

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



**Update prepared by the Climate Prediction Center**  
Climate Prediction Center / NCEP  
1 February 2021

# Overview

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- The RMM index suggests the intraseasonal signal has shifted westward into phase 6 over the western Pacific during the past week.
- Dynamical models continue to favor an eastward propagating MJO during week-1. However, there are differences relative to the strength and evolution of the intraseasonal signal beyond week-1, as well as larger model spread compared to previous guidance. Given this, and the ongoing destructive interference with La Niña, there is much uncertainty in the MJO outlook.
- Should the MJO become more coherent and propagate across the western Pacific, the potential exists for increased chances for below-normal temperatures across much of the CONUS into mid February.
- Increased chances for tropical cyclone activity look to continue across portions of the southern Indian Ocean and the South Pacific 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:

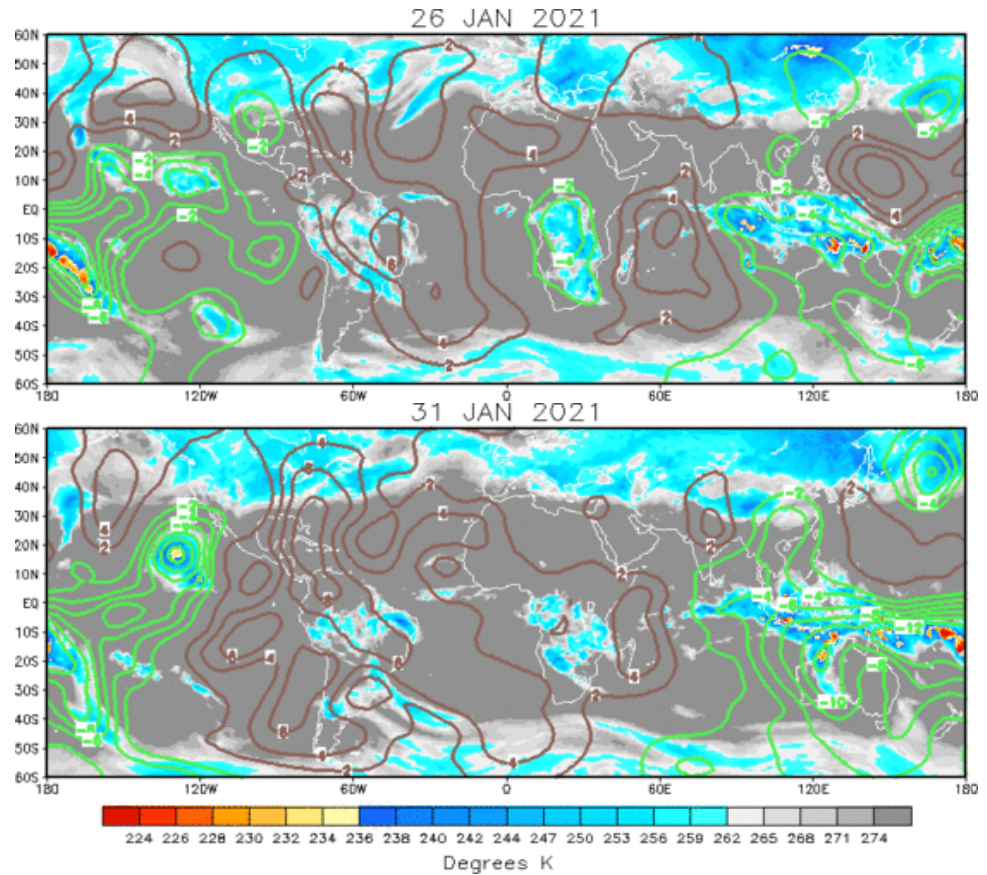
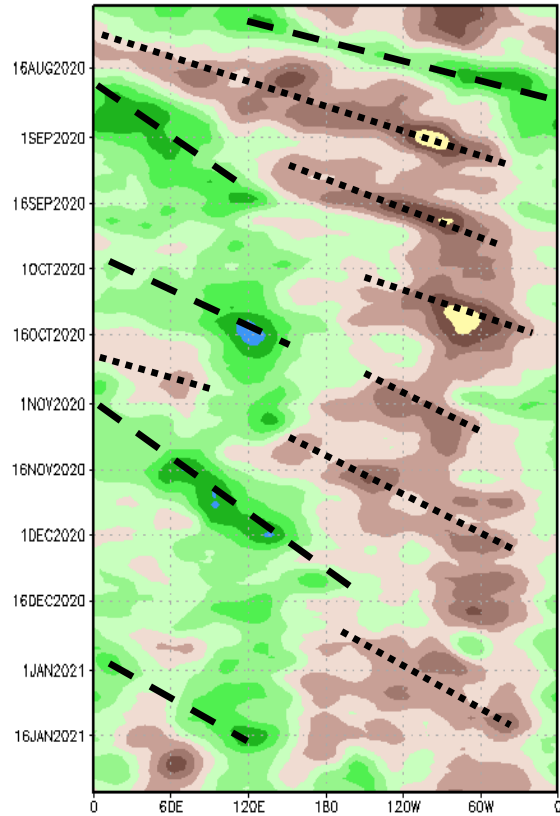
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

