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

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
27 December 2021

Overview

- Both velocity potential based MJO and RMM indices indicate an active West Pacific MJO event with little continued eastward propagation in recent weeks.

- There is disagreement among the dynamical models regarding the predicted evolution of the MJO, leading to continued uncertainty in the outlook.

- Tropical cyclone formation is favored over the southern Pacific where any coherence of the MJO is more likely to manifest itself during the next two weeks.

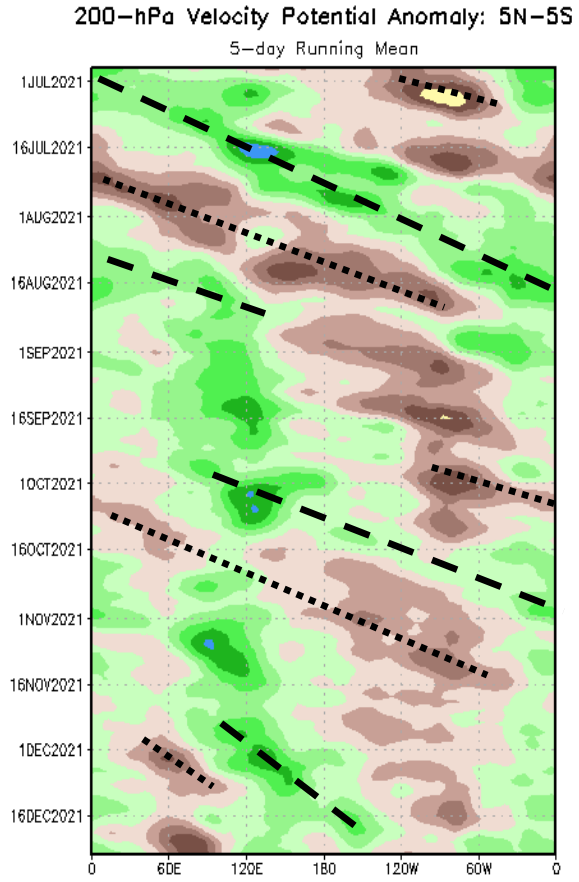
- While West Pacific MJO events typically favor colder than normal conditions across the CONUS, extended range model guidance continues to mimic more of an amplified negative Pacific North American pattern, suggestive of La Niña dominating the extratropical response over North America.

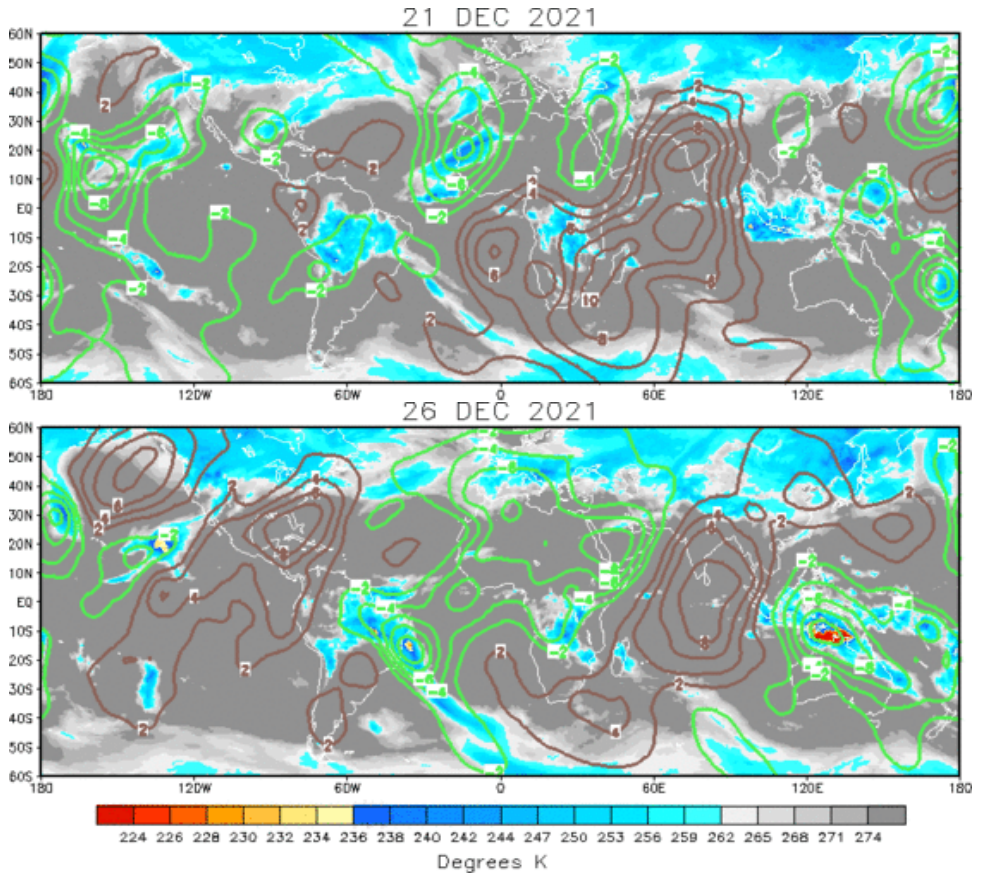
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

