

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



**Update prepared by the Climate Prediction Center**  
Climate Prediction Center / NCEP  
28 December 2020

# Overview

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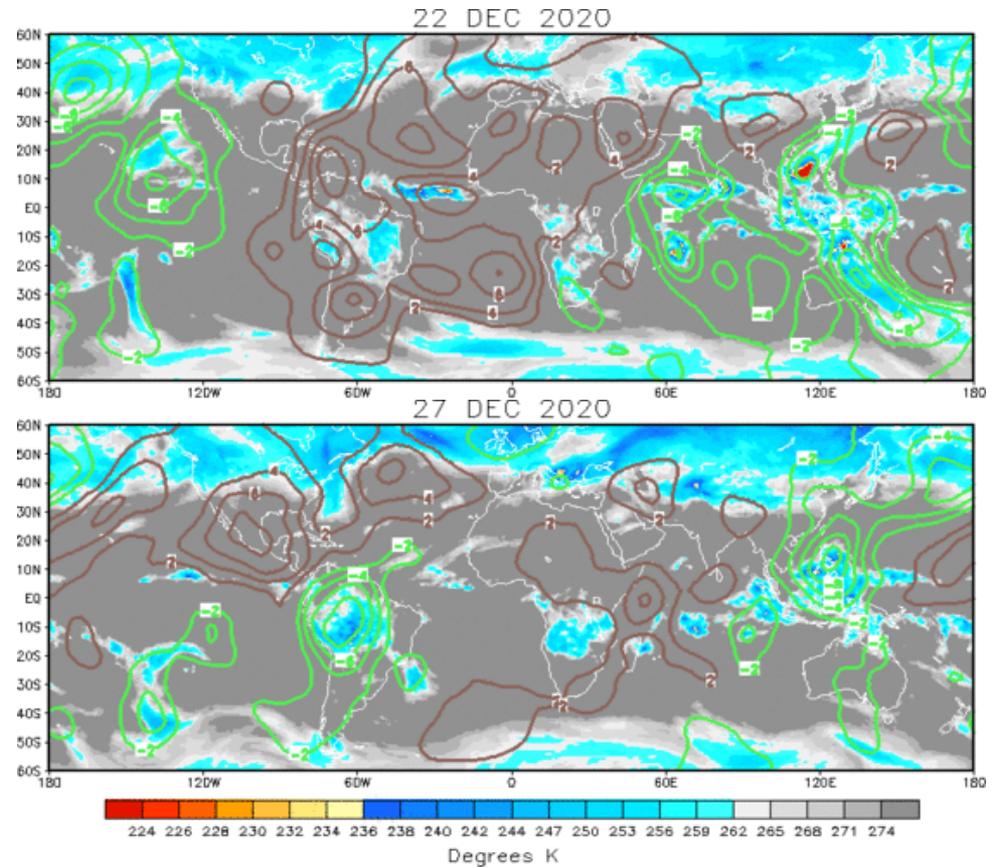
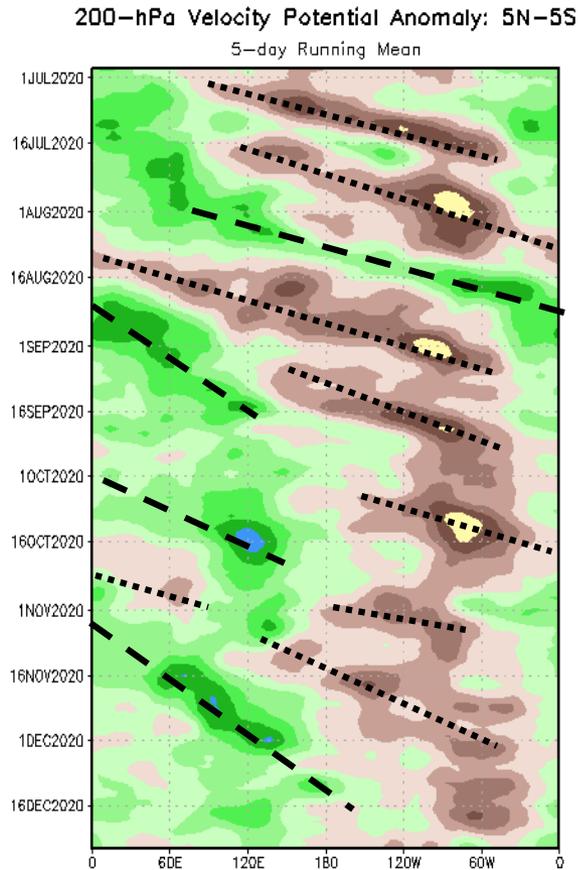
- La Niña conditions dominate the convective variability over the equatorial Indian and Pacific oceans, while mid-latitude wave breaking from the Northern and Southern hemispheres adds significant noise and variability to the lower and upper level wind fields over the Pacific.
- The MJO remains weak but models are in good agreement that an event will form over the Indian Ocean during Week-2.
- There is potential for tropical cyclone development in the Indian Ocean during the next two weeks.

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).

