

# **CURRENT AND FUTURE SATELLITE PROGRAMS AND SYSTEMS IN INDIA**

**Devendra Singh and R.C.Bhatia**  
**Email: [dschahar@hotmail.com](mailto:dschahar@hotmail.com)**

**INDIA METEOROLOGICAL DEPARTMENT**  
**NEW DELHI, INDIA**

# INSAT Meteorological Satellite Applications Programme

- Round the clock surveillance of weather systems including severe weather events around the Indian region.
- Operational parameters for weather forecasting – cloud cover, cloud top temperature, sea surface temperature, snow cover, cloud motion vector, outgoing long wave radiation etc.
- Collection and transmission of meteorological, hydrological and oceanographic data from remote/inaccessible areas through Data Collection Platforms.
- Timely dissemination of warning of impending disasters such as cyclones through Cyclone Warning Dissemination Systems.
- Dissemination of Meteorological information including processed images of weather systems through Meteorological Data dissemination system

# INDIAN NATIONAL SATELLITE (INSAT) - PAST & PRESENT

<b>Satellite</b>	<b>Lunch date</b>	<b>Met Payload with Wavelength Bands</b>	<b>Major Applications</b>	<b>Active/ Inactive</b>
<b>INSAT-1A</b>	<b>April 10, 1982</b>	<b>Very High Resolution Radiometer(VHRR) Bands: Visible: 0.55-0.75µm IR : 10.5-12.5µm</b>	<b>Monitoring cyclones &amp; monsoon CMV Winds OLR Rainfall Estimation</b>	<b>Inactive</b>
<b>INSAT-2B</b>	<b>August 8, 1983</b>	<b>--do--</b>	<b>--do--</b>	<b>Inactive</b>
<b>INSAT-1C</b>	<b>July 22, 1988</b>	<b>--do--</b>	<b>--do--</b>	<b>Inactive</b>
<b>INSAT-1D</b>	<b>June 12, 1990</b>	<b>--do--</b>	<b>--do--</b>	<b>Inactive</b>

<b>Satellite</b>	<b>Lunch date</b>	<b>Met Payload with Wavelength Bands</b>	<b>Major Applications</b>	<b>Active/ Inactive</b>
<b>INSAT-2A</b>	<b>July 10, 1992</b>	<b>Very High Resolution Radiometer(VHRR) Bands: 0.55-0.75µm 10.5-12.5µm</b>	<b>Monitoring cyclones &amp; monsoon CMV Winds OLR Rainfall Estimation Mesoscale features Flood/Intense precipitation advisory Snow detection</b>	<b>Inactive</b>
<b>INSAT-2B</b>	<b>July 23, 1993</b>	<b>1. VHRR : payload Band : 0.55 – 0.75µm Vis: 2km 10.5 – 12.5µm IR: 8 km</b>	<b>--do---</b>	<b>Inactive</b>
<b>INSAT-2E</b>	<b>April, 1999</b>	<b>1.VHRR: As above +WV Band: 5.7 – 7.1µm 8km 2. CCD Payload Bands : 0.63 -0.79µm Vis: 2 km 0.77-0.86µm NIR 1.55-1.70µm SW IR: 1km</b>	<b>--do--</b>	<b>Active</b>

<b>Satellite</b>	<b>Lunch date</b>	<b>Met Payload with Wavelength Bands</b>	<b>Major Applications</b>	<b>Active/ Inactive</b>
<b>Kalpana-1</b>	<b>12th Sept., 2002</b>	<b>Very High Resolution Radiometer(VHRR)</b> <b>Bands:</b> <b>0.55-0.75µm vis: 2km</b> <b>10.5-12.5µm IR: 8 km</b> <b>WV Band:</b> <b>5.7-7.1µm – 8km</b>	<b>Monitoring cyclones &amp; monsoon</b> <b>CMV Winds</b> <b>OLR</b> <b>Rainfall Estimation</b>	<b>Active</b>
<b>INSAT-3A</b>	<b>10 April 2003</b>	<b>1. VHRR : payload</b> <b>Band : 0.55 – 0.75µm</b> <b>10.5 – 12.5µm</b> <b>5.7 – 7.1µm</b> <b>2. CCD Payload</b> <b>Bands : 0.63 -0.68µm</b> <b>0.77-0.86µm</b> <b>1.55-1.70µm</b>	<b>As above &amp; Mesoscale features</b> <b>Flood/intense precipitation advisory</b> <b>Snow detection</b>	<b>Active</b>

