

ASMC CLIMATE BULLETIN

MARCH 2024

HIGHLIGHTS:

July – December 2023 Climate Review:

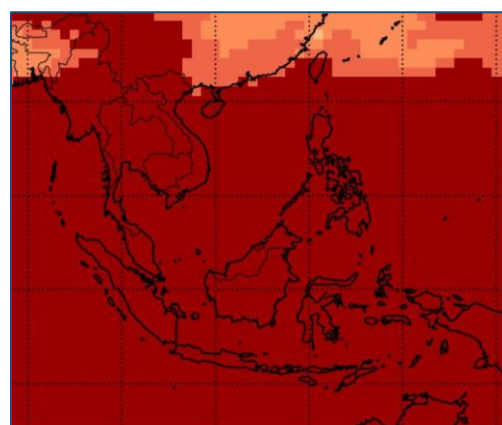
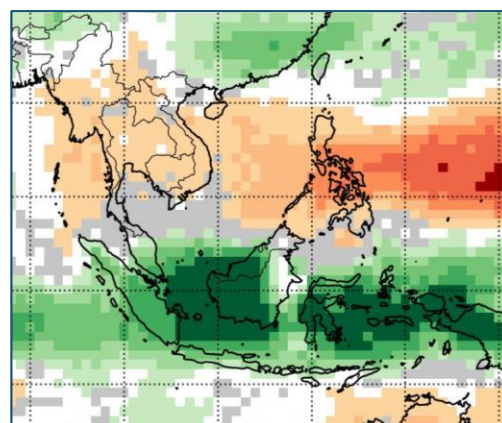
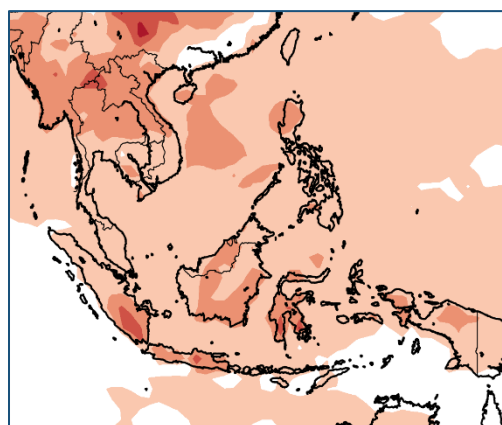
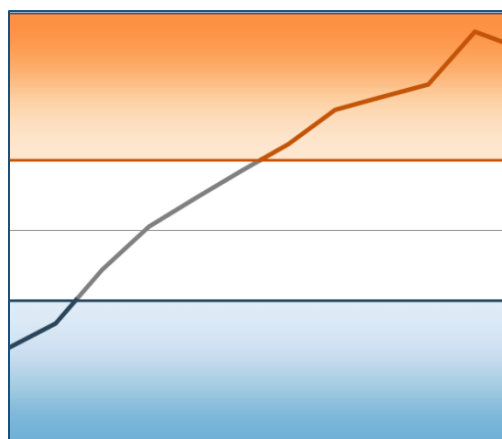
- Both an El Niño and positive IOD event were present.

March to August 2024 Climate Outlook:

- El Niño conditions likely to transition into ENSO neutral during Q2 2024.
- Above-normal rainfall is predicted over the southern ASEAN region with below-normal rainfall predicted over much of the northern ASEAN region.
- Above-normal temperature is predicted for the entire ASEAN region.

**ASMC SPECIALISED
METEOROLOGICAL CENTRE**

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CLIMATE REVIEW (JUL – DEC 2023)

El Niño and positive IOD events

El Niño Southern Oscillation (ENSO)

El Niño conditions were present for the second half of 2023. The warming of the Nino3.4 index from the start of 2023 continued, with the 1-month Nino3.4 index passing the 0.65°C threshold in July 2023 (Figure 1). The index continued to increase, reaching a peak value of 1.83°C, indicating a moderate-strong El Niño event (although not as strong as the 2015/2016 El Niño). Key atmospheric indicators of ENSO (e.g. trade wind strength and cloudiness) indicated El Niño conditions during the second half of the year, with the strongest signal from September onwards.

