A S M C
B U L L E T I N

ASEAN SPECIALISED METEOROLOGICAL CENTRE

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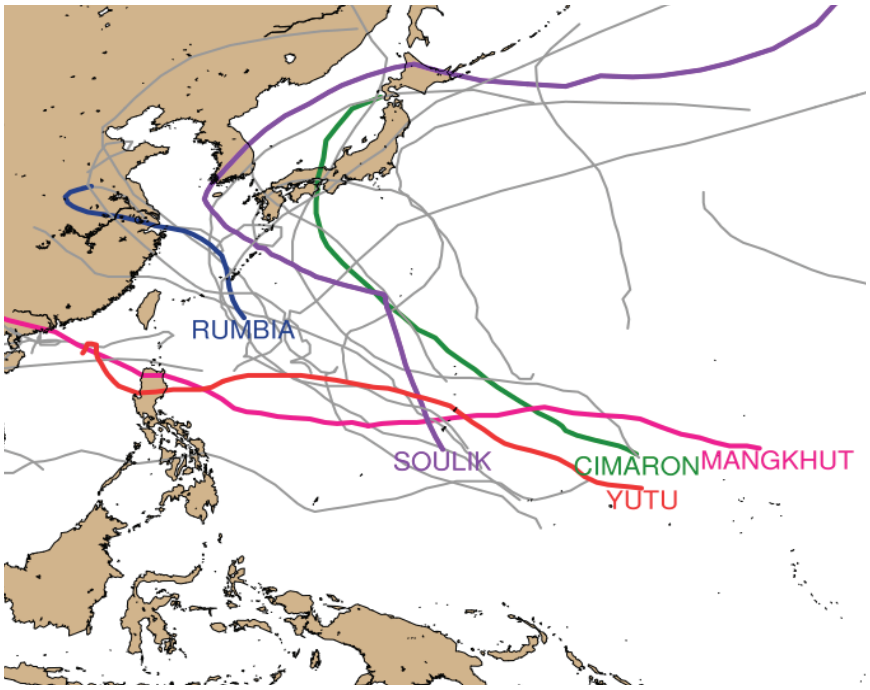
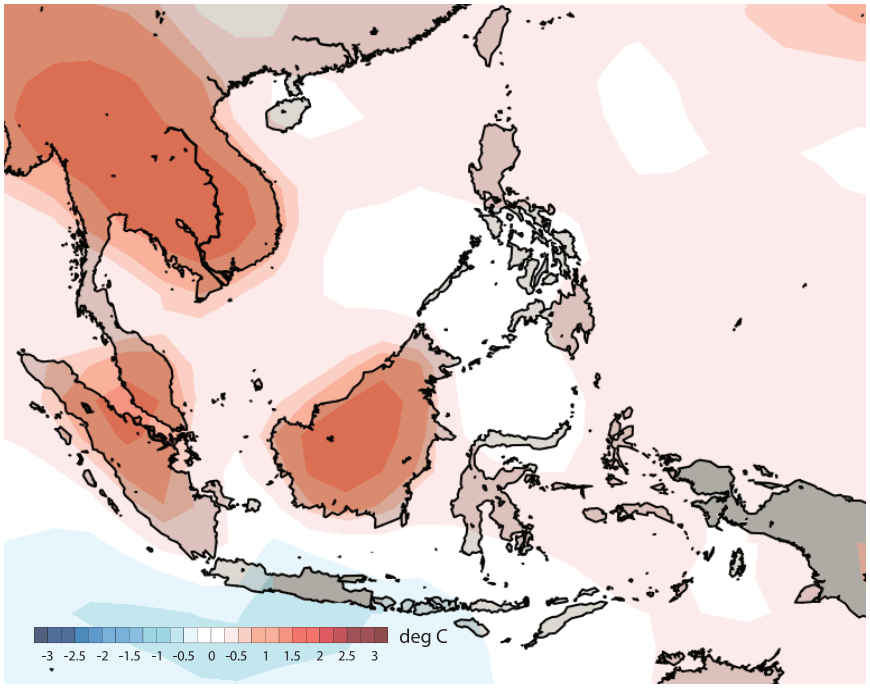




HIGHLIGHTS

- Neutral ENSO overall in the 2nd half of 2018.
- Eastern Indian Ocean sea surface temperatures and the Madden-Julian Oscillation influenced regional rainfall patterns in the second half of 2018.
- El Niño conditions may develop from the 2nd quarter of 2019.
- Brief periods of transboundary haze over southern Southeast Asia during dry weather conditions between July to October 2018.
- Events: ASMC Workshop on the Use and Interpretation of Data for Fire and Haze Monitoring for the Mekong Sub-region & ASEANCOF-11.

CLIMATE REVIEW (JUL – DEC 2018)

Warm SSTs but overall neutral ENSO

Overall, the second half of 2018 was neutral for the El Niño Southern Oscillation (ENSO). Earlier in May 2018, models assessed by the Climate Prediction Centre/International Research Institute (CPC/IRI) predicted the sea surface temperature (SST) anomalies to become warmer towards the end of 2018 (Figure 1).

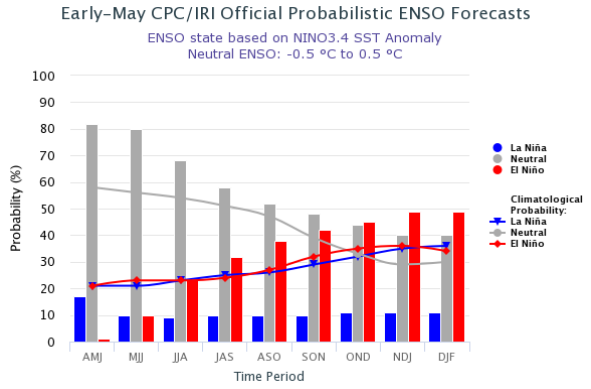


Figure 1: El Niño Southern Oscillation (ENSO) probabilistic forecast based on Nino3.4 index showed 40-50% chance of SST reaching El Niño conditions towards the end of 2018. Credit: CPC/IRI.

