

Appendix 7  
Integrated Marine Biogeochemistry and Ecosystems Research (IMBER) Project

**Annual Report to SCOR August 2015**

**A. Introduction**

Integrated Marine Biogeochemistry and Ecosystem Research (IMBER, [www.imber.info](http://www.imber.info)) is an international global environmental change research project, co-sponsored by the Scientific Committee on Oceanic Research (SCOR) and the International Geosphere-Biosphere Programme (IGBP, ending in 2015 after 30 years). The goal of IMBER science is to develop a comprehensive understanding of, and accurate predictive capacity for, ocean responses to accelerating global change and the consequent effects on the Earth System and human society. The 2005 IMBER Science Plan and Implementation Strategy (SPIS) outlined questions and approaches to address this goal. The SPIS was updated in 2010 when the Global Ocean Ecosystems Dynamics (GLOBEC) project ended and its activities were incorporated into IMBER. Having completed its first 10 years, IMBER is now planning its next scientific phase. A new SPIS that will form the basis for the next decade of IMBER research has been developed and will be submitted to SCOR for review and approval in Fall 2015. The current structure of IMBER (Fig. 1) provides the starting point for implementation of the SPIS.

IMBER’s strong commitment to curiosity-driven science provides the foundation for its new 10- year research plan. However, the environmental issues facing society, particularly those relating to global environmental change, are issues that challenge natural and social sciences and humanities. Integration of the understanding provided by curiosity-driven natural science and the problem-driven, societally relevant science requires research that cross the interfaces between these disciplines (transdisciplinary research). A clear message from the 2014 IMBER Open Science Conference (OSC) and community consultation associated with development of the SPIS was that transdisciplinary research must be part of any future research agenda. This is underscored by the science discoveries and highlights presented in the next section, most of which are drawn from publications subsequent to the OSC.

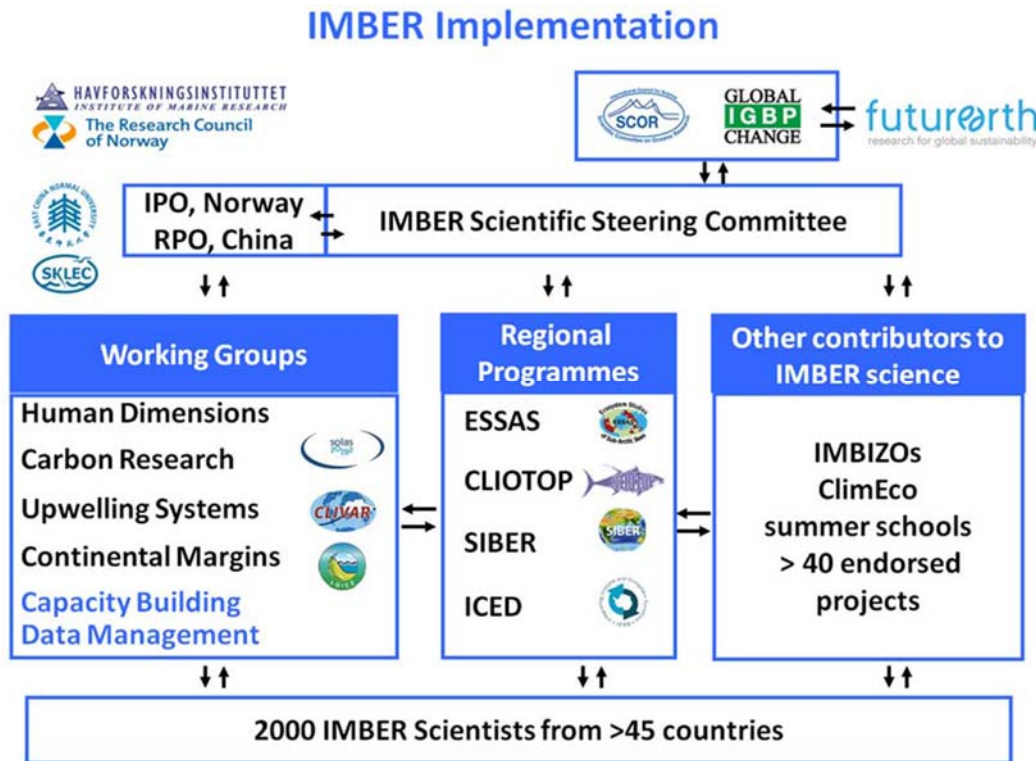


Fig. 1. Structure of IMBER.

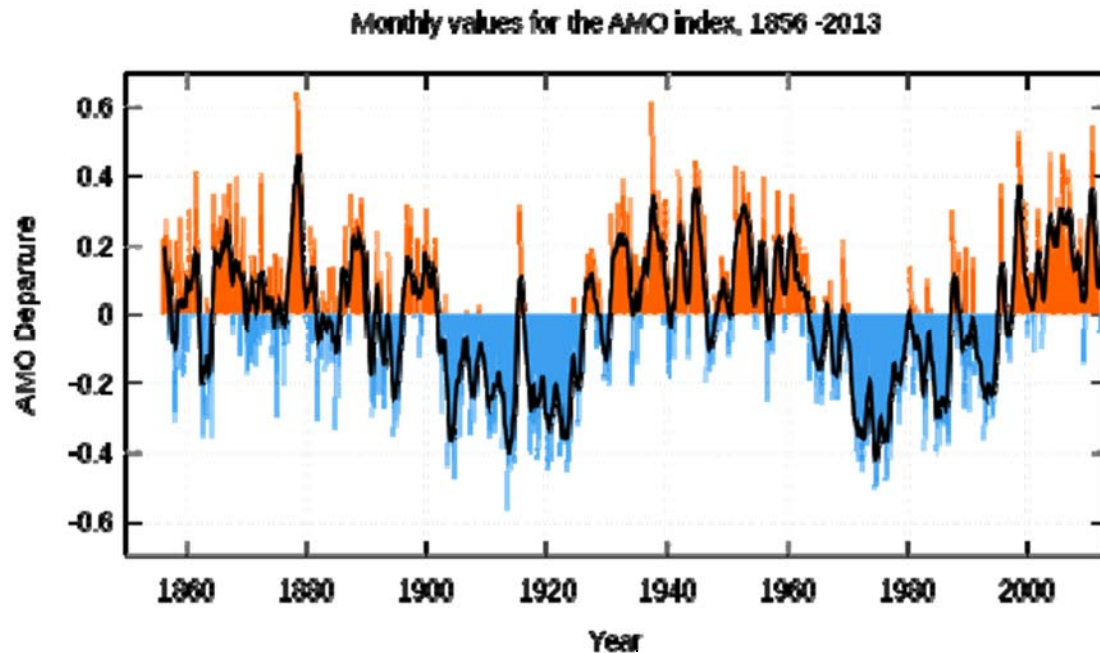
### *Selected recent IMBER discoveries and highlights*

- IMBER advanced understanding of climate effects on marine ecosystems in the Anthropocene
- IMBER advanced understanding of natural-human science interactions in marine systems
- IMBER is developing societal-ecological decision support frameworks for marine systems
- IMBER promoted and undertook capacity building and knowledge transfer activities
- IMBER research informs sustainable use of marine ecosystems

