

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



**Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
15 April 2024**

Overview

- The MJO has continued to weaken as global tropical circulation has become less organized. The Tropical Pacific also appears to be moving away from El Niño conditions, with SST anomalies declining in all Niño regions and a widespread decline in upper ocean heat content.
- While ensemble solutions generally show continued eastward propagation of the MJO into the western Pacific, RMM forecasts generally favor much weaker and less coherent intraseasonal activity during the next few weeks.
- The global tropics have been rather quiet lately with respect to Tropical Cyclone (TC) activity. This is climatologically the least active time of year, and with a weak MJO providing little support, TC genesis is not very likely during the coming forecast period.

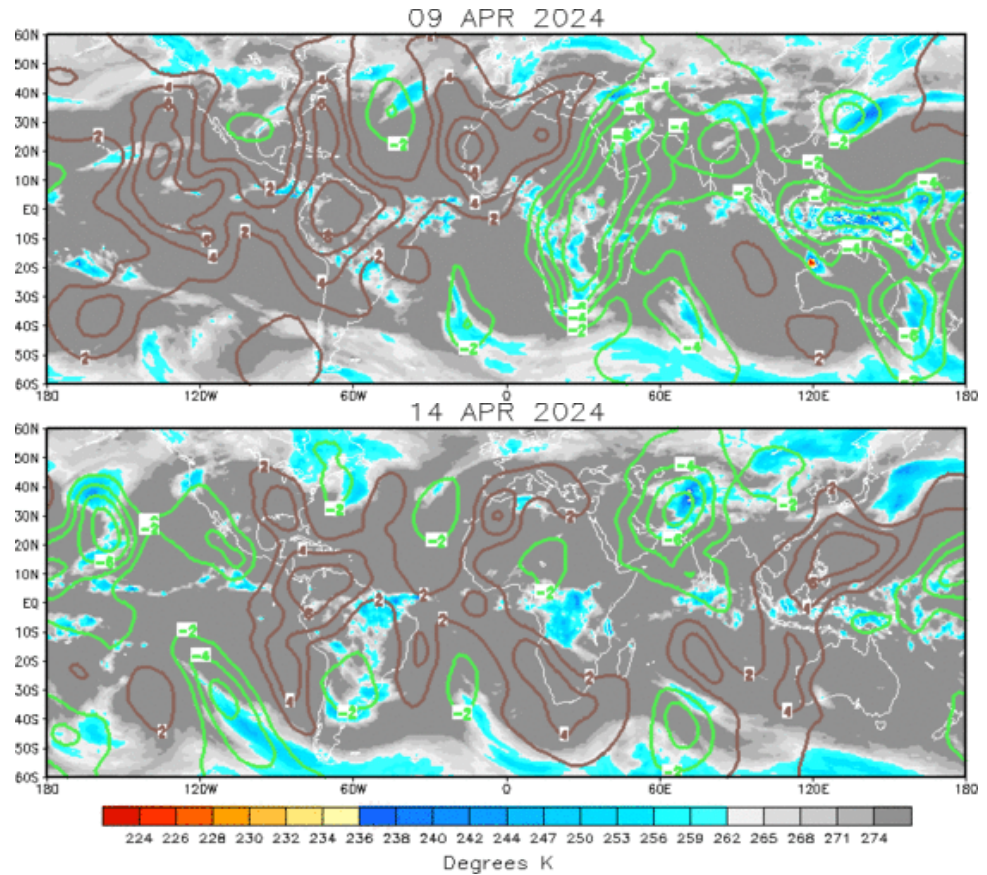
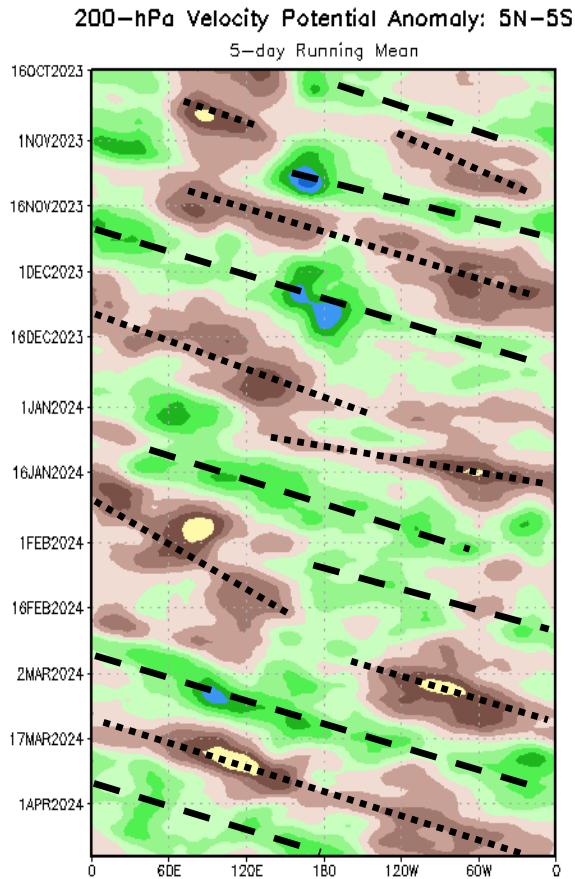
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:

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

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

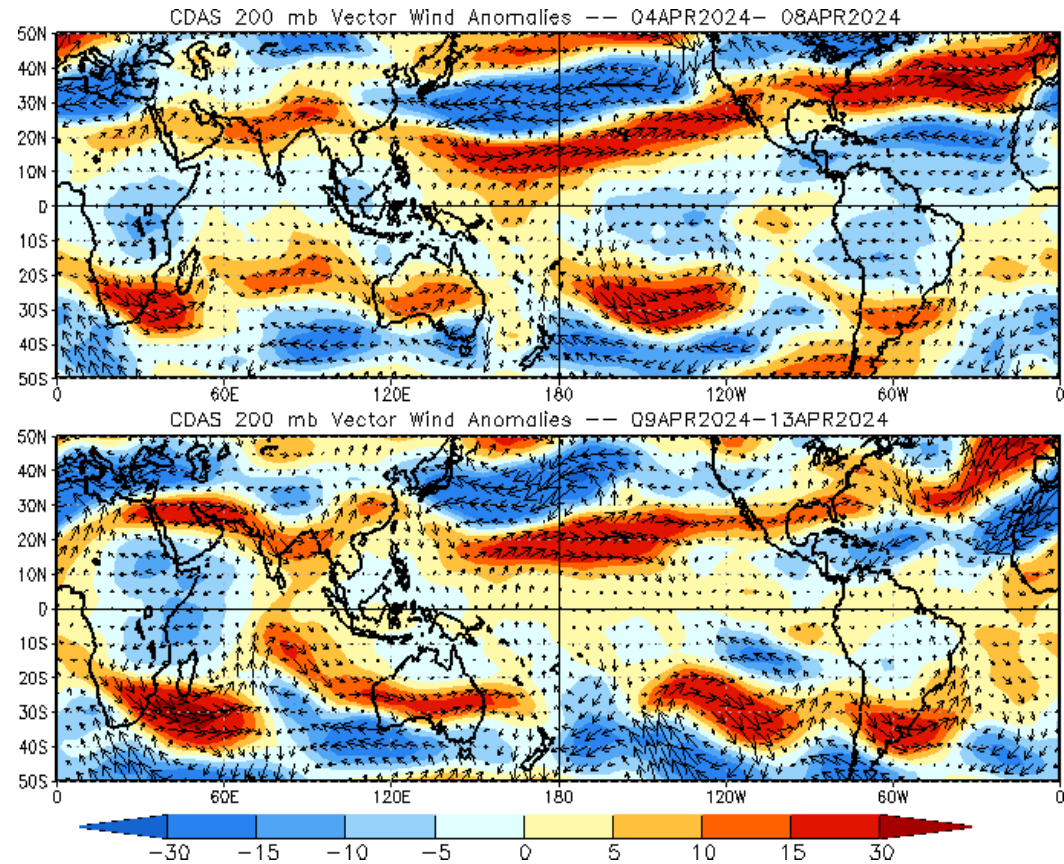
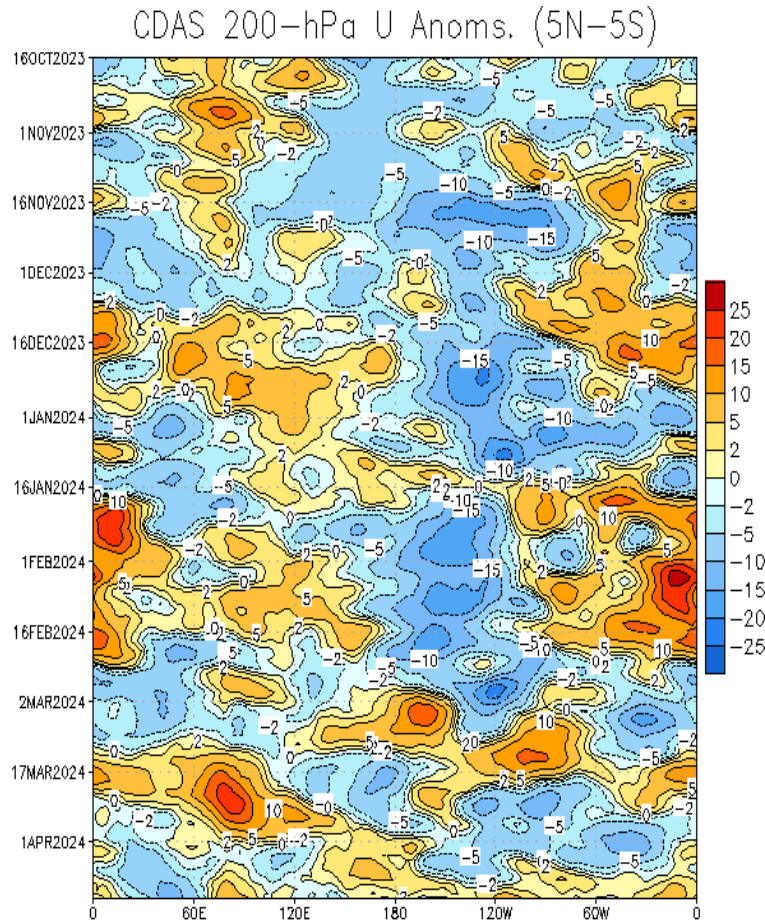
Brown shades: Anomalous convergence (unfavorable for precipitation)



- Continued eastward propagation of a wave-1 pattern is evident in the time-longitude plot, consistent with MJO activity, albeit on the fast side of the phase speed spectrum.
- However, spatial maps reveal a breakdown of coherent wave-1 structure to global tropical convection. A broad area of anomalous convergence over the Americas and Atlantic and a smaller area over the Maritime Continent remain, while pockets of anomalous divergence are scattered around the globe.

