



Joint ISRO-IMD Report on updates and Future Plans

Presented to CGMS-50 Plenary Session, Agenda#2

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Recent Developments

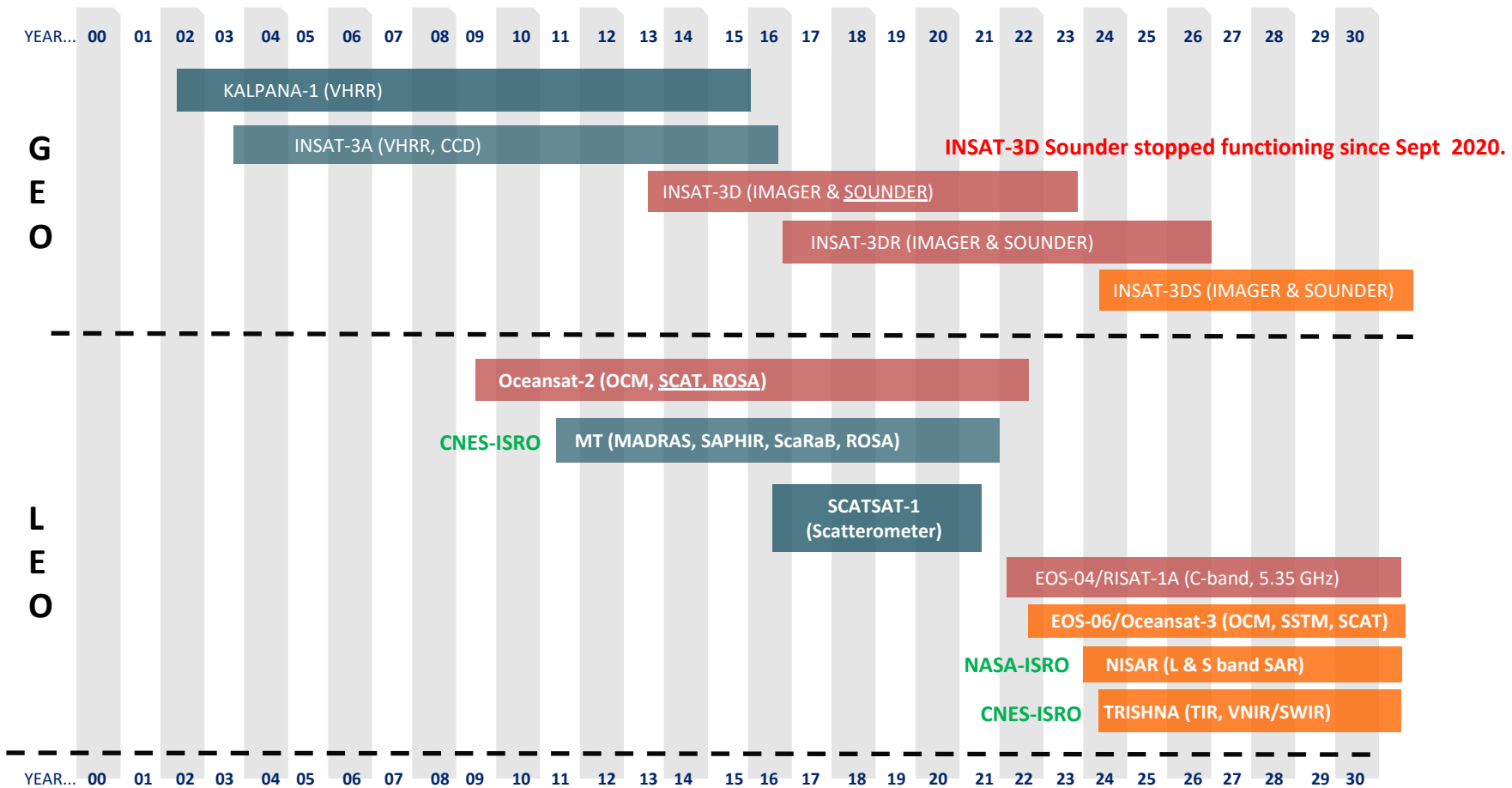
- ISRO has recently reviewed the activities related to CGMS and updated the representatives to Working Groups and Task Teams. This is expected to accelerate the contribution of ISRO to CGMS.
- ISRO intend to participate in the WG-1 Collision avoidance and debris management Task Group. ISRO has a strong group working on this subject. Nomination will be sent soon.
- ISRO welcomes the WMO unified data policy for International data exchange and hope to work out the details soon in discussions with WMO.
- ISRO welcomes the incorporation of Socio-economic impacts of satellite missions, as one of the CGMS objectives. ISRO will be contributing to this activity in the near future.
- The Remote Sensing Data policy of India is under review. Data above 5m spatial resolution is proposed to be distributed free of cost and without any restriction.
- The future missions approval and funding is under review. Updates on continuity for missions (Oceansat and INSAT-3D series) will be provided in due course of time.

