Status on the current and future satellite systems by IMD

Presented to CGMS-45, Plenary session, agenda item D.6
Overview - Planning of IMD satellite systems
### Overview - Planning of IMD satellite systems

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<tbody>
<tr>
<td>INSAT-1A (1982)</td>
<td>VHRR (VIS,TIR)</td>
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<td>OLR, CMV, Rain, Cloud Image</td>
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<td>INSAT-1B (1983)</td>
<td>VHRR (VIS,TIR)</td>
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<td>OLR, CMV, Rain, Cloud Image</td>
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<td>OLR, CMV, Rain, Cloud Image</td>
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<td>CCD (VIS,NIR,SWIR)</td>
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<td>OLR, AMV, UTH, Rain, Cloud Image</td>
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<td>Kalpana-1 (2002)</td>
<td>VHRR (VIS,WV,TIR)</td>
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<td>OLR, AMV, UTH, Rain, Cloud Image</td>
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<td>INSAT-3A (2003)</td>
<td>VHRR (VIS,WV,TIR)</td>
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<td>OLR, AMV, UTH, Rain, Cloud Image</td>
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<td>CCD (VIS,NIR,SWIR)</td>
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<td>OLR, AMV, UTH, Rain, Cloud Image</td>
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<td>INSAT-3D (2013)</td>
<td>Imager (VIS, SWIR, MIR, WV, TIR1, TIR2)</td>
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<td>OLR, AMV, UTH, Rain, Cloud Image</td>
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<tr>
<td></td>
<td>Sounder (18 IR + VIS)</td>
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<td>Temperature, humidity profiles, Ozone</td>
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<tr>
<td>INSAT-3DR (2016)</td>
<td>Similar to INSAT-3D</td>
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<td>OLR, AMV, UTH, Rain, Cloud Image</td>
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<tr>
<td>INSAT-3DS (2022)</td>
<td>Similar to INSAT-3D</td>
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<td>OLR, AMV, UTH, Rain, Cloud Image</td>
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**Coordination Group for Meteorological Satellites - CGMS**

Agency IMD, version 1, Date 15 June 2017
Current Indian Geostationary Meteorological Satellites

- Kalpana-1: 73.2°
- INSAT-3D: 74°
- INSAT-3DR: 82°

8th September 2016
INSAT-3DR similar to INSAT-3D, is an advanced meteorological satellite of India configured with an imaging System and an Atmospheric Sounder was launched on 08th September 2016 from SDSC SHAR, Sriharikota using GSLV-F05 successfully and placed at 74 deg East. The significant improvements incorporated in INSAT-3DR are:

- Imaging in Middle Infrared band to provide night time pictures of low clouds and fog
- Imaging in two Thermal Infrared bands for estimation of Sea Surface Temperature (SST) with better accuracy
- Higher Spatial Resolution in the Visible and Thermal Infrared bands

And, like its predecessor INSAT-3D, INSAT-3DR carries a Data Relay Transponder as well as a Search and Rescue Transponder. Thus, INSAT-3DR will provide service continuity to earlier meteorological missions of ISRO and further augment the capability to provide various meteorological as well as search and rescue services.

**Payloads of INSAT-3DR:**
INSAT-3DR carries a multi spectral Imager, 19 channel Sounder, Data Relay Transponder and Search and Rescue Transponder.
Current Indian Geo stationary Meteorological satellites

At present the following three INSAT satellites are in operation

Kalpana-1 is a metrological satellite which was launched in September 2002. It is located at 74° east. For meteorological observation, METSAT carries a Very High Resolution Radiometer (VHRR) capable of imaging the Earth in the visible, thermal infrared and water vapor bands. It also carries a Data Relay Transponder (DRT) for collecting data from unattended meteorological platforms.

INSAT-3D is a India's advanced weather satellite and was launched in the early hours of July 26, 2013 from Kourou, French Guiana, and has successfully been placed in Geosynchronous orbit. It is a dedicated meteorological satellite and carries four payloads: Imager (Six Channels), Sounder (Nineteen Channels), Data Relay Transponder (DRT) & Satellite Aided Search and Rescue (SAS & R).

