

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

Report of the SCOR/IOC/IGBP GLOBEC International Project for 2005/ 2006  
to the SCOR General Assembly. Concepcion, Chile, 23-26 October 2006

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### 1. RECENT PROGRESS: Symposia and Workshops

#### 1.1. GLOBEC-sponsored symposia

Most symposia activities of GLOBEC are currently aligned to synthesis efforts. GLOBEC is conducting this synthesis at various levels, including along the regional scale that was so successfully used in the implementation phase of GLOBEC. The table below summarises the synthesis symposia planned or conducted along this regional scale:

REGIONAL GLOBEC PROGRAMMES	SYNTHESIS SYMPOSIA
GLOBEC-ICES CCC	Bergen, Norway, 11-14 May 2004
GLOBEC-PICES CCCC	Honolulu, USA, 19-21 April 2006
SPACC	Brest, France, 2-5 October 2006 (workshop) And symposium TBC 2008
SOUTHERN OCEAN GLOBEC	TBC
ESSAS	1 <sup>st</sup> OSM Victoria, Canada, 16-20 May 2005
CLIOTOP	1 <sup>st</sup> OSM La Paz, Mexico, 3-7 December 2007
FINAL GLOBEC OSM	Late 2009

GLOBEC symposia during this reporting period are;

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

This successful symposium was used to integrate GLOBEC's research in Sub-Arctic regions, and to launch the new GLOBEC regional programme ESSAS (Ecosystem Studies of Sub-Arctic Seas). It was attended by over 240 participants from 16 countries. Two implementation workshops were also held, each drawing over 100 participants. Prof. R.T. Barber (Duke, USA) delivered the invited keynote speech, on "How will ocean warming in the next 50 years affect sub-Arctic marine ecosystems". Prof. V. Smetacek (AWI, Germany) provided a symposium summary. Some of the presentations and the full programme of talks are available at [www.globec.org](http://www.globec.org). The proceedings of the symposium will be published as a special issue of *Deep-Sea Research II*, and will include 30-40 papers.

- *PICES/GLOBEC symposium on 'Climate variability and ecosystem impacts on the North Pacific: a basin-scale synthesis', Honolulu, April 19-21, 2006.*

This symposium was designed to continue the programme of GLOBEC symposia along regional lines by synthesising the knowledge acquired as part of the PICES-GLOBEC Climate Change

and Carrying Capacity in the North Pacific (CCCC). The programme of the symposium was being drafted by the steering committee, chaired by Dr Harold Batchelder (Corvallis, USA) and Prof. Suam Kim (Pusan, Korea). The themes were:

1. Regime shifts, especially examination of the ocean and ecosystem responses to known strong, infrequent changes in the North Pacific, such as those that occurred in 1977, 1989, and 1998;
2. Ecosystem productivity and structural responses to physical forcing, with an emphasis on shorter than inter-decadal time scales-interannual (El Niño-La Niña), seasonal and event scales; and
3. Pan-Pacific comparisons, with an emphasis on comparisons of similar species or processes from multiple coastal ecosystems and of open ocean-coastal linkages and climate connections.

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

- ***PICES XIV meeting, Vladivostok, Russia, 30 September - 8 October 2005***, including the following GLOBEC/PICES CCC sessions:
  - The comparative response of differing life history strategists to climate shifts
  - Modeling climate and fishing impacts on fish recruitment
  - Evidence of distributional shifts in demersal fish in relation to short- and long-term changes in oceanographic conditions.
- ***AMEMR: Advances in Marine Ecosystem Modelling Research, Plymouth, UK, 27-29 June 2005***

This GLOBEC-endorsed symposium, which included 5 members of the GLOBEC SSC in its Steering Committee, was designed to discuss recent advances in model-based marine ecosystem understanding and predictive capability. A special issue in the *Journal of Marine Systems* is currently in preparation. AMEMR will have a follow-on in 2007.

- ***6th International Crustacean Congress, 18-22 July 2005, Glasgow, Scotland.***

This symposium hosted a GLOBEC session on "The scope for ecophysiological and behavioural adaptation to environmental change in mero- and holoplanktonic Crustacea"

- ***AGU Ocean Science Meeting, 20-24 February 2006, Honolulu, Hawaii.***

This popular symposium had two special GLOBEC sessions in the programme:

- [Toward a Synthesis of Understanding of Zooplankton Population Variability Across Ocean Basins](#) (synthesis of Southern Ocean, Georges Bank, Northeast Pacific GLOBEC programmes)
- [GLOBEC-CLITOP \(Climate Impacts on Oceanic Top Predators\) Special Session](#) on this Regional programme
- ***PICES XV meeting, Yokohama, Japan, 13 - 22 October 2006***, including the following GLOBEC/PICES CCC sessions:

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1. Modelling and historical data analysis of pelagic fish, with special focus on sardine and anchovy (Covenors S-I Ito, M Kishi, B Megrey and F Werner)
2. Key recruitment processes and life history strategies: bridging the temporal and spatial gap between models and data
3. Synchronous and asynchronous responses of North Pacific boundary current systems to climate variability

Plus a pre-meeting workshop on “Climate forcing and marine ecosystems”.

- ***ESSP Global environmental change: regional challenges. An Earth System Science Partnership Global Environmental Change Open Science Conference. Beijing, China, 9-12 November 2006.***

This is the 2nd Open Science Conference of the Earth System Science Partnership (IGBP, WCRP, IHDP and DIVERSITAS). It includes the GLOBEC session "**Marine ecosystems: trends, feedbacks and predicting future states**", co-convened by Francisco Werner and Manuel Barange), contributing to GLOBEC's synthesis.

- ***The Humboldt Current System: Climate, ocean dynamics, ecosystem processes, and fisheries, Lima, Peru. 27 November - 1 December 2006.***

This multi-sponsored symposium has the following main topics:

1. Intra-annual to inter-annual, multi-decadal to centennial-scale variability in the Humboldt Current System
2. Climate and ocean dynamics, and biogeochemical cycles.
3. Lagrangian processes, plankton dynamics and larval survival of fish resources.
4. From phytoplankton to apex predator and fishers, and back
5. Adaptive strategies of fish and other key species in a highly variable ecosystem
6. Adaptive management

The Proceedings will appear in a special issue of *Progress in Oceanography*.

- ***GLOBEC ESSAS Symposium: Ecosystem dynamics in the Norwegian Sea and Barents Sea. Tromsø, Norway, 12-15 March 2007.***

A suite of projects on ecosystem changes and interactions in several high-latitude environments have been or are currently carried out in Norway/Barents Sea under the GLOBEC umbrella. These include the ADAPT, CLIMAR and NESSAS projects, and the new GLOBEC regional program, Ecosystem Studies of Sub-Arctic Seas (ESSAS), together with the upcoming International Polar Year (IPY). Common for these activities are that they are focussing in on fundamental research on Arctic and Sub-Arctic Seas. A symposium offers an opportunity to present the results and findings from these programs.

<http://www.nfh.uit.no/hmenyvis.aspx?id=2554&locallang=uk>.

- ***GLOBEC CLIOTOP 1<sup>st</sup> Symposium “Climate Impacts on Oceanic Top Predators”. La Paz, Mexico, 3-7 December 2007.***

This will be the first CLIOTOP symposium, following from 3 years of intense workshops to implement the synthesis objectives of CLIOTOP. The symposium has special interest in presenting comparative studies between regions or species and papers dealing with an integrated approach, combining observation/experiments and modelling. GLOBEC has submitted a request to SCOR to support developing country scientists wishing to attend this symposium (see Appendix 1).

- ***GLOBEC/PICES/ICES 4<sup>th</sup> International Zooplankton Production Symposium: Human and climate forcing of zooplankton populations. Hiroshima, Japan, 28 May-1 June 2007.***

Zooplankton research is central to GLOBEC. This symposium follows on the very successful 3<sup>rd</sup> IZPS held in Gijon, Spain, May 2003, with identical sponsors. Several sessions are tailored to GLOBEC's synthesis:

[http://www.pices.int/meetings/international\\_symposia/2007\\_symposia/4th\\_Zooplankton/4th\\_Zoopl.asp](http://www.pices.int/meetings/international_symposia/2007_symposia/4th_Zooplankton/4th_Zoopl.asp). GLOBEC and PICES have submitted a request to SCOR to support developing country scientists wishing to attend this symposium (see Appendix 2).

## 1.2. GLOBEC workshops

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

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

This workshop, attended by 18 scientists from the ICES area, met to a) determine the zooplankton species in the diets of cod, their temporal and spatial changes; b) determine the variability in zooplankton populations and their relationships to cod; c) examine the vital rates of zooplankton that are relevant to cod life histories; d) determine how the timing of zooplankton production and spatial dynamics of nauplii relates to the spawning, distribution and survival of early stages of cod; e) establish the links between zooplankton and later stages of cod; f) study long-term changes in phenology, abundance and size composition of zooplankton and possible consequences for cod. An ICES Cooperative Report is expected. This was a synthesis workshop of the GLOBEC-CCC programme.

- ***GLOBEC/IOC Study Group on Regime Shifts, 4-5 June 2005 (Rome, Italy) and 28-29 October 2005 (Brest, France).***

This study group met twice to put together a review paper for a major journal (*Nature/Science*) that would exemplify the process of identifying, detecting and preventing regime shifts, and applying the knowledge to management and governance of marine resources. The examples used (corals, upwelling systems, NE Pacific and Newfoundland coast) are used to design observational systems that would operationalize the process. The group is co-funded by IOC and GLOBEC and is a GLOBEC I+S effort.

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

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

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- ***GLOBEC-CLIOTOP Working Group 4 (Synthesis and Modeling) workshop, La Jolla, USA, 8-10 November 2005.***

This workshop was held at the Southwest Fisheries Science Center's (SWFSC, US National Marine Fisheries Service) La Jolla Laboratory. The ToR of the meeting were specifically geared toward:

1. Review inter-sessional work conducted by participants
2. Develop research ideas that could support the future work of the Group and provide collaborative opportunities for its participants
3. Agree on specifications for global data sets of catch and effort statistics and environmental data.

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

The workshop was used to fit the NEMURO-FISH ecosystem model (an NPZ model with compartments for pelagic fish) to data from several areas that have large populations of anchovy and sardine, with the objective to ascertain if the replacement between both species could be explained as driven by decadal-scale climate variability that permeates through the food web. The workshop is a APN/ IAI/ PICES/ GLOBEC/ JFA activity. This activity is to be followed up during PICES XV, through a specific session and a short meeting to continue homogenising data and procedures.

- ***Workshop on Indices of meso-scale structures. Nantes, France, 22-24 February 2006.***
- ***Advancements in modeling physical-biological interactions in fish early-life history: recommended practices and future directions. Nantes, France, 3-5 April 2006:***

These two workshops have received GLOBEC endorsement, but are not organised or funded by GLOBEC. The first intended to review numerical methodologies for the construction of indices of meso-scale structures such as fronts, eddies, transport, upwelling and vertical hydrographic changes. It plans to disseminate available tools and software for the automatic detection of such structures and construct time series of such structures. The second workshop intended to evaluate the present state and next steps in the developing field of modelling physical-biological interactions in lake, estuarine, shelf and ocean ecosystems. Both workshops will be used to present ongoing GLOBEC research and place it in a broader context. As such, these workshops contribute to GLOBEC's I+S phase.

- ***GLOBEC workshop on Mathematical modelling of zooplankton dynamics, Marseille, France. 2-5 May 2006:***

This workshop is a joint activity of two GLOBEC Working Groups, Focus 2 WG (Process Studies) and Focus 3 WG (Predictive and Modelling Capabilities). The thematic target of the workshop is "Key issues in the parameterization of zooplankton models" and we hope it is a significant contribution to the GLOBEC Integration and Synthesis effort. During the workshop, 25 GLOBEC scientists:

1. synthesized current knowledge on key processes for major zooplanktonic taxa,
2. discussed the validity of known mathematical formulations and parameterization commonly used in zooplankton models
3. defined approaches and guide research to implement the mathematical formulation of key processes for key species.

A multi-authored paper is being drafted.

- ***GLOBEC CCC Workshop on the Decline and Recovery of Cod Stocks throughout the North Atlantic including tropho-dynamic effects. St John's, Canada, 8-11 May 2006:***

This workshop was hosted by the Northwest Atlantic Fisheries Centre, Fisheries and Oceans, Canada, in St. John's from May 9-12, 2006, co-convened by Brian Rothschild (USA), Svein Sundby (Norway), George Lilly (Canada) and Kai Wieland (Greenland). The CCC programme has for some time noticed the similarity in the abundance trends of many of the stocks, from high values in the 1960s that in some cases persisted through into the 1970s and 1980s, followed by a decline to relatively low levels. This workshop compared the changes that have occurred in all of the cod stocks around the Atlantic to assess the relative importance of climate-induced ecosystem changes and fishing as causes of the observed declines. (<http://www.ices.dk/globec/workshops/Decline/WKDRC.htm>).

- ***GLOBEC ESSAS/PICES Workshop to compare four Sub-Arctic marine ecosystems St Petersburg, Russia, 12-14 June 2006:***

PICES and GLOBEC will jointly sponsor a workshop to compare the marine ecosystems of the Okhotsk Sea/Oyashio region, the Bering Sea, the Newfoundland/Labrador Shelf and the Barents Sea. The workshop will provide a foundation for the new GLOBEC regional program, Ecosystem Studies of Sub-Arctic Seas (ESSAS). PICES and ESSAS share the goal of developing comparative studies of the Sub-Arctic Seas and understanding how climate variability will affect their productivity and ability to support sustainable commercial and subsistence harvests. The goals of the workshop will be:

1. to lay the groundwork for developing the data sets needed to achieve the appropriate comparisons and,
2. to commence developing the teams necessary to synthesize available data and develop models for predicting the effects of climate variability on these ecosystems.

- ***GLOBEC Focus 1 workshop on impact of climate variability on marine ecosystems: a comparative approach, Berlin, Germany, 4-8 September 2006:***

This workshop, a major I+S effort for GLOBEC, has a working title of "Climate variability of large exploited fish populations and their ecosystems". The workshop will be held at the Museum for Natural History in Berlin, Germany, and the papers (which MUST be delivered before the workshop commences, 'Dahlem Conference style') will be published in a special issue of the *Journal of Marine Systems*. The workshop is structured in four groups:

1. Group 1: Climate variability and teleconnection patterns of marine populations
2. Group 2: Impacts of past climate variability on marine ecosystems (over the past two millenia)
3. Group 3: Mechanisms linking climate variability to marine ecosystems
4. Group 4: Sensitivity of marine ecosystems to climate and human exploitation

- ***20-24 November 2006. ICES/GLOBEC workshop on long-term variability in SW Europe. Lisbon, Portugal.***

This is a new working group of ICES, chaired by J. Alheit, M.F. Borges, A. Lavin and A. Uriarte, set up with the objective to rescue, collate and jointly analyze decadal-scale, long-term time series of physical, chemical and biological data from ecosystems surrounding the Iberian peninsula with a focus on long-term changes of small pelagic fish. The scientific

objectives are to identify possible links to climate variability and to look for possible telecommunication patterns with European and other marine ecosystems.

- ***SPACC synthesis workshop. Roscoff, France, 2-6 October 2006:***

This workshop is intended to bring together the lead authors of the SPACC synthesis book, and the SPACC Executive Committee members, to plan the final stages of the publication. The authors would circulate their draft chapters in preparation for the meeting, so that areas of overlap, knowledge gaps and style differences can be ironed out. The book is expected to be ready for publication in June 2007.

In addition, GLOBEC has/will host the following SSC/working group meetings in 2005/2006:

- ***31 August - 2 September 2005: GLOBEC Focus 4 Working Group meeting Victoria, Canada***
- ***25-26 September 2005: GLOBEC Focus 3 WG meeting. Aberdeen, Scotland***
- ***17-20 October 2005: GLOBEC Focus 2 WG meeting. Dartington, UK***
- ***14-15 December 2005: GLOBEC-IMBER End to End Foodweb Task Team meeting, Hamburg, Germany (see below)***
- ***27 February - 1 March 2006: GLOBEC-CLIOTOP SSC meeting. Hawaii, USA***
- ***23-25 April 2006: GLOBEC SSC meeting. Honolulu, Hawaii, USA.***
- ***15-16 June 2006: GLOBEC-ESSAS SSC meeting, St Petersburg, Russia***
- ***26-29 September 2006: GLOBEC-IMBER Executive Committees Meeting. UK***
- ***September 2006: GLOBEC CLIOTOP WG3 workshop on "comparing trophic models"workshop. Noumea, New Caledonia.***
- ***July 2007. CLIOTOP WG5 (Socio-economic aspects and management activities) workshop. NCAR, Boulder, USA***

More information is available on the GLOBEC website.

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

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### **2.1. Links with IMBER**

The GLOBEC and IMBER Executive Committees had their 1<sup>st</sup> joint meeting in Brest, France, 25-27 October 2005, with a view to implement IGBP-SCOR agreements in relation to the "IGBP Oceans Box", summarized as follows:

- GLOBEC will continue to completion of the project in December 2009 as specified in its Implementation Plan
- IMBER will develop research activities with a ten-year life, with its scientific emphases thus extending until 2014. The project will be allowed to develop its own identity.
- IMBER and GLOBEC will be encouraged to begin to develop joint activities starting in 2003. The two SSCs will be encouraged to hold back-to-back or overlapping meetings.
- The extent and speed of development of joint activities and project integration will be at the discretion of the SSCs for the two projects.
- There will be a single integrated ocean project, including scientific aspects of GLOBEC and IMBER, in place by 2009.

