

# **Madden-Julian Oscillation:**

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



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

# Overview

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- The RMM index weakened over the past week with little evidence of eastward propagation, indicating incoherent intraseasonal activity.
- Recent OLR observations show three zonally narrow regions of enhanced convection: over Africa and the western Indian Ocean, over the Maritime Continent, and over the SPCZ region.
- Dynamical model MJO index forecasts show a westward shift in the index, with a potential for renewed eastward propagation across the Pacific during Week-2. The amplitude of this signal is highly uncertain.
- Based on recent observations and the model forecasts, the MJO is anticipated to remain weak during the next two weeks. La Niña conditions are favored to be the dominant driver of global tropical convective anomalies.

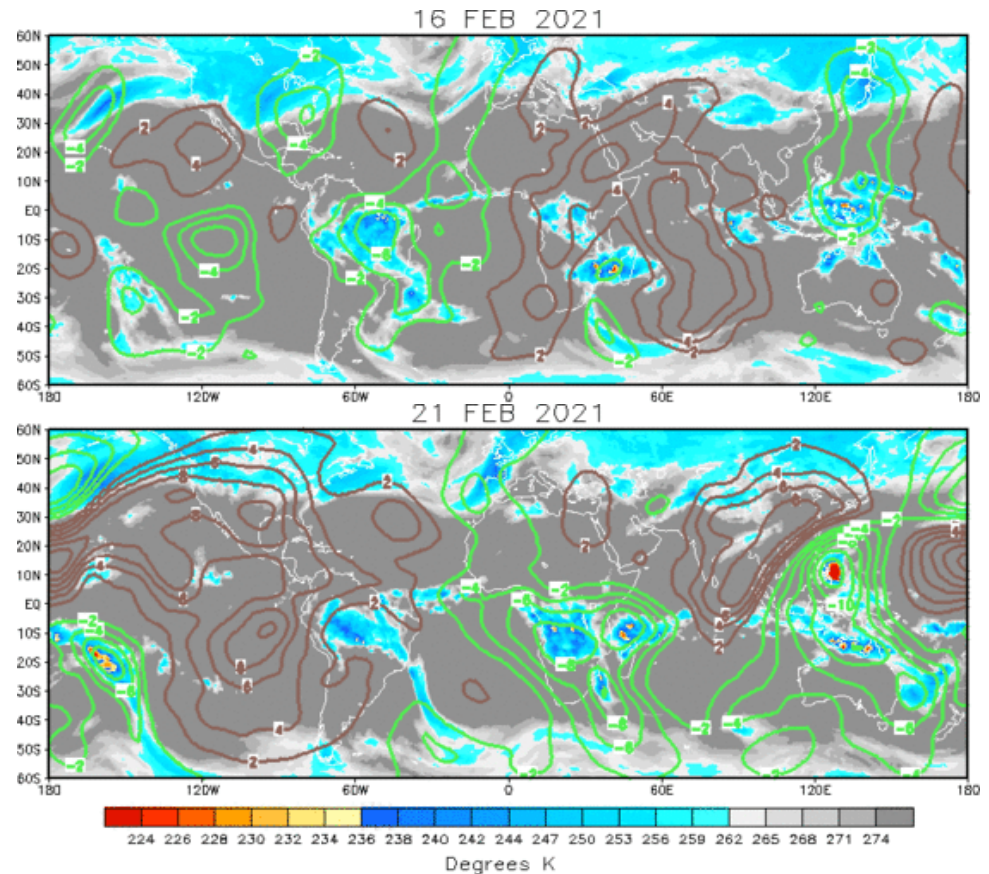
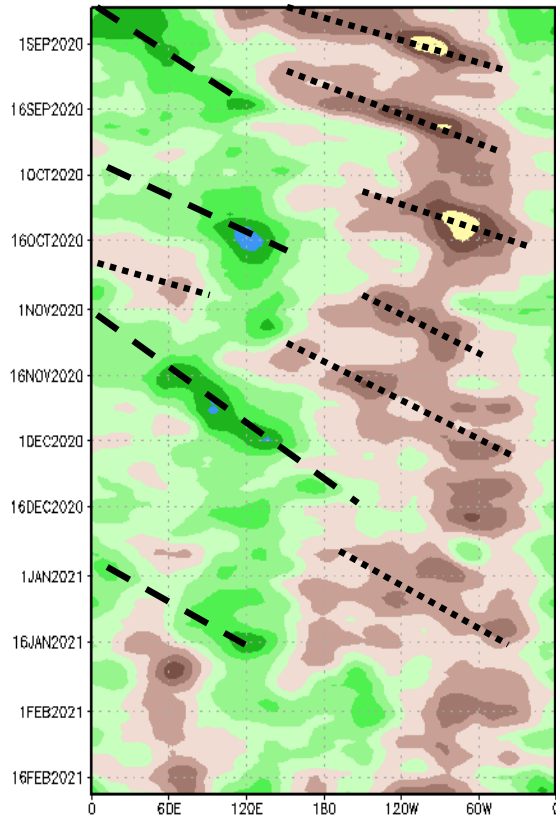
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:  
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

