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

Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
24 February 2025

Overview

- The coherent MJO activity seen in the RMM index observations has begun to both weaken and stall due to destructive interference with strong equatorial Rossby wave activity and the low-frequency base state.

- Dynamical model RMM forecasts favor the return of eastward propagation of the MJO signal into Phase 1 during Week-1 and moving into the Indian Ocean by early March.

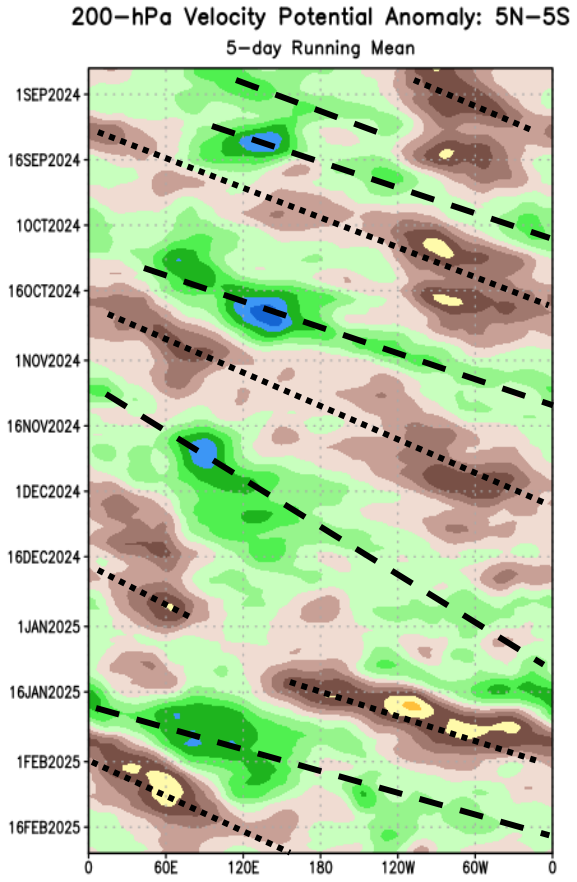
- Given the MJO evolution, tropical cyclone (TC) development is favored in the western Indian Ocean during Week-2. Model guidance also indicates an enhanced potential for TC formation north of Australia and westward into the South Indian during Week-3.

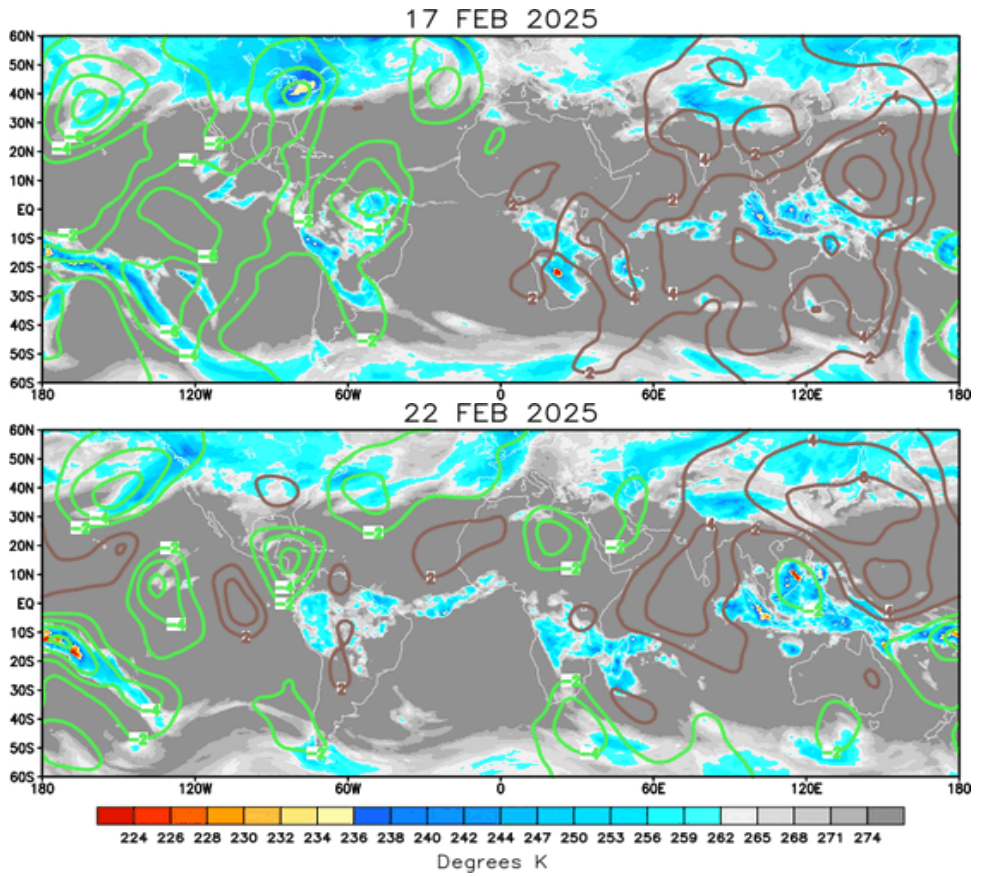
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

