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

Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
18 March 2024

Overview

- A robust MJO event continues to unfold, with the enhanced convective phase now crossing the Western Pacific.

- Widespread enhanced convection overspread the eastern Indian Ocean and western Maritime Continent, which is a departure from the weakening ENSO base state.

- Dynamical models are in good agreement with tight ensemble clustering that strong MJO activity continues to propagate eastward from the Western Pacific and into Western Hemisphere over the next two weeks. The forecasted phase speed is faster than recent observations.

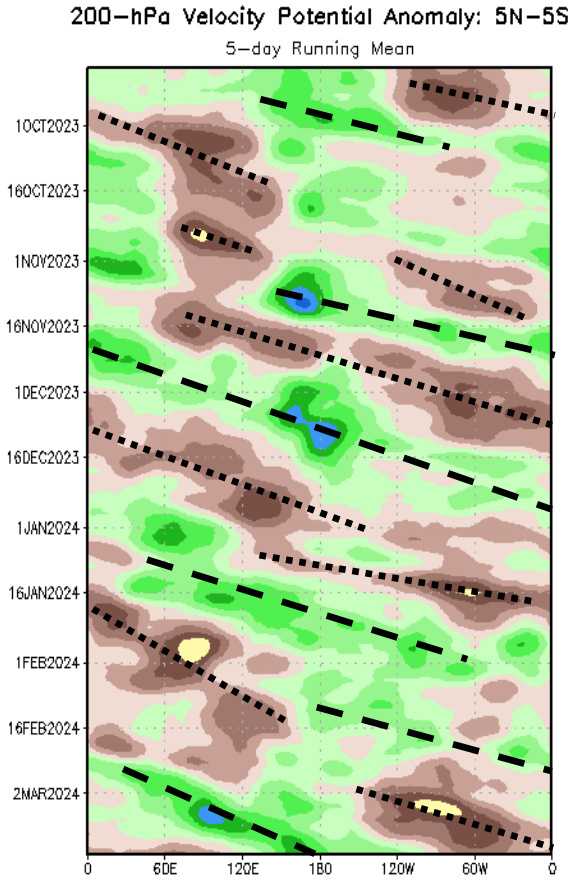
- The suppressed phase of the MJO is moving into the Maritime Continent. This tends to suppress tropical cyclone (TC) activity in the Australia and South Pacific regions, which have been active recently.

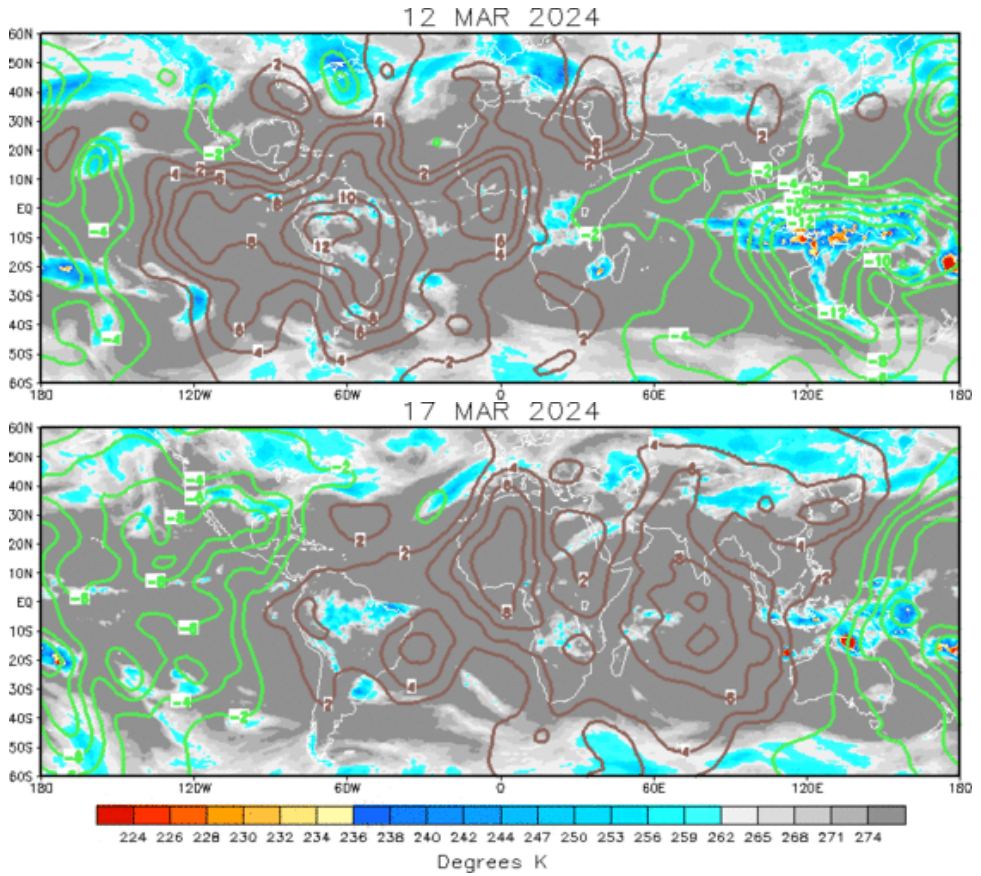
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

