Report on IIOE-2 activities in 2018

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Summary

1) IIOE-2 is now in mid-term and activities are increasing widely. Publications are now flowing well. The JPO's are active and the website is a highlight of IIOE-2.
2) The SSC meets annually (last time in March in Jakarta) allowing all those driving IIOE-2 forward to exchange ideas and ensure integration of a very wide range of scientists active in the Indian Ocean
3) IIOE-2 Executive continues to meet electronically at 3-monthly intervals to discuss and agree strategy and high-level developments.
4) Nine new projects involving 14 countries were endorsed by IIOE-2 in 2018.
5) Four major cruises took place in the last year and some 70 are various stages of planning.
6) Indian Ocean Bubble was published three times in 2018.
7) Among the major issues being grappled with are: a) simplifying the administrative structure for IIOE-2 delivery and b) given the slow start of IIOE-2 with some countries yet to be fully involved together with the large number of cruises planned, should we extend IIOE-2 beyond 2020?

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Mission: IIOE-2's mission is *to advance our understanding of the Indian Ocean and its role in the Earth System in order to enable informed decisions in support of sustainable development and the well-being of humankind.*

Ownership: IIOE-2 is a tripartite programme with SCOR working with IOC and IOGOOS as co-sponsors. This means that the *modus operandi* has elements of the requirements of all three sponsors.

Joint Programme Offices: There are two JPO's - one in Perth funded by the Australian Government and one in Bangalore funded by the Indian Government.

Website: http://www.iioe-2.incois.gov.in/IIOE-2/index.jsp

SCOR's role: Our primary role is to facilitate research activities in IIOE-2 and to provide steerage for this. SCOR resources this by funding T&S for the Science Themes Chairs and the IIOE-2 co-chair to attend IIOE-2 SSC Meetings.

New Projects: Nine new projects have been endorsed over the past 12 months as part of the IIOE-2 (see http://www.iioe-2.incois.gov.in/IIOE-2/Endorsed_Projects.jsp). These range from regional studies such as *Australia's: the large marine ecosystem of the Arafura Sea: what are the physical drivers?* through intermediate size programme such as Russia's: *Indian Ocean Comprehensive Oceanographic Expedition of the Russian Federation* to global programmes: Costopulos' *The Global Seamount Project*.

Publications: The full list of IIOE-2 MSS is given on http://www.iioe-2.incois.gov.in/IIOE-2/Publications.jsp?mode_pub_id=AR. Over the past year, the following – probably incomplete list - MSS have been published:

Author	*Title*	*Journal*
Bristow, L.A. et al.	N_2 production rates limited by nitrite availability in the Bay of Bengal oxygen minimum zone.	*Nature Geosci* https://doi.org/10.1038/ngeo2847
Wojtasiwicz et al	Autonomous profiling float observations reveal the dynamics of deep biomass distributions in the denitrifying oxygen minimum zone of the Arabian Sea.	*J Marine Systems* https://doi.org/10.1016/j.jmarsys.2018.07.002
Subrahmanyam et al	Detection of Intraseasonal Oscillations in SMAP Salinity in the Bay of Bengal.	*Geophysical Res Letters* https://doi.org/10.1029/2018GL078662
Sarma & Bhaskar	Ventilation of oxygen to the oxygen minimum zone due to anticyclonic eddies in the bay of Bengal.	*J Geophysical Research* https://doi.org/10.1029/2018JG004447

Hood et al	Biogeochemical and ecological impacts of boundary currents in the Indian Ocean.	*Progress in Oceanography* https://doi.org/10.1016/j.pocean.2017.04.011
Wall-Palmer et al	Vertical distribution and diurnal migration of atlantid heteropods.	*Marine Ecology Progress Series* https://doi.org/10.3354/meps12464
Martin et al	Particulate polyphosphate and alkaline phosphatase activity across a latitudinal transect in the tropical Indian Ocean	*Limnology & Oceanography* *DOI: 10.1002/1no.10780*
Huang et al	Vertical propagation of mid-depth zonal currents associated with surface wind forcing in the equatorial Indian Ocean	*J. Geophys. Res*
Huang, K., W. Han, D. Wang, W. Wang, Q. Xie, J. Chen, and G. Chen	Features of the Equatorial Intermediate Current Associated with Basin Resonance in the Indian Ocean.	*J. Phys. Oceanogr.,* https://doi.org/10.1175/JPO-D-17-0238.1
Karmakar, A., A. Parekh, J.S. Chowdary, et al., 2018:	Inter comparison of Tropical Indian Ocean features in different ocean reanalysis products	*Clim. Dyn.,* https://doi.org/10.1007/s00382-017-3910-8
Li, J., C. Liang, Y. Tang, X. Liu, T. Lian, Z. Shen, and X. Li, 2018:	Impacts of the IOD-associated temperature and salinity anomalies on the intermittent equatorial undercurrent anomalies.	*Clim.Dyn* https://doi.org/10.1007/s00382-017-3961-x.
Pujiana, K. and M.J. McPhaden, 2018	Ocean's response to the convectively coupled Kelvin waves in the eastern equatorial Indian Ocean	*J. Geophys. Res.,* https://doi.org/10.1029/2018JC013858
Pujiana, K., J.N. Moum and W.D. Smythe, 2018	The role of turbulence in redistributing upper ocean heat, fresh water, and momentum in response to the MJO in the equatorial Indian Ocean	*J. Phys. Oceanogr., 48,* 197-220
Zhang, Y., M. Feng, Y. Du, H. Philips, N. Bindoff, and M.J. McPhaden, 2018	Strengthened Indonesian Throughflow drives decadal warming in the southern Indian Ocean.	*Geophys Res. Lett.* https://doi.org/10.1029/2018GL078265

The following MSS are currently in press in two Special Issues of *Deep Sea Research II* devoted to the IIOE-2.

Author	*Title*	*Highlights*
Prend et al.	Impact of freshwater plumes on intraseasonal upper ocean variability in the Bay of Bengal	Results demonstrate the critical importance of freshwater plumes to improved understanding of the upper-ocean heat budget and air-sea interaction in the Bay of Bengal
Woulds et al.	Impact of benthic ecosystem C-cycling to future changes in dissolved oxygen availability	Results suggest that benthic communities on the Indian continental slope possess some functional resilience, and that future expansion of marine hypoxia, while impacting benthic ecosystem structure, may not have as marked an effect on biological carbon cycling.
Wang et al.	Mini warm-pool during pre-summer monsoon favors the rapid intensification of tropical cyclones in the Bay of Bengal.	Results from the analysis of RAMA data suggests that the development of a “mini warm-pool” in the central Bay of Bengal during pre-summer favors the rapid intensification of tropical cyclones.
Sutton et al.	Habitat associations of cetaceans and seabirds in the tropical eastern Indian Ocean	Aggregations of both cetaceans and seabirds were observed at two significant submarine topographic features in the eastern Indian Ocean (Scott Reef and Browse Cliffs), particularly during summer when encounters and abundances of odontocetes were far greater.
Baer et al.	Biogeochemistry of the oligotrophic eastern Indian Ocean	This paper reports some of the first measurements of primary production, nitrogen uptake, and phytoplankton abundance across biogeochemical provinces along a transect from 28ºS to 18ºN in the eastern Indian Ocean, along 95°E, which is a large but understudied region of the global ocean.
Singh et al.	The community structure of the deep-sea nematode community associated with polymetallic nodules in the central Indian Ocean basin	This study of the community structure of the deep-sea nematode community associated with polymetallic nodules in the central Indian Ocean basin reveals undescribed species associated with nodule crevices
Jackson et al.	Marine debris pathways across the southern Indian Ocean.	Using a single drift trajectory in combination with data from other current drifters released along the Western Australian coast between 2008 and 2013, from earlier satellite-tracked drifters and a selection of

		historical drift bottle returns, drift patterns across the southern Indian Ocean between Western Australia and east Africa were analysed to quantify inter-continental debris transport rates via the South Equatorial Current (northern east-west pathway) and the South Indian Ocean Current (southern west-east pathway).
Wiles et al.	Submarine canyons of NW Madagascar: a first geomorphic insight	High resolution multibeam bathymetric data reveal four, previously unrecognized, submarine canyons extending to the toe of the continental slope in the eastern Mozambique Channel. The geomorphology of the canyons is best explained as varied stages (youthful to mature) of canyon evolution. The discovery of these canyons highlights the complexity of the Madagascan Continental slope, and the future potential for multidisciplinary research in this region.
Hense and Beckmann	Modelling nitrogen-oxygen dynamics in the central Arabian Sea: Large-scale meridional structure and seasonal variations	This biogeochemical modeling study of the Arabian Sea reveals that: (i) the oxygen minimum zone is neither vertically nor horizontally homogeneous, (ii) minute differences in oxygen concentration determine the thickness of the nitrite layer, (iii) there is hardly any seasonal cycle in OMZ area but a pronounced seasonal cycle in nitrite, and (iv) the nitrogen loss is accomplished by a succession of denitrification and anammox, based on the seasonal supply of labile detritus. The nitrogen loss in the Arabian Sea can only be understood by taking into account the diversity, vertical arrangement and temporal succession of microbial processes.

Meetings in 2018

When	*What*	*Where*
March 19 - 23	Annual meeting of IIOE-2 SSC	Jakarta
April 08 - 13	Indian Ocean's past, present and Future	Vienna EGU's General Assembly
May 14 - 15	FUST Ocean – Ocean science for sustainable development	Brussels
June 03 - 08	Eastern Indian Ocean Upwelling Research Initiative (EIOURI)	Honolulu AOGS meeting
June 25 - 30	Past, present and future sea level changes	Qingdao CLIVAR – FIO Summer School
November 28 – 30	IIOE-2 Science & Research	Kiel Workshop

Cruises: Four cruises have taken place in the last year including NOAA's vessel Ronald H Brown. This vessel carried out research in April – June 2018 to study how the western Indian Ocean has changed over the past 23 years. Note that some 70 cruises are in planning now and are scheduled before 2020.

A full list of cruises is given at http://www.iioe-2.incois.gov.in/IIOE-2/Expedition.jsp

Indian Ocean Bubble: This occasional publication produced by INCOIS India continues to provide an informal mechanism for exchanging views and ideas within the community. Three issues were published in 2017/18. See http://www.iioe-2.incois.gov.in/IIOE-2/Bubble.jsp#

Media Clippings: Nekton Indian Ocean Mission see https://www.youtube.com/watch?v=7chMYnEHM78&feature=youtu.be

Request: I request $25k to allow key scientists (IIOE-2 Co-Chair and Chairs of WG1 & ST's) to attend the 2019 IIOE-2 SSC that will take place in Port Elizabeth in March 2019. This is already budgeted.