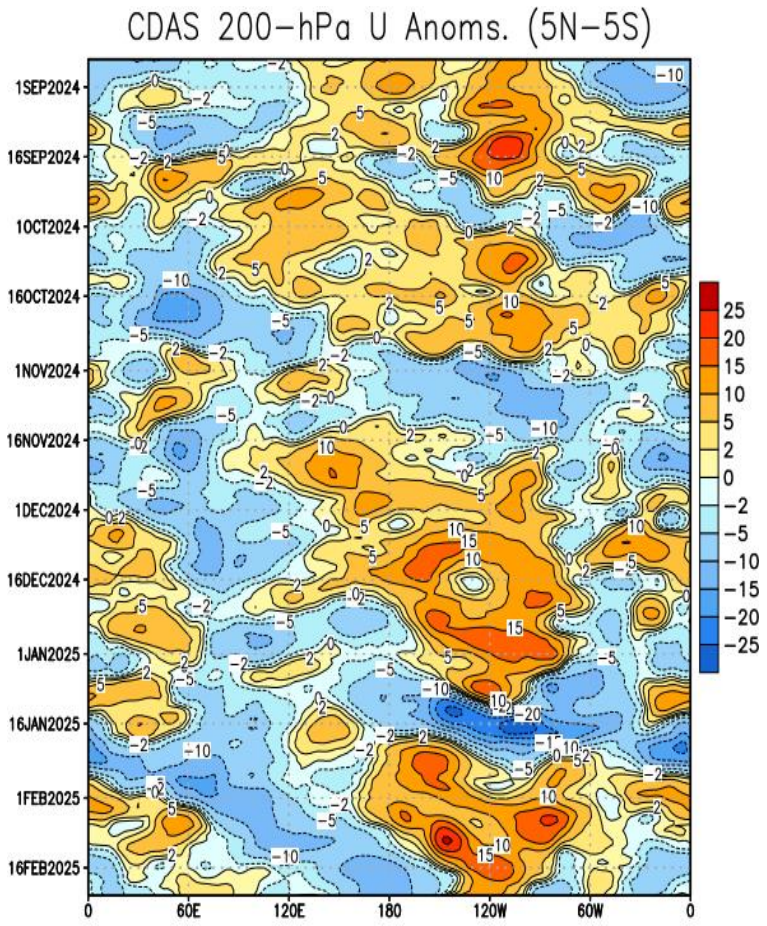


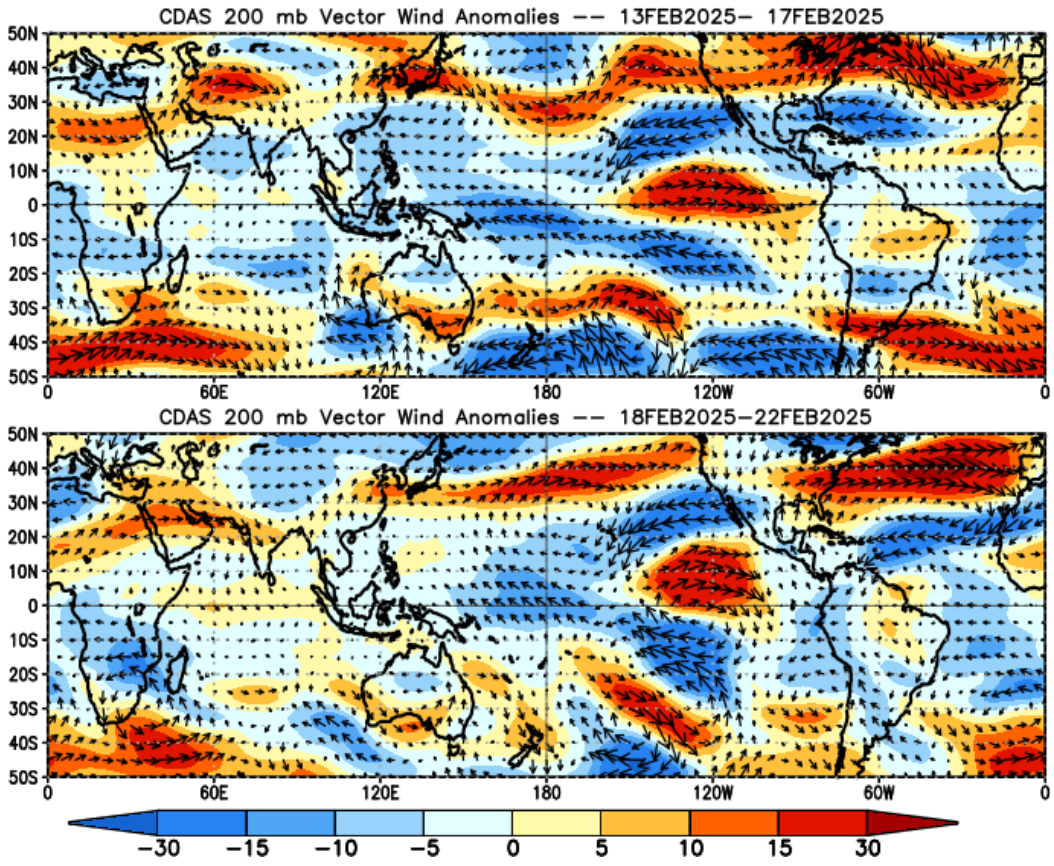


- The time/longitude plot indicates the eastward propagation of subseasonal activity is less evident compared to earlier in February, where there are more stationary features more recently.
- The wave-1 pattern that had been becoming less organized over the past few weeks has now completely dissolved into a chaotic pattern. This is likely due to destructive interference with a strong equatorial Rossby Wave and the low-frequency base state.

