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

Newsletter

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

Volume-9, Issue-1
January, 2025

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.

Global Ocean Reanalysis based on MOM5-GODAS

The ocean is the major component of the Earth system. However, observations over the ocean have always been unevenly distributed, and they come with errors. Satellite observations also cannot provide a complete and accurate picture of the 3D state of the ocean at a given point in time. Ocean Reanalyses fill the gaps in the observational record by combining models and observations. Accurate ocean reanalyses are essential, as they provide the most realistic representations of past oceanic conditions, serving as benchmarks against which climate models can be validated on different time scales. In recent times, the rise of artificial intelligence (AI) has revolutionized data analysis, allowing us to uncover complex patterns in large datasets. Reanalysis datasets have emerged as tools of excellence for these objectives because they offer a physically consistent global reconstruction of past weather conditions devoid of spatial or temporal gaps. Ocean reanalysis data is primarily used for understanding and studying long-term ocean climate trends, identifying climate variability patterns, providing historical context for current ocean conditions, informing climate change research, supporting ocean forecasting systems, and aiding in marine resource management, making it a crucial tool for researchers, climate scientists, and operational oceanographers, with applications in areas like fisheries management, marine pollution monitoring, and coastal planning.

The National Centers for Environmental Prediction (NCEP) produces operational reanalysis products based on the Global Ocean Data Assimilation System (GODAS) with the Modular Ocean Model (MOM3/MOM4p0d) as a physical model and 3D-Var as the data assimilation method. In this study, we upgraded the physical model of GODAS with MOM5 and produced a 2003-2010 ocean reanalysis. All in-situ observed temperature and salinity profiles obtained from different platforms such as Argo, moored buoy, XBTs etc were assimilated down to 750 m depth. The subsurface temperature bias with respect to EN4 observations up to 700 m depth significantly reduced in the reanalysis product when temperature and salinity observations were assimilated (ASSIM-TS) as compared to without assimilation (CONTROL) (Figure 1). These biases are even comparable to Ocean ReAnalysis System 5 (ORAS5) produced by the European Centre for Medium-Range Weather Forecasts (ECMWF), which is considered to be one of the best reanalysis products (Figure 1). Significant improvements are found in the subsurface temperature and salinity fields over the northwest Atlantic and Pacific Ocean, Nino 3.4, and Indian Ocean thermocline ridge regions in MOM5-GODAS reanalysis as compared to ORAS5 (Figures 2 and 3).

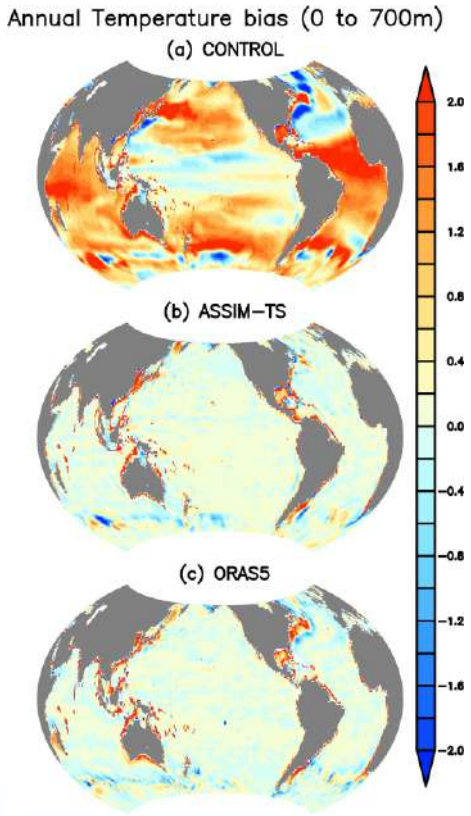


Figure-1: Upper Ocean (0-700 m) temp bias (°C) with respect to EN4 (a) without assimilation (CONTROL) (b) temperature and salinity assimilation in MOM5-GODAS (ASSIM-TS) and (c) ORAS5.

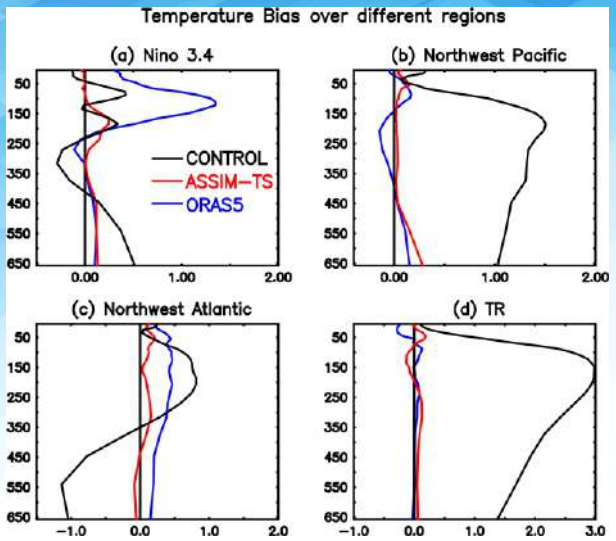


Figure-2: Upper ocean temperature bias (°C) with respect to EN4 observations over (a) Nino 3.4 (170° W-120° W; 5° N-5° S) (b) Northwest Pacific (120° E-140° W; 20° N-40° N) (c) Northwest Atlantic (70° W-50° W; 20° N-45° N) (d) Indian Ocean thermocline ridge or dome region (50° E-70° E; 3° S-13° S).

