



Weather Monitoring by IMD

For Prelims: [India Meteorological Department \(IMD\)](#), [INSAT 3D satellite](#), [INSAT 3DR satellite](#), [Infrared](#), [Cyclones](#), [Water Vapour](#), [Clouds](#), [Temperature](#), [Humidity](#), [Tropical Storm](#)

For Mains: Significance of INSAT 3D and INSAT 3DR satellites in revealing the meteorological conditions.

[Source: TH](#)

Why in News?

Recently, The [India Meteorological Department \(IMD\)](#) issued a warning about a strong probability of "very dense fog" in Haryana, Chandigarh, and Delhi.

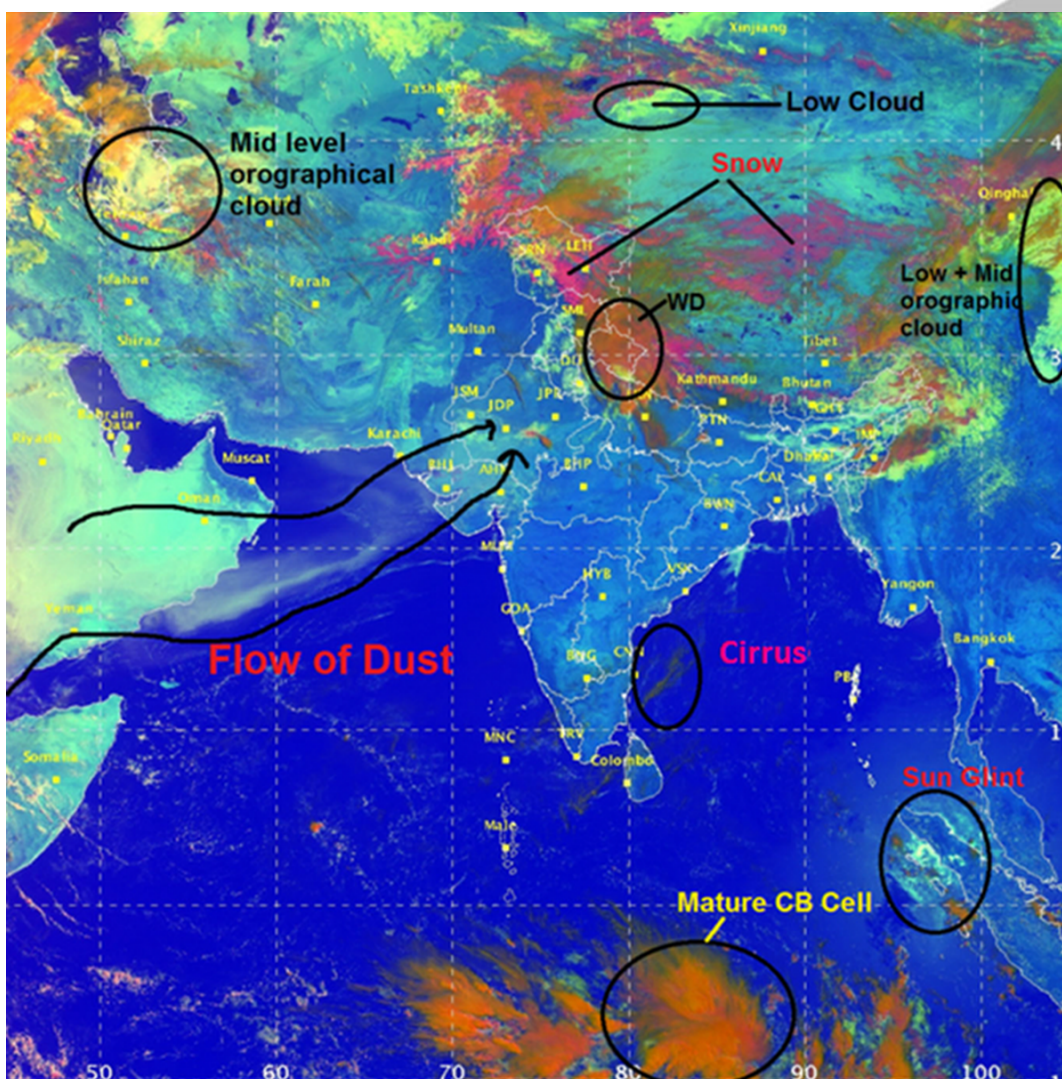
- IMD has also accompanied alerts with maps from the [INSAT 3D satellite](#), and sometimes from the [INSAT 3DR satellite](#).

What is INSAT-3DR?

- About:**
 - The IMD uses **INSAT -3D** and **INSAT-3DR** satellite data for weather forecasting/monitoring purposes.
 - INSAT-3DR, similar to INSAT-3D**, is an advanced **meteorological satellite of India** configured with an **imaging System** and an Atmospheric Sounder.
 - An atmospheric sounder **measures how the physical properties of a column of air vary with altitude**.
 - It has several **infrared channels** from **longwave** to **shortwave bands** and one **visible band**.
 - The significant improvements incorporated in **INSAT-3DR** are:
 - Imaging in the **Middle Infrared band** to provide **nighttime pictures of low clouds and fog**.
 - Imaging in two **Thermal Infrared bands** for estimation of **Sea Surface Temperature (SST)** with better accuracy.
- Mechanism of Imaging System of INSAT-3DR:**
 - RGB (Red, Green, Blue) Imager:** The colouration of images from the **RGB imager on the INSAT 3D satellite** relies on two factors:
 - Solar Reflectance:** It is a ratio of the **amount of solar energy reflected by a surface** and the amount of solar energy incident on it.
 - Brightness Temperature:** It is the relationship **between the temperature of an object and the corresponding brightness** of its surface.
 - Prediction and Monitoring of Snow and Clouds:**
 - While **snow** and [clouds](#) exhibit similar **solar reflectance** in the **visible spectrum**.
 - Snow strongly absorbs radiation of the **shortwave infrared**.
 - The **INSAT 3D** and **INSAT 3DR** satellites utilise **day and night microphysics**

modes through their **RGB imager**.

