

INDIAN GLIDER PROGRAMME

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Group Director

Ocean Observations, Data Management and Information & Communication Technology

Indian National Centre for Ocean Information Services (INCOIS)

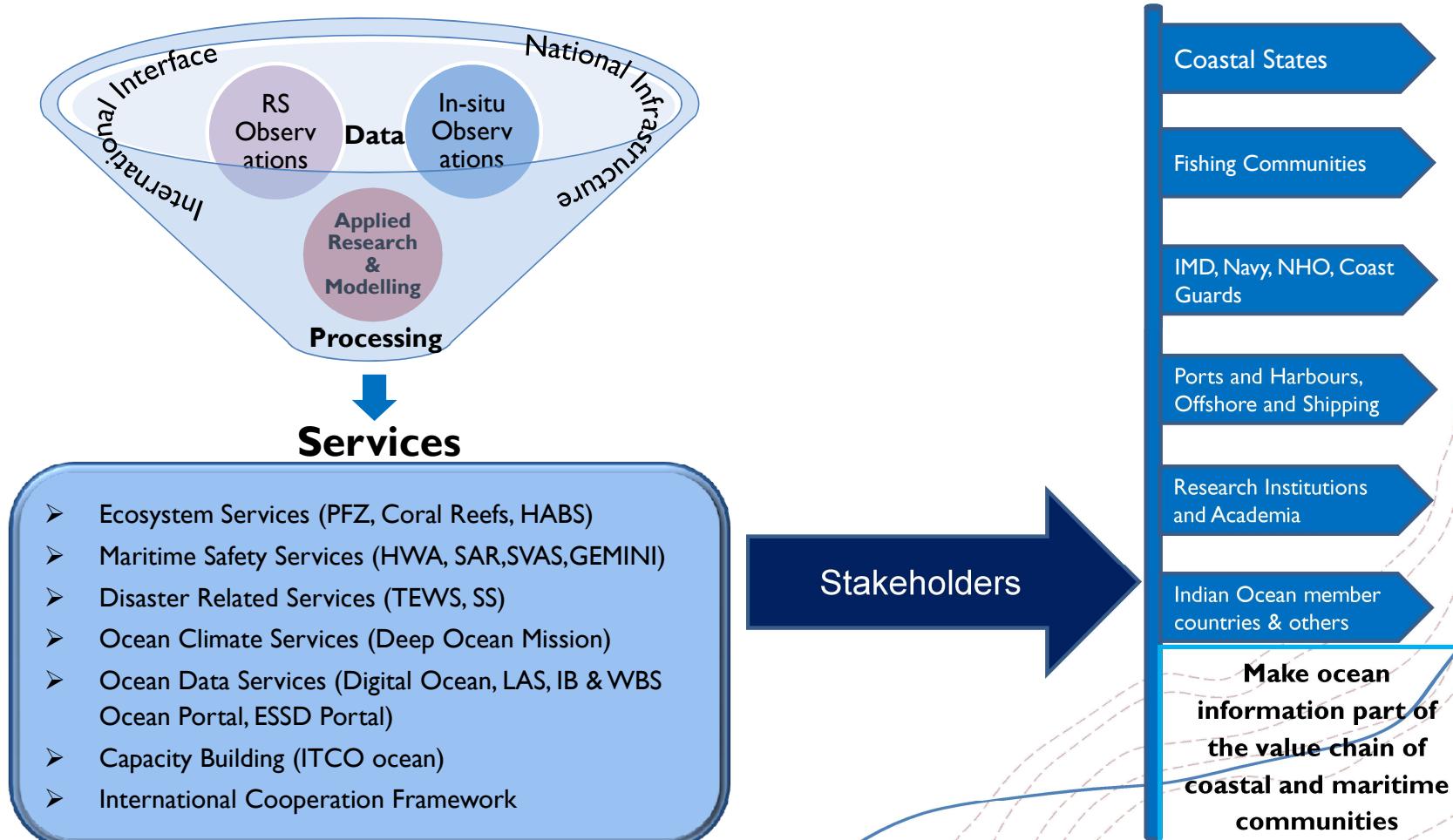
Ministry of Earth Sciences

Hyderabad, India

Ocean Glider Programme, Steering Group Meeting 01 Dec 2022

Ocean Observations, Information and Advisory Services

Mission: To provide the Ocean Information and Advisory Services to Society, Industry, Government Agencies and Scientific Community through Sustained Ocean Observations and Constant improvements through Systematic and Focussed Research



Operational Ocean Services

Ecosystem Services

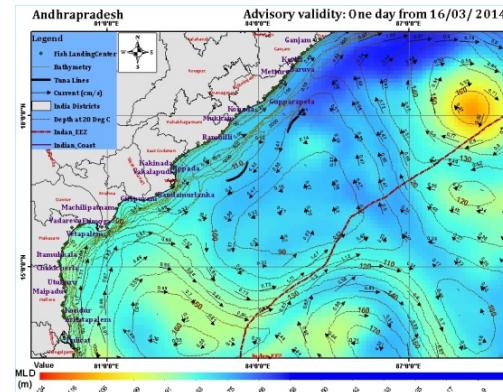
Marine Fishery Advisory Services

Harmful Algal Bloom Information

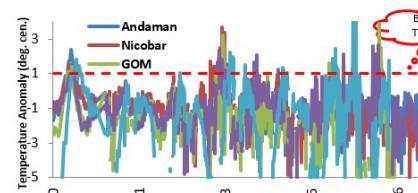
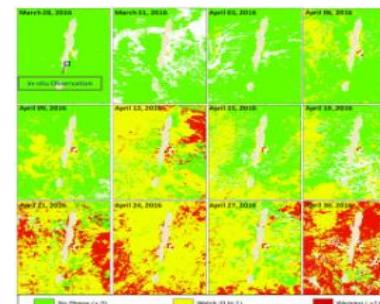
Coral Bleaching Alerts