# FUTURE SATELLTE PROGRAM

<p><b>INSAT-3D</b></p>	<p><b>around 2006</b></p>	<p><b>6 channel Imager</b>  <b>Band : 0.55 – 0.75<math>\mu</math>m (Vis-1 km), 1.55 – 1.70<math>\mu</math>m (IR-1km), 3.70-3.95<math>\mu</math>m(Mid Wave IR- 4 km), 6.5-7.10 <math>\mu</math>m (Thermal IR- 4 km), 10.3-11.3<math>\mu</math>m (T IR- 4 km), 11.3-12.5<math>\mu</math>m(WV- 8 km)</b></p> <p><b>Sounder</b>  <b>Bands : 19 channels between 0.69-14.71 <math>\mu</math>m</b></p>	<p><b>Monitoring cyclones &amp; monsoon</b>  <b>CMV Winds</b>  <b>OLR</b>  <b>Rainfall Estimation</b></p> <p><b>Temperature and Humidity profiles in the atmosphere.</b></p>	
<p><b>Megha-Tropiques</b>  <b>(A joint project by ISRO and CNES, France with the objective of studying the water cycle and energy exchanges in the tropics).</b></p>	<p><b>around 2006</b></p>	<p><b>SAPHIR 6 bands around 183 GHz (10 km Res.)</b></p> <p><b>SCARAB Radiation instrument in short &amp; long wave (40 km Res.)</b></p> <p><b>MADRAS 89 &amp; 157 GHz radiometer</b>  <b>10, 18 &amp; 37 GHz radiometer (10 km Res.)</b></p>	<p><b>Water vapor profile upto 12 km</b></p> <p><b>Radiation budget</b></p> <p><b>Ice particles in cloud tops, cloud liquid water and precipitation; sea surface wind speed.</b>  <b>23 GHz : Integrated water vapor</b></p>	

## **CYCLONE WARNING DISSEMINATION SYSTEM (CWDS)**

IMD has installed 250 specially designed receivers within the vulnerable coastal areas for direct transmission of warnings to the officials and people using broadcast capability of INSAT satellite. Recently this technology has been upgraded to digital transmission. Initially 100 Digital CWDS have been deployed in the coastal areas of Andhra Pradesh.

Area Cyclone Warning Center (ACWC) special warning bulletins transmitted every hour in local language to the affected areas.

## **METEOROLOGICAL DATA DISSEMINATION (MDD)**

Under this program analogue type cloud imagery data transmitted through INSAT S-band broadcast along with other conventional meteorological data and FAX analysed and forecast weather charts.

There are 33 MDD receiving stations in India and also operating in neighboring countries at Sri Lanka and Male under bi-lateral agreement. In general processed images are sent every three hours, and every hour during the cyclone period.

## **INTERNET PRODUCTS**

INSAT satellite processed Global and Sector images (IR, Visible, WV) are provided through IMD Internet web ([www.imd.ernet.in](http://www.imd.ernet.in)) every three hours, and every hour during the cyclone period in real-time.

# KALPANA 1 IMAGES

( [Home](#) )

## FULL DISC



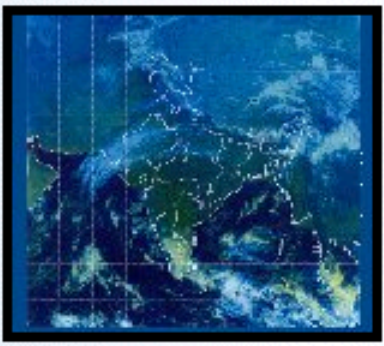
[Visible Channel](#)

[Infra-red Channel](#)

[Colour Composite](#)

[Water Vapour Channel](#)

