

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



**Update prepared by the Climate Prediction Center**  
**Climate Prediction Center / NCEP**  
**20 January 2020**

# Overview

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- The MJO propagated east from the Maritime Continent to the Pacific Ocean during mid-January.
- Dynamical model guidance indicates that the MJO weakens during Week-1 as other modes of variability interfere. There is an increasing model consensus that enhanced convection becomes more persistent across the equatorial Pacific, near and east of the Date Line.
- It is becoming less likely that the MJO plays a major role in the temperature pattern over North America during the next two weeks as the circulation pattern at the higher latitudes continues to be dominated by extratropical modes of variability.

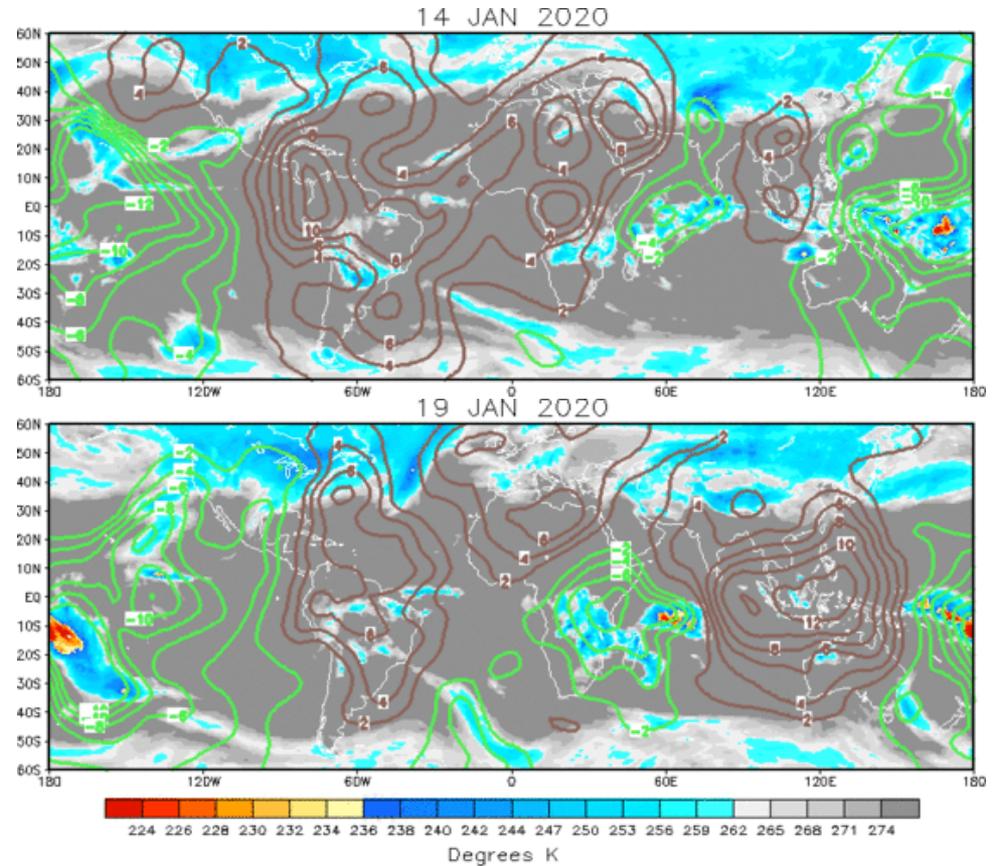
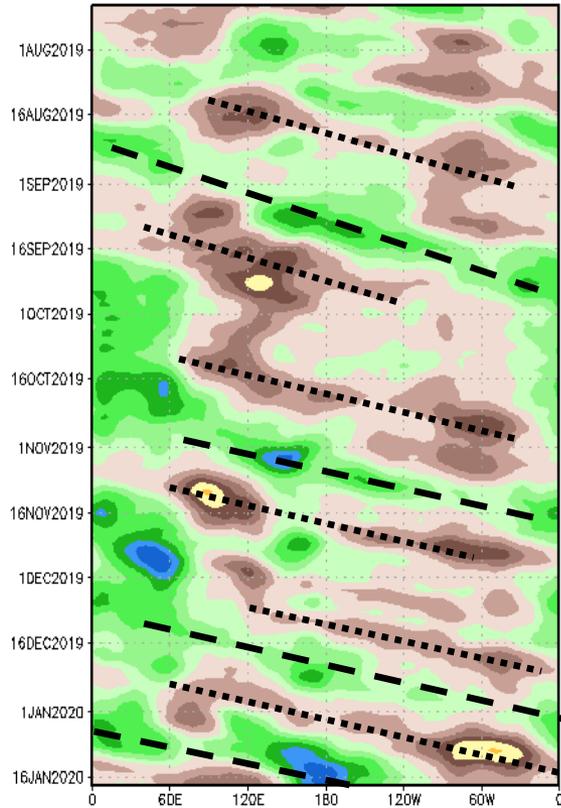
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:  
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

