

Climate Change Impact: Powerful cyclones hold back onset of Southwest Monsoon 2021

Climate change has an invariable relation with changing weather patterns, which is quite evident in terms of increasing powerful cyclones and changing rainfall pattern. We just saw two back to back cyclones – Tauktae and Yaas on either side of the Indian coast intensifying rapidly to extremely severe cyclone and very severe cyclone, respectively. All this was attributed exceptional warming of ocean waters due to global warming.

Matthew Roxy Koll, a climate scientist at the Indian Institute of Tropical Meteorology, Pune states, “It is now a well-known fact that the global ocean has absorbed 90% of the excess heat generated by greenhouse gas (GHG) emissions since 1970. This has led to anomalous ocean warming in Arabian Sea and Bay of Bengal, which in turn makes cyclones intensify rapidly. Heat is energy, and cyclones intensify rapidly by turning the potential energy stored in the ocean to kinetic energy. The western tropical Indian Ocean has been warming for more than a century, at a rate faster than any other region of the tropical oceans and turns out to be the largest contributor to the overall trend in the global mean sea surface temperature (SST). Tropical cyclone heat potential (THCP) is a measure of heat in the upper ocean that is available as an energy source for cyclones. The warm colors indicate that the [current Arabian Sea conditions can support cyclogenesis.](#)”

Climate Change and Cyclogenesis

Observations indicate that frequency of [extremely severe cyclonic storms \(ESCS\) over the Arabian Sea](#) has increased during the post-monsoon seasons of 1998–2018 (high confidence). There is medium confidence in attributing this observed increase to human-induced SST warming.

According to report by the Ministry of Earth Sciences (MoES), Government of India, Assessment of Climate Change over the Indian region, climate models project a rise in the intensity of tropical cyclones in the North India Ocean (NIO) basin during the twenty-first century. It also suggested that climate change signal to changes in SST and associated Tropical Cyclone (TC) activity might emerge sooner in the Indian Ocean as compared to other ocean basins. Another potential concern in the NIO region is that TC intensities particularly in the Arabian Sea (AS) region exhibit an unprecedented rise in the recent years. High-resolution global climate model experiments indicate that anthropogenic global warming has increased the probability of extremely severe cyclonic systems during the post-monsoon season in the AS region. Some recent studies suggest that increasing anthropogenic emissions of black carbon and sulfate can play a role in reducing the vertical wind shear to favor more intense TC activity in the AS region.

What Cyclone Yaas and Tauktae did to onset of Monsoon 2021

The deadly phenomenon of global warming is now trying to strike a chord with Southwest Monsoon, which can be cause of worry.

Monsoon 2021 has entered Indian mainland of Kerala on June 3, two days after its normal date. The official onset date for the Monsoon is June 1, with an error margin of +/- 4 days.

Earlier the weather models were indicating timely arrival of Monsoon, in fact a day or two prior to the date. But the formation of tropical storm Yaas in the Bay of Bengal, coinciding at the time of onset of Monsoon held the Monsoon wave.

According to **GP Sharma, ex-AVM Meteorology, Indian Air Force and President-Meteorology and Climate Change at Skymet Weather** said, “Exceptional warming of ocean waters triggered two very powerful cyclonic storms Tauktae and Yaas in Arabian Sea and Bay of Bengal, respectively. These systems had taken away much of the kinetic energy from the water bodies, which had almost ceased the weather activity in Kerala. Required wind pattern and speed too were absent and thus, delayed the Monsoon onset.” **Image Credit: [Windy](#)**

Figure 1: Cyclone Yaas in Bay of Bengal

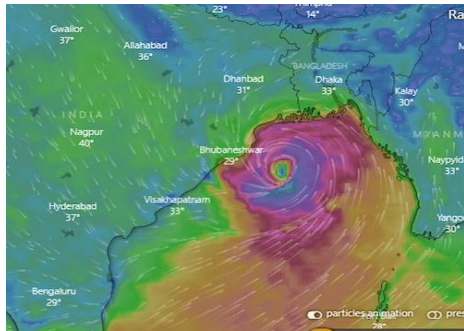
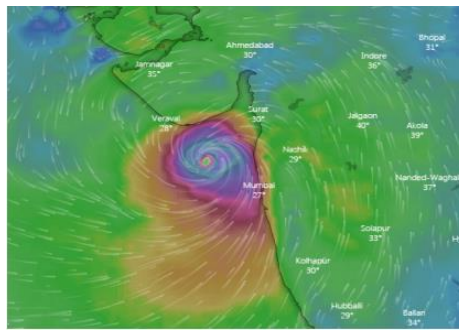


