

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



**Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
25 March 2024**

Overview

- A strong MJO event continues, with the intraseasonal signal now moving across the Western Hemisphere (phases 8 and 1).
- The MJO is forecast to continue its eastward propagation returning to the Indian Ocean by early April, although dynamical models suggest a possible slower phase speed and weakening in amplitude.
- This MJO evolution favors increasing tropical cyclone activity across portions of the Indian Ocean and eventually toward northern Australia by week-3. However, the decreasing seasonal climatology keeps confidence on the lower side.

A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:

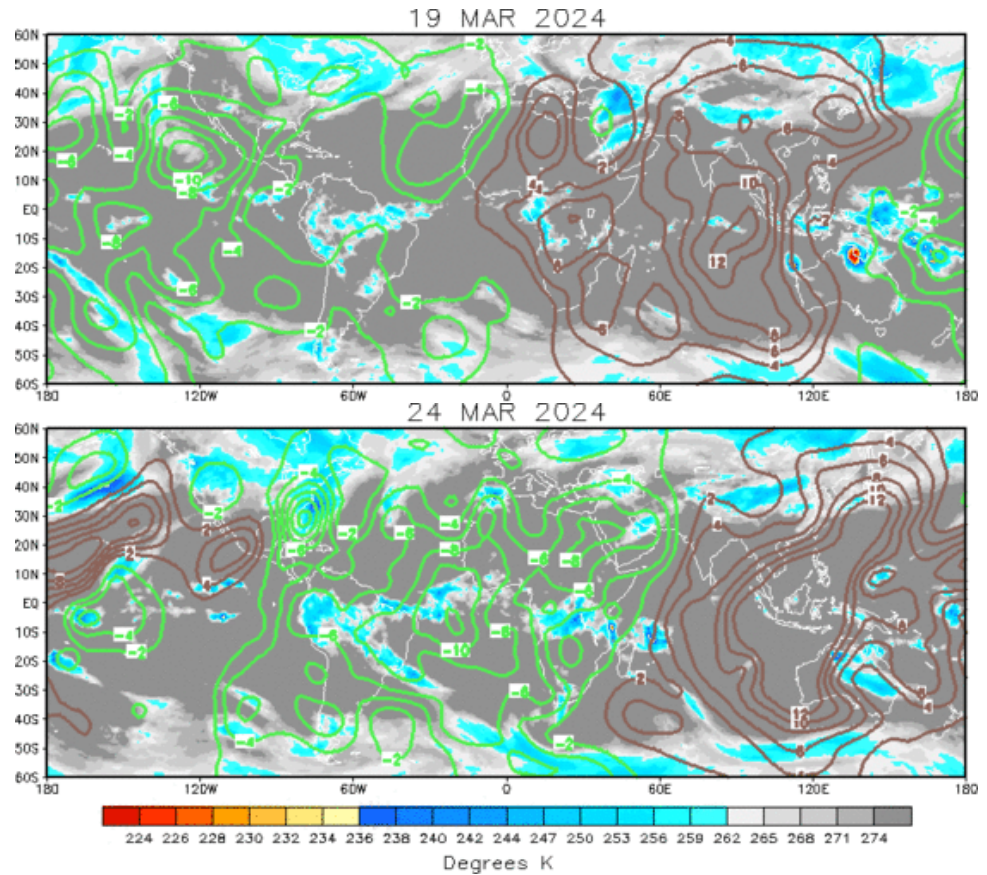
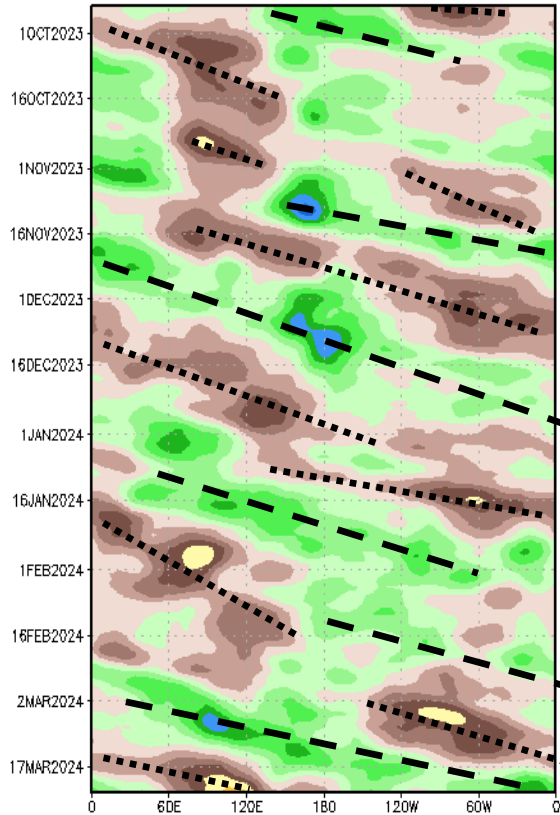
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

