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

Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
6 January 2025

Overview

- Following an active MJO propagation, the intraseasonal signal has weakened back into the RMM-based unit circle as it moved through the Western Hemisphere.

- This weakening is forecast to be temporary as dynamical models indicate a resurgence of the MJO over the Indian Ocean as it constructively interferes with the low frequency convective signal over the region that is tied to the emerging La Niña.

- The predicted strengthening of the enhanced convective envelope across the Indian Ocean favors increased chances for tropical cyclone development across the climatologically active areas of the southern Indian Ocean and spreading to the north of Australia.

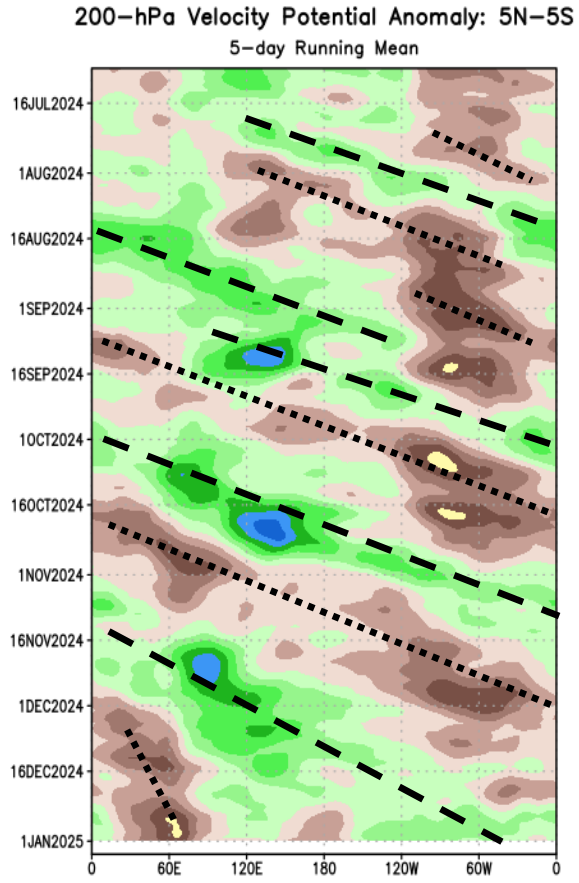
- While below-normal temperatures are forecast across much of the central and eastern U.S. in the near-term, the strengthening MJO across the Indian Ocean historically favors a warm extratropical response over the U.S., and a pattern reversal toward warmer temperatures could begin toward the end of the month or in early February.

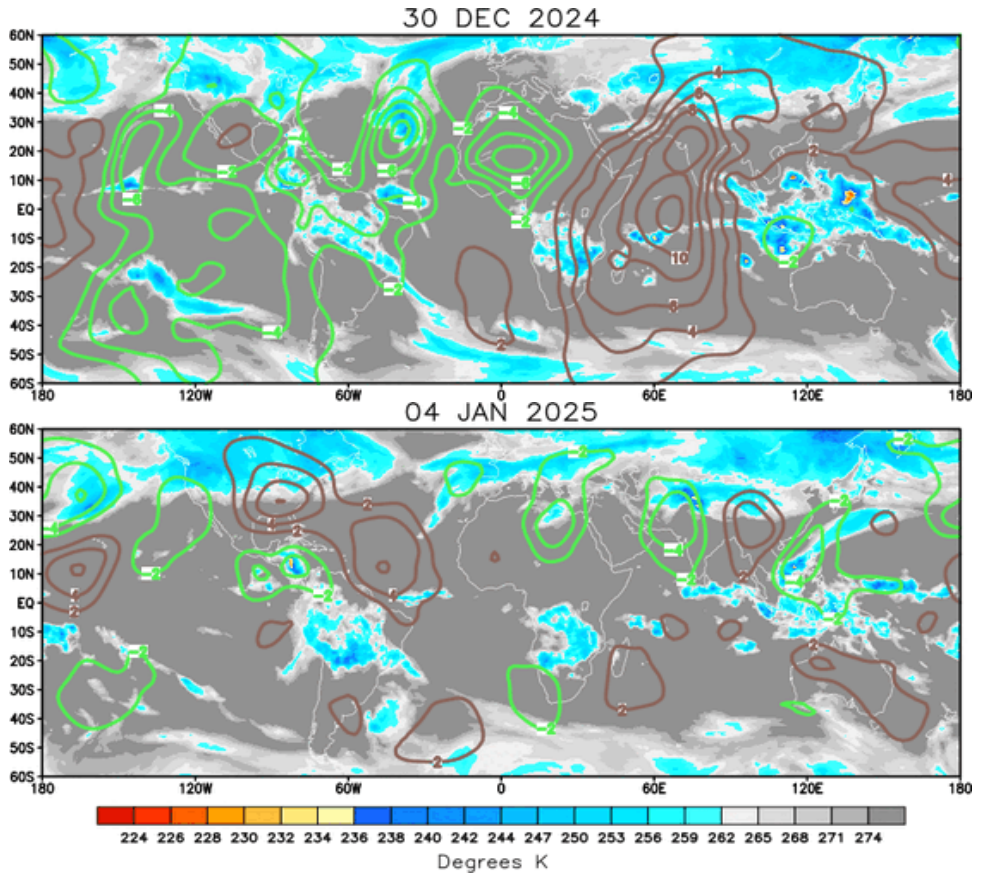
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