## SECTOR



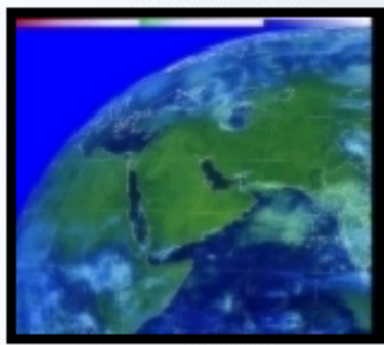
[Visible Channel](#)

[Infra-red Channel](#)

[Colour Composite](#)

[Water Vapour Channel](#)

## NORTH WEST SECTOR



[Visible Channel](#)

[Infra-red Channel](#)

[Colour Composite](#)

[Water Vapour Channel](#)



## **OTHER SATELLITE PRODUCTS**

### **PDUS for METEOSAT-5 data reception**

A PDUS receiving station installed in early 2000 in IMD, New Delhi to receive high-resolution imagery data from METEOSAT-5 satellite located at 63<sup>0</sup> E.

### **RECEPTION OF NOAA SATELLITE DATA**

The AVHRR and TOVS data from NOAA series of polar orbiting satellites are received and processed by IMD at New Delhi and Chennai through HRPT receiving station. The New Delhi HRPT receiving station upgraded to receive the NOAA (K, L, M, N series) satellite data.

### **INDO-US co-operation**

INDO-US data exchange center has been established in 1999 for exchange of data with NOAA/NASA under the co-operation in Earth Atmospheric Sciences.

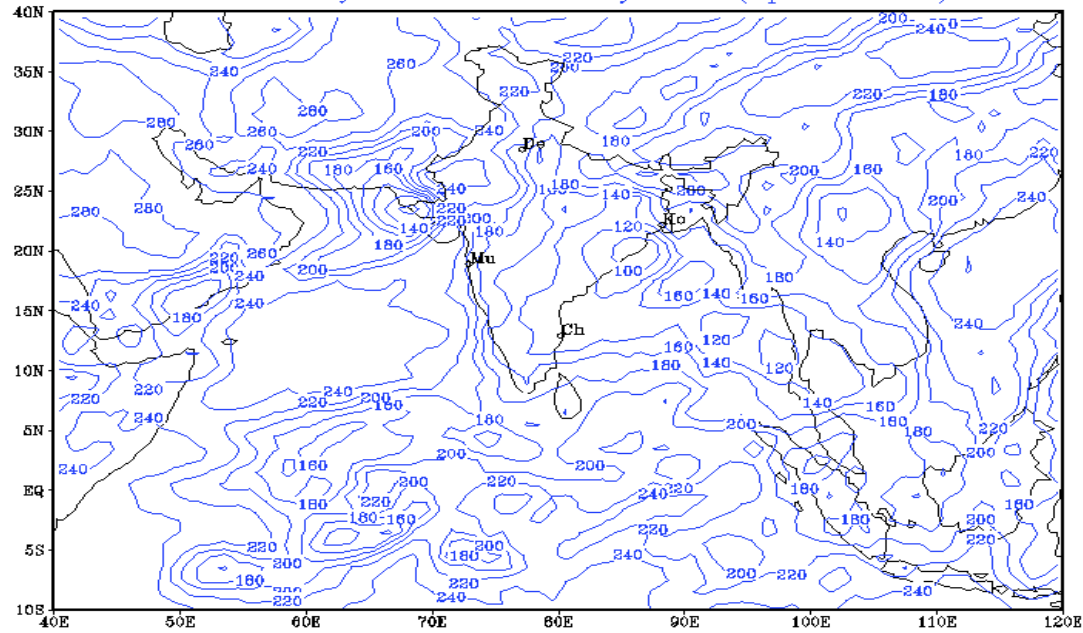
IMD providing INSAT cloud imagery data every three hours in real-time to NOAA/NASA and receiving GOES satellite series data.

These data products are being used by a number of scientists for specific studies.

