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

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

Overview

- There has been a steady eastward propagation of the MJO across the Indian Ocean into the Western Pacific during the past several weeks.

- Dynamical models indicate a continued eastward propagation into the Western Hemisphere with most solutions keeping the RMM signal outside the unit circle throughout the forecast period.

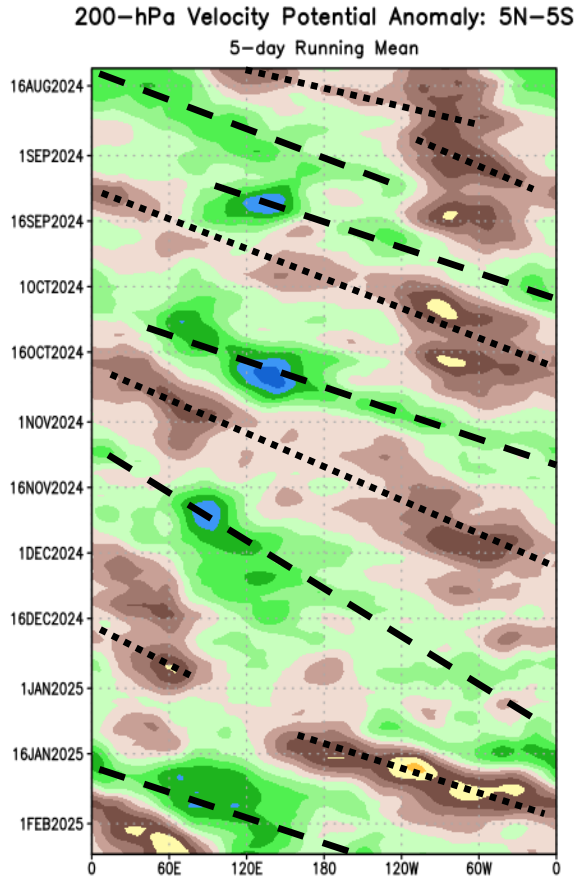
- The MJO supports increased chances of tropical cyclone (TC) development across the South Pacific for weeks 2 and 3. Model guidance also indicates enhanced potential for TC formation near Madagascar.

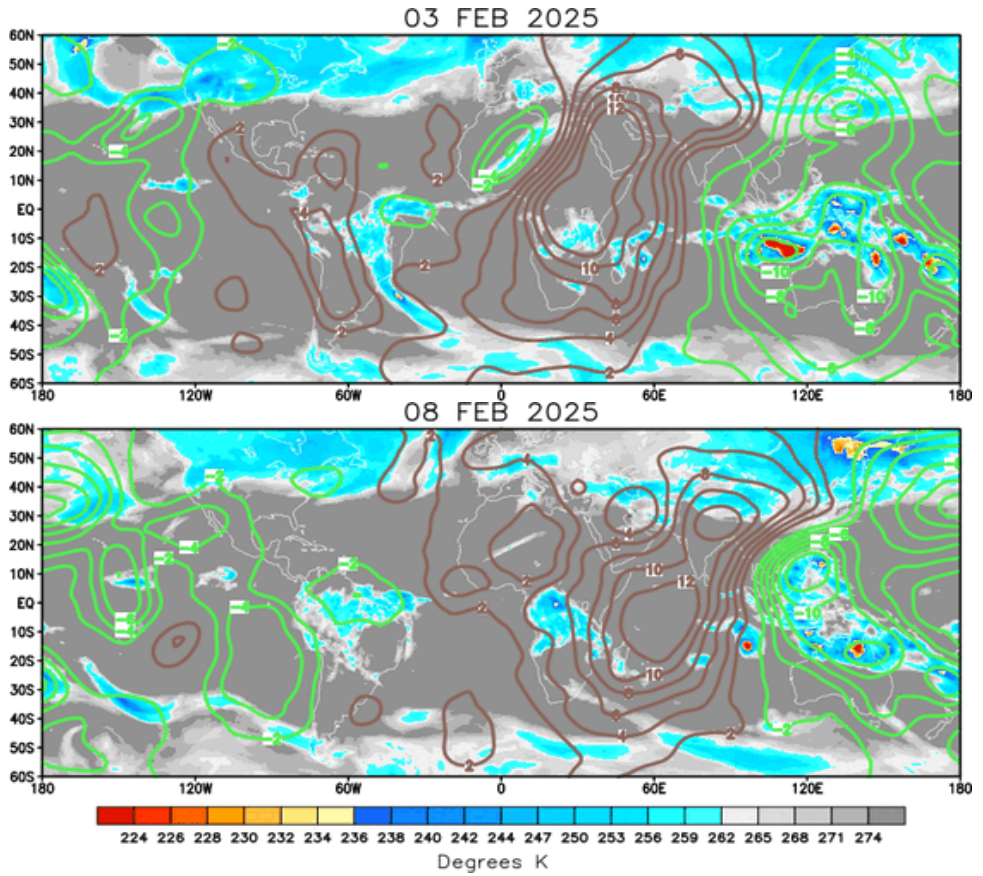
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

