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

Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
2 December 2024

Overview

- An active MJO event continues, with the enhanced convective phase now crossing the Maritime Continent.

- A strong westerly wind burst is underway over the eastern Indian Ocean basin, which may provide favorable conditions for tropical cyclone formation over the southeastern Indian Ocean or northwest of Australia.

- Dynamical model forecasts depict continued eastward propagation of the MJO signal, but with a much slower phase speed as the signal constructively interferes with a base state trending slowly towards La Niña conditions and a negative IOD event.

- Extended range forecasts from the ECMWF and GEFS show the signal crossing the West Pacific later in December, with a continued slow phase speed and increased uncertainty.

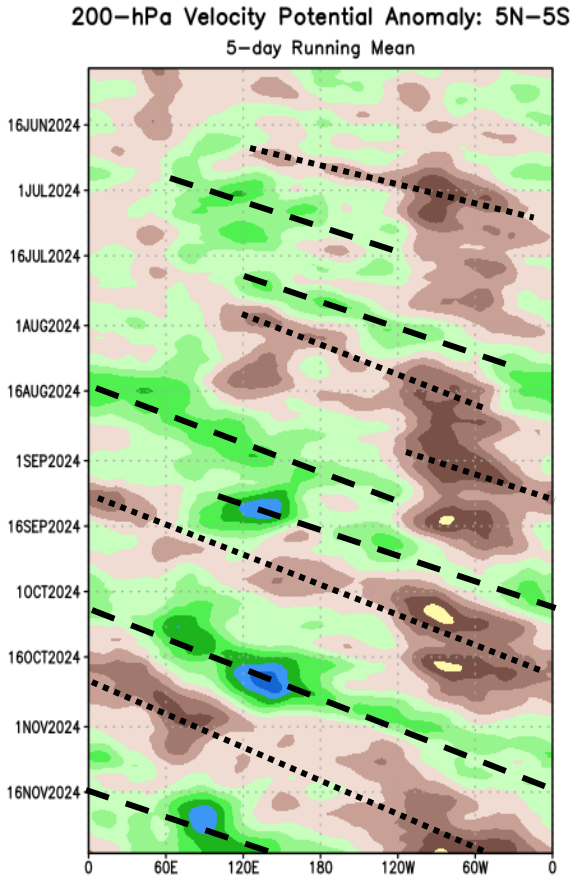
- Enhanced divergence across the Maritime Continent due to the MJO and a negative IOD event may result in areas of persistent enhanced rainfall across portions of the Maritime Continent and Australia.

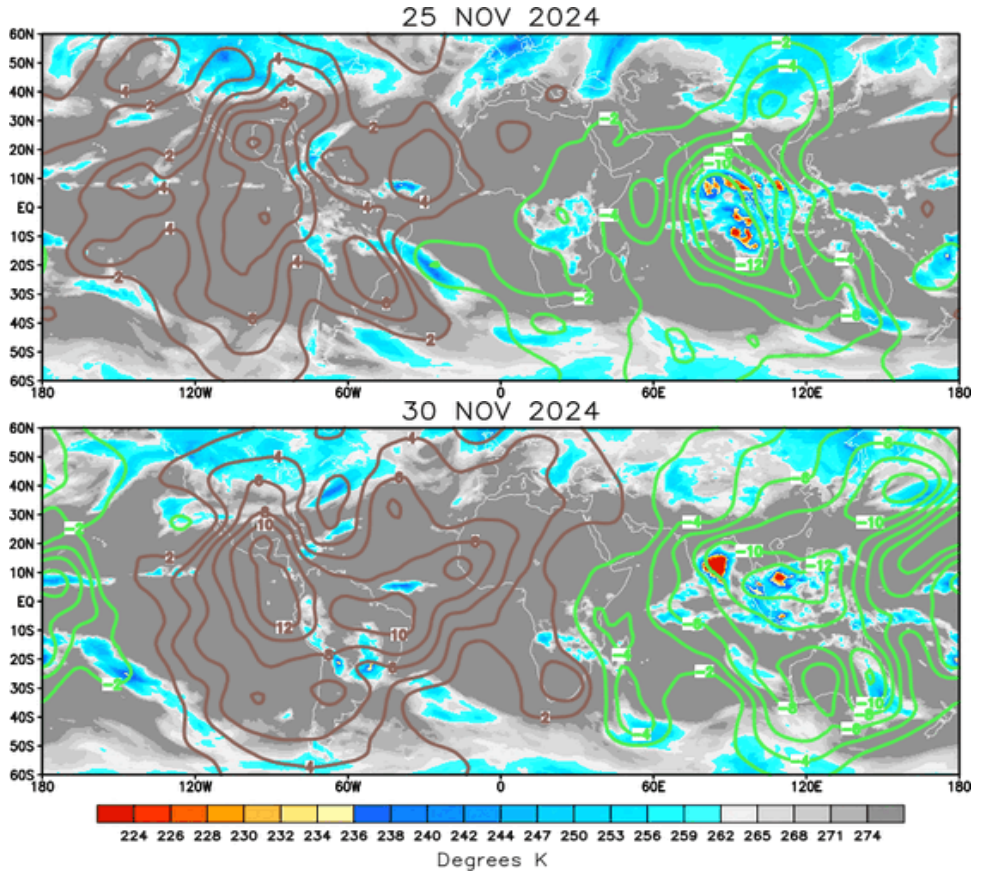
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

