



2nd International  
Indian Ocean  
Expedition  
2015-2020

# Newsletter

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

Volume-4, Issue-5  
May, 2020

*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.*

## Congratulations to Professor Lynnath Beckley on receiving the Australian Marine Sciences Jubilee Award

The UNESCO Intergovernmental Oceanographic Commission (IOC) and its Perth Programme Office (PPO) would like to congratulate Professor Lynnath Beckley of Murdoch University on receiving the esteemed Australian Marine Sciences Association (AMSA) Jubilee Award for her extensive contribution to marine research in Australia. Prof. Beckley has been a long-time supporter of marine research in Western Australia/Australia and has made profound contributions in international ocean research.



Professor Lynnath Beckley led a major IIOE-2 expedition aboard the RV Investigator in 2019

Prof. Beckley has been an important contributor to the Second International Indian Ocean Expedition (IIOE-2:2015-25) from the very beginning and supports many alliances complementary to the IIOE-2 including Sustained Indian Ocean Biogeochemistry and Ecosystem Research (SIBER). She has engaged through her vast reserves of energy, enthusiasm and personal time in many global marine research coordination efforts designed to advance understanding of the Indian Ocean. Prof. Beckley is also the chair of the IIOE-2 Australian National Committee, and in mid-2019 led a major IIOE-2 expedition off WA which involved a large international team of scientists and students on the RV Investigator re-traversing the '110° East' transect of the

original IIOE-1 of 1959-65 to examine the effects of climate change, oceanographic processes and marine biota.

UNESCO-IOC Executive Secretary / ADG UNESCO Dr Vladimir Ryabinin said: "... Prof. Beckley's support of programs within the UNESCO framework through international alliances such as facilitated by the local UNESCO IOC office in Perth have been of immense value to ocean science. Prof. Beckley has entrained many emerging scientists into her framework of research and educational initiatives including through Capacity Development forums that she has generously led and supported. This has resulted in benefits to many from countries not so developed in ocean science."

Prof. Beckley is a truly inspiring advocate for the protection of our oceans. UNESCO IOC and its PPO look forward to continuing to collaborate and are proud to be associated with her.

Also see: <https://www.murdoch.edu.au/news/articles/murdoch-marine-scientist-receives-prestigious-career-award>

Report Courtesy: Nick D'Adamo, UNESCO-IOC Perth Programme Office, Australia, E-mail: [nick.dadamo@bom.gov.au](mailto:nick.dadamo@bom.gov.au)

## New IIOE-2 Endorsed Project- Dinitrogen Fixation in the Indian Ocean: an interbasin and seasonal comparison (DINDE)

Biological dinitrogen ( $N_2$ ) fixation sustains primary production globally, fueling the marine food chain and promoting  $CO_2$  sequestration. While  $N_2$  fixation has been extensively studied in the North Atlantic, North and South Pacific Oceans, the Indian Ocean remains a mystery, being absent from basin-scale  $N_2$  fixation estimations and thus from global ocean budgets. Nonetheless, modeling studies suggest high  $N_2$  fixation activity in the Indian Ocean which await to be validated with in situ data.

The Indian Ocean basin is divided into the Arabian Sea to the west and the Bay of Bengal to the east of Indian subcontinent, whose circulation is controlled by the Asian monsoon system. In the Arabian Sea, the summer monsoon drives coastal upwelling off Yemen and Somalia, while the winter monsoon causes convective mixing in its northern part. Both processes bring deep nutrient-rich waters to the surface promoting strong phytoplankton blooms. This phytoplankton biomass is advected offshore and subsequently respired in the water column, creating the thickest oxygen minimum zone of the world's oceans. The effects of the reversing monsoons are similar in the Bay of Bengal, but here the large freshwater inputs from the Brahmaputra and Ganges rivers promote stratification constraining mixing with nutrient-rich deep waters and hence phytoplankton blooms.