- **Day Microphysics:** Data from **INSAT 3D** examines **solar reflectance** at three wavelengths: **0.5 μm (visible)**, **1.6 μm (shortwave infrared)**, and **10.8 μm (thermal infrared)**.
 - The strength of the **visible signal determines** the amount of **green colour**.
 - The strength of the shortwave infrared signal, the amount of **red colour**
 - The strength of the **thermal infrared signal**, the amount of **blue colour**.
- **Night Microphysics:** This component of the satellite's operation is determined **not by a single but by evaluating the strength of the difference between two signals**.
 - The computer calculates the amount of red colour based on the difference between two thermal infrared signals.
 - The quantity of **green colour** varies according to the difference between a **thermal infrared** and a **middle infrared signal**.
 - The amount of **blue colour** is not derived from a difference but is determined by the **strength of a thermal infrared signal** at a wavelength.



• **Measurement of Temperature, Humidity and Water Vapour:**

- By combining day and night microphysics data, the **presence of moisture droplets** of different shapes and temperature differences over time, can be identified.
- It is helpful in tracking the **formation, evolution** and **depletion of cyclones** and other **weather events**.
- **INSAT 3D** and **INSAT 3DR** both use **radiometers** to make their **spectral measurements**.

- A radiometer is a device that measures the **temperature** or **electrical activity**. Both satellites also carry **atmospheric sounders**.
- These are devices that measure **temperature** and **humidity**, and study **water vapor** as a function of their heights from the ground.

What are the Other Weather Forecasting Methods?

- Apart from tracking satellite data, IMD collaborates with **ISRO** for ground-based observations from the **Automatic Weather Stations (AWS)**, the **Global Telecommunication System (GTS)** that measures temperature, sunshine, wind direction, speed and humidity.
 - Meanwhile, the Agro-meteorological Tower (AGROMET) and **Doppler Weather Radar (DWR) systems** augment the observations.
- In **2021**, **IMD adopted a new strategy** for issuing monthly and seasonal operational forecasts for the southwest monsoon rainfall by modifying the existing two-stage forecasting strategy.
 - The new strategy is **based on the existing statistical forecasting system and the newly developed Multi-Model Ensemble (MME)-based forecasting system**.
 - The **MME approach uses the coupled global climate models (CGCMs)** from different global climate prediction and research centres, including **IMD's Monsoon Mission Climate Forecasting System (MMCFs) model**.
- All these technological strides have been possible since the **National Monsoon Mission (NMM)** was initiated in 2012.

India Meteorological Department

- **About:**
 - **IMD** was established in **1875**. It is the **National Meteorological Service** of the country and the principal government agency in all matters relating to meteorology and allied subjects.
 - It works as an agency of the **Ministry of Earth Sciences** of the Government of India.
 - It is headquartered in **New Delhi**.
 - IMD is also one of the **six Regional Specialized Meteorological Centres** of the **World Meteorological Organization**.
- **Roles and Responsibilities:**
 - To take meteorological observations and to provide current and forecast meteorological information for optimum operation of weather-sensitive activities like agriculture, irrigation, shipping, aviation, offshore oil explorations, etc.
 - To warn against severe weather phenomena like **tropical cyclones**, norwesters, **dust storms**, heavy rains and snow, cold and **heat waves**, etc., which cause destruction of life and property.
 - To provide meteorological statistics required for agriculture, water resource management, industries, oil exploration and other nation-building activities.
 - To conduct and promote research in meteorology and allied disciplines.

UPSC Civil Services Examination, Previous Year Questions (PYQs)

Prelims

Q. In the South Atlantic and South-Eastern Pacific regions in tropical latitudes, cyclone does not originate. What is the reason? (2015)

- (a) Sea surface temperatures are low
- (b) Inter-Tropical Convergence Zone seldom occurs
- (c) Coriolis force is too weak
- (d) Absence of land in those regions

Ans: (b)

Ans:

- The most proximate reasons for the lack of cyclones in the South Atlantic and South Eastern Pacific ocean is the rare occurrence of the Inter-Tropical Convergence Zone (ITCZ) over the region.
- It becomes very difficult or nearly impossible to have genesis of tropical cyclones, unless synoptic vorticity (it is a clockwise or counterclockwise spin in the troposphere) and convergence (i.e., large scale spin and thunderstorm activity) are provided by ITCZ.
- Therefore, option (b) is the correct answer.

Mains

Q. The recent cyclone on the east coast of India was called “Phailin”. How are the tropical cyclones named across the world? Elaborate. **(2013)**

Q. Discuss the meaning of colour-coded weather warnings for cyclone prone areas given by India Meteorological Department. **(2022)**

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