EARLY WANING SERVICES FOR OCEAN HAZARDS

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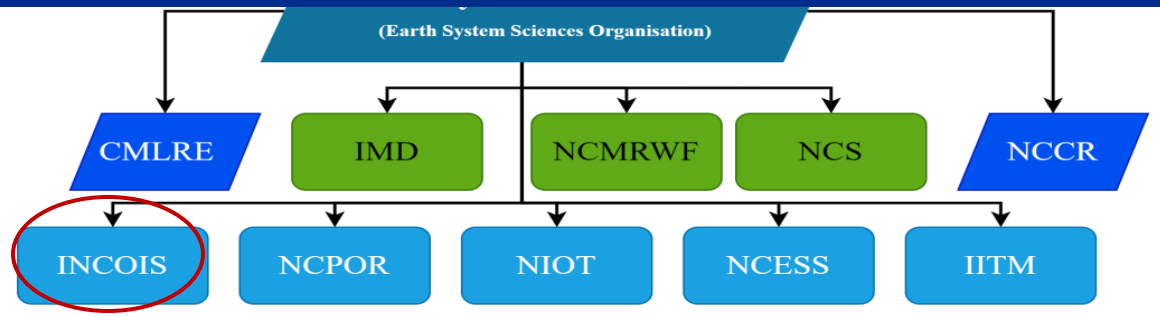
Co-Chair GOOS/UNESCO, Vice Chair ET-MOR/WMO

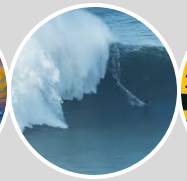
RIMES Council Meeting
07 May 2025

Earth System Science & Services – Institutional Mechanism



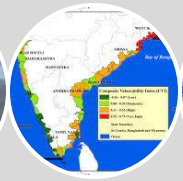
INCOIS Mission: To provide the Ocean Information and Advisory Services to Society, Industry, Government Agencies and Scientific Community through Sustained Ocean Observations and Constant improvements through Systematic and Focussed Research

Ecosystem Related Services (PFZ, Coral Reefs, HABs)



Ocean Sate Forecast Services

Early Warning Services (TEWS, SS, HWA, SAR)



Coastal Geospatial Services (CVI, MHVM, 3DGIS)

Data Related Services (IB & WBS, Ocean Portal)

Contributions to Weather & Climate

Capacity Building (ITCO Ocean)

International Interface

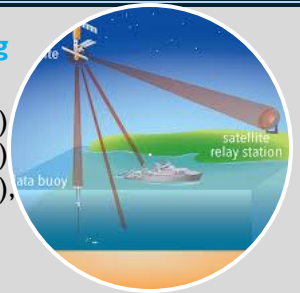
National Infrastructure Network

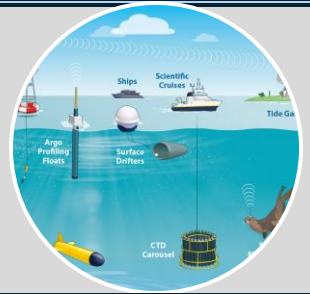
Satellite Oceanography

Ocean Science and Modelling

Remote Sensing Satellites

Oceansat-1 (1999)
Oceansat-2 (2008)
Oceansat-3 (2022),
SARAL – ALtiKa,
Foreign Satellites





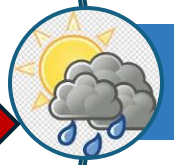
In-situ Observations

Argo, Drifters, XBT/XCTD, Current Meter, Glider, uCTD, ECFS, ASIMET, Flux Mooring, CTD, VMP, Lagrangian Float, Radiometer, GNSS, SMA, WRB, AWS, BPRs, HF Radars, Tide gauges, Moored Buoys

Users

Fishing Community

Coastal States

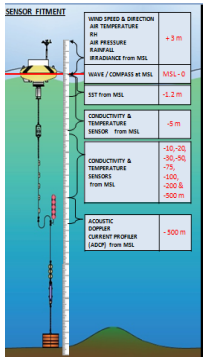


IMD, Navy, NHO, Coast Guards

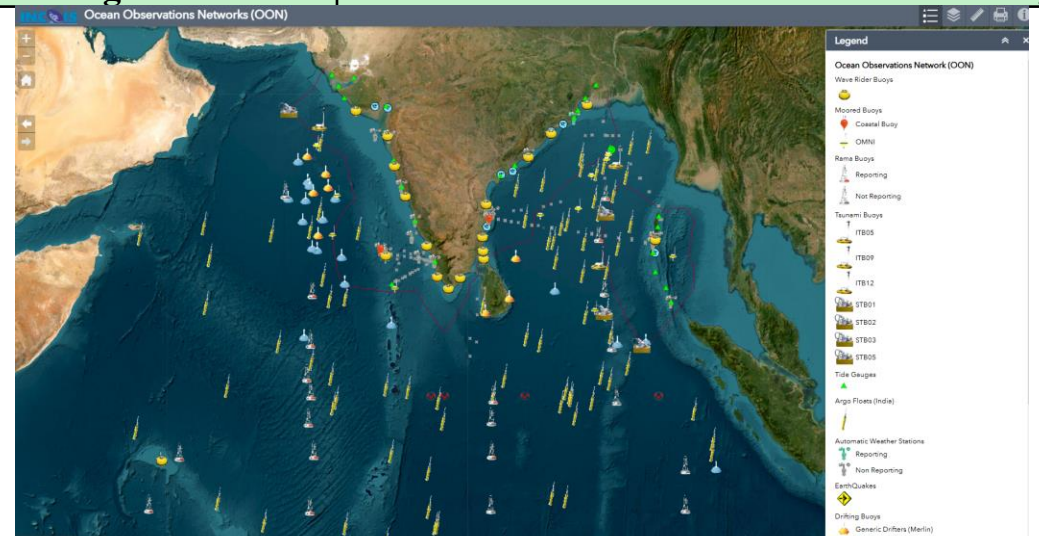
Ports, Harbors, Offshore and Shipping

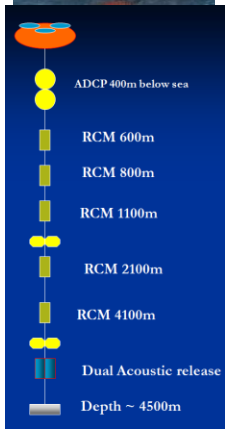
Research Institutions, Academia

MoES open and coastal ocean in-situ networks



Platforms	Target
Open Ocean Networks	
Argo	Deploy 40 floats/year
Drifter	Deploy 30 floats/year
Tsunami buoy	Maintain 7 moorings
Equatorial current meter	Maintain 3 moorings
XBT/XCTD	Maintain 3 transects
Ship-based AWS	Maintain 34 AWS
OMNI moorings	Maintain 12 moorings
RAMA programme	Support mooring in the EIO, BoB and AS
Coastal Ocean Networks	
Coastal ADCP	Maintain17 moorings
Tide gauge	Maintain 36 stations.
Wave rider buoy	Maintain 16 moorings
HF Radar	Maintain 5 stations
Coastal moorings	Maintain 3 moorings
Water quality moorings	Maintain 6 moorings





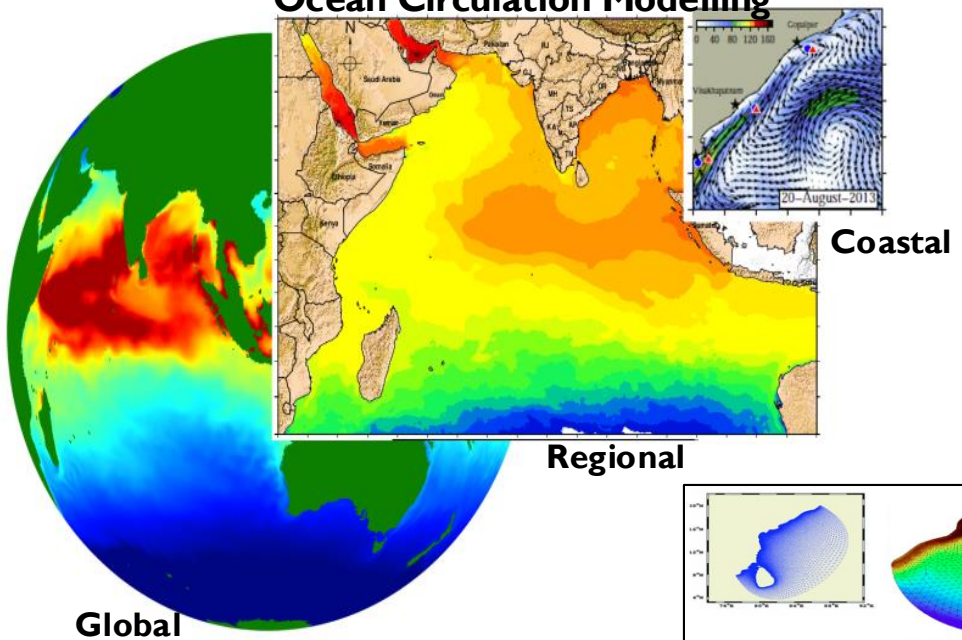
Ocean Prediction System

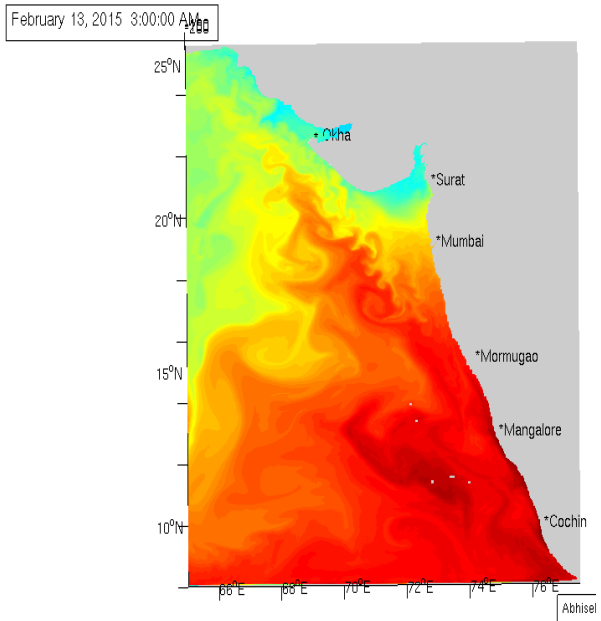
INCOIS Ocean Modeling and Data Assimilation Activities