INSAT-3DR is a India's advanced dedicated meteorological satellite and was launched on 8th September, 2016 which carries four payloads: Imager (Six Channels), Sounder (Nineteen Channels), Data Relay Transponder (DRT) & Satellite Aided Search and Rescue (SAS & R).

INSAT-3DR will be used in staggered mode with INSAT-3D in order to reduce temporal resolution to 15 minutes.
Present Operational Status

The present IMDPS system is used for processing and dissemination of data from all the three currently operational Geostationary satellites (Kalpana-1, INSAT-3D, INSAT-3DR).

<table>
<thead>
<tr>
<th>INSAT Series</th>
<th>Temporal Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>K1-VHRR</td>
<td>Half Hourly (0015 &amp; 0045 UTC)</td>
</tr>
<tr>
<td>3D -Imager (6 Channel)</td>
<td>½ hourly (0000 &amp; 0030 UTC)</td>
</tr>
<tr>
<td>3D -Sounder (19 Channel)</td>
<td>1 ½ hourly (two times region-B) and hourly (Three times Region-A)</td>
</tr>
<tr>
<td>3DR -Imager (6 Channel)</td>
<td>½ hourly (0015 &amp; 0045 UTC)</td>
</tr>
<tr>
<td>3DR -Sounder (19 Channel)</td>
<td>Hourly (Three times Region-A) and 1 ½ hourly (two times region-B)</td>
</tr>
</tbody>
</table>

Sounder Scan Strategy

Sector -B,

- No. of FS Blocks: 8
- No. of SS Blocks: 6
- Approximate Scan Duration: 87 minutes

Sector-A
- 0000UTC-INSAT-3D
- 0100UTC-INSAT-3D
- 0200UTC-INSAT-3D
- 0300UTC-INSAT-3D
- 0400UTC-INSAT-3D
- 0500UTC-INSAT-3D

Sector-B
- 0000UTC-INSAT-3DR
- 0130UTC-INSAT-3DR
- 0300UTC-INSAT-3D
- 0430UTC-INSAT-3D

Then this cycle will be repeated on six hourly basis.
Geophysical parameters/products of INSAT-3D/3DR Imager

1. VIS/MIR winds
2. WV winds
3. CMV
4. LL winds
5. HL winds

1. QPE
2. IMR
3. HE

1. SST
2. LST
3. INS
4. UTH
5. Rain Estimate
6. CTBT
7. Fog
8. Snow
9. Fire
10. Cloud mask
11. Smoke
12. AOD
13. AMV
14. OLR
15. VIS/MIR winds
16. WV winds
17. CMV
18. LL winds
19. HL winds

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Wind Derived Products from INSAT-3D/3DR Imager Winds

Vorticity

Wind Shear

Convergence & Divergence
### Coordination Group for Meteorological Satellites - CGMS

**Detail of Images Generated from INSAT-3D/3DR Imager**

<table>
<thead>
<tr>
<th>Sector Name</th>
<th>Channels</th>
<th>No. of Images</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-Disk</td>
<td>IR1, IR1_Temp, IR2, IR2_Temp, MIR, MIR_Temp, VIS, SWIR, WV, WV_temp, MP</td>
<td>11</td>
</tr>
<tr>
<td>Asia-Sector</td>
<td>IR1, IR1_Temp, IR2, IR2_Temp, MIR, MIR_Temp, VIS, SWIR, WV, WV_temp, MP, CTBT</td>
<td>12</td>
</tr>
<tr>
<td>NEQUAD-Sector</td>
<td>IR1, IR1_Temp, IR2, IR2_Temp, MIR, MIR_Temp, VIS, SWIR, WV, WV_temp, MP</td>
<td>11</td>
</tr>
<tr>
<td>NWQUAD-Sector</td>
<td>IR1, IR1_Temp, IR2, IR2_Temp, MIR, MIR_Temp, VIS, SWIR, WV, WV_temp, MP</td>
<td>11</td>
</tr>
<tr>
<td>SGP-Sector</td>
<td>IR1, IR1_Temp, IR2, IR2_Temp, MIR, MIR_Temp, VIS, SWIR, WV, WV_temp, MP</td>
<td>11</td>
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<tr>
<td>NEQ (HR-Sector)</td>
<td>IR1_HR, IR1_HRBlue, IR1_Temp_BD, IR1_Temp_NHC, IR2_HR, IR2_HRBlue, VIS_HR, VIS_HRBlue, WV_HR, WV_HRBlue, MIR_HR, MIR_HRBlue, SWIR_HR, SWIR_HRBlue</td>
<td>14</td>
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<tr>
<td>NWQ (HR-Sector)</td>
<td>IR1_HR, IR1_HRBlue, IR1_Temp_BD, IR1_Temp_NHC, IR2_HR, IR2_HRBlue, VIS_HR, VIS_HRBlue, WV_HR, WV_HRBlue, MIR_HR, MIR_HRBlue, SWIR_HR, SWIR_HRBlue</td>
<td>14</td>
</tr>
<tr>
<td>Bay of Bengal (HR-Sector)</td>
<td>IR1_HR, IR1_HRBlue, IR1_Temp_BD, IR1_Temp_NHC, IR2_HR, IR2_HRBlue, VIS_HR, VIS_HRBlue, WV_HR, WV_HRBlue, MIR_HR, MIR_HRBlue, SWIR_HR, SWIR_HRBlue</td>
<td>14</td>
</tr>
<tr>
<td>Arabian Sea (HR-Sector)</td>
<td>IR1_HR, IR1_HRBlue, IR1_Temp_BD, IR1_Temp_NHC, IR2_HR, IR2_HRBlue, VIS_HR, VIS_HRBlue, WV_HR, WV_HRBlue, MIR_HR, MIR_HRBlue, SWIR_HR, SWIR_HRBlue</td>
<td>14</td>
</tr>
<tr>
<td>Amarnath Yatra (HR-Sector)</td>
<td>IR1_HR, IR1_HRBlue, IR1_Temp_HR, IR2_HR, VIS_HR, VIS_HRBlue, WV_HR, SWIR_HR, SWIR_HRBlue, MIR_HR, MIR_HRBlue, SWIR_HR, SWIR_HRBlue</td>
<td>11</td>
</tr>
<tr>
<td>Vaishno Devi (HR-Sector)</td>
<td>IR1_HR, IR1_HRBlue, IR1_Temp_BD, IR1_Temp_NHC, IR2_HR, IR2_HRBlue, VIS_HR, VIS_HRBlue, WV_HR, WV_HRBlue, MIR_HR, MIR_HRBlue, SWIR_HR, SWIR_HRBlue</td>
<td>14</td>
</tr>
<tr>
<td>Nepal (HR-Sector)</td>
<td>IR1_HR, IR1_HRBlue, IR1_Temp_HR, IR2_HR, VIS_HR, VIS_HRBlue, WV_HR, SWIR_HR, SWIR_HRBlue, MIR_HR, MIR_HRBlue, SWIR_HR, SWIR_HRBlue</td>
<td>12</td>
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<tr>
<td>Fog (HR-Sector)</td>
<td>IR1_HR, IR1_HRBlue, IR1_Temp_HR, IR2_HR, VIS_HR, VIS_HRBlue, WV_HR, SWIR_HR, SWIR_HRBlue, MIR_HR, MIR_HRBlue, SWIR_HR, SWIR_HRBlue, DMP, NMP</td>
<td>13</td>
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</tbody>
</table>

Total No of Images generated half hourly: 162
Geophysical parameters of INSAT-3D/3DR Sounder:

- Temperature profile
- Geo potential height profile
- Humidity profile
- Maximum vertical theta -e differential
- Layer & perceptible water index (1000-900, 900-700, 700-300 hpa)
- Lifted Index
- Total ozone
- Dry microburst index
Calibration Activities of IMD
Calibration Activities at IMD

- Establishment of **In-situ Calibration** and Validation site for INSAT-3D/3DR satellite for Visible and SWIR sensor,

- Sustained and Coordinated Processing of Environmental Satellite data for Climate Monitoring (**SCOPE-CM**) for past Kalpana-1 and INSAT series of satellites

- **Lunar/Moon** Calibration of INSAT-3D/3DR
In-Situ calibration

The establishment of idle CAL/VAL site is very important because post-launch calibration and characterization of meteorological satellite sensors is a keenly felt need in most applications of satellite data for climate research which requires very high accuracies which can only be assured if the calibration of the instruments on board different satellites is accurately known and maintained.

Since the visible sensor on INSAT-3D has no onboard calibration device, it is necessary to develop post-launch calibration coefficients (or slopes) which take into account the in-orbit degradation of the sensor so that the derived products are rendered accurate.

A CAL/VAL site is therefore needs to be established and maintained.

Work done (Since 2013) for the Site suitability for vicarious calibration of imager. It was found that site spatial variability was a critical factor in site selection and sensor calibration. The comparison of TOA radiance computed for Visible & SWIR channels over Great Rann of Kutch and INSAT-3D satellite radiance matches as per expected.
The Committee on Earth Observation Satellites (CEOS) Working group on Calibration and Validation identified several sites around the world based on the selection criteria, such as low probability of atmospheric interruptions, high spatial homogeneity, weak directional effects, flat reflectivity spectrum etc. Calibration sites are never chosen randomly, and to be adequate they must satisfy a certain number of criteria.

Based on the above criteria, we have selected a desert site in Great Rann of Kutchh (GROK), India. GROK site characterized as high and uniform reflectance land, was chosen to carry out vicarious calibration. The experimental site is placed about 40km away from Bhuj between Khawda and Loriya in Great Rann of Kutchh. The site is accessible near to road on the way to Khawda.
Initially, a joint campaign (Cal/Val team) with SAC/ISRO team were carried out from in 2013 to find a suitable site after visiting several locations in this region for the purpose to get information of uniformity, accessibility, useable area and local information of the site.

Again, joint campaign collaboration with SAC team during in 2014, 2015 and 2016. This study details measurements carried out for the purpose of vicarious calibration of visible (VIS) and shortwave infrared (SWIR) channels of INSAT-3D imager over Bhuj in Great Rann of Kutchh.

Recent joint campaign of SAC/ISRO and IMD team were carried out from February 6th to February 10, 2017
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Spatial Variability of the Sites

Courtesy: Joint report IMD and SAC,(ISRO)
The TOA radiance was simulated by 6S RT model using ground measurements. The conclusions based on this study are summarized below

1. GROK site is the preferred site for post launch calibration due to its accessibility, high degree of homogeneity, which helps to derive precise vicarious calibration coefficients.

2. The 6S simulated radiances are well comparable with the INSAT-3D imager measured radiance for all three dates over GROK and for WROK.

3. The estimated overall uncertainties in the calibration coefficients are found to be 3% in VIS and 4% in SWIR channels
The major objective of this SCOPE-CM (Sustained and Coordinated Processing of Environmental Satellite data for Climate Monitoring) project is the generation of a Fundamental Climate Data Record (FCDR) of calibrated and quality-controlled geostationary sensor data.

The FCDR will contain the visible, IR window and water vapour absorption channels of geostationary satellites. It is proposed to utilise the inter-satellite methodology developed by GSICS to tie existing time series of satellite data to the best reference available in space.
The India Meteorological Department (IMD) has been a part of the SCM-06 IOGEO project team.

1. EUMETSAT (Darmstadt, Germany) Rob Roebeling, Tim Hewison, Alessio Lattanzio, and Viju John
2. EUMETSAT CM SAF, DWD (Offenbach, Darmstadt) Marc Schröder
3. JMA (Tokyo, Japan) Masaya Takahashi
5. CMA NSMC (Beijing, China) Peng Zhang, Xiuing Hu
6. IMD (Delhi, India)* Ashim Kumar Mitra (IMD)
Recent work done for [GSICS/IOGEO] inter-comparison study

**Workflow**

- Participants develop test datasets which consists of sensor equivalent re-calibrated radiances* in each sensor’s native resolution (intermediate files);
- Each participant could place their data on their FTP site at EUMETSAT;
- EUMETSAT takes the lead in performing the comparisons between the intermediate files and the references dataset. EUM then provides the Spectral Band Adjustment Factors (SBAFs) that are needed to convert the sensor equivalent re-calibrated radiances* to reference sensor normalised radiances** (inter-calibration corrections);
- EUM creates files of reference sensor normalised radiances of all sensors in a common grid which will be used for comparison.

![Graph showing the normalized SRF for different sensors](image)

**Monitored Instr.:** Meteosat-7 (EUMETSAT), Meteosat-10 (EUMETSAT), GOES-13 (NOAA), GOES-15 (NOAA), MTSAT-2 (JMA), FY-2 (CMA), and Kalpana (IMD)
INSAT-3D Calibration using Moon data has been started at IMD

- Lunar is resembling of moon. The purpose was to enable moon to be used as a radiance calibration source for earth-orbiting remote-sensing spacecraft.

- Using moon as reference of source for radiometric calibration and sensor stability.

- Follow this document

- Downloaded GIRO_v1.0.0 model from
  https://gsics.nesdis.noaa.gov/wiki/Development/GiroUtil

(Courtesy: Sebastian, Tim Hewison and Masaya)
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<tr>
<th>Spectral Bands</th>
<th>(um)</th>
<th>Resolution (km)</th>
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<tr>
<td>Visible</td>
<td>0.55 - 0.75</td>
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<tr>
<td>Short Wave Infra Red</td>
<td>1.55 - 1.70</td>
<td>1</td>
</tr>
<tr>
<td>Mid Wave Infra Red</td>
<td>3.70 - 3.95</td>
<td>4</td>
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<tr>
<td>Water Vapour</td>
<td>6.50 - 7.10</td>
<td>8</td>
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<tr>
<td>Thermal Infra Red –1</td>
<td>10.30 - 11.30</td>
<td>4</td>
</tr>
<tr>
<td>Thermal Infra Red –2</td>
<td>11.30 - 12.50</td>
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INSAT-3D MIR on 05 July, 2015 0859 UTC
Coordination Group for Meteorological Satellites - CGMS

Dissemination through a dedicated IMD web site Updated every fifteen Minutes

http://satellite.imd.gov.in/insat.htm
Dissemination through a dedicated IMD web site Updated every fifteen Minutes

http://satellite.imd.gov.in/joy_insat_final.htm

- Provision to view last 48 channel images/products images through drop down menu.
- Product description of all Imageries and Products are made available on webpage.
- Provision for running Animation for all channel images/products images for last 48 scans along with date and time selection.
Online Archival of all channel images & products images are available of last six month

http://satellite.imd.gov.in/archive/

Index of /archive

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Apache/2.2.15 (Red Hat) Server at satellite.imd.gov.in Port 80
RAPID (Real time Analysis of Products & Information Dissemination) :- It is a web based quick visualization and analysis tool for satellite data on a real time basis. This introduces Next Generation Weather Data Access & Advanced Visualization.

http://www.rapid.imd.gov.in
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Provision of generation of T-phi gram for 105 locations.

20AUG2015_0300_Ahmedabad

Nearest Sounding Location
Distance = 0.21 Deg.
LAT: 23.25, LON: 72.60

Tck: 22.0 °C
Td: 23.10 °C
LCL: 935.84 hpa
LFC: 935.84 hpa
CAPE: 160.15 J/kg
CIN: -430.98 J/kg
CCL: 953.1 hpa
Conv. Temp: 26.4 °C
Pfsc: 998.10 hpa
Rapid Scan Strategy of Imager of INSAT-3DR to be adopted during Cyclone/specific weather event.

- Extent of coverage: 6 Blocks (3° coverage in 234 lines)
- No. of repetitions: 6
- Time required: 27 minutes
- (6 blocks with 6 repetitions)

Super Rapid Scan Strategy of Imager of INSAT-3DR to be adopted during thunderstorm activities on need basis.

Extent of Coverage: 1 Blocks (0.50 N-S in 39 scan lines)
No. of repetitions: 6
Scan duration: 5 minutes
SCATSAT-1 is a continuity mission for Oceansat-2 Scatterometer to provide wind vector data products for weather forecasting, cyclone detection and tracking services to the users. The satellite carries Ku-band Scatterometer similar to the one flown onboard Oceansat-2. The spacecraft is built around standard IMS-2 Bus and the mass of the spacecraft is 371 kg. The spacecraft has been put in SSP orbit of 720 km altitude with an inclination of 98.1 deg by PSLV-C35 on September 26, 2016 from the First Launch Pad of SDSC SHAR, Sriharikota. The mission life of the satellite is 5 years.

- IMS-2 Bus
- Ku-Band (13.515 GHz) Pencil beam Scatterometer
- Ground resolution: 50 km x 50 km
- Swath: 1440 Km
- Polarization: HH and VV
- Wind Direction: 0 to 360 deg with accuracy of 20 deg
- Wind Speed: 4 to 24 m/s with accuracy of 10% or 2m/s

Objectives:
- To provide global wind vector data for national and international user Community.
- To provide continuity of weather forecasting services to the user communities.
- To generate wind vector products for weather forecasting, cyclone detection and tracking.
SCATSAT-1 Dataset Availability

The SCATSAT-1 dataset is available on following link: ftp://ftp.mosdac.gov.in/

FTP directory /2017/JAN/ at ftp.mosdac.gov.in

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<td>L4SPOLAR</td>
<td>S1L4BH_2017001_ASC_IN.jpg</td>
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</table>
IMD is in process to install Multi-Mission Meteorological Data Receiving & Processing System (MMDRPS), for reception, processing and dissemination of meteorological data of INSAT-3D/3DR/3DS and Kalpana-1. MMDRPS will have very high end processing system which will cut down the processing time from currently 15 minutes to 5 minutes. MMDRPS will have storage capacity of the order of 1PB which will facilitate online sharing of processed data for all Indian meteorological satellites to the registered users as per IMD data policy.
**FUTURE GEO SATELLITES – INSAT-3DS**

**INSAT-3DS:** India will launch this exclusive third meteorological satellite of this series in 2022.

<table>
<thead>
<tr>
<th>Payloads</th>
<th>Channel</th>
<th>Resolution</th>
<th>Data Rate/Bandwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imager</td>
<td>visible (0.52-0.77 µm)</td>
<td>1x1 Km</td>
<td>3.92725 Mbps</td>
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<tr>
<td></td>
<td>SWIR (1.55-1.70 µm)</td>
<td>1x1 Km</td>
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</tr>
<tr>
<td></td>
<td>MIR (3.8-4.0 µm)</td>
<td>4x4 Km</td>
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<tr>
<td></td>
<td>WV (6.5-7.1 µm)</td>
<td>8x8 Km</td>
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<tr>
<td></td>
<td>TIR-1 (10.3-11.3 µm)</td>
<td>4x4 Km</td>
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<tr>
<td></td>
<td>TIR-2 (11.5-12.5 µm)</td>
<td>4x4Km</td>
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<tr>
<td>Sounder</td>
<td>LWIR -7 channel (14.71-12.02 µm)</td>
<td>10x10 Km</td>
<td>40.00 Kbps</td>
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<td>MWIR-5 Channel (11.03-6.51 µm)</td>
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<tr>
<td></td>
<td>SWIR-6 Channel (4.57-3.74 µm)</td>
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<td>VIS (0.695 µm)</td>
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<tr>
<td>DRT</td>
<td>Up link 402.75MHz</td>
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<tr>
<td>S&amp;SR</td>
<td>Up link 406.05MHz</td>
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**FUTURE GEO SATELLITES – GISAT-1**

**Launch Schedule:** 2019, Geostationary orbit, 83E

**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.

<table>
<thead>
<tr>
<th>Band</th>
<th>Ch</th>
<th>SNR/N EdT</th>
<th>IFOV (m)</th>
<th>Range (µm)</th>
<th>Channels (µm)</th>
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<tbody>
<tr>
<td>MX-VNIR</td>
<td>4</td>
<td>&gt; 200</td>
<td>50</td>
<td>0.45 - 0.875</td>
<td>B1: 0.45-0.52</td>
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<td>B2: 0.52-0.59</td>
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<td>B3: 0.62-0.68</td>
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<td>B4: 0.77-0.86</td>
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<td>B5N: 0.71-0.74</td>
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<td></td>
<td></td>
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<td>B6N: 0.845-0.875</td>
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<tr>
<td>HySI-VNIR</td>
<td>60</td>
<td>&gt; 400</td>
<td>500</td>
<td>0.375 - 1.0</td>
<td>Δλ &lt; 10 nm</td>
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<td>HySI-SWIR</td>
<td>150</td>
<td>&gt; 400</td>
<td>500</td>
<td>0.9 - 2.5</td>
<td>Δλ &lt; 10 nm</td>
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<tr>
<td>MX-LWIR</td>
<td>6</td>
<td>NEdT &lt; 0.15K</td>
<td>1500</td>
<td>7.0 – 13.5</td>
<td>CH1: 7.1-7.6</td>
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<td>CH2: 8.3-8.7</td>
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<td>CH3: 9.4-9.8</td>
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<td>CH4: 10.3-11.3</td>
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<td>CH5: 11.5-12.5</td>
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<td></td>
<td>CH6: 13.0-13.5</td>
</tr>
</tbody>
</table>

**GISAT Scan scenario**

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

- Every 10 minute interval
- 30-minutes triplet every 6 hour for winds
  - Tropical Cyclone
  - Nowcasting
  - Cloud properties
  - SST/LST
  - Rainfall
  - Radiance Assim
  - Winds
  - Ozone wind
  - Total Ozone
  - SO2 Monitoring
  - Atmospheric turbulence
  - Fog application
  - Climate application
IMD - GNSS Network – Present Status

25 GNSS + 5 GPS
Coordination Group for Meteorological Satellites - CGMS

Dissemination through a dedicated IMD web site Updated every fifteen Minutes

http://gnss.imd.gov.in/TrimblePivotWeb/
GNSS Network data are also being used for variation of XYZ Coordinate with respect to IGS Reference Stations for seismological use
Coordination Group for Meteorological Satellites - CGMS

Satellite Bulletins issued by IMD

Special Winter bulletin

Thunderstorm Bulletin

Daily rainfall over north India
IRS Multi-spectralsatellite Product (6pm) rainfall over north India (in mm)

Interpretation of derived products (based on RGB)
RGB Composite Product: 3rd Movie Dyeing of the Composite Product: 3rd Movie

Agency IMD, version 1, Date 15 June 2017
Special Satellite Fix Bulletin for Cyclone

TCN0 DEMS 120600
A. TROPICAL DISTURBANCE (YAKDAM)
B. 11/0600Z
C. 11JL
D. 095E
E. INGAT 3D
F. 140/450
G. VIS / IR
H. REMARKS: EYE PATTERN WITH EMBEDDED DISTANCE GREATER THAN 0.75 DEGREE (E 6, EYE ADJUSTMENT FOR RAGGED EYE = 1.5 R. F. = 0.5) VEILING DT = 45 P.T. = 4.0 PT IS BASED ON PT.
I. ADDL POSITIONS NIL
JIG: 12/12250E, 992N
IMD has carried out a study for using RAPID and RGB imageries (Day Time Microphysics) for Nowcasting and identification of weather phenomena's by identifying their thresholds.
R&D Work carried out:

- IMD has carried out a study for using RAPID and RGB imageries (Night Time Microphysics) for Nowcasting and identification of weather phenomena's by identifying their thresholds.

![Image of R&D Work carried out](image-url)
Key issues of relevance to CGMS:

- IPWG Rapporteur to liaise with IMD (AK Sharma) on the development of precipitation validation sites over India action ref. no. A44.03 WGII/4.

  IMD has already given consent to host precipitation validation site to WMO vide email dated 13-04-2017 to Mr. Ralaph Ferraro / Dr Raaj Ramasankaran and is waiting for response from the concerned Scientist to provide necessary software and interface to set up the validation site. Focal point from IMD is Dr. S K Peshin, Head (SATMET)/Scientist-G.

- IMD to provide more information (documentation, availability details, URL) about the RAPID tool, for inclusion in the WMO webpage on Visualization Tools to CGMSSEC action ref. no. A44.08 WGII/6.

  IMD has provided the RAPID User Guide vide email dated 01st May 2017.

- CGMS agencies to make available a non real-time cache of satellite level 1 data over the previous 2-3 months, similar to the NOAA CLASS system action ref. no. R43.07 WGII/10.

  This action will be closed after establishment of MMDRPS in March 2018.
To be considered by CGMS:

- Explore the possibility implementing arrangement with NOAA/EUMETSAT in terms of data sharing and application algorithm development
- IMD propose to have close collaboration regarding Cal/val site development with CMA
THANKS