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

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

Overview

- The RMM index observations depict a strengthening MJO during late May, with the signal gaining amplitude and propagating eastward over the Indian Ocean.

- The ECMWF model is the most bullish with the MJO continuing to propagate eastward to the West Pacific by early June.

- Upper-level velocity potential anomaly forecasts have a coherent wave-1 pattern of enhanced divergence (convergence) shifting east over the Pacific (Atlantic and Africa) during the next two to three weeks.

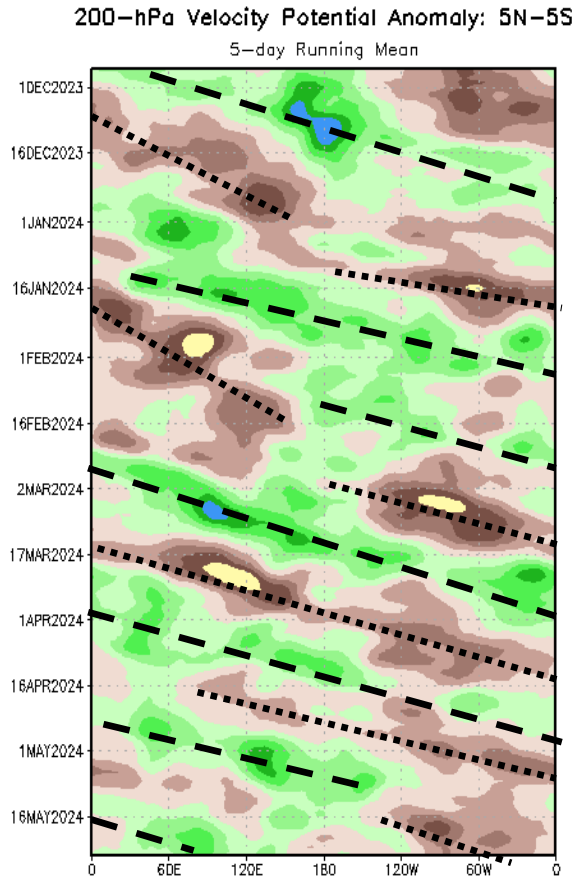
- The MJO would strongly favor tropical cyclone development across the South China Sea and West Pacific during early to mid-June. Also, there is an increased chance of above-normal temperatures for much of India.

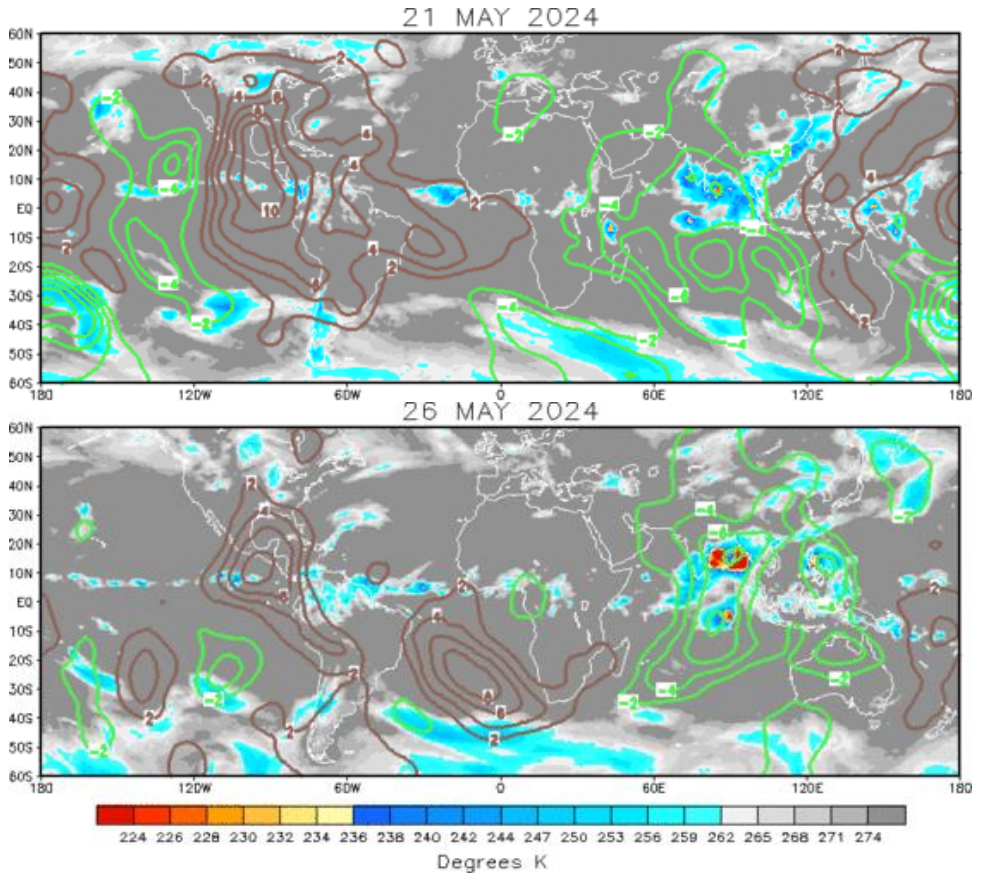
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

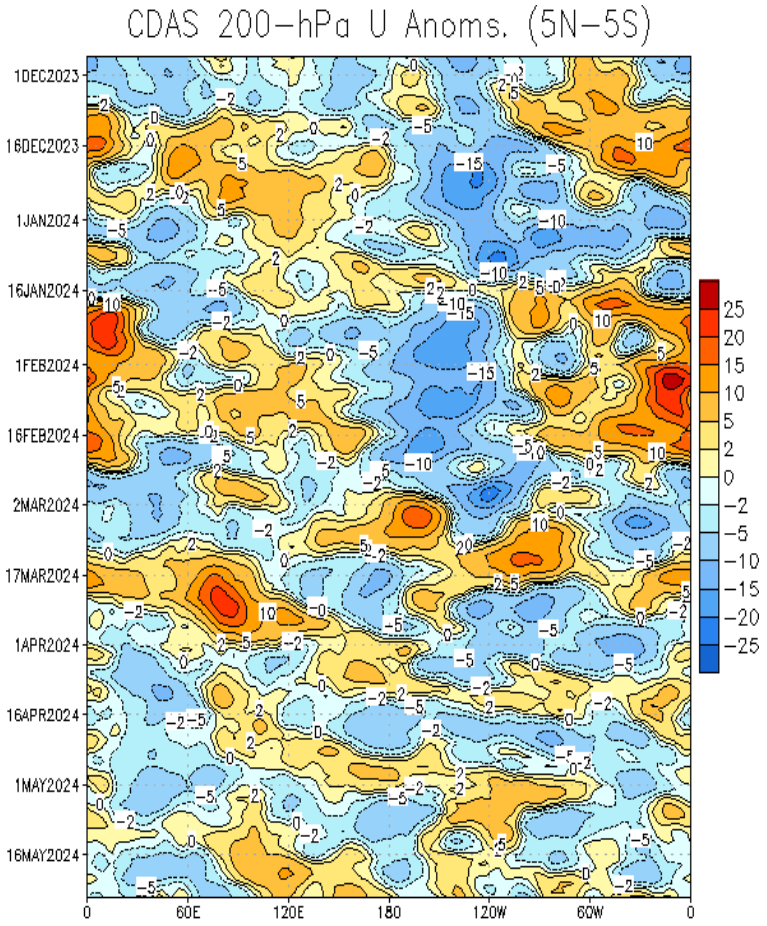


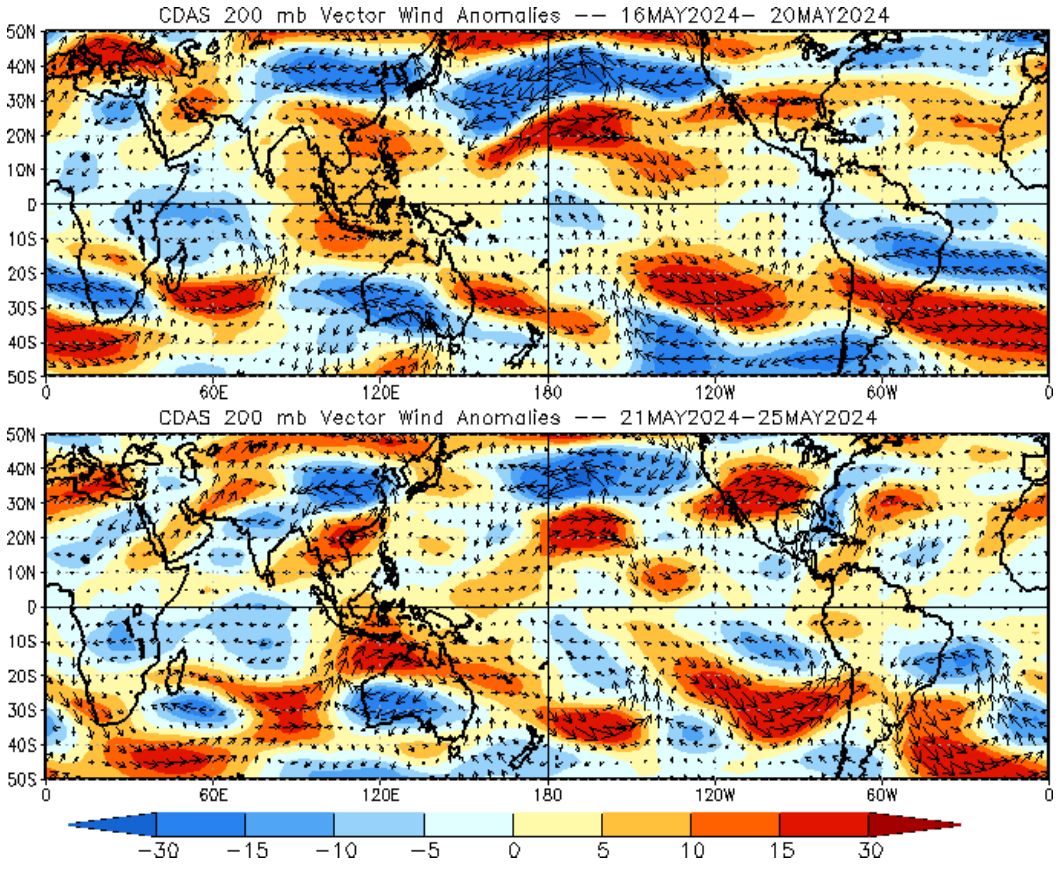


- Spatially, the pattern became better organized during late May with enhanced (suppressed) divergence aloft largely overspreading the eastern (western) Hemisphere, more consistent with a wave-1 pattern.
- The anomalous upper-level divergence recently shifted east to the Maritime Continent and West Pacific consistent with a strengthening MJO.

200-hPa Wind Anomalies

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

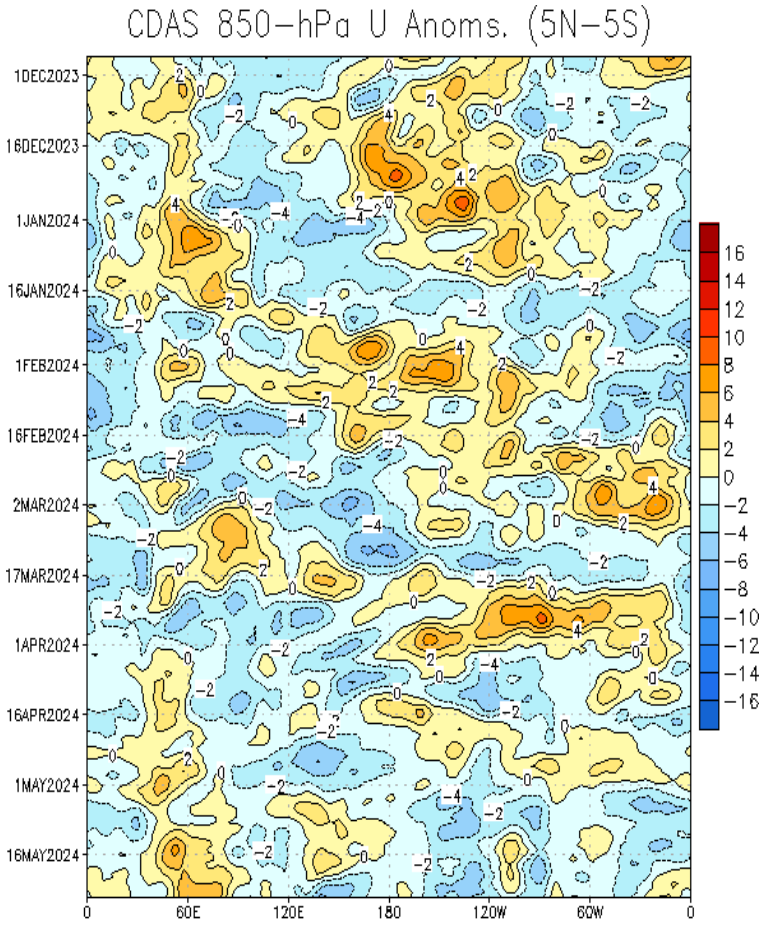


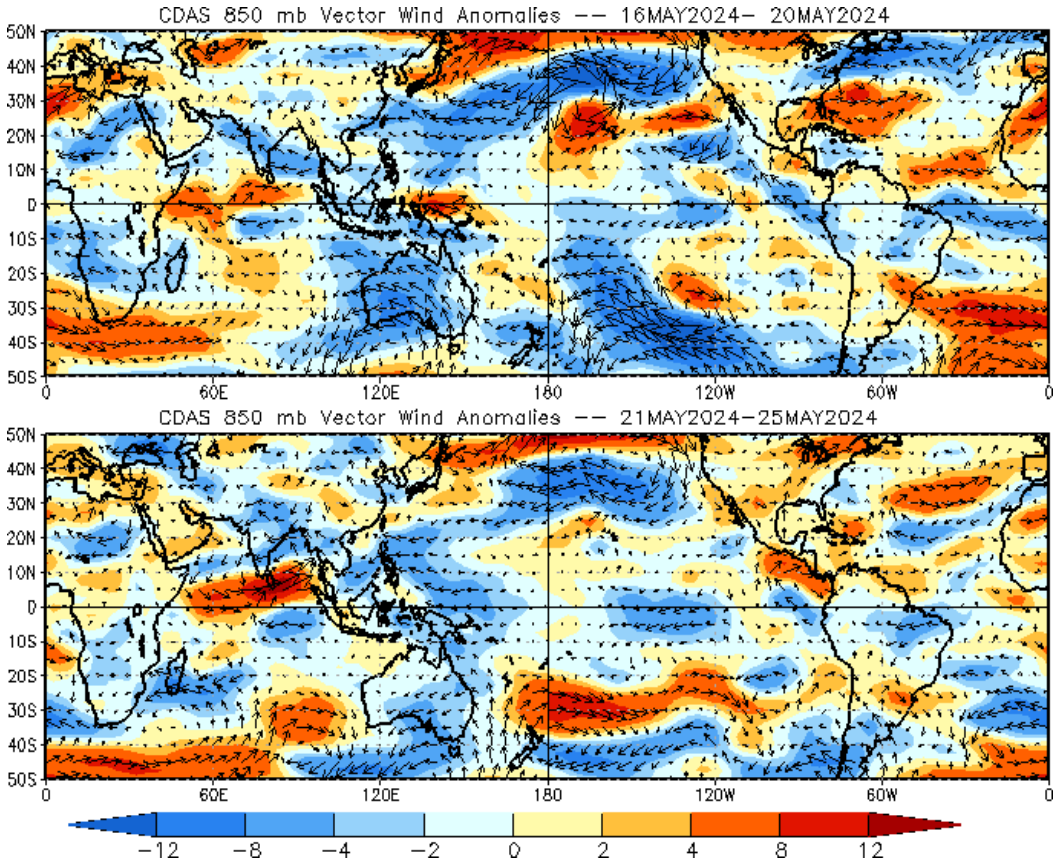


- An enhanced subtropical jet extending into the lower-latitudes of North America is contributing to amplified ridging and promoting warmer and drier than normal conditions for many parts of the tropical Americas.
- Enhanced westerlies have strengthened over the Maritime Continent with easterly anomalies overspreading the Indian Ocean as the MJO propagated eastward.

850-hPa Wind Anomalies

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

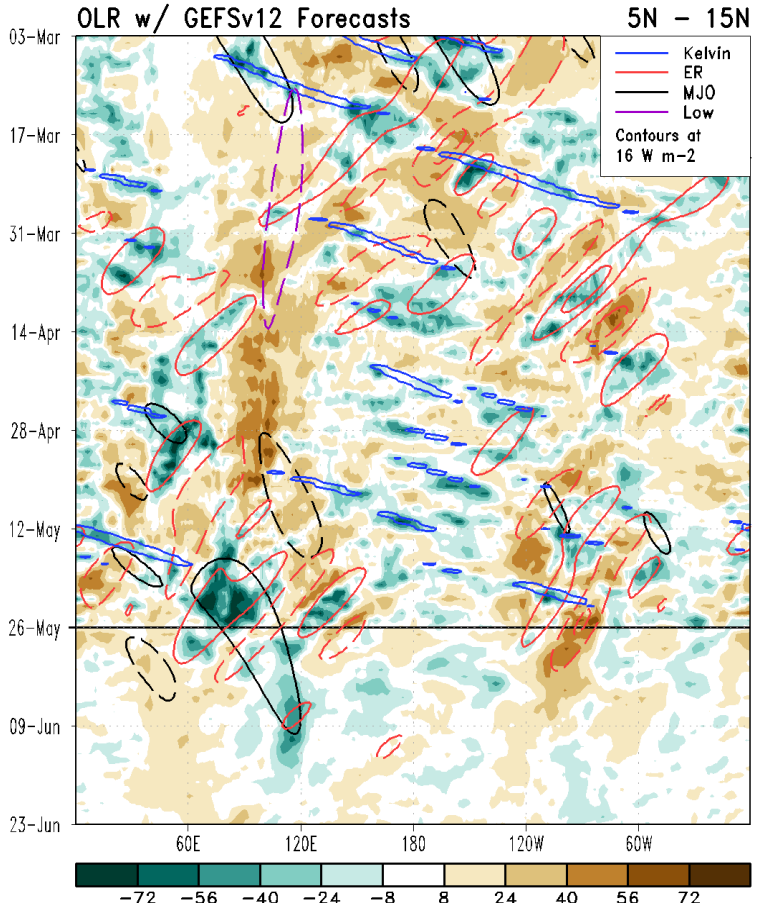


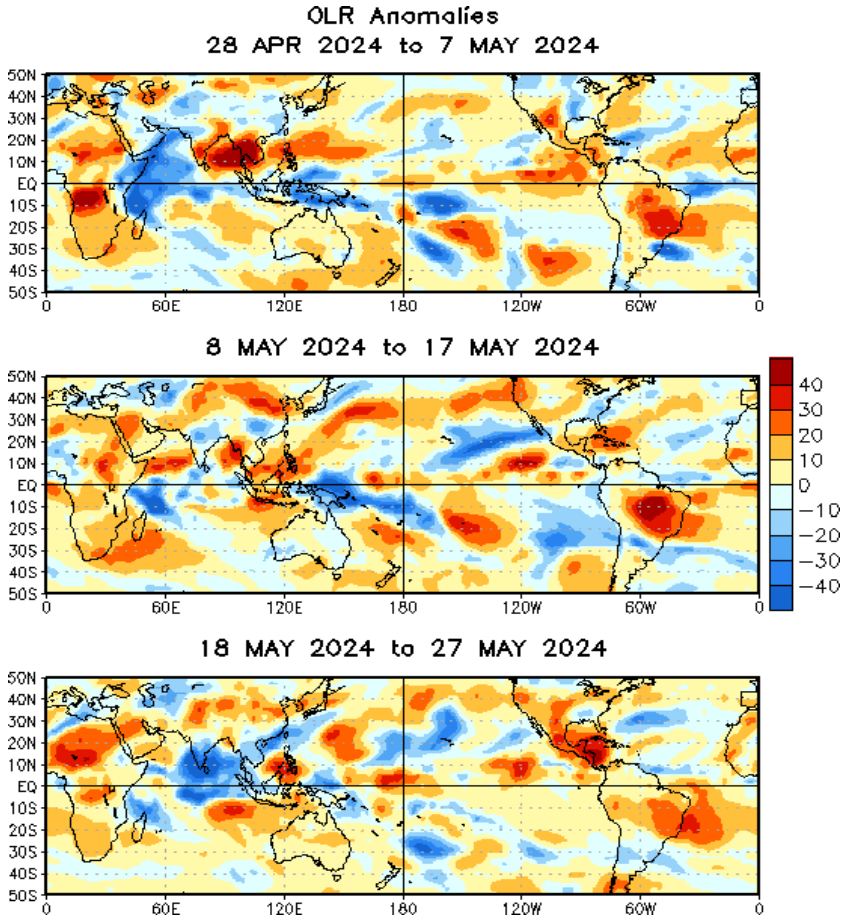


- Strongly anomalous lower-level westerlies persist near 60E, aiding in the formation of low-latitude Tropical Cyclones (Ialy and 25S) during mid-May over the southern Indian Ocean.
- Lower-level wind anomalies appear rather mixed across the eastern equatorial Pacific, but cyclonic flow was observed offshore of Central America.

Outgoing Longwave Radiation (OLR) Anomalies

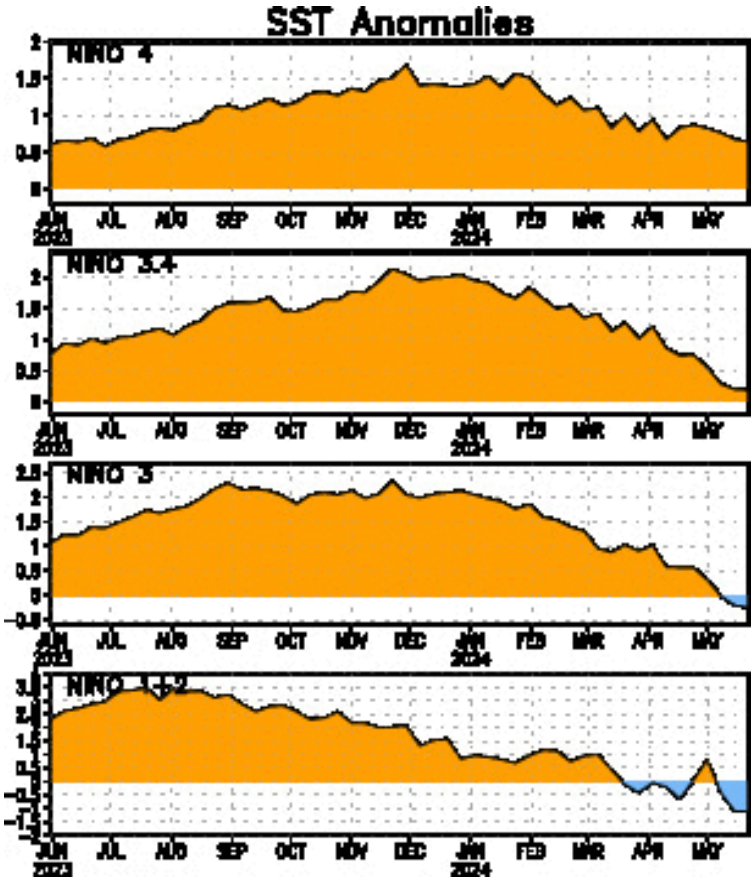
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

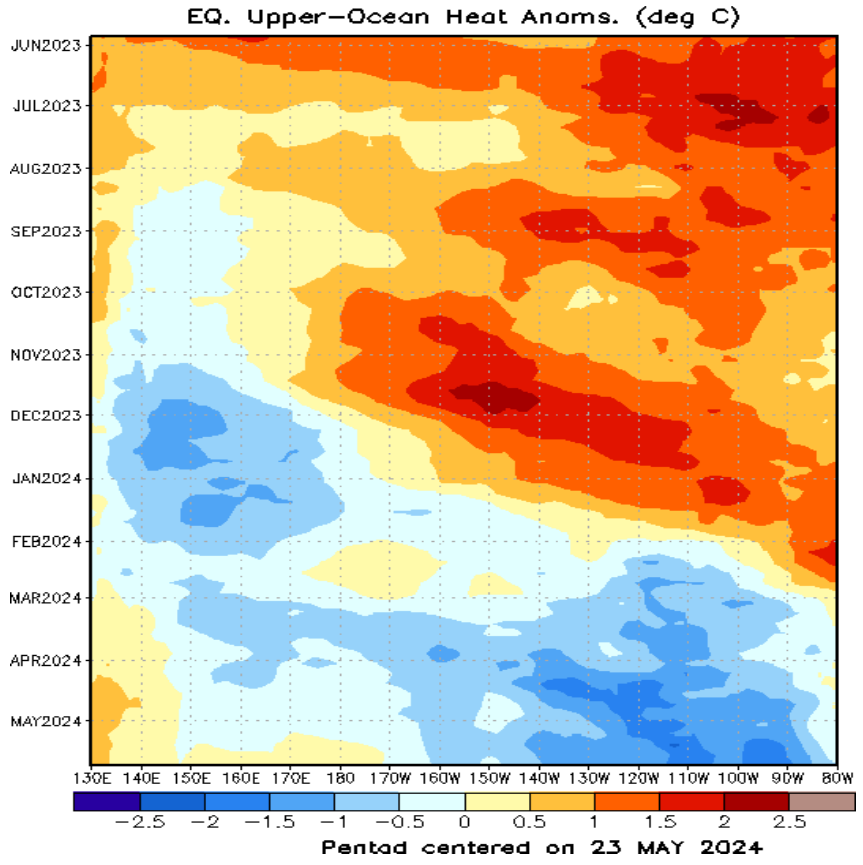




- Enhanced convection persisted near 60E and 150E along and south of the equator.
- The GEFS depicts slow eastward propagation of the enhanced convection across the eastern Indian Ocean and Maritime Continent.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

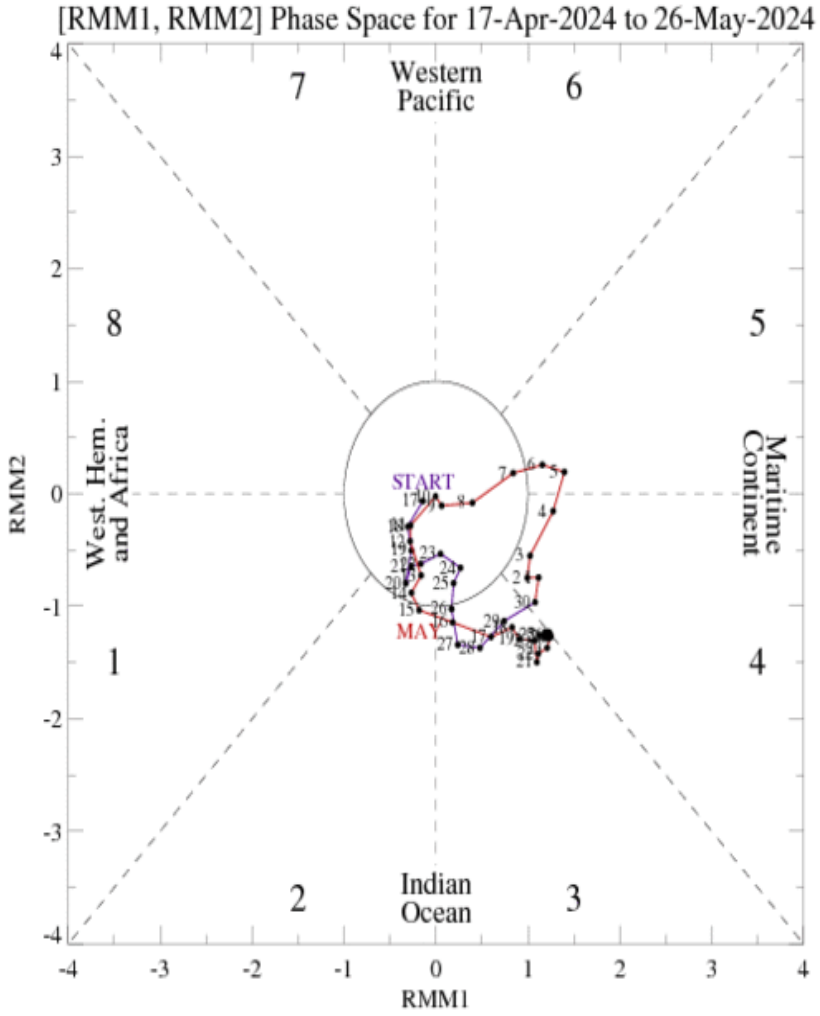




- SSTs in the easternmost NINO regions continue to trend downward since February, indicative of a decaying El Niño. Nino1+2 has been exhibiting more volatile swings with the mean anomalies since early April.
- Negative subsurface temperature anomalies continue to be observed across nearly the entire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

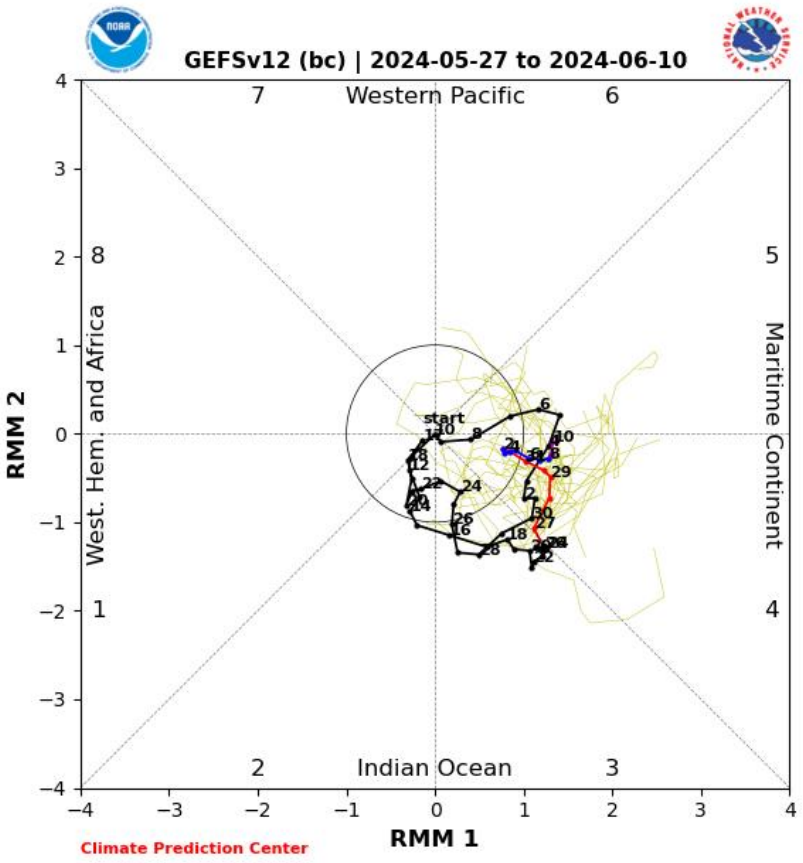
MJO Index: Recent Evolution

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

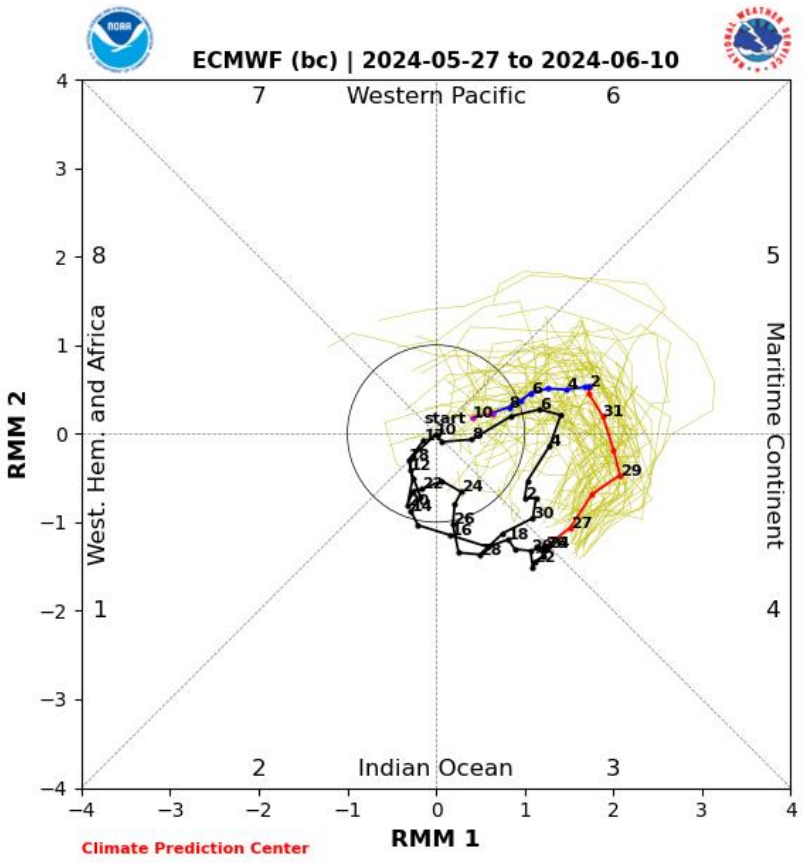


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

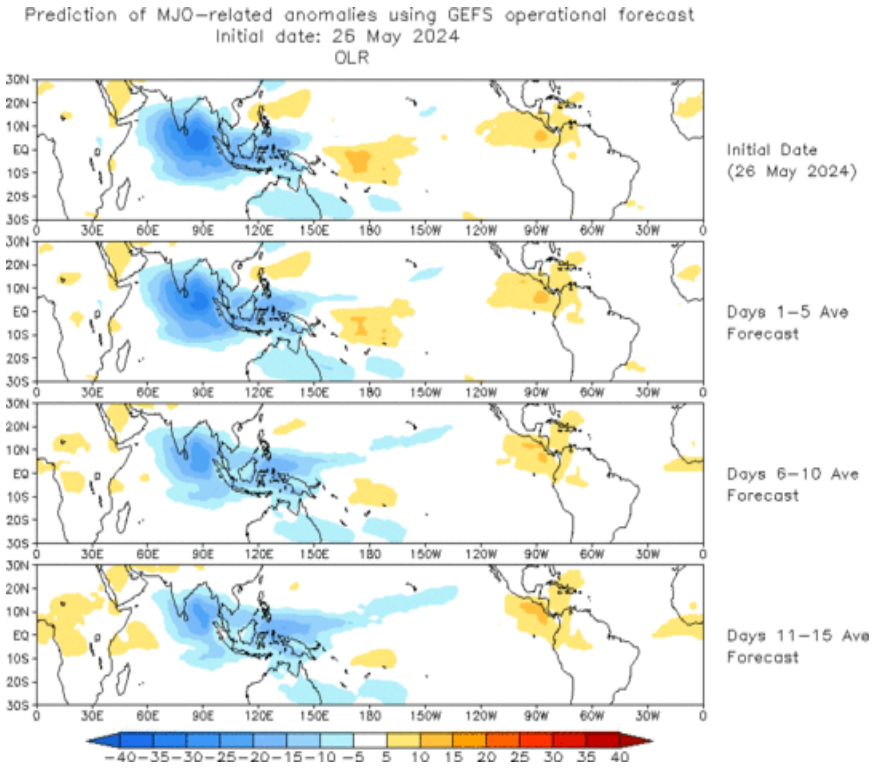


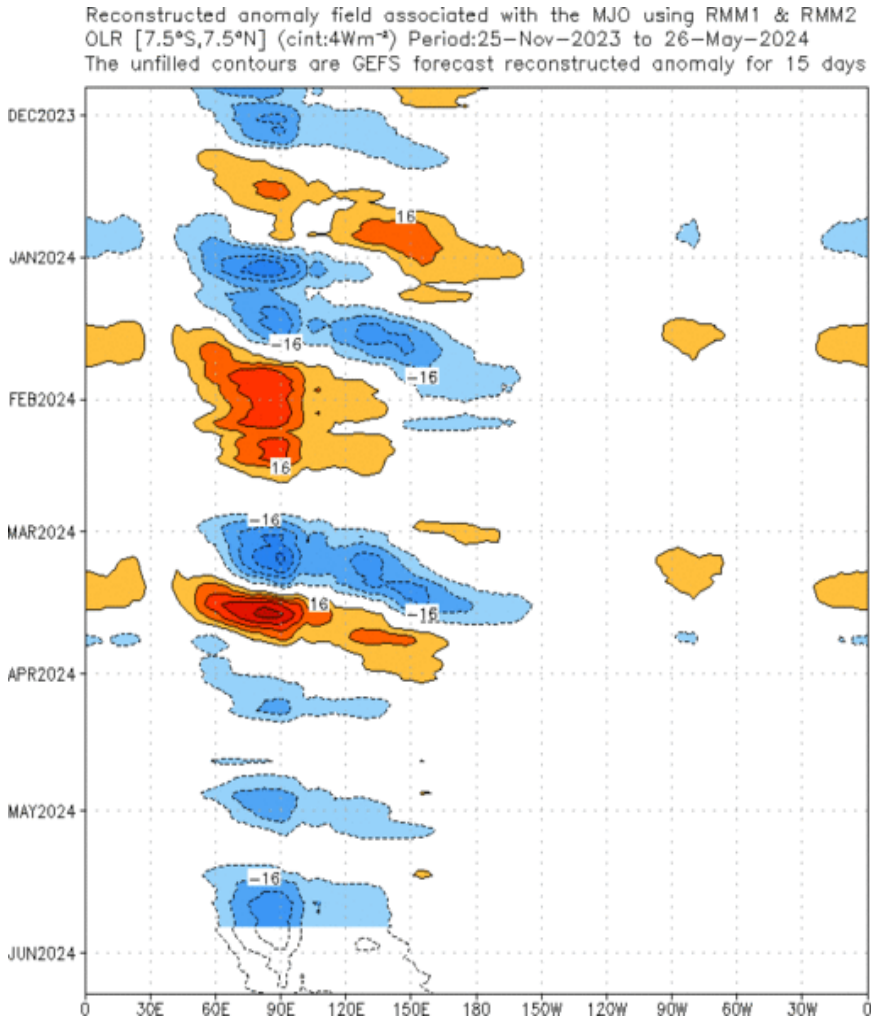
ECMWF Forecast

- The ECMWF model maintains continuity from previous days with a continued eastward propagation of the MJO from the Maritime Continent to the West Pacific through early June. However, there is large ensemble spread among the GEFS members which lowers forecast confidence on the MJO evolution.
- 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.)

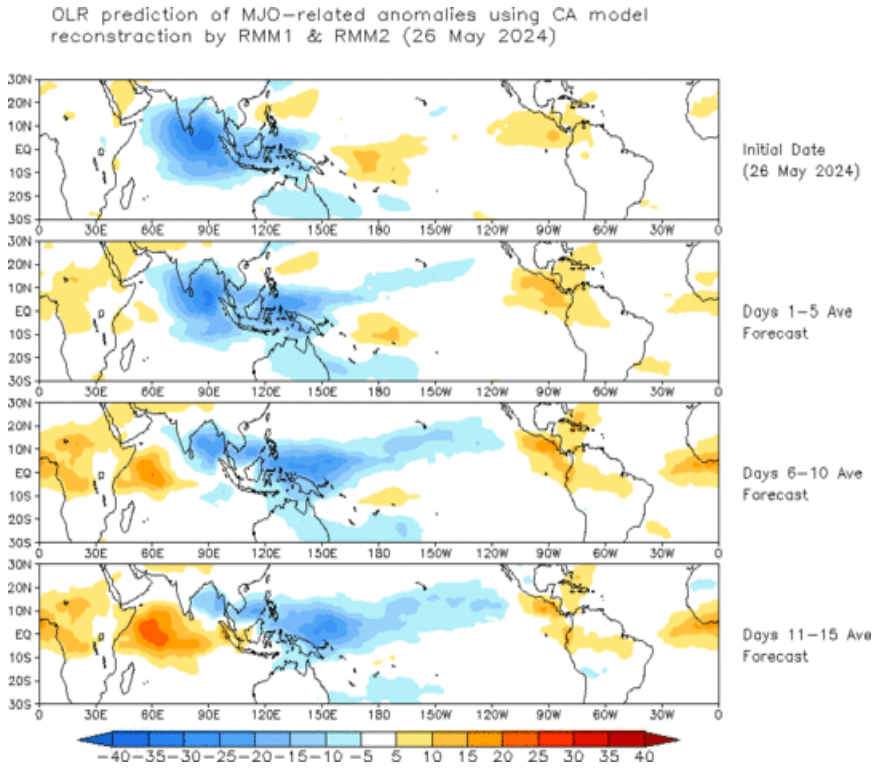


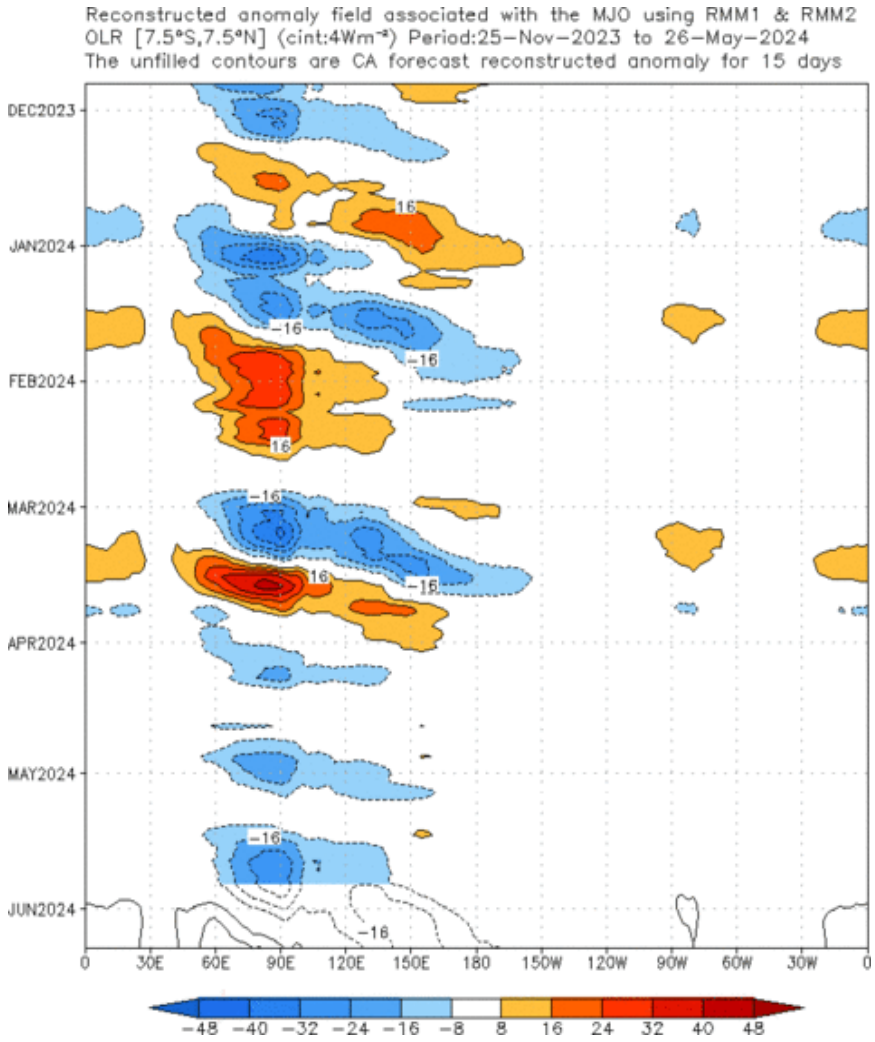


- The GEFS favored enhanced convection persisting over the eastern Indian Ocean and West Pacific during the next two weeks.

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.)

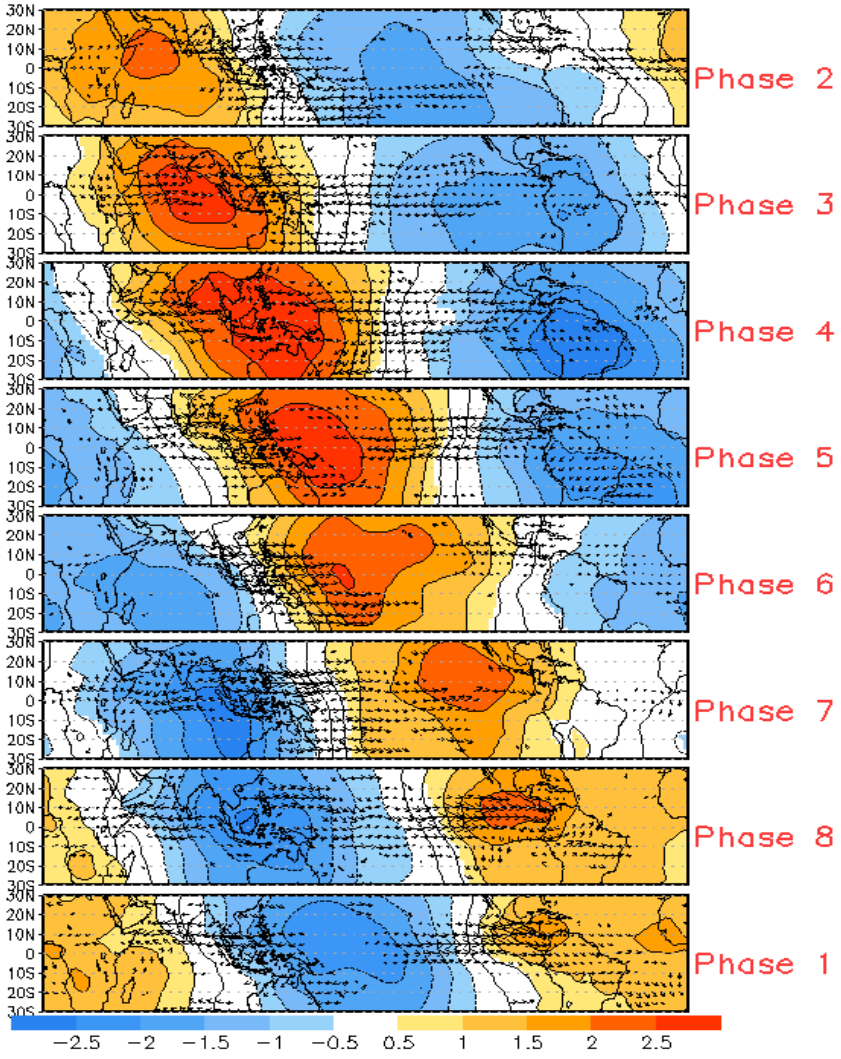




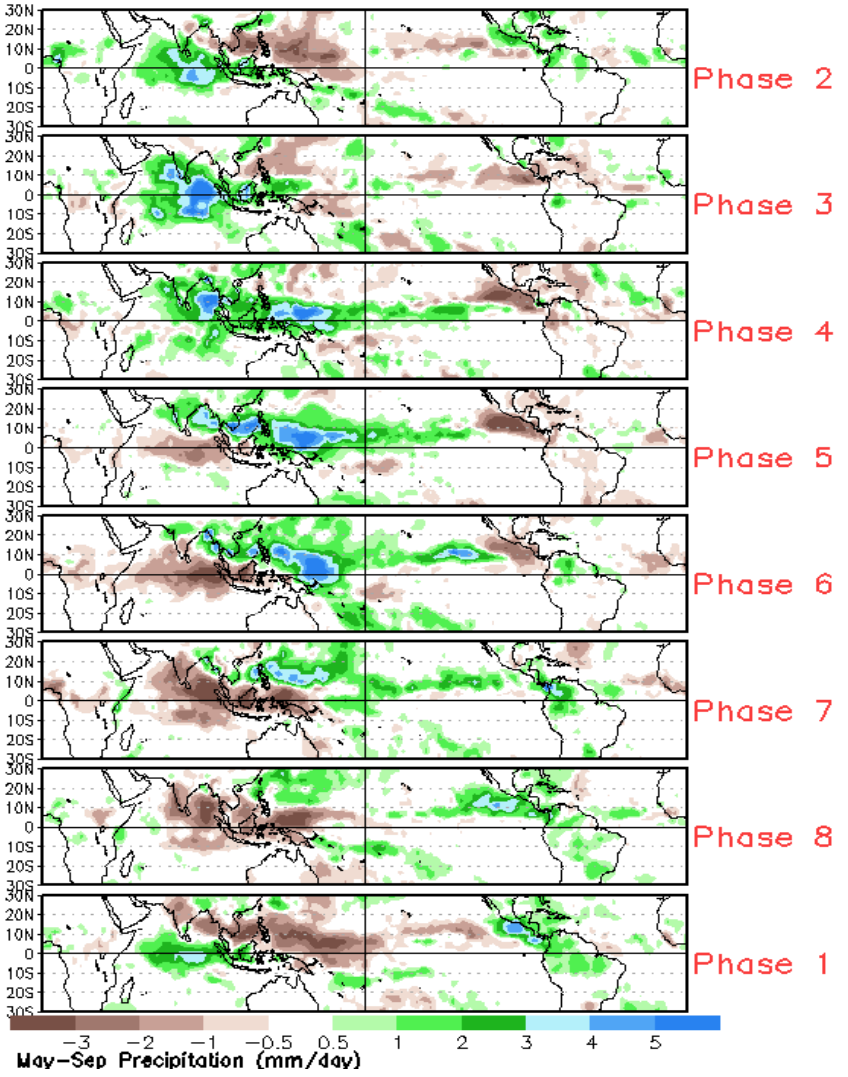
- Compared to the GEFS, the constructed analog tool is more progressive with the convective anomalies, and is more reflective of a canonical MJO.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



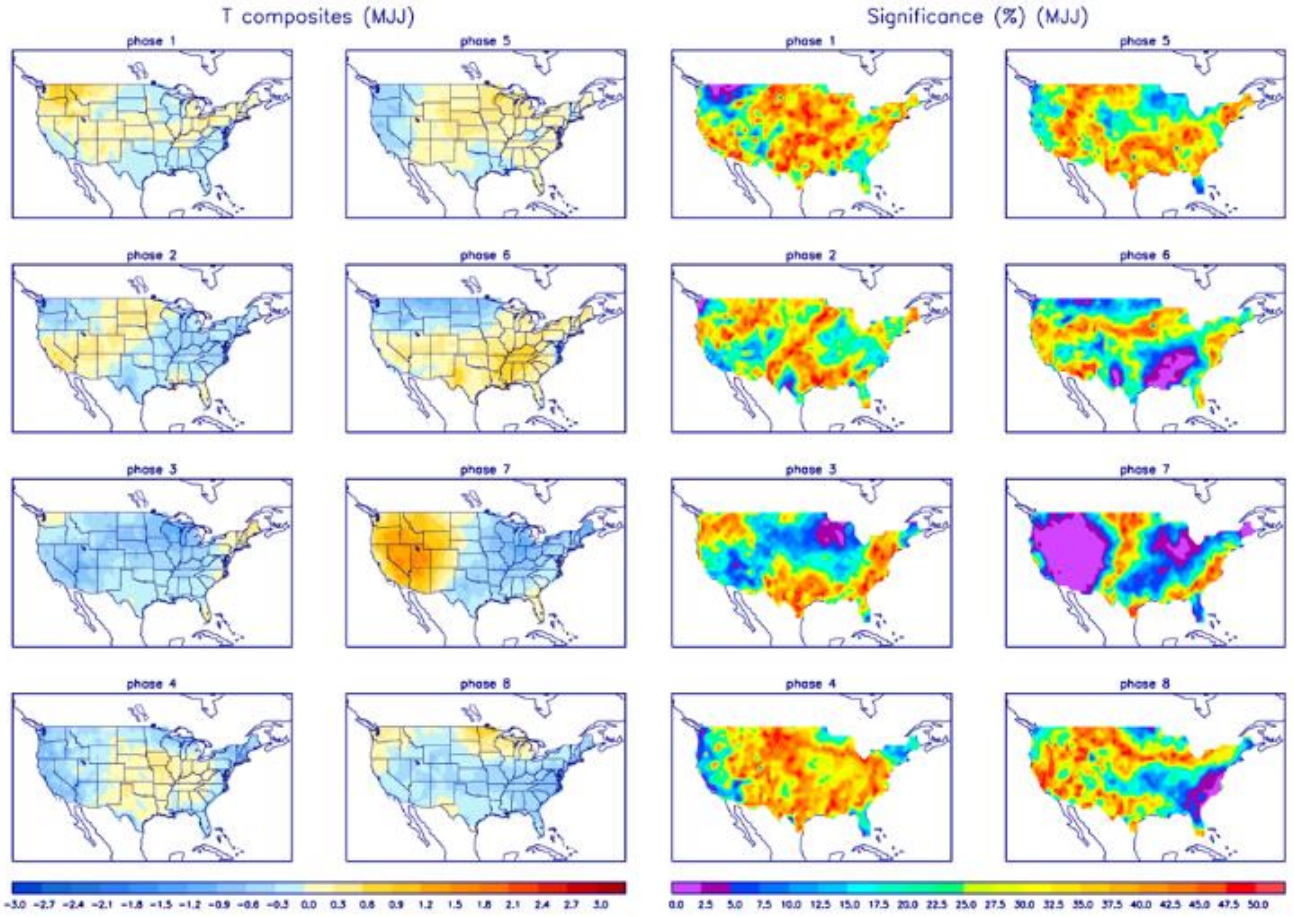
Precipitation Anomalies



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.

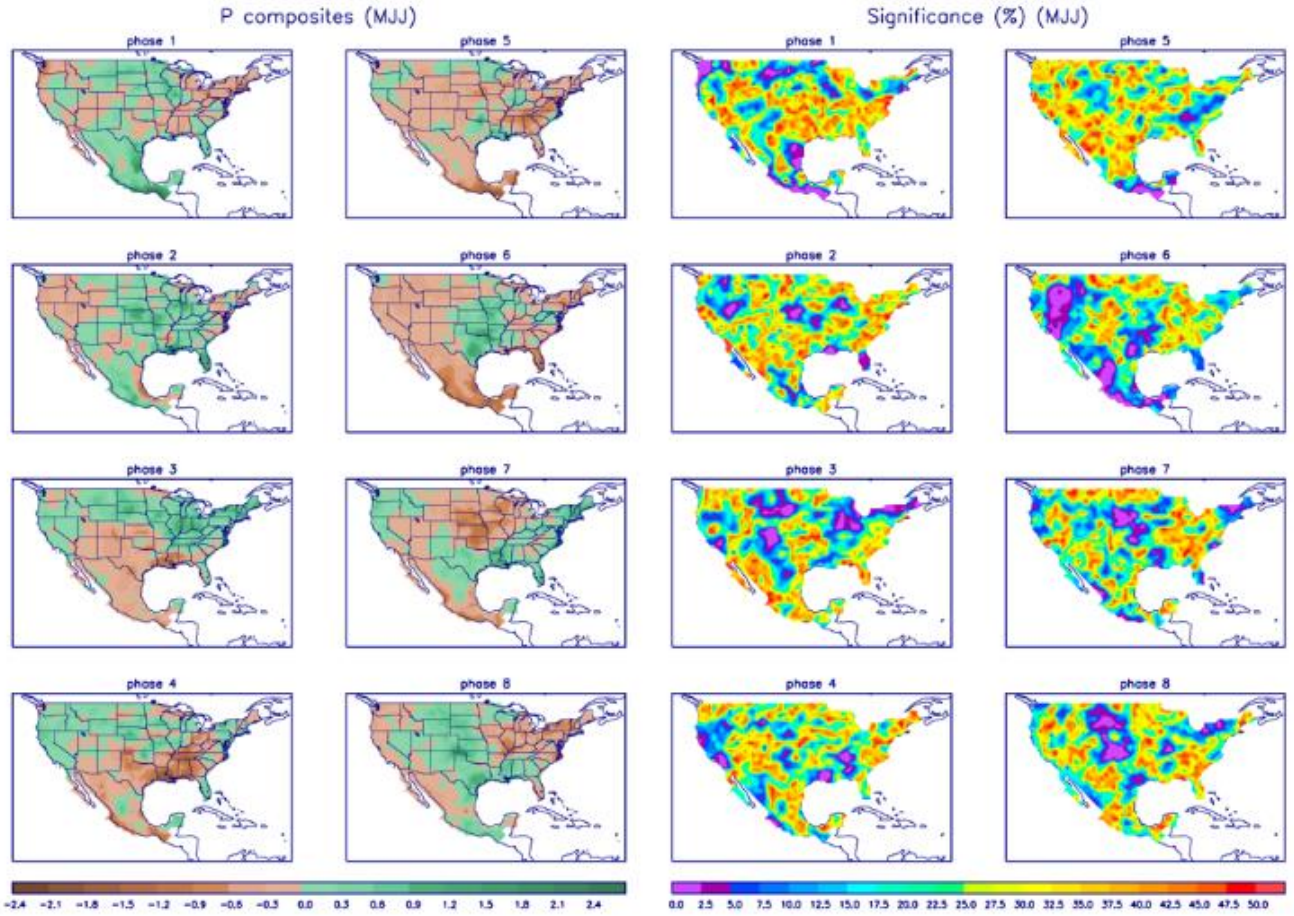


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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.



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