

Appendix 6

Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) Project

IMBER Annual Report to SCOR, September 2012

MAJOR ACTIVITIES AND ACHIEVEMENTS

- Posters describing the IMBER project and research results were presented at 10 international meetings (see <http://www.imber.info/index.php/Products/Posters>)
- IMBER was involved in 8 special sessions at the TOS/ASLO/AGU 2012 Ocean Sciences Meeting, Salt Lake City, USA, 20–24 February 2012 (see <http://www.imber.info/index.php/Meetings/IMBER-Special-sessions/TOS-ASLO-AGU-2012-Ocean-Sciences-Meeting-20-24-Feb.-2012-Salt-Lake-City-Utah-USA>)
- IMBER convened three special sessions at the Planet Under Pressure Conference, held in London, UK, 26-19 March 2012 (see <http://www.imber.info/index.php/Meetings/IMBER-Special-sessions/Planet-Under-Pressure-26-29-March-2012-London-UK>). These involved the Human Dimensions working group, SOLAS-IMBER Ocean Acidification (SIOA) working group and CLIOTOP
- Two IMBER special sessions were convened at the EGU Annual Assembly, Vienna, Austria, 22-27 April 2012 (see <http://www.imber.info/index.php/Meetings/IMBER-Special-sessions/EGU-General-Assembly-22-27-April-2012-Vienna-Austria>)
- IMBER workshop (*Effects of climate change on advective fluxes in high latitude regions*) convened by ESSAS and ICED at the 2nd ICES/PICES/IOC International Symposium, Yeosu, Korea, 15-19 May 2012 (see <http://www.imber.info/index.php/Meetings/IMBER-Special-sessions/2nd-ICES-PICES-IOC-International-Symposium-15-19-May-2012-Yeosu-Korea>)
- Joint IMBER/SOLAS/IOCCP Carbon Synthesis Meeting, Paris, France, 14-16 September 2011
- Launch of the Surface Ocean CO₂ Atlas (SOCAT), Paris, France, 16 September 2011
- First Sustained Indian Ocean Biogeochemistry and Ecosystem Research (SIBER) national programme initiated in India with funding from the Ministry of Earth Sciences.
- IMBER partners with the *Too Big To Ignore* global research partnership to promote and revitalize small-scale fisheries, November 2011
- 5th IMBER China/Japan/Korea meeting and training course in Shanghai, China, 22-25 November 2011
- Relocation of the IMBER IPO to the Institute of Marine Research in Bergen, Norway, 17 April 2012
- Ms. Lisa Maddison appointed as Deputy Executive Officer of the IMBER IPO, 17 April 2012
- Dr. Bernard Avril appointed as the Executive Officer of the IMBER IPO, 4 June 2012
- 8th IMBER SSC meeting in La Paz, Mexico, 12-15 June 2012, was held in conjunction with the CLIVAR SSG meeting. A half-day mini-symposium was organised with Mexican scientists involved in IMBER-type research
- Approval of the proposal to establish an Ocean Acidification International Coordination Centre (OA-ICC), Monaco, May 2012
- IMBER ClimECO₃ Summer School in Ankara, Turkey, 28-31 July 2012
- IMBER workshop on Capacity Building and Needs Assessment for the Asia-Pacific Region, Shanghai, China, 31 July – 4 August 2012

PLANNED ACTIVITIES

- The 15th Biennial Challenger Conference for Marine Science - *Ocean challenges in the 21st century* in Norwich, UK, 3–6 September 2012
- Inaugural meeting of the *Too Big To Ignore* global partnership in St. Johns, Newfoundland, Canada, 4–7 September 2012

- ESSAS session on *Subarctic-Arctic interactions: ecological consequences* at the ICES Annual Science Conference in Bergen, Norway, 21-22 September 2012
- ESSAS workshop on Arctic-Subarctic Interactions at the PICES Annual Meeting in Hiroshima, Japan, 12-21 October 2012
- IMBER Natural and Social Science Data Management Workshop, Goa, India, 27 January 2014.
- IMBER IMBIZO III at the National Institute of Oceanography in Goa, India, 28–31 January 2013 (<http://www.imber.info/index.php/Meetings/IMBIZO/IMBIZO-III>)
- 2nd CLIOTOP Symposium, Nouméa, New Caledonia, 11-15 February 2013
- IMBER Special session - *Primary production variability and coastal-offshore export in upwelling regions* - at the 45th International Liège Colloquium on Ocean Dynamics, Liège, Belgium, 13–17 May 2013
- 9th IMBER SSC meeting in Las Palmas, Gran Canaria, Spain, 17–19 June 2013
- IMBER Open Science Meeting in Bergen, Norway, 23-27 June 2014

WORKING GROUPS

The activities of IMBER's five 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 currently three sub-groups dealing with carbon in the surface ocean, carbon in the interior ocean and ocean acidification. However, the existing groups do not consider dissolved organic carbon production, transformation and storage. To address this gap, a proposal to establish a group to address key issues within this topic, submitted by members of the successful SCOR working group on the Microbial Carbon Pump, is currently being considered by the IMBER SSC.

SIC SG1 and SG2 and IOCCP convened *The Ocean Carbon Cycle at a Time of Change: Synthesis and Vulnerabilities* meeting at UNESCO, Paris, France, 14-16 September 2011. The objective of the meeting was to push forward regional to global-scale ocean carbon synthesis activities, specifically towards identifying how global change has been affecting the ocean carbon cycle in the last two decades and its ability to take up CO₂ from the atmosphere. These syntheses revealed that, despite impressive advances in data availability, data analyses and supporting model-based studies, many critical gaps remain (e.g., the nature and drivers of the seasonal cycle of CO₂ in the surface ocean and the separation of changes in ocean DIC into natural or anthropogenic CO₂). These topics were used to guide breakout group discussions. See the full meeting report at <http://www.imber.info/index.php/Meetings/IMBER-sponsored-and-endorsed-meetings/2011/Joint-SOLAS-IMBER-IOCCP-Carbon-SIC-Synthesis-Meeting-14-16-Sept.-2011-UNESCO-Paris-France>

Following recommendations that emerged from the meeting, planning is underway to organise a meeting in conjunction with the 9th International CO₂ Conference in Beijing, China in June 2013, to consider surface ocean inter- and extrapolation methods, and an inter-comparison of methods developed to analyse decadal time-scale changes in the ocean interior.

Initially, a special journal issue was envisaged as a product of the meeting. However, many attendees have contributed to a series of synthesis chapters for the Regional Carbon Cycle Assessment and Processes (RECCAP) effort (<http://www.globalcarbonproject.org/reccap/>). Several of the ocean chapters are in review for *Biogeosciences* (see http://www.biogeosciences-discuss.net/special_issue83.html). Many of these syntheses have been included in the Intergovernmental Panel on Climate Change Assessment Report (IPCC AR5).

Sub-group 1 (SG1) Surface Ocean CO₂ Fluxes (Leader: Andrew Lenton, Australia)

Andrew Lenton replaced Dorothee Bakker as Chair of SIC WG1 in 2011.

The major output of this group is a global atlas of surface ocean pCO₂ measurements—the Surface Ocean CO₂ Atlas (SOCAT). It was launched on 16 September 2011 at the Carbon Synthesis meeting described above, and is a

compilation of the publically available surface water fCO₂ (fugacity of CO₂) data obtained from more than 2,100 cruises that occurred between 1968 and 2007. The data were quality controlled. SOCAT contains approximately 7.5 million measurements of various carbon parameters in a common format. See <http://www.socat.info/>.

An article entitled *Surface Ocean CO₂ Atlas (SOCAT) gridded data products* was submitted to *Earth System Science Data Discussions* and is now available as a discussion paper at: http://www.earth-syst-sci-data-discuss.net/papers_in_open_discussion.html. There was also an article in *EOS* (Global data products help assess changes to ocean carbon sink, *EOS*, 20 March 2012, Vol. 93 No. 12: 125-132).

Two meetings were held by SG1 this year. The first, in Seattle, Washington, USA in May 2012, was to discuss the automation of SOCAT, and the second in Tsukuba, Japan in July 2012, dealt with quality controlling SOCAT Version 2.0.

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

SG2 co-ordinates international research on ocean interior biogeochemical changes, undertakes synthesis activities and aims to develop sustainable observing systems, including the addition of oxygen sensors to the international Argo float programme (ARGO-O₂).

This group held two meetings in the past year: one following the Carbon Synthesis meeting in Paris on 16 September 2011, and the second in conjunction with the Ocean Sciences meeting in Salt Lake City, Utah, USA in February 2012. Members of the group organised a session entitled *The changing ocean carbon cycle: data syntheses, analyses and modelling* at the meeting.

SIC SG2 submitted a proposal to establish a SCOR Working Group on *Quality control procedures for oxygen and other biogeochemical sensors on floats and gliders*, in response to the 2012 call for proposals (see <http://www.scor-int.org/2012GM/Float%20Sensors.pdf>).

Currently, the focus of SIC SG2 is to move forward with the intercomparison study of the different methods to determine the changes in carbon in the ocean's interior. A meeting in this regard is planned for summer 2013.

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

The SOLAS-IMBER Ocean Acidification (SIOA) working group co-ordinates international research efforts and synthesis activities in ocean acidification. To obtain the resources necessary to undertake this coordination, the SIOA developed a proposal to obtain funding to establish an Ocean Acidification International Coordination Centre (OA-ICC) to coordinate the key activities necessary at the international level to ensure effective use of the science investment in ocean acidification. The proposal was submitted to the International Atomic Energy Agency (IAEA), as part of the Peaceful Uses Initiative and was approved in May 2012. The OA-ICC has been established at the IAEA-Environment Laboratories in Monaco and Dr. Lina Hansson has been appointed as the Executive Director. Dr. Jean-Pierre Gattuso is discussing taking on the position of Scientific Director for the OA-ICC. The group's annual meeting, originally scheduled for November 2011, was postponed to 22-23 March 2012, because of the delayed response from IAEA to their proposal. At the meeting, which was held in Ville Franche sur Mer, France, the SIOA discussed the governance of the OA-ICC and future activities.

Members of the SIOA convened the *Ocean Acidification: Ecological impacts and societal implications* session at the Planet Under Pressure conference in London, UK in March 2012.

2 IMBER-LOICZ Continental Margins Working Group

The joint IMBER-LOICZ Continental Margins Working Group (CMWG) held its first meeting in Halifax, Canada from 18-20 June 2012. As the group has multiple responsibilities (unlike its predecessor, the Continental Margins Task Team (CMTT), which was tasked only with drafting the Continental Margins Implementation Plan), it was decided to rename the group the Continental Margins Working Group.

In addition to planning the workshop that members of the CMWG will convene at IMBIZO III, much of the meeting was dedicated to revising the Continental Margins Implementation Plan drafted by the CMTT. This draft is long and outdated, so the decision was made to produce a short paper outlining the problem and the rationale, for submission to a peer-review journal, following approval by the IMBER and LOICZ SSCs. An updated addendum to the existing draft implementation plan, that highlights current important issues and questions for continental margins, will also be published.

The meeting coincided with an international conference celebrating the 30th anniversary of the United Nations Law of the Sea Convention and several CMWG members presented talks at the conference which was titled *Regulation of continental shelf development: Rethinking international standards*.

The CMWG held a special session (*Changing Biogeochemistry and Ecosystems in the Western North Pacific Continental Margins Under Climate Change and Anthropogenic Forcing*) at the Ocean Sciences Meeting in Salt Lake City, Utah, USA, February 2012.

The CMWG will lead the *Biogeochemistry-ecosystem interactions on changing continental margins* workshop at IMBIZO III in Goa, India in January 2013.

The second working group meeting is scheduled to be held just prior to IMBIZO III in Goa, to finalise of the Continental Margins Implementation Plan.

3 Capacity Building Task Team (CBTT)

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 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).

