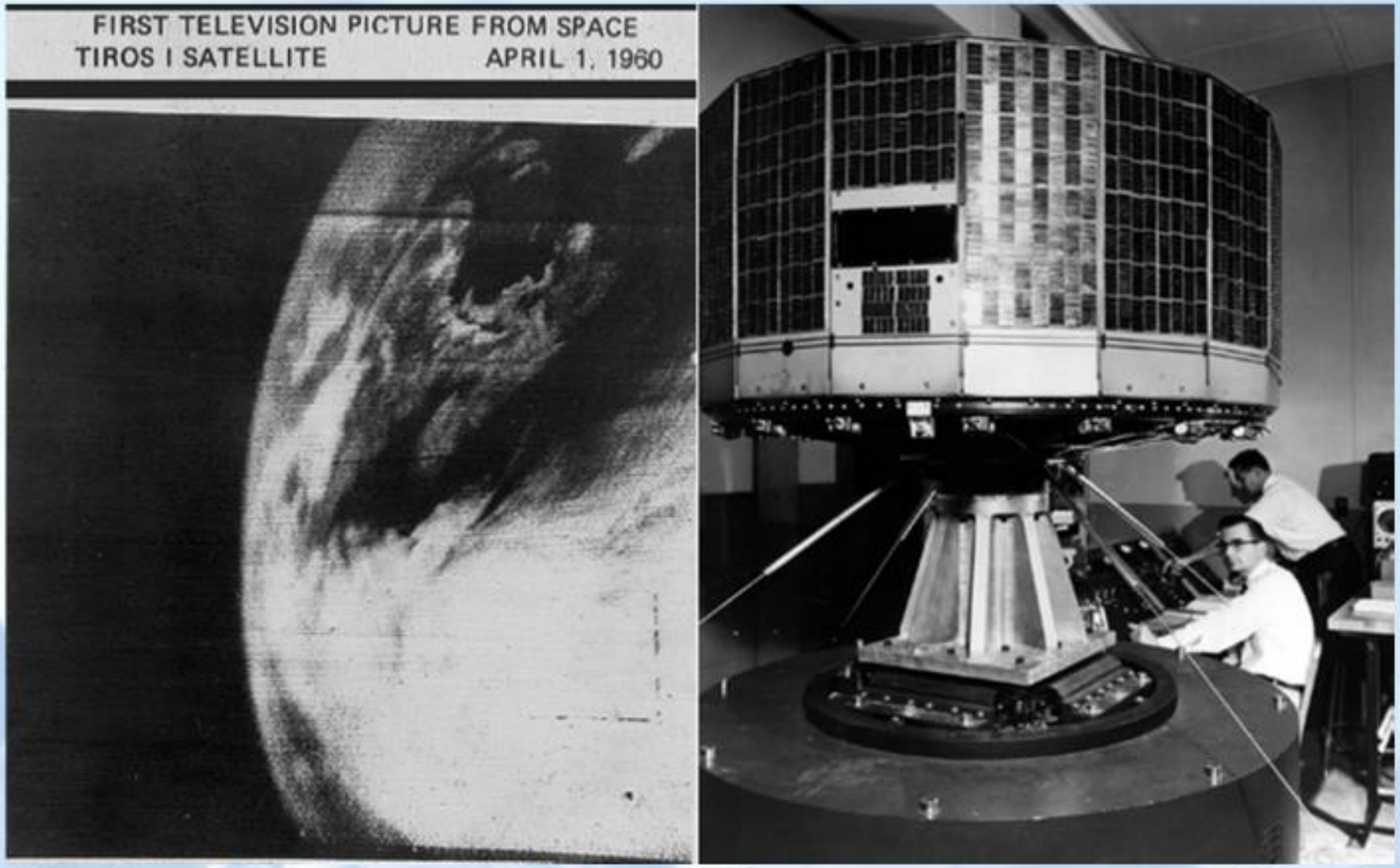
**Dr Neeti Singh**
**Scientist – C**
**20.11.2024 to 23.11.2024**

**Sat- Met Division India Meteorological Department,**
**Mausam Bhawan, Lodhi Road, New Delhi-110**

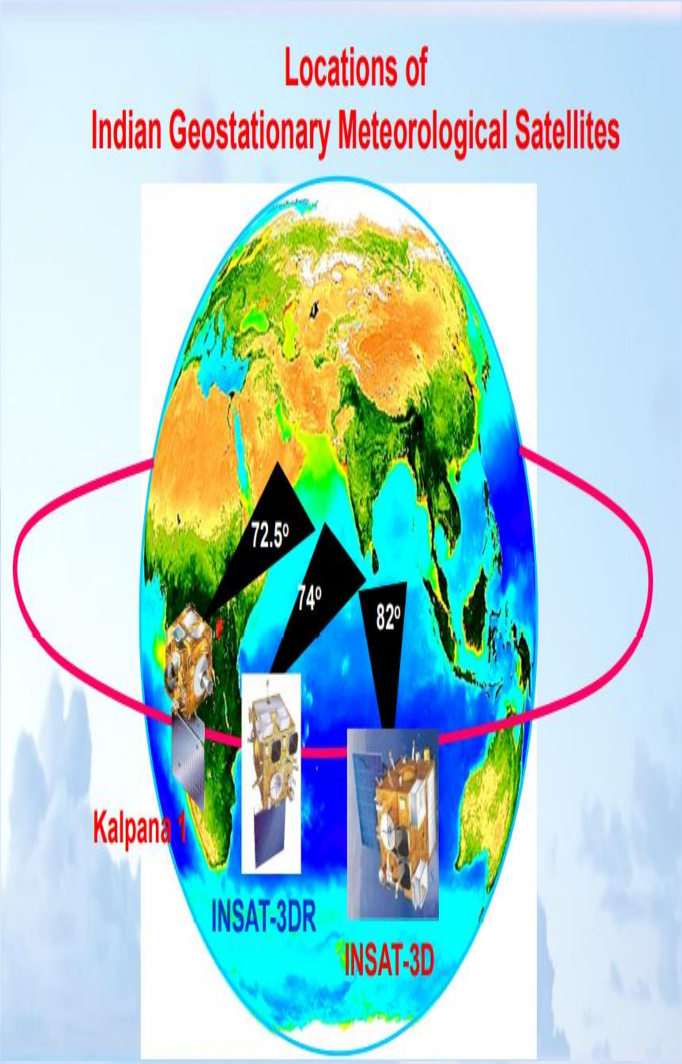
# New era begins



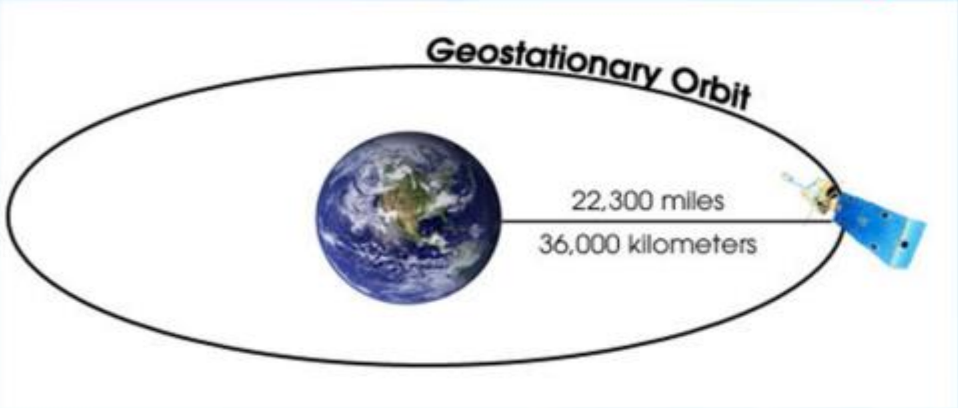

- (Left) The first televised image from space captured by the TIROS-1 satellite (pictured right) on April 1, 1960. *Images courtesy of NASA.*

# SATELLITES (GEO Satellites) Covering Indian Domain
# This is a new concept of Geo-Ring of covering Globe

| | | | | |
|---|---|---|---|---|
| **INSAT- 3A:** | **93.5º E longitude** | **Geostationary orbit** | **April 10, 2003** | **European Ariane-5 Launch Vehicle** |
| **INSAT-3DR** | **74° E.** | **Geostationary orbit** | **8 September 2016** | **Geosynchronous Satellite Launch Vehicle (GSLV Mk II) from the Satish Dhawan Space Centre** |
| **KALPANA-1(formerly Metsat 1)** | **72.5ºE longitude** | **Geostationary orbit** | **September 12, 2002** | **Polar Satellite launch vehicle (PSLV)** |
| **Meteosat -7** | **location 57º E** | **Geostationary satellite** | | **Operated by EUMETSET** |



# Geostationary Satellites



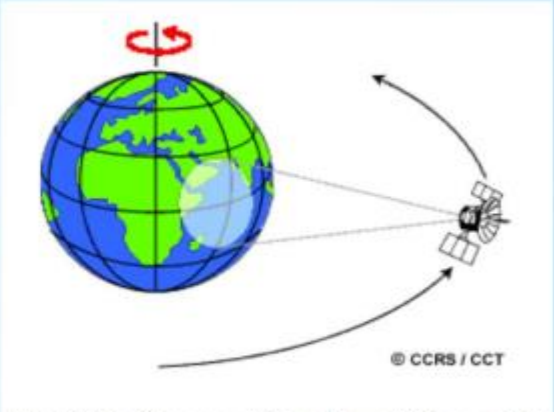
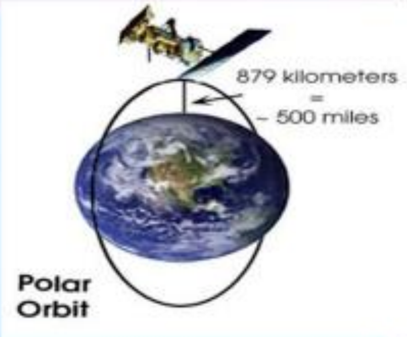




Fig.6. Pictorial representation of a geostationary orbit

- Geostationary satellites orbit approximately 35,785 kilometers (22,236 miles) above the equator, completing one orbit every 24 hours. Thus, their orbit is synchronized with the rotation of the Earth about its axis, essentially fixing their position above the same point on the equator (hence the name"geostationary").

