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

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
14 December 2020

Overview

- The RMM index indicates the MJO has become better organized over the eastern Maritime Continent (phase 5) during the last week.

- Dynamical model spread remains high, as ensemble means favor a decline of the intraseasonal signal over the Maritime Continent and western Pacific likely due to destructive interference with the ongoing La Niña. This limits forecast confidence on the predicted evolution and strength of the MJO into late December.

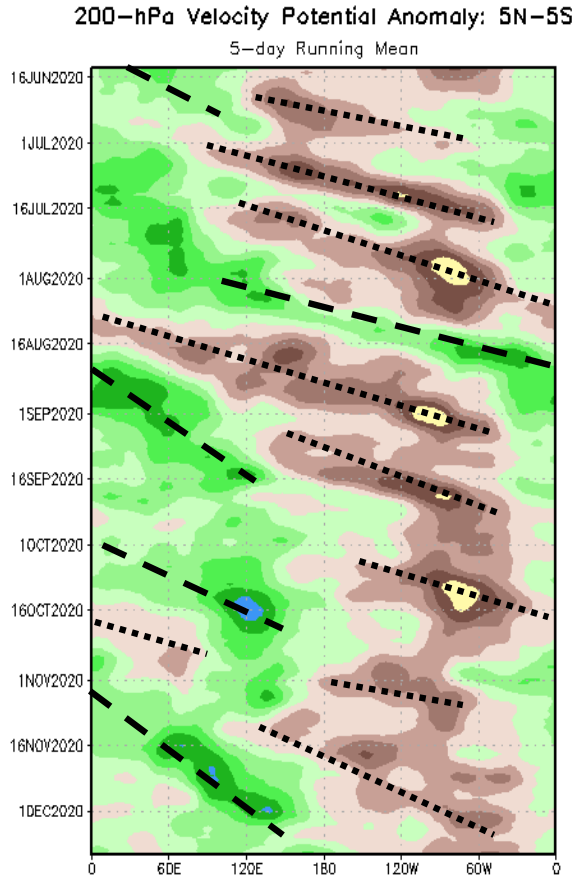
- The enhanced phase of the MJO and predicted Rossby wave activity are anticipated to increase chances for TC formation over the southern Indian Ocean and West Pacific during the next two weeks as supported by model guidance.

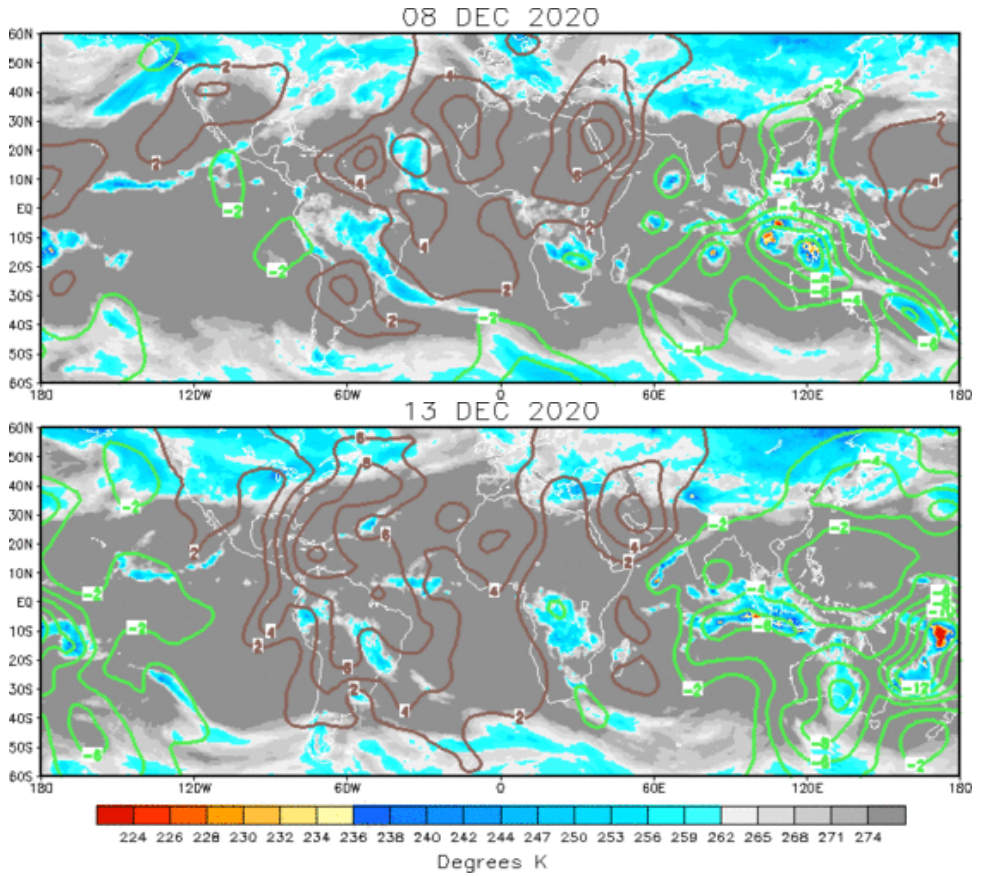
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

