

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



Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
1 July 2024

Overview

- The MJO has been largely incoherent for most of June, but has shown some signs of reorganization over the Indian Ocean during the past week based on upper-level velocity potential and wind anomaly fields.
- Dynamical models favor continued, but slow eastward propagation of the MJO signal across the Maritime Continent and possibly reaching the Western Pacific during the next few weeks, but several forecasts maintain a low amplitude event in RMM space later in July.
 - The low amplitude favored may be attributed to forecast anomalies that are of opposite sign on both sides of the equator, effectively offsetting any coherent intraseasonal signal in the zonal averaging.
- The RMM forecast evolution is supported in the upper-level velocity potential anomalies fields with weak MJO activity coming through the filtering, but show a large-scale low frequency response prevailing in the global tropics.
- Tied to the slow eastward propagation of the MJO, the large scale environment still looks to become more favorable for tropical cyclogenesis in the western Pacific, with decreasing chances in the western Hemisphere towards the middle of July.

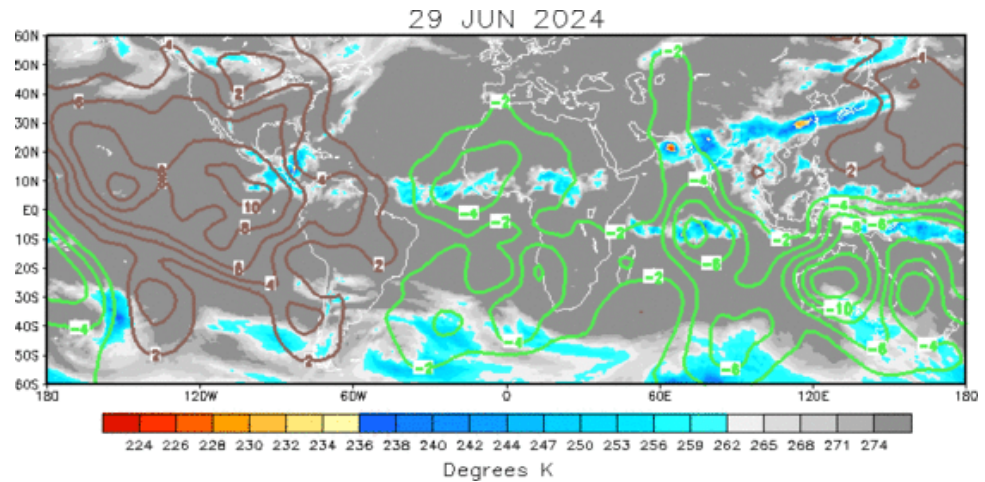
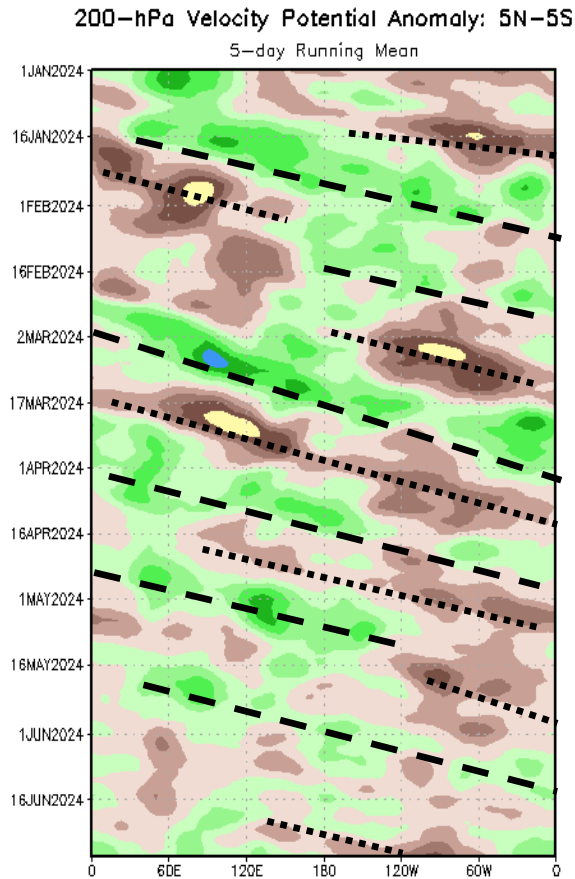
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:

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

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

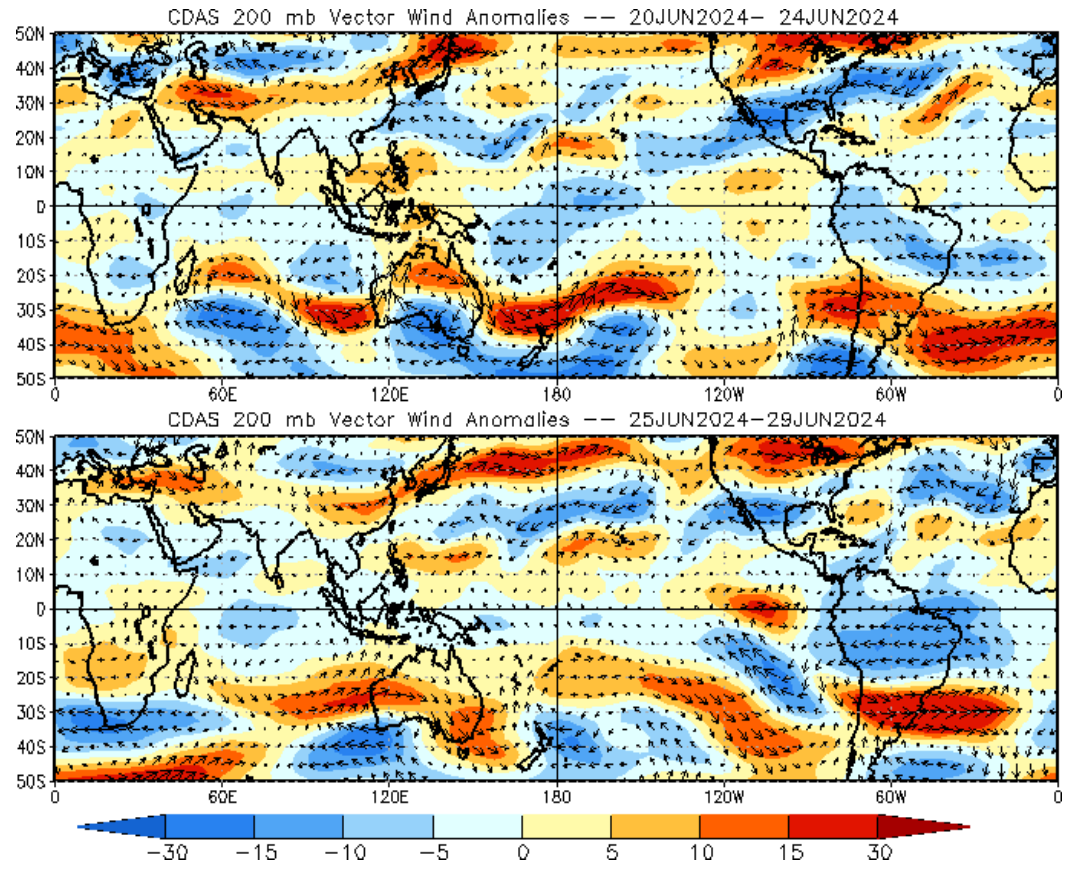
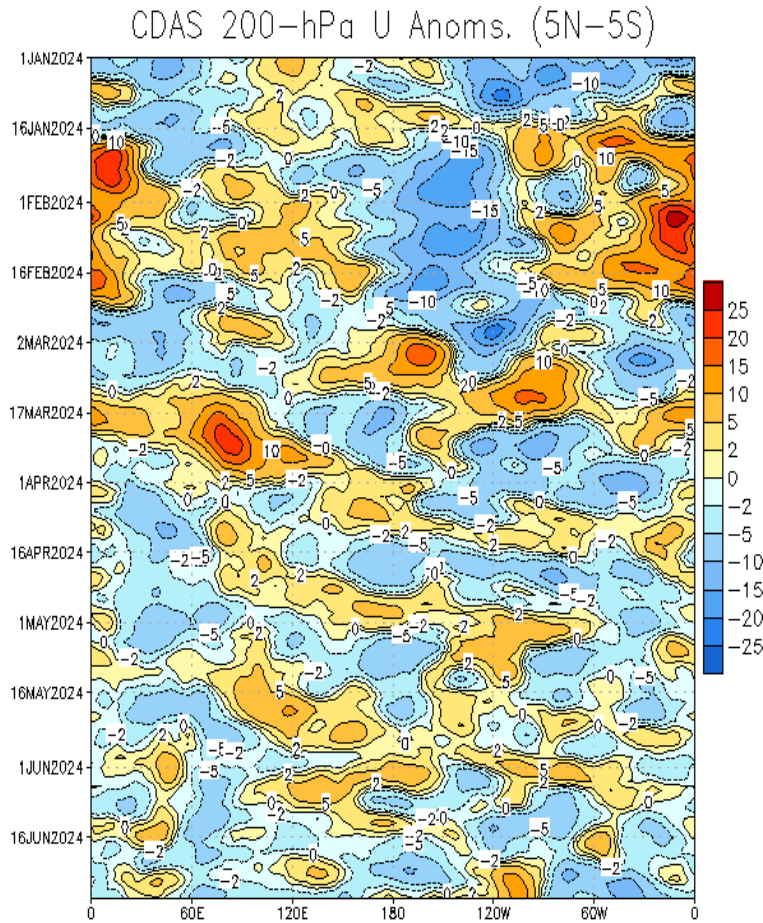
Brown shades: Anomalous convergence (unfavorable for precipitation)



- Upper-level velocity potential anomalies reveal a more coherent pattern following several weeks of disorganized activity.
- An eastward shifting envelope of suppressed divergence aloft is depicted in the lime/longitude plot, consistent with a reemerging subseasonal signal.

200-hPa Wind Anomalies

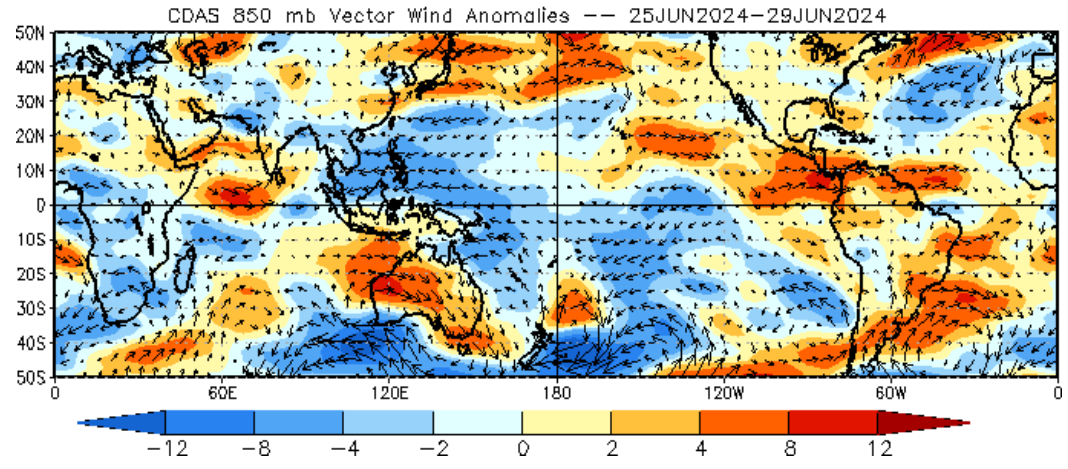
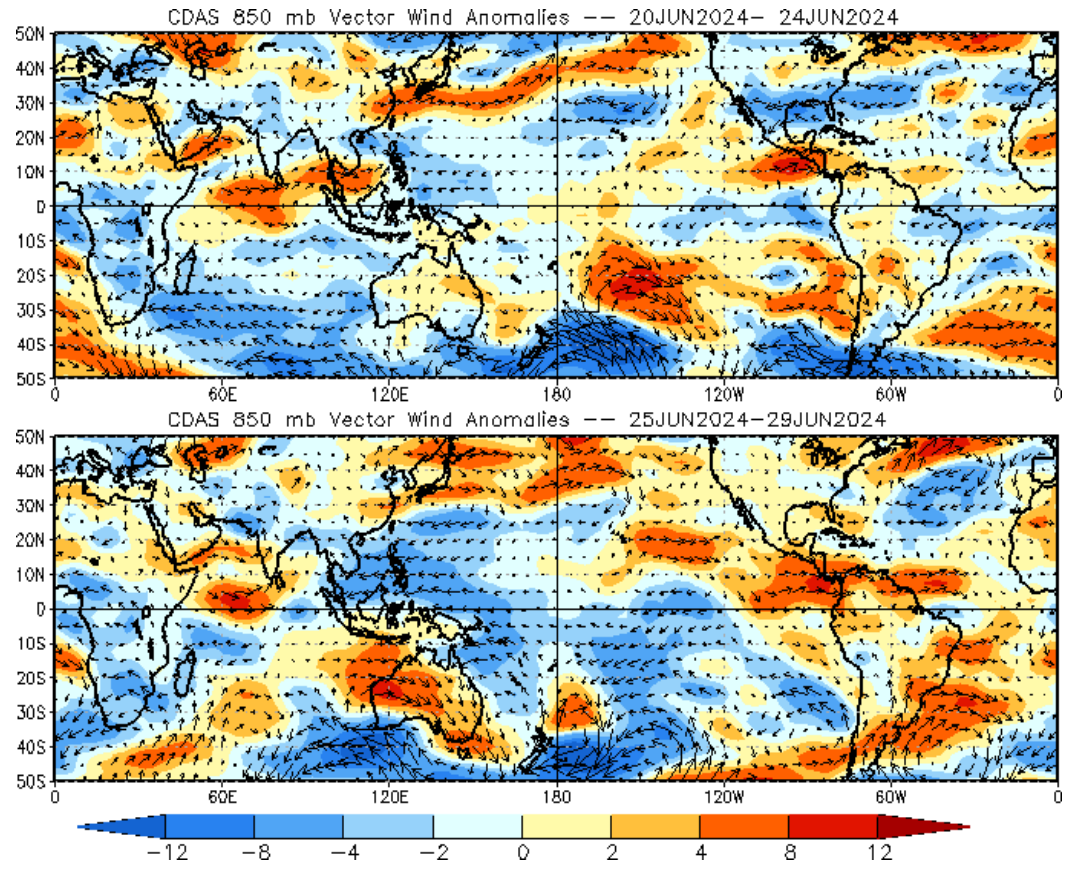
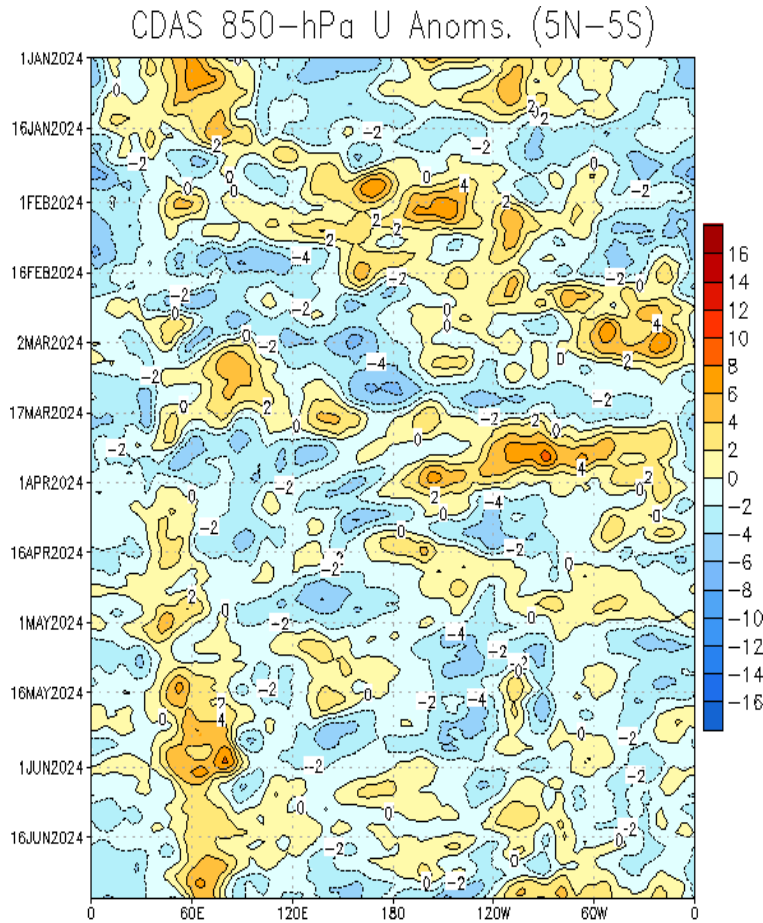
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Tied to an anticyclonic circulation over South America, anomalous easterlies strengthened over the tropical Americas to help relax shear.
- West of the Date Line, wind anomalies appear rather weak along the equator, where the stronger anomalies are observed in the higher latitudes.