# Polar-Orbiting Satellites




- The average altitude of polar orbiters is 850 km, which is considerably lower than geostationary satellites.
- Each polar orbiter, whose track is essentially fixed in space, completes 14 orbits every day while the Earth rotates beneath it. So polar orbiters get a worldly view, but not all at once.
- These low-flying satellites scan the Earth in swaths(link is external)about 2600 kilometers wide, covering the entire earth twice every 24 hours
- Polar-orbiting satellites pick up the high-latitude slack left by geostationary satellites.

# Visualization Types

## Resolutions

- Spatial resolution: Actual area on earth represented by a single pixel of satellite image
  – Visible 1 km x 1 km, water Vapour 8 km x 8 km
- Temporal resolution : Time after which the observation i.e. image is available
  – INSAT 3D : 30 Minutes
- Spectral Resolution: The spectral bandwidth with which the data is collected

  Wavelength Bands used

  – INSAT-3D/R: 0.65 μm(visible), 1.62 μm(SWIR), 3.9 μm (MIR)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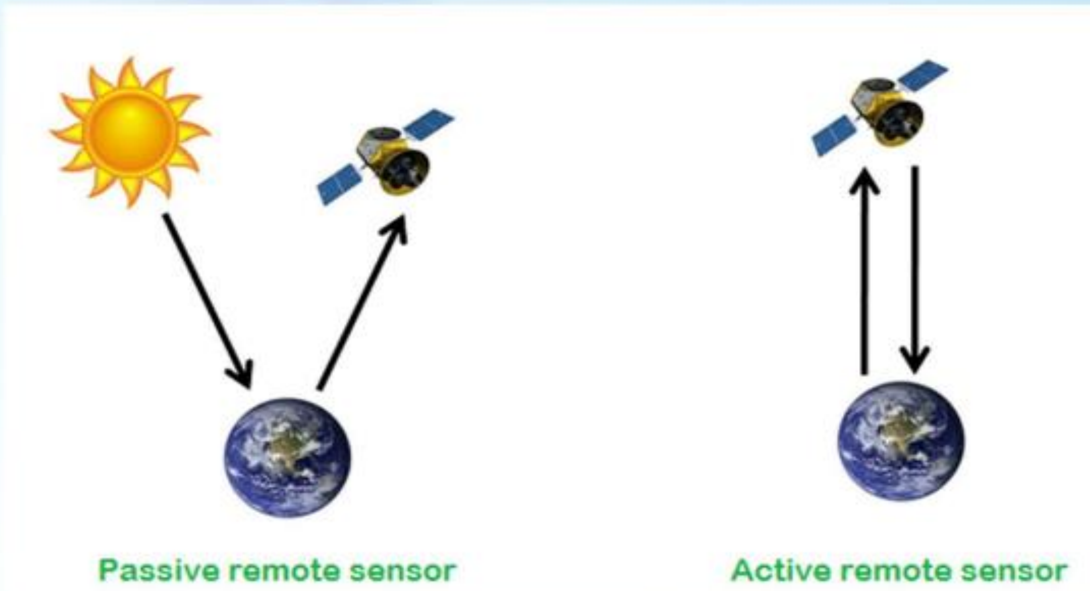
# Types of sensors

## Active vs Passive




- Passive sensors depends on Solar energy whereas Active sensors have their own source

# Remote Sensing

- Remote Sensing’ refers acquisition of characteristic information's of an object or phenomenon without making any direct or physical contact with the object.
- It involves the measurement of physical properties of objects located at remote distance from the measuring instruments.
- Thus measurement of meteorological parameters through satellite is an example of remote sensing.

Primary Instrument

The main mission is carried out by primary instrument

- Imager
- Sounder

- Imager is a multichannel instrument that senses radiant energy and reflected solar energy from the earths surface and atmosphere.(10 bit)

- Sounder provides data to determine the vertical temperature and moisture profile of the atmosphere, surface and cloud top temperature and ozone distribution.(12 bit)
- Other instrument on board the spacecraft are a search and rescue transponder , a data collection and relay system .

- 6 channel imager
- 19 channel sounder

# MET Data Transmitter

| | | Imager | Sounder |
|---|---|---|---|
| 1 | Transmit Frequency | C-Band 4781 MHz | C-Band 4798 MHz |
| 2 | Data Format | NRZ-M | NRZ-S |
| 3 | Data Modulation Scheme | QPSK | BPSK |
| 4 | Data Rate | 3.92 Mbps | 40 Kbps |
| 5 | EIRP | 23 dBW | 7 dBW |
| 6 | Transmit coverage | Indian mainland | Indian mainland |
| 7 | Cross polarization insolation | 2 ddb over 90% | Indian landmass coverage |

## Basic principles of satellite imagery interpretation

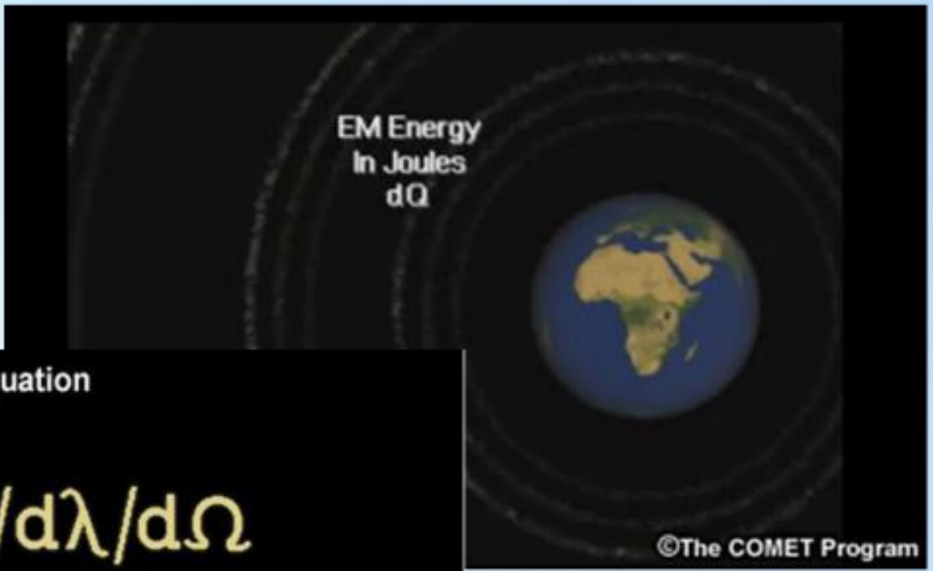
(a) Brightness
(b) Texture - smooth, fibrous, opaque, or mottled.
(C) Shape
(d) Pattern
(e) Size:
(f) Vertical Structure:

# SPECTRAL REGIONS USED FOR REMOTE EARTH OBSERVATION

- Visible spectrum (0.4-0.7 m): It is the frequency range of the human eye. Maximum solar radiation. Subdivided into three bands: R, G, B.
- Near-infrared (0.7-1.1 m): Also called photographic reflected IR. It is the solar energy reflected by any body. Its behavior is similar to the visible spectrum.
- Middle infrared (1.1-8 m): Solar radiation and emission mixing. The atmosphere is significantly affected. It is exploited to measure concentrations of water vapor, ozone, aerosols, etc.
- Thermal infrared (8-14 m): Radiation emitted by the bodies themselves. Tp can be determined by a body (thermal IR). Images may be available at any time of the day.
- Microwave (1mm-1m): There is a growing interest of Remote Sensing in this band. Atmospheric disturbances are minor and it is transparent to clouds. Active sensors are typically used.

| Name | Wavelenght range | Radiation source | Surface property of interest |
|---|---|---|---|
| Visible (V) | 0.4 – 0.7 µm | Solar | reflectance |
| Near InfraRed (NIR) | 0.7 – 1.1 µm | Solar | reflectance |
| ShortWave InfraRed (SWIR) | 1.1 - 3 µm | Solar | reflectance |
| MidWave InfraRed (MWIR) | 3 – 5 µm | Solar, Thermal | Reflectance, temperature |
| Thermal InfraRed (TIR) | 8 – 14 µm | Thermal | temperature |
| Microwave, radar | 1 mm – 1 m | Passive: thermal Active: artificial | Temperature (P) Roughness (A) |

# Radiance




**Planck Radiance Equation**

$$R_\lambda = dQ/dt/dA/d\lambda/d\Omega$$

(1) (2) (3) (4) (5) (6)

(1) Represents the radiance detected at the satellite sensor for a given wavelength

(2) Represents the energy coming from the earth and arriving at the top of the atmosphere

(3) Represents the measurement time interval over which the satellite sensor is sensing energy coming from the earth

(4) Represents the detector area on the satellite that energy is striking

(5) Represents the wavelength interval that the satellite is sensing

(6) Represents the solid angle through which the satellite views the earth

# Basic Laws used

- Planck's Law can be generalized as - ***Every** object emits radiation at **all** times and at **all** wavelengths*

--- While all matter emits radiation at all wavelengths, it does not do so *equally*.