**Selected recent discoveries and highlights from IMBER regional programmes, working groups and related research projects are:**

*From: Ecosystem Studies of Sub-Arctic Seas (ESSAS):*

- The Atlantic Multidecadal Oscillation (AMO), with a 60-80 year periodicity (Fig. 2), was shown to extend into the high latitudes and Arctic regions, as observed in temperature and sea-ice data (*Drinkwater et al., 2014*)



*Fig. 2. 157 year development of the Atlantic Multidecadal Oscillation Index expressed as standardized anomalies and de-trended, i.e. excluding the anthropogenic signal. (<http://www.esrl.noaa.gov/psd/>).*

- Contrary to the general perception of increased primary production in frontal regions, enhanced production is not observed in association with the Polar Front in the Barents Sea and the Arctic Front in the Norwegian Sea. The International Polar Year (IPY) project NESSAR (Norwegian component of the ESSAS) was the first to demonstrate that these frontal regions are primarily density compensating with strong interleaving between the warm, saline Atlantic waters and the cold, low saline Arctic waters. Turbulence near the fronts is relatively weak. Although mixing occurs through both double diffusion and current shear, it is not strong enough to mix nutrients into the surface layers during the stratified period. No secondary upwelling circulation was observed and, hence nutrients are low in the frontal region once the spring bloom is over (*Drinkwater and Tande, 2014*).
- Circulation on the Bering Sea shelf, through the Bering Strait and on the Chukchi Sea shelf, is tightly coupled, with transport anomalies through the Strait driven by the longitudinal location of the Aleutian Low (*Danielson et al., 2014*).
- Much of the diatom production on the Bering Sea shelf is consumed by protists in the microzooplankton, rather than by zooplankton such as copepods and krill, as previously believed. These microzooplankton are also

important in the food web, supporting a large summer zooplankton biomass on the shelf, when they can be more abundant than phytoplankton (Sherr *et al.*, 2013; Stoecker, *et al.*, 2014).

***From: Integrating Climate and Ecosystem Dynamics in the Southern Ocean (ICED):***

- Antarctica's Ross Sea is projected to lose more than half its summer sea ice by 2050 and more than three quarters by 2100. This will be a dramatic change for the area, which is one of the few polar regions that has experienced an increase in summer sea ice coverage over the past few decades. This loss of sea ice has important implications for biological production of the Ross Sea (Smith *et al.*, 2014).
- Winter fast-ice trends over the past 100 years for the South Orkney Islands, Antarctica, demonstrate marked inter-annual variability and long-term changes. These findings indicate the need for caution in interpreting changing ice conditions based on shorter-term satellite series (Murphy *et al.*, 2014).
- Despite inhabiting one of the strongest currents in the world's oceans, Antarctic krill appear to be able to influence their distribution at large oceanic scales through behavior that facilitates maintenance of population centers (Tarling and Thorpe, 2014).
- Due to warming, species richness may increase in Antarctic water masses as sub-Antarctic species increasingly encroach southwards (Ward *et al.*, 2014).
- Changes in penguin abundance and distribution can be used to understand the response of species to climate change and fisheries pressures, and to gauge of ecosystem health (Waluda *et al.*, 2014).
- Zooplankton faecal pellet production is a key control of the efficiency of deep carbon transfer in the Scotia Sea. This area contains the largest seasonal uptake of atmospheric carbon dioxide yet measured in the Southern Ocean (Manno *et al.*, 2015).
- Dissolution dominating calcification processes in polar pteropods are close to the point of Aragonite undersaturation (Bednaršek *et al.*, 2014).
- IMBER/ICED scientists contributed to a Southern Ocean biogeographic atlas, [www.biodiversity.aq](http://www.biodiversity.aq).

***From: Sustained Indian Ocean Biogeochemistry and Ecosystem Research (SIBER):***

- The Indonesian Throughflow (ITF) is a chokepoint in the upper ocean thermohaline circulation that carries Pacific water through the strongly mixed Indonesian Sea and into the Indian Ocean. This suggests that most of the ITF nutrient supply goes into the thermocline waters, where it can support new production and impact Indian Ocean biogeochemical cycling (Ayes *et al.*, 2014).

***From: Climate Impacts on Ocean Top Predators (CLIOTOP):***

- From the 137-year long record of the El Niño-Southern Oscillation (ENSO), no significant trend can be detected, and the recent multi-decadal variability is similar to earlier decades. ENSO has not fundamentally changed over the period of large increase in atmospheric CO<sub>2</sub>, and the potential of predicting the future states of the fisheries and ecosystems are quite limited. (Harrison and Chiodi, 2015)
- Major uncertainties in modelling frameworks are broadly categorised into those associated with (i) deficient knowledge in the interactions of climate and ocean dynamics with marine organisms and ecosystems; (ii) lack of observations to assess and advance modelling efforts and (iii) an inability to predict with confidence natural ecosystem variability and longer term changes as a result of external drivers (e.g. greenhouse gases, fishing effort) and the consequences for marine ecosystems. As a result of these uncertainties and intrinsic differences in the structure and parameterisation of models, users are faced with considerable challenges associated with making appropriate choices on which models to use. A key research direction is the development of management systems that are robust to this unavoidable uncertainty. (Evan *et al.*, 2015)

***From: SOLAS/IMBER Carbon (SIC) Working Group:***

- The Surface Ocean CO<sub>2</sub> Atlas (SOCAT, [www.socat.info](http://www.socat.info)), compiled by the international marine carbon community, provides access to quality-controlled surface CO<sub>2</sub> data (Fig. 3). The first two versions were released in 2011 and 2013, respectively. Version 2 contains 10.1 million quality-controlled, surface ocean fCO<sub>2</sub> (fugacity of CO<sub>2</sub>) values from 1968 to 2011 for the global oceans and coastal seas. Version 3 of the Atlas was released on 7 September 2015 (Bakker *et al.*, 2014; Pfeil *et al.*, 2013; Sabine *et al.*, 2013).

- Scientific applications of SOCAT include: 1) quantification of the ocean carbon sink and 2) ocean acidification and their temporal and spatial variation, 3) validation of ocean carbon models and coupled climate carbon models, and 4) provision of constraints for atmospheric inverse models used to estimate land carbon sink (*Landschützer et al., 2014; Lauvset et al., 2015; Rödenbeck et al., 2014; Séférian et al., 2014; Tjiputra et al., 2014*).
- SOCAT synthesis products represent an impressive achievement in coordinating international researchers to deliver publicly accessible and uniformly quality-controlled data for marine carbon and ocean acidification research that can be used for research and to inform international policy and climate negotiations.

