IIOE-2 2nd International Indian Ocean Expedition 2015-2025

Newsletter

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

Volume-6, Issue-1
January, 2022

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.

Reviews and syntheses: Physical and biogeochemical processes associated with upwelling in the Indian Ocean

Upwelling is a process by which cooler, nutrient-rich subsurface water replaces the warm surface water. This can cause a significant change in the upper surface water properties that impact the local ecosystem and biogeochemistry. The dynamics that drives this upward flow of water depends on local and remotely forced air-sea interactions, coastal geometry and currents and thus, varies from one region to the other. A recent paper by Vinayachandran et al. (Biogeosciences, 2021) provides a review of the upwelling systems along the coast of the Indian Ocean extending from the tip of South Africa to the southern coast of Australia. The observed features, dynamical mechanisms and their impact on the biogeochemistry and ecosystem are presented. While the physical boundary of the coast is one of the necessary conditions for the water to upwell, easterlies drive upwelling along the equator due to Ekman divergence as the change in Coriolis force across the equator acts as a dynamic boundary. Upwelling is also possible in the open ocean without physical or dynamic boundaries and is driven by windstress curl.

Cyclonic eddies dominate upwelling in the Agulhas current region. The alongshore winds and topographic effect also augment the eddy driven upwelling, causing enhanced chlorophyll concentration along the continental margin. A similar eddy driven upwelling is also seen along the coast of Madagascar and within the Mozambique coast, which stimulates new production and redistribution of phytoplanktons. The western Arabian Sea along the coast of Somalia and Arabia presents a classical Ekman type upwelling during the summer monsoon; however, such upwelling is modulated by the remotely forced Rossby waves generated offshore by the windstress curl. Eventually, the upwelled nutrients along the Somali coast accumulates in the north, leading to spatial heterogeneity in the chlorophyll concentration. In contrast, chlorophyll concentration is more uniform along the coast of Arabia.

The upwelling along the coast of India is driven by alongshore monsoon winds and the coastally trapped waves. As the upwelling is generally weaker in the Bay of Bengal due to strong river discharge induced stratification, the primary productivity is weaker along the east coast than on the west coast of India. Similar mechanisms are in play along the coast of Java and Sumatra, where equatorial Kelvin waves and coastal winds determine the intensity of the upwelling.

In contrast to the above, the upwelling along the west coast of Australia is sporadic and is characterized by the anomalous Leeuwin currents.Open ocean upwelling in the thermocline ridge region in the south tropical Indian Ocean and within Sri Lanka Dome is primarily driven by windstress curl. The propagation of Rossby wave, often driven by climate modes, also modules such open ocean upwellings.The review highlights that despite significant progress in our understanding of the major upwelling systems of the Indian Ocean, three are areas where the unavailability of quality observation is evident. The northern coast of the Arabian Sea and the eastern coast of the Bay of Bengal in the north Indian Ocean are found to be the least observed sectors. Additional focused, long-term and sustainable observation networks and high-resolution ocean modelling are recommended for further understanding of the upwelling systems and their impact on air-sea coupling and ecology on the Indian Ocean.

