

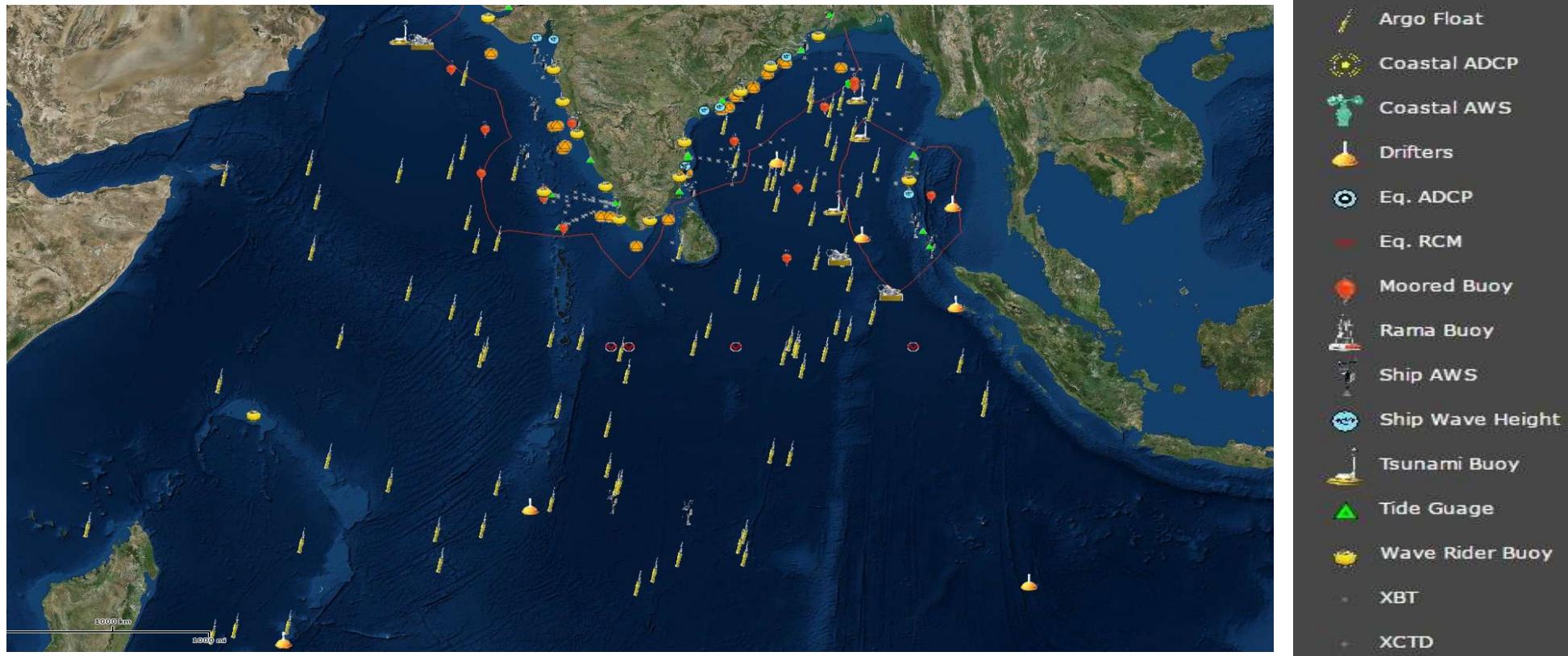


FORECASTING / DATA SYSTEMS

TVS UDAYA BHASKAR, INCOIS, MOES, GOVT OF INDIA.



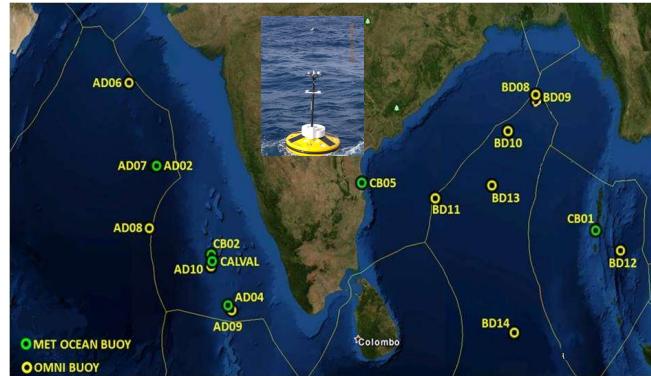
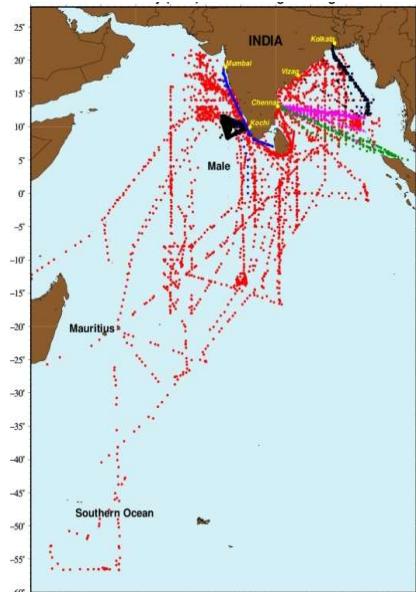
OCEAN OBSERVATIONS AND DATA - NEEDS AND OPPORTUNITIES



