Trends in the North Indian Ocean's Storm Cycle

Mains: *GS-I – Geography | Important Geophysical phenomena such as earthquakes, Tsunami, Volcanic activity, cyclone etc.*

Why in News?

The cyclonic disturbances over the North Indian Ocean, which include the Arabian Sea, the Bay of Bengal, and the land area in between, have changed drastically over the last century.

What is cyclonic disturbances?

- **Cyclonic disturbances –** These are *low-pressure weather systems* characterized by *inward-spiraling* winds.
- The word Cyclone is derived from the *Greek word 'Cyclos'* meaning the coils of a snake.
- **Coined by –** Henry Peddington because the tropical storms in the Bay of Bengal and the Arabian Sea appear like coiled serpents of the sea.
- **2 types –** Tropical cyclones & extra-tropical cyclones (temperate cyclones).

Tropical cyclones	Extra-tropical cyclones
These form over ***warm tropical oceans*** (above 26.5°C) and are powered by the release of latent heat from condensing water vapor.	They form ***over land or sea in mid-latitudes*** (30°-60°), along polar fronts where cold/warm air meet.
Energy are derived from latent heat from condensation in rising moist air.	Get its energy from horizontal temperature gradients (cold vs warm air masses).
They typically moves from east to west.	They moves from west to east.
They are known by ***different regional names,*** such as hurricanes in the Atlantic and typhoons in the Pacific.	Driven by the subtropical westerly jet stream, they travel east across Iran, Afghanistan, and Pakistan to reach the Indian subcontinent.
It covers smaller area but much stronger winds and more destructive.	It covers larger areas, bring varied weather (rain, snow, blizzards).

What is the ongoing trend in storm activity across the North Indian Ocean?

- **Frequency of cyclonic disturbances has shifted** – Cyclone activity rose until the 1970s, fell sharply by the 2000s, and is now climbing again but not back to earlier highs.
- **Inverted U-shaped trend in the past century** –
    - Between 1900 and 1920 (averaged under 10); by the 1930s (risen above 15),

marking a long period of stability until the 1970s.
    - However, the 1980s and 1990s saw a sharp decline, and hit a low about 8 in the 2000s.
    - Between 2010s and 2020s, the activity rebounded and is rising again, but still below the mid-century peak levels.
- **Regional Origin Shift –** The overall decline in disturbances in recent years is driven almost entirely by a sharp drop in activity within the Bay of Bengal.
    - **Bay of Bengal –** Once the primary hub of cyclonic disturbances, has seen a sharp decline in recent decades, driving the overall fall in activity.
    - **Arabian Sea –** The Arabian Sea has seen growing cyclonic activity, but its frequency remains below that of the Bay in recent years.
    - **Implication –** The cyclone risk is increasingly moving westward toward the Arabian Sea.
- **Intensification & Severity –** *Fewer storms overall, but stronger ones*, with the Arabian Sea becoming a growing hotspot due to faster warming.
    - A disturbance starts small (low-pressure <31 kmph), then can grow into depression (31–49), and further into a deep depression (50–61).
    - **Severity –** Cyclonic Storm (62–88), Severe Cyclonic Storm (89–117), Very Severe (118–166), Extremely Severe (167–221), Super Cyclonic storm (≥222).
- Since the 1970s, more Bay of Bengal storms have reached severe levels.
- Arabian Sea storms are *both increasing and intensifying,* creating higher risk and forecasting challenges.

Generally, warmer oceans provide more energy to tropical storms, making cyclones stronger and their paths harder to predict.

- **Seasonality Shift –** More cyclones now form later in the year.
    - In Bay of Bengal – The disturbances increasingly occur in *October–December* instead of July–September.
    - Prior to the 1980s, activity was concentrated in July-September, since then, the focus has shifted to October–November.

How do these shifts in the North Indian Ocean positively impact India?

- **Reduced exposure to cyclones** – With fewer total disturbances, India faces lower overall exposure to cyclones, means less disruption to agriculture, fisheries, and coastal livelihoods compared to the mid-20th century peaks.
- **Decline in Bay of Bengal activity –** The Bay of Bengal, once the most cyclone-prone region, has seen a sharp decline in disturbances.
- This reduces risk for Odisha, West Bengal, and Andhra Pradesh, & allows better resource allocation for disaster management along the eastern coast.
- **Stronger preparedness & monitoring –** Although fewer disturbances occur, those that do form are more predictable targets for monitoring.
- It pushes India to strengthen early-warning systems, disaster preparedness, and resilient infrastructure.
- **Seasonal shift benefits –** Storms now occur later in the year (October–December),

giving monsoon crops more time to mature before cyclone strikes.
- Disaster preparedness calendars can be adjusted to focus on the post-monsoon months, improving readiness.

How do these shifts in the North Indian Ocean negatively impact India?

- **Uneven decline –** The overall decline in disturbances is uneven - Arabian Sea activity is rising, exposing the western coast (Gujarat, Maharashtra, Kerala) to new risks.
- **Growing vulnerability of the western coast –** With rise in Arabian Sea activity, the western coast (Mumbai, Kochi, Lakshadweep) is becoming more vulnerable.
- Infrastructure and preparedness on this coast have historically been weaker, raising the potential for greater damage.
- **Disproportionate Impact –** Severe cyclones cause disproportionate losses—damaging lives, property, and agriculture far more than weaker storms.
- **Challenges in Arabian Sea –** The Arabian Sea is heating faster than average, producing stronger, less predictable cyclones, this makes forecasting and disaster planning more difficult.
- **Compound Flooding Risks –** The post-monsoon cyclones coincide with the retreating monsoon, increasing the chance of compound flooding.
- **Danger for Fishing Communities –** Fishing communities face an extended period of risk into winter, threatening livelihoods and safety.

What lies ahead?

- Looking ahead, fewer storms are forming, yet those that do are stronger, later in season, and more hazardous.
- The shifts in frequency, intensity, geography, and timing are reshaping cyclone dynamics in the North Indian Ocean, requiring improved forecasting, coastal planning, and disaster management.

References

1. The Hindu | Fewer but stronger cyclones: Four trends
2. NDMA | Cyclones
3. Hong Kong Observatory | Tropical cyclones & Extra-tropical cyclones