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

Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
31 March 2025

Overview

- The MJO rapidly propagated eastward to the Maritime Continent and West Pacific during late March, but the RMM index signal retrograded westward back towards the Maritime Continent inside the unit circle. A passing Kelvin wave contributed to the degradation of the MJO signal.

- Dynamical model RMM index forecasts depict a weak MJO, with the signal remaining inside the unit circle over the next two weeks. Eastward propagation continues during Week-1, but then retrogrades westward in Week-2, remaining over the Western Pacific.

- Due to the expectation for a weak, incoherent MJO, forecast uncertainty is high for weeks 2 and 3 (April 9-15 and April 16-22).

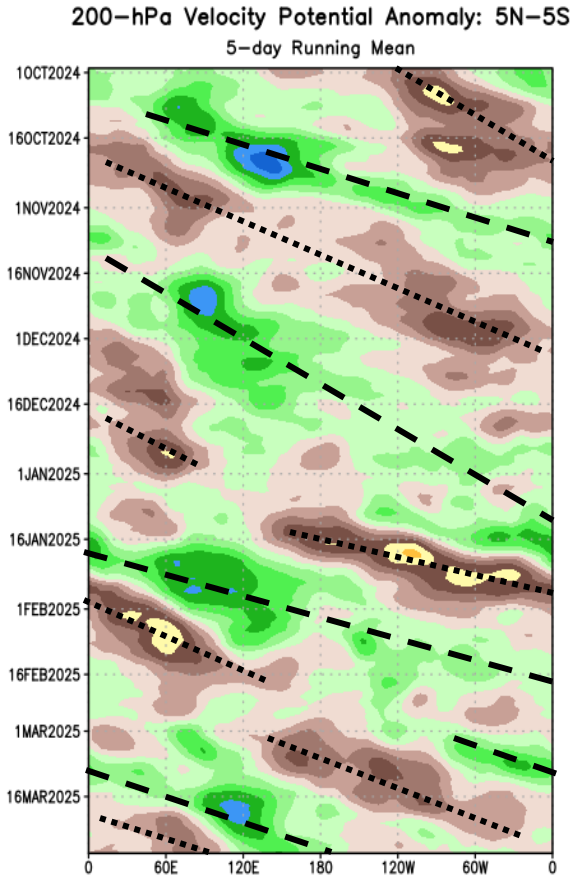
- April is typically a less active time of year for tropical cyclones globally. Based on climatology and dynamical model forecasts, tropical cyclone development is most likely to occur surrounding northern Australia during early to mid-April, although probabilities are low.

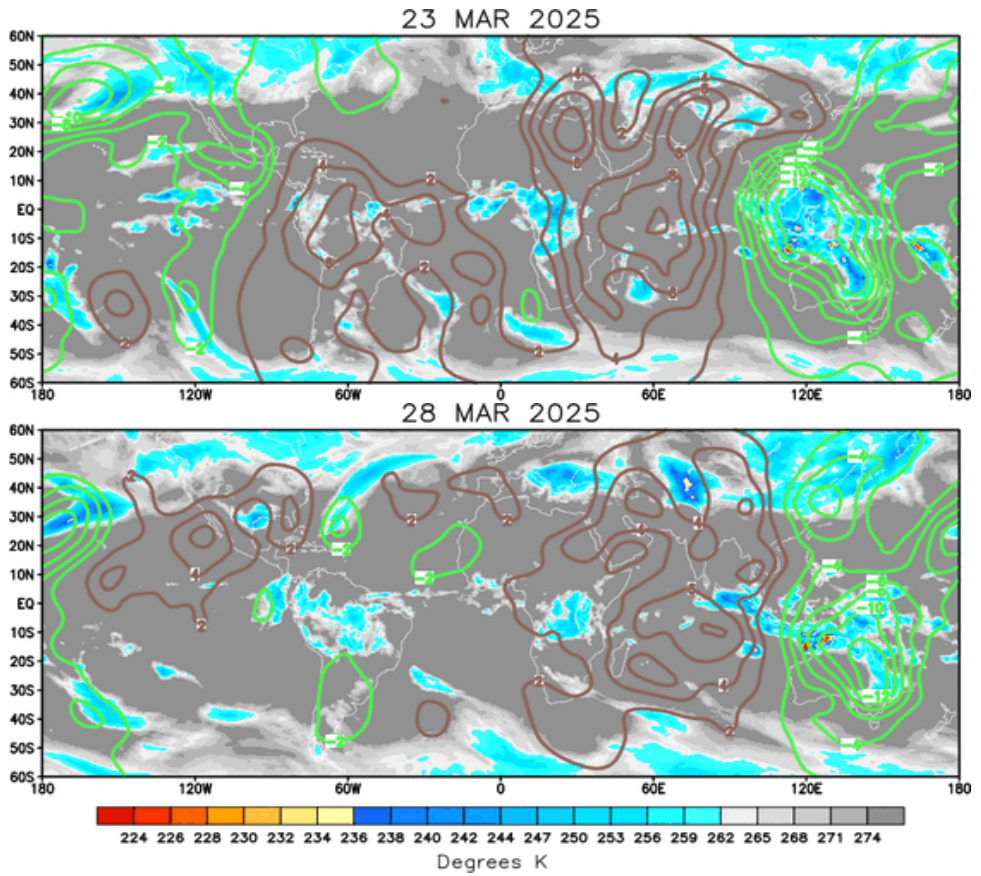
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

