Status report on the current and future satellite systems by ISRO

Presented to CGMS-52 plenary session, agenda item [xx]

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Coordination Group for Meteorological Satellites

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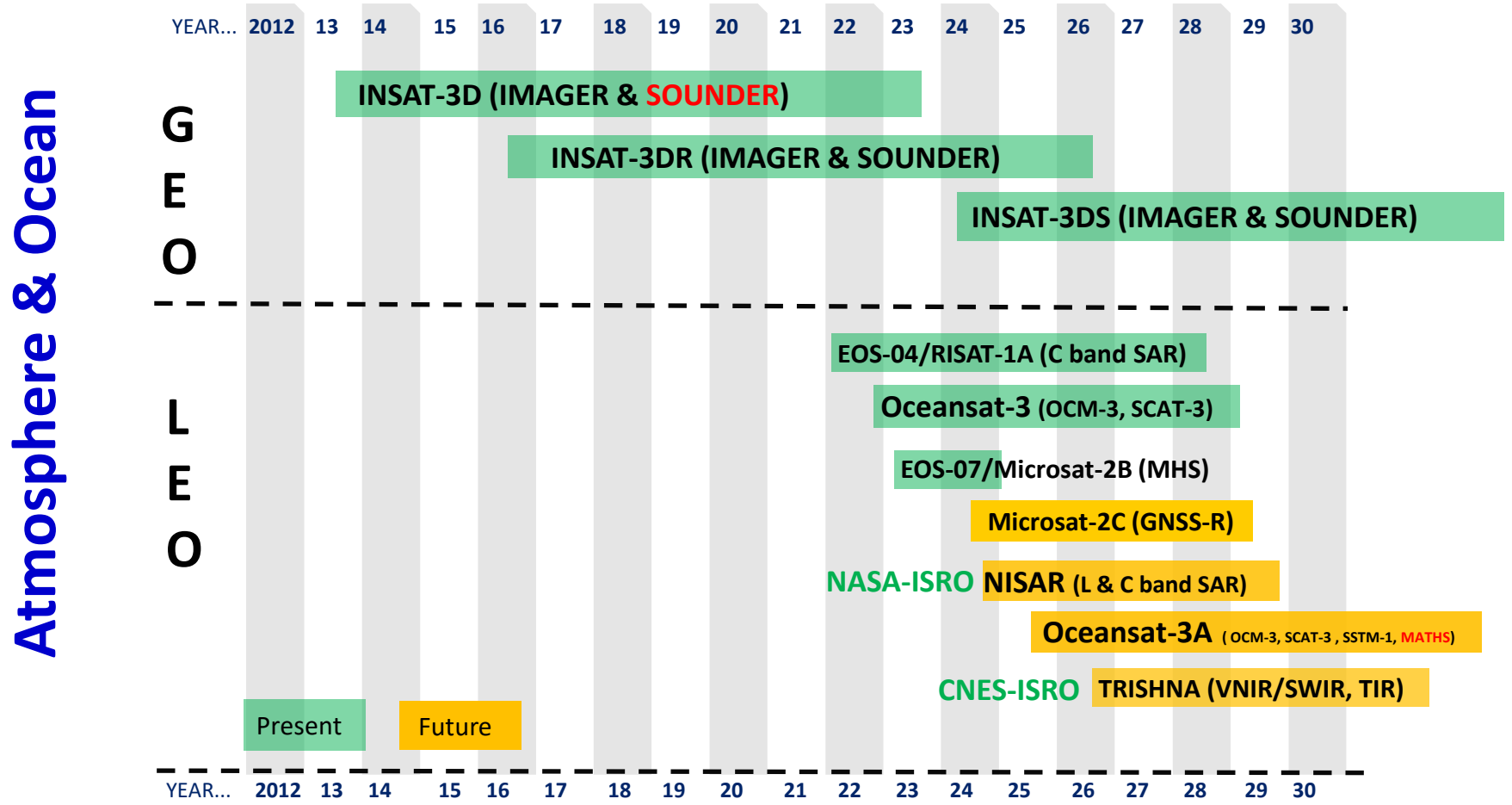
Executive summary

