

### **3.0 LARGE-SCALE OCEAN RESEARCH PROJECTS**

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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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Jurgen Alheit	GERMANY	Astrid Jarre	DENMARK
Kevern Cochran	ITALY	Daniel Lluch-Cota	MEXICO
Brad de Young	CANADA	Olivier Maury	FRANCE
Ruben Escribano	CHILE	Ian Perry	CANADA
Roger Harris	UK	Jeffrey Runge	USA
Eileen Hofmann	USA	Yasunori Sakurai	JAPAN
James Hurrell	USA	Svein Sundby	NORWAY

**Executive Officer:** Manuel Barange

**Executive Committee Reporter:** Peter Burkill

## **GLOBEC: Global Ocean Ecosystem Dynamics**

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

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

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#### **1.1. GLOBEC-sponsored international symposia**

- **GLOBEC/PICES/ICES 4th International Zooplankton Production Symposium: human and climate forcing of zooplankton populations.** Hiroshima, Japan, 28 May-1 June 2007. Zooplankton research is central to GLOBEC, and for this reason GLOBEC has been a sponsor of this series of symposia for some time. The 4<sup>th</sup> IZPS followed on the very successful 3<sup>rd</sup> IZPS held in Gijon, Spain, May 2003, also co-sponsored with ICES and PICES. The symposium was attended by 334 participants from 46 countries, who contributed 141 oral and 250 poster presentations. There will be two special issues from the symposium, one in the *ICES Journal of Marine Science* 65(3), 2008, covering most of the contributions presented, and one in *Deep-Sea Research II* on “Krill biology and ecology”, resulting from Workshop #3. SCOR supported three developing country scientists to the meeting.
- **GLOBEC CLIOTOP 1<sup>st</sup> Symposium “Climate Impacts on Oceanic Top Predators”.** La Paz, Mexico, 3-7 December 2007. The first CLIOTOP symposium focused on implementing the synthesis objectives of CLIOTOP following from three years of intensive workshops. The symposium had a special interest in presenting comparative studies between regions or species and papers dealing with an integrated approach, combining observation/experiments and modelling. SCOR was a co-sponsor of this symposium through support of developing country scientists. The symposium sessions were attended by almost 200 scientists delivering 93 oral and 73 poster presentations.
- **GLOBEC-IMBER-SOLAS-EUROCEANS symposium on “Dynamics of Eastern Boundary Upwelling Ecosystems: integrative and comparative approaches”.** Las Palmas, Spain, 2-6 June 2008. This was the first symposium co-sponsored by all three SCOR marine projects, receiving generous support from SCOR to developing country scientists. The symposium considered most aspects of the dynamics, structure and functioning of the four major eastern boundary upwelling ecosystems linked to the Benguela, California, Canary (African Canary and Iberian Peninsula) and Humboldt Current systems. These aspects include climate and ocean dynamics, climate change, physics of the ocean and atmosphere, biogeochemistry, ecosystem production, ecology (including behavioural ecology), food-web structure and dynamics, trophic interactions, fisheries assessment and

management. The symposium was convened by Pierre Fréon, IRD (France), Javier Aristegui, ULPGC (Spain) and Manuel Barange, PML (UK) and was a clear success. More than 350 scientists attended the symposium, with very even representation from each of the four regions. The symposium website is [www.upwelling-symposium.org](http://www.upwelling-symposium.org). Approximately 40 papers are expected to be published in *Progress in Oceanography*.

- **ICES/PICES/IOC symposium on “Effects of climate change on the world's oceans”.** Gijón, Spain, 19-23 June 2008 (co-sponsored by GLOBEC, WCRP and SCOR). The symposium had its origins in the high scientific and social relevance to assess the consequences of climate change on the world's oceans and on our poor understanding of the sensitivity and adaptability of natural and managed ecosystems to climate change. The symposium focused on the major issues of climate change that affect the ocean: oceanic circulation, climate modelling, cycling of carbon and other elements, acidification, oligotrophy, changes in species distributions and migratory routes, sea-level rise, coastal erosion, etc. For more information visit [http://www.pices.int/meetings/international\\_symposia/2008\\_symposia/Climate\\_change/climate\\_background\\_3.aspx](http://www.pices.int/meetings/international_symposia/2008_symposia/Climate_change/climate_background_3.aspx).
- **GLOBEC-FAO-EUROCEANS symposium on “Coping with global change in marine social-ecological systems”.** Rome, Italy, 8-11 July 2008. This symposium is the culmination of the GLOBEC Focus 4 working group activity. It was highly successful, and was attended by more than 200 scientists from both natural and social science disciplines. Social-ecological systems have marine (including physical-biological sub-systems) and human (including cultural, management, economic, and socio-political sub-systems) components which are highly inter-connected and interactive. The central goals of this symposium were to share experiences across disciplines and to identify key next steps and common elements and approaches that promote resilience of marine social-ecological systems in the face of global changes. The meeting was convened by Ian Perry (Fisheries & Oceans Canada, Nanaimo, Canada), Rosemary Ommer (University of Victoria, Victoria, Canada) and Philippe Cury (IRD/CRH, Sète, France). For more information visit [www.peopleandfish.org](http://www.peopleandfish.org).
- **ICES-GLOBEC symposium “Linking Herring: linking biology, ecology and status of populations in the context of changing environments”.** Galway, Ireland, 26-29 August 2008. This symposium is intended to provide the ultimate link to our understanding of herring populations in the Atlantic and Pacific oceans. The convenors are Maurice Clarke (Ireland), Mark Dickey-Collas (The Netherlands) and Aril Slotte (Norway). Scientific Steering committee members include Emma Hatfield (UK), Doug Hay (Canada), Richard Nash (Norway), Deirdre Brophy (Ireland) and Øyvind Fiksen (Norway). The meeting has the following planned sessions:
  1. Herring in the middle - the trophic and ecological interactions and impacts of herring - Andrew Bakun (USA)
  2. Managing change - management and exploitation of herring in a dynamic environment, within the context of long-term change - Martin Pastoors (The Netherlands)
  3. Variable production - particularly the role of reproduction, recruitment and life history strategies

4. Population integrity - the rigidity of stocks and the drivers of migration
5. Counting herring - qualitative and quantitative estimation of herring and its application - John Simmonds (UK)
6. Advances in herring biology- Audrey Geffen (Norway)

The symposium website is <http://www.linkinherring.com/>.