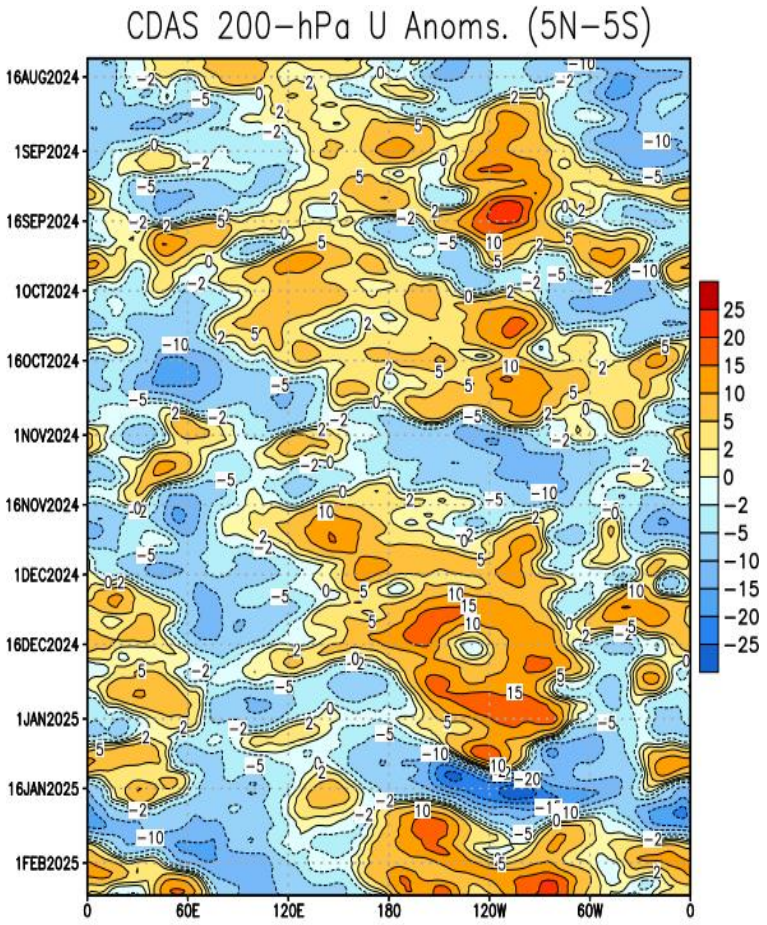


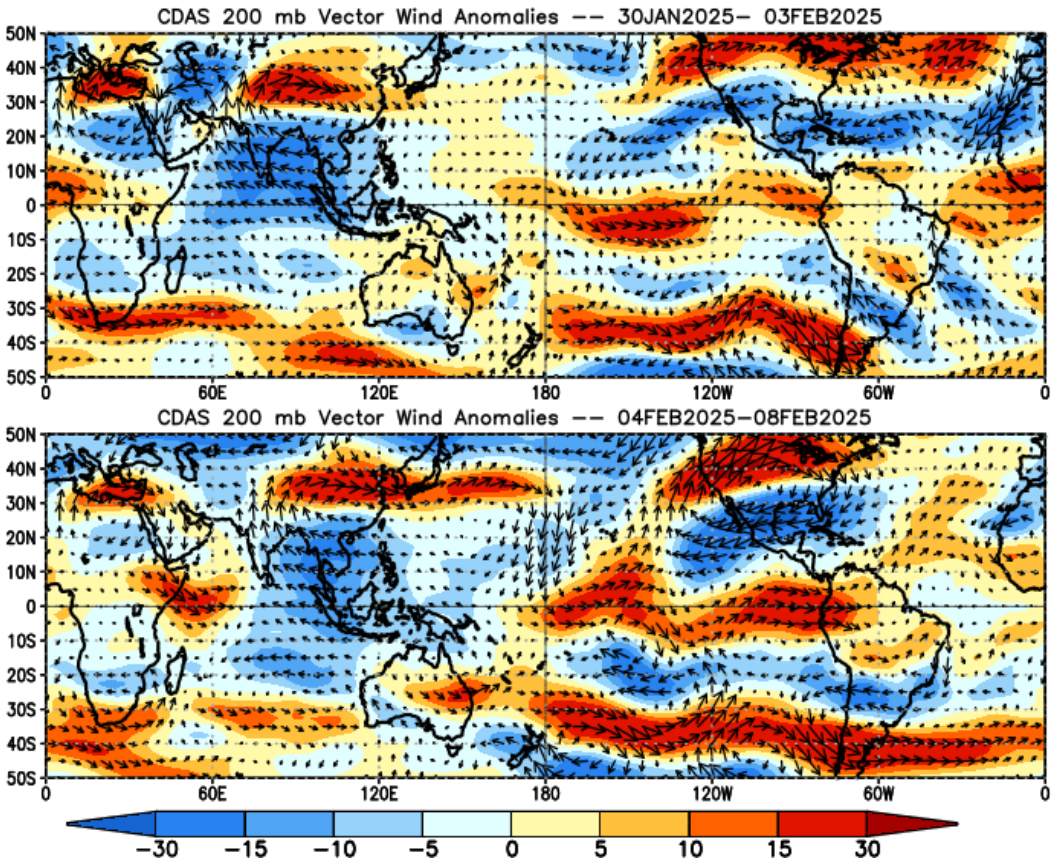


- A very robust wave-1 asymmetry pattern developed in the upper-level global velocity potential field during February.
- Eastward propagation of the broad-scale features is evident, with enhanced divergence aloft crossing the Pacific and reaching the western Hemisphere.
- Some destructive interference with the cold ENSO base state is evident over the equatorial Pacific.

