

# **Madden-Julian Oscillation:**

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



**Update prepared by the Climate Prediction Center**  
**NWS / NCEP / CPC**  
**2 January 2023**

# Overview

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- An active MJO signal is noted across the Maritime Continent and Western Pacific.
- Despite enhanced Rossby Wave activity, the enhanced intraseasonal signal has continued to propagate eastward, and is beginning to destructively interfere with the La Niña base state.
- During the next week to 10 days, the MJO may continue to enhance chances of tropical cyclone (TC) development across the western Pacific on both sides of the equator, with some potential for TC development increasing later in week-2 across the western Indian Ocean as the convective envelope circumnavigates the globe.
- While MJO propagation into phases 8 and 1 may ultimately favor a relatively cooler pattern to develop across much of the continental U.S., the dynamical models continue to persist above normal temperatures across the country through at least mid-January.

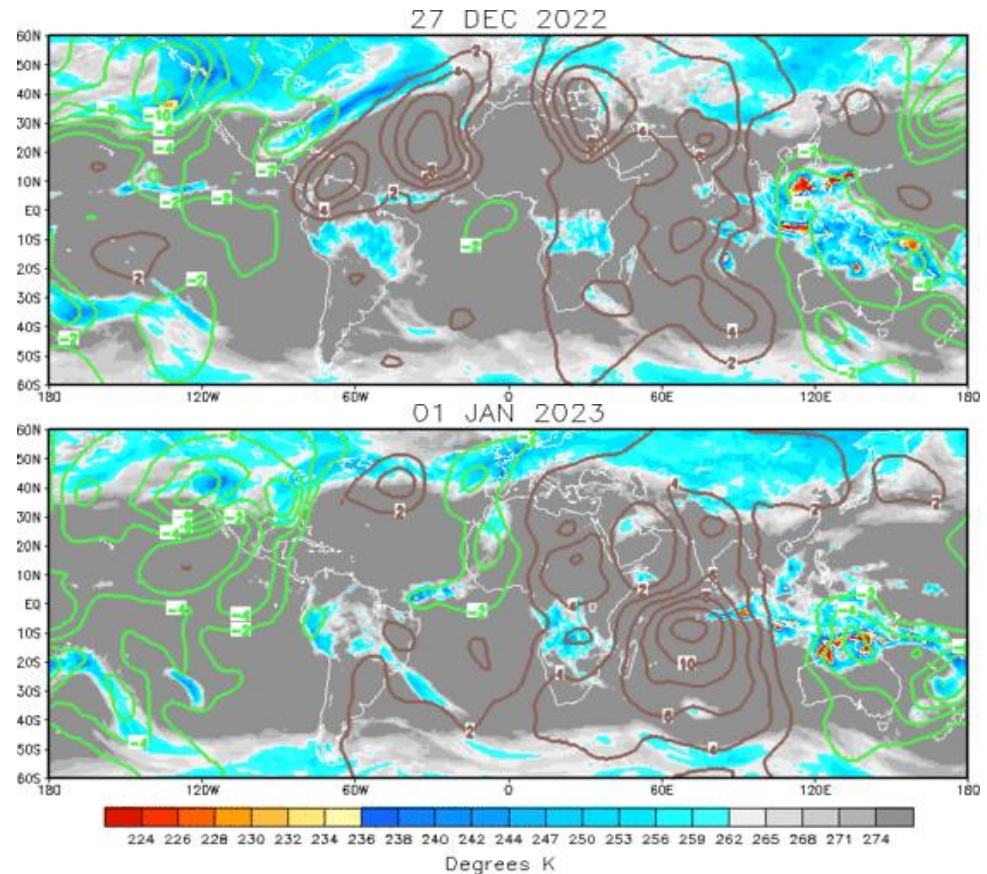
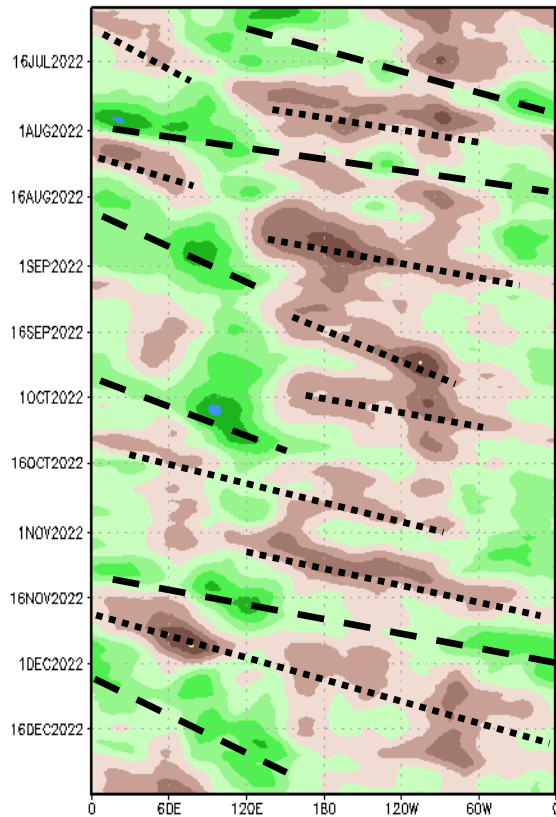
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:  
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

