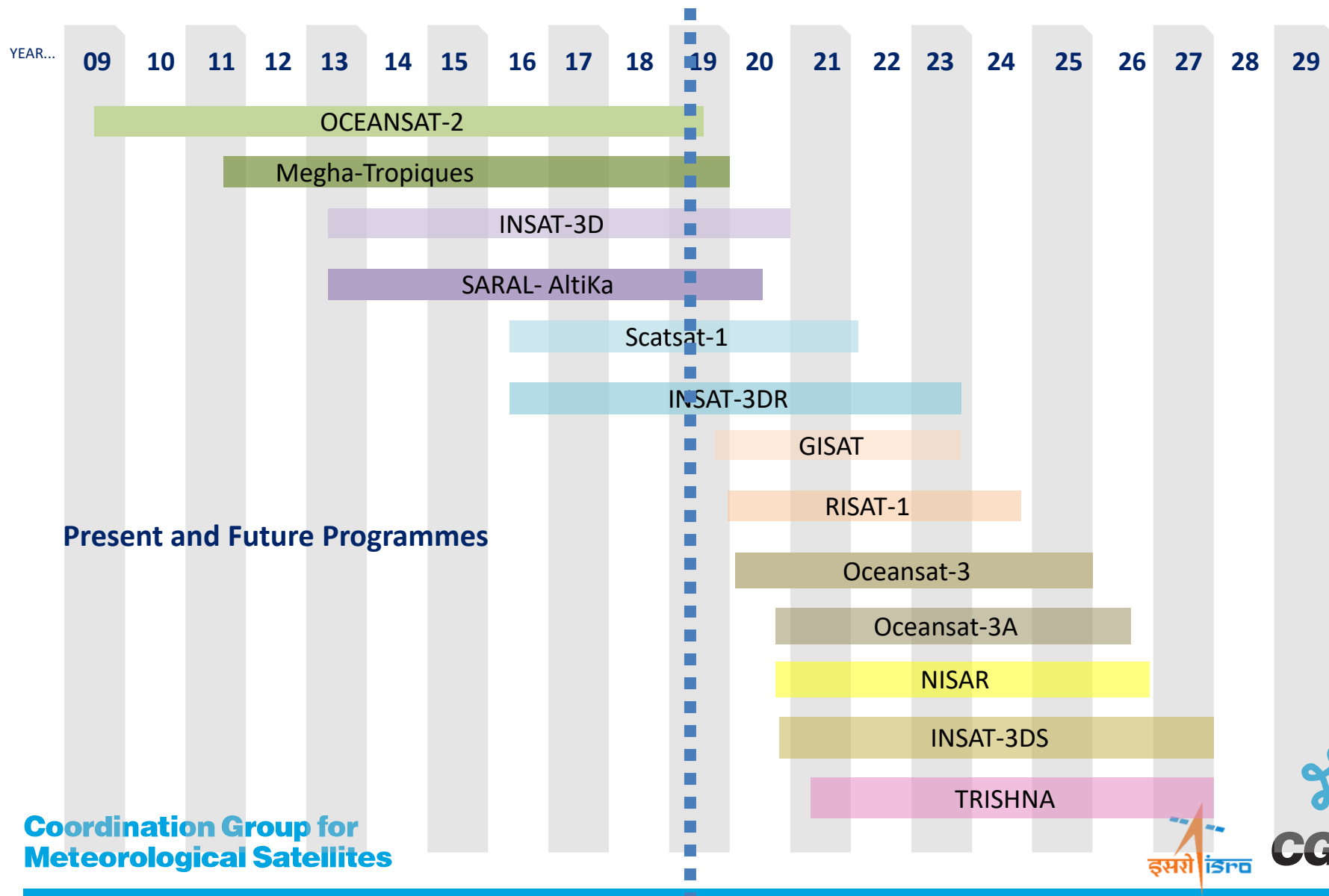


Status report on the current and future satellite systems by ISRO

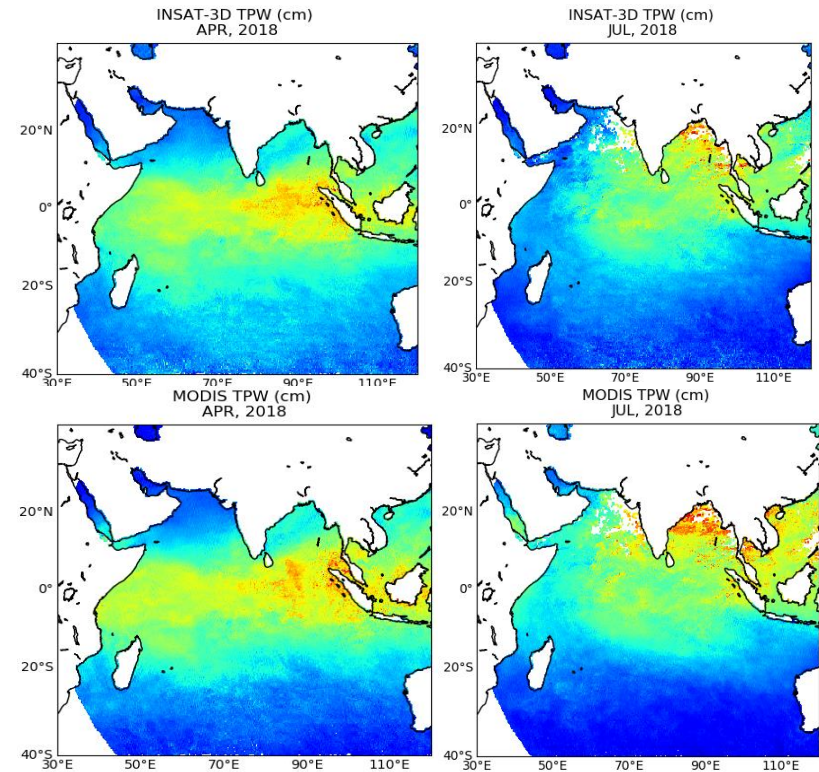
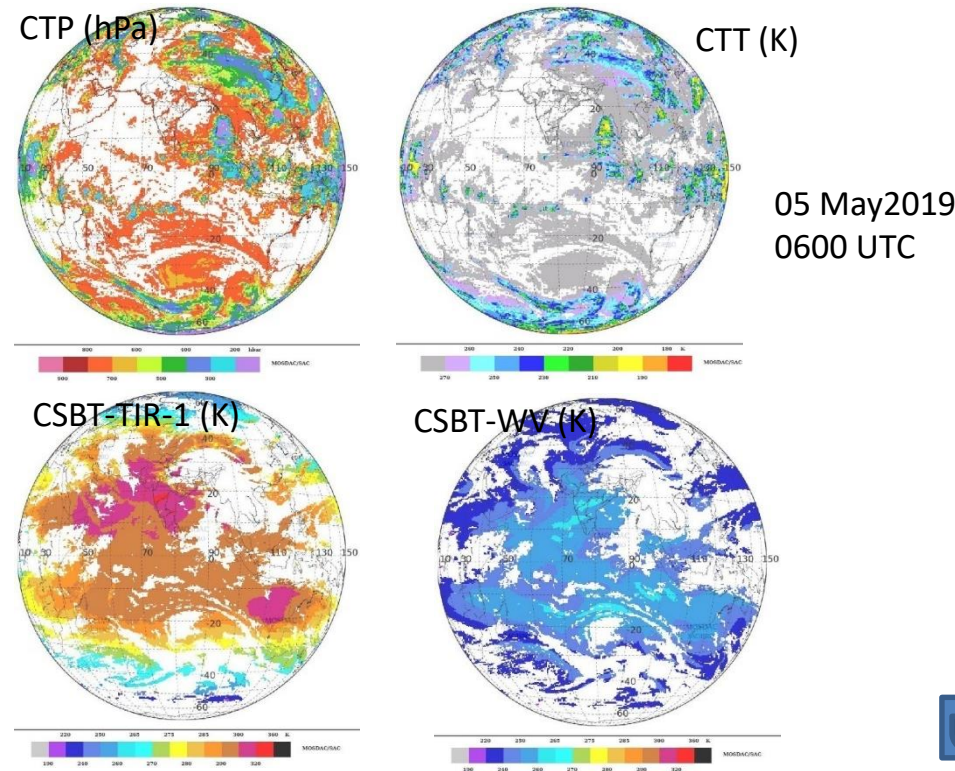
Presented to CGMS-47 plenary session, agenda item 4

EXAMPLE - Overview - Planning of ISRO satellite systems for Oceans and Atmosphere



CURRENT GEO SATELLITES : INSAT-3D/3DR

- Both INSAT-3D/3DR are operational Geo missions.
- New products of cloud properties (CTT,CTP), CSBT (WV, TIR) and TPW are fully operational.



