



# Space based products for water resources management

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**Water resources management is the activity of planning ,developing , distributing and managing the optimum use of water resources.**

**An aspect of water cycle management**

**Incorporate earth observations into water resource management**

**Components of water cycle:**

1. Precipitation
2. Runoff
3. Evapotranspiration
4. Condensation
5. Infiltration
6. Percolation

**Is it possible to retrieve these components from satellite observation directly or indirectly ??**

## Useful for water resources management and hydrological model input

### Direct measurement

1. Rain
2. Soil Moisture
3. Snow and ice
4. Temperature
5. Humidity
6. Winds
7. Surface Radiation

### Indirect measurement

1. Ground Water
2. Vegetation index
3. Evapotranspiration
4. Runoff

From satellite as well as land surface models

# Application of space science in Water Recourses Domain

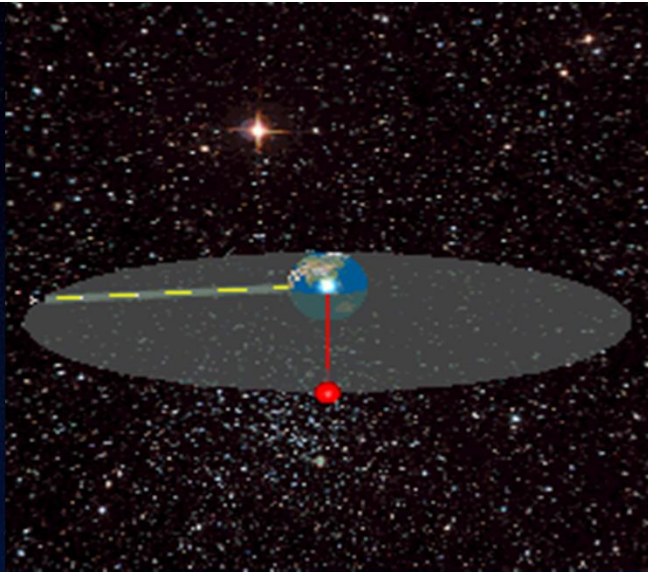
**Earth Observations  
for water resources  
management**

**Climate & Environment**



**Disaster Management Support Programme**

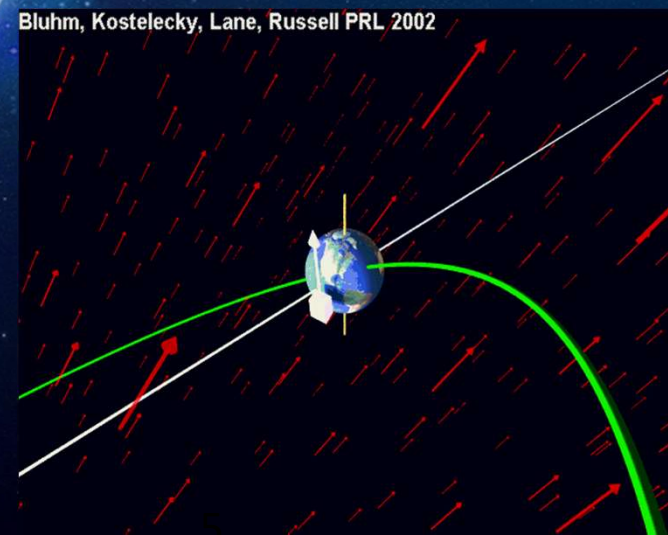
2/5/2021



← Geosynchronous orbit



Sun synchronous orbit



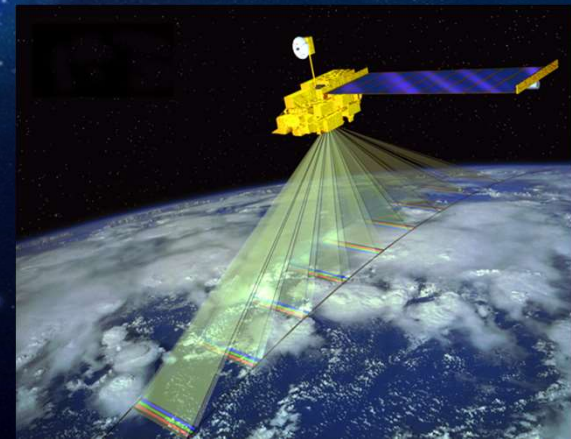
# Earth Observation

14 operational satellites (Sun-synchronous orbit) – RESOURCESAT-1, 2, 2A, CARTOSAT-1, 2, 2A, 2B, 3, RISAT-1 and 2, OCEANSAT-2, Megha-Tropiques, SARAL and SCATSAT-1, and 4 (Geostationary orbit)- INSAT-3D, Kalpana & INSAT 3A, INSAT -3DR.

IRS-1A in 1988



**APPLICATIONS:** agriculture, **Water Resources Management**, urban planning, rural development, mineral prospecting, environment, forestry, ocean resources and disaster management.



2/5/2021

# Disaster Management Support Programme

## Flood



## Extreme rainfall events



## Cyclone



## Agricultural Drought



# Climate & Environment

Satellites and ground based observations systems for studying the climate and environmental parameters of earth.



