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

Newsletter

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

Volume-7, Issue-11
November, 2023

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.

Brainstorming on the future road map for International Indian Ocean Expedition

The Second International Indian Ocean Expedition (IIOE-2) is a major global scientific program executed with the engagement of the international scientific community in collaborative oceanographic and atmospheric research focused on the Indian Ocean. With participation from numerous countries and scientific institutions, IIOE-2 strives to advance knowledge on climate change, marine ecosystems, ocean circulation, and biodiversity in the Indian Ocean, ultimately contributing to the sustainable management of this critical region and its resources. The program was initially formulated for a period of five years (2015-2020) and was subsequently extended for another five years till 2025.

During the past seven years, the IIOE-2 community has contributed significantly to the understanding of the Indian Ocean in terms of observational data, research and capacity development. the Early Career Scientists Network initiated under the IIOE-2 has been proving itself to be a focal component of the IIOE-2, by providing a platform for the younger generation of scientists to come together, exchange ideas and work together as well as with their senior colleagues under IIOE-2 framework. Considering the sustained and significant progress of IIOE-2 in catering to the growth of our knowledge of the Indian Ocean, it is felt that not only should IIOE-2 continue beyond its current tenure, but should also align itself with the UN Decade of Ocean Science for Sustainable Development.

The Participants

e-ClassRoom at ITCOocean, INCOIS

To discuss and deliberate upon the ways to sustain the IIOE-2 beyond 2025 and to achieve its overarching goals, the IIOE-2 Project Office at the Indian National Centre for Ocean Information Services (INCOIS) hosted a brainstorming during 28-30 November, 2023 bringing together some of the distinguished researchers, leaders and policymakers across the globe active in such Indian Ocean-focused forums as the Indian Ocean Global Ocean Observing System (IOGOOS), Indian Ocean Region Panel of CLIVAR/IOC-GOOS (IORP), Indian Ocean Observing System Resources Forum of IOGOOS (IRF), Sustained Indian Ocean Biogeochemistry and Ecosystem Research of IMBeR/IOGOOS (SIBER), IOC Regional Committee for the Central Indian Ocean (IOCINDIO) and the Scientific Committee on Oceanic Research (SCOR).

Three cruises by R/V SONNE in the northern Indian Ocean planned for 2024

Monitoring and better understanding the northern Indian Ocean oxygen minimum zones (OMZ) of the Arabian Sea and the Bay of Bengal are essential to facilitate the prediction of global change impacts on mid-water oxygenation in these vulnerable regions of the world ocean. The OMZ originates from enhanced primary productivity in monsoonal upwelling areas and the inflow of oxygen depleted water masses. Productivity and oceanic circulation are undergoing extreme changes due to enhanced nutrient supply and, respectively, global climate change, which is already altering and will further modify the role of the Arabian Sea and the Bay of Bengal in the global nitrogen cycle in the future. There is evidence that both, the Arabian Sea and the Bay of Bengal, are losing oxygen and thereby become a growing sink of oceanic nitrogen. In the Arabian Sea this may lead to an expansion of the OMZ (Rixen et al., 2014) and in the Bay of Bengal the threshold to denitrification may be crossed soon (Bristow et al., 2017; Löscher, 2021).

In 2024 the German Research vessel R/V SONNE is scheduled to carry out three international cruises in the Arabian Sea and the Bay of Bengal in order to study oceanographic and atmospheric processes.