# 200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

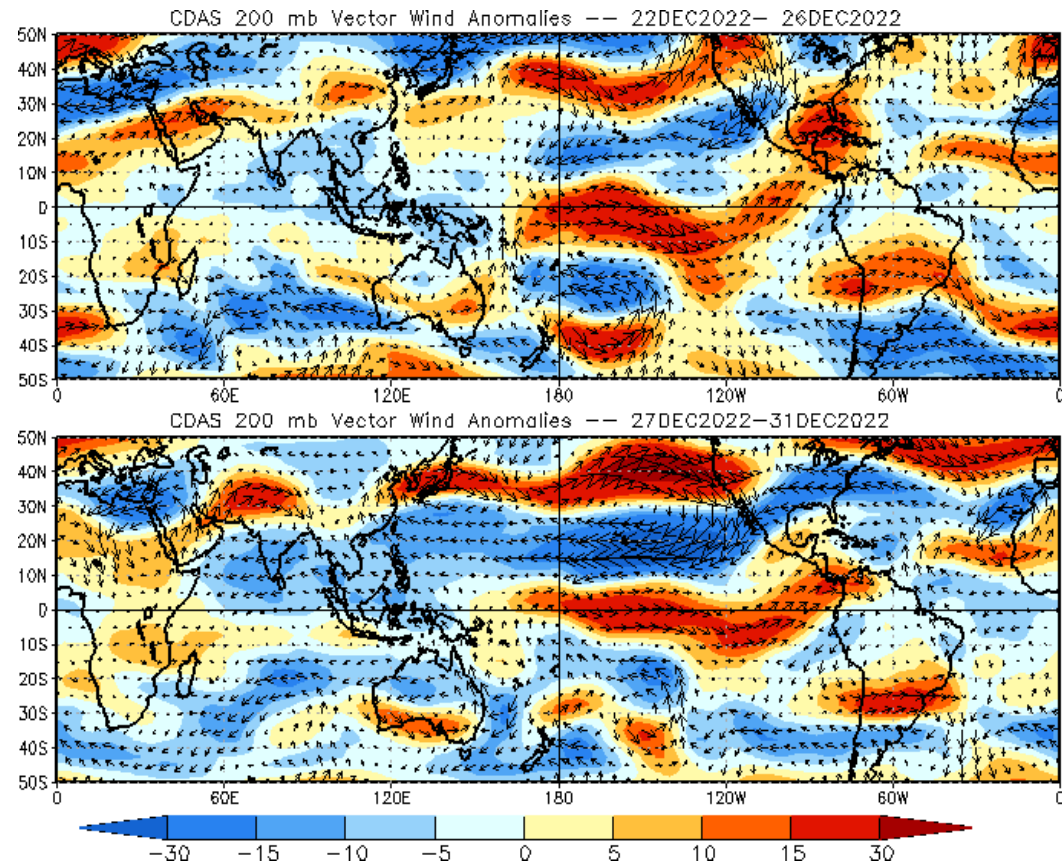
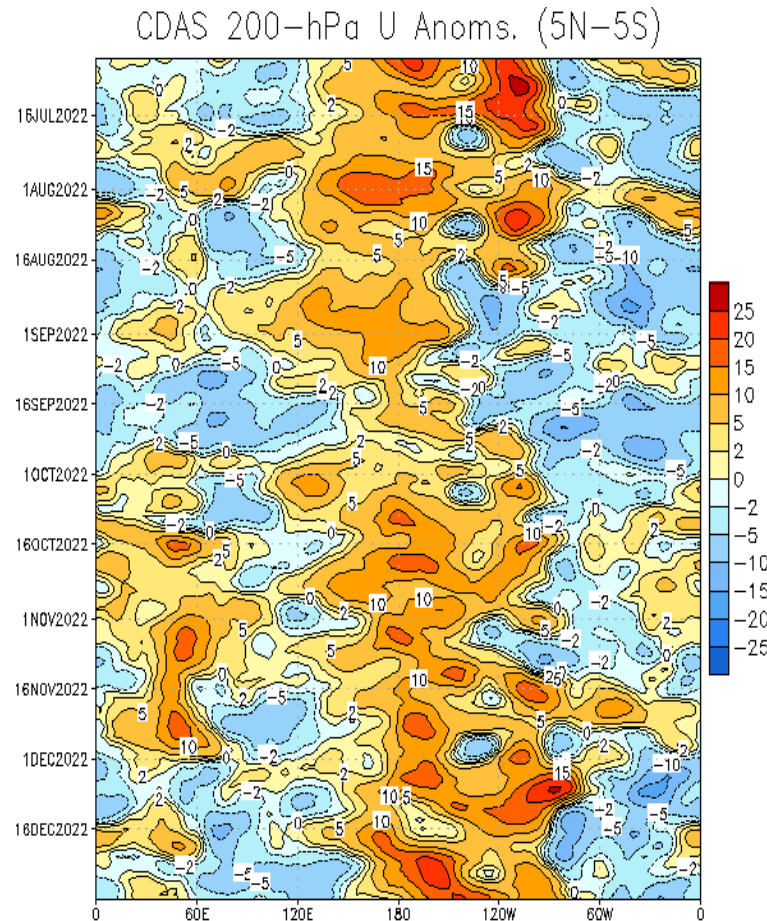
200-hPa Velocity Potential Anomaly: 5N–5S  
5-day Running Mean



- An active, eastward propagating MJO signal is noted in the upper-level velocity potential field during the month of December.
- The MJO has begun to destructively interfere with the La Niña base state, with anomalous upper-level divergence (enhanced convection) building across the Pacific.

