Cyclone Dana

For Prelims: Cyclone Dana, Bhitarkanika National Park, Storm Surges, North Indian Ocean Region, Monsoon, Atmosphere, Cumulonimbus Clouds, Madden Julian Oscillation (MJO), World Meteorological Organization (WMO), Building Code, Cyclone Warning System, mangroves.

For Mains: Formation of Cyclones, Cyclone Disaster Preparedness and Mitigation

Source: DTE

Why in News?

According to the **India Meteorological Department (IMD)**, **Cyclone Dana** is expected to make **landfall** as a **severe cyclone (wind speed: 89 to 117 kmph)** along the **Odisha coast** near **Bhitarkanika National Park** and **Dhamra Port**.

What are Key Facts About Cyclone Dana?

- **About:**
  - **Emergence:** It is the third cyclone to form in the **North Indian Ocean region** and the second to make **landfall** along the Indian coast in 2024 after **Cyclone Remal**.
    - It is the first cyclone in the **post monsoon cyclone** season.
  - **Naming of Dana:** The **World Meteorological Organisation (WMO)** states that Cyclone Dana was named by **Qatar**. In Arabic, "Dana" signifies '**generosity**' and also refers to 'the most perfectly sized, valuable, and beautiful pearl.'
- **Reasons for Intense Rainfall:**
  - **Intense Convection:** The cyclone is showing **intense convection** in its western sector, which extends up to the upper layers of the **atmosphere.**
    - Intense convection begins when **warm, moist air rises, cools, and expands**, causing moisture to condense into **water droplets and form clouds**.
    - As the **rising air continues** to cool and condense, it forms **cumulonimbus clouds**, typical of **thunderstorms** and creates conditions conducive to **heavy rainfall**
  - **Warm Moist Air:** There is an **influx of warm, moist air into the core of the cyclone,** which further **enhances convection** leading to more intense rainfall.
    - The influx of warm, moist air helps to **maintain and intensify the cyclone** and enhances the cyclone's strength which results in intense rainfall over a relatively small area.
  - **Madden Julian Oscillation (MJO) Influence:** Currently, MJO is **conducive for convection** hence heavy rainfall.
    - The **MJO** is made up of **two parts**: an **enhanced rainfall phase** and a **suppressed rainfall phase**.
      - During the **enhanced phase**, surface **winds converge**, causing **air to rise and create more rainfall**. In the suppressed phase, winds converge at the top of the atmosphere, causing air to sink and leading to less rainfall.

- This dipole structure **moves west to east in the Tropics**, creating more **cloudiness and rainfall** in the **enhanced** phase, and more **sunshine** and **dryness in the suppressed phase**.

What are Key Points About the Naming of Cyclones?

- **Historical Evolution:** In the late **1800s**, the practice began in the **Caribbean**, naming storms after **saints** from the **Roman Catholic calendar**.
  - After **World War II,** the use of **female names** became common for better organisation in tracking storms.
  - Following criticism of **gender bias**, the naming system was updated in **1979** to include both **male and female names**, alternating between the two.
- **Establishment of Naming System:** The practice of naming cyclones in the **North Indian Ocean** region began in **2000** by the **World Meteorological Organization (WMO),** a **specialised agency** of the UN.
- **Collaborative Naming Lists:** In the **North Indian Ocean**, a collaborative list of cyclone names was established by **Tropical Cyclone Regional Body (TCRB).**
  - TCRB in the North Indian Ocean is a group of **13 countries** namely B**angladesh, India, Maldives, Myanmar, Pakistan, Sri Lanka, Oman, Thailand, Iran, Qatar, Saudi Arabia, United Arab Emirates and Yemen**.
- **Suggestion Submission Process:** Each of the **13 member countries** is required to provide **13 suggestions** for names to a WMO panel which reviews and finalises the name.
- **Global Standardisation:** Naming cyclones facilitates **easier identification** for both the media and the public, helping them follow the cyclone's progress and potential threats.
- **Rotation and Retirement of Names:** Names on the cyclone list are **rotated periodically,** ensuring a fresh selection over time.
  - **Retired names**, typically those associated with **deadly or destructive storms**, are replaced with new suggestions to avoid negative associations.

