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

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

Overview

- The MJO signal has weakened somewhat and its eastward propagation of tropical convection has stalled, but nonetheless the MJO is favored to re-strengthen and resume eastward propagation during week-2.

- Some changes in the observed wind patterns in both the lower and upper atmosphere portend a potential weakening of the long-lived La Nina.

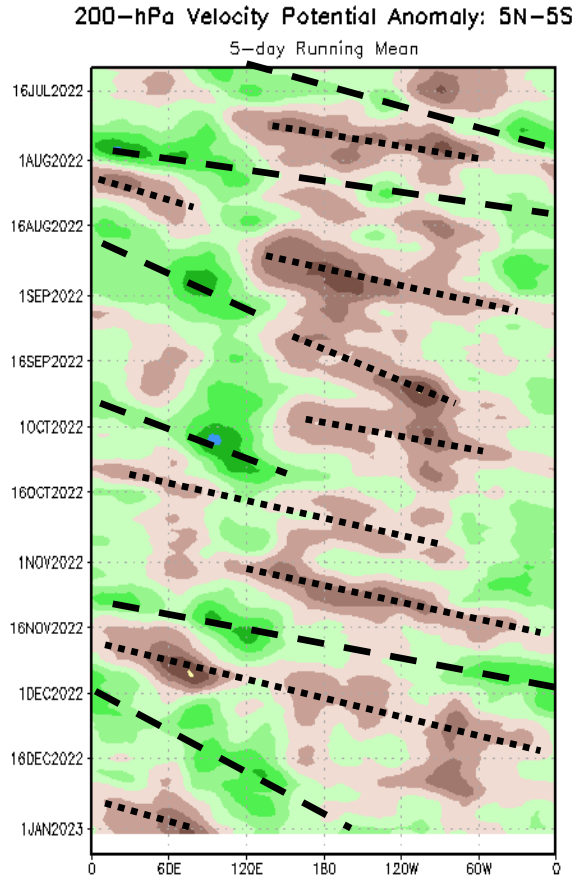
- Tropical cyclone (TC) activity has been relatively quiet recently, but some chances for TC formation in the southwestern Indian Ocean and South Pacific remain during week-2 time period.

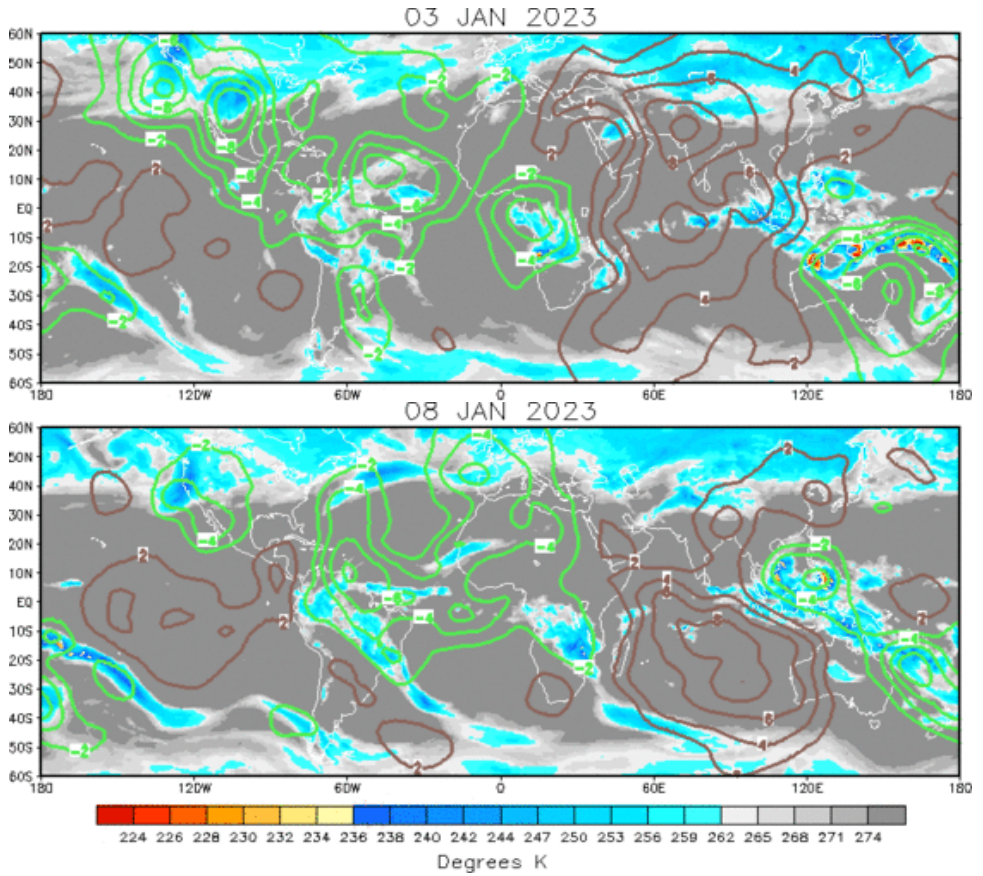
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)



