

A YEAR REVIEW

2023

# CLIMATE & WEATHER

BRUNEI DARUSSALAM

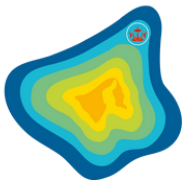
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## 2023 Climate and Weather Review

2023 was Brunei's second warmest year with 0.5°C increase from the long-term average since 1970, after the record high in 2016. This can be attributed to the warming of the climate globally, and also due to the El Niño phenomenon which began to develop by second quarter of 2023. The last three months of the year reached record-breaking highest monthly mean temperature records in the last five decades. A mixture of below-normal and above-normal monthly total rainfall was observed in 2023. This is partly due to the influenced of La Niña conditions during the start of the year and transitioning to El Niño conditions during the second half of the year.

### Temperature

The annual mean temperature in 2023 was 28.5°C, making it the second warmest year on record for Brunei with 0.5°C above the long-term<sup>1</sup> average of 28.0°C. The highest temperature of 2023 was observed on the 24<sup>th</sup> of April with a record of 36.4 °C. At the Brunei International Airport (BIA) climate station, the mean temperature for the last ten years from 2014 to 2023 reached a new high of 27.91°C, 0.11°C above the previous record of 27.79°C for the decade from 2013 to 2022.

In 2023, monthly mean temperatures at the BIA climate station were mainly near or above the long-term average, except for March where below-normal mean temperature was recorded (Figure 1). Eight out of twelve months in 2023 were warmer than their respective long-term monthly mean temperatures, with December (28.9°C) having the highest increase of 1.26°C warmer than the long-term mean. The year's monthly mean temperatures for October, November, and December reached record-breaking highest temperature means since records began in 1970.

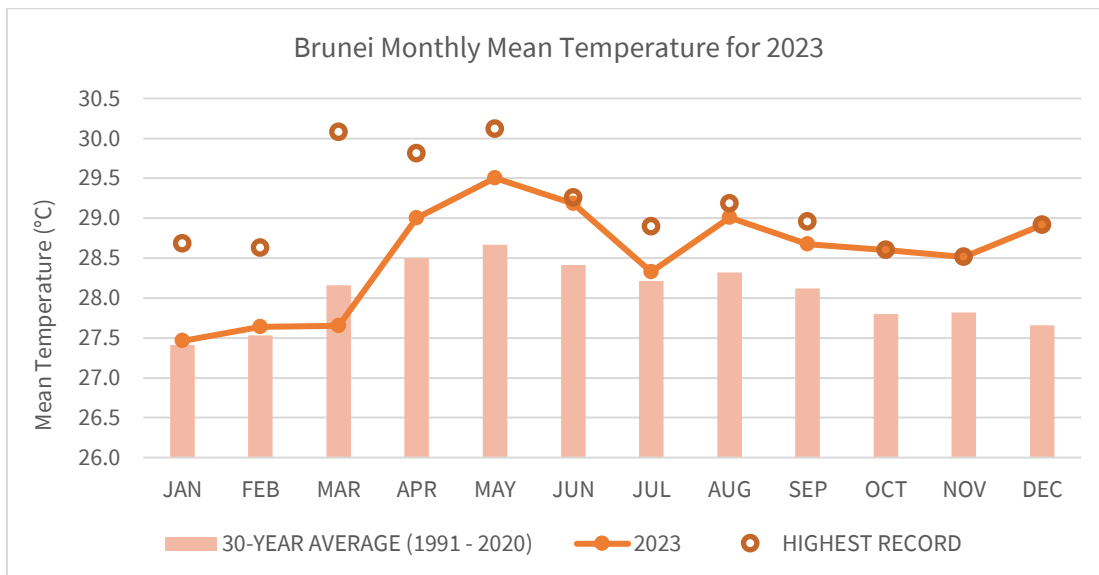


Figure 1 - BIA climate station monthly mean temperature for 2023 (solid line), long-term mean temperature (bars, 1991-2020), and the historical extremes (circle).

