

# **Madden-Julian Oscillation:**

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



**Update prepared by the Climate Prediction Center**  
**Climate Prediction Center / NCEP**  
**25 October 2021**

# Overview

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- The MJO remains weak, with no remaining amplitude on the CPC velocity potential based MJO index and the RMM-based index being within the unit circle.
- Destructive interference with the La Niña base state, as well as Kelvin and Rossby wave activity over the Indian Ocean, likely caused the breakdown of the intraseasonal signal.
- Dynamical model forecasts generally favor an amplifying signal over the Western Hemisphere and Indian Ocean, with a potential return of enhanced convection to the Maritime Continent by the end of the two week period.
- Enhanced convection shifting from the Western Hemisphere to the Indian Ocean may provide a window for late season Atlantic tropical cyclone development.
- Recurving West Pacific tropical cyclones may play a role in the evolution of the mid-latitude pattern.

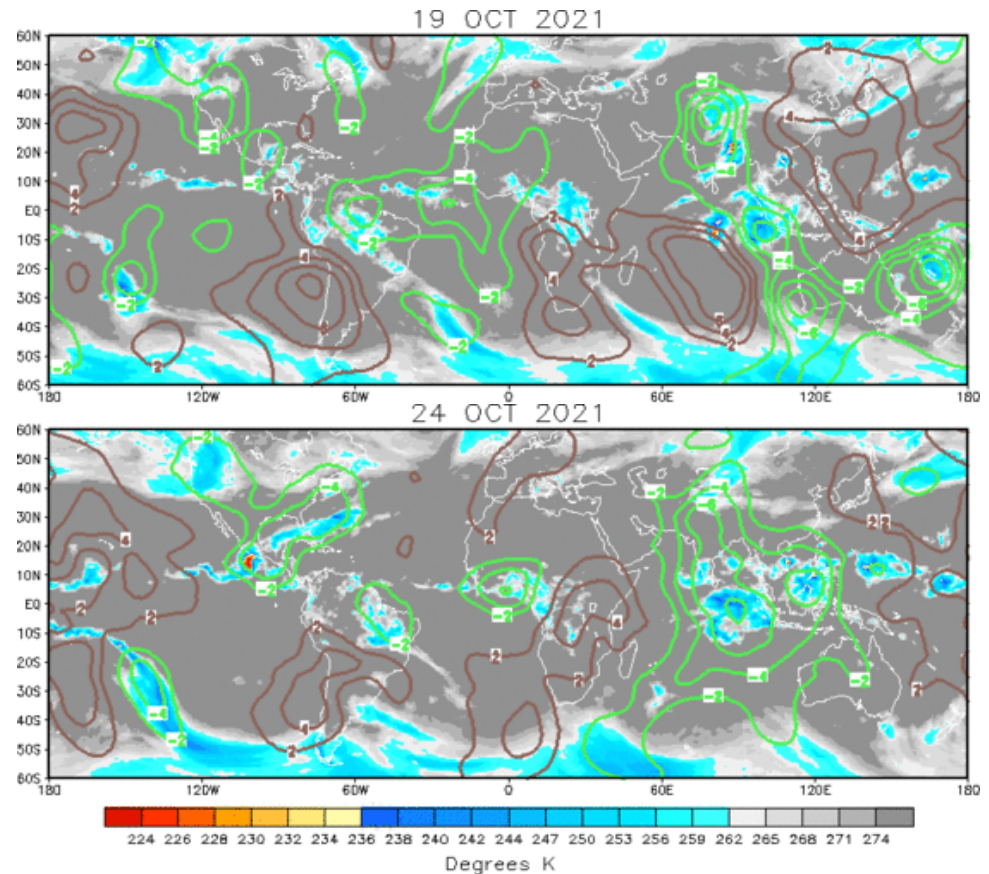
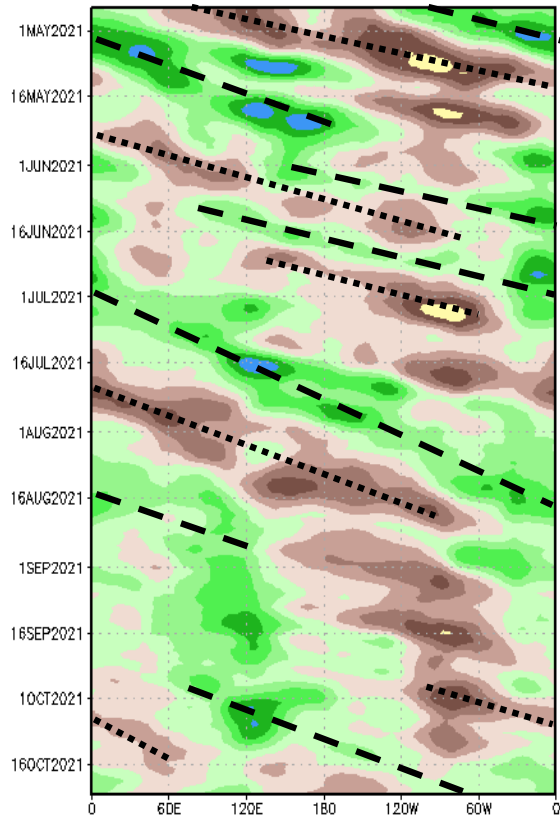
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:  
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

