Appendix 6

Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) Project

IMBER Annual Report to SCOR, June 2011

MAJOR ACTIVITIES AND ACHIEVEMENTS

- IMBER IMBIZO II
- Data Management Dry Cruise
- SIBER Science Plan and Implementation Strategy finalisation
- IMBER posters presented at IPY Oslo Polar Science Conference, WCRP OSC, ESSAS OSM, Liège Colloquium,
- Second ESSAS OSM
- First meeting of the IMBER Human Dimensions Working Group
- First SIBER SSC meeting
- SIBER establishes an International Project Office
- IMBER Special Session at the Liège Colloquium
- Official opening of the IMBER China Regional Project Office (RPO)
- Two IMBER Special Sessions at EGU
- IMBER Special Session at ASLO
- IMBER promotion at Portes overtes
- ICED/EUR-OCEANS Rapid change in polar systems workshop
- Five IMBER session proposals submitted for the Planet Under Pressure conference
- IMBER promotion at SEATECH week
- IMBER presentations at the NRC Ocean Studies Board Meeting and the OCB Summer Workshop
- First meeting of the IMBER Data Management Committee

PLANNED ACTIVITIES

- Joint SOLAS/IMBER/IOCCP Carbon Synthesis Meeting
- IMBER poster presentation at the Marine Sciences and European Research Infrastructure symposium, Brest, France June 2011
- 5th IMBER China/Japan/Korea meeting in Shanghai, China, November 2011
- Five possible IMBER sessions at Planet Under Pressure meeting, London, UK, March 2012
- Third IMBER Summer School in Ankara, Turkey, August 2012
- IMBIZO III (possibly in China), 2013
- First IMBER Open Science Meeting, planning underway for 2014

WORKING GROUPS

The Human Dimensions and Continental Margins working groups were finalized in late 2010 and early 2011, respectively. This brings the number of IMBER working groups to five. The activities of the IMBER working groups during the past year follow.

1 SOLAS-IMBER Carbon (SIC!) Working Group

The joint SOLAS-IMBER carbon group oversees the scientific aspects of marine carbon process studies as outlined in the SOLAS-IMBER Carbon Research Implementation Plan (http://www.imber.info/products/Carbon_Plan_final.pdf)

There are three sub-groups involved in moving carbon research forward. They focus on establishing and supporting ocean observing systems and aim to ensure that the different observing elements are integrated into a coherent set of observations. Several white papers and plans developed in the context of the OceanObs'09 conference were published during 2010 (see publications below – Monteiro et al 2010; Gruber et al 2010 and Feely et al 2010).

A meeting 'The Ocean Carbon Cycle at a Time of Change: Synthesis and Vulnerabilities' is being organised by SIC SG1 and SG2 and IOCCP at UNESCO, Paris from 14-16 September 2011. The goal is for new analyses and the global synthesis to be completed by early 2012, for inclusion in the IPCC AR5. A Special Issue will also be published on the science presented at the meeting.

Sub-group 1 (SG1) Surface Ocean CO_2 Fluxes (Leader: Dorothee Bakker, UK)

Dorothee Bakker has replaced Nicolas Metzl as Chair of SIC SG1.

The main goal of the SG1 is to enable a more accurate estimation of ocean-atmosphere CO_2 flux. The development of the Surface Ocean CO_2 Atlas (SOCAT) is a major accomplishment in this regard. It presents all the publically available surface water fCO_2 (fugacity of CO_2) data (8.8 million values) from the coastal seas and global oceans, in a common format. SOCAT will be launched at a special session at the SIC Synthesis meeting in Paris on 14 September 2011.

The global surface ocean fCO_2 data set with second level quality control and a global gridded product of monthly surface water fCO_2 means, with no temporal or spatial interpolation (i.e. bin averages) will be available. The SOCAT data set is seen as an important building block for future global carbon research, such as understanding the response of surface water fCO_2 and the oceanic CO_2 sink to increasing levels of atmospheric CO_2 in a changing climate.

A proposal to hold a special SOCAT session on 'The Changing Ocean Carbon Cycle: Data Synthesis, Analyses and Modelling' at the Ocean Sciences meeting on 20-24 February 2012 has been submitted.

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

The membership of the SIC SG2 has been revised and there are now eight members. They will hold their first meeting in conjunction with the Synthesis meeting in Paris in September 2011.

The group intends to provide a global synthesis of ocean interior carbon changes (oceanic uptake, transport and storage of anthropogenic CO_2). Since 2009, the focus has been the quality control and synthesis of interior carbon observations from the Repeat Hydrography Programme. This is being done basin-by-basin, examining the changes in oceanic storage of anthropogenic CO_2 through time. This estimation of the change in oceanic storage of anthropogenic CO_2 is fundamental to understanding the global carbon cycle.

The working group also intends to support the establishment of an observing system for ocean biogeochemistry - Oxygen on Argo - by including oxygen, nitrate, chlorophyll and pH sensors on autonomous floats.

A joint meeting was held with the Global Carbon Project in October 2010 in the context of their REgional Carbon Cycle Assessment and Processes (RECCAP) project, which aims to establish the mean carbon balance of large regions of the globe at the scale of continents and large ocean basins.

Sub-group 3 (SIOA) SOLAS-IMBER Ocean Acidification (Leader: Jean-Pierre Gattuso, France)

The SOLAS-IMBER Ocean Acidification Working Group has representatives from ocean acidification research programmes from the Australia, China, France, Germany, Japan, UK and USA. The goal of the SIOA is to undertake synthesis activities and to coordinate research efforts in ocean acidification at the international level. Considerable synthesis work has already been undertaken, much of it by members of the SIOA (e.g. *Ocean Acidification* edited by Jean-Pierre Gattuso and Lina Hansson to be published in September 2011 by Oxford University Press).