Coastal Water Quality Nowcast and Forecast

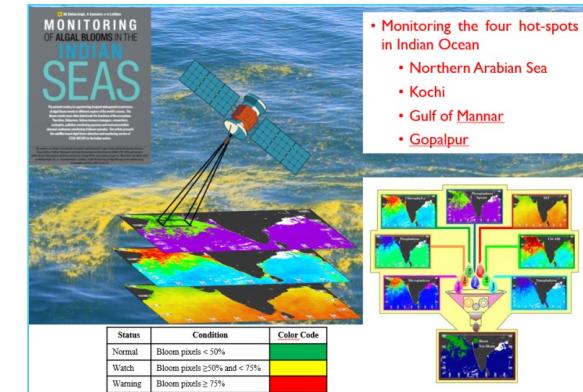
Marine Fishery Advisory Services



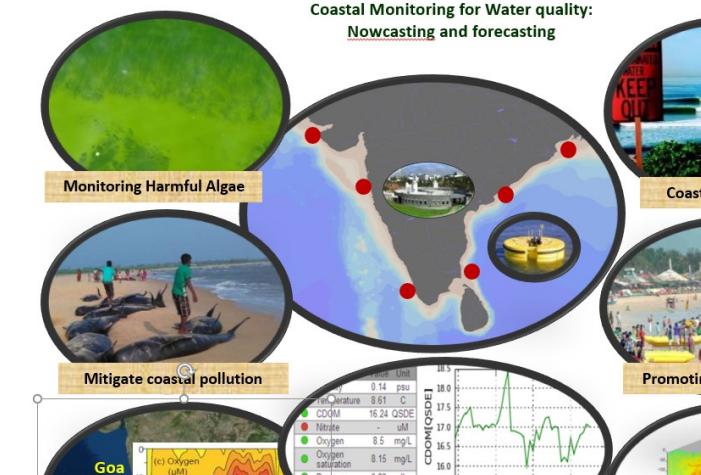
Coral Bleaching Alerts



Harmful Algal Bloom Information



Coastal Water Quality Nowcasting and Forecasting



Operational Ocean Services

Multi-Hazard Early Warning Services

Tsunami Early Warning

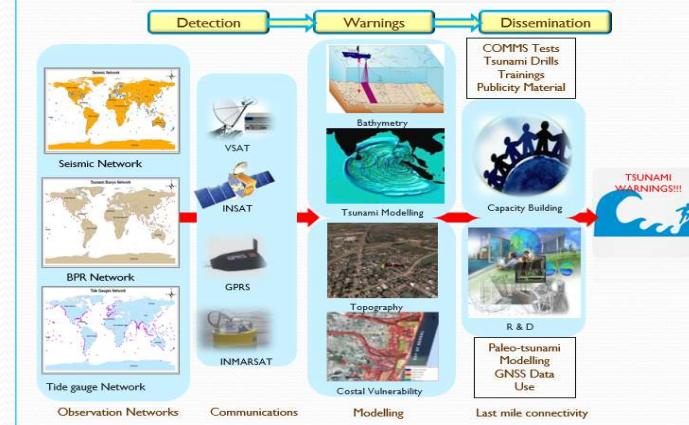
Storm Surge Early Warning

Ocean State Forecast

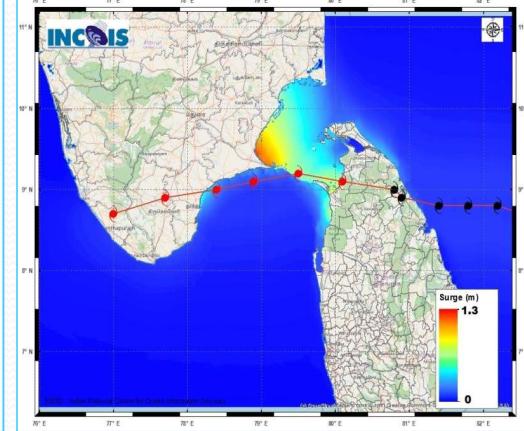