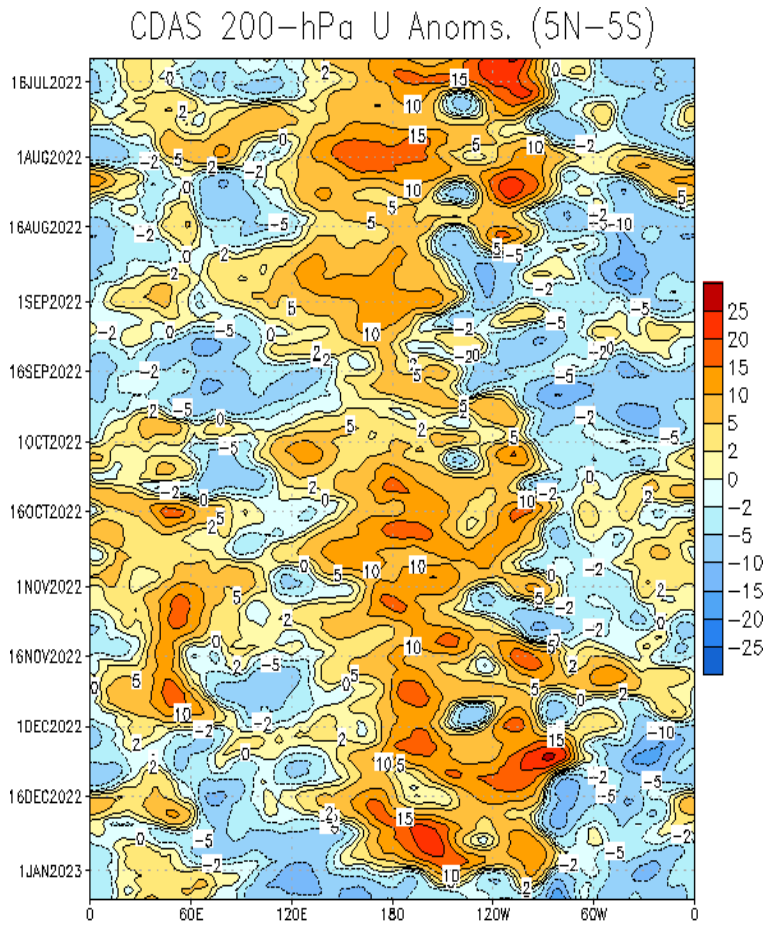


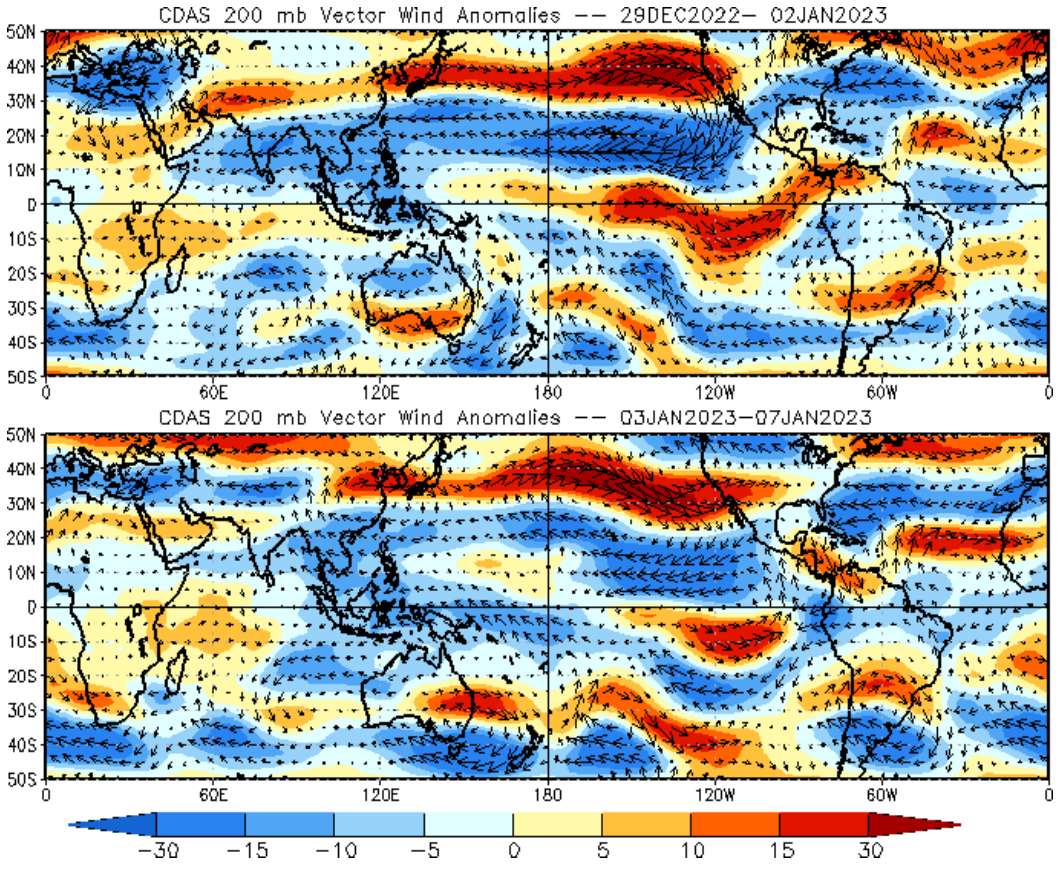
- An active, eastward propagating MJO signal is noted in the upper-level velocity potential field during the month of December.

- Anomalous upper-level divergence (enhanced convection) continues over and to the east of the Maritime Continent, potentially signaling a reducing influence from the La Nina base state.

