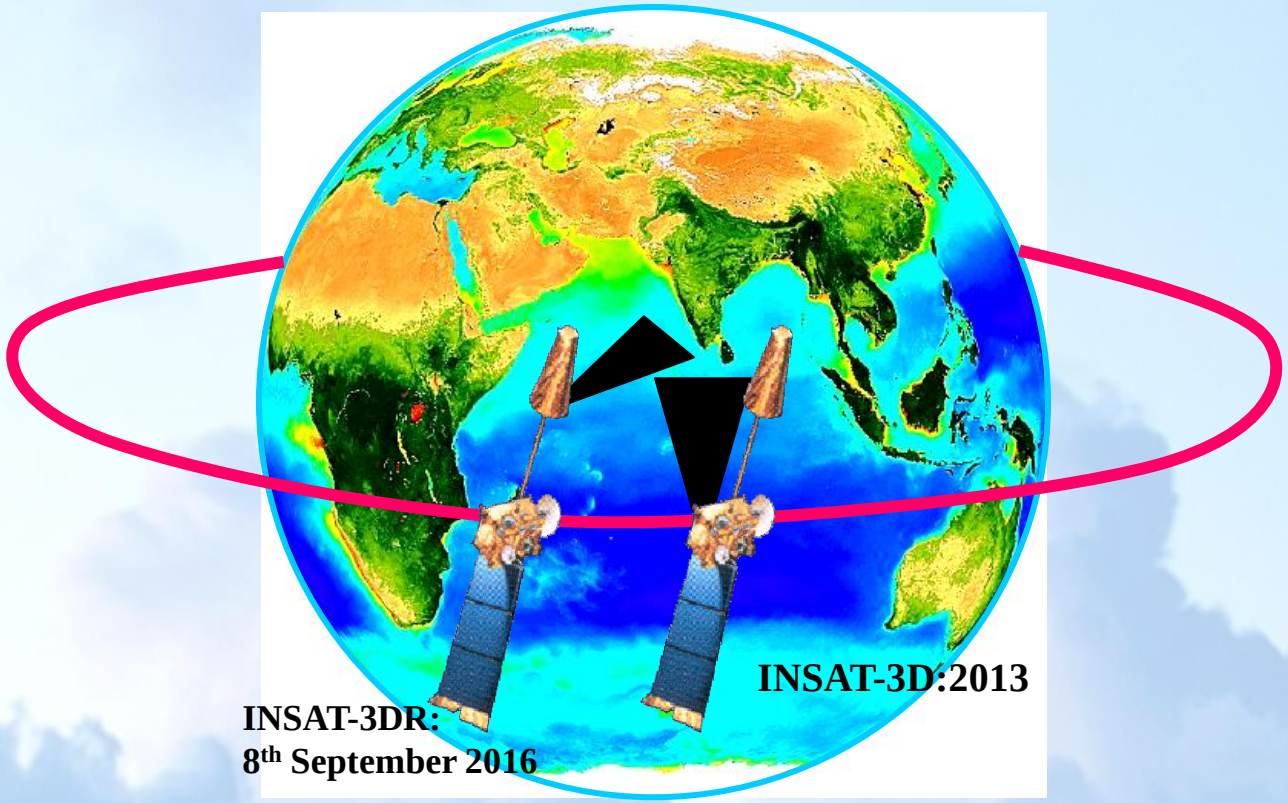
GDWG Meeting-20-10-2020

India Meteorological Department Report
Dr R.K. GIRI

भारत मौसम विज्ञान विभाग
INDIA METEOROLOGICAL DEPARTMENT

Current Indian Geostationary Meteorological Satellites



INSAT-3D:2013

INSAT-3DR:
8th September 2016

INSAT-3D/3DR-INDIA's Advanced Weather Satellite

Mission objectives:

•To monitor earth's surface, carryout oceanic observations and its environment in various spectral channels of meteorological importance.

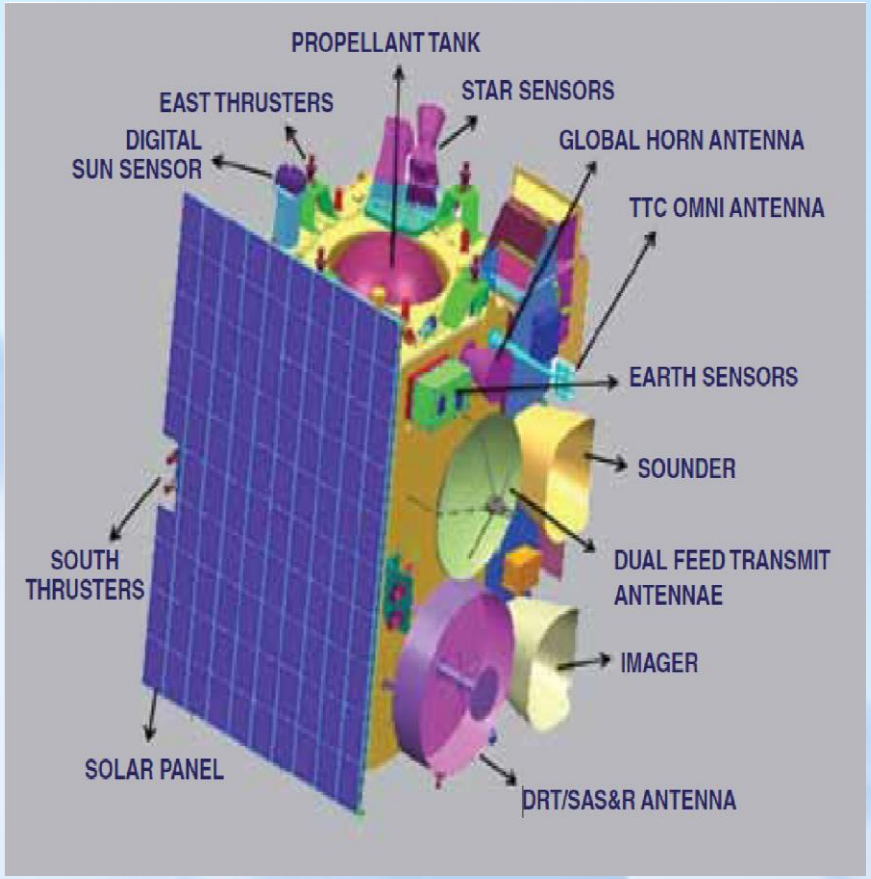
•To provide the vertical profile of temperature and humidity parameters of the atmosphere.

•To provide the data collection and data dissemination capabilities from the Data Collection platforms (DCPs).

