

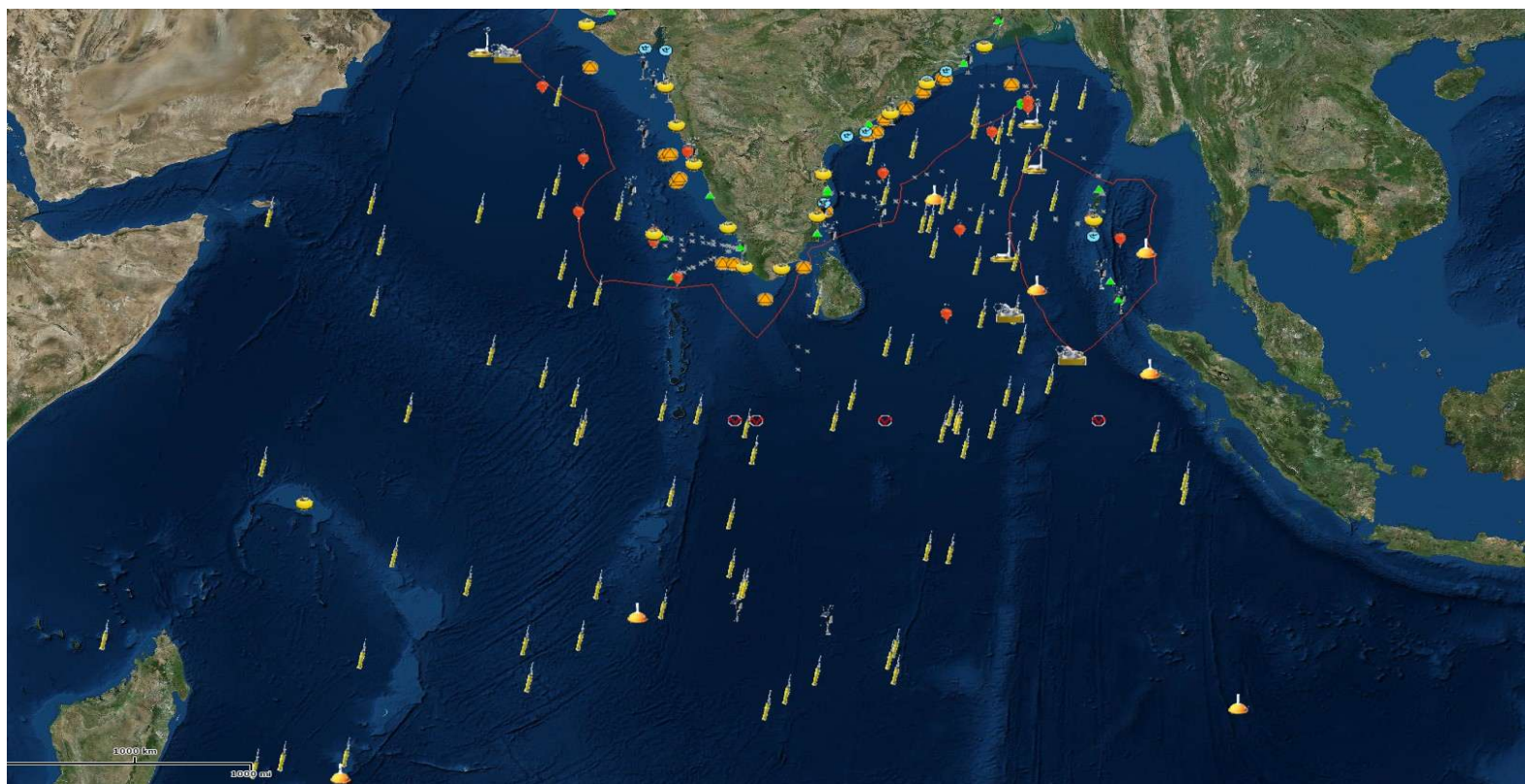


# FORECASTING / DATA SYSTEMS

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



# OCEAN OBSERVATIONS AND DATA - NEEDS AND OPPORTUNITIES



- Argo Float
- Coastal ADCP
- Coastal AWS
- Drifters
- Eq. ADCP
- Eq. RCM
- Moored Buoy
- Rama Buoy
- Ship AWS
- Ship Wave Height
- Tsunami Buoy
- Tide Gauge
- Wave Rider Buoy
- XBT
- XCTD

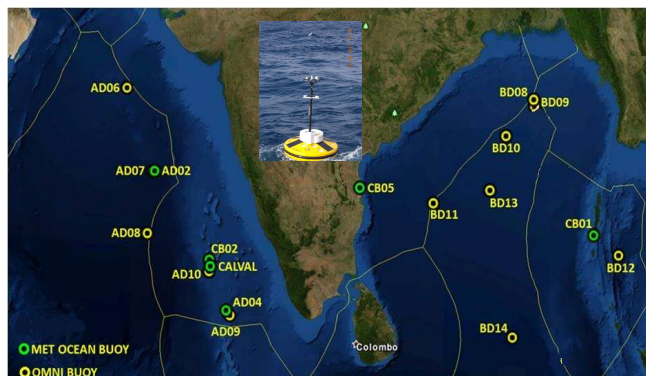
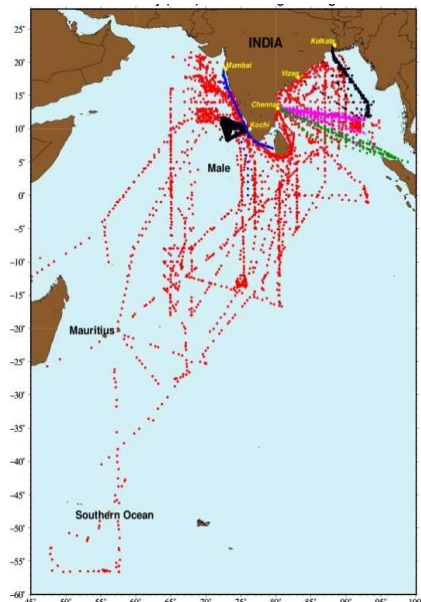


