



# Status of Indian Satellite System

भारत मौसम विज्ञान विभाग  
INDIA METEOROLOGICAL DEPARTMENT

A.K.Sharma  
Sat.Met.Div

# Brief History

Brief history: Satellite Meteorology branch of IMD really started in 1982 with the launch of INSAT-1A which was a multipurpose satellite meant for services to Meteorology, Doordarshan and Communication. Before that Indian meteorologists were using analog imageries received from U.S. Polar orbiting satellites series of TIROS-N. Many satellites for meteorological purposes were launched after the launch of INSAT-1A as given below:

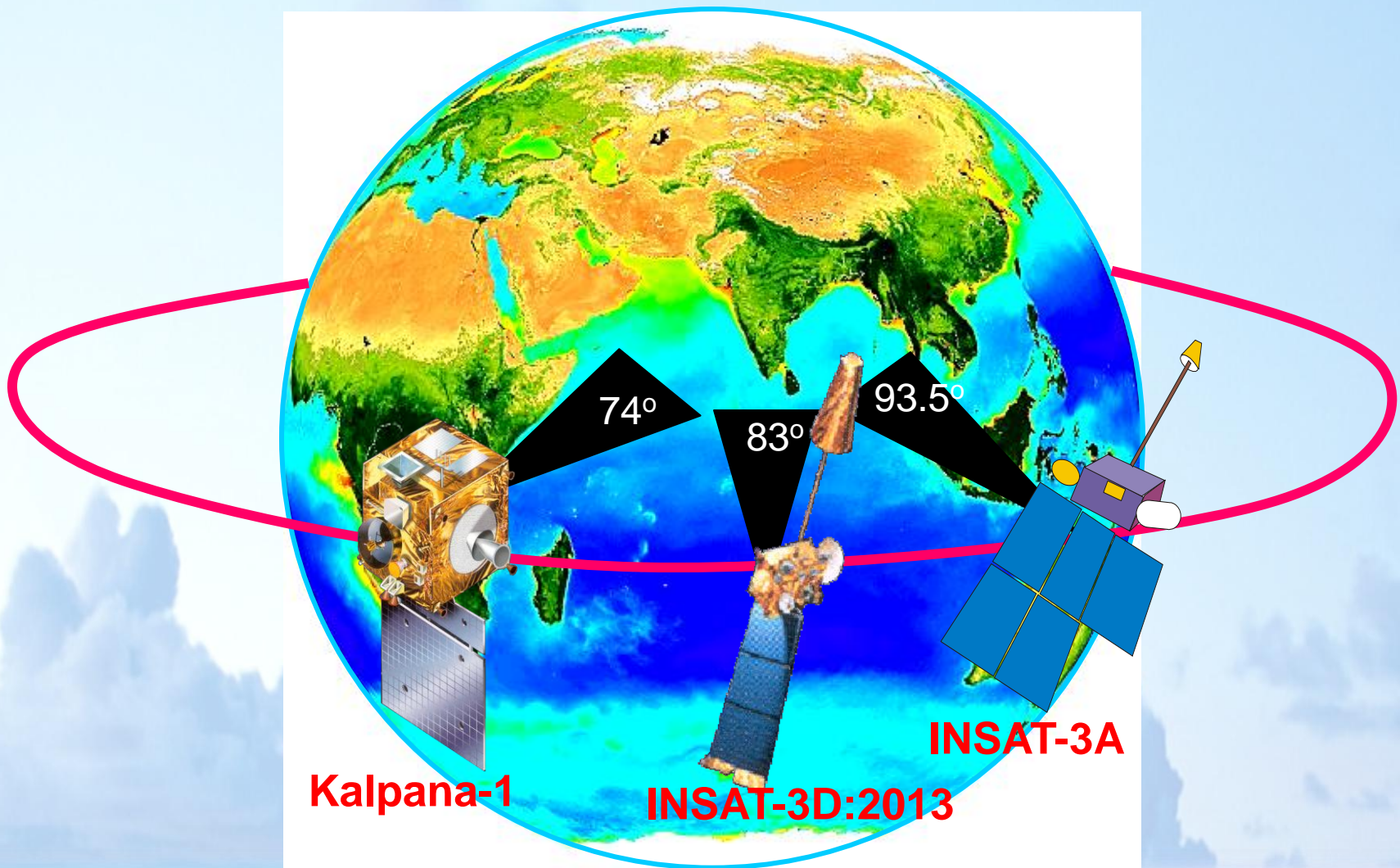
- INSAT-1A – 10 April 1982
- INSAT-1B – 30 August,1983
- INSAT-1C – 21 July 1988
- INSAT-1D – 12 June,1990
- INSAT-2A – 10 July, 1992
- INSAT-2B – 23 July,1993
- INSAT-2E – 03 April 1999
- KALPANA-1 – 12 Sept.2002
- INSAT-3A – 10 April 2003

Two Channel VHRR

Three Channel VHRR



# Current and future Indian Geostationary Meteorological Satellites



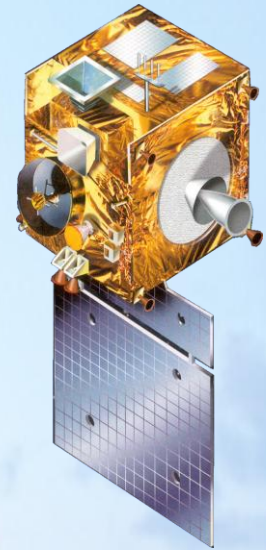
# INSAT-3A and Kalpana-1

(2003) (2002)

Location : INSAT 3A : 93.5°E  
Kalpana-1 : 74°E

Payload : (i) VHRR and CCD camera in INSAT -3A  
(ii) VHRR in Kalpana-1

- VHRR Bands ( $\mu\text{m}$ )
  - Visible : 0.55 – 0.75
  - Water vapour : 5.70 – 7.10
  - Thermal Infra Red : 10.5 – 12.5
- Resolution (km) : 2 X 2 for Visible  
8 X 8 for WV & TIR
- CCD Camera Bands ( $\mu\text{m}$ )
  - Visible : 0.62 – 0.68
  - Near Infra Red : 0.77 – 0.86
  - Short Wave Infra Red : 1.55 – 1.69
- Resolution (km) : 1 X 1 for all bands



# Present Status

**Currently Operational INSAT Series of Satellites used by India Meteorological Department:**

- 1. KALPANA-1**
- 2. INSAT-3A**
- 3. INSAT-3C ( for satellite data communications)**
- 4. Oceansat-II ( Ocean winds,Sunsynchronous)**
- 5. Megha-Tropiques ( at 20 deg. Inclination, products under validation )**



- ❖ **KALPANA-1 (K-1) is the main operational Satellite having three channels in VIS (0.55-0.75um), IR (10.5-12.5uM) and WV (5.7-7.1 um) bands. 48 scans/day of VHRR images are received from K-1.**
- ❖ **INSAT-3A is the standby satellite having three channel VHRR and a CCD payload of three channels and hourly images of VHRR and 5 images of CCD are received per day.**



- ❖ All VHRR data are processed, analyzed and advisories based on the imageries/Products provided to National Weather Forecasting Centre (NWFC) of the organisation.
- ❖ Half Hourly images are very useful in monitoring Tropical Cyclones and meso-scale systems like thunderstorms, squall lines and providing heavy rainfall advisories.
- ❖ Images as well as digital data are transmitted to other regional and State forecasting offices of IMD in near real-time for use in their local forecasting through Digital Meteorological Data Dissemination (DMDD) system in LRIT/HRIT format . Three stations of DMDD are also installed at Maldives, Nepal and Srilanka.



❖ Images and products generated from satellite data are displayed on IMD Website [www.imd.gov.in](http://www.imd.gov.in) .Some products are also assimilated into the NWP models.

List of products:

- ❖ Cloud Motion Vectors (CMV)
- ❖ Water Vapour Winds (WVW)
- ❖ Outgoing Longwave Radiation (OLR)
- ❖ Quantitative Precipitation Estimates (QPE)
- ❖ Sea Surface Temperature (SST)
- ❖ Upper Tropospheric Humidity (UTH)
- ❖ Cloud Top Temperatures (CTT)
- ❖ Daily/weekly/monthly/seasonal averages of several products



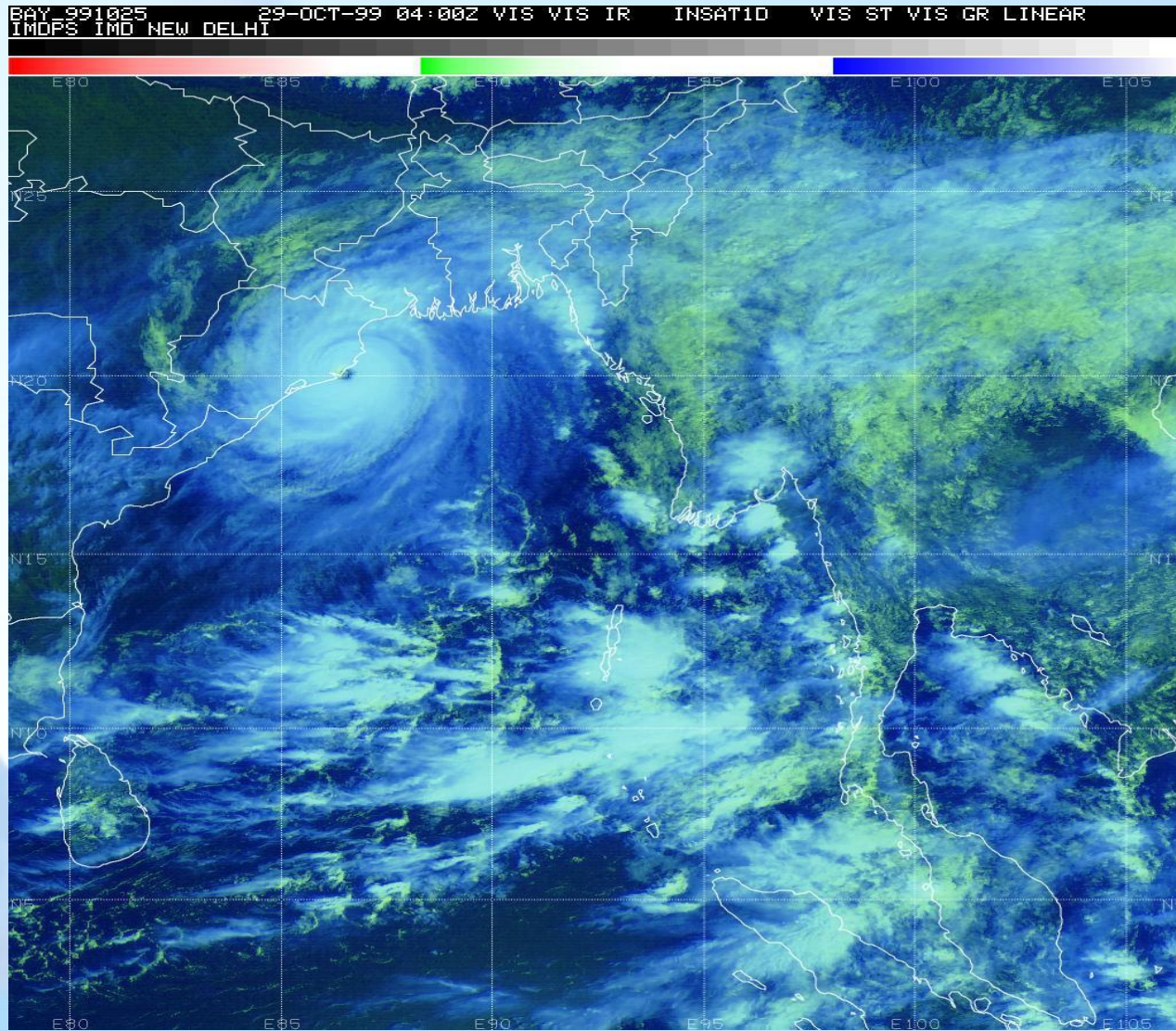


# Contd.

- ❖ **Satellite images in all three channels and color composites.**
- ❖ **Images in different sectors displaying various parts of India and neighbouring countries e.g. North-west sector, north - east sector etc.**



# TROPICAL CYCLONE, 29-10-1999 BAY OF BEGAL



11/7/2012

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# FOG

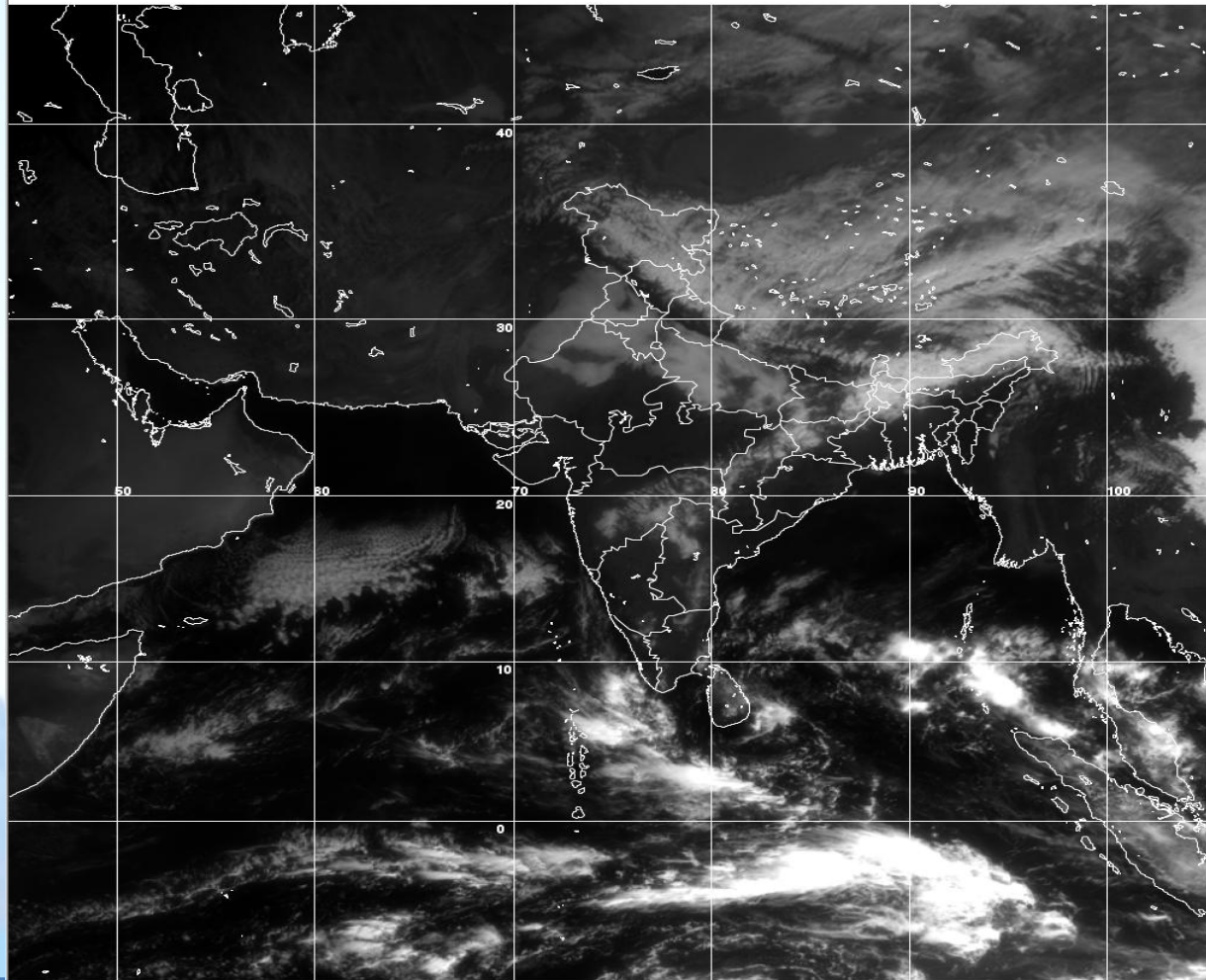
Projection : MER  
ASI\_VIS

01-01-2011 / 04:30Z

Sat: KALPANA-1



VIS Linear Stretch 1.0%



11/7/2012

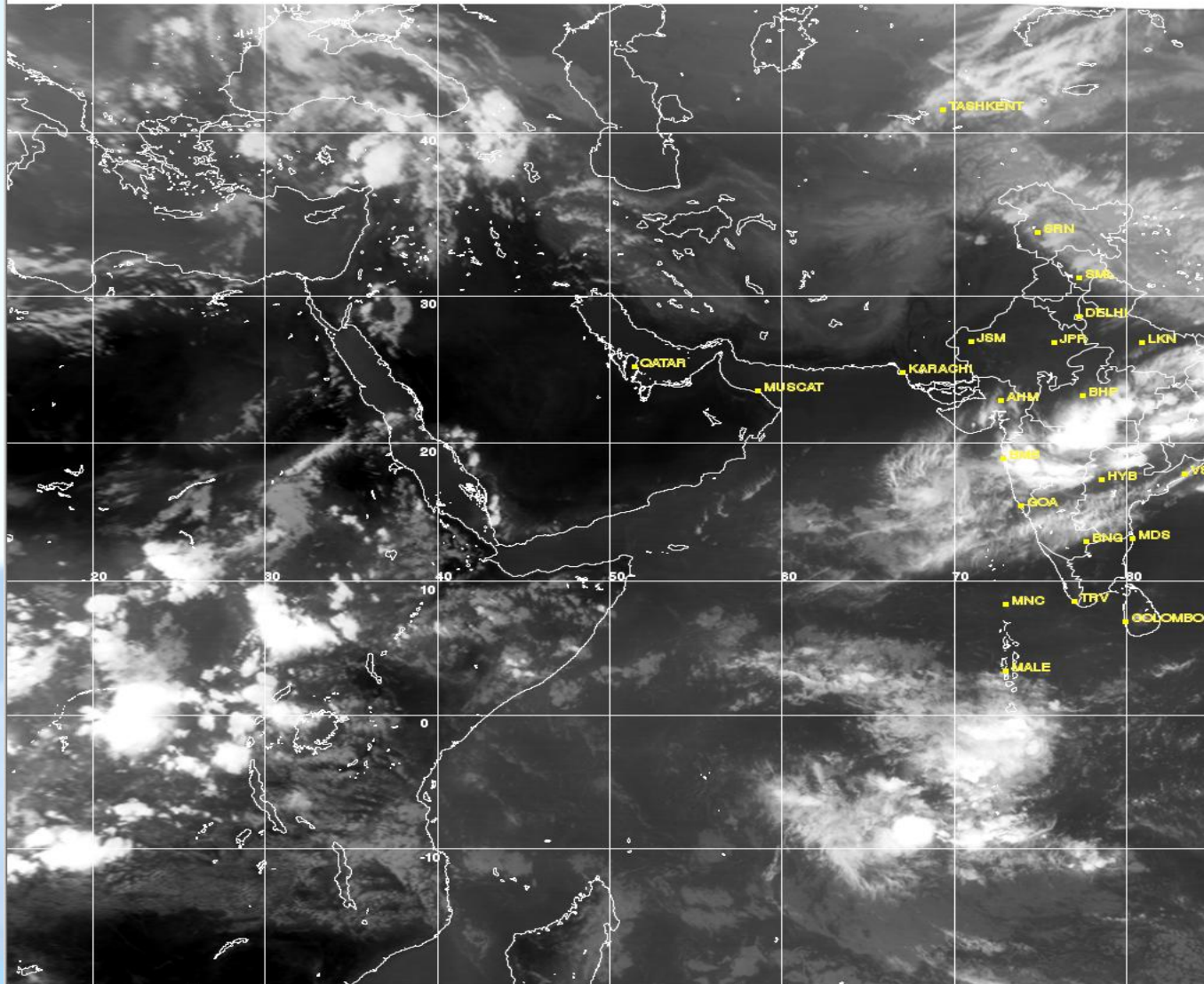
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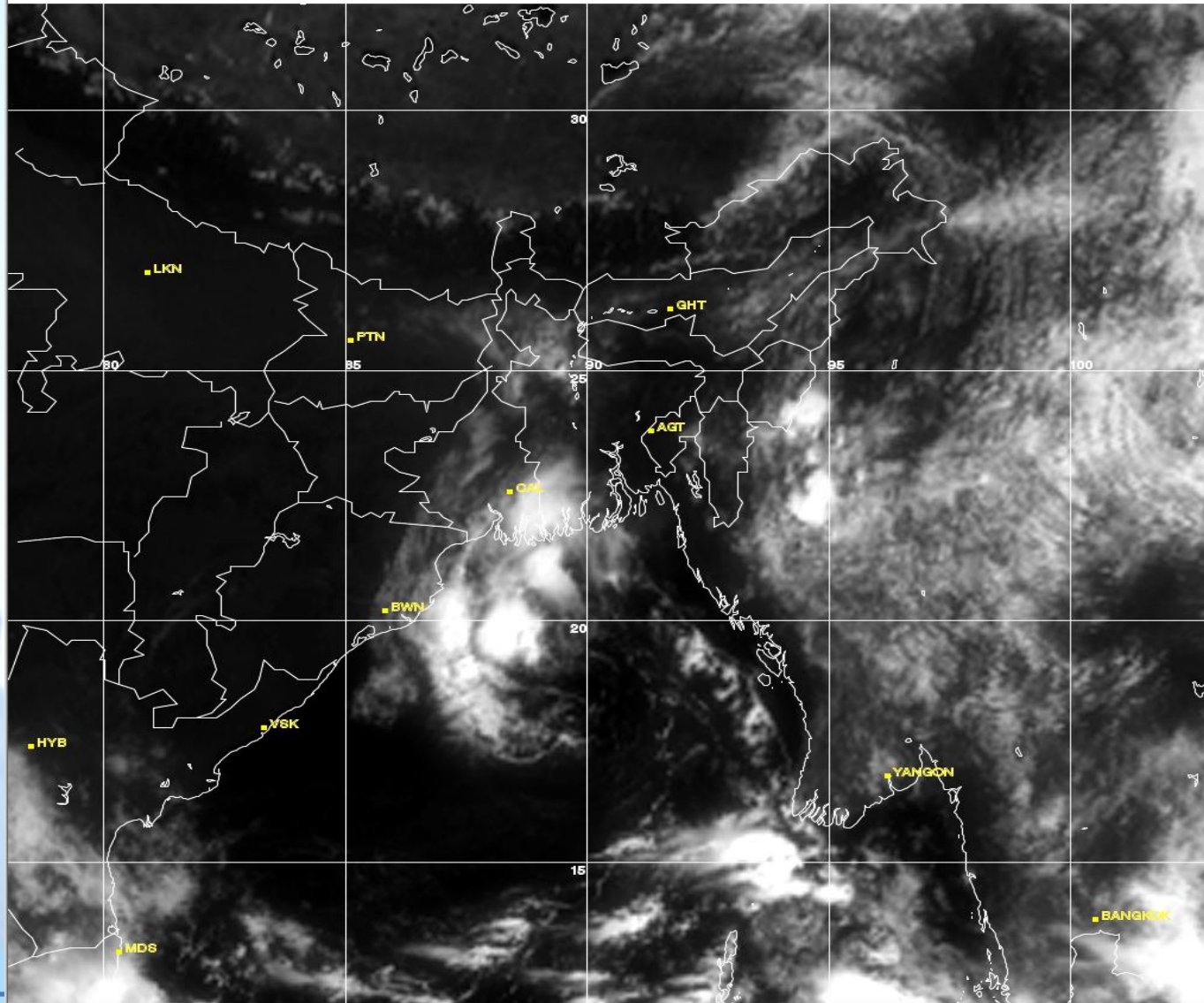


TIR Linear Stretch 1.0%

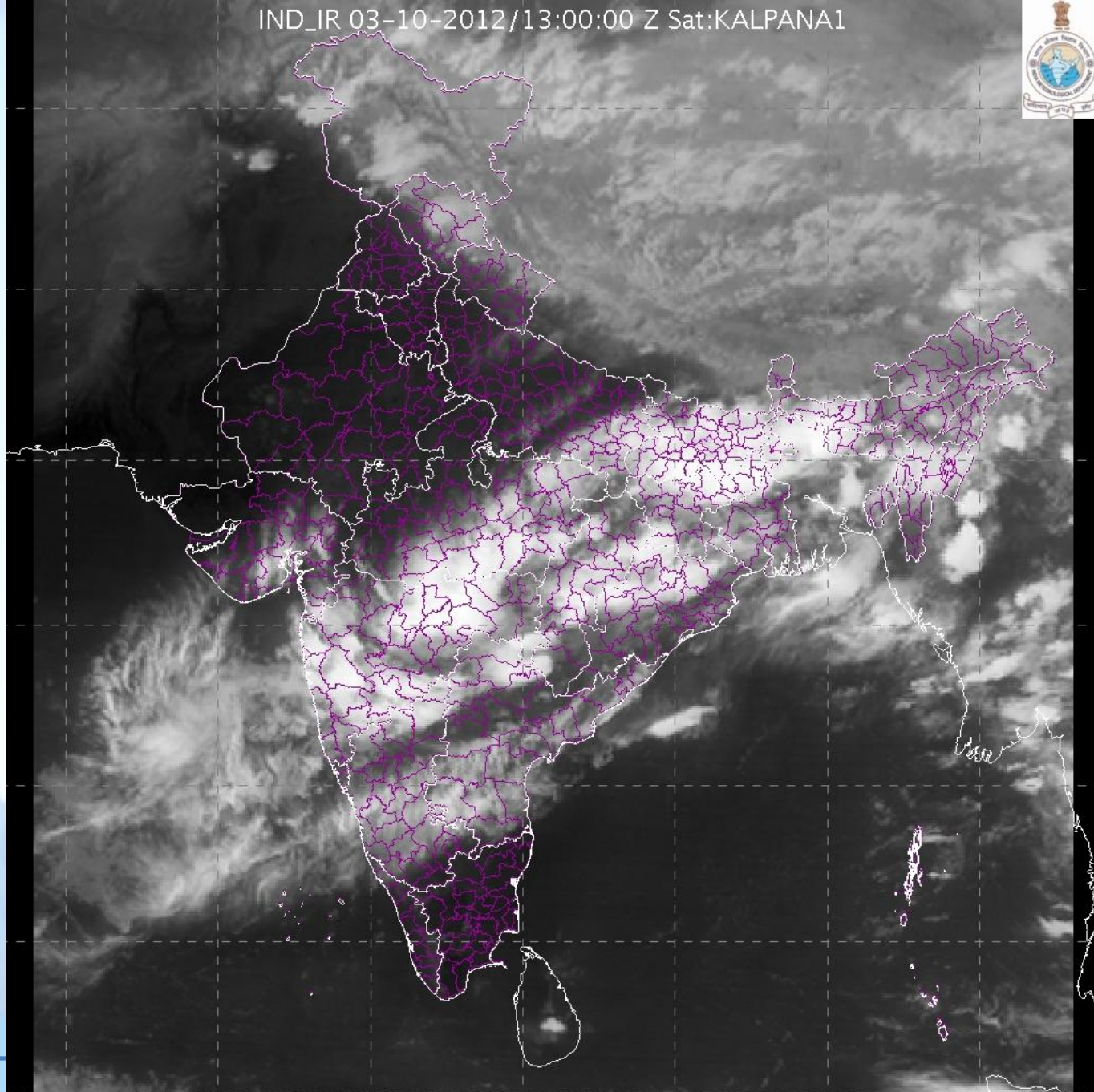




VIS Linear Stretch 1.0%



IND\_IR 03-10-2012/13:00:00 Z Sat:KALPANA1

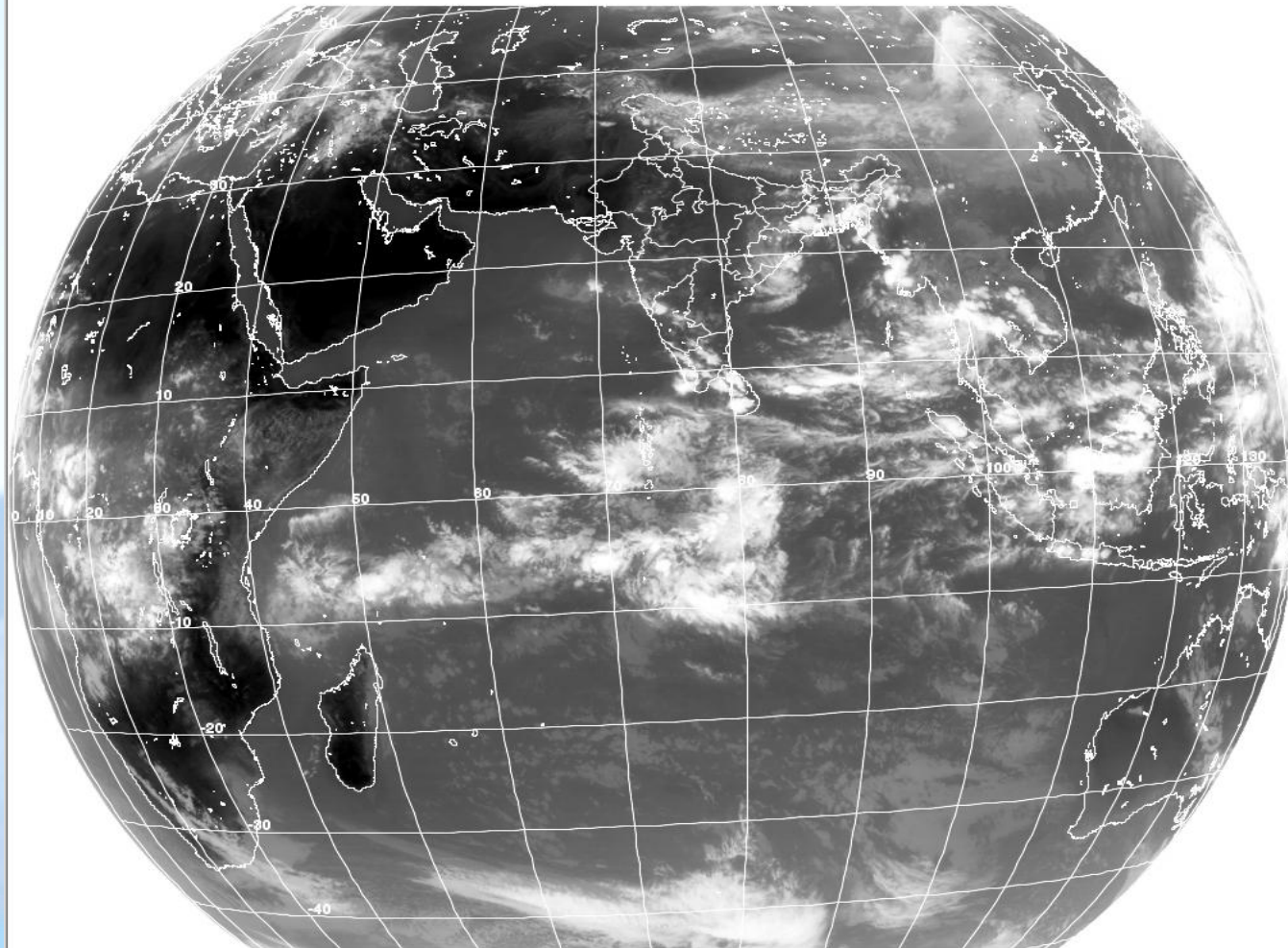


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TIR Linear Stretch 1.0%



Projection : None  
GLOBE\_COMPOSITE

03-10-2012 / 12:00Z

Sat: INSAT-3A



VIS Linear Stretch 0.0%

VIS Linear Stretch 1.0%

TIR Linear Stretch 0.0%



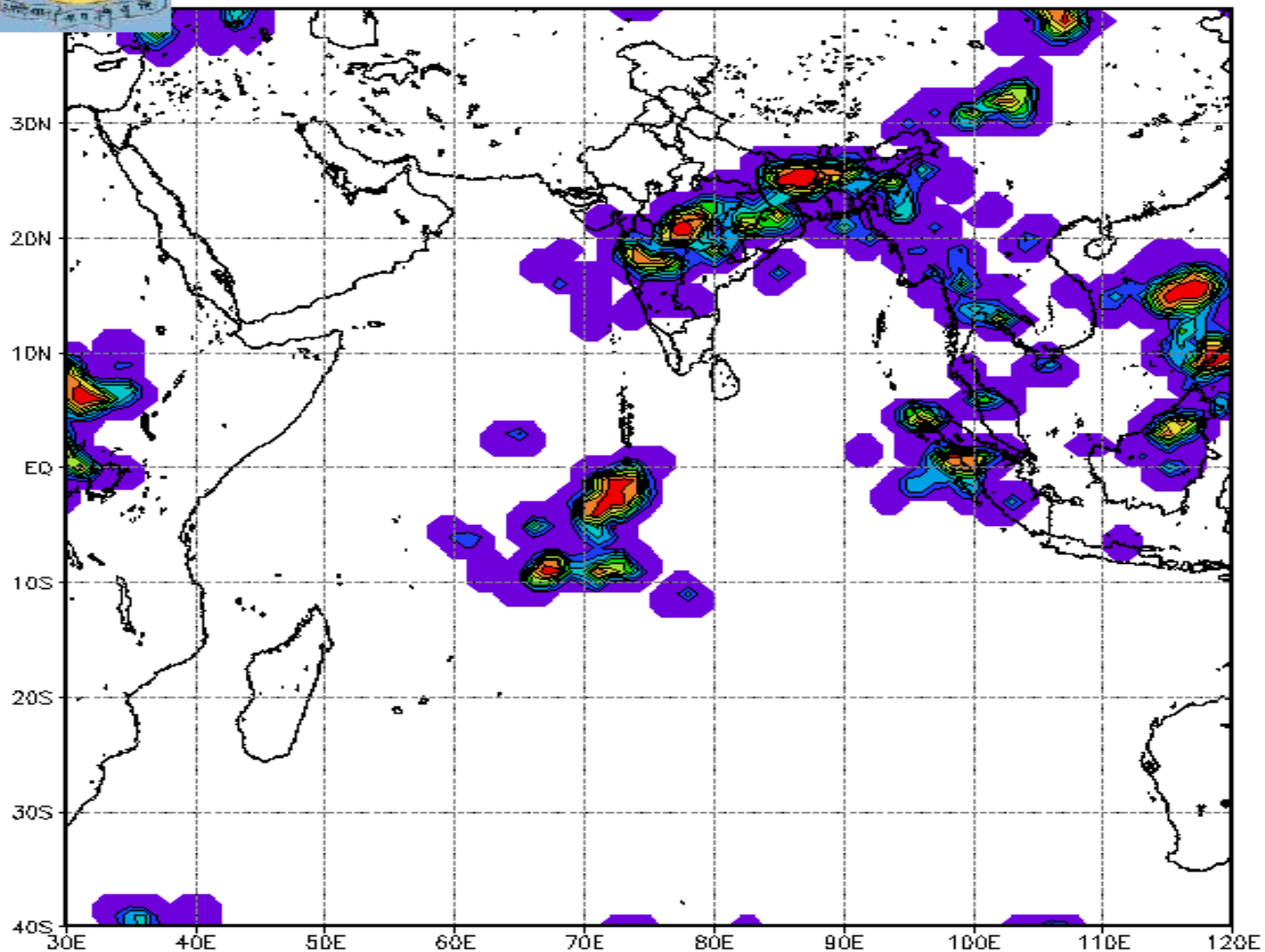
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KALPANA-1 QPE (mm,  $1^{\circ} \times 1^{\circ}$ ) 03OCT2012 13:30 Z



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KALPANA-1 03OCT2012 13:00 WV VHR

100-250 hPa

WATER VAPOUR WIND

(1Kt = 0.5 m/s)

251-350 hPa

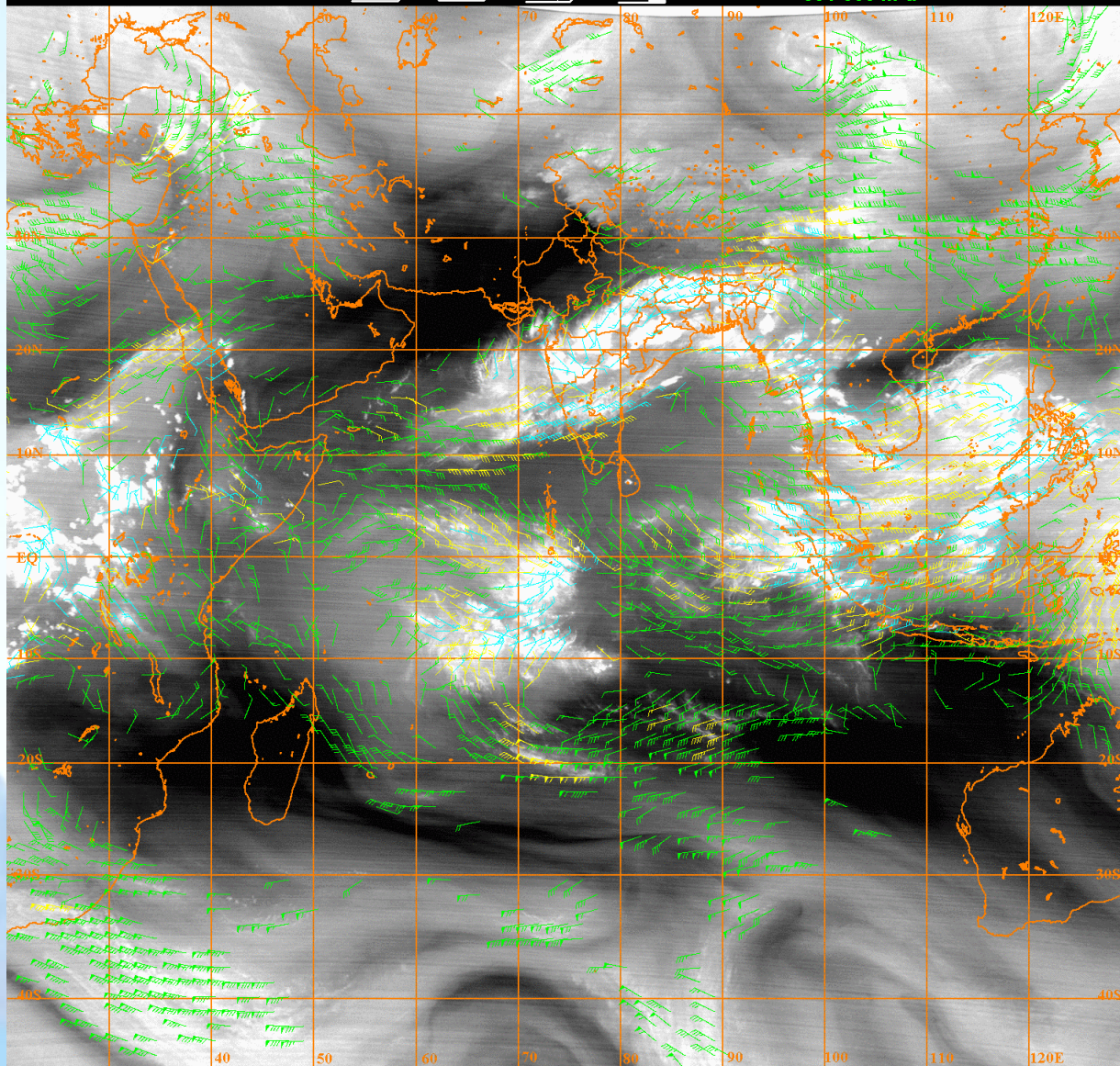
10 Kt

15 Kt

20 Kt

50 Kt

351-500 hPa



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KALPANA-1 03OCT2012 13:00 IR VHRR

CLOUD MOTION WIND

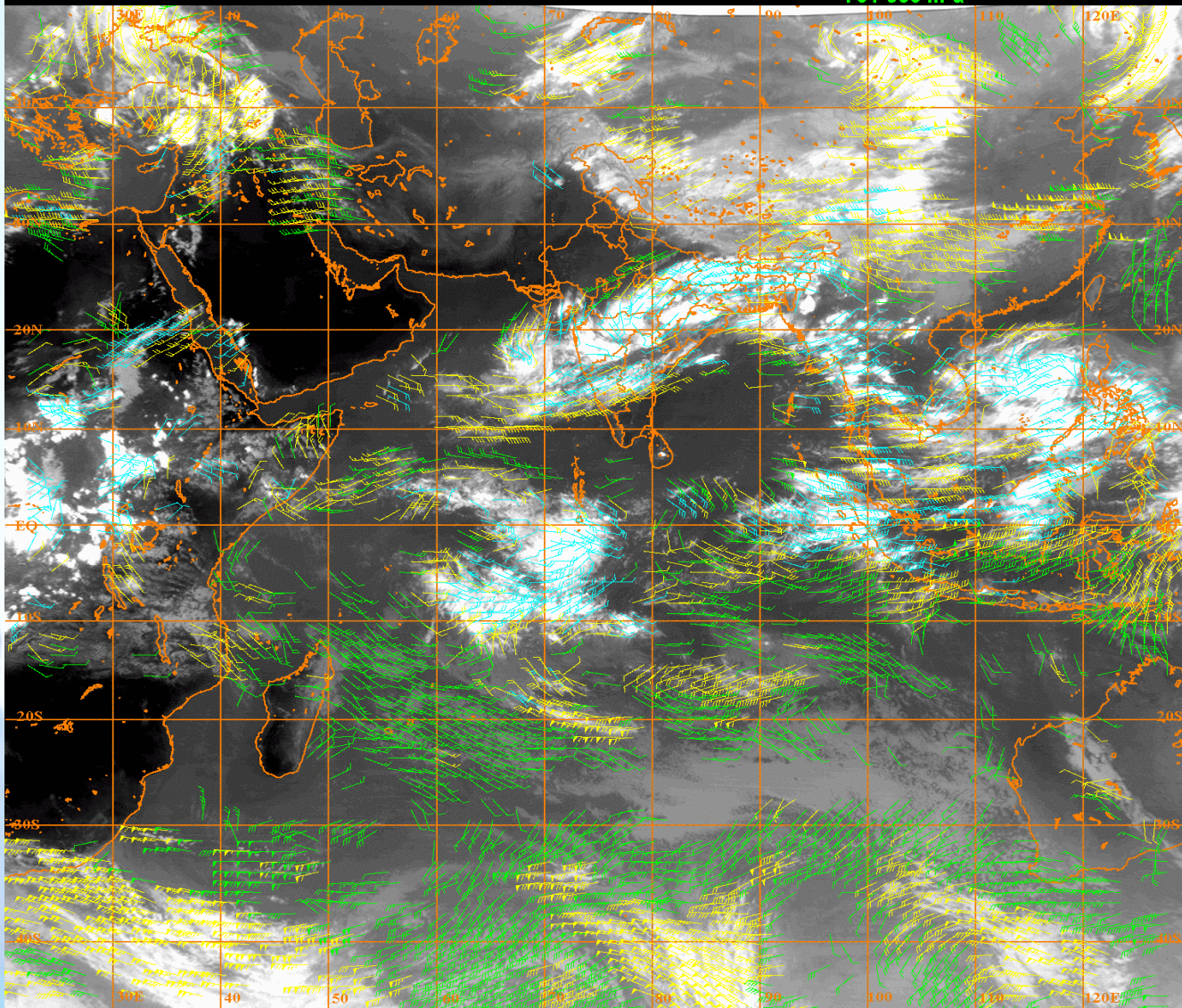
(1Kt = 0.5 m/s)

10 Kt / 15 Kt / 20 Kt / 50 Kt

100-300 hPa

301-700 hPa

701-950 hPa

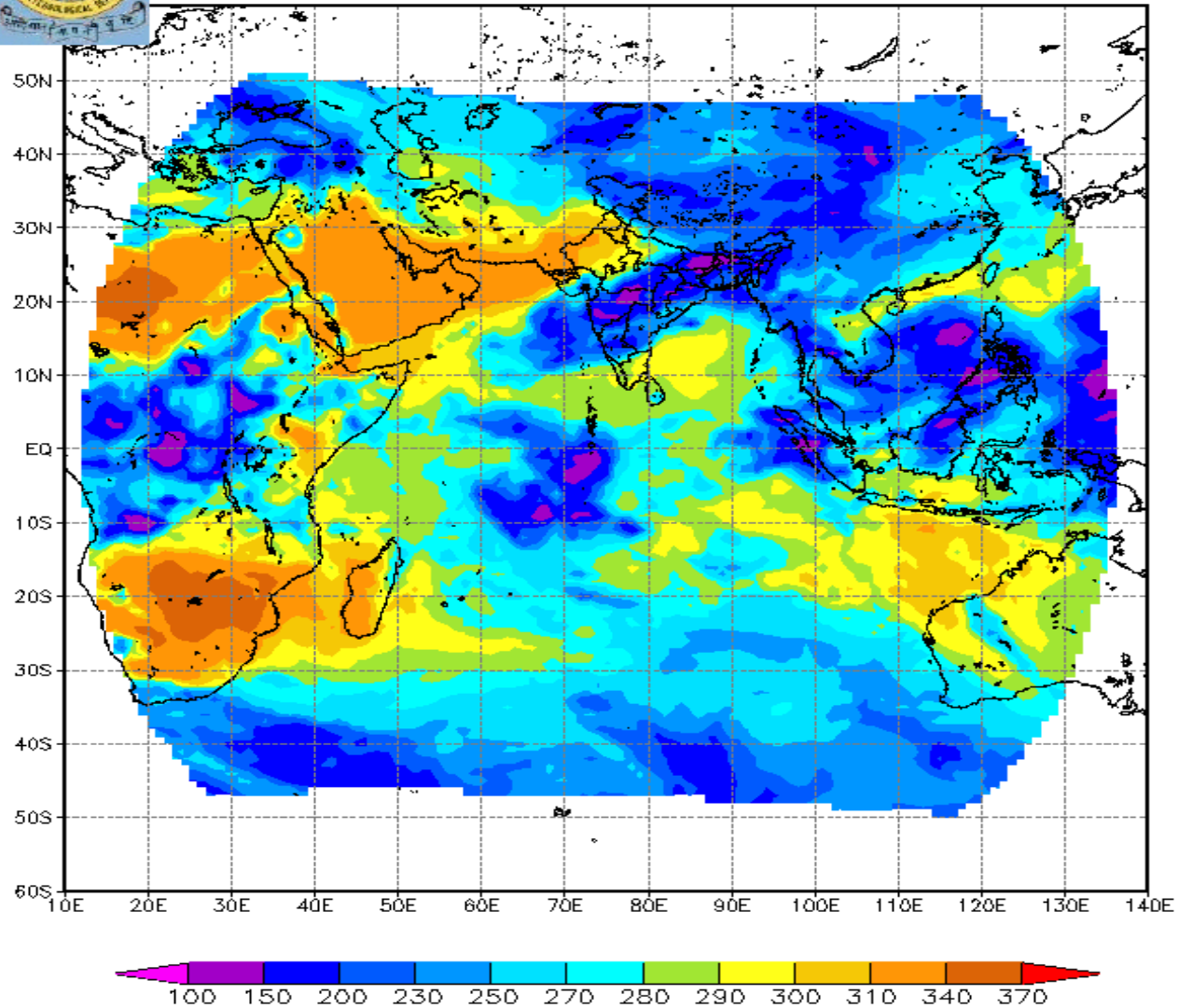


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KALPANA-1 OLR ( $\text{W/m}^2$ ) 03OCT2012 13:30 Z



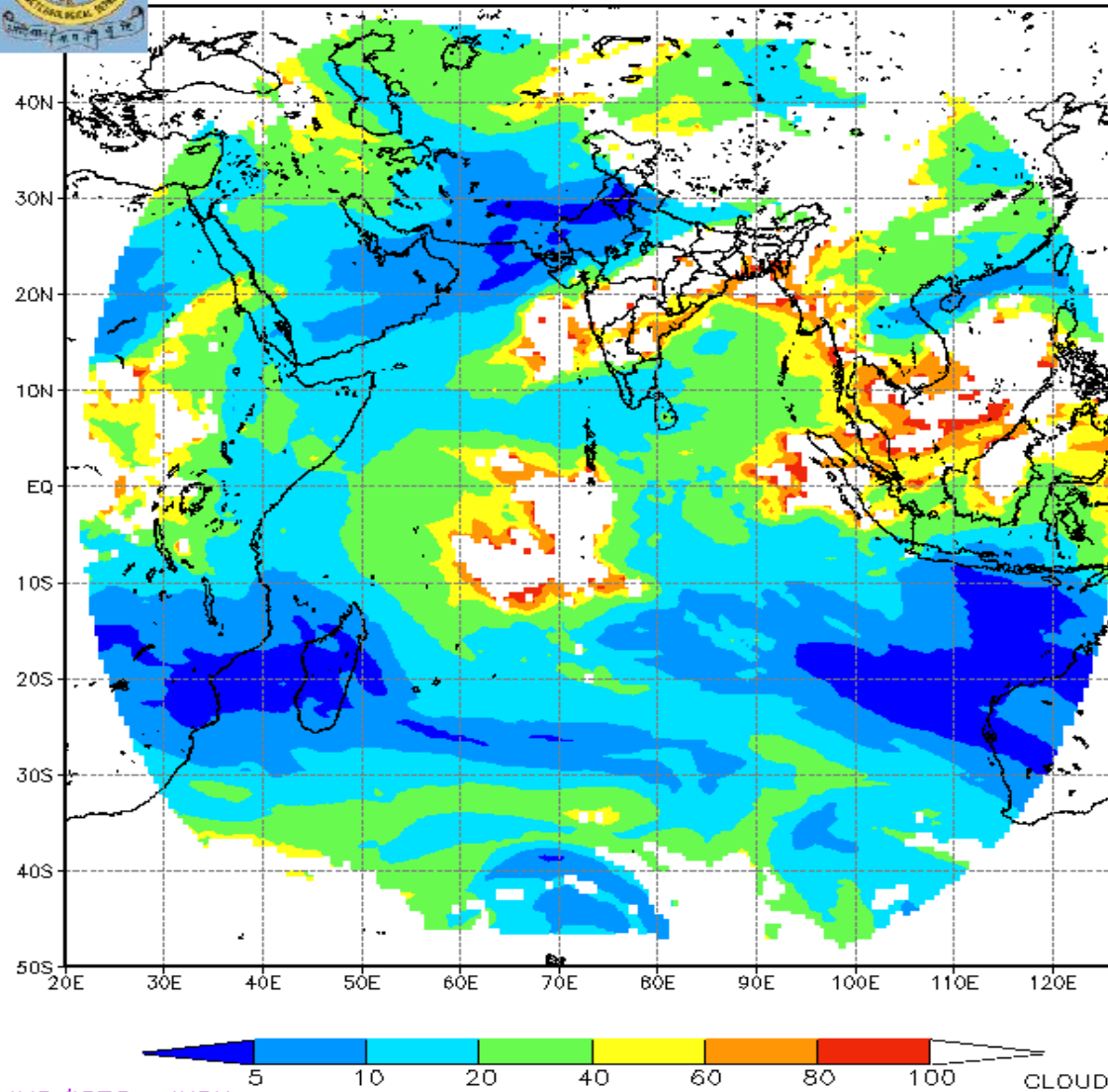
IMD/ISRO, INDIA

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KALPANA-1 UTH (%) 03OCT2012 13:30 Z



IMD/ISRO , INDIA

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04OCT2012 1200UTC

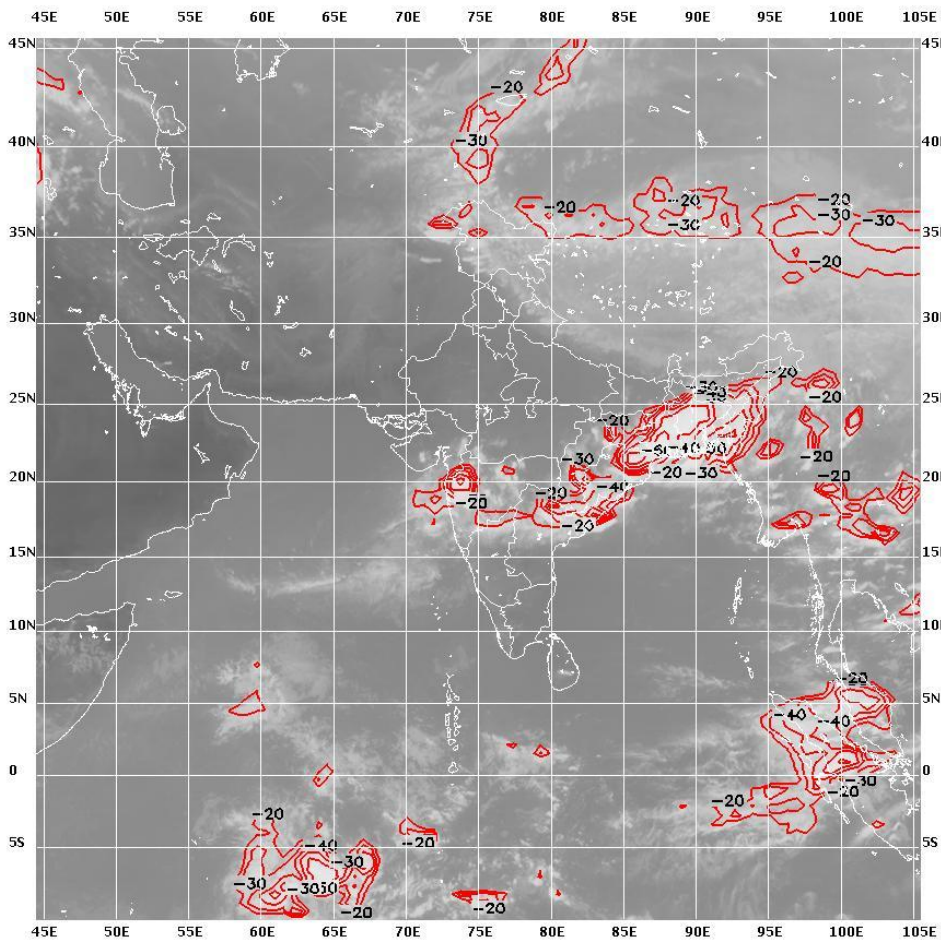
Sensor : VHR

SAT : KALPANA-1

ASIA\_MER

Proj : MERCATOR

Resolution : 8000 m



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- **Imagery Data as well as derived products are archived in the National Satellite Data Centre (NSDC), established at New Delhi.**
- **Data are made available to all organizations, research institutes, Universities etc. within India. Data to other countries is provided as a bilateral MOU between two countries/organizations.**



- ❖ Data from CCD payload of INSAT-3A is received & processed 5 times a day (03,04,05,07,09 UTC) by INSAT-3D/K1/3A ground segment.
- ❖ CCD image is also used in providing advisory to main forecasting centre.
- ❖ Currently NDVI product is also being derived.





25SEP2012 0600UTC

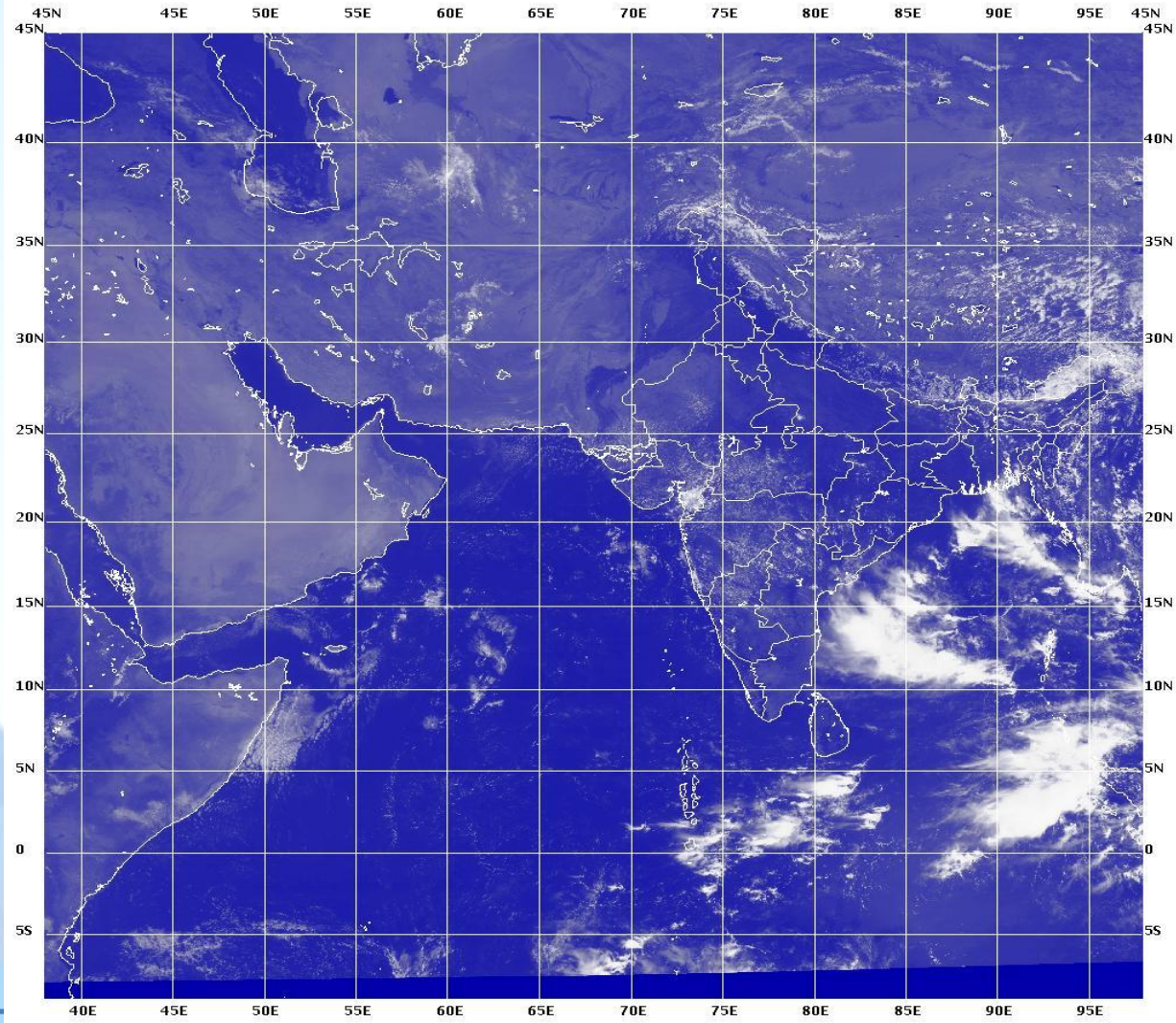
Sensor : CCD

SAT : INSAT-3A

CCD-ASIA

Proj : MERCATOR

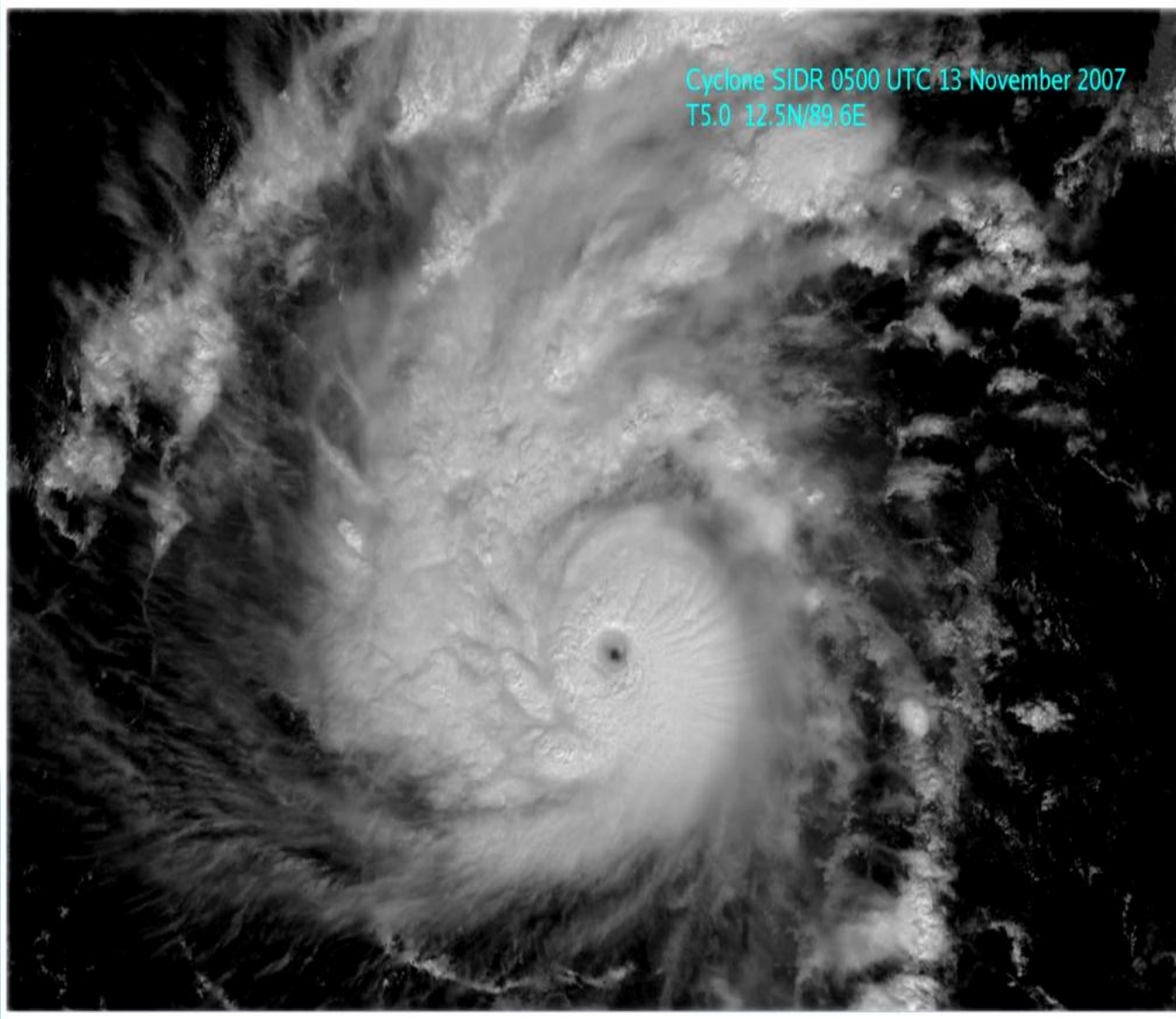
Resolution : 6205 m



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**VISIBLE  
IMAGE  
From  
INSAT-3A  
CCD**



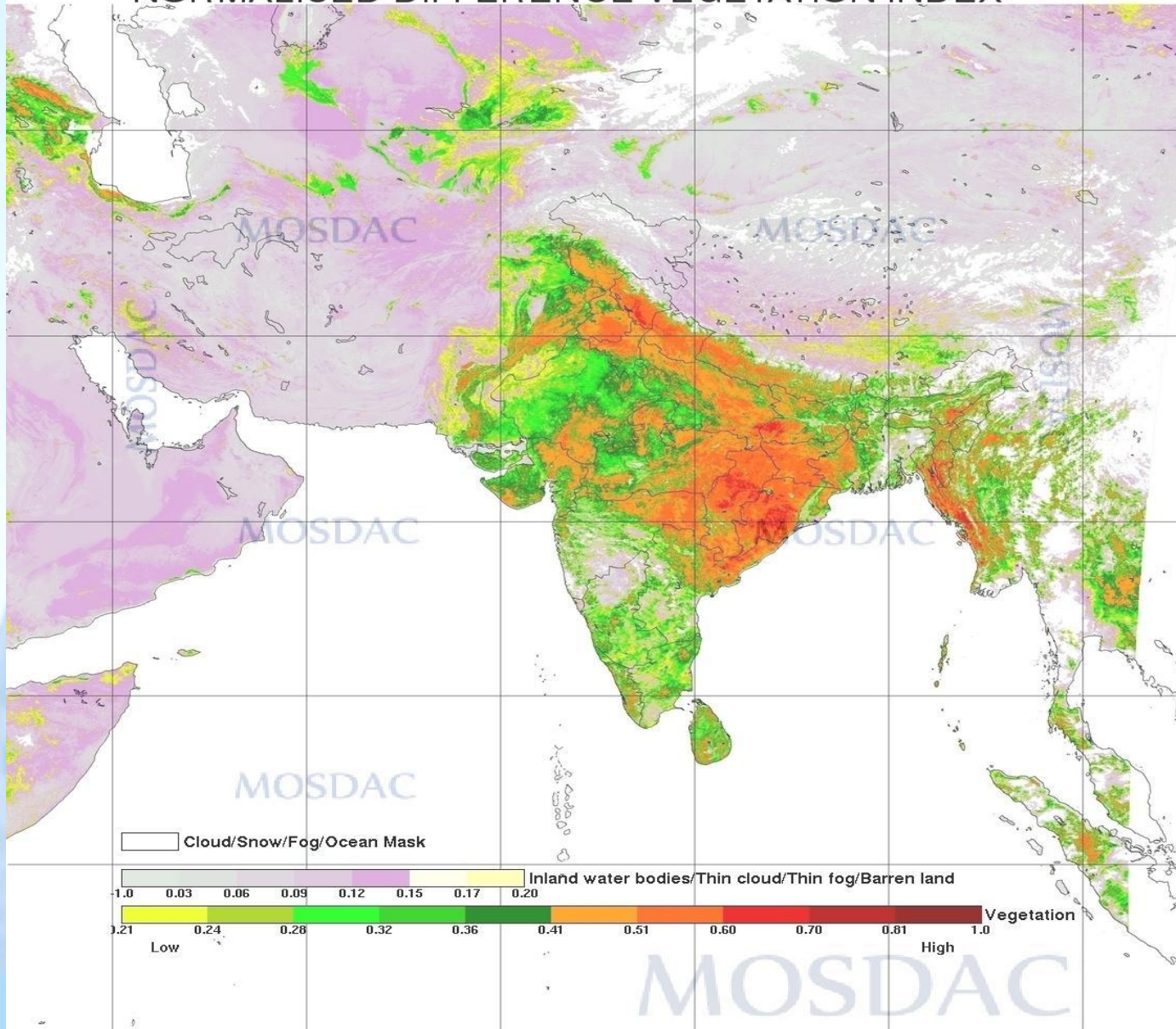
11/7/2012

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# NORMALISED DIFFERENCE VEGETATION INDEX



# Payloads on Oceansat-II

- ❖ Ku- Band Scatterometer (OSCAT)
- ❖ Ocean Color Monitor
- ❖ ROSA Radio Occultation payload.
- ❖ Oceansat data and products can be accessed through NRSC website

[www.nrsc.gov.in](http://www.nrsc.gov.in)



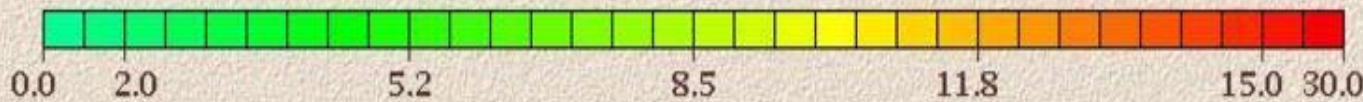
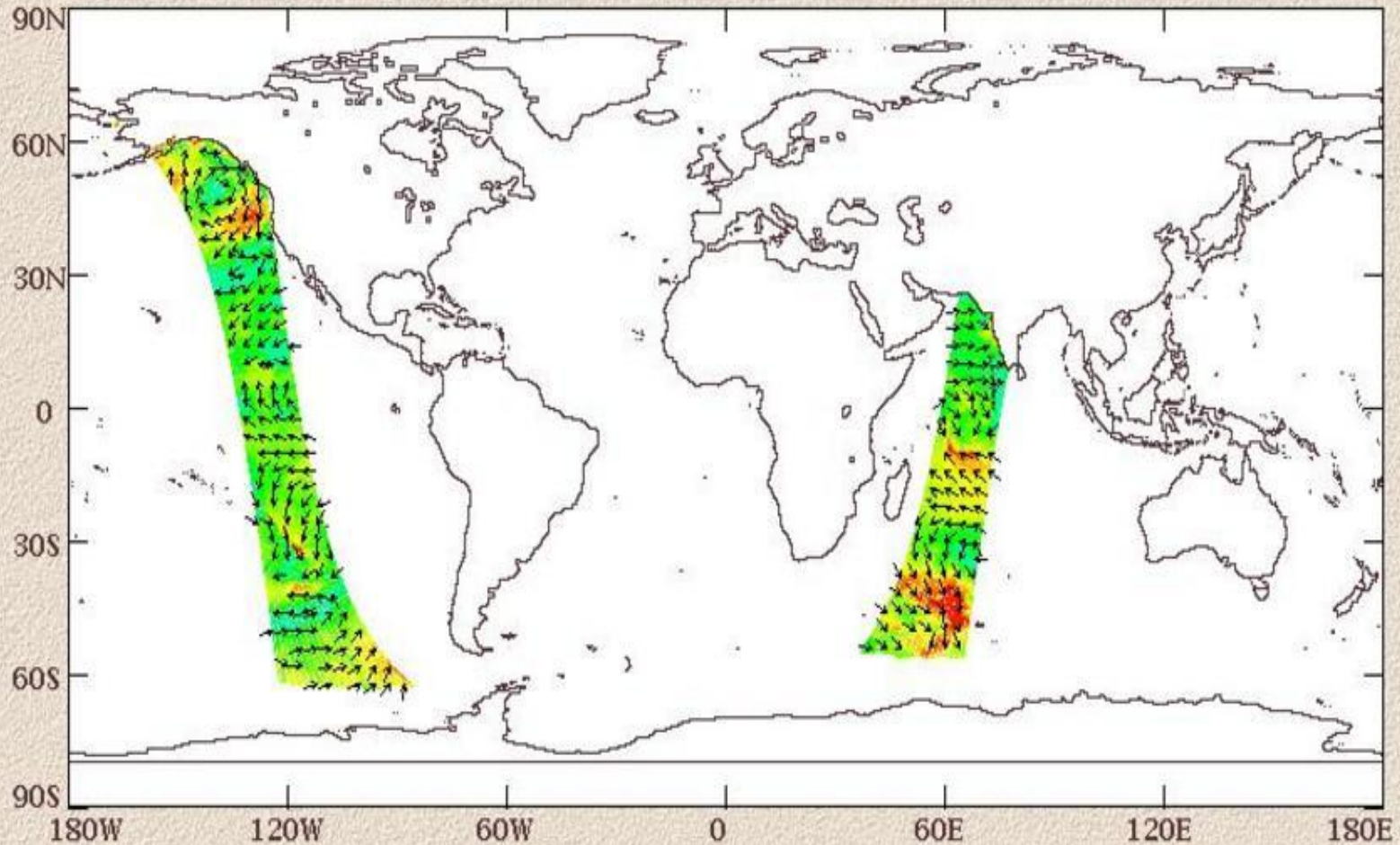
# Oceansat-II

<b>Launch date</b>	Sept 23, 2009
<b>Launch site</b>	SHAR, Sriharikota
<b>Launch vehicle</b>	PSLV - C14
<b>Orbit</b>	Polar Sun Synchronous
<b>Altitude</b>	720 km
<b>Inclination</b>	98.28
<b>Period</b>	99.31 minutes
<b>Local time of Eq. crossing</b>	12 noon 10 minutes
<b>Repetitivity cycle</b>	2 days
<b>Payloads</b>	OCM, SCAT and ROSA
<b>Mass at lift off</b>	960 kg
<b>Mission Life</b>	5 years



# OSCAT Wind Velocity

O2 SCAT Level-2B Wind Velocity (m/s) : Revolution: 16053\_16054, Day No.:278, Year: 2012,04OCT2012





# Future Plans

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# Future Satellites

• **Megha-Tropiques (Launched on 12 Oct. 2011)**

• **INSAT-3D**





# Megha-Tropiques

<b>Lift-off Mass</b>	<b>1000 kg</b>
<b>Orbit</b>	867 km with an inclination of 20 deg to the equator
<b>Launch date</b>	October 12, 2011
<b>Launch site</b>	SDSC SHAR Centre, Sriharikota, India



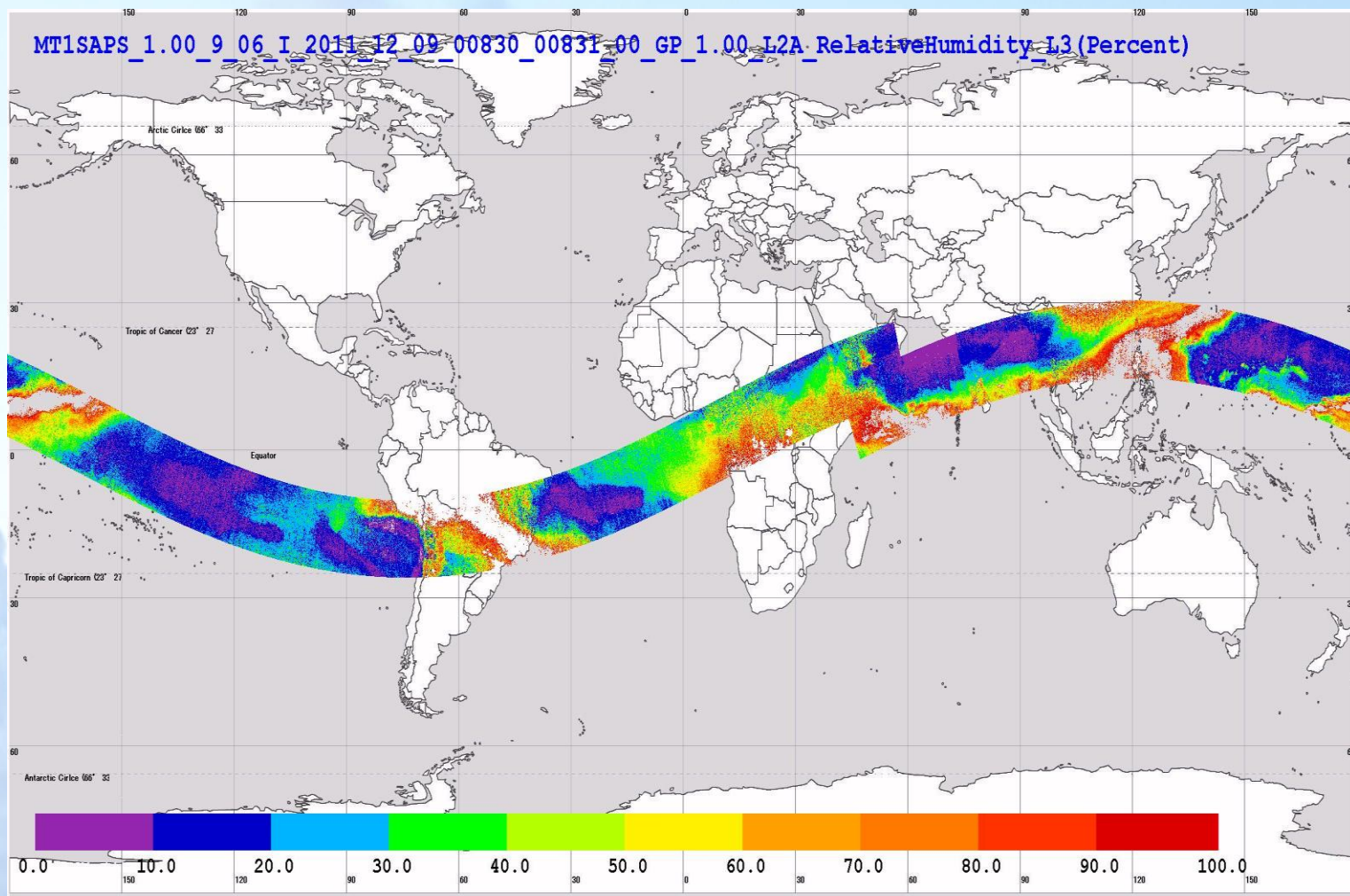
# Megha-Tropiques PAYLOADS

- **MADRAS** (Microwave Analysis and Detection of Rain and Atmospheric Structures), a multi-frequency scanning microwave imager at 18, 23, 37, 89 and 157 GHz, to measure precipitation and cloud properties. Its high frequency channels at 89 and 157 GHz respond to ice particles in cloud tops thus allowing detection of the convective rain areas over land as well as oceans. The other parameters measured are: cloud liquid water and precipitation over ocean (18 and 37 GHz), integrated water vapour over ocean (23 GHz) and surface wind speed over ocean (18 GHz).
- **SAPHIR**, a millimetre wave humidity sounder. It is a 6-channel sounder, which enables retrieving information in six atmospheric layers, from the Earth surface up to 12-km height. The horizontal resolution will be 10 km.
- **ScaRaB** (Scanner for Radiation Budget), a four-channel Earth radiation budget instrument, at 0.5-0.7  $\mu\text{m}$ , 0.2-4 $\mu\text{m}$ , 0.2-50 $\mu\text{m}$  and 10.5-12.5 $\mu\text{m}$ . With a spatial resolution of 40 km, it measures the outgoing longwave and shortwave radiation from the top of the atmosphere.
- **GPS-ROS** (Radio Occultation Sounder), GPS receiver to measure the vertical profile of temperature and humidity at the point of radio occultation.

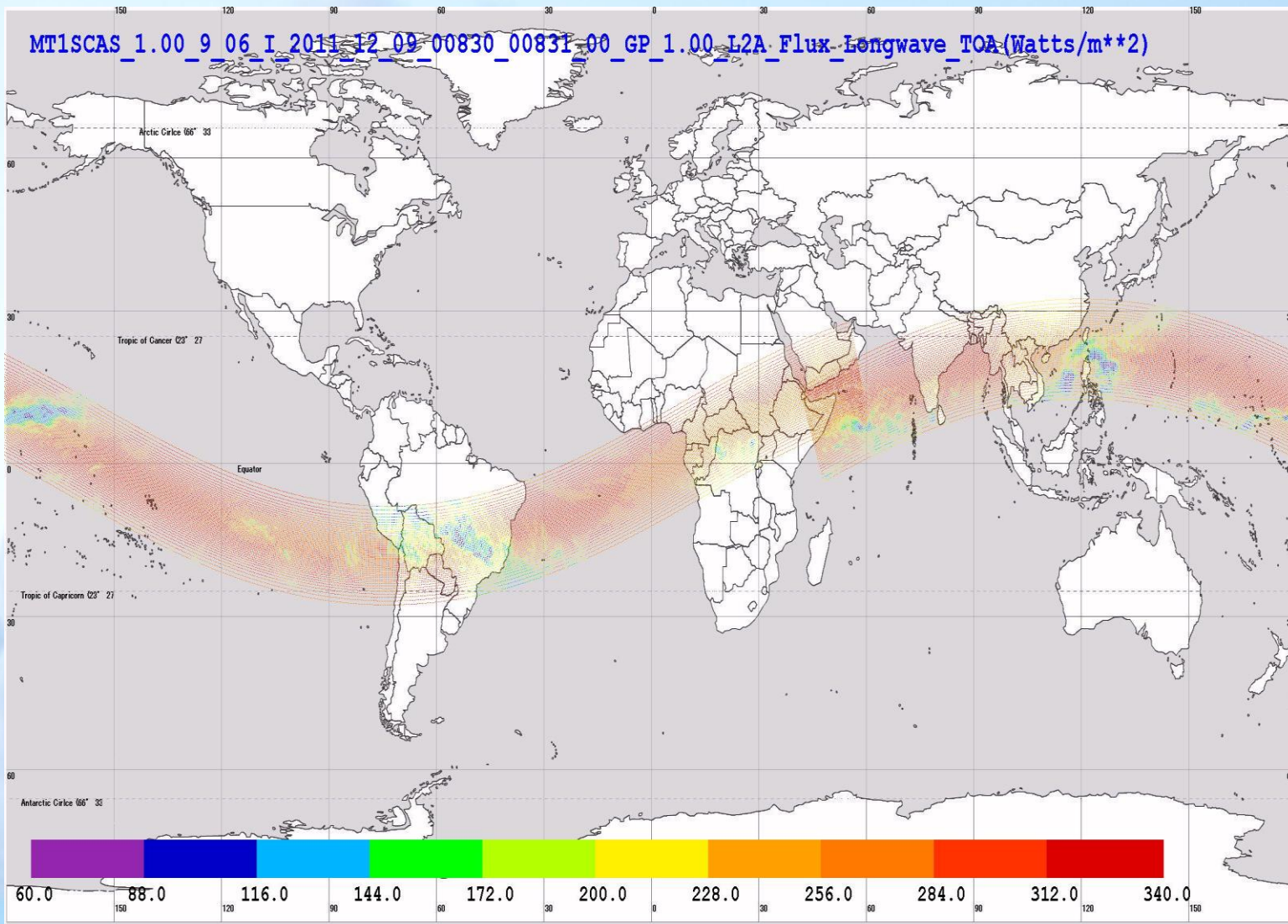
[www.mosdac.gov.in](http://www.mosdac.gov.in)



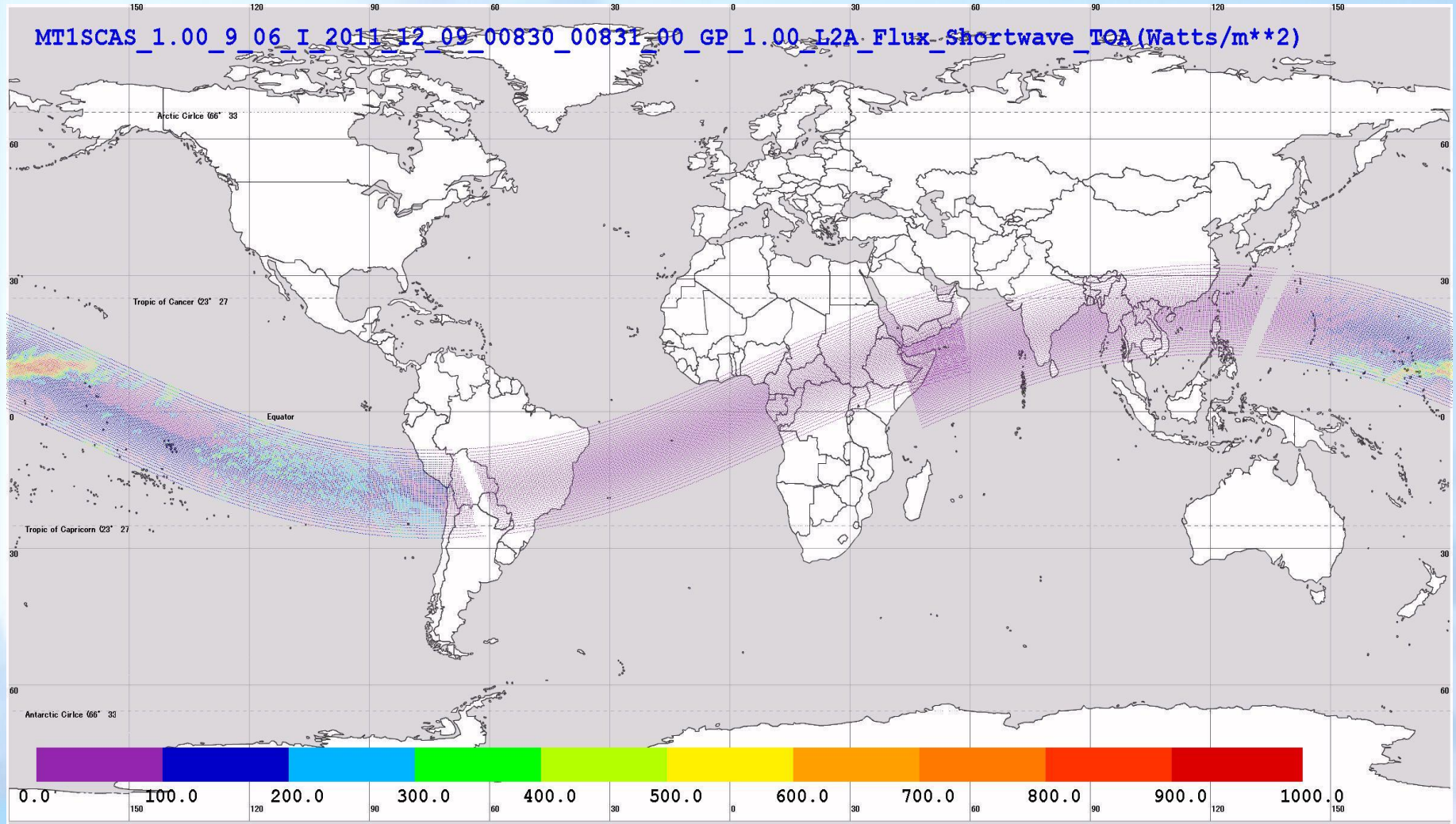
# MT sample products



# MT sample products



# MT sample products



# Payloads on INSAT-3D Satellite

- 1. Six Channel Imager**
- 2.19 Channel Sounder**



# INSA-3D Imager channels

Channel no.	Spectrum ( $\mu\text{m}$ )	IGFOV( $\mu\text{rad}$ )	S/N or NEDT (K)	Scene condition
1	0.52 – 0.72	28	150:1	100% albedo
2	1.55 – 1.70	28		
3	3.80 – 4.00	112	1.4K	300K
4	6.50 – 7.00	224	1K	230K
5	10.3 – 11.2	112	0.35K	300K
6	11.5 – 12.5	112	0.35K	300K



# INSAT-3D Sounder channels

Channel No.	Centre Wavelength $\mu\text{m}$ (cm-1)	Bandwidth $\mu\text{m}$ (cm-1)	NEDT AT 300K (typical) K
1	14.71 (680)	0.281 (13)	1.5
2	14.37 (696)	0.268 (13)	1
3	14.06 (711)	0.256 (13)	0.5
4	13.64 (733)	0.298 (16)	0.5
5	13.37 (749)	0.286 (16)	0.5
6	12.66 (790)	0.481 (30)	0.3
7	12.02 (832)	0.723 (50)	0.15
8	11.03 (907)	0.608 (50)	0.15
9	09.71 (1030)	0.235 (25)	0.2
10	07.43 (1345)	0.304 (55)	0.2
11	07.02 (1425)	0.394 (80)	0.2
12	6.51 (1535)	0.255 (60)	0.2
13	4.57 (2188)	0.048 (23)	0.15
14	4.52 (2210)	0.047 (23)	0.15
15	4.45 (2245)	0.0456 (23)	0.15
16	4.13 (2420)	0.0683 (40)	0.15
17	3.98 (2513)	0.0663 (40)	0.15
18	3.74 (2671)	0.140 (100)	0.15
19	0.695 (14367)		0.1% albedo





## *Geophysical Parameters to be derived from INSAT -3D*

No.	Parameters	Input Channels	No.	Parameters	Input Channels
1.	Outgoing Long wave Radiation (OLR)	TIR -1, TIR -2, WV	10.	Water Vapor Wind (WVW)	WV, TIR -1, TIR -2
2.	Quantitative Precipitation Estimation ( QPE)	TIR -1, TIR -2, WV	11.	Upper Tropospheric Humidity (UTH)	WV, TIR -1, TIR -2
3.	Sea Surface Temperature (SST)	SWIR, TIR -1, TIR -2, MIR	12.	Temperature, Humidity profile & Total ozone	Sounder all channels
4.	Snow Cover	VIS, SWIR, TIR -1, TIR -2	13.	Value added parameters from sounder products	Sounder products
5.	Snow Depth	VIS, SWIR, TIR -1, TIR -2	14.	FOG	SWIR, MIR , TIR -1, TIR -2
6.	Fire	MIR, TIR -1	15.	Normalized Difference Vegetation Index	CCD
7.	Smoke	VIS, TIR -1, TIR -2, MIR	16.	Flash Flood Analyzer	TIR -1, TIR -2, VIS
8.	Aerosol	VIS, TIR -1, TIR -2	17.	HSCAS	VIS
9.	Cloud Motion Vector (CMV)	VIS, TIR -1, TIR -2	18.	Tropical Cyclone-intensity /position	AODT technique, TIR-1, TIR-2



**Thank You**

A.K.Sharma  
IMD



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