Report for the year 2021 and future activities

SOLAS ‘India’
compiled by: Sheryl Oliveira Fernandes

First things first…Please tell us what the IPO may do to help you in your current and future SOLAS activities.?
Would the SOLAS IPO be able to extend help towards production of a SOLAS India newsletter?

PART 1 - Activities from January 2021 to Jan/Feb 2022

1. Scientific highlight
Describe one scientific highlight with a title, text (max. 300 words), a figure with legend and full references. Please focus on a result that would not have happened without SOLAS, and we are most interested in results of international collaborations. (If you wish to include more than one highlight, feel free to do so).

Review article # 1: Physical and biogeochemical processes associated with upwelling in the Indian Ocean.

This paper reviewed the phenomena of upwelling along the coast of the Indian Ocean extending from the tip of South Africa to the southern tip of the west coast of Australia. Observed features, underlying mechanisms, and the impact of upwelling on the ecosystem were presented. Based on enhanced sea surface chlorophyll a concentration, upwelling was stated to be a key driver enhancing biological productivity in all sectors of the coast. Along the west coast of India, upwelling has several biogeochemical implications, including oxygen depletion, denitrification, and high production of CH₄ and dimethyl sulfide. The review identified the northern coast of the Arabian Sea and eastern coasts of the Bay of Bengal as the least observed sectors. Sustained long-term observations with high temporal and spatial resolutions and high-resolution modelling efforts were recommended for a deeper understanding of upwelling, its variability, and its impact on the ecosystem.


Review article # 2: Atmospheric gas-phase composition over the Indian Ocean.

The manuscript reviewed the progress in detecting and understanding atmospheric gas-phase composition over the IO and its local and global impacts. It took into account results from recent Indian Ocean ship campaigns, satellite measurements, station data and information on continental and oceanic trace gas emissions. The distribution of all major pollutants and greenhouse gases showed pronounced differences between the landmass source regions and the IO with strong gradients over coastal areas. Surface pollution and ozone were highest during the winter monsoon
over the Bay of Bengal and the Arabian Sea coastal waters. This was attributed to air mass advection from the Indo-Gangetic Plain and continental outflow from Southeast Asia. Unusual types of wind patterns lead to pronounced deviations of typical trace gas distributions. Future research initiatives suggested were long-term changes of pollution and ozone, their dynamics due to changing emissions and transport patterns and understanding the impacts of atmospheric pollution on oceanic biogeochemistry and trace gas cycling.


2. Activities/main accomplishments in 2021 (e.g., projects; field campaigns; workshops and conferences; model and data intercomparisons; capacity building; international collaborations; contributions to int. assessments such as IPCC; collaborations with social sciences, humanities, medicine, economics and/or arts; interactions with policy makers, companies, and/or journalists and media).

3. List SOLAS-related publications published in 2021 (only PUBLISHED articles). If any, please also list weblinks to models, datasets, products, etc.

Publications from January 2021- February 2022:


Jyothibabu, R., Karnan, C., Arunpandi, N., Santhi Krishnan, S., Balachandran, K.K., Sahu, K.C., Significantly dominant warm-core eddies: An ecological indicator of the basin-scale low biological production in the Bay of Bengal. Ecological Indicators, 121: 107016, ISSN 1470-160X.


4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2021? If yes, who? How did you engage?

Engagement with stakeholders/societal partners/external research users could not be initiated due to the COVID-19 pandemic.

PART 2 - Planned activities for 2022 and 2023

1. Planned major national and international field studies and collaborative laboratory and modelling studies (incl. all information possible, dates, locations, teams, work, etc.).

   1. A manuscript synthesizing SOLAS activities in the Indian Ocean was proposed during the SOLAS side meeting held as part of the Annual Meetings of Indian Ocean Global Ocean Observing System (IOGOOS) – XVII, 24th March 2022. Contributors for the same were sought.
   2. Expeditions in the Arabian Sea, Bay of Bengal and Indian Ocean have been planned onboard ORV Sagar Kanya and other chartered scientific vessel(s) for:
      - Studying the influence of seabed features & open ocean exchanges on coastal ocean dynamics.
      - The Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction (RAMA) consisting of moored observation buoys in the IO to collect meteorological and oceanographic data.
      - Biogeochemistry of trace elements and isotopes.
      - Ocean acidification along east coast of India.
      - Assessing carbon budget in Southern Ocean.