# 200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

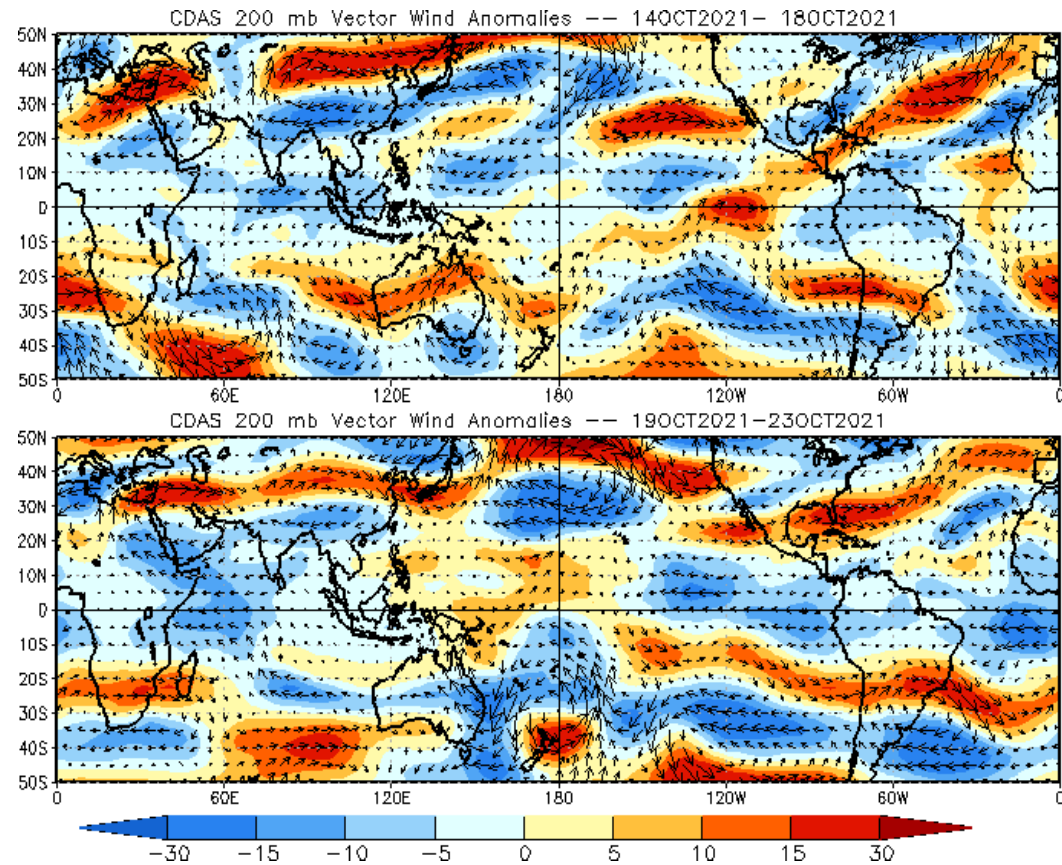
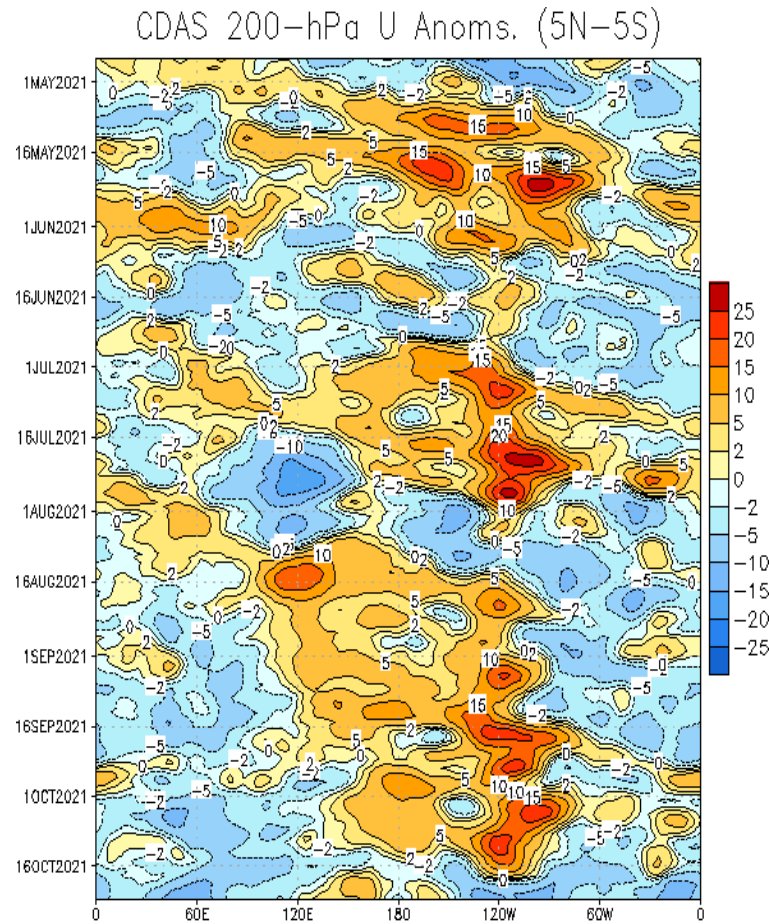
200-hPa Velocity Potential Anomaly: 5N-5S  
5-day Running Mean



- Following an extended period of MJO activity during the late spring and summer, a stationary pattern is observed from late summer and into the fall.
- Some intraseasonal activity was evident in early October, destructively interfering with the La Niña base state, though the signal weakened rapidly by mid-October.

