



# Taiwan's Climate in 2023

Central Weather Administration, Taiwan

In 2023, the global mean temperature exceeded the 1901-2000 average by 1.19°C, ranking as the warmest on record since 1880. Taiwan experienced a similar scenario, with the annual mean temperature reaching 24.6°C (1.32°C above average), making 2023 the 7<sup>th</sup> warmest year on record (FIG. 1). Over the last three decades, the temperature in Taiwan has shown an upward trend, increasing at an average rate of 0.27°C per decade, which surpasses the global rate of 0.22°C per decade. Furthermore, the mean temperature of 2023 was above the climatological normal (1901-2000) across many regions of Taiwan, especially in the west (FIG. 2).

Taiwan's annual total precipitation of 2023 reached 1883.5mm, about 87.2% of the climatological median (1991-2000). Precipitation levels were below normal in northern and western Taiwan (FIG. 2), while eastern Taiwan saw above normal precipitation, primarily attributed to typhoons during the summer and autumn (FIG. 3). As a result of the extreme drought conditions between June 2022 and May 2023, more than two-thirds of meteorological weather stations across the country reported annual number of rainy days that was among the 10 lowest on their respective record (FIG. 2).

## Global and Taiwan's Annual Mean Temperatures 1880-2023

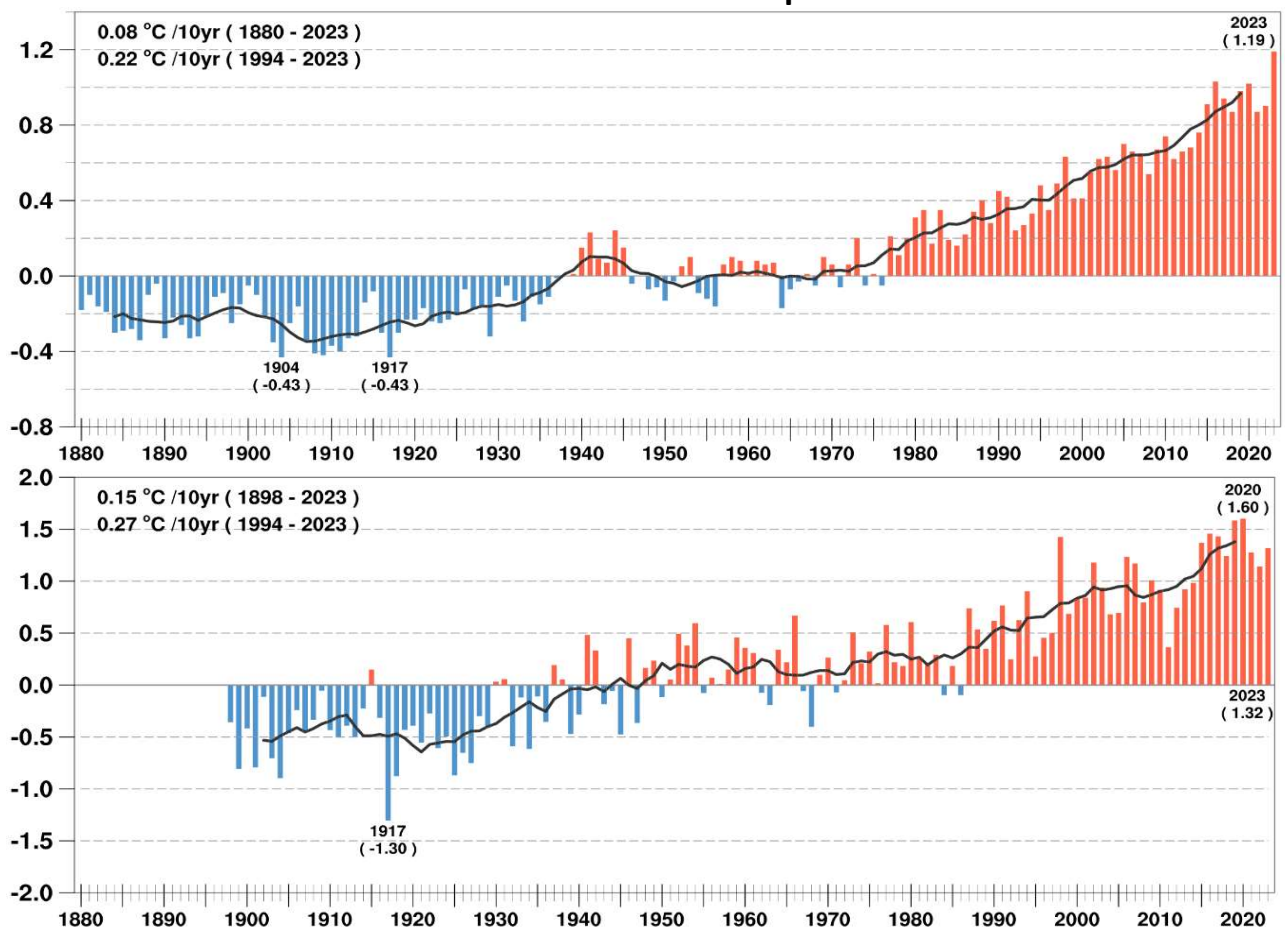
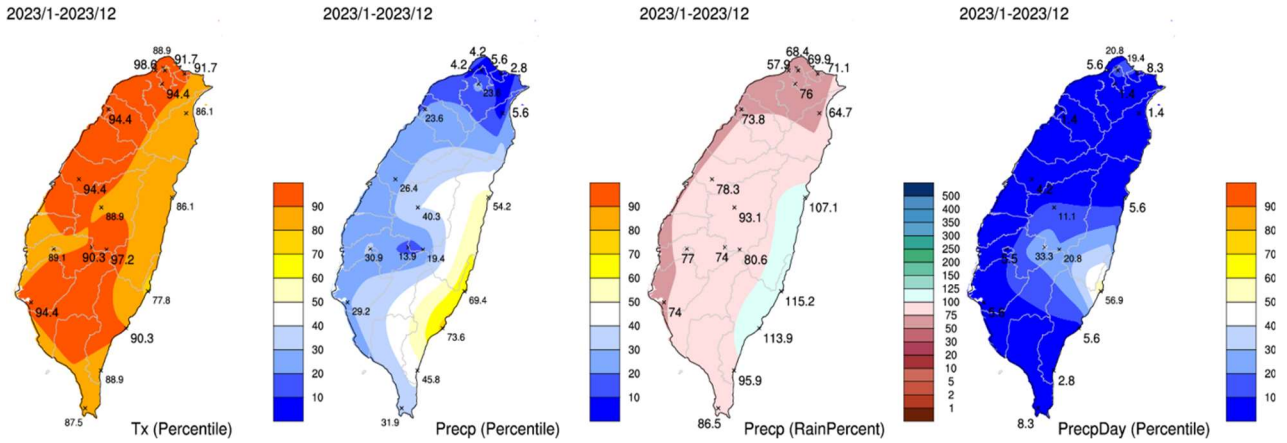
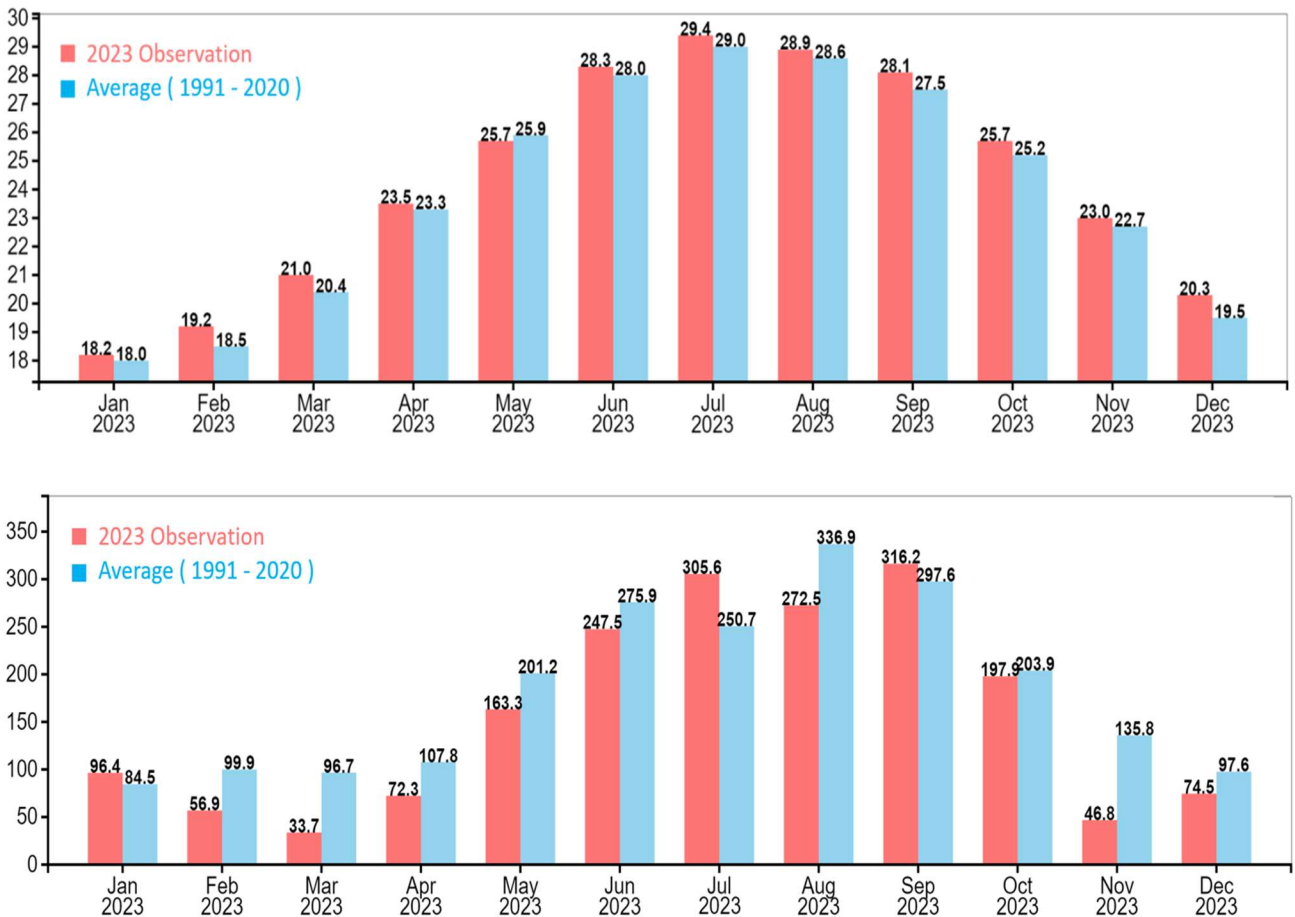


