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

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

Overview

- MJO indices continue to depict an enhanced West Pacific signal, and upper-level velocity potential anomalies show the enhanced phase crossing the central Pacific.

- The amplitude of the MJO has decreased, and the RMM-based MJO index depicts little eastward propagation over the past week due to interference from the La Niña base state and Rossby wave activity.

- The GEFS and ECMWF ensembles depict persistent enhancement over the West Pacific, with little to no eastward propagation. It is possible that this signal may reflect a temporary weakening of the La Niña atmospheric response.

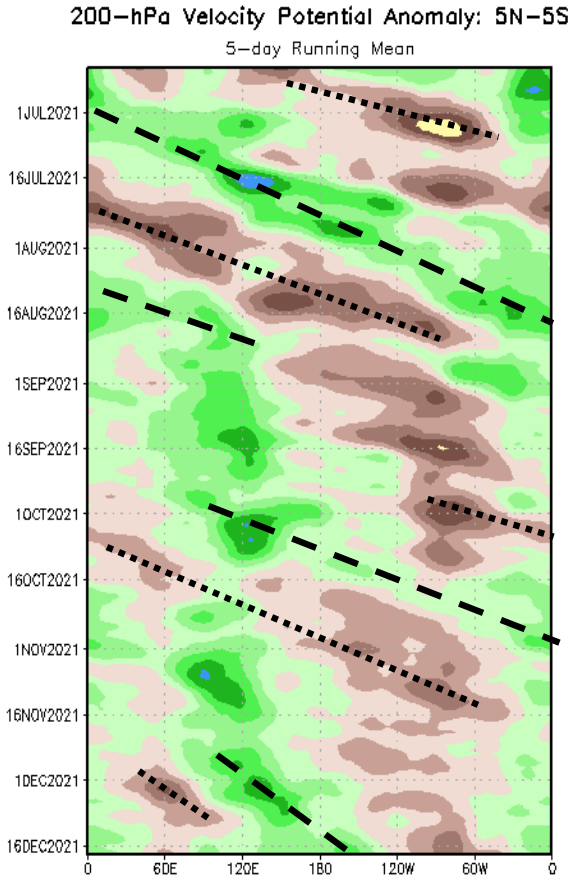
- There is considerable uncertainty regarding the potential for this MJO event to remain coherent as it crosses the Pacific.

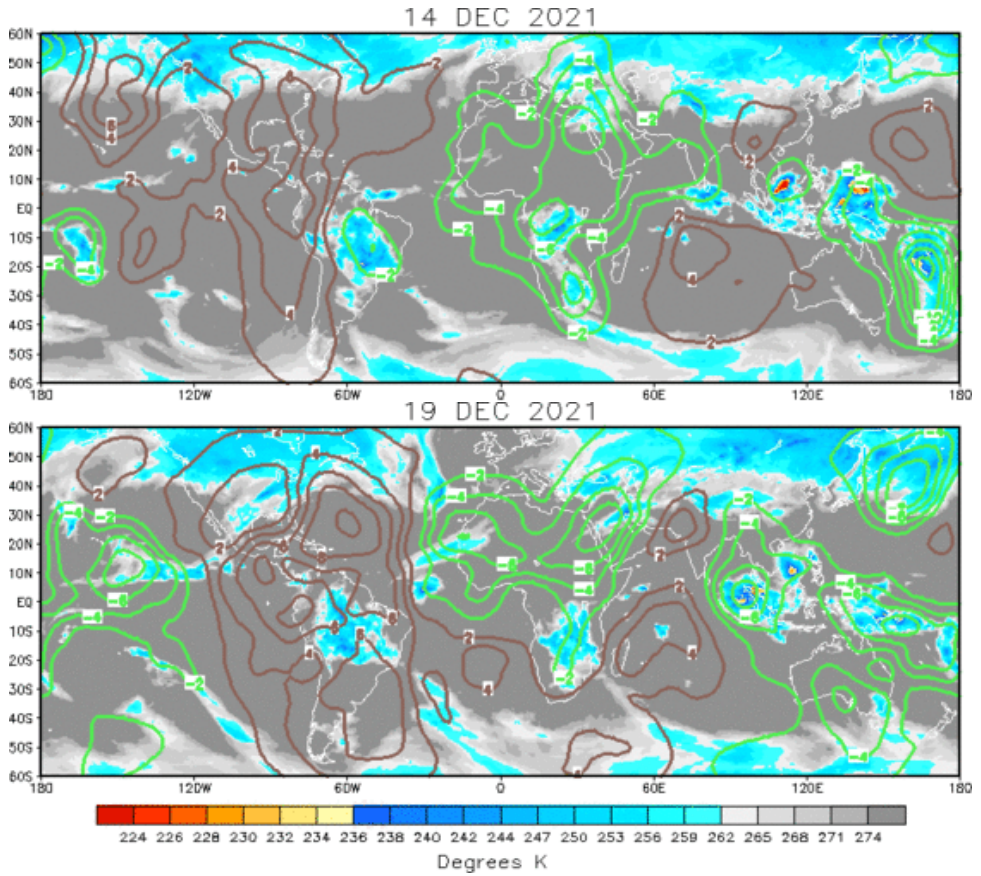
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