The two sub-basins are good candidates to hold an important  $N_2$  fixation activity. The oxygen minimum zone of the Arabian Sea harbors high fixed nitrogen loss rates, which in the absence of important atmospheric nitrogen inputs can only be balanced with fixed nitrogen gains via biological  $N_2$  fixation. In the Bay of Bengal, nitrogen losses and gains are unbalanced by  $\sim 4.7$  Tg N per year which together with the low  $^{15}N$  values measured in sediment traps point towards an important role of  $N_2$  fixation in this basin (e.g. see a related news item below on Dinitrogen fixation rates in the Bay of Bengal during summer monsoon).

$N_2$  fixation is performed by specialized prokaryotes called 'diazotrophs' which include filamentous and unicellular cyanobacteria, bacteria and archaea groups. The filamentous cyanobacterium *Trichodesmium* thrive in oligotrophic, warm and stratified waters, and has been recurrently observed in the Indian Ocean during the nutrient- poor episodes of the intermonsoon. Unicellular cyanobacterial and non-cyanobacterial (bacterial and archaeal) diazotrophs display a larger geographic distribution and can thrive in relatively nutrient-rich and cold waters such as coastal upwelling systems or estuarine environments. In the Indian Ocean, non-cyanobacterial diazotrophs have been observed during the summer monsoon when the waters are nutrient-rich and phytoplankton productivity is high. To date, we do not know what controls cyanobacterial vs. non-cyanobacterial activity in the two sub-basins and to what extent this process contributes to reactive nitrogen inputs in the Indian Ocean.

The goal of the DINDE project is to decipher the role of cyanobacterial vs. non-cyanobacterial diazotrophy in the two sub-basins of the IO between monsoon seasons. As the Indian Ocean is warming faster than any other basin in the world's oceans, quantifying its  $N_2$  fixation capacity and understanding its biogeochemical dynamics emerges as a priority in current oceanographic research. DINDE lays the ground for a new collaboration between India and France and integrates the second International Indian Ocean Expedition (IIOE-2) by joining cruises on German and Indian vessels. This project has been endorsed by IIOE-2 (IIOE2-EP41).

[Report Courtesy: Mar Benavides, Mediterranean Institute of Oceanography (MIO), France.  
E-mail: [mar.benavides@ird.fr](mailto:mar.benavides@ird.fr)]

## Response of the Bay of Bengal to 3-7-day Intraseasonal Oscillations during the 2019 Southwest Monsoon

Intraseasonal oscillations (ISOs) heavily impact the variability and strength of southwest monsoon rainfall in the Bay of Bengal (BoB). Of these ISOs, the 3-7-day mode associated with synoptic-scale variability and oscillations in the monsoon trough directly impact the active and break cycles of the monsoon, which in turn control the patterns of flooding (active phase) and droughts (break phase) over the Indian subcontinent and the surrounding areas. The 2019 southwest monsoon was the first strong monsoon since 1994. During this most recent strong monsoon, 3-7-day events, superimposed on a background signal of the 30-90-day Madden-Julian Oscillations (MJO), significantly increased precipitation over central India

(Figure-1), with this region receiving over 1500 mm of rain. In contrast, monsoonal precipitation over southern India was principally controlled by the 10-20-day and 30-90-day ISOs, and this region received less than half of the amount of rainfall received over central India. Both the 3-7-day and 10-20-day ISOs seem to be heavily influenced by the Indian Ocean Dipole (IOD) and MJO. The strong, positive IOD and northward MJO propagation served as background processes that conditioned both the ocean and atmosphere for intense 3-7-day events.

The strong monsoon of 2019 owes much of its strength to a combination of the super IOD and ISO variability, with 3-7-day variability heavily modulating the active and break phases of the monsoon, the former of which led to significant flooding in many parts of India. Wind stress perturbations in the northern and central BoB confined 3-7-day ISO variability to the upper mixed layer. In the southern BoB, however, anticyclonic mesoscale eddying allowed for a deeper penetration of 3-7-day variability in temperature, salinity, and geostrophic currents down to 300 m.

