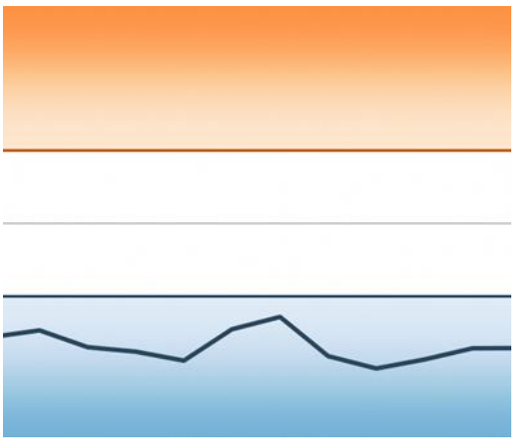
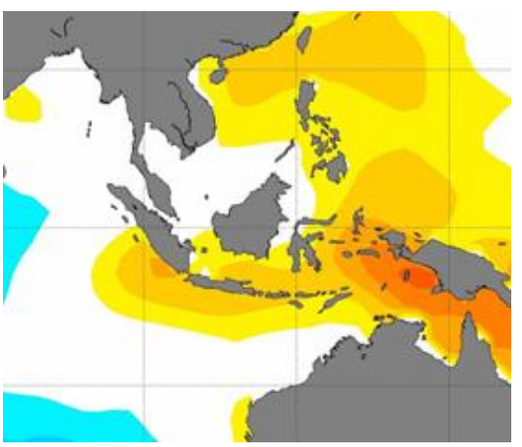
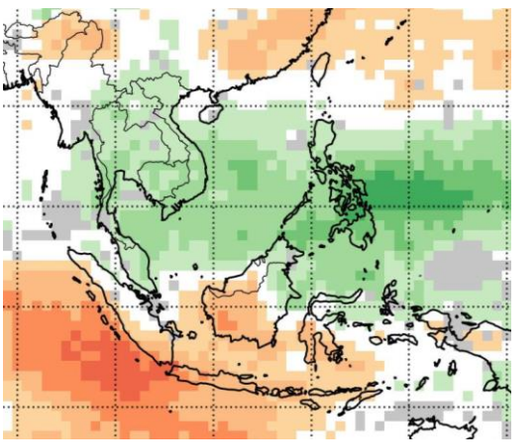
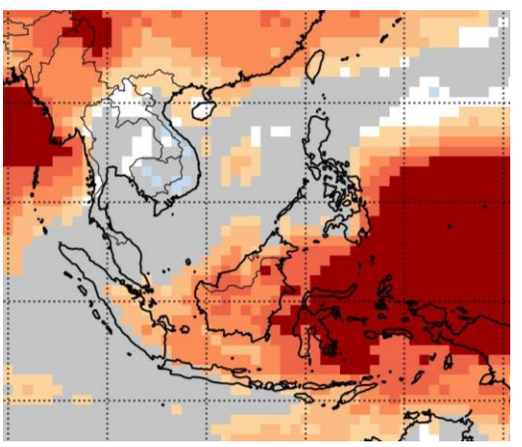
ASMC CLIMATE BULLETIN

MARCH 2023









HIGHLIGHTS:

July – December 2022 Climate Review:

- An Indian Ocean Dipole (IOD) event in Q3 of 2022 with continued La Niña conditions in the second half of 2022.

March to August 2023 Climate Outlook:

- La Niña conditions likely to transition into ENSO neutral by Q2 2023.
- Above-normal rainfall is predicted over northern Maritime Continent and much of Mainland Southeast Asia, with below-normal rainfall predicted over much of southern half of the Maritime Continent.

ASMC SPECIALISED METEOROLOGICAL CENTRE

http://asmc.asean.org

CLIMATE REVIEW (JUL – DEC 2022)

Persistent La Niña conditions and a negative IOD event

El Niño Southern Oscillation (ENSO)

The second half of 2022 saw the La Niña conditions continue. After a slight warming of the Nino3.4 index in June 2022 (although the index was still showing La Niña conditions), the index cooled again after July, persisting until the end of the year (Figure 1). Key atmospheric indicators of ENSO (e.g. trade wind strength and cloudiness) also indicated La Niña conditions during the second half of the year.

