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

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

Overview

- RMM index observations continue to show coherent MJO activity since the beginning of 2025, with the enhanced phase propagating across the Western Pacific and entering the Western Hemisphere during the past week.

- With a strong equatorial Rossby wave favored over the equatorial Pacific, dynamical model RMM forecasts favor a slowed and erratic evolution of the MJO signal during the next week or so. Beyond this time however, forecasts depict a more canonical eastward propagation of the MJO that reaches the Indian Ocean towards the beginning of March.

- Based on both subseasonal and interannual modes favored, the large-scale environment is expected to become increasingly favorable for tropical cyclone (TC) development over the Indian Ocean, with decreasing chances for genesis over the South Pacific.

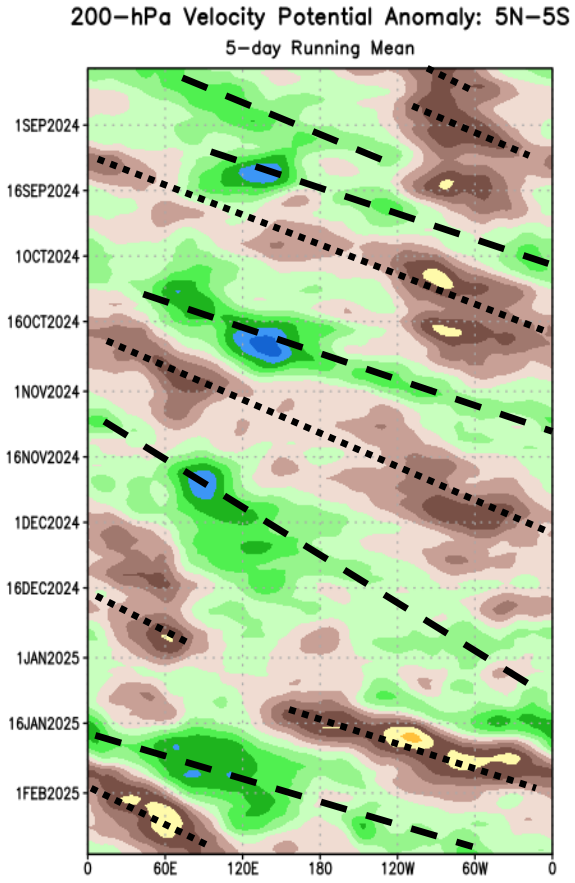
- Should the MJO remain coherent over the Indian Ocean, a potential late winter extratropical response features a retrograding longwave trough over North America, signaling the return of warmer temperatures over the eastern U.S. with more enhanced onshore flow over western North America.

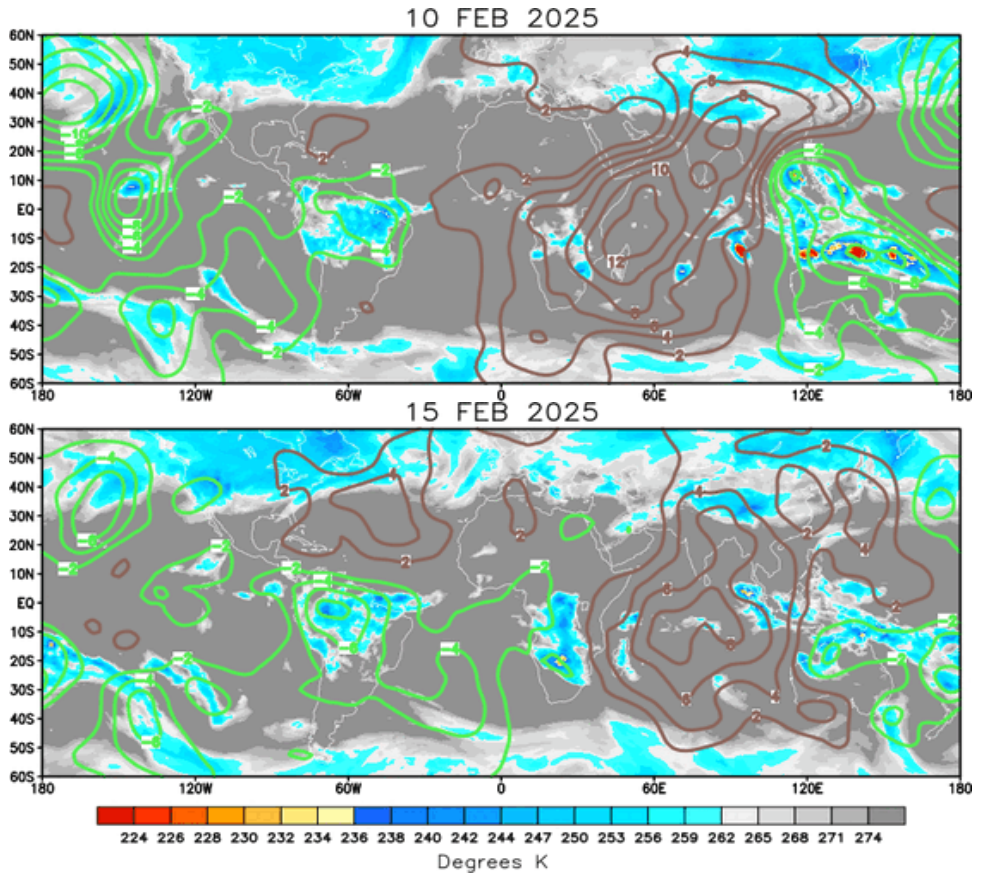
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

