

## 1. Review of Regional Weather Conditions for December 2017

1.1 In December 2017, Southeast Asia experienced northeast monsoon conditions with drier weather conditions over the northern ASEAN region, and rainy or wet weather conditions in the southern ASEAN region. Most of the rain during the month fell within the region bounded between 10°S and 10°N of the Equator. The most intense rain that fell during the month was over the central South China Sea and to the east of the Philippines. These areas coincided with the path of the tropical cyclones crossing the central South China Sea, north of Borneo after making landfall in the Philippines. The rainfall distribution for December 2017 is shown in Figure 1.

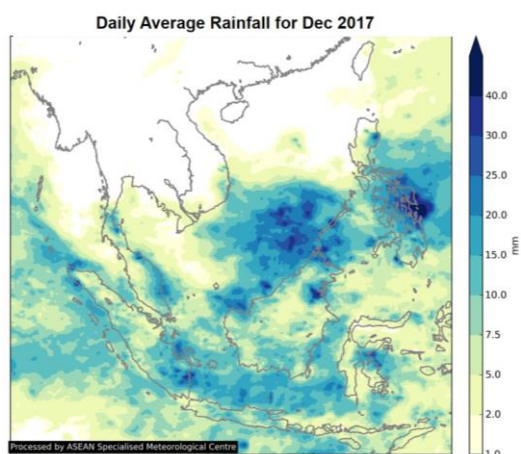


Figure 1: Daily average rainfall for the ASEAN region in December 2017. (Source: JAXA Global Satellite Mapping of Precipitation)

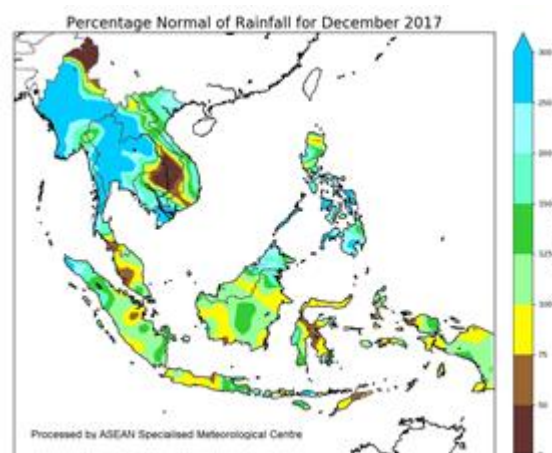


Figure 2: Percent of Normal Rainfall for December 2017. The rainfall data may be less representative for areas with a less dense rainfall network.

1.2 In the second half of December 2017, intensification of the high pressure system in northern Asia brought a monsoon surge or a sudden surge of cold winds over the South China Sea. As these strong northeasterly winds blew equatorward over the South China Sea, it gathered moisture and led to the development of persistent rain clouds over large parts of the equatorial region. The surges brought strong winds and spells of moderate to heavy rain to Borneo, Peninsular Malaysia and Singapore. In particular, the eastern coastal states of Peninsular Malaysia and northern coast of Borneo were affected by heavy rainfall and intense floods arising from the monsoon surges.

1.3 Above-normal rainfall was recorded in most parts of the northern ASEAN region except for the eastern parts of Cambodia and the southern parts of Laos and Vietnam where below-normal rainfall was received. Most parts of the southern ASEAN region received normal to above-normal rainfall. Figure 2 shows the percent of normal rainfall for December 2017.