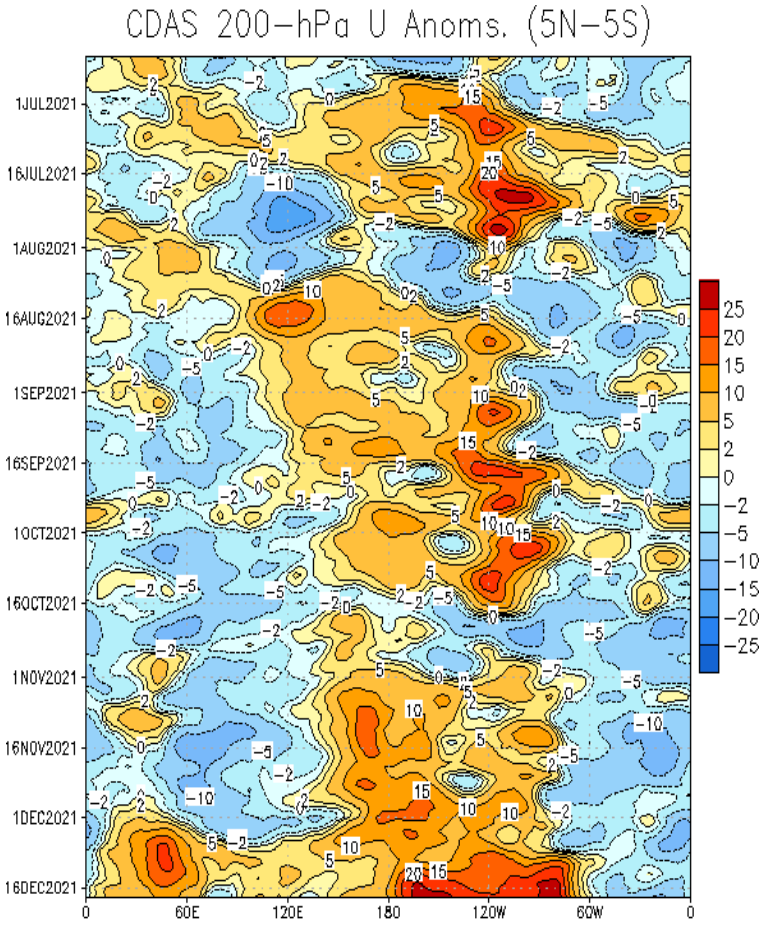


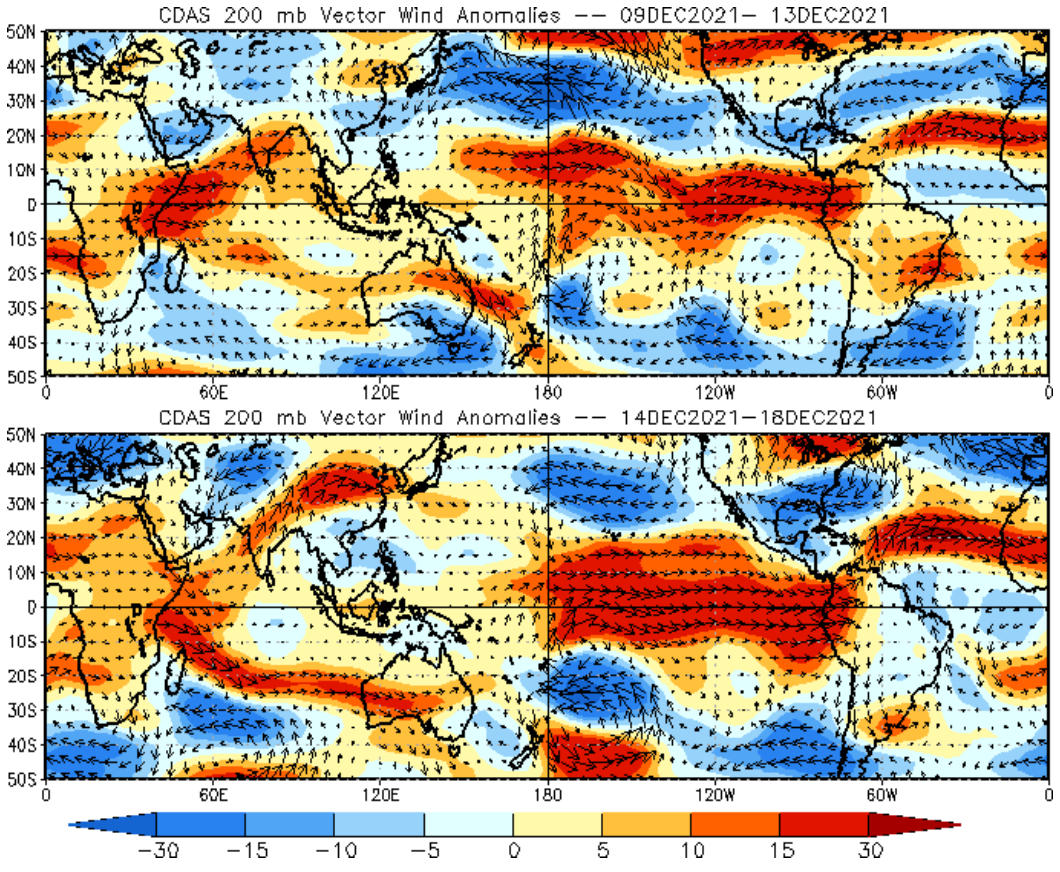


- Following a long period dominated by the low frequency La Niña signal, an active, slowly evolving MJO pattern is evident over the central Pacific.
- Enhanced convection over the Maritime Continent is destructively interfering with the suppressed phase of the MJO.
- Persistent enhanced divergence remains in place over Africa.