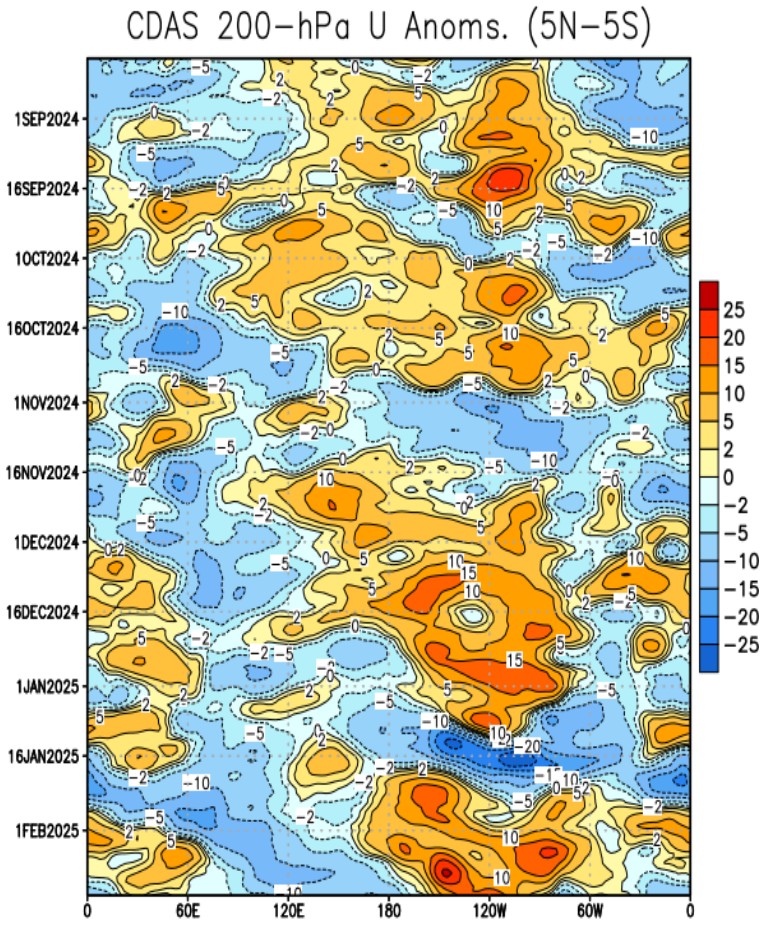


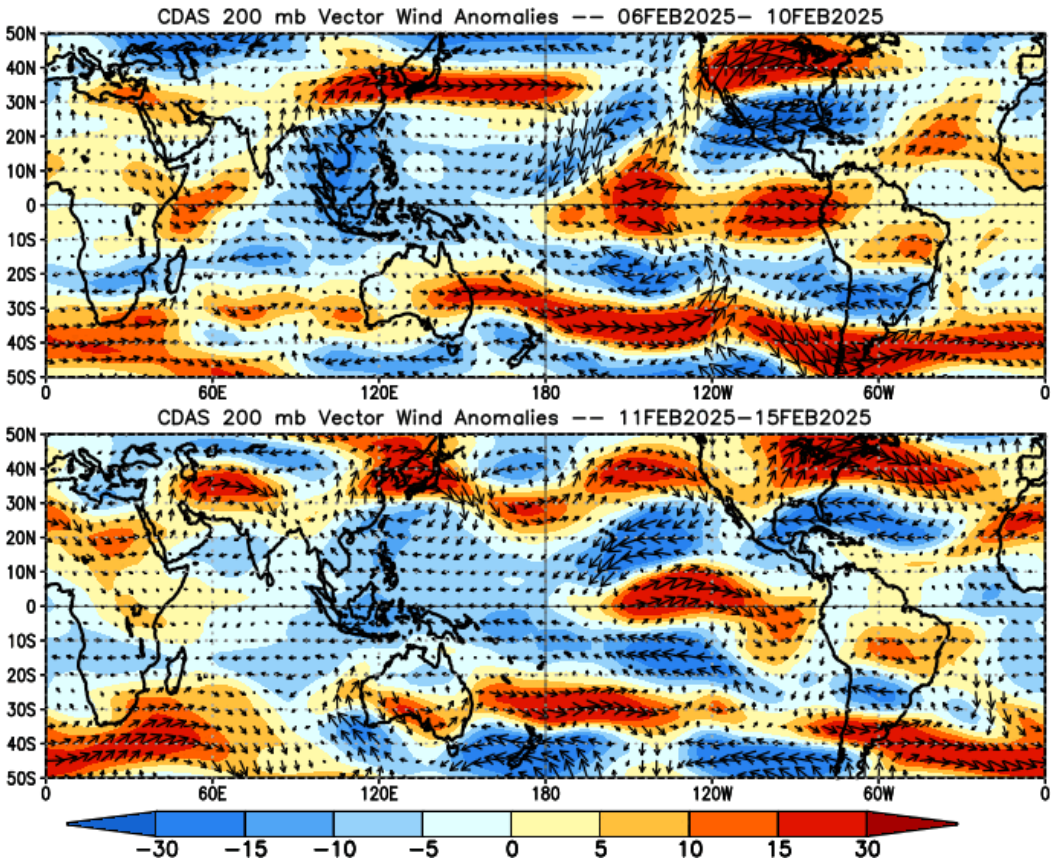


- The time/longitude plot indicates continued eastward propagation of subseasonal activity, with a robust increase in suppressed convergence over the western Indian Ocean which is likely tied to constructive interference with a low frequency footprint over this part of the basin.
- The leading edge of the enhanced divergence envelope appears to have again crossed the Prime Meridian, though its structure north the equator has become more incoherent.