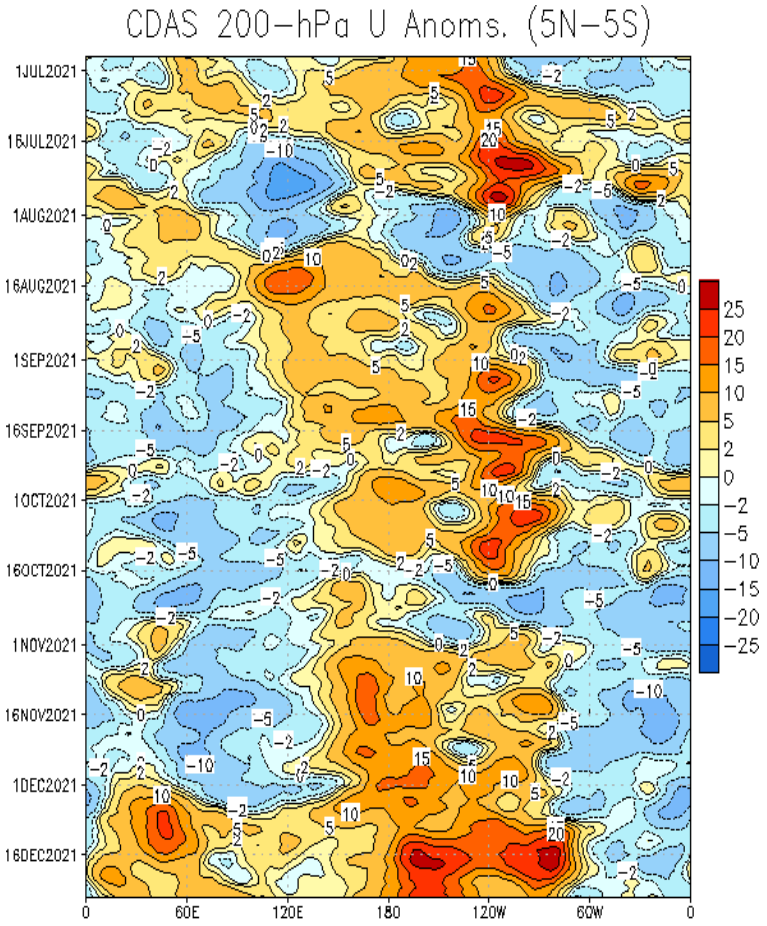


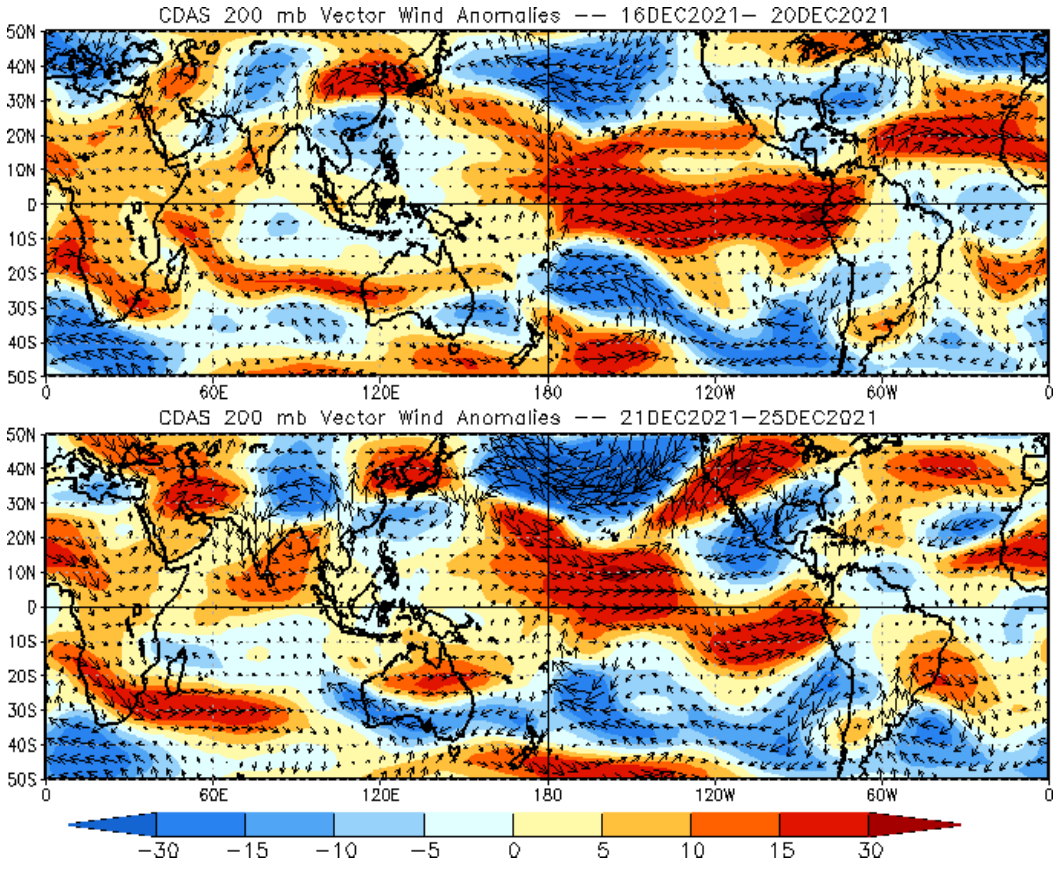


- Since reemerging over the Maritime Continent in late November, the intraseasonal signal slowly shifted eastward across the Western Pacific.
- An incoherent spatial pattern remains evident in the upper-level velocity potential field, likely due to ongoing competing interference with other modes of tropical variability.
- Suppressed conditions have strengthened throughout much of the Indian Ocean.

200-hPa Wind Anomalies

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



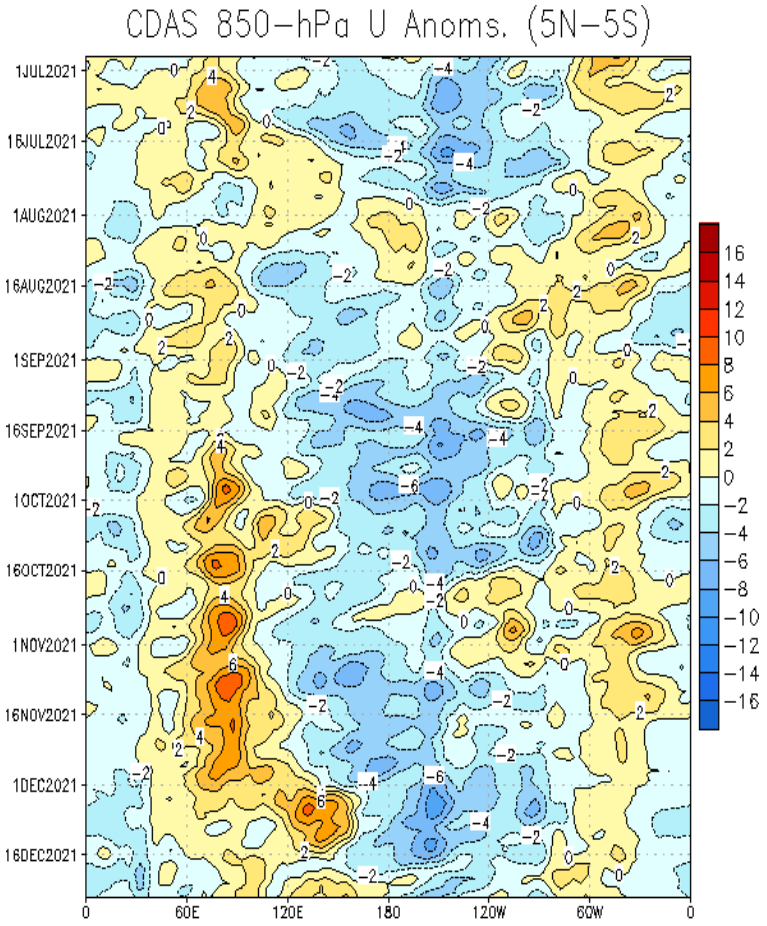


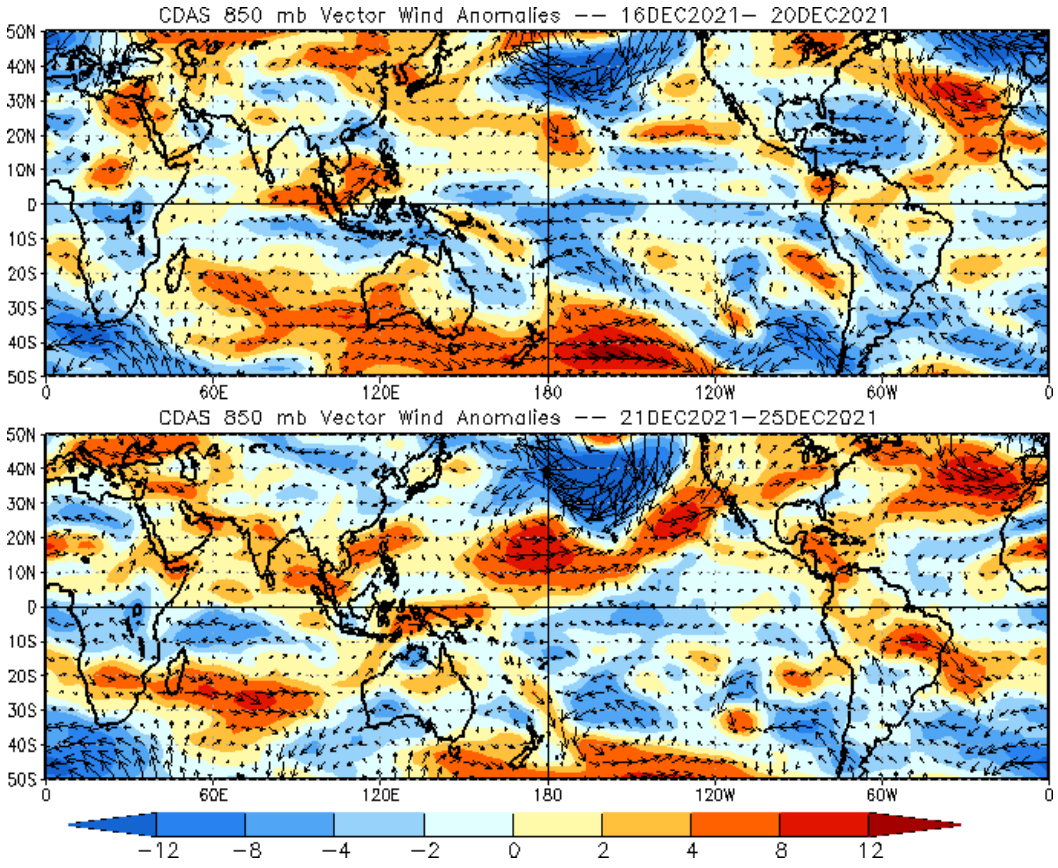
- Anomalous upper-level westerlies remain quite robust throughout the equatorial Pacific, consistent with the low frequency base state.