The main agreements on interactions between both programmes were:

1. Executive meetings will be co-located to allow a joint session of both Executive Committees on an annual basis
2. Sections will be established in the IMBER and GLOBEC Newsletters to highlight joint activities.
3. In the case of combined activities (e.g. ICED) the IPOs will coordinate the publication of reports. Each report will have dual numbering to reflect the report series of both programmes.
4. Joint session of GLOBEC-IMBER SSCs will be held at the IGBP Congress (2008)
5. At the 2007 joint Executive meeting, a Transition Task Team (TTT) will be appointed to develop the scientific content of the addendum to the IMBER Science Plan, to reflect the science of the second phase of IMBER, including:
  - Outstanding questions identified during the GLOBEC synthesis
  - Ongoing research in GLOBEC's CLIOTOP and ESSAS regional programmes
  - Results of the first phase of IMBER
6. GLOBEC and IMBER agree that co-endorsement of national projects can occur if requested.

The following are common activities between IMBER and GLOBEC:

- **GLOBEC-IMBER End to End Foodweb Task Team meeting  
Hamburg, Germany, 14-15 December 2005:**

Members of the TT include: Ken Denman (Canada), Dave Karl (USA), Fritz Köster (Denmark), Coleen Moloney (South Africa, co-chair), Mike St John (Germany, co-chair), Svein Sundby (Norway), Rory Wilson (UK). The life span of the task team will end with the publication of a paper, after which the GLOBEC and IMBER SSCs will jointly appoint members of an e2e working group.

- ***Integrated Analyses of Circumpolar Climate Interactions and Ecosystem Dynamics in the Southern Ocean (ICED)***

ICED is a continuation of the still running GLOBEC Southern Ocean Programme, co-sponsored by SCAR, SCOR, GLOBEC and IMBER. ICED will bring together climatologists, oceanographers, biogeochemists, ecosystem and fisheries scientists to generate unique circumpolar databases and models to address three globally important questions:

1. how do climate processes affect the dynamics of circumpolar ecosystems?
2. how does ecosystem structure affect circumpolar ocean biogeochemical cycles?
3. how should ecosystem structure and dynamics be included in the development of sustainable approaches to managing exploitation?

- ***Chinese GLOBEC/IMBER programme***

The China GLOBEC programme has reached its third phase after nearly 10 years of endeavour of China GLOBEC I (BoSEC, 1997-2000) and China GLOBEC II (EYSEC, 1999-2004). A new 5-year programme on GLOBEC and IMBER has been approved by the Ministry of Science and Technology of China (MOST) with a total funding of US\$4.0 million from 2006 to 2010. Prof. Qisheng Tang is the chief scientist and nearly 70 scientists will be involved in the programme,

entitled "Key Processes and Sustainable Mechanisms of Ecosystem Food Production in the Coastal Ocean of China".

- **EUROCEANS**

EUROCEANS (European Network of Excellence for Ocean Ecosystems Analysis) is a network of excellence co-funded by the Sixth Framework Programme for Research and Technological Development of the European Communities (FP6). The network gathers more than 60 research institutes and universities from 25 countries. Its activities started in January 2005, running for 4 years until December 2008. EUROCEANS is set up as a contributor to GLOBEC and IMBER at European level. In addition, the GLOBEC IPO hosts the EUR-OCEANS Knowledge Transfer Unit (KTU), designed to transfer the advancements of the network to advisory, policy and socio-economic users.

### 2.2. International Polar Year (IPY)

The 2007-2009 International Polar Year is under planning. GLOBEC's role in fostering and coordinating international research on marine ecosystems has been recognised by having two regional programmes, ESSAS (Ecosystem studies of Sub-Arctic Seas) and ICED (Integrated Analyses of Circumpolar Climate Interactions and Ecosystem Dynamics in the Southern Ocean), as LEAD PROJECTS for IPY.

### 2.3. Publications



The GLOBEC publication list can be interactively searched at [www.globec.org](http://www.globec.org). Since 2000 the list includes a **total of 1,647 publications** (1466 refereed, 181 non-refereed), with a substantial and escalating increase in output over the period 2000-2005.

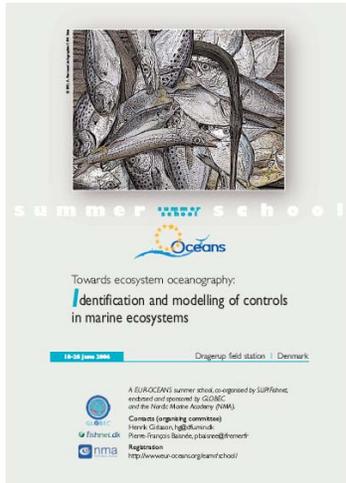
This is an underestimate of the total publications of GLOBEC researchers, as they have to be logged in the website by the authors themselves and have to acknowledge their contribution to GLOBEC in the article. The real figure is likely to be at least an order of magnitude higher. The following are special issues

of GLOBEC and IPO publications printed in 2004/2005/2006:

1. **Batchelder, H.P., Lessard, E.J., Strub, P.T., Weingartner, T.J.** 2005. US GLOBEC biological and physical studies of plankton, fish and higher trophic level production, distribution, and variability in the northeast Pacific. *Deep-Sea Research II* 52(1-2), 1-374
2. **Castro, LR, P. Fréon, C.D. van der Lingen, and A Uriarte (Eds.)** 2005. Report of the SPACC Meeting on Small Pelagic Fish Spawning Habitat Dynamics and the Daily Egg Production Method (DEPM). GLOBEC Report 22: xiv, 107 p.
3. **Drinkwater, K.F., H. Loeng, B.A. Megrey, N. Bailey and R.M. Cook (Eds.)** 2005. The influence of climate change on North Atlantic Fish stocks. *ICES Journal of Marine Science* 67: 1203-1542.
4. **Hanesson, R., M. Barange and S. Herrick Jr. 2006. (Eds.)** Climate Change and the Economics of the world's fisheries: Examples from pelagic fish stocks. *New Horizons in Environmental Economics Series*. Edward Elgar, New York.

5. **Hunt, G.L., Jr and K.F. Drinkwater (Eds.). 2005.** Ecosystem Studies of Sub-Arctic Seas (ESSAS) Science Plan. GLOBEC Report No.19, viii, 60pp.
6. **Hunt, G.L., Jr and K.F. Drinkwater (Eds.). 2005.** Background on the Climatology, Physical Oceanography and Ecosystems of the Sub-Arctic Seas. Appendix to the ESSAS Science Plan. GLOBEC Report No.20, viii, 96pp.
7. **Maury, O. and P. Lehodey (Eds.). 2005.** Climate Impacts on Oceanic Top Predators (CLIOTOP). Science Plan and Implementation Strategy. GLOBEC Report No.18, ii, 42pp.
8. **van der Lingen, C.D., Castro, L., Drapeau, L. and D. Checkley, Jr. (Eds.). 2005.** Report of a GLOBEC-SPACC Workshop on Characterizing and Comparing the Spawning Habitats of Small Pelagic Fish. GLOBEC Report 21: xii, 33p.
9. *GLOBEC Newsletter 11.1 and 11.2 April/ October 2005*
10. *GLOBEC Newsletter 12.1 April 2006*

#### 2.4. GLOBEC/EUROCEANS Summer School



GLOBEC has teamed up with EUROCEANS to organize a summer school entitled “*Towards ecosystem oceanography: Identification and modelling of controls in marine ecosystems*”. The school took place on 19-28 June 2006 and was attended by 30 students and practitioners. The venue was the Dragerup field station in Denmark. The lecturers were Philippe Cury (France), Volger Grimm (Germany), Niels Stenseth (Norway) and Christian Mullon (France).

#### 2.5. GLOBEC IPO

Following the successful bid to renew the funding of the GLOBEC IPO until March 2010 through the UK’s Natural Environment Research Council and the Plymouth Marine Laboratory, the IPO and SCOR have submitted a proposal to renew our funding bid through the USA-NSF. If this bid is successful GLOBEC will be supported to tackle the extensive programme of workshops outlined above. This is in addition to long-standing funding agreements with IGBP and IOC.

In addition, as part of the GLOBEC IPO involvement in the European network of Excellence EUROCEANS the Office has grown to incorporate an additional project officer to focus on Knowledge Transfer.

#### 2.6. Integration and Synthesis plans

GLOBEC is embarking on an I+S phase that will lead the programme to its conclusion in December 2009. On the webpage I+S activities can be proposed on line, and the community has the opportunity of requesting information on specific outputs.

# 3-12

A major I+S activity currently under planning is the final GLOBEC book, to be published in the IGBP Book Series (currently in Elsevier). The draft structure of the book is as follows:

## **DRAFT GLOBEC International Synthesis Book Outline Global Change and Marine Ecosystems**

- Chapter 1: Introduction (short)
- Chapter 2: Historical
- Chapter 3: Dynamics of Marine Systems
- Chapter 4: Marine Ecosystems under the influence of humans
- Chapter 5: Marine Systems as Part of the Earth System
- Chapter 6: Human Dimension
- Chapter 7: Projection and future scenarios
- Chapter 8: Responsible management
- Chapter 9: Summary and next steps toward sustainability

The GLOBEC Executive Committee (Werner, Field, Harris, Hofmann, Perry, Barange) will meet in Plymouth, September 2006 to flesh out the contents of the volume and discuss drafting issues.

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

### **2.7. Carbon Offsetting**

To play our part in tackling climate change, GLOBEC has teamed up with Climate Care© to offset our greenhouse gas emissions. Climate Care© is an organisation that reduces greenhouse gases on behalf of companies and individuals by running sustainable energy and reforestation projects across the world. As well as cutting greenhouse gases, the projects help to improve people's standards of living and protect wildlife habitats. To find out more about Climate Care© and its projects, please visit <http://www.climatecare.org>.

From May 2006 attendees to GLOBEC-sponsored meetings are given the opportunity to voluntarily donate Climate Care £7.50 per tonne of CO<sub>2</sub> reduction associated with their flights to attend GLOBEC meetings. GLOBEC acts as an intermediary between attendees and Climate Care©, by holding per diem reimbursements as per voluntary requests. For fairness the amount deducted from claims is calculated as an average of flights taken by all participants to attend a given meeting (approximately USD10-35). Climate Care provides the GLOBEC IPO with a six-monthly certificate showing the projects that have benefited from the investment, which is available to those using this voluntary service.

### **2.8. GLOBEC SSC 2006**

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

<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

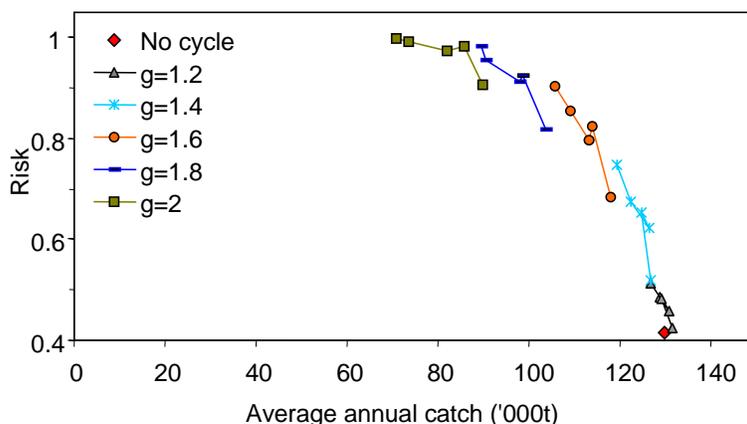
Dr Ruben Escribano	M	Chile	SSC	1 <sup>st</sup> term 2007
Prof John Field	M	South Africa	SSC	1 <sup>st</sup> term 2004
Dr Roger Harris	M	UK	SSC Past-Chair, Focus 2	(Ex-Officio)
Prof Eileen Hofmann	F	USA	SSC, SO Chair	(Ex-Officio)
Dr James W. Hurrell	M	USA	SSC	1 <sup>st</sup> term 2007
Dr Astrid Jarre	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
Prof Rosemary Ommer	F	Canada	SSC, Focus 4 co-Chair	2 <sup>nd</sup> term 2006
Dr Ian Perry	M	Canada	Focus 4 co-Chair	(Ex-Officio)
Dr David 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	1 <sup>st</sup> term 2008
Prof Francisco Werner	M	USA	SSC Chair, Focus 3	2 <sup>st</sup> term as Chair 2007

At the end of 2006 one member rotates off (Rosemary Ommer). GLOBEC does not plan to replace her at this stage, but will include Prof Brad de Young (Canada, Chair GLOBEC Focus 3 working group) as ex-officio member. This is in recognition that this working group (Predictive and modelling capabilities) needs to be represented at the SSC meetings during our I+S phase.

### 3. RESEARCH HIGHLIGHTS 2006

The GLOBEC IPO produces an annual research highlights brochure, which is available for download from the GLOBEC website. The following are specific highlights extracted for the 2005/06 publications:

1. **Management of marine resources affected by shifts of ecosystem state need management systems that take into account the length of the shift and its amplitude.** (J. De Oliveira. 2006. Long-term harvest strategies for small pelagic fisheries under regime shifts: the South African fishery for pilchard and anchovy. In: R. Hannesson, M. Barange and S. Herrick jr. (Eds) *Climate Change and the economics of the world's fisheries: examples of small pelagic stocks*. Edward Elgar, Cheltenham, UK. pp. 151-204)



Initial results of 500 simulations over a 100-year projection period relating average annual catch (over the simulated period) to risk. Risk is defined as the probability that adult biomass falls below 20% of the average adult biomass (in the absence of exploitation) at least once over the projection period. The parameter  $g$  indicates the amplitude of a regime shift, from

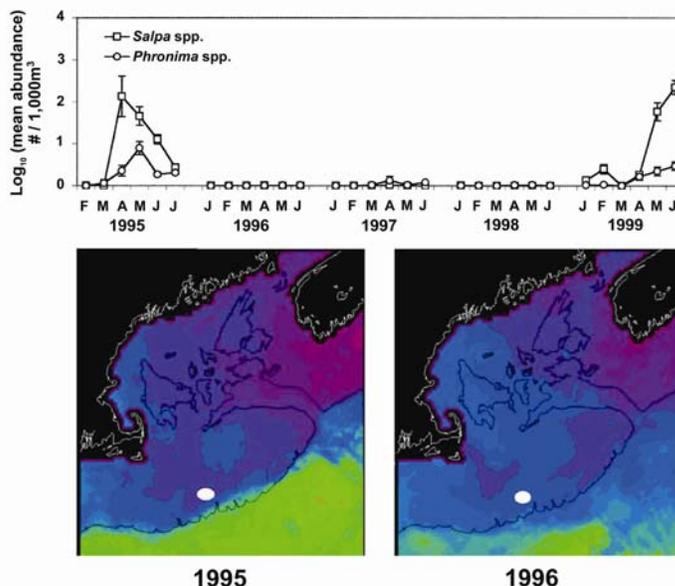
# 3-14

1 (no cycle or shift) to 2 (doubling at the peak or halving at the trough of the cycle of the functions that generate recruitment). The results show that yield decreases and risk of collapse increases, as the population is subject to shifts of state of increased amplitude.

Environmentally driven long-term changes in exploited populations are rapidly being recognized as critical in fisheries science, because they can cause confusion in management when scientists are unable to separate the impacts of fisheries with those of the environment. In this contribution De Oliveira uses the Management Procedure (MP) approach to investigate harvesting and management strategies in the face of sinusoid-like fluctuations in resource biomass due to changes in the state of the ecosystem (regime shifts). Alternative MPs are proposed and assessed under diverse scenarios, based on the amplitude, frequency and predictability of the regime shifts. The results are only applicable to the South African anchovy and sardine case because simulations are tied to the existing programme of monitoring, assessment and management. They suggest that management procedures that account for regime shifts are effective when the fishery for one species results in substantial by-catch of the other. The importance of this effect is more significant the larger the amplitude of the regime shift.