200-hPa Wind Anomalies

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

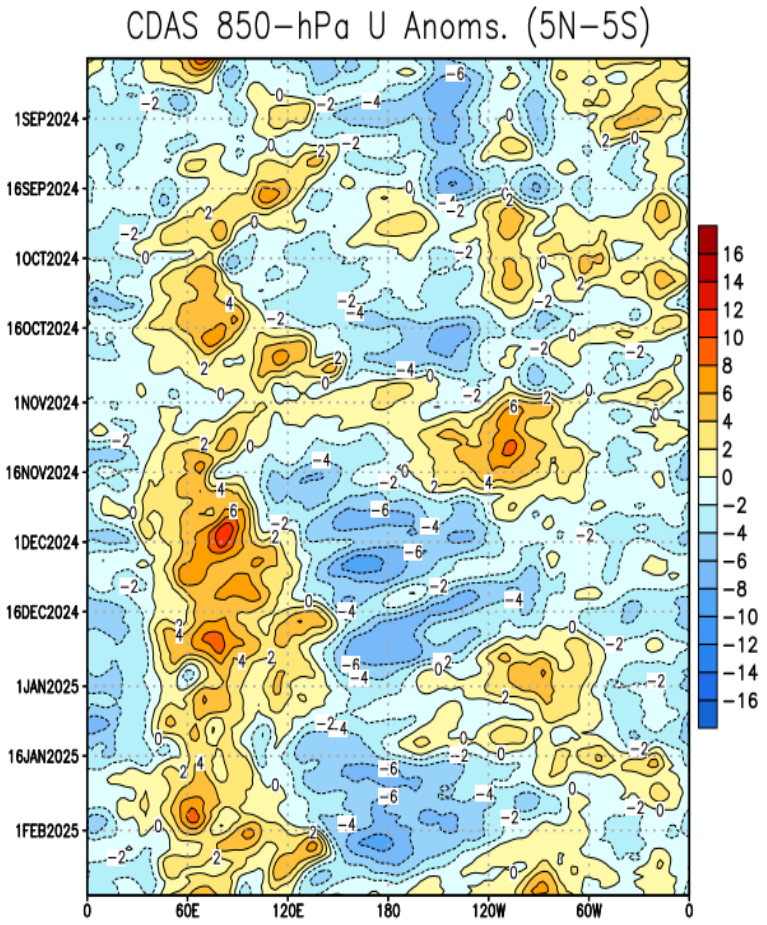


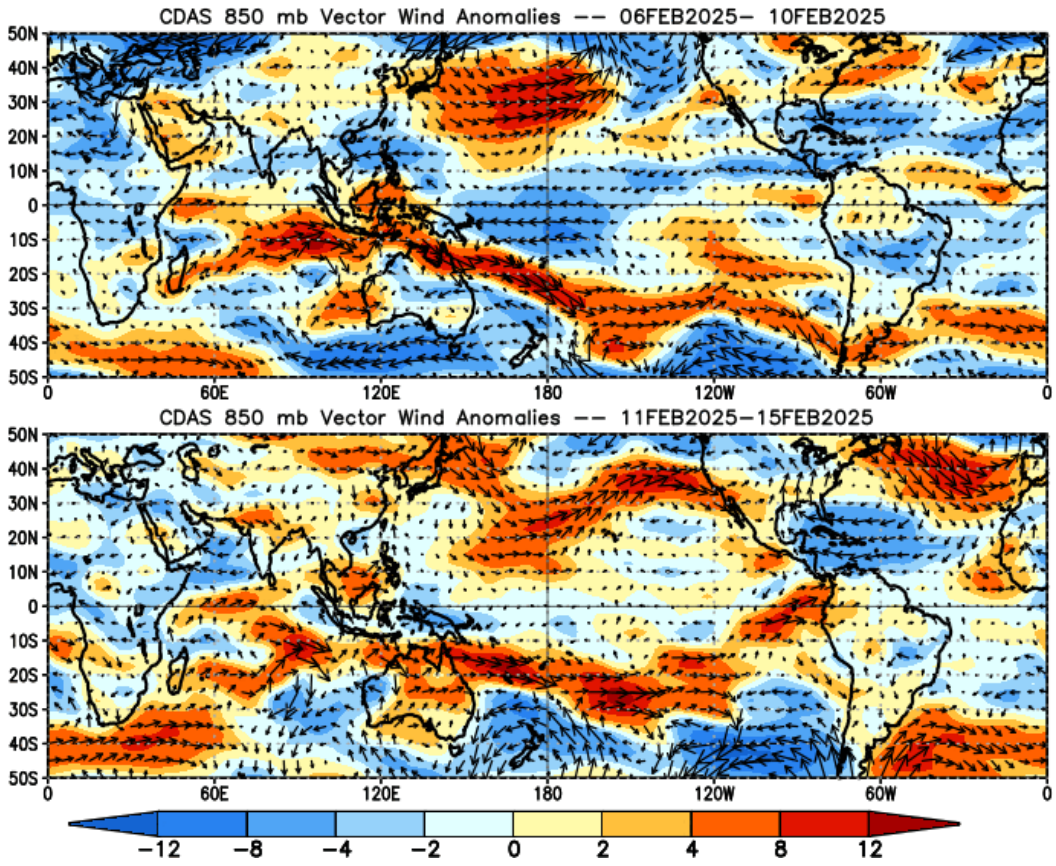


- The easterly phase of the MJO reached the Date Line, while continuing to weaken the upper-level westerlies associated with the ongoing La Nina over the eastern Pacific.
- An anomalous anticyclonic circulation aloft remains a predominant feature over the CONUS, and has shifted eastward to bring warmer conditions over the eastern U.S. towards the middle of February.

850-hPa Wind Anomalies

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

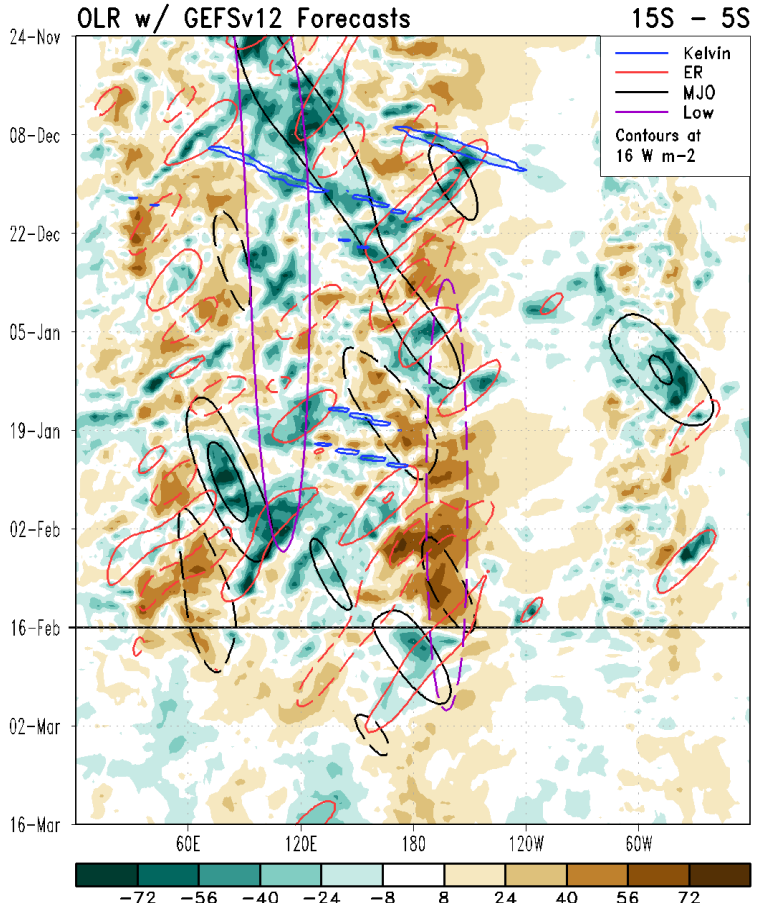


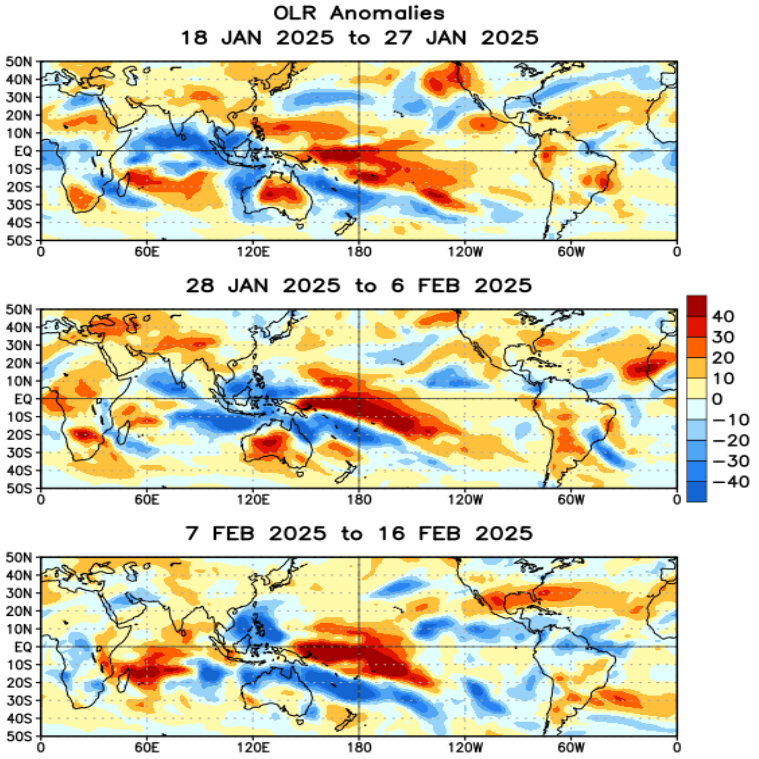


- Tied to La Nina, the enhanced trade regime appeared to have relaxed on two fronts, one associated with encroaching the westerly MJO phase over the Maritime Continent, and the other likely associated with equatorial Rossby wave activity injecting more westerlies into the central Pacific.
- Strong lower-level westerlies persist mainly south of the equator in the Indian Ocean and South Pacific, and likely contributed to the development of multiple tropical cyclones since early February.