200-hPa Wind Anomalies

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

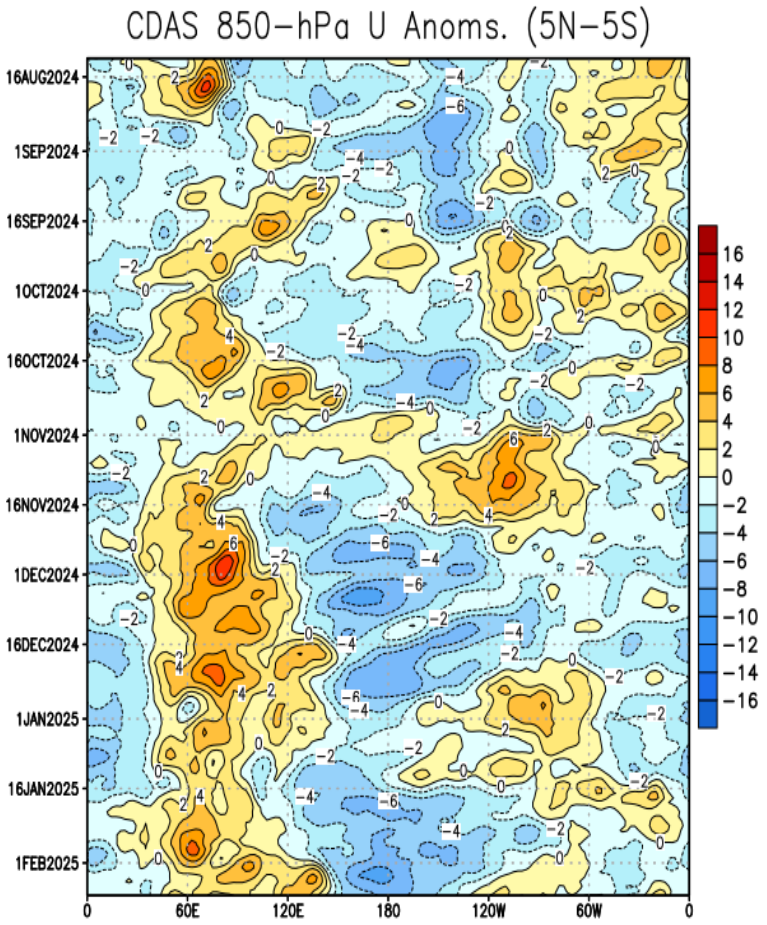


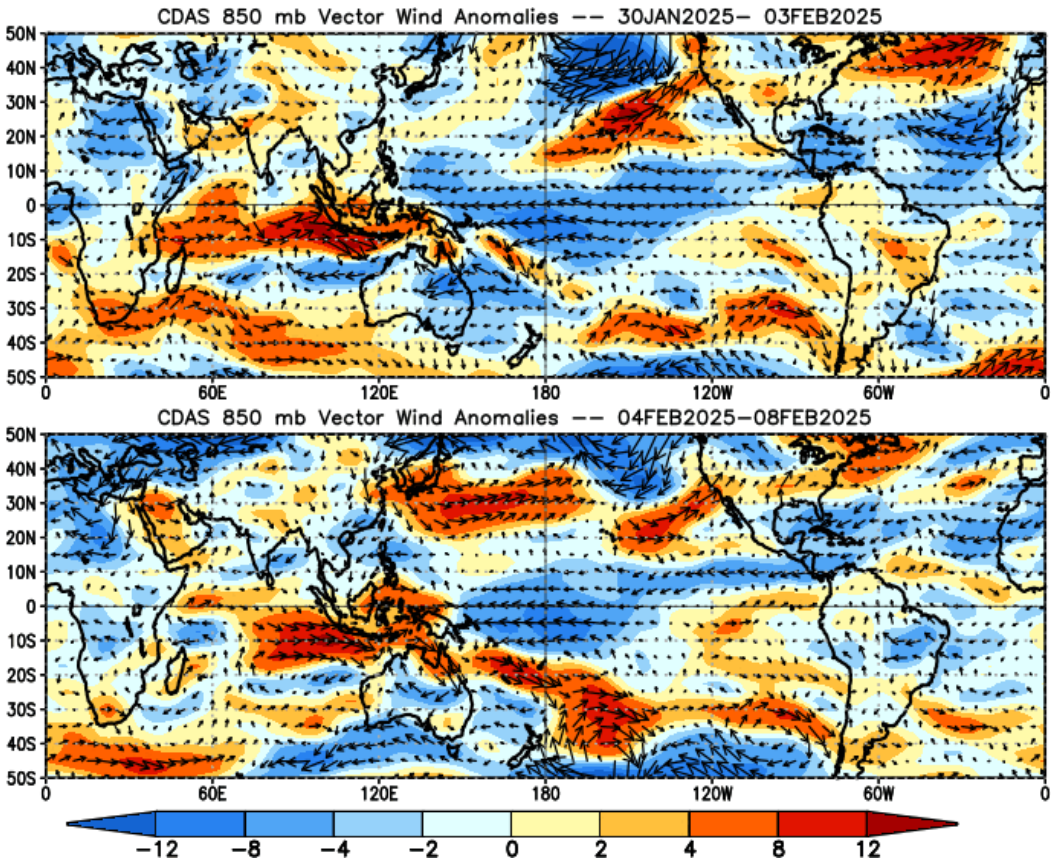


- Anomalous upper-level westerlies associated with the MJO have been propagating across the tropical Pacific during February, with widespread anomalous upper-level easterlies over the Indian Ocean.
- Strong ridging is noted over the West Coast of the U.S., displacing the jet stream northward.

850-hPa Wind Anomalies

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

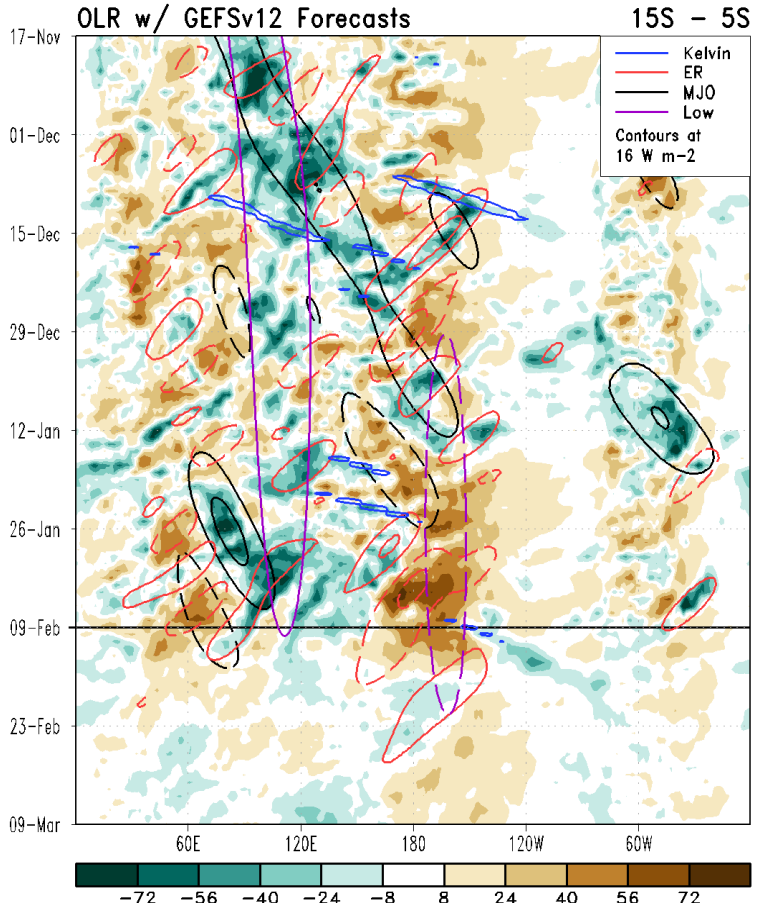


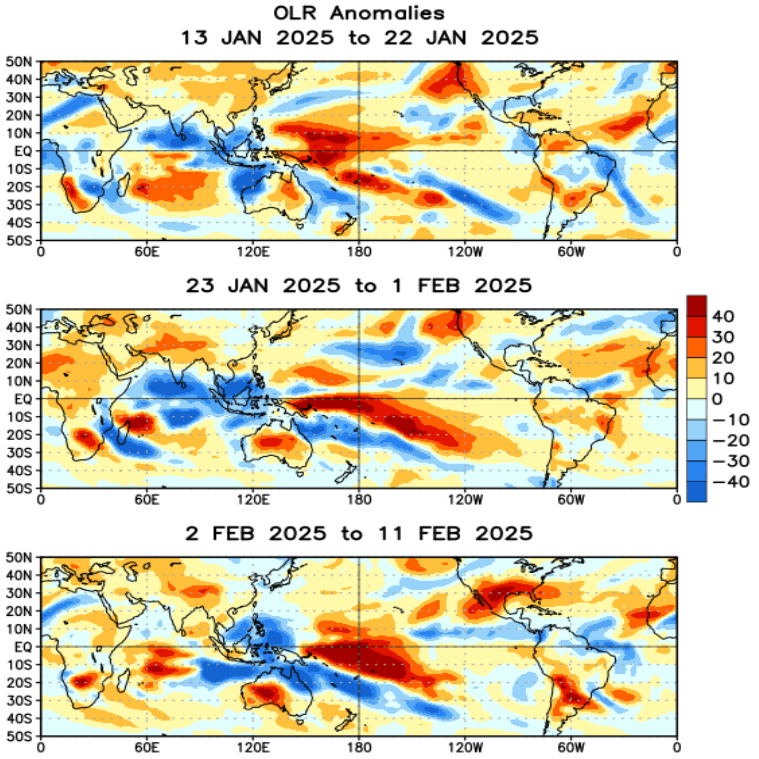


- A persistent area of low-level westerlies has remained established across the equatorial Indian Ocean for the past several months, while enhanced trade winds persist for much of the tropical Pacific. These meet over the Maritime Continent, resulting in strong low-level convergence.

