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BULLETIN

ASEAN SPECIALISED METEOROLOGICAL CENTRE

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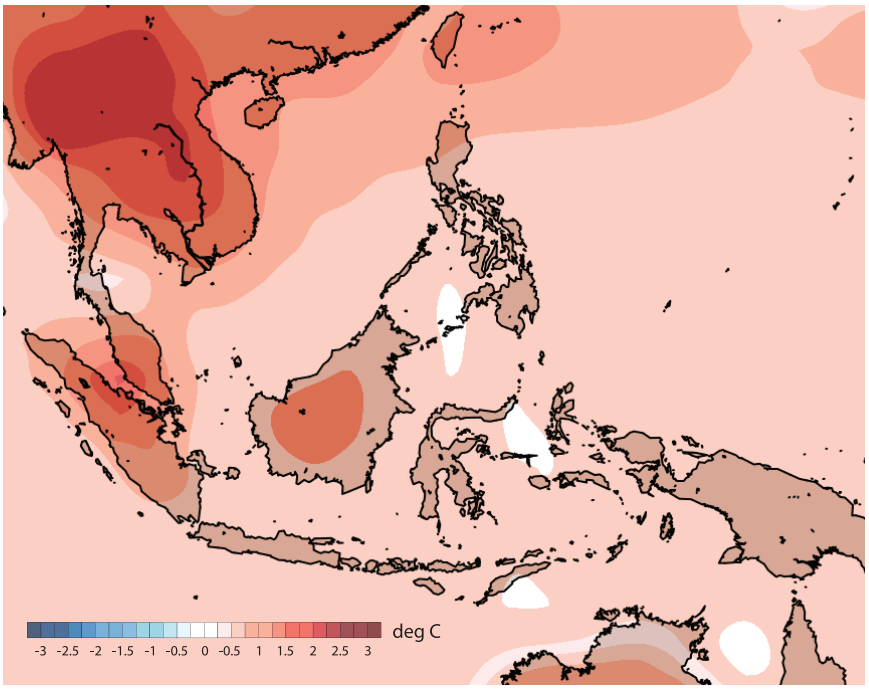

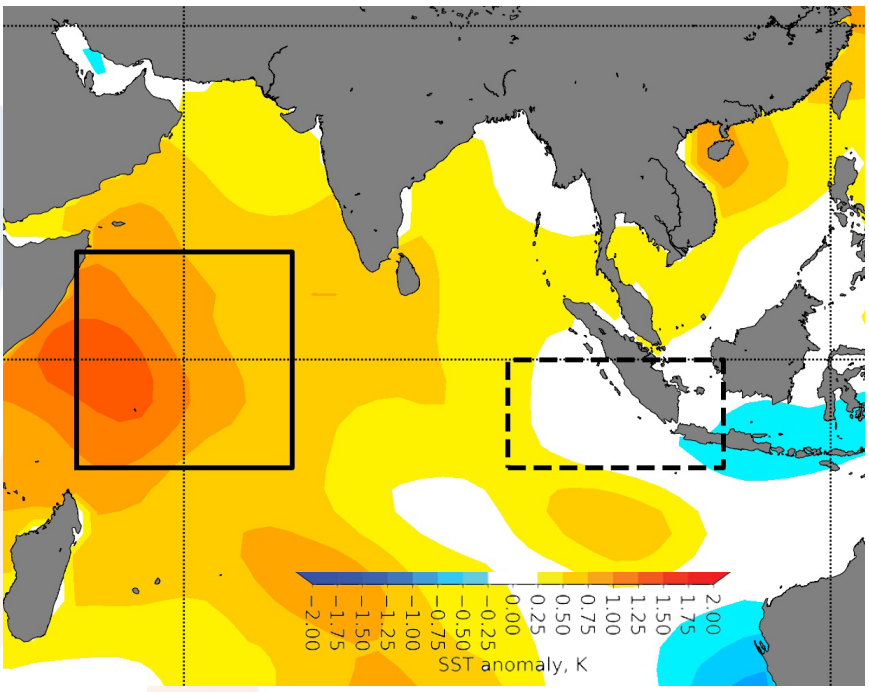

HIGHLIGHTS

- Overall, neutral ENSO conditions were observed in the first half of 2019. No clear ENSO prediction for the rest of 2019.
- The Indian Ocean Dipole (IOD) is positive but is expected to weaken towards the end of the year.
- The Madden-Julian Oscillation (MJO) was active and affected regional rainfall patterns.
- More hotspots detected in the Mekong sub-region compared to the previous year.
- Events: (1) ASMC Workshop on the Use and Interpretation of Data for Land/Forest Fires and Transboundary Haze for the Southern ASEAN region and (2) S2S-SEA III Workshop.

CLIMATE REVIEW (JAN – JUN 2019)

Overall neutral ENSO and active IOD

For brief periods since October 2018, the sea surface temperatures (SSTs) in the tropical Pacific Ocean (Nino3.4) reached borderline El Niño levels (Figure 1). However, the warming was not sustained above El Niño levels and the atmosphere responded only intermittently to the SST warming. Thus, ENSO was considered overall neutral during the first half of 2019.

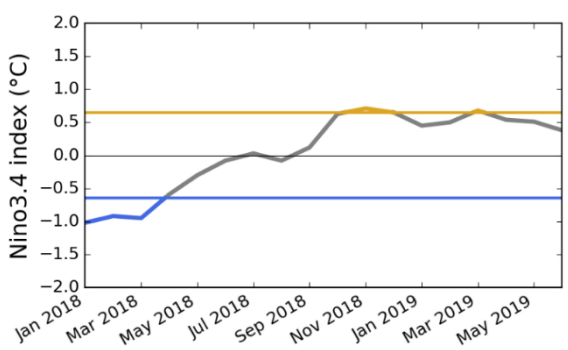

Figure 1: The Nino3.4 index (detrended) using the 1-month SST anomalies. Warm anomalies (≥ +0.65; brown) correspond to El Niño conditions while cold anomalies (≤ -0.65; blue) correspond to La Niña conditions, otherwise neutral (> -0.65 and < +0.65; grey). Reference methodology: Turkington, Timbal, & Rahmat, 2018.

Outlooks for the first half of 2019, from the Copernicus C3S database generated in December 2018 (Figure 2), were mostly consistent with the Nino3.4 development. By May 2019, surface warming over the Nino3.4 region had significantly weakened, but the Indian Ocean SST rapidly developed strong anomalies (Figure 3).

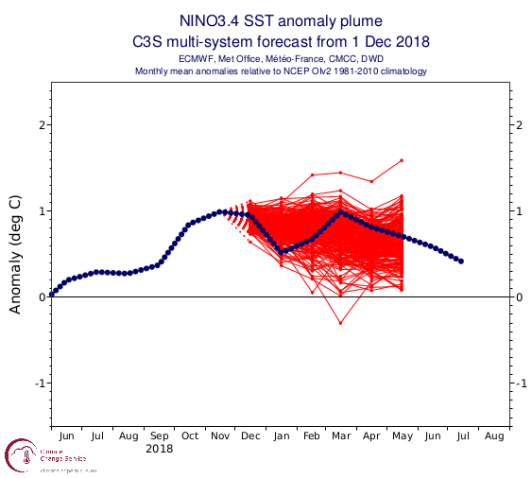

Figure 2: Forecasts of Nino3.4 index's strength (red lines) in December 2018 for the first half of 2019 from various seasonal prediction models of international climate centres. Credit: Copernicus C3S.