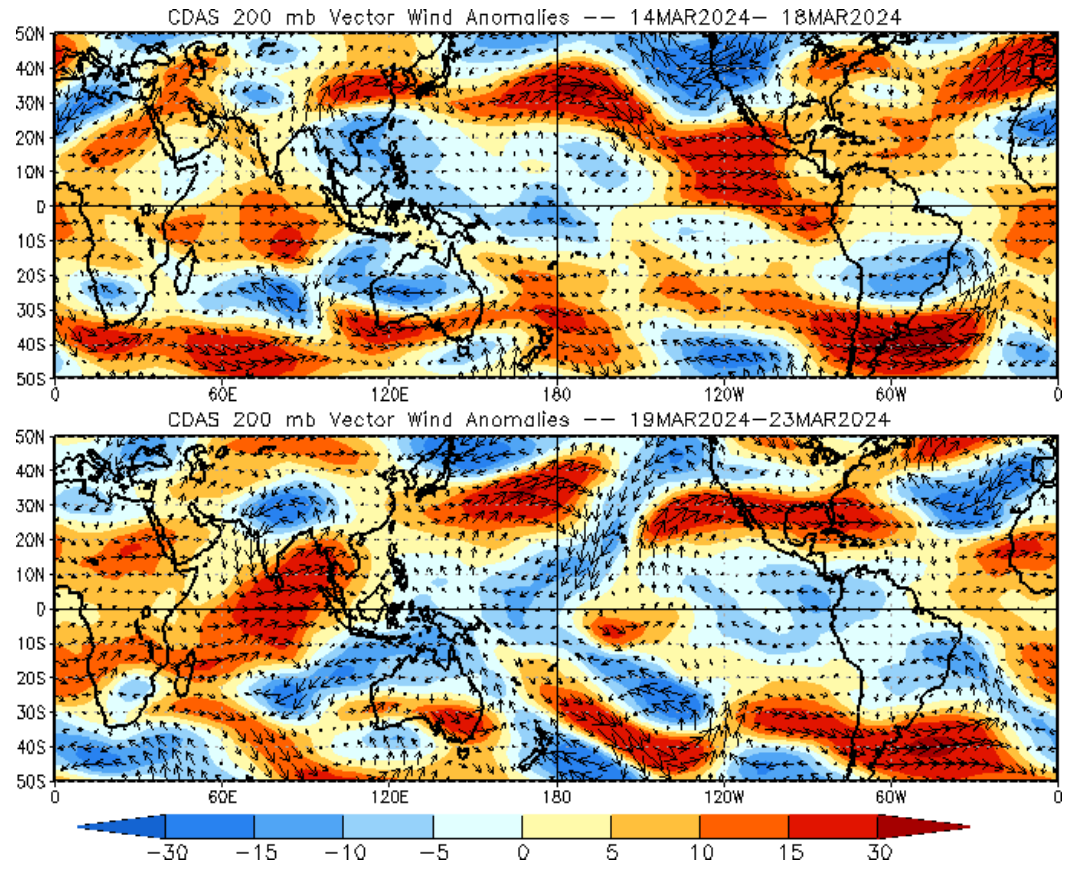
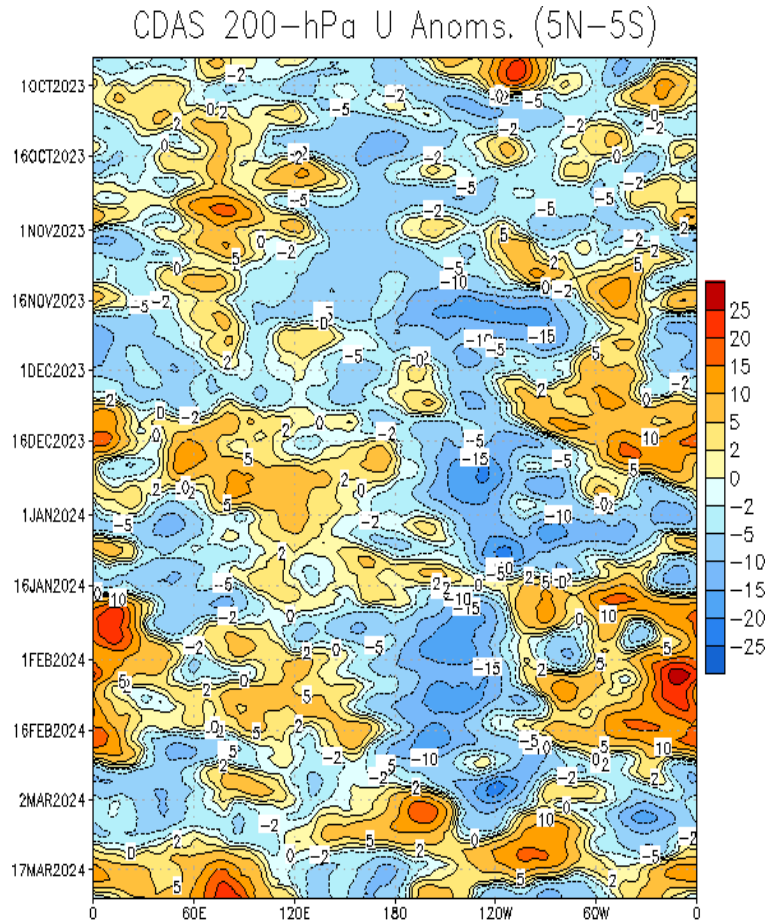
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- The upper-level velocity potential time-lon plots indicates a complete circumnavigation of positive anomalies during the past month.
- A wave-1 asymmetry continues to be reflected in the global upper-level velocity potential field with a slight eastward shift compared to last week.
- Enhanced convection tied to El Niño over the central Pacific results in some destructive interference with the overall suppressed convective signal moving over the region.

200-hPa Wind Anomalies

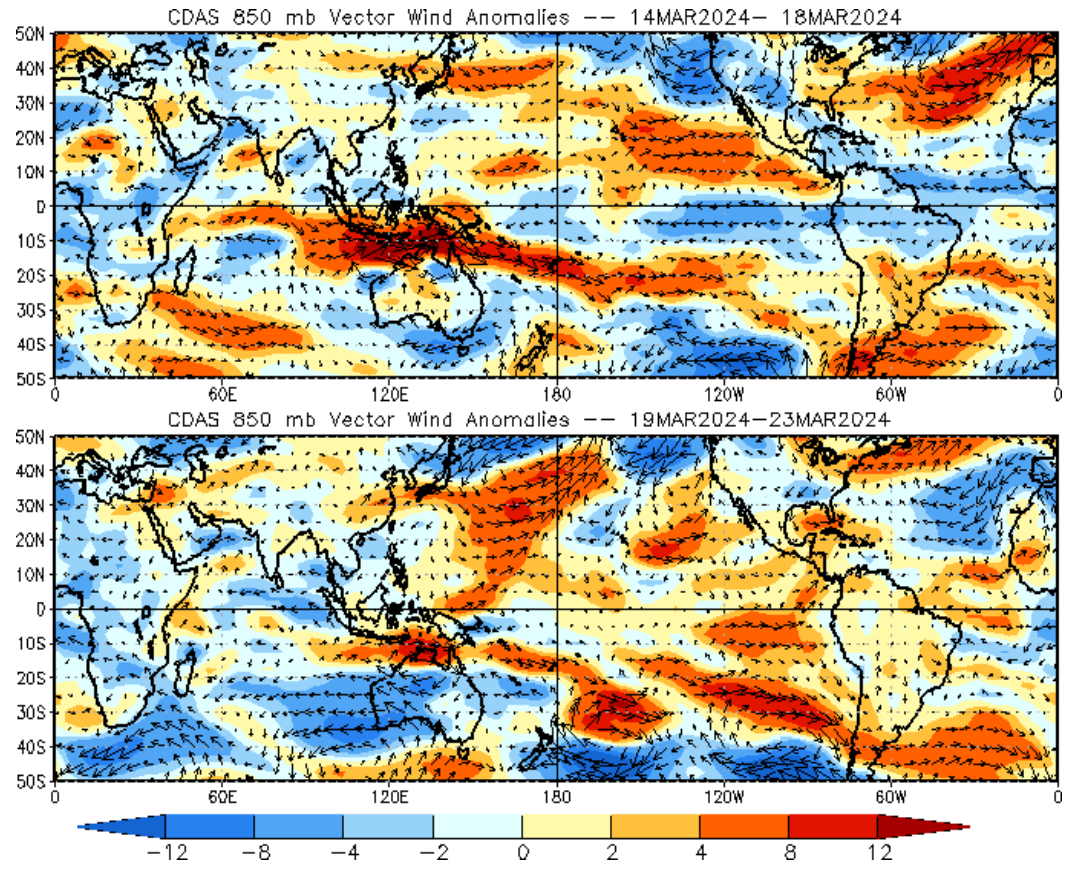
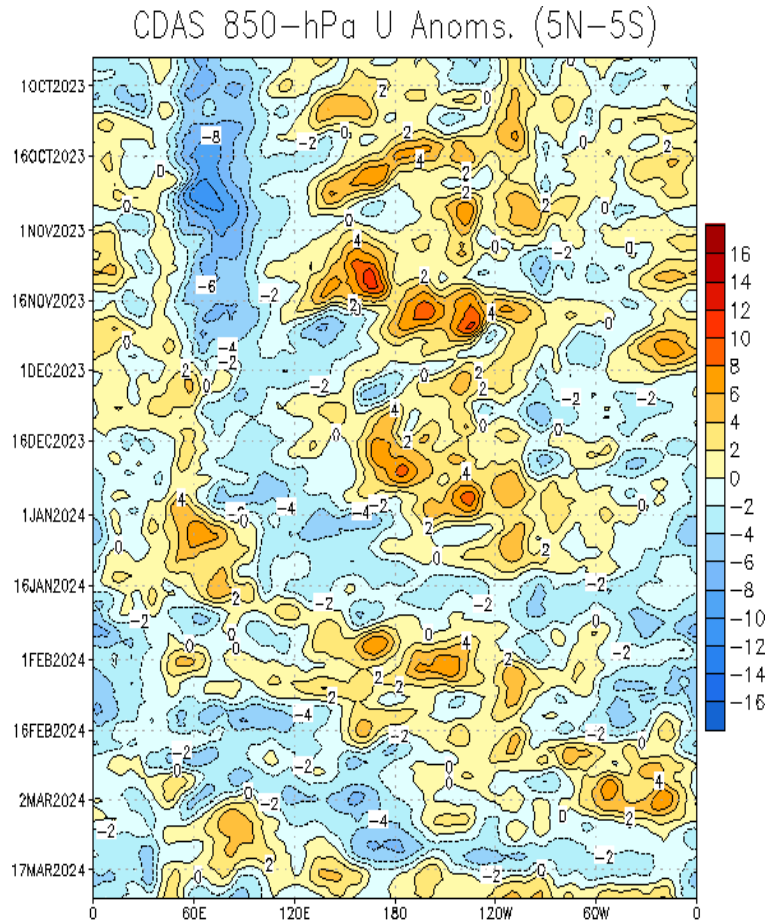
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- The time-lon plot depicts an eastward propagation of anomalous upper-level westerlies around the globe tied to the recent MJO propagation.
- In the wake of the MJO, anomalous upper-level easterlies are returning to parts of the equatorial Pacific.
- An active subtropical jet is evident over southern North America, with anomalous upper-level easterlies noted over the western United States.