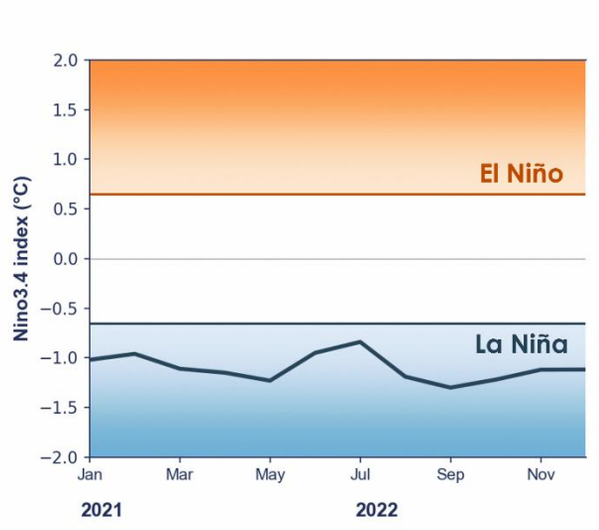


Figure 1: The Nino3.4 index (detrended) using the 1-month SST anomalies. Warm anomalies (≥ +0.65; orange) correspond to El Niño conditions while cold anomalies (≤ -0.65; blue) correspond to La Niña conditions, otherwise neutral (> -0.65 and < +0.65). Reference methodology: Turkington, Timbal, & Rahmat,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

In June 2022, models from the Copernicus C3S multi-model system predicted the ENSO conditions to weaken in June, with some models predicting a strengthing again of La Niña conditions, while others predicted weak La Niña or ENSO neutral conditions (Figure 2). However, most models from August 2022 indicated weak to moderate La Niña continuing for the rest of 2022, with some favouring a strengthening in La Niña conditions and a few others returning to ENSO neutral.

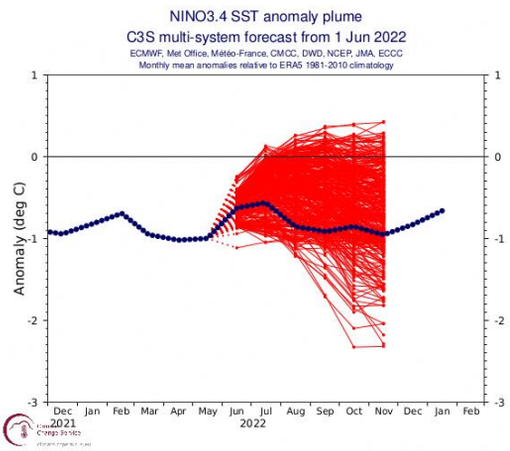


Figure 2: Forecasts of Nino3.4 index's strength (red lines) in June 2022 for the second half of 2022 from various seasonal prediction models of international climate centres. Observed values are in blue. Credit: Copernicus C3S.C

Indian Ocean Dipole (IOD)

From May 2022 onwards, there were signs of a negative IOD developing, with the negative IOD event established by the end of June 2022 (Figure 3). The negative IOD was strongest between July-August 2022, and started showing signs returning to neutral from October onwards. By December 2022, the IOD Index was close to zero, indicating a return to neutral conditions. Typically, negative IOD events bring wetter conditions to the ASEAN region.

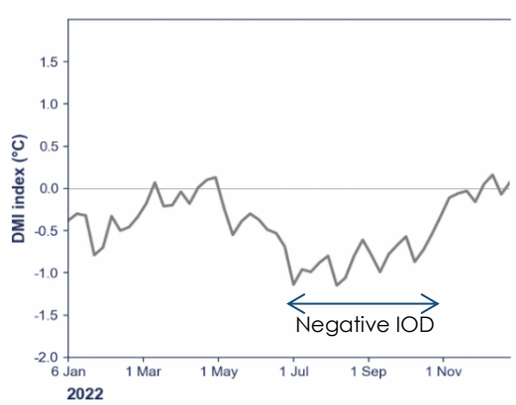


Figure 3: Indian Ocean Dipole (IOD) index showing an episode of negative IOD event in the second half of 2022. Data Credit: Bureau of Meteorology, Australia.

