

# **Madden-Julian Oscillation:**

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



**Update prepared by the Climate Prediction Center**  
**Climate Prediction Center / NCEP**  
**9 August 2021**

# Overview

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- The RMM index and CPC velocity potential index both depict an active MJO with the enhanced phase now over the Western Hemisphere.
- Rossby wave activity is becoming increasingly apparent in the wind and OLR fields, and will interfere with the MJO over the next week or so.
- Dynamical model MJO index forecasts favor increasing amplitude and decreased phase speed over the Indian Ocean during Week-1, followed by faster propagation to the Maritime Continent during Week-2.
- The MJO and Rossby wave activity favors increased tropical cyclone activity across the Atlantic basin, and a break in Monsoon convection across South and Southeast Asia.

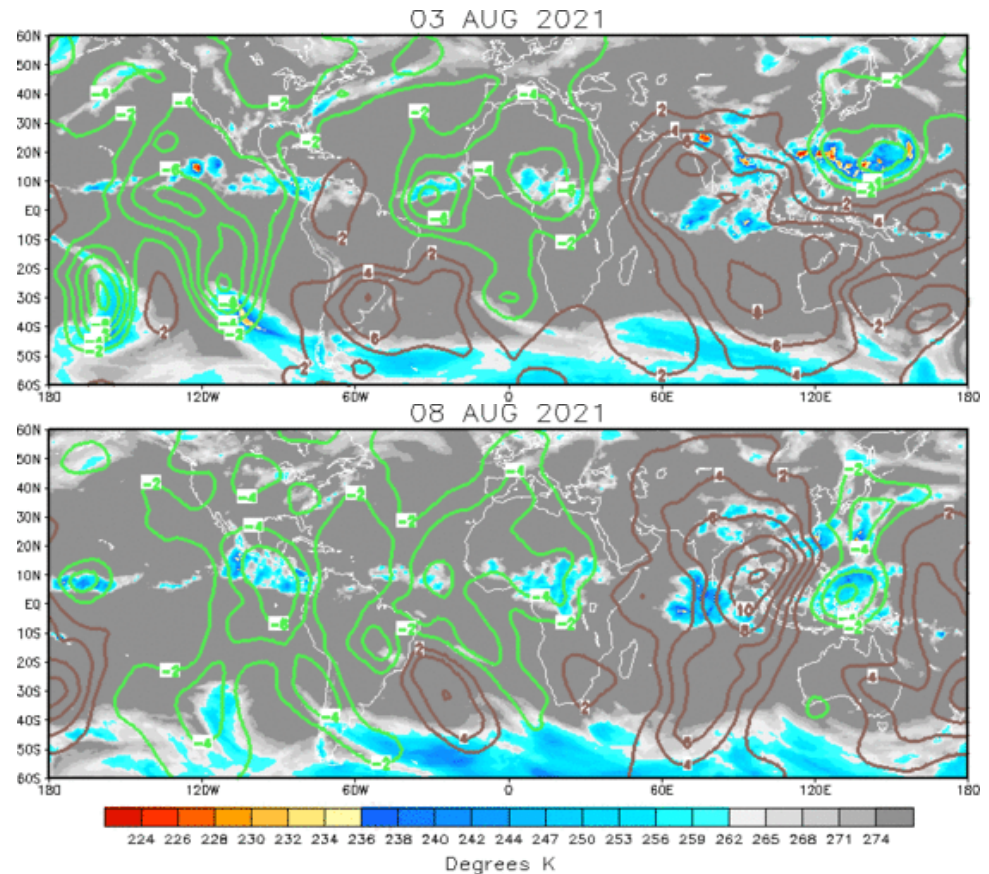
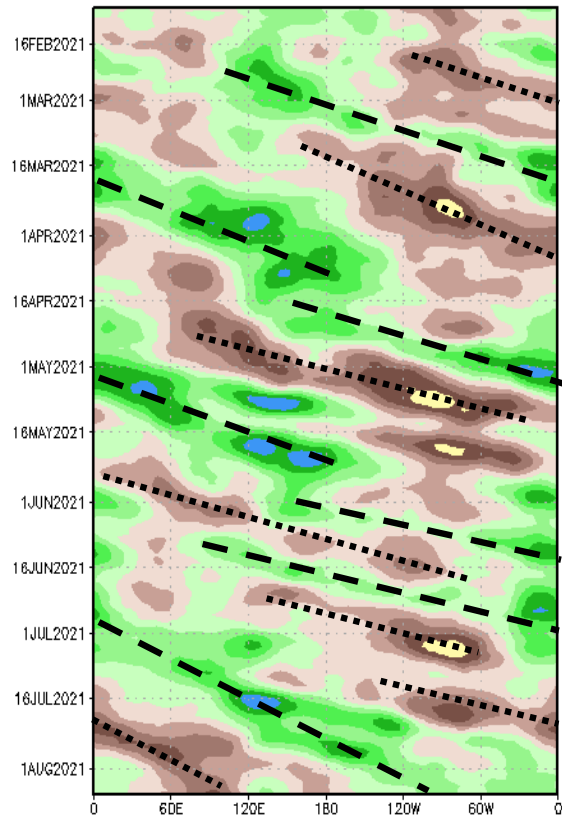
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:  
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

