2nd International Indian Ocean Expedition 2015-2025
IIOE-2
(A basin-wide research program co-sponsored by IOC-UNESCO, SCOR and IOGOOS)

Newsletter

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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.

Integrating Global Reanalyses and Ship-Based Observations to Characterize the Chemical Composition of aerosols in the Arabian Sea

Knowledge of the chemical composition of atmospheric aerosols is a key to understanding aerosol-cloud-climate interactions and surface water biogeochemistry in the oceanic regions. Shukla et al., (2025, see citation below) have studied the chemical composition of atmospheric particles in the Arabian sea and evaluated aerosol composition using long-term reanalysis datasets from CAMS and MERRA-2. By integrating seasonal ship-based chemical measurements in the Arabian Sea with the reanalysis global datasets, the study provides invaluable insights into aerosol variability, major sources, and trends in a data-scarce area, while also highlighting the strengths and limitations of the reanalysis products. Key findings include regional distribution of aerosols and the performance of current models in capturing dust and PM10 concentrations, pointing to the need for additional observations and further model development. Despite the difference in magnitudes, these models successfully reproduced the key seasonal features e.g., winter-time maxima in sulphate. While sulphate enhancement is most pronounced along India's arabian Sea coast, the monsoon-time sea salt spike is strongest near the east coast of the Middle-East region. Trend analysis results from both models indicate a statistically significant increase in sulphate aerosols in the Arabian Sea during 2003–2022 period (0.4 μg m-3 y-1 in winter). Overall, this work not only fills a critical knowledge gap but also serves as a reference for future ship-based expeditions and for improving chemistry-climate models to better understand the natural and anthropogenic effects on climate.

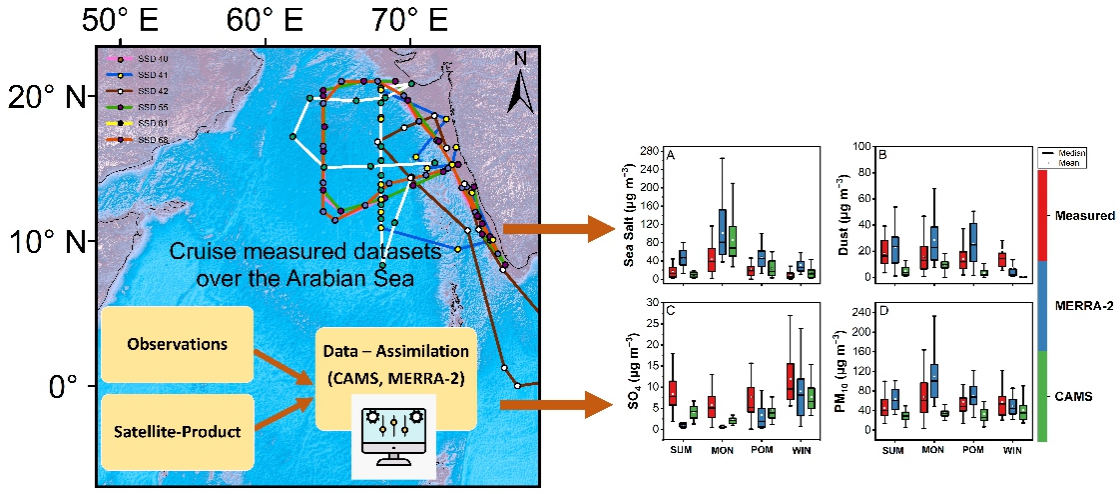


Figure-1: The cruise track in the Arabian Sea along with a box plot comparing the aerosol species concentrations collected during the cruise with those from the global reanalysis products CAMS and MERRA-2

Citation: *Shukla, G., Ojha, N., Kumar, A., Harithasree, S., Girach, I., & Sahu, L. K. (2025). Chemical composition of aerosols over the Arabian Sea based on global reanalyses data and on–board ship measurements. Atmospheric Environment, 121085.*
DOI– https://doi.org/10.1016/j.atmosenv.2025.121085

[Report Courtesy: *Ashwini Kumar, Principal Scientist CSIR–National Institute of Oceanography, Geological Oceanography Division, Dona Paula, Goa–403004; E–mail : ashwinikumarjha@gmail.com]*

Optics and pigments reveal Distribution of Phytoplankton Communities in the Eastern Indian Ocean

Ecological factors shape phytoplankton pigment composition, leading to variations in pigment ratios among species. To adapt to diverse light environments, different phytoplankton have evolved distinct pigment combinations exhibiting unique light absorption properties and spectral signatures. These signatures play a crucial role in refining inverse models and enabling the remote detection of pigment composition and concentration. Therefore, evaluating species-level variations, community assemblages, and pigment composition is essential for a comprehensive understanding of phytoplankton dynamics.