# 200-hPa Wind Anomalies

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

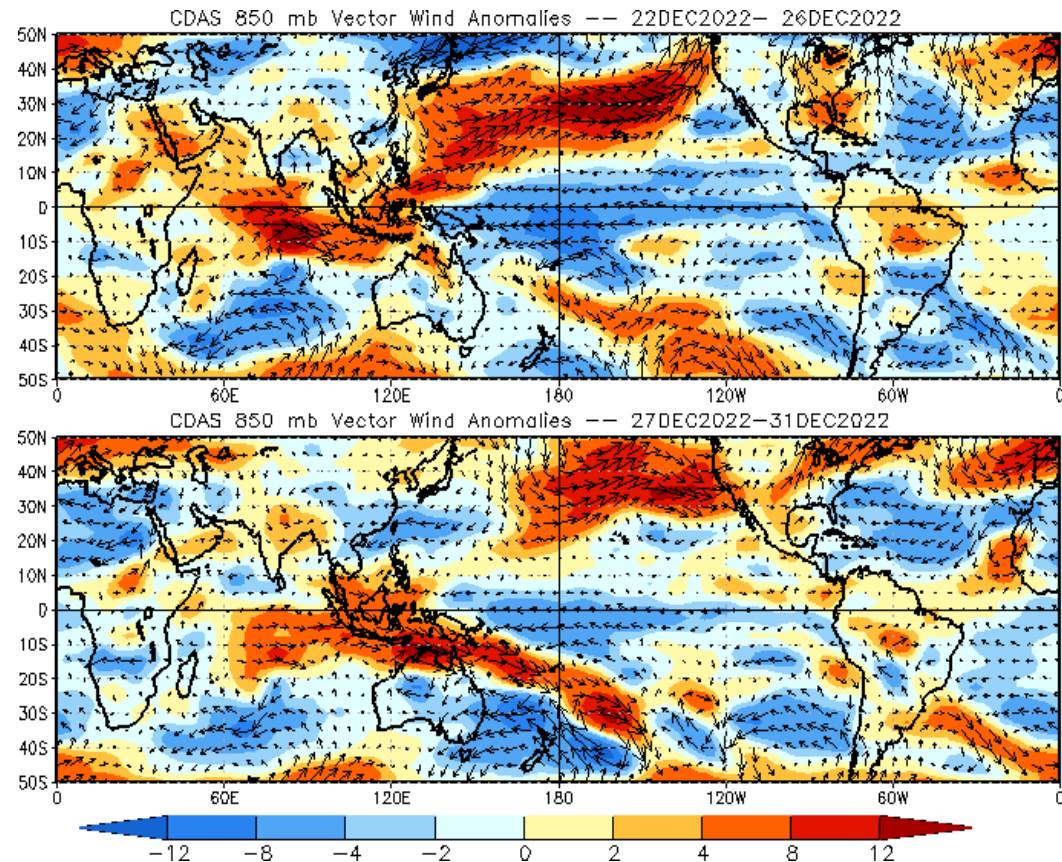
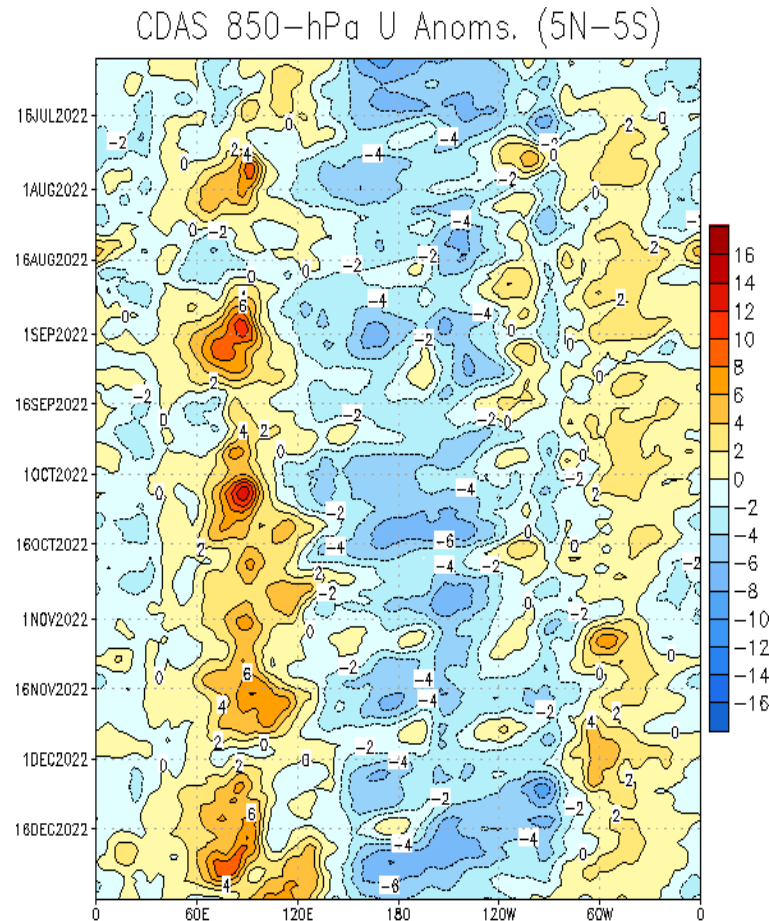


- A large upper-level anti-cyclonic feature is noted across the northeast Pacific.
- Strong upper-level westerly anomalies continue to dominate the central and eastern tropical Pacific close to the Equator, consistent with La Niña.
- Anomalous upper-level easterlies have expanded across the Maritime Continent and Western Pacific.



# 850-hPa Wind Anomalies

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

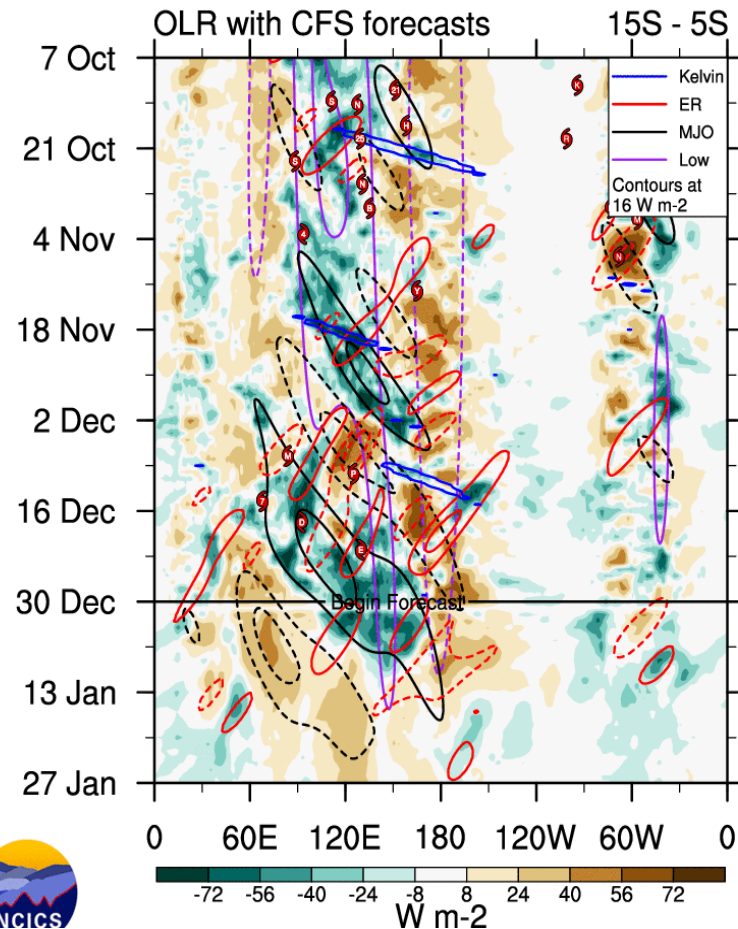


- Large low-level westerly wind anomalies dominate the northeast Pacific, with pronounced onshore flow and atmospheric river activity along the west coast of the Contiguous U.S.
- Low level westerlies have increased and expanded eastward across the Maritime Continent and southwest Pacific, leading to increased convergence near the surface.
- Enhanced trades (easterlies) continue across the equatorial central Pacific.