- *Wein's Law states that the **wavelength of peak emission is inversely proportional to the temperature** of the emitting object.*

--- the hotter the object, the shorter the wavelength of max emission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- *The Stefan-Boltzmann Law states that the **total amount of energy** per unit area emitted by an object is **proportional to the 4th power of the temperature**.*

*--- Emitted Energy is directly proportional to Temperature*

- *Kirchhoff's Law states that for an object whose temperature is not changing, an object that **absorbs radiation well at a particular wavelength will also emit radiation well** at that wavelength*

*---If absorption at a particular wavelength is good then emission at that wavelength is also good.*


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# What is brightness temperature?

Definition of Radiance »

## Planck Equation and Brightness Temperature

**Brightness Temperature Equation**

$$T_{b\lambda} = \frac{C_2}{\lambda \ln\left(\frac{C_1}{\lambda^5 B_\lambda} + 1\right)}$$

$C_1 = 1.19 \times 10^{-8}$ (W m$^{-2}$ ster$^{-1}$ cm$^4$)

$C_2 = 1.439$ (Kelvin • cm)

$B_\lambda$ = Planck Radiance

$\lambda$ = Wavelength of the Emitted Energy

**Planck Radiance Equation**

$$B_\lambda(T) = \frac{C_1 \lambda^{-5}}{\exp\left(\frac{C_2}{\lambda T}\right) - 1}$$

$C_1 = 1.19 \times 10^{-8}$ (W m$^{-2}$ ster$^{-1}$ cm$^4$)

$C_2 = 1.439$ (Kelvin • cm)

$T$ = Temperature of the Emitting Surface

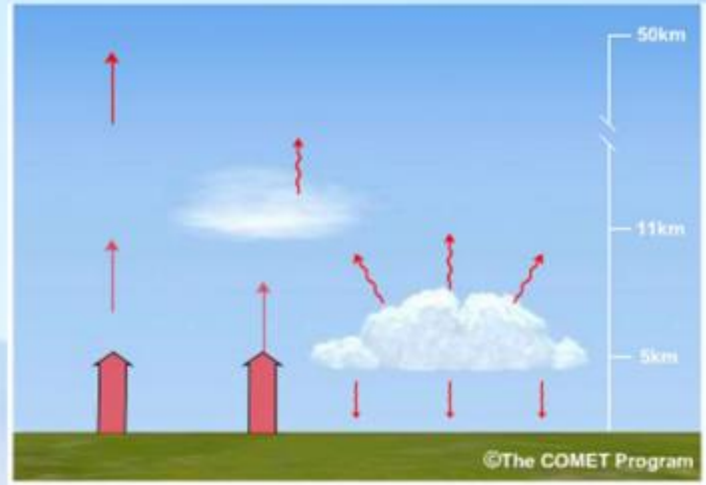
$\lambda$ = Wavelength of the Emitted Energy

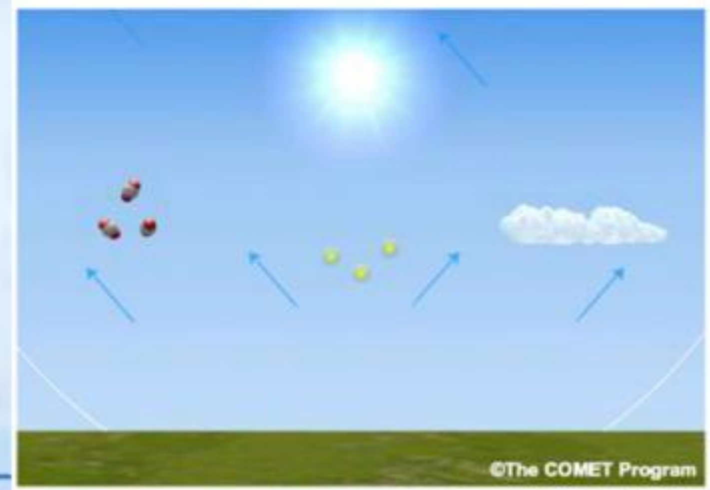


When given a radiance measurement, meteorologists often refer to the associated brightness temperature. The equation on the left is an inversion of the Planck equation which expresses brightness temperature as a function of Planck radiance and wavelength.

# Visible and Infrared

- Infrared energy is emitted 24 hours a day and is sensed by satellites continuously
- visible imagery is available only during daylight hours since sunlight is reflected only during that period