Oil Spill Trajectory

Marine Search and Rescue

Tsunami Early Warning System

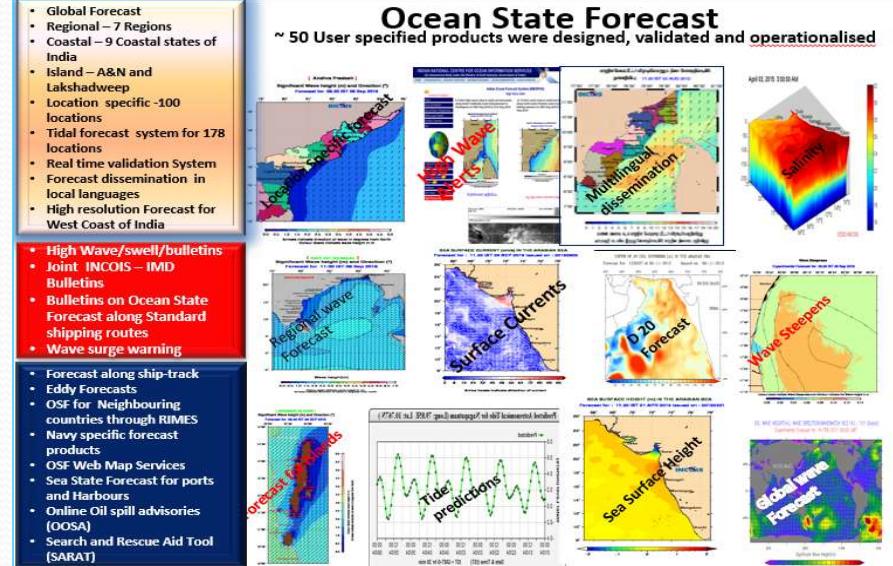


Storm Surge Early Warning System



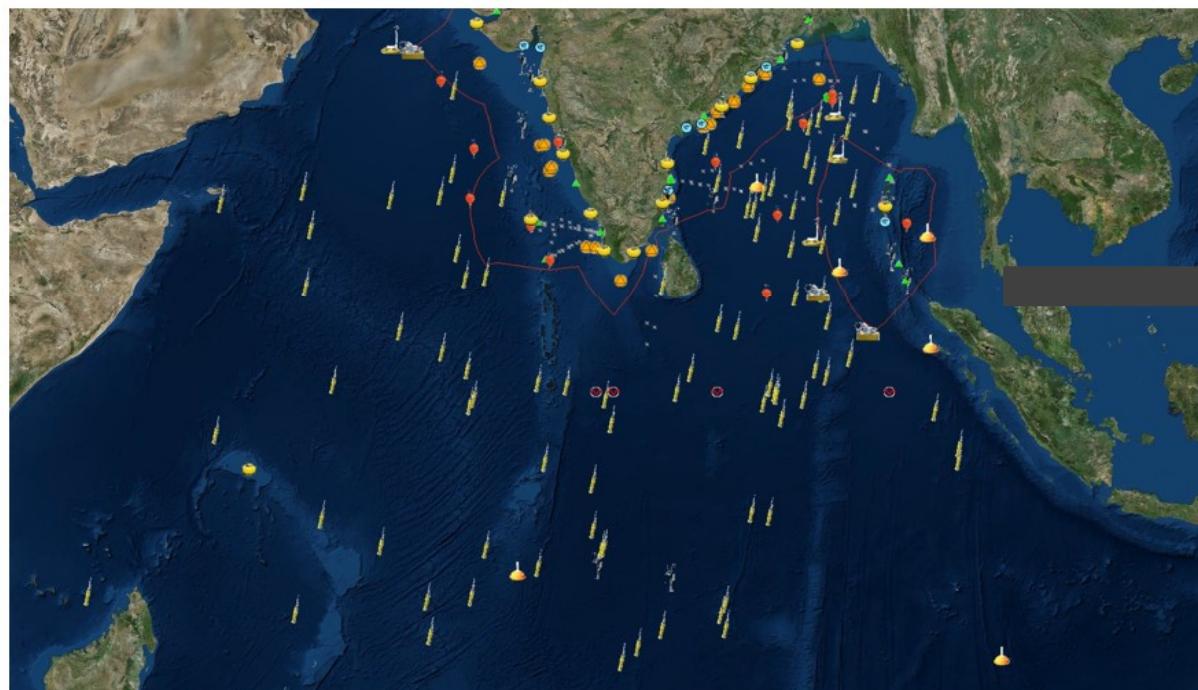
Ocean State Forecast

~ 50 User specified products were designed, validated and operationalised



OCEAN OBSERVATIONS BY INDIA

To obtain long term high quality in-situ sub-surface oceanographic and near surface parameters to support operational services



Status and Future Plans (2022-2026)