# 200-hPa Wind Anomalies

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

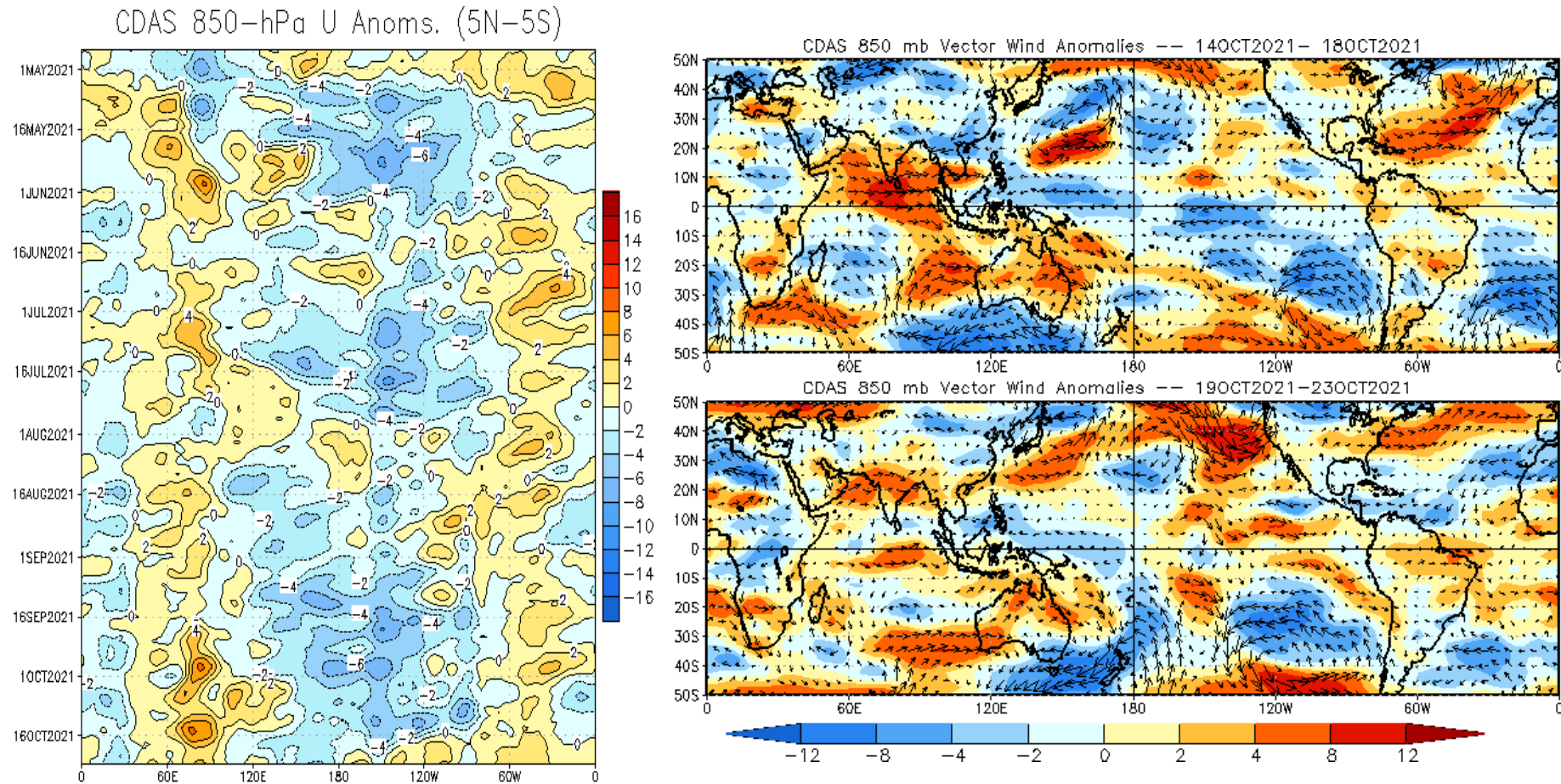


- The low frequency state was disrupted, with easterly anomalies developing over the equatorial East Pacific.
- Westerly anomalies returned fairly rapidly over the West Pacific.



# 850-hPa Wind Anomalies

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



- While enhanced trade winds remained entrenched west of the Date Line, westerly anomalies developed across much of the equatorial Pacific east of the Date Line.
- Westerly anomalies remain persistent over the Indian Ocean and equatorial Atlantic basins.

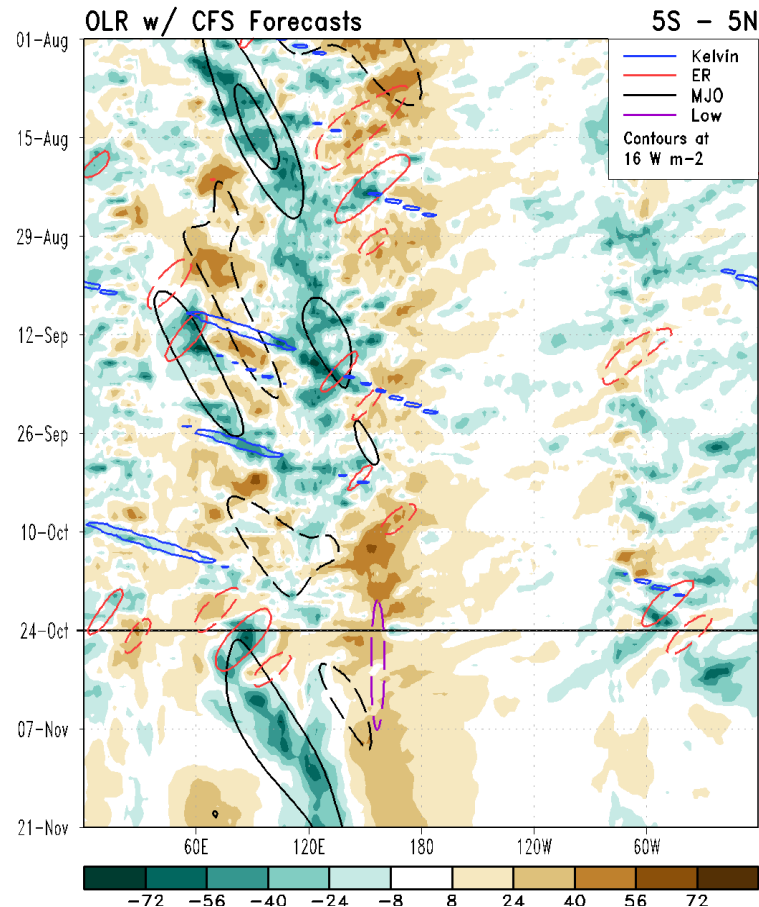
# Outgoing Longwave Radiation (OLR) Anomalies

Green shades: Anomalous convection (wetness)

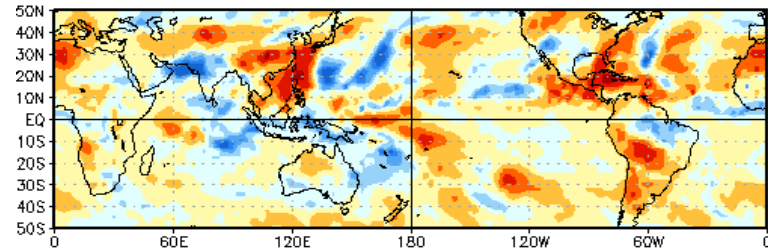
Brown shades: Anomalous subsidence (dryness)

Blue shades: Anomalous convection (wetness)

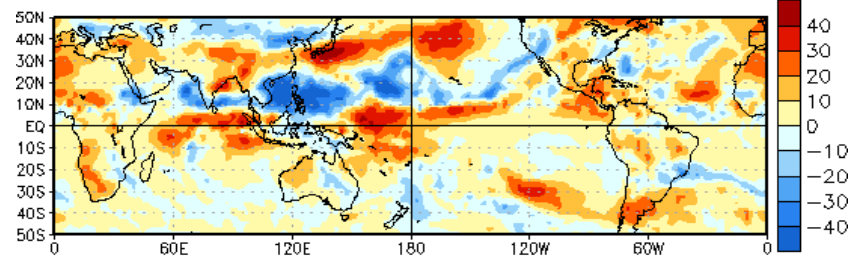
Red shades: Anomalous subsidence (dryness)



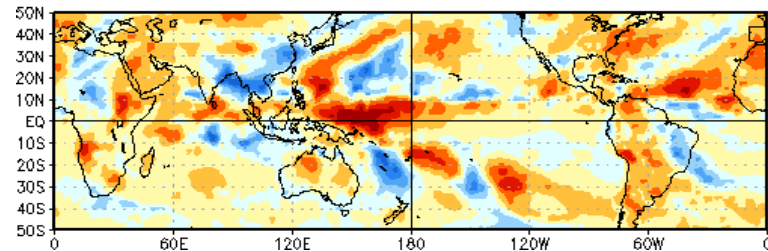
OLR Anomalies  
23 SEP 2021 to 2 OCT 2021



