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

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

Overview

- A robust and fast-moving MJO propagated east from the Indian Ocean to the western Maritime Continent during mid to late January.

- The dynamical model forecasts are in good agreement that the MJO continues its eastward propagation to the West Pacific by early February.

- The MJO is expected to contribute to a favorable large-scale environment for tropical cyclone (TC) development over the South Indian Ocean and near northern Australia from February 5 to 11 with an increasing chance of TC genesis over the South Pacific by mid-February.

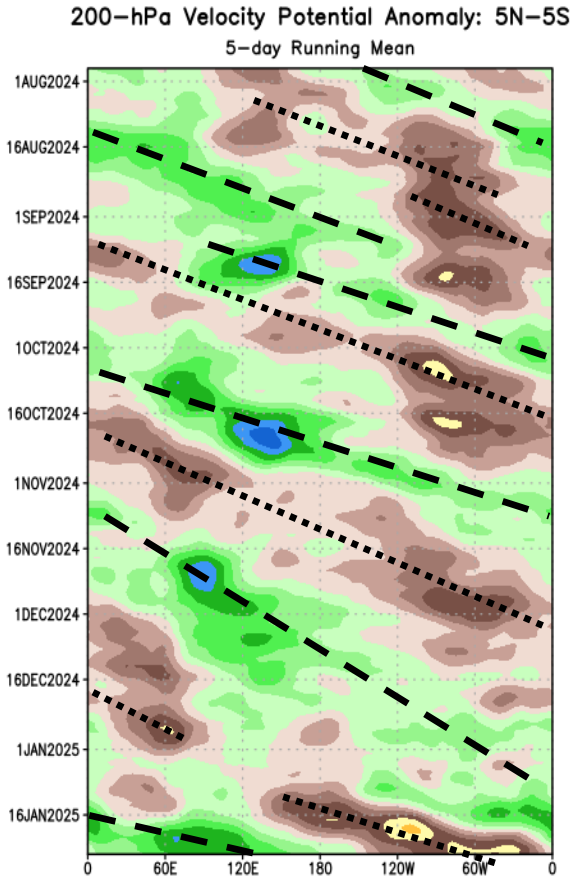
- An eastward propagating Indian Ocean and Maritime Continent MJO historically favors a warm response over the eastern CONUS during the next two weeks, which is quite a change in the pattern during much of January.

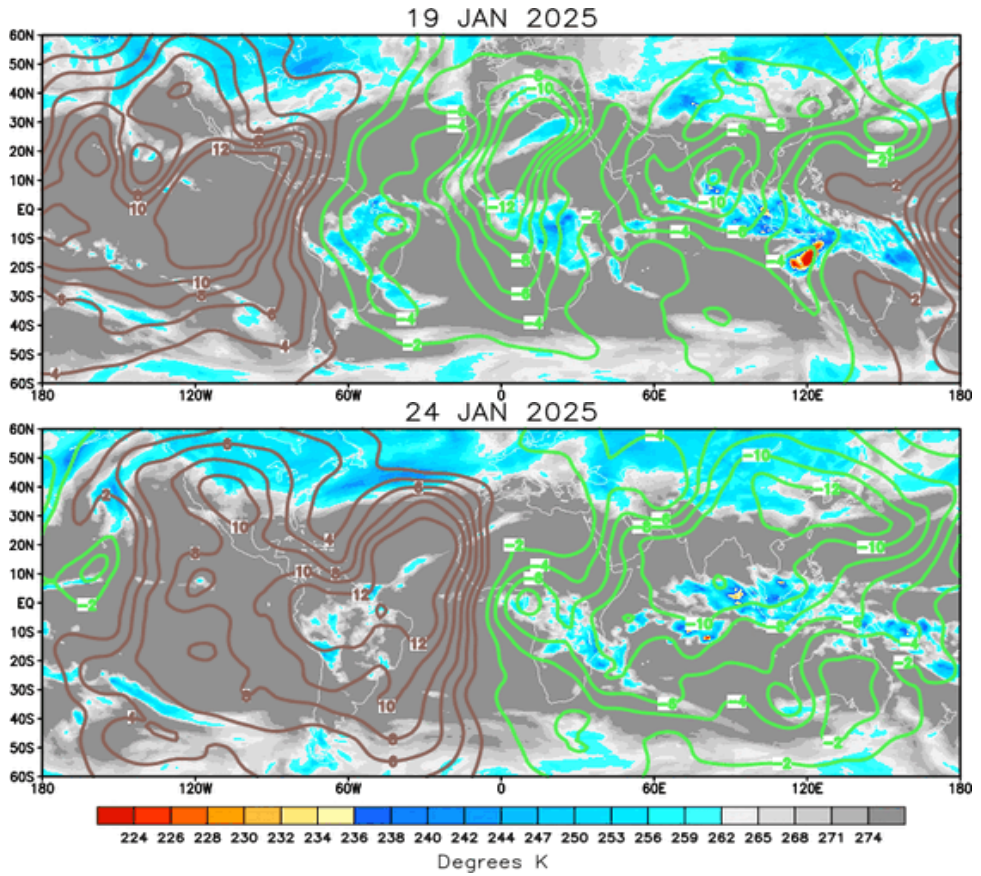
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