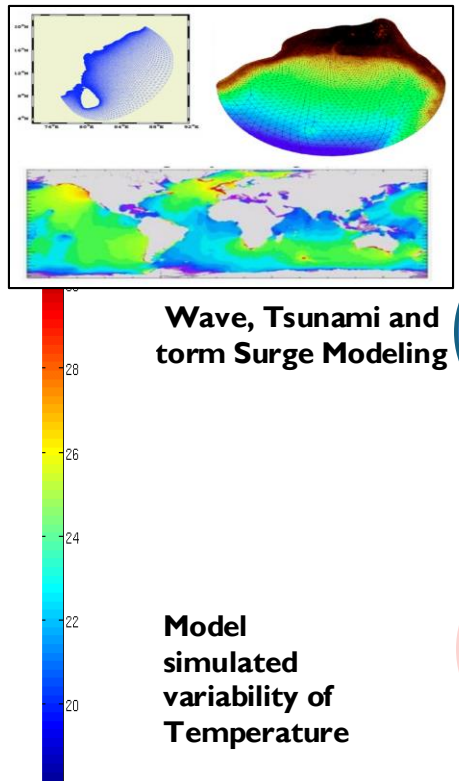
- Ocean Modeling Mission
- Deep Ocean Mission
- Monsoon Mission
- Coastal Water Quality Monitoring and Forecast Program

Ocean Predict (GODAE OceanView)

Ocean Circulation Modelling







Model simulated variability of Temperature

Wave, Tsunami and torm Surge Modeling

- Ocean Analysis (GODAS)
  - Monsoon Forecast (CFS model)
  - Tropical Cyclone Heat Potential
  - Cyclone Prediction
  - Climate Indices
- Data Assimilation (LETKF, 3DVAR, OI)
- Circulation Models (ROMS, MOM, HYCOM)
  - Regional Analysis
  - Regional and Coastal Forecasts
  - Value Added Services (OOSA, SARAT)
- Wave, Tsunami, Cyclone, Storm Surge (Wavewatch III ADCIRC, SWAN, HWRF+HYCOM)
  - Forecast and Advisory services

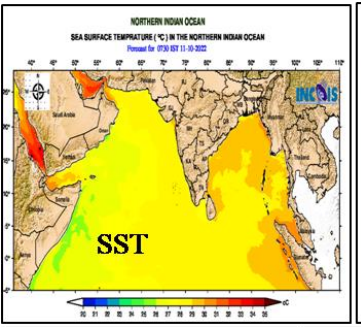
Ocean State Forecast Products

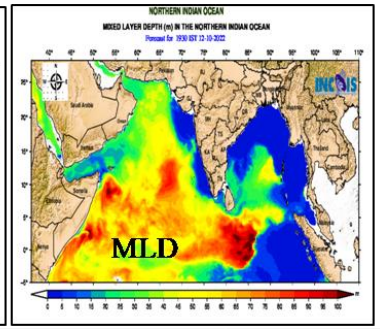
- Wave – Period/Height /Direction
- Wind Speed/Direction
- Ocean currents- Speed/Direction
- Sea Surface Temperature
- Salinity
- Mixed layer Depth
- Depth of the 20 degree isotherm
- Tide predictions

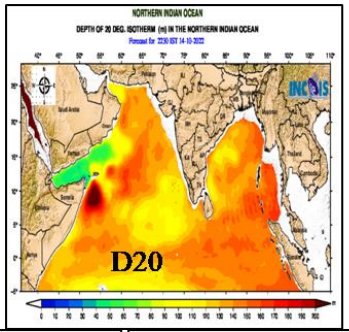
- High Wave Warning/Alert
- Swell Surge Warning/Alert
- High Currents Warning/Alert
- Swell Surge Warning/Alert
- Small Vessel Advisory Services

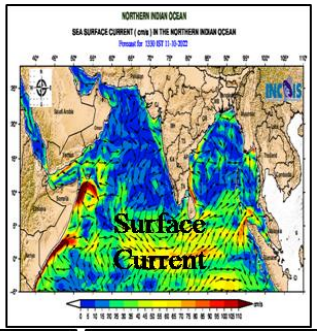
- Online Oil spill advisory (OOSA)
- Search and Rescue Aid Tool (SARAT)

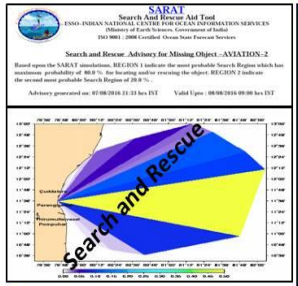
https://incois.gov.in/portal/osf/osf.jsp