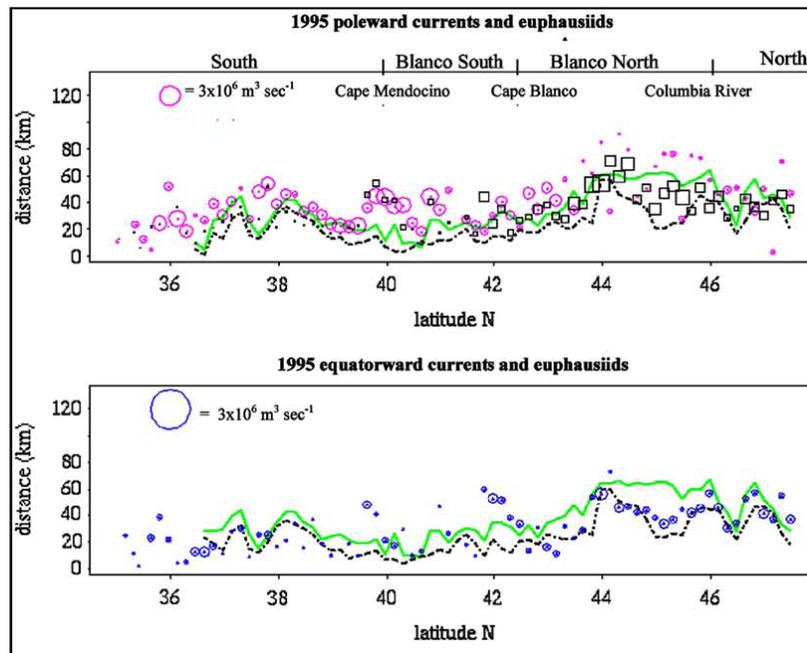
## 2. Increases in gelatinous zooplankton linked to oceanic warm water intrusions onto the continental shelf (Brown, H., S.M. Bollens, L.P. Madin and E.F. Horgan. 2005. Effects of warm water intrusions on populations of macrozooplankton on Georges Bank, Northwest Atlantic. *Continental Shelf Research* 25(1): 143-156)

As part of the Georges Bank/North West Atlantic US GLOBEC programme, macrozooplankton and micronekton were collected January–June, 1995–1999 to examine the effects of warm water intrusions of populations of macrozooplankton, including the gelatinous *Salpa* spp., and the shrimp-like amphipod *Phronima* spp. on Georges Bank. Abundances of these two organisms showed striking interannual variability, and were only abundant on the southern flank and in the Northeast Channel in late spring/early summer of 1995 and 1999, periods during which satellite imagery showed the presence of warm water intrusions. Warm water intrusions can directly affect *Salpa* spp. and *Phronima* spp. populations by advecting them onto Georges Bank, although other, more resident populations, especially those inside the 100 m isobath, seem to be little affected by such intrusions.



Log-transformed abundance and standard error of *Salpa* spp. and *Phronima* spp., 1995-1999 (top) and 3-day optimally interpolated satellite-derived sea surface temperature images for May 1995 and 1996 (bottom). The images show intrusion of warm oceanic water onto the shelf in 1995 (in green). Intrusions change the structure of the pelagic community of continental shelves by importing oceanic species.

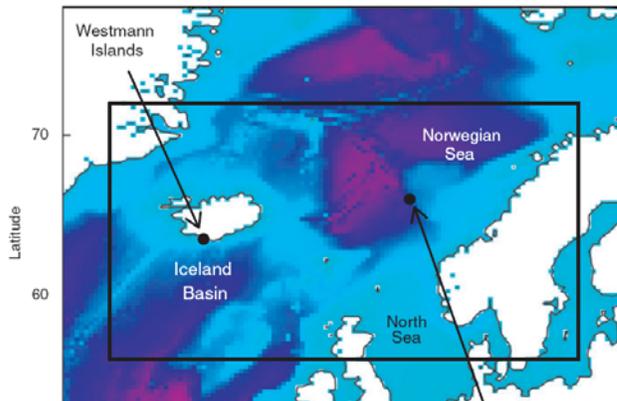
3. **Macrozooplankton in the California Current use equatorward/ poleward currents to maximise their chances of survival in a variable environment** (Swartzman, G., B. Hickey, P. M. Kosro and C. Wilson 2005. Poleward and equatorward currents in the Pacific Eastern Boundary Current in summer 1995 and 1998 and their relationship to the distribution of euphausiids. *Deep-Sea Research II* 52:73-88)



Distribution and flow volume transport ( $\text{m}^3 \text{s}^{-1}$ ) for 1995 of the largest equatorward currents (blue) and poleward currents (magenta) by latitude and distance (km) from the coast. The volume transport circles are proportional in area to the current flow volume for that core current. Locations of the centroids of euphausiid distribution are shown by squares proportional in size to the total biomass for each transect. Green solid and black broken lines show locations of the 800 and 200-m isobaths, respectively.

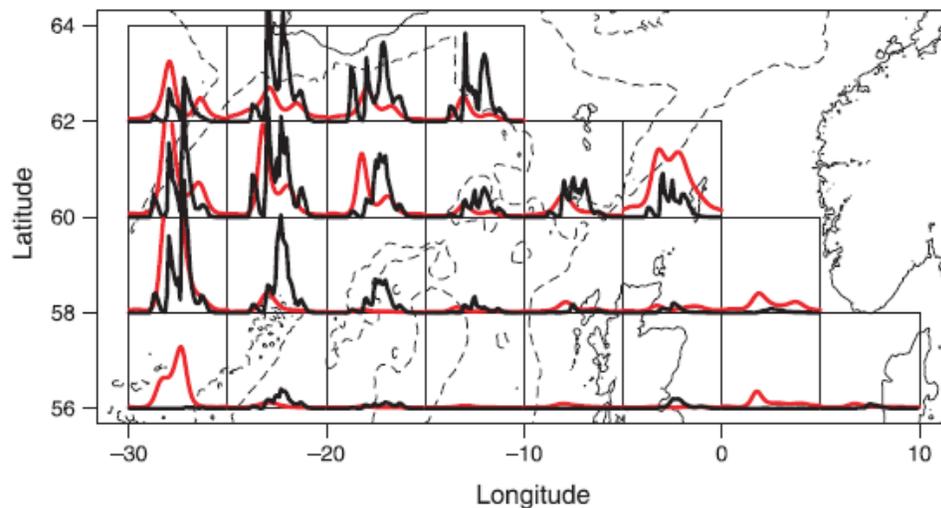
Work conducted as part of the US GLOBEC NEP programme has revealed a significant relationship between the location of euphausiid patches and the location and strength of the poleward undercurrent. The robustness of the relationship, however, varied with year and with region. There was no relationship between equatorward currents and euphausiid patches. As there is substantial spatial (and temporal) variability in location of both poleward and equatorward currents, local transport of aggregations of euphausiids can be quite variable. The authors suggest that having a broad onshore–offshore distribution allows euphausiids to extend their range in a highly variable environment, thus reducing risk of the whole population encountering poor feeding and high predation conditions. Thus, different euphausiid patches would encounter a different mix of poleward and equatorward current velocities. Their net transport through diel migration would be the ensemble average of a spatially and temporally dynamic system. This flexibility, while not resulting in an optimal response to favorable local conditions (i.e., ability to stay close to large food patches), might, in the long run, compensate for the uncertainty of where favorable conditions may occur.

4. **Modelling suggests that the awakening of diapaused *Calanus finmarchicus* in the North Atlantic is triggered by light, coinciding with the vernal equinox.** (Speirs, D.C., W.S.C. Gurney, M.R. Heath and S.N. Wood. 2005. Modelling the basin-scale demography of *Calanus finmarchicus* in the north-east Atlantic. Fisheries Oceanography 14(5): 333-358).



(Top left) The north-east Atlantic, with the inset box marking the boundaries of the model domain. The colours indicate the bathymetry of the region.

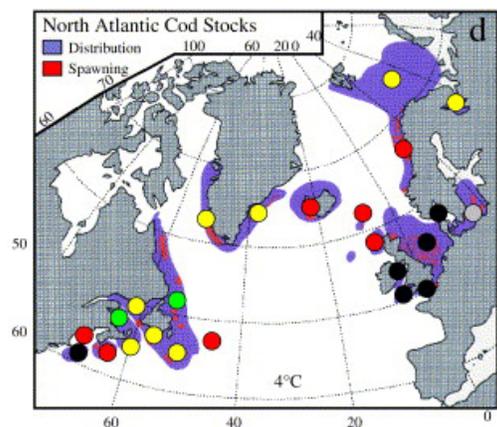
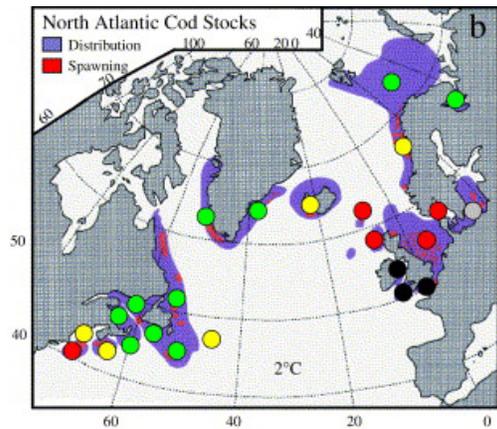
(Bottom) Comparison between the average predictions of the photoawakening model over each of the boxes shown (black line), and a GAM fitted to field data from the continuous plankton recorder (CPR) for the same box over the period 1990–2000 and realized for 1997 (red line). The abscissa of each plot represents time from 0 to 365 days, while the ordinate runs from 0 to  $2 \cdot 10^4$  individuals  $m^{-3}$ .



In this paper, a coupled physical–biological model describing the spatio-temporal distribution of *Calanus finmarchicus* over an area of the North Atlantic and Norwegian Sea is reported. The model explicitly represents all the life-history stages and is implemented in a highly efficient discrete space–time format. The underlying hydrodynamics comes from the Hamburg Shelf–Ocean Model (HAMSOM). The spatio-temporal distribution of food powering development and reproduction is inferred from SeaWiFS sea-surface colour observations. We confront the model with distributional data from continuous plankton recorder observations, overwintering distribution data from a variety of EU, UK national and Canadian programmes which were collated as part of the Trans-Atlantic Study of Calanus (GLOBEC- TASC) programme, and high-frequency stage-resolved point time series obtained as part of the TASC programme. We test two competing hypotheses concerning the control of awakening from diapause and conclude that only a mechanism with characteristics similar to photoperiodic control can explain the test data. The photo-awakening hypothesis assumes that diapause entry is cued by low local food abundance, while awakening is cued by photoperiod. This model produces the synchronous transfer of almost all the diapausers to the surface at around day 80, but still predicts significant abundance of diapausing individuals at depth from midsummer onwards. The value of the photoperiod cue that was found to generate a satisfactory time of emergence from diapause was

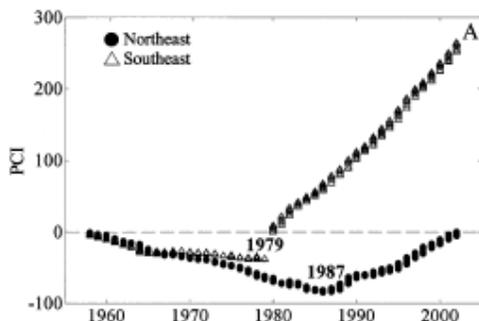
12 h of light. This means surface activity begins at the vernal equinox and hence will occur at the same time at all locations.

5. **The highs and lows of Atlantic cod stocks responses to ocean warming** (Drinkwater, K.F. 2005. The response of Atlantic cod (*Gadus morhua*) to future climate change. ICES Journal of Marine Science 62: 1327-1337).



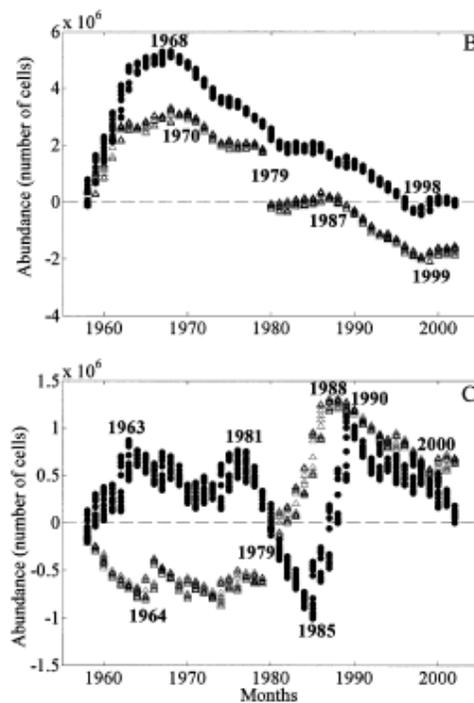
Future CO<sub>2</sub>-induced climate change scenarios from Global Circulation Models (GCMs) indicate increasing air temperatures, with the greatest warming in the Arctic and Subarctic. Of particular note is the expected increase in ocean temperature. Based upon the observed responses of cod to temperature variability, stocks in the Celtic and Irish Seas are expected to disappear under predicted temperature changes by the year 2100 (black in figure), while those in the southern North Sea and Georges Bank will decline. Cod will likely spread northwards along the coasts of Greenland and Labrador, occupy larger areas of the Barents Sea, and may even extend onto some of the continental shelves of the Arctic Ocean. In addition, spawning sites will be established further north than currently. Individual growth rates for many of the cod stocks will increase, leading to an overall increase in the total production of Atlantic cod. These responses are highly uncertain, however, as they will also depend on the changes to climate and oceanographic variables besides temperature, such as plankton production, the prey and predator fields, and industrial fishing.

Expected changes in the abundance of the cod stocks with a temperature increase of (b) 2°C, and (d) 4°C above current levels. Green= increase; Yellow= no change; Red= Decrease; Black= Collapse; Grey= Uncertain.



6. **Long-term time series show a change in dominance in North Atlantic phytoplankton communities** (Leterme, S.C., M. Edwards, L. Seuront, M.J. Attrill, P.C. Reid and A.W.G. John. 2005. Decadal basin-scale changes in diatoms dinoflagellates, and phytoplankton color across the North Atlantic. Limnology and Oceanography 50(4): 1244-1253).

Index,  
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the



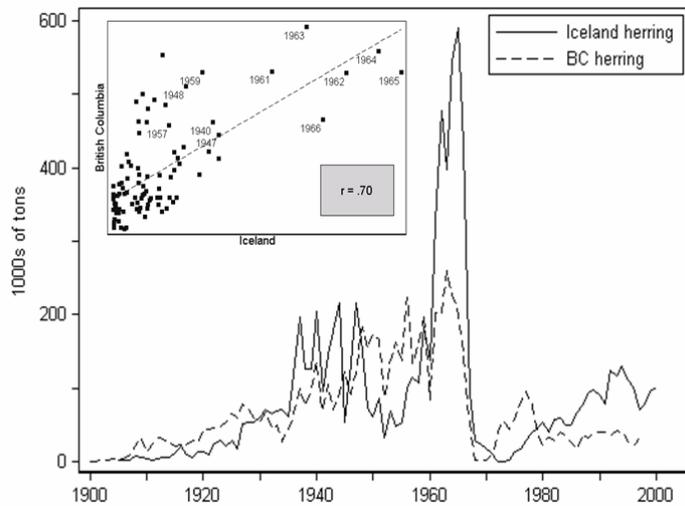
*Cumulative sums of the (A) Phytoplankton Colour (B) total diatoms abundance, and (C) total dinoflagellates abundance for each month over the period ranging from 1958 to 2002 (540 data points) in Northeast and the Southeast Atlantic.*

The Continuous Plankton Recorder (CPR) survey has been used to characterize phytoplankton and zooplankton space–time dynamics in the North Sea since 1931 and in the North Atlantic since 1939. Phytoplankton biomass is assessed from these samples by visual assessment of the green color of the silk mesh, the Phytoplankton Color Index, and the total count of diatoms and dinoflagellates. In an analysis conducted for the period ranging from 1958 to 2002, and based on 12 monthly time series, we demonstrate increasing trends in Phytoplankton Colour Index and total dinoflagellates and a decrease in total diatoms. These observations are consistent with the hypothesis that warmer surface temperatures (related to the increasing North Atlantic Oscillation winter index) promote earlier, or more intense stratification of the upper water column. This in turn creates an environment favoring the growth of dinoflagellates over diatoms in both parts of the eastern North Atlantic, a change that has significant consequences for the ecology and food web dynamics of the North Atlantic.

- 7. Technological teleconnections may explain correlations between fish catches in different ocean basins** (Hamilton, L., O. Otterstad and H. Ögmundardóttir. 2006. Rise and fall of the herring towns: impacts of climate and human teleconnections. pp. 100-125. In: R. Hannesson, M. Barange and S.F. Herrick (Eds.). *Climate change and the economics of the world's fisheries*. Edward Elgar Publishing Ltd, Cheltenham, UK.)

Correlations between small-pelagic fisheries catches have been noted across long distances, and even across oceans. Correlation between 20<sup>th</sup> century catches of herring from waters off Iceland and British Columbia are striking. Both series show nearly simultaneous take-offs in the late 1930s, and peaks followed by collapse in the 1960s. It might seem reasonable to guess that they are linked climatically, with changes communicated in some way through the atmosphere. The inset scatterplot reveals that the two fisheries' correlation derives mainly from the common boom from 1930 to 1970, and particularly from the high-catch outliers of the early 1960s. These high points represent artifacts of international markets and technology rather than signs of unprecedented abundance. Power-block assisted purse-seines of strong nylon mesh, guided by sonar to find schooling fish, were innovations after World War II that allowed rising catches at a time of falling stocks. In this example, it appears that human activities, instead or in addition to climatic forces, caused the herring catches to follow parallel trends across different oceans. In general, the hypothesis of “human teleconnections” across spatially or ecologically distinct fisheries deserves serious consideration as we look for signals from climate. Technologies and markets have global reach, and act rapidly. Moreover, the ecological consequences of fishing down dominant species could well extend this reach to a wide range of non-targeted marine

species, as well as to social systems on land.



*20<sup>th</sup> century trends in herring catches off Iceland and British Columbia. Inset shows scatterplot indicating a linear relationship between both time series.*

Details of these and other highlights can be found on the GLOBEC website, [www.globec.org](http://www.globec.org), under GLOBEC Publications.