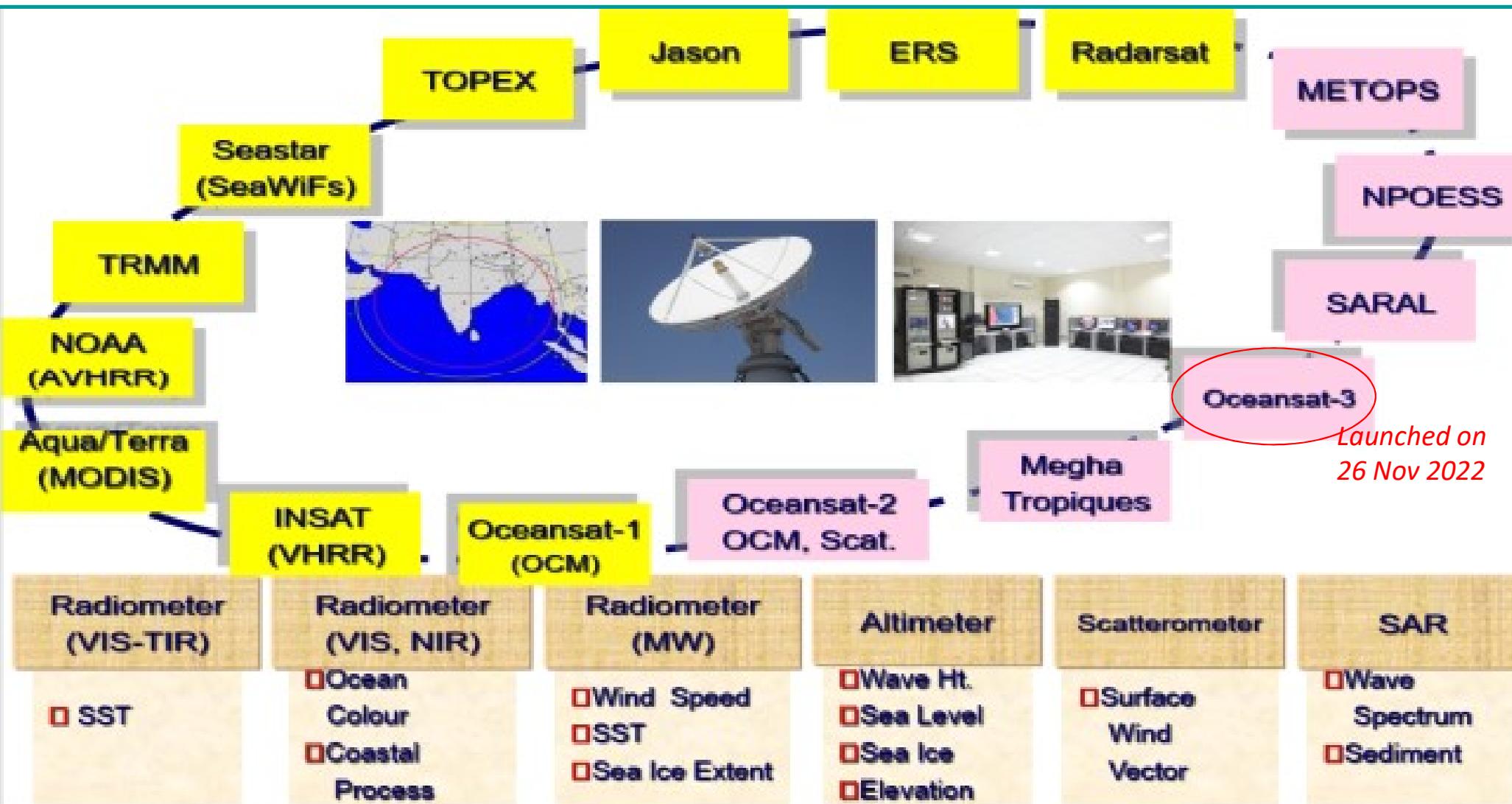
Indian National Centre for Ocean Information Services (INCOIS)

- Argo Floats [493 (73 BGC) – 50 per year]
- Drifting Buoys [430 – 30 per year]
- Automatic Weather Stations onboard Research Vessels [36 – Sustain]
- Wave Rider Buoys [16 - Sustain]
- Wave Drifters[4 - 150]
- Tide Gauges[36 – Sustain and setup 15 new TG and GPS]
- Tsunami Buoys [4 - Sustain]
- Gliders (10 + 2)
- XBT/XCTD Surveys [3 transects - Sustain]
- Coastal ADCP [17 - Sustain]
- Equatorial Current Meter Mooring [3 - Sustain]
- INCOIS Flux Mooring (1)

National Institute of Ocean Technology (NIOT)

- OMNI Buoy Network [12 - Sustain]
- Tsunami Buoys [3 - Sustain]
- HF RADARS [5 Pairs – Sustain]

Space-based Ocean Observing Systems



Modelling and Prediction Systems



INCOIS Ocean Modeling and Data Assimilation Activities

Ocean Modeling Mission

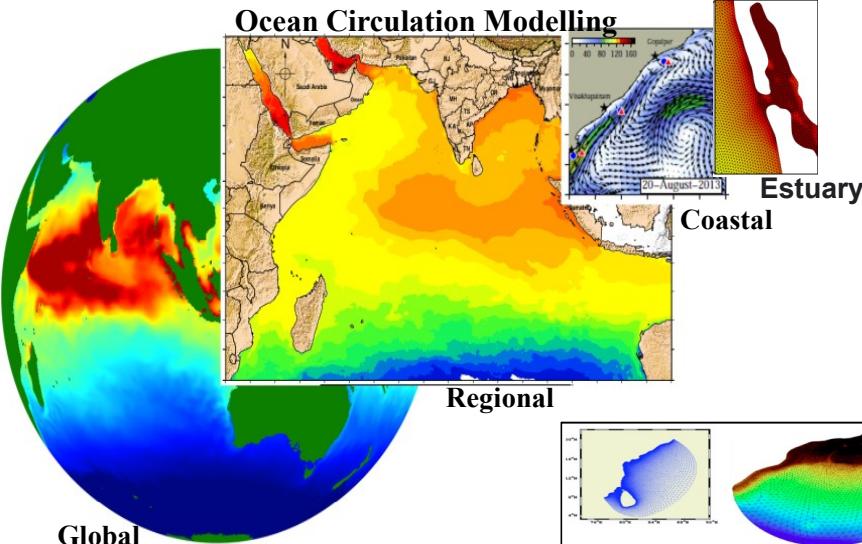
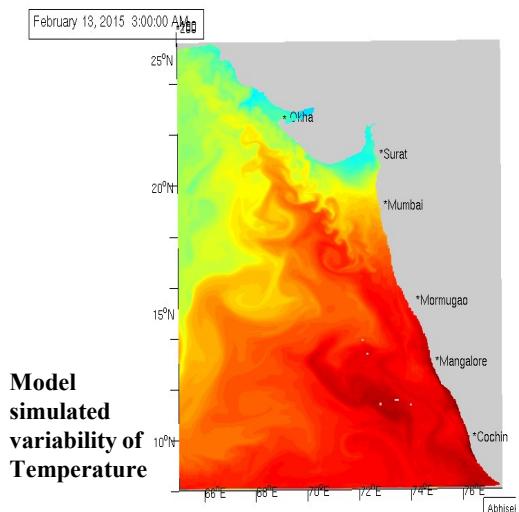
Deep Ocean Mission