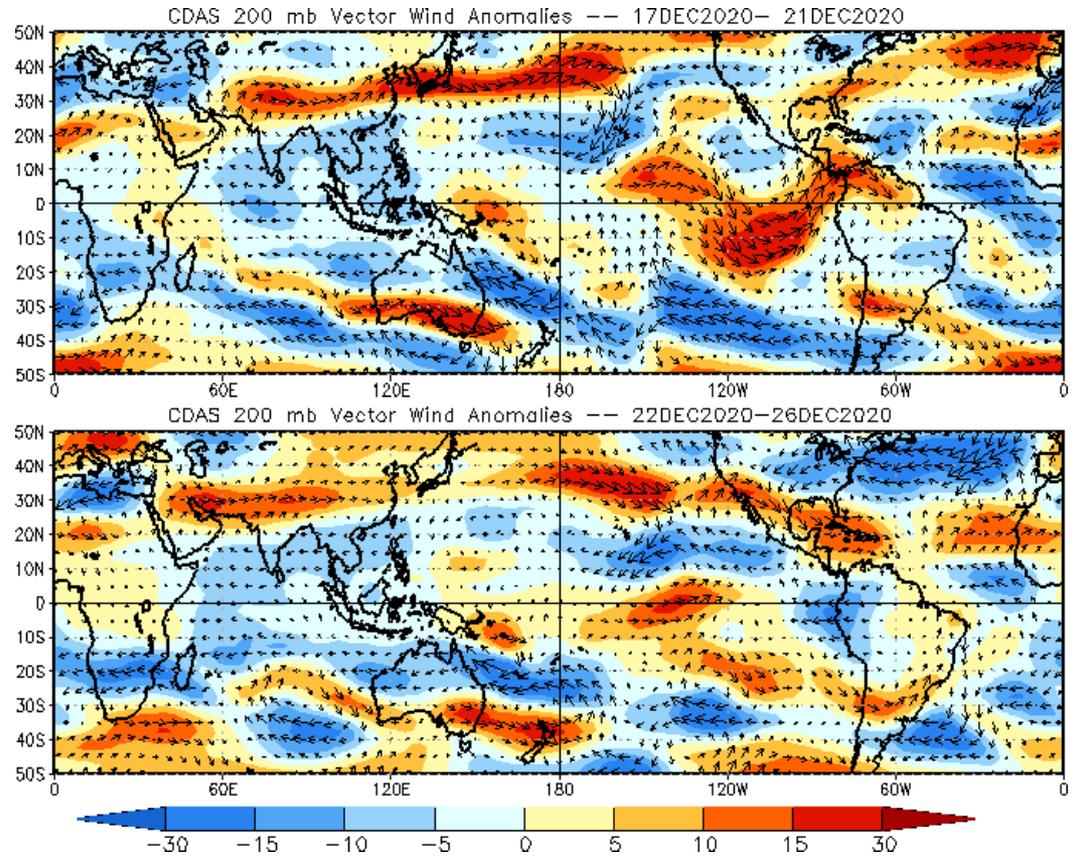
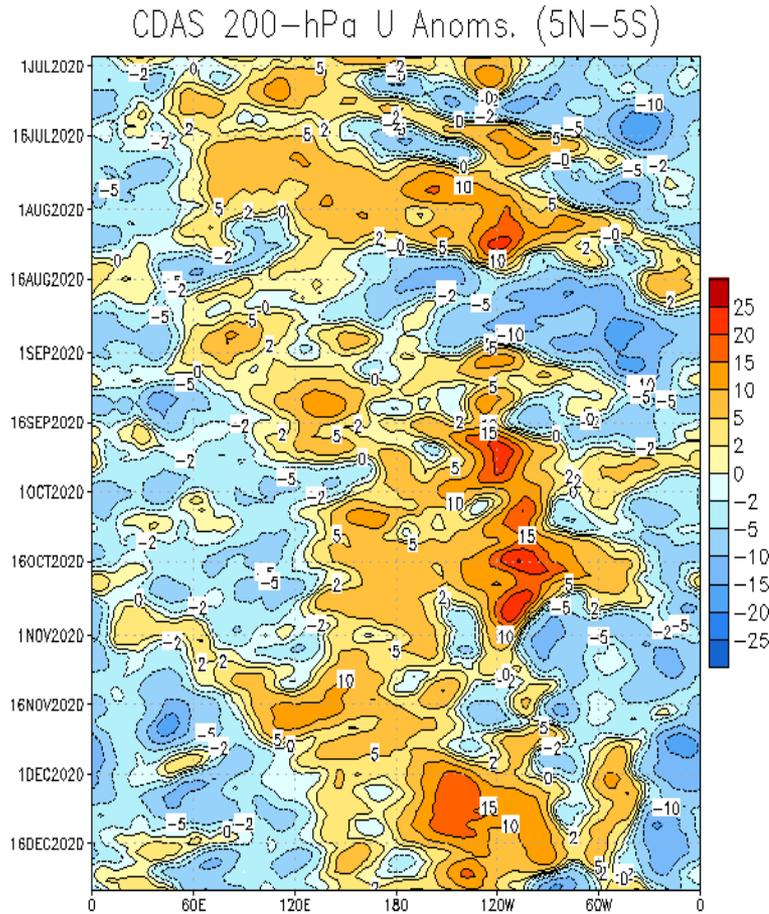
**Brown shades:** Anomalous convergence (unfavorable for precipitation).



- The MJO was active during much of November and early December, with slow eastward propagation from the Indian Ocean to the far West Pacific.
- The upper-level pattern has become increasingly disorganized as the intraseasonal MJO signal moves away from the constructive interference offered by La Niña.

