2022 Climate and Weather: The Year in Review

2022 was Singapore's sixth wettest year since 1980 with an average annual total rainfall of 3012 mm[1]. This is nearly 19% higher than the long-term 1991 – 2020 average. Rainfall for most months was above average, with October 2022 recording the highest October total rainfall in the last four decades. The higher-than-average total rainfall in 2022 was partly influenced by prevailing La Niña conditions along with a negative Indian Ocean Dipole. Despite the high rainfall, Singapore's annual mean temperature in 2022 was the tenth highest since temperature records began in 1929, tied with five other years.

Temperature

At the Changi climate station, mean temperature for the last ten years from 2013 to 2022 reached a new high of 28.01°C, 0.04°C above the previous record of 27.97°C for the decade from 2012 to 2021. The annual mean temperature in 2022 was 27.9°C, 0.1°C above the long-term[2] average of 27.8°C. Similar to 2021, 2022 was the tenth warmest year since temperature records began in 1929 (tied with 2021, 2018, 2014, 2009 and 2004). Islandwide, the year's highest temperature of 36.8°C at Admiralty on 1 April was the second highest recorded temperature for Singapore, after the record high of 37.0°C at Tengah in April 1983.

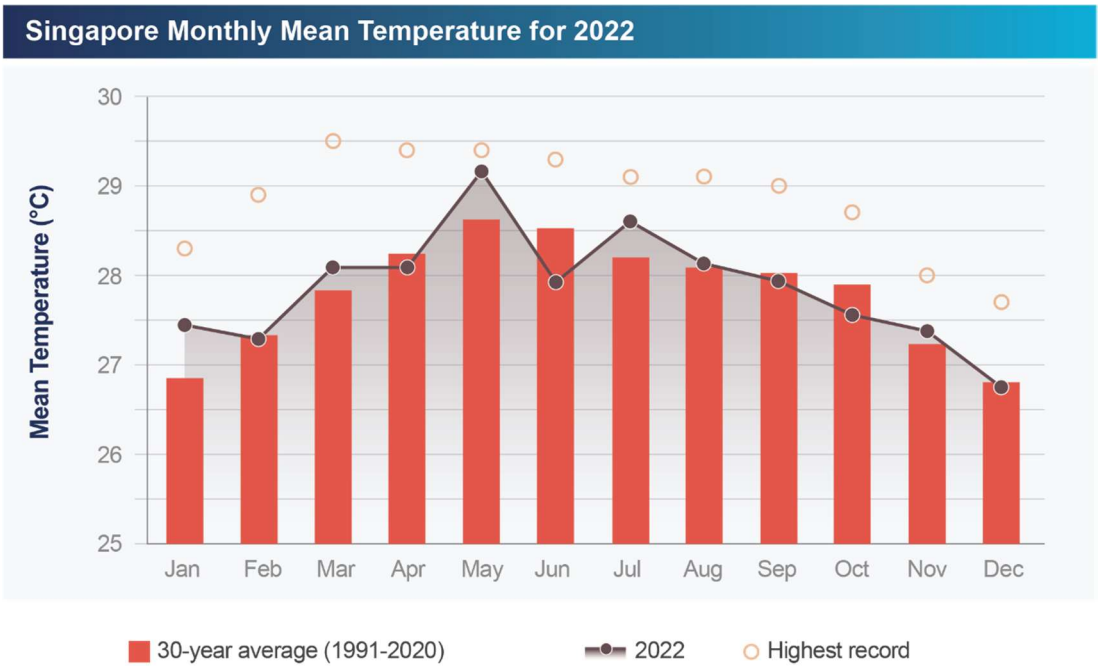

Figure 1: Changi climate station monthly mean temperature for 2022 (solid line), long-term average (bars, 199 1– 2020) and the corresponding historical extremes (circle).

[1] Singapore average rainfall is calculated based on 32 stations across the island with continuous rainfall records since 1980.