   Research cruise details can be availed at: https://ncpor.res.in/pages/view/248-research-vessel-moment; https://incois.gov.in/IIOE-2/Expedition.jsp

2. Events like conferences, workshops, meetings, summer schools, capacity building etc. (incl. all information possible).

   Completed events:
   1. The International Indian Ocean Science Conference (IIOSC), 14-18 March 2022; virtual mode.
   2. SOLAS side meeting held as part of the Annual Meetings of Indian Ocean Global Ocean Observing System (IOGOOS) – XVII, 24th March 2022; virtual mode.

3. Funded national and international projects/activities underway.
Research output from a number of studies funded by various Government agencies in India and overseas have been listed in point no. 3 (Part 1). Some of the funding agencies are:

- Ministry of Earth Sciences (MoES)
- Council of Scientific and Industrial Research (CSIR)
- Ministry of Human Resource and Development
- Department of Science and Technology
- Space Applications Centre, ISRO.
- Texas A & M University, Texas, USA
- Department of Defense, USA

4. Plans / ideas for future national or international projects, programmes, proposals, etc. (please indicate the funding agencies and potential submission dates).

Future research directives discussed during SOLAS India meetings were:

- Tracking constituent exchange among suspended aerosol particles.
- Understanding role of sea-surface microlayer in air-sea exchange of reactive gases.

5. Engagements with other international projects, organisations, programmes, etc.

Projects endorsed by IIOE-2 are as follows:

<table>
<thead>
<tr>
<th>Sr. no.</th>
<th>Project no.</th>
<th>Project title</th>
<th>Lead investigator/ co-investigator from India and contact details</th>
<th>Month and year of endorsement</th>
<th>Period of project</th>
</tr>
</thead>
</table>
E-mail: jasbose@gmail.com | June, 2021 | 16 January, 2020 - 15 January, 2025 |
E-mail: arvinds@prl.res.in | April, 2020 | September 2020 - August 2023 |
<p>| 3       | IIOE2-EP30  | Physical Deterministic Sea Surface Temperature | Prof. Animesh Maitra, Institute of Radio Physics and Electronics, University of Calcutta, India | April, 2018 | March 2018 to March 2021 |</p>
<table>
<thead>
<tr>
<th>No.</th>
<th>IIOE2-EP</th>
<th>Project Title</th>
<th>Investigator</th>
<th>E-mail</th>
<th>Start Date</th>
<th>End Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>EP16</td>
<td>Biogeochemistry of Trace Elements and Isotopes in the Indian Ocean (GEOTRACES-INDIA)</td>
<td>Dr. Sunil Kumar Singh, Physical Research Laboratory, Ahmedabad 380009, India</td>
<td><a href="mailto:sunil@prl.res.in">sunil@prl.res.in</a></td>
<td>March, 2017</td>
<td>April 2011-continuing</td>
</tr>
<tr>
<td>5</td>
<td>EP18</td>
<td>Impact of climate variability on the Indian Ocean: Role of Gelatinous zooplankton structuring food web structure and community assemblages</td>
<td>Dr. Bijoy Nandan Sivasankaran, Cochin University of Science and Technology, Ernakulam, India</td>
<td><a href="mailto:bijoynandan@yahoo.co.in">bijoynandan@yahoo.co.in</a></td>
<td>May, 2017</td>
<td>NA</td>
</tr>
<tr>
<td>6</td>
<td>EP17</td>
<td>Real-time Meteorological and Oceanographic data collection using moored buoy network in Indian Seas (OON-INDIA)</td>
<td>Dr. R. Venkatesan, NIOT, Chennai, India</td>
<td><a href="mailto:venakt@niot.res.in">venakt@niot.res.in</a></td>
<td>May, 2017</td>
<td>1996-continuing</td>
</tr>
<tr>
<td>7</td>
<td>EP23</td>
<td>Influence of Indian Ocean sector of the Southern Ocean dynamics and biogeochemistry on the tropical weather and climate (ISESO)</td>
<td>Dr. Anil Kumar N, NCAOR, Goa 403 804, India</td>
<td><a href="mailto:anil@ncaor.gov.in">anil@ncaor.gov.in</a></td>
<td>August, 2017</td>
<td>2002-continuing</td>
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