The CBTT organised a workshop to analyse the capacity development needs for IMBER-related research in the Asia-Pacific region, which took place from 31 July – 4 August 2012 at the East China Normal University, Shanghai, China. It is anticipated that the workshop results will be published in the Policy Forum section of *Science*. The participants proposed that a mentoring system be developed for the IMBIZO III that would allow established scientists to mentor early-career and developing country scientists participating in the IMBIZO.

IMBER ClimECO summer schools are held every two years and have proved to be a successful capacity building mechanism for students and early-career scientists. ClimECO₃ was held at the Middle East Technical University in Ankara, Turkey, 23-28 July 2012. The summer school focused on: *A view towards integrated earth system models. Human-nature interactions in the marine world*. Fifty participants were selected from the 168 applicants to facilitate the hands-on nature of the training. The selected participants were from 26 countries and were from both natural and social science disciplines. Additional information is available at:

<http://www.imber.info/index.php/Science/Working-Groups/Capacity-Building/Summer-Schools/ClimECO3-July-2012-Ankara-Turkey>. Raghu Murtugudde (USA) and Beth Fulton (Australia) co-chaired the Organising Committee and Baris Salihoglu was the local host.

All the lectures were webcast live and were followed by several people from around the world. Recordings of the broadcasts will be available on the IMBER website soon. SCOR Developing Country Travel funds were used to provide travel support for five participants, from Benin, Nigeria, Tunisia, Indonesia and the Ukraine.

4 Data Management Committee

The IMBER Data Management Committee (DMC) promotes a cooperative data management approach, involving experienced data management specialists from the start of a project, and training young scientists in good data management procedures. The group is chaired by Alberto Piola (Argentina).

The *IMBER Data Management Cookbook* on best practices for data management has been widely distributed to laboratories and research vessels. It can be downloaded from the IMBER web site (<http://www.imber.info/index.php/Science/Working-Groups/Data-Management/Cookbook>) or alternatively, printed copies can be requested from the IMBER office (imber@imr.no). The document is available in English and Spanish.

As with previous IMBIZOs, the DMC is organising a Data Management workshop the day before the start of IMBIZO III. This will enable participants and local students and scientists to learn about good data management techniques from data management specialists. This workshop will deal with both natural and social science data. The DMC will also operate a booth during IMBIZO III, where participants will be able to discuss their particular data management issues and problems.

5 Working Group on Human Dimensions

The IMBER Human Dimensions Working Group (HDWG) is co-chaired by natural scientist, Alida Bundy (Canada) and two social scientists, Marie-Caroline Badjeck (Canada) and Moenieba Isaacs (South Africa). The working group focuses on the interactions between human and ocean systems, and has an objective of creating an integrated and interactive natural-social science marine research community within IMBER.

The HDWG held its second meeting in London, UK, 26-29 March 2012. The objectives of this meeting were to further develop the HDWG work plan for the next five years, and to develop the ADaPT (Assessment from Description, Appraisal and Typology) conceptual framework, which will be a major output of the working group. The ADaPT framework is intended as a tool to enable decision makers to weigh potential outcomes to a specific challenge facing a marine-human system quickly and appropriately, by comparing it with situations (and responses) that have previously occurred elsewhere. The development of the typology for ADaPT requires a broad suite of case studies to capture the diversity of ecosystems, social systems, governing systems and sectors. These will be drawn from the IMBER Regional Programmes and also from participants in the *Understanding and forecasting human-ocean-human interactions, drivers and pressures, with respect to global change* workshop at IMBIZO III, which is being convened by members of the HDWG.

The HDWG, in collaboration with LOICZ and the Large Marine Ecosystem Network, organised a session at the Planet Under Pressure Conference in London in 2012. The title was: *Toward a sustainability-science knowledge-network on marine-ecosystems: achieving innovative, transdisciplinary stewardship across multiple scales*. http://www.planetunderpressure2012.net/pup_session.asp?19214. The presentation, “*Understanding and forecasting human-ocean-human interactions with respect to global change*” given by Ratana Chuenpagdee on behalf of the HDWG, is to be submitted as a ‘Ghoti’ article to *Fish and Fisheries*.

The HDWG plans to hold its next meeting in conjunction with IMBIZO III in Goa, India in January 2013.

REGIONAL PROGRAMMES

IMBER has four regional programmes. Updates on their activities follow.

1. Climate Impact on Top Oceanic Predators (CLIOTOP)

CLIOTOP is a 10-year programme that started in 2005. Its aim is to use a worldwide comparative approach to identify the impact of anthropogenic and natural forcings on the structure and function of open ocean pelagic ecosystems and their top predator species. The SSC membership was revised in late 2011, in accordance with criteria such as gender balance and geographical distribution, stipulated by the IMBER SSC.

CLIOTOP is based on the interactive activities of its six working groups that focus on key processes and scales. For information on working group activities, see <http://www.imber.info/index.php/Science/Regional-Programmes/CLIOTOP>.

CLIOTOP led a two-day session entitled *Global science for global governance of oceanic ecosystems and fisheries* at the Planet Under Pressure conference in London on 25 and 26 March 2012.

Several CLIOTOP affiliates contributed to the *Vulnerability of tropical Pacific fisheries and aquaculture to climate change* book, presenting syntheses, summaries and new results, mainly focused on tuna.

CLIOTOP will hold the 2nd CLIOTOP Open Science Symposium in Nouméa, New Caledonia, 11-15 February 2013. The symposium is intended to bring together several initiatives investigating the impacts of climate change on the world's living marine resources and the people who depend on them. The theme of the symposium is *Certainty of change in pelagic systems – detection, attribution, prediction and adaptation*.

2. Ecosystem Studies of Sub-Arctic Seas (ESSAS)

ESSAS was started in 2005 and focuses on the impacts of climate change on Sub-Arctic marine ecosystems and their sustainability. ESSAS has four working groups and several national and multi-national projects.

ESSAS convened a session on *Arctic-subarctic interactions* at the TOS/ASLO/AGU 2012 Ocean Sciences Meeting (20-24 Feb. 2012, Salt Lake City, Utah, USA).

ESSAS and ICED organised a one-day workshop on *The effects of climate change on advective fluxes between the Arctic and Antarctic* at the PICES/ICES/IOC meeting in Yeosu, Korea on 14 May 2012. The objective was to review the advection of water masses within and between polar and subpolar regions, examine their forcing mechanisms and determine their role on the ecology of these high-latitude regions. The establishment of a new IMBER working group to continue the comparisons of Arctic and Antarctic ecosystems is being considered.

ESSAS members produced a special issue of *Deep Sea Research Part II: Topical Studies in Oceanography*, entitled "Understanding Ecosystem processes in the Eastern Bering Sea", which was published in June 2012. The articles describe newly acquired data in the context of historical data and assess the implications for the future of the Bering Sea ecosystem.

Several peer-reviewed journal articles, as well as a chapter in *The Barents Sea. Ecosystem, Resources*, were published by ESSAS scientists and a listing of these is available at http://www.imr.no/essas/publications_and_reportlist/primary_publications/en.

3. Integrating Climate and Ecosystems Dynamics (ICED)

ICED seeks a better understanding of Southern Ocean ecosystem dynamics and the development of sustainable management procedures. The ICED Science Plan was published in 2008 and is implemented through a coordinated circumpolar approach using data synthesis, fieldwork and modelling.

ICED scientists participated in a special session on *Oceanographic Processes at the Antarctic Continental Margins* at the Ocean Sciences Meeting in Salt Lake City, Utah, USA in February 2012. E. Hofmann from IMBER co-convened this session.

ICED convened a session at the SCAR (Scientific Committee on Antarctic Research) XXII Conference that was held in Portland, Oregon, USA, 13-25 July 2012. The theme of the conference was *Antarctic Science and Policy Advice in a Changing World*, and the ICED session was entitled *Response of Southern Ocean ecosystems to change*.

ICED continues to use the online fieldwork mapping tool to coordinate fieldwork in the Southern Ocean. It is progressing well, especially with cruise planning information and data rescue (particularly for zooplankton). See

(<http://www.iced.ac.uk/science/fieldworkmap.htm>). As part of the EUR-OCEANS Consortium flagship *Polar Ecosystem Change and Synthesis* (PolEcoSyn), ICED is creating a network of EU polar scientists who could provide information on Southern Ocean fieldwork for the fieldwork map.

The results of the ICED Southern Ocean Food Web Modeling Workshop that was held at the Center for Coastal and Physical Oceanography, Old Dominion University, Virginia, USA in April 2008, have been published online (see <http://www.sciencedirect.com/science/article/pii/S0079661112000237>).

4. Sustained Indian Ocean Biogeochemical and Ecological Research (SIBER)

SIBER is co-sponsored by IMBER and the Indian Ocean Global Ocean Observing System (IOGOOS) and focuses on understanding climate change and anthropogenic forcing on biogeochemical cycles and ecosystems in the Indian Ocean. The SIBER Science Plan and Implementation Strategy (IMBER Report No. 4) was published in September 2011. SIBER held its second SSC meeting in Chennai, India, 26-28 July 2011 (see IMBER Report No. 6 at <http://www.imber.info/index.php/Science/Regional-Programmes/SIBER>). SIBER III will be held in Cape Town, South Africa in October 2012.

The SIBER International Project Office is based at the Indian National Centre for Ocean Information Services (NCOIS) in Hyderabad, India. Dr. Satya Prakash is the Executive Officer. The SIBER website (<http://www.incois.gov.in/Incois/siber/siber.jsp>) has been established by the SIBER IPO. There are plans to produce a semi-annual SIBER Newsletter, to communicate SIBER activities and other relevant information about Indian Ocean research and monitoring programs.

Fourteen projects have been initiated under the Sustained Indian Ocean Biogeochemistry and Ecosystem Research (SIBER) national programme that is funded by India's Ministry of Earth Sciences (MoES). Six of these projects deal with the open ocean and the remainder relate to estuaries and coasts.

SIBER organized a special session, entitled *Physical and biogeochemical processes in the Indian Ocean: Recent progress and toward future collaborations*, for the Asia Oceania Geosciences Society (AOGS) - AGU (WPGM) Joint Assembly, held from 13-17 August 2012 in Singapore.

ENDORSED PROJECTS

IMBER currently has 34 endorsed projects from 14 countries (Argentina, Brazil, Canada, Chile, China, Denmark, France, Germany, Italy, Japan, New Zealand, Spain, UK and USA). Nine projects were endorsed by IMBER this past year. They including the following:

Gulf of Trieste – Time-series (GoTTs)

The Gulf of Trieste in the North Adriatic Sea is part of the international network of Long Term Ecological Research (LTER) that records hydrological, biological and biochemical data monthly. An increasing number of parameters have been added, with the aim of increasing understanding of the dynamics of the marine ecosystem of the Gulf of Trieste and to evaluate the role of the oceans in the global energy balance. Local-scale studies consider coastal and transition waters and address problems related to their sustainable management. See <http://nettuno.ogs.trieste.it/ilter/BIO/>.

Atmospheric deposition and ocean plankton dynamics (ADEPT)

ADEPT will consider the effect of atmospheric aerosol deposition on the dynamics of a low-nutrient low-chlorophyll marine (LNLC) system, namely the Mediterranean Sea, using a comparative approach at various scales. At the basin scale, satellite chlorophyll data will be related to modeled Saharan dust deposition. At the coastal scale, simultaneous measurements of dust deposition and chemical and biological parameters in the water column will be taken at several locations across the NW Mediterranean, and the relationship between both sets of variables examined. Laboratory experiments with altered aerosol concentrations will be conducted to study plankton stimulation dynamics, utilization of organic matter by bacteria, and changes in bacterial composition and diversity

(see <http://www.imber.info/index.php/Science/Endorsed-projects/ADEPT-March-2012>).