200-hPa Wind Anomalies

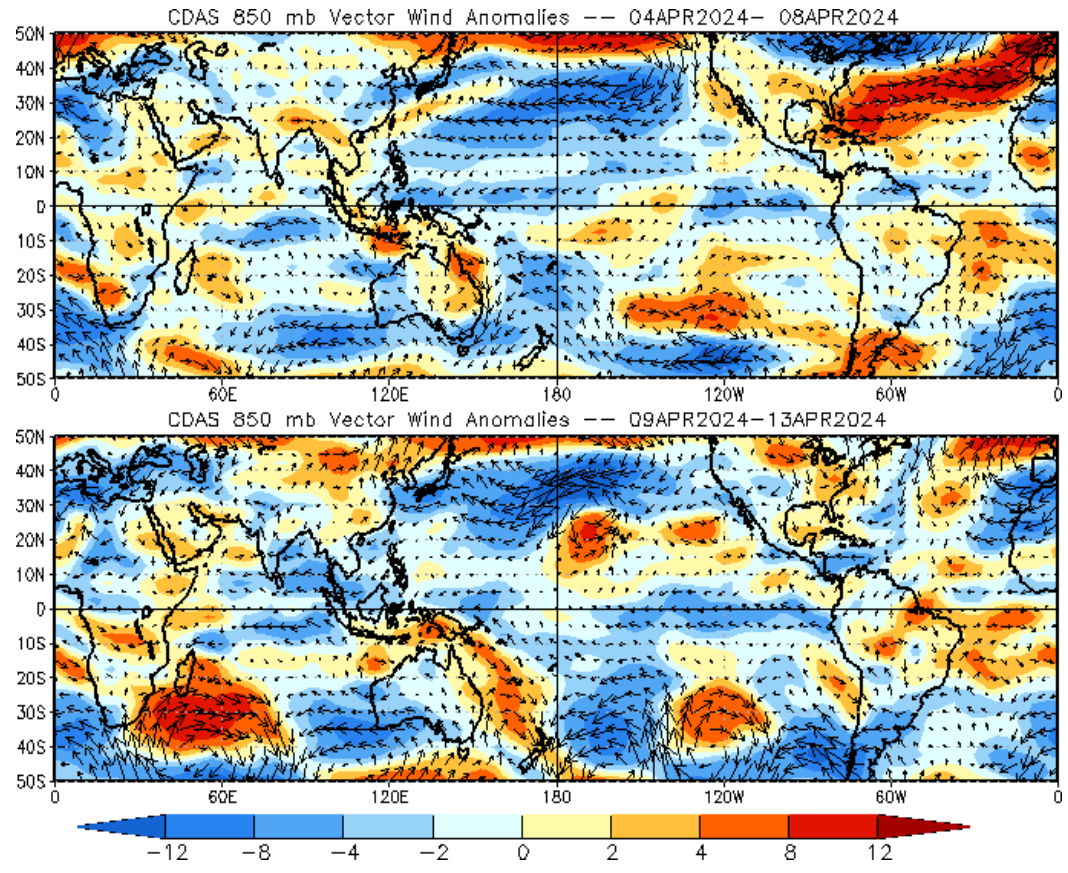
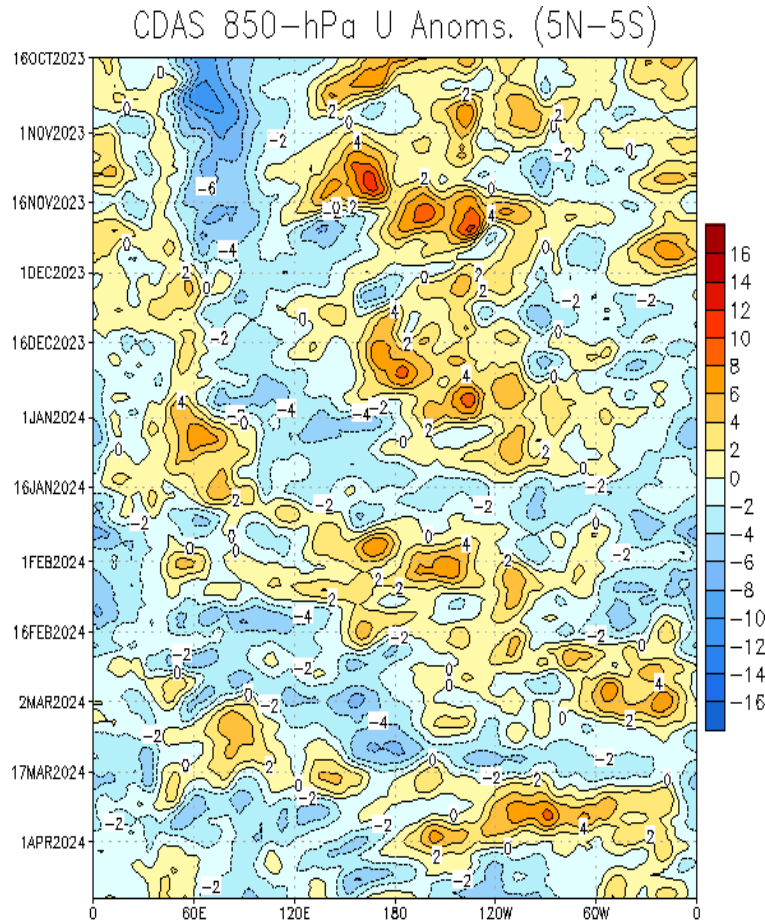
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Upper-level winds in the global tropics have been approaching climatological normal, with very small anomalies for most of the tropics except for the western Indian Ocean.
- The subtropical jet remains active across the North Pacific and southern North America.

850-hPa Wind Anomalies

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

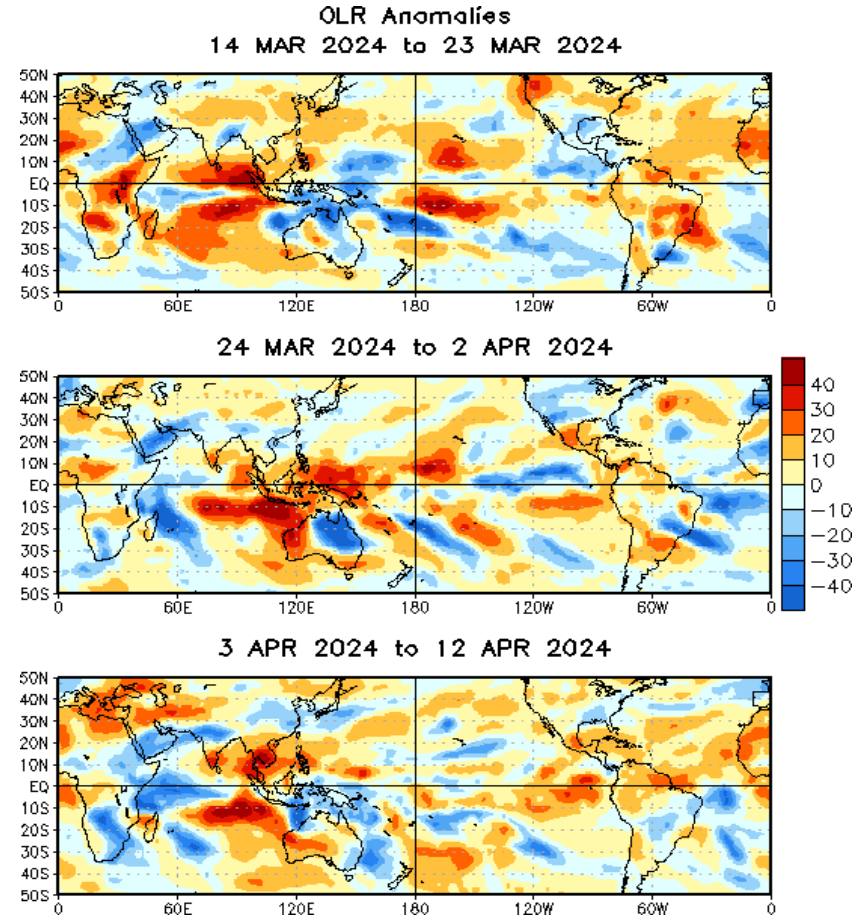
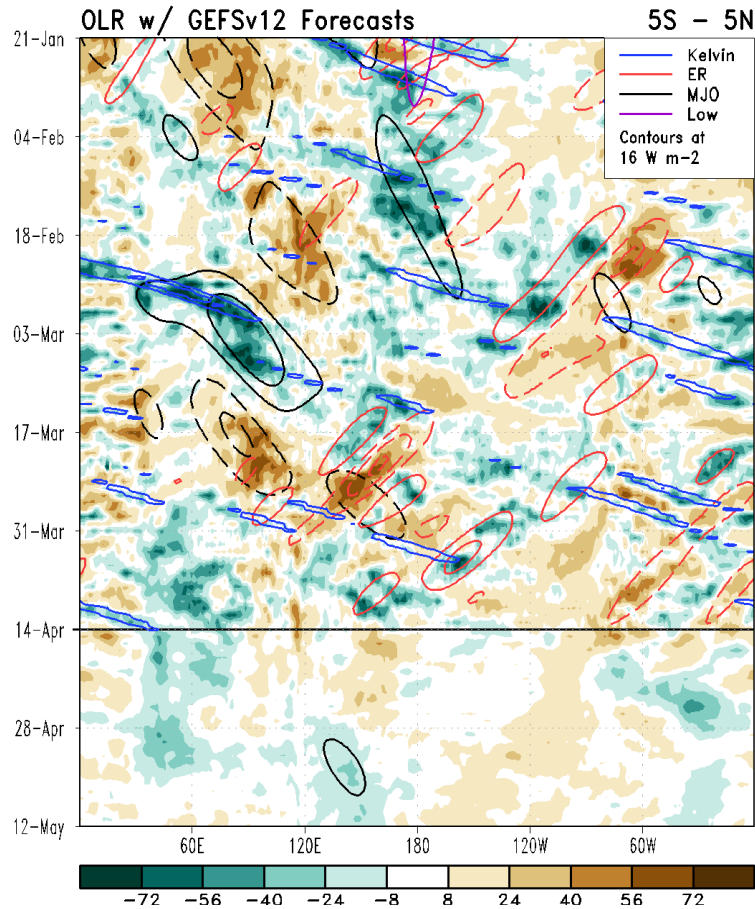


- Enhanced trade winds have been becoming stronger and more widespread over the last few weeks, both over the Tropical Pacific and Indian Oceans.
- Persistent strong anomalous low-level easterlies have been widespread over the North Pacific.