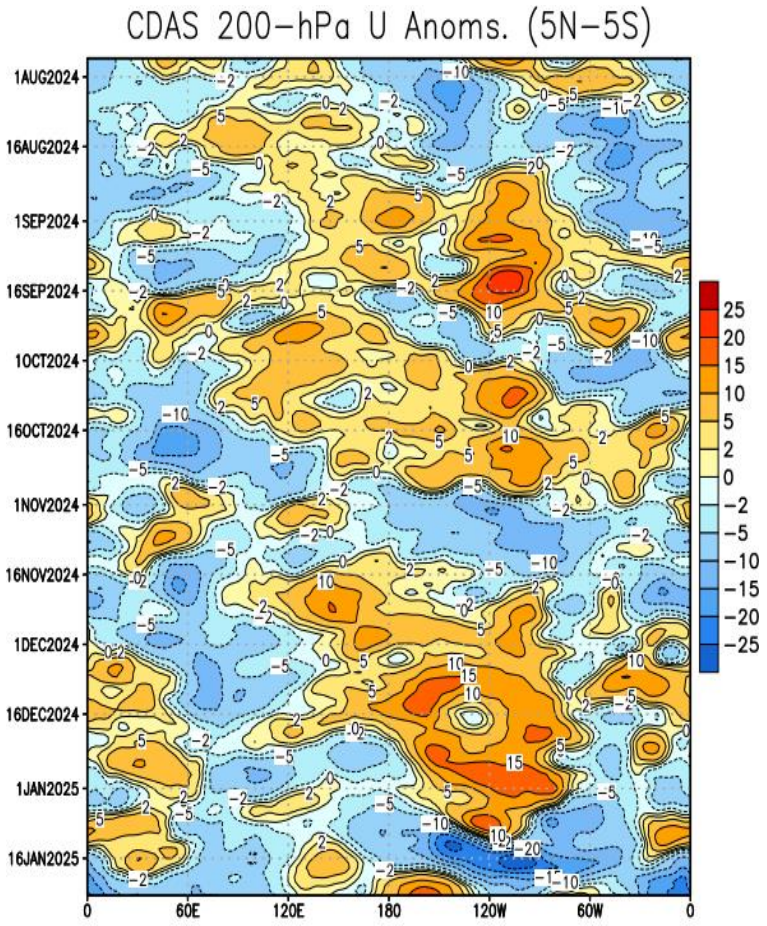


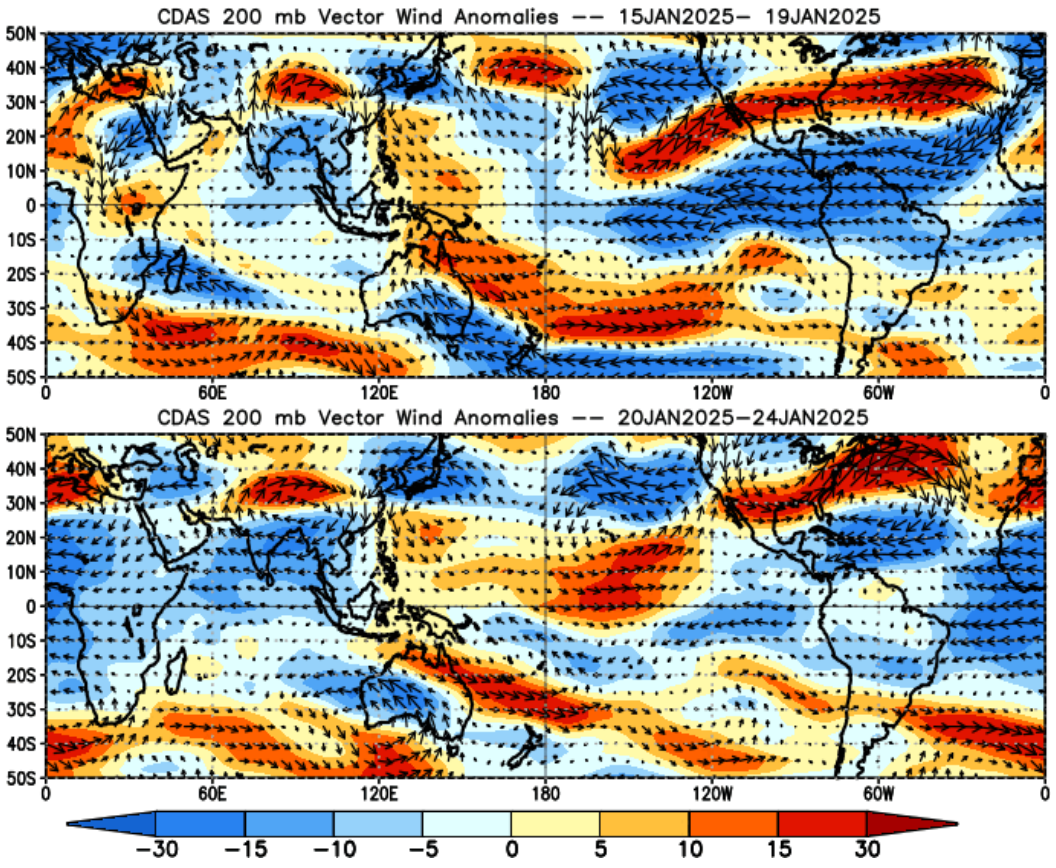


- The upper-level pattern became quite disorganized during early January but has since redeveloped the wave-1 asymmetry characteristic of MJO activity.
- Most recently, the convergence/divergence dipole has become very amplified with anomalous upper-level divergence (convergence) over the Indian Ocean and Maritime Continent (Americas).