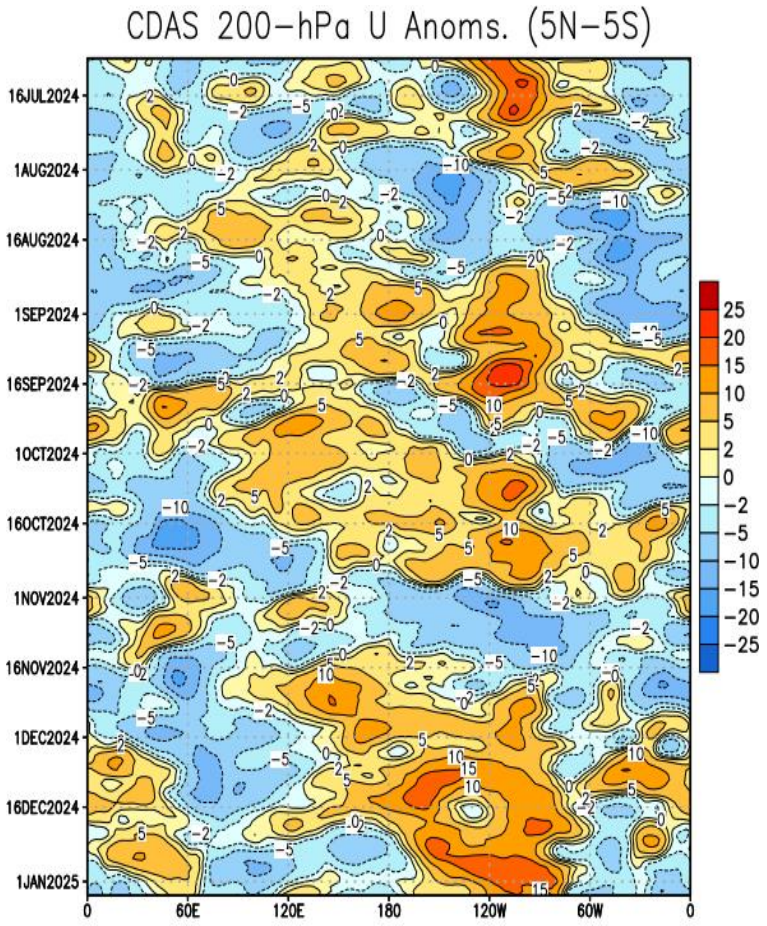


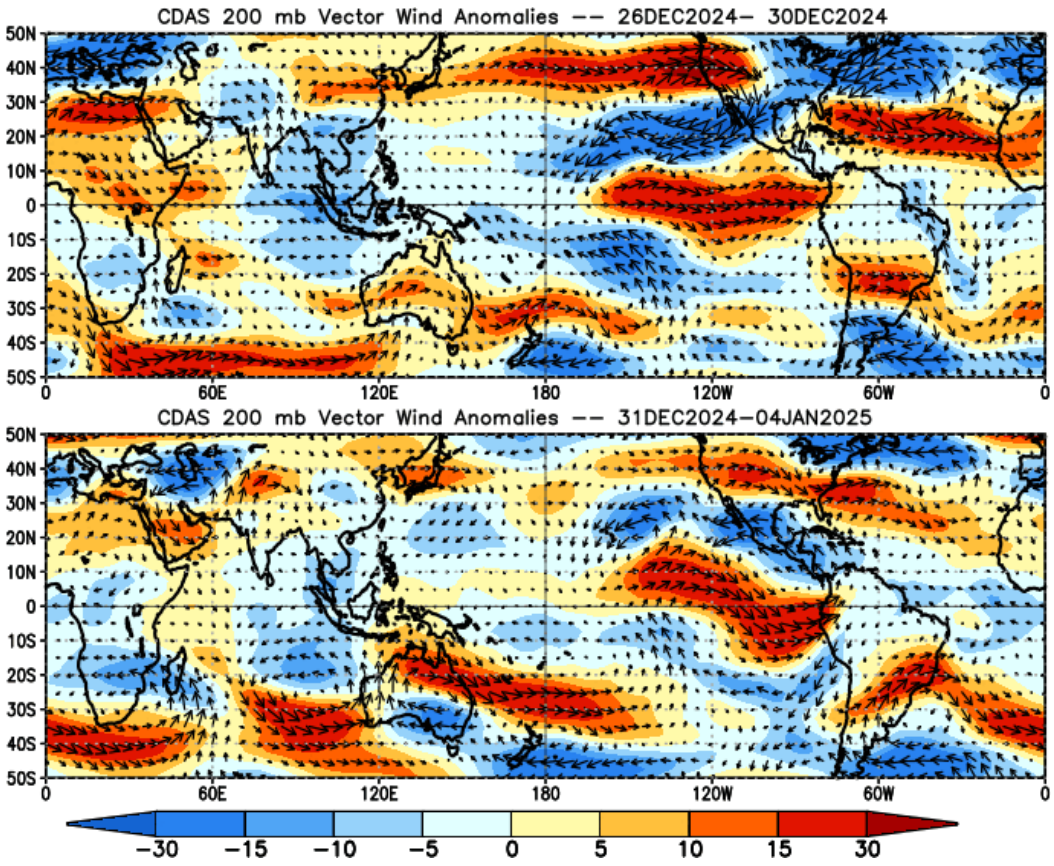


- During the past week, the global upper-level velocity potential field has become more disorganized, consistent with a weakening of the MJO over the Western Hemisphere.
- The time-lon plot indicates some evidence of a low frequency suppressed convective signal across the western Indian Ocean, and while this is still observed to some degree in the spatial field, it has weakened since late December due to increasing destructive interference from the MJO upstream.