# 200-hPa Velocity Potential Anomalies

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

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

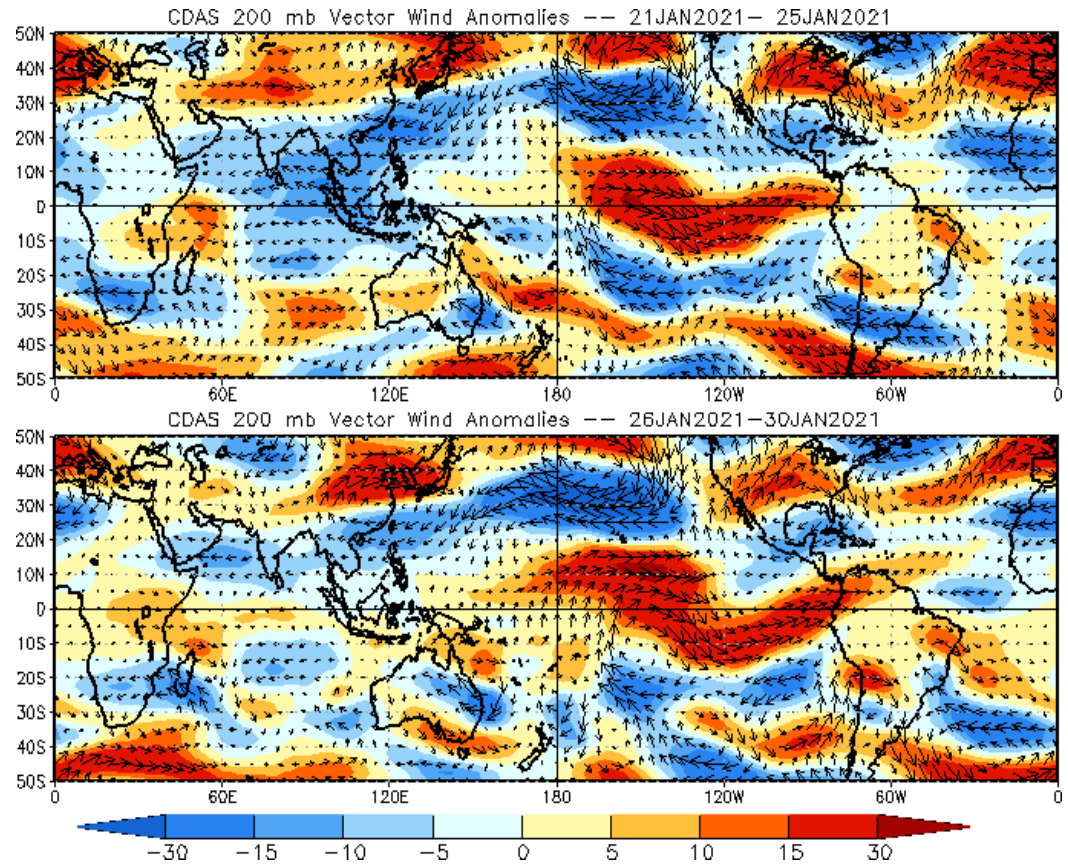
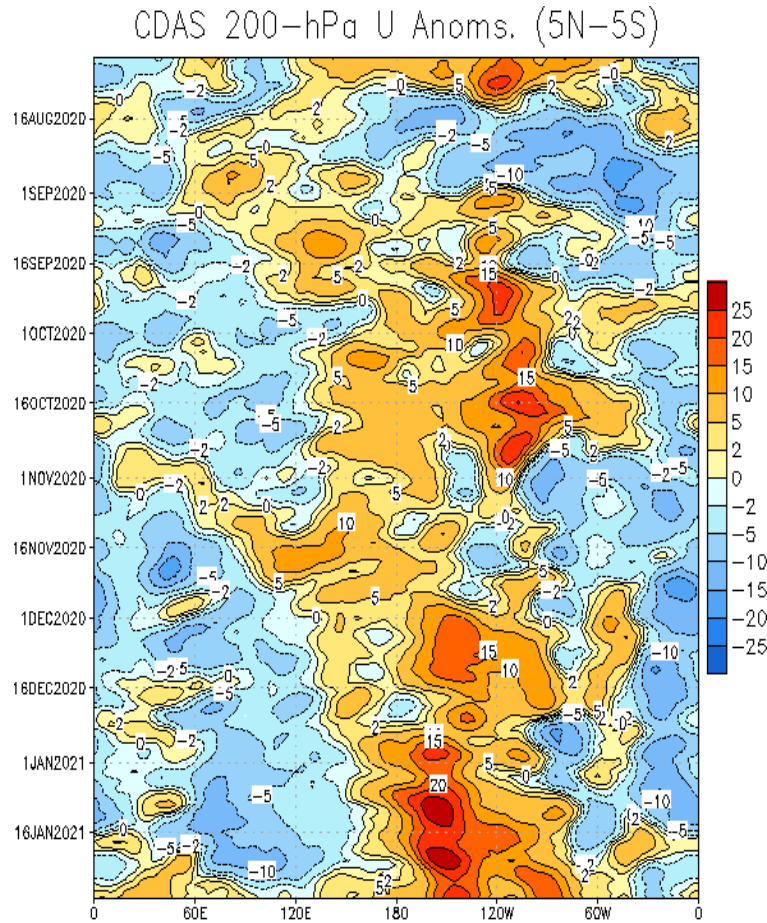
200-hPa Velocity Potential Anomaly: 5N-5S  
5-day Running Mean



- Upper-level velocity potential anomalies have become more stationary following an eastward shift of the pattern last week.
- Enhanced convection persists across much of the South Pacific with weakened suppressed conditions to the west of the Date Line suggestive of continued destructive interference with La Niña.

