

# **Madden-Julian Oscillation:**

## **Recent Evolution, Current Status and Predictions**



**Update prepared by the Climate Prediction Center**  
**Climate Prediction Center / NCEP**  
**14 March 2022**

# Overview

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- The MJO has shown better signs of organization, which is reflected in the observational RMM index and upper-level velocity potential anomalies depicting the leading edge of the main convective envelope shifting eastward over Africa and the western Indian Ocean during the past week.
- There is good agreement in the dynamical models favoring continued eastward propagation of the MJO across the Indian Ocean and into the Maritime Continent during the next two weeks. Several ensemble members suggest the possible development of a high amplitude event.
- The enhanced phase of the MJO, as well as predicted Kelvin and Rossby wave activity, is expected to increase chances for tropical cyclone formation mainly over the Indian Ocean during the next two weeks.
- The potential for the MJO to constructively interfere with the low frequency footprint would favor an extratropical response typical of La Niña, yielding warmer than normal temperatures across eastern North America later in March.

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>

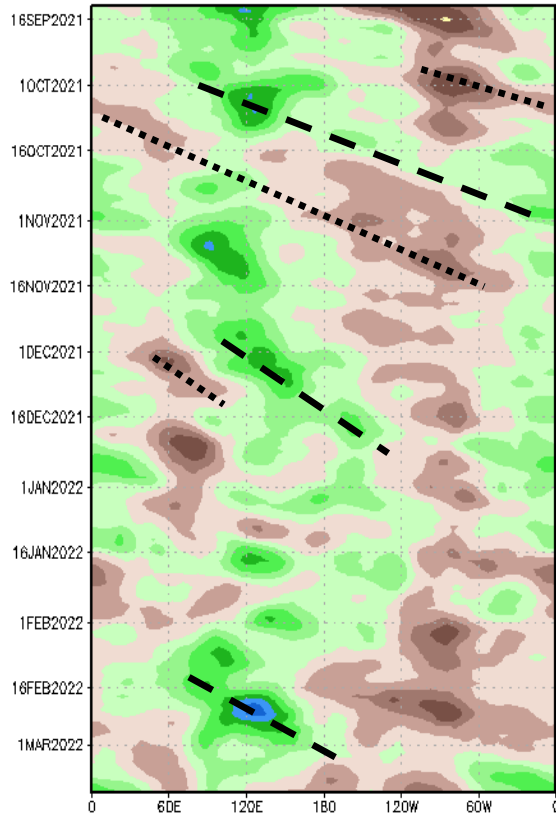
# 200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

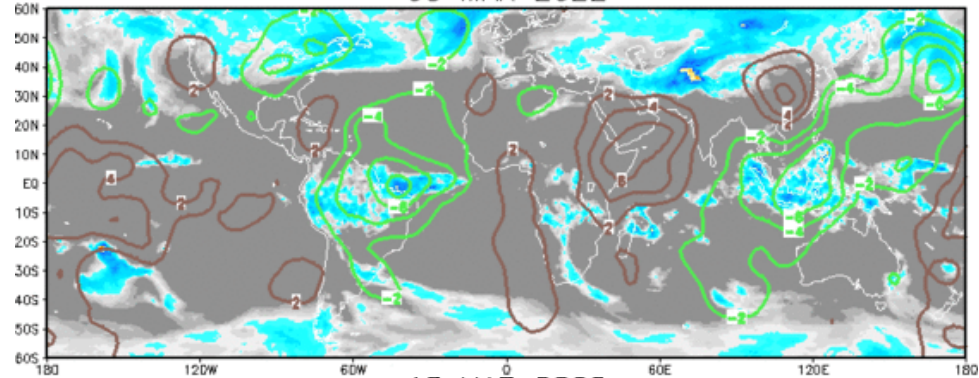
Brown shades: Anomalous convergence (unfavorable for precipitation)

