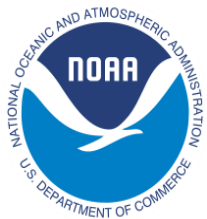


Madden-Julian Oscillation: Recent Evolution, Current Status and Predictions



Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
20 May 2024

Overview

- As previously forecast, the RMM index observations reflect reorganizing MJO activity, with the signal slowly gaining amplitude and propagating eastward over the Indian Ocean. The renewed MJO signal likely contributed to pair of low-latitude, late season tropical cyclones forming south of the equator during the past week.
- There is good continuity in the RMM forecasts favoring continued eastward propagation of the MJO over the Maritime Continent at a slowed phase speed during the next few weeks. Consistent with previous iterations of the MJO propagating over this part of the tropics, the models generally feature a rapid weakening of the signal by early June.
- Upper-level velocity potential anomaly forecasts show a more coherent picture of the MJO reaching the Western Pacific, but continue to differ in the regards to phase speed adding to uncertainty in the outlook.
- Strengthening lower-level westerlies forecast over the equatorial Indian Ocean supports additional tropical cyclone development in the basin and the western Pacific later in May.
- While the large-scale environment may not be entirely supportive tropical cyclogenesis in the eastern Pacific and Atlantic, development is possible given growing support in the model tools during week-3.

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

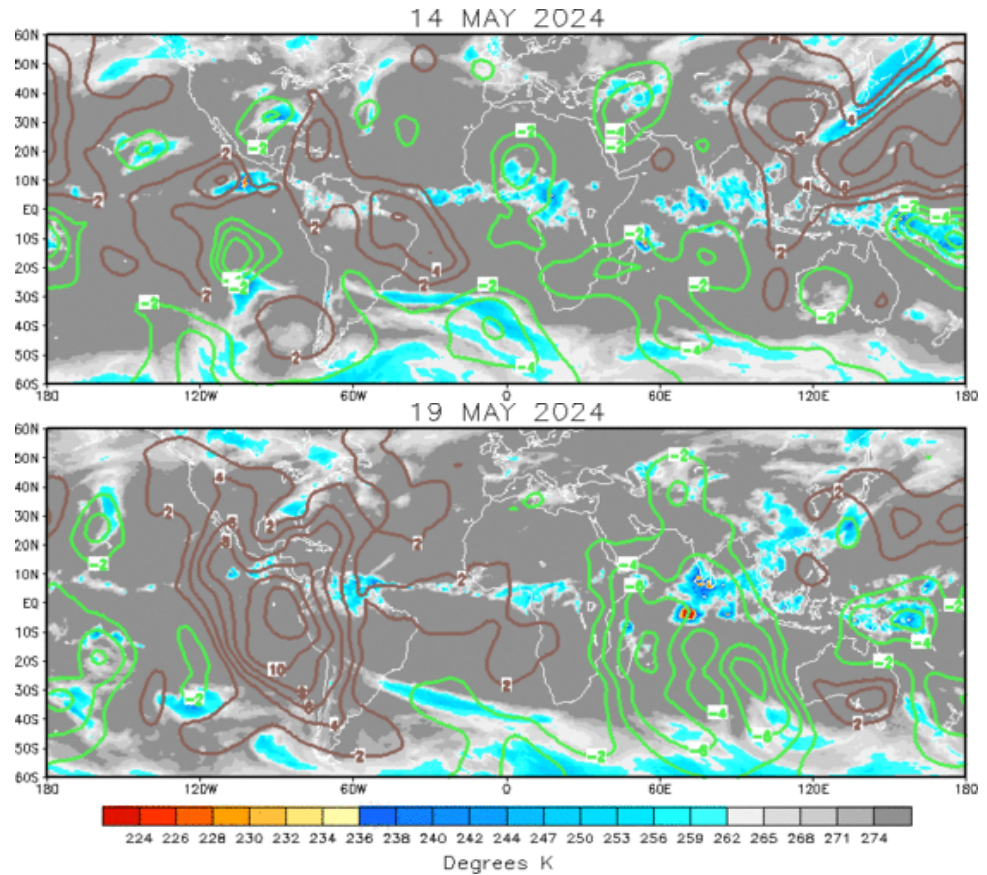
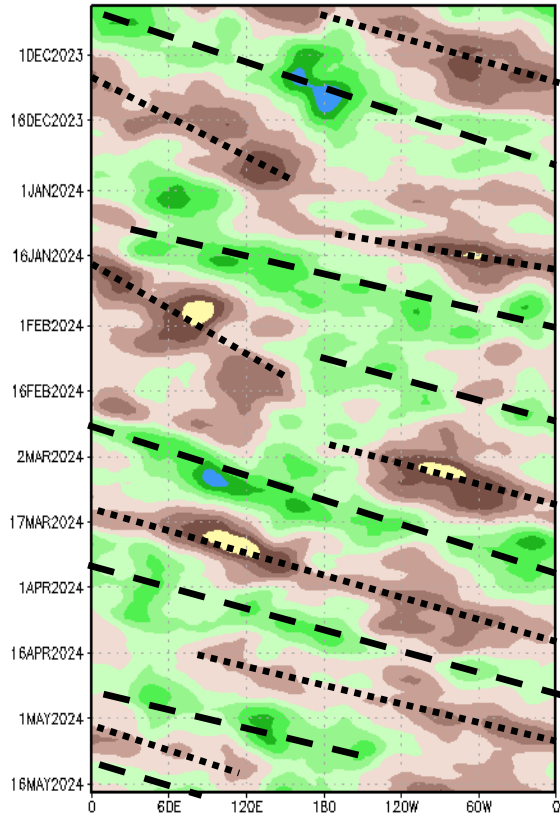
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

