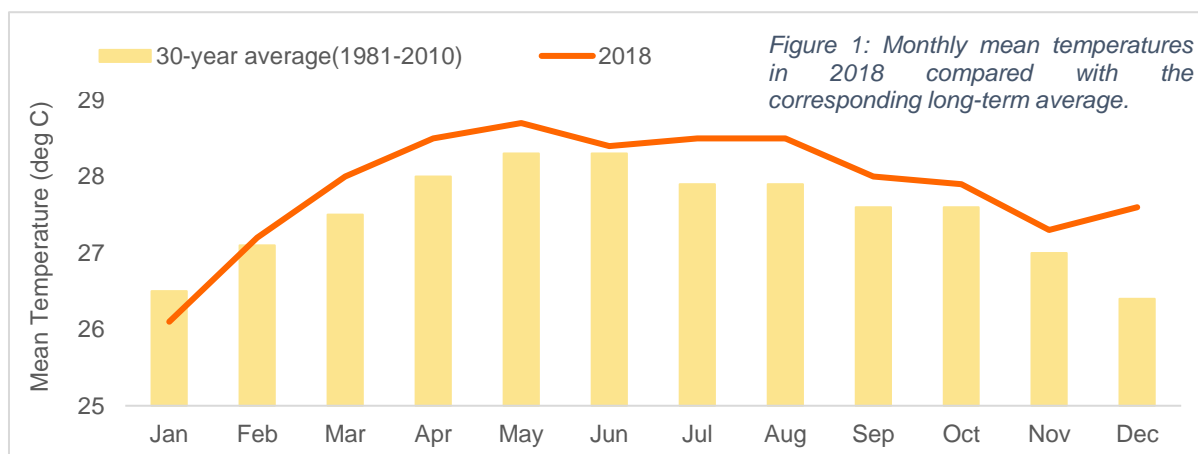


2018 Climate and Weather: The Year in Review

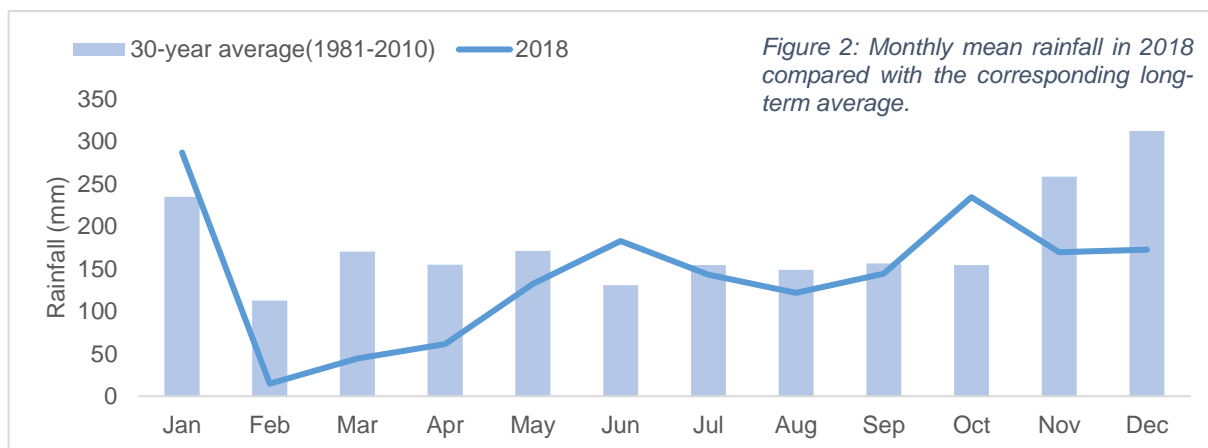
2018 saw a continuation of above-average temperatures over Singapore, with the year recording a mean annual temperature of 27.9°C. This is 0.4°C higher than the 1981-2010 long-term average, and 0.2°C warmer than 2017's mean annual temperature of 27.7°C. Overall, this made 2018 the joint eighth warmest year on record, since Singapore temperature records started in 1929.

Singapore's top ten warmest years have all occurred in the past 25 years, and eight of them were recorded in this century. The last 10 years from 2009 to 2018 also marks the warmest decade recorded in Singapore with mean temperature of 27.89°C, surpassing the previous record (1997 to 2006) by 0.02°C. These are signs of the long term warming trend in Singapore.

Above-average temperatures were recorded in all months, with the exception of January. An extended cool spell over Singapore from 10 to 14 January contributed to the below-average monthly temperature of 26.1°C, 0.4°C below the 1981-2010 long-term average for January. This is an example that naturally occurring short periods of cold weather can be experienced



against the backdrop of long-term global warming. In contrast, the year concluded with a notably warm December at 27.6°C, 1.2°C warmer than the long-term average. It is the second warmest December recorded since 1929, behind December 2015 (27.7°C).



