



Committee on Earth Observation Satellites

Agency Updates – ISRO

Raj Kumar,
Space Applications Centre, ISRO

Indian Space Research Organisation

CEOS Plenary 2018

Agenda Item 4.12

Brussels, Belgium

17 – 18 October 2018





Natural Resources Inventory & Management

RESOURCESAT- 2 & 2A



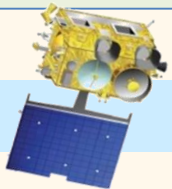
Large Scale Mapping, Infrastru. Planning & Cartography

CARTOSAT-1, CARTOSAT-2 (3) & 2S (4)



Oceanography

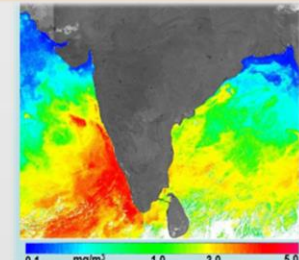
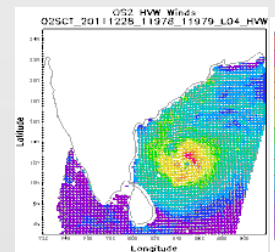
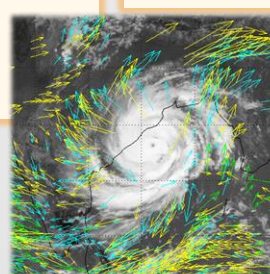
OCEANSAT-2 ; SARAL ; SCATSAT-1



Weather and Climate

INSAT 3D & 3DR ; MEGHA-TROPIQUES

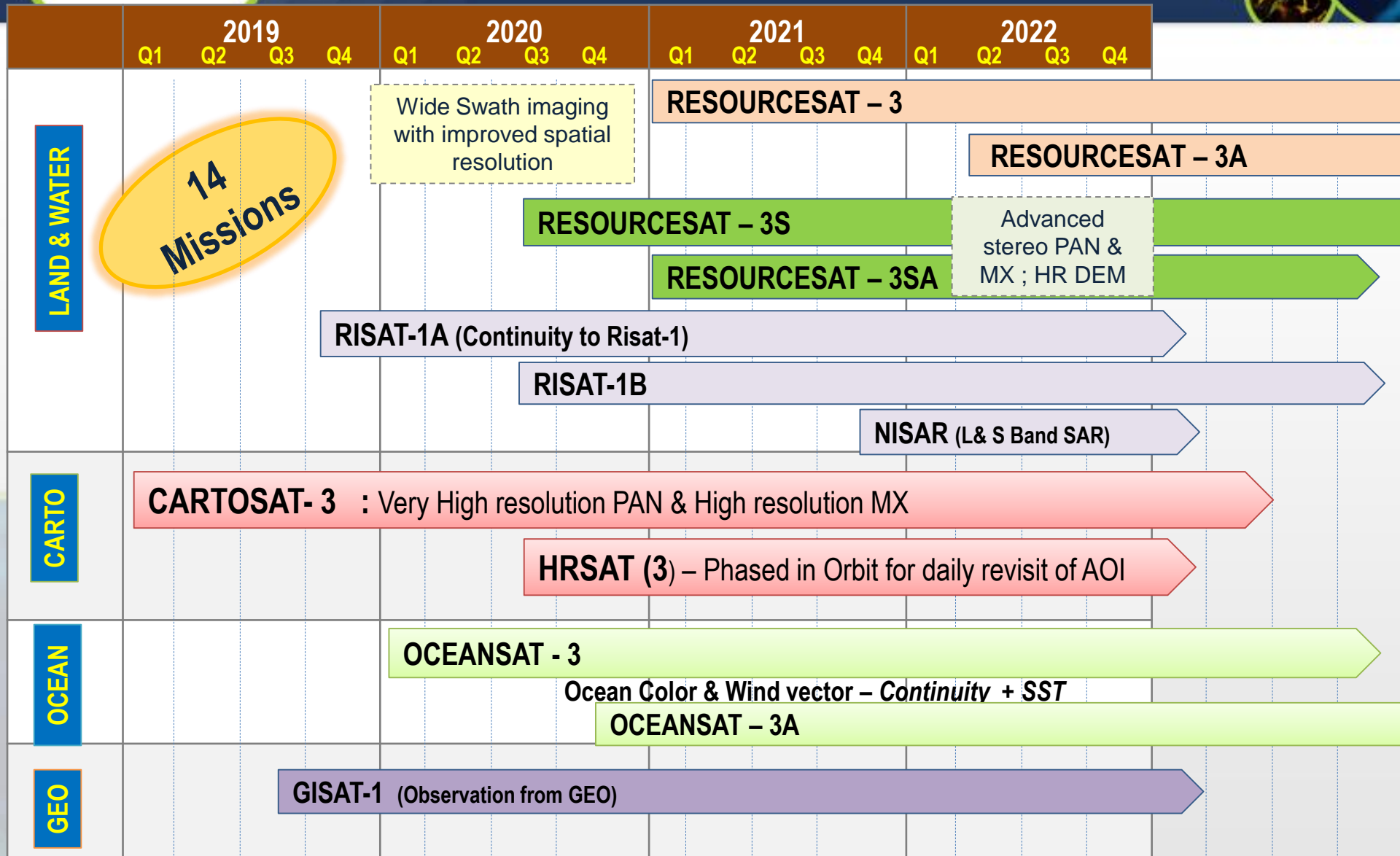
- Three tier imaging : 56 m / 23 m / 5.8 m
- Revisit Capability : 03 / 11 / 03 days
- 2.5 m Stereo imaging
- Sub-meter PAN and 1.5 m Multi-spectral
- Ocean color 360 m with 2 days revisit
- PFZ, Ocean State Forecast
- Ocean Altimetry, Surface Wind Vector
- 6 Bands Imager – 48 images per day
- 19 Channel Sounder – Atm. Profiles
- Radio Occultation – humidity profiles