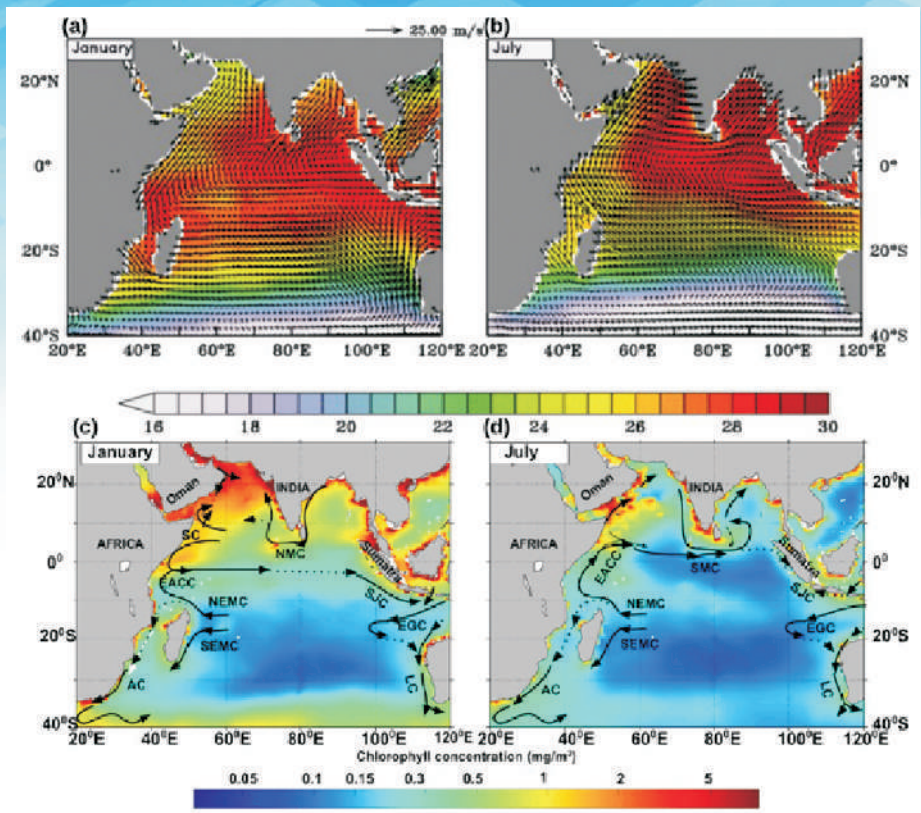


Figure: Upper panels show climatological (Locarnini, 2018) sea surface temperature (SST) averaged from surface to 50m depth (shaded) and NASA Quick Scatterometer (QuikSCAT) (http://apdrc.soest.hawaii.edu./, last access: 3 November 2021) winds (vectors ms 1/, for the months of (a) January and (b) July. The colour scale for SST is given below the panels, and the scale vector for wind speed is given at the top. Lower panels show a schematic representation of the major current systems (modified after Schott et al., 2009) in the Indian Ocean for (c) January and (d) July, overlaid on chlorophyll (shaded, mg m^{-3}) climatology. Abbreviations (not all shown in the figure but used throughout) are as follows: Agulhas Current (AC), West India Coastal Current (WICC), East India Coastal Current (EICC), Sri Lanka Dome (SLD), South Equatorial Current (SEC), South Equatorial Countercurrent (SECC), Northeast Madagascar Current and Southeast Madagascar Current (NEMC and SEMC), East African Coastal Current (EACC), Somali Current (SC), Southern Gyre (SG) and Great Whirl (GW), Northeast Monsoon Current (NMC), South Java Current (SJC), Indonesian Throughflow (ITF), East Gyral Current (EGC), Leeuwin Current (LC), and Southwest Monsoon Current (SMC). Chlorophyll data are monthly climatology data from SeaWiFS (http://nomads.gfdl.noaa.gov, last access: 3 November 2021).

Citation:Vinayachandran, P.N., Masumoto, Y., Roberts, M.J., Huggett, J.A., Halo, I., Chatterjee, A., Amol, P., Gupta, G.V., Singh, A., Mukherjee, A., Prakash, S., Beckley, L. E., Raes, E. J. and Hood, R. (2021) Reviews and syntheses: Physical and biogeochemical processes associated with upwelling in the Indian Ocean. Biogeosciences, 18(22), pp.5967-6029.

[Report Courtesy: Dr. Abhisek Chatterjee, Scientist, INCOIS, Hyderabad , India E-mail: abhisek.c@incois.gov.in]

Impact of tropical cyclones on the hydrobiology of Asia's largest brackish water lagoon

Cyclones can exert a wide range of short- and long-term impacts on the ambient hydrobiology of coastal lagoons. It is known that the extent of the impact is determined by the physico-meteorological characteristics (such as wind velocity, pressure drop, land fall location) of a cyclone and geographic, geomorphic, and bathymetric characteristics of a lagoon. A group of researchers from the University of Georgia (USA), Chilika Development Authority (India), and XIM University (India) analyzed the impact of two cyclones that made landfall in the vicinity of Chilika lagoon in two different seasons: cyclone Fani during pre-southwest monsoon (May 03, 2019), and cyclone Titli towards the end of the south-west monsoon (October 11, 2018).