[2] This refers to the most recent 30-year reference period from 1991 to 2020.

In 2022, monthly mean temperatures at the Changi climate station were mainly near or above the long-term average (Figure 1). In particular, January (27.4°C) and May (29.2°C) were both 0.6°C warmer than their respective long-term monthly mean temperatures and ranked the sixth and fifth warmest of the respective months since temperature records began in 1929. The notably warmer-than-average conditions were associated with well below-average rainfall in these months (see Figure 3 below).

June and October were 0.6°C and 0.3°C cooler than their respective long-term monthly mean temperatures, making them the coolest June and October in the past 10 years.

Rainfall

Higher-than-average annual total rainfall was recorded at most of the islandwide[3] stations in 2022. The annual total rainfall averaged across these stations (3012.0 mm) is 18.8% above the long-term average of 2534.3 mm. This ranks 2022 as the sixth wettest year since 1980. The Changi climate station recorded 2207.8 mm of rainfall for the year, which is 4.5% above its long-term annual average of 2113.3 mm. The station also observed a total of 210 raindays[4] in 2022, the third highest number of annual raindays on record after the record high of 222 set in 1973 and 1927.

Based on the islandwide average, above-average monthly total rainfall was recorded in nine months of 2022. Six of these months were among the top 10 wettest for their respective months since 1980 (Figure 2). The year's wettest month was October, with total rainfall of 412.0 mm which is about twice the month's long-term average. It is not common for the year's wettest month to fall in October, with the previous occurrence in 1985. October 2022's rainfall of 412.0 mm exceeds the previous October high of 389.3 mm in 2011, making October 2022 the wettest October in the last four decades.

La Niña conditions prevailed throughout 2022, although weakening temporarily during the middle of the year. Based on historical observations, La Niña events tend to have the strongest effect on Singapore's rainfall during the Southwest Monsoon season and the weakest effect during the Northeast Monsoon season.

Along with La Niña conditions, a negative Indian Ocean Dipole (IOD[5]) was also present in 2022. In the second quarter of 2022, there were signs of a negative IOD developing, with the negative IOD established by the middle of the year. This negative IOD persisted for a number of months before returning to a neutral phase by the end of 2022. A negative IOD typically results in wetter-than-average conditions over Singapore and the nearby region.

[3] The 32 stations with continuous rainfall records starting from 1980.

[4] A rainday is defined as a day with 0.2 mm rainfall recorded at a rainfall station.

[5] The IOD refers to a sustained change in the difference between sea surface temperatures (SSTs) in the tropical western and eastern Indian Ocean. The IOD varies between three phases – positive, negative, and neutral.