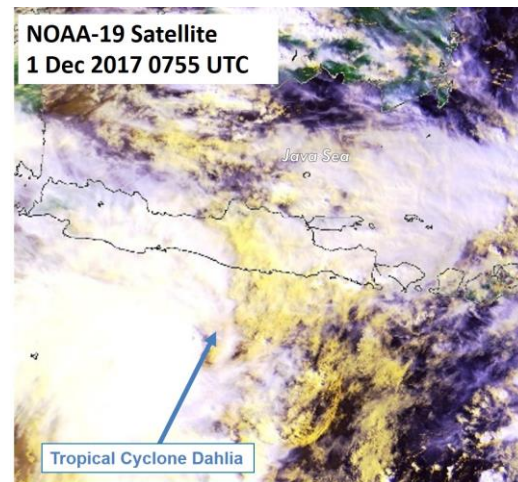
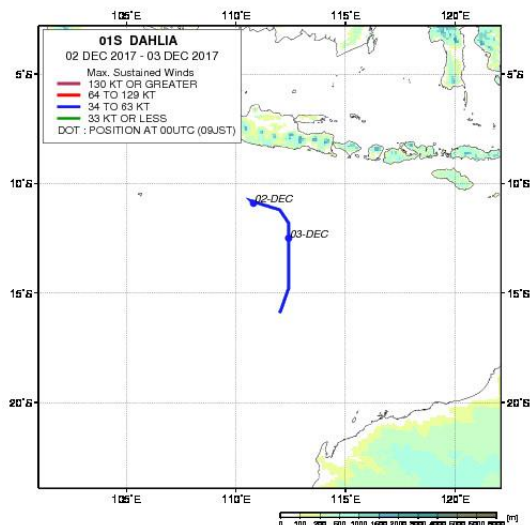


Figure 3: (Left) Historical storm track for Tropical Cyclone Dahlia. (Source: JAXA); (Right) NOAA-19 satellite image on 1 December 2017 shows Typhoon Dahlia, located south of Java.

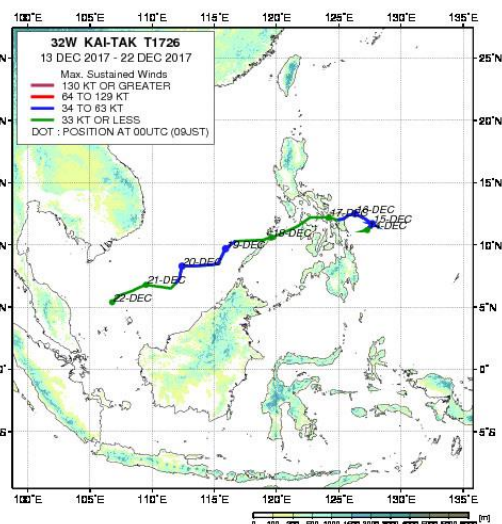


Figure 4: Historical storm track for Typhoon Kai-Tak. (Source: JAXA)

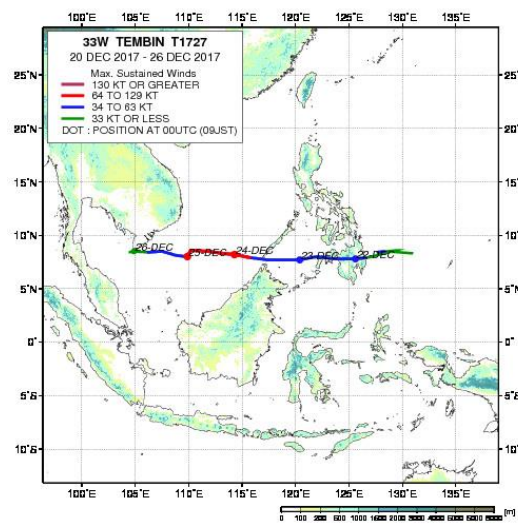


Figure 5: Historical storm track for Typhoon Tembin. (Source: JAXA)

1.4 In December 2017, 3 tropical cyclones brought heavy rainfall and strong winds to the region. On 1 December, Tropical cyclone “Dahlia” (Figure 3) moved over the Indian Ocean, south of Java, bringing heavy rains to Java’s southern coast. On 14 December, a tropical depression (Figure 4) over the western Pacific Ocean, east of Cebu, the Philippines, intensified into Typhoon “Kai-Tak” and tracked over the South China Sea towards Peninsular Malaysia after making landfall in central Philippines. Heavy rain from the bands of “Kai-Tak” fell over the eastern coastal states of Peninsular Malaysia. As “Kai-Tak” dissipated over the South China Sea, another tropical depression over the western Pacific Ocean developed and tracked westwards and intensified into Typhoon “Tembin” over the South China Sea (Figure 4) before dissipating over water as it approached the southern Vietnam.