200-hPa Wind Anomalies

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

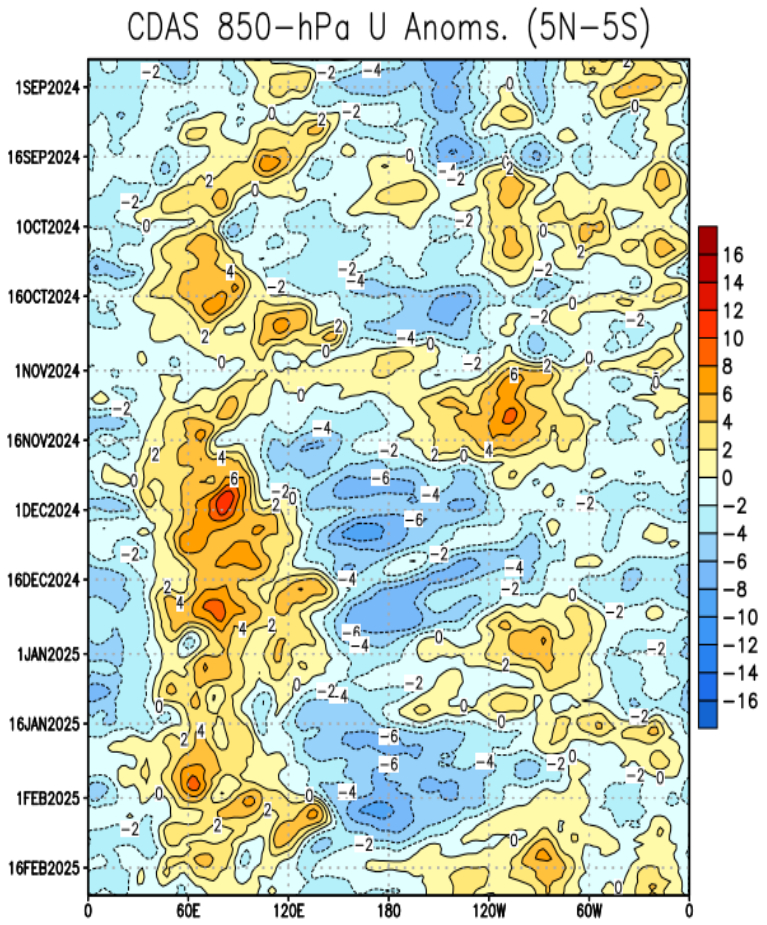


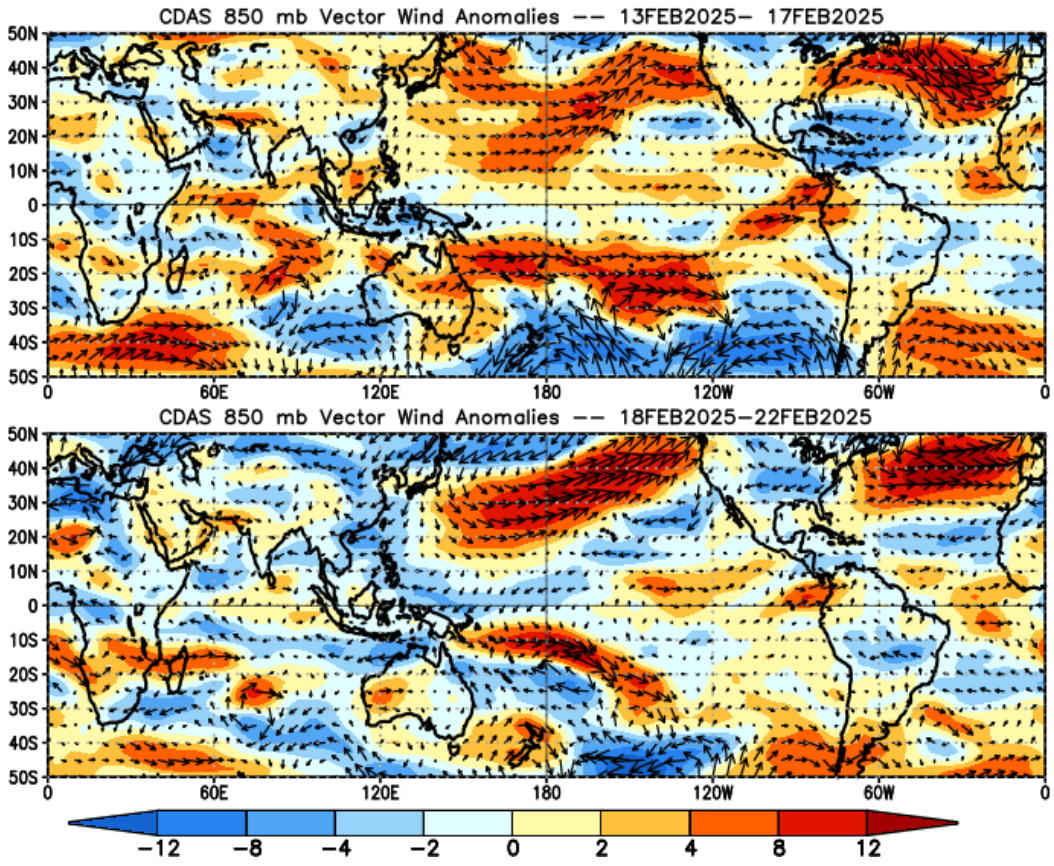


- The strong anomalous upper-level westerlies associated with the ongoing La Nina over the eastern Pacific continue to erode as anomalous easterlies propagate past the Date Line.
- The strong Northern Hemisphere jet feature weakened over the western U.S.

850-hPa Wind Anomalies

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

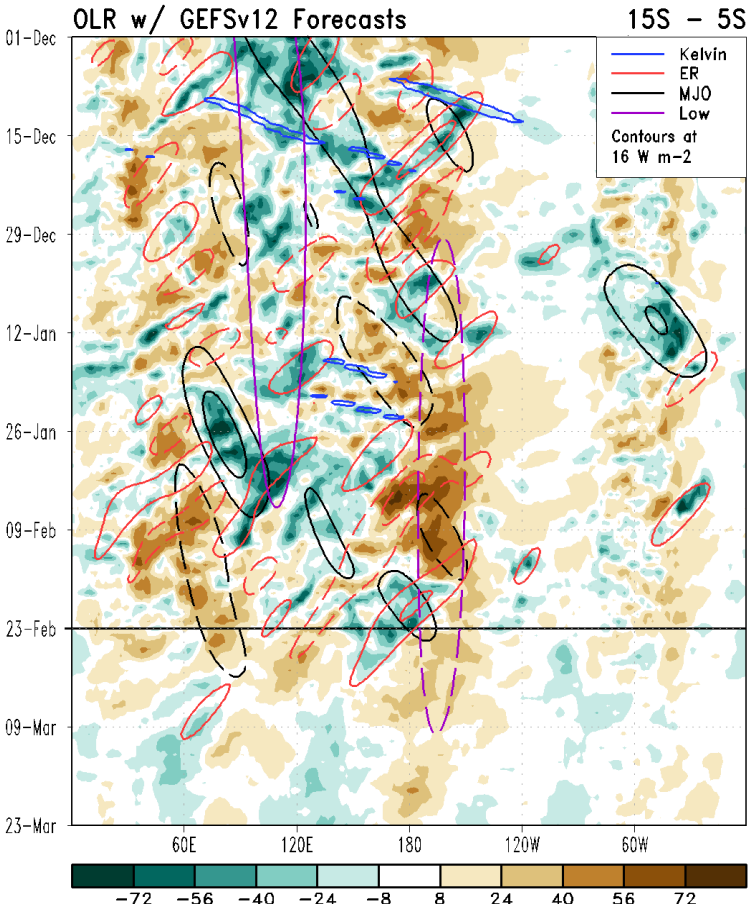


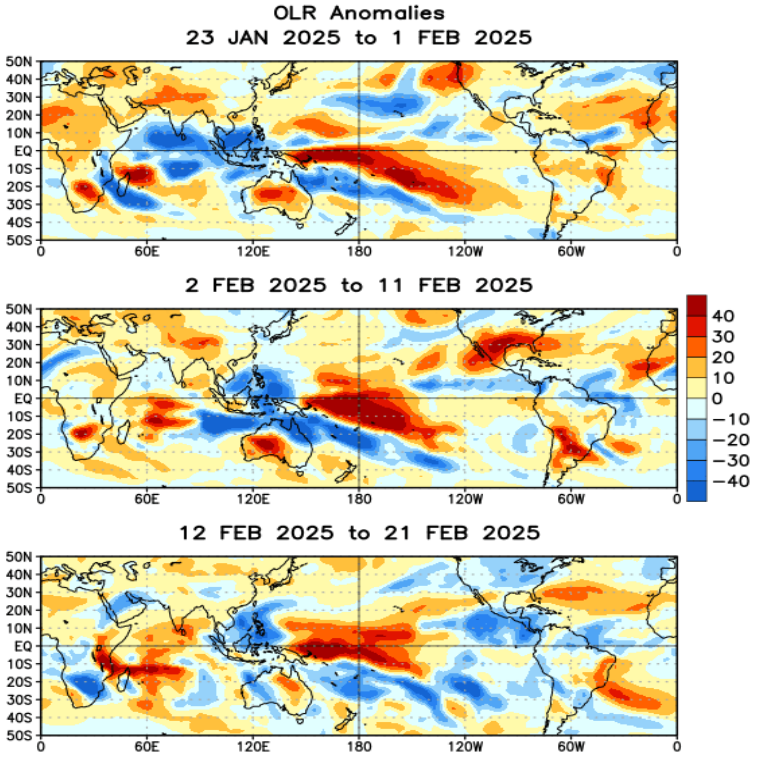


- Enhanced trades weakened over much of the equatorial Pacific giving way to anomalous westerlies from the east and the west.
- The low-level westerlies over the equatorial Indian Ocean also weakening to levels not seen since early November.
- South of the equator, anomalous easterlies developed in the Indian Ocean, with westerlies persisting in the South Pacific.