Outgoing Longwave Radiation (OLR) Anomalies

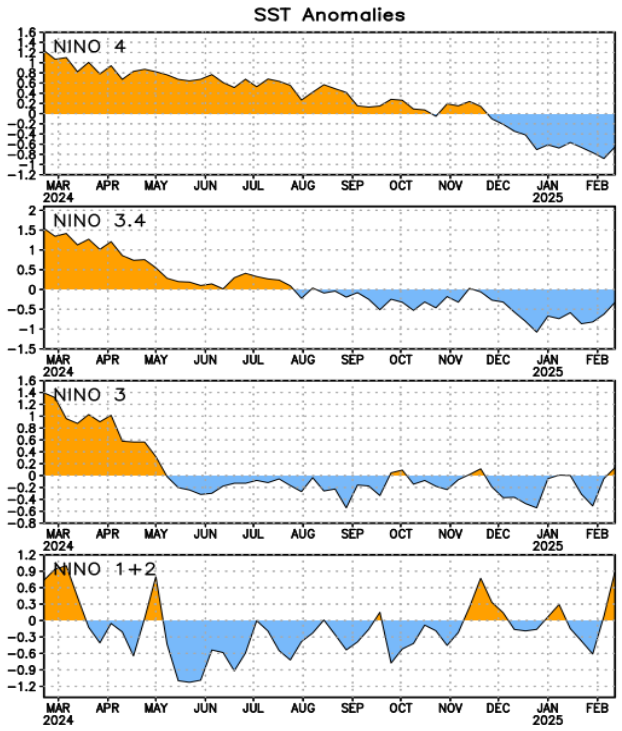
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

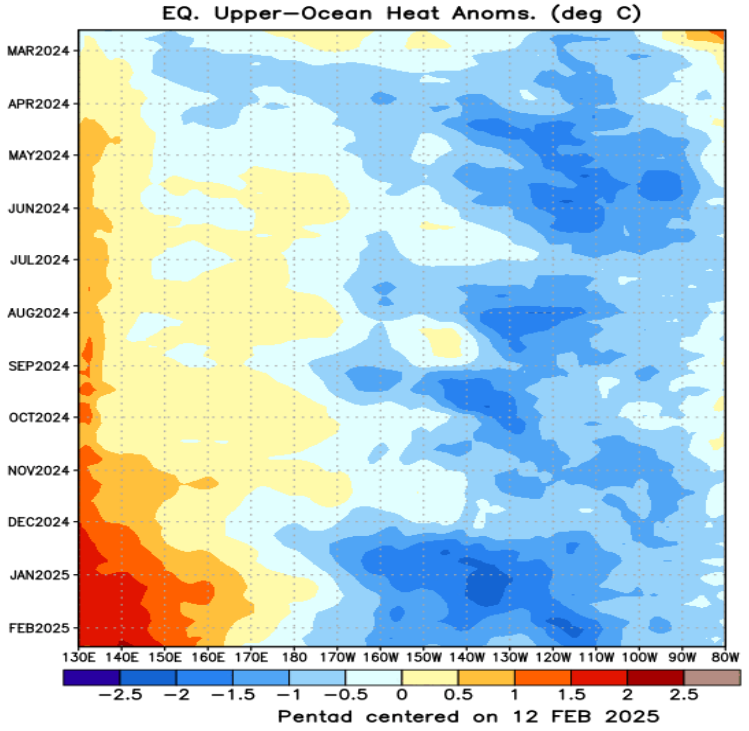




- OLR filtering clearly shows the enhanced convective MJO envelop crossing the western Pacific where it is destructively interfering with the suppressed convective footprint along the Date Line. Spatially, the MJO appears to be expressing itself off the equator in the central and eastern Pacific.
- OLR forecasts from the GEFS favor the return of suppressed convection over the western and central Pacific by the beginning of March

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

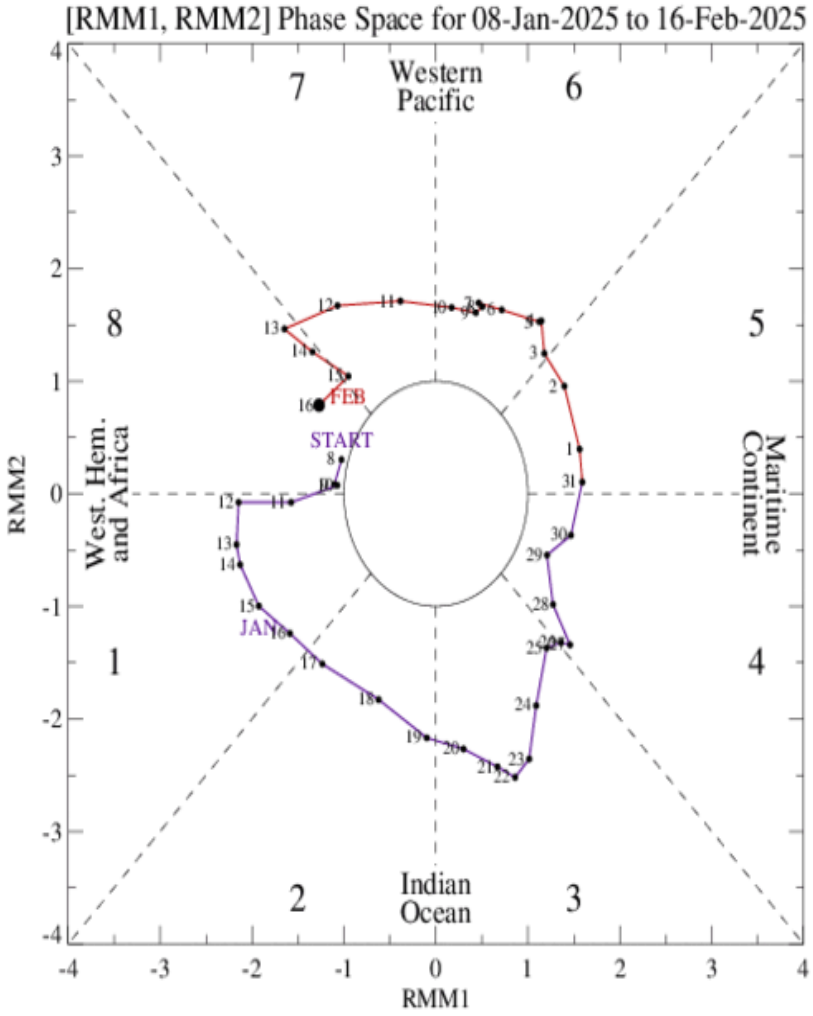




- The recent trade wind surge across the central Pacific resulted in a downtick in the Nino 4 region, though a more pronounced warming trend is observed in since late January.
- Positive subsurface heat content anomalies have increased west of the Date Line, with negative subsurface heat content anomalies showing more of a westward expansion in the equatorial Pacific in February.

