Space based products for water resources management

Prepared By:
Nidhi Misra
Water Recourses Informatics Division (WRID)
Water Recourses Group (WRG)
Remote Sensing Applications Area (RSAA)
National Remote Sensing Centre (NRSC)
Indian Space Research Organization (ISRO) Hyderabad

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 ??

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

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

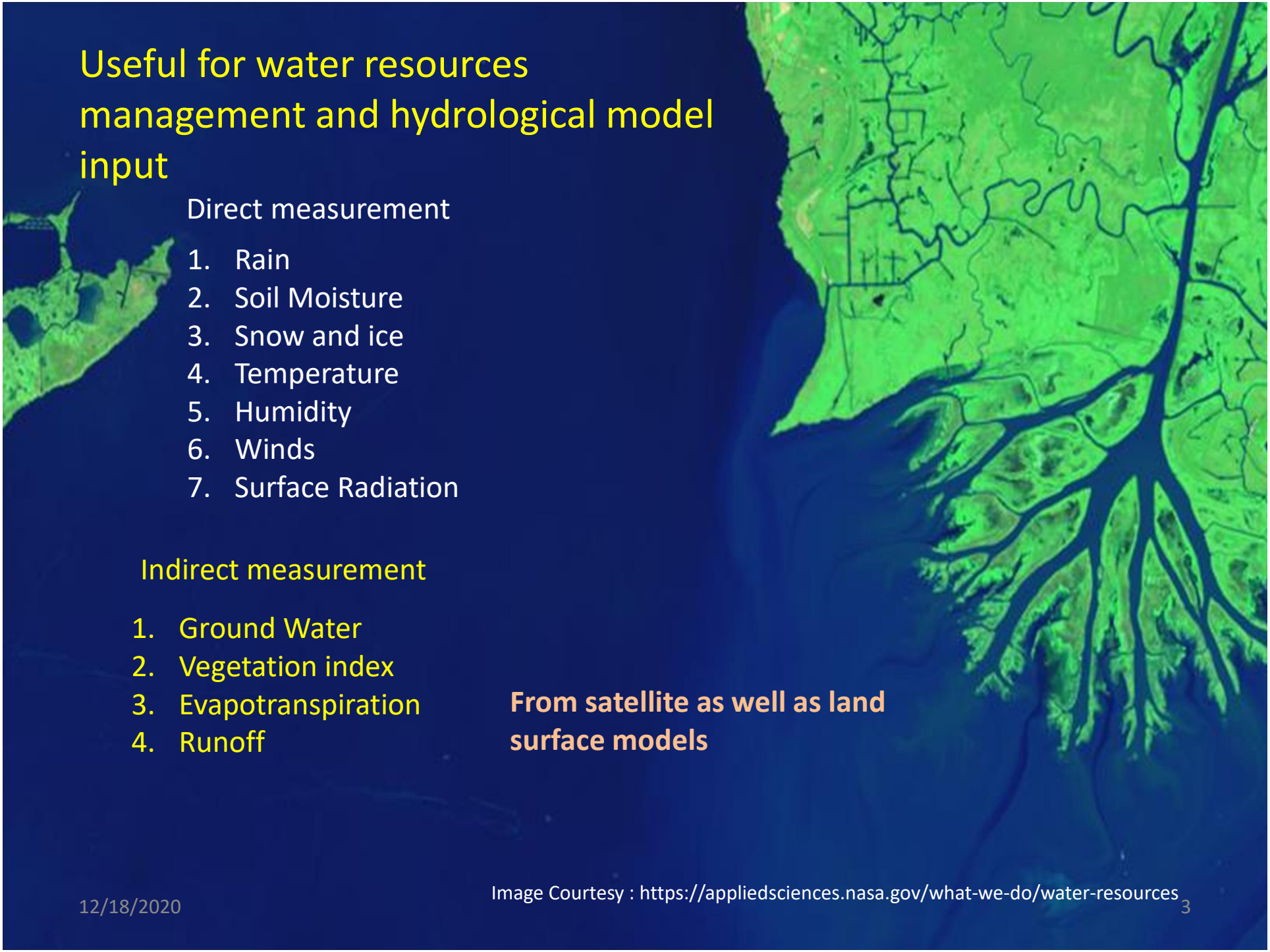


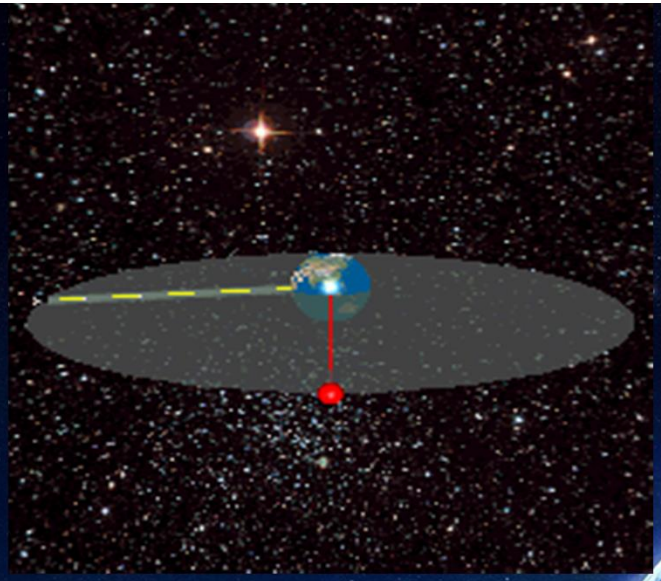
Image Courtesy : https://appliedsciences.nasa.gov/what-we-do/water-resources