<sup>1</sup> This refers to the most recent 30-year reference period from 1991 to 2020.

## Rainfall

Near-average annual total rainfall was recorded at the Brunei International Airport Station in 2023. The annual total of 3121.0 mm is only about 1.80% above the long-term average of 3065.9 mm. The station also observed a total of 221 raindays<sup>2</sup> in 2023, 4.74% above the long-term average of 211 raindays.

A mixture of below-normal and above-normal monthly total rainfall was observed in 2023. Five out of twelve months (April, May, June, August, and December) recorded below-normal monthly total rainfall (Figure 2). The driest month of 2023 was in August with a total rainfall of 76.4 mm, which is about a third of the month's long-term average. It is rare for the year's driest month to fall in August, with previous occurrences in 2011, 1985, and 1981.

Four months in 2023 (February, March, July, and September) recorded above-normal monthly total rainfall (Figure 2). The year's wettest month was in September with a total rainfall of 580.9 mm, which is more than twice the month's long-term average of 235.1 mm. It is not very common for the year's wettest month to fall in September, with previous occurrences in 2010, 2004, 1983, and 1975. September 2023 was the second wettest September on record in Brunei, after the record high of 713.9 mm in September 1983.

The inland areas of Brunei, particularly over Belait and Tutong districts, recorded more total annual rainfall compared to other areas of the country (Figure 3). The annual total rainfall distribution of 2023 was comparable to the long-term average distribution.

The main climate driver that influences Brunei's climate in 2023 was the El Niño Southern Oscillation (ENSO<sup>3</sup>). After three consecutive years of La Niña, the conditions gradually weakened during the start of 2023 and shifted to neutral conditions. By April 2023, El Niño conditions were established and reached its peak by end of the year. El-Niño episode usually bring about drier-than-average conditions for Brunei, while La Niña episode to typically results in wetter-than-average conditions. However, there's still considerable variability from year to year, meaning that not every El Niño or La Niña event will have the same impact on Brunei's rainfall.

Along with El Niño conditions, a positive Indian Ocean Dipole (IOD<sup>4</sup>) was also present in 2023. Positive IOD was established during the third quarter of 2023 and persisted for a number of months before gradually shifting to a neutral phase by the end of 2023. A positive IOD tend to result in drier-than-average conditions over Brunei and the nearby region.

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<sup>2</sup> A rainday is defined as a day with at least 0.1 mm rainfall recorded at the station.

<sup>3</sup> ENSO refers to the recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. El Niño and La Niña are the extreme phases of the ENSO cycle; between these two phases is a third phase called ENSO-neutral.

<sup>4</sup> IOD refers to the difference in sea surface temperature between the tropical western and eastern Indian Ocean. IOD varies between three phases – positive, negative and neutral.