As part of the Australian participation in the second International Indian Ocean Expedition (IIOE-2), a research voyage was carried out on the R/V Investigator from 13th May to 19th June 2019 along 110° E line (Fig. 1). Phytoplankton pigments and absorption properties were measured along a 3300 km transect starting from mesotrophic conditions (chlorophyll concentration about 0.5 mg m^{-3}) around 40° S to oligotrophic conditions (0.04 mg m^{-3}) near 10° S. A unsupervised spectral cluster analysis was applied to phytoplankton absorption data, in which the absorption-based clusters serve as a reference for identifying different phytoplankton pigment assemblages and their depth in the water column. The resulting clusters reflect variations in phytoplankton pigment compositions and degrees of pigment packaging, categorised into distinct groups: mesotrophic waters, surface oligotrophic waters, waters near the deep chlorophyll maxima and low-chlorophyll deep waters at depths exceeding 100 m. Our findings demonstrate the effectiveness of using spectral absorption data to map phytoplankton pigment groups in the water column (Figure-2). Our results were obtained under mostly oligotrophic conditions, which present challenges for the optical assessment of phytoplankton community composition due to the diversity and low concentrations of phytoplankton pigments. Our data reveal surprising differences in the relationship between chlorophyll-specific absorption, community composition, and size structure in the Indian Ocean compared to other regions, particularly under oligotrophic conditions and at similar chlorophyll-a concentrations at various depths. The cluster analysis supported the finding that pigment composition plays a significant role in determining the spectral shape of the phytoplankton absorption. The present study highlights the importance of further bio-optical investigations in the Indian Ocean, particularly in oligotrophic zones. This underscores the necessity for extensive research incorporating co-located data on pigments and optical characteristics for development of bio-optical algorithms.