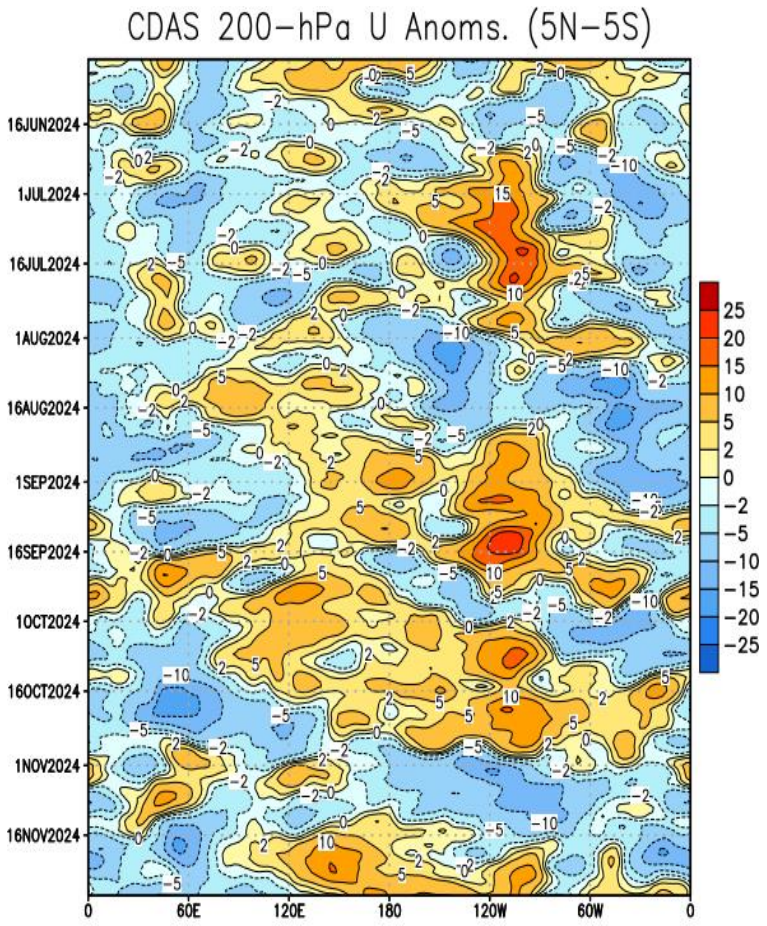


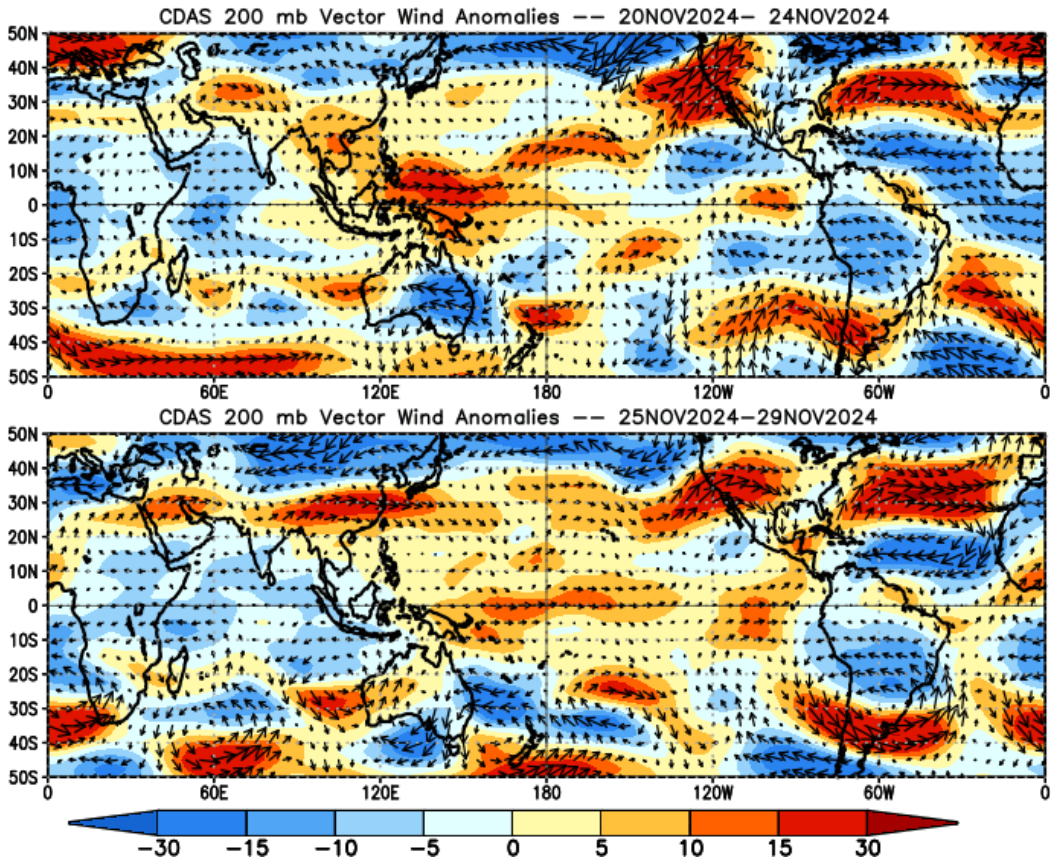


- A robust wave-1 pattern aloft became established during the latter half of November.
- Eastward propagation of this signal remains apparent, with the enhanced divergent envelope pushing just east of the Date Line at the end of November.
- Constructive interference between the intraseasonal signal and the low frequency base state appears to be slowing the overall eastward propagation of the broad-scale convective envelopes.