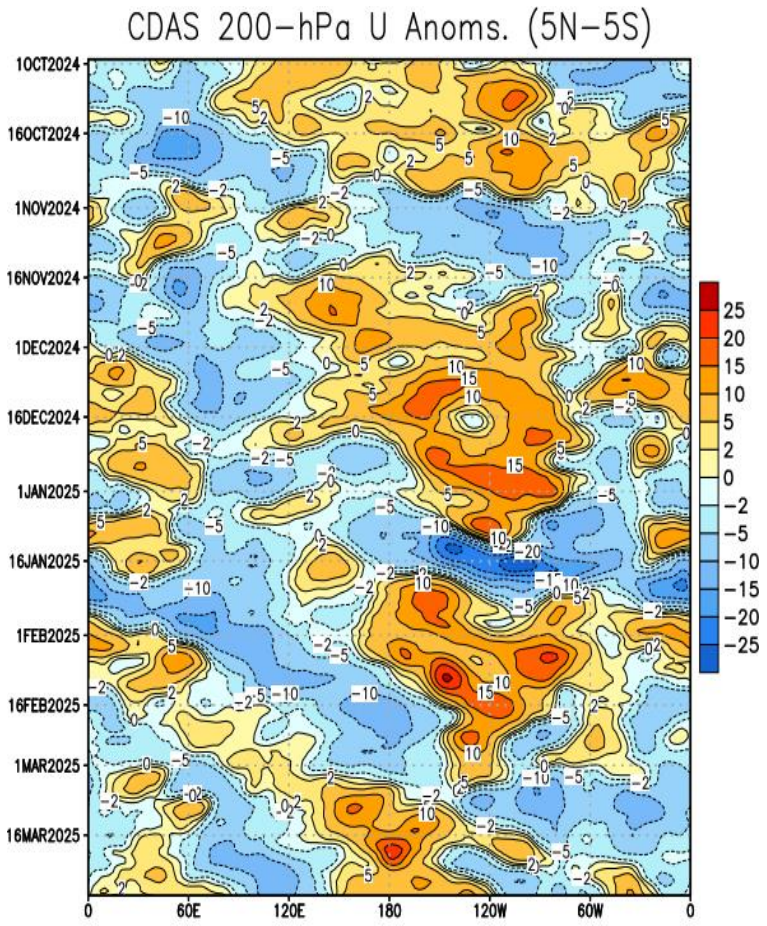


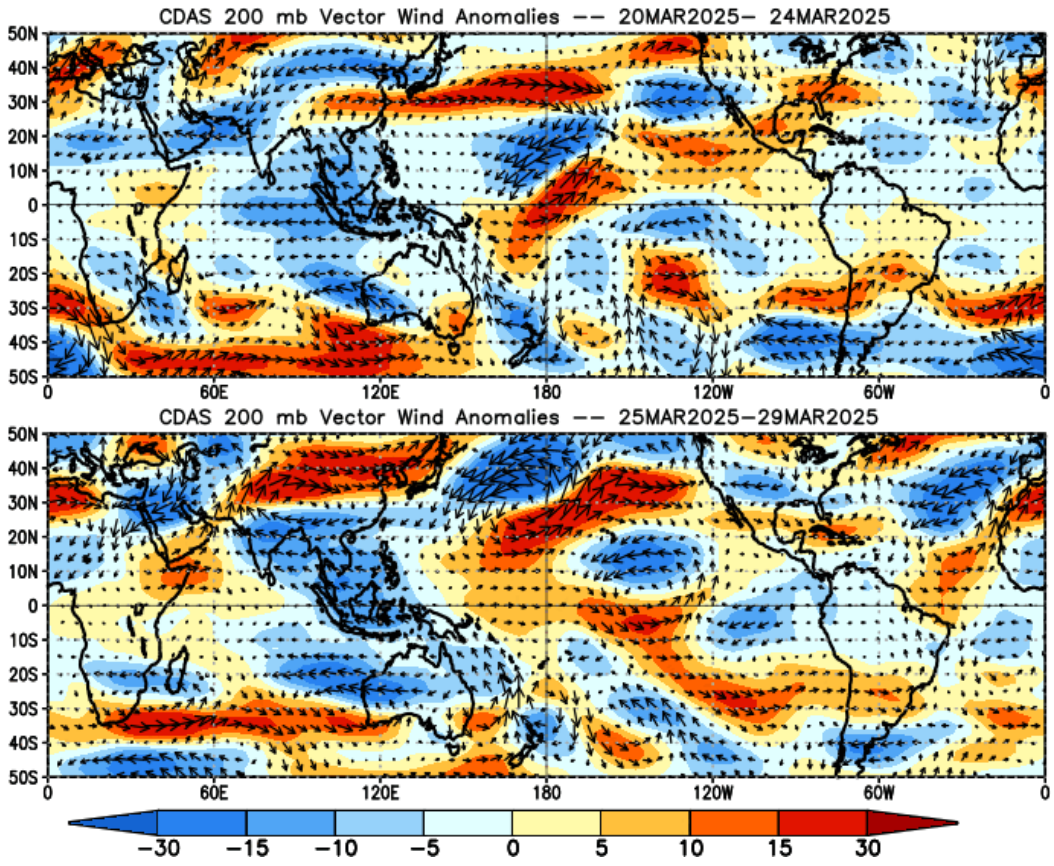


- As the MJO constructively interfered with La Niña, anomalous upper-level divergence strengthened over the Maritime Continent.
- The Wave-1 pattern broke down to a Wave-2 like pattern in late March with weak signals over the Pacific and Atlantic Oceans. The strong, anomalous upper-level divergence over the Maritime Continent weakened slightly and slowly propagated eastward.