1.5 In December 2017, prevailing winds blew predominantly from the northeast or east in the northern ASEAN region and from the west or northwest in the southern ASEAN region. Strong

anomalous westerly winds were recorded between 5° S and 10° N, extending from the Indian Ocean to the western Pacific Ocean due to the passage of typhoons “Kai-Tak” and “Tembin” in the South China Sea. Figure 6 shows the average and anomalous winds at 5000 feet.

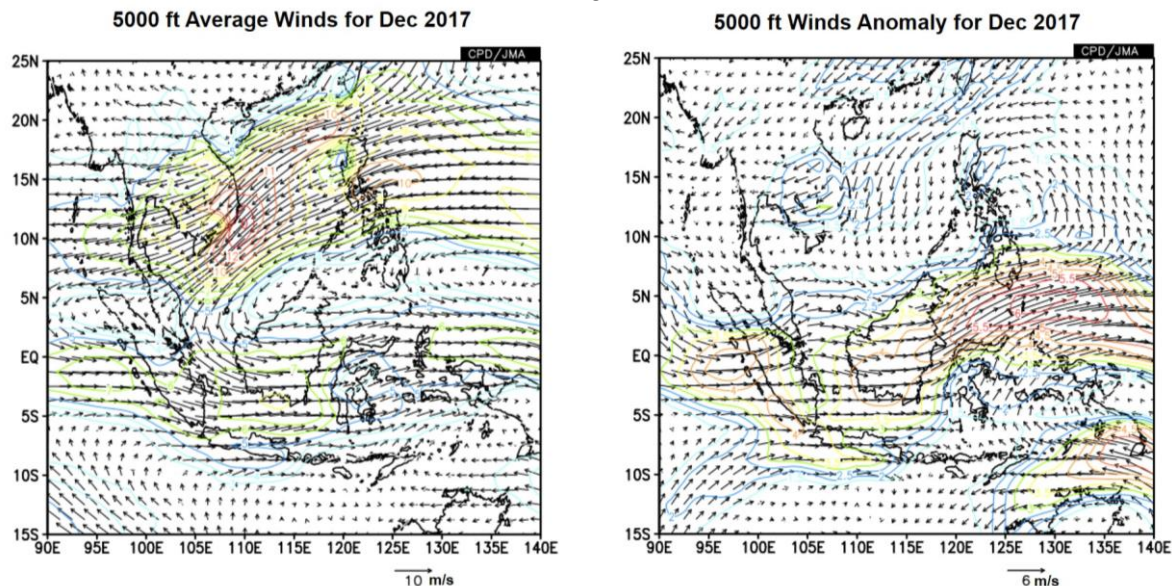


Figure 6: 5000 ft average winds (left) and anomaly (right) for December 2017. (Source: JMA)

1.6 During the month, sea surface temperatures (SSTs) over the Niño 3.4 region in the equatorial Pacific Ocean remained at La Niña values. The stronger than average trade winds and below-average cloudiness indicate La Niña conditions.

1.7 The Madden Julian Oscillation (MJO)<sup>1</sup> was active throughout most of December 2017, propagating from a start phase of Phase 5, ending in Phase 2 towards the end of the month. The MJO however did not play a significant role in modulating the rainfall over the Southeast Asia regions. The rainfall was more likely modulated by the typhoons and monsoon surges in the region.

<sup>1</sup> The MJO is characterised by an eastward propagation of clouds and rainfall over the tropics with an average cycle of 30 to 60 days. The MJO is more prominent between the Indian and western Pacific Ocean, and consists of two phases – an enhanced rainfall (convection) phase and a suppressed rainfall phase.