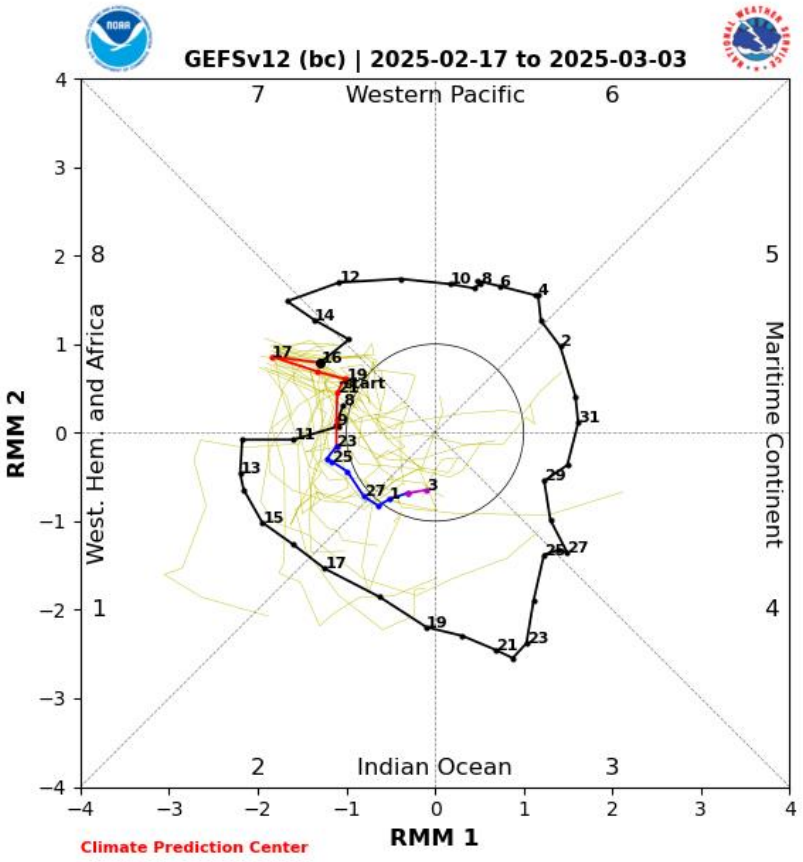
MJO Index: Recent Evolution

- The RMM index depicts coherent MJO activity, with the signal consistently remaining outside the unit circle and nearly completing a full global circumnavigation since early January.
- More recently however, RMM observations show a loss of amplitude while retreating back into phase 7