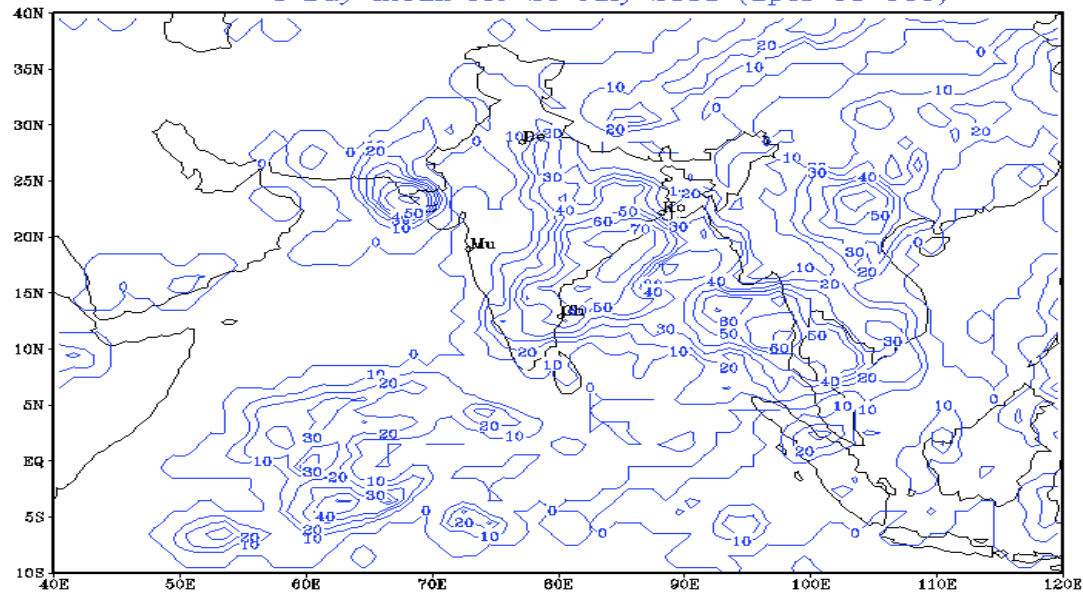
## **Satellite Products generated at IMD**

- **Cloud Motion Vectors (CMVs) – Daily at 00 UTC processed operationally.**
- **Quantitative Precipitation Estimates (QPEs) based on modified Arkin method using cloud top temperature accumulated over 1x1 lat./long grid and correlated to rainfall.**
- **Outgoing Long-wave Radiation (OLR) is derived from thermal IR data using physical and statistical algorithms, based on radiative transfer principles.**
- **Sea Surface Temperatures (SST) is derived using the single channel (10.5-12.5 ) brightness temperature.**
- **Water vapor channel data (5.7-7.1 ) provides information on mid-tropospheric water vapor and flow pattern associated with incursion of water vapor during monsoon onset.**
- **Vertical Temperature Profiles (VTPRs)**

IMD New Delhi Kalpana-1 OLR (w/m\*\*2) Analysis **OLR**  
1 Day mean for 26 July 2003 (upto 03 UTC)



IMD New Delhi Kalpana-1 QPE (mm) Analysis **QPE**  
1 Day mean for 26 July 2003 (upto 03 UTC)