3 OCT 2021 to 12 OCT 2021

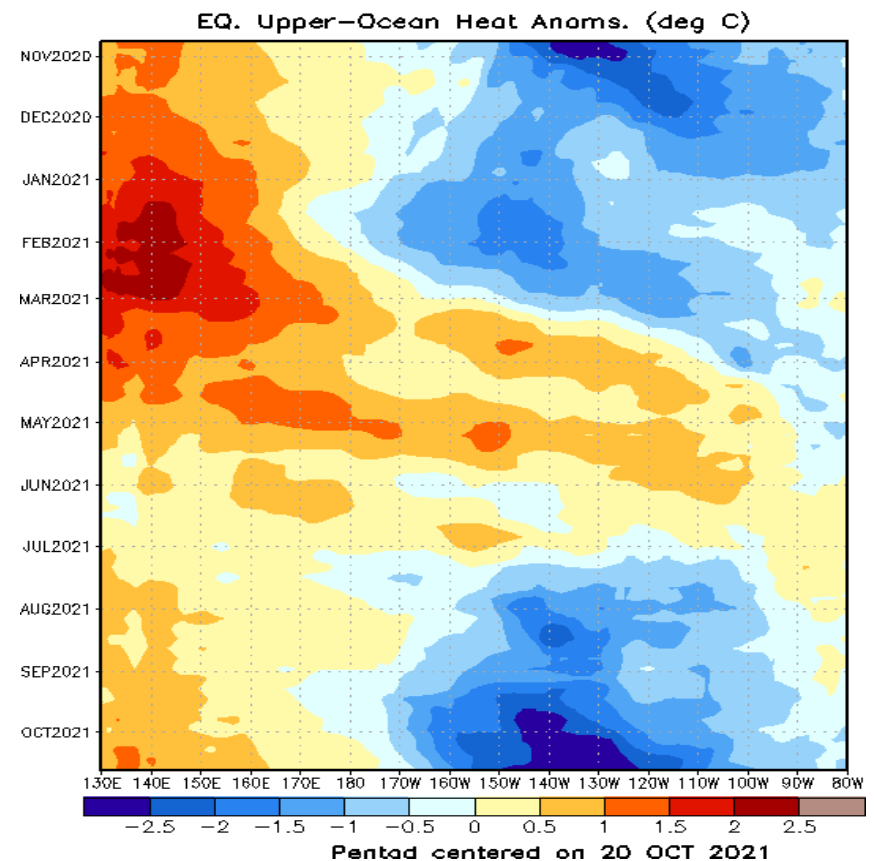
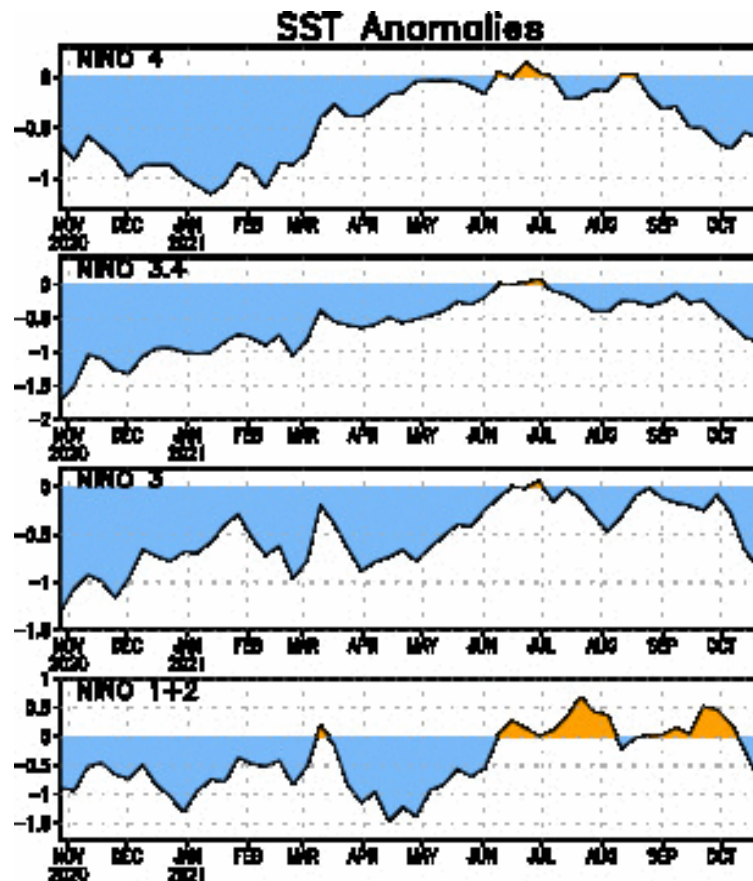


13 OCT 2021 to 22 OCT 2021



- An intraseasonal signal or Kelvin wave activity briefly disrupted the low frequency state in late September, though suppressed convection remained anchored along the Equator just west of the Date Line.
- The CFS favors MJO-like eastward propagation across the Indian Ocean into early November, followed by a return to the La Niña base state.

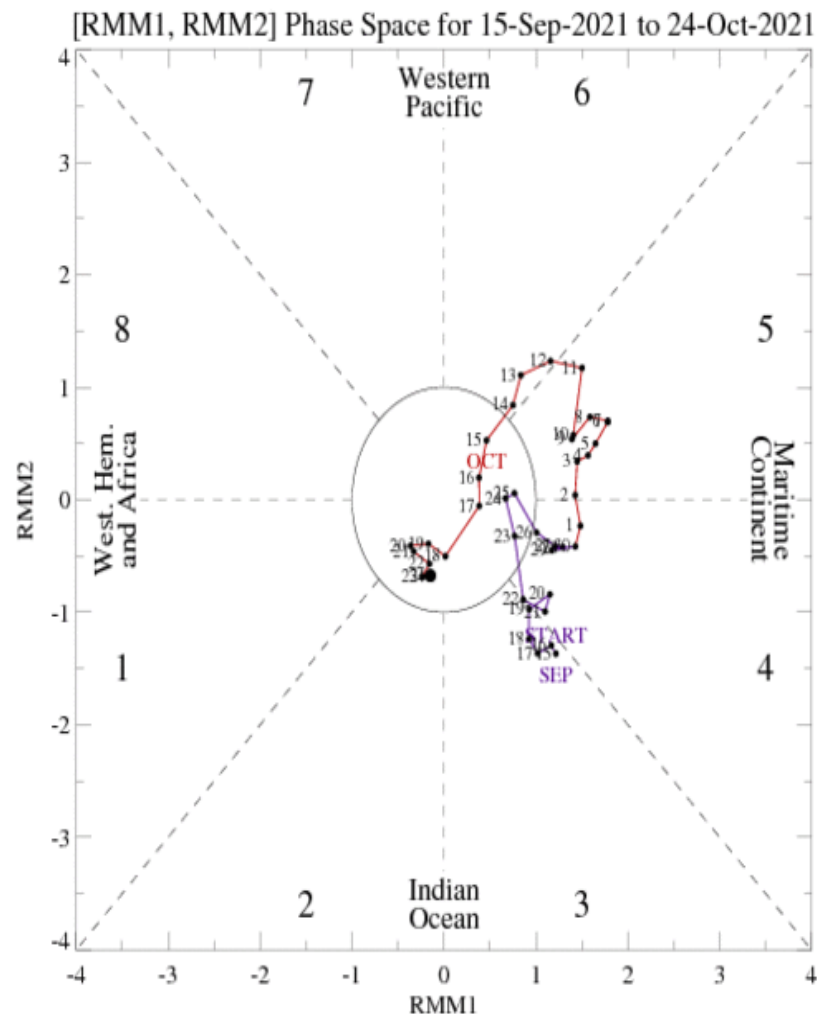
# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Negative upper-ocean heat anomalies continue to intensify across much of the central and eastern equatorial Pacific. A substantial sub-surface cooling is evident near 140W since late September.
- Below-normal sea surface temperatures are now observed within all Niño regions, consistent with the development of La Niña conditions.