# 200-hPa Wind Anomalies

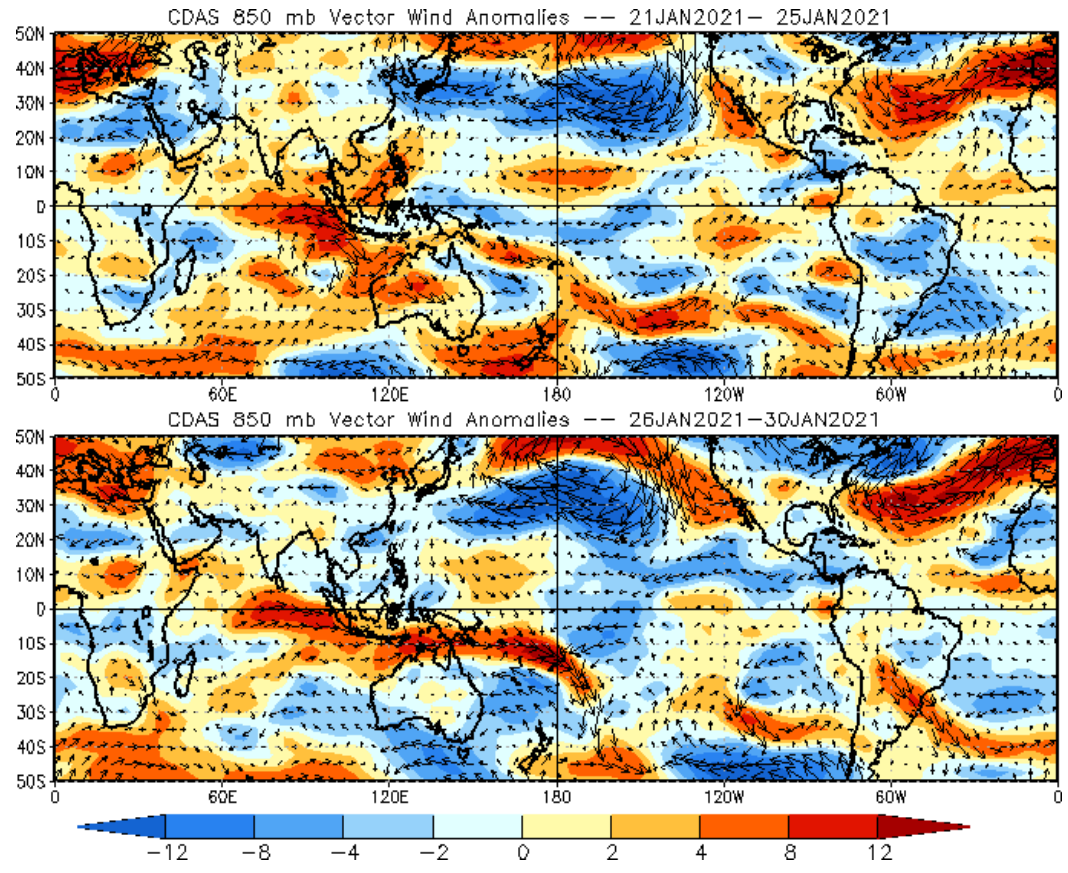
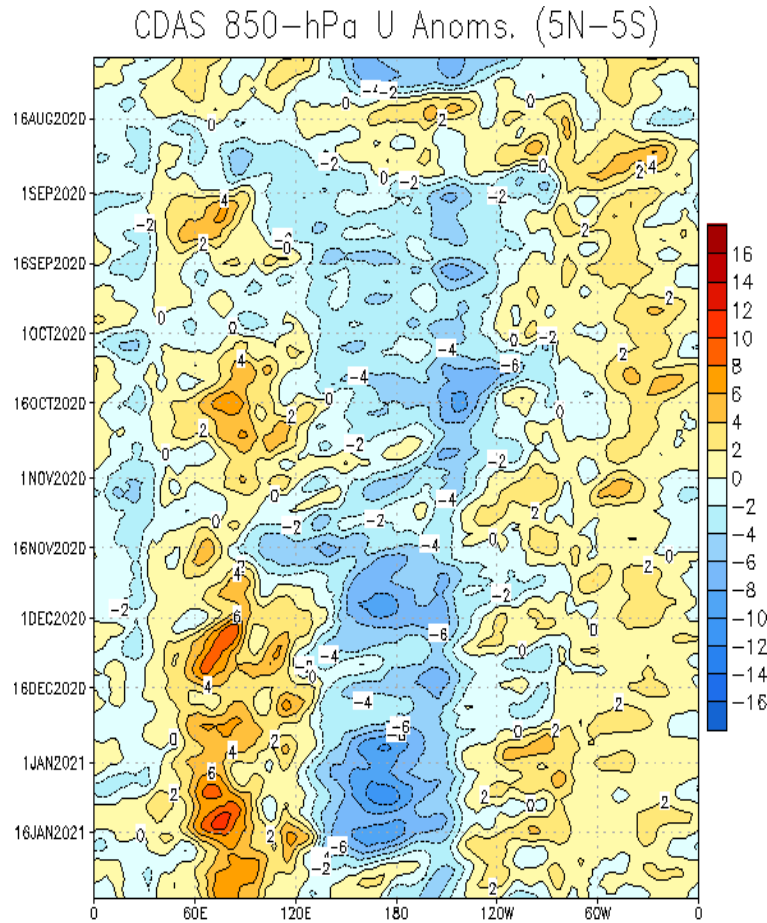
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Anomalous easterlies have transitioned to westerlies over the Indian Ocean and Maritime Continent. Anomalous westerlies have returned to the west of the Date Line in the equatorial Pacific.
- Wave breaking continues to inject mass from the higher latitudes of the Pacific into the tropics to help reinforce anomalous westerlies to the east of the Date Line which remain considerably strong.

# 850-hPa Wind Anomalies

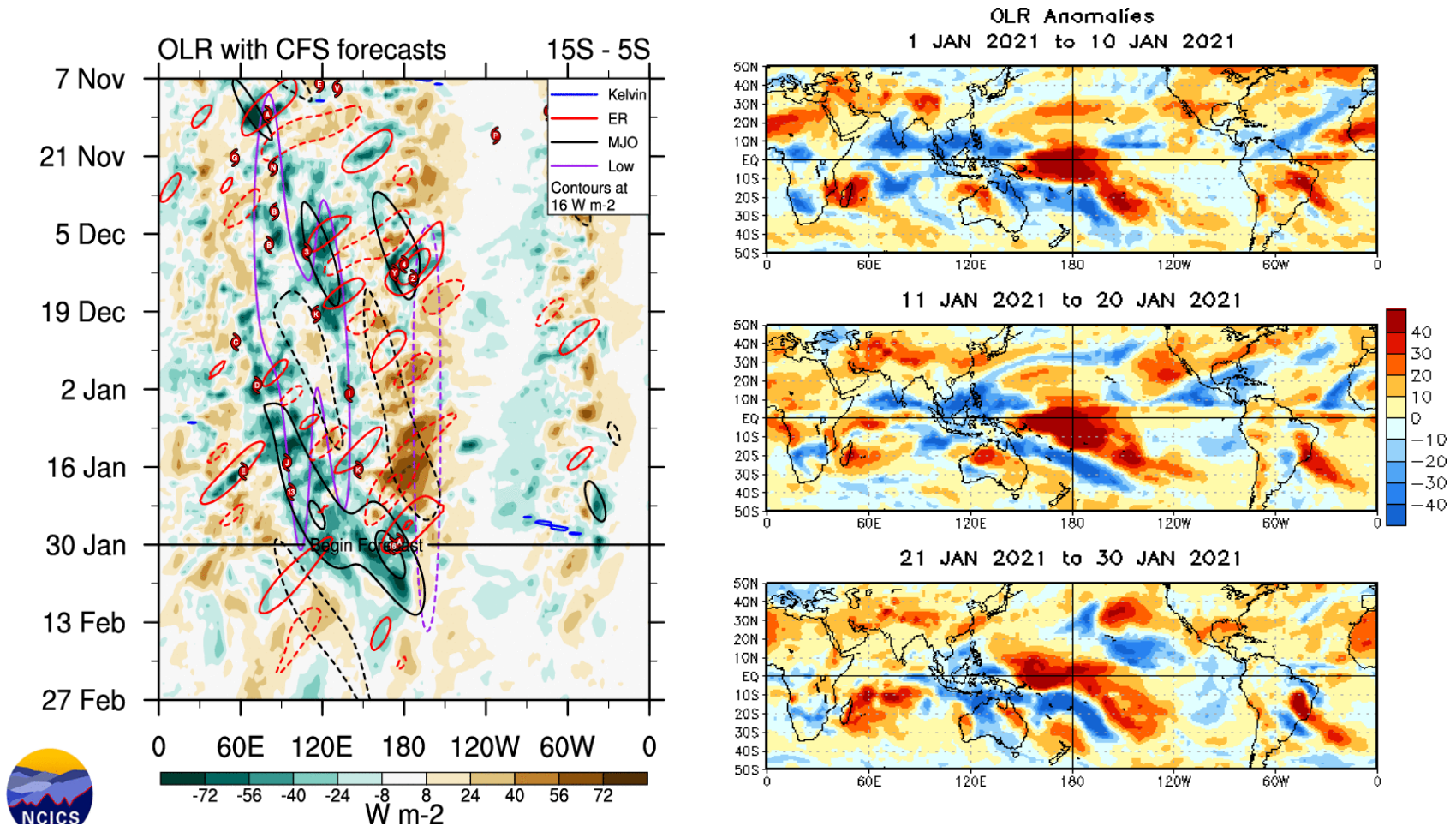
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- A strong band of anomalous westerlies are observed over the Maritime Continent and to the west of the Date Line associated with ongoing tropical cyclone activity in the South Pacific.
- Weakened trade winds persist across parts of the eastern equatorial Pacific.