850-hPa Wind Anomalies

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

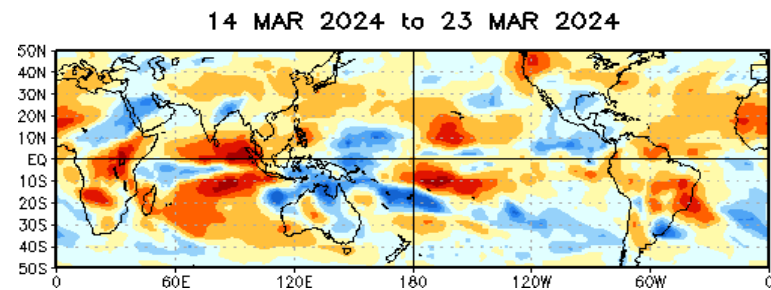
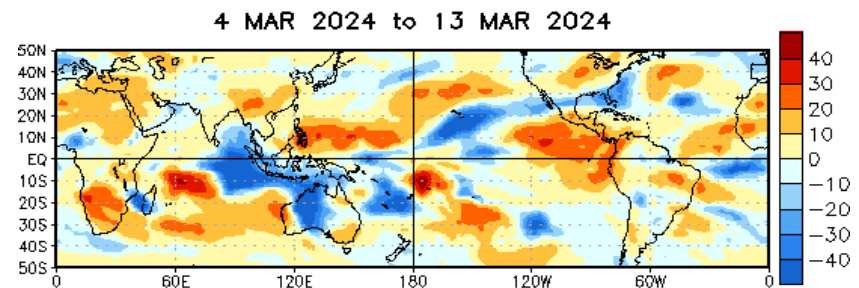
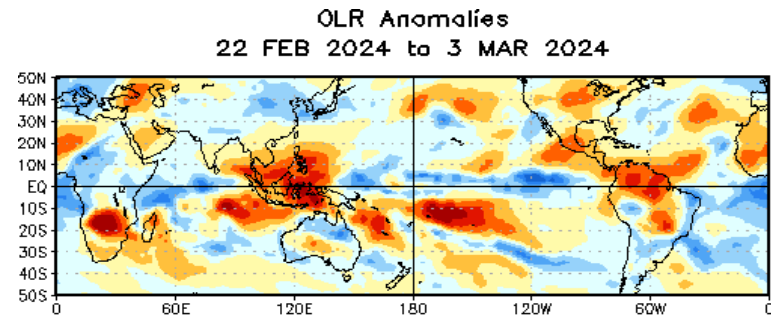
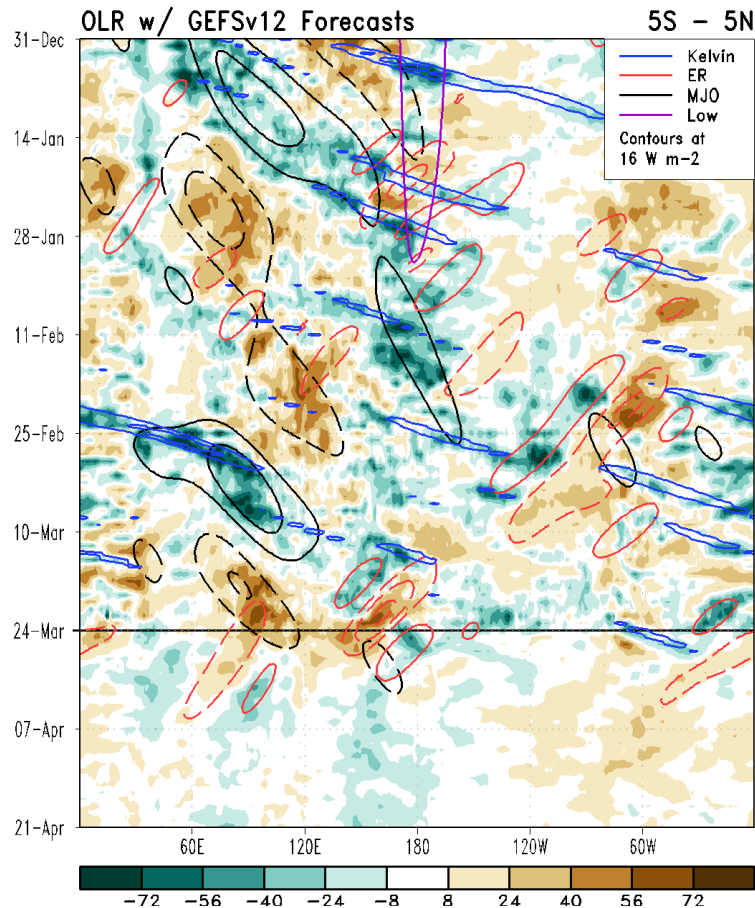


- Anomalous low-level easterlies previously noted across the equatorial Pacific have weakened, with rebuilding of the anomalous low-level westerlies which are more consistent with El Niño.
- Anomalous low-level westerlies have persisted across the northern coast of Australia and into the southwest Pacific, but are weaker compared to last week due to decreasing tropical cyclone activity.

