

Recent Developments in Information Systems and Earth Observation Services

Indian Space Research Organisation (ISRO)

Agency Report

Presented in **WGISS-53** March 22nd - 24th 2022



Geospatial Data and Services

<https://bhuvan.nrsc.gov.in>



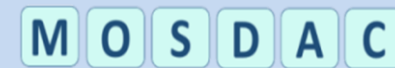
EO Data Hub

<https://bhoonidhi.nrsc.gov.in>



Geospatial Analysis

<https://vedas.sac.gov.in>



Meteorology and Oceanographic Satellite Data Archival Centre

<https://mosdac.gov.in>



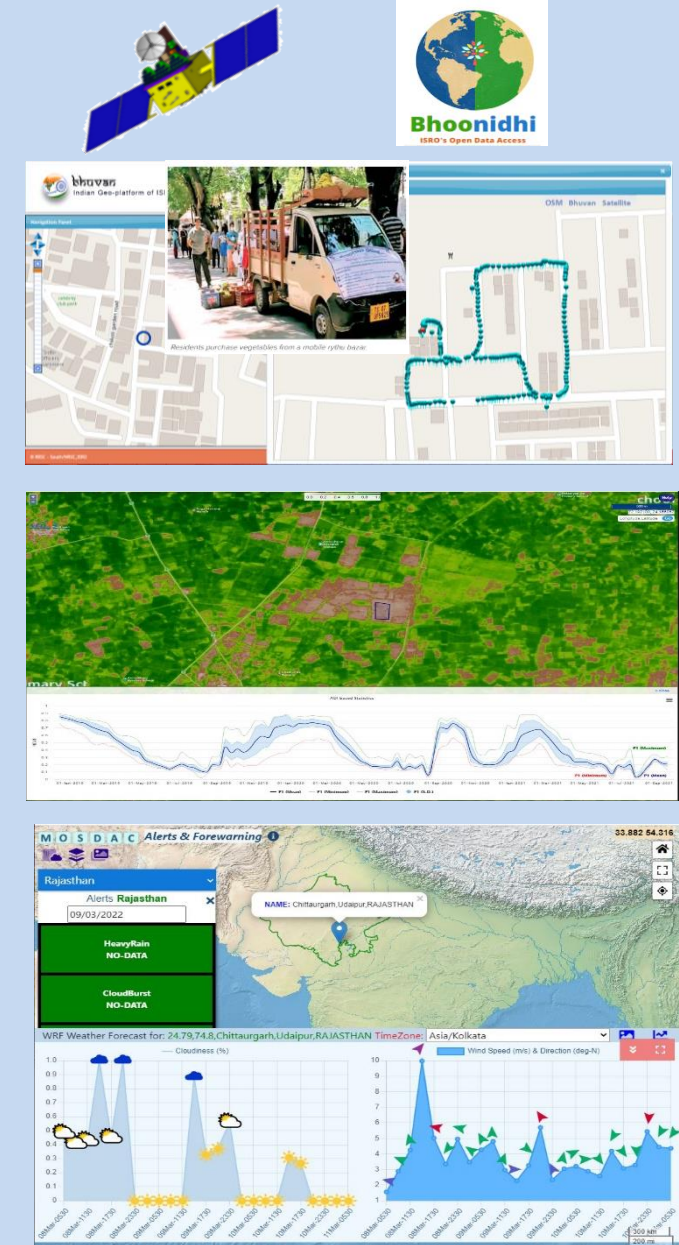
National Information System for Climate and Environment Studies

<https://nrsc.gov.in>

ISRO Agency Report : Summary Slide

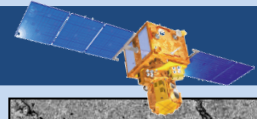
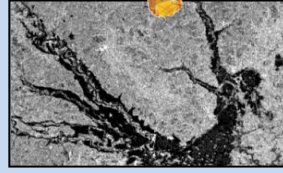
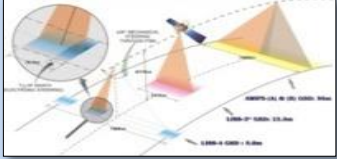


- **EOS-6, INSAT-3DS and NISAR** are Forthcoming Earth Observation missions
- **Bhoonidhi** : <https://bhoonidhi.nrsc.gov.in>
 - Regional Data Hub available for users to order and download data. Bhoonidhi Vista is data visualization and analysis tool available with Bhoonidhi for quick visualization of full resolution data
- **Bhuvan**: <https://bhuvan.nrsc.gov.in>
 - Following New Applications Released
 - **Bhuvan Lite** : Lite weight data visualization tool, **Bhuvan Wiki** : Knowledge Sharing Platform, **Bhuvan Yuktdhara** : Regional Level Planning Tool, **Bhuvan** : National Hydrology Project
- **VEDAS**: <https://vedas.sac.gov.in>
 - Enhancing Geo-Spatial Analysis
 - AI based Time series forecast of NDVI, Field level crop monitoring , Monitoring of Reservoirs/Inland water bodies, Web enabled Long term data analysis
- **MOSDAC**: <https://mosdac.gov.in>
 - Ocean-Eye, SCORPIO, Netra and Safe Beach are new applications released on MOSDAC
 - Alert and Forewarning services, now available for Indian States and South East Asian Countries.
 - Working on Ocean and Weather Data Cubes
 - Weather and Ocean Data Analytics
- **National Information system for Climate and Environment Studies (NICES)**: <https://nrsc.gov.in>
 - Data available for download from Bhuvan
 - Satellite-retrieved geophysical product inventory (70-products, including derived products)
 - Products from National Satellites (24), International satellites (15) and Model outputs (9)
 - Atmospheric Lightning ECV – using ground-based Detection Sensor Network



Indian Earth Observation System : In-Orbit Satellites

RESOURCESAT- 2 & 2A, EOS-04



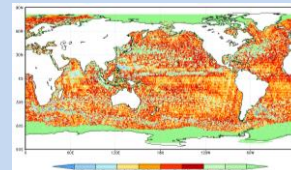
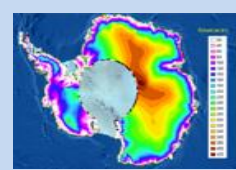
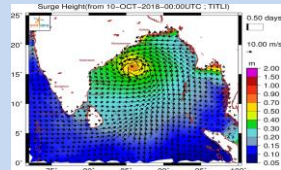
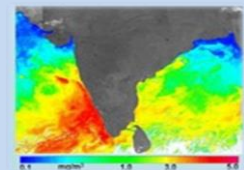
- Three tier imaging : 56 m / 23 m / 5.8 m
- Revisit Capability : 03 / 11 / 03 days
- C-Band SAR (3-50m resolution) / 17 to 24 days repeativity

CARTOSAT-2E & CARTOSAT-3



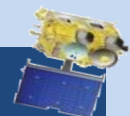
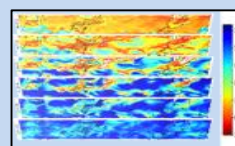
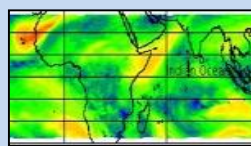
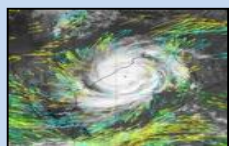
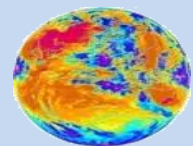
- 60 cm PAN & 1.5 m Multi-spectral
- 28 cm PAN & 1 m Multi-spectral

SARAL



- Ocean Altimeter

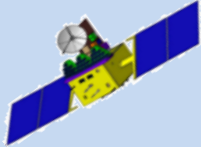
INSAT-3D & 3DR



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

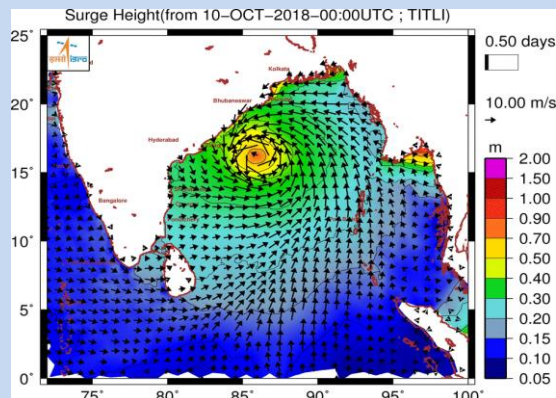
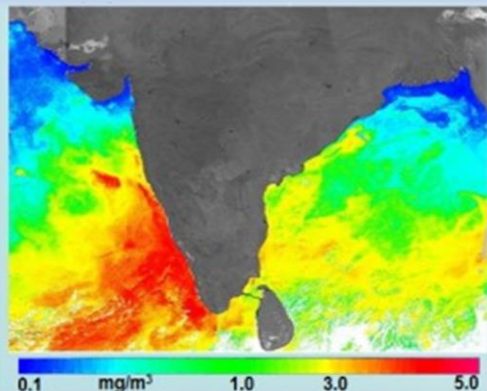
Indian Earth Observation System : **Forthcoming Missions**

EOS-6



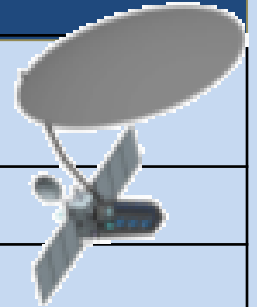
Ocean Color, SST & Winds

Orbit	Sun synchronous
ECT	12:00 Hrs
Payloads	OCM (13 bands: 407 to 1020 nm) : 360 m Scatterometer-3 (Ku Band - 13.51GHz) SSTM-1 (2 Bands: 11 & 12 μ m) : 1080 m



NISAR

Frequency	L-band 1.26 GHz S-band 3.2 GHz
Swath	Up to 200 km
Incidence Angles	~ 34 - 48 degrees
Resolution	3 to 10m
Repetivity	30 days
Orbit	747 km ; ECT: 6:00 Hrs



INSAT-3DS



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)

Bhoonidhi :Regional Hub for Satellite Data Dissemination



BHOONIDHI

We enable access to our extensive archive of Remote Sensing data from 44 satellites, including Indian and Foreign Remote Sensing sensors acquired over 31 years. We also facilitate the Regional distribution of Sentinel and Landsat-8 data in India.

- *Data repository from ISRO Indian & Non-Indian Remote sensing satellites*
- *Regional Hub for Sentinel and Landsat and NovaSAR*



Bhoonidhi Browse & Order

Search, View and Download/Order open/priced data of various IRS missions, Landsat-8, Sentinel 1&2 and NovaSAR

<https://bhoonidhi.nrsc.gov.in>



Bhoonidhi Vista

Visualize the daily acquired data and temporal cycle based mosaic

<https://bhoonidhi.nrsc.gov.in/vista/index.html>

- ✓ Single-window quick-look catalogue for ISRO's EO data archive
- ✓ User friendly options to ease target area identification combination of multiple satellite/sensor , Event based, Natural language text based search options.
- ✓ Seamless ordering and dissemination of Open & Commercial satellite data products.
- ✓ Serves as a regional data hub for the Sentinel data products (*< 1.30 hour data on-boarding time for all Sentinel datasets*)

Open Data/Commercial data @Bhoonidhi (Indian)

Cartosat

Resourcesat

Oceansat-2

Scatsat-1

IRS

Open Data @Bhoonidhi(Other Agencies)

SENTINEL 1A, 1B (GRD)

SENTINEL 2A, 2B (level 1C, 2A)

NOVASAR (AIS data)

LANDSAT 8

OS2 - OCM GAC, SCAT

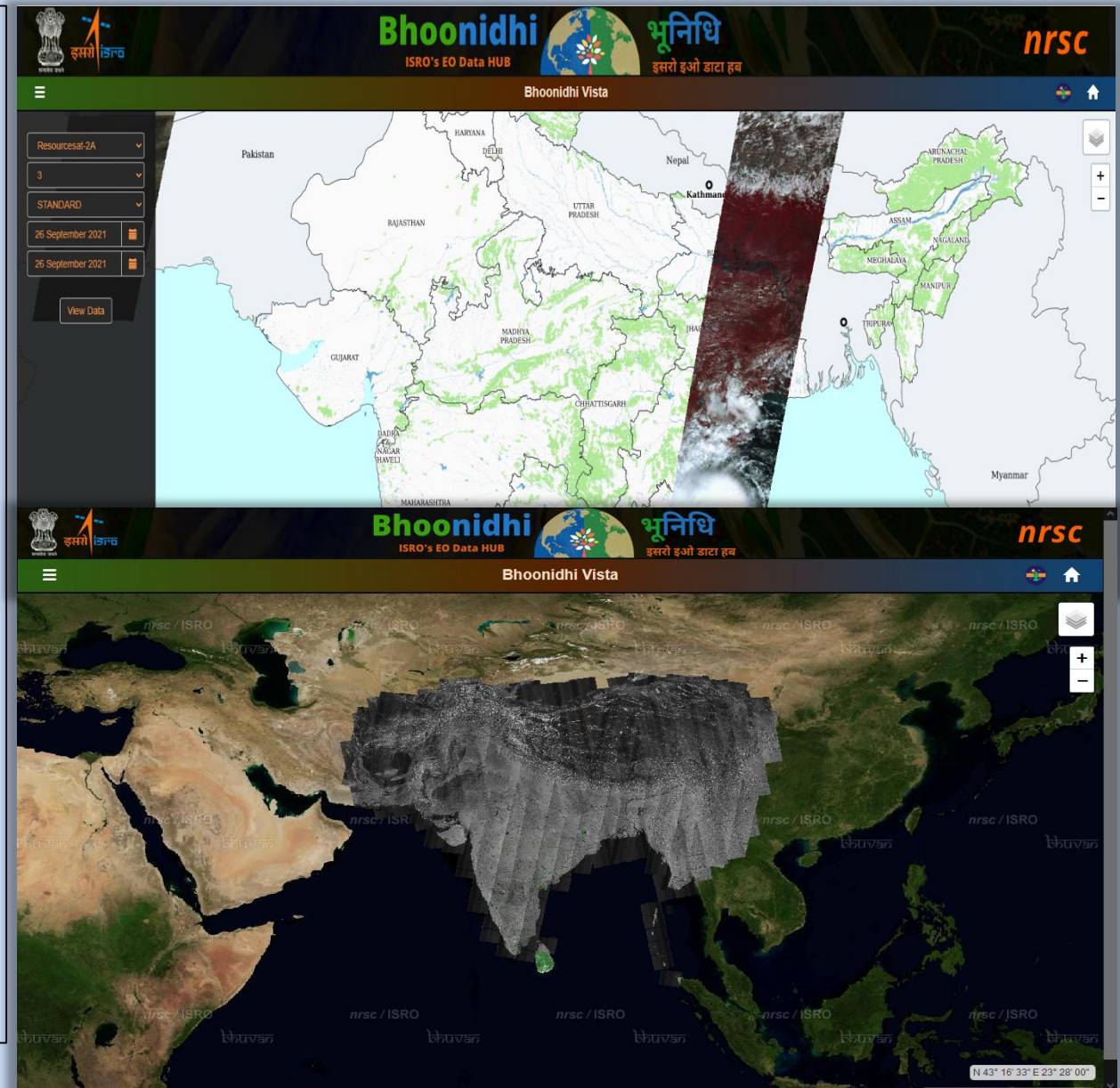
Bhoonidhi Vista: Visualization and Analysis

Data Visualization service at Bhoonidhi providing full resolution data visualization capability through WMS (Web Map Service)

- Multi Mission- Multi Sensor support
- Visualize as and when available
- Multiple Visualization Options (Day-wise and between dates)
- Bhoonidhi-VISTA Time Lapse animation

Mission/Sensors supported :

- ✓ Sentinel 1A(SAR)
- ✓ Sentinel 2A/2B(MSI)
- ✓ Resourcesat-2(AWIFS/LISS-3/L4MX)
- ✓ Resourcesat-2A(AWIFS/ LISS-3/L4MX)

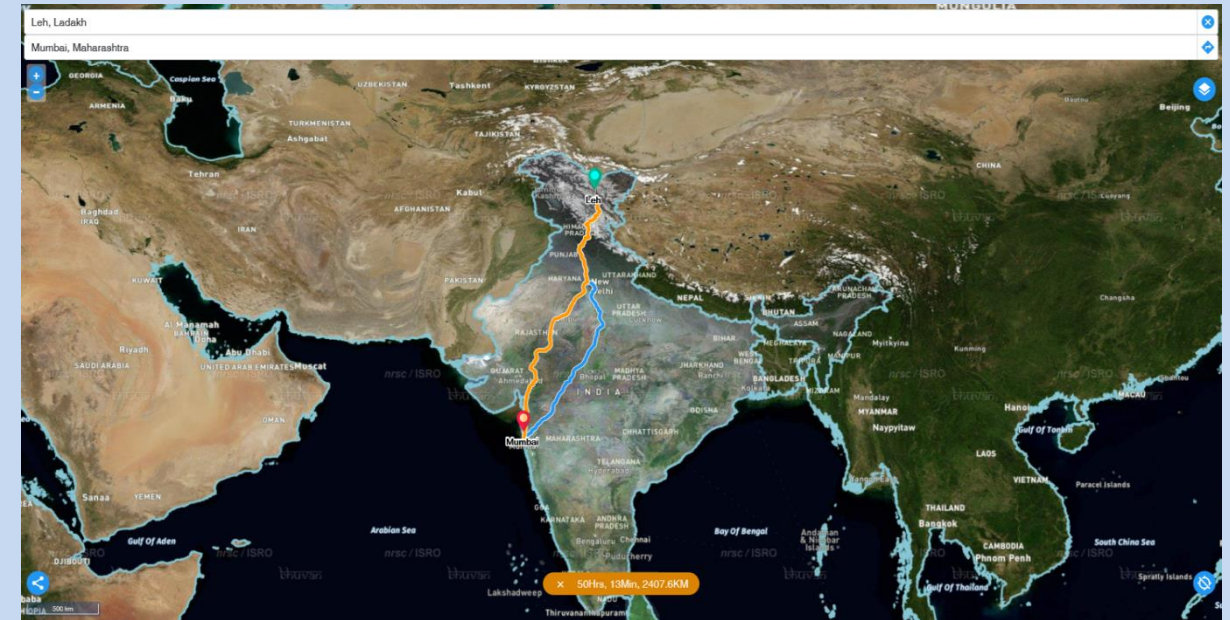


Bhuvan : Geo-Spatial Data and Services



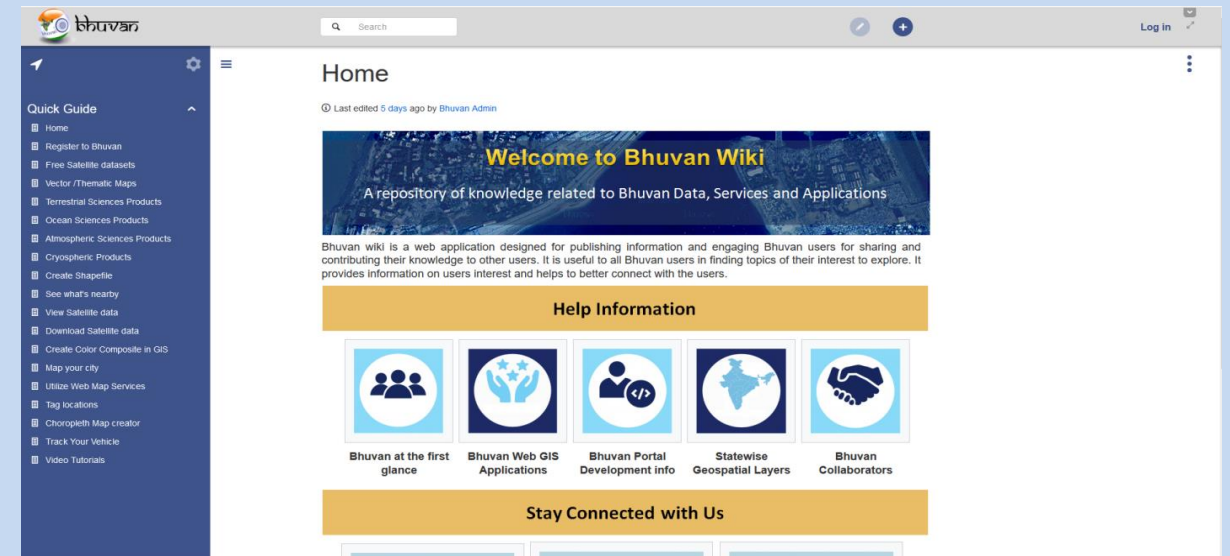
Bhuvan Lite : Lite Weight EO Data Visualization Tool

- Progressive Web Application along with device level caching and push notifications.
- Platform independent application with the motto of "Utility with Simplicity".
- Works well with Android as well as iOS mobile users.
- Faster and lighter version for public with improved search, satellite image and base map.
- Provides distance & directions and facilitates sharing.
- Location permission will also enable use of tracking mode facility on GPS enabled devices.



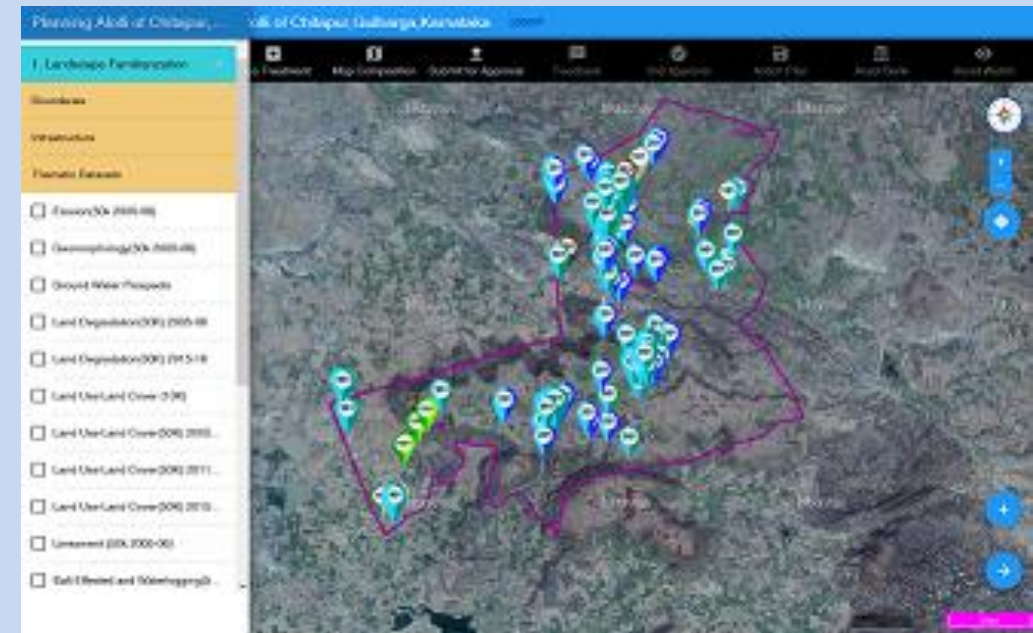
Bhuvan Wiki : Knowledge Sharing Platform

- Web application designed for publishing information and engaging Bhuvan users for sharing and contributing their knowledge to other users.
- Useful to all Bhuvan users in finding topics of their interest to explore.
- Provides information on users interest and helps to better connect with the users.



Bhuvan Yuktdhara : Regional Level Planning Tool

- Geospatial planning portal for gram-panchayat level planning of MGNREGA activities across India.
- Integrates a wide variety of spatial datasets to enable a holistic approach towards planning using open source GIS tools



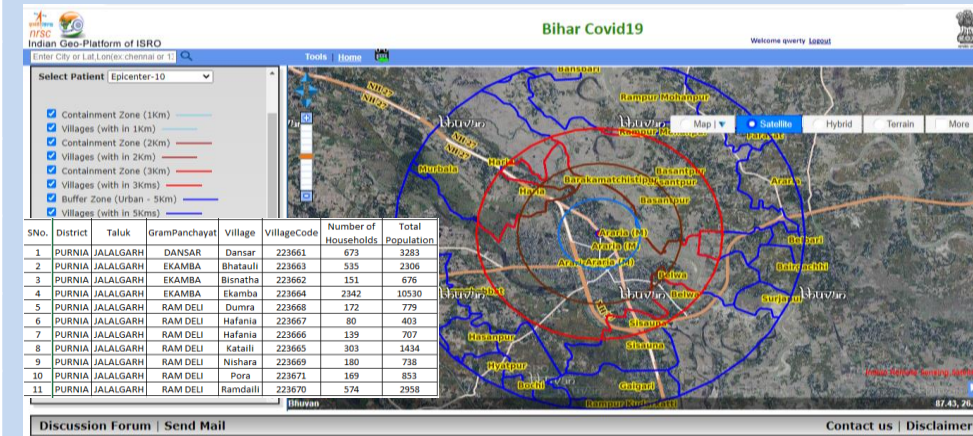
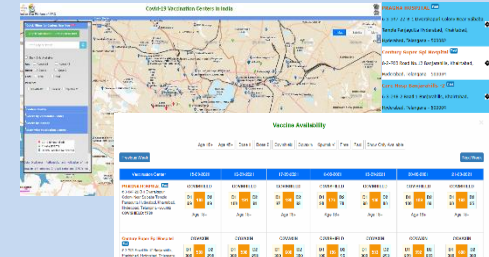
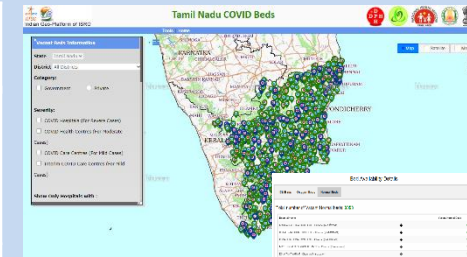
Bhuvan : National Hydrology Project

- Hosts various geospatial hydro products generated under NRSC NHP studies
- Functionalities for visualisation, query and download of the products.
- The various sub-modules are [Flood Early Warning](#), [Evapotranspiration](#), [Glacial Lakes](#), [Snowmelt Runoff](#), [Hydrological Modelling](#), [Irrigation Management](#), [Hydrological Drought](#).

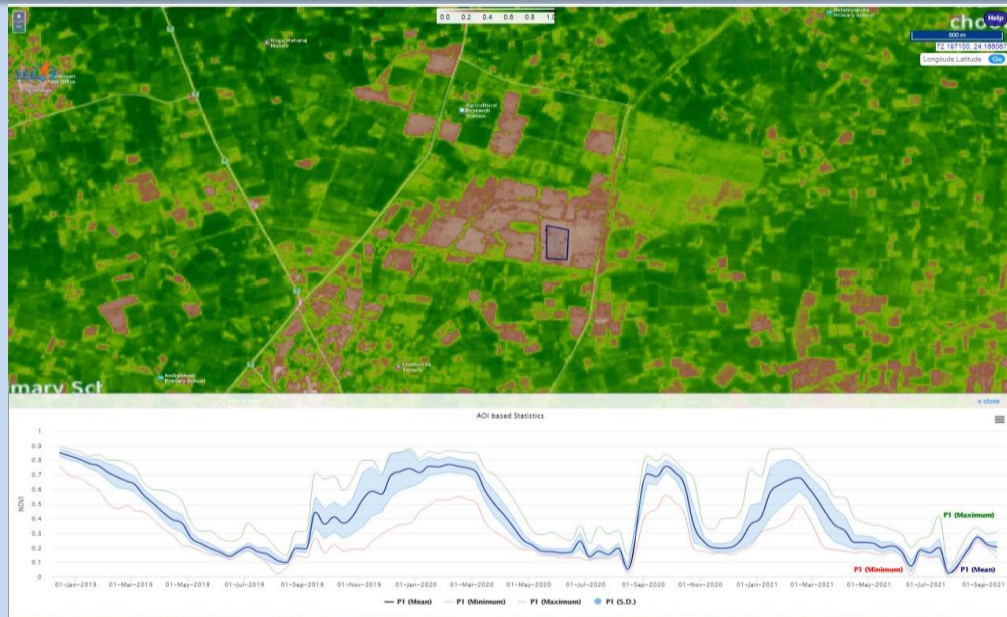
Bhuvan : Support during COVID-19



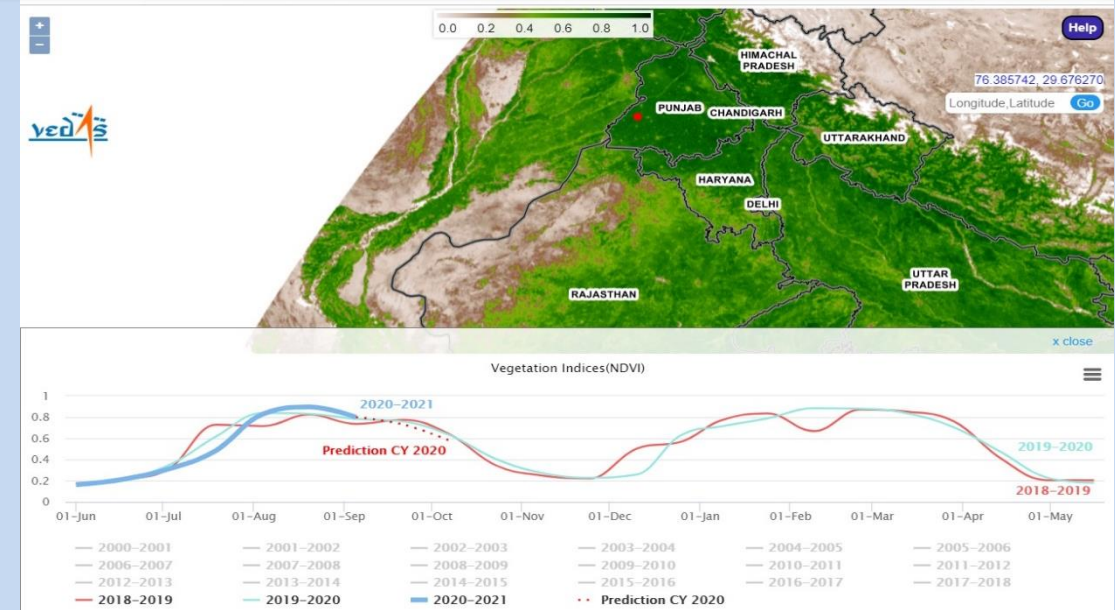
Projects	Users
COVID 19 Dashboard	Ministry of Health and Family Welfare
COVID-19 Containment strategy	Bihar Health Department
Mobile Rythu Bazar Tracking for Department of Agriculture	Govt of Telangana
Home Quarantine Tracker - Narayanpet Dist Collectorate	Govt of Telangana
Citizen Reporting & Officer Reporting for Department of Health	Govt of Telangana
Monal 2020 : Patient Geolocation & Contact Tracing	ECIL
Annapurna Meal Centers, GHMC	Govt of Telangana
Amma Unavagam, Greater Chennai Corporation	Govt of Tamil Nadu
Patient geolocation & Tracing (112+ India)	CDAC
Vaccination Centres	PMO
Tamil Nadu COVID Beds	Department of Public Health, Tamil Nadu



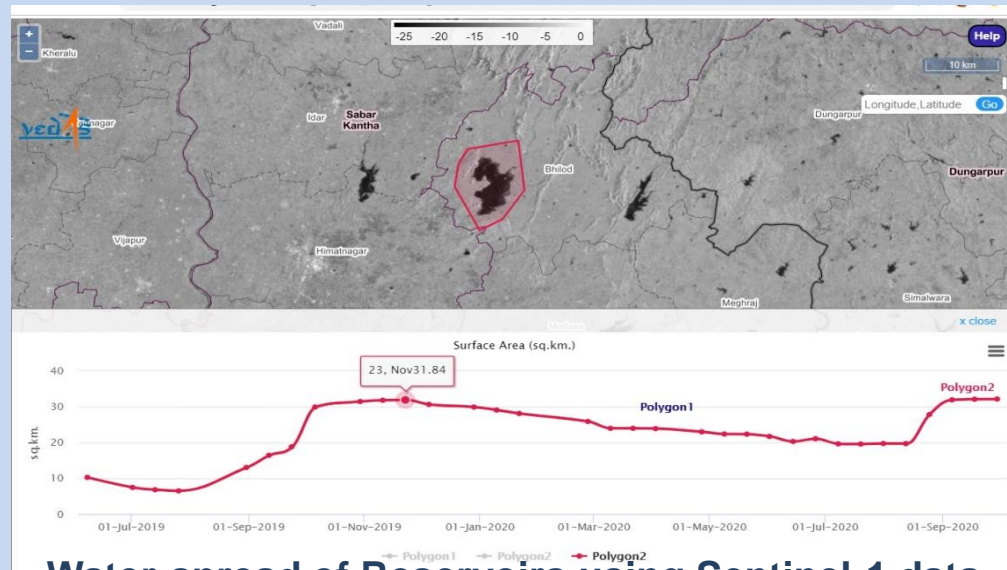
VEDAS : Geo-Spatial Analysis



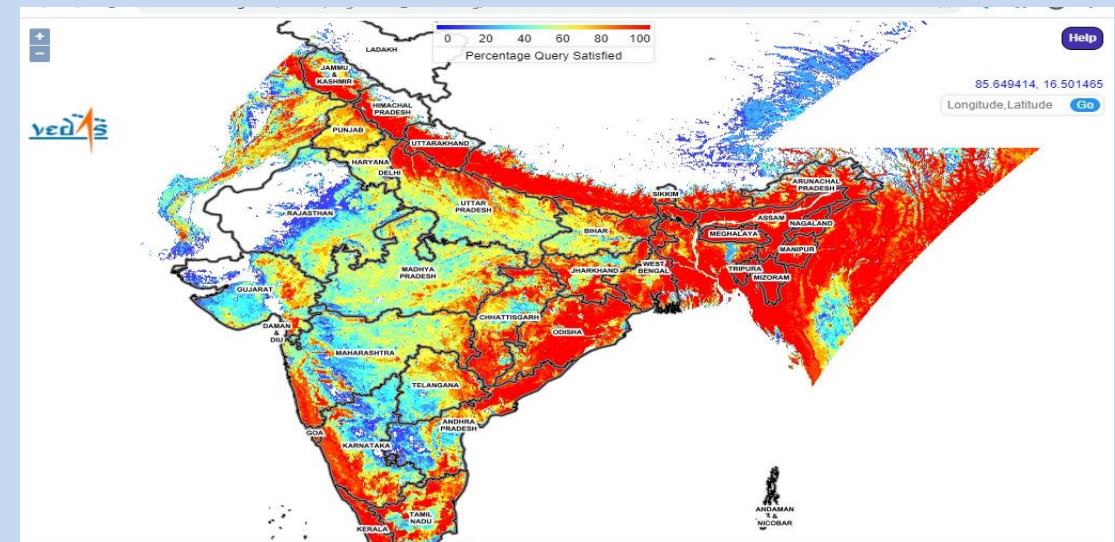
Field level crop monitoring and analysis using Sentinel-2 data



AI based NDVI Time series Forecasting using LSTM (RNN)

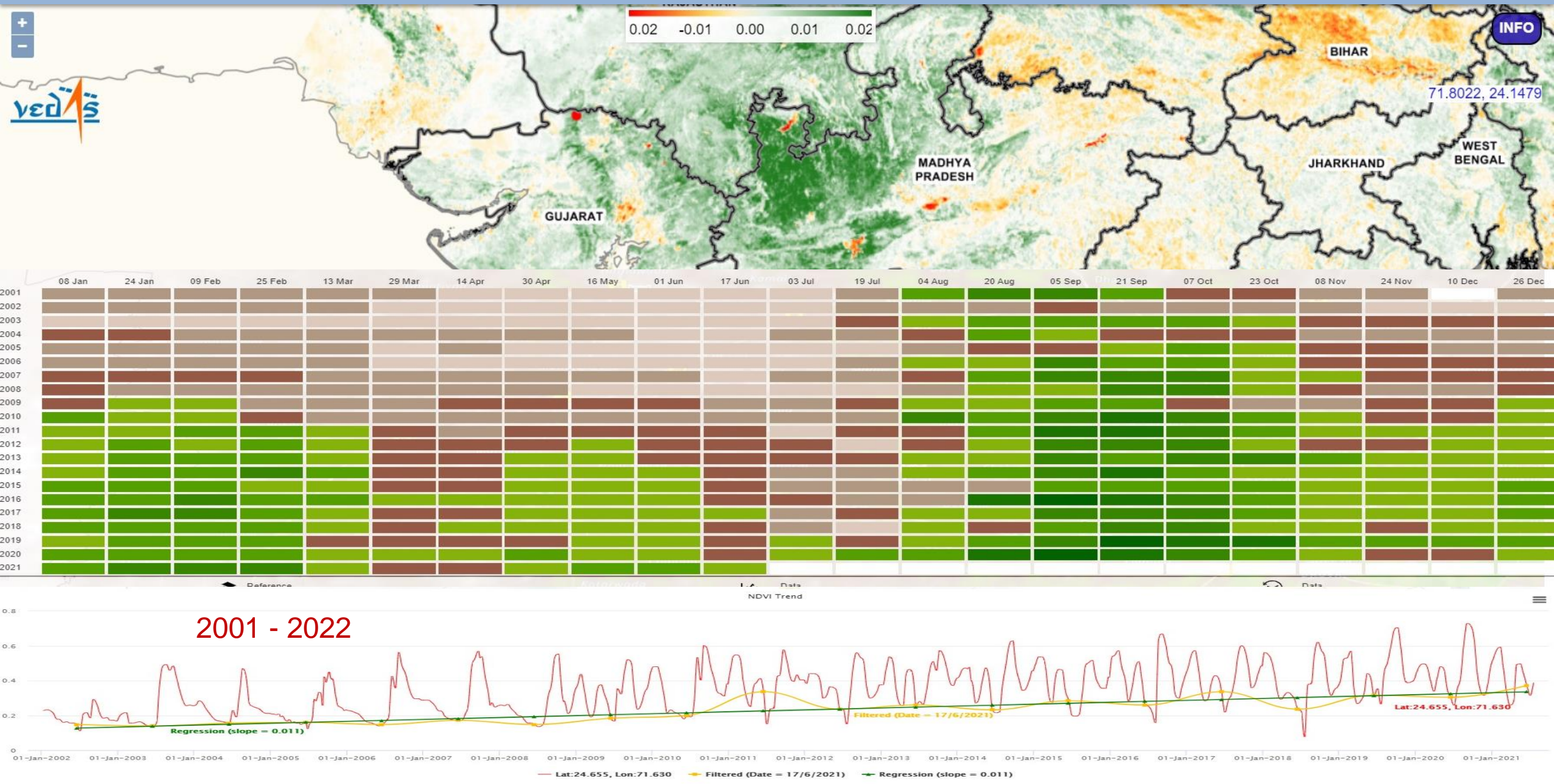


Water-spread of Reservoirs using Sentinel-1 data



1 June 2019 – 31 May 2020 0.4 < NDVI < 1.0

VEDAS :Long term Trend Analysis



VEDAS :Geo-Spatial Calculator

← → ↺ vedas.sac.gov.in/vstatic/geocalc/index.html ☆ 🌐 👤 ⋮

Expression Builder x Close

Expression Type: **Maximum** (dropdown)
Dataset: NDVI - 15 (dropdown)
Search:

Multiple Image Operators

- Minimum
- Maximum** (selected)
- Mean
- Sum
- Standard Deviation

Two Image Operators

- Add (A+B)
- Subtract (A-B)
- Multiply (A*B)
- Divide (A/B)

Single Image Operators

- Individual Image
- Image Thresholding
- Add Constant
- Subtract Constant
- Multiply by Constant
- Divide by constant

2019-DEC-08 2020-FEB-08 2020-APR-08 2020-JUN-08 2020-AUG-08

2020-JAN-08 2020-MAR-08 2020-MAY-08 2020-JUL-08 2020-SEP-08

2020-JAN-22 2020-MAR-22 2020-MAY-22 2020-JUL-22 2020-SEP-22

Palette: White to G
Pallete Values:
Expression2 Add to Map

Expression list (-) ☒ Expression1

vedas Geospatial Calculator Reference Layers Data Analysis

Indian Store-house for Meteorological and Oceanographic Data

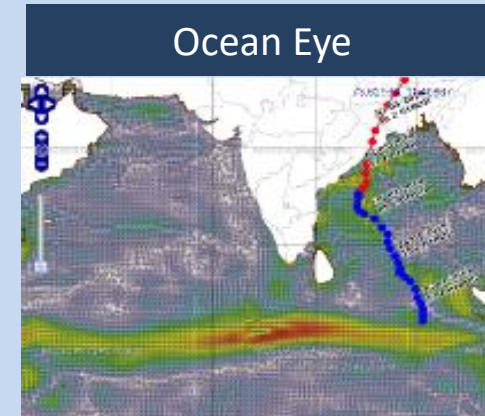
- 8 Indian Satellite, 194 Products and 23 applications (INSAT-3D/3DR, SCATSAT-1, Megha-Tropiques, SARAL, Kalpana-1, INSAT-3A, Oceansat-2)
- GISAT, Oceansat-3 and INSAT-3S planned
- Total of **13 million** products disseminated to **139 countries**
- Weather and Ocean State Forecast

Major Applications

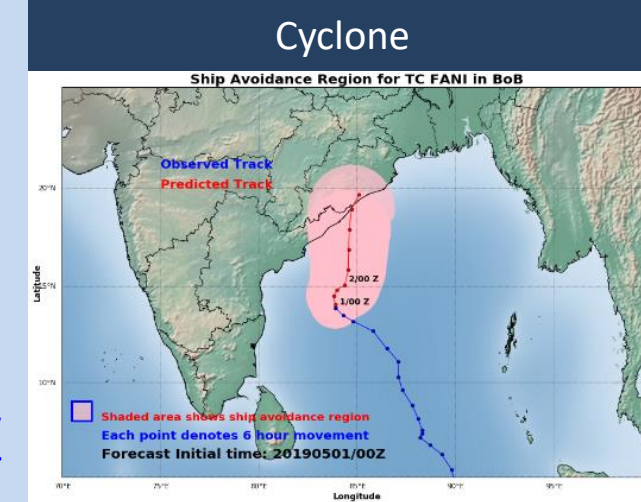
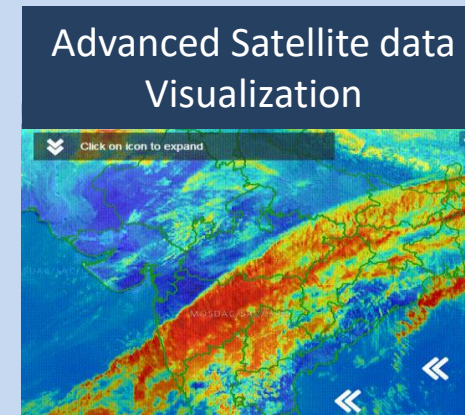
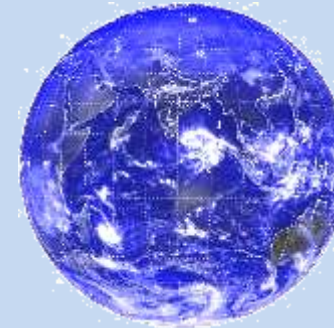
- Automated Ocean Forecast to ships (**Ocean-Eye**)
- Cyclone Track and Intensity forecasting (**SCORPIO**)
- Nowcasting of Heavy rain and Cloud burst (**Netra**)
- Rip current forecast for 175 beaches(**Safe Beach**)
- Heat/Cold wave alerts

Data Analytics and Visualization

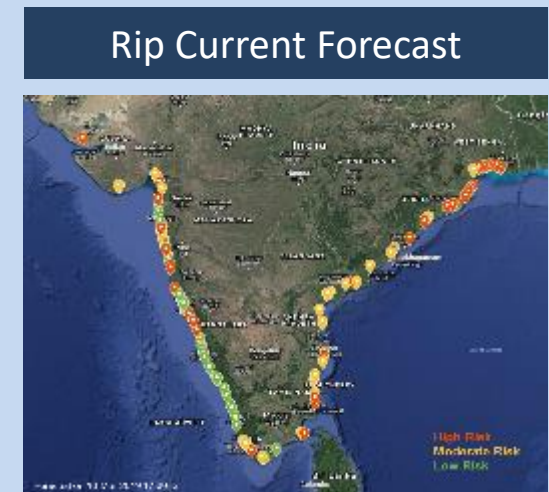
- An Integrated data visualization system for Earth Observation, In-situ data & Forecast Information (<https://mosdac.gov.in/live>)



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

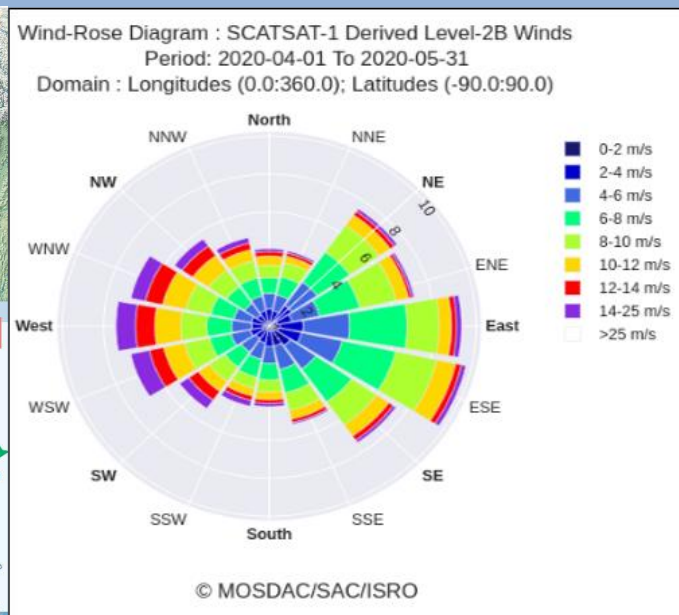
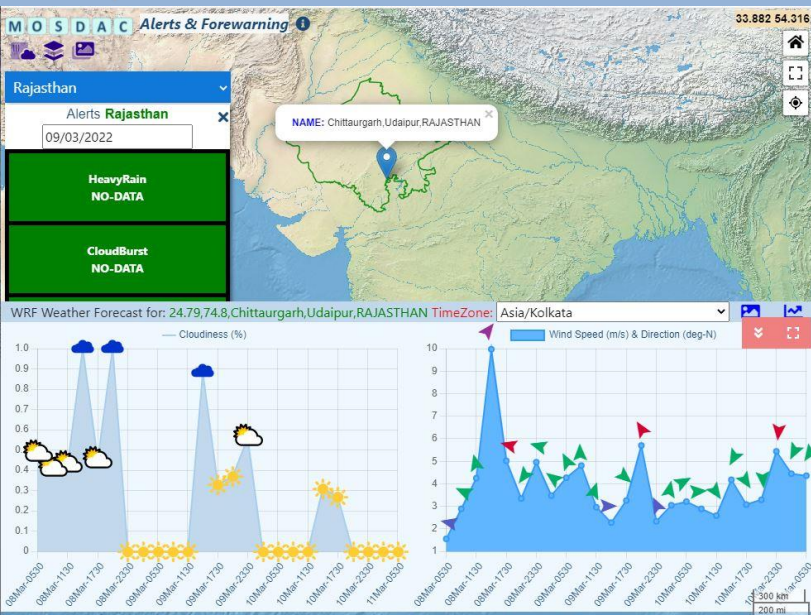


<https://mosdac.gov.in/scorpio>



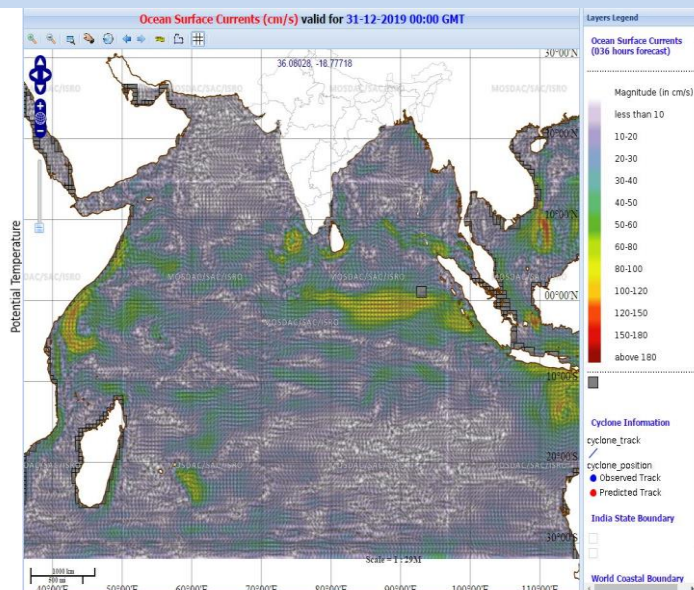
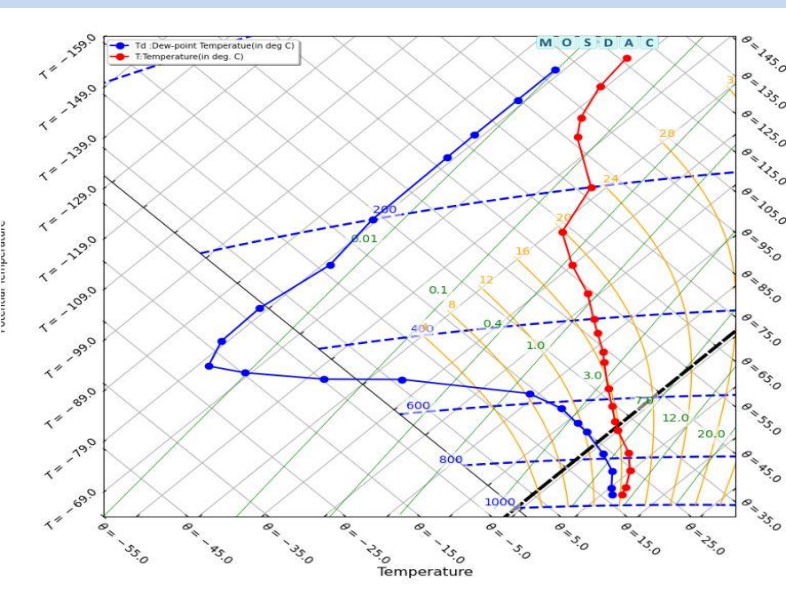
https://mosdac.gov.in/rip_current_forecast

Data Analytics for Weather/Ocean Monitoring



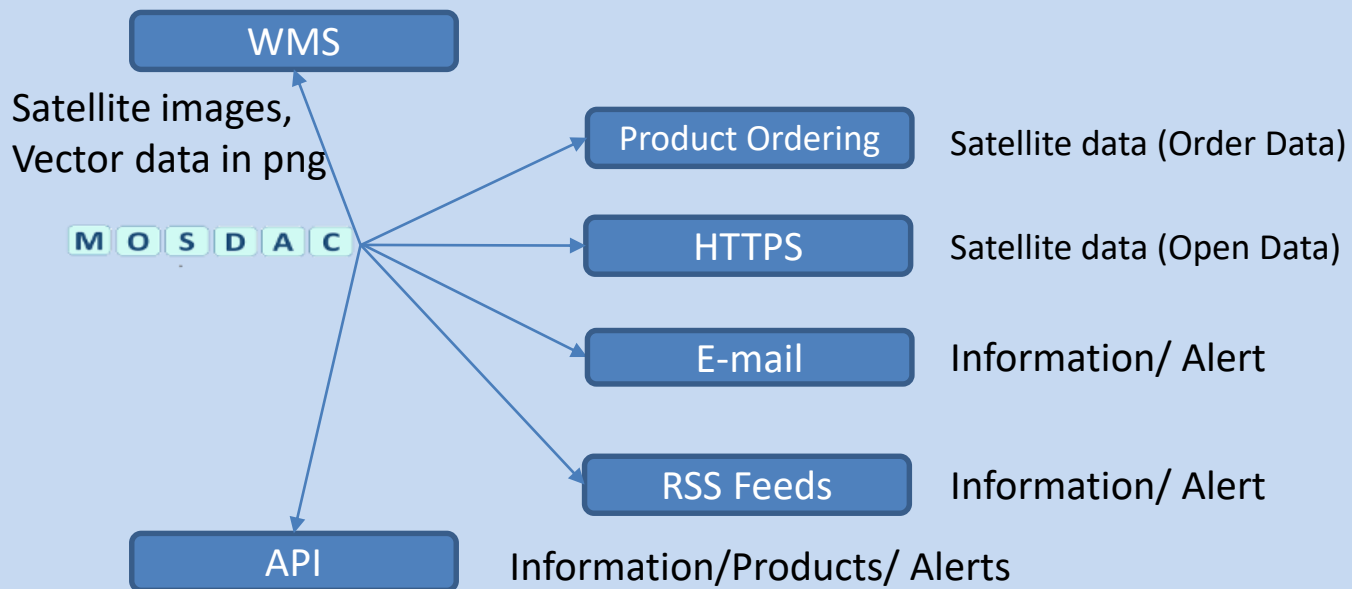
Data Analytics for Weather/Ocean Monitoring

- Alert and Forewarning Services
- Scalable on-line analytics with enhanced decision making capability
- Automated data mining from data
- Data Cube
 - Weather Data Cube
 - Ocean Data Cube



M O S D A C

Weather & Ocean Data Exchange



API Based Data Access

- Extreme Weather Event Alerts: Nowcast Cloudburst, Heavyrain and cyclone
- Solar and Wind Forecast: 15 minutes WRF forecast
- Weather: 3 Hourly WRF based weather forecast
- Data Services:
 - AWS time series
- Opensearch: MOSDAC Metadata searching capabilities
- Rip current forecast: 6 Hourly forecast for next 6 days.

Service	Metadata
WMS	Self Describing, Get-Capabilities response returns a defined XML document providing information about the services
Product Ordering	Order and Download Archived Products using catalogue/enhanced catalogues services. Capability to put Standing Order for NRT data access
HTTPS	Https based access to Open Data
E-mail	User can subscribe to e-mail based dissemination of information/alerts (Currently this service is available only to authorized users)
RSS-Feeds	Access to Image chips and alert information using RSS feeds
API	API based data access using API gateway

National Information system for Climate and Environment Studies (NICES)



Terrestrial Products


Ocean Products

Atmospheric Products


Model Derived
Products


Cryosphere Products

<http://bhuvan.nrsc.gov.in/data/download/index.php>

 **Gateways to Indian Earth Observation**

Welcome User [Login](#)


National Remote Sensing Centre 


Open Data Archive Enter City or Lat,Lon(ex:chennai) 


[FAQ](#) [Policy](#) [Disclaimer](#) [Feedback](#)


NRSC/ISRO Open data and product archive facilitates the user to select, browse and download data from this portal

Select Category : ☐ Satellite/Sensor ☐ Theme/Products ☒ Program/Projects

Select Project : National Information System for Clim 

Select Group : Atmospheric and Climate Sciences 

Select Product : 



KILOMETERS 0 200 400

National Information system for Climate and Environment Studies (NICES)

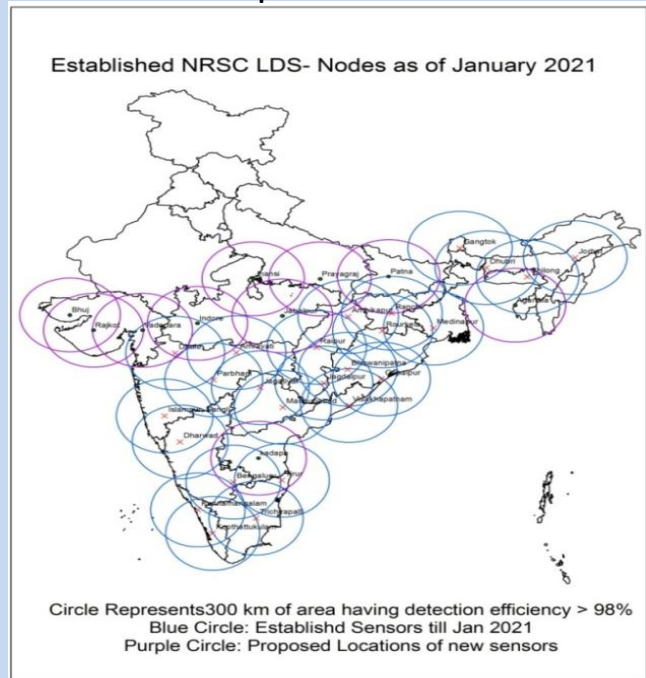


- Satellite-retrieved geophysical product inventory (**70-products, including derived products**)
- Products from **National Satellites (24)**, **International satellites (15)** and Model outputs (9)
- User downloads: about **40,000 downloads per year**.
- **NICES: 15** products have the potential to become ECVs (**28 of 54** ECVs are amenable through satellites).

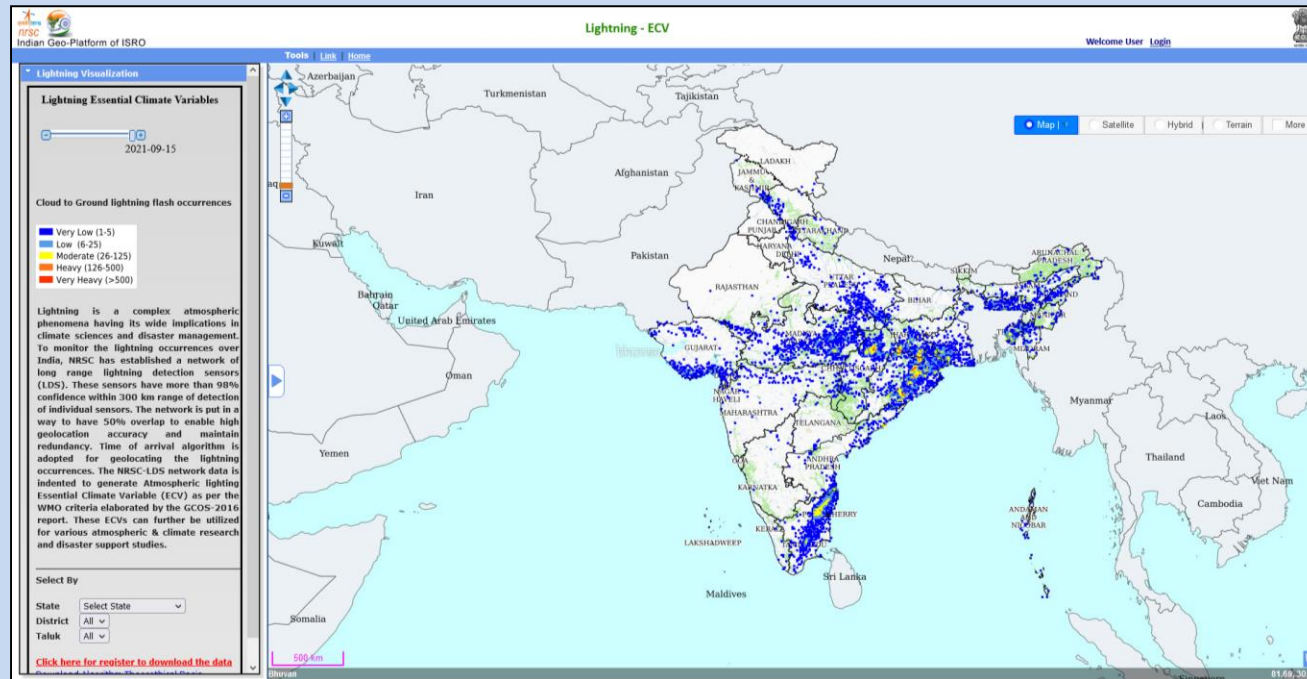
Time span (products)	NICES Geophysical products
20 - 30 years (4)	Ocean Heat Content, Ocean Mean Temperature, Tropical Cyclone Heat Potential, Eddy Kinetic Energy
15 - 20 years (4)	Surface Soil Moisture, Forest Fire, Snow Melt and Freeze, Mean Sea Level Anomaly
10 - 15 years (7)	Chlorophyll, Kd ₄₉₀ , LULC, Land degradation, Tropospheric Ozone, Net sown area (Agriculture), Cloud Cover and Cloud Fraction
5 - 10 years (15)	Albedo, NDVI, Vegetation Fraction, Surface Water Body Fraction, Snow Cover Fraction, Himalaya Glaciers, Snow Albedo, Model-TCHP, Model-D26, Ocean Surface Currents, Total Alkalinity, Dissolved Inorganic Carbon, Planetary Boundary layer Height, Ocean Surface Winds, Wind Stress, Wind Curl, Sea Level Pressure.

National Information system for Climate and Environment Studies (NICES)

58 units are required for 98% confidence



Lightning ECV for Climate Research



NRSC-LDS ECV map/data link: <https://bhuvan-app1.nrsc.gov.in/lightning>

Challenges in Lightning Studies:

- Nationwide monitoring with equal statistical weight and significance,
- Building a quality database of Lightning ECV for Climate Research,
- Identification of Vulnerable Zones and inter-annual variability,
- Investigate the Lightning impact on Chemistry & Dynamics,
Atmospheric Nitrogen fixation problem,
Dynamical impact and GPS Navigation problem,.
- Ingesting the LDS data into NWP models for better Lightning now-casting.



Thank you

<https://www.isro.gov.in>