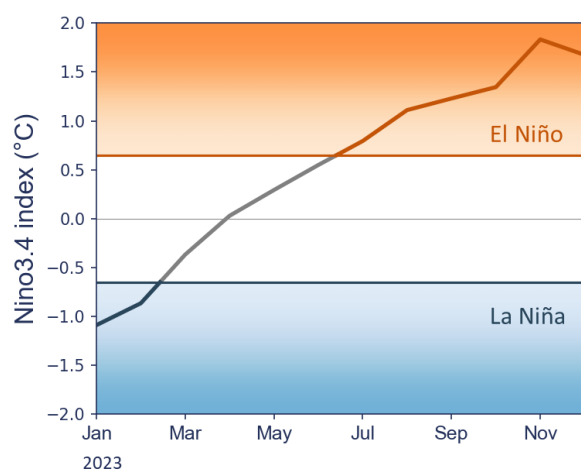


Figure 1: The Nino3.4 index (detrended) using the 1-month SST anomalies. Warm anomalies ($\geq +0.65$; orange) correspond to El Niño conditions while cold anomalies (≤ -0.65 ; blue) correspond to La Niña conditions, otherwise neutral (> -0.65 and $< +0.65$). Reference methodology: Turkington, Timbal,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

In June 2023, models from the [Copernicus C3S](#) multi-model system predicted El Niño conditions from June/July 2023 (Figure 2). The strength of the El Niño conditions varied between weak to strong El Niño conditions by the end of 2023.

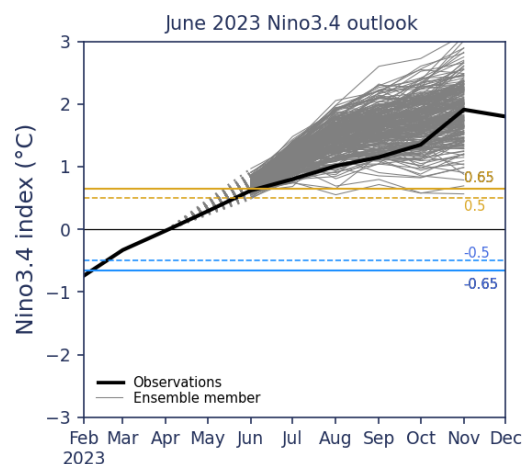


Figure 2: Forecasts of Nino3.4 index's strength (red lines) in June 2023 for the second half of 2023 from various seasonal prediction models of international climate centres. Observed values are in black. Data credit: Copernicus C3S.

Indian Ocean Dipole (IOD)

From July 2023 onwards, there were signs of a positive IOD developing, with the positive IOD event established by the end of August 2023 (Figure 3). The positive IOD was strongest in October 2023, although not as strong as the 2019 positive IOD. The positive IOD started showing signs of weakening from November onwards, although still present at the end of December 2023. Typically, positive IOD events bring drier conditions to parts of the ASEAN region.

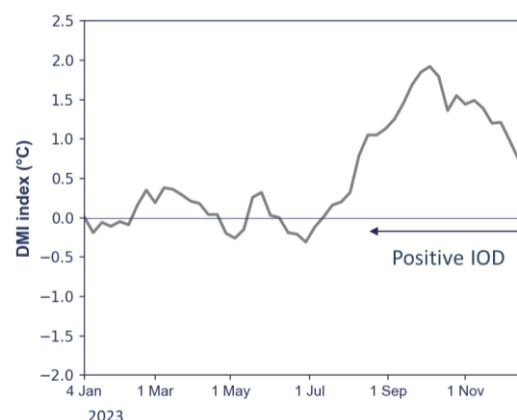


Figure 3: Indian Ocean Dipole (IOD) index showing an episode of negative IOD event in the second half of 2023. Data Credit: Bureau of Meteorology, Australia.