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

## 1.2 GLOBEC workshops, regional and national symposia

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

- **PICES XVI Annual Meeting.** Victoria, Canada, 26 October-4 November 2007. The meeting included the following GLOBEC/PICES CCC sessions:
  1. Towards ecosystem-based management: recent developments and successes in multi-species modeling;
  2. Fisheries interactions and local ecology; and
  3. Operational forecasts of oceans and ecosystems

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

- **GLOBEC-BENEFIT synthesis symposium.** Swakopmund, Namibia, 19-21 November 2007. BENEFIT, one of the most successful capacity building efforts of GLOBEC, was completed in December 2007. A special GLOBEC Report with scientific highlights, history of the project and appraisal of its achievements by its advisory panel, will be published before the end of 2008.
- **GLOBEC Germany Symposium.** 14-15 November 2007. Hamburg, Germany. This symposium concluded the activities of this successful GLOBEC national programme.
- **3<sup>rd</sup> Japan-Korea-China GLOBEC symposium.** Hakodate, Japan, 13-15 December 2007. The 3<sup>rd</sup> regional symposium provided new information and a forum for discussion regarding new research findings of the national GLOBEC programmes in this region. Particular topics of interest were ecosystem structure and environmental factors, food web tropho-dynamics, physical-biological processes and models, climate change, regime shifts, bottom-up and top-

down control of marine ecosystems, and ecosystem-based management. How to integrate GLOBEC and the Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) project after 2009 were discussed at the symposium.

- **GLOBEC-ESSAS 2008 Science Meeting.** Halifax, Canada, 15-19 September 2008. A series of ESSAS workshops is planned in Halifax, Nova Scotia. The workshops will include a follow-up 1-day session on predicting future climates in the ESSAS regions, a 1-day workshop devoted to presentations and discussions from the 2008 Science meeting in Hakodate, a half-day session on advective processes and a 1-day workshop on assessing the best approaches to using models for comparing the ESSAS regions and their responses to climate change.
- **GLOBEC Synthesis book Editors meeting.** Halifax, Canada, 18-19 September 2008. This meeting will be used to complete the editing of the GLOBEC synthesis book, to be submitted to Oxford University Press in October 2008, to appear in time for the GLOBEC 3<sup>rd</sup> OSM in June 2009.
- **2<sup>nd</sup> GLOBEC QUEST\_Fish PI meeting.** UK, 14-15 October 2008. QUEST\_Fish is a programme affiliated to GLOBEC that attempts to use climate change and ecosystem predictions to estimate the potential for fish production in the future, and the socio-economic consequences of these. For more information visit <http://web.pml.ac.uk/quest-fish/default.htm>.
- **PICES XVII Annual Meeting.** Dalian, China, 23 October-2 November 2008. The meeting includes the following GLOBEC sessions:
  1. GLOBEC CCCC Topic Session - Marine system forecast models: Moving forward to the FUTURE.
  2. GLOBEC ESSAS Workshop - Status of marine ecosystems in the sub-arctic and arctic seas - Preliminary results of IPY field monitoring in 2007 and 2008
  3. GLOBEC CCCC - Climate scenarios for ecosystem modelling (II)
  4. GLOBEC CCCC/ESSAS Workshop – Marine ecosystem model inter-comparisons
- GLOBEC/ICES/PICES workshop on changes in distribution and abundance of clupeiform small pelagic fish in relation to climate variability. Kiel, Germany, 3-7 November 2008.

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

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

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- 10-12 June 2008: GLOBEC-CLIOTOP SSC meeting. Plymouth, UK
- 18-19 September 2008: GLOBEC-ESSAS SSC meeting, Halifax, Canada
- 20 September 2008: GLOBEC Executive meeting. Halifax, Canada

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

## **2. RECENT DEVELOPMENTS AND PUBLICATIONS**

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### **2.1. Links with IMBER and future developments beyond 2010**

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

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

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

## 2.2. Publications

### *2007-2008 Special Issues and books*

- Michael J. Dagg, Roger Harris, Sin-ichi Uye, Luis Valdes (Eds.) 2008. 4<sup>th</sup> International Zooplankton Production Symposium: Human and Climate forcing of Zooplankton Populations. *ICES Journal Marine Science* 65(3): 277-495.
- Eileen E. Hofmann, Peter H. Wiebe, Daniel P. Costa and Joseph J. Torres (Eds.) 2008. Dynamics of plankton, krill and predators in relation to environmental features of the western Antarctic Peninsula and related areas: SO GLOBEC Part II. *Deep-Sea Research II* 55(3-4): 269-558.
- George L. Hunt Jr., Kenneth Drinkwater, Stewart M. McKinnell and David L. Mackas (Eds.) 2007. Effects of Climate Variability on Sub-Arctic Marine Ecosystems - A GLOBEC Symposium, GLOBEC-ESSAS Symposium on "Effects of climate variability on sub-arctic marine ecosystems". *Deep-Sea Research II* 54(23-26): 2453-2970.
- Fidel Echevarría, Jose Luis Acuña, Santiago Hernández León, Enric Saiz, A. Miguel P. Santos and Manuel Barange (Eds.) 2007. Ecological functioning of the Iberian seas: a synthesis of GLOBEC research in Spain and Portugal. *Progress in Oceanography* 74(2-3), 95-422.
- Qisheng Tang, Jilan Su, Michio J. Kishi and Im Sang Oh (Eds) 2007. Selected papers from the Second China-Japan-Korea GLOBEC Symposium on the Ecosystem Structure, Food Web Trophodynamics and Physical-biological Processes in the Northwest Pacific, Second China-Japan-Korea Joint GLOBEC Symposium, 2004 *Journal of Marine Systems* 67(3-4): 203-322.
- Michio J. Kishi, Bernard A. Megrey, Shin-ichi Ito and Francisco E. Werner (Eds.) 2007. Special Issue on NEMURO (North Pacific Ecosystem Model for Understanding Regional Oceanography) and NEMURO.FISH (NEMURO for Including Saury and Herring) - Modelling of North Pacific Marine Ecosystems. *Ecological Modelling* 202(1-2): 1-224, 2007.
- H.P Batchelder and S. Kim. (Eds) 2008. Climate variability and ecosystem impacts on the North Pacific: a basin-scale synthesis. *Progress in Oceanography* 77(2-3): 83-258

In total GLOBEC has produced 26 special issues, and at least three additional issues are currently in press. The whole list is available at

[http://web.pml.ac.uk/globec/products/publications/special/spec\\_list.htm](http://web.pml.ac.uk/globec/products/publications/special/spec_list.htm).

### *2007/8 GLOBEC Reports*

- P.H. Wiebe, R.P. Harris, M.A. St. John, F.E. Werner and B. de Young. (Eds.). 2007. BASIN. Basin-scale Analysis, Synthesis, and INtegration. GLOBEC Report 23 and U.S. GLOBEC Report 20. 1-56pp.
- Robert J. Olson and Jock W. Young (Eds.). 2007. The role of squid in open ocean ecosystems. Report of a GLOBEC-CLIoTOP/PFRP workshop, 16-17 November 2006, Honolulu, Hawaii, USA. GLOBEC Report 24: vi, 94pp.