200-hPa Wind Anomalies

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

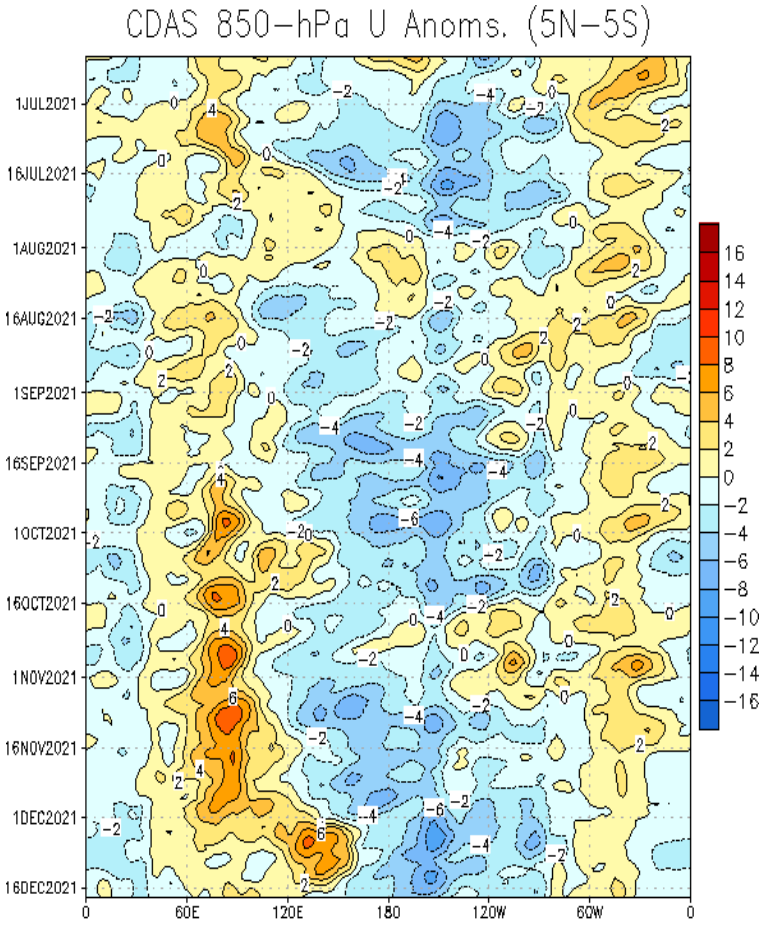


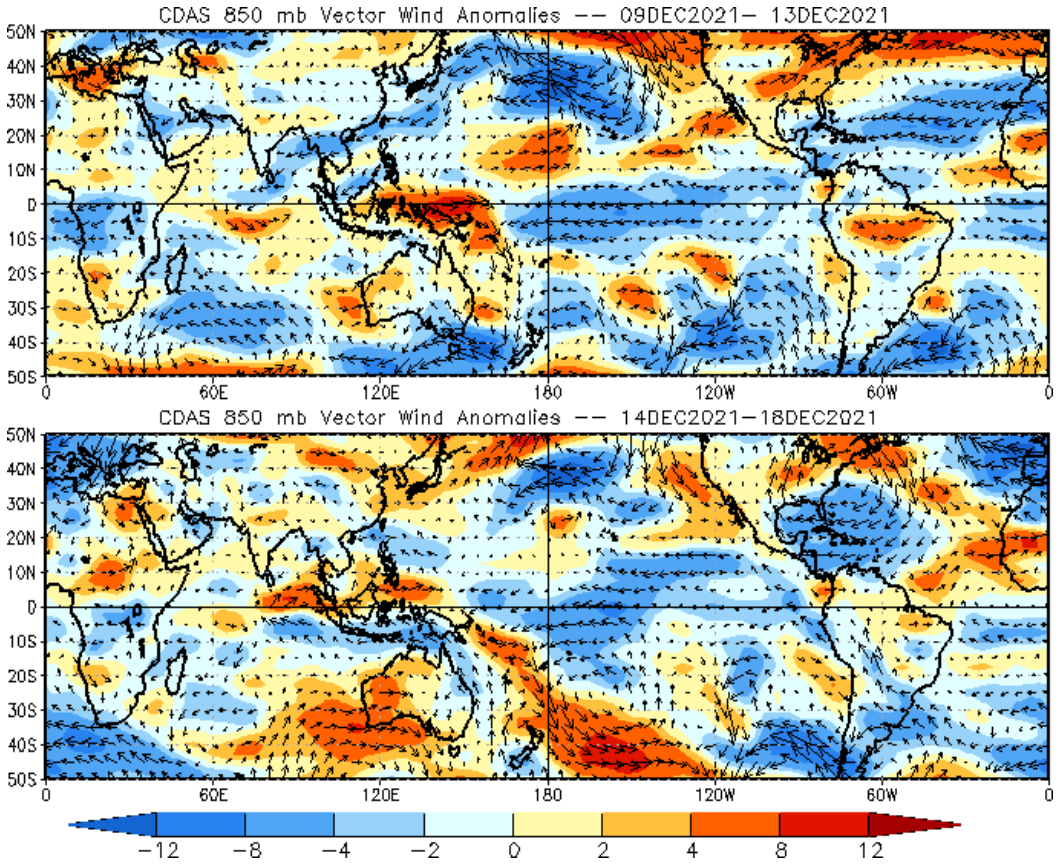


- Westerly anomalies strengthened over the east-central Pacific.
- Easterly anomalies persisted over the tropical Atlantic.

850-hPa Wind Anomalies

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





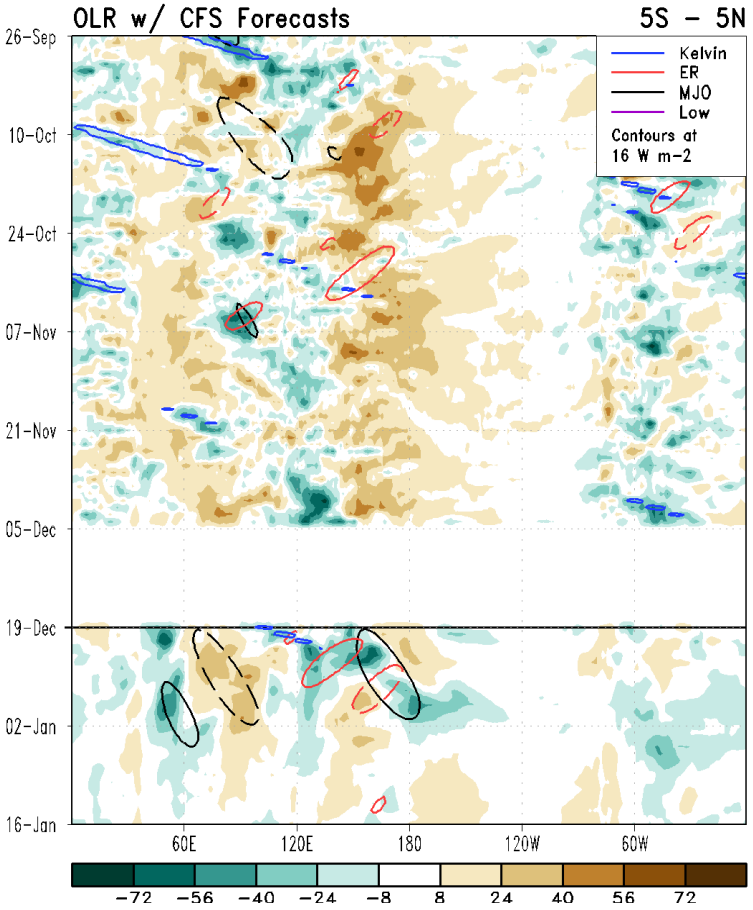
- The westerly wind burst that developed over the far West Pacific in early December failed to propagate to the central Pacific.

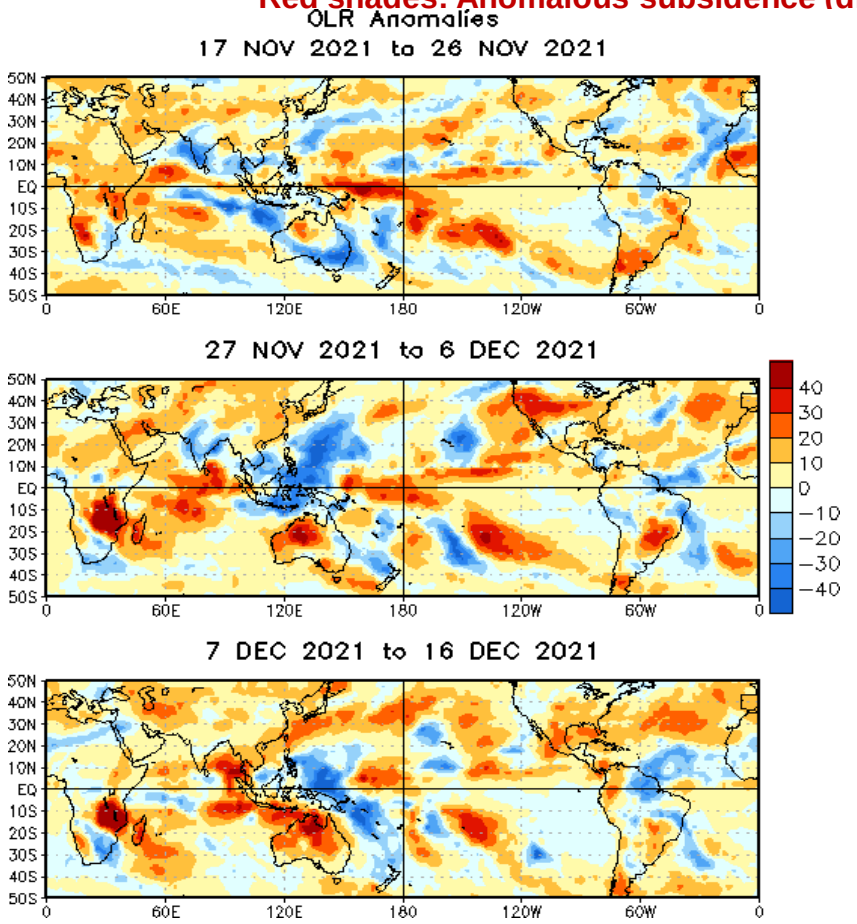
- A highly amplified pattern is evident over North America.