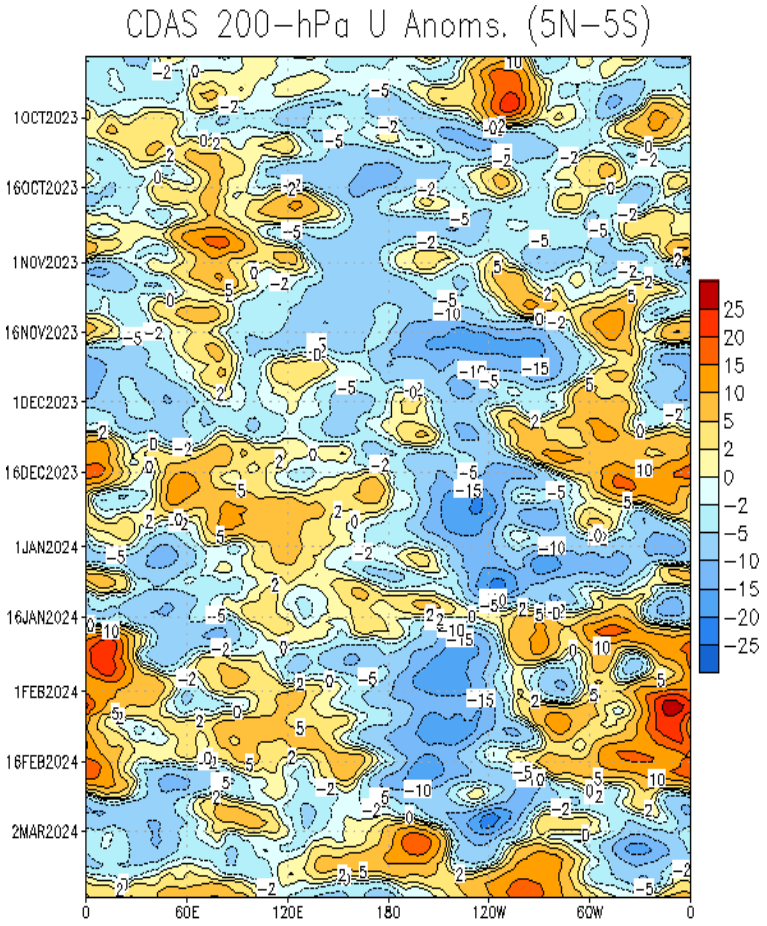


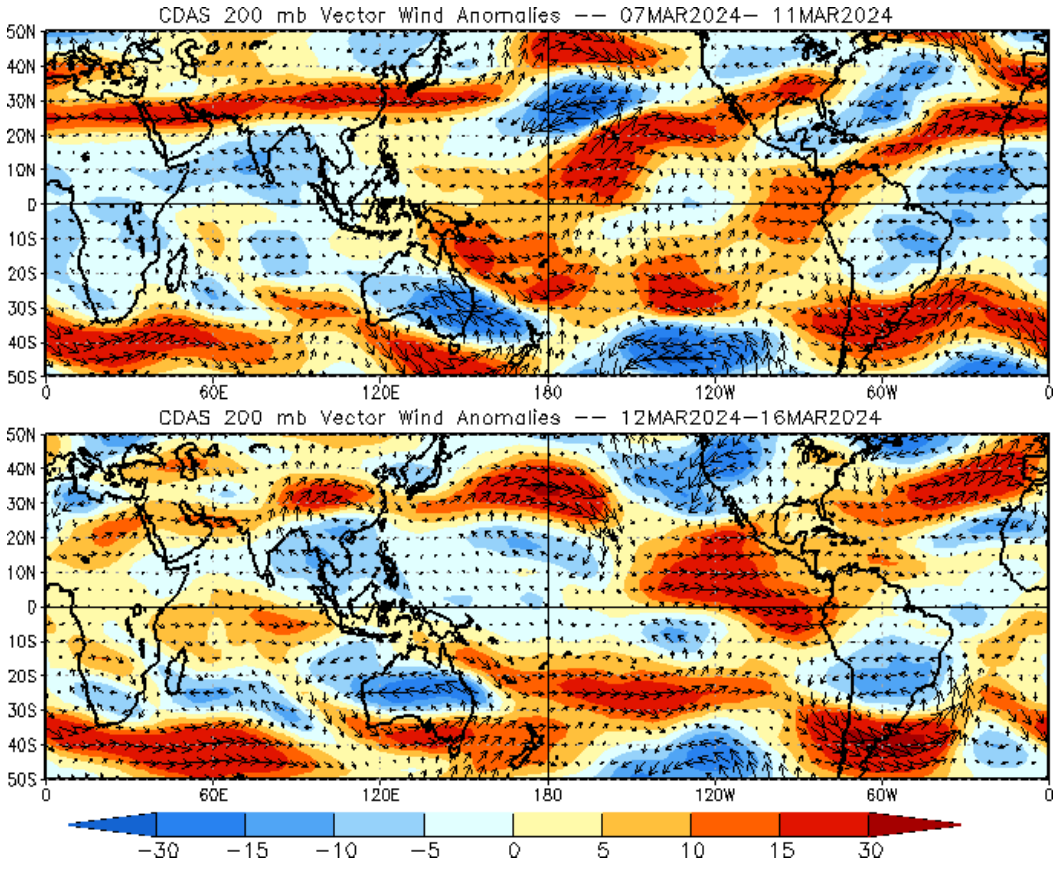


- Wave-1 symmetry is very clear in recent velocity potential anomaly maps, with the enhanced phase of the MJO moving east past the Date Line and into the Eastern Pacific.
- El Nino-enhanced convection continues near the Date Line, which has been interfering with both the enhanced and suppressed MJO phases as they have moved through this zone.