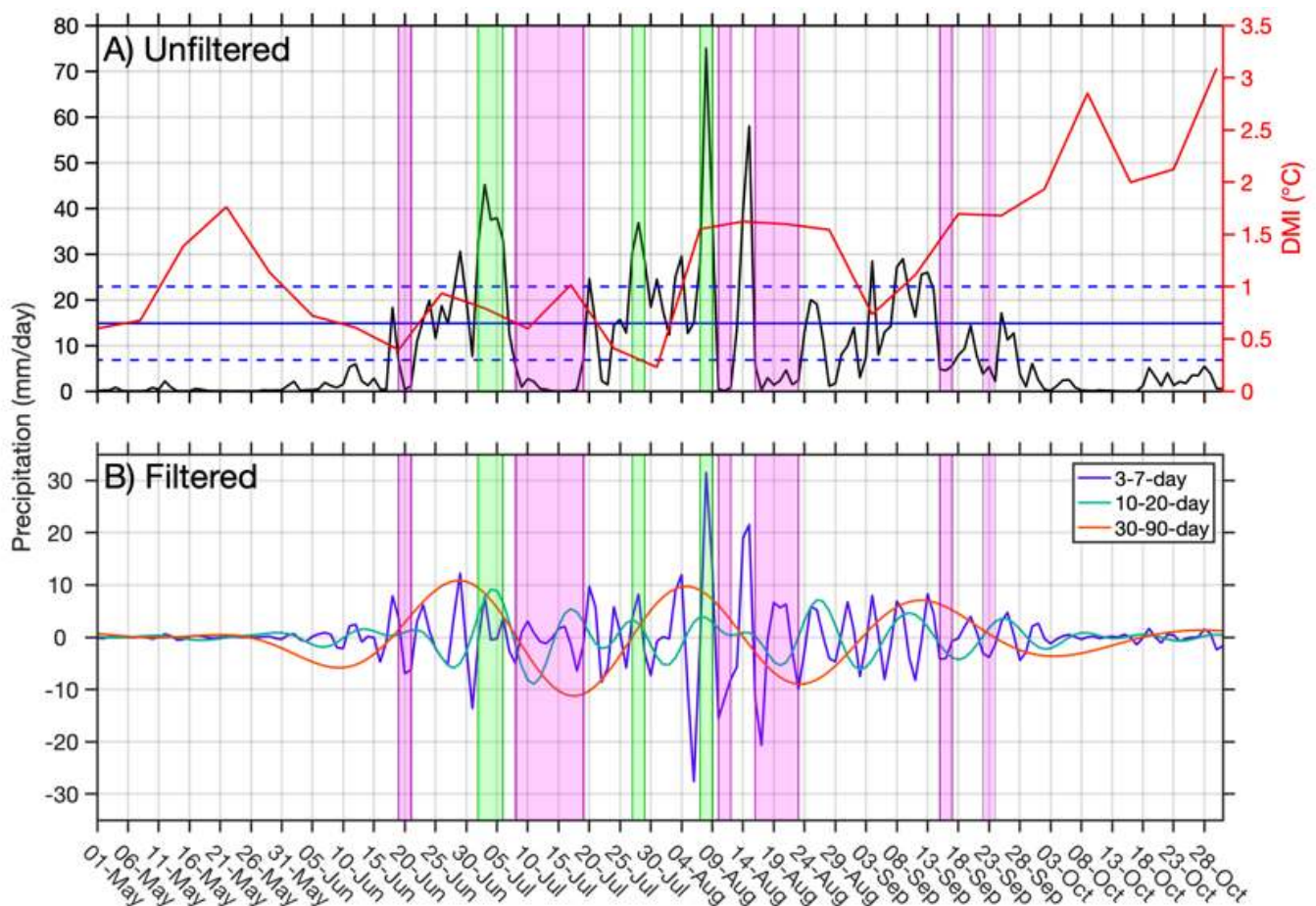


Figure-1: Box averaged time series of (top) unfiltered GPM precipitation over central India (73-78E, 20-25N) (black; mm/day) and Dipole Mode Index (DMI; red; °C) and (bottom) GPM precipitation bandpass filtered with 3-7-day synoptic oscillations (purple; mm/day), the 10-20-day ISO (teal; mm/day), and the 30-90-day ISO (orange; mm/day) in the same central India box. In the top figure, the solid blue line indicates the mean July/August rainfall over central India and blue dashed lines indicate  $\pm 0.5$  standard deviation. Weekly DMI values are retrieved from NOAA and are calculated as the difference in OISST anomalies between DMI West (50-70E, 10S-10N) and DMI East (90E-110E, 10S-0N). Active phases of the monsoon are indicated by green boxes; magenta boxes indicate break phases based on criteria from Singh and Nakamura (2010).

Citation: Subrahmanyam, B., H. L. Roman-Stork, V.S.N. Murty (2020). Response of the Bay of Bengal to 3-7-day Synoptic Oscillations during the Southwest monsoon of 2019, *Journal of Geophysical Research-Oceans*, 125, e2020JC016200. <https://doi.org/10.1029/2020JC016200>

[Report Courtesy: B. Subrahmanyam, University of South Carolina, Columbia, United States.  
E-mail: sbulusu@geol.sc.edu]

## Dinitrogen fixation rates in the Bay of Bengal during summer monsoon

Phytoplankton in the oceans perform approximately 50% global primary production. Bioavailable nitrogenous nutrients (N) (e.g., nitrate, nitrite, ammonium, urea and amino acids, excluding dinitrogen ( $N_2$ ) gas) are often