Temperature Conditions

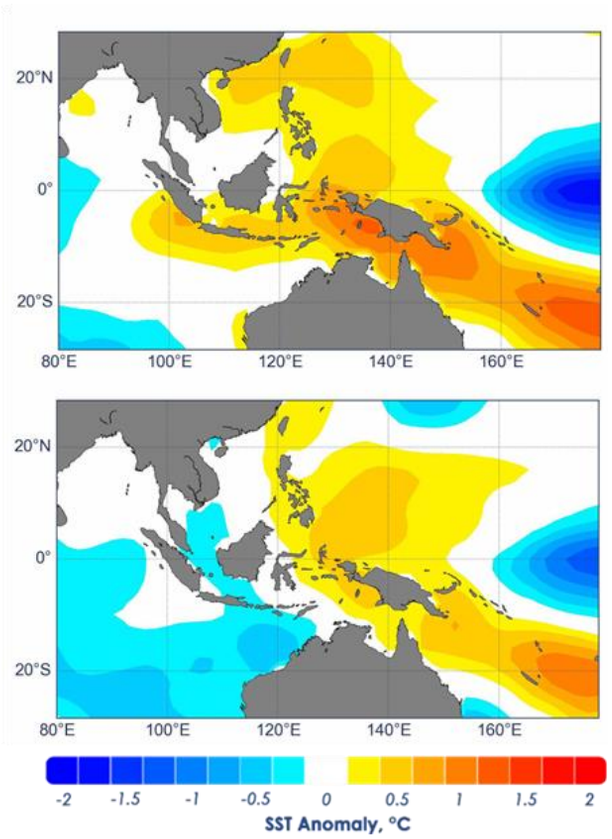


Figure 4: Average sea surface temperature (SST) anomalies for July – September 2022 (upper) and October – December 2022 (lower). SSTs were warmer than average for much of the Southeast Asia region in July – September 2022 with the warm pattern sustaining over the eastern region in October – December 2022. The reference climatology is from 1991 to 2020. Data: IRI Data Library.

Warm SST anomalies were observed for much of the area to the east and southwest of ASEAN region between July and September 2022, with the warms SST remaining over the eastern part of the ASEAN region during October - December (Figure 4). These warm anomalies in the west of the Pacific are a common feature of La Niña events, while warm anomalies in the southeastern tropical Indian Ocean are a feature of negative IOD events. Weakening of the warm SST anomalies in the southwestern ASEAN region and sustained warm anomalies in the eastern ASEAN region are in line with the continued La Niña conditions and decay of the negative IOD in the latter part of the year.

