DOE and ONR) during the SSC meeting held in Washington, D.C. in March 2009. For the past month, SOLAS has welcomed contributions from the community towards these important developments in SOLAS science. SOLAS is distributing the white papers on the SOLAS international Web site and request comments and input.

- Sea-ice biogeochemistry and interactions with the atmosphere
- Ocean-derived aerosols: production, evolution and impacts
- Atmospheric control of nutrient cycling and production in the surface ocean
- Ship plumes: impacts on atmospheric chemistry, climate and nutrient supply to the oceans
- Activity of oxygen minimum (OMZ) in the Pacific (AMOP-SOLAS)
- SOLAS Observatory and MOIN: the Minimalist OceanSITES Interdisciplinary Network

- SOLAS large-scale field experiments - A compendium of proposals

These seven new initiatives will form the basis of the afternoon discussion sessions at the SOLAS Open Science Conference in November 2009.

The leader of the first initiative on ‘Sea-ice biogeochemistry and interactions with the atmosphere’, Jacqueline Stefels submitted a proposal to SCOR for a working group on Sea-ice biogeochemistry. This working group would have the aim of understanding the coupling between ice physics and biogeochemical processes at the sea-ice-atmosphere interfaces as a prerequisite to quantify the role of ice-covered oceans in climate change scenarios, in the past, present and future.

SOLAS Open Science Conference (OSC) 2009, 16-19 Nov 09, Barcelona, Spain

The SOLAS OSCs were held in Damp, Germany (Feb. 2000), Halifax, Canada (Oct. 2004), and Xiamen, China (March 2007). It was felt that the format of the most recent two OSCs provided unique opportunities to network and establish collaborations in an incredibly useful way. Therefore, the SOLAS SSC decided to follow the same format for the 2009 OSC.

The 2009 SOLAS OSC will be held on 16-19 November 2009 in Barcelona, Spain. This OSC is being organised by the local hosts, Isabel Cacho and Rafel Simo (Spain, both SSC members) and the IPO. A maximum of 300 scientists are expected to attend the OSC.

This OSC will include plenary talks, long poster sessions (posters will be on display over the duration of the conference), and afternoon discussion and synthesis sessions.

- The plenary talks will be divided into eight thematic sessions, each comprising a keynote talk and several shorter talks by invited speakers (total of 28 talks).
- Parallel discussion sessions provide an informal setting where “hot” topics can be debated, with the aim of furthering research and establishing collaborations. Seven session topics have already been chosen; they are initiatives that the SOLAS SSC identified as being of important to the SOLAS Mid-term Strategy (see above). Seven more sessions proposed by the community will take place.

Until now the OSCs were held about every second year. This year, in particular, the Summer School and the OSC are 3 months apart. In order to avoid this clash in the future, it was decided during the 2009 SSC meeting, to hold future OSCs every 3 years, so the next OSCs should be held in 2012 and 2015. It was also suggested to launch a call to host the OSC 2012; the first release of the call is scheduled for the OSC in Barcelona.

4th SOLAS International Summer School (SSS), 3-15 August 2009, Cargese, Corsica

The SSS is held biennially at the Institut d’Etudes Scientifiques de Cargese in Corsica, France. This site provides a unique environment for the Summer School, with academic classrooms, laboratory facilities, and a nearby port. For each SSS, Veronique Garcon (France) has been able

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to secure the French research vessel *Thetys II* for ship-based practical workshops. Garcon (SSC member and new SSS coordinator) and the IPO are responsible for the planning and operation of the 4th SOLAS Summer School. For this 4th edition, 72 PhD-level students from 25 different countries (20 from developing countries and 52 from developed countries) spent more than two weeks in Cargese. 14 lecturers provided instruction on all aspects of SOLAS science, and this year discussions included publication of research and on the ethics of scientific endeavors.

The lectures from the 2007 Summer School were developed into a textbook. (Title: *Surface Ocean-Lower Atmosphere Processes*, editors: Corinne Le Quere and Eric Saltzman, publisher: AGU). The volume is designed to provide graduate students, postdoctoral fellows, and researchers with a basis for understanding current research issues in biogeochemical interactions between the surface ocean and lower atmosphere. The volume served as a textbook for the SOLAS Summer School 2009; every participant received a copy of the textbook.

To run the SOLAS International Summer Schools, we rely on generous support from various bodies. For example in 2009, the school kindly received support from SCOR, the National Science Foundation (NSF), International Geosphere - Biosphere Programme (IGBP), Centre National d'Etudes Spatiales (CNES), Centre National de la Recherche Scientifique (CNRS), Deutsche Forschungsgemeinschaft (DFG), Natural Environment Research Council (NERC) and other national funding agencies, universities, projects (53 sources in total). In particular, the first three programmes mentioned above help to bring most of the developing countries students to the school. SOLAS is extremely grateful for the support from these programs.

The SOLAS Summer School is highly successful, as self-evaluations from the students and lecturers have shown, and also from the excellent "after-SSS" careers of the alumni. 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.

Following SSC members' suggestions, other locations to host the SSS are still investigated. In parallel, discussions are underway to reassess the future of the Summer School (new format, new targeted audience, new goals...potential new type of event?). These discussions will take into account the fact SOLAS is entering a new phase of its lifetime.

COST Action 735

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' 735 which seeks to develop global air-sea flux data sets of gases and aerosols. The IPO administers the networking funds.