200-hPa Wind Anomalies

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

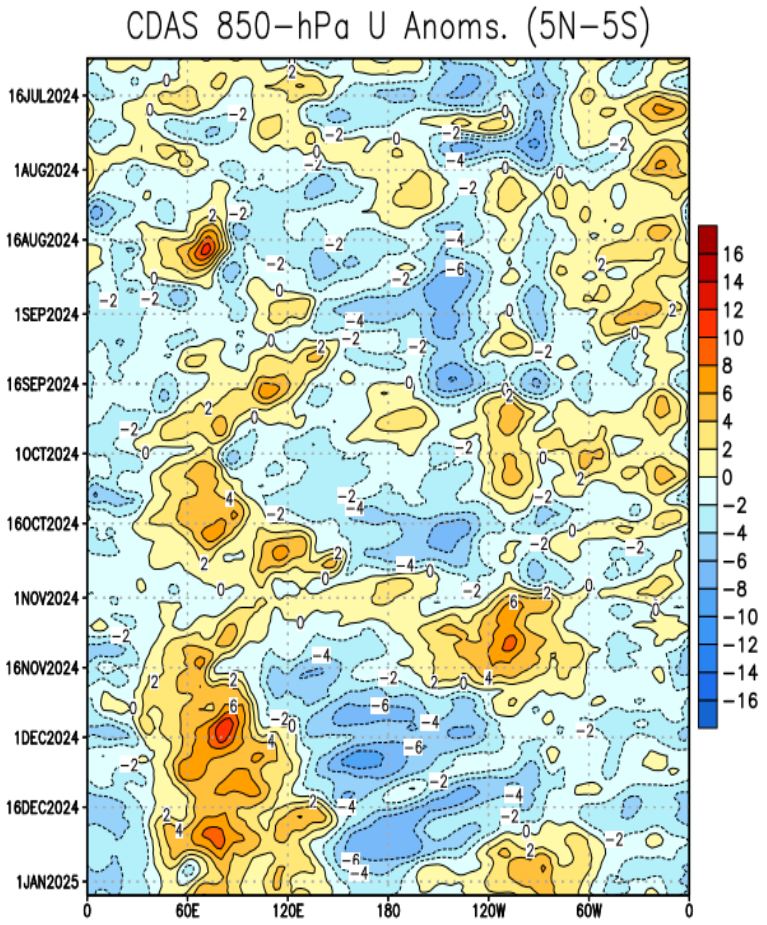


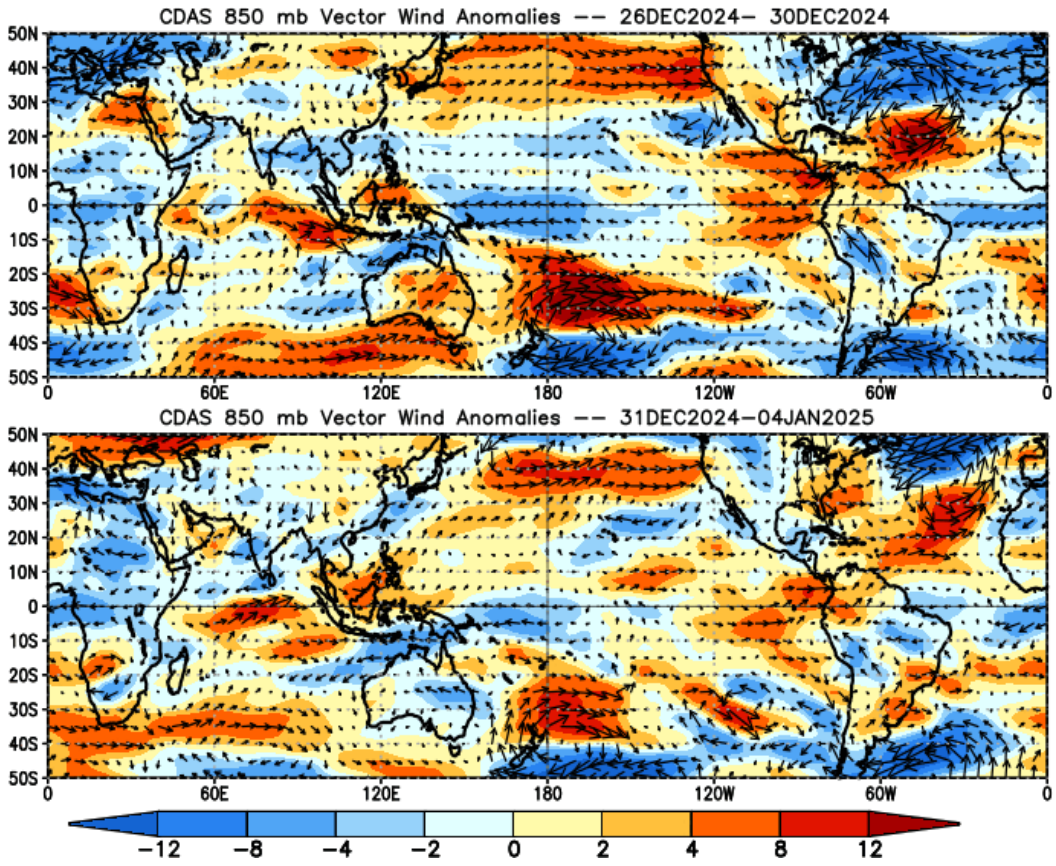


- Anomalous upper-level easterlies (westerlies) are noted over the eastern (western) Indian Ocean, owing to enhanced convergence aloft and the suppressed convective pattern seen over the region.
- Enhanced upper-level westerlies are apparent over the continental U.S., indicating a southward shift of the jet stream and colder air shifting southward.

850-hPa Wind Anomalies

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

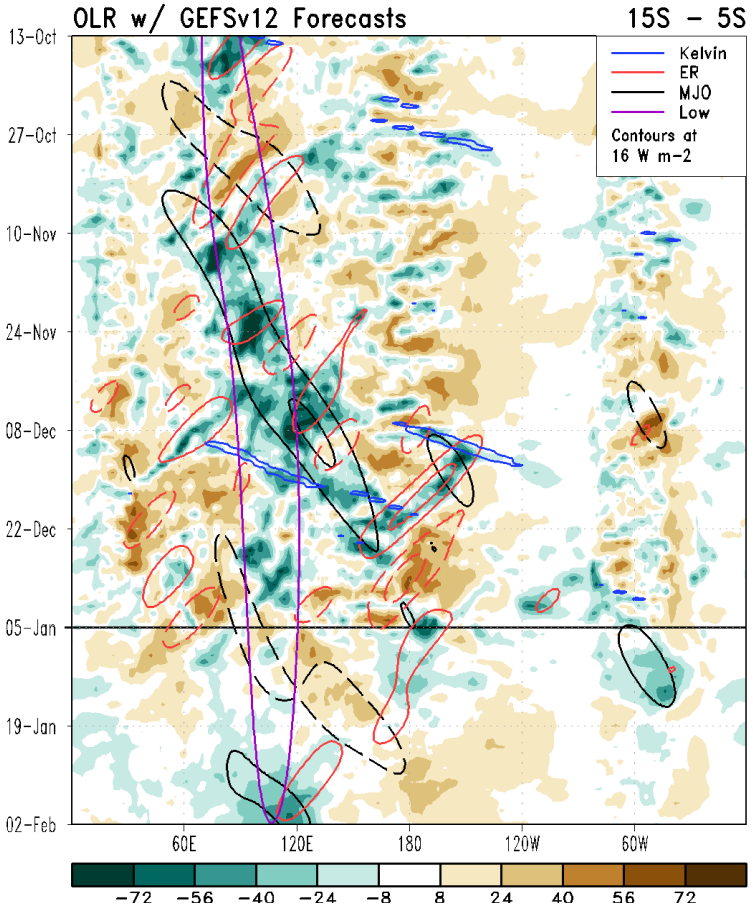


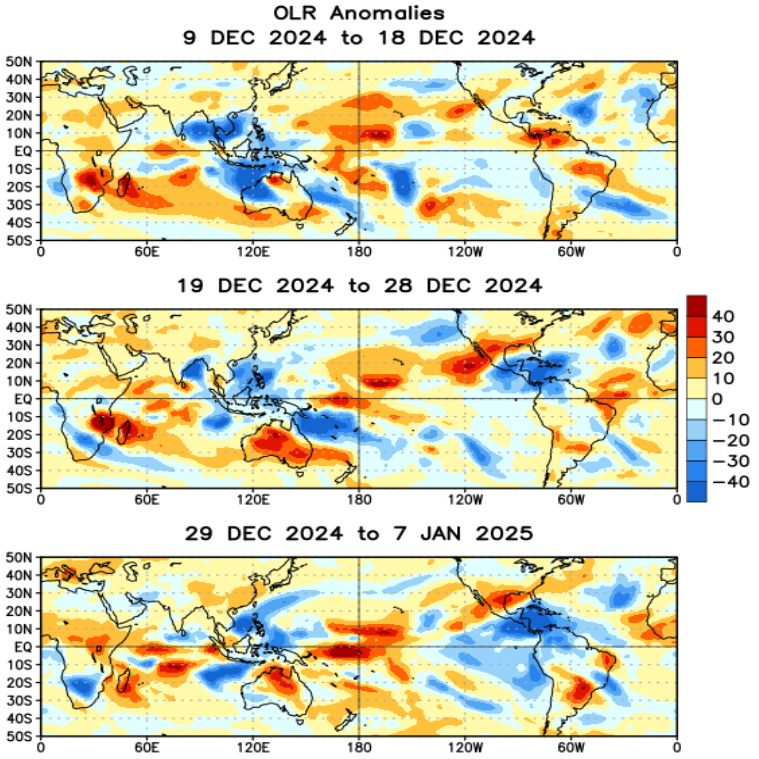


- Low-level westerlies persist across much of the equatorial Indian Ocean.
- Enhanced trades over the central Pacific are beginning to weaken.
- The low-level flow pattern reversed across the eastern CONUS with a strong southerly (northerly) component in late December (early January).