## PARAMETERS MEASURED AND ARCHIVED PERTAINING TO IND-OCN

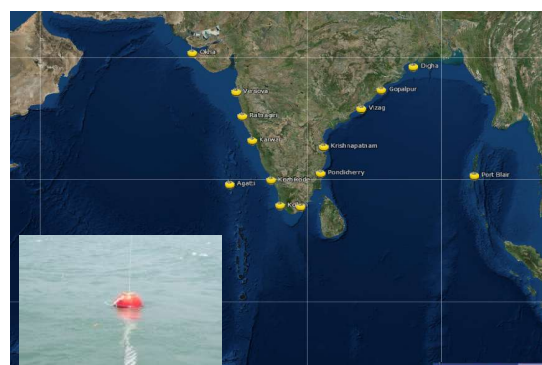
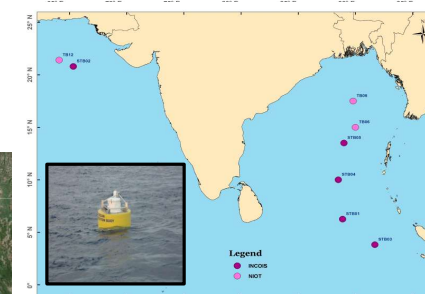
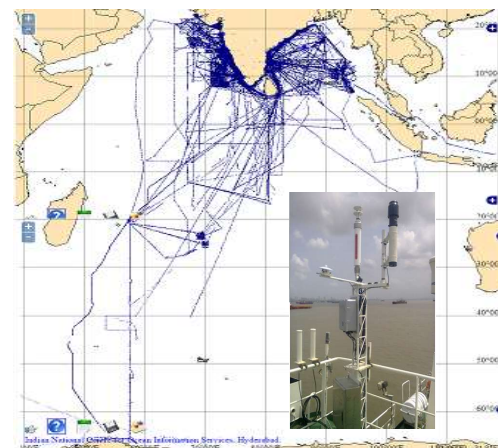
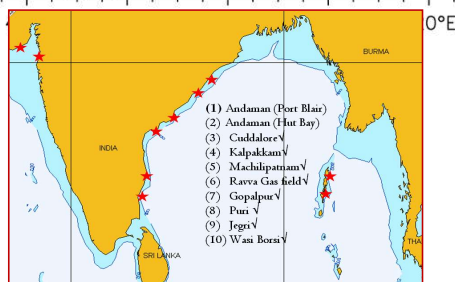
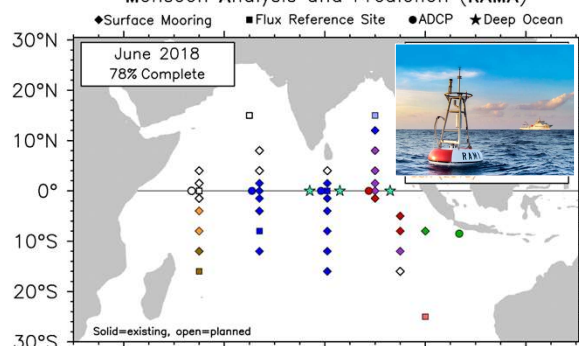
- Temperature (surface / sub-surface)
- Salinity (Surface / sub-surface)
- Currents (Surface / sub-surface)
- Chlorophyll
- Dissolved Oxygen
- Backscattering (BBP700)
- Wave
- Wind
- Water Quality
- Air Temperature
- Humidity
- Pressure
- Radiation
- Rainfall



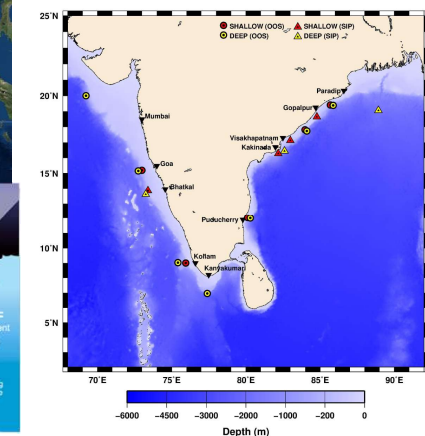
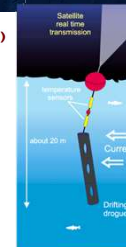
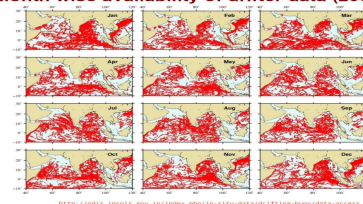
# IN SITU DATA