At its first meeting in 2009, the SIOA recommended a programme of international activities which are critical to assess the effects of ocean acidification, but currently not funded at national or international. The SIOA met in Washington, DC (USA) in November 2010. Representatives of several of the US federal funding agencies also attended this meeting. It was concluded that the SIOA has neither the time nor the human and financial resources to independently launch any of the activities it identified in the coordinating program. This prompted the group to reassess its role in Ocean Acidification research. Following the recommendation of the International Reference User Group (RUG) on Ocean Acidification, the SIOA recommended the need to establish an “Ocean Acidification International Coordination Office (OA-ICO)” that would have the responsibility to oversee implementation of the activities that are needed to move ocean acidification forward at the international level. If this recommendation comes to fruition, the terms of reference of the SIOA will be revised. The IMBER SSC were not in favour of disbanding the group, which is considered to be an important component of the SIC group.

An SIOA session proposal was submitted for the Planet Under Pressure conference in London in 2012.

2 Continental Margins Task Team

The membership of the new joint IMBER-LOICZ Continental Margins Task Team (CMTT) was finalised in January 2011. There are nine members led by Kon-Kee (KK) Liu (Taiwan), the IMBER co-chair, and Helmuth Thomas (Canada) the LOICZ co-chair. In addition, there are five Associates, whose specialised expertise can be called upon as required.

One of the first tasks for the CMTT is to finalise and publish the Continental Margins Implementation Strategy that was drafted by the original CMTT. IMBER and LOICZ SSC members have identified several sections that need to be included, for example, the impact of humans in the continental margins. Once the document is completed, terms of reference will be developed for the CMTT to move it forward.

The IMBER regional project office in China (IMBER RPO) is responsible for the coordination of IMBER continental margins activities. One of the first major events currently being investigated is the organisation of a Continental Margins – Human Dimensions IMBIZO in Shanghai, China in 2013.

A proposal to hold a continental margins session at the Planet Under Pressure Meeting in London in 2012 was submitted.

3 Capacity Building Task Team (CBTT)

The CBTT has eight members and is chaired by Jing Zhang (China). He also represents IMBER in an ex-officio capacity on the SCOR Capacity Building Committee (see http://www.scor-int.org/capacity.htm for details).

Capacity building is an important aspect in all IMBER activities, and the CBTT aims to facilitate the participation of early-career scientists and scientists from developing countries in IMBER and IMBER-related activities and training programmes. It also attempts to develop the research capabilities in regions where there are very few scientists involved in IMBER-related research. The Capacity Building Strategy and Implementation Plan is available at: http://www.imber.info/products/Capacity_Building_final.pdf.

The CBTT plans to undertake an IMBER training/capacity building needs analysis in early 2012. They also wish to instigate a mentoring system whereby established scientists mentor early-career and developing county scientists attending international conferences.

The IMBER Summer Schools, held every second year, have proved to be a successful capacity building mechanism. The ClimECO_2 summer school (co-organized with IUEM and GIS Europôle Mer) was held at the Institut Universitaire Européen de la Mer (IUEM) in Brest, France on 23-27 August 2010. It was entitled: Oceans, Marine Ecosystems, and Society facing Climate Change - A Multidisciplinary Approach. Seventy-five participants from 26 countries attended. Additional information is available at: http://www.europolemer.eu/en/climeco2_0.php.

Plans are under way for the third IMBER Summer School, which will be held at the Ankara University in Ankara, Turkey in August 2012. The theme will be the feedbacks between ecosystems, biogeochemistry, and the Earth System in a warming world. Raghu Murtugudde (USA) and Baris Salihoglou (Turkey) will co-chair the organising committee that is currently being established.

4 Data Management Committee

The IMBER Data Management Committee (DMC) promotes a cooperative data management approach that includes involving experienced data management specialists from the start of a project, and also training young scientists in good data management procedures. The group is chaired by Alberto Piola (Argentina) and has six additional members. Su Mei Liu (China) was appointed to the group in 2010, to improve the geographic coverage of the DMC. The DMC held its first meeting in Crete, Greece on 9 October 2010.

The DMC organised a one-day Data Management Dry Cruise before the start of IMBIZO II for IMBIZO participants and local students and scientists (please see the report in the Training section below).

The Data Management Cookbook has been widely distributed to laboratories and research vessels and can be downloaded from the IMBER Web site (http://www.imber.info/DM_cookbook1.html). Alternatively, printed copies are available on request from the IMBER office (imber@univ-brest.fr). The document will soon be available in Spanish.

5 Working Group on Human Dimensions

The IMBER Human Dimensions Working Group (HDWG) was formed in 2010 in response to the recommendation of the IMBER-GLOBEC Transitional Task Team that the interactions between humans and marine systems should be incorporated into IMBER science. Recognising the challenge of integrating the natural and social science aspects, the group has a natural scientist co-chair, Alida Bundy (Canada) and two social scientist co-chairs, Marie-Caroline Badjeck (Malaysia) and Moenieba Isaacs (South Africa).

The HDWG held its first meeting in Paris, France in April 2011, where the scope of the working group was considered and a work plan devised. The report of the meeting can be seen at: http://www.imber.info/HD_WG.html. The organisation of an international scoping meeting is being investigated, as is the possibility of a Continental Margins – Human Dimensions IMBIZO in 2013.

