Committee on Earth Observation Satellites

Agency Updates – ISRO

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Space Applications Centre, ISRO

Indian Space Research Organisation

CEOS Plenary 2018

Agenda Item 4.12

Brussels, Belgium

17 – 18 October 2018

Current Operational Capabilities

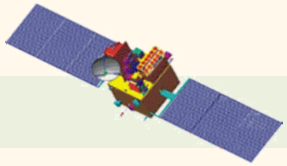
Natural Resources Inventory & Management

RESOURCESAT- 2 & 2A

- Three tier imaging : 56 m / 23 m / 5.8 m
- Revisit Capability : 03 / 11 / 03 days

Large Scale Mapping, Infrastru. Planning & Cartography

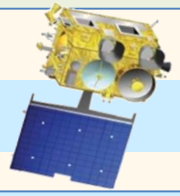
CARTOSAT-1, CARTOSAT-2 (3) & 2S (4)



- 2.5 m Stereo imaging
- Sub-meter PAN and 1.5 m Multi-spectral

Oceanography

OCEANSAT-2 ; SARAL ; SCATSAT-1

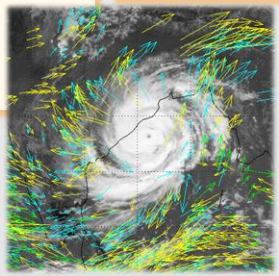


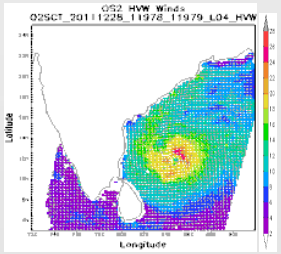
- Ocean color 360 m with 2 days revisit
- PFZ, Ocean State Forecast
- Ocean Altimetry, Surface Wind Vector

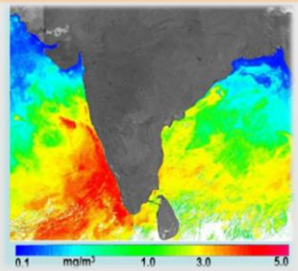
Weather and Climate

INSAT 3D & 3DR ; MEGHA-TROPIQUES

- 6 Bands Imager – 48 images per day
- 19 Channel Sounder – Atm. Profiles
- Radio Occultation – humidity profiles







Future Satellite Missions

2019 Q1 Q2 Q3 Q4 | 2020 Q1 Q2 Q3 Q4 | 2021 Q1 Q2 Q3 Q4 | 2022 Q1 Q2 Q3 Q4

LAND & WATER

14 Missions

Wide Swath imaging with improved spatial resolution

RESOURCESAT – 3

RESOURCESAT – 3A

RESOURCESAT – 3S

Advanced stereo PAN & MX ; HR DEM

RESOURCESAT – 3SA

RISAT-1A (Continuity to Risat-1)

RISAT-1B

NISAR (L& S Band SAR)

CARTO

CARTOSAT- 3 : Very High resolution PAN & High resolution MX

HRSAT (3) – Phased in Orbit for daily revisit of AOI

OCEAN

OCEANSAT - 3

Ocean Color & Wind vector – *Continuity* + *SST*

OCEANSAT – 3A

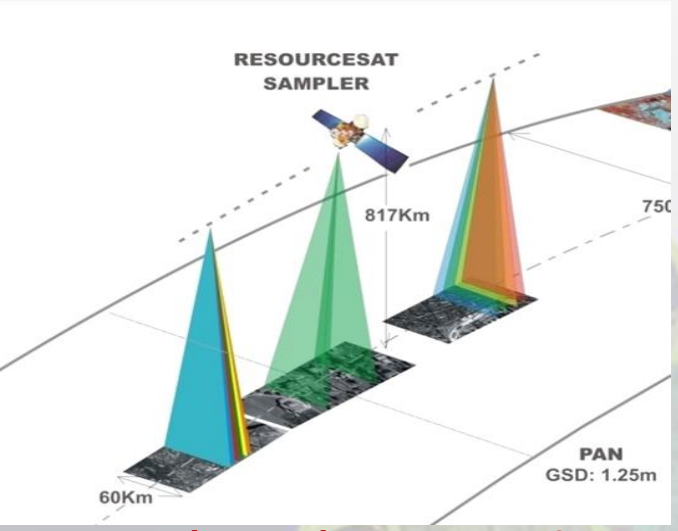
GEO

GISAT-1 (Observation from GEO)