200-hPa Wind Anomalies

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

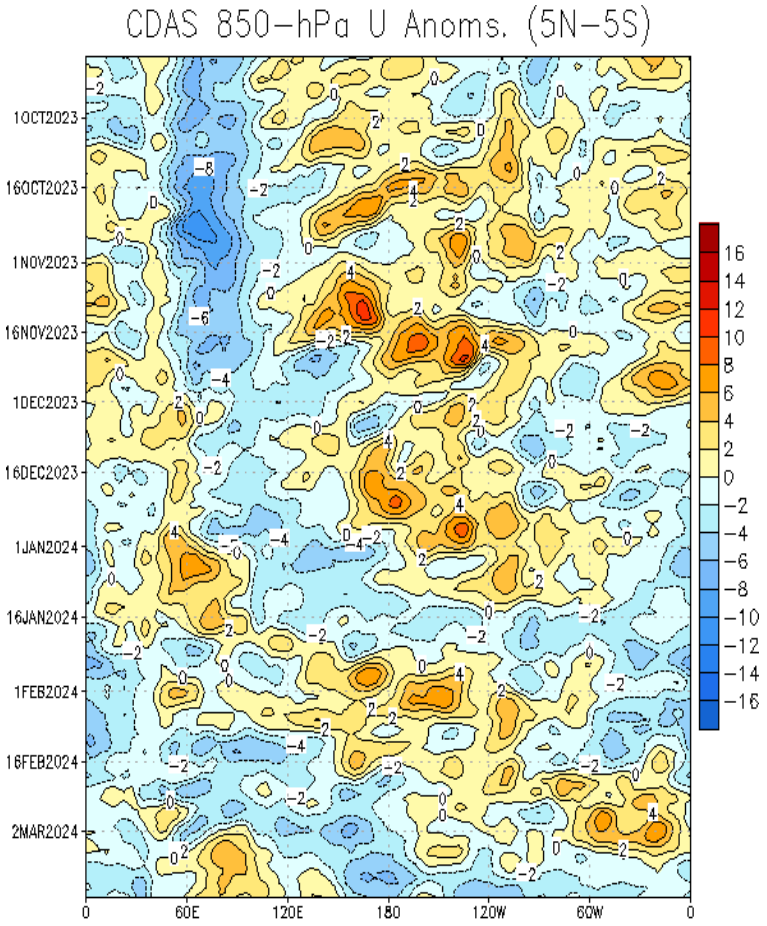


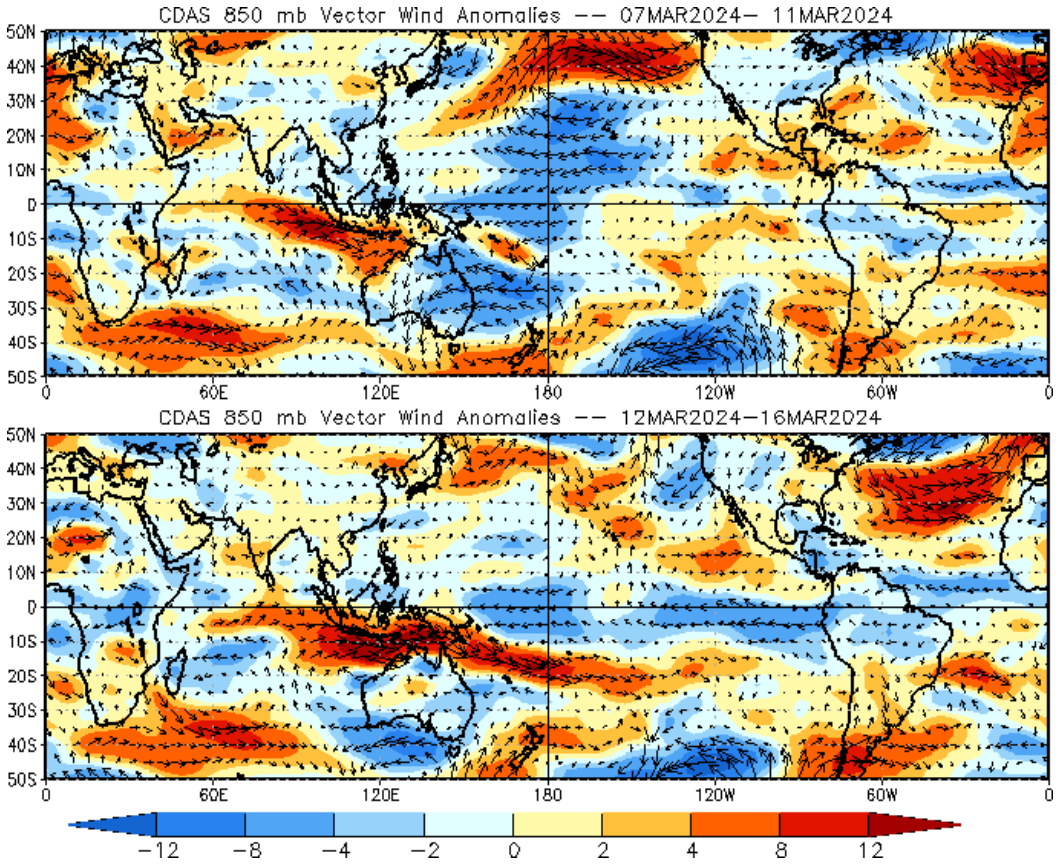


- An active subtropical jet over the Eastern Pacific (which has been a regular feature this boreal winter) has subsided recently, giving way to anomalous easterlies over the West Coast.
- The Hovmoller plot depicts and area of eastward-propagating anomalous westerlies which has overcome the low-frequency El Nino footprint, indicative of robust MJO activity

850-hPa Wind Anomalies

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

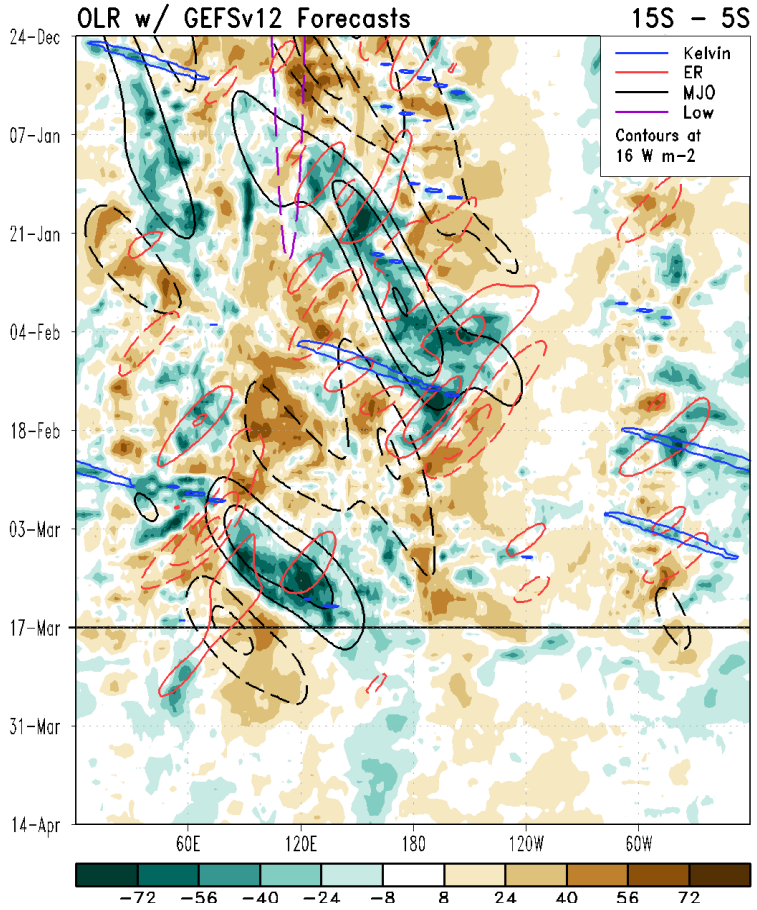


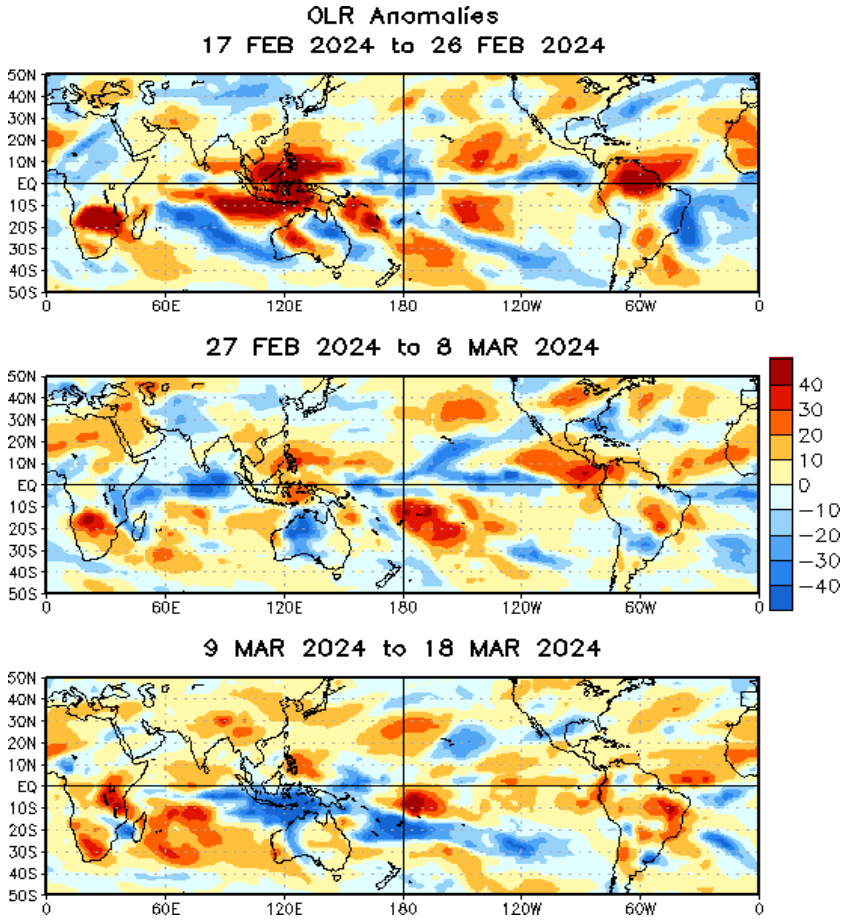


- Easterly anomalies (i.e. enhanced trades) have become widespread over the Equatorial Pacific recently, potentially leading to upwelling along the Equator and further breaking up the already weakening El Nino.
- Strong westerly anomalies have been observed along the northern coast of Australia, likely a combination of MJO and recent TC activity.