FIG. 1. Global (upper) and Taiwan (lower) long-term annual mean temperature anomalies time series (compared to 1901-2000 average). The solid line shows the 9-year running mean. Taiwan's annual mean temperature is calculated from the average of 6 centennial stations (Taipei, Taichung, Tainan, Hengchun, Hualien and Taitung).

## Annual Mean Temperature and Total Precipitation of Taiwan in 2023



## Monthly Mean Temperature and Precipitation of Taiwan in 2023



# Significant Climate Anomalies and Events in 2023



## Below-normal Number of Rainy Days

Weather alternated between warm and cold in the first half of the year, and was warmer than normal in the second half.

Number of rainy days was the 4<sup>th</sup> lowest on record.



## Below-normal Rainfall in Spring (Feb.-Apr.)

Spring recorded the 5<sup>th</sup> lowest amount of rain and the lowest ever number of rainy days.



## Below-normal to Normal Rainfall in Meiyu Season (May-Jun.)

Temperature was normal in May but warm in June. Yushan Station recorded its highest temperature for this season.



## Significant Rainfall in Summer (Jul.-Aug.)

In July, typhoons, low-pressure belts and strong local convections brought significant rainfall to Taiwan.

In August, typhoon outer circulations caused heavy rain in the mountain areas in eastern, central and southern Taiwan.



## Warm Weather and Unequal Rainfall Distribution in Autumn (Sep.-Nov.)



## Record High Gust Wind during Typhoon KOINU



## Little Rain and High Number of Sunshine Hours in November

In September and October, Typhoons HAIKUI and KOINU caused heavy rainfall in Taiwan in succession.

