

Summary of 2024 NW Pacific Typhoon Season and Verification of Seasonal Forecasts

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Summary

The 2024 NW Pacific typhoon season saw below average activity with an ACE index 30% below the 1991-2020 climate norm; however, the season was very deadly and destructive. The TSR forecasts verified well overall; however, ACE was underestimated, primarily due to an unusual burst of typhoon activity from late-October to mid-November.

Features of the 2024 NW Pacific typhoon Season

- 23 named storms, 15 typhoons, 9 intense typhoons and an ACE index of 204. The 1991-2020 climatology values are 26,16,9 and 301 respectively.
- The 2024 NW Pacific typhoon season was the deadliest season since 2013 (around 1,200 deaths in total) and the fourth costliest season on record, mostly due to typhoon Yagi.
- Typhoon Yagi was a deadly and extremely destructive super-typhoon which impacted the Philippines, China and Vietnam with destructive winds and flooding rains. Yagi was the strongest typhoon to strike Hainan since Rammuson in 2014 and one of the strongest on record to make landfall in northern Vietnam. It is one of only four super-typhoons (1-minute sustained winds \geq 130 kts) recorded in the South China Sea.
- An unusual surge in activity occurred from late October through the first half of November. Five typhoons formed during this period of which four were classified as very strong or violent by the Japan Meteorological Agency (JMA). Four typhoons existed simultaneously in November for the first time on record, and the November ACE index of 64 was the highest since 1992. This active period will be discussed later in the document.
- The Philippines were frequently hit by strong typhoons in 2024. Between the 7th and 18th November, four category 4 (1-minute sustained winds of 130-155 mph) typhoons made landfall in the archipelago. This is more category 4 typhoon landfalls than the previous seven years combined and is in addition to several less intense tropical cyclone landfalls earlier in the season.
- The first storm of the 2024 NW Pacific typhoon season formed on the 23rd May which is the fifth latest start to a typhoon season on record.

Verification of Seasonal Forecasts

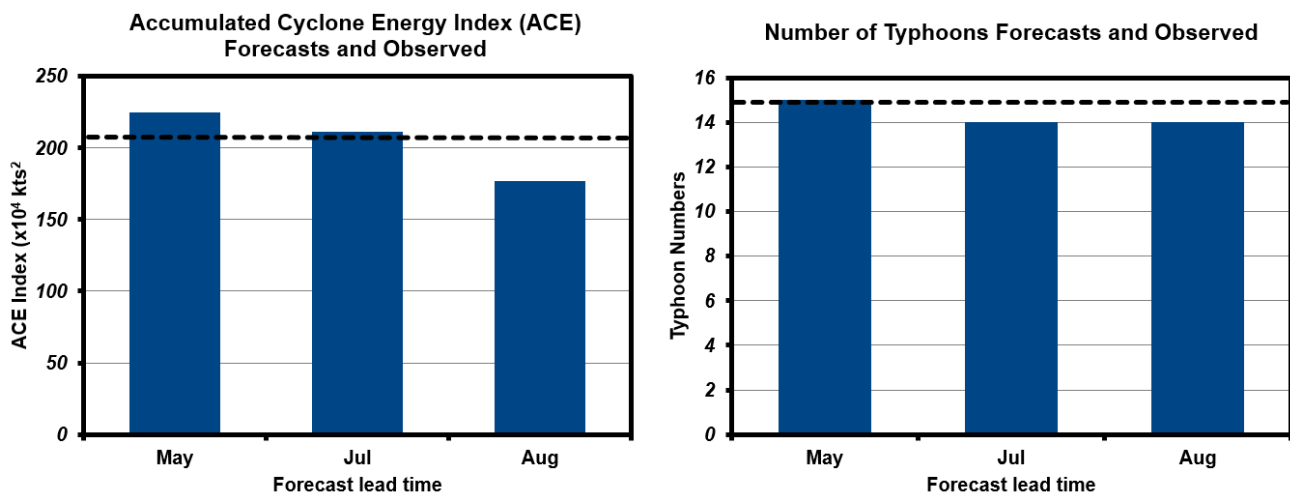


Figure 1: Comparison of forecast ACE index and typhoon numbers compared to observed (black dashed line).

In general, the TSR forecasts verified well in 2024. The forecast for ACE was lowered in August due to number of known inhibiting factors at the time:

1. Very low pre-August activity. Pre-August ACE index is positively correlated (Pearson $r^2=0.52$) with total seasonal ACE index.
2. Forecast development of La Niña conditions through summer and autumn. La Niña conditions tend to result in below-average typhoon seasons and vice-versa for El Niño.
3. A negative Pacific Decadal Oscillation (PDO). The PDO is weakly positively correlated with seasonal typhoon activity; however, if the PDO is negative and La Niña conditions are in place, the PDO tends to enhance the suppressing effect of La Niña.