# 200-hPa Wind Anomalies

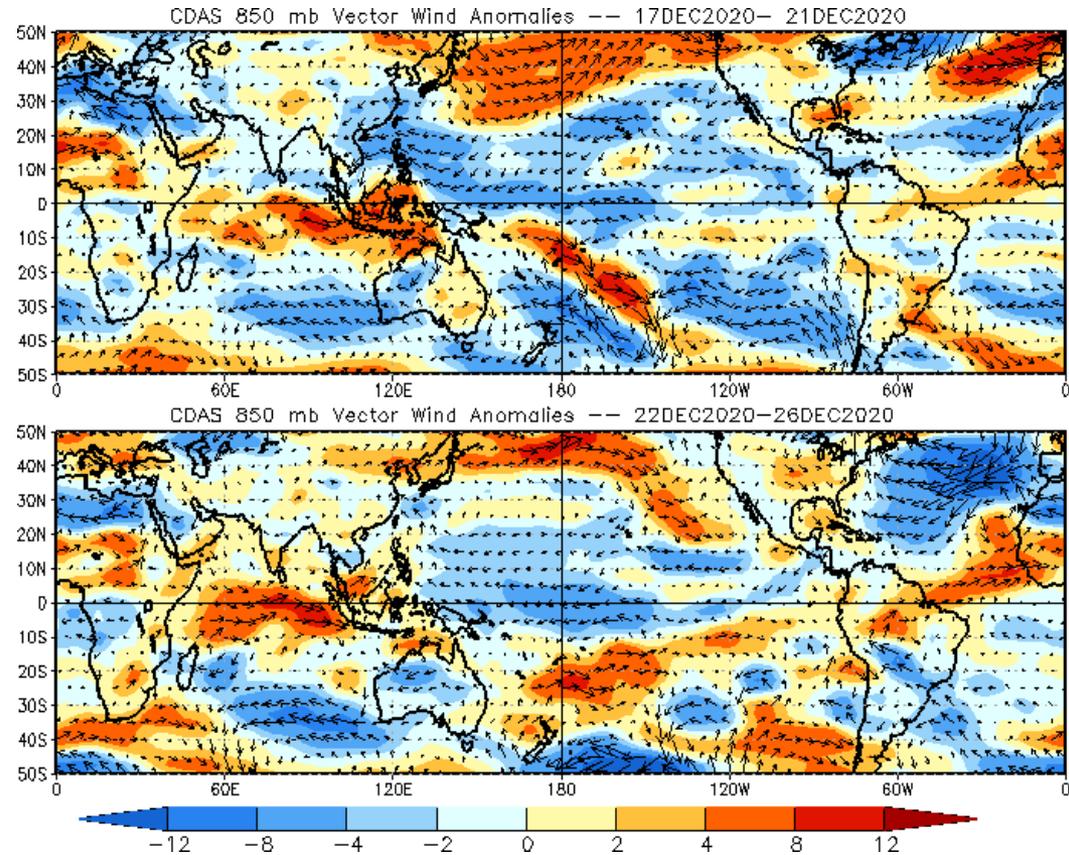
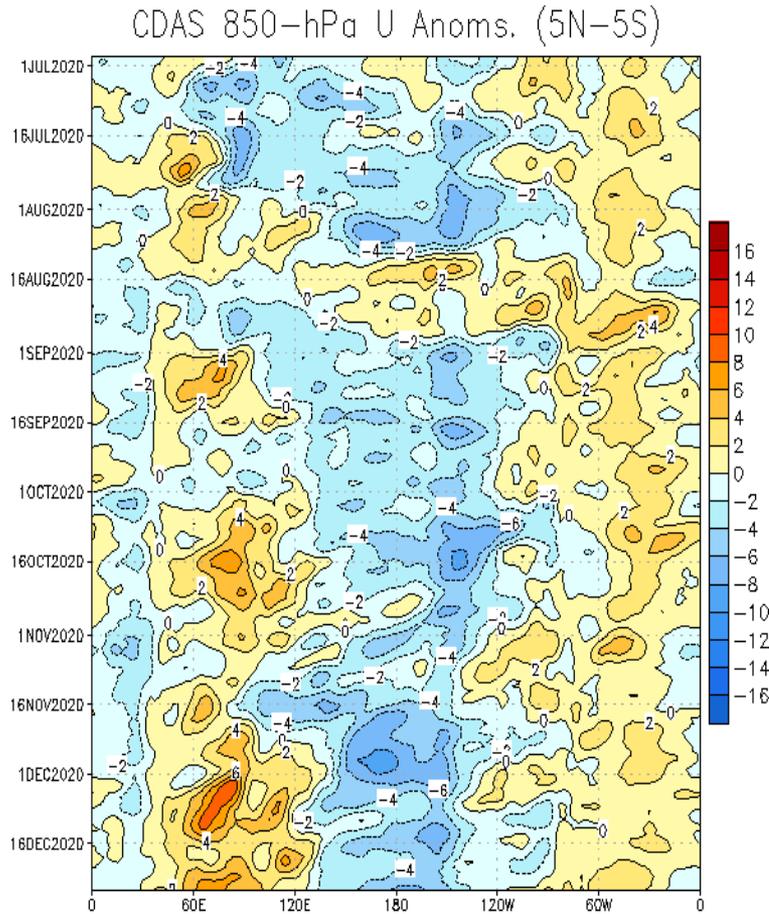
Shading denotes the zonal wind anomaly. **Blue shades: Anomalous easterlies.** **Red shades: Anomalous westerlies.**



- There is evidence of wave breaking over the central and eastern Pacific in the Northern and Southern Hemispheres.
- The upper-level westerlies along the equator just east of the Date Line are consistent with La Niña conditions.

# 850-hPa Wind Anomalies

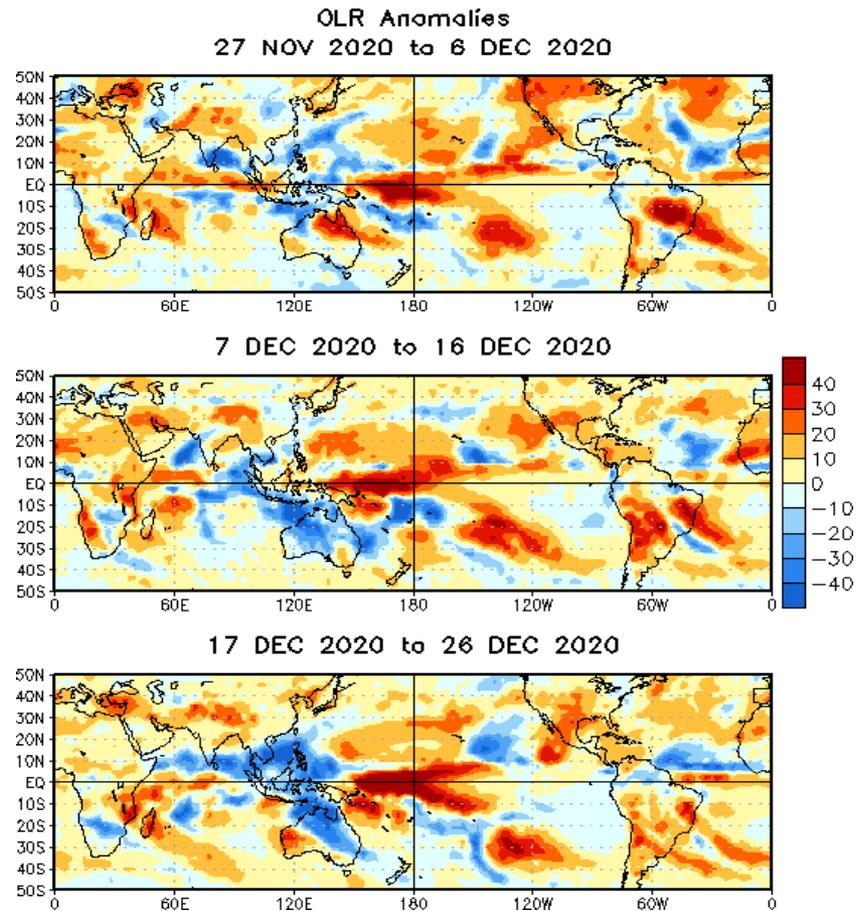
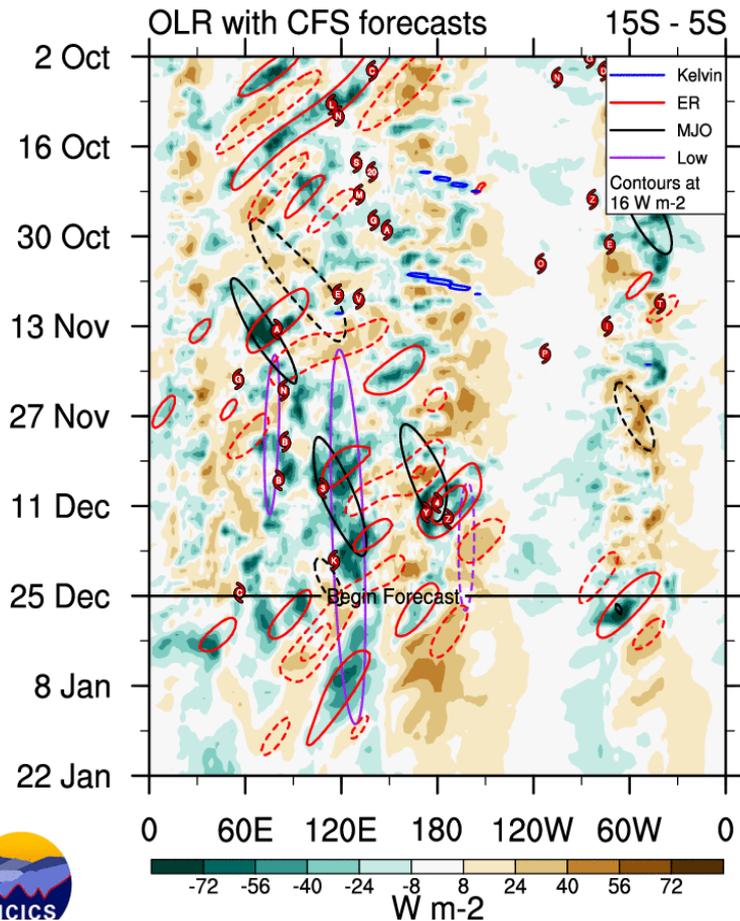
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Anomalous low-level easterlies along the Equator in the Pacific are consistent with La Niña conditions.
- These easterlies were also enhanced by higher frequency Rossby and Kelvin wave activity during December.
- There hasn't been much tropical wave activity in the Indian Ocean lately; the anomalous westerlies project strongly onto low-frequency modes, likely dominated by La Niña since there isn't evidence to support a negative IOD event.