Application of space science in Water Recourses Domain

Earth Observations for water resources management

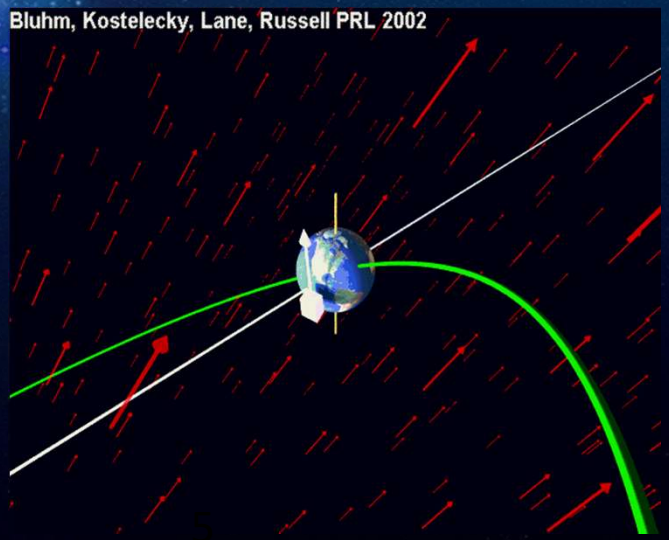
Climate & Environment

Disaster Management Support Programme



Geosynchrono
us orbit

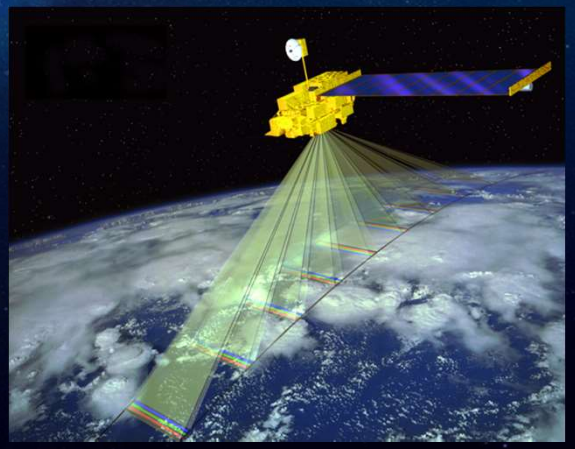
Sun
synchronous
orbit



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.

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.

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

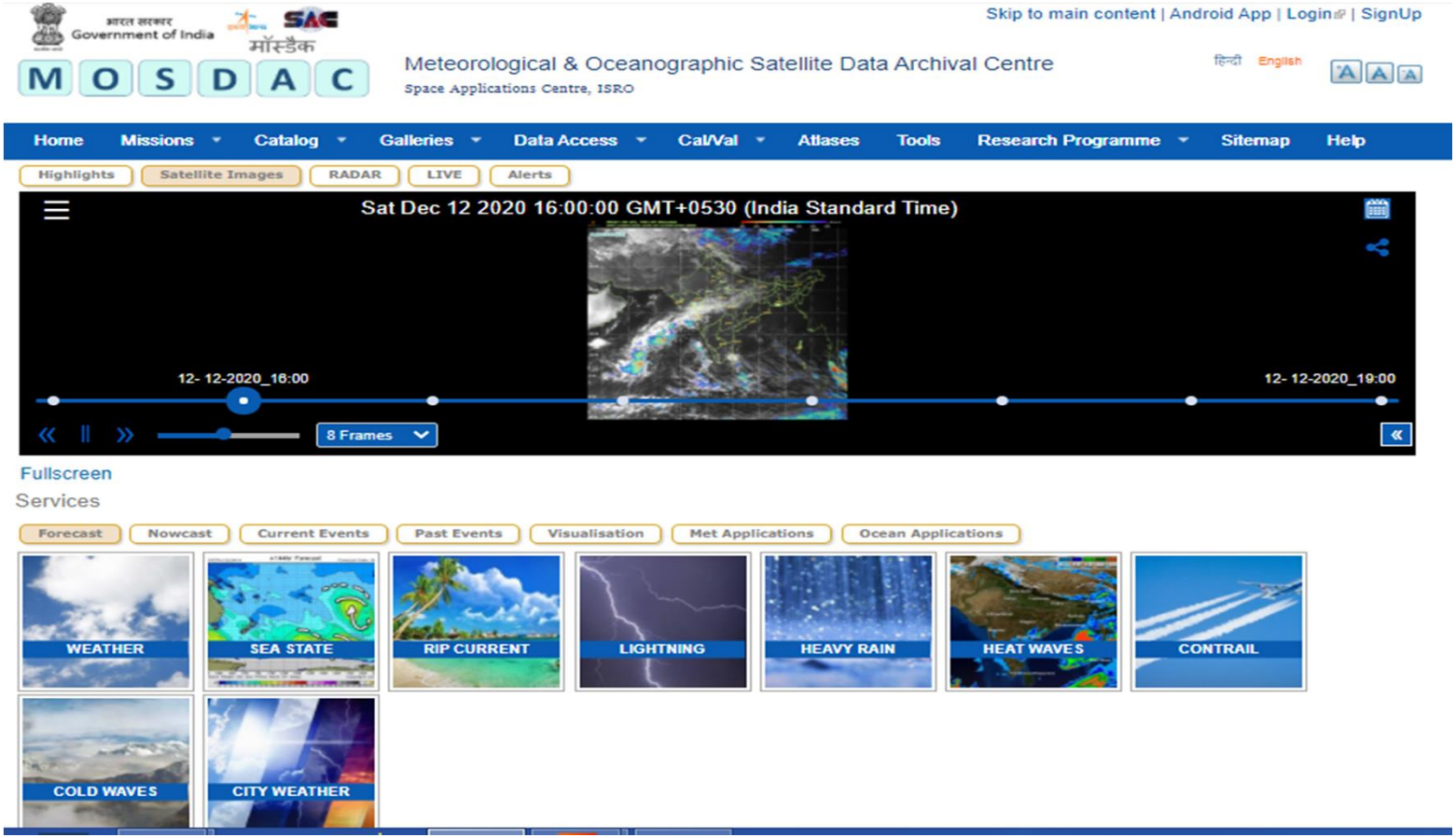
Direct estimation of water cycle components
OR
Hydrological models or numerical models (Geophysical parameters)