200-hPa Wind Anomalies

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

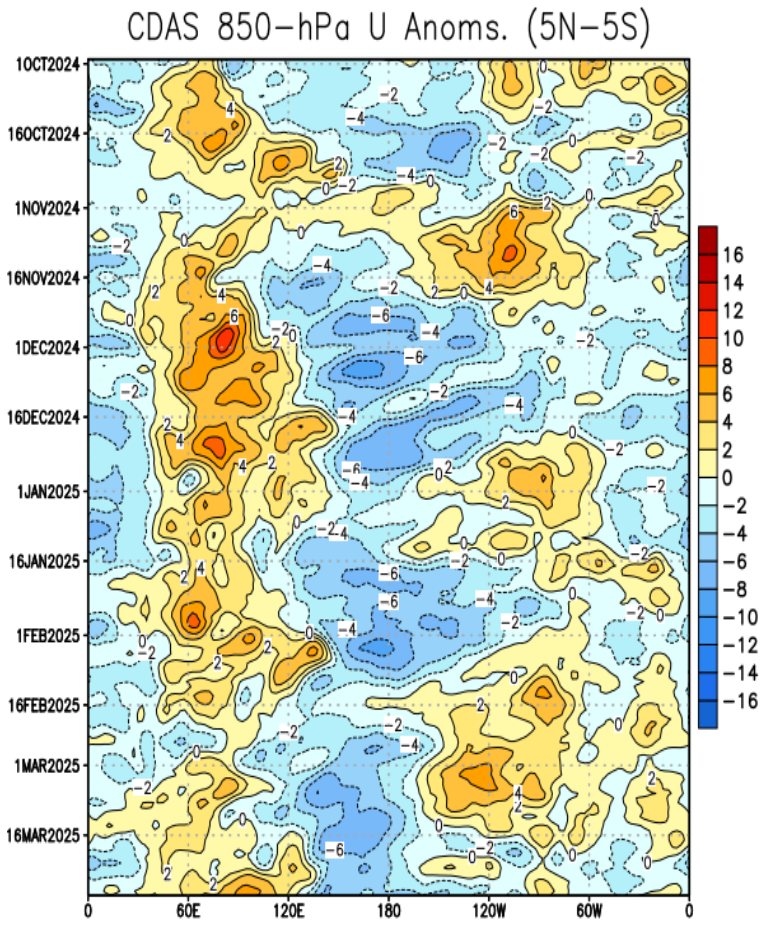


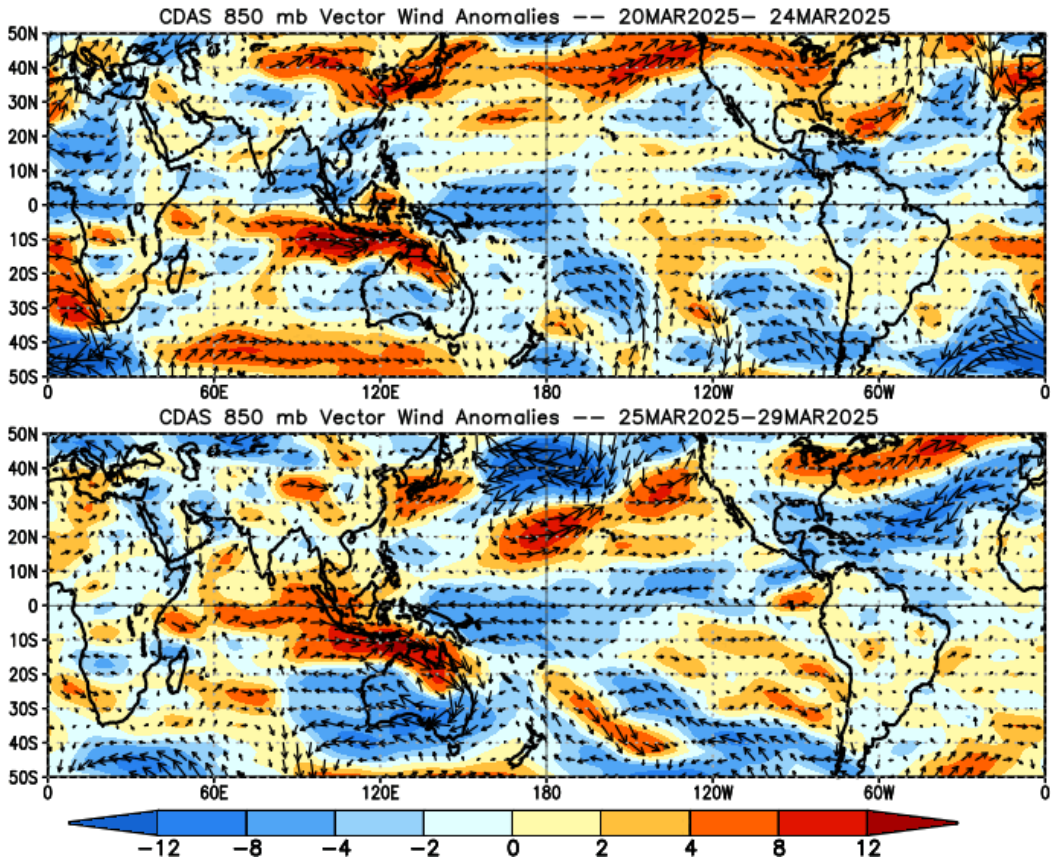


- During late-March, the easterly phase of the MJO continued to propagate eastward from 120W to 60W. Anomalous westerlies expanded outward from the Date Line, covering most of the western and central Pacific Ocean.
- Westerlies began to build back into the southwestern Indian Ocean basin, converging with the strong easterlies to the east.

850-hPa Wind Anomalies

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

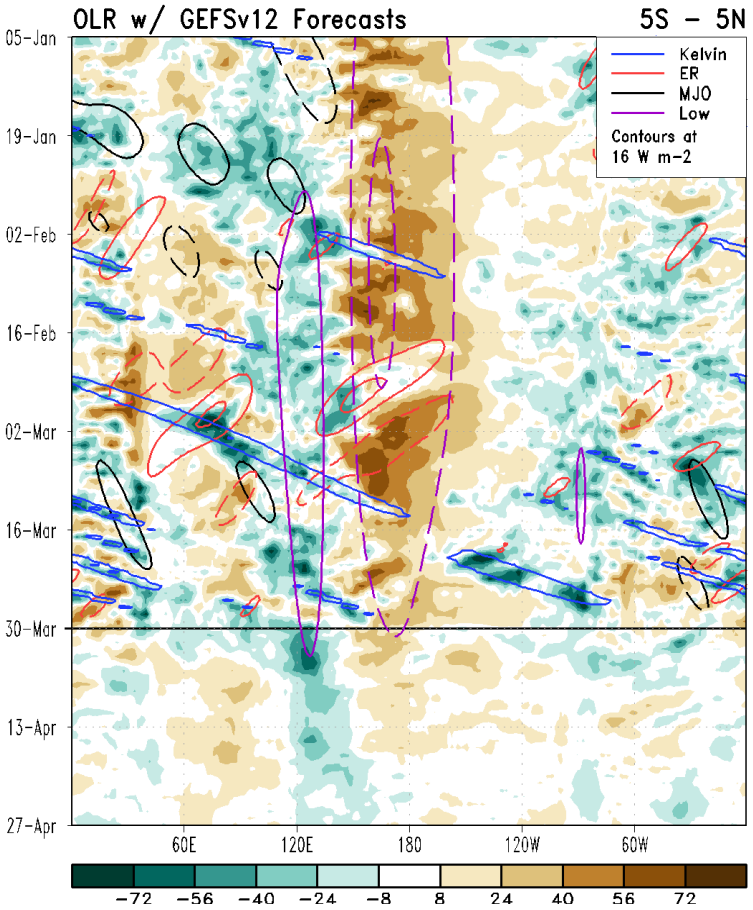


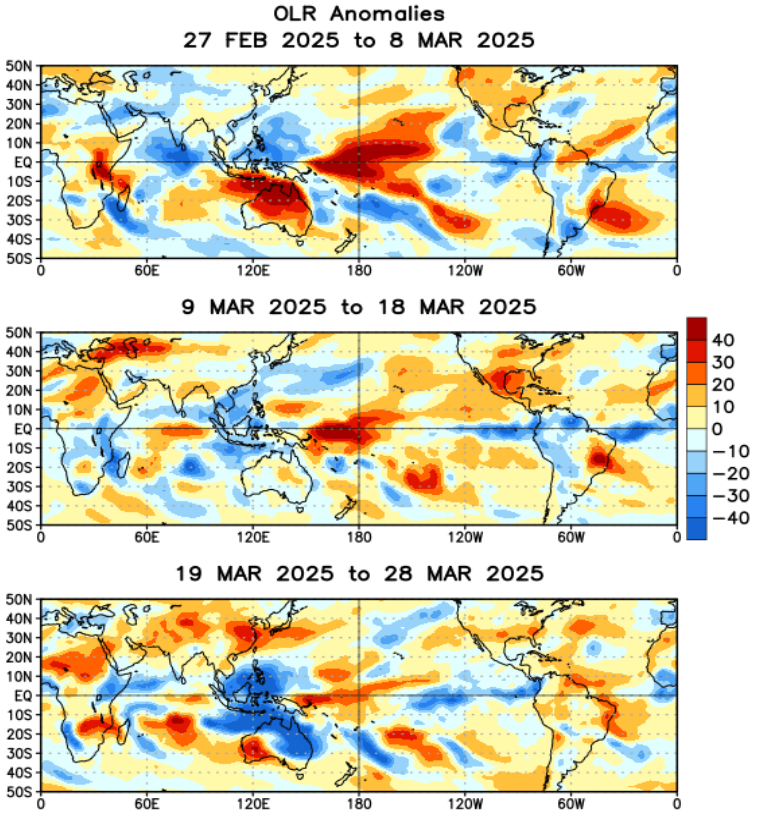


- Compared to the zonal winds aloft, there is less evidence of eastward propagating features in the low-level time/longitude plot.
- The persistent low-level westerlies continued to ease over the equatorial East Pacific, allowing for continuous enhanced trade winds along the entire equatorial Pacific Ocean.
- Strong westerlies still persist just off the South American coast prohibiting oceanic upwelling in the region.