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Appendix 1



Dr Ed Urban  
Executive Director  
SCOR  
The John Hopkins University  
USA

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Fax (01752) 633101/ 160  
[globec@pml.ac.uk](mailto:globec@pml.ac.uk)  
[www.globec.org](http://www.globec.org)

25 June 2004

Dear Ed:

As you know GLOBEC is teaming with PICES and ICES in co-sponsoring and organising the **4th International Zooplankton Production Symposium: Human forcing of zooplankton populations**, to be held in Hiroshima, Japan, May 28 – June 1, 2007.

This symposium follows on the successful 3rd IZPS, held in Gijon, Spain, May 2003, with identical set of sponsors.

GLOBEC and PICES would like to request a contribution from SCOR to cover the expenses of 3-5 scientists from developing countries to attend this important symposium. The amount would range between \$6,000 (3 scientists supported) and \$10,000 (5 scientists supported). SCOR would be adequately acknowledged in the book of abstracts and Proceedings.

We would be grateful if you could bring this request to the attention of the SCOR General Assembly at their meeting in Concepcion in October 2006.

Thanks you in advance for your consideration. Regards,

Manuel Barange  
Director GLOBEC International Project Office  
and  
Alex Bychkov  
Executive Secretary PICES

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



## Appendix 2



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[www.globec.org](http://www.globec.org)

Dr Ed Urban  
 Executive Director  
 SCOR  
 The John Hopkins University  
 USA

25 June 2004

Dear Ed:

GLOBEC is sponsoring and organising the 1st CLIOTOP Symposium, “**Climate Impacts on Oceanic Top Predators**” in La Paz, Mexico, 3-7 December 20071.

This symposium is part of the implementation strategy of CLIOTOP, which as you know is one of GLOBEC’s regional programmes. CLIOTOP is aimed at identifying, characterising and modelling the key processes involved in the dynamics of oceanic pelagic ecosystems.

This symposium follows on the series of synthesis GLOBEC regional symposia that started in 2004 with the ICES/GLOBEC Symposium on “**The Influence of Climate Change on North Atlantic Fish Stocks**” (Bergen, May 2004, no SCOR support requested), continued with the successful GLOBEC Symposium on “**Climate Variability and Sub-Arctic Marine Ecosystems**” (Victoria, Canada, May 2005, SCOR-supported), and the PICES/GLOBEC Symposium on “**Climate variability and ecosystem impacts on the North Pacific: A basinscale synthesis**” (Honolulu, USA, April 2006, SCOR-supported). Regional symposia have been identified by GLOBEC as one of its main strategies for integration and synthesis.

GLOBEC would like to request a contribution from SCOR to cover the expenses of 3-5 scientists from developing countries to attend this important symposium. The amount would range between \$6,000 (3 scientists supported) and \$10,000 (5 scientists supported). SCOR would be adequately acknowledged in the book of abstracts and Proceedings.

We would be grateful if you could bring this request to the attention of the SCOR General Assembly at their meeting in Concepcion in October 2006.

Thanks you in advance for your consideration. Regards,

Manuel Barange  
 Director GLOBEC International Project Office

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



### Appendix 3. GLOBEC National, Multinational and Regional Programmes (Shaded are completed projects)

#### National

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

#### Multi-National and Regional

Start Year	Countries	Funding	Contact
1997- 2007	<b>BENEFIT:</b> South Africa, Namibia, Angola, Norway, Germany	Norwegian and German donor agencies, Governments of Angola, Namibia, South Africa	N. Sweijd
2000-2003	<b>LIFECO:</b> Norway, Germany, UK, Denmark	EU FP 5	M. St John
1996-1999	<b>TASC:</b> Norway, UK, Denmark, Iceland, Germany, France, ICES	EU MAST	K. Tande
1999-2001	<b>ENVIFISH:</b> EU countries, Angola, Namibia, South Africa	EU INCO	L. Nykjaer
1997-2000	<b>VIBES:</b> France, South Africa	IRD (ORSTOM)	P. Freon
2001-ongoing	<b>IDYLE1 and 2/ ECO-UP:</b> France, South Africa	IRD (ORSTOM)	P. Freon
2002- 2004	<b>NATFISH:</b> Norway, Morocco, Mauritania, Senegal, Italy	EU INCO	L. Nykjaer
2001-ongoing	<b>OFCCP:</b> USA, New Caledonia, Mexico, Australia, France, New Zealand, Japan, IATTC	National Funding agencies of participating countries, GEF.	P. Lehodey
Start Year	Countries	Funding	Contact
1993-ongoing	<b>SPACC:</b> Spain, France, Germany, Japan, Chile, Peru, Senegal, Mauritania, Portugal, USA, Mexico, and others	National, GLOBEC	D. Checkley and C. Roy
1993-ongoing	<b>CCC:</b> ICES countries	National, ICES	G. Ottersen and K. Wieland
Ongoing	<b>CCCC:</b> Japan, China, Korea, Russia, Canada, USA	National, PICES	S. Kim and H. Batchelder

Ongoing	<b>SO GLOBEC</b> : USA, Australia, UK, Germany, IWC, and others.	National	E. Hofmann
2005-ongoing	<b>ESSAS</b>	National, GLOBEC, PICES	G. Hunt
2004-ongoing	<b>CLIOTOP</b>	National, GLOBEC	O. Maury and P. Lehodey

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## 3.2 Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) (joint with IOC)

### Terms of Reference:

- To oversee the development of a Science Plan for the international SCOR/IOC program on the Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) and to submit it within one year for the approval of the sponsors of the program and subsequent publication. The SSC should ensure that the Science Plan has input from the international HAB scientific community.
- To develop a detailed Implementation Plan for GEOHAB taking into account input from the scientific community, for presentation and approval by the sponsors and publication within two years.
- To coordinate and manage the resulting activities in accordance with the GEOHAB Science and Implementation Plans.
- To collaborate, as appropriate, with organizations such as ICES, PICES, etc. and related programs such as GLOBEC, LOICZ, and the emerging Global Ocean Observing System.
- To ensure effective communication between related national and regional HAB research efforts.
- To report regularly to SCOR and IOC, and to other bodies as needed, on the state of planning and accomplishments of GEOHAB.

### Chair:

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The Martin Ryan Marine Science Institute  
National University of Ireland  
Galway, IRELAND  
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### Vice Chair:

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Fax: +33 (0)4 93 76 37 39  
Email: [marcel@obs-vlfr.fr](mailto:marcel@obs-vlfr.fr)

### Members:

Leonardo Guzman	CHILE	Patricia Glibert	USA
Marcel Babin	FRANCE	Raphael Kudela	USA
Allan Cembella	CANADA	Alicia Lavin	SPAIN
Einar Dahl	NORWAY	Dennis McGillicuddy	USA
Wolfgang Fennel	GERMANY	Robin Raine	IRELAND
Ken Furuya	JAPAN	Ming-Jiang Zhou	CHINA-Beijing
Patrick Gentien	FRANCE		

**Ex-officio Member:** Beatriz Reguera (IOC IPHAB)

**IOC Staff:** Henrik Enevoldsen

**Executive Committee Reporter:** Julie Hall

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

ACTIVITIES 2005-2006  
(submitted by Robin Raine and Ed Urban)**1. 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 2005 SCOR Executive Committee Meeting.

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

A report of the Open Science Meeting on HABs in Upwelling Systems, hosted at the Instituto Nacional de Investigação Agrária e das Pescas (INIAP-IPIMAR), in Lisbon, Portugal on 17-20 November 2003, has been completed and published.<sup>2</sup> The Open Science Meeting served to identify interested participants and research regions and to bring together the international community to design core research. The meeting report provides a general overview of HABs in the designated upwelling systems (California Current System, Iberian Upwelling System and Benguela Upwelling System) and details 8 high-priority research activities to be addressed in understanding the ecology and oceanography of HABs in upwelling systems. Much of the content of the Open Science Meeting report was included in a paper published in *Oceanography*.<sup>3</sup>

A Core Research Project Committee for Upwelling Systems includes Grant Pitcher (South Africa, chair), Teresa Moita (Portugal), Francisco Figueiras (Spain), Raphael Kudela (USA), Trevor Probyn (South Africa), Sonia Sanchez (Peru), and Vera Trainer (USA) and is responsible for implementation of this CRP. The Upwelling CRP Subcommittee met prior to the 2006 GEOHAB SSC meeting. The group published a report of the OSM in *Harmful Algae News*, inviting participation in the CRP. There has been some response to the article in HAN and with the progress now made in planning of the CRP, the committee will interact with those who have shown interest. The subcommittee meeting in January developed projects based on the key questions developed at the OSM and described in the Upwelling report. The second purpose of the meeting was to develop a practical mode of operation of the CRP. One development from the meeting is that the Humboldt Current system will be incorporated in the CRP. Not all key questions will be addressed immediately. The CRP Subcommittee has assigned responsibility for each CRP component and compiled a listing of potential collaborators. Objectives and work plans for each CRP component have been drafted. Vera Trainer drafted an article about the progress on this CRP for HAN, to summarize progress on this CRP and to point to the Web site. Implementation activities were discussed and international coordinators were identified. Subcommittee members will ensure that this document gets distributed to the people on the list. The Upwelling Subcommittee will develop a Web page. The Upwelling Subcommittee will

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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.

<sup>2</sup> GEOHAB 2005. *Global Ecology and Oceanography of Harmful Algal Blooms, GEOHAB Core Research Project: HABs in Upwelling Systems*. G. Pitcher, T. Moita, V. Trainer, R. Kudela, P. Figueiras, T. Probyn (Eds.) IOC and SCOR, Paris and Baltimore. 82 pp.

<sup>3</sup> Kudela, R., G Pitcher, T Probyn, F Figueiras, M Moita and V Trainer. 2005. Harmful algal blooms in coastal upwelling systems. *Oceanography* 18(2):184-197.

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attempt to write review papers on each of the six topics to compare previous research in the various upwelling systems, as a useful starting point for each project. In terms of capacity building, the CRP will try to make it possible to have students travel among the regions.

Two members of the CRP Committee are members of the international GEOHAB SSC, to ensure a strong linkage between the Committee and the SSC. It is intended that much of the work of the CRP Committee will be conducted by means of the GEOHAB Web site and through the establishment of a CRP mailing list. Periodic meetings of the Committee may be organized and combined with GEOHAB SSC meetings, for example, in conjunction with the GEOHAB SSC meeting in January 2006 (the meeting report is available at <http://ioc.unesco.org/hab/Upwelling%20IP-2006%20Final.pdf>).

An invitation to participate in the Core Research Project: HABS in Upwelling Systems has recently been sent to all participants of the Open Science Meeting. A “town hall” meeting has been scheduled for one evening during the 12<sup>th</sup> International Conference on Harmful Algae, to be held in Copenhagen, Denmark on 4-8 September 2006 (see <http://www.bi.ku.dk/hab/>).

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

The Open Science Meeting on Harmful Algal Blooms in Fjords and Coastal Embayments took place in Viña del Mar, Chile from 26-29 April 2004 under the co-direction of Allan Cembella (Alfred Wegener Institute, Germany) and Leonardo Guzmán (IFOP, Chile). More than 60 participants attended at least part of the meeting, which featured 11 key lectures, more than 25 posters presented by participants and an extensive and lively discussion and question periods following each theme.

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

Invited speakers were invited to prepare a manuscript based upon their presentations, subject to peer review and publication in a special issue of the Elsevier journal *Harmful Algae*. The research plan from the open science meeting will be published in late 2006. A CRP subcommittee will be formed and may meet soon after the report is published.

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

The Open Science Meeting on HABS and Eutrophication was held on 7-10 March 2005 in Baltimore, Maryland, USA, under the leadership of Patricia Glibert assisted by a Steering Committee of Don Anderson (USA), Edna Graneli (Sweden), Mingjiang Zhou (China-Beijing), Icarus Allen (UK) and Michele Burford (Australia). This meeting served to obtain community input for the development of a detailed research plan for the Core Research Project – Harmful Algal Blooms in Eutrophied Systems. The plan was drafted by the Steering Committee based on the input of the approximately 120 participants at the meeting, and has been printed by IOC and distributed to meeting participants, sponsors, and other interested scientists. The steering

committee for this research project met in conjunction with the June 2006 meeting of the American Society of Limnology and Oceanography in Victoria, B.C., Canada.

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

The fourth Open Science Meeting, on HABs and Stratification, was held on 5-8 December 2005, at the UNESCO Headquarters in Paris, France, under the leadership of Patrick Gentien. This meeting was designed to bring experts together to review the state of knowledge of the physical and chemical processes related to stratification, and their interaction with microscopic algae. As profiling techniques have improved, persistent and spatially coherent plankton patches have been described at scales smaller than those of standard sampling. These patches are recurrent in coastal systems and their study is essential to understanding the development of HABs. The meeting addressed topics relating to the physical processes relevant to stratification, the maintenance of HAB populations in thin layers, the selection of assemblages by different turbulent regimes, the influence of phytoplankton communities on small-scale physical properties, the implications for sampling, monitoring and operational oceanography, and the required detection systems. The report from the meeting is in preparation.

#### **2. GEOHAB Modelling**

The 2006 GEOHAB SSC meeting featured an extended discussion on modelling, particularly on the content of a potential modelling workshop. The aim is to identify modellers and to get them involved in the CRPs. HAB modelling is not very different from biogeochemical models or particle-tracking models of low-density species. The specific HAB aspects will require species-specific and site-specific modifications. There is no HAB-specific modelling community, but there are modellers who are interested in HAB problems. In most cases, modellers are physical oceanographers and mathematicians, and HAB biologists need to talk with modellers to ask and answer the right questions. Options for the workshop include

1. Model intercomparisons—This would involve modellers talking to each other
2. Dialogue meeting of HAB researchers and modellers. Model representations, introduction to models relevant for the CRPs, including tutorials
3. HAB modelling sessions at conferences (ICES, AMEMR)
4. Summer school

Option 4 was preferred by the SSC. The SSC stressed the need for modelling workshops to get down to a practical level. Species-of-interest models are required for GEOHAB. Also, models should include forecasts as well as models for numerical experimentation. The dialogue between modellers and biologists may be easier if the participants understand what each other are talking about (i.e., the main workshop would be preceded by a tutorial for biologists). They don't need to go into the nuts and bolts of models. Not how to solve differential equations, but why we use them. The biologists don't need to know the details of the physics, but the scales on which they work. The organizers could consider one or two optional days before the meeting for a math/modelling primer. The SSC agreed on attempting a shorter, practical meeting, rather than a larger teaching meeting. Also the SSC agreed that it will require a practical implementation meeting to integrate models into the CRPs. The SCC will scale the meeting to the funding available. The meeting will focus on developing roadmaps of how prediction through modelling and monitoring can be achieved and to give a pattern for how models can be developed for each CRP.

It was agreed to have a student component of the meeting as GEOHAB will have students involved in the CRPs. Summer 2008 was considered the earliest for the meeting/workshop.

**3. Second SCOR Summit of International Marine Projects**

GEOHAB will participate in the second SCOR Summit of International Research Projects, to be held in London, UK in December 2006 (see [www.jhu.edu/scor/ProjCoord2.htm](http://www.jhu.edu/scor/ProjCoord2.htm)). GEOHAB will be represented by Robin Raine and Henrik Enevoldsen.

**4. XI International Conference on Harmful Algae**

A GEOHAB display will be constructed for the 12<sup>th</sup> International Conference on Harmful Algae held in Copenhagen, Denmark, on 4-8 September 2006, to promote the strategy, mission and achievements of GEOHAB. The display will provide a focal point for distribution of GEOHAB documents. Also, as noted above, the Upwelling CRP will host an informal “town hall” meeting one evening to discuss how new individuals can get involved in this CRP.

**5. SSC Meeting: Villefranche, France, January 2006**

A Scientific Steering Committee meeting was held on 23-25 January 2006 in Villefranche, France. The following issues were discussed at the meeting:

- a. GEOHAB Terms of Reference—The SSC agreed that it should stay focused on coordination of GEOHAB research to ensure that success of GEOHAB as a research program and not divert its focus to a broader set of related activities. However, an important point of the discussion is that GEOHAB must make more effort to publicize GEOHAB progress to the worldwide HAB community, and to be more of a leader and catalyst in international HAB research. Since the meeting, a Microsoft Access database of all past SSC members and participants of all GEOHAB meetings was prepared by the SCOR Secretariat for future mailings.
- b. Status of Core Research Projects (see above)
- c. Framework Activities—A summer school on observing systems was discussed briefly, but more discussion was devoted to modelling activities (see above).
- d. Changes needed for the GEOHAB Web site.
- e. GEOHAB representation, presentations, and special sessions at relevant scientific meetings, and meetings of other research projects.
- f. GEOHAB data management and protocols— The CRPs need to allocate significant resources for data management and there would be synergies if the CRPs could share a person to manage data. The SSC recalled that it previously had agreed that GEOHAB CRPs will not compile primary data, only metadata. On each CRP Web page there will be a listing of where data are located. It was agreed to develop or use existing structures to maintain metadata.
- g. GEOHAB endorsement mechanism
- h. Potential new SSC members—New nominations for SSC members will be presented at the SCOR meeting in Chile.
- i. The time and place of the next SSC meeting

**6. SSC Meeting: Tokyo, Japan, March 2007**

The 2007 GEOHAB SSC meeting will be held at the University of Tokyo, hosted by SSC member Ken Furuya, who has obtained special funding to convene an Asian GEOHAB meeting, to stimulate involvement of Asian scientists in GEOHAB. The SSC meeting will focus on implementation of GEOHAB Core Research Projects.