200-hPa Wind Anomalies

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

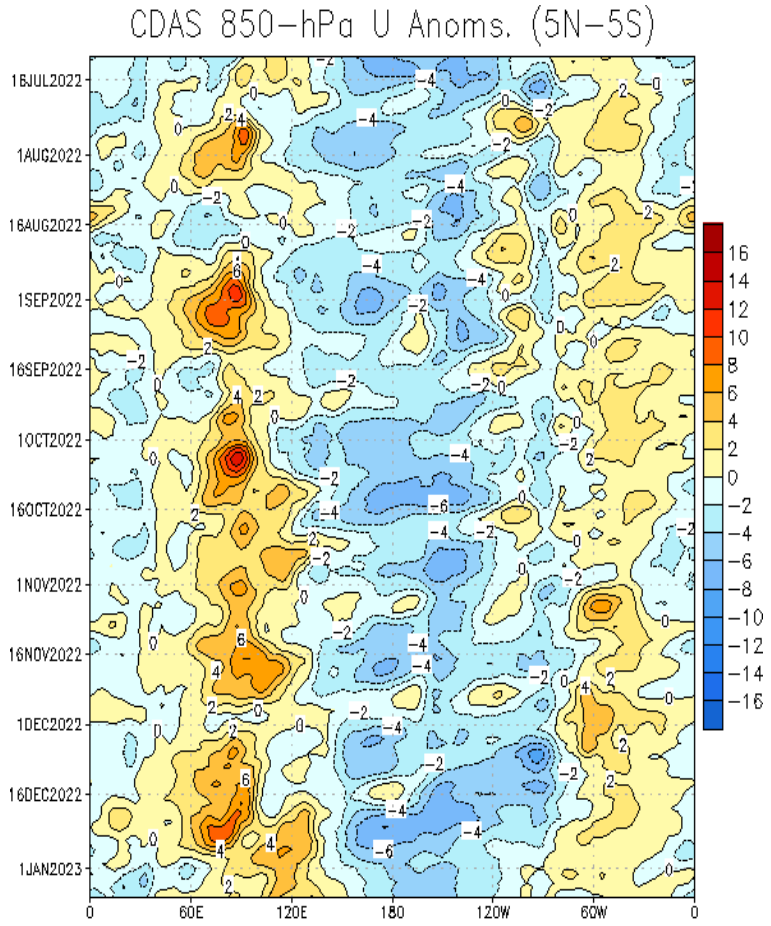


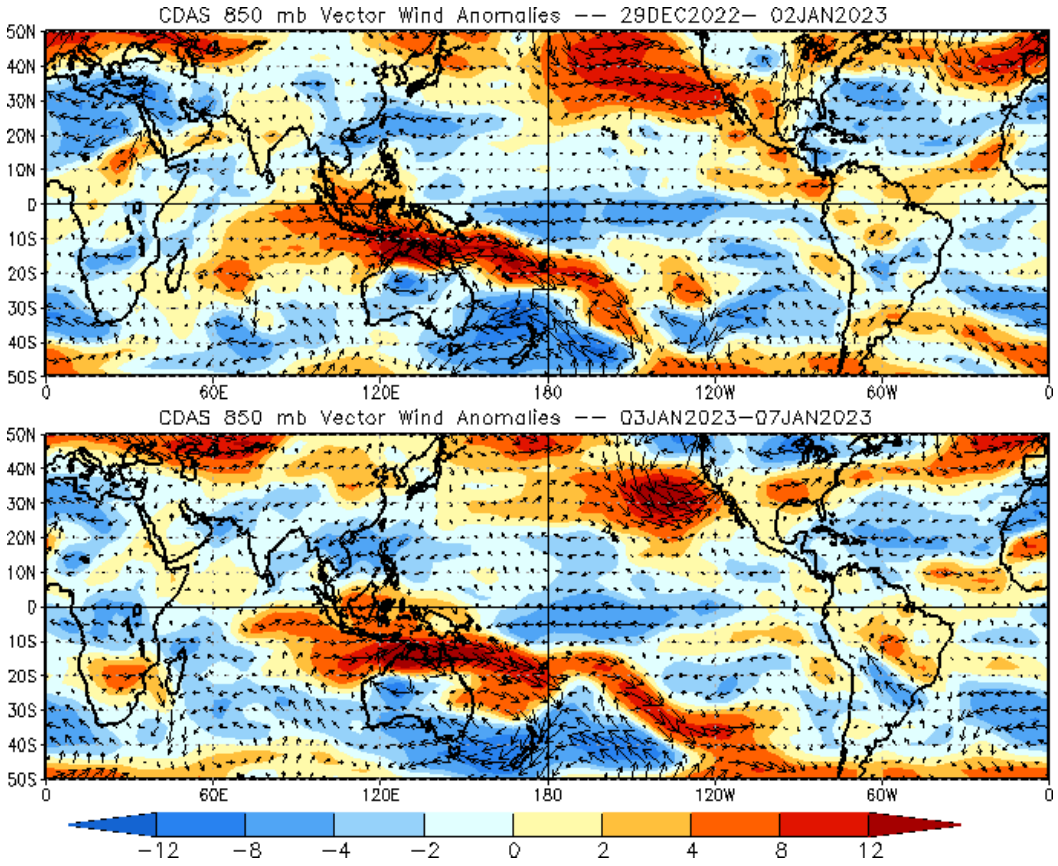


- There has been a large shift in the tropical upper-level flow pattern. Persistent anomalous westerlies near and east of the Date Line have been replaced by weak anomalous easterlies. A large anticyclonic circulation aloft over the northwest Pacific might be playing a role in eroding this persistent wind feature.
- The most recent slackening of the anomalous easterlies occurred in September 2022, though the current break is more pronounced, at least initially, with westerly anomalies completely eliminated over the tropical Pacific north of the equator.

850-hPa Wind Anomalies

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

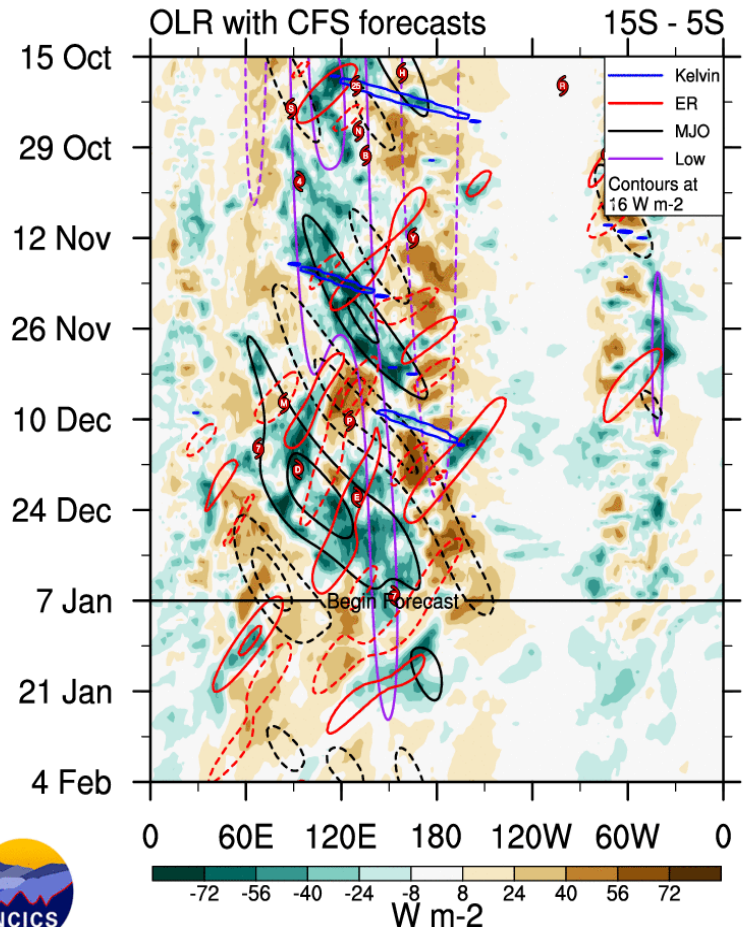


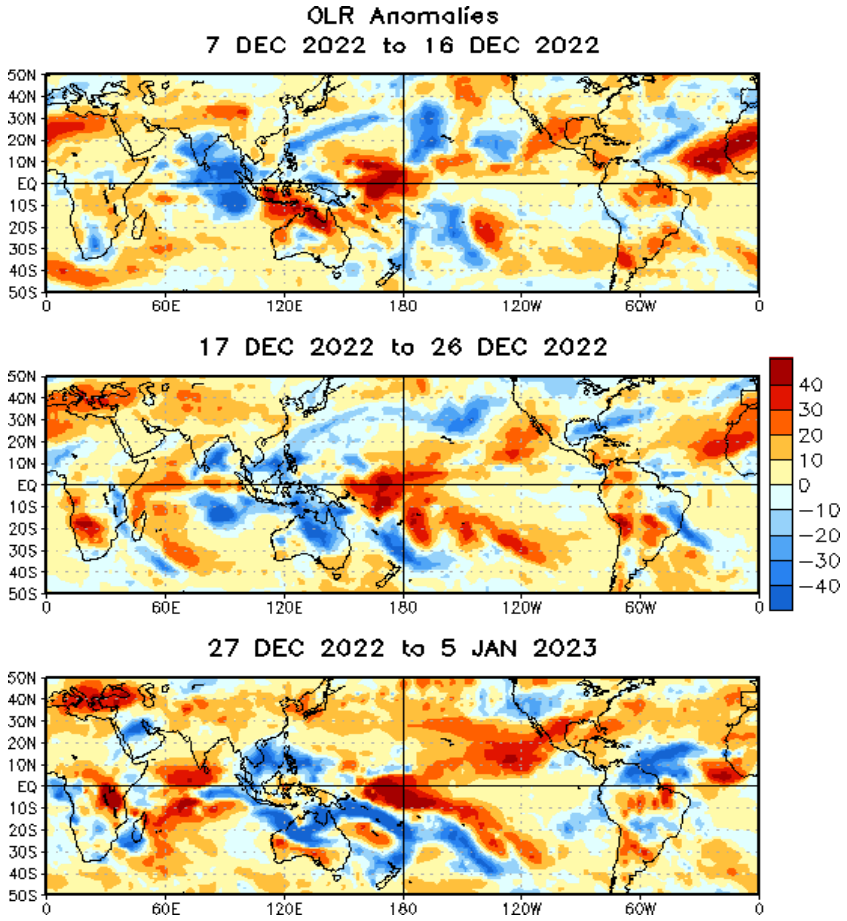


- Large low-level westerly wind anomalies dominate the northeast Pacific, with pronounced onshore flow and atmospheric river activity continuing along the west coast of the Contiguous U.S.
- Strong low level westerlies persist across the Maritime Continent and southwest Pacific, leading to increased convergence near the surface.
- Enhanced trades (easterlies) continue across the equatorial central Pacific, though their areal coverage has been reduced in recent weeks.