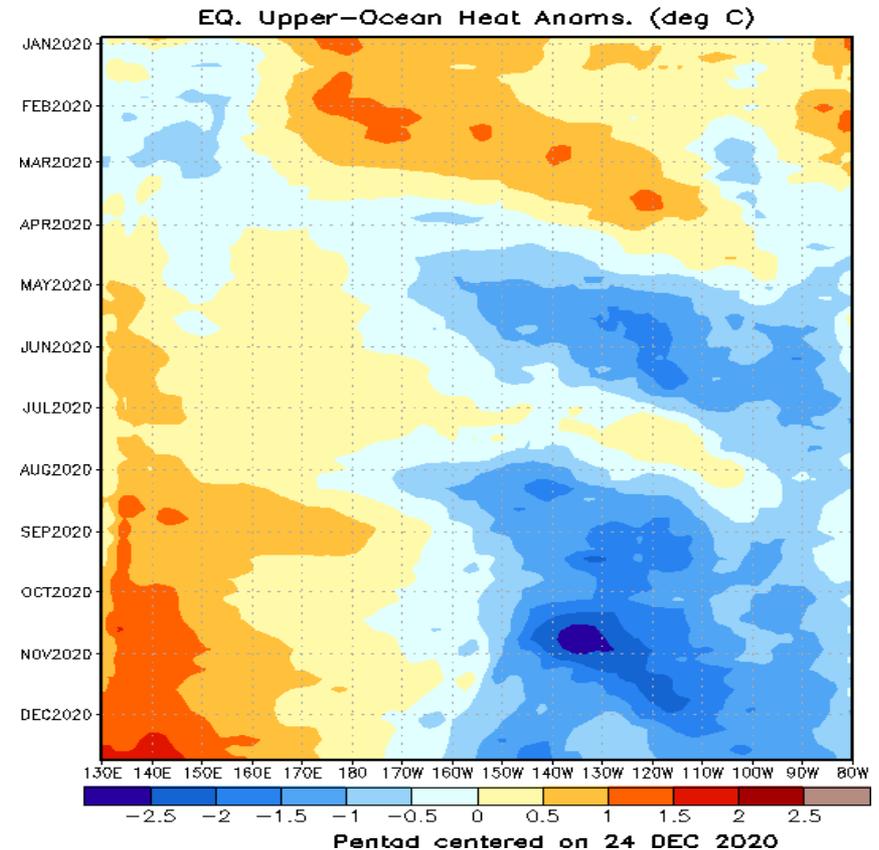
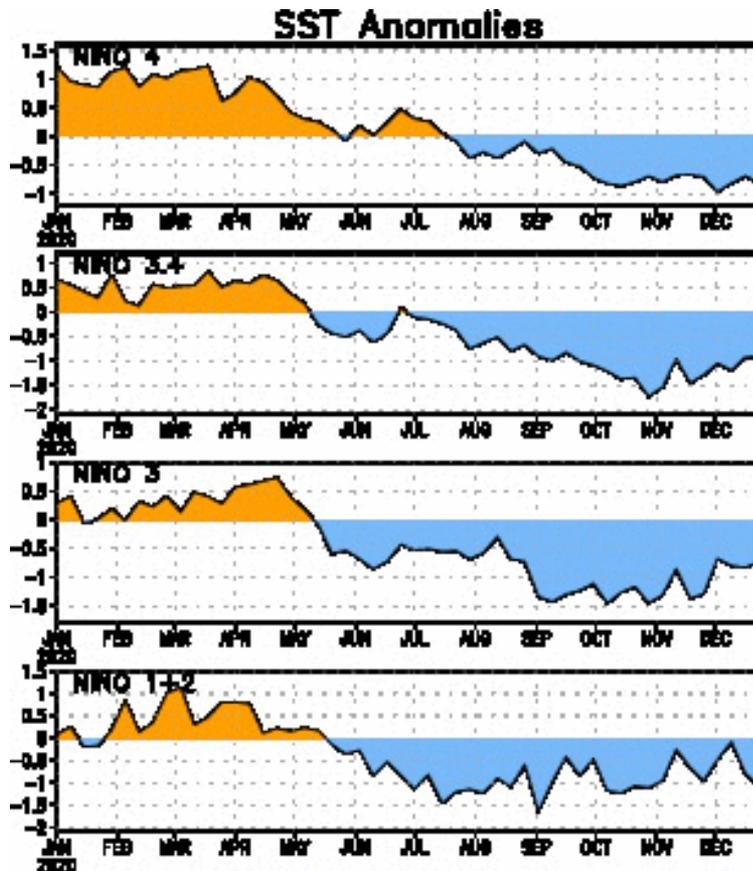
# Outgoing Longwave Radiation (OLR) Anomalies

**Blue shades: Anomalous convection (wetness).** **Red shades: Anomalous subsidence (dryness).**



- There has been a large region of anomalous convection over the Maritime Continent since early December, which is consistent with an atmospheric response to anomalously warm SSTs related to La Niña.