pointed out as a factor that limits primary production in the Sunlit layer of the oceans. On the contrary, low N in the oceans creates a suitable niche for  $N_2$  fixing microorganisms which reduce the most abundant but relatively inert  $N_2$  to  $NH_4^+$ . Therefore, in N limited marine environments, biological  $N_2$  fixation provides a significant source of N for primary production and thus, helps in sustaining ocean fertility. The Bay of Bengal which is the north-eastern part of the Indian Ocean is one such region which is generally nitrate-poor and warm due to prevailing stratification and thus, could favour  $N_2$  fixation. In a recent study, Saxena et al. (2020), have commenced the first  $N_2$  fixation study in the photic zone of the Bay of Bengal using  $^{15}N_2$  gas tracer incubation experiment during summer monsoon (12 July- 2 August, 2018). The observed  $N_2$  fixation rates varied from 4 to 75  $\mu\text{mol N m}^{-2} \text{d}^{-1}$ . These rates are low in terms of percentage contribution ( $< 1\%$ ) to primary production. Due to summer monsoon, turbidity owing to copious riverine discharge and cloud cover over the Bay of Bengal might have contributed towards the low rates of  $N_2$  fixation. However, the upper bound of these  $N_2$  fixation rates is higher than the rates measured in other oceanic regimes, such as the Eastern Tropical South Pacific, the Tropical Northwest Atlantic, and the Equatorial and Southern Indian Ocean. This study underscores the global importance of the Bay of Bengal in the global marine nitrogen cycle.