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# Earth observation data for water resources management



Data obtained from earth observation satellites (Historical and Near Real Time ) is available on 3 different ISRO's web portals MOSDAC , VEDAS and Bhoonidhi.

- Standard products
- Geophysical products

**Direct estimation of water cycle components**

**OR**

**Hydrological models or numerical models (Geophysical parameters)**

Portal hosts retrieved parameters from satellite data as well as developed applications from satellite data.

# Meteorological & Oceanographic Satellite Data Archival Centre (MOSDAC) Space Applications Centre, ISRO



## Data related to missions :

SCATSAT-1, INSAT-3DR, INSAT3D, KALPANA-1, INSAT3A, MeghaTropiques, SARAL-Altika , Oceansat-2

The screenshot displays the MOSDAC website interface. At the top, there are logos for the Government of India and ISRO, along with the text 'Meteorological & Oceanographic Satellite Data Archival Centre, Space Applications Centre, ISRO'. A navigation menu includes 'Home', 'Missions', 'Catalog', 'Galleries', 'Data Access', 'Cal/Val', 'Atlases', 'Tools', 'Research Programme', 'Sitemap', and 'Help'. Below the menu, there are tabs for 'Highlights', 'Satellite Images', 'RADAR', 'LIVE', and 'Alerts'. The main content area shows a satellite data viewer for 'Sat Dec 12 2020 16:00:00 GMT+0530 (India Standard Time)'. The viewer includes a timeline from 12-12-2020\_16:00 to 12-12-2020\_19:00 and a '8 Frames' dropdown. Below the viewer, there are 'Fullscreen' and 'Services' sections. The 'Services' section has tabs for 'Forecast', 'Nowcast', 'Current Events', 'Past Events', 'Visualisation', 'Met Applications', and 'Ocean Applications'. Under these tabs, there are several service cards: 'WEATHER', 'SEA STATE', 'RIP CURRENT', 'LIGHTNING', 'HEAVY RAIN', 'HEAT WAVES', 'CONTRAIL', 'COLD WAVES', and 'CITY WEATHER'.

# Geophysical parameters (for Hydrological Models):



- Land Surface Temperature
- Upper Tropospheric Humidity
- Outgoing Longwave Radiation
- Sea Surface Temperature
- Insolation
- Hydro-Estimator Rain
- INSAT Multi Spectral Rain
- Quantitative Precipitation Index
- Cloud Mask
- Diffused Normal Irradiance(DNI)
- Direct Horizontal Irradiance(DHI)**
- Global Horizontal Irradiance(GHI)

**Add To Favourite**

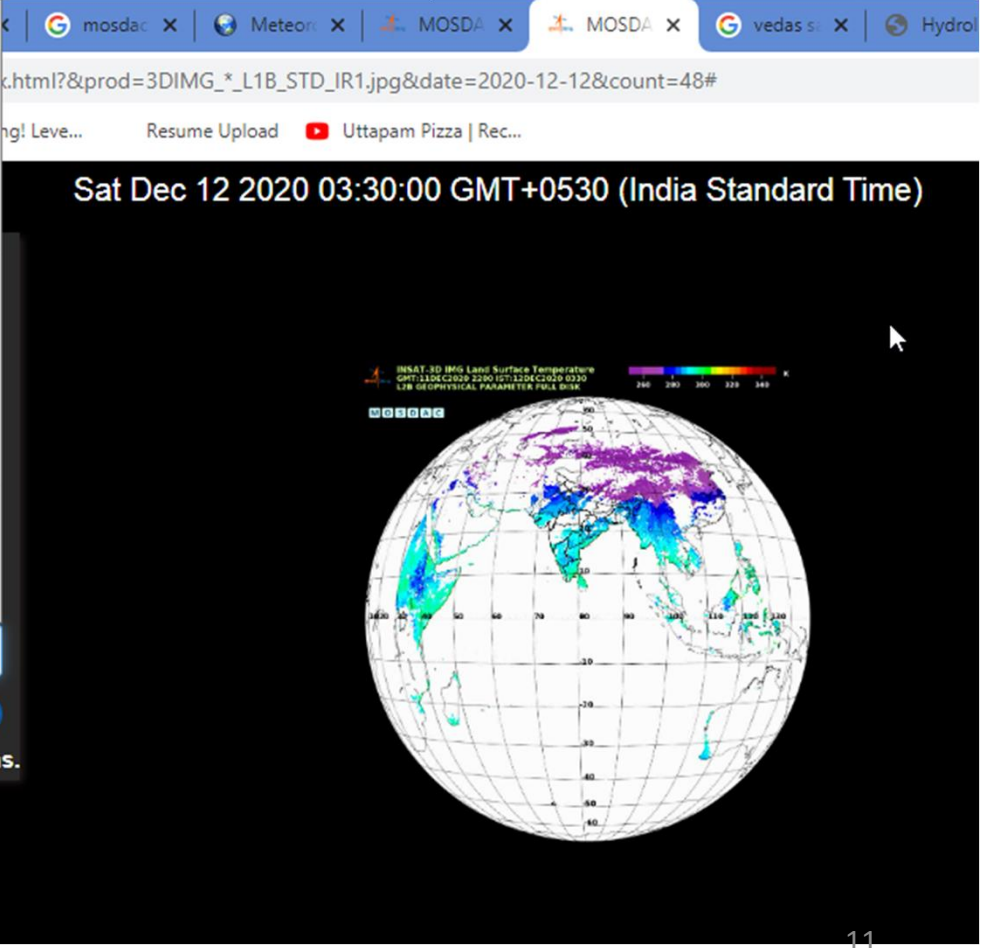
AutoLoad 15mins.

