

Geospatial Data & Applications for ocean Information Services



Dr. Balakrishnan Nair
Group Director, INCOIS

Our mission is 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”*

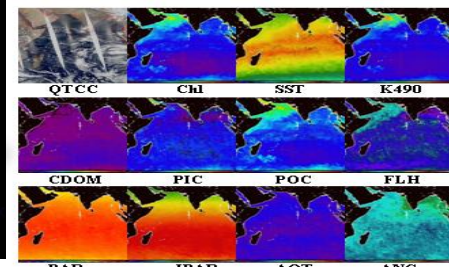
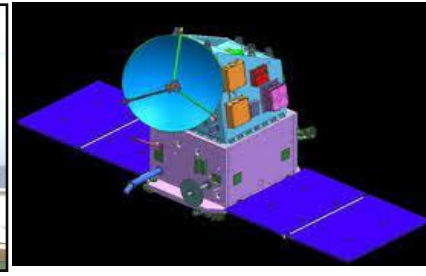
Our stake holders are:

All those who depend on Sea for livelihood and those who leave on the coasts

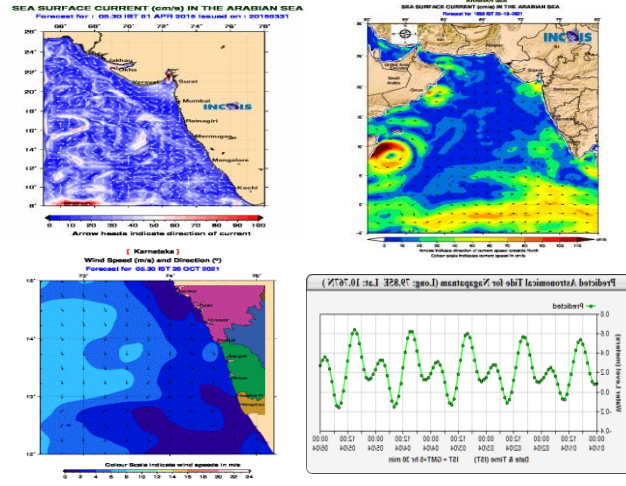
- *Fishermen*
- *Coastal population*
- *Navigators*
- *Ports & Harbours*
- *Maritime Industries (oil, shipping, Power..)*
- *Navy, Coast Guard, Marine Police*
- *Disaster Management agencies*
- *Coastal Tourism*
- *State Administration*
- *Academia and Researchers*



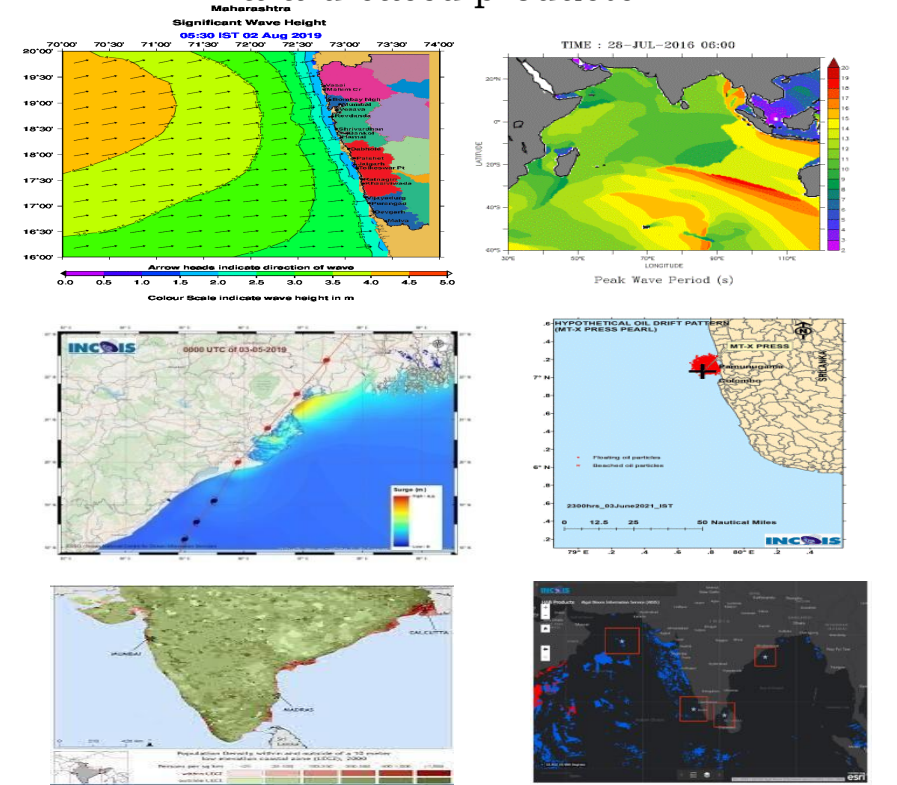
Ocean Information & Forecast System



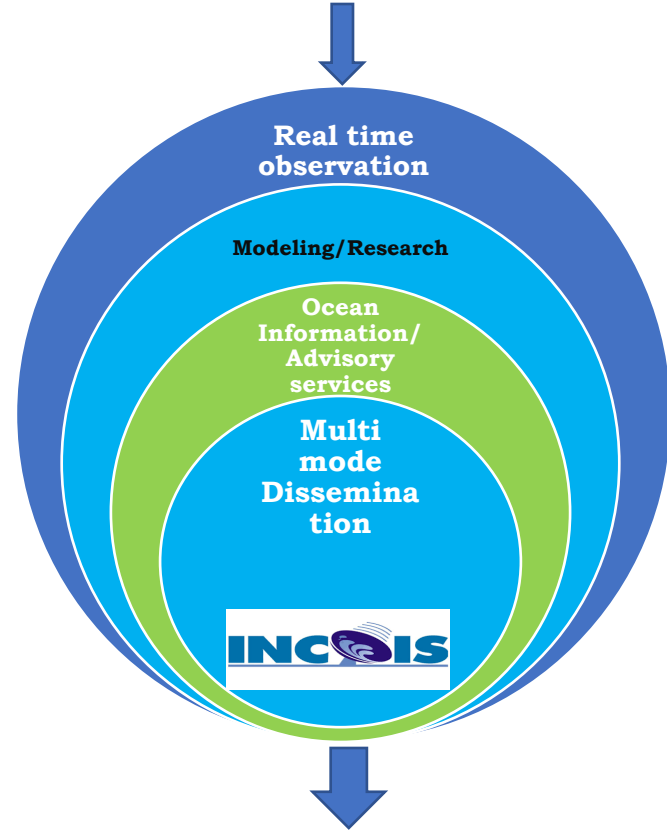
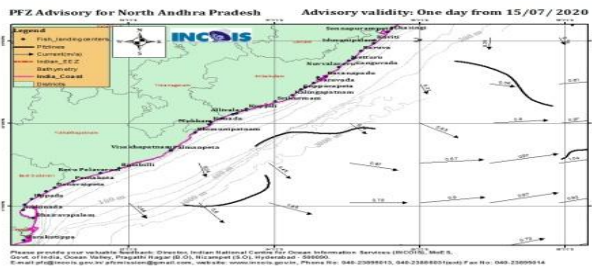
Customized products