This COST Action 735 has held one management committee meeting in Nov. 2008 in Barcelona, Spain and has sponsored six young scientists (mostly PhD students) to carry out a Short Term Scientific Mission in 2008-2009. Coordinated efforts have been facilitated by the following workshops:

- Sub-WG3 “Coastal CO₂/N₂O/CH₄ Fluxes” meeting (22-23 January 2009, Kiel, Germany)
- Sub-WG1 “Halocarbon Database” meeting (11-12 February 2009, Kiel, Germany)
- Sub-WG1 “Aerosol Iron Solubility and Database” meeting (23-24 February 2009, Norwich, UK)
- Sub-WG2 “Surfactants and the Microlayer Gas Exchange” meeting (18-19 March 2009, Plymouth, UK)
- Sub-WG1 “Processes Controlling O₃ in the Marine Boundary Layer” meeting (12 May 2009, York, UK)
- Sub-WG1 “SOCAT Atlantic-Indian-Southern Ocean Regional” meeting (25-26 June 2009, Norwich, UK)

Reports are available to download at <http://www.cost-735.org/meetings/meetings.html>

Planning is underway for the year 2009-2010 and the next Management Committee meeting will take place in November in Barcelona, Spain.

Fast Track Initiatives (FTI)

In May 2009, IGBP launched two fast-track initiatives proposed by SOLAS and other IGBP core projects.

- 1) Upper Ocean Nutrient Limitation: processes, patterns and potential for change (2009-2011). Coordinator: Mark Moore (NOCS, UK), Co-coordinators: Matt Mills (Stanford Univ., USA)
- 2) Megacities and the Coastal Zone: air-sea interactions (2009-2011). Coordinators: Roland von Glasow (UEA, UK) and Tim Jickells (UEA, UK)

Plans are underway to secure funds and organize workshops. A request for funding from SCOR for the FTI on Megacities and coastal zone is attached to this report.

SOLAS Endorsed Projects

SOLAS has endorsed the following projects in 2009:

- EPOCA *Endorsed since early 2009)
The EU FP7 Project EPOCA (European Project on Ocean Acidification) was launched in May 2008 with the overall goal to advance our understanding of the biological, ecological, biogeochemical, and societal implications of ocean acidification.
- DUNE (Endorsed since early 2009)
The main goal of DUNE, a dust experiment in a low-nutrient, low-chlorophyll ecosystem, is to estimate the impact of atmospheric inputs on an oligotrophic ecosystem submitted to strong atmospheric inputs.
- FLATOCOA (Endorsed since July 2009)
The goal is to know the amount of continental atmospheric dust deposited on the Southern Ocean, including determination of the bioavailable fraction. Special attention is

given to Fe and other micro-nutrients, including Zn, Cd, Mn, P, Si and Co.

The endorsement submission forms are available at

<http://www.uea.ac.uk/env/solas/science/researchendorsements/resentprojects/endorsedprojects.html>.

Asian Dust and Ocean Ecosystem (ADOES)

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 on inputs of masses of dust from the Asian plateau. Two ADOES workshops were held in 2005 and 2006. The Joint 4th Workshop on ADOES with Asian SOLAS to be held on 20-24 May 2009, JeJu, Korea was postponed to a later date, unknown yet.

SOLAS/IMBER EGU special session

A joint IMBER/SOLAS special session has been conducted at the 2005, 2006, 2007, 2008 and 2009 EGU General Assemblies in Vienna. This event is well attended every year.

Tropical Eastern North Atlantic Time-Series Observatory (TENATSO)

Significant effort has been placed into 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, and there is significant participation by U.S.-funded scientists.

The May 2009, *IGBP Newsletter* No. 73 included an article on “SOLAS and Cape Verde scientists establish an atmosphere and ocean observatory off North West Africa” by D. Wallace

SOLAS- IMBER Carbon Group

With IMBER, SOLAS has developed a Joint Carbon Implementation Plan (SOLAS IMP3). This group has recently agreed to move towards a “flat structure” that aims to have three Working Groups (WGs), each with a Chair. These WGs will work cooperatively with the International Ocean Carbon Coordination Project (IOCCP). Terms of reference are been developed. The three WGs are as follow:

- WG1 - Surface Ocean Systems

Chair: N. Metzl, France

Nicolas expressed his desire to step down. Replacement is currently being considered. This WG has been organising several workshops in order to establish the Surface Ocean CO₂ Atlas (SOCAT).

- WG2 - Interior ocean carbon storage

Chair: N. Gruber, Switzerland

This WG has recently held a symposium on “Decadal Variations of the Ocean’s Interior Carbon Cycle: Synthesis and Vulnerabilities,” in Switzerland on July 13-17, 2009.

- WG3- Ocean Acidification – Will be formed soon.

Chair: Jean-Pierre Gattuso, France

This WG is being built from groups and structures already in place (EPOCA for example).

SOLAS Funding

This year is rather exceptional event-wise for SOLAS, with two major SOLAS events are taking place in the same year, which has inevitably had a significant impact on the SOLAS budget, with impacts on commitments for other activities. With the development of the Mid-term Strategy initiatives, securing further funding will be crucial in order to implement them and to start the synthesis exercise. Seeking funding for coordinating activities remains an overwhelming constraint for the project and the IPO.