Consistent with this prediction, the tropical Pacific SST anomalies neared El Niño thresholds from October 2018 onwards (Figure 2). However, the SST anomaly spatial pattern differed from the classical El Niño pattern, with the warm SST anomalies extending further into the western Pacific (Figure 3). Furthermore, the warm SSTs did not draw a sustained response from the atmosphere. Since the ocean-atmosphere coupling required for an El Niño to mature was absent, the ENSO was largely in neutral state for the second half of 2018.

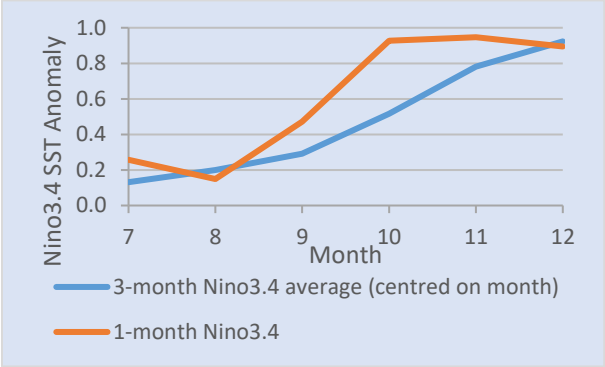


Figure 2: Nino3.4 index for 3-month average, centred on the month (blue) and 1-month average (orange) values which reached El Niño levels by October 2018. Data: ERSST version 5.

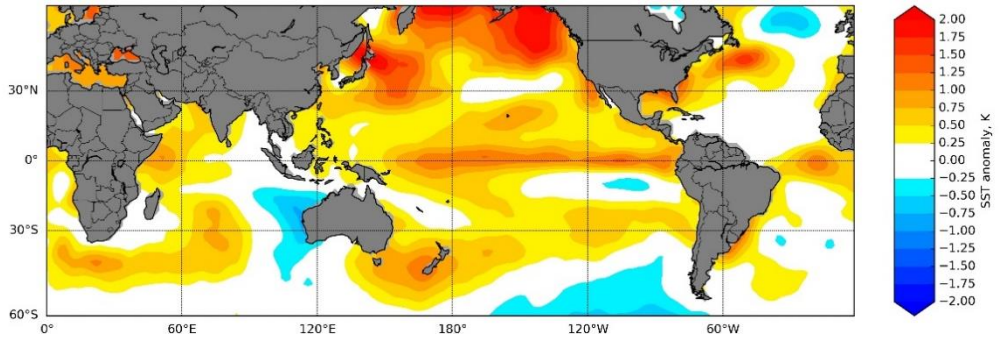


Figure 3: Warmer-than-average sea-surface temperature anomalies (warm shades) for October-December 2018 season over the tropical Pacific Ocean neared El Niño thresholds. However, the atmosphere failed to respond and to impact the global weather patterns. Data: ERSST version 5.

The Indian Ocean Dipole (IOD) was mostly within neutral values in the second half of 2018. It was however marginally positive due to the colder-than-average SST in the eastern Indian Ocean in the third quarter of 2018, especially September (Figure 4).

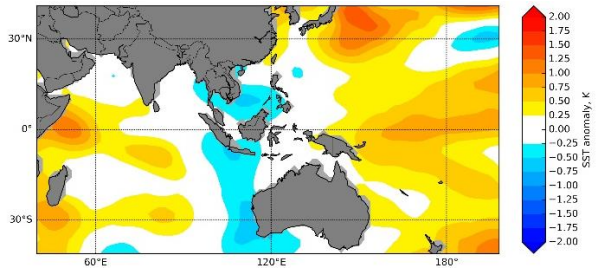


Figure 4: Sea-surface temperature anomalies for September 2018 over the eastern Indian Ocean that were colder-than-average. Data: ERSST version 5.

The Madden-Julian Oscillation (MJO) was, in the last quarter of 2018, more active than in the third quarter (Figure 5). October 2018 saw the MJO emerging in Phase 1, propagating to Phase 3, and then re-appearing in Phase 1 in November 2018. From there, the MJO traversed around the globe fully to Phase 8 in November, and then continued propagating for another round until the last day of December 2018 to Phase 5. In July 2018, the MJO emerged in Phase 5 but survived until only Phase 6 which was uncharacteristic of an MJO propagation event.

Due to the neutral ENSO conditions, rainfall anomalies did not show any region-wide and seasonally-consistent patterns which are typical of El Niño throughout the July-September or October-December 2018 seasons (Figure 6).

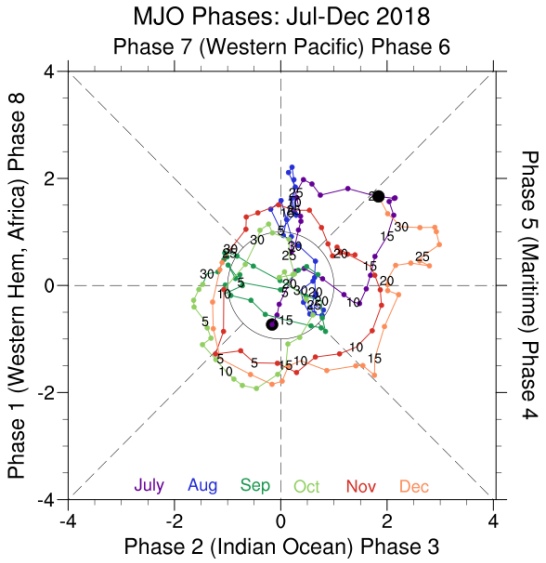


Figure 5: MJO phases from July to December 2018. The MJO was active throughout except for August and September. Data: BoM, Australia.