- A wave train is evident in the northern Hemisphere, with a strong jet extending into western North America in late December.

850-hPa Wind Anomalies

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



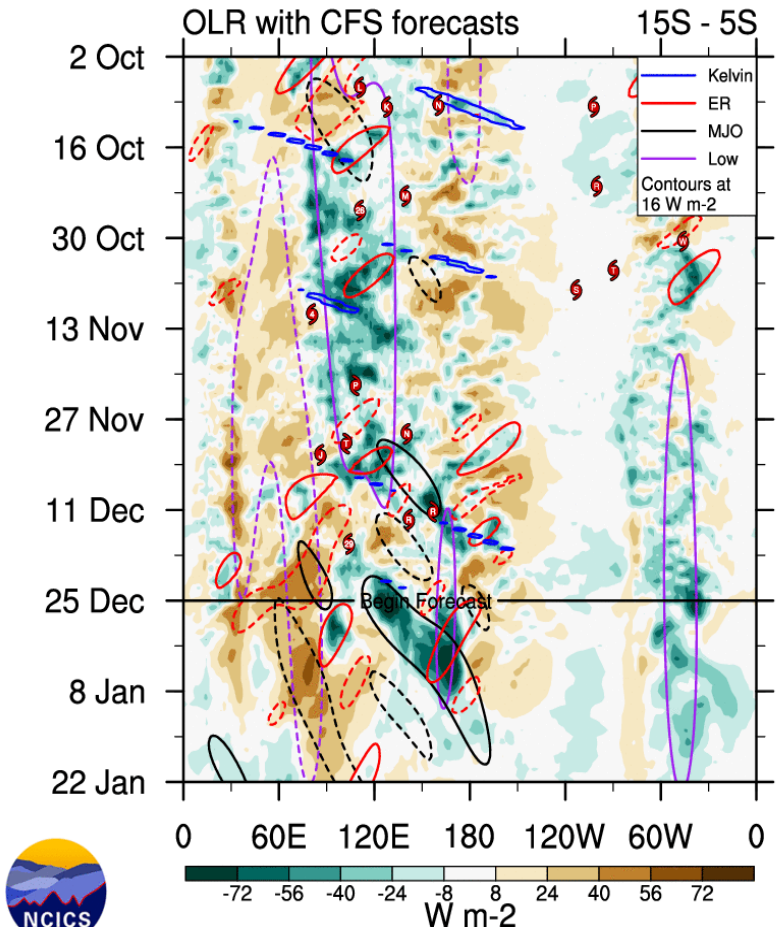


- Anomalous lower-level westerlies have redeveloped over the Maritime Continent and the Western Pacific, with a strong anomalous cyclonic circulation in the Central Pacific helping to disrupt the enhanced trades near the Date Line along the equator.

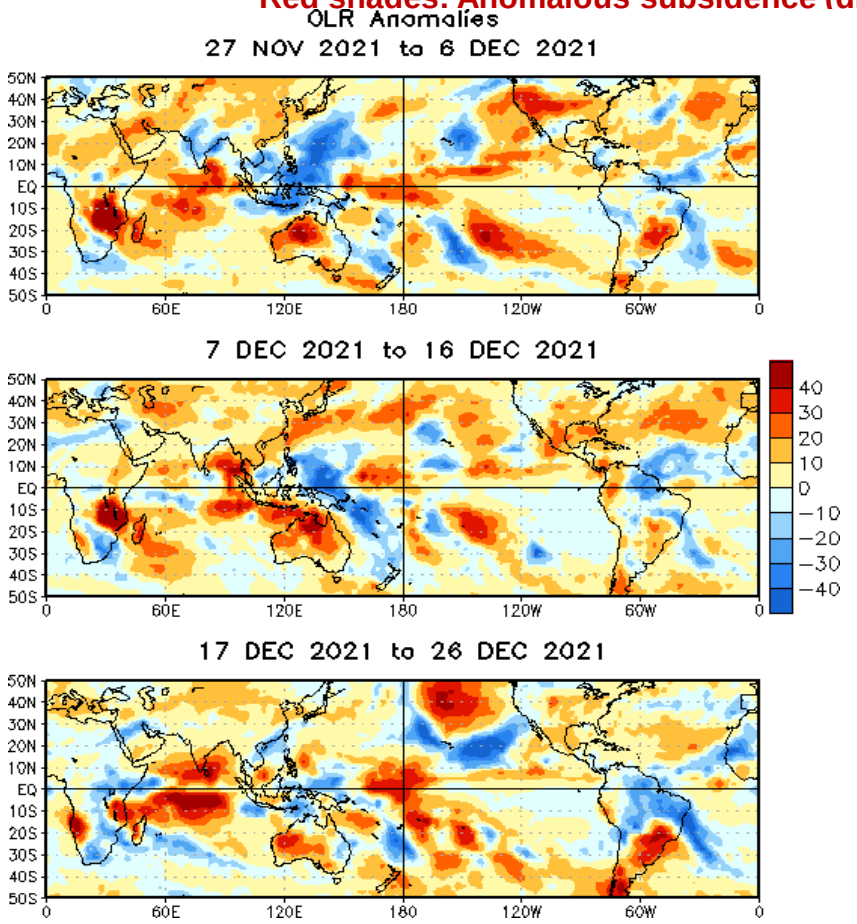
- Anomalous easterlies have developed in the equatorial Indian Ocean, mainly south of the equator.