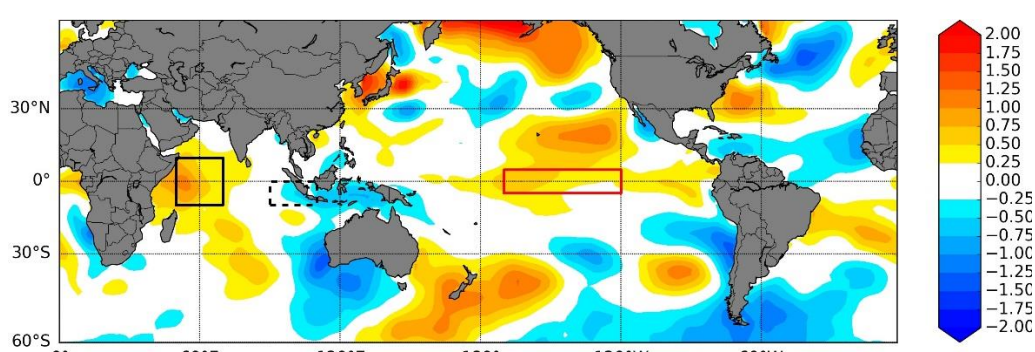

Figure 3: Detrended SST anomalies for May 2019 with respect to 1976-2014 climatology using ERSST v5 data. Warm shades show regions of relative warming, while cool shades show regions of relative cooling. The tropical Pacific Ocean Nino3.4 Region is outlined in red. The Indian Ocean Dipole index is the difference between average SST anomalies over the western Indian Ocean (solid black box) and the eastern Indian Ocean (dotted black box).

The Indian Ocean SST exhibited the dipole pattern anomalies in May-June 2019 with the western and eastern Indian Ocean developing positive (warm) and negative (cold) anomalies respectively. The Indian Ocean Dipole (IOD) has therefore been positive since May 2019. Along with these developments, drier-than-normal conditions appeared in the region, especially over the eastern Indian Ocean (Figure 4) as early as May 2019.

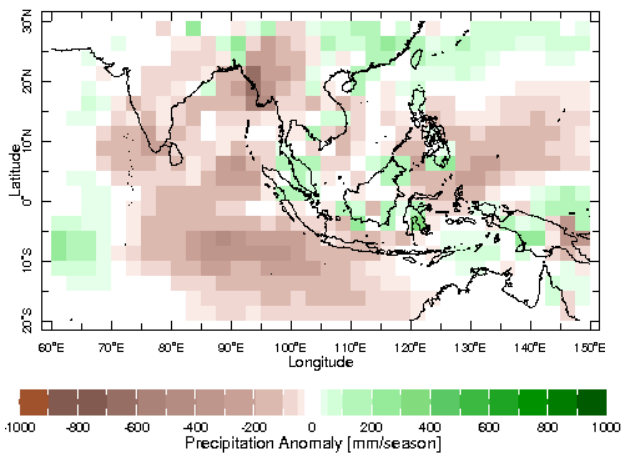

Figure 4: May and June 2019 rainfall anomaly from CAMS_OPI dataset. Credit: IRI Data Library.

Temperature conditions were warmer than usual during the first half of 2019 (Figure 5). Drier conditions arising from a combination of positive IOD and the passing of strong MJO in suppressed phases contributed to the warm conditions during this period. The long-term global warming trend would have also contributed to the warmer conditions in Southeast Asia.

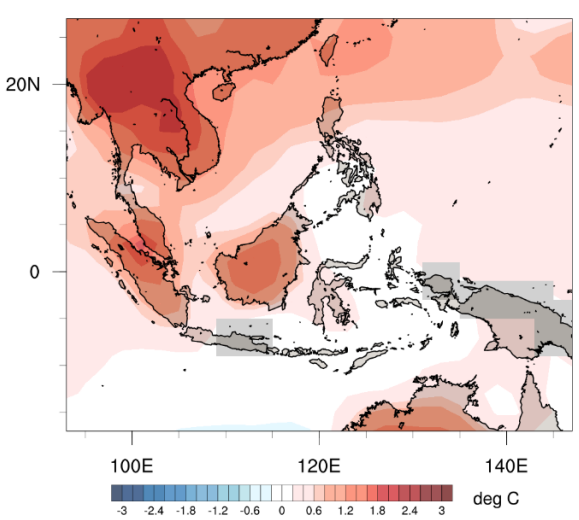

Figure 5: January-June 2019 average surface temperature anomalies (˚C) show warmer conditions (red shades) over land for most parts of Southeast Asia. Credit: IRI Map Room.

The Madden-Julian Oscillation (MJO) was active for much of the first half of 2019. The strong MJO emerged in the first two weeks of the new year in the suppressed convective Phases 6-8. It then weakened momentarily and re-emerged in the last week of January 2019 propagating fully from the Maritime Continent (Phases 4-5) to the Western Pacific (Phases 6-7), Western Hemisphere, and Africa (Phases 8 and 1). It subsequently continued strongly to the Indian Ocean (Phases 2-3) before gradually weakening in the Maritime Continent in the second week of March 2019 (Figure 6, top).

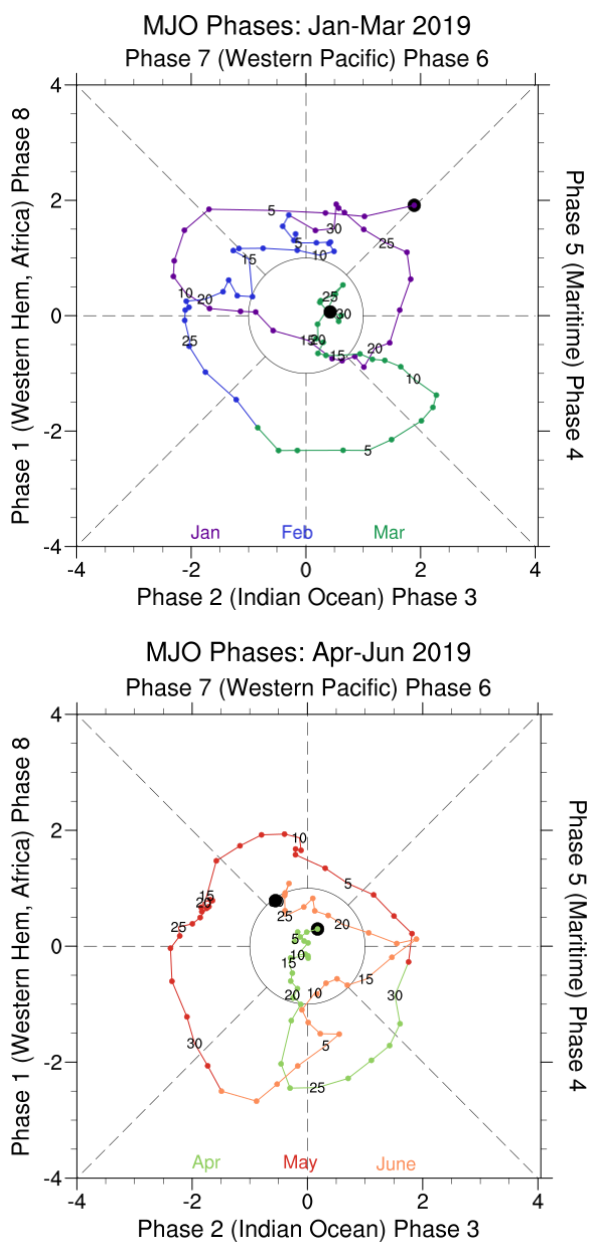

Figure 6: MJO phases from January to March (top) and April to June (bottom) 2019. The MJO was active during this period and was strong from late February to early March 2019 and from late April to early June 2019.