Outgoing Longwave Radiation (OLR) Anomalies

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

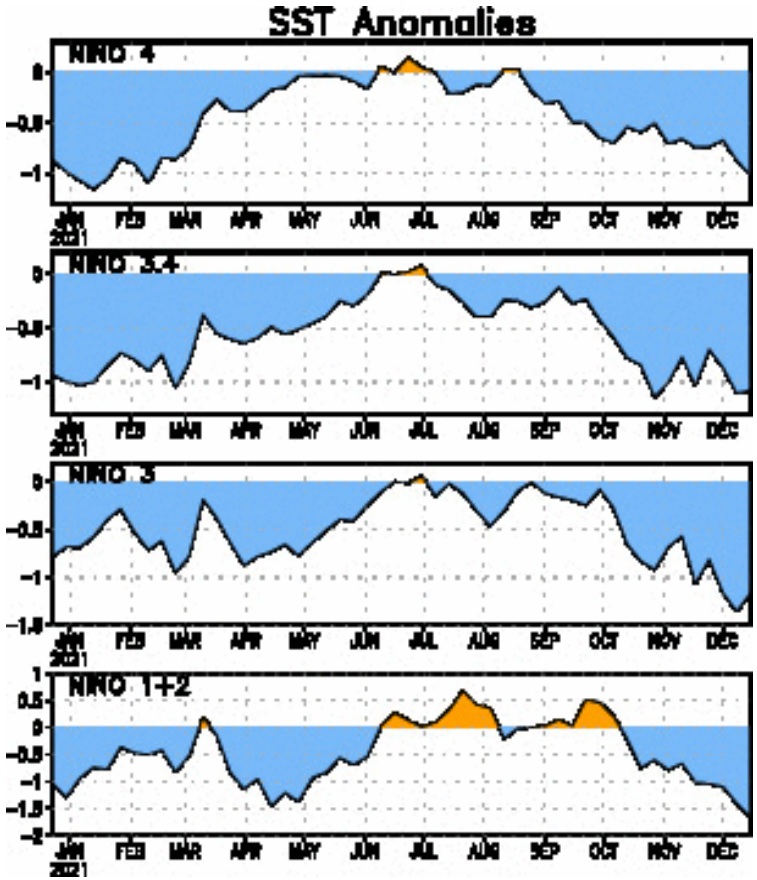
Blue shades: Anomalous convection (wetness)
Red shades: Anomalous subsidence (dryness)

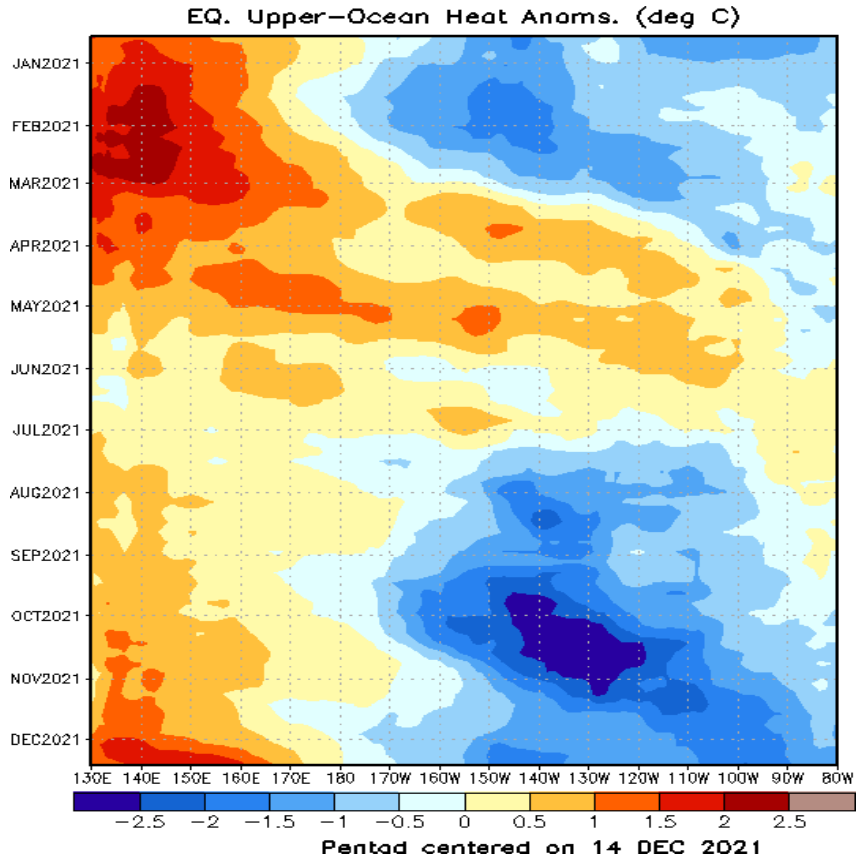




- Prior to an early December data outage, the low frequency La Niña signal was the dominant driver of anomalous tropical convection.
- Despite the weakening of the low-level MJO footprint, the CFS continues to depict enhanced convection crossing the Pacific over the next two weeks.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

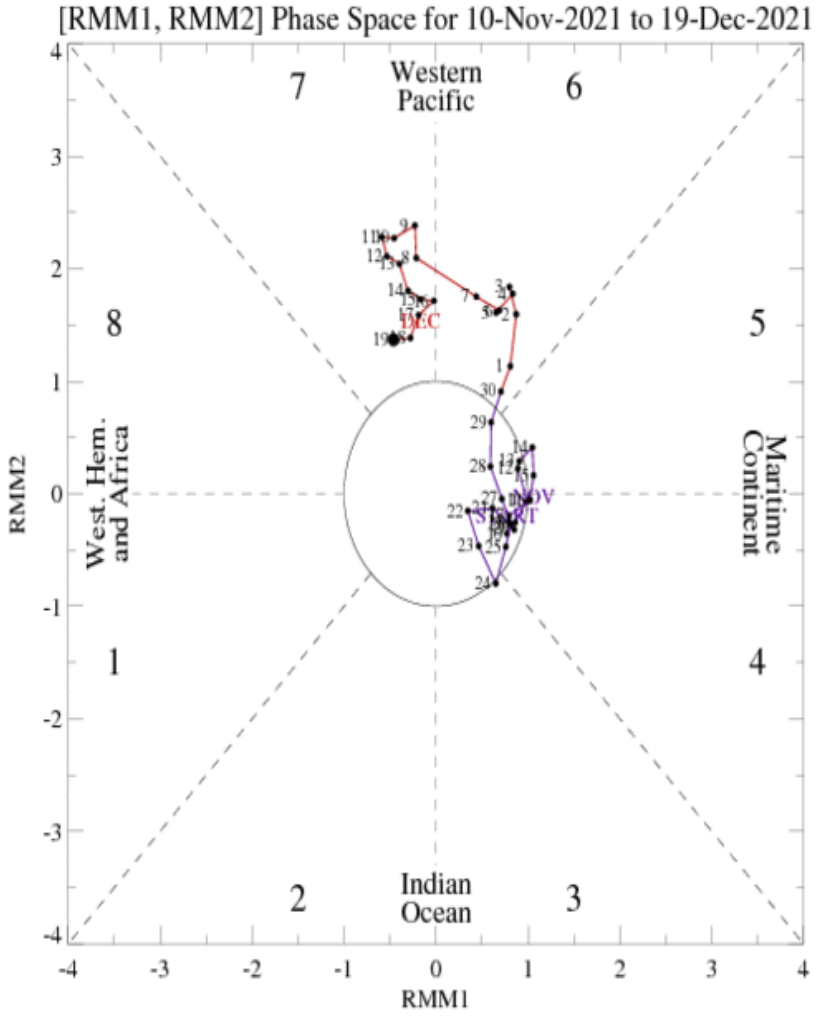




- Negative upper-ocean heat content anomalies have increased slightly across the central Pacific during December.
- Positive upper-ocean heat content anomalies have increased across the West Pacific during the past month.
- Consistent with La Niña, below-normal sea surface temperatures (SSTs) continue to be observed within all Niño regions, with SSTs holding steady or decreasing during November and early December.