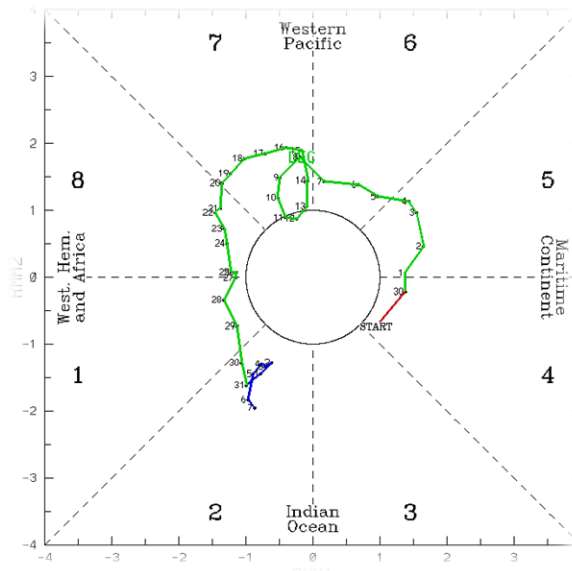


Figure 7: The MJO phase diagram for December 2017 (green). The MJO phase diagram illustrates the movement of the MJO through different phases, which correspond to different locations along the equator. The distance of the index from the centre of the diagram is correlated with the strength of MJO. When the index falls within the circle, the MJO is considered weak or indiscernible. (Source: Bureau of Meteorology)

## 2. Review of Land/Forest Fires and Smoke Haze Situation

2.1 Dry weather conditions prevailed over the northern ASEAN region in the second half of December 2017. This led to an increase in the number of hotspots detected, in particular in parts of Thailand, Cambodia and Vietnam. There were no significant smoke plume or haze observed from these hotspots.

2.2 Wet weather conditions prevailed in the southern ASEAN region, which helped to subdue hotspot activities there. Satellite images of hotspots detected in the ASEAN region in December 2017 are shown in Figure 8: NOAA-19 satellite image on 9 December shows wet weather conditions prevailed over most parts of the southern ASEAN region. to 11.

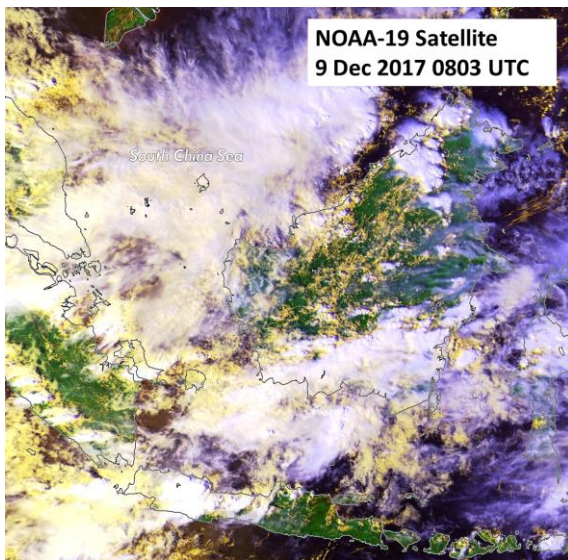


Figure 8: NOAA-19 satellite image on 9 December 2017 shows wet weather conditions prevailed over most parts of the southern ASEAN region.

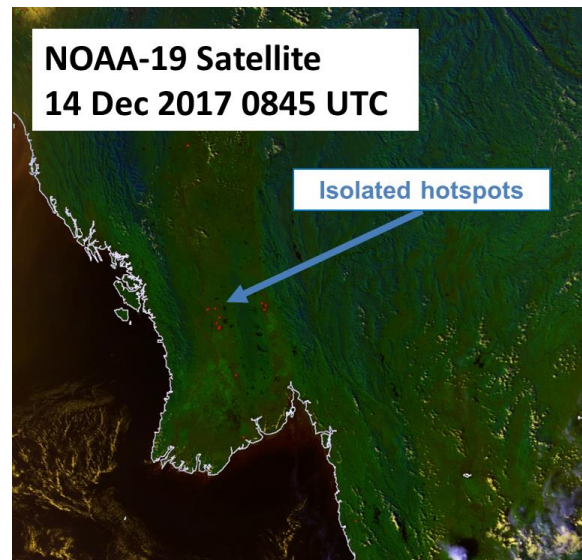


Figure 9: NOAA-19 satellite image on 14 December 2017 shows isolated hotspots detected over Myanmar