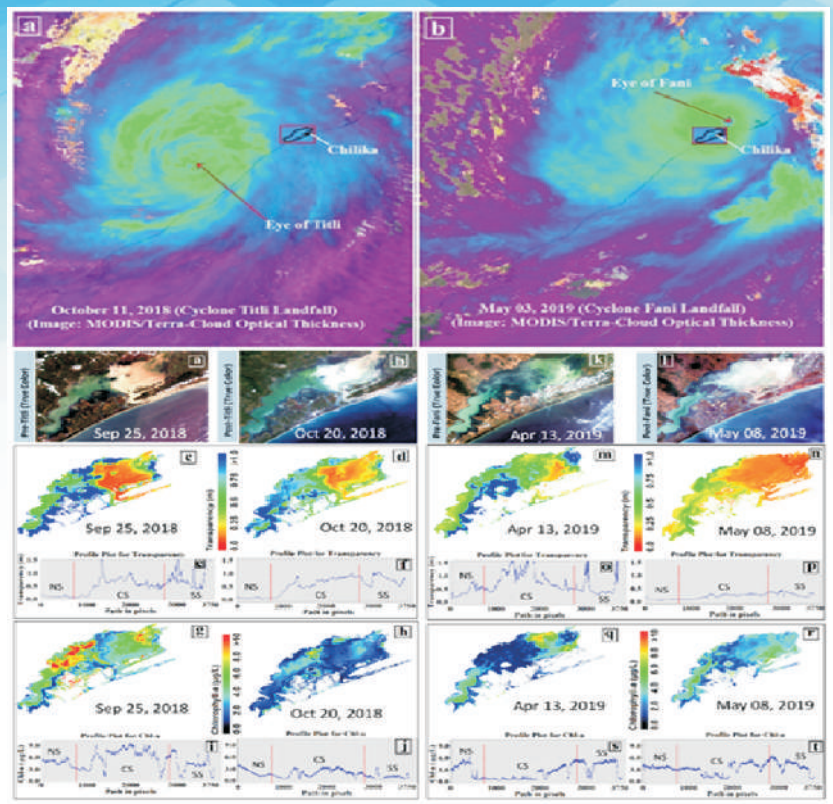


Figure: MODIS/Terra derived satellite images showing landfall of both cyclones (a) Titli, and (b) Fani (Left panel) and maps showing pre and post-cyclonic impact (Right panel); using true color Sentinel 2-MSI image (Titli: a and b; Fani: k and l), model-derived transparency maps (Titli: c and d; Fani: m and n), transparency transect (transect: blue line in maps) analysis across three sub-sectors (Titli: e and f; Fani: o and p), model-derived Chl-a maps (Titli: g and h; Fani: q and r), and Chl-a transect analysis across three sub-sectors (Titli: i and j; Fani: s and t).

They hypothesized that the landfall timing of a cyclone could be potentially crucial in determining the hydrobiological impact of a monsoon-regulated tropical coastal lagoon such as Chilika. The study comprised in situ and satellite-measurements of water quality parameters, including nutrient, salinity, water temperature, transparency, chlorophyll-a (chl-a), total suspended matter (TSM), and colored dissolved organic matter (CDOM) before and after the passage of the cyclones. The results showed that although both the cyclones were of comparable intensities, their impact on the lagoon's water quality was contrasting after the landfall. The post-southwest monsoon cyclone (Titli) produced a substantial increase in total nitrogen (TN) and total phosphorous (TP), a large drop in salinity, CDOM, and chl-a compared to pre-southwest monsoon cyclone (Fani) that did not result in any such substantial changes except for a marginal elevation in chl-a concentration.

Based on the studies, the researchers concluded that the controlling factor in determining the impact of a cyclone on a monsoon-regulated lagoon is the rate and duration of freshwater discharge to the lagoon, which was a strong pulse for Fani and a continued high flow for Titli. They also concluded that the antecedent conditions of the lagoon and the watershed at the time of a cyclone's landfall is a key criterion in determining the hydrobiological impact.

Citation: Mishra, D.R., Kumar, A., Muduli, P.R., Acharyya, T., Acharya, P., Singh, S. and Rastogi, G., 2021. Landfall season is critical to the impact of a cyclone on a monsoon-regulated tropical coastal lagoon. Science of The Total Environment. 70, p.145235. https://doi.org/10.1016/j.scitotenv.2021.145235

[Report Courtesy : Sambit Singh (E-mail: sambitsinghjspur@gmail.com), Susmita Raulo Tamoghna Acharyya (E-mail: acharyyat@xim.edu.in, XIM University, Bhubaneswar, India]

The Indian Ocean Bubble, Issue No.15 is now available online

Web Link: https://iioe-2.incois.gov.in/IIOE-2/pdfviewer_pub.jsp?docname=IIOE-2-DOC_OM_231.pdf

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: 15 February, 2022

Send your contributions as usual to iioe-2@incois.gov.in

IIOSC-2020 Conference rescheduled to 14-18 March, 2022

International Indian Ocean Science Conference (IIOSC) 2020 was postponed due to COVID-19 pandemic situation. We are happy to inform that the conference is now rescheduled to March 14-18, 2022 as IIOSC-2022 conference. We are hoping to have an in-person conference in Goa, India (with an option to join online) in the hope that COVID situation eases by then. In the event that the travel situation does not improve, IIOSC-2022 will still go ahead as an online event.