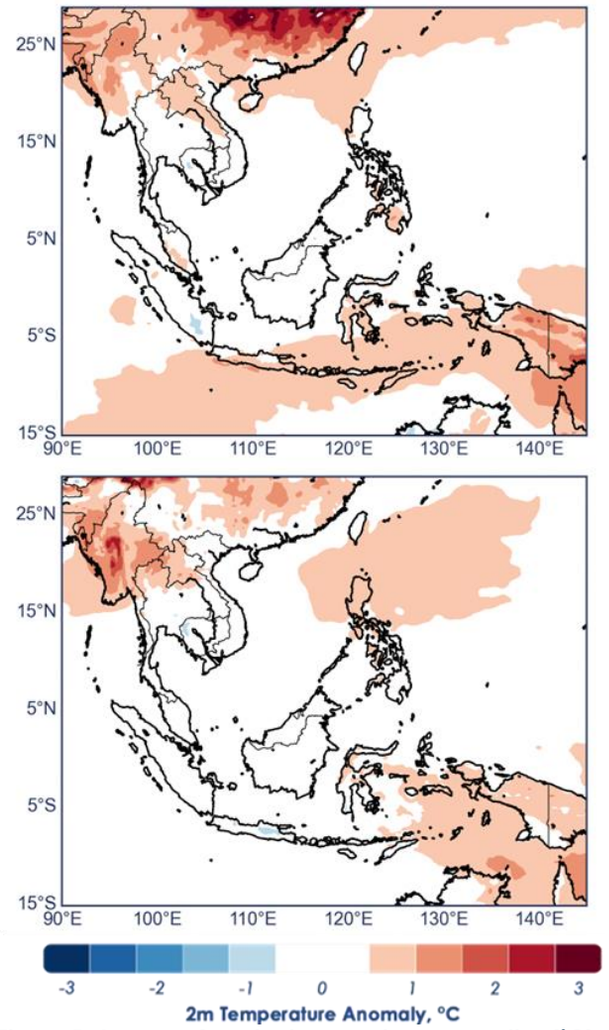


Figure 5: Average 2-metre temperature anomalies (˚C) against 1991-2020 climatology for July – September 2022 (upper) and October – December 2022 (lower) show a mix of near- to above-average temperatures (white and red shades, respectively) for Southeast Asia in the second half of 2022. Data: ECMWF.

Overall, Southeast Asia experienced near- to above-average temperatures in the second half of 2022 (Figure 5). For Mainland Southeast Asia between July and September 2022, above-average temperature was recorded over Lao PDR and parts of Myanmar (Figure 5; upper), which intensifed between October and December 2022, especially over Myanmar (Figure 5; lower). The Maritime Continent experienced a mix of near- to above-average temperatures throughout the second half of 2021, with above-average temperature over the southern Maritime Continent between July and September 2022, and above-average temperature over southeastern Maritime Continent between October and December 2022.

Rainfall Conditions

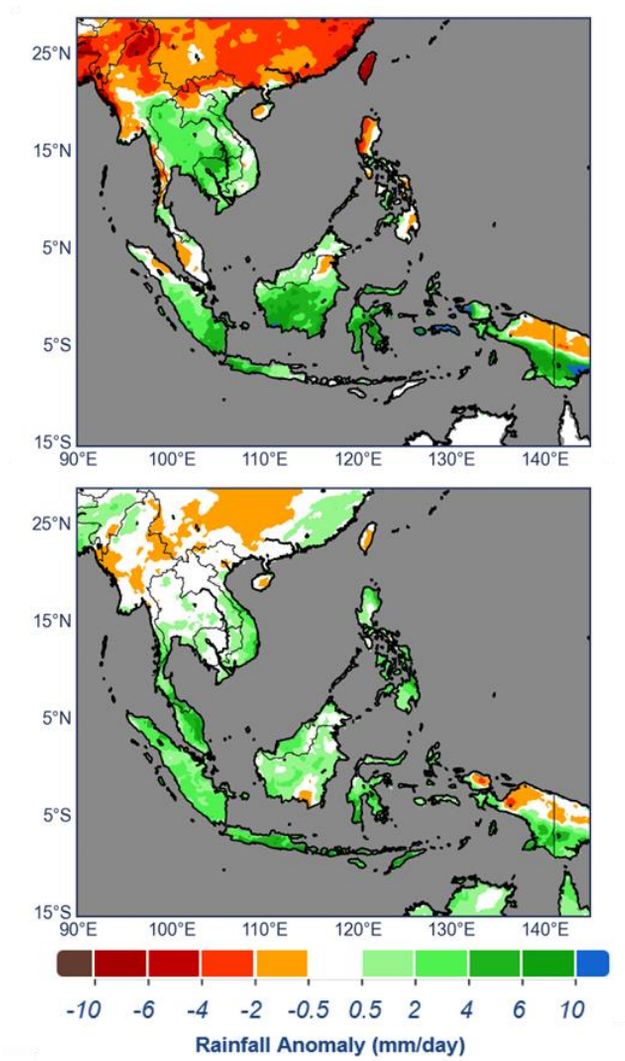


Figure 6: Rainfall anomaly (in mm/day) for July – September 2022 (upper) and October – December 2022 (lower) against 1991-2020 climatology from CHIRPS dataset. Areas in green experienced wetter than average conditions, while those in orange experienced drier than average conditions. Data: IRI Data Library.

During the July to September 2022 period (Figure 6; upper), most of the Maritime Continent – apart from regions over the Philippines, around the Malay Peninsula and Papua – recorded above-average rainfall, which was likely influenced by both the negative IOD event and the La Niña event during this time. Mainland Southeast Asia experienced a mix of below- and above-average rainfall, with below-average rainfall for the western parts and above- average for the rest of the region.