•To provide the satellite aided search and rescue services.

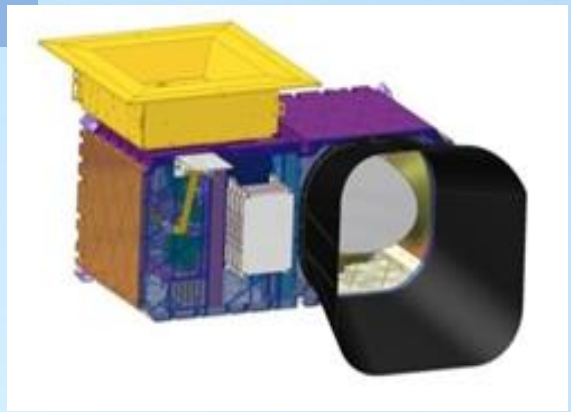
Payloads

- Six channel imager
- Nineteen channel sounder
- Data Relay Transponder(DRT)
- Satellite aided Search and Rescue(S&SR) System.



Meteorological payloads are state-of-art and have significant technological improvement in sensor capabilities and higher resolution compared to earlier INSAT missions

INSAT-3D/3DR-Imager



It is multi-spectral (optical radiometer) capable of generating the images of the earth in six wavelength bands significant for meteorological observations, namely, visible, shortwave infrared, middle infrared, water vapor and two bands in thermal infrared regions. The Imager generates images of the earth disk from geostationary altitude of 36,000 km every 26 minutes and provide information on various parameters, namely, outgoing long-wave radiation, quantitative precipitation estimation, sea surface temperature, snow cover, cloud motion winds, etc

The Imaging System of INSAT-3D has the following significant improvements over that of KALPANA and INSAT-3A:

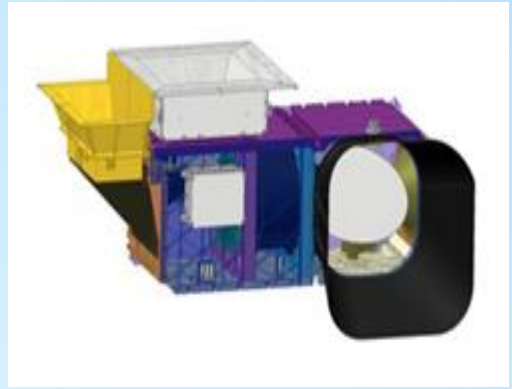
- Improved 1 km resolution in the visible band for the monitoring of mesoscale phenomena and severe local storms
- Imaging in Middle Infrared band to provide night time pictures of low clouds and fog.
- Imaging in two Thermal Infrared bands for estimation of Sea Surface Temperature (SST) with better accuracy.
- Higher Spatial Resolution in the Thermal Infrared band.

INSAT-3D Imager Channel Specification and their uses

Channels Number	Channel ID	Channel name	Spectral range (µm)	Resolution (Km)	Purpose
1.	VIS	visible	0.55 – 0.75	1.0	Clouds, Surface features
2.	SWIR	short wave infrared	1.55 – 1.70	1.0	Snow, Ice and water phase in clouds
3.	MIR	medium wave infrared	3.7 – 3.9	4.0	Clouds, Fog, Fire
4.	WV	water vapour	6.5 – 7.1	8.0	Upper-Troposphere Moisture
5.	TIR1	long wave infrared	10.3 – 11.3	4.0	Cloud top and surface temperature
6.	TIR2	split	11.5 - 12.5	4.0	Lower-Troposphere Moisture

INSAT-3DR-Sounder

INSAT-3D carries a newly developed 19 channel sounder, which is the first such payload to be flown on an ISRO satellite mission. The Sounder has eighteen narrow spectral channels in shortwave infrared, middle infrared and long wave infrared regions and one channel in the visible region. The ground resolution at nadir is nominally 10x10km for all nineteen channels. Atmospheric Sounding System, provide vertical profiles of temperature 40 levels (surface to 70 km), Humidity 21 levels (surface to 15 km) and integrated ozone from surface to top of the atmosphere These profiles are available for a selected region over Indian landmass every one hour and for the entire Indian Ocean Region every sixth hours



The salient features of INSAT-3D sounder design are as follows:

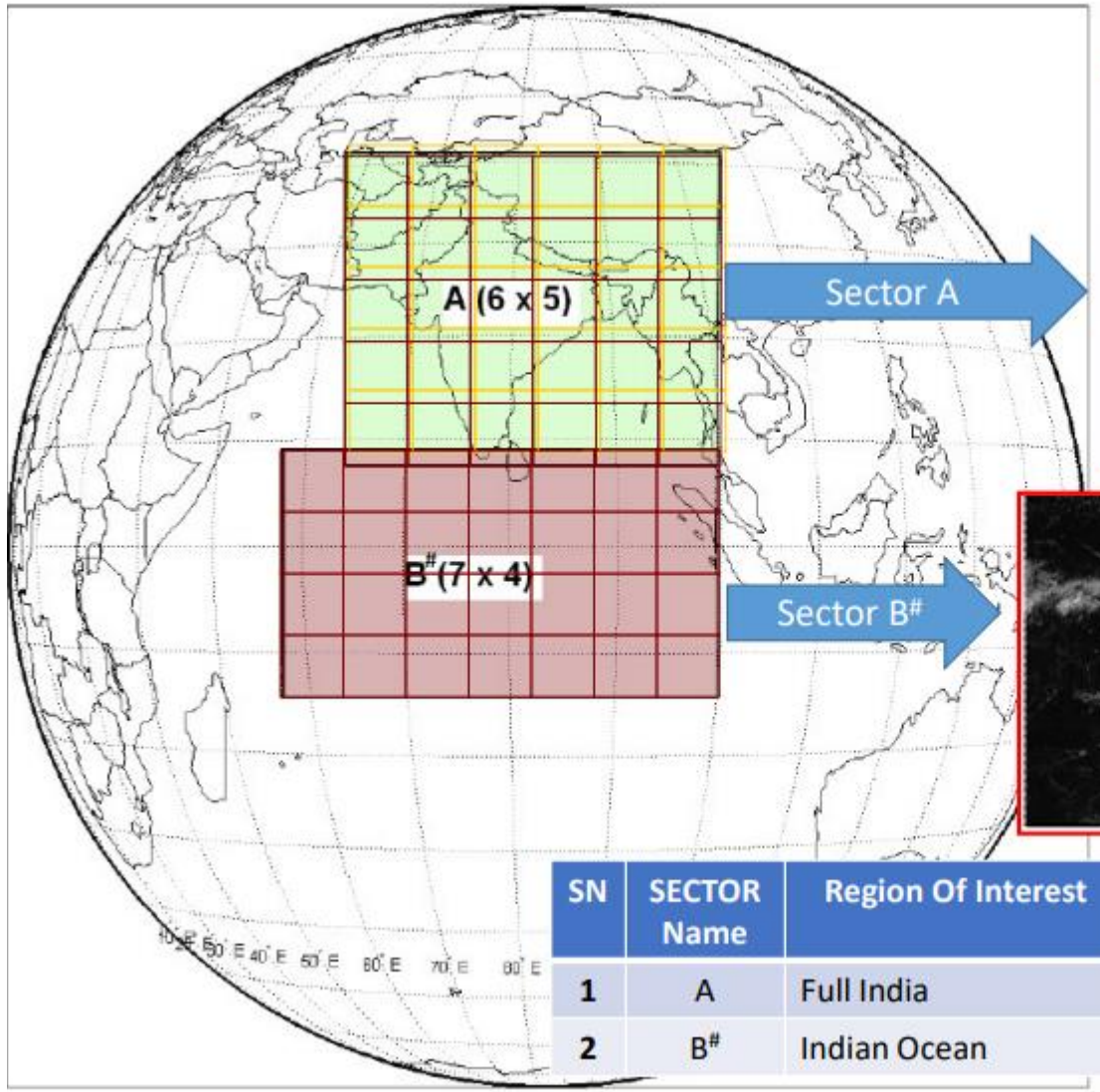
1. Blackbody calibration sequence is modified as compared to VHRR of earlier satellites.
2. In order to improve noise performance, facility to collect two or four samples (0.2 sec or 0.4 sec step & dwell time) of the same area also which can then be processed on ground. This will increase the sounding time proportionally.
3. A biannual rotation of yaw by 180 degree has been introduced to reduce the cooler patch temperature. This is to be taken care during processing.