850-hPa Wind Anomalies

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

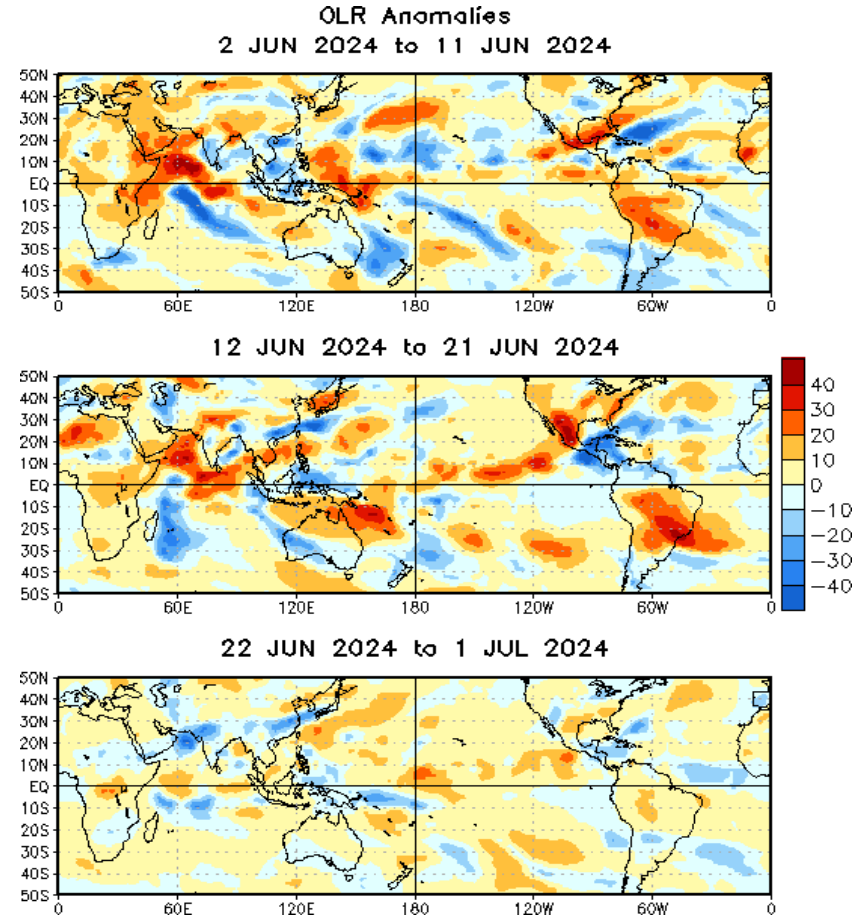
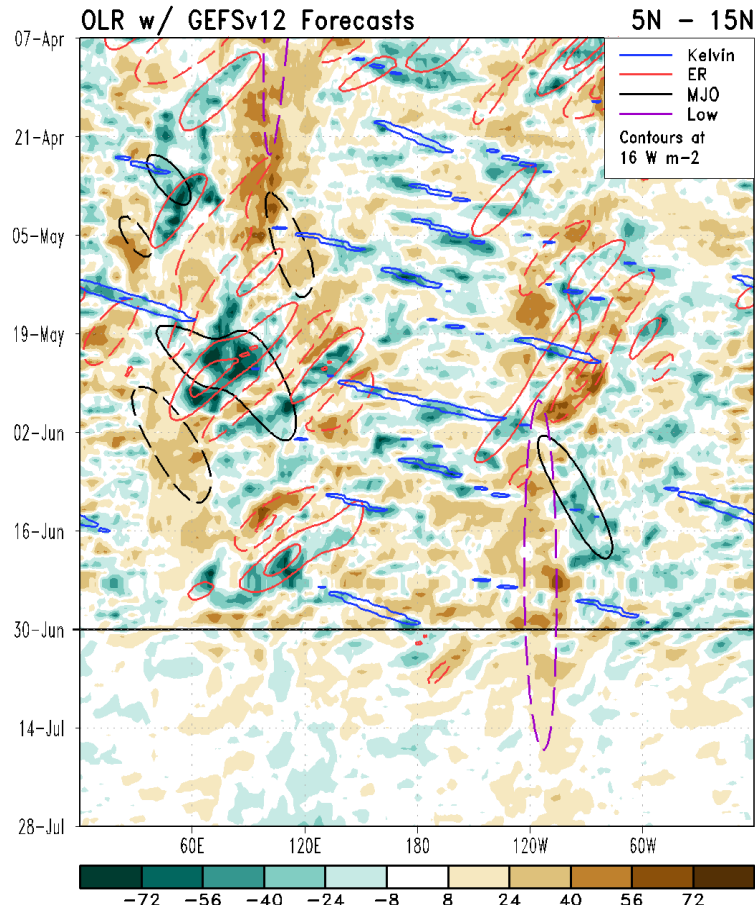