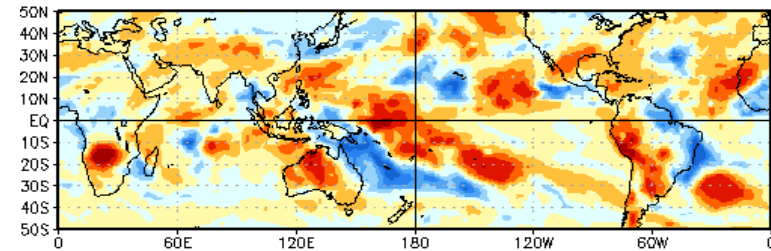
# Outgoing Longwave Radiation (OLR) Anomalies

**Green shades: Anomalous convection (wetness)**

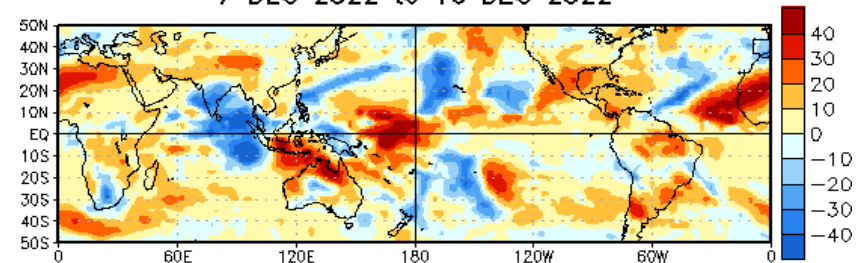
**Brown shades: Anomalous subsidence (dryness)**



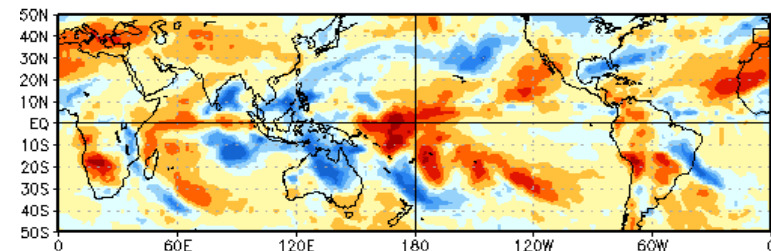
OLR Anomalies  
27 NOV 2022 to 6 DEC 2022



7 DEC 2022 to 16 DEC 2022

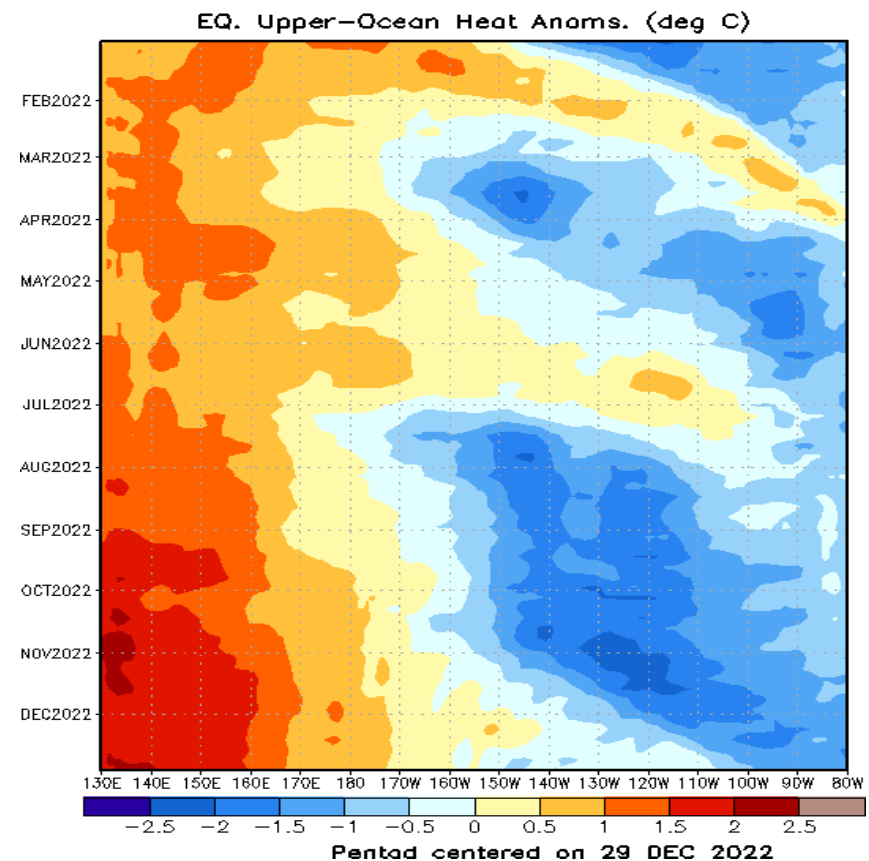
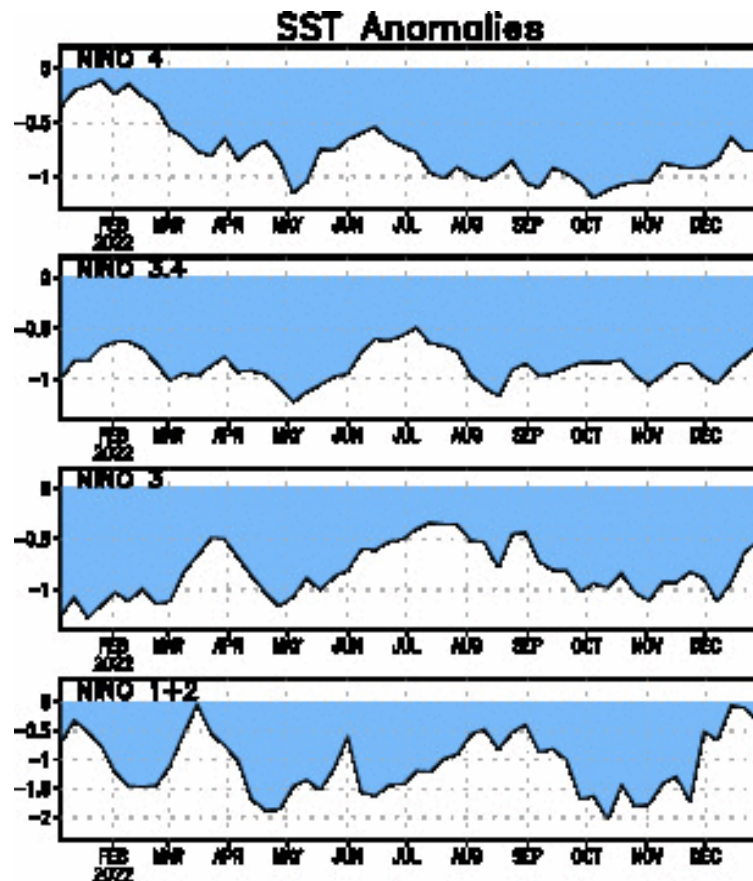


17 DEC 2022 to 26 DEC 2022



- The low frequency ENSO base state and MJO remain the most dominant features in the OLR field.
- Rossby wave activity has been interfering with the MJO, although a clear eastward propagation is noted with negative OLR anomalies increasing over the western Pacific.