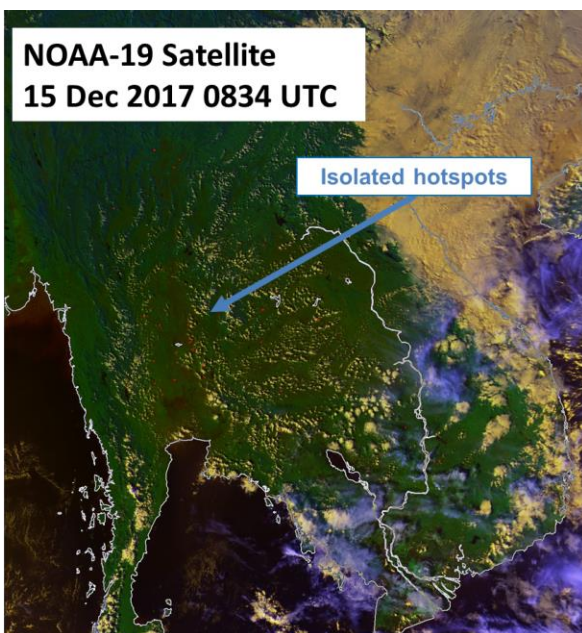


Figure 10: NOAA-19 satellite image on 15 December 2017 shows isolated hotspots over parts of the Mekong sub-region.

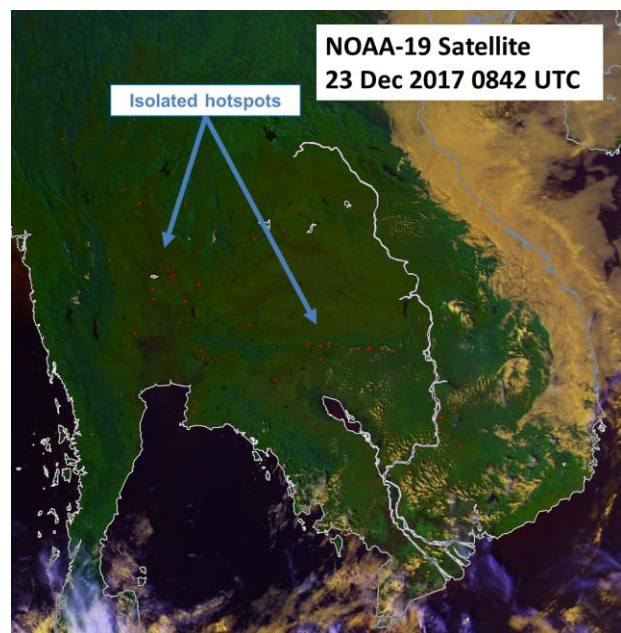
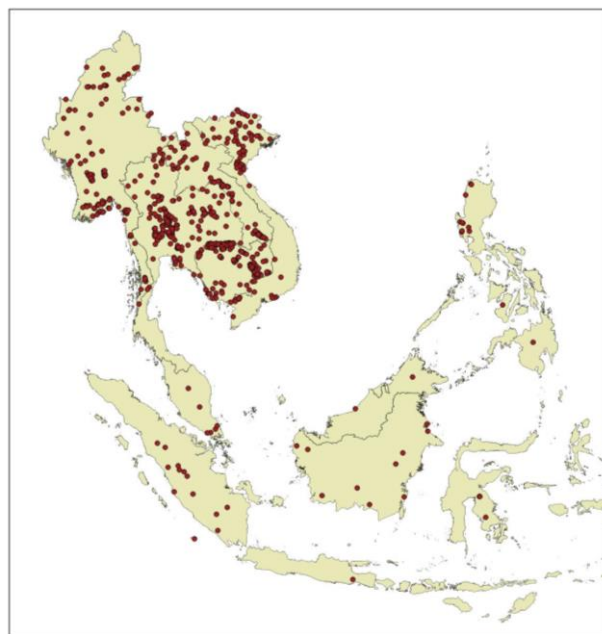


Figure 11: NOAA-19 satellite image on 23 December 2017 shows dry conditions over most parts of the Mekong sub-region.