Future Satellite Missions



14 Missions



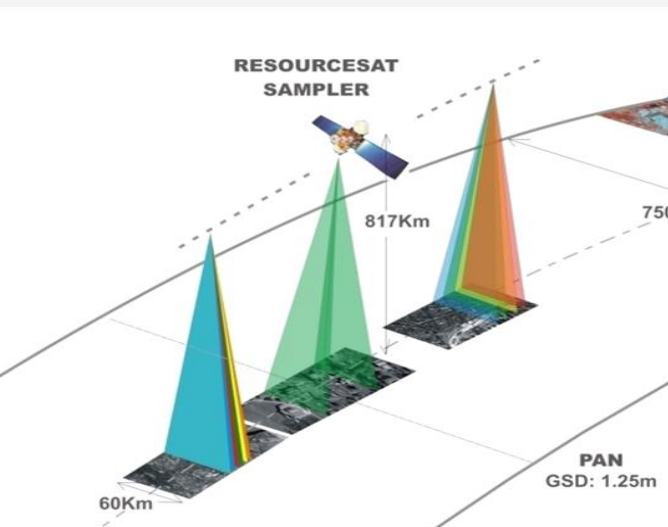
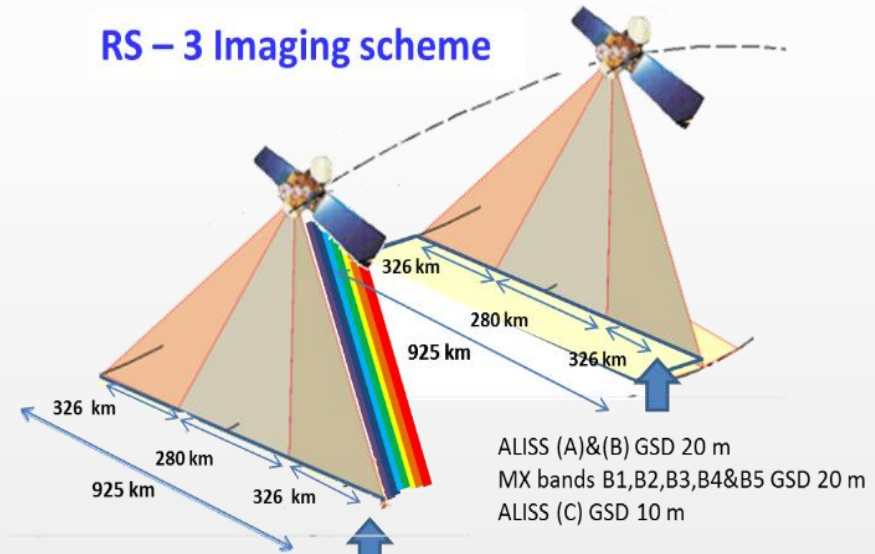