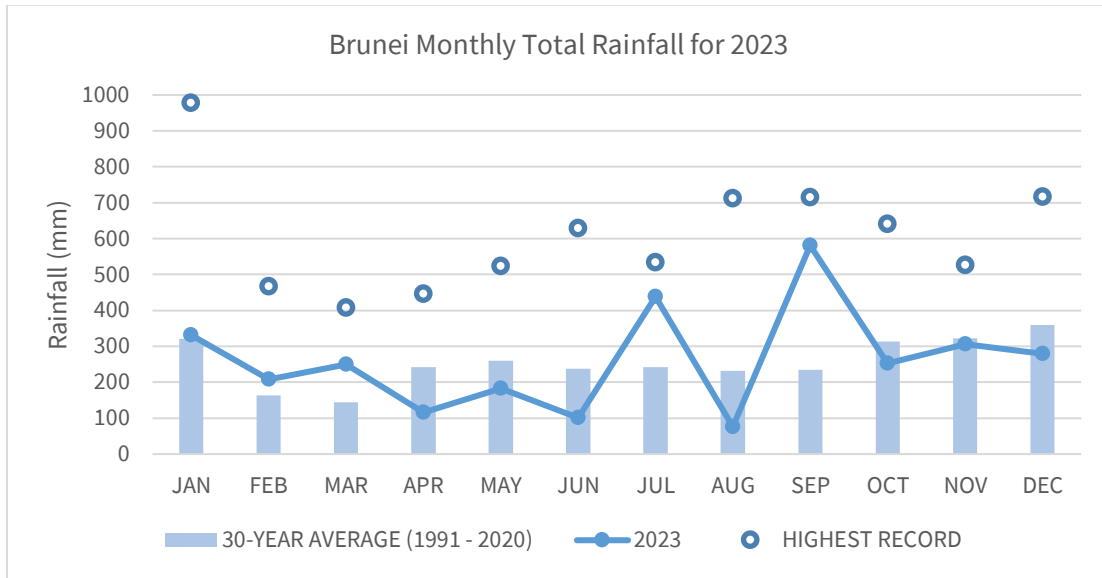


Figure 2 - BIA climate station monthly total rainfall for 2023 (solid line), long-term mean monthly rainfall (bars, 1991-2020), and the historical extremes (circle).

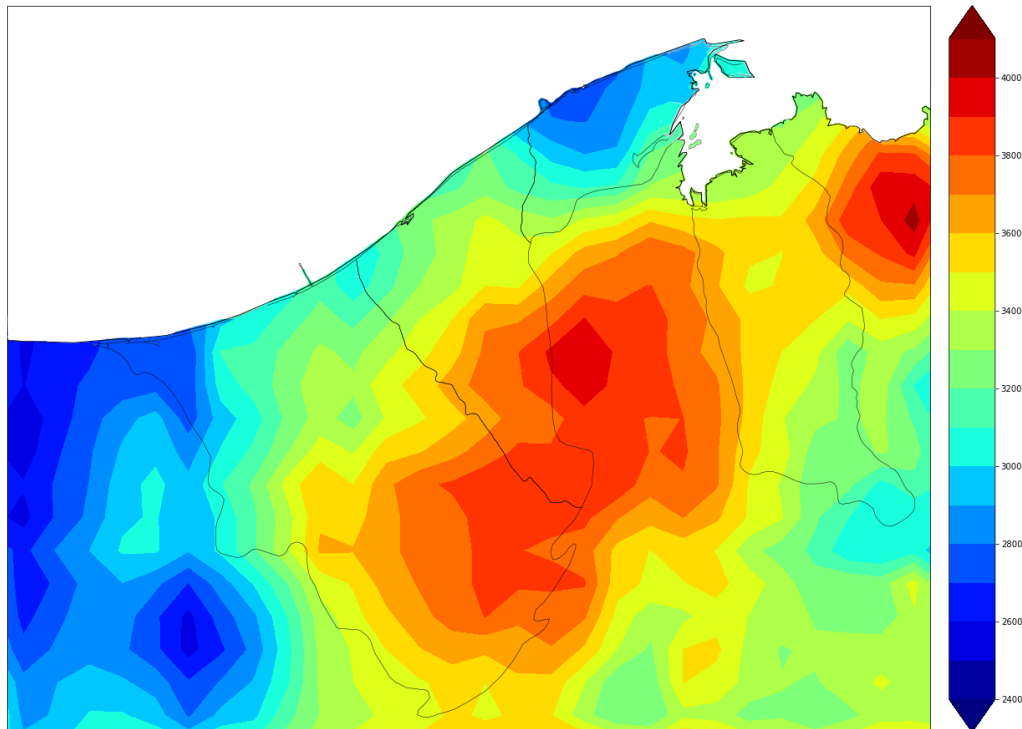


Figure 3 – Annual total rainfall distribution for Brunei (data source: Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS), processed by DSNP)