# 200-hPa Velocity Potential Anomalies

**Green shades:** Anomalous divergence (favorable for precipitation).

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

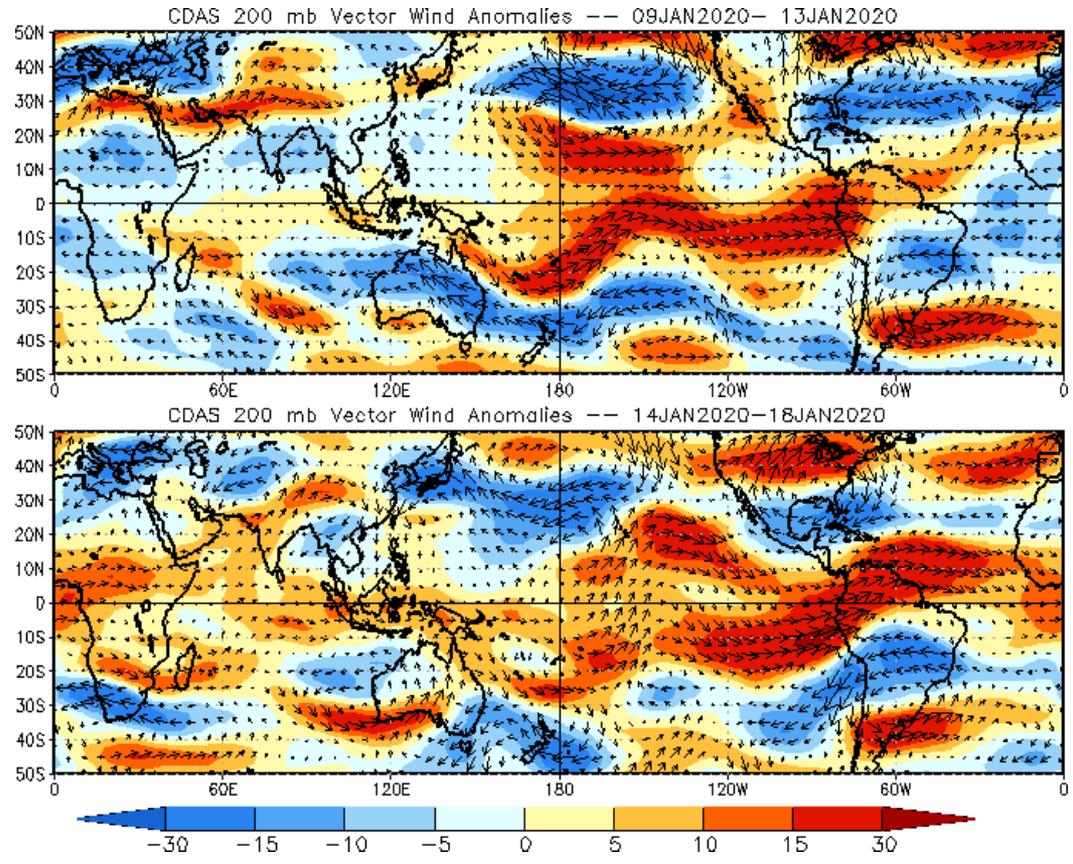
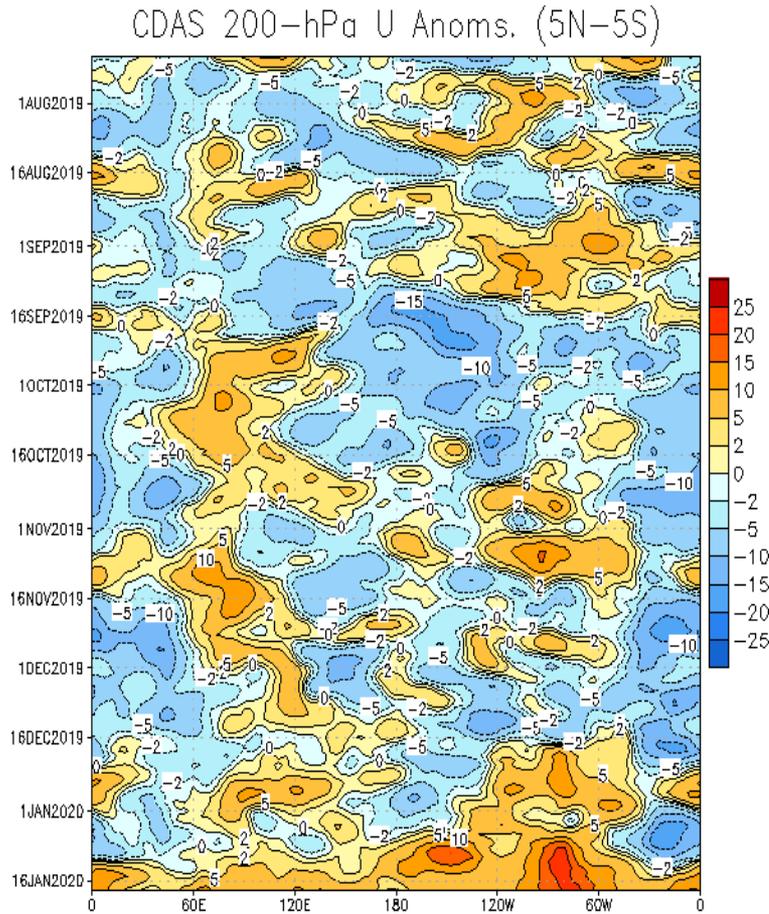
200-hPa Velocity Potential Anomaly: 5N-5S  
5-day Running Mean



- Anomalous upper-level divergence shifted east over the Pacific Ocean during mid-January, while anomalous upper-level convergence returned to the eastern Indian Ocean, Maritime Continent, and Australia. An equatorial Rossby wave is moving westward from the Indian Ocean to Africa.