Outgoing Longwave Radiation (OLR) Anomalies

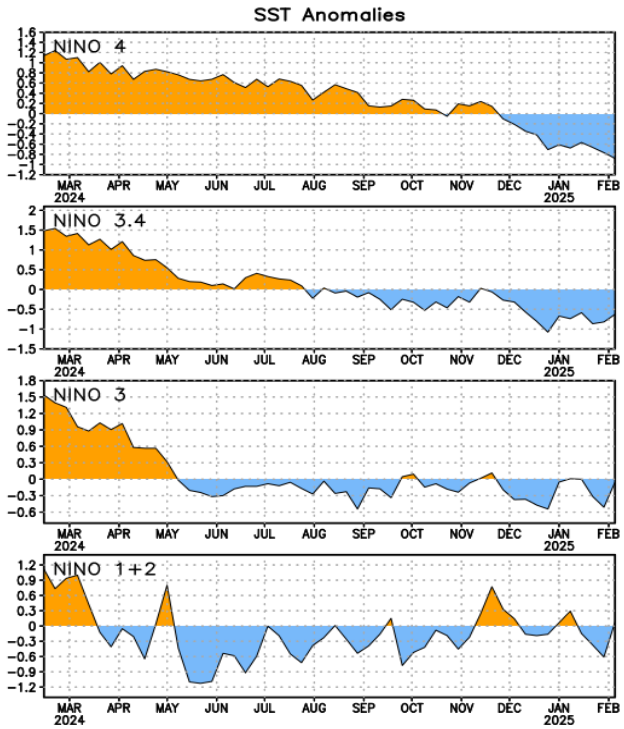
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

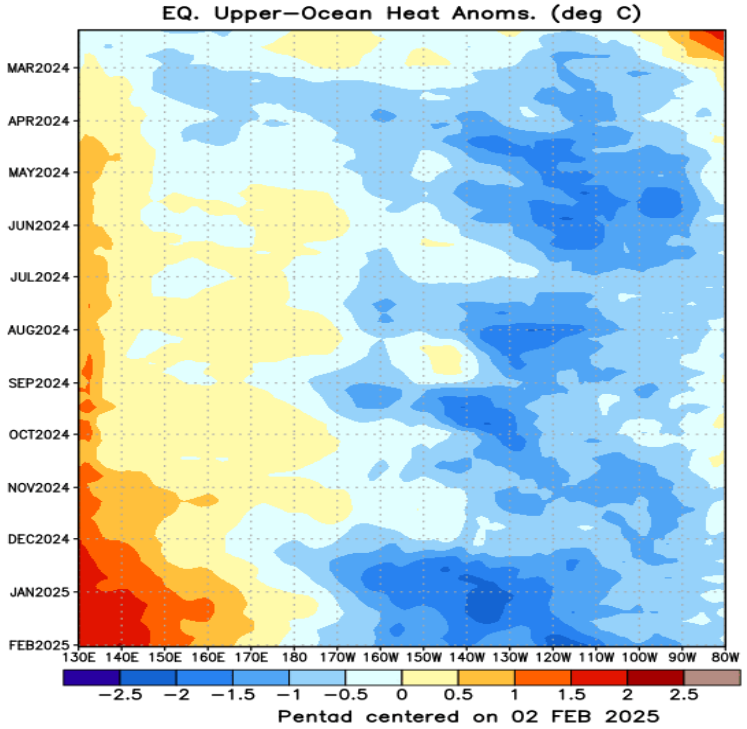




- MJO activity has become much more apparent recently in the OLR Hovmoller, although the low-frequency La Nina footprint continues to be a major factor in tropical convection patterns.
- Suppressed convection near the Date Line has become more anomalous over the last month, as has anomalously enhanced convection over the Maritime Continent.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

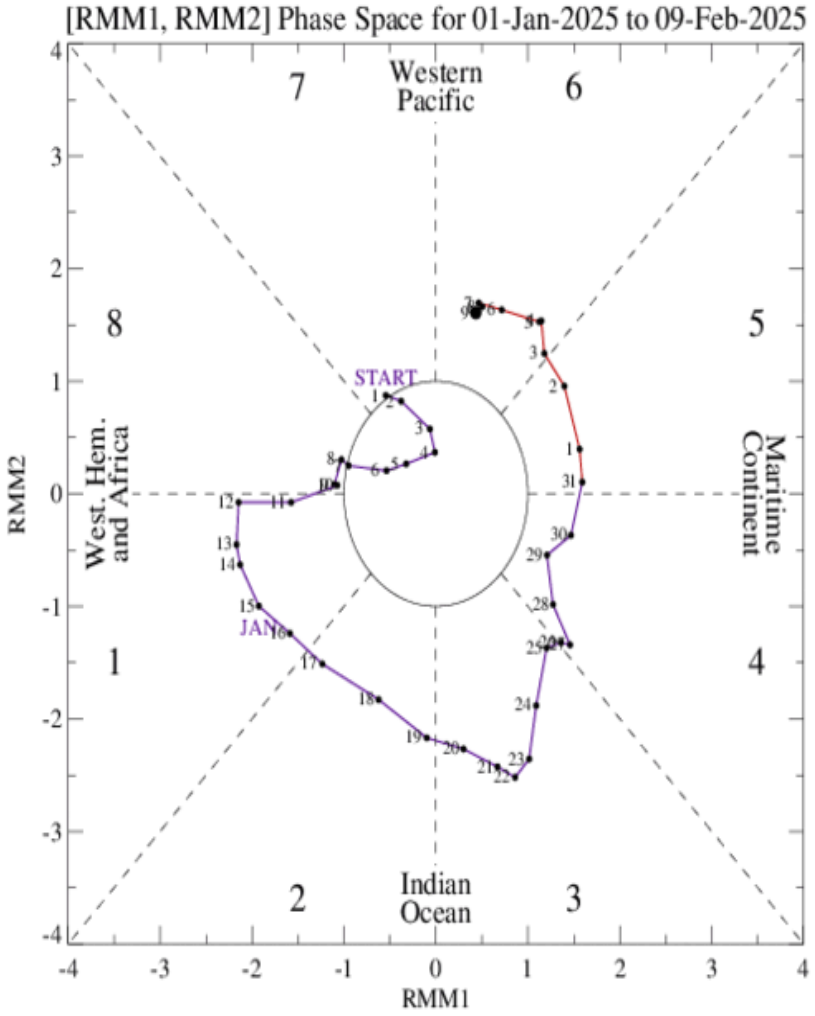




- Enhanced trades across the Central Pacific and subsequent upwelling continue to result in negative SST anomalies across all NINO regions consistent with La Niña.
- Positive subsurface heat content anomalies have increased west of the Date Line, with negative subsurface heat content anomalies remaining in place across the Central and Eastern Pacific.