The HDWG, in collaboration with LOICZ, submitted a proposal to hold a session at the Planet Under Pressure Conference in London in 2012.

REGIONAL PROGRAMMES

IMBER has four regional programmes. Integrating Climate and Ecosystem Dynamics (ICED) was established jointly by GLOBEC and IMBER and moved fully into IMBER when GLOBEC ended in early 2010. Climate Impact on Oceanic Top Predators (CLIOTOP) and Ecological Studies of Sub-Arctic Seas (ESSAS) began under GLOBEC and are now officially IMBER programmes. The Sustained Indian Ocean Biogeochemistry and Ecosystem Research (SIBER) Programme was initiated under IMBER. Updates on the activities of these regional programmes follow.

Climate Impact on Top Oceanic Predators (CLIOTOP)

CLIOTOP is a 10-year programme that started in 2005 that is focused on a global comparison of the impact of climate variability (at various scales) and fishing on the structure and function of open ocean pelagic ecosystems and their top predator species. .

The incorporation of CLIOTOP into IMBER requires some modification of its Science Plan and Implementation Strategy (SPIS) to align it more with IMBER science. The changes were discussed at the CLIOTOP mid-term workshop, ‘CLIOTOP into the future - Building Scenarios for Oceanic Ecosystems in the XXI Century’, held in Paris, France in February 2010, with input provided by the IMBER SSC. The updated SPIS is expected before the end of 2011.

CLIOTOP has six interactive working groups that focus on key processes and scales.

WG 1: Early life history of top predators aims to determine the environmental characteristics that influence the timing and intensity of reproduction and larval survival.
WG 2: Physiology, behaviour and distribution investigates the factors (including anthropogenic forces) affecting spatial dynamics and population structure, as well as reproductive and feeding-related behaviour.
WG 3 Trophic pathways in the open ocean pelagic ecosystems compares trophic pathways among and within oceans and investigates whether seasonal and spatial variability can be used to explore the impacts of climate variability. It also considers the importance of mesopelagic versus epipelagic prey resources for oceanic top predators and if this is affected by climate change.

WG 4 Synthesis and modelling explores the importance of fisheries exploitation and the dynamic environment in structuring pelagic ecosystems and seeks the most appropriate mechanism(s) to provide the greatest predictive power.
WG 5 Socio-economic aspects and management strategies considers the socio-economic pressures on tuna fisheries and whether fisheries organisations addressed the impacts of climate variability and climate change. It also examines the usefulness of fisheries management decision support tools and how the flows in capital and knowledge among the world's large fisheries respond to variability.
MAAS (6) Mid-tropic automatic acoustic sampling aims to provide global scale monitoring of mid-trophic level organisms through the development of observational platforms equipped with multi-frequency acoustics to identify and quantify mid-trophic organisms.

CLIOTOP submitted a position paper entitled 'Global Science for Global Governance of Oceanic Ecosystems' to Science in December 2010. The paper argues that new mechanisms of global governance resting on large scale international scientific endeavour are urgently needed to address impacts of global change on oceanic ecosystems and the sustainability of fisheries. It was not accepted by Science and is being revised for submission elsewhere.

CLIOTOP Publications include a special volume of Progress in Oceanography:

> CLimate Impacts on Oceanic TOp Predators (CLIOTOP)
> CLIOTOP International Symposium La Paz, Mexico 03-07 December 2007
> Volume 86, Issues 1-2, Pages 1-316 (July-August 2010)
> Editors: Patrick Lehodey, Olivier Maury and Mélanie Rathburn

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

The 2010 ESSAS Annual Science Meeting held in Reykjavik, Iceland from 30 August - 1 September, 2010 highlighted the ongoing research by the working groups and in other ESSAS areas.

A major event was the second ESSAS OSM that was held in Seattle, WA USA from 22-26 May 2011. The meeting showcased the progress made by the ESSAS working groups, and the national and multi-national programs affiliated with ESSAS, and focused the future directions for ESSAS science, especially in regard to interfacing with IMBER science objectives.

Publications:
NORway-CANada Comparison of Marine Ecosystems (NORCAN) special volume in *Progress in Oceanography* compares various aspects of the marine ecosystem in the Labrador Sea and shelves with those in the Barents and Norwegian Seas. It should be published later in 2011.

A special volume of *Journal of Marine Systems* presenting the results of the IPY Norwegian Ecosystem Studies of Sub-Arctic and Arctic regions will be published in 2012.

Integrating Climate and Ecosystems Dynamics (ICED)
ICED was developed jointly by IMBER and GLOBEC to determine the main control of Southern Ocean ecosystem dynamics and potential for feedbacks as part of the Earth system. The ICED Science Plan was published in 2008 and is implemented through data synthesis, fieldwork coordination, and modelling.

ICED identified the coordination of Southern Ocean fieldwork as a priority and has developed online fieldwork mapping tool for collating information on relevant field activities. Progress is being made, particularly with respect to cruise planning information and data (particularly on zooplankton) rescue (see http://www.iced.ac.uk/science/fieldworkmap.htm).

The ICED/EUR-OCEANS Foresight Workshop 'Rapid change in polar ecosystems' was held in Bremerhaven, Germany in November 2010. The workshop focused on change in polar ecosystems and on strengthening and coordinating European research in this area.

Several important ICED publications have been submitted. These include: a key ICED paper based on the Food Web Modelling workshop and a book based on a Southern Ocean special issue of the *Philosophical Transactions of the Royal Society*.