200-hPa Wind Anomalies

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

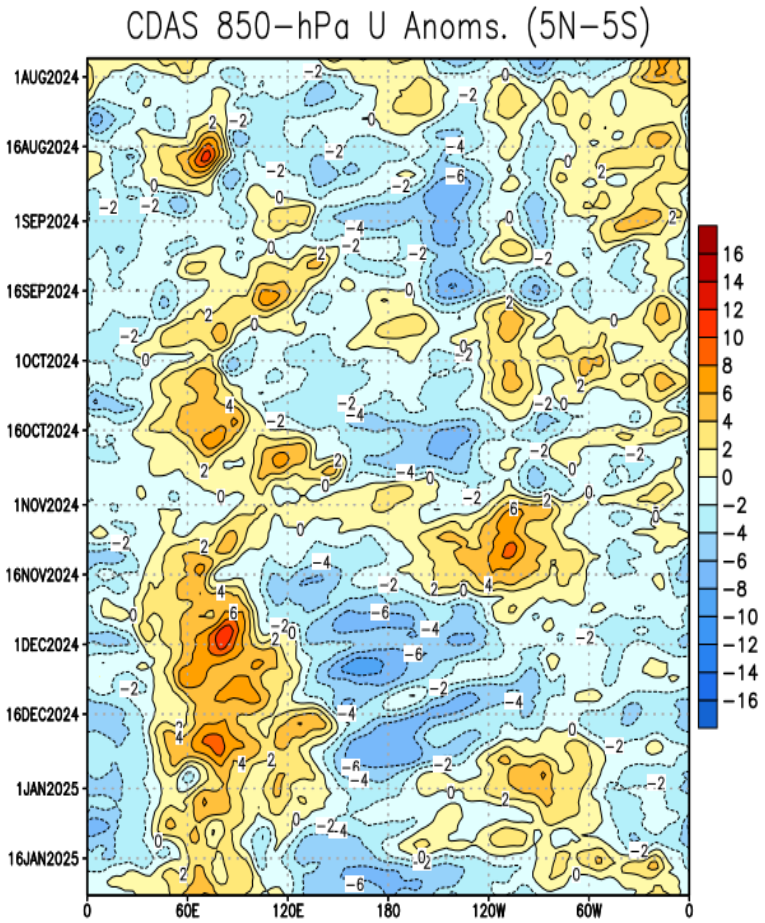


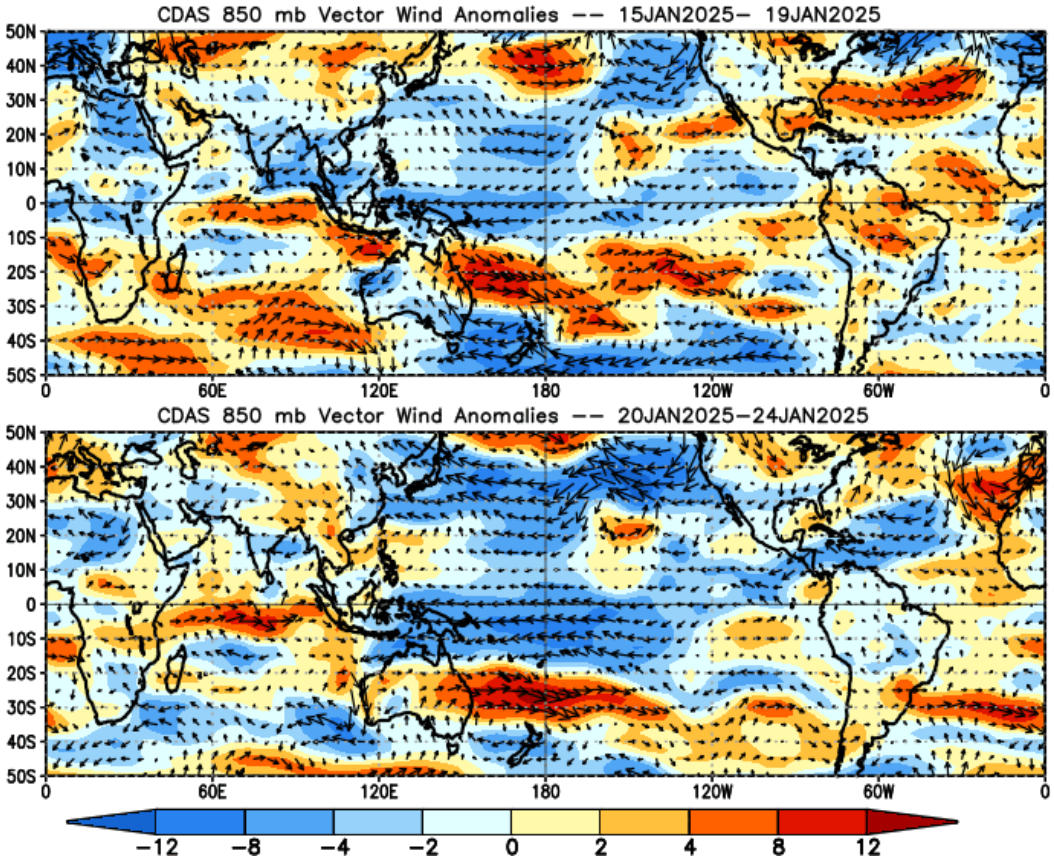


- Persistent cyclonic circulation near Hawaii is noted, as well as a robust subtropical jet over the tropical eastern Pacific and southern U.S. in the most recent pentad.
- Anomalous upper-level easterlies recently became more prominent across the Indian Ocean with anomalous upper-level westerlies near the Date Line.

850-hPa Wind Anomalies

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

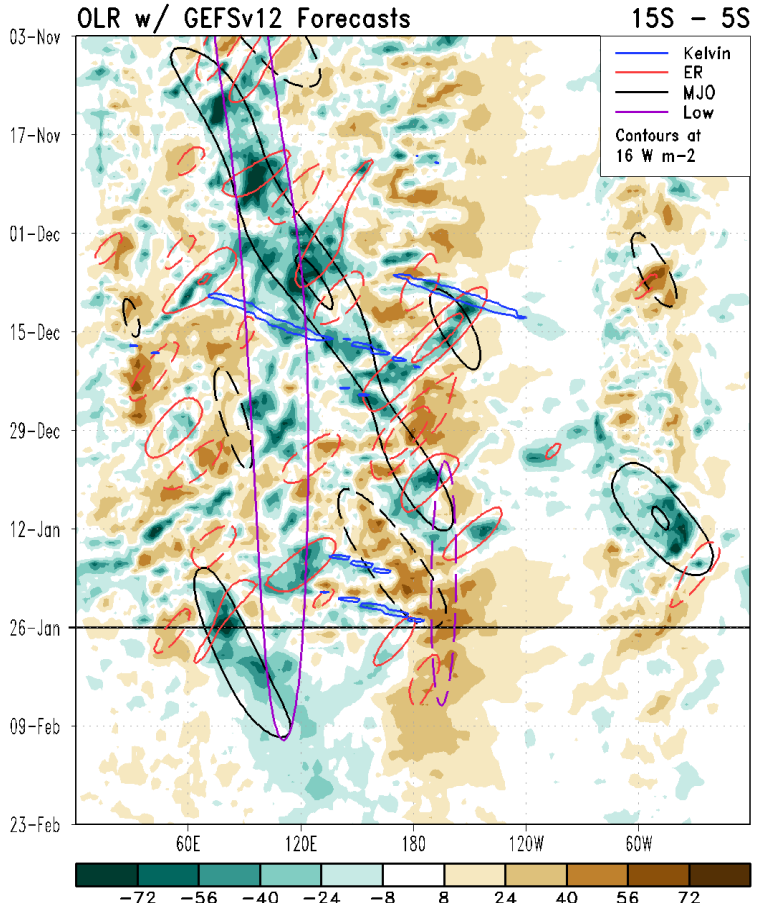


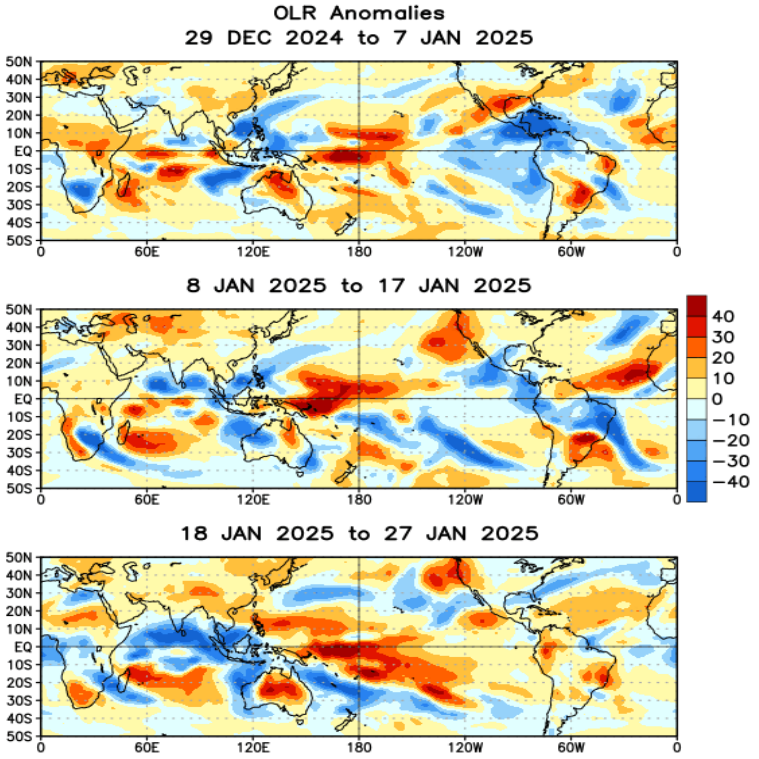


- Low-level westerlies persist, but remained weak across much of the equatorial Indian Ocean relative to much for December.
- The enhanced trade regime continues over the central Pacific, consistent with the La Nina base state.