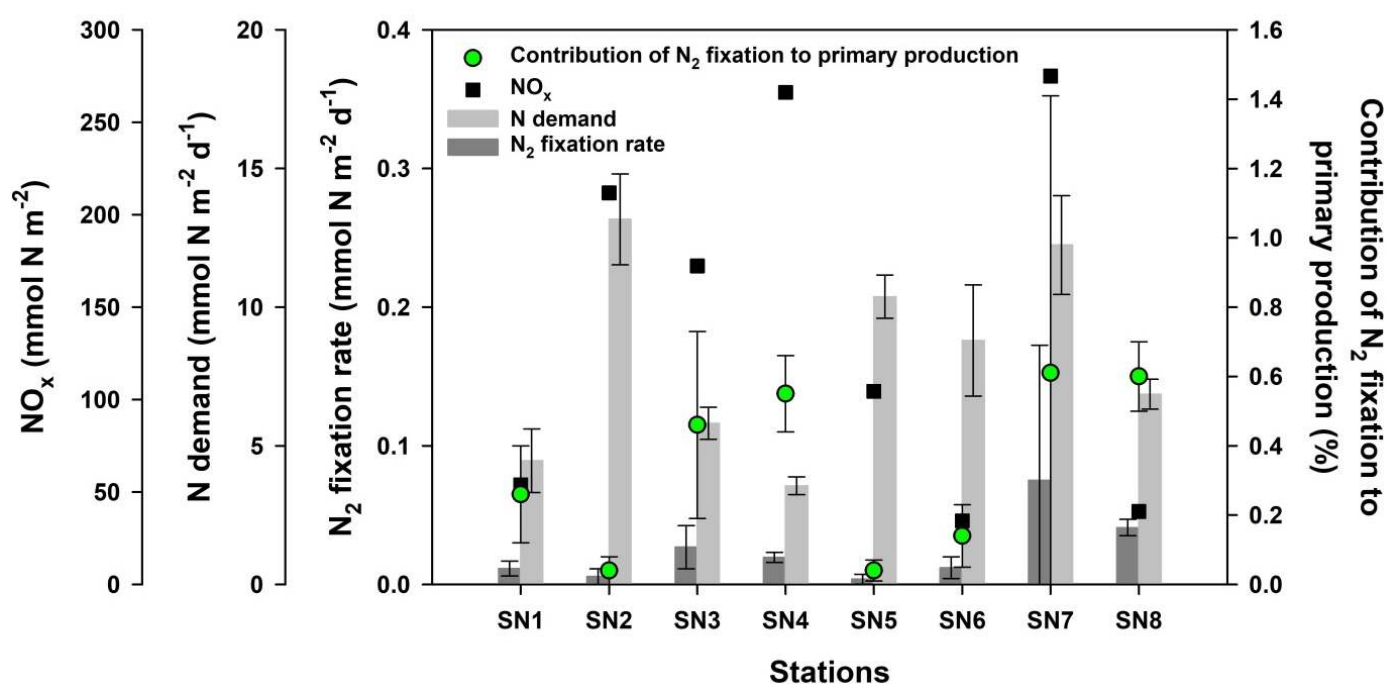


Figure: Photic zone integrated  $NO_x$  (nitrate + nitrite), N demand,  $N_2$  fixation rate and contribution of  $N_2$  fixation to primary production at all the stations.

Reference: Himanshu Saxena, Deepika Sahoo, Mohammad Atif Khan, Sanjeev Kumar, A. K. Sudheer, Arvind Singh (2020). Dinitrogen fixation rates in the Bay of Bengal during summer monsoon. Environmental Research Communication. doi:10.1088/2515-7620/ab89fa

[Report Courtesy: Himanshu Saxena, Physical Research Laboratory, Ahmedabad, India. E-mail: himanshu@prl.res.in]

## POSTPONEMENT of the 15<sup>th</sup> Pan Ocean Remote Sensing Conference (PORSEC-2020) and Capacity Building Tutorial to year 2021

It is with regret that we announce that the 15<sup>th</sup> Pan Ocean Remote Sensing Conference (PORSEC2020) and capacity building tutorial, scheduled for 15-22 September 2020, have unfortunately been postponed to 2021 over Coronavirus (COVID-19) concerns. We continue to monitor the situation and will decide and announce the new dates sometime around September of this year, or when the situation becomes normal again.

In the meantime, we are continuing accepting new abstracts and registrations, which will remain open until 15 September 2020. The Committee has decided to publish the first volume of abstract proceedings (with ISBN) by December 2020, prior to the conference. At that time we will also consider the preparation of and call for papers for a first volume of a Special Issue of the International Journal of Remote Sensing (IJRS), prior to the conference. We will send out the details to all participants once we have made the decision.

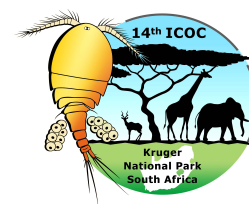
The Committee has arrived at this decision after realizing our capacity to keep an audience sufficiently “distanced” and considering the current uncertainty around gatherings and people’s justifiable precautions regarding their own health.