During the October to December 2022 period, much of the Maritime Continent and southeastern parts of Mainland Southeast Asia recorded above-average rainfall (Figure 6; lower). This wet pattern was typically observed during La Niña events in the Northeast Monsoon (mid-November to March) period. Elsewhere, a mix of below- to above-average rainfall was recorded.

Madden-Julian Oscillation

While two of the main climate drivers (IOD and ENSO) were active during various times in the second half of 2022, intra-seasonal variability can still play a role in influencing the region's rainfall.

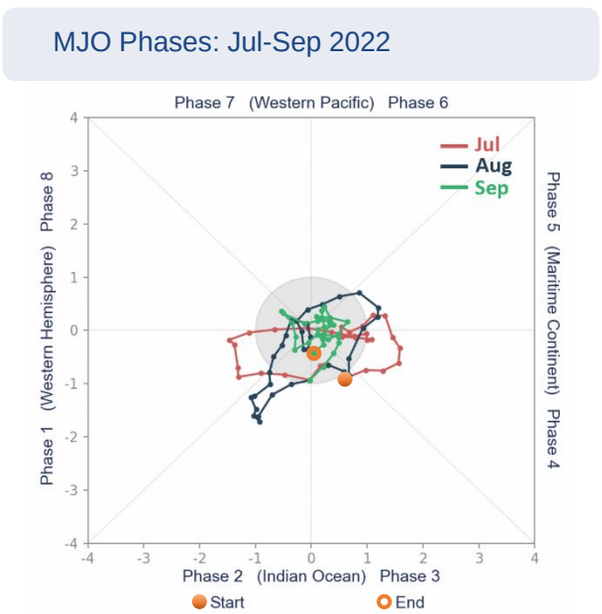


Figure 7: MJO strength and phases during July (red), August (blue) and September (green) 2022. The orange dots mark the start and end of the timeseries. Data: BoM, Australia.

At the intra-seasonal timescale during July to September 2022, 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 in the Maritime Continent (Phases 4 and 5) in early July 2022, weakening in the second week and emerging over the Western Hemisphere (Phases 8 and 1) in the last week of July 2022 (based on the RMM index). While there were some signs of an MJO signal over the Maritime Continent in the first week of August, there was no clear MJO signal for most of August 2022, with an MJO singal only briefly emerging again over the Indian Ocean (Phase 2) towards

the end of August. Between July and August, Phase 4 tends to bring wetter conditions to much of the region, while Phases 7 to 8 tend to bring drier conditions, and Phase 2 and Phase 5 bring a mix of drier and wetter conditions.

For September 2022, the MJO signal was weak or not discernible based on the RMM plot. As there was no significant MJO activity, the contribution to rainfall conditions over the ASEAN region in September was negligible.

MJO Phases: Oct-Dec 2022

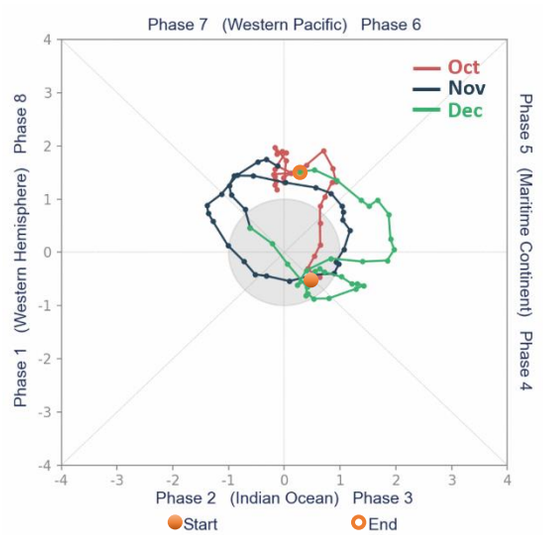


Figure 8: MJO strength and phases during October (red), November (blue) and December (green) 2022. The orange dots mark the start and end of the timeseries. Data: BoM, Australia.