Outgoing Longwave Radiation (OLR) Anomalies

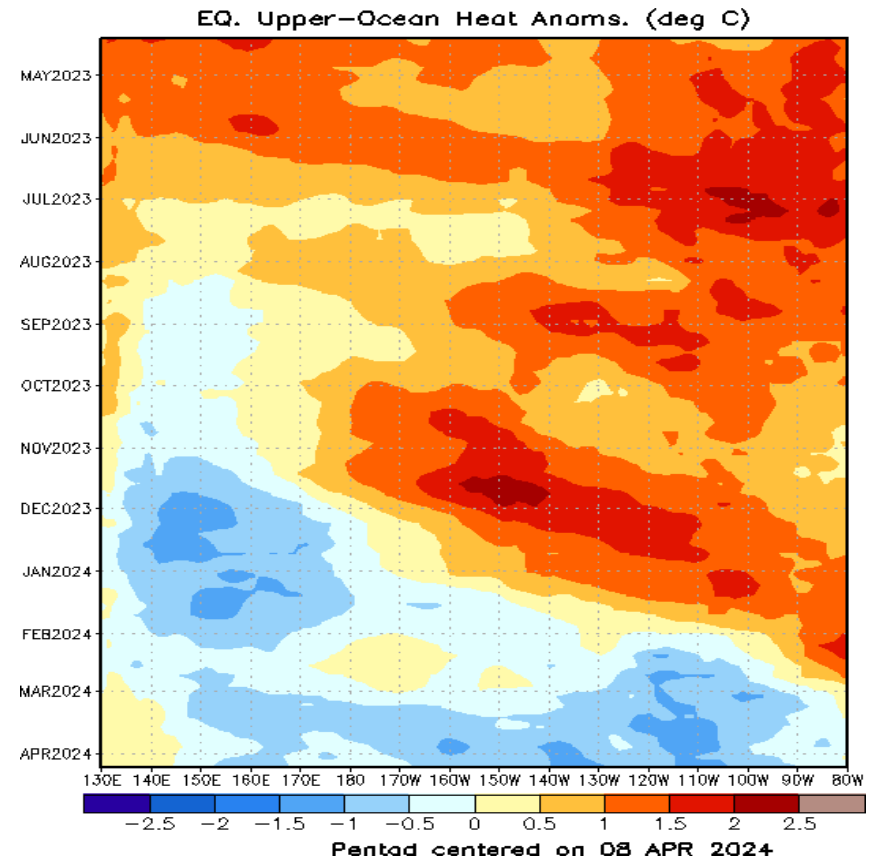
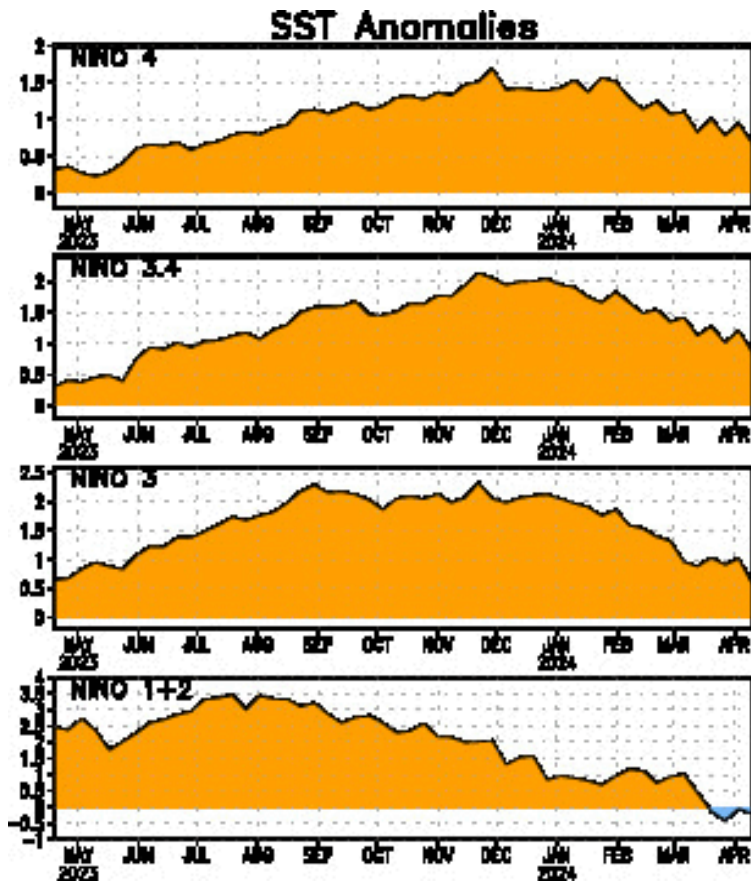
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- Enhanced convection returned and is persisting over eastern Africa and parts of the Indian Ocean along and off the equator.
- Low-frequency features over the Tropical Pacific have become much less apparent over the last month while an Indian Ocean Dipole-like pattern has emerged recently and is favored to continue, enhancing convection along the eastern coast of Africa.