Data: BoM, Australia.

For the second quarter of 2019, the MJO began propagating strongly around the globe from late April 2019 in Phase 2 (Figure 6, bottom). It continued propagating eastward, reaching Phase 2 again in early June 2019. The MJO's propagation through the Maritime Continent affected rainfall patterns and intensity as expected. As an example, in the second quarter of 2019, the MJO brought wetter conditions to parts of the region around the equator as it was in the rainfall-enhancing Phases 2-4 in late April (Figure 7, top) and Phases 2-3 in June 2019 (Figure 7, bottom).

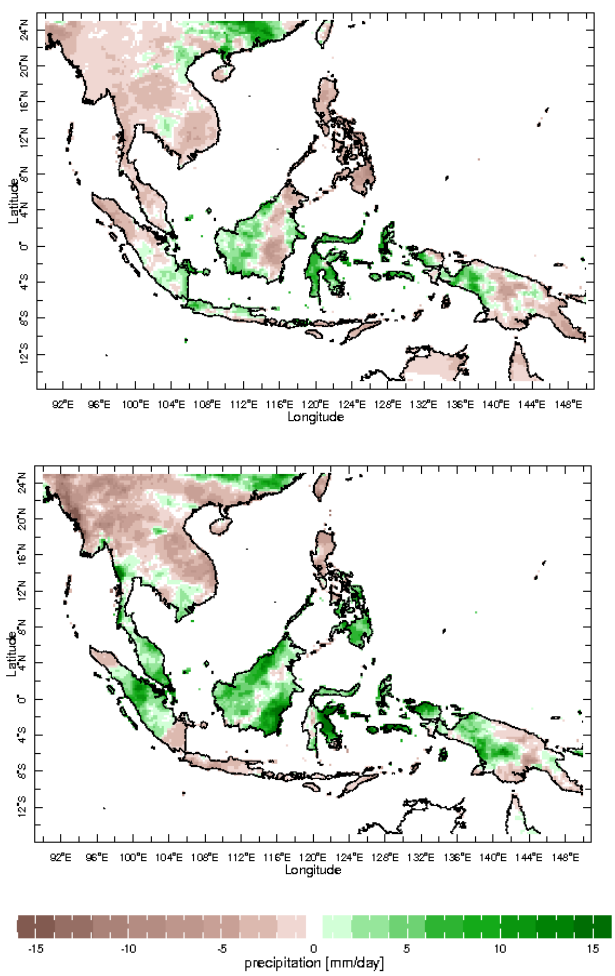

Figure 7: Regional rainfall anomaly patterns (mm/day) during the passage of MJO from 20-30 April 2019 when the MJO was in Phases 2-3 (top) and 1-10 June 2019 in Phases 2-3 (bottom). Credit: IRI Map Room.

During May 2019, when the MJO was mostly in Phases 6-8 and Phase 1, the region experienced relatively drier conditions, a usual response for the region (Figure 8, top). These short-term anomalies show the substantial difference from the long-term seasonal anomalies from April-June 2019, suggesting strong intra-seasonal influences from MJO (Figure 8, bottom).

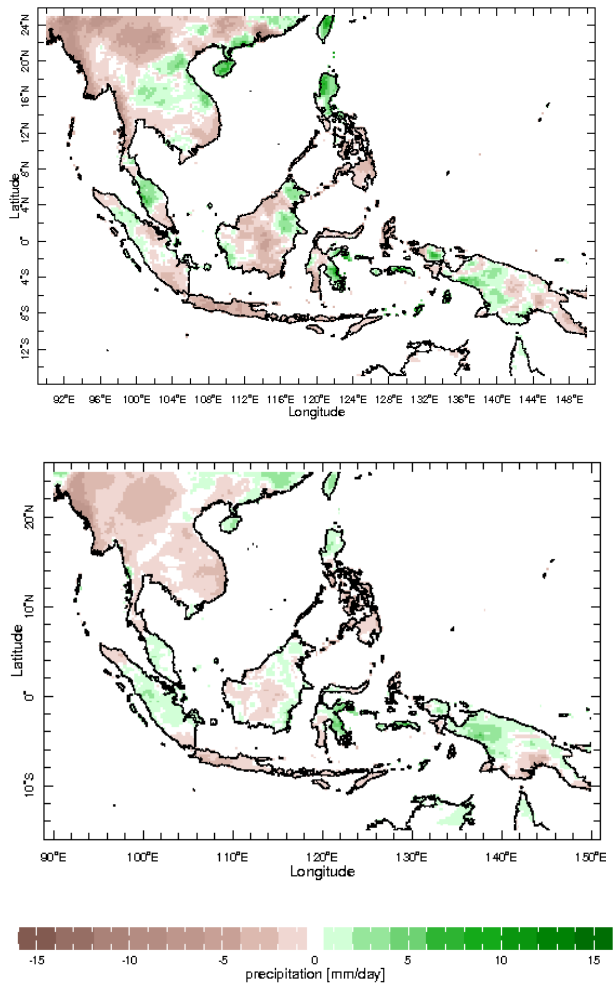

Figure 8: Regional rainfall anomaly patterns (mm/day) during the passage of MJO from 5-30 May 2019 when the MJO was in Phases 6-8 and Phase 1 (top) and for the April-June 2019 season as a whole (bottom). Credit: IRI Map Room.

REGIONAL FIRE AND HAZE SITUATION (JAN – JUN 2019)

More hotspots detected in the Mekong sub-region compared to the year 2018

The traditional dry season of the Mekong sub-region began in late-2018 and extended into early May 2019. Between January and February 2019, prolonged dry weather led to persistent hotspot activities in Cambodia, eastern Thailand, and southern Lao PDR (Figure 9). Smoke haze from the hotspots shrouded much of the southern half of the Mekong sub-region. Hotspots with smoke plumes were also detected in southern Viet Nam on some days.

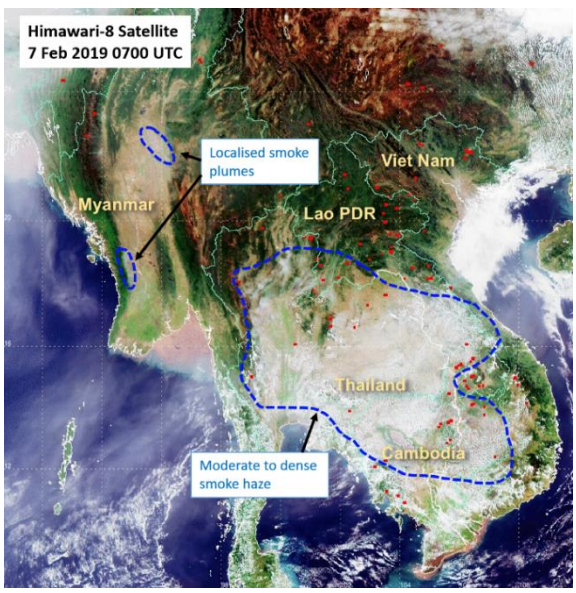

Figure 9: Himawari-8 satellite image on 7 February 2019 shows widespread haze over Thailand, northern Cambodia and southern Lao PDR.