Deep-water submarine canyons and slopes in the Mediterranean and Cantabrian Seas: from synchrony of external forcings to living resources (DOSMARES)

DOSMARES has two objectives. First, to gain an understanding of the effects of the atmospheric teleconnections between the Bay of Biscay (or Cantabrian Sea) and the north-western Mediterranean Sea, and their impacts on the deep ecosystem, (pelagic and benthic). Second, to increase our knowledge of the way the transfer of the signal from the external forcings towards the deep ecosystem controls community structure and population dynamics, thus affecting valuable living resources. The project is structured along three axes of activity, each corresponding to a work package: 1) Characterization of external forcings and abiotic conditions; 2) Links between abiotic conditions, populations and pelagic and benthopelagic resources; and 3) Links between abiotic conditions, populations and benthic resources. (See <http://www.imber.info/index.php/Science/Endorsed-projects/DOSMARES-March-2012>.)

Mediterranean Sea Acidification in a changing climate (MedSeA)

The MedSeA project aims to forecast chemical, climatic, ecological-biological, and socio-economical impacts resulting from the combined influences of anthropogenic acidification and warming, while taking into consideration the unique characteristics of the region. An interdisciplinary approach, using observations, experiments and modeling will be used.

Projections will be based on new observations of chemical conditions as well as new observational and experimental data on the responses of key organisms and ecosystems to acidification. These will be fed into existing ocean models that take into account the Mediterranean's fine-scale features. Results will inform policymakers responsible for developing regional strategies for adaptation and mitigation. (See <http://www.imber.info/index.php/Science/Endorsed-projects/MedSeA-February-2012>.)

Carbon Transport and Acidification Rates in the North Atlantic (CATARINA)

CATARINA aims to study ocean perturbation and its consequences in response to the rise in atmospheric CO₂ due to human activities. Its goal is to quantify the Meridional Overturning Circulation and water mass ventilation changes and their effect on ocean uptake and storage capacity of anthropogenic carbon. An estimation of this variability is essential to evaluate future scenarios of climate changes.

CATARINA also aims to determine the effect of current CO₂ emissions and past atmospheric CO₂ concentrations on the production and preservation of CaCO₃ in the North Atlantic, and the potential impact of future ocean acidification on calcareous organisms. This will be done using culture experiments. CATARINA is part of a decadal experiment that started in 1997, where sampling along the A25 Greenland-Portugal hydrography/geochemistry section has been repeated every alternate year since 2002 within the OVIDE project. The CATARINA cruise was carried out in June-July 2012. (See <http://www.imber.info/index.php/Science/Endorsed-projects/CATARINA-December-2011>.)

Coastal Ocean Microbial Plankton and Temperature (COMITE)

COMITE will address the effects of future warming on the ecology and biogeochemical role of temperate coastal microbial assemblages using three approaches:

1. Retrospective analysis of the linkages between temperature, other environmental drivers and bacterial community structure and size-abundance relationships in a coastal time series initiated in 2002 off Xixón, Spain (southern Bay of Biscay);
2. Monthly experiments assessing the response of different bacterial groups to ambient temperature (-3 and +3°C) over an annual cycle; and
3. A comprehensive evaluation of the temperature dependence of organic matter fluxes through microbial plankton during four significant oceanographic periods (spring phytoplankton bloom, summer stratification, autumn bloom and winter mixing).

The final goal of COMITE data analysis is to build a predictive, testable model on the effects of realistic temperature rises on the biogeochemical role of oceanic bacteria. Among other novel approaches, the project will

1. Test whether enhanced metabolism due to higher temperature will result in lower bacterial biomass; and
2. Integrate bacterial phylogenetic and physiological structure within the temperature response as formulated in the metabolic theory of ecology.

(See <http://www.imber.info/index.php/Science/Endorsed-projects/COMITE-December-2011>.)

Processes Regulating Iron Supply at the Mesoscale - Ross Sea (PRISM-RS)

The Ross Sea continental shelf is one of the most productive areas in the Southern Ocean, and may comprise a significant, but unaccounted for, oceanic CO₂ sink, largely driven by phytoplankton production. The processes that control the magnitude of primary production in this region are not well understood, but data suggest that iron limitation is a factor. Field observations and model simulations indicate four potential sources of dissolved iron to surface waters of the Ross Sea:

1. Circumpolar Deep Water (CDW) intruding from the shelf edge;
2. Sediments on shallow banks and nearshore areas;
3. Melting sea ice around the perimeter of the polynya; and
4. Glacial meltwater from the Ross Ice Shelf.

It is hypothesized that hydrodynamic transport via mesoscale currents, fronts and eddies facilitate the supply of dissolved iron from these sources to the surface waters of the Ross Sea polynya. These hypotheses will be tested through a combination of *in situ* observations and numerical modeling, complemented with satellite remote sensing. The research will provide new insights and a mechanistic understanding of the complex oceanographic phenomena that regulate iron supply, primary production, and biogeochemical cycling. The research will thus form the basis for predictions about how this system may change in a warming climate.

See <http://www.imber.info/index.php/Science/Endorsed-projects/PRISM-RS-November-2011>.

Changes in carbon uptake and emissions by oceans in a changing climate (CARBOCHANGE)

CARBOCHANGE aims to provide the best possible process-based quantification of net ocean carbon uptake under changing climate conditions using past and present ocean carbon cycle changes. It aims to improve the quantitative understanding of key biogeochemical processes (particle flux, ecosystem community structure, lateral advection) and physical processes (overturning circulation, ice cover, mixing) through a combination of observations and models. The project will deliver calibrated future evolutions of ocean pH and carbonate saturation as required by the research community on ocean acidification in the EU project EPOCA and others. The time history of atmosphere-ocean carbon fluxes past, present and future will be synthesised globally, as well as regionally, for the transcontinental RECCAP project. Observations and model results will merge into GEOSS/GEO through links with the European coordination action COCOS and will prepare the marine branch of the European Research Infrastructure ICOS. Results of the project will be summarised for policy makers working on climate change mitigation through specifically targeted outreach papers. (See <http://www.imber.info/index.php/Science/Endorsed-projects/CARBOCHANGE-November-2011>.)

Barite bio-organic-mineralization processes at mesopelagic depths (BIOBAM)

Mineralization length scales are important indicators of the capacity of intermediate layers for longer-term carbon sequestration. A quantitative representation of this process is thus essential to every simulation of the oceans' role in the global carbon cycle. Barium barite (Ba-BaSO₄) in suspended matter is a proxy of carbon mineralization fluxes. It seems that barite precipitation occurs in micro-environments (e.g., biogenic aggregates) sinking out of the surface layers into mesopelagic waters. Barite formation appears closely linked (directly or indirectly) with prokaryotic degradation of Organic Matter (OM) and thus with the carbon remineralization rate. Barite proxy in contrasting

environments suggests that the extent of mesopelagic carbon mineralization is closely linked to specific ecosystem characteristics (e.g., differences in phytoplankton community composition, grazing pressure, trophic interactions and types of aggregates formed). However, detailed understanding of the processes controlling the formation and fate of aggregates beyond the surface layer is still unclear.

BIOBAM will focus on the subsurface and mesopelagic particle fluxes to better understand the link between the processes of barite formation, degradation and remineralization of OM and the characteristics of exported particles, and their dependency on ecosystem structure. Pressure-controlled batch-incubation experiments will be used to simulate particles sinking throughout the mesopelagic zone.

(See <http://www.imber.info/index.php/Science/Endorsed-projects/BIOBAM-September-2011>.)

IMBER-ENDORSED MEETINGS AND ACTIVITIES

Second PICES/ICES/IOC international symposium - *Effect of climate change on the world's oceans*, Yeosu, Korea, 15-19 May 2012.

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/>

PICES Annual meeting - *Mechanisms of Marine Ecosystem Reorganization in the North Pacific Ocean*, Khabarovsk, Russia, 14 - 23 October 2011. More information at: <http://www.pices.int/meetings/annual/PICES-2011/2011-background.aspx>

EUR-OCEANS Conference - *Ocean deoxygenation and implications for marine biogeochemical cycles and ecosystems*, Toulouse, France, 24–26 October 2011

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

The 5th China-Japan-Korea (CJK) IMBER Symposium: *Global ocean ecosystem dynamics, integrated marine biogeochemistry and ecosystem research*, Shanghai, China, 22-24 November 2011. Over 80 scientists from the three countries participated to review IMBER-related research and activities. The Symposium focus was on the impact of climate change and anthropogenic forcings on physical processes, biogeochemical cycles and ecosystem functioning in the northern Pacific. More information at: <http://www.imber.info/index.php/Meetings/IMBER-sponsored-and-endorsed-meetings/2011/5th-China-Japan-Korea-IMBER-Symposium-and-Training-22-25-Nov.-2011-Shanghai-China>. An article summarizing the meeting outcomes was published by the conveners (Jing Zhang, Hiroaki Saito and Se-Jong Ju) in *EOS* (Volume 93 No. 15, 10 April 2012). A one-day training course for students and early career scientists was held in conjunction with the CJK meeting, on 25 November 2011 (see below).

OUTREACH ACTIVITIES

IMBER website

The IMBER website is the project's main communication tool: <http://www.imber.info/>. The new IMBER website, redesigned to provide more news and information about IMBER science, activities and related events, was launched in October 2011.

The IPO has developed and maintains several other web sites for IMBER activities and events, such as the IMBIZO III website (<https://www.confmanager.com/main.cfm?cid=2614>), ClimECO₃ summer school web page (<http://www.imber.info/index.php/Early-Career/IMBER-Summer-Schools/ClimECO3-July-2012-Ankara-Turkey>), the CLIOTOP web page (<http://www.imber.info/cliotop.html>), the SOLAS/IMBER/IOCCP Synthesis meeting (http://www.imber.info/sponsored_meetings_SIC_sept2011.html).

IMBER Update

The electronic *IMBER Update* Newsletter is emailed to ~1,600 scientists three times a year. It can also be downloaded from: <http://www.imber.info/index.php/News/Newsletters>.

Issue No. 20 – May 2012 focused on French IMBER-related science, in recognition of the host country of the IMBER IPO from 2005-2012.

Issue No. 19 - December 2011 was dedicated to IMBER's SIBER regional programme following the publication of its Science Plan and Implementation Strategy

Issue No. 18 - September 2011 examined the Human Dimension in IMBER science

The theme of the next issue (September 2012) will be IMBER science in Norway – the IMBER IPO's new host country.

eNews

The eNews Bulletin is published electronically each month, providing information about IMBER and IMBER-relevant activities and events. It also includes funding possibilities and calls for proposals, job opportunities, and workshop and conference announcements.

Promotional Material

Brochures and posters are used to promote IMBER at meetings and conferences. An updated version of IMBER's brochure has been produced by the China Regional Project Office. An all-new brochure is planned. IMBER poster templates that can be adapted to a specific meeting topic or audience can be downloaded from the IMBER website (<http://www.imber.info/useful-downloads.html>) and are available on request from the IPO.

Training

ClimECO₃

IMBER organised the ClimECO₃ summer school at the Middle East Technical University in Ankara, Turkey in July 2012. The summer school was designed 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. The post-summer school evaluations indicate that ClimECO₃ was a success and was enjoyed by the participants. All lectures were web cast live and will be archived on the IMBER website.

China-Japan-Korea IMBER training course

As mentioned above, a one-day training course was held in conjunction with the 5th IMBER China-Japan-Korea meeting. Twenty-one participants were introduced to current information regarding IMBER and some of the projects that it collaborates with (e.g., the North Pacific Marine Sciences Organization (PICES) and its Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems (FUTURE) programme), as well as systemic knowledge of physical, chemical and multi-disciplinary approaches to ocean science. All lectures were web-cast live.

Open access for climate scientists training

IMBER sponsored the Open Access for Climate Scientists Training Course (October 2011, Copenhagen, Denmark) and a member of the IMBER Data Management Committee (DMC) was scheduled to give a presentation. Unfortunately, this was cancelled due to illness. The lectures were all web-cast live and all resulting peer-reviewed publications are freely available via open access.

INTERNATIONAL PROJECT OFFICE (IPO)

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 project's activities, maintain communication links both within and outside the programme, and maintain a data and information archive.

