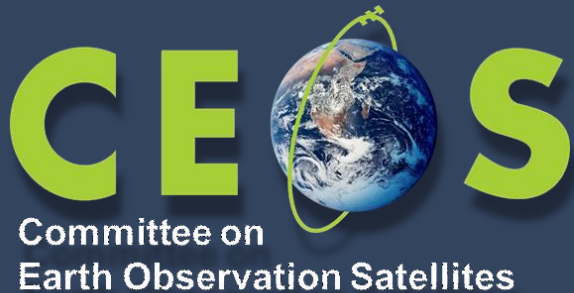




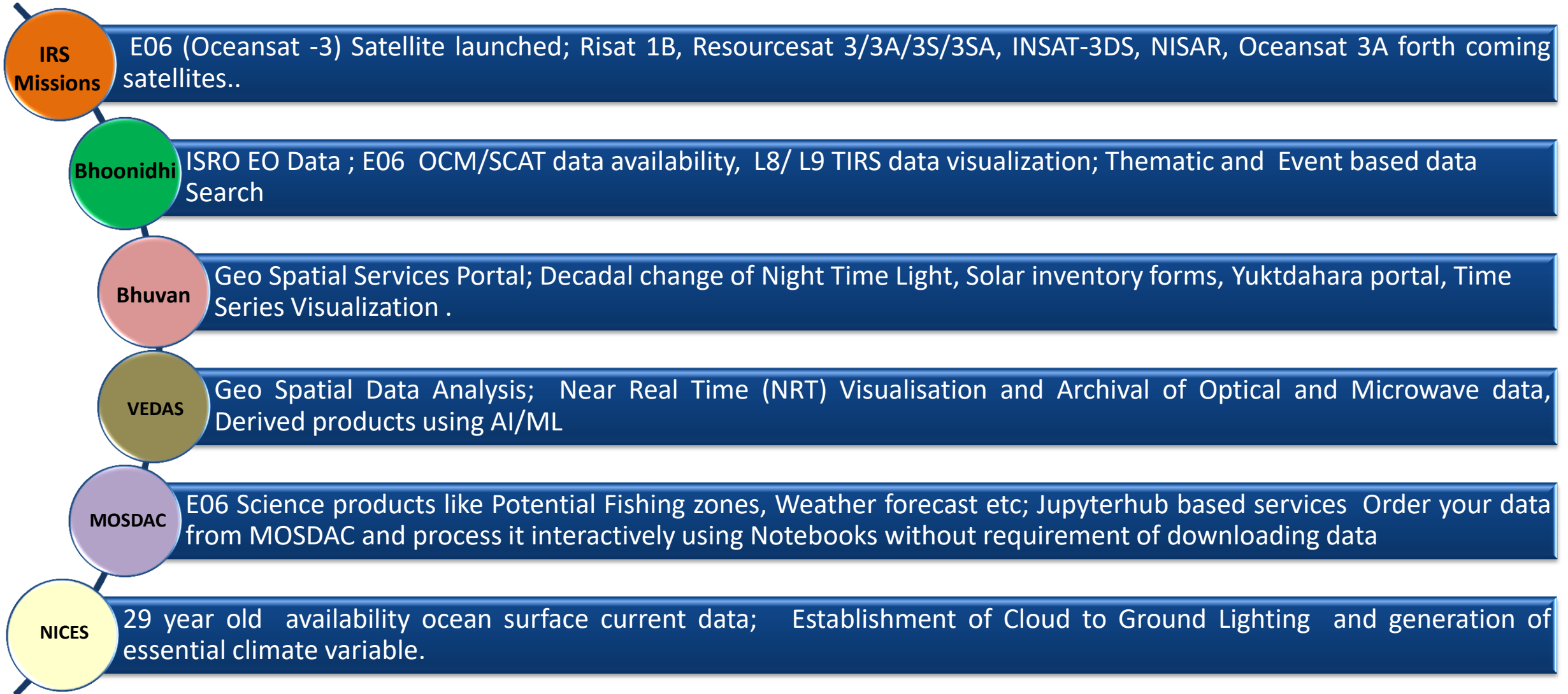
Agency Report

Indian Space Research Organisation



T. Sai Kalpana, ISRO
Agenda ID: 2023.04.20_09.00
WGISS-55
Córdoba, Argentina(CONAE)
18th – 20th April 2023

Executive Summary



Sensor Specifications

OCM-3

- Spectral resolution 20 / 10 / 8 (Application bands) & 20 / 40 (Atmospheric correction bands)
- Swath is 1500 Km
- Spatial resolution is 366m (Local Area Coverage- LAC Mode), Spatial resolution is 366m 1080m (Global Area Coverage- GAC Mode)
- 13 spectral bands in optical region (0.402 to 1.030 microns)
- Two days revisit and 13 days complete Globe Area Coverage is ensured without Sun glint

Scatterometer

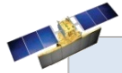
- Nominal mode provides 12.5 X 12.5 km grid for wind vector



Applications

- OCM-3 has been used for a variety of geophysical and biological applications, including forecasting Potential Fishing Zones (PFZs), estimating primary productivity, studying coastal processes, calculating aerosol radiative forcing, and studying physical-biological coupled processes etc.
- SCAT-3 data applications applied to the study of vegetation, soil moisture, polar ice, global change, Effect of surface winds on biological productivity-PFZ changes etc.

EO Missions (Current)



RESOURCESAT-2 & 2A, EOS-04 & CARTOSAT-2E & 3

- Natural Resources & Disaster Mgmt;
- Large Scale Mapping



- Three tier imaging : 56 m / 23 m / 5.8 m
- C-Band SAR (3-50m resolution)
- 60 cm / 28 cm PAN & 1/ 1.5 m Multi-spectral

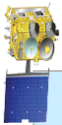


EOS-06 , SARAL

- Ocean Color
- Ocean Surface Winds; Ocean Altimetry



- Ocean Colour – 360 m
- Ocean surface Winds & Sea surface wave height



INSAT 3D & 3DR

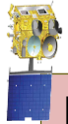
- Weather Forecasting
- Atmosphere
- Climate studies



- 6 Channel Imager – 48 images per day
- 19 Channel Sounder – Atm. Profiles

* EOS-04, EOS-06 recently launched satellites

EO Missions (Planned)



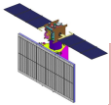
INSAT-3DS (2023-24) - Meteorological Satellite

Orbit	36000 km (GEO)
	Every 30 min
Payloads	<ul style="list-style-type: none"> 6 channel Imager (Visible, MIR, WV, TIR and SWIR) 19 channel Sounder (18 narrow spectral channels in 3 IR bands, 1 channel in visible band)



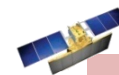
OCEANSAT-3A (2024-2025)

