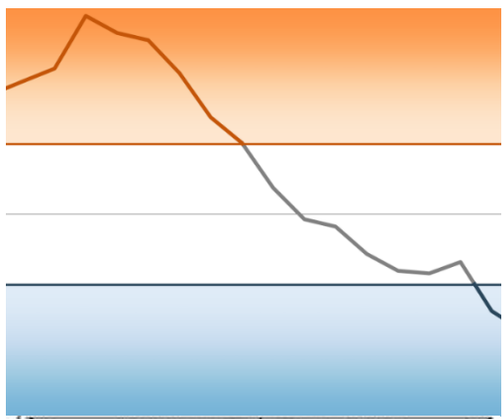
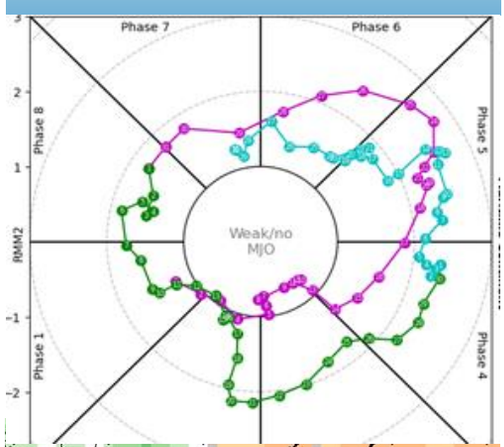
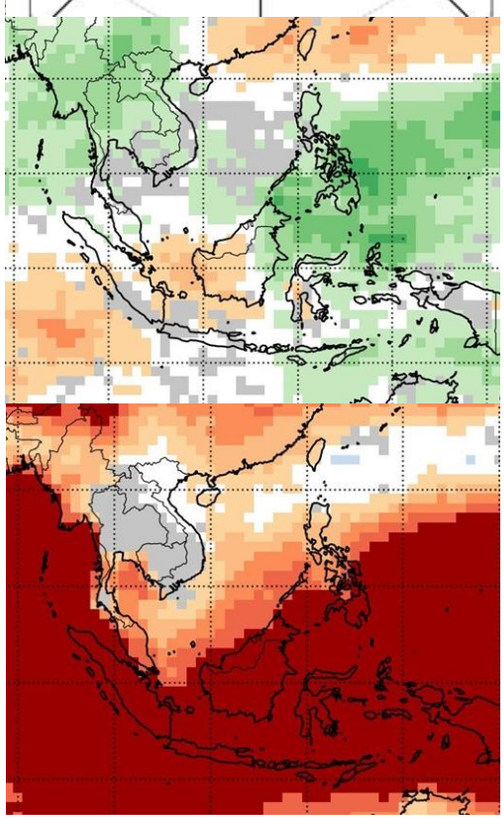
ASEAN SPECIALISED METEOROLOGICAL CENTRE

ASMC CLIMATE BULLETIN

MARCH 2025







HIGHLIGHTS:

July – December 2024 Climate Review:

- Warmer than average land and sea surface temperature
- MJO was unusually active October - December

March to August 2025 Climate Outlook:

- La Niña conditions likely to transition into ENSO neutral by Q2 2025.
- Above-normal rainfall is predicted over the eastern Maritime Continent and much of Mainland Southeast Asia for March - May

ASMC SPECIALISED METEOROLOGICAL CENTRE

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CLIMATE REVIEW (JUL – DEC 2024)

Transition towards La Niña conditions with signs of a short-lived negative Indian Ocean Dipole

El Niño Southern Oscillation (ENSO) refers to an ocean-atmosphere phenomenon in the tropical Pacific and is an important climate driver for year-to-year variability in Southeast Asia's rainfall and Temperature. The Indian Ocean Dipole (IOD) is a similar phenomenon in the Indian Ocean that also influences the region. More information at: https://asmc.asean.org/asmc-el-nino/.

El Niño Southern Oscillation (ENSO)

ENSO neutral conditions were present for much of the second half of 2024, with signs of La Niña conditions towards the end of the year. From July onwards there was a gradual decrease in the Nino3.4 index, although it only crossed the La Niña threshold in December 2024 (Figure 1). Key atmospheric indicators of ENSO (e.g. trade wind strength and cloudiness) showed signs of La Niña conditions during the last quarter of the year, with strengthening of the trade winds and increased cloudiness over the western Pacific that are typical of La Niña conditions becoming more persistent from December.