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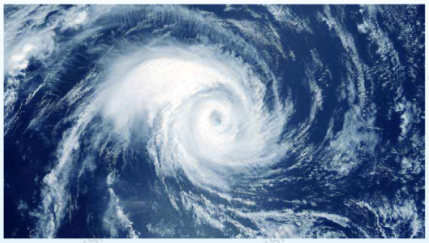
CYCLONE

Drishti IAS

Cyclones are rapid **inward** air circulation around a **low-pressure** area.

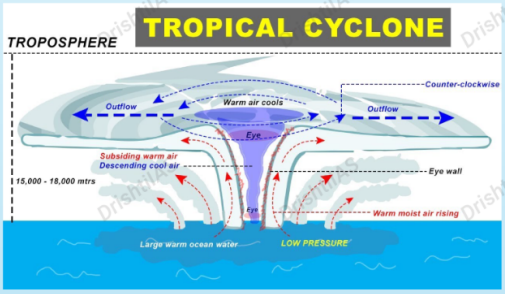


Cyclone v/s Anticyclone

Pressure System	Pressure Condition at the Center	Pattern of Wind Direction	
		Northern Hemisphere	Southern Hemisphere
Cyclone	Low	Anticlockwise	Clockwise
Anticyclone	High	Clockwise	Anticlockwise

Classification

- **Tropical Cyclones;** originate between the **Tropics of Capricorn and Cancer**
- **Extra Tropical/ Temperate Cyclones;** originate in the **Polar Regions**



Conditions for Formation

- Large sea surface with temperature >27° C.
- Presence of the **Coriolis force**
- Small **variations in the vertical wind speed**
- **A pre-existing weak low- pressure area**
- **Upper divergence** above the sea level system

Nomenclature

- Nodal Authority - **World Meteorological Organization (WMO)**
- Indian Ocean Region - **Bangladesh, India, Maldives, Myanmar, Oman, Pakistan, Sri Lanka** and **Thailand** contribute to naming cyclones that occur in this region.

Different Names for Tropical Cyclones

- **Typhoons** - Southeast Asia and China
- **Hurricanes** - North Atlantic and eastern Pacific
- **Tornados** - West Africa and southern USA
- **Willy-willies** - Northwest Australia
- **Tropical Cyclones** - Southwest Pacific and Indian Ocean