Outgoing Longwave Radiation (OLR) Anomalies

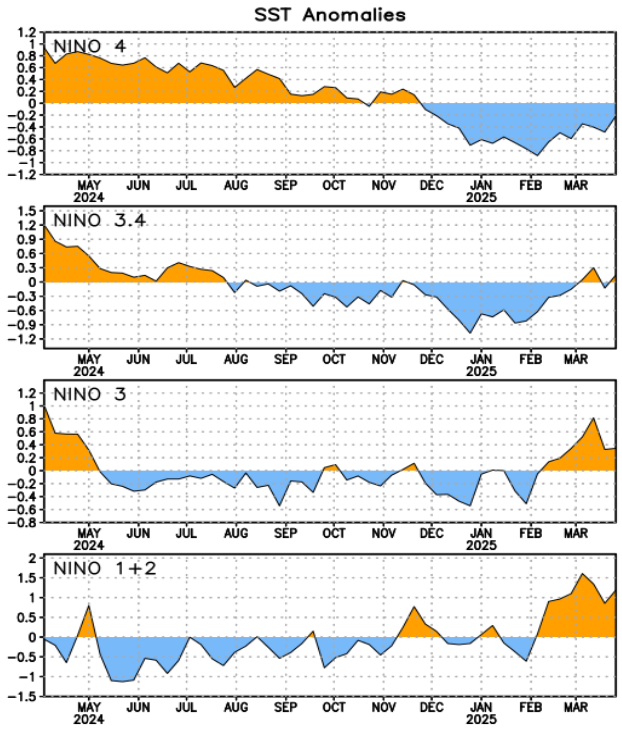
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

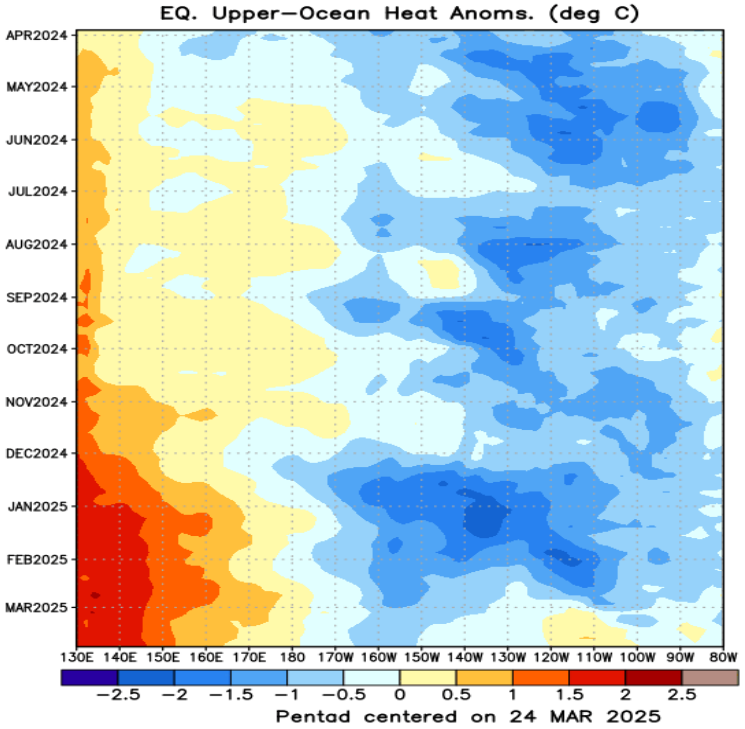




- La Niña driven suppressed convection across the equatorial Central Pacific has begun to erode, with convection expanding from the eastern Pacific Ocean towards the Dateline.
- The MJO led to more enhanced convection over the Maritime Continent and eastern Australia and drier conditions over the central Indian Ocean during late March.
- Strong Kelvin Wave activity over the eastern Pacific in late March led to destructive interference with the suppressed phase of the MJO.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

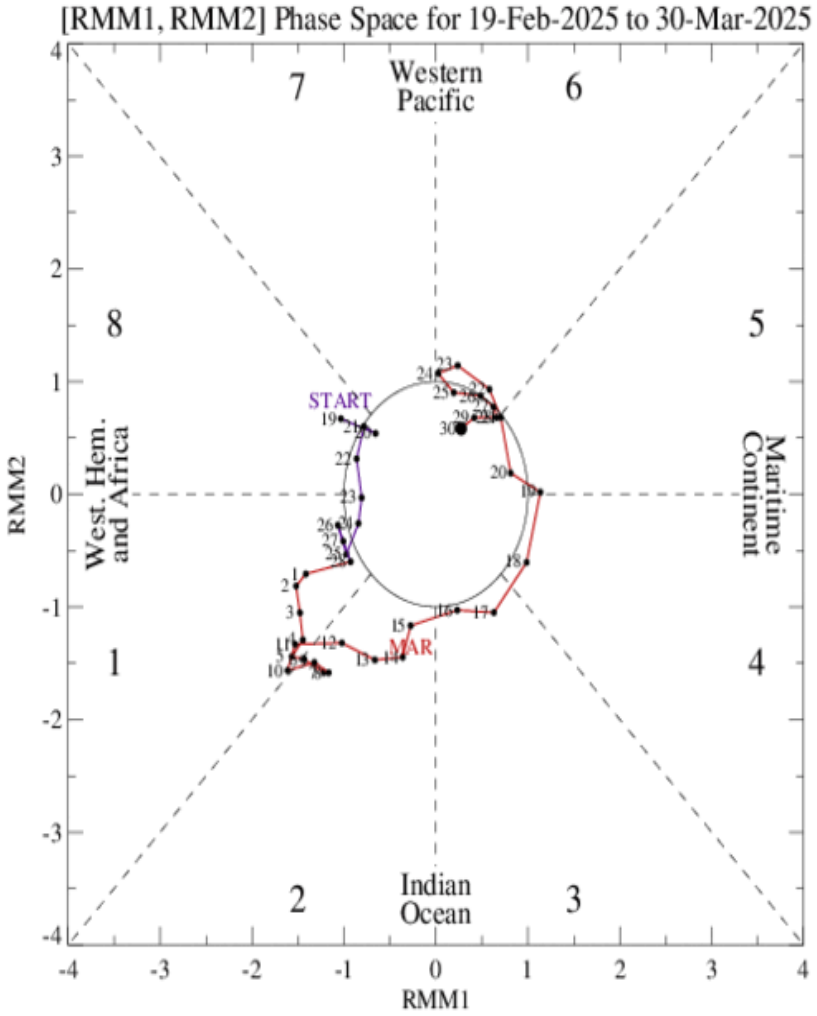




- SST anomalies briefly became positive in the Nino 3.4 region and are hovering along the zero line.
- The Niño 1+2 and Niño 3 regions have remained positive since early February but are showing signs of some cooling over the past few weeks.
- Warmer waters continue to persist in the Eastern Pacific in response to the low-level westerlies in the region.

