

Madden-Julian Oscillation: Recent Evolution, Current Status and Predictions



Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
28 March 2022

Overview

- Consistent with previous forecasts, the RMM index indicates the MJO continued to propagate eastward across the Maritime Continent while decreasing in amplitude during the last week, where it currently resides within the RMM unit circle.
- While RMM forecasts show the intraseasonal signal remaining weak heading into early April, there is a good deal of ensemble spread in the dynamical models, as lower-level zonal wind forecasts have become more suggestive of the MJO reemerging over the Western Hemisphere.
- Upper-level conditions are expected to be favorable for tropical cyclone formation over the western Pacific during early April.

A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:

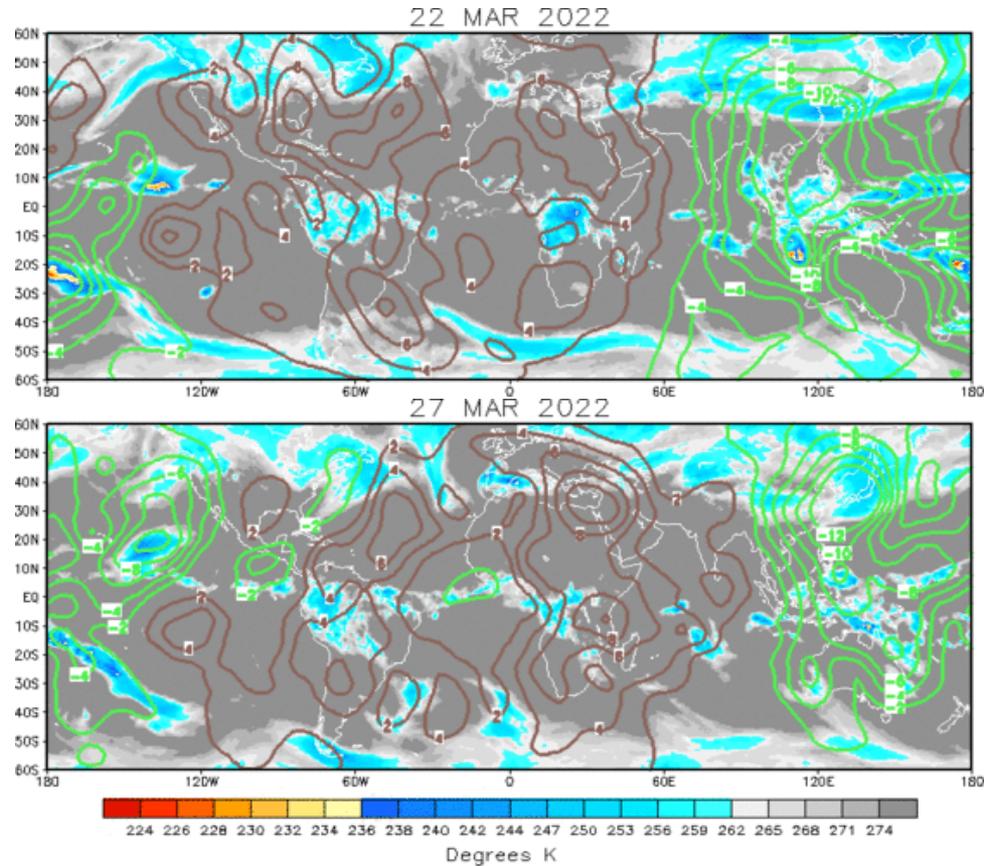
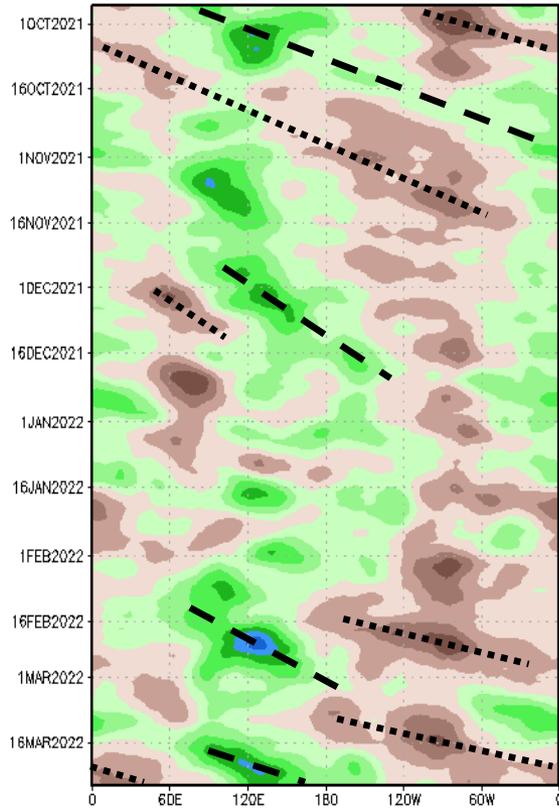
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