- ICES-GLOBEC-EUROCEANS 2007. Report of the Workshop on the Integration of Environmental Information into Fisheries Management Strategies and Advice (WKEFA). Copenhagen, Denmark (18-22 June 2007). J. Simmonds and M. Barange (Eds.) ICES Advisory Committee on Fishery Management. ICES CM 2007/ACFM:25 ([http://www.euroceans.eu/training\\_and\\_outreach/wp9/](http://www.euroceans.eu/training_and_outreach/wp9/))

### 2007/8 Publications

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

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

### 2.3. GLOBEC Synthesis book

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

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

- Preface
- Introduction – Manuel Barange et al.

#### Section 1. The changing ocean ecosystems

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

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

- 2.1. Dynamics of marine ecosystems: physical processes – Brad deYoung et al.
- 2.2. Dynamics of marine ecosystems: ecological processes – Coleen Moloney et al.
- 2.3. Dynamics of marine ecosystems: observation and experimentation – Roger Harris et al.
- 2.4. Dynamics of marine ecosystems: integration and modelling – Cisco Werner et al.

#### Section 3. The human dimensions of marine ecosystem change

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

## Section 4. A way forward

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

For more details, follow the links to Integration and Synthesis plans in [www.globec.org](http://www.globec.org).

### 2.4. GLOBEC 3<sup>rd</sup> Open Science Meeting

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

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

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

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

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

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

A poster session will also be included, and a commercial fair is under consideration.

The website for the conference is <https://www.confmanager.com/main.cfm?cid=1345&nid=10031>, and it can also be accessed directly from the GLOBEC website [www.globec.org](http://www.globec.org).

### 2.5. GLOBEC SSC 2008

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

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<b>Name</b>	<b>Gender</b>	<b>Country</b>	<b>Function</b>	<b>Term end</b>
Dr Jürgen Alheit	M	Germany	Chair Focus 1, SPACC Exec	(Ex-Officio)
Dr Kevern Cochrane	M	Italy	SSC – FAO link	1 <sup>st</sup> term 2008
Prof Brad deYoung	M	Canada	Chair Focus 3	1 <sup>st</sup> term 2009
Dr Ruben Escribano	M	Chile	SSC	2 <sup>st</sup> term 2010
Dr Roger Harris	M	UK	Chair Focus 2	(Ex-Officio)
Prof Eileen Hofmann	F	USA	SSC, SO Chair	(Ex-Officio)
Dr James Hurrell	M	USA	SSC	2 <sup>nd</sup> term 2010
Dr Astrid Jarre	F	Denmark	SSC	1 <sup>st</sup> term 2008
Dr Daniel Lluch-Cota	M	Mexico	SSC	1 <sup>st</sup> term 2008
Dr Olivier Maury	M	France	SSC	1 <sup>st</sup> term 2008
Dr Ian Perry	M	Canada	Chair, Focus 4 co-Chair	1 <sup>st</sup> chair term 2010
Dr Jeffrey Runge	M	USA	SSC	2 <sup>st</sup> term 2008
Prof Yasunori Sakurai	M	Japan	SSC	1 <sup>st</sup> term 2008
Prof Svein Sundby	M	Norway	SSC	2 <sup>st</sup> term 2008
Prof Francisco Werner	M	USA	Past SSC Chair	(Ex-Officio)

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

### 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

# 3-12

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**Members:**

Icarus Allen	UK		
Marcel Babin	FRANCE	Ken Furuya	JAPAN
Elisa Berdalet	SPAIN	Dennis McGillicuddy	USA
Stewart Bernard	South Africa	Suzanne Roy	CANADA
Liam Fernand	UK	Ming-Jiang Zhou	CHINA-Beijing

**Ex-officio Member:** Leonardo Guzman (IOC IPHAB)

**IOC Staff:** Henrik Enevoldsen

**Executive Committee Reporter:** Huasheng Hong

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

### ACTIVITIES 2007-2008

#### **1. SSC Meeting: Annapolis, Maryland, April 2008**

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

#### **2. Implementation of Core Research Projects**

The GEOHAB *Implementation Plan*<sup>1</sup>, published in November 2003, specified the formation of Core Research Projects (CRPs) related to four ecosystem types—upwelling systems, fjords and coastal embayments, eutrophic systems, and stratified systems. Initiation of these CRPs has been the primary GEOHAB activity since the 2007 SCOR Executive Committee Meeting.

##### **A. Core Research Project: HABs in Upwelling Systems**

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

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

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

##### **C. Core Research Project: HABs and Eutrophication**

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

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<sup>1</sup> 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.

## **D. Core Research Project: HABs and Stratification**

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

The GEOHAB SSC discussed the possibility of starting a new CRP on benthic systems, which would include algae that contribute to ciguatera, probably the most widespread of all algae-related poisonings. All SSC members recognize the importance of this issue, but it is not obvious who would be the appropriate champion for the activity and whether GEOHAB can afford to fund another CRP.

## **3. GEOHAB Modelling**

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

## **Objectives**

The objectives for the meeting will be to

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

**Structure**

The workshop will consist of four connected elements:

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

**Product**

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

**4. 13th International Conference on Harmful Algae**

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

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

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

**6. Asian GEOHAB**

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

**7. International Programme Office [IPO]**

GEOHAB, SCOR and IOC continue to seek the establishment of an International Programme Office to help implement, co-ordinate and manage GEOHAB resources in accordance with the approved international *GEOHAB Science Plan* and *Implementation Plan*. IOC and SCOR seek a commitment to host the IPO for GEOHAB with basic operational funds of US\$200,000 per year. For support of the Executive Officer and Administrative Assistant, IOC and SCOR seek international funds from national funding agencies for a period of no less than 3 years and preferably at least 5 years. Until the GEOHAB IPO is established, the co-sponsors of GEOHAB

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are responsible for sharing IPO duties, as one of their many tasks. This situation is unsatisfactory for the long-term progress and success of the programme.

### 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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## **Integrated Marine Biogeochemistry and Ecosystem Research**

### **IMBER Annual Report to SCOR August 2008**

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#### **Major Activities and Achievements**

##### **Working groups**

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

##### **IMBER/SOLAS Carbon Working Group**

IMBER and SOLAS have established a joint carbon implementation group (SIC!). The group is now chaired by Truls Johannessen (Norway) and works closely with the International Ocean Carbon Coordination Panel (IOCCP). Three sub-groups have been formed to move forward the implementation of the carbon research. A Joint SOLAS/IMBER Carbon Research implementation plan has been published electronically (February 2006) ([http://www.imber.info/products/Carbon\\_Plan\\_final.pdf](http://www.imber.info/products/Carbon_Plan_final.pdf)) and is currently being revised. A SIC! Group meeting is being planned for October 2008, in conjunction with the Ocean in High CO<sub>2</sub> Symposium in Monaco.

