

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



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

# Overview

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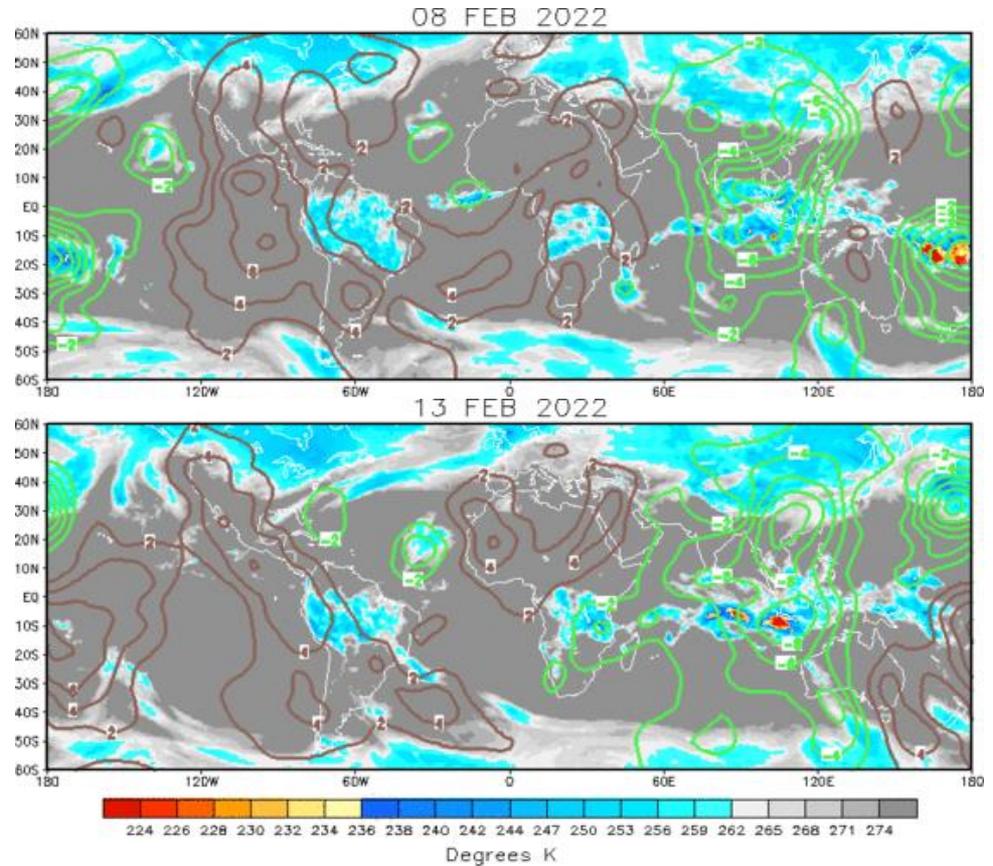
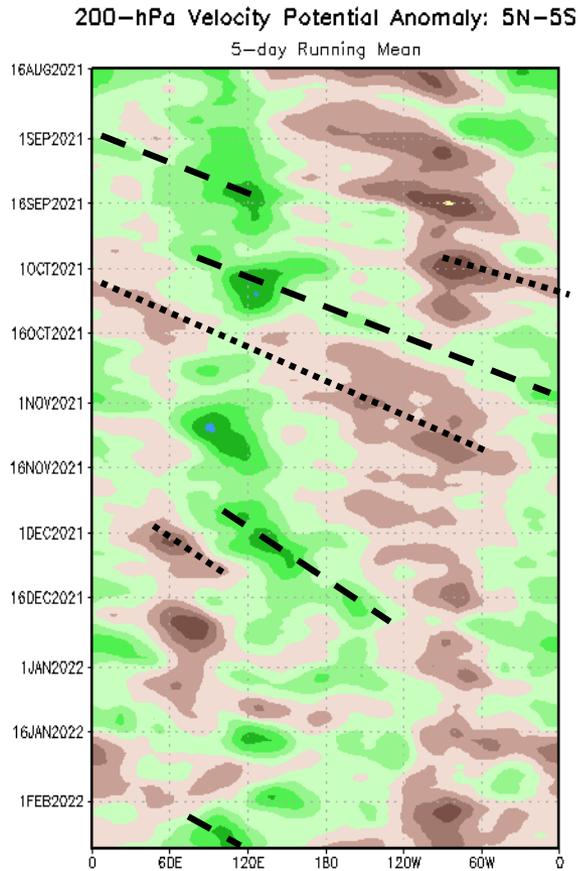
- The magnitude of the RMM-based MJO index has increased during early February, with an enhancement of the intraseasonal signal across the Indian Ocean.
- Dynamical model MJO index forecasts depict a robust MJO event propagating eastward to the Maritime Continent during the next 2 weeks.
- Based on this predicted MJO and model guidance, the South Indian Ocean is likely to remain active, with an uptick in activity also possible across the southwest Pacific by the end of February.
- Given the increasing likelihood that the MJO constructively interferes with La Niña, an atmospheric response typical of La Niña is expected across the mid-latitudes of the North Pacific and North America during the latter half of February and into early 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)**