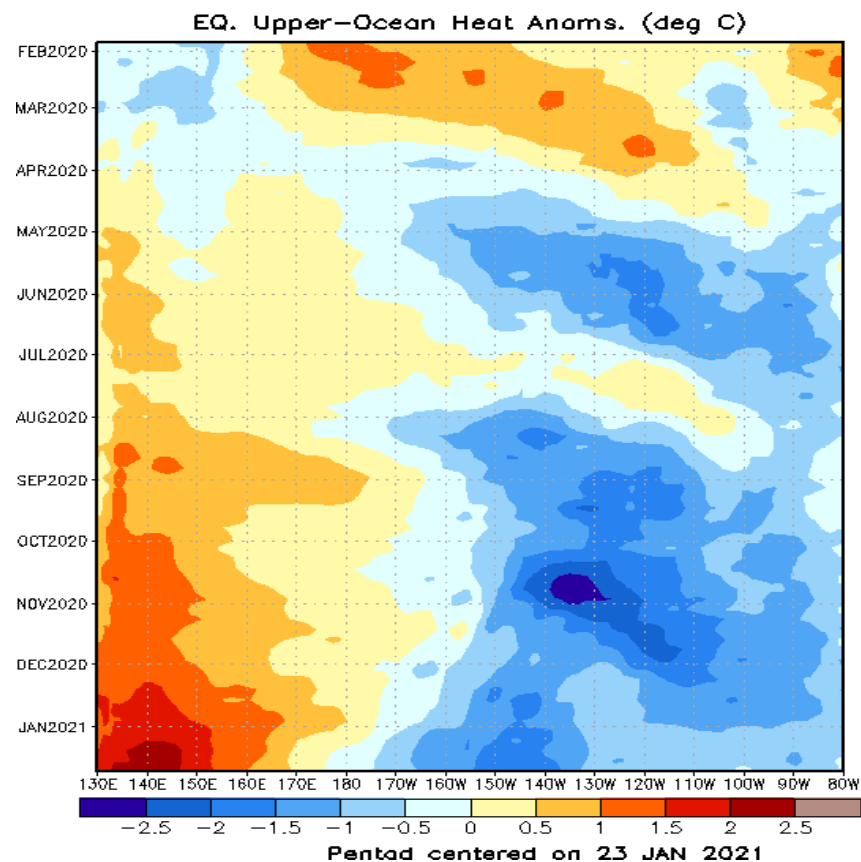
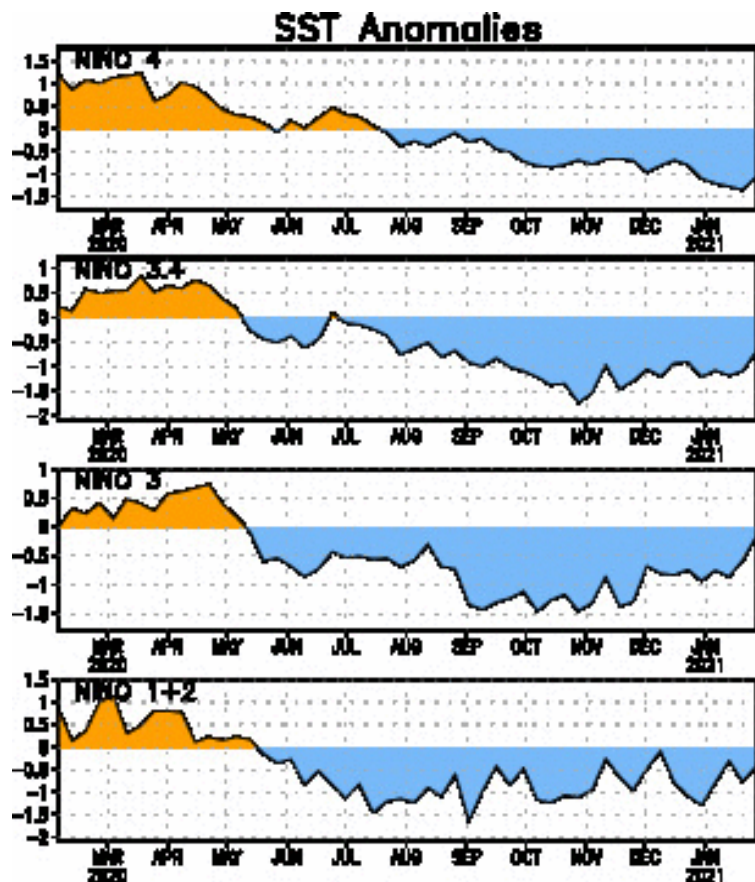
# Outgoing Longwave Radiation (OLR) Anomalies

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



- Enhanced (suppressed) convection has been established over the Maritime Continent (Central Pacific) since mid-December in association with warm (cold) sea surface temperatures and the ongoing La Niña.
- Enhanced convection remains favored to increase over the South Pacific to the west of the Date Line during the next two weeks, also tied to Rossby wave and tropical cyclone activity in the region.

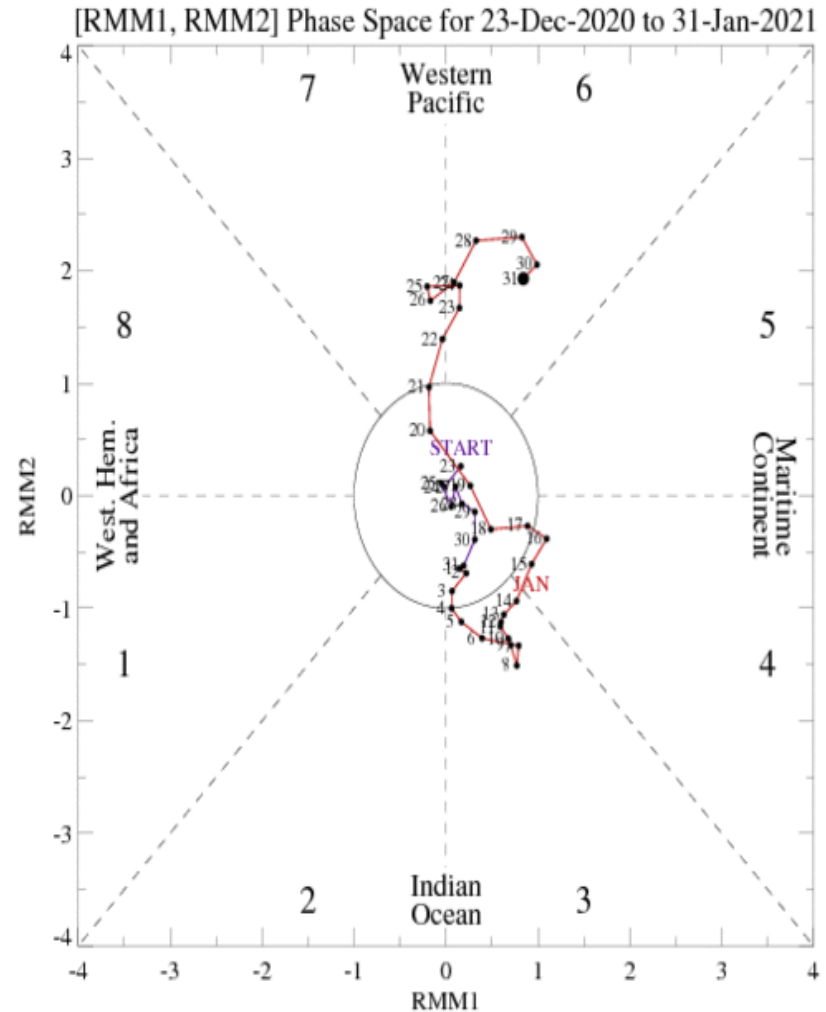
# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Following destructive interference with the base state by a downwelling Kelvin wave during July, the subsequent upwelling phase pushed the Pacific into La Niña conditions.
- Anomalous cold conditions have shifted westward across the central Pacific. However, all Niño regions suggest a weakening of the below-normal SST's since mid-January.