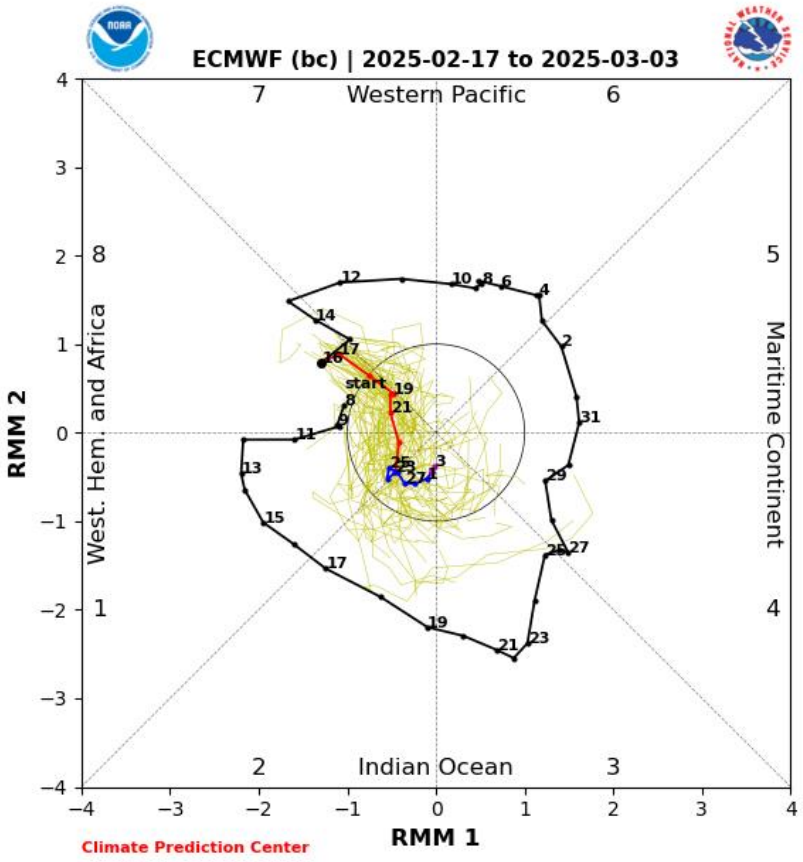


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

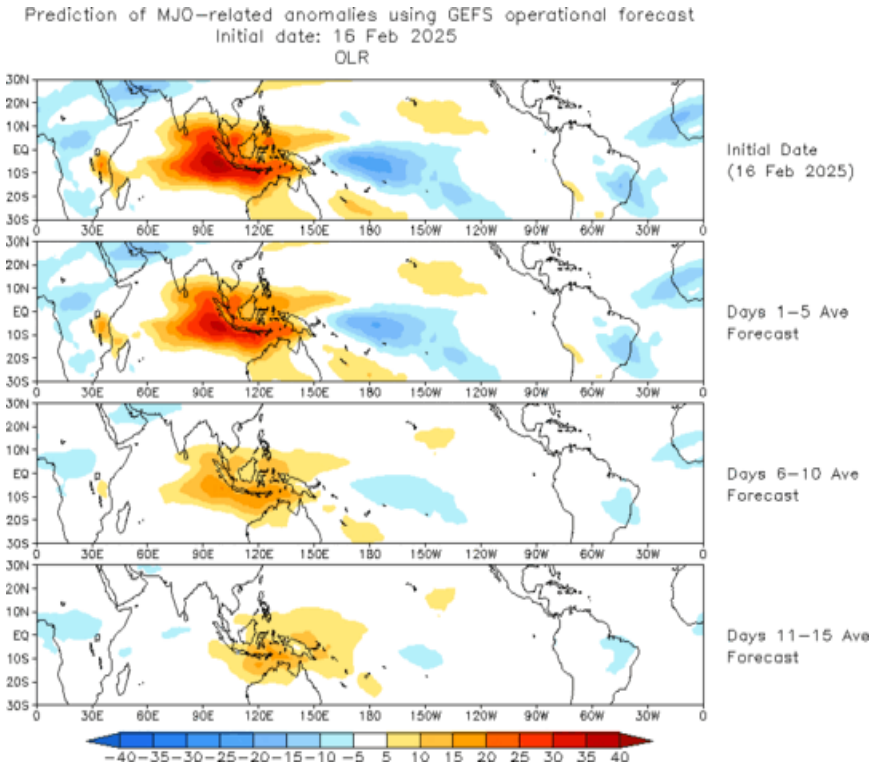


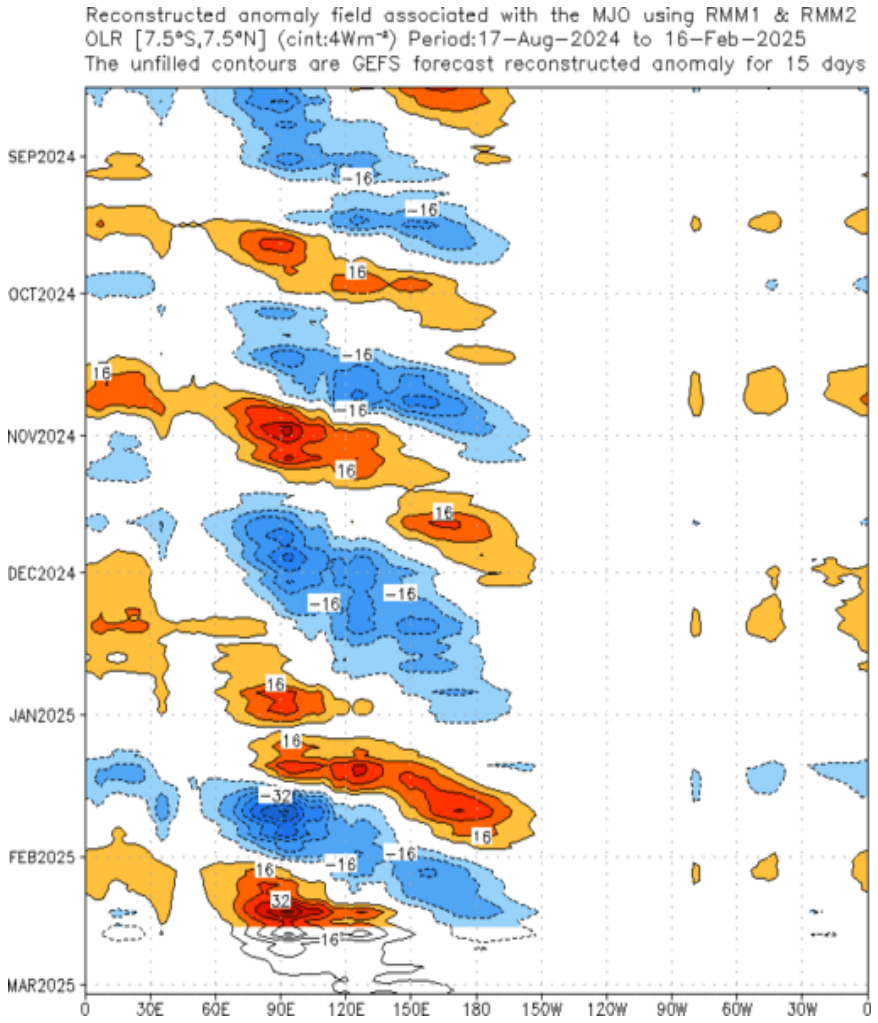
ECMWF Forecast

- Both the GEFS and ECMWF ensembles show an erratic evolution likely tied to Rossby wave activity during the next week or so, followed by the resumption of a more canonical eastward propagating signal later in February.
- Model solutions are split on the strength of the MJO as it returns to the Indian Ocean, with non bias corrected solutions favoring a stronger subseasonal outlook.

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.)

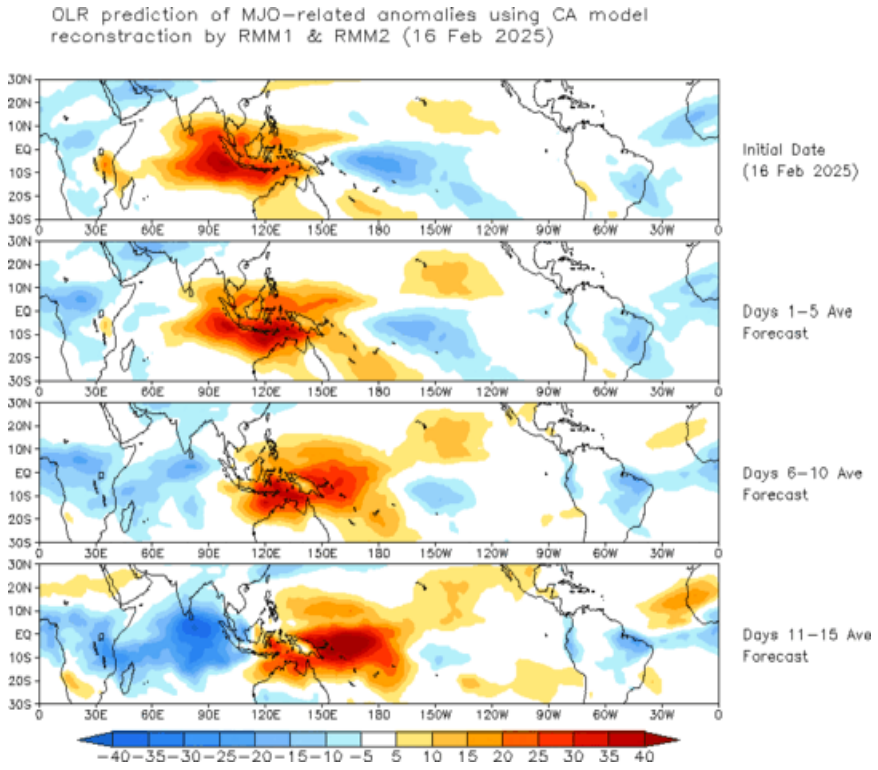


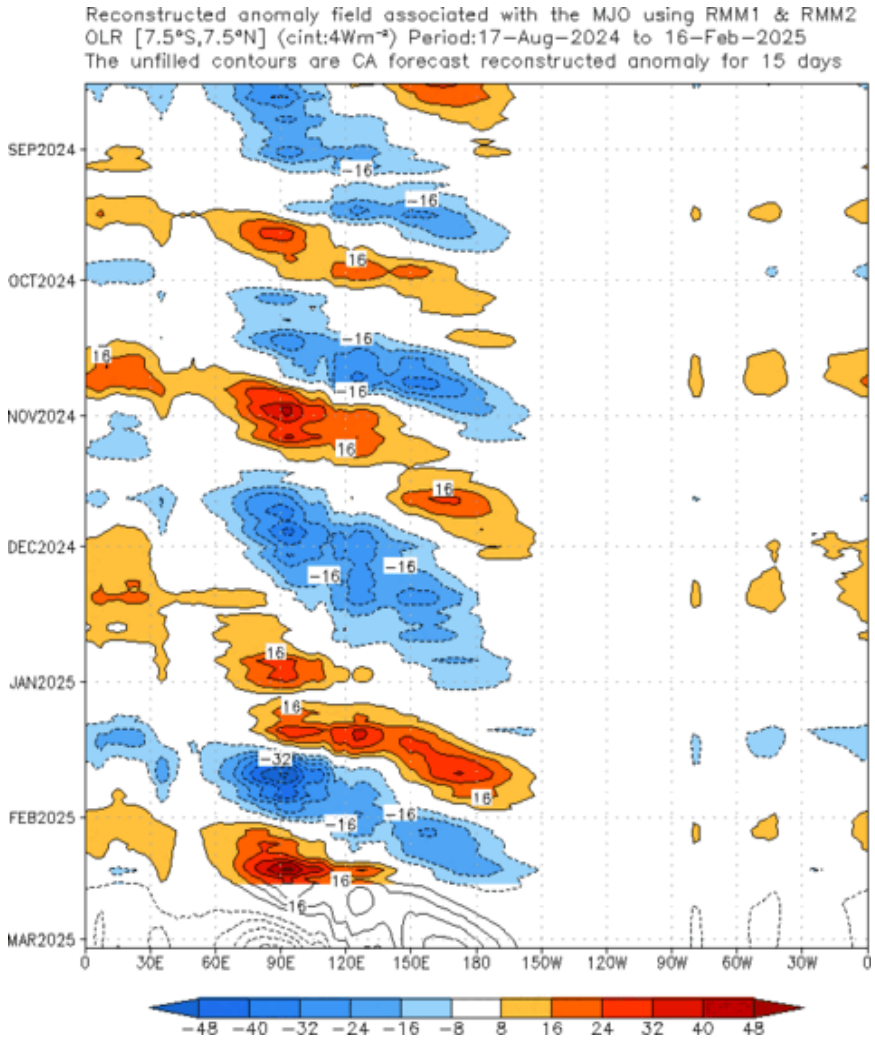


- The GEFS OLR forecast depicts a slowed convective dipole that weakens with time.