## Weather Extreme in 2023

	2023	Historical Extremes*
<b>Hottest Day (°C)</b>	36.4 °C 24th April	38.0 °C 28th March 1983
<b>Coollest Day (°C)</b>	21.2 °C 8th March	18.4 °C 13th January 1985
<b>Warmest Month (°C)</b>	29.5 °C May	30.1 °C March 1998
<b>Coollest Month (°C)</b>	27.5 °C January	25.8 °C January 1972
<b>Wettest Day (mm)</b>	126.7 mm 31st December	275.0 mm 30th September 2019
<b>Wettest Month (mm)</b>	580.9 mm September	977.0 mm January 2009
<b>Driest Month (mm)</b>	76.4 mm August	<0.1 mm March 1998

\*Temperature records since 1970; Rainfall records since 1969

Table 1 - Temperature and rainfall extremes recorded at the BIA climate station in 2023, and the corresponding historical extremes.

## Notable Weather Events in 2023

### Wettest September in More Than a Decade

September 2023 was the wettest September since 2010 and was the wettest month of the year 2023. The wet weather in September was mainly triggered by the active development of tropical storms, namely Violent Typhoon Saola, Very Strong Typhoon Haikui, and tropical storms Kirogi and Yun-yeung.

On 18 September, a total of 113.9 mm of rainfall is recorded, making it the wettest day of the month. Northeasterly and easterly winds converged over Brunei, resulting in unsettled weather conditions. Satellite imagery (Figure 4) on this day shows dense convective clouds around the northeast region of Borneo, where a nearby low pressure area was identified over the Sulu Basin. Widespread thunderstorms were affecting many areas of the country during the early hours of the day (Figure 5). This day was the fifth wettest September day, with the wettest being on the 30th September 2019 with a value of 275.0mm since records began in 1969.