# MJO Index: Recent Evolution

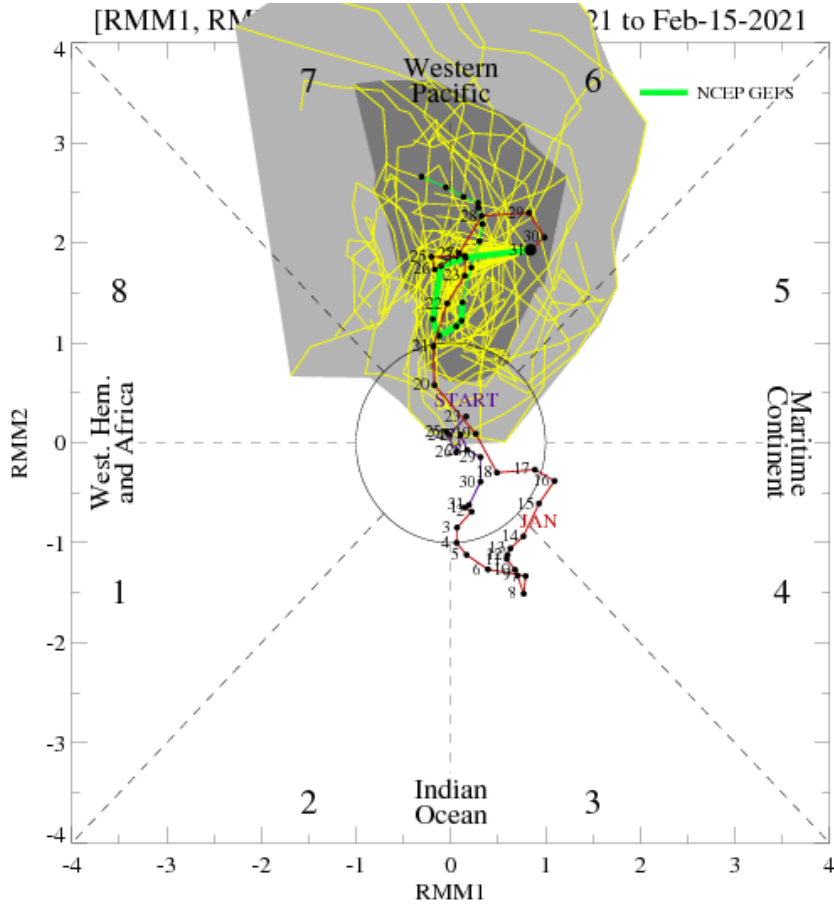
- The tropical convection and wind patterns have projected more strongly onto the RMM index during late January with the intraseasonal signal shifted westward into phase 6 recently.



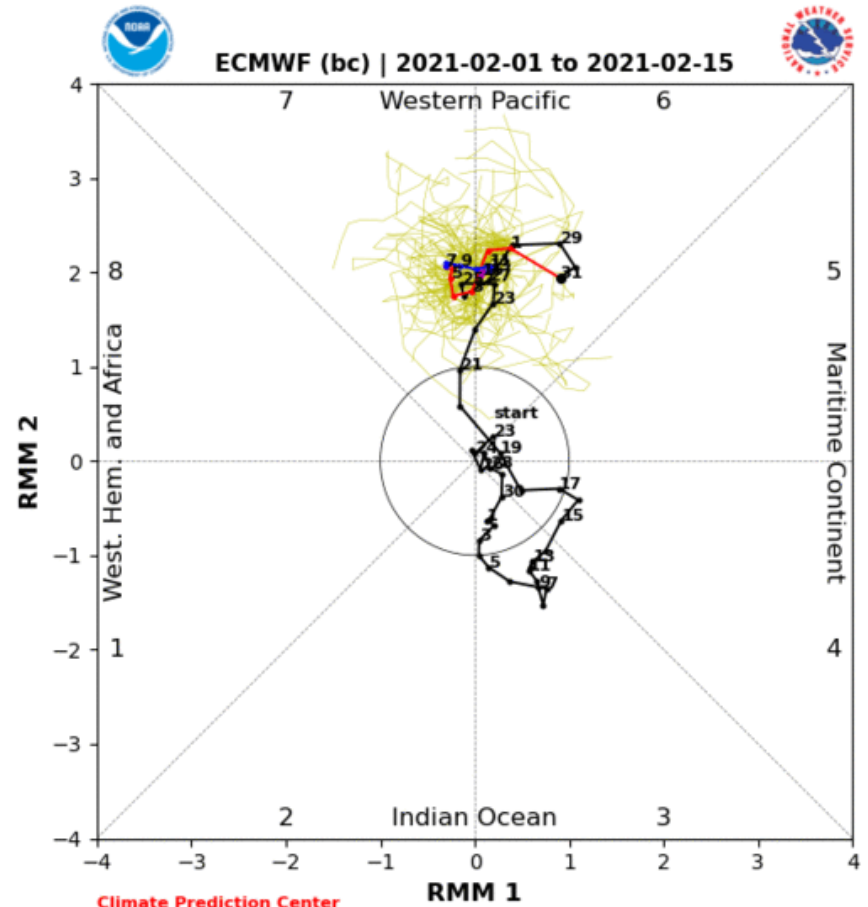
For more information on the RMM index and how to interpret its forecast please see:  
[https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC\\_MJOinformation.pdf](https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf)