- While a Central America Gyre (CAG) dissolved since mid-June, anomalous westerlies remain over the eastern Pacific, with a notable strengthening over the tropical Atlantic associated with TC activity.
- Conversely, trades become more enhanced over equatorial Pacific mainly west of 120E, where the strongest easterlies likely suppressed tropical cyclogenesis in the western Pacific during late June.
- Anomalous westerlies persist over the western Indian Ocean, suggestive of a low frequency response.

Outgoing Longwave Radiation (OLR) Anomalies

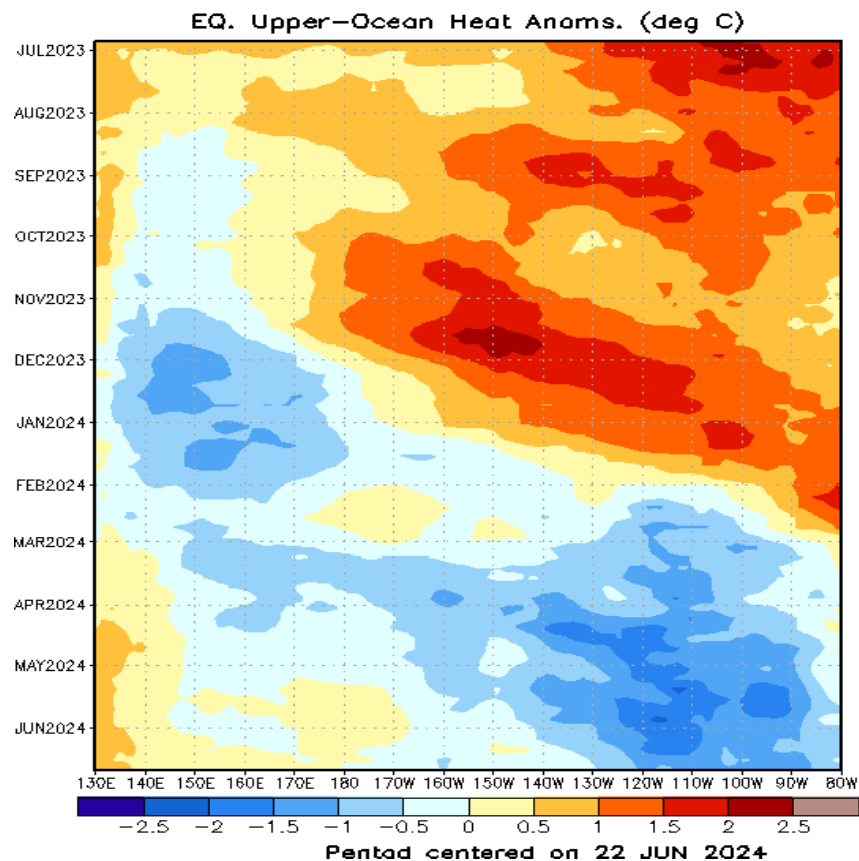
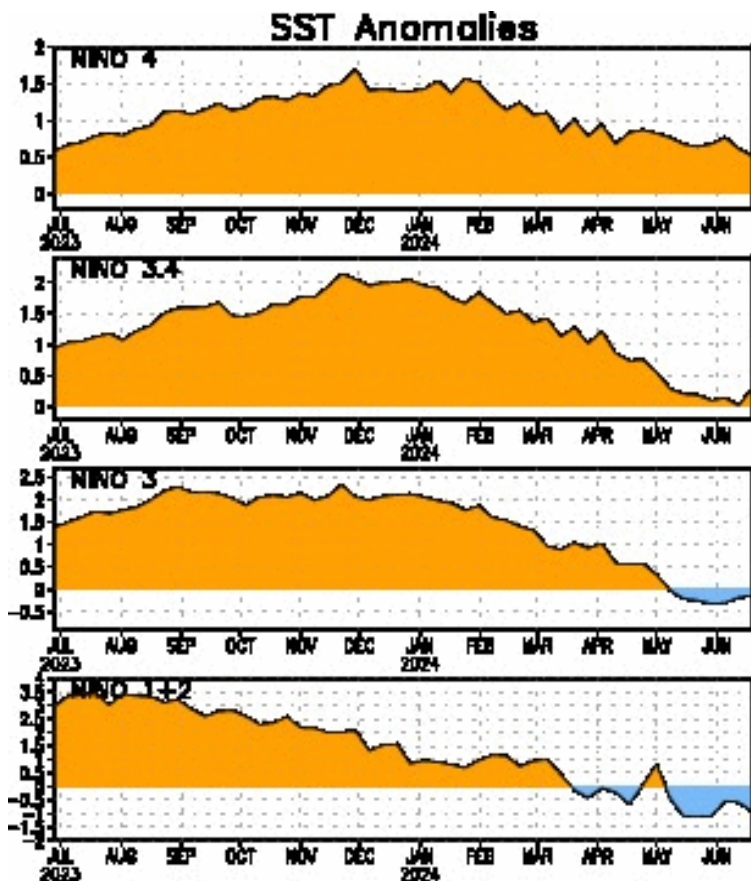
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- Compared to earlier in June, convective anomalies have become more muted throughout the global tropics.
- The GEFS OLR forecast anomalies show a slight uptick in convection over the eastern Hemisphere, while favoring a low frequency suppressed footprint near 120E coming through the objective filtering.