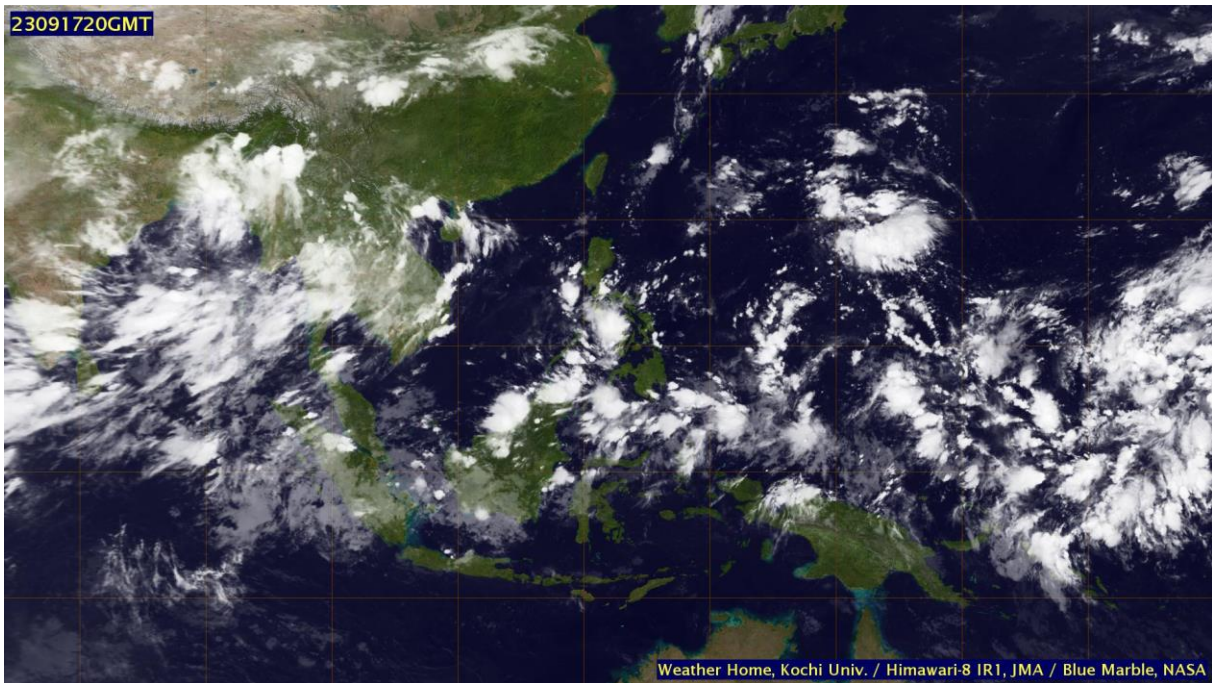


Figure 4 - Satellite Imagery on the 18 September 2023 at 8pm, showing dense convective clouds over Brunei and Sabah. (source: Kochi University / Himawari-8, JMA)

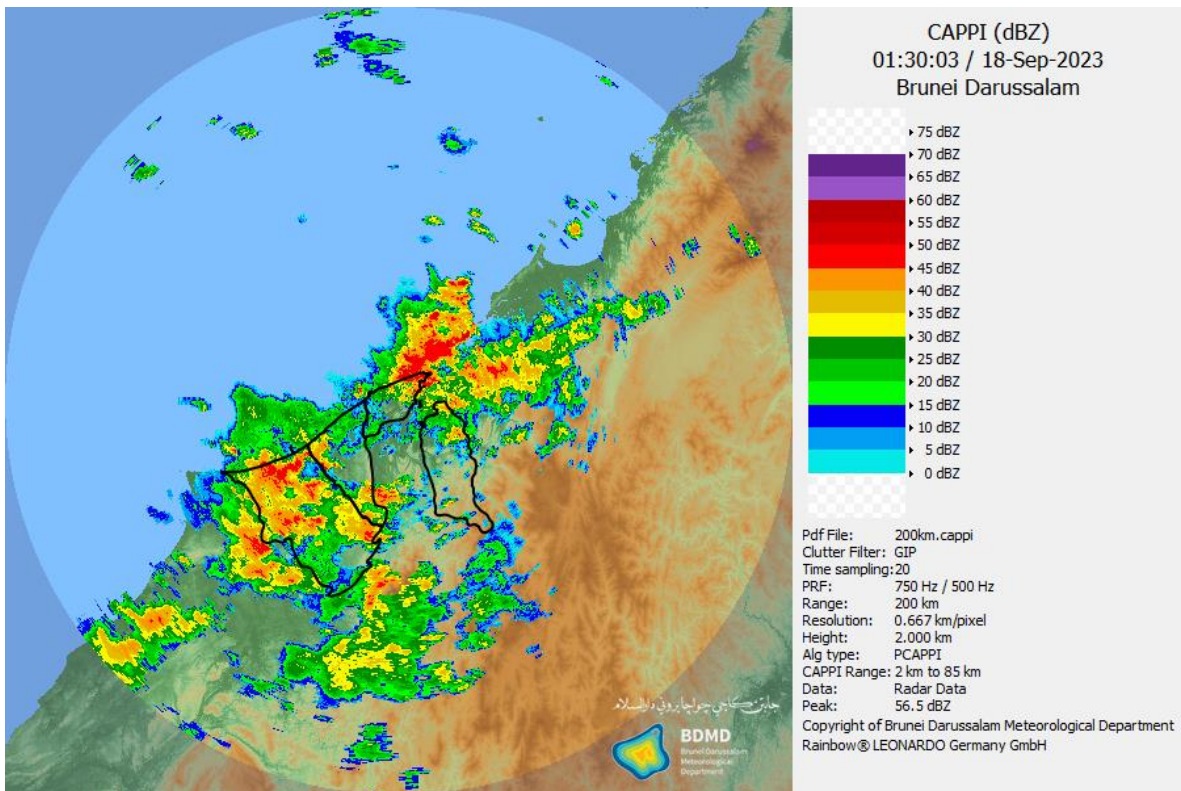


Figure 5 – Weather radar image at 1.30 am in the early morning of 18 September 2023, showing scattered heavy thunderstorms over many areas of the country.