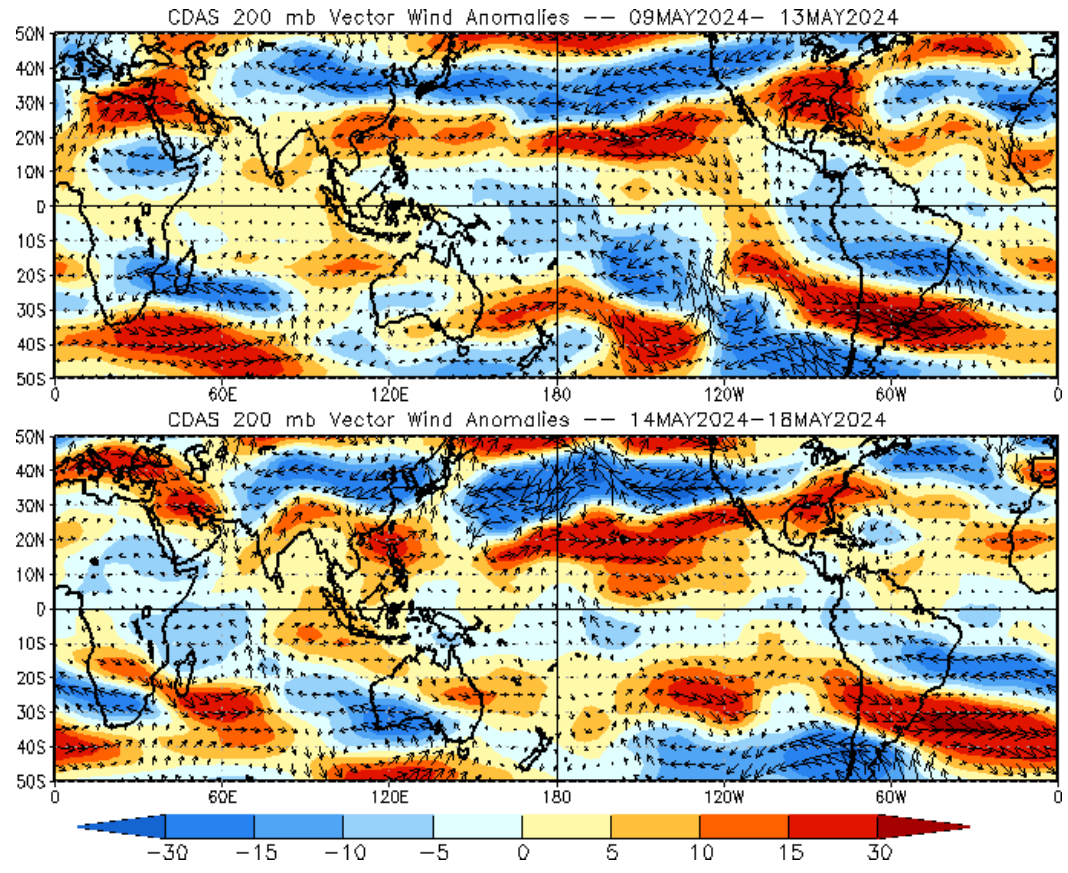
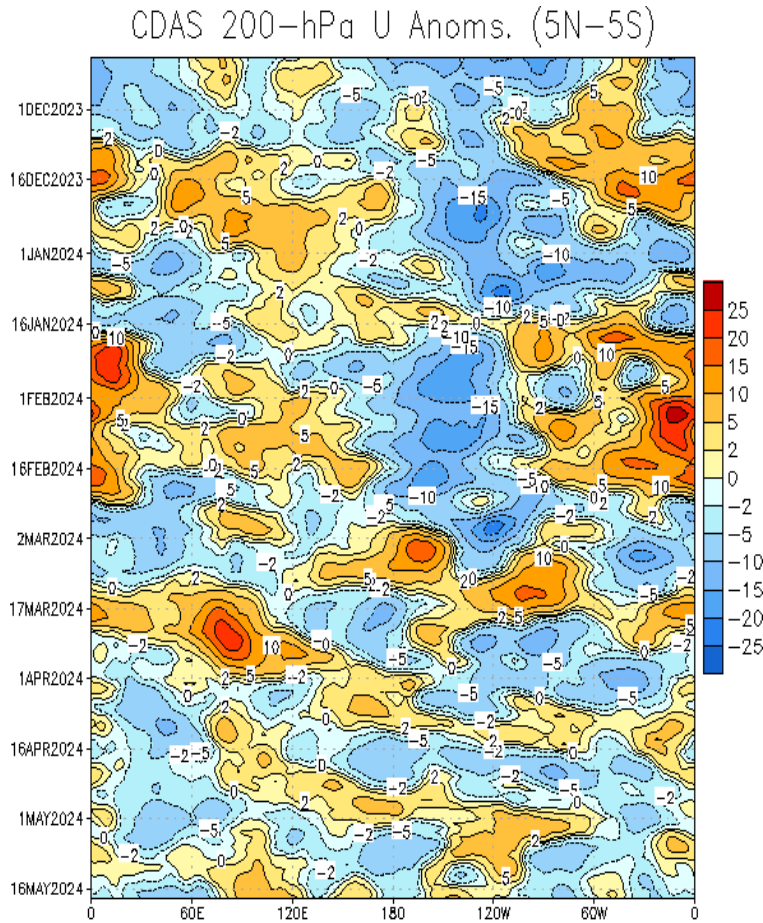
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- Time/longitude plots of upper-level velocity potential anomalies show a fairly fast progression of eastward propagating features this spring.
- Spatially, the pattern has become better organized since last week with enhanced (suppressed) divergence aloft largely overspreading the eastern (western) Hemisphere, more consistent with a wave-1 pattern.

