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

Newsletter

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

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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.

High-resolution numerical modelling of seasonal volume, freshwater and heat transport along the Indian coast

The study investigates the exchange of waters between the Arabian Sea (AS) and the Bay of Bengal (BoB) which helps to regulate its salinity (see Figure-1). This study focuses on the distinct oceanographic processes that govern the alongshore volume transport (AVT) and freshwater transport (AFT) across the eastern and western coasts of India, as well as the broader role of meridional heat transport (MHT) in regulating these dynamics. For this we use the high-resolution MITgcm model configuration.

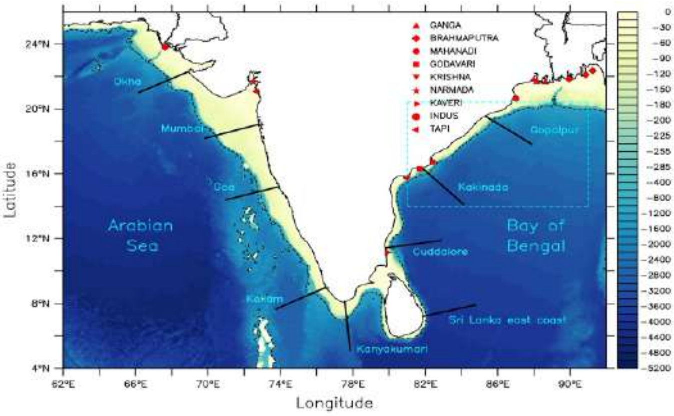

Figure-1: Study area depicting the bathymetry of the domain in colour scale. The red symbols represent the discharge points of major river systems in India. All transects are 3° in length (solid black lines).

Our findings based on AVT and AFT reveal the differences between the eastern and western coasts of India. Along the eastern coast, the AVT exhibits strong seasonal variability (see Figure-2), governed by the East Indian Coastal Current (EICC) and the poleward-flowing Western Boundary Current (WBC). The seasonal influence of the EICC leads to stronger equatorward flows during the monsoon period, driven by enhanced freshwater input from river discharge. This is evident in the significant peaks in AFT during the southwest monsoon season, with freshwater accounting for up to 6.03% of the total transport. During this time, riverine discharge and monsoonal precipitation intensify the flow of freshwater along the coast, particularly in the BoB. In contrast, the AVT along the western coast is characterized by large intraseasonal oscillations, mainly driven by the Western Indian Coastal Current. Unlike the eastern coast, where AVT and AFT follow a similar seasonal pattern, the western coast exhibits an inverse relationship between AVT and AFT. This discrepancy can be attributed to the complex salinity dynamics in the Arabian Sea, where the interplay of evaporation, freshwater input, and ocean circulation governs the transport patterns.

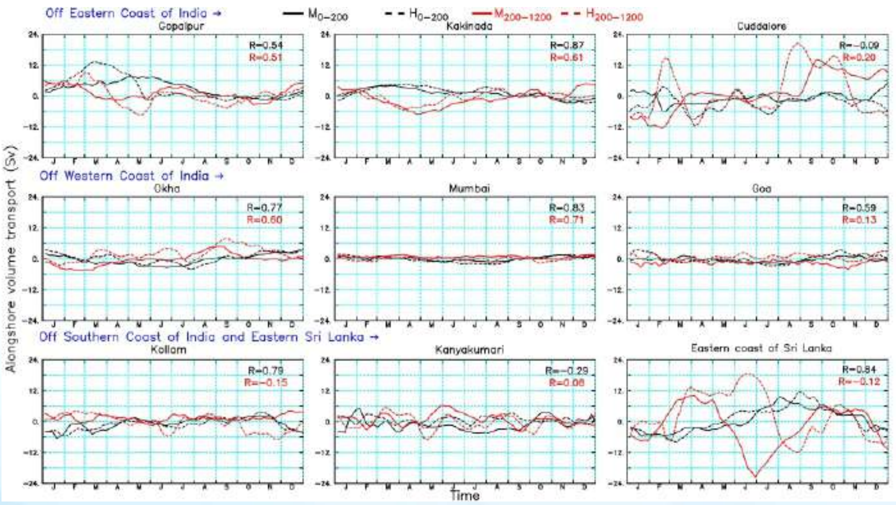

Figure-2: AVT (in Sv) of the MITgcm (solid lines) and INC-HYC (dashed lines) with their correlation coefficients.

