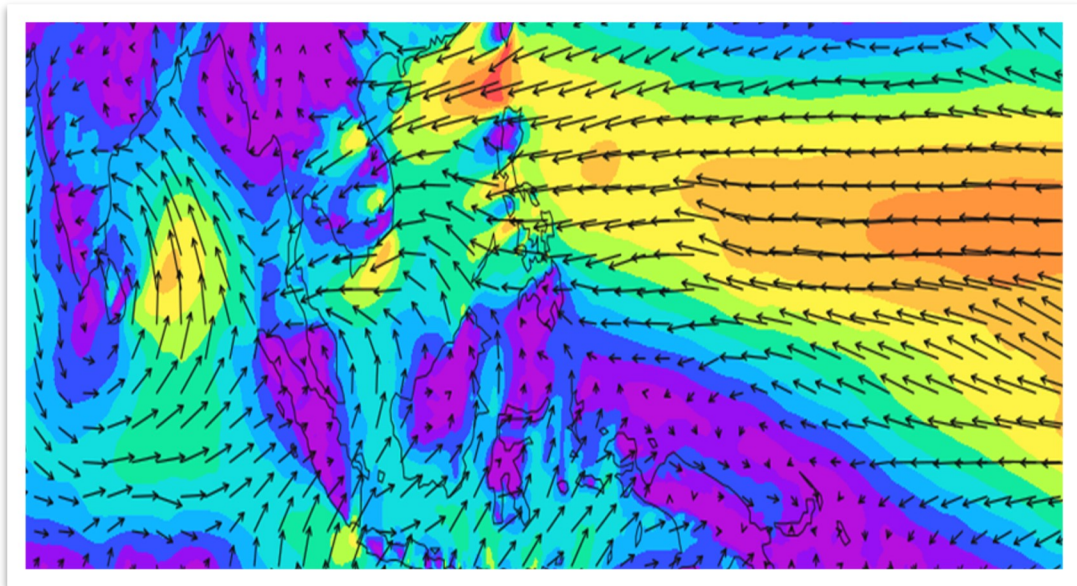


# NORTHEAST MONSOON REPORT

## KUALA LUMPUR MONSOON ACTIVITY

### MAY 2022



**MALAYSIAN METEOROLOGICAL DEPARTMENT  
MINISTRY OF ENVIRONMENT AND WATER**



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## Introduction

Atmospheric and oceanic observations were consistent with La Niña from November 2021 to March 2022. This was based on below normal sea surface temperatures (SSTs) observed from the east-central to eastern equatorial Pacific during this period. On the other hand, above normal SSTs prevailed in the western equatorial Pacific. Meanwhile, anomalous easterly winds were observed in the equatorial Pacific in the lower troposphere, while in the upper troposphere, anomalous westerly winds were prevalent in the central – eastern equatorial Pacific. Convective activity was generally enhanced in the Maritime Continent and Western Pacific while suppressed over the central Pacific during this time. These atmospheric and oceanic observations collectively indicate La Niña. By forecaster consensus and multi-model ensemble, La Niña has a 59% chance of continuing between June – August 2022, and a 50 – 55% chance of continuing throughout Northern Hemisphere fall 2022.

A negative IOD event preceded the northeast monsoon of 2021/22. Negative IOD was observed until November 2021. The negative IOD event approached its end, in November 2021. For the remainder of the northeast monsoon season, or December – April, the IOD remained neutral. Model outlooks showed potential for negative IOD to develop in the coming months. Majority of international climate models show possibility of negative IOD development in May, with all five (5) models attaining negative IOD threshold by June. Nonetheless, model outlooks usually have lower accuracy beyond Northern Hemisphere spring. Negative IOD events are characterized by enhanced convective activity in the southern Maritime Continent and anomalously warm waters in the eastern equatorial Indian Ocean.