200-hPa Wind Anomalies

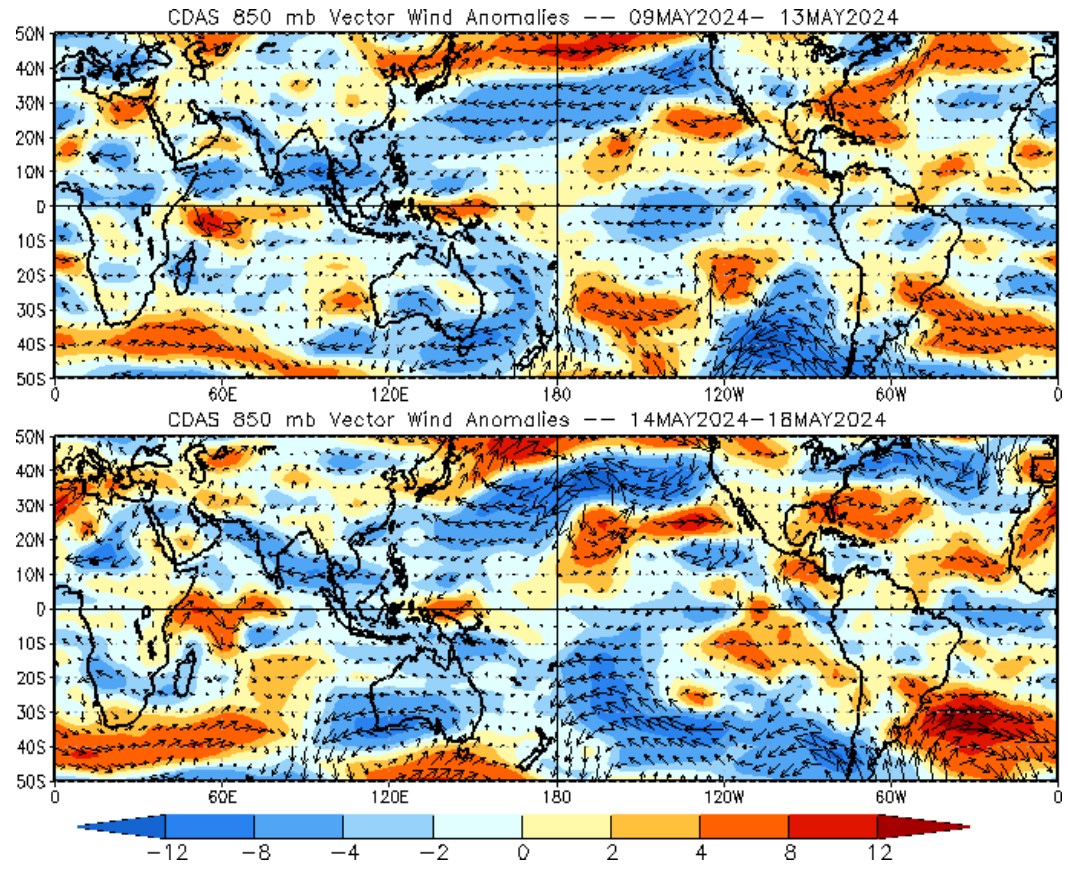
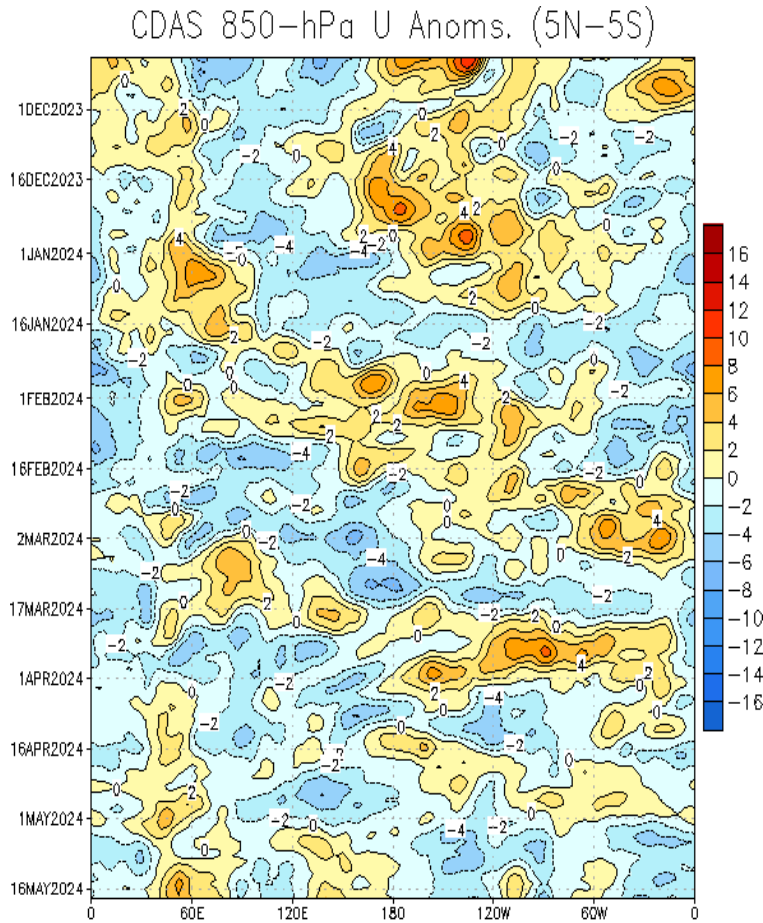
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- The return of enhanced easterlies (westerlies) aloft over the western (eastern) Indian Ocean is suggestive of renewed MJO activity over the basin.
- Enhanced easterlies over the equatorial Pacific became more relaxed, with anomalous westerlies becoming more pronounced north of the equator.
- An enhanced subtropical jet extending into the lower-latitudes of North America is contributing to amplified ridging and promoting warmer and drier than normal conditions for many parts of the tropical Americas.

850-hPa Wind Anomalies

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

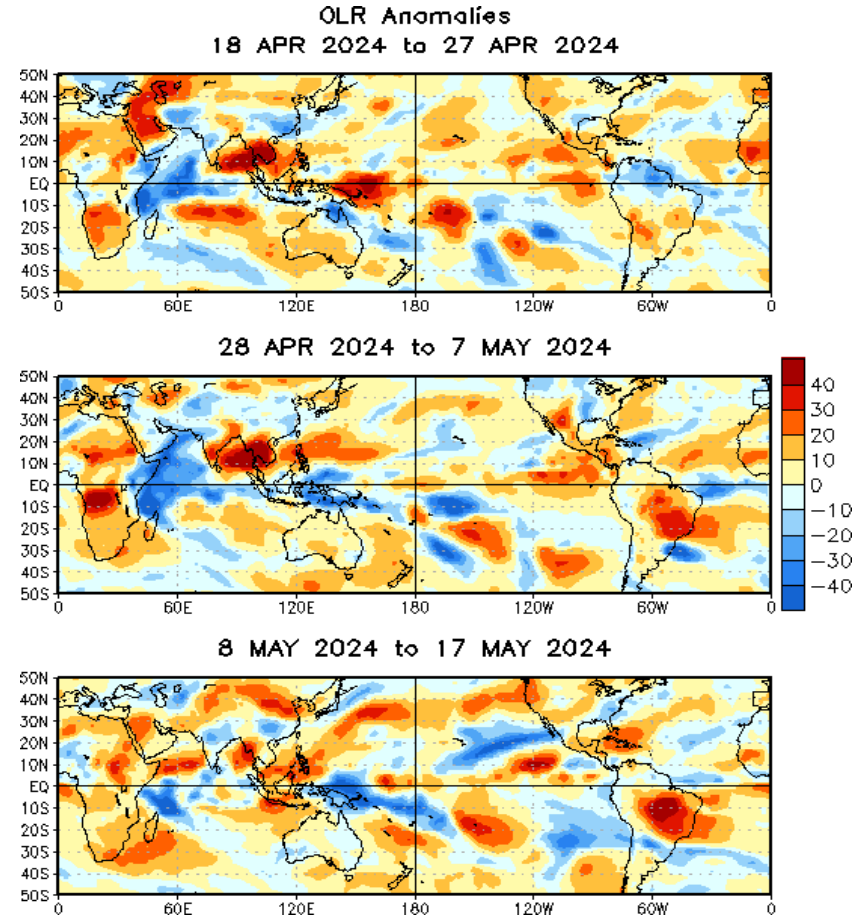
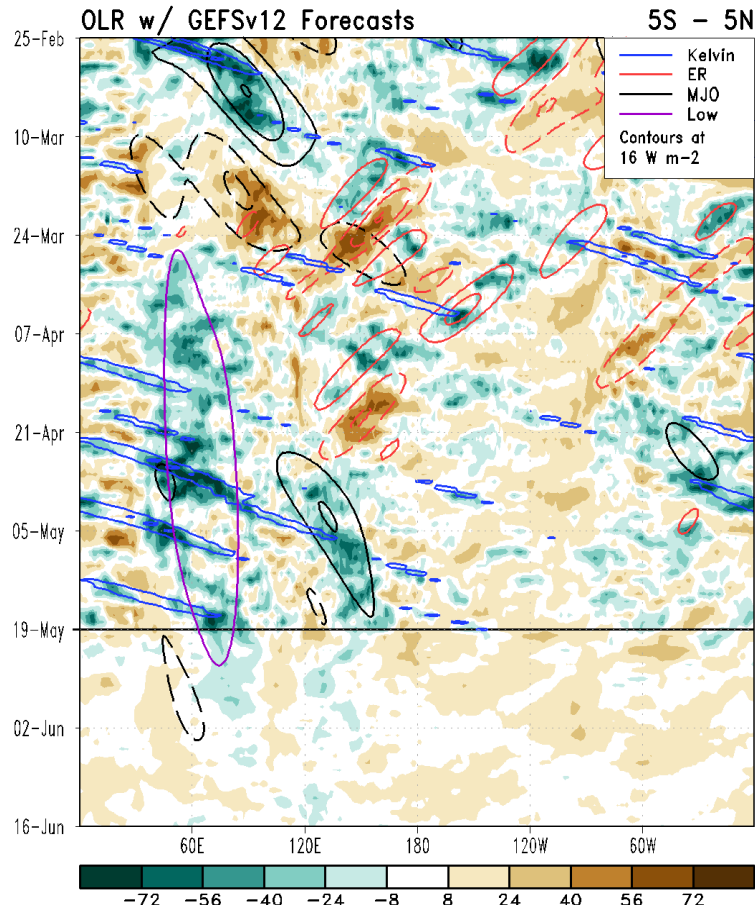


