

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
2 May 2022

Overview

- The MJO remains weak and incoherent, as reflected in the RMM index and in the latest upper-level wind and velocity potential fields which continue to depict a fairly stagnant pattern.
- Dynamical model RMM forecasts generally show an increased potential for the MJO to reemerge over the Africa and Indian Ocean during early May. However, the associated development of enhanced convection appears to be tied to Kelvin and Rossby wave activity favored in the region.
- Upper-level conditions are expected to be favorable for tropical cyclone (TC) formation mainly in the Indian Ocean during the outlook period.
 - The passage of a convectively coupled Kelvin Wave and anomalous lower-level westerlies favored over the eastern Pacific is conducive for possible early-season TC development in the basin, however there is little support in this realization in probabilistic TC tool guidance.
- Given the uncertainty with the strength and evolution of the MJO, any extratropical response in the mid-latitudes is more likely to be driven by the ongoing La Niña circulation during the outlook period.

A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

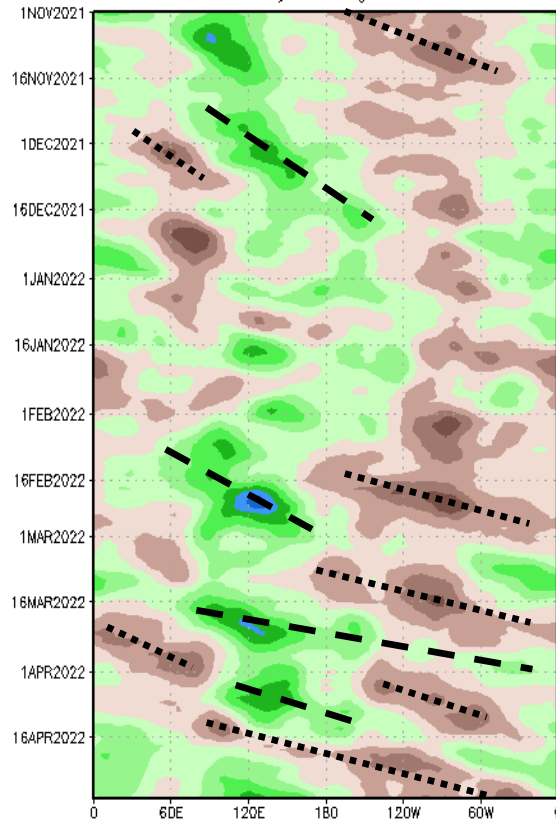
200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

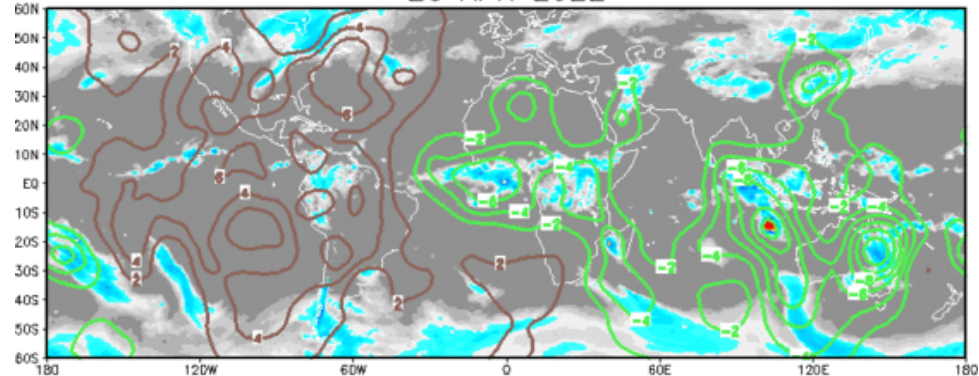
Brown shades: Anomalous convergence (unfavorable for precipitation)

200-hPa Velocity Potential Anomaly: 5N-5S

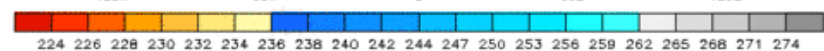
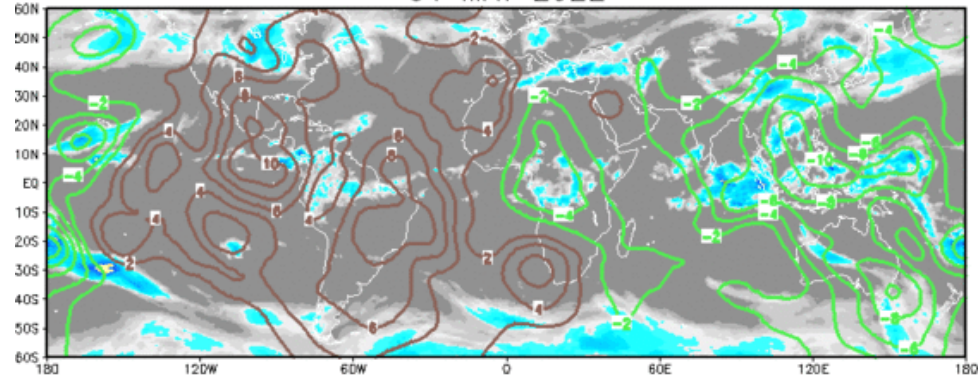
5-day Running Mean