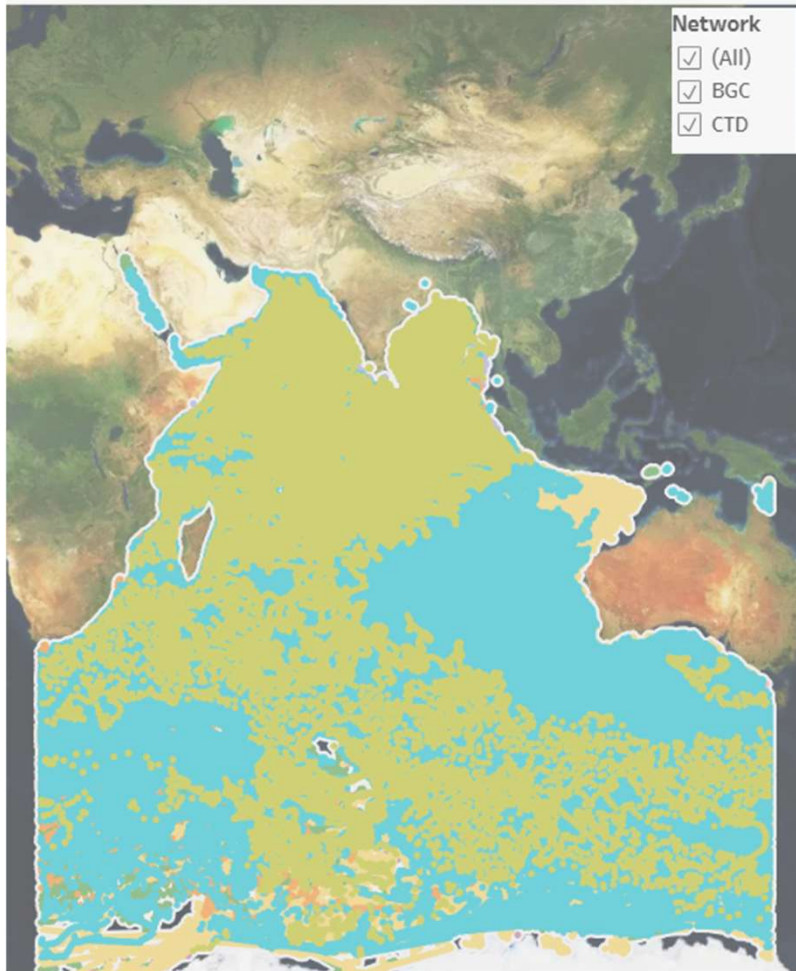
Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction (RAMA)



Month wise availability of drifter data (2000-15)

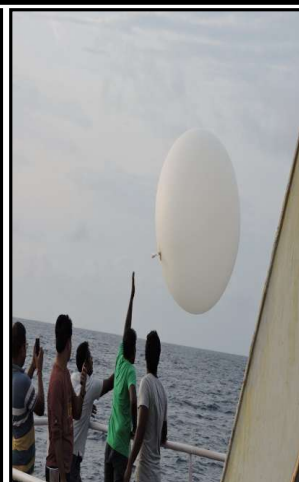
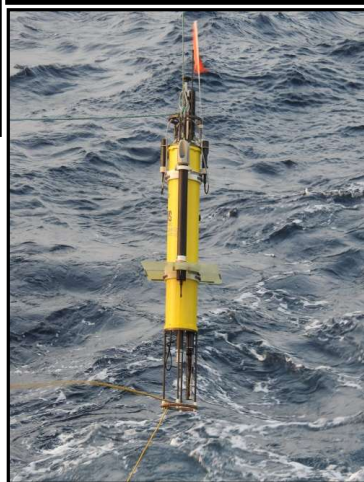
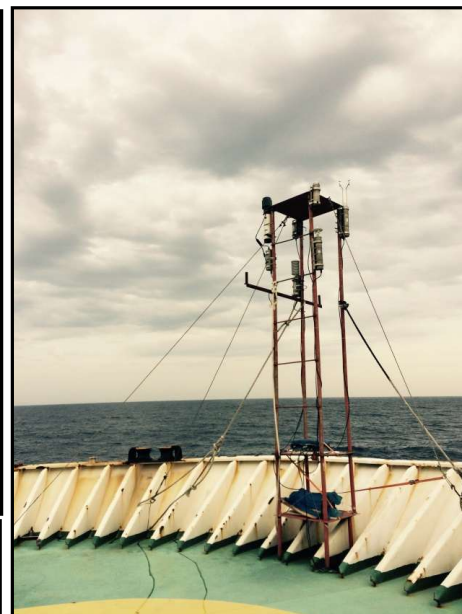


# THE INDIAN ARGO PROGRAM (587 FLOATS BY INDIA)



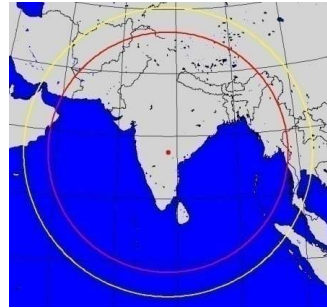


## PROCESS SPECIFIC OBSERVATIONAL PROGRAMME



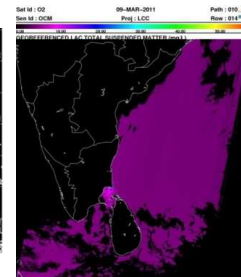
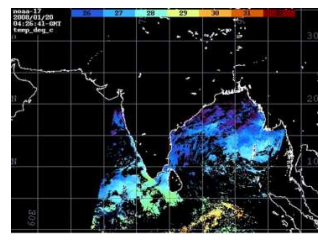
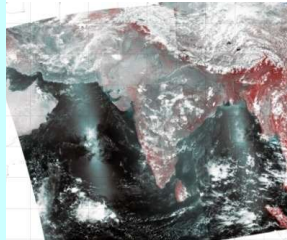
**Objective:** To observe and understand fine scale processes and its interaction with large scale systems in the ocean.

