2nd International Indian Ocean Expedition 2015-2020

Newsletter

(A basin-wide research program co-sponsored by IOC-UNESCO, SCOR and IOGOOS)

Volume-2, Issue-8
August, 2018

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 to determine how those dynamics affect climate, extreme events, marine biogeochemical cycles, ecosystems and human populations.

BGC-Argo observations of the deep biomass distributions in the Arabian Sea OMZ

Oxygen concentration in seawater directly affects biogeochemical cycles in the ocean, including those of carbon and nitrogen. Denitrification processes occurring under hypoxic conditions and including all microbe-mediated transformations that convert fixed nitrogen to N_2, control the amount of fixed nitrogen in the ocean and hence influence primary productivity and atmospheric CO_2 concentrations. The Arabian Sea Oxygen Minimum Zone (OMZ) is the second most intense and the thickest of the three major OMZs of the open ocean. Its contribution to the global marine pelagic denitrification has been estimated to vary between 8 and 21%. Mapping the distribution of oxygen concentration levels in the global ocean, as well as denitrification and the microbes responsible for it, is still limited, because this usually requires laborious and expensive efforts with oceanic research vessels. In this study we used data from 13 autonomous profiling biogeochemical (BGC) Argo floats (~ 1600 profiles) to explore the potential of bio-optical methods to map deep biomass distribution in the Arabian Sea. Dissolved oxygen sensors revealed concentrations below 5 μmol kg^{-1} for much of the depth range between 200-400 m and below 1 μmol kg^{-1} in the centre of the OMZ, which is well below climatological values. Optical particle backscatter sensors revealed intensities within the upper OMZ that were nearly as high as within the euphotic zone. The distribution of these particulate scatterers was confined to oxygen concentrations below 1 μmol kg^{-1} and were very similar to those of nitrate deficits estimated from a float with an ultra-violet nitrate sensor, suggesting backscatter may be a useful proxy to investigate the changing dynamics of denitrification. These results offer a useful path for examining denitrification dynamics in OMZs. Full-text version of the publication can be accessed at: https://www.sciencedirect.com/science/article/pii/S0924796317301379#f0025

Wojtasiewicz B., Trull T. W., Udaya Bhaskar TVS, Gauns M., Prakash S., Ravichandran M., Shenoy D. M., Slawinski D., and Hardman-Mountford N. J. (2018) Autonomous profiling float observations reveal the dynamics of deep biomass distributions in the denitrifying oxygen minimum zone of the Arabian Sea, Journal of Marine Systems, DOI:10.1016/j.jmarsys.2018.07.002

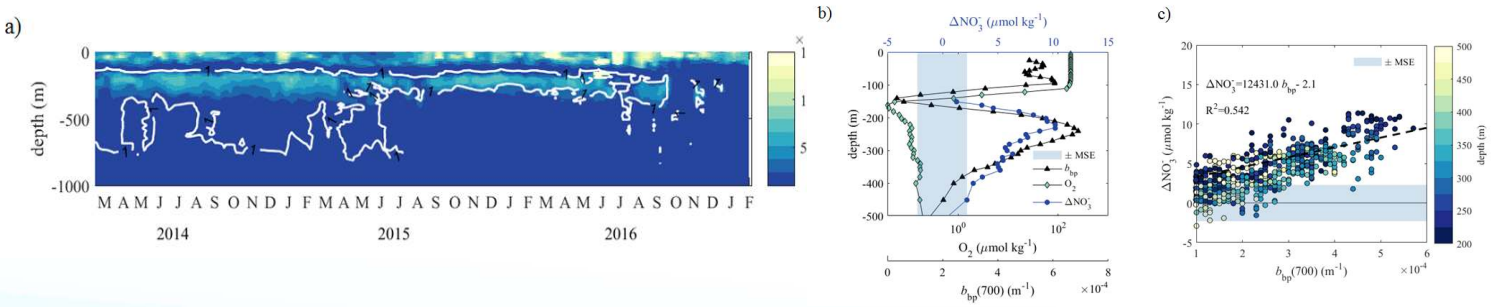

Figure: a) Time series of particulate backscattering from a BGC-Argo float (#2902120) that transited westward across the southern Arabian Sea; the white contour indicates oxygen concentration of 1 μmol kg^{-1}; b) profile of particulate backscattering b_{bp}(700) and nitrate deficit recorded on 12 February 2012; c) relation between particulate backscattering b_{bp}(700) and nitrate deficit (MSE = 2.29 μmol kg^{-1}).

[Report Courtesy: Wojtasiewicz B, *CSIRO, Australia.]*

Statistical Evidence for the Role of Southwestern Indian Ocean Heat Content in the Indian Summer Monsoon Rainfall