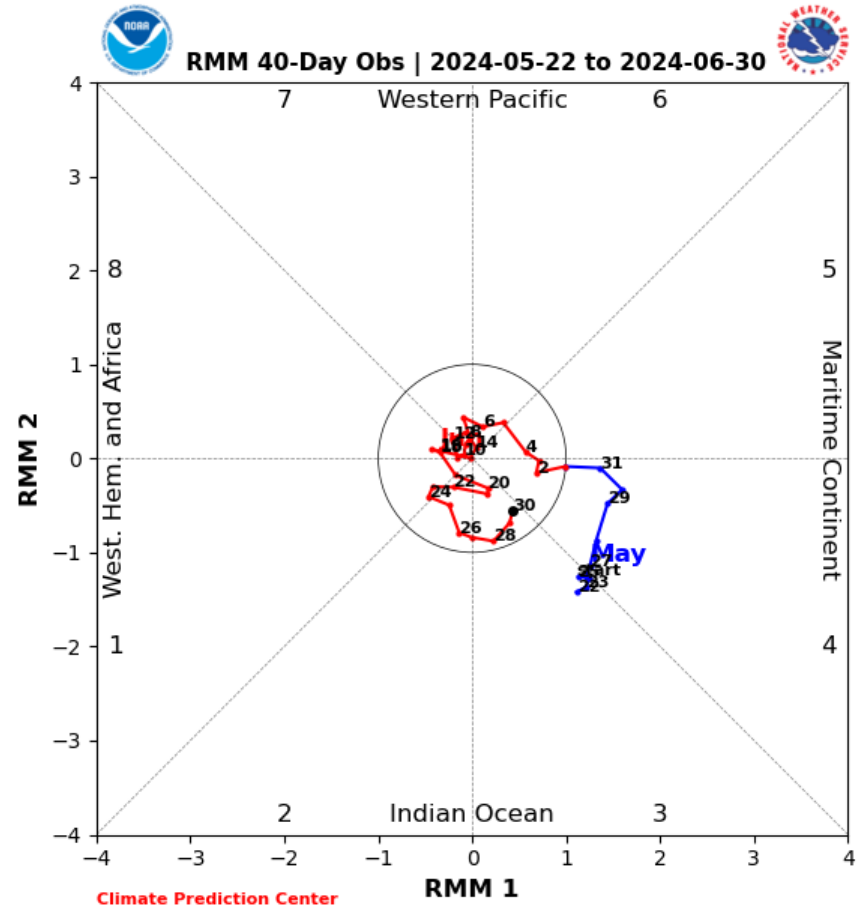
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- SSTs continue to trend downward, with negative SST anomalies observed in the easternmost Niño regions, indicative of a transitioning ENSO pattern.
- The western extent of the negative subsurface temperature anomalies in the eastern Pacific weakened during June possibly associated with an oceanic downwelling event.

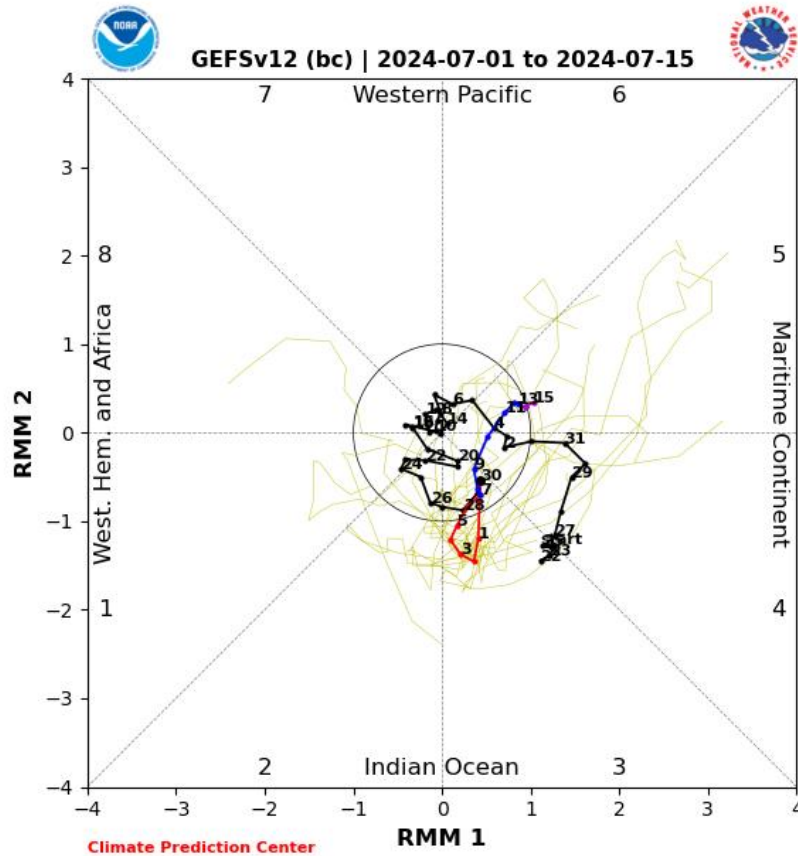
MJO Index: Recent Evolution

- Since mid-June, RMM observations show the MJO signal gaining some amplitude while slowly propagating eastward over the Indian Ocean.