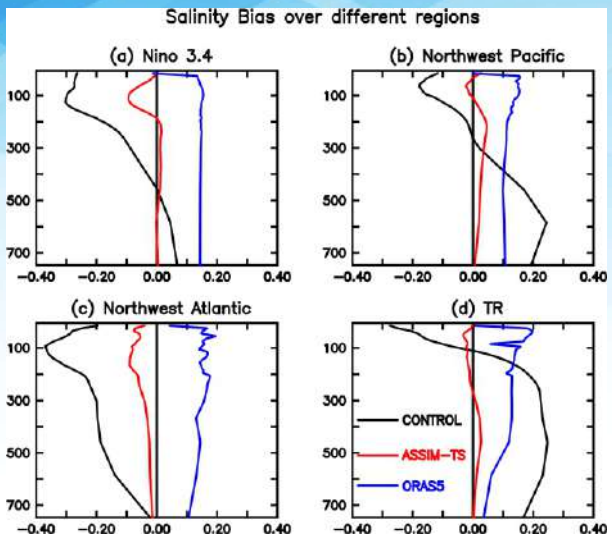


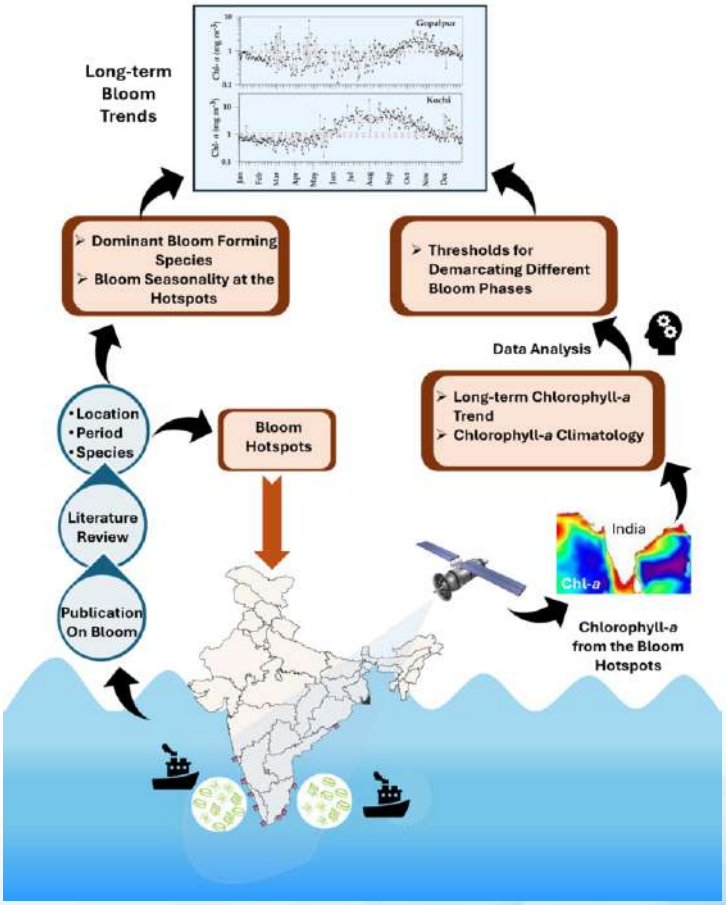
Figure-3: Upper Ocean salt bias (psu) with respect to EN4 analysis over (a) Nino 3.4 (170° W-120° W; 5° N-5° S) (b) Northwest Pacific (120° E-140° W; 20° N-40° N), (c) North West Atlantic (70° W-50° W; 20° N-45° N), (d) Indian Ocean thermocline ridge or dome region (50° E-70° E; 3° S-13° S).

Citation: Rahaman, H., Pokhrel, S., Saha, S. et al. Improved GODAS reanalysis with MOM5 and impact of altimeter assimilation. Model. Earth Syst. Environ. 11, 88 (2025). https://doi.org/10.1007/s40808-024-02269-9

Report Courtesy: [Hasibur Rahaman (rahman@incois.gov.in)and Raheema Rahman (r.rahman-rf@incois.gov.in), INCOIS, Hyderabad, India]

Algal Bloom Watch: Hotspots and New Chlorophyll-a Thresholds for Indian Coastal Waters

India's coastline, known for its rich biodiversity, faces an increasing challenge and opportunity in the form of algal blooms. These events, characterized by a rapid surge in phytoplankton biomass, are becoming more frequent and intense due to environmental and human-driven factors. A pioneering study by researchers from the Indian National Centre for Ocean Information Services, in collaboration with the National Institute of Oceanography and Berhampur University, researches the dynamics of these blooms and establishes new thresholds for effective monitoring.