The hotspot distribution and daily hotspot charts for December 2017 are shown in Figure 122, 2.3 Figure 133 and Figure 144.

# NOAA-19 Hotspots Distribution for Dec 2017



Processed by ASEAN Specialised Meteorological Centre

Figure 12: NOAA-19 hotspots distribution in December 2017.

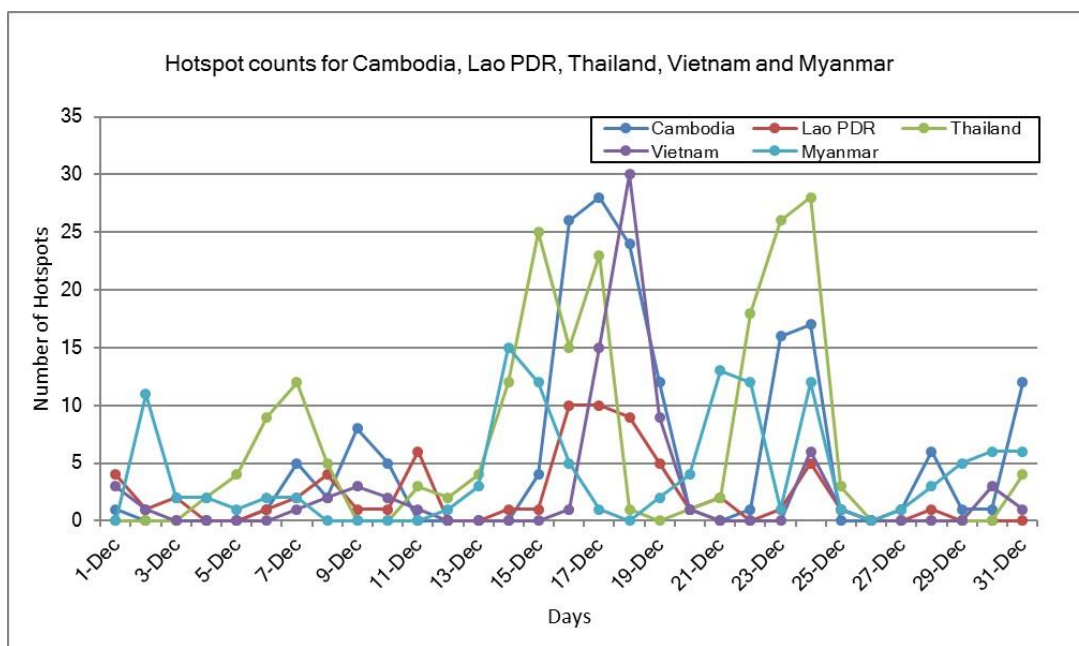


Figure 13: Hotspot Counts in Cambodia, Lao PDR, Thailand, Vietnam and Myanmar in December 2017.