- Strongly anomalous lower-level westerlies persist near 60E, aiding in the formation of low-latitude Tropical Cyclones (Ialy and 25S) over the southern Indian Ocean.
- Lower-level wind anomalies appear rather mixed across the eastern equatorial Pacific.

Outgoing Longwave Radiation (OLR) Anomalies

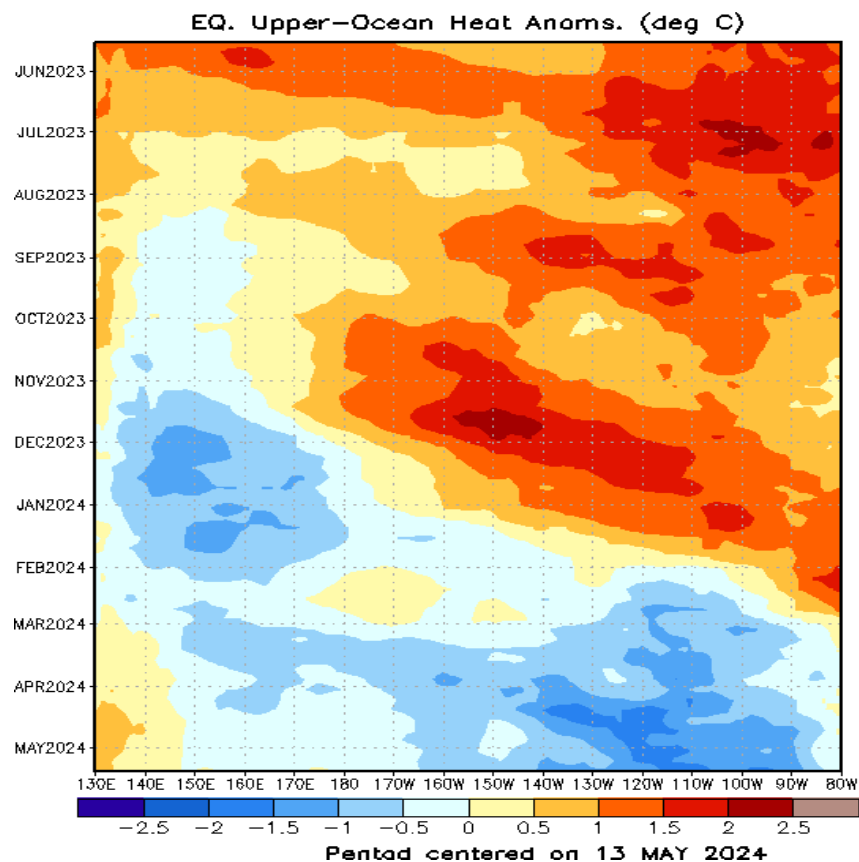
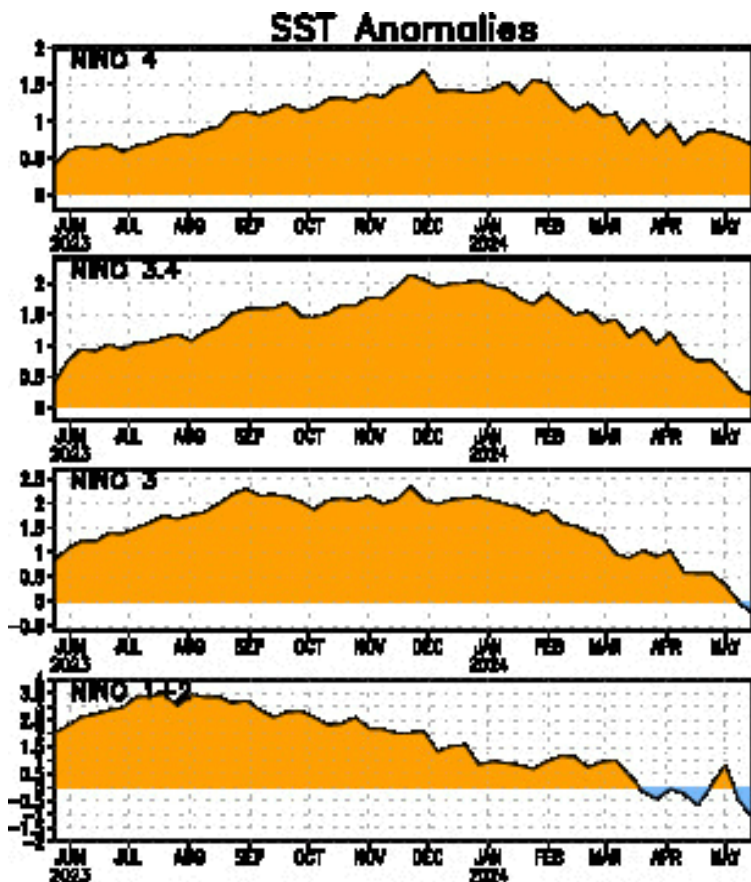
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- Enhanced convection persisted near 60E and 150E along and south of the equator.
- Suppressed convection overspread the Maritime Continent following an uptick earlier in May.
- The GEFS continues to favor largely suppressed convection for much of the Tropics, except near 120E where convection looks to remain either neutral or enhanced through mid-June.