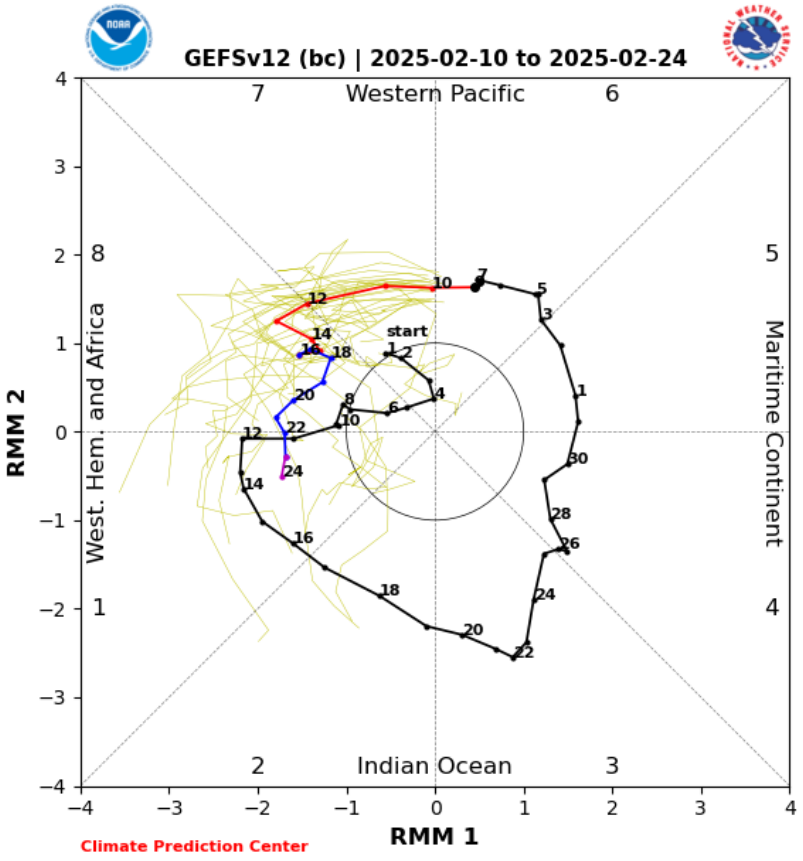
MJO Index: Recent Evolution

- During the past several weeks, there has been a robust propagation of the MJO across the Indian Ocean and Maritime Continent, although the RMM signal decreased in strength recently, likely tied to interference with the low frequency La Niña base state.
- RMM index currently centers the MJO over the Western Pacific.