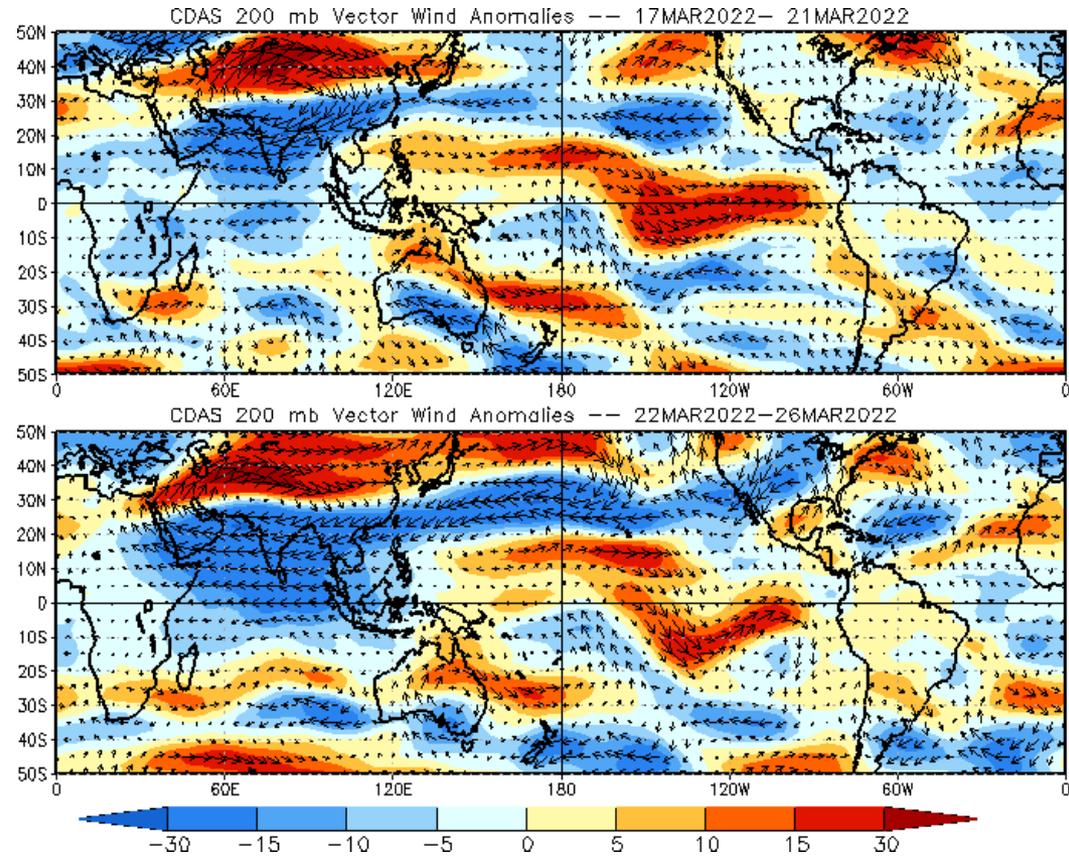
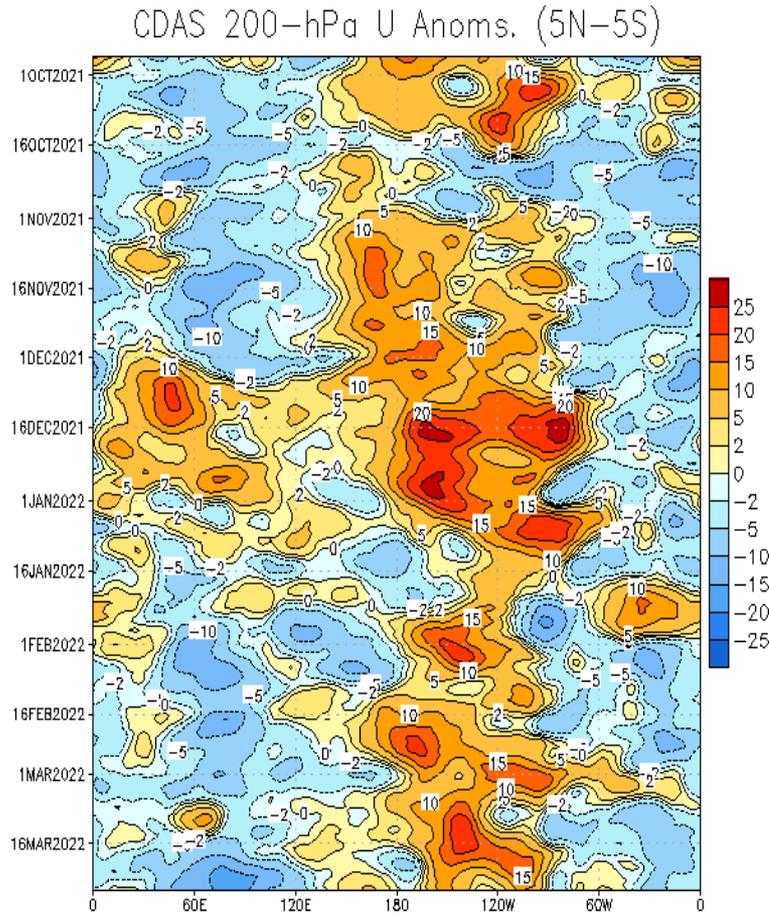
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- A fairly coherent wave-1 pattern continues to be observed in the upper-level velocity potential fields.
- During the last week, the leading edge of the enhanced divergence envelope shifted further eastward into the western Hemisphere, with more suppressed conditions developing over Africa and the western Indian Ocean.

200-hPa Wind Anomalies

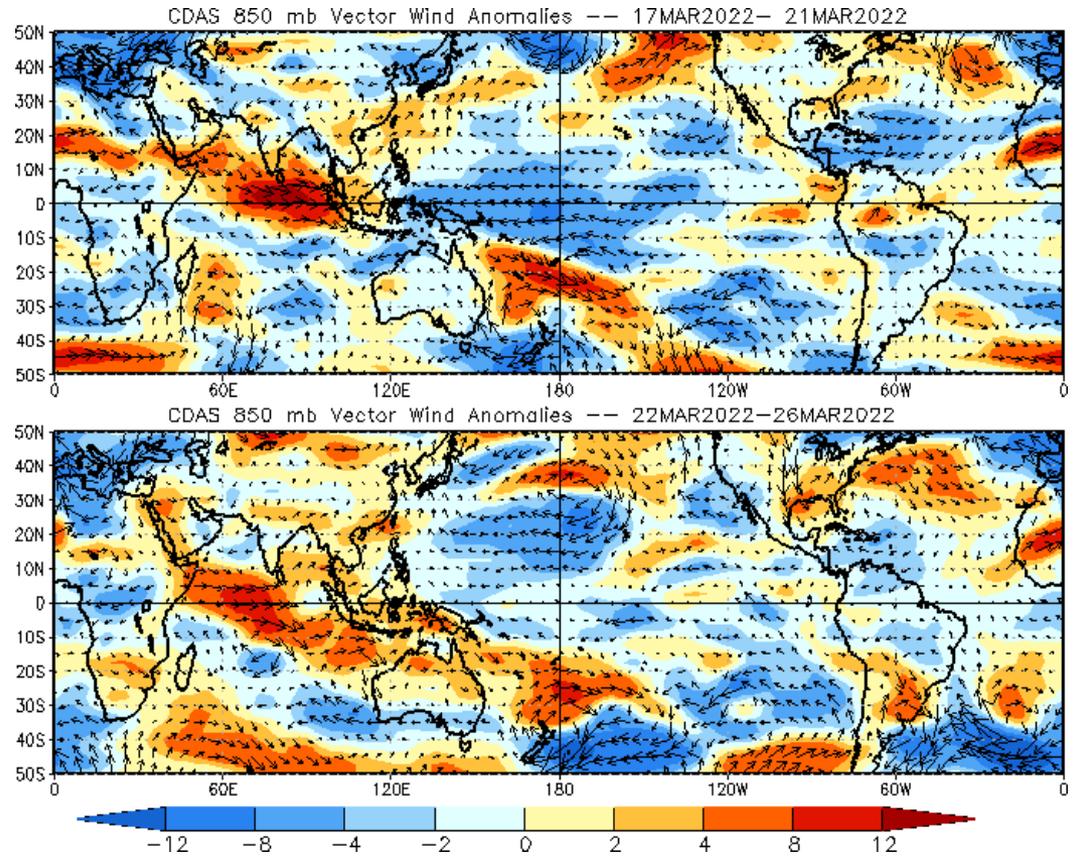
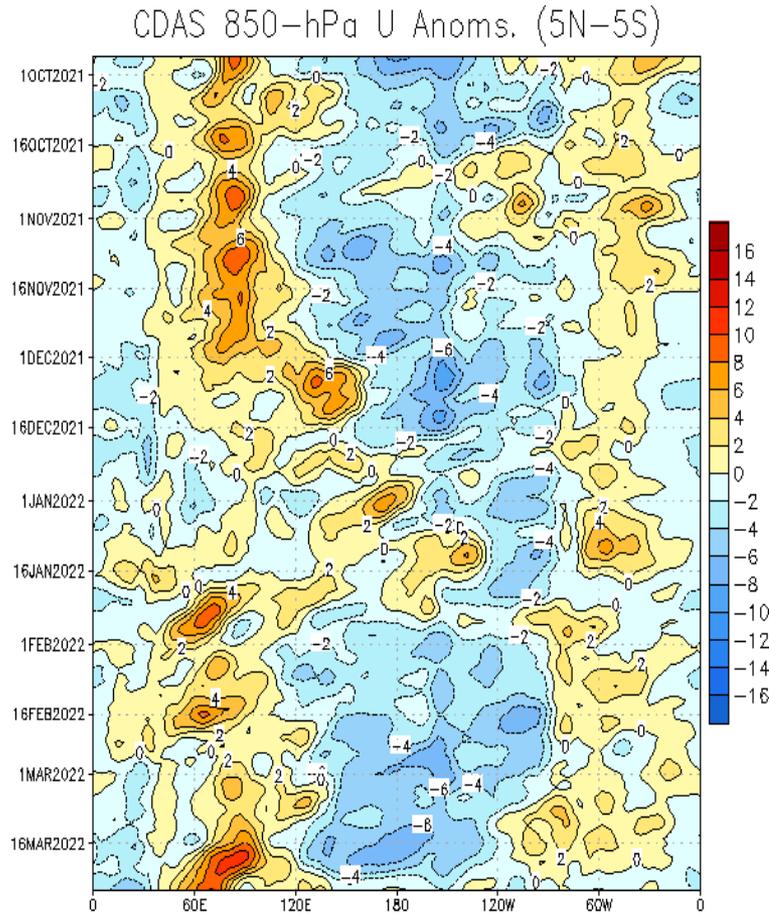
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Consistent with the ongoing La Nina, a broad region of anomalous upper-level westerlies persists over the equatorial Pacific, though some weakening is observed near 120W.
- Anomalous easterlies have strengthened and shifted eastward into the Maritime Continent, aiding the enhancement of divergence aloft over western Pacific.
- A broad band of anomalous easterlies are also observed well to the north of equator, indicative of a northward displaced jet over the Northern Hemisphere relative to normal.