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

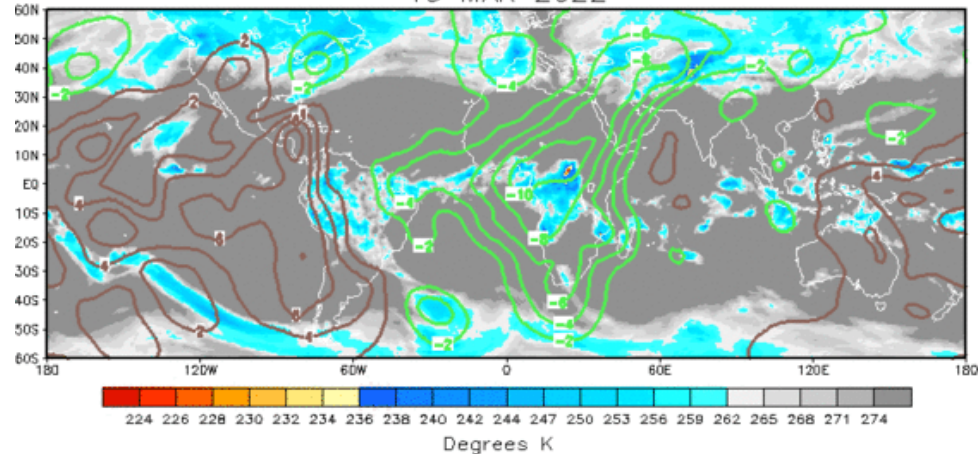
5-day Running Mean



08 MAR 2022



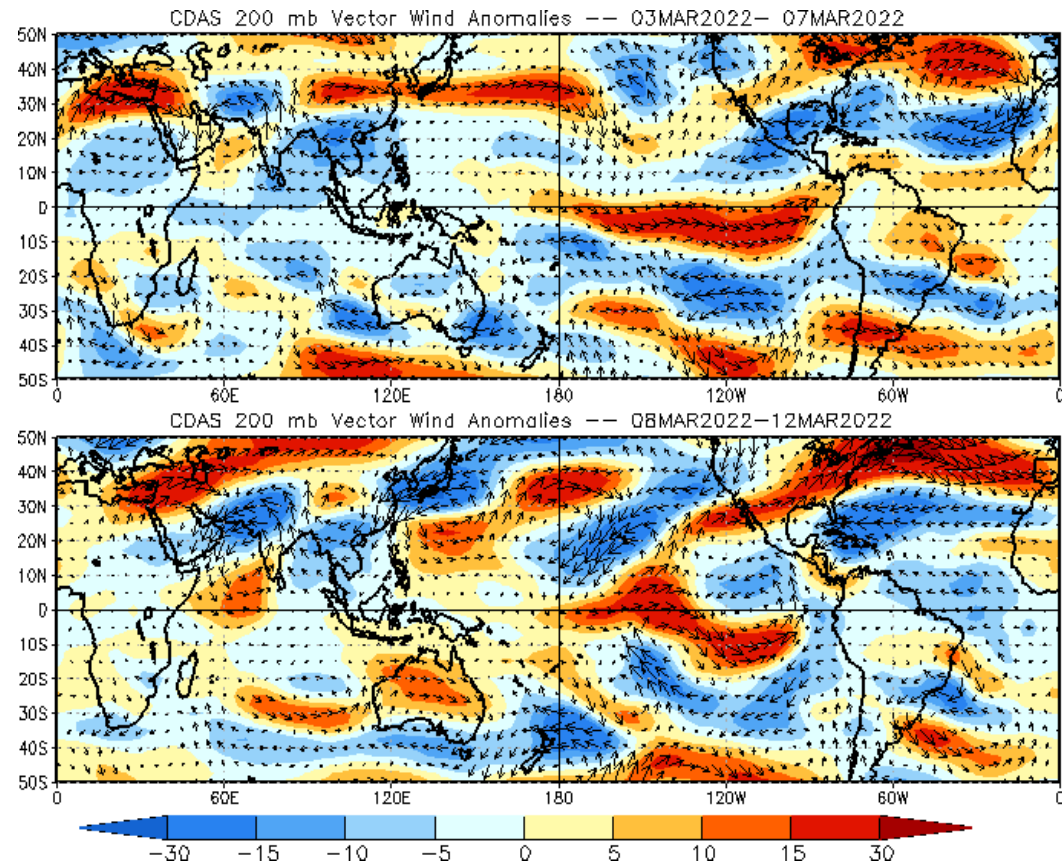
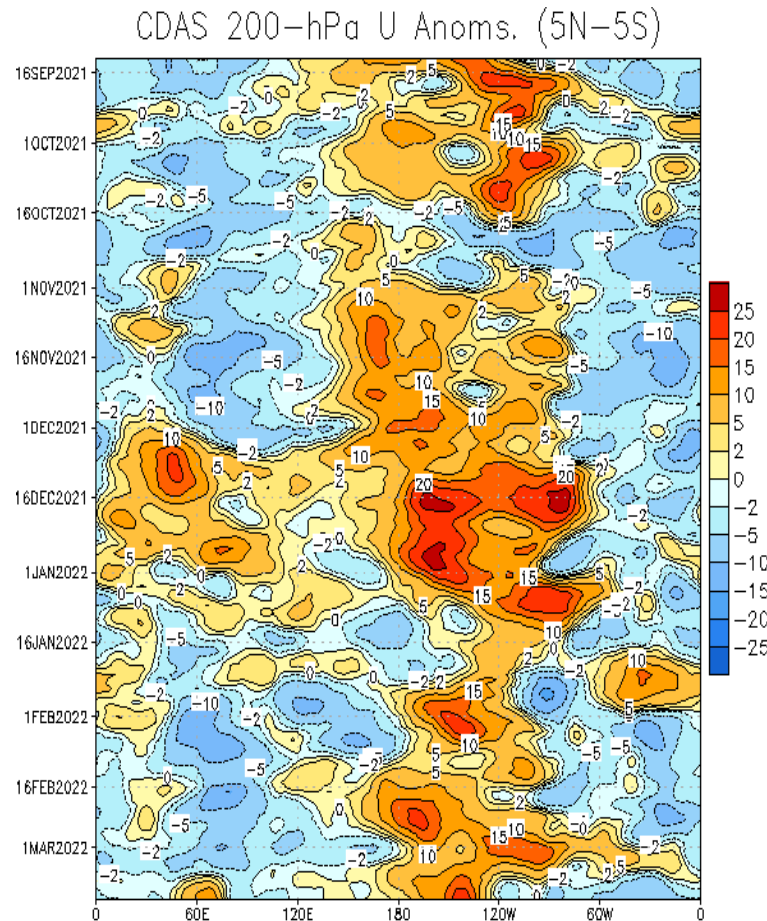
13 MAR 2022



- During the past week, the velocity potential pattern has become more coherent with more enhanced (suppressed) convection and anomalous divergence (convergence) aloft observed over Africa (equatorial Pacific).
- The renewed intraseasonal activity appears to be tied to a convectively coupled Kelvin wave that propagated eastward from the Western Hemisphere earlier in March.