Programmatic Developments

- ISRO-IMD Team validated products in Multi-Mission Data Reception and Processing System (MMDRPS, developed by ISRO) which is operational at IMD, since Jan 2021 for INSAT-3D/3DR.
- SCATSAT-1 with Ku-band Scatterometer completed the mission in February, 2021.
- ISRO-CNES joint mission SARAL/AltiKa is functioning in mispointing mode and the mission is extended till December 2022, provided the health of the satellite is satisfactory. The mission will be further reviewed in December 2022.
- ISRO-CNES joint mission MeghaTropiques was launched into orbit in October 2011. Due to an on-board anomaly in March 2019, the data availability has become low. ISRO-CNES JSC decided to announce the end of mission.
- ISRO's GSICS activities will be shortly extended to MetOp-C/IASI and JPSS/CrIS for IR Channels and Ray-Matching method for Vis/SWIR channels using Aqua/MODIS and JPSS/VIIRS.
- Oceansat-3 is scheduled for launch in September 2022 with Ku-band scatterometer, Sea Surface Temperature Monitor (SSTM), and Ocean Color Monitor (OCM-3).
- INSAT-3DS is getting ready for launch and the schedule will be announced shortly.

ISRO's Instruments Updates & Planned launches

Atmosphere & Ocean

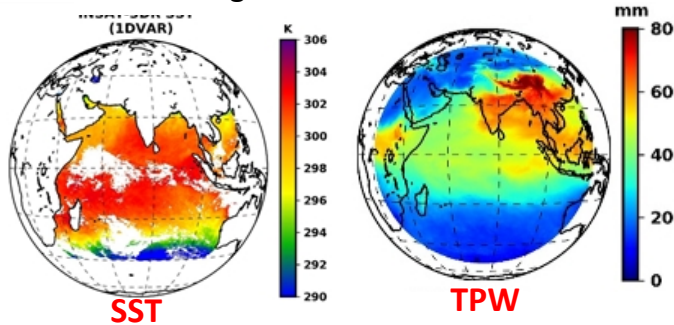


INSAT-3D/3DR Imager/Sounder

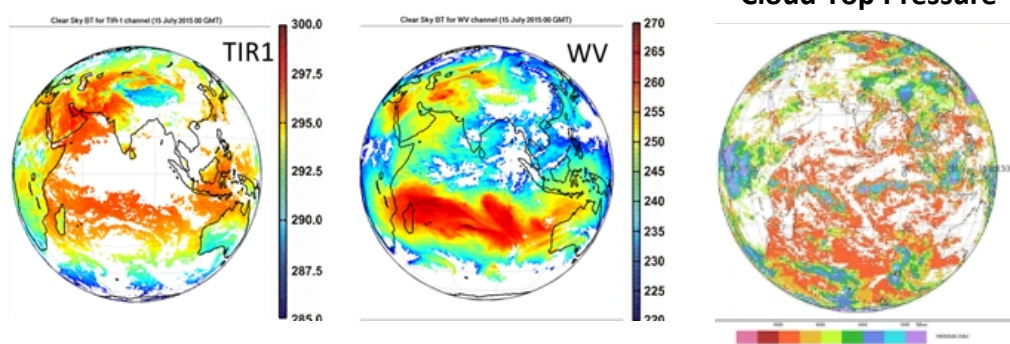
Multi-Mission Meteorological Data Receiving and Processing System (MMDRPS)

- Under **Antrix & IMD MoU**: Complete processing of INSAT-3D series of satellites, including Data Reception, Processing, Parameter Retrieval, Visualisation/Dissemination, and Validation developed by ISRO
- **Operational at IMD, new Delhi** since Jan 2021
- Additional 15 Parameters were added in MMDRPS over previous IMDPS system.