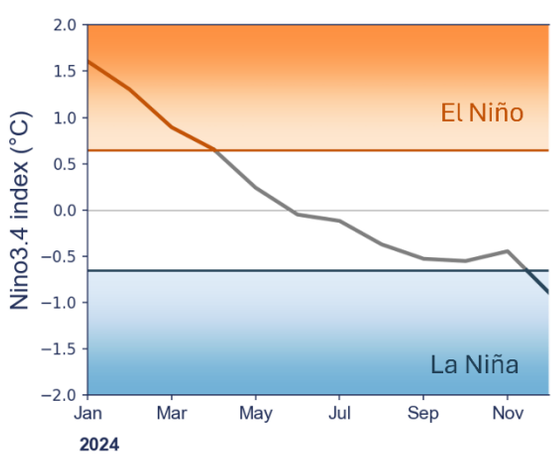

Figure 1: The Nino3.4 index (detrended) using the 1-month values. Warm values (≥ +0.65; orange) correspond to El Niño conditions while cold values (≤ -0.65; blue) correspond to La Niña conditions, otherwise neutral (> -0.65 and < +0.65). Reference methodology: Turkington, Timbal, & Rahmat, 2018.

In June 2024, models from the Copernicus C3S multi-model system predicted a gradual reduction of the Nino3.4 index with La Niña conditions to develop during September-October 2024. However, some models predicted the ENSO neutral conditions to persist (Figure 2). The strength of the potential La Niña conditions varied between weak to moderate by the end of 2024.

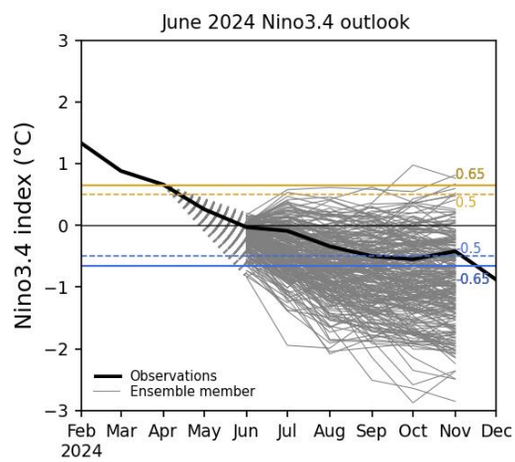

Figure 2: Forecasts of Nino3.4 index's strength (red lines) in June 2024 for the second half of 2024 from various seasonal prediction models of international climate centres. Observed values are in blue. Data credit: Copernicus C3S (https://climate.copernicus.eu/charts/c3s_seasonal/)

Indian Ocean Dipole (IOD)

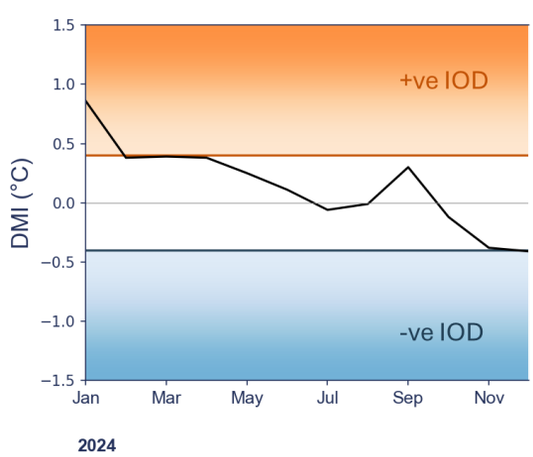

Figure 3: Indian Ocean Dipole (IOD) index showing predominantly neutral IOD conditions in 2024, based on the Dipole Mode Index (DMI).

For much of the second half of 2024, the IOD index was within the neutral range. Towards the end of the year, there were signs of a negative IOD with the index near the negative IOD

threshold in November – December 2024. Negative IOD events typically bring wetter conditions to parts of Southeast Asia.