Outgoing Longwave Radiation (OLR) Anomalies

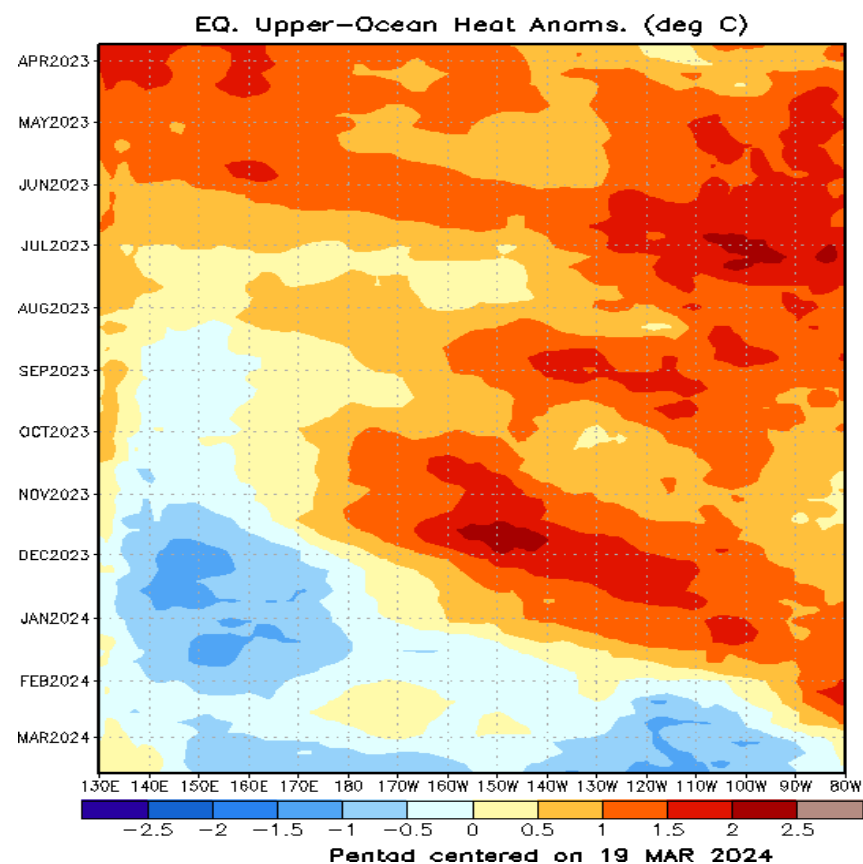
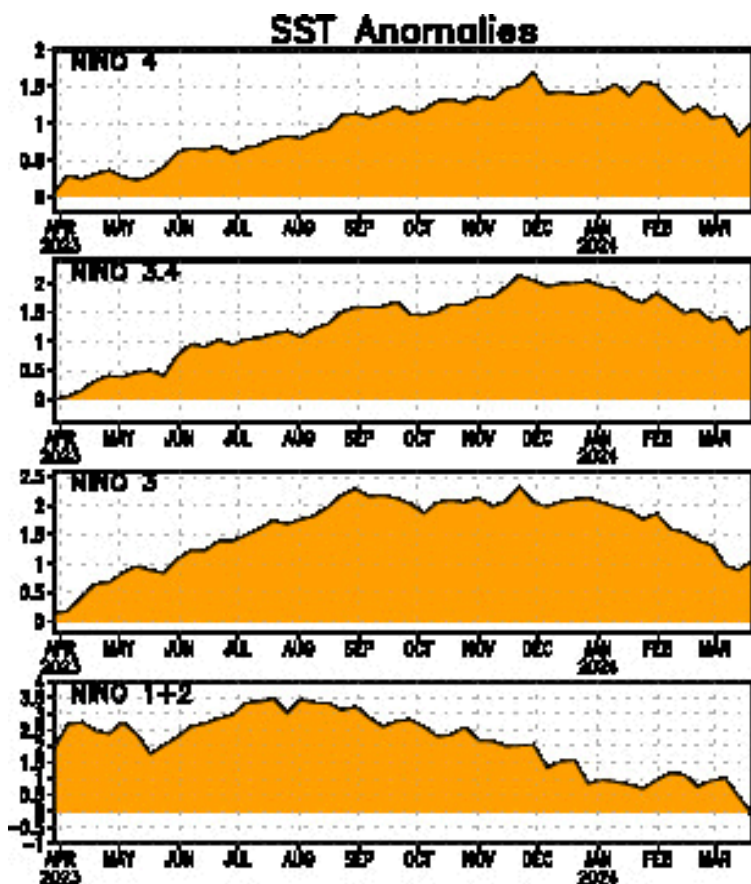
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- OLR plots are largely incoherent, with little evidence of an active MJO apparent through the objective filtering or in the spatial plots, except for some enhanced negative OLR anomalies across Central America.
- OLR-based forecasts remain weak but do show some areas of negative OLR anomalies increasing west of the Date Line during the next 2 weeks.
- Strong negative OLR anomalies are indicated across northern Australia due in part to Tropical Cyclone Megan, which meandered across the region during mid-March.