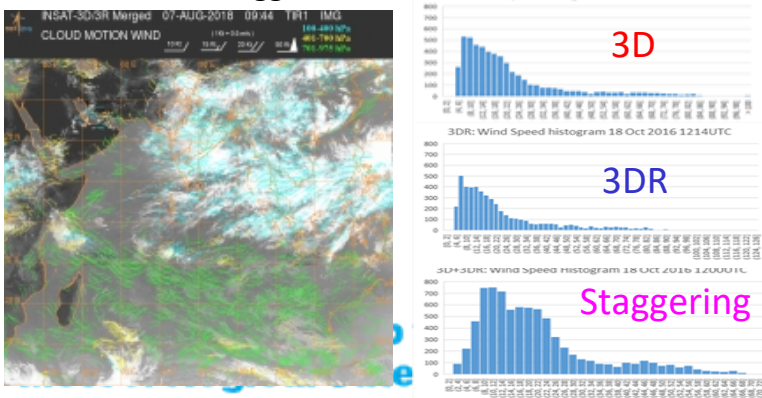
1D-VAR Algorithm for SST & TPW



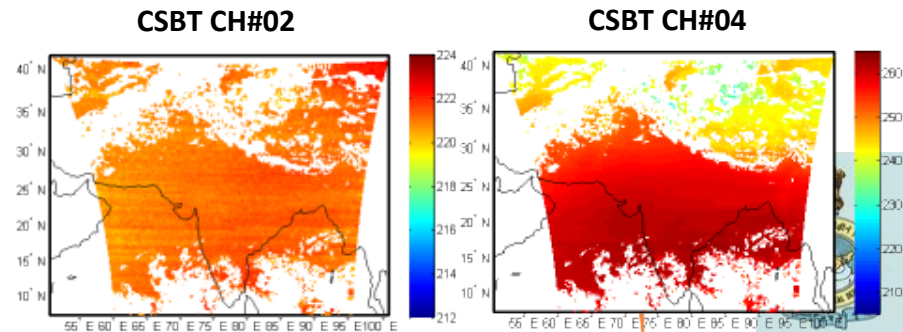
Clear sky Brightness Temperature



INSAT-3D/3DR Staggered Winds

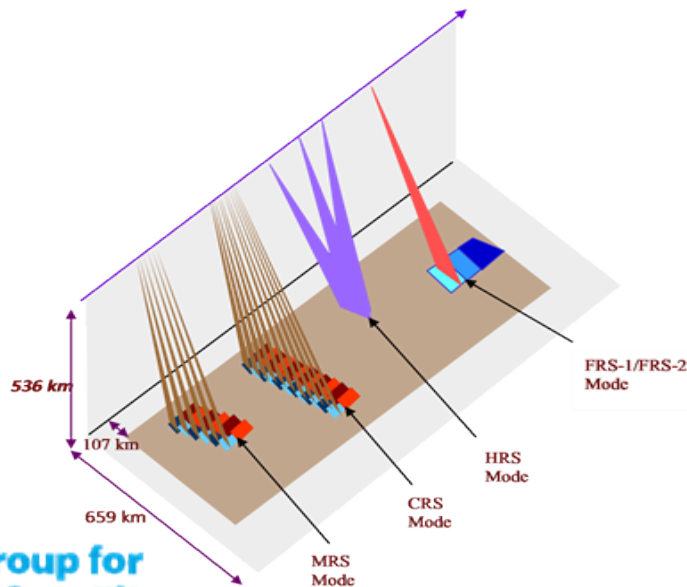


INSAT-3DR Sounder Clear Sky Brightness Temperature (CSBT)