Outgoing Longwave Radiation (OLR) Anomalies

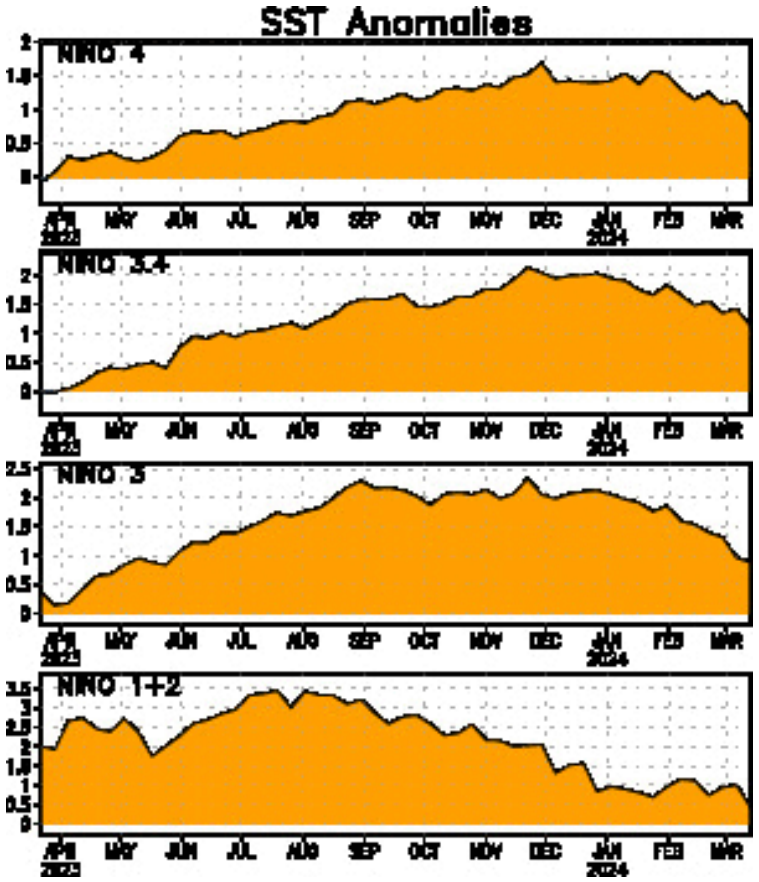
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

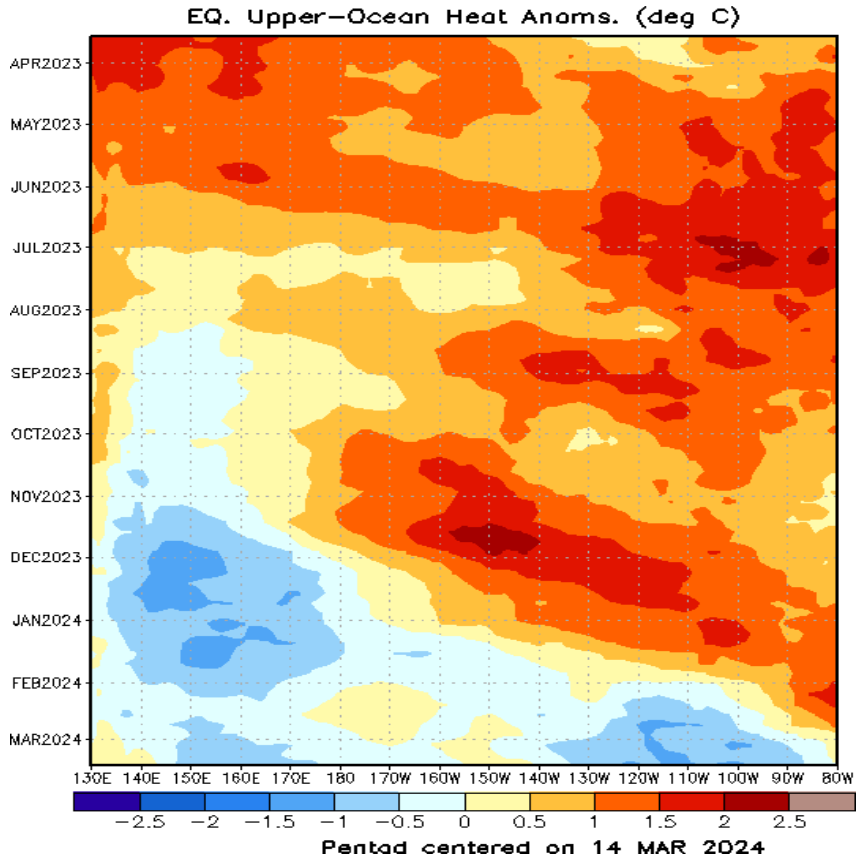




- The MJO signal is well represented in the objective filtering, with the enhanced phase nearing the Date Line.
- OLR anomalies over the Maritime Continent have reversed notably recently, a reflection of the high amplitude of the MJO signal of late.
- GEFS forecast depictions of MJO activity are a little mixed, with a clearer propagation of the suppressed phase into the Indian Ocean than the enhanced phase moving through the Western Hemisphere.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

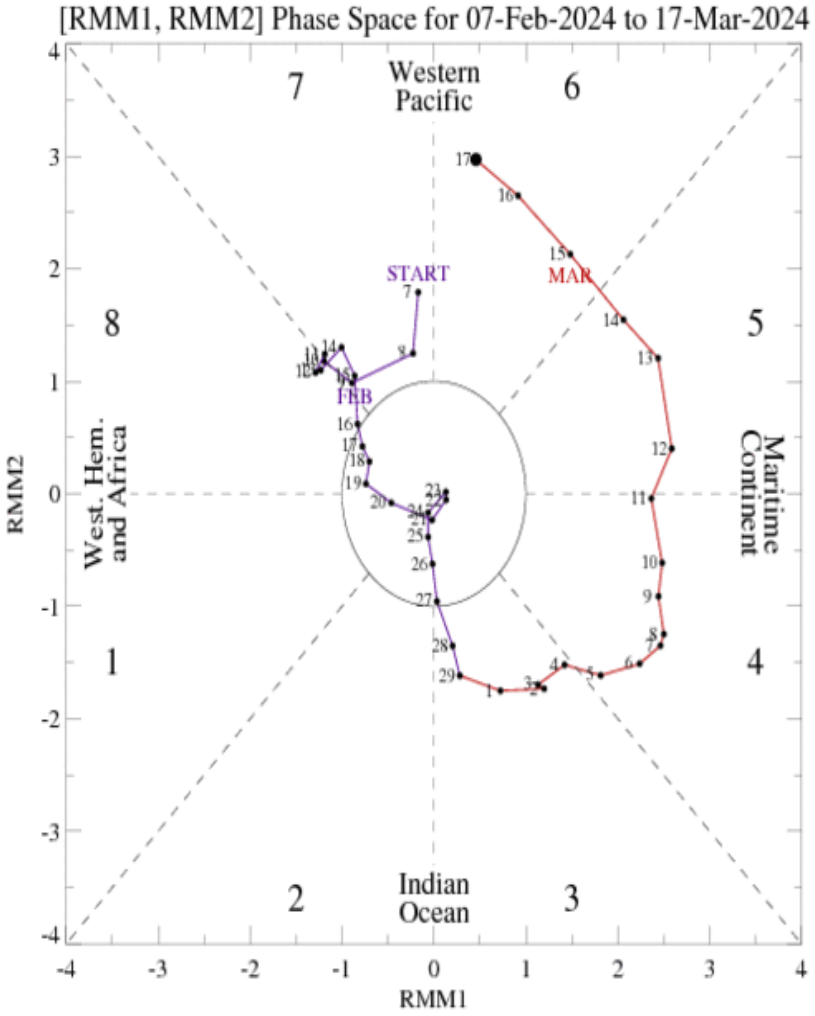




- There has been a notable downward trend in SST anomalies in all NINO regions during the past two months suggestive of a weakening El Niño.
- Subsurface anomalies have flipped sign over the central and eastern Equatorial Pacific due to upwelling generated in part by MJO activity. Positive heat anomalies are nearly gone now for the entire Tropical Pacific.