Monsoon Mission

Coastal Water Quality Monitoring and Forecast Program

Ocean Predict (GODAE Ocean View)

Model simulated variability of Temperature



Ocean Analysis (GODAS)

Data Assimilation (LETKF, 3DVAR, OI)

Circulation Models (ROMS, MOM, HYCOM)

Wave, Tsunami, Cyclone, Storm Surge (Wavewatch III, ADCIRC, SWAN, HWRF+HYCOM)

Satellite: Model Forcing-Validation-Data

Monsoon Forecast (CFS model)

Tropical Cyclone Heat Potential

Cyclone Prediction

Climate Indices

Regional Analysis

Regional and Coastal Forecasts

Value Added Services (OOSA, SARAT)

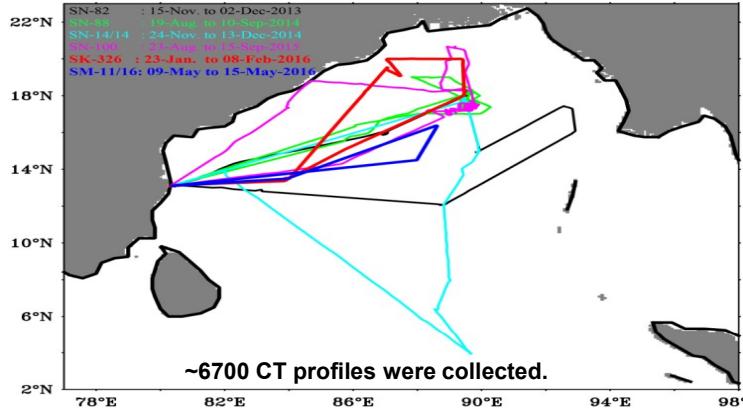
Forecast and Advisory services

Ocean Mixing and Monsoon (OMM): Air-Sea Interaction Research Initiative (ASIRI)

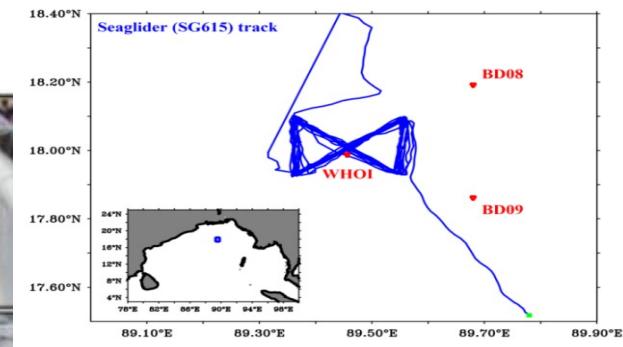
Collaborative between National Monsoon Mission Program, (MoES), India- Office of Naval Research, US

To obtain multi-scale observation in the near surface layer in the Bay of Bengal to improve our knowledge on the air-sea exchange and sub-mesoscale process

OMM Cruise Tracks

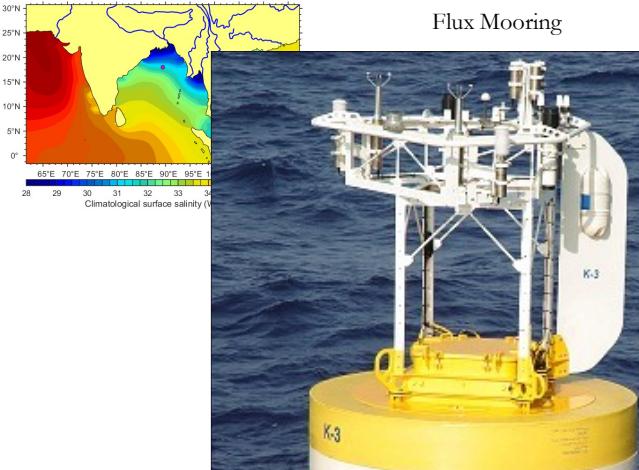


INCOIS First Seaglider mission
Total Dives/Profiles: 541/1082)