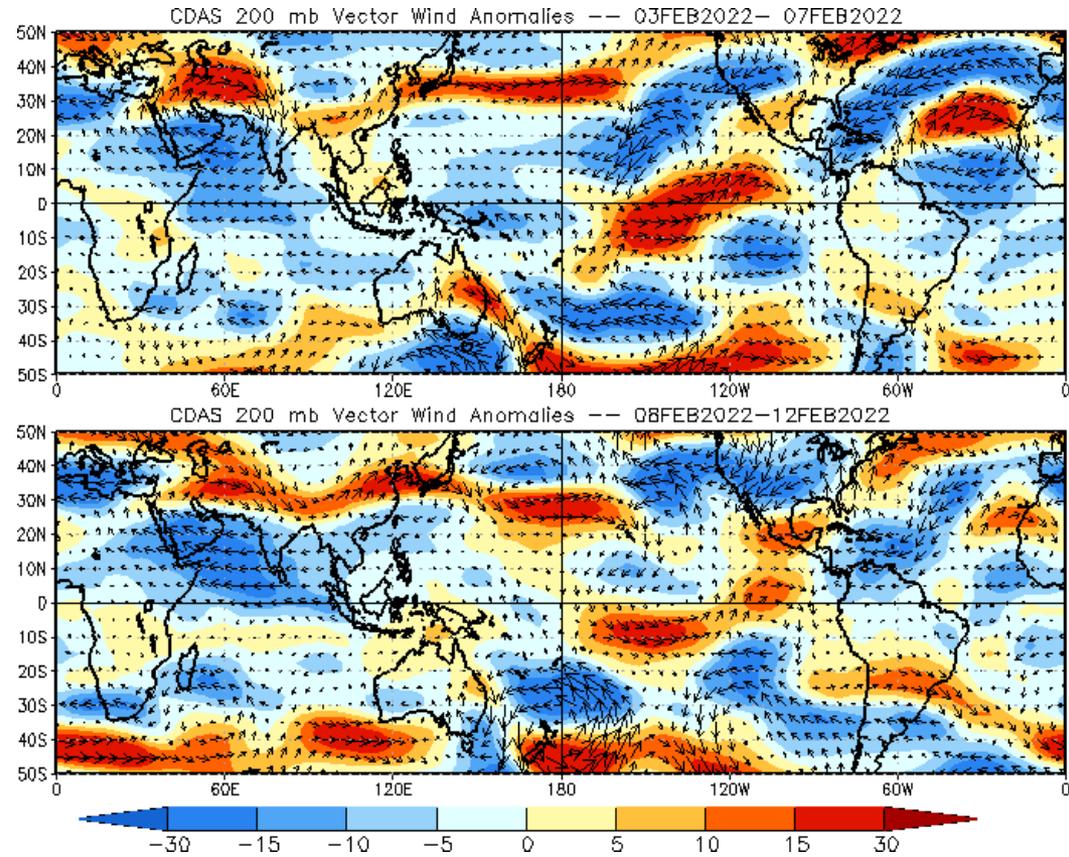
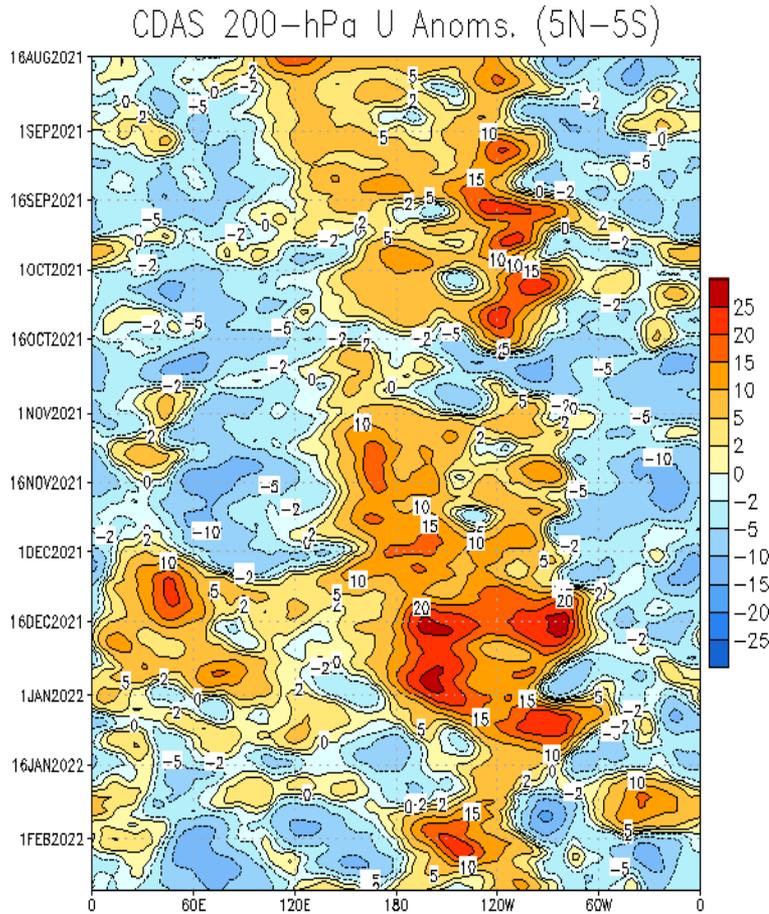
**Brown shades: Anomalous convergence (unfavorable for precipitation)**



- During the past two weeks, other tropical modes such as Kelvin and equatorial Rossby wave activity were influencing the global velocity potential pattern, with little influence from the MJO.
- Recently, the velocity potential pattern has become more coherent with suppressed convection over the Western Hemisphere, and enhanced convection across the Eastern Hemisphere.