Resourcesat Sampler – 3S / 3SA (Q3 2020 / Q1 2021)

Sensor	GSD	Swath	Revisit
PAN	1.25 m	60 km	Revisit of 4 Days
MX	2.5 m	60 km	
Orbit: 633 km ; ECT: 10:30 Hrs			

Resourcesat - 3 & 3A (Q1 2021 / Q2 2022)

RS – 3 Imaging scheme



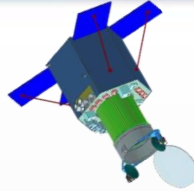
Advanced stereo PAN & Multi-spectral imaging

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 μ m	240 m		
Orbit: 795 km ; ECT: 10:30 Hrs			

Wide Swath imaging with improved spatial resolution



Cartosat-3 (Q1 2019)

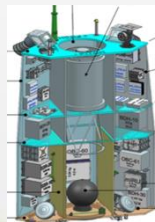


- PAN : 400 - 950 nm
- MX (4) : 45 -520 nm, 520-590 nm, 620-680 nm, 770-860 nm
- Better Agility with 4 Control Momentum Gyros (CMGs)
- Location accuracy < 15m with FOGs and Mk4 Star Sensors
- Ka Band Transmission to support higher data rate (20 Gbps)
- Second Data Reception Terminal (S/X/Ka) at Antarctica

Sensor	GSD	Swath	Revisit
PAN	0.28 m	17 km	5 Days
MX	1.14 m	17 km	

Orbit: 505 km ; ECT: 10:30 Hrs

HRSAT-1 (3 Nos.) (Q3 2020)



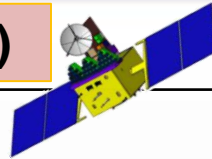
- PAN : 0.45 - 0.8 μm ,
- MX (3) : 0.52-0.59 μm ; 0.62-0.68 μm , 0.77-0.86 μm
- LWIR : 7.1-11 μm
- Constellation of 3 satellites launched in a single mission & phased 120 deg apart
- Systematic coverage of high resolution data of the country twice a year & feasibility of daily revisit of Area of Interest

Sensor	GSD	Swath	Revisit
PAN	1 m	15 km	Daily (AOI)
MX	< 4 m	15 km	
LWIR	20 m	6 km	

Orbit: 660 km ; ECT: 9:30 Hrs



OCEANSAT- 3 / 3A (Q1 2020) / (Q4-20)



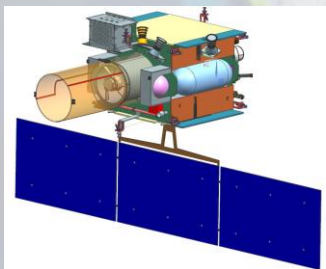
Daily global observation with 2 satellites

- Increased no. of bands (13) than earlier OCM-2 (08 bands)
- Better SNR (1000)
- Spectral bandwidth improved to 10-20 nm (OCM-3).
- Worldwide in-situ data collection using ARGOS

Orbit	Sun synchronous
Payloads	OCM-3 (13 bands: 407 to 1020 nm) : 360 m Scatterometer-3 (Ku Band - 13.51GHz) SSTM-1 (2 Bands: 11 & 12 μm) 1080 m Argos-4 (CNES Payload)
Swath	1400 x 1400 km
Orbit	720 km ; ECT: 12:00 Hrs

Integrated observations of Land, Ocean & Atm. with appropriate wave regions

GISAT-1 (Q3 2019)