Temperature Conditions

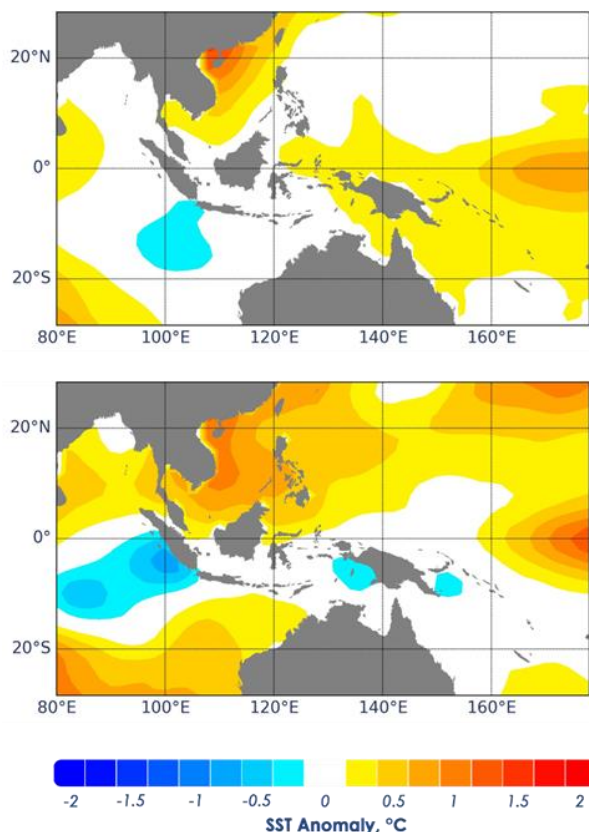


Figure 4: Average sea surface temperature (SST) anomalies for July – September 2023 (upper) and October – December 2023 (lower). SSTs were warmer than average (orange shades) for the equatorial Pacific Ocean in July – September 2023, and much of the region around Southeast Asia in October – December 2023, apart from the southeastern Indian Ocean that experienced cooler than average temperatures (blue shades) associated with the positive IOD. The reference climatology is from 1991 to 2020. Data: [ERSSTv5](#).

Both the El Niño and positive IOD events influenced the SSTs around the ASEAN region in the second half of 2023 (Figure 4). While warm SST anomalies were observed for the western equatorial Pacific Ocean for July – September 2023, the SSTs were still warmer to the east, indicative of El Niño conditions. By October – December 2023, these SSTs cooled to below-to-near average temperatures, more in line with typical El Niño conditions. In the southeastern Indian Ocean (near Sumatra), cool SST anomalies strengthened between July – September and October – December 2023, in line with the strengthening positive IOD event.

Elsewhere, warm SSTs in the northern ASEAN region expanded during the second half of 2023. Confined to the South China Sea during July –

September 2023, and the warm SST anomalies covered most of the regions north of the equator during October – December 2023.