26 APR 2022



01 MAY 2022

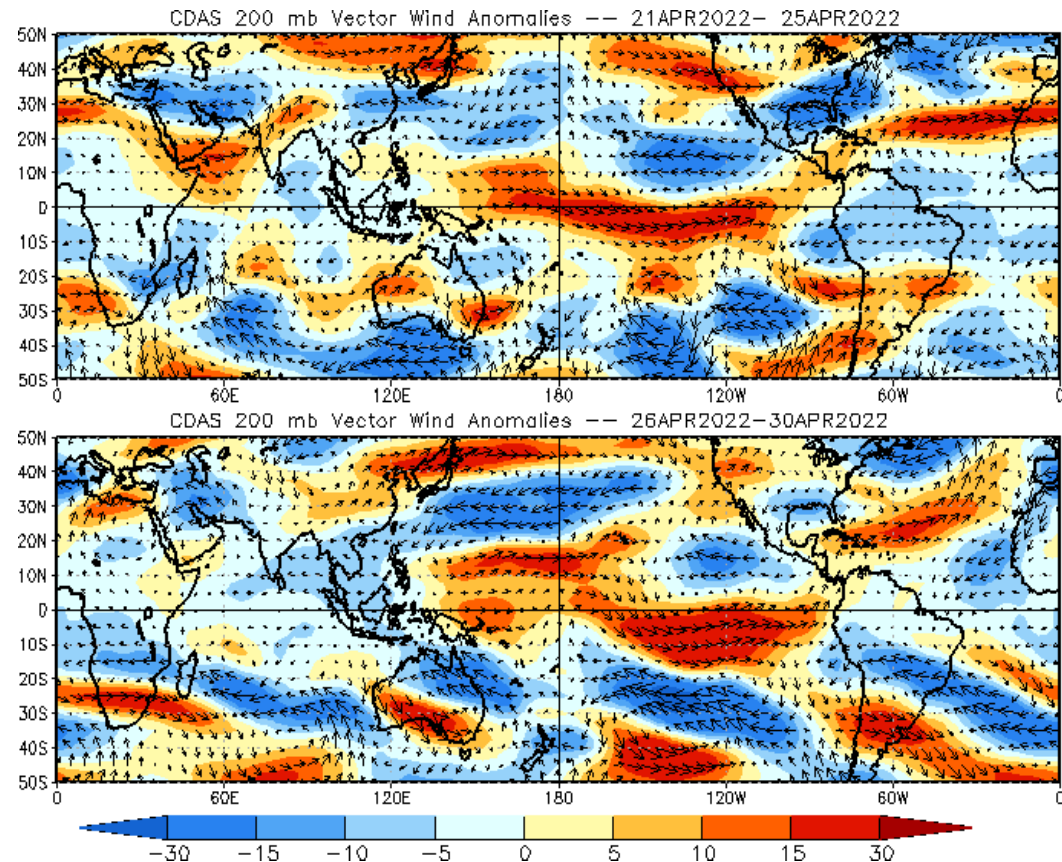
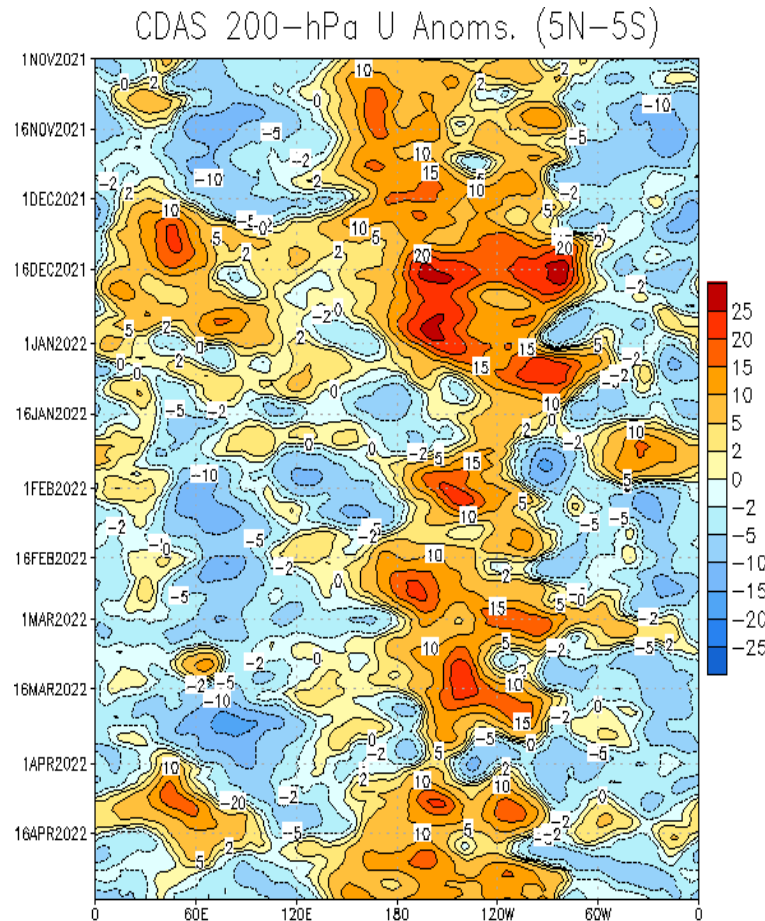


Degrees K

- The latest upper-level velocity potential anomaly pattern reveals little to no eastward propagation of enhanced conditions during the past week. Anomalous convergence aloft also remains stationary over the Americas since mid-April, with some suppressed conditions expanding eastward over the Atlantic recently.
- Similar to last week, there appears to be two enhanced centers of action, one to the east of the Prime Meridian and the other near 120E.

200-hPa Wind Anomalies

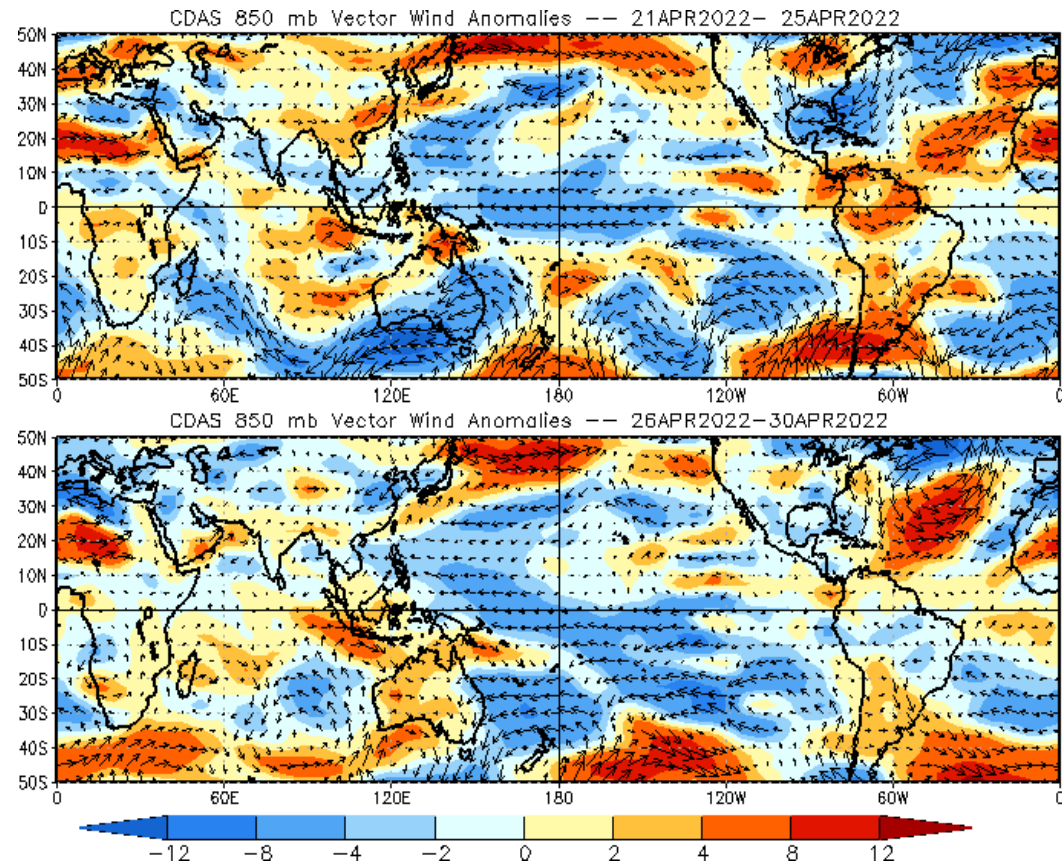
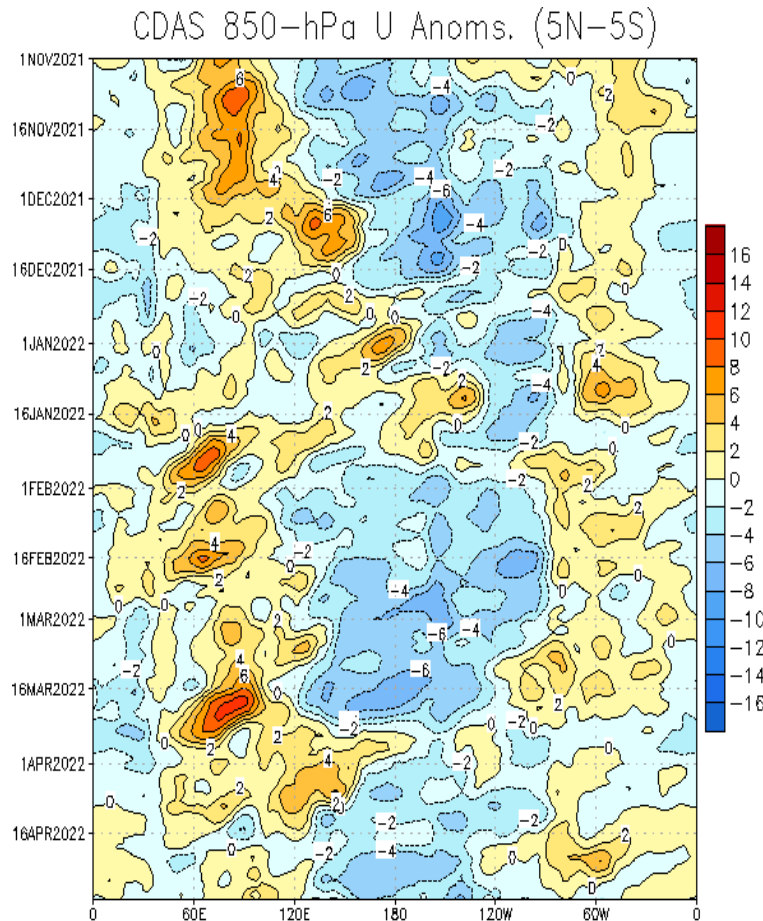
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Anomalous upper-level westerlies persist throughout the equatorial Pacific, consistent with ongoing La Niña conditions.
- Anomalous easterlies aloft strengthened slightly over the equatorial Indian Ocean.