After 3 years of no typhoon landfall, HAIKUI made landfall in Taiwan in September.

During Typhoon KOINU, LanYu Station saw maximum surface gust wind of 95.2 m/s on Oct. 4, highest ever on its record.



## Less Tropical Cyclogenesis in Western North Pacific

17 tropical cyclones formed over the western North Pacific in 2023, the 2<sup>nd</sup> lowest number since 1958. Only 4 formed in autumn, the lowest number on record.

4 typhoons (DOKSURI, KHANUN, HAIKUI and KOINU) approached Taiwan, which was slightly above the climatological normal.

# Tropical Cyclones

In 2023, a total of 17 tropical cyclones (TCs) formed over the western North Pacific, significantly below the long-term annual average (1991-2020) of 25.4. Warnings were issued for 6 typhoons, and 4 of them (DOKSURI, KHANUN, HAIKUI and KOINU) caused damage to Taiwan (FIG. 4). The total number of tropical cyclones approaching Taiwan in 2023 was slightly above the normal value (3.2), after 9 consecutive years of below-normal numbers (FIG. 5).

**Tropical Cyclone Tracks and Numbers, 2023**

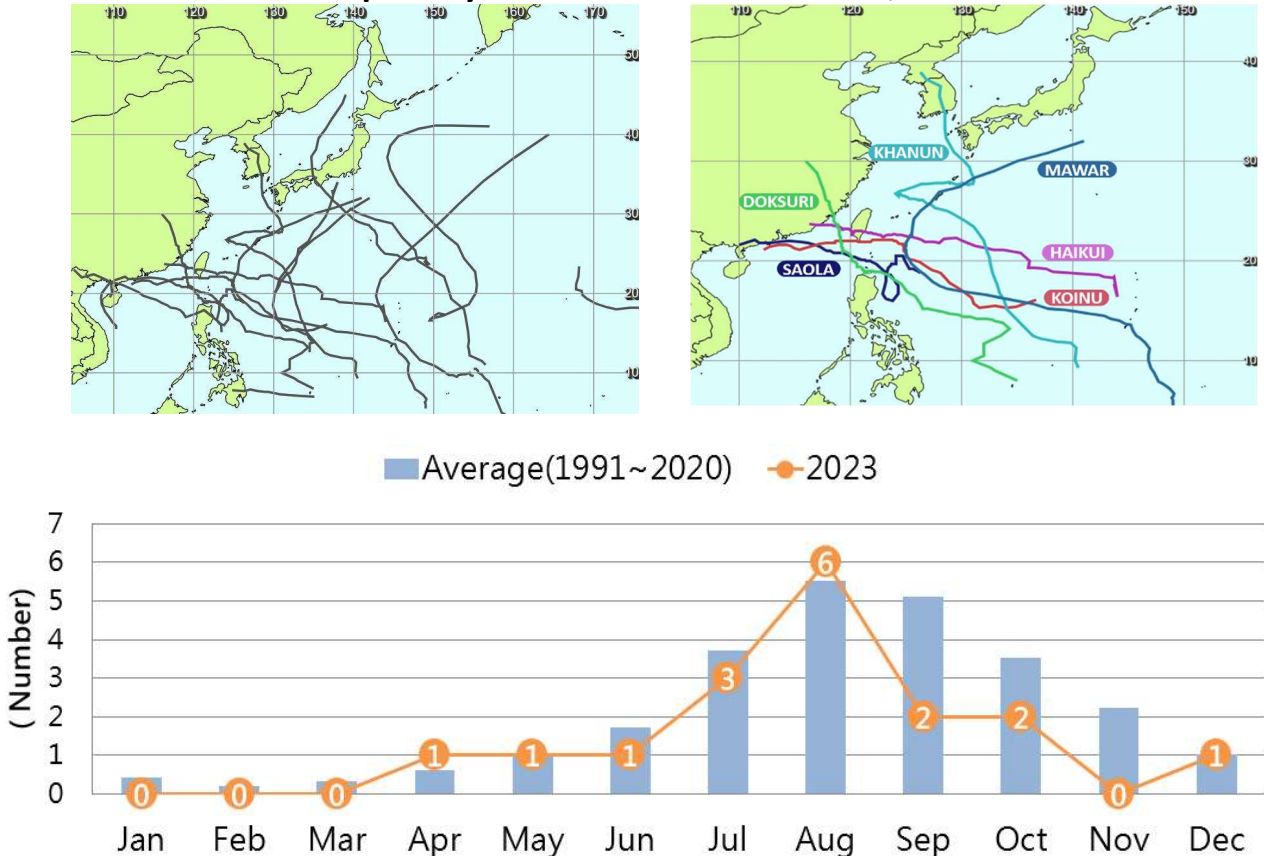