- Presently, 2 satellites INSAT-3D and INSAT-3DR are operational in GEO.
- INSAT-3DS has been launched on 17-Feb-2024, with many improvements to mitigate the issues related to the blackbody calibration and mid-night sun-intrusion in INSAT-3D/3DR. INSAT-3DS will replace INSAT-3D at 82 E after IOT.
- EOS-06 (Oceansat-3), launched on 26 Nov 2022 is operational with Ku-band scatterometer, and 13-band Ocean Color Monitor (OCM-3).
- Data from Scatterometer and OCM-3 has been released to the users through BHUVAN web-portal.
- EOS-07 (Microsat-2B) was launched on 10-Feb-2023 in low-inclination orbit with 6-channel Microwave Humidity Sounder (MHS). MHS L1 and L2 data available through MOSDAC web-portal.
- 6 years (2014-2021) of INSAT-3D data has been reprocessed for VIS/SWIR channels.

Overview - Planning of ISRO satellite systems



These Satellite Data are available at MOSDAC & Bhoonidhi sites

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EOS-06/Oceansat-3 (OCM & SCAT) – Operational Products & Dissemination

Ocean biophysical Products:

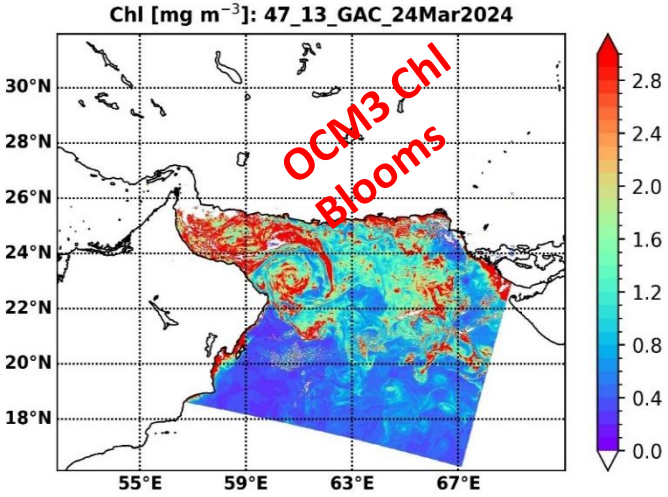
- Chlorophyll-a Concentration
- Remote Sensing Reflectance
- Aerosol Optical Depth
- Total Suspended Matter
- Diffuse Attenuation Coefficient

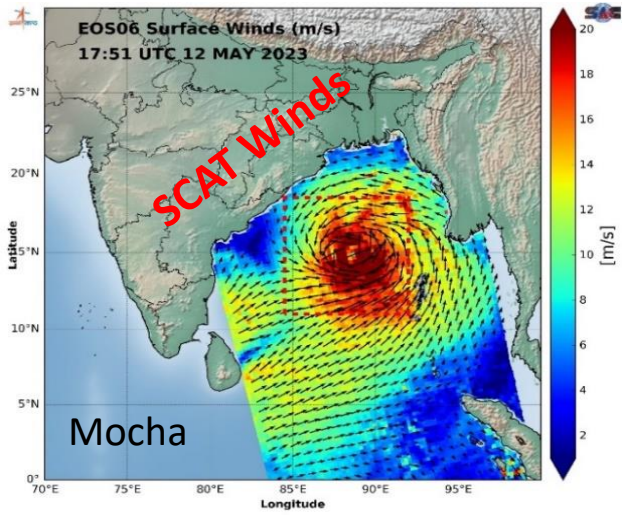
Land biophysical Products:

- NDVI
- Vegetation Fraction

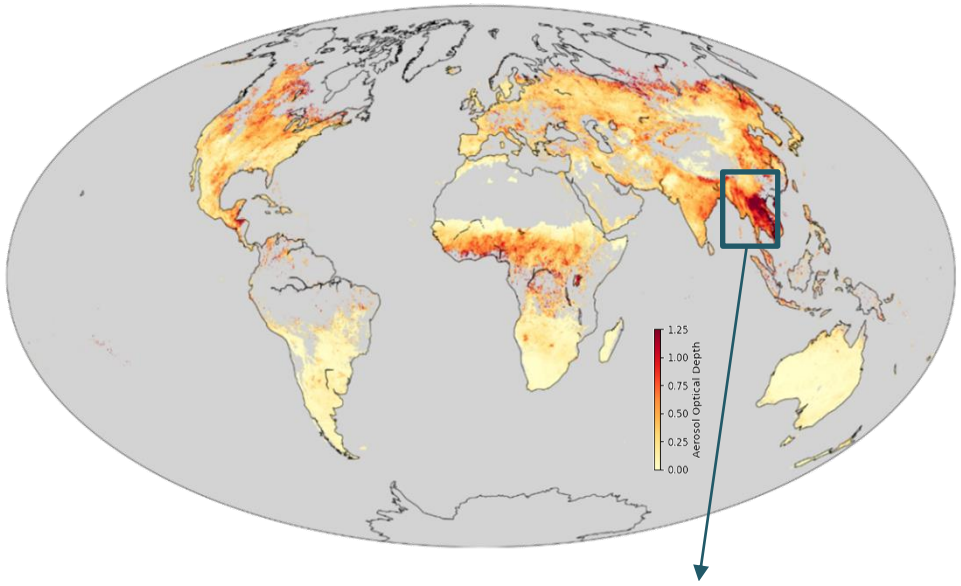
Sea Surface Wind Vector

Global sea ice extent (flagging)





OCM-3 Aerosol Optical Depth : April-2023



Thick layer of aerosol blanketed the skies in April due to hundreds of fires burning in Southeast Asia.

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Products available from:
https://bhoonidhi.nrsc.gov.in ; https://mosdac.gov.in

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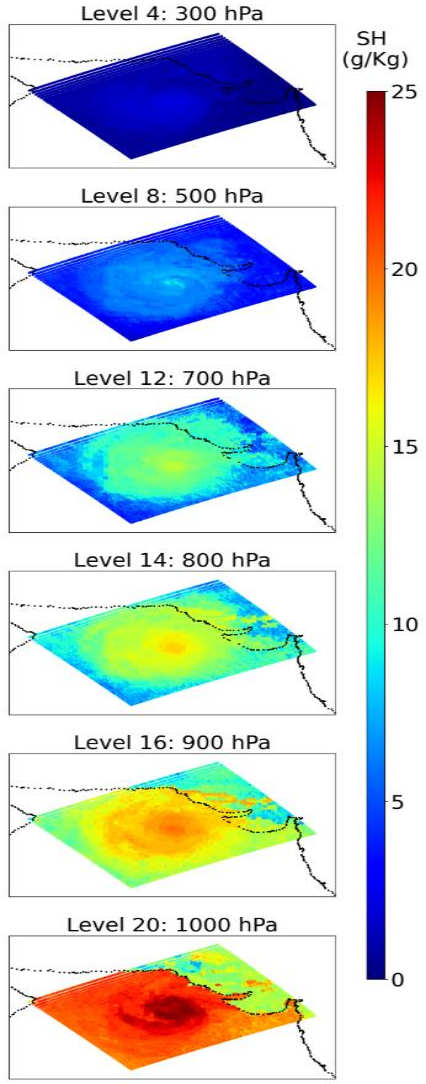
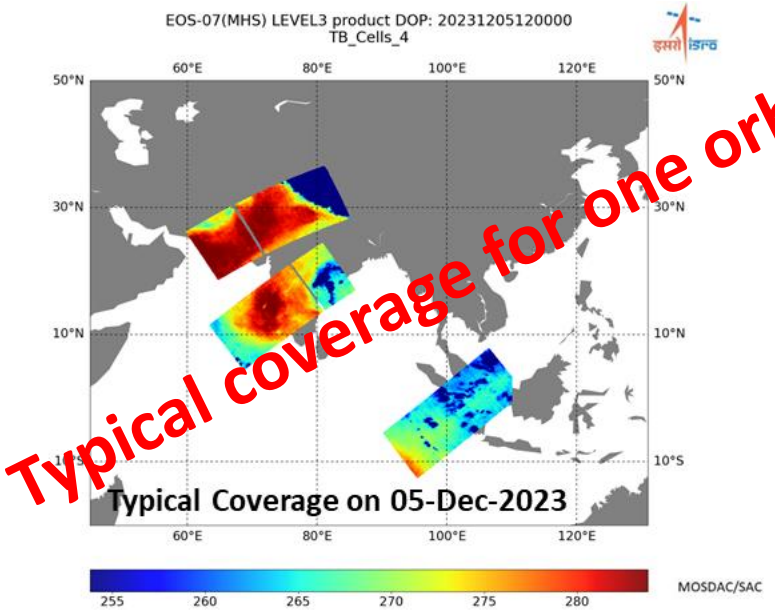
EOS-07 Millimeter-Wave Humidity Sounder (MHS)