Hazard based products

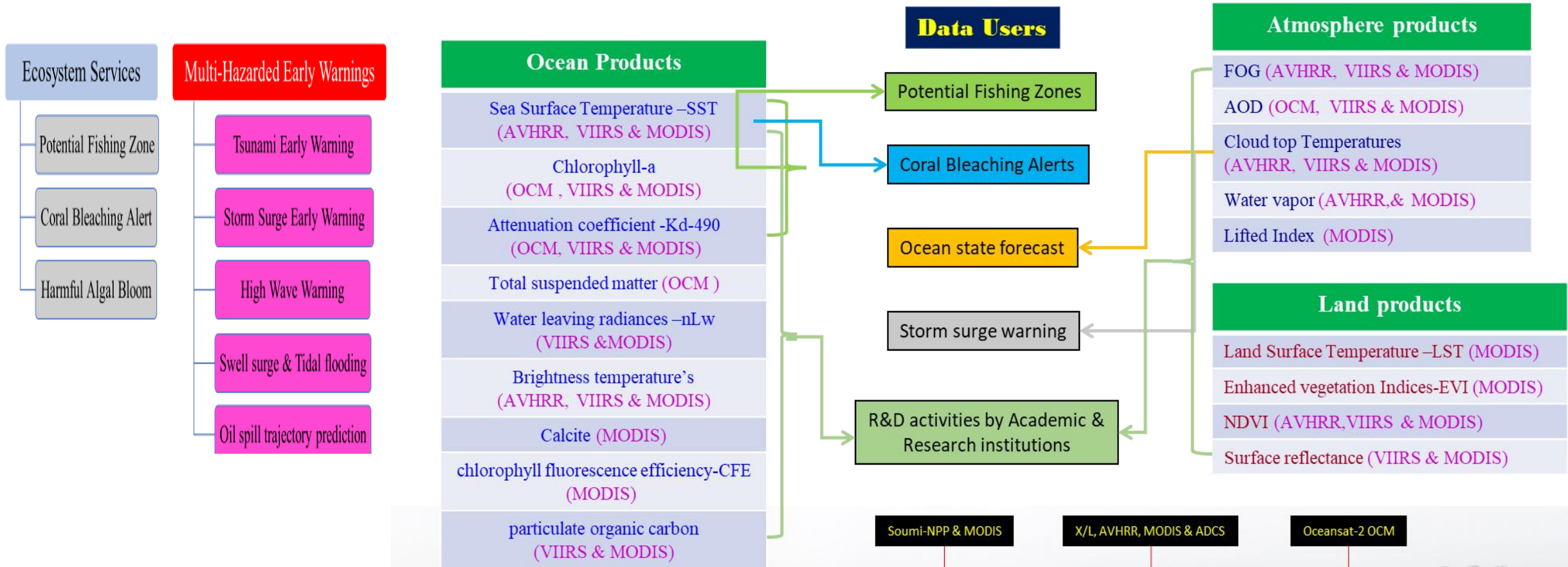


Fisheries & Ecosystem services

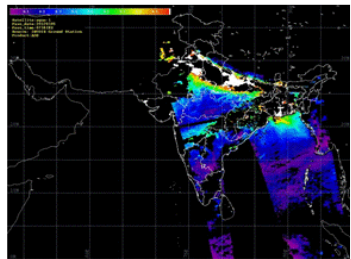


STAKEHOLDERS OF BLUE ECONOMY

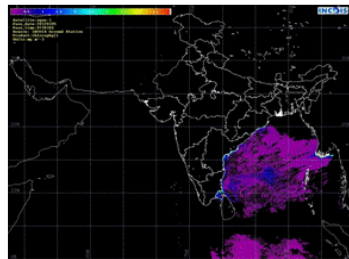
INCOIS established 3 Groundstation's to meet the in-house operational advisory services.
 Acquiring **AVHRR** (Metop-1, Metop-2, NOAA-18 & NOAA-19), **VIIRS** (Soumi-NPP), **MODIS** (AQUA & TERRA) & **OCM** (Oceansat-2).



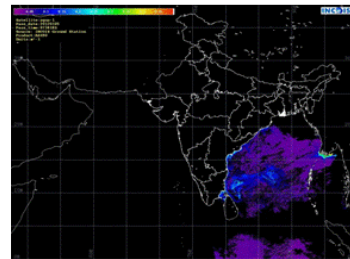
Sample MODIS Operational data products generated at INCOIS Ground Station



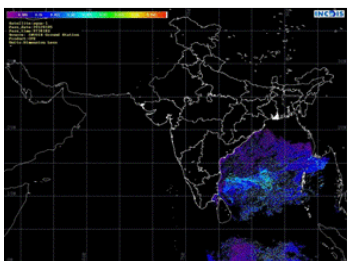
AOD



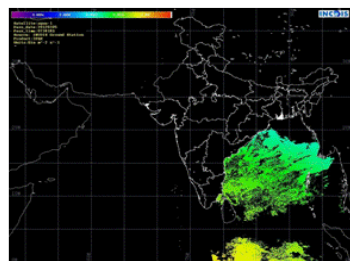
Chlorophyll-a



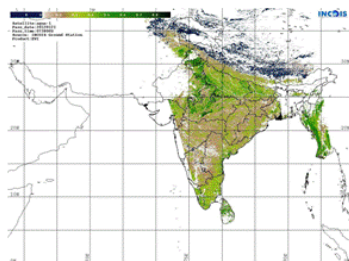
Kd-490



CFE

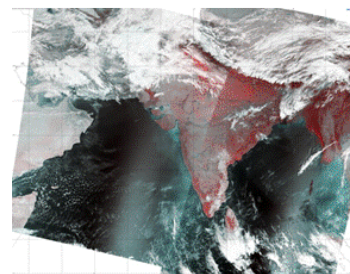


IPAR

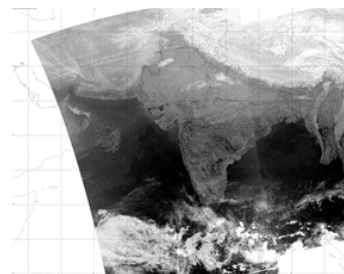


EVI/NDVI

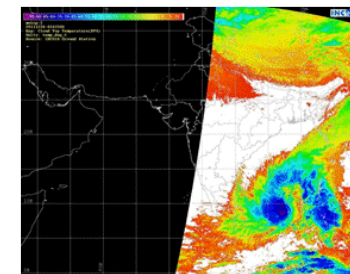
AVHRR Operational composite data products generated at INCOIS Ground Station



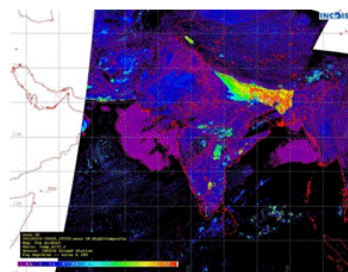
FCC



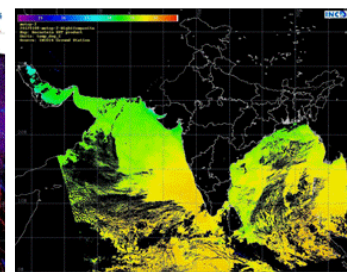
Inverse TIR



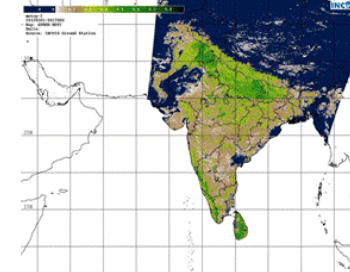
Cloud top Temp



Day/Night Fog

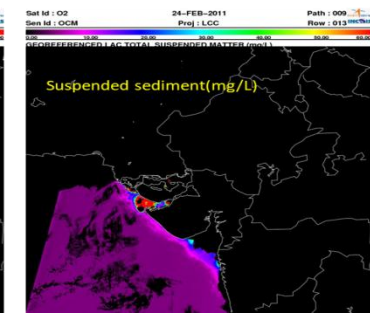
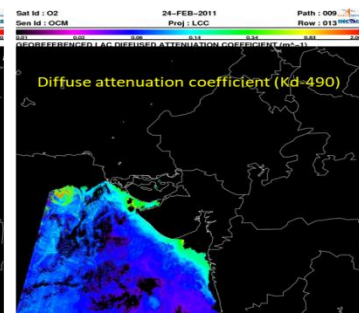
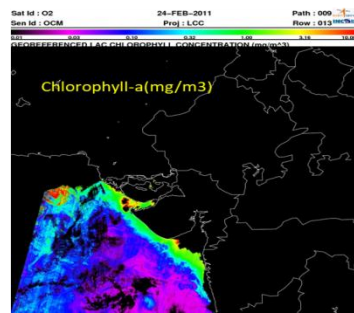
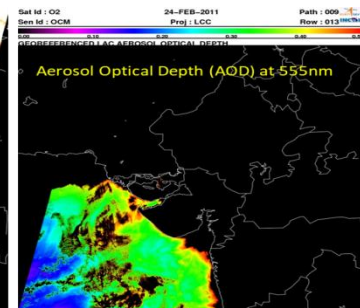
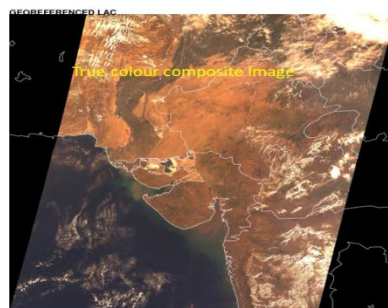