# 200-hPa Wind Anomalies

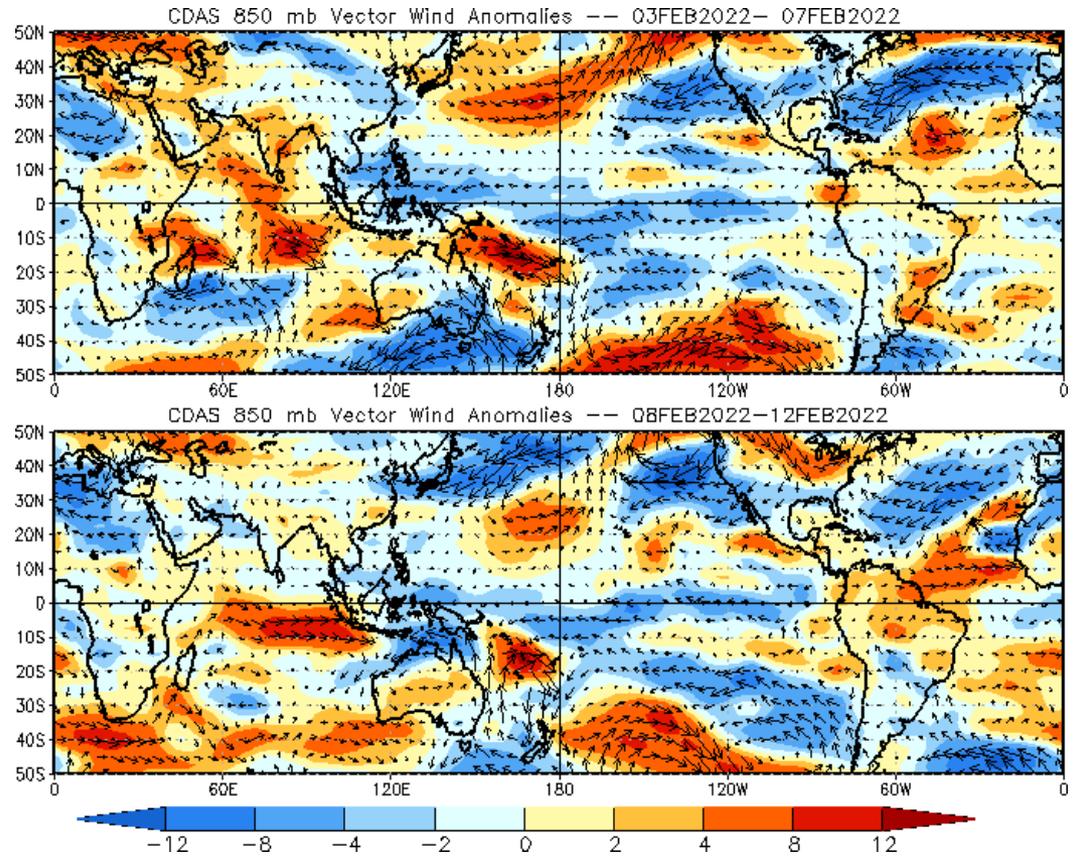
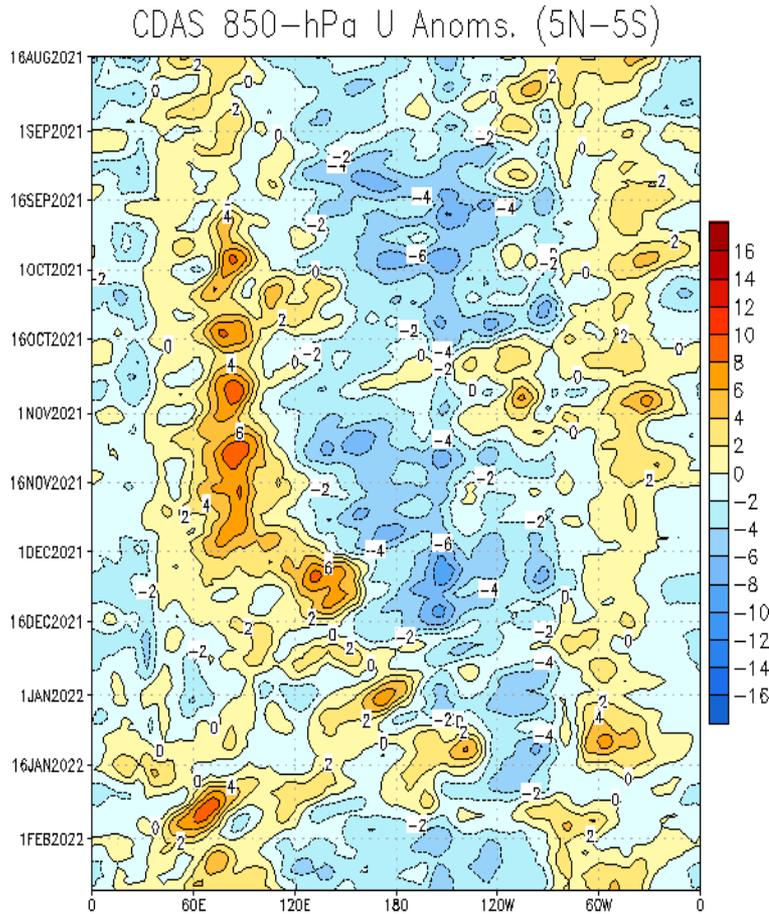
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Upper level easterly wind anomalies continue to increase across the Indian Ocean, leading to enhanced divergence across the eastern Indian Ocean and Maritime Continent.
- Upper level westerly wind anomalies persist over much of the equatorial Pacific, which is consistent with an enhanced Walker Circulation associated with La Niña.

# 850-hPa Wind Anomalies

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

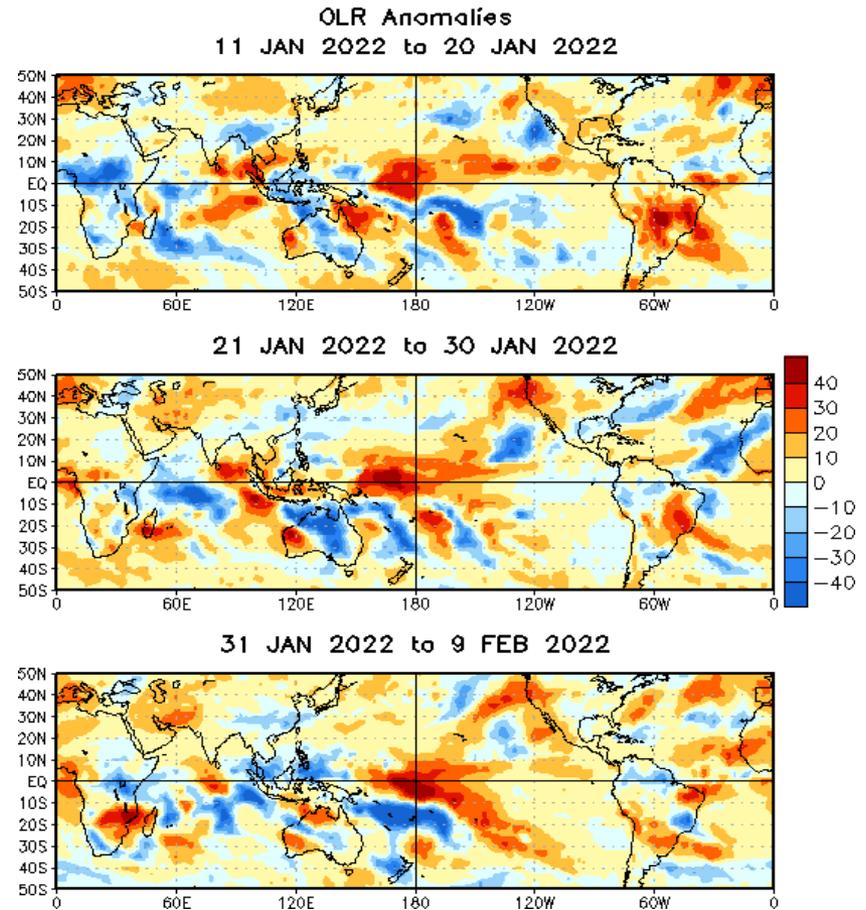
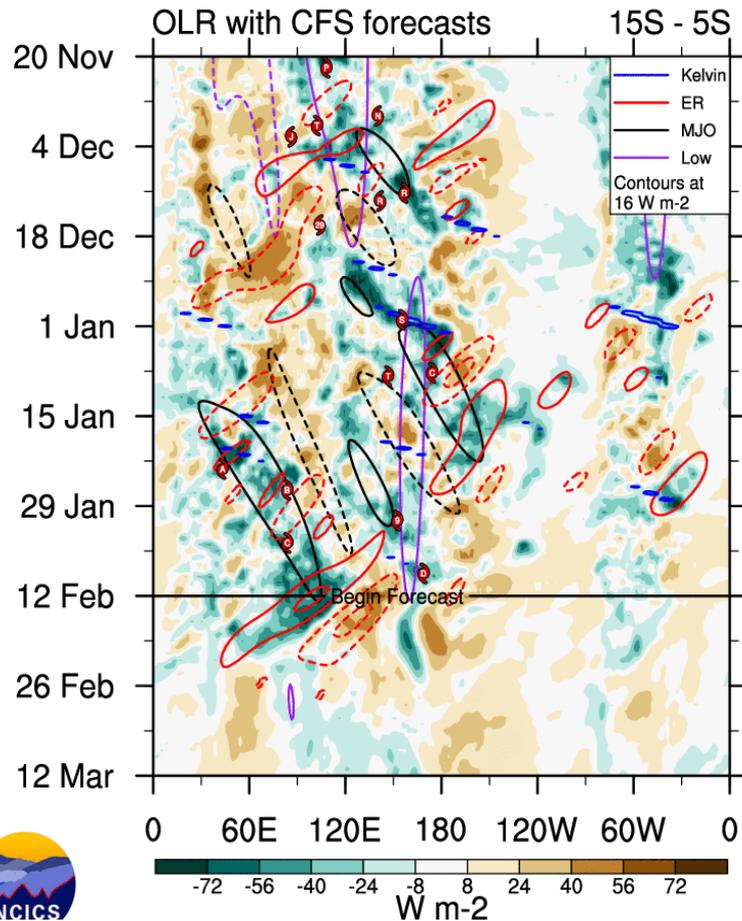