FIG. 4. 17 named TCs tracks over the western North Pacific in 2023 (top left) and 6 for which warnings were issued (top right). Monthly number of named TC formation for 2023 and monthly average calculated over 1991-2020 (bottom).

**Annual Number of Named Tropical Cyclone That Approach Taiwan**

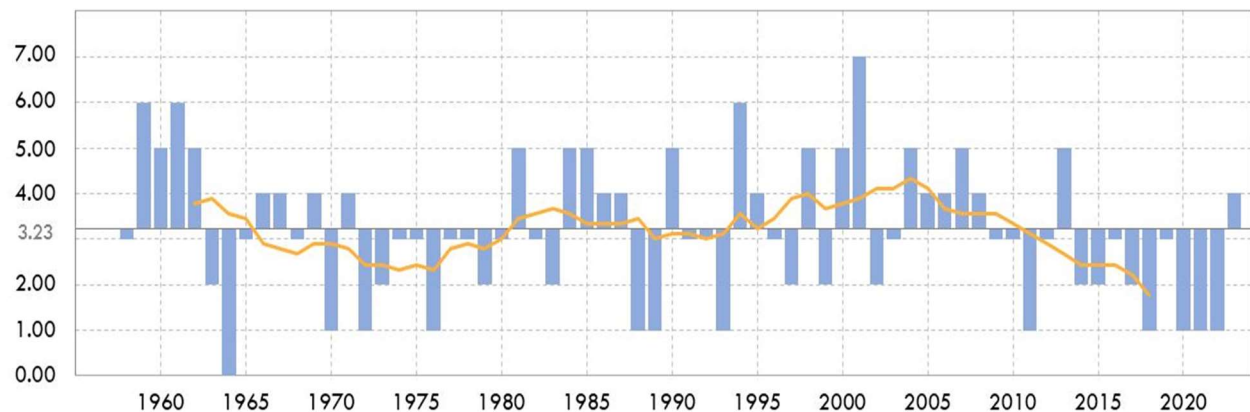


FIG. 5. Annual number of named TCs that approach Taiwan (bar chart) and its 9-year running mean (line graph) since 1958 compared to 1991 -2020 average (3.2).

# Possible Climate Factors of No Typhoon Landfall in Taiwan from 2020 to 2022

FIG. 6 shows the number of typhoons making landfall in Taiwan from 1945 to 2022. Apart from the three-year absence of typhoon landfalls in Taiwan from 2020 to 2022, the other years with no typhoon landfalls in Taiwan include 1946, 1954, 1964, 1972, 1973, 1978, 1983, 1985, and 1993. This accounts for a total of 12 years, constituting 15.4% of the entire 78-year dataset. In terms of consecutive years, there are only two such periods of with no typhoon landfalls, which are 1972 to 1973 and 2020 to 2022, the latter marking the first recorded instance of three consecutive years without typhoon landfalls in the past 78 years.