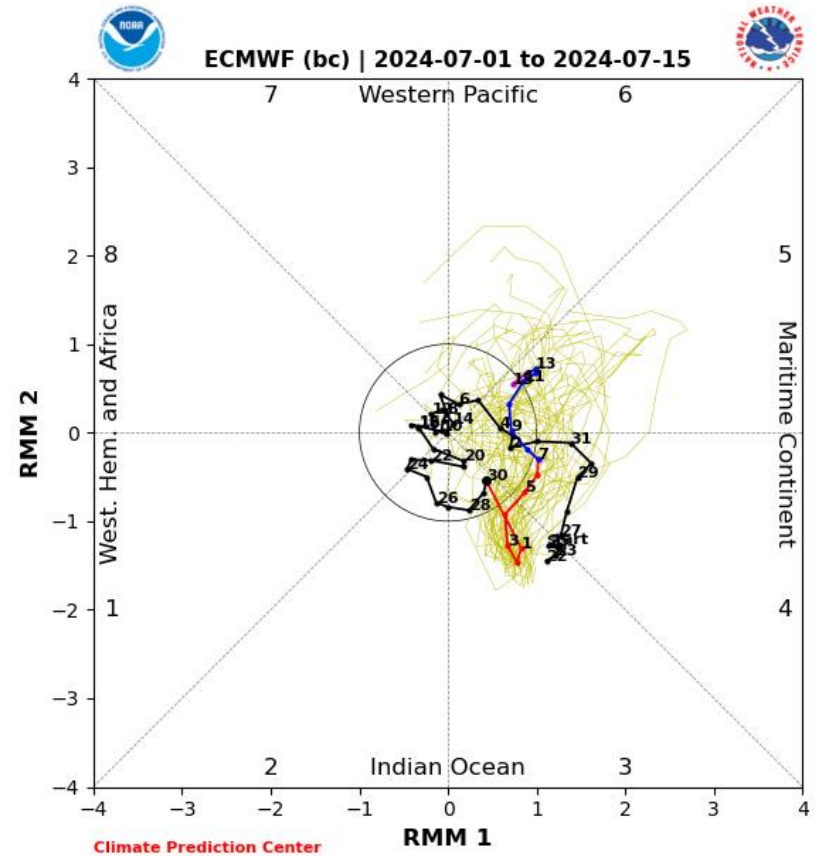


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



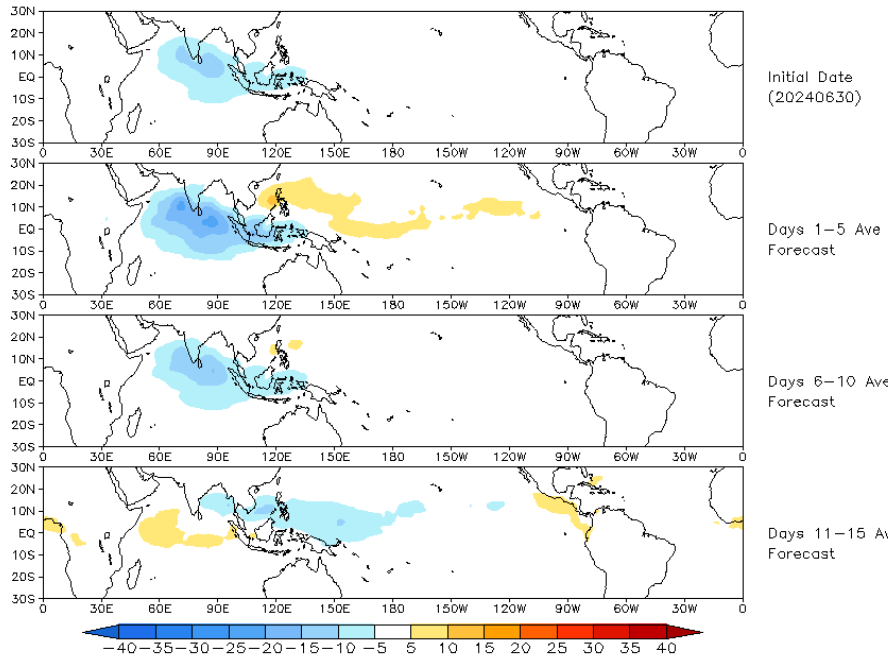
ECMWF Forecast

- RMM forecasts suggest the potential for interference with an Rossby wave activity, followed by a slow eastward propagation of the MJO signal into the Maritime Continent at a low amplitude.

MJO: GEFS Forecast Evolution

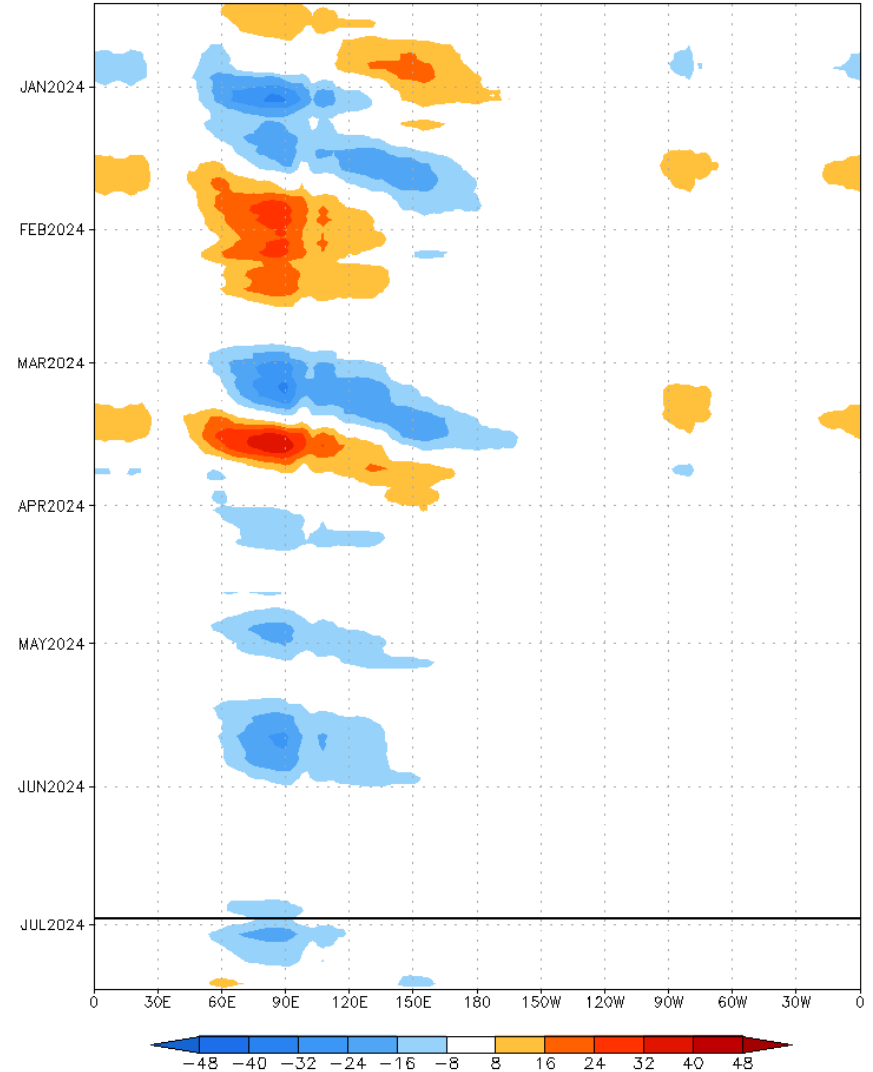
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

OLR prediction of MJO-related anomalies using GFS model reconstruction by RMM1 & RMM2 (20240630)



- The GEFS favors much of the enhanced convection in this Indian Ocean to shift into the Maritime Continent and western Pacific, with more suppressed convection developing over parts of Africa and the western Indian Ocean later in the period.

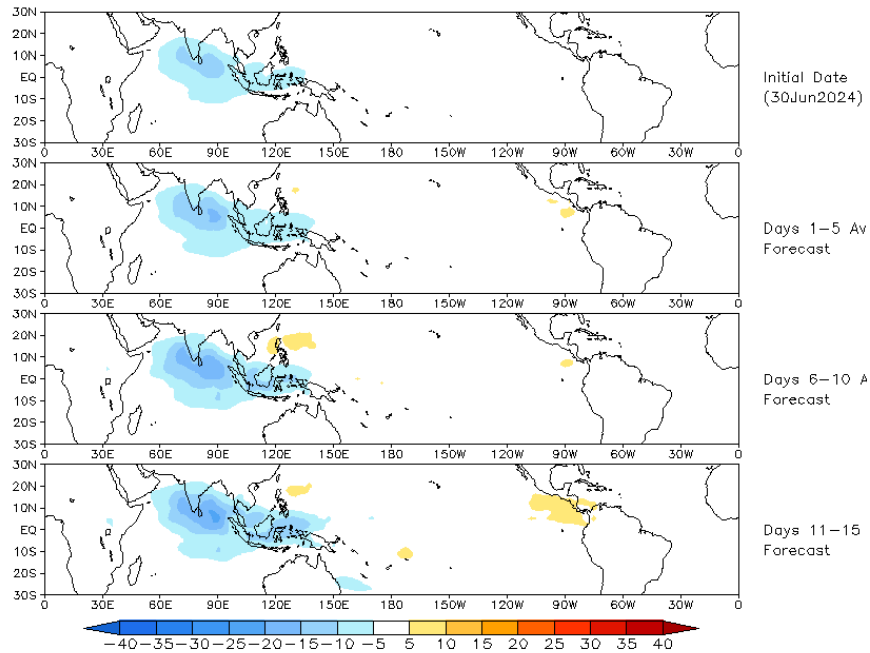
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) 15-Day GFS forecast starting: 20240630