- Enhanced equatorial Rossby wave activity over the Indian Ocean has resulted in low level westerly wind anomalies and a subsequent disruption of the trades.
- Easterly low level wind anomalies continue over much of the equatorial Pacific, which is consistent with the canonical La Niña atmospheric response.

# Outgoing Longwave Radiation (OLR) Anomalies

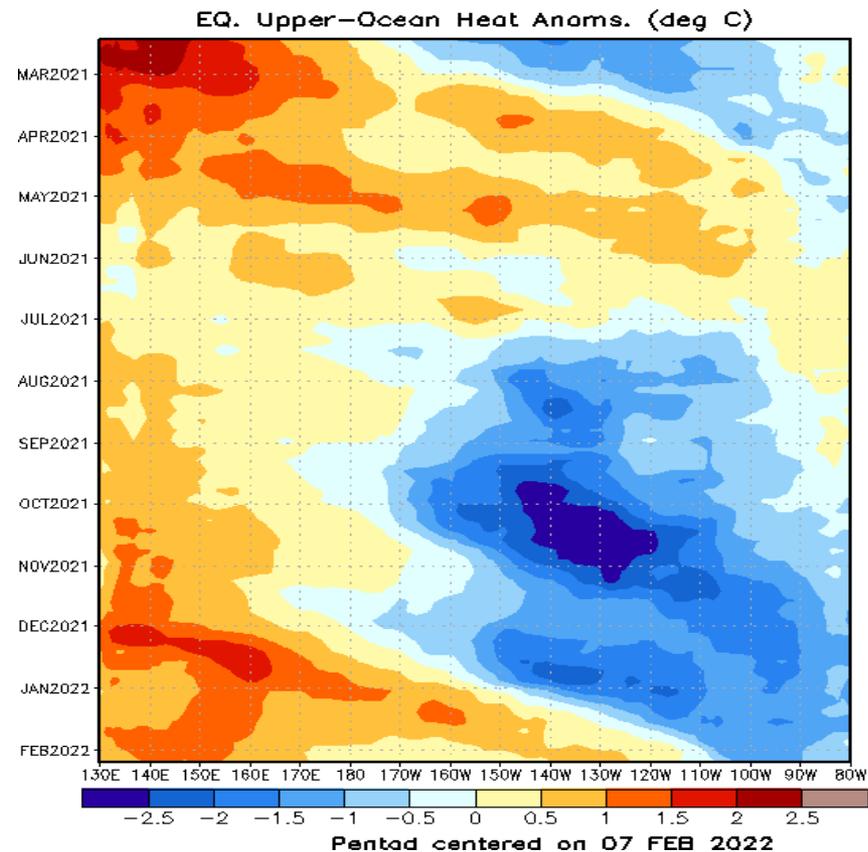
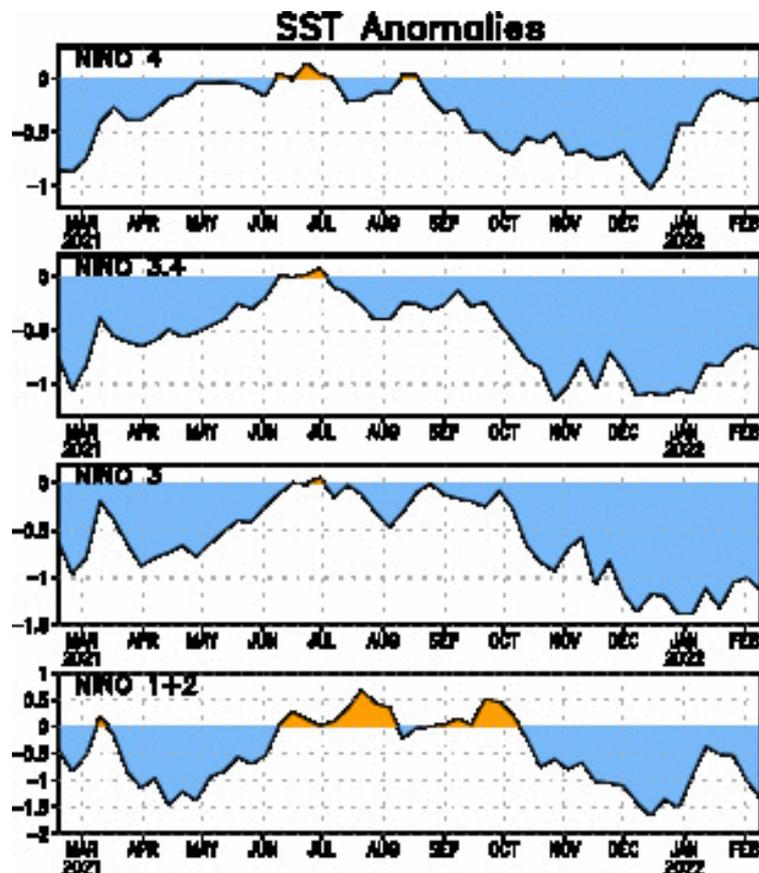
**Green shades: Anomalous convection (wetness)**

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



- Positive OLR anomalies expanded across the equatorial central Pacific, consistent with La Niña, with negative OLR anomalies developing across the southern Indian ocean, tied to enhanced Rossby Wave activity.
- Elsewhere, the pattern has been generally incoherent due to a reduced MJO signal and several competing modes of tropical and extra-tropical variability.