Fri Dec 11 2020 21:45:00 GMT+0530 (India Standard Time)

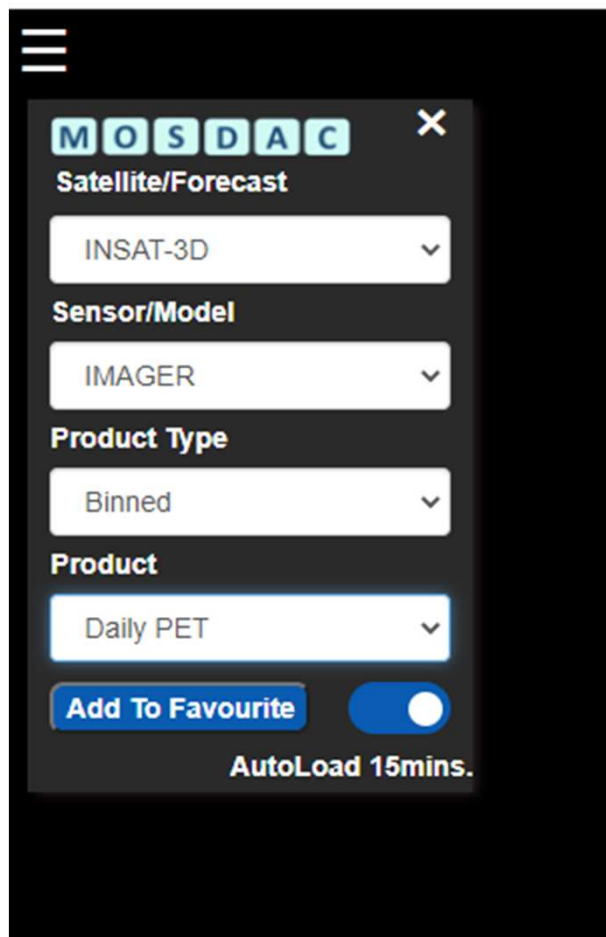
- Dust
- Cloud Effective Radius
- Cloud Optical Thickness
- Aerosol Optical Depth
- Snow**
- Fog
- Fire & Smoke
- IR Wind
- WV Wind
- VIS Wind
- MIR Wind
- Merged IR Wind(INSAT-3D & 3DR)
- Land Surface Temperature

**Add To Favourite**

AutoLoad 15mins.



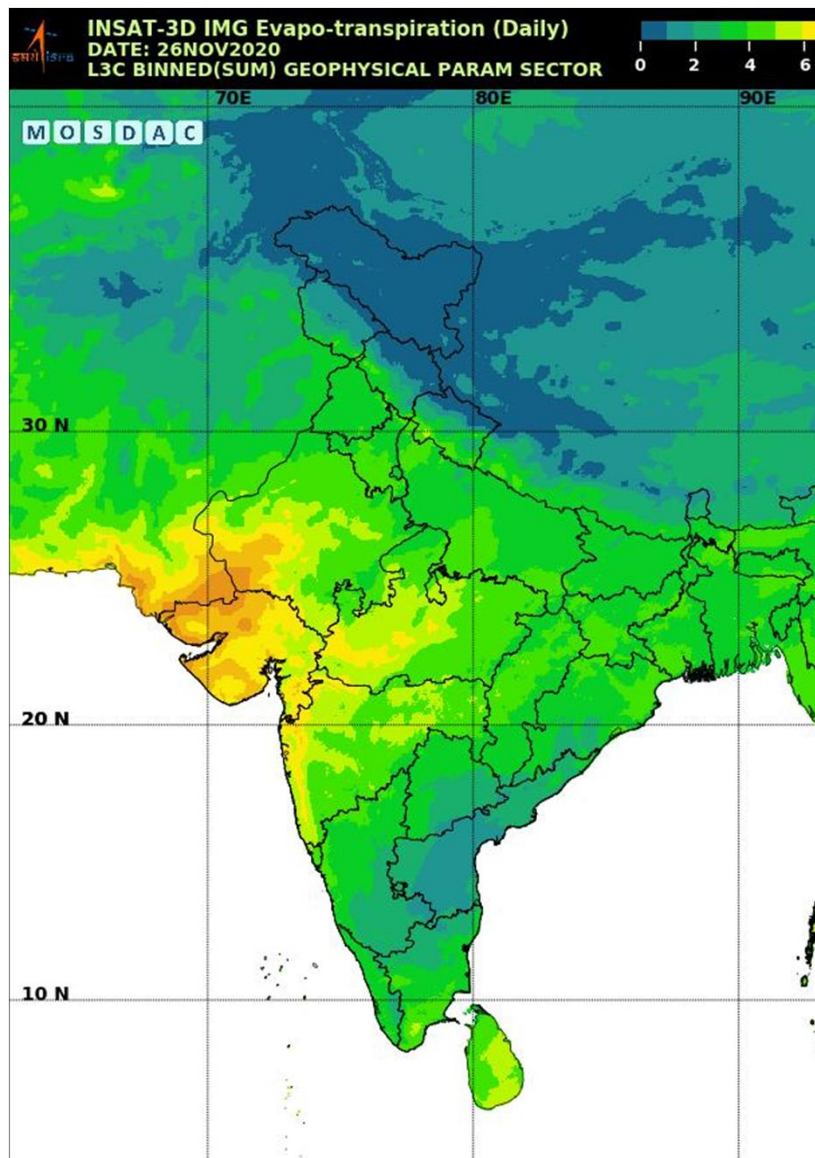
Reference document :  
INSAT3D ATBD  
2/5/2021