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

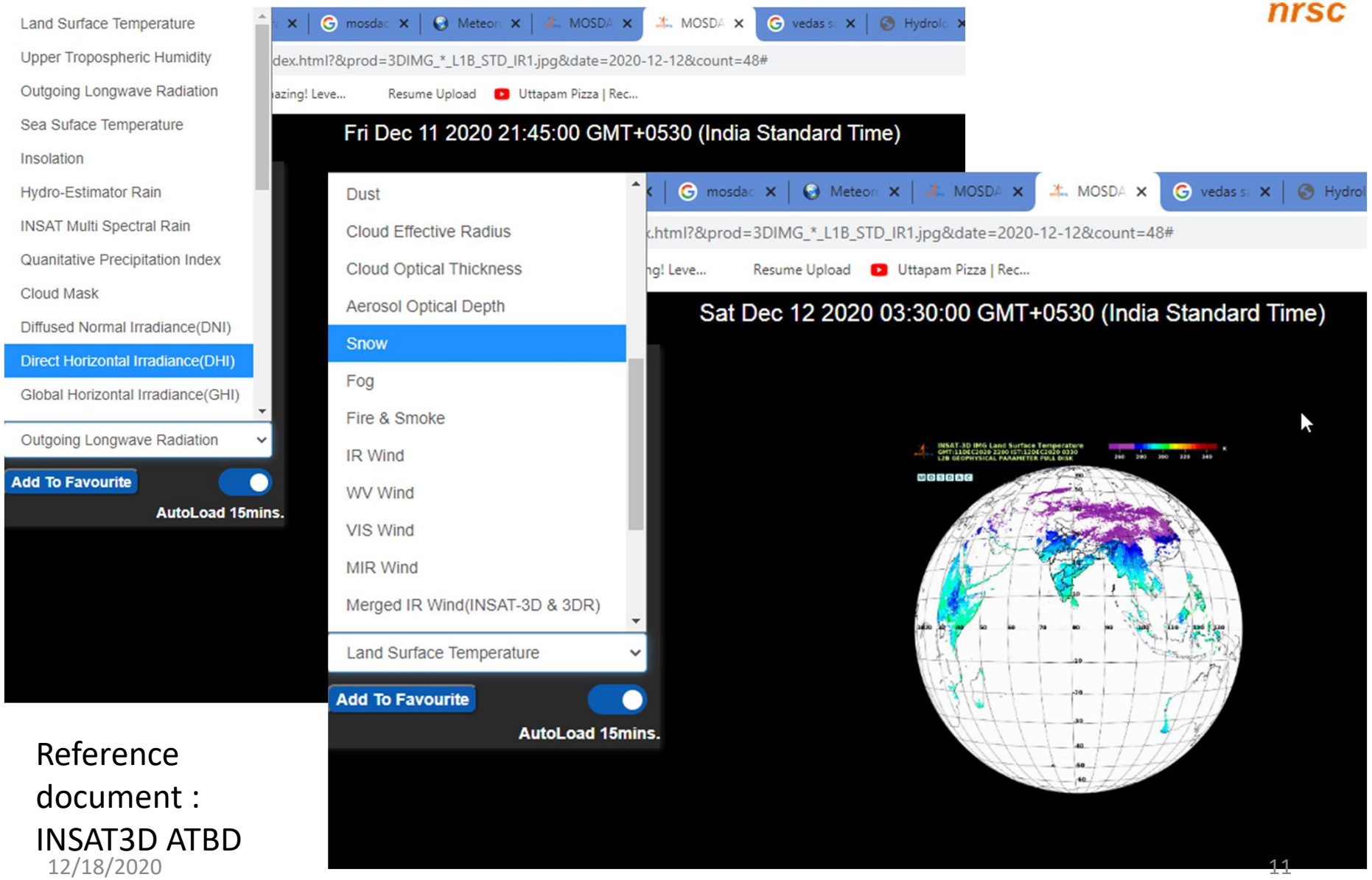
Meteorological & Oceanographic Satellite Data Archival Centre (MOSDAC) Space Applications Centre, ISRO

Data related to missions :

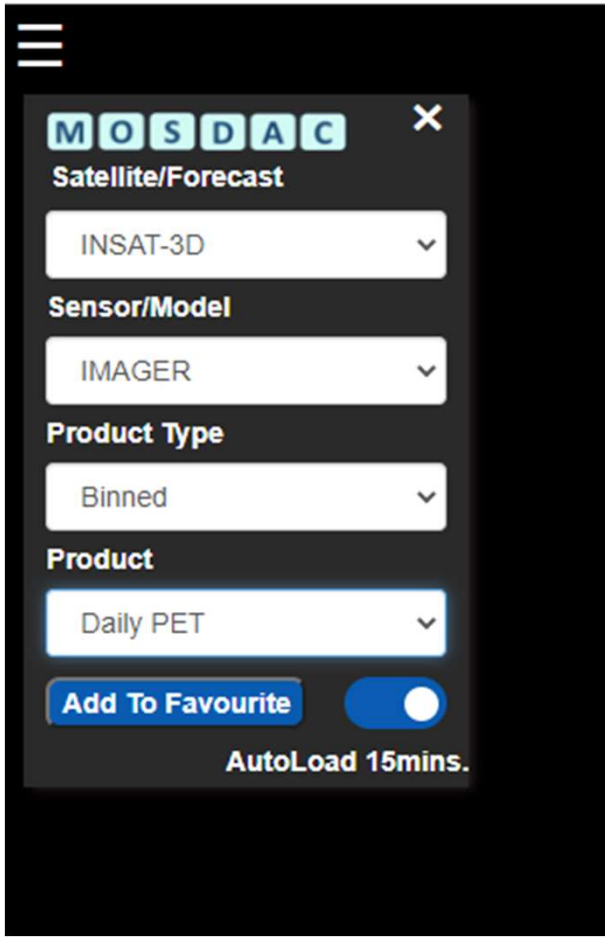
SCATSAT-1, INSAT-3DR, INSAT3D, KALPANA-1, INSAT3A, MeghaTropiques, SARAL-AltiKa , Oceansat-2