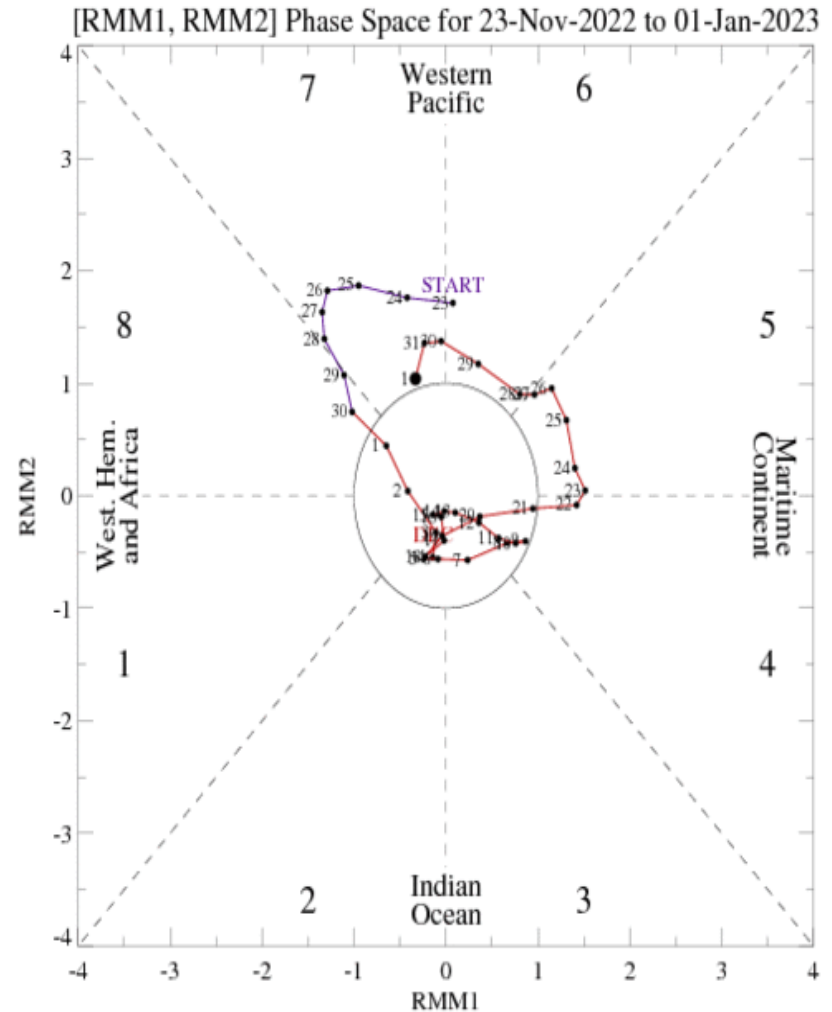
# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Positive upper-ocean heat content anomalies expanded across the Central Pacific throughout December.
- SSTs remain below average across all Niño basins, although a general warming trend is noted in all of the basins since early December.

# MJO Index: Recent Evolution

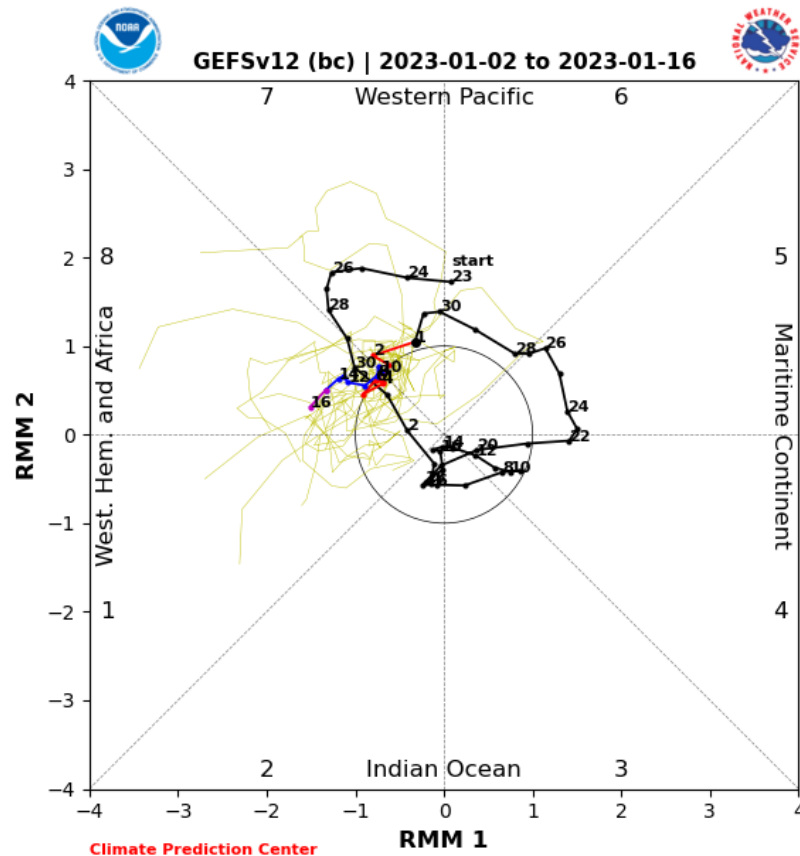
- During the past week, the RMM-based MJO index has propagated eastward from the Maritime Continent into the Western Pacific.