Outgoing Longwave Radiation (OLR) Anomalies

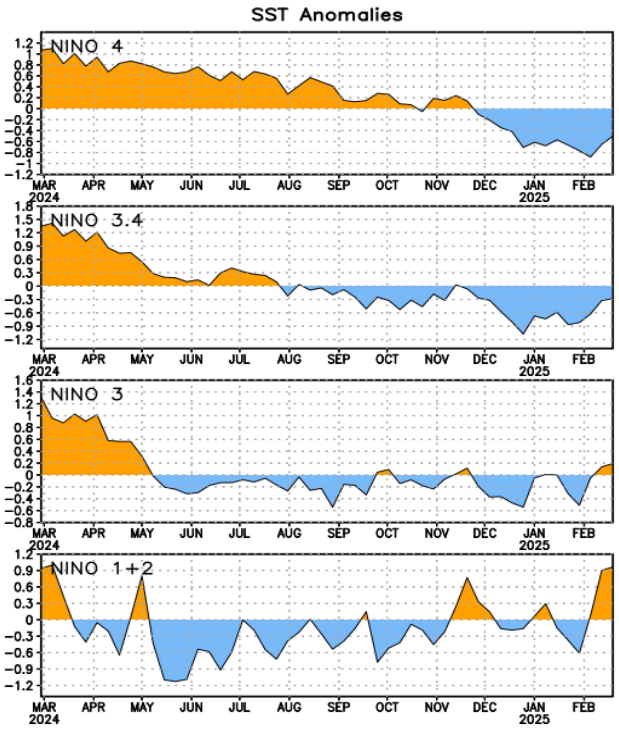
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

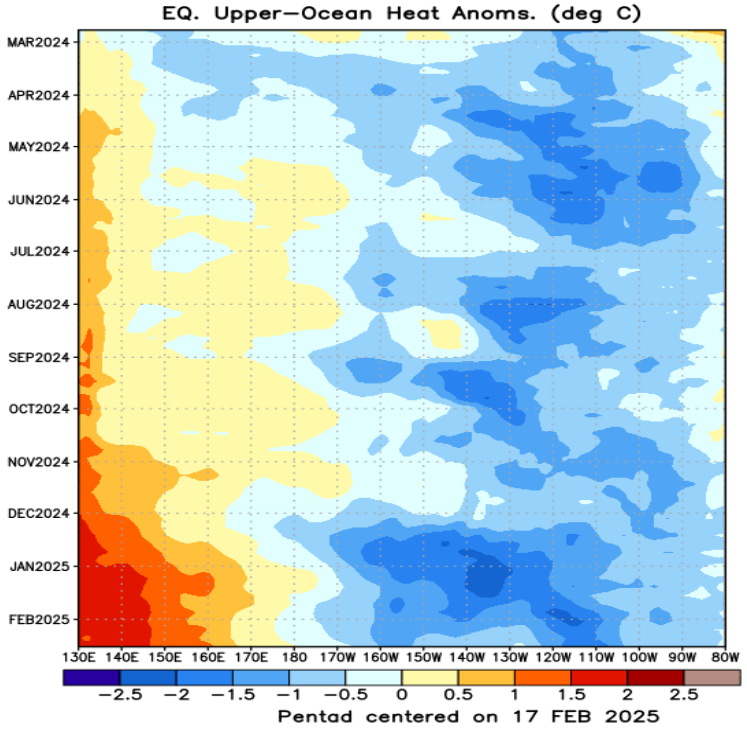




- The recent interaction between the enhanced convective MJO envelope and the strong Rossby Wave activity destructively interfered with the low-frequency signal near the Date Line, allowing for enhanced convection over the past week.
- Based on the GEFS, the suppressed convective associated with the low-frequency La Nina base state is favored to return and continue strengthening over the next month.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

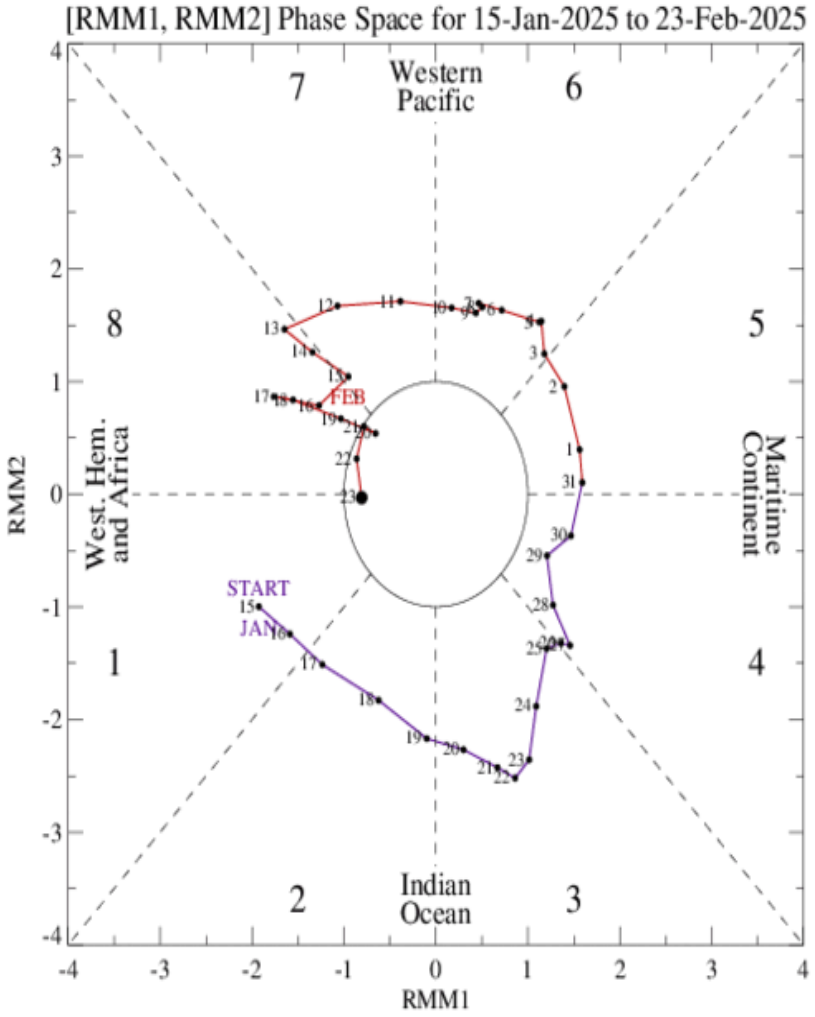




- The uptick in all four regions continued with Nino3 becoming positive.
- Positive subsurface heat content anomalies have extended eastward back to the dateline while maintaining a strong signal over the Western Pacific. The negative subsurface heat content anomalies have weakened in February.