# 200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

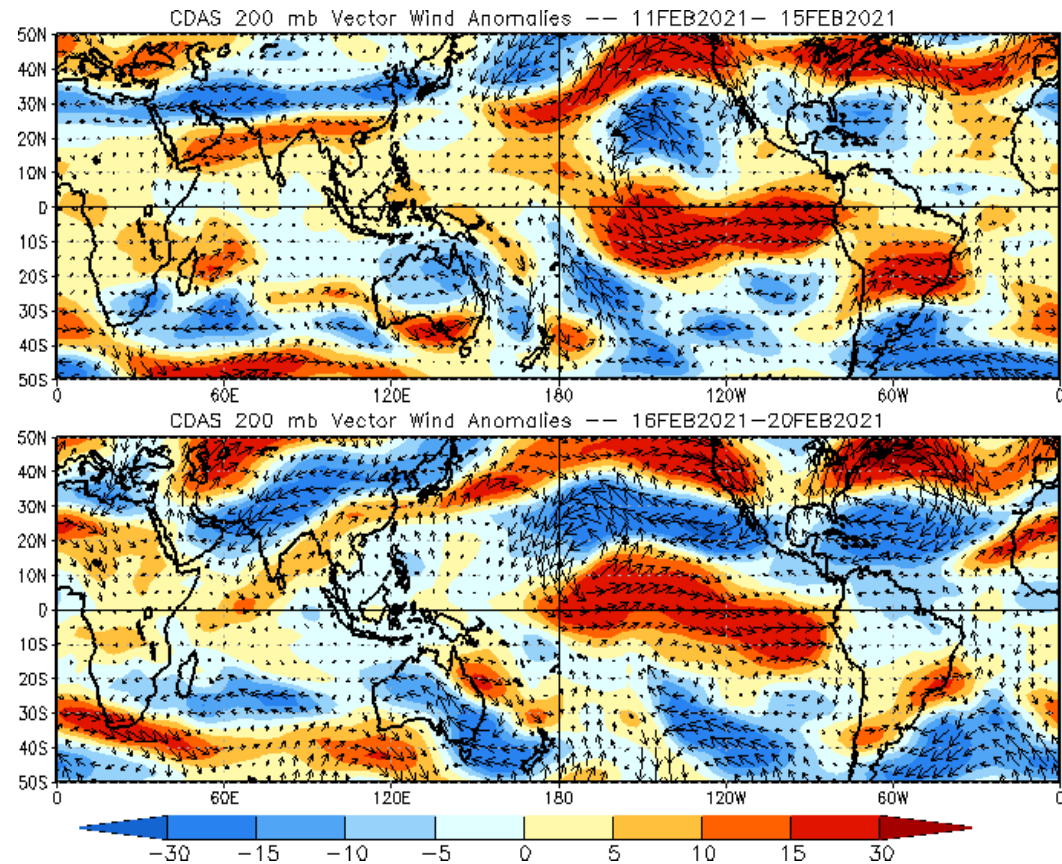
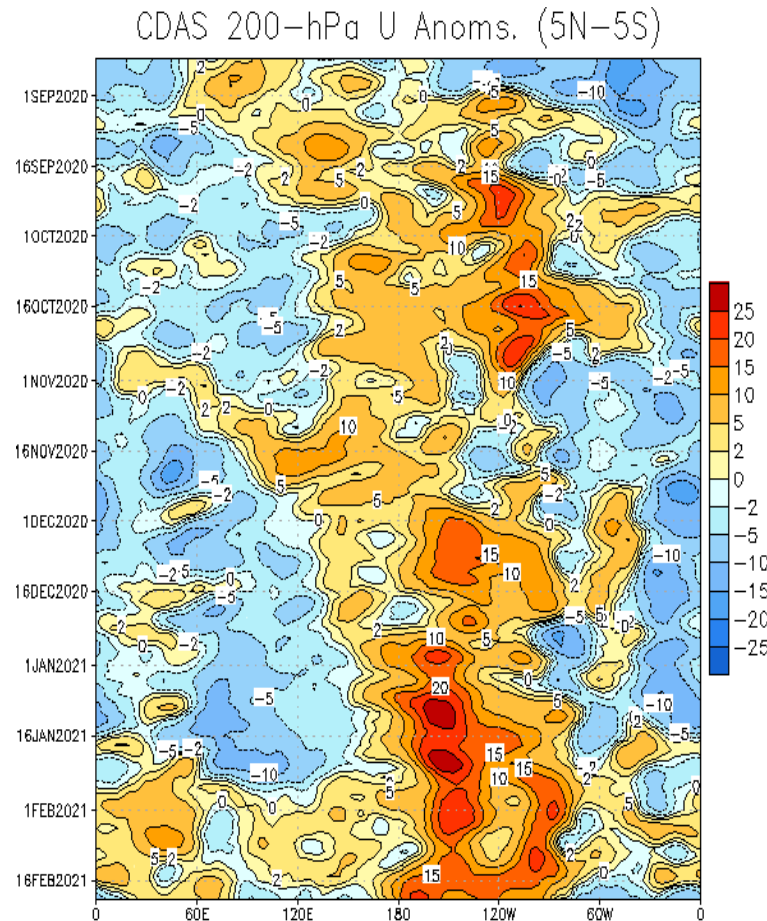
200-hPa Velocity Potential Anomaly: 5N-5S  
5-day Running Mean



- Since early February, westward propagation of the anomalous divergence signal was evident, partly due to a response to Tropical Storm Dujan.
- There are currently three discrete regions of enhanced convection: Africa and the western Indian Ocean, the Maritime Continent, and the SPCZ region.