Day/Night SST

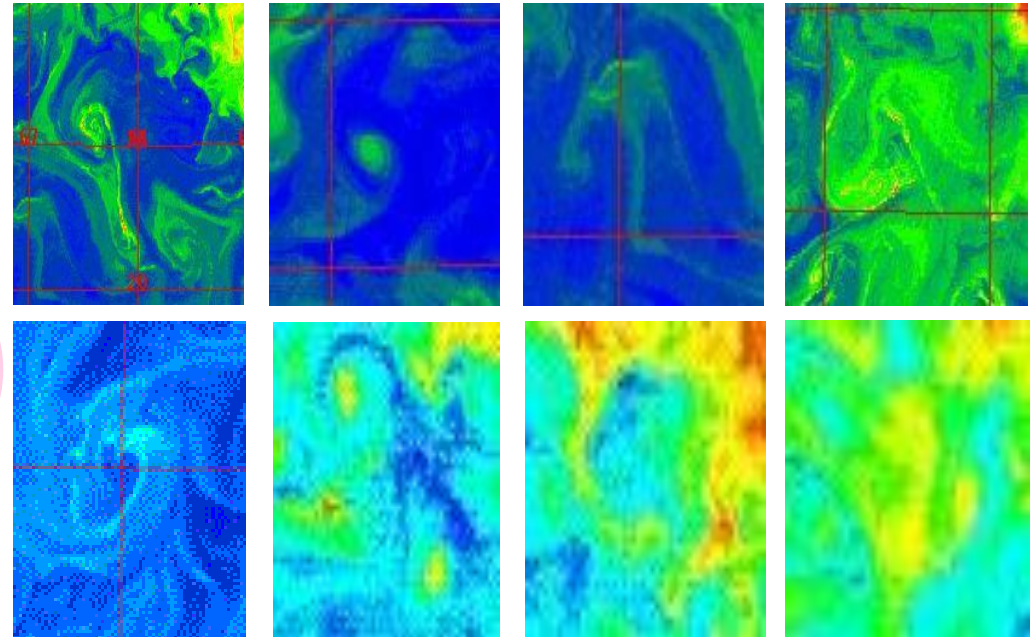
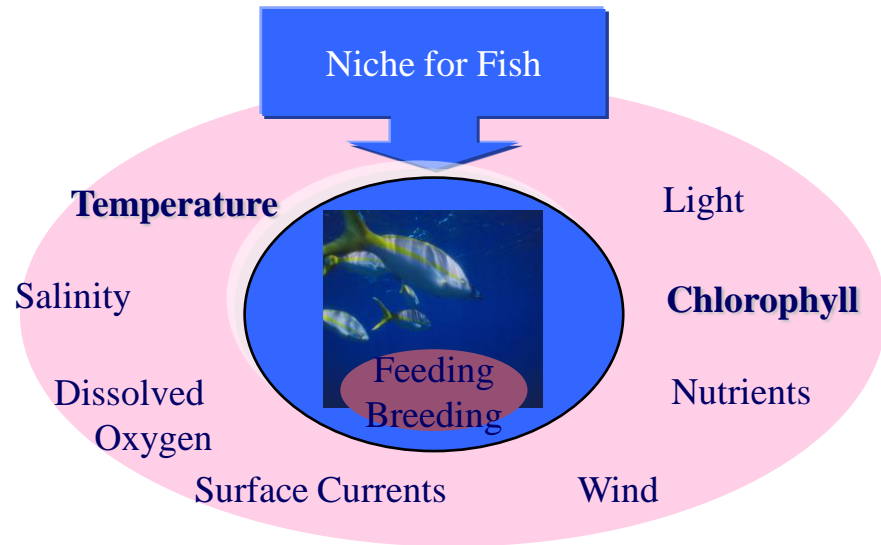
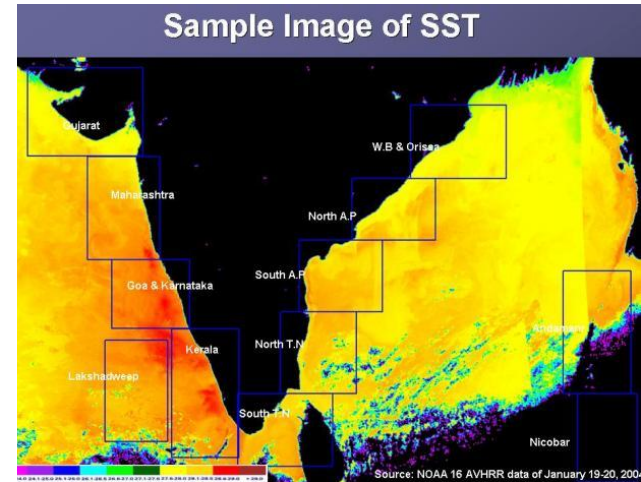
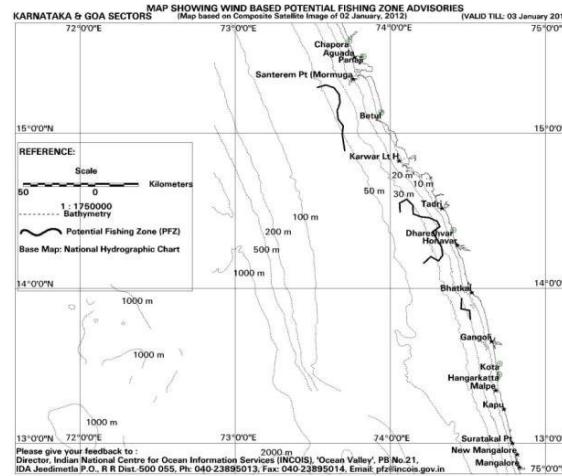
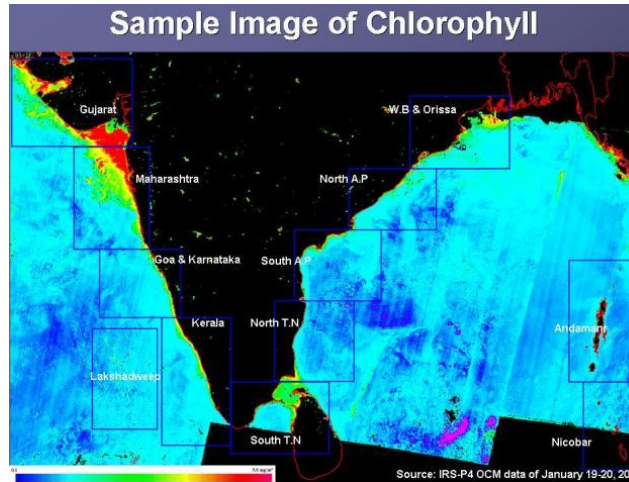