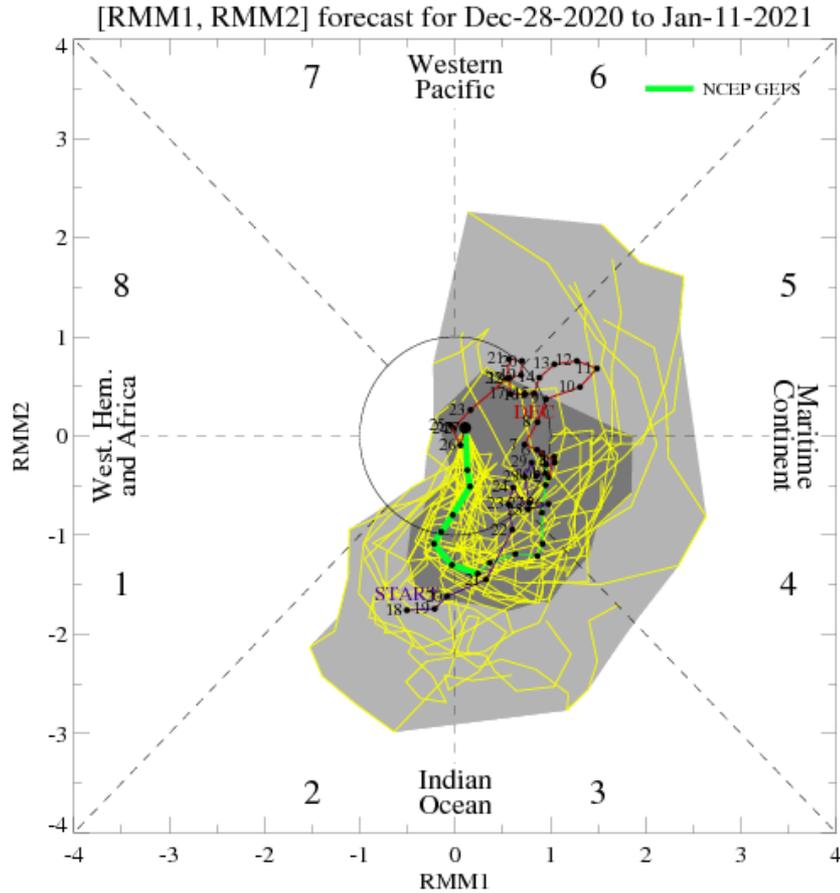
# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



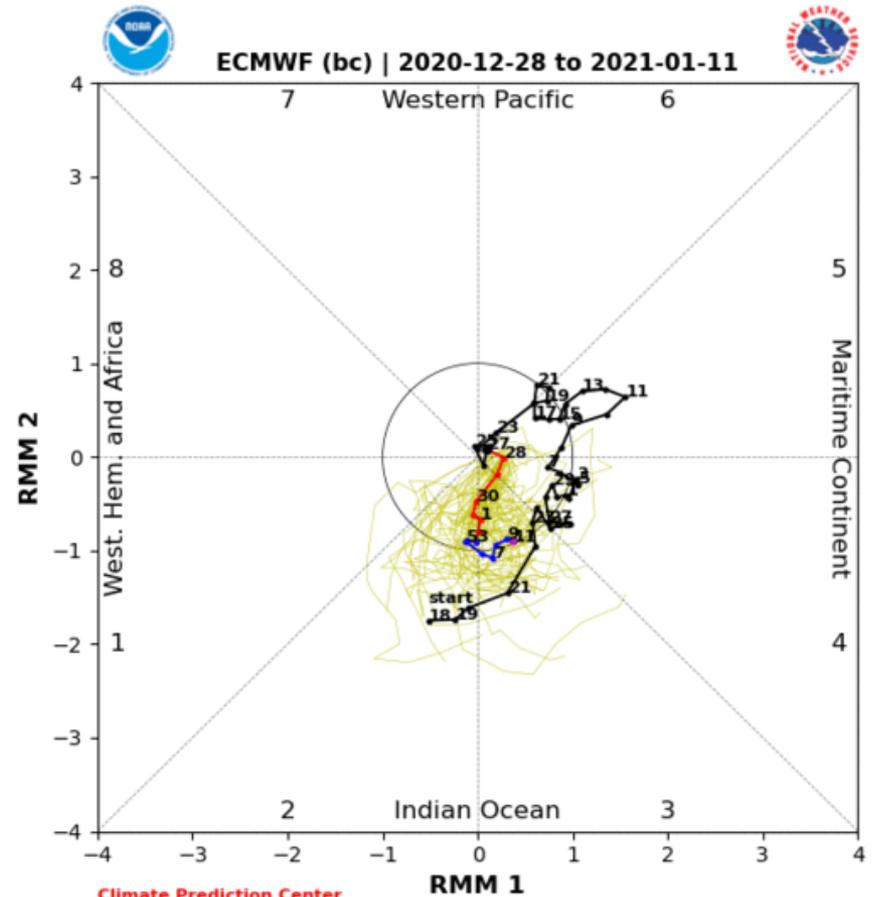
- Following destructive interference with the base state by a downwelling Kelvin wave during July, the subsequent upwelling phase has pushed the Pacific into La Niña conditions.
- Cold anomalies shifted slightly westward across the central Pacific during November and early December.