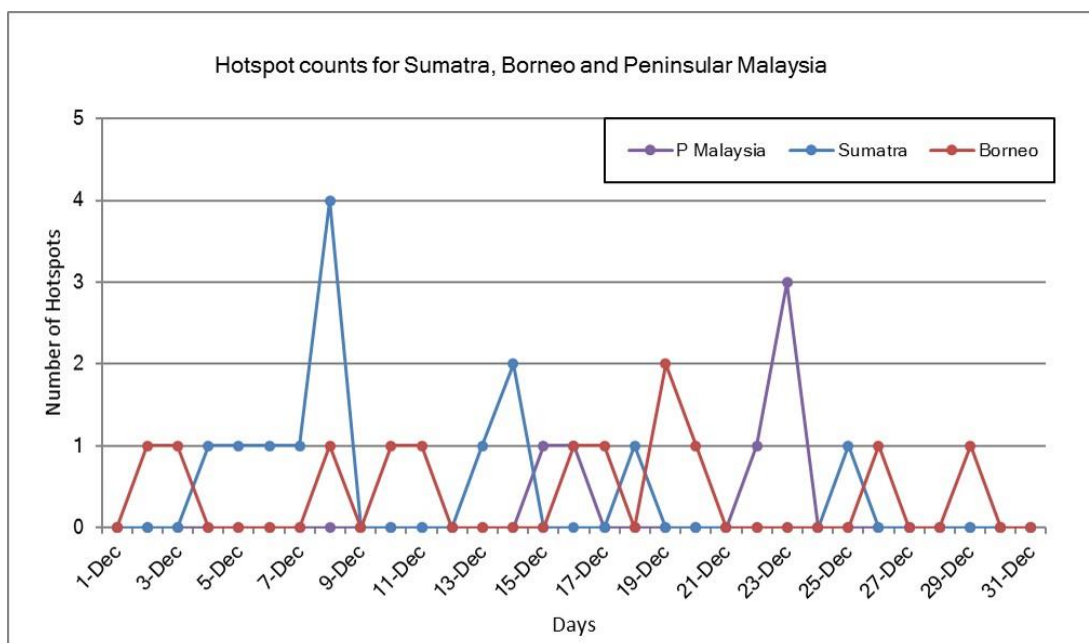


Figure 14: Hotspot Counts in Sumatra, Borneo and Peninsular Malaysia in December 2017.

### 3. Outlook of El Niño/La Niña and Indian Ocean Dipole

3.1 Experts from International climate centers assessed that the tropical Pacific Ocean will continue to be cool and La Niña conditions would prevail until about March 2018.

3.2 The region is currently experiencing Northeast Monsoon conditions. Typically, for Southeast Asia, the impact from La Niña is wetter-than-normal rainfall conditions. For the weather over the near-equatorial region, the impact of La Niña is usually less pronounced during the Northeast Monsoon season (Dec – Mar) as compared to the Southwest Monsoon season (Jun – Sep).

3.3 In December 2017, the Indian Ocean Dipole (IOD) index remained at neutral levels (Figure 15). In the coming months, international climate models forecast the IOD to remain neutral and it is not likely to have a significant influence on the weather over the region for the next few months. The formation of IOD typically starts around May or June, and peaks between August and October before decaying rapidly between December and April.



### Indian Ocean Dipole Index Time Series

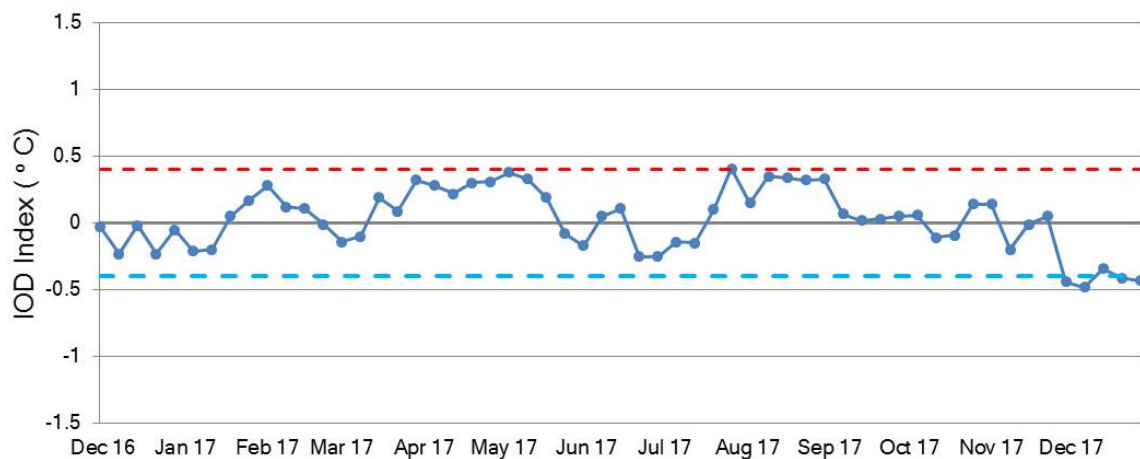


Figure 15: Indian Ocean Dipole (IOD) index time series. The IOD index was at neutral levels in December 2017. (Source: Bureau of Meteorology, Australia)