850-hPa Wind Anomalies

Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.

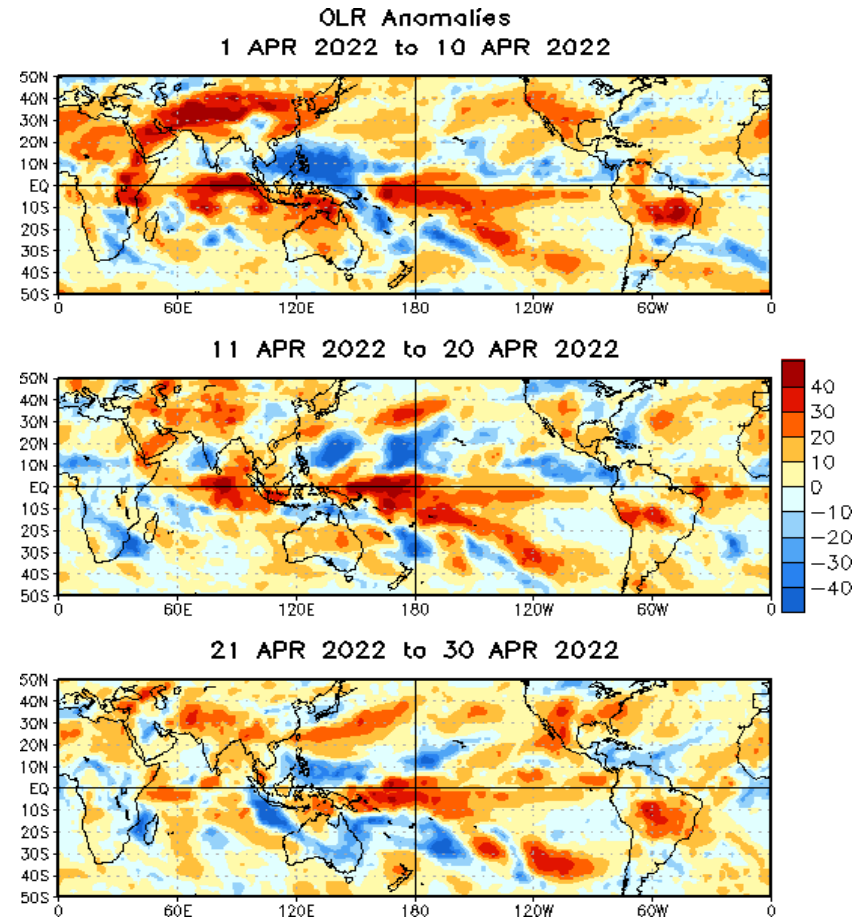
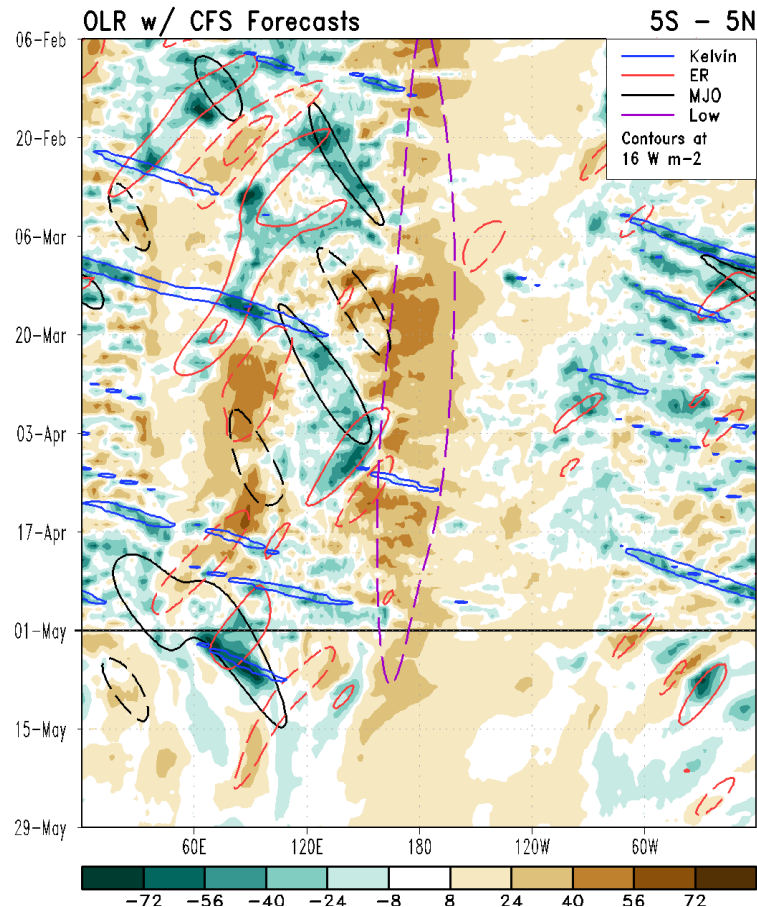


- Enhanced trades prevail throughout the central and western Pacific Ocean, while a more relaxed trade regime continues over the eastern Pacific along and to the north of the equator during April.
- Lower-level wind anomalies are weak across the equatorial Indian Ocean, though stronger westerlies persist closer to the Maritime Continent.