# 200-hPa Wind Anomalies

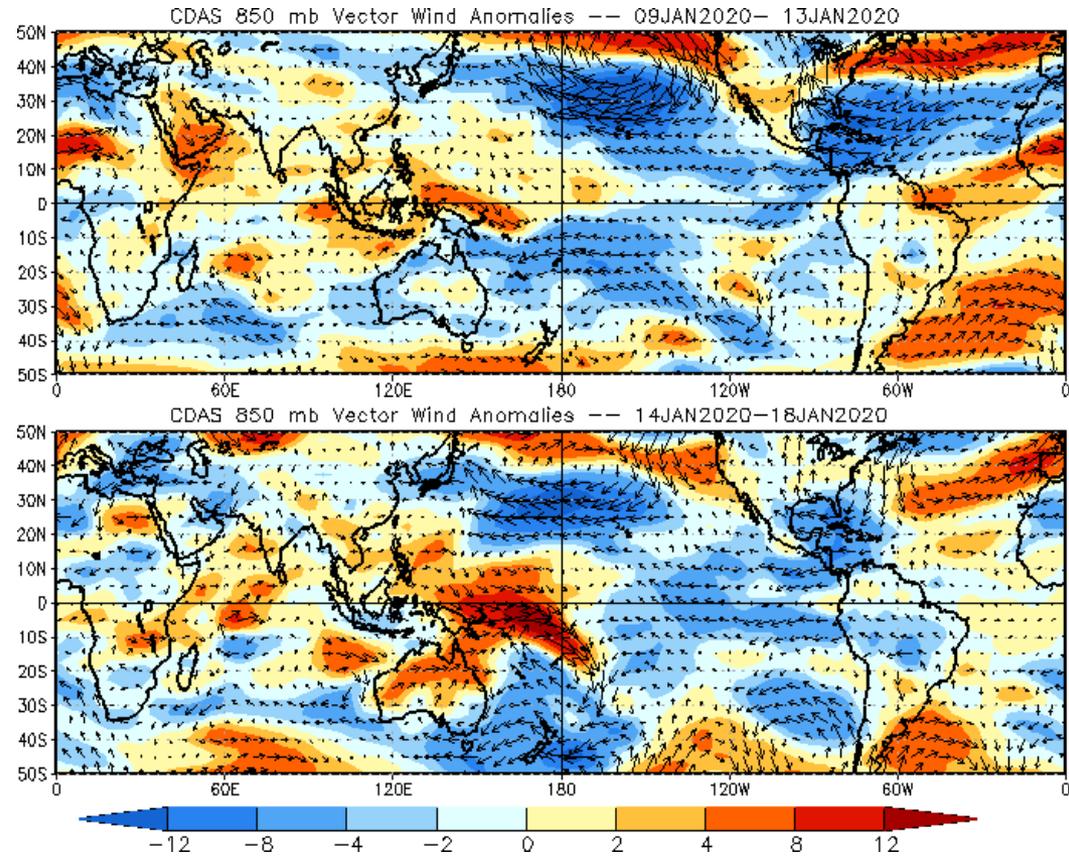
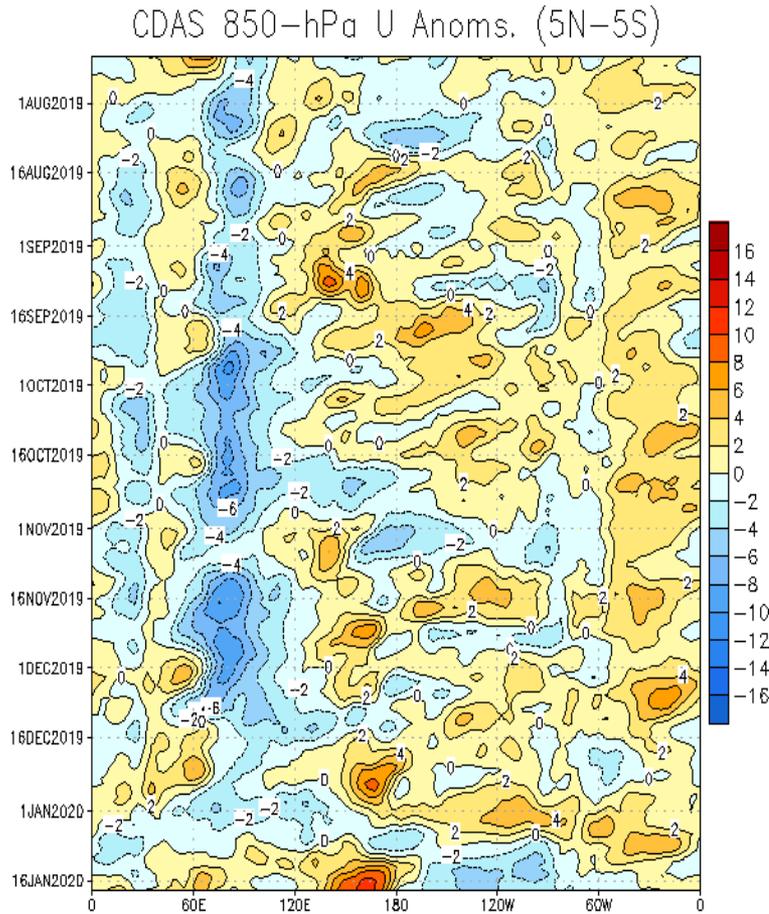
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Strong anomalous westerlies persist over the central and eastern Pacific which are enhancing subtropical flow into parts of North and South America.
- Cyclonic circulation aloft centered off the equator continues at the Date Line.