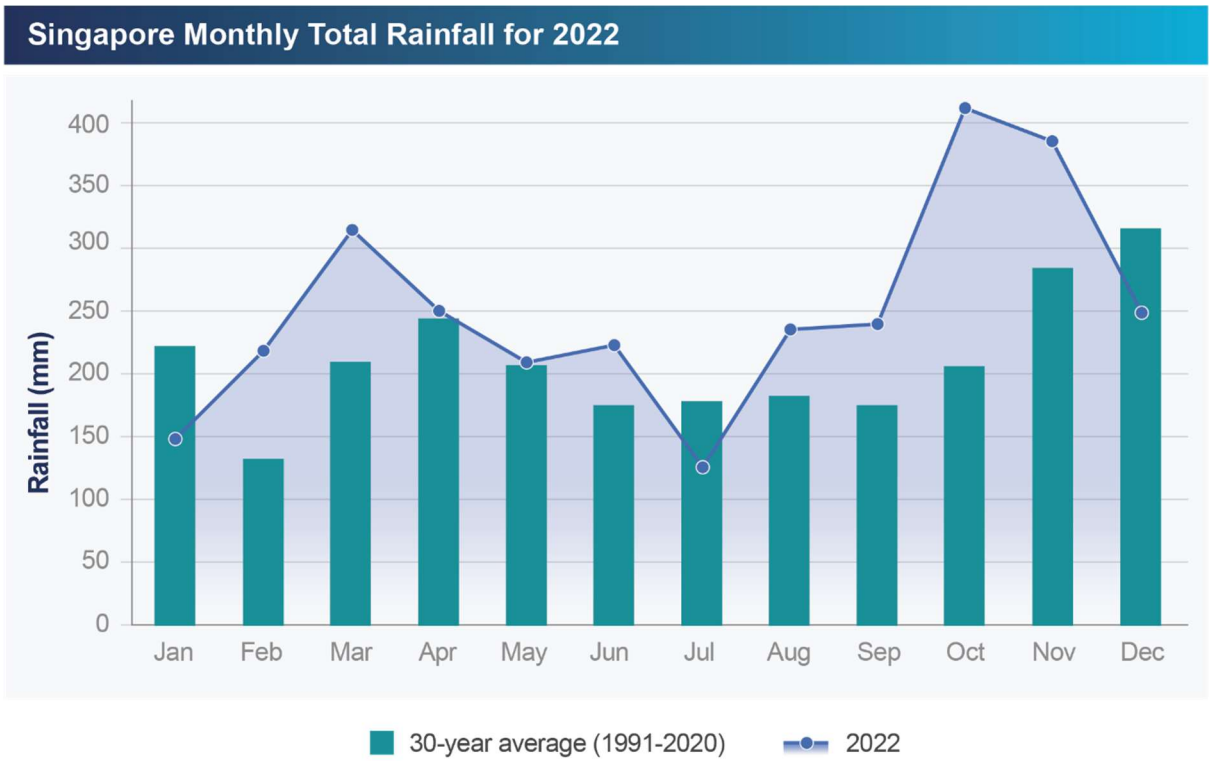

Figure 2: Singapore average monthly total rainfall for 2022 (solid line) and long-term average (bars, 1991 – 2020). The average annual total rainfall of 3012.0 mm for 2022 is 18.8% above the long-term annual average of 2534.3 mm.