Outgoing Longwave Radiation (OLR) Anomalies

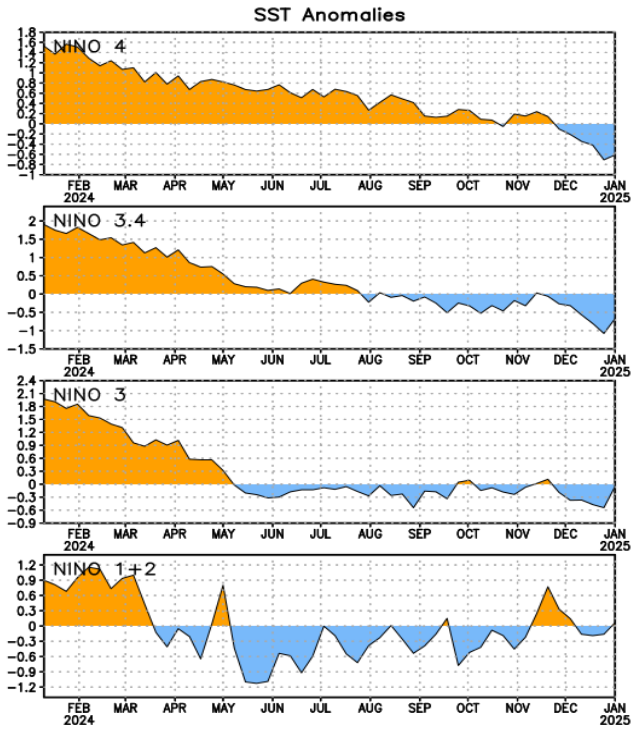
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

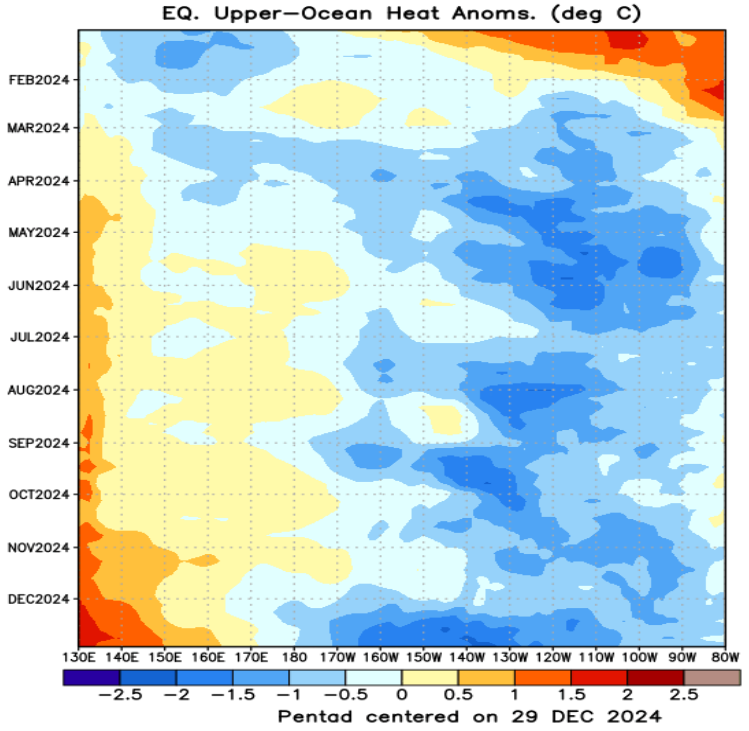




- Enhanced convection has been persistent across the eastern Indian Ocean and Maritime Continent since November, with the MJO and Rossby Wave activity driving the tropical forcing further to the east.
- The time-lon plot depicts the MJO strengthening across the Indian Ocean by late January, and constructively interfering with the low frequency convective signal.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

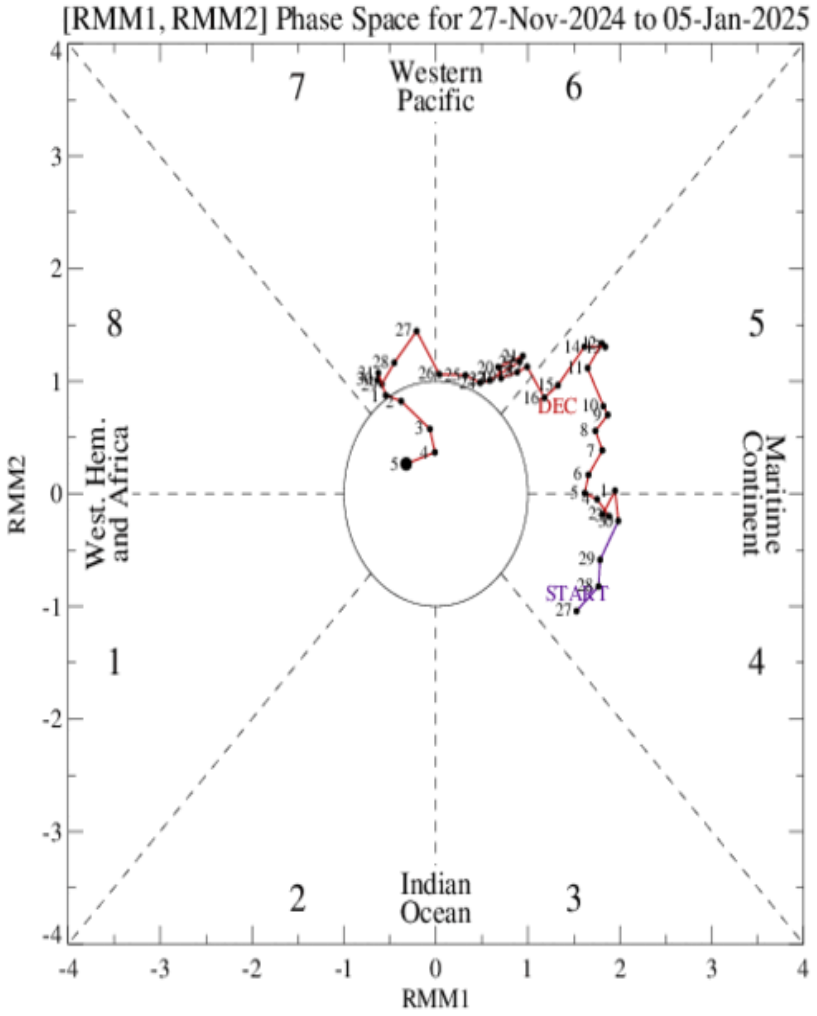




- Enhanced trades and subsequent upwelling during the past month resulted a sharp drop in sea surface temperatures across the Niño 3.4 and Niño 4 regions, with anomalies below -1.0°C over the Niño 3.4 region, supportive of the developing La Niña event.
- Negative subsurface temperature anomalies are established east of the Date Line, with an increase in positive subsurface temperature anomalies over the Western Pacific.