# REMOTE SENSING OBSERVATIONS (INDIAN & FOREIGN)



## Remote Sensing Data

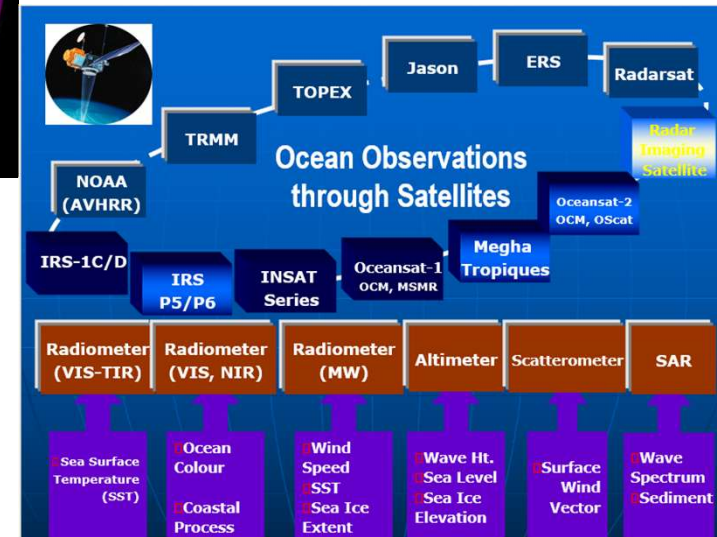
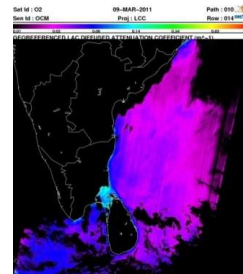
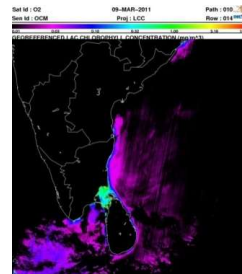
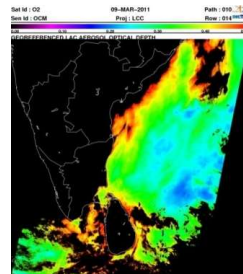
- Oceansat-3/2/1, NOAA-18 & 19, METOP A & B, Terra and Aqua (MODIS), NPP



## In-situ Data

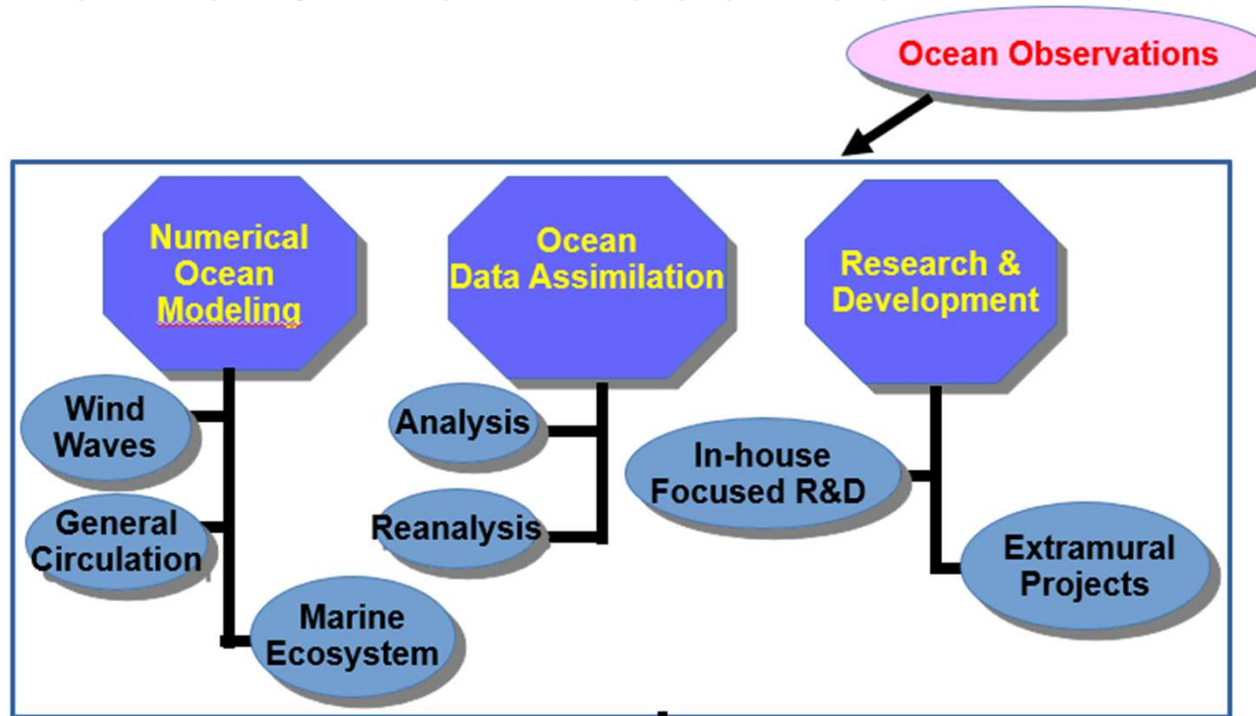
- Argo Floats, Drifting Buoys in the Indian Ocean