An important aspect of the study is the interaction between eddies and coastal currents, which play a crucial role in redistributing freshwater and heat along the coasts. Mesoscale eddies, particularly in the BoB, influence vertical mixing and stratification, transporting freshwater zonally and meridionally. The study also emphasizes the role of MHT in determining the thermal structure of the north Indian Ocean (NIO). MHT in the AS is notably stronger than in the BoB (see Figure 3), primarily due to the differences in wind intensity, stratification, and vertical mixing. During the pre-monsoon season, poleward heat transport by the WBC creates strong thermal gradients, while in winter, reduced heat transport is driven by weaker winds and cooler atmospheric conditions. The overall pattern shows that the NIO acts as a heat source during the summer monsoon and as a heat sink during winter, with the meridional transport of heat playing a key role in balancing the region's heat budget.

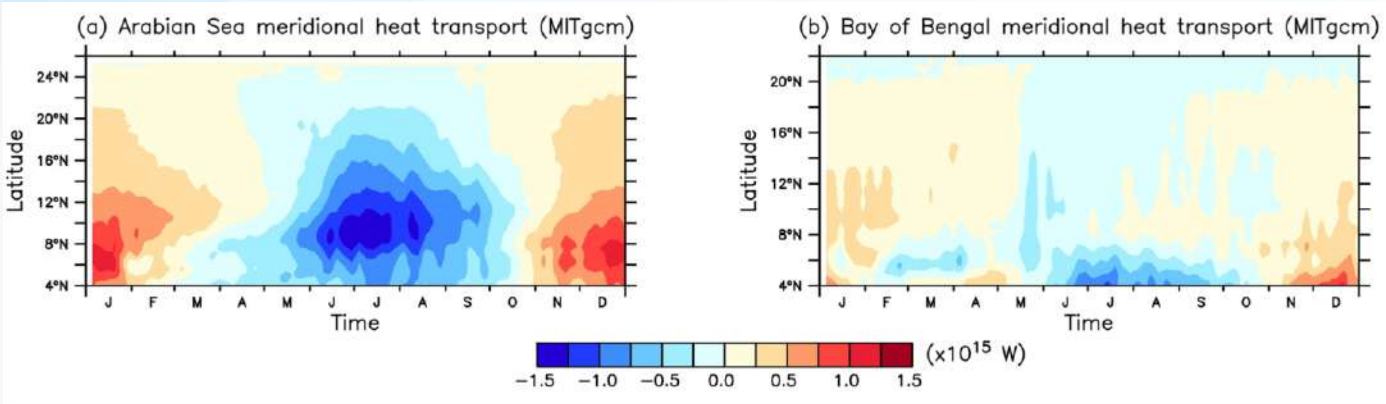

Figure-3: Meridional heat transport (in PW) computed over the upper 100 m for the AS and BoB. Red (blue) colour indicates northward (southward) transport.

Citation: Madkaiker, K., Rao, A. D., and Joseph, S.: High-resolution numerical modelling of seasonal volume, freshwater, and heat transport along the Indian coast, Ocean Sci., 20, 1167–1185.

https://doi.org/10.5194/os-20-1167-2024

[Report Courtesy: Kunal Madkaiker, Centre for Atmospheric Sciences, Indian Institute of Technology Delhi, New Delhi, India; E-mail: kunal.ajit.madkaiker@cas.iitd.ac.in]

Tracking the Progress of Indian Oil Sardine Research

Indian oil sardine (Sardinella longiceps), dominating the Malabar upwelling zone, accounts for approximately 17–20% of India's total marine fish landings and constitutes about 66–96% of the total global catch. As a planktivorous species, sardine primarily consumes diatoms, acting as a vital energy conduit between lower trophic plankton and higher trophic predators, including large fish and marine mammals, thereby sustaining the marine food web. Due to its notable role in the ecological and economic contexts, oil sardine research in India started as early as 1924, by investigating the sardine's life cycle, growth and behavior. As an effort to track the development of Indian oil sardine research extensive literature survey, data mining, and scientometric analysis were carried out, which revealed a noticeable shift in the growth of literature, research area focuses, and research requirements.