Figure-1: Research vessel R/V SONNE

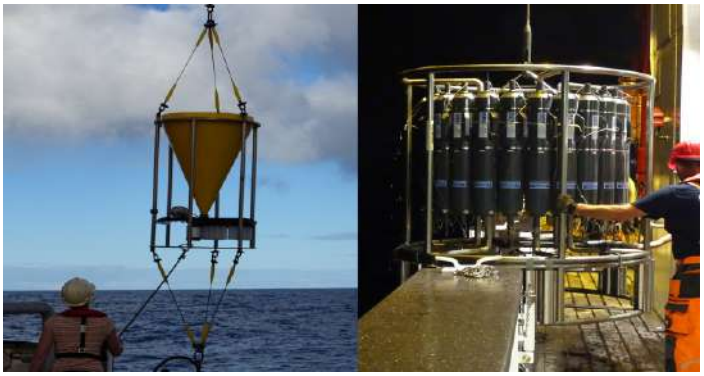


Figure-2: Work on board: Sediment trap and CTD

` On R/V SONNE cruises 302 and 303, scheduled for January/February 2024 as part of the WAST DREDGE and BIOCAN-IIOE2 projects, a team of scientists, technical staff and students from Pakistan and Germany will sample water, suspended matter, sinking particles and sediments in a station grid off the coast of Pakistan. The collaborating institutions are the National Institute of Oceanography in Karachi, the University of Hamburg, the Eberhard Karls University of Tübingen, the Leibniz Center for Tropical Marine Research in Bremen, the Helmholtz Center Hereon in Geesthacht, the Helmholtz Center for Ocean Research Kiel and the Leibniz Institute for Baltic Sea Research in Warnemünde. Expedition 302 will transit RV SONNE from the southern Indian Ocean to the northern Indian Ocean, recording long-standing particle flux studies and sampling the southern region of the Arabian Sea. Cruise 303 will focus on the processes in the OMZ, with an emphasis on the current nitrogen cycle. A typical winter situation can be observed with heavy rain events. They can lead to enormous amounts of suspension input through seasonally active rivers into coastal regions which can be deposited as so-called event layers in laminated sediments. The laminae are well preserved in the OMZ because of the lack of bioturbation by bottom-dwelling organisms. We aim to collect undisturbed sediments from the shelf and slope in order to study processes of the geological history in high resolution. The study off the Pakistan coast will be complemented by resampling some of the open ocean stations studied in seasonal resolution during the international JGOFS campaign in 1995 and during a cruise of R/V METEOR in 2007.

The overarching goal of the R/V SONNE cruise 305, as part of the BIOCAT-IIOE2 project, is to quantify key microbial processes in the water column and ocean/atmosphere exchanges to assess their impact on the OMZ of the Bay of Bengal. To this end, we will conduct a measurement campaign during April/May 2024 which covers the main carbon and nitrogen cycle processes as well as physical processes in the water column. The oceanic measurements will be complemented by an intensive atmospheric measurement program onboard to investigate the effects of atmospheric inputs on water column processes. During the R/V SONNE cruise 305, the GEOMAR Helmholtz Centre for Ocean Research Kiel, the Universität Hamburg, the Leibniz Institute for Tropospheric Research (TROPOS, Leipzig) and the University of Southern Denmark (SDU, Odense, DK) are collaborating. A team of 40 scientists, students and technicians will perform measurements in the water column and in the atmosphere at about 45 stations and seven 24-hour stations along the cruise track from the equatorial eastern Indian Ocean via the central Bay of Bengal to the shelf off Bangladesh. The results of BIOCAT-IIOE2 will contribute to a significantly improved assessment of the future impacts of global climate change and pollution for the ecosystems and the OMZ of the Bay of Bengal.

The WAST DREDGE, BIOCAN-IIOE-2 and BIOCAT-IIOE2 projects are funded by the German Federal Ministry of Education and Research (BMBF) and are coordinated by Niko Lahajnar, Birgit Gaye (Universität Hamburg) and Hermann Bange (GEOMAR, Kiel), respectively. They are a contribution to both the MARE:N program of the German Federal Government and the IIOE2 (iioe-2.incois.gov.in) and SOLAS (www.solas-int.org) programs.

References:

Bristow, L. A., Callbeck, C. M., Larsen, M., Altabet, M. A., Dekaezemacker, J., Forth, M., Gauns, M., Glud, R. N., Kuypers, M. M. M., Lavik, G., Milucka, J., Naqvi, S. W. A., Pratihary, A., Revsbech, N. P., Thamdrup, B., Treusch, A. H., and Canfield, D. E.: N2 production rates limited by nitrite availability in the Bay of Bengal oxygen minimum zone, Nat. Geosci., 10, 24-29, 10.1038/ngeo2847 https://www.nature.com/articles/ngeo2847#supplementary-information, 2017.

Löscher, C. R.: Reviews and syntheses: Trends in primary production in the Bay of Bengal – is it at a tipping point?, Biogeosciences Discuss., 2021, 1-15, 10.5194/bg-2020-494, 2021.