SCATSAT-1: L4 Data Products

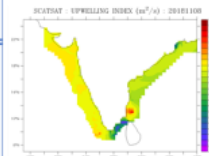
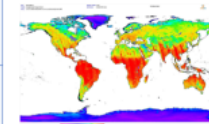
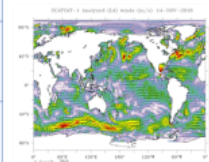
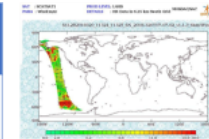
Category	Parameter	Res (Km)	Format
L1B	Scan mode Sigma0	25,50	HDF5
L2A	Swath grid Sigma0	25,50	HDF5
L2B	Winds	25,50	HDF5
L3S	Sigma0 (Day wise Global gridded)	25,50	HDF5
L3W	Winds (Day wise Global gridded)	25, 50	HDF5
L4AW	Analyzed winds	25	Netcdf
L4HW	High Resolution Winds	6.25	Netcdf
L3IC	Ice cover	25	Geotiff
L4-India, Fullglb, NPolar, Spolar	Sigma0, gamma0, BT	2	Geotiff

Products	Dissemination Method
L1, L2A	On user request and with authentication
L2B, L3, L4	As an open FTP
Quickbrowse	Anonymous user on MOSDAC portal

Category	LEVEL 4 Data Products at MOSDAC GeoTiff Sigma0, Gamma0,BT (2 Km Resolution)
INDIA	VVDES,VVASC,VVBOTH, HHDES,HHASC,HHBOTH
GLOBAL	VVDES,VVASC,VVBOTH, HHDES,HHASC,HHBOTH
NPOLAR24	VVBOTH, HHBOTH
NPOLAR72	VVDES, HHDES
SPOLAR24	VVBOTH, HHBOTH
SPOLAR72	VVASC, HHASC

Value added data products

Product	L3BT	L3IC	L4AW	L4HW	L4FULLGL OBE	L4INDIA	L4NPOLAR	L4SPOLAR	L4UI
Definition	Brightness Temperature	Ice Mask	Analyzed winds	High spatial density winds	Global Sigma0/Gamma0	India Sigma0/Gamma0	Sigma0/Gamma0	Sigma0/Gamma0	Upwelling Index
Spatial Coverage	Global	Global	Global	Swath	Global	India	North Pole	South Pole	India
Generation frequency	Daily	Daily	Daily	Revolution-wise	Daily	Daily	Daily	Daily	Daily
Spatial Sampling	0.25°X0.25°	0.25°X0.25°	0.25°X0.25°	0.0625°X0.0625°	0.02°X0.02°	0.02°X0.02°	0.02°X0.02°	0.02°X0.02°	0.25°X0.25°
Format	Geotiff	HDF5	NetCDF	HDF5	Geotiff	Geotiff	Geotiff	Geotiff	Netcdf



CURRENT LEO SATELLITES: **Oceansat-2**

- An 8-band Ocean Colour Monitor (**OCM**) with 360 m spatial resolution; Swath -1420 km (working)
- A Ku-Band Pencil beam **SCATTEROMETER** (OSCAT) with a ground resolution of 50 km x 50 km; Swath – 1800 km (terminated in March 2014)
- Radio Occultation Sounder for Atmospheric studies (**ROSA**) - Developed by the Italian Space Agency – ASI (working)

To generate long-term CDR of ocean surface winds, archived OSCAT are being re-processed using SCATSAT-1 algorithm

CURRENT LEO SATELLITES: **Megha-Tropiques**

- A 9-channel passive microwave radiometer – MADRAS
- A 6-channel microwave humidity sounder - SAPHIR
- An Earth Radiation Budget instrument – ScaRab
- A RO instrument - ROSA

Recently an anomaly is noted in the on board media system as temperature increases. Hence every 3rd orbit data is recorded