# 200-hPa Wind Anomalies

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

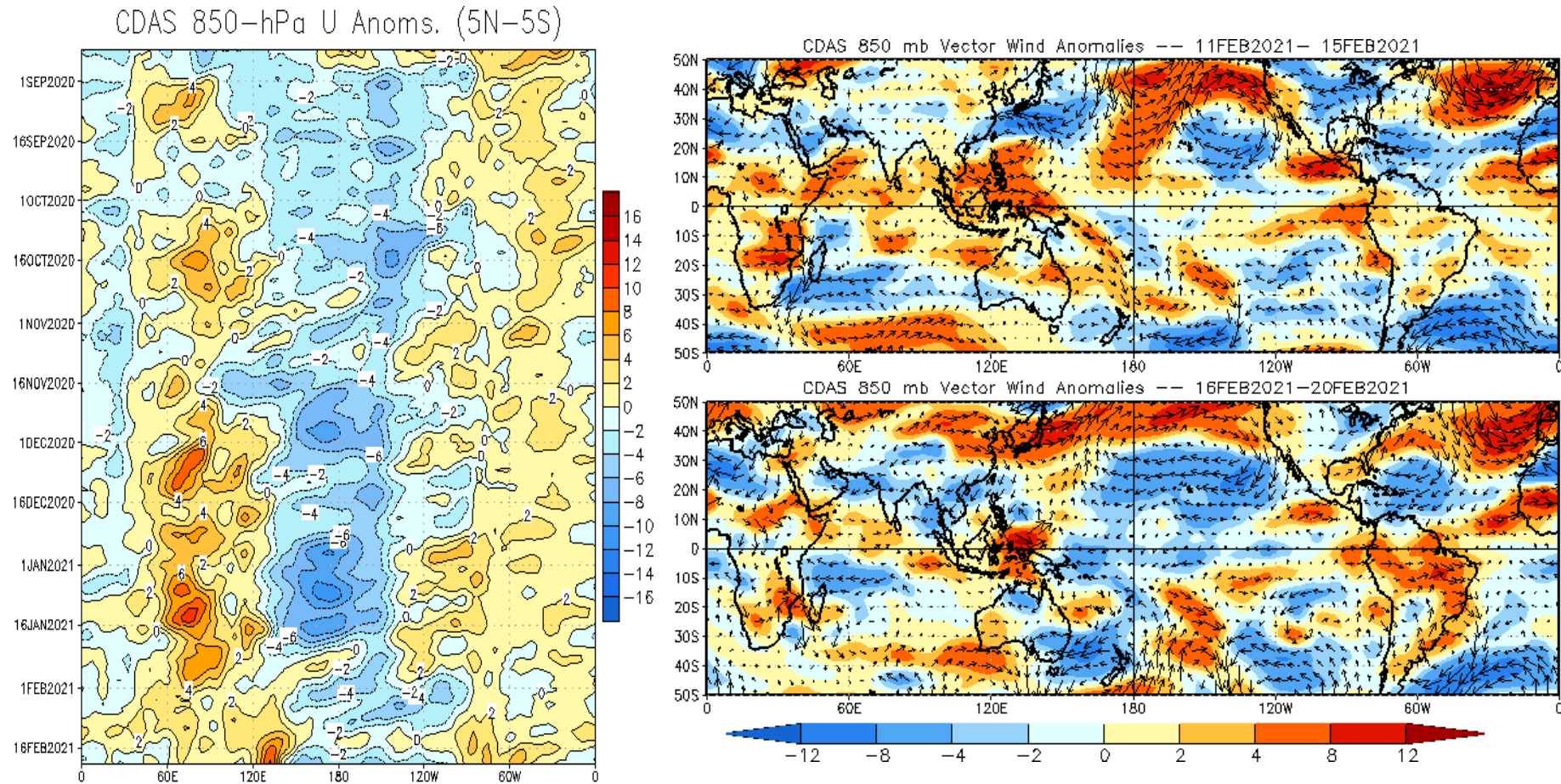


- Robust anticyclonic circulation just east of the Date Line over the North Pacific continues to transport mass towards the Equator, helping to generate strong westerly anomalies. This pattern is consistent with a La Niña response.
- There appears to be a weak Northern Hemisphere midlatitude response to enhanced convection over the SPCZ region.



# 850-hPa Wind Anomalies

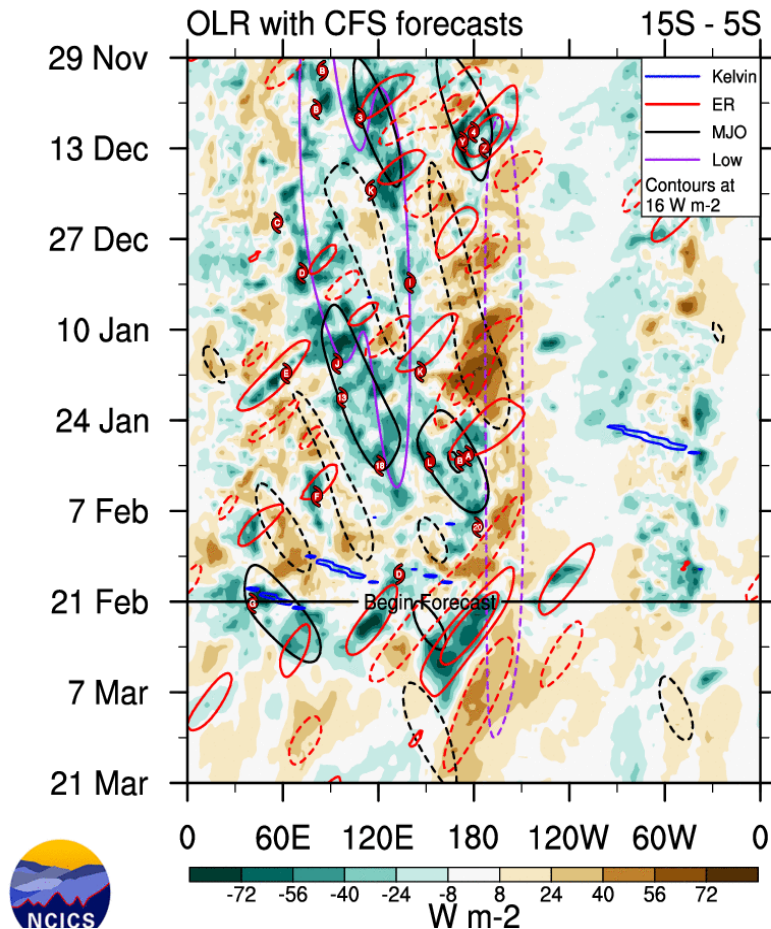
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



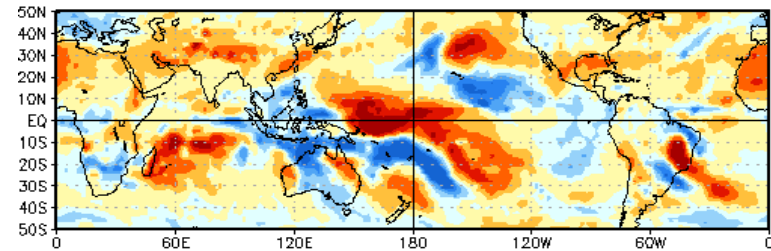
- Enhanced trade winds associated with La Niña activity returned to much of the Pacific basin.
- The envelope of westerlies over the Maritime Continent is zonally narrow, but exhibits characteristics of a westerly wind burst associated with the equatorial Rossby wave, with twin off-Equator cyclonic circulations producing strong westerly winds along the Equator.

# Outgoing Longwave Radiation (OLR) Anomalies

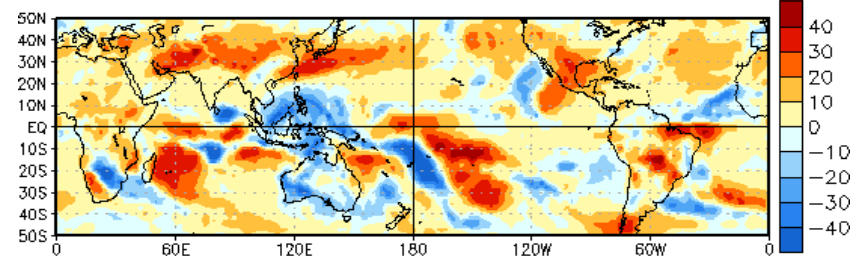
**Blue shades: Anomalous convection (wetness).** **Red shades: Anomalous subsidence (dryness).**



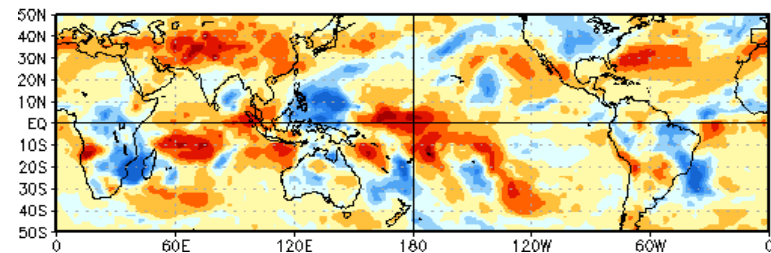
OLR Anomalies  
21 JAN 2021 to 30 JAN 2021