Outgoing Longwave Radiation (OLR) Anomalies

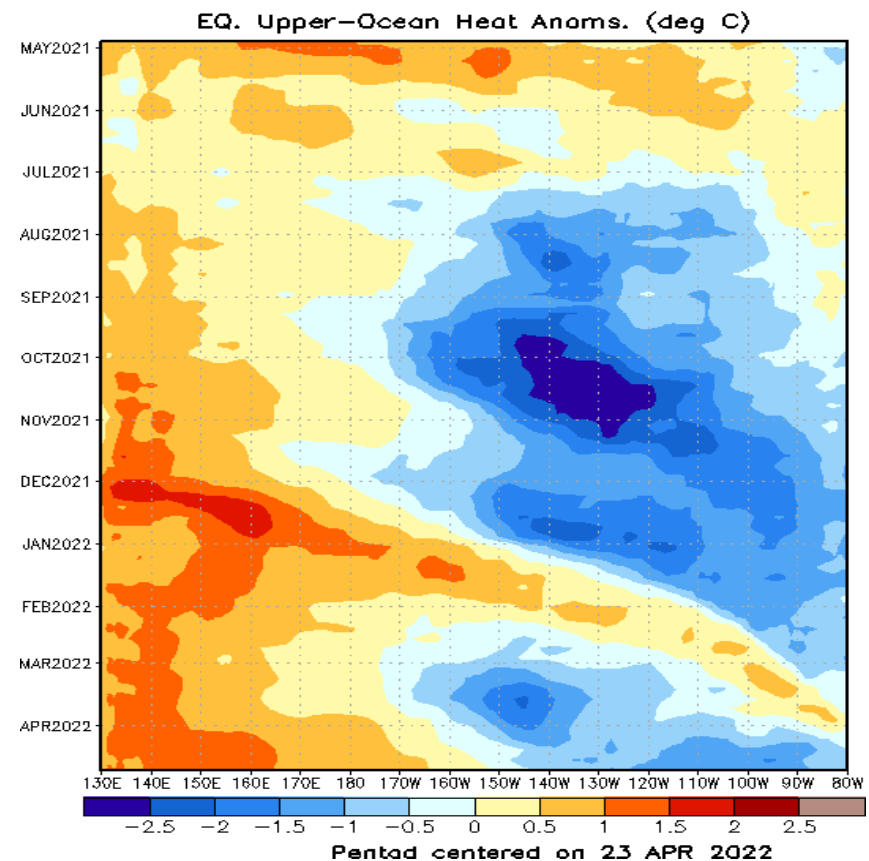
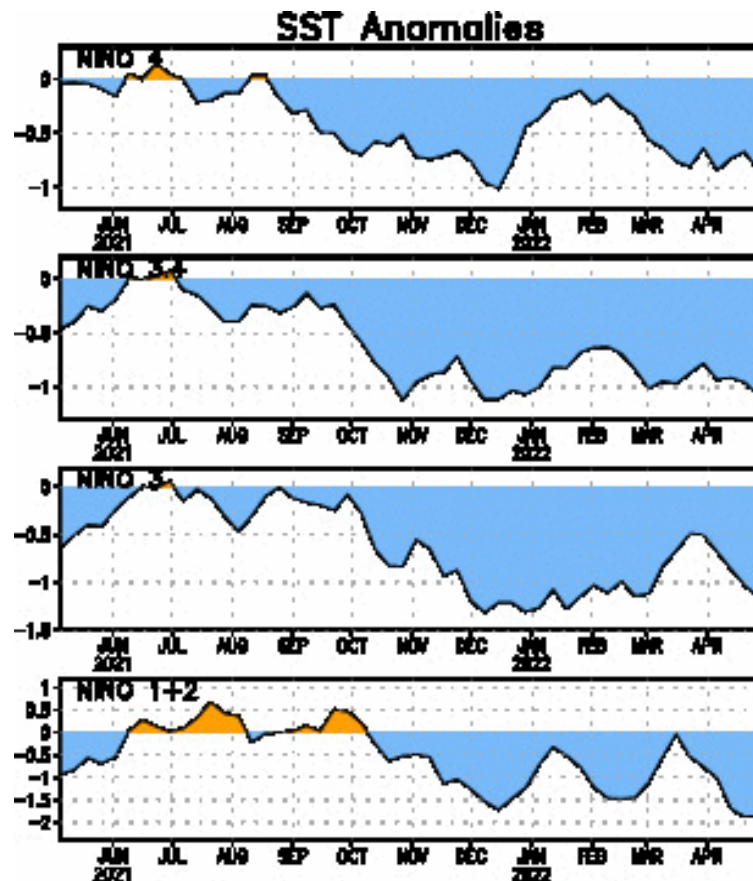
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- Tied to the ongoing La Niña, strongly suppressed convection along and to the west of the Date Line remains the most prominent feature in the OLR field over the past several months.
- Forecasts favor the development of enhanced convection across the Indian Ocean during the next two weeks, where MJO, Rossby and Kelvin wave activity are analyzed in the filtering.