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

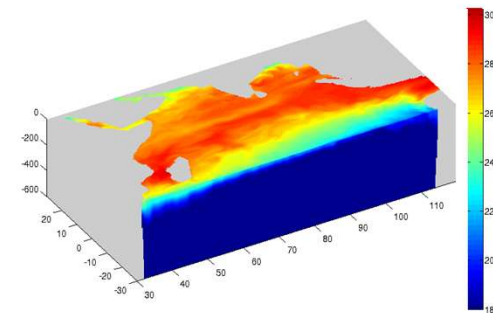
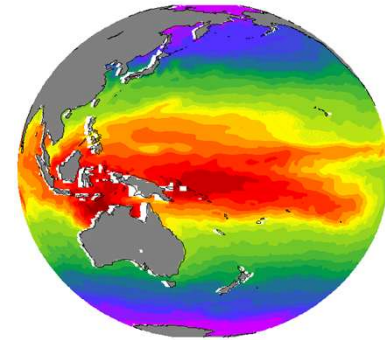




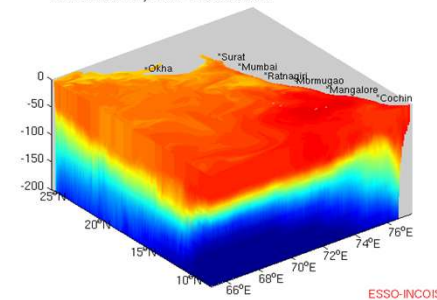
# FORECASTING THROUGH OCEAN MODELLING DATA



**Global :**  
Modular Ocean Model (  $1^{\circ}$ - $1/4^{\circ}$  resolution)  
**Indian Ocean:**  
Regional Ocean Modeling System ( $1/12^{\circ}$ )  
Hybrid Co-ordinate Ocean Model ( $1/16^{\circ}$ )  
**Coastal:**  
Regional Ocean Modeling System ( $1/48^{\circ}$ )



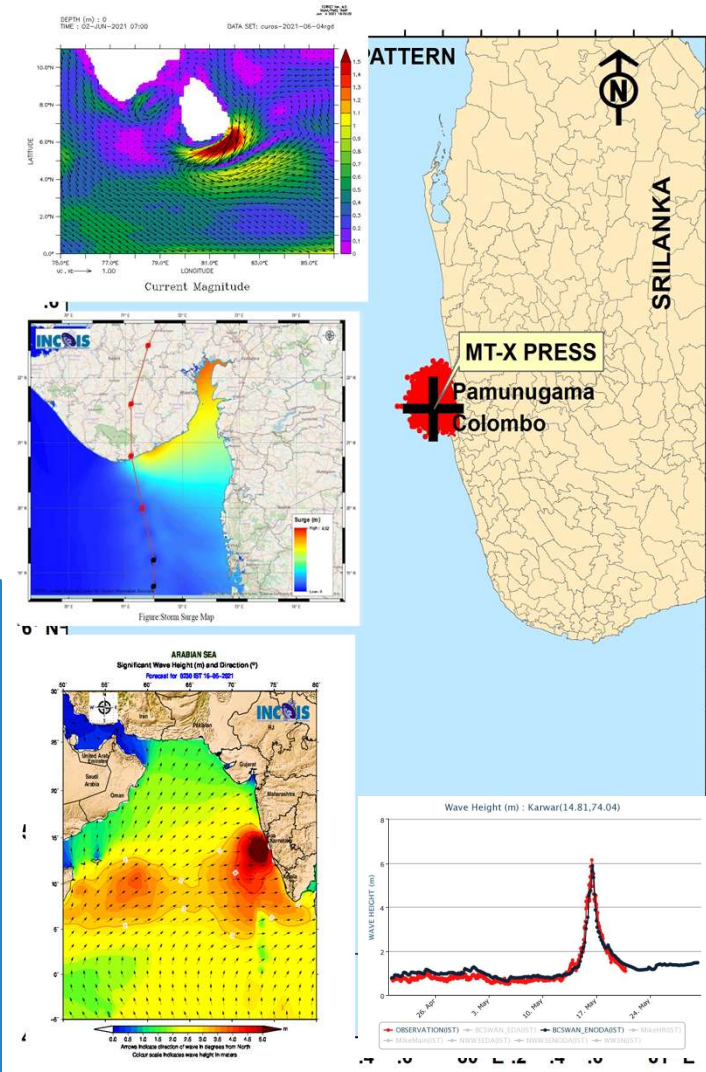
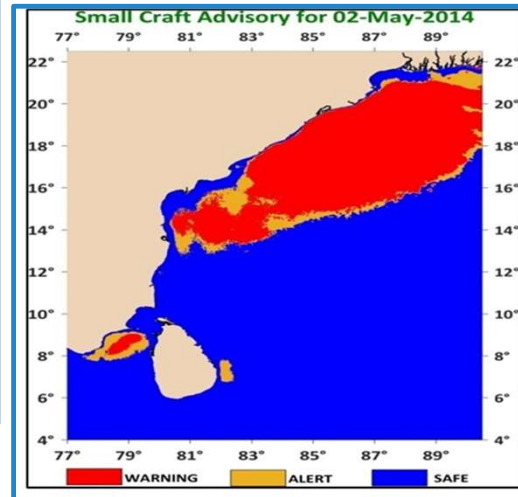
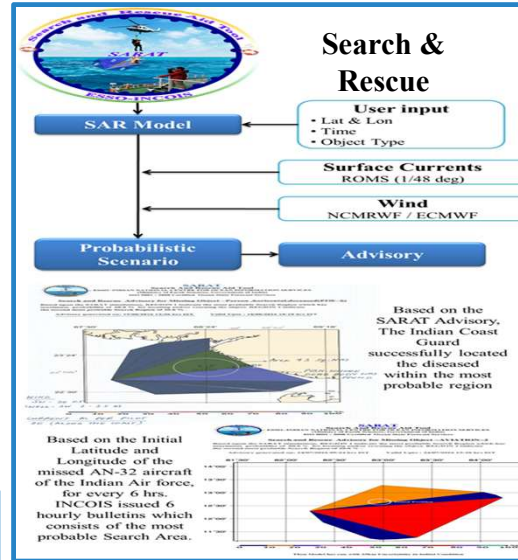
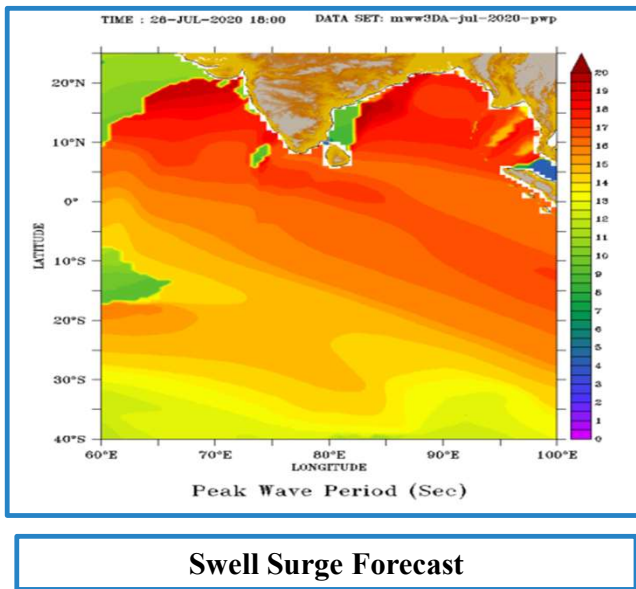
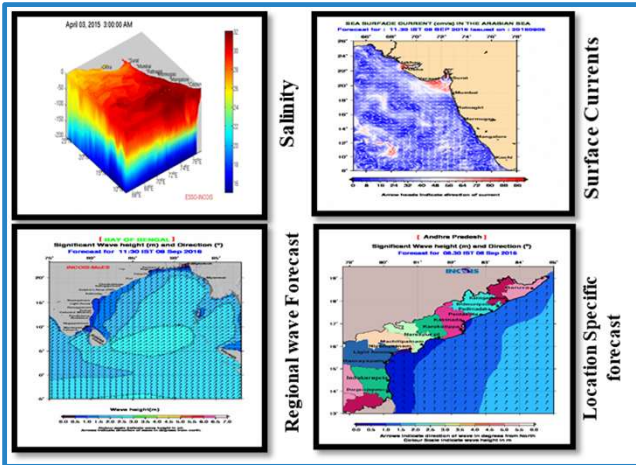
November 22, 2016 3:00:00 AM