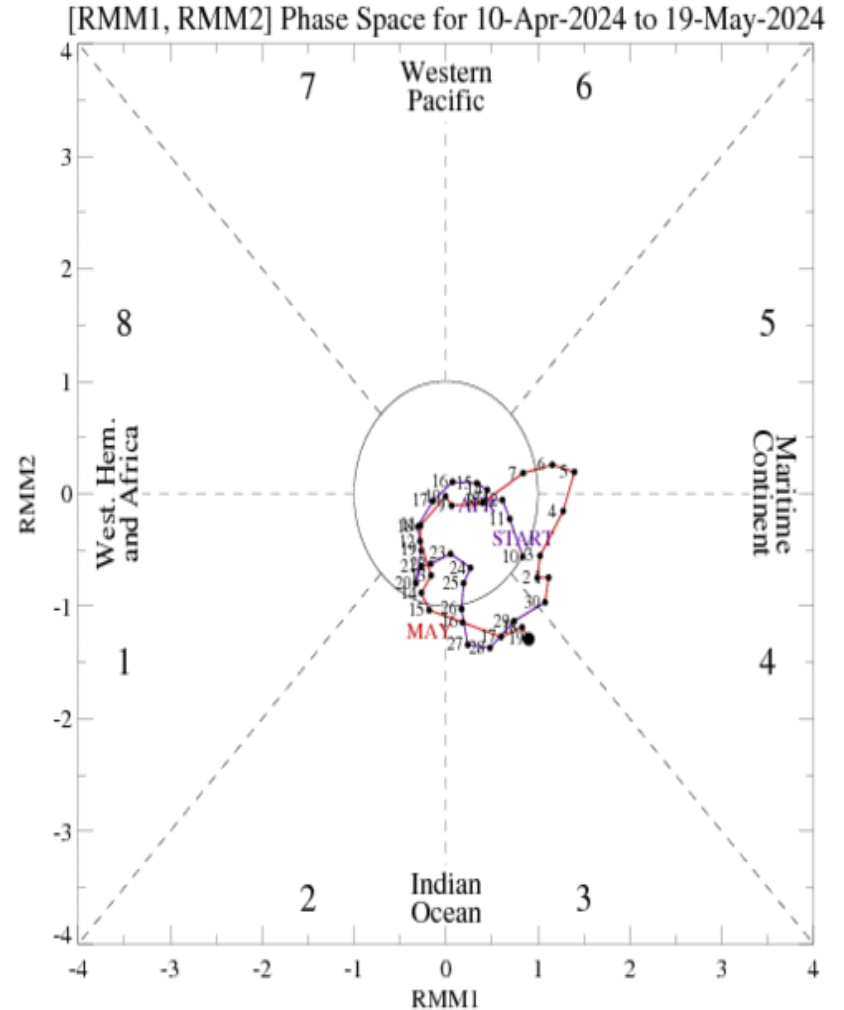
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- SSTs in the easternmost NINO regions continue to trend downward since February, indicative of a decaying El Niño. Nino1+2 has been exhibiting more volatile swings with the mean anomalies since early April.
- Negative subsurface temperature anomalies continue to be observed across nearly the entire Pacific, with cooling most pronounced across the Eastern Pacific.

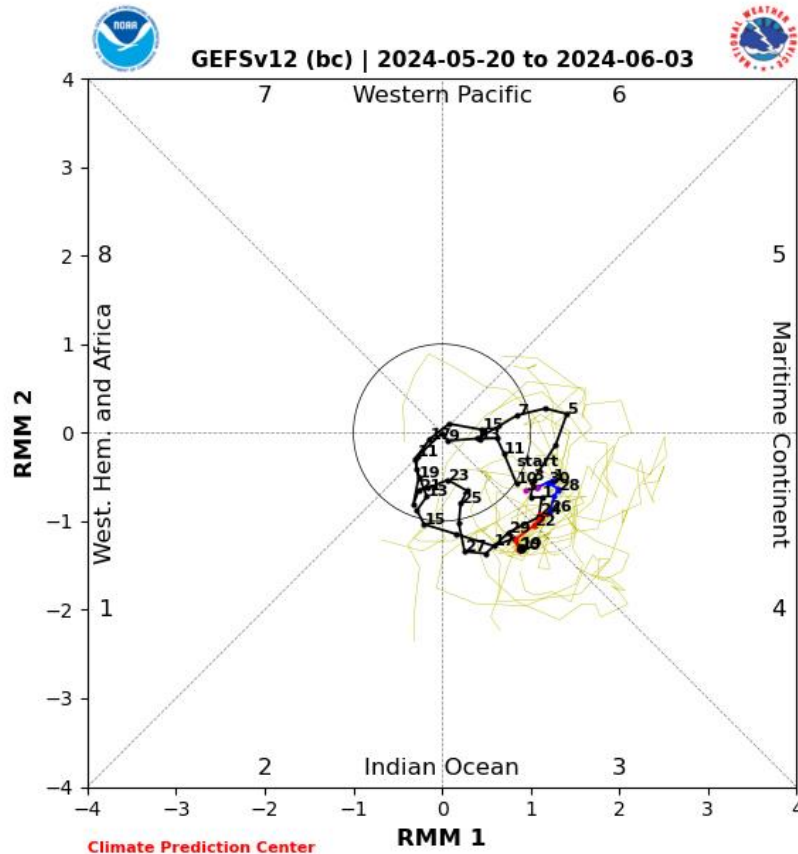
MJO Index: Recent Evolution

- The RMM index features an MJO signal slowly gaining amplitude while propagating eastward across the Indian Ocean (phase 3) during the past week.

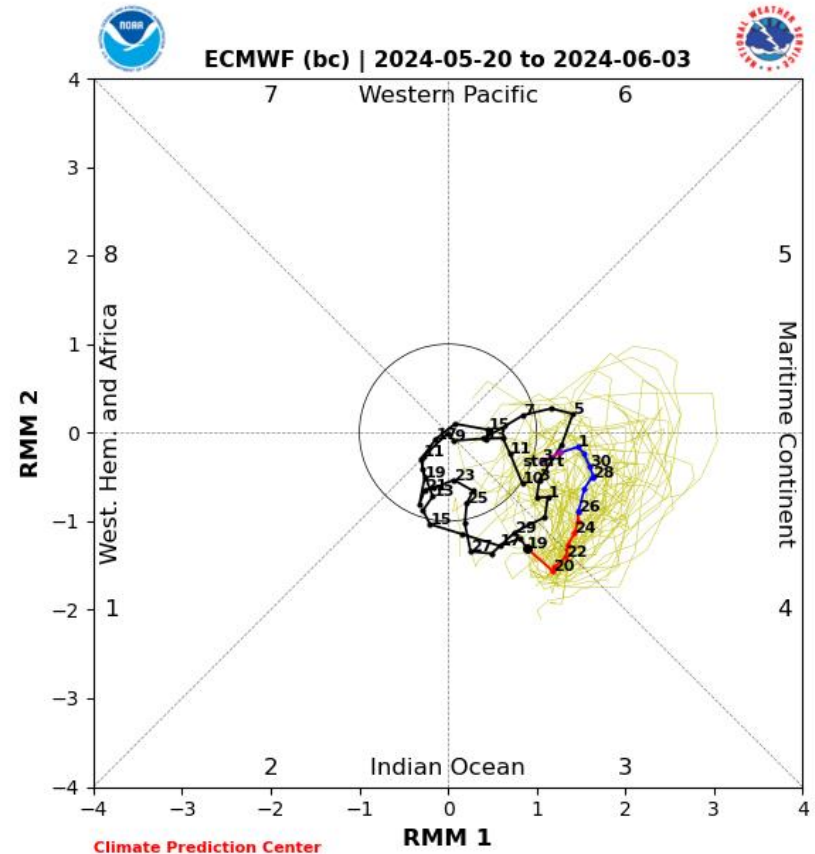


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



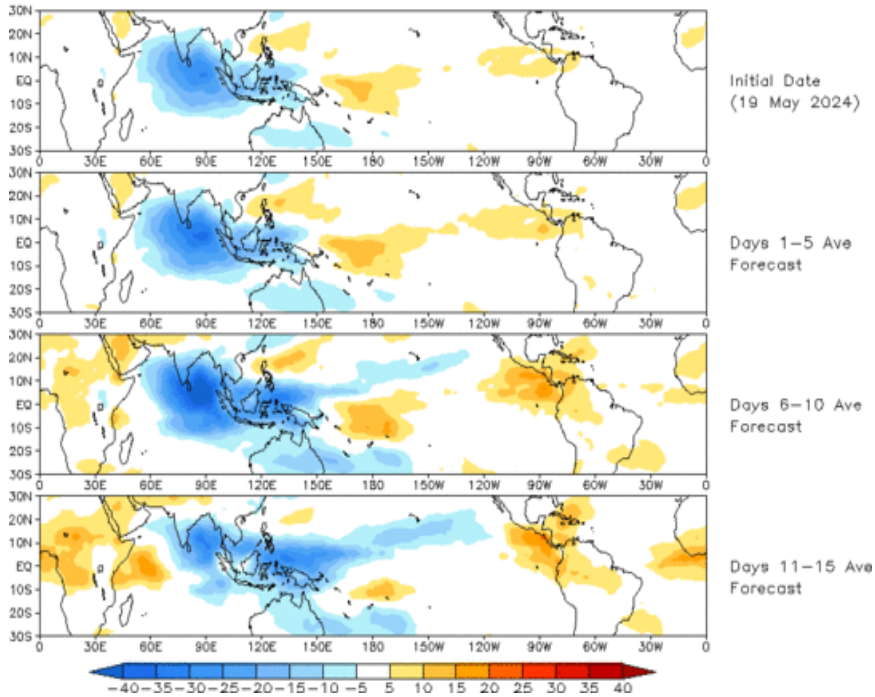
ECMWF Forecast

- Good continuity exists in the dynamical models favoring continued eastward propagation of the MJO signal from the Indian Ocean and into the Maritime Continent at a slowed phase speed.
- Like previous iterations, extended range mean solutions fail to fully propagate the MJO signal at a high amplitude over the Western Pacific.
- Both RMM observations and forecasts predominantly reside on the right hand side of the phase plot, and may be indicative of the shifting background state.

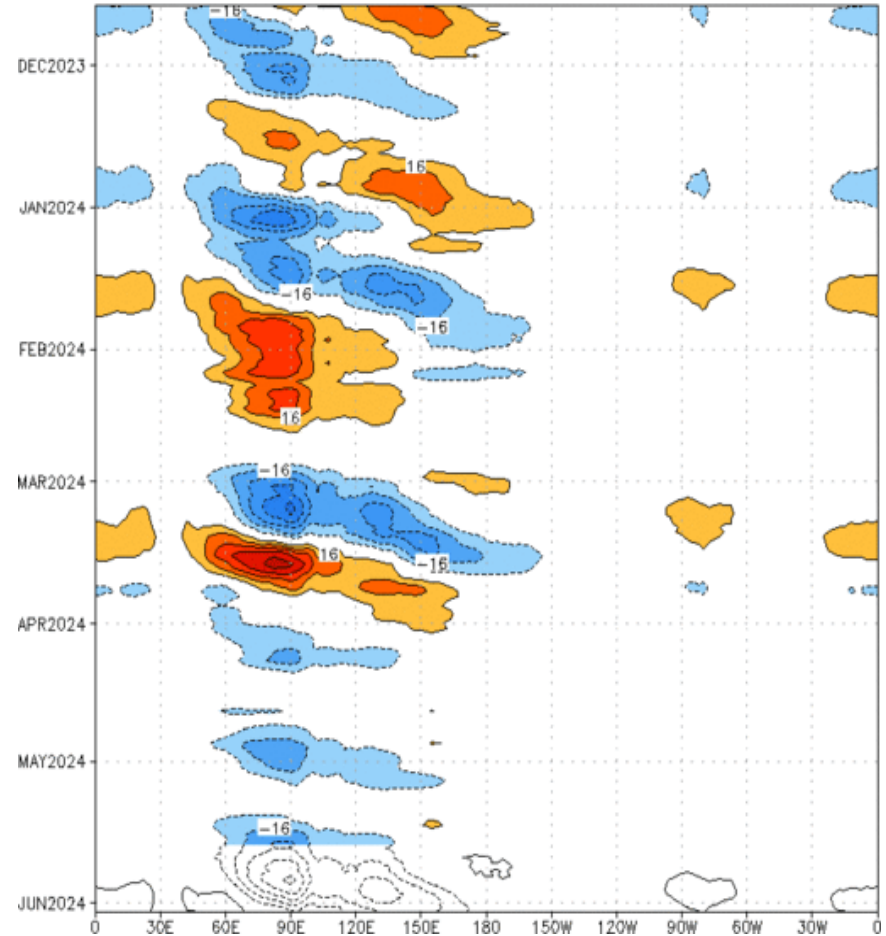
MJO: GEFS Forecast Evolution

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: 19 May 2024
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:18-Nov-2023 to 19-May-2024
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

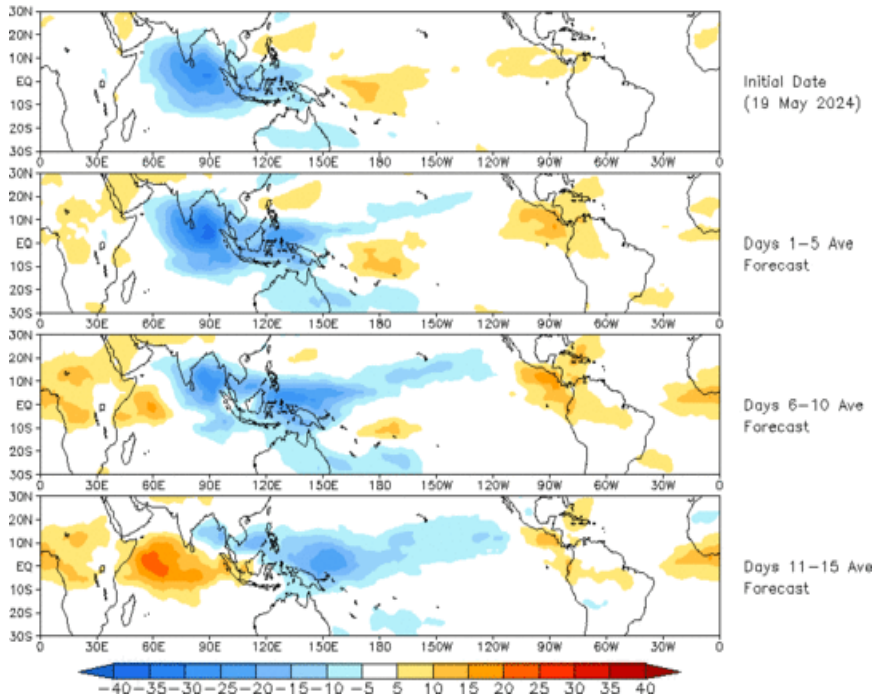


- The GEFS favored enhanced convection remaining nearly stationary over the Indian Ocean, while enhancing (suppressing) convection over the western (eastern Pacific) during the next two weeks.

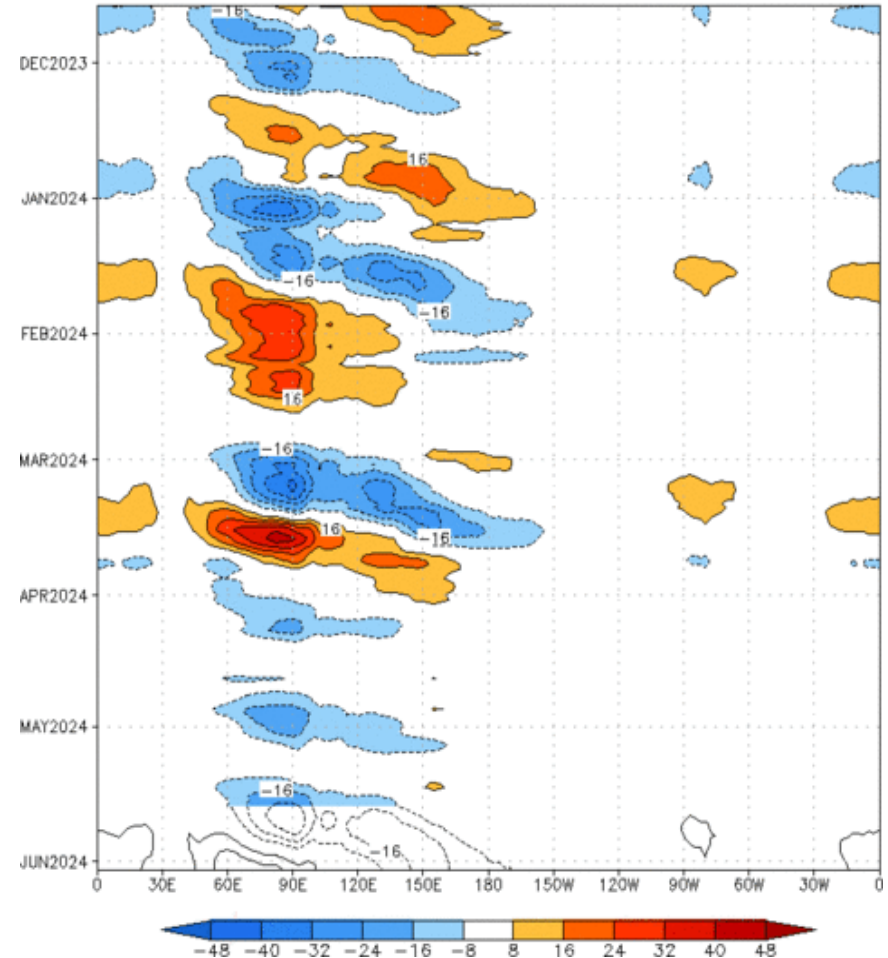
MJO: Constructed Analog Forecast Evolution

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 (19 May 2024)



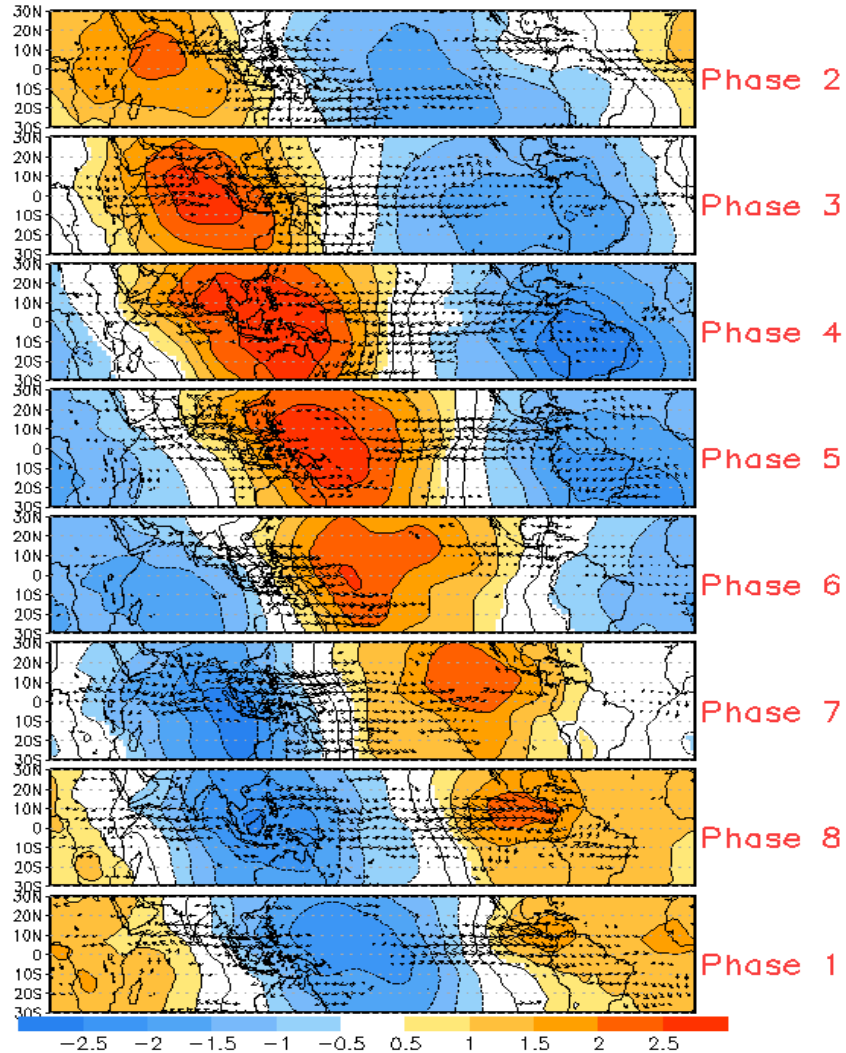
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:18-Nov-2023 to 19-May-2024
The unfilled contours are CA forecast reconstructed anomaly for 15 days



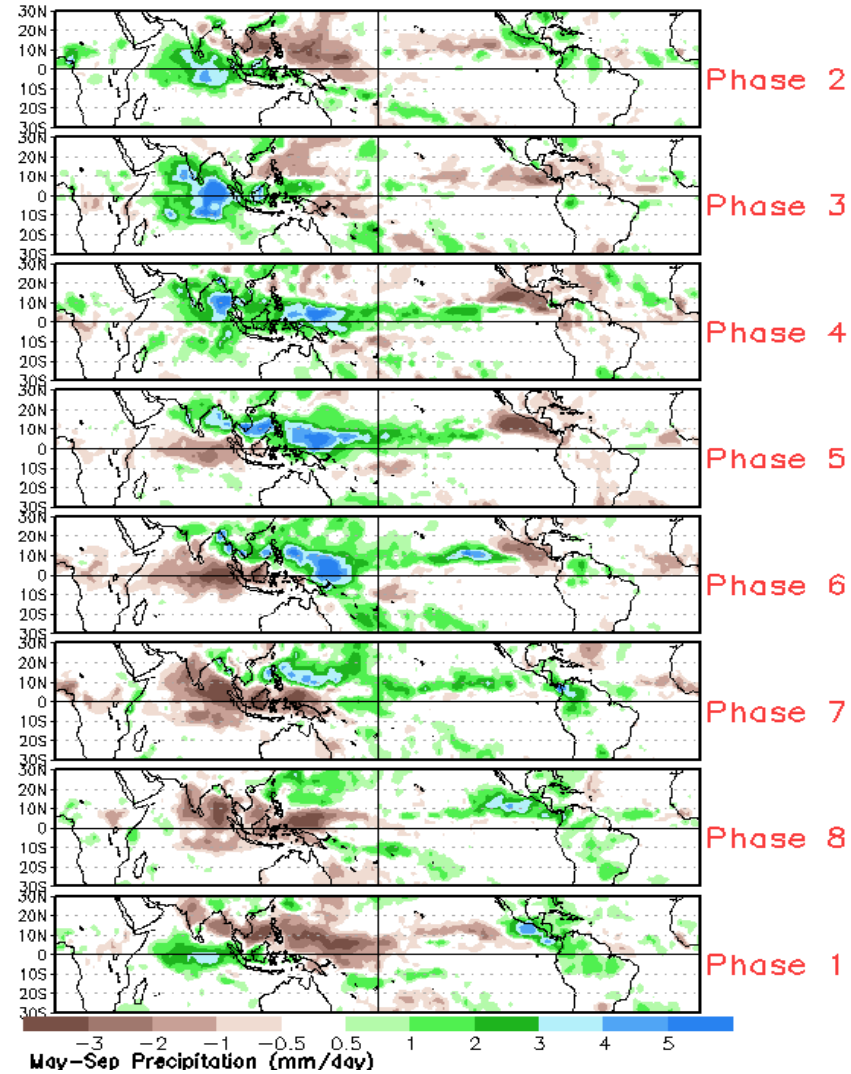
- Compared to the GEFS, the constructed analog tool is more progressive with the convective anomalies, and is more reflective of a canonical MJO.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



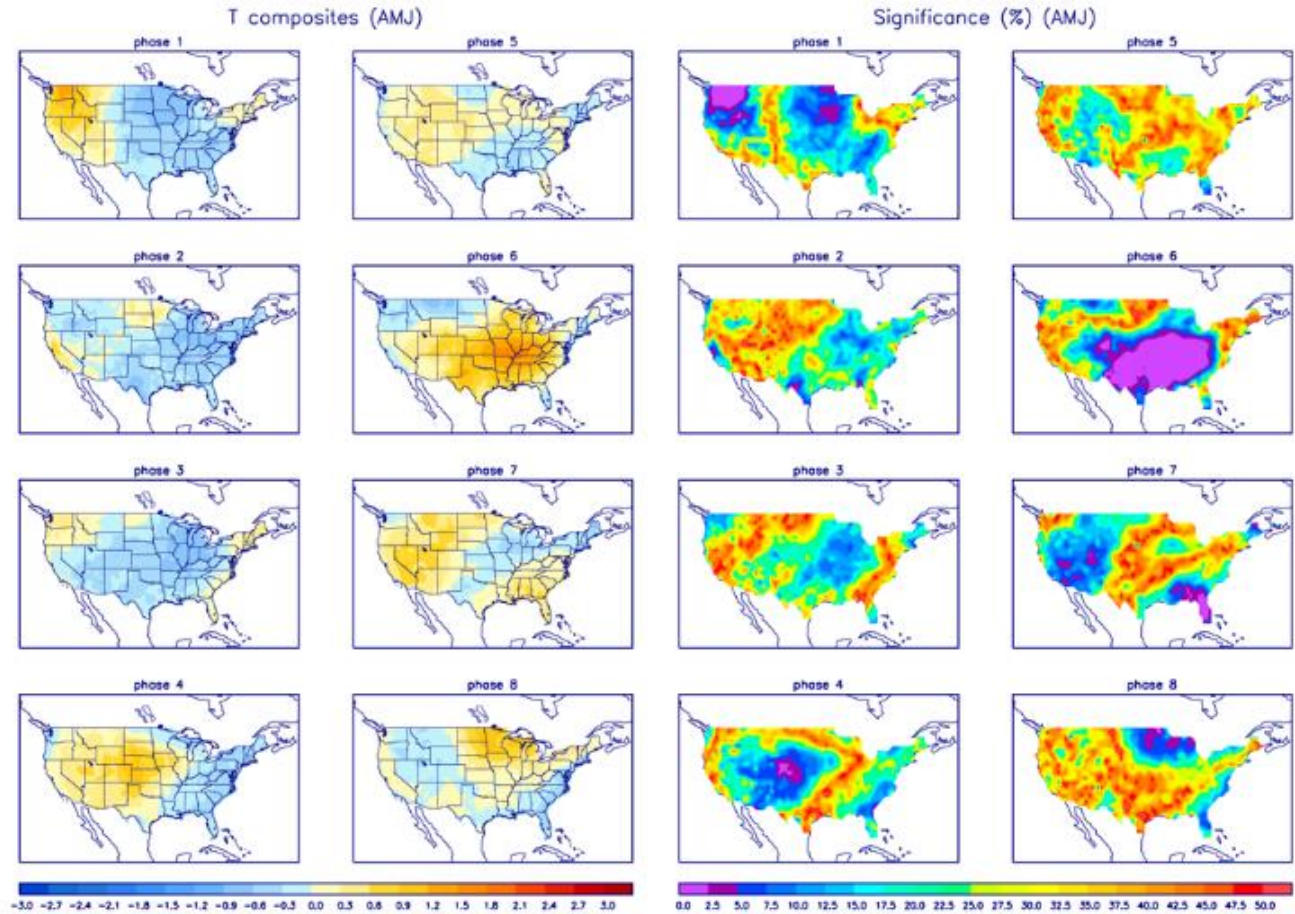
Precipitation Anomalies



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.