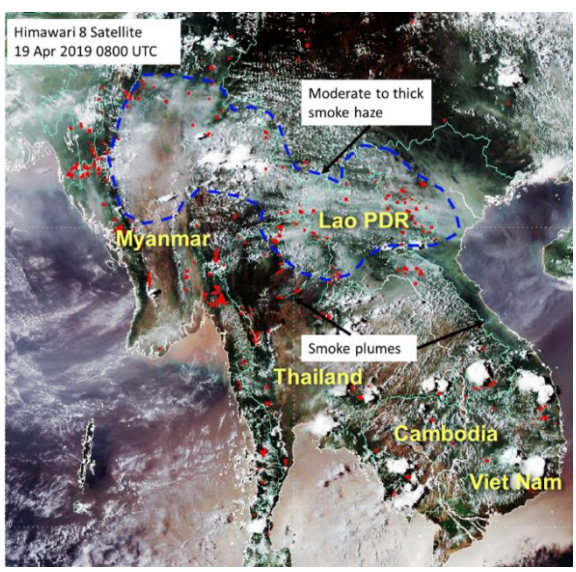

Figure 10: Himawari-8 satellite image on 19 April 2019 shows northern Mekong sub-region shrouded in thick smoke haze from land fires.

Between March and April 2019, there were persistent hotspot activities in the northern Mekong sub-region, encompassing much of Myanmar and the northern parts of Thailand and Lao PDR (Figure 10). Moderate to dense smoke haze engulfed these areas for an extended period. Some of the smoke haze was also blown to parts of Viet Nam by the prevailing winds. By mid-May 2019, the return of shower activities helped to improve the haze situation and subdue the hotspot activities in the sub-region.

In the first half of 2019, the number of hotspots detected was 30% higher than that detected in the same period last year. Significant clusters of hotspots were detected in eastern Myanmar, Lao PDR, and northern Cambodia.

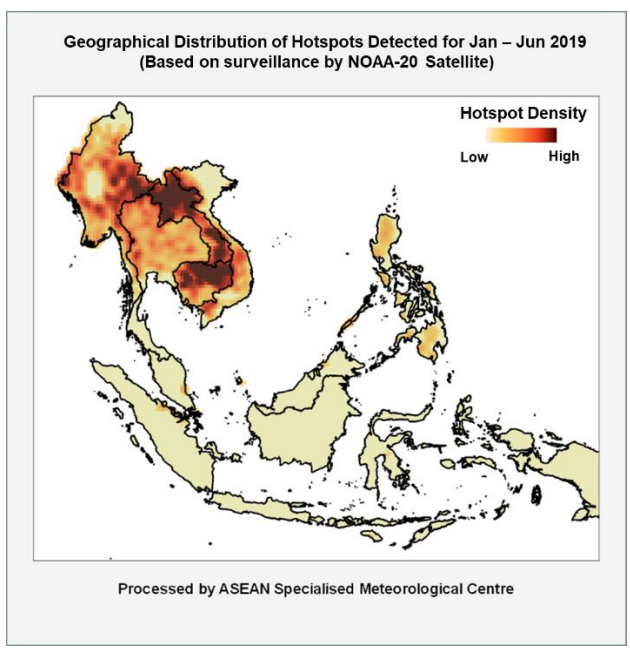

Figure 11: Hotspot density map based on NOAA-20 satellite from January to June 2019.

For the southern ASEAN region, periods of dry weather between January and March 2019 led to occasional hotspots with smoke plumes in central Sumatra and along the east coast of Peninsular Malaysia. With an increase in shower activities in April 2019, the hotspots were gradually subdued.

CLIMATE AND HAZE OUTLOOK (SEP 2019 – FEB 2020)

Neutral ENSO, but positive IOD set to persist until the end of the year

ENSO conditions are currently neutral and the SST anomalies over the Nino3.4 region are weakening. Model outlooks from international centres (C3S Copernicus) are generally predicting Nino3.4 SST anomalies to continue weakening until around November 2019 (Figure 12). Beyond that, however, the model outlooks are uncertain and showing a wide spread of possible outcomes. SST anomaly ensemble-mean predictions show neutral SST conditions over the eastern-central Tropical Pacific Ocean for the upcoming September-November (SON) 2019 season (Figure 13) until the November 2019-January 2020 season (not shown).

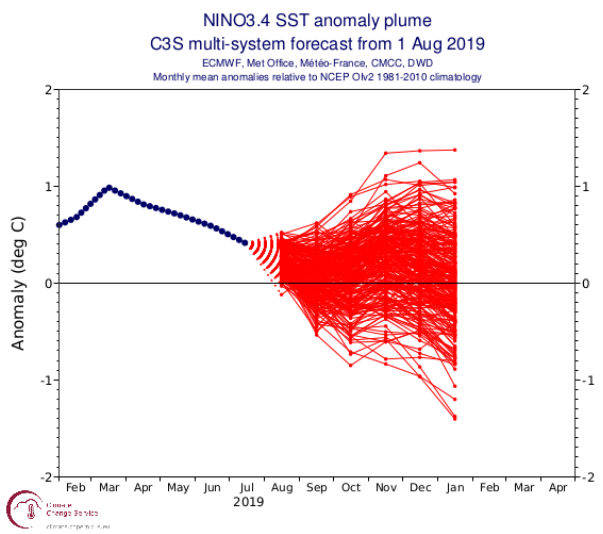

Figure 12: Nino3.4 SST anomaly predictions from C3S Copernicus models showing a widespread of Nino3.4 predictions. Credit: C3S Copernicus.

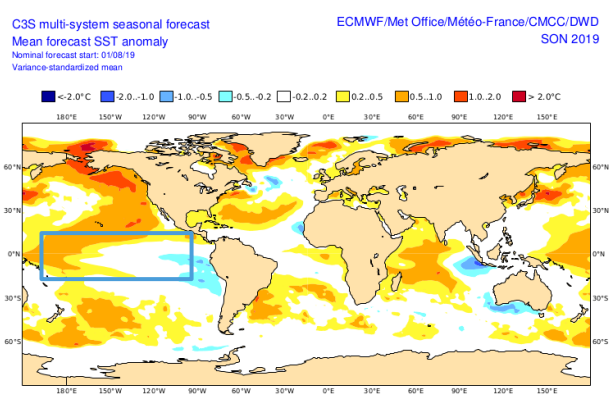

Figure 13: SST anomaly prediction for September-November (SON) 2019 from C3S model ensemble showing on average neutral SST conditions over the eastern-central tropical Pacific Ocean (blue box). Credit: C3S Copernicus.

The IOD is set to persist for the next few months in its positive phase and continue influencing the weather patterns in this region. The positive IOD is expected to rapidly weaken towards the end of the year (Figure 14).