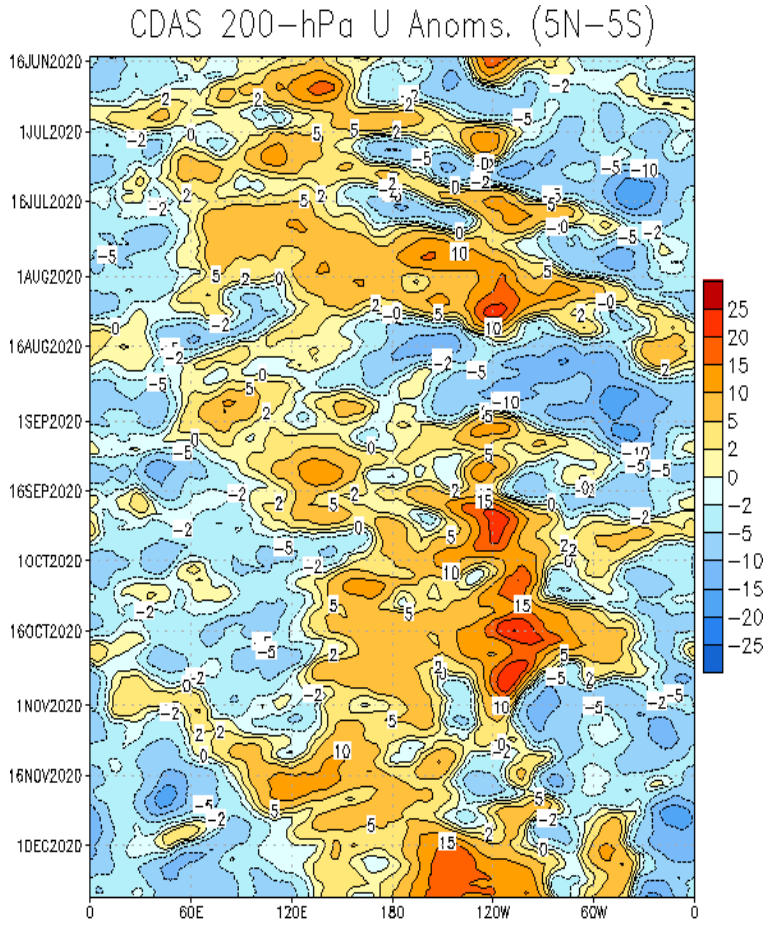


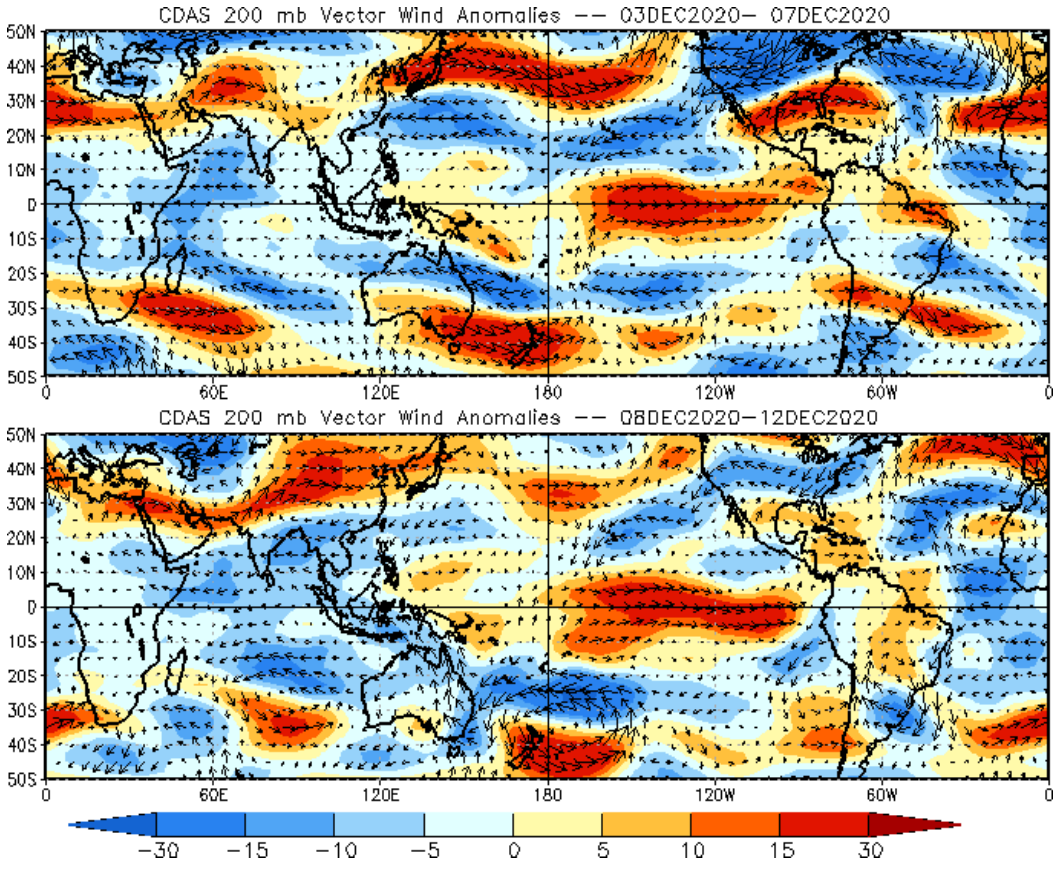


- The MJO strengthened during mid-November as it propagated east over the Indian Ocean.
- A wave-1 pattern in the upper-level circulation remains apparent, and there has been some evidence of eastward propagation of the enhanced envelope since early December.