# 200-hPa Wind Anomalies

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

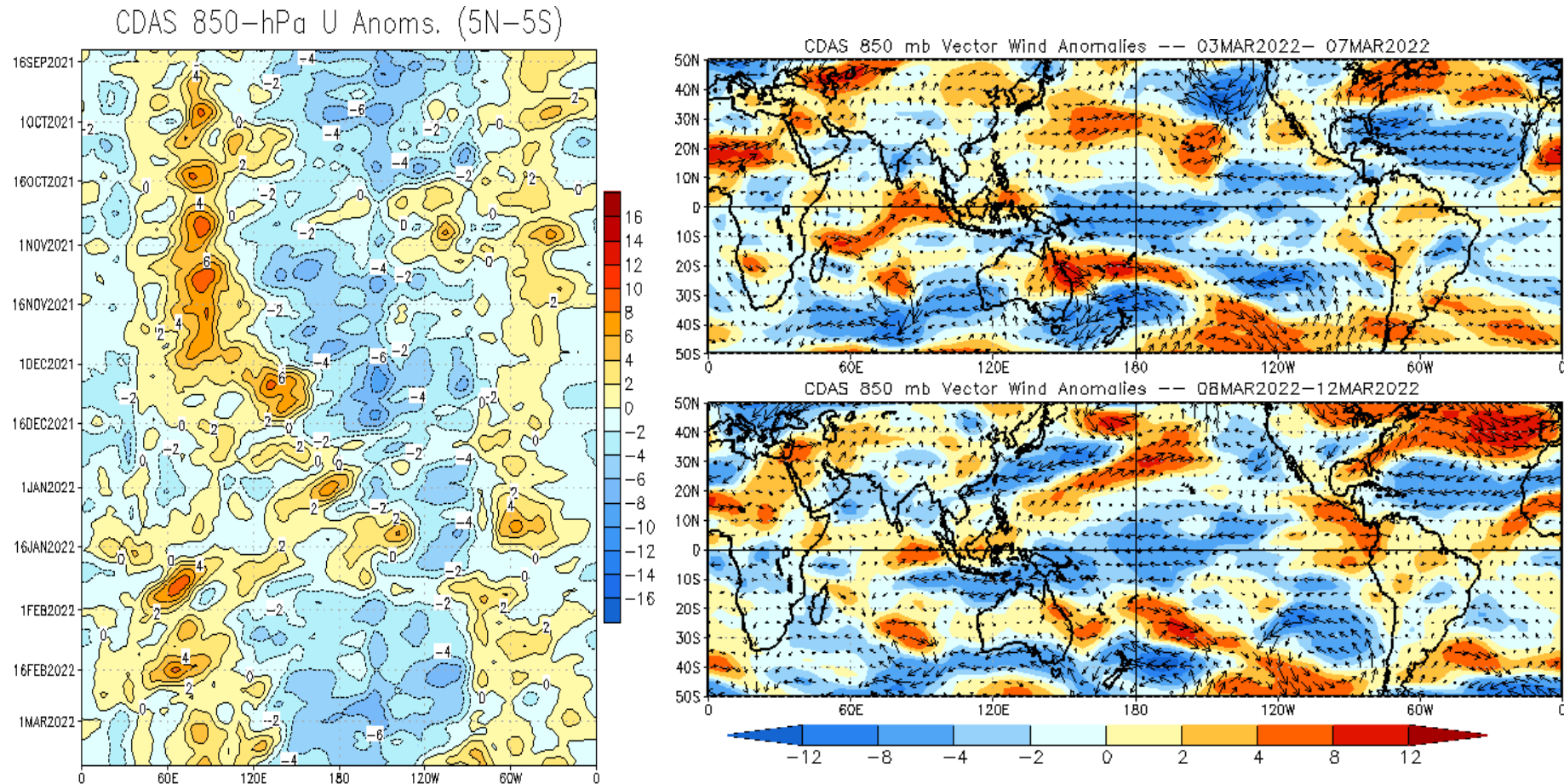


- Consistent with the ongoing La Nina, a broad region of anomalous upper-level westerlies persists over the equatorial Pacific, reinforced by deep troughing to the east of the Date Line.
- There are better indications of a wave train aloft across the northern Hemisphere in the most recent analysis.
- Anomalous westerlies (easterlies) developed over the western Indian Ocean (Atlantic) and are contributing to enhanced divergence aloft over equatorial Africa.



# 850-hPa Wind Anomalies

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

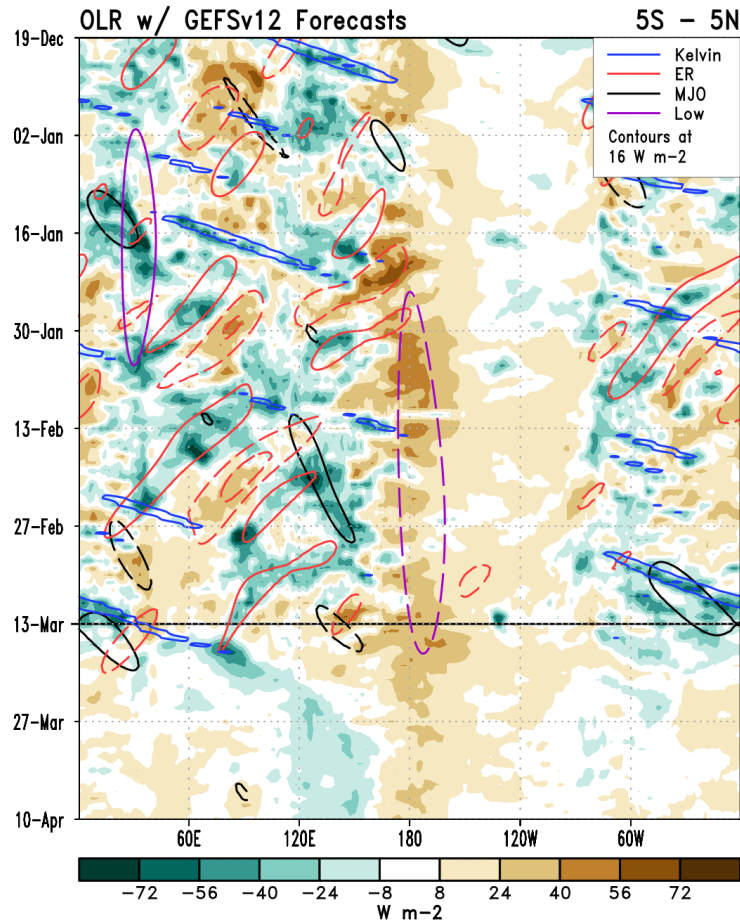


- Enhanced trade winds persist across equatorial central Pacific, though anomalous westerlies have emerged over the eastern Pacific.
- Unlike the upper-level fields, lower-level winds appear more disorganized over Africa, with anomalous westerlies anchored over the eastern Indian Ocean and Maritime Continent consistent with the low frequency footprint.

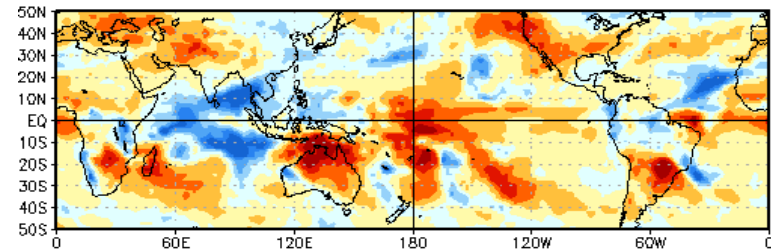
# Outgoing Longwave Radiation (OLR) Anomalies