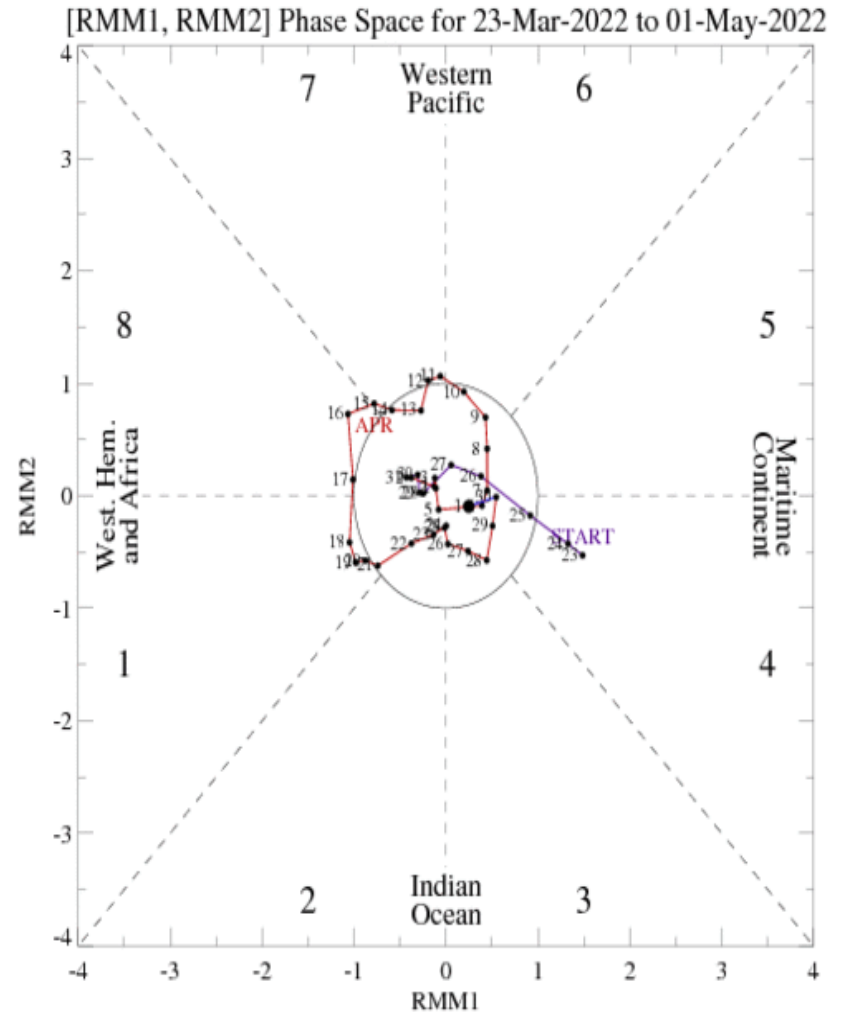
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Following a moderation of sea surface temperatures (SSTs) in parts of the central and eastern Pacific likely tied to an oceanic downwelling Kelvin wave this past winter, SSTs have re-cooled considerably since mid-March.
- With strengthening above-normal upper-ocean heat content observed west of 150°W along the equator since March, this suggests that anomalous cold waters in the Niño 4 region have become more shallow.

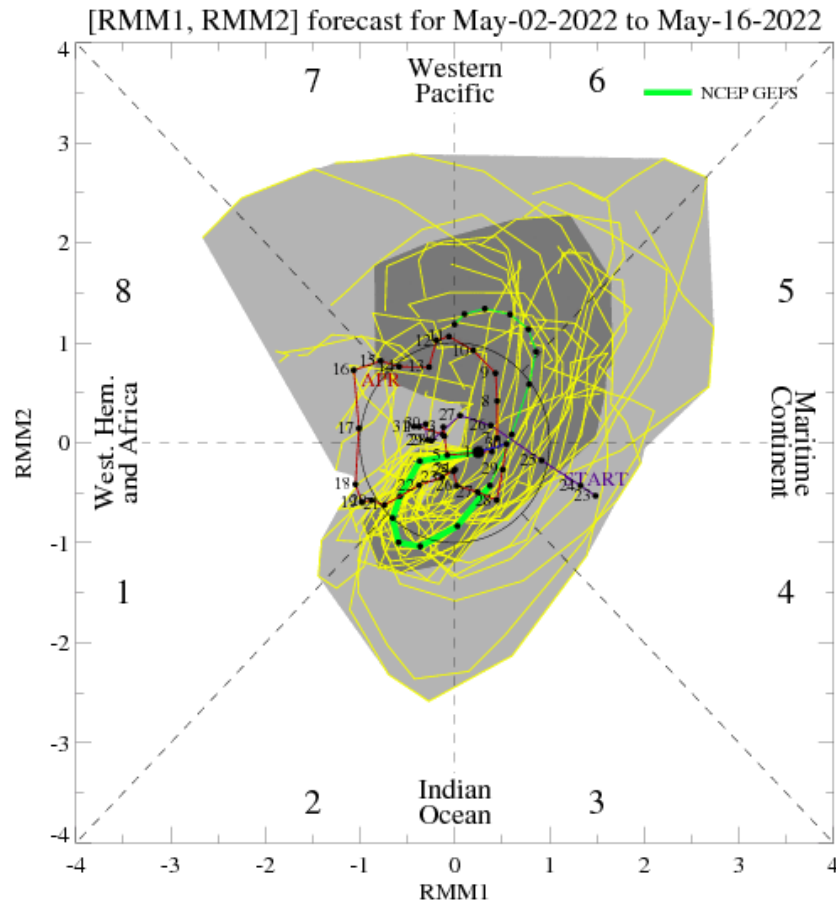
MJO Index: Recent Evolution

- The RMM index indicates the intraseasonal signal continues to be weak, remaining within the unit circle during the past seven days.