200-hPa Wind Anomalies

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

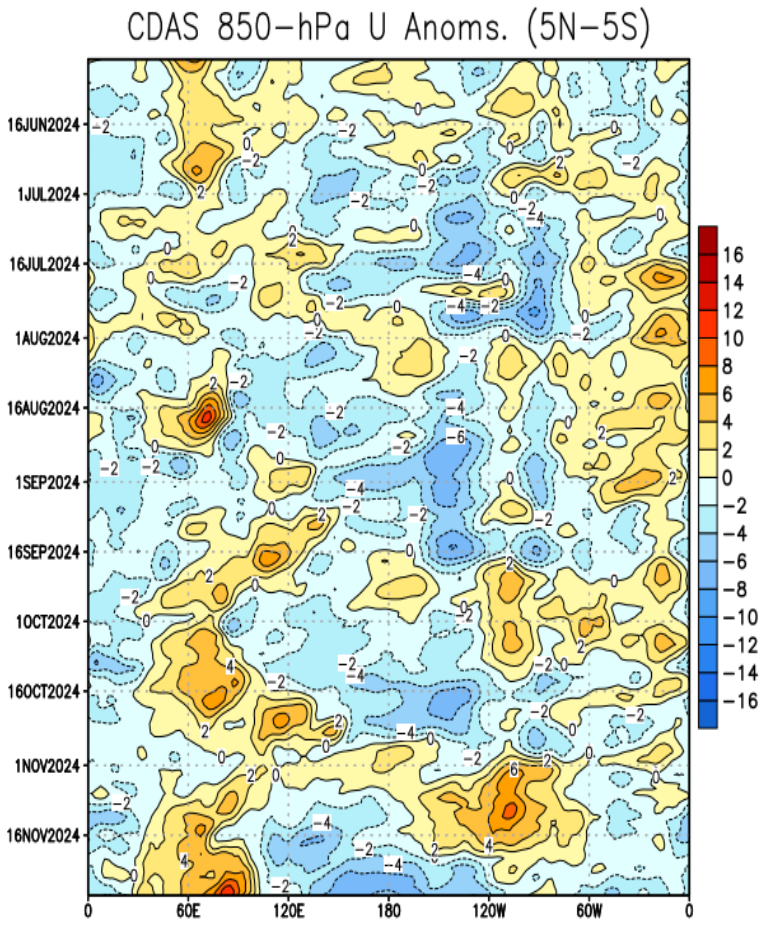


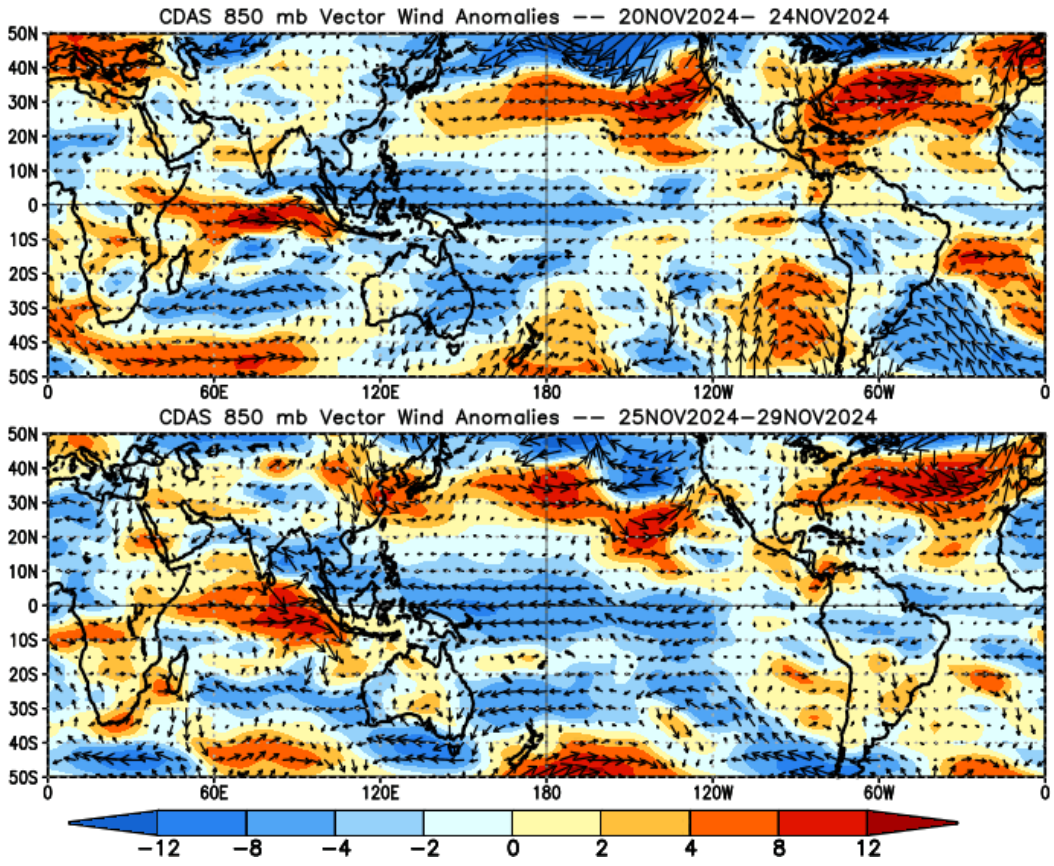


- Eastward propagation of an envelope of enhanced westerlies aloft is apparent over the Pacific, while easterly anomalies overspread the Indian Ocean basin.
- Strongly enhanced divergence is now centered over the Maritime Continent, consistent with the upper level velocity potential analysis.

850-hPa Wind Anomalies

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

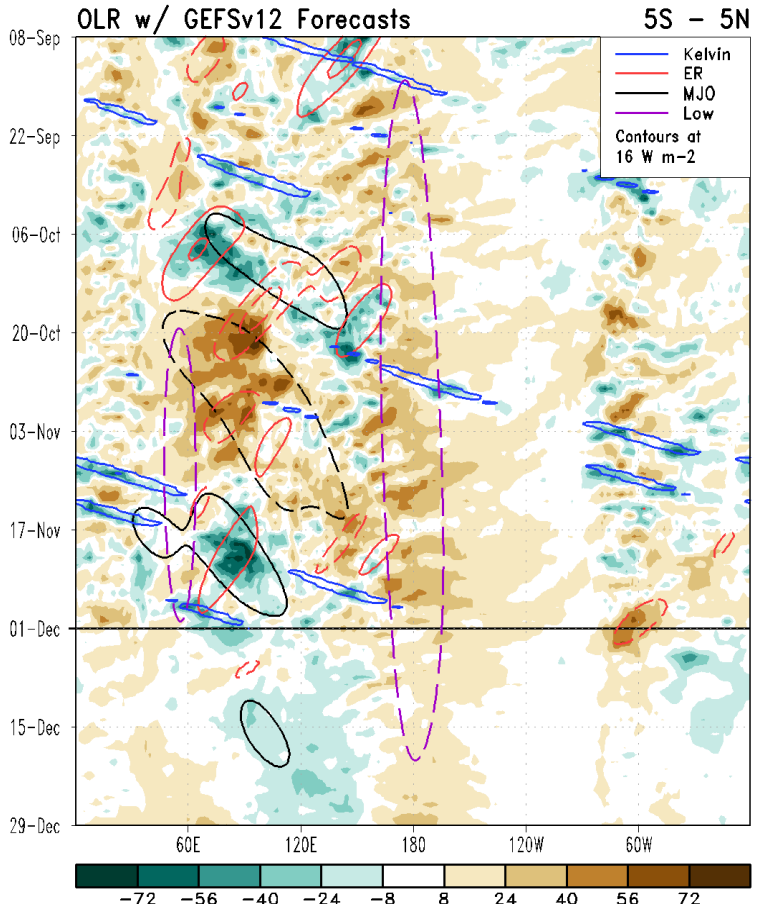


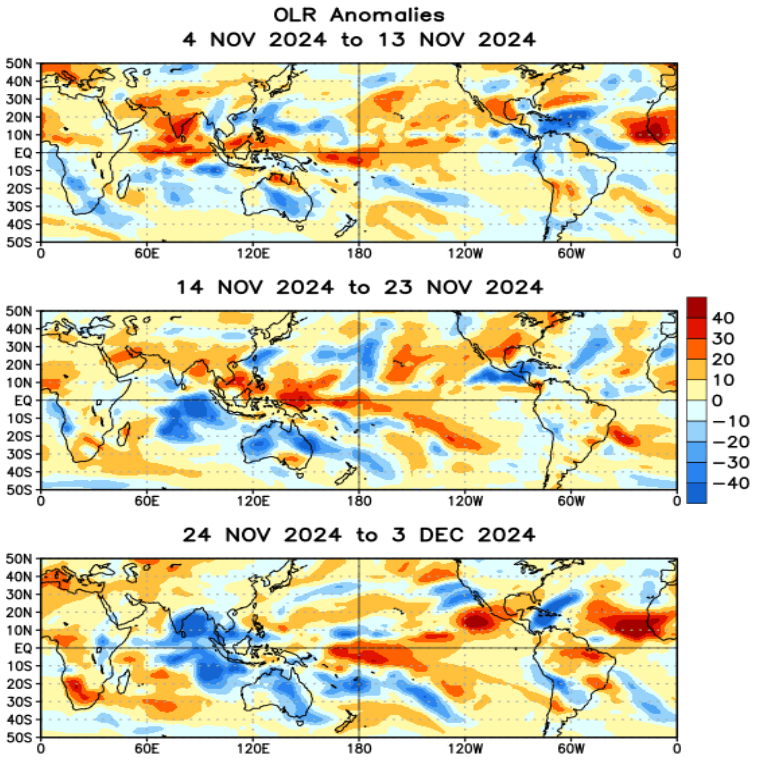


- Unlike the upper-level fields, the low-level wind field exhibits less apparent eastward propagation.
- A strong westerly wind burst (WWB) is underway over the eastern Indian Ocean, which may promote tropical cyclone development in the vicinity during Week-1 or early Week-2.
- In contrast, a trade wind surge is underway across the western and central Pacific, though weaker anomalies remain across the far eastern Pacific, with westerlies over portions of Central America.