Orbit	• 720 km; SSO; ECT: 12:00 hrs
Swath	• 1400 km
Payloads	<ul style="list-style-type: none"> OCM 360 m (407-1020 nm) SSTM 1 km (11 & 12 μm) SCAT (Ku band - 13.51 GHz)



RISAT-1B (2023-2024)–Microwave Satellite

Frequency	<ul style="list-style-type: none"> C-band (5.40 GHz) Single, Dual & Full
Modes	• Strip map, CRS, MRS, Spot
Resolution	• 3 to 6 m, 25 m, 50 m
Swath	• 10 km to 240 km
Incidence Angles	• 20° – 49°
Repetivity	• 17-24 days



Resourcesat - 3 & 3A (2025)

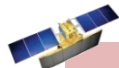
Sensor	GSD	Swath	Revisit
ALISS-3 (A,B & C)	20 m	925 km	4 days
ALISS-3 (C)	10 m	280 km	11 days
ATCOR 0.4-1 μm	240 m		

EO Missions (Planned)



NISAR with NASA (2024)

Frequency	<ul style="list-style-type: none">L-band 1.26 GHzS-band 3.2 GHz
Swath	<ul style="list-style-type: none">Up to 200 km
Incidence Angles	<ul style="list-style-type: none">~ 34 - 48 degrees
Resolution	<ul style="list-style-type: none">3 to 10m
Repetivity	<ul style="list-style-type: none">30 days



Resourcesat Sampler – 3S / 3SA (2025)

Sensor	GSD	Swath	Revisit
PAN	1.25 m	60 km	Revisit of 4 Days
MX	2.5 m	60 km	

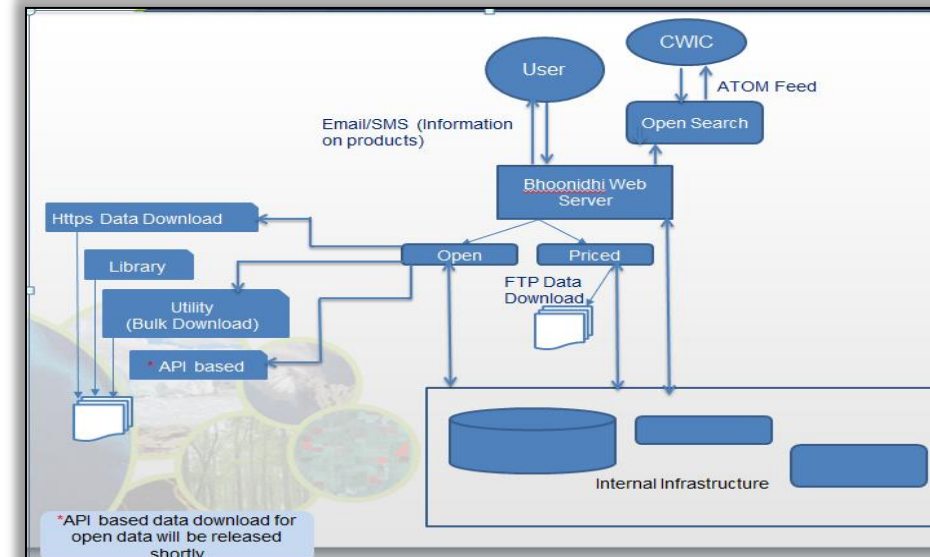
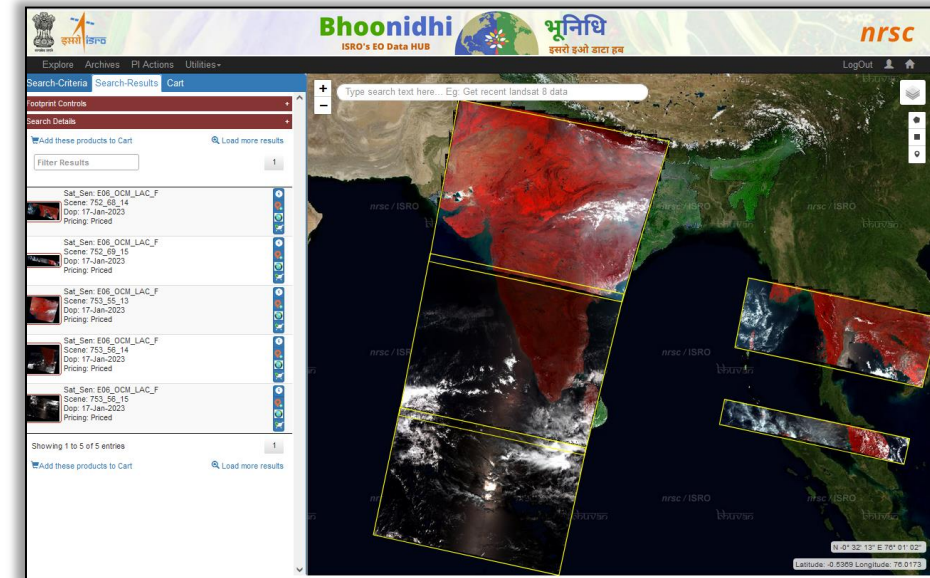
TRISHNA with CNES (2026-27)

Resolution	57 m; 1060 km swath; SSPO
Repetivity	8 days (3 days revisit)
TIR (CNES)	4 bands (8.6 to 11.5 μ m)
VSNIR (ISRO)	7 bands (485 to 1610 nm)

Bhoonidhi web portal enables access to archive of Remote Sensing data from 47 satellites, including Indian and Foreign Remote Sensing Sensors data acquired over 33 years.

Search, View, Add to Cart, Place work order (Priced data), Download (Free & Open data)

- ✓ Bhoonidhi Resources has an archive of help material provided to the users to access and sample products to download
- ✓ ISRO Oceansat3 satellite: EOS-06 (26Nov2022) is a follow on mission of Oceansat-2 imaging satellite
 - ❑ OCM
 - LAC Mode - 360m - Open data
 - GAC Mode -1Km - Open data
 - ❑ SCAT - 25km, 12.5km products – Open data
- ✓ Regional Hub of Sentinel1&2 – now Sentinel-1 SLC is also available.
- ✓ Non IRS Satellites - NOVASAR, Soumi NPP, JP1,L8,L9 data in India region.
- ✓ Landsat- 8 & Landsat- 9 TIRS @ Bhoonidhi Vista for temperature analysis.
- ✓ Thematic data - E06 and Oceansat-2 OCM/SCAT Geophysical products, Cartosat-1 DEM and Event based search is enabled @ Bhoonidhi.



Bhoonidhi



Browse & Order

Search, View and Download ,

Paid CART Interface,

Proforma (PI) ,

Place work order

https..
SFTP..