Our sincere apologies for any inconvenience that the postponement may have caused. We wish to thank all speakers, sponsors, exhibitors and participants for their continued support of the event, and we look forward to seeing you at the new date that we will announce.

[Report Courtesy: Nurul Hazrina Idris, Chair of PORSEC2020 LOC, Universiti Teknologi Malaysia, Skudai, Johor, MALAYSIA. E-mail: nurulhazrina@utm.my]

## POSTPONEMENT of 14<sup>th</sup> International Conference on Copepoda (ICOC 2020) to 2021

Due to the COVID-19 virus, the ICOC 2020 and pre-conference workshop scheduled to take place in June 2020, have been postponed by one year. The new dates will be 31 May – 4 June 2021 for the preconference workshop at the University of Limpopo in Polokwane, and 6 – 12 June for the conference in Skukuza, Kruger Park, South Africa. The conference will still be referred to as the ICOC2020 and not the ICOC2021.



Unfortunately, increase in prices and costs can be expected, with an increase in the accommodation costs and probably also in the registration fees. These can only be calculated at a later date. The registration website will stay open for new participants to register and book, while the list of people who already registered will be saved, together with all the payments already received, and transferred to the bookings for June 2021.

Abstract submissions for the ICOC 2020 in June 2021 have re-opened. Please go to <https://app.oxfordabstracts.com/dashboard/events/1160> where you can decide whether you want to keep your abstract as submitted for June 2020 or whether you want to change it for June 2021. Note that there is no deadline yet, and this will be determined at a later stage, probably 30 December 2020.

Visit [https://www.abevents.co.za/web\\_icoc2020/](https://www.abevents.co.za/web_icoc2020/) for further details.

## POSTPONEMENT of International Indian Ocean Science Conference (IIOSC)-2020

In view of the recent outbreak of COVID-19, the safety of delegates is of paramount importance for the conference organisers. Therefore, upon recommendation of UNESCO-IOC amid concerns raised by many delegates spread across the world, the International Indian Ocean Science Conference (IIOSC)-2020 has been postponed till further notice.

More details on the Conference are available at the website <https://iiosc2020.incois.gov.in/>

### MESSAGE BOARD

- ✉ IIOSC-2020 Letter to Airlines
- ✉ Instructions for Presenters
- ✉ Allowed Poster size A0 (118 cm height x 84 cm width)



## Endorse your projects in IIOE-2

Don't miss the opportunity to network, collaborate, flesh out your research project and participate in IIOE-2 cruises!!

The endorsement of your scientific proposal or a scientific activity focusing on the Indian Ocean region is a recognition of the proposal's or activity's alignment with the mission and objectives of IIOE-2, of its potential for contributing to an increased multi-disciplinary understanding of the dynamics of the Indian Ocean, and of its contribution to the achievement of societal objectives within the Indian Ocean region. Over 41 international, multi-disciplinary scientific projects have already been endorsed to date by the IIOE-2. Yours could be the next one!

Visit <https://iioe-2.incois.gov.in/IIOE-2/EndorsementForm.jsp> for further details and for projects already endorsed by IIOE-2 [https://iioe-2.incois.gov.in/IIOE-2/Endorsed\\_Projects.jsp](https://iioe-2.incois.gov.in/IIOE-2/Endorsed_Projects.jsp).

## CLIVAR May 2020 Bulletin is available online



The International CLIVAR Project Office distributes a monthly bulletin with announcements, funding opportunities, meeting notifications relevant to the ocean/climate science community.

The latest CLIVAR Bulletin May, 2020 is available at:

<https://mailchi.mp/clivar.org/clivar-may-2020-bulletin>

### Call for Contributions

Informal articles/short notes of general interest to the IIOE-2 community are invited for the next (June-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 June, 2020**



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<https://iioe-2.incois.gov.in/IIOE-2/Bubble.jsp>



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