##### ***WG1 Surface Ocean System (SOS) (leader: Nicolas Metzler (France))***

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

collaboration with IOCCP, CARBOOCEAN, CDIAC and with all contributors of surface pCO<sub>2</sub> data.

WG2 Ocean Interior (leader: Nicolas Gruber (Switzerland))

This group covers inventory and observations, natural variability, transformation, designing a strategy for leverage for the ARGO program, and interaction with modelling. They have developed the initiative “*The Oxygen-Argo Program (ARGO-O<sub>2</sub>)*”.

This group also prepared a FP7 proposal entitled “*Towards Global Observatories for Oxygen Depletion (OXYWATCH O<sub>2</sub>)*”. The proposed project would be 3-year project starting in 2009 and includes 15 partner organizations. The work packages themes are Coordination and Management, Oxygen Sensor Technology Development, Oxygen Float Pilot Study, Coastal Oxygen Glider Study, Atmospheric Oxygen Study, Synthesis, Modelling and Prediction, Outreach, Dissemination and Communication.

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

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

*WG3 Carbon cycle climate sensitivities and feedbacks*

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

Global Ocean Shipbased Hydrographic Investigations Panel (GO\_SHIP)

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

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

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

### Continental Margins Task Team

LOICZ and IMBER have formed a joint IMBER/LOICZ Continental Margins Task Team. The task team consists of 10 members and is co-chaired by Jack Middelburg (The Netherlands) and Nancy Rabalais (USA). The group organized a Continental Margins Open Science Conference at the East China Normal University in Shanghai on 17-21 September 2007

(<https://www.confmanager.com/main.cfm?cid=792>). The aims of the Conference were to estimate the relative importance of changing forcings (global, local, and human) and to determine how much of the changes in shelf ecosystems can be attributed to the respective forcings. Invited speakers delivered keynote presentations at the beginning of the sessions. This was followed by high-standard oral and poster presentations, with discussion session wrapping up each session. A total of 110 scientists from 25 countries attended this conference. The major outcome was the identification of research foci for the development of an implementation plan of collaborative research efforts on continental margin biogeochemistry and ecosystems, its responses to global changes and its feedback effects on the Earth System and human society. Oral and poster sessions were instrumental in highlighting the new findings and new directions in continental margins research. A meeting report was published in *EOS* (Kelly-Gerreyn et al., see publication section). A list of IMBER and LOICZ themes have been identified that include sources and sinks of CO<sub>2</sub>, coupled model of ecosystems and biogeochemistry for continental margins, coupling of element cycles, regeneration, modeling of coupled ocean-seafloor systems, and ocean-shelf exchange. The task team is preparing a draft Science Plan and Implementation Strategy for IMBER and LOICZ continental margins biogeochemistry and ecosystems research.

### Capacity Building Task Team

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

IMBER is organizing (in collaboration with EUR-OCEANS) a Summer School on End to end Food Webs in Ankara, Turkey, on 11-16 August 2008. Prof. Temel Oguz, a member of the Capacity Building Task Team, is the organizer of this Summer School. The IMBER IPO supported the organizers and prepared a website ([http://www.imber.info/E2E\\_EcoModel\\_programme.html](http://www.imber.info/E2E_EcoModel_programme.html)). Participants will be Ph.D students and young post-docs working with biogeochemical cycles and end to end food webs. Confirmed lecturers are Icarus Allen (UK), Temel Oguz (Turkey), Mike St. John (Germany), and Jing Zhang (China). The programme consists of lectures, discussions, practical work/experiments and poster sessions. The formal lectures will be webcast live and will allow scientists around the world hear the lectures and ask questions.

#### Data Management Committee

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

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

The main priorities for this year are

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

The data management committee is organizing a workshop entitled “*BEER - Being Efficient and Environmentally Responsible*” to be held before the IMBER IMBIZO on Sunday, November 9 in Miami (USA). This workshop and discussion will present the benefits of adding a Data Integration Scientist to all projects, and will introduce the various data integration and handling techniques illustrated in the IMBER Data Integration Cookbook. Scientists of all experience levels are invited to participate in this workshop and contribute to the discussion. Confirmed lecturers are Raymond Pollard, Todd O’Brien (NOAA) and Gwen Moncoiffe (BODC).

#### Human Dimension

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

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## End to end food web Task Team

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

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

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

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

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

Coleen Moloney and Mike Roman are co-chairing one of the three IMBER IMBIZO workshops on *Ecological and Biogeochemical Interactions in End to End Food Webs*.

(<https://www.confmanager.com/main.cfm?cid=1185&nid=8821>). A plenary speaker (Hiroaki Saito, Japan) will introduce the workshop topic to the IMBIZO. The workshop will be considering two perspectives:

- material cycles related to high trophic level species - what are the relative impacts of change on material cycles through predator-prey interactions (looking from the top down)?

- transformations of elements linked to low trophic level species - what indices should be used to describe material transfer from photosynthesis to fisheries (looking from the bottom up)?

## **Regional Projects**

### Integrating Climate and Ecosystems Dynamics (ICED)

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

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

### Sustained Indian Ocean Biogeochemical and Ecological Research (SIBER)

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

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

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

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## North Pacific Marine Science Organization (PICES)

PICES is developing a new interdisciplinary programme named **F**orecasting and **U**nderstanding **T**rends, **U**ncertainty and **R**esponses of North Pacific Marine **E**cosystems (FUTURE). The vision of FUTURE is to understand and forecast responses of North Pacific marine ecosystems to climate change and human activities at basin-wide and regional scales, and to broadly communicate this scientific information to members, governments, resource managers, stakeholders and the public. During the last annual meeting in Victoria (Oct. 2007), an open forum on FUTURE were held and comments on the science plan were received from the PICES community. There are many overlaps in the science plan between FUTURE and IMBER, for example, studying the mechanisms underlying ecosystem response to natural and anthropogenic forcing, developing effective ways to communicate complexity to policy makers, resource managers, and society, etc. The new FUTURES project is a natural and appropriate venue for collaboration between IMBER and PICES. The importance of the collaboration with external projects such as IMBER was accepted by the workshop attendees. The science plan of FUTURE was approved by the PICES Governing Council early this year ([http://www.pices.int/members/scientific\\_programs/FUTURE/FUTURE\\_final\\_2008.pdf](http://www.pices.int/members/scientific_programs/FUTURE/FUTURE_final_2008.pdf)).