CURRENT LEO SATELLITES: **SARAL: Satellite with Argos and Altimeter**

-Joint Indo-French satellite mission for oceanographic studies

Hosted on MOSDAC FTP Site

Altika Payload:

- **Ka-band** (35.75 GHz, BW 500 MHz) radar altimeter
- Dual-frequency microwave radiometer (23.8 & 37 GHz)
- DORIS & Laser Retro-reflector Array
- Repeat Cycle: 35 days

• Three primary geophysical parameters from SARAL/Altika are:

- **Sea Surface Height (SSH)**--- After subtracting the mean sea surface, also used as sea level anomaly (SLA) or Sea surface height anomaly (SSHA)
- **Significant Wave Height (SWH)**
- **Ocean Surface Winds**
- **Currently the system is in drifting orbit mode and there is large mis-pointing since February 2019.**

Available Data at mis-pointing <0.09 degree² (As recommended by CNES):

Jan 2019 : ~ 100% ; Feb 2019 : ~ 60% ; Mar 2019: ~ 75% (From Fig. 1)

Valid data After applying all other checks (recommended in User Handbook) for all mis-pointing angles:

Jan 2019 : ~ 95% ; Feb 2019 : ~ 60% ; Mar 2019: ~ 80%

ARGOS Data Collection System:

- Contributes to development and operational implementation of global ARGOS DCS.
- Collect a variety of data from ocean buoys to transmit the same to the ARGOS Ground Segment for subsequent processing and distribution.

FUTURE GEO SATELLITES: (GISAT)

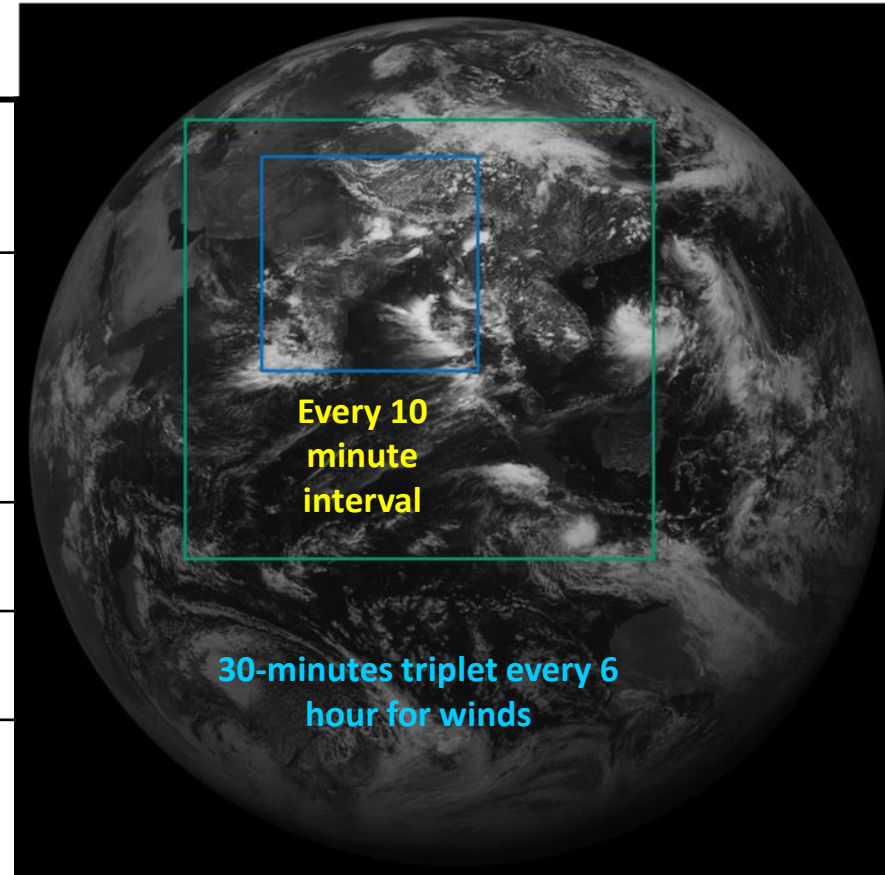
Launch Schedule: 2019, Geo orbit, 83E

MX-VNIR: Multispectral - Vis Near Infrared, HySI-VNIR: Hyperspectral Imager - Vis Near Infrared, HySI-SWIR: Hyperspectral Imager - Short Wave Infrared, MX-LWIR: Multispectral - Long Wave Infrared.