Temperature Conditions

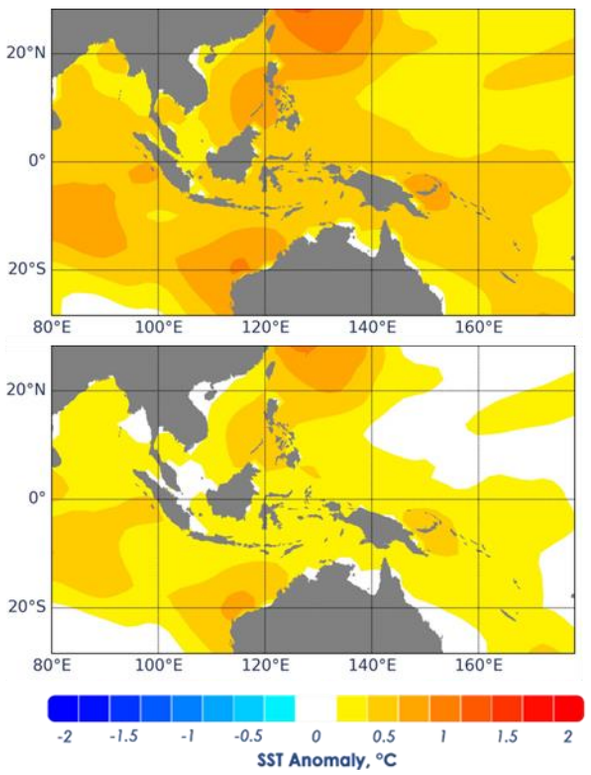

Figure 4: Average sea surface temperature (SST) anomalies for July – December 2024 (upper) and for the same period but removing the long-term warming trends (lower). SSTs were warmer than average (orange shades) for most of the region, even removing the long-term warming trend. Anomalies refer to difference from the 1991-2020 climatology. Data: ERSSTv5.

Throughout the second half of 2024, the sea surface temperatures (SSTs) around the ASEAN region were warmer than average (Figure 4; upper). Removing the long-term warming trend (Figure 4; lower), these SSTs were still warmer for much of the region, potentially associated with the 2023/2024 El Niño event.

Overall, much of the ASEAN region experienced above-average temperatures in the second half of 2024 (Figure 5). During July – September 2024 (Figure 5; upper), most of the southern ASEAN region experienced temperatures between 0.5°C – 1.0°C warmer than average. Over the northern ASEAN region temperature anomalies were milder with only the eastern and northwestern parts of the region recording anomalies of 0.5°C – 1.0°C. The warm anomalies over most of the southern ASEAN region persisted through October – December 2024 (Figure 5; lower). Over the northern ASEAN region, warm anomalies of 0.5°C – 1.0°C above average were recorded mostly over the western and eastern parts of the region during October – December 2024.

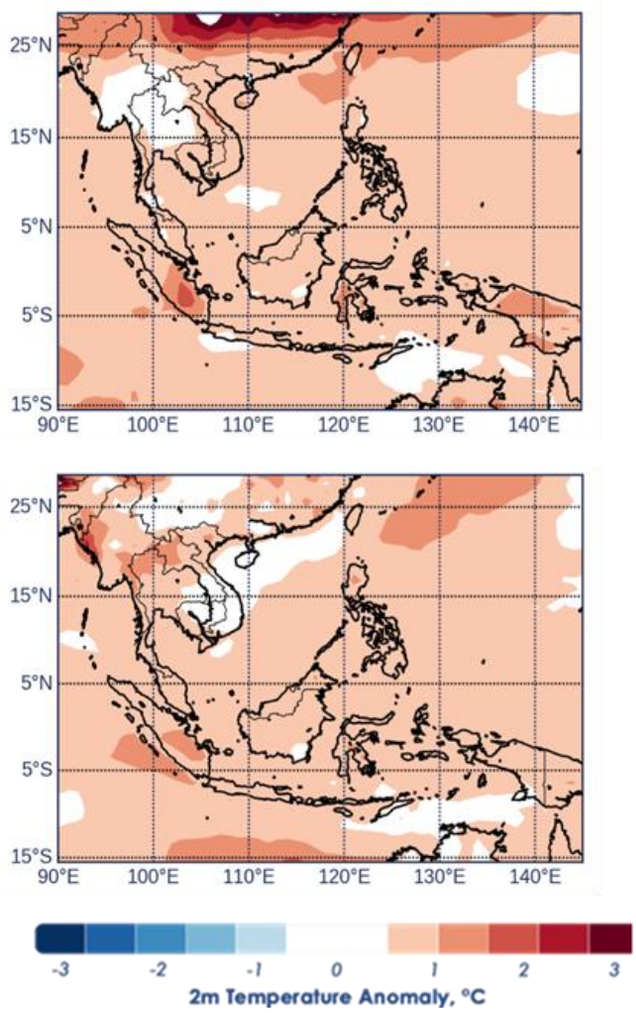

Figure 5: Average 2-metre temperature anomalies (˚C) against 1991-2020 climatology for July – September 2024 (upper) and October – December 2024 (lower) show above-average temperatures (red shades) for much of the southern ASEAN region in the first half of 2024. Data: ECMWF, ERA5.