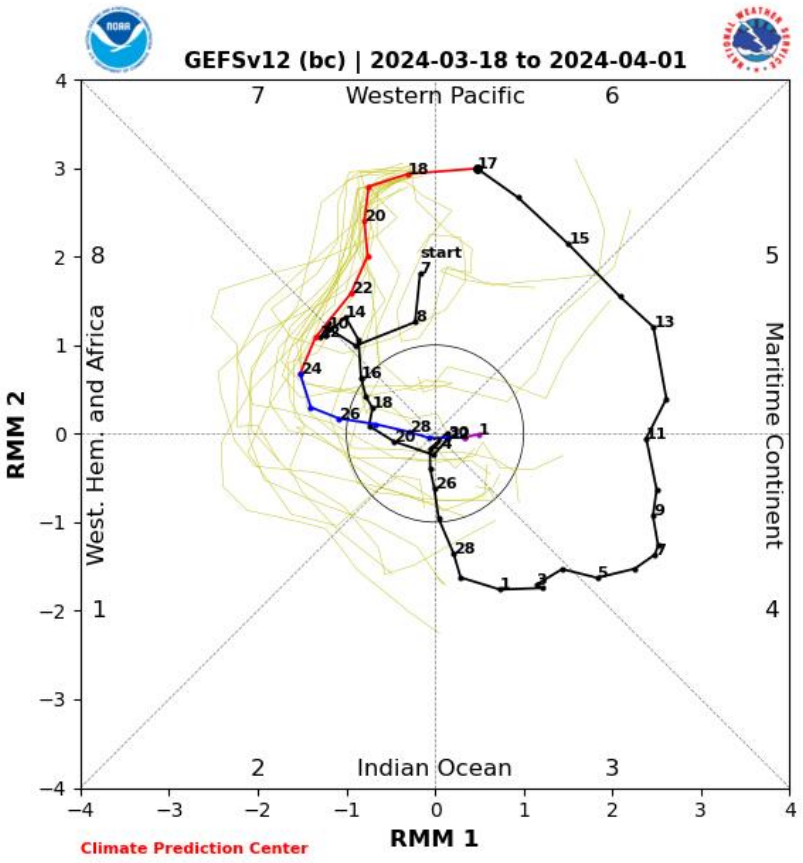
MJO Index: Recent Evolution

- The RMM-based MJO index reflects strong MJO activity, with clearly established eastward propagation from the Indian Ocean well into the Western Pacific at high amplitude.
- The 120-day mean, removed for RMM calculations, still includes anomalies from the IOD event last year, and can potentially be further complicated by the forecasted shift from El Nino to La Nina. Such issues have been affecting RMM interpretation for some time now.