NDVI

Oceansat-2
Ocean Colour Monitor (OCM)
data products

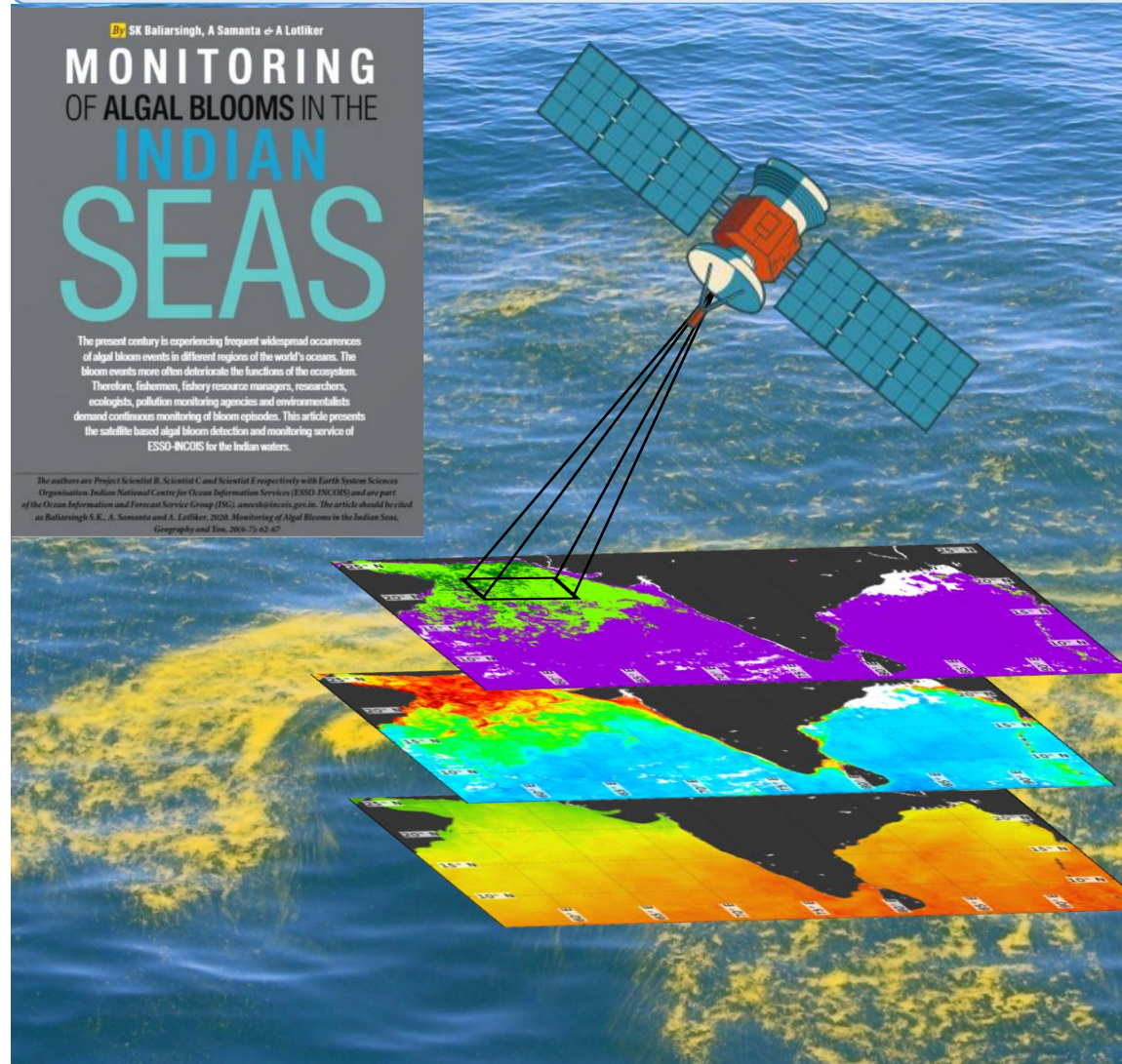


Potential Fishing Zone Advisory Service

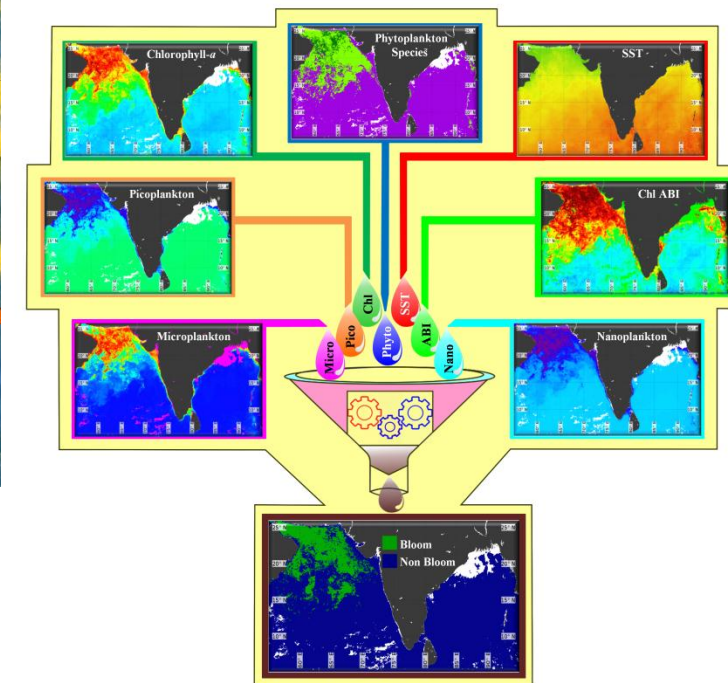


**Key Indicators: Eddies, Rings, Meanders,
Tongue/Mushroom features
Upwelling, Thermal Fronts**

Algal Bloom Information Service

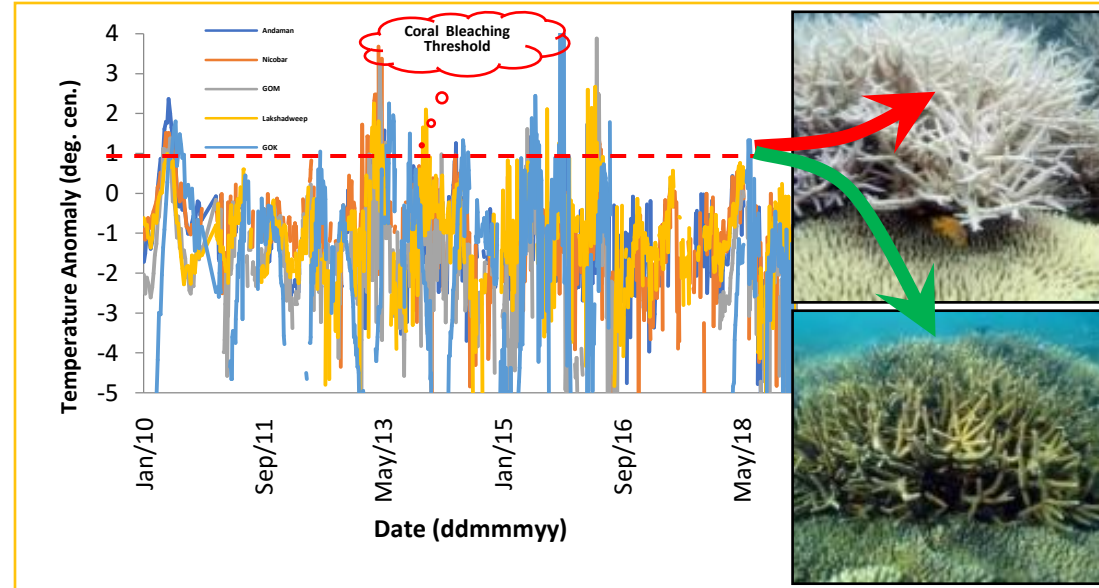
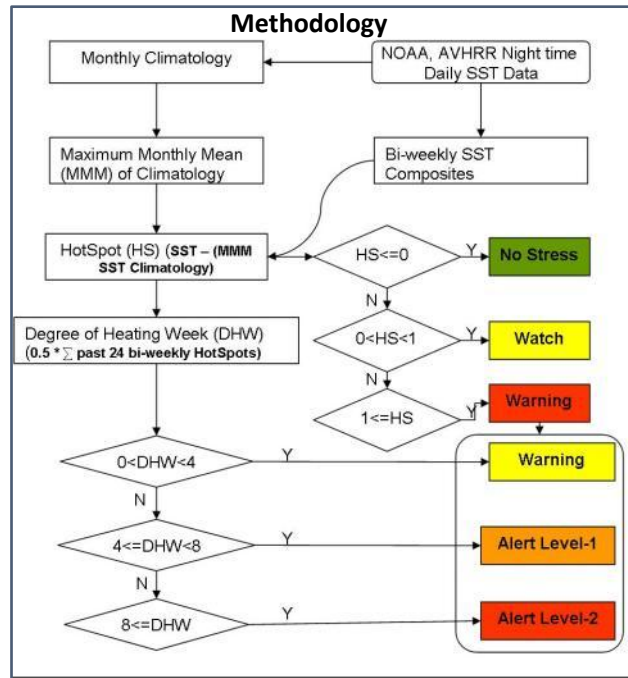


- Inaugurated on 24 Feb 2020
- Monitoring the four hot-spots in Indian Ocean
 - Northern Arabian Sea
 - Kochi
 - Gulf of Mannar
 - Gopalpur



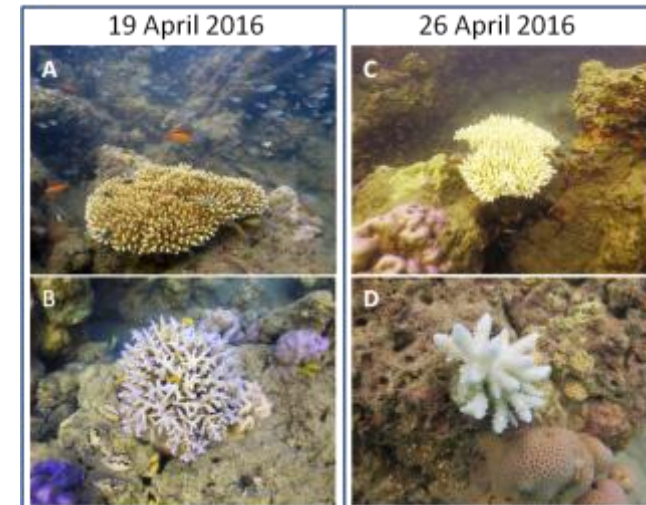
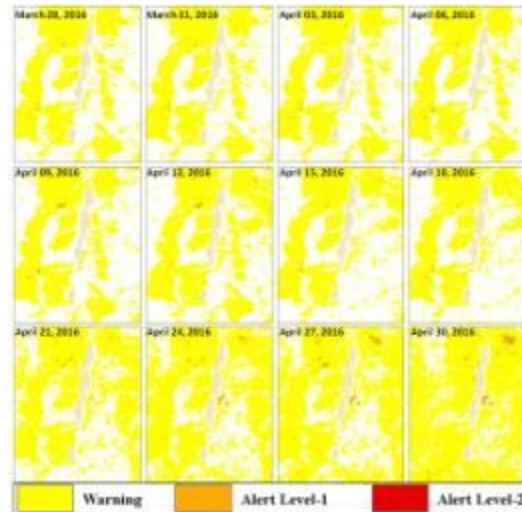
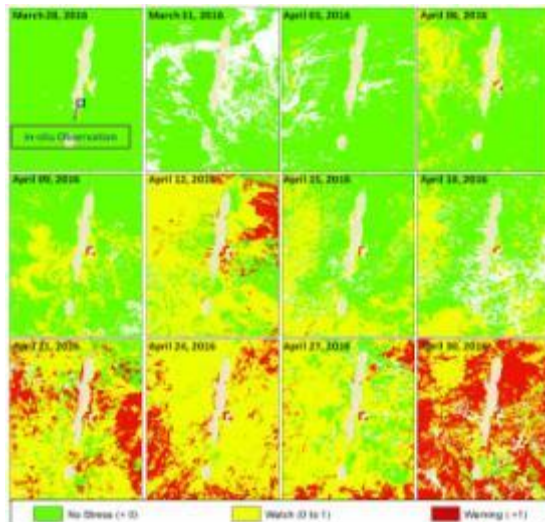
Status	Condition	Color Code
Normal	Bloom pixels < 50%	Green
Watch	Bloom pixels $\geq 50\%$ and < 75%	Yellow
Warning	Bloom pixels $\geq 75\%$	Red

Coral Bleaching Alert System (CBAS) - A satellite-derived SST based Service



Service initiated since Feb 2011 and 122 advisories provided every year

Bleaching event was recorded during the April-May 2016 at Andaman validated with Field Data



“Satellite based advisory service to predict thermal stress on an important coral ecosystem”