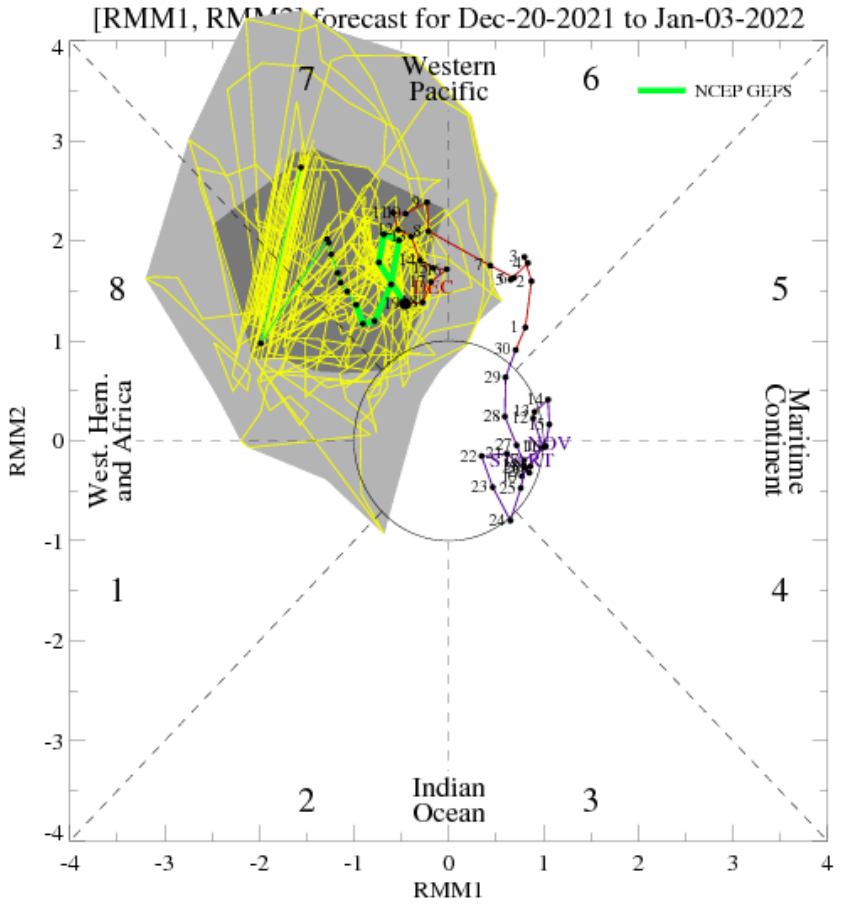
MJO Index: Recent Evolution

- The RMM based MJO index continues to exhibit a Pacific signal, but there has been a reduction in both amplitude and eastward propagation of the signal, likely due to the weakening low-level response.