850-hPa Wind Anomalies

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

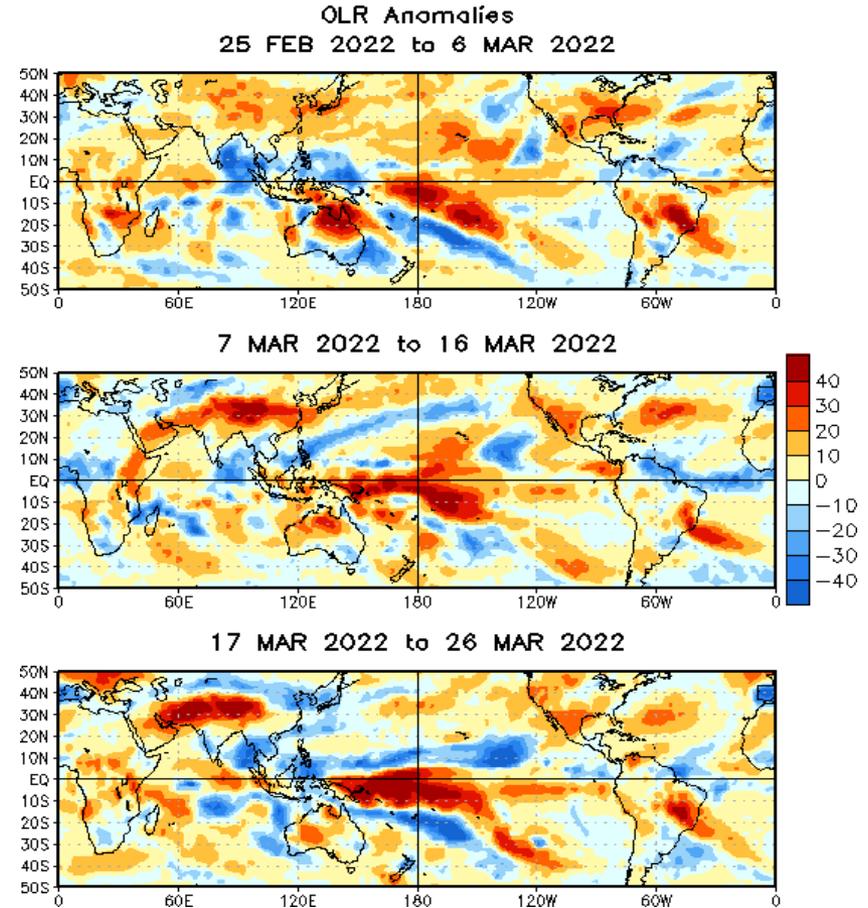
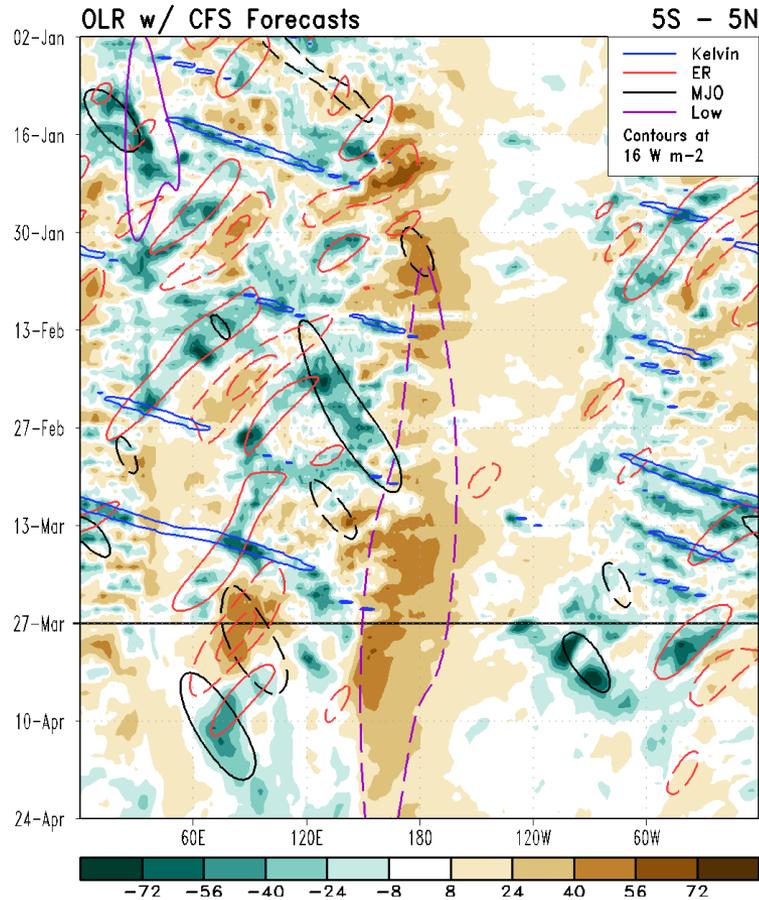


- The enhanced trade wind regime tied to the ongoing La Niña has relaxed, suggestive of an eastward propagating feature destructively interfering with the low frequency footprint over the equatorial Pacific.
- A surge of anomalous westerlies is evident over the equatorial Indian Ocean after the middle of March, with more westerlies developing over the Maritime Continent during the last week.