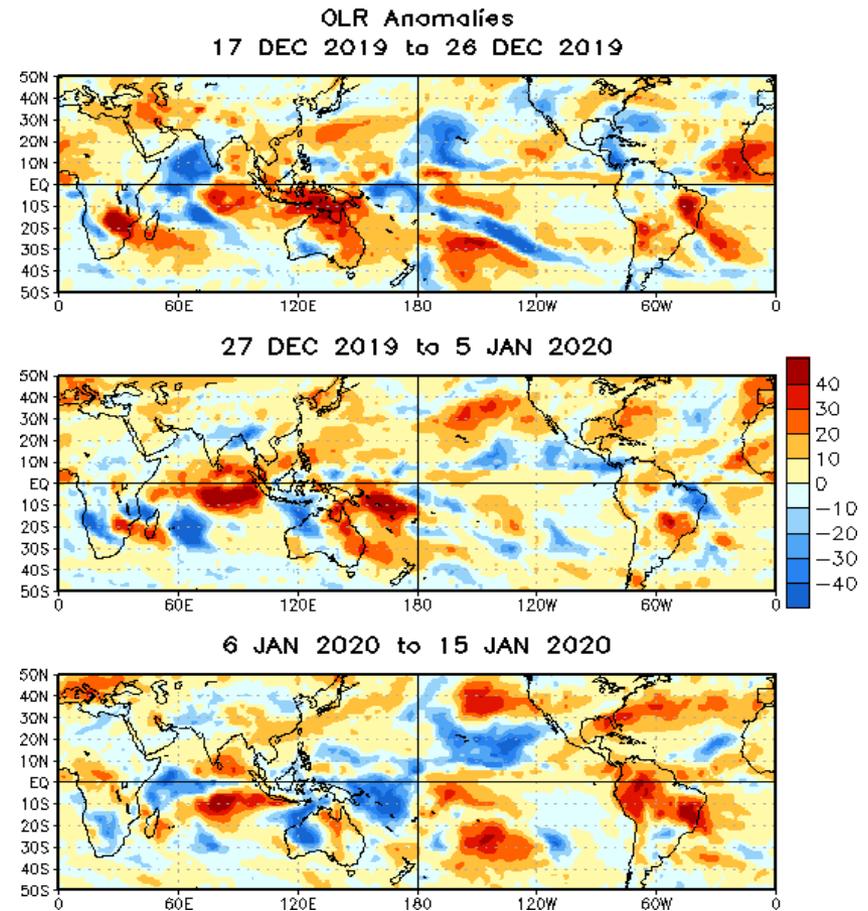
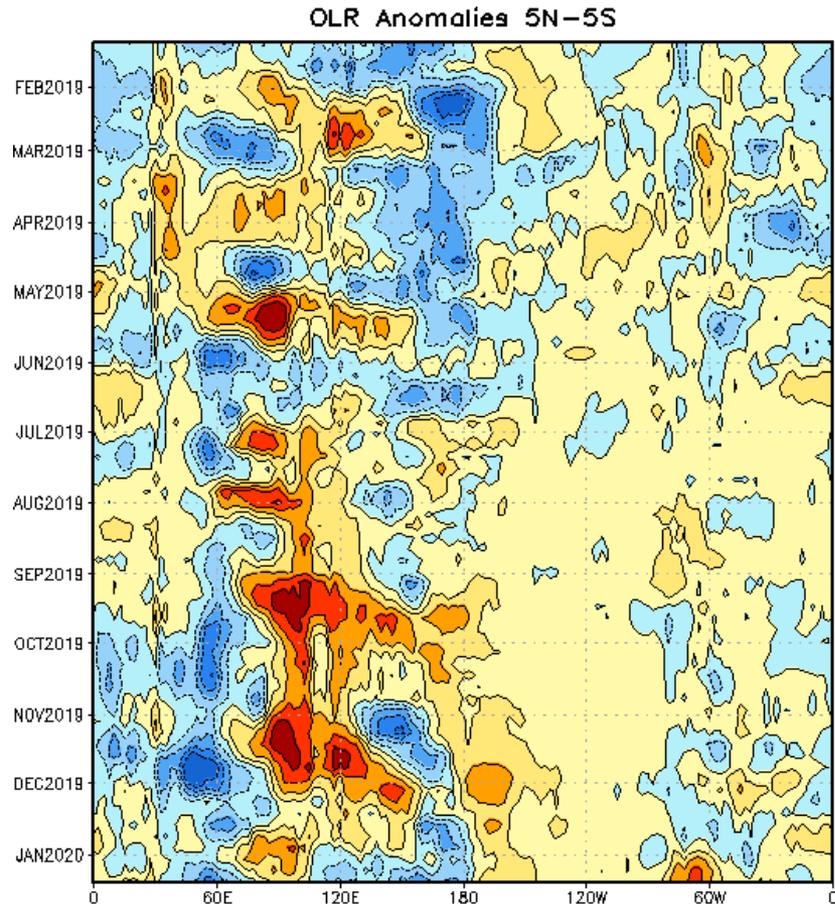
# 850-hPa Wind Anomalies

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



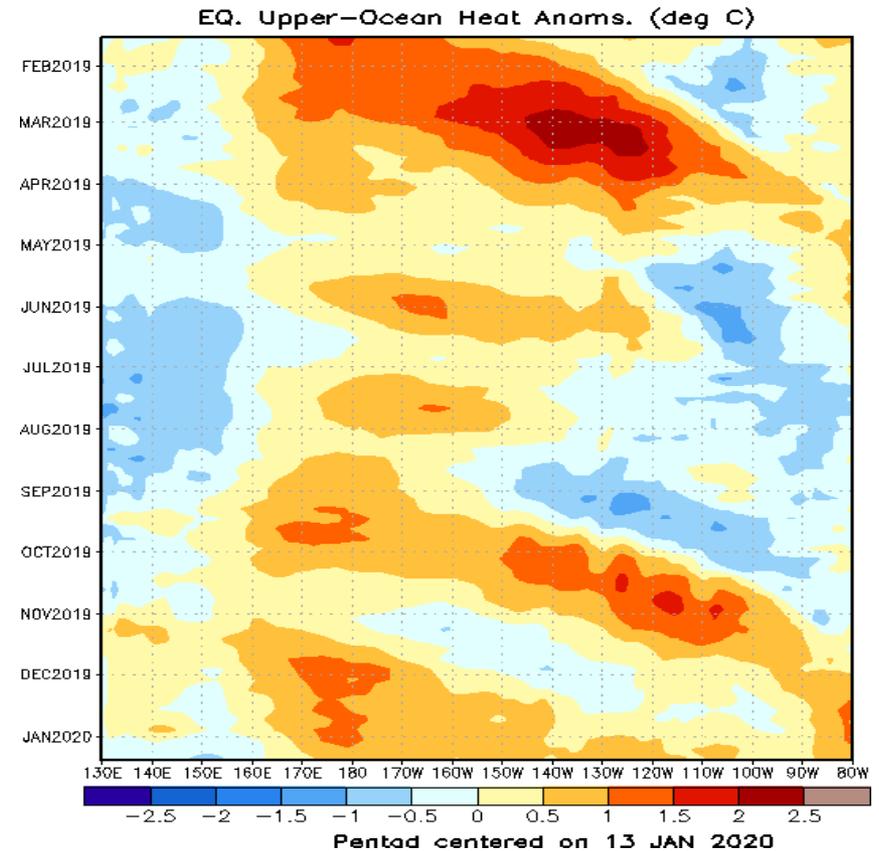
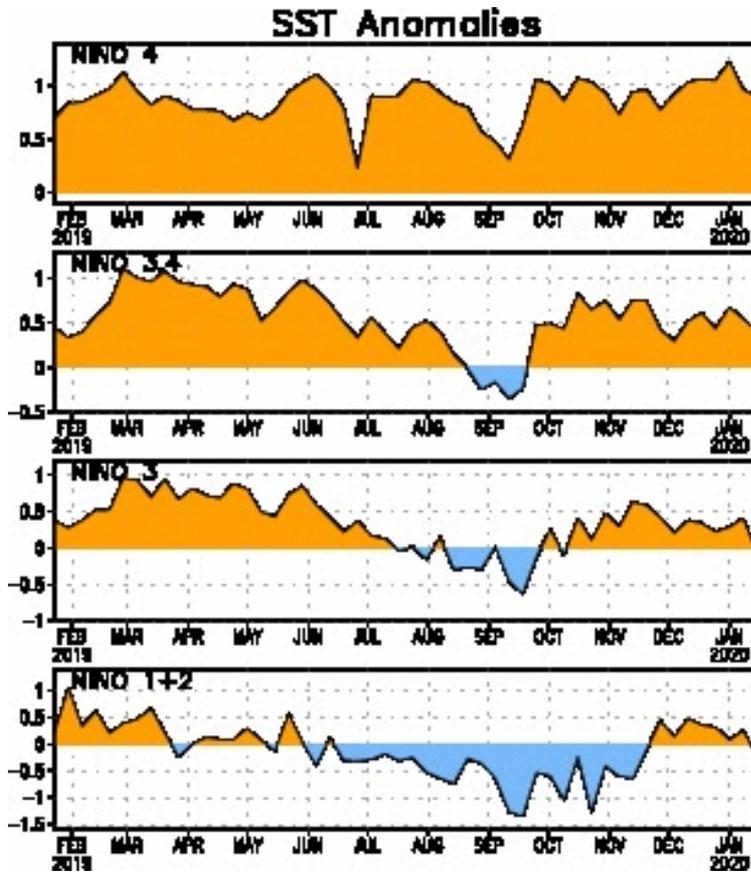
- Anomalous southeasterly low-level flow from the Caribbean Sea and Gulf of Mexico resulted in flooding rainfall across parts of the central United States during early January.
- This recent MJO led to the strongest westerly wind burst observed during the past six months, and it is overspreading the western and central equatorial Pacific.