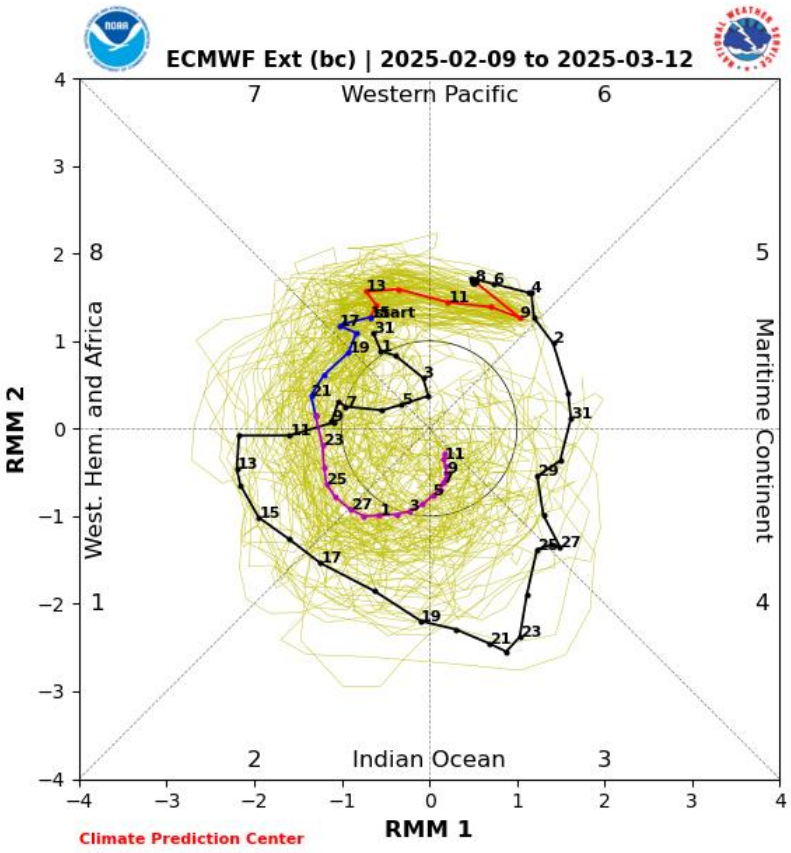


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

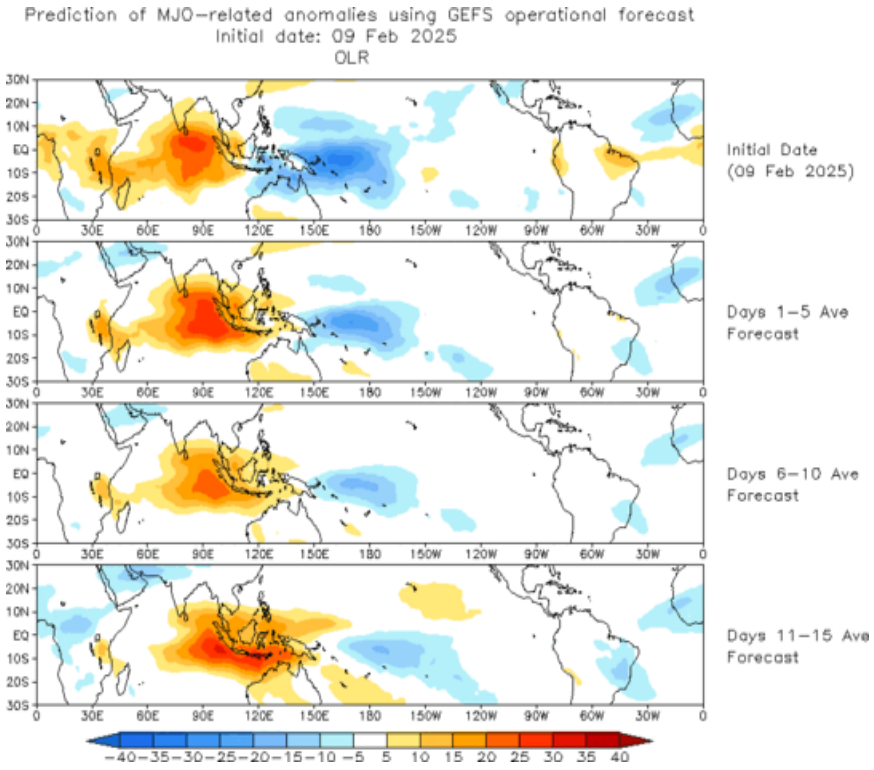


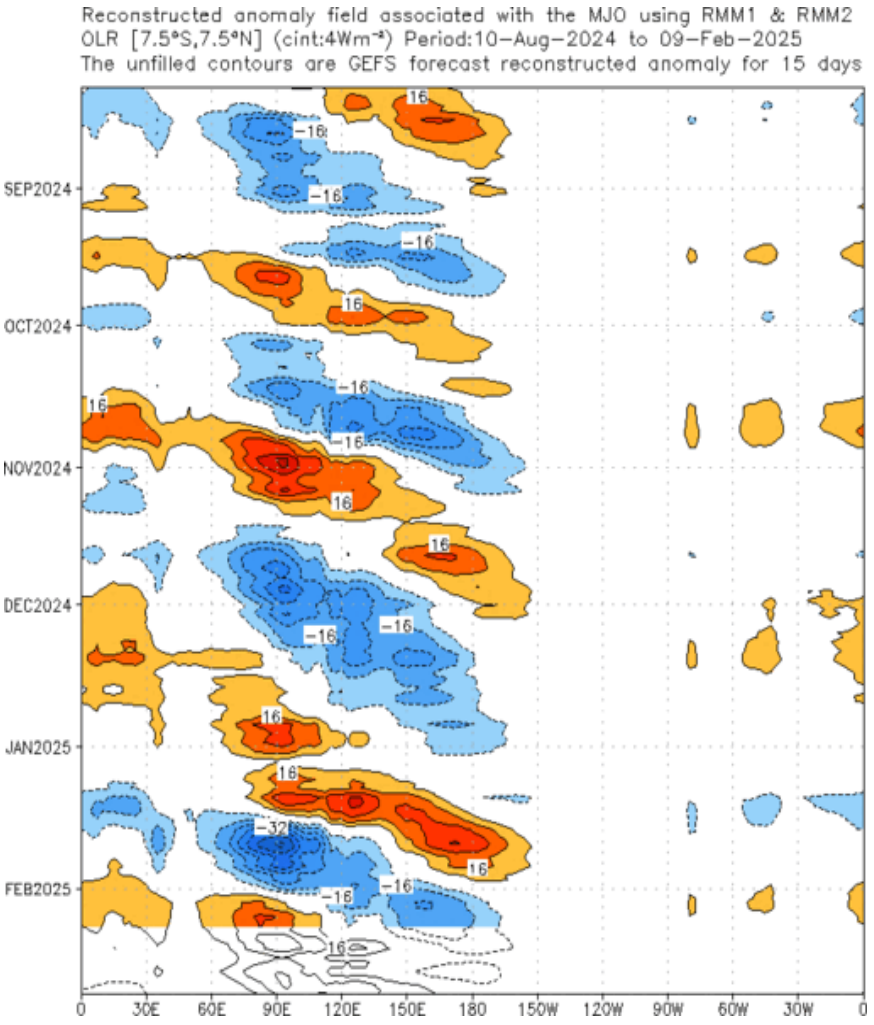
ECMWF Forecast

- Both the GEFS and ECMWF ensembles depict a continued eastward propagation of the MJO into the Western Hemisphere over the next week.
- Model solutions generally favor an enhanced MJO over the next several weeks, with solutions remaining almost universally outside the unit circle throughout the forecast period.

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.)

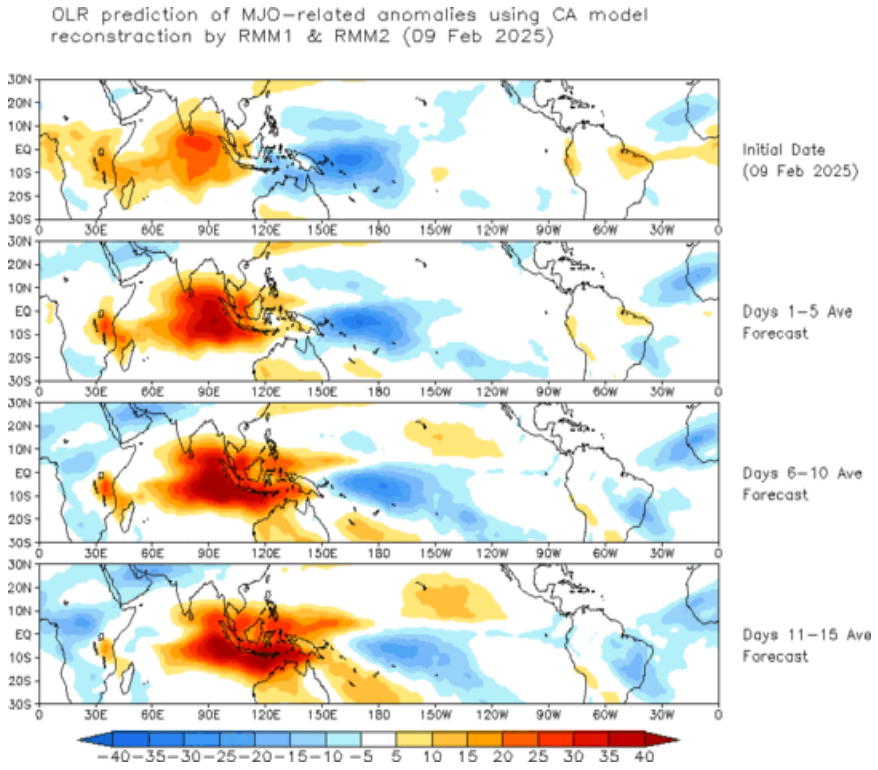


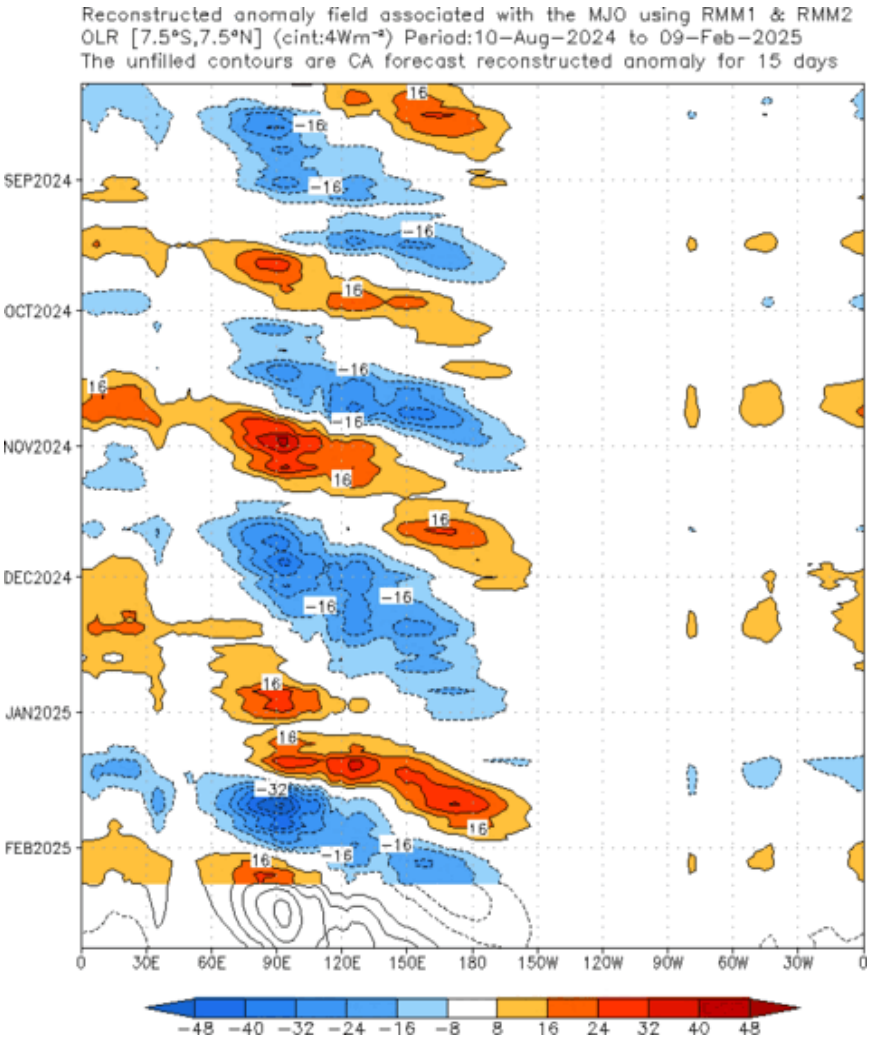


- The GEFS OLR forecast depicts positive OLR anomalies (suppressed convection) extending across the Indian Ocean and propagation into the Maritime Continent. during the next 2 weeks, while negative OLR anomalies (enhanced convection) move from the Western Pacific into the Western Hemisphere.