## Wettest Day in 2023

Wettest day recorded in 2023 was on the last day of the year, 31st December, with a value of 126.7 mm. An active Intertropical Convergence Zone (ITCZ) was observed on this day where low pressure areas were identified around the Equator line, combined with a northeasterly surge over the South China Sea (Figure 6). Thunderstorms were affecting many areas of the country, particularly in the Brunei Muara district, during New Year's Eve (Figure 7). The final day of 2023 recorded more than one third of the long-term average rainfall of the month of December.

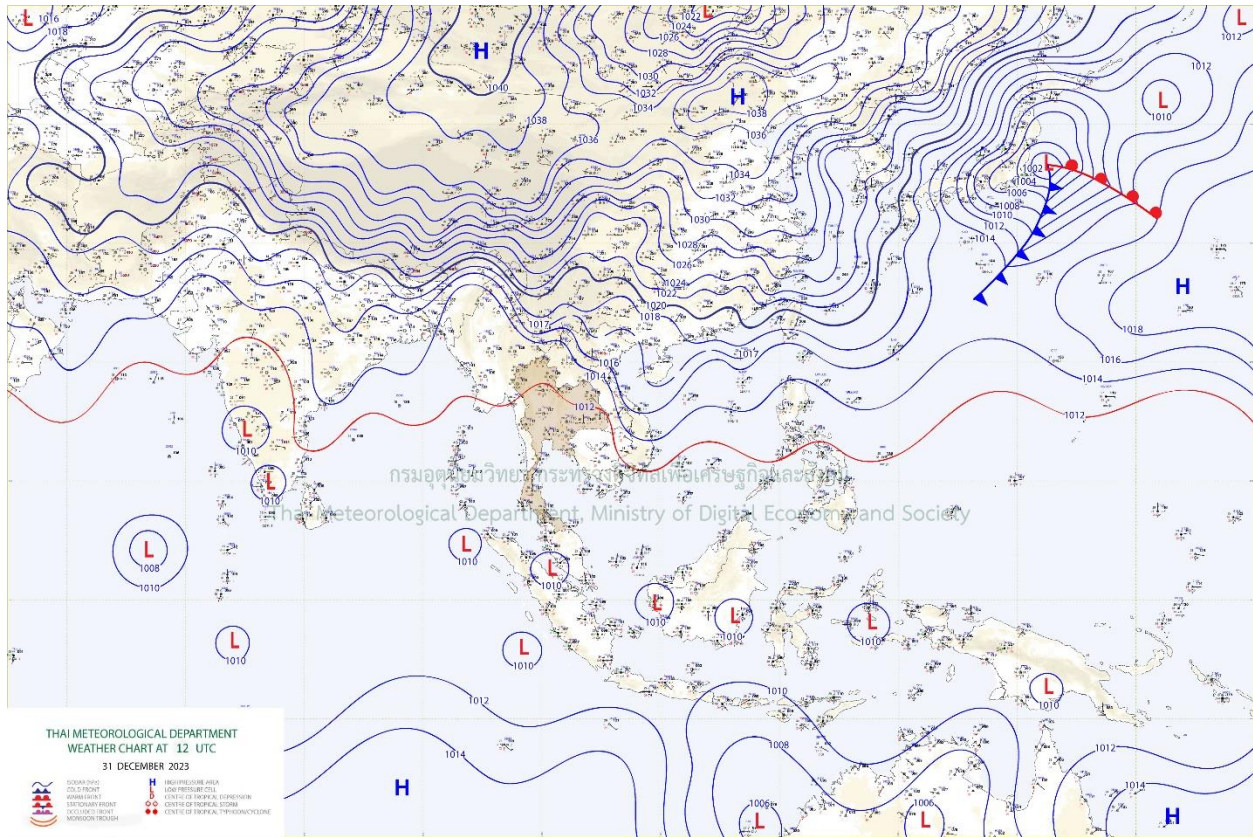


Figure 6 – Surface weather chart on the 31 December 2023 at 8 pm, showing several low pressure systems around the equatorial region and cold surge coming from northern Asia towards South China Sea which gave the persistent northeasterly wind over the region (source: Thailand Meteorological Department).