## **New Endorsed Projects**

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

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

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

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

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

The POTES program (Pressure effects On marine prokaryoTES) project concerns the role of marine micro-organisms in the mineralization of particulate (POM) and dissolved (DOM) organic matter and on the regeneration of biogenic compounds (silicates, carbonates) in the

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

- (i) The processes of OM mineralization (transformation of POC into DOC, hydrocarbon biodegradation, respiration) and on the regeneration of biogenic compounds (silicates, carbonates) in intermediary and deep oceanic waters;
  - (ii) The structural ((phylo)genetic) and functional (activities) dynamics of prokaryotic communities;
  - (iii) The flux of POM in the water column and the kinetic of particle transformation in the mesopelagic zone ; these information will be incorporated into a model describing the transformation of particles by micro-organisms in the entire water column.
- (website: [www.com.univ-mrs.fr/LMGEM/potes](http://www.com.univ-mrs.fr/LMGEM/potes)) (Contact: [tamburini@univmed.fr](mailto:tamburini@univmed.fr))

### **Outreach activities**

#### IMBER website

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

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

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## ***IMBER update***

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

## **eNews**

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

## **IPO Report to SSC**

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

## **Brochure and Poster**

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

## **Training**

### **CLIMECO**

IMBER, CLIVAR, GLOBEC and EUR-OCEANS jointly organised training for young scientists entitled "Climate-driven ecosystem changes" on April 21-24, 2008. The motivation came from the need to make the connection between climate and ocean scientists to better understand the sensitivity of the ocean to climate change. The goals were to bring together young marine scientists working on biogeochemistry and ecosystems research (grad students, postdocs) with climate scientists and upscale the climate drivers of ocean processes that are relevant for impact on the marine environment. We received 190 applications from young marine scientists and the selection of the 30 candidates was a challenge. The numerous applications have allowed us to choose a group of high-level science PhD and post-docs and lead us to expect a productive training.

The CLIMECO training workshop was a combination of scientific plenary sessions on defined themes followed by discussions and "hands-on" sessions where young scientists with a marine

biogeochemistry/ecosystems background learned how to use climate data. This included sourcing relevant data, scrutinising its quality and knowing how to make use of it. Eight invited lecturers presented plenary sessions on the following topics:

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

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

#### Summer School in Ankara

IMBER is organising with EUR-OCEANS a summer school entitled *Analyses of end to end marine food webs and biogeochemical cycles* that will be held at the Middle East Technical University, Ankara (Turkey) on August 11-16, 2008. The summer school aims to provide participants with an overview of methods, models and approaches for analyzing the interactions between marine biogeochemical cycles and end to end food webs studies. It will introduce to participants recent research foci on the interactions of end to end marine food webs and biogeochemical cycles to better understand and predict changes in marine ecosystems. The summer school will be organized around two lectures series on *Main processes controlling marine food webs* and *Advances in end-to-end food web modelling*. For each topic, a combination of theoretical lectures and practical workshops will be given. The discussion and poster sessions will be organized to stimulate interactions among student and also between students and the lecturers. The organizers are also planning debates on hot topics pertinent to end-to-end ecosystem research and participants presentations. Lecturers will be Icarus Allen, Temel Oguz, Mike St. John, and Jing Zhang. Further information can be found on the summer school website: [http://www.imber.info/E2E\\_EcoModel\\_home.html](http://www.imber.info/E2E_EcoModel_home.html).

#### International Project Office (IPO)

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

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different working groups and task teams, providing administrative support for the program's activities, maintaining communication inside and outside the program, and maintaining a data and information archive.

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

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

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

## **Interactions with other projects and programmes**

### **SOLAS**

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

### **LOICZ**

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

(<https://www.confmanager.com/main.cfm?cid=792>). (See section on Continental Margins Task Team).

## **GLOBEC**

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

### IMBER/GLOBEC Transition Team

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

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

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

The timetable for this activity will be as follows:

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

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

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## **CLIVAR**

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

## **EUR-OCEANS**

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

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

## **CARBOOCEAN**

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

## **GODAE**

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

## **National activities**

IMBER activities are starting in many countries (e.g. Chile, P.R. China, Finland, France, Germany, India, Italy, Japan, Netherlands, New Zealand, Norway, Spain, Taiwan, Turkey, UK, USA). China has 5 years of funding IMBER/GLOBEC programme and will be hosting the Second Large Marine Ecosystems Conference; IMBER-JAPAN was established under the Science Council of Japan, chaired by Hiroaki Saito. A North West Pacific cruise has been funded for Summer 2008. France has funded the CYBER programme "CYcles Biogéochimiques,

Ecosystèmes et Ressources". Spain has many projects and activities that are closely related to IMBER goals and will contribute significantly. In the United Kingdom, the Oceans 2025 programme (a partnership of seven leading UK marine centres) aims to improve understanding of how the ocean behaves, how it is changing, and what this means for society. There are nine science themes within Oceans 2025 ([www.ocean2025.org](http://www.ocean2025.org)), of which most are relevant to IMBER.

### **Future Activities**

#### **IMBER IMBIZO 2008**

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

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

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

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

**BEER:** *Data integration training* (Miami, November 9, 2008)

Invited speaker: Todd O’Brien (NOAA, Marine Ecosystems Division, USA) and Gwenaelle Moncoiffé (British Oceanographic Data Center, Liverpool, UK)

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

## **Global synthesis Symposium 2009**

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

## **IMBER-sponsored meetings**

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

### 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:** Robert Duce

GEOTRACES PLANNING GROUP  
ANNUAL REPORT TO SCOR  
July 2008

SCOR Scientific Steering Committee for GEOTRACES

*Co-Chairs*

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

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

*Members*

Per Andersson, Sweden

Philip Boyd, New Zealand

Ken Bruland, USA

Minhai Dai, China

Hein de Baar, Netherlands

Martin Frank, Germany

Toshitaka Gamo, Japan (Alternate: Jing

Zhang)

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

SCOR-supported meetings during 2007/2008

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

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

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

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

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

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

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

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

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

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

Participants agreed that there is a particular value in workshops like this because it helps keep modelers on track looking at real-life problems. That is, observationalists are closest to the cutting-edge questions, so interaction between modelers and observationalists can help steer modeling toward the most pressing problems. Now is the time to be steering the modelers, rather than trying to engage the modelers long after the data are collected. The workshop also provided cross fertilization among modelers. There were very different types of models represented, from 1-D complex biogeochemistry models to high-resolution models (e.g., ECCO) that assimilate many types of data to improve ocean circulation.