Sustained Indian Ocean Biogeochemical and Ecological Research (SIBER)
SIBER is a new regional programme sponsored by IMBER and Indian Ocean GOOS and is focused on understanding climate change and anthropogenic forcing on biogeochemical cycles and ecosystems in the Indian Ocean. The SIBER Science Plan and Implementation Strategy has been accepted by IMBER and IOGOOS and will be published by late summer 2011. The first SIBER SSC meeting took place from 12 to 16 July 2010 in Perth, Australia, together with IOGOOS, CLIVAR's Indian Ocean Panel (IOP) and the newly formed Indian Ocean Resources Forum (IRF). At this meeting working groups dedicated to promoting SIBER science in the European Union, USA, Australia, Africa, Oman/Kuwait/Pakistan, Indonesia/Thailand and Japan/China were established.

Two major achievements for SIBER are: the establishment of the SIBER International Project Office in Hyderabad, India with Dr. Satya Prakash as the Executive Officer, and the initiation of the first national SIBER programme in India with funding from the India's Ministry of Earth Sciences.

SIBER and IOP submitted a session proposal to the Planet Under Pressure conference. The proposed session will focus on climate and anthropogenic impacts on regional oceanography, ecosystems and fisheries in the Indian Ocean.

ENDORSED PROJECTS
IMBER currently has 26 endorsed projects from 14 countries (Argentina, Brazil, Canada, Chile, China, Denmark, France, Germany, Italy, Japan, New-Zealand, Spain, UK and USA).

The following projects have been endorsed by IMBER since the last annual report to SCOR:

INTC-TMCO (Materials transfer through the continent-sea interface)
Leading applicant: Luiz LACERDA (Brazil)

INTC-TMCO (2009-2014) aims to study the transport, accumulation, cycling and biogeochemistry of nutrients, organic matter and trace metals in the land-ocean interface in different coastal systems of Brazil.

In line with the IMBER themes, INTC-TMCO will evaluate the changes in sediment, organic matter, nutrients and pollutants fluxes from the continent downriver to the estuarine area. The human dimensions aspect of the project will examine the social-economic impacts of the artisan fisheries and irrigated agriculture of the basins and global/regional climate change scenarios (by analysing changes in biodiversity proxies of global and land use changes, including changing of natural ecosystems and biodiversity to construct future scenarios and propose planning strategies). Further information at http://www.inct-tmcocean.com.br/ (in Portuguese)

MEECE (Marine Ecosystem Evolution in a Changing Environment)
Leading applicant: Icarus ALLEN (UK)

MEECE (2008-2012) aims to use predictive models to explore the impacts of both climate drivers (acidification, light, circulation and temperature) and human induced drivers (fishing, pollution, invasive species and eutrophication) on planktonic and benthic marine ecosystems. A regional approach has been chosen which includes: Barents Sea, NW European Shelf, North Sea, Baltic Sea, Biscay Bay, Black Sea, Adriatic, North Aegean Sea and Benguela ecosystem. MEECE is the first project to attempt to use predictive models that consider the full range of drivers to elucidate the responses of the marine ecosystem in a holistic manner, rather than driver-by-driver as has been done in the past. MEECE explores multiple driver impacts on complex environments through numerical simulation models which include dynamic feedbacks. Further information can be found at http://www.meece.eu/

ANACONDAS & ROCA (Amazon iNfluence on the Atlantic: CarbOn export from Nitrogen fixation by DiAtom Symbioses (ANACONDAS) and The River Ocean Continuum of the Amazon (ROCA)
Leading applicant: Patricia L. Yager (USA)

The ANACONDAS & ROCA (2009-2012) projects aim to study the effects of the Amazon River on the carbon and nitrogen cycles of the western tropical North Atlantic Ocean. The links between riverine micronutrient ratios, enhanced N_2-fixation, phytoplankton community structure and succession, and the sequestration of excess C into the deep ocean via the biological pump will be examined. To predict the evolution of this regional C export as climate changes, these links and their sensitivity to changes in the Amazon itself and other climate impacts on the tropical Atlantic Ocean must be understood. The objectives are to address specifically how C cycling and sequestration in the tropical North Atlantic is influenced by the Amazon River through its impact on pelagic ecosystem dynamics and the sensitivity of this ecosystem to anthropogenic climate change. Efforts will be made to identify the links between riverine micronutrient ratios, enhanced N_2-fixation, phytoplankton community structure and succession, and the sequestration of excess C into the deep ocean via the biological pump.

VECTOR (VulnErability of the Italian coastal area and marine Ecosystems to Climatic changes and Their rOle in the Mediterranean caRbon cycles)
Leading applicant: Cesare Corselli (Italy)

The VECTOR project (2006-2010) aims to study the most significant impacts of climate change on the Mediterranean marine environment and its role in carbon sequestration, to determine possible future impact scenarios on the Italian coast. Five areas of study were selected: the Northern Adriatic shelf, the Central Adriatic coastal area, the Calabrian margin in the Ionian Sea, the Napoli Gulf and the Tuscan coast in the Tyrrhenian Sea. The proposed scenarios concern (1) the modification and the extension of the coastal areas, (2) the morphology of the backshore-foreshore-shoreface, (3) the alongshore littoral transport, (4) the aerosol transport from the sea to the coastal area; and (5) the related impacts on the areas subject to anthropogenic activities as well as on freshwater reserves. These scenarios will be associated with those related to changes in the Venice lagoon, in neritic and pelagic ecosystems in term of biodiversity, productivity, invasive species and the distribution of commercially important species. The risks associated with the proposed scenarios will focus on the impacts of climate change on coastal area biodiversity (considered from a socio-economic point of view), tourism, agriculture, fisheries and livestock. Further information at http://vector.conismamibi.it/sito%20inglese/e-index.htm.