Cyclones in India

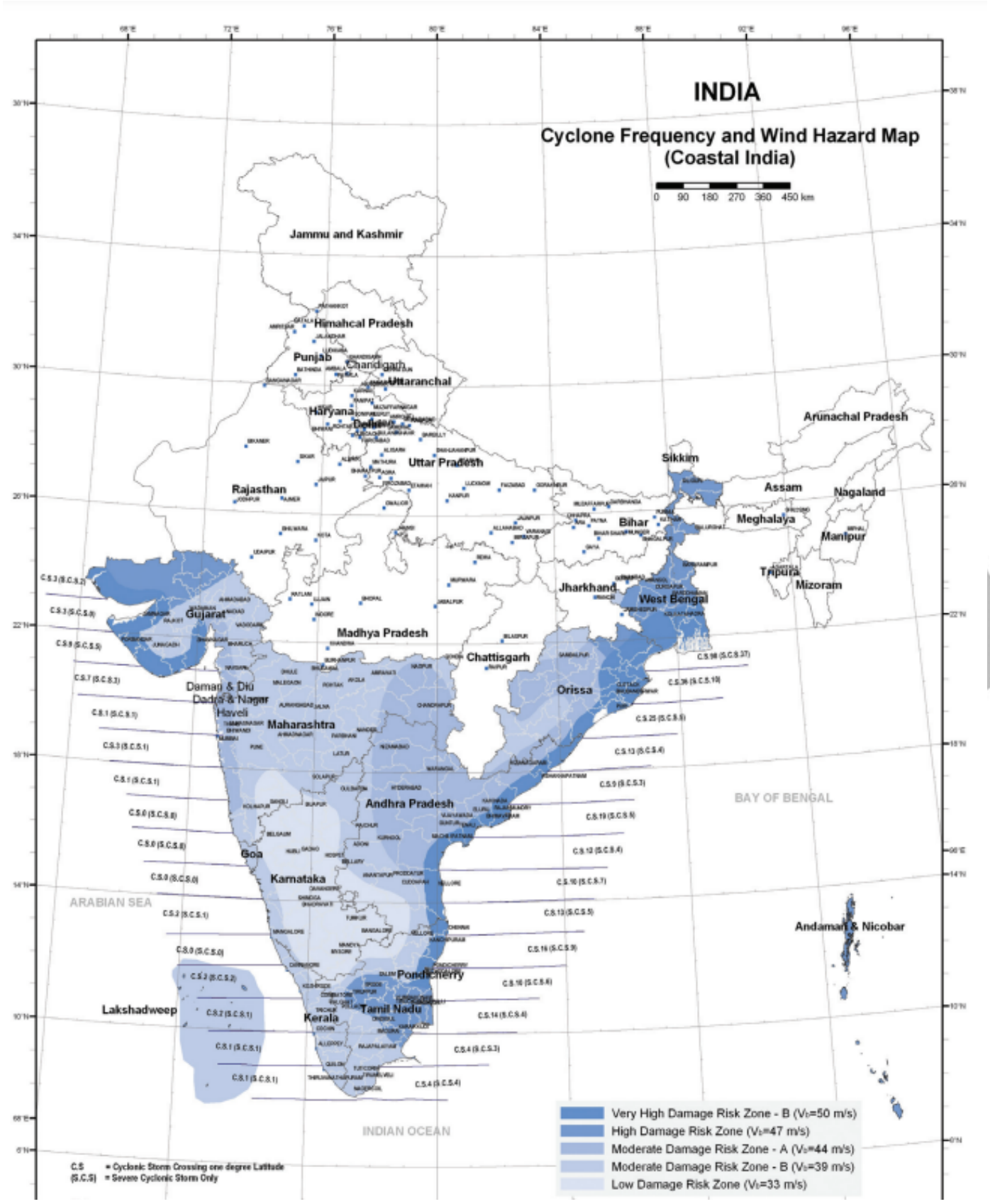
- **Bi-annual Cyclone Season** - March to May and October to December
- Recent Cyclones - **Tauktae, Vayu, Nisarga and Mekanu** (in Arabian Sea) and **Asani, Amphan, Fani, Nivar, Bulbul, Titli, Yaas and Sitrang (in Bay of Bengal)**

What Factors are Responsible for Formation of Tropical Cyclones?

- **Warm Ocean Waters:** Sea surface temperatures of at **least 27°C** are essential for tropical cyclone development. Warm water provides the **heat and moisture** needed to fuel the **storm's**

rising air and convection process.

- **Coriolis Force:** The **Coriolis effect**, caused by Earth's rotation, is necessary to give the cyclone its **spin**. This force is **weak near the equator**, so tropical cyclones generally form at **least 5° north or south of the equator** .
- **Low Wind Shear:** Low vertical **wind shear** (the difference in wind speed and direction at different altitudes) is crucial. High wind shear can disrupt the vertical structure of the storm, preventing it from strengthening .
- **Pre-existing Disturbance:** A tropical disturbance, such as a **low-pressure system,** provides the initial organisation of **air circulation** around which a cyclone can form.
- **Convergence of Air:** The convergence of **warm, moist air at the surface**, which rises and cools, creating **clouds and thunderstorms**, is fundamental to developing the cyclone's core.



What are the Impacts of Cyclone?

- **Human Impact**: Cyclones can cause **widespread casualties** due to strong winds, storm surges, and **flooding**. Thousands of people may be **evacuated or displaced**, leading to temporary or permanent loss of homes.
- **Infrastructure Loss:** Strong winds can cause **power outages** and structural damage, while flooding **disrupts transportation and communication**.