# Outgoing Longwave Radiation (OLR) Anomalies



- The decaying positive IOD and strengthening MJO resulted in the development of enhanced convection across parts of the Maritime Continent and Australia at the end of December into the New Year.
- Enhanced convection became more prevalent across the Pacific Ocean by mid-January and extended northeast to Hawaii.
- Conversely, suppressed convection intensified over South America during mid-January.

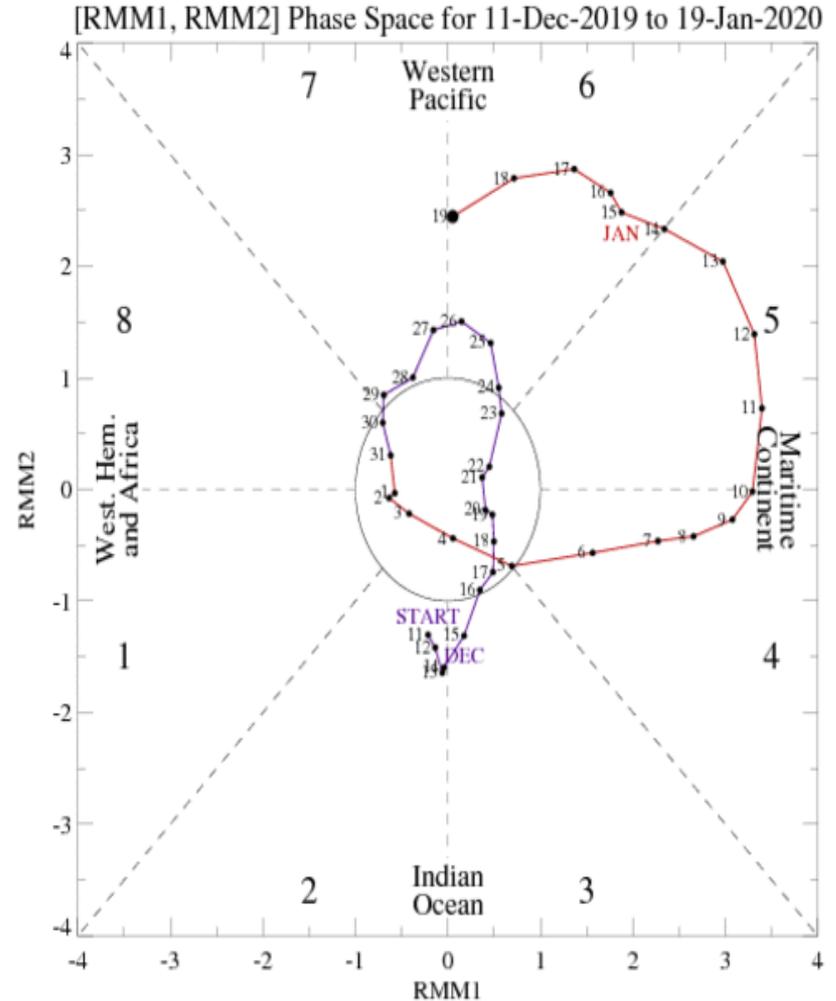
# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



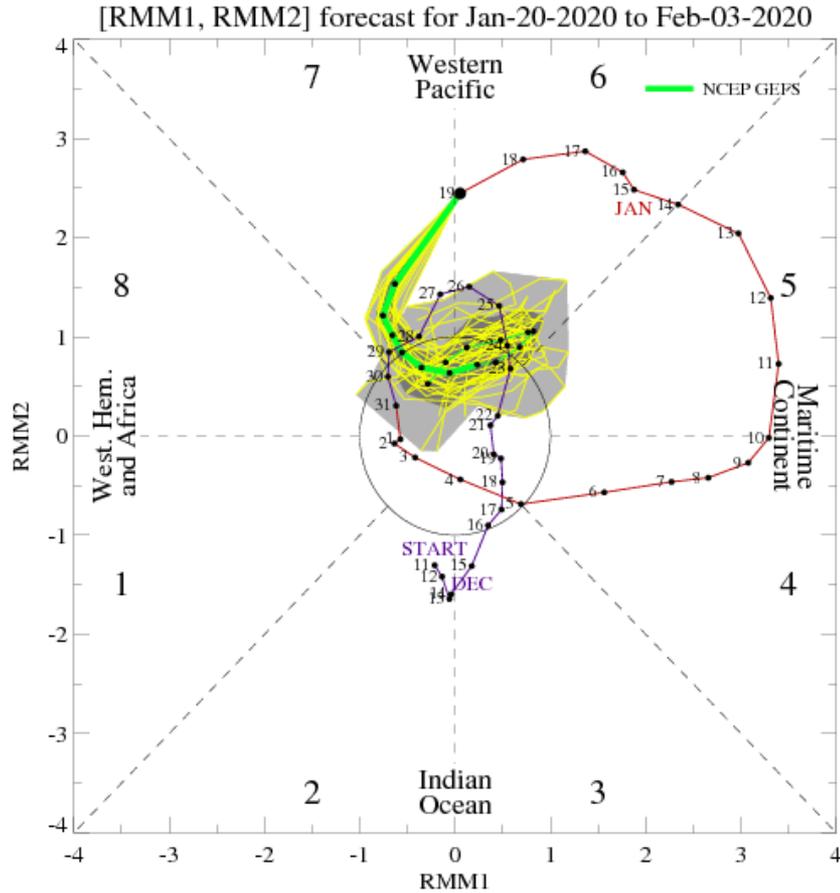
- Upper-oceanic heat content anomalies remain slightly above-normal across most of the basin, with anomalies in the eastern Pacific showing an increase at the start of the month. This is likely due to anomalous westerlies east of the Date Line late in December.
- The response to the recent and strong westerly wind burst is not evident in these plots, as of early January.