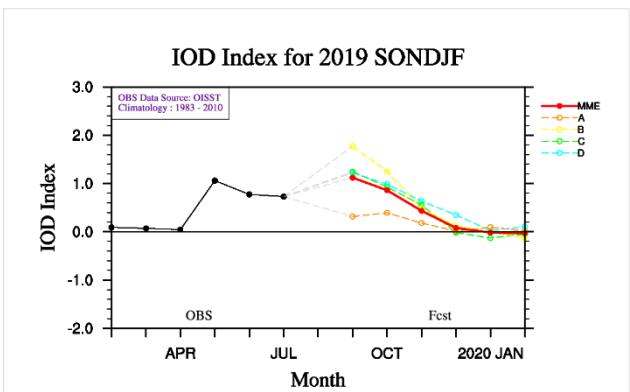

Figure 14: IOD index predictions from the APEC Climate Centre's multi-model ensemble (APCC MME) continue to be positive but will rapidly weaken towards the end of the year. Credit: APCC.

For the upcoming September-November 2019 season, predictions from C3S models assessed by the SEA RCC-Network Long-range Forecasting Node show drier conditions, on average, will continue for the southern half of ASEAN region. Elsewhere, models predict either above-normal rainfall conditions or no clear signal during this period (Figure 15).

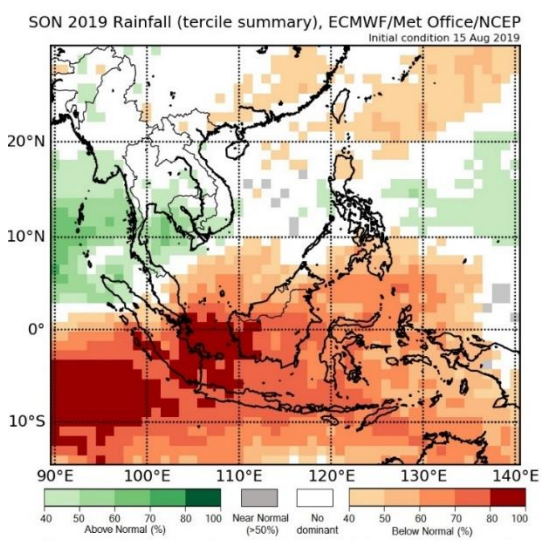

Figure 15: Rainfall tercile summary predictions of multi-model ensemble model for September-November 2019. Brown shades show regions with a higher likelihood of drier conditions, while green shades show regions with a higher likelihood of wetter conditions (contains modified Copernicus C3S information).

For temperature, most parts of the ASEAN region are predicted to continue experiencing warmer-than-normal conditions during SON 2019 (Figure 16).

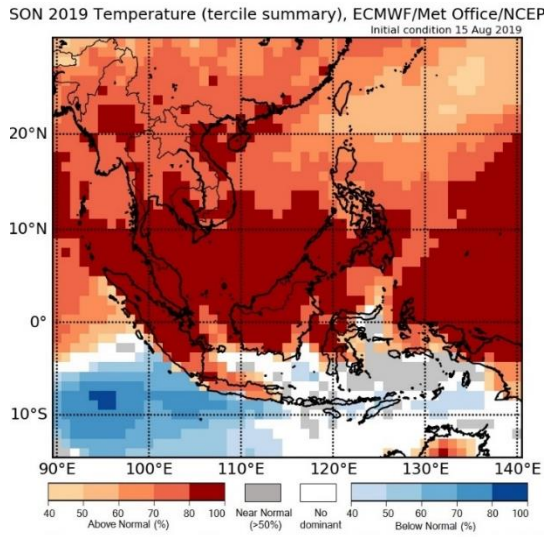

Figure 16: Temperature tercile summary predictions of multi-model ensemble model for September-November 2019. Red shades show regions with a higher likelihood of warmer conditions, while blue shades show regions with a higher likelihood of cooler conditions (contains modified Copernicus C3S information).

During the 2019 Southwest Monsoon season (June-September) thus far, the southern ASEAN region has been drier-than-normal and could contribute to a further escalation of hotspot activities in the fire-prone areas in the region. This, in turn, is likely to increase the risk of transboundary haze occurrence. Climatologically, wet conditions return to the southern ASEAN region typically in the latter half of October. A return of showers in late October 2019 is expected to subdue the hotspot activities in the southern ASEAN region. Conversely, for the northern ASEAN region, the rainy season is likely to gradually transition to the dry season towards the end of 2019. An increase in hotspot activities can be expected around the end of 2019.

SIGNIFICANT WEATHER EVENTS IN SOUTHEAST ASIA

Northwest Pacific TC Season Synopsis (Jan – Jun 2019)

Article contributed by Mr Junie Ruiz

Weather Specialist in the Climate and Agrometeorology Division, Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)

Six tropical cyclones (TCs) affected the region from January to June 2019. One of the TCs, Tropical Storm "Pabuk" (31 December 2018 to 4 January 2019) formed in the South China Sea and affected the western part of the Maritime Continent. The other five TCs formed along the Northwest Pacific region and entered the Philippine Area of Responsibility (PAR) (Figure 17).

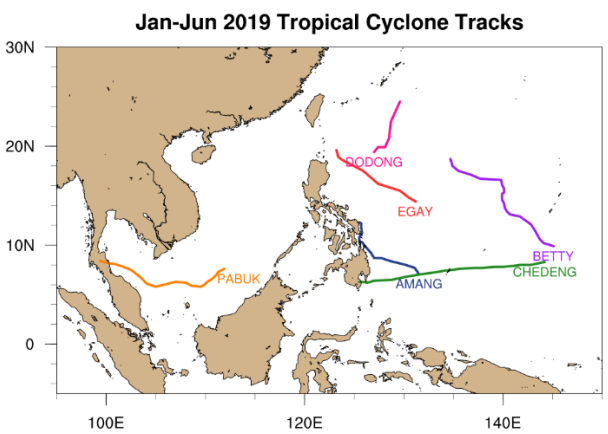

Figure 17: Tracks of notable tropical cyclones that affected the region from January to June 2019. Data: Japan Meteorological Agency.

In the first quarter of 2019, three TC's developed and entered PAR. Two of them, Tropical Depression (TD) "Amang" (19-21 January) and TD "Chedeng" (15-19 March) made landfall and affected the eastern regions of the Philippines. TD "Amang" developed from a Low-Pressure Area (LPA) while it was inside the PAR. It then crossed the eastern parts of central and southern Philippines (Figure 18, top). TD "Amang" caused widespread flooding, flash floods, and landslides and inflicted damages to infrastructure and agriculture.

TD "Chedeng", the third TC that developed in the PAR (Figure 18, bottom), made landfall over the eastern part of southern Philippines and caused extreme flooding and landslides along its track. It then weakened into an LPA following landfall. The third TC was TD "Betty" (22-28 February) which developed into a Typhoon that was given an international name "Wutip", but it did not affect the Philippines. The tracks of these first quarter TCs were typical during this time of the year.