EO Satellites in making

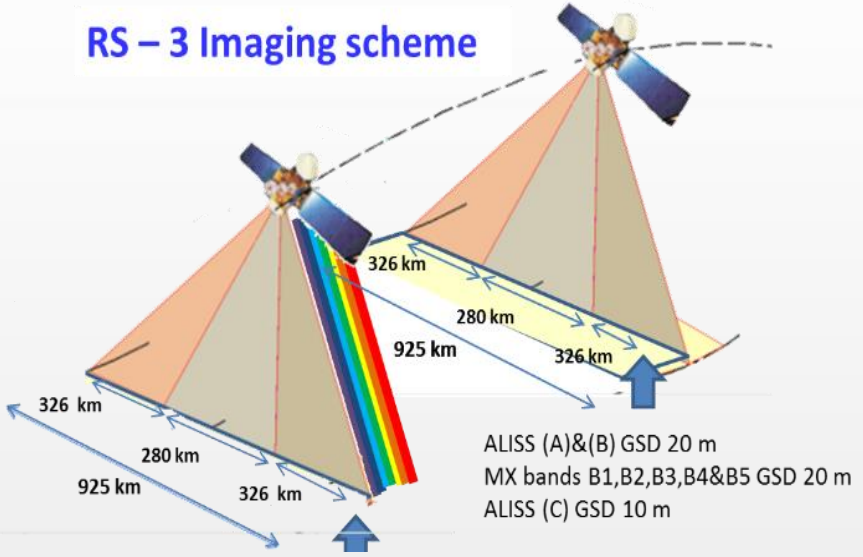
Resourcesat Sampler – 3S / 3SA (Q3 2020 / Q1 2021)

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			



Advanced stereo PAN & Multi-spectral imaging

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

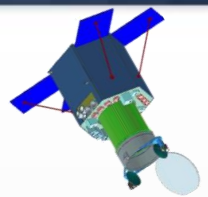


Sensor	GSD	Swath	Revisit
ALISS-3 (A,B & C)	20 m	925 km	4 days
ALISS-3 (C)	10 m	280 km	11 days
ATCOR 0.4-1 µm	240 m		
Orbit: 795 km ; ECT: 10:30 Hrs			

Wide Swath imaging with improved spatial resolution

EO Satellites in making

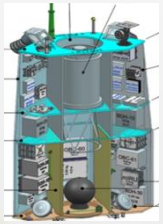
Cartosat-3 (Q1 2019)



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			

- 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

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

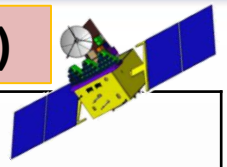


Sensor	GSD	Swath	Revisit
PAN	1 m	15 km	Daily (AOI)
MX	< 4 m	15 km	
LWIR	20 m	6 km	
Orbit: 660 km ; ECT: 9:30 Hrs			

- 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

EO Satellites in making

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



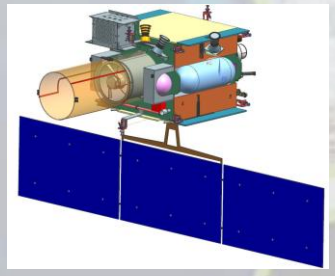
Orbit	Sun synchronous
Payloads	OCM-3 (13 bands: 407 to 1020 nm) : 360 m Scatterometer-3 (Ku Band - 13.51GHz) SSTM-1 (2 Bands: 11 &12 µm) 1080 m Argos-4 (CNES Payload)
Swath	1400 x 1400 km
Orbit	**720 km ; ECT: 12:00 Hrs**