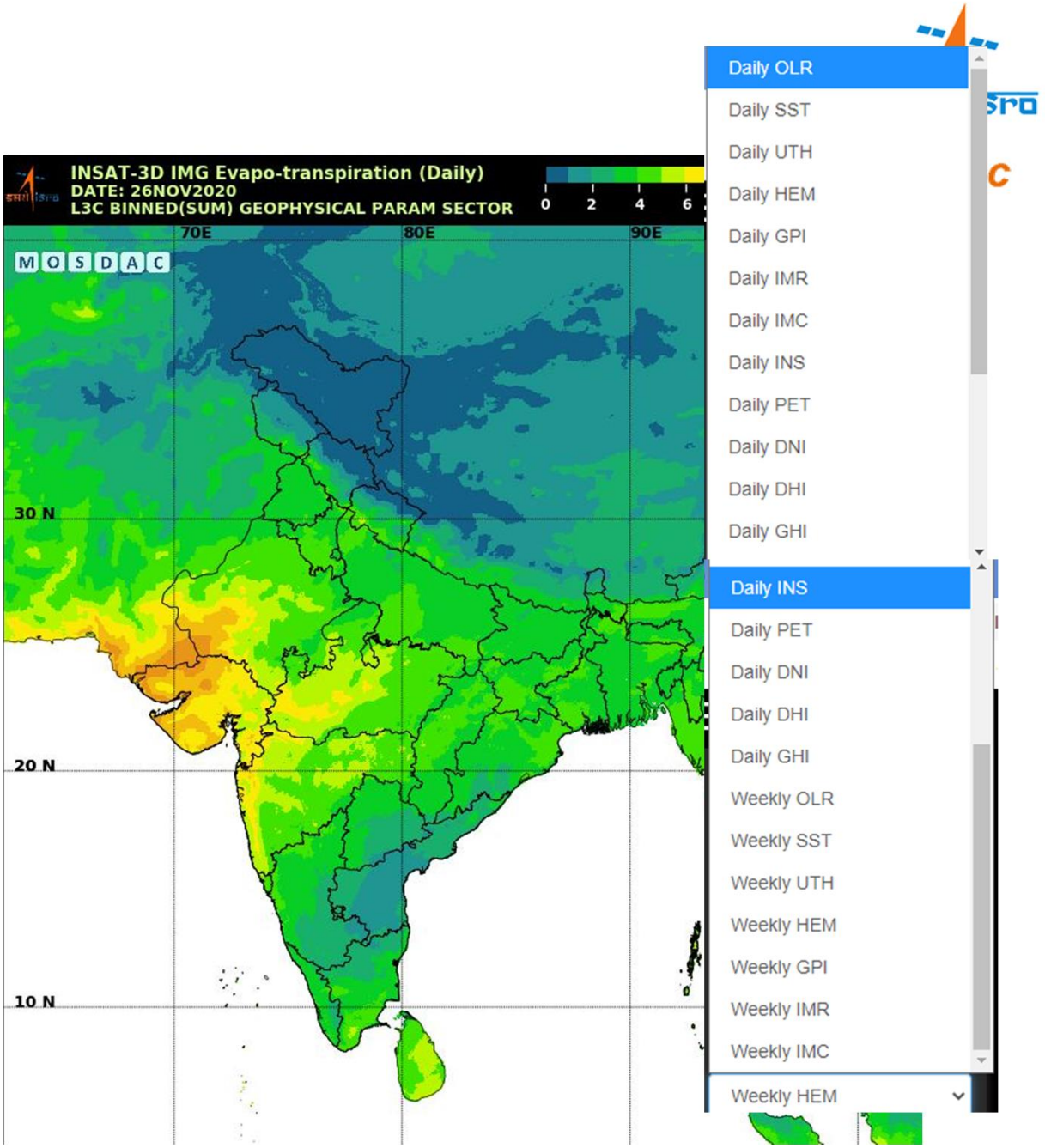


Geophysical parameters (for Hydrological Models):