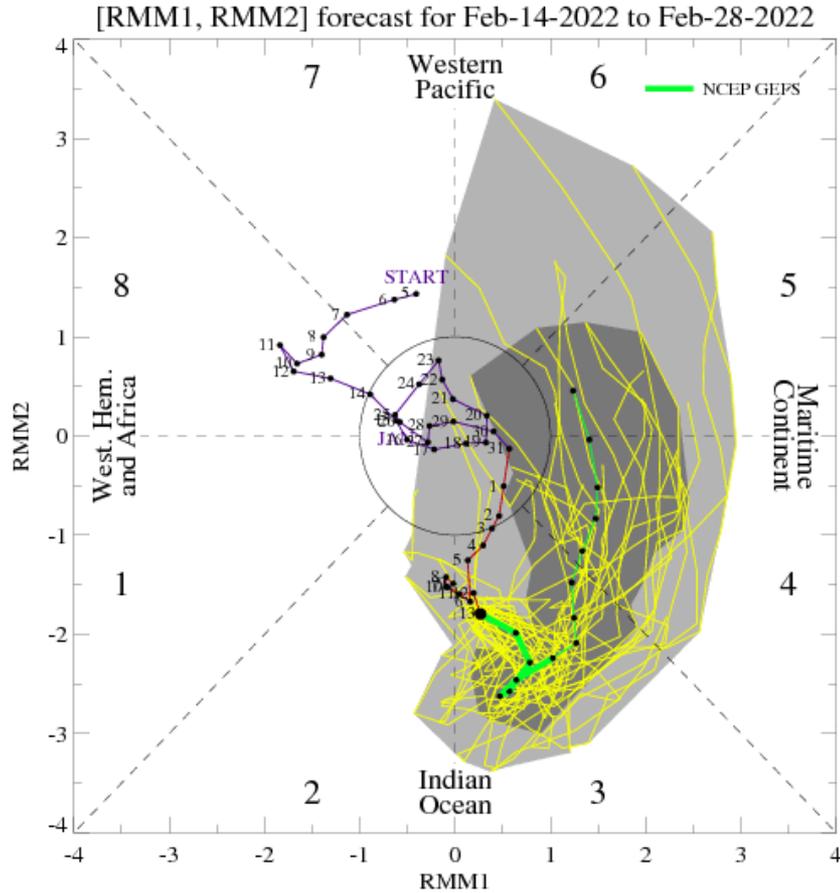
# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



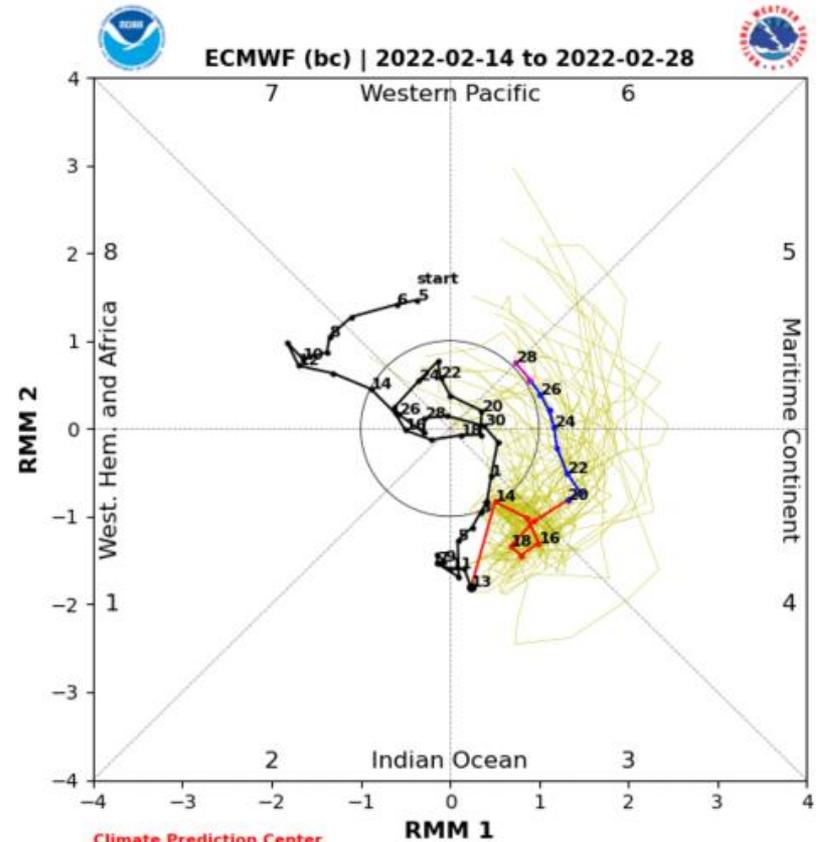
- Positive oceanic heat content anomalies continue to expand eastward through the equatorial Pacific in response to a downwelling Kelvin Wave and a subsequent increase in the thermocline.
- While SST anomalies remain negative in all regions, a large warming was observed over the Niño 4 region during January tied to this downwelling Kelvin Wave.
- Some warming has also been observed in the Niño 3-4 region, with stronger negative SST anomalies remaining focused further east over the Niño-3 and Niño 1-2 regions.