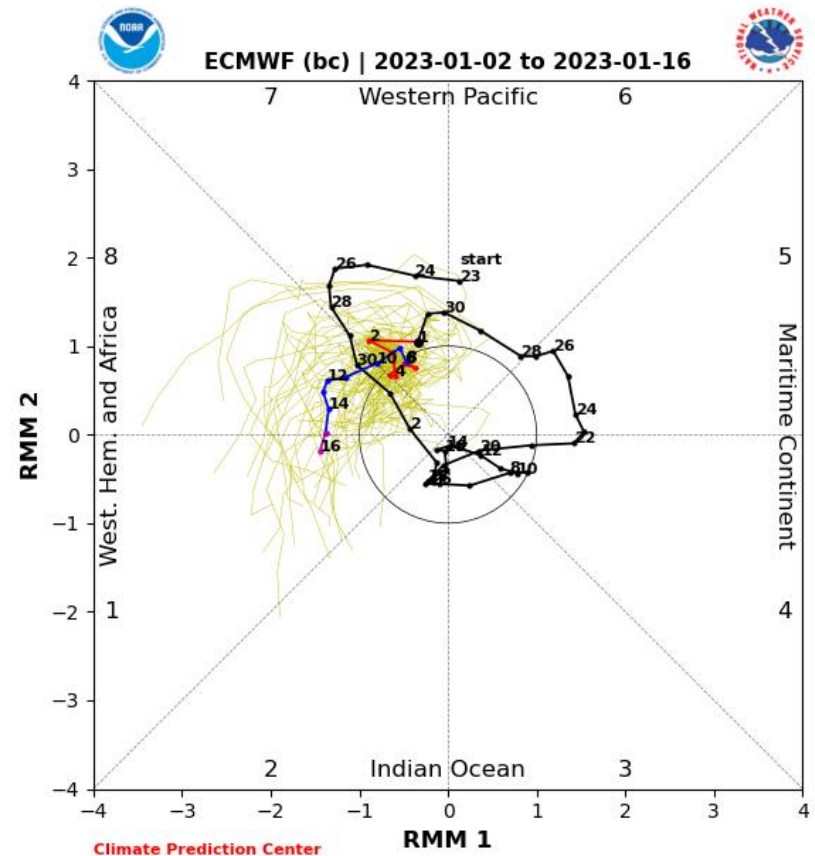
For more information on the RMM index and how to interpret its forecast please see:  
[https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC\\_MJOinformation.pdf](https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf)



# MJO Index: Forecast Evolution



**GEFS Forecast**



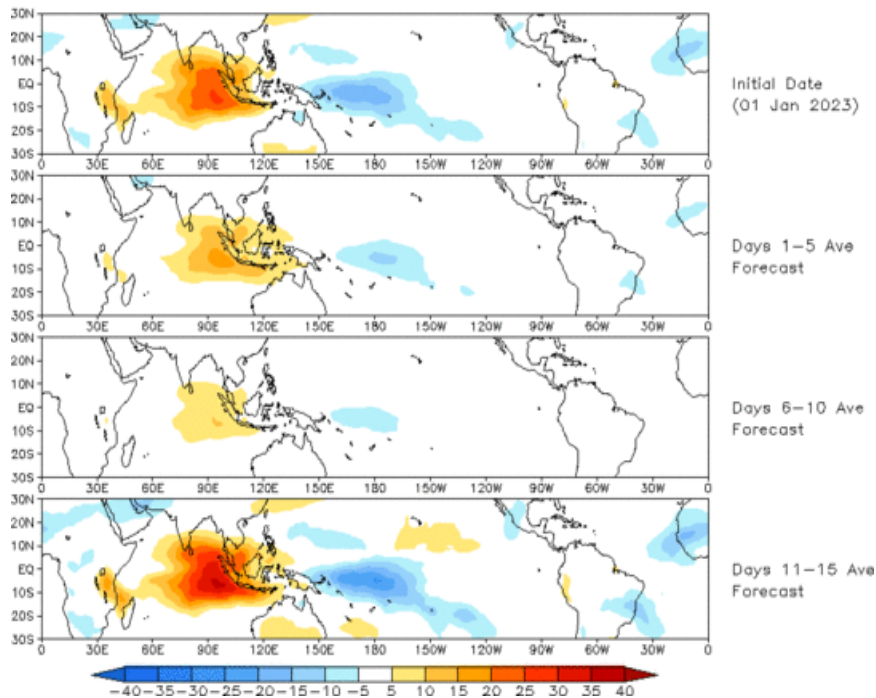
**ECMWF Forecast**

- Although some additional eastward propagation of the RMM-based MJO index is noted in the GEFS, the signal is fairly weak and incoherent with large ensemble spread.
- The ECMWF ensemble depicts a stronger and more coherent eastward propagation of the MJO into the Western Hemisphere.

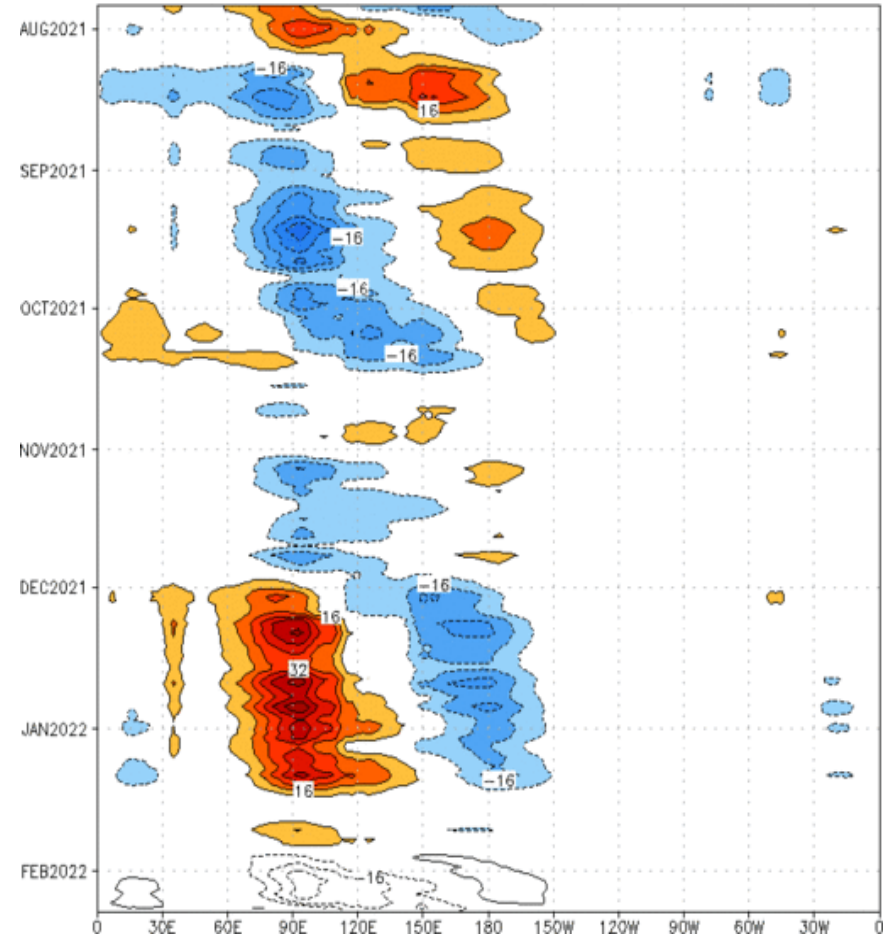
# MJO: GEFS Forecast Evolution

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: 01 Jan 2023  
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2  
OLR [7.5°S,7.5°N] (cont:4Wm<sup>-2</sup>) Period:27-Jul-2021 to 26-Jan-2022  
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