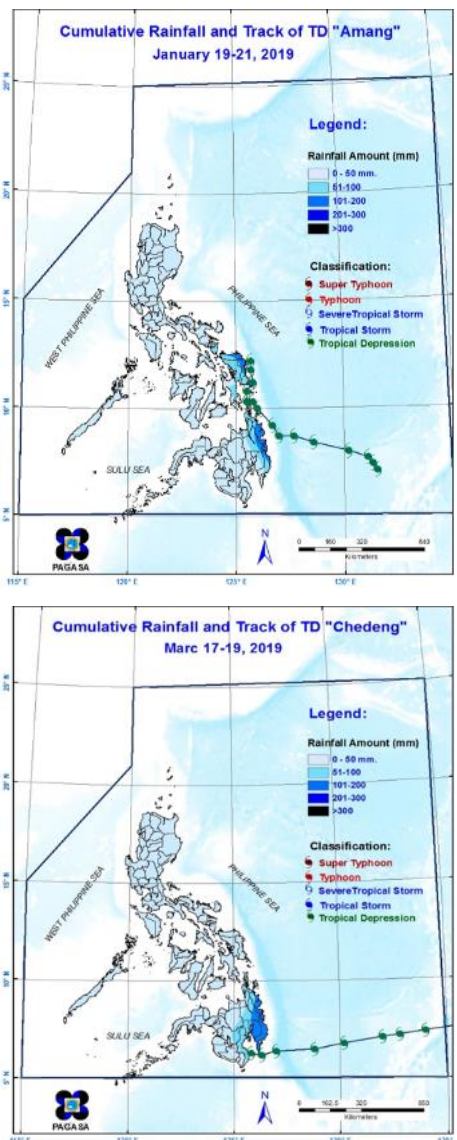

Figure 18: Track of TD "Amang" (top) and TD "Chedeng" (bottom) and the events' cumulative rainfall over the PAR.

The second quarter TCs all occurred in June 2019. TC development was less during this period due to the weak El-Niño conditions developing then over the central tropical Pacific Ocean. In June, TD "Dodong" and TD "Egay" developed into TCs inside the PAR, but did not make landfall on

any part of the Philippines. Their influence, however, enhanced the Southwest Monsoon flow slightly and the enhanced flow affected the rainfall in the western sections of the country.

Flash Floods in Southeast Sulawesi (Jun 2019)

Article contributed by Ms Marlin Denata and Ms Suci Pratiwi

Staff of Division for Climate Variability Analysis, Agency for Meteorology, Climatology and Geophysics of the Republic of Indonesia (BMKG)

On 2 June 2019, flash floods due to heavy rain were reported over North Konawe district in Southeast Sulawesi. CNN Indonesia reported financial loss up to 674.8 Billion Rupiah due to the event. The flash floods impacted 1,436 households and 5,888 people were evacuated according to Indonesia's Disaster Management Agency (BNPB) (Figure 19).

As part of the disaster response and relief efforts to the flash floods in North Konawe, BNPB monitored the situation continuously together with the local Disaster Management Agency (BPBD) and the local government in Southeast Sulawesi province. They sent an evacuation team, provided logistical assistance and continuously updated the public on the situation with weather information alerts from BMKG. The North Konawe Regent declared a state of emergency from 2-16 June 2019.

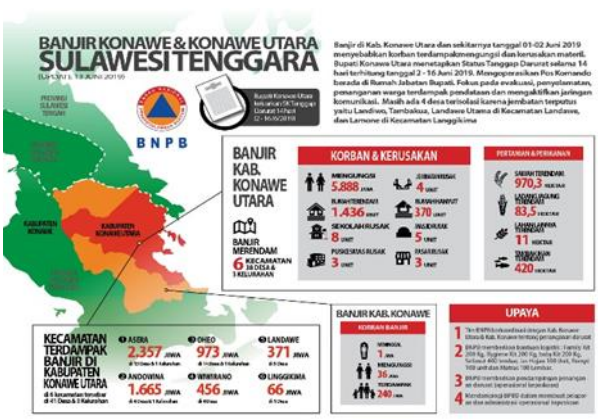

Figure 19: An infographic (in local language) illustrating the impact of and disaster response for the flash floods. Credit: BNPB.

Based on the analysis of accumulated rainfall from 1-10 June 2019, the highest rainfall occurred over North Konawe district (Figure 20). During this period, the MJO was observed to be in Phases 2 and 3 (over the Indian Ocean). Also, the Asia Monsoon Index during the period (averaged over 1-10 June 2019) was observed to be active and stronger than its climatology, possibly enhancing the rainfall over Indonesia, including Southeast Sulawesi.

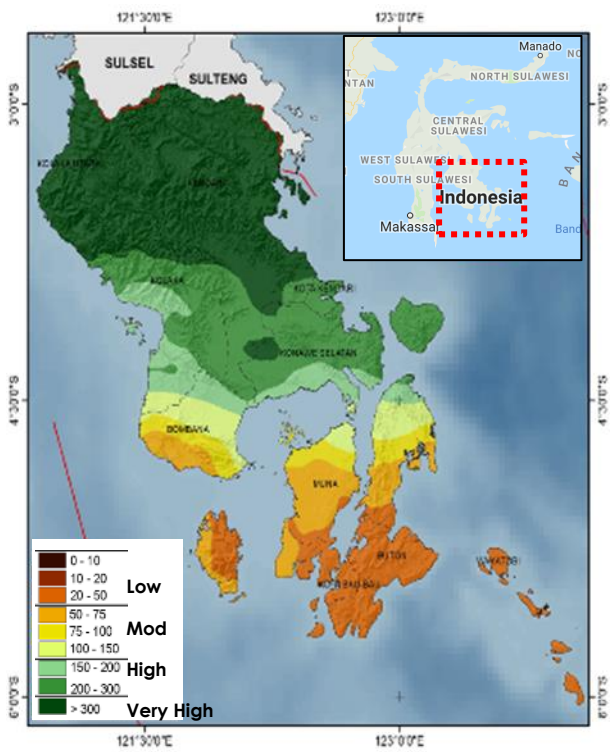

Figure 20: Rainfall amounts (mm) over North Konawe District from 1-10 June 2019. Credit: Google Map (inset).

Figure 21 shows the actual rainfall amount averaged over Southeast Sulawesi from 1-10 June 2019 (~250 mm) was higher than its climatology for the same period (~80 mm).

ECMWF S2S Forecast

Figure 22 shows the deterministic rainfall amount forecasts valid between 1 and 10 June 2019 initialised on 27 May 2019. The high rainfall amounts were forecast over Southeast Sulawesi at least one week before the event.

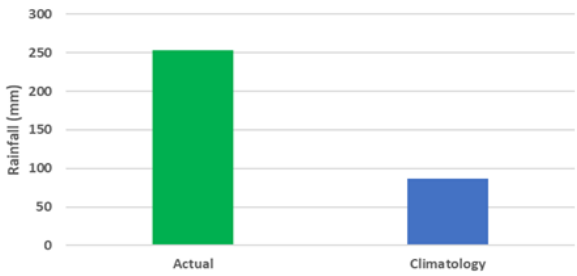

Figure 21: Actual rainfall amount averaged over Southeast Sulawesi from 1-10 June 2019 (green) compared to the same period's climatology (blue).

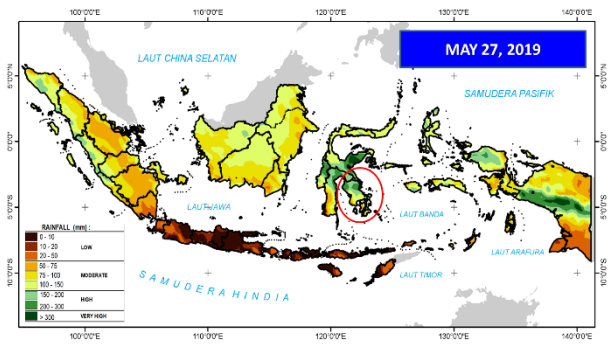

Figure 22: Deterministic rainfall amount forecast from ECMWF initialised on 27 May 2019, showing potentially high rainfall amounts over the period 1-10 June 2019.