PARAMETERS MEASURED AND ARCHIVED PERTAINING TO IND-OCN

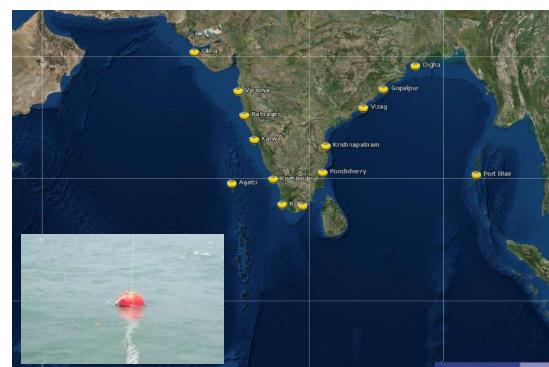
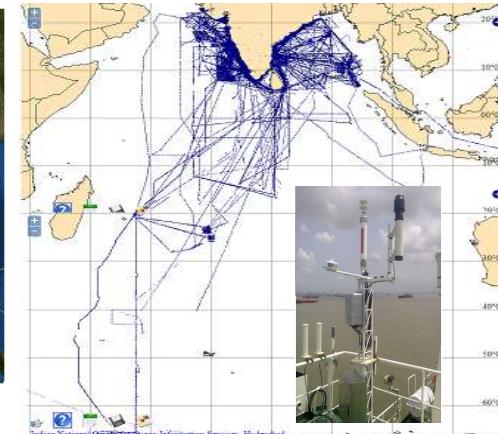
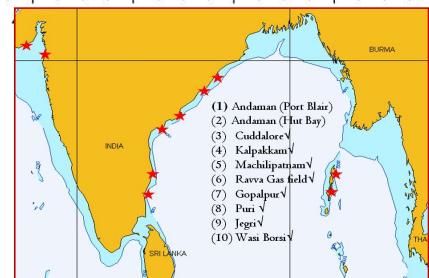
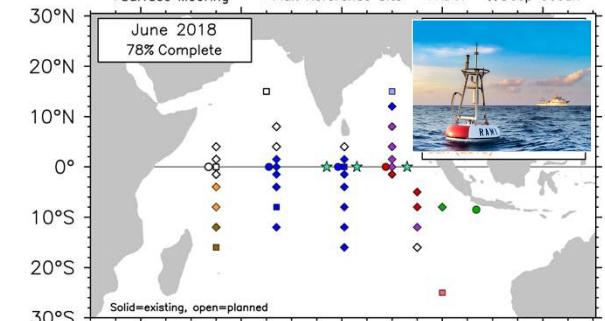
- Temperature (surface / sub-surface)
- Salinity (Surface / sub-surface)
- Currents (Surface / sub-surface)
- Chlorophyll
- Dissolved Oxygen
- Backscattering (BBP700)
- Wave
- Wind
- Water Quality
- Air Temperature
- Humidity
- Pressure
- Radiation
- Rainfall

IN SITU DATA

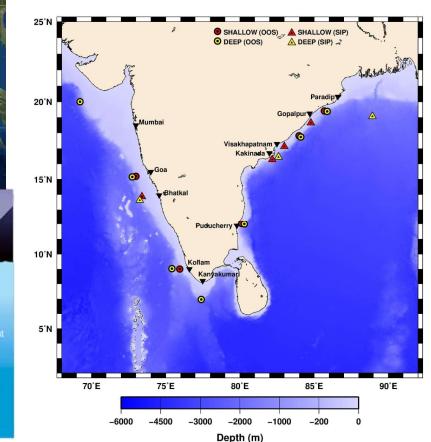
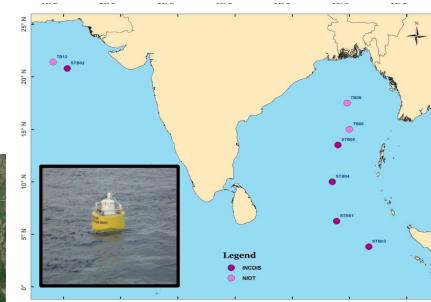
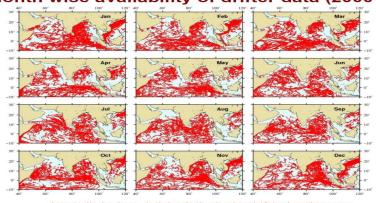


Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction (RAMA)