**Green shades:** Anomalous convection (wetness)

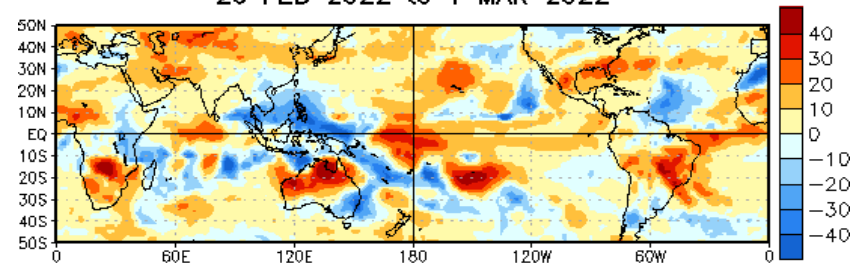
**Brown shades:** Anomalous subsidence (dryness)



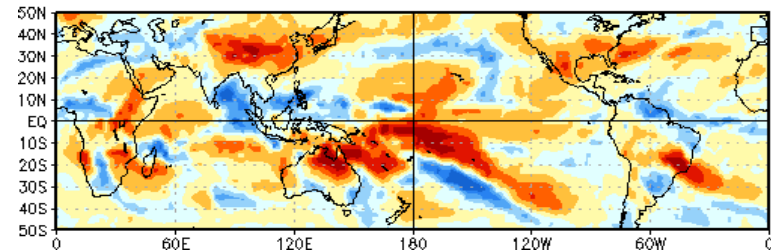
OLR Anomalies  
10 FEB 2022 to 19 FEB 2022



20 FEB 2022 to 1 MAR 2022

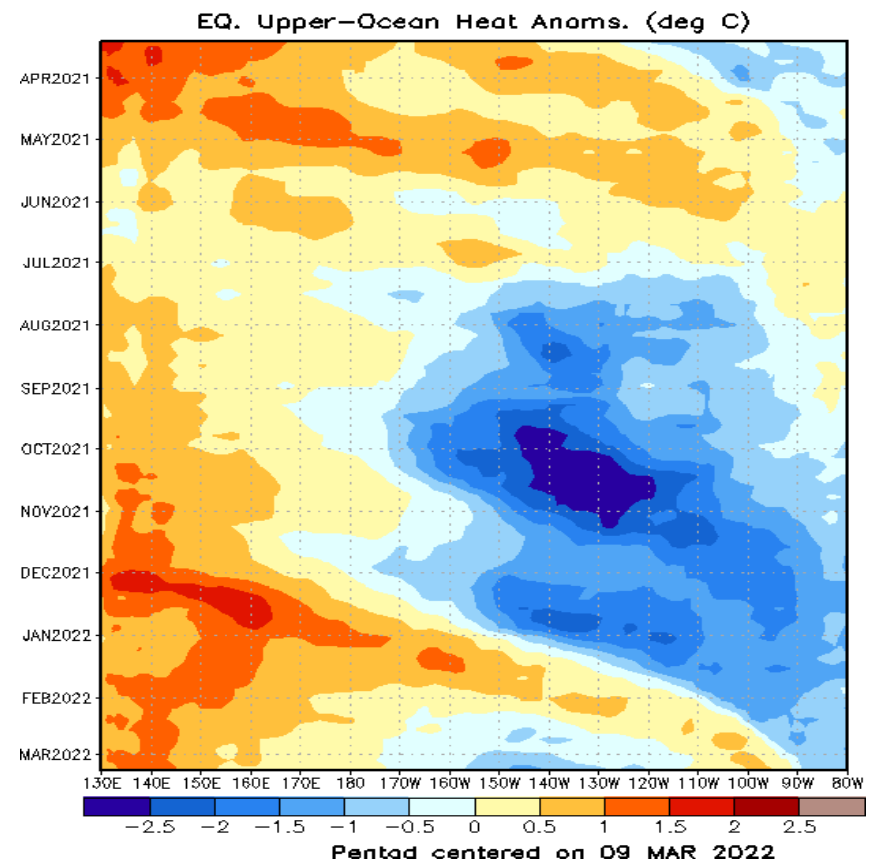
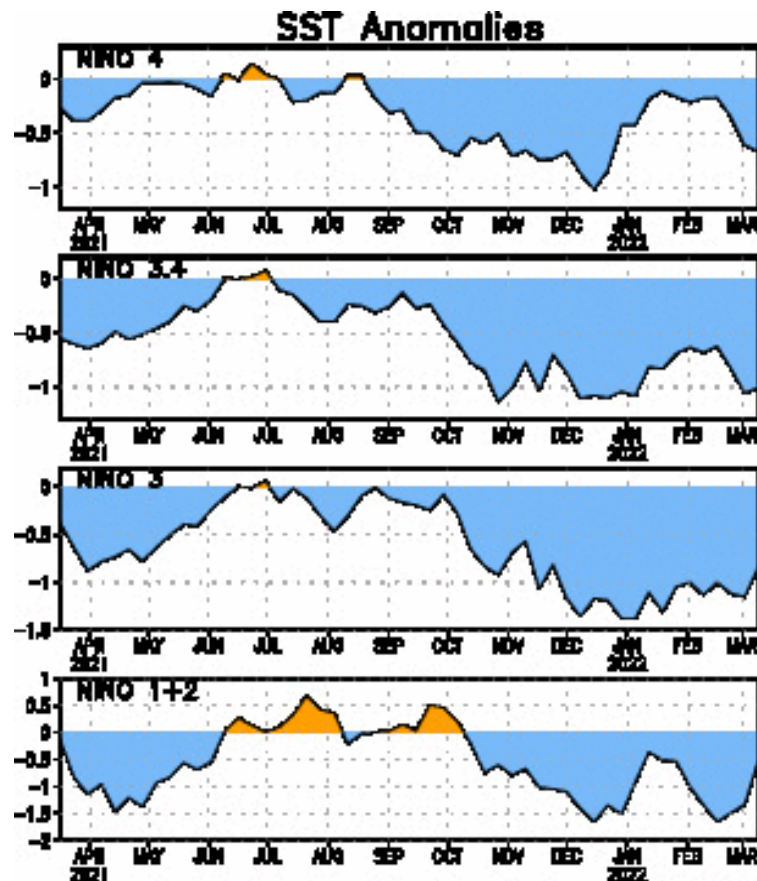


2 MAR 2022 to 11 MAR 2022



- An envelope of enhanced convection has shifted eastward over Africa, with both MJO and Kelvin wave activity coming through the filtering along the equator.
- Forecasts favor more enhanced convection over the Indian Ocean and Maritime Continent where it looks to again constructively interfere with La Niña later in March.