With the neutral ENSO conditions during the second half of 2024, the warmer temperatures than average are partly associated with the long-term warming trend as well as the warm SSTs.

Rainfall Conditions

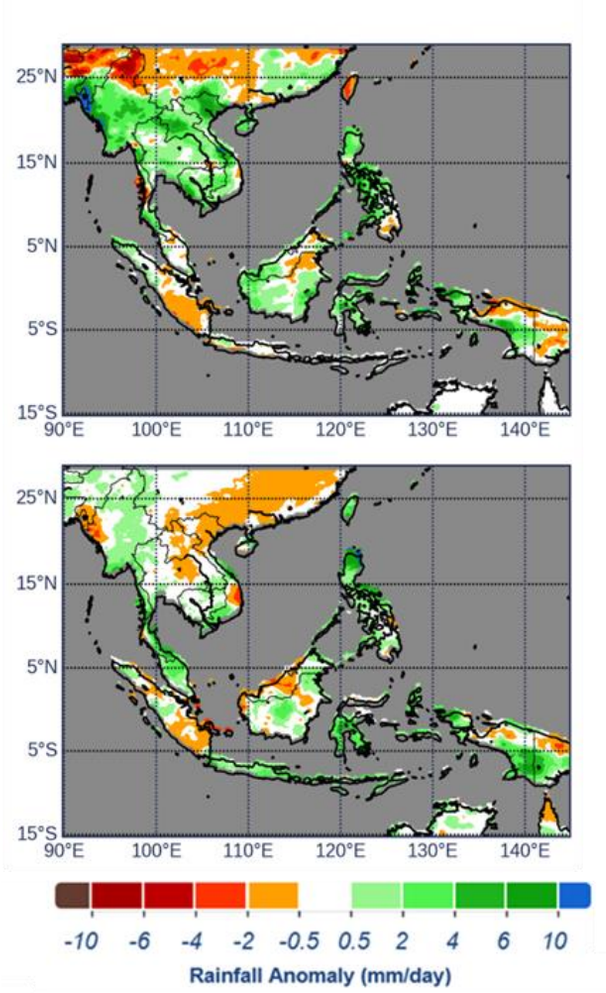

Figure 6: Rainfall anomaly (in mm/day) for July – September 2024 (upper) and October – December 2024 (lower) against 1991-2020 climatology from CHIRPS dataset. Areas in green experienced wetter than average conditions, while those in orange experienced drier than average conditions. Data: CHIRPS, IRI Data Library.

During the July to September 2024 period (Figure 6; upper), much of the Maritime Continent experienced above-average rainfall, except for parts of the western and central region. Western parts of Mainland Southeast Asia experienced above-average rainfall, with a mix of below- to above-average rainfall for the rest of the region.

During the October to December 2024 period (Figure 6; lower), much of the central and eastern Maritime Continent recorded above-average rainfall, while the southern and much of the western parts of the region experienced near average and below-normal rainfall, respectively. Much of Mainland Southeast Asia recorded above-average rainfall during this period.

Madden-Julian Oscillation

On top of ENSO and IOD, intra-seasonal variability can also play a role in influencing the region's rainfall. The Madden-Julian Oscillation (MJO) is one key sources of variability at this timescale and is characterised by a pulse of cloud or rain that moves around the equator, with a typical cycle around 30 to 60 days. The location of the enhanced convective activity is divided into regions, or phases as in Figures 7 and 8, with values greater than 1 (black circle) typically indicating the presence of an MJO signal.