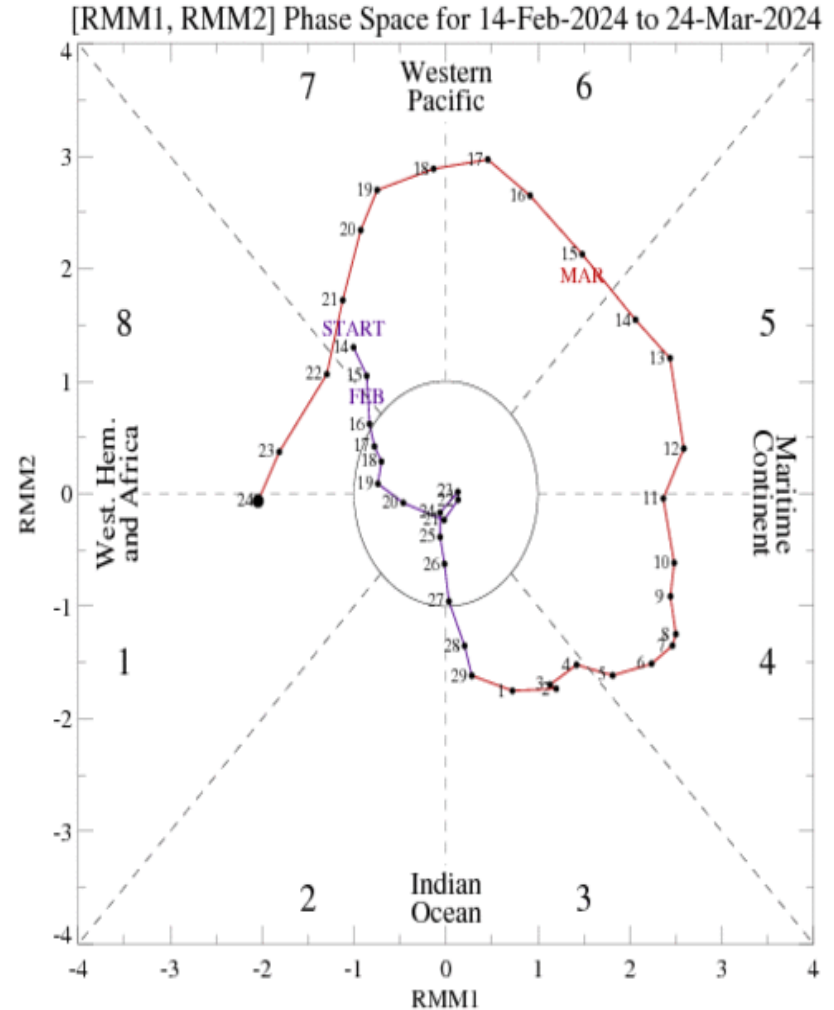
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- SSTs in all NINO regions have trended downward over the past 2 months, suggestive of a decaying El Niño.
- Enhanced low-level easterlies associated with the recent MJO propagation resulted in substantial upwelling and expanding below-normal subsurface temperature anomalies over most of the equatorial Pacific.

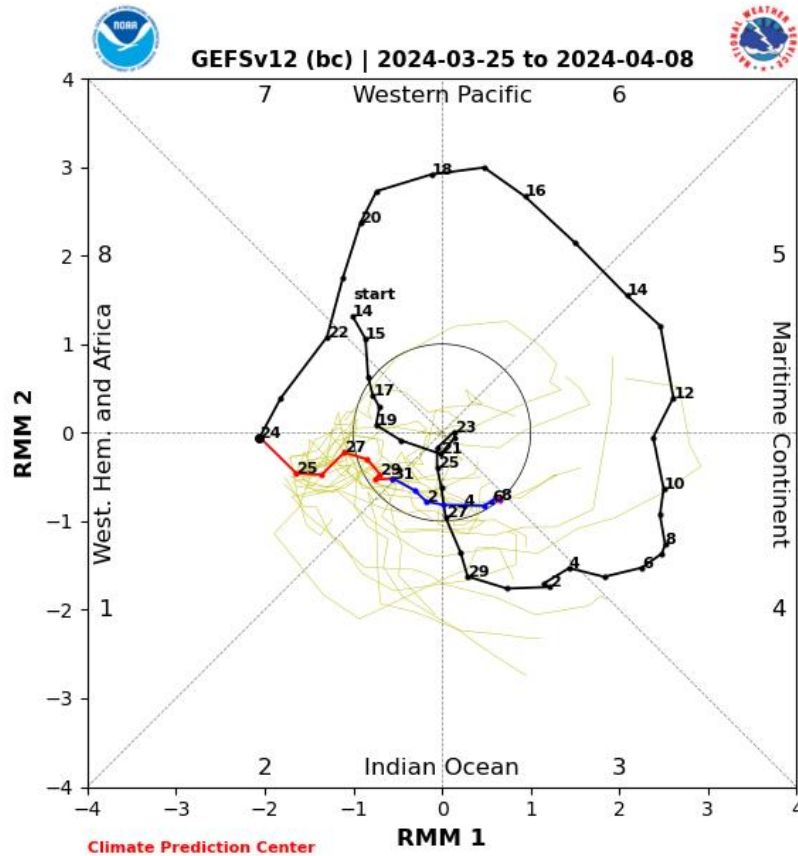
MJO Index: Recent Evolution

- The RMM-based MJO index depicts a robust MJO event propagating around the globe since late-February, with the intraseasonal signal now residing across the Western Hemisphere (phases 8 and 1).
- The 120-day mean, removed for RMM calculations, still includes anomalies from the IOD event last year, and can potentially be further complicated by the forecasted shift from El Nino to La Nina. Such issues have been affecting RMM interpretation for some time now.