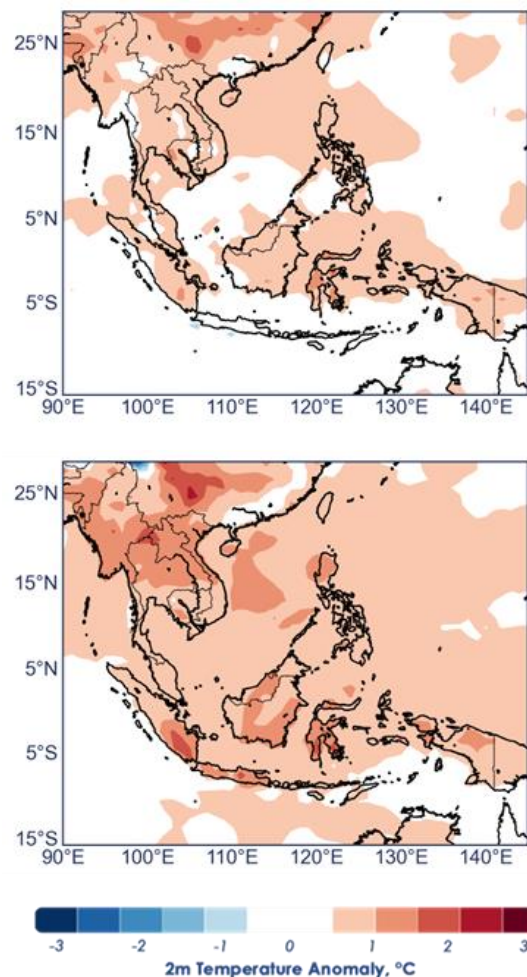


Figure 5: Average 2-metre temperature anomalies (°C) against 1991-2020 climatology for July – September 2023 (upper) and October – December 2023 (lower) show above-average temperatures (red shades) for much of Southeast Asia in the second half of 2023. Data: [ECMWF](#), [ERA5](#).

Overall, the ASEAN region experienced above-average temperatures in the second half of 2023 (Figure 5). During July – September 2023 (Figure 5; upper), most of the region experienced temperatures on average between 0.5°C – 1.0°C warmer. These warm anomalies increased for October – December 2023 (Figure 5; lower), with parts of both the northern and southern ASEAN region experienced temperatures more than 1.5°C above average.

Warmer than average temperatures are typical of El Niño events during this period, along with the long-term warming trend.

Rainfall Conditions

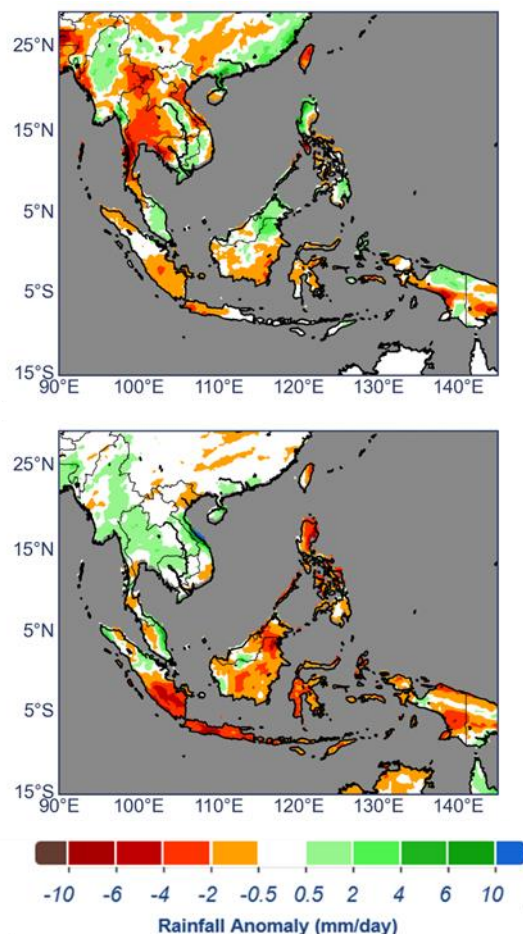


Figure 6: Rainfall anomaly (in mm/day) for July – September 2023 (upper) and October – December 2023 (lower) against 1991-2020 climatology from CHIRPS dataset. Areas in green experienced wetter than average conditions, while those in orange experienced drier than average conditions. [Data: CHIRPS, IRI Data Library](#).

During the July to September 2023 period (Figure 6; upper), much of the Maritime Continent experienced below-average rainfall, which was likely influenced by the El Niño event during this time. Central parts of Mainland Southeast Asia experienced below-average rainfall, with a mix of below- to above-average rainfall for the rest of the region.

During the October to December 2023 period, most of the Maritime Continent recorded below-average rainfall, apart from the western Maritime Continent (Figure 6; lower). This dry pattern was typically observed during El Niño events in the Northeast Monsoon (mid-November to March) period. The southwestern Maritime Continent was particularly drier than average, likely from both the El Niño as well as the positive IOD events.

Mainland Southeast Asia recorded near-to above-average rainfall during this period.

Madden-Julian Oscillation

While two of the main climate drivers (IOD and ENSO) were active during various times in the second half of 2023, intra-seasonal variability can still play a role in influencing the region's rainfall.