Following the decision of the French Consortium to reduce the support for the IMBER IPO, a proposal was submitted to the Research Council of Norway to host the IMBER IPO. This proposal was approved in December 2011, for a period of five years. Consequently, the IPO relocated to the Institute of Marine Research (IMR) in Bergen, Norway in mid-April 2012. Unfortunately, this move resulted in the resignations of the Deputy Executive Officer (DEO, Sophie Beauvais), Acting DEO (Juliette Remetz-Planchon) and Administrative Assistant (Virginie Le Saout), who were not able to relocate. Lisa Maddison was appointed as the Deputy Executive Officer and Bernard Avril took up the Executive Officer position on 4 June 2012. The half-time Administrative Assistant position is shared by Anita Jacobsen and Turid Loddengaard, who are employed by IMR.

In 2011, support for the activities of the IPO and IMBER was provided by:

- IGBP: support towards the SSC meeting (13 750 €);
- SCOR: support from NSF (\$50 000, grant until August 2012);
- French Consortium: support for IPO salaries and running expenses (129 000 €)

IMBER REGIONAL PROJECT OFFICE IN CHINA (CHINA RPO)

The IMBER China Regional Project Office (RPO) opened at the East China Normal University (ECNU) in Shanghai, P.R. China in March 2011. Liuming Hu is the Deputy Executive Officer and Fang Zuo is the Administrative Assistant. In addition to supporting the IPO, the RPO is responsible for the IMBER Continental Margins and Capacity Building activities, and promoting IMBER activities in the Asia-Pacific region. The RPO is financially supported by the ECNU.

INTERACTIONS WITH OTHER PROJECTS AND PROGRAMMES

SOLAS

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: Andrew Lenton (Australia)

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

Kon-Kee (KK) Liu (IMBER) and Helmuth Thomas (LOICZ) lead the joint IMBER/LOICZ CMWG (see page 4). As the theme of IMBIZO III relates to continental margins, several LOICZ affiliates will participate in, and in some instances, co-convene the workshops.

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 strong links with SIBER to cooperate to implement both physical and biogeochemical instruments on the IndOOS infrastructure.

IMBER and CLIVAR held concurrent SSC meetings in La Paz, Mexico in June 2012, and had a one-day joint meeting and social event. Discussions are underway regarding the establishment of a joint working group.

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 IMBER IPO assisted 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). A poster about IMBER research in deoxygenated zones was presented. IMBER SSC members (e.g., Carol Robinson and Niki Gruber) were invited speakers at the conference.

A successful proposal was submitted to the EUR-OCEANS call for funding for conferences for IMBIZO III. The sum of 15,000 euros was awarded to support IMBIZO III.

PICES

PICES and IMBER continue to collaborate and interact on a regular basis. A joint IMBER-PICES session entitled, *How well do our models really work and what data do we need to check and improve them?*, was held at the PICES Annual Meeting in Khabarovsk, Russia, 19-20 October 2011. IMBER provided travel support for Drs. Alexander Kurapov, Kenneth Rose and Nikolay Diansky, who were invited speakers in this session.

IMBER co-sponsored the second International PICES, ICES and IOC Symposium on *Effects of Climate Change on the World's Oceans*, held in Yeosu Korea, 14-18 May 2012. IMBER provided travel support for two invited speakers, Drs. Carin Ashjian and Nina Karnovsk, to attend a joint IMBER-PICES session. ICED and ESSAS convened a workshop on *Effects of climate change on advective fluxes in high latitude regions* (see page 7).

PICES supported five students or early-career scientists from PICES member countries, to attend the ClimECO₃ summer school in Ankara, Turkey in July 2012.

PICES have agreed in principal to support invited speakers from North Pacific countries to attend IMBIZO III. The amount of sponsorship will be decided at the PICES 2012 Annual Meeting in October 2012.

Too Big To Ignore

IMBER has partnered with the *Too Big To Ignore* initiative, which is a research network that aims to promote and revitalize small-scale fisheries around the world. Its main goal is to improve understanding of the real contribution of small-scale fisheries to food security, nutrition, sustaining livelihoods, poverty alleviation, wealth generation and trade, as well as the impacts and implications of global change processes such as urbanization, globalization, migration, climate change, aquaculture, and communication technology on small-scale fisheries. It also aims to create an interactive web platform, a Small-scale Fisheries Information System (SFIS) for global and local analysis of small-scale fisheries and their contributions to the broader society. Many of the objectives of the IMBER HD-WG overlap with those of the initiative. The initiative is lead by IMBER SSC member Ratana Chuenpagdee. <http://toobigtoignore.net/>. The inaugural meeting of the partnership was held from 4-7 September 2012 in St. Johns, Newfoundland, Canada.

NATIONAL ACTIVITIES

To increase IMBER's international exposure, National Contacts are established 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:

Australia

Australia is involved in the ICED regional programme via the Australian Antarctic Division (AAD), the Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC) and the Institute of Marine and Antarctic Studies (University of Tasmania).

The AAD and ACE CRC hosted the 2nd international workshop of the ICED's Southern Ocean Sentinel Monitoring project, entitled *Southern Ocean Ecosystem Change and Future Projections* in May 2012 in Hobart, Tasmania. This workshop focused on the state of knowledge of Southern Ocean food webs and how these might change in the future. The activities included the following:

- The ICED Sentinel aims to develop methods to assess the state of Antarctic and Southern Ocean marine ecosystems and to develop a field program to estimate change in Southern Ocean ecosystems. The workshop reviewed progress on this project and developed a program of work that will further these aims and to develop a proposal by 2017 for benchmarking Southern Ocean Ecosystems in 2020.
- Modelling Southern Ocean Ecosystems - this was the first of two meetings (the next will be held at the British Antarctic Survey, UK in 2013) on building end-to-end ecosystem models. A modelling action group aims to have working models within two years.
- The workshop made substantial progress in writing summaries of the effects of climate change and ocean acidification on Antarctic and Southern Ocean marine ecosystems. These summaries will be consolidated into a publication for the peer-reviewed literature. This will form an important contribution to the literature that can be used by the IPCC in its 5th assessment review.

Belgium

Current projects contributing to the IMBER aims and activities include the following:

- Biogeochemical Cycles in the Southern Ocean: Role within the Earth System (BIGSOUTH); www.belspo.be/belspo/SSD/science/projects/BIGSOUTH.E.pdf, funded by BELSPO
- Tracing and Integrated Modelling of Natural and Anthropogenic Effects on Hydrosystems: towards sustainable solutions (TIMOTHY); www.ulb.ac.be/rech/inventaire/projets/8/PR4168.html, funded by BELSPO
- Remote sensing of turbid waters in the Short Wave Infrared (SEASWIR), funded by BELSPO
- Information System on the Eutrophication of our coastal areas (ISECA); www.iseca.eu/en; funded by EC INTERREG IV.A 2 Seas Programme

IMBER related activities in 2011-2012

- University of Liège hosted the 43rd International Liège Colloquium on Ocean Dynamics *Tracers of physical and biogeochemical processes, past changes and ongoing anthropogenic impacts* (May 2011). An IMBER special session was chaired by Javier Aristegui (IMBER SSC Vice Chair), and the 44th International Liège Colloquium on Ocean Dynamics - *Remote sensing of colour, temperature and salinity - new challenges and opportunities* (May 2012); <http://modb.oce.ulg.ac.be/colloquium>)
- *Journal of Marine Systems* Special issue on *Tracing and Integrated Modelling of Natural and Anthropogenic Effects on Hydrosystems: The Scheldt River Basin and Adjacent Coastal North Sea* (Guest editors: C. Lancelot, E. Deleersnijder and N. Gypens)
- *Journal of Marine Systems* Special issue on *Traces and Tracers: Selected papers from the Joint Liège Colloquium on Ocean Dynamics – Bonus-GoodHope – GEOTRACES meeting* (Guest editors: Bob Anderson, Bruno Delille, Marilaure Grégoire, Catherine Jeandel, Sabrina Speich)
- Alberto Borges is actively contributing as an Associate Member to the Implementation Plan of the IMBER-LOICZ CMWG.

Future plans

University of Liège will host the 45th International Liège Colloquium on Ocean Dynamics *The variability of primary production in the ocean: from the synoptic to the global scale* (13-17 May 2013). Javier Aristegui will lead an IMBER special session.

Brazil

The IMBER-endorsed project *Materials transfer through the continent-sea interface* (INCT-TMCOcean) (www.inct-tmcocean.com.br), aims to quantify transport, alterations and fate of sediments, nutrients, organic matter and trace metals from the continent to the ocean on the northeast Brazilian continental shelf, and to investigate the relationships between that transport and biological processes. Results are relevant for building scenarios for the sustainable development of coastal areas in the light of climate change, both at regional and global scales.

Examples of 2011 peer-reviewed publications

- Maioli, O.L.; Rodrigues, K.C.; Knoppers, B.A. & Azevedo, D.A. 2011. Distribution and sources of aliphatic and polycyclic aromatic hydrocarbons in suspended particulate matter in water from two Brazilian estuarine systems. *Continental Shelf Research*, 31: 1116-1127.
- Sifeddine, A.; Meyers, P.A.; Cordeiro, R.C.; Albuquerque, A.L.S.; Bernardes, M.C.; Turcq, B. & Abrão, J.J. 2011. Delivery and deposition of organic matter in surface sediments of Lagoa do Caçó (Brazil). *Journal of Paleolimnology*, 45:385–396.
- Gomes, F.C.; Godoy, J.M.; Godoy, M.L.D.P.; Carvalho, Z.L.; Lopes, R.T.; Sanchez-Cabeza, J.A.; Osvath, I. & Lacerda, L.D. 2011. Geochronology of anthropogenic radionuclides in Ribeira Bay sediments, Rio de Janeiro, Brazil. *Journal of Environmental Radioactivity* 102: 871-876.
- Dias, F.J.S.; Lacerda, L.D.; Marins, R.v. & De Paula, F.C.F. 2011. Comparative analysis of rating curve and ADP estimate of instantaneous water discharge through estuaries in two contrasting Brazilian rivers. *Hydrological Processes* 25: 2188–2201.
- Carreira, R.S.; Araújo, M.P.; Costa, T.L.F.; Spörl, G. & Knoppers, B.A. 2011. Lipids in the sedimentary record as markers of the sources and deposition of organic matter in a tropical Brazilian estuarine-lagoon system. *Marine Chemistry* 127: 1-11
- Rudoff, N.M.; Kampei, M. & Rezende, C.E. 2011. Spectral mapping of the Paraíba do Sul River plume (Brazil) using multitemporal Landsat images. *Journal of Applied Remote Sensing* 5(1): 1-19.
- Di Benedetto, A.P.M.; Souza, C.M.M.; Kehrig, H.A.; Rezende, C.E. 2011 Use of multiple tools to assess the feeding preference of coastal dolphins. *Marine Biology* 158: 2209–2217.
- Melo-Magalhães, E.M.; Moura, A.N.; Medeiros, P.R.P.; Lima, E.L.R. & Koenig, M.L. 2011. Phytoplankton of the São Francisco river estuarine region (Northeastern Brazil): a study of its diversity. *Brazilian Journal of Aquatic Sciences and Technology*, 15(1): 95-105.
- Silva, M.V.N.; Sial, A.N.; Ferreira, V.P.; Neumann, V.H.; Barbosa, J.A.; Pimentel, M.M. & Lacerda, L.D. 2011. Cretaceous-Paleogene Transition at the Paraíba Basin, Northeastern, Brazil: Carbon-Isotope and mercury subsurface stratigraphy. *Journal of South American Earth Sciences* 32: 379-392.
- Azevedo, J.S.; Braga, E.S.; Favaro, D.T.; Perretti, A.R.; Rezende, C.E. & Souza, C.M.M. 2011. Total mercury in sediments and in Brazilian Ariidae catfish from two estuaries under different anthropogenic influence. *Marine Pollution Bulletin* 62: 2724-2731.
- Costa, T.L.F.; Araújo, M.P.; Knoppers, B.A.; Carreira, R.S. 2011. Sources and distribution of particulate organic matter of a tropical estuarine-lagoon system from NE Brazil as indicated by lipid biomarkers. *Aquatic Geochemistry*, 17: 1-19.