200-hPa Wind Anomalies

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

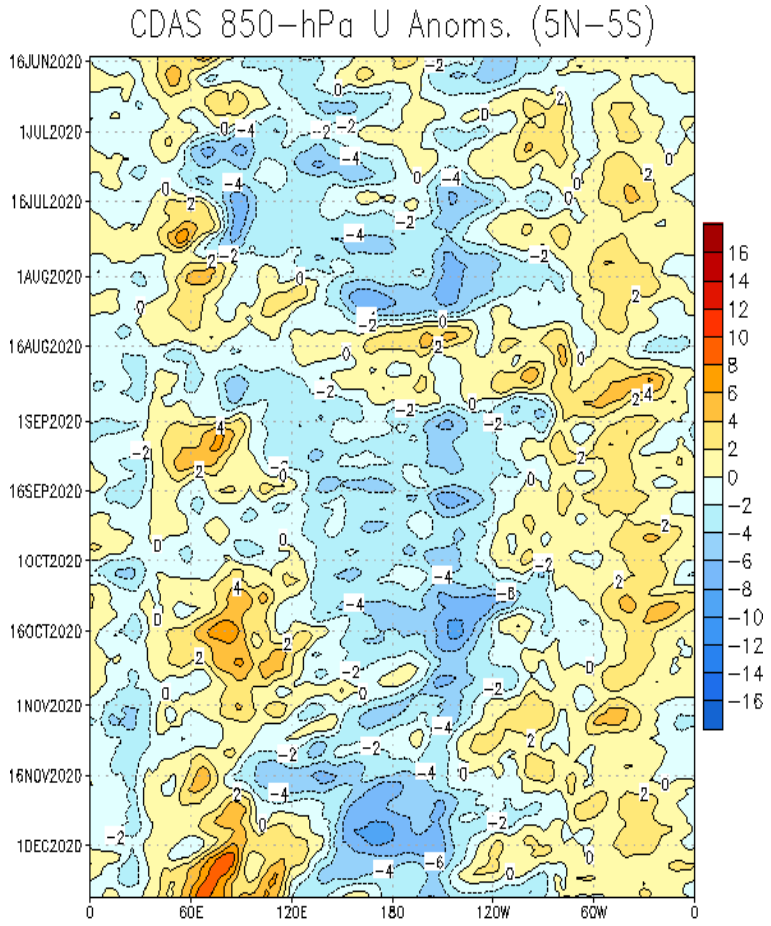


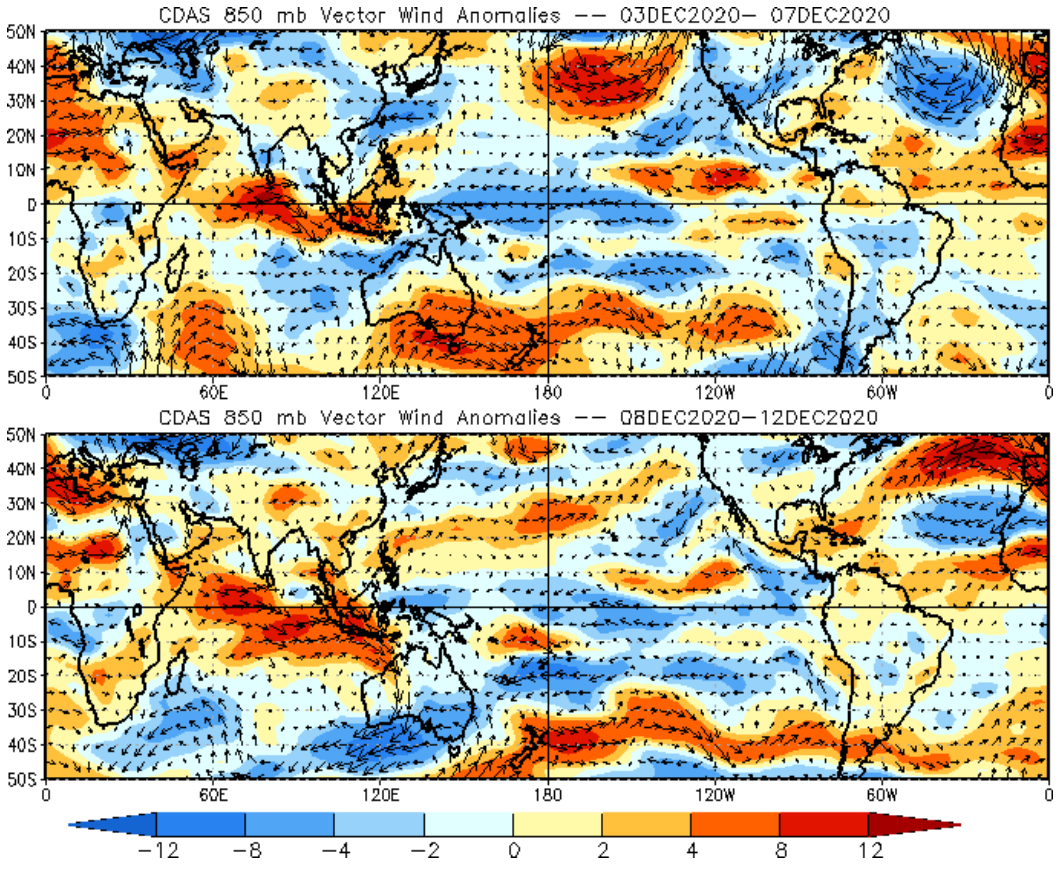


- Since late November, anomalous westerlies have considerably strengthened east of the Date Line along the equatorial Pacific. This appears to be reinforced by an anomalous cyclonic circulations in both hemispheres over the Pacific.
- Anomalous easterlies over the western Indian Ocean have also expanded eastward over the Maritime continent, which aligns with the RMM index during the last week.