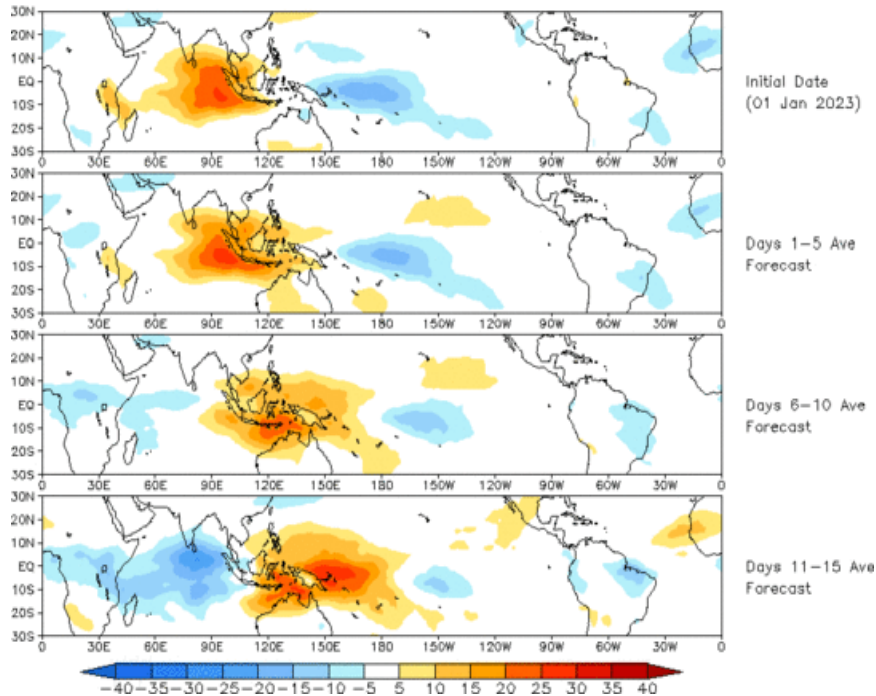


- The GEFS-based OLR anomaly fields depict negative OLR anomalies (enhanced convection) expanding across the central Pacific, and nearly stationary positive OLR anomalies (suppressed convection) over the Indian Ocean and Maritime Continent.

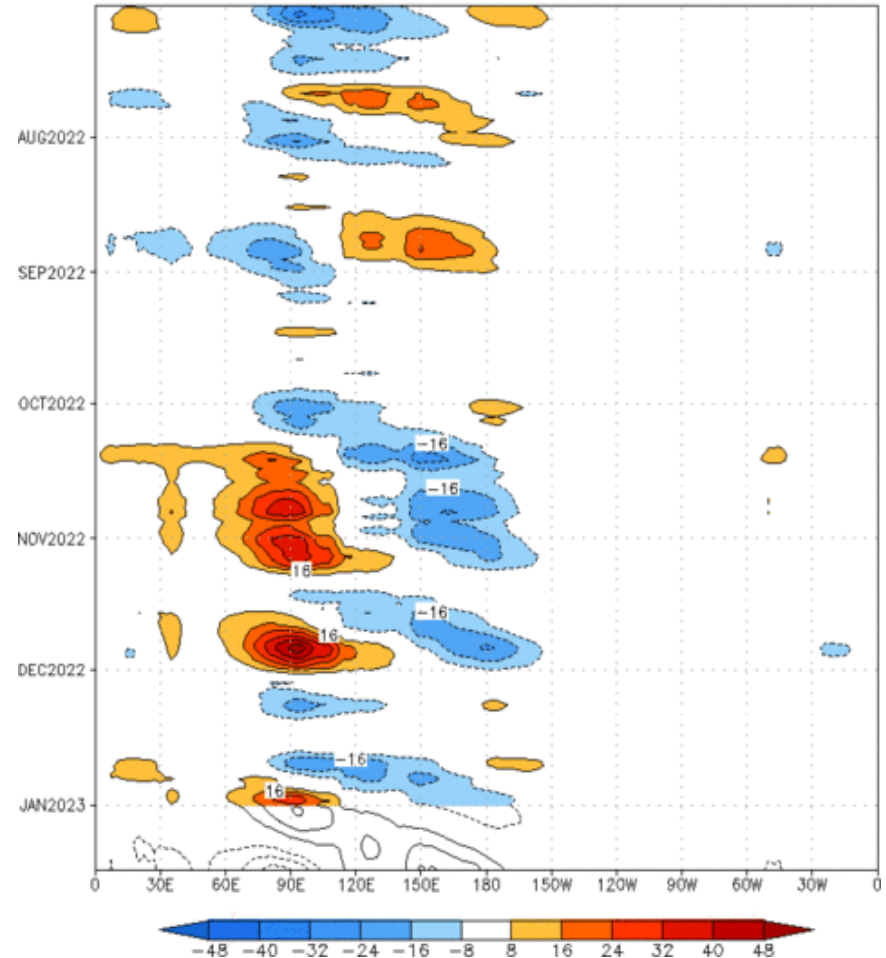
# MJO: Constructed Analog Forecast Evolution

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 (01 Jan 2023)