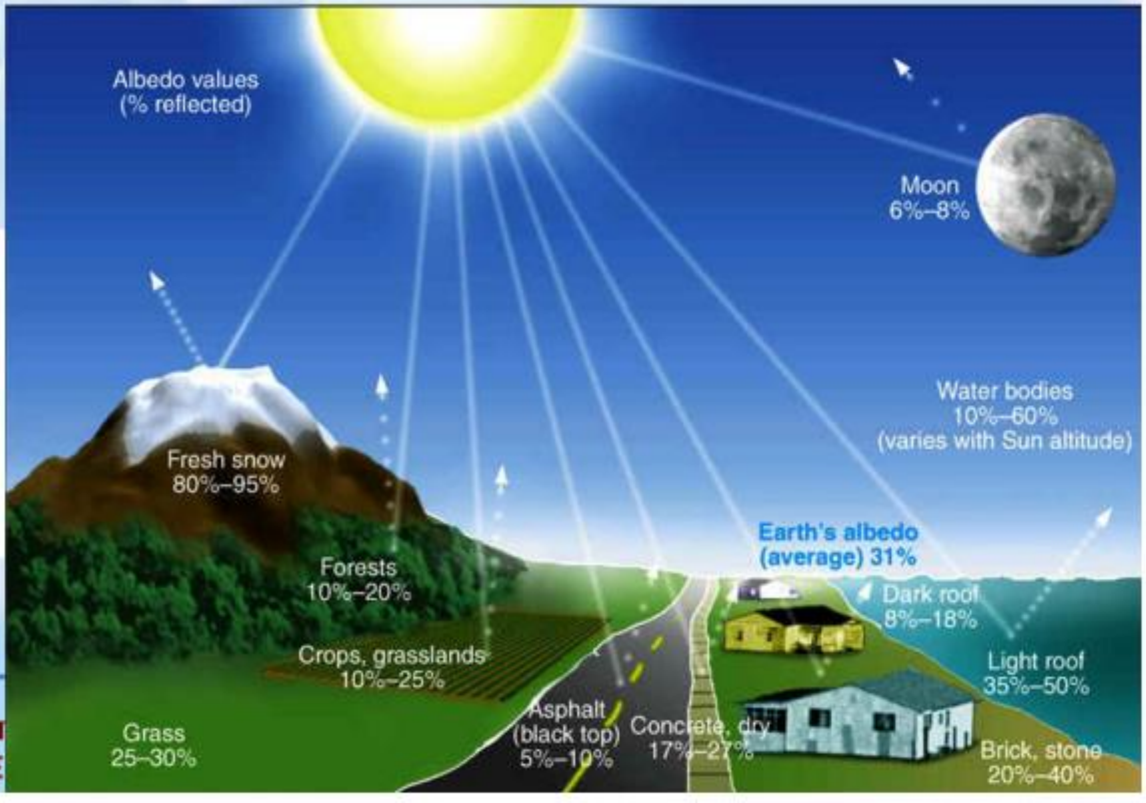


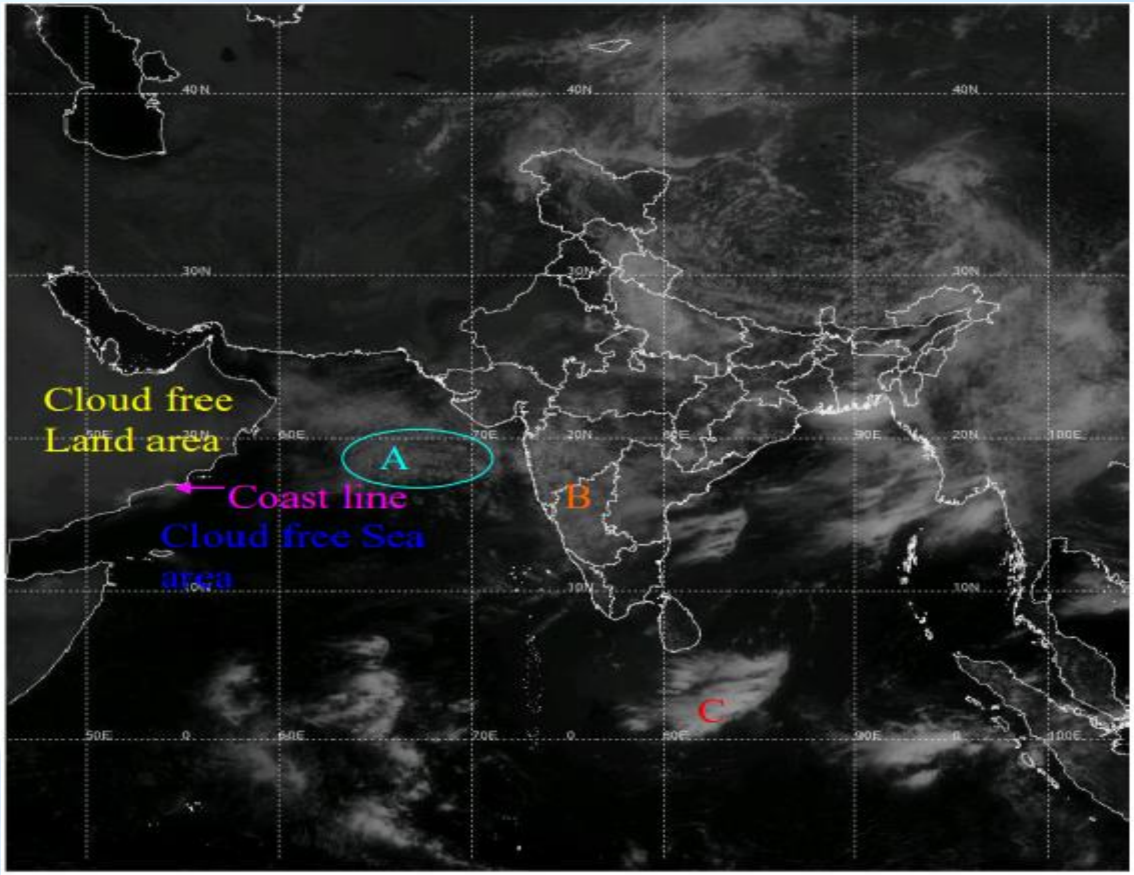
# Visible imagery

- Now, assuming that it is during the day, the brightness of the visible light reflected by an object back to the satellite largely depends on the object's *albedo*, which is simply the ratio of the amount of reflected light to the amount of light incident on the object

- Land appears brighter than the sea but darker than clouds.

# Visible image showing different features



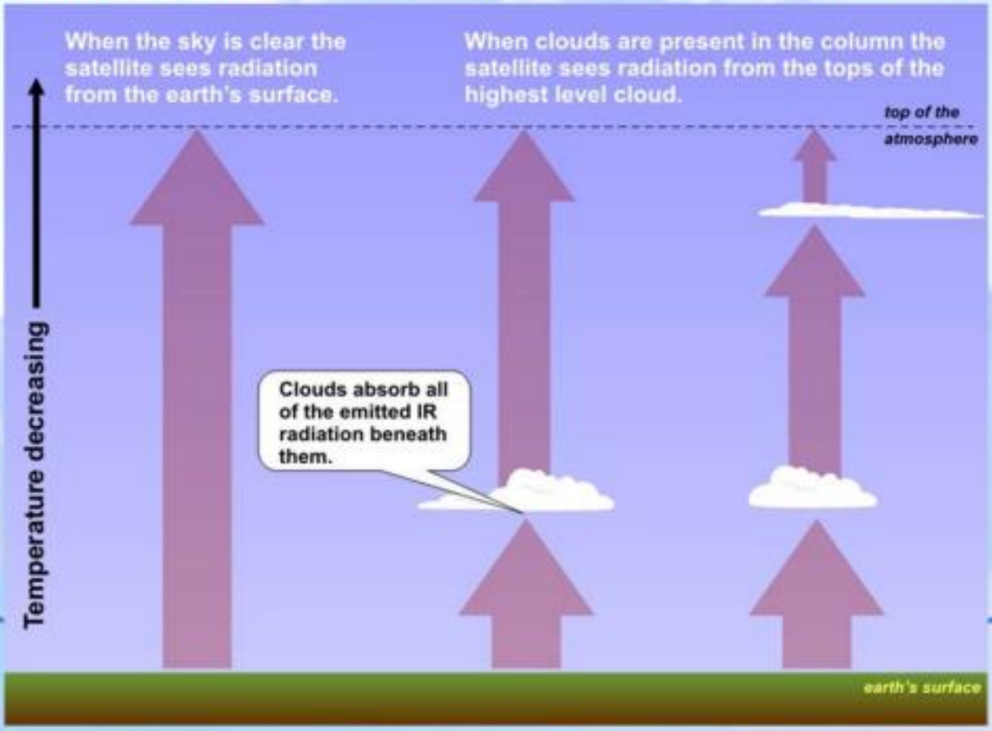

*A: Low Clouds(Cu) over Sea, B: Low/medium clouds over land, C: Cumulonimbus clouds.*

# Visible

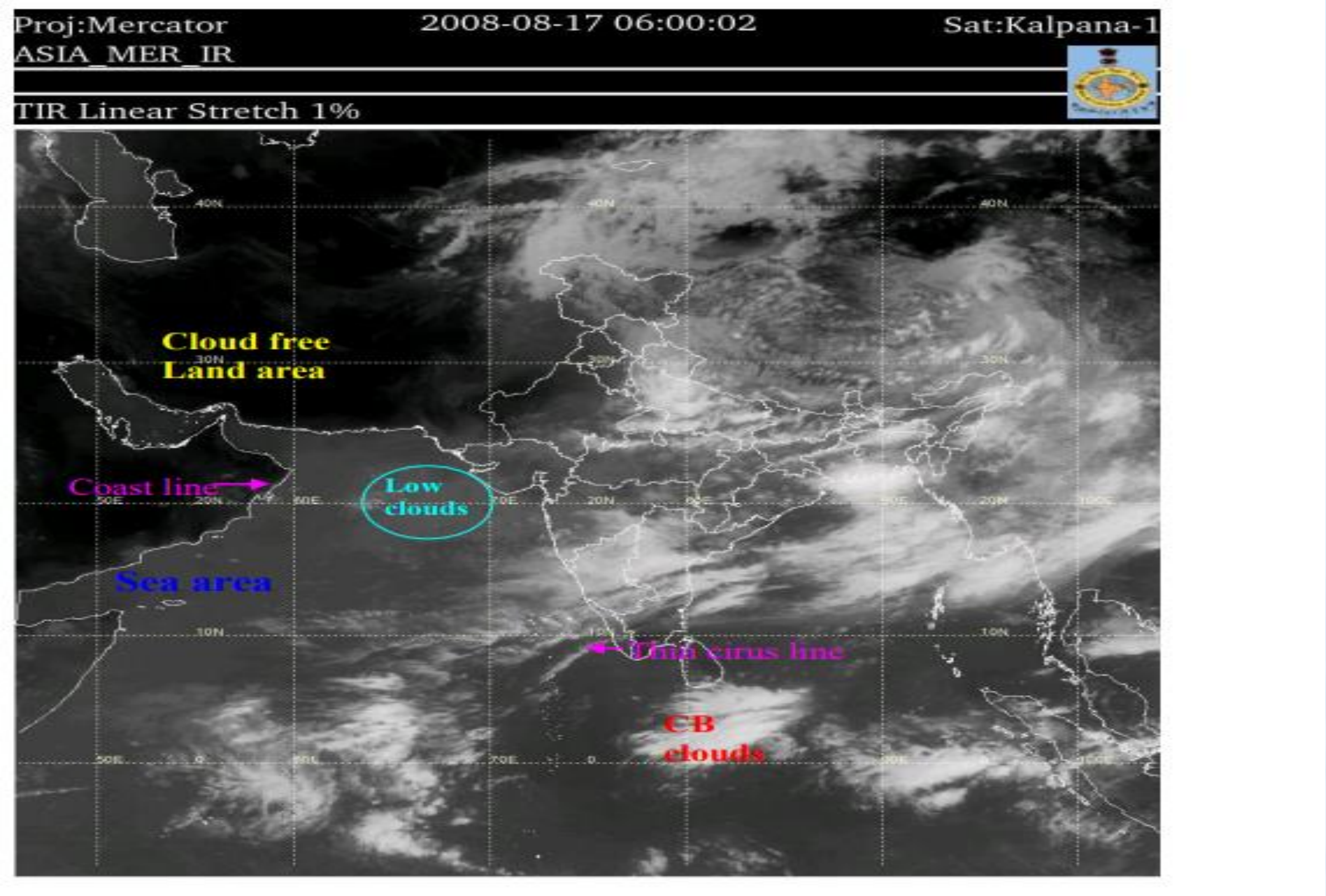
- **Distinguishing clouds over a snow-covered** area: is difficult as in visible images both have almost the same brightness (large albedo). Animation of the visible image can reveal clouds moving over the stationary snow/ice.
- **Thin clouds:** thin clouds over a high albedo desert surface may be seen as misleadingly bright because of scattering light from lower surfaces reaching to the satellite.