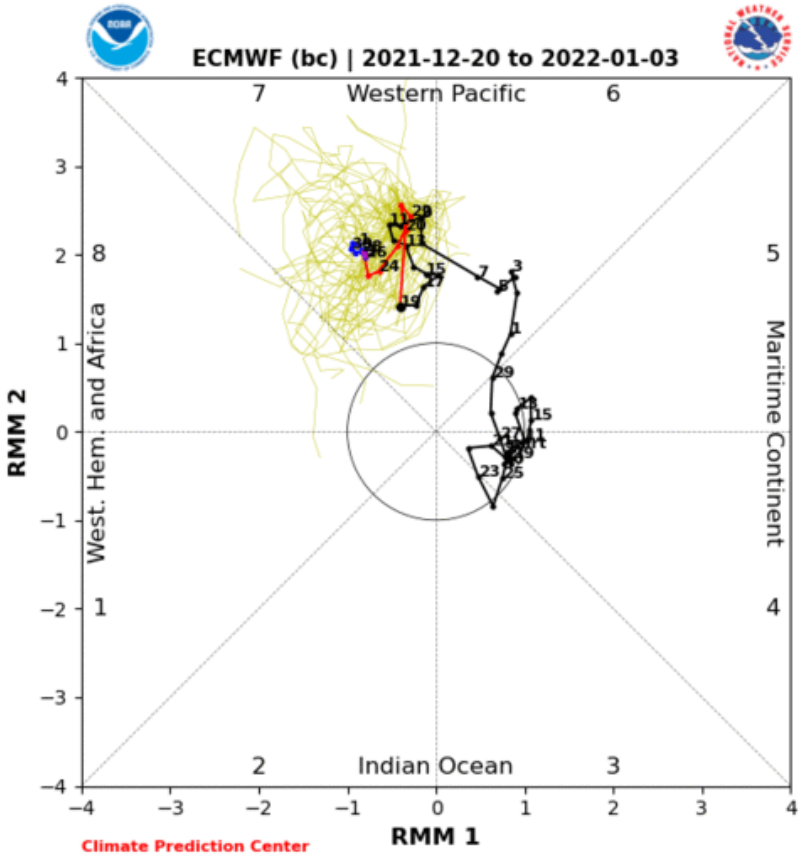


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

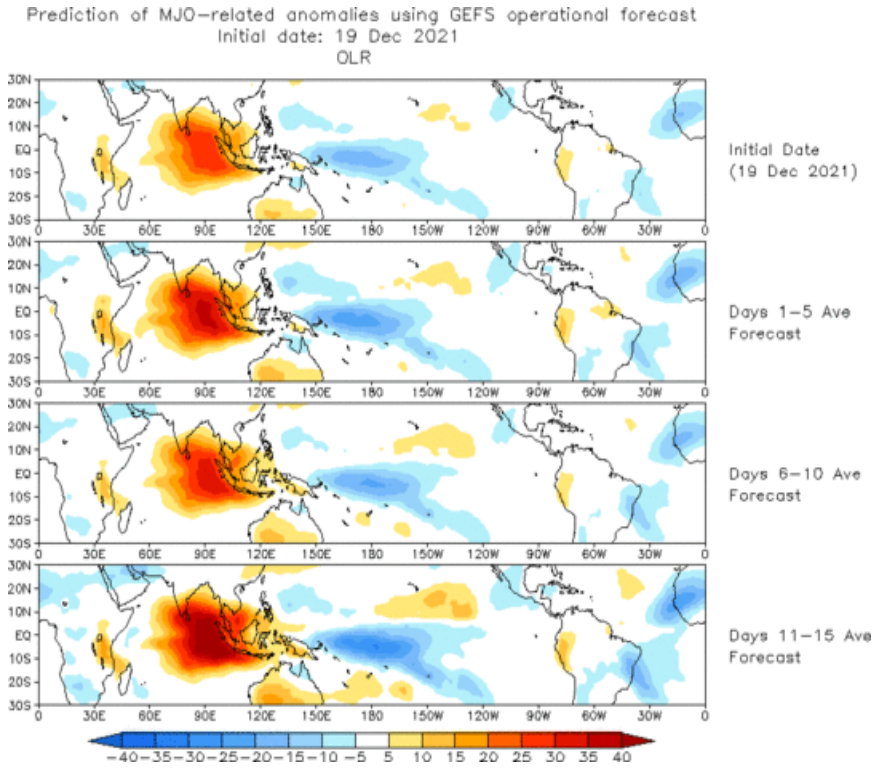


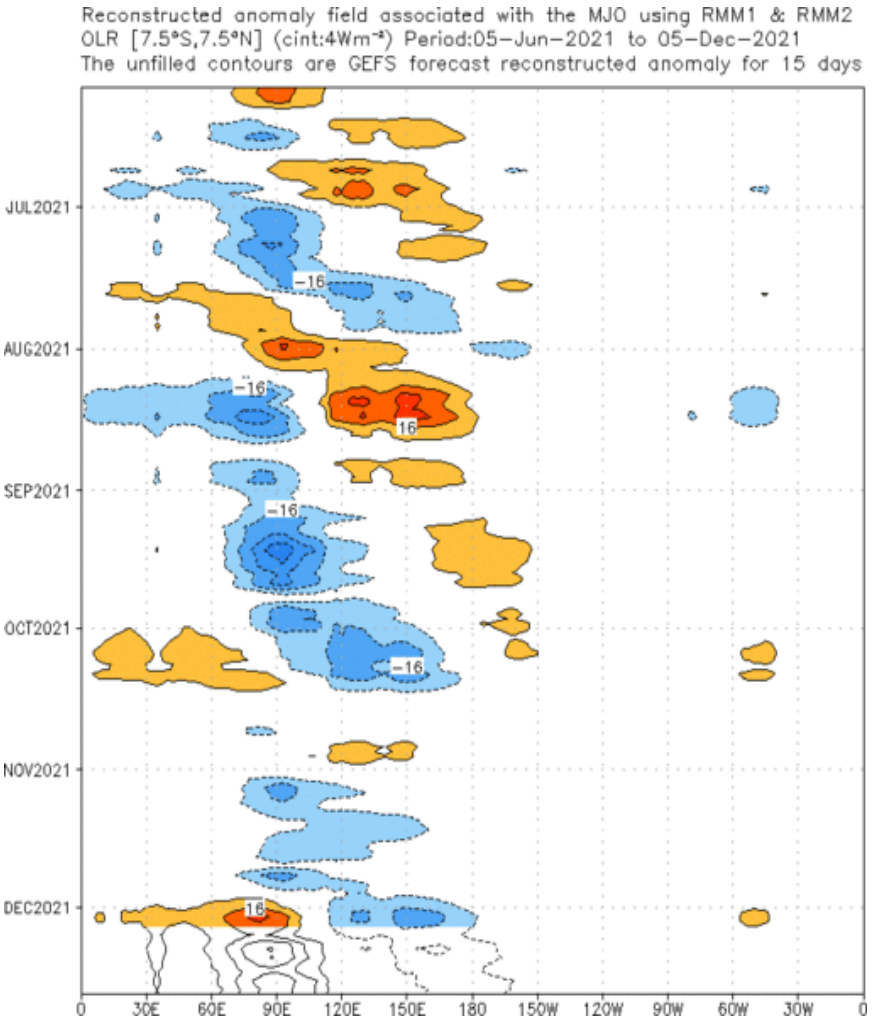
ECMWF Forecast

- Both the GEFS and ECMWF ensembles depict a persistent West Pacific enhanced signal, which may be due to continued destructive interference among the weakening MJO, the La Niña base state, and Rossby wave activity.
- Very few ensemble members from the GEFS or ECMWF depict MJO propagation across the Western Hemisphere.
- There is a likely climatology issue impacting the last three days of the GEFS forecast.

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.)

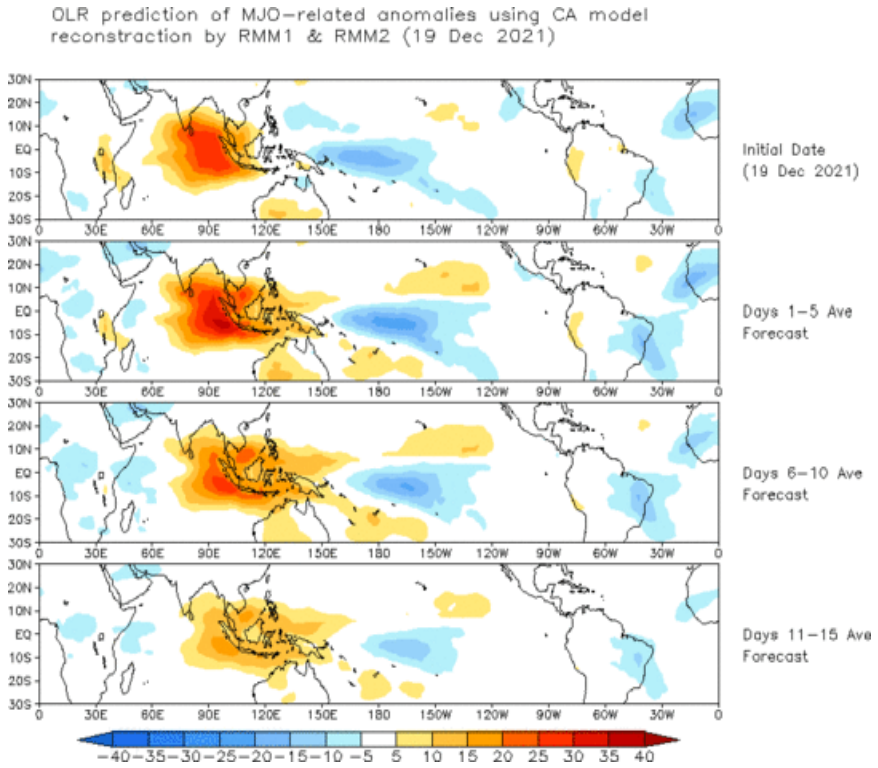


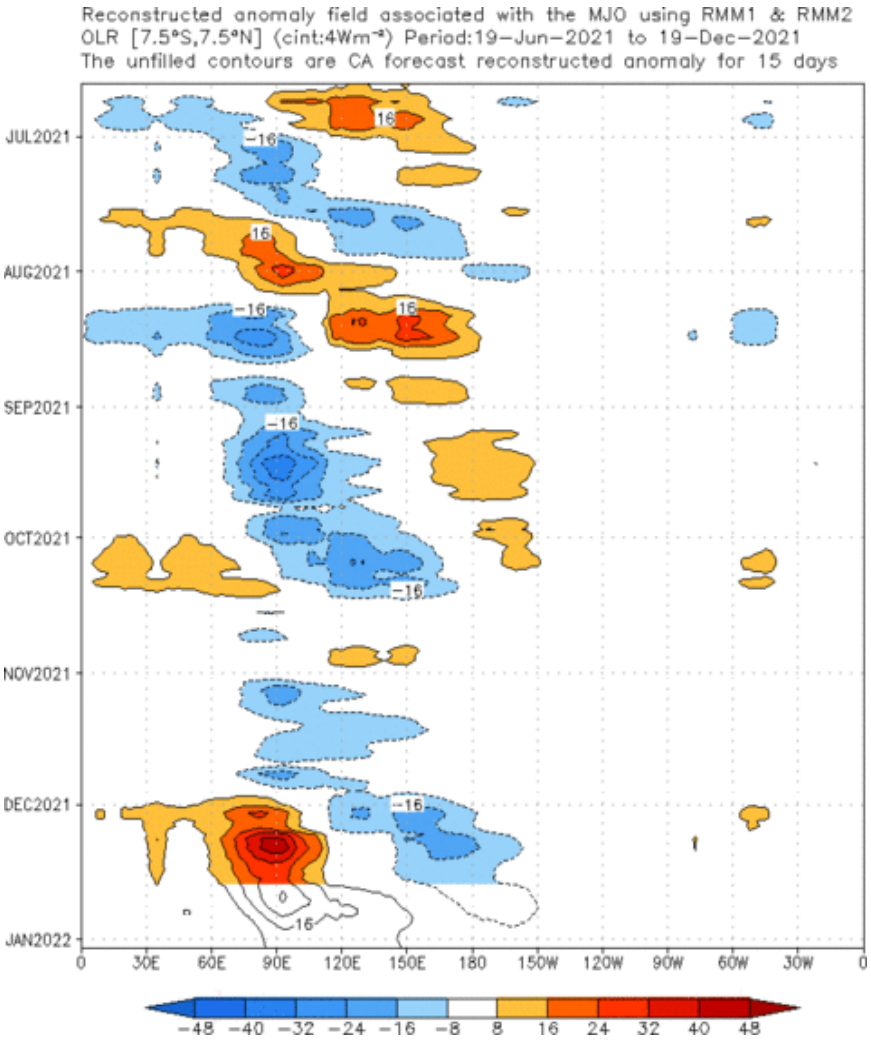


- The GEFS RMM-based OLR anomaly forecast depicts persistent enhanced (suppressed) convection over the tropical Pacific (Indian Ocean), which is not consistent with recent observations.