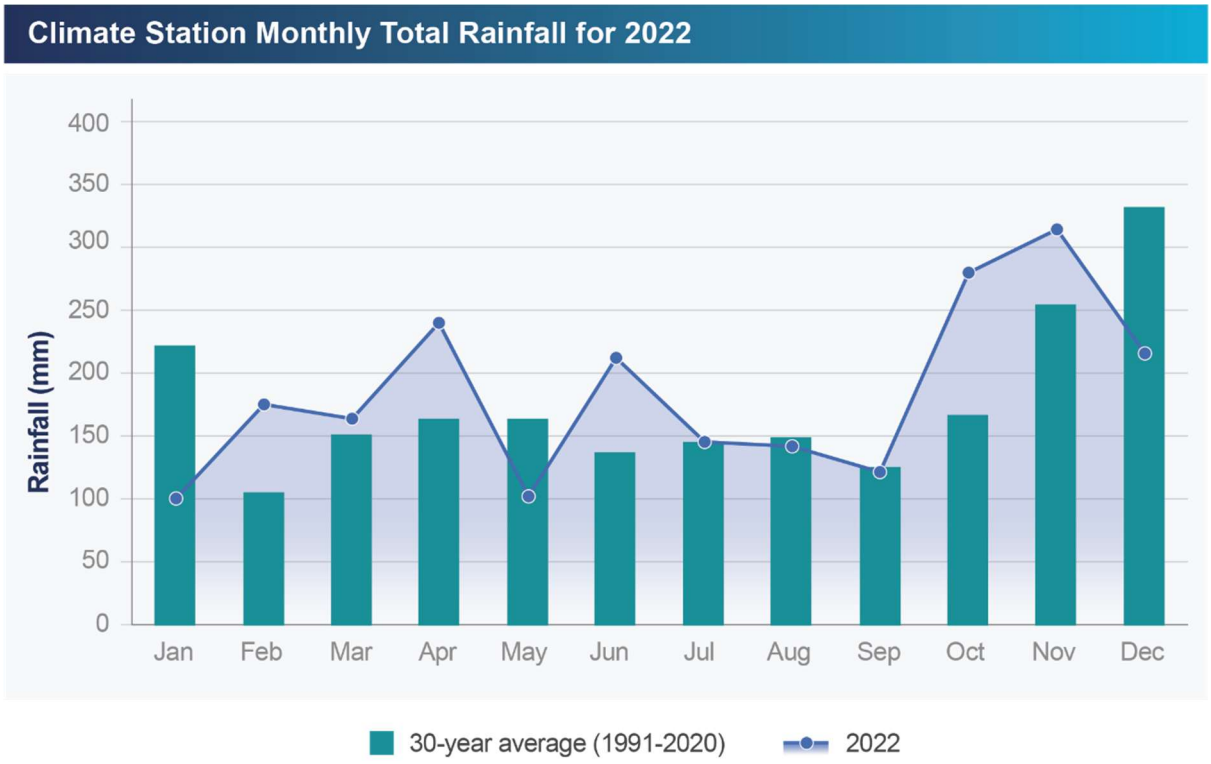

Figure 3: Changi monthly total rainfall for 2020 (solid line) and long-term average (bars, 1991 – 2020). The annual total rainfall of 2207.8 mm for 2022 is 4.5% above the long-term annual average of 2113.3 mm.

Weather Extremes in 2022

Figure 4: Extreme weather records based on all available stations in 2022.

	Climate Station Records	
	2022	**Historical Extremes***
Hottest Day *(°C)*	35.4 29 May	**36.0** 26 Mar 1998
Coolest Day *(°C)*	22.2 20 Jul	**19.4** 30 – 31 Jan 1934
Warmest Month *(°C)*	29.2 May	**29.5** Mar 1998
Coolest Month *(°C)*	26.8 Dec	**24.2** Jan 1934
Wettest Day *(mm)*	59.4 3 Jun	**512.4** 2 Dec 1978
Wettest Month *(mm)*	313.8 Nov	**818.6** Jan 1893
Driest Month *(mm)*	99.8 Jan	**0.2** Feb 2014
Strongest Wind Gust *(km/h)*	57.4 17 Apr	**90.7** 29 Nov 2010

**Rainfall records since 1869; temperature records since 1929; wind records since 1984*

Table 1: Temperature, rainfall and wind extremes recorded at the climate station in 2022 and the corresponding historical extremes.