Outgoing Longwave Radiation (OLR) Anomalies

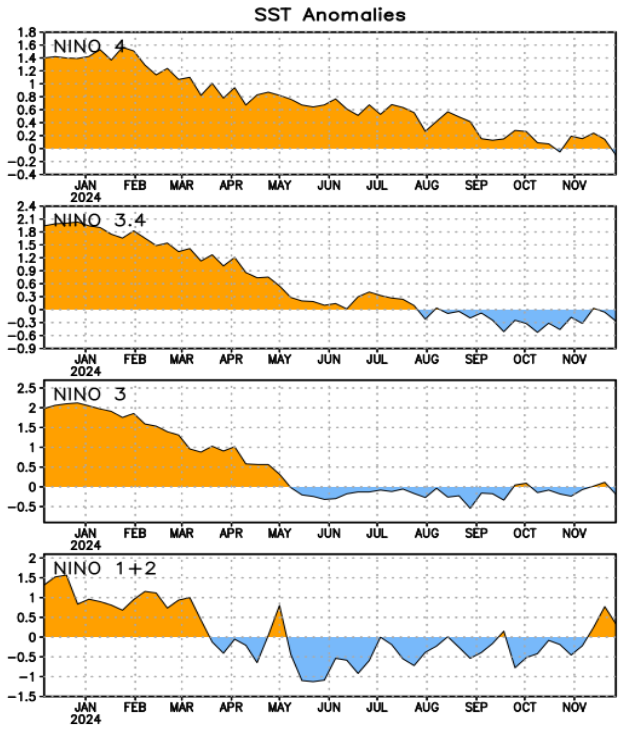
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

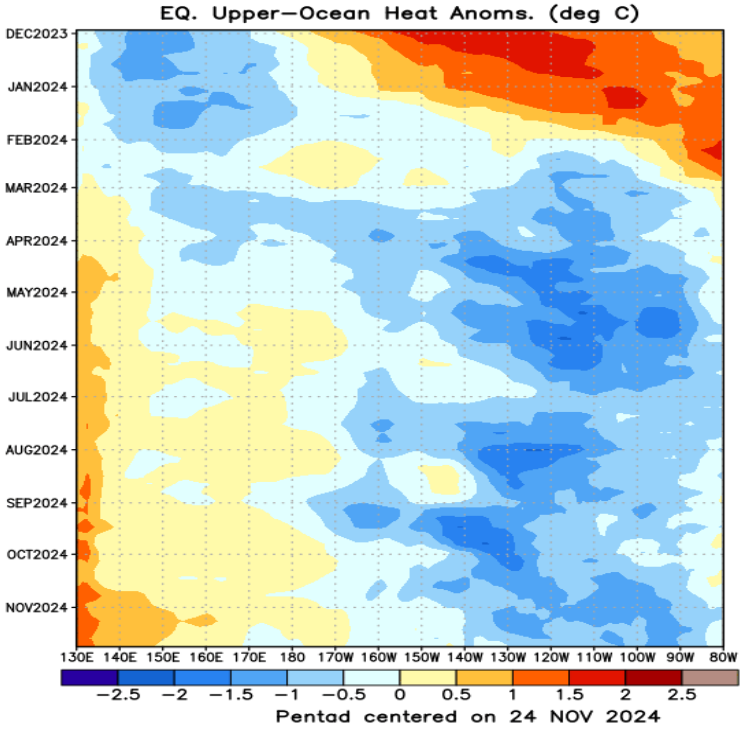




- Negative OLR anomalies associated with the MJO enhanced phase have increased in coverage and amplitude across the eastern Indian Ocean, though a slight weakness right along the Equator has resulted in a more mixed time-longitude analysis.
- GEFS-based OLR anomaly forecasts show a much slower evolution, with enhanced convection persisting over the Maritime Continent and far West Pacific by mid-December, and suppressed convection near the Date Line. This pattern is more consistent with a La Niña type response.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

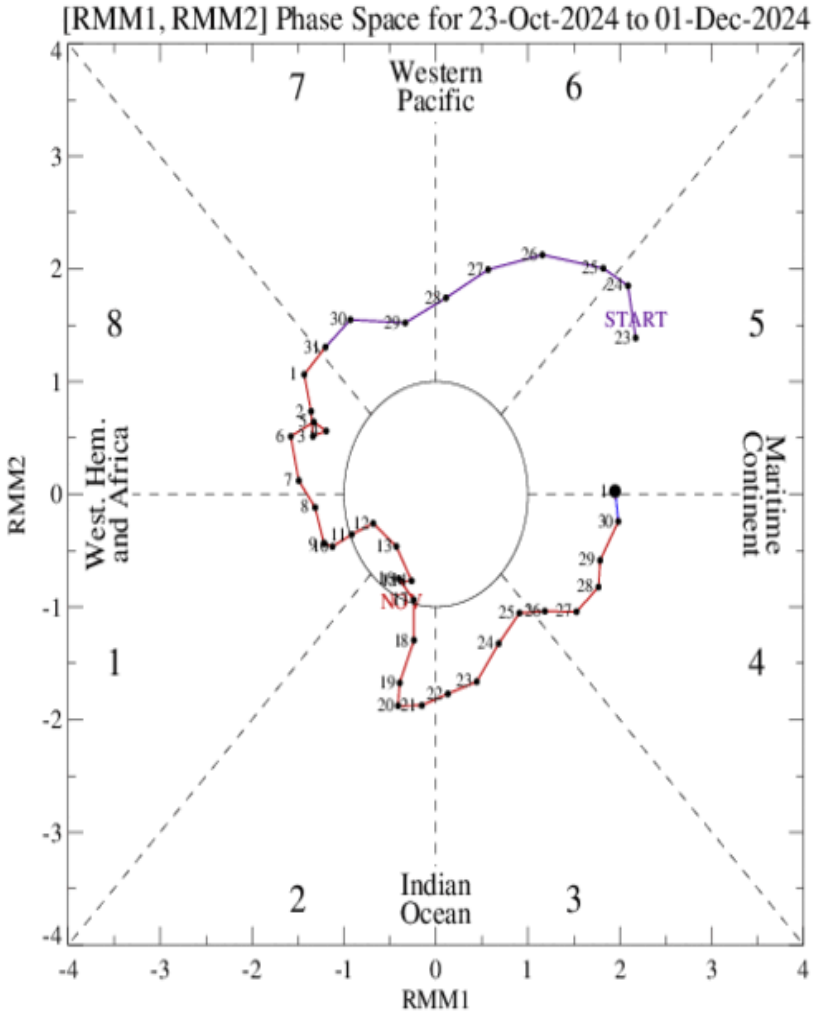




- SST anomalies remain slightly below average across most of the Pacific basin, though recent MJO activity resulted in a surge of warmer SSTs across the far eastern Pacific.
- The subsurface oceanic temperature anomaly field is fairly weak, with negative anomalies across the East Pacific. A slight eastward expansion of positive anomalies across the far western Pacific was observed during November, likely in response to recent MJO activity.