The MJO (Madden-Julian Oscillation) is a 30–60-day intra-seasonal variability affecting convective activity and wind circulation, along the equator. Strong MJO is defined by real-time multivariate MJO (RMM) index amplitude exceeding 1.0. Strong MJO was observed over the Maritime Continent during the second and third decades of November 2021. The MJO index amplitude continued to be above 1.0 and is in the Maritime Continent until December 2021, when it shifted eastwards to the Western Pacific and remained throughout the month. In the middle of March 2022, the MJO was in Africa and moved eastwards to the Indian Ocean, where it intensified. Subsequently on the third week of March, it shifted eastwards to the Maritime Continent, where it weakened and dissipated after several days.

In November 2021 to March 2022, two storms attaining tropical storm intensity or higher were recorded over the western north Pacific Ocean. They are category 4 typhoon Nyatoh (29 November – 04 December 2021) and category 5 typhoon Rai (12 – 21 December 2021). It is lower than the climatological average number of storms reaching tropical storm status or higher between November – March.

## 1. Weather Conditions from November 2021 to March 2022

The northeast (winter) monsoon for Malaysia was established from 3<sup>rd</sup> November 2021 to 13<sup>th</sup> March 2022. It is usually characterized by prevailing easterly to northeasterly winds in the South China Sea and northern Maritime Continent. Lower tropospheric circulation at the 925hPa pressure level is depicted in **Figure 1**. Beginning from November 2021, northeasterly winds prevailed throughout the northern South China Sea. Intense convection is observed in the near-equatorial regions of the Maritime Continent, namely Gulf of Thailand, coastal Vietnam, eastern Bay of Bengal, and western Java. The double near equatorial trough feature is clearly visible this month, the northern trough extending from the southern Bay of Bengal to Peninsular Malaysia, while the southern trough is over the Indian Ocean (10 – 5 °S). In December 2021, northeasterly winds intensified and prevailed everywhere north of 5 °N over the Bay of Bengal and northern Maritime Continent. Increased rainfall is observed on the windward side of the Maritime Continent. The double near equatorial trough feature is clearly visible, with the northern trough centered at 5 °N, while the southern trough is at 5 °S. By January and February 2022, there is increase of cross-equatorial flow, observed in the northern Maritime Continent and Bay of Bengal. Compared to the early part of the northeast monsoon (November – December), region of enhanced rainfall has generally moved to the south of 5 °N. In March 2022, the northeasterly flow slackened considerably, while anticyclonic circulation is observed in Taiwan and northern Philippines. This signal shows the beginning of the northeast monsoon withdrawal.