Outgoing Longwave Radiation (OLR) Anomalies

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



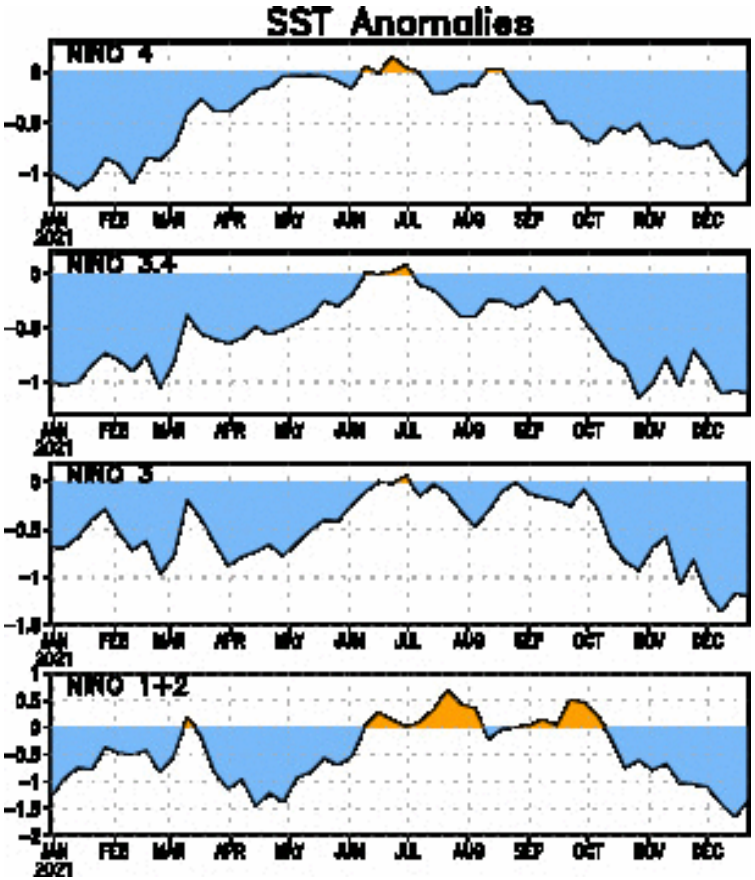
Blue shades: Anomalous convection (wetness)
Red shades: Anomalous subsidence (dryness)

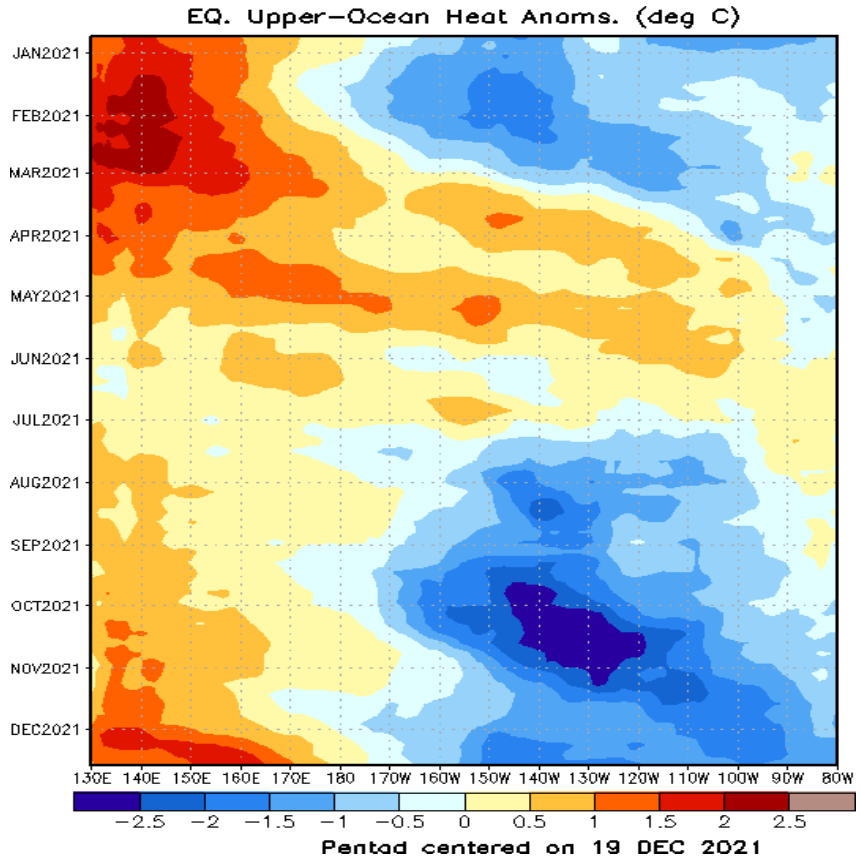


- Suppressed convection has strengthened over the western and central Indian Ocean.

- Dynamical models favor the return of enhanced convection shifting eastward toward the Date Line entering the New Year, which is better depicted south of the equator in the guidance.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



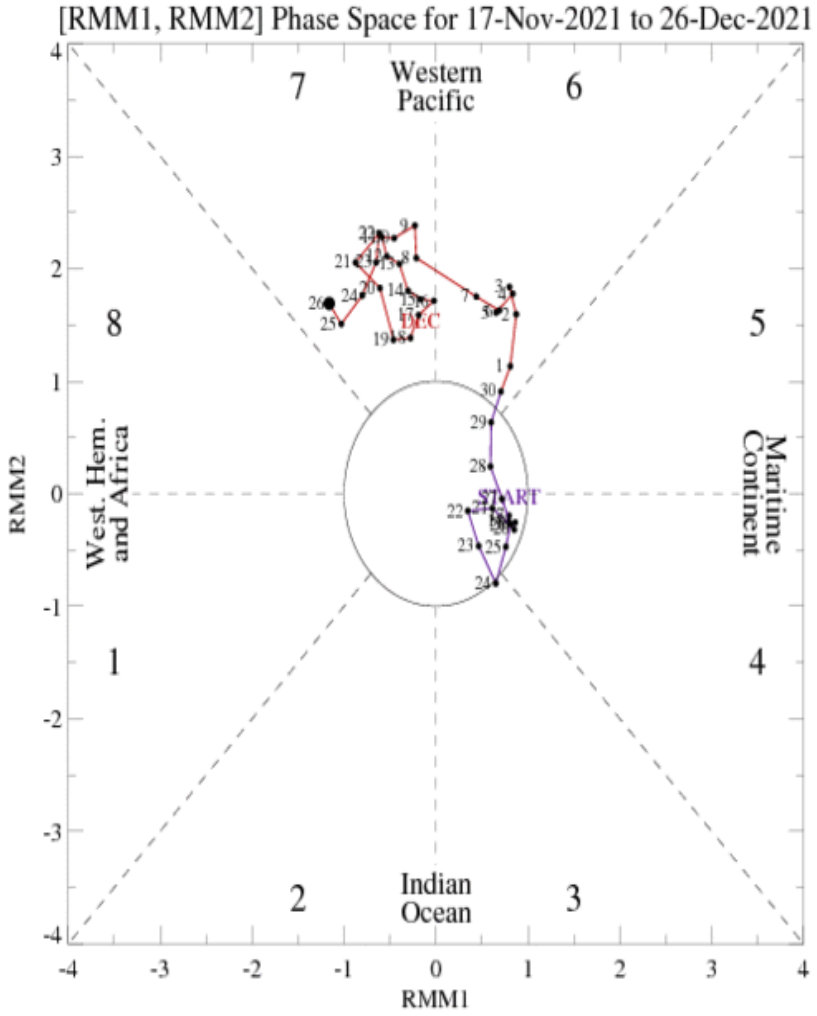


- A westerly wind burst event in early December likely triggered a downwelling oceanic Kelvin wave, leading to anomalously warmer conditions being observed within the upper-ocean across the west-central Pacific.

- At the surface, below-normal temperatures continue to be observed within all Niño regions, with SSTs holding steady or decreasing during December consistent with La Niña.