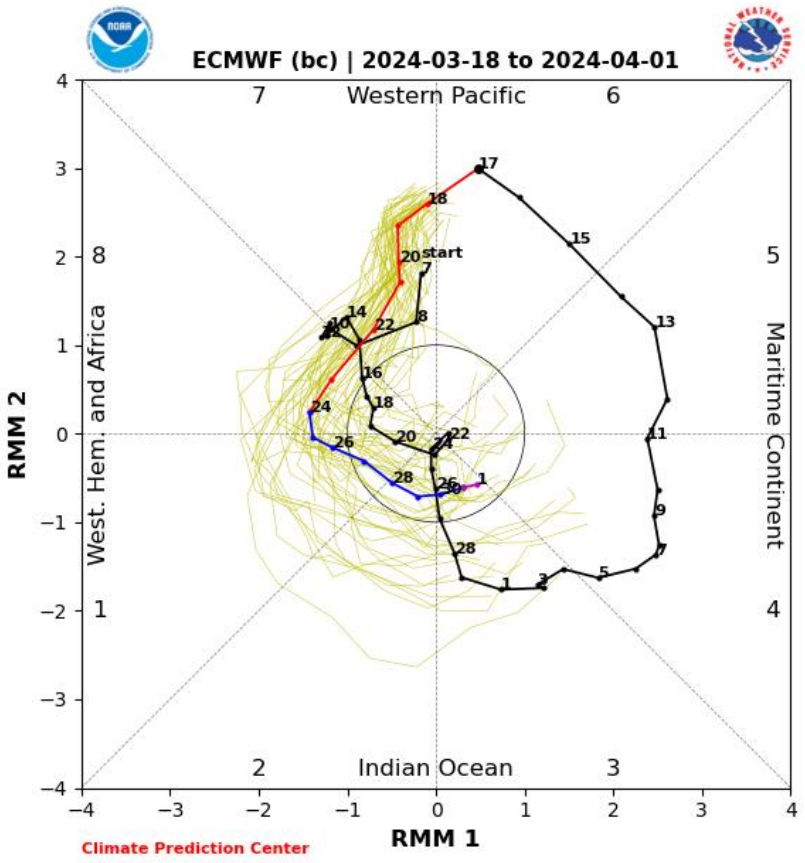


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

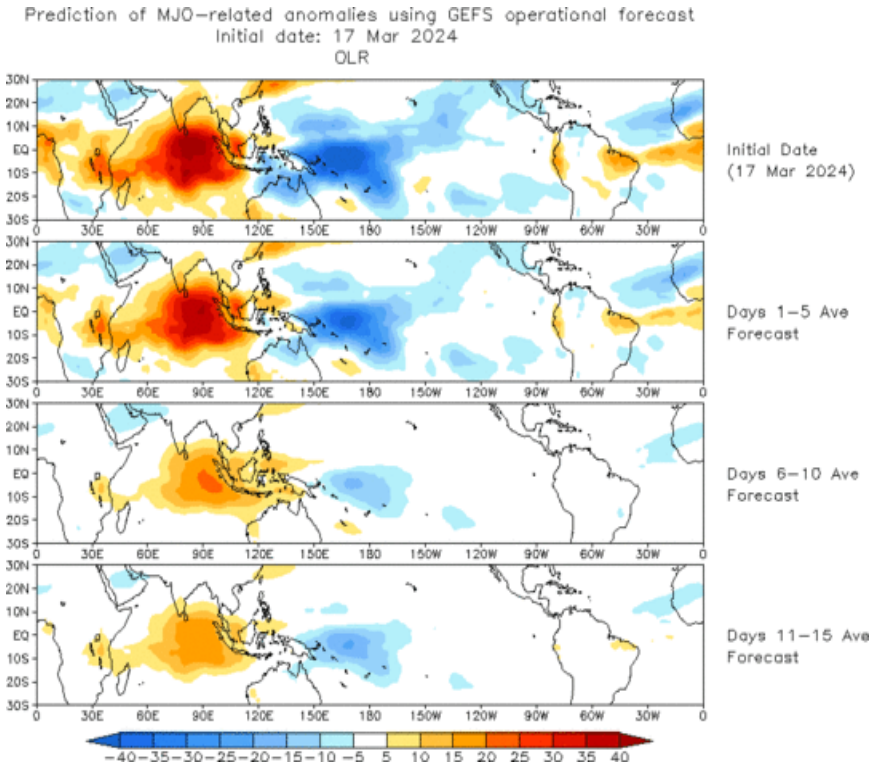


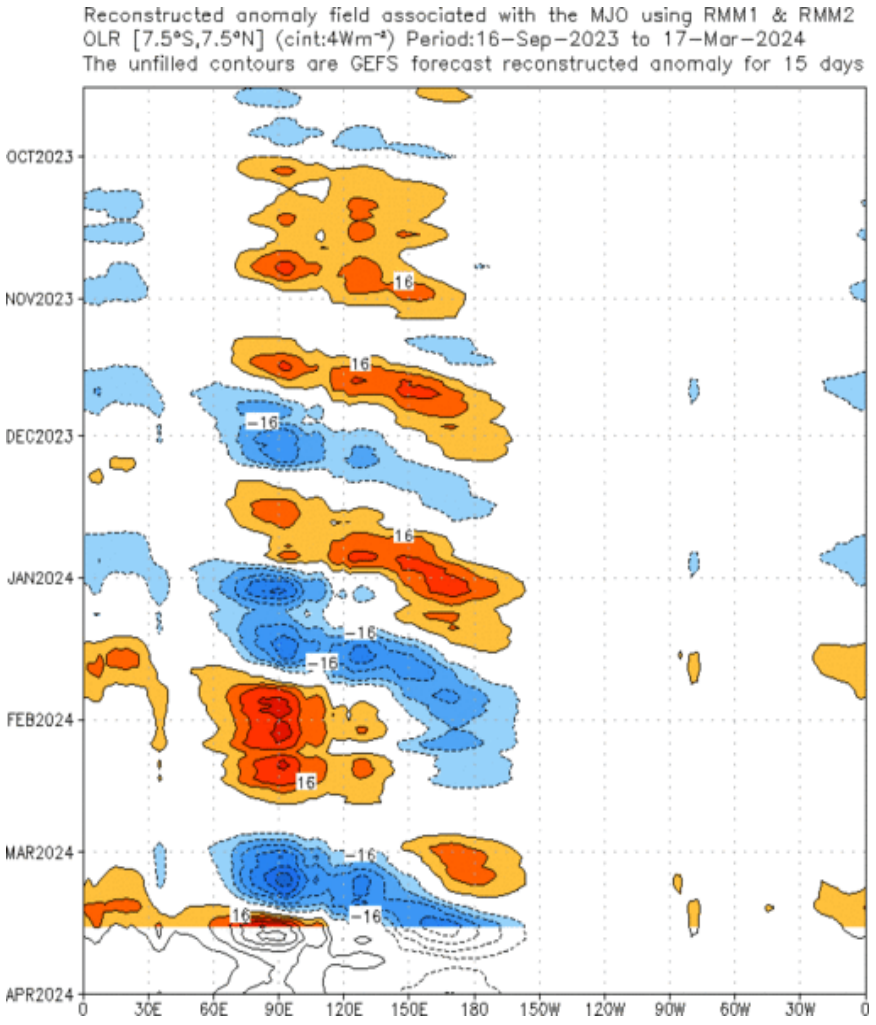
ECMWF Forecast

- The GEFS and ECMWF forecasts are in very good agreement, both among their respective ensemble members and with respect to each other, depicting a continued eastward propagation of the RMM signal.
- Both models show MJO propagation that is faster in week-1, then slows as the RMM index moves into phases 2 and 3.
- The signal weakens over time in both models, but whether this is due to and actual weakening of the MJO or due to the 120-day mean confounding the RMM calculation is difficult to determine.

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.)

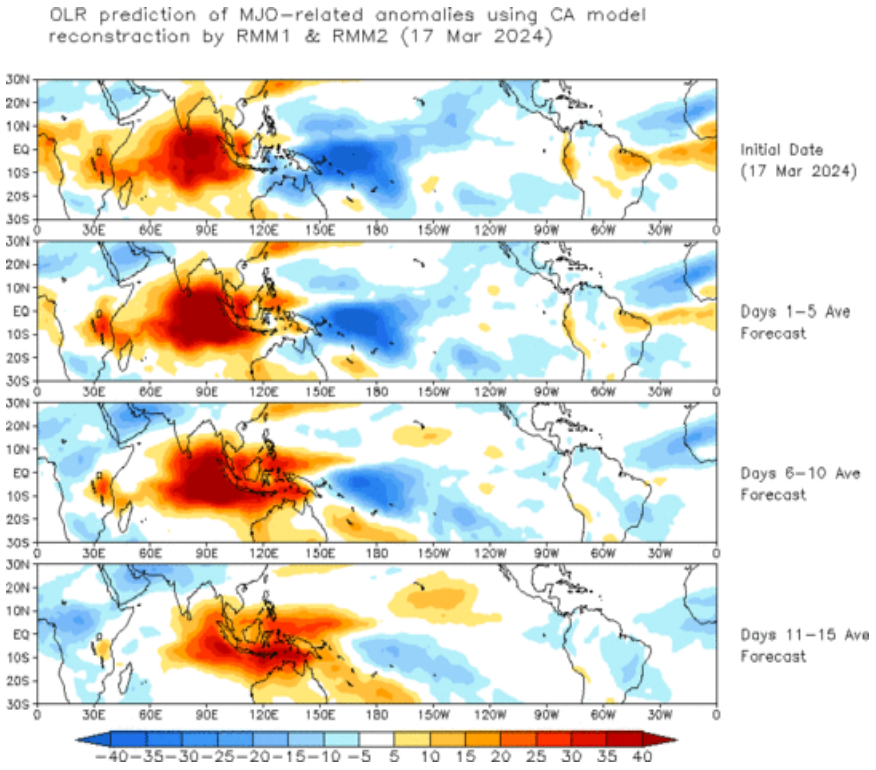


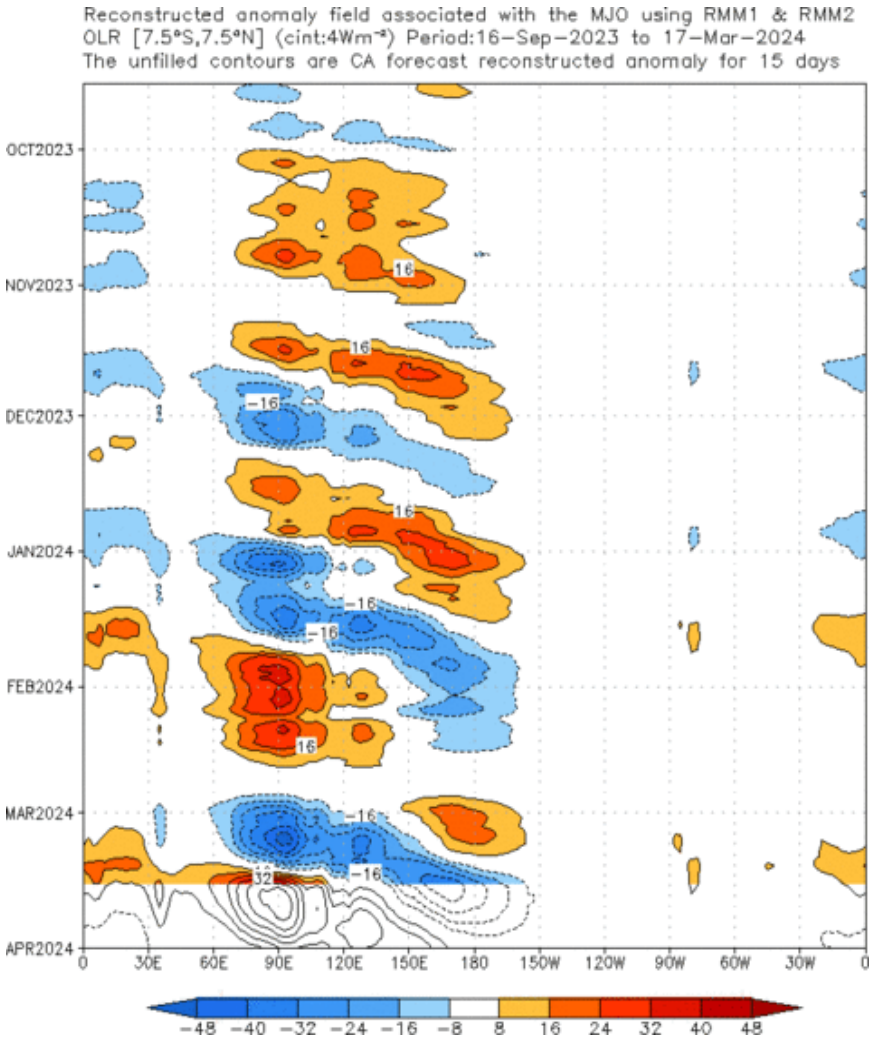


- The GEFS RMM-based tool shows little movement in the OLR pattern, with suppressed (enhanced) convection over the Indian Ocean (Western Pacific).
- These features are both depicted as weakening through week-2.