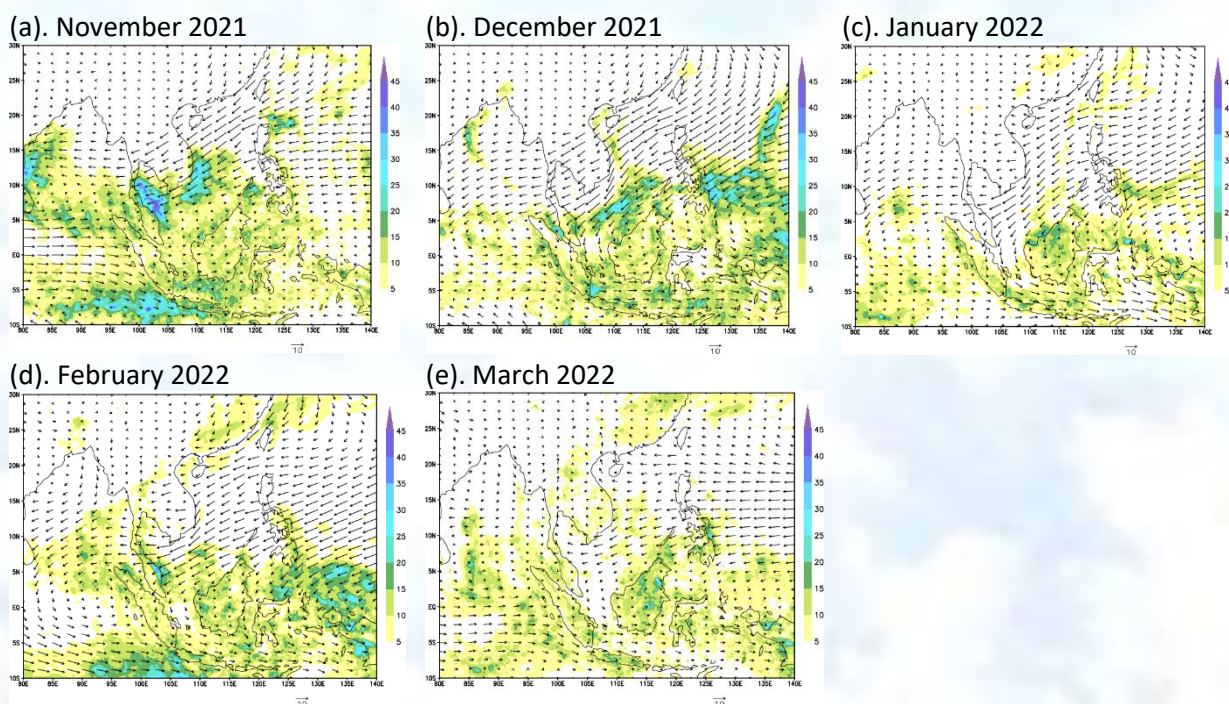


Figure 1: 925-hPa monthly average wind vector ( $\text{ms}^{-1}$ ) and monthly average rainfall (shaded color, mm) for (a) November 2021, (b) December 2021, (c) January 2022, (d) February 2022, and (e) March 2022.

Intra-seasonal variations of wind flow in the lower troposphere (925hPa) are depicted in **Figure 2**. Warm colors indicate anomalous westerly winds, while cool colors indicate anomalous easterly winds. MJO signals are indicated by green arrows. These lines track eastward propagation of anomalous westerly winds. The MJO reported in this section is consistent with the RMM indices produced by the Bureau of Meteorology, Australia (BOM). The MJO which was located on the Indian Ocean in early November 2021, moved eastwards and reached the Maritime Continent towards the middle of November 2021. It remained in the Maritime Continent

until December 2021. By early December, the MJO has moved eastwards to the western Pacific. Another strong MJO episode was clearly observed over the Indian Ocean from the middle of March 2022. It subsequently shifted eastwards to the Maritime Continent by the third week of March 2022, where it weakened and dissipated. Equatorial Rossby wave signals are indicated by purple arrows. These lines track the westward propagation of anomalous low-level westerlies. Equatorial Rossby wave observation is consistent with the weekly MJO update prepared by the Climate Prediction Center (CPC), National Atmospheric and Oceanic Administration (NOAA). Strong equatorial Rossby wave was observed to move from the western Pacific to the Indian Ocean, over the month of January 2022. This equatorial Rossby wave reached the Indian Ocean by the final week of January 2022.