# **Ocean State Forecasts** **45 User specified daily forecast products for India** **and 06 Neighbouring Countries**

## **FORECASTING SERVICES USING MODELLING DATA**



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

## INTEGRATED OCEAN INFORMATION AND FORECAST SYSTEM

Maldives

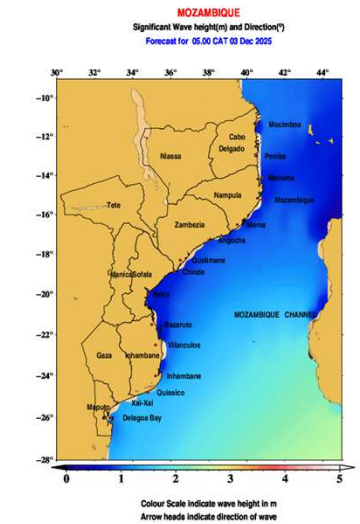
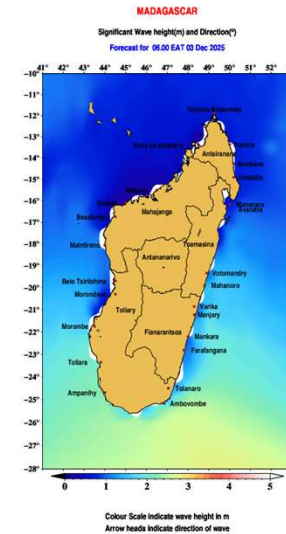
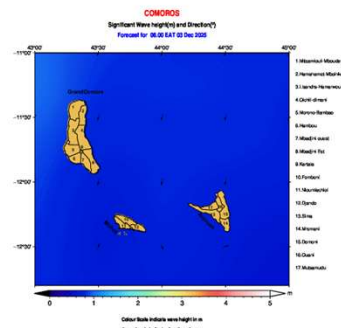
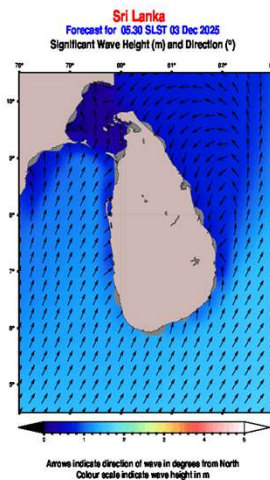
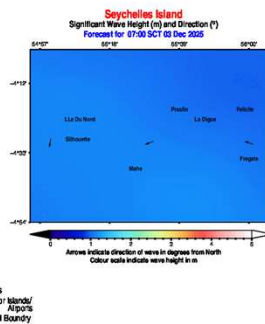
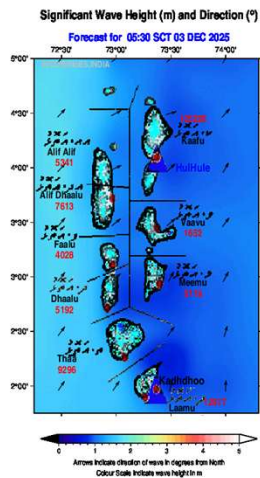
Seychelles