As the ocean-atmosphere coupling from ENSO was absent, sub-regional anomalies could be influenced by other sources of climate variability. For example, the drier conditions over the western Maritime Continent in July-September 2018 (Figure 6, left), could have been influenced by the eastern Indian Ocean SST anomalies, especially during September 2018 when the cold SST anomalies were at their peak and given that the MJO was relatively inactive in the third quarter.

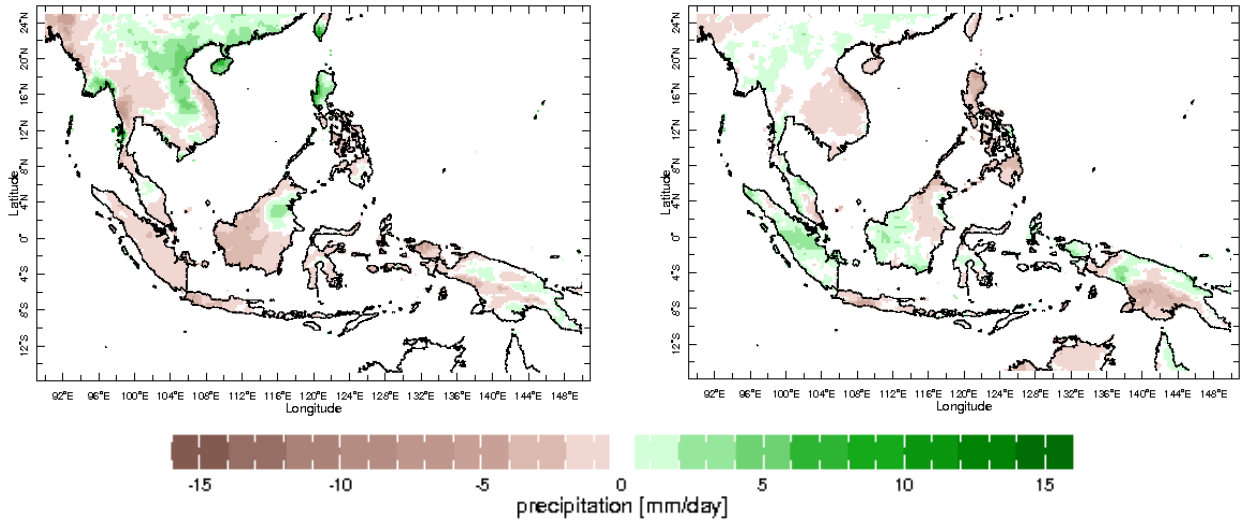


Figure 6: (Left) July-September 2018 and (right) October-December 2018 seasonal average rainfall anomalies (mm/day) over Southeast Asia under neutral ENSO conditions. Sub-regional wetter (green shades) and drier (brown shades) rainfall anomalies could be due other sources of climate variability. Credit: IRI Map Room.

As the MJO was active in the last quarter of 2018, it significantly influenced the shorter-term (intra-seasonal) rainfall patterns in that period. For example, from 2 to 12 November the region experienced wetter conditions in the western parts of the Maritime Continent (Figure 8) consistent with the typical effects of the MJO for the Phases 2 to 4. Similarly, the rainfall anomalies from 5 to 20 December 2018 reflected strong influence of the MJO Phases 2 to 4 (Figure 9). The October-December seasonal rainfall anomaly pattern in Figure 6 (right panel) resembles those in Figure 8 and Figure 9. Thus, the MJO was a clear driver of rainfall anomaly patterns in the region in the last quarter.

For temperature, it was warmer-than-average for the second half of 2018 especially in the western half of Southeast Asia (Figure 7). The warmer conditions could be part of the long-term global climate warming trend.

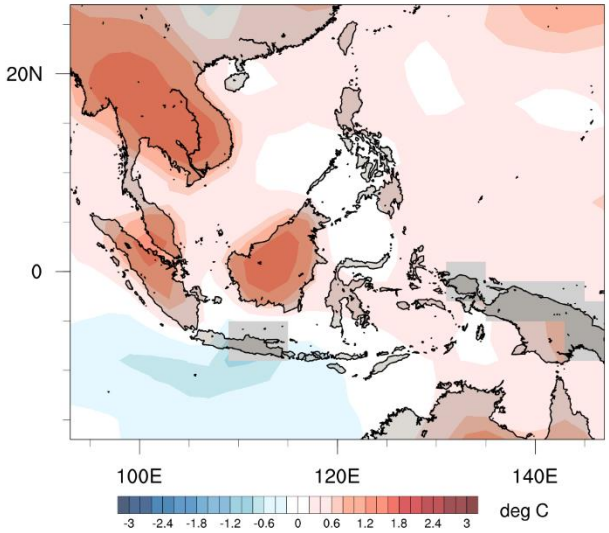


Figure 7: July-December 2018 average surface temperature anomalies (˚C) show warmer conditions (red shades) over the western half of Southeast Asia. Credit: IRI Map Room.