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.)

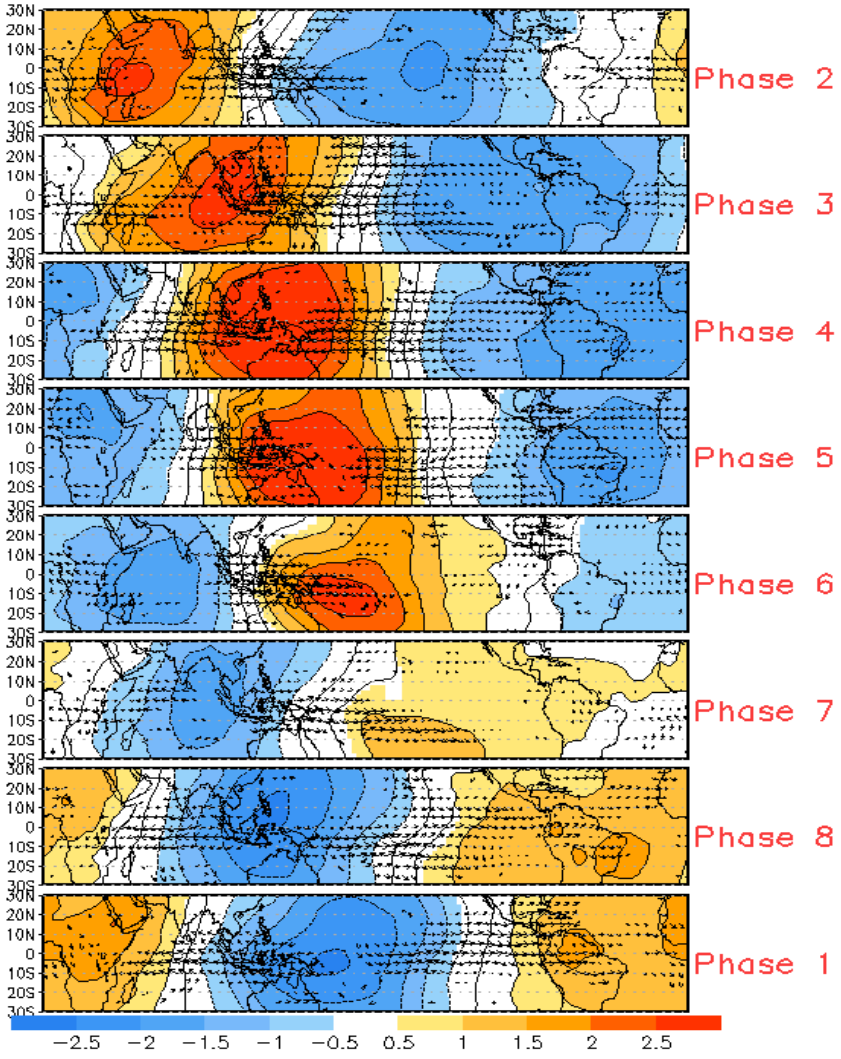




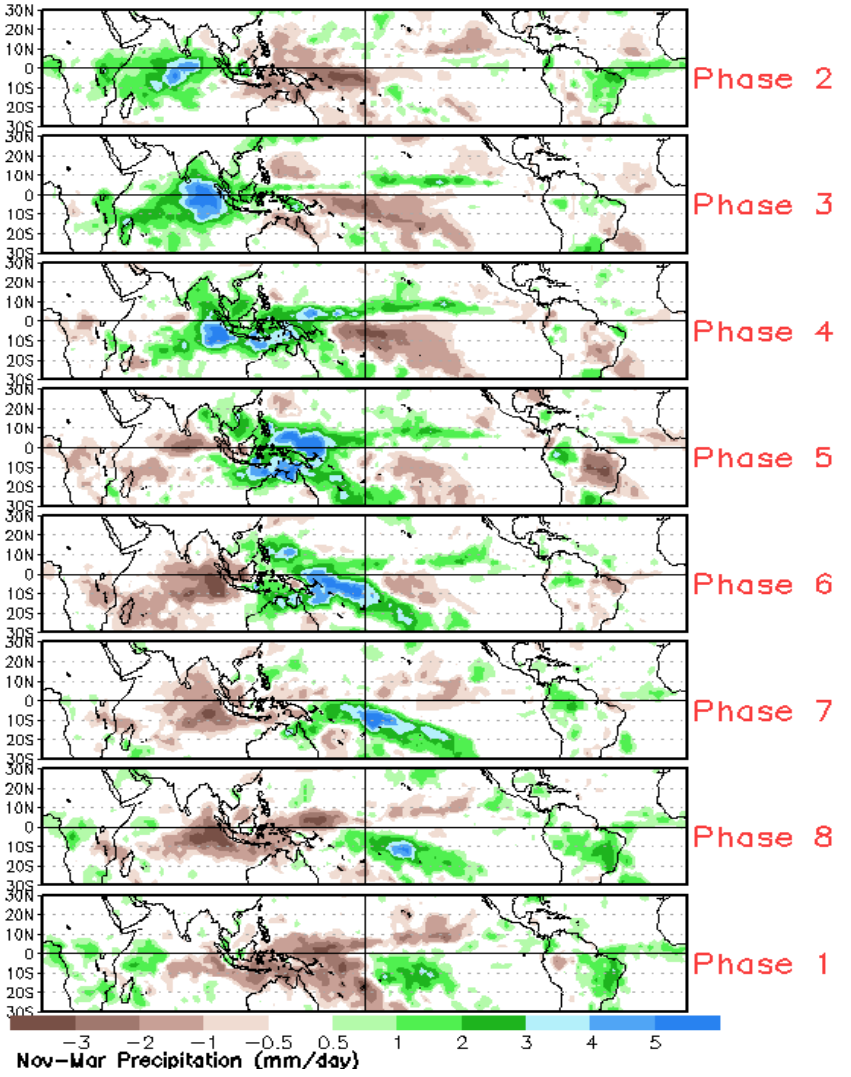
- Contrast to the GEFS, the constructed analog forecast comparably more progressive and more robust with the convective anomalies across the global tropics.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