# MJO Index: Forecast Evolution



**GEFS Forecast**



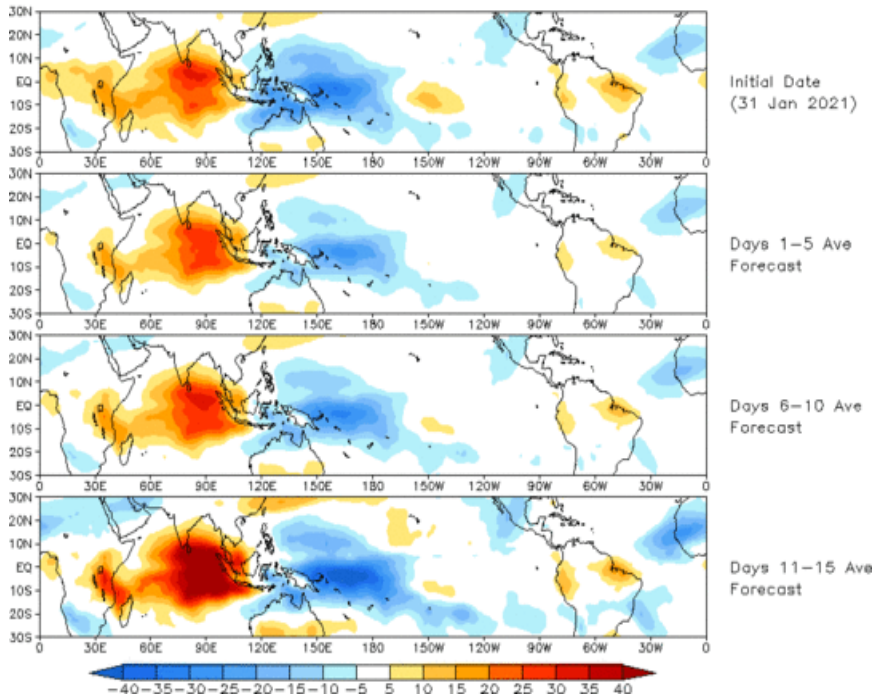
**ECMWF Forecast**

- Dynamical models continue to favor the eastward propagation of intraseasonal signal over the western Pacific into phase 7 during week-1, with increased differences in the ensemble means among the models during week-2.
- Ensemble spread has increased since last week, with more members falling within the unit circle by mid-February.

# MJO: GEFS Forecast Evolution

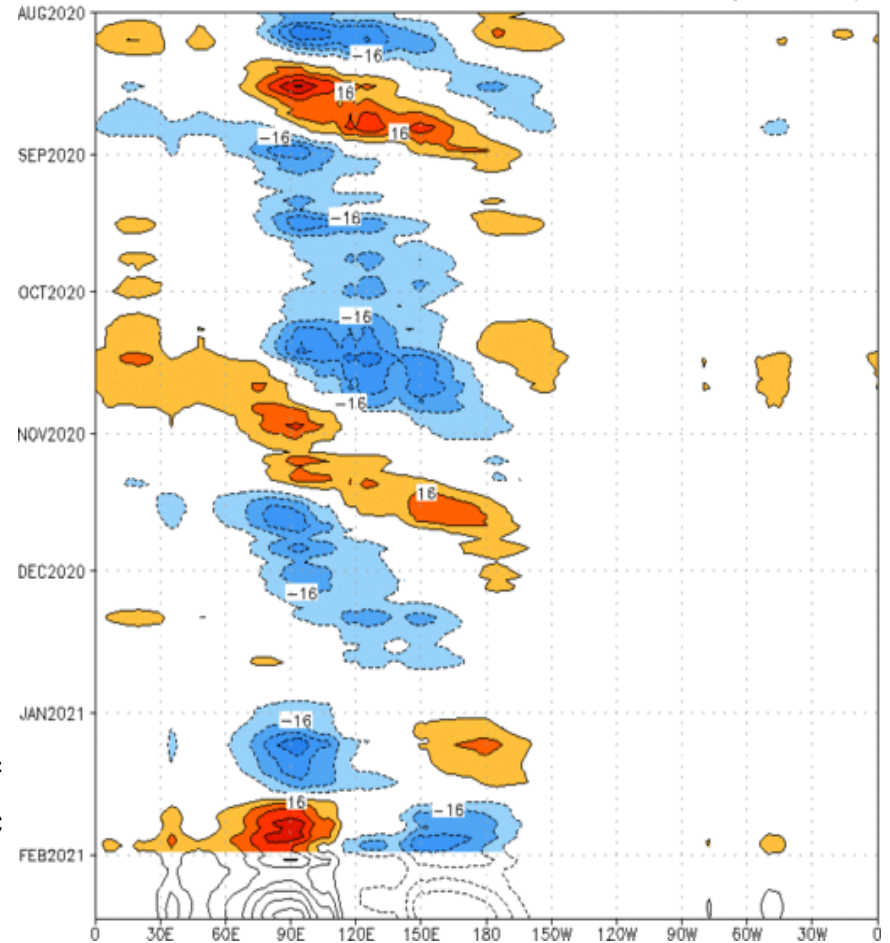
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast  
Initial date: 31 Jan 2021  
OLR



- The GEFS predicts a relatively stationary pattern of enhanced (suppressed) convection over the Pacific (Indian Ocean) during the next two weeks.

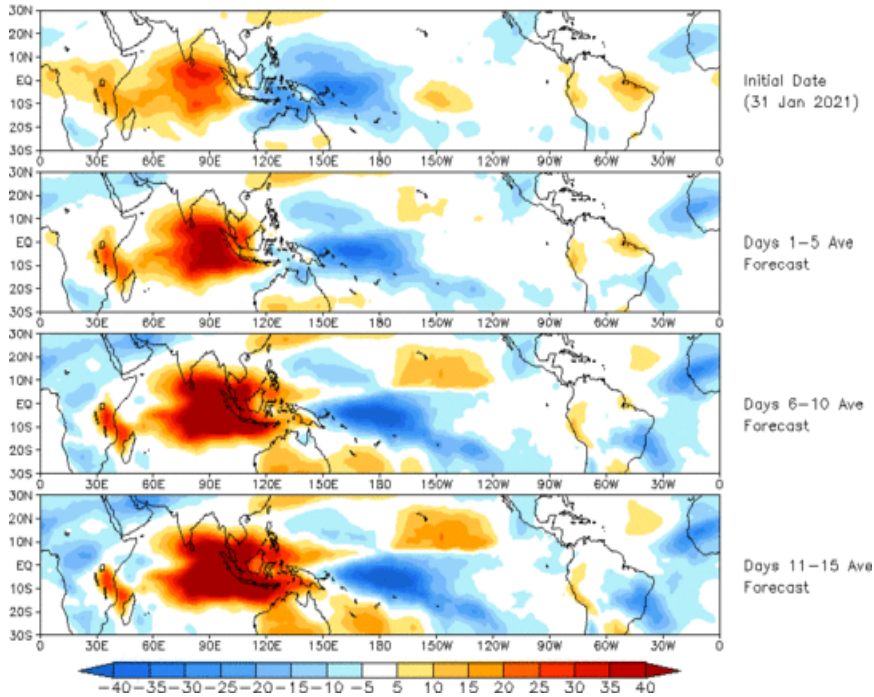
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2  
OLR [ $7.5^{\circ}\text{S}, 7.5^{\circ}\text{N}$ ] (cont:  $4\text{Wm}^{-2}$ ) Period: 01-Aug-2020 to 31-Jan-2021  
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