The 2018 annual total rainfall at most stations across the island was close-to-average. At the Changi Climate Station, however, the rainfall recorded was 1708 mm which was about 21% below the 1981-2010 long-term average. The largest shortfalls were experienced at the end of the Northeast Monsoon season (November and December) and during the first inter-monsoon period (February to April). The months with above-average rainfall amounts were January, June, and October.

Largely, 2018 was an El Niño Southern Oscillation (ENSO¹) neutral year with no significant influence on Singapore's climate. Weak La Niña conditions prevailed in the first quarter of 2018 and there were signs of weak El Niño conditions developing towards the end of 2018.

Weather Extremes in 2018

	All Available Stations*	Climate Station (Changi)	Climate Station (Changi) Records
Hottest Day (°C)	35.6 6 Mar (Admiralty) and 5 Oct (Marina Barrage)	35.0 25 Apr	36.0 26 Mar 1998
Coldest Night (°C)	20.5 30 Mar (Tengah)	21.3 14 Jan	19.4 30 - 31 Jan 1934
Wettest Day (mm)	179.8 26 Jun (Ulu Pandan)	60.6 10 Oct	512.4 2 Dec 1978
Warmest Month (°C)	29.5 May (Marina Barrage)	28.6 May	29.5 Mar 1998
Coollest Month (°C)	25.7 Jan (Pulau Ubin & Jurong West)	26.1 Jan	24.2 Jan 1934
Wettest Month (mm)	648.2 Jun (Ulu Pandan)	287.0 Jan	818.6 Jan 1893
Strongest Wind Gust (km/h)	133.3 30 Mar (Tengah)	55.6 15 Nov	90.7 29 Nov 2010

Table 1: Extremes in 2018 at Changi Climate Station compared to the historical records; additional information from all available stations provides local conditions to complement the climate station.

Notable Weather Events in 2018

A remarkable cool spell

Overall January 2018 was a cool month experiencing wet weather on most days arising from a few monsoon surge² episodes, Sumatra squalls and localised thunderstorms. The monsoon surge episode from 10 to 14 January 2018 brought five consecutive days of cool weather across the Island, with daily minimum temperature dipping to 21.2°C on 14 January. This was the longest cool spell Singapore has experienced in at least in the last two decades.

Hailstones and waterspout

January 2018 was also an eventful month for Singapore weather. On 30 January, intense thunderstorm reaching a height of more than 14km brought rain and hailstones over the northern parts of the island at Ang Mo Kio, Seletar and Yishun. This is relatively rare in the tropics where hailstones usually melt before reaching the ground. On 31 January, a waterspout³ associated with an intense thunderstorm developed over the sea areas off the east coast of Singapore. Strong wind gusts from the waterspout blew sail boats on the beach a few meters inland.

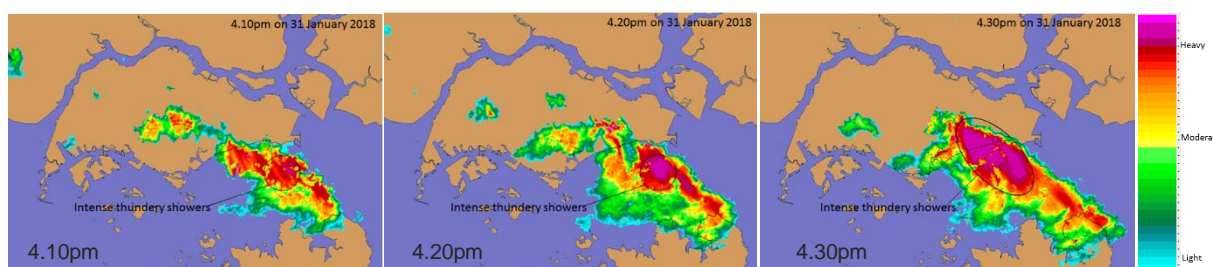


Figure 3: Weather radar images of the heavy rainfall over the East Coast Park area in the late afternoon of 31 January 2018.

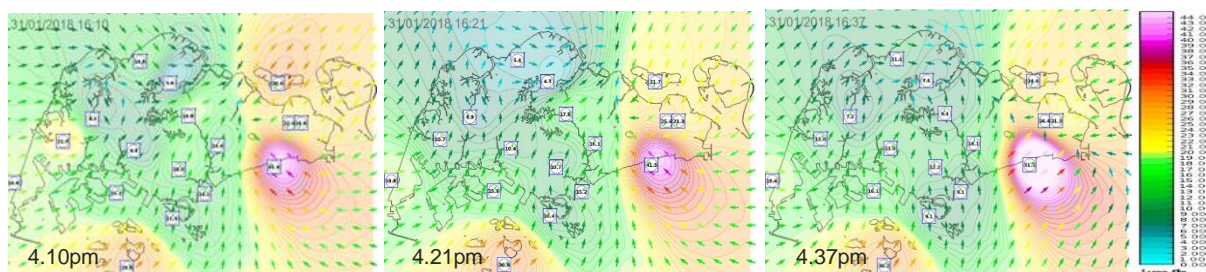


Figure 4: Wind contours on 31 January 2018 between 4pm and 4.40pm showing strong winds over the East Coast Park area