Reference document : INSAT3D ATBD

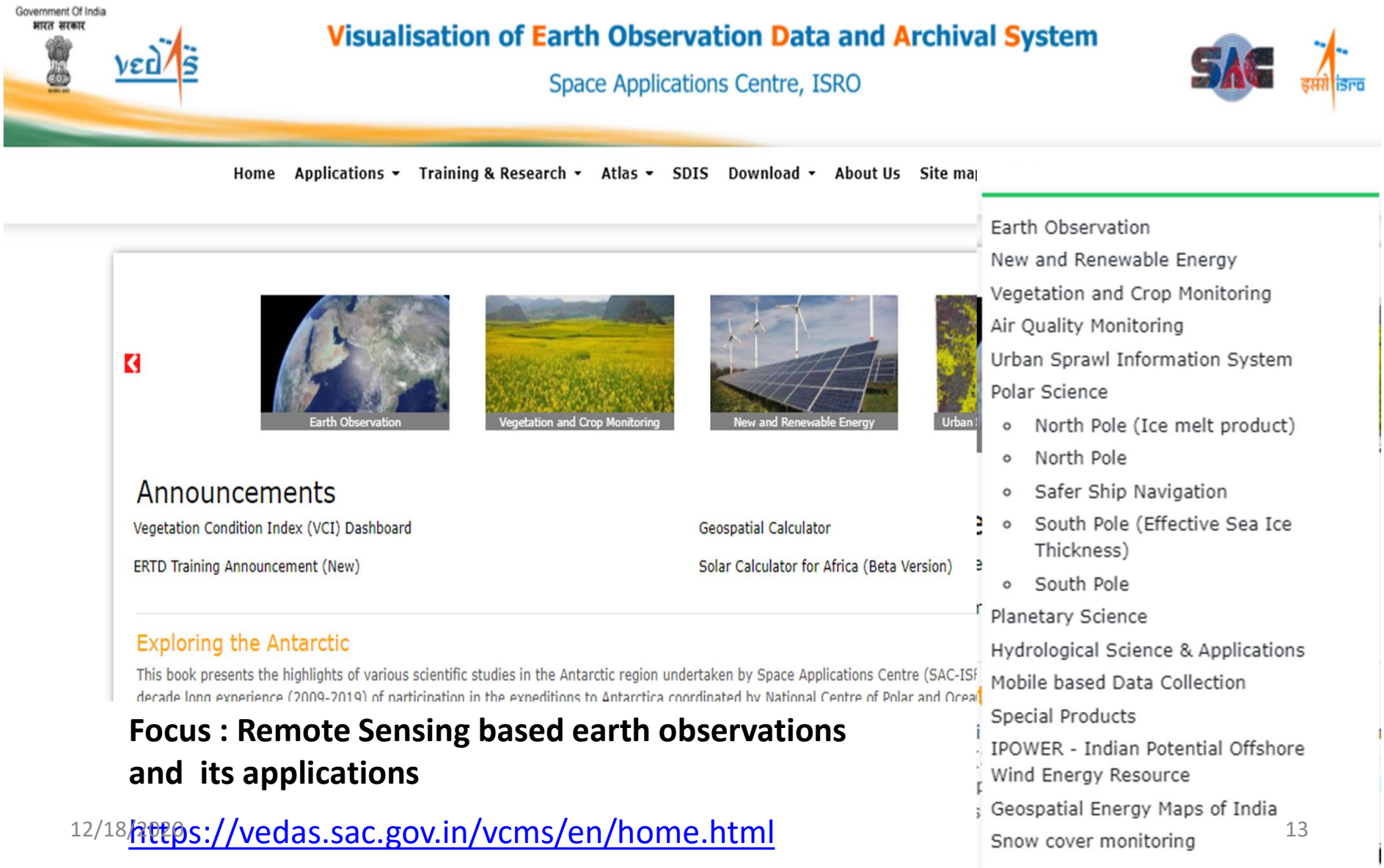




https://www.mosdac.gov.in/

Data visualization and data download

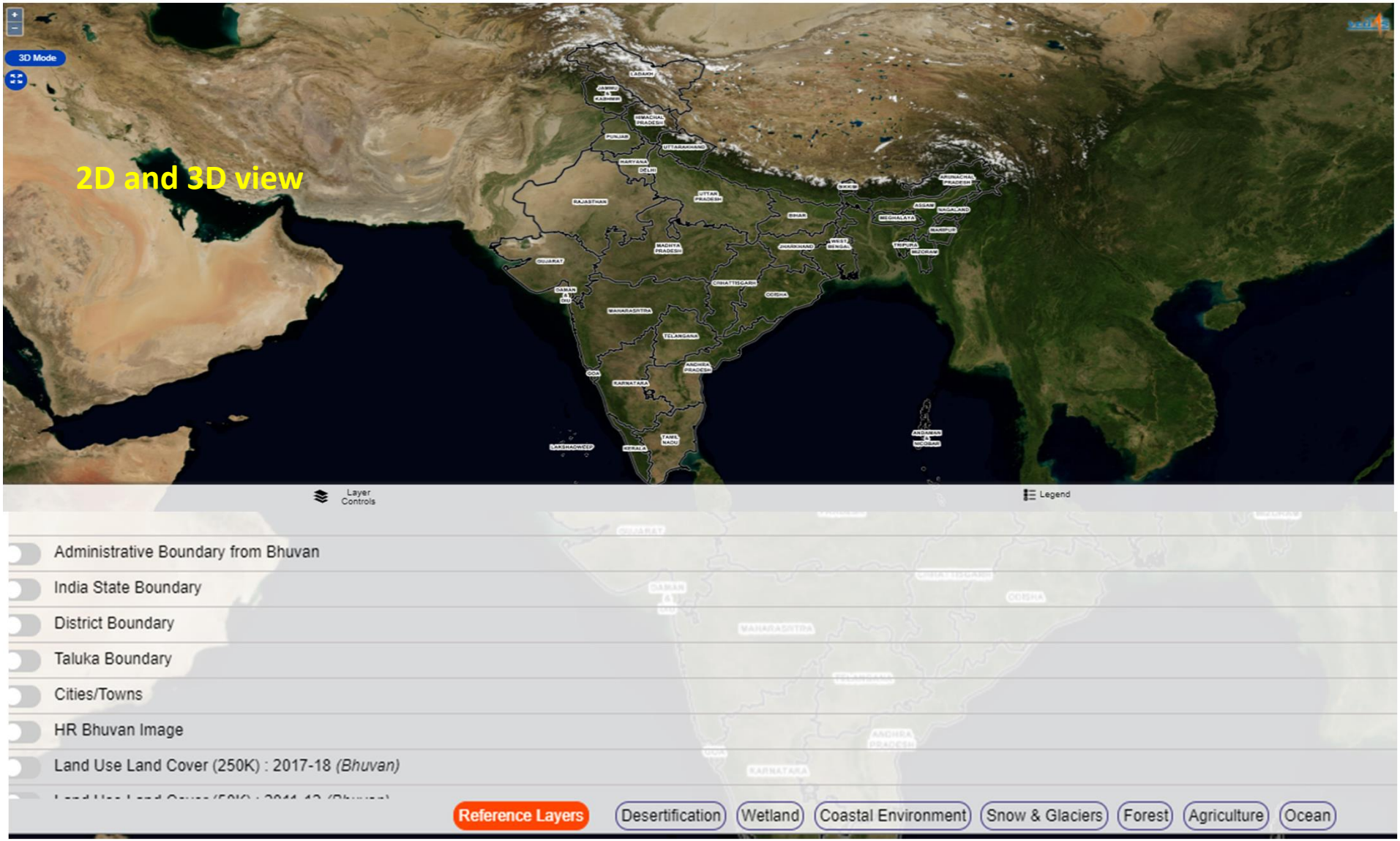
Visualization of Earth observation Data and Archival System (VEDAS) Space Applications Centre, ISRO



Focus : Remote Sensing based earth observations and its applications

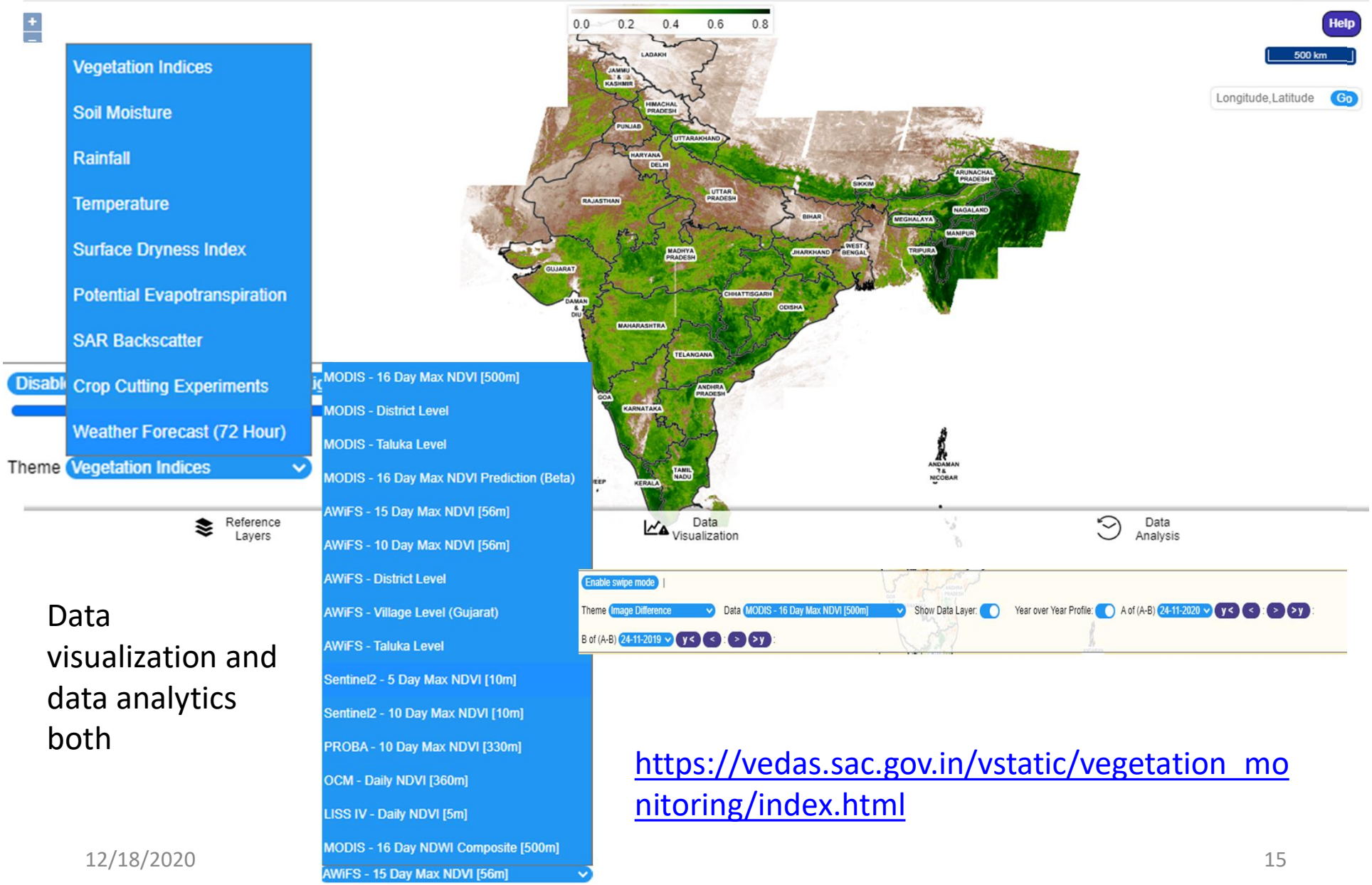
https://vedas.sac.gov.in/vcms/en/home.html