During October to December 2022, there was increased MJO activity, although predominantly between Phases 4 and 8 (Figure 8). An MJO signal emerged in the second week of October over the Western Pacific (Phase 6), propagated eastwards before persisting over Phase 7 for the rest of October. This MJO signal propagated eastwards in the first week November but weakened and became indiscernible in the second week based on the RMM Index. During the second half of November, an MJO signal emerged over the Maritime Continent and propagated eastwards through the Western Pacific. The MJO signal then weaken and become indiscernible for the first week of December. An MJO signal emerged over the Indian Ocean (Phase 3) and propagated through the Maritime Continent with variability in strength reaching the Western Pacific (Phase 6) on the last few days of the year.

Typically during October to December, Phase 6 tends to bring wetter conditions to eastern Maritime Continent and Phases 4 and 5 tend to bring wetter conditions for most of the ASEAN region, while Phases 7 and 8 tend to bring drier conditions for the western Maritime Continent. Coupled with the La Niña conditions, the MJO may have also contributed to the wetter conditions over much of the Maritime Continent between October and December (Figure 6; lower).

CLIMATE OUTLOOK (Mar – August 2023)

IOD conditions remain neutral and La Niña conditions are likely to transition into ENSO neutral by March- April 2023

ENSO Outlook

At the start of 2023 La Niña conditions were present over the central and eastern tropical Pacific Ocean, with negative 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 by March – April 2023 (Figure 9). After April the outlook is uncertain, although currently the models predict a low probability of La Niña conditions towards the middle of the year.

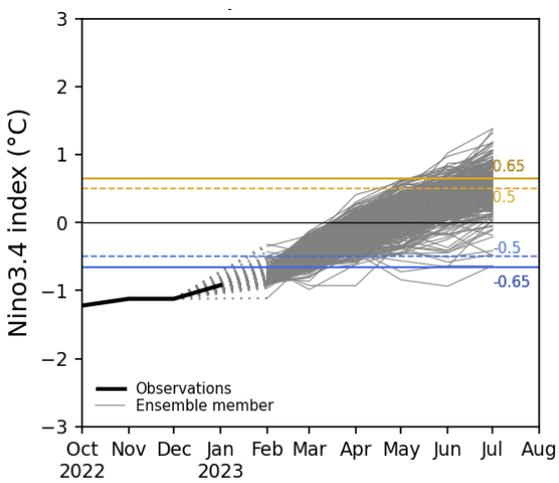


Figure 9: Nino3.4 detrended SST anomaly predictions from the modified C3S Copernicus models output showing colder temperatures until the end of February. Subsequently, most models predict ENSO neutral conditions for March–May (MAM) 2023 period.

In agreement with the Nino3.4 index predictions, the ensemble-mean predictions of SST anomalies show ENSO neutral conditions over the tropical Pacific Ocean during March – May 2023 (Figure 10). During ENSO neutral conditions, tropical Pacific SSTs and easterly trade winds are around their climatological values and have little-to-no effect on seasonal rainfall anomalies over Southeast Asia.

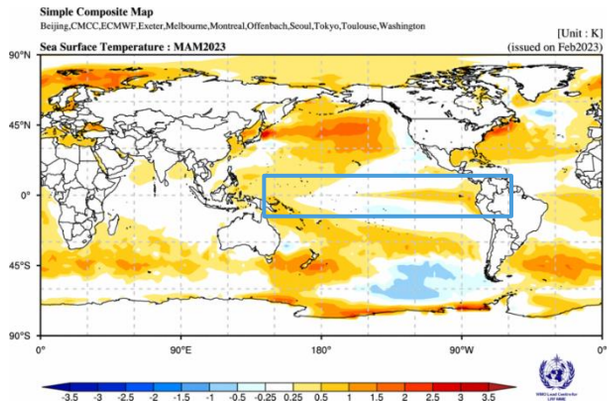


Figure 10: SST anomaly prediction for March-May (MAM) 2023 from WMO showing ENSO neutral conditions in the tropical Pacific Ocean (blue box). Credit: WMO Lead Centre for Long-Range Forecasting.

IOD outlook

The current IOD neutral conditions are likely to persist during March-May 2023 (Figure 11), with no SST anomalies predicted over the tropical Indian Ocean during this time period (Figure 10).