Outgoing Longwave Radiation (OLR) Anomalies

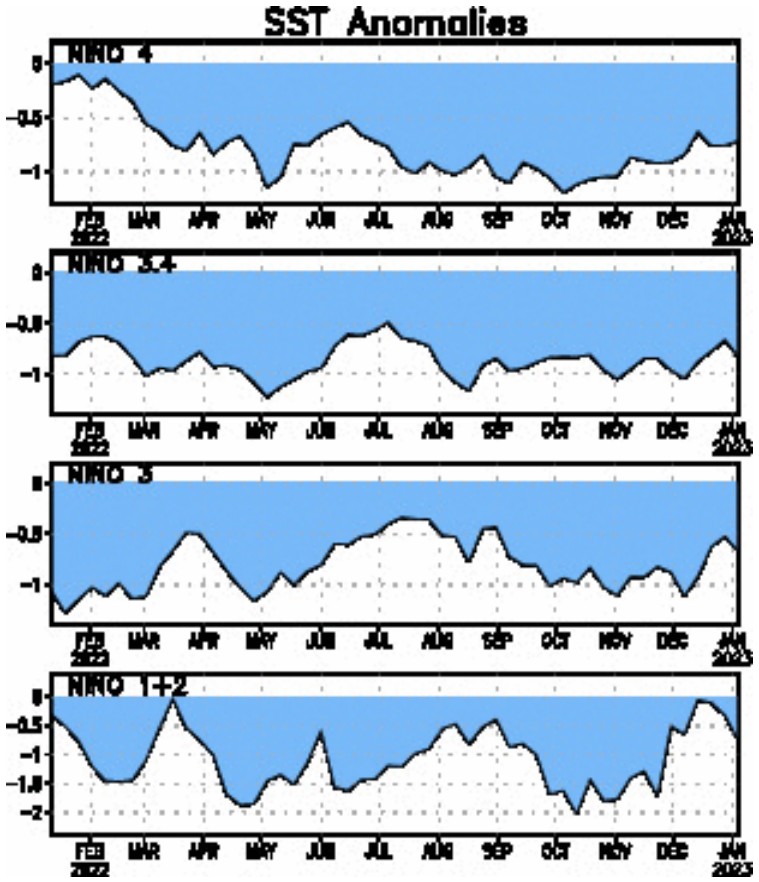
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

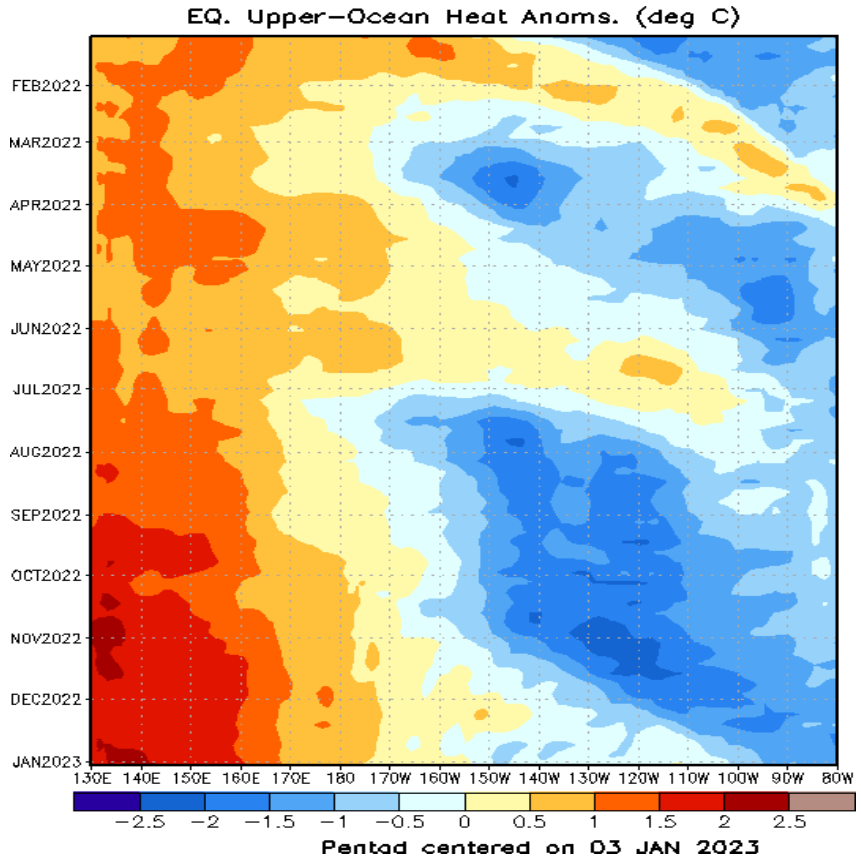




- The low frequency La Nina base state and MJO remain the most dominant features in the OLR field.
- Rossby wave activity and La Nina has been interfering with the MJO, although a clear eastward propagation is noted with negative OLR anomalies traversing the Maritime Continent and tropical South Pacific.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

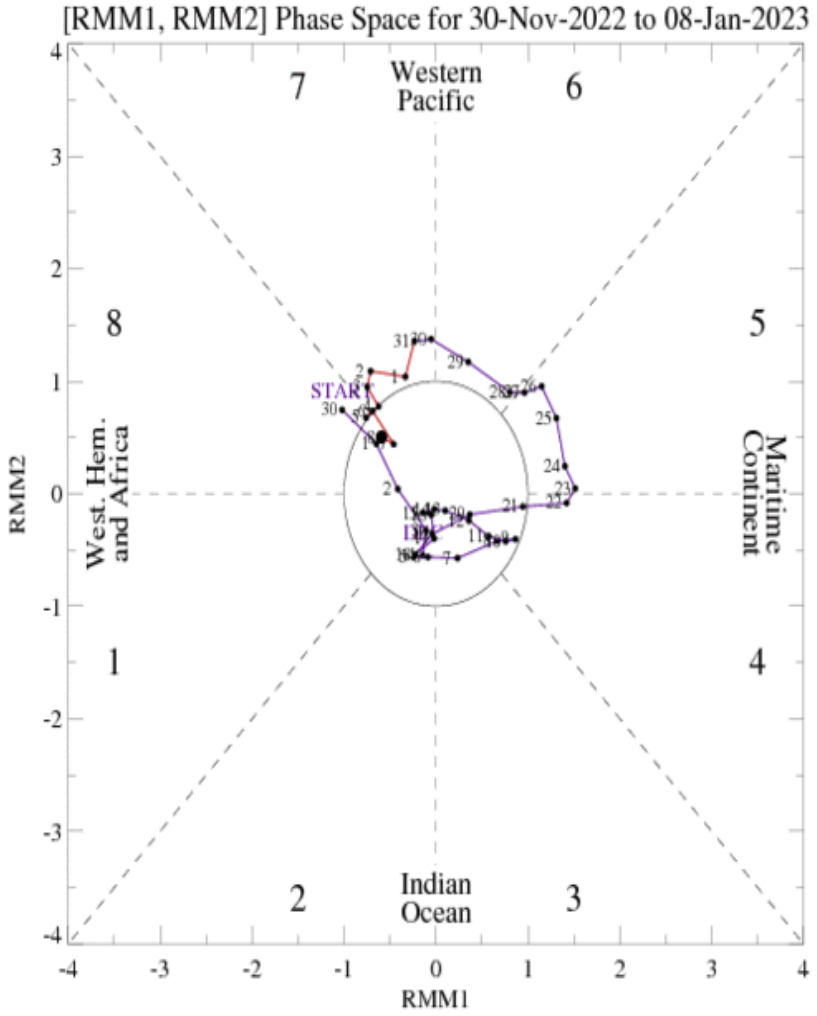




- Positive upper-ocean heat content anomalies expanded across the Central Pacific throughout December and negative anomalies continue to decrease in magnitude.
- SSTs remain below average across all Niño basins, although a general warming trend is noted in all of the basins since early December.