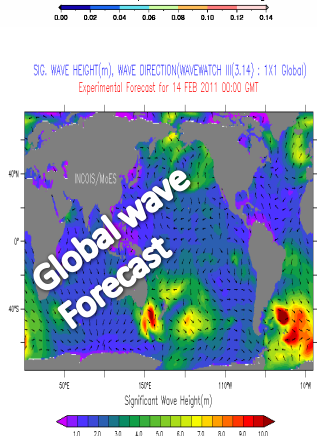
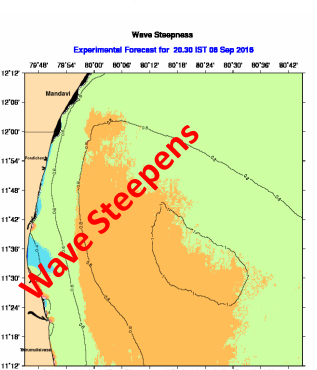
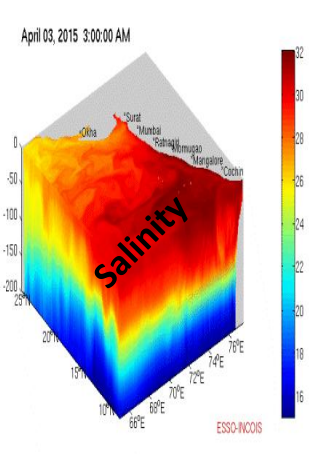
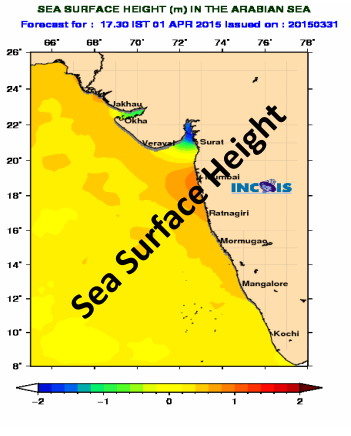
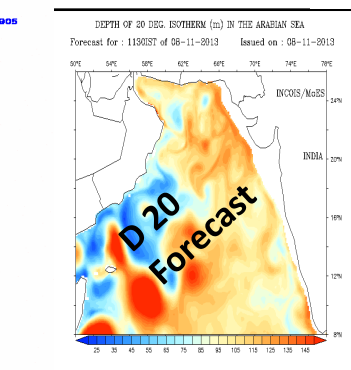
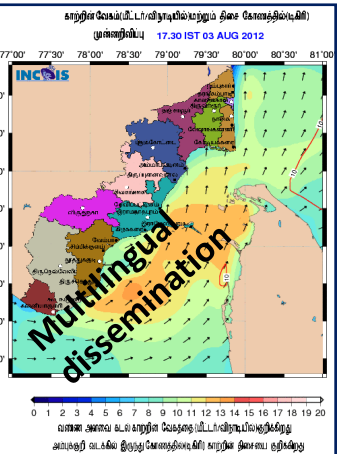
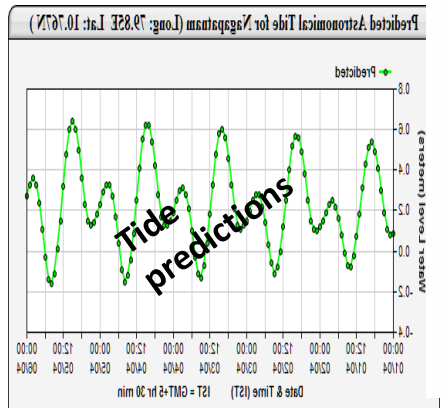
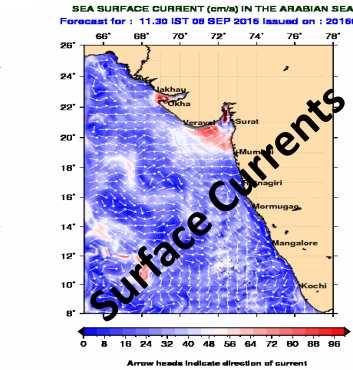
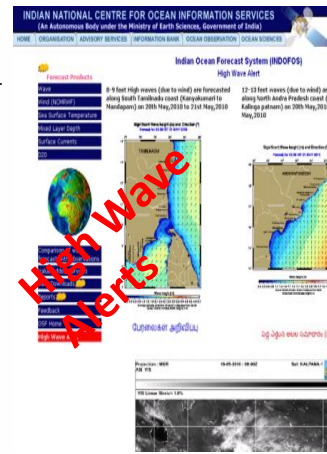
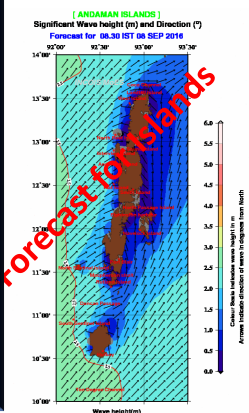
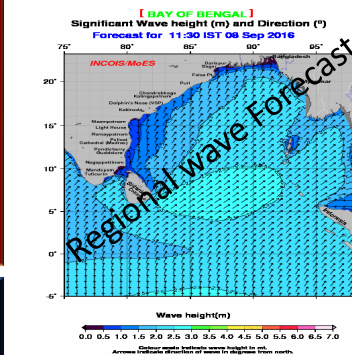
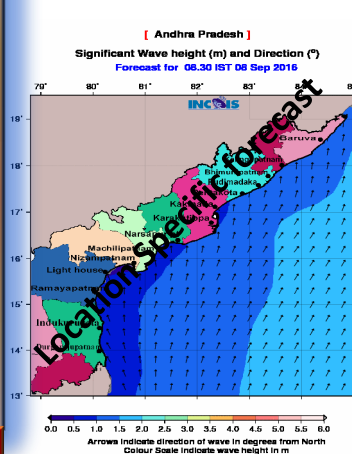
Ocean State Forecast & Early Warnings

45 User specified products were designed, validated and operationalised

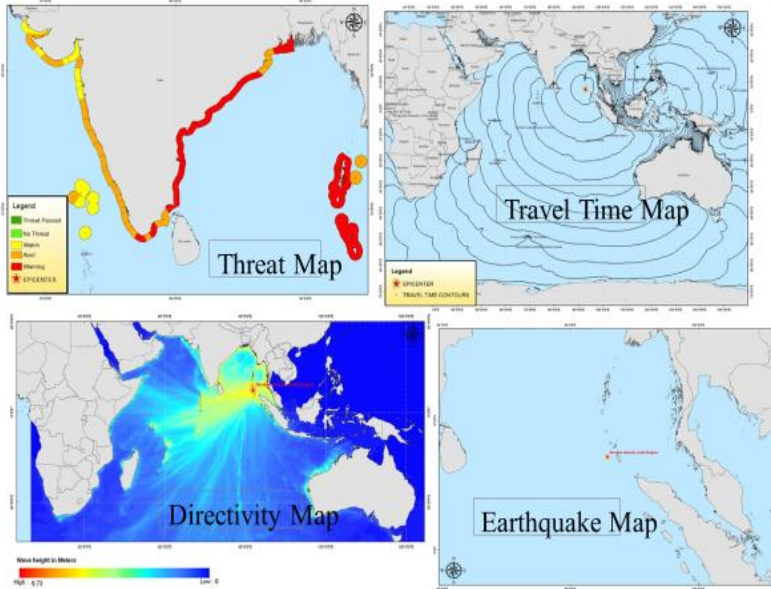
- Global Forecast
- Regional – 7 Regions
- Coastal – 9 Coastal states of India
- Island – A&N and Lakshadweep
- Location specific -100 locations
- Tidal forecast system for 178 locations
- Real time validation System
- Forecast dissemination in local languages
- High resolution Forecast for West Coast of India

- High Wave/swell/bulletins
- Tsunami Warning
- Joint INCOIS – IMD Bulletins including storm surge warning also
- Bulletins on Ocean State Forecast along Standard shipping routes

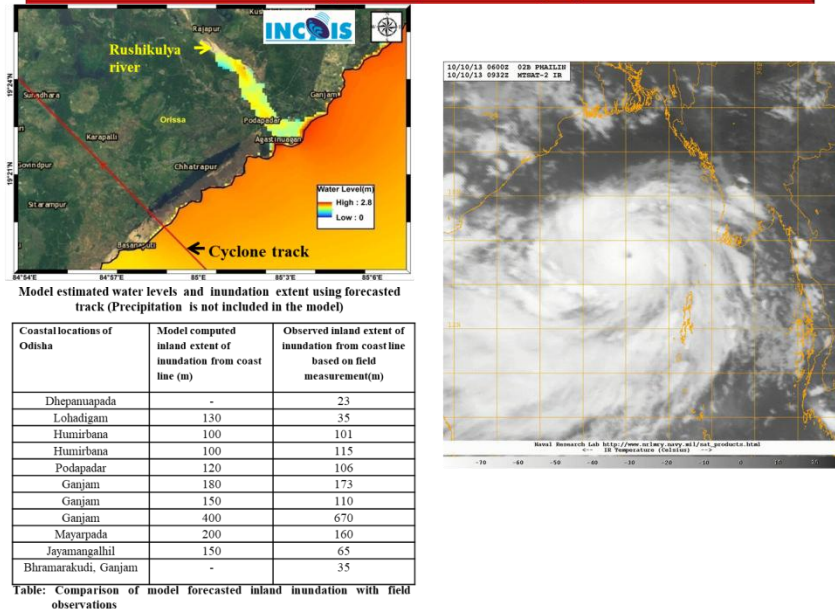
- Forecast along ship-track
- Eddy Forecasts
- OSF for Neighbouring countries through RIMES
- Navy specific forecast products
- OSF Web Map Services
- Sea State Forecast for ports and Harbours
- Online Oil spill advisories (OOSA)
- Search and Rescue Aid Tool (SARAT)