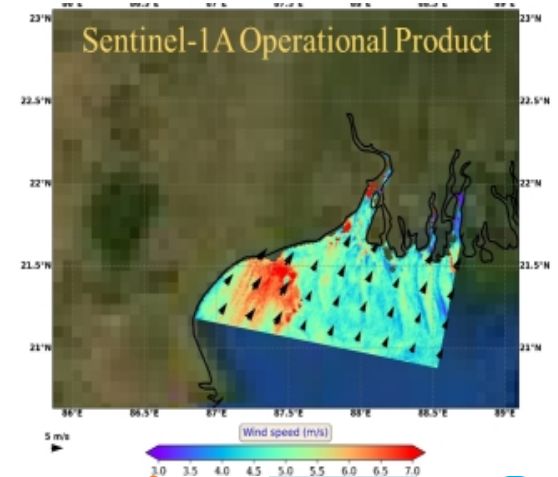
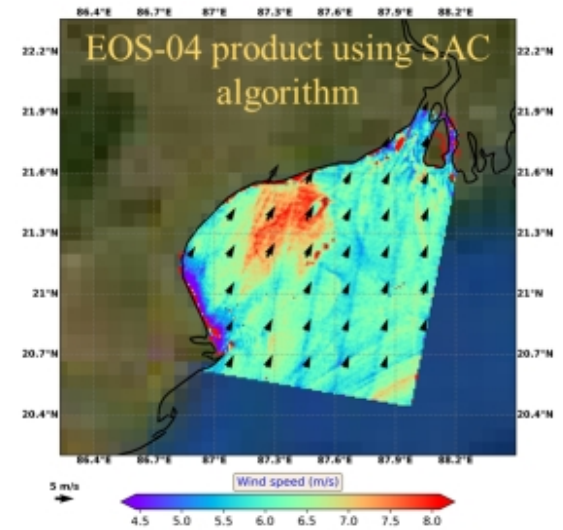


EOS-04/RISAT-1A (2022)

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



Ocean surface winds from C-band SAR



EOS-6/Oceansat-3

Oceansat Series: The journey so far...

Oceansat-1 (1999):

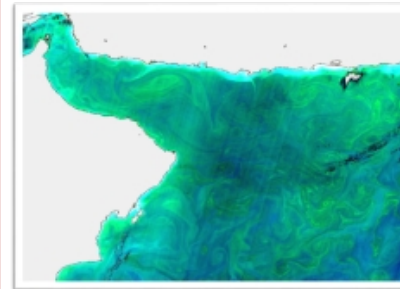
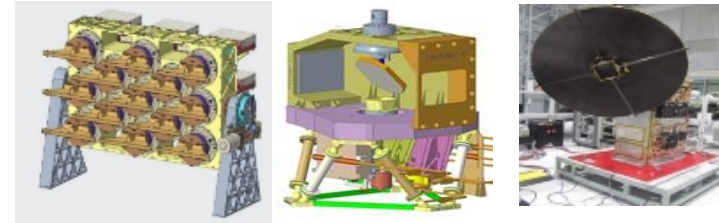
8-band OCM: 412, 442, 489, 512, 557, 670, 768, and 867 nm
4-channel V/H pol MSMR @ 6.6, 10.65, 18 and 21 GHz

Oceansat-2 (2009):

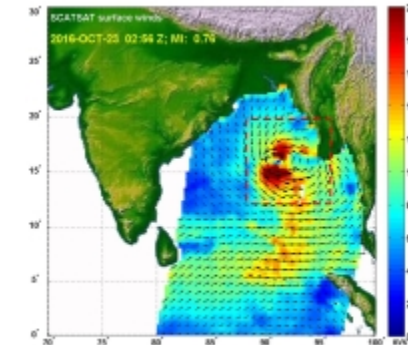
OCM-2, 8-Bands
Ku-band Scatterometer (SCAT),
Radio Occultation Sounder for Atmosphere (ROSA).

Oceansat-3 (2022):

- **Ku-band Scatterometer (SCAT-3) Exp. High Res. (6.25 km) mode**
- **13-band Ocean Colour Monitor (OCM-3) Narrow Bandwidth**
- **2-band Sea Surface Temperature Monitor (SSTM)**
- **ARGOS by CNES**



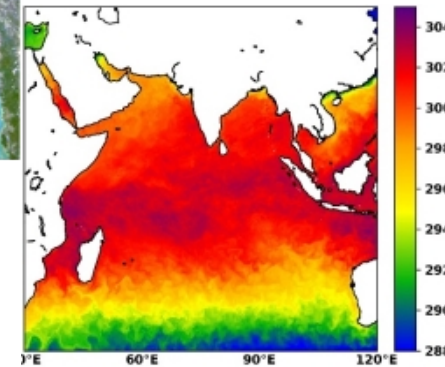
Algal Bloom from Oceansat-2, OCM in the waters of Gulf of Oman and north-west Arabian Sea