Notable Weather Events in 2022

Wettest March In Almost 15 Years

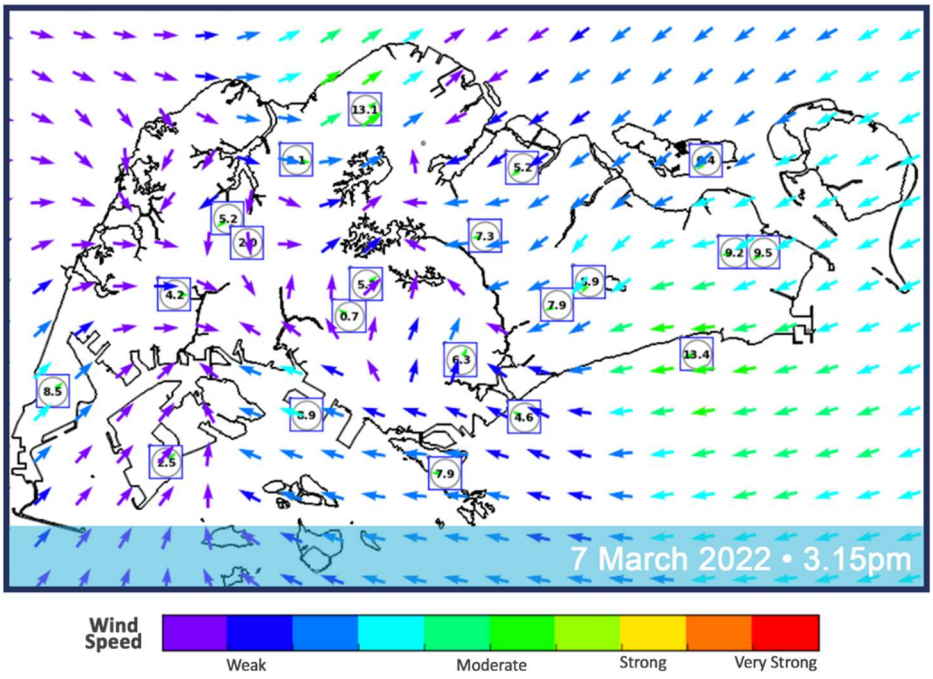

Figure 5: Convergence of winds over Singapore on 7 March 2022 led to the formation of thunderstorms.

March 2022 was the wettest March since 2009 and among the wettest months of 2022, with most parts of the island receiving above-average rainfall. The wet weather in March 2022 was mainly triggered by strong solar heating of land areas coupled with convergence of winds over the island (Figure 5).

Figure 6. Storm clouds forming over southwestern Singapore on 7 March 2022 (photo courtesy of Edward Yip).

On 7 March, heavy thundery showers fell in the late afternoon and evening, particularly over southern and western Singapore (Figures 6 and 7) where flash floods were reported in some areas including Jurong West. With a highest daily total rainfall of 134.2 mm recorded at Jurong West, this was the second wettest March day in the last 10 years.

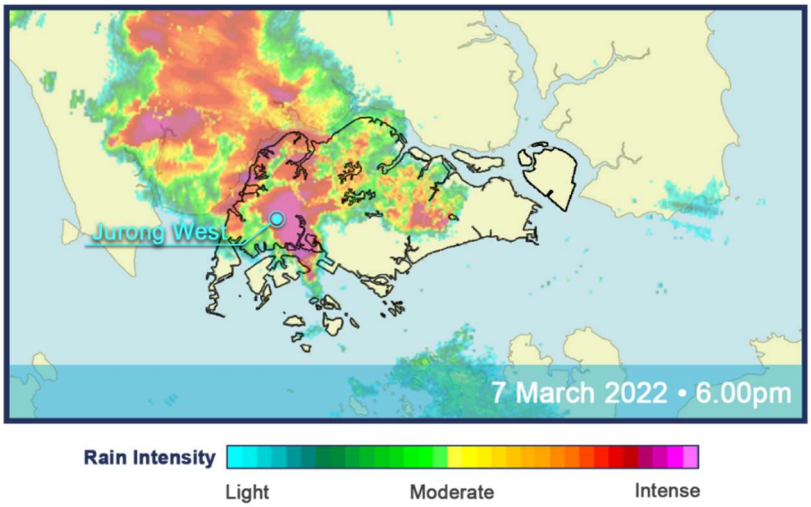

Figure 7. Weather radar image at 6pm on 7 March 2022 showing the formation of heavy thunderstorms over western Singapore.

Scorching May Breaks Temperature Records

May is statistically among Singapore's warmest months of the year, and May 2022 was no exception. While Singapore's average rainfall for the month was near the long-term average, there were 11 days with little or no rain. In the second half of the month, the presence of dry air over equatorial Southeast Asia (Figure 8) coincided with the dry phase of the Madden-Julian Oscillation, which resulted in very warm weather over Singapore. Daily maximum temperatures exceeded 34.0°C on 22 days in May, and of these, the temperatures exceeded 35.0°C on 13 days.

