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# Impact of cyclone on Indian monsoon's onset

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**Why in News:** The impact of global warming on the monsoons are manifest in the onset, withdrawal, its seasonal total rainfall, and its extremes. Global warming also affects the cyclones over the Indian Ocean and the typhoons over the north western Pacific Ocean.

## About Onset of Indian Monsoon

The onset of the monsoon over Kerala signals the beginning of the four-month (June-September) southwest monsoon season, during which India gets more than 70% of its annual rainfall. It is an important day in the economic calendar of the country.

Contrary to what is sometimes assumed, the onset does not mean the first rain of the season. That can start happening in certain places even before the onset is declared.

For example, the Andaman and Nicobar Islands usually start receiving monsoon rainfall between May 15 and May 20, and it starts raining along the Kerala coast in the last week of May.

However, 'onset' is a technical expression with a specific definition — and the IMD does not officially declare onset until certain prescribed conditions are met.

## Conditions that determine the onset of monsoon

According to the IMD, the onset of the monsoon happens when there is a significant transition in the large-scale atmospheric and ocean circulations in the Indo-Pacific region. IMD announces the onset of the monsoon only after certain precisely defined and measurable parameters are met.

The IMD essentially looks at the consistency of rainfall over a defined geography, the intensity of the rainfall, and the wind speed.

**RAINFALL:** The onset is declared if at least 60% of 14 designated meteorological stations in Kerala and Lakshadweep record at least 2.5 mm of rain for two consecutive days at any time after May 10. The onset over Kerala is declared on the second day, as long as specific wind and temperature criteria are also fulfilled.

The 14 enlisted stations are: (i) Minicoy, (ii) Amini, (iii) Thiruvananthapuram, (iv) Punalur, (v) Kollam, (vi) Alappuzha, (vii) Kottayam, (viii) Kochi, (ix) Thrissur, (x) Kozhikode, (xi) Thalassery, (xii) Kannur, (xiii) Kasaragod, and (xiv) Mangaluru.

**WIND FIELD:** The IMD says that the depth of westerlies should be up to 600 hectopascal (1 hPa is equal to 1 millibar of pressure) in the area that is bound by the equator to 10°N latitude, and from longitude 55°E to 80°E. The 10th parallel North passes through Kochi; and the area bound by the 55th and the 80th meridians East stretches from the middle of Iran to about Chennai.

The zonal wind speed over the area bound by 5-10°N latitude (Maldives to Kochi) and 70-80°E longitude (Arabian Sea to Chennai) should be of the order of 15-20 knots (28-37 kph) at 925 hPa.

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**HEAT:** The INSAT-derived Outgoing Longwave Radiation (OLR) value — which is a measure of the energy emitted to space by the Earth's surface, oceans, and atmosphere — should be below 200 watt per sq m ( $\text{wm}^2$ ) in the area between the 5°N and 10°N latitudes, and 70°E and 75°E longitudes.

### **Delay in onset of the monsoon**

The normal date of the onset of the monsoon over the Kerala coast is June 1, and this year's delay is significant. However, neither an early nor a late onset of the monsoon is unusual.

So, in 2021, 2019, 2016, 2015, 2014, 2012, and 2011, the monsoon onset was realised after June 1. And in 2022, 2018, 2017, and 2010, the onset was realised before June 1. In 2020 and 2013, the monsoon was exactly on time, hitting the Kerala coast on June 1.

The IMD had predicted a delay of four days this year (onset on June 4), and a delay of six days in 2019 (onset on June 6); in both these years, the onset was realised on June 8. But there is always a margin of error in these predictions

### **Impact on Tropical Cyclone on Indian Monsoon**

Some cyclones in the North Indian Ocean have had both positive and negative impacts on the onset of the monsoon.

Since the circulation of winds around the cyclones is in the anticlockwise direction, the location of the cyclone is critical as far as the cyclone's impact on the transition of the monsoon trough is concerned. (The monsoon trough is a low-pressure region that is a characteristic feature of the monsoons.)

For example, if a cyclone lies further north in the Bay of Bengal, the back-winds blowing from the southwest to the northeast can pull the monsoon trough forward, and assist in the monsoon's onset.

Earlier this year, the Bay of Bengal had Cyclone Mocha develop in the first half of May and intensify briefly into a 'super cyclonic storm', before weakening rapidly upon landfall. Mocha's northwest to east trajectory over the Bay was the result of unusual anticyclones (which rotate clockwise) that have been parked over the Arabian Sea and the Bay of Bengal since March.

Mocha dissipated on May 15 and the back-winds helped the monsoons set in on time over the Andaman and Nicobar Islands.

One severe consequence of the anomalous anticyclones since March is that both the Arabian Sea and the Bay of Bengal have warmed by more than 1°C in the pre-monsoon season.

### **Impact of reason cyclones in late arrival of Monsoon**

The late-season cyclone Biparjoy is still chugging along in the warm Arabian Sea and may well rapidly intensify – i.e., have its wind speeds increase by 55 kmph within 24 hours – before making landfall.

Cyclone Biparjoy is not interacting much with the monsoon trough at this time. However, its late birth as well as the late onset of the monsoon are both closely related to typhoons in the northwestern Pacific Ocean.

On May 19, Typhoon Mawar was born and dissipated away by June 3. Mawar qualified as a 'super typhoon' and is thus far the strongest typhoon to have taken shape in May. It is also the strongest cyclone of 2023 so far.

Tropical storm Guchol is now active just to the east of the Philippines and is likely to continue northwest before veering off to the northeast. These powerful typhoons are thirsty beasts and demand moisture from far and wide.

Mawar pulled winds across the equator into the North Indian Ocean, setting up southwesterly winds over parts of the Arabian Sea and the Bay of Bengal. 'Southwesterly' means blowing from the southwest.

Southwesterly winds over the Arabian Sea are welcome news: they bring large quantities of moisture onto the Indian subcontinent. On the other hand, southwesterly winds over the Bay of Bengal are bad news for the monsoon. The monsoon winds over the southern Bay of Bengal sweep in from the southwest and west, but they turn around and head northwest towards India from the southeast.

Winds were southwesterly over the entire Bay when Mawar was active. This continues to be the case now due to Guchol, which has become a 'severe tropical storm' now. Winds have been blowing strongly towards the northeastward over the Bay, a key reason why the monsoon trough has been struggling to reach Kerala.