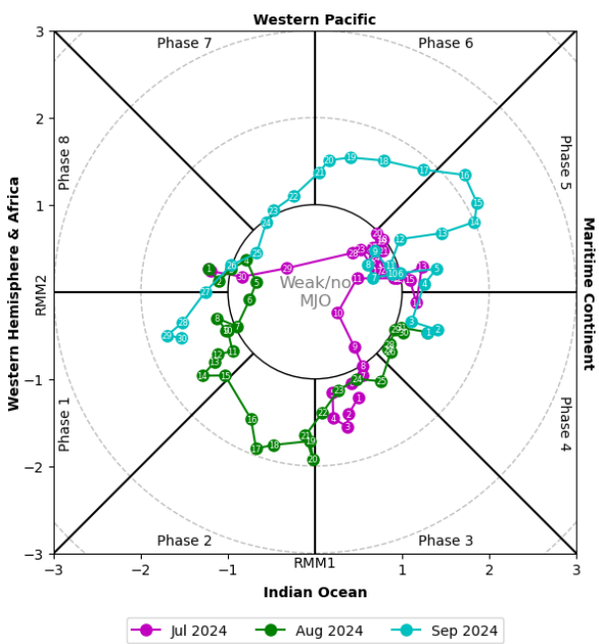

Figure 7: MJO strength and phases during July to September 2024. Data: BoM, Australia (http://www.bom.gov.au/climate/mjo/)

During July to September 2024 the Madden-Julian Oscillation (MJO) signal was active (outside the unit circle) on about two-thirds of days (Figure 7). An MJO signal was present over the Indian Ocean (Phase 3) in early July 2024, weakening by the second week and remaining within the unit circle for almost all of the rest of the month. A new MJO event initiated in the first few days of August 2024 over the Western Hemisphere and Africa (Phases 8 and 1). It strengthened as it propagated eastwards to the Indian Ocean (Phase 2) by the third week of the month.

Throughout the remainder of August and September 2024, the MJO continued to propagate eastwards through the Indian Ocean (Phase 3), Maritime Continent (Phases 4 and 5), Western Pacific (Phases 6 and 7) and back to the Western Hemisphere and Africa (Phases 8 and 1). During this time the signal had a relatively weak amplitude (near the unit circle), with the exception of one week around the middle of September 2024, when there was a brief but substantial strengthening of the signal as it propagated from the eastern Maritime Continent to the West Pacific (Phases 5 and 6). These phases typically bring wetter conditions to the eastern Maritime Continent and southeastern Mainland Southeast Asia. However, Phases 1 and 2, which were seen during August, typically bring drier conditions for these regions, making the MJO's influence difficult to discern in July – September 2024 (Figure 6, upper).

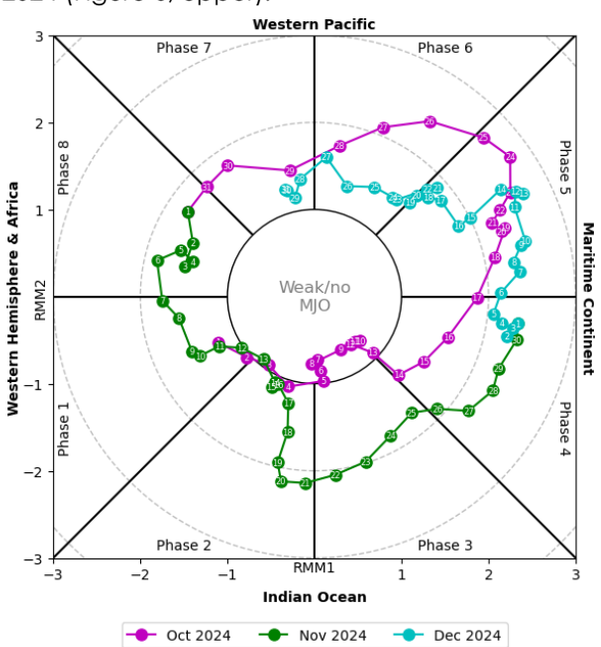

Figure 8: MJO strength and phases during October to December 2024. Data: BoM, Australia (http://www.bom.gov.au/climate/mjo/)

During October to December 2024 (Figure 8), the MJO signal was active (outside the unit circle) on 88.0% of days, making this the most active October–December period on record (using records from 1974 to 2024, omitting 1978 due to missing data). On average during October to December, the MJO signal is strong on 61.7% of days. The MJO event that initiated in early August 2024 (see above), having already circumnavigated the globe once by the start of October 2024, had made almost two more complete circumnavigations by the end of December 2024. During this time, the amplitude tended to be considerably higher than was seen in July to September 2024. The amplitude was especially strong as the MJO propagated through the eastern Maritime Continent (Phase 5), in mid- to late-October 2024 and again in early- to mid-December. Such an MJO signal typically brings wetter conditions to the eastern Maritime Continent, while the western Maritime Continent typically is entering drier conditions, especially over land. This pattern in line with the wetter conditions over the eastern Maritime Continent compared to the western Maritime Continent during October – December 2024.