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.)

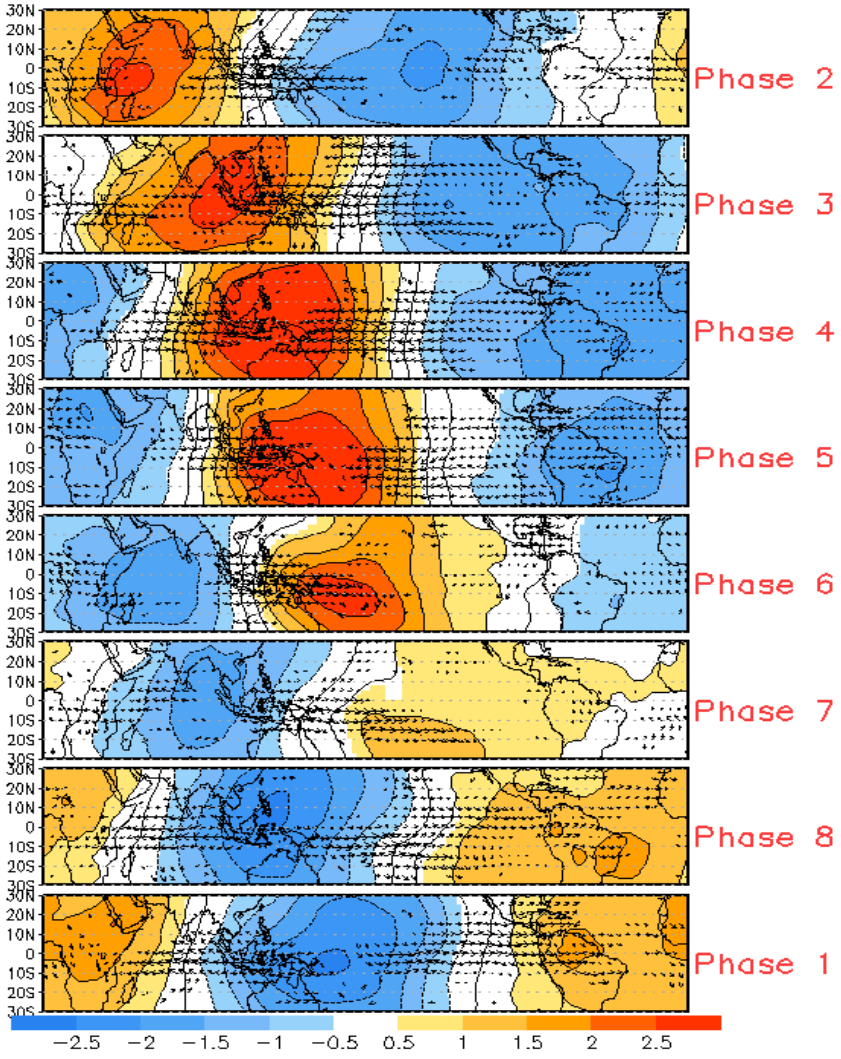




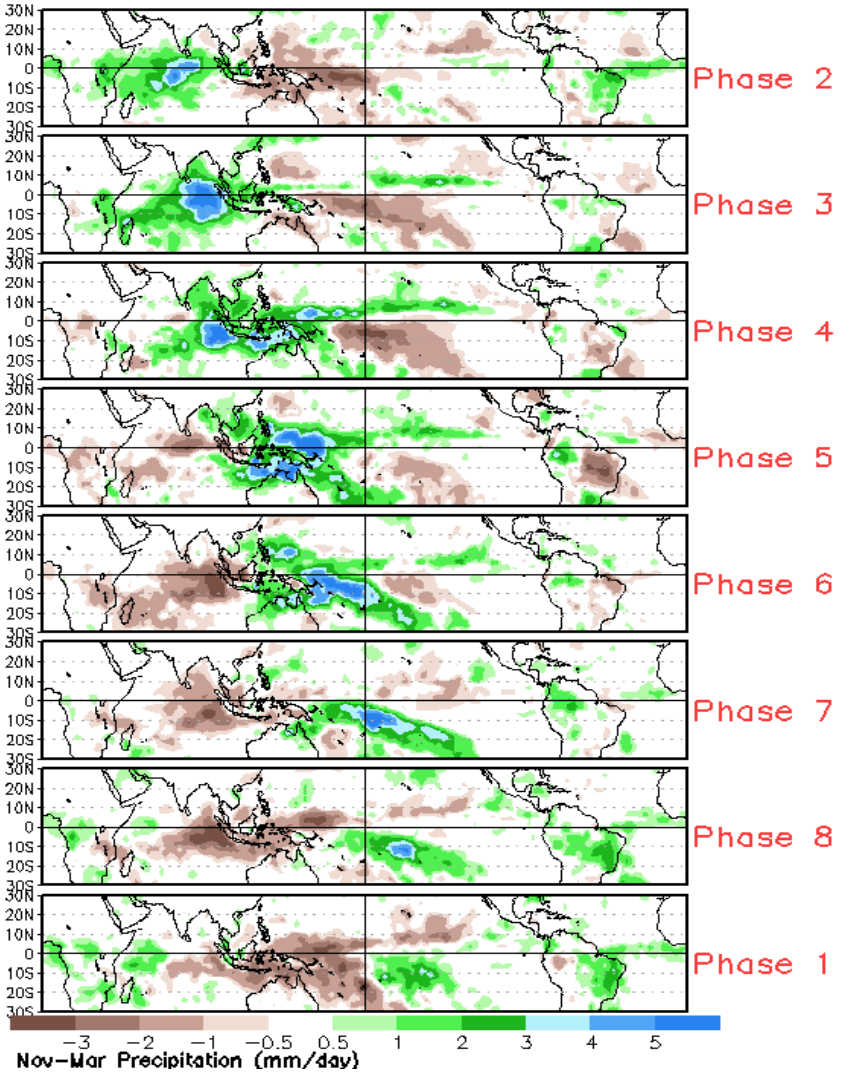
- The constructed analog forecast is very similar to the GEFS although is has larger anomalies for both the suppressed and enhanced phases of the MJO.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



