



# SIBER



## Sustained Indian Ocean Biogeochemistry and Ecosystem Research

### A New Basin-wide, International Program in the Indian Ocean

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#### Introduction to SIBER

Although there have been significant advances in our ability to describe and model the oceanic environment, our understanding of the physical, biogeochemical and ecological dynamics of the Indian Ocean is still rudimentary in many respects. This is partly due to the fact that the Indian Ocean remains substantially under-sampled in both space and time, especially compared to the Atlantic and Pacific Oceans. The situation is compounded by the Indian Ocean being a dynamically complex and highly variable system under monsoonal influence. The biogeochemical and ecological impacts of this complex physical forcing are not yet fully understood (Hood et al. 2008, Hood et al. 2009).

The Indian Ocean is also warming rapidly (Alory et al. 2007, Alory & Meyers 2009), but the impacts of this warming on the biota, carbon uptake, and nitrogen cycling have not been quantified. The increasing population density and rapid economic

growth of many of the countries surrounding the Indian Ocean make the coastal environments particularly vulnerable to anthropogenic influences. Warming and anthropogenic effects are also impacting valuable fish species. These influences and their socioeconomic impacts need to be quantified. Understanding the processes that drive biogeochemical and ecological responses to anthropogenic effects is necessary to provide a sound basis for the sustainable management of this globally important ocean. An understanding of these processes is also necessary to predict the impacts and feedbacks of the Indian Ocean as part of the Earth System.

The Sustained Indian Ocean Biogeochemistry and Ecosystem Research (SIBER) program is an emerging basin-wide research initiative sponsored jointly by the Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) program and Indian Ocean GOOS (IOGOOS) with close ties to CLI-

VAR's Indian Ocean Panel (IOP). The long-term goal of SIBER is to understand the role of the Indian Ocean in global biogeochemical cycles and the interaction between these cycles and marine ecosystem dynamics. This understanding will be required in order to predict the impacts of climate change, eutrophication, and harvesting on the global oceans and the Earth System, and it is fundamental to policy makers in the development of management strategies for the Indian Ocean. To address this goal, emphasis will be given to the analysis required to predict and evaluate the impacts of physical and anthropogenic forcing on biogeochemical cycles and ecosystem dynamics in the Indian Ocean.

SIBER has been motivated by the deployment of new coastal and open-ocean observing systems in the Indian Ocean that have created new opportunities for carrying out biogeochemical and ecological research. The IOP is coordinating the deployment of a basin-wide observ-

ing system in the Indian Ocean (the Indian Ocean Observing System, IndOOS, which includes the Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction, RAMA) (International CLIVAR Project Office 2006, McPhaden et al. 2009). Although there are significant challenges, deployment of an array of more 30 buoys is planned in the open ocean between 20° N and 20° S spanning the entire basin. These deployments, which are already well underway, are accompanied by Argo floats and a variety of physical oceanographic survey and mooring support cruises. In addition, several nations in the Indian Ocean are deploying coastal observing systems. All of these programs provide a unique opportunity for staging international, interdisciplinary research. SIBER will leverage these sampling and monitoring activities and it will provide the basin-wide scientific coordination and communication required to predict Indian Ocean biogeochemical cycles and ecosystem dynamics in the context of climate change and other anthropogenic influences.