Launch: 10-Feb-2023, SDSC/ISRO, SSLV-D2

- Demonstration of in-house developed mm-wave technology
- 450 km altitude, 37 deg inclined orbit
- Swath: ~1000 km
- Experimental: 15 minutes of orbit coverage
- 6-channel cross-track scanning Radiometer operating at 183.31±15.75 GHz band
- Spatial resolution of 10 km @Nadir

Humidity Profile during TC BIPARJOY (13 June 2023





Impact in NWP Model:

Evaluation of MHS data by NCMRWF/MoES in their Operational Assimilation System -Assimilation of Microsat-2B/MHS data improves the model initial conditions

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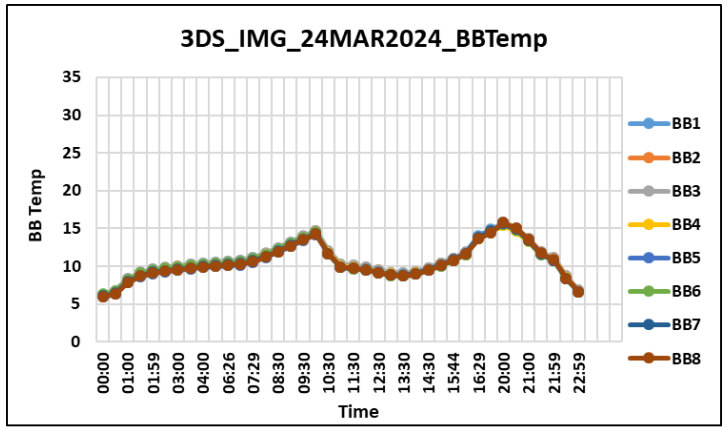
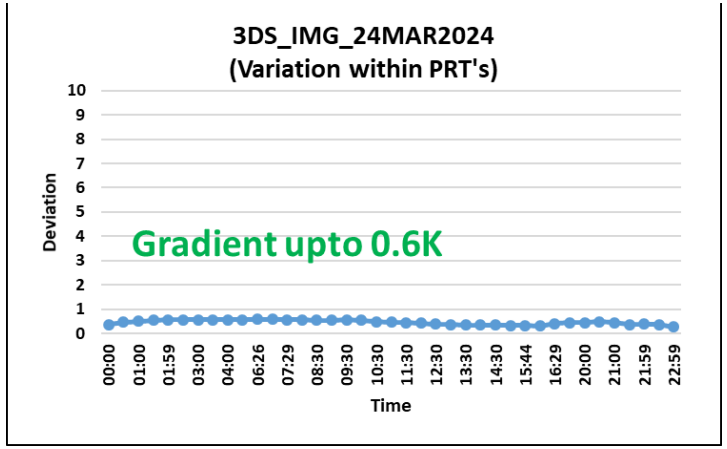
INSAT-3DS