Rixen, T., Baum, A., Gaye, B., and Nagel, B.: Seasonal and interannual variations in the nitrogen cycle in the Arabian Sea, Biogeosciences, 11, 5733-5747, 10.5194/bg-11-5733-2014, 2014.

[Report Courtesy: Birgit Gaye (birgit.gaye@uni-hamburg.de) and Niko Lahajnar (niko.lahajnar@uni-hamburg.de), Institut for Geology, Universität Hamburg, Hermann Bange (hbange@geomar.de), GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany]

Advection-Based Tracking and Analysis of Salinity Movement in the Indian Ocean

The Bay of Bengal (BoB) is a complex ocean system owing to its unique geographic setting and the combination of forcing by seasonally reversing monsoon winds and large quantity of freshwater supply to the bay from river runoff and rainfall. The large excess of freshwater input from rainfall and rivers to the BoB, compared to loss by evaporation, makes the salinity of the Bay far lower compared to the rest of the Indian Ocean. Maintaining a long-term steady state condition requires that the excess freshwater be flushed out and water of high salinity flow into the Bay. The outflow of low salinity water occurs along its eastern and western boundaries and the inflow of high salinity water (> = 35 psu) occurs during summer monsoon in the southern BoB. Advection of the high salinity water along with the prevailing circulation and the ensuing mixing is well realized as the principal mechanisms for maintaining the salinity distribution in the BoB.

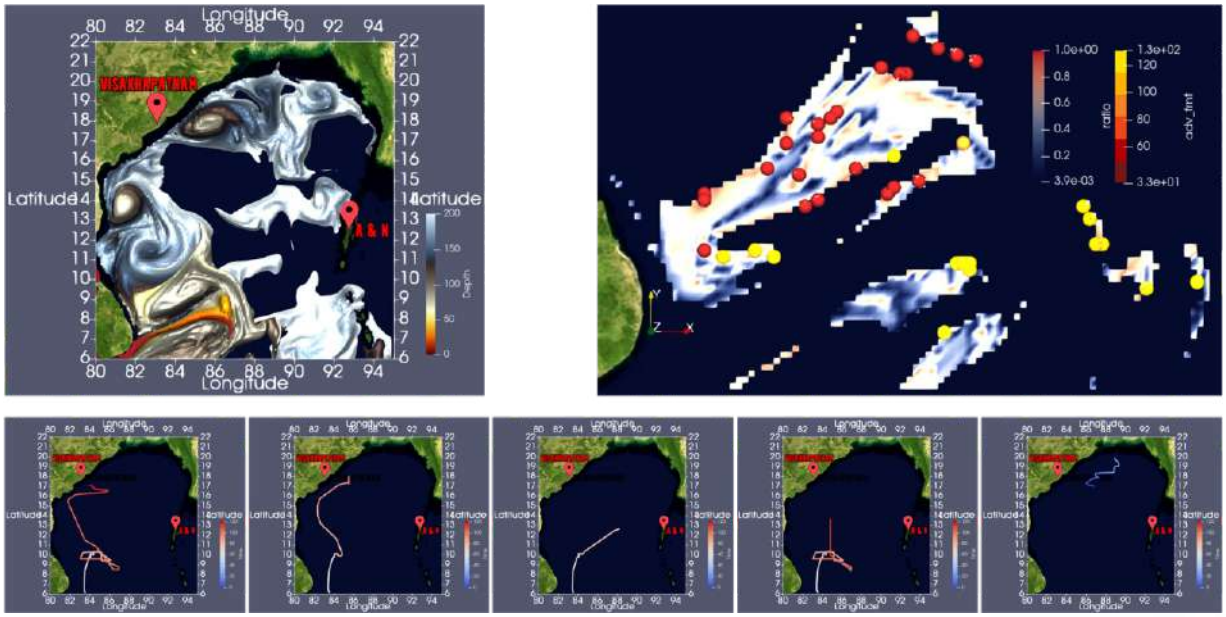


Figure: Advection tracks of the HSC in the BoB. (top-left) The advection study focuses on the envelope of the high salinity water, which is represented by the 35 ± ε isovolume. (top-right) Advection points are identified within this isovolume as points where the ratio of advection value to total salinity movement is above a given threshold. Advection points are shown at a depth of 100m near Sri Lanka. (bottom) Five tracks extracted by the method that indicate significant movements of the HSC after originating from south BoB and reaching the centre of BoB. The forking of paths into three major directions near Sri Lanka Dome was observed in a previous study of the HSC.