Outgoing Longwave Radiation (OLR) Anomalies

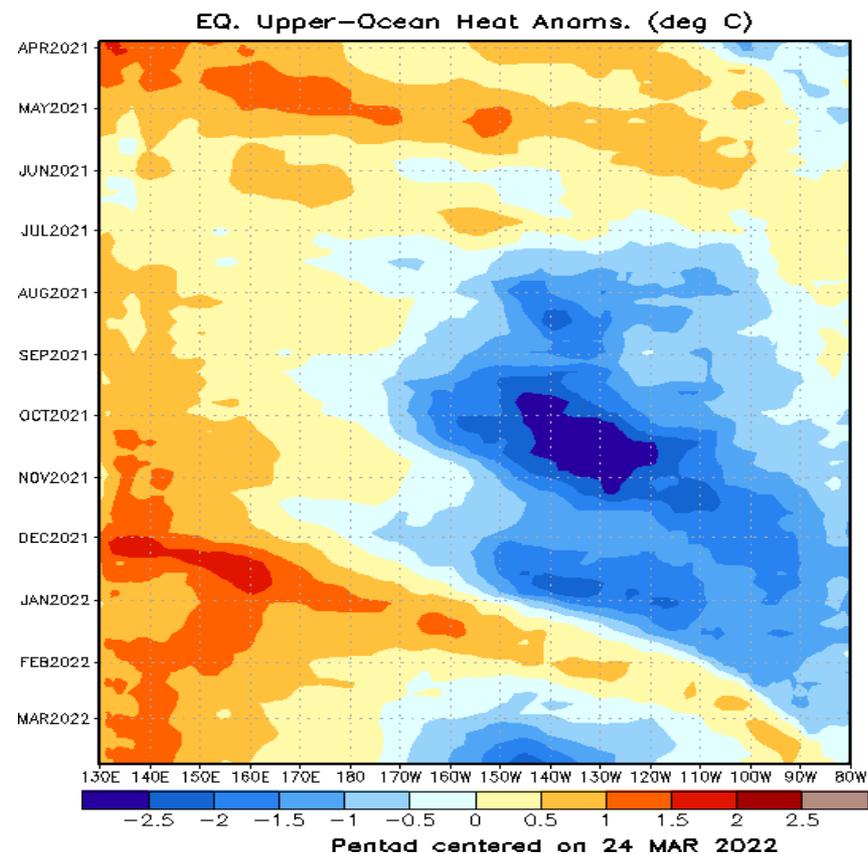
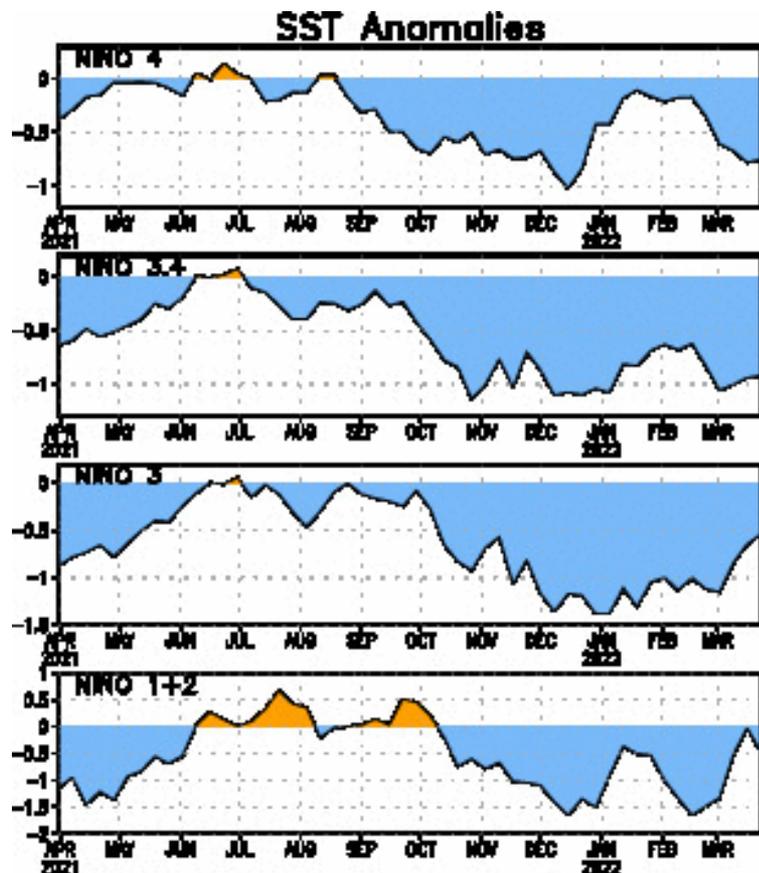
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- Unlike recent trends in the zonal wind fields, intraseasonal activity is much less evident in the OLR observations along the equator as suppressed convection remains anchored to the west of the Date Line.
- Forecasts favor the development of enhanced convection over the Western Hemisphere tied to both MJO and Rossby Wave activity during the next two weeks.