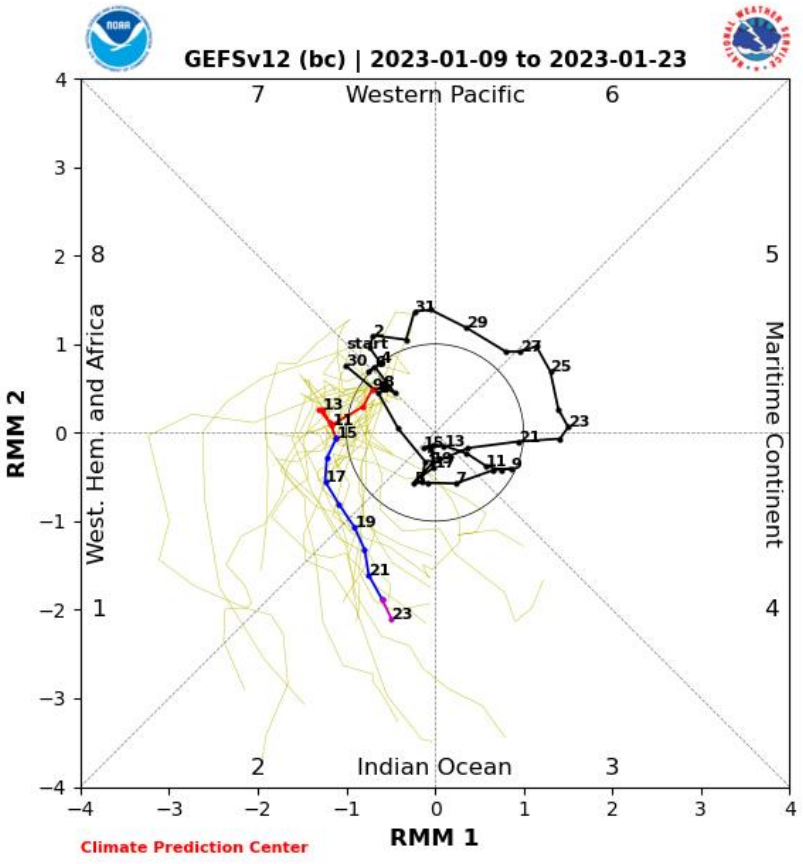
MJO Index: Recent Evolution

- During the past week, the RMM-based MJO index has weakened somewhat and slowed its eastward progression. The index is currently in phase 8 (Western Hemisphere) inside the unit circle.