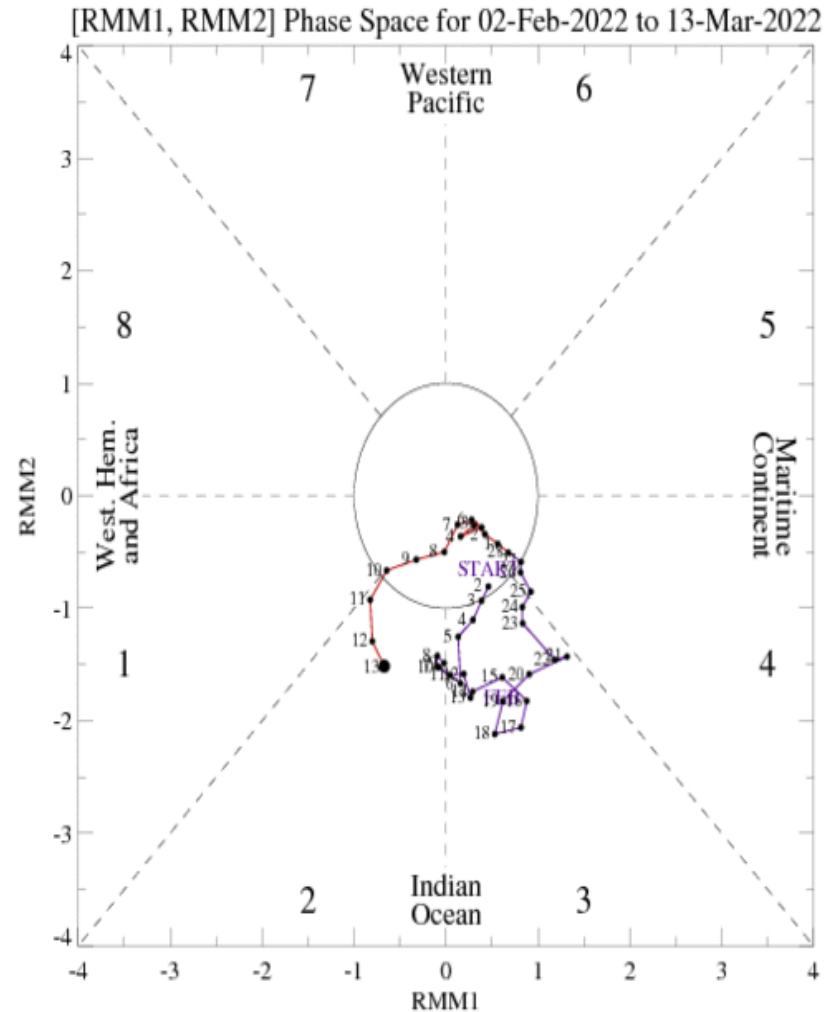
# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- 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.
- Despite a warming trend in the Niño1+2 region since early March, negative SSTs remain in place across all Niño regions.

# MJO Index: Recent Evolution

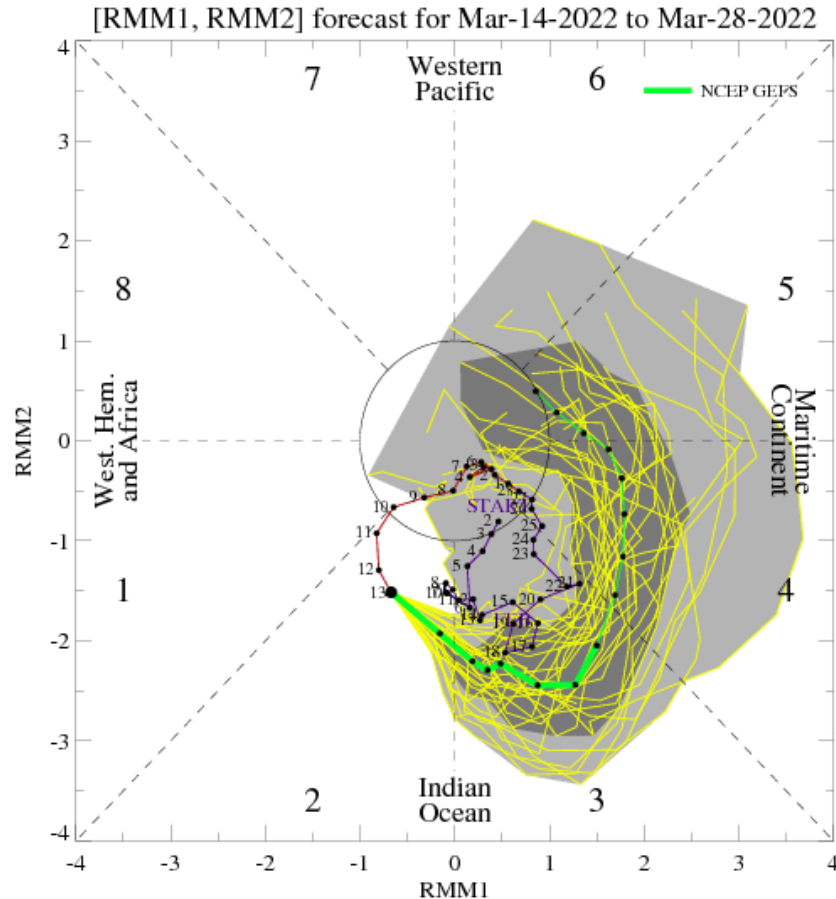
- During the past week, the RMM index indicates an increase in amplitude of the intraseasonal signal with eastward propagation over the western Indian Ocean.