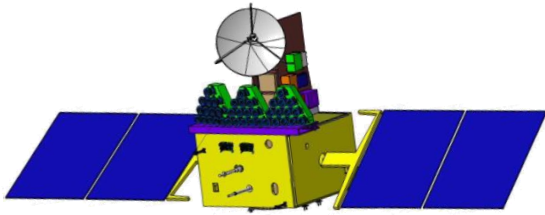
Band	Ch	SNR/NEdT	IFOV (m)	Range (μm)	Channels (μm)
MX-VNIR	6	> 200	50	0.45 - 0.875	B1: 0.45-0.52 B2: 0.52-0.59 B3: 0.62-0.68 B4: 0.77-0.86 B5N: 0.71-0.74 B6N: 0.845-0.875
HyS-VNIR	60	> 400	500	0.375 - 1.0	$\Delta\lambda < 10 \text{ nm}$
HyS-SWIR	150	> 400	500	0.9 - 2.5	$\Delta\lambda < 10 \text{ nm}$
MX-LWIR	6	NEdT < 0.15K	1500	7.0 - 13.5	CH1: 7.1-7.6 CH2: 8.3-8.7 CH3: 9.4-9.8 CH4: 10.3-11.3 CH5: 11.5-12.5 CH6: 13.0-13.5

GISAT Scan scenario

Scan area for two scan scenario (5° & 10°)



FUTURE MISSION: OCEANSAT-3 (2020) & 3A (2020)

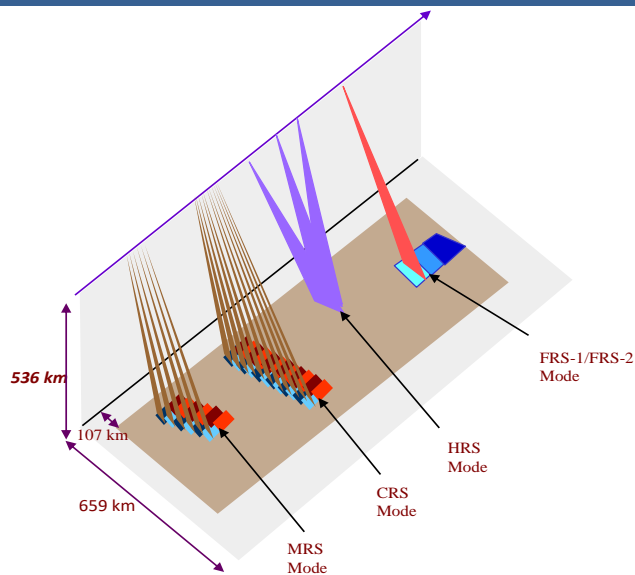


Payloads:

- **13-band Ocean Colour Monitor (OCM)** - 400-1010 nm range; 360 m resolution; 1400 km swath , Global Coverage in 2 days.
- **2-band Long Wave Infra Red (LWIR)** around 11 and 12 μm
- **Ku-Band Pencil beam SCATTEROMETER**

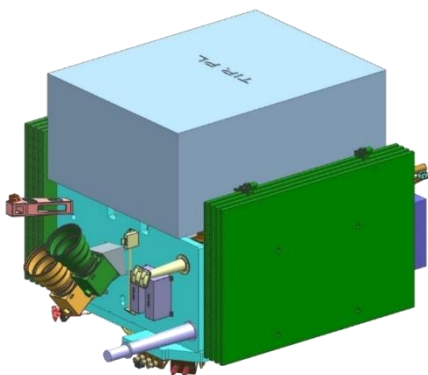
Band No.	λ_c (nm)	Application
B1	412	Yellow Substance Absorption
B2	443	Low Chlorophyll, Yellow Substance
B3	490	Moderate Chl., yellow substance
B4	510	High Chl., Chl. Species, TSM, algal blooms
B5	555	High Chl., Chl. Species, TSM, algal blooms
B6	566	Phycoerythroblin pigment (PE), Trichodesmium bloom detection
B7	620	Algal blooms, TSM
B8	670	Algal Blooms, baseline for chl. Fluorescence
B9	681	Chl. Fluorescence for high concentrations
B10	710	Extrapolation to VIS bands better in atmos. Correction baseline for chl. fluorescence
B11	780	Atmospheric correction; avoids O ₂ absorption band
B12	870	Atm. Correction. Good separation from previous bands. Better for coastal waters
B13	1010	Atm. Correction. Good for coastal waters. Useful for aerosol & foam discrimination
B14	11250	Sea surface temperature
B15	12250	Sea Surface Temperature