Future perspectives of new Brazilian IMBER endorsed projects

Between 2009 and 2011, government agencies substantially increased funds for oceanographic research in Brazil and a number of multi-disciplinary oceanographic surveys were conducted over the south and southeastern Brazilian continental shelf. New oceanographic vessels will be available soon for research and new mooring sites with continuous biological measurements are also expected and partially funded. It is anticipated that at least two new projects will apply for IMBER endorsement in 2012.

France

Key initiatives contributing to the investigation of the sensitivity of marine biogeochemical cycles and ecosystems to global change, on time scales ranging from years to decades:

- CYcles Biogéochimiques, Ecosystèmes et Ressources (CYBER); www.insu.cnrs.fr/lefe/cycles-biogeochimiques-environnement-et-ressources-cyber; until 2015. Scientific activities within CYBER are organized in four foci, some being the French counterpart of international programmes (IMBER, SOLAS, and GEOTRACES). The first focus is a French contribution to IMBER and deals with the ecosystem structure, functional diversity, ecosystem functioning and biogeochemical cycles and trophic transfers in the ocean. For information about CYBER see: www.insu.cnrs.fr/co/files/rendu_cyber.pdf and www.insu.cnrs.fr/co/prospectives/oa/2010/cycles-biogeochimiques-environnement-et-ressources
- Marine Ecosystems Response in the Mediterranean Experiment (MERMEX) (<http://mERMEX.com.univ-mrs.fr>) is dedicated to biogeochemical cycles and the structure and functioning of the Mediterranean marine ecosystem. Key publication: MERMEX Group, F., 2011. Marine Ecosystems Responses to climatic and anthropogenic forcings in the Mediterranean. *Progress in Oceanography*, 2, 91: 97-166.
- Earth, Ocean, Continental Surfaces and Atmosphere (TOSCA) (www.cnes.fr/web/CNES-en/7454-earth-sciences.php,2011-2015) has an ocean component that funds projects dedicated to the understanding of ocean primary productivity from sub-mesoscale to basin scale in coastal and open ocean, based on the use of the satellite images from different spatial missions.

Related projects supported by national programmes

- Biogeochemistry and Optics South Pacific Experiment (BIOSOPE)
- www.obs-vlfr.fr/proof/vt/op/cc/biosope/bio.htm. IMBER-endorsed (2001-2011)
- Biogeochemistry from the Oligotrophic to the Ultraoligotrophic Mediterranean (BOUM) www.com.univ-mrs.fr/BOUM. IMBER-endorsed (2006-2011). BOUM special issue in *Biogeosciences Discussion* (http://www.biogeosciences-discuss.net/special_issue63.html) in late 2012.
- Pressure effects On marines prokaryotes (POTES) - IMBER-endorsed project. www.com.univ-mrs.fr/LMGEM/potes
- Toward AN eddying Global Green Ocean (TANGGO). www.tanggo.grenoble.cnrs.fr/web
- Etude in situ de l'impact de la diversité biologique sur la reminéralisation de la matière organique à l'interface eau-sédiment (BIOMIN). <http://www.epoc.u-bordeaux.fr/index.php?lang=en&page=eqecobiocprojets>
- Observations du zooplancton et micronecton dans la zone économique calédonienne pour mieux comprendre la distribution du thon germon (NECTALIS).
- Les Patterns de la Répartition Spatio-Temporelle du Phytoplancton dans l'Océan: Caractérisation par une Nouvelle Approche Observationnelle (BIOPATTERNS). <http://wwwz.ifremer.fr/lpo/SO-Argo-France>.
- Novel Argo Ocean observing System (NAOS) <http://wwwz.ifremer.fr/naos/Argo>
- Kerguelen Ocean and Plateau compared Study KEOPS2) www.obs-vlfr.fr/keops2
- Impact of climate change on the fate of terrestrial carbon exported to the Arctic Ocean, on the photosynthetic production of organic carbon, and on microbial diversity (MALINA). www.obs-vlfr.fr/Malina

National Projects started in 2012

- VAriability of vertical and troPHic transfer of fixed N₂ in the southwest Pacific and potential impact on the oceanic carbon pump (VAHINE). Contact: Sophie Bonnet (MIO)
- Dissolved Organic matter composition and degradation in the ocean (DORADE). Contact: Panagiotopoulos Christos (MIO)
- OCEANS-C13. Contact: Lo Monaco (LOCEAN)
- A MACROscope for Oceanic Earth System (MACROES) www.macroes.ird.fr

Projects supported by European programmes and coordinated in France

European Project on Ocean Acidification (EPOCA), www.epoca-project.eu. This EU FP7 funded, IMBER-endorsed project, ended in May 2012. EPOCA generated a large amount of critical data. Since the launch of the

project, there have been more than 170 publications. A major product was the book “Ocean Acidification” (September 2011), edited by J.-P. Gattuso and L. Hansson and with contributions from many EPOCA scientists.

EUR-OCEANS Consortium (EUR-OCEANS), www.eur-oceans.eu, favours joint initiatives between key research and funding organisations across Europe, to help the community to make significant advances in marine science. The focus of the Consortium is on the impact of climate/global change on marine ecosystems and biogeochemical cycles, and the construction of scenarios relevant to the emerging International Platform on Biodiversity and Ecosystem Services (IPBES).

Other European projects with French contributions: **MedSeA**, <http://medsea-project.eu/> (endorsed by IMBER), **CARBOCHANGE**, <http://carbochange.b.uib.no> (endorsed by IMBER); **EURO-BASIN** from the International Basin-scale Analysis, Synthesis and Integration (BASIN) Programme, <http://na-basin.org>; **MEECE** www.meece.eu; **PERSEUS**, www.perseus-net.eu

Key IMBER-related meetings in 2011-2012

Colloquium on *Coastal ecosystems vulnerability to global change and extreme events*, October 2011, Biarritz. http://wwz.ifremer.fr/biarritz_2011_eng/

TOSCA colloquium organized by CNES, March 2012, Paris, <http://cnes.cborg.fr/TOSCA>

Germany

Geochemistry and Ecology of the Namibian Upwelling System (GENUS) <http://genus.zmaw.de>

After a successful first phase (2009-2012), the GENUS project (funded by BMBF, the German Federal Ministry for Education and Research) has been extended until 2015. GENUS requests for ship time on large German research vessels off southwest Africa have been approved for oceanography following positive evaluation. In addition to the existing cooperation with Namibia, further cooperation with South Africa and Angola is being established with the *Science Partnerships for the Assessment of Complex Earth System Processes in southern Africa* (SPACES) Programme (www.ptj.de/wtz-suedliches-afrika).

Biological Impacts of Ocean ACIDification (BIOACID) www.bioacid.de

The first three-year phase of the BIOACID project (funded by BMBF, the German Federal Ministry for Education and Research) ended on 31 August 2012. The results of BIOACID research, as well as those of the international partner programs EPOCA, UKOARP and MedSeA, show the growing evidence of potential biological impacts of ocean acidification. They affirm that this global change phenomenon may pose a serious threat to marine organisms and ecosystems. Despite a wealth of knowledge on specific effects of acidification and the related changes in seawater chemistry on the physiology of individual marine taxa, many uncertainties still remain. Because the majority of studies are based on single-species experiments, little is currently known about possible impacts on natural communities, food webs and ecosystems. Few studies have addressed possible interacting effects of environmental changes occurring in parallel, such as ocean acidification, warming, and deoxygenation and changes in surface layer stratification and nutrient supply. Almost completely unknown at present is the potential for evolutionary adaptation to ocean acidification. To pave the way for a more encompassing assessment of future biological responses to ocean change and their possible socio-economic consequences Phase 2 of BIOACID (09/2012 – 08/2015) will include the following:

- Strengthen the integration within the BIOACID community to allow for more realistic community-level experimentation and field observation
- Focus more on interacting affects through multiple stressors
- Expand evolutionary biology to assess the potential for adaptation of key taxa
- Integrate socio-economic assessments and stakeholder involvement

- The overarching focus of BIOACID II will be to address and better understand the chain from biological mechanisms, through individual organism responses, through food web and ecosystem effects, to economic impacts.
- BIOACID has been extended for a second 3-year phase starting on 1 September 2012. Building on the knowledge gained during Phase 1, BIOACID II will aim at community-level responses to ocean acidification, their ecosystem and biogeochemical consequences and socio-economic impacts.

India

The national **Sustained Indian Ocean Biogeochemical and Ecological Research** (SIBER, www.incois.gov.in/Incois/siber/siber.jsp) programme, supported by the Ministry of Earth Sciences (MoES), has been continued. Internationally, SIBER is jointly endorsed and supported by IMBER and IO-GOOS (Indian Ocean Global Ocean Observing System). Its Science Plan and Implementation Strategy was published in 2011. The 2nd SIBER SSC meeting was hosted by the National Institute of Ocean Technology, Chennai, in July 2011. The Indian National Centre for Ocean Information Services (INCOIS), Hyderabad, now hosts SIBER's International Project Office. SIBER-India consists of 14 projects that are clustered under two groups as summarized below.

Open-Ocean Cluster

- 1) Long-term monitoring of oceanographic, biogeochemical and ecological processes in the North Indian Ocean through establishment of open-ocean time series stations in the Arabian Sea and Bay of Bengal. Contact: S.W.A. Naqvi, National Institute of Oceanography (NIO), Goa.
- 2) Elucidation of long-term changes in microbial communities in intensely denitrifying and oligotrophic environs through metagenomic analyses. Contact: N. Ramaiah, NIO, Goa.
- 3) Flow of matter through trophic levels and biogeochemical cycles in marine and estuarine ecosystems. Contact: Sujitha Thomas, Central Marine Fisheries Research Institute, Mangalore.
- 4) Particulate organic carbon export flux from upper Arabian Sea and Bay of Bengal using ²³⁴Th as a tracer. Contact: R. Rengarajan, Physical Research Laboratory, Ahmedabad.
- 5) The role of anaerobic ammonium oxidation (anammox) in nitrogen-loss from the Arabian Sea. Contact: R. Ramesh, Physical Research Laboratory, Ahmedabad.
- 6) Modelling of marine biogeochemical cycles in the Indian Ocean. Contact: M.K. Sharada, CSIR Centre for Mathematical Modelling and Computer Simulation, Bangalore.

Estuaries & Coasts Cluster

- 1) Dynamics of selected biogenic elements in Indian estuaries – A case study of the Mandovi–Zuari estuarine system. Contact: S.W.A. Naqvi, NIO, Goa.
- 2) Assessing macro and meiobenthic diversity off Goa Coast with special emphasis on OMZ. Contact: C. Annapurna, Andhra University, Visakhapatnam.
- 3) Atmospheric deposition and its influence on nutrients in coastal waters of Goa - West coast of India. Contact: Vishnu Murty Matta, Goa University.
- 4) Assessing the anthropogenic impact on south-west coast of India. Contact: B.R. Manjunatha, Mangalore University.
- 5) Role of heterotrophic bacteria and cyanobacteria in the nitrogen cycle in the Cochin estuary and coastal waters with special reference to nitrification, denitrification and nitrogen fixing capabilities. Contact: A.A. Mohamed Hatha, Cochin University of Science and Technology, Cochin.
- 6) Time-Series studies on the biogeochemical aspects in the estuarine and coastal waters of Kochi, southwest coast of India. Contact: V.N. Sanjeevan, Centre for Marine Living Resources and Ecology, Kochi.
- 7) Hydro-biological studies of Vellar–Coleroon estuarine system. Contact: T. Balasubramanian, Centre of Advanced Study in Marine Biology, Annamalai Univ., Parangipettai, Tamilnadu.
- 8) Biogeochemical dynamics of the Hooghly-Matla estuarine systems along the northeast coast of the Bay of Bengal, India. Contact: S. K. Mukhopadhyay, University of Calcutta.

Regular cruises have been planned to two time-series locations – the Arabian Sea and Bay of Bengal. The observations in the coastal regions are proceeding as planned. However, there are problems in operation/maintenance of the two open ocean time-series sites. There are two major constraints. First, the MoES

research ships are overcommitted, and so sufficient ship time is not available for SIBER projects. Secondly, in the case of the Arabian Sea, piracy is a major issue.

Two new projects proposed by the National Institute of Oceanography (NIO) are (1) Ocean Science Toward Forecasting Indian Marine Living Resource Potential, and (2) Indian Aquatic Systems: Impact of Deoxygenation, Eutrophication and Acidification. Although, formal approval is yet to be obtained, these projects are likely to provide the main thrust for addressing IMBER-relevant issues in the Indian Ocean region.

Japan

1. Research Cruises

A research cruise entitled *Comparative oceanography between the North and South Pacific related to biogeochemical processes and biological communities in the subtropical systems* was conducted during December 2011 - January 2012 in the subtropical and tropical Pacific on the R/V *Hakuho-maru* (KH-11-10, Contact: K. Furuya). The cruise gathered 30 scientists related to SOLAS and IMBER. Detailed distributions and fluxes of a variety of chemical and biological parameters within the oligotrophic region in the both North and South Pacific should be obtained and compared.

Another research cruise related to IMBER took place in July-August 2012 in the western North Pacific, on board R/V *Hakuho-maru* (KH-12-3, P.I. Dr. H. Ogawa).

2. Symposia

Comparative oceanography in the subtropical Pacific related to plankton communities and biogeochemical cycles, October 2011, Tokyo - convenors: K. Furuya and H. Saito.

Recent findings and future challenges of IMBER-Japan activities, June 2012, Tokyo - www.aori.u-tokyo.ac.jp/english/aori_news/meeting/2012/20120604.html - convenors: H. Ogawa and H. Saito.

These symposiums were organized mainly by the IMBER-Japan community. Speakers from various disciplines including physics, chemistry, and biology presented the latest knowledge of biogeochemical cycles and plankton ecosystems in Pacific Ocean from each viewpoint.

3. Funding

A proposal entitled *A New Image of the Ocean – the function and the sustainable use* was submitted by a mainly IMBER-related group in Japan including both the natural and the social sciences (contact: K. Furuya) to a large-scale research fund - *Scientific Research on Innovative Area* - sponsored by Ministry of Education, Culture, Sports, Science and Technology. The proposal was successful and the project has been funded for five years (2012-2016).

Korea

IMBER-related Korean research activities have been extended from coastal and marginal seas to the open ocean. Most of these activities are focused on the first two IMBER research themes - *Interactions between biogeochemical cycles & food webs* and *Sensitivity to Global Change*. On-going IMBER-related research projects include the following:

- Korea East Asian Seas Time-series (EAST) – 1 (2006-2015), <http://east-1.snu.ac.kr/intro/index.php>
- Understanding the mechanisms of the East Sea ecosystem changes (2011-2016)
- Assessment of climate impact on marine ecosystem of the south sea of Korea (2008-2013)
- Study of the physical dynamics of the Yellow Sea bottom cold water and its impact on the ecosystem (2009-2014)
- Long-term change of structure and function in marine ecosystems of Korea (LTMER-KOREA) (2011-2016)
- Northwestern Pacific Ocean Study on Environment & Interactions between Deep Ocean & marginal seas (POSEIDON) (2006-2015)

These projects are being conducted to identify, quantify and model the physical and biogeochemical processes responding to climate variability and their linkage to changes in the marine ecosystems of Korean waters (Yellow Sea, East/Japan Sea, East China Sea, etc.). Real-time monitoring data of meteorological and oceanic parameters including $p\text{CO}_2$ have been provided from three surface monitoring buoys launched in East/Japan Seas, the southern coastal seas and tropical Pacific through these projects. Multidisciplinary research cruises have been carried out in Korean waters and the north western Pacific by Korea Institute of Ocean Science & Technology (KIOST), previously KORDI, http://eng.kiost.ac/kordi_eng/main/) since July 2012. Results from these projects have been presented at various international and regional conferences, such as 2nd ICES/PICES/IOC International Symposium on *Effects of Climate Change on the World's Oceans* (May 2012, Yeosu, Korea, www.pices.int/meetings/international_symposia/2012/Yeosu/sci_program.aspx).

Namibia

The Northern Benguela upwelling system off Namibia continues to attract scientific interest due to the extremes in environment and the often unpredictable behaviour of this important system that supports a cornerstone fishery industry. Regrettably Namibia's own capacity for research into large-scale aspects of relevance to IMBER within the northern Benguela is limited due to difficulty in obtaining appropriate ship-time for the local research vessels and the lack of sophisticated sampling equipment and analytical capabilities. Such investigations are predominantly carried out by foreign scientists. However, interesting in-house inshore research includes the influence of nutrient ratios on phytoplankton blooms with special focus on toxic dinoflagellates; the biology of local jellyfish species, and biodiversity studies on littoral and benthic invertebrate species. Exciting collaborative research with Norwegian colleagues has provided interesting information about the Bearded Goby, a fish species well suited to the Namibian benthic environment.

In the first half of 2011 Namibia was honoured by sabbatical visits from distinguished scientists Prof. Lisa Levin and Prof. Dave Checkley, both from Scripps Institution of Oceanography, and Prof. Anne-Gro Salvanes from the University of Bergen. They were based at the National Marine Information and Research Centre NatMIRC of the Namibian Ministry of Fisheries and Marine Resources, at Swakopmund. Their time with Namibian scientists and students enhanced our understanding of benthic ecology, fisheries dynamics and fish behavior. The visits allowed direct exposure to acknowledged experts in fields of marine science that are largely neglected in Namibia because national marine research is mainly fisheries-driven, with limited opportunity to extend into academic fields, and lacking in sophisticated amenities. The spectrum of activities carried out during their visits included the initiation of new projects, teaching activities to students of the University of Namibia, and weekly seminars at NatMIRC

Two German-initiated and -funded partnerships are currently running in Namibia:

- Science Partnerships for the Assessment of Complex Earth System Processes (SPACES)
Projects involving Namibia will be funded under the SPACES-Declaration signed by the BMBF, Germany and the MoE, Republic of Namibia, on October 28, 2010. The first call for projects went out early January 2012. Under the SPACES programme, the RV *Maria S Merian* was used to carry out a Training and Capacity Building Cruise in Namibian waters in September and October 2011 for researchers and students from ten different African countries and Germany. This was coordinated through the University of Namibia's Sam Nujoma Marine and Coastal Research Centre SANUMARC. The aim of this cruise was to contribute to better understanding of the Benguela Current Ecosystem, thereby fostering cooperation by helping to set up partnership projects in research and development.
- The Geochemistry and Ecology of the Namibian Upwelling System (GENUS) project started in 2009 and is endorsed by IMBER and the Census of Marine Life (CoML) and CMarZ (Census of Marine Zooplankton) initiatives. GENUS builds on the previous regional Benguela Environment Fisheries Interaction and Training (BENEFIT), 1997-2007 and the Benguela Current Large Marine Ecosystem (BCLME). These initiatives fostered fruitful cooperation with research institutions in the Benguela region (South Africa, Namibia and Angola). Cruise MSM 17/3 onboard RV *Maria S Merian* was dedicated to the GENUS project and represented the third field campaign within this project since 2009. The research focused on the northern Benguela region

under low to moderate upwelling conditions during austral mid-summer and aimed to clarify linkages between climate change, biogeochemical cycles of nutrients, and ecosystem structure.

New Zealand

The second *New Zealand Fisheries Oceanography* voyage was successfully completed in November 2011 (www.niwa.co.nz/fisheries-oceanography-ii-chatham-rise-tan1116-voyage-log). The 21-day research voyage on board RV *Tangaroa* focused on measuring the abundance, distribution and trophic connections of key mid-trophic level taxa in the Chatham Rise region of New Zealand. Key mid-trophic level taxa studied included meso- and macrozooplankton, mesopelagic fish (especially myctophids), squid, larval and juvenile fish, and hyperbenthic invertebrates (especially shrimps and prawns).

In February 2012, a cruise of the *Surface Ocean Aerosol Processes* (SOAP), www.niwa.co.nz/atmosphere/projects/soap took place on board RV *Tangaroa* to study relationships between ocean productivity, sulphur biogeochemistry, air-sea gas exchange and aerosol formation, again over the Chatham Rise, to understand the role ocean processes play in cloud formation and climate.

In the coastal zone of New Zealand, the multi-disciplinary *Taking Stock* project (contact: Alison MacDiarmid, NIWA), developed five balanced end-to-end ecosystem models representing the food-web of the Hauraki Gulf in five periods through history: (1) present day; (2) 1950 AD, just prior to onset of industrial-scale fishing; (3) 1790 AD, before European whaling and sealing; (4) 1500 AD, early Maori settlement phase; (5) 1000 AD, before human settlement in New Zealand. The models show how the structure and function of these New Zealand shelf ecosystems are likely to have changed during human occupation in response to climate variation and human activities such as fishing.

The *Ross Sea food-web modelling: Data from the New Zealand International Polar Year-Census of Antarctic Marine Life* voyage to the Ross Sea in 2008 has continued to provide insights into the feeding of key biota, and overall trophic relationships in the Ross Sea region of Antarctica.

Other work in New Zealand over the last year includes research on the effects of ocean acidification on plankton in New Zealand waters, including research on coccolithophore blooms.

Russia

The Laboratory of Arctic Research (contact: Igor Semiletov), Laboratory of Physical Oceanography (contact: Vyacheslav Lobanov) and Hydrochemistry Laboratory (Pavel Tishchenko), of the Pacific Oceanological Institute (POI) carry out IMBER-related studies.

Arctic Study

During the past year, two international expeditions to the east Arctic region of Russia were carried out. In these expeditions, the drilling of the underwater permafrost of the Laptev Sea to a depth of 65 m occurred, in April 2011. The first results about the structure of the sediments of Laptev Sea using paleo- and biomarkers suggest the existence of methane flux from sediments to the seawater and then to the atmosphere. For the first time, it is shown that terrestrial organic matter caused by erosion of soil is the dominant source of organic matter to the Russian Arctic Seas (Laptev Sea, East Siberian Sea). These seas are a source of CO₂. Mechanisms of seasonal variability of CO₂ emission by Arctic Seas were investigated. Peculiarities of the distributions of carbonate system parameters in the Arctic Seas were studied in these expeditions. Methane fluxes were observed by means of bubbles from the sea to the atmosphere using sonic methods. Emission fields of methane were studied in detail.

Laboratory of Arctic Research's publications related to IMBER research

Charkin A.N., Dudarev O.V., Semiletov I.P., Kruhmalev A.V., Vonk J.E., Sánchez-García L., Karlsson E., and Ö. Gustafsson (2011). Seasonal and interannual variability of sedimentation and organic matter distribution in the Buor-Khaya Gulf: the primary recipient of input from Lena River and coastal erosion in the southeast Laptev Sea. *Biogeosciences*, 8, 2581-2594, doi:10.5194/bg-8-2581-2011;

- Semiletov I.P., Pipko I.I., Shakhova N.E., Dudarev O.V., Pugach S.P., Charkin A.N., McRoy C.P., Kosmach D., and Ö. Gustafsson (2011). Carbon transport by the Lena River from its headwaters to the Arctic Ocean, with emphasis on fluvial input of terrestrial particulate organic carbon vs. carbon transport by coastal erosion. *Biogeosciences*, 8, 2407-2426, doi:10.5194/bg-8-2407-2011;
- Sánchez-García L., Alling V., Pugach S., Vonk J., van Dongen B., Humborg C., Dudarev O., Semiletov I., and Ö. Gustafsson (2011). Distribution, sources and inventories of particulate organic carbon in the Laptev and East Siberian Seas. *Global Biogeochemical Cycles*, 25, GB2007, doi: 10.1029/2010GB003862;
- Karlsson, E.S., Charkin, A., Dudarev, O., Semiletov I., Vonk, J.E., Sánchez-García, L., Andersson, A., and Gustafsson Ö. (2011). Carbon isotopes and lipid biomarker investigation of sources, transport and degradation of terrestrial organic matter in the Buor-Khaya Bay, SE Laptev Sea. *Biogeosciences*, 8, 1865-1879, doi:10.5194/bg-8-1865-2011;
- Gustafsson Ö., van Dongen B.E., Vonk J.E., Dudarev O.V., and I.P. Semiletov (2011). Widespread release of old carbon across the Siberian Arctic echoed by its large rivers. *Biogeosciences*, 8, 1737-1743, doi: 10.5194/bg-8-1737-2011.
- Pipko I.I., Semiletov I.P., Pugach S.P., I. Wählström, and Anderson L.G. (2011). Interannual variability of air-sea CO₂ fluxes and carbon system in the East Siberian Sea. *Biogeosciences*, 8, 1987-2007, doi:10.5194/bg-8-1987-2011;
- Anderson, L.G., Björk, G., Jutterström, S., Pipko, I., Shakhova, N. Semiletov, I. and Wählström, I. (2011). East Siberian Sea, an Arctic region of very high biogeochemical activity. *Biogeosciences*, 8, 1745-1754, doi:10.5194/bg-8-1745-2011

Shelf of Peter the Great Bay (Japan Sea) Study

The laboratories of Physical Oceanography and Hydrochemistry of POI collaborate in the study of biogeochemical processes in estuarial and coastal areas near Vladivostok, in two programmes: *Seasonal hypoxia of Peter the Great Bay (Japan Sea)* and *Production/destruction processes in estuaries of rivers of Peter the Great Bay (Japan Sea)* supported by the Russian Foundation for Basic Research (RFBR). Four hydrochemical expeditions were carried out to study the seasonal variability of the hydrochemical properties of the waters of Ussuriyskiy Bay and estuaries of Artemovka, Shkotovka and Razdolnaya Rivers. It was established that Artemovka and Knevichanka Rivers are significant contributors of nutrients into Ussuriyskiy Bay. During the summer high eutrophication of Knevichanka and Artemovka Rivers results in a bloom in Murovinaya Bight. This exhibits extremely high values of pH (9) and extremely low values of carbon dioxide partial pressure (30 µatm). Ussuriyskiy Bay is a sink for atmospheric carbon dioxide during winter, spring and autumn seasons. A hydrochemical mooring with sensors of temperature, conductivity, pressure, dissolved oxygen, turbidity of inorganic particles, chlorophyll fluorescence, and optical sensors - TRIPLET-ECO, was deployed in the Amurskiy Bay. Using this approach the assessment of eutrophication status of Amurskiy Bay was characterized as high.

Hydrochemistry Laboratory's publications related to IMBER research

- Khodorenko N.D., Volkova T.I., Zvalinskii V.I., and Tishchenko P. Ya (2012). Extraction Kinetics and Quantitative Analysis of Bottom Sediments for Humic Substances. *Geochemistry International*, 50(4), 385-391.
- Tishchenko P.Ya., Pavlova G.Yu., and Shkirmikova E.M. (2012). A New Look at the Alkalinity of the Sea of Japan. *Oceanology*, 52(1), 21-33.
- Dong-Jin Kang, P.Y. Tishchenko, Hyun Kahng (2011). On board Comparison of Total Hydrogen Ion Concentration (pH) and Total Alkalinity measurements in Seawater. *J. Korean Soc. Mar. Envir. Eng.*, 14(3), 205-211
- Tishchenko P.Y., Dong-Jin Kang, R.V. Chichkin, A.Yu. Lazaryuk, Chi Shing Wong, W.K. Johnson (2011). Application of potentiometric method using a cell without liquid junction to underway pH Measurements in surface seawater. *Deep-Sea Res. I*, 58, 778-786.
- NOWPAP CEARAC 2011: Integrated Report on Eutrophication Assessment in Selected Sea Areas in the NOWPAP Region: Evaluation of the NOWPAP Common Procedure ISBN 978-4-9902809-5-6.
- Tishchenko P.Ya., Pavlova G.Yu., Shkirmikova E.M. (2012). Alkalinity of the Japan/East Sea // Ecosystem status report of the Japan Sea. Canada. PICES. (accepted).
- Tishchenko P.Ya., Pavlova G.Yu., Shkirmikova E.M. (2012). Peculiarities in distribution of the N:P ratio in seawater of the Japan/East Sea // Ecosystem status report of the Japan Sea. Canada. PICES. (accepted).

Spain

Five ongoing national or international projects coordinated in Spain are currently endorsed by IMBER: (i) **Circumnavigation Expedition Malaspina 2010: Global change and biodiversity exploration of the global ocean (MALASPINA 2010)**, led by Carlos M. Duarte; (ii) **Coastal ocean microbial plankton and temperature (COMITE)**, led by Xosé Anxelu Gutiérrez Morán; (iii) **Mediterranean Sea acidification in a changing climate (MedSeA)** led by Patrizia Ziveri; (iv) **Deep-water submarine canyons and slopes in the Mediterranean and Cantabrian seas: from synchrony of external forcings to living resources (DOS MARES)**, led by Miquel Canals; and (v) **Aerosol deposition and ocean plankton dynamics (ADEPT)**, led by Franz Peters. Information about these projects may be found through links at the IMBER web site.

Although Spain does not have a national IMBER programme, several projects funded in the 2011 call of the National Subprogram of Marine Science and Technology are closely related to IMBER goals. We have selected ten projects of this call that deal with IMBER scientific goals. They have received about 42% of the 5.42 M€ distributed by the subprogram in 2011 (ship time not included), and obtained additional funds of about 1.10 M€ for training of nine PhD students.

- Aerosol deposition and ocean plankton dynamics (ADEPT), led by Franz Peters (CSIC, Barcelona).
- Topics in copepod ecology: understanding ecophysiological key factors that regulate copepod populations, led by Enric Saiz Sendrós (CSIC, Barcelona).
- Sources of organic matter and functional diversity of microplanktonic communities in deep North Atlantic waters (MODUPLAN), led by Marta Varela (IEO, A Coruña).
- Oceanographic impact on the distribution and trophic ecology of wild common octopus paralarvae in a seasonal upwelling area (LARECO), led by Ángel Francisco González González (CSIC, Vigo).
- Dynamics and ecological role of small pelagic fishes in the Northwestern Mediterranean: Energy transfer from planktonic organisms and top predators (**ECOTRANS**), led by Isabel Palomera (CSIC, Barcelona).
- Fluxes of Greenhouse gasses in the Natural Park of the Bay of Cádiz: Interrelation with anthropogenic factors (FLIPA), led by Teodora Ortega Díaz (Univ. of Cádiz).
- Scaling, monitoring and predicting marine plankton metabolism in a changing ocean (SCALAR), led by Pablo Serret Ituarte (Univ. of Vigo).
- Dark-ocean water mass boundaries and mixing zones as "hot spots" of biodiversity and biogeochemical fluxes across the Mediterranean Sea and Eastern North Atlantic (HOTMIX), led by Javier Aristegui Ruiz (Univ. of Las Palmas de Gran Canaria) and Xosé Antón Álvarez Salgado (CSIC, Vigo).
- Response of coastal ecosystems to allochthonous inputs of matter in the context of anthropogenic global environmental change (REIMAGE), led by Emilio Fernández (Univ. of Vigo) and F. Gómez Figueiras (CSIC, Vigo).
- Effect of seawater acidification (CO_2 and HCO_3^- rise) on nutrient uptake by marine phanerogams, led by José A. Fernández (Univ. of Málaga).

United Kingdom

Arctic study of ocean acidification impacts has begun

The research is part of the **UK Ocean Acidification (UKOA)** research programme, funded by the NERC, DEFRA and DECC (see www.nerc.ac.uk/research/programmes/oceanacidification/).

An Arctic research cruise aboard the RRS *James Clark Ross* gathered thirty researchers from eight laboratories in June-July 2012 to study the effect of ocean acidification on the Norwegian, Barents and Greenland seas. The scientists studied the impact of the changing chemistry on marine organisms and ecosystems, the cycling of carbon and nutrients in the sea and how the sea interacts with the atmosphere to influence climate. Two approaches will be used in this study. Firstly, the researchers looked at how ecosystems vary between areas where the chemistry of seawater is naturally more acidic or alkaline. By contrasting the observations over a range of different conditions, researchers will discover how acidification may affect organisms living in their natural environment, where natural selection and adaptation have had time to play out. The second approach is experimental, using tanks of natural seawater collected from the upper ocean and brought into controlled conditions on deck. This natural seawater was subjected to various levels of CO_2 that are likely to occur in the future.

NERC has agreed funding for a programme on shelf sea biogeochemistry

The continental shelf regions have been identified as the most valuable biome on Earth in one recent environmental economic analysis and their value to the UK is particularly high given the scale and economic significance of the UK continental shelf. Continental shelf regions are the sites of major biogeochemical transformations that occur at a scale that affects the whole Earth system, including carbon storage and denitrification, but we do not understand the controls on these processes and therefore cannot predict how they will change in the future.

Arctic Research Programme

The first phase of a five-year NERC Arctic Research Programme (www.nerc.ac.uk/research/programmes/arctic/documents/arctic-awards.pdf) is mainly focusing on physical processes with some aerosol studies, with the following projects:

- Arctic Predictability and Prediction On Seasonal to Inter-annual Timescales (APPOSITE)
- Aerosol-Cloud Coupling And Climate Interactions in the Arctic (ACCACIA)
- The Environment of the Arctic: Climate, Ocean and Sea Ice (TEA-COSI)
- Methane and Other Greenhouse Gases in the Arctic - Measurements, Process Studies and Modelling (MAMM)
- Submarine Estimates of Arctic Turbulence Spectra (SEATS)

Main UK-centred activities in the Integrating Climate and Ecosystems Dynamics in the Southern Ocean (ICED) programme

- The British Antarctic Survey (BAS) has led activities to develop integrated analyses of the seasonal dynamics of Southern Ocean ecosystems, which has generated the DSR II volume describing the changing system dynamics between spring, summer and autumn in the Scotia Sea. This is a contribution to the ICED Programme. *DISCOVERY 2010: Spatial and Temporal Variability in a Dynamic Polar Ecosystem* (2012) Edited by Geraint A. Tarling, Peter Ward, Angus Atkinson, Martin A. Collins and Eugene J. Murphy. 59–60, (January 2012), <http://www.sciencedirect.com/science/journal/09670645/59>
- The EUR-OCEANS Consortium developed and funded a Polar Flagship activity led jointly by BAS and the Alfred-Wegener Institute (AWI). This aims to develop analyses of Polar Ecosystem change and generate a European network of polar ocean ecosystem scientists. In conjunction with ICED it is undertaking a synthesis of understanding end-to-end operation of Southern Ocean ecosystems.
- The **NERC ‘Funded International Opportunities’** Funded Project on ICED begins in July 2012 and will further develop coordination of Southern Ocean ecosystem science activities, including analyses and models to undertake projections of the future state of Southern Ocean ecosystems.
- Over the last year, BAS scientists have contributed to food web modelling activities, including the ICED food web modelling paper that is now published in *Progress in Oceanography*. BAS scientists have also contributed in comparative analyses of the west Antarctic and South Georgia ecosystems. Major progress is being made in data syntheses, modelling and development of projections. UK researchers have contributed in the coordination and development of a number of ICED meetings and workshops, including a major session at the IPY meeting and the second Sentinel meeting in Hobart in early May aimed at understanding the status of Southern Ocean ecosystems.

NERC funded responsive mode grants

A range of individual grant projects of relevance to IMBER have also been funded and we will endeavour to engage the scientists involved with IMBER.

USA

OCB Scientific Leadership Changes

- Scientific steering committee – OCB welcomes five new members, including **Simone Alin** (NOAA/PMEL), **Barney Balch** (Bigelow), **Sonya Dyhrman** (WHOI), **Ricardo Letelier** (OSU), and **Jorge Sarmiento** (Princeton)
- Ocean acidification subcommittee – OCB welcomes four new members, including **Simone Alin** (NOAA/PMEL), **Cathy Pfister** (U Chicago), **Joe Salisbury** (UNH), and **Kim Yates** (USGS)

- Ocean Time-Series Advisory Committee - OCB welcomes five new members, including **John Dunne** (NOAA/GFDL), **Ricardo Letelier** (OSU), **Susanne Neuer** (ASU), **Mary Jane Perry** (U Maine), and **Paul Quay** (UW)

Upcoming and Recent Meetings

- **2012 OCB summer workshop** (July 2012, Woods Hole, MA, www.who.edu/workshops/ocbworkshop2012). This year's meeting includes sessions on the following cross-disciplinary themes:
 - Multiple stressors in marine ecosystems
 - Ocean biogeochemistry from satellite data
 - Land-ocean transport and linkages with global change
 - Integrating measurements across multiple time and space scales
 - New observations from an Arctic Ocean in rapid transition
- **International Ocean Acidification Monitoring Workshop** (June 26-28, 2012, Seattle, WA) (Conveners: NOAA Ocean Acidification Program Office, University of Washington, Northwest Association of Networked Ocean Observing Systems (NANOOS))
- **Ocean acidification data management workshop** (March 13-15, 2012, Seattle, WA) (Conveners: NOAA Ocean Acidification Program Office, University of Washington, Northwest Association of Networked Ocean Observing Systems (NANOOS))
- **OCB Scoping Workshop A Biogeochemical Flux program aligned with the Ocean Observatories Initiative** (May 2011, Woods Hole, MA)
- **OCB Ocean Acidification Principal Investigators' Meeting** (March 2011, Woods Hole, MA)

Partner Activities and Co-Sponsorships

- **Joint Scientific Working Groups with U.S. CLIVAR** (2012-2015) – Outcome of joint U.S. CLIVAR/OCB science session at 2011 Summer OCB workshop
- **Oceanic carbon uptake in the CMIP5 models** (Co-Chairs: Annalisa Bracco, Curtis Deutsch, Taka Ito)
- **Heat and carbon uptake by the Southern Ocean** (Co-Chairs: Joellen Russell, Igor Kamenkovich)
- **Coastal Synthesis Activities** with the North American Carbon Program
- **East Coast Regional Team Meeting** (January 19-20, 2012, Gloucester Point, VA)
- **Coastal Synthesis Wiki Site** (updates on regional coastal synthesis activities)
- Articles on regional synthesis activities published in OCB newsletter (east coast, west coast, Gulf of Mexico, Arctic, Great Lakes)
- OCB co-sponsored **SOLAS meeting on nitrogen fixation methods** (Feb. 2012, Kiel, DE)
- OCB providing **travel support for U.S. students to participate in IMBER ClimECO3 summer school**

Education, Public Outreach, Policy

- OCB publishes **open letter about ocean acidification**, recommending that ocean acidification be considered a key consideration for international decision makers
- **ASLO e-lecture on ocean acidification** (Authors: Richard Feely, NOAA/PMEL, Scott Doney, WHOI)
- OCB provided support for five U.S. students to participate in **Friday Harbor Laboratories summer course Experimental Approaches to Understanding Ocean Acidification** (June-July 2011)
- **OCB ocean fertilization website** cited as a primary informational resource by the USG delegation to the London Convention

Ocean Observing Activities

- Town Hall at 2012 Ocean Sciences Meeting on Development of Global Autonomous Biogeochemical Observing System (OCB)
- SCOR Working Group Proposal (pending): Quality control procedures for oxygen and other biogeochemical sensors on floats and gliders (Lead PIs: Ken Johnson, MBARI, Arne Körtzinger, IFM-GEOMAR)
- Molecular Methods Pilot Cruise (May 2012, Lead PI: Ginger Armbrust); measurements include inorganic and organic geochemistry, -omics, nitrogen cycling, etc. (outcome of the OCB scoping workshop The molecular biology of biogeochemistry: Using molecular methods to link ocean chemistry with biological activity)

Reports and Publications (OCB and others)

- **2011 U.S. Carbon Cycle Science Plan** (U.S. Carbon Cycle Science Program), www.carboncyclescience.gov/USCarbonCycleSciencePlan-August2011.pdf
- OCB Scoping Workshop Report: A Biogeochemical Flux program aligned with the Ocean Observatories Initiative (May 2011, Woods Hole, MA), <http://gbf-ooi.who.edu/>
- OCB Ocean Acidification Principal Investigators' Meeting Report (March 2011, Woods Hole, MA), www.us-ocb.org/publications/OCB_OA_PIwksHP2011.pdf
- National Research Council report "Assessing Requirements for Sustained Ocean Color Research and Operations", https://download.nap.edu/catalog.php?record_id=13127

More information available at www.us-ocb.org.

FUTURE ACTIVITIES

IMBER IMBIZO III will be held at the National Institute of Oceanography (NIO) in Goa, India, 28–31 January 2013. The overall theme is: *The future of marine biogeochemistry, ecosystems and societies. Multi-dimensional approaches to the challenges of global change in continental margins and open ocean systems.* Only 120 participants will be accepted to participate in IMBIZO III. The format of the meeting will be the same as that at previous IMBIZOs – joint plenary and poster sessions and three concurrent, but interacting workshops. The workshop themes are the following:

1. Biogeochemistry-ecosystem interactions on changing continental margins
2. The impact of anthropogenic perturbations on open ocean carbon sequestration via the dissolved and particulate phases of the biological carbon pump
3. Understanding and forecasting human-ocean-human interactions, drivers and pressures, with respect to global change.

For additional information, see: [IMBIZO III](#).

An optional data management workshop, that will consider good data management practices and processes for dealing with both natural- and social science data, will be held prior to IMBIZO III, on 27 January 2012.

The **First IMBER Open Science Meeting** (OSM) will be held in Bergen, Norway, on 23-27 June 2014. The Scientific Organising Committee has been established and planning is underway.

PUBLICATIONS

There are currently more than 756 peer-reviewed research papers in the IMBER database. In 2011, 83 papers were published and 10 so far in 2012.

Selected publications

1. Comeau S, Gattuso J-P, Nisumaa A-M, Orr J (2011) Impact of aragonite saturation state changes on migratory pteropods. *Proceedings of the Royal Society B: Biological Sciences* doi:10.1098/rspb.2011.0910.
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4. Mackey A P, Atkinson A, Hill S I, Ward P, Cunningham N J, Johnston N M, Murphy E J (2011) Antarctic macrozooplankton of the southwest Atlantic sector and Bellingshausen Sea: Baseline historical distributions (Discovery Investigations, 1928–1935) related to temperature and food, with projections for subsequent ocean warming, *Deep-Sea Research II* doi:10.1016/j.dsr2.2011.08.011.

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6. The Mermex group, Durrieu de Madron X, Guieu C, Sempéré R, et al., (2011) Marine ecosystems' responses to climatic and anthropogenic forcings in the Mediterranean, *Progress in Oceanography* 91, 97-166.
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8. Murphy, E. J., E. E. Hofmann. 2012. End-to-end in Southern Ocean ecosystems. *Current Opinion in Environmental Sustainability*. 4, 264-271. [Link](#)
9. Renner, A. H. H., S. E. Thorpe, et al. (2012). Advective pathways near the tip of the Antarctic Peninsula: Trends, variability and ecosystem implications. Deep Sea Research Part I: Oceanographic Research Papers 63: 91-101. (ICED Programme contribution) [Link](#)
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11. Saba V S, Friedrichs M A M, and the PPARR team (2011) An evaluation of ocean color model estimates of marine primary productivity in coastal and pelagic regions across the globe, *Biogeosciences* 8, 489-503, doi: 10.5194/bg-8-489-2011.
12. Simeon L, Hill, Keeble K, Atkinson A and Murphy E (2011) A food web model to explore uncertainties in the South Georgia shelf pelagic ecosystem, *Deep-Sea Research II* doi:10.1016/j.dsr2.2011.09.001.
13. SIBER Science Plan and Implementation Strategy (2011). IMBER Report No. 4.
14. Nisumaa A-M, Schlitzer R, Hansson L & Gattuso J-P (2012) EPOCA data management activities: a summary. See <http://www.imber.info/index.php/Science/Working-Groups/SOLAS-IMBER-Carbon/Subgroup-3/Publications-and-reports/EPOCA-data-management>

Special journal issues

Current Opinion in Environment Sustainability (July 2012) Aquatic and marine systems. Ian Perry, Alida Bundy and Eileen Hofmann (eds.). Vol 3 Issue 3 : 253-374

Books and chapters in books/edited volumes:

1. Bell J D, Johnson J E and Hobday A J (2011) Vulnerability of Tropical Pacific Fisheries and Aquaculture to Climate Change. Secretariat of the Pacific Community, Noumea, New Caledonia.
2. Gattuso J-P, Hansson L (eds.) (2011) Ocean Acidification, Oxford University Press. 326pp.
3. Hood R R, Naqvi S W A, Wiggert J D, Landry M R, Rixen T, Beckley L E, Goyet C, Cowie G L, Maddison L M (eds.) (2011) SIBER Science Plan and Implementation Strategy, IMBER Report No. 4.
4. Kleypas, J. A., Anthony, K. R. N. and Gattuso, J.-P. (2011), Coral reefs modify their seawater carbon chemistry – case study from a barrier reef (Moorea, French Polynesia). *Global Change Biology*.
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6. Moutin T, Prieur L, Jeanthon C, Borges A V (eds.) (2011) Biogeosciences Special issue in Vol 8 (10 papers): Interactions between planktonic organisms and the biogeochemical cycles of biogenic elements in the Mediterranean Sea during intense summer stratification: the BOUM experiment.
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9. Ommer R E, Perry I, Cochrane K L, Cury P (eds.) (2011) Fleets, Sites and Conservation Goals: Game Theoretic Insights on Management Options for Multinational Tuna Fisheries. In: *World Fisheries: a Social-Ecological Analysis*. Wiley-Blackwell. 60-88

10. 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.
11. Pollard R, Moncoiffé G, O'Brien T (2011) Recetario para el Manejo de Datos IMBER - Una guía para el buen manejo de datos Reporte IMBER 3, Secretaria de la Oficina de Proyecto Internacional (OPI), Plouzané, France. 16pp.
12. Pörtner H-O, Gutowska M, Ishimatsu A, Lucassen M, Melzner F, Seibel B (2011) Effects of Ocean Acidification on Nektonic Organisms. Ocean Acidification (344pp). Jean-Pierre Gattuso and Lina Hansson (eds).
13. Smith W O Jr., Hofmann E E, Mosby A (2011) Aquatic Biogeochemistry – Marine, in: R A Meyers (ed.), *Encyclopaedia of Sustainability Science and Technology*, DOI 10.1007/978-1-4419-0851-3, Springer Science and Business Media, LLC.

UPCOMING PUBLICATIONS

- Hood R R, Drinkwater K F, Mihalopoulos N (In Press, Accepted Manuscript) Introduction: Large-Scale Regional Comparisons of Marine Biogeochemistry and Ecosystem Processes – Research Approaches and Results *Journal of Marine Systems* [Link](#)
- Murphy, E. J., E. E. Hofmann, et al. (In Press, Corrected Proof). "Comparison of the structure and function of Southern Ocean regional ecosystems: the Antarctic Peninsula and South Georgia." *Journal of Marine Systems*. [Link](#)
- Salihoglu, B., S. Neuer, S. Painting, R. Murtugudde, E.E. Hofmann, J.H. Steele, R.R Hood, L. Legendre, M.W. Lomas, J. Wiggert, S.-I. Ito, Z. Lachkar, G. Hunt, K. Drinkwater and C.L. Sabine, in press, Bridging marine ecosystem and biogeochemistry research: Lessons and recommendations from comparative studies, *Journal of Marine Systems*. [Link](#)

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