Outgoing Longwave Radiation (OLR) Anomalies

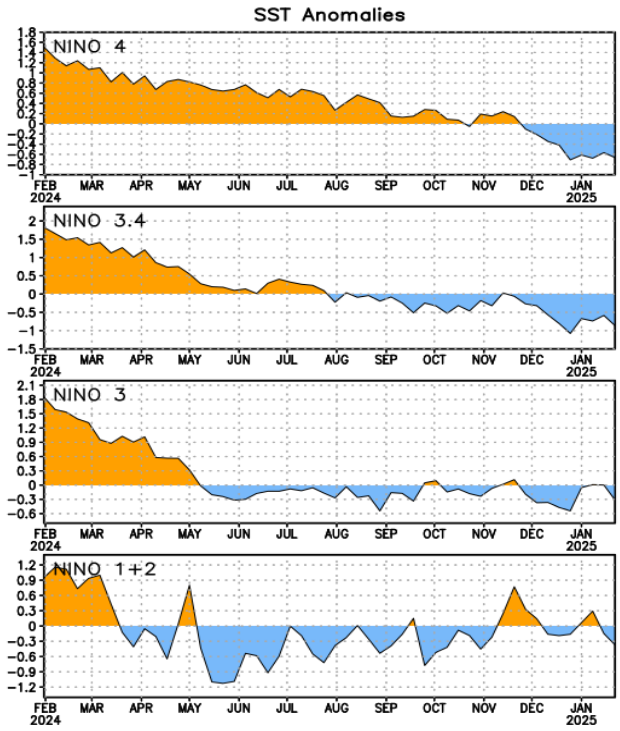
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

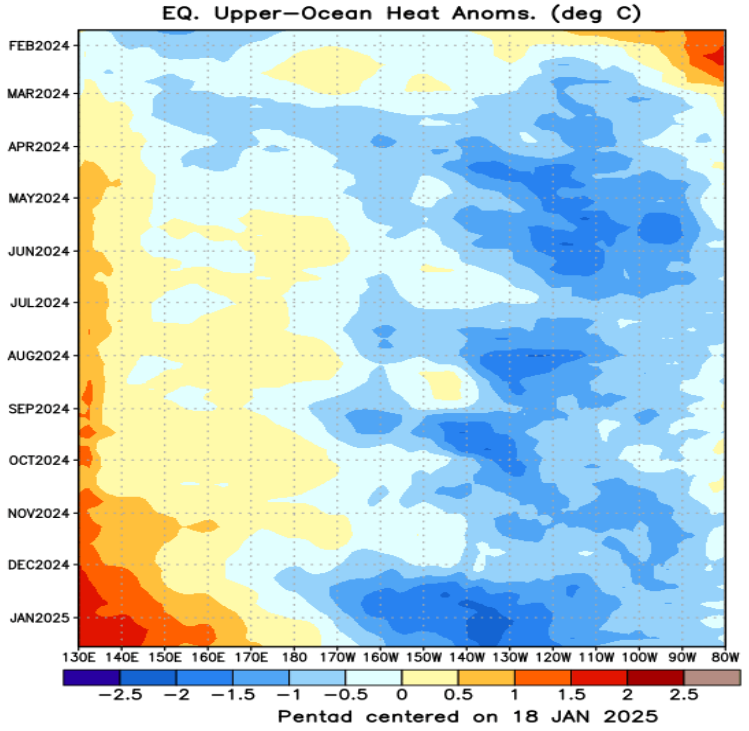




- Tropical convection became quite incoherent early in January, but organized MJO structures have come through the objective filtering recently, indicating increased MJO activity.
- The suppressed convective footprint tied to La Nina has expanded further westward from the Date Line.
- OLR forecasts from the GEFS show the low frequency convective dipole strengthening, suggestive of a constructively interfering MJO in the outlook. .

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

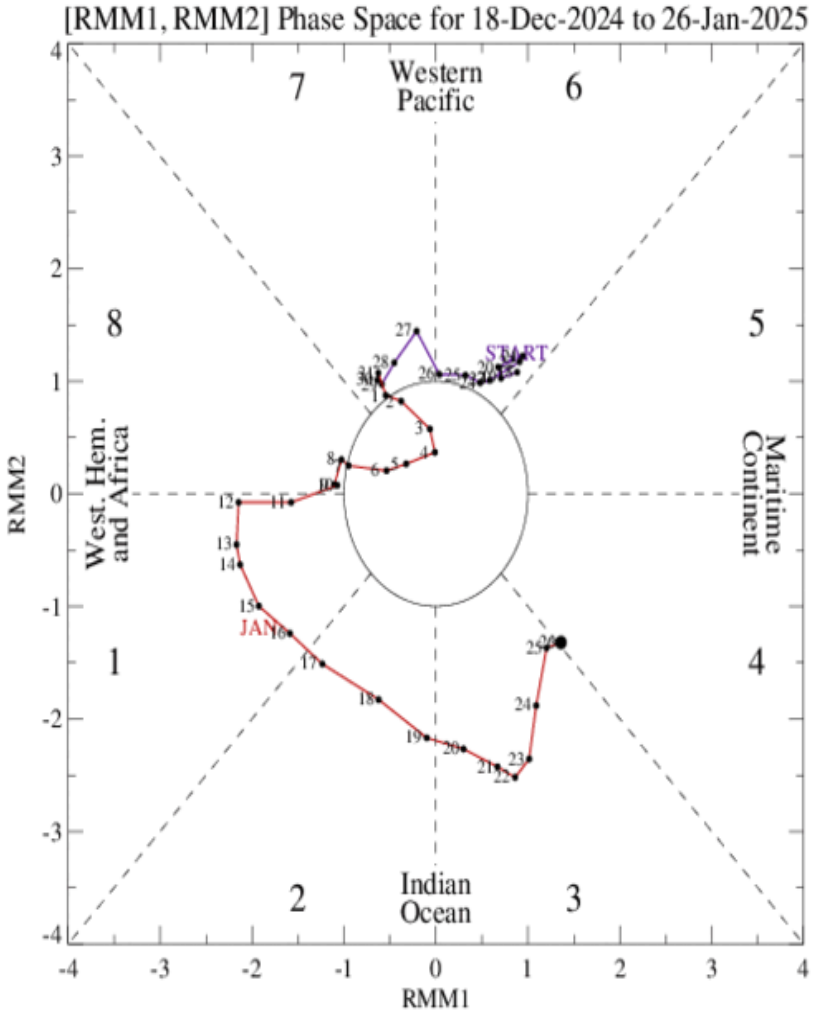




- Enhanced trades and subsequent upwelling during December resulted a sharp drop in sea surface temperatures across the Niño 3.4 and Niño 4 regions.
- Subsurface heat content of the Equatorial Pacific also indicates a continued development of La Nina conditions, with a noted strengthening and expansion of the Western Pacific Warm Pool and deepening cold anomalies east of the Date Line.