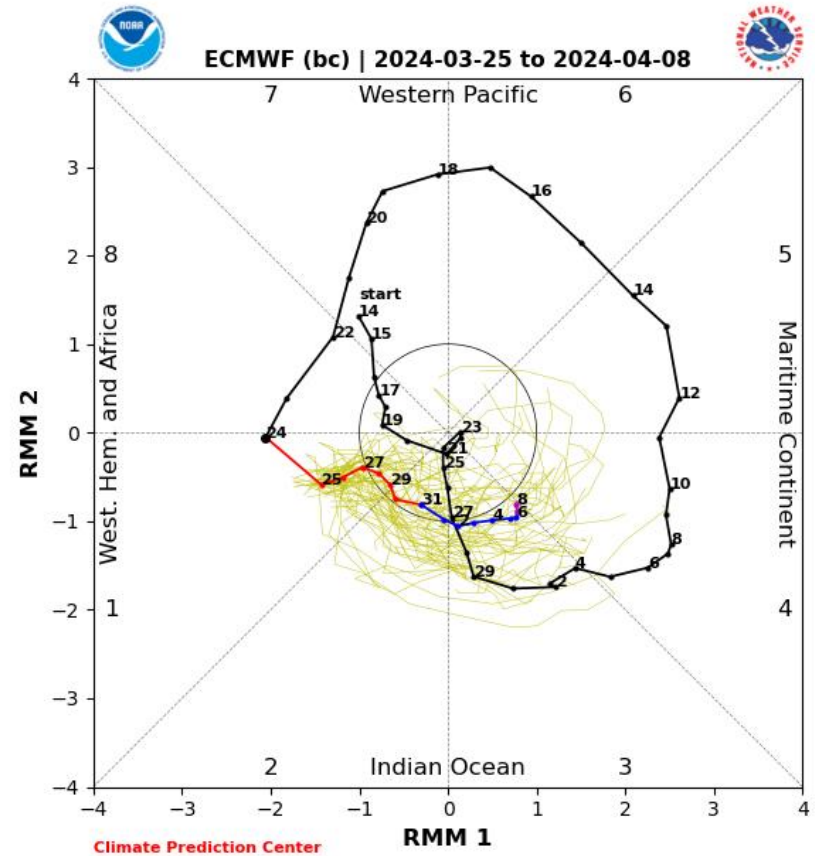


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



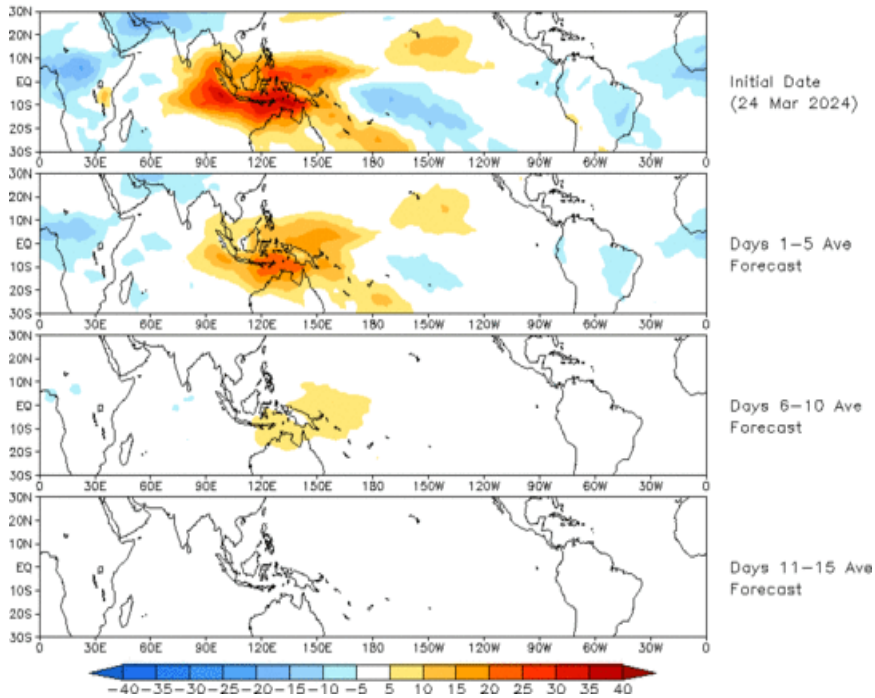
ECMWF Forecast

- Good agreement exists between the GEFS and the ECMWF ensembles regarding the MJO returning to the Indian Ocean by early April.
- There are some indications that the MJO may weaken in amplitude and slow down over the next couple of weeks, but uncertainty in these forecasts remains elevated due to the issues highlighted on the previous slide.

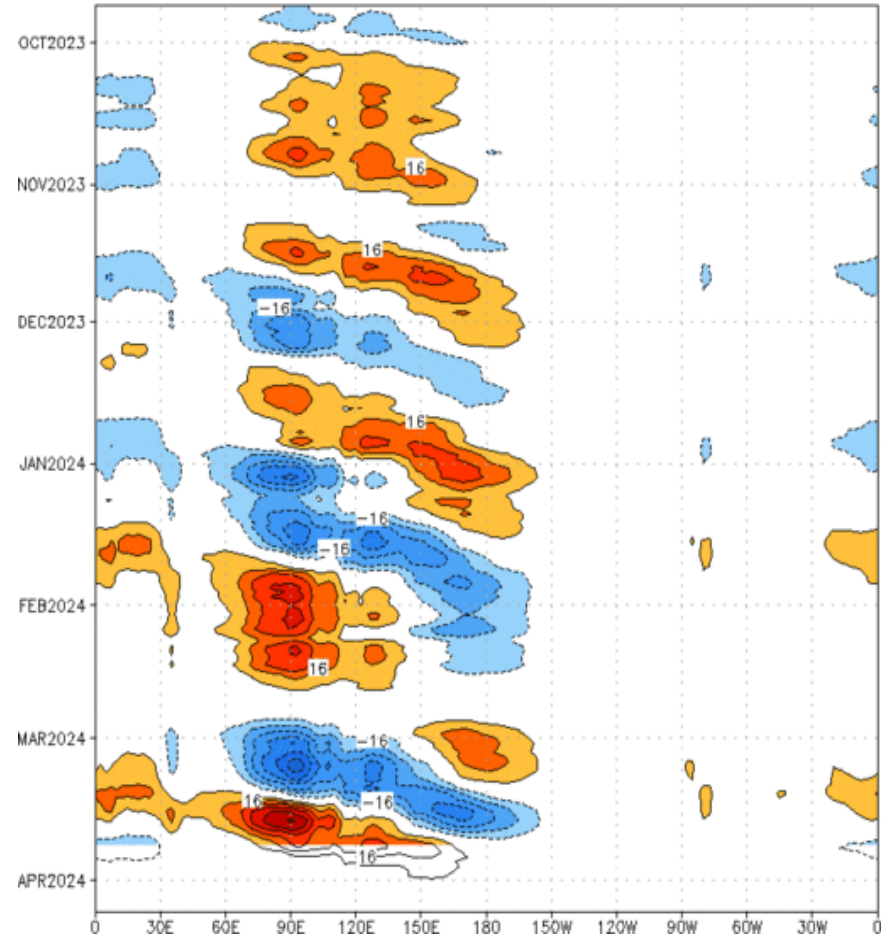
MJO: GEFS Forecast Evolution

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 Mar 2024
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:23-Sep-2023 to 24-Mar-2024
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

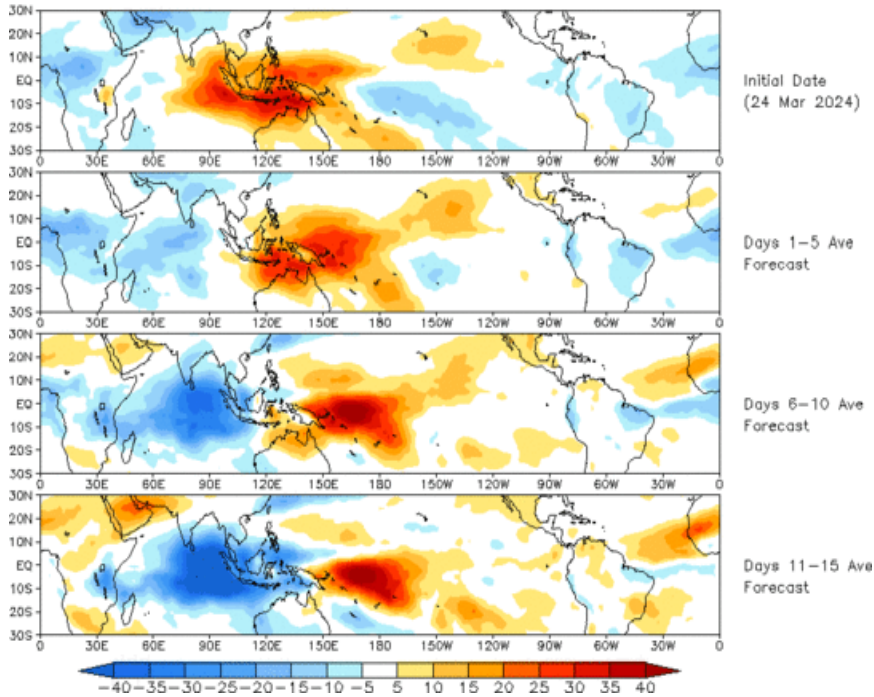


- The GEFS RMM-based tool depicts positive OLR anomalies (suppressed convection) across the eastern Indian and western Pacific oceans, shifting slightly eastward with time and weakening during week-2.
- Negative OLR anomalies (enhanced convection) are noted across portions of Africa and South America during week-1.