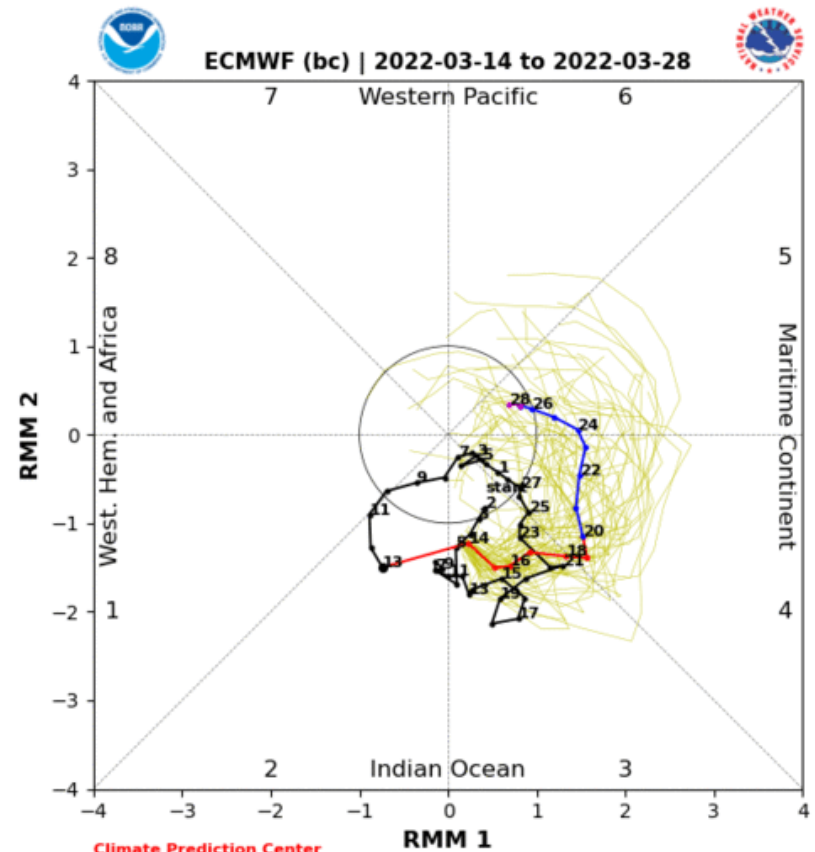
For more information on the RMM index and how to interpret its forecast please see:  
[https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC\\_MJOinformation.pdf](https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf)



# MJO Index: Forecast Evolution



**GEFS Forecast**



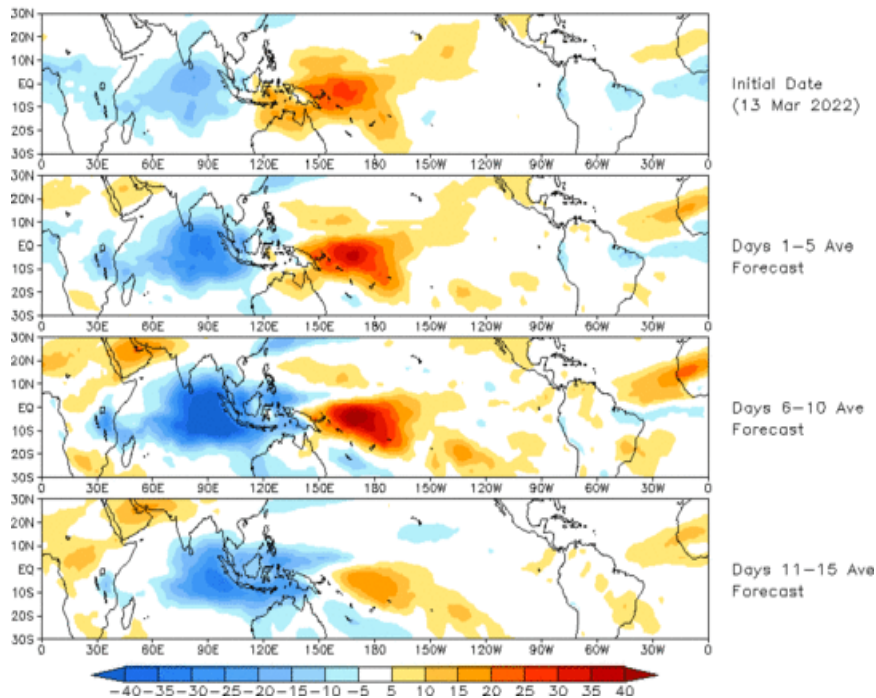
**ECMWF Forecast**

- Dynamical models favor continued eastward propagation of the intraseasonal signal over the Indian Ocean and into the Maritime Continent during the next two weeks.
- Several ensemble members from the GEFS and ECMWF depict the development of a high amplitude event through late March.

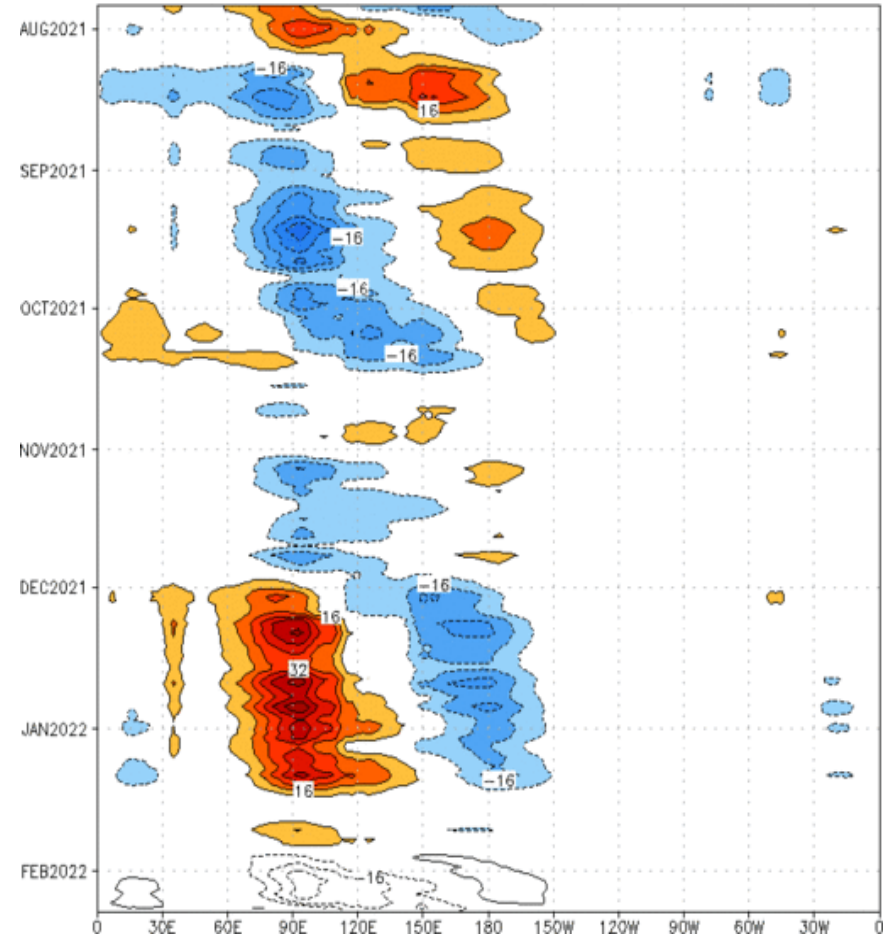
# MJO: GEFS Forecast Evolution

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: 13 Mar 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