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

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

EO Satellites in making

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

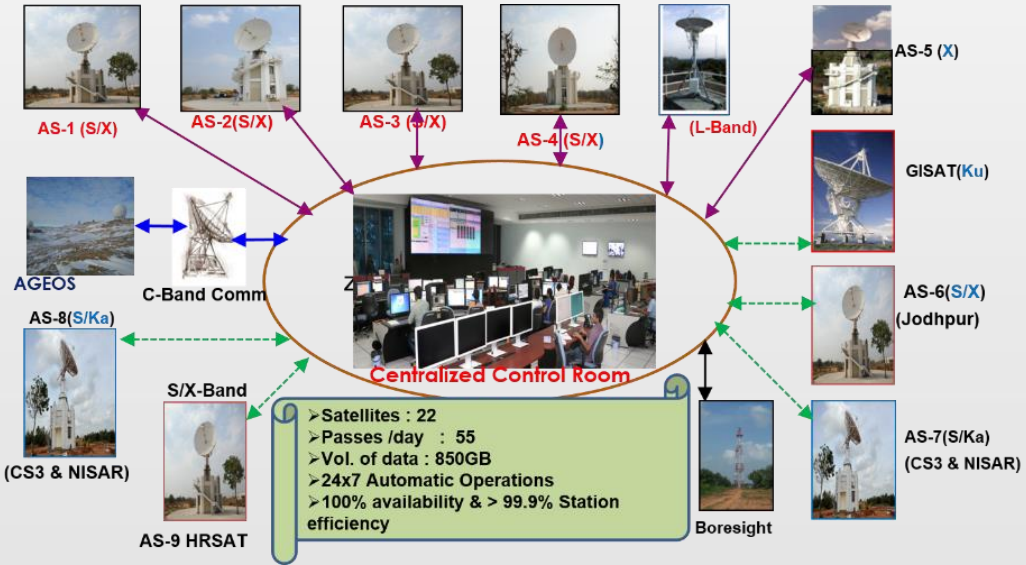
MAJOR SCIENCE APPLICATIONS

- 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

Satellite data reception

Ground Segment for Earth Observation Satellites (IMGEOS & AGEOS)

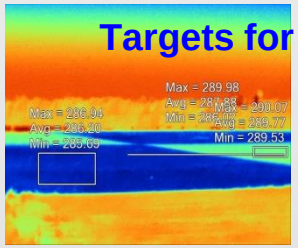
- S/X - 7.5 M(4), L -1.2 M(1), S/X - 4.5 M(1) Antenna Systems at Shadnagar ground station with Centralized Control room
- Antarctica ground station for Earth Observation Satellites (AGEOS) at Bharati, Antarctica (7.5 M S/X and S/X/Ka DRS)
- AGEOS - TTC & Payload data supported for 14 IRS missions/ 55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

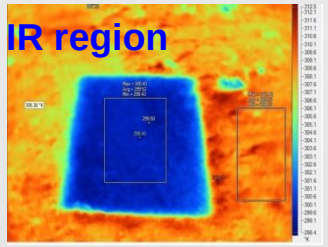


Cal-Val Initiatives

- 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



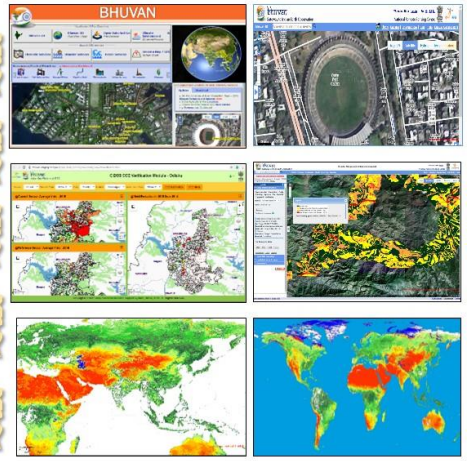


Data Dissemination Platforms

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

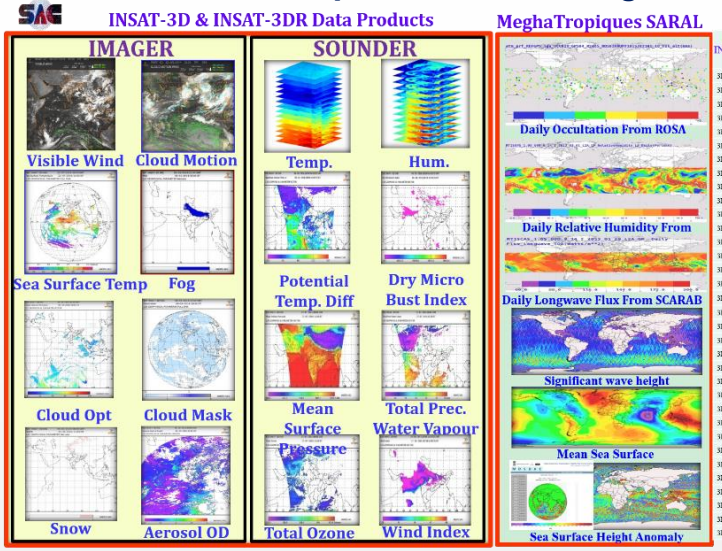
BHUVAN — Geo-spatial Data Collaboration Platform