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.)

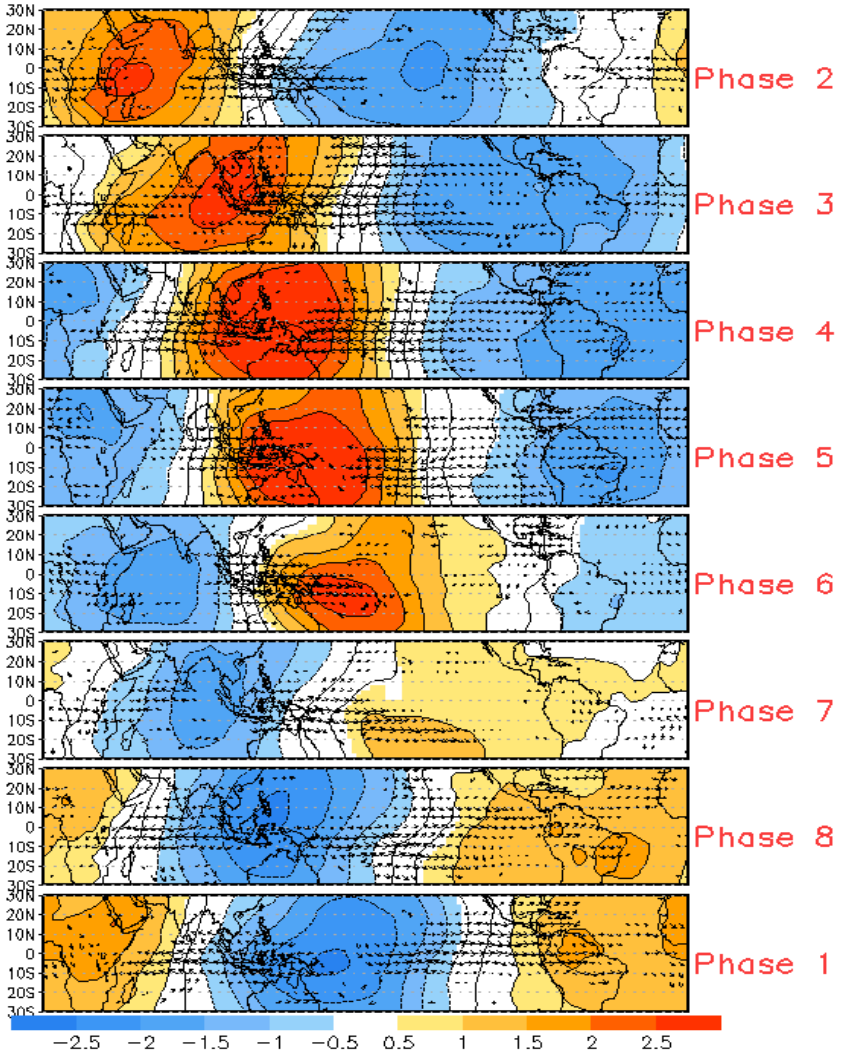




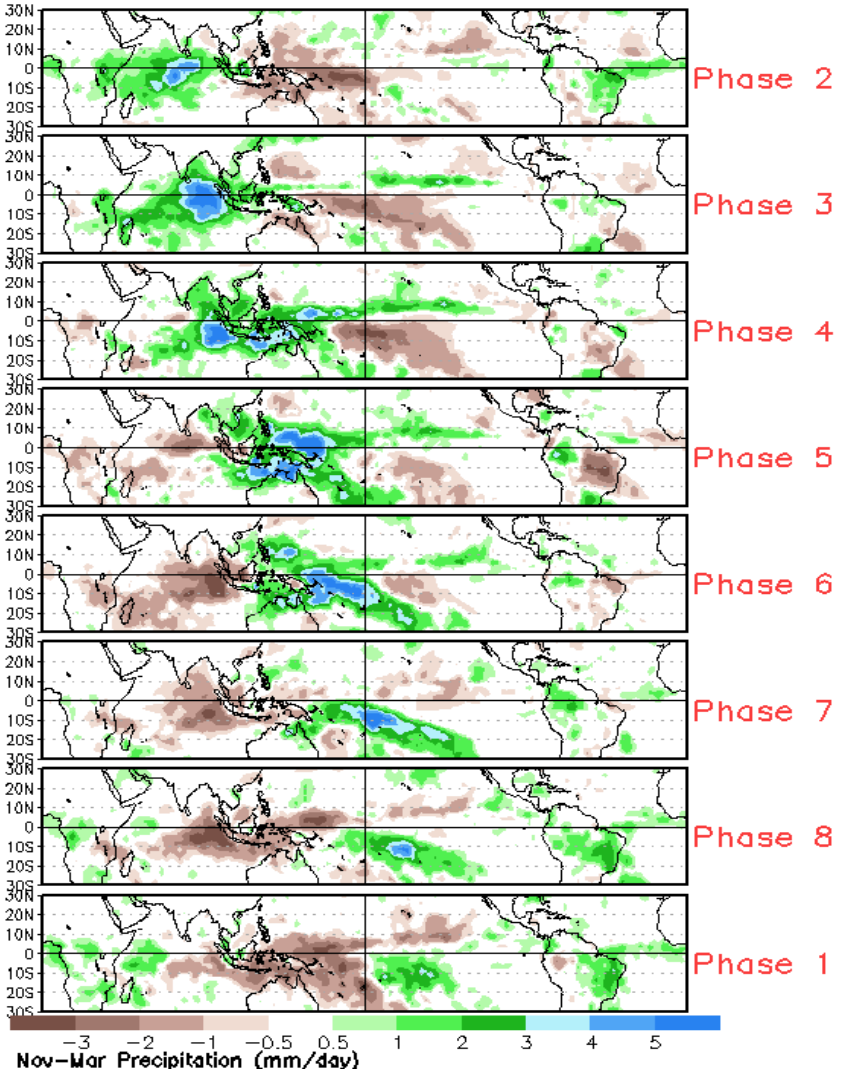
- The constructed analog depicts a more progressive MJO signal, with a weaker amplitude than the GEFS.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