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.)

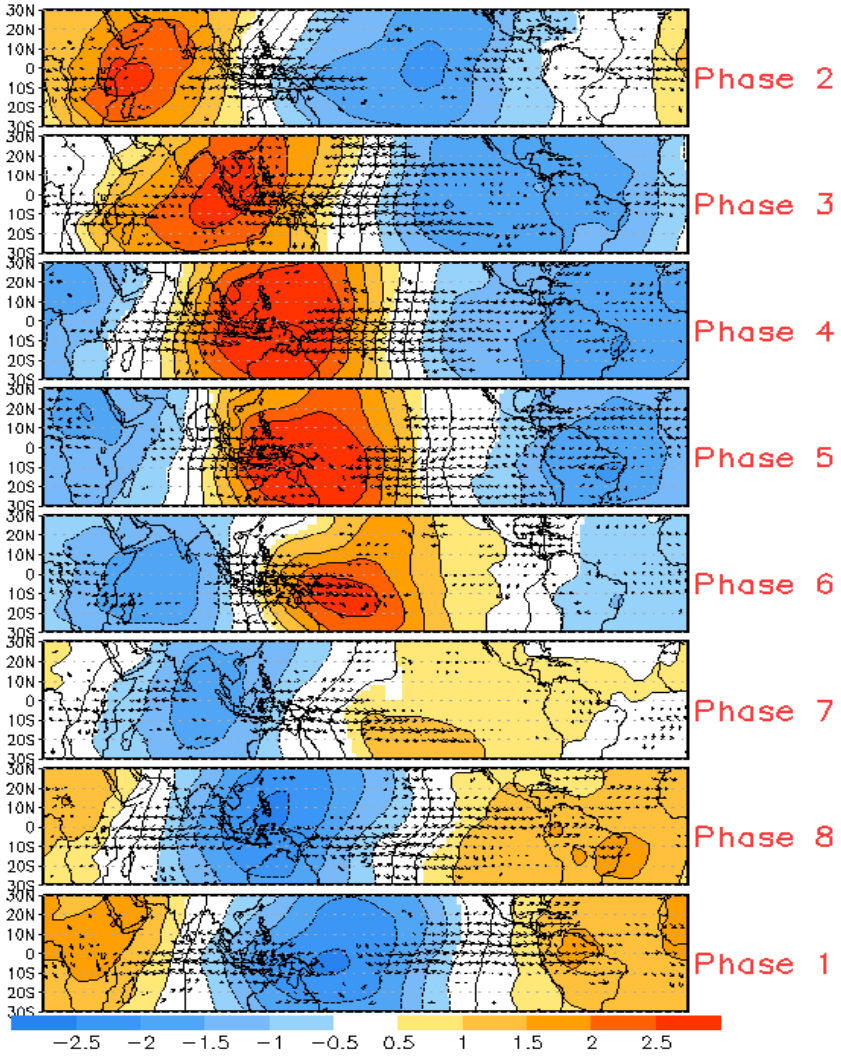




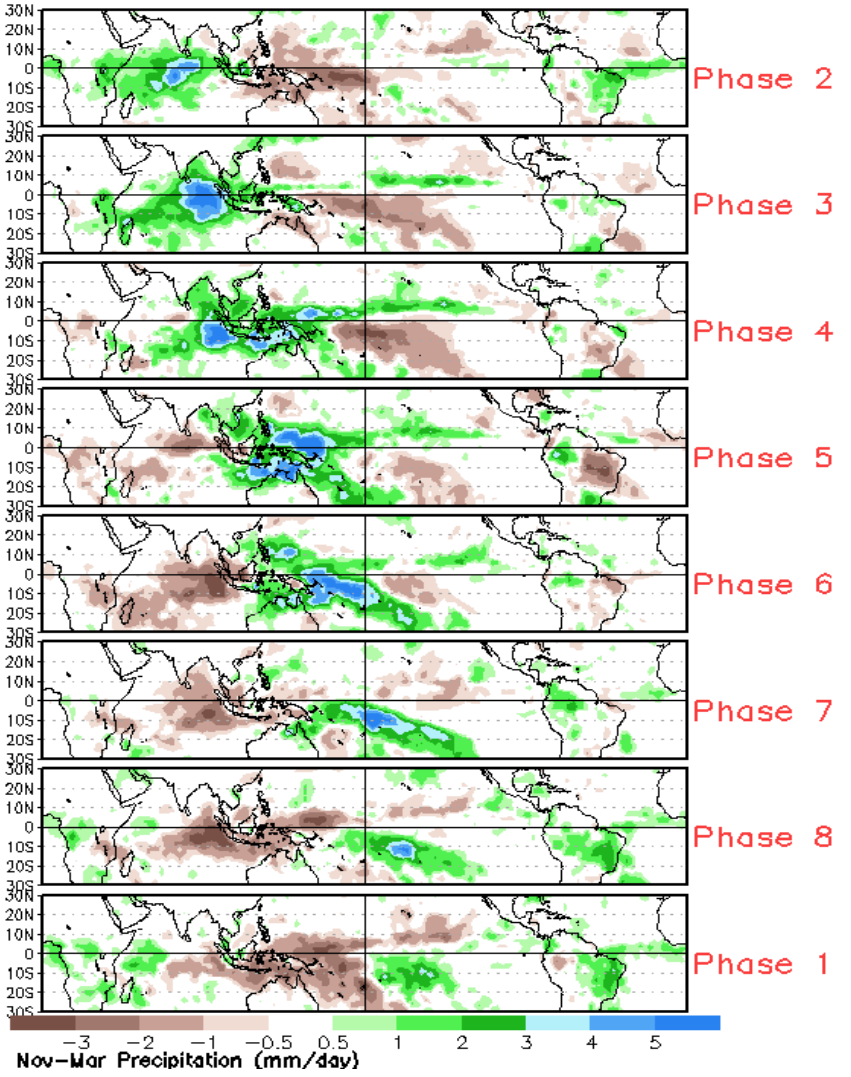
- The constructed analog tool depicts a much more coherent MJO, with steady propagation of the suppressed phase from the Indian Ocean into the Maritime Continent and the emergence of enhanced convection over Africa during week-2.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