Bhoonidhi



VISTA

Visualize at Full Resolution

Visualize the NRT daily acquired data and temporal cycle based mosaic,

Quick animation of a point AOI

For Online Visual Analysis

Bhoonidhi



UPAGRAH

Orbit Viewer

Orbit Viewer - Live satellite/orbit tracking

Quick View of all satellites at predicted UTC time.

Satellite Tracker

Bhoonidhi

API services

STAC is a standard conforming the API exposing NRSC's EO data catalogue , which will enable users to use STAC API.

API Services for Automated machine to machine data Exchange

*Development in Progress

Bhoonidhi



Code lab which is a fully managed Jupyter hub platform to access Bhoonidhi hosted satellite image datasets and processing

Platform to Develop Analytical tools

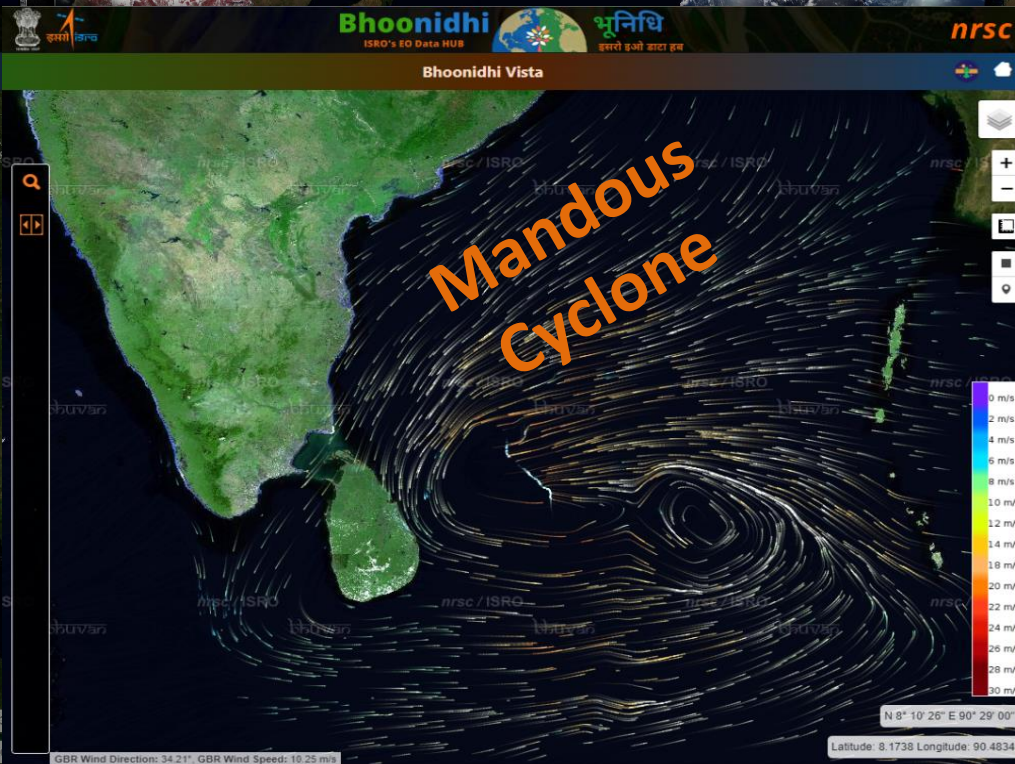
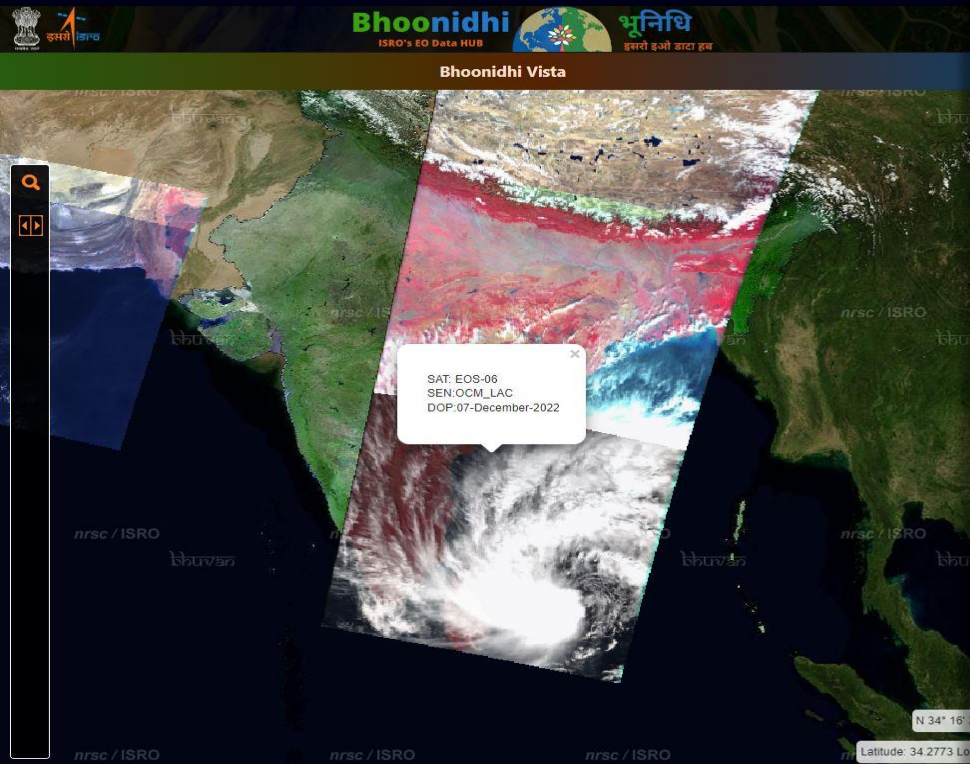
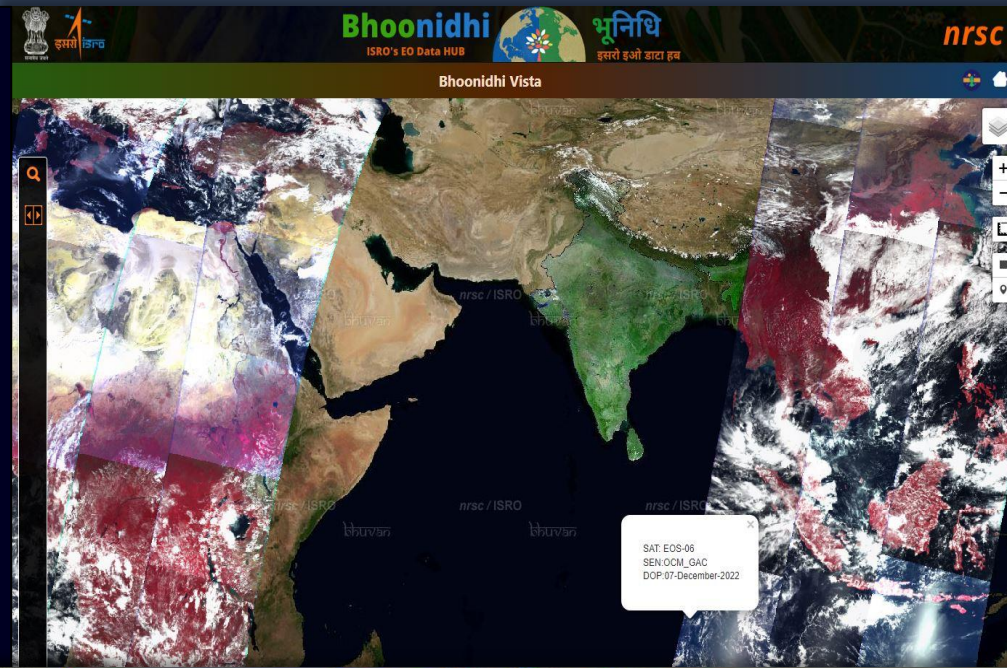
*Currently available for Internal ISRO users