IMBER-ENDORSED MEETINGS AND ACTIVITIES

"Open access for climate scientists'" training, Copenhagen Denmark, 26 October 2011. More information at: http://www.openaccessweek.org/.

Advances in Marine Ecosystem Modelling Symposium - AMEMR III 'The Next Generation', Plymouth, UK, 27-30 June 2011. More information at: http://www.amemr.info/http://www.amemr.info/.

Workshop on paleo-ocean acidification and carbon cycle perturbation events, 26-28 August 2010, Catalina Island, USA

The 14th Biennial Challenger Conference for Marine Science on "OCEAN CHALLENGES IN THE 21ST CENTURY", 6-9 September 2010, Southampton, UK. More information at: http://www.challenger2010.org.uk/.

OUTREACH ACTIVITIES

IMBER website

The IMBER web site (http://www.imber.info/) is the main communication tool for the dissemination of science results and other information relating to IMBER programmes and activities. The web site is currently being redesigned and updated and the new site will become active in mid-summer 2011.

The IPO has developed and maintains several other web sites for IMBER activities and events, such as the CLIOTOP web page (http://www.imber.info/cliotop.html), SIBER (http://www.imber.info/SIBER.html) and the SOLAS/IMBER/IOCCP Synthesis meeting (http://www.imber.info/sponsored_meetings_SIC_sept2011.html).

IMBER Update
The electronic newsletter *"IMBER Update"* is published three times each year. The end-of-year issue, published in December, was dedicated to the two major IMBER events of 2010—IMBIZO II and the ClimECO$_2$ Summer School—and showcased some of the IMBER science that was presented.

The newsletter also provides highlights of recent IMBER science, reports of the activities of the IMBER working groups and regional programmes as well as upcoming IMBER-related conferences and workshops. IMBER Update can be downloaded at http://www.imber.info/newsletters.html. The newsletter is emailed to about 1200 people who have requested copies of the newsletter, or who are involved with IMBER in some way.

There are plans to produce a printed newsletter beginning in 2012.

eNews
The electronic eNews bulletin is published monthly to provide information on IMBER activities and current events within the IMBER scientific network. It includes calls for funding, job opportunities, conferences and workshops.

Promotional Material
Brochures and posters are used to promote IMBER at meetings and conferences. A new brochure, aimed at policy-makers, funding agency representatives and others who wish to know about IMBER, is currently being developed. The IMBER poster template can be adapted to a specific meeting topic or audience. The brochure and posters can be downloaded from the IMBER website (http://www.imber.info/useful-downloads.html) and are available on request from the IPO.

Training

ClimECO$_2$
In August 2010, IMBER, in collaboration with IUEM and GIS Europôle Mer, organized the ClimECO$_2$ Summer School in Brest, France. It aimed to provide participants with an overview of methods, models and approaches for analyzing the impact of climate change on marine ecosystems and the consequences for society. ClimECO$_2$ was by all accounts a great success and enjoyed by more than 70 participants (natural and social scientists working in the realm of 'oceans and climate change') from 26 countries.

Dry Cruise workshop
The Data Management Dry Cruise workshop mentioned in the Working Group section above, was aimed (though not exclusively) at early career scientists and students. The objective of this one-day workshop was to increase awareness of the importance and benefits of establishing and following data management procedures, and to provide hands-on training on data management and data preservation.

Alberto Piola (IMBER SSC member) and Cyndy Chandler (BCO-DMO, USA) led the workshop, and other members of the DMC also participated. Training was based on the data management procedures outlined in the extremely successful '*IMBER Data Management Cookbook*' that was published by the DMC in April 2009.

There were about 50 participants (mostly early career scientists and local students from various Greek universities and institutions, but also some more established scientists). The meeting was very well

received. Prior to the meeting, participants submitted specific problems or issues that they had encountered and the DMC addressed these at the workshop, making it a very practical course.

INTERNATIONAL PROJECT OFFICE (IPO)

The IMBER IPO is based in Brest, France at the Institut Universitaire Européen de la Mer (IUEM). Lisa Maddison is Executive Officer, and Virginie Le Saout is the Administrative Assistant. Sophie Beauvais resigned from the Deputy Executive Officer (DEO) position in March 2011. Juliette Remetz-Planchon is the Acting-DEO until the end of 2011.

The primary role of the IPO is to ensure that the decisions of the IMBER SSC are carried out. To do this, the IPO needs to secure funding for IMBER activities, support the IMBER working groups and task teams, provide administrative support for the programme's activities, maintain communication links both within and outside the programme, and maintain a data and information archive.

The IPO is funded by a French consortium that includes: the University of Brest, IUEM, the Region of Brittany, Ifremer, the Conseil Général de Bretagne (Department authorities) and the City of Brest, Centre National de la Recherche Scientifique (CNRS), Institut de Recherche pour le Développement (IRD), Université de Bretagne Occidentale (UBO). A meeting was held with representatives of the French sponsors in Paris, France in October 2010 where they unanimously agreed to renew the funding contract for a further three years at the same level of funding. However, subsequently, due to budget constraints, it has been decided to discontinue support for the IPO when the current contract expires at the end of 2011. A proposal has been submitted to the Norwegian Research Council for support for the IPO. If this proposal is successful, the IPO will be relocated to Bergen.