# MJO Index: Forecast Evolution



**GEFS Forecast**



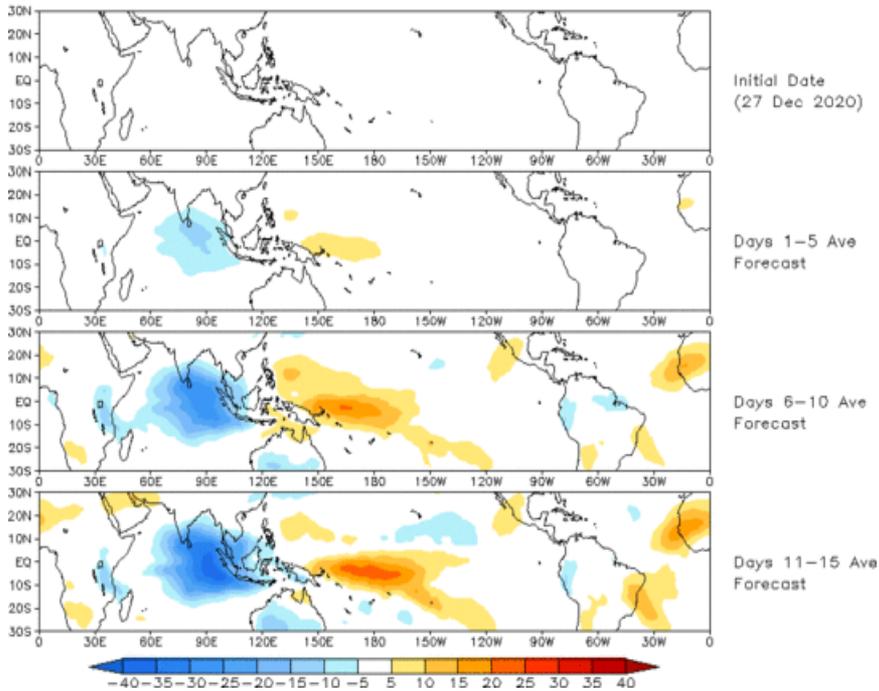
**ECMWF Forecast**

- The GEFS and ECMWF predict an MJO signal evolving over the Indian Ocean during Week-2.
- This is the strongest MJO forecast in some time and there is especially high confidence since so many ensemble members appear to be in agreement.

# MJO: GEFS Forecast Evolution

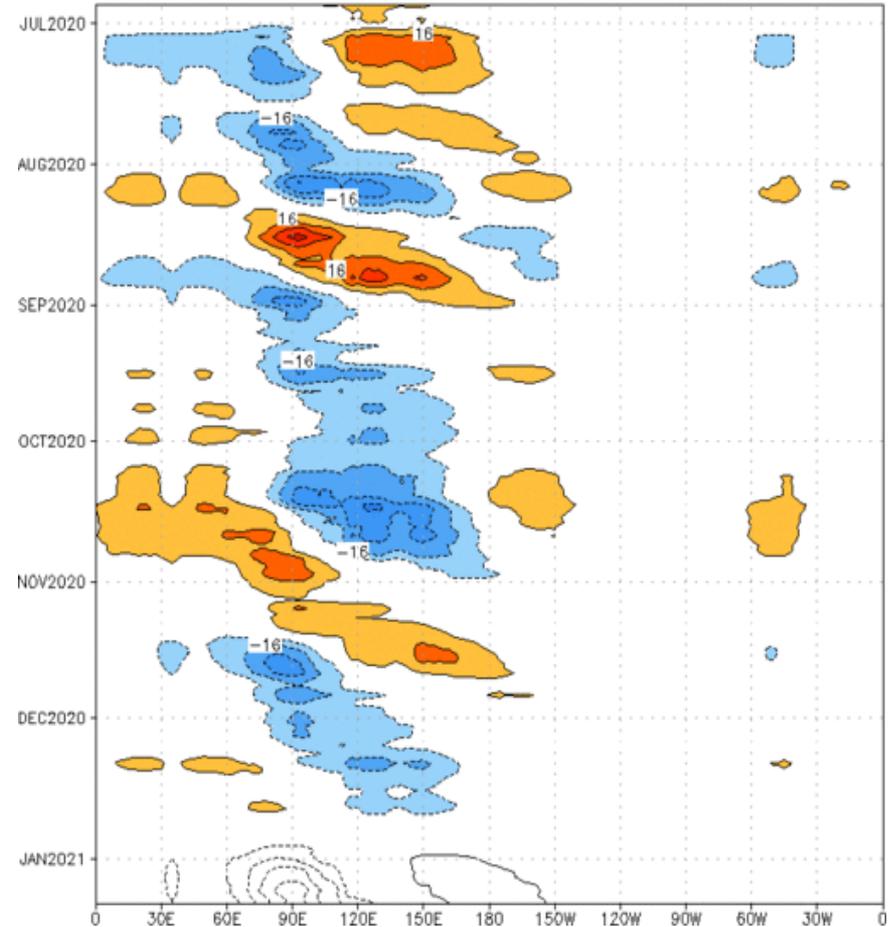
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast  
Initial date: 27 Dec 2020  
OLR



- This GEFS forecast matches the previous slide's RMM forecast – a strong MJO signal is forecast to develop during Week-2.

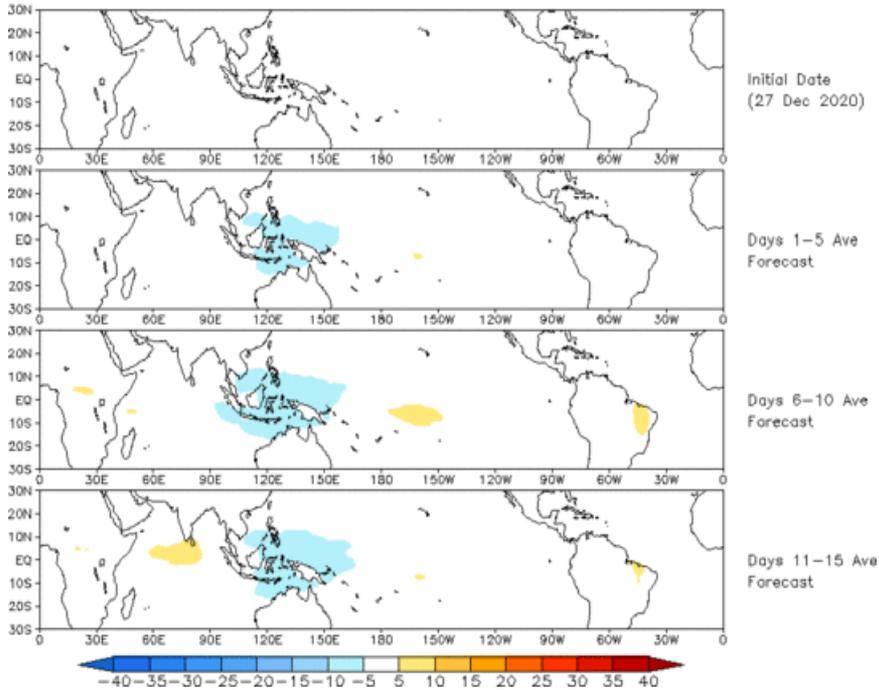
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2  
OLR [7.5°S,7.5°N] (cont:4Wm<sup>-2</sup>) Period:27-Jun-2020 to 27-Dec-2020  
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