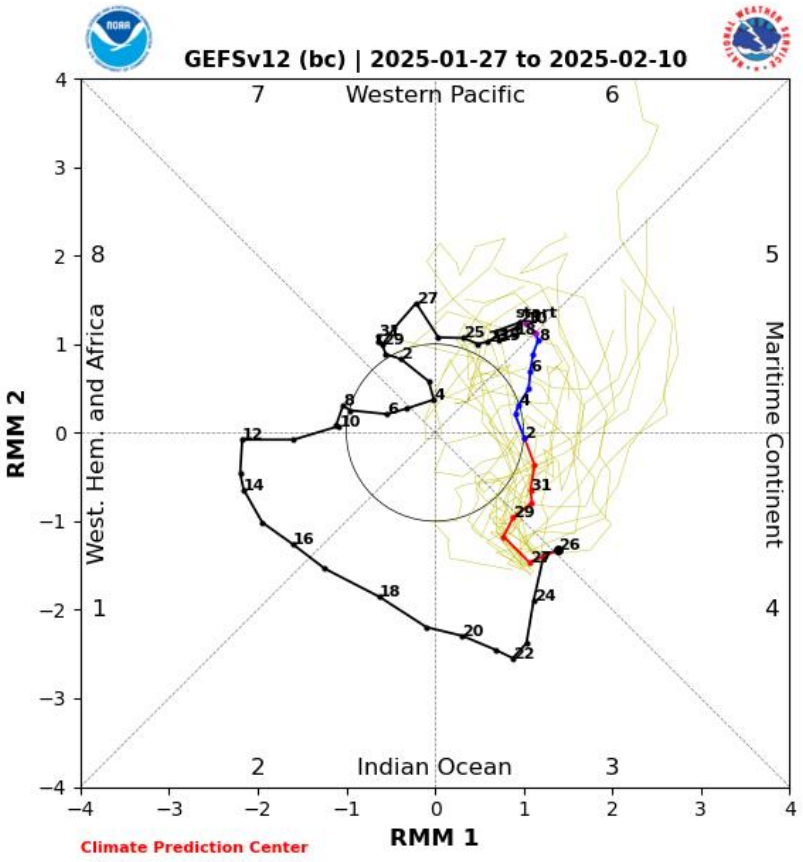
MJO Index: Recent Evolution

- Since weakening and falling within the RMM unit circle during early January, the MJO signal has strengthened considerably, with an increase in amplitude of ~ 2 standard deviations in the past week.
- During mid to late January, the RMM index has moved swiftly from phases 1-2 to approaching phase 4.