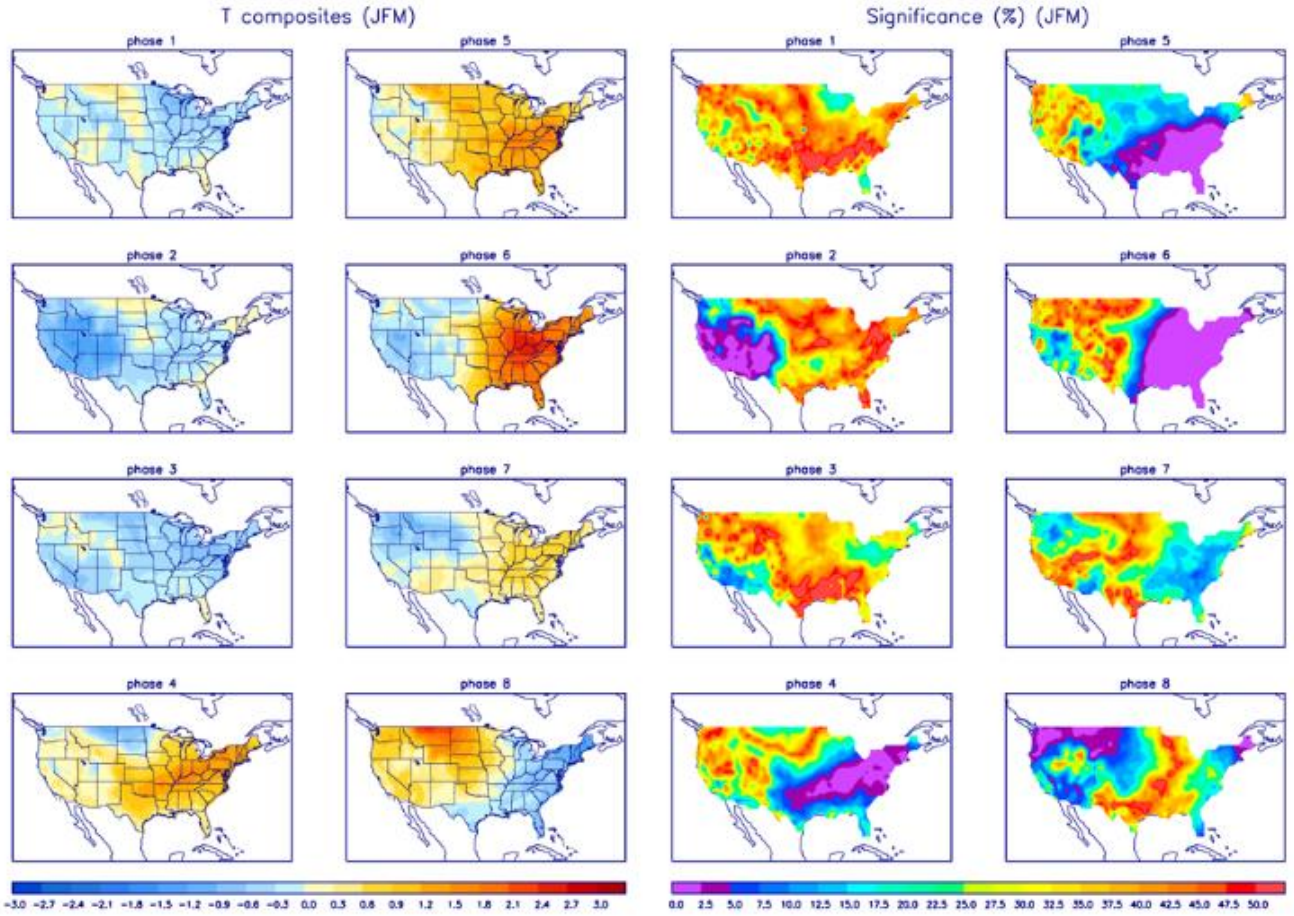
Precipitation Anomalies



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.

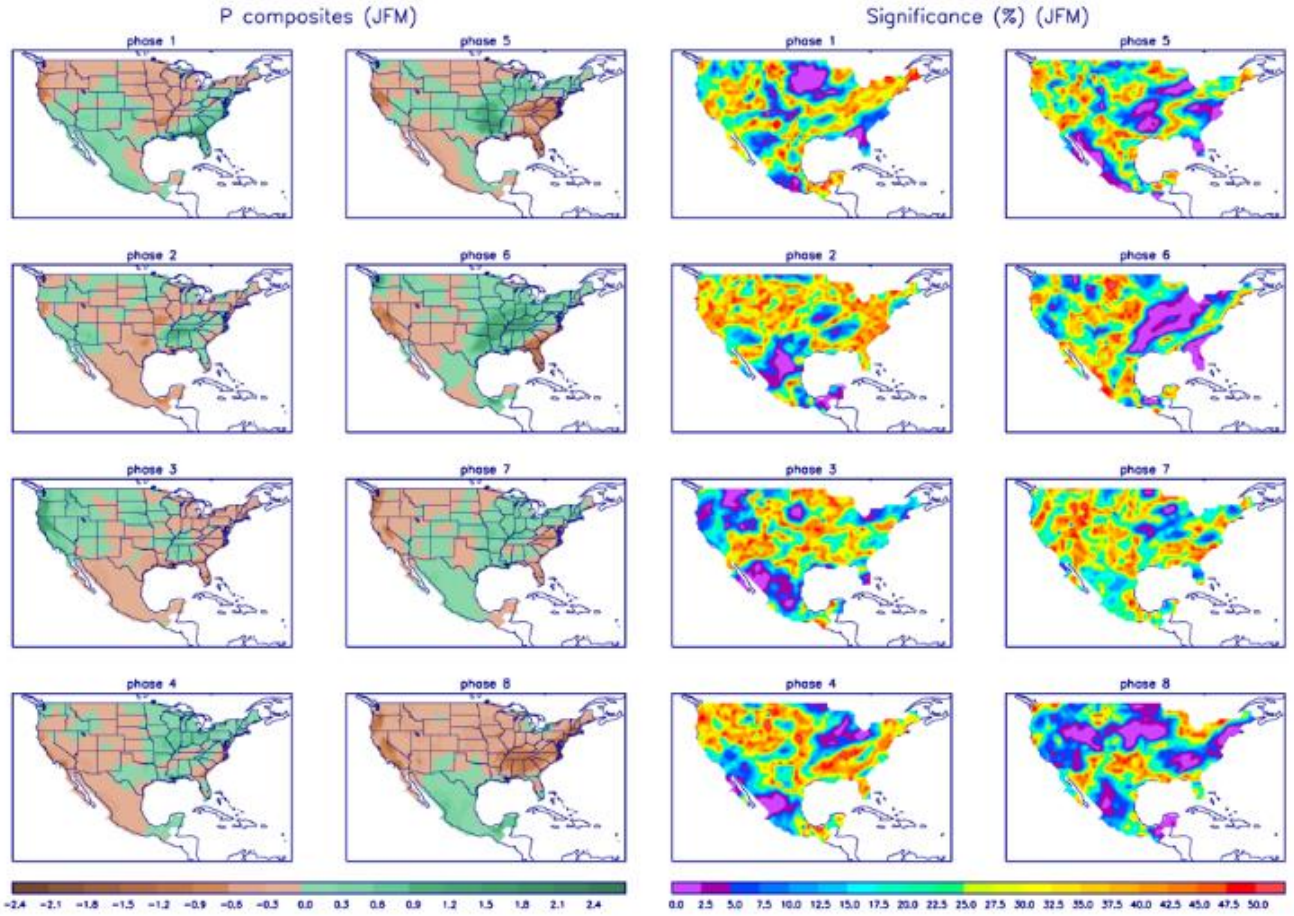


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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.



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