Sri Lanka

Comoros

Madagascar

Mozambique



IOCINDIO-MS

(Forecast Services can be extended to other MS too)



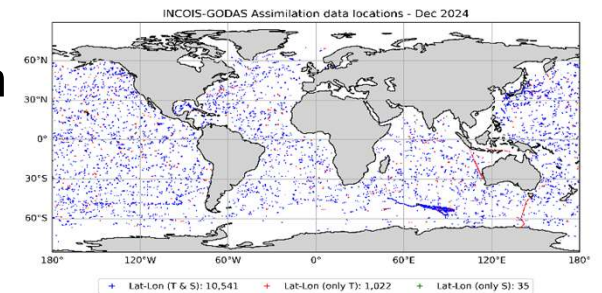
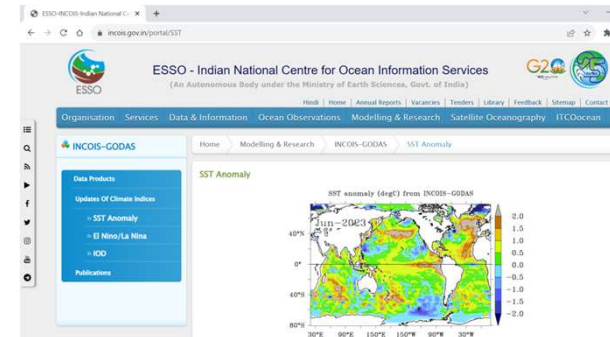
# INCOIS- GLOBAL DATA ASSIMILATION SYSTEM

**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

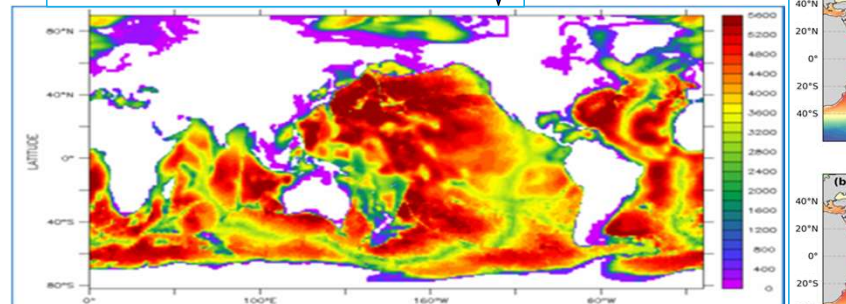
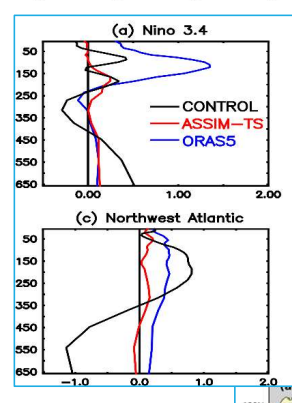
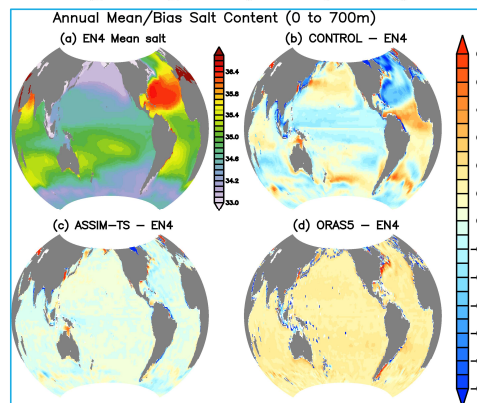
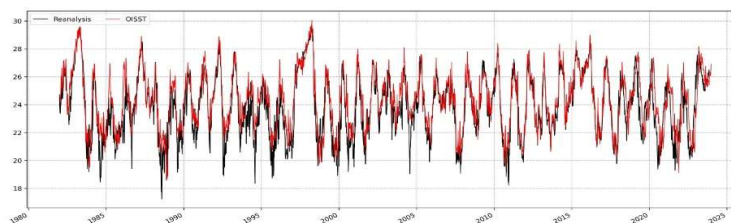
**Data assimilation  
scheme:** 3D VAR

**Parameters assimilated:**

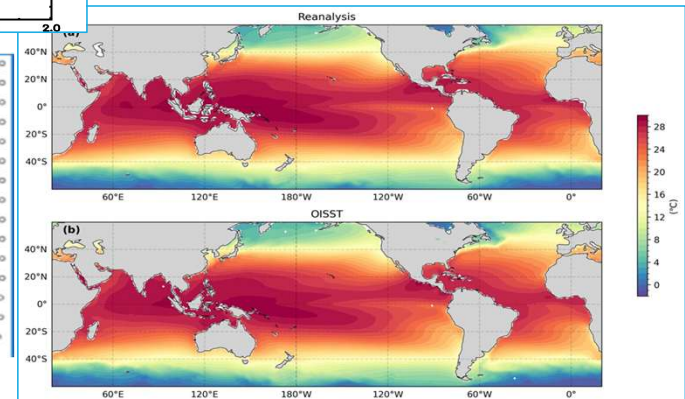
Temperature and salinity  
profiles from Argo, XBT,  
and moored buoys