#### 4. Outlook (January – March 2018)

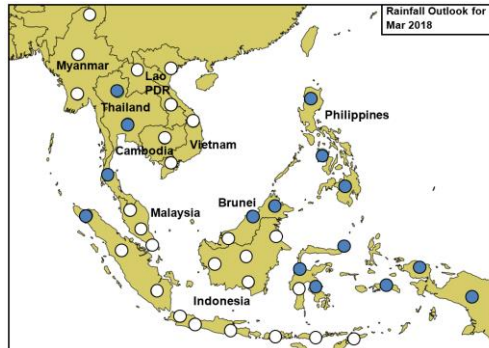
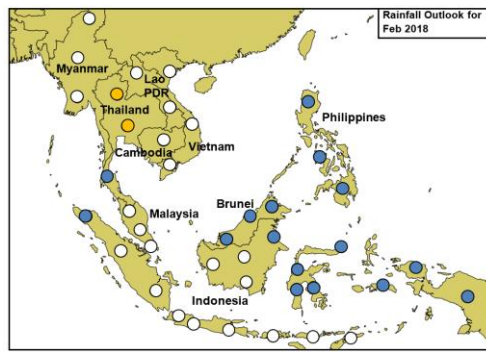
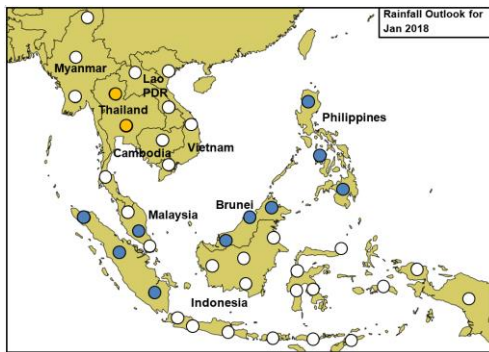
4.1. The Northeast Monsoon season is forecast to extend into March, with prevailing winds in the region blowing from the northwest or northeast. An increase in hotspot activities can be expected as the traditional dry season becomes established in the Mekong sub-region.

4.2. In the southern ASEAN region, wet weather conditions are expected for the next few months over most parts of the region. This would help subdue hotspot activities, especially in the fire-prone provinces of Sumatra and Kalimantan., mostly over southern Sumatra, the southern and would bring moderate to heavy shower activities to most parts of the region. The wet weather would help to subdue hotspot activities.

4.3. In the third week of January, above-normal rainfall is expected over the Philippines, Peninsula Malaysia, and the eastern parts of the southern ASEAN region (around Papua and the Lesser Sunda Islands). Over the southern parts of Sumatra and Borneo, and parts of the Mekong sub-region, normal to below-normal rainfall are expected. In the last week of January, above-normal rainfall is expected over the southern ASEAN region, and normal to below normal rainfall for the northern ASEAN region.

4.4. For the January-February-March season, slightly above-normal rainfall is expected for the Philippines. Near-normal rainfall is expected over most parts of the Mekong sub-region during the season, except for Thailand where slightly-below normal rainfall is expected in January and February, and slightly above-normal in March. For the southern ASEAN region, near-normal to slightly above-normal rainfall is expected. The rainfall outlook for January, February and March 2018 are shown in Figure 16.





- - Above Normal (67<sup>th</sup> to 100<sup>th</sup> percentile)
- - Slightly Above Normal (50<sup>th</sup> to 83<sup>rd</sup> percentile)
- - Normal (33<sup>rd</sup> to 67<sup>th</sup> percentile)
- - Slightly Below Normal (17<sup>th</sup> to 50<sup>th</sup> percentile)
- - Below Normal (0 to 33<sup>rd</sup> percentile)

Figure 166: Rainfall Outlooks for the ASEAN Region – January 2018 (top left), February 2018 (top right), and March 2018 (bottom left)