# MJO Index: Recent Evolution

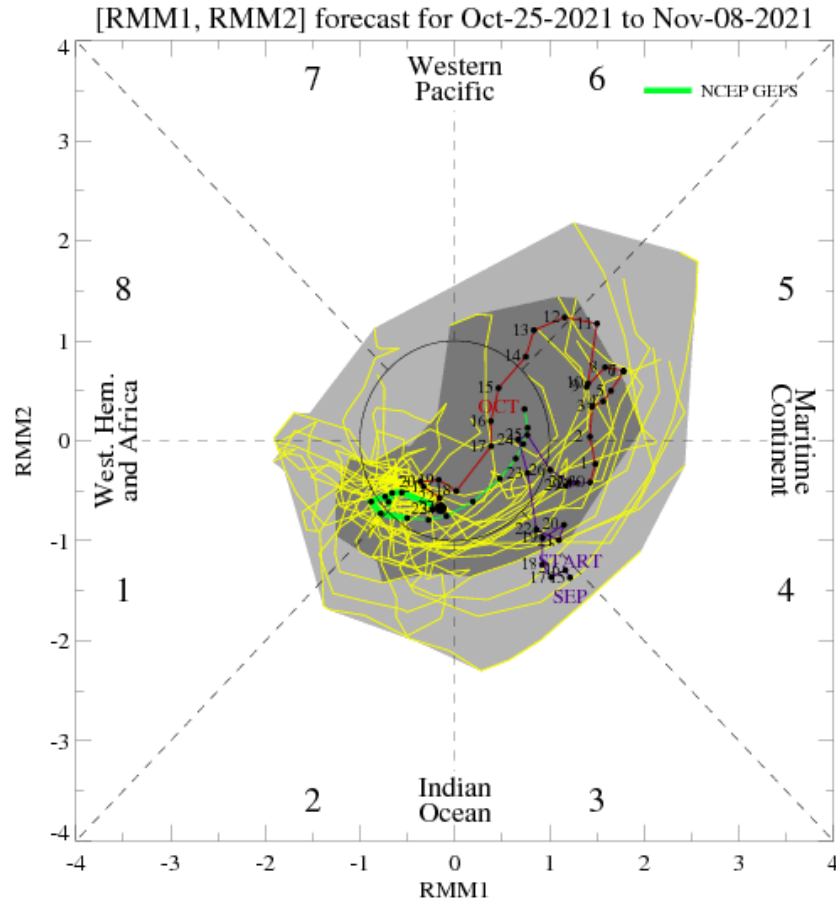
- The RMM index weakened rapidly during mid-October, with Kelvin and Rossby wave activity over the Indian Ocean now provoking more of a response than any remnant signal over the Pacific.
- The movement of the RMM-based index since mid-September appears shifted towards the Maritime Continent, which is consistent with developing La Niña conditions.



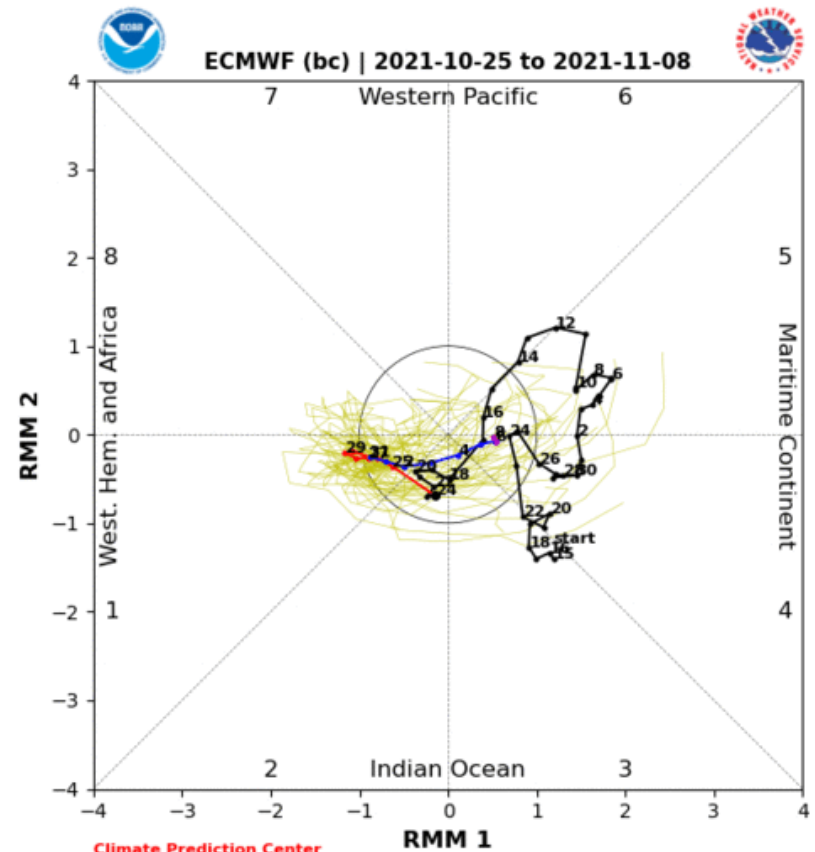
For more information on the RMM index and how to interpret its forecast please see:  
[https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC\\_MJOinformation.pdf](https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf)