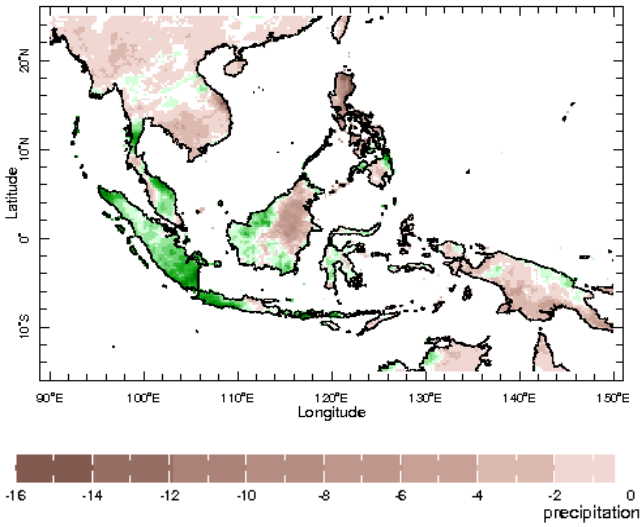
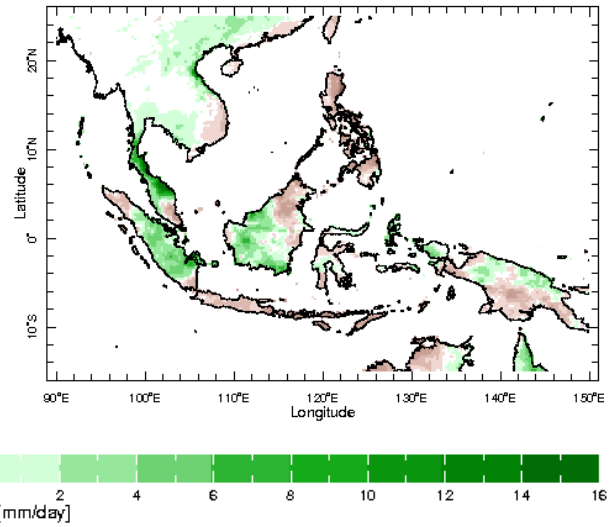


Figure 8: Regional rainfall anomaly pattern from 2-12 November 2018 when the MJO was in Phases 2 to 4. Credit: IRI Map Room.



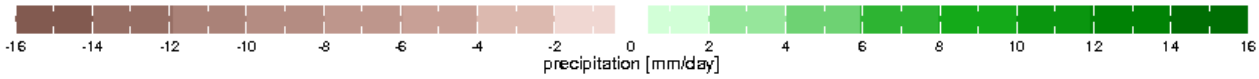


Figure 9: Regional rainfall anomaly pattern from 5-20 December 2018 when the MJO was also in Phases 2 to 4. Credit: IRI Map Room.

REGIONAL FIRE AND HAZE SITUATION (JUL – DEC 2018)

Brief occurrence of transboundary haze during periods of dry weather

The dry season of the southern Southeast Asia region set in around July 2018 and persisted till October 2018. During this period, there were occasions of increased hotspot activities in central Sumatra and Kalimantan that led to transboundary haze pollution affecting neighbouring areas.

In mid-August 2018, persistent hotspot activities were detected in Riau, Sumatra following a period of dry weather. The smoke haze from Riau was blown across the Strait of Malacca and contributed to hazy conditions and a deterioration of air quality in western and northern parts of the Peninsular Malaysia for a few days (Figure 10). Hazy conditions were also observed in western Sarawak due to smoke haze from West Kalimantan (Figure 11). An increase in shower activities in late August helped to improve the situation.

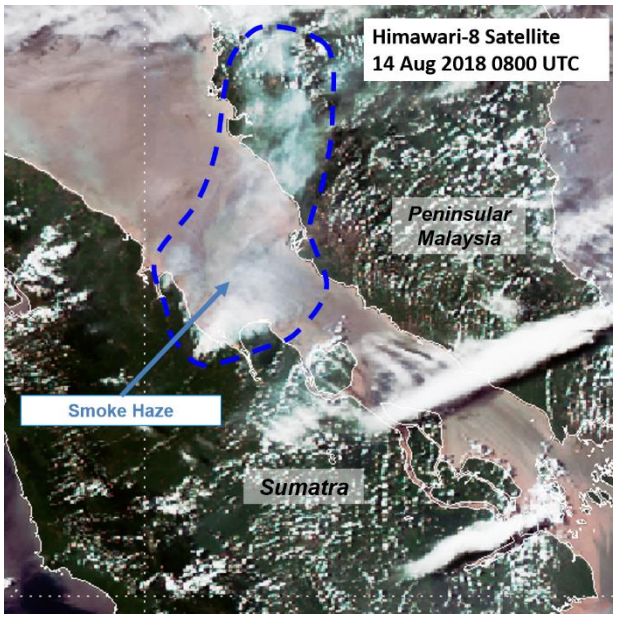


Figure 10: Himawari-8 satellite image on 14 August 2018 shows moderate smoke haze from northern Riau spreading northward across the Strait of Malacca to northwestern Peninsular Malaysia.

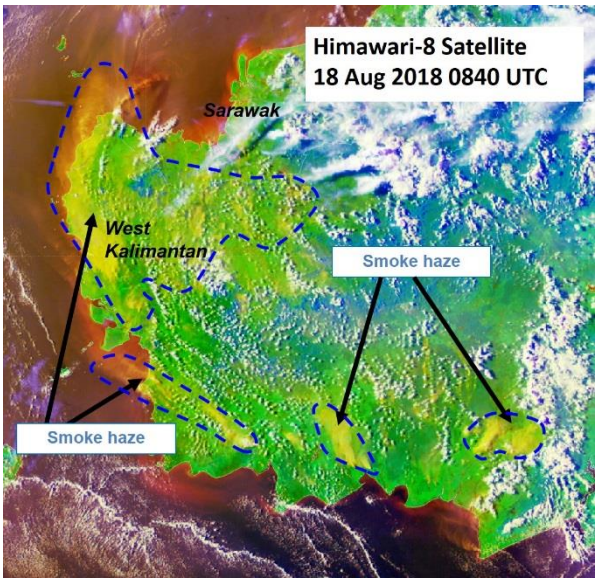


Figure 11: Himawari-8 satellite image on 18 August 2018 shows smoke haze observed over several parts of Kalimantan. Some of the haze was blown by the prevailing southerly winds towards the western parts of Sarawak.