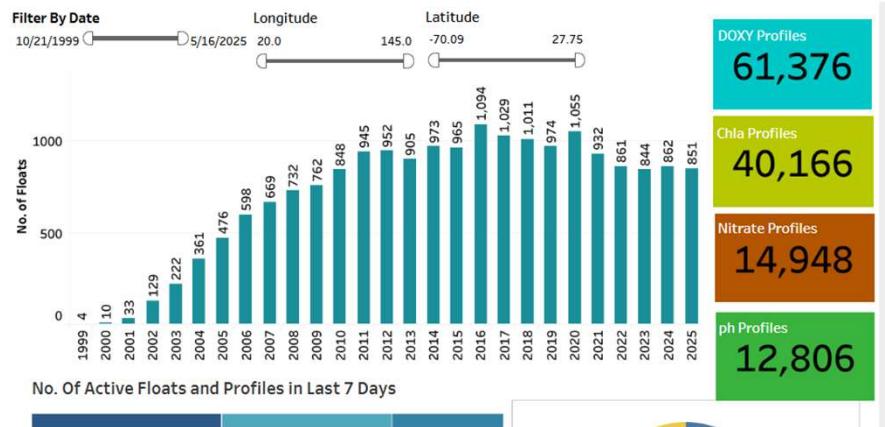
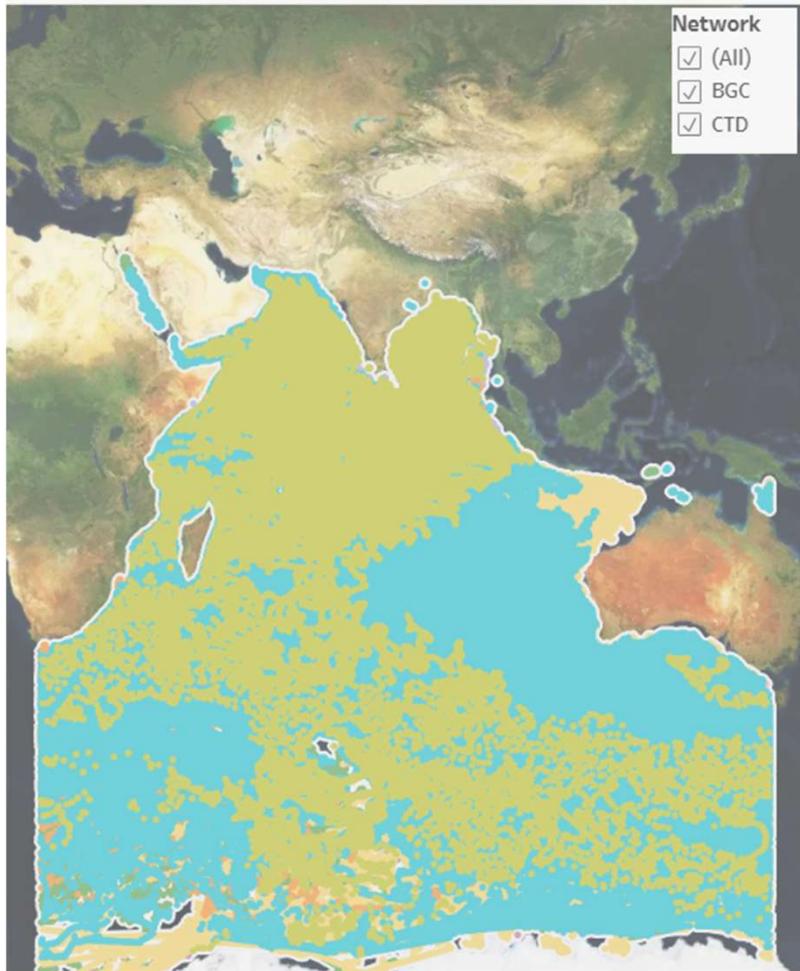
◆ Surface Mooring ■ Flux Reference Site ● ADCP ★ Deep Ocean



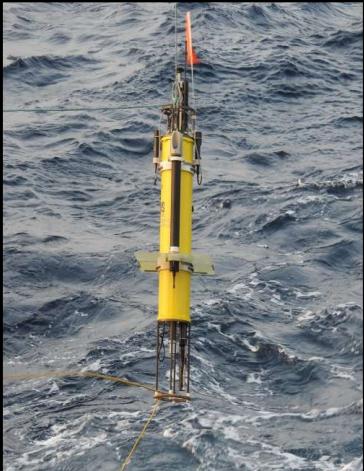
Month wise availability of drifter data (2000-15)



THE INDIAN ARGO PROGRAM (587 FLOATS BY INDIA)

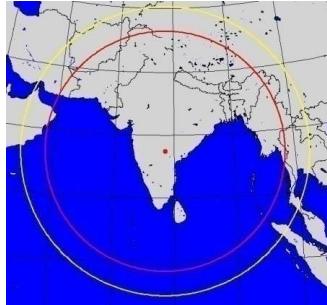


PROCESS SPECIFIC OBSERVATIONAL PROGRAMME



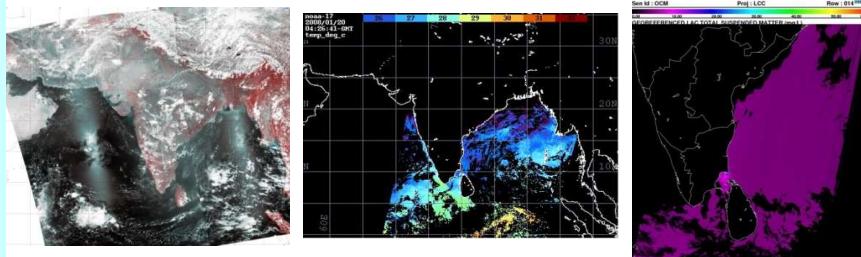
Objective: To observe and understand fine scale processes and its interaction with large scale systems in the ocean.

REMOTE SENSING OBSERVATIONS (INDIAN & FOREIGN)