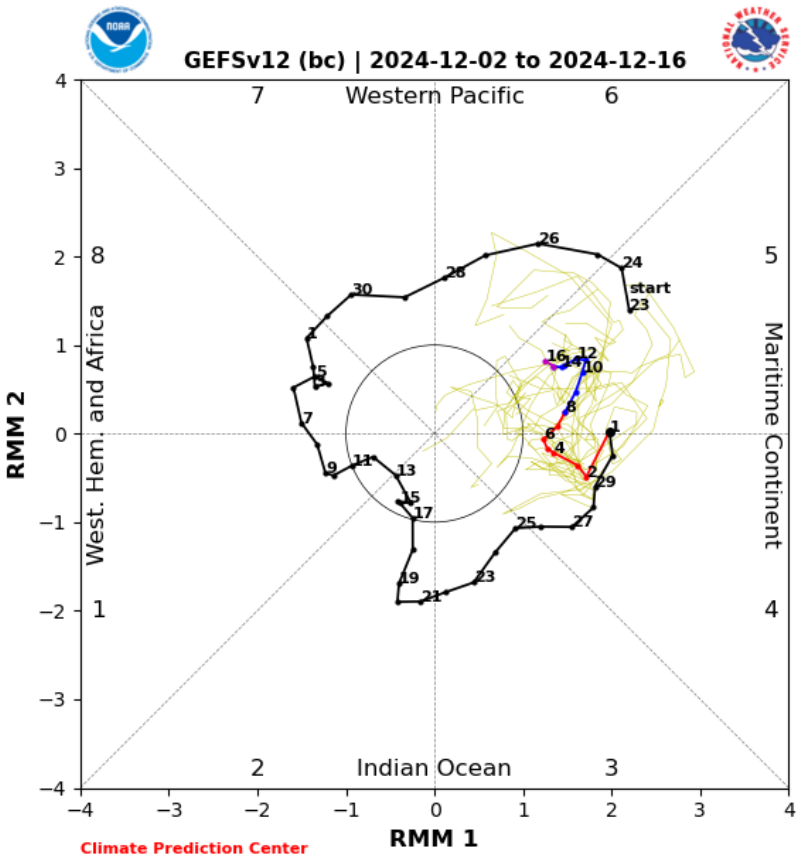
MJO Index: Recent Evolution

- Steady eastward propagation of the MJO was observed during the past two weeks, with the enhanced convective signal now crossing the Maritime Continent.