Orbit	Geo-stationary satellite with 24-hour orbital period		
Payloads	MX - VNIR (6 bands)	[0.45 - 0.87 μm]	: 45 meter
	MX - LWIR (6 bands)	[7.1 - 13.5 μm]	: 1.5 x 1.5 km
	HS - VNIR (158 bands)	[0.38 - 1.0 μm]	: 320 meter
	HS - SWIR (256 bands)	[0.9 - 2.5 μm]	: 192 meter
W-E & E-W scan (Programmed to any value between 2.5 km /s to 250 km /s)			
Swath	1000 X 1000 km ; 3000 X 3000 km ; 6000 X 6000 km		



RISAT-1A (Q4 2019) & 1B (Q3 2020)

Frequency	C-band (5.35 GHz) Single, Dual & Circular (Hybrid)
Modes	Strip map, CRS, MRS, Spotlight
Resolution	3 to 6 m, 25 m, 50 m
Swath	10 km to 240 km
Inc Angles	20° – 49°
Repetivity	25 days - 240 km swath systematic
Orbit	536 km ; ECT: 6:00 Hrs

- Day/Night/ All weather imaging
- Continuity to RISAT-1 Mission
- Full polarimetry mode in RISAT-1B
- 2 Satellites for better coverage & revisit

NISAR (Q4 2021)

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

SweepSAR technique to image wide swath at high spatial resolution

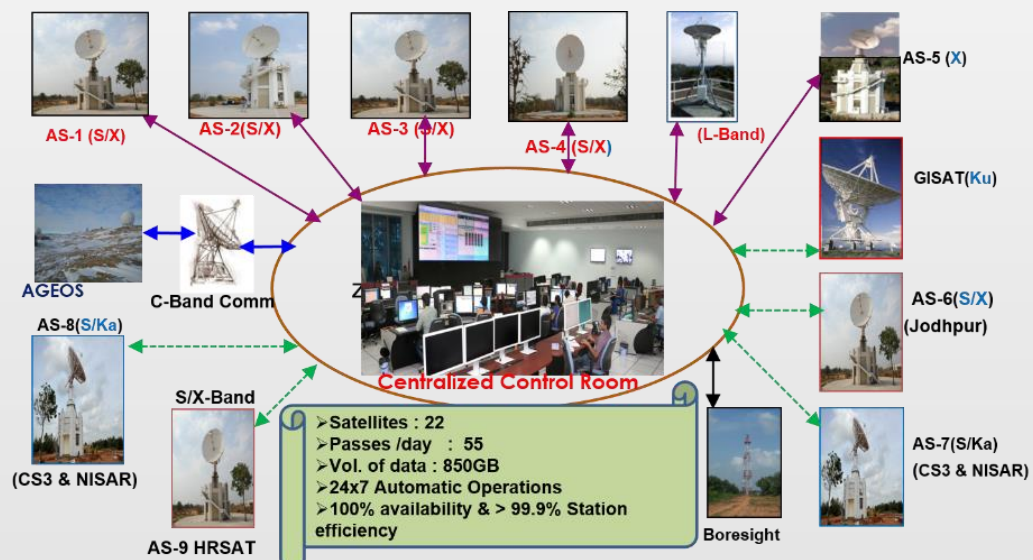
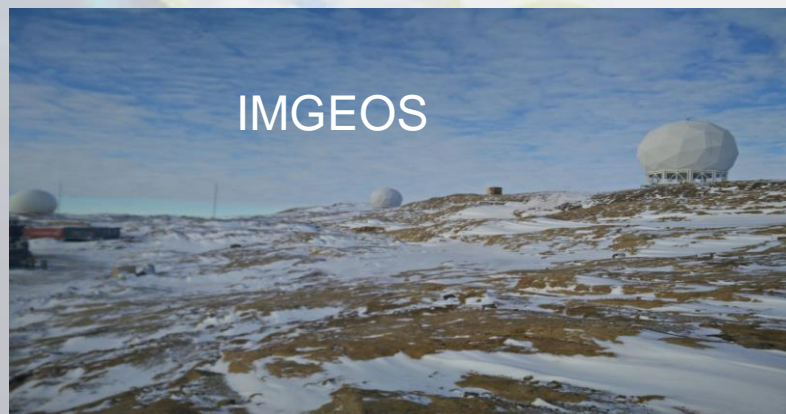
MAJOR SCIENCE APPLICATIONS