Reviews of MJO influence for the individual months can be found on the ASMC website (e.g., https://asmc.asean.org/subseasonal-weather-review-of-regional-weather-for-december-2024).

CLIMATE OUTLOOK (Mar – August 2025)

La Niña conditions are likely to transition into ENSO neutral by April- May 2025

ENSO Outlook

At the start of 2025 La Niña conditions were present over the tropical Pacific Ocean, with negative sea-surface temperature (SST) anomalies over the Nino3.4 region. However, Nino3.4 outlooks from international centres indicate a weakening of the anomalies and a transition into ENSO neutral conditions by April – May 2025 (Figure 9). After April the outlook is uncertain, although currently the models predict ENSO conditions are most likely to be neutral towards the middle of the year.

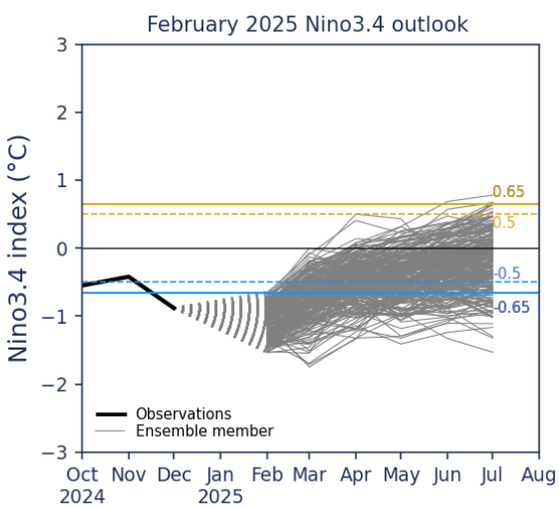

Figure 9: Nino3.4 detrended SST anomaly predictions from the modified C3S Copernicus models output showing colder temperatures until the end of April. Subsequently, most models predict ENSO neutral conditions for May–July 2025 period.

In agreement with the Nino3.4 index predictions, the ensemble-mean predictions of SST anomalies show weak La Niña or ENSO neutral conditions over the tropical Pacific Ocean during March – May 2025 with remain slightly warmer over the central and western tropical Pacific Ocean compared to in the east (Figure 10). Sea-surface temperature anomalies are predicted to be positive for much of the other tropical ocean regions.

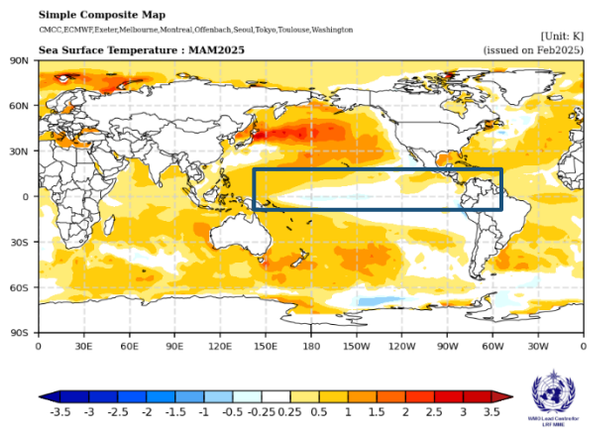

Figure 10: SST anomaly prediction for March-May (MAM) 2025 from WMO showing ENSO neutral conditions in the tropical Pacific Ocean (blue box). Credit: WMO Lead Centre for Long-Range Forecasting.

IOD outlook

The IOD was neutral in February 2025. IOD neutral conditions are likely to persist during March-May 2025 (Figure 11), with no significant difference predicted for the SST anomalies between the western and eastern tropical Indian Ocean during this time period (Figure 10). There are signs of a negative IOD to develop during June-July 2025, although IOD predictions tend to be less skilful at this time of the year.