MJO Phases: Jul-Sep 2023

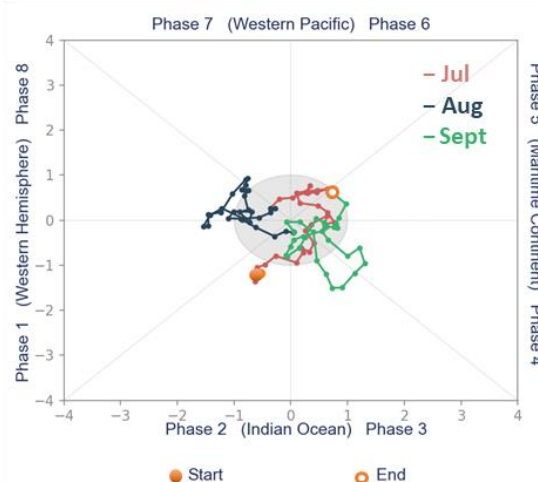


Figure 7: MJO strength and phases during July (red), August (blue) and September (green) 2023. The orange dots mark the start and end of the timeseries. [Data: BoM, Australia](#).

At the intra-seasonal timescale during July to September 2023, the Madden-Julian Oscillation (MJO) signal tended to be weak for most of the time (within the unit circle) (Figure 7). An MJO signal was present over the Indian Ocean (Phase 2) in early July 2022, weakening by the second week. While there were some signs of an MJO signal over the Western Hemisphere in August (Phase 1), there was no sustained eastward propagation outside the unit circle. For September 2023, an MJO signal developed over the Indian Ocean (Phase 3) during the first week. However, during the second week the signal weakened over the Maritime Continent (Phase 4). As there was no significant MJO activity, the contribution to rainfall conditions over the ASEAN region during July – September was likely negligible.

MJO Phases: Oct-Dec 2023

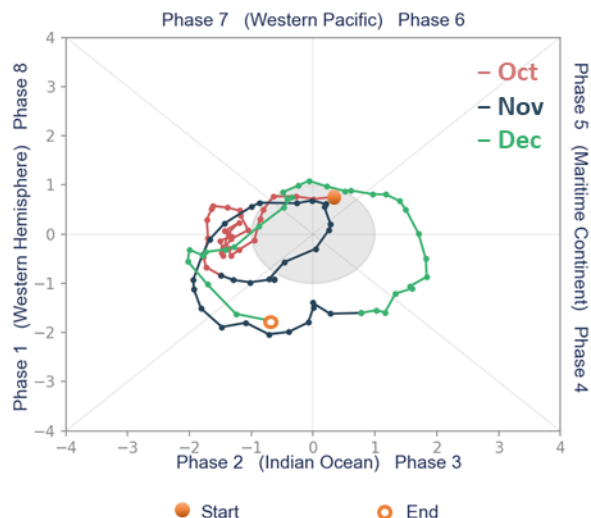


Figure 8: MJO strength and phases during October (red), November (blue) and December (green) 2023. The orange dots mark the start and end of the timeseries. [Data: BoM, Australia](#).

During October to December 2022, there was increased MJO activity (Figure 8). There were signs of an MJO signal emerging in the second week of October over the Western Hemisphere (Phases 8 and 1), although this signal weakened during the first week of November over the Indian Ocean (Phase 2). An MJO signal emerged again over the Western Hemisphere (Phase 8) in the second half of November, which continued propagating eastward reaching the Maritime Continent (Phase 4) in the first week of December. The signal weakened over the Western Pacific (Phases 6 and 7) before strengthening again over the Western Hemisphere (Phase 1) during the last week of December.

The MJO signal completed a full circle around the globe during October – December 2023, including through Phases 4 and 5 that typically bring wetter conditions for the region and Phases 8 and 1 that typically bring drier conditions. However, with slightly longer time in the Western Hemisphere (Phases 8 and 1), may have contributed to the drier conditions, although with the El Niño and positive IOD events (Figure 6l lower).