# Infrared satellite imagery...

- is based on the fact that measuring an object's IR emission tells you something about its temperature.
- displays the temperature of either cloud tops or the earth's surface (if the sky is clear).
- can be combined with the assumption that temperature decreases with height to allow cloud-top heights to be determined. Colder cloud-top temperatures mean higher clouds.
- is ***not*** able to give any *direct* indication of cloud thickness or the presence of precipitation (although inferences can be made in some cases).



# IR image showing different features



# Infrared

Detection of fog and low clouds

( a) **During night time fog** and low clouds can not be differentiated from other land surface features because of negligible temperature contrast among them.

(b) **Land sea contrast:** In IR imagery coastline can be seen clearly only when there is a large difference between land and sea surface temperatures.

| | VIS imagery | IR Imagery | WV Imagery |
|---|---|---|---|
| Cumulus (Cu) clouds | easily seen in visible picture if there are no other clouds above them | covering a large area can only be seen as a dark gray shade. | can not normally be detected. |
| Towering cumulus clouds | appears as bright white | appears as light gray ton | appears as dark gray tone like in IR |
| Cumulonimbus (Cb) clouds | very white cloud with very bright top | very bright white tones with well defined boundaries | Cb is easily identified as bright white shades |
| Stratus Clouds(St) or Fog | a uniform bright tone, smooth texture with sharp boundaries. Shade becomes darker | Difficult because of low temperature contrast between these (very low) clouds/fog | stratus and fog can not be detected in WV imagery |
| Stratocumulus(Sc) clouds | as cloud sheet or parallel bands and the shades varies from white to light gray | medium to dark gray shades | – can not be detected |

## Indian Satellites:

Currently INSAT consists of two Geostationary satellites viz., INSAT-3A and KALPANA- 1 in operation having meteorological payload

The Indian National Satellite (INSAT) System is a joint venture of the.

- Department of Space (DOS),
- India Meteorological Department (IMD),
- Department of Telecommunication (DOT),
- All India Radio (AIR)
- Doordarshan.

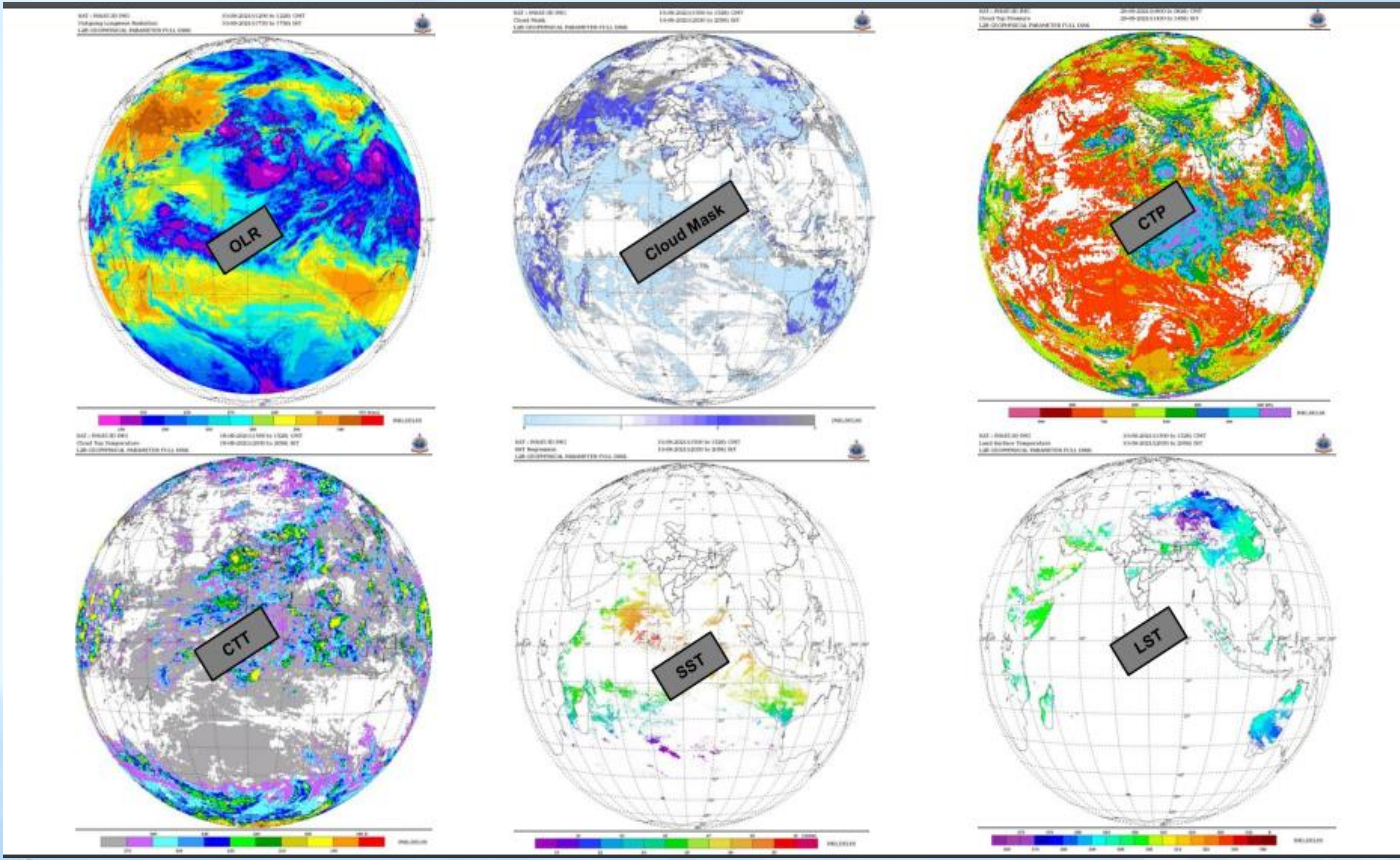
## MMDRPS INSAT 3D/3R (Channels Imager + Sounder)

INSAT 3D/3R carries a six channel imager and 19 channel sounder. The 6 spectral channels of INSAT-3D imager are:

| Spectral Band | Wave length (μm) | Ground Resolution |
|---|---|---|
| VIS | 0.55 – 0.75 | 1km |
| SWIR | 1.55 – 1.70 | 1 km |
| MIR | 3.80 – 4.00 | 1 km |
| WV | 6.50 – 7.10 | 8 km |
| TIR-1 | 10.3 – 11.3 | 4 km |
| TIR-2 | 11.5 – 12.5 | 4 km |

## Geophysical Parameters to be derived from INSAT -3D (sounder)

| Sl. No. | Parameters | Input Channels | Sl. 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* |




भारत मौसम विज्ञान विभाग
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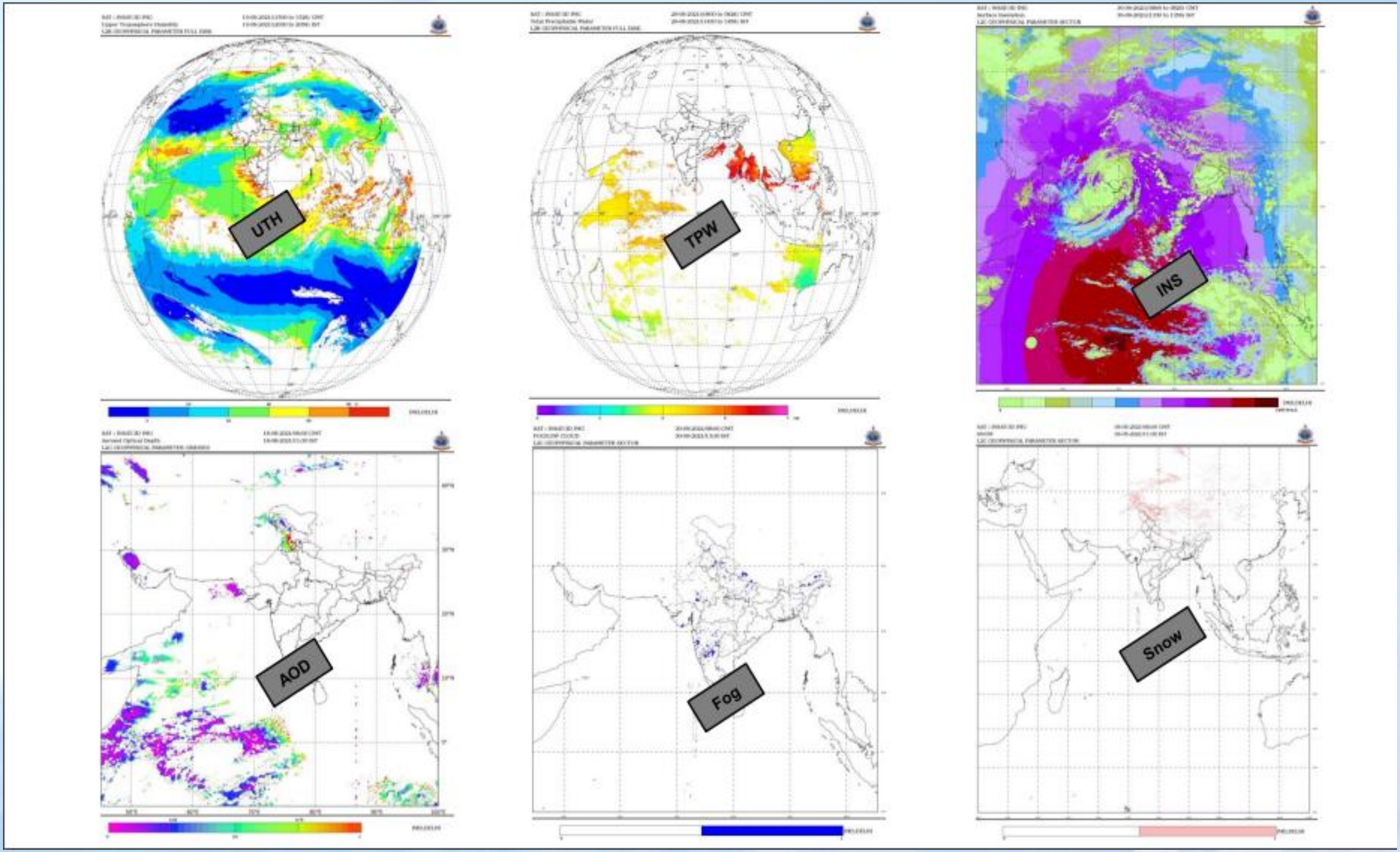
UTH
TPW
INS
AOD
Fog
Snow