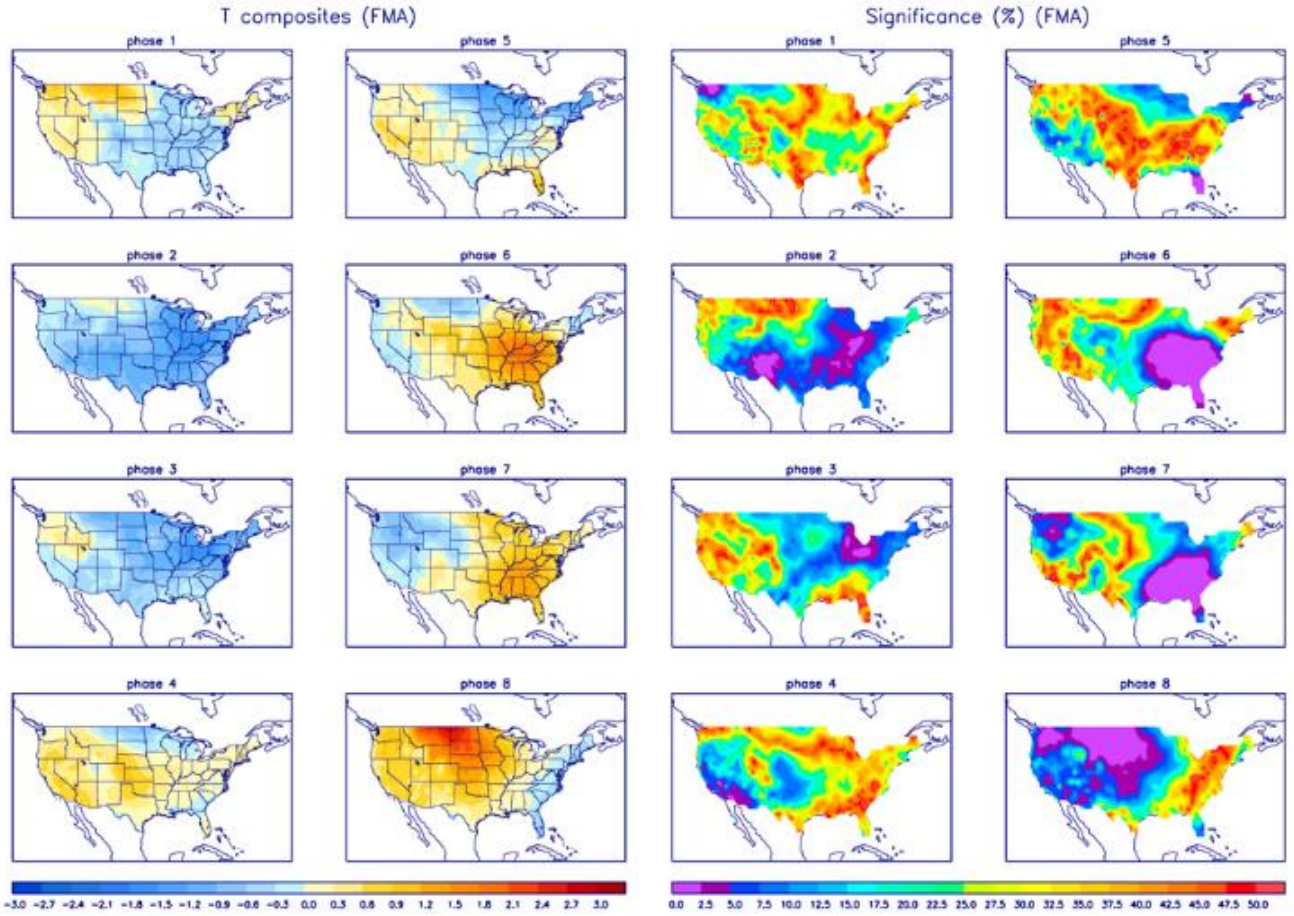
Precipitation Anomalies



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.

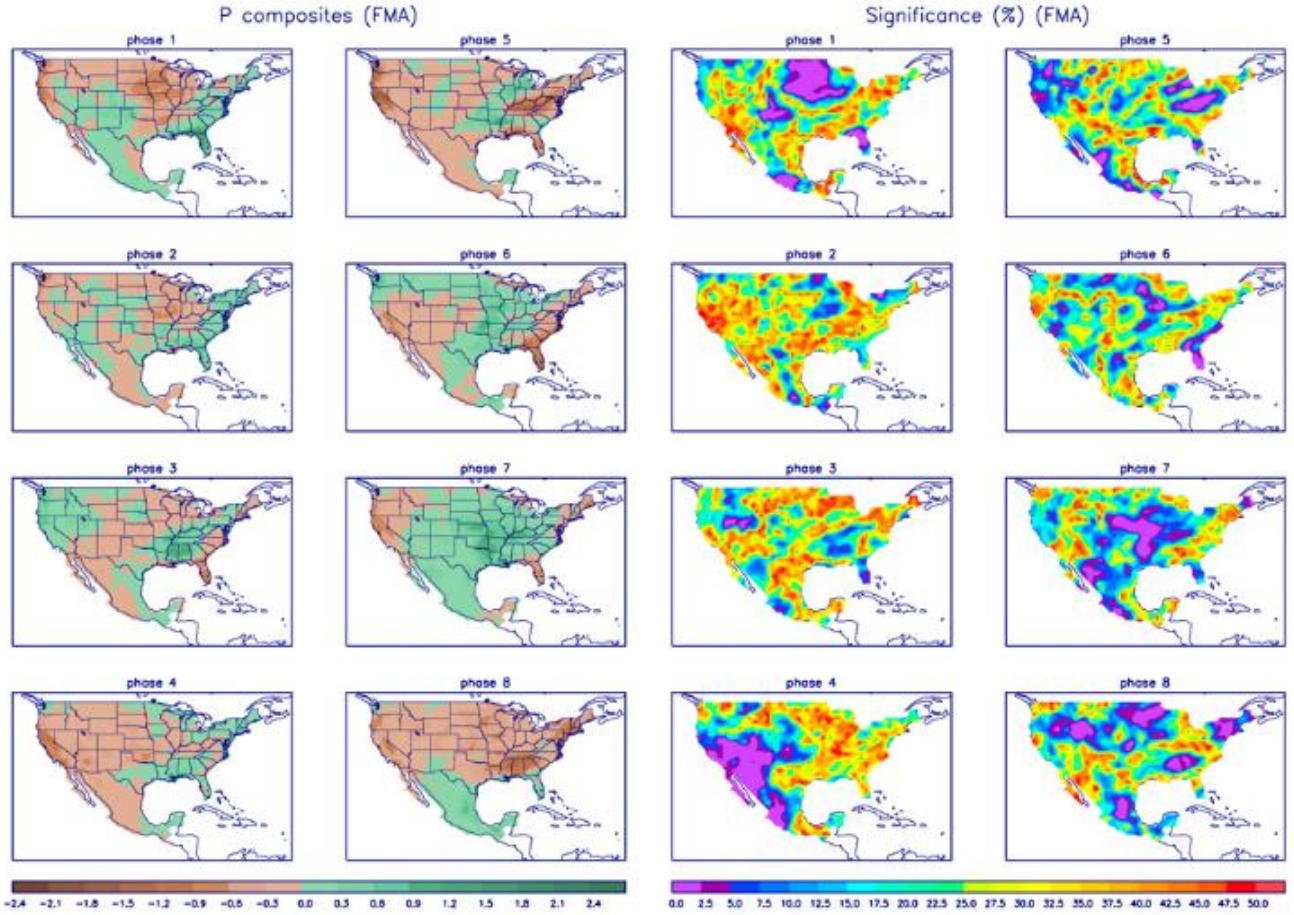


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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