# MJO Index: Recent Evolution

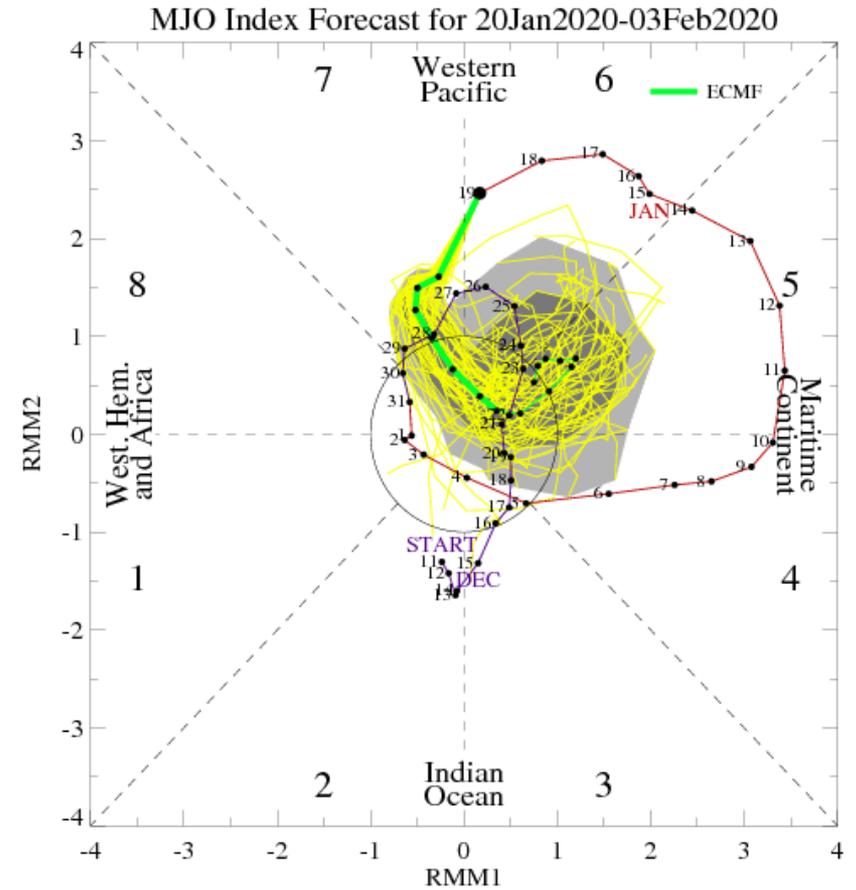
- The decay of the IOD aided in the resurgence of the MJO signal over the Maritime Continent at the beginning of January.
- The enhanced phase of the MJO shifted east from the Maritime Continent to the Pacific Ocean during the past two weeks.



# MJO Index: Forecast Evolution



**GEFS Forecast**



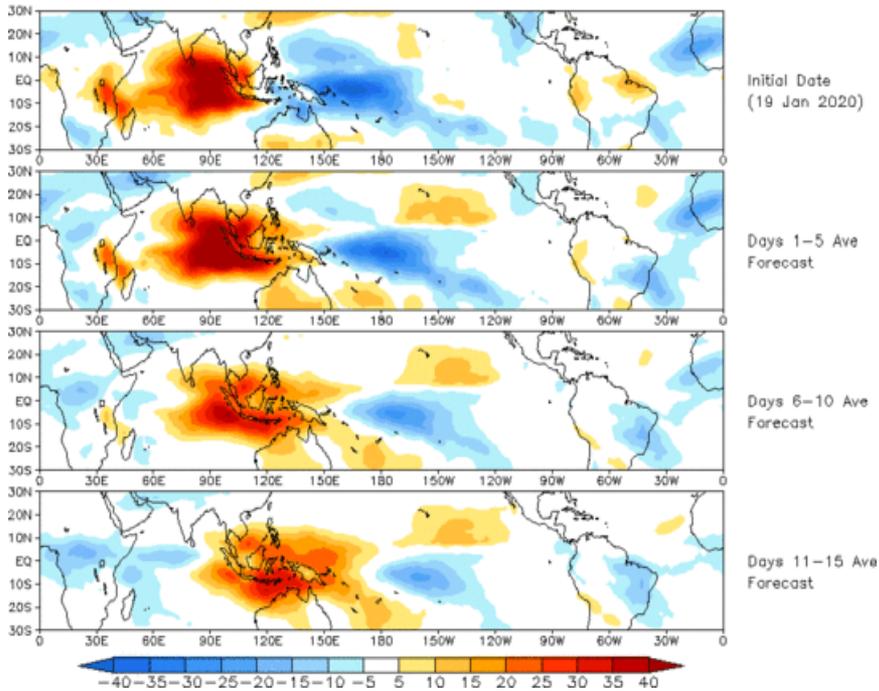
**ECMWF Forecast**

- The GEFS and ECMWF model indicate a decrease in amplitude of the RMM index as other modes of variability (Kelvin and Rossby waves) weaken the MJO.