bhoonidhi.nrsc.gov.in

E06 Data Visualization

@Bhoonidhi Vista

- Mandous cyclone viewed by E06 LAC/ GAC/ SCAT
- L1C OCM products with default GCS projection are enabled for visualization
- L3WW product of SCAT is enabled as animation



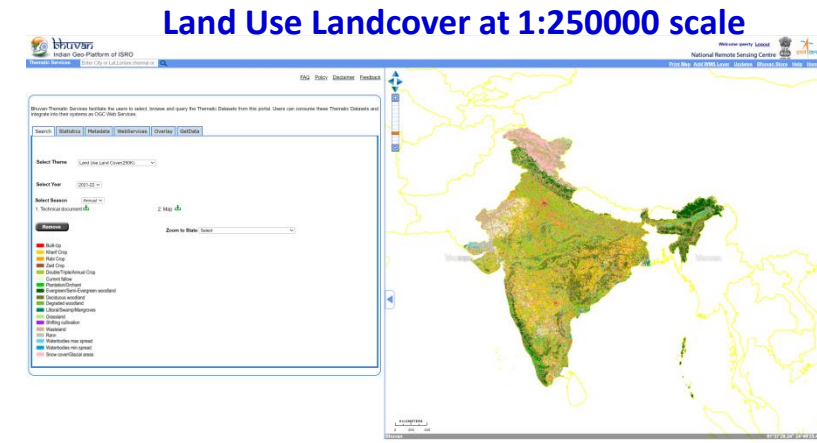


- Cartosat-1 DEM
- Scatsat-1
- Oceansat2 OCM & SCAT
- E06 OCM3 & SCAT3

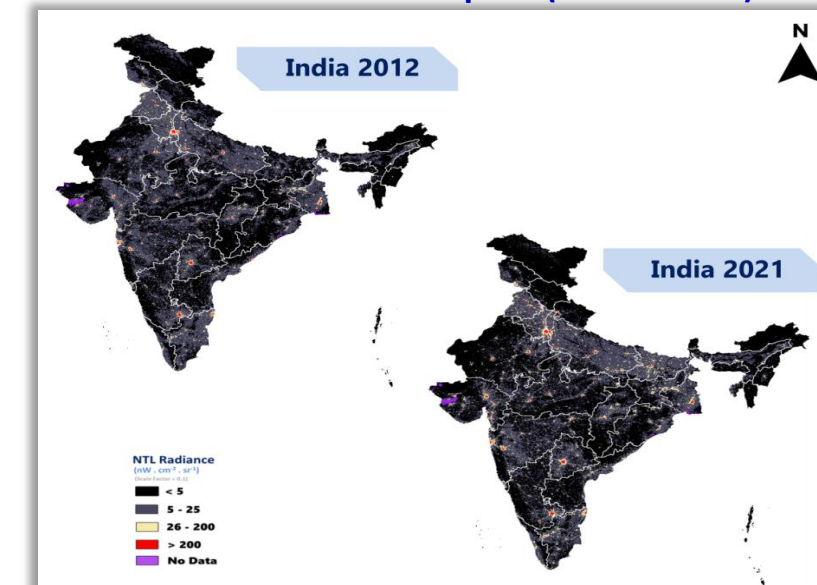
**Thematic Data Ordering
@Bhoonidhi**

Data

- Landuse Landcover at 1:250000 scale (2020-21, 2021-22).
- Satellite Imagery Data - Resourcesat - AWiFS 2022 (Jan, Feb, Mar, Apr, May, Jun, Sept, Oct, Dec), 2023 (Jan, Feb), LISS-3 2022 (Jan-Mar, Apr-Jun, Oct-Dec) 2023 (Jan-Mar), Cartosat 2S 2023 (in progress)
- In-situ Atmospheric CO2 data



Night Time Light (NTL)
over India from Space (2012 – 2021)



Value Added Services (AI/ML)

- Decadal Change of Night Time Light (NTL) over India from Space (2012 – 2021) : Approx. 43% increase observed from 2012 to 2021 with respect to base year 2012
- Solar Farms inventory using Resourcesat LISS III imagery