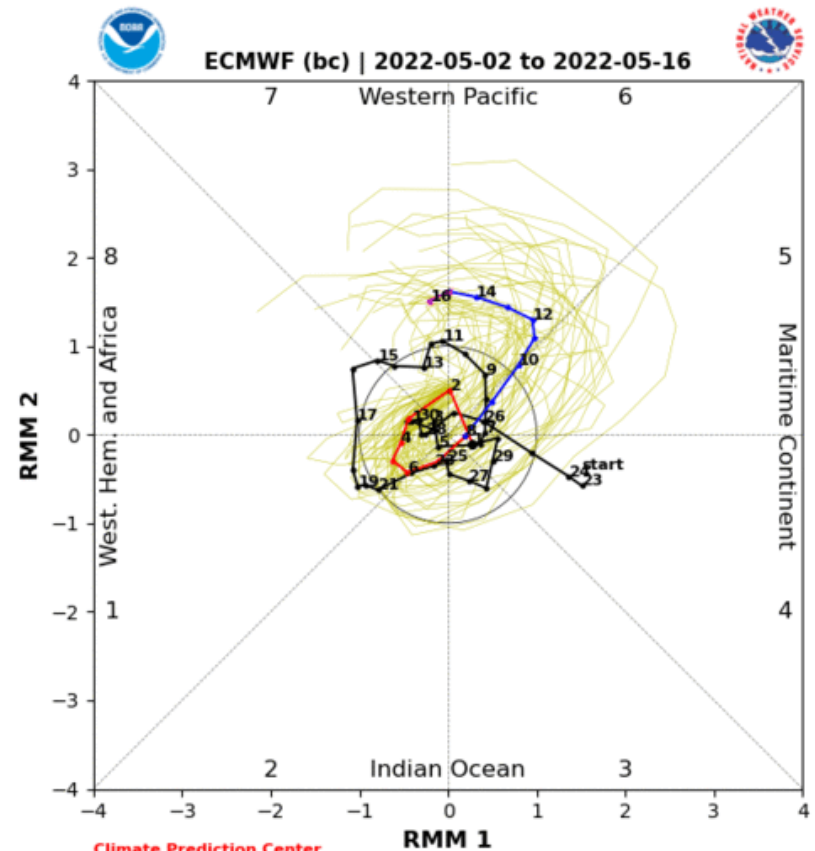


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



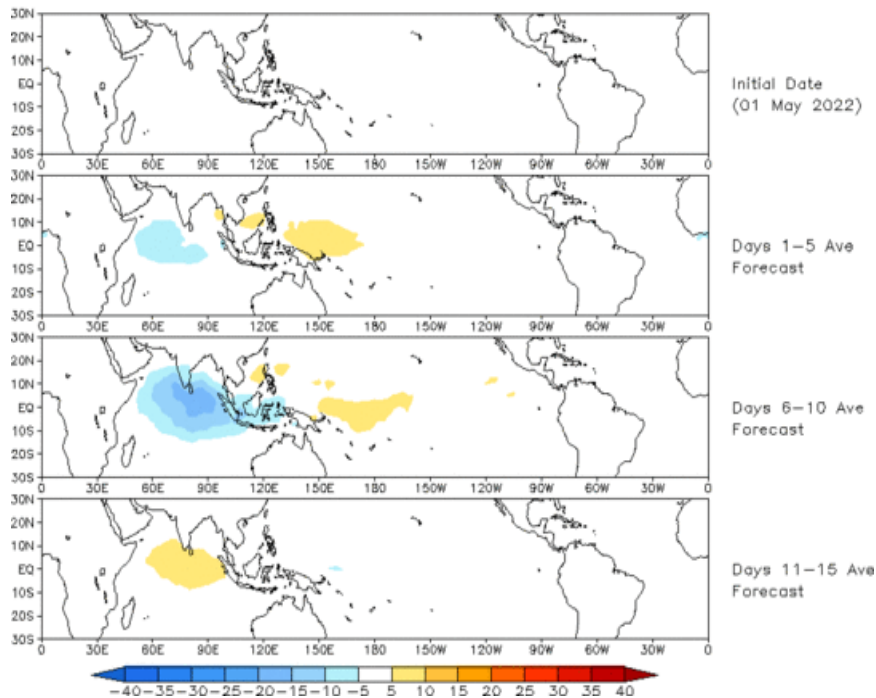
ECMWF Forecast

- Dynamical model RMM forecasts generally suggest a possible reemergence of the MJO over phases 1 or 2 during week-1. However, much of this signal is likely tied to Kelvin and Rossby wave activity favored over the Indian Ocean early in the period.
- Several ensemble members in the GEFS and ECWMF show eastward propagation of the signal across the Maritime Continent and western Pacific during week-2 at a phase speed that is more in line with a convectively coupled Kelvin wave.

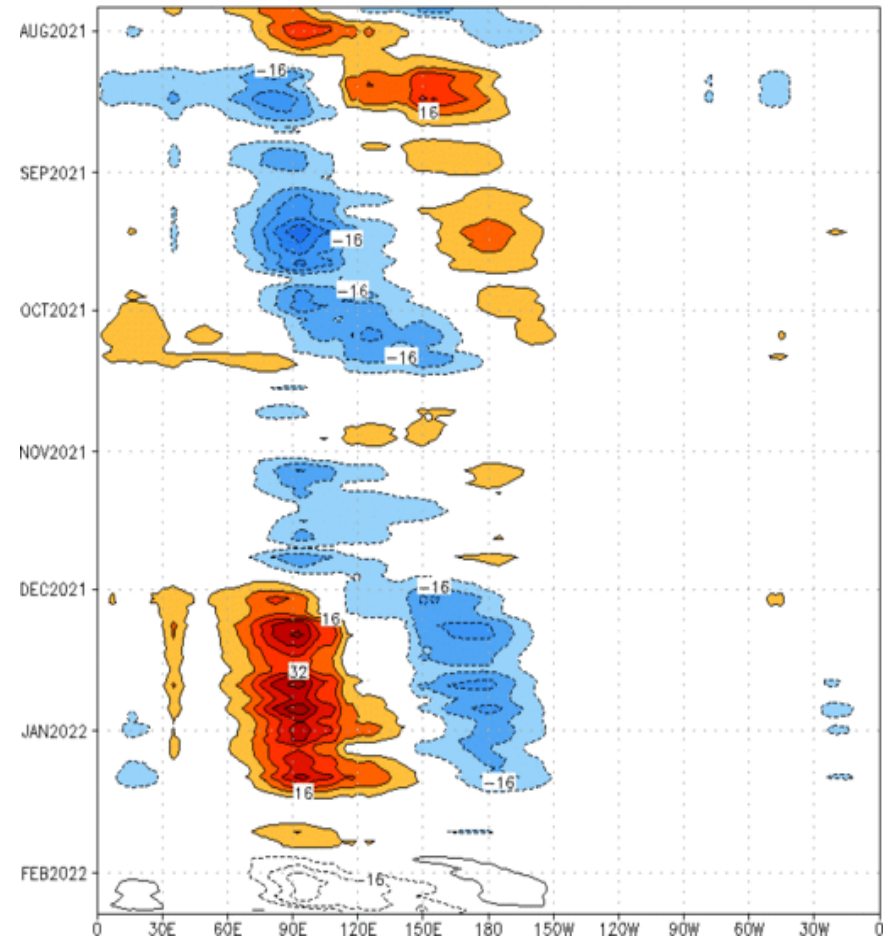
MJO: GEFS Forecast Evolution

Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 01 May 2022
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [$7.5^{\circ}\text{S}, 7.5^{\circ}\text{N}$] ($\text{cont: } 4\text{Wm}^{-2}$) Period: 27-Jul-2021 to 26-Jan-2022
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

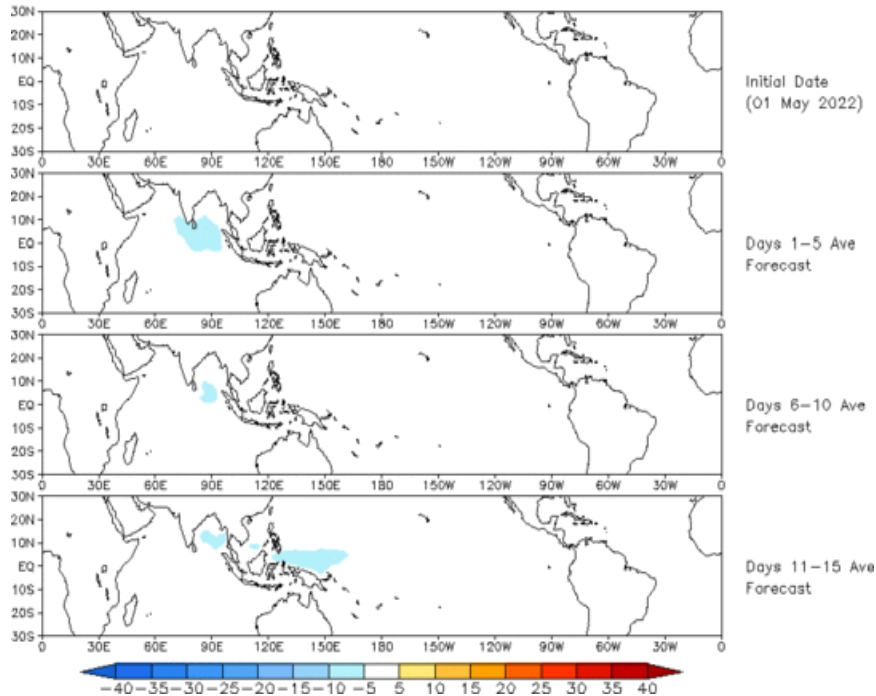


- The GEFS RMM-based OLR field depicts the development of enhanced convection over the Indian Ocean that shift eastwards, but rapidly weakens during week-2.