During the review period, with the rainy weather experienced in the northern Southeast Asia, the hotspot activities there remained generally subdued (Figure 12). In December 2018, the number of hotspots detected gradually increased in the Mekong sub-region as the region's traditional dry season began with the onset of the Northeast Monsoon.

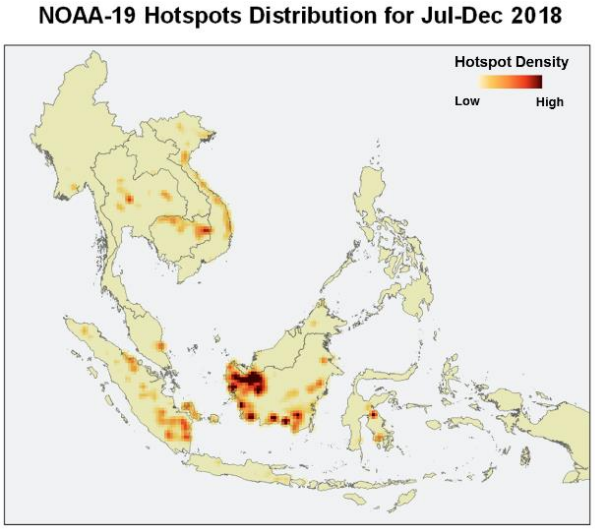


Figure 12: Hotspot density map based on NOAA-19 satellite hotspot data from July to December 2018.

CLIMATE AND HAZE OUTLOOK (MAR – AUG 2019)

El Niño conditions may develop from the second quarter of 2019

ENSO conditions at the start of 2019 indicated slightly warm sea surface temperature (SST) anomalies over the tropical Pacific Ocean. Around the end of 2018, the anomalies were briefly near El Niño thresholds but they did not draw a sustained response from the atmosphere over the tropical Pacific (observed from large-scale cloud development and trade winds). Furthermore, the SST anomalies weakened in January 2019.

For the March-May 2019 season, a residual El Niño risk remains (Figure 13) and there have been resurging, early signs of El Niño conditions developing from the second quarter of 2019 onwards. However, the ENSO system tends to reset during this period, and hence the predictability is low. For June to July 2019, C3S Copernicus' models predict a range of Nino3.4 values (Figure 14). The range starts off from weakly warm SST anomalies until April 2019, and then most model simulations diverge to predict neutral to weak El Niño SST anomalies (more likely). Only a few simulations predict moderate to borderline strong El Niño (less likely). Overall, models tend towards a rebound of the SST warming from the middle of 2019.

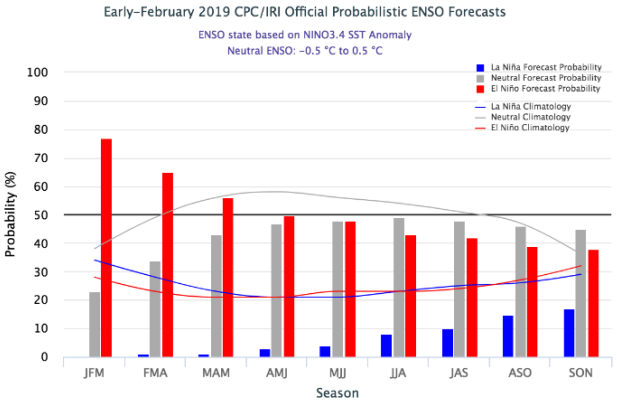


Figure 13: ENSO probabilistic forecast based on Nino3.4 index showing residual risk for El Niño conditions (red) occurring in March-May (MAM) 2019 season, and subsequently reduced and becoming comparable to the likelihood of neutral conditions. Credit: IRI/CPC.

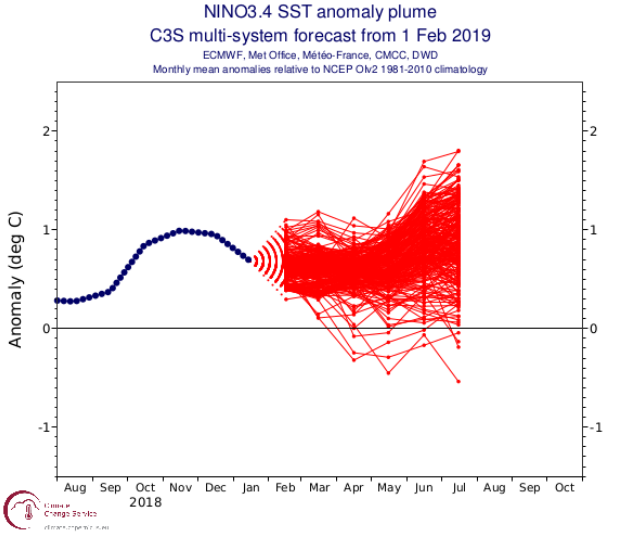


Figure 14: Nino3.4 sea surface temperature anomaly predictions from C3S Copernicus models showing a spread of Nino3.4 predictions ranging mainly from neutral to weak El Niño conditions. Credit: C3S Copernicus.

The early signs of El Niño conditions developing from the second quarter of 2019 onwards could partially be due to the system being triggered by warm SST conditions expected to persist in March-May 2019 (Figure 15). However, it is still early to predict at this point the likely behaviour of ENSO in the second half of 2019. El Niño is a complex phenomenon and model predictions made during this time of the year have low skill, especially in predicting its onset timing and intensity.