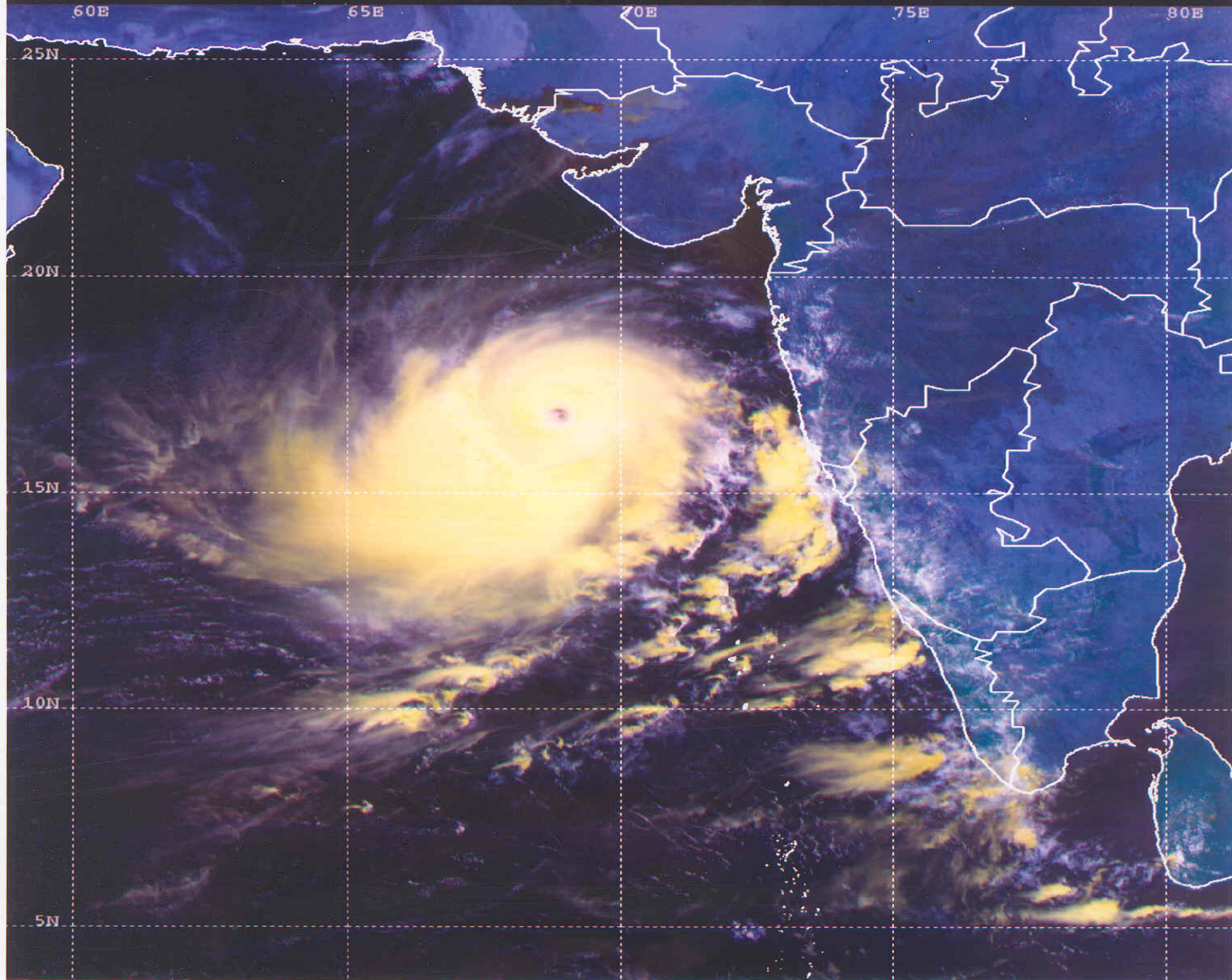
# Synoptic Applications in IMD

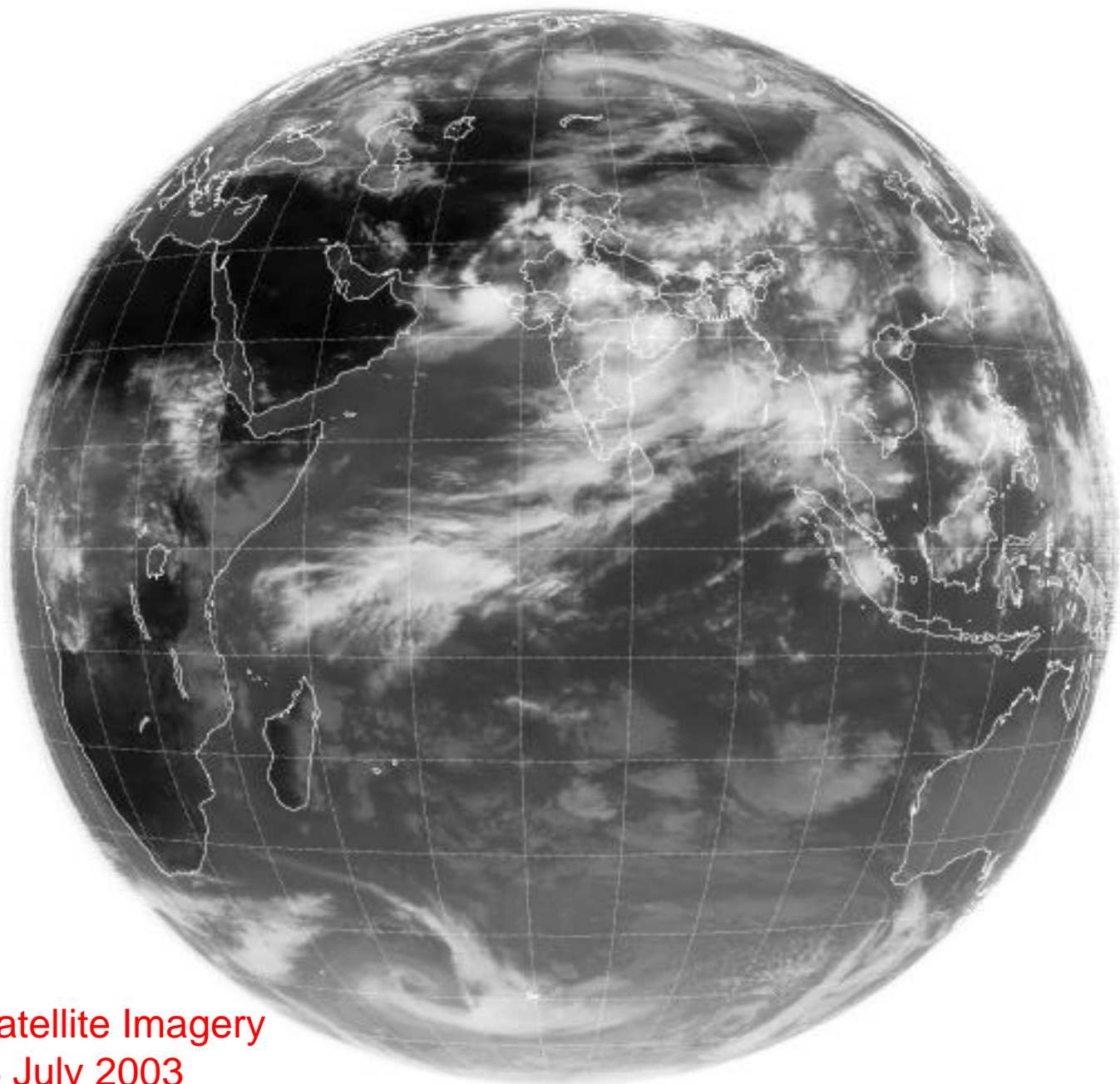
- Major application, the **monitoring** of Synoptic weather systems
- Watch and monitor growth of rapidly developing weather phenomena like **cumulonimbus cells, thunderstorm complexes**
- **Identify and locate** primary synoptic systems like **troughs/ridges**, jet streams and regions of intense convection, inter tropical convergence zones etc.
- Monitor onset and **progress of monsoon**
- Detect genesis and growth of **Tropical Cyclones** and monitor their intensification and movement till landfall.