- Launched on 17-Feb-2024 using GSLV-F14 rocket, from SDSC/ISRO
- 6-Channel imager & 19-Channel Sounder (18 IR + 1 VIS
- Improvements over INSAT-3D/3DR to mitigate the issues related to the blackbody calibration and mid-night sun-intrusion
- Presently in IOT phase at 83E. After IOT it will replace INSAT-3D at 82E

Detector Blackbody Temp (Deg C)

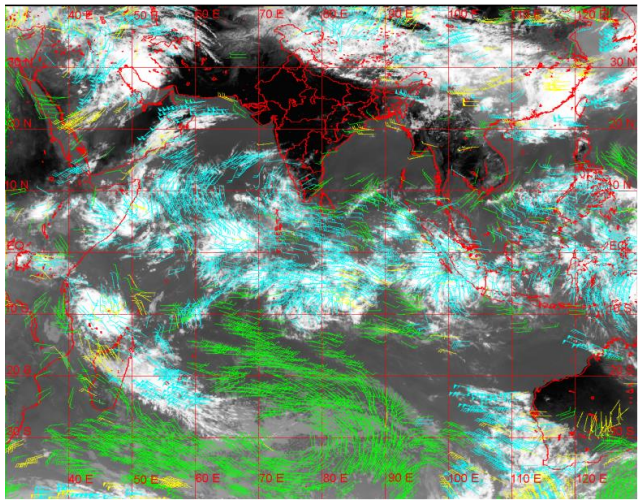


Blackbody Temp Deviation (Deg C)

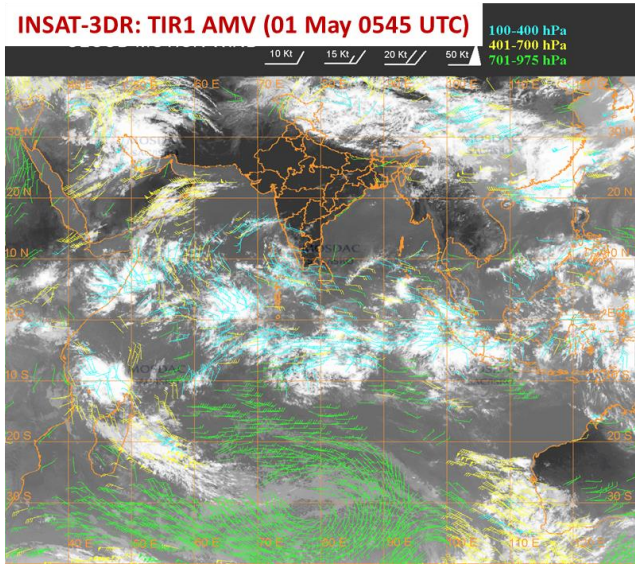


Results suggest stable BB temperature and gradients also within specs

INSAT-3DS: TIR1 AMV (01 May 0600 UTC)



INSAT-3DR: TIR1 AMV (01 May 0545 UTC)



More AMVs in INSAT-3DS than INSAT-3DR: Suggesting Stable Platform

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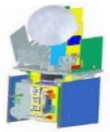
FUTURE INDIAN SATELLITES

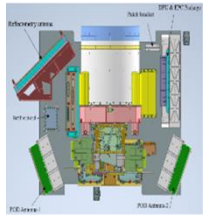
Oceansat-3A (2025)



- ARGOS in Oceansat-3 will be replaced by Millimeter-wave Atmospheric Temperature and Humidity Sounder (MATHS) Payload
- A 20-channel cross-track scanning Radiometer operating at 50-60GHz and 183.31± 16.25GHz bands
- Spatial resolution of 25 km and 15 km, for O_2 and H_2O bands, respectively.

MicroSat-2C GNSS-R (2024)

- ISRO's first GNSS-R mission with dual frequency (L1+L5) operation utilizing both GPS and IRNSS constellations as ***Technology Demonstration Satellite***.
- Soil Moisture, Ocean wind, Surface inundation and Significant Wave Height are defined as ***Baseline products***.
- Global Observation planned over globally selected targets including Indian regions.