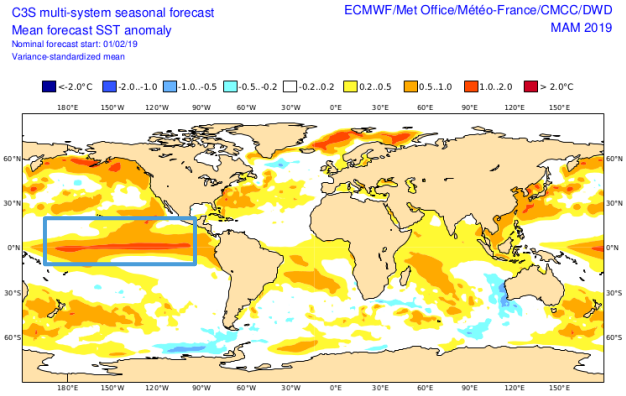


Figure 15: SST anomaly forecast for March-May (MAM) 2019 from C3S model ensemble showing warm SST anomalies persisting over the east-central tropical Pacific Ocean (blue box). Credit: C3S Copernicus.

For rainfall, models from the WMO Lead Centre for Long-Range Forecast Multi-Model Ensemble (WMO LC-LRFMME) favour below-normal (drier) conditions over the northern and eastern halves of

Southeast Asia for the March – May 2019 season, with higher probabilities (60-70%) over the region around the Philippines (Figure 16). Drier-than-normal conditions may contribute to a further escalation of hotspot activities and a deterioration in the haze situation currently persisting over the Mekong sub-region. From April 2019, the haze situation over the sub-region is expected to gradually improve with more rain showers expected as the dry season eases. Hotspot activities in southern Southeast Asia are likely to remain generally subdued, although isolated hotspots may develop during brief periods of dry weather.

For the southwestern corner of the Maritime Continent, the WMO LC-LRFMME predicts above-normal (wetter) conditions but with limited probabilities (40-50%). The multi-model ensemble seasonal predictions from the International Research Institute for Climate and Society (IRI) provide a similar outlook for the regions above.

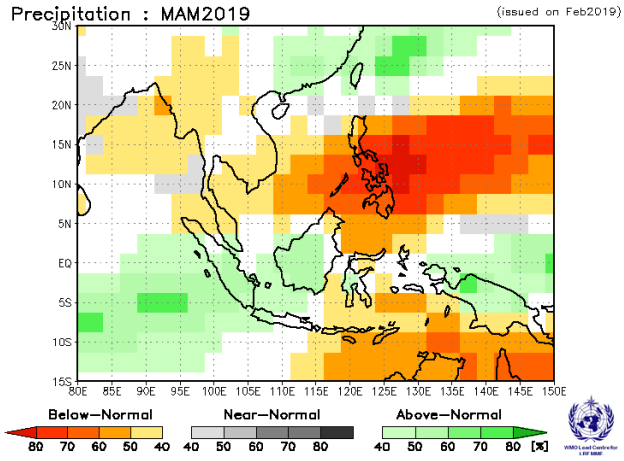


Figure 16: Multi-model ensemble rainfall probabilistic prediction from WMO LC-LRFMME for the March-May (MAM) 2019 season. Credit: WMO LC-LRFMME.

For the subsequent June-August 2019 season, various multi-model ensembles assessed indicate no clear signal for rainfall patterns over Southeast Asia which could be due to the absence of a strong climate driver (e.g. ENSO) during that period. As with ENSO predictions, rainfall predictions for the later period are provisional. A more in-depth, consensus forecast for the June-August 2019 season jointly assessed by ASMC and the ASEAN National Meteorological and Hydrological Services (NMHSs) will be available by the first week of June 2019 on ASMC's website.

Around June 2019 with the onset of rainy season over northern Southeast Asia, hotspot activities in the Mekong sub-region are expected to be subdued. In southern Southeast Asia, the traditional dry season typically sets in around June or July and an increase in hotspot activities can be expected in the fire-prone provinces of Sumatra and Kalimantan during periods of drier weather. This may lead to transboundary haze pollution affecting parts of the region.

For temperature, models predict the region to experience above-normal (warmer) conditions in general, with stronger probabilities over the Maritime Continent (60-80%) than elsewhere. The qualitative rainfall and temperature outlooks are assessed for the region in general. For specific updates on the national scale, the relevant ASEAN National Meteorological and Hydrological Services should be consulted.

NORTHWEST PACIFIC TC SEASON SYNOPSIS (JUL – DEC 2018)

Article contributed by Rusy G. Abastillas

Senior Weather Specialist, Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)

During the second half of 2018, tropical cyclones (TCs) over the Northwestern Pacific were active and a majority of these TCs entered the Philippine Area of Responsibility (PAR). The third quarter (July-September 2018 season) was the peak of the TC occurrence, with tracks concentrated to the north of the Philippines. However, during the last quarter (October-December 2018), TCs were less frequent but more destructive since these crossed or made landfall directly over the central and the southern parts of the Philippines.

Overall, twenty-two (22) TCs developed over the Northwest Pacific and fifteen (15) of these entered the PAR in the second half of 2018 (Figure 17, left). Significant TCs that caused devastation from widespread flooding, flash floods, and landslides occurred during July to September when these TCs enhanced the peak Southwest Monsoon rainfall. Several areas of the country were declared under state of calamity because of the damages to agriculture and infrastructure, and also the loss of lives due to landslides in mountainous areas. TCs that developed in August, but did not enter the PAR, include Tropical Storm "Rumbia" and Typhoons (TYs) "Soulik" and "Cimaron". These events also intensified the Southwest Monsoon rainfall causing floods in most areas of northern and central Philippines.