During 2010-2011, support for activities of the IPO and IMBER was provided by:

- **IGBP**: support for the SSC meeting ($18.3K).
- **SCOR**: support from NSF ($50K annually, grant until August 2012);
- **French Consortium**: support for IPO salaries and running expenses ($172K)

IMBER REGIONAL PROJECT OFFICE IN CHINA (CHINA RPO)

The IMBER China Regional Project Office (RPO) officially opened at the East China Normal University (ECNU) in Shanghai in March 2011. It is hosted and financially supported by the ECNU. Dr. Liuming Hu has been appointed as the Deputy Executive Officer and an Administrative Assistant will be appointed shortly. The RPO does not work independently but supports IMBER activities, focusing mainly on continental margins activities, as well as other IMBER activities in the Asia-Pacific region.

INTERACTIONS WITH OTHER PROJECTS AND PROGRAMMES

SOLAS

Joint SOLAS/IMBER Carbon Research group (SIC!)

The joint **SOLAS/IMBER Carbon Group** (SIC!) was formed in Oct 2005. This group works in close collaboration with IOCCP.

There are three sub-groups within the SIC group:
SG1-Surface Ocean Systems. Chair: Dorothee Bakker (UK)
SG2-Interior Ocean. Chair: Nicolas Gruber (Switzerland)
SG3-Ocean Acidification. Chair: Jean-Pierre Gattuso (France)
(See the activities of these groups on pages 3 and 4).

LOICZ

Joint IMBER/LOICZ Continental Margins Task Team (CMTT)

A new **IMBER/LOICZ CMTT** has been established. Kon-Kee (KK) Liu is the IMBER co-chair and Helmuth Thomas his LOICZ counterpart (see page 4).

CARBOCHANGE

IMBER had a MOU with the CARBOOCEAN. This project has now been finished and a new EU FP7 project 'Changes in Carbon uptake and emissions by oceans in a changing climate' (CARBOCHANGE), which follows on from CARBOOCEAN, has been developed.

The main foci of the project, which has a four year timeframe, are: understanding processes in the mesopelagic and twilight zone, observations, developing methodologies for data assimilation, synthesis activities and outreach. As these would contribute to IMBER's goals, IMBER is currently investigating the possibility of signing a MOU with CARBOCHANGE so that it becomes a contributing project to IMBER.

CLIVAR

Climate Variability and Predictability (CLIVAR), is a core project of the World Climate Research Programme (WCRP). Its focus is the role of the oceans in climate variability and change, particularly on physical climate changes.

The Indian Ocean Panel (IOP) has developed strong links with SIBER to cooperate to implement both physical and biogeochemical instruments on the IndOOS infrastructure.

The Global Ocean Ship-based Hydrographic Investigations Program (GO-SHIP) is co-sponsored by the IOC-SCOR International Ocean Carbon Coordination Project (IOCCP) and CLIVAR, in collaboration with IMBER, SOLAS, Argo and OceanSITES. The GO-SHIP Development Plan, which outlines priorities and timelines for coordinating national hydrography programmes into a global coordinated network, and the organizational framework and budget required to develop a sustained programme, will be published by early 2011.

IMBER and CLIVAR are investigating the possibility of holding back-to-back SSC meetings in 2012, with a one-day joint meeting.

EUR-OCEANS

IMBER signed a MOU with the EUR-OCEANS Network of Excellence, and continues to retain links with the new EUR-OCEANS Consortium (EO).

The MAAS (Mid-trophic Automatic Acoustic Sampler) component of CLIOTOP was selected for EO 'Foresight workshop' funding. The meeting entitled, 'Toward a global observation and modelling system

for studying the ecology of the open ocean using acoustics', was held from 3-6 May 2011 in Bergen, Norway.

The IMBER IPO is assisting with the administrative and logistical organisation of EUR-OCEANS Conference – 'Ocean deoxygenation and implications for marine biogeochemical cycles and ecosystems' (24-26 October 2011, Toulouse, France). An IMBER poster will be presented. Several IMBER SSC members have been invited to speak at the conference.

IMBER applied to EUR-OCEANS for funding for IMBER/SOLAS synthesis meeting 'The Ocean Carbon Cycle at a time of change: synthesis and vulnerabilities'. Although it does not fit into any of the usual EO calls, a small amount of funding (about €5K) will be provided.

PICES

Interaction and collaboration between PICES and IMBER has continued during the past year. For example, PICES generously supported nine early career scientists, from PICES member countries, to attend the ClimECO_2 summer school.

As the workshop themes of IMBIZO II were of relevance to PICES's science programme FUTURE (Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems), PICES co-sponsored IMBIZO II and provided travel support for three invited speakers from North Pacific countries.

There will be a joint IMBER-PICES session entitled, 'How well do our models really work and what data do we need to check and improve them?', at the PICES Annual Meeting in Khabarovsk, Russia, 14-23 October 2011. IMBER will provide the travel costs for one of the invited speakers in this session.

In the interest of continued collaboration and cooperation, IMBER has agreed to co-sponsor the second International PICES, ICES and IOC Symposium on "Effects of Climate Change on the World's Oceans", that will be held from 14-18 May 2012, in Yeosu (Korea). Support will be provided for an invited speaker to attend a joint IMBER-PICES session.