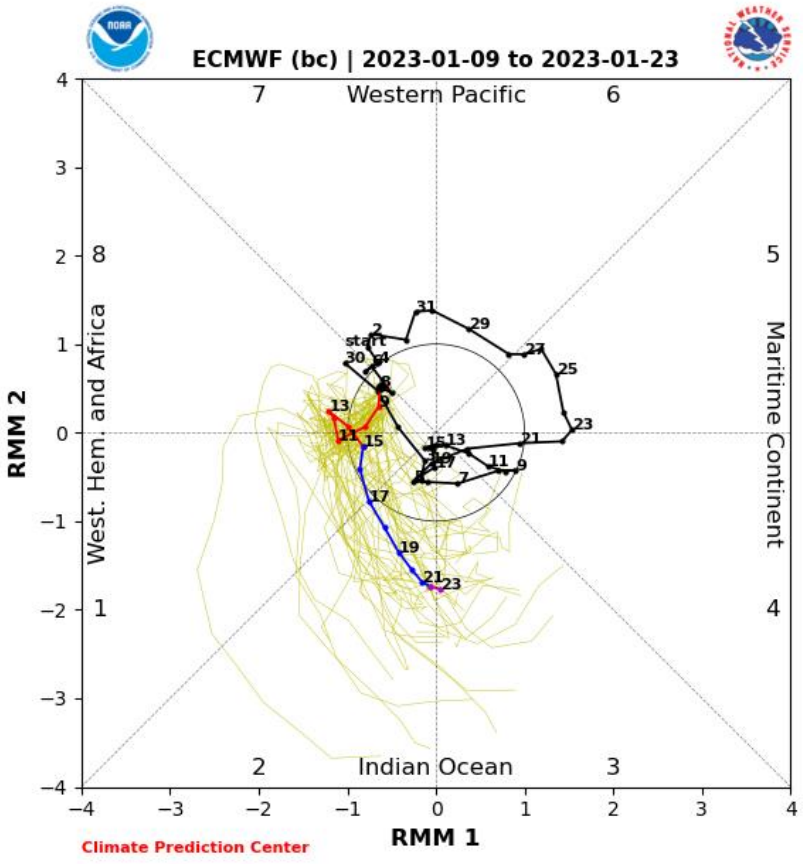


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

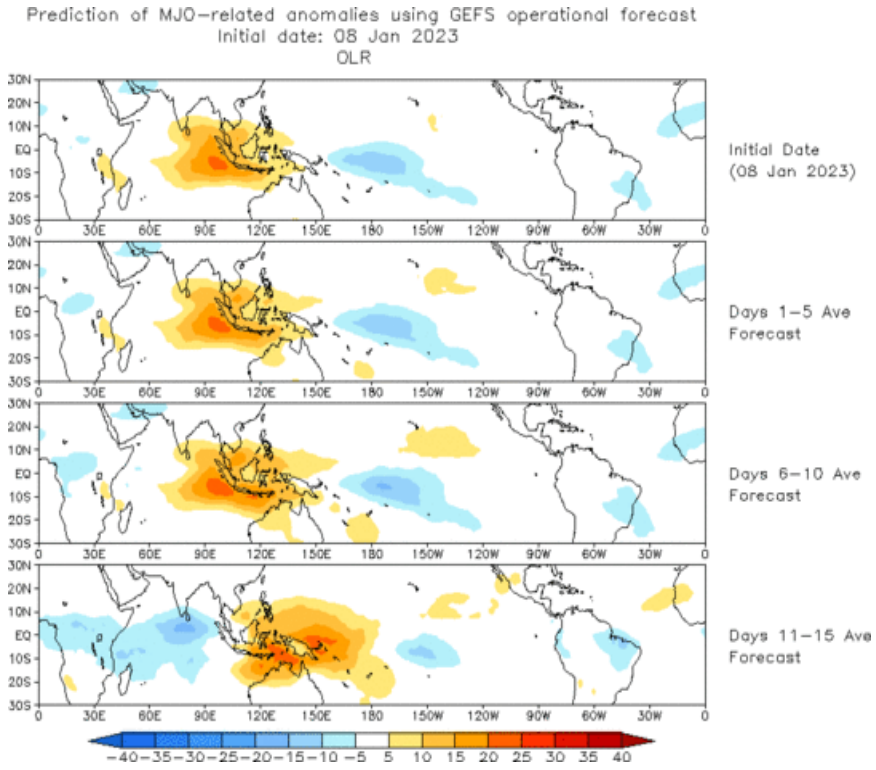


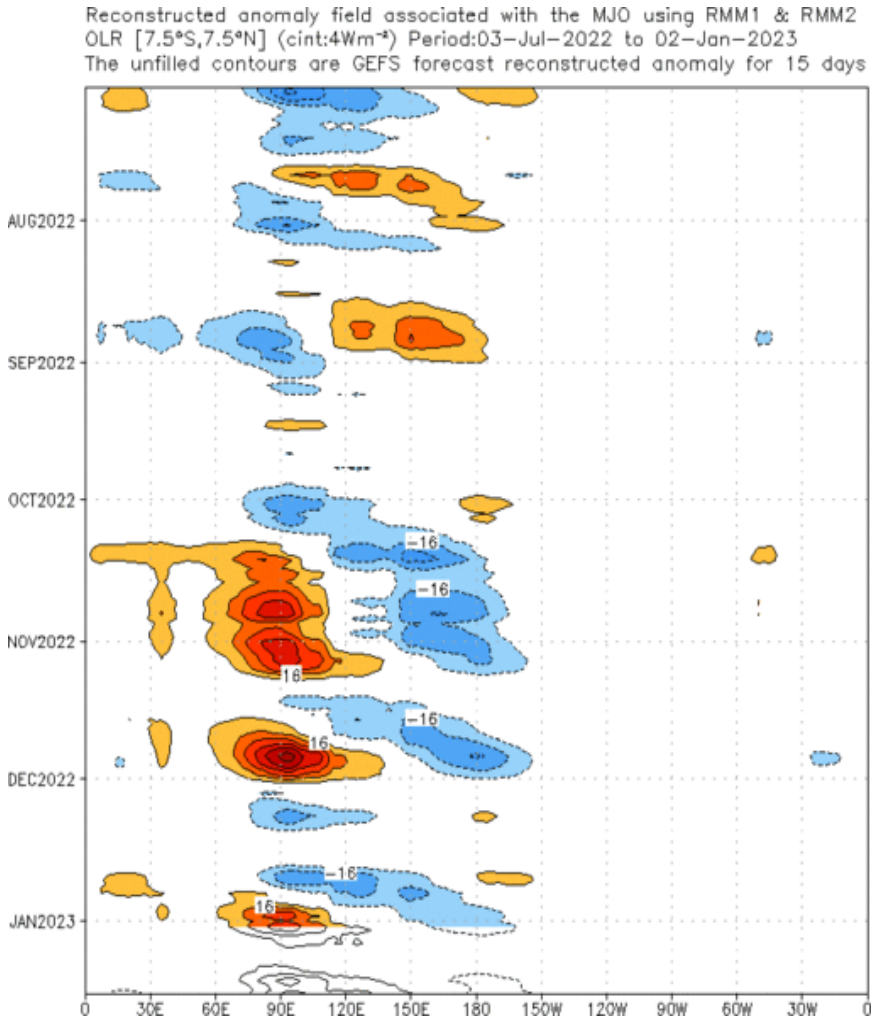
ECMWF Forecast

- There is good agreement between various model solutions depicting a brief stalling of eastward propagation of MJO signal before once again shifting eastward and intensifying during the week 2-3 time period.
- ECMWF solutions generally favor faster eastward movement early in forecast period.

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.)

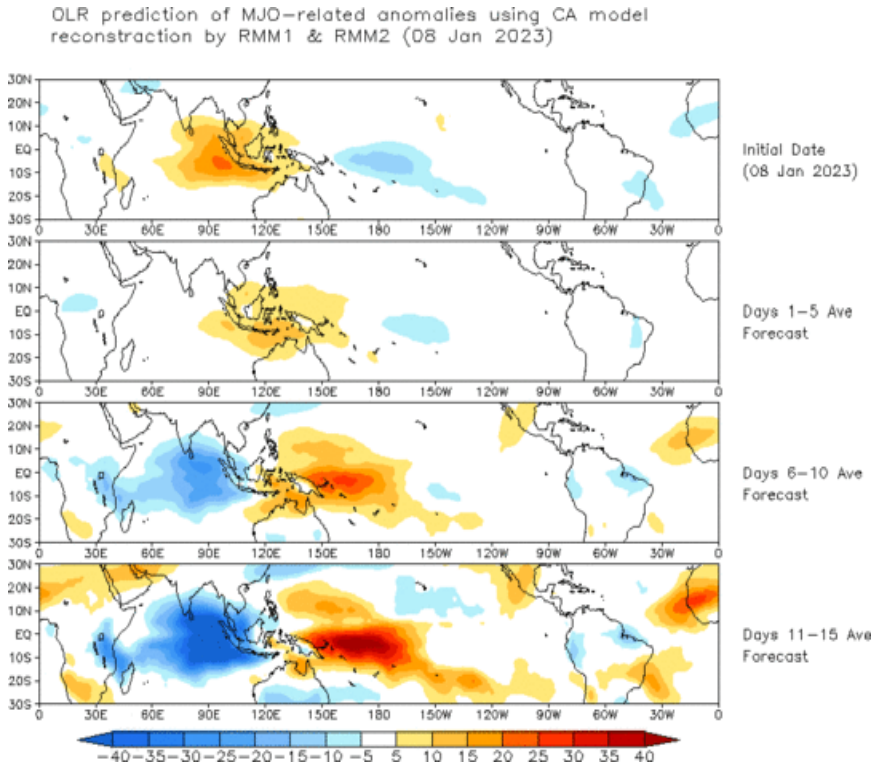


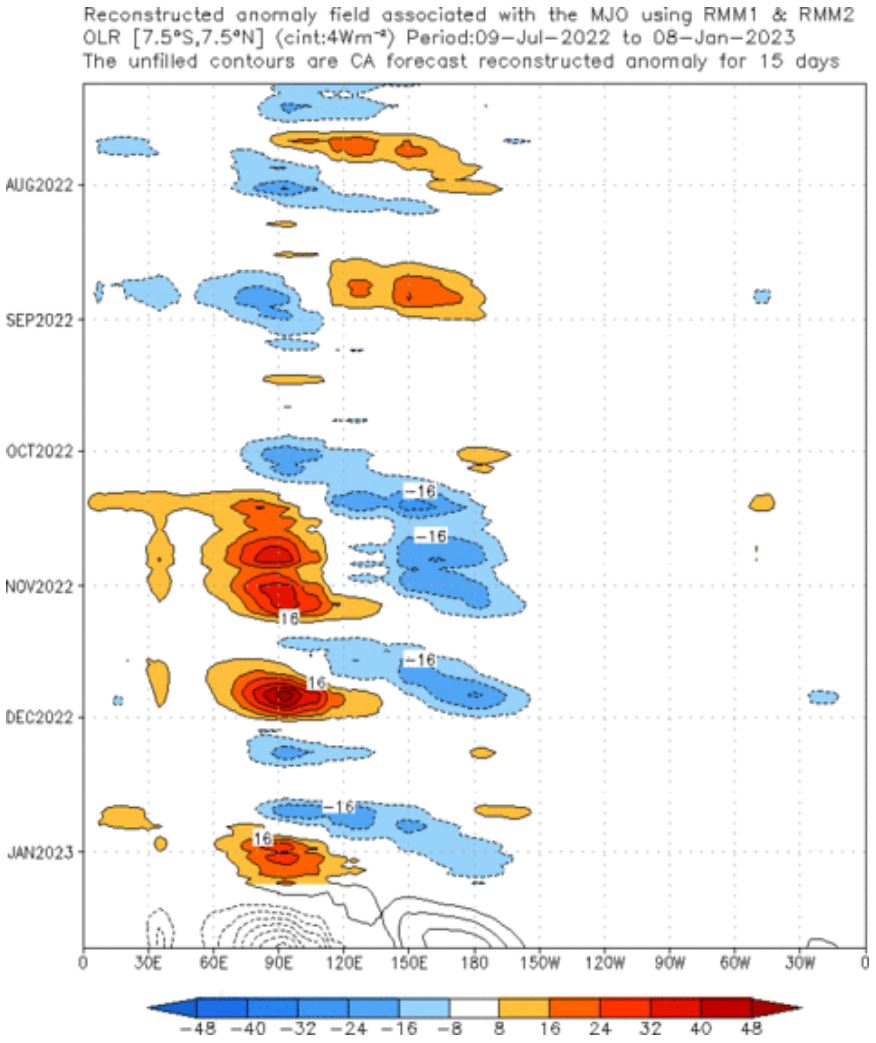


- The GEFS-based OLR anomaly fields depict nearly stationary positive OLR anomalies (suppressed convection) over the Indian Ocean and Maritime Continent early, before resuming eastward propagation of the signal late in week-2.