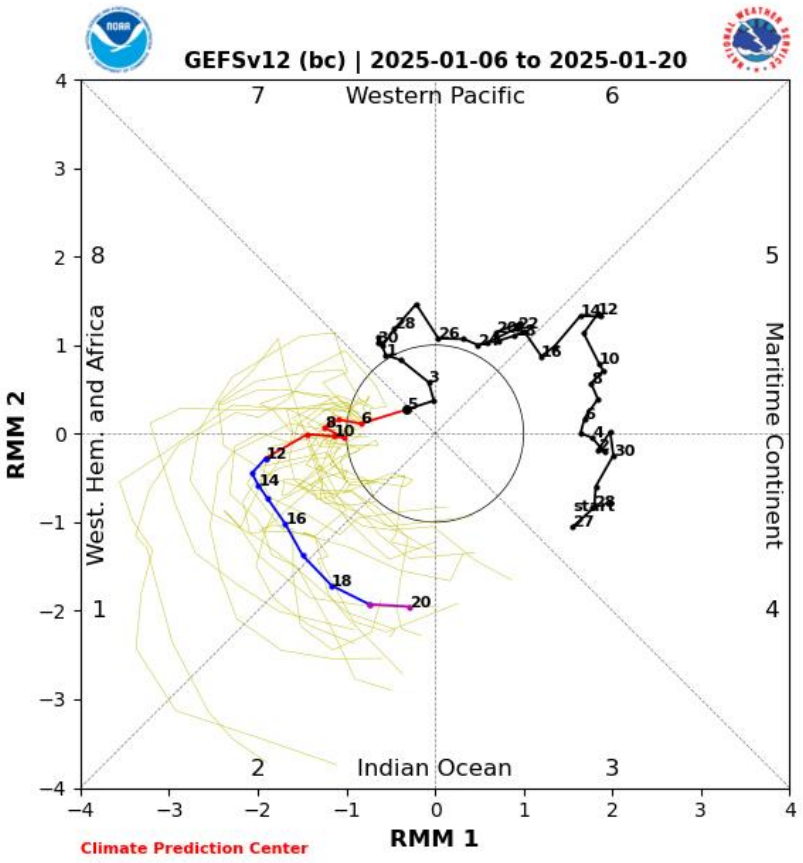
MJO Index: Recent Evolution

- The MJO has slowly propagated into the Western Pacific during the past several weeks, but has weakened back into the unit circle during the past few days.