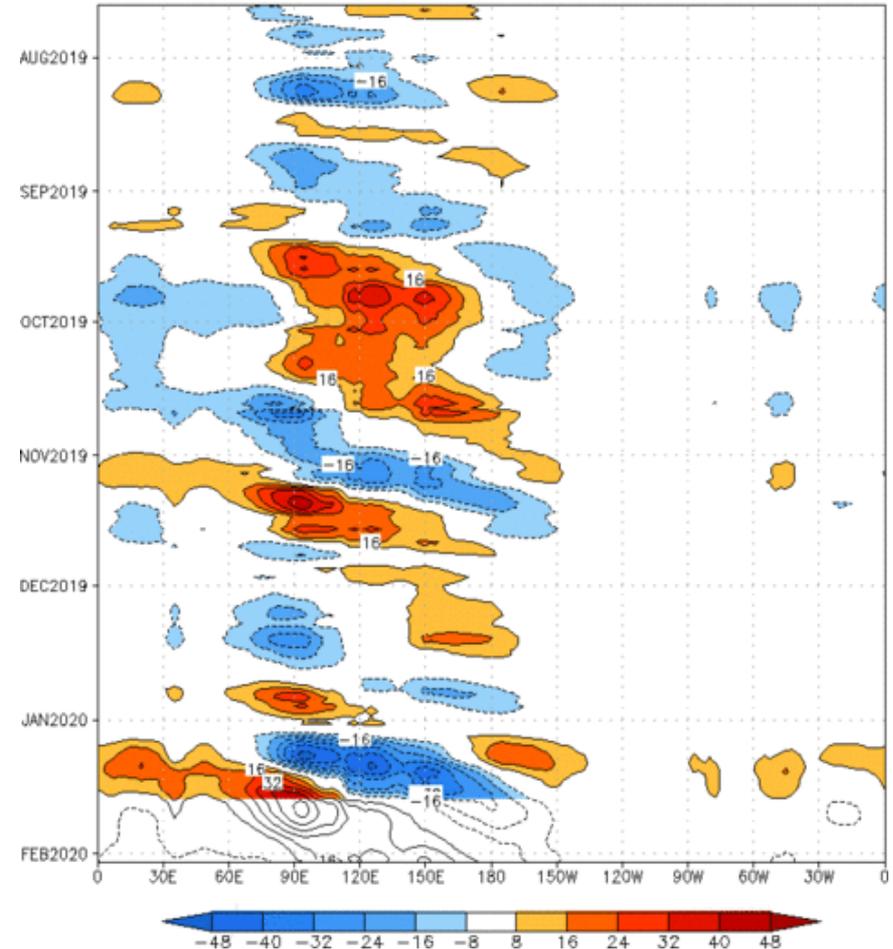
# MJO: Constructed Analog Forecast Evolution

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 (19 Jan 2020)



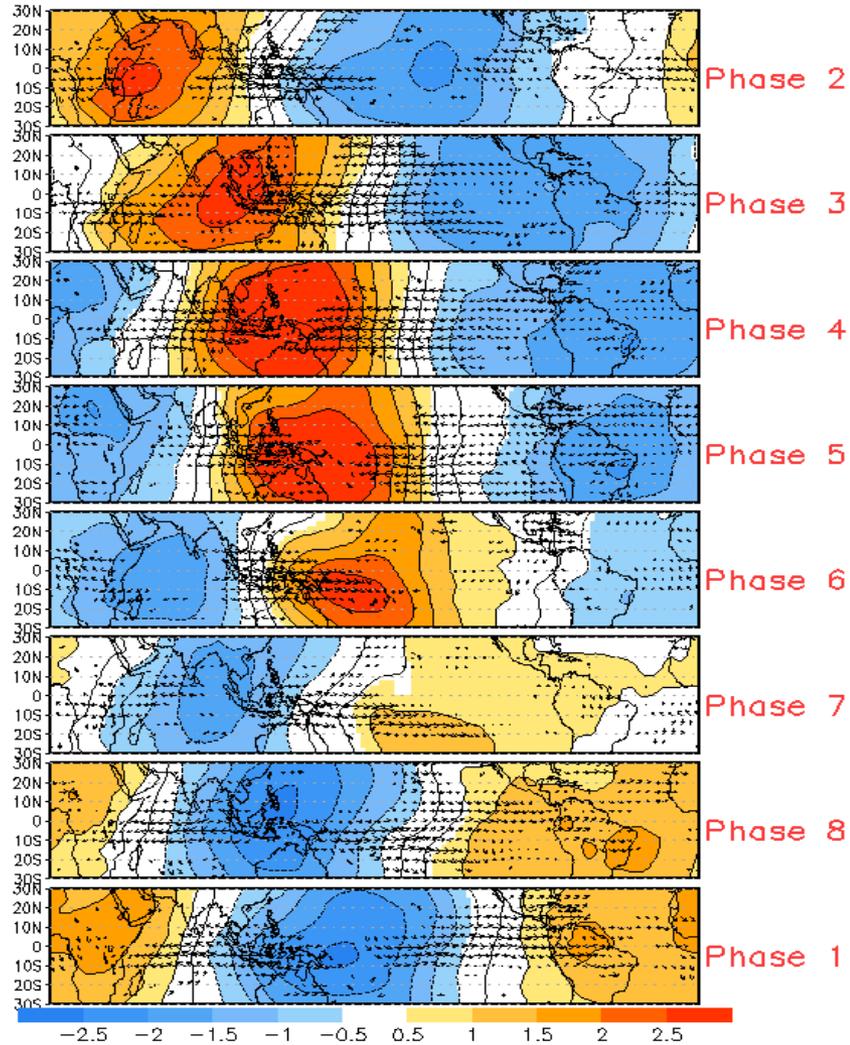
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm<sup>-2</sup>) Period:20-Jul-2019 to 19-Jan-2020  
The unfilled contours are CA forecast reconstructed anomaly for 15 days