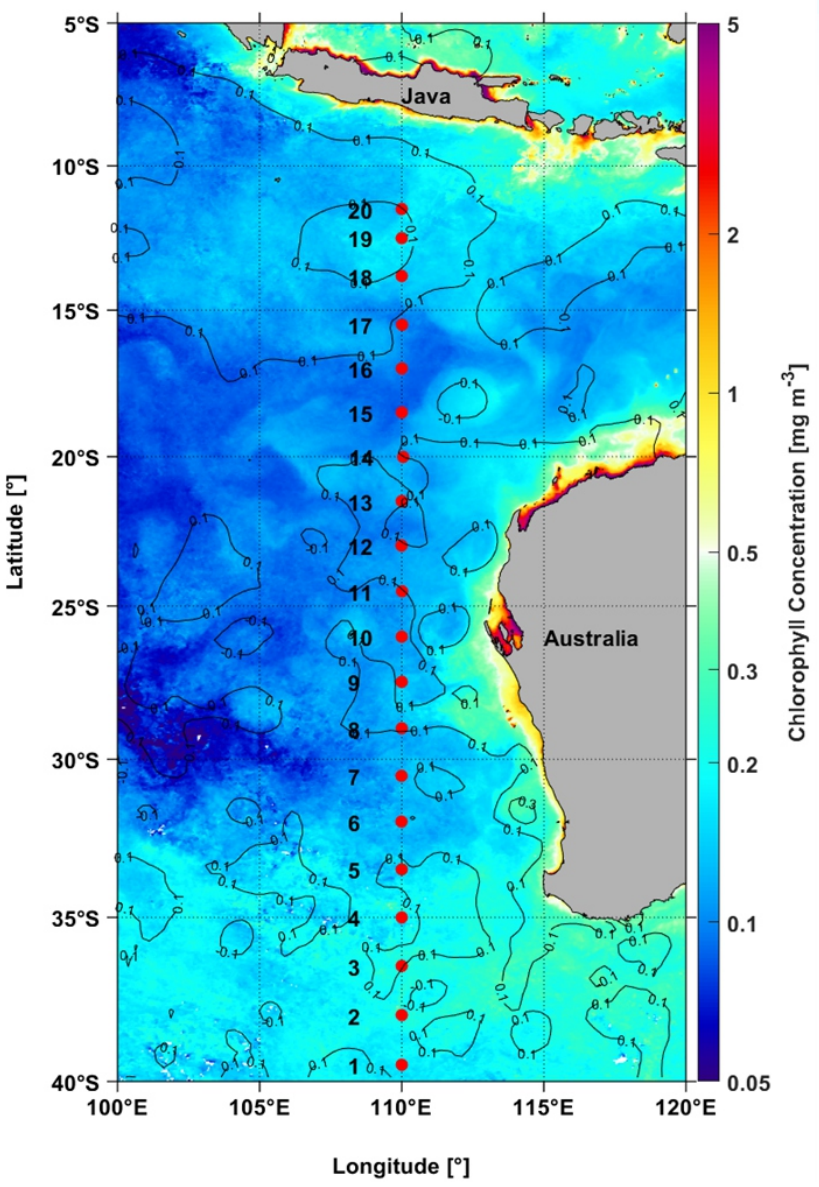


Figure-1: The 20 stations sampled along the 110°E voyage (red dots) from May 17 (station 1) to June 5, 2019 (station 20). The background image shows the monthly average chlorophyll-a concentration (mg m^{-3}) for May, obtained from MODIS Aqua, with overlaid contours of the Jason-3 averaged Sea Level Anomalies (SLA).

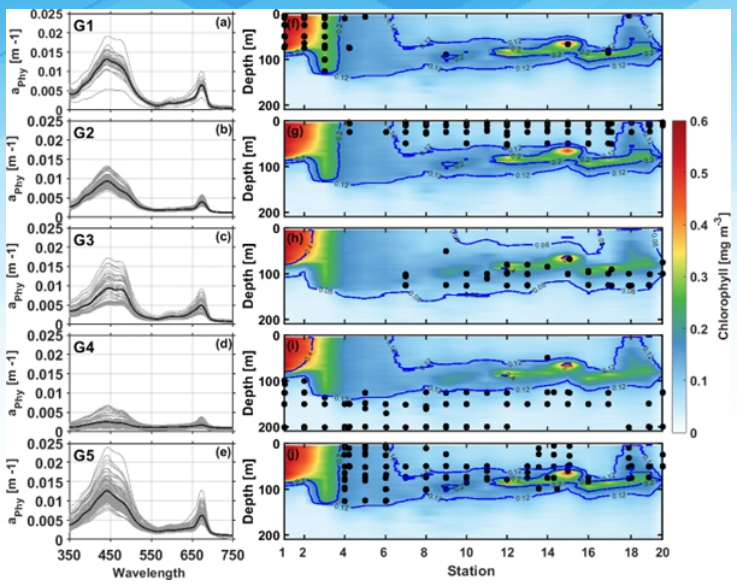


Figure-2: The Five clusters of phytoplankton absorption spectra (panels (a) to (e)) and their respective positions along the transect (panels (f) to (j)). The color shading indicates the TChl-a concentration [mg m^{-3}].

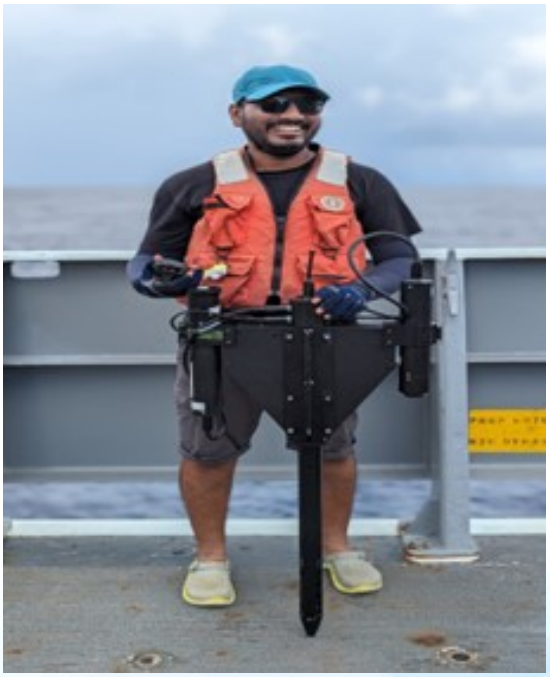
Citation: *Parida, Chandanlal, and Antoine David. "Phytoplankton communities distribution along a physical gradient in the eastern Indian Ocean based on their pigments and absorption properties." Deep Sea Research Part II: Topical Studies in Oceanography (2025)"*

[Report Courtesy : *Chandanlal Parida (E–mail : chandan.parida@curtin.edu.au), and David Antoine, Curtin University, Perth, Australia.]*

2025 IOCCG Travor-Platt Memorial Scholarship award winner: R Chandra Sekhar Naik

IOCCG Platt Scholars are early career scientists who will gain valuable experience in the field of ocean and in-land water remote-sensing and applications from outside their home country. R Chandra Sekhar Naik hails from India and will work with Joaquim Goes and Antonio Mannino (USA) on training: Advancing Marine Optics and Remote Sensing, spanning across NASA Goddard Space Flight Center and Lamont Doherty Earth Observatory (LDEO).