Upon entering the BoB, high salinity water continuously evolves and changes its physical properties. In a previous study (Singh et al., 2022), we employed geometric and topological descriptors to track high salinity water. In a subsequent study, we have tracked salinity movement due to ocean currents as compared to other phenomena (diffusion, dispersion, mixing of water). For studying the movement of salinity due to currents, we considered advection, which is defined as the mechanical transport of solutes in the fluid along with the movement of the fluid. We have designed and implemented an advection-based tracking method and to measure the transport of salinity through BoB due to currents. We comparison against the movement of high salinity water observed using the previous method. Some of the salient results of our study are being published in the forthcoming issue of Computers & Geosciences (Singh et al. 2024).

The source of high salinity water in the southern BoB is the high salinity core (HSC) that intrudes into the Bay from the Arabian Sea along with the Summer Monsoon Current (SMC). This paper presents computational methods to study HSC movement that can be attributed to advection. This finer grained analysis helps explain the processes that direct the HSC movement and its path within the BoB. The constantly evolving shape of the HSC, the continuously changing non-uniform distribution of salinity levels within the HSC, and the dynamic current make it difficult to study the effect of advection on the salinity movement. While advection may be directly visualized using pathlines of the velocity field, there exists no clear feature descriptor based on advection to support the finer-grained analysis.

Specifically, the paper makes the following contributions:

- Introduction of a novel feature of the HSC, called the advection front, that helps track its movement as directed by the velocity field.
- Parallel algorithms and methods to compute, track, and analyze the advection front.
- A visual analysis tool to study salinity transport due to advection in the BoB.
- New results and inferences on salinity transport due to ocean currents in the BoB.

Reference:

Upkar Singh, P. N. Vinayachandran, and Vijay Natarajan. Advection-based tracking and analysis of salinity movement in the Indian ocean. Computers and Geosciences, 182, 2024, 105493:1–10.

[Report Courtesy: Upkar Singh (upkarsingh@iisc.ac.in), P.N. Vinayachandran (vinay@iisc.ac.in), and Vijay Natarajan (vijayn@iisc.ac.in), Centre for Atmospheric and Oceanic Sciences, Indian Institute of Science(IISC), Bangalore, India]

Challenges and conservation strategies for the Irrawaddy Dolphins of Chilika Lagoon

Wildlife around the globe is under the pressure of anthropogenic impact, and it's crucial to monitor their ecological status in order to develop successful conservation plans. Irrawaddy Dolphins (Oracella brevirostris, henceforth IRD) are listed as one of the species on the IUCN's threatened list. A substantial subpopulation of IRD lives in Chilika Lagoon, a unique brackish-water habitat on the eastern seaboard of India adjoining the Bay of Bengal. Chilika is an ecological hotspot and an internationally recognized habitat for IRD. However, there are only a few hundred left, and they're struggling to survive. Consequently, these dolphins have been granted the highest level of protection under the Indian Wildlife Protection Act. Nevertheless, a great deal of work still has to be done because their conservation efforts haven't received the recognition they rightly deserve. IRD plays an important role in monitoring the ecological status of Chilika Lagoon. They also contribute significantly to the sustenance of local communities engaged in fishing and tourism. An article published recently compiles an array of research on IRD and makes important links between their physiology, behavior, and threats - whether from climate change or human-caused reasons. This article further goes on to present a comprehensive plan for the conservation and management of these IRDs with its main objective of securing their existence in Chilika. Within the confines of Chilika, IRDs confront a plethora of threats, including the obstruction and rerouting of rivers that flow into the lagoon, unsustainable tourism centered around dolphin-watching, environmental contamination, and the entanglement of these creatures in fishing nets. Predictions about the climatic changes, such as the possible increase in the lagoon's water temperature, increased littoral drift, rising sea levels, and an increasing frequency of cyclones, all serve to worsen their difficult situation. The necessity for a transition from an approach predominantly centered on the species to one that focuses on the ecosystem at large emerges as a critical step for their long-term survival.