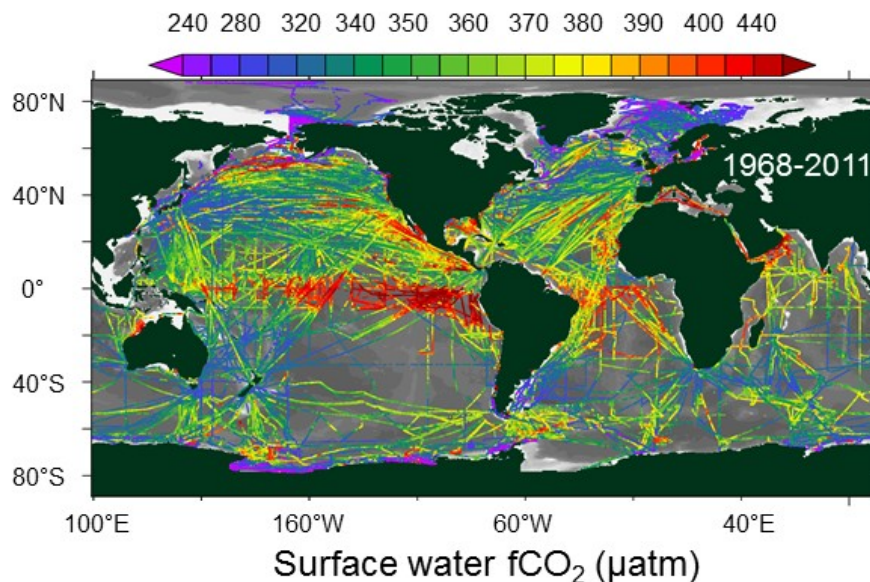


Fig. 3. The global distribution of surface water  $f\text{CO}_2$  values in SOCAT version 2 for 1968 to 2011 (<http://www.socat.info/>; Bakker et al. (2014))

**From: Capacity Building Task Team:**

- IMBER is proactive in building and strengthening the scientific capacity of early to mid- career researchers, and scientists from developing countries. A major activity in facilitating capacity building is the biannual international, transdisciplinary ClimEco (Climate and Ecosystems) summer school. To date, more than 300 students and early career researchers, many from developing countries, have attended the four summer schools organized by IMBER (*Hofmann et al., submitted*).

**From: Human Dimensions Working Group (HDWG):**

- IMBER-ADApT (Assessment based on Description, Responses and Appraisal for a Typology) developed by the HDWG, is an integrated assessment framework built on knowledge learned from past responses to global change issues. It will enable decision makers, researchers, managers and local stakeholders to make more efficient decisions for marine sustainability, and to evaluate most effectively where resources should be allocated to reduce vulnerability and enhance resilience of coastal people and communities to global change (*Bundy et al., 2015*; <http://www.imber.info/index.php/eng/Science/Working-Groups/Human-Dimensions/IMBER-ADApT>).

**From: Continental Margins Working Group:**

- The quest for resources is driving exploration and exploitation on continental margins, including the Arctic margins. Disasters, such as the 2010 BP-Deepwater Horizon oil spill, are likely to occur with increasing frequency and exacerbate on-going threats, such as coastal hypoxia. The IMBER-LOICZ Continental Margins Working Group (CMWG) found that the prevailing Law of the Sea promotes exploitation, but with

insufficient responsibility and accountability to stem unsustainable development on continental margins. Recommendations from CMWG activities focus on reforms based on better understanding of the social-ecological systems (*Levin et al., 2015*), assessment of risks associated with development, and effective governance (*Glavovic et al., 2015*).

***From Endorsed projects:***

**GALATHEA**

- Nutrient availability is considered to be a primary control on size structure of phytoplankton communities, with small cells being more competitive at low nutrient concentrations. However, research from the GALATHEA project indicates that temperature also appears to have a direct effect, with small cells dominating the community structure in warmer water. This temperature effect on cell size has implications for the ocean as a carbon sink because of the slower sinking rate of small cells (*Mousing et al., 2014*).
- Localised vertical mixing between 200 m and the depth of the deep chlorophyll maximum (DCM, approximately 130 m) stimulates phytoplankton activity and alters the distribution of zooplankton. Eel larvae in the Sargasso Sea tend to be concentrated in areas of deep mixing. This deep localized mixing may be responsible for heterogeneity in plankton distributions. Research continues to better understand the processes leading to this vertical mixing (*Richardson et al., 2014*).
- It is expected that ocean warming will lead to increased bacterial activity and faster remineralisation of particulate organic carbon (POC) in the surface layers, which increase POC export to deep waters, potentially decreasing the strength of the biological pump. This temperature sensitivity of remineralisation in the global ocean has now been quantified and is an important input for modelling of the ocean carbon cycle (*Bendtsen et al., 2015*).

**PERSEUS**

- Changes in the structure and functioning of the Black Sea food web between 1960 and 2000 were investigated with four models developed to evaluate trophic transfers. These models showed new energy pathways resulting from changes in trophic components and the conversion of significant amounts of system production to detritus. This shift in the food web led to various ecosystem-wide changes (*Akoglu et al., 2014*).
- The project provided the first climatology of the seasonal thermocline slope and the upper-ocean heat storage rate in the Mediterranean Sea. This has implication of sub-basin circulation patterns and the ocean heat storage. Climatologies of the mixed layer depth and temperature in the Mediterranean Sea was also updated (*Houpert et al., 2014*).
- Biogeochemical data of the surficial and sub-surficial sediments of the Adriatic Sea were processed using statistical Q factor data analysis. Four different biogeochemical facies were identified, indicating that the biogeochemical and sedimentary processes of the Adriatic Sea have changed slightly in the last century (*Spagnoli et al., 2014*).
- The connection between climate variability and anchovy spawning and recruitment in the Black Sea and other ecosystems, was studied using a two-way coupled lower trophic level and anchovy bioenergetics model. Temperature was the dominant factor influencing early life stages and the population dynamics of Black Sea anchovy through its effect on anchovy egg production and recruitment success. Each 2°C decrease in summer mean temperature resulted in a 12- to 19-day delay in egg production. This strong link between climate variability and anchovy spawning and recruitment could have important prediction potential for short-term anchovy stock estimations for fisheries management (*Guraslan et al., 2014*).
- Human activities, such as shipping, aquaculture, and the opening of the Suez Canal, have led to the introduction of nearly 1000 alien species into the Mediterranean Sea. The local taxonomic identity of the alien species is dependent on the dominant maritime activities/interventions and the related pathways of introduction. Further research is needed to better understand how biodiversity changes will affect Mediterranean Sea food webs, ecosystem functioning, and the provision of ecosystem services (*Katsanevakis et al., 2014*).
- Climate variation has increased surface temperature and stratification, producing a decrease in winter mixing. Oxygen and nutrient dynamics in the middle pycnocline have been decoupled. Nutrient concentrations in the upper layer decreased with the decrease in anthropogenic eutrophication. Warm periods (series of warm winters) led to a decrease of oxygen in the Cold Intermediate Layer (CIL), an elevation of the hydrogen sulphide boundary and a decrease of nutrients in the surface layer. Cold periods (series of cold winters) lead to

an increase of oxygen in the CIL, deepening of the hydrogen sulphide boundary and increase of nutrient in the surface layer (Pakhomova et al., 2014).