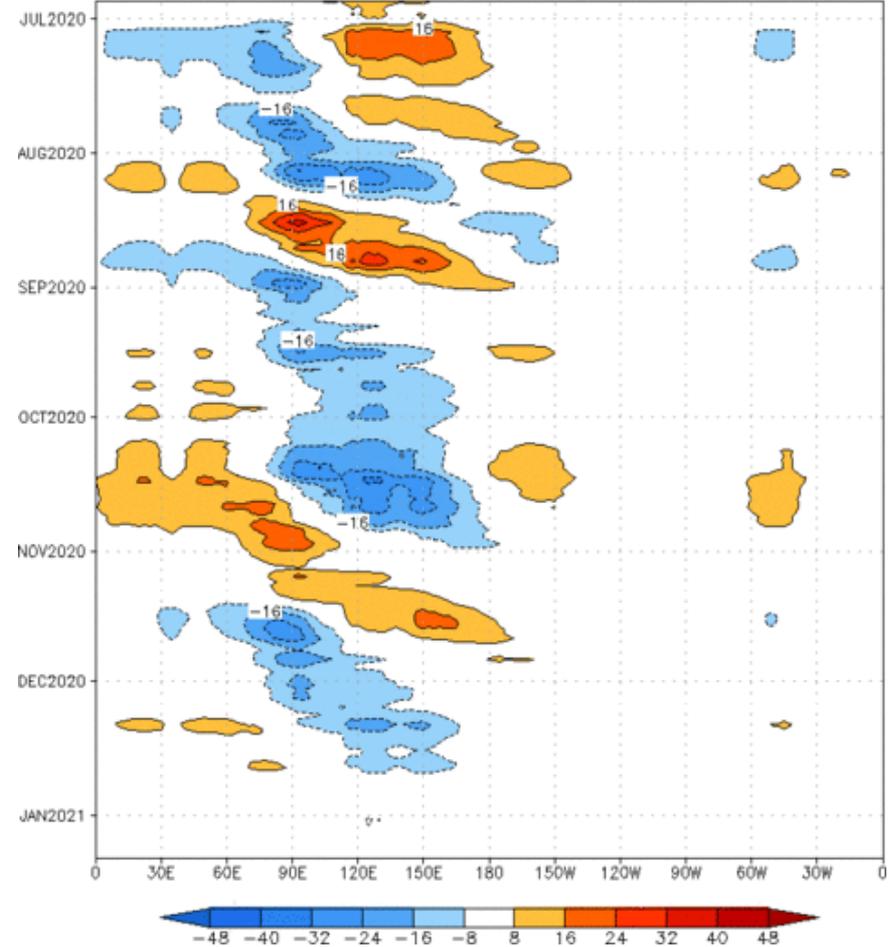
# MJO: Constructed Analog Forecast Evolution

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 Dec 2020)



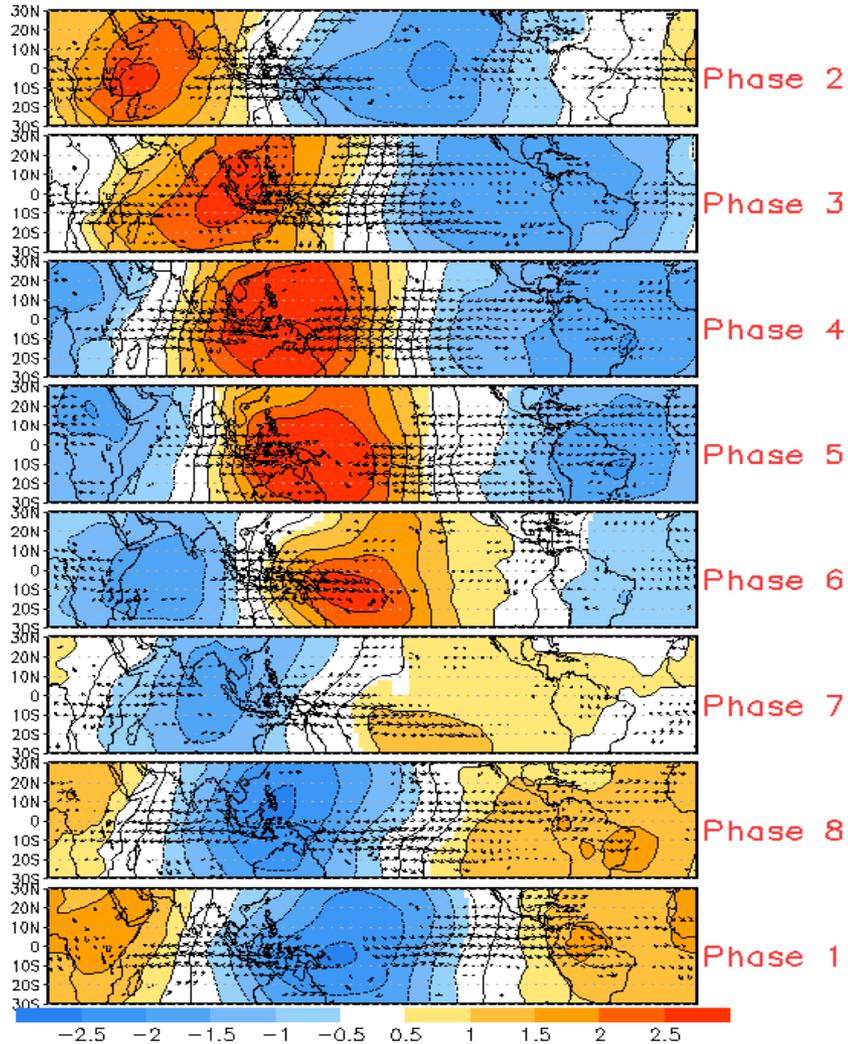
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm<sup>-2</sup>) Period:27-Jun-2020 to 27-Dec-2020  
The unfilled contours are CA forecast reconstructed anomaly for 15 days