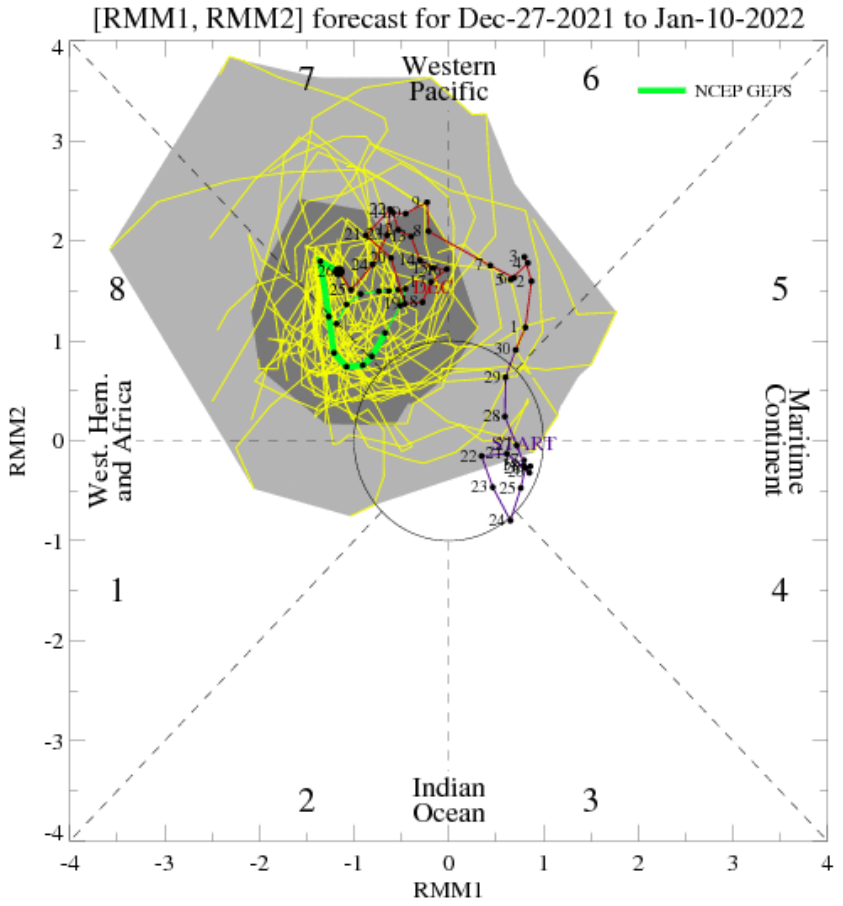
MJO Index: Recent Evolution

- The RMM based MJO index continues to exhibit a fairly stagnant west Pacific event during the past few weeks.
- However, the intraseasonal signal has shown signs of renewed eastward propagation in recent days.