In Figure 23, the plot shows probabilistic rainfall forecasts above 100 mm. The forecasts indicate an increased risk of high amounts of rainfall over the region.

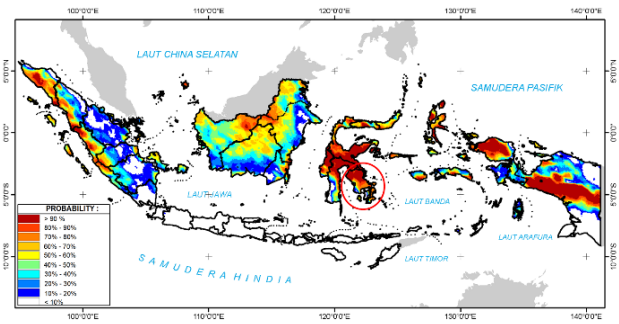

Figure 23: Probabilistic S2S forecast initialised on 27 May 2019 for the period 1-10 June 2019 for rainfall amounts more than 100 mm.

Based on the analysis of this event, the ECMWF S2S forecast had captured the extreme event at least a week in advance. The forecast could potentially be used to warn the public and disaster agencies earlier.

Extreme Warm Event over Northern Viet Nam (Jun 2019)

Article contributed by Dr Chinh Ta Huu

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The northern Viet Nam region was ranked as one of the extreme warm areas over the world in June 2019 (Tokyo Climate Center report). The data collected from observed stations over Viet Nam showed that anomalies of monthly mean temperature ranged from 2°C to over 3°C (Figure 24).

There were 25 days of the month hitting heatwave values (daily maximum temperature over 35°C). For most of these days, the daily maximum temperature fell within the range 37-40°C (extreme heatwave). Critically it reached peaks ranging from 42-43°C, which broke the records, for several days from 20-23 and 28-29 June 2019.

This event had severe impacts on the environment, society, and economy. For example, the extreme heatwave and rainfall deficiency triggered drought conditions around parts of Viet Nam and consequently water supply shortages for agriculture and daily water usage by the locals.

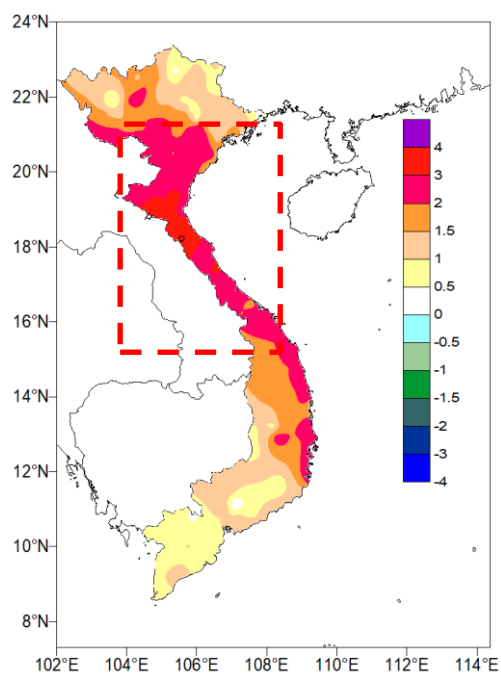


Figure 24: Temperature anomaly patterns showing much warmer conditions up to 4°C over central and northern parts of Viet Nam (red box).

The cause for the warming can be attributed to the westward displacement of the sub-tropical

high ridge and the foehn effect (Figure 25). The displacement of the sub-tropical high ridge resulted in divergence at the 500 hPa level, which suppressed cloud formation and subsequently convection. In turn, this led to an increase in direct radiation from the Sun on the ground and increased surface temperatures to levels observed during the event.

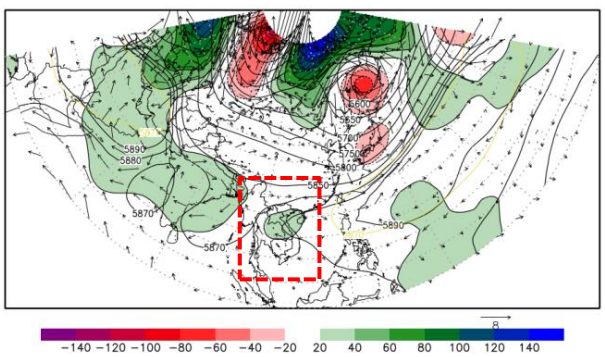


Figure 25: Upper-level divergence at 500 hPa over northern Viet Nam (red box) caused by the westward shift of the sub-tropical high ridge. The upper-level divergence caused drier and warmer conditions over the affected areas.

ASMC EVENTS

ASMC Workshop on the Use and Interpretation of Data for Land/Forest Fires and Transboundary Haze for the Southern ASEAN Region (Singapore, 26-28 June 2019)

The ASEAN Specialised Meteorological Centre (ASMC) conducted a workshop on the "Use and Interpretation of Data for Land/Forest Fires and Transboundary Haze for the southern ASEAN region" in Singapore on 26-28 June 2019. The workshop participants were from the forestry, environment and pollution control sectors of Brunei, Malaysia, and Thailand.

ASMC engages with users from the forestry, environment and pollution control sectors in the region through various means, including the conduct of customised training workshops.

In her welcome address, ASMC Director of Operations, Ms Patricia Ee emphasised the Centre's commitment to serve the region as the ASEAN centre for monitoring, assessment and early warning of fires and transboundary smoke haze. Ms Ee also emphasised on the need for collaboration among ASEAN Members to address land/forest fires and transboundary haze pollution issues.

The ASMC trainers shared on basic meteorology, remote sensing technologies, weather and climate prediction, as well as on haze modelling tools. Case studies and exercises were incorporated so that participants could apply what they have learnt and acquire practical hands-on experience with the assistance of the trainers. The participants also visited an Air Quality Monitoring station and the ASMC operations centre.

Participants on a tour of the ASMC operational facilities (top) and an Air Quality Monitoring station in Singapore (bottom). They were given a brief on how the Centre conducts monitoring and assessment of regional haze situation using the latest satellite technologies and numerical modelling tools.

Ms Haryanti Petra from the Brunei Department of Environment, Parks and Recreation commended the wide range of topics covered in the workshop. She also noted that the hands-on exercises and activities to assess hotspots and transboundary haze from satellite images were useful.

This training workshop was conducted as part of the 5-year Regional Capability Building Programme rolled out by the ASMC in 2018, aimed to benefit the ASEAN Member States through the sharing of technical knowledge and skills. Under the Programme, ASMC is investing S$5 million to

enhance its efforts in capability building covering four key priority areas, viz weather forecasting, sub-seasonal and seasonal prediction, climate change projections, and haze monitoring.

The Third Workshop of the Capability-Building Programme in Subseasonal-to-Seasonal Prediction for Southeast Asia (S2S-SEA-III, Singapore, 22-26 July 2019)

The ASEAN Specialised Meteorological Centre (ASMC) conducted the Third Training Workshop of the Capability-Building Programme in Subseasonal-to-Seasonal Predictions for Southeast Asia (S2S-SEA III) in Singapore on 22-26 July 2019. The previous two workshops were held in March 2017 and August 2018. The S2S predictions typically span timescales of 2 weeks to 2 months. The forecast range explored in this workshop series fall in the one to four weeks' timeframe.

Participants from the ASEAN NMHSs and user agencies from the region together with their trainers. NMHSs participants' interactions with potential end-users facilitated the co-development of prediction products.