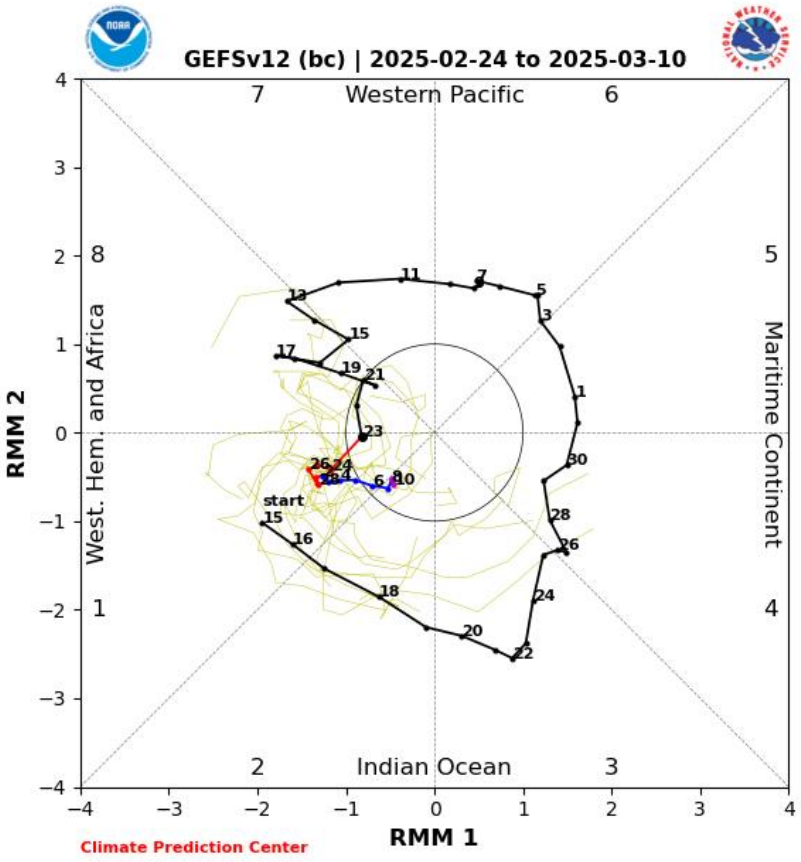
MJO Index: Recent Evolution

- Up until recently, the RMM index has depicted coherent MJO activity, with the signal consistently remaining outside the unit circle and nearly completing a full global circumnavigation since mid-January.
- However over the past two weeks, the signal has stalled in Phase 8 and retreated back into the unit circle likely due to destructive interference from strong Rossby wave activity.
- Over the past few days, the signal resumed its eastward propagation and moved into Phase 1.