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

Data visualization and data download

2/5/2021



- Daily OLR
- Daily SST
- Daily UTH
- Daily HEM
- Daily GPI
- Daily IMR
- Daily IMC
- Daily INS
- Daily PET
- Daily DNI
- Daily DHI
- Daily GHI
- Daily INS**
- Daily PET
- Daily DNI
- Daily DHI
- Daily GHI
- Weekly OLR
- Weekly SST
- Weekly UTH
- Weekly HEM
- Weekly GPI
- Weekly IMR
- Weekly IMC
- Weekly HEM

# Visualization of Earth observation Data and Archival System (VEDAS) Space Applications Centre, ISRO

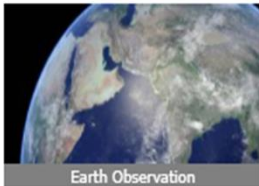


Visualisation of Earth Observation Data and Archival System


Space Applications Centre, ISRO




Home Applications Training & Research Atlas SDIS Download About Us Site map



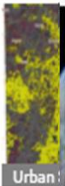
Earth Observation



Vegetation and Crop Monitoring



New and Renewable Energy



Urban Sprawl Information System

### Announcements

Vegetation Condition Index (VCI) Dashboard

ERTD Training Announcement (New)

Geospatial Calculator

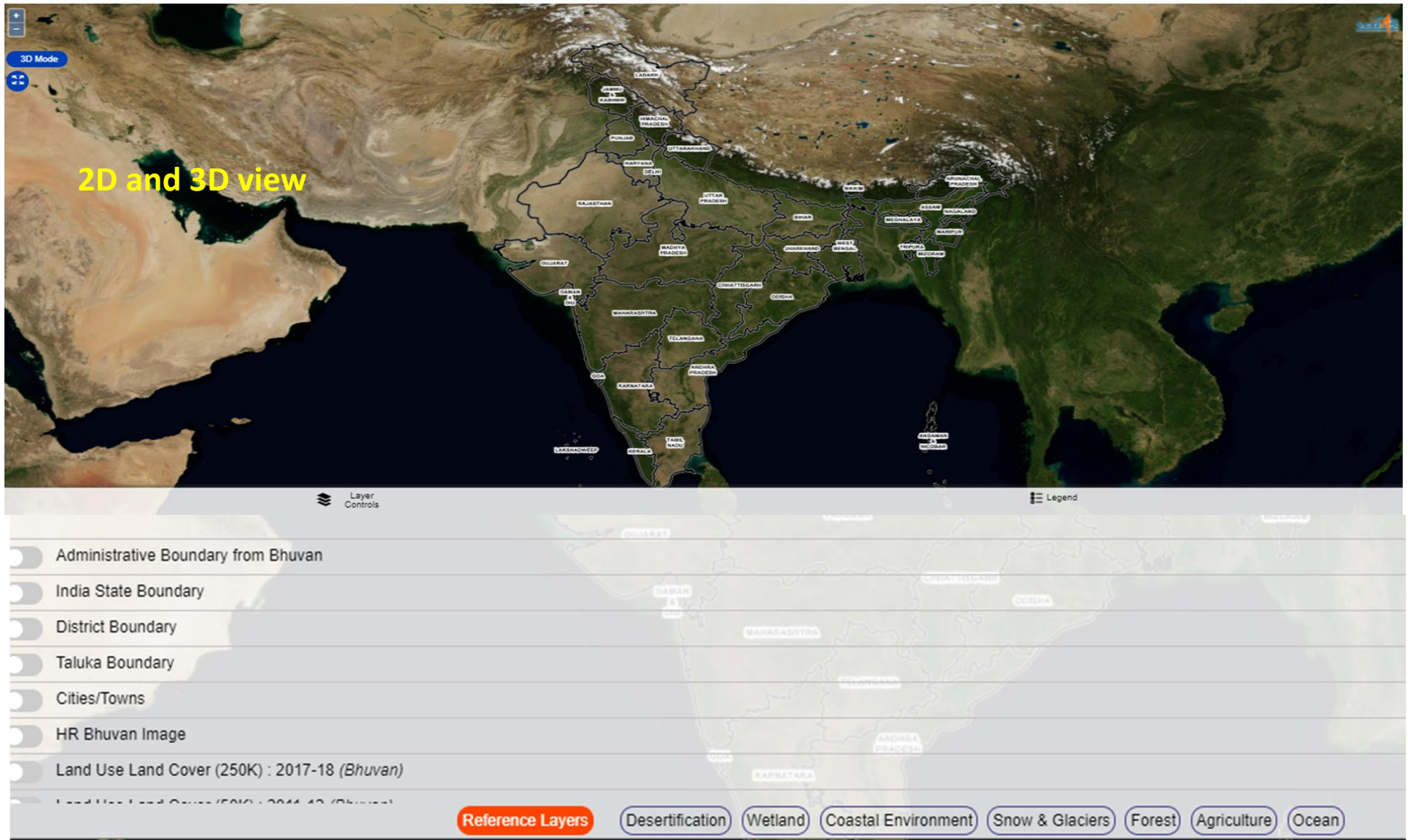
Solar Calculator for Africa (Beta Version)