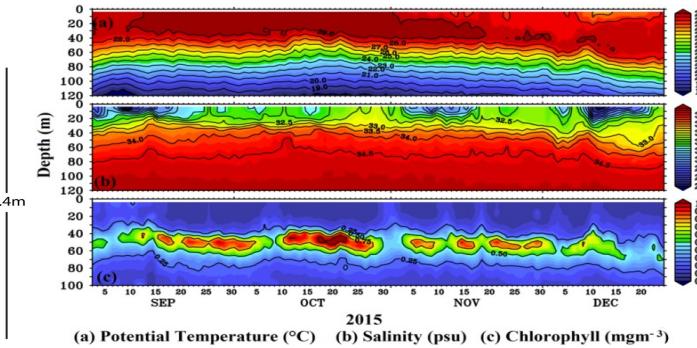


Parameters: Salinity, Temperature, Dissolved oxygen, Chlorophyll fluorescence, Optical Backscatter, PAR

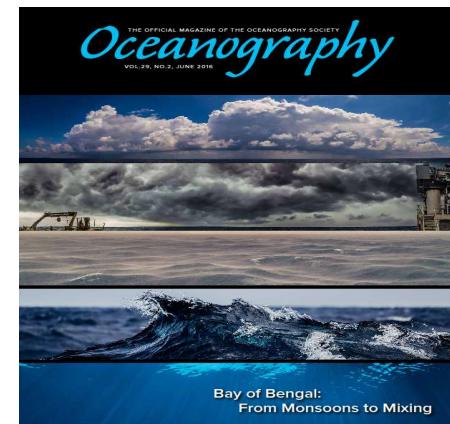
Flux Mooring



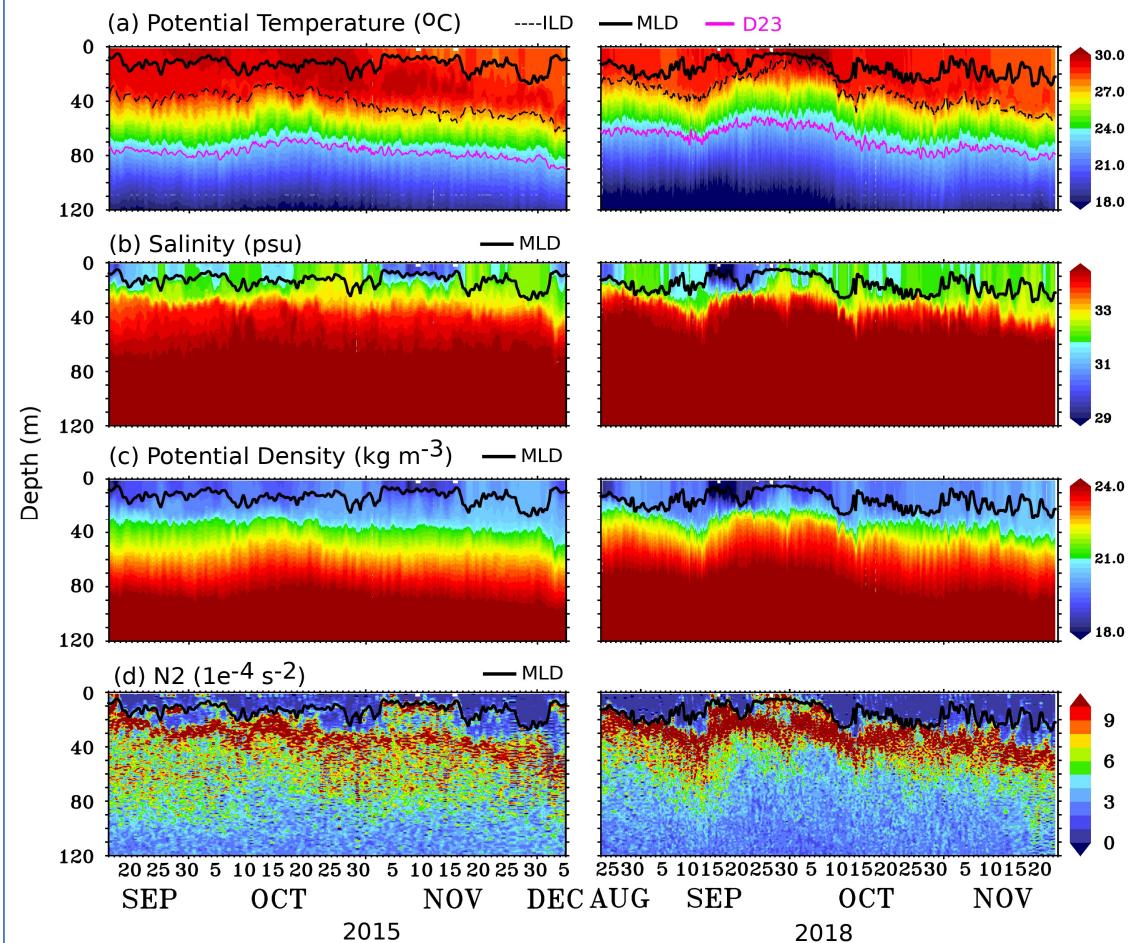
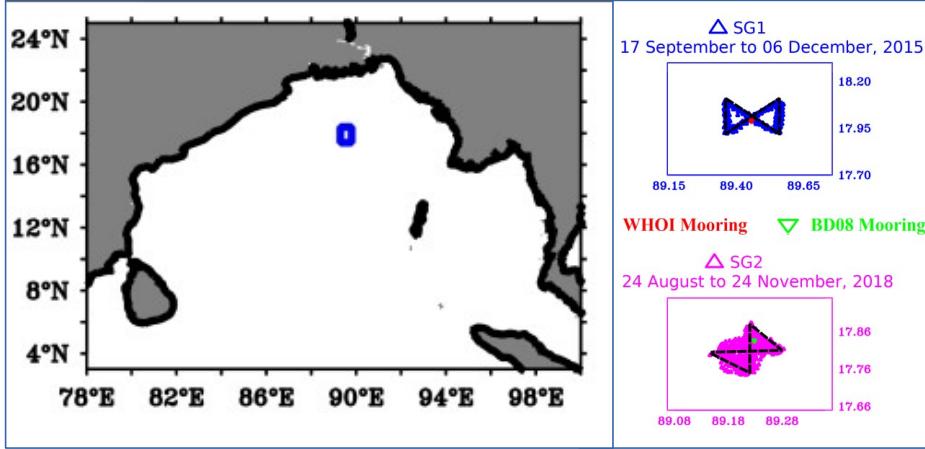
Lagrangian Float