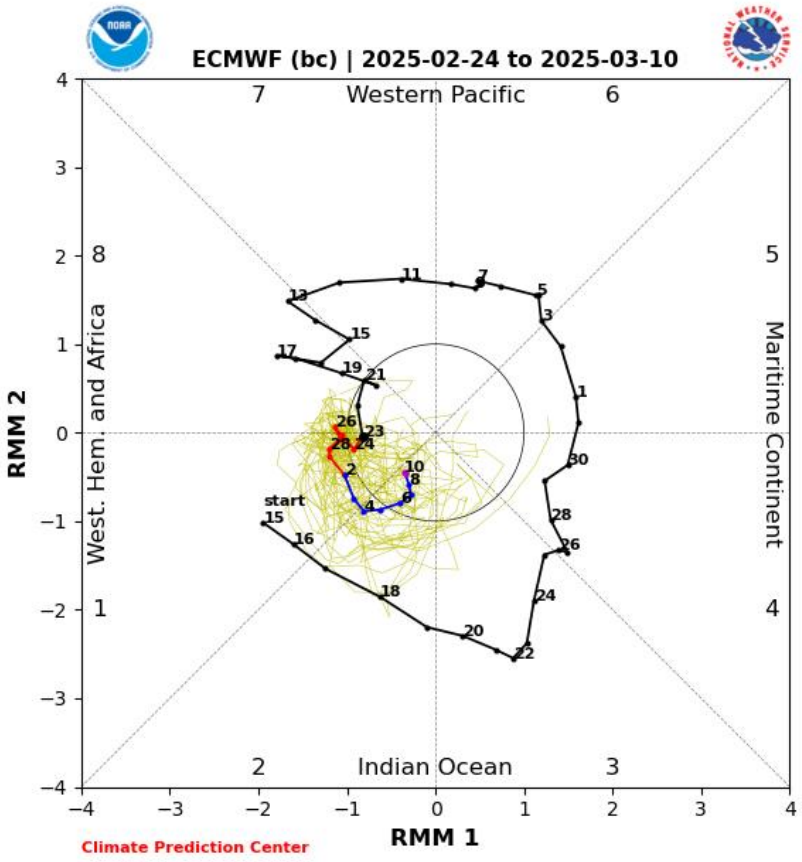


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



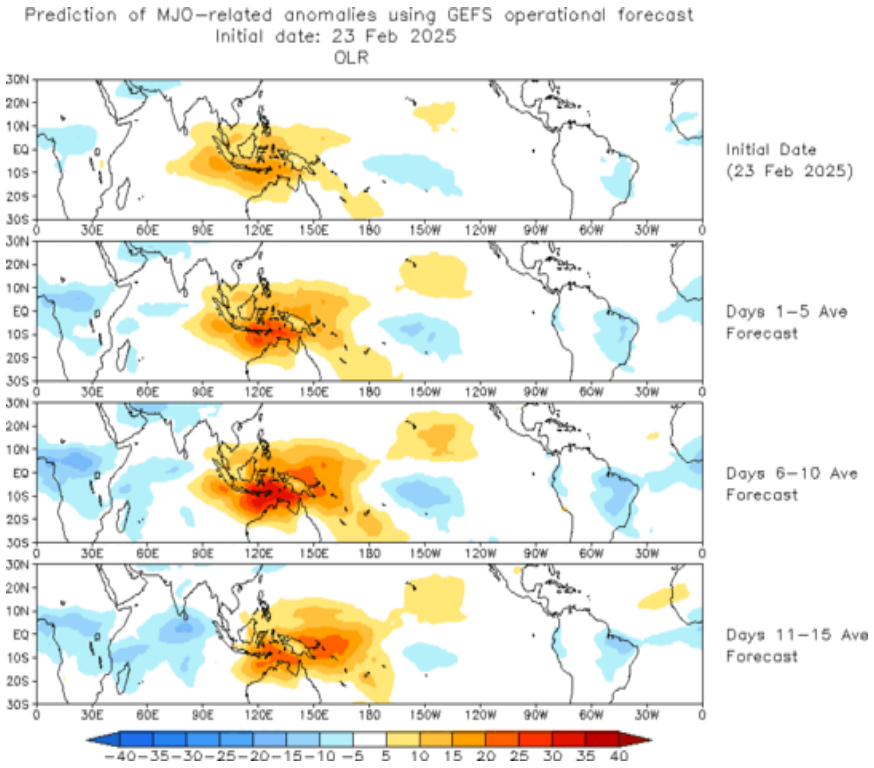
ECMWF Forecast

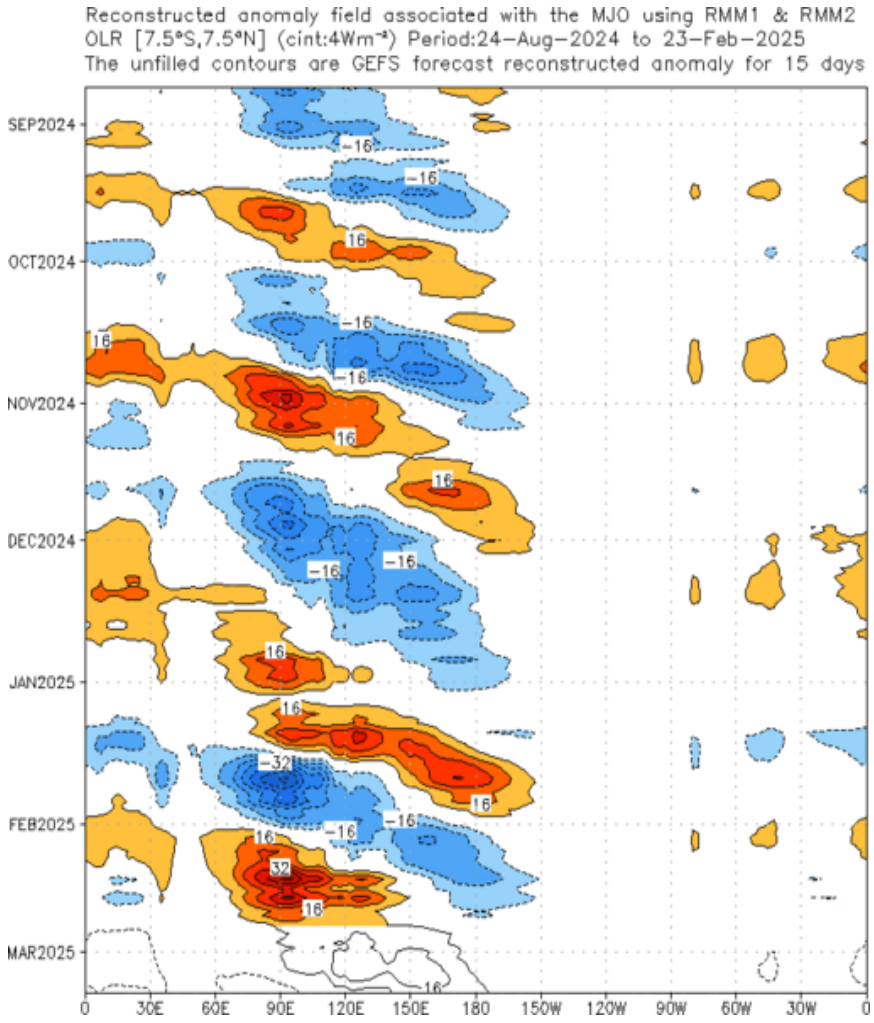
- Both the GEFS and ECMWF ensembles stall the MJO signal in Phase 1, but renew its eastward propagation into Phase 2 by the end of Week-2.

- Both models move the signal out of the unit circle by Week-2, but it retreats back inside the unit circle by the end of week-2. Many ensemble members maintain a higher amplitude event during this time.

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.)

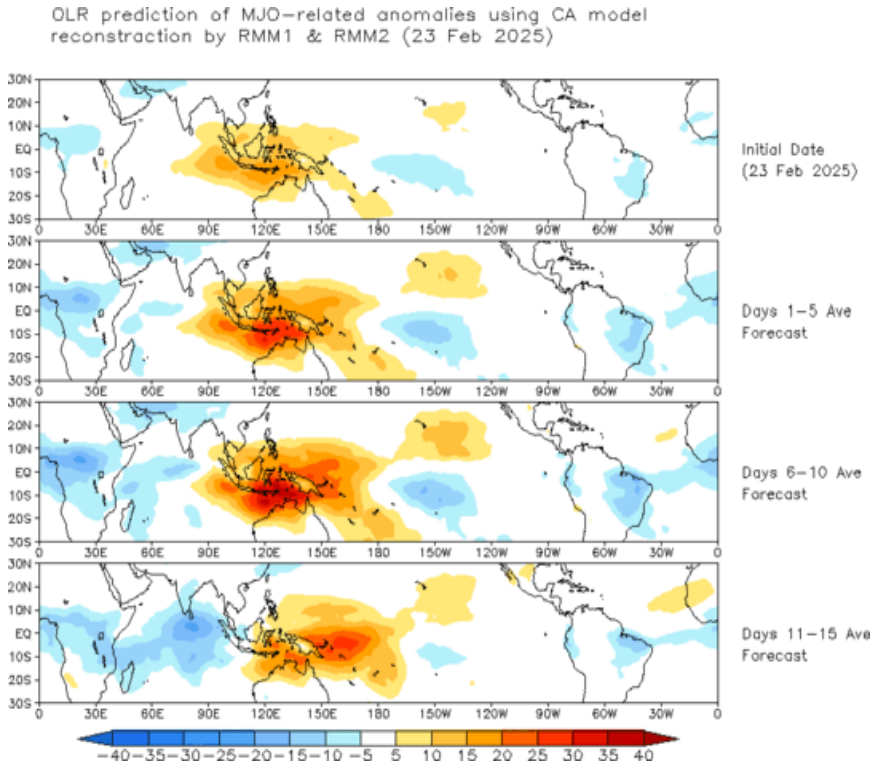


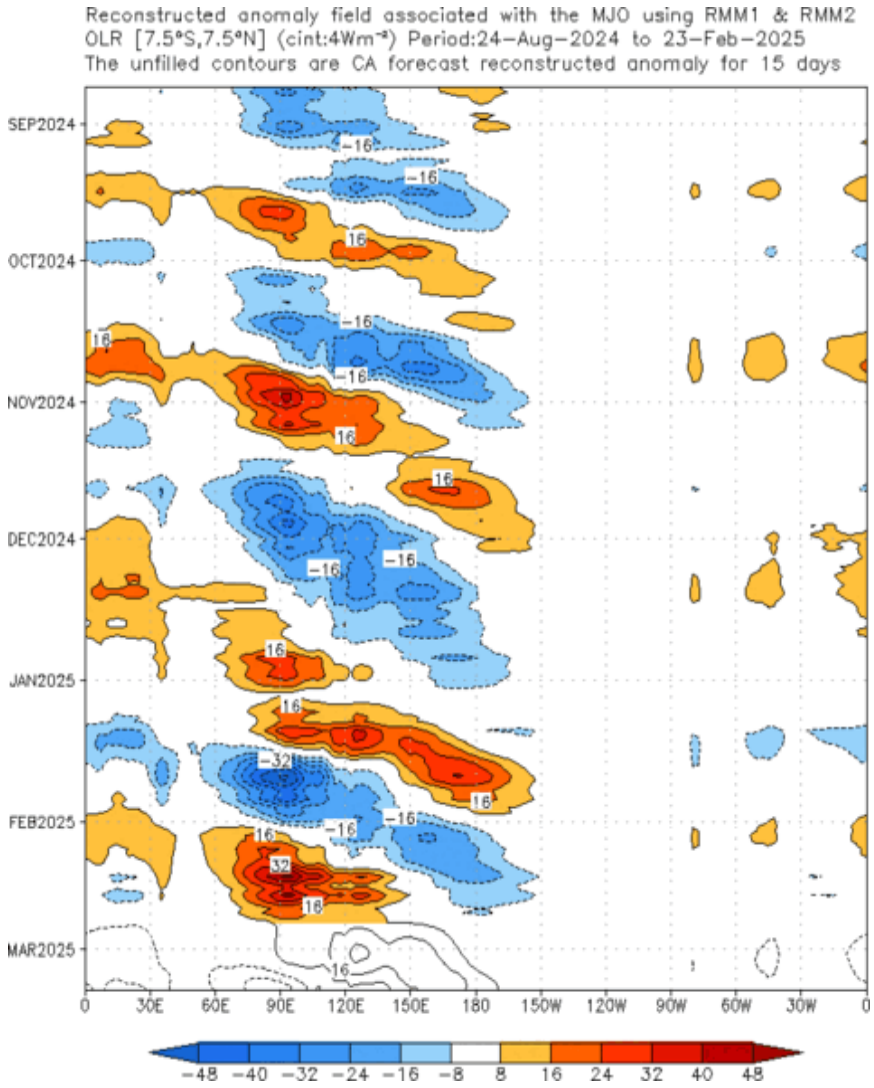


- The GEFS OLR forecast depicts positive OLR anomalies (suppressed convection) slowly propagating eastward from the western Indian Ocean to the Western Pacific. The negative OLR anomalies (enhanced convection) over the central Pacific weaken and dissipate. However, a new convective dipole begins to develop with positive OLR anomalies forming over the Indian Ocean.