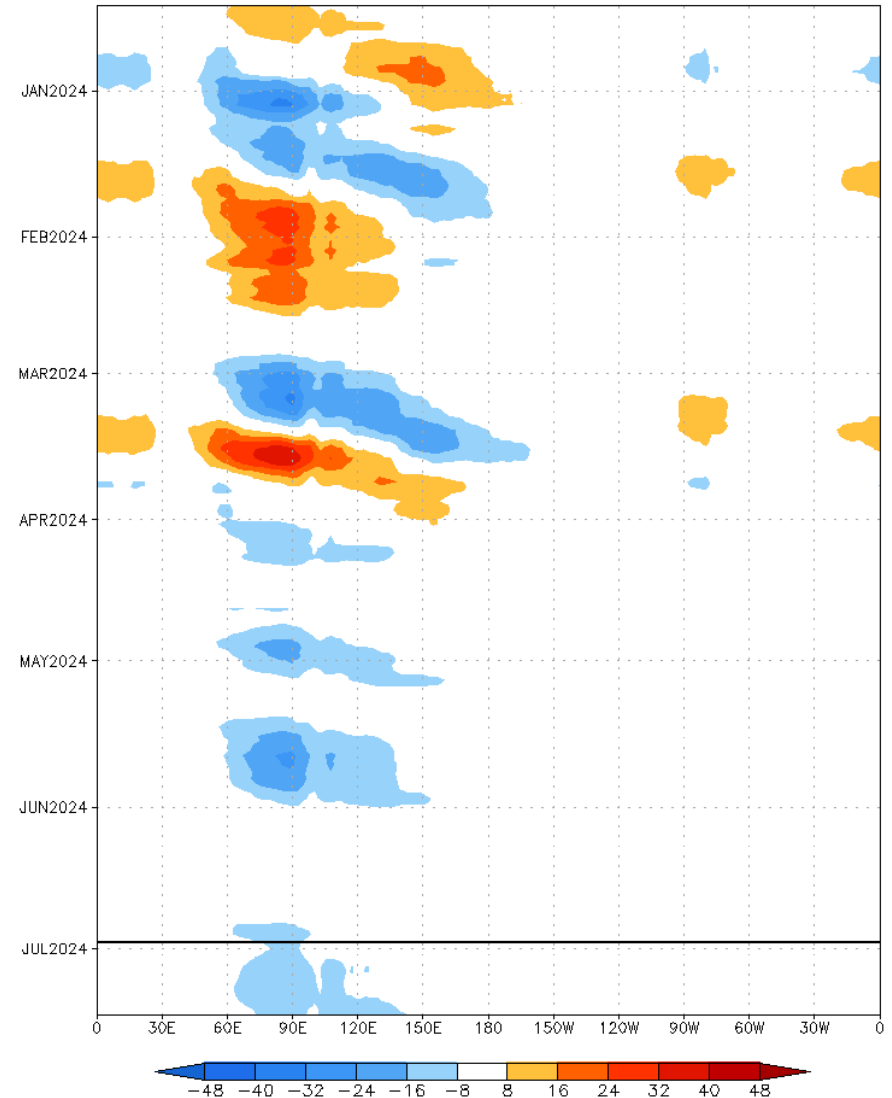
MJO: Constructed Analog Forecast Evolution

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 (30Jun2024)



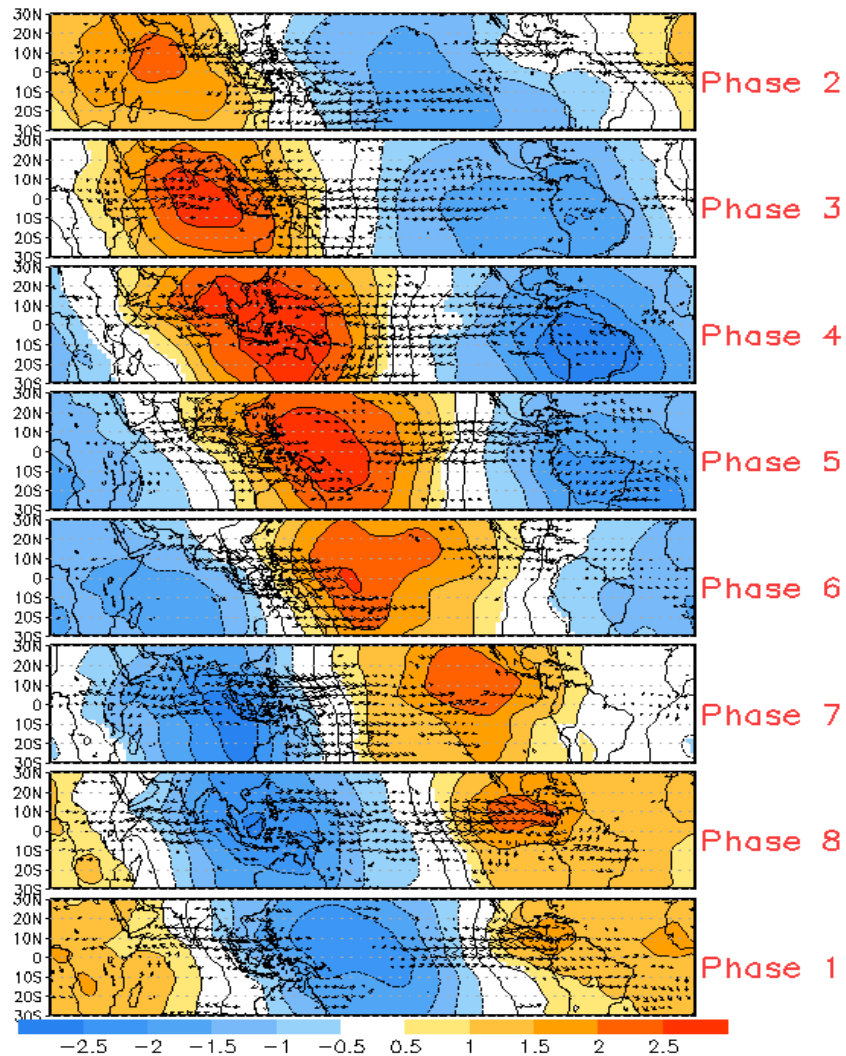
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) 15-Day CA forecast starting: 30Jun2024