- Agriculture Biomass over full crop cycle
- Surface deformation studies
- Mountain / glacier snow; Ice sheet dynamics
- Monitoring of Floods, Oil slick, Forest fires
- Coastal erosion & Coastline changes
- Land Subsidence & Landslide



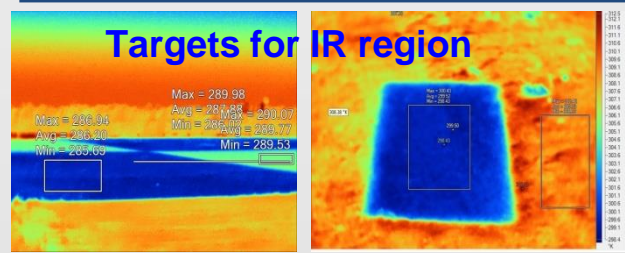
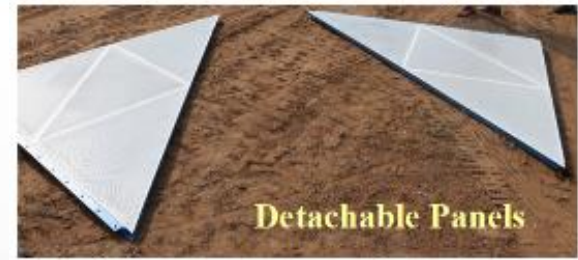
Ground Segment for Earth Observation Satellites (IMGEOS & AGEOS)

- S/X - 7.5 M(4), L -1.2 M(1), S/X - 4.5 M(1) Antenna Systems at Shadnagar ground station with Centralized Control room
- Antarctica ground station for Earth Observation Satellites (AGEOS) at Bharati, Antarctica (7.5 M S/X and S/X/Ka DRS)
- AGEOS - TTC & Payload data supported for 14 IRS missions/ 55 passes
- Data Communication Networks (ISRO / Spacenet)
- Bore Sight Test Facility
- AGEOS Communication link





- Design, Dev & of perforated detachable Corner Reflector of 2m for SAR calibration
- Design & Development of CR for permanent deployment in Antarctica as a part of establishing permanent SAR calibration site in Antarctica
- Development of Active Radar Calibrator for SAR
- Development of Cal-Val network for SAR calibration
- Periodic/scheduled calibration of IRS sensors (space/airborne) optical/microwave



Data Type	Targets
Optical VNIR & SWIR	Natural Soil/Stone Contrast bars Edge /Point
Microwave	Square Trihedral and dihedral CRs (40 to 125 cm)
Thermal	Natural material Water body

Data Dissemination Platforms



<http://www.bhuvan.nrsc.gov.in>

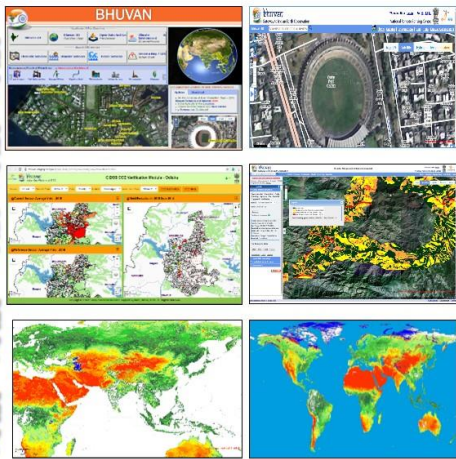
<http://www.mosdac.gov.in>

BHUVAN

Geo-spatial Data Collaboration Platform

- 1 Visualization Platform
- 2 Data & Product Clearing House
- 3 Thematic ,Disaster & Citizen services
- 4 Online Mapping & Data Collaboration
- 5 Regional Cooperation