The more remarkable TCs were Typhoons (TYs) "Mangkhut" (6-17 September) and "Yutu" (20 October–3 November) which made landfall over the northern part of the Philippines, and were packed with strong winds and heavy rainfall. The two TYs caused widespread damage across Northern and Central Luzon, particularly in the Cordillera Administrative Region (CAR), where most floods and landslides occurred. Due to the passage of TY "Mangkhut", some stations in northern Philippines, particularly in the CAR, recorded 4-day rainfall totals that surpassed their average monthly rainfall (Figure 17, right).

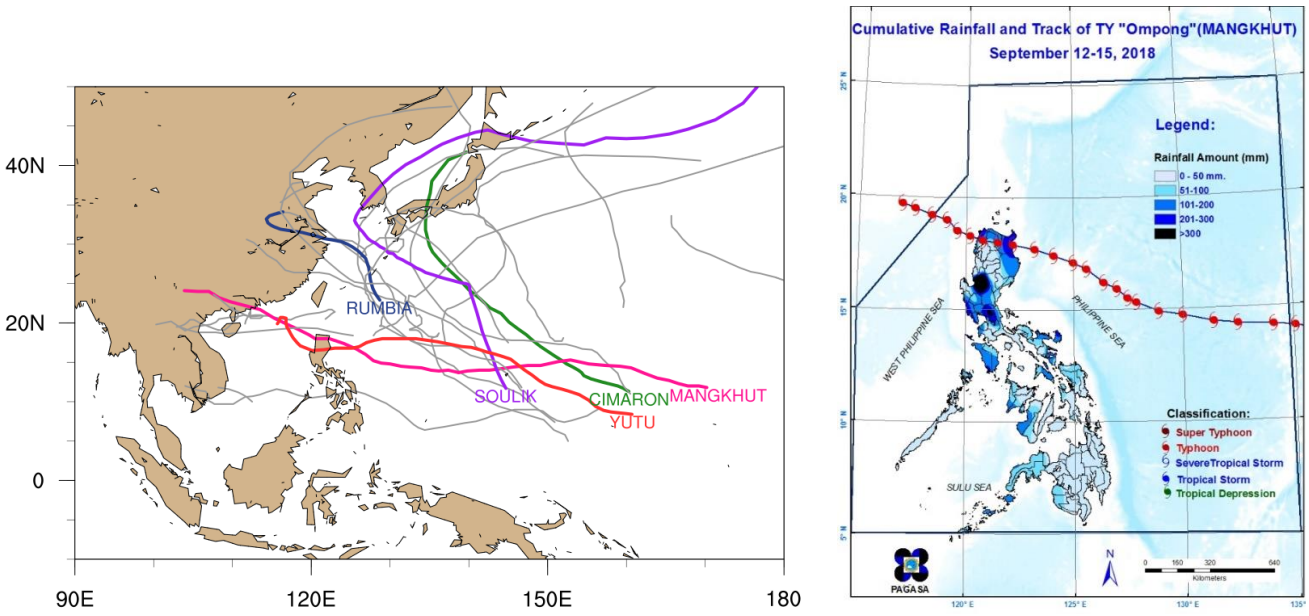


Figure 17: (Left) tracks of notable tropical storms (non-grey colour) from the Northwest Pacific ("Cimaron": 16-24 August, "Mangkhut": 6-17 September, "Rumbia": 14-19 August, "Soulik": 15-30 August, and "Yutu": 20 October-3 November) affecting the region during July-December 2018. Other storms tracks are coloured grey. Data: Japan Meteorological Agency. (Right) Track of TY "Mangkhut" and its cumulative rainfall over the PAR. Credit: PAGASA.

ASMC EVENTS

The Eleventh ASEAN Climate Outlook Forum (Kuala Lumpur, 28 Oct - 2 Nov 2018)

Held in conjunction with the WMO Space-based Weather and Climate Extremes Monitoring Demonstration Project (SEMDP) Workshop

The ASEAN Climate Outlook Forum (ASEANCOF) is a biannual meeting held ahead of the boreal summer monsoon (June – August) and winter monsoon (December – February) seasons. The last meeting, ASEANCOF-11, was held in Kuala Lumpur, Malaysia, in October 2018. The Malaysian Meteorological Department (MMD) hosted the meeting in collaboration with the ASEAN Specialised Meteorological Centre (ASMC). The event was co-sponsored by the ASEAN Science Technology and Innovation Fund (ASTIF), the Malaysian government, and the World Meteorological Organization (WMO). ASEANCOF-11 was held back-to-back with the WMO Space-based Weather and Climate Extremes Monitoring Demonstration Project (SEMDP) Workshop for East Asia and the Western Pacific.

The key objective of ASEANCOF-11 was to issue regional consensus outlooks for temperature and rainfall for the upcoming boreal winter monsoon season (December 2018 – February 2019). To generate this consensus, participants from the ASEAN National Meteorological and Hydrological Services (NMHSs) and representatives from the WMO Global Producing Centres (GPCs) shared their respective outlooks for both temperature and rainfall, as well as the outlook for relevant climate drivers for the region like the El Niño Southern Oscillation, the Indian Ocean Dipole, and large-scale anomalies in monsoon circulation.

Countries' climate outlook and the consensus shared during ASEANCOF-11 contributed to the planning activities of our stakeholders. Information from satellite providers and RCCs made available through the SEMDP activities will greatly benefit us in helping our end-users monitor extreme weather and climate conditions. – Ms Ng Swee Moi, Brunei Darussalam Meteorological Department.

A two-day workshop for the SEMDP involved relevant WMO Regional Climate Centres (RCCs) and NMHSs in designing space-based rainfall monitoring products provided by the satellite operators. The purpose is to evaluate and recommend the use of the products to monitor persistent heavy rainfall and drought events at the regional and national levels.