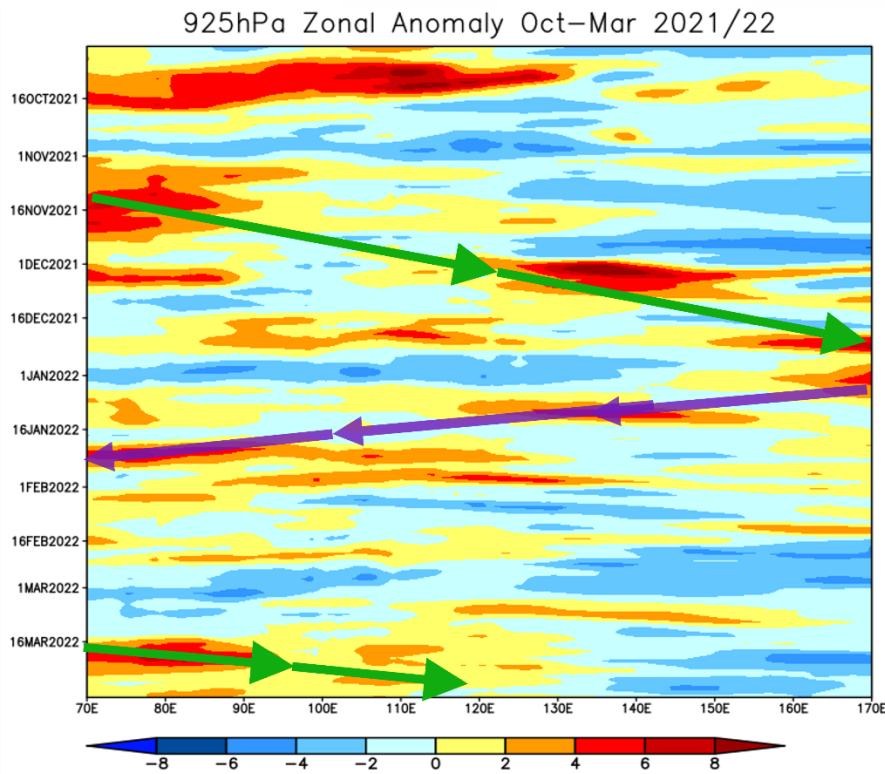


Figure 2. Time longitude cross-section of anomalous zonal wind ( $\text{ms}^{-1}$ ) averaged between  $0 - 20^\circ\text{N}$ . Anomalies are departures from 1991 – 2020 base period monthly means.

## 2. Outgoing Long Wave Radiation (OLR)

The OLR is a measure of convective activity in the tropics. Anomalous OLR between October 2021 – March 2022 is shown in **Figure 3**. Cool colors denote enhanced convection while warm colors denote suppressed convection. Between October to November 2021, convection is enhanced in the equatorial eastern Indian Ocean ( $70 - 90^\circ\text{E}$ ) because of negative IOD. Convection is also enhanced throughout the western Pacific Ocean ( $120 - 150^\circ\text{E}$ ) during the northeast monsoon but suppressed in the central Pacific ( $160 - 170^\circ\text{E}$ ). This is associated with La Niña. Intra-seasonal oscillation is clearly observed in **Figure 3**. Two strong MJO episodes, depicted by dark brown arrows, were observed. Both episodes showed region of enhanced convection propagating from the Indian Ocean to the Maritime Continent where it dissipated, between November – middle of December 2021, and middle of March 2022, respectively. Meanwhile, an equatorial

Rossby wave, depicted by the purple arrow, was clearly observed to propagate westwards from the Maritime Continent to the Indian Ocean, in January 2022.