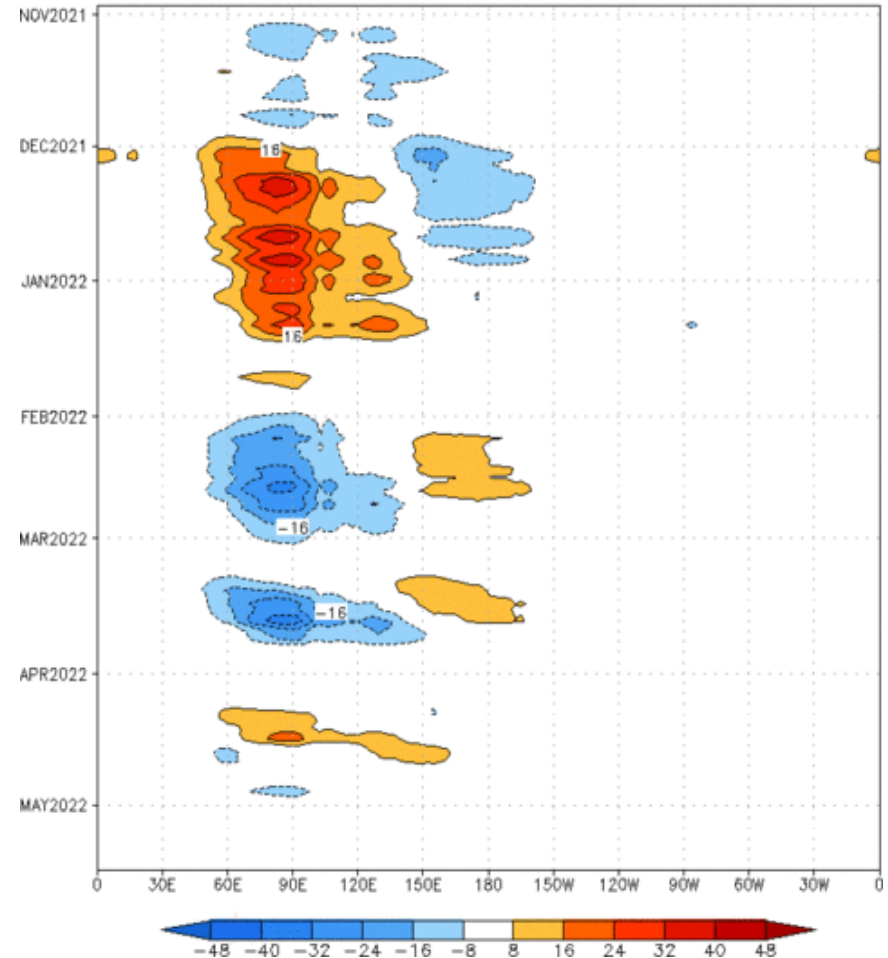
MJO: Constructed Analog Forecast Evolution

Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (01 May 2022)



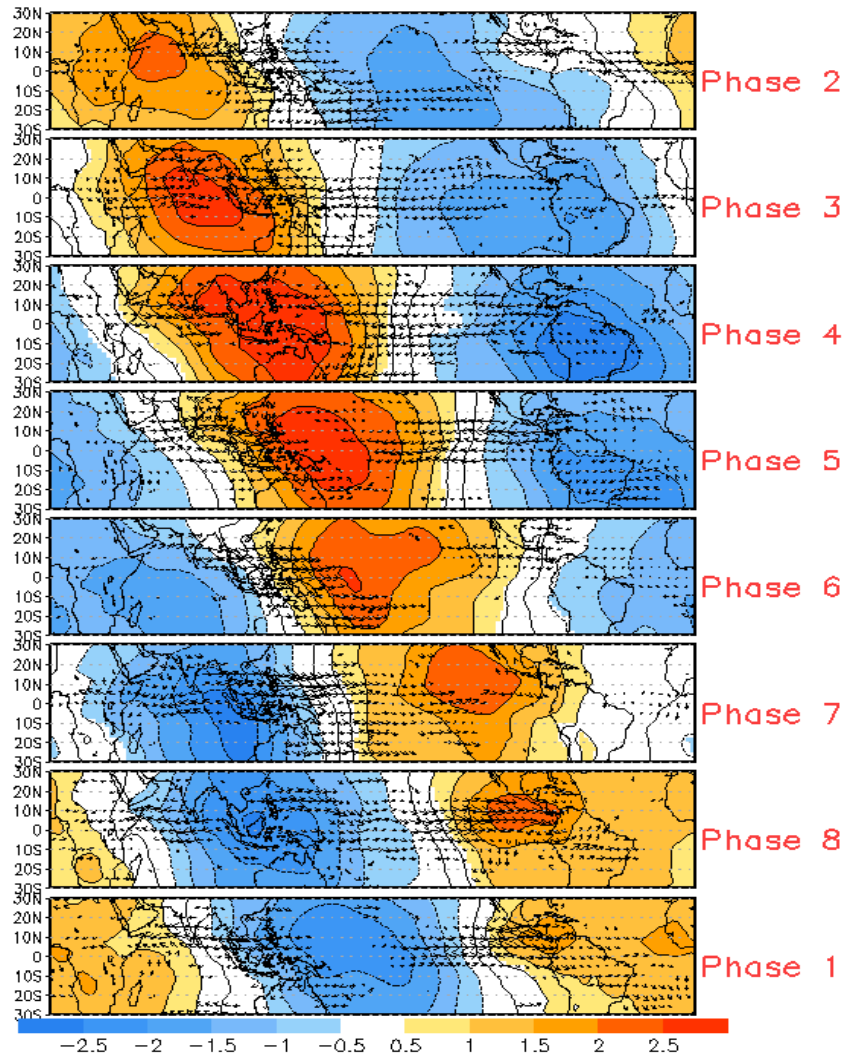
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:30-Oct-2021 to 01-May-2022
The unfilled contours are CA forecast reconstructed anomaly for 15 days