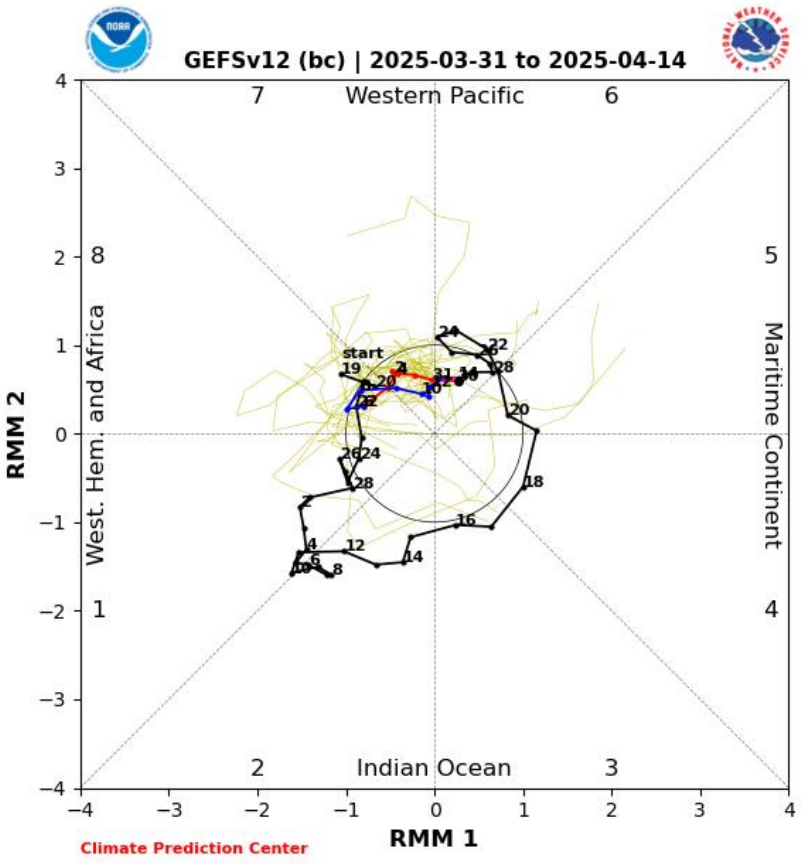
MJO Index: Recent Evolution

- From March 15-24, RMM observations show a rapid eastward propagating MJO signal traveling from the western Indian Ocean to the western Pacific Ocean, likely associated with Kelvin wave activity.
- Over the past week, the signal has retrograded westward back towards the Maritime Continent and into the unit circle.