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

### Measurement Intercalibration during the GEOTRACES programme

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

- A variety of water-sampling systems was tested for contamination of trace metals that are known to be particularly prone to contamination. Analyses conducted at sea showed that the new GO-Flo rosette constructed for U.S. GEOTRACES collected samples that are uncontaminated with Fe, Zn and Hg, as determined by comparison with individual GO-Flo bottles hung on a Kevlar wire. This is particularly valuable for Hg because it means

that the contaminant metal of greatest societal concern can be measured routinely on GEOTRACES cruises.

- A variety of filter types and pore sizes were tested to identify artefacts (e.g., contamination; absorption of dissolved TEIs) and to establish filter types and filtration protocols that are suitable for GEOTRACES cruises.
- Two types of *in situ* filtration systems were used, and samples of particulate material at the same locations were collected by filtering water from GO-Flo bottles to establish (a) if the two strategies (bottles and pumps) for collecting particulate TEIs can be used interchangeably, and (b) if either *in situ* pumping system experienced detectable contamination or other artefacts.
- Thousands of samples were recovered during the cruise for distribution to labs worldwide. Sample distribution and the comparison of results is being handled by 15 self-organized groups representing key GEOTRACES TEIs as well as selected additional trace elements and isotopes.

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

#### Data Management for GEOTRACES

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

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

#### Links with other programmes

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

## Capacity Building

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

## International Project Office

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

## National Reports

*USA:* U.S. GEOTRACES activities during the past year have focused on the intercalibration effort described above. In addition, the U.S. GEOTRACES SSC met in May 2008, at which time they reviewed all of the sections in the basin planning reports identified as being led, or potentially led, by the United States. From among these, the U.S. SSC selected two (one each in the Atlantic and Pacific Oceans) as having priority for earliest development. Implementation workshops to design section cruise plans will be held 22-24 September 2008 (Woods Hole, Atlantic section) and 1-3 October 2008 (Los Angeles, Pacific section). The workshops are open to all interested scientists, although funds for travel support are limited.

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

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

*Japan:* A major Japanese GEOTRACES expedition in the Indian Ocean, originally scheduled to

begin in late 2008, has been deferred by approximately one year due to escalating fuel costs.

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

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

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

*UK:* Proposals were submitted to NERC requesting support for two GEOTRACES sections. One (South Atlantic zonal section) was designated for funding whereas the other (equatorial Atlantic) was declined. It is anticipated that the equatorial Atlantic proposal will be revised and resubmitted.

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

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

#### GEOTRACES sessions at international conferences

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

#### Acknowledgements

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

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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.

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

**Executive Committee Reporter:** Huasheng Hong

**IGBP Liaison:** Wendy Broadgate

**Executive Officer:** Emily Breviere

*SOLAS International Project Office  
Annual Report to SCOR 2007/2008*

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**02 July 2008**

SOLAS Scientific Steering Committee (SSC)

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

The membership of the SOLAS SSC for 2008:

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

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

SOLAS International Project Office

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

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

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

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

## National Networks

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

- **Australia** –SOLAS-related research occurs at academic institutions and government laboratories (CSIRO), and collaborations with scientists from New Zealand are frequent. The Australian National Representative is Dr. Jill Cainey (Cape Grim Observatory), and she was an invited speaker at the SOLAS Open Science Meeting in Xiamen, China.
- **Belgium** – The Belgian Federal Science Policy (BELSPO) generously contributed funds to permit a half-time Secretariat for IMP1 over a 2-year period beginning January 2005, and Dr. Veronique Schoemann (from the Université Libre de Bruxelles) filled that role. Unfortunately, a proposal to renew the funding for this position has been declined. In December 2006, ULB organized and hosted the Comparison of Oceanic Dimethylsulfide Models (CODiM) workshop, which brought together 20 scientists for intercomparison of 1-D and 3-D DMS models. The results of this synthesis are still under development, and plans are being made for another workshop in a few years. The Belgian National Representative for SOLAS is Christiane Lancelot (ULB), and she is also a member of the SOLAS SSC.
- **Brazil** – The Brazilian National Representative is Amauri Pereira de Oliveira (USP), although communications with the IPO have been minimal.
- **Canada** – The C-SOLAS program was the first funded national program within SOLAS, and their five-year funding cycle (including extensions) ended in mid-2007. The C-SOLAS network has produced an incredible number of refereed publications from the 5-year funding cycle. Ongoing work within the network includes contributions to the International Polar Year effort. The National Representative for

SOLAS in Canada is Maurice Levasseur (University of Laval) who was an invited speaker at the 2007 SOLAS Open Science Meeting.

- **Chile** – SOLAS research is conducted at the COPAS (Centro de Investigación Oceanográfica en el Pacífico Sur-Oriental) institute in Concepción, with academic institutions also contributing. There are plans underway to coordinate SOLAS research with the upcoming CLIVAR Variability of American Monsoon Systems (VAMOS) Ocean-Cloud-Atmosphere-Land Study (VOCALS) field intensive in October 2008, and this collaboration involves significant participation by Chilean SOLAS researchers. Osvaldo Ulloa (Universidad de Concepción) is the SOLAS National Representative and is a member of the SOLAS SSC.
- **China (Beijing)** – China SOLAS obtained more than US\$1 million to conduct SOLAS research from 2003 to 2007, networking with neighboring countries (China-Taipei, Korea, Japan, etc) has increased, and the national scientists look forward to more progress in international cooperation across the Asian network. The Chinese are focused on the effects of dust and marine primary productivity, nitrogen loading in coastal waters and marginal seas, processes controlling mass and energy exchange at the air-sea interface, variability of CO<sub>2</sub> fluxes between the air and sea, and effect of these fluxes on cloud and radiative budgets. Cruises have been executed in the Yellow Sea and in the South China Sea. Chinese and Japanese scientists are leading an effort to establish the Asian Dust and Ocean Ecosystems (ADOES) project participants into a SOLAS Task Team, with a total of three workshops held over the past 4 years. China hosted the International SOLAS Open Science Meeting in Xiamen (6-9 March 2007). Guang-Yu Shi (Institute of Atmospheric Physics) is the National Representative to SOLAS, a member of the SOLAS SSC, and was the Chair of the Organizing Committee for the 2007 SOLAS Open Science Meeting in China.
- **China (Taipei)** – National scientists continue to participate in three major SOLAS activities: Long-term Observation and Research of the East China Sea (LORECS; the goal is to investigate the biogeochemical processes in the East China Sea that lead to uptake of carbon dioxide and to detect changes due to the damming of the Yangtze River), the Straight Watch on the Environment and Ecosystem with Telemetry (SWEET), and the South East Asia Time-Series Station (SEATS; a long-term buoy deployment in the South China Sea to understand upper ocean dynamics and variability of biogeochemical fluxes). Wu-Ting Tsai (National Central University) was an invited speaker at the 2007 SOLAS Open Science Meeting and is the National Representative for SOLAS.
- **Denmark** – The Danish SOLAS team was involved in the EU-funded Marine Effects of Atmospheric Deposition (MEAD) project, which investigated the effects of nitrogen deposition on coastal water biogeochemistry. An around-the-world cruise campaign was conducted from August 2006 until April 2007 (GALATHEA) to measure surface concentrations and fluxes of carbon dioxide. Lise Lotte Sorensen (Riso National Laboratory) was an invited speaker at the 2007 SOLAS Open Science Meeting in China and is the SOLAS National Representative in Denmark.