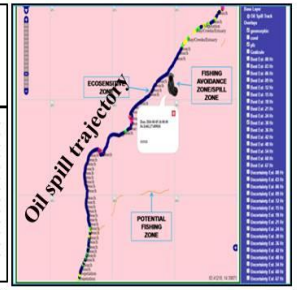


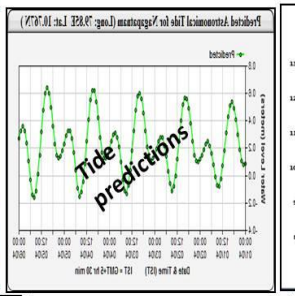


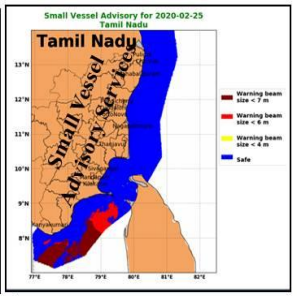


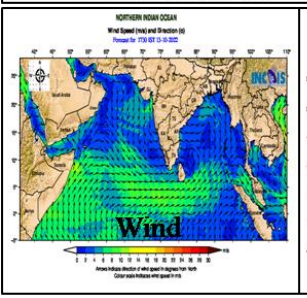


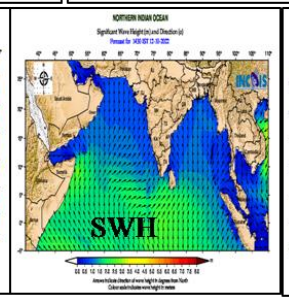


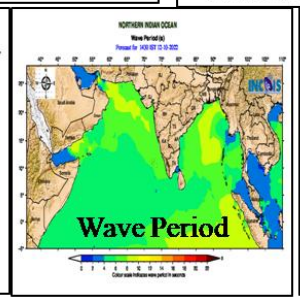


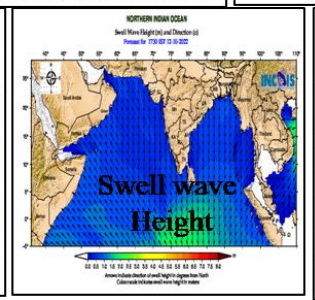


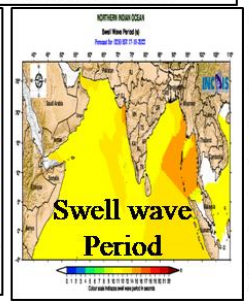


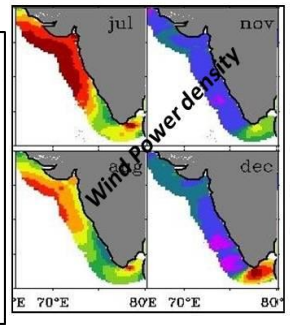


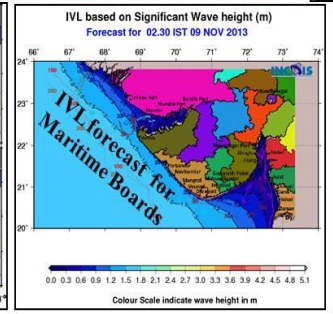


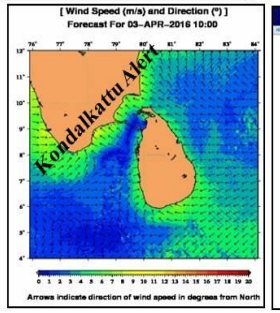


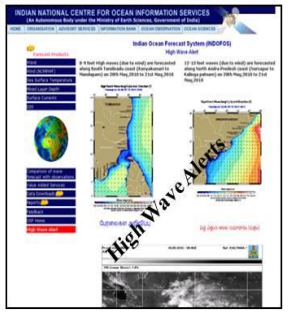






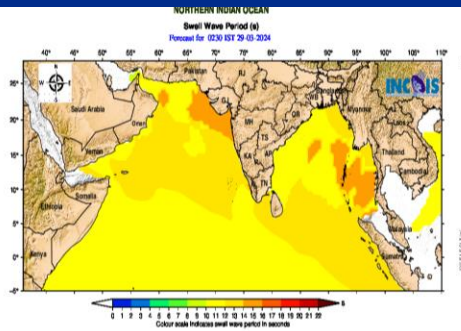


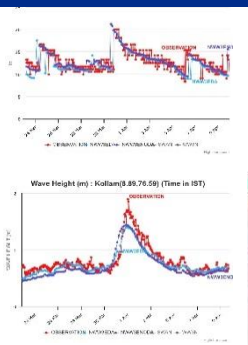


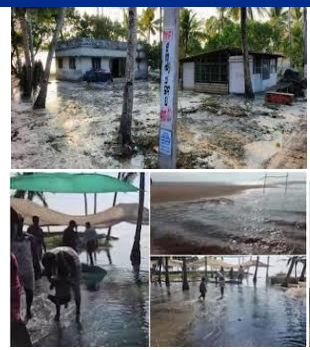


Swell Surge Warnings in March and May 2024

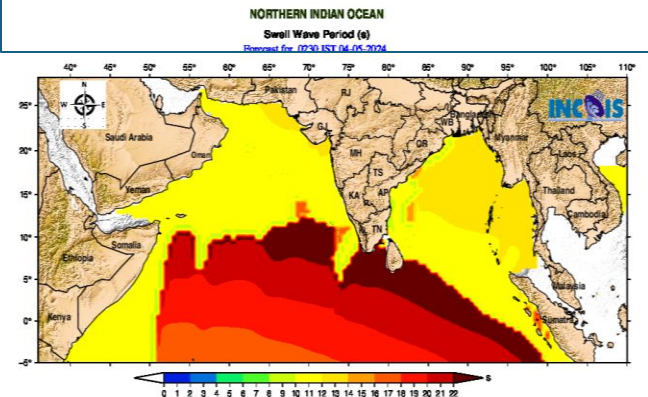
- Swell Surge happened on 31 March 2024 at a few coastal places of Southern India. High swell wave experienced Kerala.
- INCOIS issued Rough Sea/Swell surge Alerts to the respective states/UTs on 29, 30 & 31 Mar2024.
- INCOIS team surveyed the impacted areas in Kerala and observed 120 m max. inundation at Adimalatura, and 1.2 m max wave height at Pozhiyoor.

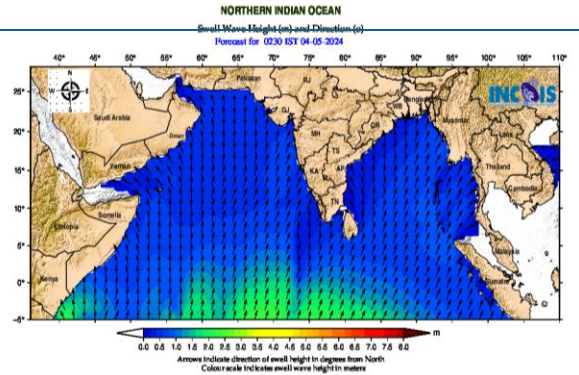


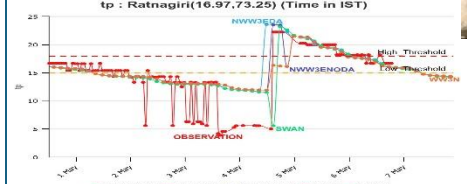


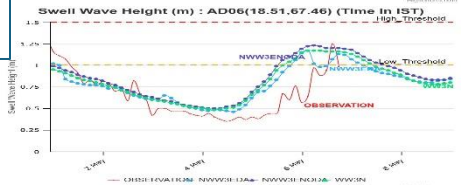


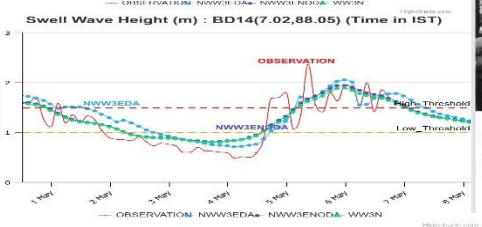
- INCOIS issued Swell surge Warning to Kerala, South Tamil Nadu and Lakshadweep, and Alerts to remaining Indian coastal states on 04 & 05 May 2024. About 1.02 cr. SMS disseminated through CAP.
- Swell surges experienced low-lying areas Kerala and TN. As per report from Kerala, low-lying areas got flooded and damages were reported at few scattered coastal districts.
- From WRB and MRB observations, it was evident that swell periods 20-25 sec and swell height 1.2-2.8 m as forecasted by models.
- **This was a success story of INCOIS as we could monitor the oceanic conditions through observations/models and forewarn the coastal states in advance.**