CLIMATE OUTLOOK (Mar – Aug 2024)

IOD conditions remain neutral and El Niño conditions are likely to transition into ENSO neutral during April - May 2024

ENSO Outlook

At the start of 2024, El Niño conditions were present over tropical Pacific Ocean, with positive sea-surface temperature (SST) anomalies over the Nino3.4 region. However, Nino3.4 outlooks from international centres indicate a rapid weakening of the anomalies and a transition into ENSO neutral conditions during April – May 2024 (Figure 9). After April the outlook is uncertain, although currently the models predict an increase in the chance of La Niña conditions towards the middle of the year.

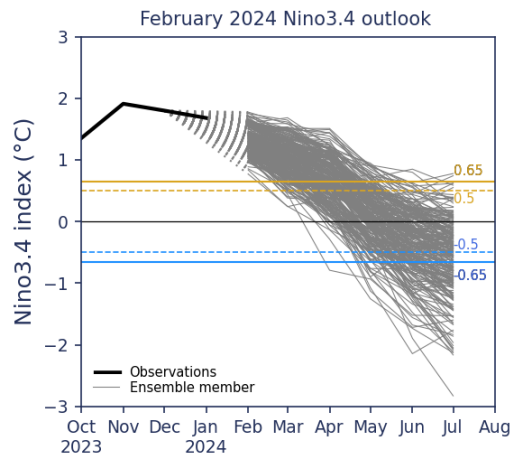


Figure 9: Nino3.4 detrended SST anomaly predictions from the modified C3S Copernicus models output showing weakening of the index, with potentially La Niña conditions developing during June – July 2024.

In agreement with the Nino3.4 index predictions, the ensemble-mean predictions of SST anomalies show weak El Niño or ENSO neutral conditions over the tropical Pacific Ocean during March – May 2024 (Figure 10). Sea-surface temperature anomalies are predicted to be positive for much of the tropical region, although remain slightly warmer over the central and eastern tropical Pacific Ocean compared to in the west.

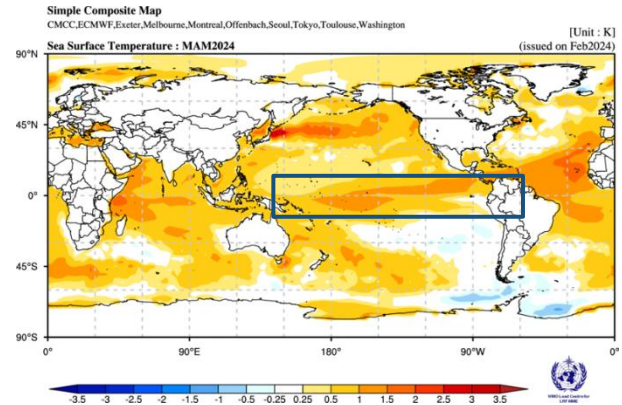


Figure 10: SST anomaly prediction for March-May (MAM) 2024 from WMO showing ENSO neutral conditions in the tropical Pacific Ocean (blue box). Credit: WMO Lead Centre for Long-Range Forecasting.

IOD outlook

The positive IOD event likely ended in early 2024, with a return to IOD neutral conditions in February. IOD neutral conditions are likely to persist during March-May 2024 (Figure 11), with no significant different predicted for the SST anomalies predicted between the western and eastern tropical Indian Ocean during this time period (Figure 10).

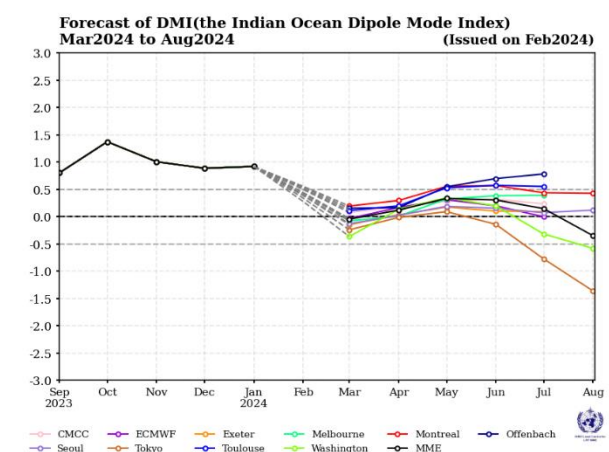


Figure 11: IOD index predictions, from models available on the WMO Lead Centre for Long-Range Forecasting, show neutral IOD conditions in the tropical Indian Ocean during March-May 2024. Credit: WMO Lead Centre for Long-Range Forecasting.