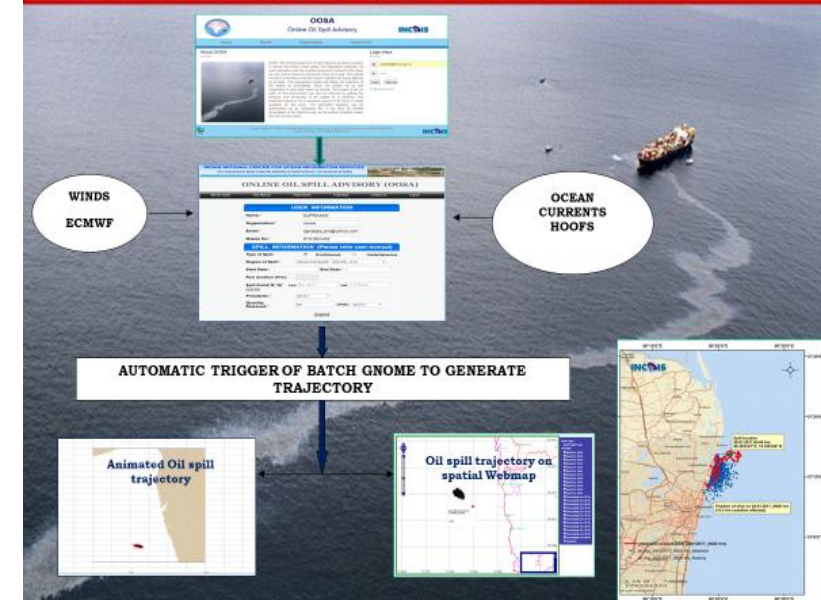
National Tsunami products



Storm Surge Early Warning System



Oil spill trajectory Predictions



High Wave Warning

The high wave alert/warning is as follows "High waves in the range of 2.8 - 4.2 meters are forecasted during 17:30 hours on 03-11-2019 to 23:30 hours of 05-11-2019 along the coast of Maharashtra from Malvan to Vasai . Surface Current speeds vary between 75 - 110 cm/sec".

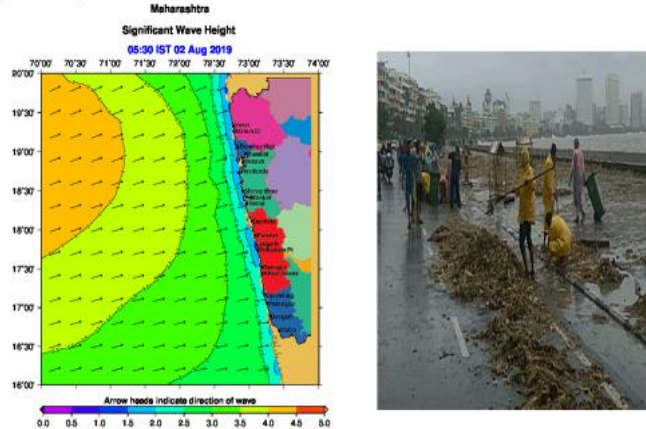
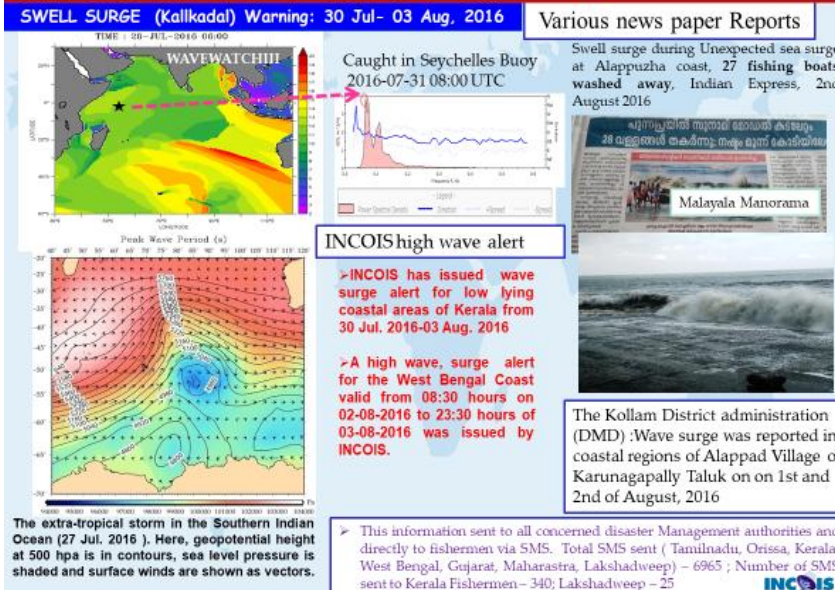


Fig: High waves along with high tides heap trash along Mumbai's Marine Drive during August 2-4, 2019

Swell surge Warning



INCOIS-IMD Joint Bulletin – RED MESSAGE

Time of issue: 09:00 hours IST Dated: 17.05.2021, Bulletin No.: INCOIS/17/05/2021/3

Sub: INCOIS-IMD Joint Bulletin - Ocean State Forecast associated with the Very Severe Cyclonic Storm "Tauktae" (pronounced as Tau'Te) over Eastcentral Arabian Sea into an Extremely Severe Cyclonic Storm: Cyclone Warning & post landfall outlook for Gujarat & Diu coasts (Red message)

The Very Severe Cyclonic Storm "Tauktae" (pronounced as Tau'Te) over eastcentral Arabian Sea moved north-northwestwards with a speed of about 20 kmph during past 06 hours, intensified into an **Extremely Severe Cyclonic Storm** and lay centred at 0530 hours IST of 17th May, 2021 over eastcentral Arabian Sea near latitude 18.5°N and longitude 71.5°E, about 160 km west-southwest of Mumbai, 290 km south-southeast of Veraval (Gujarat), 250 km south-southeast of Diu and 840 km south-southeast of Karachi (Pakistan).

It is very likely to move north-northwestwards and reach Gujarat coast in the evening hours of 17th & cross Gujarat coast between Porbandar & Mahuva (Bhavnagar district) during the night (2000 - 2300 hrs IST) of 17th May as a Very Severe Cyclonic Storm with a maximum sustained wind speed 155-165 kmph gusting to 185 kmph

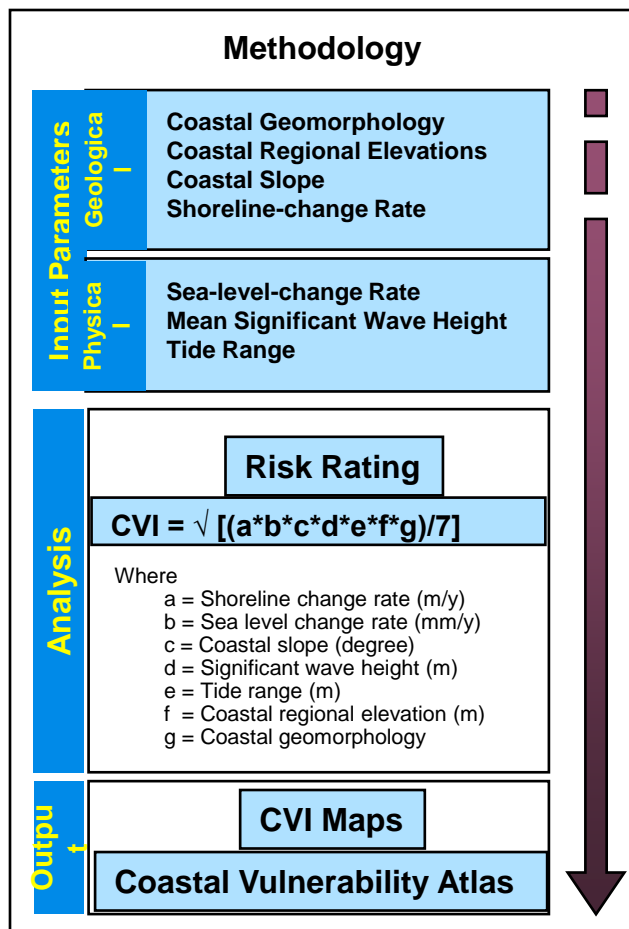
High Wave/Ocean State warning/alert for Maharashtra, Goa, Gujarat, Karnataka, Kerala and Lakshadweep