> 90,000 registered Users
95 Million tiles/ Month
900 GB of Data Flow
200+ Applications



INSAT-3D & INSAT-3DR Data Products

IMAGER

SOUNDER

MeghaTropiques SARAL

INSAT-3D & INSAT-3DR Data Products since	INSAT-3D	INSAT-3DR
JDDMG_L1B_STD: Level1 data for Imager 6 channels	03-Oct-13	11-Oct-16
JDDMG_L1C_ASIA_NER: Mercator projection for Asian Sector	03-Oct-13	05-Oct-16
JDDMG_L1C_SGP: IMAGER 6 channel in Mercator projection	05-Oct-13	03-Oct-16
JDDMG_L1B_CMRK: INSAT cloud mask	05-Oct-13	14-Oct-16
JDDMG_L1B_HEM: Hypex Estimator method	06-Oct-13	14-Oct-16
JDDMG_L1B_BRC: RADAR Calibration	11-Nov-15	08-Nov-16
JDDMG_L1B_LST: Land surface temperature	04-Mar-15	11-Oct-16
JDDMG_L1B_OLR: Outgoing Longwave Radiation	02-Oct-13	11-Nov-16
JDDMG_L1B_SST: Sea Surface Temperature	03-Oct-13	
JDDMG_L1C_UPT: Upper Tropospheric Humidity	05-Oct-13	11-Oct-16
JDDMG_L1C_GMP: Cloud Microphysical Parameters	30-Nov-15	14-Oct-16
JDDMG_L1C_FOG: Night time FOG	05-Oct-13	26-Oct-16
JDDMG_L1C_PRR: Irradiance	11-Nov-15	08-Nov-16
JDDMG_L1C_SSNB: Storm Center	02-Oct-13	14-Oct-16
JDDMG_L1C_ADD: Aerial Depth	05-Oct-13	14-Oct-16
JDDMG_L1C_GPR: GOES Precipitation Index	02-Oct-13	14-Oct-16
JDDMG_L1C_DMR: Indian Multi Spectral rainfall from IMAGER	05-Oct-13	11-Oct-16
JDDMG_L1C_SST: Sea Surface Temperature	02-Jan-14	14-Oct-16
JDDMG_L1P_IW: INSAT-3D infrared channel derived wind	08-Oct-13	14-Oct-16
JDDMG_L1P_IW_MW: MW band data of IMAGER	08-Oct-13	14-Oct-16
JDDMG_L1P_BRC: Active Radar product	02-Oct-13	14-Oct-16
JDDMG_L1P_VSW: Visible band data of IMAGER	08-Oct-13	14-Oct-16
JDDMG_L1P_WVW: Water vapour derived wind vectors	08-Oct-13	11-Oct-16
JDDMG_L1B_OLR_DLY: Daily OLR from INSAT-3D	05-Jul-15	16-Nov-16
JDDMG_L1B_SST_DLY: Daily SST from INSAT-3D	01-Jan-14	16-Nov-16
JDDMG_L1B_UPT_DLY: Daily UPT from INSAT-3D	02-Jan-14	16-Nov-16
JDDMG_L1C_GPR_DLY: Daily GPR from INSAT-3D	05-Jul-15	16-Nov-16
JDDMG_L1C_DMR_DLY: Daily DMR from INSAT-3D	03-Jun-14	16-Nov-16
JDDND_L1B_S41: Sounder Level1 data for A1 sector	03-Oct-13	
JDDND_L1B_S81: Sounder Level1 data for B1 sector	03-Oct-13	11-Oct-16
JDDND_L1B_S12: Level1 data for SOUNDER 18 Channels	18-Apr-14	14-Oct-16
JDDND_L1B_S42: Sounder Level2 data for A2 sector	05-Oct-13	
JDDND_L1B_S82: Sounder Level2 data for B2 sector	05-Oct-13	11-Oct-16

National Information System for Climate and Environment Studies (NICES)

A multi-institutional effort involving various departments and national institutions