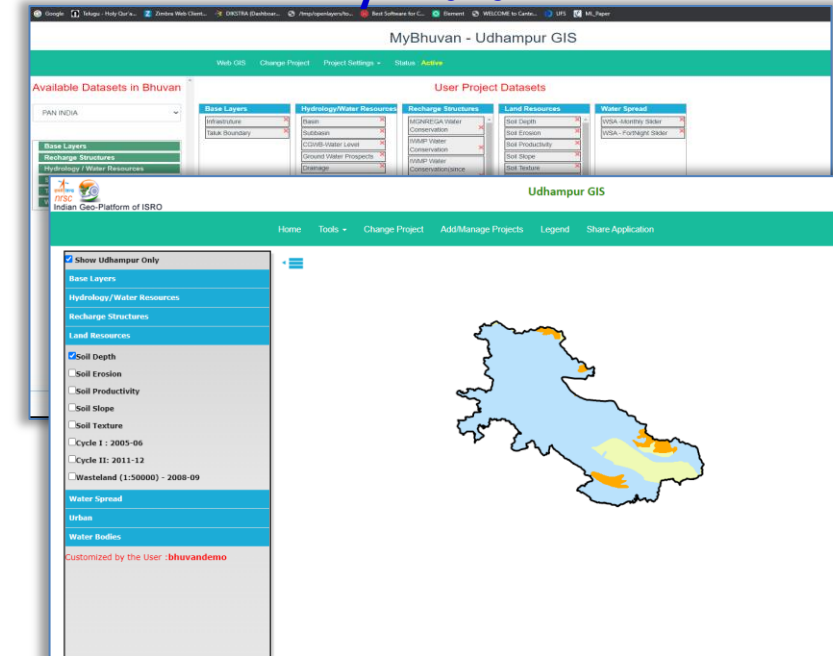
Services

- Bhuvan Time Lapse- enabling time-series visualization of geospatial data and provide the animation for download in GIF format.
- My Bhuvan- allows the user to create and customize Web GIS project using the available Bhuvan datasets with simple drag& drop options.
- Bhuvan HUMID – Hydrological Unit Model for InDia - web-based system that has pre-defined un-calibrated/calibrated SWAT model frameworks at three different hydrological units of sub-basin, watershed and micro- watershed. Provides online access to SWAT model datasets (model frameworks), facility to conduct SWAT model run and visualize outputs.
- Disaster Services – Integration of observed, forecast track along with Cone of Uncertainty using the real time cyclone feed from Indian Meteorological Department
- Yuktdhara Portal – Updation of probable locations for planning 101 NRM activities (WRDP, LRDP) & Watershed Development component 2.0 Mobile app for Monitoring activities.
- Ganesh Idol Tracking System implemented & tracked 60 vehicles as requested by Hyderabad Police

Bhuvan Time Lapse



My Bhuvan

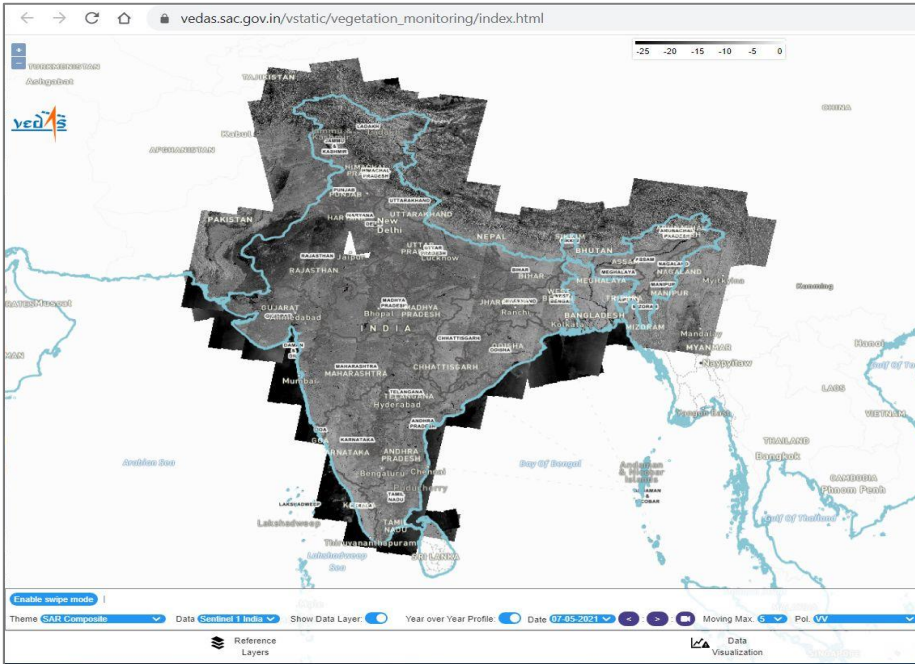


VEDAS: Geo-Spatial Analysis

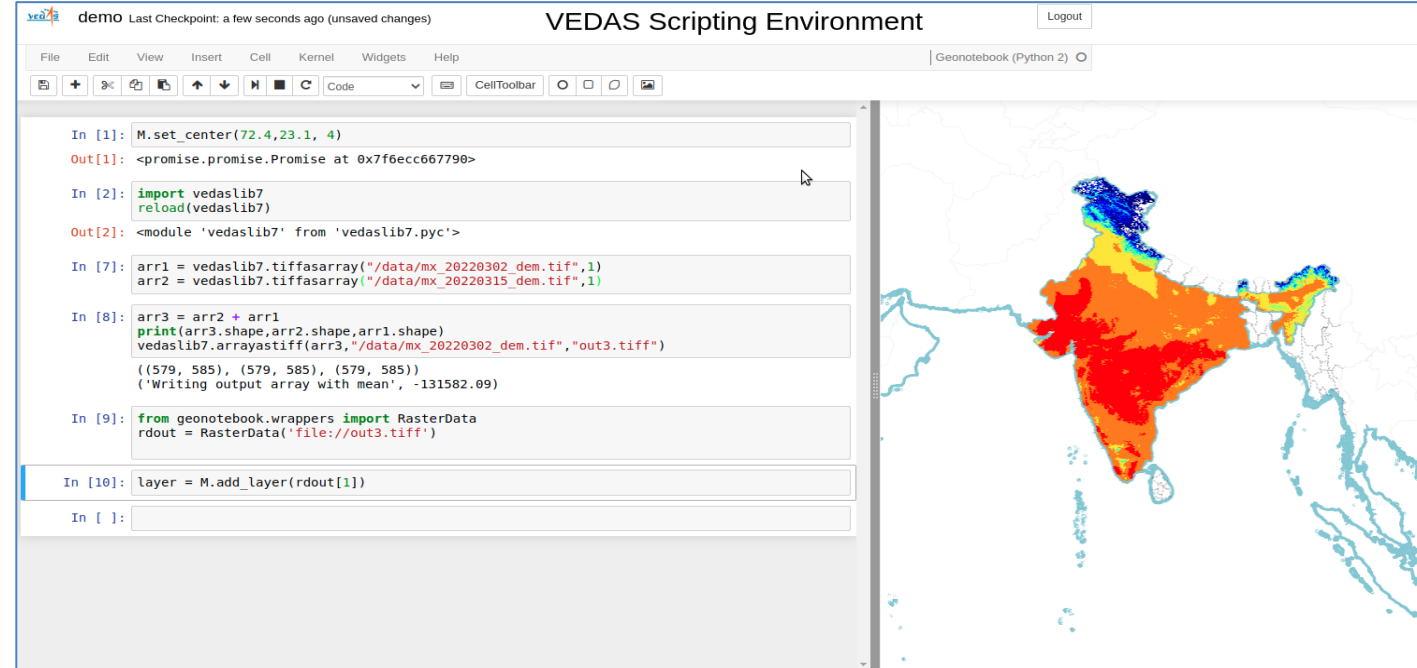
Visualisation of EO Data and Archival System (VEDAS)