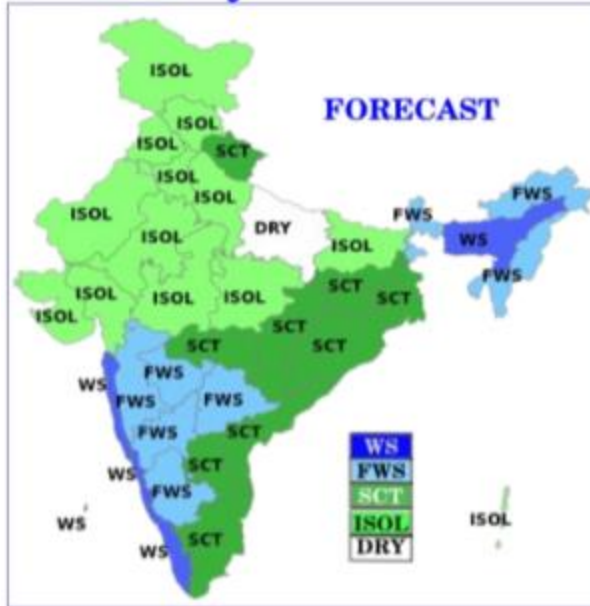
Figure 2: Cyclone Tauktae in Arabian Sea



“In fact, the arrival of Monsoon 2021 over Kerala will not see a thumping start and would be a soft one rather, added Sharma. Prior to Cyclone Tauktae, Kerala had been witnessing widespread heavy pre-Monsoon rains, indicating towards a great start of Monsoon this year. However, formation of extremely severe cyclone Tauktae and very severe cyclone Yaas had put a break on the ongoing rainfall,” **added Sharma.**

Dr Sushant Puranik, Atmospheric Sciences, Faculty for Weather Research and Forecasting, Dept of Atmospheric and Space Science and ISRO-Junior Research Fellow at University of Pune said, “Yaas intensified rapidly due to conducive atmospheric conditions taking away all the moisture and energy. Winds too started concentrating over the system. As a result, eastern arm of Monsoon that passes through Bay of Bengal became more powerful, while the western arm that moves through Arabian Sea became weak. For the onset of Monsoon, western arm must be stronger and take the lead. As a result, we are witnessing delay in Monsoon arrival over Kerala. Formation of Yaas impacted the required wind speed over Arabian Sea, while the value of OLR has also not been achieved. However, conditions are now getting favourable on account of a weather system in Arabian Sea, which has already increased rainfall across Kerala.”

As per the weathermen, formation of cyclonic circulations is likely on either side of the coastline during the first week of Jun, that would strengthen the Monsoon current. A trough is already seen running along the West Coast, off Kerala and Karnataka coast, which would be now increasing the rainfall over Southern Peninsular during the next 48-72 hours and an indicative of arrival of Monsoon. Image Courtesy: [India Meteorological Department](#)



Criteria for onset of Southwest Monsoon

According to the rulebook, there are [three criteria for declaring the onset of Monsoon](#):

Rainfall: Rainfall of 2.5 mm or more for two consecutive days over 60% of the enlisted 14 stations - Minicoy, Amini, Thiruvananthapuram, Punalur, Kollam, Allapuzha, Kottayam, Kochi, Thrissur, Kozhikode, Thalassery, Kannur, Kudulu and Mangalore.

Wind Field: Depth of westerlies should be maintained upto 600 hPa, in the box equator to Lat. 10°N and Long. 55°E to 80°E. The zonal wind speed over the area bounded by Lat. 5-10°N, Long. 70-80°E should be of the order of 15 – 20 Kts. at 925 hPa. The source of data can be RSMC wind analysis/satellite derived winds.

Outgoing Longwave Radiation (OLR): INSAT derived OLR value should be below 200 wm^{-2} in the box confined by Lat. 5-10°N and Long. 70-75°E.

Climate change and road ahead for Monsoon

As per the weathermen and scientists, impact of climate change would be more visible in the coming times. Arabian Sea will continue to witness warm sea surface temperatures due to the increasing carbon emissions, which would lead to more as well as intense cyclones.

“May being the peak month for the formation of cyclonic storms during pre-Monsoon season, might see frequent cyclones in the coming years. If such powerful systems continue to collide with the arrival of Southwest Monsoon, we might encounter slight delay in Monsoon like one in 2021. Further, if we see these cyclones during the first week of June also as weather conditions continue to be favourable, can also affect the rainfall over the Indian region for that time period. As reiterated above, formation of any strong system takes away of all the moisture and winds concentrate around it, leading to drop in rainfall,” **said Dr Puranik**.

The report "[Assessment of Climate Change over the Indian region](#)" stated that the summer monsoon precipitation (June to September) over India has declined by around 6% from 1951 to 2015, with notable decreases over the Indo-Gangetic Plains and the Western Ghats. There has been a shift in the recent period toward more frequent dry spells (27% higher during 1981–2011 relative to 1951–1980) and more intense wet spells during the summer monsoon season. The frequency of localized heavy precipitation occurrences has increased in response to increased atmospheric moisture content.

Since the middle of the twentieth century, India has witnessed a rise in average temperature; a decrease in monsoon precipitation; a rise in extreme temperature and rainfall events, droughts, and sea levels; and an increase in the intensity of severe cyclones, alongside other changes in the monsoon system. There is compelling scientific evidence that human activities have influenced these changes in regional climate. Human-induced climate change is expected to continue apace during the twenty-first century.