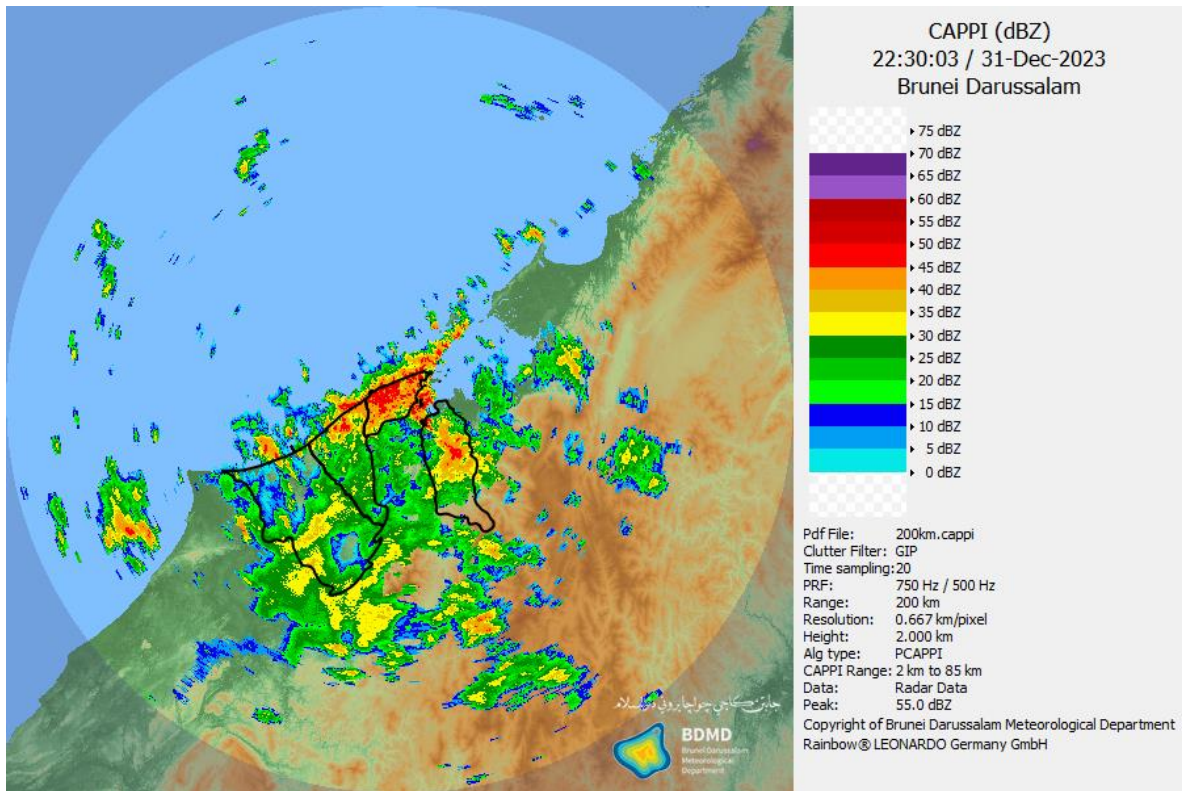


Figure 7 – Weather radar image at 10.30 pm during the New Year’s Eve of 31 December 2023, showing widespread heavy thunderstorms over many areas of the country.

### Warmest Month of The Year

Long-term average indicates that May is typically the warmest month of the year. In 2023, May was the warmest month with an average temperature of 29.5°C, with an increase of 0.84°C warmer than the long-term mean (28.7°C). 16 out of 31 days in May 2023 recorded temperatures of more than or equal to 34°C, which is considered as unusually hot day.