Tropical Cyclogenesis of Tropical cyclone KYANT (Bay of Bengal)



Sediment Discharge in Irrawaddy Delta



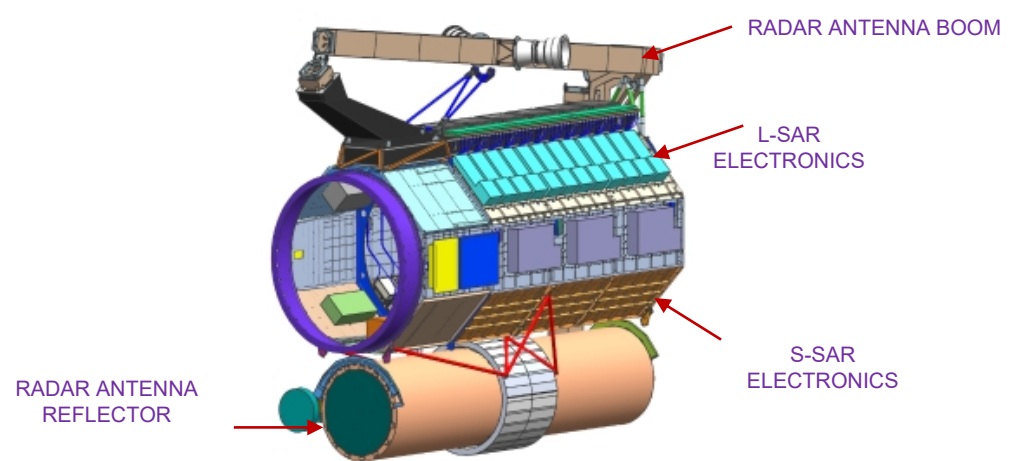
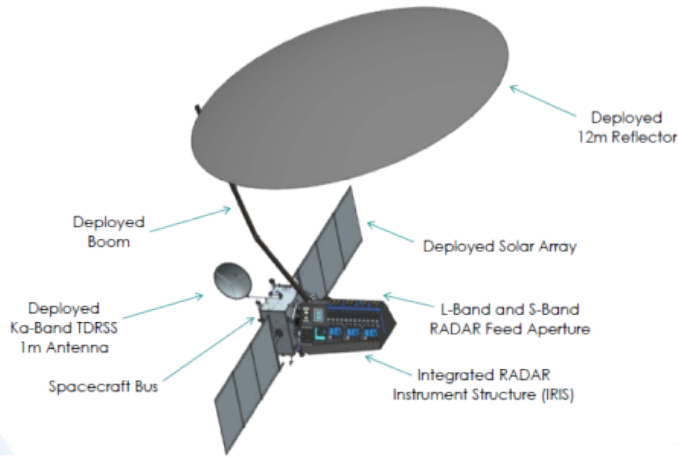
High Resolution SST

Major Applications

- **Ocean:** Ocean biology and ecosystem, Ocean State Forecast, Potential Fishing Zone Identification, Coastal zone management
- **Atmosphere:** Cyclogenesis, Track/Intensity Prediction, Numerical Weather Prediction, Air quality
- **Land:** Vegetation classifications/ growth assessment, Hydrology
- **Cryosphere:** Sea ice dynamics, Surface melting