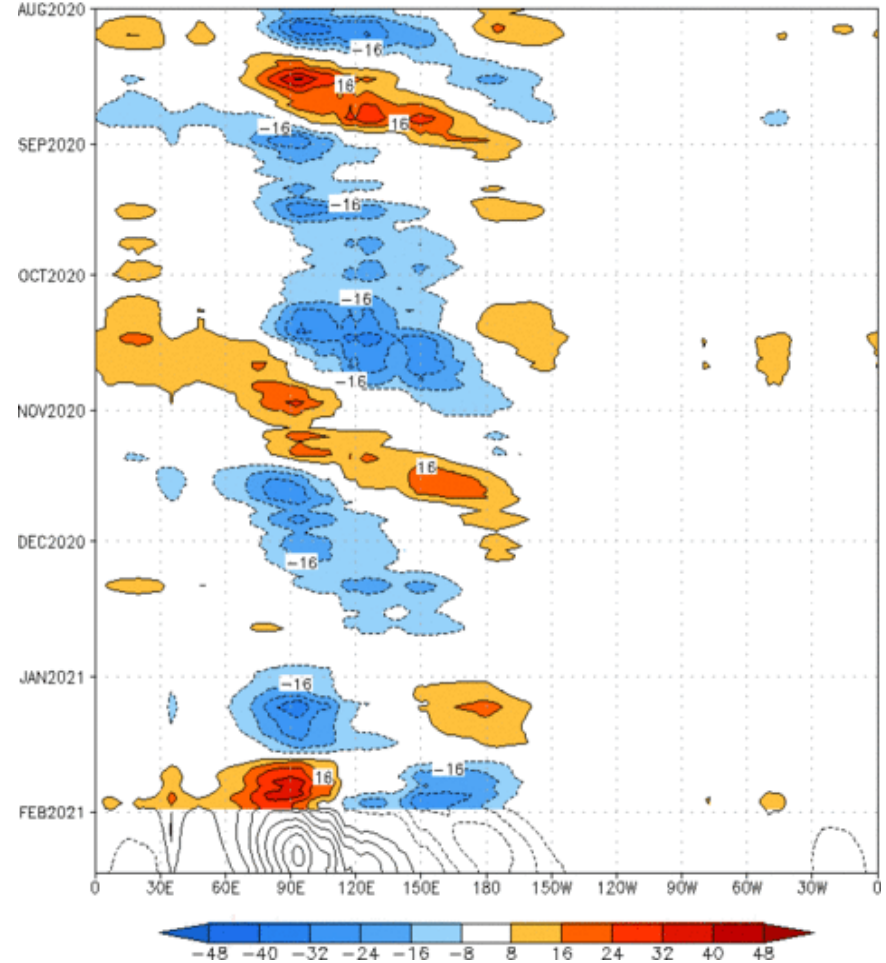
# MJO: Constructed Analog Forecast Evolution

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 (31 Jan 2021)



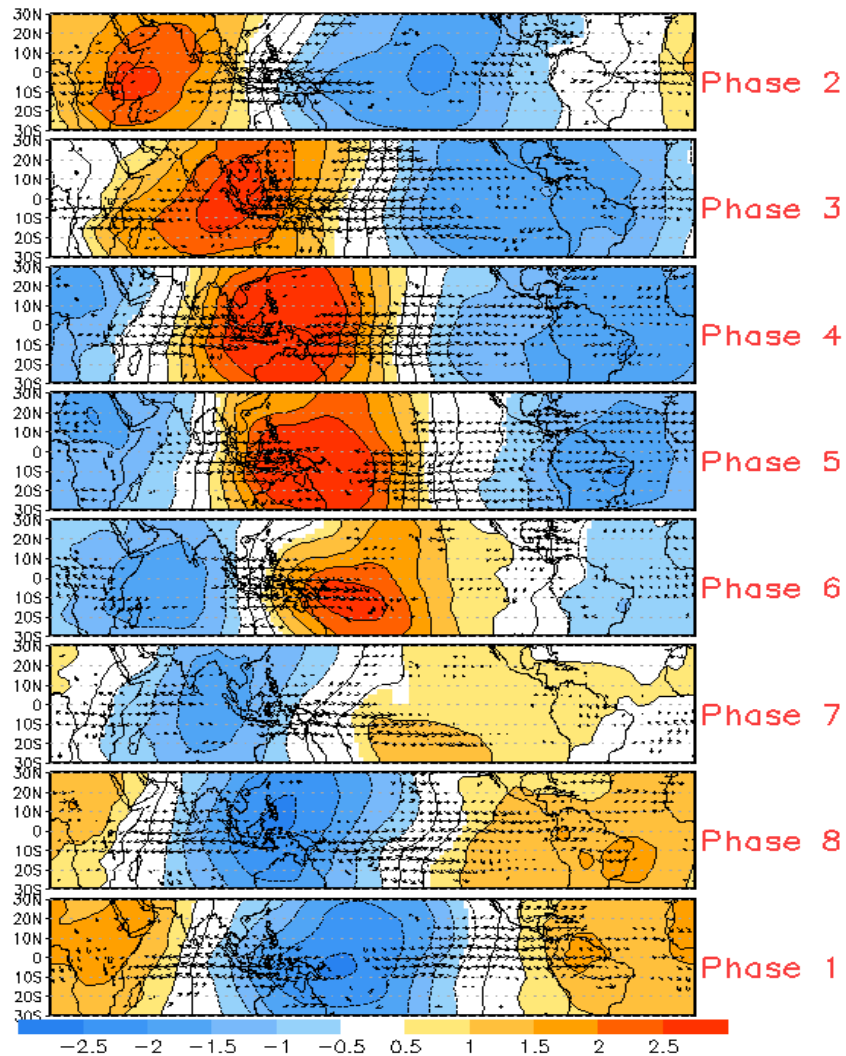
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm<sup>-2</sup>) Period:01-Aug-2020 to 31-Jan-2021  
The unfilled contours are CA forecast reconstructed anomaly for 15 days