# 200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

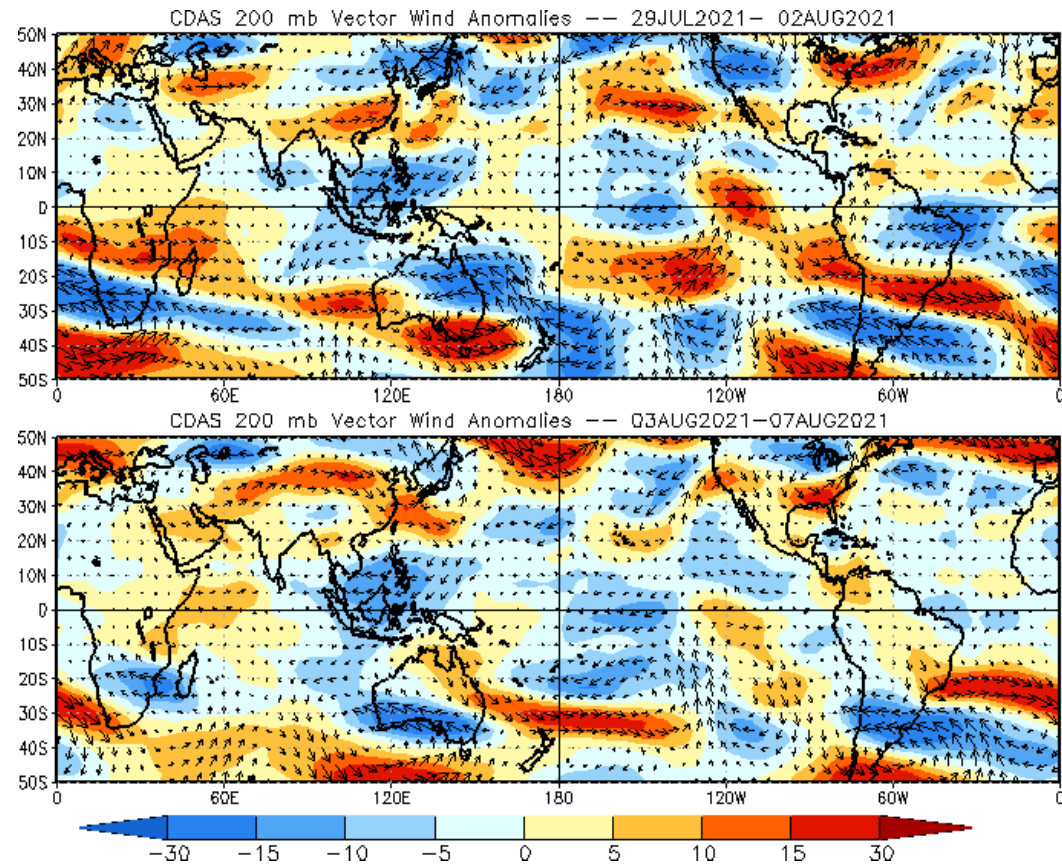
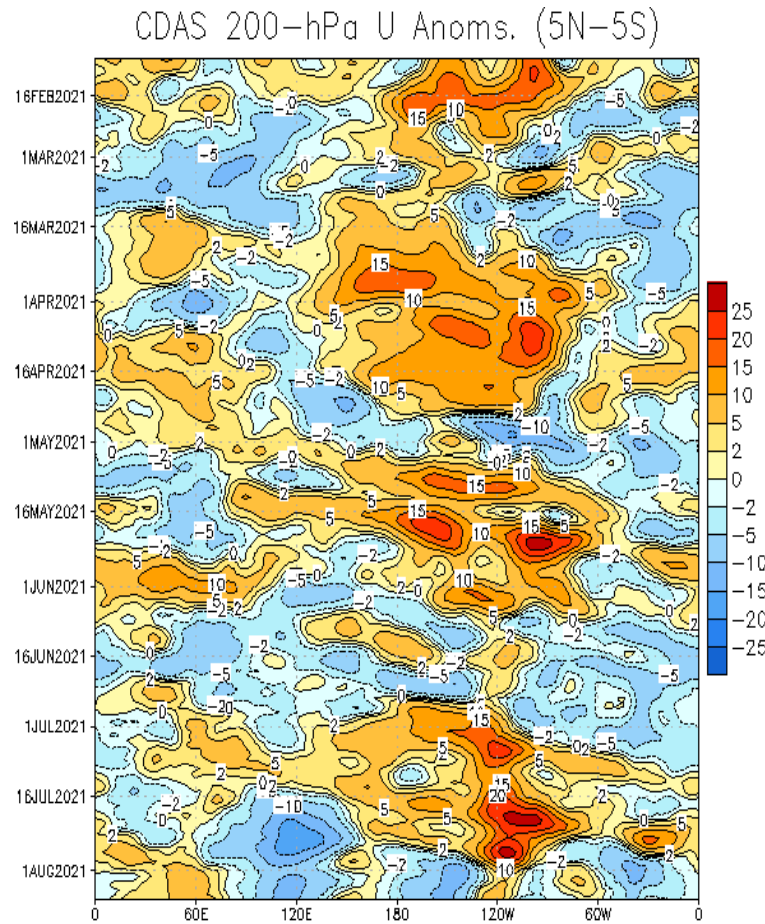
200-hPa Velocity Potential Anomaly: 5N-5S  
5-day Running Mean



- A robust intraseasonal signal remains apparent in the upper-level velocity potential field, with the enhanced convective phase now over the Western Hemisphere.
- A Kelvin wave is currently crossing the Maritime Continent and destructively interfering with the MJO suppressed phase.

# 200-hPa Wind Anomalies

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

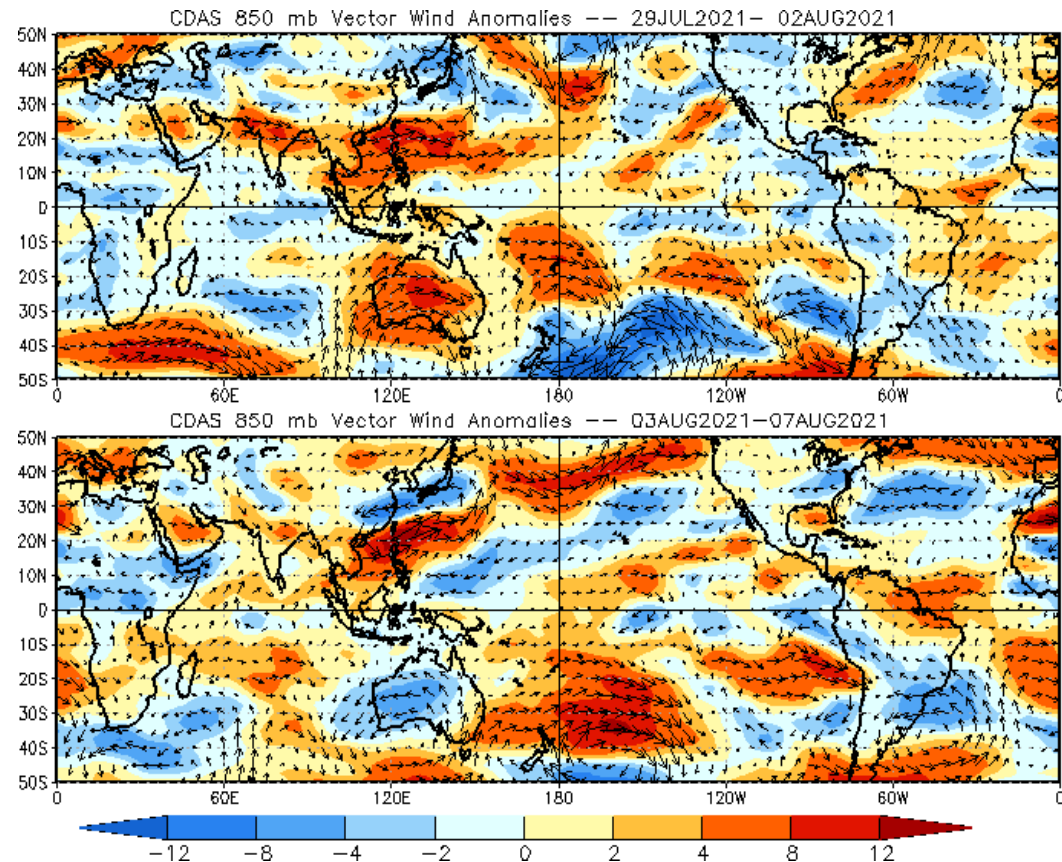
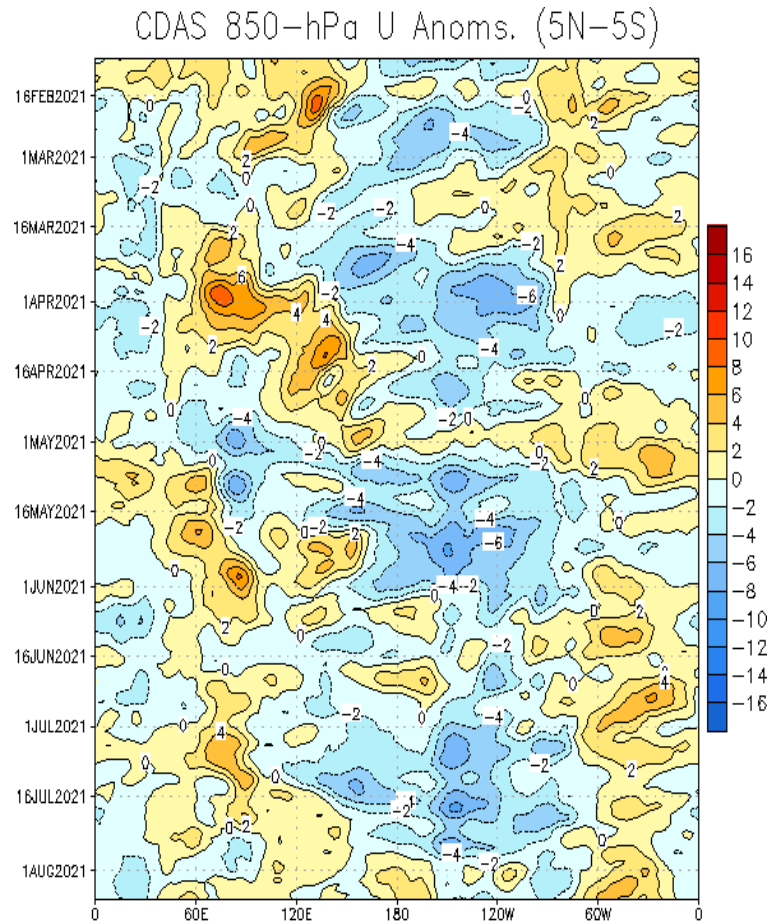