# MJO Index: Forecast Evolution



**GEFS Forecast**



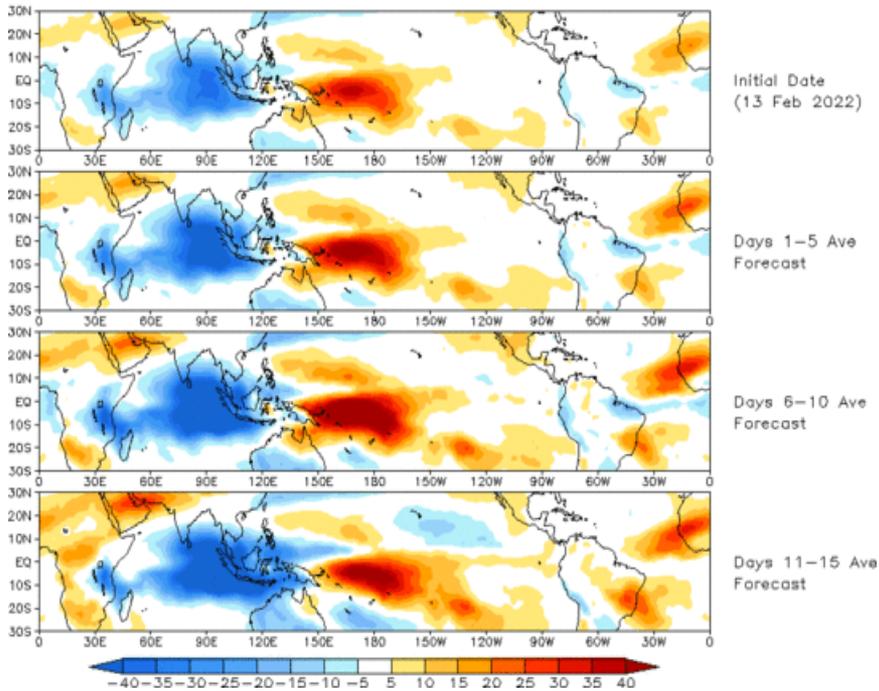
**ECMWF Forecast**

- The GEFS and ECMWF ensemble means depict a robust MJO signal emerging over the eastern Indian Ocean, and propagating eastward over the Maritime Continent during the next 2 weeks.
- This MJO event would constructively interfere with the ongoing La Niña.

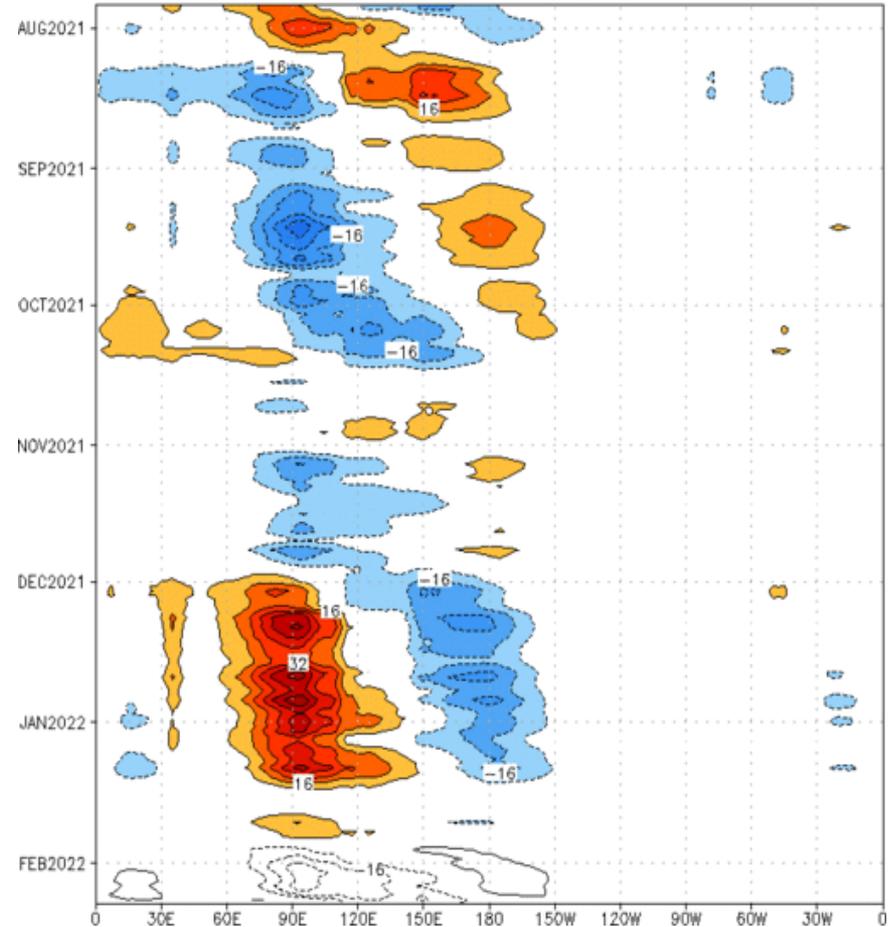
# MJO: GEFS Forecast Evolution

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 Feb 2022  
OLR



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

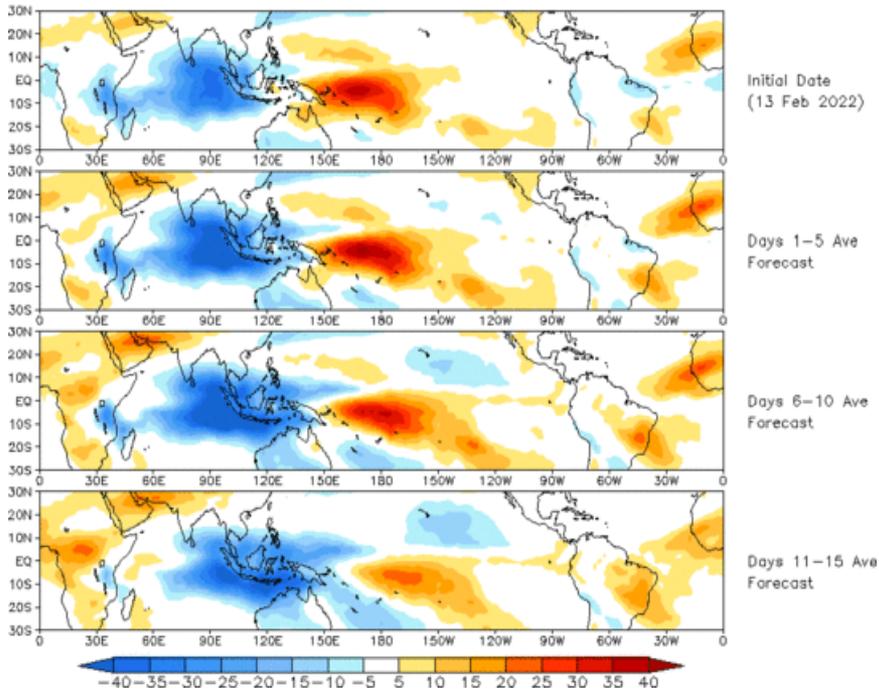


- The GEFS RMM-based OLR field depicts negative OLR anomalies (enhanced convection) expanding across the Indian Ocean and Maritime Continent, with positive OLR anomalies (suppressed convection) indicated over much of the Pacific.