# MJO Index: Forecast Evolution



**GEFS Forecast**



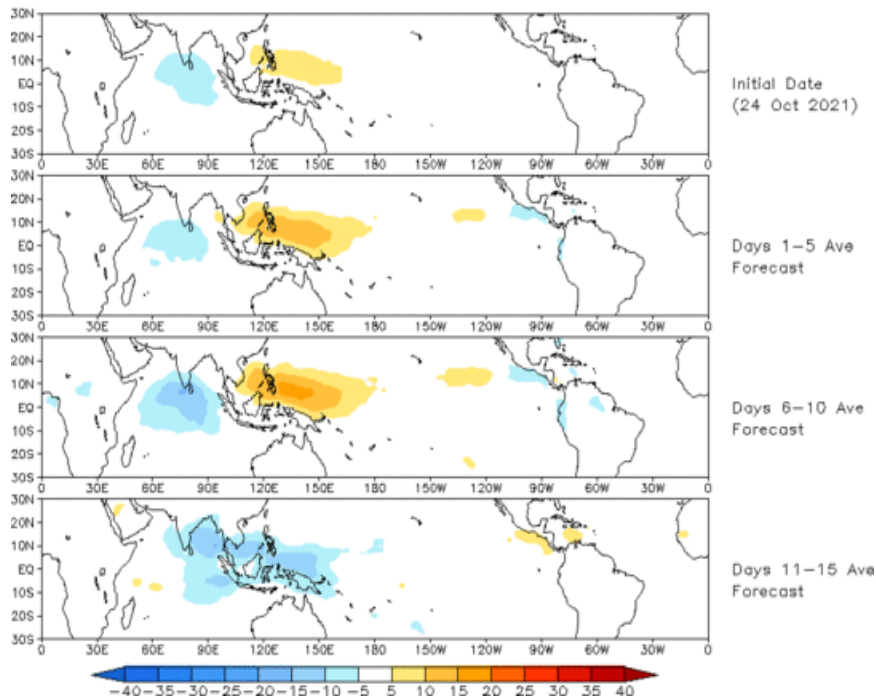
**ECMWF Forecast**

- Both the GEFS and ECMWF ensembles depict some amplification of a signal in Phase 8 or 1 early in the period, with some resumption of eastward propagation back towards the Maritime Continent in Week-2.
- The spread of the model ensemble members is quite high.

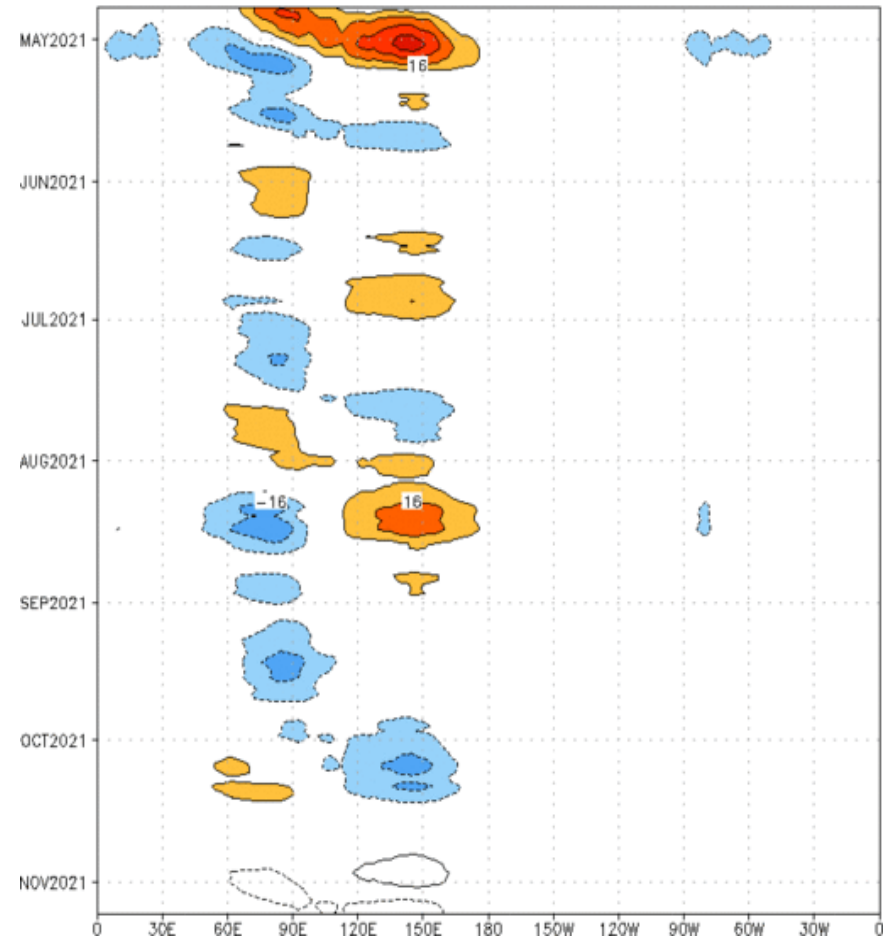
# MJO: GEFS Forecast Evolution

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: 24 Oct 2021  
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2  
OLR [7.5°S,7.5°N] ( $\text{cont: } 4\text{Wm}^{-2}$ ) Period: 24-Apr-2021 to 24-Oct-2021  
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

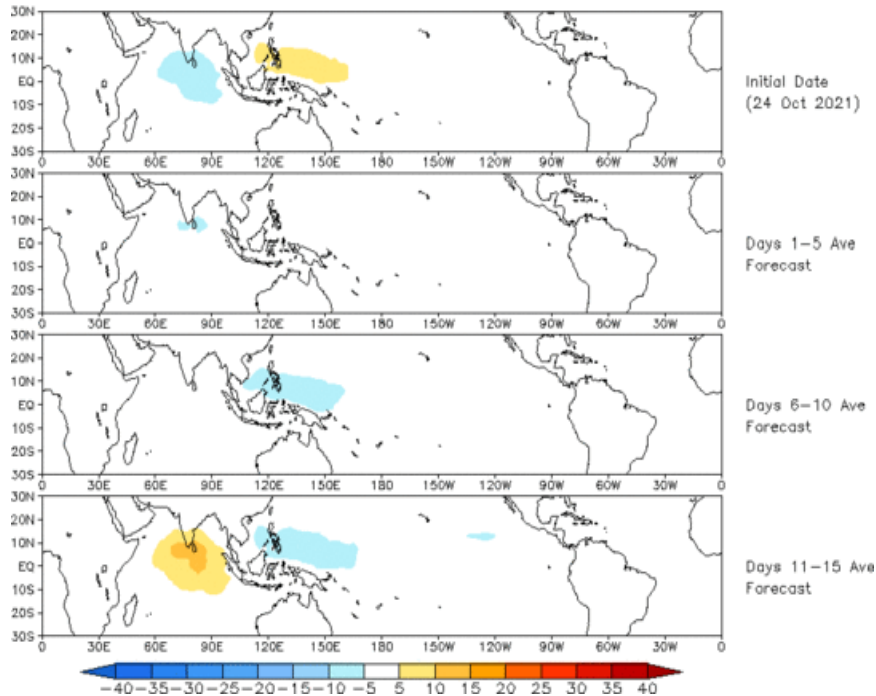


- The GEFS RMM-based OLR anomaly forecast features an amplifying Indian Ocean MJO event that propagates to the Maritime Continent by the end of the two-week period.