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.)

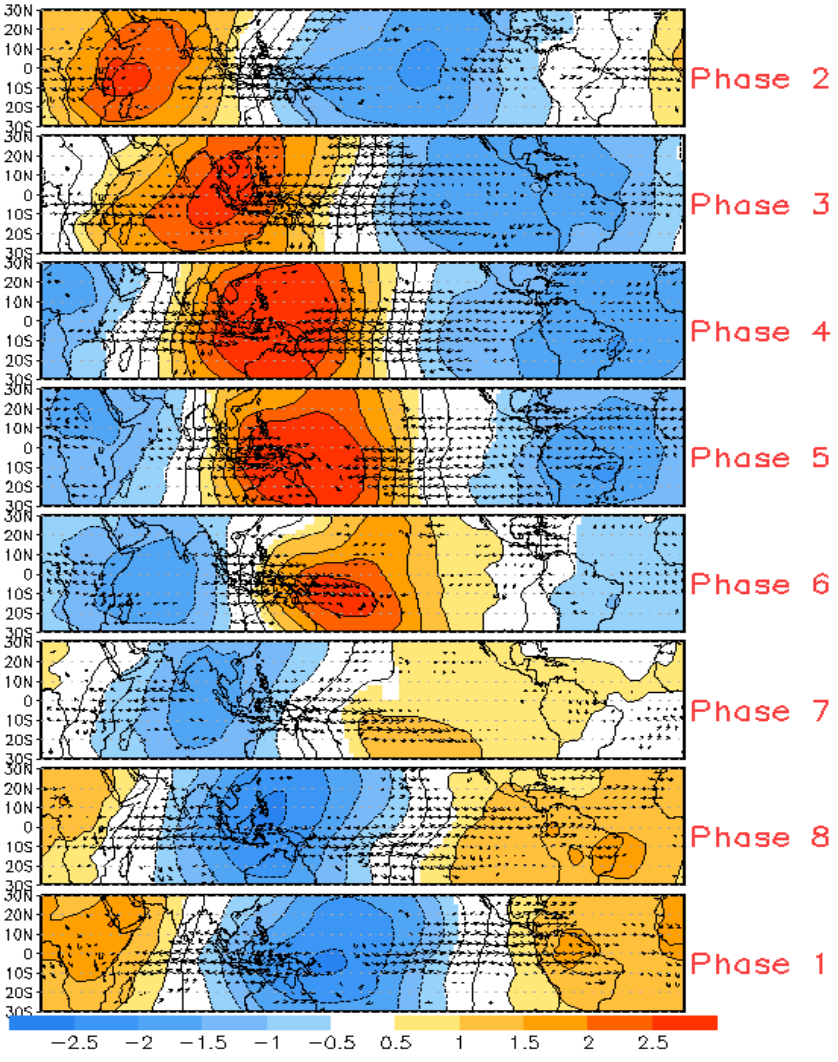




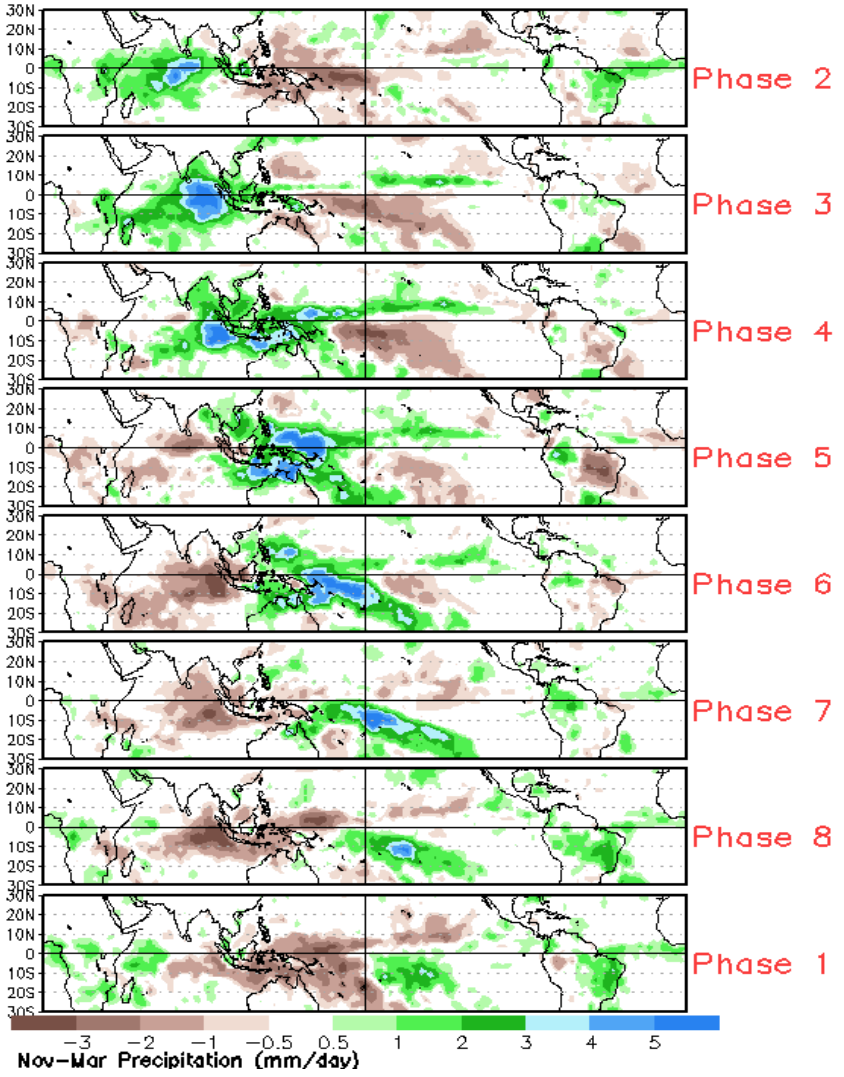
- The constructed analog forecast is very similar to the GEFS with slightly stronger anomalies.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