(NISAR) NASA-ISRO Synthetic Aperture Radar

LAUNCH: 2024



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	

GISAT-2

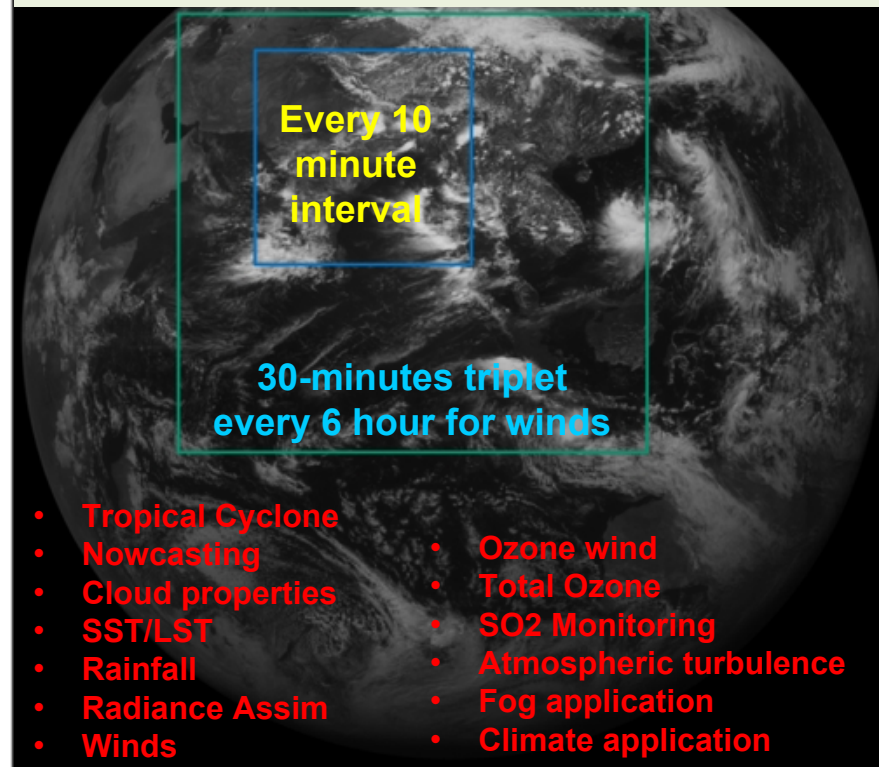
GISAT-2 is getting ready. Efforts are on to get approval for an early launch

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

Band	Ch	SNR/ NEdT @300K	IFOV (m)	Range (μm)	Channels bandwidth (μm)
MX-VNIR	6	> 200	42	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	158	> 400	320	0.375 - 1.0	$\Delta\lambda$: 4 nm
HyS-SWIR	256	> 400	190	0.9 - 2.5	$\Delta\lambda$: 7 nm
MX-LWIR	6	< 0.15K	1200	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°)



Other Upcoming Missions in Discussion Mode

GEO: INSAT-4th Generation Satellite

a) Advanced Imager (legacy: GOES-ABI)

- 16 bands from 0.5 – 13.5 μm with spatial resolution 500m for VIS and 2 km for IR
- Faster scanning for nowcasting applications
- FD (Full Disk), India (3000 km x 3000 km) and Mesoscale (1000 km x 1000 km)
- Capability to provide FD image every 5 minute, India every 2 minutes and Mesoscale images every 30 seconds.

b) Lightning mapper

c) Hyperspectral Infrared Sounder

LEO:

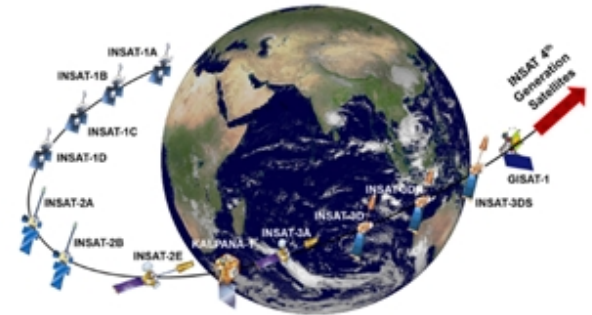
a) MW Temperature & Humidity Sounder in low-inclination orbit

b) 6-89 GHz MW Radiometer in low-inclination orbit

c) Dual Frequency Scatterometer, C/Ku with 5 km (Regional)/25 km (global) resolution.

d) Hyperspectral Infrared Sounder

Requirement for 4th Generation Indian Geostationary Satellites beyond 2024



Task Group to Generate a Report on 4th Generation of INSAT Satellites
under
MoES-ISRO sub-committee on
Advances in Atmospheric Research (AAR)



February 2018



Global Space-based Inter-Calibration System (GSICS)



Meteorological & Oceanographic Satellite Data Archival Centre
Space Applications Centre, ISRO