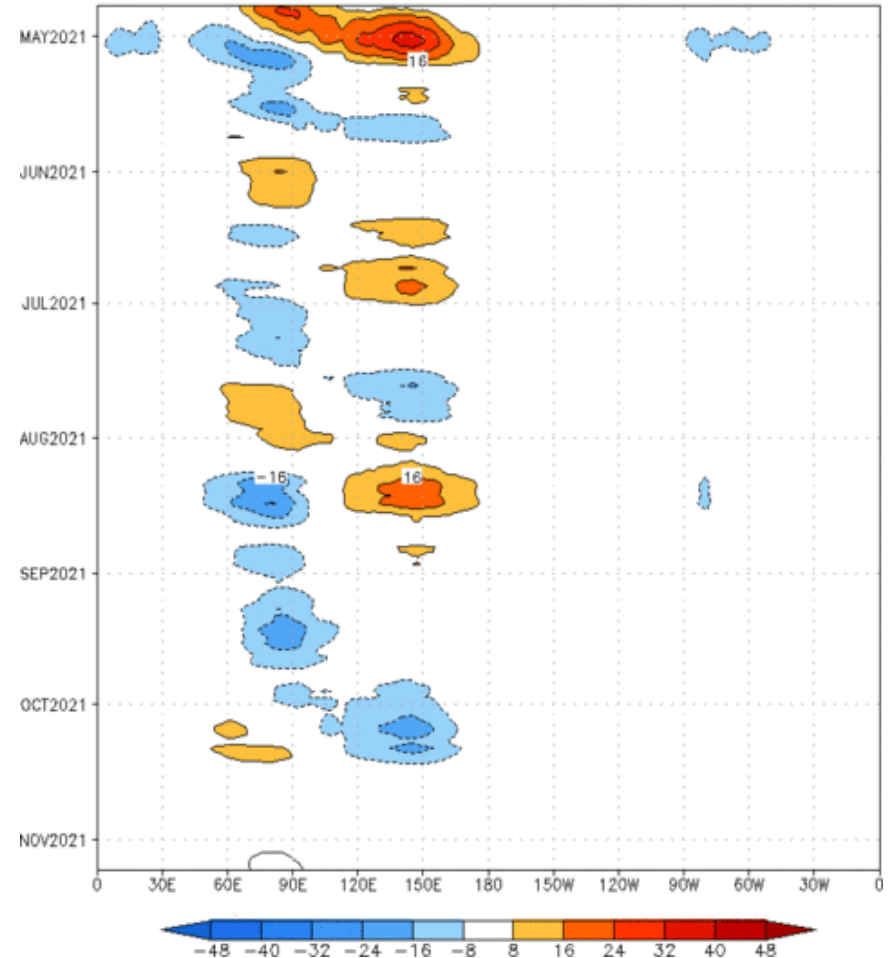
# MJO: Constructed Analog Forecast Evolution

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 (24 Oct 2021)



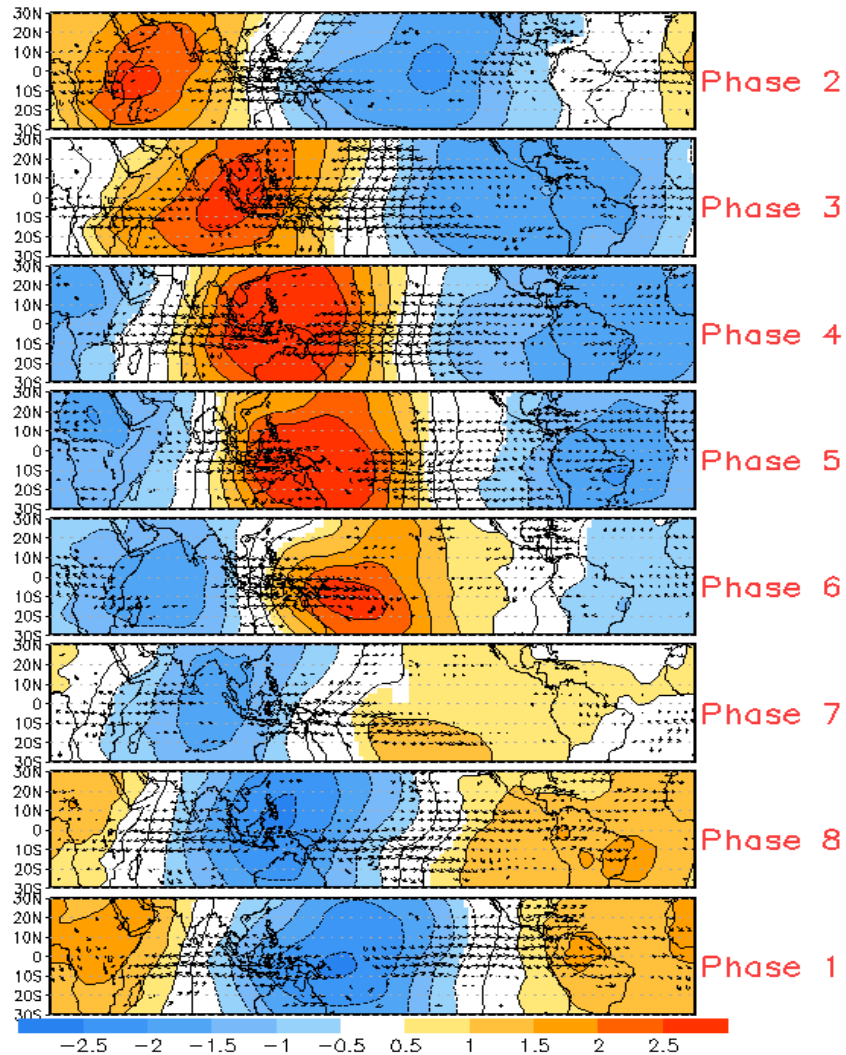
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm<sup>-2</sup>) Period:24-Apr-2021 to 24-Oct-2021  
The unfilled contours are CA forecast reconstructed anomaly for 15 days