31 JAN 2021 to 9 FEB 2021

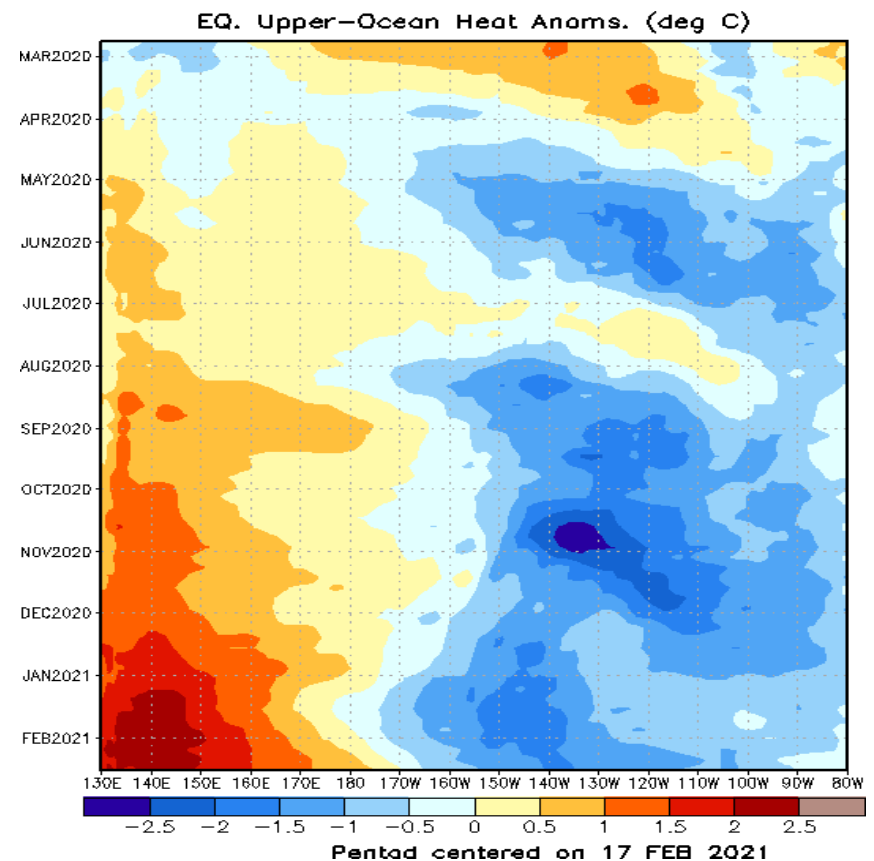
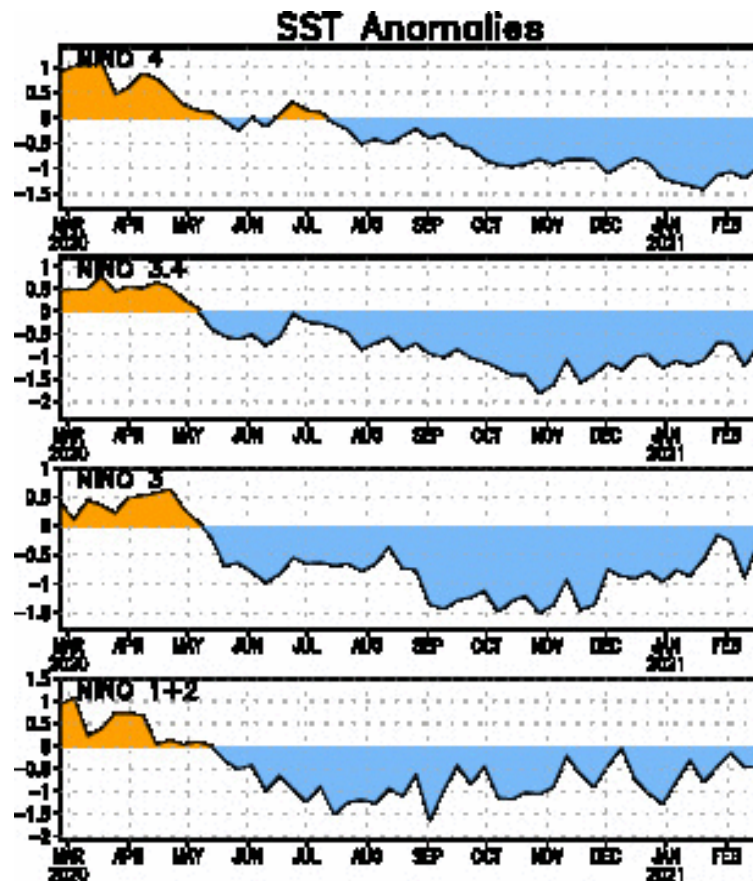


10 FEB 2021 to 19 FEB 2021



- Since early February, Rossby wave activity appears to be the dominant mode of organized convection over the West Pacific and Maritime Continent.
- Enhanced convection over Africa and the western Indian Ocean show some projection on the MJO filtered band, but convective anomalies are zonally narrow.

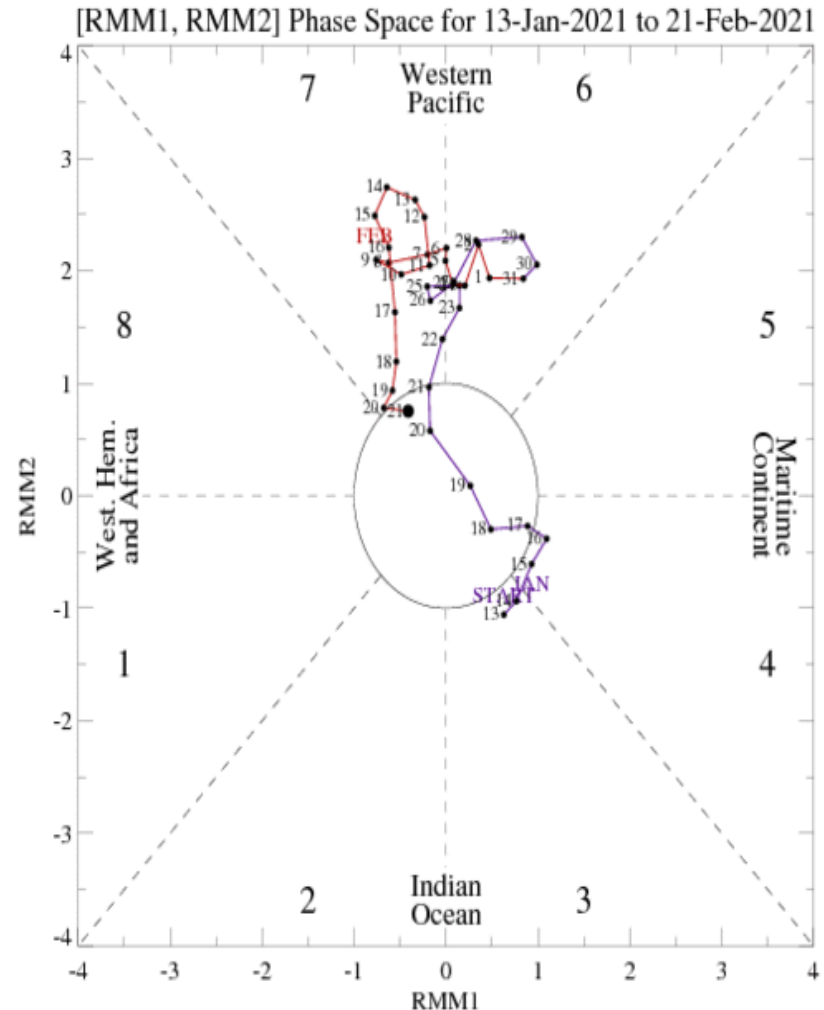
# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- 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.
- The strong Rossby wave that has moved from the Pacific to the Maritime Continent during February may have helped to initiate a downwelling Kelvin wave, which is allowing warm water to push east of the Date Line.