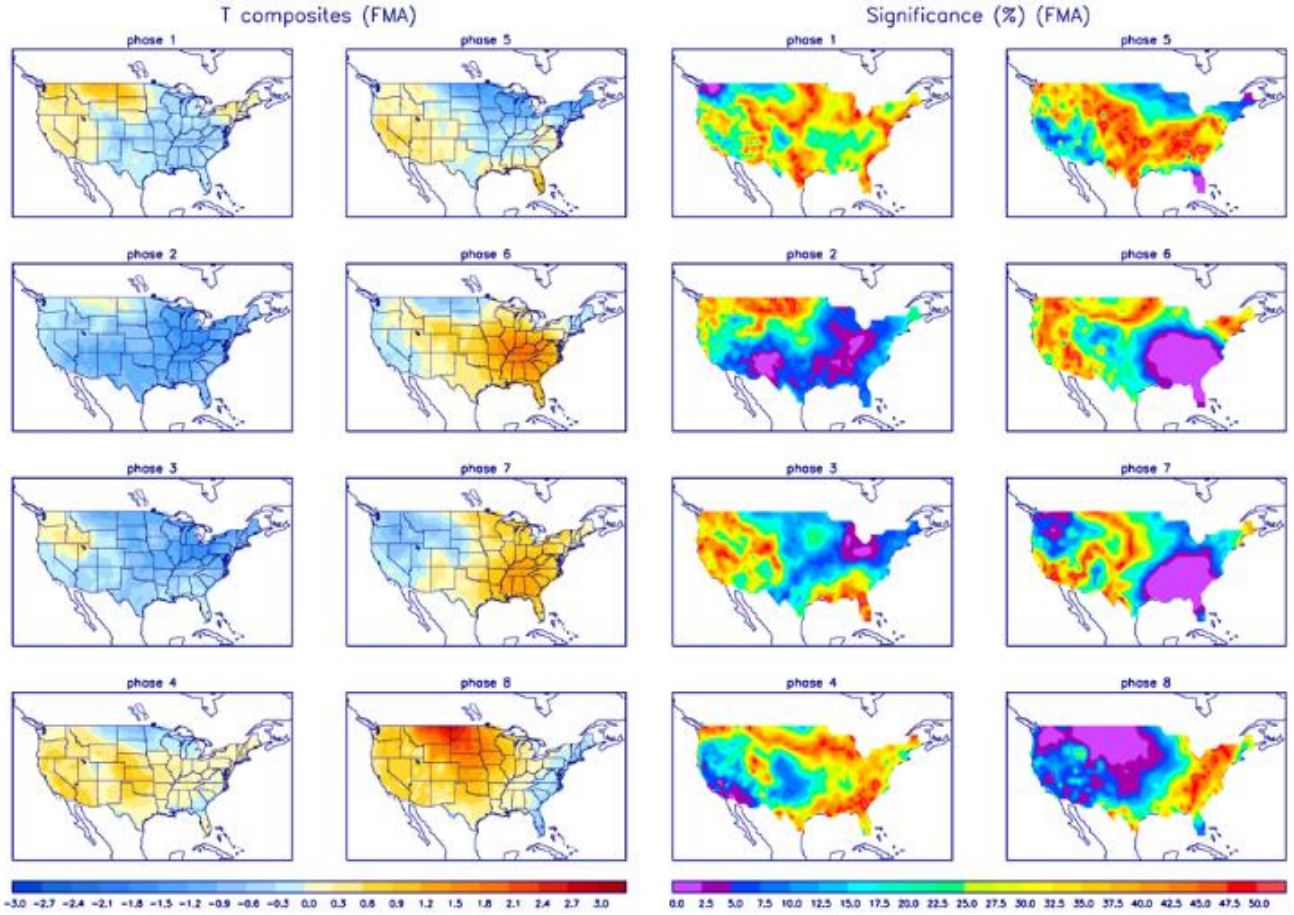
Precipitation Anomalies



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.

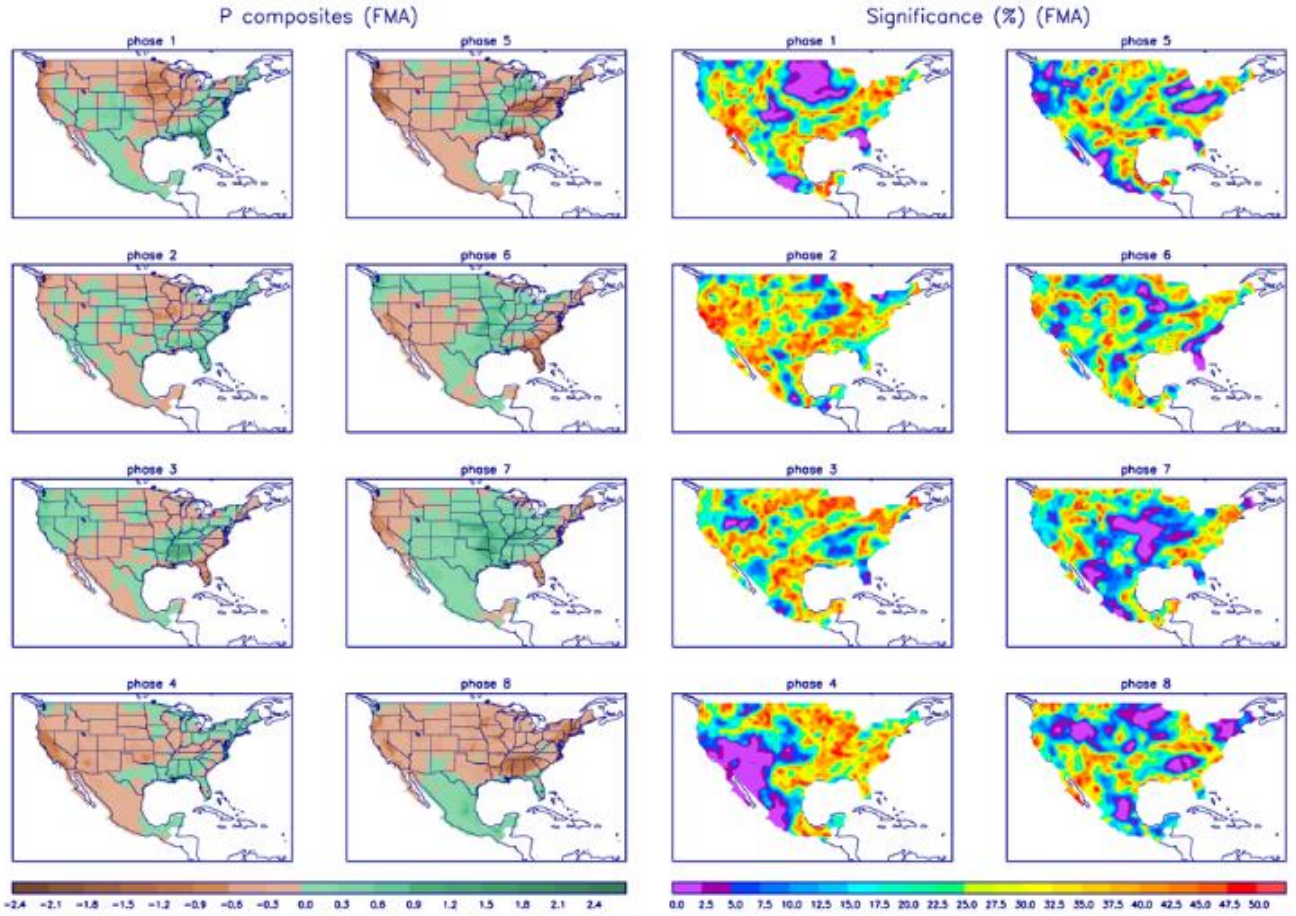


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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