The first two workshops focused on the technical capability-building of the National Meteorological and Hydrological Services (NMHSs) in S2S predictions. For the third workshop, the focus shifted to exploring prediction product development. Therefore, ASMC engaged staffs from both ASEAN NMHSs and user agencies in the region. ASEAN NMHSs were represented by nine countries comprising Brunei Darussalam, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Viet Nam. The user agencies consist of regional stakeholders and national users from the disaster-risk management or environment sectors from Lao PDR, Malaysia, Myanmar, Singapore, Thailand, and Viet Nam.

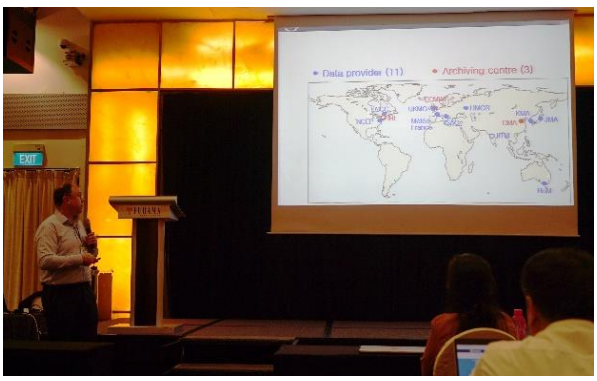
The co-chairs of S2S Prediction Project Dr Frederic Vitart (ECMWF) and Dr Andrew W. Robertson (IRI Columbia University) were supportive of the S2S-SEA workshop series since its inception in 2017. They again participated in this workshop as trainers together with Dr Angel G. Munoz from IRI Columbia University. Representatives from the United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP) and Regional Integrated Multi-hazard Early Warning System for Africa and South Asia (RIMES) also participated. They shared their expertise in designing and conducting user discussion sessions. Together, MSS and ESCAP provided sponsorship for the workshop participants' travel and accommodation.

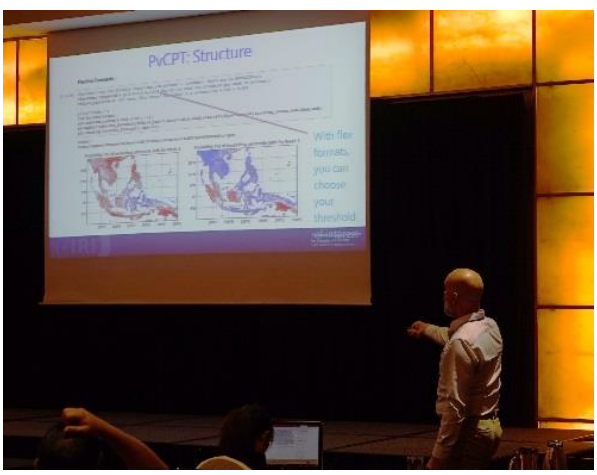
Director for the Centre for Climate Research Singapore (CCRS), Professor Erland Källén, gave the welcome address to kick-start the workshop.

Technical Training

Technical training was provided to the NMHSs on the first three days. Trainers shared on how and from where the S2S forecast and observation datasets could be accessed. Rainfall forecast values from mainly the ECMWF model were used in the workshop to assess flooding, drought, and haze in the case studies. Also used for the case studies were observation data from TRMM and CHIRPS to analyse the extreme events, and to evaluate the model's predictions. Among other topics covered, Dr Vitart shared on the need for ensemble forecast in S2S prediction, by providing examples from the ECMWF forecast and hindcast systems. This topic provided the participants with background principles for probabilistic predictions, which is a valuable tool apart from deterministic

forecasts. The importance of forecast verification and a good understanding of various forecast skill scores were heavily emphasised to ensure the forecast products were not used blindly. The NMHSs participants were also equipped with the knowledge to communicate forecast accuracy to end-users effectively.





(Top) Dr Vitart describing the S2S Database and the model data providers. (Bottom) Dr Munoz explaining the PyCPT, a key downscaling tool used in the workshop, on its structure and the types of products generated out of PyCPT.

Various prediction products were generated by the participants using the PyCPT. PyCPT, which was a tool briefly introduced at the second workshop, is an extension of the IRI's Climate Prediction Tool (CPT) in the subseasonal timescale. CPT is well-known for simplifying the application of Model Output Statistics (MOS) in seasonal predictions through the use of advanced statistical downscaling techniques such as the Principal Components Regression (PCR) and the Canonical Correlation Analysis (CCA). These techniques were used to explore calibrating and improving model forecast using carefully considered predictors.

Case Studies

A total of five high-impact disaster case studies in the region were identified and assessed in consultation with ESCAP and RIMES. The case studies covered a drought, a haze, and three flood events, providing a spectrum of scenarios to evaluate the ability of the S2S model to predict extremes. Participants were tasked with the case studies that were relevant to their regions. The NMHS participants prepared background information on the case studies with analyses on observations and forecast products. These provided the backbone for the discussions with the user agencies (on Day 4 and 5), on the types of prediction products that would be useful for the respective case studies. Together, the NMHSs and the users co-developed the forecast products of interest to their case studies. They then presented their justifications for the products co-developed and shared how these could be further explored during the planned Pilot Project in the run-up to the fourth workshop.

The NMHSs participants describing the case studies and their products to the user agencies. They were split into their groups according to their regions' relevance to the case studies.

Pilot Project

On the last day of the workshop, the objectives and the scope of the S2S Pilot Project for the Southeast Asia region was discussed with the NMHSs and user agencies. In the project, real-time S2S model predictions would be provided to the NMHSs who would then package and interpret the model information for use by the respective users. Feedback from the NMHSs and users on the products experimented during the Pilot Project

would be valuable to assess the usefulness of S2S forecasts in different applications. The sector that is of particular interest is disaster risk management, which is becoming an increasingly critical area in the face of more frequent and intense climate extremes.

Dr Vitart explaining S2S real-time Pilot Project's objectives that are focused on applications research and demonstration of products. The project will span 2 years from November 2019 to November 2021.

Upcoming Events

November 2019, Bangkok, Thailand

13th Session of the ASEAN Climate Outlook Forum (ASEANCOF-13).

The upcoming 13th Session of the Forum is a collaboration between the ASMC and Thai Meteorological Department (TMD). The Forum aims to generate consensus rainfall and temperature outlooks for the December 2019 - February 2020 boreal winter monsoon season. The consensus will be provided alongside related information on weather and climate drivers in the Southeast Asia region such as the El Niño/La Niña, Indian Ocean Dipole, and monsoons circulation. The Forum will be preceded by a pre-COF workshop session to train and update NMHS participants on the fundamental and critical topics of ensemble prediction system, probabilistic prediction, and forecast verification.

February 2020, Singapore

Third Workshop on ASEAN Regional Climate Data, Analysis and Projections (ARCDAP-3)

The ARCDAP workshop series aims to improve regional knowledge on climate variability and change, climate extremes, and the evaluation of climate simulations, as well as encourage regional information sharing. Conducted in collaboration between the WMO and ASMC, the third workshop will assess the performance of available Global Climate Models (GCMs) and Regional Climate Models (RCMs) and how well they represent climate drivers (e.g. ENSO, monsoons circulation) in the Southeast Asia region.

This bulletin is a biannual publication of ASMC. It is published annually in March and September, and provides 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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