# MJO Index: Recent Evolution

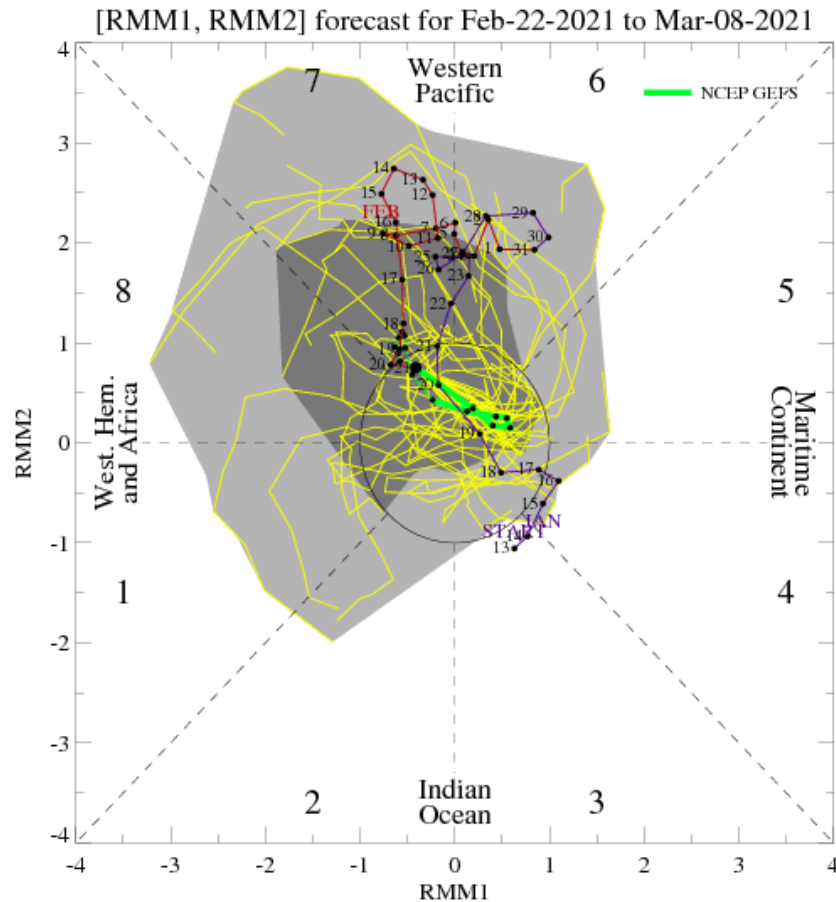
- The RMM index weakened over the past week as other modes, including enhanced convection over the western Indian Ocean and Africa, increased monsoonal convection over the Maritime Continent, and Tropical Storm Dujan interfered with the signal.
- No eastward propagation of the intraseasonal signal is evident in the RMM index.



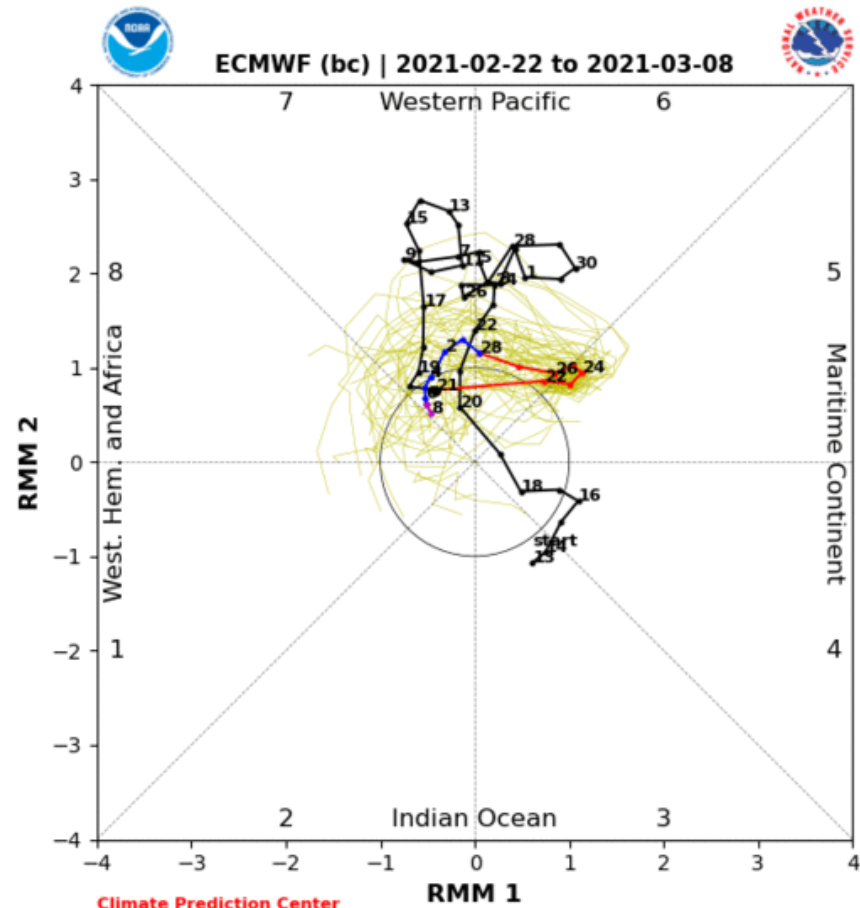
For more information on the RMM index and how to interpret its forecast please see:  
[https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC\\_MJOinformation.pdf](https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf)