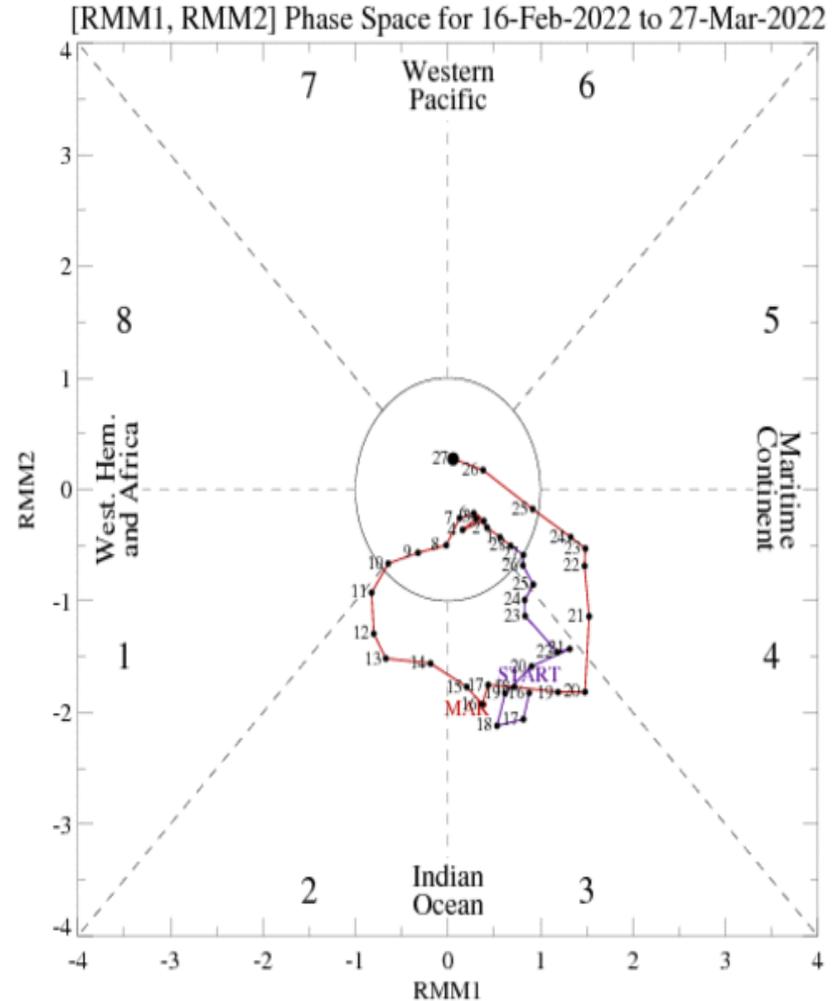
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Following the passage of a robust downwelling oceanic Kelvin wave that was generated in response to a significant westerly wind burst in December, negative upper-oceanic heat content anomalies have redeveloped between 170W and 120W.
- Negative SSTs remain in place across all Niño regions, however there is a warming trend in the Niño1+2 and Niño 3 regions likely tied to the establishment of anomalous westerlies over the eastern Pacific during March.

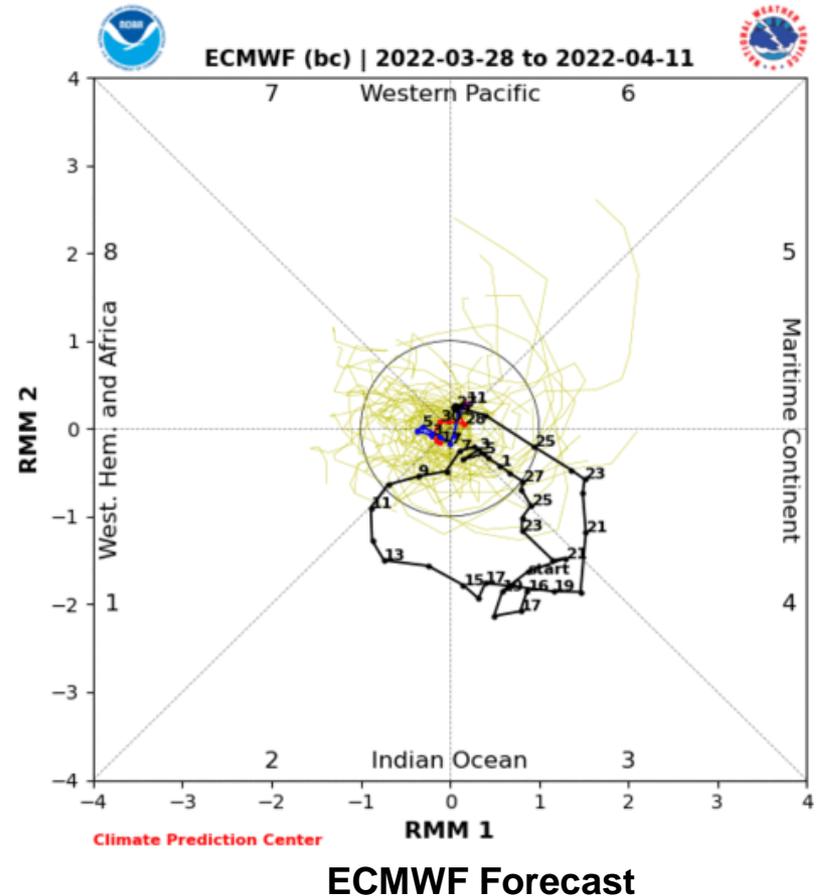
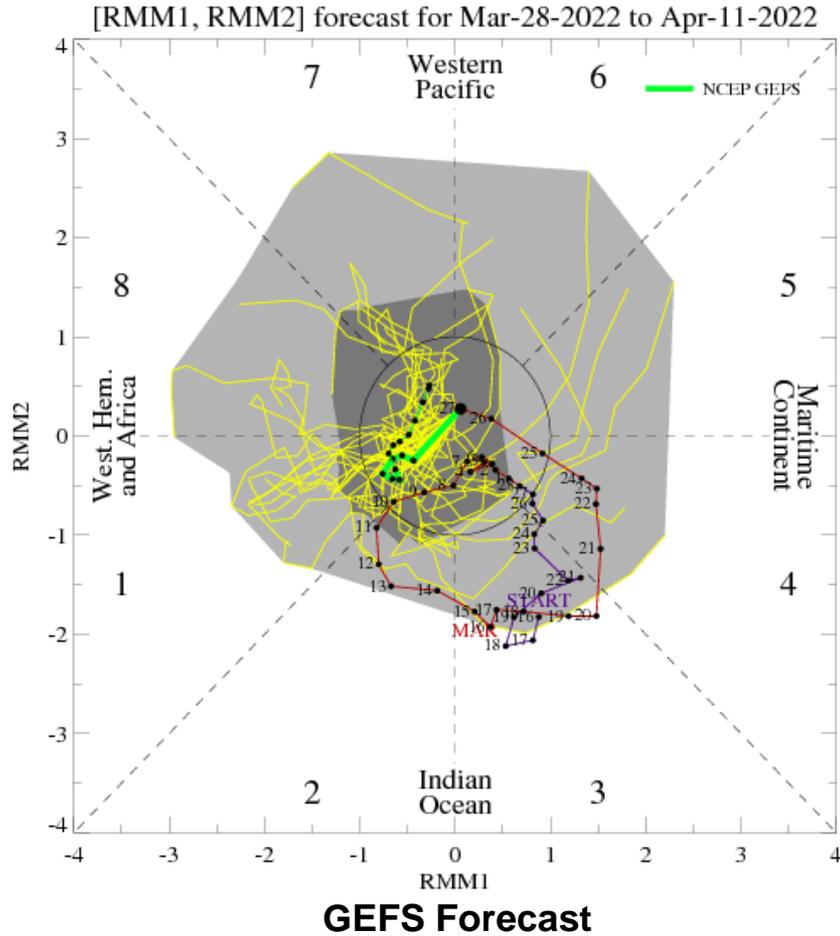
MJO Index: Recent Evolution

- During the past week, the RMM index shows the intraseasonal signal continuing to propagate eastward over the Maritime Continent while losing amplitude and falling within the unit circle.
- The reduction in amplitude (low RMM2 values) can be explained in part by the lack of a coherent convective signal over the Maritime Continent and western Pacific.