Satellite Data Visualisation Application



VEDAS Scripting Environment



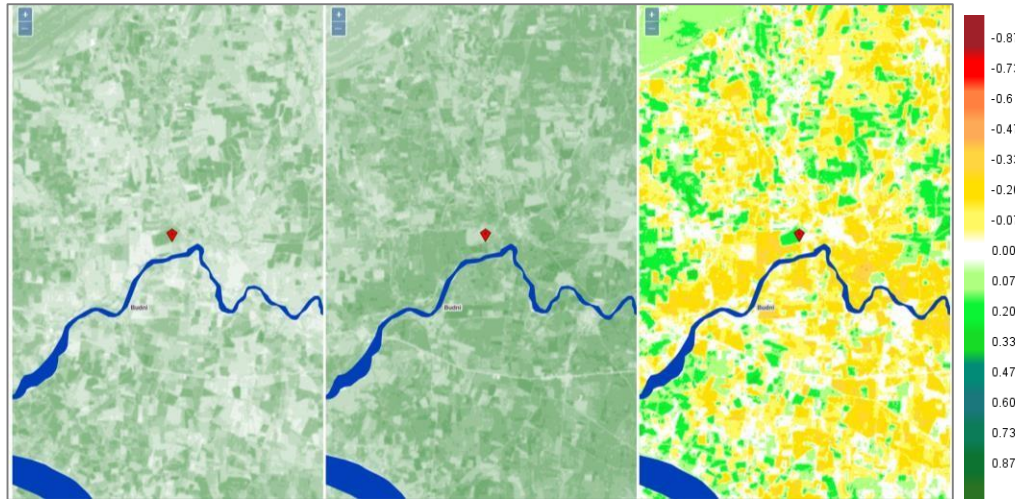
- Near Real Time (NRT) Visualisation and Archival of Optical and Microwave data from Multiple satellites. Optical Data from AWIFS, Sentinel-2, MODIS and INSAT-Visible & Thermal are available. Microwave data from Sentinel-1 C-Band SAR and ALOS L-Band SAR are included.
- Web-based geospatial calculator enable users to select archived data and perform **image analysis on web**.
- The archival of historical data on VEDAS enables **spatio-temporal data analysis**, such as difference of NDVI image of two dates, RGB compositing, multi-date NDVI classification, geospatial query tools, and long-term statistical analysis of data on web.

VEDAS: Geo-Spatial Analysis

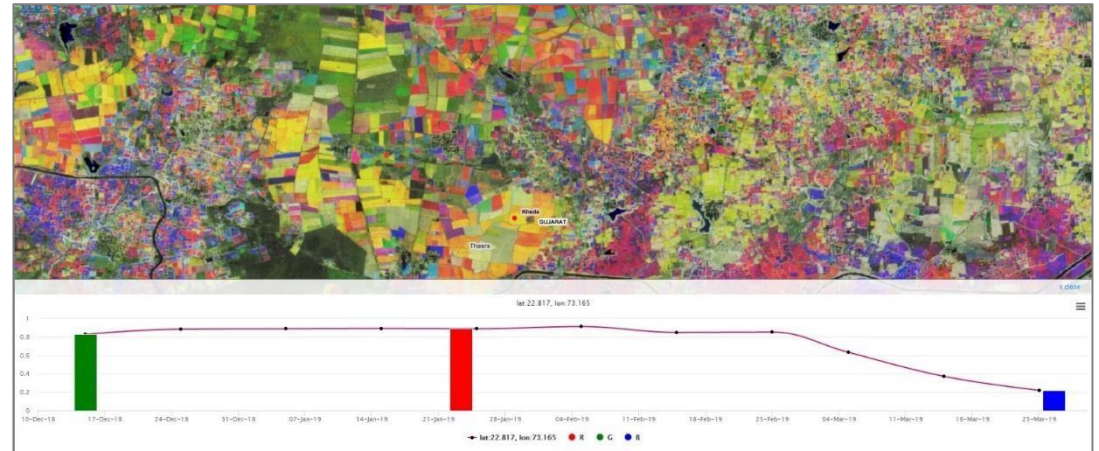
Time Series Data Analysis on Web on VEDAS



NDVI difference (Jan and March)

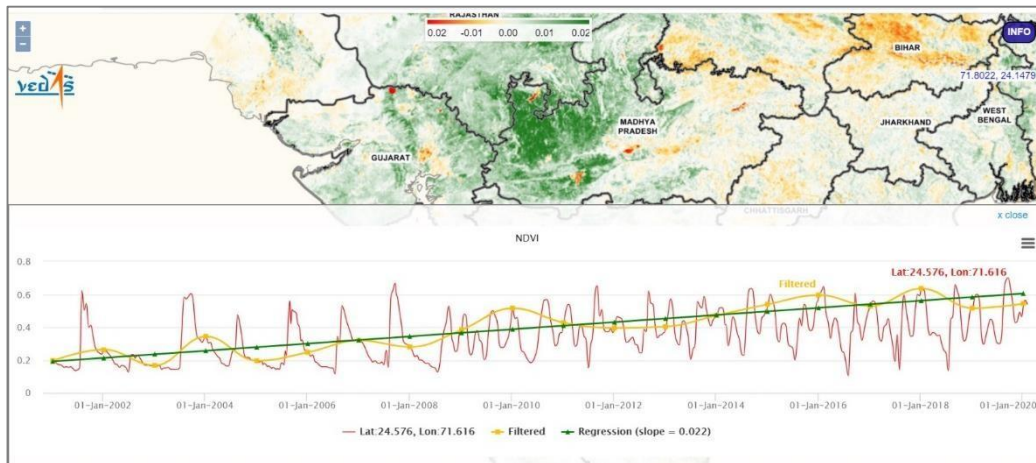


RGB composite of multi-temporal NDVI data



LISS-IV NDVI images of 23-Jan-2019, 23-Dec-2018, 23-Mar-2019

Long-term Trend Analysis of NDVI



Classification using multi-temporal NDVI data²⁰¹⁹



MOSDAC: Meteorology and Oceanography

Meteorological and Oceanographic Satellite Data Archival Centre (MOSDAC)

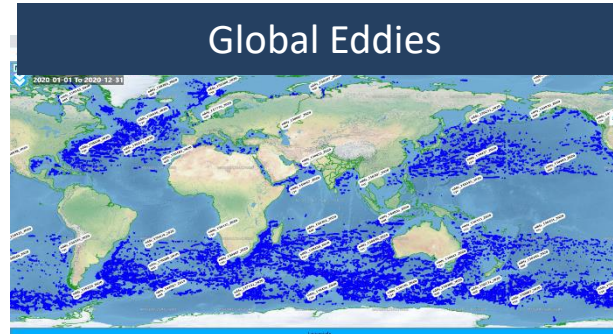


Jupiter based Interactive Computing Service (MOSAIC)