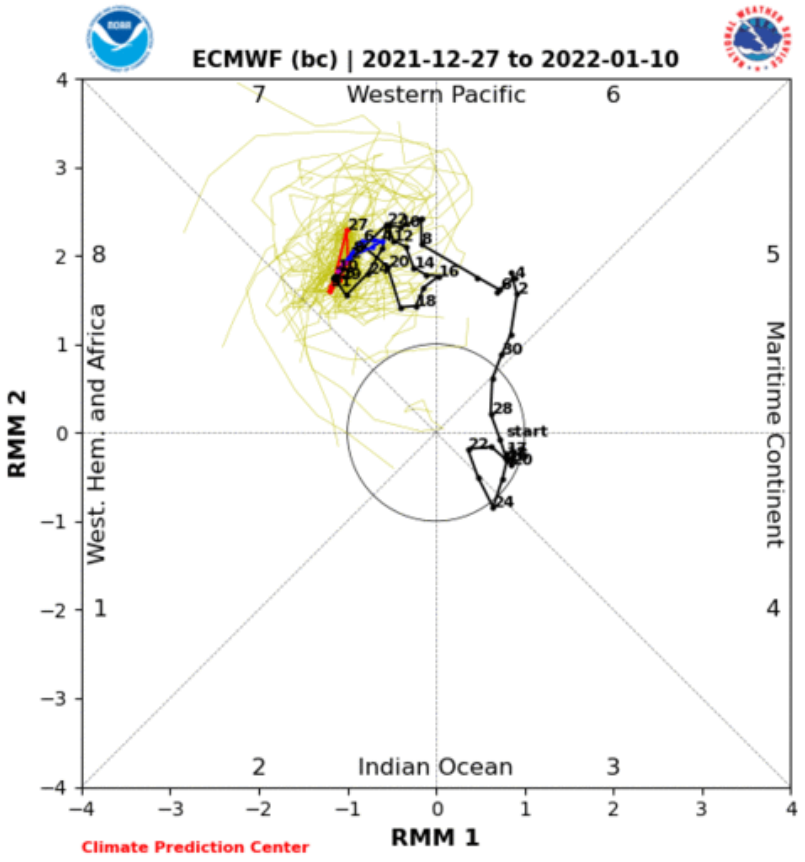


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

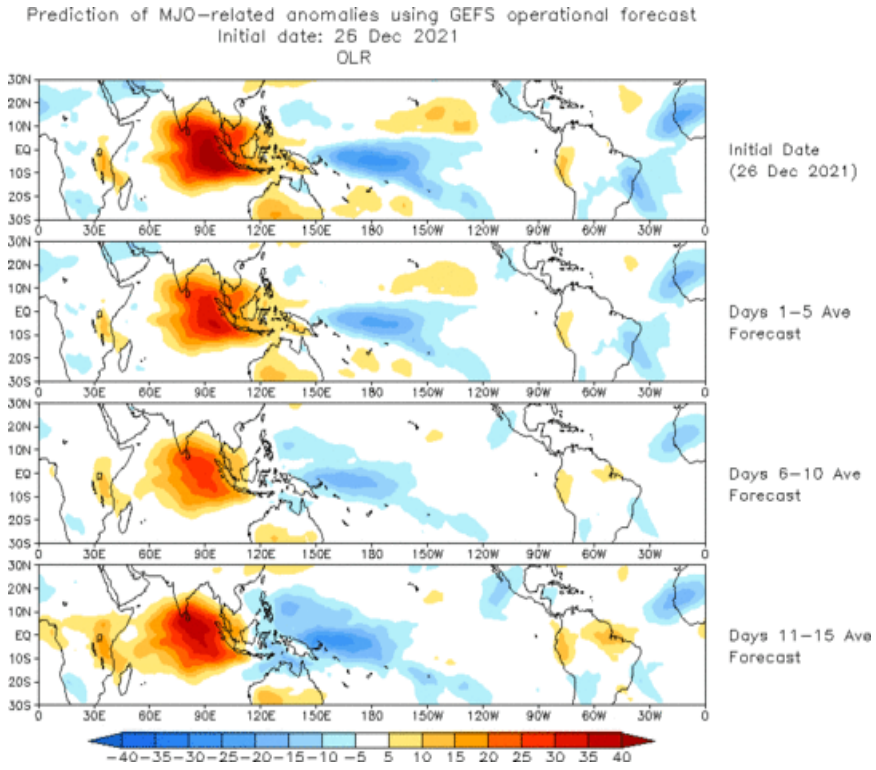


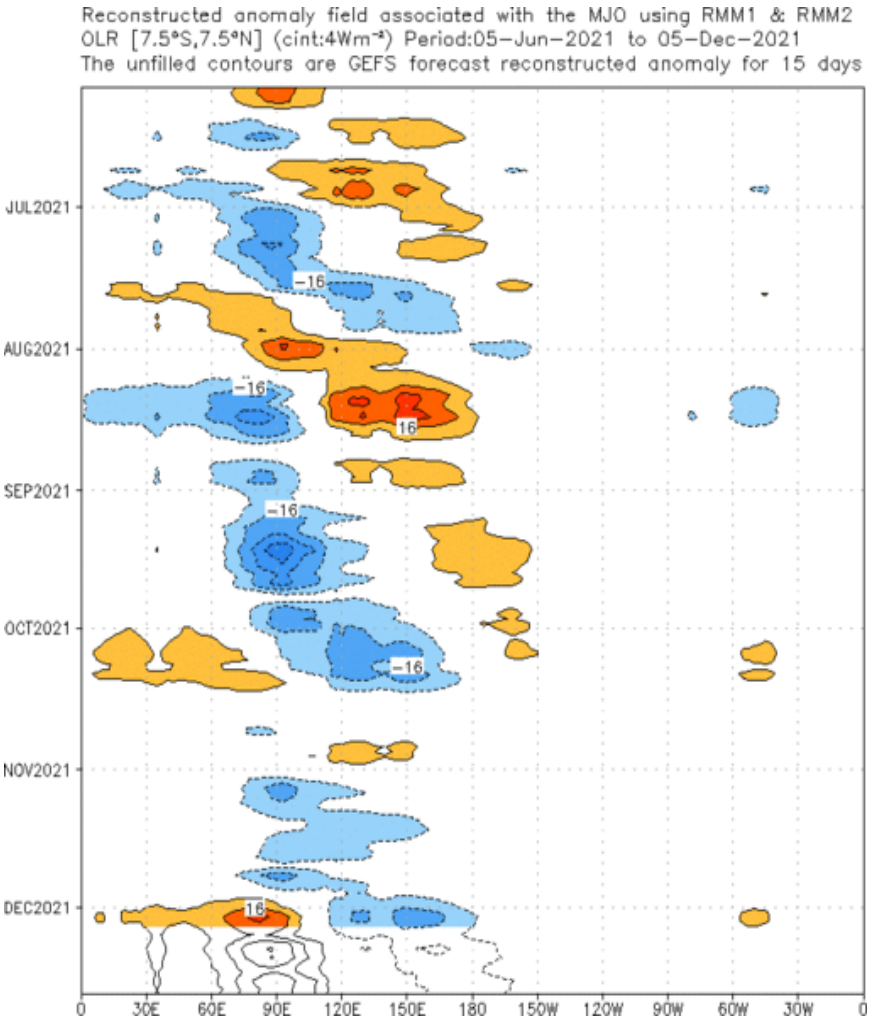
ECMWF Forecast

- Dynamical models continue to depict an enhanced West Pacific signal, with several ensemble members from the GEFS favoring a more progressive mean solution, whereas the ECWMF generally favors a more stationary intraseasonal signal during the next two weeks.

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.)

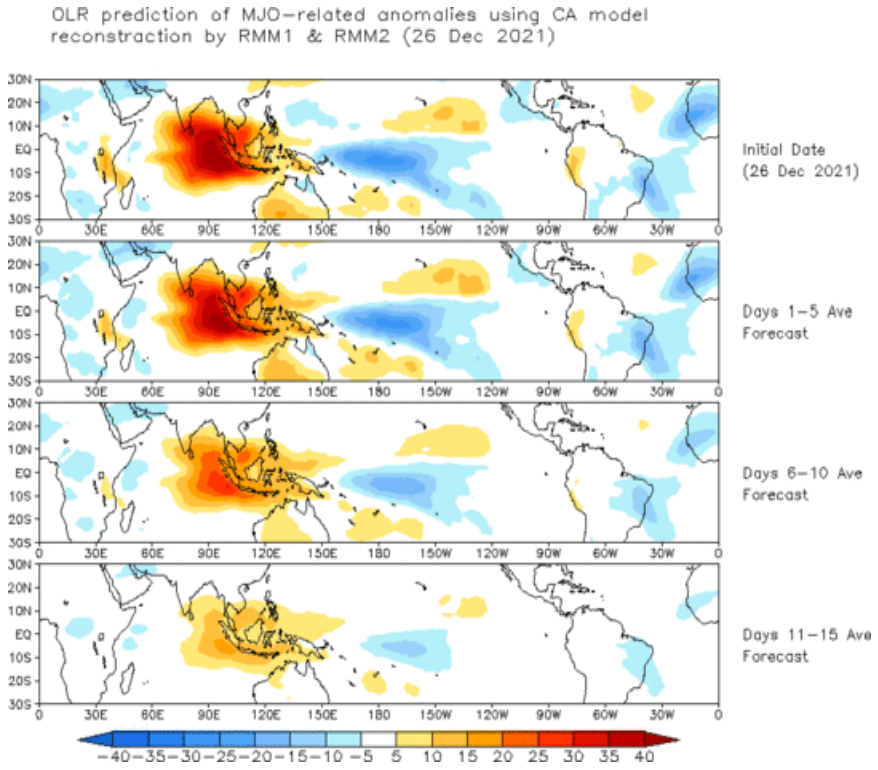


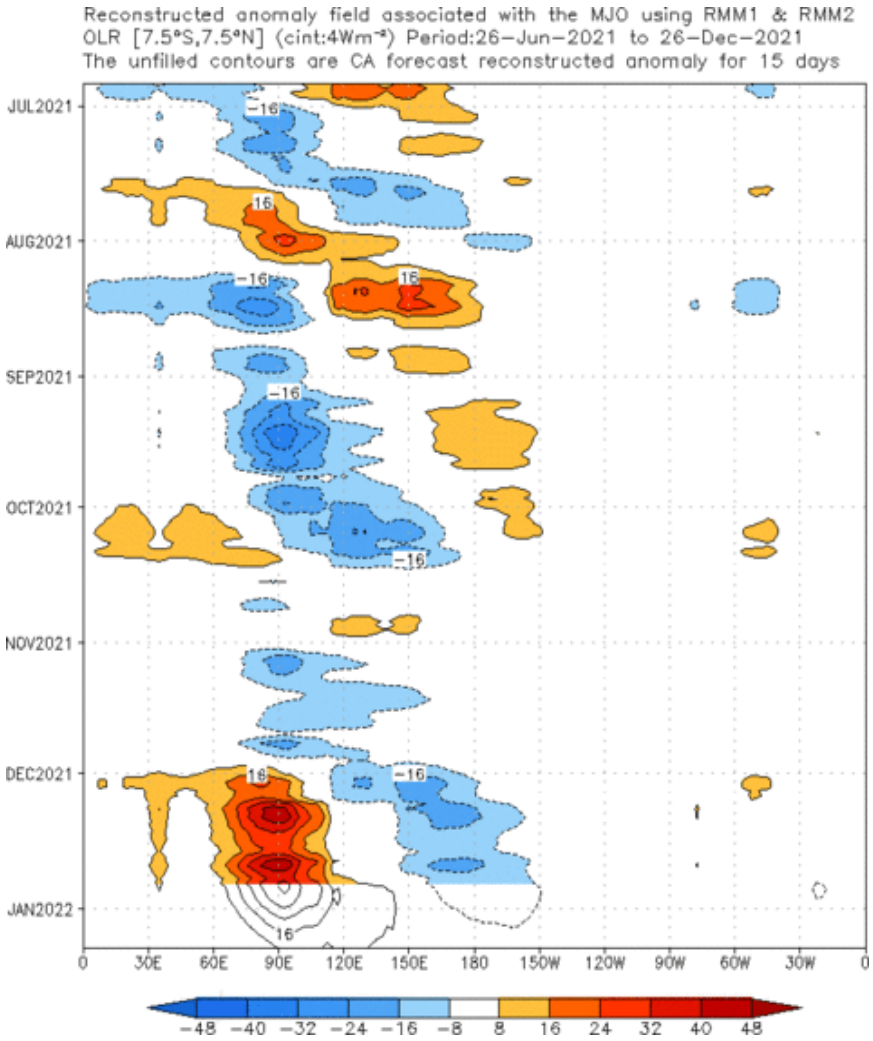


- The GEFS RMM-based OLR anomaly forecast depicts strongly suppressed convection anchored over the Indian Ocean, and a retrogression of the enhanced convection over the Pacific.