- **France** –French scientists are very active in SOLAS-related research, and the French program originally operated under the moniker of PROOF (acronym for biogeochemical processes in the ocean and fluxes). A new ‘umbrella’ for research within the SOLAS remit has been established: LEFE (Fluid Envelopes and Environment). This program includes projects on atmospheric chemistry (CHAT), biogeochemical cycles (CYBER), climate variability on a global scale (EVE), and interactions and dynamics of the ocean and atmosphere (IDAO). SOLAS-France plans a national meeting in September 2007. Remi Losno (LISA) and Veronique Garcon (SSC Member) are the SOLAS National Representatives. Dr. Garcon was an invited speaker at the 2007 SOLAS Open Science Meeting in Xiamen.
- **Germany** – D-SOLAS scientists are very active in the SOLAS research regimes, combining institutional (Max Planck Institutes) and university researchers. The SOLAS effort in Germany operates under the recently funded (6.5m EUR over 5 years) SOPRAN (Surface Ocean Processes in the Anthropocene). SOPRAN includes 12 institutions, 43 investigators, and has four main foci: interphase transfer at the air-sea interface, effect of anthropogenic CO<sub>2</sub> on marine ecosystems and sea-air flux of gases, production and emission of radiatively and chemically active gases in the tropics, and the oceanic response to dust deposition. D-SOLAS has teamed up with UK-SOLAS to plan the development of a unique atmospheric (UK) and oceanic (D) observatory in the Cape Verde Islands. Cruises and aircraft flights funded by each nation in the vicinity of the observatory are also planned, making optimal use of the facility and the continuous data set. In addition, collaborations have been developed for Cape Verde with researchers in the USA. An atmospheric-related SOLAS proposal will soon be submitted to national funding agencies, and this program is called the Marine Multi-Phase Halogen Chemistry and its Coupling to Nitrogen and Sulfur Cycles (MAPHiNS). Doug Wallace (IfM-GEOMAR, Kiel) is one of the German National Representatives and has been named as new Chair of the International SOLAS SSC. He was also an invited speaker at the 2007 SOLAS Open Science Meeting in China. The other National Representative is Uli Platt (University of Heidelberg).
- **India** – SOLAS and IMBER collaborate strongly in India, but resources within the nation are limited. Interest areas include oxygen dynamics in the upper ocean, halocarbon fluxes, and time-series measurements of biogeochemical species. The Indians have established a new time-series station in the coastal Bay of Bengal, and this project is funded for the next 3 years. Dileep Kumar (NIO, Goa) is the SOLAS National Representative and is a former member of the SOLAS SSC.
- **Ireland** – A small number of scientists are working on SOLAS-related research within the nation, and a planning and coordinating meeting was held in Galway in November 2006. Irish scientists led the 2006 experimental effort for Marine Aerosol Production (MAP), which was funded by the European Commission. Brian Ward (Galway) is the SOLAS National Representative.

- **Japan** – SOLAS in Japan recently received a boost with the successful funding of the Western Pacific Air-Sea Interaction Study (W-PASS). This award amounts to about US\$ 9 million over 5 years to understand primary production in the Western Pacific, to determine how the marine ecological system will respond to changing atmospheric composition, to determine how production and emission of biogenic gases will affect the composition of the atmosphere, and to evaluate the contribution of marine biogenic gases to global warming. Mitsuo Uematsu (University of Tokyo) is the SOLAS National Representative and is a former member of the SOLAS SSC. Shigenobu Takeda is a member of the SOLAS SSC and has been named Vice-Chair.
- **Korea** – There are SOLAS activities within the nation, much of it occurring at the Korean Ocean Research and Development Institute (KORDI). In addition, university researchers are working on controlled (mesocosm) biogas transfer experiments, biogeochemical cycling, and other SOLAS research areas. Sung Yang (Gwangju University) is the SOLAS National Representative, although communication with the IPO has been minimal.
- **Netherlands** – The universities and government laboratories in the nation have a tradition of strong science in SOLAS research areas and have been successful at developing international projects funded by the EU. SOLAS research is in the fields of air-sea exchange of aerosols, DMS, CO<sub>2</sub> and momentum fluxes. Several institutions work on the EU-integrated project CARBOOCEAN. Recent years have seen more emphasis on IMBER-related research. During the 2006 SOLAS SSC meeting in Amsterdam, the Netherlands SOLAS/IMBER/GEOTRACES network held a well-attended one-day workshop in which the SSC was invited to participate. Jacqueline Stefels (University of Groningen) is an SSC Member and is the National Representative.
- **New Zealand** – A cruise was conducted in March 2006 to investigate the nitrogen cycle in the subtropical waters off NW New Zealand. Future NZ-SOLAS research includes investigations of event-based dust storms from Australia, and they plan to follow up on the two previous cruise expeditions with more perturbation and natural event investigations. Phil Boyd (NIWA) is the SOLAS National Representative.
- **Norway** – Norwegian SOLAS at present does not have direct national funding for SOLAS science, but several activities are underway within the country. The Norwegians have been successful in obtaining EU funds for their SOLAS-related research, including work toward long-term measurements of natural carbon dioxide variability in the North Atlantic. Norwegian SOLAS scientists are involved in investigations of the cycling of bioreactive gases between the air and sea, mesocosm perturbation experiments, coupled 3-d modeling, etc. through CARBOOCEAN, which is endorsed by SOLAS and is housed at the University of Bergen. Abdirahman Omar (Bjerknes Centre) is the SOLAS National Representative.
- **Russian Federation** – A national climate program exists, and SOLAS-related studies here include atmospheric anthropogenic gases and chemical components of the Earth

climate. Sergey Gulev (Russian Academy of Sciences) is a member of the SOLAS SSC and is the SOLAS National Representative.