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

GEOHAB, SCOR and IOC continue to seek the establishment of an International Programme Office to help implement, co-ordinate and manage GEOHAB resources in accordance with the approved international *GEOHAB Science Plan* and *Implementation Plan*. IOC and SCOR seek a commitment to host the IPO for GEOHAB with basic operational funds of US\$200,000 per year. For support of the Executive Officer and Administrative Assistant, IOC and SCOR seek international funds from national funding agencies for a period of no less than 3 years and preferably at least 5 years. Until the GEOHAB IPO is established, the co-sponsors of GEOHAB are responsible for overseeing programme progress, as one of their many tasks. Despite consideration of the location of the IPO in Norway, China, United Kingdom and Germany, none of these options have materialized. This situation is unsatisfactory for the long-term progress and success of the programme.

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## GEOHAB Finances

Income	2005	2006	2007
Carry-over from previous year (NSF grant)	\$15,485.04	\$30,647.57 (1)	\$52,595.45
NOAA	\$24,000.00		
NSF (through SCOR)	\$30,000.00	\$17,500.00 (2)	30000
IOC	\$21,134.00	\$20,000.00	20000
IFREMER	\$2,250.00		(3)
SCOR Support for LDC Travel	\$1,508.64		
Other sources (YSI, DNR, CRC)	\$3,000.00		
NOAA Funding for Eutrophication CRP (for 2 years)		\$32,000.00	
Registration Fees	\$26,292.00		
Total	\$123,669.68	\$100,147.57	\$102,595.45
Expenses			
Publications (formatting, printing, mailing, copyrights)	\$30.00		(4)
Advertising			
SCOR Administrative Expenses	\$316.03		
SCOR LDC Travel Support	\$1,508.64		
IOC Expenses (airfares)	\$7,268.00		
Other Meetings			
SSC Meeting		\$14,433	\$34,784
HABs in Upwelling Systems		\$9,156.62	\$12,000.00
HABs in Fjords and Coastal Embayments		\$6,000.00	\$12,000.00
HABs and Stratification	\$27,534.22	\$12,000.00	\$12,000.00
HABs and Eutrophication	\$56,365.22	\$5,963.00	\$16,000.00
Modelling Committee			
Booth at Copenhagen Meeting			
Observation Systems and Instrumentation Committee			
Total	\$93,022.11	\$47,552.12	\$86,784.00
Remaining	\$30,647.57	\$52,595.45	\$15,811.45

(1) Includes first 5 months in 2006

(2) 7 months from June 1, 2006

(3) IFREMER provided 15,000 euros in 2005 toward building "GEOHAB Europe"

(4) Does not yet include some publication costs for 2006

### 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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#### Members:

Ann Bucklin	USA	Jack Middelburg	NETHERLANDS
Wilco Hazeleger	NETHERLANDS	Syed Wajih Ahmad Naqvi	INDIA
David Hutchins	USA	Raymond Pollard	UK
Arne Körtzinger	GERMANY	Hiroaki Saito	JAPAN
Carina Lange	CHILE	Carol Turkey	UK
Coleen Maloney	SOUTH AFRICA	Jing Zhang	CHINA-Beijing

**Executive Committee Reporter:** Bob Duce

**IGBP Liaison:** Beatriz Balino (during Wendy Broadgate's maternity leave)

**Executive Officer:** Sylvie Roy



Integrated Marine Biogeochemistry and  
Ecosystem Research

## **IMBER**

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

Annual Report 2006

Submitted by Sylvie Roy

On behalf of the IMBER Scientific Steering Committee

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#### **Establishment of the IMBER International Project Office**

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The official opening of the IMBER IPO was held on October 25, 2005 at the European Institute for Marine Studies (IUEM) in Brest. 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 office is now fully staffed, Sylvie Roy was appointed Executive Officer in August 2005, Elena Fily started as administrative assistant in September 2005, Sophie Beauvais was appointed as the deputy executive officer in October 2005. The IMBER IPO is actively working on the implementation and promotion of IMBER.

#### **SSC and Executive Meetings**

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##### **2005 Executive Meeting**

The Second IMBER Executive Committee meeting was held in Brest on October 25-27. This meeting was jointly held with the GLOBEC Executive Committee. The focus was to continue work on the Implementation plans for IMBER over the next 6 to 12 months and to develop a plan for moving the relationship between IMBER and GLOBEC forward. A framework for interactions between IMBER and GLOBEC was drafted and circulated to the respective SSCs for approval.

##### **2006 SSC Meeting**

The Third IMBER Scientific Steering Committee Meeting was held on May 10-12, 2006, at the European Institute for Marine Studies in Brest (France) home of the IMBER International Project Office. The meeting focused on reviewing the implementation of IMBER to date and identifying future priorities including interactions with other projects.

### **Plans for 2006-2007**

The next IMBER Executive meeting will be held jointly with GLOBEC in Plymouth (England) on September 27-29, 2006.

### **Implementation of IMBER**

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

#### **End-to-End food web Task Team**

The End-to-End food web Task Team, a joint activity with GLOBEC, is co-chaired by Coleen Moloney (South Africa) and Mike St John (Germany). The team met in Hamburg (Germany) in December and is preparing a review for publication in 2006, which lays out i) why we need to tackle end-to-end food webs in our studies at this time, ii) what the key challenges are and how we can meet them, and iii) how we can make headway in the experimental, observational and modelling components of marine end-to-end food webs. The manuscript entitled "Newton and Kelvin meet Darwin in the complex sea of global change: unravelling marine food webs end to end", with authorship (St John et al.) was submitted to *Science* in early July. The task team will be disbanded when the paper is published. However, the task team recommended the formation of a new IMBER/GLOBEC activity: End-to-end working group to be jointly appointed by the IMBER and GLOBEC SSCs. Some continuity in membership is preferred, but a new group composition is probably needed. The task team will make recommendations regarding scientific issues and refine the terms of reference for this group for the next IMBER/GLOBEC Executive meeting in September 2006. A budget of 10K USD was approved for the activities of this group in 2007.

In conjunction with this activity IMBER will co-sponsor the International Symposium on "Parameterization of trophic Interactions in Ecosystem Modeling" that EUR-OCEANS is organising in early 2007. This symposium will provide a review, synthesis, and forum for discussion of the present understanding of trophic interactions at key interfaces and provide a vision for the development of future modelling strategies. IMBER has agreed to support five participants to attend this symposium.

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

Recognizing the need for scientific discussion and coordination of marine carbon research within IMBER and SOLAS, the two projects have established a joint carbon implementation group. The group is co-chaired by Truls Johannessen (Norway) and Arne Körtzinger (Germany) and works closely with the IOCCP (International Ocean Carbon Coordination Project). It is understood that the joint SOLAS/IMBER Carbon (S.I.C) group will oversee all scientific aspects of marine carbon process studies. A Joint SOLAS/IMBER Carbon Research implementation plan has been published electronically and is considered to be a living document that will be updated regularly ([http://www.imber.info/products/Carbon\\_Plan\\_final.pdf](http://www.imber.info/products/Carbon_Plan_final.pdf)). The S.I.C. group met in September 2005 in Broomfield, Colorado, (USA). One major outcome of this meeting was the creation of three sub-groups to move forward the implementation of the carbon research.

Sub-Group 1 Surface ocean CO<sub>2</sub> fluxes (Chair: Nicolas Metzl, France).

This group is focused on synthesis, instrumentation and technology development, VOS and mixed layer sampling strategy. Their first major action is to organize with IOCCP an International Workshop on Volunteer Observation Ships Network Design and Data

Synthesis (UNESCO, Paris, 11-13 April 2007). The Co-chairs of the organizing committee are Nicolas Metzl and Bronte Tillbrook.

Sub-Group 2 Interior ocean carbon storage (Chair: Nicolas Gruber, Switzerland). This group will cover inventory and observations, natural variability, transformation, designing a strategy for leverage for the Argo program, and interaction with modeling. They took the lead on the initiative “Friends of Oxygen on Argo” (FOA). Their objective is to submit a white paper suggesting the addition of Oxygen sensors on Argo buoys to the Argo SSC by the end of 2006. The group met on June 28-30 at the North Atlantic Synthesis meeting in Iceland organized by CARBOOCEAN. This group is also involved with the International Repeat Hydrography Carbon Advisory Group. It was suggested that this group take the lead on a new activity aimed at broadening the Repeat Hydrography Strategy and identifying the most important questions. This activity could start in 2007 and involve CLIVAR.

Sub-Group 3 Carbon cycle climate sensitivities and feedbacks (Chair: Kitack Lee, Korea). This group has not yet been formed. It will focus on the response of ecosystems and biogeochemical cycle to natural and anthropogenic changes, feedbacks to the Earth System, and future perspective (prediction). Email discussion has been initiated between this group and IOCCP to identify the science issues and develop guidelines and protocols for mesocosm experiments. It was suggested to link Kitack Lee with the IGBP/SCOR Fast Track Initiative on Ocean Acidification.

#### **Continental Margins Task Team**

LOICZ and IMBER have agreed to form a joint LOICZ/IMBER Continental Margin Task Team. The task team consists of 10 members. The task of this group is to organize, by email and perhaps a short logistic meeting by a few, a small Open Science Conference in the second half of 2007 in Shanghai on the biogeochemistry and ecosystems for continental margins. As part of fund raising for this activity, IMBER plans on submitting a proposal to SCOR for travel funds for scientists from developing countries and countries with economies in transition. Based on the outcome of this conference, the task team will recommend to the IMBER and LOICZ SSCs a strategy for implementation of continental margins research in the two projects and suggest a group of people identified from the OSC to take the implementation forward.

#### **Capacity Building Task Team**

The Capacity Building Task Team chaired by Wajih Naqvi is composed of 8 members. The task team developed a capacity-building strategy and implementation plan to be used by IMBER to guide capacity-building issues. 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. The aim is also to strengthen graduate education in ocean sciences. The task team is now developing the approach that should be taken to ensure that the strategy is implemented, and may recommend the formation of a longer term working group.

In relation to its capacity-building activities, IMBER is trying to develop a floating university program. This could potentially be accomplished in collaboration with EUR-OCEANS.

#### **Data Management Task Team**

IMBER has decided to focus on metadata management. A Data Management Task Team chaired by Raymond Pollard was appointed to develop and implement a data management plan, and develop metadata guidelines for IMBER projects. The IMBER Deputy Executive Officer, Sophie

Beauvais, was appointed as the IMBER Data Liaison Officer at the IPO to support the Data Management task team. Raymond and Sophie are planning a meeting with Roy Lowry at the British Oceanographic Data Centre to determine the best strategy for IMBER.

### **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.

## **Promotion of IMBER in the science community**

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### **Communication Plan**

An IMBER communication plan has been developed and made available on the IMBER website. The critical audiences targeted by this plan over the ten year duration of the program are the scientific community, funding agencies, decision makers, and the broader public. It is proposed that the IMBER Communication plan take a staggered multiphase approach to target these key audiences at the appropriate phase of the program. Thus, the first three years should focus on building awareness and involvement of the scientific community and promoting IMBER to the potential funding agencies. From year 4, outreach of science results should still include scientists and funding agencies, but also be more proactive to decision makers and broader public. This second phase should start slowly after year 3 and last until year 10.

### **Website**

The IPO has developed a new IMBER website which was made publicly available in March 2006 (see [www.imber.info](http://www.imber.info))

### **Newsletter**

The three issues of the IMBER electronic "*IMBER update*" have been published in December 2005, March and June 2006. The IPO plans to publish the newsletter quarterly.

### **Brochure and poster**

A brochure giving an overview of the IMBER project is being produced and will be sent out to scientists and institutions. A poster is being produced for use at conferences.

## **IMBER activities**

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### **Sponsored meetings**

- Advances in Marine Ecosystem Modeling Research Symposium (AMEMR), June 27-29<sup>th</sup> 2005, Plymouth, UK.
- Sustained Indian Ocean Biogeochemical and Ecological Research (SIBER) workshop. October 3-6, 2006, Goa, India.
- PICES/IMBER session at the PICES XV Annual Meeting "Boundary Current Ecosystems" October 13-21, 2006 Yokohama, Japan.
- International Conference on the Humboldt Current System: Climate, ocean dynamics, ecosystem processes, and fisheries. Nov 27-Dec 1, 2006, Lima, Peru.
- Symposium on Parameterisation of trophic interactions in Ecosystem Modeling. March 7-9, 2007, Cadiz, Spain.

## **Regional Activities**

**ICED** (Integrated analysis of Circumpolar Climate interactions and Ecosystem Dynamics in the Southern Ocean)

ICED is a joint initiative between IMBER, GLOBEC, SCAR and EUR-OCEANS. The ICED initiative will develop a coordinated circumpolar approach to understand climate interactions in the Southern Ocean, the implications for ecosystem dynamics, the impacts on biogeochemical cycles and development of management procedures. The first Science Planning Workshop for ICED was held 24-26 May 2005 at the British Antarctic Survey, Cambridge, UK. ICED directly addresses the questions put forward as a science focus for IMBER such as: 1) how do climate processes affect the dynamics of circumpolar ecosystems? 2) how does ecosystem structure affect circumpolar ocean biogeochemical cycles? 3) how should ecosystem structure and dynamics be included in the development of sustainable approaches to managing exploitation? A Science Plan for the ICED project was developed and will be submitted to both IMBER and GLOBEC for approval. ICED is also preparing a special session at the XXIX SCAR meeting in Hobart on July 9-19, 2006.

**OECOS** (Ecodynamics Comparison in the Oceanic Subarctic Pacific)

The Oregon State University (OSU, Corvallis) was the site of an international workshop sponsored by PICES (with assistance from the OSU Research Office and the OSU College of Oceanic and Atmospheric Sciences) on May 23-24, 2005. Japanese (OECOS-west) and North American (OECOS-east) scientists discussed the fundamental questions and observational details of proposed comparative studies of ecological processes in the upper waters of the oceanic subarctic Pacific. The questions addressed by the project will serve to improve our understanding of the range of ecosystem function within HNLC regions; specifically those areas with tight control on biomass accumulation such as the eastern subarctic Pacific. IMBER is working with OECOS to develop a strong relationship.

**PRIMO** (Formation and dynamics of the Oxygen Minimum Zone in the Peru-Chile Current system)

Chile, Peru and France have proposed a multi-national project to study the Oxygen Minimum Zone in the Peru-Chile current system. The main objectives are to understand what physical and biogeochemical processes are involved in the formation and variability of the OMZ of the SE Pacific on time scales of a few days to the interannual time scales for the present ocean, and to assess the impacts of its variability on productivity and biological processes in the water and sedimentation.

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

The workshop on Sustained Indian Ocean Biogeochemical and Ecological Research (SIBER) will be held at the National Institute of Oceanography in Goa, India on October 3-6, 2006. The goals of the SIBER Workshop will be to 1) review the state of our knowledge and scientific understanding of the biogeochemical and ecological dynamics of the Indian Ocean in relation to physical oceanographic variability; 2) identify prominent gaps in our understanding especially as they pertain to the role of physical and ecological processes in regulating biogeochemical cycles and the carbon cycle in particular; and 3) formulate a plan for the implementation of a biogeochemical and ecological observational and modelling research program that leverages and substantially enhances the planned CLIVAR/GOOS Indian Ocean observing system. At this workshop the development of an IMBER Indian Ocean regional activity will be discussed.

### **Contributing projects**

#### **EUR-OCEANS (European Network of Excellence for Ocean Ecosystems Analysis)**

The European Network of Excellence EUR-OCEANS is a key contributing project in Europe as a Network of Excellence funded by the European Union. The overall networking objective of EUR-OCEANS is to achieve lasting integration of European research organizations on global change and pelagic marine ecosystems and the relevant scientific disciplines. EUR-OCEANS brings together 160 Principal Investigators (from 66 member organisations in 25 countries). An overview of the different work packages of EUR-OCEANS was presented during the last IMBER SSC meeting. This year, EUR-OCEANS and IMBER signed a memorandum of understanding (M.O.U.) to formalize collaboration and are investigating areas where the two projects can work together. One clear example is the IMBER co-sponsoring of the International Symposium on "Parameterisation of trophic Interactions in Ecosystem Modeling" that EUR-OCEANS is organising in early 2007.

#### **CARBO-OCEAN**

CARBOOCEAN is a European integrated project aimed at an accurate scientific assessment of marine carbon sources and sinks, with special emphasis on the Atlantic and Southern Oceans on a time scale -200 to +200 years from now. An MOU was signed between IMBER and CARBO-OCEAN, which will focus on Themes 1 and 2 of IMBER. . Forty-seven partners and associated collaborators participate to the implementation. The second annual CARBOOCEAN meeting will be held 4-8 December 2006 in Las Palmas, Canary Islands.

### **National Activities**

#### **Canada**

In Canada, the main initiative will come from funding for the IPY. A GEOTRACES/IMBER initiative has been submitted by Roger François; Canadian Arctic Margin Experiment (CAME).

Venus and Neptune observation: The cables are in the water for VENUS and the data are being collected. Neptune needs funding for instruments.

A meeting on the Line P Time-series organized by PICES will be held in Victoria (July 2006).