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.)

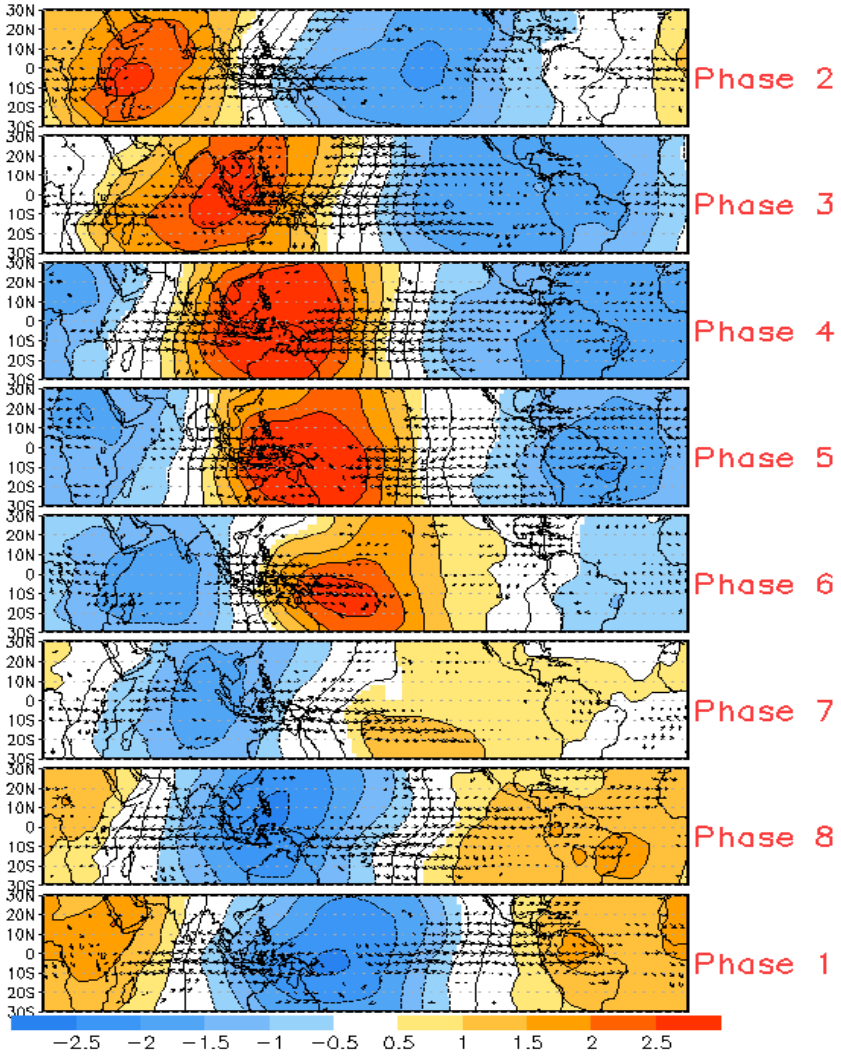




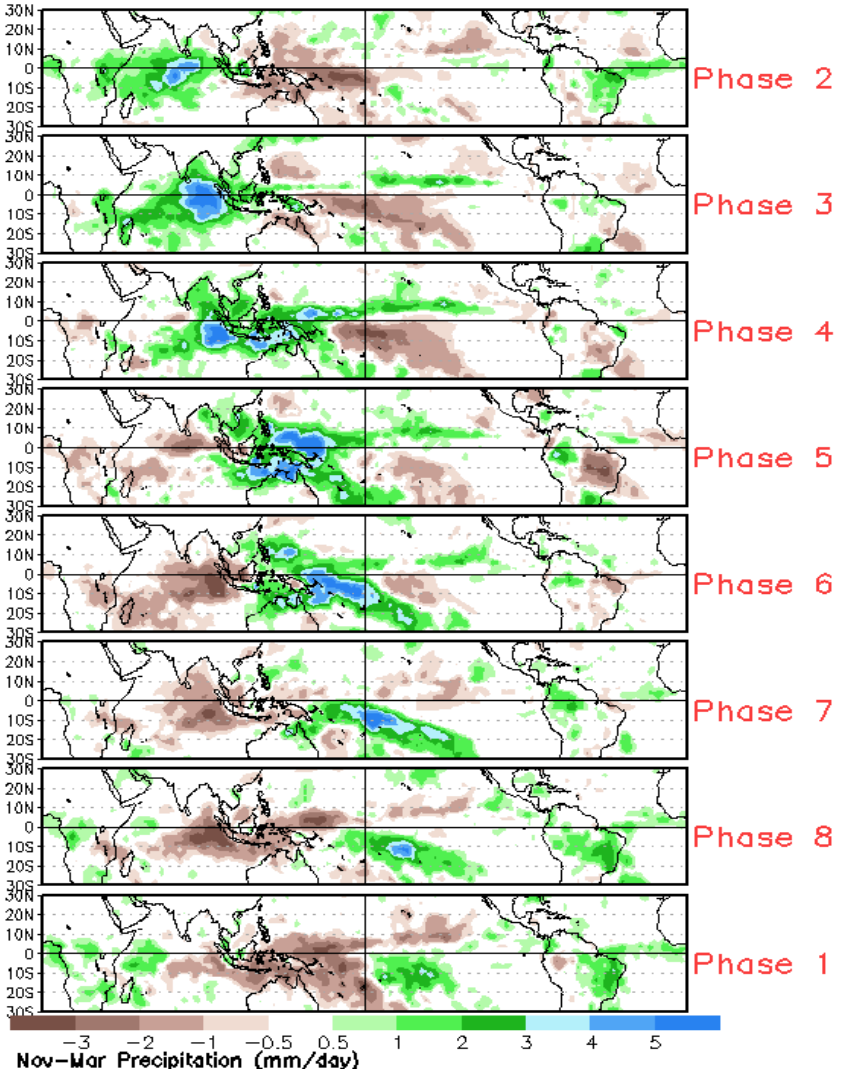
- The constructed analog depicts a more progressive MJO signal than the GEFS, but with an amplitude that weakens with time.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