**Relaxation:** ERSST (Huang et al.  
2017)

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

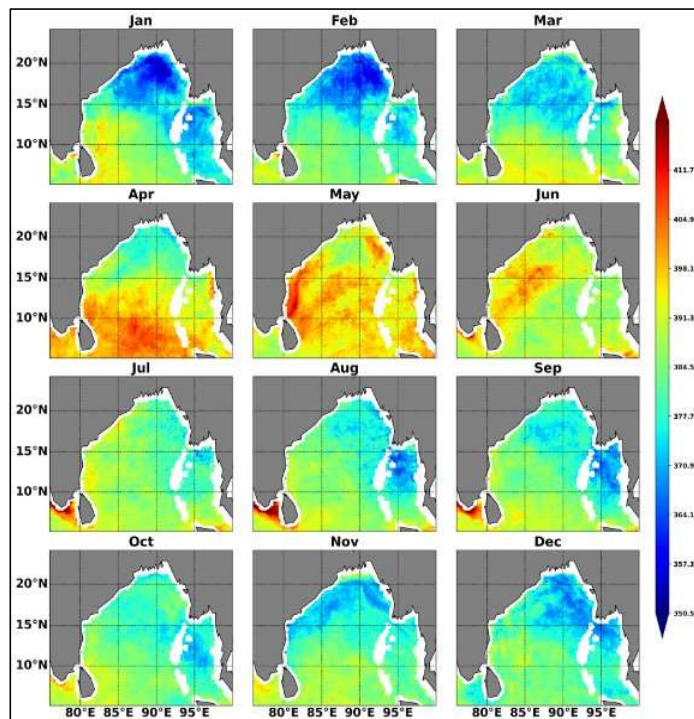


Name	Country/Organization	Time period
ECCO	NASA,USA	1992-2017
BRAN	BoM, Australia	1993-2021
SODA	University of Maryland, USA	1980-2020
NCEP-GODAS	NOAA/NCEP,USA	1980-2024
INCOIS-GODAS	INCOIS,India	1979-2023
ORAS5	ECMWF,EU	1979-present
GLORYS	Mercator Ocean, France	1993-present
C-GLORS	CMCC Italy	1980-present
GloSea5	Met Office,UK	2014-ongoing

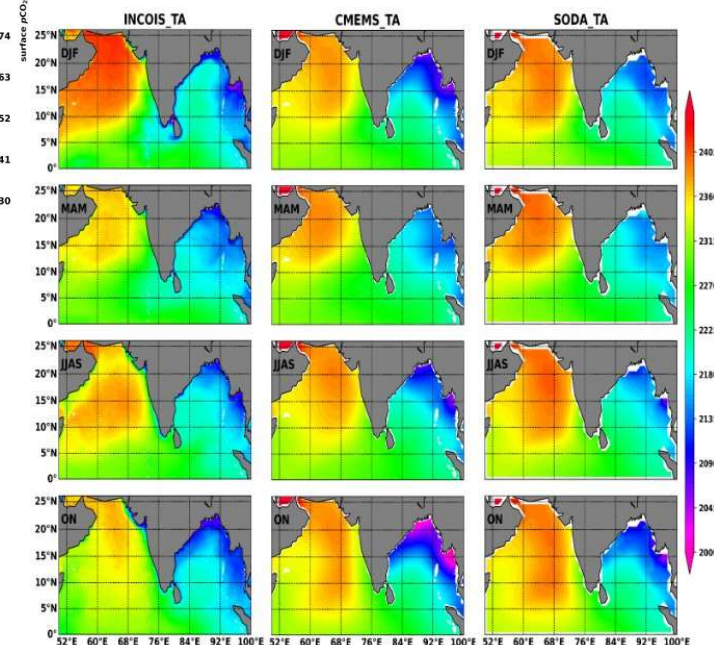
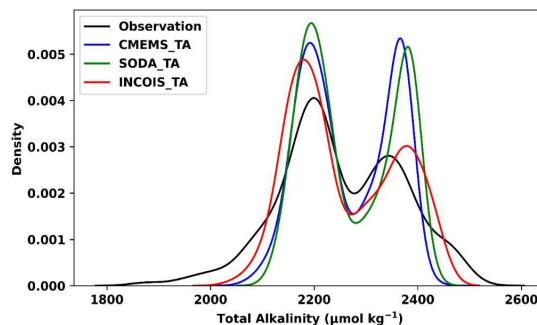
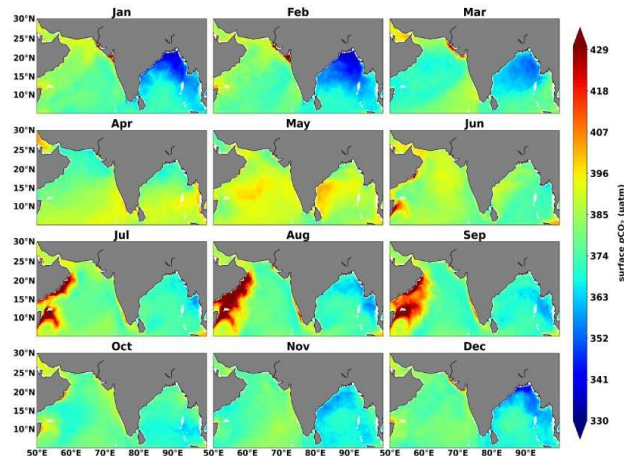




# MACHINE LEARNING BASED MONTHLY PRODUCTS



Surface pCO<sub>2</sub>



Total Alkalinity

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## 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





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*Thank You*