GEO: INSAT-4th Generation Satellite

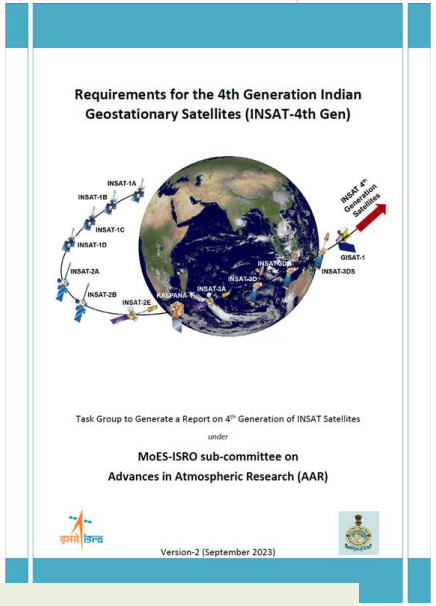
(Proposal received from MoES, India)

a) Advanced Imager

- 18 bands from 0.5 – 13.5 µm with spatial resolution 500m for VIS and 2 km for IR
- Faster scanning for nowcasting applications

b) Lightning mapper

c) Hyperspectral Infrared Sounder



Other LEO Missions: (Suggested by MoES, India)

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
d) Hyperspectral Infrared/Microwave Sounder

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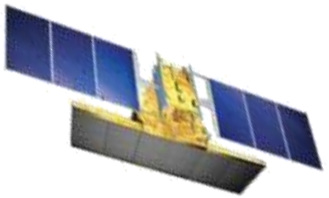
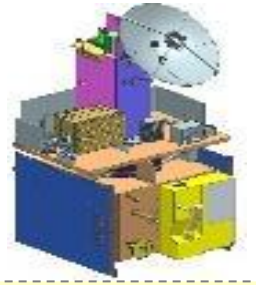
Upcoming Earth Observation Missions

RISAT-1 B



All-weather;
Day& Night Imaging

Oceansat-3A

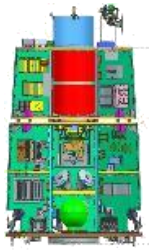


Ocean Color & Wind vector – Continuity + SST

L & S Band SAR (NISAR)

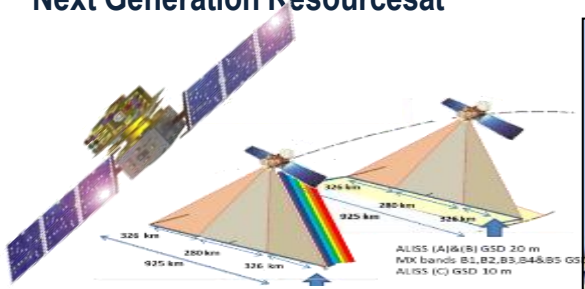
All-weather;
Day & Night Imaging

HRSAT



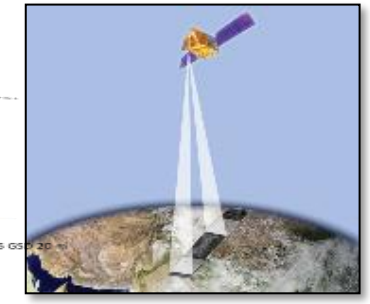
Daily re-visit of Area of Interest

Next Generation Resourcesat



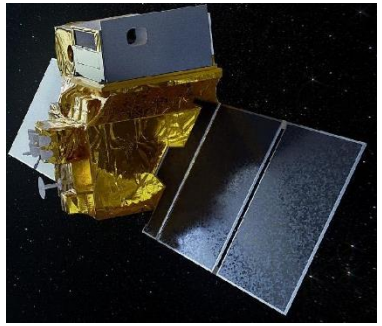
Wide Swath imaging with improved spatial resolution

High resolution Stereo



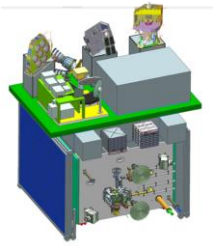
Concurrent Stereo & MX imaging

High res. TIR & VSNIR (TRISHNA)