FUTURE MISSION: RISAT-1A (2020)



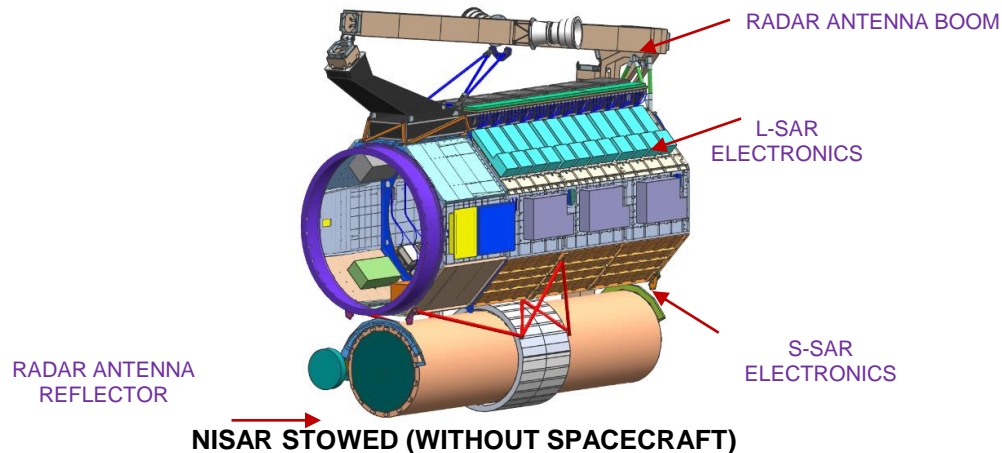
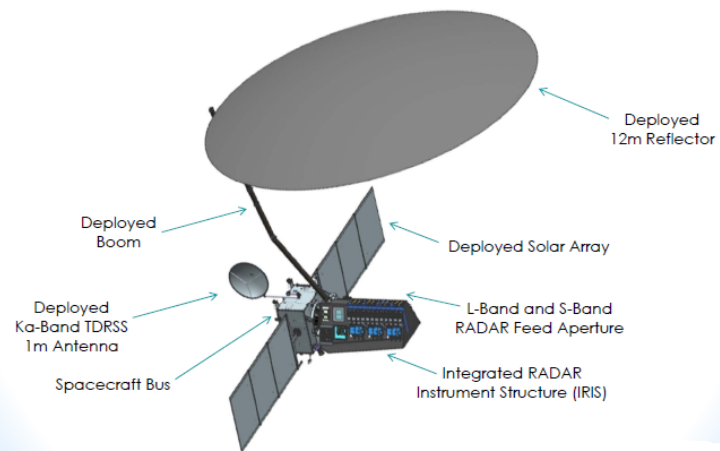
Frequency	C-band (5.35 GHz)
Polarization	Single, Dual , & Circular (Hybrid)
Swath	10 km to 240 km
Incidence Angles	20° – 49°
Spatial Resolution	3 to 8, 25, 50 m
Repetivity	25 days for 240 km swath – systematic
Modes	Stripmap, CRS, MRS, Spotlight

FUTURE MISSION: TRISHNA (2021)



Thermal Infrared Instrument	4 bands (8.6 to 11.5 μm) 50 m resolution at NADIR 930 km swath
VNIR/SWIR Instrument	6 bands (485 to 2130 nm) 50 m resolution at NADIR 930 km swath