Strongest Wind Gust recorded since 2010

During the year, heavy rains and strong wind gusts from intense thunderstorms caused several incidents of flash floods, fallen trees and damage to property. On 30 March 2018, strong wind gusts from an intense thunderstorm over the western part of Singapore caused substantial damage to chicken farms in the Lim Chu Kang area. The maximum wind gust of 133.3km/h recorded at Tengah weather station on that afternoon was the strongest wind gust recorded over Singapore since 2010.

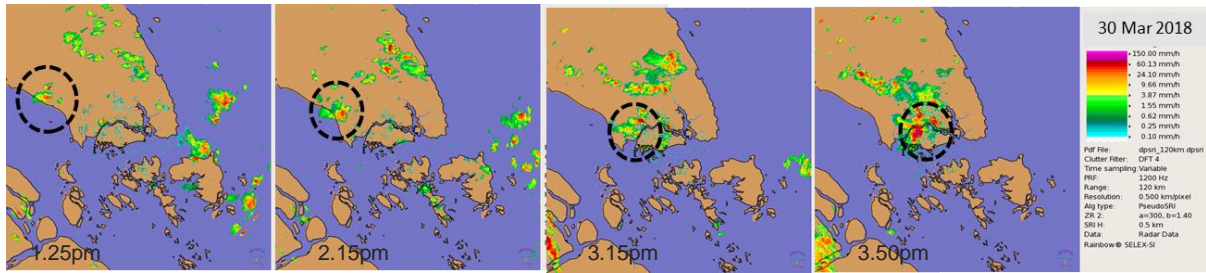


Figure 5: Weather radar images of the thunderstorm propagating and intensifying over the western part of Singapore on 30 March 2018.



Figure 6: Damaged chicken farms in Lim Chu Kang on 30 March 2018. (Source: STOMP <https://stomp.straitstimes.com/singapore-seen/farms-damaged-and-structures-collapsed-by-thunderstorm-in-lim-chu-kang-1-injured>)



Figure 7: Overflowing seawater at the East Coast Park area on 2 February 2018 (Source: The Straits Times © Singapore Press Holdings Limited. Permission required for reproduction)

Flooding due to high tides

Around noon on 2 February 2018, an exceptional high tide⁴ of 3.44m coupled with strong northeasterly winds over sea areas northeast of Singapore, pushed seawater along the eastern coast of the island several metres inland leaving parts of the East Coast Park covered by water (see Figure 7). The seawater flowed through drains and canals from the East Coast Park area onto roads in Katong before subsiding around 1pm.

Second warmest December ever recorded since 1929

December 2018 experienced several warm days, particularly in the second half of the month due to the presence of a low pressure system in the northern South China Sea that brought dry and stable atmospheric conditions over Singapore and the surrounding vicinity. At the climate station in Changi, the mean monthly temperature for December 2018 was 27.6°C, 1.2°C above the long-term average. This makes December 2018 the second warmest December since 1929, 0.1°C below the December 2015 record. On 28 and 30 December, the climate station recorded a maximum temperature of 33.8°C, which ties with the highest ever recorded December daily maximum temperature set on 2 December 1948.

¹ El Niño Southern Oscillation (ENSO) is a recurring climate pattern caused by interactions between the atmosphere and the ocean in the tropical Pacific. During El Niño, the central-eastern equatorial Pacific Ocean is

warmer than usual, leading to drier and warmer conditions especially during the June to October period over Southeast Asia. During La Niña, the central-eastern equatorial Pacific is cooler than average and the atmosphere over the Southeast Asia region is typically wetter than average. The frequency of El Niño or La Niña events are irregular.

² A monsoon surge refers to the strengthening of north-easterly winds blowing from a strong high-pressure system over the northern Asian continent toward the South China Sea, bringing periods of prolonged widespread rain and windy conditions to the surrounding region including Singapore and Peninsular Malaysia. Although the surge from the north is relatively cooler and drier, it becomes moist as it travels over the warmer parts of the southern South China Sea and helps to enhance deep convection over the equatorial South China Sea.

³ A waterspout is a rotating column of winds associated with intense thunderstorms over the sea. Similar in appearance to their land counterparts, the tornados, they are generally weaker and not as destructive. Typically, waterspouts have strong wind gusts of 40 – 80km/h. They lose their energy quickly upon nearing the coast, and are usually short-lived.

⁴ Tide levels of 3m and above are considered higher than normal and tides above 3.3m are considered extreme. When extremely high tides occur at times of relatively strong winds they can bring localised flooding in low-lying areas even without rainfall.