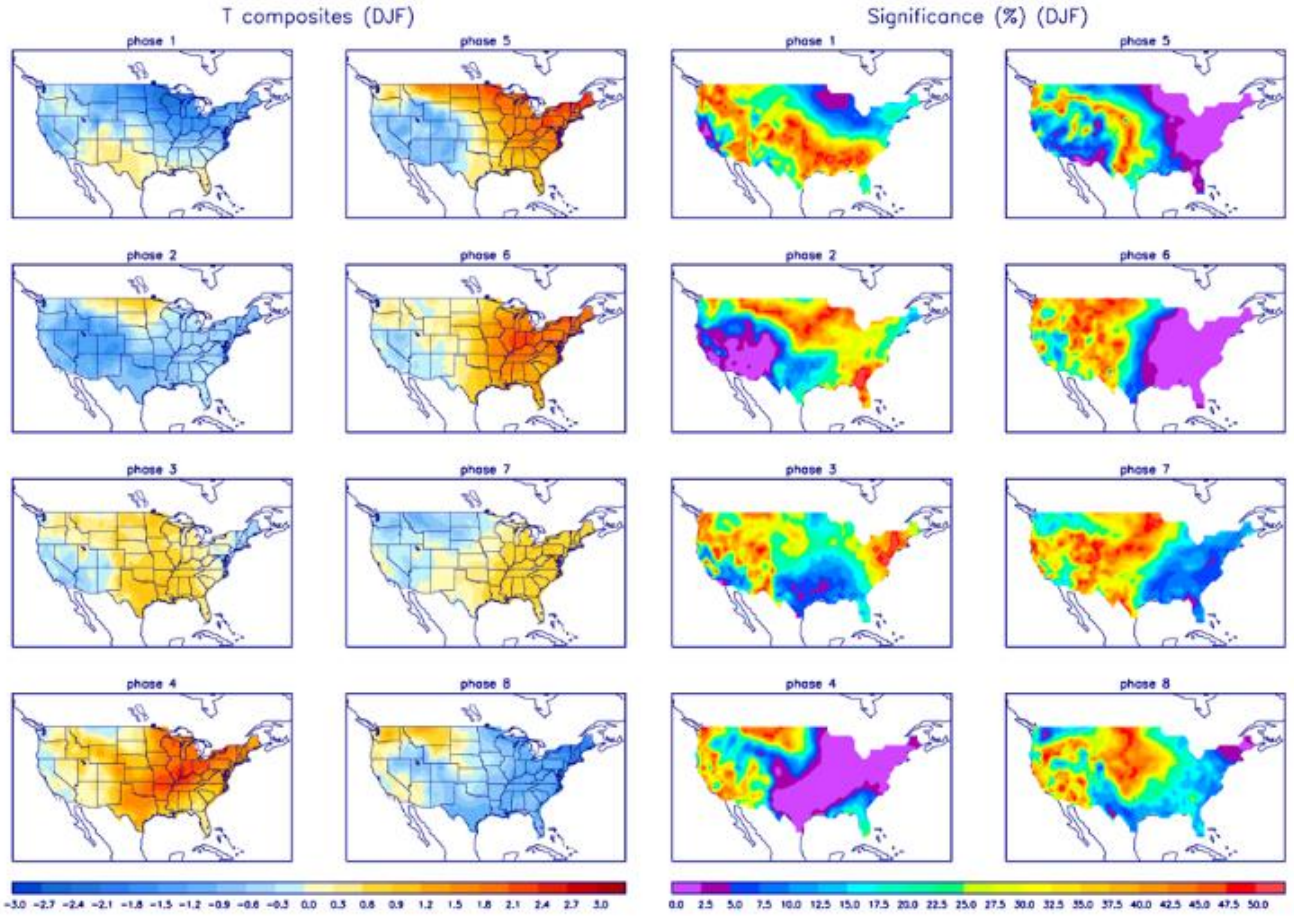
Precipitation Anomalies



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 - Temperature

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.

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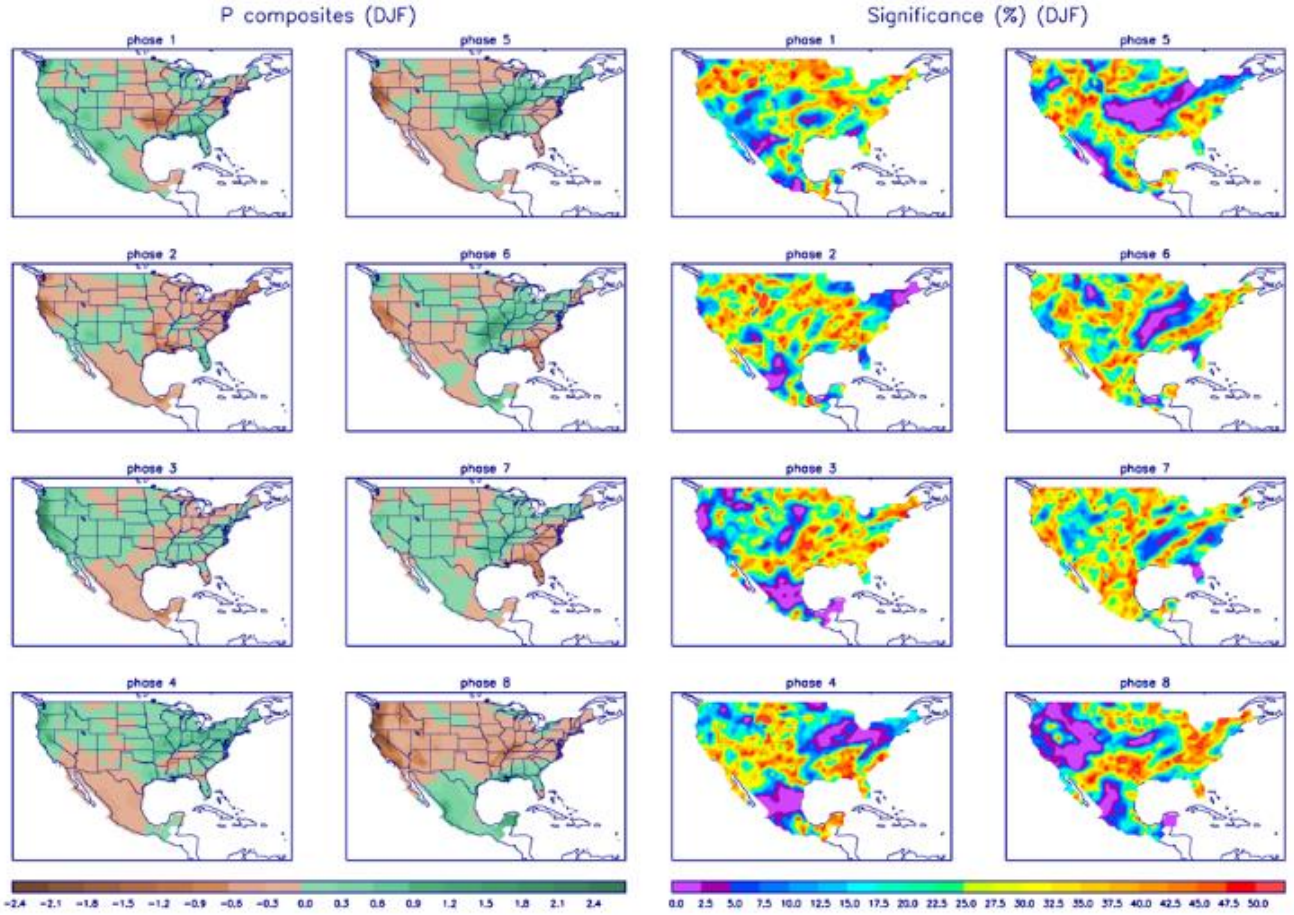

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