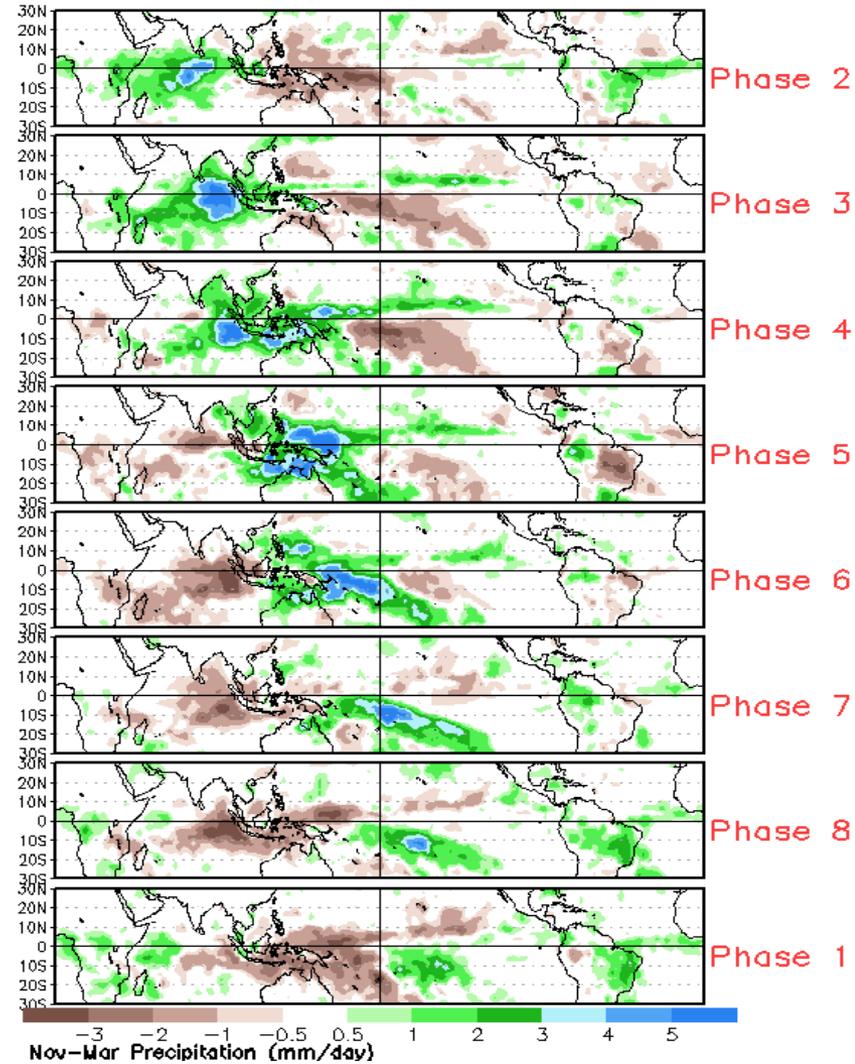
- The constructed analog tool does not forecast MJO development during the next two weeks.

# MJO: Tropical Composite Maps by RMM Phase

## 850-hPa Velocity Potential and Wind Anomalies



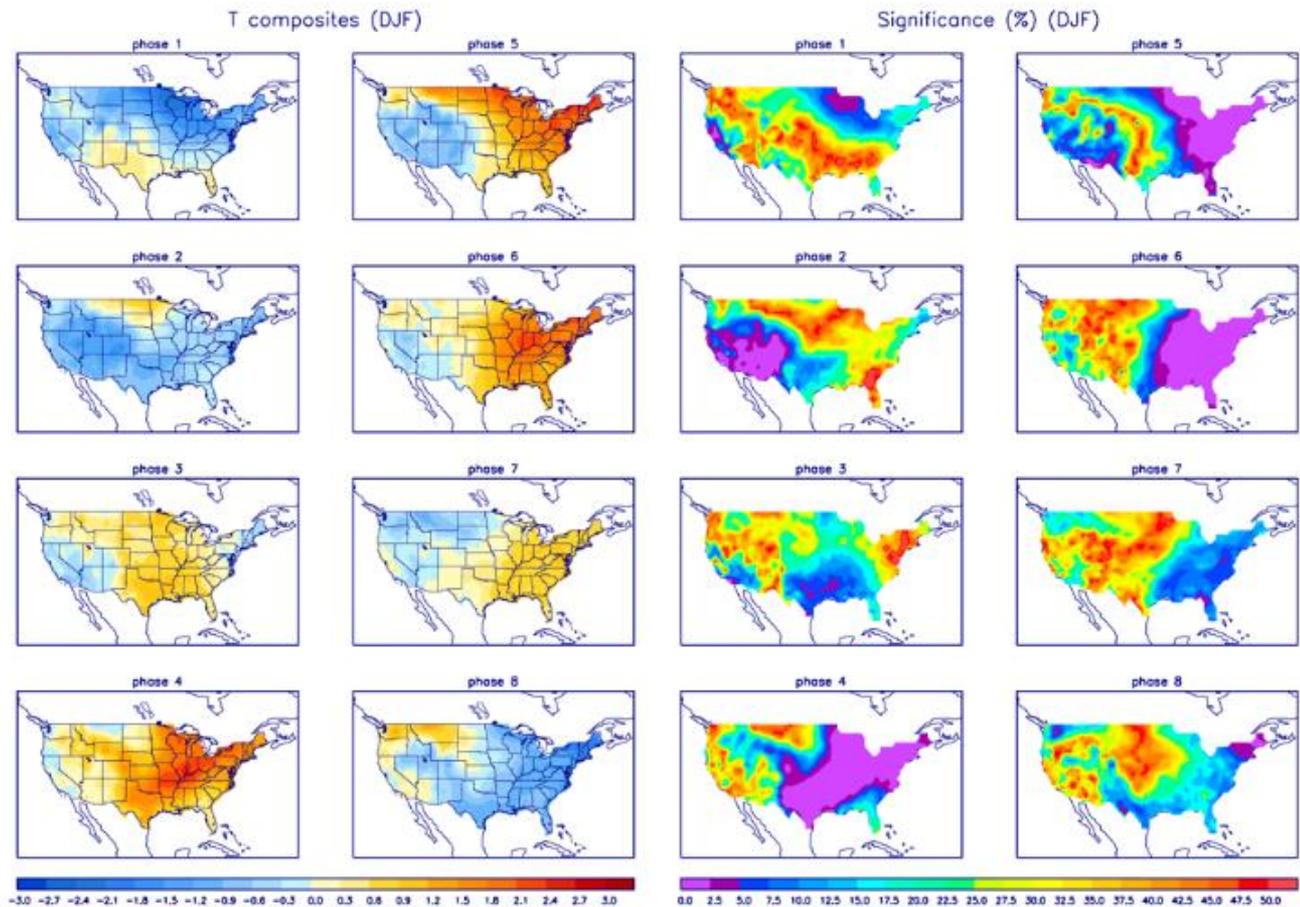
## Precipitation Anomalies



# 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.

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