#### **Chile**

COPAS (Center for Oceanographic Research in the eastern South Pacific) was established in March 2002 at the University of Concepción in Chile. The COPAS Center is devoted to advanced basic scientific research on the circulation, biogeochemical cycling, ecology and paleoceanography of the Eastern South Pacific Ocean. The Center also provides advanced training opportunities to young scientists for research careers in oceanography and related areas. Three scientific questions have been identified and are being addressed from a multidisciplinary and synergistic point of view through six initial research programs. This multi- and interdisciplinary research is based on direct observations, retrospective analyses, experimental work, and modelling.

#### **China-Beijing**

A new 5-year IMBER/GLOBEC programme has been approved by the Ministry of Science and Technology of China (MOST). Prof Qisheng Tang and nearly 70 scientists are involved in the programme entitled "Key Processes and Sustainable Mechanisms of Ecosystem Food Production in the Coastal Ocean of China". The scientific focus of the programme will be on coupling mechanisms of the marine biogeochemical cycles and the end-to-end food web interactions in the China seas to promote sustainable food production and ecosystem-based management in

coastal ocean ecosystems from the perspectives of both anthropogenic impacts and natural changes. A kickoff meeting was held in Qingdao (China) in January 2006. During this meeting, the group leaders started developing the implementation strategy of the programme. Sylvie Roy attended this meeting at the invitation of the Chinese.

### **Finland**

The Finnish SCOR Committee expressed their interest to IMBER programme. They decided to make actions to join IMBER by participating with researchers in international IMBER-oriented cruises and organizing international research cruises on the *R/V Aranda* in the Baltic Sea and elsewhere in near future.

### **France**

The new French ocean program CYBER (CYcles Biogéochimiques, Ecosystèmes et Ressources, French acronym for “Biogeochemical Cycles, Ecosystems and Resources”) is a program that takes over the former PROOF program that was essentially dedicated to the study of ocean fluxes. Scientific activity within CYBER is now structured around four major themes, each of them being the French counterpart of international initiatives:

- Theme 1: Ecosystem structure, functional diversity and biogeochemical cycles (IMBER);
- Theme 2: Biogeochemical cycles of trace elements and isotopes (GEOTRACES);
- Theme 3: Biological and biogeochemical processes within continental margins (LOICZ-IMBER-GLOBEC);
- Theme 4: Biological and biogeochemical processes at air-sea interface (SOLAS).

Two major French campaigns have been successful recently: BIOSOPE (Oct-Dec 2004, South Pacific) and KEOPS (Jan-Feb 2005, Kerguelen Plateau). BIOSOPE focuses on the biogeochemical and optical characteristics of different trophic regimes in the southeast Pacific Ocean, and especially the oligotrophic area associated to the central part of South Pacific Gyre. This program has been endorsed by IMBER. The general objective of KEOPS is to improve our understanding of the response of the Southern Ocean to the global climate change. Particularly, KEOPS will study the effect of natural iron fertilisation of the ocean by the Kerguelen Plateau on the biological pump of CO<sub>2</sub> and on the cycles of other chemical compounds relevant for climate.

### **Germany**

Three IMBER-related initiatives are under way in Germany:

1. A German IMBER project proposal has been submitted to a German funding body with 2008 as a starting date and a planned duration of 2 to 3 years. The goal of the project is to understand, how shelf ecosystems will react to global change and to develop predictive capacities for these reactions. The studies will focus on the North Sea and Northern Benguela Upwelling.
2. A new project focused on the determination of seasonal-to-decadal time changes in sub-surface oceanic oxygen storage and transport is being developed.
3. The University of Kiel (IFM-GEOMAR) has submitted a proposal entitled “The Future Ocean” to the Excellence Cluster initiative of the German Research Ministry. This project includes two main research topics: "Greenhouse Oceans" and "Resources and Risks". Decision will be made at the end of October 2006.

IMBER has also provided a letter of interest to support a national proposal to establish an open-access off-shore mesocosm facility administered by IFM-GEOMAR in Kiel. The purpose of the proposal is to set up a research platform dedicated to studying the consequences of ocean change (such as ocean warming, ocean acidification, changes in ocean redox state, and loss of species diversity ...) on an ecosystem level. The proposed facility will be comprised of two components: (1) an infrastructure component centered around a mobile, off-shore mesocosm and (2) a network component that coordinates and operates off-shore mesocosm activities.

### **India**

The Council of Scientific and Industrial Research (CSIR) has approved a project entitled “Impact of anthropogenic perturbations on oceanographic – atmospheric processes in and around India in the context of Global Change”. This project is coordinated by the National Institute of Oceanography (NIO), Goa and comprises three activities of interest to IMBER:

- Transport and transformations of nitrogenous fertilizers from agricultural field to the ocean: Impact on coastal ecosystem and exchanges with atmosphere;
- Reconstruction of upwelling intensity/anoxia on seasonal to centennial time scales from coral and sedimentary records;
- Long term times series measurements including calibration of critical atmospheric and oceanographic parameters.

### **Japan**

The Japanese IMBER National Committee was set up under the Global Environmental Research Liaison Committee of the Science Council of Japan (SCJ) in January 2005 in Nagoya (Japan). This group is developing a research strategy and funding proposal for an IMBER-related study, as well as developing relationships with SOLAS-Japan and Japan-GLOBEC. IMBER-Japan proposed a North-South transect cruise in the western North Pacific, and obtained 52 days ship time in 2008 with Japan-SOLAS. IMBER-related scientists also got ship time in 2009 for the subarctic Pacific and for the subtropical North Pacific.

DEEP (Deep-Sea Ecosystem and Exploitation Programme) is an ongoing GLOBEC-related research programme focusing on the interaction between epipelagic and mesopelagic ecosystems. The Agriculture, Forestry and Fisheries Research Council, the Japanese funding agency for agriculture, forestry and fisheries sciences, is planning a new research programme on the marine ecosystem regime shift after DEEP. If it takes off successfully (from 2007), the programme would be an IMBER-Japan activity with GLOBEC.

There are also several ongoing research programmes in Japan that will contribute to the IMBER project including the biological pump study in the NW North Pacific Ocean (JAMSTEC); carbon sequestration to the deep sea and the Subtropical Nitrogen Fixation Flux Study (SNIFFS); and the EAST-WEST comparison of the subarctic Pacific ecosystems.(OECOS).

### **Netherlands**

IMBER was presented to 140 scientist during a meeting held in April 2005. Following this meeting, a firm plan for a national oceanographic expedition in the Indian Ocean, including SOLAS and IMBER, have been made for 2007. Funding plans have been delayed for one year and there was a very recent SOLAS/IMBER/GEOTRACES joint meeting in Amsterdam to discuss future research plans.

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## New Zealand

An ocean ecosystem project has been funded for 12 years. Two cruises in the permanently oligotrophic region to the northeast of New Zealand investigating the nitrogen cycle will be contributions to the IMBER project. In 2008-2009, a cruise on the east coast of New Zealand will focus on mesopelagic processes and will link to a strong modeling component in the project.

## South Africa

There is no national IMBER project in South Africa. The Benguela region is the focus of most ecosystem research, but there is little open ocean research undertaken. Marine ecosystem research is embedded in regional studies in Somali and Benguela currents and largely focused on continental margins. There is also a South African Marine Research program: "Society, Ecosystems and Changes" involving social and natural scientists.

## USA

IMBER organized an evening informational session at the 2005 annual meeting of ASLO, held on Feb. 22, 2005, in Salt Lake City, Utah. The title of the session was "U.S. National and International Projects on Carbon, Ecosystems, and Global Change: Status and Discussion." The session was intended to highlight IMBER in the context of other international ocean projects that the United States was developing or involved with, such as GLOBEC, SOLAS and the U.S. Ocean Carbon and Climate Change (OCCC) project. The OCCC scientific steering group (SSG) is chaired by Scott Doney. The recently formed Ocean Carbon Biogeochemistry (OCB) is also chaired by Scott Doney and is composed of the OCCC SSG (8) and 8 additional members with a variety of expertise. An Ocean Carbon Cycle science workshop will be held at WHOI on July 10-13, 2006.

## IMBER Scientific Steering Committee in 2005.

Name	Expertise	Institution	Gender	Country
Ann Bucklin	Biology and Ecosystems	University of Connecticut	F	United States
Jay T. Cullen	Chemistry	University of Victoria	M	Canada
Julie Hall (Chair)	Biology and Ecosystems	NIWA	F	New Zealand
Dennis A. Hansell (Vice Chair)	Carbon	University of Miami - RSMAS	M	United States
Wilco Hazeleger	Physics and Climate	Royal Netherlands Meteorological Institute	M	The Netherlands
David Hutchins	Biology and Ecosystems	University of Delaware Graduate College of Marine Studies	M	United States
Arne Körtzinger	Carbon	Institute of Marine Research University of Kiel	M	Germany
Carina Lange	Paleoceanography	University of Concepción - Centro COPAS	F	Chile
Jack Middleburg	Sediment-Water Interface	NIOO-KNAW - CEME	M	Netherlands
Coleen Moloney	Sediment-Water Interface	University of Cape Town	F	South Africa
Patrick Monfray (Vice Chair)	Modeling and Integration	OMP/LEGOS	M	France
S. Wajih Ahmad Naqvi	Biogeochemistry	National Institute of Oceanography	M	India
Raymond Pollard	Physics and Climate	National Oceanography Centre, Southampton	M	United Kingdom
Hiroaki Saito	Biology and	Tohoku National Fisheries Research	M	Japan

	Ecosystems	Institute		
Carol Turley	Biology and Ecosystems	Plymouth Marine Laboratory	F	United Kingdom
Jing Zhang	Biogeochemistry	East China Normal University State Key Laboratory of Estuarine and Coastal Research	M	China-Beijing

### **Acknowledgements**

The IPO is supported by Centre National de la Recherche Scientifique (CNRS), Institut de Recherche pour le Développement (IRD), Université de Bretagne Occidentale (UBO) and the Brittany Region. We would like to thank the Institut Universitaire Européen de la Mer (IUEM) in Brest for their sponsorship of the IMBER IPO, Wendy Broadgate and Ed Urban for their ongoing support of the IMBER project, Bill Young and John Bellamy for their work on the IMBER SP/IS and to Paul Treguer for his dedicated support of the IMBER project.

### 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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#### Full Members

Martin Frank	SWITZERLAND
Toshitaka Gamo	JAPAN
Catherine Jeandel	FRANCE
Bill Jenkins	USA
Tim Jickells	UK
S. Krishnaswami	INDIA
Denis Mackey	AUSTRALIA
Keith Moore	USA
Raymond Pollard	UK
Reiner Schlitzer	GERMANY

#### Associate Members

Jess Adkins	USA
Per Andersson	SWEDEN
Ed Boyle	USA
Greg Cutter	USA
Minhan Dai	CHINA-Beijing
Hein de Baar	NETHERLANDS
Anton Eisenhauer	GERMANY
Roger Francois	CANADA
Chris German	UK
Pere Masque	SPAIN
Chris Measures	USA
Jim Moffett	USA
Kristin Orians	CANADA
Andreas Oschlies	UK
Mukul Sharma	USA
Karen von Damm	USA
Michiel Rutgers	
van der Loeff	GERMANY
Jing Zhang	JAPAN

**Executive Committee Reporter:** Robert Duce

GEOTRACES PLANNING GROUP  
ANNUAL REPORT TO SCOR 2005/2006  
July 2006

SCOR planning group for GEOTRACES

*Co-Chairs*

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

*Other Full Members*

Martin Frank, Germany  
Toshitaka Gamo, Japan  
Catherine Jeandel, France  
William J. Jenkins, USA  
Tim Jickells, UK  
Seth Krishnaswami, India  
Denis Mackey, Australia  
J. Keith Moore, USA  
Raymond Pollard, UK  
Reiner Schlitzer, Germany

*Associate Members*

Jess Adkins, USA  
Per Andersson, Sweden  
Edward A. Boyle, USA  
Greg Cutter, USA  
Minhan Dai, China  
Hein de Baar, Netherlands  
Anton Eisenhauer, Germany  
Roger Francois, Canada  
Chris German, UK (moving to USA)  
Pere Masque, Spain  
Chris Measures, USA  
Jim Moffett, USA  
Kristin Orians, Canada  
Andreas Oschlies, UK  
Mukul Sharma, USA  
Karen von Damm, USA  
Michiel Rutgers van der Loeff, Germany  
Jing Zhang, Japan

Development of Science Plan for GEOTRACES

The primary goal of GEOTRACES SCOR planning group activity over the last year has been to complete our Science Plan. A draft of the Science Plan was sent out for review by SCOR in July 2005. Substantial reviews were received from nine anonymous referees. The planning group drafted a comprehensive response to these reviews. That response was presented to SCOR and, following approval from SCOR, it was used as a basis for revising the Science Plan. The revised Science Plan was approved by SCOR in January 2006.

Members of the planning group made further revisions to the text and figures in February and March, after which the document was forwarded to the printers (Clyvedon Press, UK). During the two months leading up to the writing of this report, members of the planning group, with tremendous help from Ed Urban, have reviewed and revised three drafts of the galley proofs. We anticipate that the final changes will be implemented in early August, and that printed copies will soon be available for distribution.

SCOR meetings

- The full SCOR Planning Group did not meet during the past year. Business has been handled via e-mail.
- Two subcommittees established by the planning group met during the past year, with travel support provided by SCOR:
  - i) *Standardisation and Intercalibration*: During the meeting of the full planning group held in Vienna, Austria (May, 2005), Greg Cutter (Old Dominion University, USA) was asked to lead

a subcommittee on Standards and Intercalibration. That committee met at the IAEA laboratory in Monaco (24-25 October 2005) and produced a set of recommendations that have been embodied in a report that was circulated among planning group members for comments. The report was revised based on those comments, and is now posted on the GEOTRACES web site ([www.geotraces.org](http://www.geotraces.org)) for review by the broader community.

Building on the recommendations from that report, Cutter and colleagues are preparing a proposal to the U.S. NSF to be submitted 15 August 2006, to secure ship time and major infrastructure (e.g., trace metal-clean rosette systems) to host an international intercalibration cruise. The format of the cruise is planned to follow that used during the intercalibration for iron that was conducted as part of the SAFe program.

- ii) *Data Management*: During the meeting of the full planning group held in Vienna, Austria (May 2005), Raymond Pollard (National Oceanography Centre, UK) and Chris Measures (University of Hawaii, USA) were asked to lead a subcommittee on Data Management. That committee met at the British Oceanographic Data Centre, Liverpool, UK (30 Nov. – 2 Dec., 2005) and produced a set of recommendations that have been embodied in a report that was circulated among planning group members for comments. The report was revised based on those comments, and is now posted on the GEOTRACES web site ([www.geotraces.org](http://www.geotraces.org)) for review by the broader community.

#### Future issues

The GEOTRACES Planning Group has nearly completed its mission of creating a Science Plan. GEOTRACES is in the process of replacing the planning group with a Scientific Steering Committee. At the time of the writing of this report, 17 of the 19 individuals who were invited to serve on the SSC have either agreed, or have recommended an alternate. As soon as we have a decision from the last 2 people, a list of names will be forwarded to SCOR for review, comment, and approval.

#### Links with other programmes

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

- *SOLAS*, was represented on the GEOTRACES planning group by Tim Jickells (University of East Anglia, UK). Jickells has chosen not to serve on the GEOTRACES SSC, but rather to continue serving in a non-SSC capacity as a liaison between GEOTRACES and SOLAS.
- *IMBER*. Raymond Pollard is a member of both the GEOTRACES Planning Group and the IMBER SSC. The IMBER SSC and the GEOTRACES planning group have agreed that, in the future, Jay Cullen (University of Victoria, Canada) will serve as the liaison between IMBER and GEOTRACES. Continuing with the tradition started in 2004, Gideon Henderson (co-chair of the GEOTRACES Planning Group) attended the 2006 IMBER SSC Meeting (Brest, France, May 2006).

#### Developments at national and international levels

During the transition between the planning group and the SSC, we do not have a complete report of national and regional activities. Following is a partial list:

- A combined GEOTRACES planning meeting for China and for the western Pacific region was held in Xiamen, China during the last week of August 2005 (Minhan Dai, host and contact). More than 40 scientists participated, primarily from China, but with representatives as well from Taiwan, Hong Kong, South Korea and Japan.
- Several national proposals have been submitted for cruises in both the Arctic and Southern Oceans during the International Polar Year (IPY). Hein de Baar (The Netherlands) is coordinating GEOTRACES IPY activities.
- The first GEOTRACES cruise occurred in November 2005, while the *Polarstern* was en route from Germany to the Southern Ocean. This cruise initiated the process of developing analytical protocols and the intercalibration of methods that will be essential to the generation of internally consistent data throughout the GEOTRACES program (contact person Michiel Rutgers van der Loeff, AWI, Germany).
- A major proposal was submitted to NERC (UK) on 1 July 2006 for a Consortium Award to repeat the Atlantic Meridional Transect as a GEOTRACES cruise (contact Gideon Henderson, The University of Oxford).
- A proposal to the U.S. NSF to establish a US GEOTRACES project office has been recommended for funding. To the extent permitted by available resources, the US project office will assist with matters pertaining to international GEOTRACES until an international project office can be established (Contact Bob Anderson, Lamont-Doherty Earth Observatory).

#### GEOTRACES: Spreading the word

We have strived to engage the wider research community through publications, special sessions, and open meetings at international research conferences.