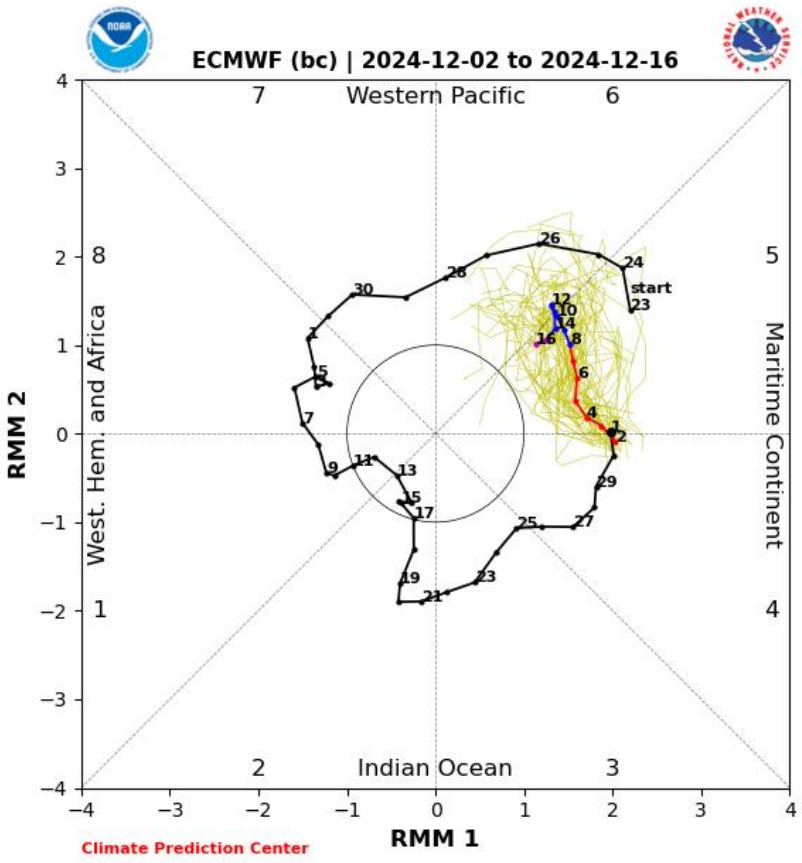


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

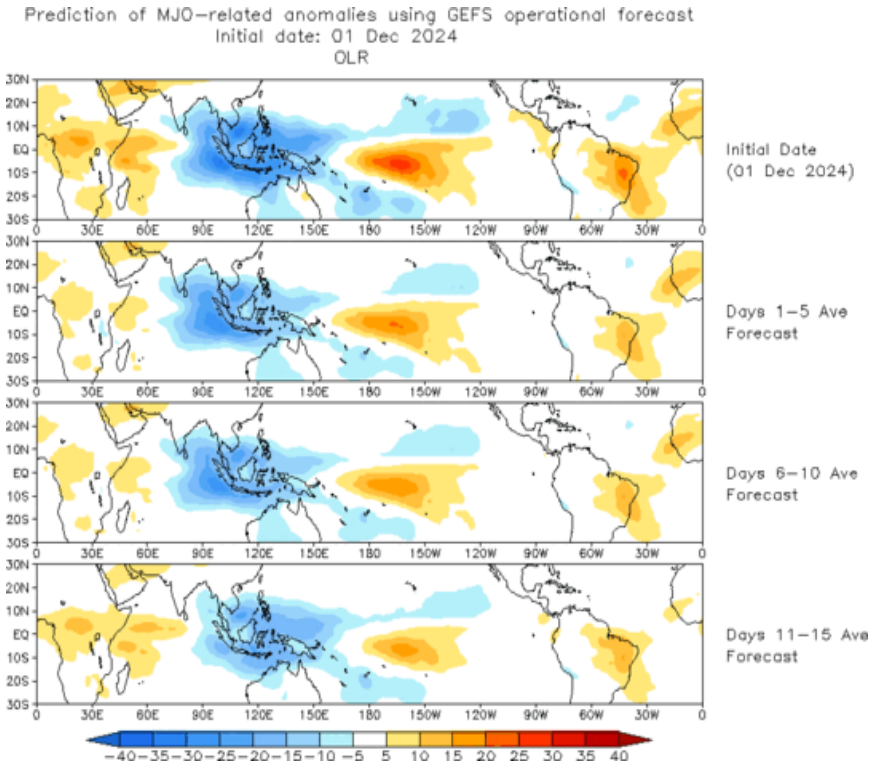


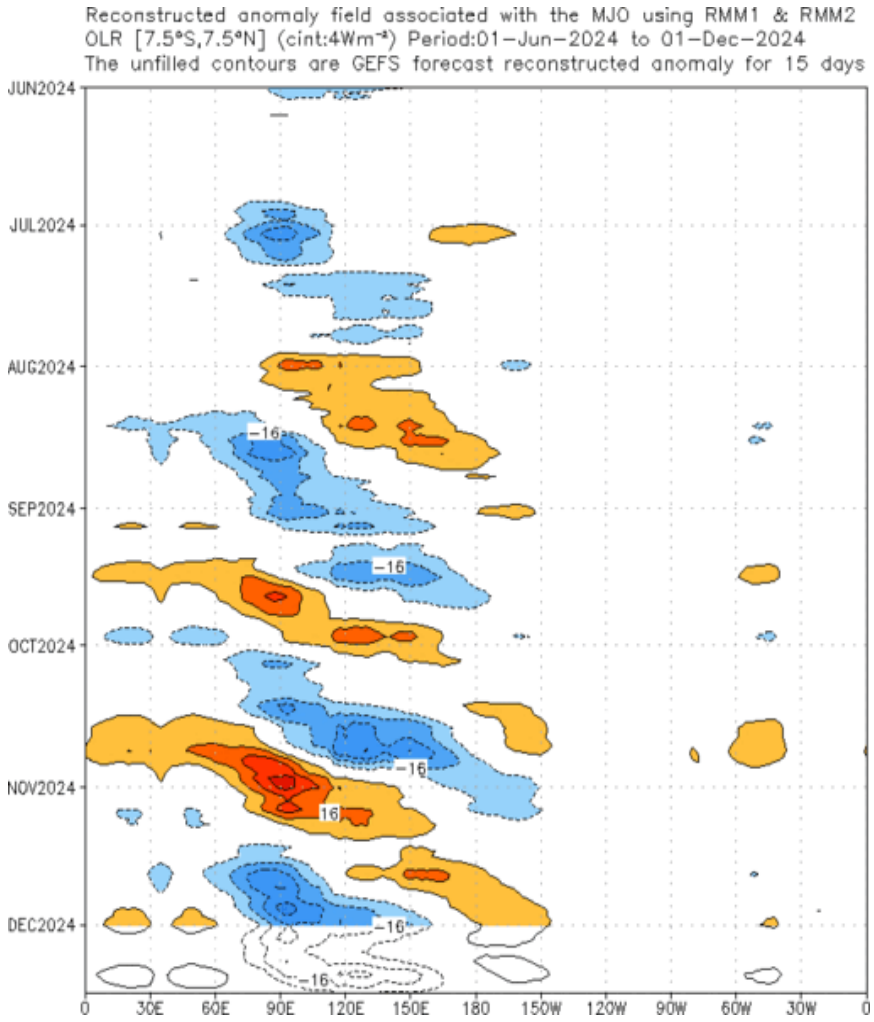
ECMWF Forecast

- Both the GEFS and ECMWF depict continued eastward propagation of the MJO signal, but with a much slower phase speed due potentially to interference from the low frequency base state.
- The extended GEFS and ECMWF forecasts (not pictured) show slow eastward propagation across the West Pacific during Weeks 3 and 4, with the GEFS maintaining a higher amplitude than the ECMWF. The low-level wind field depicted in the model guidance remains much more stationary, which may partly explain the slowed evolution.

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.)

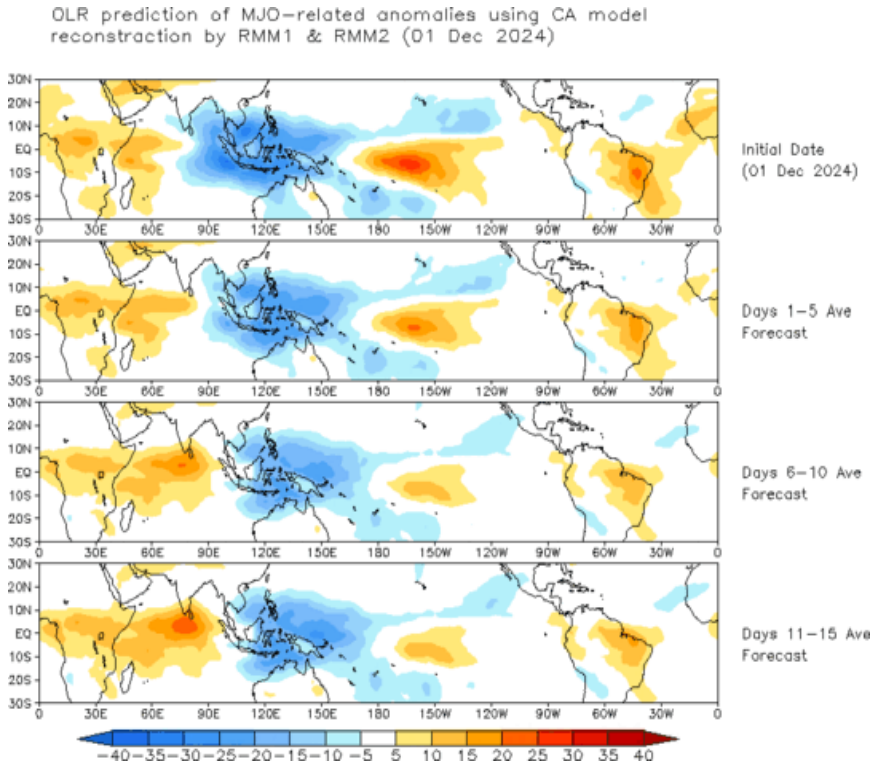


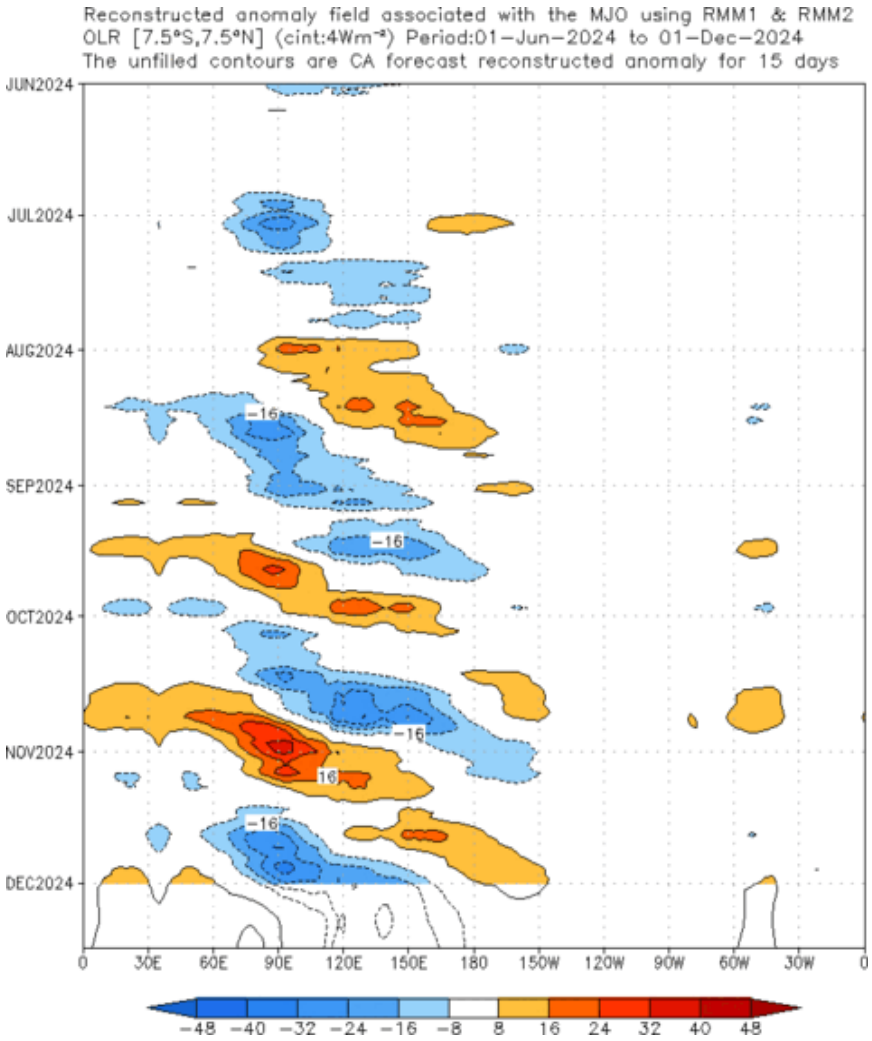


- The GEFS OLR anomaly forecast based on the RMM index shows a slowed eastward propagation of an amplified signal.