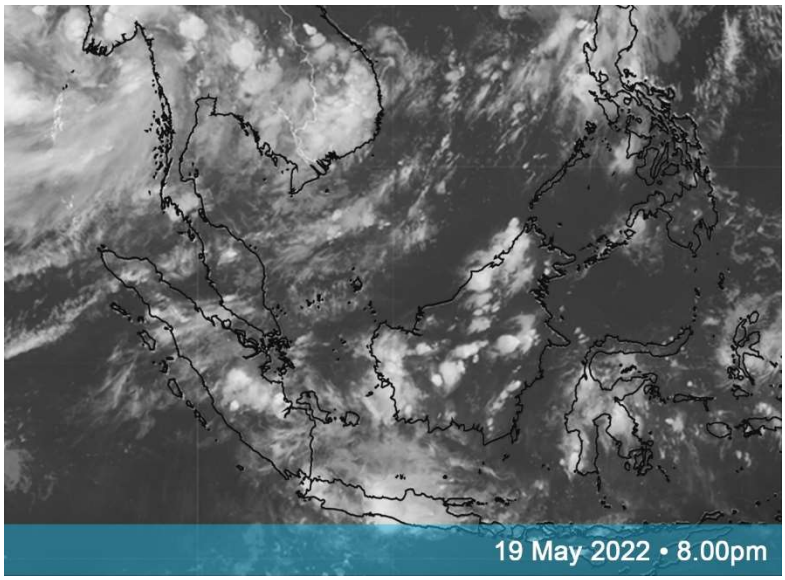

Figure 8: Satellite imagery on 19 May 2022 showing drier weather and clear skies over Singapore and its vicinity.

The dry and warm weather led to new temperature records for May. On 13 May, the highest daily maximum temperature of 36.7°C was recorded at Admiralty, the warmest day in May on record and surpassing the previous high of 36.5°C on 16 May 2010 and 3 May 2016. The highest daily minimum temperature of 29.5°C was recorded at East Coast Park on 18 May, 0.1°C above the previous high on 10 May 2016 and 9 May 2018. On 29 May, the Changi climate station recorded a maximum temperature of 35.4°C, tying the record on 1 May 2005 for the warmest day in May at the climate station.

Wettest October in Four Decades

October 2022 was exceptionally wet, with a high number (11) of Sumatra squalls affecting Singapore. There were several tropical cyclones that formed in the South China Sea and western Pacific Ocean during the month. The large-scale convergence of winds in the region associated with these tropical cyclones is conducive to the formation of Sumatra squalls, which often bring widespread showers and gusty winds to Singapore in the predawn hours and morning. For one such occurrence on 5 October (Figure 10), daily total rainfall of 138.1 mm was recorded at Pasir Panjang, the highest for the month.