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VOL. 29, NO. 2, JUNE 2016



Ocean Mixing and Monsoon (OMM)- Glider Mission

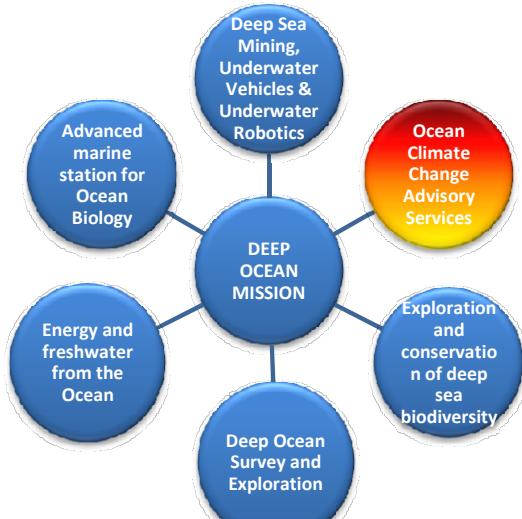


Summary

- Gliders data are utilized to understand the sub-seasonal variability of mixed layer (ML) temperature (MLT) and Barrier Layer Temperature (BLT) in northern Bay of Bengal (nBoB).
- During the freshening events, the drop in sea surface salinity (SSS) varied between 2-6 psu with $\sim 0.3\text{-}1.4 ^{\circ}\text{C}$ cooling in SST.
- The variability in the mixed layer heat budget are mainly dominated by effective surface heat flux (Q_{eff}) where the penetrative component of shortwave radiation (Open) dominates whenever ML becomes shallow (<10 m).
- The barrier layer (BL) and TI are stronger during the winter of 2015 than to the winter of 2018, and the magnitude of TI during 2015 was two times higher than that during 2018.
- The horizontal advection and vertical process are mainly governing the variability in the mixed layer salinity where local fresh water flux (evaporation-precipitation) are not much significant.

Quantification of various oceanic processes on the variability of sea surface temperature in the northern Bay of Bengal using seaglider and mooring observations

V. P. Thangaprakash, M.S. Girishkumar, J. Sreelekha, N. Sureshkumar, M. Ravichandran, S. Shivaprasad, D. Sengupta, E. Pattabhi Rama Rao, Tom Farrar, S.S.V.S. Ramakrishna, Craig Lee (Manuscript to be submitted; December 2022)



Deep Ocean Mission – Ocean Climate Change Advisory Services



The Meridional overturning circulations (Cross Equatorial Cell and subtropical cell) and Indonesian Throughflow are the primary driving factors for the ventilation of the north Indian Ocean.

Sea Level

- Based on statistical and dynamical downscaling using a suite of statistical techniques such as AI/ML and high-resolution global/regional ocean general circulation model

Cyclones & Storm Surge

- Decadal and longer timescale projection of tropical cyclones and its intensity will be based on statistical models for identification of cyclogenesis

Waves

- Extreme waves projection will be based on global/regional wave model forced by suitable atmospheric historical / projected forcing.

Biogeochemistry

- Impact of climate change on the Indian Ocean BGC & HAB will be based on in-situ, satellite & models for projection.

Deep Ocean Observations

- Strong observational network specifically designed to capture long term changes in ocean climatic conditions

Scientific Background

- ❖ Understanding the temporal and spatial variability of OMZ.
- ❖ Track and monitor water mass properties and ventilation processes of the North Indian Ocean.
- ❖ Assess and tune model simulations for the physical and biogeochemical parameters.