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.)

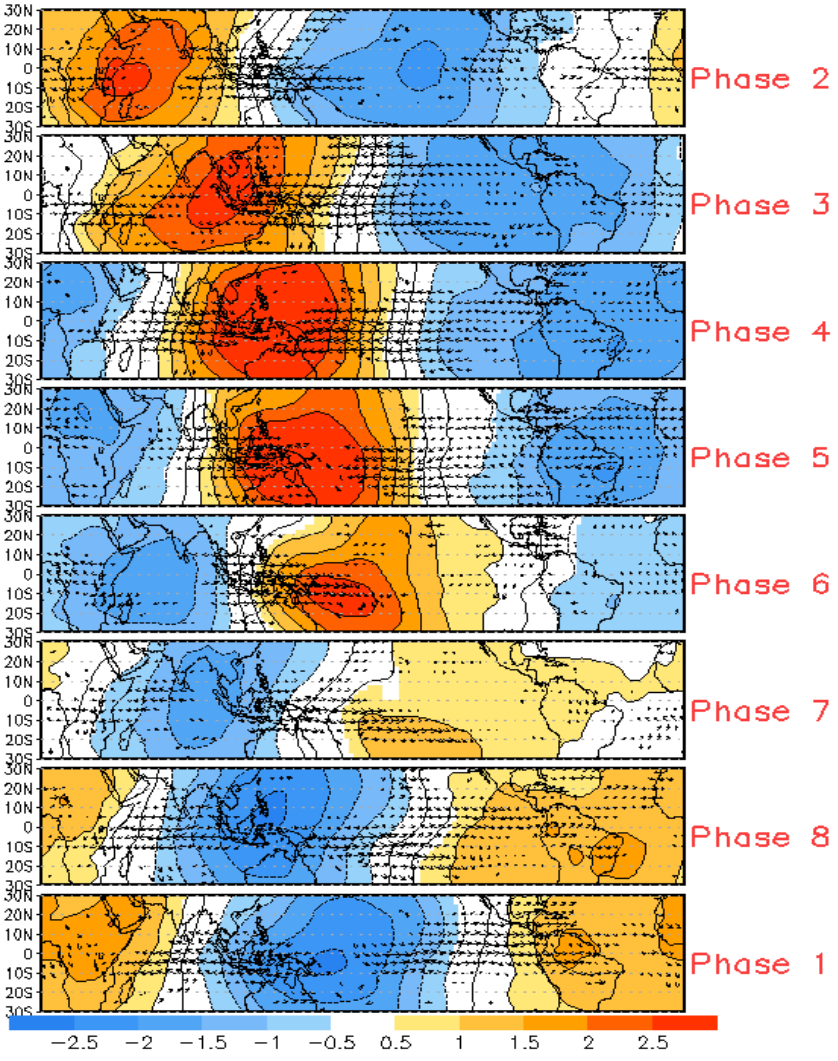




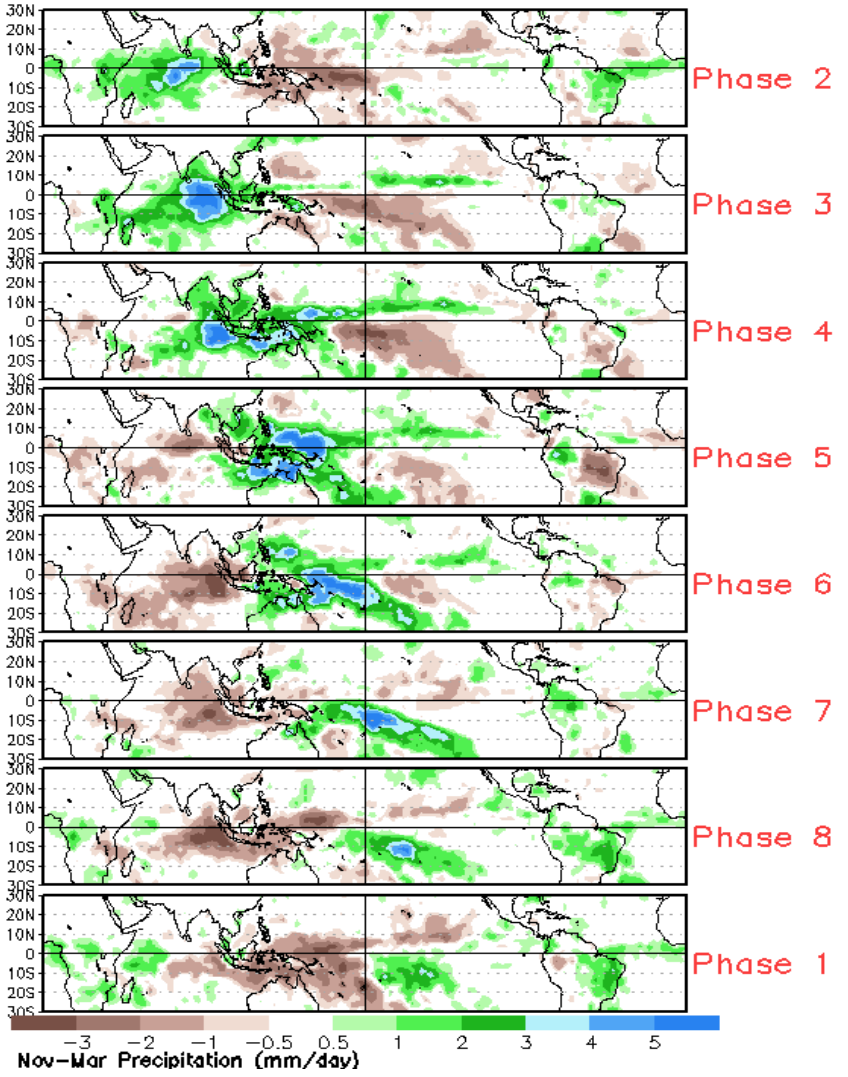
- The constructed analog forecast also shows a more stationary evolution, but displaces the enhanced signal a bit eastward of the GEFS, with an enhanced West Pacific event.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