- Biomass size distribution, light absorption properties and carbon and nitrogen uptake rates were analysed in phytoplankton assemblages along coast–offshore gradients in the Alboran Sea. Surface nitrate concentration was  $>1 \mu\text{M}$  at the coastal stations and less than the detection limit at the offshore stations. Phytoplankton community biomass was dominated by diatoms at the coastal sites; dinoflagellates and picoplankton contributed  $<30$  and  $7\%$ , respectively (Mercado et al., 2014).
- Studies of nutrients and phytoplankton during a deep convection episode showed that nutrient supplies were equivalent to the annual river discharge and that these events counterbalance decreased surface silicate to nitrate ratio. New hypotheses were proposed to explain triggering of the intense spring bloom (Severin et al., 2014).
- An overview of the pressures impacting the Southern European Seas (SES) and their roles in altering the environmental status was undertaken. Additional knowledge and improved understanding is needed to undertake a scientific Good Environmental Status (GES) evaluation. Some of the indicators for the *Marine Strategy Framework Directive* (MSFD) are almost impossible to evaluate for operational purposes (e.g. those related to biodiversity, food web structure, marine litter and microplastics, underwater noise and energy). Additional targeted scientific priorities were identified for the SES to help reduce uncertainties and gaps in data and knowledge (Crise et al., 2015).
- The swarms of Portuguese Man-of-War (*Physalia physalis*) that appeared in summer 2010 in the Mediterranean Sea had dramatic consequences, including the region's first recorded human fatality attributed to a jellyfish sting. Analyses of the meteorological and oceanographic conditions of the Northeast Atlantic Ocean in the months prior to the appearance of *P. physalis* and simulation of the probable drift of Atlantic populations into the Mediterranean basin suggested that the swarms resulted from an unusual combination of meteorological and oceanographic conditions the previous winter, and was not a permanent invasion due to favourable climatic changes (Prieto, et al., 2015).
- Trawls in the coastal areas of the Eastern Mediterranean and Black Sea found up to 1211 items of litter per  $\text{km}^2$ . Plastics were the most abundant (mostly bags and bottles) litter, up to 95% of the total, in all study areas. More than half of marine litter items were of medium size:  $10 \times 10 \text{ cm}$ ,  $<20 \times 20 \text{ cm}$ . The results are presented in a recent report, supporting the Marine Strategy Framework Directive (MSFD) implementation, as well as efforts to discourage plastic carrier bag use (Ioakeimidis et al., 2015).
- A visual census of marine litter on the seafloor of the Saronikos Gulf (Greece) was combined with environmental education in a novel two-day research cruise, in which schoolchildren actively participated in using a Remote Operated Vehicle (ROV). Marine litter proved to be an ideal theme to enhance the environmental awareness of schoolchildren (Ioakeimidis et al., in press).
- The first observation-based acidification trends in the water masses of the Atlantic basin over the past two decades were presented and compared with climate model results. Observations and model output confirm that pH changes in surface layers are dominated by the anthropogenic component. In mode and intermediate waters, the anthropogenic and natural components are of the same order of magnitude and sign (about  $-0.002 \text{ yr}^{-1}$ ). Large changes in the natural component of newly formed mode and intermediate waters are associated with latitudinal shifts of these water masses caused by the Southern Annular Mode in the South Atlantic and by changes in the rates of water mass formation in the North Atlantic (Aida et al., 2015).

#### CARBOCHANGE

- Identifying the magnitude of a trend and the point in time when this signal emerges from the background noise of natural variability is essential for the detection of climate change. Even strong trends, in both the physical climate and carbon cycle system, can be masked by variability over decadal timescales in areas with high natural variability. Because natural variability, unlike the trend, is affected by the seasonal cycle, observational data must be interpreted with caution. Intra-annual variability may obscure the representiveness of irregularly sampled seasonal measurements taken over a year and, thus, the interpretation of any observed trends (Keller et al., 2014).
- Global  $\text{CO}_2$  emissions from fossil-fuel combustion and cement production will increase by  $2.5\%$  ( $1.3\text{--}3.5\%$ ) to  $10.1 \pm 0.6 \text{ GtC}$  in 2014, 65% above 1990 emissions. The cumulative emissions of  $\text{CO}_2$  (from 1870–2014) will reach about  $545 \pm 55 \text{ GtC}$  (Le Quéré et al., 2014).

- It has been argued that controlling only the Earth's temperature (e.g. the 2°C target) may not be sufficient to control the other impacts of climate change. Six target variables (air temperature, sea-level rise, aragonite, primary production levels, soil, and carbon loss) were analysed under different limits using a state-of-the-art cutting-edge Earth system model. The results showed that allowable carbon emissions were considerably reduced, suggesting that mitigation efforts focused solely on a temperature target will not limit the risk arising from human-induced emissions (*Steinacher et al., 2013*).
- By 2100, under the high CO<sub>2</sub> emission scenario RCP8.5, pH reductions exceeding -0.2 (-0.3) units are projected to be about 23% (~15 %) for waters of North Atlantic deep-sea canyons and ~8% (3 %) waters over seamounts, including seamounts proposed as sites for marine protected areas. The spatial pattern of impacts reflects the depth of the pH perturbation and does not scale linearly with atmospheric CO<sub>2</sub> concentration. Impacts may cause negative changes of the same magnitude, or exceeding the current target of 10% of preservation of marine biomes set by the Convention on Biological Diversity, implying that ocean acidification may offset benefits from conservation/management strategies that rely on regulation of resource exploitation (*Gehlen et al., 2014*).

*Too Big To Ignore (TBTI, <http://toobigtoignore.net/>)*

- **To address the marginalization of small-scale fisheries in policy and governance, an Information System (ISSF, <http://issf.toobigtoignore.net/>), containing information such as fishing area, gear type, targeted species and catch fate, has been developed.** As of March 2015, ISSF contained 1,740 records contributed by 400 individuals from 140 countries. This extensive and comprehensive information system makes possible for the first time the development of evidence-based descriptions of the existence and importance of small-scale fisheries around the world (Jentoft and Chuenpagdee, 2015).

## **B. Activities of IMBER Regional Programmes**

### **Ecosystem Studies of Sub-Arctic Seas (ESSAS) Regional Programme**

The ESSAS programme ([www.imr.no/essas](http://www.imr.no/essas)) focuses on the impacts of climate change on sub- Arctic and Arctic marine ecosystems and their sustainability. The recent expansion of ESSAS research interests into the Arctic resulted in modifying the name to Ecosystem Studies of Sub- Arctic and Arctic Seas, which retains the programme acronym. Comparative ecosystem studies are an important part of ESSAS research and this provides a basis for interactions with other IMBER regional programmes.

ESSAS held an annual science meeting (in conjunction with its Science Steering Committee (SSC) meeting) at the University of Washington in Seattle, WA, USA on 15-17 June 2015. The theme of the symposium was “The Role of Ice in the Sea”. Session themes included:

- Humans, Ice and the Sea in the Subarctic and Arctic Past
- The Role of Sea Ice in the Arctic and Subarctic
- Ecological Roles of Glaciers in the Sea
- Socio-economics of Management for Resilience

An ESSAS-related special issue of the journal *Progress in Oceanography* on “Modelling and observational approaches to understanding marine ecosystem dynamics” will be published in 2015. In addition, 11 papers describing results from the Norway-USA Climate Change and Marine Ecosystems Workshop will be submitted to *Elementa: Science of the Anthropocene* before the end of 2015.

RACArctic (Resilience and Adaptive Capacity of Arctic marine systems under changing climate), a joint Japan-USA-Norway activity, was recently awarded 500k Euros from the Belmont Forum to synthesise information from regional studies.