# Use of various wavelengths

| Channel | Cloud | Gases | Application |
|---|---|---|---|
| HRV 0.7 | Absorption <------------> Scattering; 1 ------<------ Emissivity ------>------ 0 | Broad band VIS | Surface, aerosol, cloud detail (1 km) |
| VIS 0.6 | | Narrow band | Ice or snow |
| VIS 0.8 | | Narrow band | Vegetation |
| NIR 1.6 | | Window | Aerosols, **snow<>cloud** |
| IR 3.8 | | Triple window | SST, **fog**<>surface, ice cloud |
| WV 6.2 | | Water vapour | **Upper** troposphere 300 Hpa humidity |
| WV 7.3 | | Water vapour | **Mid**-troposphere 600 Hpa humidity |
| IR 8.7 | | Almost window | Water vapour in boundary layer, **ice<>liquid** |
| IR 9.7 | | Ozone | Stratospheric winds |
| IR 10.8 | | Split window | CTH, cloud analysis, **PW** |
| IR 12.0 | | Split window | Land and **SST** |
| IR 13.4 | | Carbon dioxide | +10.8: Semitransparent-cloud **top**, air mass ana |


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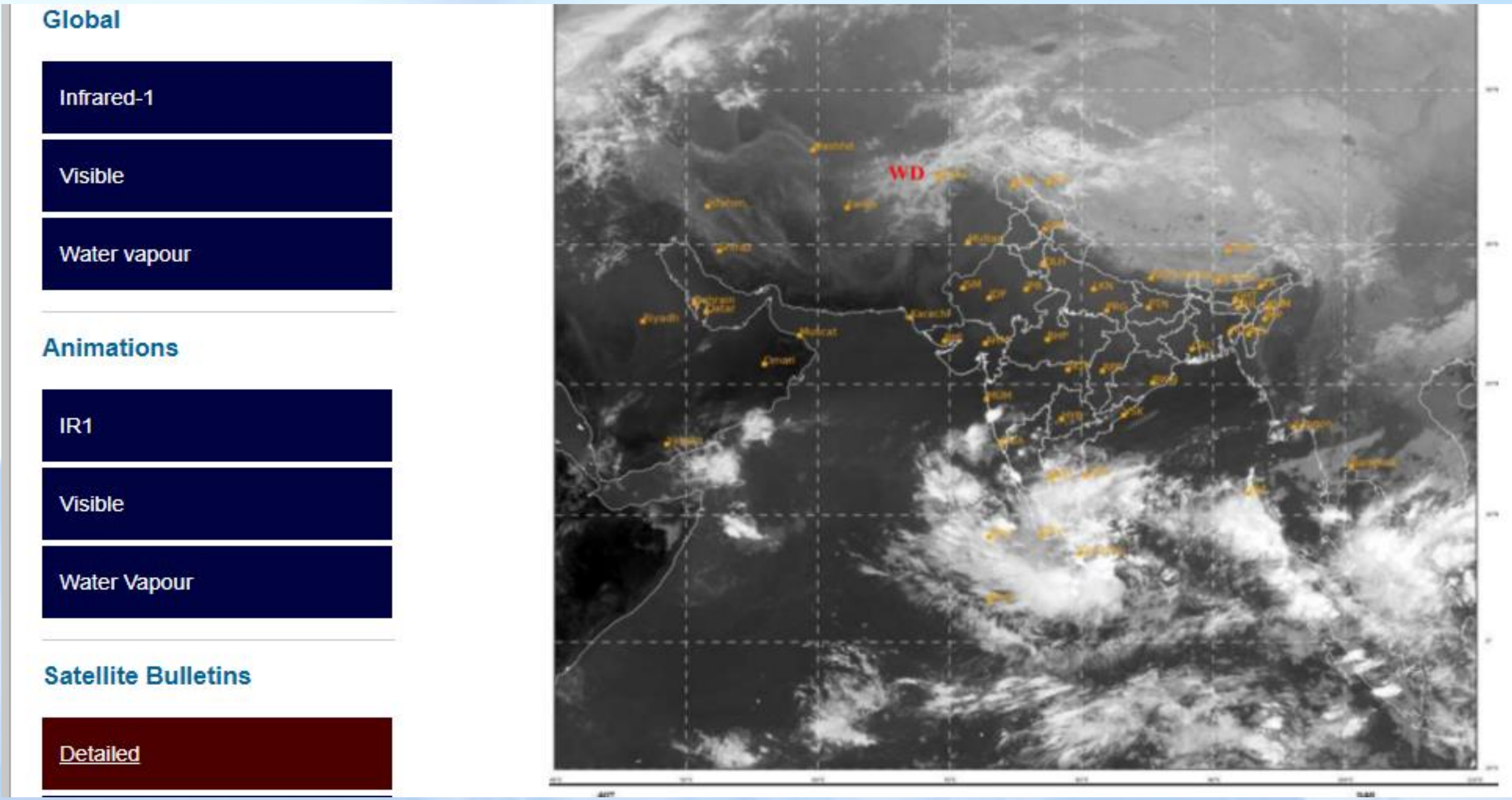
# https://satellite.imd.gov.in/

https://mausam.imd.gov.in/imd_latest/contents/satellite.php



# Classification of Low Pressure Systems

| Low Pressure System | Abbreviation | Wind Speed Assiciated (Knots) | T.No. |
|---|---|---|---|
| Well marked Low | WML | < 17 | 1.0 |
| Depression | D | 17-27 | 1.5 |
| Deep Depression | DD | 28-33 | 2.0 |
| Cyclonic Storm | CS | 34-47 | 2.5, 3.0 |
| Severe Cyclonic Storm | SCS | 48-63 | 3.5 |
| Very Severe Cyclonic Storm | VSCS | 64-89 | 4.0,4.5 |
| Extremely Severe Cyclonic Storm | ESCS | 91-119 | 5.0, 5.5,6.0 |
| Super Cyclonic Storm | SuCS | ≥120 | 6.5 to 8.0 |
| | | | |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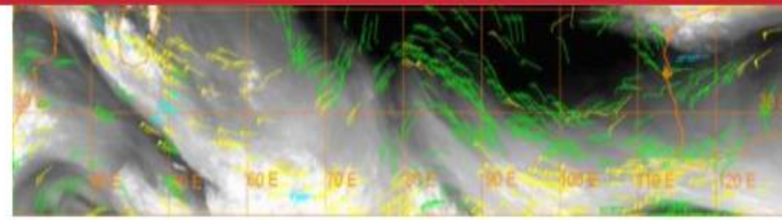
Satellite Images

mausam.imd.gov.in/imd_latest/contents/satellite.php#.



**CLOUDS DESCRIPTION WITHIN INDIA:-**

**NORTH:-**

SCT LOW/MED CLOUDS WITH EMBDD MOD TO INT CONVTN OVER LADAKH AND WK TO MOD CONVTN OVER J&K N HP N UTRKND (.)

**EAST:-**

SCT LOW/MED CLOUDS WITH EMBDD WK TO MOD CONVTN OVER SKM ARUPR (.) ISOL TO SCT LOW/MED CLOUDS OVER CHTGH ORS COTL GWB EXT N SHWB REST NE STATES (.)

**WEST:-**

SCT LOW/MED CLOUDS WITH EMBDD INT TO V INT CONVTN OVER CENTRAL KKN ADJ MADHYA MAHA (MINIMUM CTT MINUS 90 DEG C) (.) SCT LOW/MED CLOUDS WITH EMBDD MOD TO INT CONVTN OVER SOUTH MADHYA MAHA AND WK TO MOD CONVTN OVER S KKN GOA (.) SCT LOW/MED CLOUDS OVER S MP REST MAHA (.)