<https://mosdac.gov.in/s/>

Global Oceanic Eddies Detection and Tracking System



<https://mosdac.gov.in/eddy/>

Oil Spill Tracking over Global Ocean (Application for Oil spill Nowcasting)



<https://mosdac.gov.in/oilspill/>

Fish Catch over Indian Ocean (Application of EOS-06)



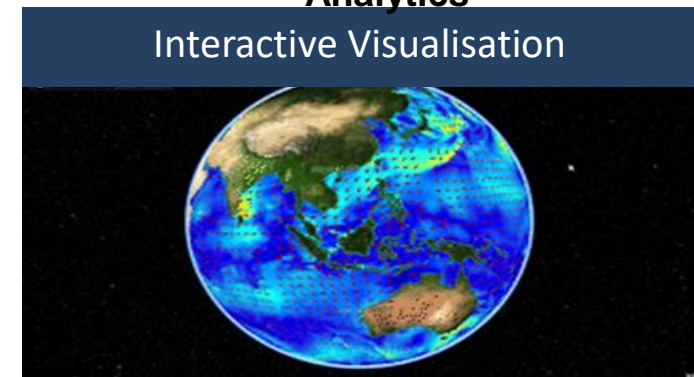
<https://mosdac.gov.in/pfz/>

Weather Alerts and Forewarning for South East Asian Countries



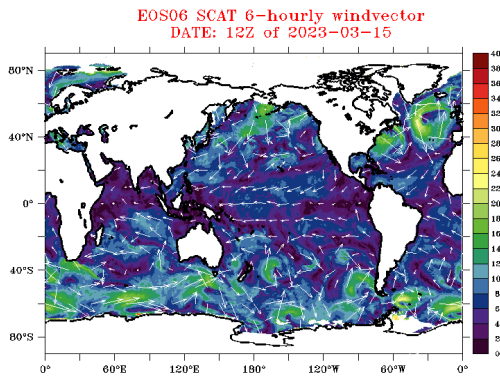
<https://mosdac.gov.in/afs/country>

Enhanced the Interactive Visualization Tool (LIVE) for Web Analytics

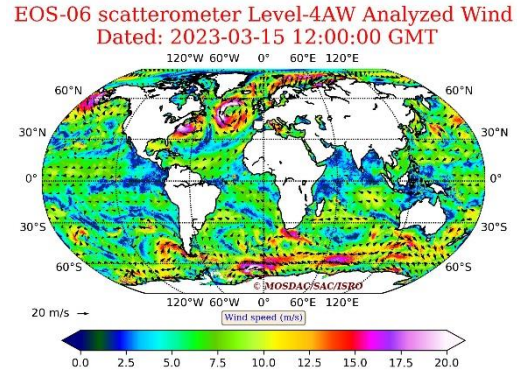


<https://mosdac.gov.in/live/>

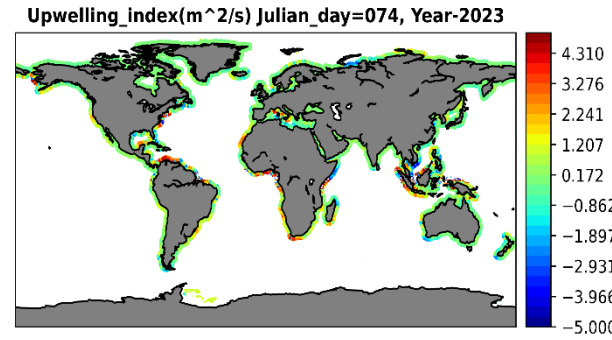
MOSDAC: E06 Science Products



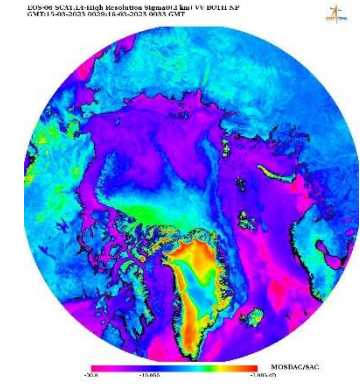
6-hourly Analysed Wind Vector



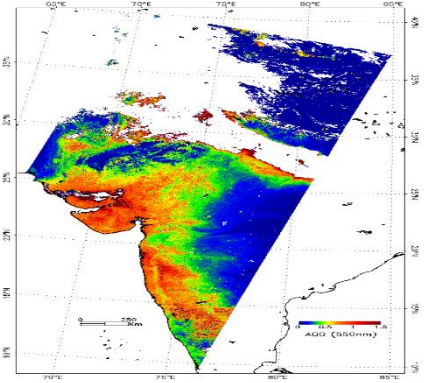
Daily Analysed Wind Vector



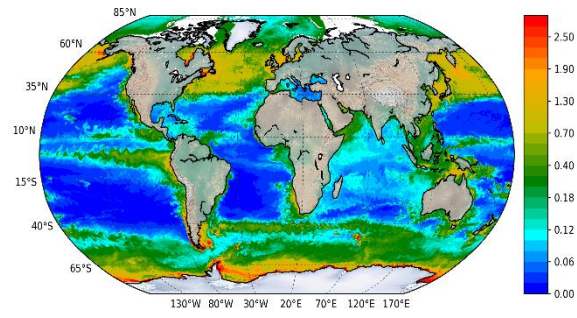
Upwelling Index near Coast



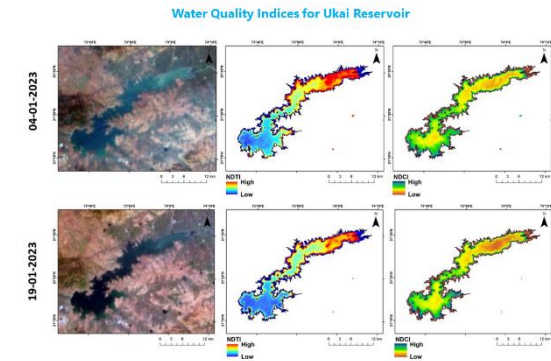
High resolution BT, Sigma-0, Gamma-0 over Land



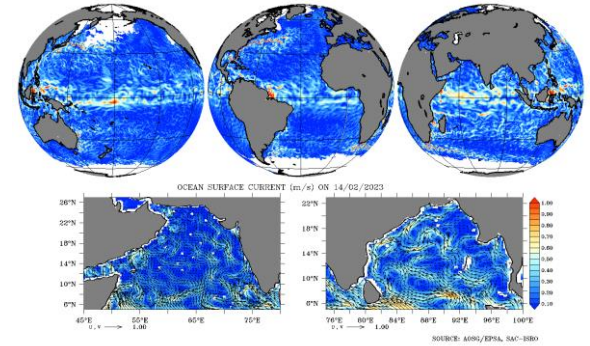
Aerosol Optical Depth over Land



Daily Analysed Chlorophyll



Inland Water Quality



Surface Ocean Currents

WMO Core Metadata Standards (ISO 19115:2003)