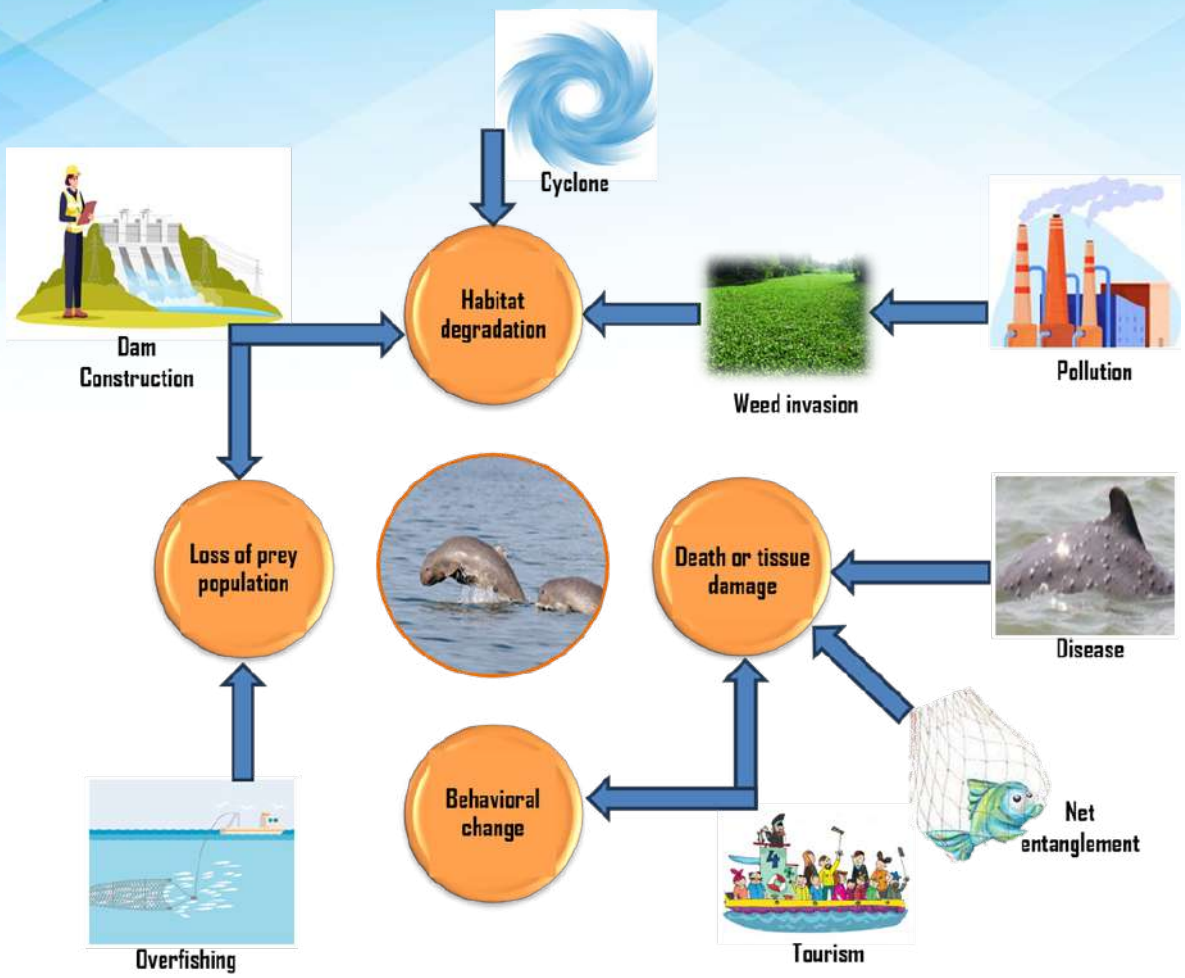


Diagram illustrating both human-induced and natural threats affecting the Irrawaddy Dolphin population in Chilika Lagoon (Source: Acharyya et al. 2023).