**SOUTH:-**

SCT TO BKN LOW/MED CLOUDS WITH EMBDD INT TO V INT CONVTN OVER KRNTK NICOBAR ILS (MINIMUM CTT MINUS 93 DEG C) TN (MINIMUM CTT MINUS 78 DEG C) (.) SCT LOW/MED CLOUDS WITH EMBDD MOD TO INT CONVTN OVER RYLSM COTL AP KER LKSDP ANDAMAN ILS (.) SCT LOW/MED CLOUDS OVER TLNGN (.)

**ARABIAN SEA:-**

SCT TO BKN LOW/MED CLOUDS WITH EMBDD INT TO V INT CONVTN OVER CENTRAL ARSEA SOUTH ARSEA AND COMORIN (.)

**BAY OF BENGAL & ANDAMAN SEA:-**

SCT TO BKN LOW/MED CLOUDS WITH EMBDD INT TO V INT CONVTN OVER SOUTH BAY AND

Type here to search 18°C ENG 20:22

# Important Facts

- Only twelve, countries from the list below (**USSR, USA, France, Japan, China, UK, India, Russia, Ukraine, Israel, Iran and North Korea**).
- Which satellite is used in India to track cyclone.

**SCATSAT-1** – Satellite for Weather Forecasting, Cyclone Detection and Tracking - ISRO.

The Advanced Scatterometer (ASCAT) Data Products - noaa ...

https://manati.star.nesdis.noaa.gov › datasets › ASCAT..

# ASCAT

- OSWT Home
- Product Description
- Data Products
  - QuikSCAT/SeaWinds
  - OSCAT
  - RapidSCAT
  - ASCAT (METOP-A) >>
  - ASCAT (METOP-B)
  - ASCAT (METOP-C)
  - WindSAT
  - Altimeter
  - SMAP
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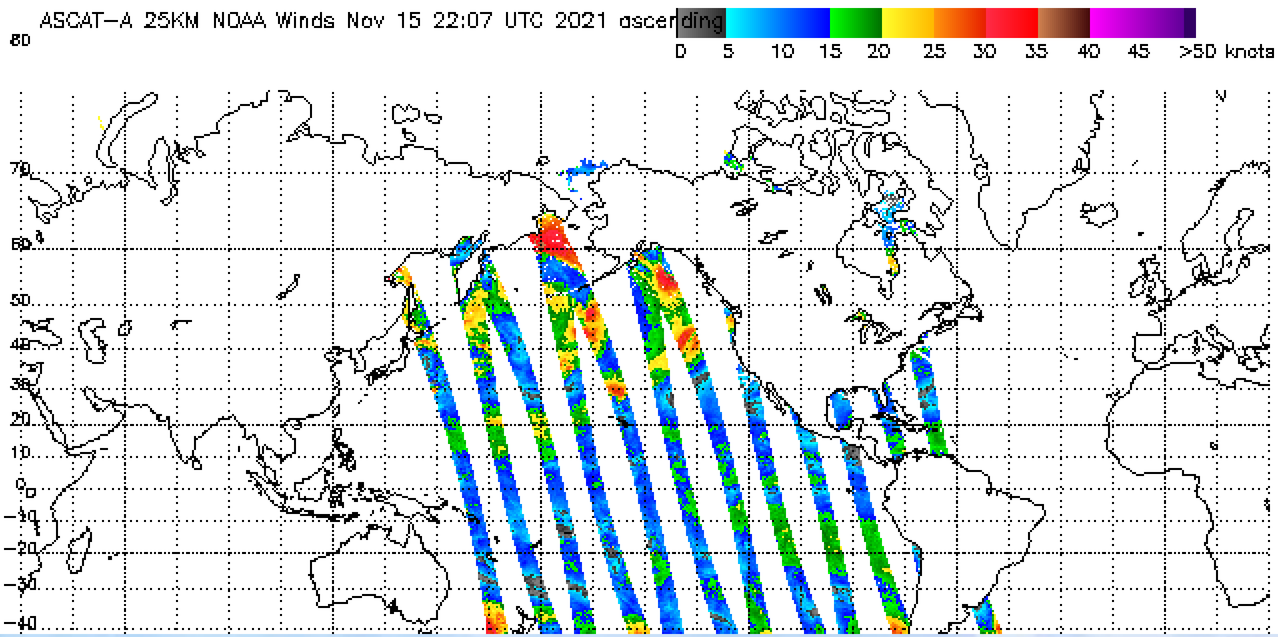
**Data from Satellite/Instruments: Advanced Scatterometer (ASCAT METOP-A)**

| Additional Products | Year | Month | Day | | |
|---|---|---|---|---|---|
| NOAA wind vectors 10x15 (25 | 2021 | 11 | 24 | Global(80N80S-180E180W) | Get Images |

**The ASCAT instrument on Metop-A's mission ended on November 15, 2021. Metop-A was launched on 19 October 200 and operated a little over 10 years beyond its design life. You can find more information at https://www.eumetsat.int/plans-metop-end-life.**

**Ascending Pass**



| Name | Long Name | Type |
|---|---|---|
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| GeoX | GeoX | 1D |
| GeoX1 | GeoX1 | 1D |
| GeoX2 | GeoX2 | 1D |
| GeoY | GeoY | 1D |
| GeoY1 | GeoY1 | 1D |
| GeoY2 | GeoY2 | 1D |
| GreyCount | GreyCount | 1D |
| IMG_MIR | Middle Infrared Count | Geo2D |
| IMG_MIR_RADIANCE | Middle Infrared Radiance | 1D |
| IMG_MIR_TEMP | Middle Infrared Brightness Temperature | 1D |
| IMG_SWIR | Shortwave Infrared Count | Geo2D |
| IMG_SWIR_RADIANCE | Shortwave Infrared Radiance | 1D |
| IMG_TIR1 | Thermal Infrared1 Count | Geo2D |
| IMG_TIR1_RADIANCE | Thermal Infrared1 Radiance | 1D |
| IMG_TIR1_TEMP | Thermal Infrared1 Brightness Temperature | 1D |
| IMG_TIR2 | Thermal Infrared2 Count | Geo2D |
| IMG_TIR2_RADIANCE | Thermal Infrared2 Radiance | 1D |
| IMG_TIR2_TEMP | Thermal Infrared2 Brightness Temperature | 1D |
| IMG_VIS | Visible Count | Geo2D |
| IMG_VIS_ALBEDO | Visible Albedo | 1D |
| IMG_VIS_RADIANCE | Visible Radiance | 1D |
| IMG_WV | Water Vapor Count | Geo2D |
| IMG_WV_RADIANCE | Water Vapor Radiance | 1D |
| IMG_WV_TEMP | Water Vapor Brightness Temperature | 1D |
| Latitude | latitude | Geo2D |
| Latitude_VIS | latitude | Geo2D |
| Latitude_WV | latitude | Geo2D |
| Longitude | longitude | Geo2D |
| Longitude_VIS | longitude | Geo2D |
| Longitude_WV | longitude | Geo2D |
| Sat_Azimuth | Satellite Azimuth | Geo2D |
| Sat_Elevation | Satellite Elevation | Geo2D |
| SCAN_LINE_TIME | Scan Time for Water Vapor Resolution | — |
| Sun_Azimuth | Sun Azimuth | Geo2D |
| Sun_Elevation | Sun Elevation | Geo2D |
| time | time | — |
| 3RSND_26APR2023_1100_L2B_SB1_V01R00.h5 | 3RSND_26APR2023_1100_L2B | Local File |
| CLD_FLG | Cloud Flag | Geo2D |
| CLR_PIX | Percentage Clear Pixel | Geo2D |
| CLR_SKY_BT1 | Clear Sky BT1 | Geo2D |
| CLR_SKY_BT10 | Clear Sky BT10 | Geo2D |
| CLR_SKY_BT11 | Clear Sky BT11 | Geo2D |
| CLR_SKY_BT12 | Clear Sky BT12 | Geo2D |
| CLR_SKY_BT13 | Clear Sky BT13 | Geo2D |
| CLR_SKY_BT14 | Clear Sky BT14 | Geo2D |

**File "3RIMG_30APR2023_2345_L1B_STD_V01R00.h5"**

File type: Hierarchical Data Format, version 5

```
netcdf file:/E:/DESKTOP/delete/3RIMG_30APR2023_2345_L1B_STD_V01R00.h
  dimensions:
    GeoX = 2805;
    GeoX1 = 1402;
    GeoX2 = 11220;
    GeoY = 2816;
    GeoY1 = 1408;
    GeoY2 = 11264;
    GreyCount = 1024;
    time = 1;
  variables:
    int GeoX(GeoX=2805);

    int GeoX1(GeoX1=1402);

    int GeoX2(GeoX2=11220);

    int GeoY(GeoY=2816);

    int GeoY1(GeoY1=1408);

    int GeoY2(GeoY2=11264);

    int GreyCount(GreyCount=1024);

    ushort IMG_MIR(time=1, GeoY=2816, GeoX=2805);
      :bits_per_pixel = 10; // int
      :resolution = 4.0f; // float
      :resolution_unit = "km";
      :_FillValue = 1023US; // ushort
      :lab_radiance_scale_factor = 2.97275E-4f; // float
      :lab_radiance_add_offset = -0.00457981f; // float
      :lab_radiance_quad = -2.00028E-12; // double
      :lab_radiance_scale_factor_gsics = 3.44217E-4f; // float
      :lab_radiance_add_offset_gsics = -0.0141867f; // float
      :lab_radiance_quad_gsics = -2.31614E-12; // double
      :radiance_units = "mW.cm-2.sr-1.micron-1";
      :coordinates = "time Latitude Longitude";
      :wavelength_unit = "micron";
      :central_wavelength = 3.907f; // float
      :bandwidth = 0.2f; // float
      :long_name = "Middle Infrared Count";
      :invert = "true";
      :_ChunkSizes = 1U, 186U, 2805U; // uint
```