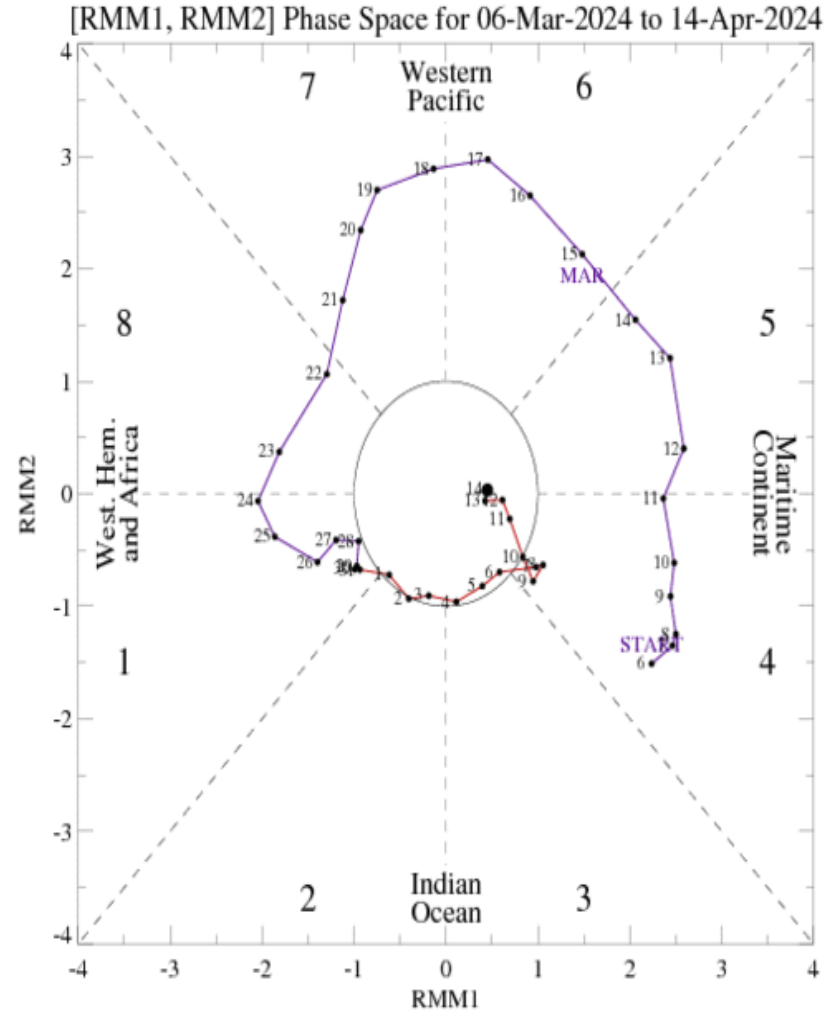
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- SSTs in all NINO regions have trended downward over the past 2 months, suggestive of a decaying El Niño, with a sharp decrease across NINO 1+2 during March where the SST anomalies have flipped to negative tied to strong upwelling over the region.
- Negative subsurface temperature anomalies continue to be observed across nearly the entire Pacific, with increasing negative anomalies across the eastern Pacific.

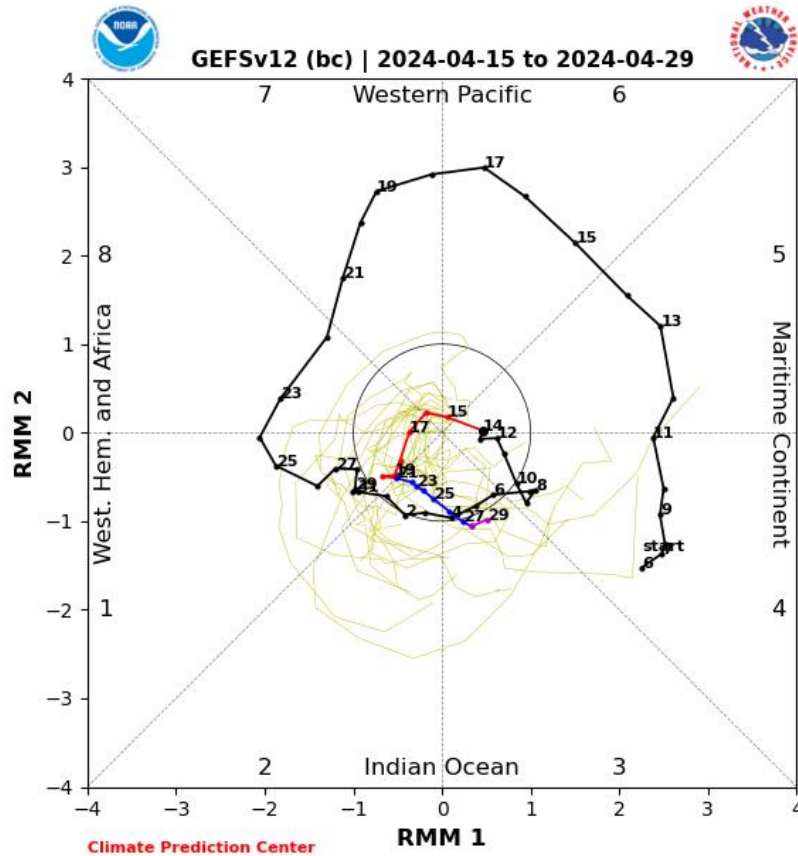
MJO Index: Recent Evolution

- Since late March, the RMM-based MJO index has considerably slowed down and weakened, with the RMM index moving near the edge of the unit circle as the MJO traversed the Indian Ocean.
- Over the last week eastward propagation of the RMM signal continued, but the amplitude has continued to drop, possibly the result of extensive interference to the MJO from emerging low frequency variability.