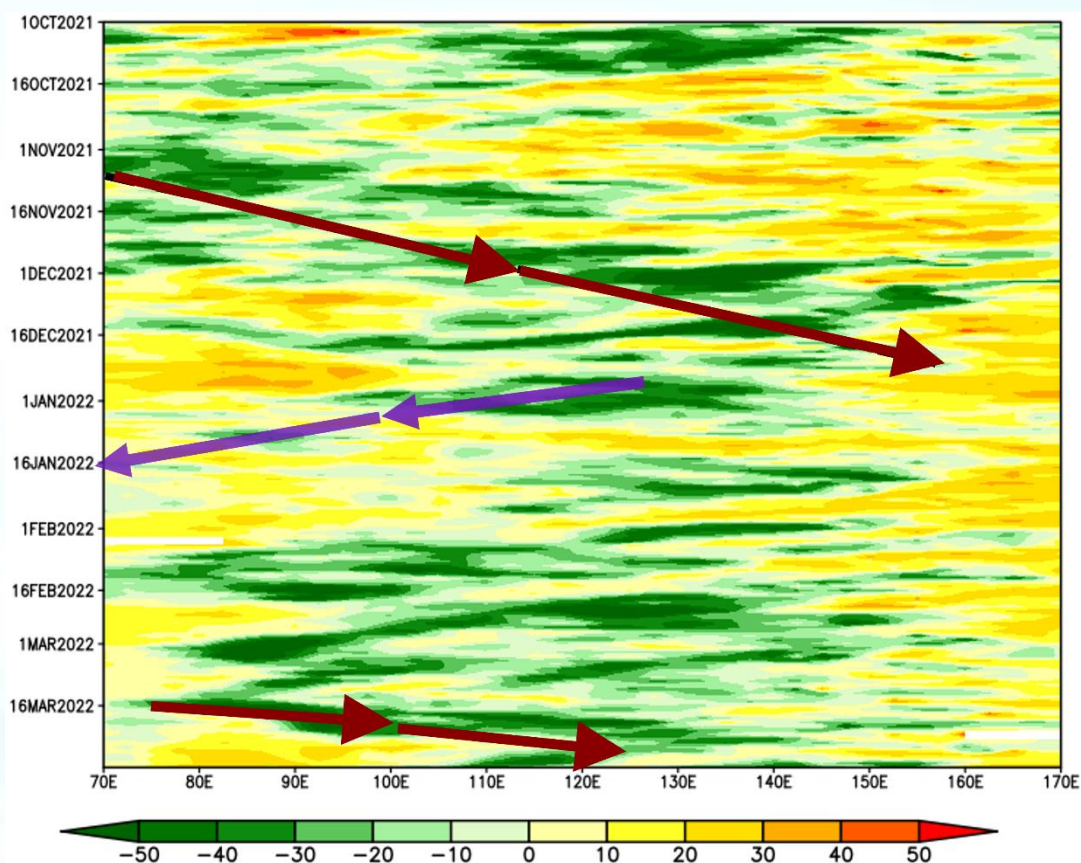


Figure 3. Time-longitude cross-section of OLR averaged between 0 – 20 °N. Anomalies are departures from the 1975 – 1999 base period monthly means.

### 3. Weather Outlook from May – July 2022

The southwest monsoon (or summer monsoon) is usually established from May to September. It is generally characterized by westerly to southwesterly winds over the South China Sea, Indochina, and the northern Maritime Continent. The southwest monsoon is also the rainy season for India, and East Asia. However, during this season, it is generally drier in Malaysia, and its neighboring regions.

Based on multi-model ensemble, an increased chance of above normal rainfall is expected over much of southern South-East Asian region. However, in the western Maritime Continent, higher chance of below normal rainfall is expected.

Seasonal outlook for Malaysia was based on forecaster consensus and analysis of several models. These models are NCEP CFSv2 (National Centers for Environmental Prediction, Coupled Forecast System Model version 2), JMA Ensemble Prediction System by Tokyo Climate Center, European Center for Medium Range Weather Forecast (ECMWF), and Seasonal Climate Forecast, International Research Institute for Climate Society (IRI).

Over in Malaysia, the monsoon transition phase is expected between the middle of March to middle of May. It is characterized by light and variable winds, and rapidly developing thunderstorms in the evening. From the middle of May 2022, the weather in Malaysia is influenced by the southwest monsoon. In May 2022, most

areas of Malaysia are expected to receive average monthly rainfall. However, slightly below normal rainfall is expected over the southern parts of Peninsular Malaysia West Coast. Slightly below normal rainfall is also expected over western Sarawak, during this month. In June 2022, Malaysia is expected to receive average monthly rainfall, in general. Meanwhile in July 2022, most areas of Malaysia are expected to receive average monthly rainfall, except for western Sarawak, where slightly above normal rainfall is expected.

#### **4. Data**

ERA5 reanalysis dataset produced by the ECMWF are used to plot wind charts. OLR charts were generated using the NOAA daily un-interpolated dataset. Rainfall data was taken from the Global Precipitation Measurement (GPM) dataset produced by NASA (National Aeronautics and Space Administration) and JAXA (Japan Aerospace Exploration Agency). In this report, wind anomalies are taken with respect to the 1991-2020 base period, while OLR anomalies are taken with respect to 1979 – 1995, that are provided by NOAA. Additionally, this report also refers to the MJO RMM indices produced by the Bureau of Meteorology, Australia. Climatology of storms reaching tropical storm intensity or higher, are taken from the Regional Specialized Meteorological Center (RSMC) Tokyo. The seasonal outlook over the ASEAN (Association of Southeast Asian Nations) were based on the ASEANCOF (ASEAN Climate Outlook Forum) on April 29. Malaysian seasonal outlook was based on the latest seasonal outlook issued by MET Malaysia.