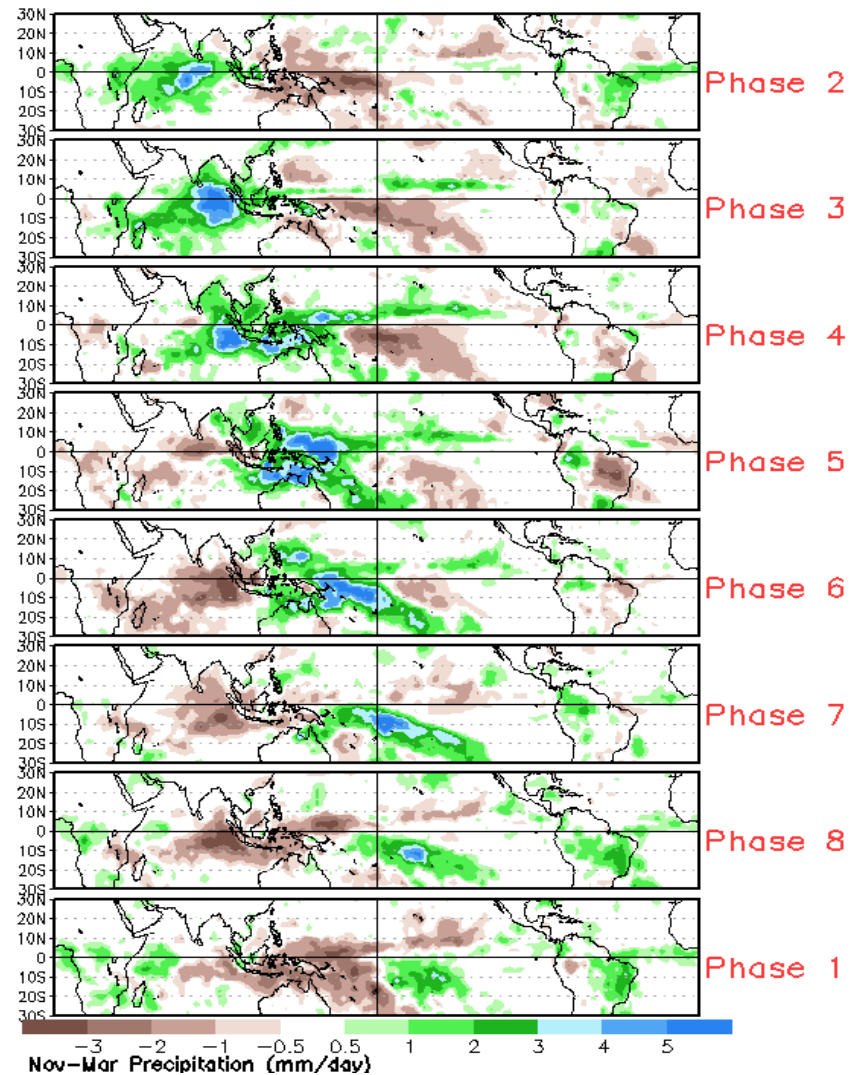
- The constructed analog continues to suggest more of an eastward propagating MJO event compared to the GEFS, with enhanced convection returning over the western Hemisphere and Africa later in February.

# MJO: Tropical Composite Maps by RMM Phase

## 850-hPa Velocity Potential and Wind Anomalies



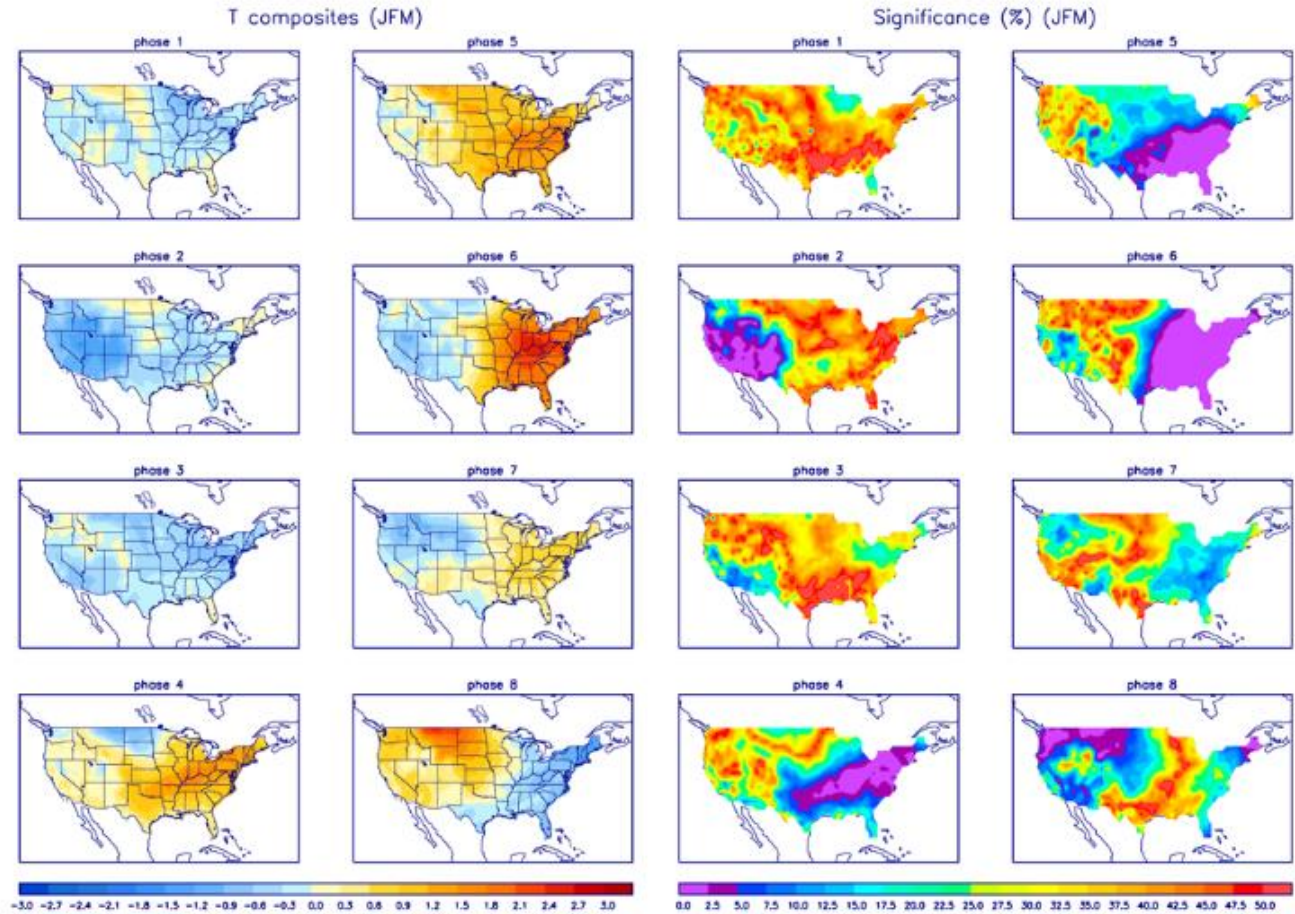
## Precipitation Anomalies



# 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.