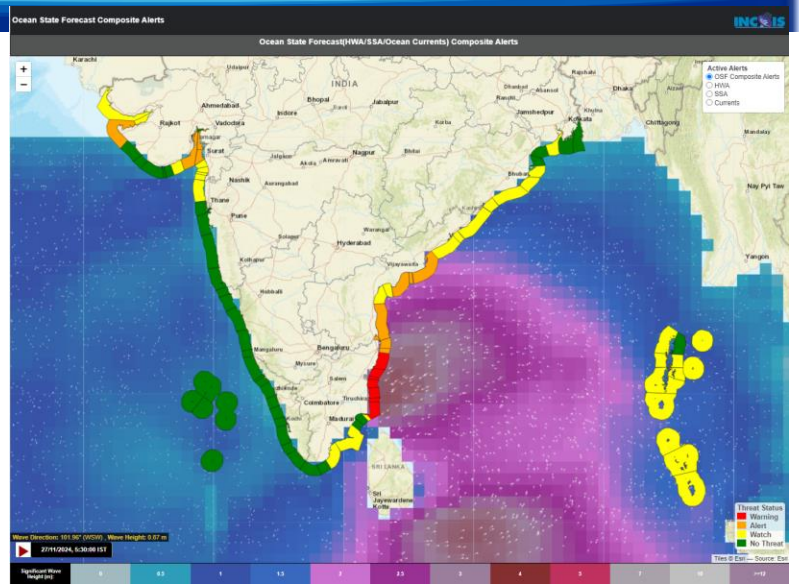


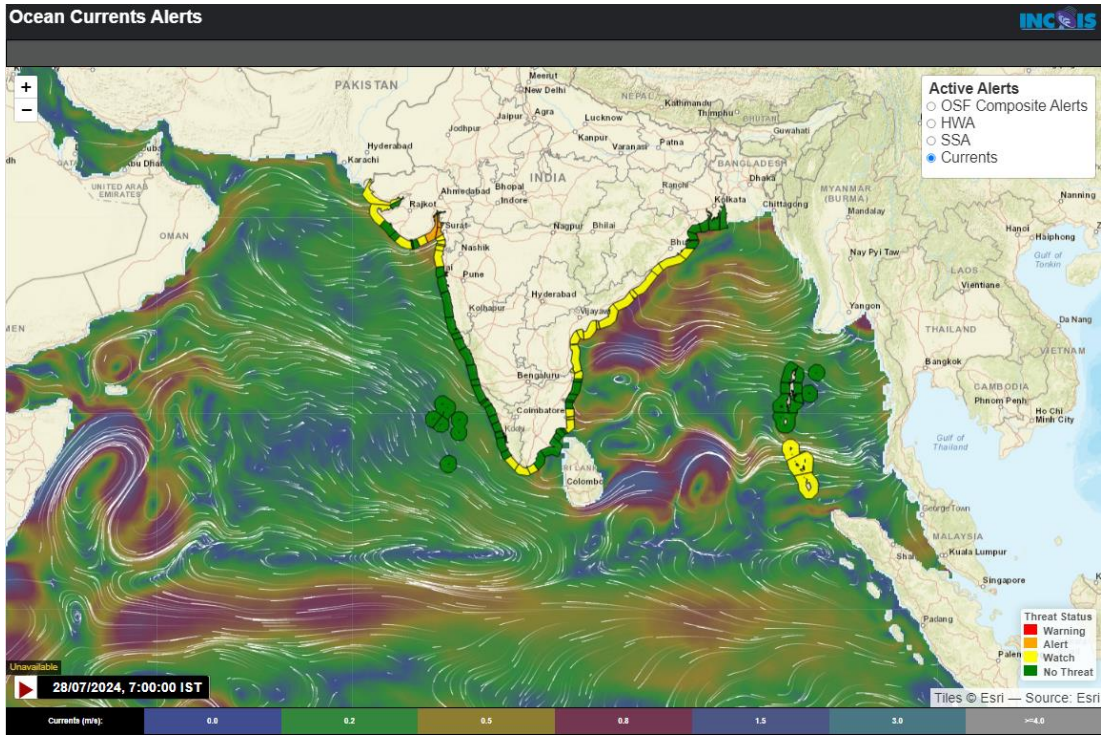


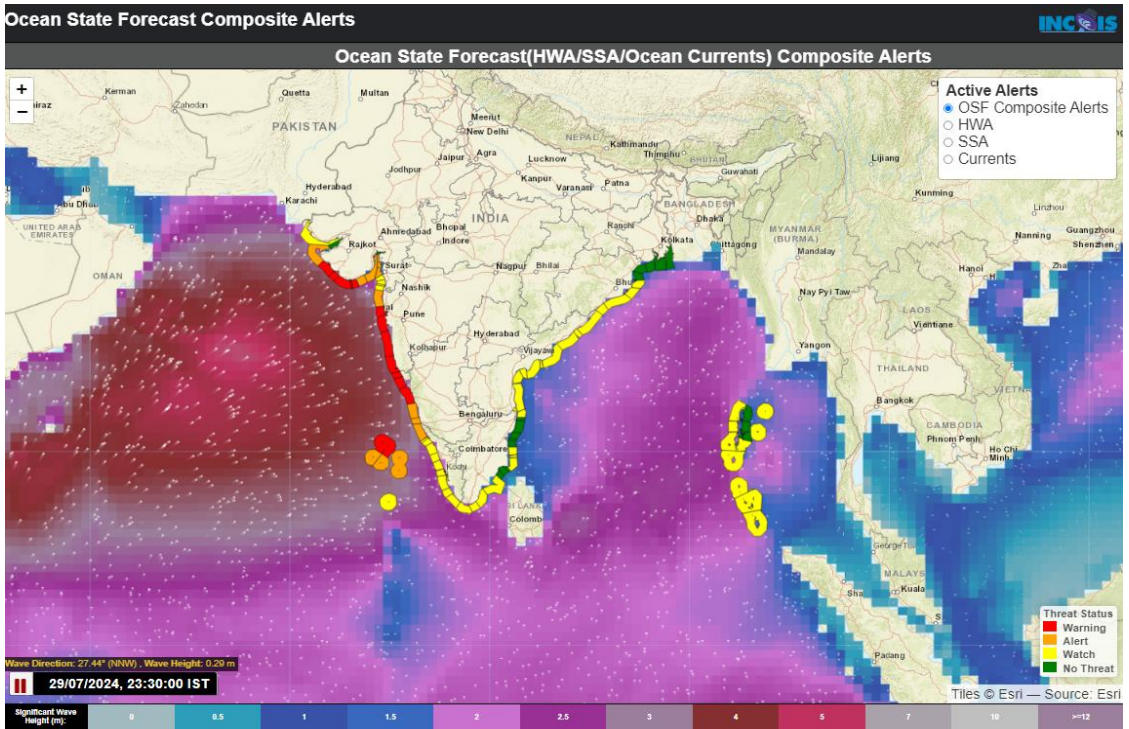


High Wave and Currents Alerts

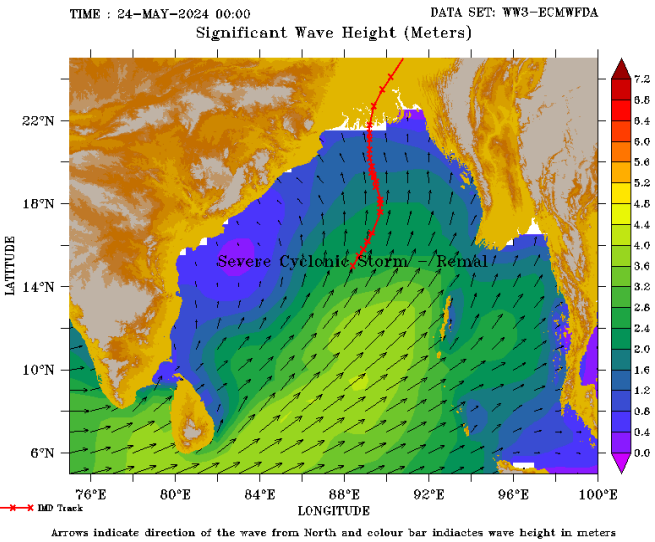
SURAT - [ALERT]	HIGH WAVE WATCH	High Wave Watch for the coast of SURAT,GUJARAT from Kosamba (Mangelvad) To Bhimpur. High waves in the range of 1.9 - 2.0 meters are forecasted during 08:30 hours on 29-07-2024 to 17:30 hours on 30-07-2024. It advised that no immediate action is required. Check for updates.	28-07-2024
	OCEAN CURRENT ALERT	Ocean Currents Alert for the coast of SURAT,GUJARAT from Kosamba (Mangelvad) To Bhimpur. Surface current speeds in the range of 1.2 - 1.8 m/sec are forecasted during 16:00 hours on 28-07-2024 to 19:00 hours on 30-07-2024. It advised that Harbour & marine operations to be careful.	28-07-2024







INCOIS-IMD Joint Bulletins during Extreme Events- SCS Remal



midnight of today, the 26th may 2024 as a severe cyclonic storm with maximum sustained wind speed of 110-120 kmph gusting to 135 kmph. Forward sector of wall cloud region is entering into land. The landfall process has commenced over coastal areas of Bangladesh and adjoining West Bengal. It will continue for next 4 hours.

High Wave/Ocean State Warning/Alert for West Bengal, Odisha, Andaman, Nicobar, Tamil Nadu South, Tamil Nadu North, and Andhra Pradesh:

West Bengal:

Table: Forecasted wave height, swell height and maximum wave height for coastal region into the ocean upto10 km off West Bengal.

Location	From (IST)	To (IST)	Significant Wave Height (m)	Swell Height (m)
Digha	22:50 hrs , 26-05-2024	11:30 hrs, 27-05-2024	3.6 – 7.1	1.7 – 3.5
Pargana Sagar	22:50 hrs , 26-05-2024	11:30 hrs, 27-05-2024	3.7 – 7.2	1.5 – 3.6
Purba Medinipore	22:50 hrs , 26-05-2024	11:30 hrs, 27-05-2024	3.5 – 7.1	1.8– 3.6
South Paraganas	22:50 hrs , 26-05-2024	11:30 hrs, 27-05-2024	3.7– 7.0	1.7 – 3.4

Offshore: High waves in the range of 3.5 – 7.2 meters are forecasted during 22:50 hours on 26-05-2024 to 11:30 hours of 27-05-2024 beyond 10 km off the coast of West Bengal from Digha to Bakkhali. Surface Current speeds vary between 60 - 120 cm/sec

Odisha

Table: Forecasted wave height and swell height for coastal region into the ocean upto 10 km off Odisha

Location	From (IST)	To (IST)	Significant Wave Height (m)	Swell Height (m)
Ganjam	22:50 hrs , 26-05-2024	11:30 hrs, 27-05-2024	3.5 – 6.5	1.7 – 3.2
Puri	22:50 hrs , 26-05-2024	11:30 hrs, 27-05-2024	3.4 – 6.5	1.6 – 3.3
Jagatsinghpur	22:50 hrs , 26-05-2024	11:30 hrs, 27-05-2024	3.4 – 6.6	1.7 – 3.4
Kendrapada	22:50 hrs , 26-05-2024	11:30 hrs, 27-05-2024	3.5 – 6.6	1.8 – 3.3
Bhadrak	22:50 hrs , 26-05-2024	11:30 hrs, 27-05-2024	3.4 – 6.7	1.8 – 3.3
Balasore	22:50 hrs , 26-05-2024	11:30 hrs, 27-05-2024	3.6 – 6.7	1.7 – 3.4

Offshore: High waves in the range of 3.5 – 6.7 meters are forecasted during 22:50 hours on 26-05-2024 to 11:30 hours of 27-05-2024 beyond 10 km off the coast of Odisha from Gopalpur to Chandipur. Surface Current speeds vary between 50 - 120 cm/sec.

INCOIS issued Joint Bulletins for the severe cyclonic storm Remal during 24-26 May 2024

Mode	Number
SMS Alerts (through CAP platform)	17,71,782
NO. of INCOIS-IMD Joint Bulletins Issued	14
Bulletins sent to emails	5,040
No. of NAVIC messages	12

Storm Surge Early Warnings

S.No.	Cyclone Name	Duration	No. Bulletins / Products Issued
1	Severe Cyclonic Storm REMAL	24-May-2024 to 28-May-2024	14

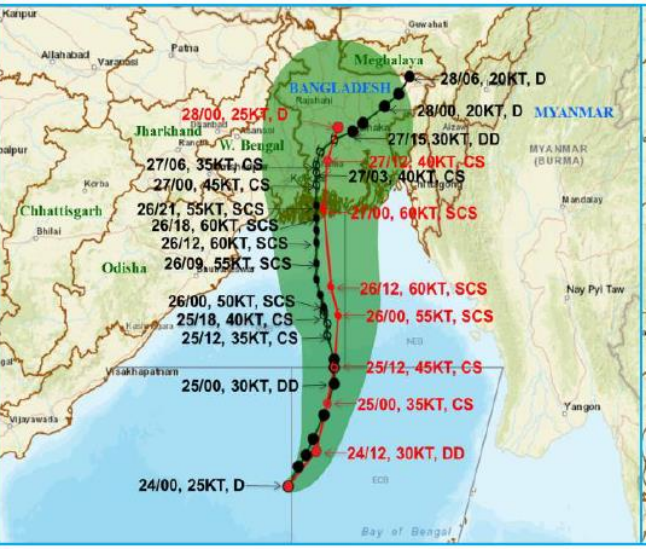
EVENT SUMMARY:

Cyclone Name	FENGAL [pronounced as FEINJAL]
Place of Land Fall	North Tamil Nadu-Puducherry coasts between Karaikal and Mahabalipuram close to Puducherry
Time of Land Fall	Evening of 30th November
Wind Speed at the time of landfall	70-80 kmph gusting to 90 kmph
Expected Maximum Storm Surge *	Around 0.7 m
Expected Maximum Inundation Extent	Upto 0.13 km

STORM SURGE HEIGHT INFORMATION:

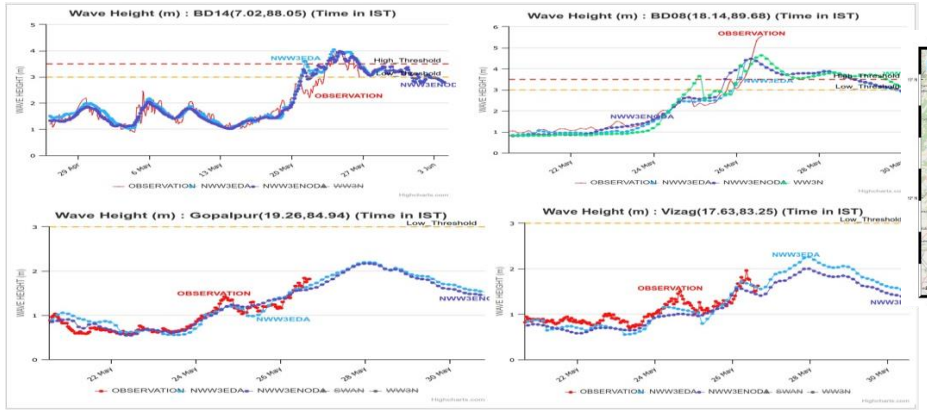
* The below listed surge heights are over and above astronomical tide.