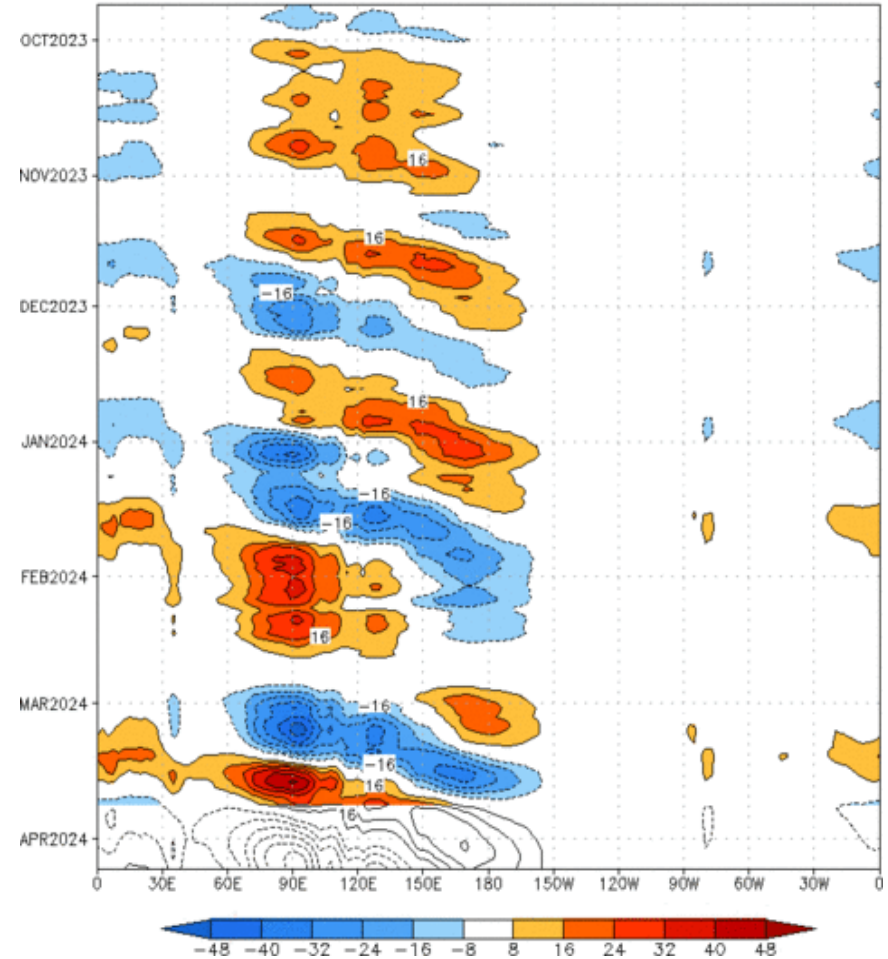
MJO: Constructed Analog Forecast Evolution

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 Mar 2024)



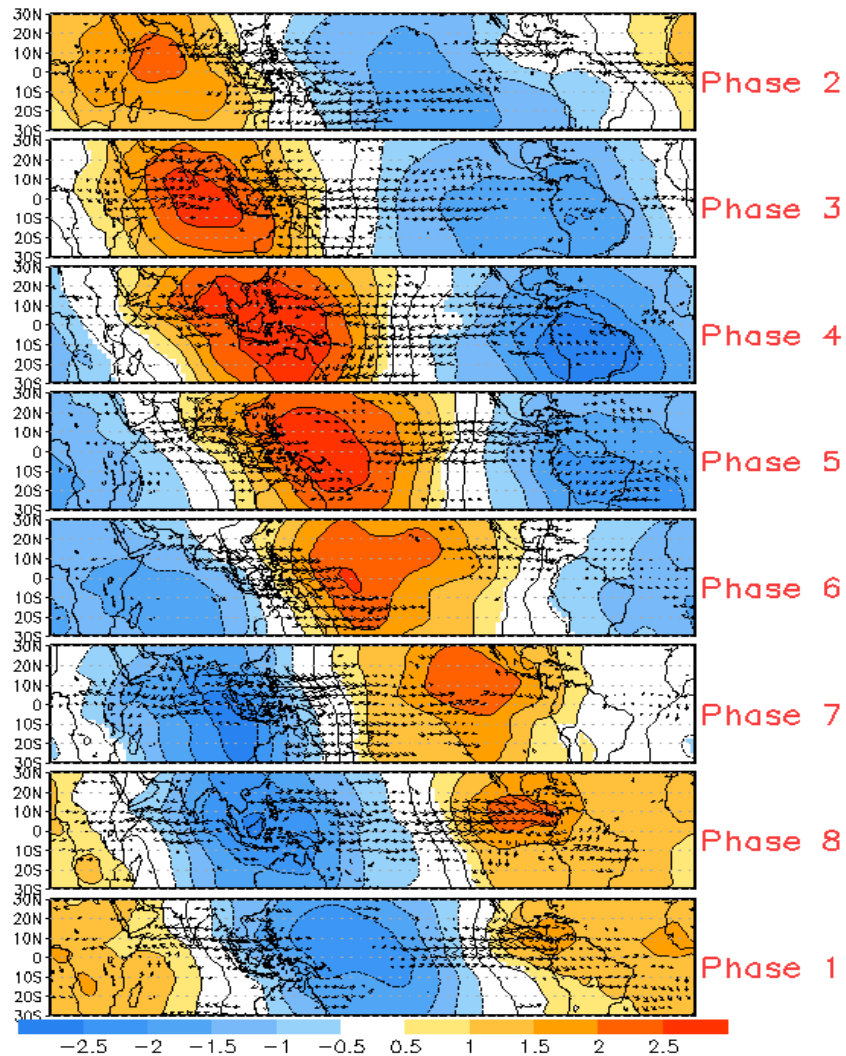
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm²) Period:23-Sep-2023 to 24-Mar-2024
The unfilled contours are CA forecast reconstructed anomaly for 15 days