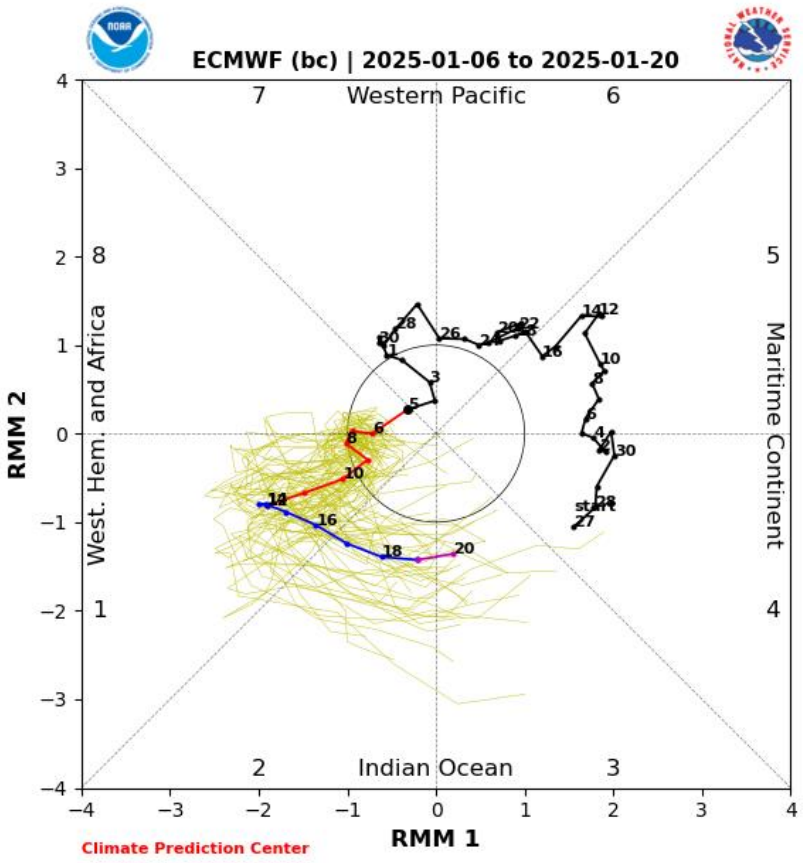


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

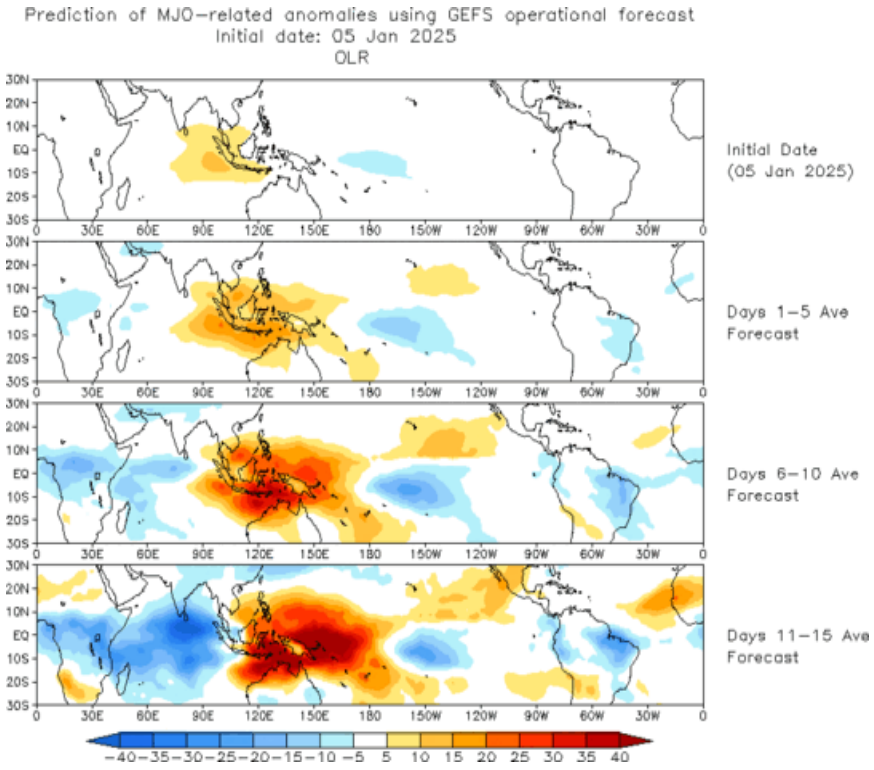


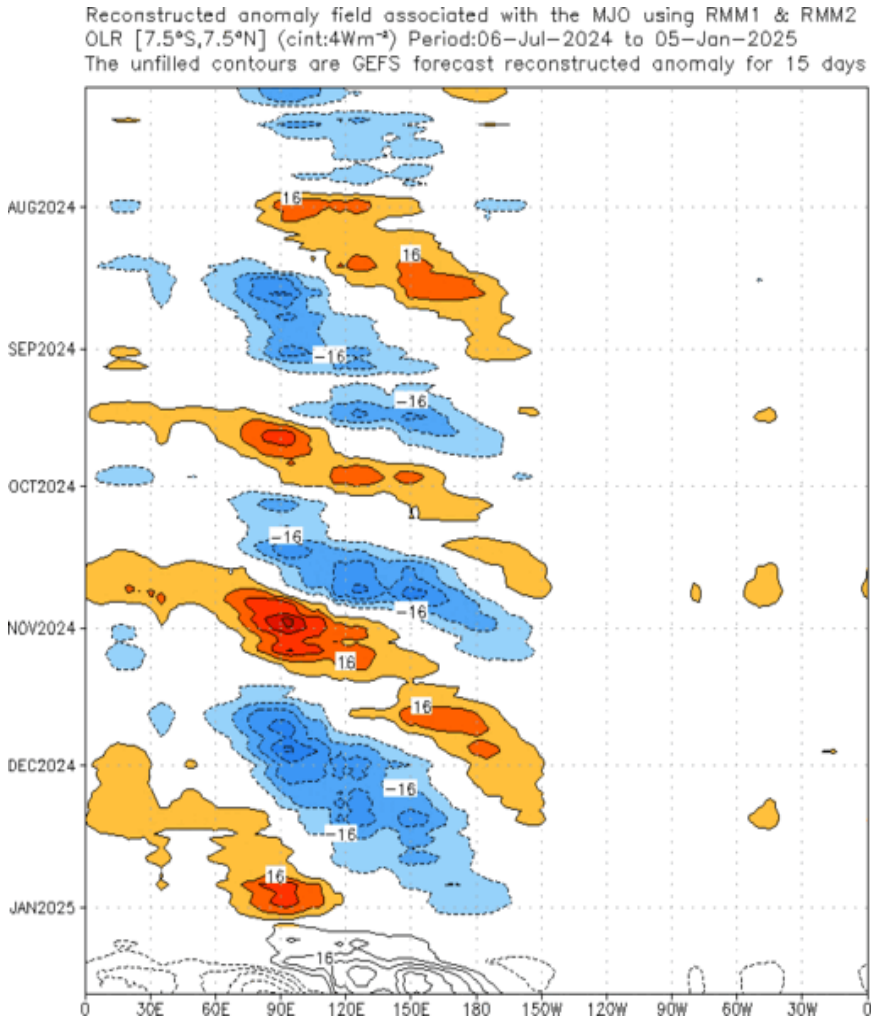
ECMWF Forecast

- Following a brief weakening of the MJO across the Western Hemisphere, the ECMWF and GEFS ensembles depict re-strengthening of the intraseasonal signal across the Africa and the Indian Ocean by the end of week-2.

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.)

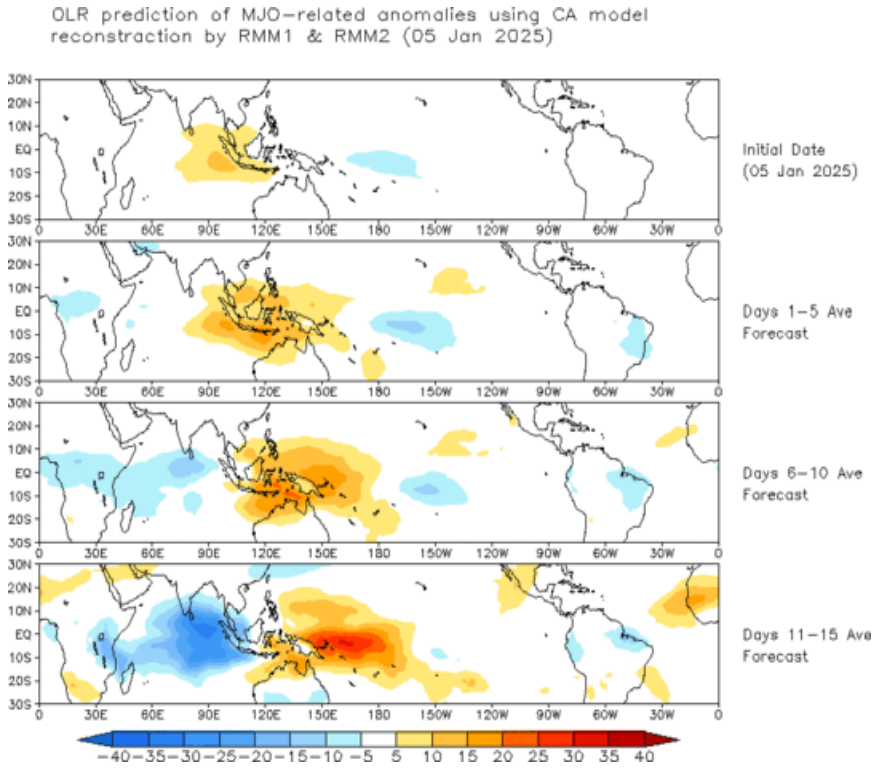


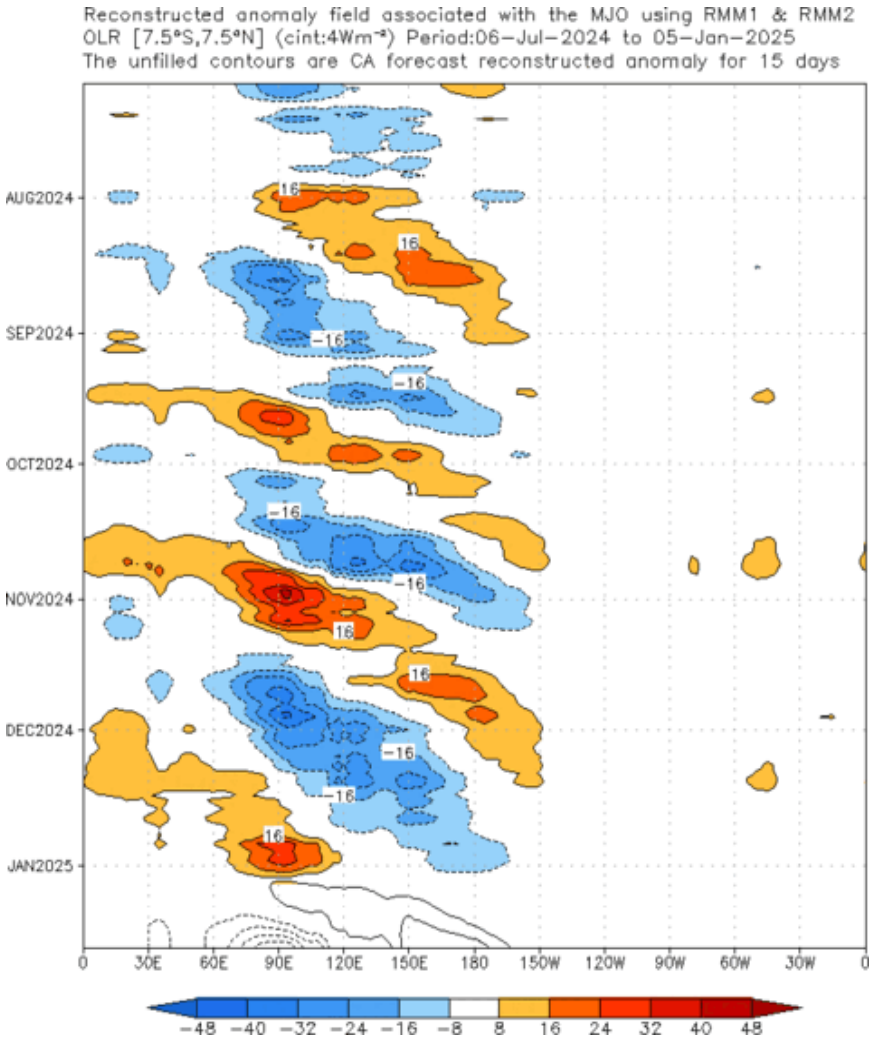


- The GEFS OLR anomaly forecast depicts negative OLR anomalies (enhanced convection) building across the Indian Ocean during week-2.
- Conversely, positive OLR anomalies (suppressed convection) increase across the Maritime Continent and Western Pacific.