Chandra is a PhD research scholar and project scientist at the INCOIS-KUFOS joint research centre under the supervision of Aneesh Lotliker (INCOIS). He has articipated in many ocean-going cruises and handled large datasets from the Bay of Bengal and the Arabian Sea region, has routinely helped with the collection of marine bio-optical data, and is familiar with various analytical methods for pigment and turbidity analysis.



Chandra's training at NASA GSFC will focus on HPLC pigment analysis, absorption measurements, and bio-optical algorithm development, working with Dr. Antonio Mannino's team to refine satellite-based phytoplankton retrievals. At LDEO, he will collaborate with Dr. Joaquim Goes on algorithm validation using hyperspectral datasets (NOAA-VIIRS, NASA-GLIMR, and PACE), explore marine biogeochemistry, and contribute to capacity-building initiatives through workshops, seminars, and by strengthening collaborative research in ocean sciences between INCOIS, NASA, and Columbia University.

For more information : https://ioccg.cmail20.com/t/t-e-skthlil-tthitdckt-r/ and https://ioccg.org/what-we-do/training-and-education/ioccg-fellowship-recipients/

2025 ASI & IPFC 12 Annual Meeting

There will be Themed and Special Sessions. For **Themed Sessions**, there are

- Systematics (covering evolution, taxonomy, and biogeography)
- Ecology (including larval fish ecology)
- Sustainable Fisheries
- General Fish Biology (encompassing Physiology, Neurobiology, Behavior, Developmental Biology, and more)

Whereas for **Special Sessions**, there will be 8 sessions:

1. Investigating the biogeography of freshwater fishes of Asia
2. Exploring the diverse roles of fish parasites in taxonomy, evolution and ecological interactions
3. Choral reefs: fish communication
4. Diadromous fishes: biodiversity, life traits and conservation
5. Resilience and sensitivity of fishes to climate change and environmental stressors: from genes to ecosystems
6. Charting the Future of Indo-Pacific Shark and Ray Research and Conservation: Emerging Trends, Critical Needs, Practical Solutions
7. Gateway to the Past: Fish fossils and otoliths of the Indo-Pacific and their relation to fish biodiversity in time and space
8. Coral Reef Fishes as models for Eco-Evo-Devo

The deadline for the application for the PeerJ Award and the ASI Student Member Support has been extended to March 3, 2025.

Should you have any further questions, please contact e-mail 2025.asiipfc12@gmail.com

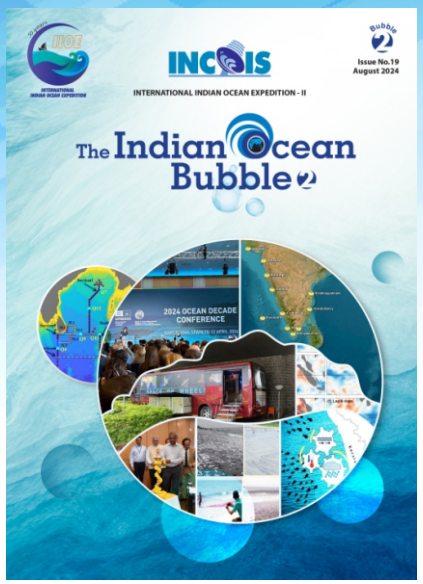
El Niño Southern Oscillation and Tropical Basin Interaction in Idealized Worlds

Webinar: In this study we discuss a set of GFDL coupled general circulaton model simulations with idealised geometries of the tropical ocean basins and land with a focus on important characteristics of El Niño Southern Oscillation(ENSO) type of variability and tropical basin interaction. In a series of 15 simulations, we first vary the zonal width of single tropical ocean basin from 50 to 360 degrees, while the rest of the tropical zone is set as a land. Further we discuss different simplified configurations of two or three tropical ocean basins. The result show remarkable changes in ENSO characteristics as a function of basin width and due to the interaction with other basins that challenge our current understanding of ENSO dynamics. The result suggest that atmospheric dynamics are largely controlling ENSO dynamics. We will discuss shallow water atmospheric (Gill-type) model results to explore how simplified atmospheric dynamics can control growth rate(Bjerknes feedback) and period of ENSO.

The CLIVER Research Focus on Tropical Basin Interaction is pleased to invite you to join us its new webinar series, the second edition by invited speakers will be presented by Dr. Dietmar Dommenget (Monash University).

Tropical Climate Variability and Coral Reefs
When? March 5, 2025 at 22:00 UTC
Where? GoTo Meeting App - Link

The Indian Ocean Bubble, Issue No. 19 is now available online



Web Link: https://iioe-2.incois.gov.in/IIOE-2/pdfviewer_pub.jsp?docname=IIOE-2-DOC_OM_301.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 (MS-Word) accompanied by suitable figures, photos (separate .jpeg files).

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

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 57 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 March-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 March, 2025

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

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