Please visit the Conference web-site https://iiosc2020.incois.gov.in/

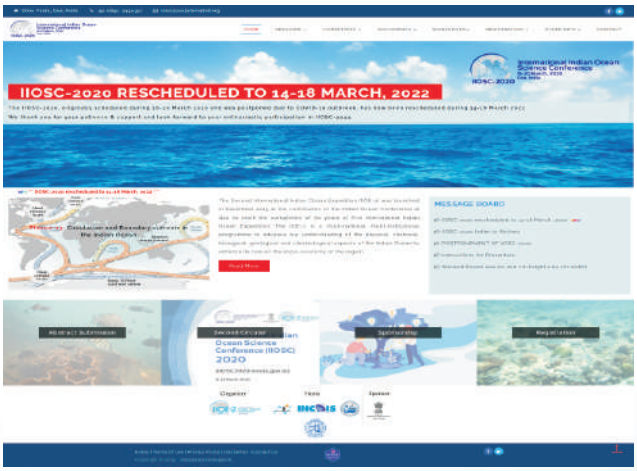
If you have any general queries regarding the conference, venue, registration, transport, accommodation or visa, please contact us at iiosc2020@nio.org / iiosc2020@incois.gov.in

Conference Website: https://iiosc2020.incois.gov.in/

IMPORTANT DATES

Early Bird Registration : 08 February, 2022 NEW

Registration Closes on : 15 February, 2022



Institution of Electrical and Electronic Engineers Oceanic Engineering Society (IEEE OES) and Marine Technology Society (MTS) are organizing the world's largest Ocean conference, Oceans 2022 Chennai for the first time in India. The event is jointly organized by the pioneers of India in the field of Ocean Technology, the Indian Institute of Technology (IIT) Madras, and the National Institute of Ocean Technology (NIOT), Chennai, and is scheduled during February 21-24, 2022, both in-person and virtual. The main theme of the conference, INSPIRE-INNOVATE-SUSTAIN, is expected to attract about 1000 delegates with 500 papers being planned for presentation with a good number of plenary sessions with talks from leading personalities around the globe contributing to the field of Ocean

With Technical paper presentations, Tutorials, social and networking opportunities, professional field trips, etc. IEEE OCEANS 2022 will provide the delegates an insight on evolving technology and knowledge in the areas of:

- UN Decade of Ocean Science for Sustainable development
- Underwater Acoustics and Acoustical Oceanography
- Sonar signal/image processing and communication
- Ocean Observing Platforms; systems and instrumentation
- Remote Sensing
- Ocean Data Visualization, Modelling, and Information Management
- Marine Environment, Oceanography and Meteorology
- Optics, Imaging, Vision and EM Systems
- Marine Law, Policy, Management, and Education
- Offshore Structures and Technology
- Ocean Vehicles and Floating Structures
- Petroleum Engineering

Some of the top plenary speakers are Dr. Margaret Leinen, Director, Scripps Institute of Oceanography, Dr. Satheesh Reddy, Secretary Department of Defence R&D and Chairman DRDO, Dr. Peter Haugan, Former Chair Intergovernmental Oceanographic Commission, UNESCO; Programme Director at Institute of Marine Research, Professor at the Geophysical Institute, University of Bergen, Norway; Dr. Shailesh Nayak, Former Secretary, Ministry of Earth Sciences to name a few. A panel discussion on the current topics of interest like Global warming with leading speakers also is planned. A student poster session featuring outstanding projects from around the globe is another event. Student Hackathon competition and other student activities will also be at the conference. A plethora of exhibitors showcasing their latest innovations will be another event.

All are welcome to register and attend the conference. Now that Covid restrictions are eased out, please attend in person. All safety precautions will be in place. For complete details visit https://chennai22.oceansconference.org/.

[Report Courtesy: M. A. Atmanand, Visiting Professor, Indian Institute of Technology, Chennai, India, E-mail: atmanandma@hotmail.com]

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 45 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.

CLIVAR January 2022 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 January, 2022 is available at:

https://mailchi.mp/clivar.org/clivar-january-2022-bulletin?e=7f5a74dc93

Call for Contributions

Informal articles/short notes of general interest to the IIOE-2 community are invited for the next (February-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 February, 2022**

The Indian Ocean Bubble-2

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