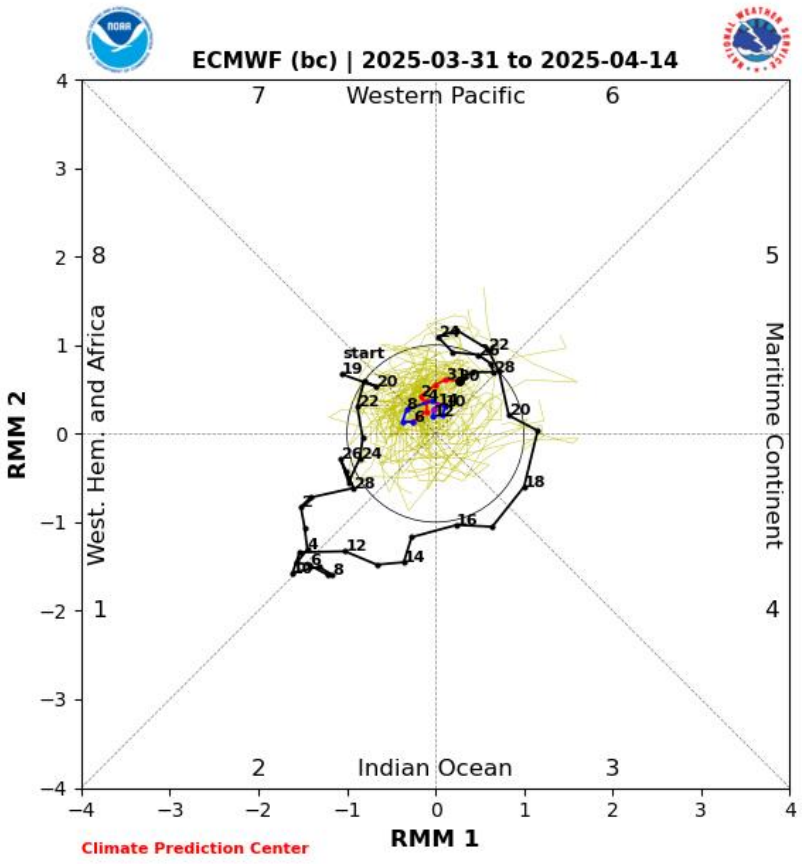


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

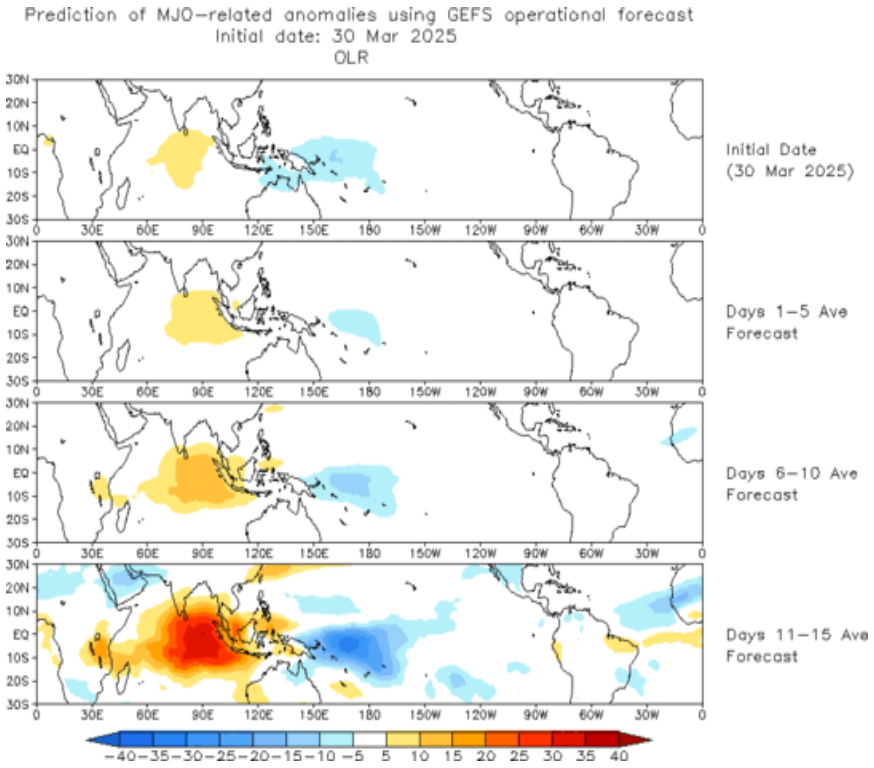


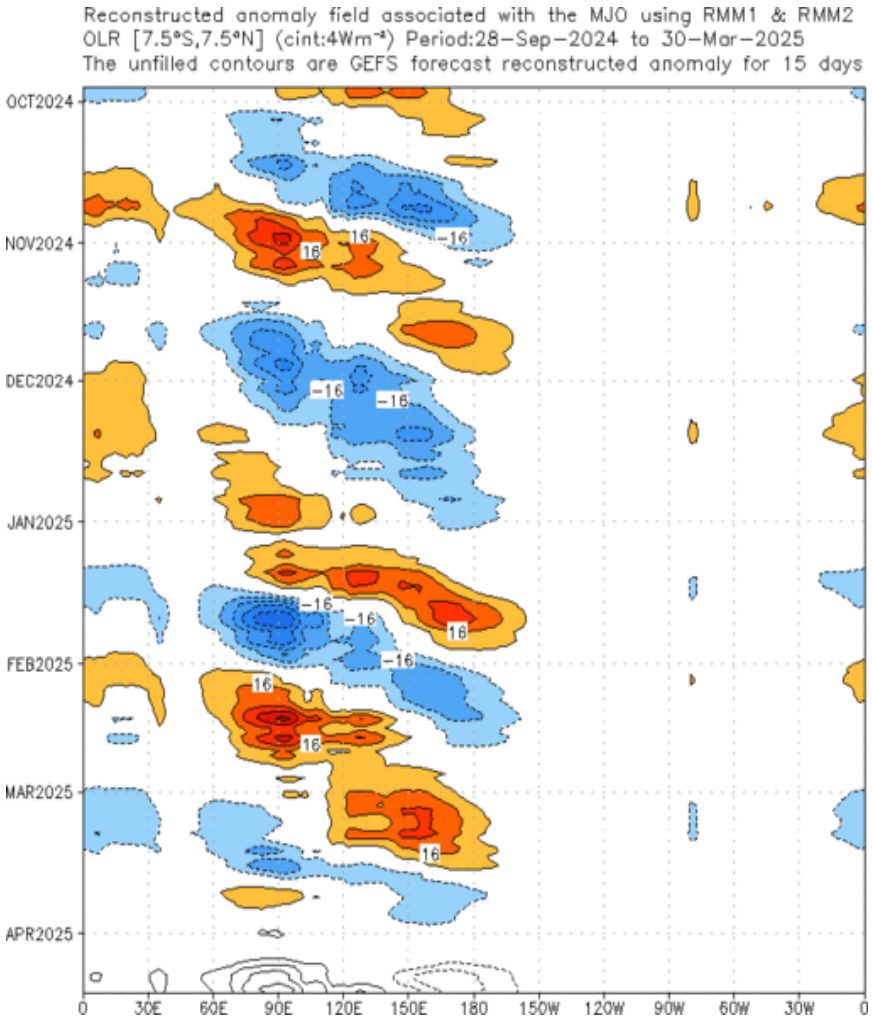
ECMWF Forecast

- Both the GEFS and ECMWF models depict a weak MJO during the next two weeks.
- Eastward propagation continues into Phase 8 during Week-1, but then both models again show a retrograding signal in Week-2 moving westward back into Phase 6.
- GEFS shows a larger spread then ECMWF with some members strengthening and emerging from the unit circle.

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.)

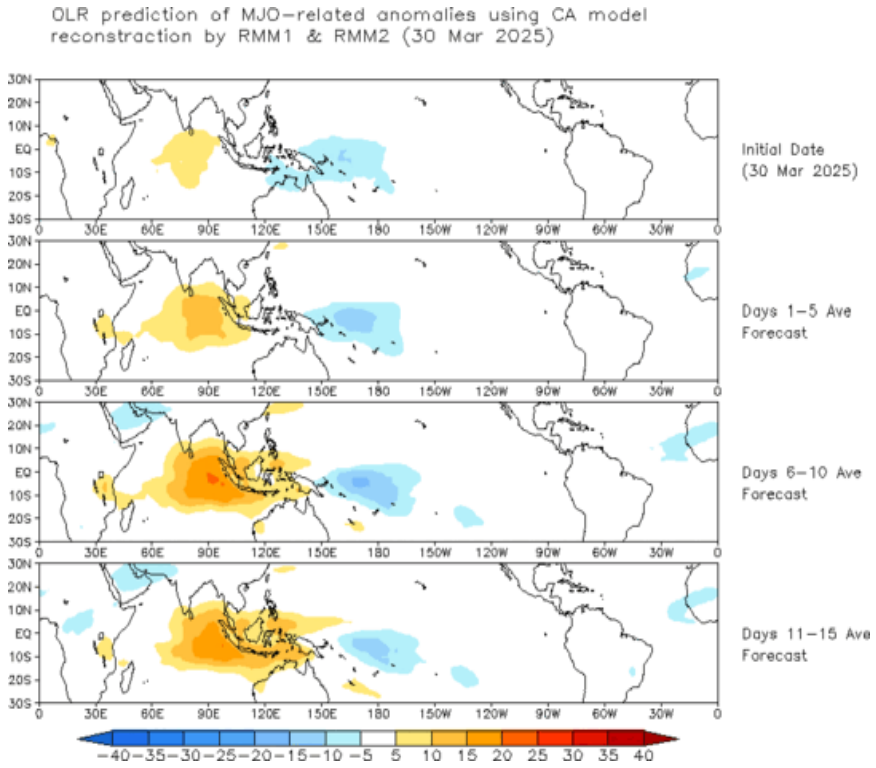


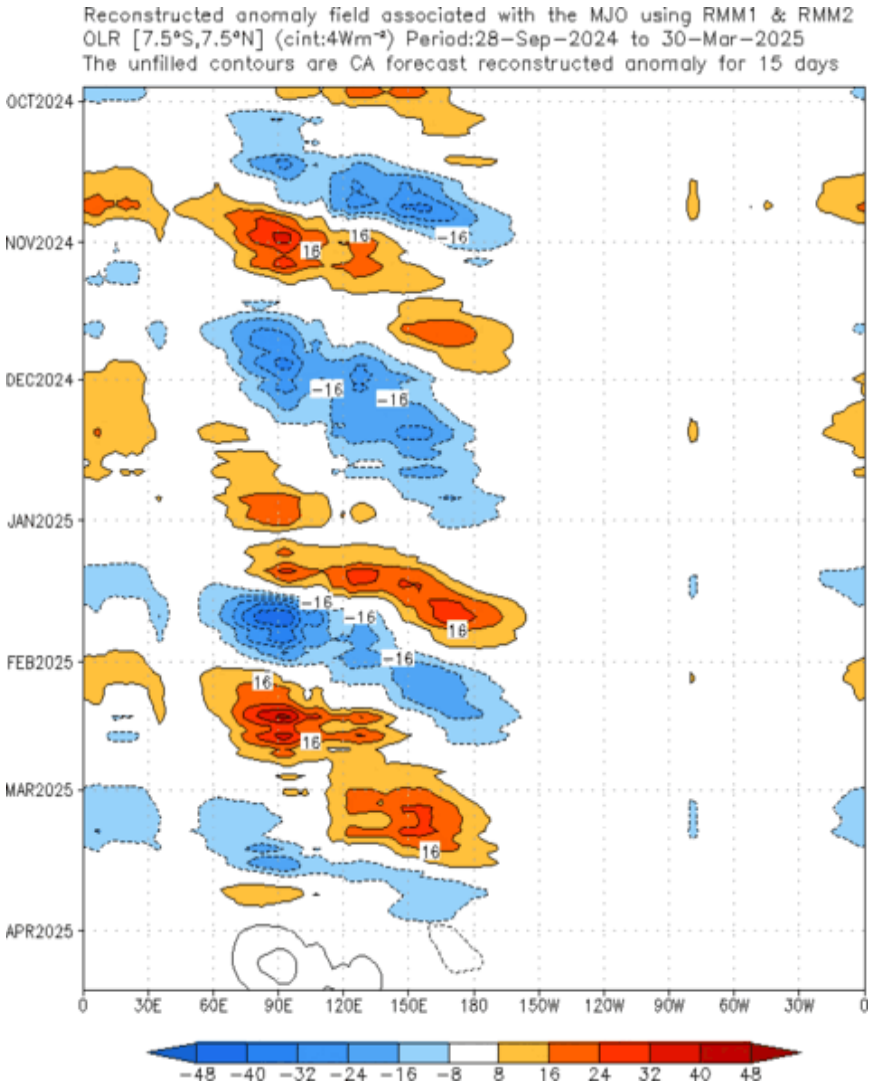


- The GEFS OLR forecast based on the RMM index forecast depicts a stationary pattern of anomalous convection with weak enhanced (suppressed) convection over the West Pacific (Indian Ocean) strengthening over the next two weeks.