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.)

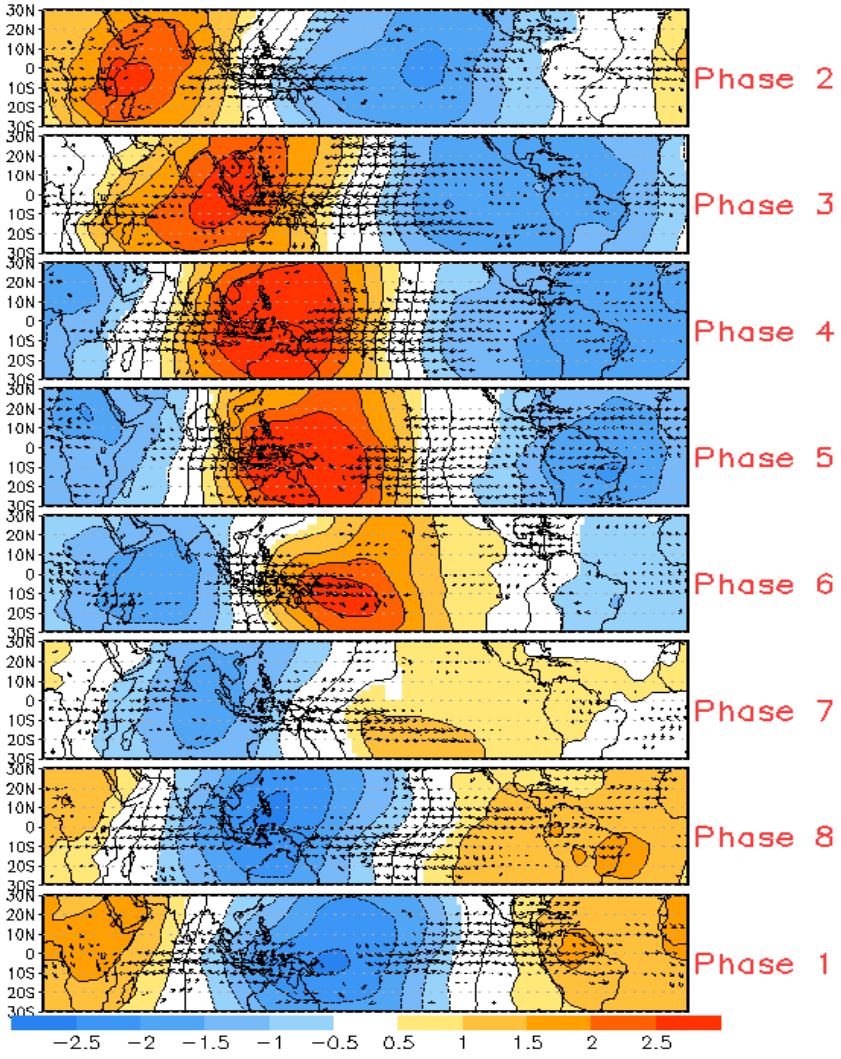




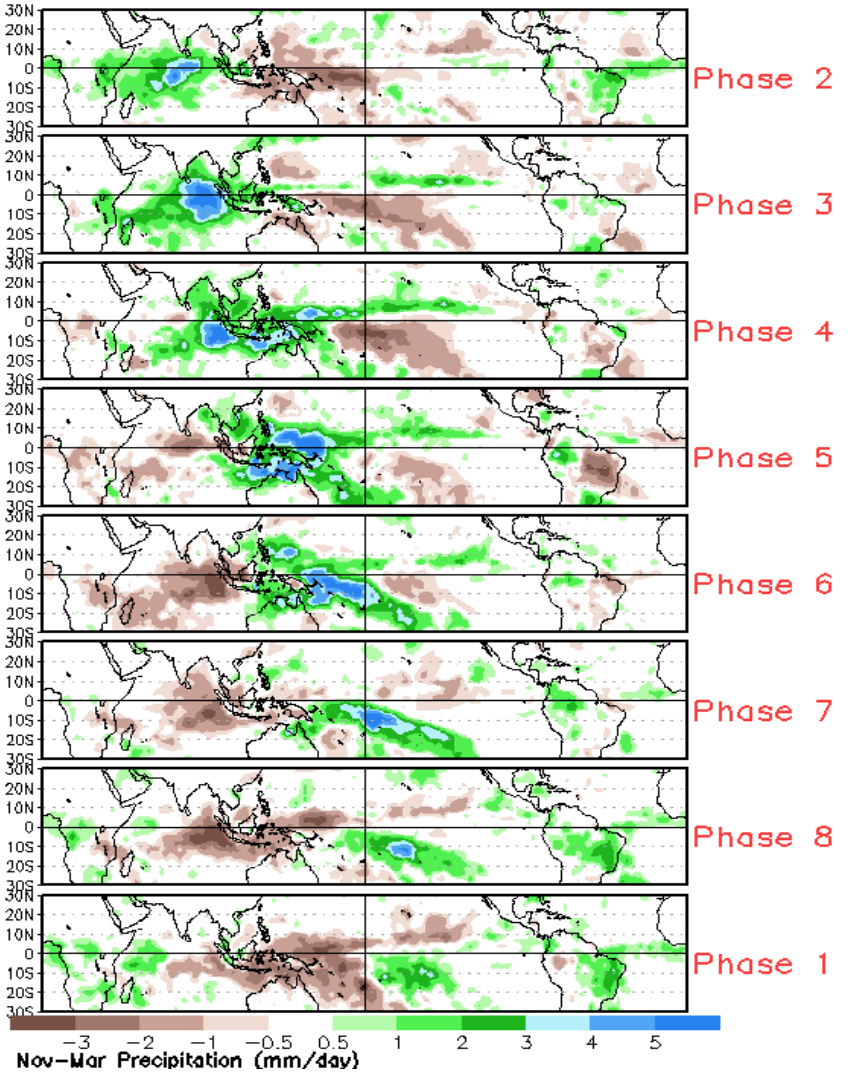
- The constructed analog forecast of RMM-based OLR depicts a more robust eastward propagation initially of the OLR anomalies compared to the GEFS, along with a strengthening of OLR dipole over the eastern Indian Ocean/Western Pacific in week-2.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