- The upper-level wind pattern has become more complex, with midlatitude wavebreaking onto the Equator generating Rossby wave activity over the east-central Pacific and the Maritime Continent.
- Upper-level westerly anomalies increased over the western Indian Ocean, which is consistent with MJO activity.



# 850-hPa Wind Anomalies

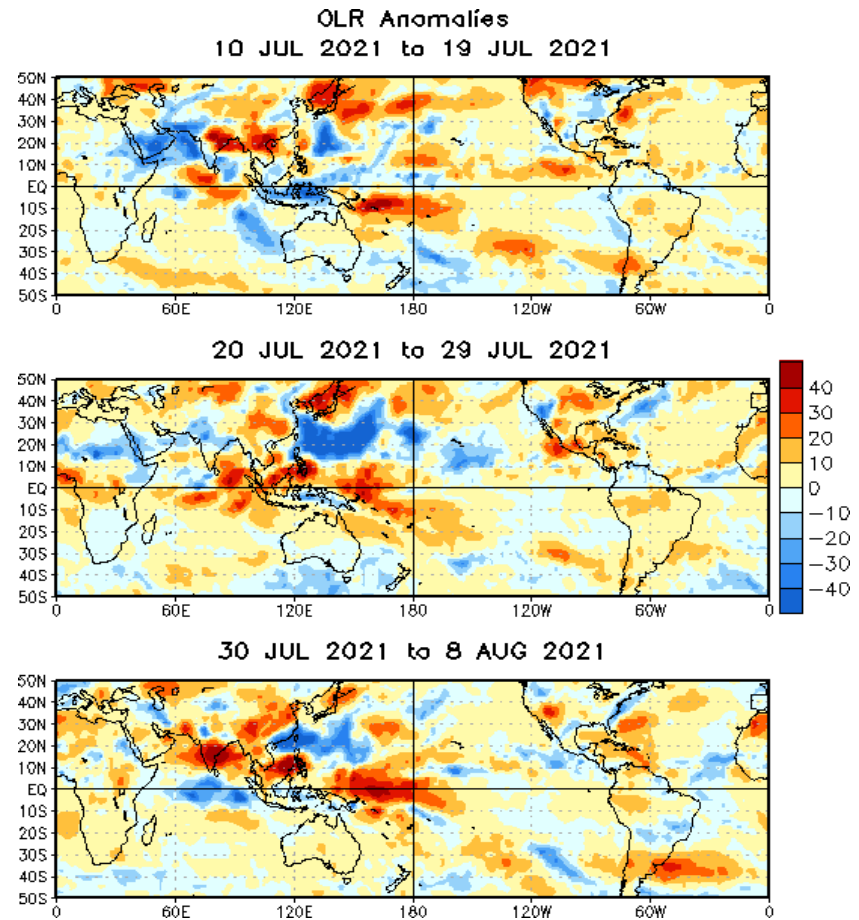
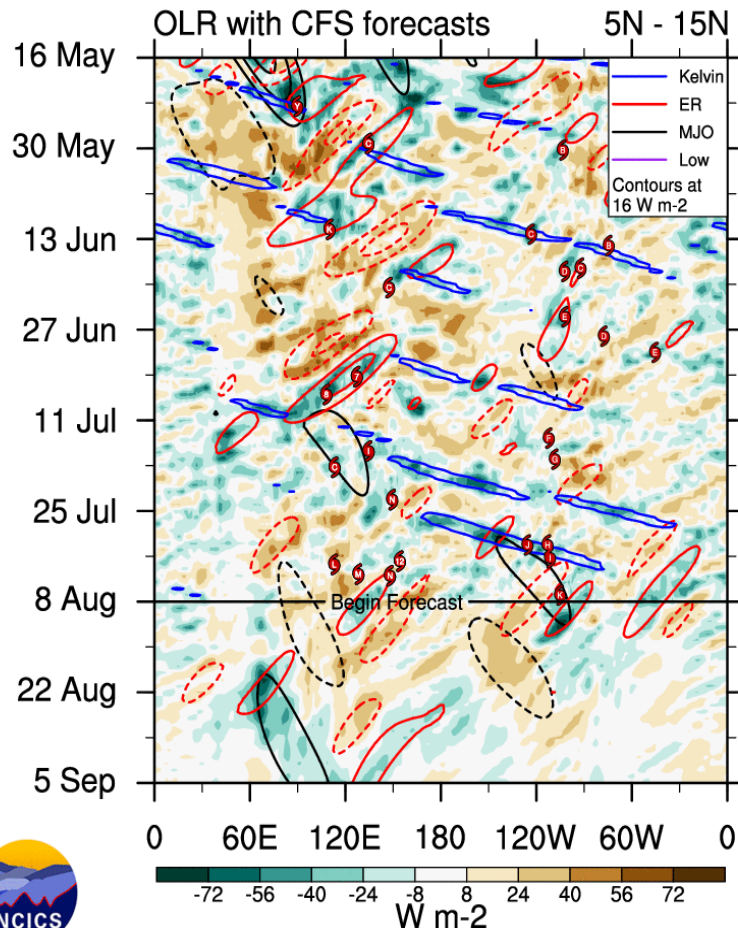
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Low-level westerly anomalies propagated east of the Date Line, with weakening trades across the eastern Pacific indicative of the intraseasonal signal destructively interfering with the low frequency base state.
- Rossby wave activity over the tropical Atlantic may be reflective of increased easterly wave activity that may promote tropical cyclogenesis.

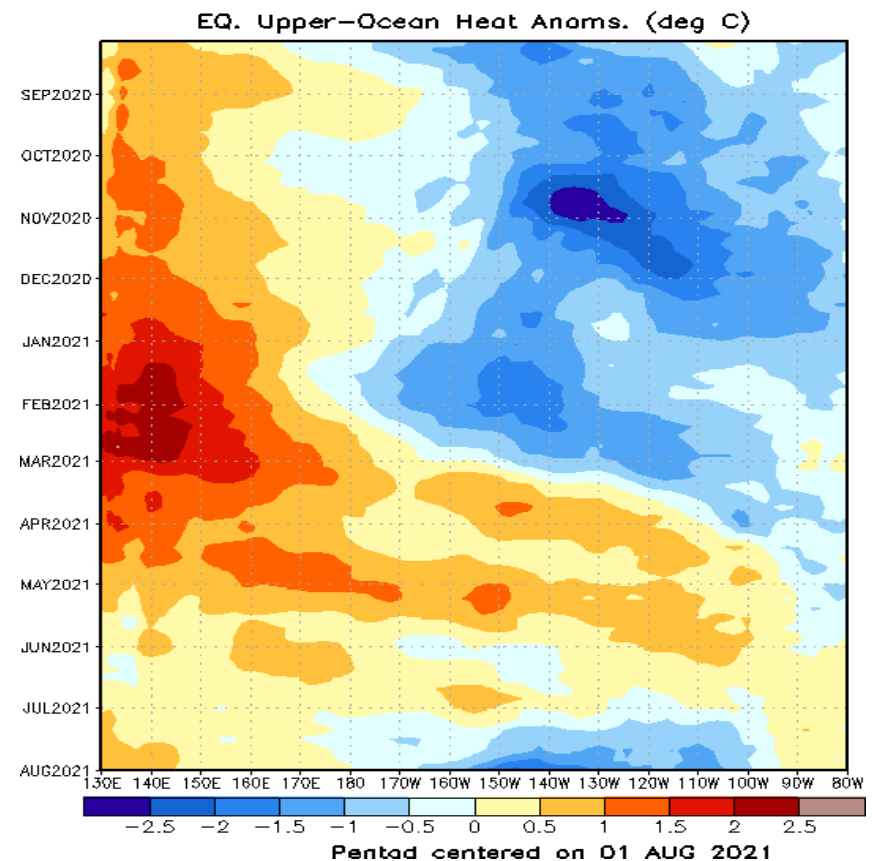
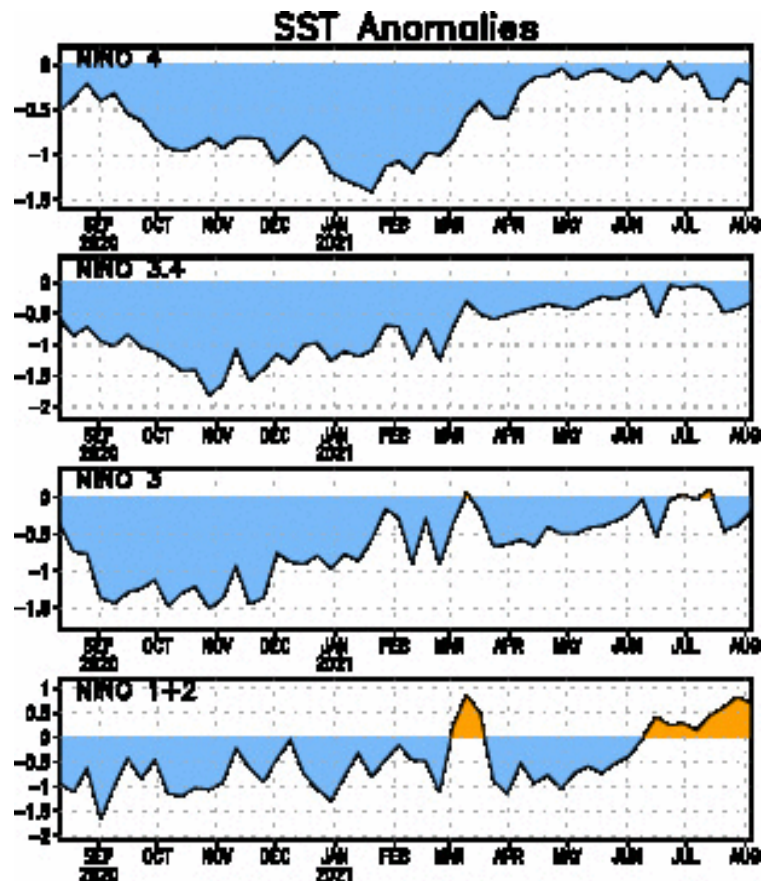
# Outgoing Longwave Radiation (OLR) Anomalies

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



- Rossby wave activity is becoming more apparent in the filtering, but increased convection over the Equatorial Indian Ocean is consistent with MJO activity as well.
- Easterly wave activity is becoming more apparent over the tropical Atlantic.

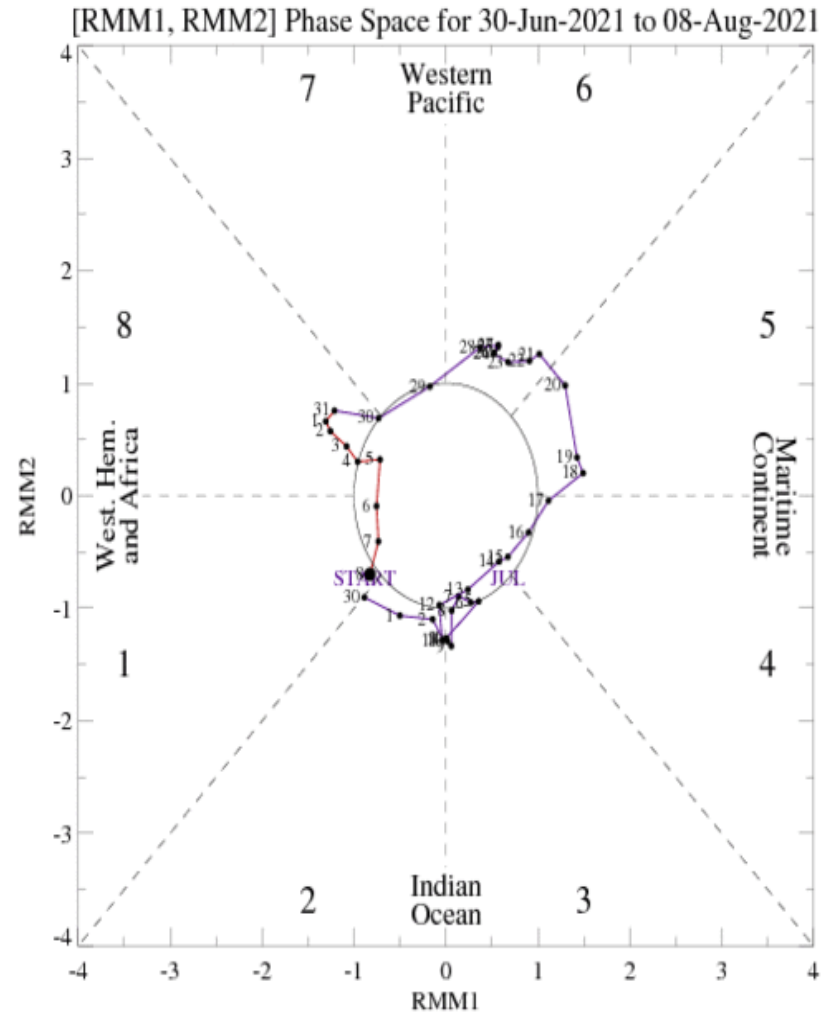
# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Multiple episodes of oceanic Kelvin wave activity led to a strengthening of upper-ocean heat content during this past spring. However, these positive anomalies have since weakened, and negative anomalies have been strengthening across much of the Pacific during the past month.
- Since mid-July, there has been a decline in the Niño indices with the exception of the Niño 1+2 region of the far East Pacific, which continues to experience warming.

# MJO Index: Recent Evolution

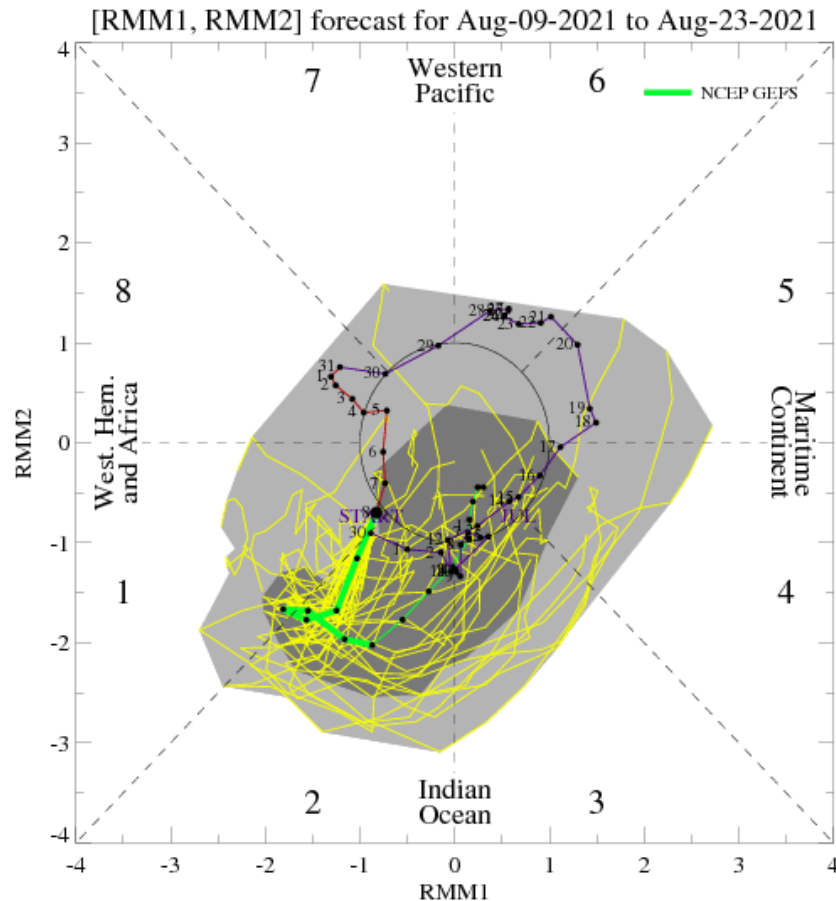
- The RMM index showed rapid propagation across the Western Hemisphere over the past week, with weakened amplitude.
- The enhanced phase is currently over Africa (Phase-1), which is consistent with the CPC velocity potential based index.



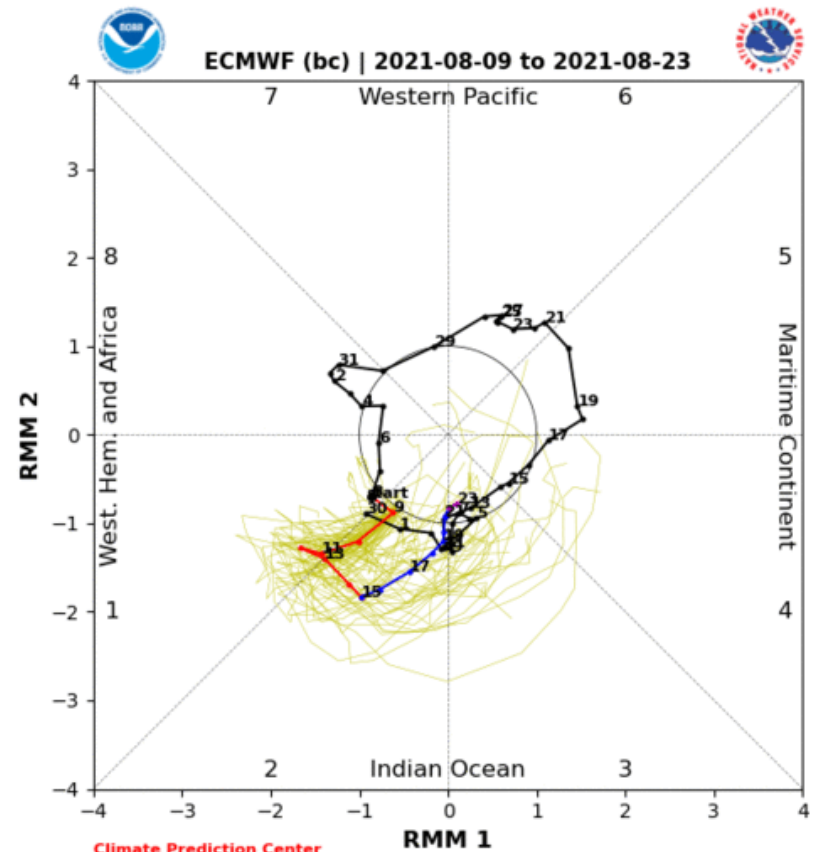
For more information on the RMM index and how to interpret its forecast please see:  
[https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC\\_MJOinformation.pdf](https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf)



# MJO Index: Forecast Evolution



**GEFS Forecast**



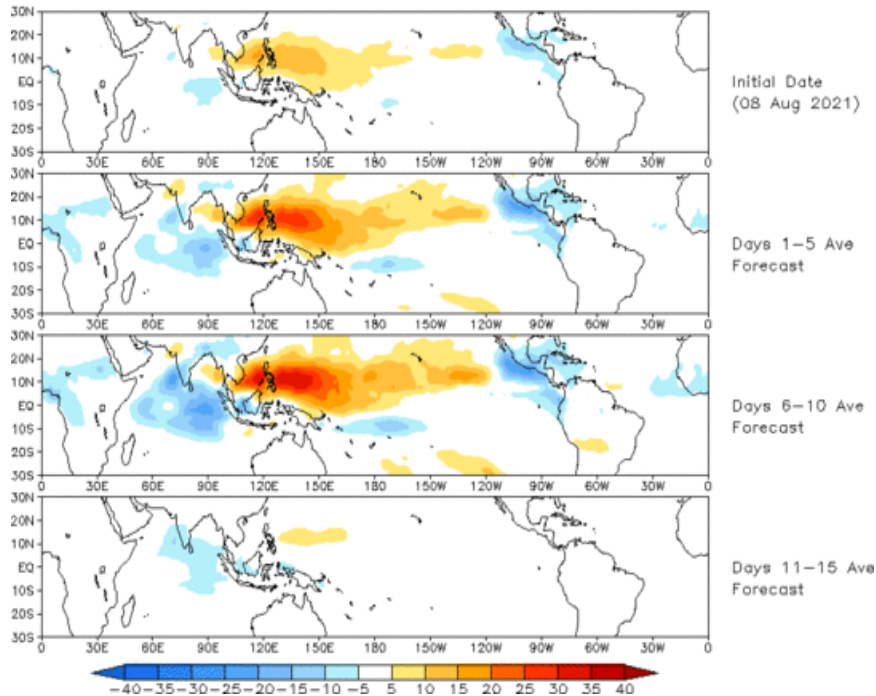
**ECMWF Forecast**

- Dynamical models are remarkably consistent, and show slowed propagation and enhanced amplitude over Africa and the western Indian Ocean during Week-1, due in part to Rossby wave interference.
- Both the GEFS and ECMWF favor renewed eastward propagation of the MJO across the Indian Ocean to the Maritime Continent during Week-2.

# MJO: GEFS Forecast Evolution

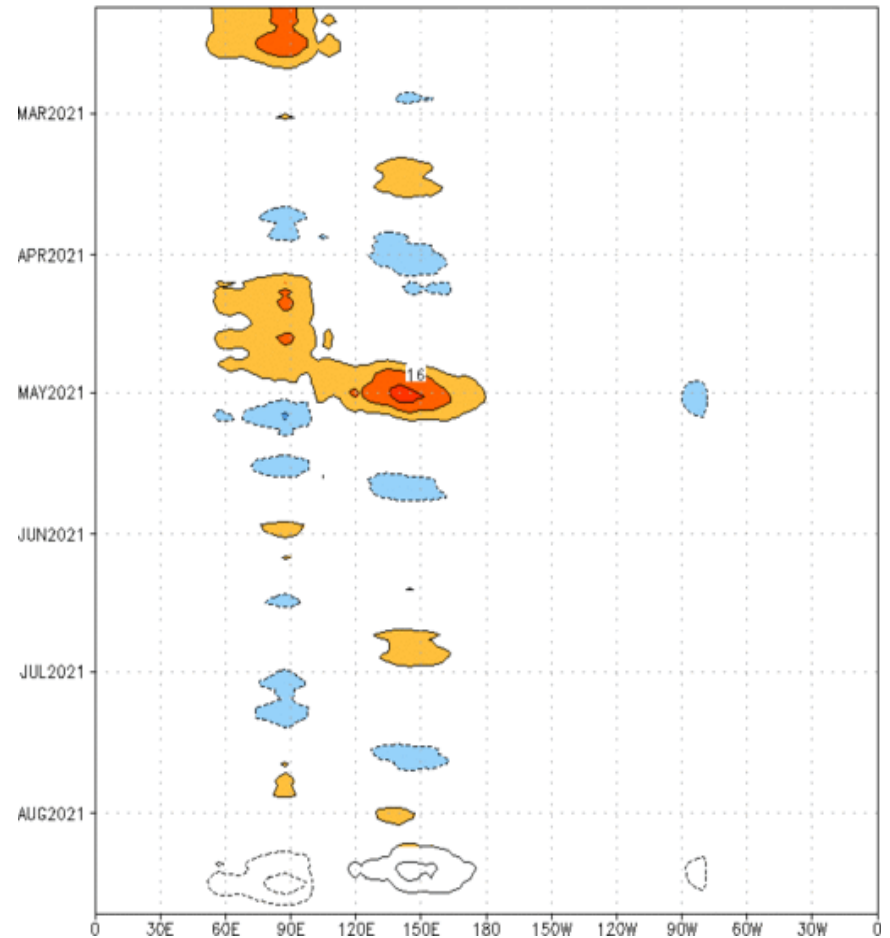
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast  
Initial date: 08 Aug 2021  
OLR



- The GEFS RMM-based OLR anomaly forecast features an increasing amplitude Indian Ocean MJO event with slow eastward propagation, followed by weakening anomalies towards the end of Week-2.

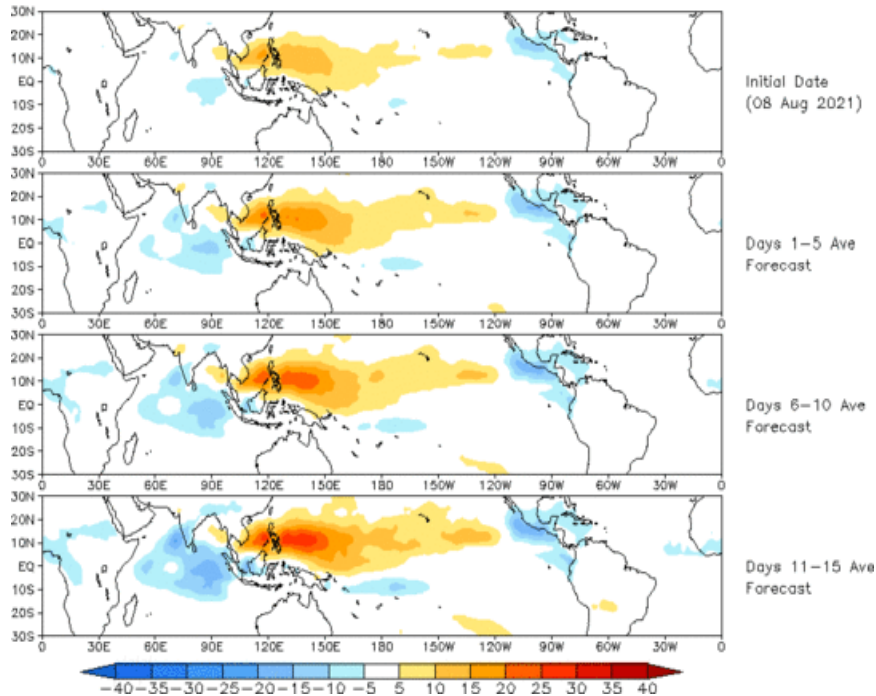
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2  
OLR [7.5°S, 7.5°N] ( $\text{cont: } 4\text{Wm}^{-2}$ ) Period: 06-Feb-2021 to 08-Aug-2021  
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