- **Southern Africa** – Immediately after the 2008 IGBP Congress in Cape Town, a group of committed national scientists held a joint SOLAS/IMBER workshop to communicate and coordinate a regional network in southern Africa. A number of talks were provided by members of the SSCs of the projects, and the local scientists demonstrated some of the impressive work being conducted within the SOLAS and IMBER interest areas. Discussions resulted in the incorporation of the regional network, and Dr. Carl Palmer was appointed as Representative.
- **Spain** – A SOLAS Committee has been established and includes 7 leaders within the Spanish community. Specific funding for SOLAS research is not coordinated at the agency level, but air-sea interaction is a national research priority. Spanish scientists work on quantification of air-sea carbon dioxide exchange and the marine biotic effects on this flux, the investigation of links between DMS and climate, the deposition of inorganic and organic compounds and marine productivity and respiration in oligotrophic environments. Rafel Simo (CSIC in Barcelona) is the SOLAS National Representative, and the 2009 SOLAS Open Science meeting will be held in Barcelona during the month of November.
- **United Kingdom** - The UK-SOLAS programme has been developed in close cooperation with the Atlantic Meridional Transect project (AMT) and the Centre of Excellence for the Observation of Air-Sea Interactions and Fluxes (CASIX). The Natural Environmental Research Council (NERC) programme UK-SOLAS was initiated in early 2004 with \$21M over 5 years. The first annual meeting was held in July 2006 in Manchester, and the next annual meeting is scheduled for August in Leeds. Funding has also been approved for the installation of a SOLAS atmospheric sampling station in Cape Verde, and German SOLAS will be coordinating some of their activities around this station as well. NERC has also generously provided funding for the SOLAS-IPO over a 5-year period beginning in 2004. The National Representative for SOLAS in the UK is Phil Williamson (UEA).
- **United States** – US-SOLAS has published a Science Implementation Strategy with four foci:
  1. Quantification of biogeochemical interactions and feedbacks between the ocean and atmosphere,
  2. Understanding the exchange processes at the air-sea interface and the role of transport and transformation in the atmospheric and oceanic boundary layers,
  3. Characterization of air-sea fluxes of CO<sub>2</sub> and other long-lived radiatively active gases, and
  4. Promoting enabling technologies, outreach, and data management.

Funding for US-SOLAS is expected to come from the consortium of the National Science Foundation (NSF), the National Oceanic and Atmospheric Administration

(NOAA) and the National Aeronautics and Space Administration (NASA). As a scientifically powerful, relatively well-funded nation, a healthy US-SOLAS program is of fundamental importance to the continued success of the international effort. Wade McGillis (LDEO) is the SOLAS National Representative from the USA.

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

### Other Activities

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

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

The 2007 SOLAS OSM was held on 6-9 March in Xiamen, China and was organized by local hosts at the University of Xiamen and the IPO. This OSM included a relatively small number of plenary talks (20), long poster sessions (posters were on display over the duration of the conference), and

afternoon discussion and synthesis sessions on topics determined to be of importance by the community. The conference was attended by 235 scientists from about 30 nations of the world.

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

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

The SOLAS SSC is concerned about the plans by some corporate interests to conduct large-scale iron fertilization of the ocean surface in the guise of ‘carbon offsetting’. In response to this, the SSC has developed a position statement. “Large-scale fertilisation of the ocean is being actively promoted by various commercial organisations as a strategy to reduce atmospheric CO<sub>2</sub> levels. However the current scientific evidence indicates that this will not significantly increase carbon transfer into the deep ocean or lower atmospheric CO<sub>2</sub>. Furthermore there may be negative impacts of iron fertilization including dissolved oxygen depletion, altered trace gas emissions that affect climate and air quality, changes in biodiversity, and decreased productivity in other oceanic regions. It is then critical and essential that robust and independent scientific verification is undertaken before large-scale fertilisation is considered. Given our present lack of knowledge, the judgement of the SOLAS SSC is that ocean fertilisation will be ineffective and potentially deleterious, and should not be used as a strategy for offsetting CO<sub>2</sub> emissions.”

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

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

Along with the International Oceanic Carbon Coordination Project (IOCCP), the Global Carbon Project (GCP), and IMBER, SOLAS co-sponsored the April 2007 workshop in Paris on “Surface Ocean CO<sub>2</sub> Variability and Vulnerabilities”. More than 100 scientists from 20 nations met in Paris to review the current knowledge base and develop deeper international collaboration to resolve the variability and processes governing ocean surface carbon dioxide. The workshop included a number of breakout working group meetings on topics of value to the ocean carbon community, a discussion

on observing systems, and the development of a cross-basin synthesis of surface ocean carbon observations. The organizing committee is currently working on a summary report of the meeting which will include recommendations for further research and networking within the community. SOLAS continues to be directly involved in other IOCCP-coordinated efforts, including the Surface Ocean CO<sub>2</sub> Atlas (SOCAT) and the Global Ocean Ship-based Hydrographic Investigations Panel (GO\_SHIP).

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

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

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

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

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

The Ocean-Atmosphere-Sea Ice-Snow (OASIS) project has been endorsed by SOLAS. This large international project has links with the International Study of Arctic Change (SEARCH) and may be complemented by the work of the Climate in the Cryosphere (CliC) Arctic Panel.

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

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

SOLAS has developed a network in Southern Africa, and a joint meeting was held in coordination with IMBER and the SOLAS SSC in May in Cape Town after the IGBP Congress. The initiation of this network began during the 2006 IGAC/CACGP/WMO Conference on Atmospheric Chemistry at the Interfaces in Cape Town, and a subsequent meeting of interested scientists was held in Cape Town in March 2007.

In late 2006, SOLAS was provided networking funds from the European Coordination in the field of Scientific and Technical Research office (COST) for a dedicated 'Action' which seeks to develop global air-sea flux data sets of gases and aerosols. This effort has resulted in coordinated efforts for DMS (coordinated by Drs. Rafel Simo of CSIC Barcelona and Tom Bell of UEA), halocarbons (coordinated by Drs. Jim Butler of NOAA and Birgit Quack of IFM-GEOMAR, and included a February 2008 meeting in London), flux parameterizations (coordinated by Drs. Jeff Hare of UEA and David Woolf of Thurso and included a workshop in February 2008 in Norwich), dust transport and characterization (coordinated by Drs. Alex Baker and Tom Bell, both of UEA), CO<sub>2</sub> (coordinated across various channels, including IOCCP and CARBOOCEAN), and others. This five-year project will provide a platform for dedicated closely focused efforts on developing flux data sets of great value to SOLAS.

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

## **Capacity Building and Inclusion of Developing Country scientists**

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

In 2007, more than 15 young developing world scientists were accepted into the SOLAS Summer School.

The SOLAS IPO is developing the lectures from the summer school into an online learning tool and to develop a SOLAS textbook. Currently, the presentations are available on the summer school Web site, but these will be expanded into an online reference. These will be sent on CD to all those who applied for the summer school, and it will also be available on the Web. The IPO will also provide free hard copies or CDs of the *SOLAS Science Plan and Implementation Strategy* to anyone who requests them.

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