850-hPa Wind Anomalies

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

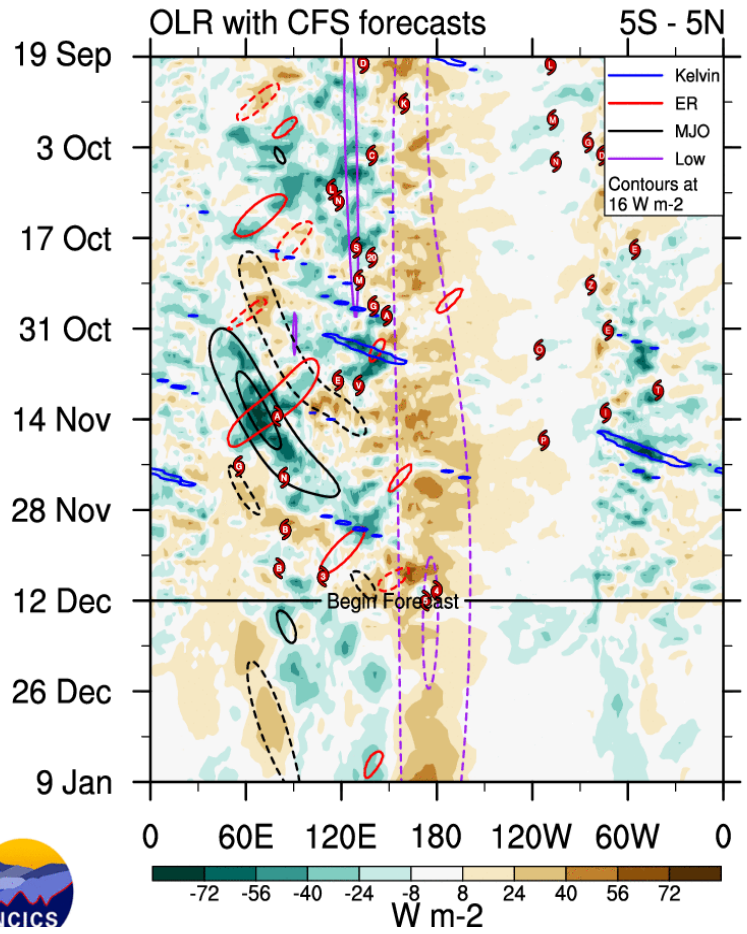


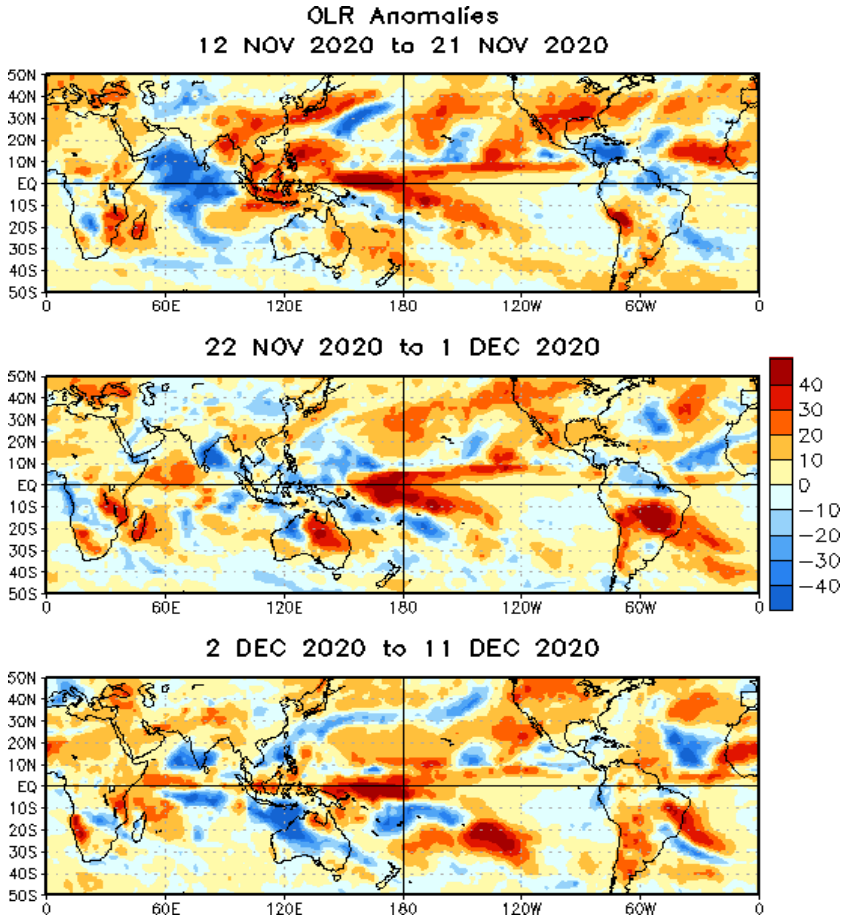


- Low-level anomalous westerlies have strengthened over the eastern Indian Ocean and Maritime Continent, as enhanced trades, tied to the ongoing La Niña, have slightly weakened to the west of the Date Line.