To ensure the survival and preservation of IRDs in Chilika, this article advocates essential actions such as the establishment of protected zones, restoration of their habitats, the safeguarding of critical ecosystems, sustainable management of boat traffic, collaborative efforts with local fishing communities, ongoing research and vigilant monitoring, community involvement and awareness campaigns, the reinforcement of legislation and its meticulous enforcement, sustainable and conscientious tourism practices, and the mitigation of the impact of climate change. The preservation of IRDs in Chilika necessitates a multi-pronged, collaborative approach that simultaneously addresses ecological and socioeconomic considerations. By implementing these comprehensive conservation measures, Chilika can continue to serve as a sanctuary of immense importance for these exceptional and vulnerable aquatic mammals, ensuring their survival for generations yet to come. Safeguarding these dolphins goes beyond just conservation; it represents a commitment to fostering a harmonious coexistence with the natural world.

Citation: Acharyya, T., Das, D.B., Raulo, S., Srichandan, S., Baliarsingh, S.K., Singh, S., Sudatta, B.P., & Sahoo, C.K. (2023). Surviving in a warming and crowded world: a review of Irrawaddy dolphin in Asia's largest brackish water lagoon. Journal of Coastal Conservation 27, 50. https://doi.org/10.1007/s11852-023-00982-8

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

SCOR WG 167 Copernicus Special Issue Launched

The SCOR Working Group 167, RUSTED, aims at assuring the quality of aerosol trace element solubility data produced by the international research community and its use in Earth System models.

RUSTED is now calling for manuscripts to contribute to its special issue on "Reducing the Uncertainty in aerosol Soluble Trace Element Deposition." This is a Copernicus inter-journal special issue lead by the journal "Atmospheric Measurement and Techniques", but submissions are also welcome in "Atmospheric Chemistry and Physics," "Aerosol Research," and "Biogeosciences."

Scheduled Sis (List of Special issues which are scheduled for publication in AMT):
www.atmospheric-measurement-techniques.net/articles_and_preprints/scheduled_sis.html

Scheduled Sis (List of Special issues which are scheduled for publication in ACP):
www.atmospheric-chemistry-and-physics.net/articles_and_preprints/scheduled_sis.html

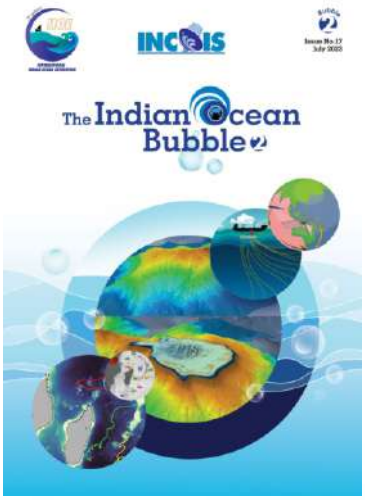
Scheduled Sis (List of Special issues which are scheduled for publication in AR):
www.aerosol-research.net/articles_and_preprints/scheduled_sis.html

Scheduled Sis (List of Special issues which are scheduled for publication in BG):
www.biogeosciences.net/articles_and_preprints/scheduled_sis.html

The RUSTED special issue welcomes cutting-edge studies which advance our knowledge of the deposition of soluble aerosol trace elements and their impacts on marine ecosystems as well as manuscripts addressing challenges and/or recent advances in the field of aerosol trace element deposition. This call is open to the wider international researchers community working on trace element biogeochemistry at the air-sea interface. Please request for your inclusion to the RUSTED SI when submitting your manuscript to one of the above mentioned contributing journal.

For more information, please email Mingjin Tang (mingjintang@gig.ac.cn) or Morgane Perron (morgane.perron@univ-brest.fr)

The Indian Ocean Bubble, Issue No.17 is now available online



Web Link: https://iioe-2.incois.gov.in/IIOE-2/pdfviewer_pub.jsp?docname=IIOE-2-DOC_OM_260.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 extended upto: 15 December, 2023

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

Join us for the Ocean Insights – Indian Ocean Seminar Series feat. ECRs. !