NATIONAL ACTIVITIES

IMBER National Contacts (NC) help to coordinate research and communication within countries and with the broader IMBER community. IMBER currently has national activities in 31 countries (Argentina, Australia, Belgium, Brazil, Canada, Chile, China, Finland, France, Germany, Greece, India, Italy, Japan, Republic of Korea, Mexico, Namibia, The Netherlands, New-Zealand, Norway, Oman, Peru, Russia, South Africa, Spain, Switzerland, Taiwan, Turkey, UK, Uruguay and USA). Examples of some activities are the following:

Belgium

There are no specific IMBER endorsed/contributing projects in Belgium, but some national programmes contribute to IMBER aims and activities (e.g. BIANZO II, BIGSOUTH, DIAPICNA, FishPop Trace, FRFC COREAM, FWO-ODYSSEUS and FWO-TANA).

An IMBER special session 'IMBER: Tracing physical and biogeochemical processes at the coastal and ocean interface' was held at the 43rd International Liège Colloquium on Ocean Dynamics on 3-6 May

2011, Liège, Belgium. Javier Arístegui (IMBER SSC Vice-Chair) was one of the conveners. He also gave a key-note address and chaired the IMBER session.

France
CYBER (Biogeochemical Cycles, Ecosystems and Resources) is France's contribution to IMBER. It deals with ecosystem structure, functional diversity and biogeochemical cycles in the oceans, through field observations, laboratory and modelling experiments.
In addition, five other French projects have been endorsed by IMBER (BIOSOPE, POTES, EPOCA, BOUM and MALINA).

India
The most important development concerning IMBER in India has been the establishment of SIBER as an national programme. SIBER-India consists of 14 projects covering the Indian Ocean basin.

Japan
The IMBER- endorsed project POMAL (Population Outbreak in Marine Life) is the only national project of relevance to IMBER. It is due to finish in March 2012.
IMBER scientists participated in the research cruise entitled 'Biogeochemical interactions of aerosol, trace metals, organisms in the tropical and subtropical North Pacific' carried out from 18 May - June 2010.

Mexico
Mexico recently joined the IMBER national network with the appointment of Salvador Lluch-Cota as the national contact.
There are currently no IMBER-endorsed Mexican projects but the PIs of the Mexican projects IMECOCAL (a large-scale programme that conducts ecosystem level research), PMC (Mexican carbon programme) and ECORED (national research programme that considers biogeochemical cycles, climate change and the human dimension) have been contacted by the IMBER IPO to begin the endorsement procedure.

Namibia
Namibia recently joined the IMBER national network and Bronwen Currie is the national contact. There are no Namibian endorsed projects, but Namibia is involved in the IMBER-endorsed GENUS (Geochemistry and Ecology of the Namibian Upwelling System) project.

Netherlands
The Netherlands has no dedicated IMBER endorsed projects. Most of the marine research is focused in the Wadden Sea, but several small, individual projects relevant to IMBER are conducting research in the ocean and continental shelf areas. These include topics such as: ocean acidification, hypoxia research, Indian Atlantic Exchange and cold water coral and ecosystem functioning.

Russia
There are no Russian IMBER endorsed projects, but several research institutes are carrying out IMBER-relevant projects. These include studies of the changes in the Caspian Sea ecosystem in response to sea level rise and other forcings, and fluxes of CO_2 and methane in Arctic Seas.

Spain
Three national projects have been endorsed by IMBER: CAIBEX (Shelf-Ocean Exchange in the Canaries-Iberian Large Marine Ecosystem), MALASPINA (Circumnavigation Expedition -Global Change and Biodiversity Exploration of the Global Ocean) and LUCIFER (Lunar Cycles and Iron Fertilization).
There are several other projects that have recently been funded that are closely related to the IMBER goals and the IPO will approach the PIs of these projects to seek IMBER endorsement.

FUTURE ACTIVITIES

Third IMBER *ClimECO* Summer School at Ankara University, Ankara, Turkey, August 2012. Raghu Murtugudde and Baris Salihoglou have been appointed as co-conveners and the organising committee is currently being established. Once appointed, the committee will develop the programme.

5th IMBER China-Japan-Korea meeting, Shanghai, November 2011. Invitations have been sent to the IMBER SSC members in Japan and Korea on behalf of Jing Zhang, who is the convener of this meeting, asking them to appoint representatives from their respective countries to serve on the organising committee. The possibility of including Taiwan in the meeting is being investigated.

IMBER IMBIZO III. The IMBIZO is normally held every second year, but as there are several big meetings being held during 2012, it has been decided to delay IMBIZO III until 2013. The RPO is investigating the possibility of holding the meeting at the East China Normal University. It has been suggested that IMBIZO III be a dedicated Continental Margins-Human Dimensions meeting. Several people have been identified to serve on the Scientific Organising Committee.

First IMBER Open Science Meeting (OSM). It has been decided to hold an OSM in August 2014. A call for bids to host the meeting has been put out. The closing date is 1 October 2011.

PUBLICATIONS
There are currently more than 400 peer-reviewed research papers in the IMBER database. In 2010, 168 papers were published and 58 so far in 2011.

Selected publications

Drinkwater K, Beaugrand G, Kaeriyama M, Kim S, Poertner H, Polovina J, Ottersen G, Takasuka A, Perry I. 2010. On the processes linking climate to ecosystem changes. *Journal of Marine Systems*, 79: 374-388.

Feely R, Fabry V, Dickson A, Gattuso J-P, Bijma J, Riebesell U, Doney S, Turley C, Saino T, Lee K, Anthony K, Kleypas J. 2010. An International Observational Network for Ocean Acidification in *Proceedings of OceanObs'09: Sustained Ocean Observations and Information for Society* Vol 2, Venice, Italy, 21-25 September 2009, Hall J, Harrison D, Stammer D (eds.) ESA Publication WPP-306, doi:10.5270/OceanObs09.cwp.29.