LAUNCH: 2021



Parameters	L-band SAR	S-band SAR
Orbit	747 Km with 98.5° Inclination	
Frequency (wavelength)	1.25GHz (24cm)	3.20 (9.3cm)
Repeat cycle	12 days	
Time of Nodal Crossing	6AM / 6PM	
Polarization	Single (SP), Dual (DP), Circular (CP), Quad (QP) and Quasi-quad pol (QQP)	
Incidence angle range	33 – 47 deg	
Available Range Bandwidths	5 MHz, 20 MHz, 40 MHz, 80 MHz	10 MHz, 25 MHz, 37.5 MHz, 75 MHz
Resolution (Azimuth × Slant range)	6.9m × 7.5m (for 20MHz bw) 6.9m × 1.9m (for 80MHz bw)	6.4m × 6m (at 25MHz bw) 6.4m × 2m (for 75MHz bw)
Max. Swath width	> 240 Km	
Data and Product Access	Free & Open	

Missions Beyond 2020

- Continuity to the operational series - Oceansat, INSAT (met from Geo) are ensured.
- ISRO is interested in missions such as
 - Temperature, Humidity Sounder (in advanced stage)
 - Advanced Microwave Radiometer
 - Altimeter
 - Precipitation Radar
 - Wind Profiler
 - Atmospheric Chemistry, Aerosol mapping Missions
- There are opportunities for collaboration with international partners.



Application of Space Technology for the benefit of the common man

Assured data availability until 2024

<https://mosdac.gov.in>

USER ORIENTED SERVICES ON WEB

Features:

- Multi Mission Satellite Data Repository
- In-situ and CAL-VAL data hosting
- NRT dissemination as open data
- Forecast & Alerts dissemination
- Tools & Utilities
- Research and Training programs

Services:

- Weather and Ocean State Forecast
- Nowcast, Current Events, Past Events
- Advisories
- Visualization
- Met Applications
- Ocean Applications

Announcements
 SMART | MOSDAC Research & Training Initiative |
 SMART_Research_Programme_Brochure.pdf#
 SARAL-Altika Coastal Product | Science Product is now available |
 Digital Object Identifier (DOI) | Digital Object Identifiers (DOI) based persistent identifiers for products introduced in MOSDAC. |
 List of DOI-final-flash.pdf#
 MOSDAC: A Decade of Service to the Nation |
 decade-mosdacpdf.pdf#

Alerts
 Heavy Rain (Nowcast) : Heavy Rain Alerts in Bellampalle Asifabad Aheri cities of India
 Heavy Rain (Forecast) : Heavy Rain Alerts in Thrissur Kochi Trivandrum cities of India

Coordination Group for Meteorological Satellites



LIVE (Let's Interactively Visualize Earth)

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

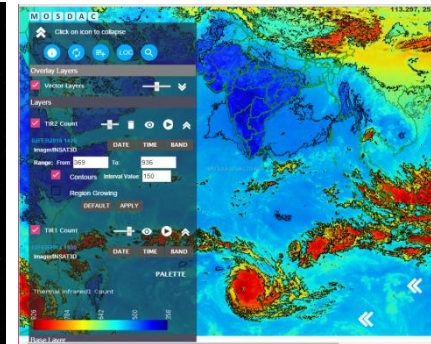
Web based visualization & analysis system;

- Provides Earth observation in Near Real Time
- Met. & ocean data products derived from satellite
- Model forecast and ground observations

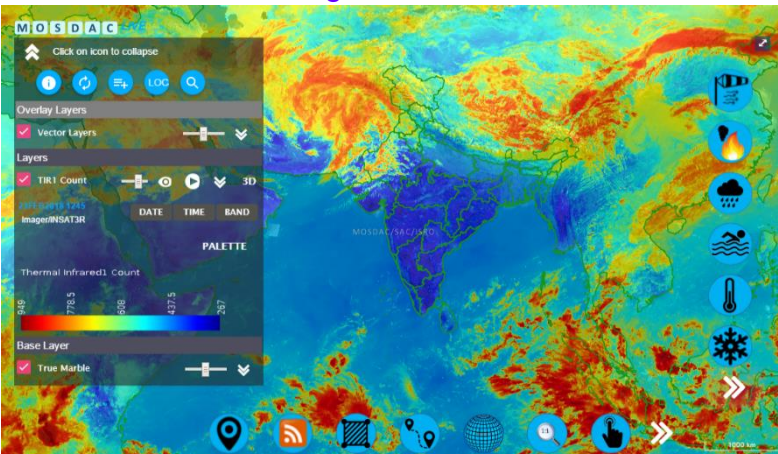
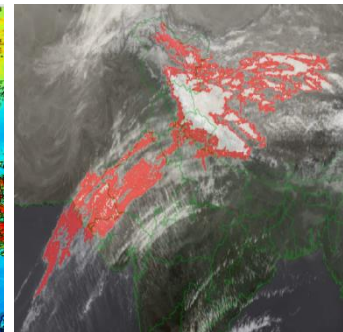
3D View