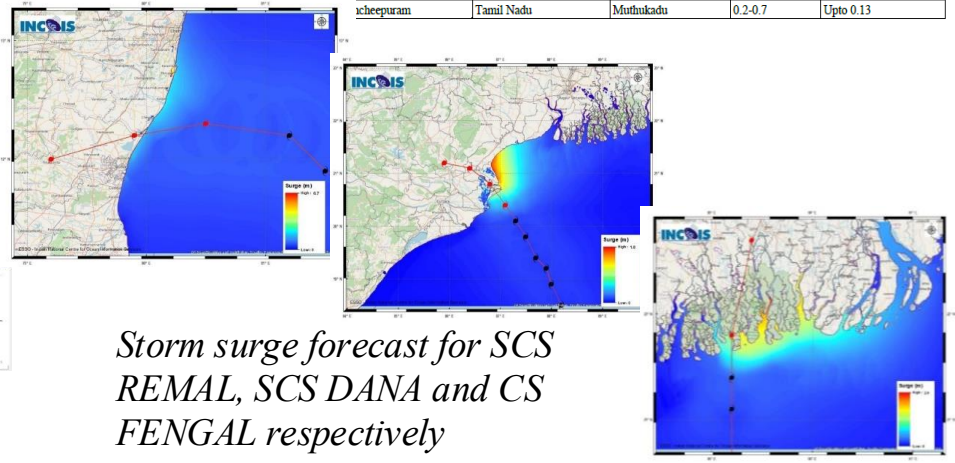
MANDAL/ TALUK	DISTRICT	STATE / UNION TERRITORY	NEAREST PLACE OF HABITATION	STORM SURGE (m)*	EXPECTED INUNDATION EXTENT (km)
	ıcheepuram	Tamil Nadu	Muthukadu	0.2-0.7	Upto 0.13



IMD Track

Observation and forecast comparisons

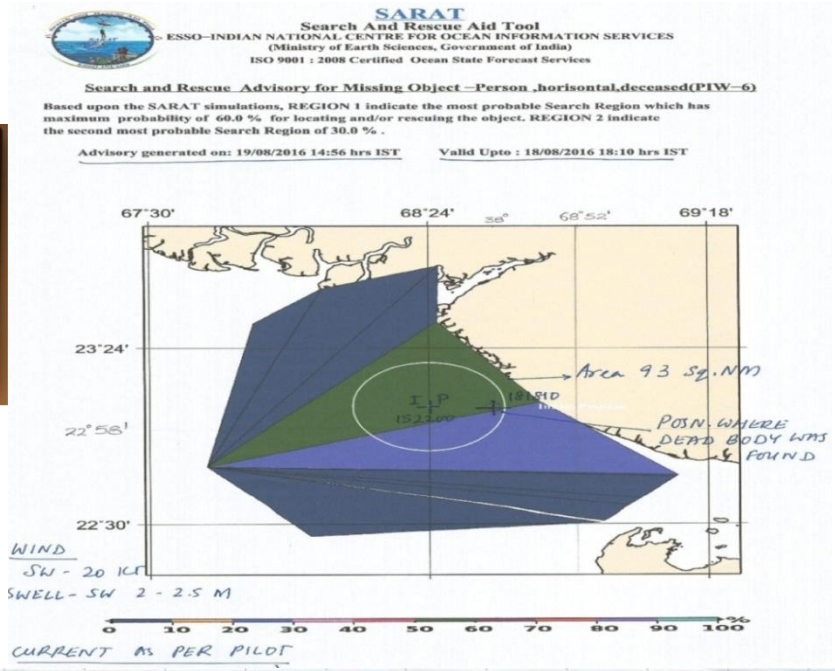




Storm surge forecast for SCS REMAL, SCS DANA and CS FENGAL respectively

Search and Rescue Aid Tool (SARAT)

Based on the SARAT Advisory, The Indian Coast Guard successfully located the deceased within the most probable region



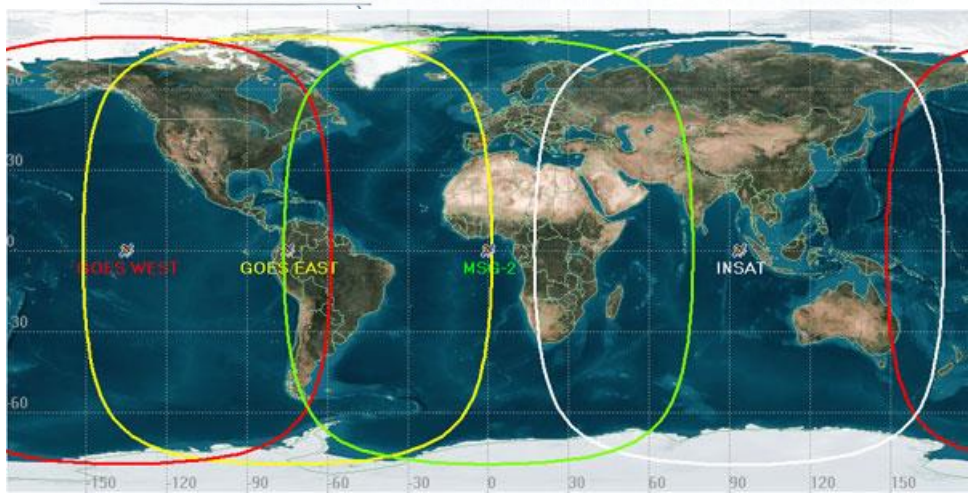
SAR Model

User input
- Lat & Lon
- Time
- Object Type

Surface Currents
ROMS (1/48 deg)

Wind
NCMRWF / ECMWF

Probabilistic Scenario → **Advisory**



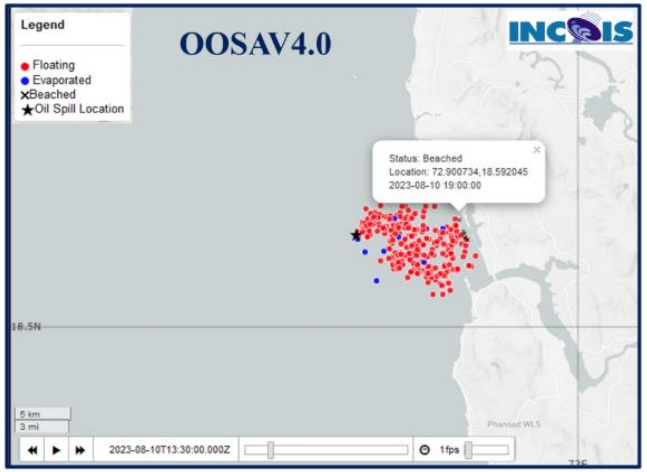
A geostationary orbiting search and rescue (GEOSAR) constellation with SAR instrument packages

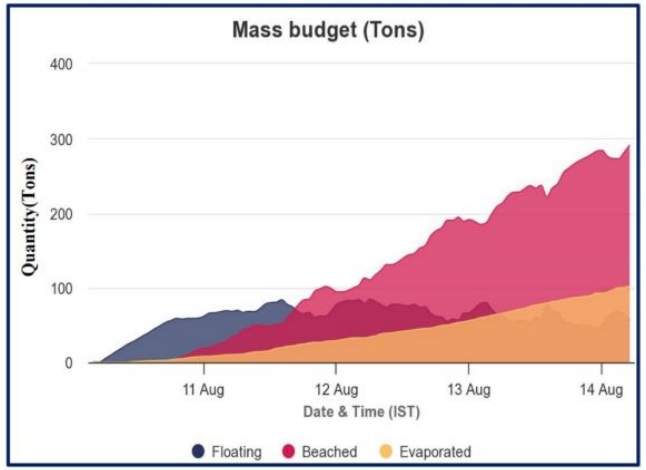
Oil Spill Trajectories

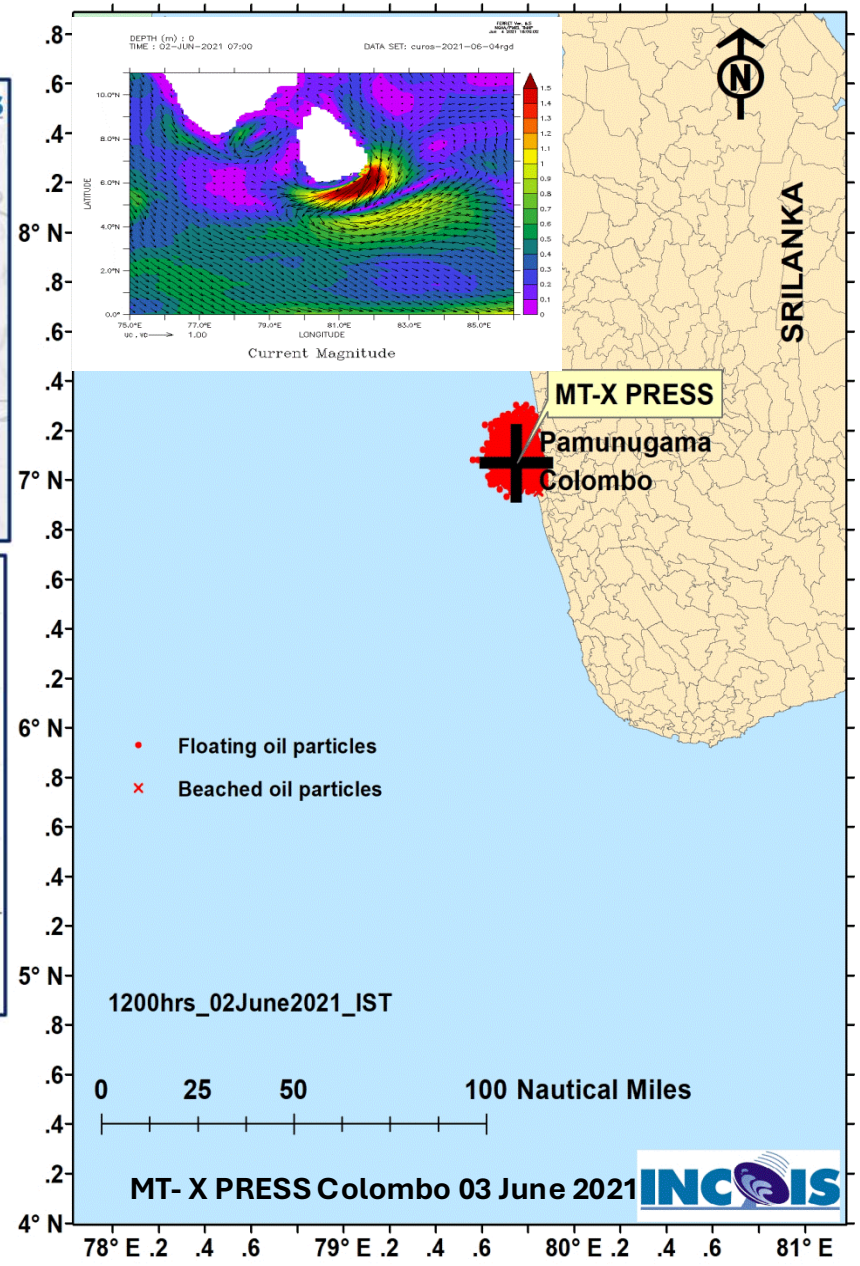
ONLINE OIL SPILL ADVISORY (OOSA)