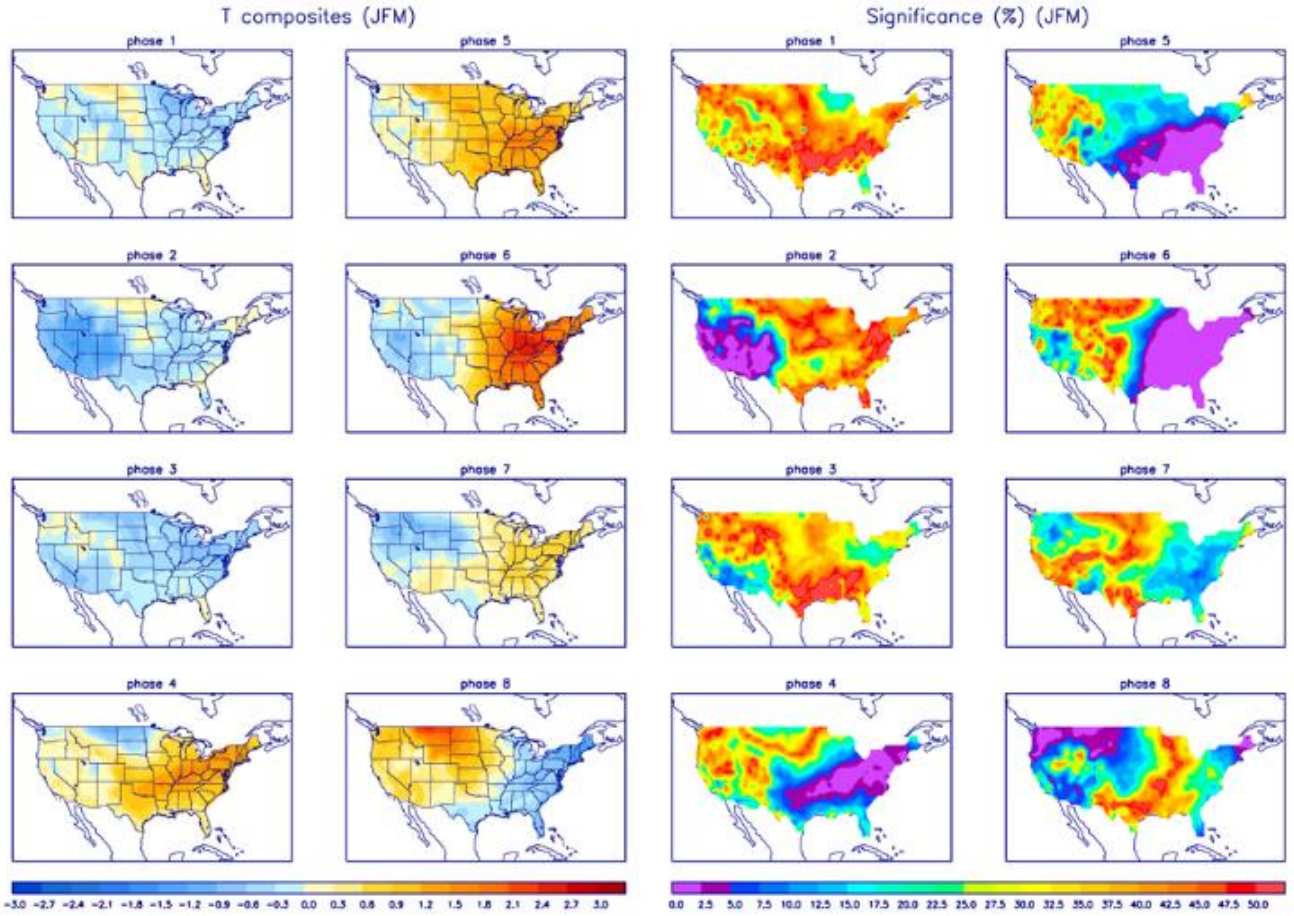
Precipitation Anomalies



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.

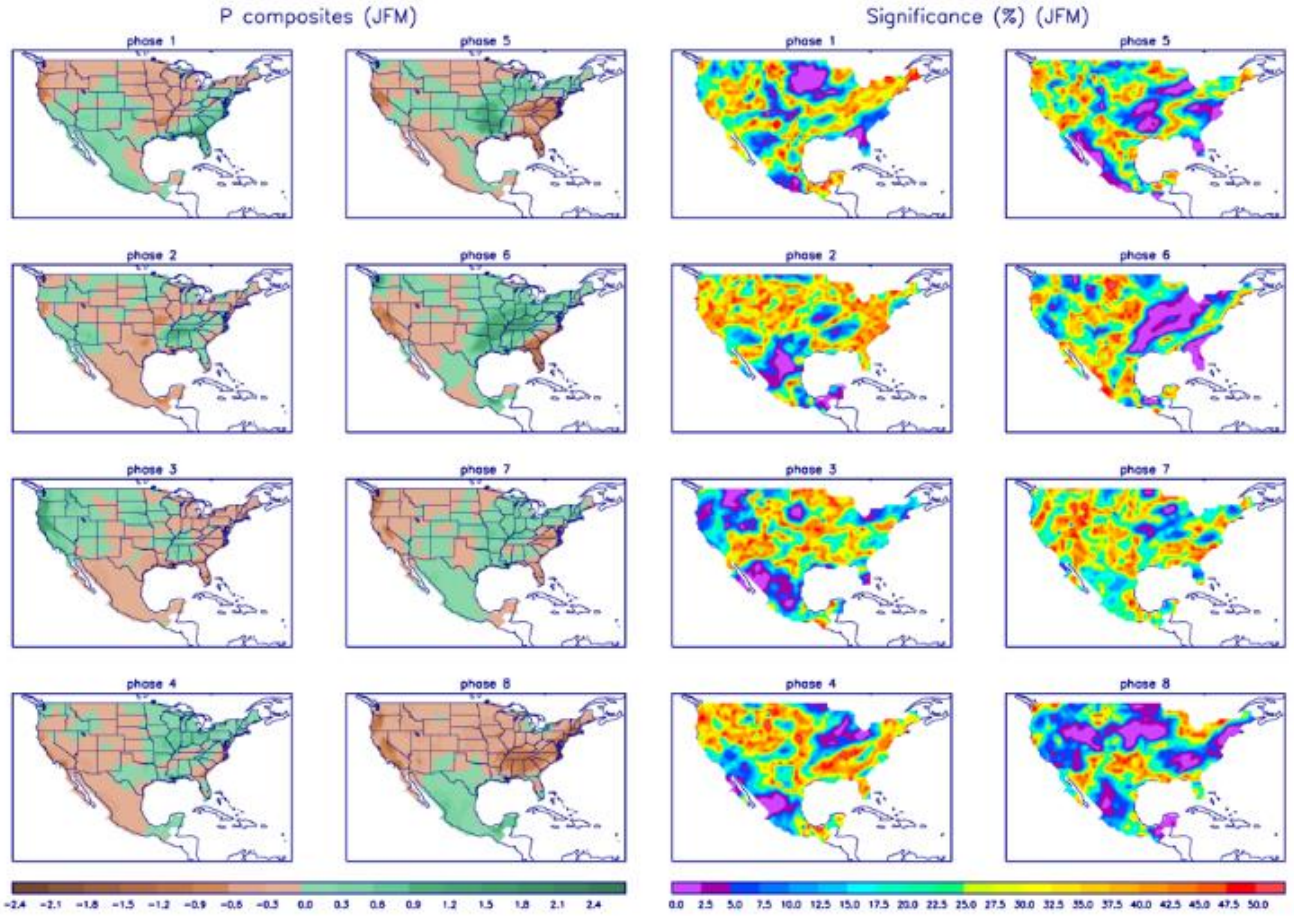


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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