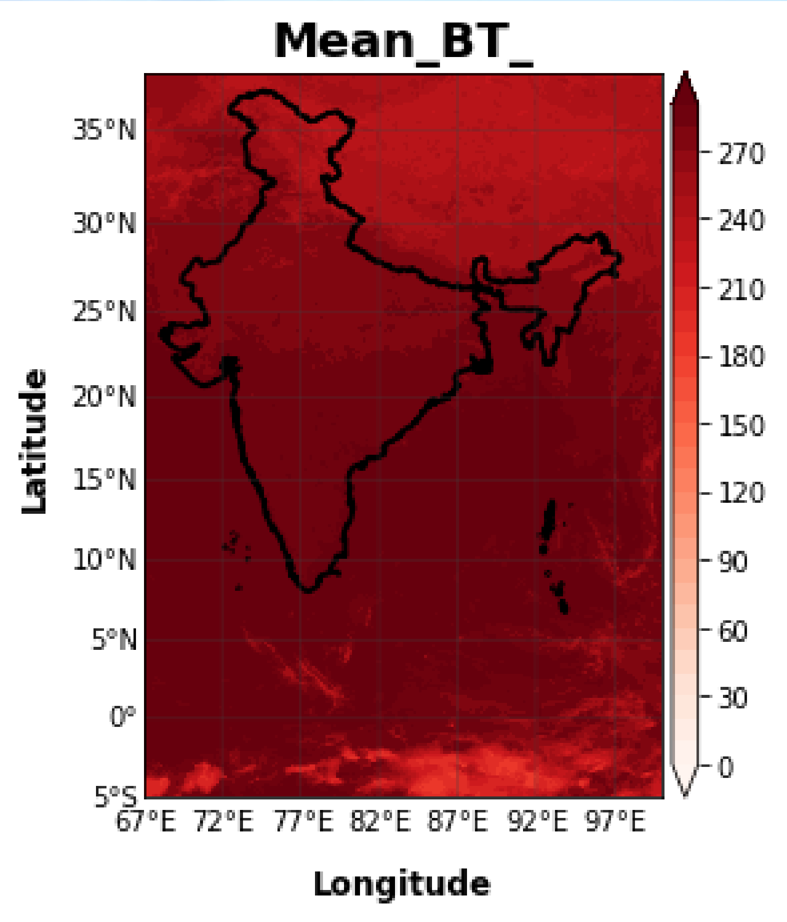
| Name | Long Name | Type |
|---|---|---|
| time | time | — |
| 3RSND_26APR2023_1100_L2B_SB1_V01R00.h5 | 3RSND_26APR2023_1100_L2B | Local File |
| CLD_FLG | Cloud Flag | Geo2D |
| CLR_PIX | Percentage Clear Pixel | Geo2D |
| CLR_SKY_BT1 | Clear Sky BT1 | Geo2D |
| CLR_SKY_BT10 | Clear Sky BT10 | Geo2D |
| CLR_SKY_BT11 | Clear Sky BT11 | Geo2D |
| CLR_SKY_BT12 | Clear Sky BT12 | Geo2D |
| CLR_SKY_BT13 | Clear Sky BT13 | Geo2D |
| CLR_SKY_BT14 | Clear Sky BT14 | Geo2D |
| CLR_SKY_BT15 | Clear Sky BT15 | Geo2D |
| CLR_SKY_BT16 | Clear Sky BT16 | Geo2D |
| CLR_SKY_BT17 | Clear Sky BT17 | Geo2D |
| CLR_SKY_BT18 | Clear Sky BT18 | Geo2D |
| CLR_SKY_BT2 | Clear Sky BT2 | Geo2D |
| CLR_SKY_BT3 | Clear Sky BT3 | Geo2D |
| CLR_SKY_BT4 | Clear Sky BT4 | Geo2D |
| CLR_SKY_BT5 | Clear Sky BT5 | Geo2D |
| CLR_SKY_BT6 | Clear Sky BT6 | Geo2D |
| CLR_SKY_BT7 | Clear Sky BT7 | Geo2D |
| CLR_SKY_BT8 | Clear Sky BT8 | Geo2D |
| CLR_SKY_BT9 | Clear Sky BT9 | Geo2D |
| CTP | Cloud Top Pressure | 2D |
| CTT | Cloud Top Temperature | 2D |
| DMI | Dry Microburst Index | Geo2D |
| EMS | Emissivity | 2D |
| FCST_SURF_AIR_H2OMMR | Forecast Surface Air WVMR | Geo2D |
| FCST_SURF_AIR_TEMP | Forecast Surface Air Temperature | Geo2D |
| FCST_SURF_PRES | Forecast Surface Pressure | Geo2D |
| GEO_POT_HEIGHT | Geo-Potential Height | Geo2D |
| GeoX | GeoX | 1D |
| GeoY | GeoY | 1D |
| GeoY1 | GeoY1 | 1D |
| H2OMMRFG | Humidity Profiles(First Guess) | Geo2D |
| H2OMMRPhy | Humidity Profiles(Phy) | Geo2D |
| H2OMMRReg | Humidity Profiles(Reg) | Geo2D |
| L1_PREC_WATER | L1 Prec Water(1000-900mb) | Geo2D |
| L2_PREC_WATER | L2 Prec Water(900-700mb) | Geo2D |
| L3_PREC_WATER | L3 Prec Water(700-300mb) | Geo2D |
| LAND_FRAC_FOV | Land Fraction FOV | Geo2D |
| Latitude | latitude | Geo2D |
| LI | Lifted Index | Geo2D |
| Longitude | longitude | Geo2D |
| O3VMRFG | Ozone Profiles(First Guess) | Geo2D |
| O3VMRPhy | Ozone Profiles(Phy) | Geo2D |
| O3VMRReg | Ozone Profiles(Reg) | Geo2D |
| plevels | pressure Surface | 1D |

**File "3RIMG_30APR2023_2345_L1B_STD_V01R00.h5"**

File type: Hierarchical Data Format, version 5

```
netcdf file:/E:/DESKTOP/delete/3RIMG_30APR2023_2345_L1B_STD_V01R00.h
  dimensions:
    GeoX = 2805;
    GeoX1 = 1402;
    GeoX2 = 11220;
    GeoY = 2816;
    GeoY1 = 1408;
    GeoY2 = 11264;
    GreyCount = 1024;
    time = 1;
  variables:
    int GeoX(GeoX=2805);

    int GeoX1(GeoX1=1402);

    int GeoX2(GeoX2=11220);

    int GeoY(GeoY=2816);

    int GeoY1(GeoY1=1408);

    int GeoY2(GeoY2=11264);

    int GreyCount(GreyCount=1024);

    ushort IMG_MIR(time=1, GeoY=2816, GeoX=2805);
      :bits_per_pixel = 10; // int
      :resolution = 4.0f; // float
      :resolution_unit = "km";
      :_FillValue = 1023US; // ushort
      :lab_radiance_scale_factor = 2.97275E-4f; // float
      :lab_radiance_add_offset = -0.00457981f; // float
      :lab_radiance_quad = -2.00028E-12; // double
      :lab_radiance_scale_factor_gsics = 3.44217E-4f; // float
      :lab_radiance_add_offset_gsics = -0.0141867f; // float
      :lab_radiance_quad_gsics = -2.31614E-12; // double
      :radiance_units = "mW.cm-2.sr-1.micron-1";
      :coordinates = "time Latitude Longitude";
      :wavelength_unit = "micron";
      :central_wavelength = 3.907f; // float
      :bandwidth = 0.2f; // float
      :long_name = "Middle Infrared Count";
      :invert = "true";
      :_ChunkSizes = 1U, 186U, 2805U; // uint
```

```
import numpy as np
import matplotlib.pyplot as plt
import h5py
from mpl_toolkits.basemap import Basemap
import glob
import numpy.ma as ma
import shapefile

import cmaps
path = 'C:/Users/Admin/Downloads/'

filenames =
   glob.glob(f'{path}/*3DIMG_01JAN2023_0000_L1C_ASIA_MER_V01R00.h5',
   recursive=True)
data_list = []

for filename in filenames:
    with h5py.File(filename, 'r') as h5file:
        print(h5file.keys())
        data = h5file['IMG_TIR1'][:]
        data=ma.masked_where(data==1023,data)
        lut=h5file['IMG_TIR1_TEMP'][:]
        tb=lut[data]
        #tb=np.flipud((tb[0,:,:]))
```


Mean_BT_
Latitude
Longitude
35°N
30°N
25°N
20°N
15°N
10°N
5°N
0°
5°S
67°E 72°E 77°E 82°E 87°E 92°E 97°E
270
240
210
180
150
120
90
60
30
0

# Thank You