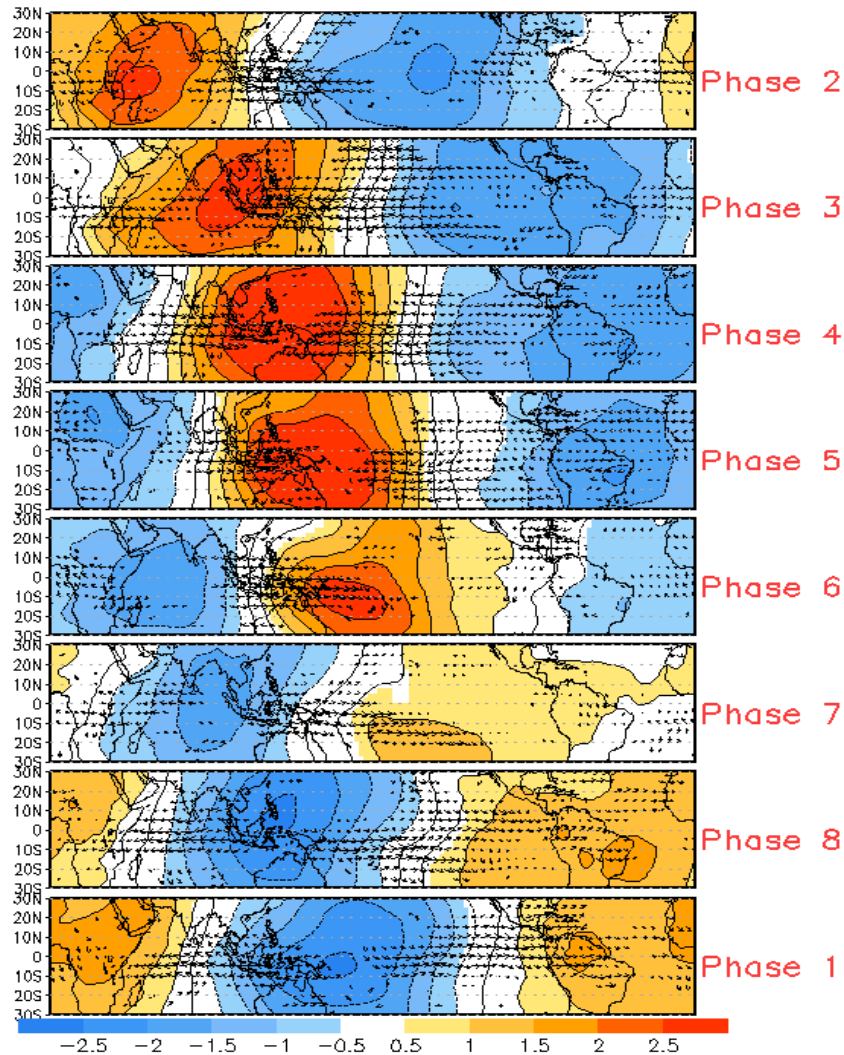
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm<sup>-2</sup>) Period:02-Jul-2022 to 01-Jan-2023  
The unfilled contours are CA forecast reconstructed anomaly for 15 days



- The constructed analog forecast of RMM-based OLR depicts a more robust eastward propagation of the positive and negative OLR anomalies compared to the GEFS, with negative OLR anomalies (enhanced convection) developing across the Indian Ocean during week-2.

# MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and  
Wind Anomalies



Precipitation Anomalies

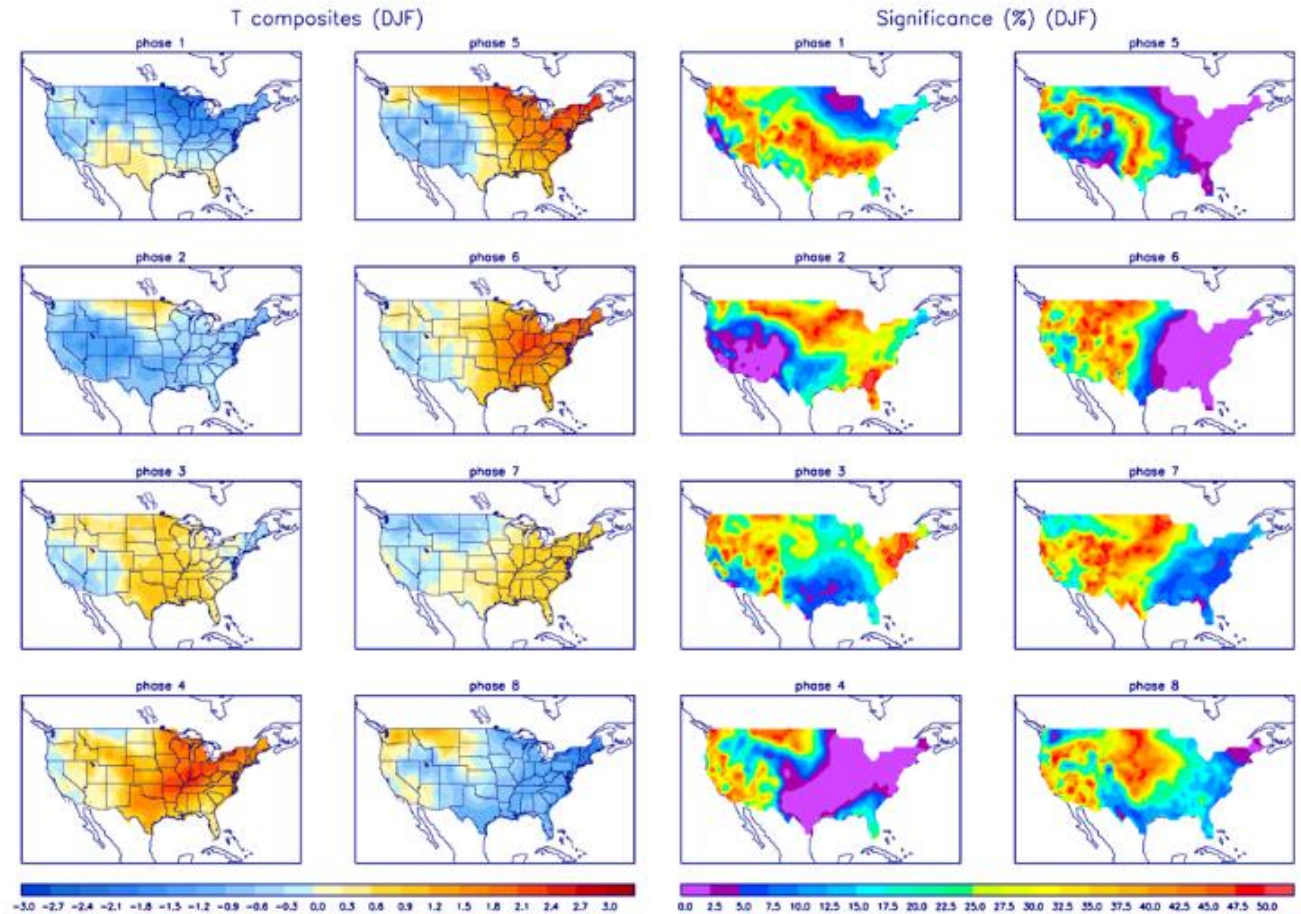




# MJO: CONUS Composite Maps by RMM Phase - Temperature

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 - Precipitation

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.