Rainfall Outlook

In the upcoming March – May 2024 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 southern ASEAN region, while small increase in chance of below-normal (drier) conditions is predicted over much of the northern ASEAN region (Figure 12). These predicted conditions during MAM 2023 correspond with the current IOD neutral conditions and the transition from El Niño conditions into ENSO neutral conditions over the tropical Pacific Ocean.

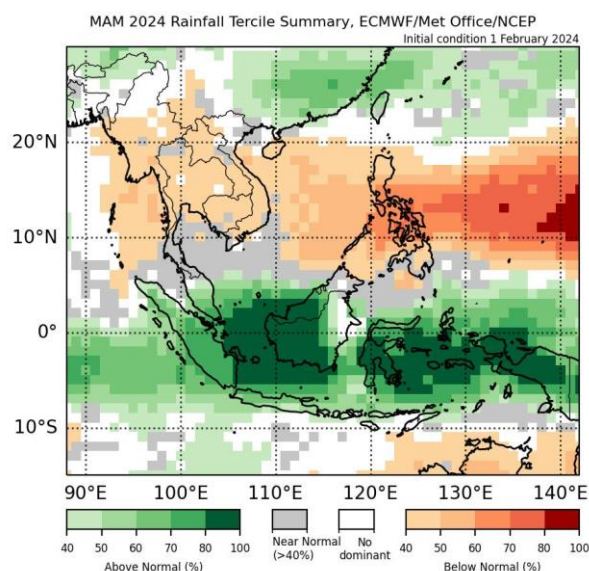


Figure 12. Rainfall tercile summary predictions from the multi-model ensemble forecast for March-May (MAM) 2024. Brown shades show regions with a higher likelihood of drier conditions, while green shades show regions with a higher likelihood of wetter conditions (contains modified Copernicus C3S information).

Based on past events, if La Niña conditions do develop towards the middle of the year, this would lead to a continued increase in chance of above-normal rainfall over the southern ASEAN region for June – August 2024.

Temperature Outlook

For temperature, above-normal (warmer) conditions during March – May 2024 are predicted over the entire ASEAN region (Figure 13). Warmer temperatures are typical for this region during the decay phase of an El Niño event.

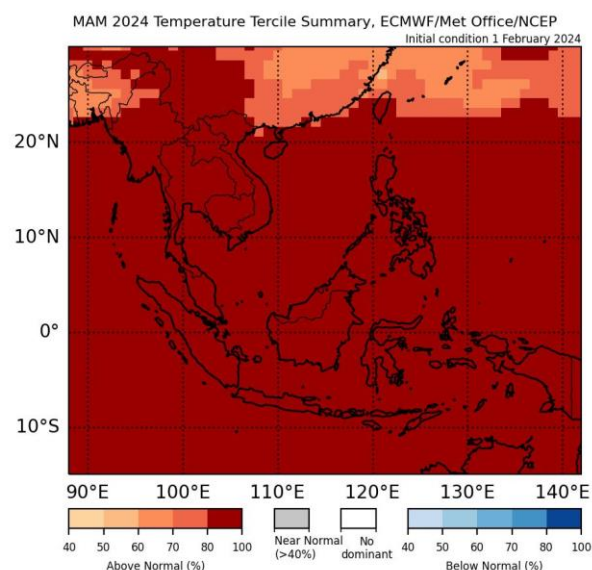


Figure 13: Temperature tercile summary predictions from the multi-model ensemble forecast for March-May (MAM) 2024. Red shades show regions with a higher likelihood of warmer conditions, while blue shades show regions with a higher likelihood of cooler conditions (contains modified Copernicus C3S information).