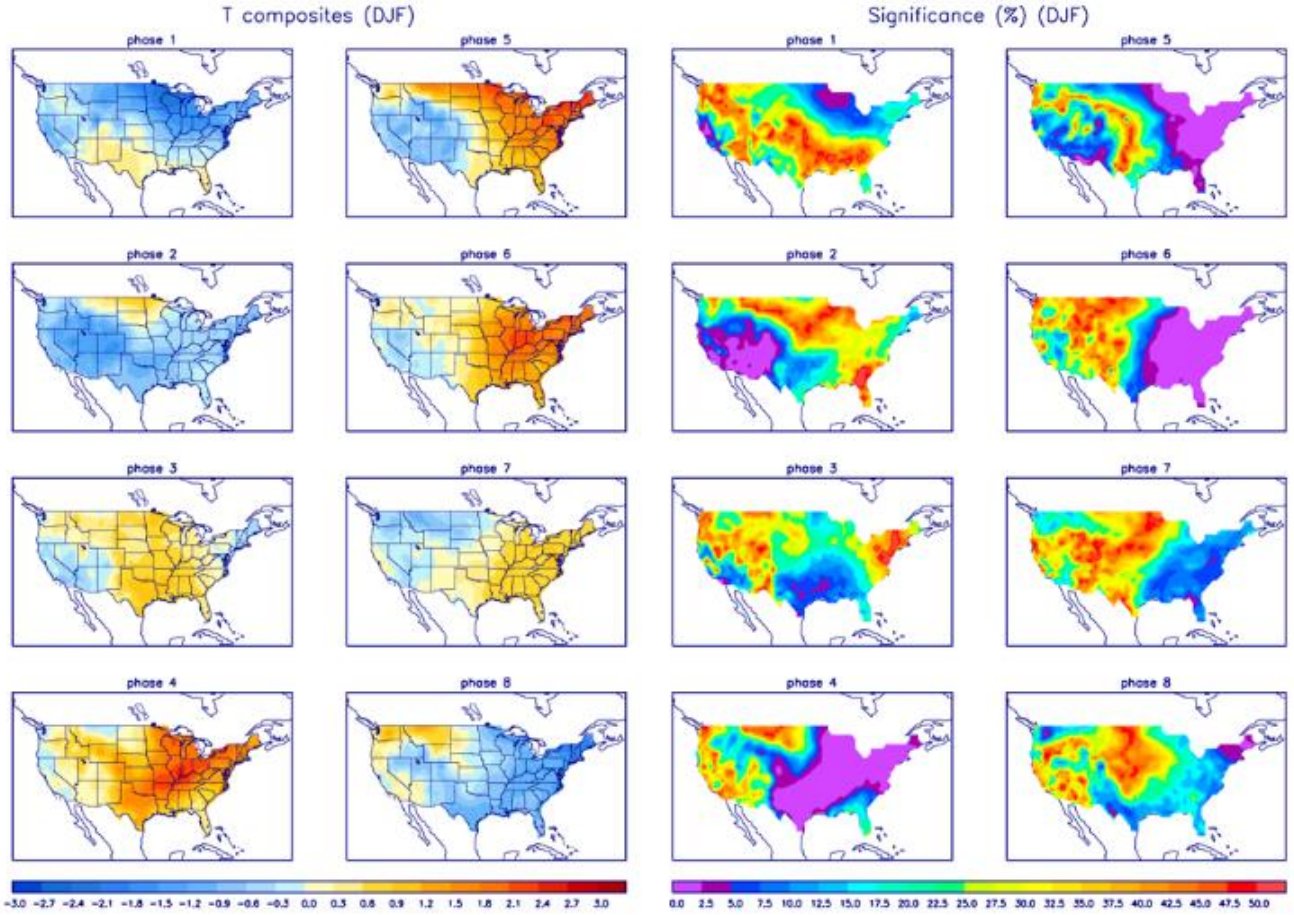
Precipitation Anomalies



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.

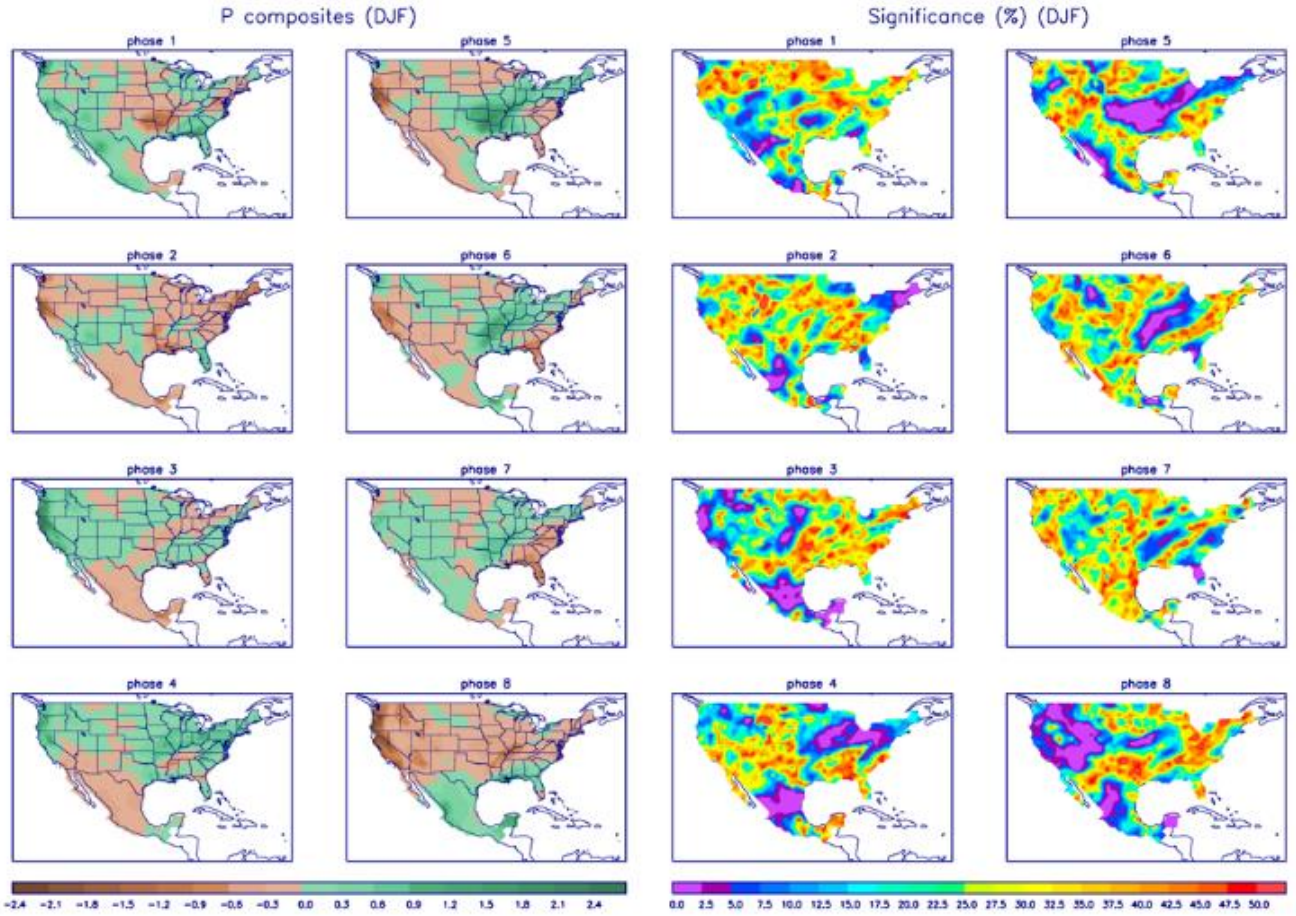


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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.



More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml