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

Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
28 April 2025

Overview

- Global tropical circulation continues to have multiple modes of variability in play, leading to the potential for interference between modes. Over the last month the RMM index has indicated weak MJO activity, with the index rarely leaving the unit circle.

- RMM-based forecasts generally favor a continuance of this behavior from the MJO well into May. Model solutions mostly keep the RMM index within the unit circle, and there is a noticeable clustering of individual solutions on the top half of the RMM diagram.

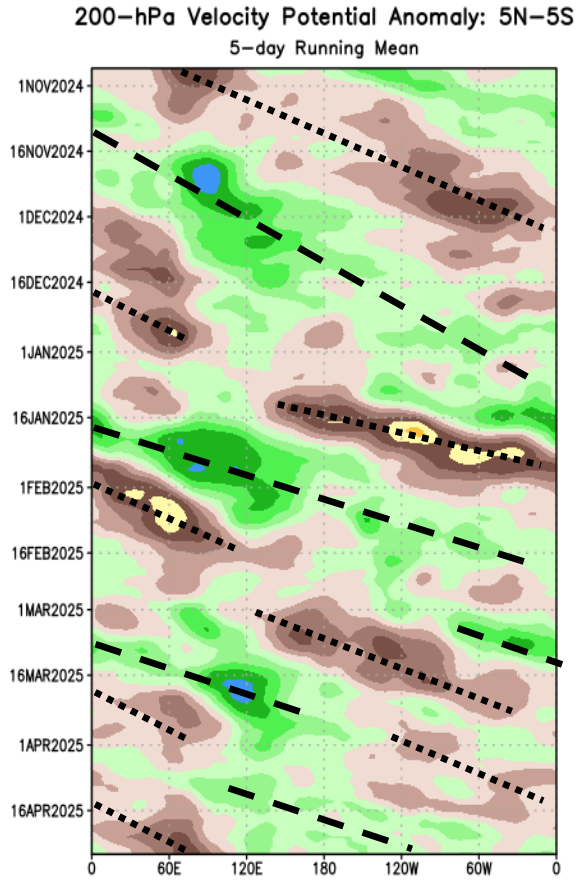
- Tropical cyclone (TC) activity has been minimal recently, consistent with global TC climatology which exhibits its minimum in April. Model guidance favors continued low levels of TC activity during the forecast period.

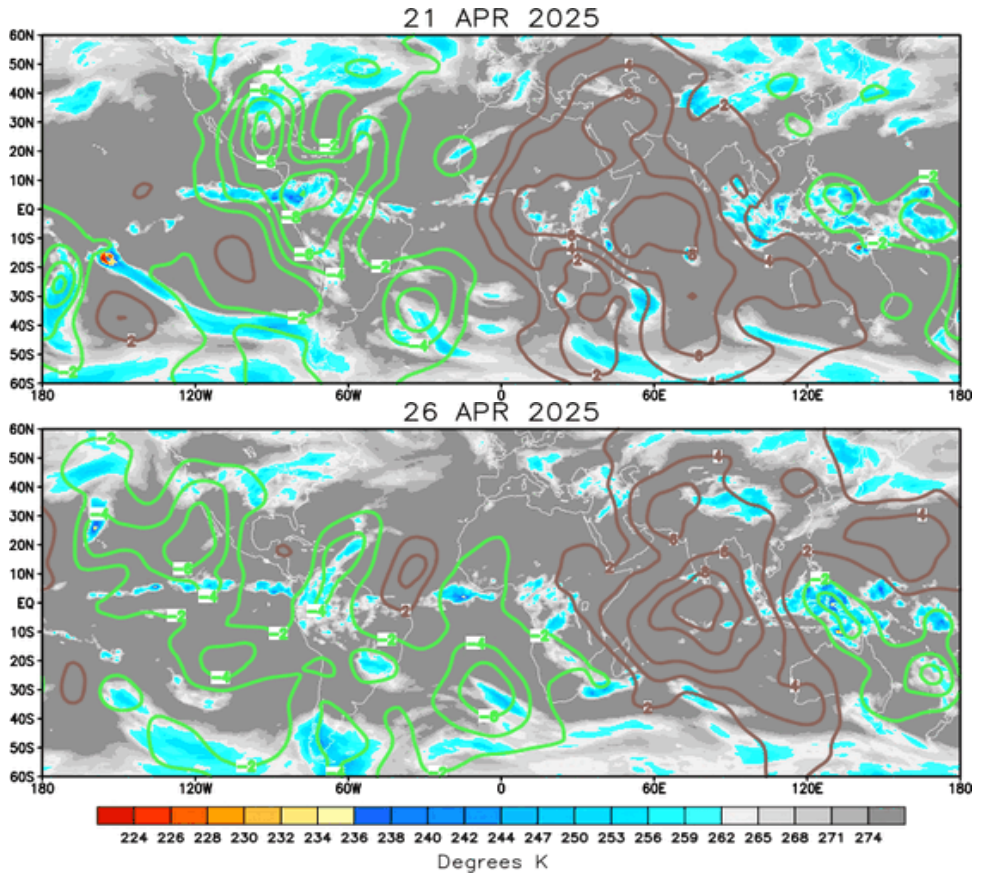
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

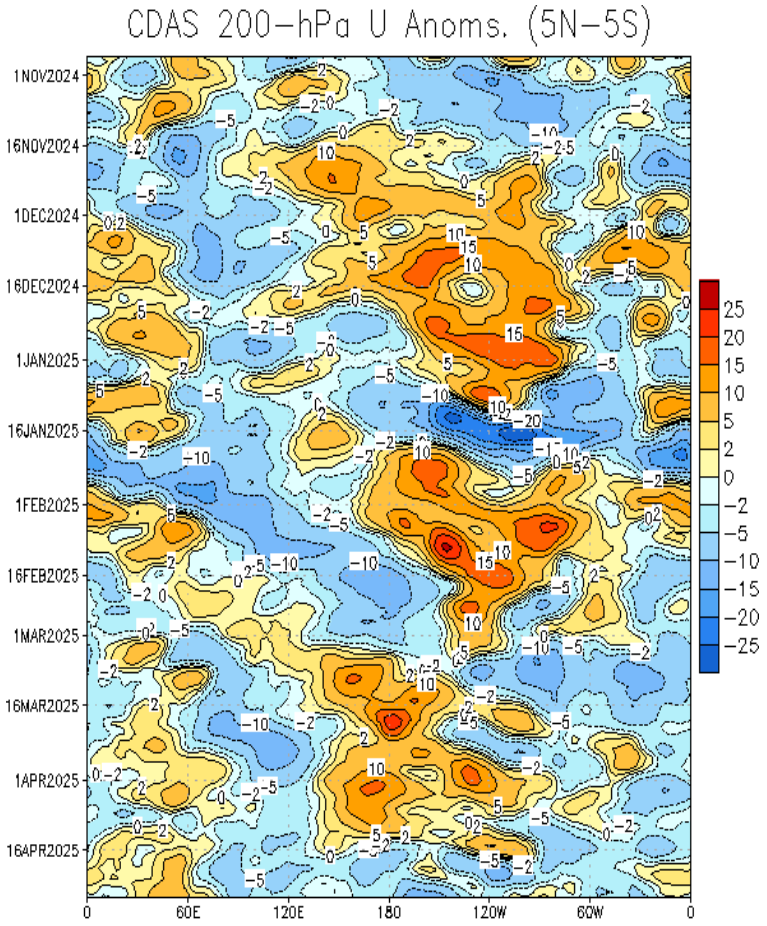


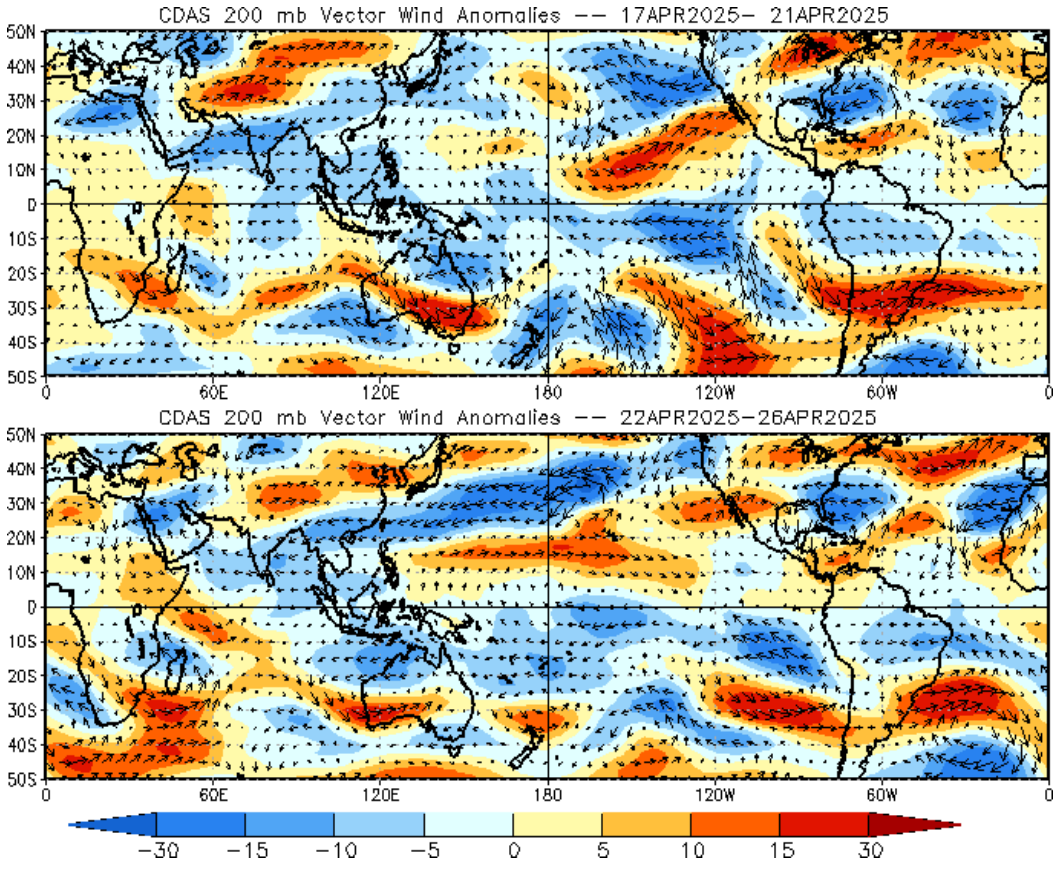


- Notable wave-1 asymmetry is notable in the 200-hPa VP anomalies despite a weak MJO signal in RMM space.
- Recently, the area of enhanced divergence, centered over the Americas, has become weaker and more diffuse, while enhanced convergence has maintained its intensity and largely remained in place over the Indian Ocean.

200-hPa Wind Anomalies

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

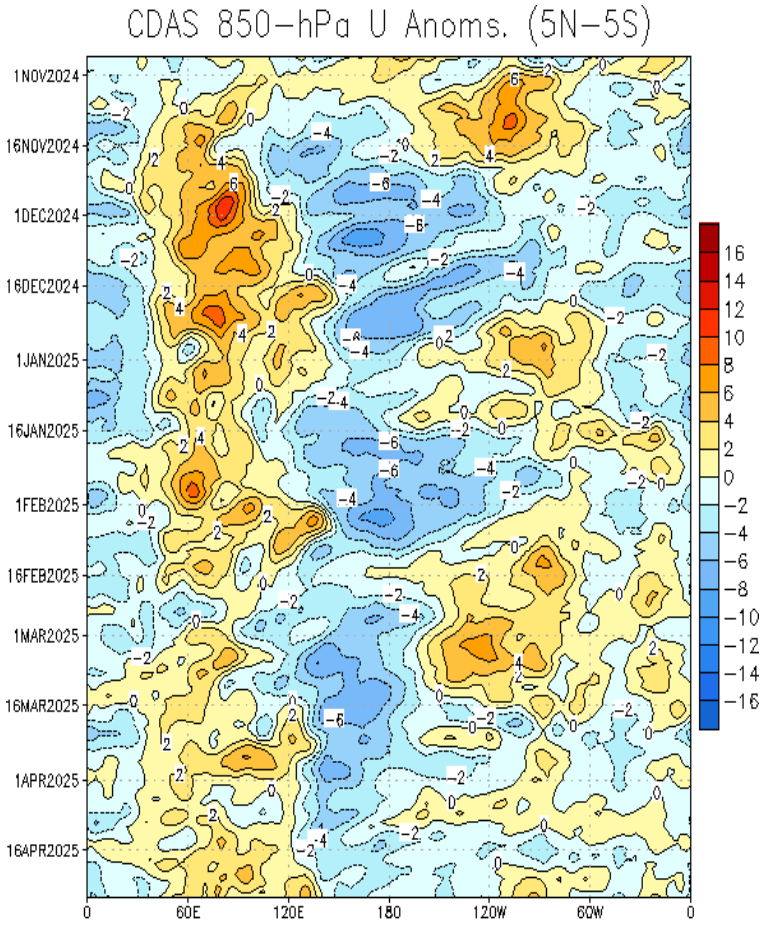


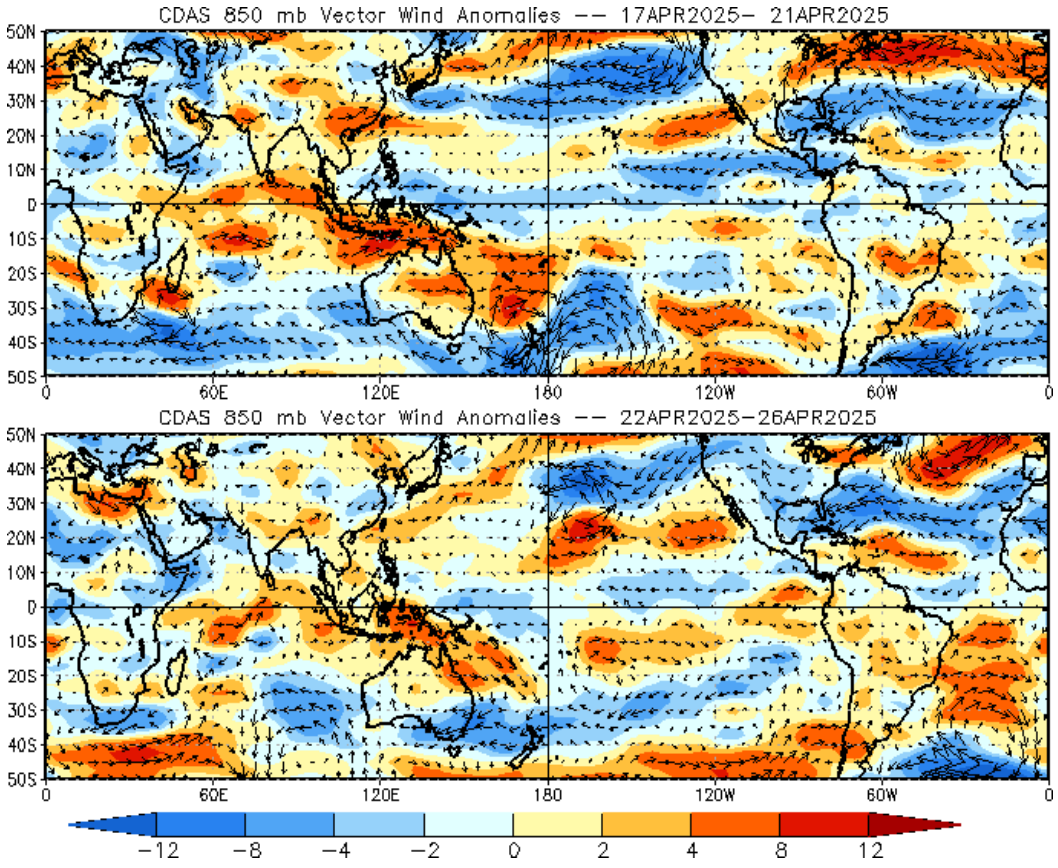


- The persistent area of anomalous upper-level westerlies across the equatorial central Pacific has been eroding over the last month and anomalies became easterly in mid-April, a possible indicator of an atmospheric response to the transition to ENSO-neutral conditions.
- Strong westerly anomalies persist across much of the tropical Pacific north of the Equator.

850-hPa Wind Anomalies

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

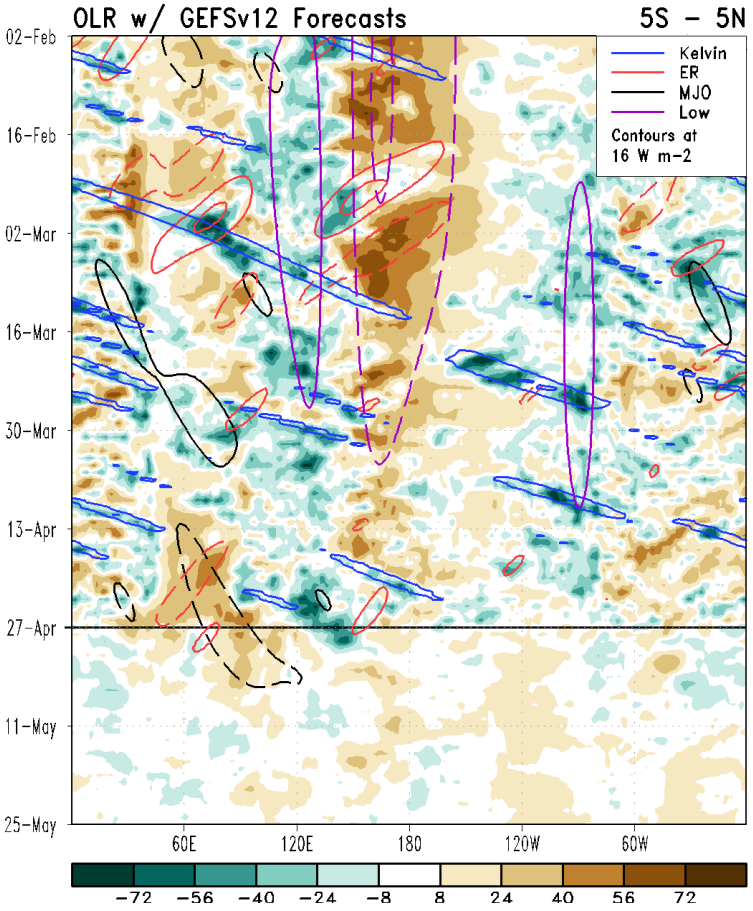


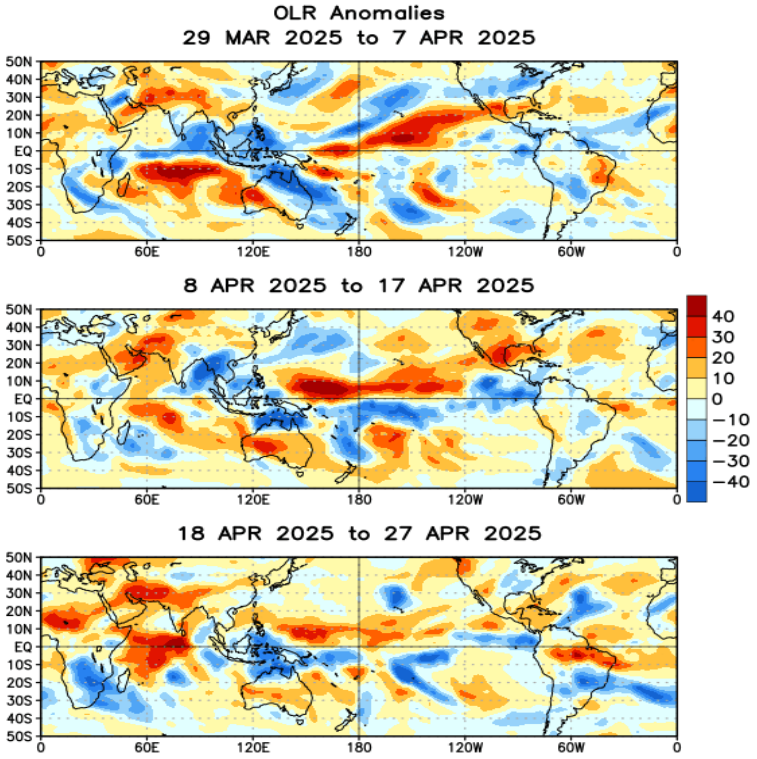


- The low-level wind pattern generally remains stationary due to little tropical forcing (MJO or ENSO), with extratropical activity dominating.
- Enhanced trades remain across the equatorial west Pacific but these continue to weaken.
- Anomalous easterlies are noted over the North Atlantic, as well as southerly anomalies into the U.S. Great Plains, feeding in abundant moisture and likely contributing to flooding conditions occurring there.

Outgoing Longwave Radiation (OLR) Anomalies

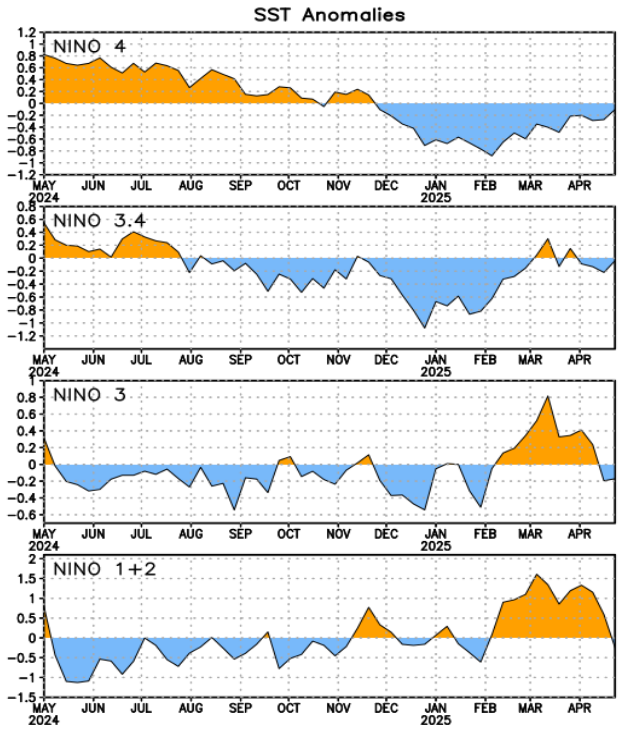
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

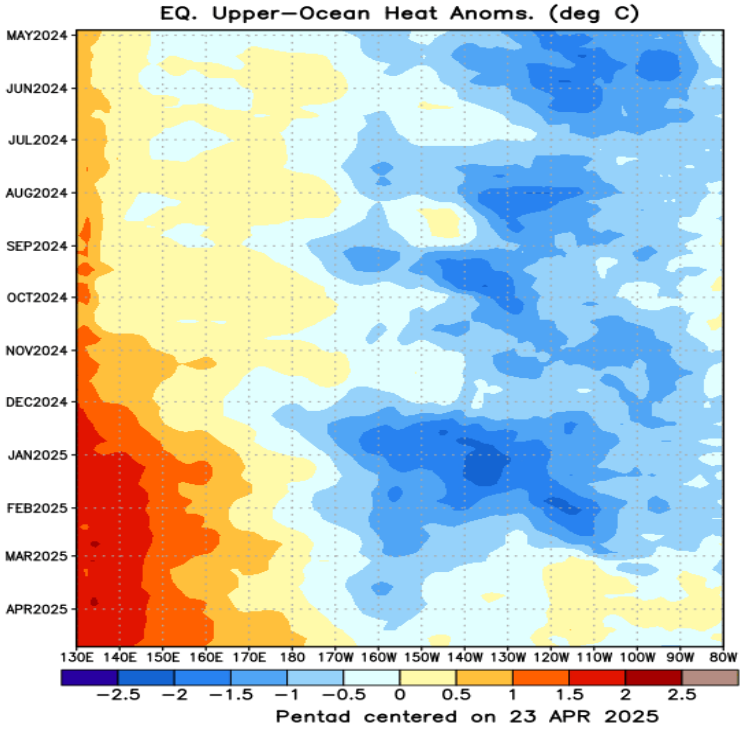




- La Niña-induced suppressed convection near the Date Line is displaced north of the Equator and appears to be weakening, while enhanced convection over the Maritime Continent continues. There is little apparent movement of major OLR anomaly features.
- There is little signal in the OLR forecasts from the GEFS beyond low-frequency features.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

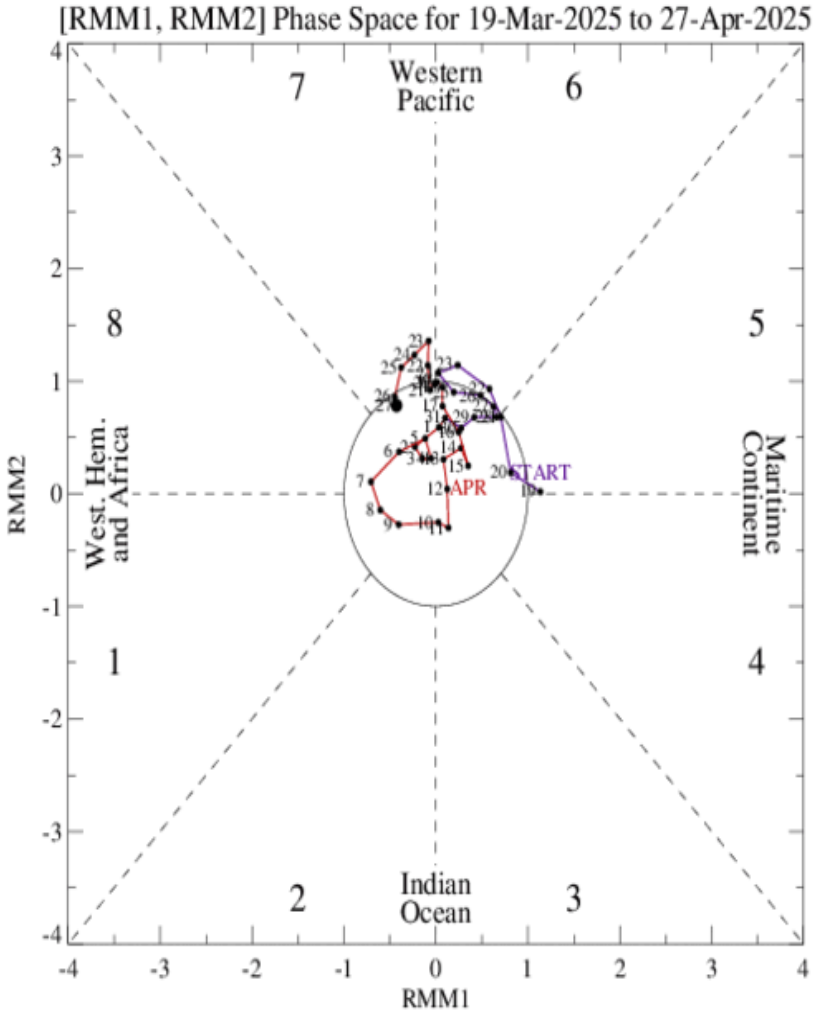




- SST anomalies in Niño 3.4 region remain variable and near zero, consistent with the transition to ENSO-neutral conditions.
- Subsurface negative temperature anomalies continue to weaken across the central Pacific, with positive anomalies emerging east of 120°W. Positive heat content anomalies are gradually increasing in magnitude west of the Date Line.

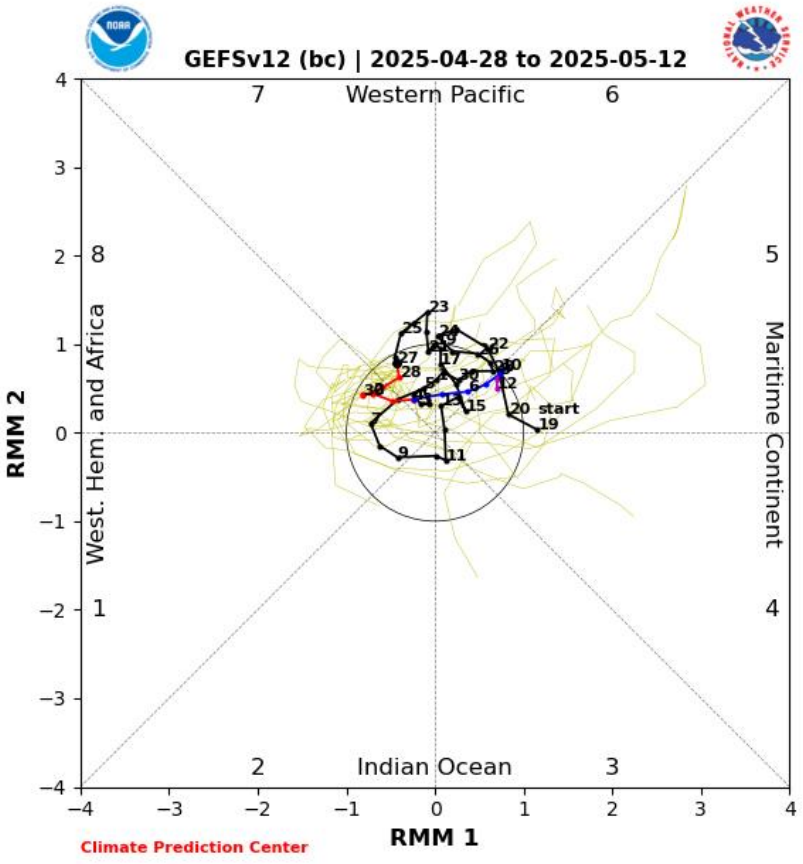
MJO Index: Recent Evolution

- The MJO signal is weak, with the RMM-based index meandering within the unit circle since late March. Of note is that the RMM index has been almost exclusively in the top half of the diagram over the last 40 days.

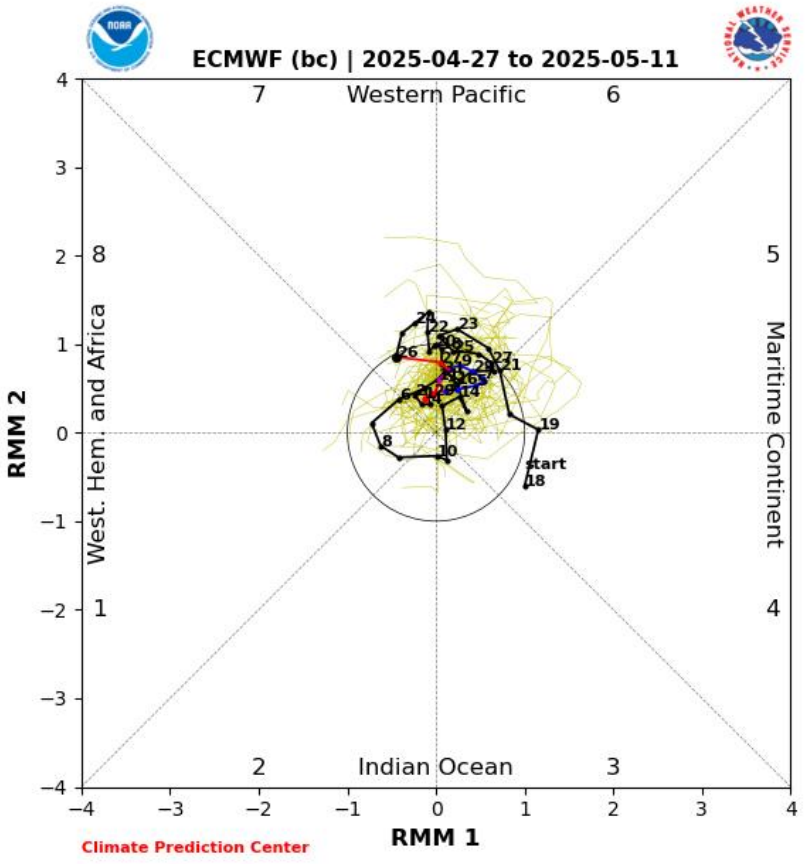


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

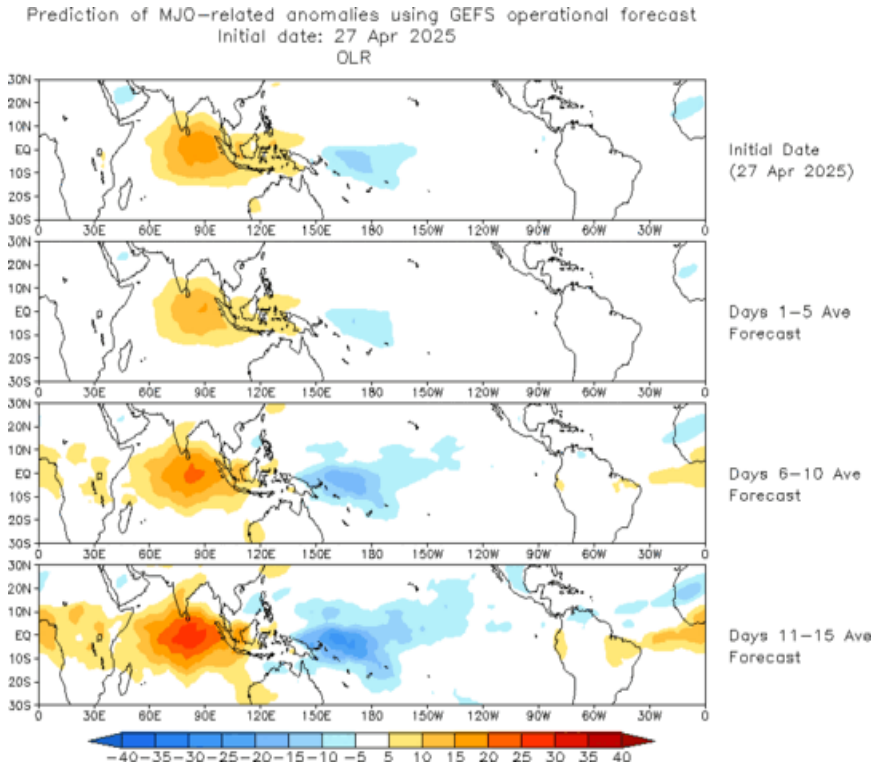


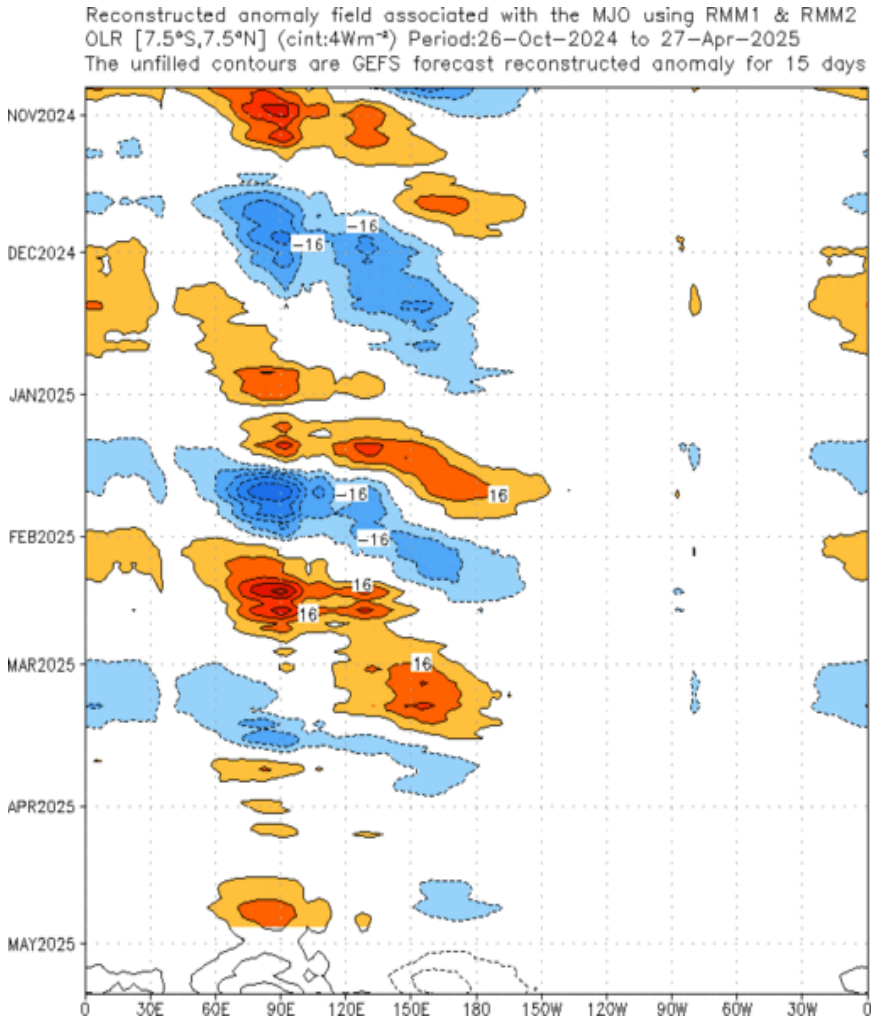
ECMWF Forecast

- Dynamical models generally agree on the MJO evolution into mid-May with ensemble means mostly staying within the unit circle throughout the forecast period.
- Similar to recent observations, ensemble member forecasts tend to cluster over the top half of the diagram.

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.)

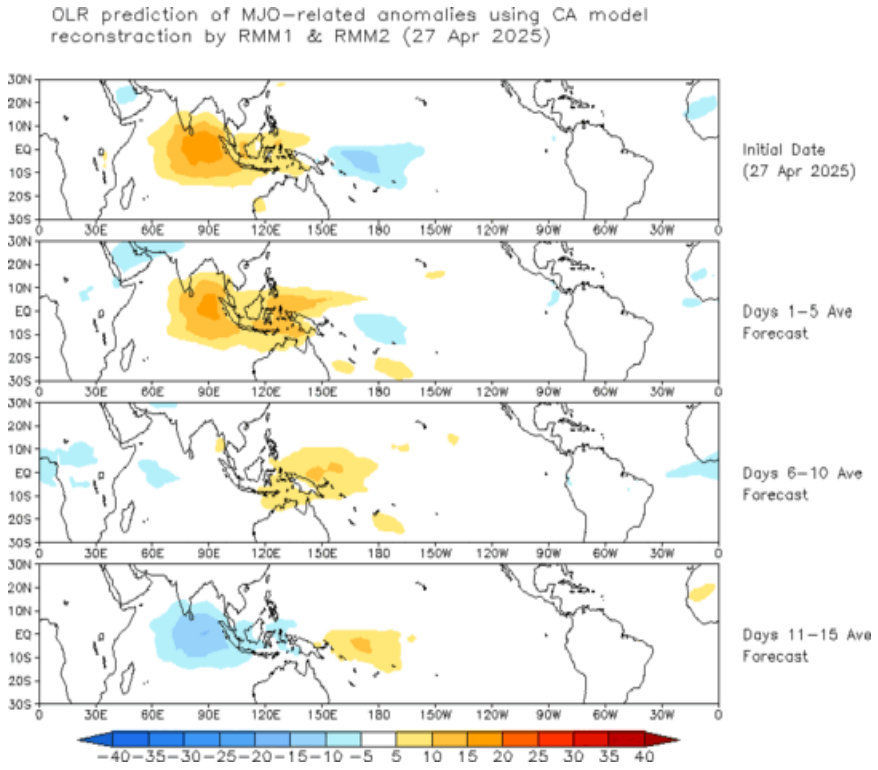


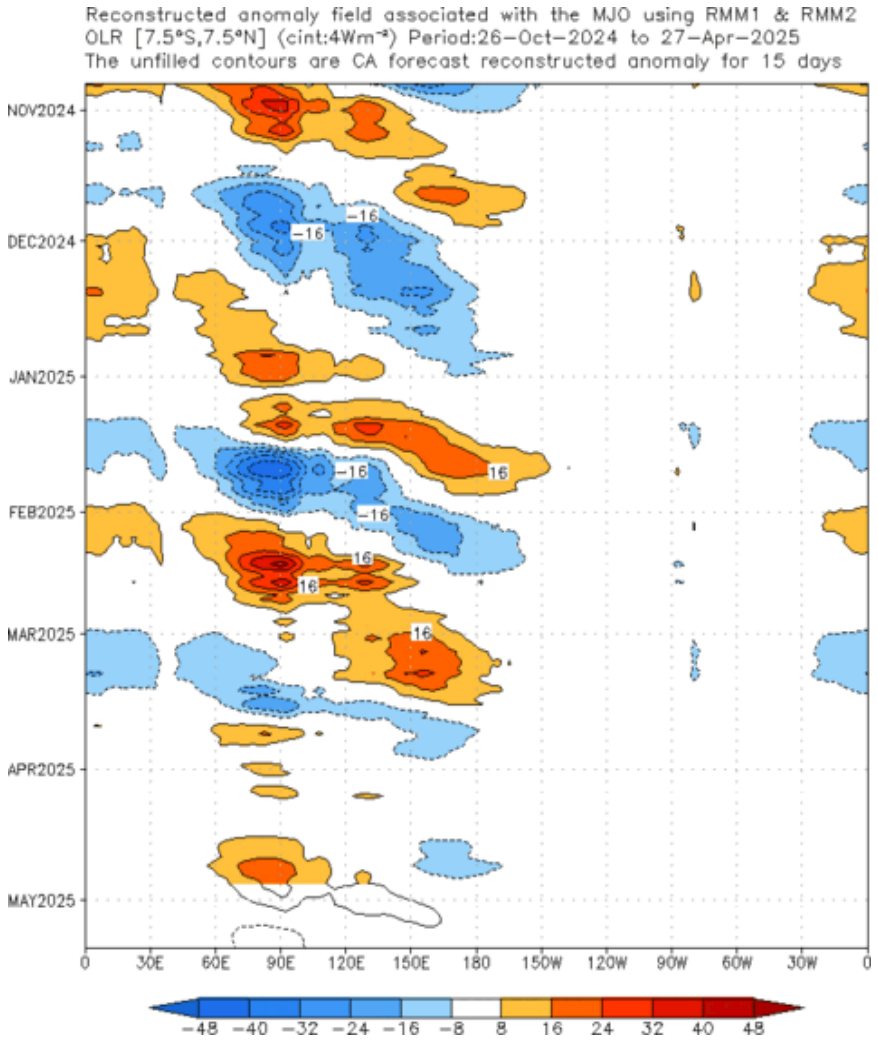


- Positive anomalies (suppressed convection) are forecast to persist across the Indian Ocean and Maritime Continent with negative anomalies (enhanced convection) across parts of the equatorial Pacific.
- The GEFS OLR forecast favors an increase in intensity of this dipole over the next two weeks.

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.)

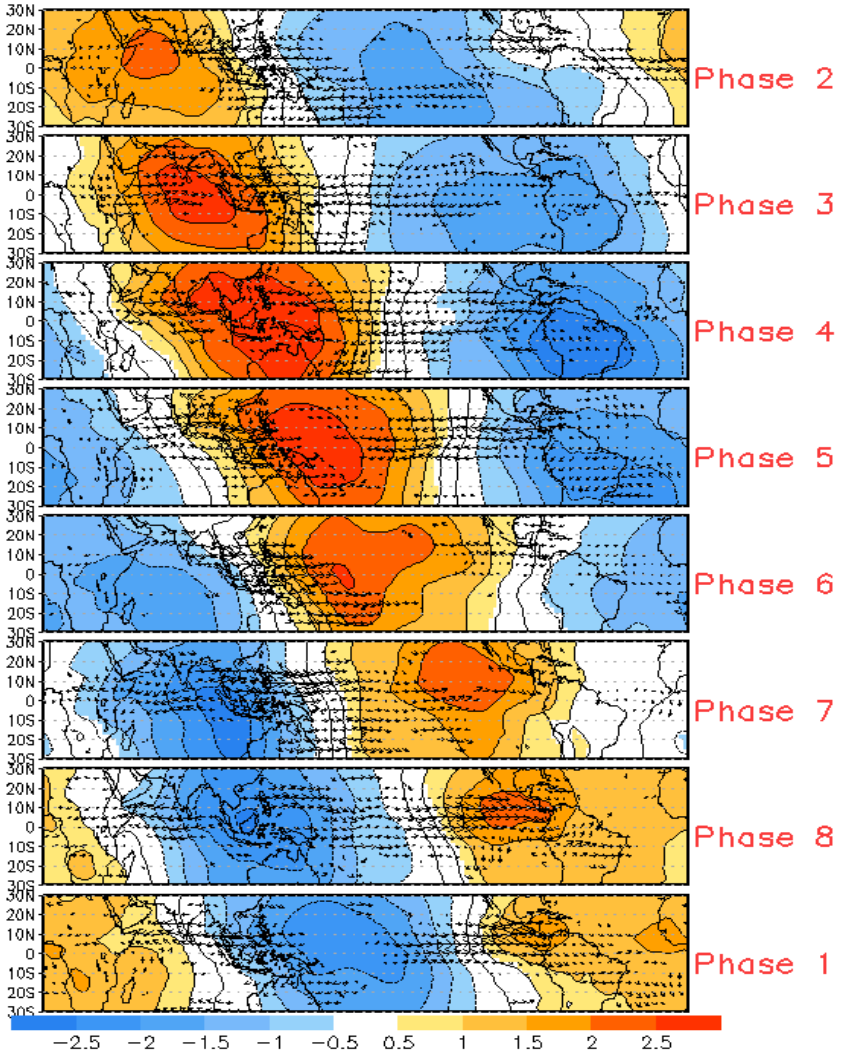




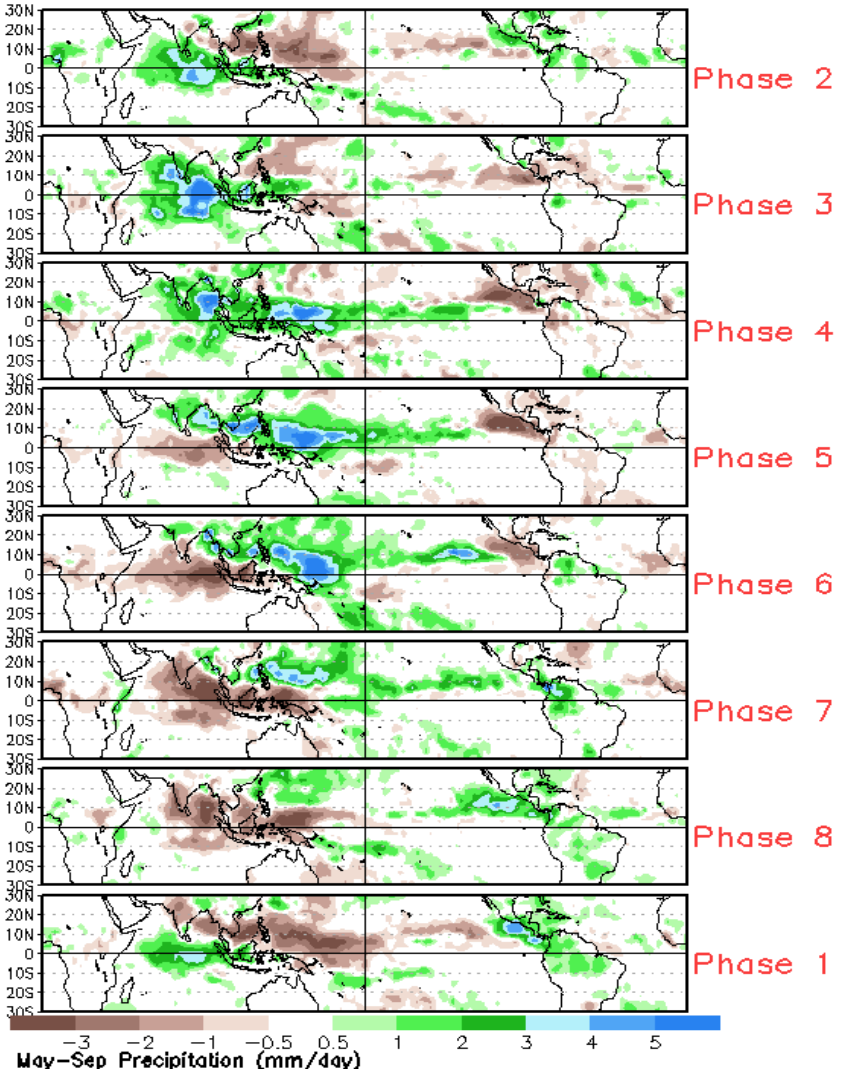
- The constructed analog forecast favors a more canonical MJO evolution, with suppressed convection shifting east from the Indian Ocean to the west-central Pacific and enhanced convection emerging over the Indian Ocean late in week-2.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



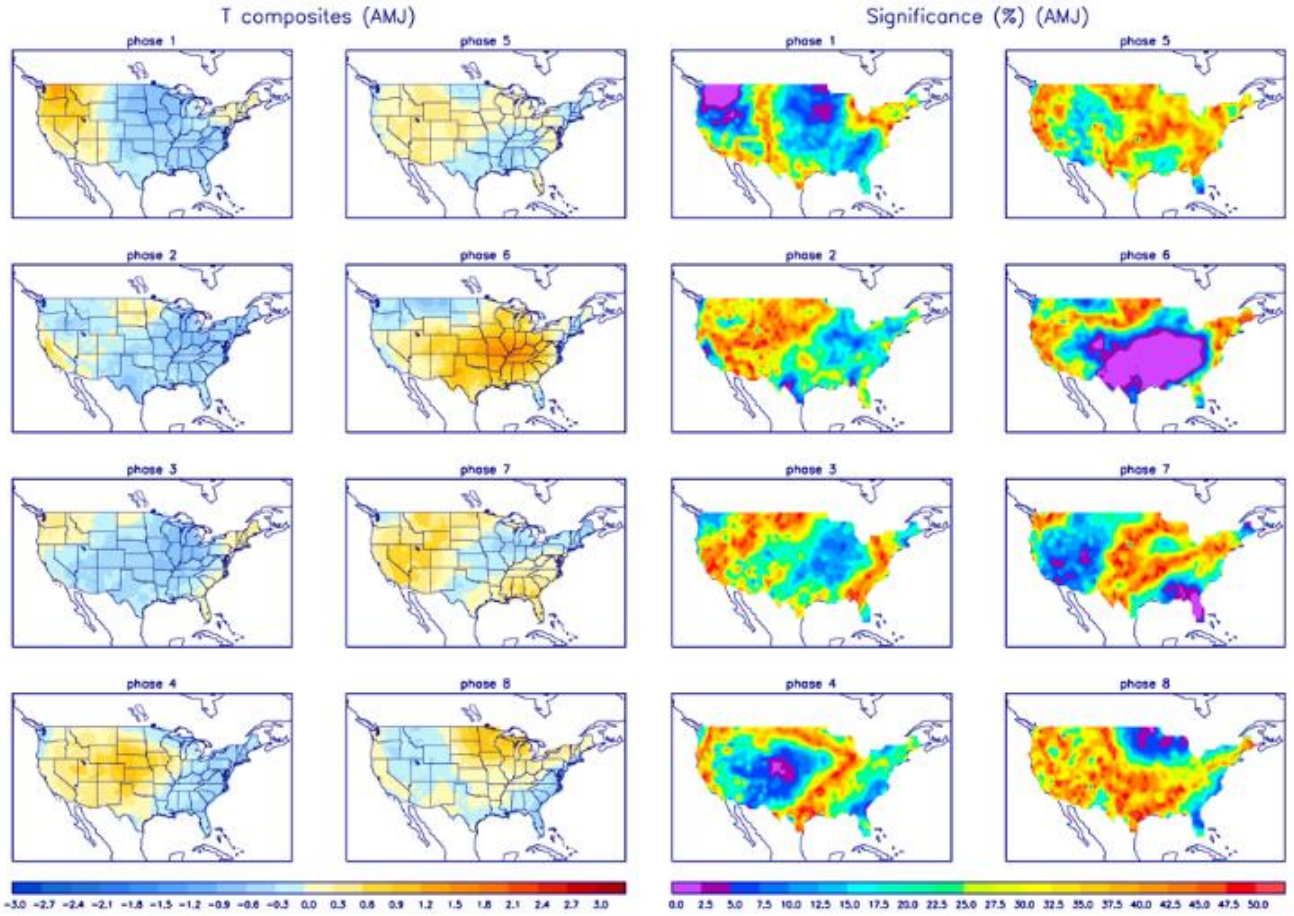
Precipitation Anomalies



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.

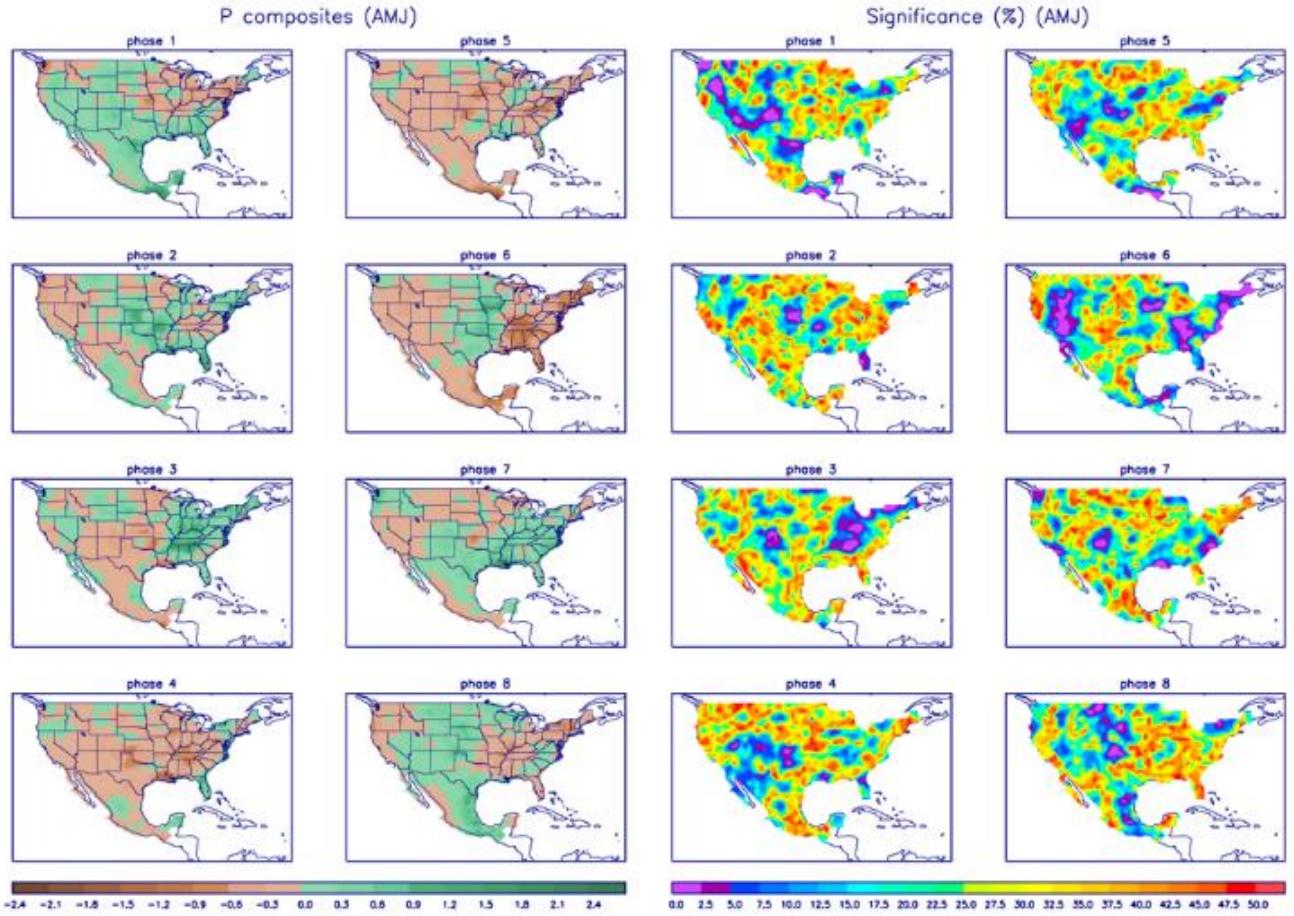


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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