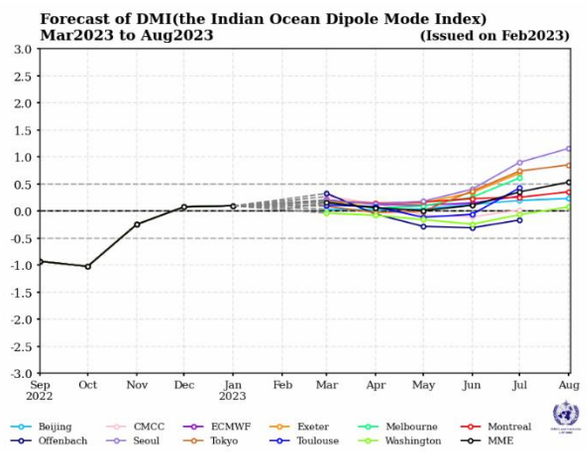


Figure 11: IOD index predictions, from models available on the WMO Lead Centre for Long-Range Forecasting, show neutral IOD conditions in the tropical Indian Ocean during March–May 2023 period. Credit: WMO Lead Centre for Long-Range Forecasting.

Rainfall Outlook

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

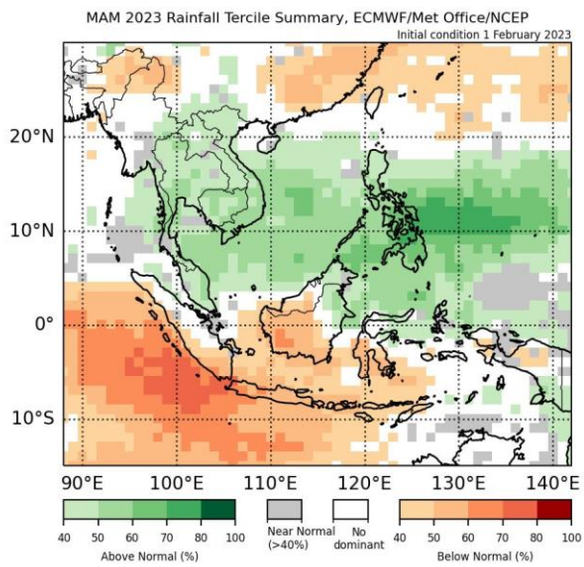


Figure 12. Rainfall tercile summary predictions from the multi-model ensemble forecast for March-May (MAM) 2023. Brown shades show regions with a higher likelihood of drier conditions, while green shades show regions with a higher likelihood of wetter conditions (contains modified Copernicus C3S information).

Temperature Outlook

For temperature, above-normal (warmer) conditions during March – May 2023 are predicted over western Mainland Southeast Asia and central and eastern parts of the Maritime Continent, with the highest probabilities over the southeastern Maritime Continent (Figure 13). Over the rest of Mainland Southeast Asia and western Maritime Continent and the Philippines, temperatures are predicted to be near-normal.

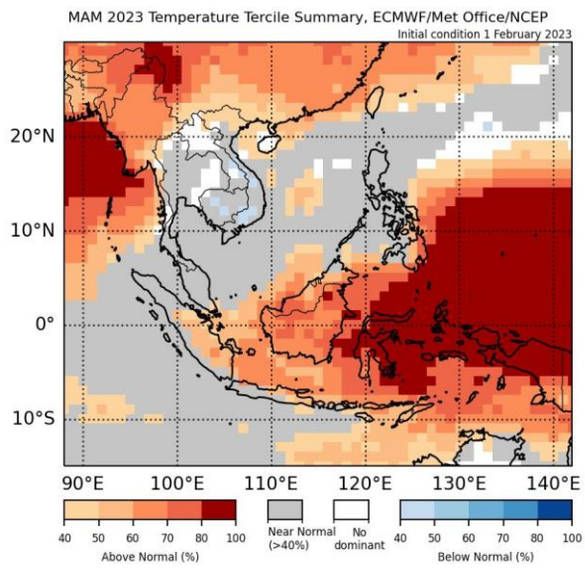


Figure 13: Temperature tercile summary predictions from the multi-model ensemble forecast for March-May (MAM) 2023. Red shades show regions with a higher likelihood of warmer conditions, while blue shades show regions with a higher likelihood of cooler conditions (contains modified Copernicus C3S information).