

IIOE-2 Annual Report 2019 for SCOR

Executive Reporter: Peter Burkill¹

Our understanding of the complex processes in the Indian Ocean is improving year-on-year but still remains rudimentary in many respects. This is largely because modern research capabilities are only now being applied to the Indian Ocean, which still remains relatively under-sampled in both space and time. The Indian Ocean is a dynamically complex and highly variable system under monsoonal influence and, we now realise, is fundamental in oceanic and coupled climatic Earth system inter-connections with all the other major oceans. The recent Indian Ocean Observing System (IndOOS) Decadal Review re-affirmed this with for example: recent studies suggesting that the Indian Ocean has stored in the order of 60% of the global oceanic heat uptake from the atmosphere over the last two decades while it is also home to 30% of the world's coral reefs and 13% of global wild-catch fisheries.

Recent impacts of IIOE-2

GLOBAL CLIMATE: Through the integrated IIOE-2 programme, we now realise how central the Indian Ocean is to the control of our global climate. The southern Indian Ocean is warming faster than any other part of the global ocean: twice the rate of the Pacific and some 50% faster than the Atlantic. Marine Heat Waves, having profound biophysical impacts, have been identified in the past few years. The focus is now shifting to understanding the mechanisms involved in the Indian Ocean's warming. There are at least two hypotheses that need to be investigated. First, the Indonesian throughflow from the Pacific has increased, bringing more warm Pacific water into the Indian Ocean. Second, the westerly winds over the equatorial Indian Ocean are becoming stronger, strengthening the downwelling conditions, leading to the warming of the upper ocean. The latter is linked to Madden-Julian Oscillations (see below) and the Indian Ocean Dipole, which itself has 'teleconnections' with Pacific Ocean met-ocean processes. With more than 40% of the world's population living in countries prone to cyclones, floods and droughts bordering the Indian Ocean, it is a study with far reaching consequences. It is vital to understand how the climate affects people and their livelihoods.

BUILDING RESEARCH CAPACITY IN THE INDIAN OCEAN REGION: This is central to all the sponsors missions and is addressed through a variety of means. The first IIOE-2 cruise set the scene by offering 50% of berths to scientists of other nations. Following IIOE-2 cruises have offered berths to other nations. SCOR has also responded by given preference in choosing scientists from nations around the Indian Ocean for some of its capacity building activities.

SUPPORTING SUSTAINABLE DEVELOPMENT: IIOE-2 endorsed initiatives link science and socio-economic analysis to inform policy-making across the Indian Ocean region. For instance, the new £8M UK/SA collaborative project Sustainable Oceans, Livelihoods and food Security Through Increased Capacity in Ecosystem research in The Western Indian Ocean (SOLSTICE–WIO) is just one example.

IMPROVING MONSOON PREDICTION: The IIOE-2-endorsed Bay of Bengal Boundary Layer Experiment (BoBBLE) has revealed new knowledge on factors regulating monsoonal variability and its implications for ocean ecosystems and the billions of people affected by the monsoons. This knowledge is critical for securing water sources and sustaining agricultural economies.

MADDEN-JULIAN OSCILLATION (MJO): The MJO is a little understood tropical weather phenomenon involving intense winds that blow over a small area of the eastern Indian Ocean. As a result, during the months of December to April, the Indian Ocean routinely gains or loses ~three trillion tons of water from the Pacific

¹ With thanks to Raleigh Hood, Hermann Bange and Nick d'Adamo for input.

Ocean every ~30 to 80 days accompanied by a sea level rise or fall of ~4cm. This accounts for ~ 30% of the total sea-level change during the period. Not only does this influence the heat budget but it also influences the polar motion of the Earth and the length of the day, the variability of which is of utmost importance to the accuracy of the Global Positioning System (GPS). This research was published in Nature Communications in a paper entitled: Basin-wide Sea Level Coherency in the Tropical Indian Ocean Driven by Madden–Julian Oscillation. (Rohith et al. <https://www.nature.com/articles/s41467-019-09243-5>)

Peer-reviewed Publications (this does not include the JMS and AOS publication list which is not yet available).

- Al-Yamani, F, and S.W.A. Naqvi. Chemical oceanography of the Arabian Gulf. 2019. *Deep-Sea Research Part II* 161: 72-80.
- Al-Yamani, F., Madhusoodhanan, R., Skryabin, V., Al-Said, T., 2018. The response of microzooplankton (tintinnid) community to salinity related environmental changes in a hypersaline marine system, northwestern Arabian Gulf. *Deep Sea Res. II* 166, 151-170.
- Baer, S.E., S. Rauschenberg, Garcia, N.S., A.C. Martiny, B.S. Twining and M.W. Lomas. 2019. Carbon and nitrogen productivity during spring in the oligotrophic Indian Ocean along the GOSHIP IO9N transect. 2019. *Deep-Sea Research Part II* 161: 81-91.
- Bange, H.W., Kock, A., Pelz, N., Schmidt, M., Schutte, F., Walter, S., Post, A.F., Jones, B.H., Kurten, B., 2018. 'Nitrous oxide in the northern Gulf of Aqaba and the central Red Sea. *Deep Sea Res. II* 166, 90-103.
- Beckley, L.E., D. Holliday, A.L. Sutton, E. Weller, M.P. Olivar and P.A. Thompson. 2019. Structuring of larval fish assemblages along a coastal-oceanic gradient in the macro-tidal, tropical Eastern Indian Ocean. *Deep-Sea Research Part II* 161: 105 – 119.
- Beckmann, A., Hense, I., 2018. 'Modelling nitrogen-oxygen dynamics in the central Arabian Sea: large-scale meridional structure and seasonal variations. *Deep Sea Res. II* 166, 114-124.
- Burdanowitz, N., Gaye, B., Hilbig, L., Lahajnar, N., Luckge, A., Rixen, T., Emeis, K.-C., 2018. Holocene monsoon and sea level-related changes of sedimentation in the northeastern Arabian Sea. *Deep Sea Res. II* 166: 6-18.
- Dréo R., L. Bouffaut, E. Leroy, G. Barruol and F. Samaran. 2019. Baleen whale distribution and seasonal occurrence revealed by an ocean bottom seismometer network in the Western Indian Ocean. *Deep-Sea Research Part II* 161: 132 - 144
- Forke, S., Rixen, T., Burdanowitz, N., Luckge, A., Ramaswamy, V., Munz, P., Wilhelms-Dick, D., Vogt, C., Kasten, S., Gaye, B., 2019. Sources of laminated sediments in the north eastern Arabian Sea off Pakistan and implications for sediment transport mechanisms during the late Holocene. *Holocene* 29, 130-144.
- Harms, N.C., Lahajnar, N., Gaye, B., Rixen, T., Dähnke, K., Ankele, M., Schwarz-Schampera, U., Emeis, K.C., 2019. Nutrient distribution and nitrogen and oxygen isotopic composition of nitrate in water masses of the subtropical southern Indian Ocean. *Biogeosciences* 16, 2715-2732.
- Hood, R. R., L. E. Beckley, B. Gaye, S K. Singh, J. Vialard & J. D. Wiggert. 2019a. The Second International Indian Ocean Expedition (IIOE-2): Motivating New Exploration in a Poorly Understood Ocean Basin (Volume 1). *Deep-Sea Research Part II* 161: 1 – 144.
- Hood, R.R., L. E. Beckley, B. Gaye, S K Singh, J Vialard, J D. Wiggert 2019b. The 2nd International Indian Ocean Expedition (IIOE-2): Motivating New Exploration in a Poorly Understood Ocean Basin (Volume 2). *Deep-Sea Research Part II* : 166, 1-186
- Huot, Y., Antoine, D., Daudon, C., 2018. 'Partitioning the Indian Ocean based on surface fields of physical and biological properties. *Deep Sea Res. II* 166, 74-79.
- Kämpf, J., Kavi, A., 2019. 'SST variability in the Eastern Intertropical Indian Ocean: on the search for trigger mechanisms of IOD events. *Deep Sea Res. II* 166, 64-74.
- Krishnamohan, K.S., Vialard, J., Lengaigne, M., Masson, S., Samson, G., Pous, S., Neetu, S., Durand, F., Shenoi, S.S.C., Madec, G., 2018. 'Is there an effect of Bay of Bengal salinity on the northern Indian Ocean climatological rainfall? *Deep Sea Res. II* 166, 19-33.
- Mao, H. M. Feng, H.E. Phillips and S. Lian Mesoscale eddy characteristics in the interior subtropical southeast Indian Ocean, tracked from the Leeuwin Current system. *Deep-Sea Research Part II* 161: 52-62.
- Menezes, V.V., Vianna, M.L., 2019. 'Quasi-biennial Rossby and Kelvin waves in the south Indian ocean: tropical and subtropical modes and the Indian Ocean Dipole. *Deep Sea Res. II* 166, 43-63.
- Miller, M.J., S. Wouthuyzen, E. Feunteun, Aoyama, J., S. Watanabe, A. Syahailatua, M. Kuroki, T. Robinet, S. Hagihara, T. Otake and K. Tsukamoto. 2019. Contrasting biodiversity of eel larvae across the central Indian Ocean subtropical gyre. *Deep-Sea Research Part II* 161: 120 – 131.

- Noyon, M., Morris, T., Walker, D., Huggett, J., 2018. 'Plankton distribution within a young cyclonic eddy off south-western Madagascar. *Deep Sea Res. II* 166, 141-150
- Pearce, A., Jackson, G., Cresswell, G.R., 2018. Marine debris pathways across the southern Indian Ocean. *Deep Sea Res. II* 166, 34-42.
- Prend, C.J., H. Seo , R.A. Weller and John.T. Farrar. 2019. Impact of freshwater plumes on intra-seasonal upper ocean variability in the Bay of Bengal. *Deep-Sea Research Part II* 161: 63-71
- Rigual-Hernández,A.S., C.H. Pilskaln, Cortina , F. Abrantes and L.K. Armand. 2019. Diatom species fluxes in the seasonally icecovered Antarctic Zone: New data from offshore Prydz Bay and comparison with other regions from the eastern Antarctic and western Pacific sectors of the Southern Ocean. *Deep-Sea Research Part II* 161: 92-104.
- Rohith et al 2019. Basin-wide Sea Level Coherency in the Tropical Indian Ocean Driven by Madden–Julian Oscillation. *Nature Communications* (www.nature.com/articles/s41467-019-09243-5)
- Saalim,S.M., R. Saraswat , T. Suokhrie and R. Nigam. Assessing the ecological preferences of agglutinated benthic foraminiferal morphogroups from the western Bay of Bengal. *Deep-Sea Research Part II* 161: 38-51.
- Singh, R. S. Sautya and B.S. Ingole. 2019. The community structure of the deep-sea nematode community associated with polymetallic nodules in the Central Indian Ocean Basin. *Deep-Sea Research Part II* 161: 16-28.
- Suntharalingam, P., Zamora, L.M., Bange, H.W., Bikkina, S., Buitenhuis, E., Kanakidou,M., Lamarque, J.-F., Landolfi, A., Resplandy, L., Sarin, M.M., Seitzinger, S., Singh, A., 2019. Anthropogenic nitrogen inputs and impacts on oceanic N₂O fluxes in the northern Indian Ocean: the need for an integrated observation and modelling approach. *Deep Sea Res. II* 166, 104 -113.
- Sutton, A.J., Jenner, K.C.S., Jenner, M.-M.M., 2018. 'Habitat associations of cetaceans and seabirds in the tropical eastern Indian Ocean. *Deep Sea Res. II* 166, 171-186.
- Twining, B.S., Rauschenberg, S., Baer, S.E., Lomas, M.W., Martiny, A.C., Antipova, O.,2019. A nutrient limitation mosaic in the eastern tropical Indian Ocean. *Deep Sea Res. II* 166, 124-140.
- White, C.M., C. Woulds , G.L. Cowie , A. Stott and H. Kitazato 2019. Resilience of benthic ecosystem C-cycling to future changes in dissolved oxygen availability. *Deep-Sea Research Part II* 161: 29-37.
- Wiles, E. A. Green , M. Watkeys , R. Botes and W. Jokat.. 2019. Submarine canyons of NW Madagascar: A first geomorphological insight. *Deep-Sea Research Part II* 161: 5-15

2019 Annual Meeting

Our 2019 IIOE-2 meeting formed part of the 3rd International Indian Ocean Science Conference held over 11th – 15th March and hosted by Nelson Mandela University, South Africa in conjunction with the Joint Project Office of IIOE-2. The conference was attended by >100 delegates from 21 countries. An aim of this conference was to bring the Second International Indian Ocean Expedition (IIOE-2) community into the WIO region so as to promote exposure and the research being undertaken by Western Indian Ocean (WIO) institutions and to promote and facilitate the building of new relationships through the vehicle of ocean science.

The main highlights of the 2019 SSC meeting were:

- a) a 4 page colour brochure on IIOE-2 (see <https://iioe-2.incois.gov.in/documents/IIOE-2/IIOE-2-HighlightsBrochure.pdf>)
- b) a review of why IIOE-2 is essential to the community and the impact it has had;
- c) involvement of 28 countries in IIOE-2;
- d) ratification of 34 projects;
- e) review of 16 research cruises that have sailed;
- f) endorsement of the IIOE-2 Early Career Scientists Network;
- g) confirmation of a slimmed down administration to oversee IIOE-2 (see below); and
- h) a very strong affirmation by the community that IIOE-2 should continue beyond 2020.

The Conference focussed on many science areas that are being researched by the IIOE-2, including:

- Evolution of heat uptake and its impact on the global ocean and climate.
- Physical-biological coupling and biogeochemistry in the western Equatorial Indian Ocean.

- Ecosystem impacts of meteorological and oceanographic conditions in upwellings of the East African Coastal Current system.
- Indian Ocean variability and monsoon prediction through the Indian Ocean Observing System including the Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction.
- Building the Indian Ocean Observing System.
- Major boundary currents around the Indian Ocean rim and their biogeochemistry.
- Biogeochemistry-Atmosphere processes in the Bay of Bengal.
- Physical and biogeochemical aspects of upwelling systems in the Indian Ocean.
- Nitrogen fixation rates, primary production and oxygen minimum zones of the Arabian Sea, comparative to the Bay of Bengal.
- Mesoscale vortices, currents and dynamical features in the Northwest Indian Ocean.
- Phytoplankton blooms in the north-western Arafura Sea during the southeast monsoon.
- Sustained ocean observations along the east coast of Africa
- Ecosystem function on seamounts and the effects of environmental stressors.

Administration

IIOE-2 continues to be well supported by the Administrative Offices of SCOR in USA, IOC in Australia and India and IOGOOS in India. This is very much appreciated by the IIOE-2 community.

The IOC, through its IOC Perth Programme Office in Western Australia provides one node of the IIOE-2 Joint Project Office (JPO) and India the other node through the Indian National Centre for Ocean Information Services (INCOIS) in Hyderabad, which also administers IOGOOS. The cash funding to IIOE-2 via IOC and IOGOOS combined will continue at ~\$30K per year, as will the significant human and supporting underpinning resourcing for these two nodes (with each node engaging at least the equivalent of two full time FTEs each). The JPO hosting (personnel and office/administrative underpinning) through their respective IOC and national government agency sponsors, combines in value to be several hundreds of thousands of dollars per year at FEC. IOC and IOGOOS have re-committed to this full framework (cash and complementary personnel/hosting) out to 2025 and request SCOR to continue its funding for research coordination as a collegiate partnership.

In 2018, the sponsors agreed to reduce the administration of IIOE-2 by forming the “Core Group”. This comprised the co-chairs, the executive officers and the chairs of Science and of Operations. We have continued to stream-line the administration further. This has been accepted by the 2019 IIOE-2 Steering Committee and reducing the number of Working Groups to three:

WG1: Science and Research (Chairs: Raleigh Hood, USA & Hermann Bange, Germany)

WG2: Data and Information Management (Chair: Cyndy Chandler, USA)

WG3: Operational Coordination (Chair: Shailesh Nayak, India)

Website (www.iioe-2.incois.gov.in):

This is the front window of IIOE-2, including details of past and future events. It is hosted by INCOIS and paid for by India.

Indian Ocean Bubble & IIOE-2 Newsletter

These informal publications help to maintain the IIOE-2 Community, keeping it in touch. The Bubble appears ~ quarterly while the Newsletter appears monthly. They are both produced by INCOIS. Items in recent copies are shown below.

| Date | Output | Topics |
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| 2019 February | Bubble 10 | <ol style="list-style-type: none"> 1) Proposed new structure for delivering IIOE-2 2) IIOE-2 Working Group 1 'Science & Research' Meeting, Kiel, 28-30 November 2018 3) First comprehensive book on the nature of Timor-Leste, underwater and on land 4) A Shout-out for Better Estimates of Ocean Mixed Layer Depths from Observations 5) Biogeochemistry of the Indian Ocean 6) Argo reaches 2 million profiles globally! But what of the Indian Ocean? 7) Ponman: A method for exploratory analysis of ocean depths using Bio-Argo 8) The improved COARE 3.5 Algorithm for ocean heat flux estimations 9) Investigating the shelf dynamics and sedimentary records of South Eastern Arabian Sea 10) multidisciplinary approach 11) New insights into the Indian Ocean |
| 2019 March | News V 3 Issue 3 | <ol style="list-style-type: none"> 1) The third meeting of the IIOE-2 Steering Committee, Nelson Mandela University, Port Elizabeth, South Africa, 11-15 March 2019 2) Deep Madagascar Basin (DMB) Experiment: A Quest to Find the Abyssal Water pathways in the Southwest Indian Ocean 3) Join the Marine Research Information Network on Biodiversity (MARINE-B) 6) Early announcement: International Indian Ocean Science Conference-2020 7) Some Upcoming Events |
| 2019 April | News V 3 Issue 4 | <ol style="list-style-type: none"> 1) The origin of 85°E Ridge and its role in the plate tectonic history of the Bay of Bengal (85ERBB) 2) Handing over the International Indian Ocean Expedition (IIOE-2) Flag 3) Early announcement: International Indian Ocean Science Conference-2020 4) Some upcoming events |
| 2019, May | News V 3 Issue 5 | <ol style="list-style-type: none"> 1) Exploring the marine biodiversity of the submarine Cape Range Canyon, north western Australia 2) Recommendations for an integrated modelling-observational approach for estimating N₂O fluxes under the IIOE-2 3) Early announcement: International Indian Ocean Science Conference-2020 4) Some upcoming events |
| 2019, June | News V 3 Issue 6 | <ol style="list-style-type: none"> 1) In the wake of HMAS Diamantina 2) Does Somali current upwell during the summer monsoon? 3) Call for papers - Special IIOE-2 Issue. Volume 3 DEEP SEA RESEARCH- PART II 4) Call for papers - Special Issue in Acta Oceanologica Sinica on "Environment and Ocean-Atmosphere Interaction in the Indian Ocean" 5) Early announcement: International Indian Ocean Science Conference-2020 6) Some upcoming events |
| 2019, August | News V 3 Issue 8 | <ol style="list-style-type: none"> 1) Exciting collaboration for IIOE-2: Deep Argo deployments from RV Investigator 2) The need for a dedicated observing system for cyclone prediction 3) International Indian Ocean Science Conference-2020 (IIOSC-2020)- Call for Abstracts 4) Some upcoming events |
| 2019 August | Bubble 11 | <ol style="list-style-type: none"> 1) Conference and integrated meetings 2) Intergovernmental Oceanographic Commission Assembly 3) Plankton Identification Workshop held in Zanzibar 4) Walter Munk- A Founding Father of Modern Oceanography (1917-2019) 5) R/V INVESTIGATOR Voyage- 110°E 6) Is Carbon-to-Chlorophyll Ratio getting its due in the Indian Ocean? 7) Boreal MJO induced coherent rise and fall of the tropical Indian Ocean 8) Dynamics of the Arabian Sea High Salinity Water Mass and Hypoxic Zones along the South West Coast of India - A Modelling Approach 9) Approach field trials of gillnets and fishing lines with alternate materials in the Arabian Sea |
| 2019 November | 12 | Next Bubble |

Media

IIOE-2 has informal outputs intended for the public. Science journalist Heather Dugmore attended the 2019 IIOE-2 meeting in Port Elizabeth, and masterminded the following media clips in the Mail & Guardian 31st May to 6th June 2019:

- a) *“Collective Ocean Action”* by Vice Chancellor Nelson Mandela University
- b) *No single nation has the capacity* by Heather Dugmore
- c) *International Indian Ocean Expedition* by Lynnath Beckley
- d) *Big thinking, big science* by Heather Dugmore
- e) *Combatting fisheries organised crime* by Heather Dugmore
- f) *Indian Ocean Africa* by Rose Boswell
- g) *World’s most advanced ocean research vessel* by Heather Dugmore
- h) *New marine robotics unit* by Akshay Lakhani
- i) *Democratising marine robotics* by Terry Sloane
- j) *Fish species overexploited or collapsed* by Tor Næsje and Paul Cowley
- k) *Sewage and contaminants in Cape Town sea* by Leslie Petrik
- l) *Maritime engineering and naval architecture* by Howard Theunissen,
- m) *Vehicle tyre particles a major marine polluter* by Andy Booth
- n) *Coastal link in the origins of human awareness* by African Centre for Coastal Palaeoscience (ACCP)
- o) *Life below water from Zanzibar* by Julius Francis
- p) *Era of marine spatial planning* by Mandy Lombard
- q) *“Tackling the ocean plastics problem now”* by Andy Cundy
- r) *One Ocean Hub* by Elisa Morgera
- s) *“The marine plastic pollution crisis”* by Peter Manyara
- t) *“IUCN Marine Mammal Task Force includes SA”* by Stephanie Plön
- u) *“Why the Indian Ocean?”* by Heather Dugmore and Peter Burkill
- v) *“India rapidly gearing up”* by Sateesh Shenoi. see https://iioe-2.incois.gov.in/documents/IIOE-2/ocean_science.pdf

A clip was published in The Herald 12 March 2019. *“Experts share Indian ocean findings”* (see https://iioe-2.incois.gov.in/documents/IIOE-2/IIOESC2019/newsclipping_sc3.jpg).

Another clip was published *32 days on the Indian Ocean exploring climate change*. Raleigh Hood (USA) 13 May 2019 (see <https://www.umces.edu/news/32-days-indian-ocean-exploring-climate-change>).

Planning the International Conference 2020

The next major event on the IIOE-2 calendar is The International Indian Ocean Science Conference (IIOESC-2020). This will be held in Goa, March 16-20 2020, to celebrate recent research in the Indian Ocean and to plan the next phase of IIOE-2. It aims at assessing the scientific understanding of the IO gained during the period of IIOE-2 from 2016 to 2020. It will focus on, but not be limited by, all six themes of IIOE-2 Science plan (i.e., human impacts and benefits; boundary current dynamics and ecosystem impacts; monsoon variability and ecosystem response; circulation, climate variability and change; extreme events; and discovery of unique physical, geological, biogeochemical and ecological features of the Indian Ocean). It will provide an opportunity for the scientists working on different facets of the Indian Ocean to present their ideas and discuss the outstanding issues, identify the knowledge gaps and plan a way forward to address such issues, including as context for a continuing IIOE-2. Presentations highlighting innovative ideas on "Translating benefits of Science to Society" or with societal implications are encouraged. IIOESC-2020 is sponsored by the Ministry of Earth Sciences (MoES), Govt. of India, and will be co-hosted by the National Institute of Oceanography (NIO) Goa, National Centre for Polar Ocean Research (NCPOR) Goa, Goa University and Indian National Centre for Ocean Information Services (INCOIS) Hyderabad.

The conference is being planned by scientists from Australia, China, France, Germany, India, Indonesia, Japan, Kuwait, Russia, South Africa, South Korea, Tanzania, UK, USA as well as SCOR, IOC and IOGOOS.

There are two 'early career' scientists on the International Planning Committee. The development of IIOE-2 beyond 2020 is likely to be a regional contribution to the UN Decade of Sustainable Ocean Development. The 4th full Steering Committee meeting of IIOE-2 will take place immediately after the conference to pick up research issues arising at IIOSC-2020 and to develop future international collaboration in IIOE-2.

Other Future Events - Cruises

Some 16 cruises have contributed to IIOE-2 in the past 4 years. These are shown in <https://iioe-2.incois.gov.in/IIOE-2/Expedition.jsp>. For the future, the following cruises are at various stages of planning. While many of these are confirmed and funded, there are several countries (China, Japan, Korea, Russia) which are active in IIOE-2 but for which plans are not known.

AUSTRALIA: Australia has had one RV Investigator voyage. There are two RV Falkor cruises in 2020 covering canyons along the south west Australian shelf edge (largely UWA) and another one to the shelf edge canyons (largely WA Museum).

FRANCE: Their involvement includes a) Durban Cyclone and Secondary Production, in June/July 2021; b) A Mahe Plateau ecosystem Survey in October/December 2021; c) Resources and coastal vulnerability in a changing Southern Ocean in Dec 2020/ Jan2021. All involve multiple nations.

GERMANY: Has already led expeditions. Germany's effort will also include an Indian Ocean cruise in September 2020, and then 9 cruises planned (and funded) through until March/April 2021 in the Indian Ocean including the Bay of Bengal.

There are other large prospective exploratory programs being planned for the Indian Ocean, such as the 'Global Seamounts Project' through the not-for-profit Global Oceans (GO) group. For example, GO is seeking significant philanthropic funds to implement 18 deep-sea expeditions over the next four years, including the Indian Ocean. This is an exemplar of an IIOE-2 related prospect that would benefit greatly from the high-level imprimatur that SCOR can provide (in concert with IOC and IOGOOS) by virtue of ongoing support for IIOE-2.

Extending IIOE-2 beyond 2020

At the 2019 IIOE-2 Steering Committee meeting, there was unanimous agreement that IIOE-2 should continue into the next decade. This was underscored by the following statement: *"Resolution of IIOE-2 Steering Committee, Meeting No 3, 12-13 March 2018: The IIOE-2 International Steering Committee, chaired by representatives of IOC, SCOR and IOGOOS, and comprising a diverse multi-national constituency, agreed to continue the mission of the IIOE-2 out to at least 2025, in order to build on the significant scientific achievements of IIOE-2 to date, the extension that will occur of many current and imminent major IIOE-2 research initiatives into the next decade, the expected emergence of many new major scientific initiatives well into the next decade strongly aligning with the IIOE-2 Science Plan, and in light of IIOE-2's clear alignment, relevancy and potential to make an important and substantive contribution to the UN Decade of Ocean Science for Sustainable Development 2021-30."*

IOC and IOGOOS have already agreed to extending IIOE-2 beyond 2020. IOGOOS did so in response to the IIOE-2 Steering Committee's unanimous agreement in March 2019 to continue as an IIOE-2 focussed alliance (see above). Then, in June 2019, the 32nd Session of the 150 Member State IOC Assembly agreed to the same. This now means that IOGOOS and IOC will continue to support IIOE-2, seamlessly and as they have done since 2015. The cash funding to IIOE-2 via IOC and IOGOOS combined will continue at ~\$30K per year, with significant human and supporting to underpin IIOE-2 with these two nodes valued at several hundreds of thousands of dollars per year (FEC values). IOC and IOGOOS have re-committed to this full

framework out to 2025 and they have requested SCOR to continue its research coordination of IIOE-2 as a collegiate partnership.

Request

That SCOR provides \$15k towards the 2020 IIOE-2 SSC providing T&S for key participants with the funds administered by SCOR's Executive Director.