Geospatial data importance for Ocean forecast services

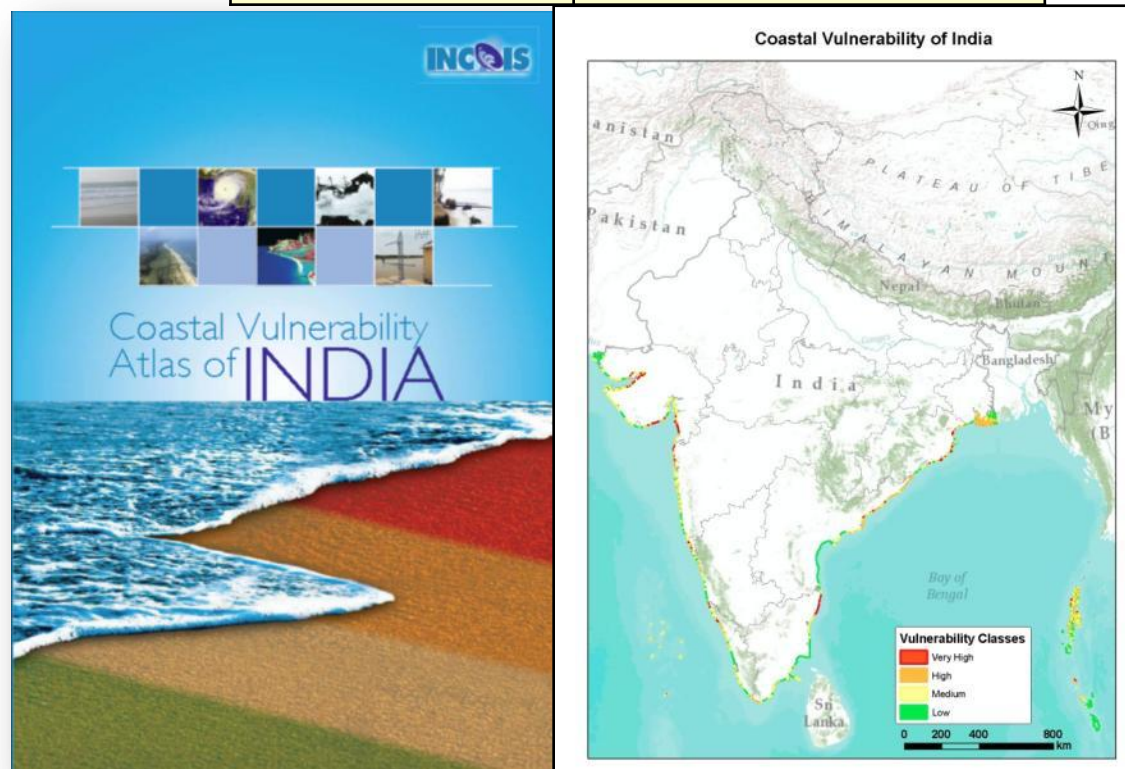
Model	Assimilated parameter	Satellite	Analysis/Forecast parameters
Wave and Swell Surge Forecasting System (WAVEWATCH III, SWAN, ADCIRC)	Significant wave height	Saral-AltiKa Altimeter –Jason2, Jason3,	Height, direction and period (of both wind waves and swell waves), Swell surge (arrival time and extent of inundation).
Regional Ocean forecast (ROMS) System (BGC)	SST SLA Chlorophyll	GHRISST L2 track data	Sea surface currents, Sea surface temperature, Mixed Layer Depth, Depth of the 20°C isotherm, Temperature & Salinity profiles
Global Ocean ANALYSIS (INCOIS-GODAS) System	Temperature and salinity profiles (SST is relaxed with 5 day time scale from OI SST)	NOAA OI (for daily SST relaxation)	Sea surface currents, Sea surface temperature, Mixed Layer Depth, Depth of the 20°C isotherm, Temperature & Salinity profiles
Basin wide Ocean Forecast (HYCOM)	SST, SLA	Jason3, Saral-AltiKa GHRSSST	Sea surface currents, Sea surface temperature, Mixed Layer Depth, Depth of the 20°C isotherm, Temperature & Salinity profiles
WRF HWRF-HYCOM coupled model	SST, SLA, Surface winds	Jason3, Saral- AltiKa GHRSSST ,SCATSAT	Cyclone intensity and track forecast
Oil spill, SAR models	--	--	---

Coastal Vulnerability Atlas

CVI Atlas covering Indian coast comprising 156 maps on 1:1lakh scales has been prepared and released on May 09, 2012

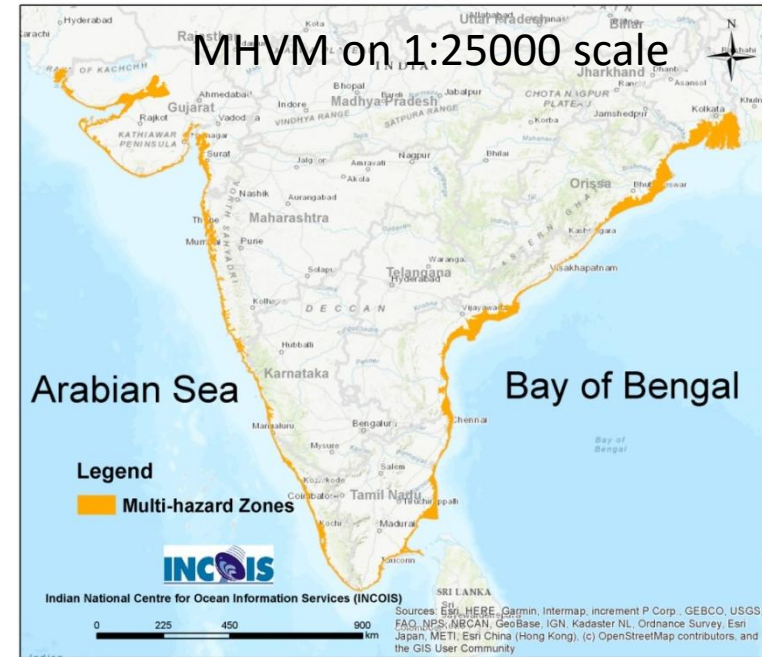
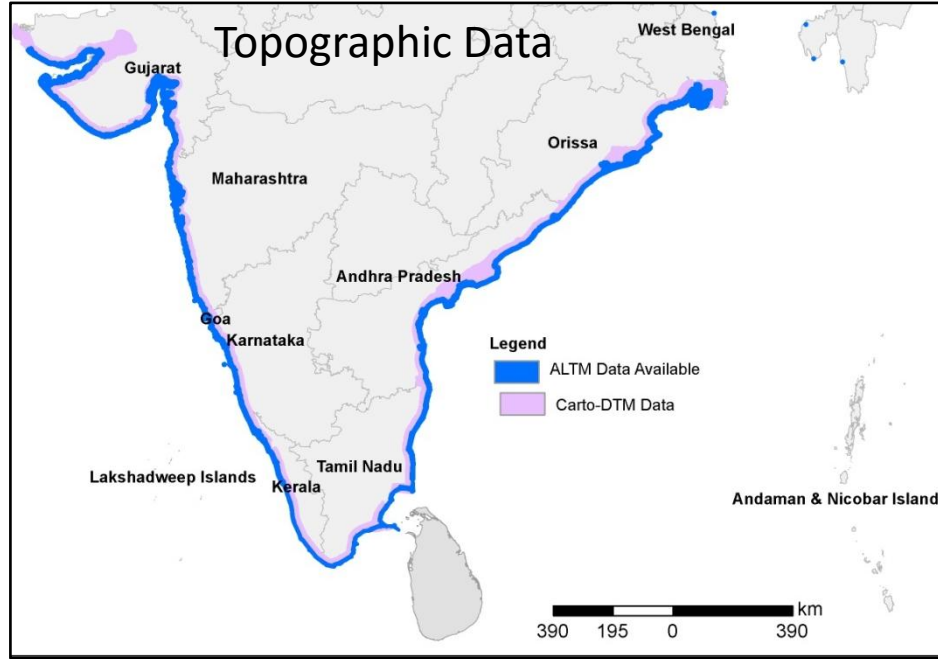


Parameter	Data
Geomorphology	IRS LISS-IV
Slope	GEBCO
Elevation	SRTM
Tidal Range	Astronomical tide from WXTide-32
Shoreline Change Rate	Landsat data (1972-2000)
Historical Sea Level	GLOSS long term tide gauge observation
Significant Wave Height	Mike-21 SW modeling