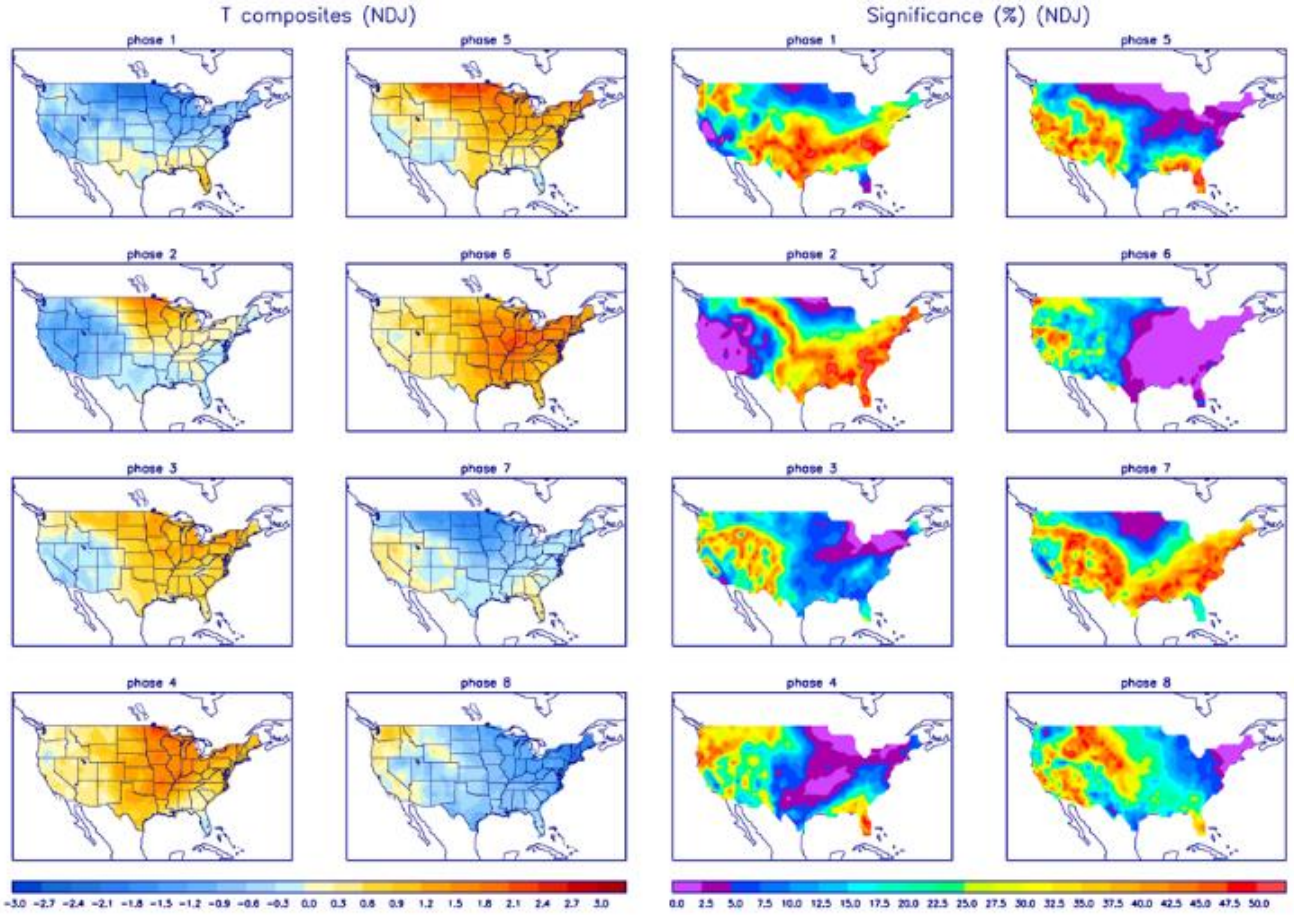
Precipitation Anomalies



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.

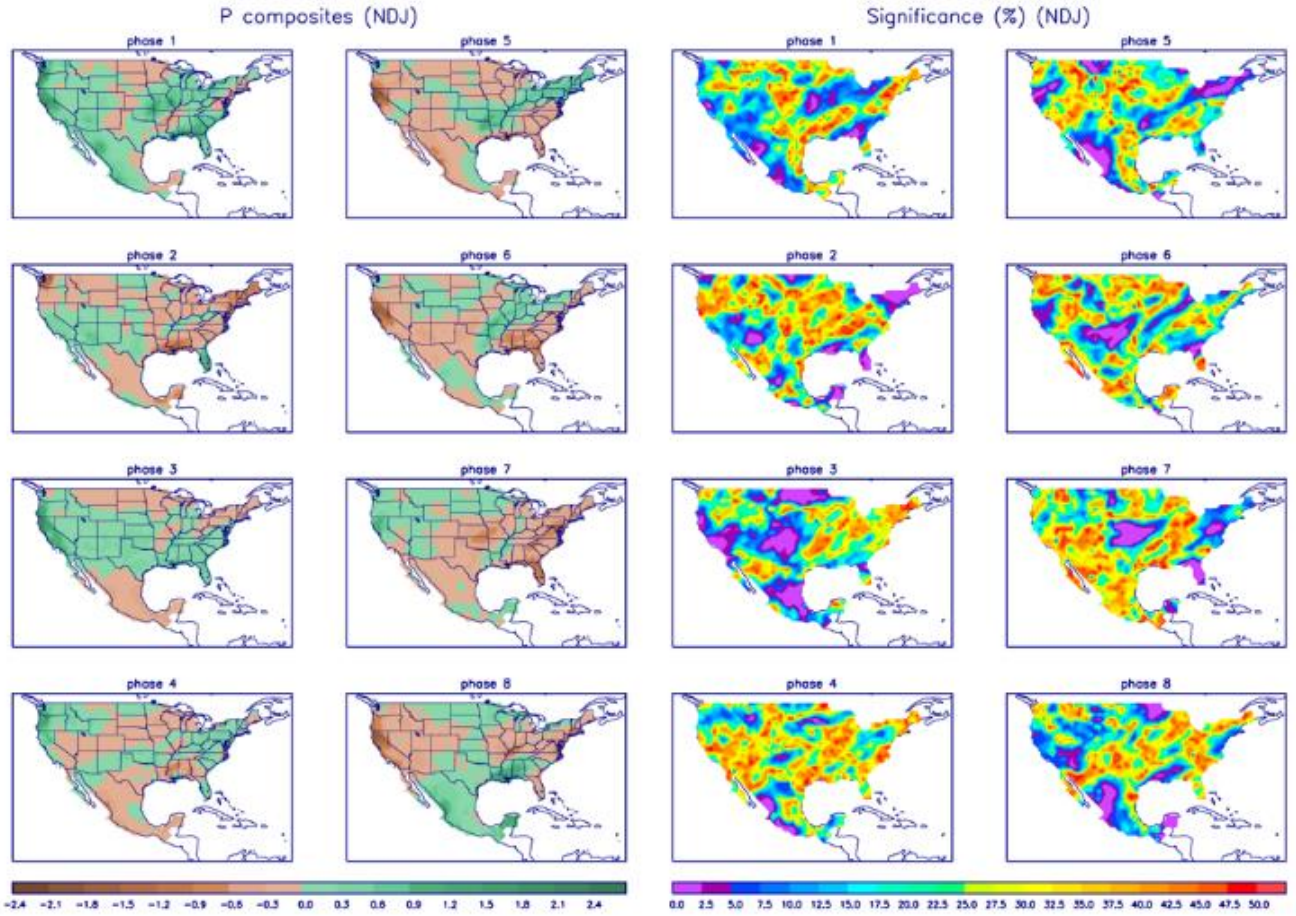


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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