### **Integrating Climate and Ecosystem Dynamics in the Southern Ocean (ICED) Regional Programme**

The ICED programme aims to better understand the climate interactions in the Southern Ocean, the implications for ecosystem dynamics, the impacts on biogeochemical cycles, and the development of sustainable management procedures. See [www.iced.ac.uk/index.htm](http://www.iced.ac.uk/index.htm).

Highlights from ICED science over the past year are described in section B. In addition, ICED scientists provided input for the IPCC AR5 chapter on polar regions. Several studies focused on assessments of changes in Antarctic ecosystems are ongoing. Also, end-to-end models that include carbon are being developed to provide scenario projections. An ICED community paper on scenarios is being developed. ICED will strengthen the science areas as outlined in the new IMBER Science Plan, and will work to establish a strong role for ICED within CCAMLR, SCAR and Future Earth.

ICED has engaged stakeholders through a partnership with the World Wildlife Federation (WWF) to hold a workshop on krill and its fishery. The WWF provided links to fisheries and NGOs. The Marine Stewardship Council certification of the krill fishery also encourages interaction between the various stakeholders.

A joint AnT-ERA / AntClim21 / ICED session on ‘Impact of climate change on Antarctic biota’ was convened at the SCAR Open Science Conference in Auckland, New Zealand on 28 August– 3 September 2014.

Revision of the online fieldwork map tool is underway, and a Southern Ocean wiki, led by the ‘Sentinel’ programme is being developed.

### **Climate Impacts on Oceanic Top Predators (CLIOTOP) Regional Programme**

CLIOTOP aims to organise large-scale comparative efforts to elucidate key processes involved in the impact of both climate variability (at various scales) and fishing on the structure and function of open ocean pelagic ecosystems and their top predator species. The ultimate objective is to develop a reliable predictive capability for the dynamics of top predator populations and oceanic ecosystems combining the effects of fishing and climate.

[www.imber.info/CLIOTOP.html](http://www.imber.info/CLIOTOP.html).

A special issue of *Deep-Sea Research II* (26 papers) was published following the 2<sup>nd</sup> CLIOTOP symposium. Meetings organized by CLIOTOP Working Groups have generated a large amount of scientific results as indicated by the publications listed on the IMBER website at (<http://imber.info/Science/Regional-Programmes/CLIOTOP>). CLIOTOP has been ongoing for almost 10 years, and is now assessing its scientific objectives and structure in terms of the new IMBER SPIS. Currently, CLIOTOP research is done through working groups, several of which will soon be concluded. The CLIOTOP SSC is now discussing a new structure for a proposed CLIOTOP phase III, for the next five years. As a start towards this process, the IMBER SSC at its meeting in June 2015 supported the continuation of CLIOTOP as a regional programme, gave a mandate to modify the programme structure, and recognized the need for flexibility in how limited resources are allocated.

CLIOTOP organised a workshop on “Variability in the movement patterns of marine predator populations: physiological, behavioural and environmental drivers” as part of the Bio-logging 5 Symposium on 22-26 September 2014 in Strasbourg, France.

CLIOTOP also participated in the Euro BASIN workshop on ‘Futures of the North East Atlantic Ocean by 2040 - a Stakeholder Consultative Workshop’ in November 2014.

Several sessions proposed for the ICES/PICES 3<sup>rd</sup> International Symposium on Climate Change Effects on Marine Ecosystems in Santos City, Brazil, March 2015 were initiated by CLIOTOP.

The 3<sup>rd</sup> CLIOTOP Symposium will be held from 14 to 18 September 2015 in San Sebastian, Spain. The title of the symposium is ‘The Future of Oceanic Animals in a Changing Ocean.’

### **Sustained Indian Ocean Biogeochemistry and Ecosystem Research (SIBER) Regional Programme**

SIBER is a basin-wide research initiative sponsored by IMBER and the Indian Ocean GOOS (IOGOOS) Programme, with close ties to CLIVAR’s Indian Ocean Panel (IOP). It focuses on understanding climate change and anthropogenic forcing on biogeochemical cycles and ecosystems in the Indian Ocean, to predict the impacts of climate change, eutrophication and harvesting ([www.imber.info/index.php/Science/Regional-Programmes/SIBER](http://www.imber.info/index.php/Science/Regional-Programmes/SIBER) and [www.incois.gov.in/Incois/siber](http://www.incois.gov.in/Incois/siber)).



SIBER's project office is hosted at INCOIS in Hyderabad, India and recently a regional office (headed by Louis Wicks) was established in Perth, Australia.

SIBER has actively supported the deployment of (new) biogeochemical sensors in the Indian Ocean. SIBER activities in the past year have been in support of the second International Indian Ocean Expedition (IIOE-2), which will be launched at the International Indian Ocean Expedition Symposium in Goa, India, 30 November-4 December 2015. The Symposium will coincide with the 50<sup>th</sup> anniversary of the National Institute of Oceanography in Goa. Data collected on IIOE-2 cruises will be submitted to national repositories, in accordance with the IOC data-sharing policy regulations.

The Eastern Indian Ocean Upwelling Research Initiative (EIOURI) has emerged as a major SIBER activity. This is a 5-year process study under the IIOE-2 in the Eastern Indian Ocean, focusing on upwelling.

SIBER has strong collaborations with various regional organizations (e.g., Indian Ocean Panel of CLIVAR and IOGOOS). A positive result is that this collaboration provides a model for CLIVAR-IMBER collaboration.

### **C. *Activities of IMBER Working Groups and Task Team***

#### **SOLAS-IMBER Carbon (SIC!) Working Group**

IMBER currently has three joint SOLAS-IMBER carbon (SIC!) working groups that consider carbon in the surface ocean systems (SOS), carbon in the interior ocean (IOC) and ocean acidification (SIOA).

##### *Surface Ocean Systems (SIC!-SOS)*

The main goal of this group is the continued development of the Surface Ocean Carbon Atlas (SOCAT).

##### *Interior Ocean Carbon (SIC!-IOC)*

This working group co-ordinates international research on interior ocean changes in carbon and biogeochemistry, undertakes synthesis activities, and aims to develop sustainable observing systems, including the addition of oxygen sensors to the international ARGO float programme (ARGO-O2). Recent activities focused on the analysis of carbon data from hydrographic surveys to determine the change in the ocean's anthropogenic CO<sub>2</sub> content since the 1990s. This analysis is now in the final stages (paper draft completed) and the synthesis project should be completed by early 2016. This group also contributed to the planning of the upcoming joint GO-SHIP/Argo/IOCCP meeting in Galway on the topic of "Sustained ocean observing for the next decade" <http://www.gaic2015.org>, assisted in the development of essential ocean variables (EOV), led by IOCCP (see <http://www.ioccp.org/foo>), and also assisted in the development of global dataset of ocean interior variables (GLODAPv2, led by CarboChange).

##### *SOLAS-IMBER Ocean Acidification (SIOA)*

The SIOA working group coordinates international efforts and synthesis activities for ocean acidification research. Within a single decade ocean acidification has gone from a research area of limited interest to one that is now considered to be a priority for ecology and environmental sciences. This rapid expansion has made it difficult for experts to share information and train new scientists from different countries.