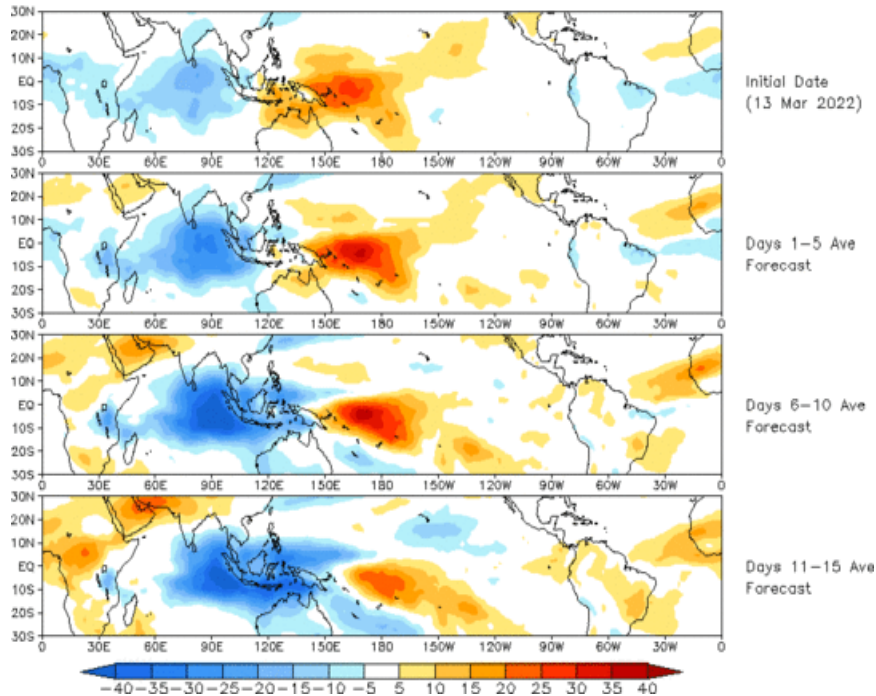


- The GEFS RMM-based OLR field depicts a robust MJO pattern consisting of a strengthening convective dipole that shifts eastward across the Indian Ocean and Pacific.

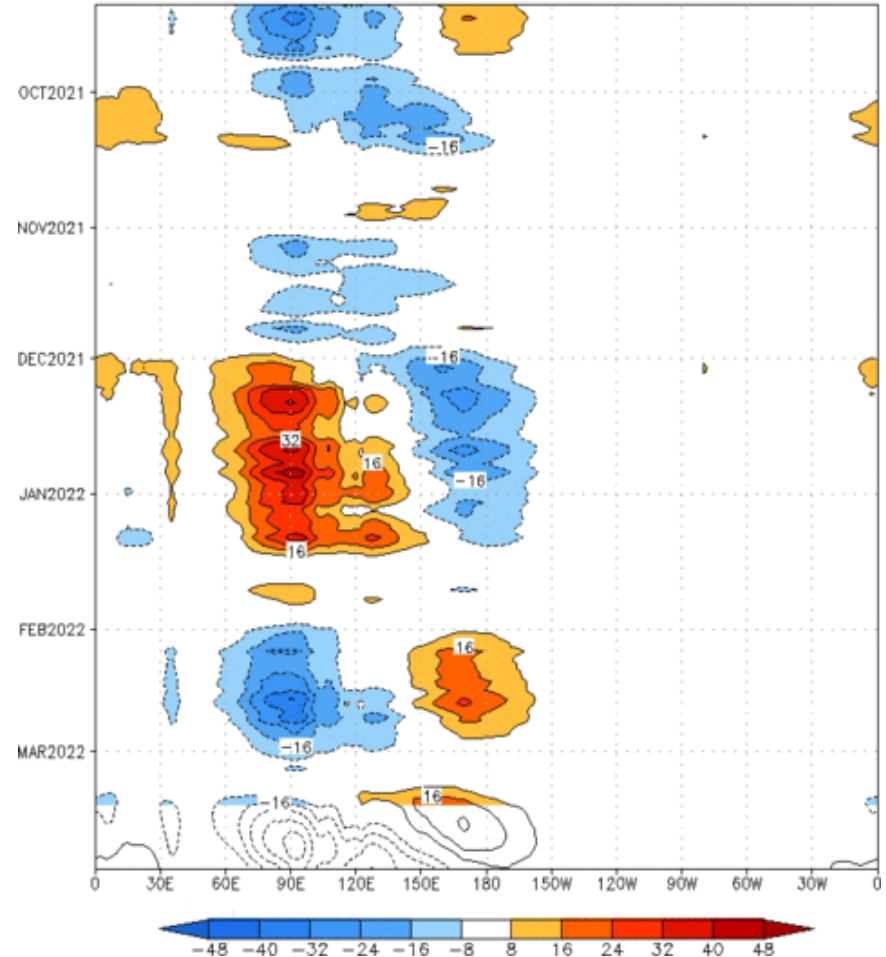
# MJO: Constructed Analog Forecast Evolution

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 (13 Mar 2022)