#### *Publications:*

- Anderson, R.F., and G.M. Henderson. 2005. GEOTRACES: A global study of the marine biogeochemical cycles of trace elements and their isotopes. *Oceanography* 18(3):76-79.

#### *Conferences:*

- An open “town meeting” will be held during the Fall meeting of the American Geophysical Union (11 December 2006, San Francisco). The general purpose of the meeting will be to inform members of the oceanographic community about the objectives and status of the GEOTRACES program, and to encourage interested scientists to participate in the planning and implementation of the GEOTRACES program. A specific mission for this meeting will be to encourage people to participate in the intercalibration effort that is being launched at this time. We believe that the intercalibration of sampling and analytical methods used to measure trace elements and their isotopes in seawater will be of great value to the oceanographic community, regardless of the level to which participants in the intercalibration are involved later in GEOTRACES cruises.
- A special session entitled “Marine Biogeochemical Cycles of Trace Elements and Isotopes: from Regional to International Networks” was held at the Western Pacific Geophysical Meeting, Beijing, China, on 24-27 July 2006. The session was well attended, and the strong showing has reportedly helped convince NSF-China to begin supporting GEOTRACES planning activities.
- A special session entitled “Evolution of ocean chemistry: past, present and future” will be held at the 2006 Goldschmidt Conference, Melbourne, Australia, 27 August - 1 September 2006.

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## Acknowledgements

We offer our special thanks to Ed Urban, who has made a heroic effort to help finalize the GEOTRACES Science Plan while also providing excellent organization and logistics support for the GEOTRACES committee meetings.

## **Budget for GEOTRACES**

	2004	2005	2006	2007
Carry-over		\$28,508	\$27,839	\$25,839
<b>Income</b>				
SCOR	\$11,989			
NSF	\$6,492	\$29,167	\$50,000	\$50,000
Other nations?				
LDEO (Boston Meeting)	airfare/meals			
IAEA				
Total Income	\$18,481	\$57,675	\$77,839	\$75,839
<b>Expenses</b>				
Publications		\$10,000		
Representation at meetings			5000	8000
Oxford Meeting	\$16,391			
Boston-LDEO	airfare/meals			
Boston-SCOR	\$2,091			
Vienna Meeting		\$0		
SSC Meeting			\$25,000	\$25,000
Exec. Comm. Meeting?				
DM Comm. Meeting		\$8,887	\$10,000	\$10,000
Stds/Protocol Meeting		\$10,949	\$12,000	\$12,000
Cruise Planning Meeting?			??	??
Other?			??	??
Total Expenses	\$18,482	\$29,836	\$52,000	\$55,000
Balance	-\$1	\$27,839	\$25,839	\$20,839

Date: Fri, 28 Jul 2006 15:35:36 -0400  
From: Bob Anderson <boba@ldeo.columbia.edu>  
Subject: GEOTRACES News  
Sender: owner-GEOTRACES\_ALL@ldeo.columbia.edu  
To: geotraces\_all@ldeo.columbia.edu  
Cc: boba@ldeo.columbia.edu, geotraces@ldeo.columbia.edu

## **GEOTRACES: An International Study of the Global Marine Biogeochemical Cycles of Trace Elements and their Isotopes**

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GEOTRACES News No. 2

Contents:

- 1) Status of Science Plan
- 2) Town meeting at Fall AGU
- 3) US GEOTRACES Project Office
- 4) Proposal for Phase-I: Intercalibration

Please forward this message to interested colleagues. To add or remove names from this distribution list, contact Moanna St. Clair at <geotraces@ldeo.columbia.edu>.

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1) Science Plan. The GEOTRACES science plan is currently with the printers (Clyvedon Press in the UK). Review of the galley proofs has just been completed, and we hope to have printed copies available soon. When available, an announcement will be made via this e-mail distribution list and instructions for obtaining a copy will be provided at that time.

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2) Town Meeting. On open public meeting to discuss GEOTRACES will be held at the Fall AGU meeting in San Francisco, Monday 11 December, 19:30 - 20:30, in the Marriott Hotel. Members of the Scientific Steering Committee will be present to answer questions and encourage community participation in various GEOTRACES activities, most importantly, the Intercalibration of sampling and analytical methods (see 4 below).

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3) A proposal for a US GEOTRACES Project Office has been recommended for funding by the US National Science Foundation. Until such time as an international project office can be established, the US office will offer support for coordination of international GEOTRACES activities to the extent that resources permit. The US Project Office will be housed at the Lamont-Doherty Earth Observatory under the supervision of Bob Anderson <boba@ldeo.columbia.edu>. Administrative support and management of the GEOTRACES web site (www.geotraces.org) will be provided by Moanna St. Clair <geotraces@ldeo.columbia.edu>.

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4) As described in the GEOTRACES Science Plan, the first major phase of international GEOTRACES activity will be a program to intercalibrate sampling and analytical methods to ensure that results obtained in different regions and by different research groups can be compared unambiguously. A group of scientists in the US (Greg Cutter, Ken Bruland, and Rob Sherrell) is taking the lead on a proposal to the US NSF to secure ship time for an INTERNATIONAL intercalibration program.

A separate message soliciting input from investigators interested in participating in the intercalibration program will be sent out soon.

---

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Date: Fri, 28 Jul 2006 15:52:26 -0400  
From: Bob Anderson <boba@ldeo.columbia.edu>  
Subject: GEOTRACES Intercalibration - Solicitation of Input  
Sender: owner-GEOTRACES\_ALL@ldeo.columbia.edu  
To: geotraces\_all@ldeo.columbia.edu  
Cc: geotraces@ldeo.columbia.edu

TO: GEOTRACES Community  
FROM: Greg Cutter (Old Dominion University, Virginia USA)  
Ken Bruland (University of California, Santa Cruz USA)  
Rob Sherrell (Rutgers University, New Jersey USA)

The GEOTRACES Standards and Intercalibration Committee completed its plan in April and a draft has been posted on the GEOTRACES web site, <http://www.geotraces.org/>, under Reports (committee membership is listed). This plan follows the recommendations of the Science Plan and provides guidance for the important first phase of GEOTRACES; it is now time to begin implementation. In this respect, Greg Cutter, Ken Bruland, and Rob Sherrell are preparing a proposal to be submitted to the US National Science Foundation for: (1) developing the sampling systems to be used in all future US GEOTRACES cruises; (2) conducting two international GEOTRACES Intercalibration cruises that would test the systems, facilitate complete intercalibrations for the GEOTRACES suite of trace elements and isotopes (TEIs; see Science Plan for details), and collect large volumes deep and surface samples to become GEOTRACES reference seawaters and allow sample storage tests; and (3) establishing two GEOTRACES Baseline stations (refer to the Plan) as a result of the Intercalibration cruises. As such, the proposed work would be very similar in concept to the SAFe (Sampling and Analysis of Fe) program, albeit much broader in scope due to the diverse array of GEOTRACES' TEIs and the

need to sample the dissolved and particulate phases. Greg Cutter will coordinate the overall effort and primarily will be responsible for developing the US GEOTRACES sampling systems. Ken Bruland will participate in the testing of the systems and in intercalibration aspects that include providing the community with GEOTRACES reference seawater samples for various TEIs. Rob Sherrell will have responsibility for particulate collection, including intercalibrations, colloidal fraction sampling, and measurements at the GEOTRACES Baseline stations.

So why are we alerting you to this activity? First, we want to make sure that the community has read and commented on the Standards and Intercalibration Plan; many did as a part of its creation, but continued feedback and modifications are an essential part of this living document. Secondly, like SAFe, the Intercalibration cruises we are proposing must be a community effort and therefore we need to identify colleagues who wish to participate in this intercalibration program. Therefore, if you are interested in participating, please provide us with the following information by 10 August:

1. Which TEIs you would determine and in what phases (particulate, colloidal, dissolved)?
2. Would you need to actually go on the cruises or just receive samples (more on this below)?
3. Could you participate with existing/planned funding or would you require a new proposal to participate (see below).

All of this information will be presented in a table in the proposal for two reasons, first to show that we will have participants/good TEI coverage and secondly to document linkages for those who will submit their own proposals (not exclusionary however). To assist you in responding and for planning, here are some more details and specifics on the proposal:

1. This proposal will cover the costs for the US sampling systems, ship time, expendables, shipping and travel, and direct personnel costs for the 3 investigators and their technical staff - all of the core needs. After complete testing and intercalibration, the entire system will be available for all US-based cruises (with complete user manuals/documentation); it will be a community asset. This proposal will NOT be able to cover costs for the other participants (US or international); hence this message and the table of interested participants.
2. The first cruise is planned for mid-2008 in the North Atlantic (e.g., Sargasso Sea/BATS Station) and the second for mid-2009 in the North Pacific (e.g., HOT Station).
3. This proposal is being submitted for the 15 August 2006 NSF deadline. If funded, those in the US who needed to submit a new proposal could do so for the 15 February 2007 or 15 August 2007 deadlines. Since the first cruise would be in mid-2008, this should give everyone in the international GEOTRACES community sufficient time to secure funding.
4. At this stage, we feel that the priority (not in ranked order) for going on the cruises will be for those who are analyzing TEIs on board (including speciation) to provide t=0 for storage tests, who have alternative sampling systems to intercalibrate with the proposed system (see below), are determining short-lived radionuclides, or require extensive shipboard sample processing. Everyone else would receive their samples collected by the shipboard teams following established protocols.
5. The TEIs to be intercalibrated at a minimum will be the GEOTRACES "Key parameters" (see Science Plan), including, Al, Fe, Mn, Cd, Cu, Zn, <sup>230</sup>Th, <sup>231</sup>Pa, and Pb and Nd isotopes. However, the speciation of selected elements (e.g., Fe, Cu; see Science Plan), other elements

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representing the broad categories of TEIs (e.g., Mo as an oxyanion), and all of these TEIs in the dissolved, colloidal, and particulate phases, will be examined. It should be noted that this choice of the key parameters is not exclusionary, but rather the minimum list to achieve overall GEOTRACES goals. The entire process from sampling, sample processing and storage, and analysis needs to be intercalibrated.

6. The planned primary US sampling system will be similar to Landing and Measures' CLIVAR system (see Intercalibration Plan for photos and description), but capable of sampling to 6000 m and holding 24 12-L Go-Flo sampling bottles (Teflon-coated, Teflon valves, etc) that can be simultaneously triggered (i.e., 3 at once while the rosette is slowly being raised to allow for large volume samples) using off-the-shelf (cheaper, easily available) equipment. Secondary sampling systems will include clean pumps and tubing for the upper 100-200 m, and in situ pumping apparatus for collection of large volume particulate samples and use of in situ extraction columns. A GEOTRACES-dedicated clean van for sample processing will also be procured. These will become a US community asset, not the property of the principal investigators. We know that there are other international sampling systems built or in the planning stages. In this respect, we hope that the 2008 and 2009 cruises will have these other systems on board (see #4) to fully intercalibrate all international systems.

Overall, it is our strategy that this Intercalibration proposal will be an international effort like the preceding SAFE intercalibration, and as such, a major part of the international GEOTRACES program. In this respect, we encourage your participation, comments, and suggestions (gcutter@odu.edu, [bruland@ucsc.edu](mailto:bruland@ucsc.edu), [sherrell@marine.rutgers.edu](mailto:sherrell@marine.rutgers.edu)). For the participant table, we'll need your inputs no later than 10 August.

### 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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Ken Denman	CANADA	Uli Platt	GERMANY
Barry Huebert	USA	Shigenobu Takeda	JAPAN
Sergey Gulev	RUSSIA	Guang-Yu Shi	CHINA-Beijing
Tim Jickells	UK	Mitsuo Uematsu	JAPAN
Truls Johannessen	NORWAY	Osvaldo Ulloa	CHILE
Christiane Lancelot	BELGIUM	Doug Wallace	GERMANY

**Executive Committee Reporter:** Laurent Labeyrie

**IGBP Liaison:** Wendy Broadgate

**Executive Officer:** Jeffrey Hare

*SOLAS International Project Office  
Annual Report to SCOR 2005/2006*

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**31 July 2006**

**SOLAS Implementation Plans**

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

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

- Focus 1:** Biogeochemical Interactions and Feedbacks between Ocean and Atmosphere
- Focus 2:** Exchange Processes at the Air-Sea Interface and the Role of Transport and Transformation in the Atmospheric and Oceanic Boundary Layers
- Focus 3:** Air-Sea Flux of CO<sub>2</sub> and Other Long-Lived Radiatively-Active Gases

It was decided that the Implementation Plan for Focus 3 would be developed jointly with the Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) project. As of October 2006, the IMPs successfully completed the task of development of the three Implementation Plans, and these are posted on the SOLAS website (<http://www.solas-int.org>). Now that these are posted, the role of the IMPs shifts toward execution of the science within the Plans. The Implementation Plans are meant to be 'living documents' and will periodically, but judiciously, be subject to review and modification.

**SOLAS Scientific Steering Committee (SSC)**

The SOLAS SSC met in Tokyo Japan at the end of May 2005 and met in Amsterdam Netherlands in early May 2006. Coincident with the meeting in Japan, the SOLAS-Asia network met for a 2-day workshop. Similarly, a workshop was held in Amsterdam for the Netherlands SOLAS/IMBER/GEOTRACES network, and the SSC was invited to participate.

## Original membership of the SSC (2001-2003):

Peter Liss (Chair), M, UK, Microlayer/Air-Sea Overview  
 Ilana Wainer, F, Brazil, Ocean Boundary Layer Physics  
 Peter Schlosser, M, USA, Air-Sea Exchange (WCRP member)  
 Bill Miller, M, Canada, Marine/Atmospheric Photochemistry  
 Katherine Richardson, F, Denmark, Biological Oceanography  
 Phil Boyd, M, New Zealand, Marine Biogeochemistry  
 Truls Johannessen, M, Norway, Ocean Carbon  
 Doug Wallace, M, Germany, Air-Sea Exchange of Greenhouse Gases  
 Patricia Matrai (Vice-Chair), F, USA, Air-Sea Sulfur Exchange  
 Ullrich Platt, M, Germany, Air-Sea Halogen Exchange  
 Barry Huebert, M, USA, Atmospheric Aerosols  
 Mitsuo Uematsu, M, Japan, Atmospheric Aerosols  
 Elsa Cortijo, F, France, Palaeo Studies  
 Ken Denman, M, Canada, Biogeochemical Modeling (WCRP member)  
 Dileep Kumar, M, India, Coastal Studies  
 Garbrand Komen, M, Netherlands, Atmospheric Boundary Layer  
 Tim Jickells, M, UK, Air-Sea Exchange of Nutrients

## Changes to the membership of the SSC:

Jan 2004:      Departed -      Ilana Wainer, F, Brazil, Ocean Boundary Layer Physics  
                  Replacement- Wade McGillis, M, USA, Ocean Boundary Layer Physics

                 Departed -      Katherine Richardson, F, Denmark, Biological Oceanogr.  
                  Replacement- Osvaldo Ulloa, M, Chile, Biological Oceanography  
    Christiane Lancelot, F, Belgium, Biological Oceanography

                 Departed -      Phil Boyd, M, New Zealand, Marine Biogeochemistry  
                  Replacement- Shigenobu Takeda, M, Japan, Marine Biogeochemistry

                 Departed -      Gerbrand Komen, M, Netherlands, Atmos. Boundary Layer  
                  Replacement- Gerrit DeLeeuw, M, Netherlands, Atmos. Boundary Layer

Jan 2005:      Departed -      Dileep Kumar, M, India, Coastal Studies  
                  Replacement- Guang-Yu Shi, M, China, Coastal Studies

Jan 2006:      Departed -      Elsa Cortijo, F, France, Palaeo Studies  
                  Replacement- Isabel Cacho Lascorz, F, France, Palaeo Studies

                 Departed -      Peter Schlosser, M, USA, Air-Sea Exchange (WCRP member)  
                  Replacement- Sergey Gulev, M, Russia, Air-Sea Exchange (WCRP member)

Jan 2007:      To Depart -      Bill Miller, M, USA, Photochemistry  
                  Nominee-      David Kieber, M, USA, Photochemistry

                 To Depart -      Doug Wallace, M, Germany, Greenhouse gases, Air-sea exchange  
                  Nominee-      Cliff Law, M, New Zealand, Trace gas exchange and nutrients

To Depart - Ken Denman, M, Canada, Biogeochemical modeling  
 Nominee- Veronique Garcon, F, France, Ecosys. dynamics, biogeochemistry

Significant change in SSC composition is anticipated at the end of 2007 (the timing coincides with two terms of the original members), including the need for selection of a new Chair. This turnover will present new challenges and opportunities for SOLAS.

### SOLAS International Project Office

The SOLAS International Project Office (IPO) was established at the University of East Anglia (UEA) in Norwich UK, with five-year funding by the U.K. National Environmental Research Council (NERC).

In June 2005, Dr. Jeffrey Hare was appointed as Executive Officer (EO) of the IPO. Jeff comes to the office from the University of Colorado, where he worked for nearly 10 years as a research marine micrometeorologist in the NOAA Environmental Technology Laboratory in Boulder. In September 2005, Dr. Emily Breviere, formerly of the Centre de Calcul Recherché et Réseau Jussieu (CCR) at the University of Pierre and Marie Curie in Paris, was appointed as IPO Project Officer. Ms. Georgia Bayliss-Brown recently received her BS degree in Environmental Sciences from UEA and is now working part time in the IPO as a Research Assistant.