# MJO: Constructed Analog Forecast Evolution

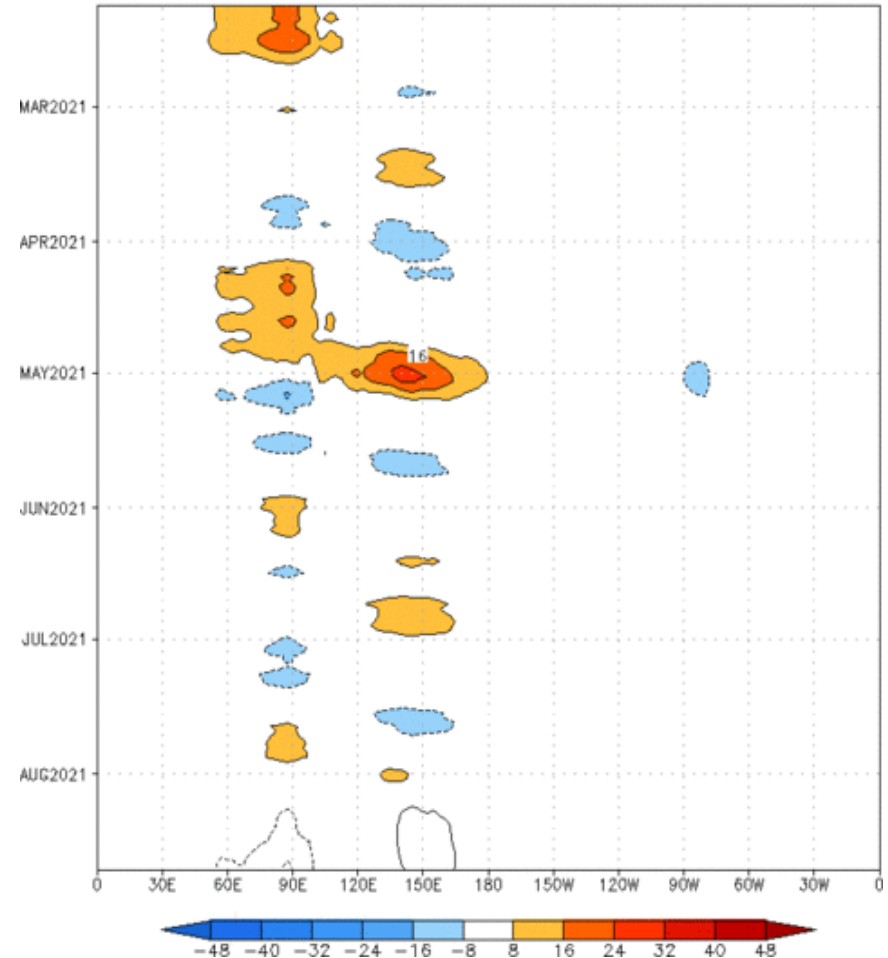
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (08 Aug 2021)



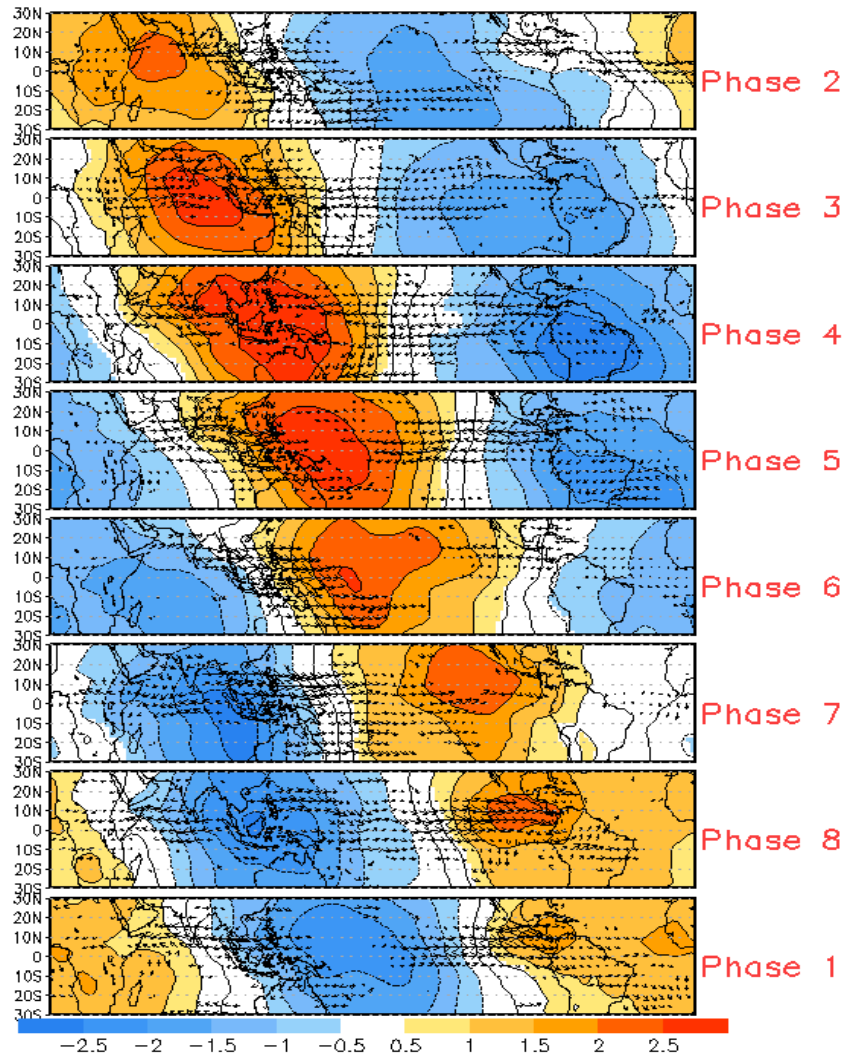
- The constructed analog forecast is similarly slowly evolving, but depicts increasing amplitude throughout the period.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S, 7.5°N] (cont: 4Wm<sup>-2</sup>) Period: 06-Feb-2021 to 08-Aug-2021  
The unfilled contours are CA forecast reconstructed anomaly for 15 days