## MJO Index: Forecast Evolution



## GEFS Forecast



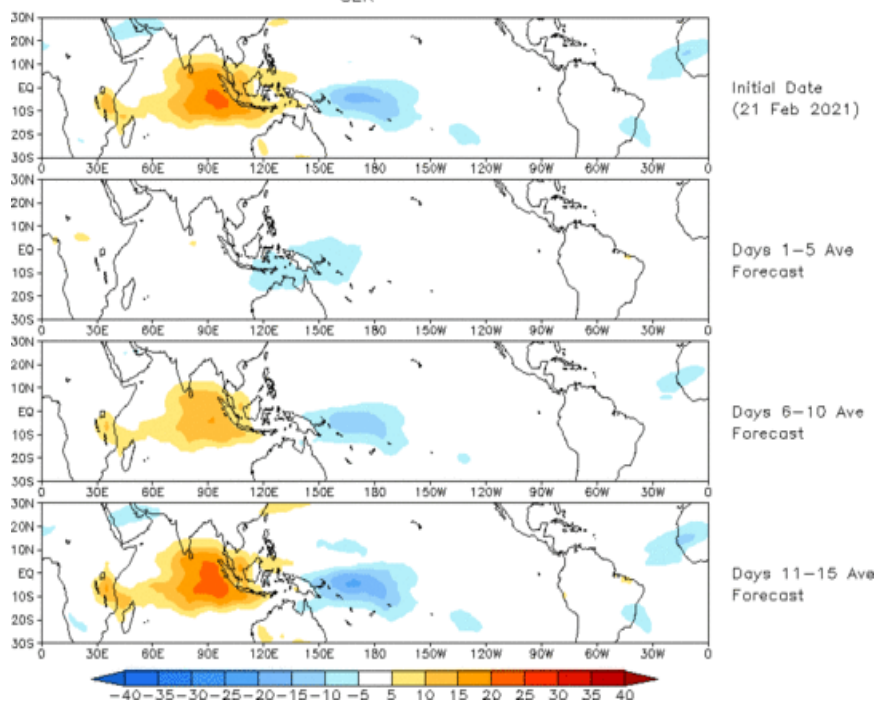
## ECMWF Forecast

- The GEFS and ECMWF both depict a weak signal over the next week, with the enhanced convective signal shifting westward towards the Date Line.
- During Week-2, both model systems show some eastward propagation of a signal across the Pacific towards the Western Hemisphere, with considerable uncertainty regarding the amplitude of this signal.

# MJO: GEFS Forecast Evolution

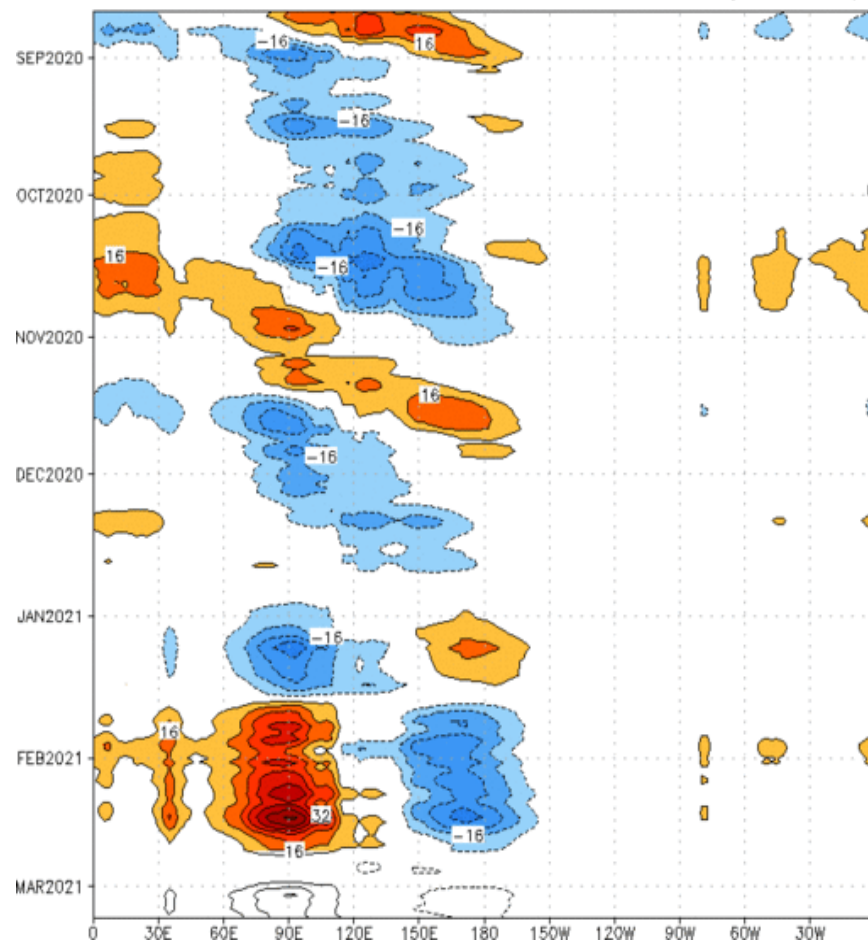
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast  
Initial date: 21 Feb 2021  
OLR



- The GEFS predicts a weakening of the convective anomalies as suggested by the RMM-index projection during Week-1, with a resurgence of convective anomalies during Week-2 in roughly the same positions as the initial conditions.

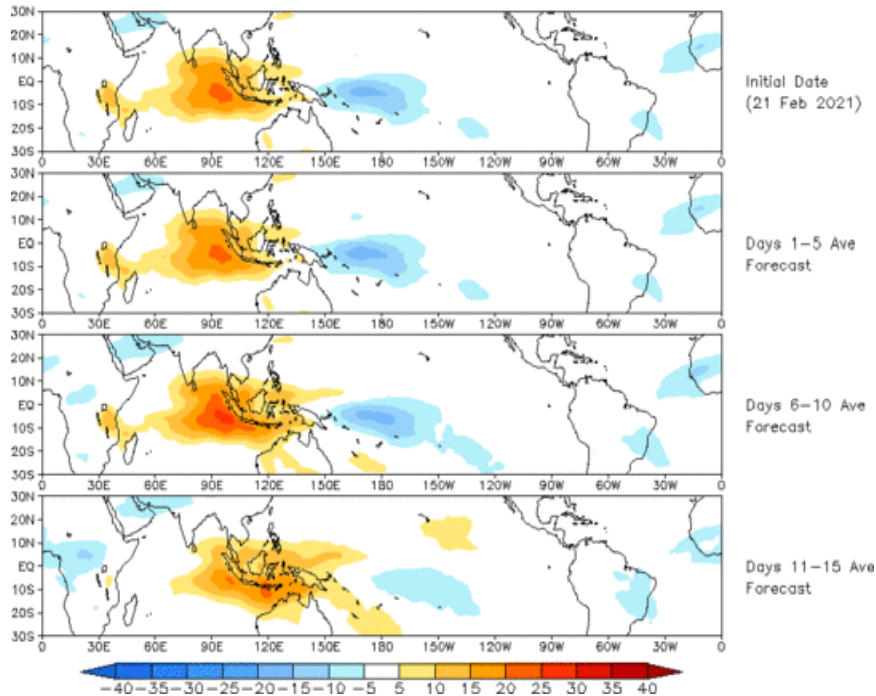
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2  
OLR [ $7.5^{\circ}\text{S}, 7.5^{\circ}\text{N}$ ] ( $\text{cont: } 4\text{Wm}^{-2}$ ) Period: 22-Aug-2020 to 21-Feb-2021  
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