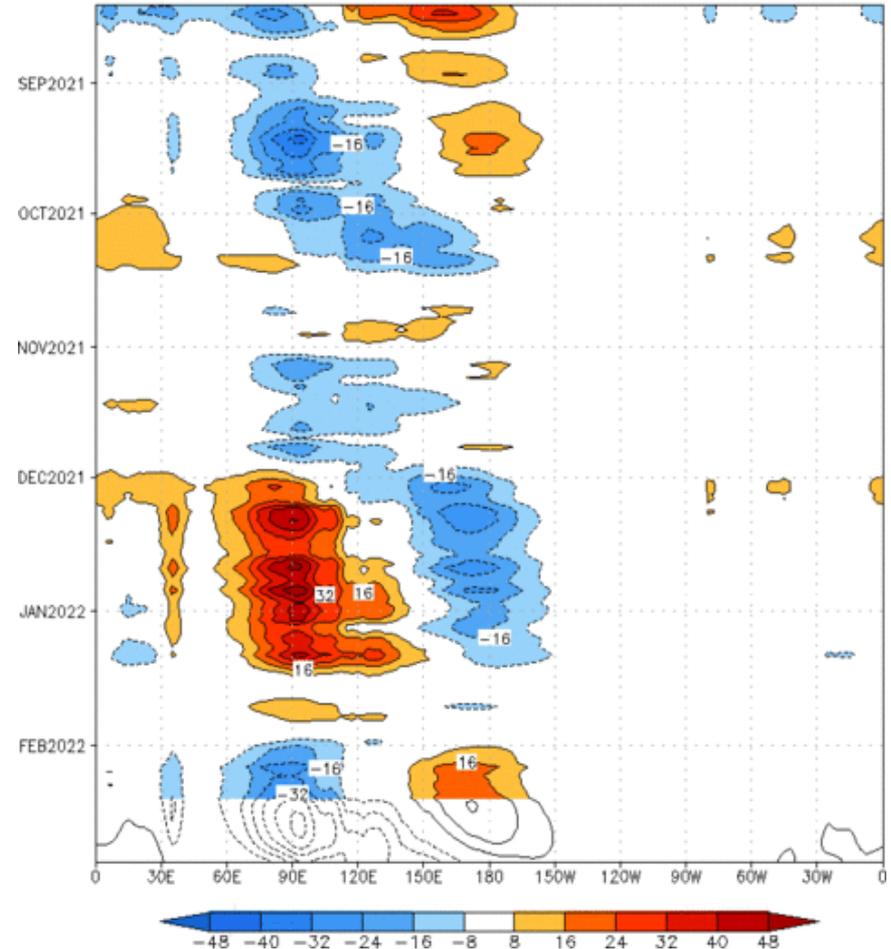
# MJO: Constructed Analog Forecast Evolution

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 Feb 2022)



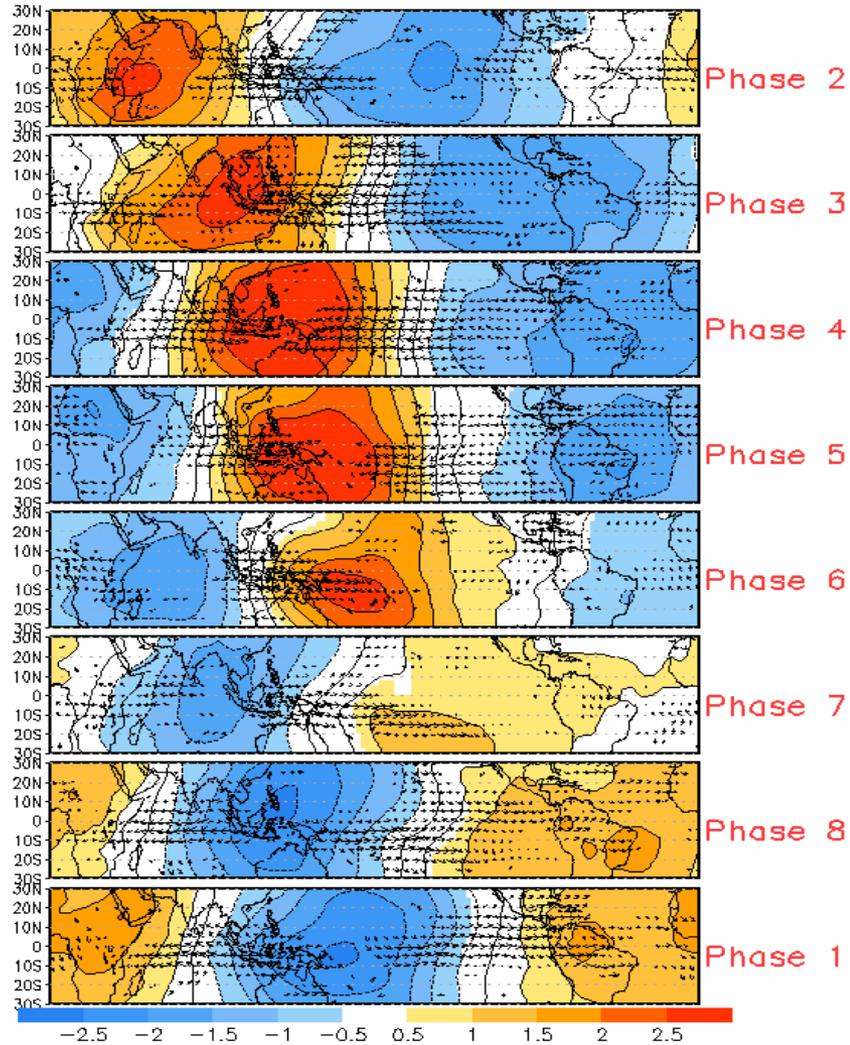
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm<sup>-2</sup>) Period:14-Aug-2021 to 13-Feb-2022  
The unfilled contours are CA forecast reconstructed anomaly for 15 days