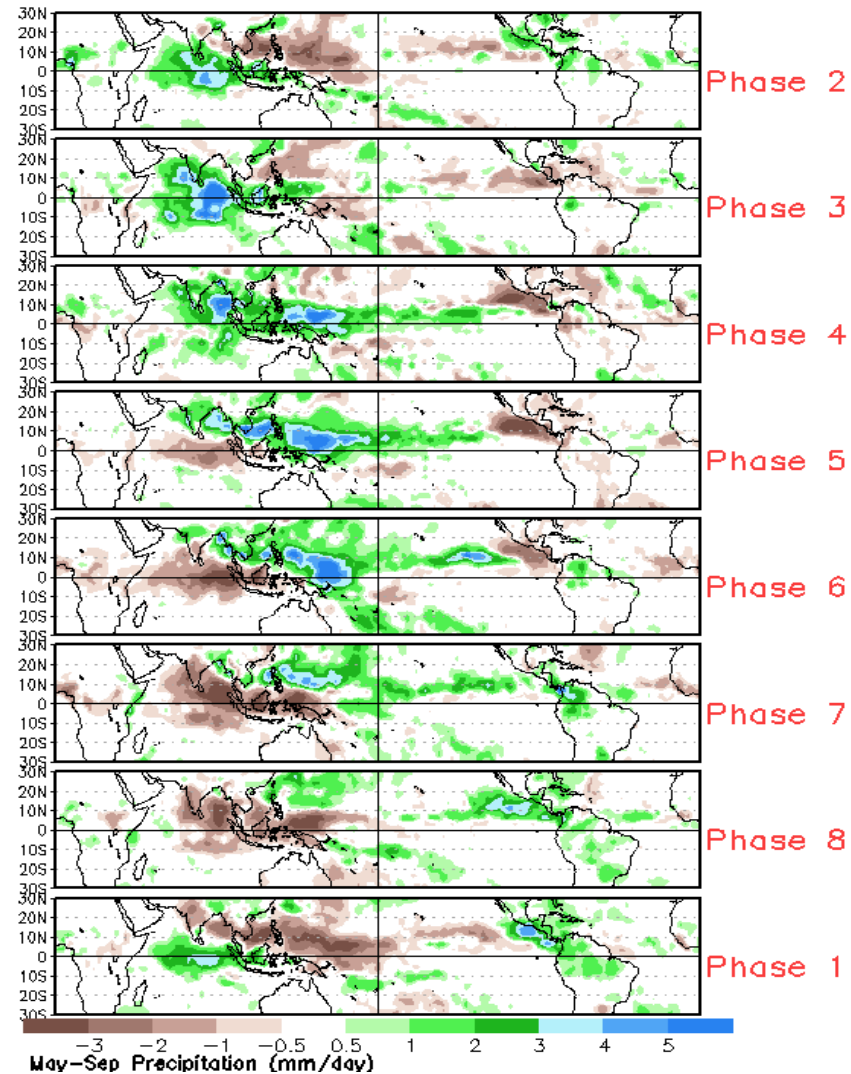


# MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and  
Wind Anomalies



Precipitation Anomalies

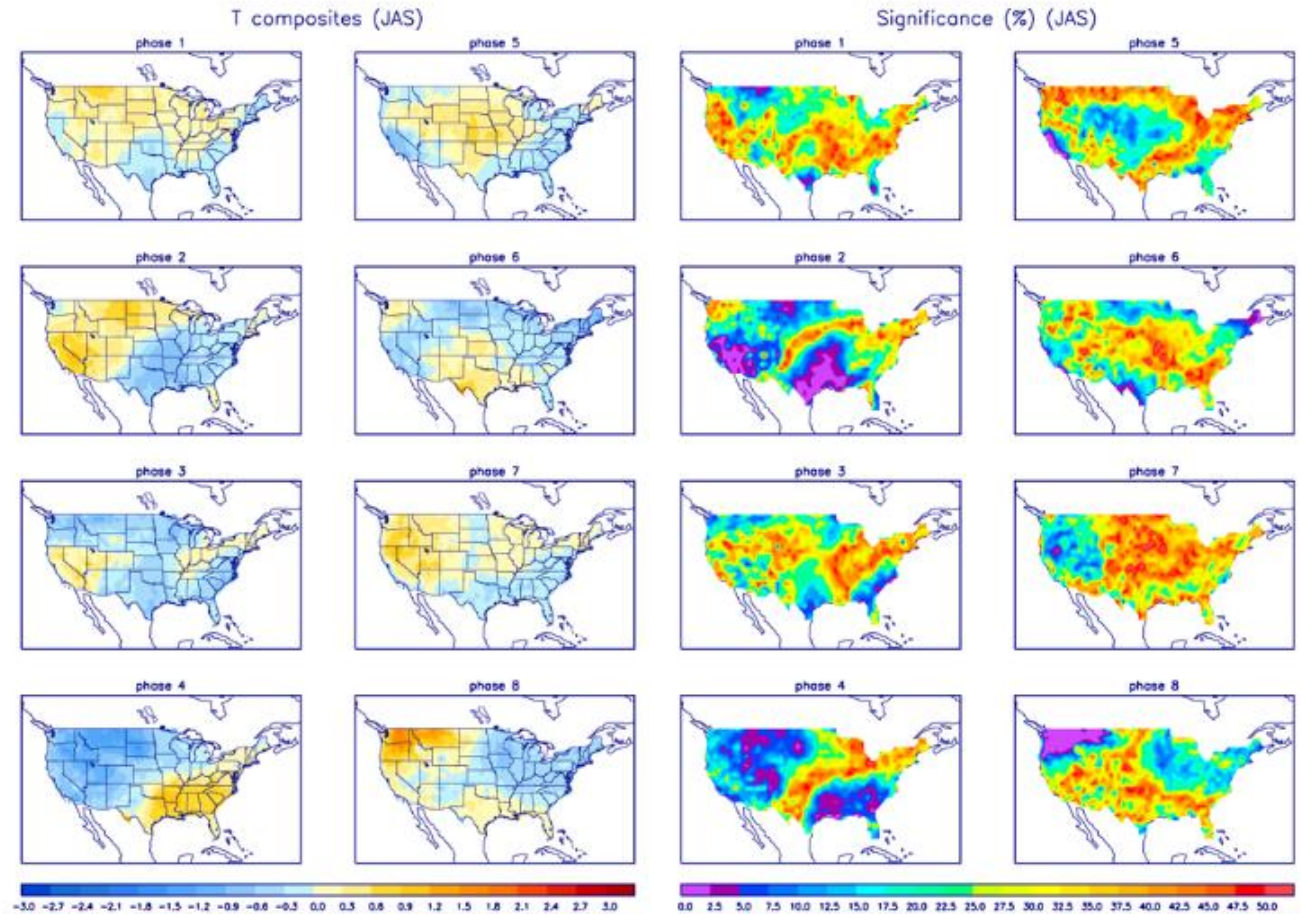




# MJO: CONUS Composite Maps by RMM Phase - Temperature

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.