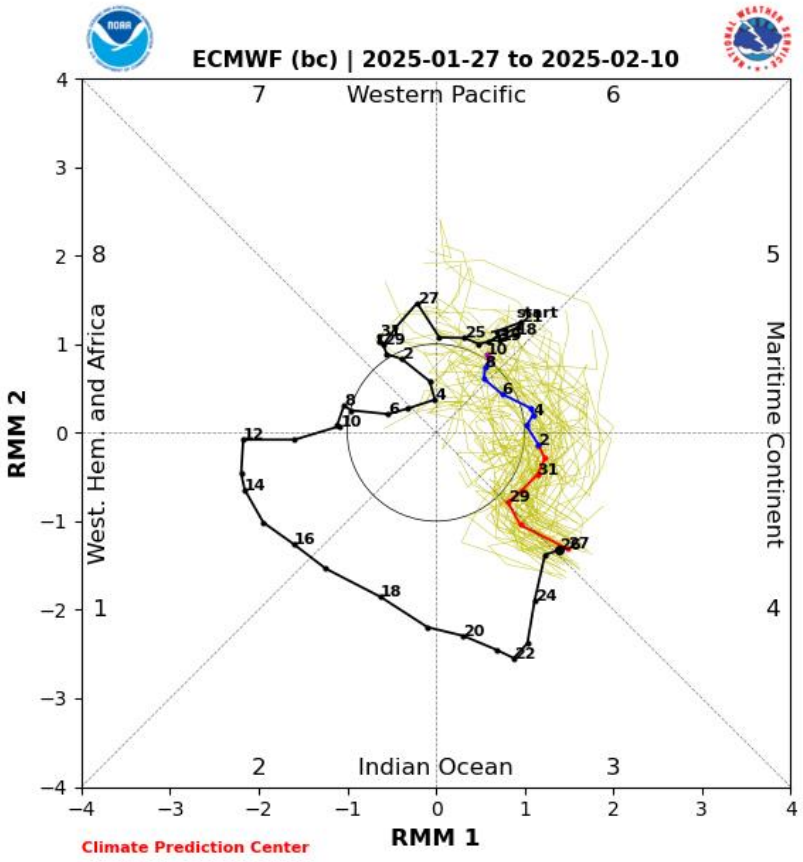


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

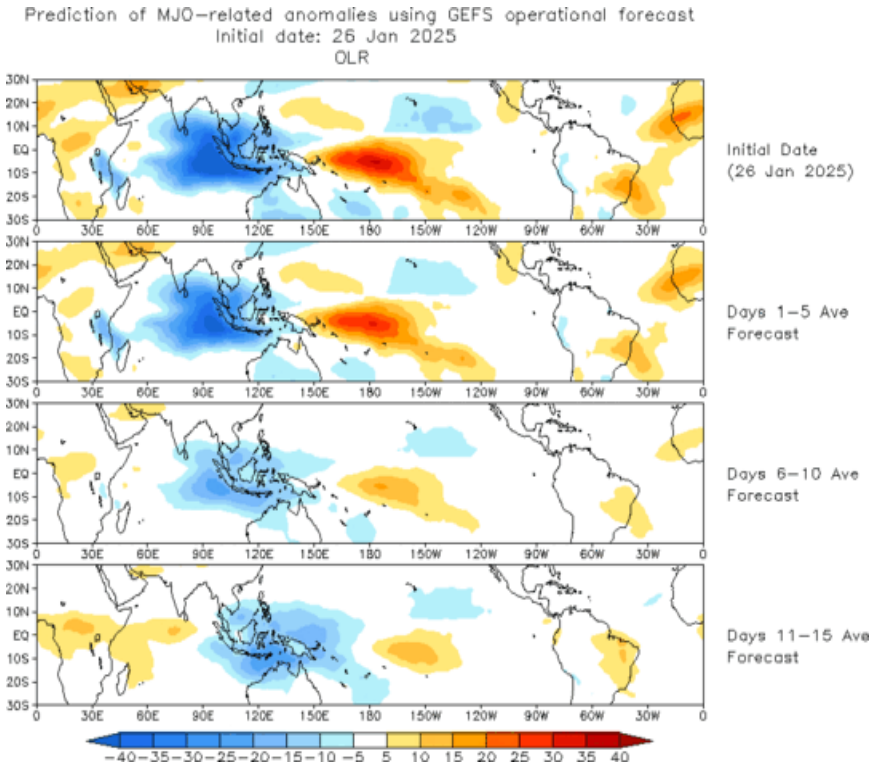


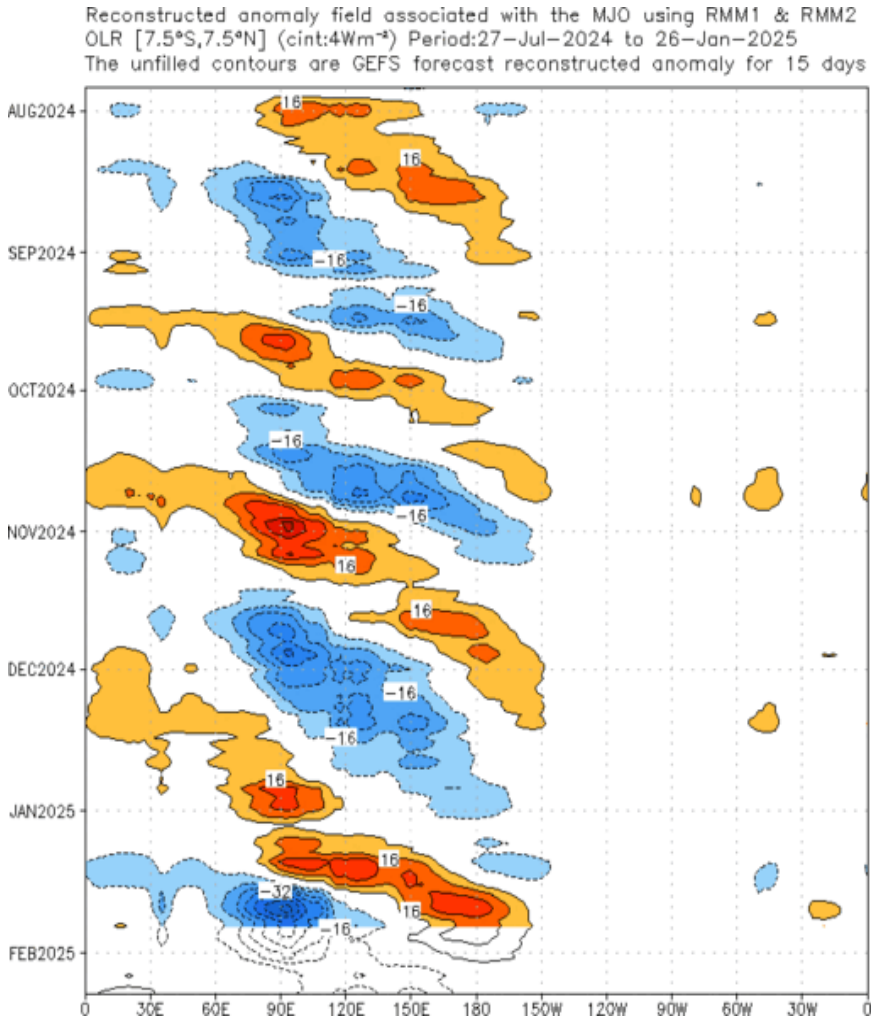
ECMWF Forecast

- Both the GEFS and ECMWF depict continued eastward propagation of the RMM index to the Maritime Continent and West Pacific through early February.
- Many of the GEFS ensemble members feature a high amplitude MJO as it constructively interferes with the La Nina base state.

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.)

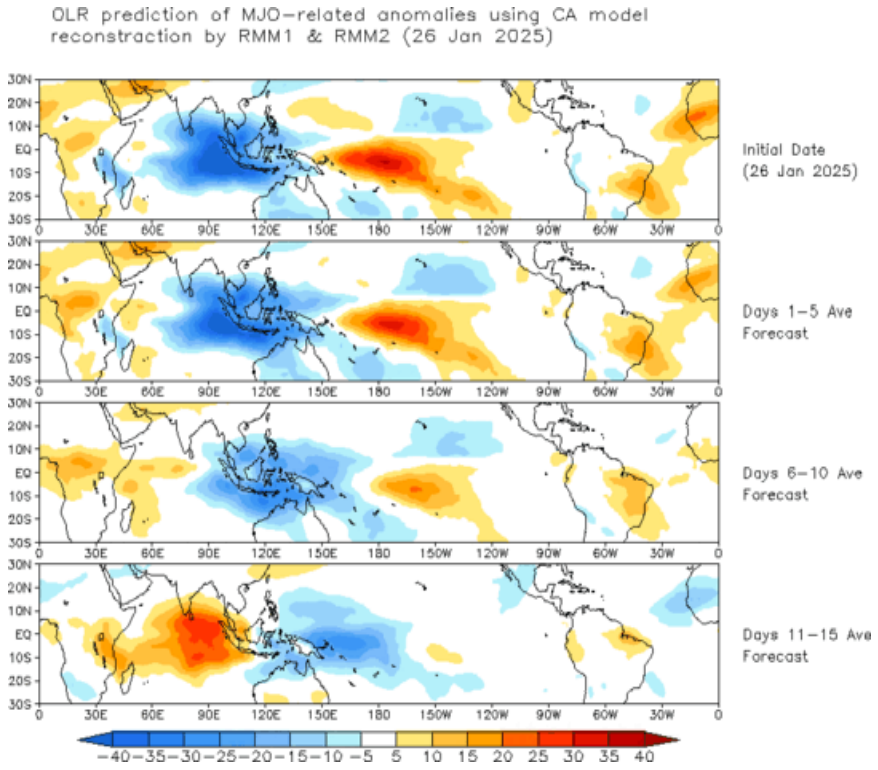


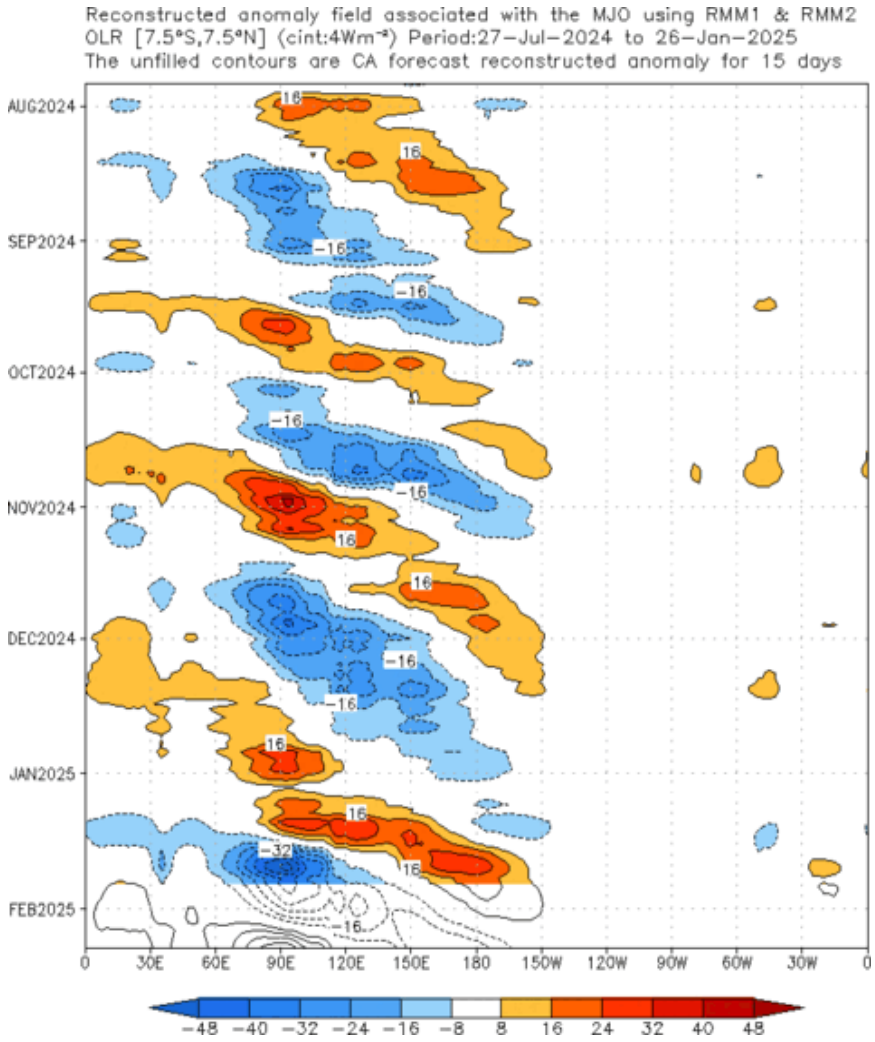


- The GEFS OLR anomaly forecast depicts a canonical MJO response with enhanced rainfall shifting east over the Maritime Continent, Australia, and the West Pacific with generally suppressed rainfall across South America and Africa.