Earth Observations



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

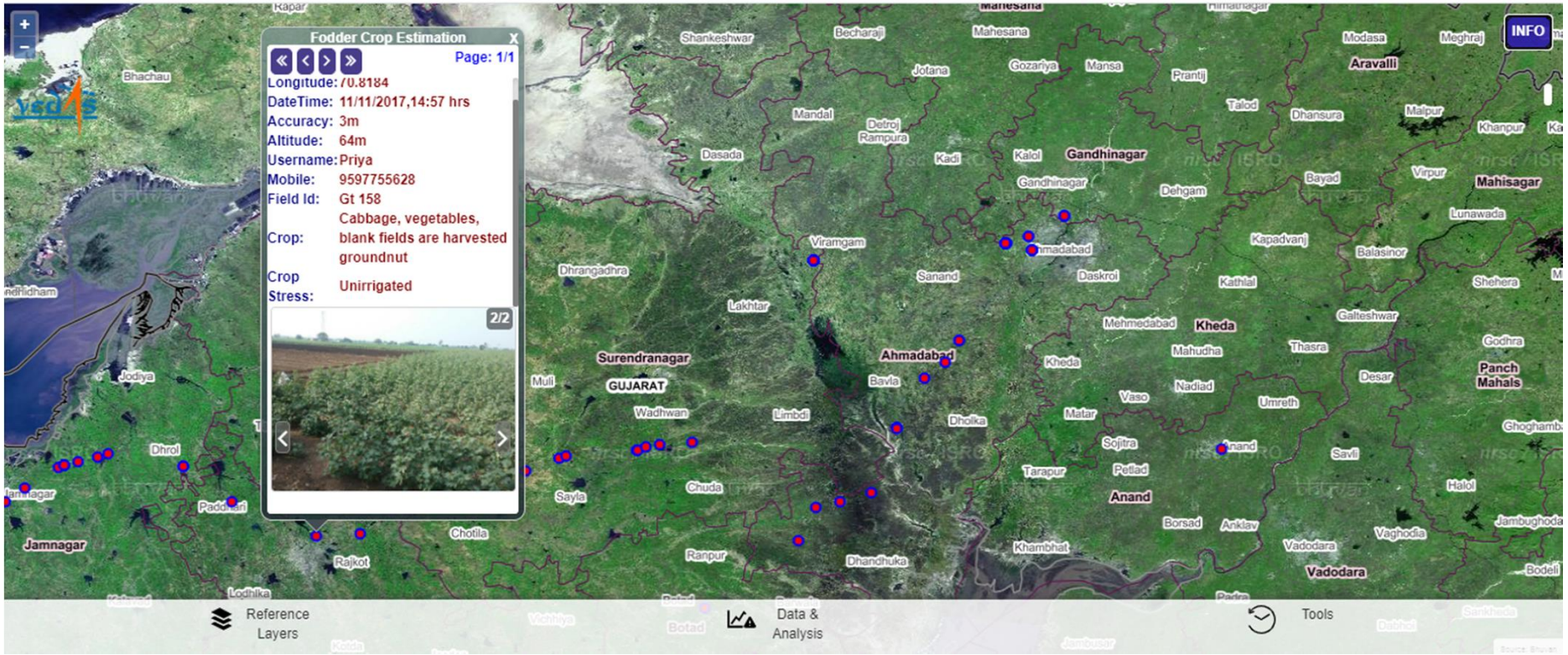
Vegetation and crop monitoring



Data visualization and data analytics both

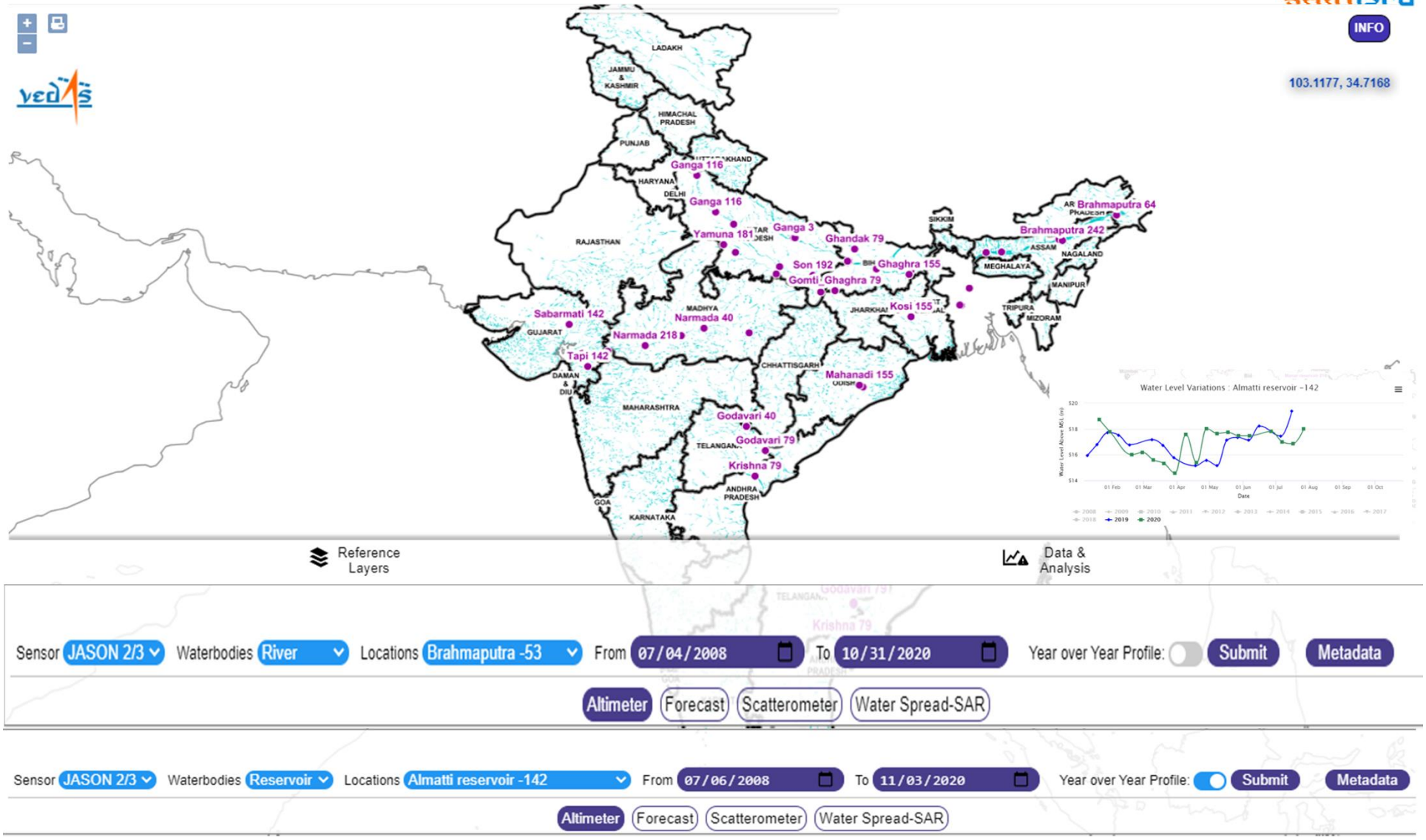
https://vedas.sac.gov.in/vstatic/vegetation_monitoring/index.html

Mobile Based Data Collection



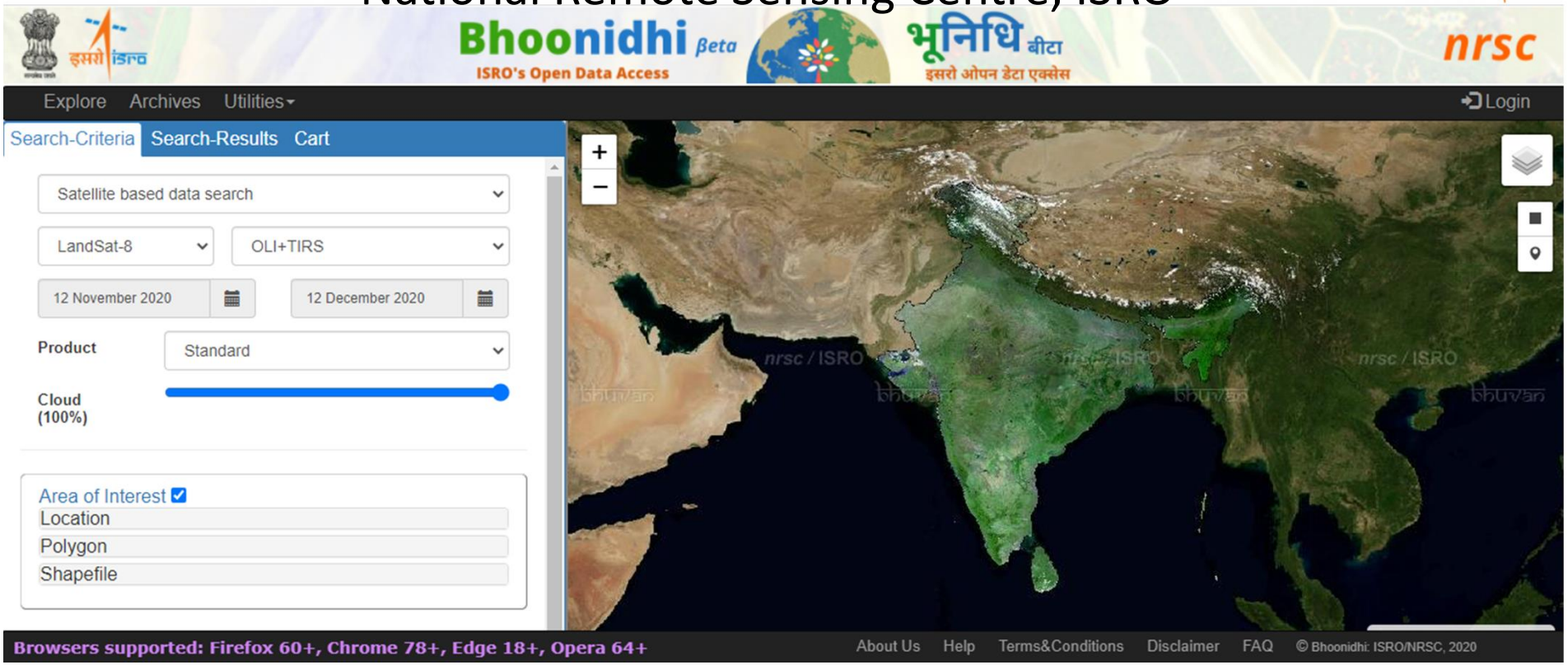
https://vedas.sac.gov.in/vstatic_1/UDC/

Hydrological Science and Applications



https://vedas.sac.gov.in/vstatic_1/hydro/

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	OCM - GAC - Georeferenced Terrain Corrected Products

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

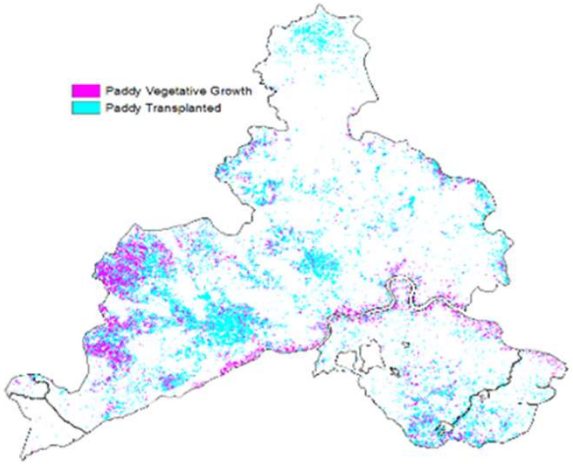
Sentinel 1 : Composed of a constellation of two satellites, **Sentinel-1A** and **Sentinel-1B**,