- Earth Observation
- New and Renewable Energy
- Vegetation and Crop Monitoring
- Air Quality Monitoring
- Urban Sprawl Information System
- Polar Science
  - North Pole (Ice melt product)
  - North Pole
  - Safer Ship Navigation
  - South Pole (Effective Sea Ice Thickness)
  - South Pole
- Planetary Science
- Hydrological Science & Applications
- Mobile based Data Collection
- Special Products
- IPOWER - Indian Potential Offshore Wind Energy Resource
- Geospatial Energy Maps of India
- Snow cover monitoring

**Focus : Remote Sensing based earth observations and its applications**

2/5/2021 <https://vedas.sac.gov.in/vcms/en/home.html>

# Earth Observations



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<https://vedas.sac.gov.in/vstatic/Eo/index.html>

# Vegetation and crop monitoring

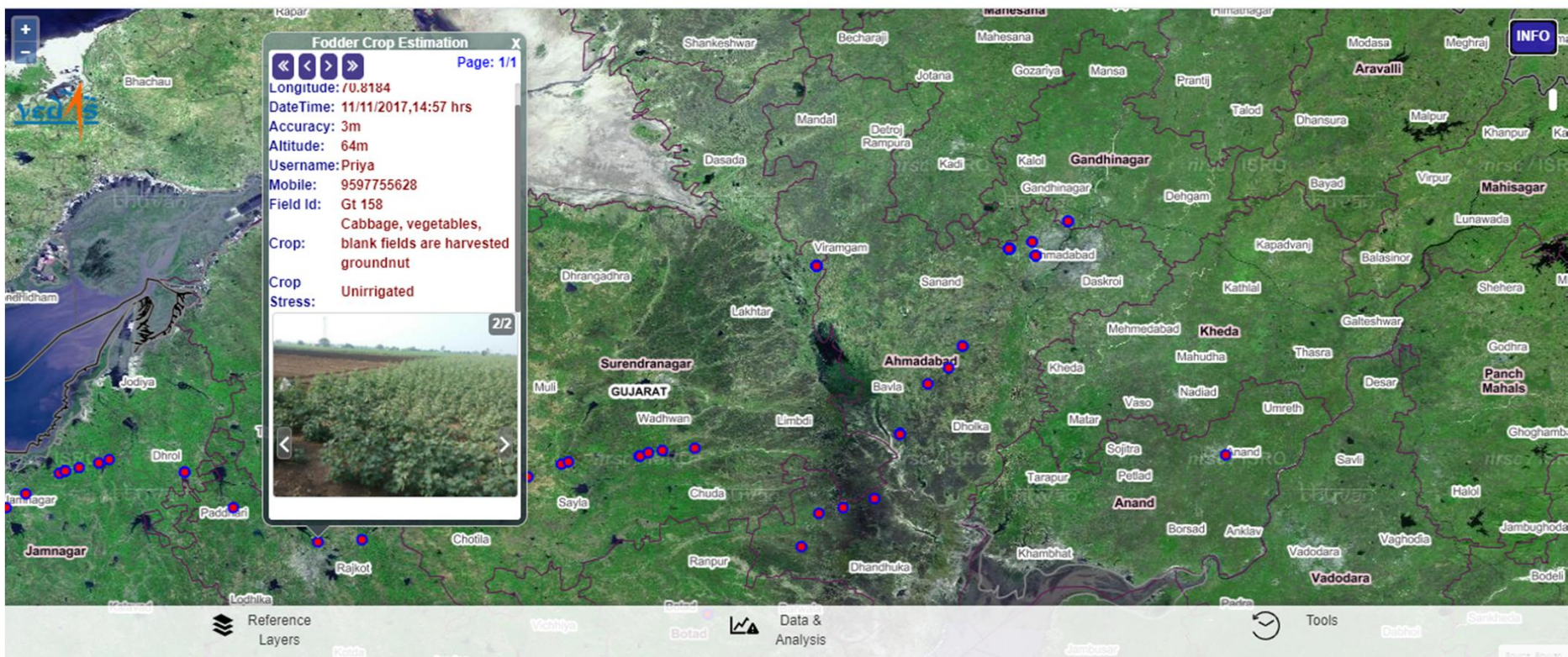
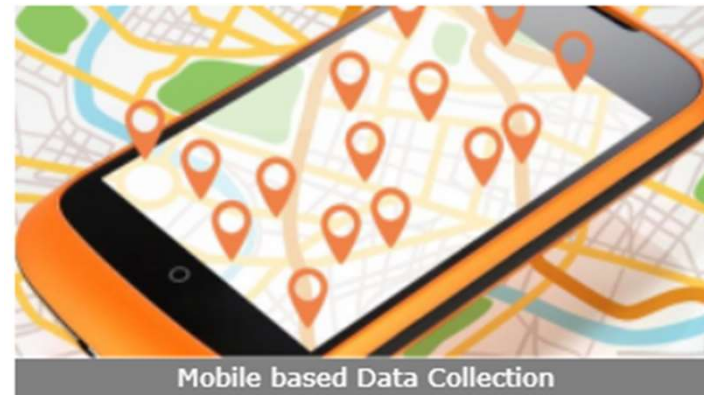


The screenshot displays the Vedas SAC Vegetation Monitoring web application. The interface includes a sidebar menu on the left with categories like 'Vegetation Indices', 'Soil Moisture', 'Rainfall', 'Temperature', 'Surface Dryness Index', 'Potential Evapotranspiration', 'SAR Backscatter', 'Crop Cutting Experiments', and 'Weather Forecast (72 Hour)'. The main area shows a map of India with a color scale from 0.0 to 0.8. A central panel lists various data layers, including MODIS, AWIFS, and Sentinel2 products. At the bottom, there are controls for theme selection (currently 'Image Difference'), data source selection (currently 'MODIS - 16 Day Max NDVI [500m]'), and time period selection (currently 'A of (A-B) 24-11-2020').

Data visualization and data analytics both

[https://vedas.sac.gov.in/vstatic/vegetation\\_monitoring/index.html](https://vedas.sac.gov.in/vstatic/vegetation_monitoring/index.html)

# Mobile Based Data Collection



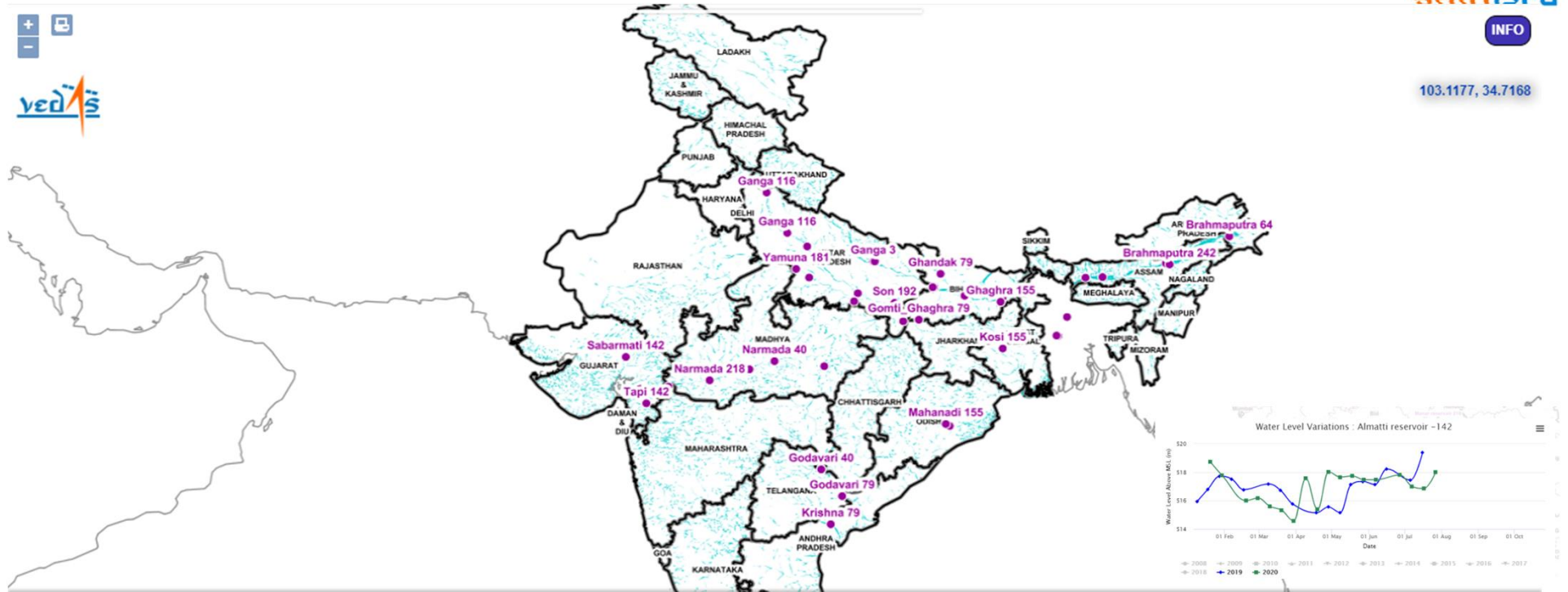


# Hydrological Science and Applications



INFO

103.1177, 34.7168



Reference Layers

Data & Analysis

Sensor **JASON 2/3** Waterbodies **River** Locations **Brahmaputra -53** From **07/04/2008** To **10/31/2020** Year over Year Profile:  **Submit** **Metadata**

**Altimeter** **Forecast** **Scatterometer** **Water Spread-SAR**

Sensor **JASON 2/3** Waterbodies **Reservoir** Locations **Almatti reservoir -142** From **07/06/2008** To **11/03/2020** Year over Year Profile:  **Submit** **Metadata**

**Altimeter** **Forecast** **Scatterometer** **Water Spread-SAR**

# Bhoonidhi (ISRO's Open Data Access) National Remote Sensing Centre, ISRO



## Satellite Data Availability

Satellite	Sensors
LANDSAT-8	OLI+TIRS - Georeferenced Terrain Corrected Products
SENTINEL-1A & 1B	Interferometric Wide Swath (IW) - VV+VH pol, L1-GRD
SENTINEL-2A & 2B	MSI - Level 1C, Level 2A
OCEANSAT-2/2021	OCM - GAC - Georeferenced Terrain Corrected Products

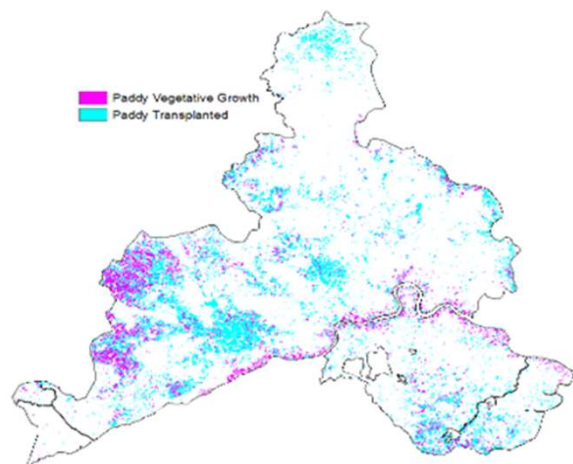
<https://bhoonidhi.nrsc.gov.in/bhoonidhi/index.html>

Sentinel 1 : Composed of a constellation of two satellites, **Sentinel-1A** and **Sentinel-1B**,

- C-Band Synthetic Aperture Radar (SAR) data
- Spatial resolution of down to 5 m and a swath of up to 400 km
- 12-day repeat cycle

**Applications** of the data collected via the Sentinel-1 mission:

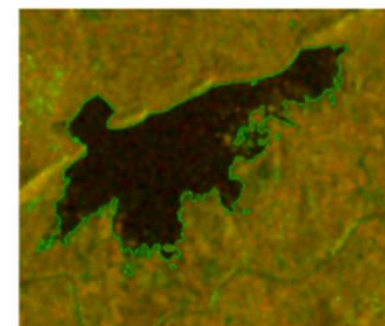
- ✓ sea and land monitoring (ex. Crop map detection, mapping of water spread area)
- ✓ emergency response due to environmental disasters



Detection of crop map



Detection of water spread area



## Sentinel 2 : **Sentinel-2A** and **Sentinel-2B**

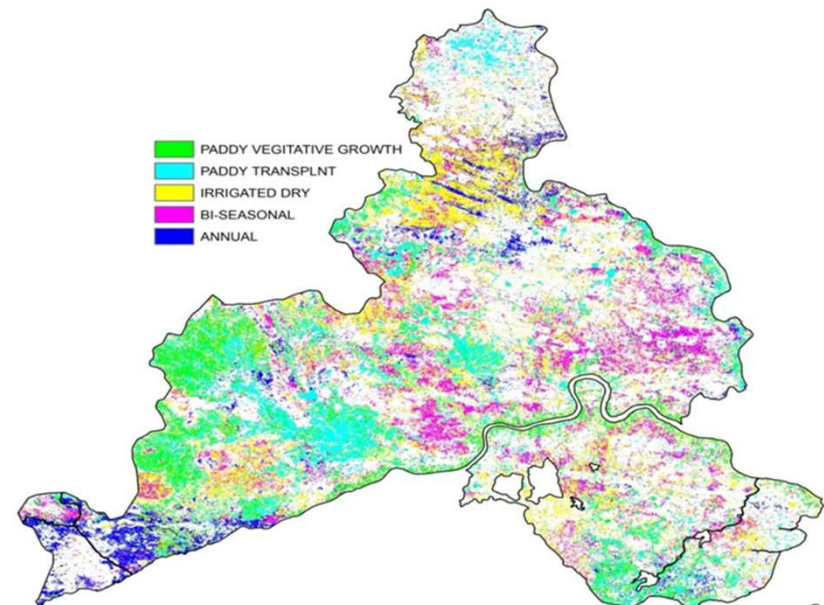
Multi Spectral imager (MSI) with 13 bands in the visible, near infrared (NIR) and short wave infrared (SWIR)

Sentinel-2 bands	Sentinel-2A & 2B		
	Central wavelength (nm)	Bandwidth (nm)	Spatial resolution (m)
Band 1 – Coastal aerosol	442.7	21	60
Band 2 – Blue	492.4	66	10
Band 3 – Green	559.8	36	10
Band 4 – Red	664.6	31	10
Band 5 – Vegetation red edge	704.1	15	20
Band 6 – Vegetation red edge	740.5	15	20
Band 7 – Vegetation red edge	782.8	20	20
Band 8 – NIR	832.8	106	10
Band 8A – Narrow NIR	864.7	21	20
Band 9 – Water vapour	945.1	20	60
Band 10 – SWIR – Cirrus	1373.5	31	60
Band 11 – SWIR	1613.7	91	20
Band 12 – SWIR	2202.4	175	20