Gruber N. 2011. Warming up, turning sour, losing breath: Ocean biogeochemistry under global change, *Phil. Trans. R. Soc*. A, 369: 1980-1996, doi: 10.1098/rsta.2011.0003.

Gruber N, Körtzinger A, Borges A, Claustre H, Doney S, Feely R, Hood M, Ishii M, Kozyr A, Monteiro P, Nojiri Y, Sabine C, Schuster U, Wallace D, Wanninkhof R. 2010. Towards An Integrated Observing System For Ocean Carbon and Biogeochemistry At a Time of Change In *Proceedings of OceanObs'09: Sustained Ocean Observations and Information for Society* Vol. 1, Venice, Italy, 21-25 September 2009, Hall J, Harrison DE, Stammer D (eds.) ESA Publication WPP-306, doi:10.5270/OceanObs09.pp.18.

Link J, Megrey B, Miller T, Essington T, Boldt J, Bundy A, Moksness E, Drinkwater K, Perry I. 2010. Comparative analysis of marine ecosystems: International surplus production modeling workshop. *Biological Letters*, doi: 10.1098/rsbl.2010.0526.

Michio K, Ito S-I, Megrey B, Rose K, Werner F. 2011. A review of the NEMURO and NEMURO.FISH models and their application to marine ecosystem investigations. *J Oceanogr*, 67:3-16 DOI 10.1007/s10872-011-0009-4.

Miller K, Charles A, Barange M, Brander K, Gallucci V, Gasalla M, Khan A, Munro G, Murtugudde R, Ommer R, Perry I. 2010. Climate change, uncertainty, and resilient fisheries: Institutional responses through integrative science *Progress in Oceanography*, 87: 338–346.

Moloney C, St John M, Denman K, Karl D, Köster F, Sundby S, Wilson R. Weaving marine food webs from end to end under global change. 2011. *Journal of Marine Systems*, 84: 106–116.

Monteiro P, Schuster U, Hood M, Lenton A, Metzl N, Olsen A, Rodgers K, Sabine C, Takahashi T, Tilbrook B, Yoder J, Wanninkhof R, Watson A. 2010. A global sea surface carbon observing system: assessment of changing sea surface CO_2 and air-sea CO_2 fluxes. *OceanObs'09 Community White Paper* Venice, Italy, 21-25 September 2009, Hall J, Harrison DE Stammer D (eds.) ESA Publication WPP-306. 13pp. doi:10.5270/OceanObs09.cwp.64.

Murphy E, Cavanagh R, Johnston N, Hofmann E (eds). 2010. Integrating Climate and Ecosystem Dynamics (ICED): Report of the Southern Ocean Food Web Modelling Workshop, 16-18 April 2008, Virginia, USA.

Planque B, Fromentin J-M, Cury P, Drinkwater K, Jennings S, Perry R. Kifani S. 2010. How does fishing alter marine populations and ecosystems sensitivity to climate? *Journal of Marine Systems*, 79 : 403-417.

Pollard R, Moncoiffé G, O'Brien T. 2011. The IMBER Data Management Cookbook - A project guide to good data practices. *IMBER Report No. 3*, IPO Secretariat, Plouzané, France. 16pp.

Turley C, Eby M, Ridgwell A, Schmidt D, Findlay, Brownlee C, Riebesell U, Fabry V, Feely R, Gattuso J-P. 2010. The societal challenge of ocean acidification *Marine Pollution Bulletin* 60: 787-792.

Special Issues

CLimate Impacts on Oceanic TOp Predators (CLIOTOP) CLIOTOP International Symposium La Paz, Mexico 03-07 Patrick Lehodey, Olivier Maury and Mélanie Rathburn December 2007 *Progress in Oceanography* Volume 86, Issues 1-2, Pages 1-316 (July-August 2010) Editors: (28 papers).

Deep Sea Research II Special Issue: Ecological and Biogeochemical Interactions in the Dark Ocean. Steinberg DK and Hansell DA (eds.) (August 2010) Volume 57 Issue 16 Pages 1429-1592. (8 papers)

Edited volumes and books published:

Alheit J, Drinkwater K, Perry R (eds.). 2010. Impact of Climate Variability on Marine Ecosystems: A Comparative Approach. Proceedings of a GLOBEC Workshop, held in Berlin, Germany, 4-8 September, 2006. *Journal of Marine Systems*, 79:227-435.

UPCOMING PUBLICATIONS

SIBER Science Plan and Implementation Strategy (2011). IMBER Report No. 4.

Murphy E, Cavanagh R, Hofmann E, Hill S, Constable A, Costa D, Pinkerton M, Johnston N, Trathan P, Klinck J, Wolf-Gladrow D, Daly K, Maury O, Doney S. Submitted. Developing integrated models of Southern Ocean food webs: including ecological complexity, accounting for uncertainty and the importance of scale. Special issue of Progress in Oceanography on Comparative Analysis of Marine Food Webs.

REQUEST FOR FUNDING

IMBER requests SCOR Developing Country Travel Funds to assist scientists from developing countries to attend the third IMBER Summer School that will be held in Ankara, Turkey in August 2012. **Amount requested: US$7 500**

ACKNOWLEDGEMENTS

IMBER would like to take this opportunity to thank SCOR for its continued support. We are extremely grateful, not only for the financial contribution, but also for the help, advice and guidance provided by Ed Urban and Liz Gross.