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.)

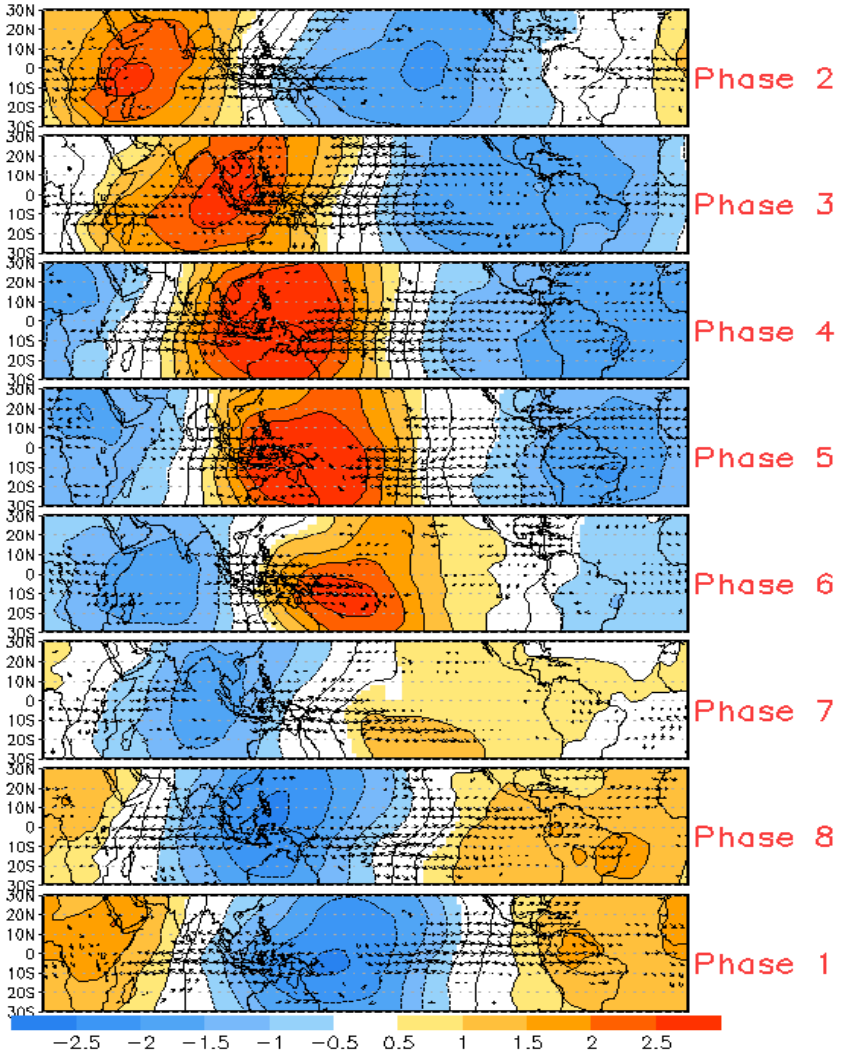




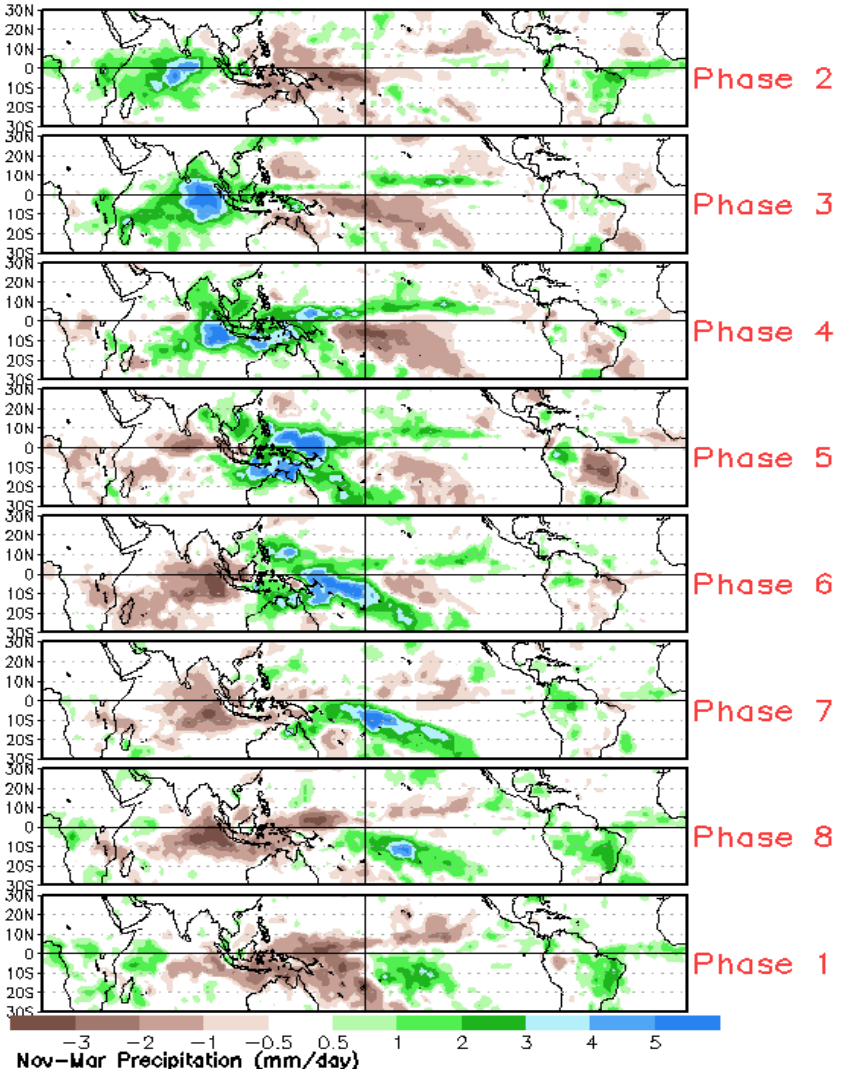
- The constructed analog forecast is similar to the GEFS except with a slightly faster eastward progression of the negative and positive OLR anomalies compared to the GEFS.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



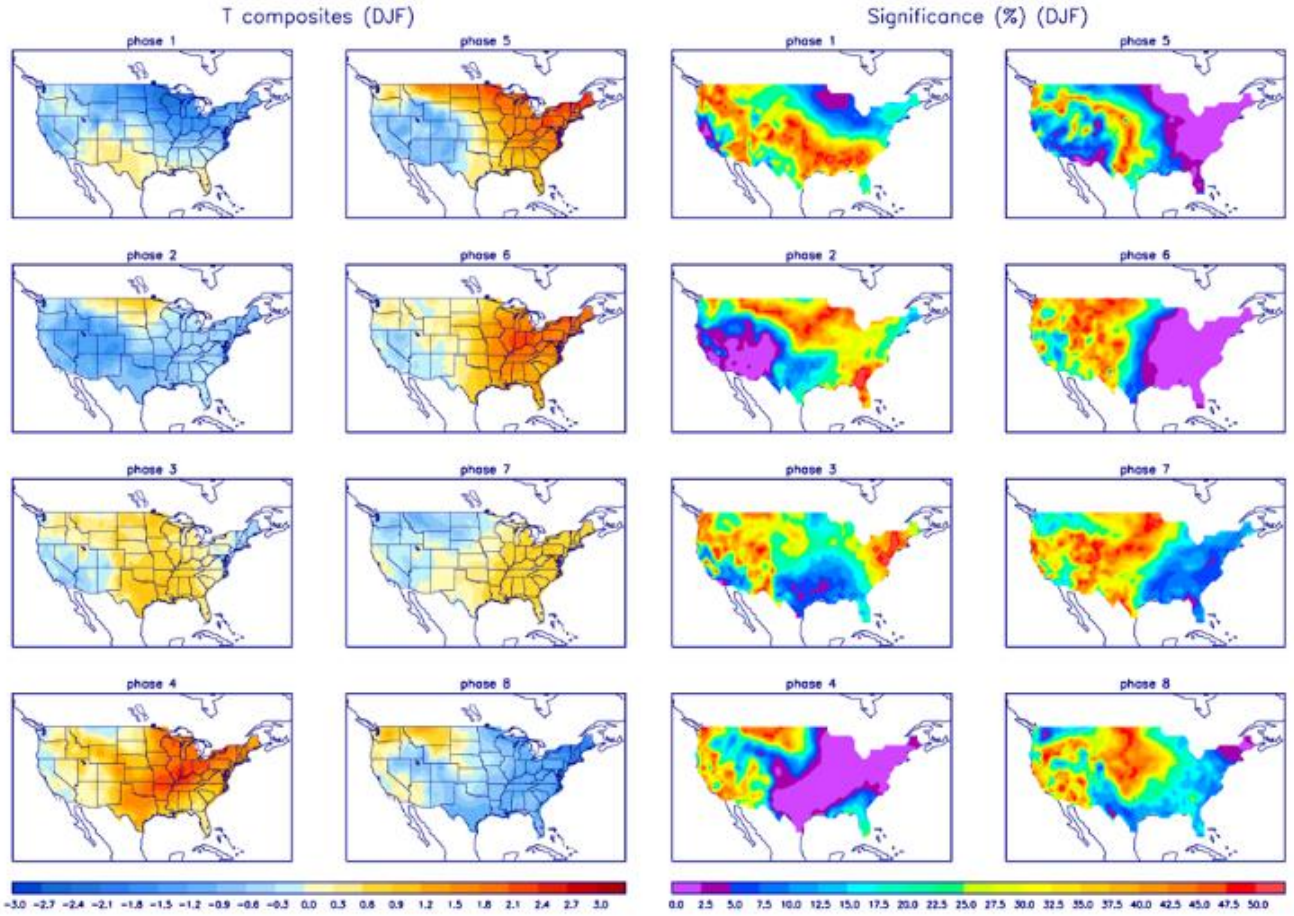
Precipitation Anomalies



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.

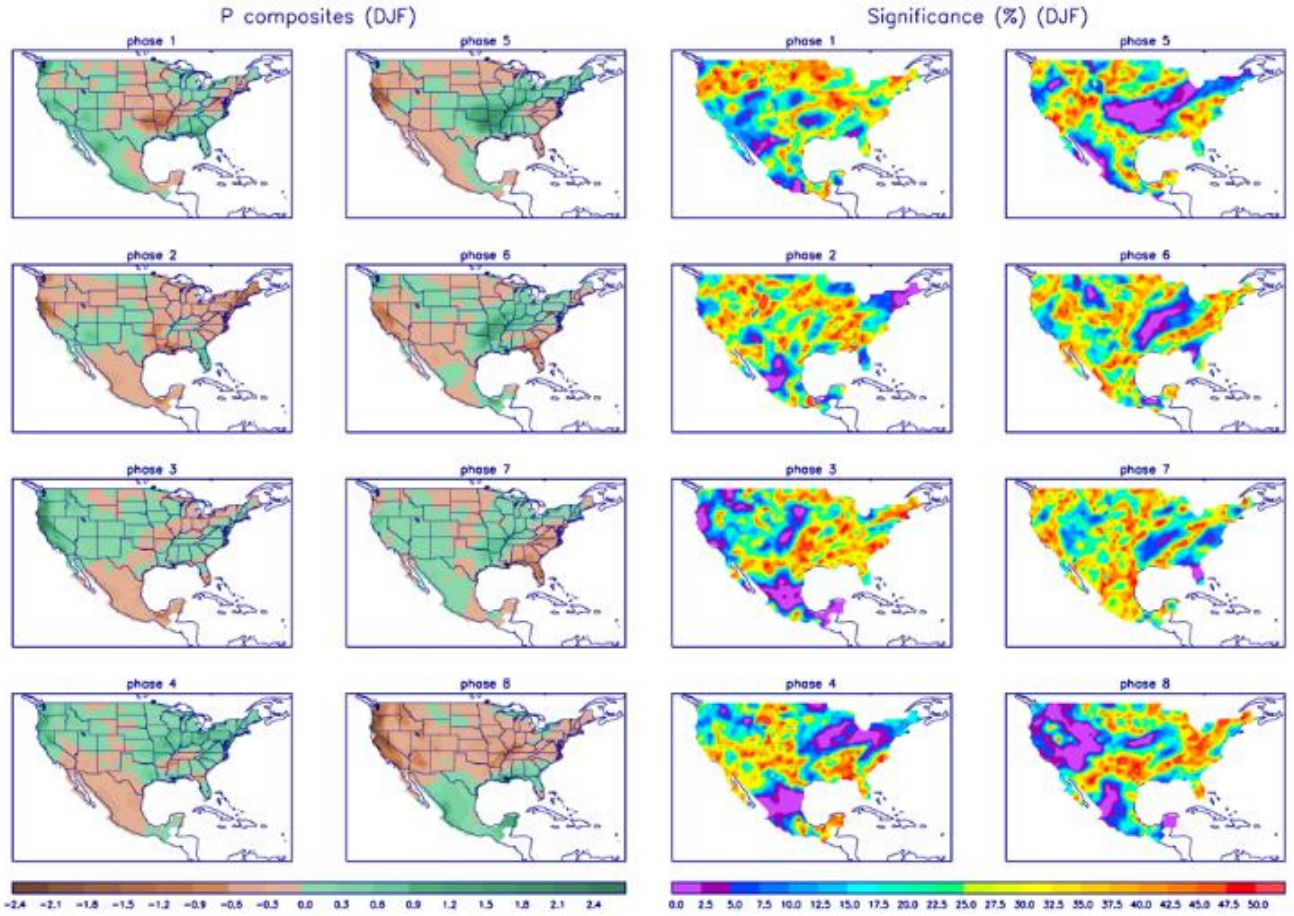


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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