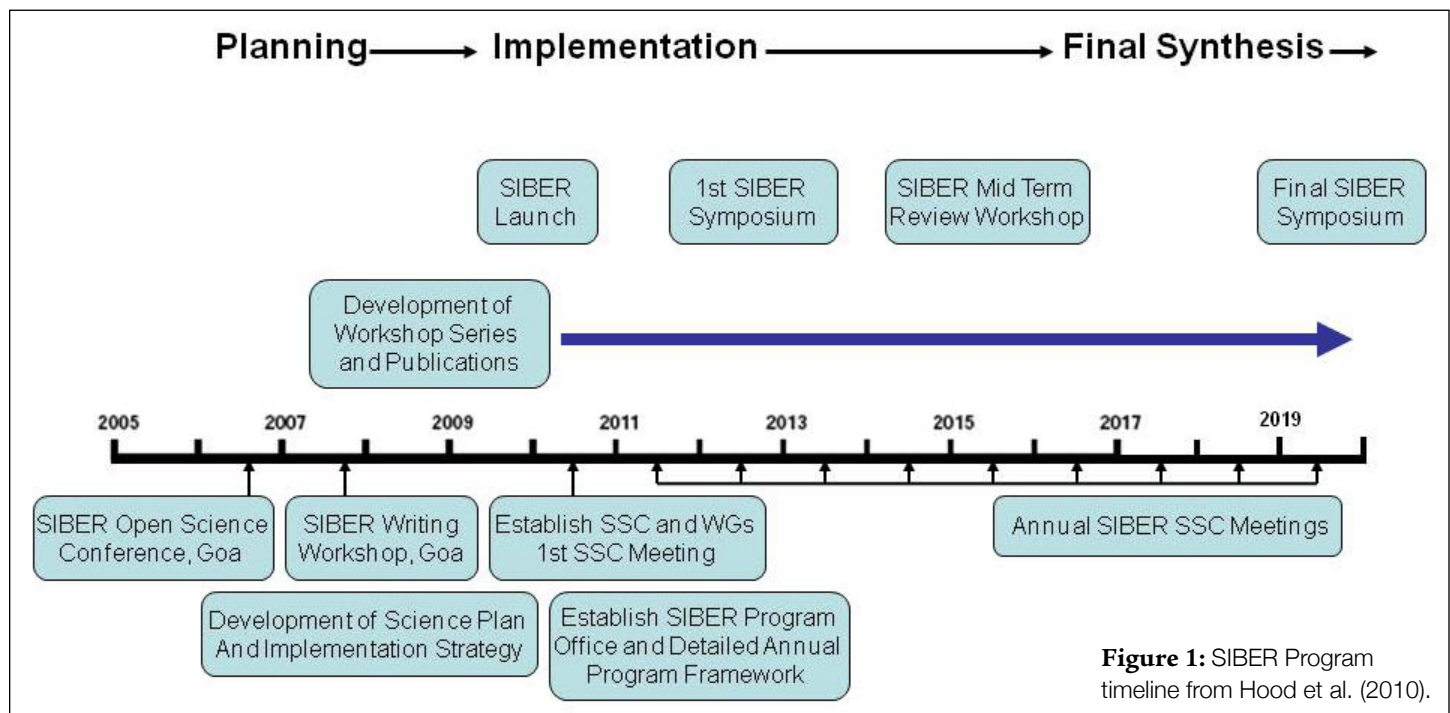
The SIBER Program reflects the importance placed on these issues by the International Geosphere-Biosphere Program (IGBP), the Scientific Committee on Oceanic Research (SCOR) and the Global Earth Observing System of Systems (GEOSS). SIBER, which has been developed with the guidance and endorsement of the IMBER and IOGOOS Programs, is ambitious and very broad. It is basin-wide, encompasses biogeochemical research from the continental margins to the deep sea and tropic levels ranging from phytoplankton to top predators including fish and humans. SIBER is intended to provide scientific guidance and potential research foci to accommodate the broad (and often regional) interests of many countries that are interested in pursuing research in the Indian Ocean. For more information on SIBER see <http://www.imber.info/siber.html>.

## Recent developments

The draft SIBER Science Plan and Implementation strategy was submitted to IMBER and IOGOOS in January 2010 (Hood et al. 2010).

Following peer review, the plan has been given preliminary approval by the IMBER and IOGOOS steering committees, and is now undergoing final editing and revision. The draft plan is available upon request from the first author. Additional comments and input are encouraged and welcome. The final plan is slated for publication in late Fall 2010. The first national SIBER program was recently established in India with funding provided by India's Ministry of Earth Sciences (MoES). Proposals that have been submitted and reviewed include 6 open ocean and 8 coastal/estuarine projects in the northern Indian Ocean.

The timeline for SIBER meetings and symposia that have been convened to date and that are planned for the future are detailed in Figure 1. SIBER convened its first official Scientific Steering Committee (SSC\*) meeting (SIBER-1) July 12-15, 2010 in Perth, Australia in a joint meeting with IOGOOS, IOP, and the newly formed Indian Ocean Resources Forum (IRF). This joint meeting brought together leaders in the Indian Ocean research community



**Figure 1:** SIBER Program timeline from Hood et al. (2010).

from many Indian Ocean rim nations and from all over the world. The goal of this meeting was to coordinate and facilitate international research efforts in the Indian Ocean.

For SIBER, the major accomplishments and action items from this meeting include:

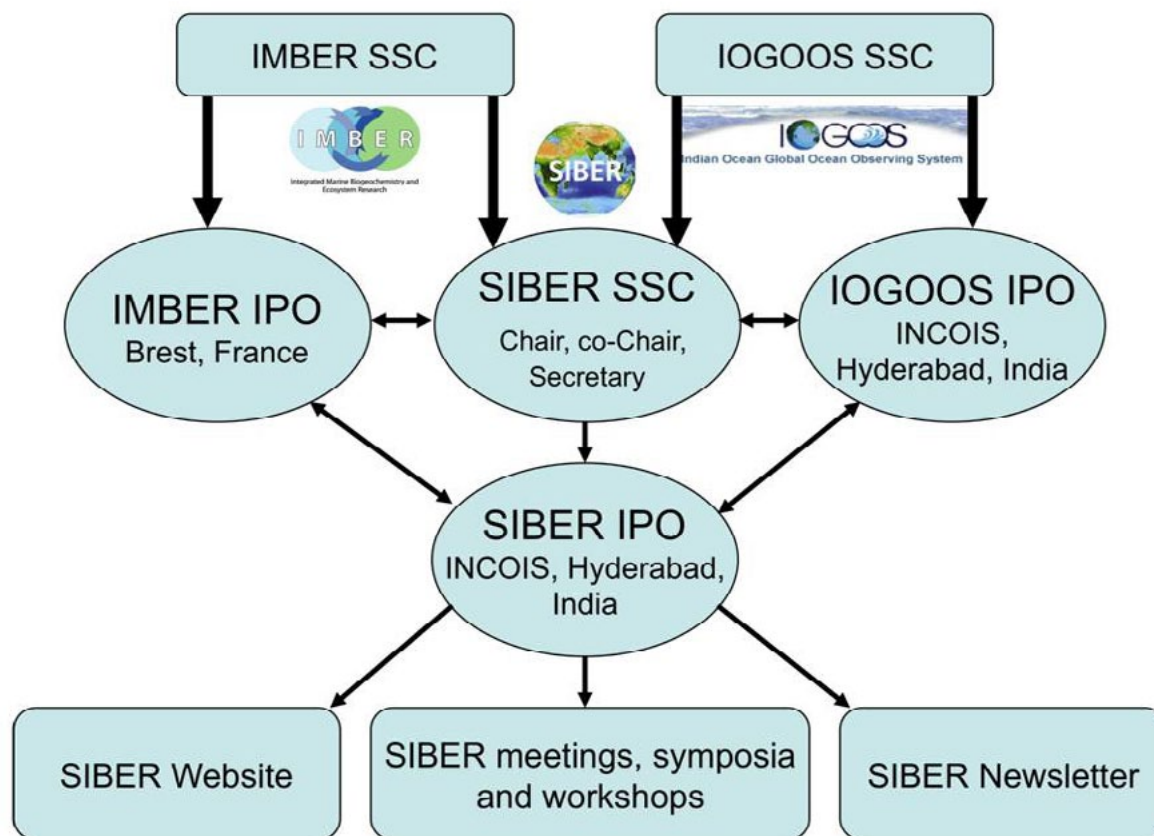
- Election of officers and establishment of a time frame for SSC member rotations.
- Addition of four new SSC members\*\* recommended by the IMBER and IOGOOS steering committees.
- Review of scientific work, plans and priorities of countries doing biogeochemical and ecological research in the Indian Ocean.
- Development of a strategy for tying SIBER into global carbon cycle research programs.

- Establishment of working groups dedicated to promoting SIBER in the EU, USA, Australia, Africa, Oman/Kuwait/Pakistan, Indonesia/Thailand and Japan/China.
- Establishment of working groups dedicated to updating the SIBER Science Plan scientific themes and questions to ensure that SIBER will continue to focus on the most important scientific questions in the Indian Ocean in the coming years.
- Development of plans to convene a joint SIBER/IOP workshop on biogeochemical sensor requirements for deployment on moorings and Argo floats.

Perhaps the most significant achievement of this meeting was the identification of resources for establishing a SIBER International Project

office (IPO). The Secretary of India's Ministry of Earth Sciences (Dr. Shailesh Nayak) and the Director of the Indian National Centre for Ocean Information Services in Hyderabad (INCOIS, Dr. Satheesh Sheno) have invited the SIBER SSC to develop a proposal for submission to MoES/INCOIS for the establishment of a SIBER IPO in Hyderabad, India. The SIBER SSC is in the process of developing this proposal that will provide specifications and resource needs to establish the IPO. A schematic diagram illustrating the relationships between the proposed SIBER IPO and the IMBER and IOGOOS IPOs, along with oversight and responsibilities, is shown in Figure 2.

\*This meeting was attended by Interim SSC members: Raleigh Hood (USA), Wajih Naqvi (India), Jerry Wiggert (USA), Catherine Goyet (France),



**Figure 2:** A schematic diagram illustrating the relationships between the proposed SIBER IPO and the IMBER and IOGOOS IPOs along with oversight and responsibilities.

Richard Matear (for Lynnath Beckley, Australia), Greg Cowie (UK), Dwi Susanto (USA/Indonesia), Adnan Al-Azri (Oman), Hiroshi Kitazato (Japan), and Tim Rixen (Germany). Interim SSC members Mike Landry (USA) and David Vousden (South Africa) were unable to attend.

\*\*New SSC members: M. Ravi-chandran (India), Mitrasen Bhikajee (Mauritius), Shiham Adam (Maldives) and Somkiat Khokiattiwong (Thailand).

## Legacy

The coordination and integration of Indian Ocean biogeochemical and ecosystem research through SIBER will advance our knowledge of this under-sampled basin and provide a major contribution to the understanding of how regional and global change may impact biogeochemical cycles and ecosystem function, not only in the Indian Ocean, but in the Earth System, creating a lasting legacy upon which future research can be built. The scientific findings will inform scientists in the international community and provide a focus for future research on important regional, basin-wide, and global issues. These findings will also provide policy makers with the sound scientific basis upon which to make decisions on the management of Indian Ocean ecosystems. SIBER will leverage and strengthen GOOS and IMBER by promoting coordinated international, multidisciplinary research in developed countries, and also human resources and infrastructure development in many developing Indian Ocean rim countries.

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