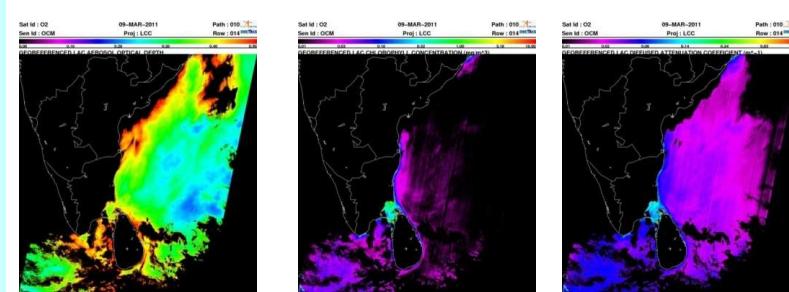
■ Remote Sensing Data

- Oceansat-3/2/1, NOAA-18 & 19, METOP A & B, Terra and Aqua (MODIS), NPP

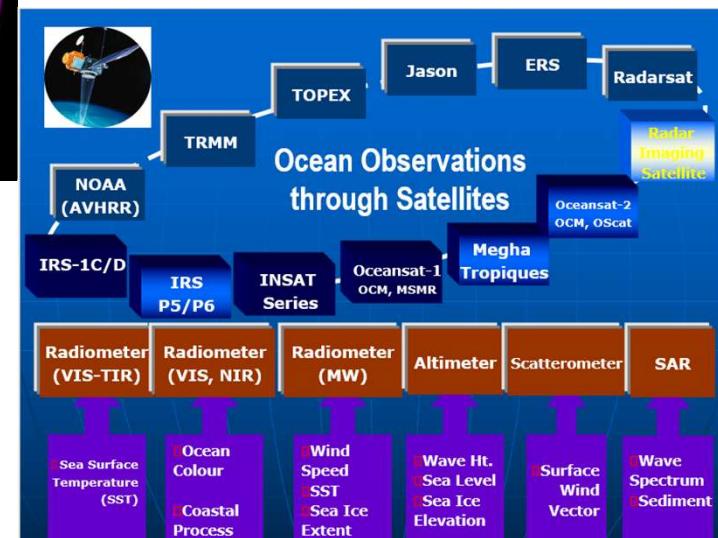


■ In-situ Data

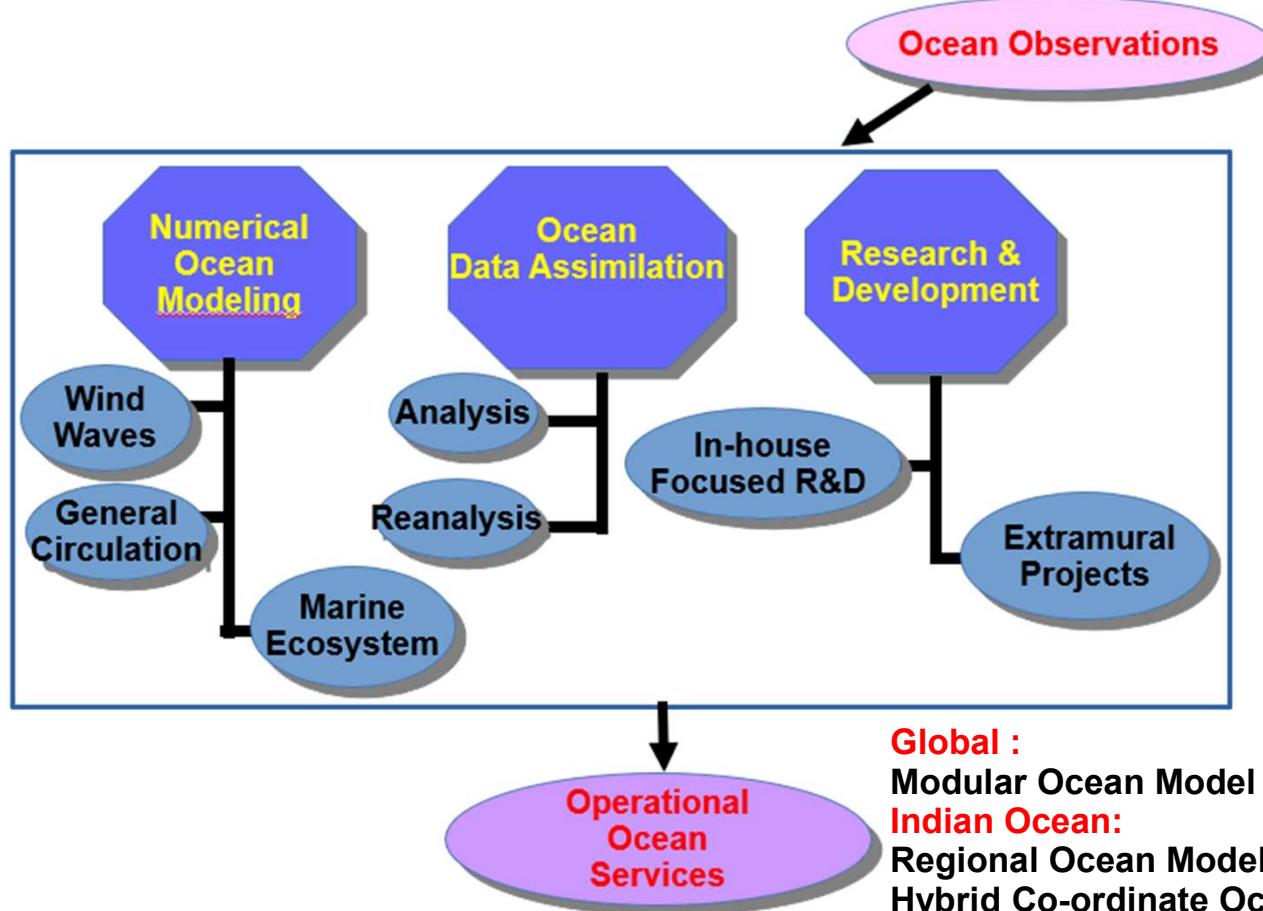
- Argo Floats, Drifting Buoys in the Indian Ocean



Data products are published on INCOIS Web-site with in 5 to 45 minutes after each pass



FORECASTING THROUGH OCEAN MODELLING DATA



Global :

Modular Ocean Model (1° - $1/4^{\circ}$ resolution)

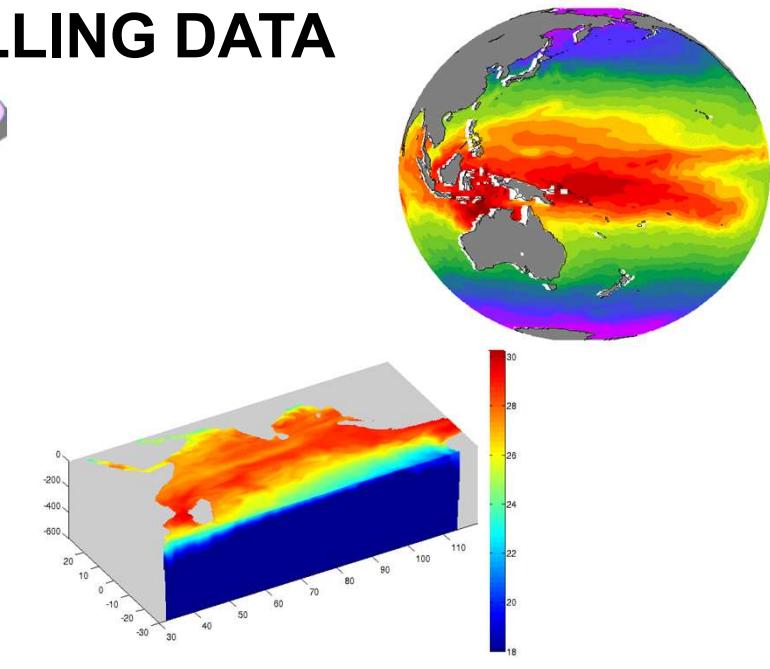
Indian Ocean:

Regional Ocean Modeling System ($1/12^{\circ}$)

Hybrid Co-ordinate Ocean Model ($1/16^{\circ}$)

Coastal:

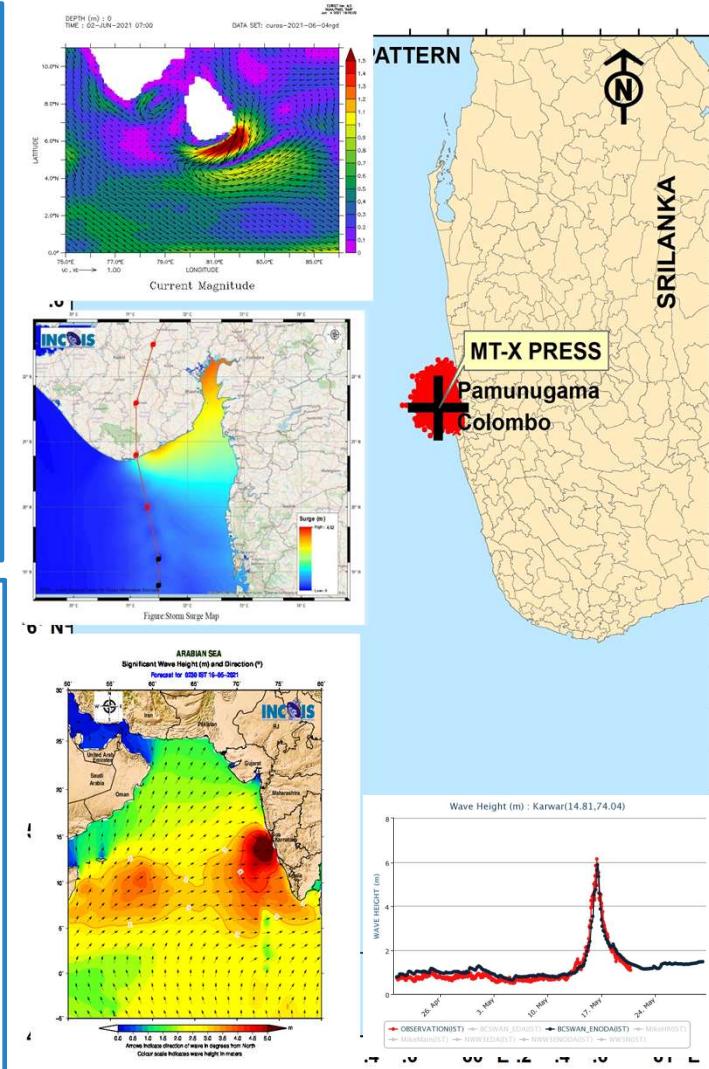
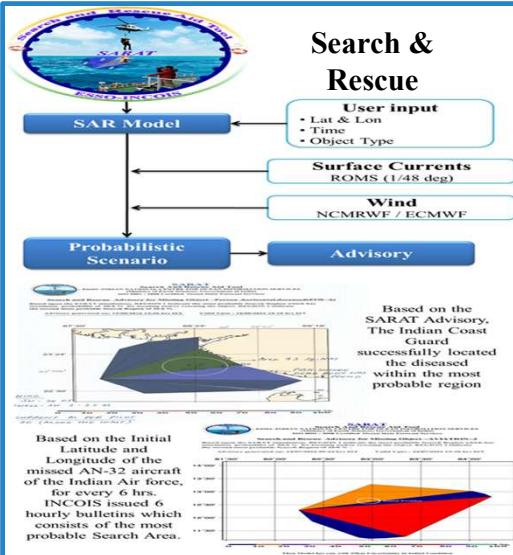
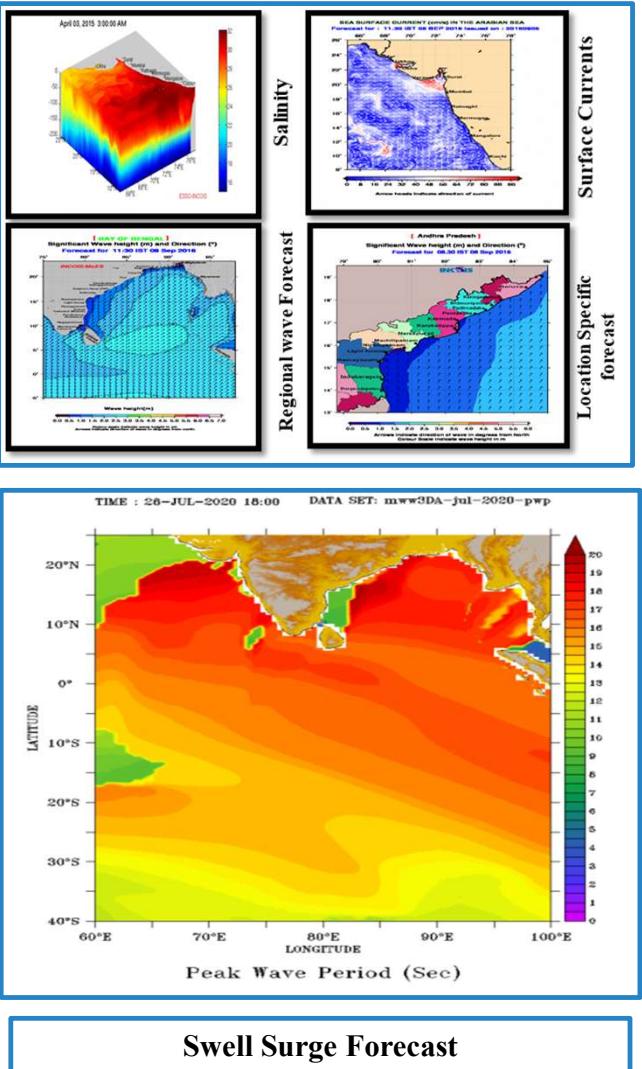
Regional Ocean Modeling System ($1/48^{\circ}$)