# MJO: Constructed Analog Forecast Evolution

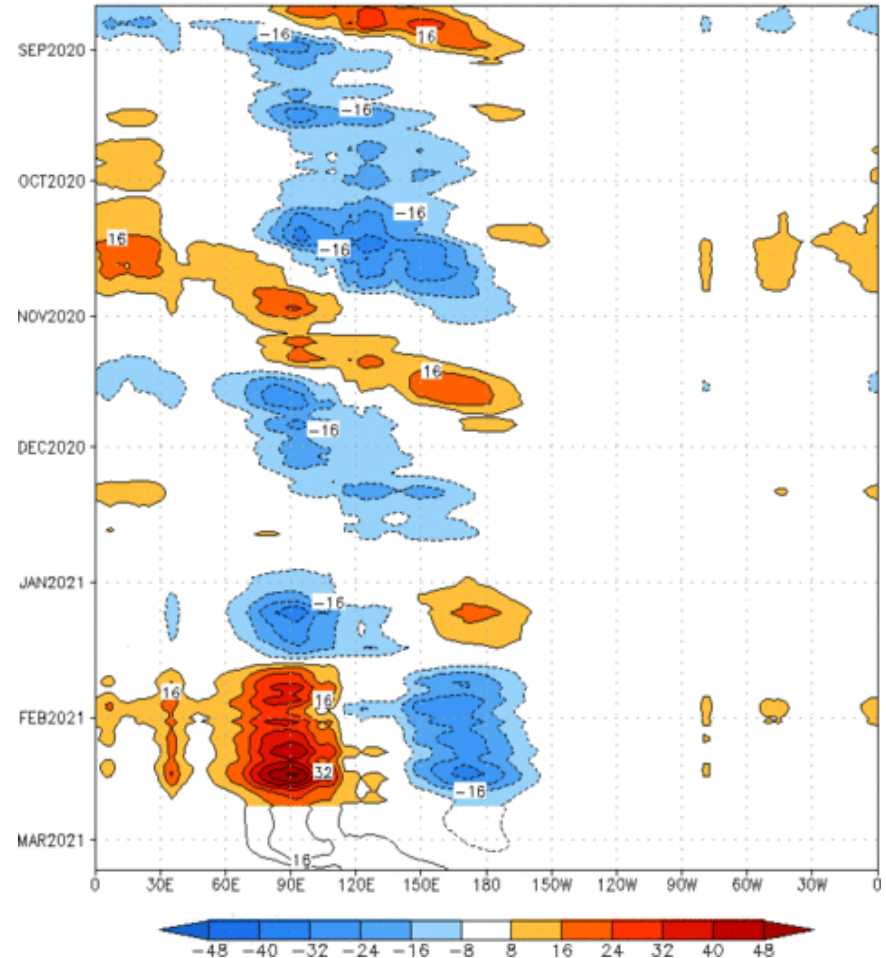
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (21 Feb 2021)



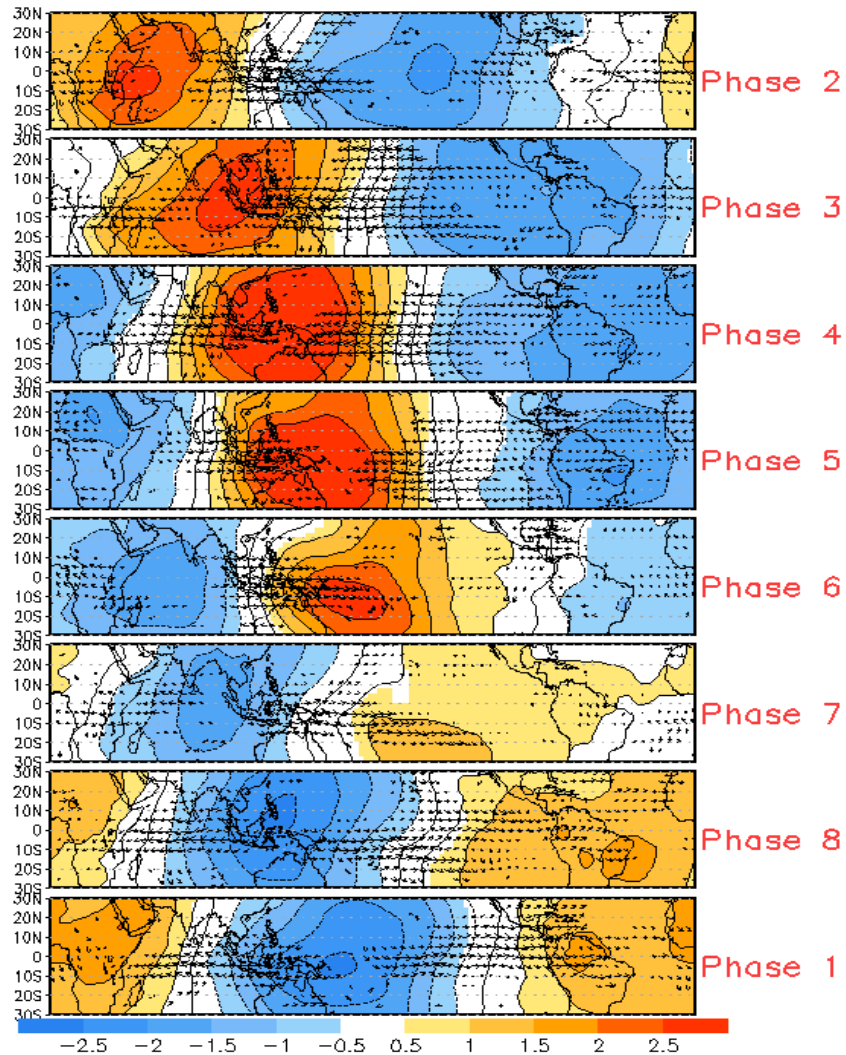
- The constructed analog predicts a slowly eastward propagating OLR pattern that weakens slightly over the next two weeks.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm<sup>-2</sup>) Period:22-Aug-2020 to 21-Feb-2021  
The unfilled contours are CA forecast reconstructed anomaly for 15 days