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

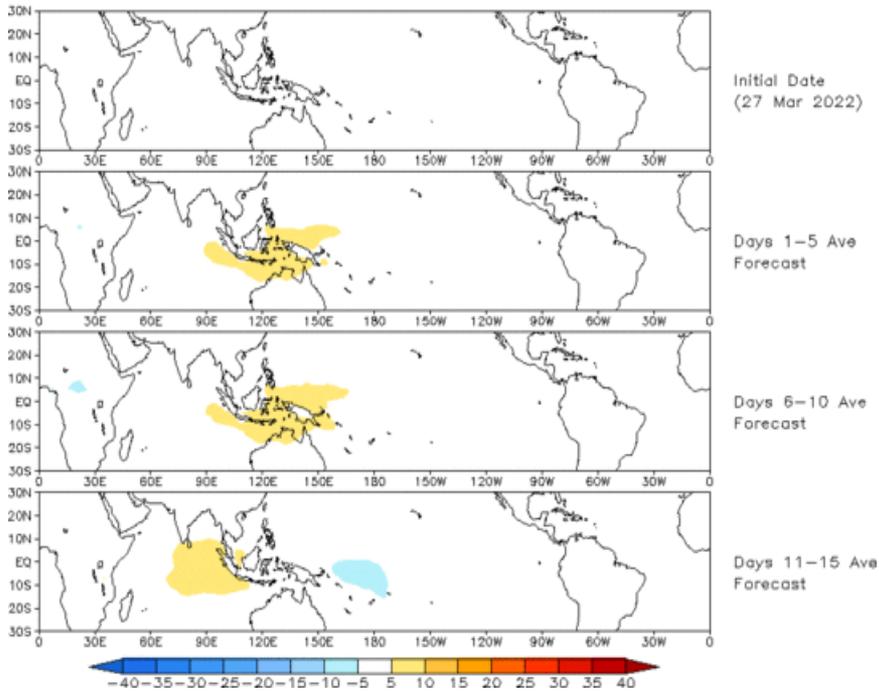


- RMM forecasts show the MJO to remain weak with values within the RMM unit circle during the next two weeks. However, there is a good deal of ensemble spread in the forecasts contributing to uncertainty in the outlook.
- Some ensemble solutions favor the reemergence of the intraseasonal signal over the Western Hemisphere in early April which is supported by zonal wind forecasts.

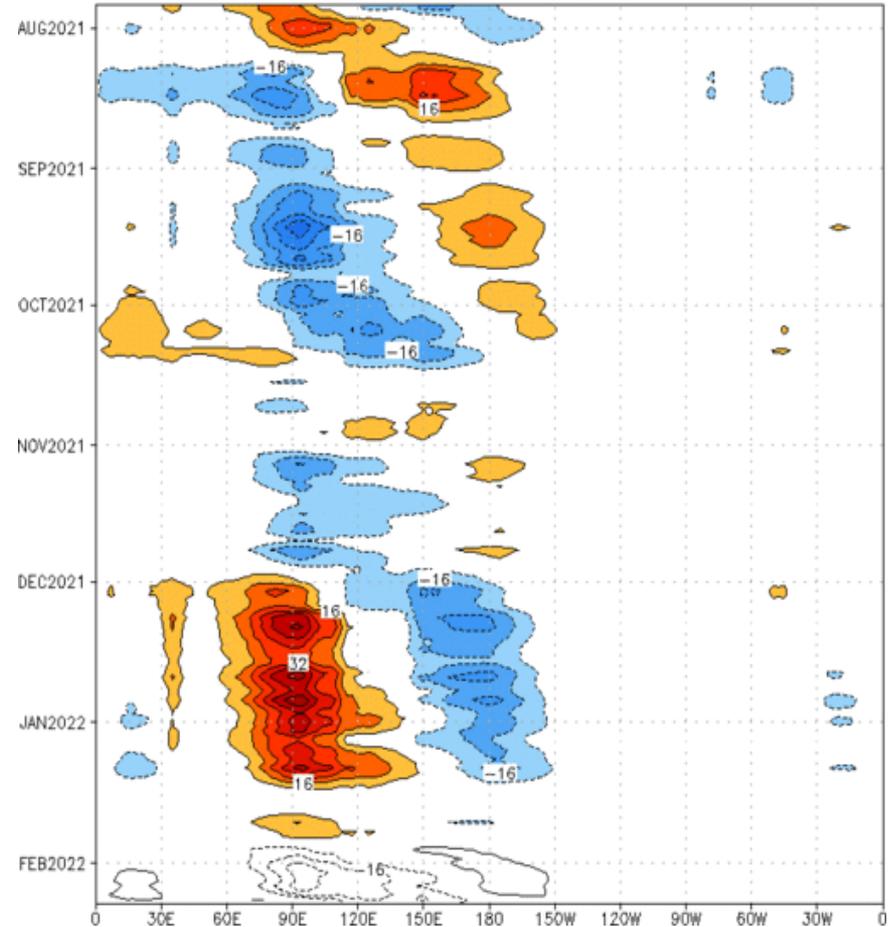
MJO: GEFS Forecast Evolution

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: 27 Mar 2022
OLR



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

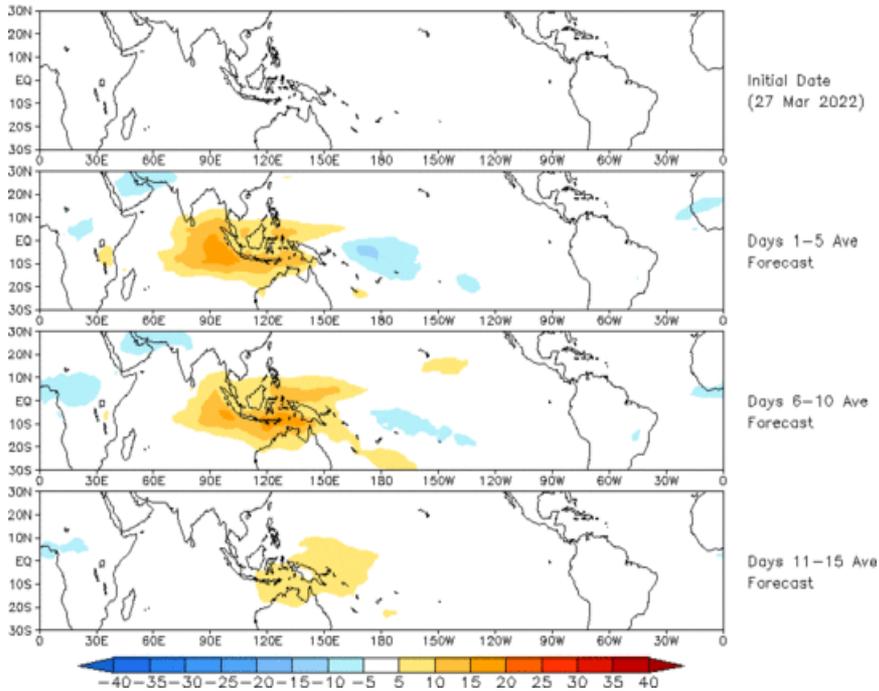


- The GEFS RMM-based OLR field depicts weak convective anomalies with little to no eastward propagation.