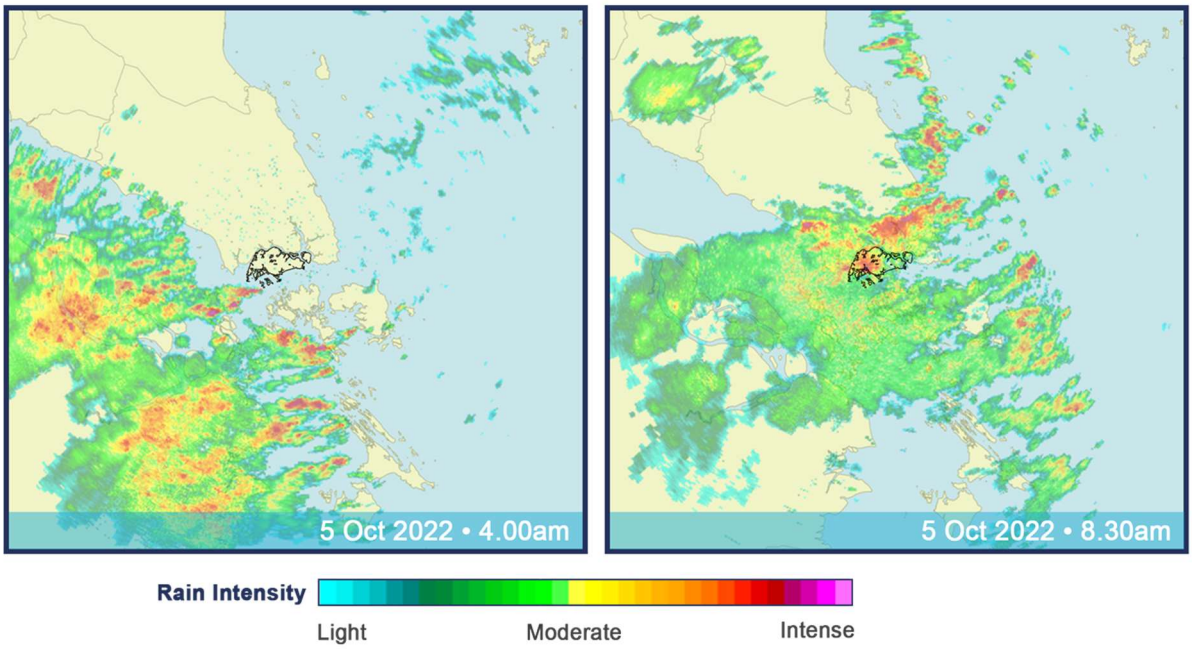

Figure 9: Weather radar images showing an organised line of thunderstorms from a Sumatra squall moving eastward toward Singapore (left) and bringing widespread thundery showers to the island (right) on 5 October 2022.

Overall, all parts of Singapore received well above-average rainfall (Figure 10), with the Kent Ridge station reporting more than three times its long-term average. Singapore's average rainfall for the month was 412.0 mm, making October 2022 the wettest October in the past four decades (Figure 11). At the Changi climate station there were 27 raindays, which exceeded the previous record of 23 for the month of October.