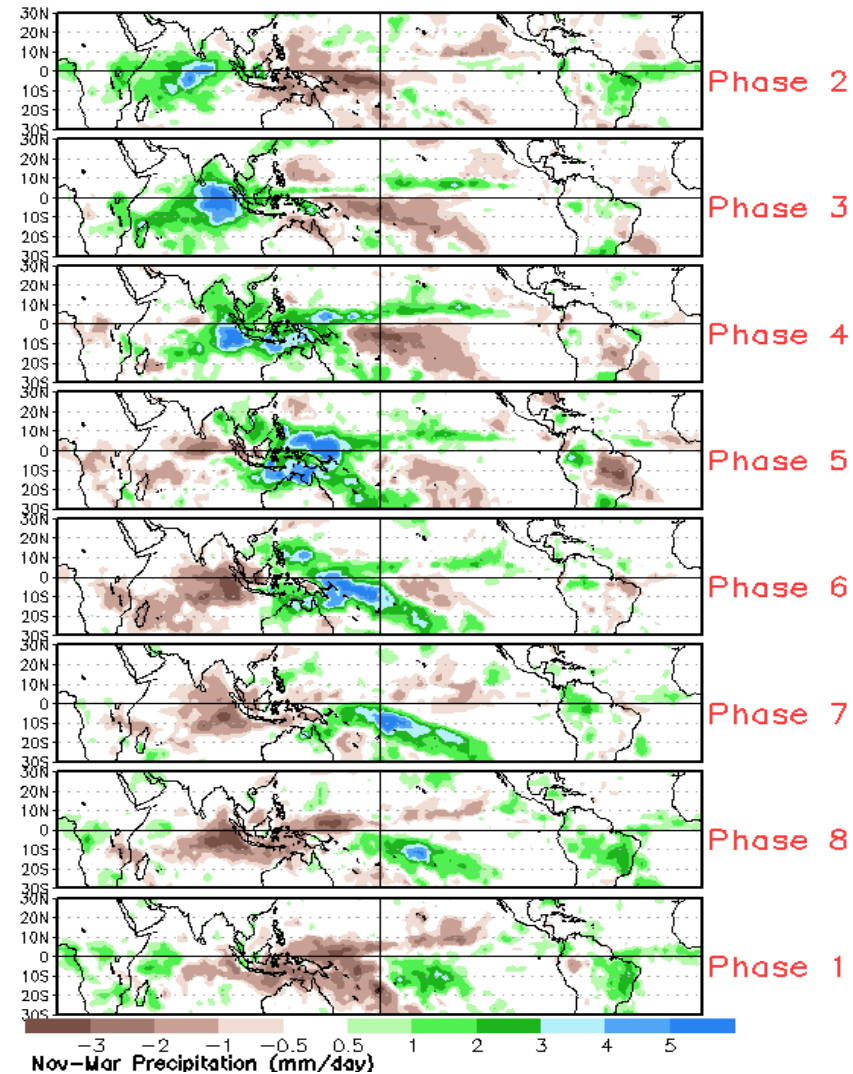
- The constructed analog depicts a convective pattern that is faster propagating and weaker than the GEFS.

# MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and  
Wind Anomalies



Precipitation Anomalies

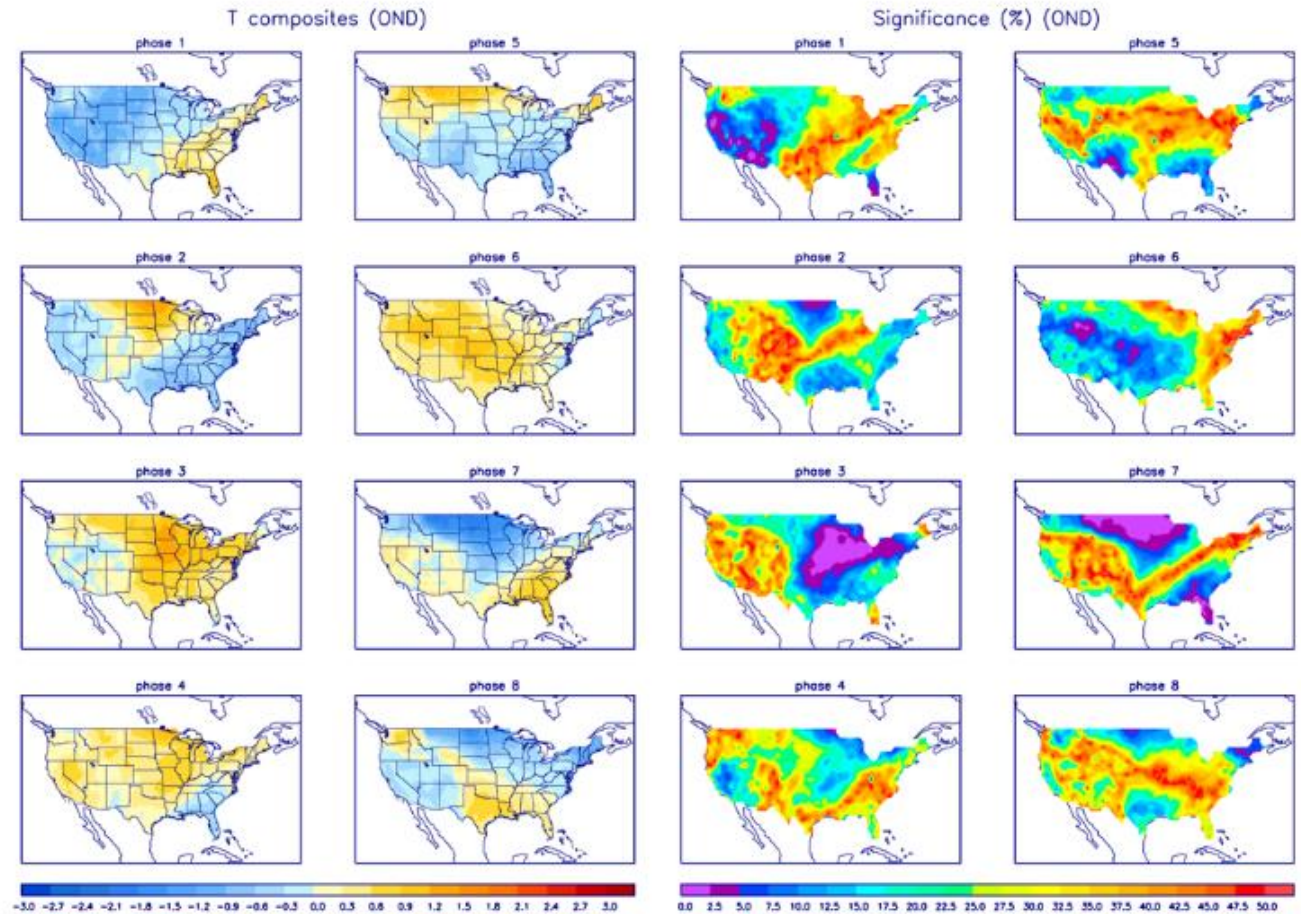




# MJO: CONUS Composite Maps by RMM Phase - Temperature

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.