### *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. Activity within the nation should accelerate if the proposed national joint Land-Ocean Interaction in the Coastal Zone (LOICZ) / SOLAS office is realized. Australian scientists led and executed the SOLAS-endorsed project, Precursors to Particles (P2P), at the Cape Grim Baseline Air Pollution Station in January 2006.
- **Belgium** – The Belgian Federal Science Policy (BELSPO) has generously contributed funds to permit a half-time Secretariat for IMP1 over a 2-year period beginning January 2005, and Dr. Veronique Schoemann fills that role from the Université Libre de Bruxelles (ULB). This agency has also provided funding for research groups within the nation to consolidate SOLAS research activities into a Cluster. The funding will establish a communications office at ULB, establish a database management strategy, help to coordinate modeling efforts, and assist in the set up of a national website. In May 2005, the 37<sup>th</sup> Liege Colloquium on Ocean Dynamics focused on Gas Transfer at Water Surfaces (SOLAS Focus 2) and was hosted by Dr. Alberto Borges of the Université Liege. In December 2006, ULB will organize and host a DMS model intercomparison workshop (SOLAS Focus 1). A SOLAS-related expression of intent has been submitted for the International Polar Year (IPY). Christiane Lancelot, of ULB, is a member of the SOLAS SSC.

- **Brazil** – There are four major experimental efforts listed on the SOLAS-BR website. These are: FluTuA – Turbulent Fluxes over the Tropical Atlantic, Numerical Study of the Surface Fluxes in the South Atlantic, Sea Waves and Coastal Monitoring at Sao Paulo State, and Global Scale Studies of Oceanic Fluxes using Remote Sensing.
- **Canada** – The C-SOLAS program is the first funded national program within SOLAS, and their five-year funding cycle is now complete. The science program was structured into three inter-related themes: 1) Biogeochemical interactions and feedbacks between oceans and atmosphere (DMS-climate connection, halogen-climate connection, carbon-climate connection, iron-climate connection), 2) Exchange processes at the air-sea interface, and 3) Integration and modeling. C-SOLAS developed a network of 43 researchers from 9 universities, 22 government researchers, 2 industrial partners, and (most significantly) over 30 graduate students. For the field phase of the work, two independent series of cruises were executed (SERIES and SABINA) and a mooring was placed in the vicinity of Ocean Station Papa in the Northeast Pacific. The C-SOLAS network has produced an incredible number of refereed publications (over 50) from the 5-year funding cycle. In 2006, the C-SOLAS network submitted a proposal to national funding agencies to continue work, but this proposal was not successful. The network held its final national open science conference in June 2006 in Toronto. Ken Denman of Fisheries and Oceans Canada (DFO) is a member of the SOLAS SSC.
- **Chile** – A significant amount of SOLAS work in Chile is conducted at the COPAS (Centro de Investigación Oceanográfica en el Pacifico Sur-Oriental) institute in Concepción, with academic institutions also contributing. There are plans underway to coordinate SOLAS research with the upcoming CLIVAR Variability of American Monsoon Systems (VAMOS) Ocean Cloud Atmosphere Land Study (VOCALS) program field intensive in October 2007, and this collaboration involves significant participation by Chilean SOLAS researchers. Osvaldo Ulloa, of the Universidad de Concepcion is a member of the SOLAS SSC.
- **China (Beijing)** – China SOLAS has obtained over 1 million US dollars to conduct SOLAS research from 2003-2007, networking with national neighbors (China-Taipei, Korea, Japan, etc.) has increased, and the national scientists look forward to more progress in international cooperation across the Asian network. An Asian-SOLAS meeting was conducted in May 2005 in Tokyo, coincident with the SOLAS SSC meeting, and presentations were conducted by scientists from India, Japan, China (Beijing), China (Taipei), and Korea. 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 are planned or 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, and a second ADOES workshop is planned for August 2006. Finally, China will host the next International SOLAS Open Science Conference in Xiamen, 6-9 March 2007.

Guang-Yu Shi of the Institute of Atmospheric Physics in Beijing is a member of the SOLAS SSC.

- **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, from the National Central University, has been invited to speak at the 2007 SOLAS Open Science Meeting in Xiamen, China.
- **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. Studies are planned for investigation of the air-sea exchange of aerosols, toward making improvement to existing parameterizations. Lise Lotte Sorensen of the Riso National Laboratory is an invited speaker at the 2007 SOLAS Open Science Meeting in China.
- **France** – Although France has not consolidated their SOLAS research efforts, a SOLAS meeting in Paris in September 2005 has helped to establish a network. French scientists are very active in SOLAS-related research, so the assembly of a national network is an important step. In the past, the French program operated under the moniker of PROOF (acronym for biogeochemical processes in the ocean and fluxes). This program had three main themes: 1) interaction between climatic changes and biogeochemical cycles through the ocean/atmosphere interface, 2) effects of climate change and natural variability on the functional structure of marine ecosystems and on biogeochemical cycles, and 3) calibration of palaeo proxies in the ocean. Eight national SOLAS projects were sponsored by PROOF: ACTION (quantifying seasonal and interannual variations of the air-sea carbon dioxide flux in the Mediterranean Sea), BIOSOPE (biogeochemical and optical properties of trophic regimes in the South East Pacific Gyre during the austral summer), FLEMENCO<sub>2</sub> (estimation of regional air-sea fluxes of carbon dioxide), KEOPS (prediction and response of the Southern Ocean to climate change), OCEVAR (interactions between climate variability and marine biogeochemical cycles on a global scale), POMME (understanding subduction mechanisms in the northeast Atlantic), UVECO (effect of UV radiation on bacterial and phytoplanktonic communities), DYFAMED (long time-series measurement station with addition of carbon dioxide and other fluxes). Veronique Garcon, of the Centre National de la Recherche Scientifique (CNRS) has been nominated for membership on the SOLAS SSC.
- **Germany** – German scientists are very active in the SOLAS research regimes, combining institutional (the Max Planck Institutes) and university researchers. The D-SOLAS effort has focused on dust deposition, iron chemistry in aerosols and the sea, biogeochemistry, sulfur and halogen-chemical transformations in the

atmosphere, and the air-sea fluxes of nitrogen and carbon compounds. Some efforts have been placed into developing the network, and a proposal has been submitted to the national science agency for consideration. Although the funding level has not been established, this proposal has been successfully accepted. This largely oceanographic program is named Surface Ocean Processes in the Anthropocene (SOPRAN), and it 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. Significantly, D-SOLAS has teamed up with UK-SOLAS to plan the development of a unique atmospheric (UK) and oceanic (D) observatory in the Cape Verde Islands. Cruises and aircraft flights funded by each nation in the vicinity of the observatory are also planned, making optimal use of the facility and the continuous data set. In addition, collaborations are planned 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 (Institute for Marine Research, Kiel) and Uli Platt (University of Heidelberg) are members of the SOLAS SSC.

- **India** – SOLAS and IMBER collaborate strongly in India, but resources within the nation are limited. Dileep Kumar, from the National Institute of Oceanography, 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 April 2005. Recently, scientists at the University of Galway lead a cruise and experimental effort under the Marine Aerosol Production (MAP) moniker.
- **Japan** – Significant progress in the SOLAS-JP network was demonstrated during the mid-2005 Asian SOLAS Workshop, held coincident with the Tokyo meeting of the SOLAS SSC. Research results were presented from the two Sub-Arctic Ocean Enrichment and Ecosystem Dynamics Study (SEEDS) iron enrichment cruises, measurements of bromomethanes and radical molecules in the atmosphere, time-series measurements, modeling of ecosystems, and results from the Studies on Antarctic Ocean and Global Environment (STAGE) experiment. The goals of the SEEDS experiments were to evaluate iron enrichment as a way of carbon dioxide sequestration and to evaluate the effects of iron enrichment to marine ecosystems, while STAGE is a 5-year series of cruises into Antarctic waters which is in its final year of funding. Other SOLAS activities include the Variability of Marine Aerosol Properties (VMAP) program, which seeks to exploit natural and man-made releases of sulfur compounds for studies of nutrient enrichment, and the Subtropical Nitrogen Fixation Flux Study (SNIFFS) which is due to occur from May to August 2006 in the subtropical North Pacific Ocean. A Joint Japan SOLAS/IMBER workshop was held at Nagoya University in March 2006. SOLAS-JP was recently informed that a major SOLAS/IMBER proposal is funded, although the final level of support is not yet apparent. Shigenobu Takeda and Mitsuo Uematsu, both at the University of Tokyo, are on the SOLAS SSC.

- **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. Kitack Lee, from Pohang University, is a member of the SOLAS-IMBER Carbon Group.
- **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. 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 were invited to participate. Gerrit DeLeeuw, from the Netherlands Institute for Applied Geoscience (TNO) is a member of the SOLAS SSC.
- **New Zealand** – Scientists from New Zealand, Australia, the United States, Canada, and the United Kingdom participated in the 2004 SOLAS Air-Sea Gas Exchange Experiment (SAGE) to investigate the biological response to iron enrichment and gas transfer with a dual tracer injection. From this experiment, the New Zealand network has gained strength and is led by scientists from the National Institute for Water and Atmospheric Research (NIWA). 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. Clifford Law of NIWA has been nominated for membership on the SOLAS SSC.
- **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 (EU-CAVASSOO, which includes scientists from the UK, Germany, France, Spain, and Norway). Norwegian SOLAS scientists are involved in investigations of the cycling of bioreactive gases between the air and sea, mesocosm perturbation experiments, coupled 3-d modeling, etc. CARBOOCEAN, which is endorsed by SOLAS is housed at the University of Bergen. Truls Johanessen, of the University of Bergen and the Bjerknes Centre for Climate Research, is on the SOLAS SSC.
- **Russian Federation** – A national climate program exists, and SOLAS-related studies here include atmospheric anthropogenic gases and chemical components of the Earth climate. The national network has not fully developed, although many researchers are working within SOLAS fields. Sergey Gulev, of the Russian Academy of Sciences, is a member of the SOLAS SSC.
- **Spain** – Specific funding for SOLAS research is not available at the national level, but a working group has been established within the general structure of IGBP-Spain. Spanish scientists work on quantification of air-sea carbon dioxide exchange and the marine biotic effects on this flux, the investigation of links between DMS and climate, the deposition of inorganic and organic compounds

and marine productivity and respiration in oligotrophic environments. Isabel Cacho Lascorz, from the University of Barcelona, is a member of the SOLAS SSC.

- **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 National Environmental Research Council (NERC) programme UK-SOLAS was initiated in early 2004 with £11M over 5 years. Eleven Round One projects were selected for funding, and the first annual meeting was held in July 2006. A call for proposals for research in halogen dynamics resulted in two funded projects, and an additional project received funding under Knowledge Transfer. Funding has also been approved for the installation of 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. Peter Liss (Chair) and Tim Jickells, both of the University of East Anglia, are members of the SOLAS SSC.
- **United States** – The U.S. program is in the final stages of science and implementation plan development and network solidification. There are plans for a process-study oriented cruise in the Southern Ocean for early 2008. 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. SSC members from the United States include Wade McGillis (Lamont-Doherty Earth Observatory), Bill Miller (University of Georgia), Paty Matrai (Bigelow Laboratory for Ocean Sciences), and Barry Huebert (University of Hawaii).
- **Europe** – SOLAS research is very strong across the continent, with over 40% of the SOLAS research community residing in Europe. The IPO was recently awarded funding for a COST Action to create flux data products from ongoing SOLAS data collection. 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.

### **Other Activities**

#### SOLAS International Summer School

Seventy-five students and 24 lecturers attended the first SOLAS International Summer School, which was held in June 2003. 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. The site provides a unique environment for the Summer School, with academic classrooms, laboratory facilities, and a

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nearby port. For example, collaborators from France have been able to secure a research vessel for ship-based practical workshops during the Summer School. The 2<sup>nd</sup> Summer School was held in September 2005, and plans are underway for the 3<sup>rd</sup> Summer School, scheduled for 22 October – 3 November 2007. 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 the SSC to be of fundamental importance to the long-term legacy of SOLAS.

### Open Science Meeting

Before the establishment of the International SOLAS structure, an Open Science Meeting (OSM) was held in Damp, Germany in the spring of 2001. This conference was largely concentrated on the establishment of the SOLAS Science Plan and on the development of the programme.

The 2004 SOLAS OSM was held in Halifax, Nova Scotia Canada, from 13-16 October. This meeting for all international science contributors was organized by the Canadian SOLAS secretariat and provided a unique forum for networking. Twenty plenary presentations and more than 175 posters were presented, and the meeting was attended by over 250 scientists and students from 24 countries. The SOLAS SSC made a subsequent decision to follow the format of the Halifax meeting for other OSMs. The unique opportunities to network and establish collaborations are felt to be incredibly useful.

The 2007 SOLAS OSM is planned for 6-9 March in Xiamen, China, and is being organized by local hosts at the University of Xiamen and the IPO. This OSM will again include a relatively small number of plenary talks (21), long poster sessions (posters will be displayed over the duration of the conference), and afternoon discussion and synthesis sessions on topics determined to be of importance by the community. We are looking forward to this exciting event, and the IPO has requested \$8k from SCOR to help bring scientists and students from less developed nations to the conference.

### Other Projects

SOLAS has close relationships with three other IGBP Core Projects. With Integrated Marine Biogeochemistry and Ecosystem Research (IMBER), SOLAS has developed a Joint Implementation Plan for ocean carbon research (SOLAS IMP3). With International Global Atmospheric Chemistry (IGAC), 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), including projects to investigate air-sea fluxes of gases in nearshore regions.

The Task Team on Halogens in the Troposphere (HiT), which is co-sponsored by SOLAS and International Global Atmosphere Chemistry (IGAC), has developed a white paper on the state of the science and strategies for future investigation. This white paper will be published, and the SOLAS and IGAC IPOs are strategizing on appropriate formats for publication. This document is available on the SOLAS website (<http://www.solas-int.org>).

The Atmosphere-Ice Chemical Interactions (AICI) Task Team is a jointly endorsed venture under IGAC and SOLAS and has issued a science plan and is strategically positioned for the International Polar Year (IPY; March 2007 - March 2009).

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.

The International Polar Year (IPY) should provide an opportunistic platform for OASIS, HitT and other research areas of SOLAS. Richard Bellerby of the Bjerknes Centre for Climate Research in Bergen is the point of contact for SOLAS polar activity.

In conjunction with the International Nitrogen Initiative (INI), SOLAS has endorsed a review of anthropogenic nitrogen impacts on the open ocean. This review will generate a published paper explaining the state of the science and the outstanding scientific issues that must be addressed. A four-day workshop is planned for UEA in Norwich (UK) for November 2006, and SCOR is generously providing funds for this activity.

SOLAS is sponsoring a dimethylsulfide (DMS) model intercomparison workshop for over 20 scientists at the Université Libre de Bruxelles (ULB) in December 2006. The development of this workshop is a direct result of the afternoon discussion sessions during the 2004 OSM in Halifax.

Special SOLAS sessions were conducted at the February 2006 American Geophysical Union / American Society of Limnology and Oceanography / The Oceanography Society (AGU/ASLO/TOS) Ocean Sciences Meeting in Honolulu and at the April 2006 European Geophysical Union (EGU) General Assembly in Vienna. In addition, a SOLAS special session is scheduled for the 2007 Fall AGU Meeting in San Francisco, and a joint IMBER/SOLAS special session will be held at the 2007 EGU General Assembly in Vienna.

SOLAS is sponsoring a workshop entitled "Modeling iron biogeochemistry and ocean ecosystems" at the October 2006 North Pacific Marine Science Organization (PICES) Annual Meeting in Yokohama, Japan.

A SOLAS-initiated meeting to review the results of the various large-scale iron enrichment experiments took place in Wellington, New Zealand, from Oct. 30 to Nov. 4, 2005. This meeting included 20 scientists 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, and the final draft of the synthesis paper is expected very soon.

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 of and the persistence of the unique stratus cloud (<http://www.eol.ucar.edu/projects/vocals/>). Current plans call for an October 2008 cruise with the possible participation of two research vessels.

The SOLAS SSC Executive Committee and the three SOLAS Implementation Groups met during the February 2006 AGU/ASLO/TOS Ocean Sciences Meeting in Honolulu. The next meeting of the full SSC will take place on 4-5 March 2007 in Xiamen, China, before the SOLAS OSM in the same city.

## **Capacity Building and Inclusion of Less Developed 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 Inter-America Institute for Global Change Research (IAI), the North Pacific Science Organization (PICES), the Atmospheric Composition Change European Network of Excellence (ACCENT), and other national funding agencies. Without this support, SOLAS would not be able to tout the capacity building engendered by this activity.

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 to anyone else who requests a CD. It will also be available on the Web. The IPO will also provide free hard copies or CDs of the SOLAS Science Plan and Implementation Strategy to anyone who requests one.

With our Open Science Meeting to occur in March 2007, SOLAS has made a request to SCOR to support the participation of scientists and students from less developed economies. SOLAS has also requested funds for participation in the OSM from the Chinese government agencies, U.S. funding agencies (NASA, NOAA, and NSF), APN, IAI, PICES, ACCENT, etc.

Jeffrey Hare  
Emily Breviere

**3.6 Land-Ocean Interactions in the Coastal Zone (LOICZ)  
(an IGBP and IHDP project)**