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.)

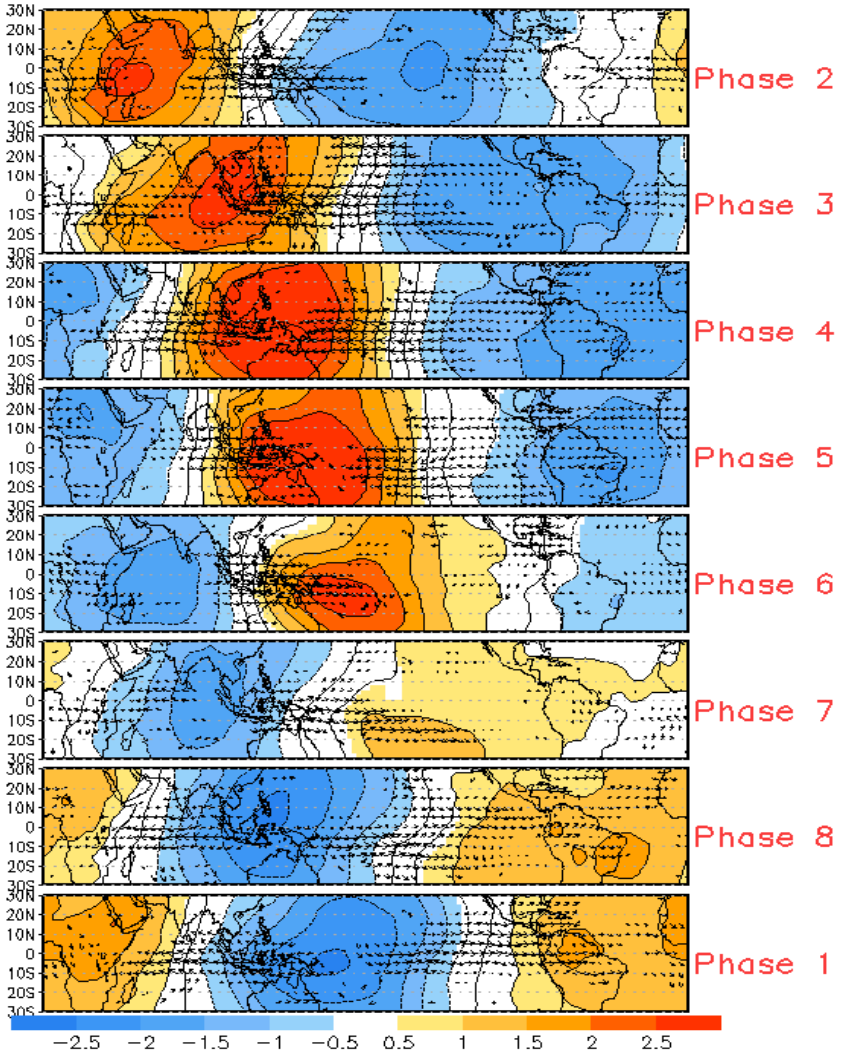




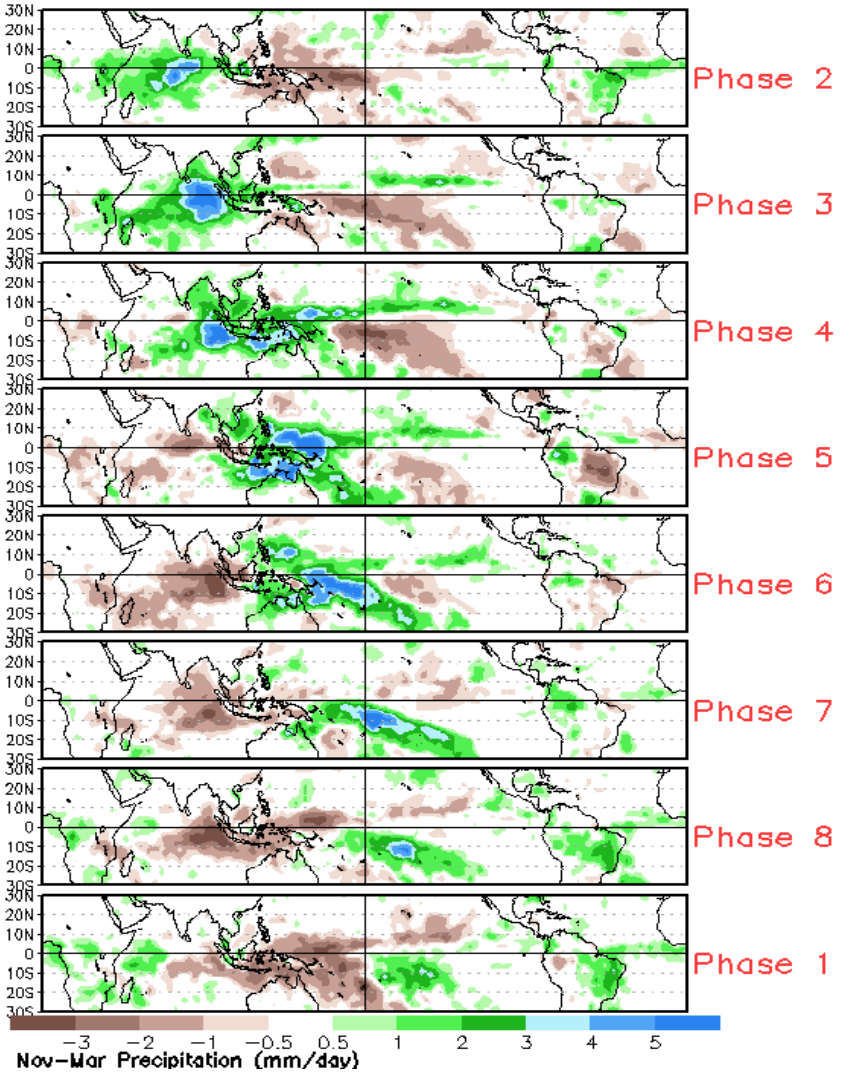
- The constructed analog (CA) forecast is similar to the GEFS although the CA is faster with drying across the Indian Ocean.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