DOI for all Data Products



<https://mosdac.gov.in/mosaic>

❖ Interactive Services

- *Jupyterhub based services*
- *Integrated with MOSDAC Single-sign-on*

❖ Interactive Computing

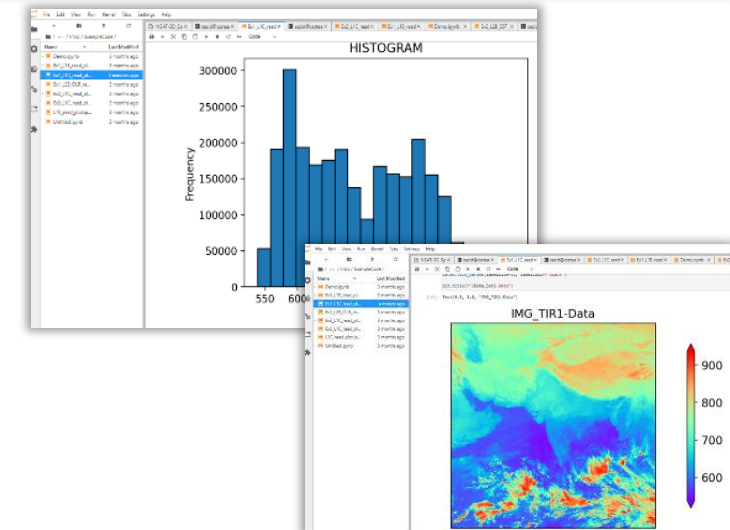
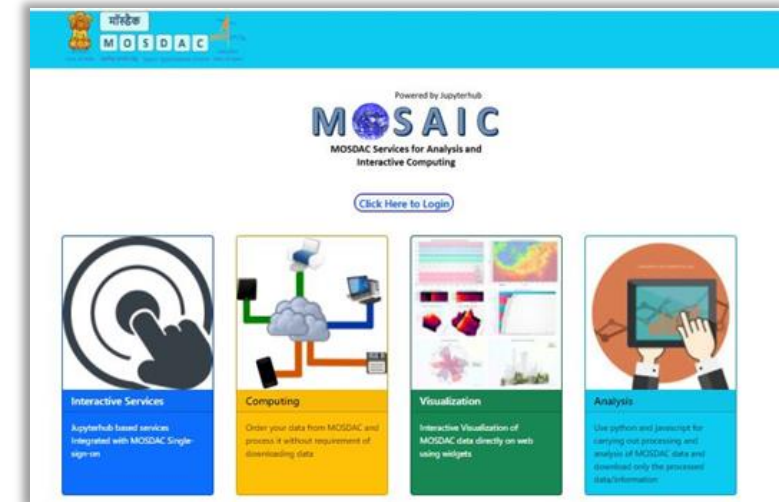
- *Order your data from MOSDAC and process it interactively using Notebooks without requirement of downloading data*

❖ Visualization

- *Interactive Visualization of MOSDAC data directly on web using widgets (ipywidgets, ipyleaflet, bqplot, pythreejs, ipyvolum, ngview)*

❖ Analysis

- *Use python for carrying out processing and analysis of MOSDAC data and download only the processed data/information*



NICES: Climate and Environment

Information and Products



Terrestrial Products (30)

Ocean Products (25)

Atmospheric Products (6)

Model Derived Products (9)

Essential Climate Variables (ECVs)

Terrestrial (5): Soil moisture, Land Use & Land Cover (LULC), Soil Carbon Density in India, Fire Regime for India, Snow Cover Fraction, Albedo

Ocean (5): Ocean Surface Winds, Ocean surface currents, Chlorophyll Concentration, Sea Surface Height Anomaly, Monthly mean sea level Anomaly

Atmosphere (3): Cloud Cover, Cloud Top Temperature, Lightning (cloud-to-ground)

- Satellite-retrieved geophysical product inventory (**70-products, including derived products**)
- Products from **National Satellites (24)**, **International satellites (15)** and Model outputs (9)
- User downloads: about **40,000 downloads per year**.

NICES: Ocean Surface Currents: merged product



29-year Ocean Surface Currents data from 1993 to 2022

Satellites used: Scatterometers (QuikSCAT, OSCAT, ASCAT, SCATSAT etc.) & Altimeters (T/P, JASON 1/2/3, SARAL AltiKa etc.) and merged NOAA AVHRR SST data

Period of data availability: 1993 - 2022

Resolution:

Spatial : 25 km x 25 km

Temporal: Daily

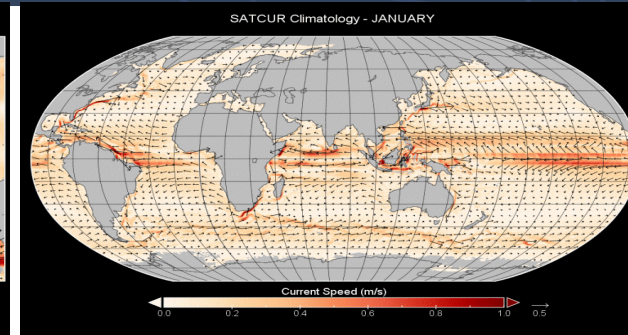
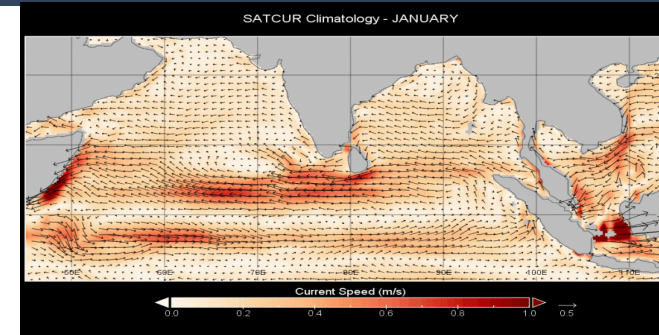


Figure: Monthly Climatology of Ocean Surface Currents (1993-2019) over Indian/Global Ocean

NRSC Lightning Detection Sensor Network (Host Locations)



Total Number of Stations: 46

Lightning: Cloud-to-Ground Lightning

Objectives:

- Establishment of a lightning detection sensor network to detect the phenomena
- Generation of **Essential Climate Variable (ECV)** & its impact on the atmospheric constituents.
- Identification of potential danger zones and vulnerable area
- Data dissemination: NICES web-portal

Thanks

saikalpana_t@nrsc.gov.in

Inputs from

National Remote Sensing Centre (NRSC)

Space Applications Centre (SAC)

ISRO Head Quarters