64 Geophysical Products

13 Essential Climate Variables

Terrestrial
Ocean
Atmospheric
Cryosphere
Model Derived

Global Normalized Difference Veg. Index

Ocean Surface Winds

Geostrophic Currents

Sea Surface Heights

Land Use Land Cover (Resourceat- AWIFS)

Albedo (16-31 Dec., 2015) OCENSAT-2 OCM

NDVI (16-31 Dec., 2015) OCENSAT-2 OCM

Snow melt and freeze (winter 2012) from Quat of

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

Visualisation of Earth Observation Data and Archival System

Space Applications Centre, ISRO

HOME
APPLICATIONS
TRAINING & RESEARCH (TREES)
ATLAS
SDIS
ABOUT US
SITEMAP
हिन्दी संस्करण

- Earth Observation
- Polar Science
- Atmospheric and Oceanic Science
- Planetary Science
- Hydrological Science & Applications
- Glacier Information System
- New and Renewable Energy
- Vegetation and Crop Monitoring
- Urban Sprawl Information System
- Snow Cover Monitoring
- Special Products

Announcement: DSM & Co... DSM Atlas... ERTD Training Announcement

IPOWER - Indian Potential Offshore Wind Energy Resource

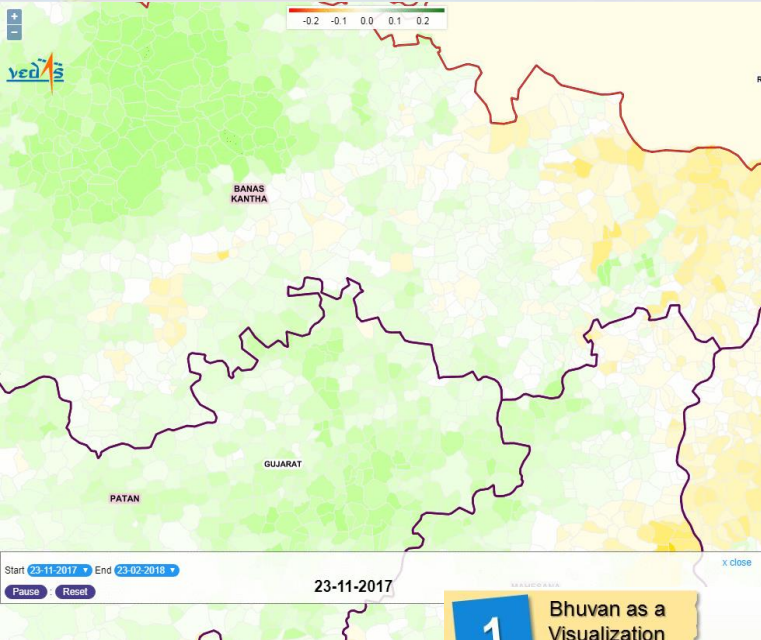
Earth Observation

New and Renewable Energy

Vegetation and Crop Monitoring

Urban Sprawl Information System

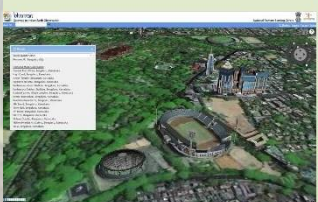
Data Dissemination Platforms & Web Analytics



1 Bhuvan as a Visualization Platform



Open Source 3D -Plug-in Free



<https://live.mosdac.gov.in> **LIVE** (Let's Interactively Visualise Earth)

Web based visualization and analysis system, provides NRT access

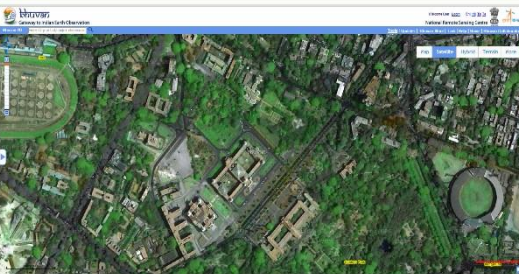
- Earth observation
- Meteorological & oceanographic products derived from satellite
- Model forecast and ground observations