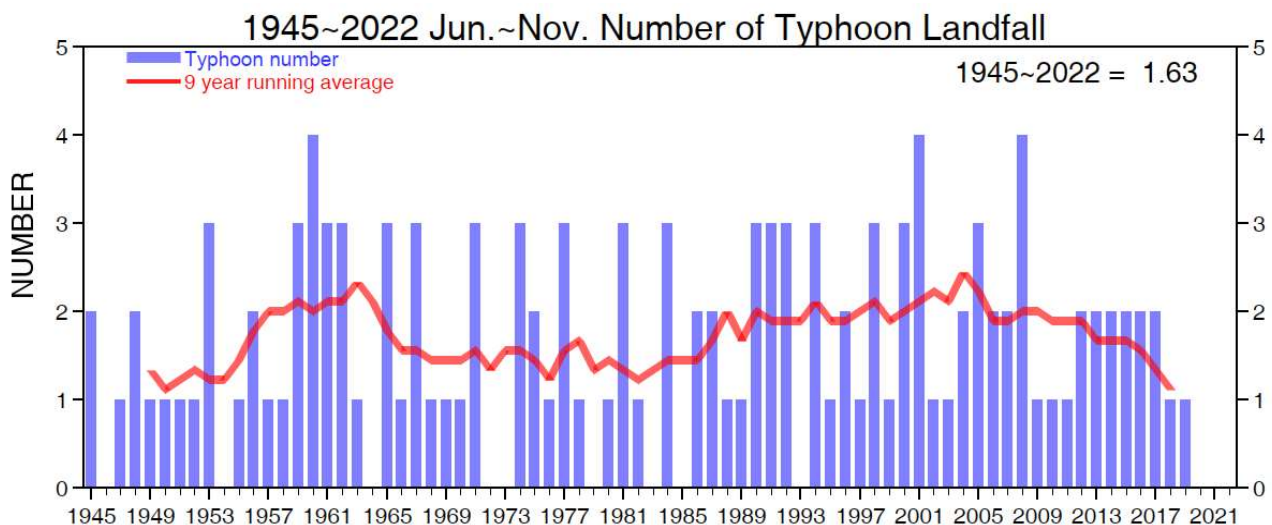


FIG. 6. Time series chart of the number of typhoons making landfall in Taiwan from 1945 to 2022 in June to November. Blue bar indicates the total number typhoons making landfall, red curve shows the 9-year running average, and top right shows the average from 1945 to 2022. Data source: Joint Typhoon Warning Center (JTWC)

The continuous absence of typhoon landfalls in Taiwan from 2020 to 2022 coincided with a three-year period of La Niña. Previous research indicates that La Niña years often involve the strengthening and westward expansion of the western North Pacific Subtropical High. This feature not only leads to less typhoon activity but also causes a slight westward shift in the typhoon's formation location and activity range compared to the climatological distribution. The years 2020 to 2022 exhibited these characteristics of the La Niña events (blue color in FIG. 7). While the climatological average shows the western North Pacific Subtropical High extending westward up to 127°E, in 2020 to 2022 it extended even further west, expanding between 110°E and 120°E (FIG. 8a). This expansion was notably stronger than the climatological average.

In terms of the climatological average of typhoon activity (FIG. 8b), the active range is typically between 10°N and 30°N along the East Asian coast to around 150°E. However, during the three-year period of 2020 to 2022, not only was the active typhoon range smaller, but there were also characteristics of a westward shift in the active positions. Therefore, it is speculated that the La Niña phenomenon in 2020 to 2022 caused the western North Pacific Subtropical High to expand westward, resulting in less active typhoon formation and a westward shift in the typhoon activity range.

In summary, the consecutive La Niña events of 2020 to 2022 strengthened the western North Pacific Subtropical High, reducing typhoon activity. However, individual typhoon tracks are mainly influenced by the current steering flow, allowing them to avoid Taiwan. This suggests that the

absence of typhoon landfalls in Taiwan from 2020 to 2022 might be a coincidental probability, as it is not significantly related to the overall strength of the western North Pacific Subtropical High.