Add contours - each layer

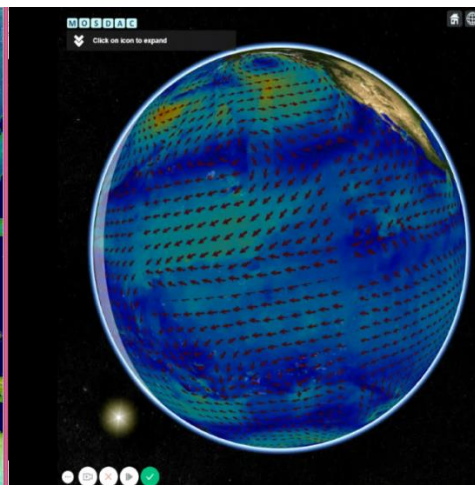
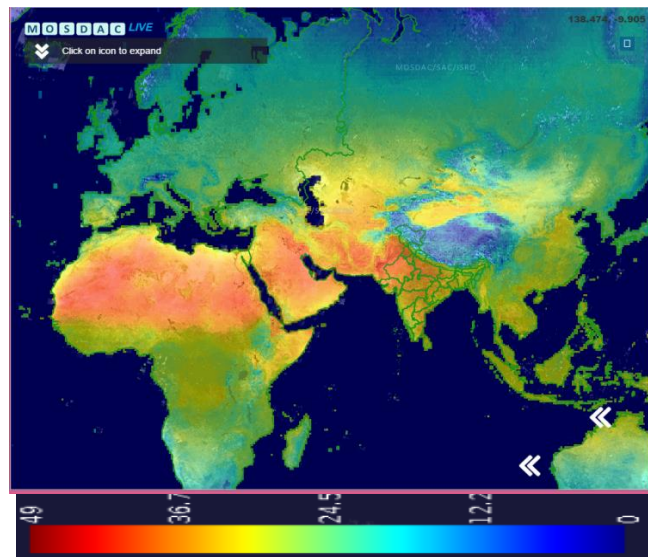


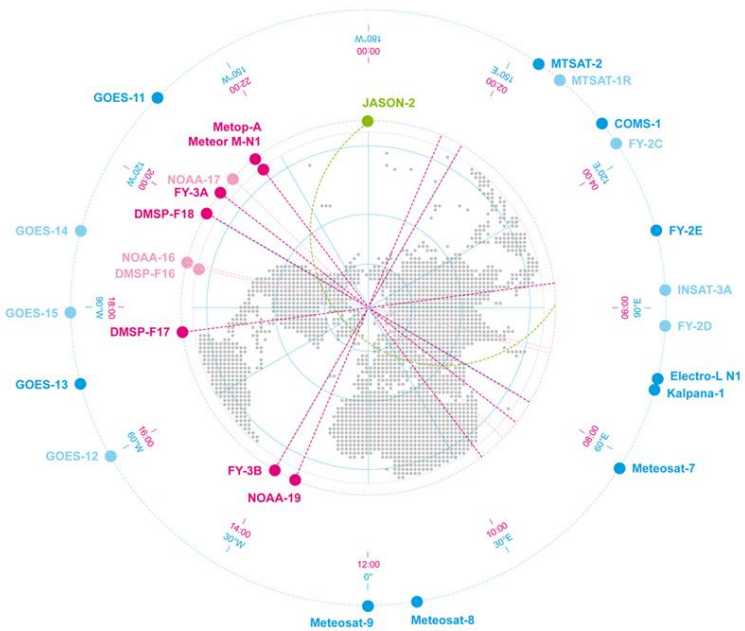
Auto region growing



Multilayer composition with vector overlay & base maps

Visualization of Climatology and 3D Visualisation of SCATSAT Winds





Thanks

avarma@sac.isro.gov.in