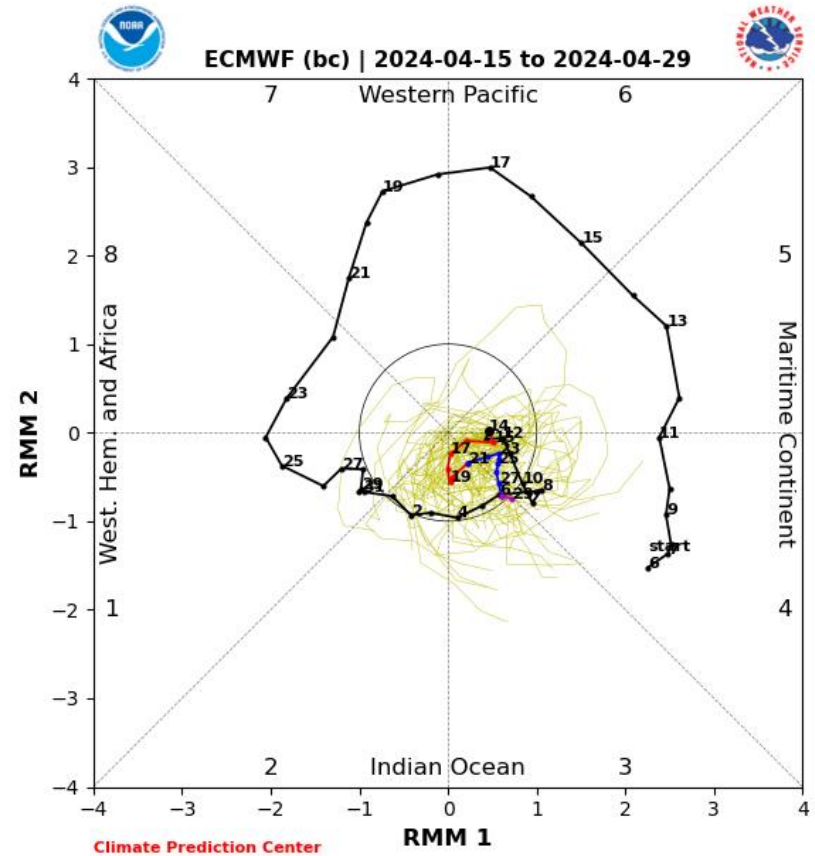


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



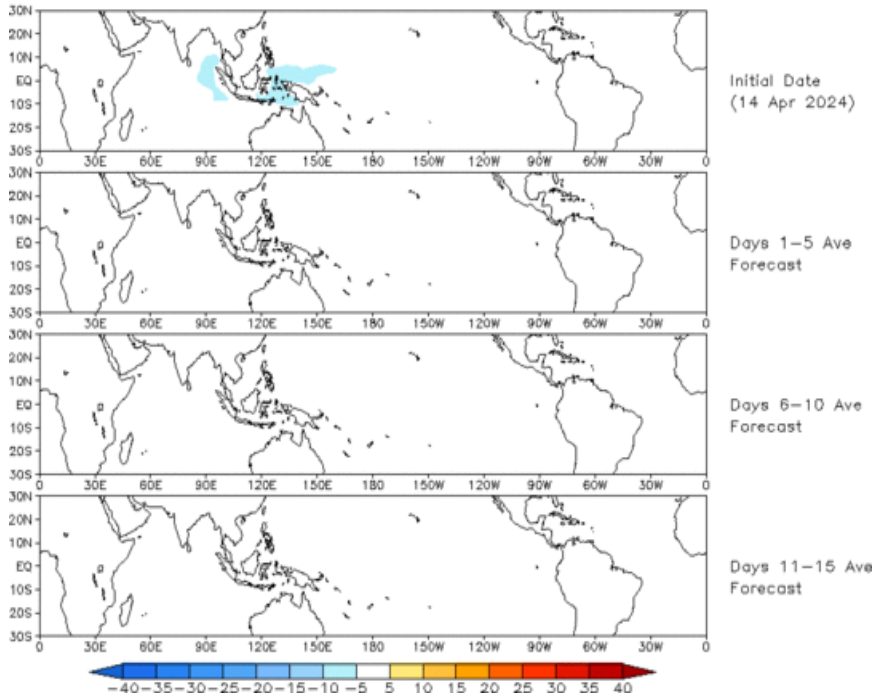
ECMWF Forecast

- A weakened MJO is generally favored in the RMM forecasts, though most models continue to depict eastward propagation despite a weak amplitude.
- The emerging low-frequency feature over the western Indian Ocean appears to be interfering with the MJO, as have several Rossby waves in recent times, apparently reducing the MJO's impact on the global tropics.

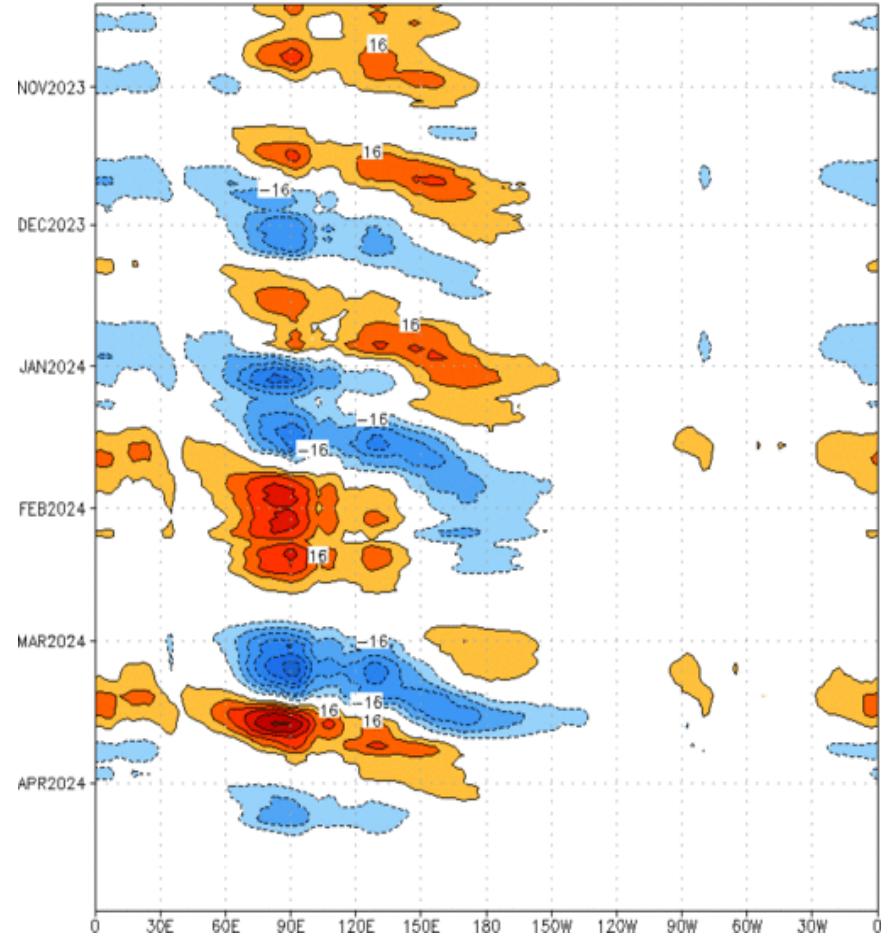
MJO: GEFS Forecast Evolution

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: 14 Apr 2024
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:14-Oct-2023 to 14-Apr-2024
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

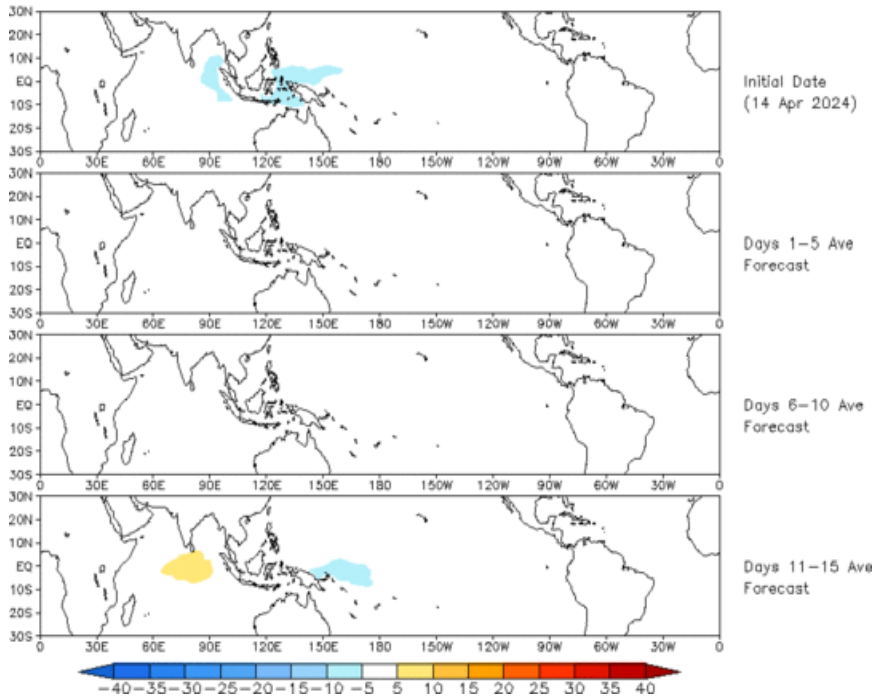


- The GEFS RMM-based tool reflects the reduced impact of the MJO in its OLR forecast, with no anomalies depicted beyond the initial date.