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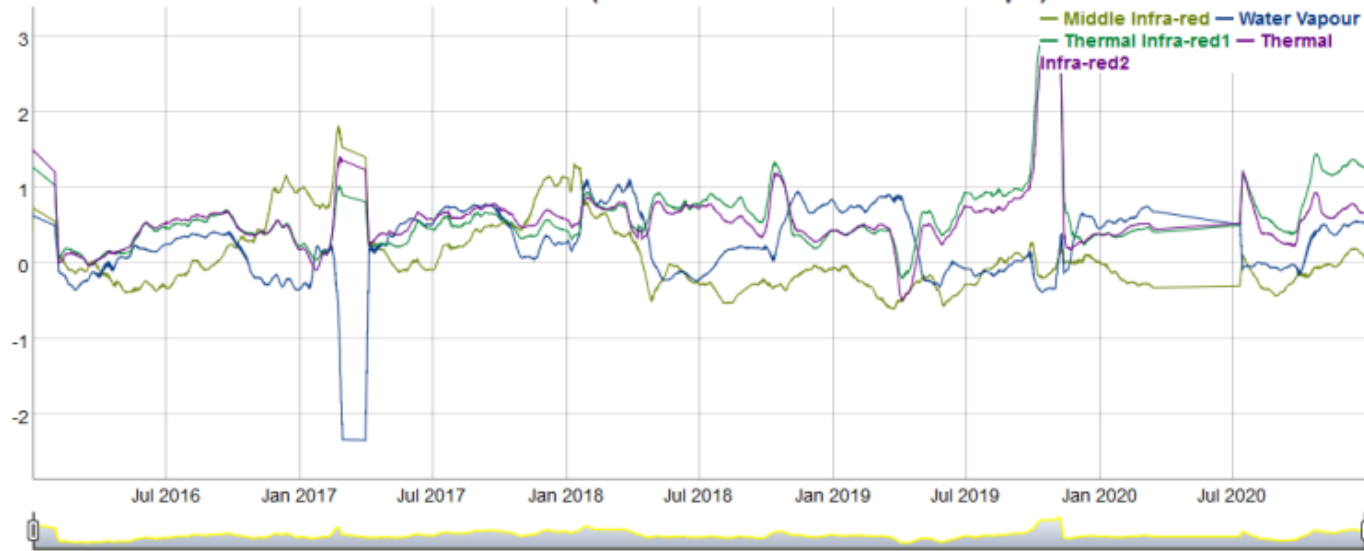


Demonstration

Monitored Parameter

BT Bias

TIMESERIES OF BT Bias (INSAT-3D IMAGER/All/ IASI/MetOpA)



Thanks

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IMD representative will provide additional update

Highlights Since CGMS-49

- Validation of all derived products recently installed in MMDRPS system for INSAT-3DR with latest state of art system
- New customized Imager product is generated operationally like, LST for National Capital Region (NCR) to monitor the high temperature episodes.
- **Uninterrupted 24X7** operation of MMDRPS system for INSAT-3DR.
- **Joint report by IMD and SAC/ISRO on validation / inter-comparison of all the INSAT 3D/DR imager/sounder products.**
- **CF Compliance of all Satellite data in IMD.**
- 1D-Var SST products with better accuracy (RMSE reduced from $\sim 0.9K$ to $\sim 0.6K$) is implemented and validated in INSAT-3DR operational chain.
- State –Wise Snow variation map from INSAT-3DR for mountain region (J&K, Ladakh, Himachal Pradesh, Uttrakhand & Sikkim) along with LST map to identify the fresh snow, melting snow area and potential vulnerability area of landslide/flash flood in mountain regions also implemented in operational chain.
- RAPID Scan (~ 5 minute) conducted successfully for monitoring the cyclonic activities for 2021-2022.
- INSAT-3D/3DR wind products are being disseminated in BUFR format through Global Telecommunication system (GTS) network for international agencies in real time basis.

Continued-

- GNSS network of IMD (25 locations) for monitoring the real time Integrated Precipitable Water Vapour (IPWV).
- RAPID- beta version will be operationalized from monsoon season of year 2022. It will have the provision to visualize the NWP, radar, in-situ observational data on a real time basis overlaid on satellite data with geo-referencing information & compatible to mobile users.
- Thanks to EUMETSAT for providing Meteosat-8/9 services over the Indian Ocean (IODC) through terrestrial link and enhancing the cooperation with EU in future development of GEO+LEO blended products, Nowcasting tool in collaboration with Nowcasting Satellite Application Facility (NWC-SAF) and CAL/VAL activities. **AND for relocating Meteosat-9 over the Indian Ocean.**

Thanks

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