3D View **Add Contours for each layer** **Auto Region Growing**

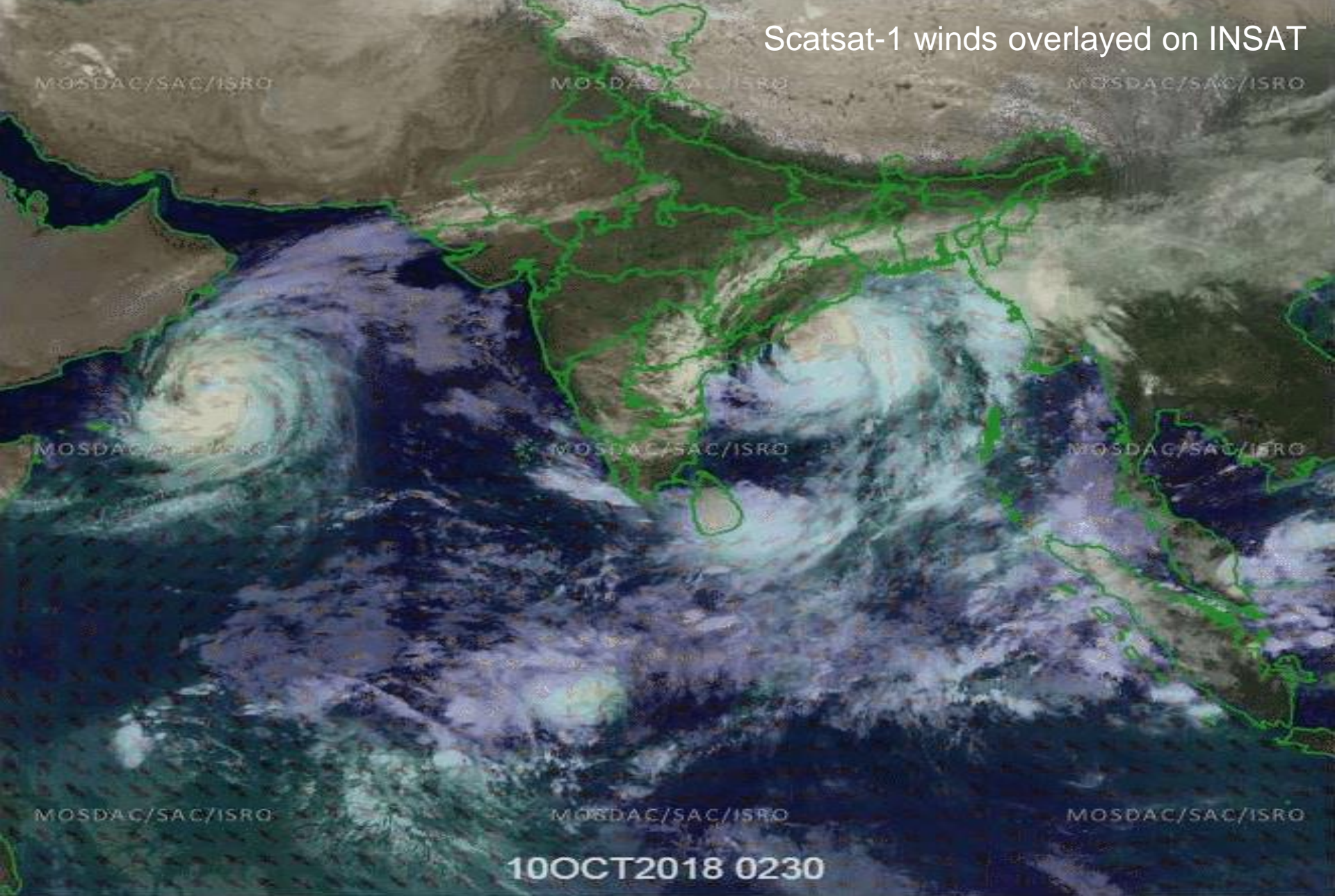
Visualization of Climatology

Multilayer composition with vector overlay & base maps

Maximum Temperature (degreeC)



Scatsat-1 winds overlaid on INSAT



10OCT2018 0230

THANK YOU