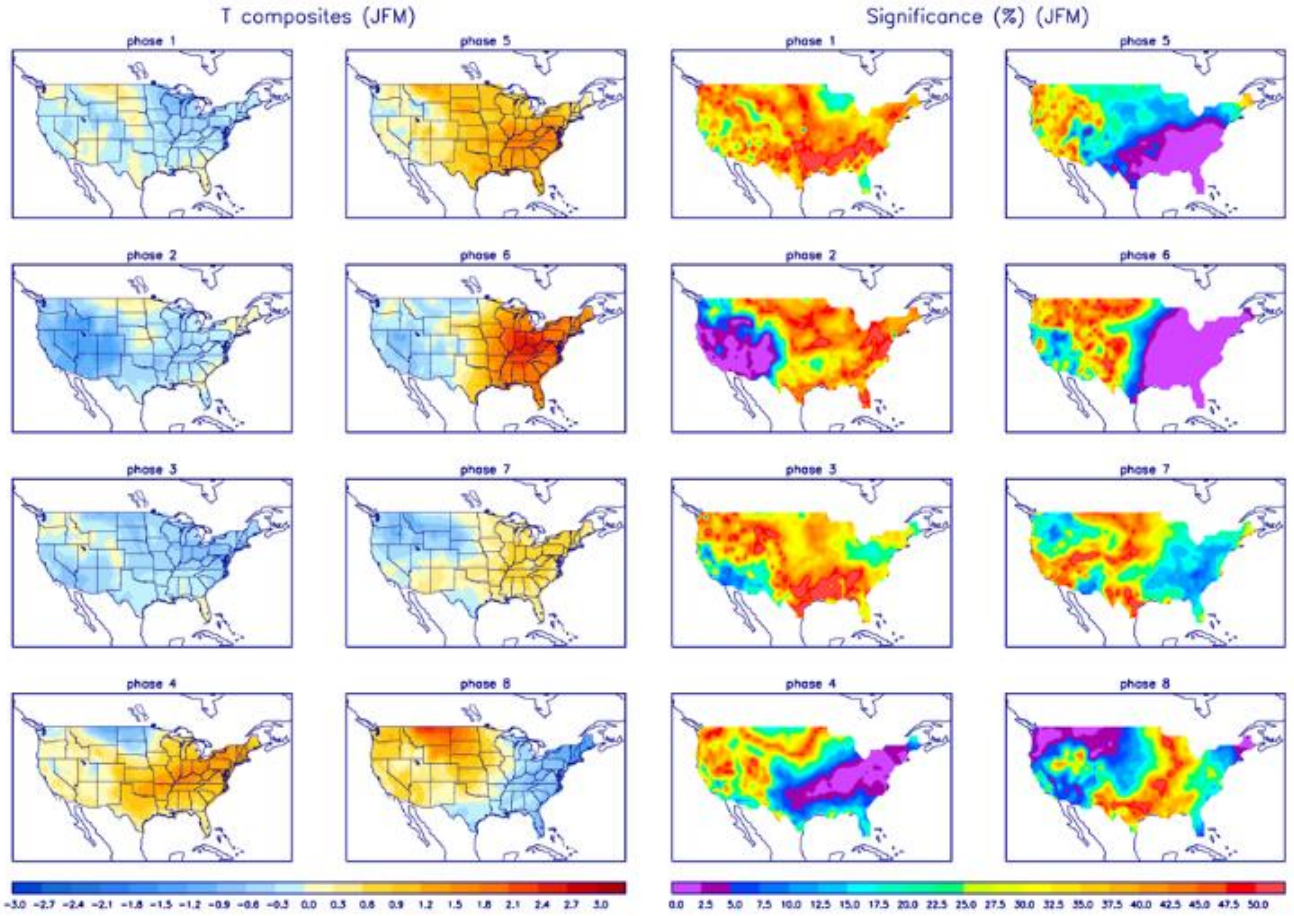
Precipitation Anomalies



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.

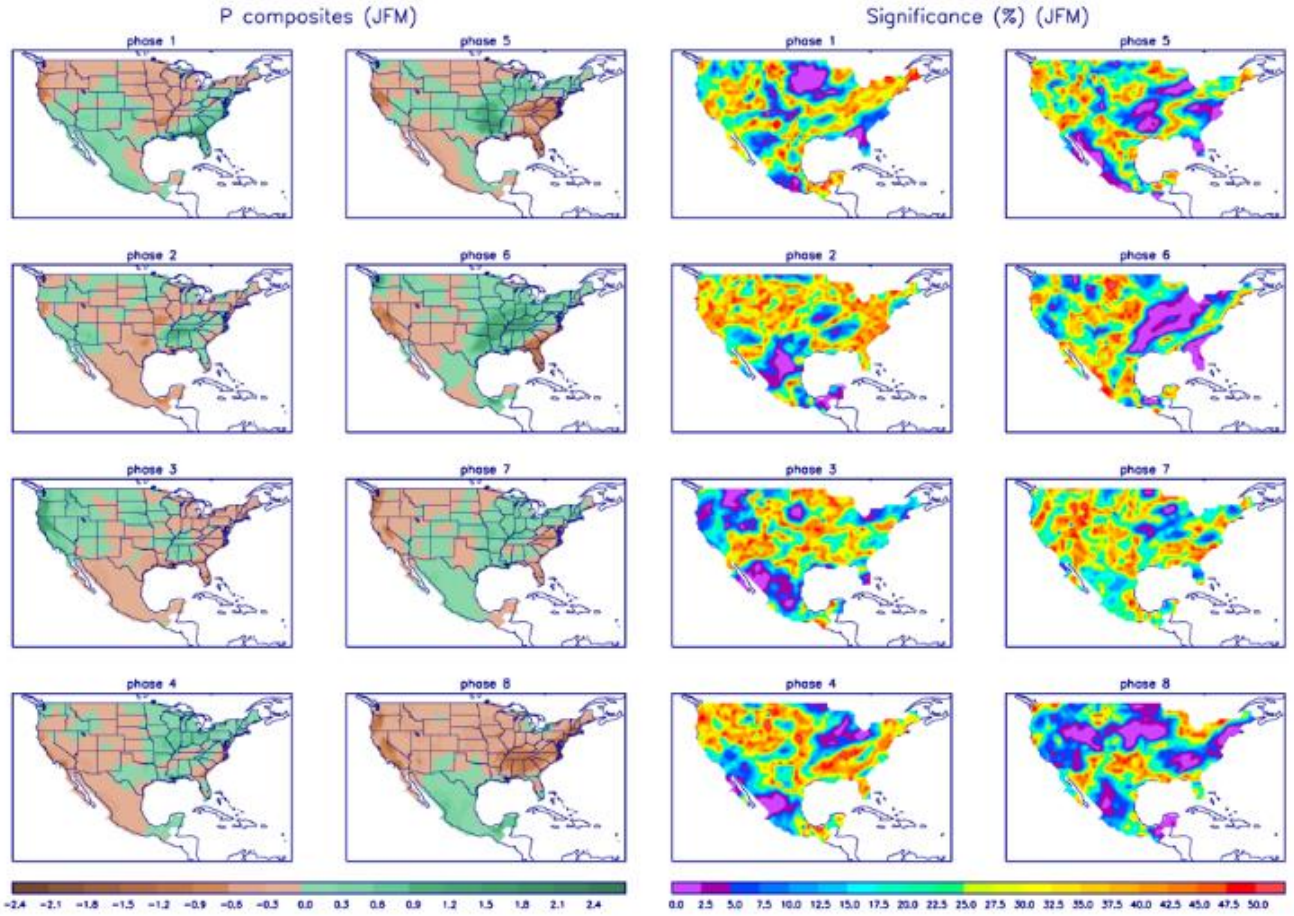


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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