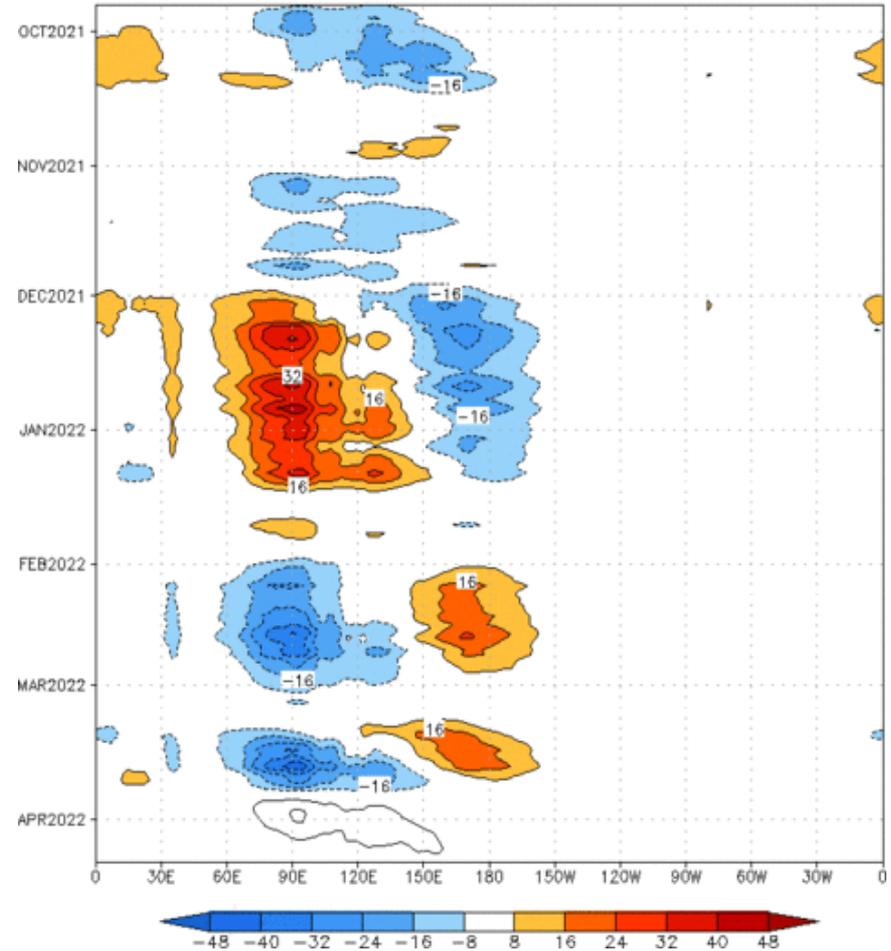
MJO: Constructed Analog Forecast Evolution

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 (27 Mar 2022)



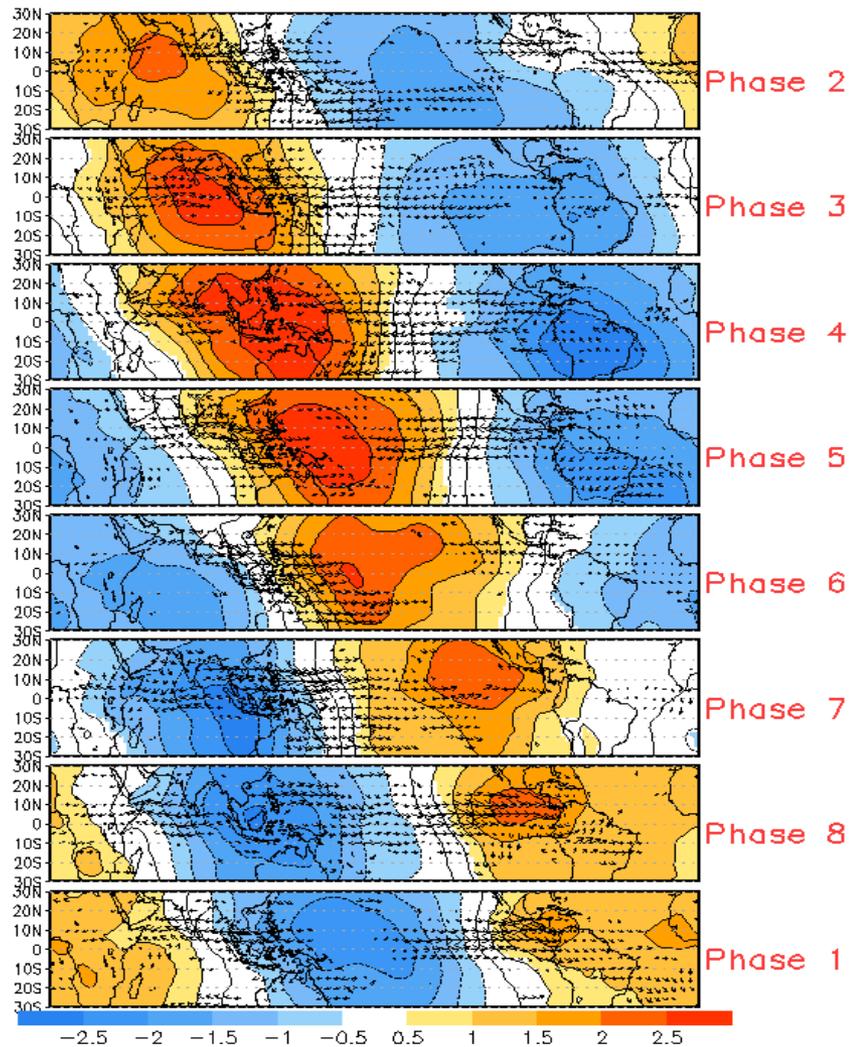
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:25-Sep-2021 to 27-Mar-2022
The unfilled contours are CA forecast reconstructed anomaly for 15 days