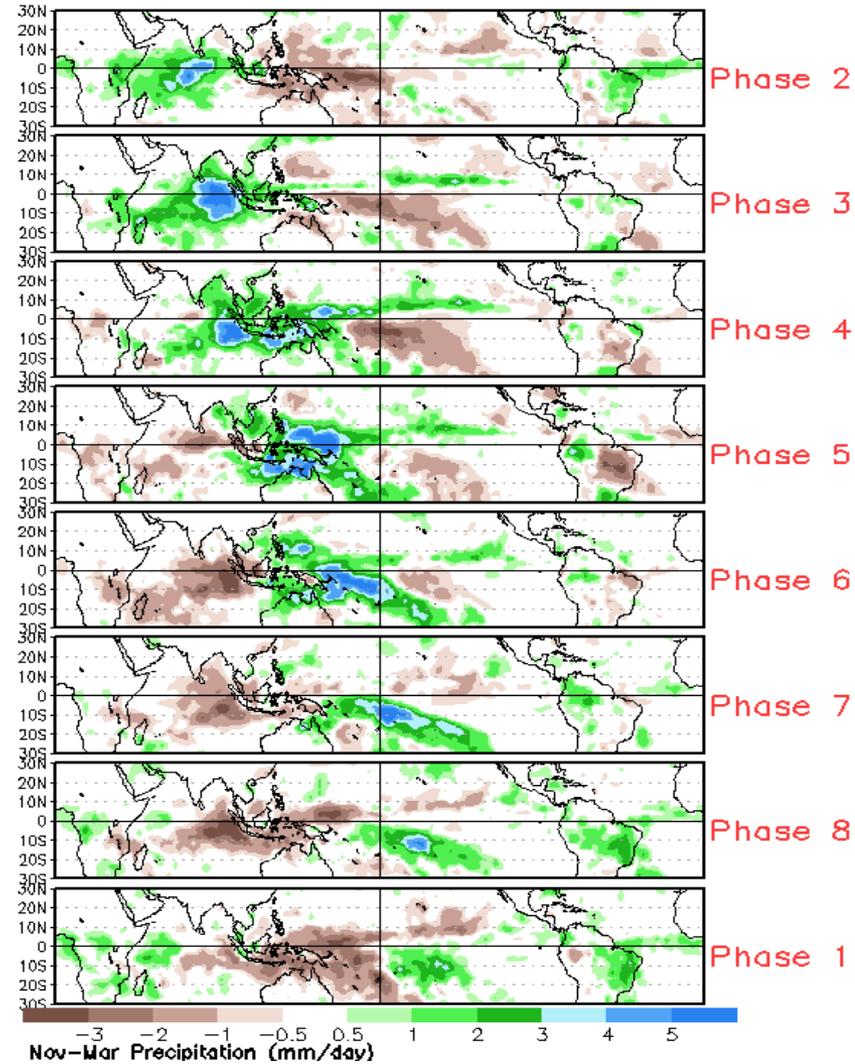
- The constructed analog MJO forecast indicates suppressed convection expanding east over the Maritime Continent while enhanced convection persists near and east of the Date Line.

# MJO: Tropical Composite Maps by RMM Phase

## 850-hPa Velocity Potential and Wind Anomalies



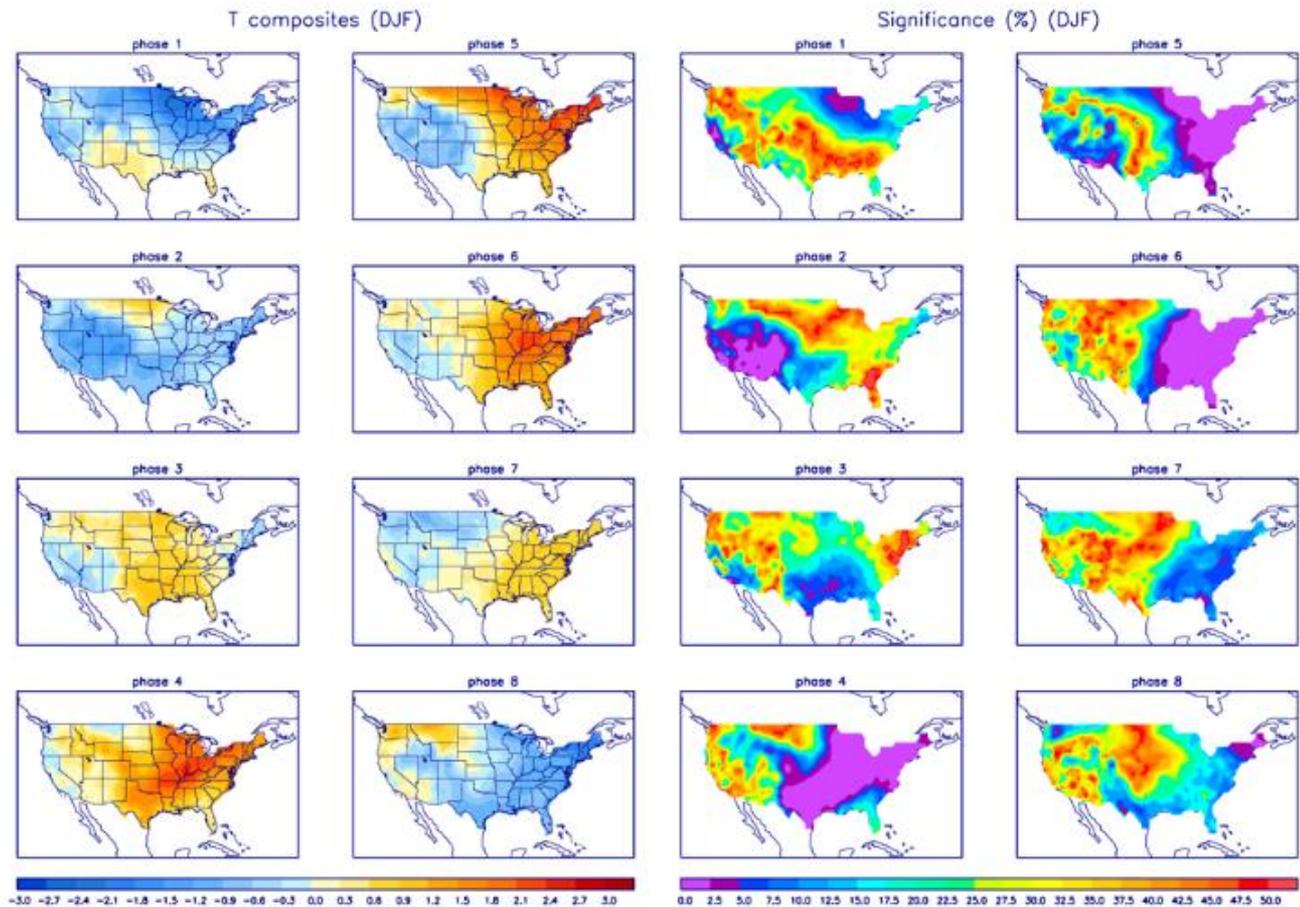
## Precipitation Anomalies



# 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.