- **Environmental Impact:** High winds and storm surges **erode coastlines, destroying natural habitats** and human structures along the shore.
    - Cyclones can cause long-term damage to **forests, wetlands, and marine ecosystems**, affecting biodiversity.
- **Agriculture Loss:** Low-lying agricultural areas are vulnerable to **seawater intrusion** and **waterlogging f**rom heavy rains, which can destroy crops and reduce agricultural productivity.
    - Prolonged rainfall may lead to **water accumulation** in fields, affecting **soil health and damaging crops.**

Four-Stage Cyclone Warning System

- **Pre-Cyclone Watch (Green):** Issued **72 hours in advance**. Alerts about **potential cyclonic disturbances** and expected adverse weather in coastal areas.
- **Cyclone Alert (Yellow):** Issued at **least 48 hours** before adverse weather begins. Provides information on the **storm's location, intensity**, and advises on safety measures.
- **Cyclone Warning (Orange):** Issued at **least 24 hours** before the onset of adverse weather. Offers detailed updates on **cyclone position, expected landfall,** and associated impacts like **heavy rainfall and strong winds**.
- **Post Landfall Outlook (Red):** Issued at **least 12 hours before landfall**. Detailed adverse weather conditions likely to **affect inland areas after landfall.**

What Measures are Needed for Effective Cyclone Disaster Preparedness and Mitigation?

- **Before Cyclone:**
    - **Land Use Planning:** Implement **land use and building codes** to restrict habitation in **vulnerable zones**, reserving them for **parks or flood diversion.**
    - **Cyclone Early Warning System:** Utilise the new **Impact-Based Cyclone Warning System** to communicate risks and preparedness actions, focusing on local populations and land use patterns.
    - **Engineered Structures:** Build structures designed to withstand **cyclone winds**, including public infrastructures like hospitals and communication towers.
    - **Mangrove Plantation:** Promote **mangrove planting** initiatives to shield coastal areas from storm surges and erosion, engaging community participation in these projects.
- **During Cyclone:**
    - **Cyclone Shelters:** Establish cyclone shelters in **high-risk areas** and ensure that shelters are connected to **major roads** for **quick evacuation and access** during emergencies.
    - **Flood Management:** Implement **sea walls, embankments, and drainage systems** to control water flow and reduce flooding from storm surges and heavy rainfall.
- **After Cyclone:**
    - **Hazard Mapping:** Create maps that indicate the **frequency and intensity of cyclones** based on historical data, including storm surges and flooding risks.
    - **Retrofitting Non-Engineered Structures:** Educate communities on retrofitting techniques, such as **building steep-slope roofs** and **anchoring poles**, to enhance the resilience of non-engineered homes.

Conclusion

Cyclone Dana underscores the importance of **proactive disaster management** measures, including effective **early warning systems, land use planning, and community involvement.** By enhancing **infrastructure resilience, implementing hazard mapping, and promoting mangrove conservation**, we can better prepare for and mitigate the impacts of cyclones on vulnerable coastal regions.

Drishti Mains Question:

Discuss the factors contributing to cyclone formation and intensification, along with measures needed for effective disaster preparedness and mitigation.

UPSC Civil Services Examination Previous Year Question (PYQ)

Prelims

Q. Consider the following statements: (2020)

1. Jet streams occur in the Northern Hemisphere only.
2. Only some cyclones develop an eye.
3. The temperature inside the eye of a cyclone is nearly 10ºC lesser than that of the surroundings.

Which of the statements given above is/are correct?

(a) 1 only

(b) 2 and 3 only

(c) 2 only

(d) 1 and 3 only

Ans: (c)

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)

Q.The 2004 Tsunami made people realise that mangroves can serve as a reliable safety hedge against coastal calamities. How do mangroves function as a safety hedge? (2011)

(a) The mangrove swamps separate the human settlements from the sea by a wide zone in which people neither live nor venture out

(b) The mangroves provide both food and medicines which people are in need of after any natural disaster

(c) The mangrove trees are tall with dense canopies and serve as an excellent shelter during a cyclone or tsunami

(d) The mangrove trees do not get uprooted by storms and tides because of their extensive roots

Ans: (d)

Mains

Q.Tropical cyclones are largely confined to the South China Sea, Bay of Bengal and Gulf of Mexico. Why? **(2014)**

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