- Delivers the trajectory of the spilled oil, which can enable the oil spill responders to plan their clean up activity
- Minimize the impact of oil spills on the marine ecosystem and on the aquatic organisms

OOSA Web Interface



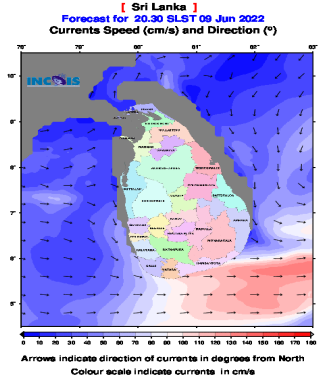


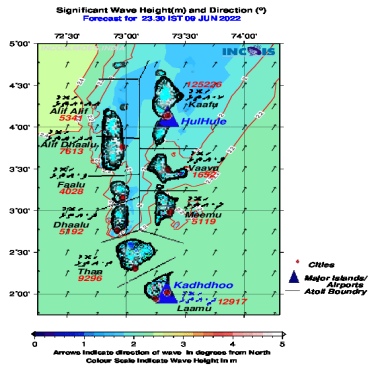


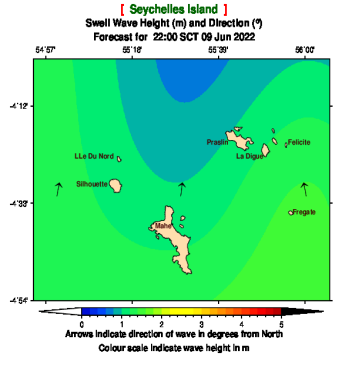
Ocean Services for RIMES member States

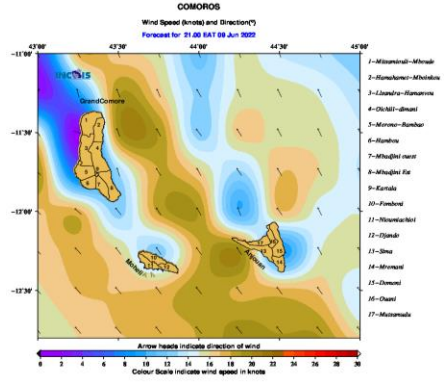
INCOIS provides Ocean Services to RIMES countries (Maldives, Seychelles, Sri Lanka, Comoros, Madagascar and Mozambique) – 3-day forecast

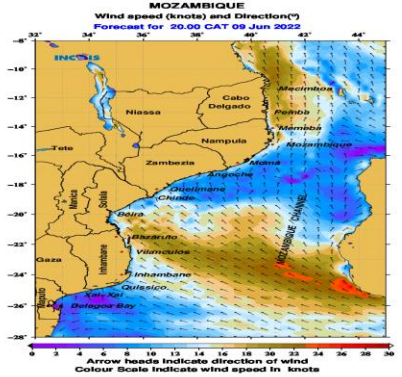
	Parameters									
Country	Wave	Wave period	Swell	Swell period	Wind	Sea Surface Temperature	Mixed Layer Depth	Surface Currents	Location Specific stations	High Wave Alert
Maldives (3 regions separately)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	21	Yes
Seychelles	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	18	Yes
Sri Lanka	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	22	Yes
Comoros	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	15	Yes
Madagascar	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	15	Yes
Mozambique	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16	Yes

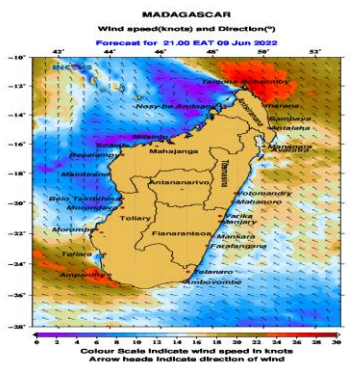






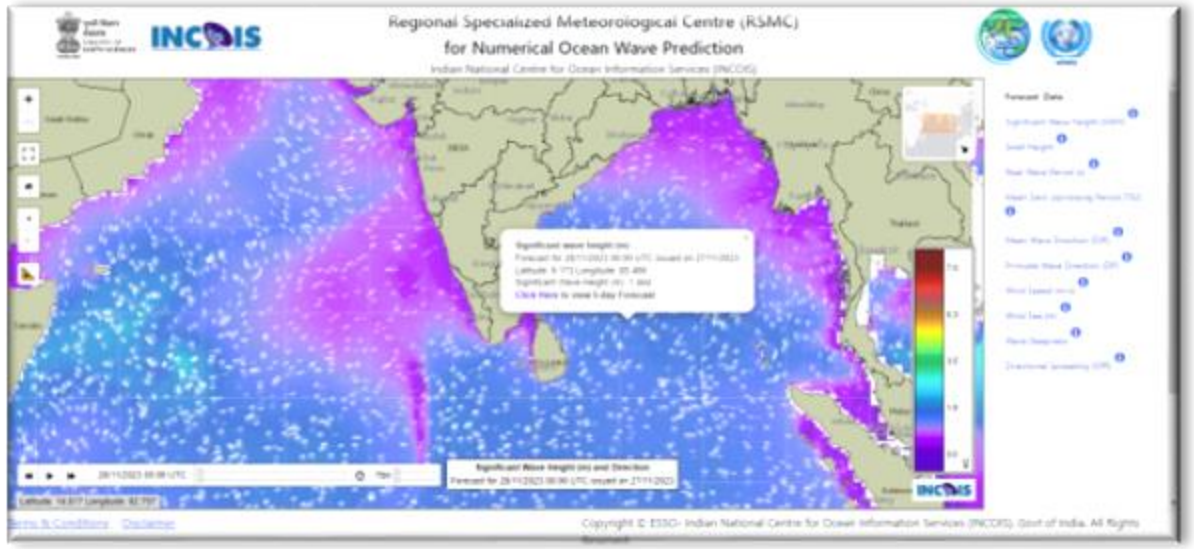




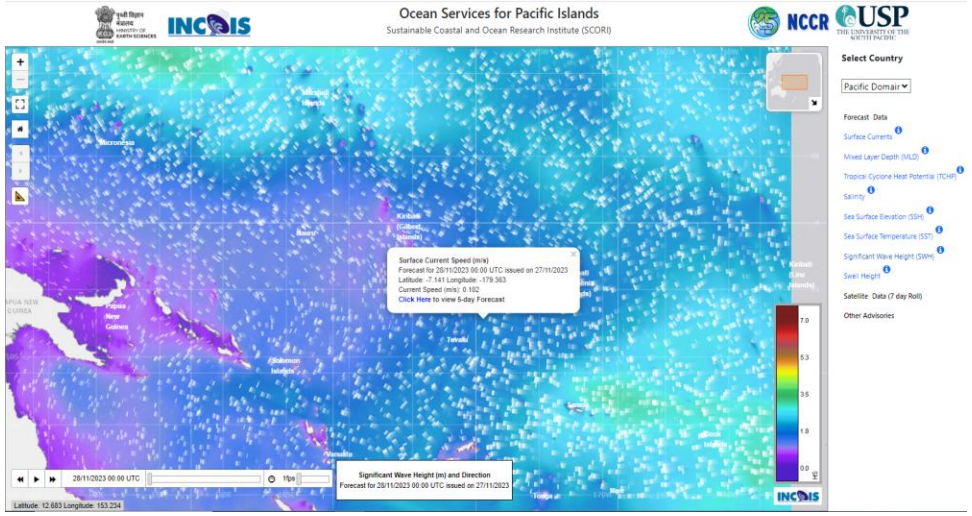


Ocean Services for International Users

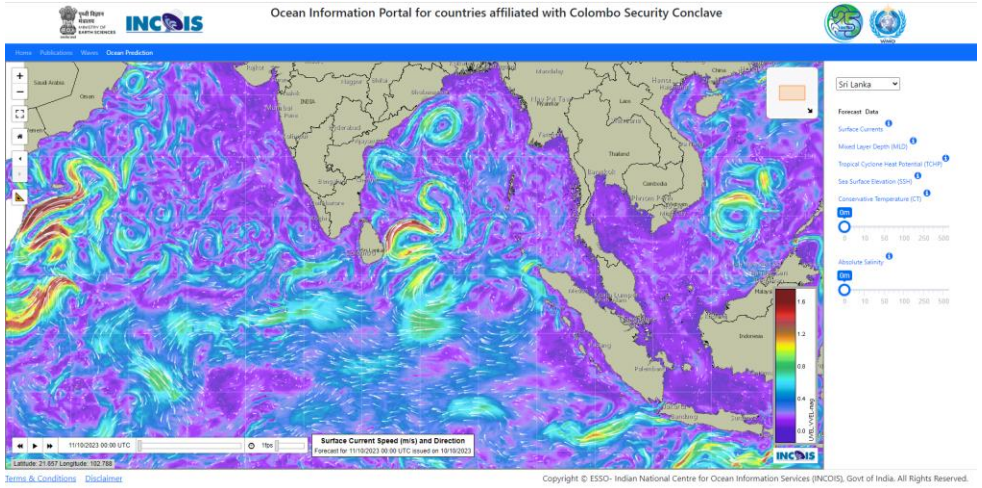
Regional Specialized Meteorological Centre (RSMC) services for Indian Ocean under WMO framework