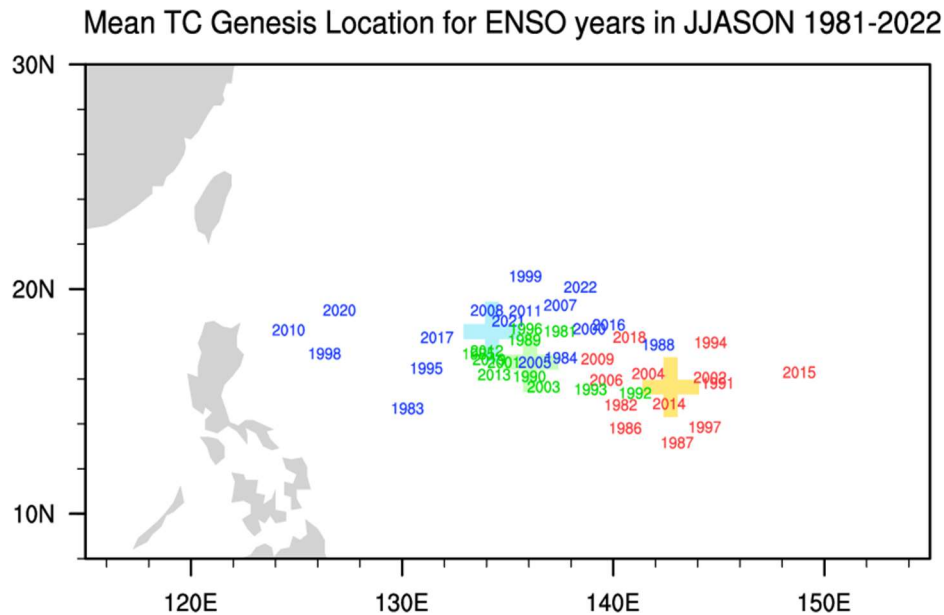


FIG. 7. Average genesis positions of western North Pacific typhoons in June to November during the period of 1981 to 2022. Red, green, and blue numbers represent El Niño, normal, and La Niña years. Orange, light green, and light blue crosses denote the average positions for El Niño, normal, and La Niña years. Data source: Joint Typhoon Warning Center (JTWC)

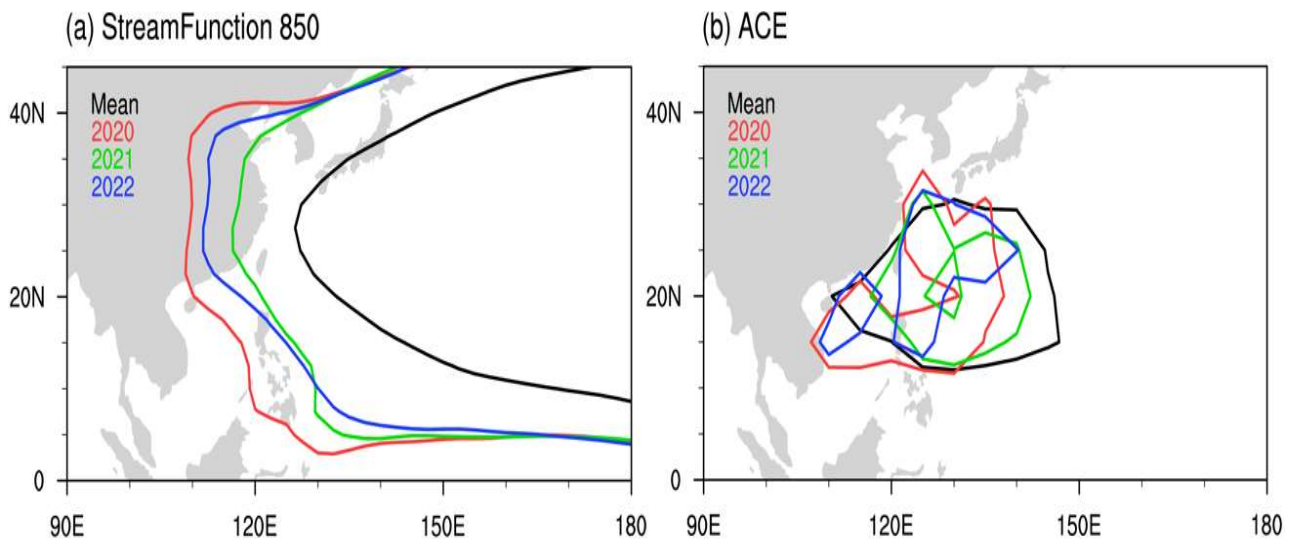


FIG. 8. (a) Shows the range of the western Pacific Subtropical High, based on the 850hPa stream function at  $2 \cdot 10^6 \text{m}^2 \text{h}^{-1}$ , and (b) shows the stronger typhoon activity area, based on ACE at  $10^5 \text{knot}^2$ . The black line represents the average from 1991 to 2020, while the red, green, and blue lines represent the years 2020, 2021, and 2022, respectively.