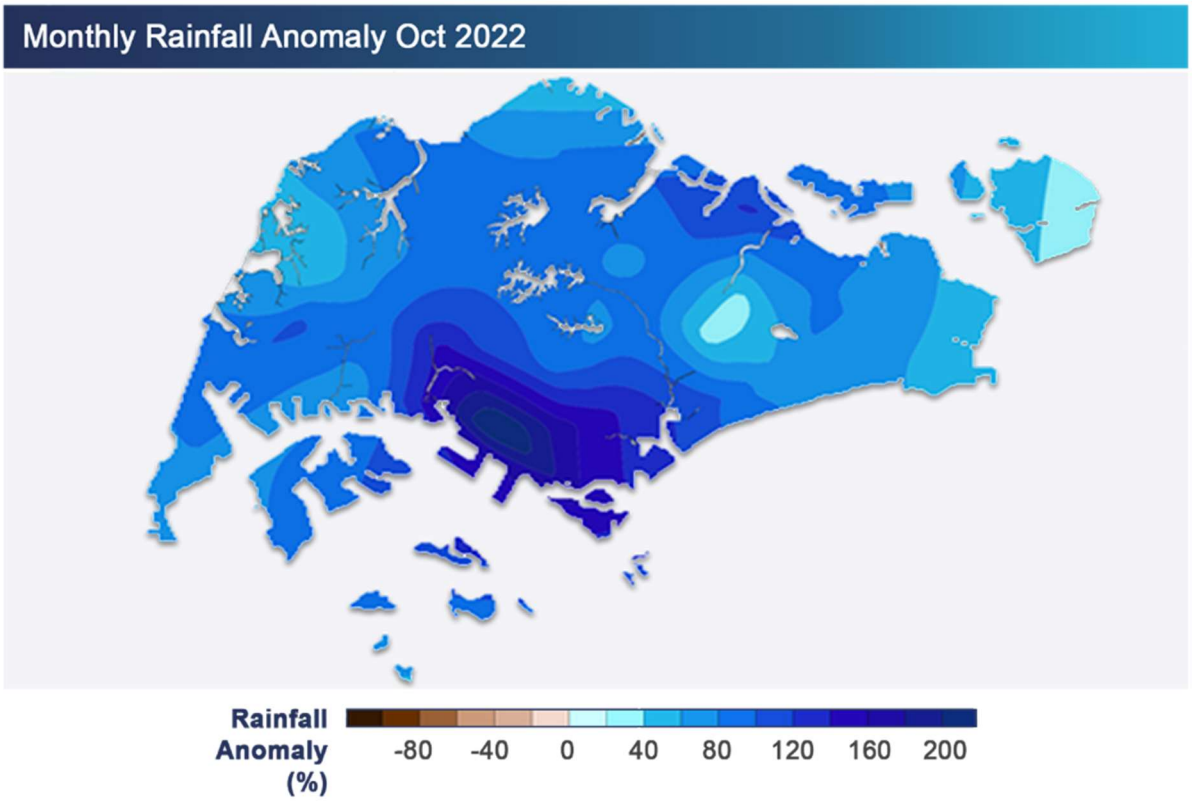

Figure 10: October 2022 is one of two months in 2022 where well above-average rainfall was recorded at every rainfall station across the island (the other month is February 2022).

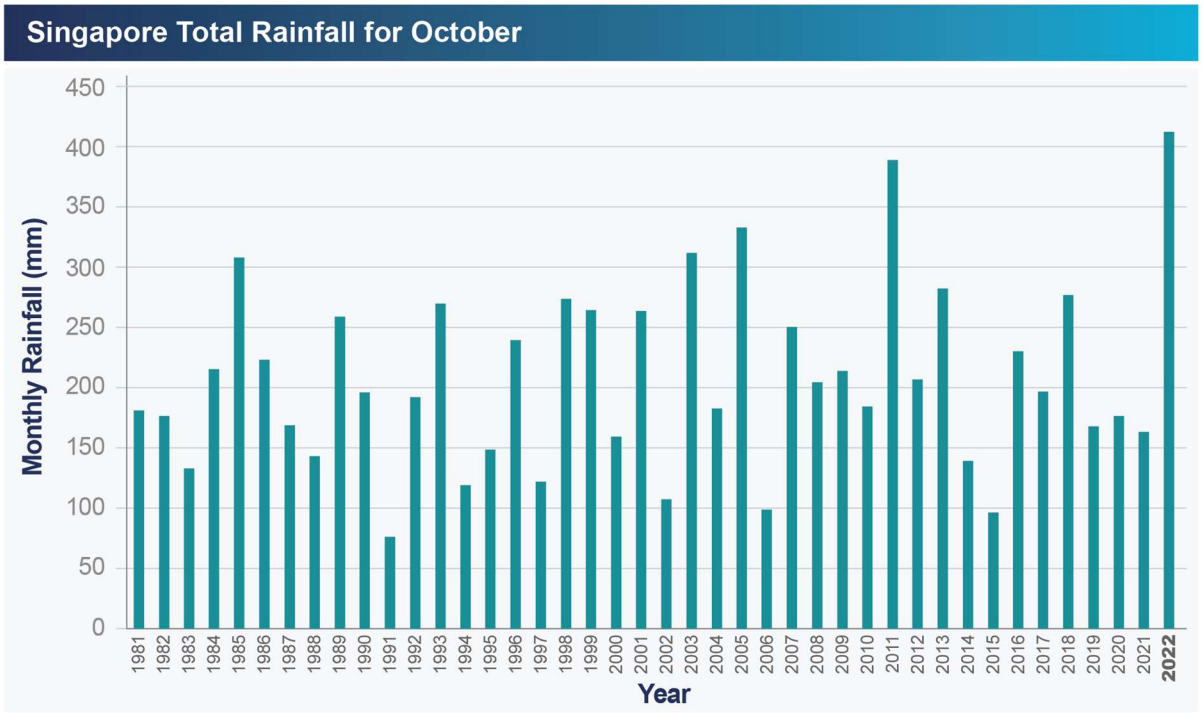

Figure 11: Singapore average rainfall for October between 1981 and 2022, with the highest value recorded in 2022.