An article on "Statistical Evidence for the Role of Southwestern Indian Ocean Heat Content in the Indian Summer Monsoon Rainfall" by T Venugopal, M.M. Ali, M. A. Bourassa, Y.Zheng, G. J. Goni, G.R. Foltz and M. Rajeevan has recently been published in Nature Scientific Reports (August 2018. DOI:10.1038/s41598-018-30552-0). The authors report that Ocean Mean Temperature (OMT) down to the 26°C isotherm depth (D_{26}) of the southwestern Indian Ocean (SIO) helps in the prediction of the sign of Indian Summer Monsoon Rainfall (ISMR) by the beginning of April itself. Currently, the sea surface temperature (SST) has been the only oceanographic input in studying the atmospheric phenomena such as cyclones and monsoons. The authors claim that the thermal energy needed for maintaining and intensifying hurricanes and monsoons comes from the upper ocean, not just from the thin layer represented by SST alone. In this context they report that the OMT of SIO during January-March has better "qualitative" (above or below 887.5 mm) predictability for ISMR, with 80% success rate, compared to SST NINO3.4, Indian Ocean Dipole Mode Index and El Niño Southern Oscillation Modoki Index, which have success rates of 60%, 52%, 48% and 56%, respectively. This may be because OMT better represents the upper ocean thermal energy conditions whose variations are mainly responsible for ISMR activity, whereas SST accounts only for the temperature of a very thin layer influenced by meteorological factors such as strong winds, evaporation, or thick clouds. In addition, compared to SST, OMT variations are more stable and consistent with less spread. The above indices or parameters help in a qualitative prediction of rainfall alone. The failure of predicting the sign of ISMR using OMT in 20% of the times implies the complexity of monsoon system determining the vagaries of ISMR, which are not always controlled by the ocean thermal energy alone represented by OMT in the SIO. Comparison of this parameter estimated for other depths revealed that OMT up to a depth of D_{26} is a better choice, which could be because of the influence of the atmospheric factors on D_{26}. Although the authors speculate on different mechanisms for the ability of OMT in the SIO having a higher predictive value for ISMR, the physical evidence needs to be explored using numerical/dynamical models.

According to the authors, the prediction for 2018 (given at the beginning of April 2018) is below 887.5 mm, with 80% probability. The details of the study are available at https://rdcu.be/4vHw. This is a collaborative research between Novosibirsk State University, Russia; Center for Ocean and Atmospheric Prediction Studies, Florida State University; Indian Institute of Tropical Meteorology, Pune; National Oceanic and Atmospheric Administration, Miami; and the Ministry of Earth Sciences, New Delhi.

[Report Courtesy: M M Ali*, International CLIVAR Monsoon Project Office, IITM, Pune, India.*]

Detection of ISO's in SMAP salinity in BoB

NASA's Soil Moisture Active Passive (SMAP) mission has revolutionized satellite-derived salinity measurements with its improved spatial and temporal coverage compared to previous salinity missions such as ESA's Soil Moisture and Ocean Salinity (SMOS) and NASA Aquarius mission and is therefore a perfect tool for understanding intraseasonal oscillations (ISOs) in sea surface salinity (SSS) in the Bay of Bengal (BoB). The authors directly apply SMAP SSS measurements to further our knowledge on the underlying mechanisms of variability of monsoonal processes by observing and analyzing ISOs in SSS in BoB and identify multiple periodicities of 30-90 day, 10-20 day and 3-7 day in SSS. The 30-90 day signal is attributed to the influence of the Madden-Julian Oscillation (MJO), which propagates eastward over the equatorial Indian Ocean and Pacific Ocean, and also northward over BoB. It helps northward propagation of regional moisture fluxes that affect active and break conditions of monsoonal rainfall, respectively characterized by heavy and scarce rainfall over BoB and the Indian subcontinent. To capture higher-frequency ISOs, the 10-20 day ISO associated with westward-propagating atmospheric cells and the 3-7 day synoptic-scale ISO were also investigated to better understand their variability and annual cycle. The meridionally varying response in salinity to these ISOs in the northern, central, and southern Bay permits the researcher for new insights of understanding intraseasonal variability of oceanic processes in BoB.

Subrahmanyam, B., Trott, C. B., & Murty, V.S.N. (2018). Detection of Intraseasonal Oscillations in SMAP salinity in the Bay of Bengal. Geophysical Research Letters, 45, 7057-7065. https://doi.org/10.1029/2018GL078662.

[Report Courtesy: Subrahmanyam Bulusu, University of South Carolina, USA.]

The Indian Ocean Bubble, Issue No. 9 is now available online

Web Link: http://www.iioe-2.incois.gov.in/IIOE-2/pdfviewer_pub.jsp?docname=IIOE-2-DOC_OM_113.pdf

Call for Contributions

Informal articles are invited for the next issue. Contributions referring Indian Ocean studies, cruises, conferences, workshops, tributes to other oceanographers etc. are welcome.

Articles may be up to 1500 words in length (Word files) accompanied by suitable figures, photos (separate .jpg files)

Deadline: **30th November, 2018**

Some Upcoming Events

- IV International Conference on El Niño Southern Oscillation: ENSO in a warmer Climate, 16-18 October 2018. Guayaquil – Ecuador.
  http://www.ensoconference2018.org/
- SOLAS Open Science Conference during 21-25 April 2019, at Hokkaido University Conference Hall, Sapporo, Japan.
  https://www.confmanager.com/main.cfm?cid=2778
- "Ocean sustainability for the benefit of society: Understanding, challenges, and solutions", 17-21 June 2019, Brest, France. Call for Sessions and Workshops at the Second Open Science Conference of the Integrated Marine Biosphere Research (IMBeR) Project.
  http://www.imber.info/en/events/osc--imber-open-science-conference/osc-2019/2019-imber-open-science-conference

Call for Contributions

Informal articles/short notes of general interest to the IIOE-2 community are invited for the next (September-end) issue of the IIOE-2 Newsletter. Contributions referring IIOE-2 endorsed projects, cruises, conferences, workshops, "plain language summary" of published papers focused on the Indian Ocean etc. are welcome. Articles may be up to 500 words in length (Word files) accompanied by suitable figures, photos.(separate.jpg files).

Deadline: **25 September, 2018**

The Indian Ocean Bubble-2

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IOGOOS Global Ocean Observing System for Indian Ocean

UNESCO United Nations Educational, Scientific and Cultural Organization | Intergovernmental Oceanographic Commission

SCOR International Council for Science Scientific Committee on Oceanic Research