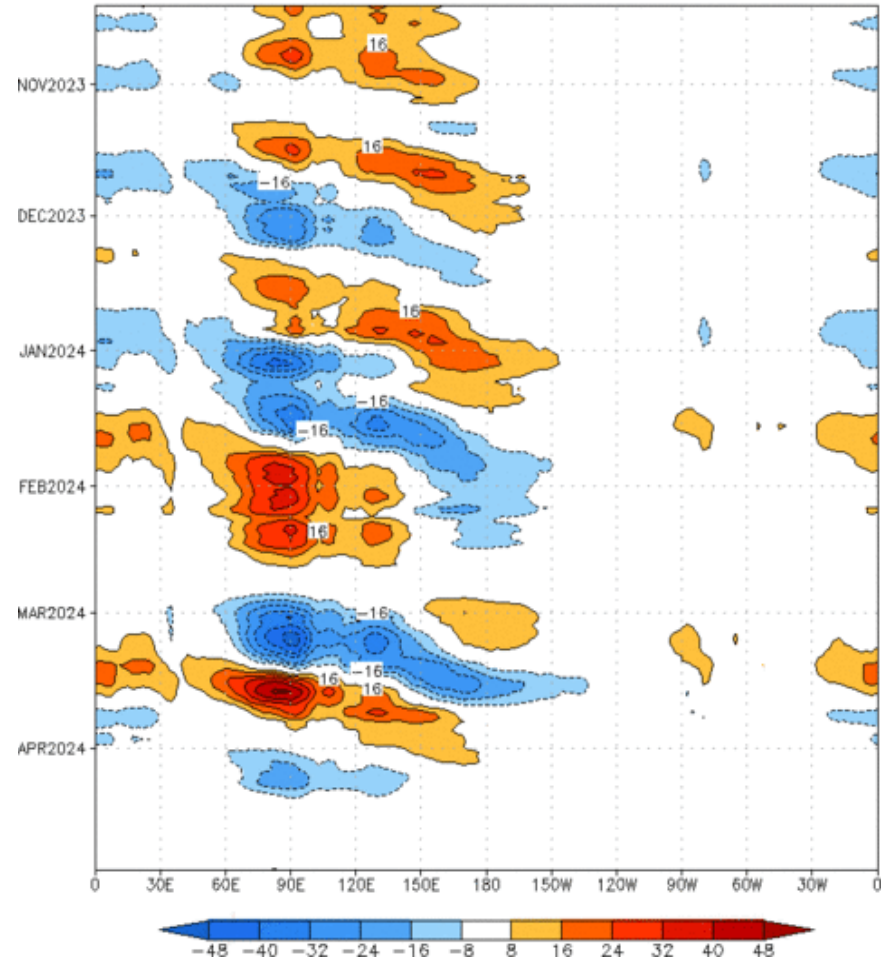
MJO: Constructed Analog Forecast Evolution

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 (14 Apr 2024)



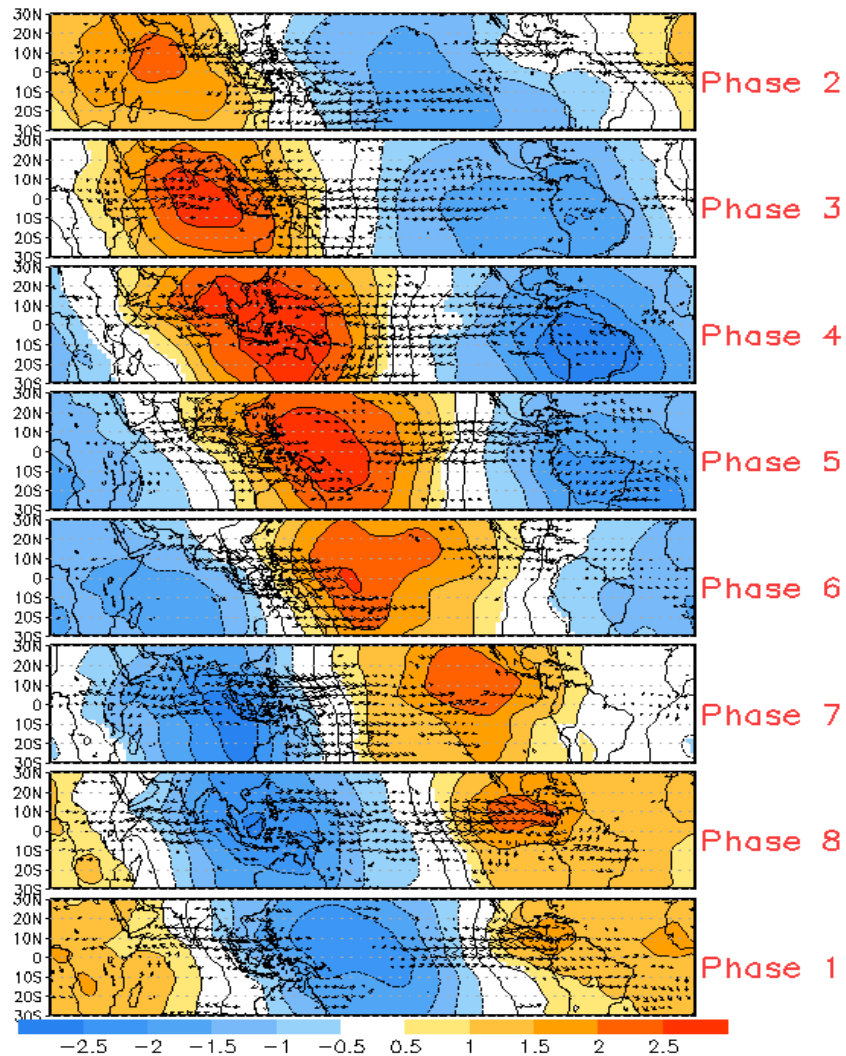
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:14-Oct-2023 to 14-Apr-2024
The unfilled contours are CA forecast reconstructed anomaly for 15 days