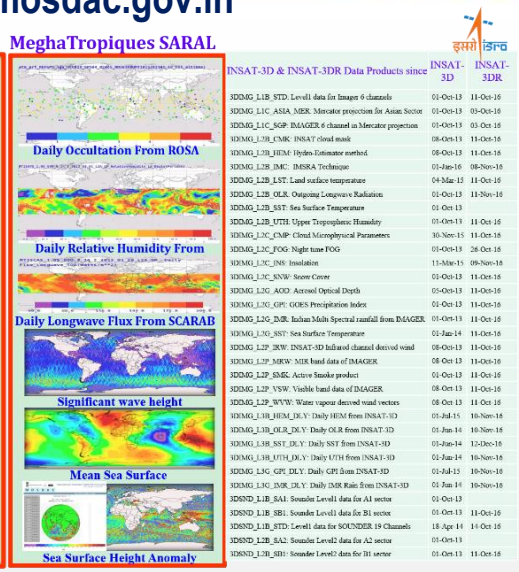
1. Visualization Platform
2. Data & Product Clearing House
3. Thematic ,Disaster & Citizen services
4. Online Mapping & Data Collaboration
5. Regional Cooperation



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

http://www.mosdac.gov.in





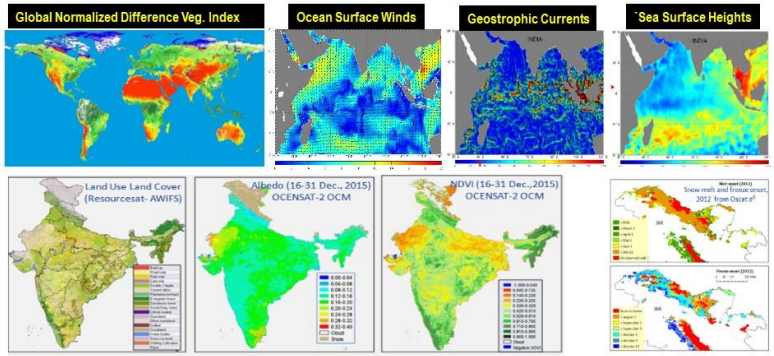
National Information System for Climate and Environment Studies (NICES)

64 Geophysical Products

A multi-institutional effort involving various departments and national institutions

13 Essential Climate Variables

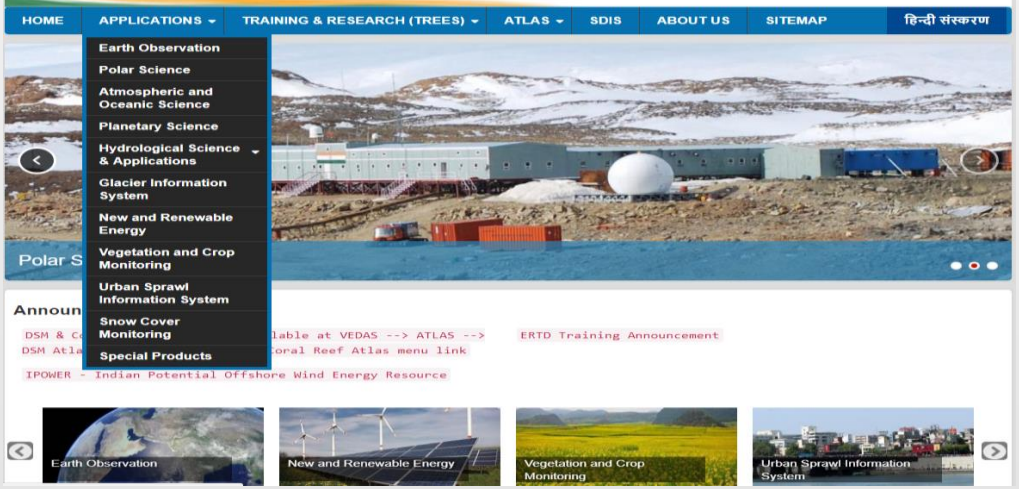
Terrestrial | Ocean | Atmospheric | Cryosphere | Model Derived



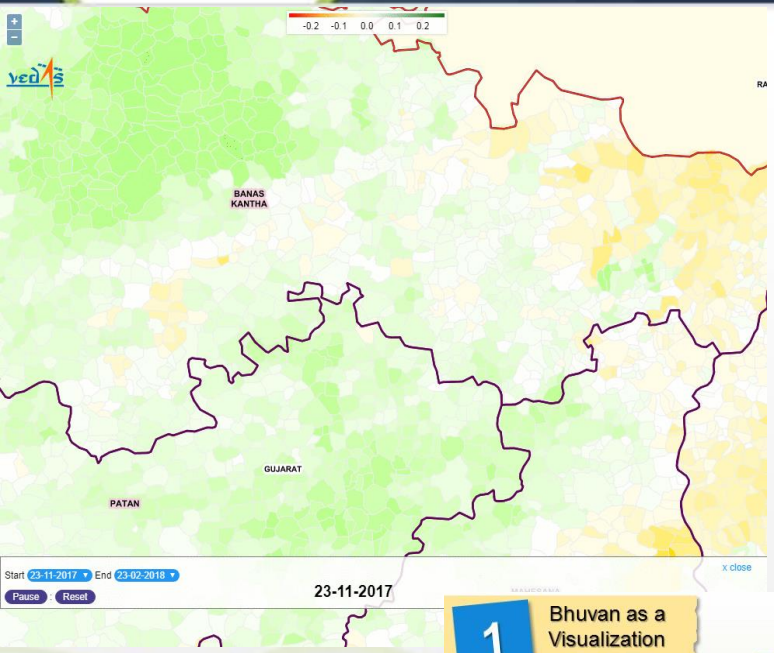
http://vedas.sac.gov.in/vedas/

Visualisation of Earth Observation Data and Archival System

Space Applications Centre, ISRO



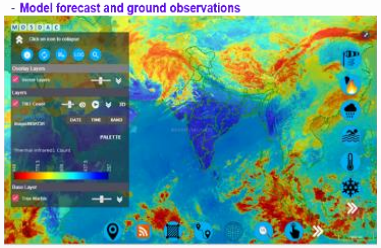
Data Dissemination Platforms & Web Analytics



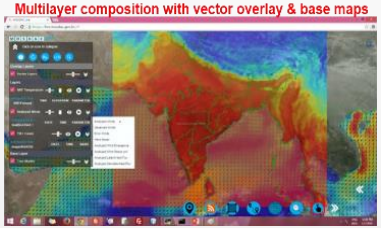
LIVE (Let's Interactively Visualise Earth)

https://live.mosdac.gov.in

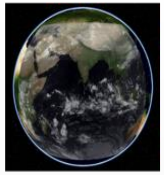
Web based visualization and analysis system, provides NRT access
- Earth observation
- Meteorological & oceanographic products derived from satellite
- Model forecast and ground observations



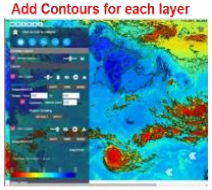
Multilayer composition with vector overlay & base maps



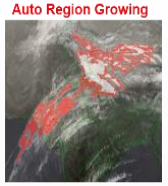
3D View



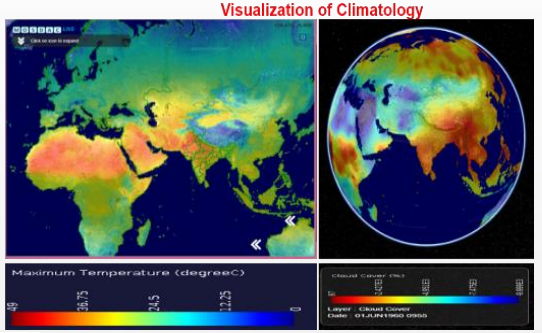
Add Contours for each layer



Auto Region Growing

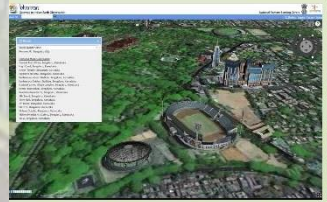


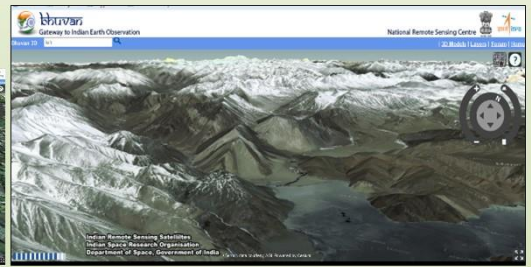
Visualization of Climatology

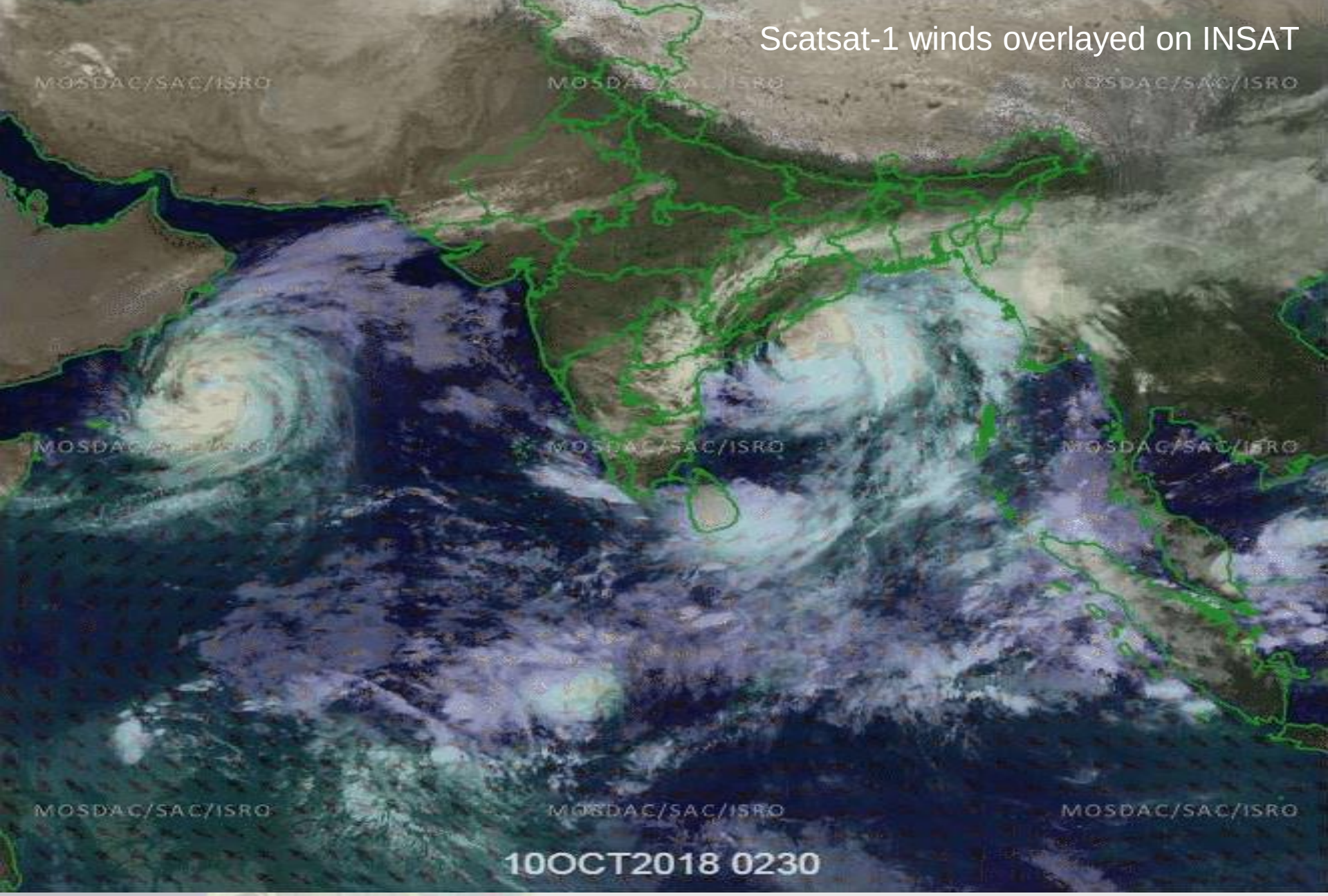


1 Bhuvan as a Visualization Platform

Open Source 3D –Plug-in Free






Scatsat-1 winds overlayed on INSAT
MOSDAC/SAC/ISRO
10OCT2018 0230

THANK YOU