CCD\_VIS at 1%

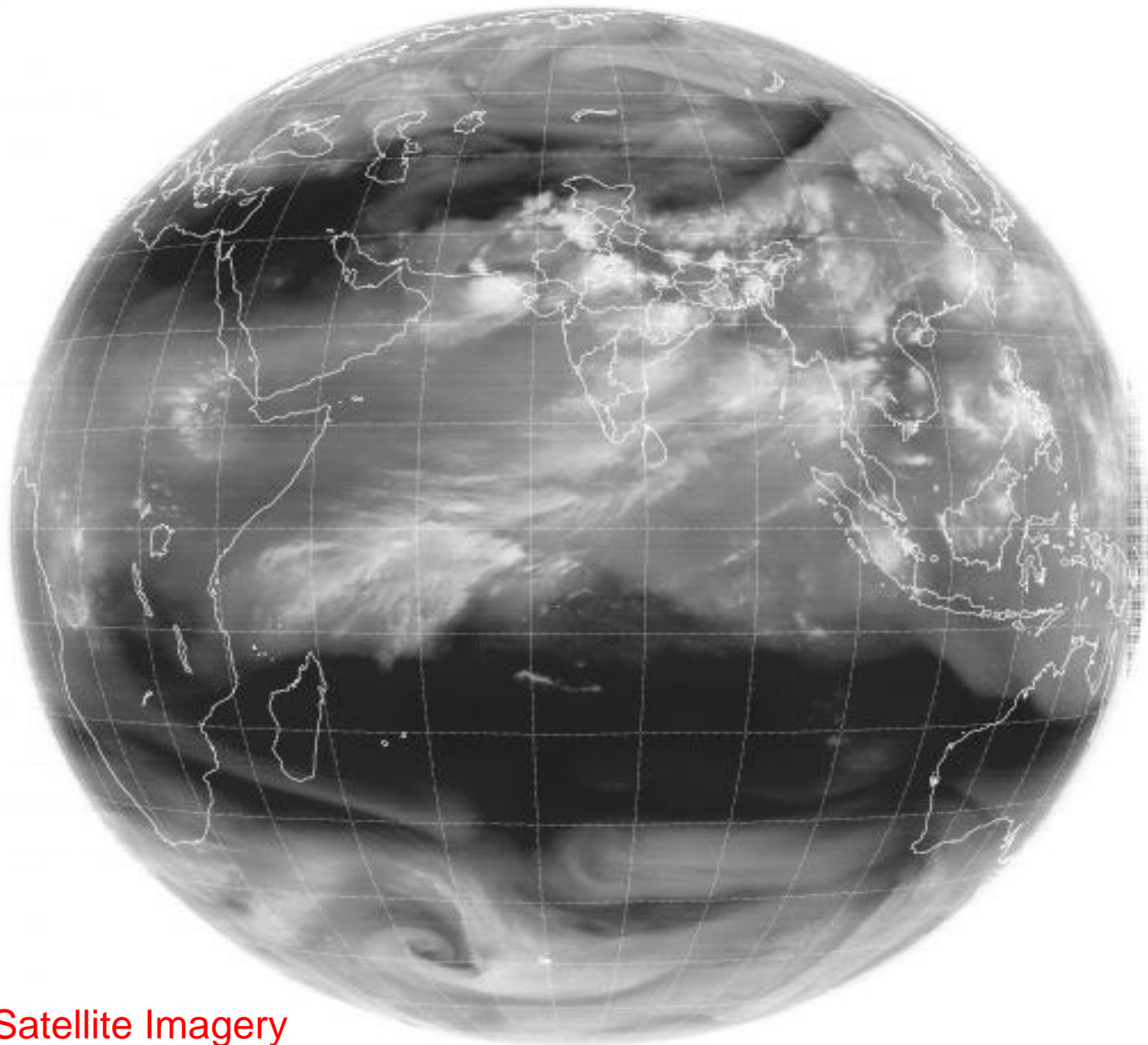
CCD\_NIR at 1%

CCD\_SWIR at 1%





Kalpana-I Satellite Imagery  
12 UTC/ 26 July 2003



Kalpana-I Satellite Imagery  
12 UTC/ 26 July 2003

## Future missions

- ❖ Several satellite missions have been planned to support the operational data needs and ongoing research efforts.
- ❖ The future INSAT missions will carry improved VHRR and vertical sounders for temperature/humidity profiles.
- ❖ The Megha -Tropiques Mission scheduled for 2006 with the objective of studying the water cycle and energy exchanges in the tropics.
- ❖ With an equatorial inclined orbit, the satellite will have high repeativity over tropical regions.
- ❖ The future appears bright for our space-based observing system. Advanced, **multispectral** (visible, IR, and passive microwave) **imagers, sounders** (infrared and microwave) and **scatterometers** are planned for launch in the near future.



- ❖ The satellite data downloads are expected to exceed several terabytes per day.
- ❖ Fortunately, communications and **computing capacity** are increasing at a rate that hopefully can accommodate this data explosion.
- ❖ It is important that the evolving **space-based observational system keep one step ahead** of the **demands** being placed by the user community and advances in numerical weather prediction.
- ❖ While it will become an enormous task and challenge to **assimilate this wealth of data** into meaningful parameters, the outlook is bright for unlocking the still-unresolved mysteries towards improving our **understanding and prediction** of atmospheric circulation systems such as **tropical cyclones**.

**THANKS**

International TOVS Study Conference, 13<sup>th</sup>, TOVS-13, Sainte Adele, Quebec, Canada, 29  
October-4 November 2003. Madison, WI, University of Wisconsin-Madison, Space Science and  
Engineering Center, Cooperative Institute for Meteorological Satellite Studies, 2003.