The study considers efforts of the Indian research community for the last 100 years to critically analyze different aspects of oil sardine research and trace out the research gaps toward sustainable management of oil sardine fishery, along with providing a foundational framework for advancing future research on this revenue-generating fishery sector (Figure-1).

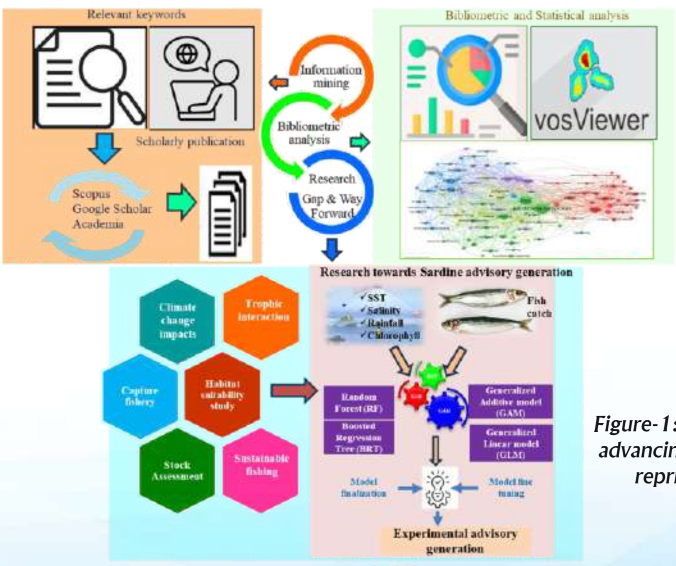

Figure-1: Schematic representing framework for advancing future research on oil sardine. Image reprinted with permission from Elsevier (Dash et al. 2024)

The evolution of research efforts now extends beyond baseline studies towards an increasing awareness of the multifaceted challenges posed by climate change and anthropogenic activities, prompting a transition toward interdisciplinary research aimed at oil sardine conservation. Additionally, it underpins the lack of comprehensive studies on oil sardine habitat suitability, especially in dynamic oceanographic conditions and environmental proxies, to predict oil sardine availability as the significant research gap. The investigation also points to the potential application of advanced predictive modeling techniques, including regression-based models such as Generalized Linear Models (GLM) and Generalized Additive Models (GAM), as well as machine learning approaches like Boosted Regression Trees (BRT) and Random Forest (RF), to predict oil sardine abundance and distribution effectively.

Citation: Dash, B., Baliarsingh, S.K., Samanta, A., Sahoo, S., Joseph, S., & Balakrishnan Nair, T.M. (2024). Evolution and Recent Trends of Indian Oil Sardine Research: A Review. Ocean & Coastal Management.

https://doi.org/10.1016/j.ocecoaman.2024.107396

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2025 ASI & IPFC 12 Annual Meeting

DEEP-SEA RESEARCH PART II

THE SUBMISSION PORTAL FOR VOL. 7 OF THE DEEP-SEA RESEARCH II SPECIAL ISSUE SERIES ON THE IIOE-2 IS NOW OPEN

Submission of manuscripts that describe the results of studies related to the physical, chemical, biological, and/or ecological variability and dynamics of the Indian Ocean (including higher trophic levels) is encouraged.

Submission of manuscripts from students and early career scientists is also encouraged.

If you are interested in submitting a manuscript, please contact Raleigh Hood (rhood@umces.edu).

Important Dates:
Editorial Acceptance Deadline: **February 15, 2025**
For more details please visit
https://www.sciencedirect.com/journal/deep-sea-research-part-ii-topical-studies-in-oceanography/about/call-for-papers#the-2nd-international-indian-ocean-expedition-iioe-2-motivating-new-exploration-in-a-poorly-understood-basin-volume-7

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 56 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.

Call for Contributions

Informal articles/short notes of general interest to the IIOE-2 community are invited for the next (November-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 November, 2024**

The Indian Ocean Bubble 2

Access the latest issue of Indian Ocean Bubble-2
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