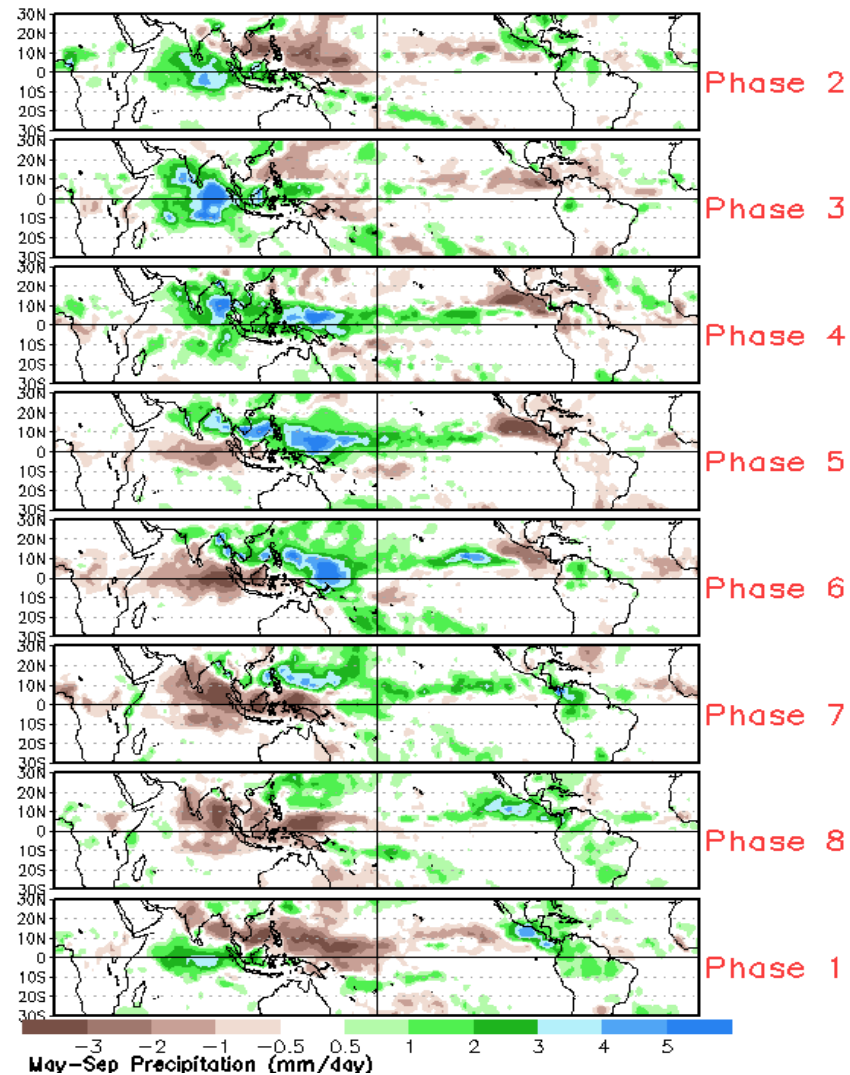
- The constructed analog tool depicts a much more coherent MJO signal, with large negative (positive) OLR anomalies propagating slowly eastward during the next 2 weeks across the Indian Ocean (Maritime Continent and Western Pacific).

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



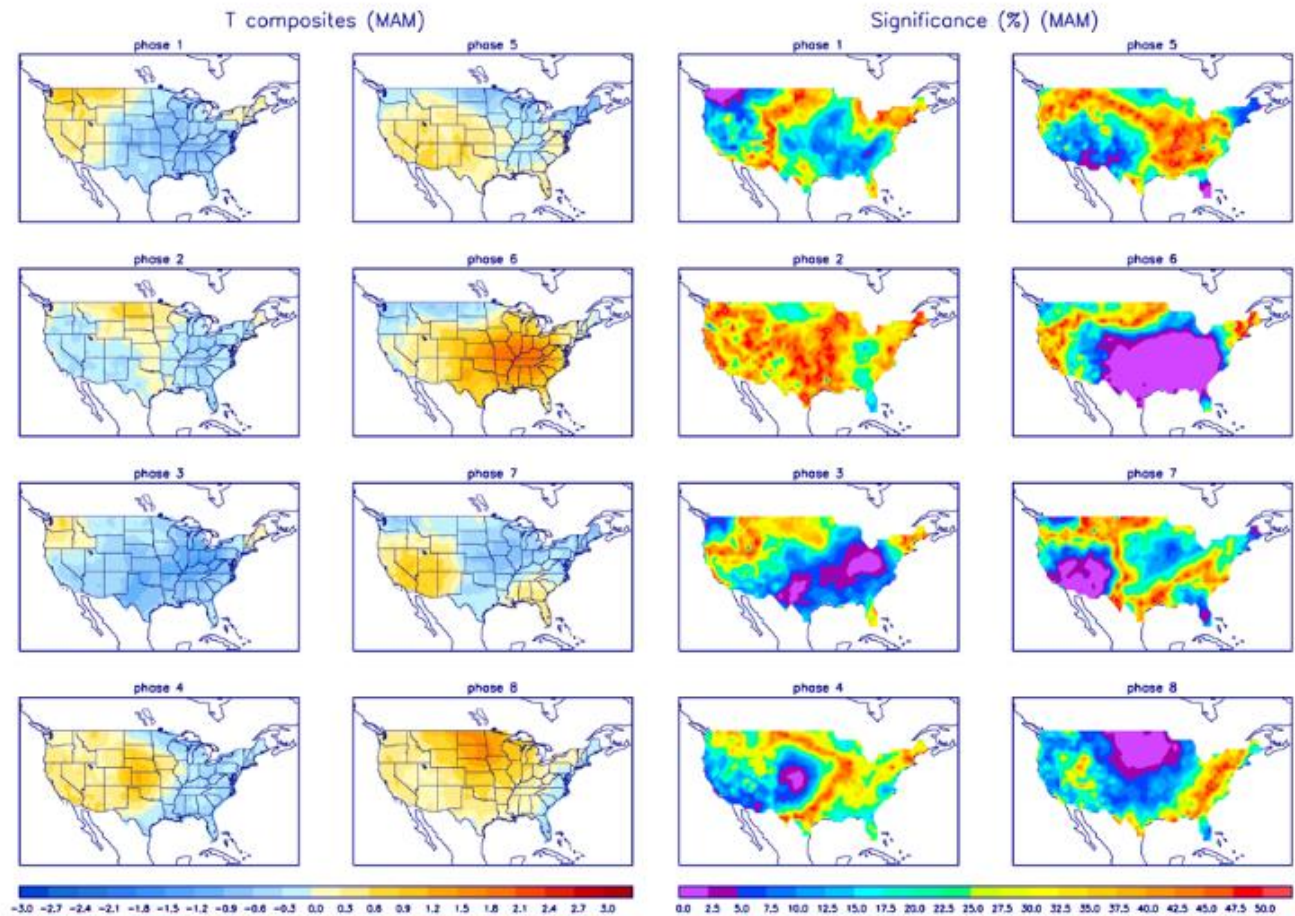
Precipitation Anomalies



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.