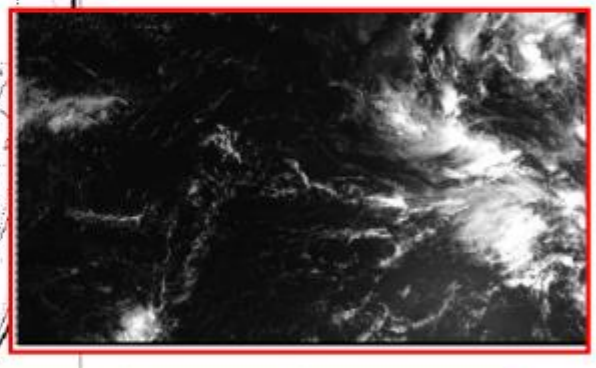
INSAT-3DR Sounder Channels Characteristics

Detector	Ch. No.	λ_c (μm)	ν_c (cm^{-1})	NEΔT @300K	Principal absorbing gas	Purpose
Long wave	1	**14.67**	682	0.17	CO_2	***Stratosphere temperature***
	2	**14.32**	699	0.16	CO_2	***Tropopause temperature***
	3	**14.04**	712	0.15	CO_2	***Upper-level temperature***
	4	**13.64**	733	0.12	CO_2	***Mid-level temperature***
	5	**13.32**	751	0.12	CO_2	***Low-level temperature***
	6	**12.62**	793	0.07	water vapor	***Total precipitable water***
	7	**11.99**	834	0.05	water vapor	***Surface temp., moisture***
Mid wave	8	**11.04**	906	0.05	window	***Surface temperature***
	9	**9.72**	1029	0.10	ozone	***Total ozone***
	10	**7.44**	1344	0.05	water vapor	***Low-level moisture***
	11	**7.03**	1422	0.05	water vapor	***Mid-level moisture***
	12	**6.53**	1531	0.10	water vapor	***Upper-level moisture***
Short wave	13	**4.58**	2184	0.05	N_2O	***Low-level temperature***
	14	**4.53**	2209	0.05	N_2O	***Mid-level temperature***
	15	**4.46**	2241	0.05	CO_2	***Upper-level temperature***
	16	**4.13**	2420	0.05	CO_2	***Boundary-level temp.***
	17	**3.98**	2510	0.05	window	***Surface temperature***
	18	**3.76**	2658	0.05	window	***Surface temp., moisture***
Visible	19	**0.695**	14367	-	visible	***Cloud***

OPERATIONAL SCENARIO OF INSAT-3DR SOUNDER

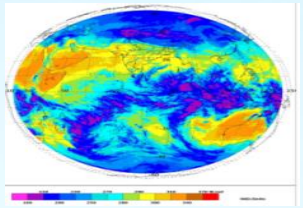
Time (UTC)	INSAT 3DR
00:00	Sector-A
01:00	Sector-A
02:00	Sector-A
03:00	Sector-A
04:00	Sector-B#
05:00	Sector-A
06:00	Sector-A
07:00	Sector-A
08:00	Sector-A
09:00	Sector-A
10:00	Sector-A
11:00	Sector-B#
12:00	Sector-A
13:00	Sector-A
14:00	Sector-A
15:00	Sector-A
16:00	Sector-B#
17:00	Sector-A
18:00	Sector-A
19:00	Sector-A
20:00	Sector-A
21:00	Sector-A
22:00	Sector-A
23:00	Sector-B#

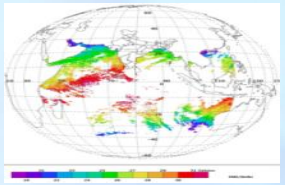


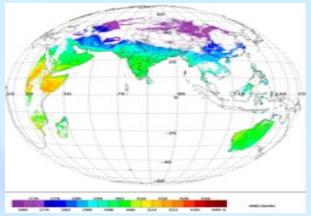


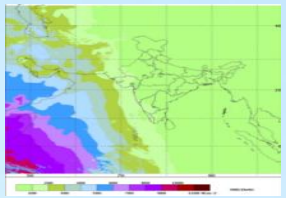
SN	SECTOR Name	Region Of Interest	Size (EWxNS)	Duration (min)
1	A	Full India	6x5	55
2	B#	Indian Ocean	7x4	52

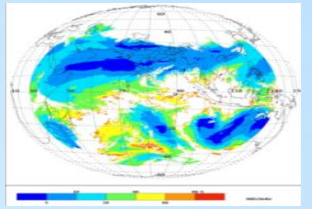
Geophysical parameters/products of INSAT-3D/3DR Imager











SST

LST

INS

UTH

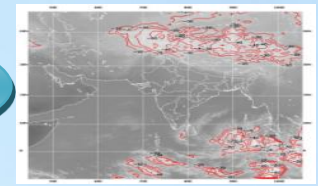
OLR

1.QPE
2. IMR
3. HE

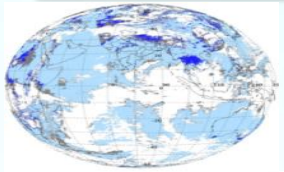
Rain Estimate

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

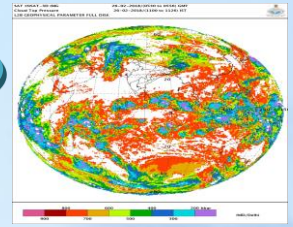
AMV



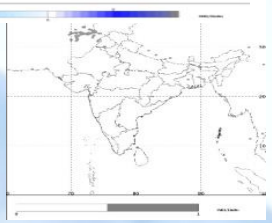
CTBT



Cloud mask



CTT & CTP



Smoke

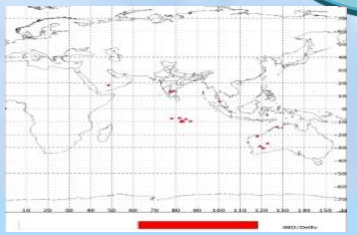
Clear sky-BT

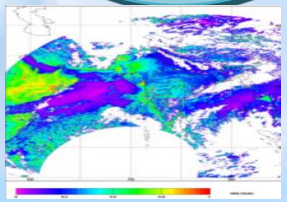
Fire

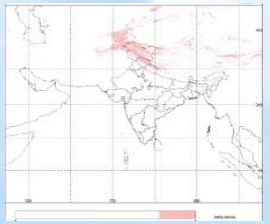
AOD

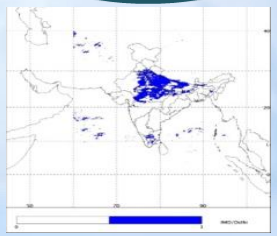
Snow

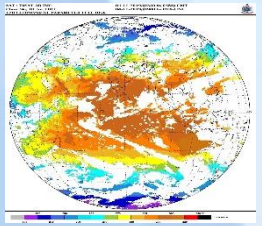
Fog











Geophysical parameters/products of INSAT-3D/3DR Imager

Product	Temporal Resolution	Horizontal Resolution	Format	Domain	Unit
Upper Tropospheric Humidity (UTH)	Half hourly, Daily, Weekly, Monthly	Per pixel	HDF/JPEG	Globe coverage	Percentage (%)
Total Precipitable Water Vapour (New Product)	Half hourly	Per Pixel	HDF/JPEG	Globe (Ocean)	cm
Sea Surface temperature (SST)	Half Hourly	0.5^0x 0.5^0	HDF/JPEG	Globe (Ocean)	degree Celsius
LST (Land Surface Temperature)	Half Hourly	Per pixel	HDF/JPEG	Globe (Land)	Kelvin
Cloud Products					
Cloud Mask	Half Hourly	Per pixel	HDF/JPEG	Globe	0- Pixel is clear, 1- pixel is cloudy, 2- pixel is probably clear 3- pixel is probably cloudy
CTT (Cloud top temperature)	Half Hourly	50 km	HDF/JPEG	Globe	Kelvin
Cloud top pressure	Half Hourly	50 km	HDF/JPEG	Globe	hPa
Effective cloud emissivity	Half hourly	50 km	HDF/JPEG	Globe	percentage (%).
Cloud Fraction	Half Hourly	50 km	HDF/JPEG	Globe	Expressed in fractions
Cloud Particle Effective Radius	Half hourly	Per Pixel	HDF/JPEG	30^0E- 130^0E 50^0S- 50^0N	Microns
Cloud Optical Thickness	Half hourly	Per Pixel	HDF/JPEG	30^0E- 130^0E 50^0S- 50^0N	percentage (%).

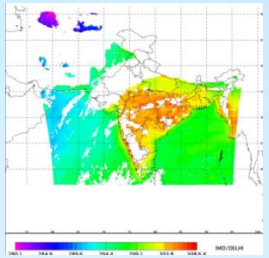
Geophysical parameters/products of INSAT-3D/3DR Imager

Rain Fall products (Quantitative Precipitation Estimation)					
Hydro Estimator Precipitation (HEM)	Half hourly, Daily, Weekly, Monthly	Per pixel	HDF/JPEG	Globe	mm/hr (mm-Daily, Weekly, Monthly)
Insat Multispectral Rainfall (IMSRA)	Half hourly, Daily, Weekly, Monthly	0.1^0x 0.1^0	HDF/JPEG	30^0E- 120^0E 40^0S- 40^0N	mm/hr (mm-Daily, Weekly, Monthly)
Global precipitation Index (GPI)	Three Hourly Accumulated	1^0x 1^0	HDF/JPEG	30^0E- 120^0E 40^0S- 40^0N	mm
IMSRA (Improved)	Half hourly, Daily, Weekly, Monthly	Per Pixel	HDF/JPEG	Globe	mm/hr (mm-Daily, Weekly, Monthly)
Atmospheric Motion Vectors (AMV) and wind Derived products					
Cloud Motion Vector (CMV/IR1-wind)	Half Hourly at Levels (100-400mb 401-700mb 701-975mb)	Point	Gif/JPEG	30^0E- 130^0E 40^0S- 40^0N	Knots
Water vapour Winds (WVW)	Half Hourly at Levels (100-250mb 251-350mb 351-500mb)	Point	Gif/JPEG	30^0E- 130^0E 40^0S- 40^0N	Knots
Visible (during day) /MIR (during night) Winds	Half Hourly at levels (600-800mb 801-975mb)	Point	Gif/JPEG	30^0E- 130^0E 40^0S- 40^0N	Knots
IRW –Merged winds	Half hourly	Point	Gif/JPEG	30^0E- 130^0E 40^0S- 40^0N	Knots
WVW-Merged winds	Half hourly	Point	Gif/JPEG	30^0E- 130^0E 40^0S- 40^0N	Knots
Vis-HR winds	Half hourly	Point	Gif/JPEG	30^0E- 130^0E 40^0S- 40^0N	Knots
Vorticity (850,700,500 & 200 hPa)	Half hourly	0.5^0 X0.5^0	Gif/JPEG	30^0E- 130^0E 40^0S- 40^0N	10^{-5} x /sec
Low Level Convergence (850-925 hPa):	Half hourly	0.5^0 X0.5^0	Gif/JPEG	30^0E- 130^0E 40^0S- 40^0N	10^{-5} x /sec
Upper level Divergence (150-300 hPa):	Half hourly	0.5^0 X0.5^0	Gif/JPEG	30^0E- 130^0E 40^0S- 40^0N	10^{-5} x /sec
Wind Shear:	Half hourly	0.5^0 X0.5^0	Gif/JPEG	30^0E- 130^0E 40^0S- 40^0N	Knots
Mid-Level wind Shear	Half hourly	0.5^0 X0.5^0	Gif/JPEG	30^0E- 130^0E	Knots

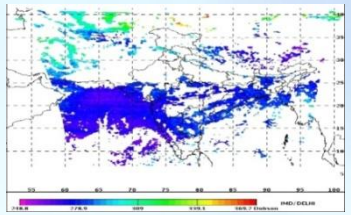
Geophysical parameters/products of INSAT-3D/3DR Imager

Miscellaneous Geophysical Products					
Snow cover	0500,0530, 0600,0630 UTC	Per pixel	HDF/JPEG	20^0E- 110^0E 50^0S- 50^0N	Unit-less
Fire	Half Hourly	Point	HDF/JPEG	60^0E- 100^0E 0^0N- 40^0N	Unit-less
Smoke	Half Hourly	Point	HDF/JPEG	60^0E- 100^0E 0^0N- 40^0N	Unit-less
Fog (Night Time/Day Time)	Half Hourly	Per pixel	HDF/JPEG	45^0E- 110^0E 10^0S- 45^0N	Unit-less
Fog Intensity	Half Hourly	Per pixel	HDF/JPEG	45^0E- 110^0E 10^0S- 45^0N	Unit-less (1,2,3,4)
Aerosol Optical Depth (AOD)	0500 to 0830 UTC on half hourly basis	Per pixel for clear sky	HDF/JPEG	45^0E- 100^0E 10^0S- 45^0N	Unit-less
Radiation Products/ Agromet Products					
Outgoing Long Wave Radiation (OLR)	Half hourly, Daily, Weekly, Monthly	Per pixel	HDF/JPEG	Globe	Watt/m^2
Net Radiation	Half hourly	Per Pixel	HDF/JPEG	60^0E- 100^0E 5^0N- 40^0N	Watt/m^2
Land surface Albedo	Half hourly	Per Pixel	HDF/JPEG	60^0E- 100^0E 5^0N- 40^0N (land)	Unit -less
Short Wave Radiation	Half hourly	Per Pixel	HDF/JPEG	40^0E- 110^0E 15^0S- 25^0N (Ocean)	Watt/m^2
Evapotranspiration (PET)	Half hourly	Per Pixel	HDF/JPEG	50^0E- 105^0E 5^0S- 41^0N (land)	mm
Actual Evapotranspiration	Half hourly	Per Pixel	HDF/JPEG	60^0E- 100^0E 5^0N- 40^0N	mm/day
Insolation	Half Hourly	Per pixel	HDF/JPEG	45^0E- 110^0E 10^0S- 45^0N	Watt/m^2

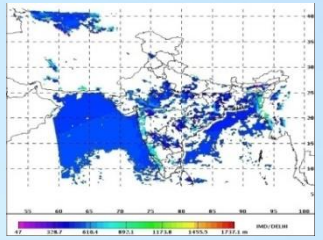
Geophysical parameters OF INSAT-3DR Sounder



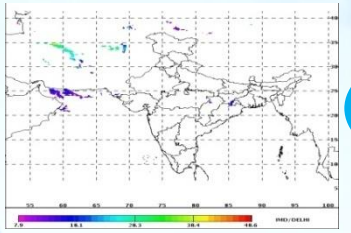
Temperature profile



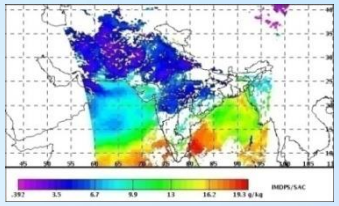
Total ozone



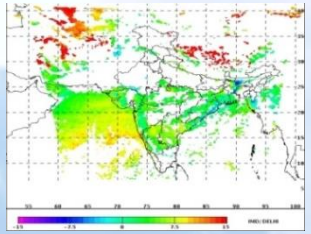
Geo potential height Profile



Dry microburst index

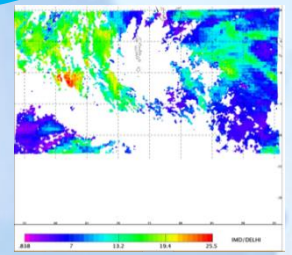


Humidity profile

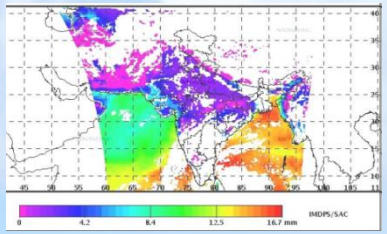


Lifted Index

Maximum vertical theta –e differential



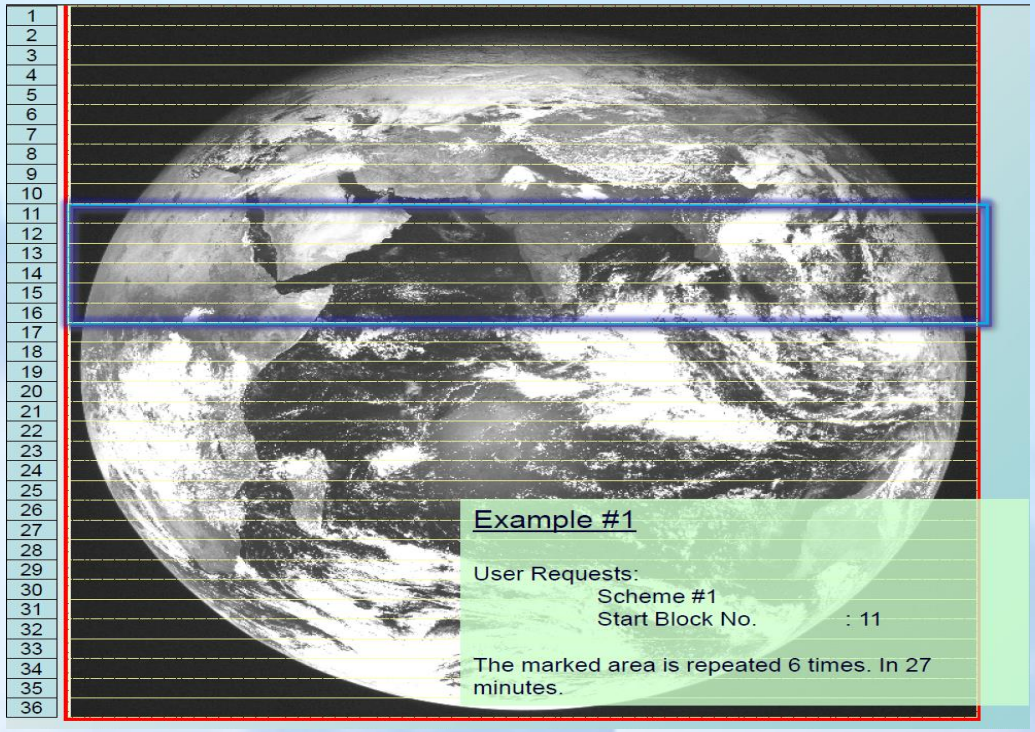
Layer & perceptible water index (1000-900, 900-700, 700-300hpa)



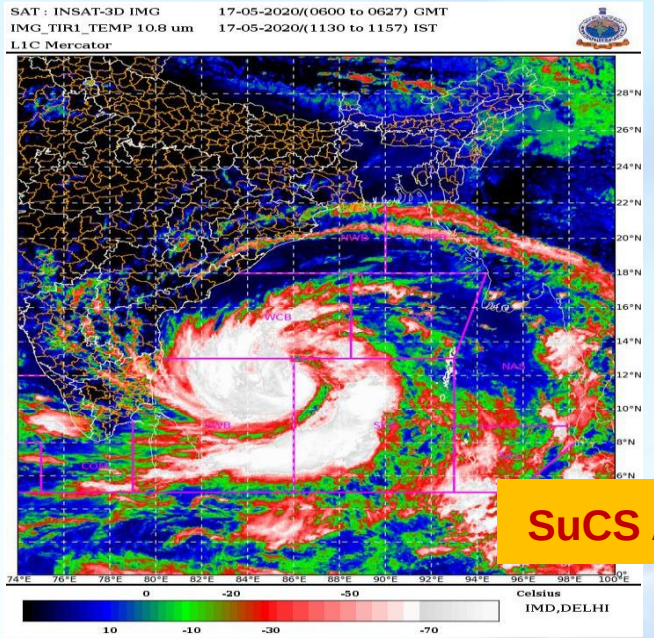
SOP of Rapid Scan Strategy of Imager of INSAT-3DR has been finalised for conducting during Cyclone/ specific extreme weather event. During the period from June 2019 to May 2020, Rapid Scan has been successfully carried out for four cyclones i.e. SuCS Kyarr, ESCS Maha, VSCS Bulbul and VSCS Pawan.

- Normal mode scan area has been divided into 36 blocks in North-South directions such that:
  - Each block covers 0.50 in N-S direction.
  - No of Scan lines for Each block: 40
  - Time required to scan each block: 45 seconds

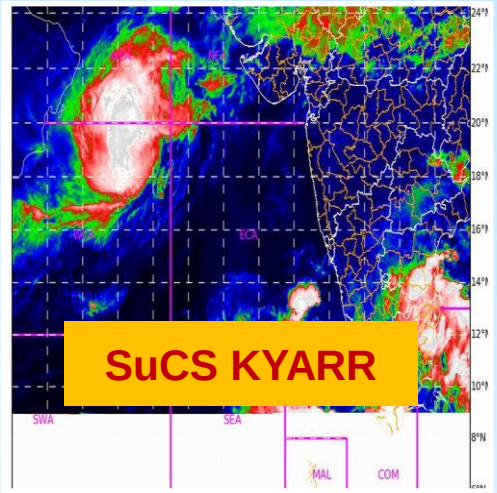
- Extent of coverage: 6 Blocks (3° coverage in 234 lines)
- No. of repetitions: 6
- Time required: 27 minutes
- (6 blocks with 6 repetitions)



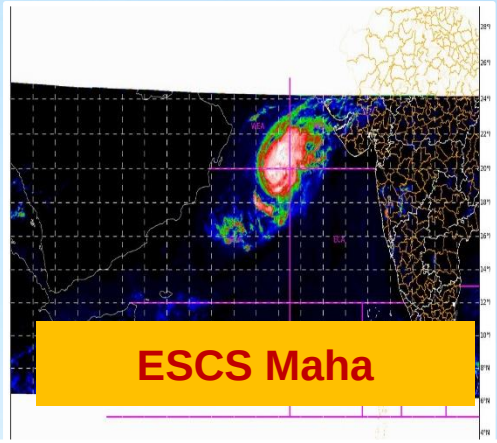
RAPID Scan conducted during June 2019 to May 2020



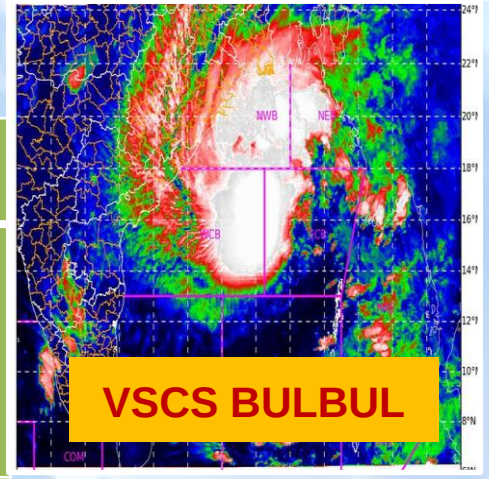
SuCS AMPHAN



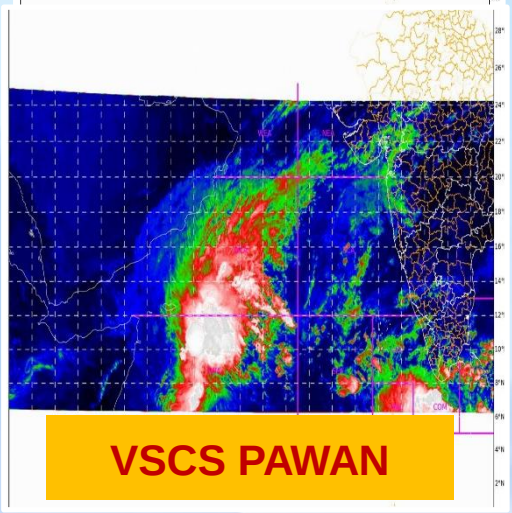
SuCS KYARR



ESCS Maha



VSCS BULBUL



VSCS PAWAN

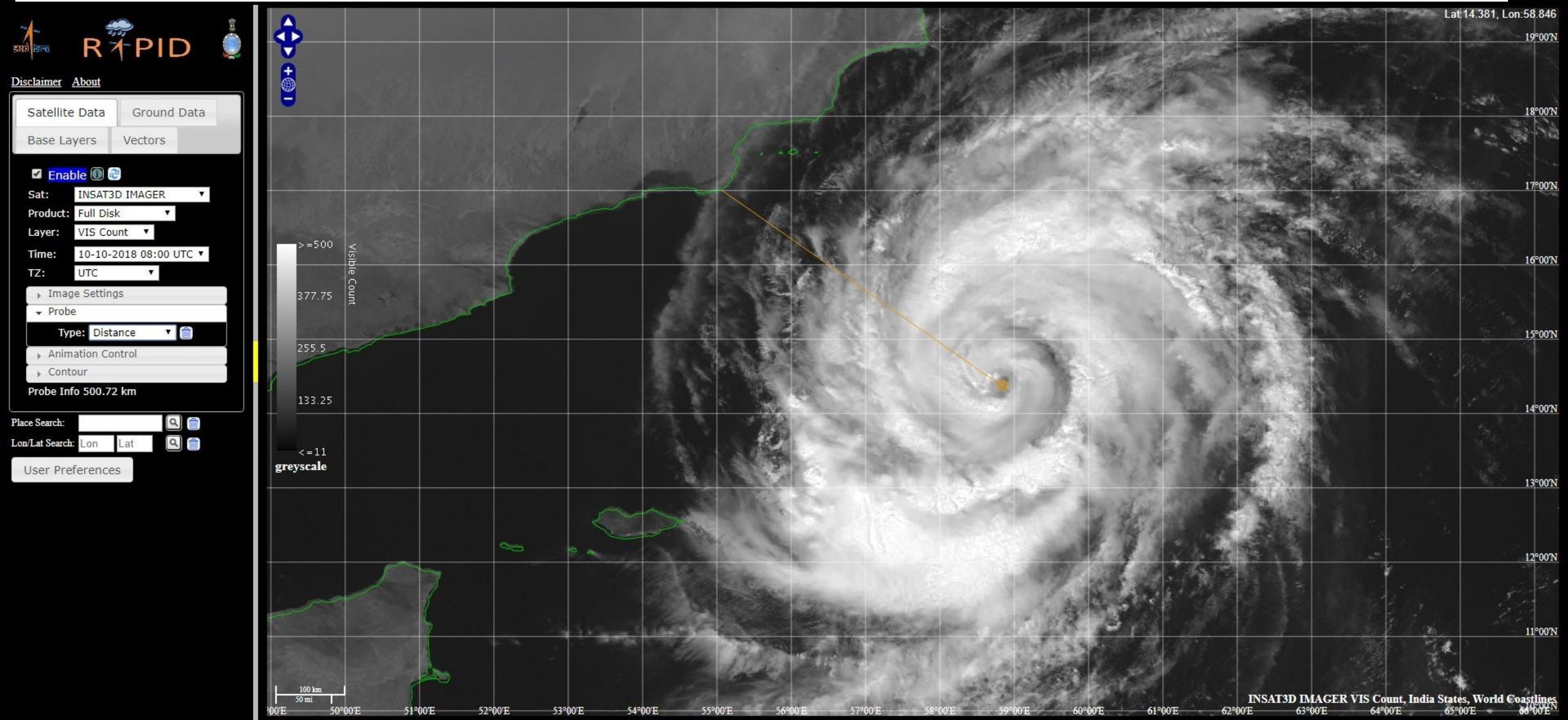
Cyclone & Intensity	Duration	Number of Scans
SuCS Kyarr	27th October- 02nd November 2019	4320
ESCS Maha	30th October-07th November 2019	
VSCS Bulbul	05th -11th November 2019	
VSCS Pawan	04th-08th December 2019	1140
SuCS Amphan	15th -21st May 2020	1560

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

- Connects atmospheric- and geosciences
- No specific OS/ software/ library / compiler required on the desktop. Acess through browserc
- Provides features of interest to scientific community
- Open standards OGC
  - Web Mapping Service (WMS) – For visualization
  - Extensions written for scientific community
- Zero learning curve

Distance Probing of Eye Region for VSCS “LUBAN” and VSCS “TITLI”



MULTI-MISSION METEOROLOGICAL DATA RECEIVING & PROCESSING SYSTEM (MMDRPS) FOR INSAT-3D, INSAT-3DR AND INSAT-3DS SATELLITES AND SYSTEM IS ON AN OPERATIONAL BASIS SINCE 01ST OCTOBER 2019

The salient features of MMDRPS are:

Image processing software for INSAT-3D/3DR and upcoming INSAT-3DS satellite data.

- MMDRPS has a very high end processing system which cuts down the processing time from 15 minutes to 7 minutes.
- Cal/ Val site data / GISCS calibration coefficient to be used in operational chain.
- System is capable to process RAPID scan data of INSAT-3DR Imager payload conducted during Extreme weather events.
- System has the capability to convert data into various standard data formats like ASCII, binary, NetCDF.
- MMDRPS have storage capacity of the order of 2.0/2.0PB(Main/ Mirror) & 324TB SSD which will facilitate online sharing of processed data for all Indian meteorological satellites to the registered users as per IMD data policy.
- All available past satellite datasets starting from 1983 will be kept in online mode in due course of time.

GNSS Network (25)

Parameters:

1. Surface- Temprature, Pressure, Humidity
2. IPWV
3. Zenith Total Delay
4. Total Electron Content

GNSS ATMOSPHERE WATER VAPOUR WATCH

SATELLITE METEOROLOGY DIVISION

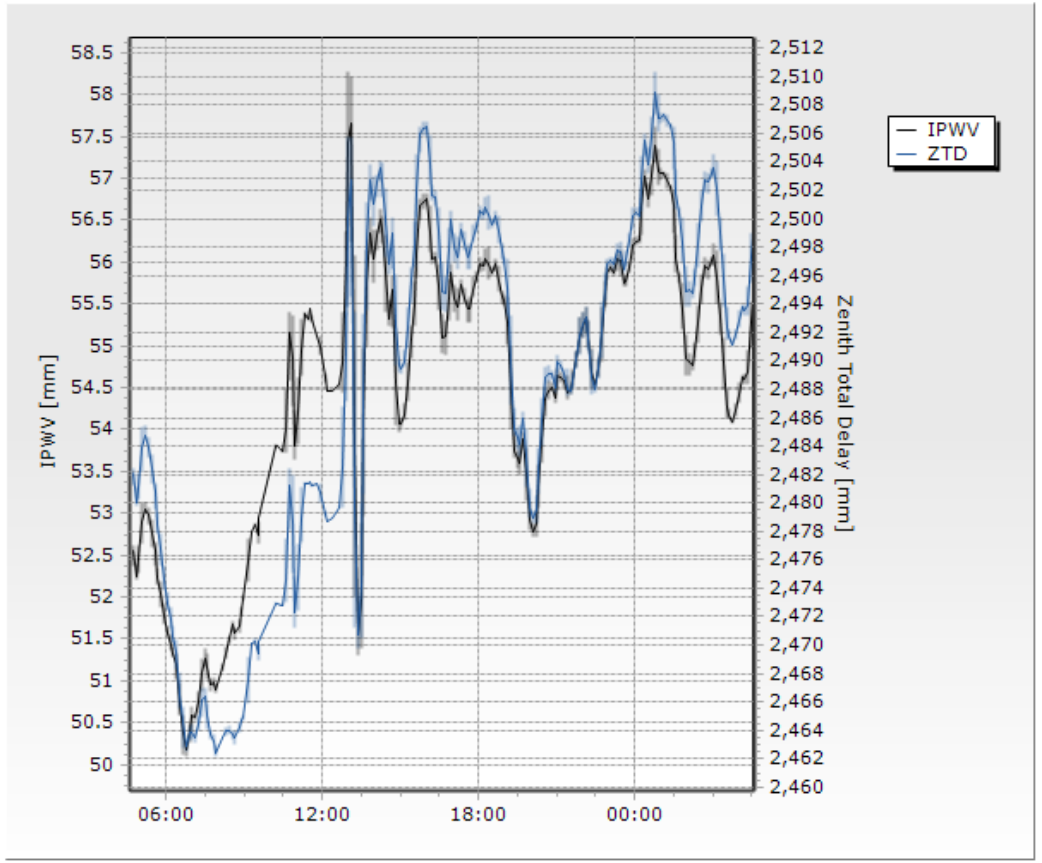
IMD ATMOSPHERE WATCH

- Home
  - Sensor Map
  - **Atmospheric Conditions**
    - IPWV Map
    - Station Chart
    - Condition Chart
    - IPWV Contour Map
    - IPWV Surface Map
    - IPWV Surface Map Animation
    - TEC Contour Map
    - TEC Surface Map
    - TEC Surface Map Animation
  - **Position Scatter Plot**
    - Position Scatter Plot
- Administrator Login

Station per Atmospheric Condition

ARGD | Timespan: Last 24 hours | Average Timespan: Raw | ☑ Display min and max values

Auto Refresh: Disabled

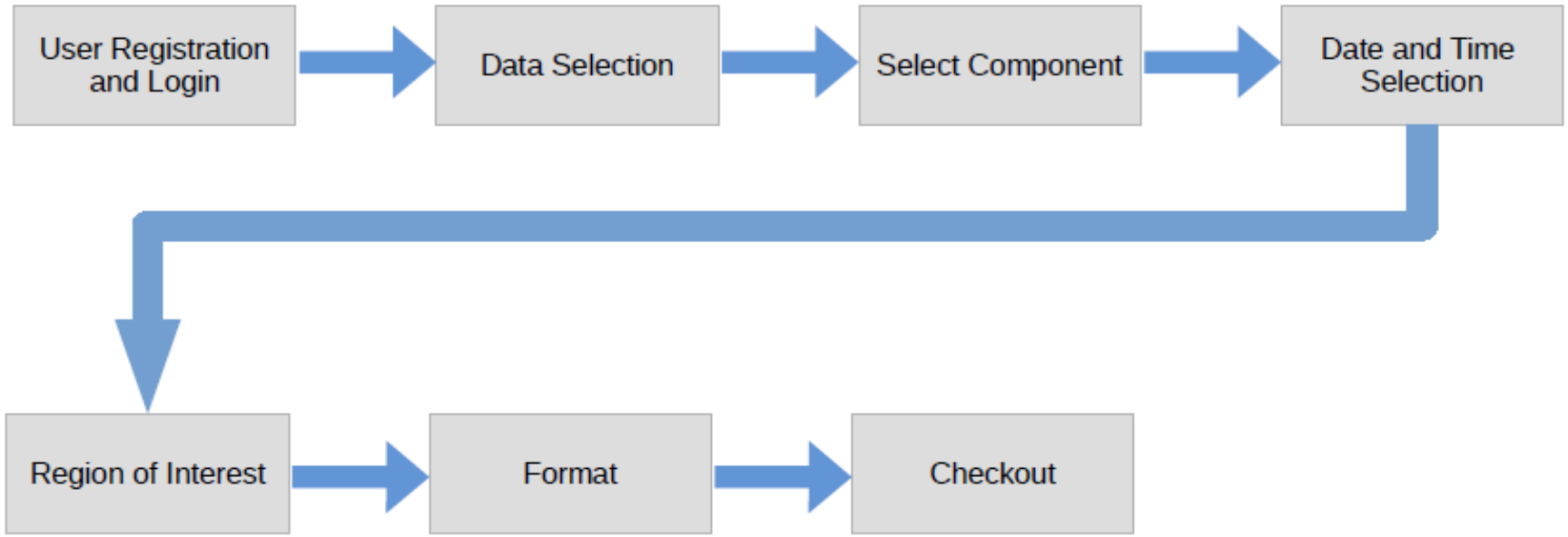


☑ IPWV
☑ Zenith Total Delay
☐ Temperature
☐ Pressure
☐ Humidity

Online Data Supply system in implementation phase and will be launched shortly.

Data Supply system (DSS) is an online software package, currently in implementation phase and will be highly beneficial in supplying INSAT-3D/3DR data to users over the internet. Data supply to the users as per IMD data policy guidelines.

Steps Involved



Timeline of upcoming satellite operations.

Geo-Imaging Satellites

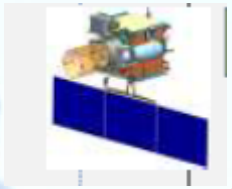
4th Qtr, 2020
- GISAT-1 Observations from GEO

1st Qtr,2021
- OCEANSAT-3A

2nd Qtr,2021
- INSAT 3DS (Imager & Sounder)

3rd Qtr,2021
- Ocean Color & Wind Vector- Continuity + SST

Ocean application satellites



4th Qtr,2020
- OCEANSAT-3

Ocean application satellites

Geo-Imaging Satellites

Thank you