The 2nd International Indian Ocean Expedition (IIOE-2): Motivating New Exploration in a Poorly Understood Basin

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Overview

The Indian Ocean remains one of the most poorly sampled and overlooked regions of the world ocean. Today, more than 25% of the world's population lives in the Indian Ocean region and the population of most Indian Ocean rim nations is increasing rapidly. These increases in population are giving rise to multiple stressors in both coastal and open ocean environments. Combined with warming and acidification due to global climate change, these regional stressors are resulting in loss of biodiversity in the Indian Ocean and also changes in the phenology and biogeography of many species. These pressures have given rise to an urgent need to understand and predict changes in the Indian Ocean, but the measurements that are needed to do this are still lacking. In response, SCOR, IOC, and IOGOOS have stimulated a second International Indian Ocean Expedition (IIOE-2). An international Science Plan and an Implementation Strategy for IIOE-2 have been developed, the formulation of national plans is well underway in several countries, and new research initiatives are being motivated. An Early-Career Scientist Network for Indian Ocean Research has self-organized to support the Expedition. The success of IIOE-2 will be gauged not just by how much it advances our understanding of the complex and dynamic Indian Ocean system, but also by how it contributes to sustainable development of marine resources, environmental stewardship, ocean and climate forecasting, and training of the next generation of ocean scientists. We encourage ASLO members to get involved.

IIOE and the Dawn of Modern Indian Oceanography

The Scientific Committee on Ocean Research (SCOR) and the Intergovernmental Oceanographic Commission (IOC) identified more than 50 yr ago that the Indian Ocean was one of the least studied ocean basins. To address this gap in knowledge, SCOR and IOC motivated one of the greatest oceanographic expeditions of all time, the International Indian Ocean Expedition (IIOE). The IIOE was a 6-yr endeavor (1960–1965) that stimulated new activities by about a dozen nations, in which all areas of oceanography and meteorology were studied across the basin (Fig. 1).

At the first meeting of the Special Committee on Oceanic Research (renamed "Scientific Committee on Oceanic Research" some years later) in 1957, participants recognized that the International Geophysical Year (then in progress) was showing the benefits of an intensive multinational focus on geoscience for a limited time period. At the same time, SCOR meeting participants identified that the Indian Ocean, largely because of its remoteness from most major oceanographic institutions, had not been much studied and would benefit most from a concerted international research effort (Deacon 1957). In addition to the fundamental knowledge in science that could be gained, it was recognized that human societies in the region would benefit from a better understanding of how the annual monsoon cycle worked and how it affected Indian Ocean fisheries and weather in the region.

Planning for the IIOE began in 1957 and the project officially continued through 1965,

FIG. 1. Top Left: Logo and field instrument case from the IIOE (courtesy of MBLWHOI library). Top right: Map of the Indian Ocean showing the cruise tracks of research vessels during the International Indian Ocean Expedition (from Behrman 1981). Bottom: Three oceanographic research vessels that participated in the IIOE, from Germany (Meteor II, left), the United States (Atlantis II, middle, Photo by Jan Hahn©Woods Hole Oceanographic Institution) and the UK (Discovery, right, from http://www.oceanswormley.org/index.html).

with 46 research vessels participating under 14 different national flags (e.g., Fig. 1). The IIOE project office, located in New York City from 1959 through mid-1962, was funded by NSF through the U.S. National Academy of Sciences (NAS) and was overseen by the NAS Committee on Oceanography (one of the predecessors of the current Ocean Studies Board of the National Research Council). IIOE became the first project of the IOC, which assumed management responsibilities for the project in mid-1962. Berhman (1981) provides a good summary of the outcomes of the IIOE.

The IIOE provided much of the scientific foundation for our modern understanding of the Indian Ocean. Six hundred fifty-six peer-reviewed publications are recorded in the 8-volume compilation of peer-reviewed publications from the IIOE (see http://scor-int.org/IIOE-1/Reprints.htm). Besides the creation of peer-reviewed research papers, atlases, and various books (e.g., Zeitzchel 1971) were produced to document the outcomes of the project. The IIOE led to the publication of the first oceanographic atlas of the basin (Wyrtki et al. 1971) and a detailed map of the Indian Ocean bathymetry (Heezen and Tharp 1966). It also revealed the existence of a transient equatorial undercurrent in the Indian Ocean analogous to the permanent undercurrents in the Atlantic and Pacific Oceans (Knauss and Taft 1964), and it contributed to the realization that old, grid-like traverses of the ocean need to be complimented with phenomena-based experiment design (Stommel 1963).