Objectives:

- ❖ Long term monitoring of deep ocean physical and biogeochemical parameters using deep sea gliders along two transects in the northern Indian Ocean, each one in Arabian Sea and Bay of Bengal and deep Argo floats.
- ❖ Observing surface waves/swells characteristics using wave drifters

Parameters:

- ❖ Sea Surface Temperature (SST)
- ❖ Wave parameters
- Vertical profiles of
 - ❖ Temperature
 - ❖ Salinity
 - ❖ Chlorophyll
 - ❖ Coloured Dissolved Organic Matter (CDOM)
 - ❖ Dissolved Oxygen,
 - ❖ Photosynthetically Active Radiation (PAR)

India Glider Programme



Parameters

- Vertical profile of temperature, salinity, chl-a, CDOM fluorescence, backscattering, Dissolved Oxygen & PAR

Applications

- Long term monitoring of **ocean physical and biogeochemical parameters** in northern Indian Ocean.
- Assess and tune model simulations** for the physical and biogeochemical parameters.

Data availability

- Delayed-mode
- Real-time

Area of Deployment & Transects

- Ocean Gliders to make two continuous transects; one in BoB and another in AS



Gliders – Present Status and Future Plans

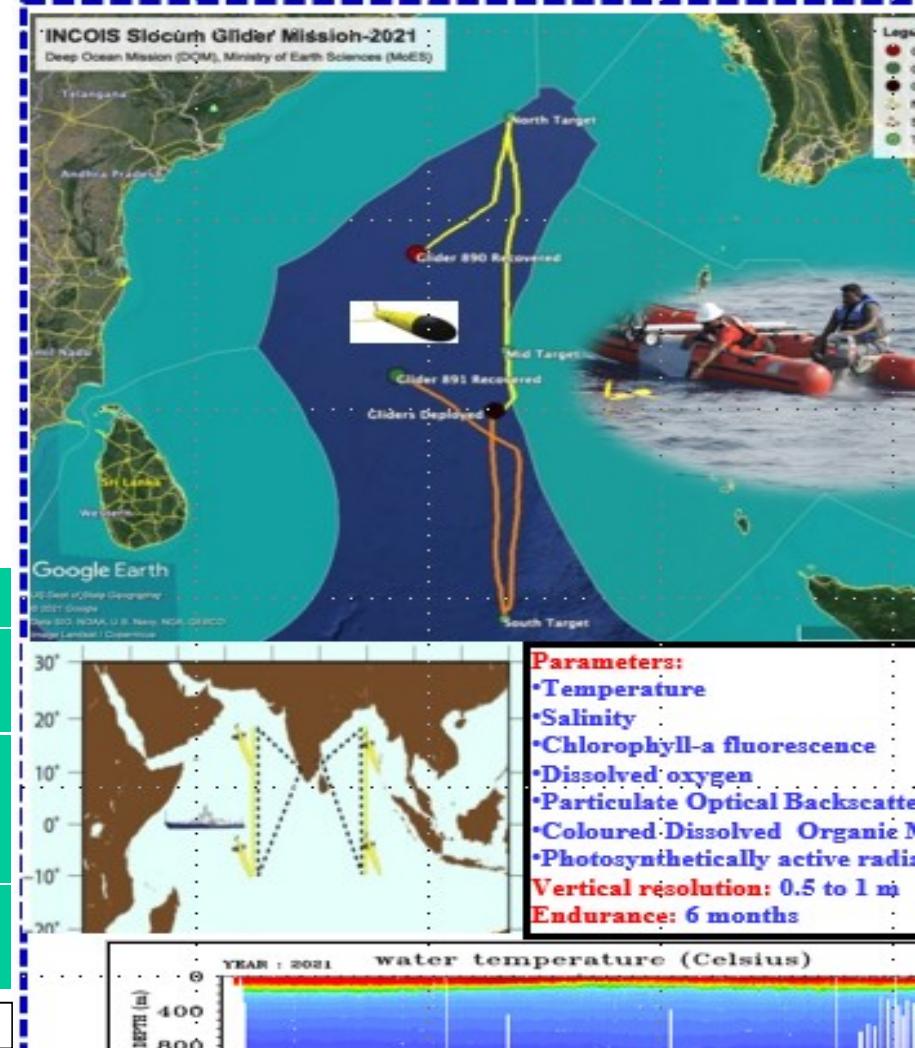
Previous Mission

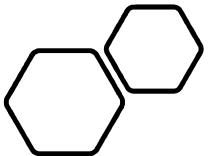
- The two slocum gliders were deployed during 05 March 2021 (SN-162) and recovered on 18 & 20 May 2021 (SK-370).
- Nearly two and half months of observing both physical and bio-geochemical variables from near surface to 1000 m depth along north and south glider transects and both travelled about ~5300 kms.
- Data processing and analysis are going on

Deep Sea Gliders Deployment/Recovery Plans *

No. of Gliders	Location	Deployment Month	Recovery Month
2 (existing)	Bay of Bengal	December 2022/January 2023	May/June 2023
2 (new)	Bay of Bengal	May/June 2023	November/December 2023

*Subject to availability of ship time and arrival of procured sensors / spares / instruments on-time





Glider Test Facility

- A dedicated Glider Test facility established at INCOIS, Hyderabad, India.
- The requirements of maintenance, including battery replacement and ballasting for different regions can be taken care in India itself.
- 4 m x 4 m Ballasting Tank Facility (BTF) available to carry out the ballasting for various oceanographic instruments at INCOIS, Hyderabad, India.
- Capable of handling 20 to 25 Gliders regardless of what type of vehicle we are operating.



Thank You!