During the two-day SEMDP workshop, participants discussed their requirements for monitoring extreme weather and climate events using satellite remote sensing, which will help to supplement ground observation data.

End-users were also invited to present their requirements for the monitoring and assessment of extreme weather and climate events. The end-users came from the Hydro and Agro Informatics Institute (HAII, Thailand), International Rice Research Institute (IRRI), and Mekong River Commission (MRC). A breakout group discussion was organised involving the NMHSs, satellite providers, GPCs, RCCs, and end-users to ensure the satellite products to be developed under the SEMDP would be relevant to the various sectors in coping with present climate variability and extremes.

On the last day, participants toured the MMD forecast office, and it gave them an idea of MMD's operational needs and its latest tools and modelling capabilities.

On the last day of the meeting, the ASEANCOF participants were given a tour of the Malaysian Meteorological Department's forecast office to learn about its operational needs, latest forecasting tools, and modelling capabilities.

ASMC Workshop on the Use and Interpretation of Data for Fire and Haze Monitoring for the Mekong Sub-region (Singapore, 4 - 6 Dec 2018)

As the dry season of the Mekong sub-region approached, the ASEAN Specialised Meteorological Centre (ASMC) conducted another round of the Workshop on the "Use and Interpretation of Data for Fire and Haze Monitoring" for the Mekong sub-region on 4 – 6 December 2018 in Singapore to aid preparatory efforts. The workshop brought together experts from the different sectors, such as forestry, environment, pollution control, meteorology, and research – all of them part of the larger community working together to address the transboundary haze pollution issue affecting the region.

Experts from the Mekong sub-region's forestry, environment, pollution control, meteorology, and research sectors attended the ASMC Workshop on the Use and Interpretation of Data for Fires and Haze Monitoring.

Each participant brought with them invaluable experiences from their work to share with others. During the Workshop, participants were introduced to a range of products and information services availed by the ASMC for applications in the monitoring and assessment of land/forest fires and haze, as well as the scientific concepts and theories enabling such applications. These products include satellite imageries, hotspot and haze information derived from satellite data, and numerical model outputs. The Workshop also covered the interpretation of ASMC's seasonal and sub-seasonal prediction products, and how such information could be applied in the planning. Participants were also introduced to the World Meteorological Organization (WMO) Information System portal (WIS portal), an online data catalogue of ASMC's products that facilitates convenient access and further downstream processing.

> *The workshop was useful for operational staff and policy-makers alike, and included relevant topics that met the learning objectives of participants. – Mr Somdet Champee, Royal Forestry Department Thailand.*

Interpreting satellite data requires an understanding of the basic principles of remote sensing and how satellite data are processed. The Workshop included hands-on exercises for participants to practise applying the concepts through interpreting satellite imageries of past haze episodes.

The ASMC WIS Portal enables functions such as automatic updates disseminated via email and/or File Transfer Protocol (FTP), depending on users' preferences.

ASMC has rolled out seasonal and subseasonal prediction products for the Southeast Asia region in 2018. During the Workshop, the interpretation of seasonal prediction was demonstrated using scenario-based simulations. The exercise was designed to enable participants to make informed decisions for each scenario using seasonal predictions.

Much of the Workshop focused on interactive and practical exercises to equip the participants with the skills to interpret the products and derive information that could be applied in ground operations. In addition to the lectures and exercises, participants were taken out of the classroom for technical visits to an Air Quality Monitoring station and the Central Forecast Office of the Meteorological Service Singapore (MSS).

A visit to the Central Forecast Office of the Meteorological Service Singapore, the host of ASMC, was arranged. Participants were introduced to the 24/7 roles and operations of the Central Forecast Office and the suite of information that is available.

Training is a continuous process. As the regional centre for monitoring, assessing, and providing early warning for transboundary haze, ASMC will continue to deliver capability-building programmes focusing on remote sensing technologies and their applications in environmental monitoring. The aim remains to enable the community to take advantage of the advances afforded by the latest technologies through sharing of expertise and knowledge transfer.

Upcoming Events

25 – 29 March 2019, Singapore

Second Workshop on ASEAN Regional Climate Data, Analysis and Projections (ARCDAP-2)

The ARCDAP-2 workshop aims to improve regional knowledge on climate variability and change, climate extremes, and the evaluation of climate simulations, in addition to encouraging regional information sharing. Conducted in collaboration with the WMO, ASMC, and Environment and Climate Change Canada (ECCC), the Workshop will include hands-on sessions to train participants in the use of ClimPACT2 software, and will build upon various recommendations set out by the first ARCDAP Workshop – the "Best Practice Workshop on Climate Change Projections and their Applications in ASEAN Countries", held in Singapore in March 2018.

22 – 26 July 2019, Singapore

Third Subseasonal-to-Seasonal Predictions Workshop for Southeast Asia

This multi-year series of workshops are aimed at building capability in subseasonal-to-seasonal (S2S) predictions (2-week to 2-month timescale) among NMHSs in Southeast Asia. The first two workshops focused on basic S2S prediction concepts, the S2S database, and training participants to generate rainfall and temperature anomalies through hands-on sessions. The upcoming third workshop will equip NMHS participants with the knowledge to generate probabilistic S2S predictions products focusing on impacts on different sectors. Participants will examine, with invited end-users, case studies of extreme events and also assess S2S predictions products that cater to the different sectors.

This bulletin is a biannual publication of ASMC. It is published annually in March and September, providing a review and outlook of weather and climate phenomena of importance to the region (e.g. ENSO, MJO, and monsoon) and their influence on the region's temperature and rainfall conditions.
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