Phytoplankton, vital to the marine food web and global primary production, can proliferate uncontrollably due to nutrient enrichment from coastal upwelling or land-based discharges, leading to algal blooms. While some blooms enhance fisheries, others, referred to as Harmful Algal Blooms, can disrupt ecosystems, deplete oxygen levels, and produce toxins harmful to marine life, fisheries, and tourism. Despite a growing prevalence of algal blooms along India's coasts, there were no specific chlorophyll-a thresholds for identifying bloom stages until now. Chlorophyll-a, a dominant pigment in marine algae, is an indicator of phytoplankton biomass. Monitoring these blooms has been challenging due to the limitations of traditional field studies in terms of cost, logistics, and accessibility. However,

advances in satellite technology are overcoming these barriers. Using satellite data and field observations, researchers have pinpointed nine major algal bloom hotspots along India's coastline. These include Goa, Mangalore, Calicut, Kochi, and Vizhinjam Bay on the west coast, and Gopalpur, Kalpakkam, Palk Bay, and the Gulf of Mannar on the east coast. Region-specific thresholds for phytoplankton biomass have been defined for these areas, allowing for the classification of bloom phases: "Likely to Bloom," "Bloom," "Intense Bloom," and "Extreme Bloom."

The study identifies various factors driving these blooms, such as nutrient input during monsoons and coastal upwelling of nutrient-rich waters. While diatoms are the dominant contributors, dinoflagellates and cyanobacteria also play a significant role, leading to ecological changes. The research highlights the importance of advanced monitoring techniques, such as region-specific bio-optical algorithms and improved satellite remote sensing. With climate change and human activities intensifying the frequency and severity of algal blooms, understanding their long-term impacts is crucial for protecting marine ecosystems and the communities dependent on them. This study represents a major advancement in monitoring algal blooms, essential for sustainably managing marine resources, fisheries, and tourism. By leveraging satellite technology, India is enhancing its ability to effectively monitor coastal algal blooms.

Source: Raulo, S., Samanta, S., Baliarsingh, S.K., Sarma, V.V.S.S., Joseph, S., Balakrishnan Nair, T.M., & Srichandan, S. (2025). Determining chlorophyll-a thresholds for characterizing algal bloom conditions: A ocean colour remote sensing approach. Science of the Total Environment, 961, 178353.
https://doi.org/10.1016/j.scitotenv.2024.178353

Report Courtesy: [Ms. Susmita Raulo (s.raulo-p@incois.gov.in), INCOIS, India, & Dr. Suchismita Srichandan (suchismita.sima@gmail.com), Berhampur University, India]

14th International Conference on Southern Hemisphere Meteorology and Oceanography

The NRF-SAEON, along with partner institutions in South Africa, are hosting the 14th International Conference on Southern Hemisphere Meteorology and Oceanography (ICSHMO) from 31 March to 4 April 2025. The conference will take place at the Cape Town International Convention Centre (CTICC). The Conference Theme is "Interconnected Earth System and Society". For details visit the website: https://icshmo2025.com/

We are encouraging the submission of abstracts and early bird registrations at this stage. We have a number of oceanography sessions that may be of interest to you and your networks, including Southern Hemisphere Boundary Currents, Air-Sea interactions, Marine Heatwaves, Emerging Technologies, Ocean and Cryosphere interactions, Mesoscale and Submesoscale processes, ocean and ecosystem modelling and prediction. In addition, a number of sessions dedicated to atmospheric interactions are planned including extreme events, extratropical processes, and climate change to list only a few.

Should you have any further questions, please contact the local organising team: icshmo2025@saeon.nrf.ac.za.

Early-bird registration : 1 September 2024 – 20 December 2024 &
Regular registration : 21 December 2024 – 28 February 2025

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

Please submit your abstract here.
The Call for Abstracts will close on February 06, 2025.
Should you have any further questions, please contact e-mail 2025.asiipfc12@gmail.com

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

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 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, 2025

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

The Indian Ocean Bubble-2

Access the latest issue of Indian Ocean

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

Join IIOE-2 Community

Enroll yourself with IIOE-2 Community
https://iioe-2.incois.gov.in/IIOE-2/Signup.jsp

Follow us: iioe-2.incois.gov.in

@IIOE2

@iioe_2

Feedback? iioe-2@incois.gov.in

The IIOE-2 Newsletter is published online by:

INCOIS

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

GOOS 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