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.)

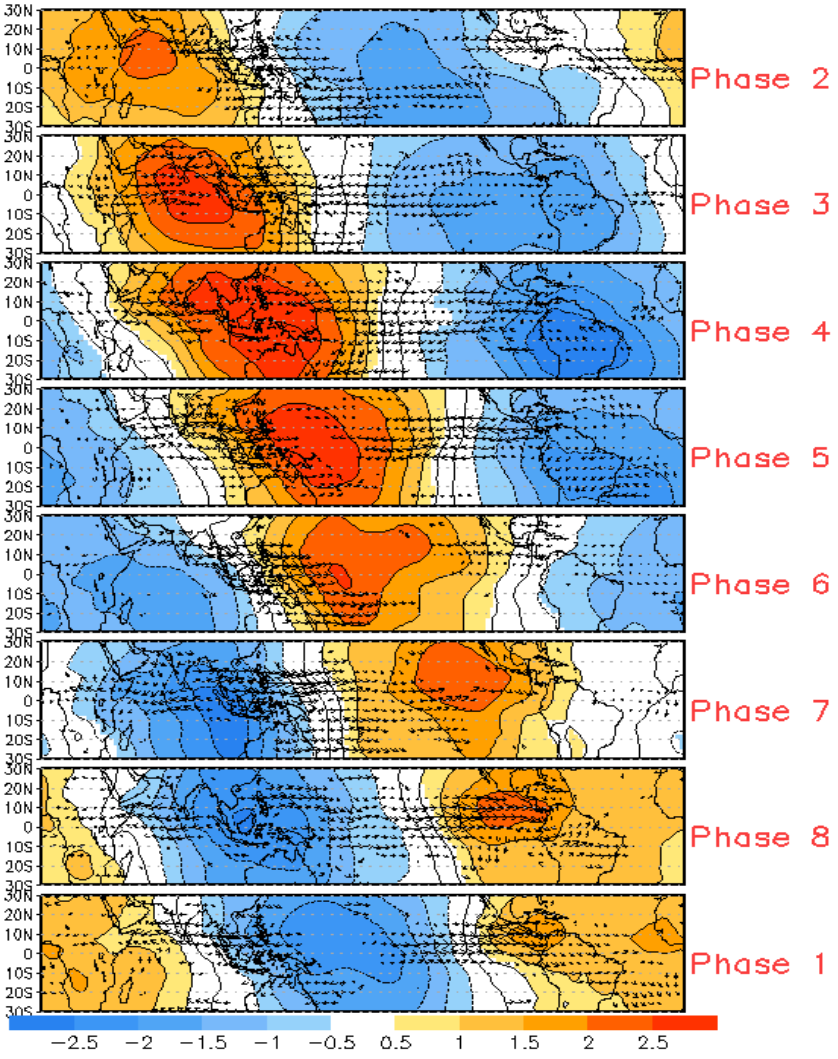




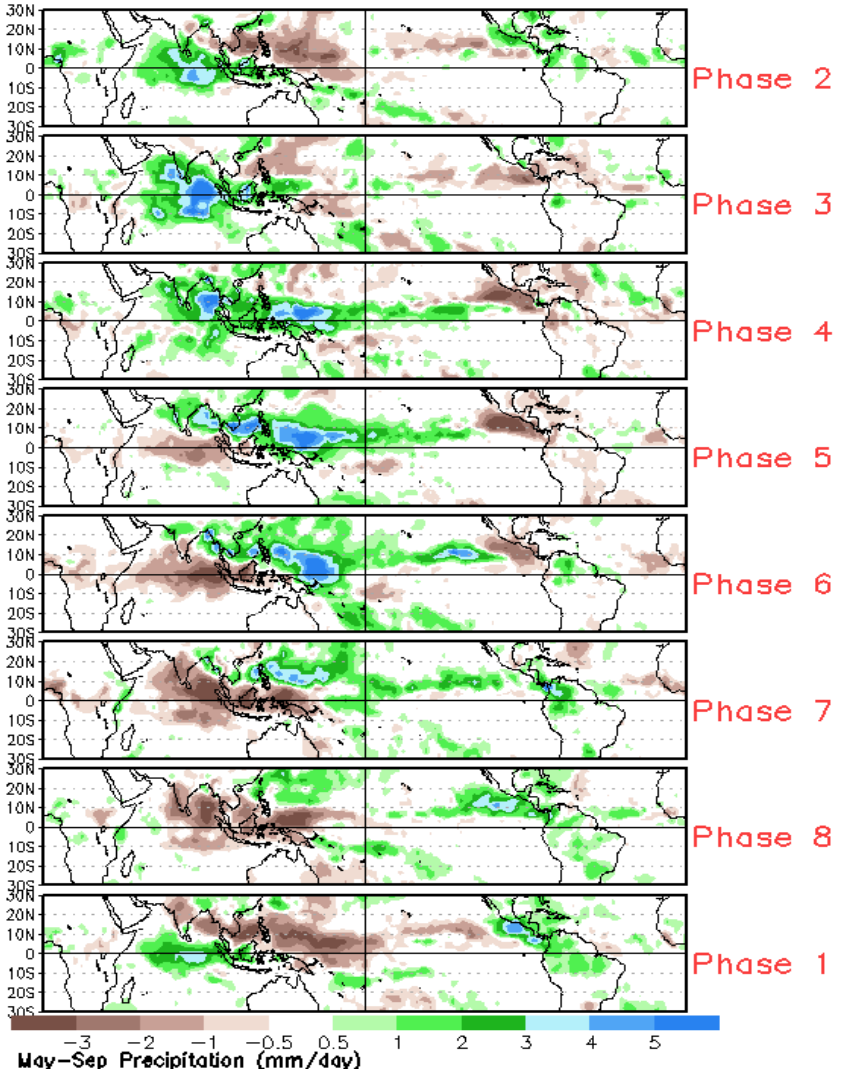
- The constructed analog forecast features a similar pattern with slight eastward propagation. The signal strengthens a bit quicker, but doesn't reach the magnitude of the GEFS at Days 11-15.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