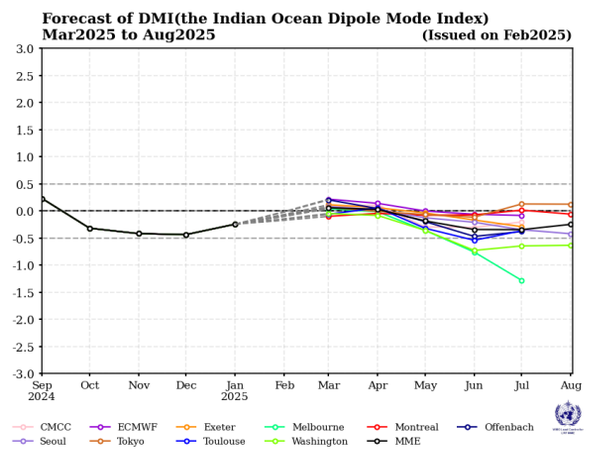

Figure 11: IOD index predictions, from models available on the WMO Lead Centre for Long-Range Forecasting, show neutral IOD conditions in the tropical Indian Ocean during March–May 2025. Credit: WMO Lead Centre for Long-Range Forecasting.

Rainfall Outlook

In the upcoming March – May 2025 period, model predictions from selected C3S models (SEA RCC-Network Long-range Forecasting Node) indicate a moderate increase in chance of above-normal (wetter) conditions over the over the eastern Maritime Continent and a small increase in chance of above-normal (wetter) conditions over much of Mainland Southeast Asia (Figure 12). Below-normal (drier) to near-normal conditions are predicted over the western and central Maritime Continent. These predicted conditions during MAM 2025 correspond with the transition from La Niña conditions into ENSO neutral conditions over the tropical Pacific Ocean.

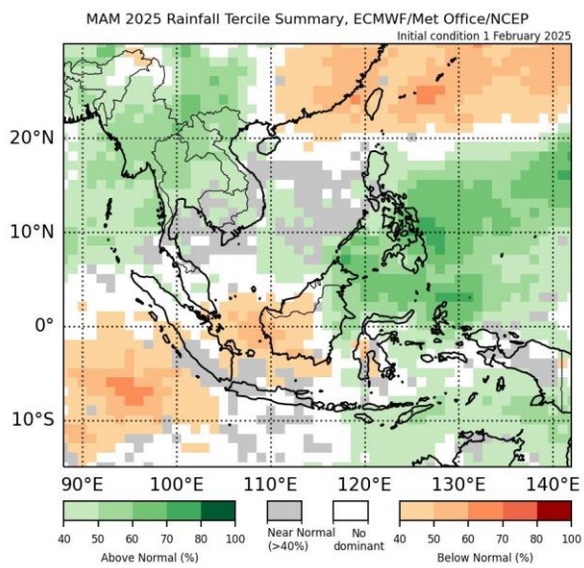

Figure 12. Rainfall tercile summary predictions from the multi-model ensemble forecast for March-May (MAM) 2025. Brown shades show regions with a higher likelihood of drier conditions, while green shades show regions with a higher likelihood of wetter conditions (contains modified Copernicus C3S information).

Temperature Outlook

For temperature, above-normal (warmer) conditions during March – May 2025 are predicted for the Maritime Continent and western Mainland Southeast Asia, with near-normal temperature predicted for central and eastern Mainland Southeast Asia (Figure 13).

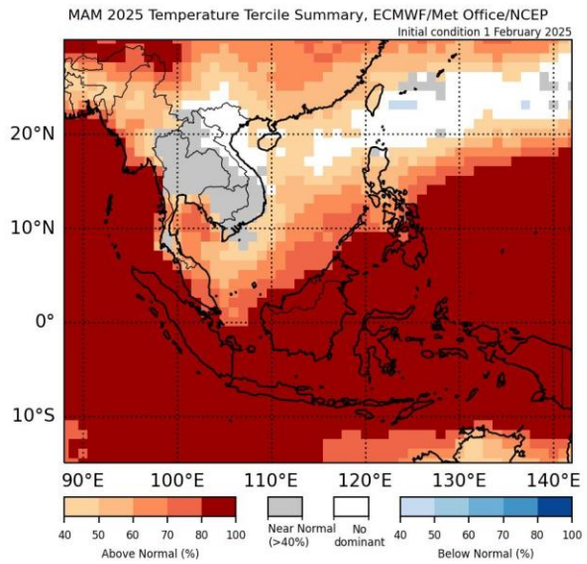

Figure 13: Temperature tercile summary predictions from the multi-model ensemble forecast for March-May (MAM) 2025. Red shades show regions with a higher likelihood of warmer conditions, while blue shades show regions with a higher likelihood of cooler conditions (contains modified Copernicus C3S information).