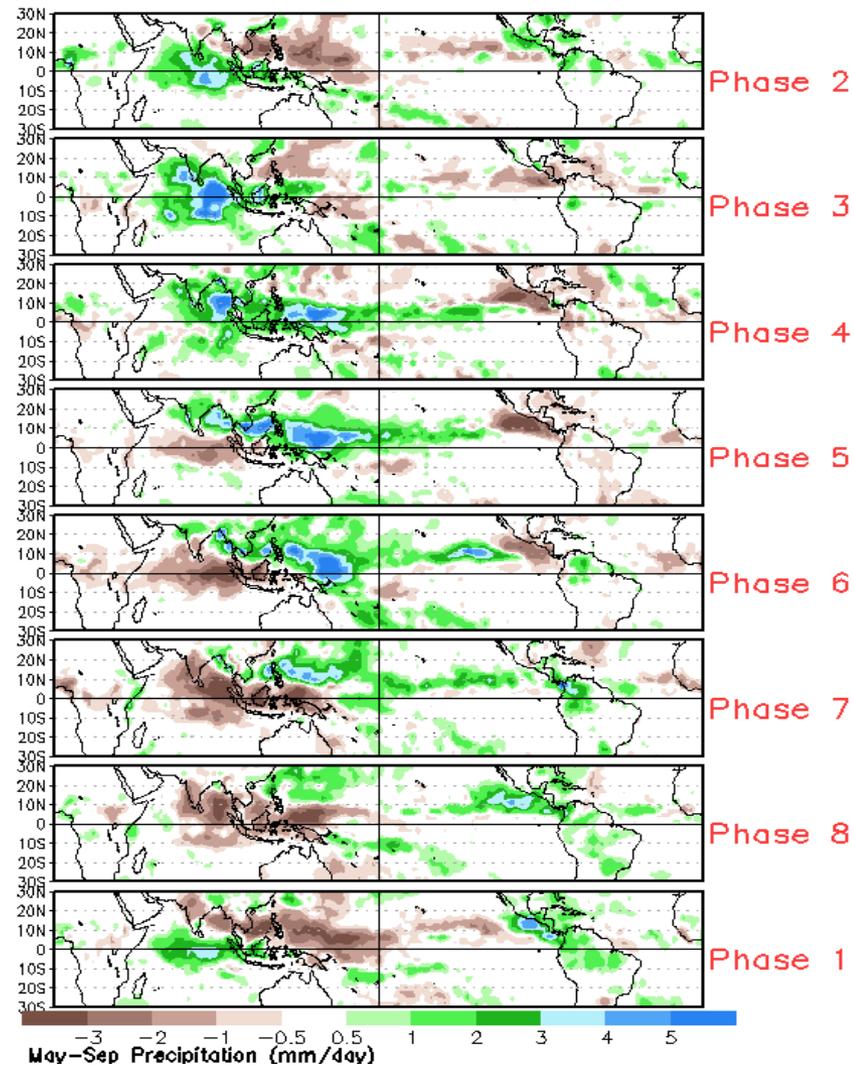
- The constructed analog favors more suppressed convection developing over the eastern Indian Ocean and Maritime Continent, with enhanced convection that diminishes over the Pacific.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



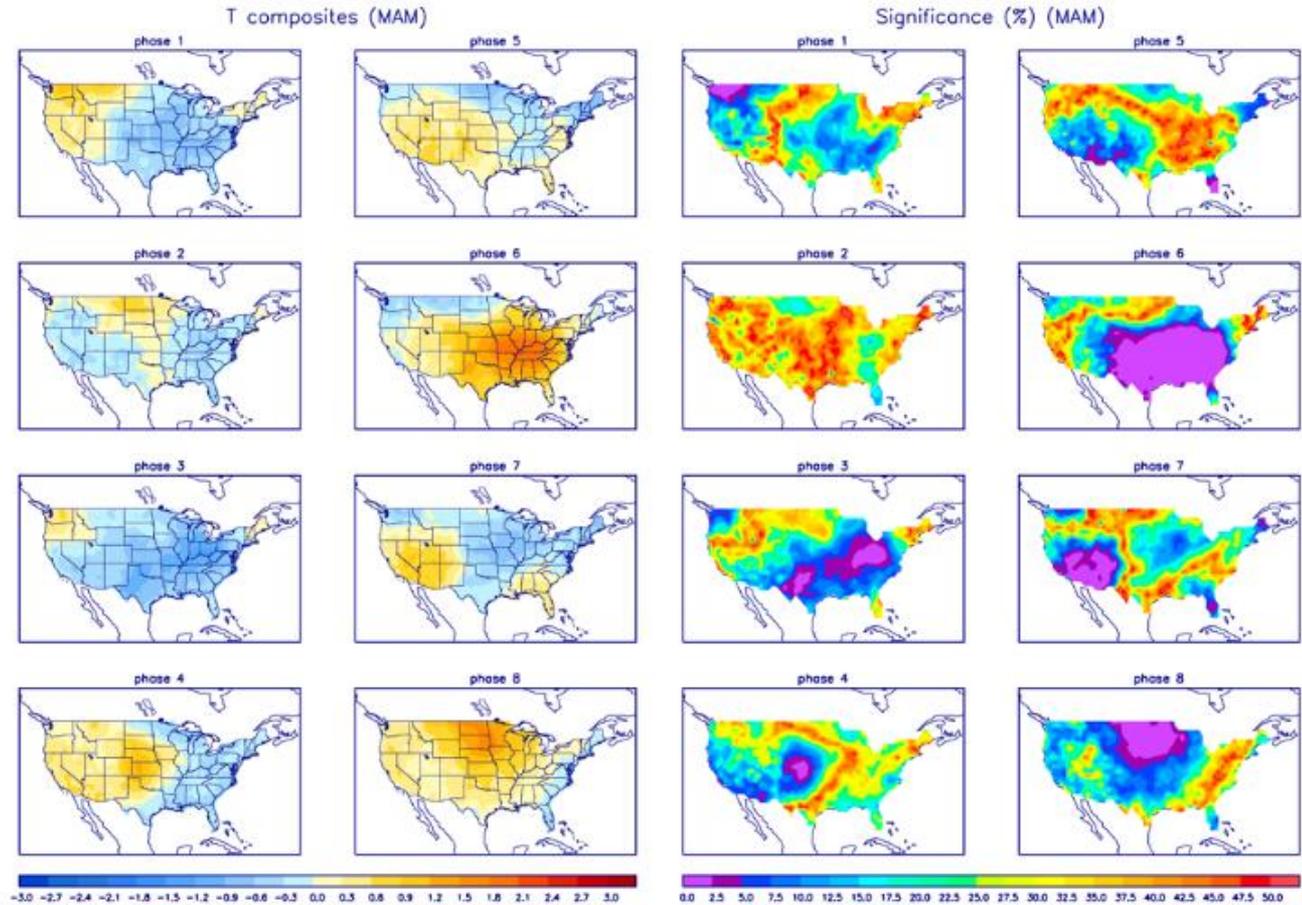
Precipitation Anomalies



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.