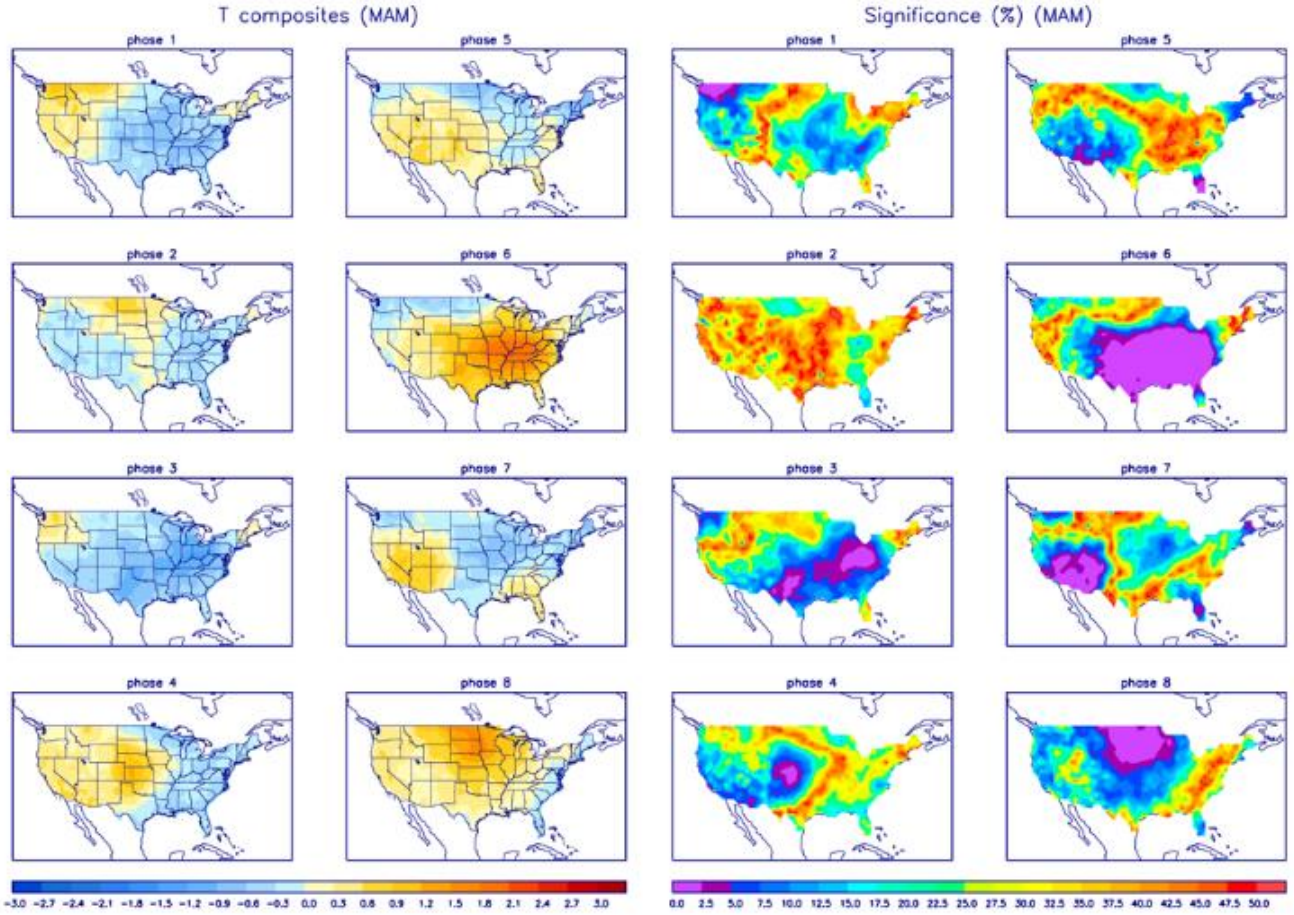
Precipitation Anomalies



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.

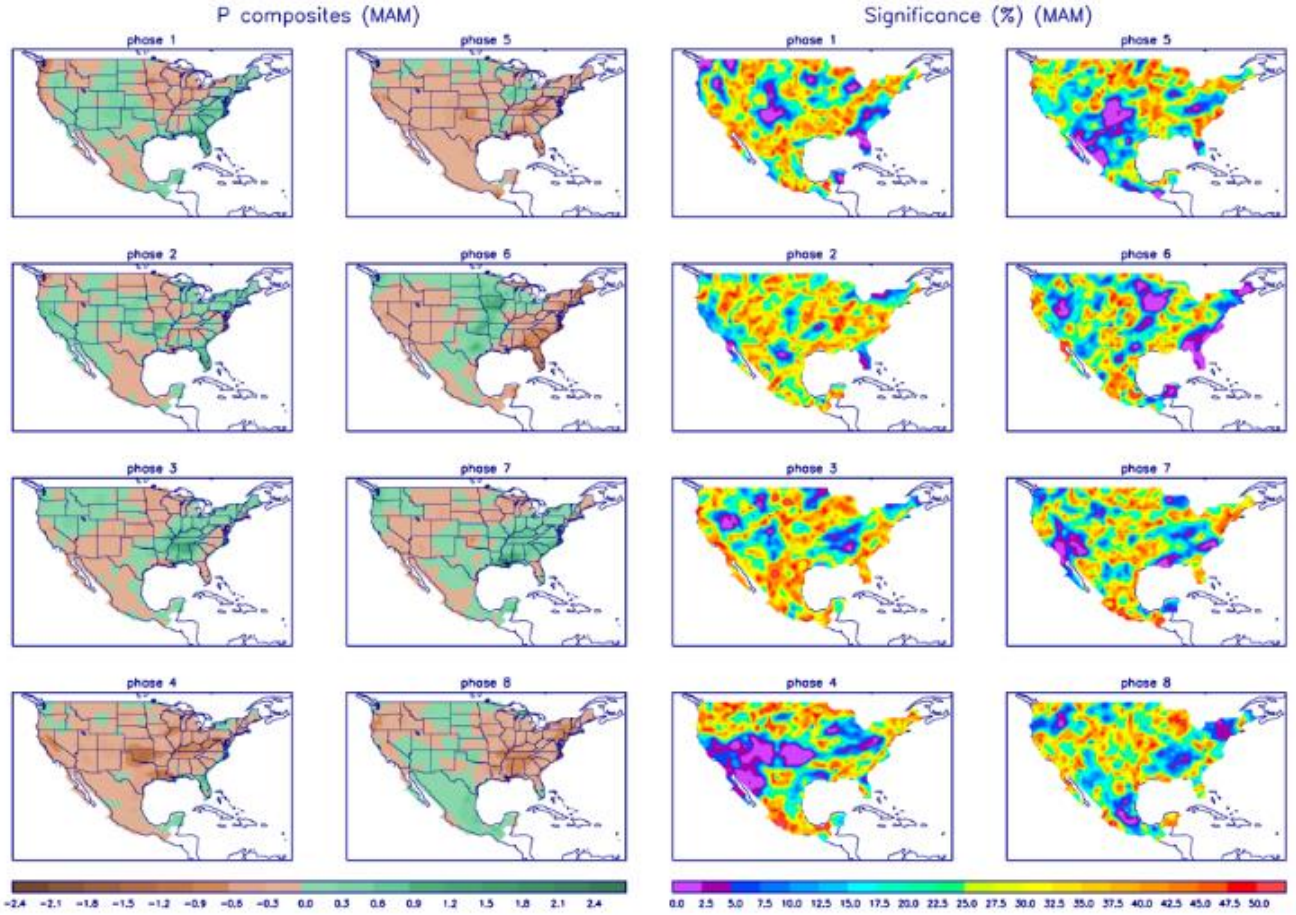


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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