The IIOE-2 Early Career Scientist Network is thrilled to present yet another exciting talk of "Ocean Insights – Indian Ocean Seminar Series feat. ECRs", designed especially for early career scientists focusing on the Indian Ocean to share about their research. This captivating seminar series offers a unique opportunity for the Early Career Researchers to showcase their work, build connections, and explore collaborations within the marine sciences community.

Whether you are an early career researcher, an experienced scientist, or simply an enthusiast seeking to broaden your knowledge of marine science in the Indian Ocean, **ALL ARE INVITED!**

Why Should You Join?

- Engaging presentations from early career marine scientists.
- Interactive Q&A sessions to delve deeper into research topics and foster innovative ideas.
- A platform to connect with like-minded researchers and experienced scientists.

Don't miss out on the opportunity to enhance your understanding of marine science in the Indian Ocean and connect with fellow researchers. Register now and mark your calendars!

Details on the upcoming talk are given below. We look forward to your enthusiastic participation!

Key Details:

Title: Ocean Insights – Indian Ocean Seminar Series feat. ECRs ; Region: Indian Ocean; Format: Online

Link: https://zoom.us/meeting/register/tJUudOGsrzkiHNzP_5mFIjstUxlUQBhS6Z-_

Date: Every first Friday of the month, starting on **01st December 2023**

Time: 10:30-11:30 SAST
14:00-15:00 IST
16:30-17:30 AWST

Please note that there will be **no talk in January** due to the holidays - and we will have a "Special Talk" on **Friday, 02 February 2024**

If you are enthusiastic about sharing your contributions, please reach out to us at the e-mail address: ecsn.iioe@gmail.com

ICES - PICES 7th International Zooplankton Production Symposium during Autumn17-22 March 2024, Hobart, Australia

SCOPE

We are living in the Anthropocene. Our oceans are warmer, more acidic, have widespread plastic and other pollution, and are subjected to increasing exploitation including overfishing. Zooplankton play a pivotal role in our oceans, as grazers of primary production, as drivers of carbon and nutrient cycles, and as prey for higher trophic level consumers including both harvested fish species and iconic marine mammals and seabirds. How zooplankton will respond to the dramatic changes in our marine ecosystems will impact the health and productivity of our oceans and our planet.

To better understand zooplankton in a changing world, ICES and PICES are holding the 7th International Zooplankton Production Symposium as a forum to discuss the latest zooplankton research. The ICES/PICES Zooplankton Production Symposium will bring together the top zooplankton researchers globally, showcasing recent advances. Understanding the current and evolving role of zooplankton will require new insights provided by:

- Assessing the impact on zooplankton of climate change, fishing, and pollution such as microplastics
- State-of-the-art sampling techniques such as DNA, imaging, and bioacoustics
- Biochemical methods applied to unravelling complex trophic ecology
- The application of cutting-edge approaches in zooplankton modelling, including size and trait-based biogeochemical and ecosystem models
- Revealing the role of microzooplankton in biogeochemical cycling and food webs
- Exploring the structure and functioning of macrozooplankton communities and their impact on carbon sequestration and trophic ecology
- Examining zooplankton in fisheries science, including dynamics of fish larvae, the impact of zooplankton on fish larval mortality and growth, and the commercial harvest of zooplankton
- Elucidating the vital role of zooplankton in polar environments
- Understanding the role of gelatinous filter feeders and jellyfish in carbon sequestration and trophic ecology
- The use of zooplankton as ecosystem indicators in a changing ocean

Our Symposium will be held over five days in the historic waterfront district of Hobart, Australia, during Autumn, from 17-22 March 2024. This event will be held in-person and provide the first opportunity since 2016 for zooplankton researchers to meet, build networks, and hear the latest science. We are monitoring the COVID-19 situation closely and will adapt our plans as needed.

The Organizing Committee invites proposals for sessions to be held during the Symposium. Proposals are welcome for sessions incorporating talks and posters, panel discussions and/or workshops. Sessions could cover, but are not limited to, the key areas listed above.