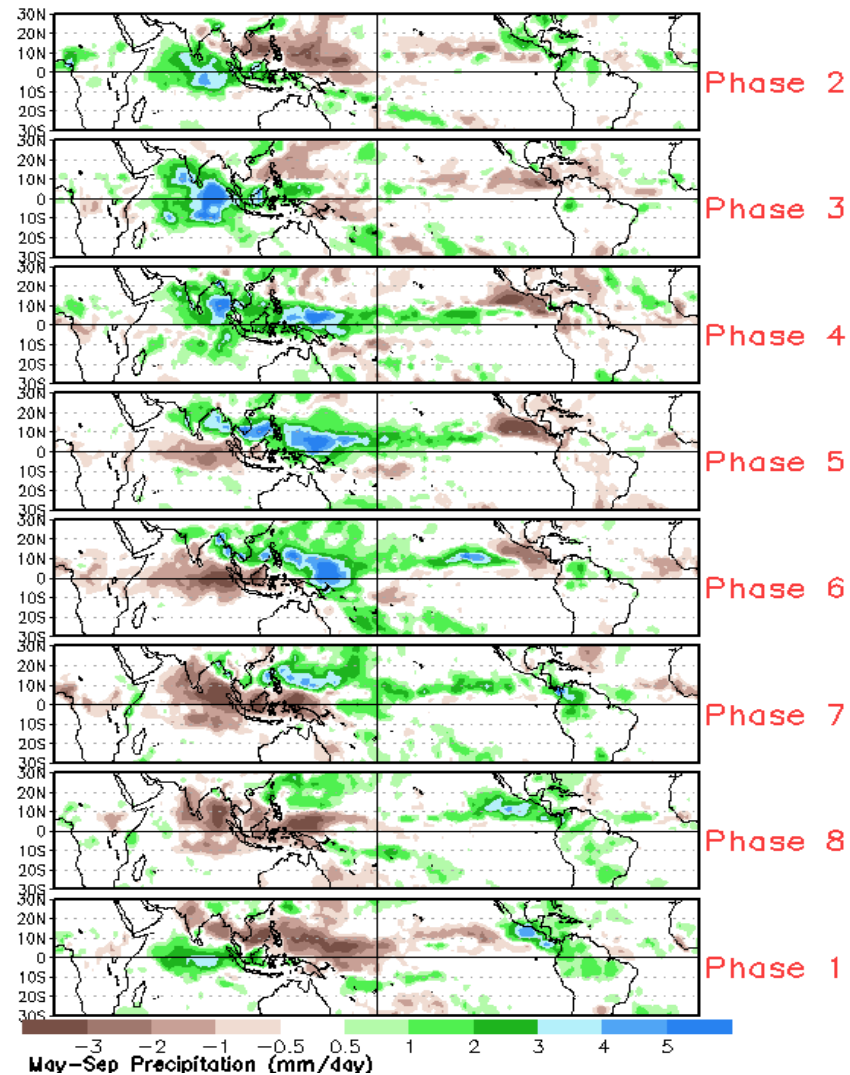
- Compared to the GFS, the constructed analog tool maintains a persistent enhanced convective pattern over the Indian Ocean and Maritime Continent, which is consistent with upper-level velocity potential forecasts.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



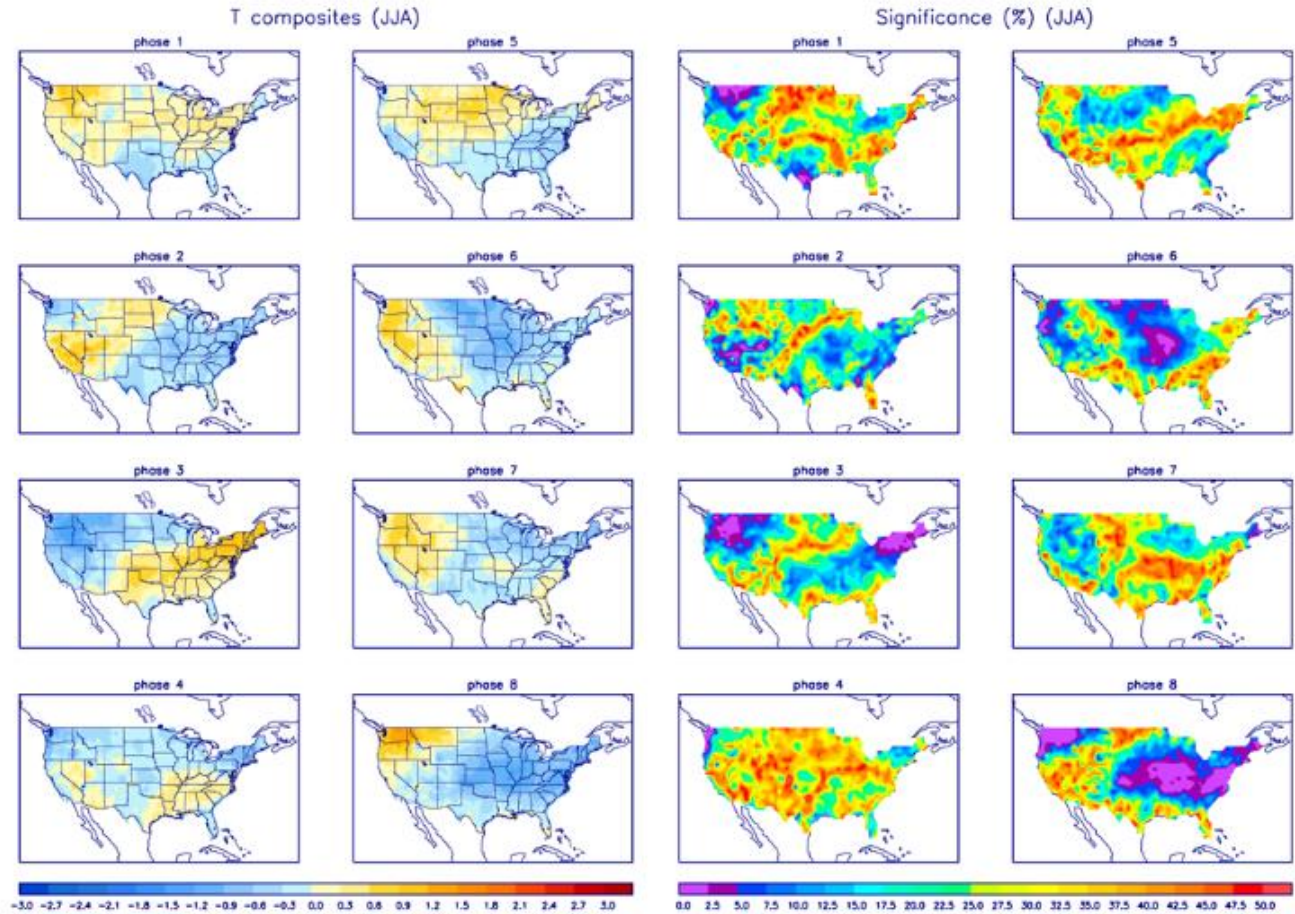
Precipitation Anomalies



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.