The planners of the IIOE recognized the importance of standardization and intercalibration: an Indian Ocean Standard Net (IOSN) was adopted for plankton hauls (Currie 1963) and intercalibration exercises were carried out for biological and chemical parameters (see http://scor-int.org/IIOE-1/Intercalibration.htm). The Indian Ocean Biological Centre was established at Cochin, India to process the biological samples collected with the IOSN. The United States invested substantial resources in studying the biology of the Indian Ocean. In addition to collecting samples with the IOSN from U.S. vessels, the United States formed the U.S. Program for Biology during the IIOE, which was mostly carried out by the *Anton Bruun* (see http://scor-int.org/IIOE-1/Cruise_Reports.htm for cruise reports and http://scilib.ucsd.edu/sio/archives/collections/moving/caljsioa_mov0050278.mp4 for a film about the work of the *Anton Bruun*). In addition, Stanford University sent the *Te Vega* with a scientific crew of graduate students to study the deep scattering layers of the Indian Ocean (Pearse et al. 2016). Finally, marine biology was the focus of the two land-based camps that were part of the IIOE, at Nosy Bé in Madagascar and Mandapam Camp in India.

Subsequent research over the last 50 yr that has built on work of the IIOE include, for example, the Indian Ocean Experiment (INDEX 1979), which investigated the physical response of the Somali Current in the Arabian Sea to the summer monsoon, and the Deep Sea Drilling Project (1968–1983), which crossed the entire Indian Ocean to collect information on mineral resources of the continental shelves and the deep ocean floor. The next cycle of coordinated investigations began with India's National Institute of Oceanography studies of the dynamics of the northern Indian Ocean coastal currents (1987–1994, supported by India's Council for Scientific and Industrial Research), which overlapped with the Netherlands Indian Ocean Program (NIOP, 1992–1993). The NIOP formed part of the international Joint Global Ocean Flux Study (JGOFS) Arabian Sea Expedition (See Deep-Sea Research II, volumes 45–49). These investigations during the 1990s focused on the biogeochemical dynamics of the central and eastern Arabian Sea and also included paleoceanographic research. At the same time, the World Ocean Circulation Experiment (WOCE; Siedler et al. 2001) had a much wider geographical coverage, with zonal and meridional sections criss-crossing the entire Indian Ocean basin. The Tropical Ocean-Global Atmosphere (TOGA) program, spanning 1985–1994, established the rudiments of a sustained ocean observing system for climate in the Indian Ocean (McPhaden et al. 1998) and together with WOCE, laid the groundwork for the ongoing International Climate and Ocean: Variability, Predictability and Change (CLIVAR) program that began in 1998 (http://www.clivar.org).

Scientific Advances of the 21st Century and Challenges in the Indian Ocean

Ocean science has changed in many ways since the completion of the IIOE. The first satellite (Sputnik) was launched the same year that SCOR began developing the idea of the IIOE. Today, a broad suite of oceanographic and meteorological sensors are deployed on Earth-observing satellites to observe ocean color, sea surface temperature, salinity, height, and wind. These satellite observations have dramatically improved the characterization of the physical and biological variability of the ocean surface, and the atmospheric forcing of that variability. In addition to observations from space, a global ocean observing system has been deployed. Especially important components in the Indian Ocean have been Argo floats, repeat hydrography (currently through GO-SHIP; http://www.go-ship.org/), and the Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction (RAMA, Fig. 2), and the tsunami detection network. Ocean modeling and improvements in computing and communication technology have made it possible to analyze and share data quickly and use it for predictions from seasonal to decadal time scales. The new measurement technologies and the field programs and observing systems using this technology provide the capacity for a much more integrated picture of the Indian Ocean variability. We can now study how the ocean changes across a wide range of space and time scales, and how these fluctuations are coupled to the atmosphere.

However, despite all these advances, the Indian Ocean remains one of the most poorly sampled and overlooked regions of the world ocean, with significant gaps in the observing system for this basin. As a result, many important scientific questions have not been answered (see IIOE-2 Science below). In addition, many pressing questions have emerged since the IIOE that are societally relevant. Today, more than 25% of the world's population lives in the Indian Ocean region (Alexander et al. 2012) and the population of most Indian Ocean rim nations is increasing rapidly. These increases in population are giving rise to multiple stressors in both coastal and open ocean environments, which include eutrophication, depletion of fresh groundwater, deoxygenation, atmospheric and plastic pollution, and overfishing. Combined with warming and acidification due to global climate change, these regional stressors are resulting in loss of biodiversity in the Indian Ocean and also changes in the phenology and biogeography of many species.

In addition, the impacts of climate change are a growing concern in the Indian Ocean. Rising sea level threatens to inundate the world's most heavily populated, low-lying areas in the Bay of Bengal (Fig. 3). The very existence of some island nations and coastal deltas is threatened in the Indian Ocean. The severity of extreme events in the Indian Ocean is projected to increase, which

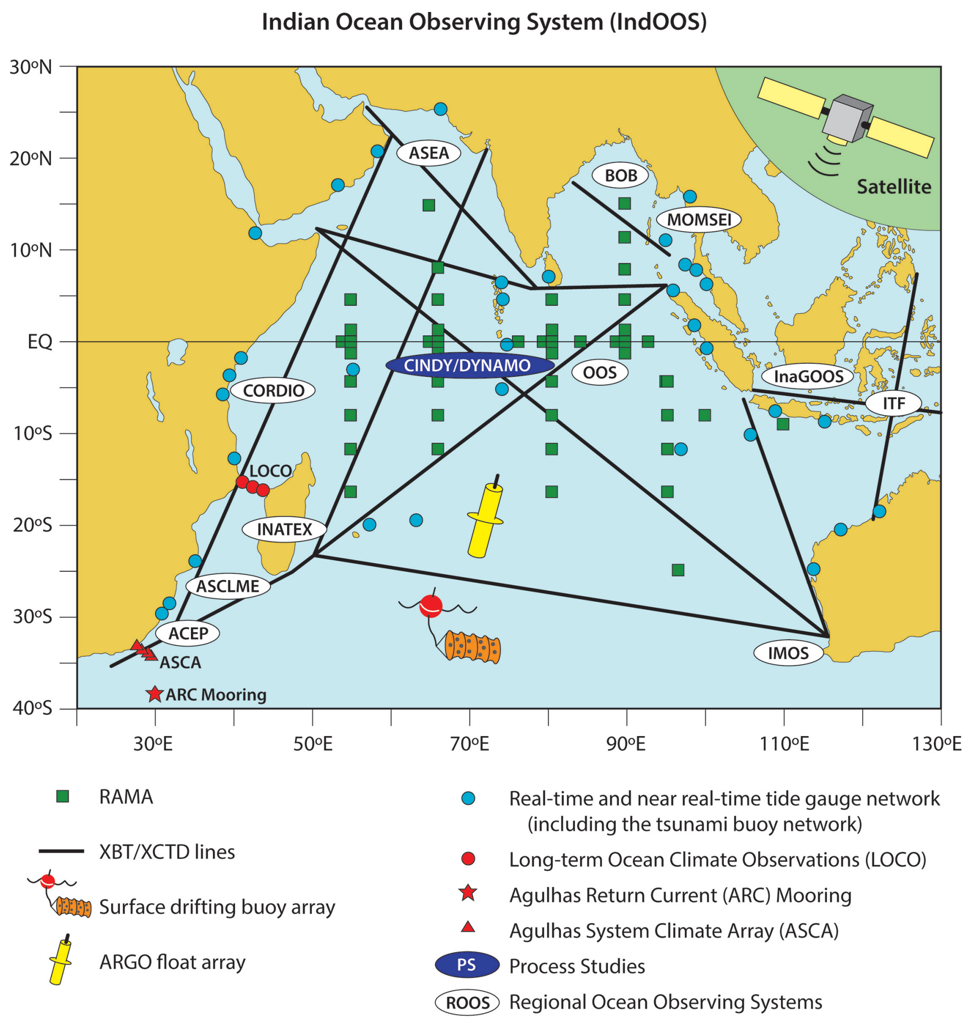

FIG. 2. The integrated observing system, with basin-scale observations by moorings, Argo floats, XBT lines, surfacedrifters and tide-gauges; as well as boundary arrays to observe boundary currents off Africa, in the Arabian Sea (ASEA) and Bay of Bengal (BOB), the Indonesian Throughflow (ITF), off Australia and deep equatorial currents. Also included are past and ongoing research programs like the Monsoon Onset Monitoring and Its Social & Ecosystem Impacts (MOMSEI) program and the Cooperative Indian Ocean Experiment on Intraseasonal Variability (CINDY/DYNAMO); as well as long term regional programs and observing systems such as the Indonesian GOOS (InaGOOS), Australia's Integrated Marine Observing System (IMOS), the Coastal Oceans Research and Development – Indian Ocean (CORDIO) program, the Indian-Atlantic Exchange in present and past climate (INATEX) program, the Agulhas Somali Current Large Marine Ecosystem (ASCLME) program, the Bay of Bengal Large Marine Ecosystem (BOBLME) program (not shown) and the African Coelacanth Ecosystem Program (ACEP). Figure provided by Yukio Matsumoto, Univ. of Tokyo.

includes increases in droughts and flooding, and the intensity of tropical cyclones and their associated rainfall. These projections, along with the high exposure and vulnerability of many populations, suggest that negative human impacts from extreme events will dramatically increase for nations in and around the Indian Ocean in the coming decades.

There are also increasing concerns about food security and fisheries, and direct anthropogenic impacts on Indian Ocean coastal environments. Of particular concern is the declining state of both artisanal and industrial fisheries in Indian Ocean rim nations, which represent some of the world's least developed countries where inhabitants are dependent on fisheries for food and employment. Direct anthropogenic impacts on coastal environments, which include coastal erosion, loss of mangroves, and degradation of coral reefs, have led to a pressing need for ecosystem preservation in the Indian Ocean to protect both fisheries and tourism.

These increased human-environmental pressures and global climate change have given rise to an urgent need to understand and predict changes in the Indian Ocean, but the measurements that are needed to do this are

BANGLEDESH POPULATION DENSITY AND LOW ELEVATION COASTAL ZONES

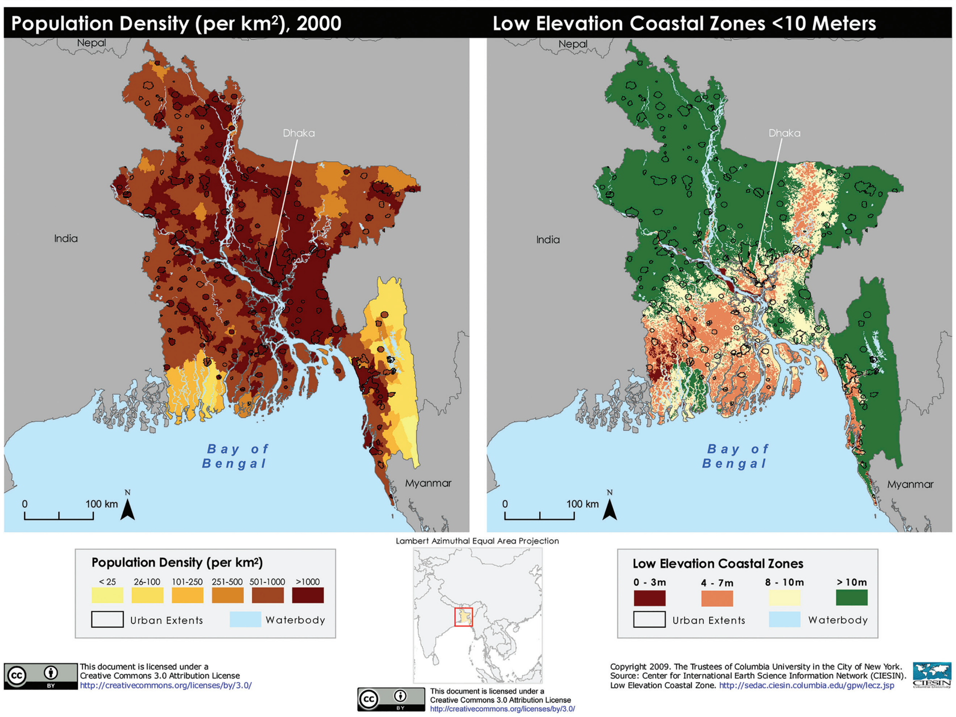

FIG. 3. (top) Flooded villages and fields around a river in Bangladesh the day after the 1991 Bangladesh cyclone had struck the country. Image from the Defense Visual Information Center, ID number DFST9206136 (Author: Staff Sergeant Val Gempis (USAF), https://commons.wikimedia.org/wiki File:Flooding_after_1991_cyclone.jpg (Bottom) Bangladesh: Population Density and Low Elevation Coastal Zones, created by McGranahan, G., Balk, D. and Anderson, B. This work is licensed to the public under the Creative Commons Attribution 2.5 License. https://www.flickr.com/photos/54545503@N04/5457306385

still lacking. Hence, there is a need for a second International Indian Ocean Expedition.

In response, SCOR, IOC and the Indian Ocean Global Ocean Observing System (IOGOOS) have stimulated a new phase of coordinated international research focused on the Indian Ocean for a 5-yr period that began in late 2015 and will continue through 2020 and perhaps beyond. The goal is to organize ongoing research and stimulate new initiatives as part of a larger expedition in this time frame. International programs that have ongoing or planned research in the Indian Ocean during this time include the Sustained Indian Ocean Biogeochemistry and Ecosystem Research (SIBER) program of the Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) project, the CLIVAR project, the Indian Ocean component of the Global Ocean Observing System (IOGOOS), GEOTRACES (a global survey of trace elements and isotopes in the ocean), the Global Ocean Ship-Based Hydrographic Investigations Program (GO-SHIP), the International Ocean Discovery Program (IODP), and others. Many countries, including Australia, China, Germany, India, Indonesia, Japan, Norway, the United Kingdom, and the United States, are planning cruises and other activities in this time frame, and new regional research programs in the Indian Ocean are under development. These national cruises and programs are serving as a foundation for this new Indian Ocean research focus: the "IIOE-2."

IIOE-2 Science

A Science Plan for IIOE-2 (Hood et al. 2015) was developed with the sponsorship of SCOR. The plan was completed in May 2015 and it was formally adopted by IOC as the essential underpinning science framework for IIOE-2 at the IOC General Assembly in June 2015 (available at: http://www.iioe-2.incois.gov.in).

The plan builds upon concepts and strategies formulated and discussed at four IOC-sponsored planning meetings (in Hyderabad, India; Qingdao, China; Mauritius; and Bangkok, Thailand), a SCOR-sponsored workshop in Bremen, Germany, and also national planning efforts in India, Australia, Germany, the United States, and the United Kingdom. These meetings included scientists from Indian Ocean rim nations, eastern Asia, Europe, and North America.

The overarching goal of IIOE-2 is to advance our understanding of interactions between geologic, oceanic, and atmospheric processes that give rise to the complex physical dynamics of the Indian Ocean region, and determine how those dynamics affect climate, extreme events, marine biogeochemical cycles, ecosystems, and human populations. This understanding is required to predict the impacts of climate change, pollution, and increased fish harvesting on the Indian Ocean and its surrounding nations, as well as the influence of the Indian Ocean on other components of the Earth System. New understanding is also fundamental to policy makers for the development of sustainable coastal zone, ecosystem, and fisheries management strategies for the Indian Ocean. Other goals of IIOE-2

TABLE 1. IIOE-2 research themes.

Theme 1: Human impacts	How are human-induced ocean stressors impacting the biogeochemistry and ecology of the Indian Ocean? How, in turn, are these impacts affecting human populations?
Theme 2: Boundary current dynamics, upwelling variability, and ecosystem impacts	How are marine biogeochemical cycles, ecosystem processes, and fisheries in the Indian Ocean influenced by boundary currents, eddies, and upwelling? How does the interaction between local and remote forcing influence these currents and upwelling variability in the Indian Ocean? How have these processes and their influence on local weather and climate changed in the past and how will they change in the future?
Theme 3: Monsoon variability and ecosystem response	What factors control present, past, and future monsoon variability? How does this variability impact ocean physics, chemistry, and biogeochemistry in the Indian Ocean? What are the effects on ecosystems, fisheries, and human populations?
Theme 4: Circulation, climate variability, and change	How has the atmospheric and oceanic circulation of the Indian Ocean changed in the past and how will it change in the future? How do these changes relate to topography and connectivity with the Pacific, Atlantic, and Southern oceans? What impact does this have on biological productivity and fisheries?
Theme 5: Extreme events and their impacts on ecosystems and human populations	How do extreme events in the Indian Ocean impact coastal and open-ocean ecosystems? How will climate change impact the frequency and/or severity of extreme weather and oceanic events, such as tropical cyclones and tsunamis in the Indian Ocean? What are the threats of extreme weather events, volcanic eruptions, tsunamis, combined with sea level rise, to human populations in low-lying coastal zones and small island nations of the Indian Ocean region?
Theme 6: Unique geological, physical, biogeochemical, and ecological features of the Indian Ocean	What processes control the present, past, and future carbon and oxygen dynamics of the Indian Ocean and how do they impact biogeochemical cycles and ecosystem dynamics? How do the physical characteristics of the southern Indian Ocean gyre system influence the biogeochemistry and ecology of the Indian Ocean? How do the complex tectonic and geologic processes, and topography of the Indian Ocean influence circulation, mixing and chemistry and therefore also biogeochemical and ecological processes?

include helping to build research capacity and improving availability and accessibility of oceanographic data from the region.

The IIOE-2 Science Plan is structured around six scientific themes (see Table 1). Each of these include a set of questions that need to be addressed in order to improve our understanding of the physical forcing that drives variability in marine biogeochemical cycles, ecosystems and fisheries in the Indian Ocean, and to develop the capacity to predict how this variability will impact human populations in the future. It is also important to emphasize that most of these questions are relevant to open-ocean, coastal, and marginal sea environments.

The IIOE-2 Science Plan is very broad. It includes geologic, atmospheric, and oceanographic research that extends from coastal environments to the deep ocean and trophic levels ranging from bacteria and phytoplankton to top predators and humans. The IIOE-2 Science Plan articulates many important scientific questions that should be considered as potential research foci for national and international studies in the Indian Ocean, while also acknowledging that many Indian Ocean rim countries that want to pursue research as part of IIOE-2 are primarily concerned with their own coastal and regional interests. The plan anticipates that national science and implementation plans will focus on specific aspects of the international plan. Indeed, the development of national plans is well underway in India, the United States and Australia, and Germany's national plan has been completed (Bange et al. 2016).

IIOE-2 Research Initiatives

In addition to coordinating ongoing research and motivating international participation, the IIOE-2 is working to initiate new research projects and programs that are designed to address the core IIOE-2 research themes. For example, international planning is underway to initiate upwelling-focused research initiatives in both the eastern and western Indian Ocean: the Eastern Indian Ocean Upwelling Research Initiative (EIOURI, see Yu et al. 2015) and the Western Indian Ocean Upwelling Research Initiative (WIOURI). These new initiatives are aligned with CLIVAR's interdisciplinary upwelling research theme and they are focused on understanding the forces that drive upwelling variability in the Indian Ocean and the resulting biogeochemical and ecological responses.

IIOE-2 Implementation

An Implementation Strategy for IIOE-2 (IPC 2015) was developed with the sponsorship of IOC. The Strategy was completed in November 2015 in response to a request from that year's IOC Assembly meeting, and presented to the IOC Executive Council in June 2016 as the essential underpinning implementation framework for IIOE-2 (available at: http://www.iioe-2.incois.gov.in).

The implementation strategy was developed by an "Interim Planning Committee" that was established by IOC in September 2014. It builds upon 4 yrs of consultations, planning, and institutional advocacy that were undertaken for the IIOE-2, which includes a vast amount of material derived from the previously mentioned IOC and SCOR planning workshops and also joint IOGOOS, SIBER, and CLIVAR/GOOS Indian Ocean Panel (IOP) meetings (available at www.iocperth.org).

This document is designed to provide a guiding strategy rather than a detailed operational procedure for IIOE-2. Full operational details are being developed by a Steering Committee that has been established to guide the Expedition. This Implementation Strategy

FIG. 4. Photo from the concluding ceremonies of the International Symposium that was convened at the National Institute of Oceanography in Goa, India, from 30 November 2015 to 04 December 2015. This Symposium was also the official launch celebration for the IIOE-2.

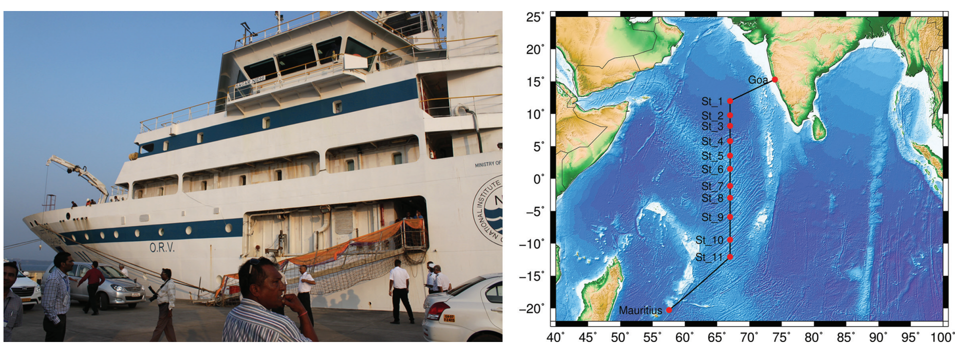

FIG. 5. The first expedition of IIOE-2 departed from the port of Goa, India on 05 December 2015 on board ORV Sagar Nidhi (left panel) after the concluding session of the Symposium. The primary objective of this expedition was to sample a hydrographic section along 67°E (right panel). The photo of the Sagar Nidhi was contributed by R. Hood and the map of the cruise track was provided by S. Prakash and S. Shenoi.

therefore focuses on providing motivations and related objectives with associated recommended actions in response to the major elements of the IIOE-2 Science Plan. The major sections of the Implementation Strategy cover governance and the structure of the IIOE-2 Steering Committee, which is currently being formed, and also the formation of a Joint Project Office, which has already been established with nodes in Australia and India.

The Implementation Strategy places a strong emphasis on ensuring that the IIOE-2 is efficiently administered and resourced. Priority is also given to ensuring proper data and information management. Another key aspiration is to leave a lasting legacy throughout the Indian Ocean region, as did the original IIOE. This will be accomplished by establishing the basis for improved scientific knowledge transfer to wider segments of society and regional governments, and through the creation of educational and capacity development opportunities that target regional and early career scientists.

Because the funding for IIOE-2 research and societal applications is being generated within each participating country, the preferred model is for each country to have an IIOE-2 national committee with a chairperson who is the point of contact for the IIOE-2 Steering Committee and the IPO framework. In most countries national committees already exist for SCOR and for IOC. National IIOE-2 committees have already been established in India, Australia, Germany, and the United States. These committees are self-sustaining, but also adhere to principles set by the sponsors of the IIOE-2 (IOC, SCOR, and IOGOOS).

The Goa 50th Anniversary Symposium and Official Launch of IIOE-2

An International Symposium was convened at NIO from 30 November to 04 December 2015 to celebrate the 50-yr anniversary of the completion of the IIOE and also the Golden Jubilee of India's National Institute of Oceanography (NIO), (Fig. 4). The symposium, co-sponsored by NIO, SCOR, and IOC, provided a forum for scientists from around the world to present results from their latest research in the Indian Ocean and plan IIOE-2 research to address outstanding issues identified in the IIOE-2 Science Plan. The Symposium consisted of keynote addresses, along with invited and contributed talks on all aspects of Indian Ocean oceanography and related climate science.

The Symposium also officially launched the IIOE-2. The first cruise of IIOE-2 departed from the port of Goa, India on 05 December 2015 on board ORV *Sagar Nidhi* after the concluding session of the Symposium. The primary objective of this expedition (which was sponsored by India's Earth System Science Organization, the Ministry of Earth Sciences, and the Government of India) was to sample a hydrographic section along 67°E that was occupied during IIOE (Fig. 5). The cruise concluded at Port Louis, Mauritius on 24 December 2015.

Engagement of Early Career Scientists

A workshop was also convened at the Goa Symposium that provided an opportunity for early-career scientists to put forward their ideas about important research topics that IIOE-2 should consider, and also strategies for developing research expertise and capacity, especially in Indian Ocean rim nations (Fig. 6). Around 50 early career scientists from around the world participated. Their discussions led to the formulation of a set of core research areas, which were deemed of particular interest to the group. These included anthropogenic stressors, biology/biogeochemistry (including corals, plankton, fisheries, and the benthos), physical oceanography and marine geology and geophysics.

This diverse group of young scientists have subsequently self-organized into an Early-Career Scientist Network for Indian Ocean Research (IIOE-2 ECSN) whose aims are to communicate recommendations for priority research in the Indian Ocean to the IIOE-2 leadership and further establish and strengthen new collaborations within the group. It was also agreed that these recommendations for priority research should be compiled and published in the form of a formal report, plan or paper (see Ansari et al. 2016).

Since the Goa symposium, ECSN members have established and maintained an active and enthusiastic communication network with young leaders emerging to continue the development of research priorities for each of the aforementioned core areas. These individuals have been tasked to coordinate and compile recommendations from their respective group members. Based upon these efforts, the IIOE-2 ECSN has drafted a set of recommendations to IIOE-2 which stress, among other things, the need for integrated ocean process studies that include modeling to address issues like deoxygenation, apparent increases in jellyfish blooms, transport, accumulation and impacts of marine debris, and the need for the development of an IIOE-2 data portal.

The next stage of development for the IIOE-2 ECSN is the creation of a dedicated website to feature ongoing research activities by members in the Indian Ocean research community as well as a discussion forum.

FIG. 6. Early career scientists discussing research ideas and strategies for capacity development in IIOE-2 at the Goa 50th Anniversary Symposium. The photo is courtesy of Benjamin Kürten.

Legacy

The IIOE-2 Science Plan and Implementation Strategy set forth ambitious goals for the project with an emphasis on creating a lasting legacy: "The motivation, coordination and integration of Indian Ocean research through IIOE-2 will advance knowledge, increase scientific capacity, and enable international collaboration in an under-sampled, poorly understood, yet important region. IIOE-2 will promote awareness of the significance of Indian Ocean processes and enable a major contribution to their understanding, including the impact of Indian Ocean variability and change on regional ecosystems, human populations, and global climate. The legacy of IIOE-2 will be to establish a firmer foundation of knowledge on which future research can build and on which policy makers can make better-informed decisions for sustainable management of Indian Ocean ecosystems and mitigation of risk to Indian Ocean rim populations. IIOE-2 will leverage and strengthen SCOR, IOC, and IOGOOS by promoting coordinated international, multidisciplinary research among both developed and developing nations, hence increasing scientific capacity and infrastructure within the Indian Ocean rim and neighboring nations.

The success of IIOE-2 will be gauged not just by how much it advances our understanding of the complex and dynamic Indian Ocean system, but also by how it contributes to sustainable development of marine resources, environmental stewardship, ocean and climate forecasting, and training of the next generation of ocean scientists from the region. If this vision of success is realized, IIOE-2 will leave a legacy at least as rich as the original expedition."

We encourage ASLO members to get involved in IIOE-2 to ensure that the major questions related to biological oceanography in the Indian Ocean that are articulated in the Science Plan are addressed.

Acknowledgments

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