FORECASTING SERVICES USING MODELLING DATA

Ocean State Forecasts

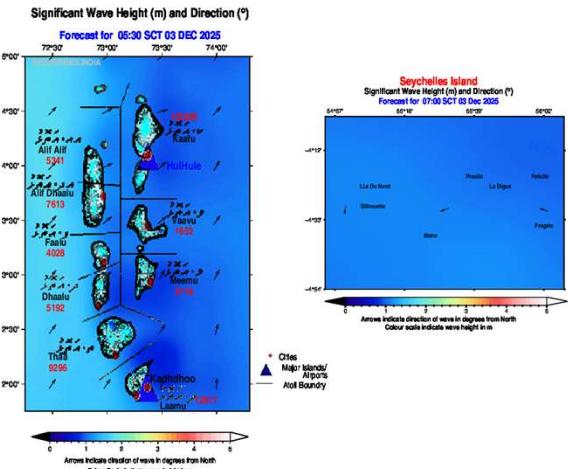
45 User specified daily forecast products for India and 06 Neighbouring Countries



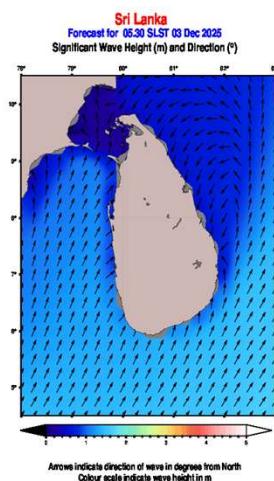
REGIONAL INTEGRATED MULTI-HAZARD EARLY-WARNING SYSTEM (RIMES)

INTEGRATED OCEAN INFORMATION AND FORECAST SYSTEM

Maldives



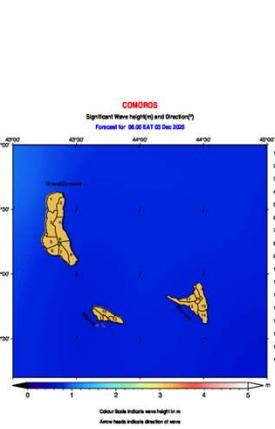
Seychelles



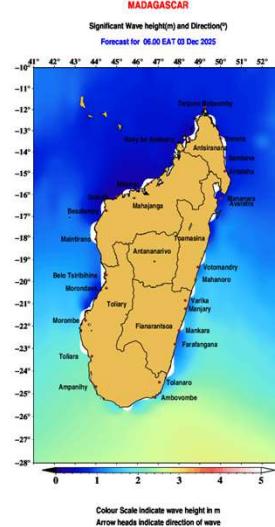
OCINDIO-MS

IOCINDIO-MS (Forecast Services can be extended to other MS too)

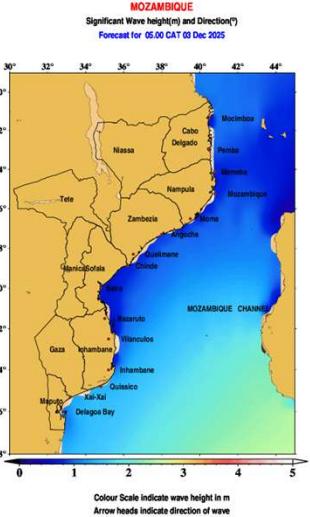
THE JOURNAL OF CLIMATE



Madagascar



Mozambique



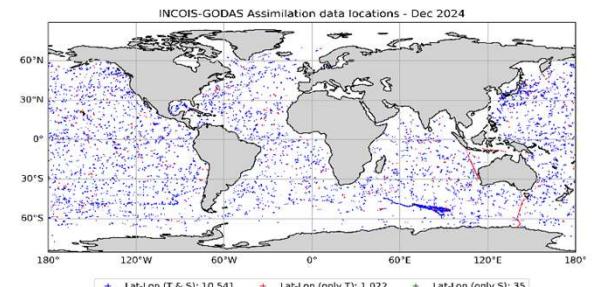
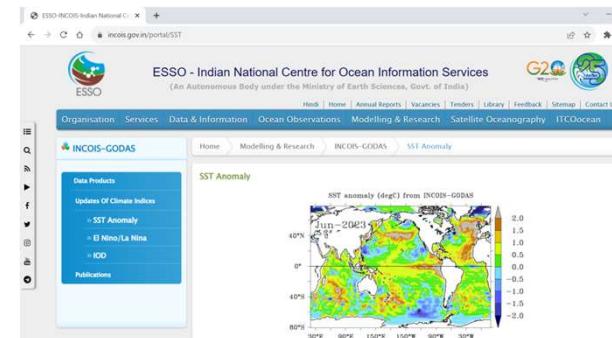
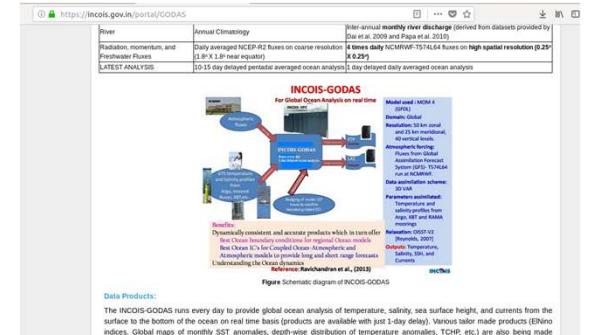
INCOIS- GLOBAL DATA ASSIMILATION SYSTEM

INCOIS operationally provide Global Ocean analysis based on GODAS.