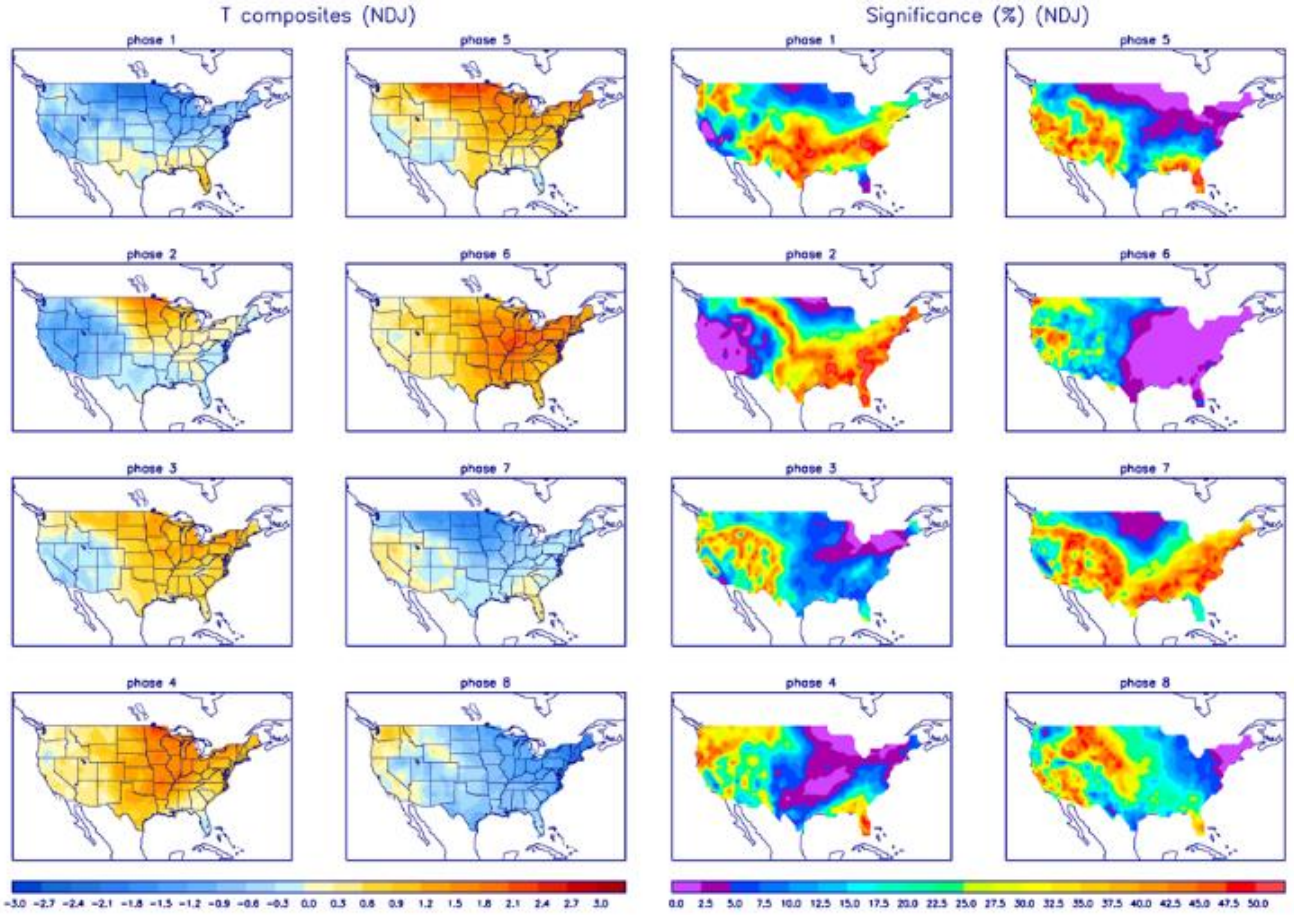
Precipitation Anomalies



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.

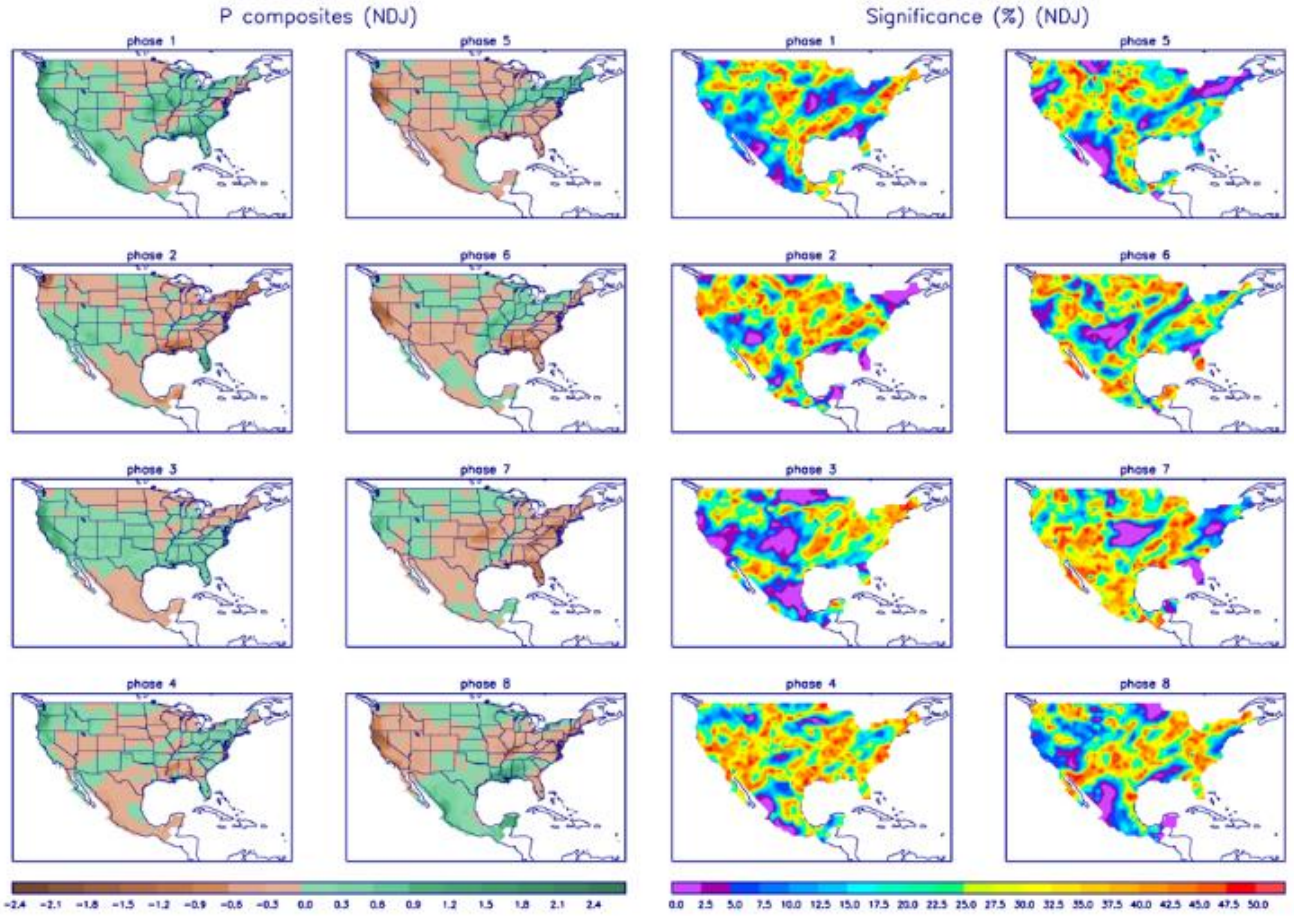


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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.

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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