Thermal Imaging

G20 Satellite



Environment & climate change

Monitoring Environment and climate variables:

- Polarization sensor- cloud & Aerosol
- GHG monitoring system
- Active Forest detection sensor
- Hy-Maths (T/H Profiles)

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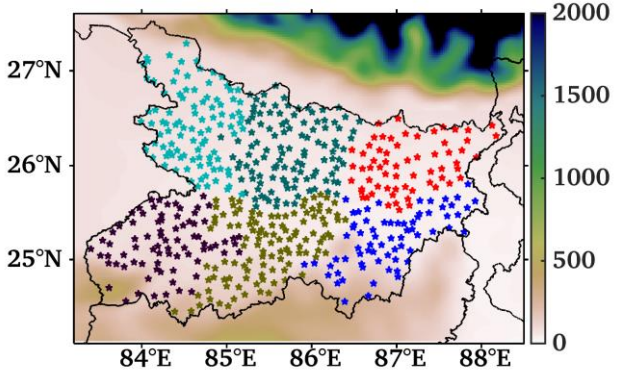
AI/ML Based Initiatives at ISRO

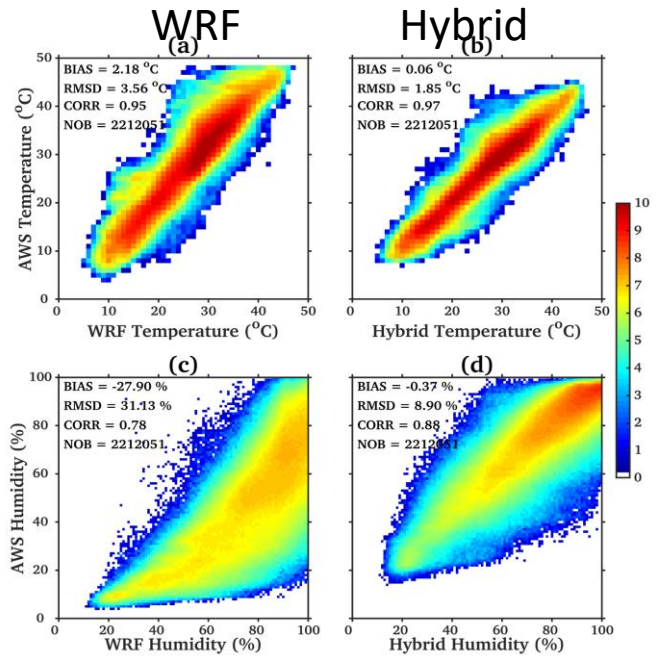
Retrieval	NWP Modeling	Applications
• TPW & SST from INSAT-3D • Humidity Profiles from EOS-07/MHS	• Hybrid Weather Forecasting: Combination of WRF Dynamical and AI/ML models	• Severe Weather Classification • Lightning detection using Deep learning • Precipitation Nowcasting • Tropical Cyclone Intensity Estimation

Hybrid Weather Forecasting is a combination of WRF Dynamical and AI/ML models

- Optimal AI/ML technique is selected in operational chain.
- 20 – 50 % Better Accuracy with AI/ML based Hybrid model.

AWS Network over Bihar
(Pilot site for testing hybrid Model)





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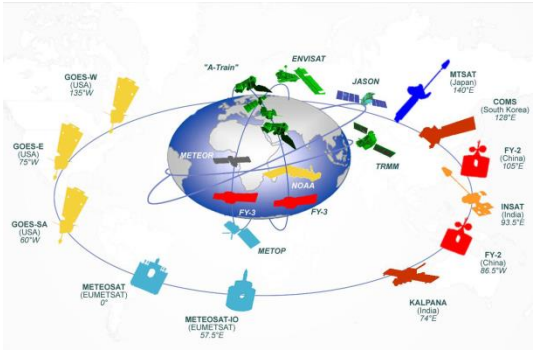

Data available through:

https://mosdac.gov.in/

https://bhoonidhi.nrsc.gov.in

Thank you

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