The forecast La Niña conditions ultimately failed to develop beyond cold-neutral. This could partly explain why the ACE index was under-predicted at this lead time; however, a bigger factor was an unusual burst of typhoon activity from late October through the first half of November, during which several very strong typhoons formed and caused significant impacts in the Philippines, China and Vietnam.

Discussion of active period during late October to mid-November:

Around 30% of the total ACE index in 2024 was generated during November and it was the most active November for ACE since 1992. The large-scale atmospheric winds and atmospheric moisture were somewhat favourable for typhoon activity during this period but not much more than normal. The Madden-Julian Oscillation was in a favourable phase for enhanced activity during the last week of October but not during November. Sea surface temperatures across the basin were warmer than average; however, this is normal during cold-neutral or La Niña conditions, so whilst this may have aided in the intensification of the typhoons that formed, it cannot explain the concentrated surge in activity that occurred over this three-week period. We conclude there is no clear explanation for the burst of typhoon activity from late October to mid-November.

Attribution of active period to climate change:

There has been at least one article published attributing the burst in typhoon activity and subsequent death and destruction across the Philippines, China and Vietnam to anthropogenic climate change and warming sea surface temperatures (SSTs) across the NW Pacific typhoon basin:

<https://www.worldweatherattribution.org/climate-change-supercharged-late-typhoon-season-in-the-philippines-highlighting-the-need-for-resilience-to-consecutive-events/>

Sea surface temperatures across the region where the strong typhoons developed and tracked in late October-November (10° - 20° N, 110° - 130° E) have undergone a warming trend over at least the last few decades, see Figure 2:

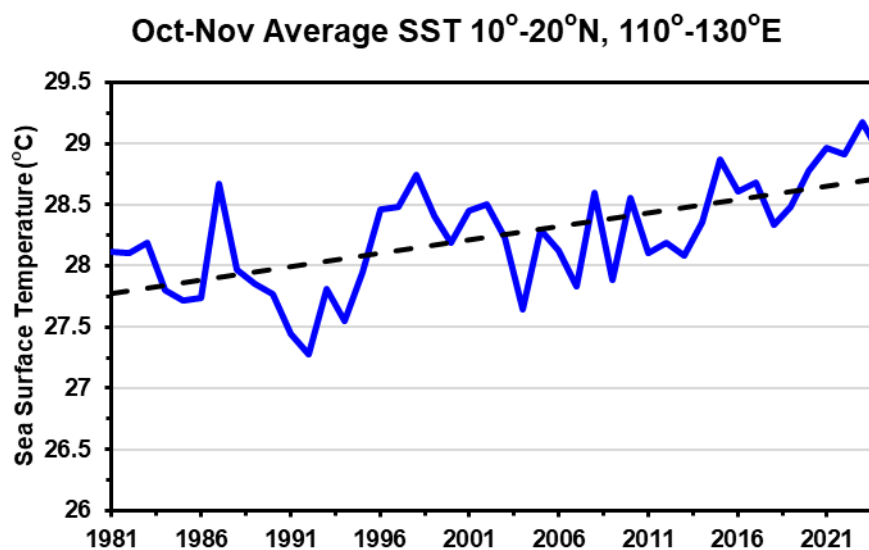


Figure 2: October-November mean sea surface temperature across the region 10° - 20° N, 110° - 130° E over the period 1981-2024 calculated from gridded NOAA OISSTv2 dataset. Dashed line is trend.

It is likely that this warming trend has made intensification of tropical cyclones into strong typhoons more likely and thus is likely to have had some influence on this very active period. However, it cannot fully explain the burst of activity. In October-November 2023, sea surface temperatures were higher than in 2024 yet typhoon activity in those two months was much lower than in 2024, and no typhoons formed in November 2023 despite normally favourable El Niño conditions. It is likely that several favourable atmospheric factors came together in October-November 2024 allowing tropical disturbances to develop into tropical cyclones, which were then able to take advantage of the warmer than average sea surface temperatures and strengthen into powerful typhoons. However, as mentioned previously, it is unknown what these factors were.

Forecasts for 2025

The TSR extended range forecast for the 2025 NW Pacific typhoon season will be issued on the 7th May. Updated TSR outlooks will be issued on the 8th July and the 7th August.