Ocean Services for Pacific Island Countries

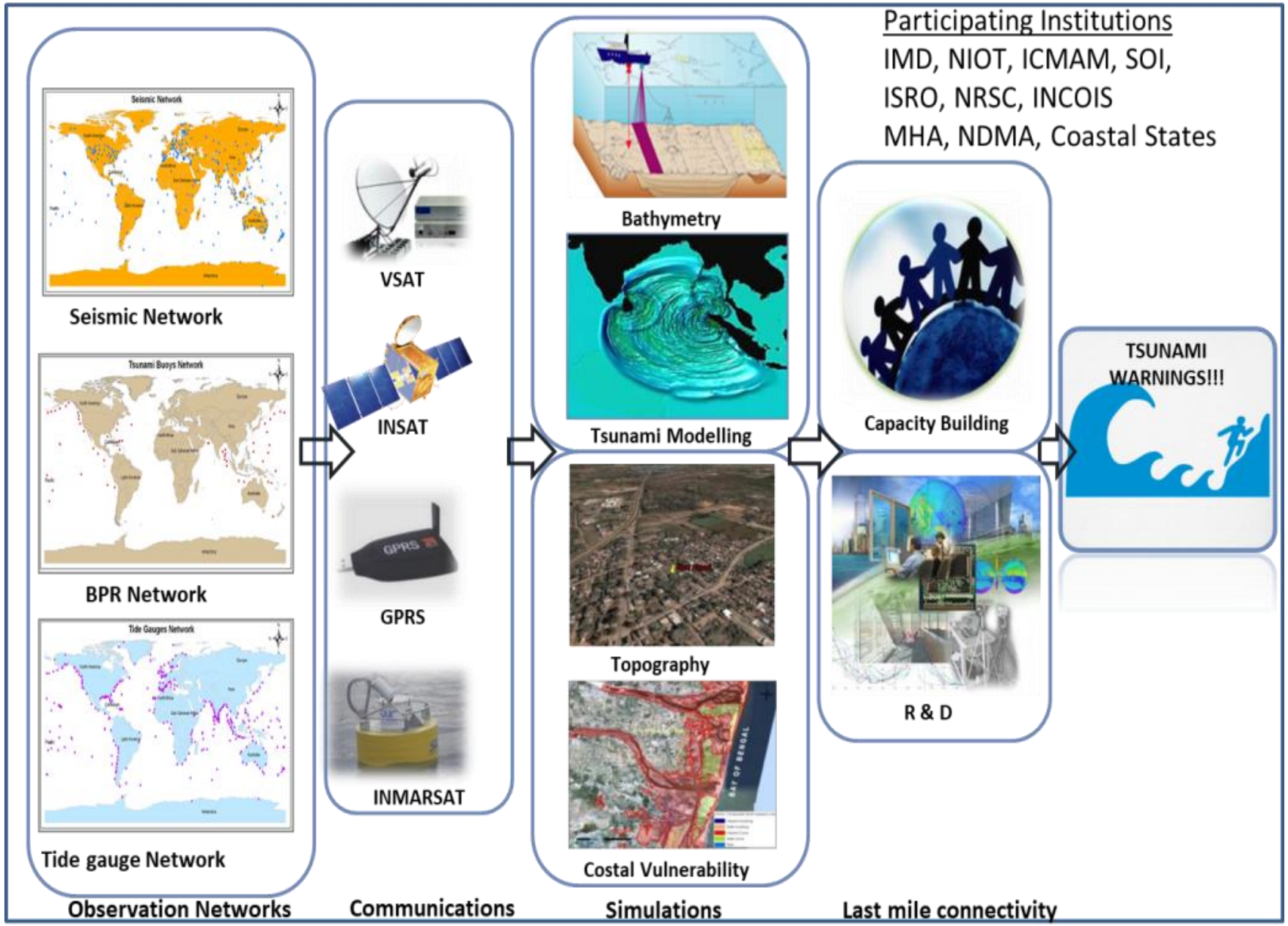


Ocean Information services under the regional framework of Colombo Security Conclave (CSC)

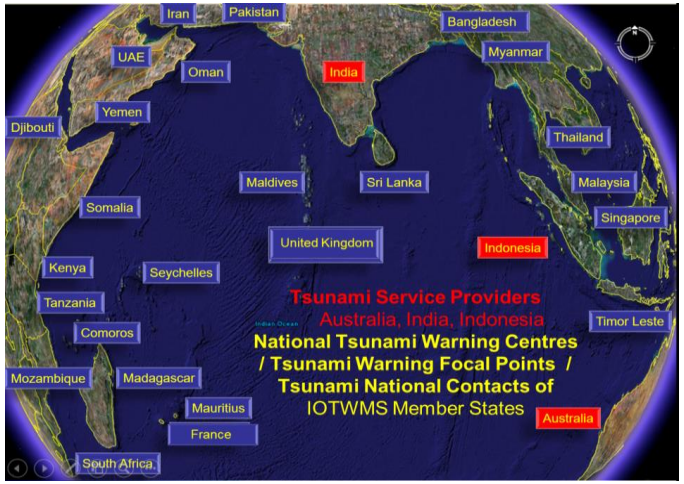


- Tsunami Services for Indian Ocean rim courtiers
- Ocean RSMC services for Indian Ocean
- Ocean services for Pacific Islands countries
- Ocean Services for RIMES member states
- Ocean Services for CSC countries
- Others

Tsunami Early Warning Services



Indian Tsunami Early Warning



Regional Tsunami Early Warning Services

Intergovernmental Coordination Group for Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS)

Certificate of Recognition

The Community of Noliasahi

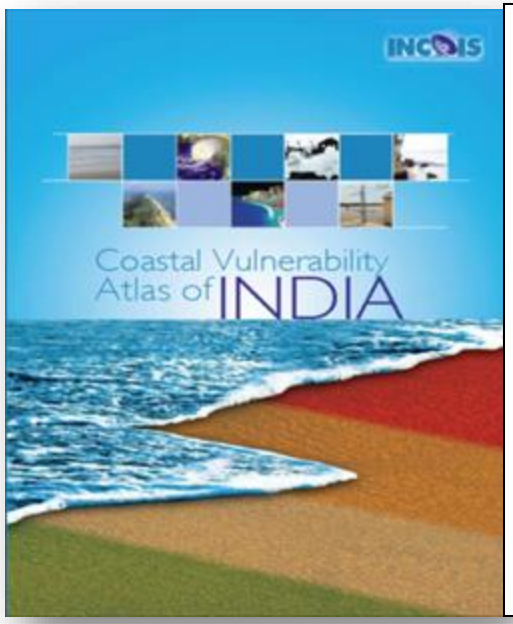
Jagatsinghpur District, Odisha, India

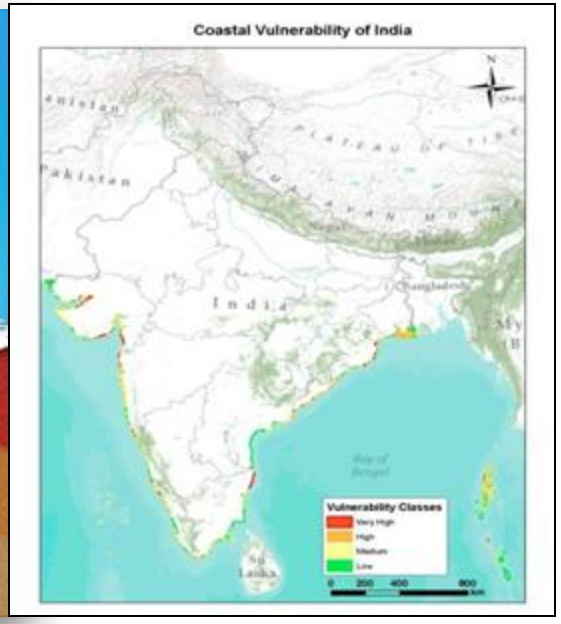
For successfully piloting the UNESCO-IOC Tsunami Ready Initiative
in Noliasahi, Jagatsinghpur District, Odisha, India
28 May 2020