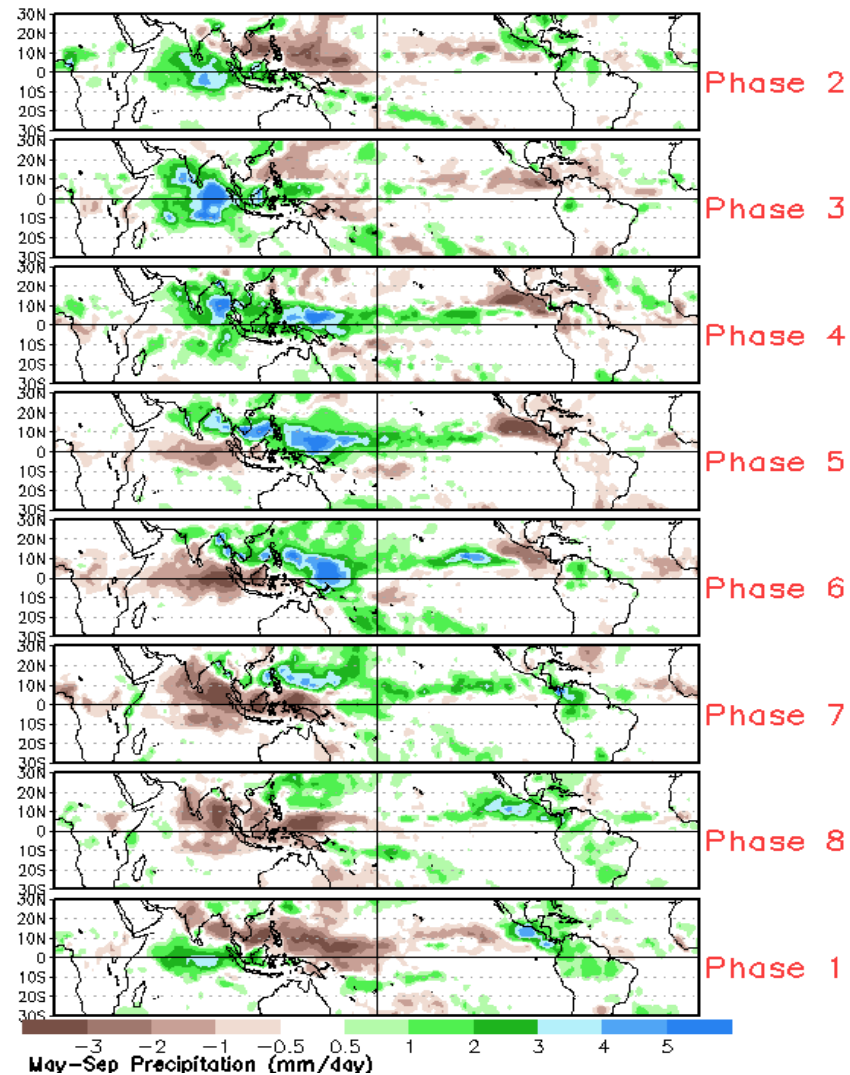
- The constructed analog tool is fairly consistent with the GEFS, with near-zero anomalies for most of the forecast period.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



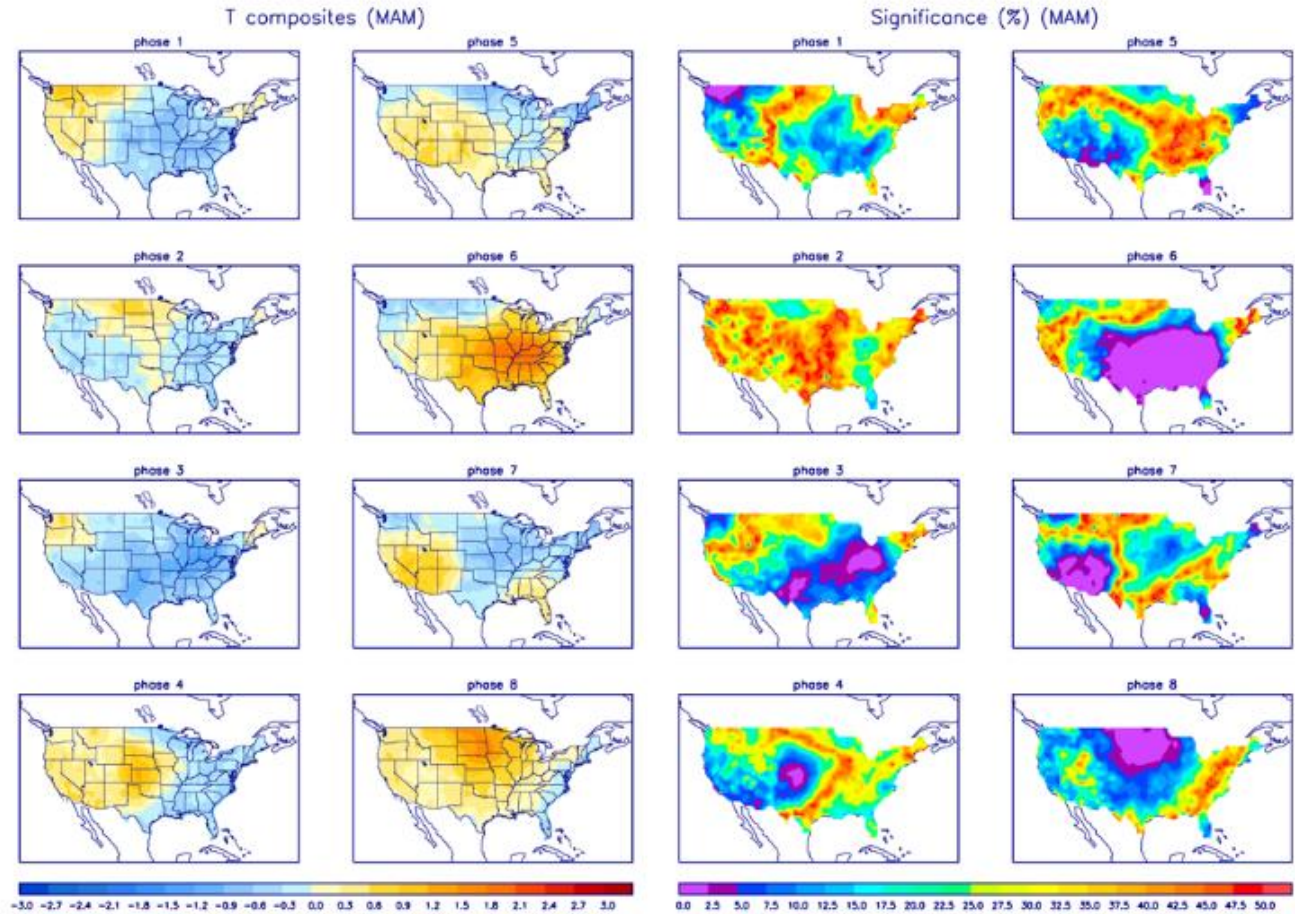
Precipitation Anomalies



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.