## Applications:

- ✓ land cover classification or water quality
- ✓ Monitoring land cover change for environmental monitoring
- ✓ Agricultural applications, such as crop monitoring and management to help food security
- ✓ Observation of coastal zones (marine environmental monitoring, coastal zone mapping)
- ✓ Inland water monitoring
- ✓ Glacier monitoring, ice extent mapping, snow cover monitoring
- ✓ Flood mapping & management

Crop map detection based on Sentinel 2 data



Landsat 8 OLI +TIR

Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS)

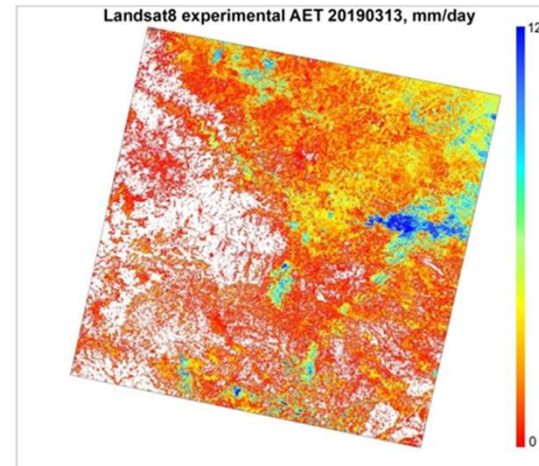
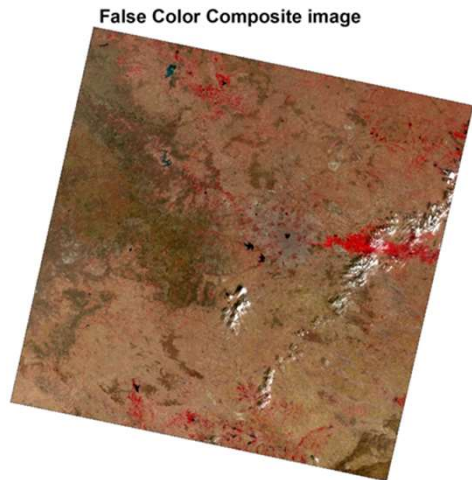


agriculture and forestry, land use and mapping, geology, hydrology, coastal resources and environmental monitoring

<b>Landsat 8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS)  Launched February 11, 2013</b>	<b>Bands</b>	<b>Wavelength (micrometers)</b>	<b>Resolution (meters)</b>
	Band 1 - Coastal aerosol	0.43 - 0.45	30
	Band 2 - Blue	0.45 - 0.51	30
	Band 3 - Green	0.53 - 0.59	30
	Band 4 - Red	0.64 - 0.67	30
	Band 5 - Near Infrared (NIR)	0.85 - 0.88	30
	Band 6 - SWIR 1	1.57 - 1.65	30
	Band 7 - SWIR 2	2.11 - 2.29	30
	Band 8 - Panchromatic	0.50 - 0.68	15
	Band 9 - Cirrus	1.36 - 1.38	30
	Band 10 - Thermal Infrared (TIRS) 1	10.60 - 11.19	100
Band 11 - Thermal Infrared (TIRS) 2	11.50 - 12.51	100	

# Tracking Agricultural Water Use From Space

# Predicting Water Demand



Landsat 8 FCC image for part of Hyderabad

Landsat 8 based Field level actual evapotranspiration

<https://eeflux-level1.appspot.com/>

The screenshot displays the Bhoonidhi beta website interface. At the top, there are logos for the Government of India, ISRO, and the National Remote Sensing Center (nrsc). The main header features the text "Bhoonidhi beta" and "ISRO's Open Data Access" in English, and "भूनिधि बीटा" and "इसरो ओपन डेटा एक्सेस" in Hindi. A navigation bar includes "Explore", "Archives", and "Utilities".

A modal window titled "Login" is open, containing a graphic of two people and a key. Below the graphic are input fields for "Username" and "Password", a "Login" button, and links for "New User" and "Forgot Password".

In the background, a satellite map of India is visible with a hand cursor over it. The map includes zoom controls (+ and -) and the text "nrsc / ISRO".

At the bottom of the page, there is a footer with the text "Browsers supported: Firefox 60+, Chrome 78+, Edge 18+, Opera 64+" and links for "About Us", "Help", and "Terms&Conditions".



<https://uops.nrsc.gov.in/ImgeosUops/FinalImgeosUops/OdapUserRegister.html>

The screenshot shows the "User Order Processing System" website. The header includes the ISRO logo and the text "National Remote Sensing Center". The main title "User Order Processing System" is displayed in large yellow letters over an aerial satellite image of a city. A navigation bar at the bottom contains links for "Home", "Bhoonidhi", "Help", and "Terms and Conditions".

2/5/2021

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





**Thank you for kind  
attention**

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Image Courtesy : <https://appliedsciences.nasa.gov/what-we-do/water-resources>

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