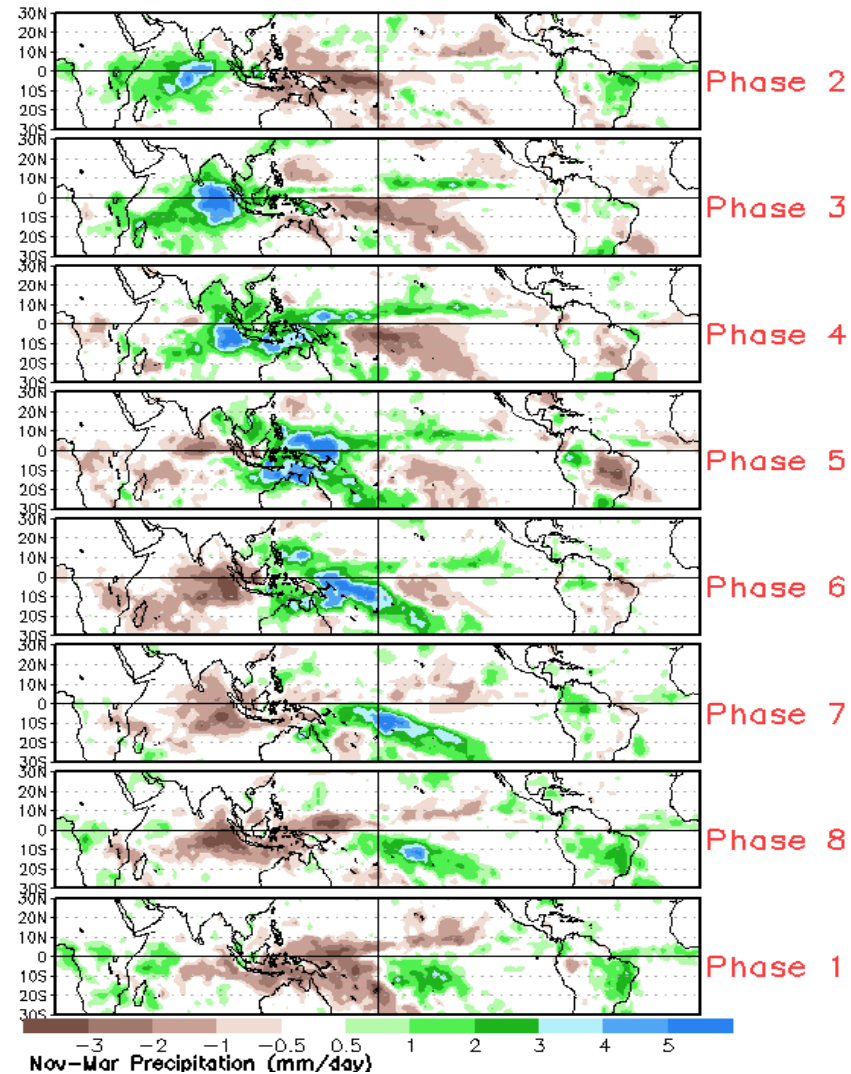


# MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and  
Wind Anomalies



Precipitation Anomalies

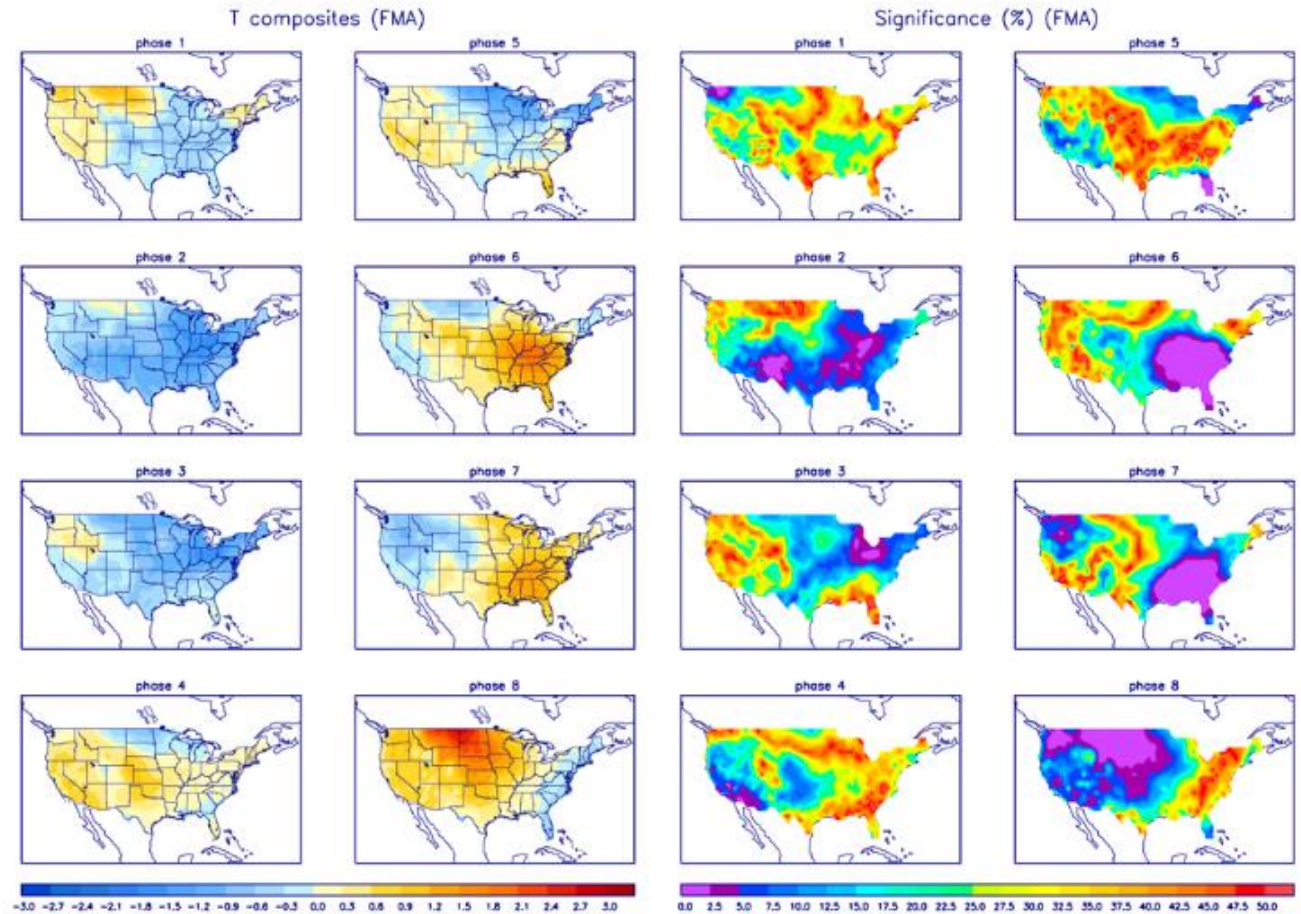




# MJO: CONUS Composite Maps by RMM Phase - Temperature

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.