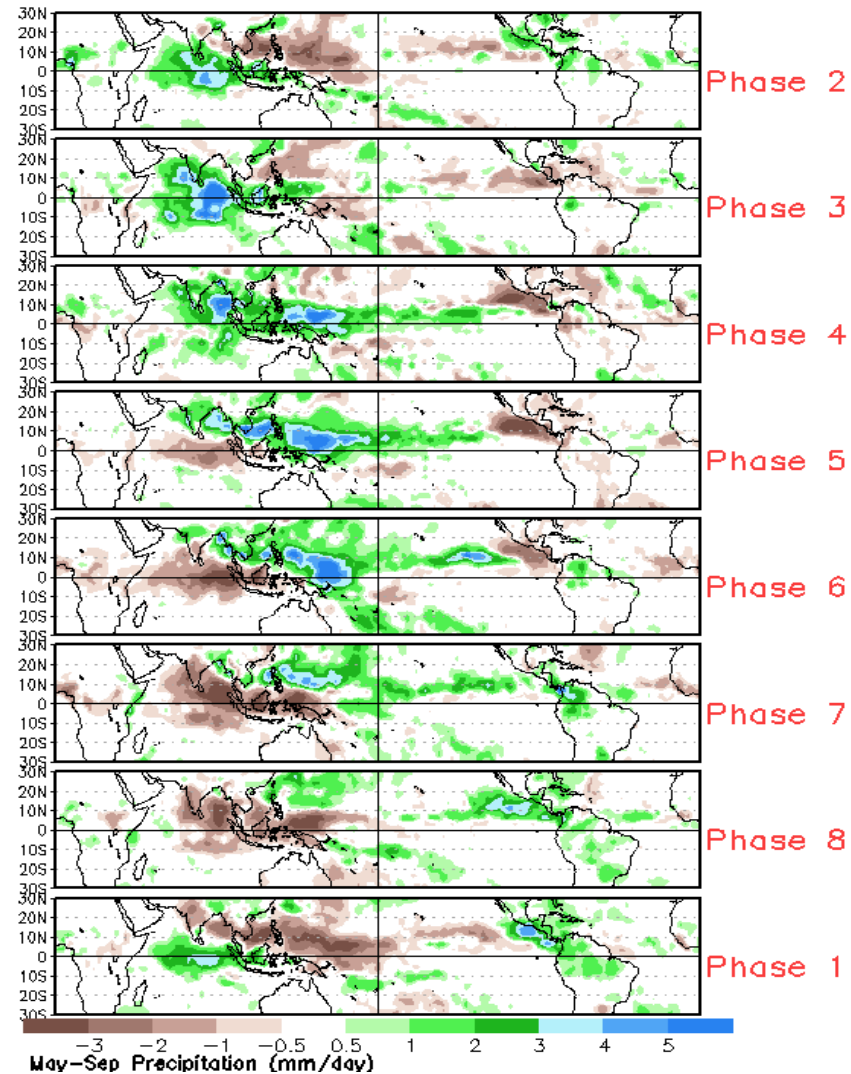
- The constructed analog forecast of RMM-based OLR anomalies depicts a muted pattern, much less suggestive of a developing MJO through mid-May compared to the GEFS.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



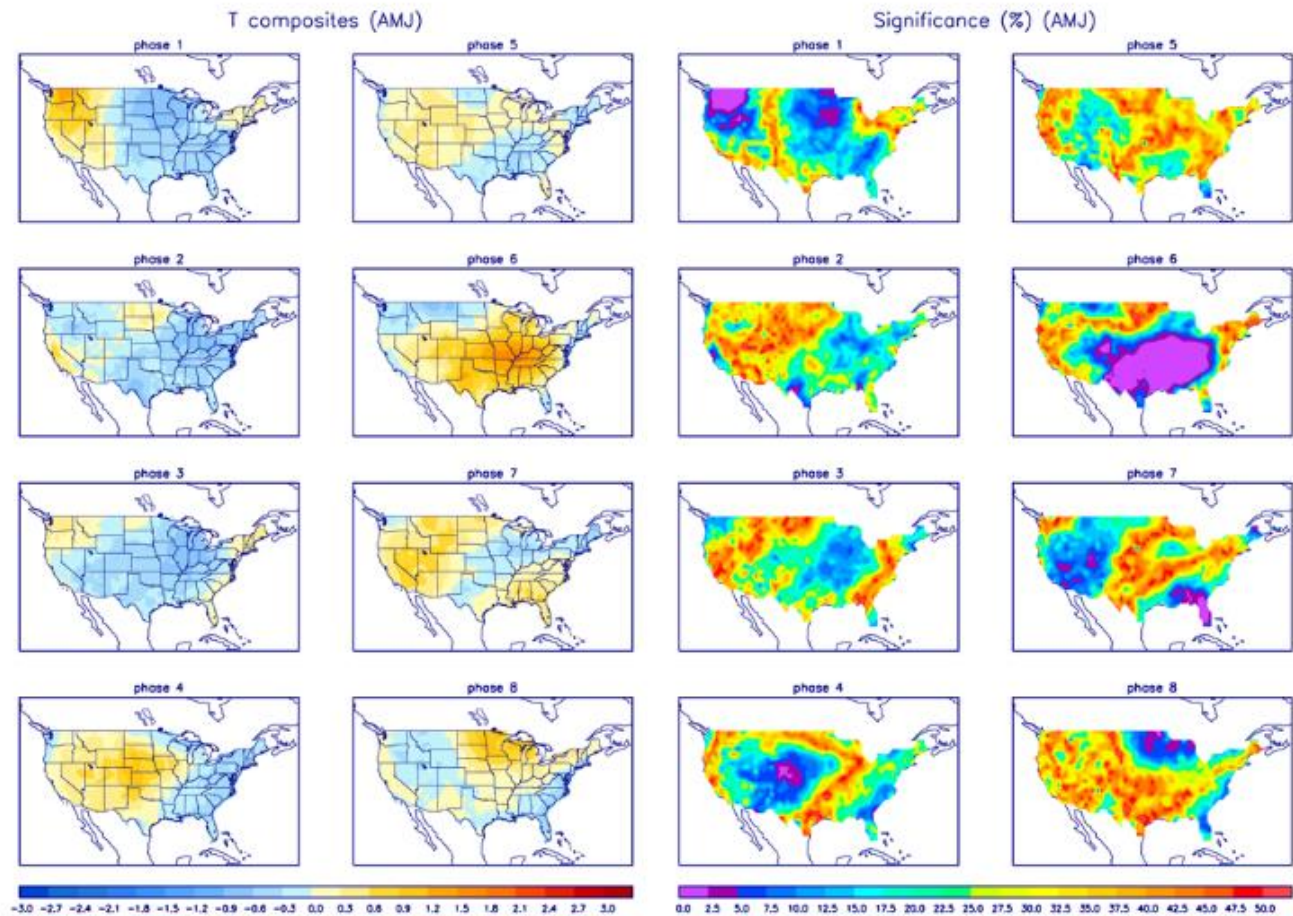
Precipitation Anomalies



MJO: CONUS Composite Maps by RMM Phase - Temperature

Left hand side plots show temperature anomalies by MJO phase for MJO events that have occurred over the three month period in the historical record. Blue (red) shades show negative (positive) anomalies respectively.

Right hand side plots show a measure of significance for the left hand side anomalies. Purple shades indicate areas in which the anomalies are significant at the 95% or better confidence level.



MJO: CONUS Composite Maps by RMM Phase - Temperature

Left hand side plots show precipitation anomalies by MJO phase for MJO events that have occurred over the three month period in the historical record. Brown (green) shades show negative (positive) anomalies respectively.

Right hand side plots show a measure of significance for the left hand side anomalies. Purple shades indicate areas in which the anomalies are significant at the 95% or better confidence level.