The Ocean Acidification International Coordination Centre (OA-ICC), initiated and mainly driven by the SIOA, is in its final year of funding (2013-2015), and a proposal has been submitted to IAEA in Monaco for three additional years of support. The Centre aims to foster scientific collaboration at the international level, promote best practices, improve observational capacities and databases, and facilitate communication and outreach. The OA-ICC is supervised by a science coordinator (SIOA's current chair). The OA-ICC advisory board includes all SIOA members and is chaired by a SIOA member. The OA-ICC produced several key products that have become fundamental building blocks for the ocean acidification research community and ocean acidification science users, including the OA-ICC web site, [www.iaea.org/ocean-acidification](http://www.iaea.org/ocean-acidification); OA-ICC news stream at [news-oceanacidification-icc.org](http://news-oceanacidification-icc.org); OA-ICC bibliographic database, <http://tinyurl.com/oaicc-biblio>; OA-ICC data compilation at <http://tinyurl.com/oaicc-data> (now including data from almost 600 publications); an SIOA / IOCCP / CARBOCHANGE comparison study of the seven publicly available software packages that compute marine carbonate chemistry was published in *Biogeosciences Discussions*; and the OA-ICC slide set *Things you should know about ocean acidification*, produced

for scientists to facilitate making presentations on ocean acidification to non-scientists [https://www.iaea.org/ocean-acidification/download/Resources/OA\\_slides-generalaudience\\_17feb2013.pdf](https://www.iaea.org/ocean-acidification/download/Resources/OA_slides-generalaudience_17feb2013.pdf).

The 4<sup>th</sup> Ocean in a High-CO<sub>2</sub> World Symposium will be held in Hobart, Australia on 3-6 May 2016. SIOA organised several side events at the IPCC *Our Common Future Under Climate Change* conference in Paris in July 2015, and produced a variety of outreach material.

#### Continental Margins Working Group (CMWG)

The CMWG is co-sponsored by IMBER and Future Earth Coasts (previous LOICZ). As human activities dominate key global processes in the Anthropocene, there is an urgent need to secure sustainability by implementing transformative governance strategies to safeguard Earth's life-support systems for long-term human well-being. Nowhere is this endeavour in greater demand than at the ocean-land interface – the continental margins, which are experiencing pressures from:

- Population growth, development intensification and rising demands for energy-intensive resources;
- Ecosystem degradation and loss;
- Rising CO<sub>2</sub> concentrations, climate change and alteration of marine biogeochemistry and ecosystems; and
- Ecosystem tipping points and rapid and irreversible changes in social-ecological systems and societal responses.

The CMWG published a synthesis paper in *Current Opinion in Environmental Sustainability* that outlines the threats to continental margin systems and potential consequences if mitigation actions are not initiated.

The CMWG is currently being restructured with a new IMBER co-chair (K Limburg) and membership. The CMWG is discussing the focus for this next phase of research. This may be regional, with particular focus on Arctic issues and regional seas. New members will be chosen for their expertise to undertake the work of the CMWG.

#### Data Management Committee (DMC)

The Data Management Cookbook (<http://imber.info/index.php/Science/Working-Groups/Data-Management/Cookbook>) remains an important and significant product of the DMC. Data management workshops have been organised at the IMBIZOs and the OSC. At IMBIZO IV the DMC will provide advice and guidance on all data-related issues. The SSC discussed if a separate committee is still needed for data management. The consensus was that continuation of DMC would be only with a revised focus and mandate (e.g. social science data use), which will require membership with different expertise. It is noted that even managing just a meta-database requires a dedicated data liaison person. Making use of international *in situ* data organizing activities, e.g. “Data kind.org” might be an approach for submitting metadata that identifies IMBER data. A plan for the future is needed if DMC shall continue, however the DMC has earlier recommended: to fully integrate data management activities in all IMBER project-wide events; to ensure that endorsed projects are prepared to comply with IMBER DM policies; and to organise a meeting of data scientists of IMBER-endorsed projects and regional programmes.

#### Capacity Building Task Team (CBTT)

The CBTT objectives are to enhance marine research capabilities in less developed countries, enhance research capabilities globally in relevant IMBER activities, and strengthen graduate education in ocean sciences. The IMBER SSC believes that the CBTT has completed its mandate and will disband this group. Capacity building will continue as it is now included in all regional programmes and working groups, and through activities, such as the summer schools and IMBIZOs.

The CBTT has produced a synthesis document describing the IMBER capacity building activities during the past ten years. It is anticipated that this document will be published later in 2015. This will be the legacy of the CBTT.

#### Human Dimensions Working Group (HDWG)

The HDWG focuses on the interactions between human and ocean systems, and aims to create an integrated and interactive natural-social science marine research community within IMBER. One of its major achievements has been the development of the I(MBER)-ADApT decision support tool (see section B).

I-ADApT has been published and is now being tested using the 23 case studies submitted thus far. The case studies developed as part of the Human-Ocean-Human workshop held at IMBIZO III are being collated into an I-ADApT synthesis book, which affords the ability to include information that is not as quantitative or synthesized to the level that is needed for a peer-reviewed publication. The HDWG wants to ensure that the information underlying the case studies is preserved.

On a longer term the intention is to develop a database of global case studies as an open-access web site to help decision makers, researchers and stakeholders decide how to respond when faced with difficult choices and trade-offs. There is an open invitation and template to supply case studies to the I-ADApT system. Because of the complex interactions and feedbacks between humans and the ocean, the case study template includes questions about the natural, social and governing systems, the stressors that affect them, their response and an appraisal of that response.

#### **IMBER-CLIVAR Upwelling Working Group**

Interest from CLIVAR in biophysical interactions and dynamics in upwelling regions resulted in formation of a joint working group on upwelling. A workshop held at the *Climate Change in the Oceans* conference in Santos, Brazil in March 2015 identified priority research areas for the working group. An Upwelling Workshop will be held at IMBIZO IV and participants will also be asked to suggest research topics that can be pursued in a 3-5 year timeframe. The 10 current working group members represent most of the global upwelling systems.

#### **D. Other IMBER activities**

##### **ClimEco Summer Schools**

IMBER ClimEco Summer Schools are held every two years and are a successful capacity building mechanism for engaging students and early-career scientists. The ClimEco4 Summer School titled, *'Delineating the issues of climate change and impacts to marine ecosystems: Bridging the gap between research, assessment, policy and management'*, was held in early August 2014, at East China Normal University, Shanghai, China. It focused on indicators that inform about the impact of global change on marine ecosystems and the human populations that depend on them, and on how to combine them so that they can be used to inform policy and decision-making. Sixty-four participants from 30 countries were selected from almost 170 applications received. SCOR provided support for two students from developing countries.

Topics covered in lectures included an overview of climate change impacts on marine ecosystems from a biophysical and human perspective, information about indicators, models, analysis, linking indicators to a regulatory or management perspective, and bridging the gap between research and information that is practically useful for management. Practical sessions each afternoon enabled participants to try out the methods and techniques covered in lectures. Several participants provided datasets so groups could select indicators and use them to evaluate the state of a system or species. Students presented their results at the end of the course. The event received excellent reviews from the participants.

Planning is now underway for ClimEco5, which will be held at the University of Rio Grande do Norte in Natal, Brazil in early August 2016. The focus of this summer school will be on *'Towards more resilient oceans: Predicting, managing and mitigating future changes in the ocean and their impacts on human societies'*. Advertising and fund-raising for the summer school will begin in Fall 2015.

##### **IMBIZO IV**

The IMBIZO IV will be held in Trieste, Italy on 26-30 October 2015. The IMBIZO has been expanded to four concurrent workshops and several integration sessions. Funding has been secured from several sponsors, including SCOR, to support students and early career researchers. The planning and preparation for the IMBIZOs is a major effort for the IPO.

##### **Development of the new IMBER Science Plan and Implementation Strategy (SPIS)**

The new SPIS is based on a position paper that was discussed at the IMBER Open Science Conference (OSC) in June 2014. The current version includes a new vision and research goal for IMBER, and is developed around three Grand Challenges (GC) and four Innovation Challenges (IC). Specific research questions relating to the GCs and ICs are intended to provide the basis for implementation of research programs. The SPIS will be submitted to SCOR and

Future Earth (FE) in October 2015 for joint review.

IMBER will maintain its focus on fundamental biogeochemistry and ecosystem research, but will expand to include aspects of sustainable oceans, human well-being, biodiversity conservation, and making science relevant to society. Another issue is to ensure that IMBER science is available in a form that can be used to influence decision-making that will safeguard marine ecosystems and their dependent human societies. Achieving this will require the involvement of a diverse science community that is drawn from a range of different disciplines, including quantitative global change social science, international relations, and ocean geopolitics. IMBER will also engage in activities that enhance integration among and between IMBER's regional programmes, working groups and endorsed projects.

#### **IMBER contributions to IGBP synthesis and celebration at AGU**

IMBER submitted a manuscript to the IGBP synthesis special issue of *Anthropocene*. Minor comments were received from reviewers, which are now being addressed. A revised manuscript will be submitted in late September. It is anticipated that this special issue will be published in late 2015.

A final IGBP celebration event will be held at the Fall Meeting of the American Geophysical Union in San Francisco on 14-18 December 2015. IMBER is co-convening a session at the meeting on 'Observing Open Ocean Biogeochemistry with Profiling Floats', and a session on 'Trajectories of change in the Southern Ocean'.

#### **IMBER and Future Earth (FE)**

At its June 2015 meeting, the IMBER SCC decided to go forward with a request to become a core project of FE. The positive and negative aspects of this transition were discussed by the SSC. The primary negative aspects are the current lack of FE funding for core projects, the apparent lack of marine focus in FE, and the strong FE focus on social science and policy. The lack of focus on the marine environment in the FE provides an opportunity for IMBER to take the lead in developing the ocean part of FE. A transition statement, based on the new SPIS, will be submitted to FE in Fall 2015.

#### **A potential new Integrated Marine Science Network**

Martin Visbeck (Future Ocean, GEOMAR, Kiel, Germany) proposed the establishment of a network of marine-related core projects (IMBER, SOLAS, LOICZ, PAGES, IOCCP, CLIVAR) sponsored by SCOR, WCRP, GOOS and FE, to improve collaboration and communication, and to make marine science a stronger force in FE. In general, IMBER supports this proposal, but has emphasized that this must be a distinct group, not part of FE. The coordination and administration of the network is still under discussion, as well as topics or regions that would be of interest to all the projects.

#### **Status of the International Project Office (IPO, Norway) and the Regional Project Office (RPO, China)**

The IPO will continue to be hosted by the Institute of Marine Research (IMR) in Bergen, Norway until April 2017. In February 2015, Einar Svendsen (oceanographer from IMR) was appointed as Executive Officer of IMBER. In spring 2015, the IPO was relocated within IMR to be closer to the management team of the *Hjort Centre for Marine Ecosystem Dynamics*, sponsored by the Institute of Marine Research, the Nansen Environmental and Remote Sensing Centre, the University of Bergen and Uni Research. This has increased interaction with a broader research community, and allows easy exchange of information on activities and publications.

Discussions with the Norwegian Research Council and the leadership of IMR have been initiated to secure funding for a second 5-year period.

The IMBER Regional Project Office (RPO) was established under a Memorandum of Understanding between IMBER and its host institution, the East China Normal University in Shanghai, China, in 2010. The initial three-year support was renewed for an additional three years (2013-2016). The RPO is essential for engagement of the research community in the Asia-Pacific region. It also provides excellent support and assistance to the IPO.

Dr. Yi Xu replaced Dr. Liuming Hu as the Deputy Executive Officer of the RPO in December 2014. She is the IMBER liaison for the Continental Margins Working Group and submitted a first-stage funding proposal to the Asia-Pacific Network (APN) to hold a CMWG workshop in Shanghai, China in 2016. Securing support for the RPO after 2016 is a priority and the process for doing this needs to be initiated.

### **E. IMBER SSC member nominations**

There are currently 15 IMBER SSC members. New members appointed in early 2015 are Masao Ishii (Japan), Ruben Escribano (Chile), and Svein Sundby (Norway). Four new SSC members will be appointed this year, and one current member (Bundy) will be extended for one year, as was done for some SSC members last year, to even out the distribution of new members.

Rynearson is eligible for appointment for a second term. In February 2015, IMBER solicited the research community for nominations for their replacements with the following expertise, identified by the IMBER Executive Committee:

- physical-biological interactions, and ecosystem functioning and dynamics
- fisheries as related to (sustainable) ecosystem-based management
- food web dynamics and diversity, and top predator interactions
- integrated studies of social, ecological and biogeochemical marine systems
- economics of marine resources

Twenty-five nominations were received. The Executive Committee ranked the nominations, and a short-list of eight nominees was tabled for discussion at the SSC meeting. It was recommended that in addition to expertise, fund raising and networking skills are also important. The agreed-upon nominees were put forward to SCOR and IGBP for approval.

Eileen Hofmann will end her term as Chair at the end of 2015. There was no call for nominations with regard to the Chair. Rather, the Executive Committee identified individuals who are/have been involved with IMBER. The Executive Committee suggested Carol Robinson (University of East Anglia, UK and former IMBER SSC member) as a possible candidate for Chair. Hofmann contacted Robinson and she agreed to be nominated. Hofmann will remain as *ex officio* Past Chair for one year.

### **F. IMBER cooperation**

IMBER has been closely collaborating for many years with SOLAS (see SIC!) and LOICZ (see CMWG) and recently with CLIVAR, and with projects and other organizations.

#### *a. Too Big To Ignore (TBTI)*

IMBER is a partner of the TBTI project. TBTI has reached its midpoint and now includes over 200 scientists from 45 countries. TBTI is conducting a global analysis, based on information systems, to better understand small-scale fisheries (SSF). IMBER information that might relate to SSF can be added at <http://issf.toobigtoignore.net>, and this can be used for case studies for I-ADApT. There will be collaboration at IMBIZO IV. It is suggested that a transdisciplinary cluster might provide topics for the ClimEco5 summer school.

#### *b. Ocean Carbon Biogeochemistry (OCB)*

OCB continues to actively support IMBER by advertising its activities and events, and by providing financial support for activities. This year OCB is providing travel support for five participants from the USA to attend IMBIZO IV. There are plans to hold a half-day session on IMBER science at the 2016 OCB summer workshop.

#### *c. GEOTRACES*

Deals with biogeochemical cycles and large scale distribution of trace elements and isotopes, featuring a worldwide set of sampling transects across ocean basins.

#### *d. WCRP*

CLIVAR, a core project of WCRP and its Indian Ocean panel work closely with SIBER. CLIVAR will hold an OSC on 19-23 September 2016 in Qingdao, China and several IMBER-related sessions will be convened as this conference. IMBER and CLIVAR are forming a Joint Upwelling WG.

#### *e. GOOS/Copernicus*

SIBER has strong connections with IO-GOOS, and IMR is involved with EURO-GOOS through Copernicus (European Programme to establish European capacity for Earth Observation). GOOS uses a system of global and

regional models of different parts of the world ocean, which consider primarily ocean physics but with some primary production included. Increased alignment with GOOS will help IMBER deal with the challenge of ocean data.

*f. ICES*

ICES science issues are similar to those considered by IMBER, but are limited to the North Atlantic and adjacent seas, and more increasingly into the Arctic. In addition to the science, ICES gives environmental and fisheries advice to member countries, which is turning into ecosystem-based management advice. The IMBER IPO will have an information booth at the ICES Annual Science Conference in Copenhagen, Denmark in September 2015

*g. IOC*

IOC activities and focus are consistent with those of IMBER. However, implementation of activities differs. IOC is advanced in observations and tsunami warnings and designed the essential ocean variables. The IMBER IPO was represented at the last IOC assembly and used this opportunity to explore funding opportunities. IOC agreed to support two participants from developing countries to attend the Upwelling workshop at IMBIZO IV and to support participants for the CLIOTOP Symposium.

*h. Hjord Centre*

The Hjord Centre on Ecosystem Dynamics is co-located with IMBER at IMR. There are many overlaps and strong collaboration is developing.

*i. PICES*

IMBER and PICES have a long-term successful collaboration and partnership. This has ensured that representatives from both communities are able to attend project activities, such as summer schools and science meetings.

*j. CARBOCHANGE*

This is an IMBER-endorsed project that ended in 2015. Results are given in Section B.

**G. Selected IMBER Publications**

IMBER-related activities have produced more than 1,000 refereed research papers since its implementation; about 150 papers were published in 2014-2015.

**Publications related to recent discoveries and highlights**

- Akoglu, E., et al. 2014. An indicator-based evaluation of Black Sea food web dynamics during 1960– 2000. *Journal of Marine Systems* 134, 113–125. <http://dx.doi.org/10.1016/j.jmarsys.2014.02.010>
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## Communication and Outreach

IMBER's main communication tool is the project website ([www.imber.info](http://www.imber.info)), which has an average of about 250 visitors each day. A new IMBER website is being developed that will be hosted at IMR. Software changes by the internet service provider in France were such that the existing IMBER website could no longer be supported. This transition has caused disruptions in availability of the IMBER website. Once the new site at IMR is launched, it will have a new, more regularly updated, news section, and the community will be encouraged to regularly send news items or articles to be featured on the website. The new IMBER website will also be accessible from a range of devices such as mobile phones and iPads.

The *IMBER Update Newsletter*, [www.imber.info/index.php/News/Newsletters](http://www.imber.info/index.php/News/Newsletters), is emailed to ~2000 scientists three times each year, and re-directed through multiple channels to about 10,000 researchers:

- **Issue n°28** - June 2015, included articles about a new ESSAS Arctic project, Canadian research in the North, a generic concept for the vertical behaviour of fish eggs in the world oceans, observing changes in the surface ocean carbon, and a world-wide evaluation of the use of ecosystem drivers of stock production in tactical fisheries management.
- **Issue n°27** - September 2014, included articles about science highlights from the IMBER Future Oceans Open Science Conference in Bergen. This included the following:
  - Predicting Fish from Physics: Strengths, weaknesses and ways forward;
  - Mesopelagic fishes in the California Current: ecosystem role, climate change impacts and the need for global observations of marine fish populations;
  - From watching to acting: adaptation in marine systems;
  - *Trichodesmium* Growth Rates: Modelling the Fundamental Niche;
  - *Phaeocystis pouchetii* bloom from the perspective of heterotrophic bacteria;
  - Should we shift towards collaborative management? Case study of the Asturian (northern Spain) gooseneck barnacle fishery;
  - Time of emergence of trends in ocean biogeochemistry;
  - Recent climatic changes enhance ongoing ocean acidification in the California Current System;
  - Diving depth of elephant seals influences mercury bioaccumulation in the north Pacific.

Other IMBER-related activities that were included featured GLODAPv2, a new and updated global ocean carbon data product, and The 2014 Community Event of the Surface Ocean CO<sub>2</sub> Atlas.

An electronic IMBER *eNews Bulletin* is published monthly, which provides information about IMBER and IMBER-relevant activities and events. Calls for funding proposals, job opportunities, workshop and conference announcements are also included.

The IMBER contact database is continuously updated with information for about 2,300 marine researchers. Finally, the IPO and RPO staff and several IMBER researchers have presented more than a dozen IMBER poster and oral presentations at many national and international meetings.

### ***H. Support from SCOR***

IMBER greatly appreciates the ongoing support received from SCOR, and the additional support for specific IMBER activities provided or managed by SCOR from other funding sources. In addition, IMBER welcomes the advice, assistance and information received from the SCOR President and secretariat, especially its Executive Director, Ed Urban, and Financial Officer, Liz Gross.

### **Funding request**

We are requesting funding to support students and researchers from developing countries to attend the ClimEco5 summer school that will be held at the University of Rio Grande, Natal, Brazil in early August 2016.

Amount requested: 7,500 USD

### ***I. Strategic development***

IMBER is in the last year of its initial 10-year science plan. The IMBER science community has clearly indicated a desire for the project to continue. The enthusiasm and support shown at the June 2014 OSC indicated that there is a

strong community of researchers engaged in IMBER science. The new Science Plan and Implementation Strategy will provide guidance for marine research for the next phase of IMBER.

At the same time, the organizational structure for international global environmental change research is changing. The IGBP, which co-sponsors IMBER with SCOR, will end in December 2015 and the core projects currently sponsored by the IGBP have been invited to become core projects under Future Earth.

IMBER has a history of connecting natural and social sciences and promoting integration across disciplines and communities. Many of IMBER's coordination and networking activities match the integrated approaches desired by FE. As a result, IMBER is well placed to take the lead in developing marine-focused efforts under FE. The transition to a combined SCOR-FE core project should not require modifications to IMBER science goals or implementation strategy.

As with SCOR, the new SPIS will form the basis for a request to FE to incorporate IMBER as core project. The request will include a description of what IMBER can bring to FE in terms of science and as an international network of researchers. The request will also include what IMBER expects from FE, such as support for SSC meetings and integrated activities, funding at the same level as provided by SCOR, and specific assistance with fund raising, outreach, communication and engagement of stakeholders. It is anticipated that the formal IMBER request to FE will be made in Fall 2015.

#### *K. Budget*

The SCOR omnibus grant from the National Science Foundation, which provides support for IMBER, was recently renewed for three years. NASA agreed to provide a one-year supplemental funding to the existing grant that supports activities of the HDWG, ESSAS and the SIOA. A three-year proposal to support NASA-relevant research in IMBER will be submitted in 2016. The limited funding available for IMBER activities has necessitated a reduction in the support provided to IMBER working groups and regional programmes.