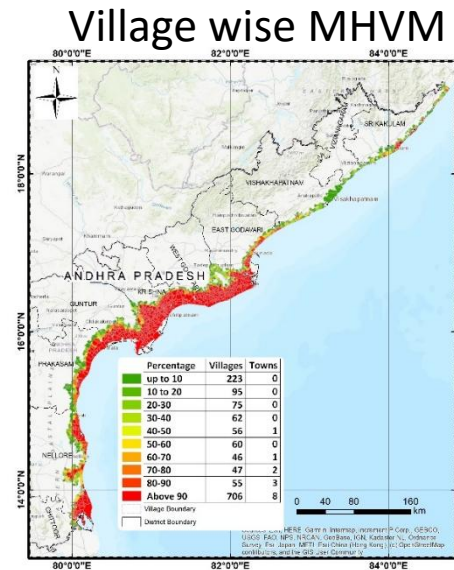


Multi-hazard Vulnerability Mapping

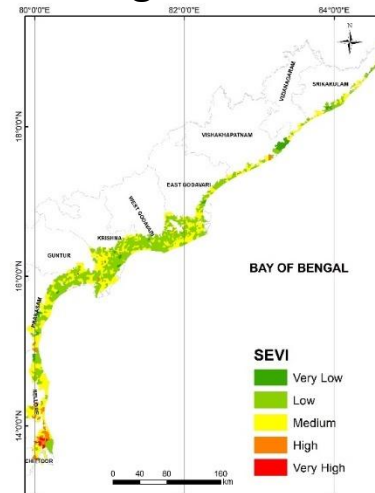
Completer for Indian Mainland



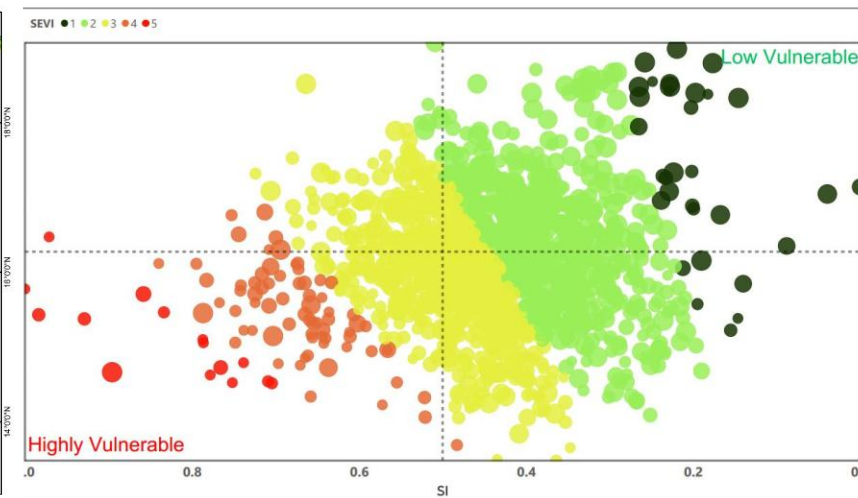
Socio-economic Vulnerability Index (SEVI)



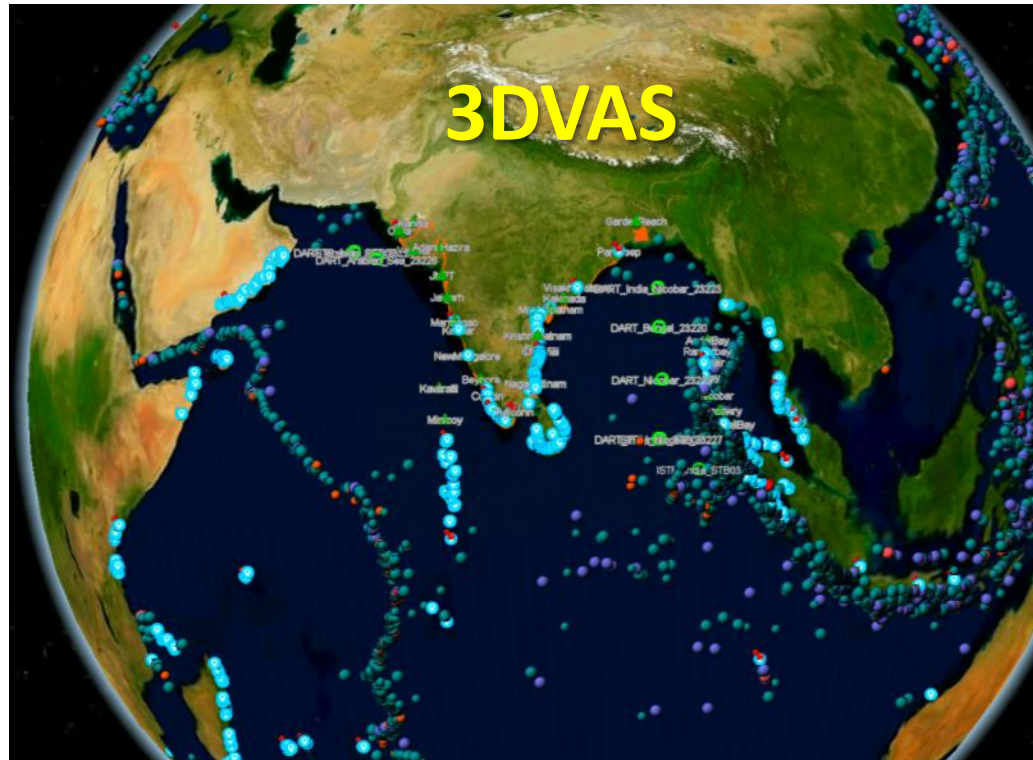
Village wise SEVI



Village level Decision matrix -SEVI



3D Visualization and analysis for disaster management



3DVAS Application integrated with 2D and 3D Geospatial data pertaining to vulnerability, geophysical and 3D GIS database

The terrain is improved by incorporating the new topographic dataset and images

Building bases converted to 3D models to have seamless 3D buildings

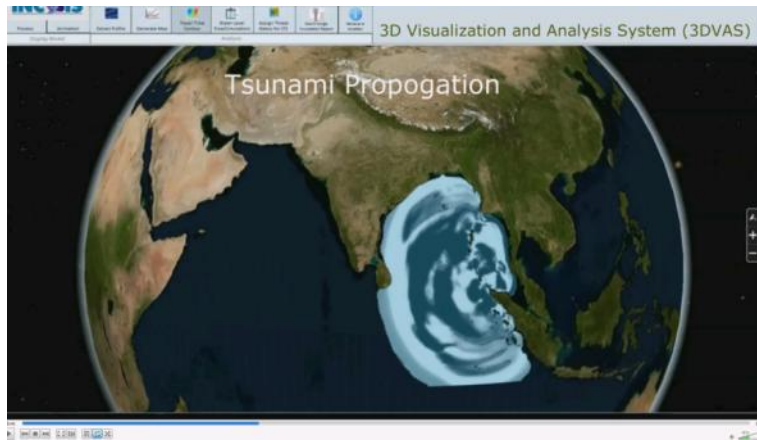
MHV Maps



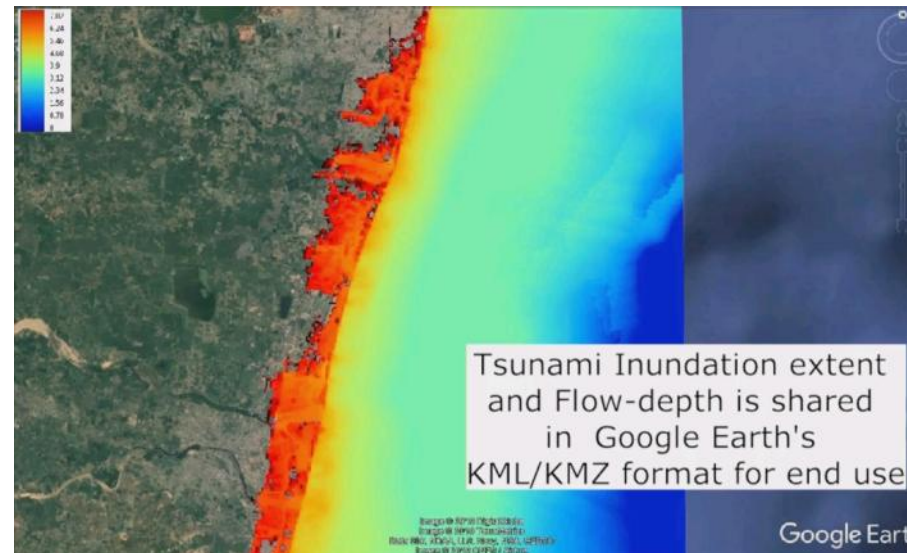
3D Buildings draped on high resolution Topography



Inundation Modeling and risk assessment in 3DVAS



Model setup, propagation and inundating modeling, Overlay of the modeling results and risk assessment at building level and generation of outputs



Summary of the satellite data requirements for INCOIS applications

Sensor	Requirement	Application	Utility in services
Ocean Color	Multispectral /Hyperspectral &/or geostationary, daily revisit	Primary productivity, bio-geo-chemical model, phytoplankton functional type, coastal processes, as a forcing in ocean models	General and Species-specific Marine Fishery Advisory Services (MFAS) PFZs, Algal Bloom Information Services (ABIS), Coral Reef Advisory Service
Altimeter	Ensure minimum four sensors in orbit	Assimilation in numerical models, merged products	Wave, swell surge forecast, Value added, species specific PFZs, ocean currents
SST	Geostationary, along OC payload	High temporal resolution, front demarcation, Assimilation in numerical models	overcome cloud cover, PFZs
Scatterometer	1800km swath, ≤ 25 km res., accuracy of ≤ 2 m/s	Primary productivity, bio-geo-chemical modeling, ocean general circulation models	Species specific PFZs, forecasting
Salinity	≤ 2 day revisit, ≤ 25 km res., large swath	Salinity fronts, fish migration studies, Assimilation in numerical models	Species specific PFZs, fish breeding
Precipitation	≥ 2 visits/day, large swath, RT/NRT	Rain-over-the-sea estimation, L4-Product for numerical ocean	Species specific PFZs, fish breeding
Nutrient / O ₂ / Carbon	First sensors in orbit daily revisit and large swath	Biogeochemical cycles, modeling, budgeting	Ecosystem studies, modeling, forecast

Thank you