The symposium website may be accessed here: https://meetings.pices.int/meetings/international/2024/zps7/scope

Proposals may be submitted here: https://meetings.pices.int/meetings/international/2024/zps7/proposals

Asia Oceania Geosciences Society (AOGS) - 21st Annual Meeting
Pyeongchang, Ganwon-do, Home to Winter Olympics during 23 - 28 June 2024

Asia Oceania Geosciences Society (AOGS) was established in 2003 to promote geosciences and its application for the benefit of humanity, specifically in Asia and Oceania and with an overarching approach to global issues. Asia Oceania region is particularly vulnerable to natural hazards, accounting for almost 80% human lives lost globally. AOGS is deeply involved in addressing hazard related issues through improving our understanding of the genesis of hazards through scientific, social and technical approaches. AOGS holds annual conventions providing a unique opportunity of exchanging scientific knowledge and discussion to address important geo-scientific issues among academia, research institution and public. Recognizing the need of global collaboration, AOGS has developed good co-operation with other international geo-science societies and unions such as the European Geosciences Union (EGU), American Geophysical Union (AGU), International Union of Geodesy and Geophysics (IUGG), Japan Geo-science Union (JpGU), and Science Council of Asia (SCA).

The website may be accessed here: https://www.asiaoceania.org/aogs2024/public.asp?page=home.asp

Session-OS06: Physics, Biogeochemistry, and Climate Dynamics of the Indian Ocean

Session Details

Section(s):
OS - Ocean Sciences (Primary)
AS - Atmospheric Sciences

Announcements

SUBMIT ABSTRACTS	APPLY FUNDING SUPPORT	2024 AWARD NOMINATIONS
17 Oct 2023 – 02 Jan 2024	17 Oct 2023 – 02 Jan 2024	17 Oct 2023 – 02 Jan 2024
Instructions | Submit Now	Instructions | Apply Now	Guidelines

Conveners

* Prof SungHyun Nam (Seoul National University)
Dr Nicolino (Nick) D'Adamo (Adjunct Research Fellow, Oceans Institute of the University of Western Australia)
Dr Dong-Jin Kang (Korea Institute Of Ocean Science And Technology)
Dr Yukio Masumoto (The University of Tokyo)

Session-OS06: Description

Recent increases in extreme events such as flooding, droughts, heatwaves, and tropical cyclones have a large impact on the population living in the Asia and Oceania countries. Increasing evidence on the roles of Indian Ocean in impacting climate extremes, climate variability, and climate change via changes in energy, hydrological and biogeochemical cycles has been reported. The Indian Ocean is of particular interest, for example, as influenced by the seasonally reversing monsoon forcing and upwelling centers in the Indian Ocean are found in the off-equatorial regions unlike in the easterly wind-forced Pacific and Atlantic Oceans. The northern region is dominated by the monsoons whereas the seasonal reversal is less pronounced in the southern region. This session invites contribution of physics, biogeochemistry, and climate dynamics of Indian Ocean based on in-situ and remotely-sensed observations, models, theories, and paleo proxies that reveal processes, variability, and projected changes within the Indian Ocean. This includes, but not limited to 1) Indian Ocean variability such as Indian Ocean Basin Mode, Indian Ocean Dipole Mode, Madden-Jullian Oscillations, 2) Upwelling in the Indian Ocean such as open-ocean upwellings or thermocline ridge/dome (e.g., Seychelles-Chagos Thermocline Ridge) and coastal upwellings at both western and eastern sides, 3) Processes underlying basin-scale or regional circulation, 4) Ocean-atmosphere interaction processes (heat, freshwater, momentum, carbon, etc.), 5) Biogeochemistry of the Indian Ocean water masses, 6) Links between ocean sciences and socio-economic requirements in the Indian Ocean, and 7) Interactions and exchanges between the Indian Ocean and other basins. Abstracts on related activities, such as capacity building, education, outreach, project development in the Indian Ocean, contributing to the UN Decade of Ocean Science for Sustainable Development and to the Second International Indian Ocean Expedition are also welcome.

Keyword(s): Indian Ocean; Physics; Biogeochemistry

DEEP-SEA RESEARCH PART II

THE SUBMISSION PORTAL FOR VOL. 7 OF THE DEEP-SEA RESEARCH II SPECIAL ISSUE SERIES ON THE IIOE-2 WILL SOON BE 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).

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 52 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 (December-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 December, 2023**

The Indian Ocean Bubble-2

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