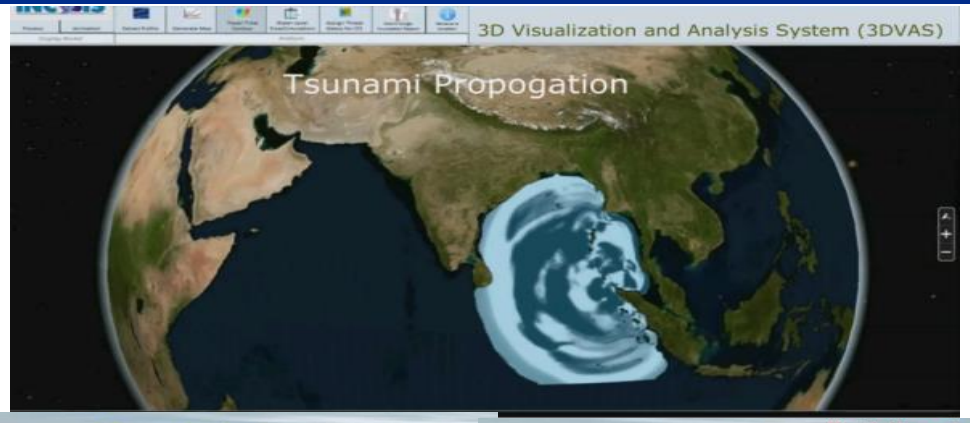
Coastal Multi Hazard Vulnerability Assessments

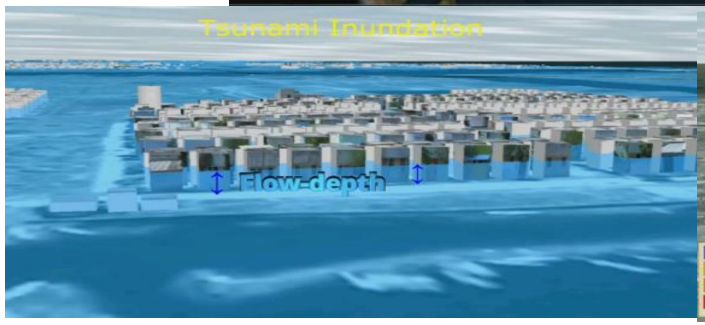
Coastal Vulnerability Atlas

1:1,00,000 scales

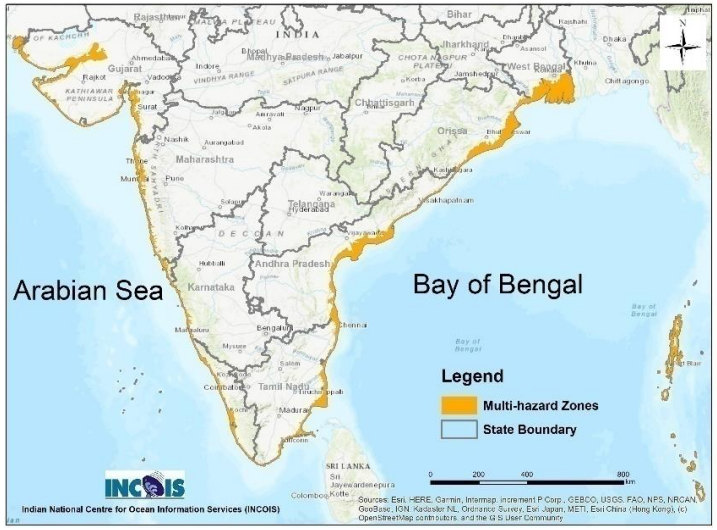




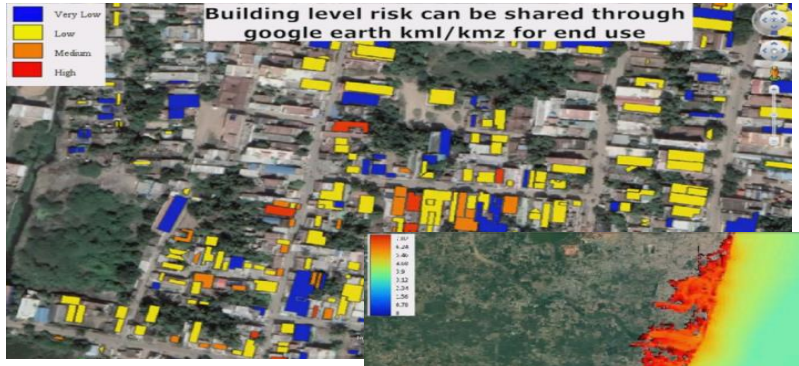


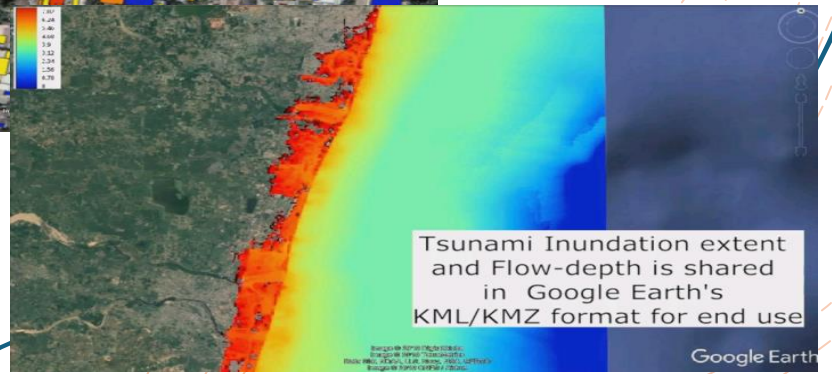


Multi-hazard Vulnerability Map



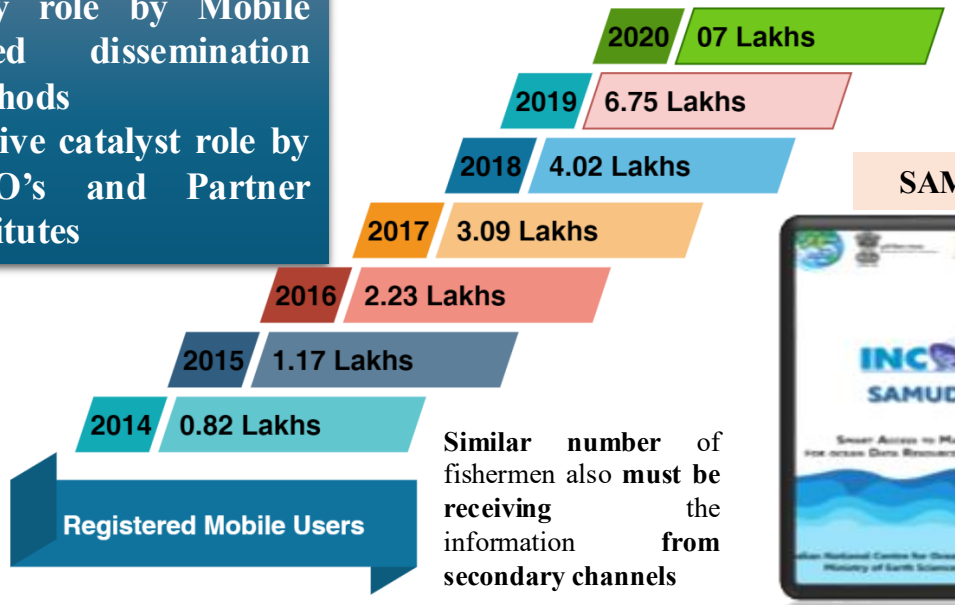
Coastal Inundation – 3D Mapping





Information Dissemination Modes

- Key role by Mobile based dissemination methods
- Active catalyst role by NGO's and Partner institutes

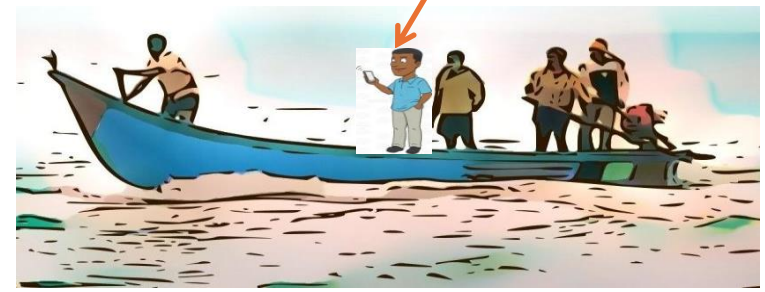


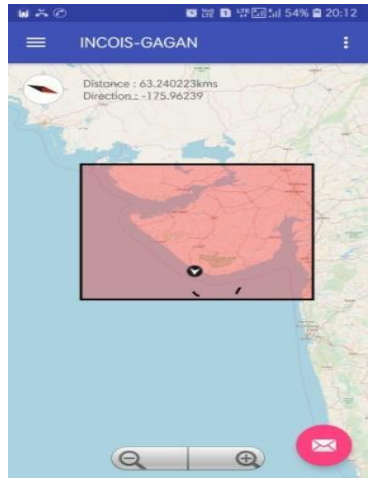
Similar number of fishermen also must be receiving the information from secondary channels

GAGAN based GEMINI

Satellite based Solution

Simple & Easy Integration
Economic
Plug & Play





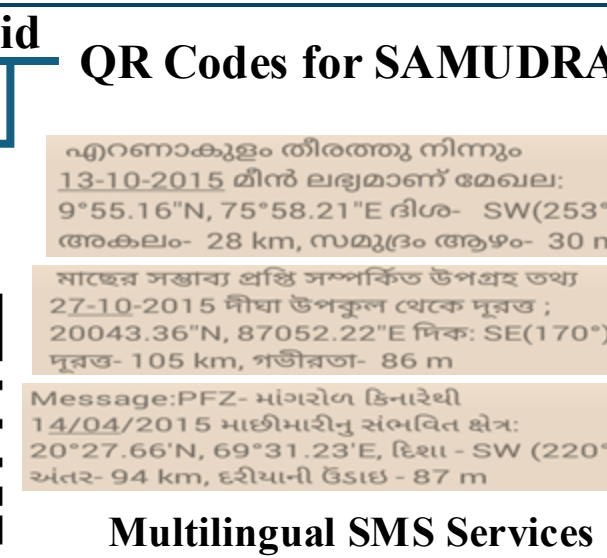
CAP-Sachet

Android

QR Codes for SAMUDRA

SAMUDRA Mobile App

iOS



Multilingual SMS Services

Thank you

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