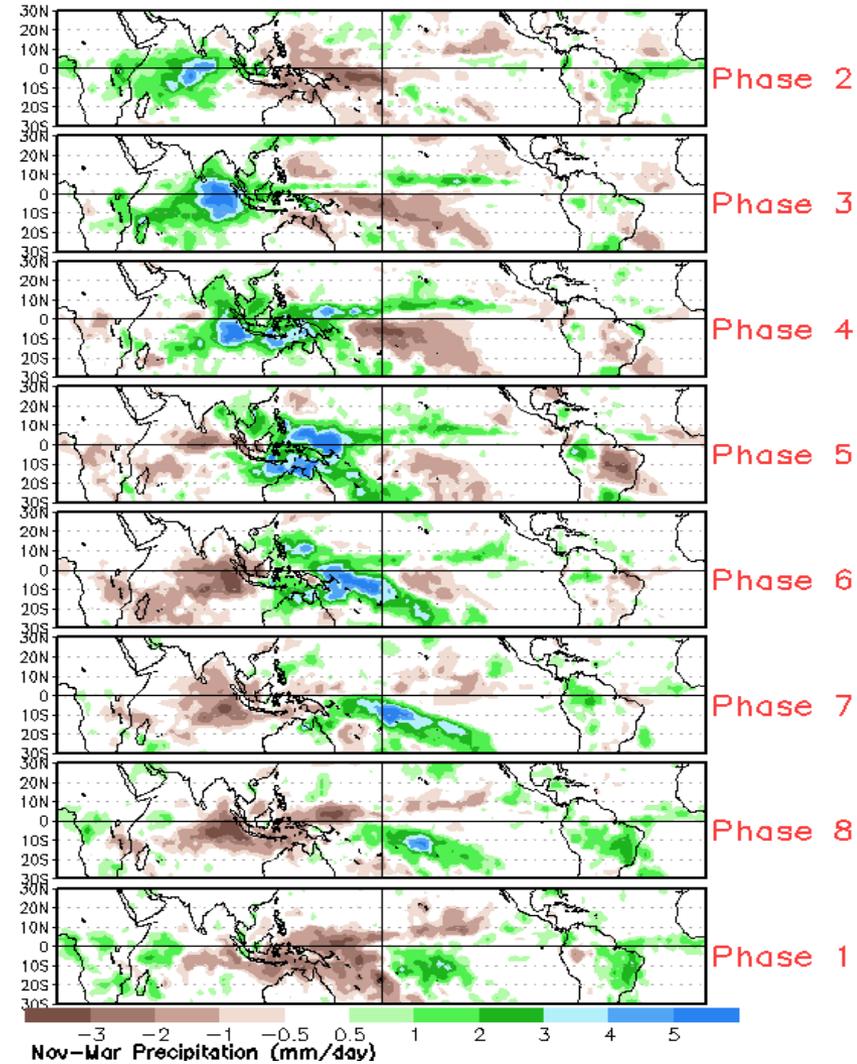
- The constructed analog tool shows a similar evolution compared to the GEFS, with a slightly further eastward expansion of the negative OLR anomalies (enhanced convection) over the western Pacific.

# MJO: Tropical Composite Maps by RMM Phase

## 850-hPa Velocity Potential and Wind Anomalies



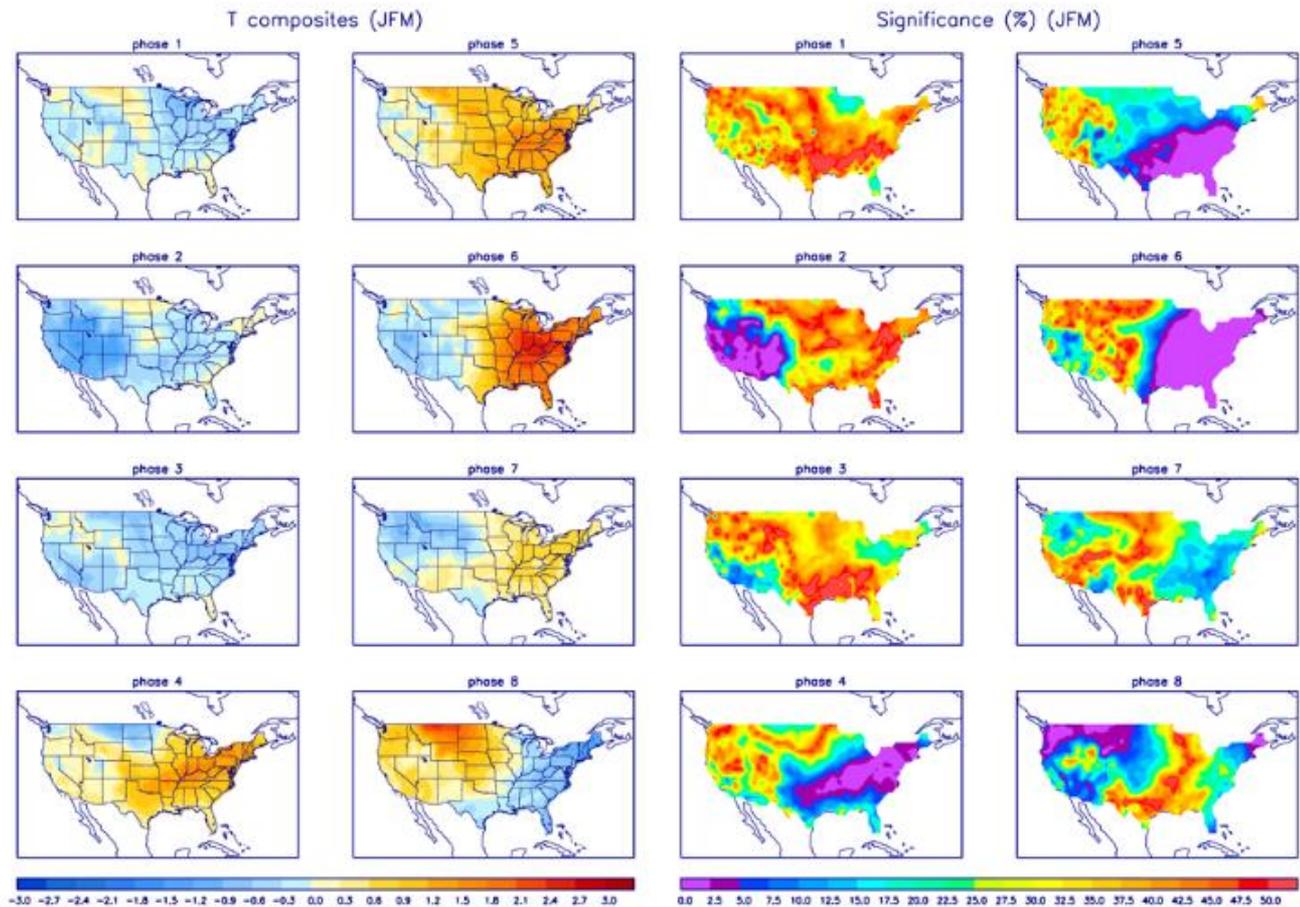
## Precipitation Anomalies



# 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.