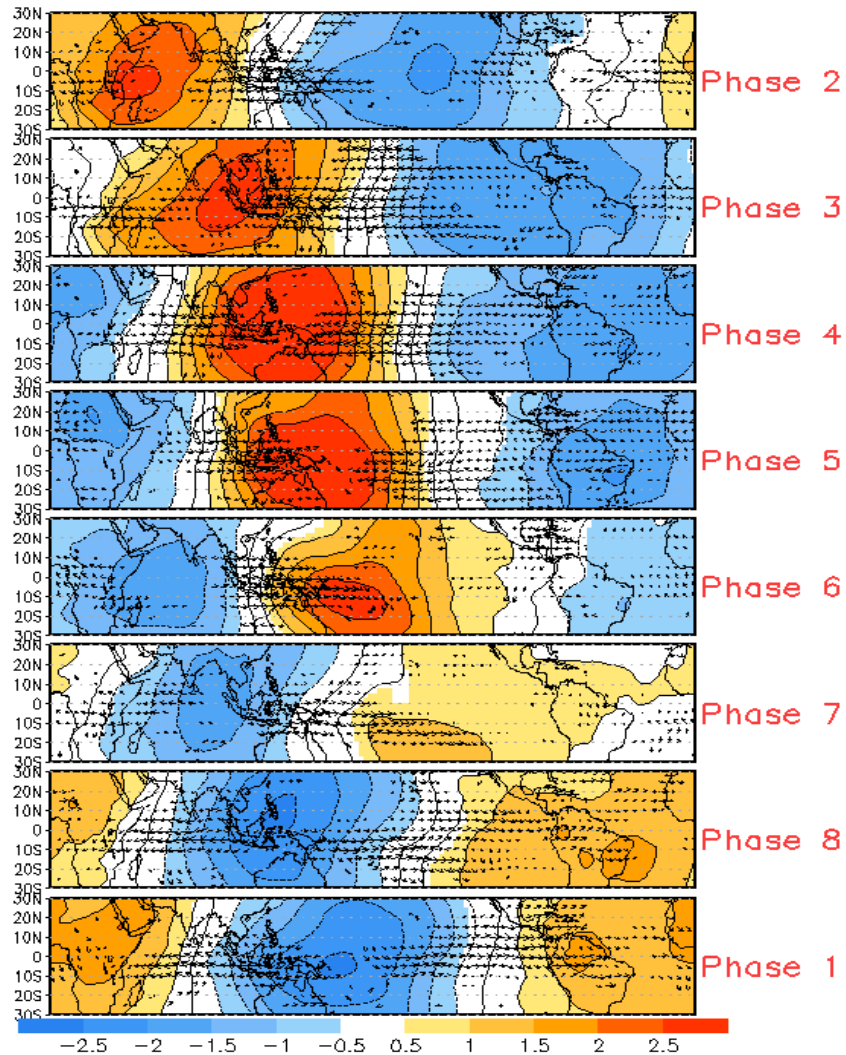
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm<sup>-2</sup>) Period:11-Sep-2021 to 13-Mar-2022  
The unfilled contours are CA forecast reconstructed anomaly for 15 days



- Similarly, the constructed analog features strong convective anomalies with enhanced convection shifting eastward into the Maritime Continent during the next two weeks.

# MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and  
Wind Anomalies



Precipitation Anomalies

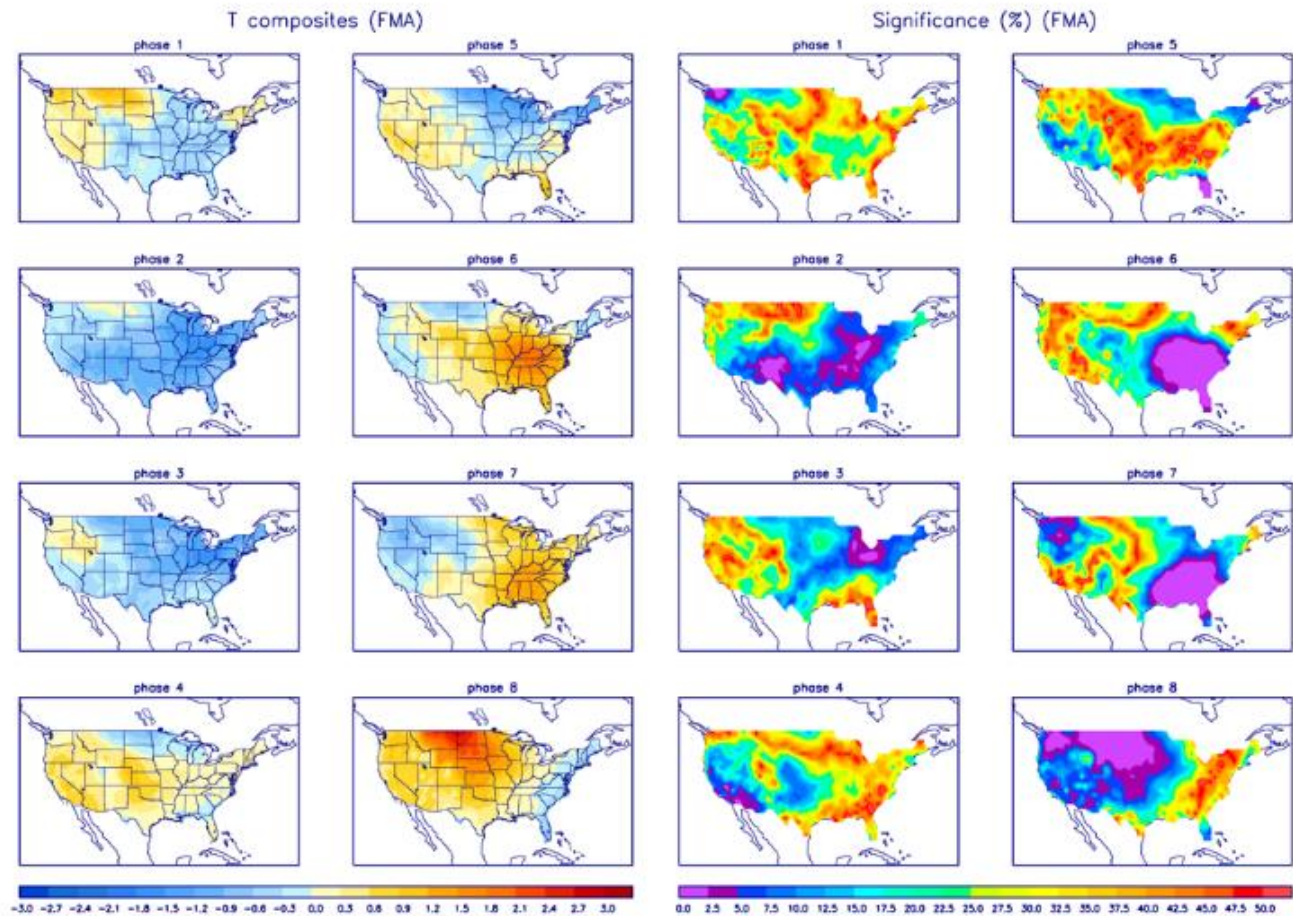




# MJO: CONUS Composite Maps by RMM Phase - Temperature

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.