❖ GODAS assimilates in-situ temperature and salinity profiles using 3D-VAR assimilation scheme into MOM4 ocean model.

❖ INCOIS Global Ocean analysis is used to

- a) Provide ocean initial conditions for Monsoon prediction
- b) Preparing climate indices
- c) Tropical Cyclone Heat Potential (TCHP) for IMD's cyclone monitoring
- d) Provide lateral boundary conditions for regional ocean models of INCOIS
- e) R&D in oceanography



INCOIS GLOBAL OCEAN REANALYSIS (IGORA) V1.0

Model used : MOM5

(GFDL)

Domain: Global

Resolution: 50 km zonal and 25 km meridional, 40 vertical levels.

Atmospheric forcing:

Fluxes from NCEP reanalysis

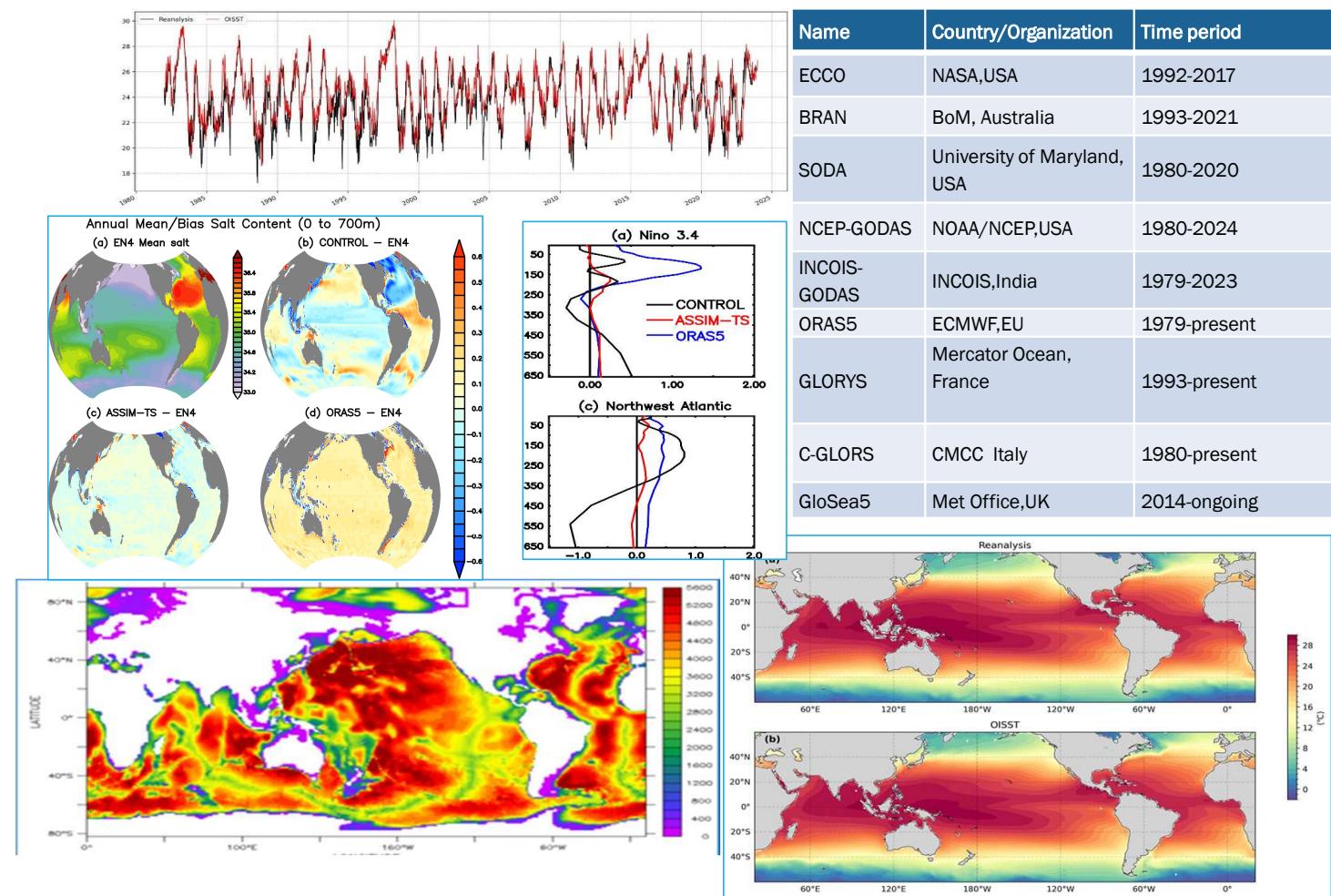
Data assimilation scheme: 3D VAR

Parameters assimilated:

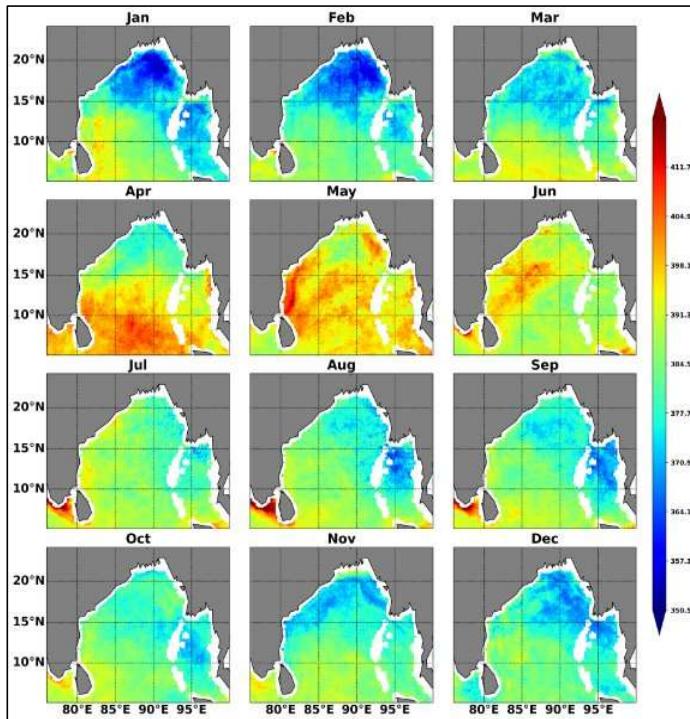
Temperature and salinity profiles from Argo, XBT, and moored buoys

Relaxation: ERSST (Huang et al. 2017)

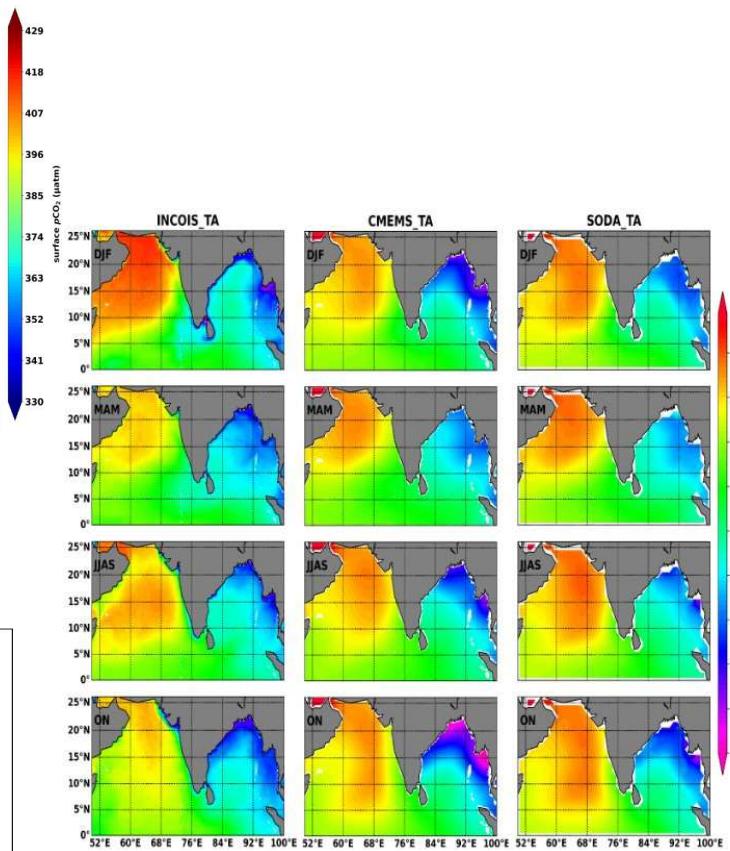
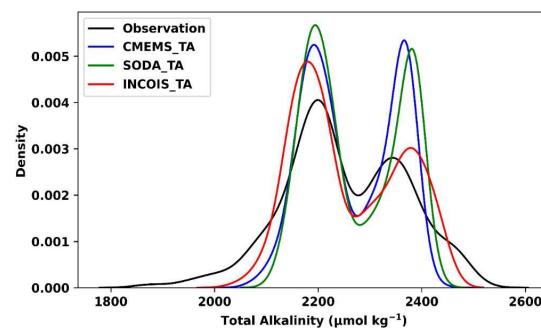
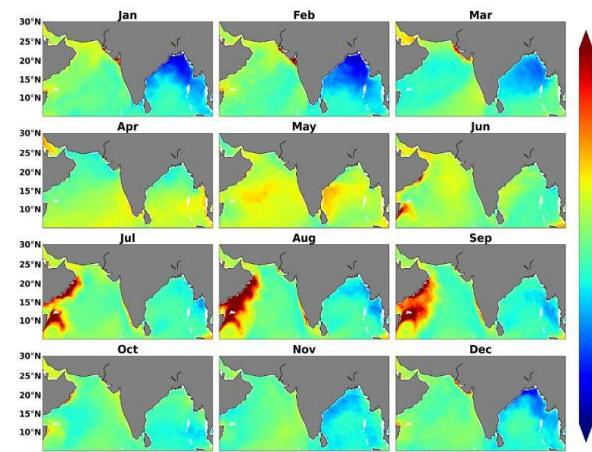
Outputs: 1979-2023, Temperature, Salinity, SSH, and Currents



MACHINE LEARNING BASED MONTHLY PRODUCTS



Surface pCO₂



Total Alkalinity

OCEAN DATA MANAGEMENT

- Central repository for the Oceanographic Data in the country
- National Oceanographic Data Centre (IODE/IOC/UNESCO) – 2004 onwards
- Argo Programme
 - National Argo Data Centre
 - Regional Argo Data Centre
- Project Data Centre
 - Continental Tropical Convergence Project (CTCZ)
 - GEOTRACES-India Data Assembly Centre
 - *Sustained Indian Ocean Biogeochemical and Ecological Research (SIBER)*
- Ocean Biogeographic Information System (OBIS) - Mirror Site (IODE/IOC)
- OceanSITES - Data Assembly Centre
- Contribution to various international programmes
 - IODE, ISPRS, OGC



Thank You