- 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

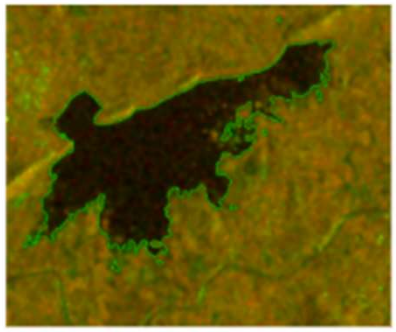
Applications of the data collected via the Sentinel-1 mission:

✓ 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**

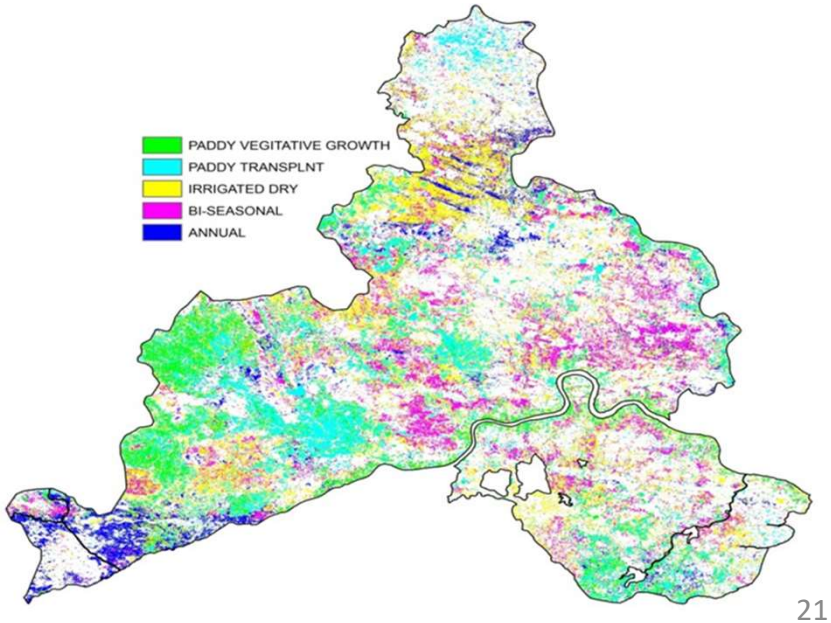
Multi Spectral imager (MSI) with 13 bands in the visible, near infrared (NIR) and short wave infrared (SWIR)

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

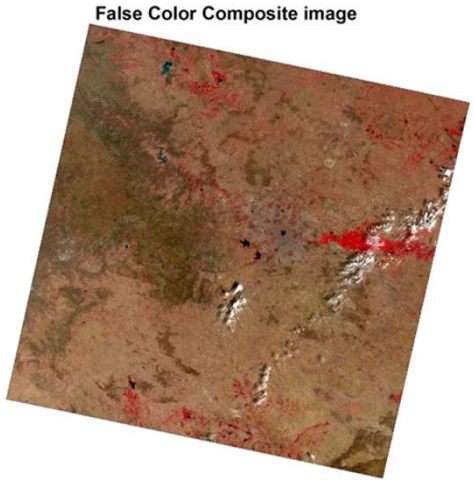
Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS)

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

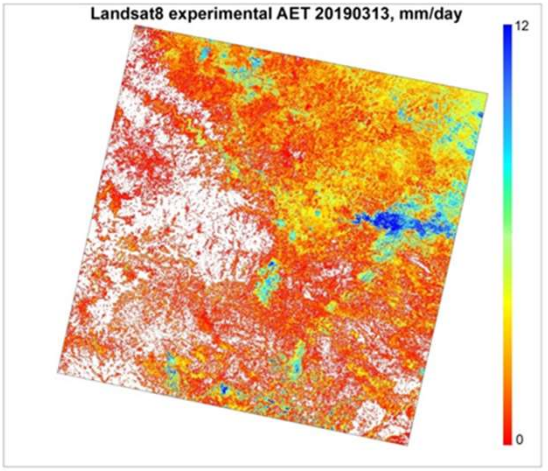
	Bands	Wavelength (micrometers)	Resolution (meters)
Landsat 8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) **Launched February 11, 2013**	Band 1 - Coastal aerosol	0.43 - 0.45	30
	Band 2 - Blue	0.45 - 0.51	30
	Band 3 - Green	0.53 - 0.59	30
	Band 4 - Red	0.64 - 0.67	30
	Band 5 - Near 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

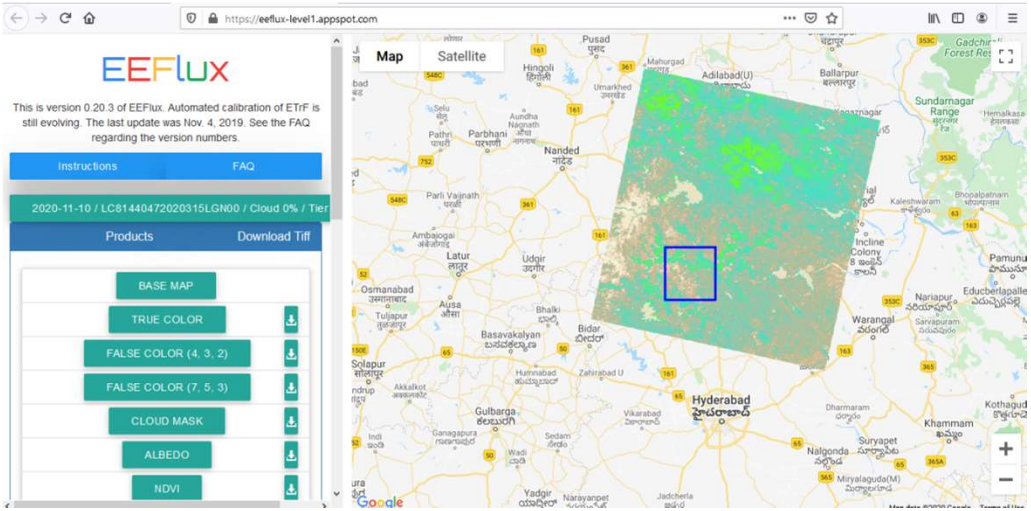
Predicting Water Demand



Landsat 8 FCC image for part of Hyderabad



Landsat 8 based Field level actual evapotranspiration



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

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

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

Thank you for kind attention

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