- The weakening easterly anomalies suggests destructive interference is ongoing between the MJO and the base state, similar to late October.
- The return of enhanced trades are observed over the eastern equatorial Pacific.

Outgoing Longwave Radiation (OLR) Anomalies

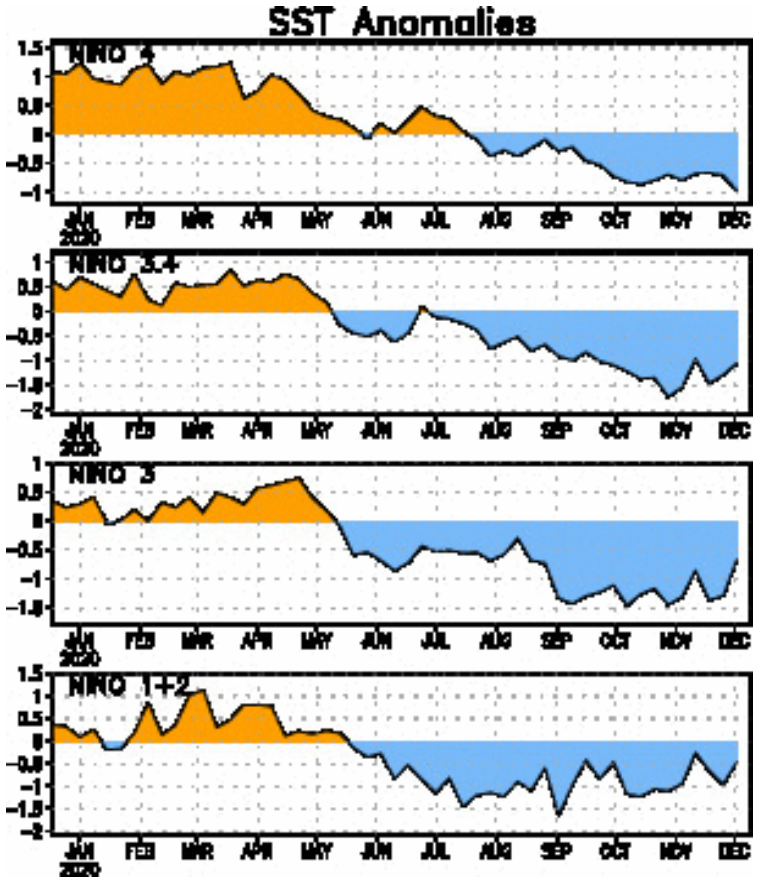
Blue shades: Anomalous convection (wetness). Red shades: Anomalous subsidence (dryness).

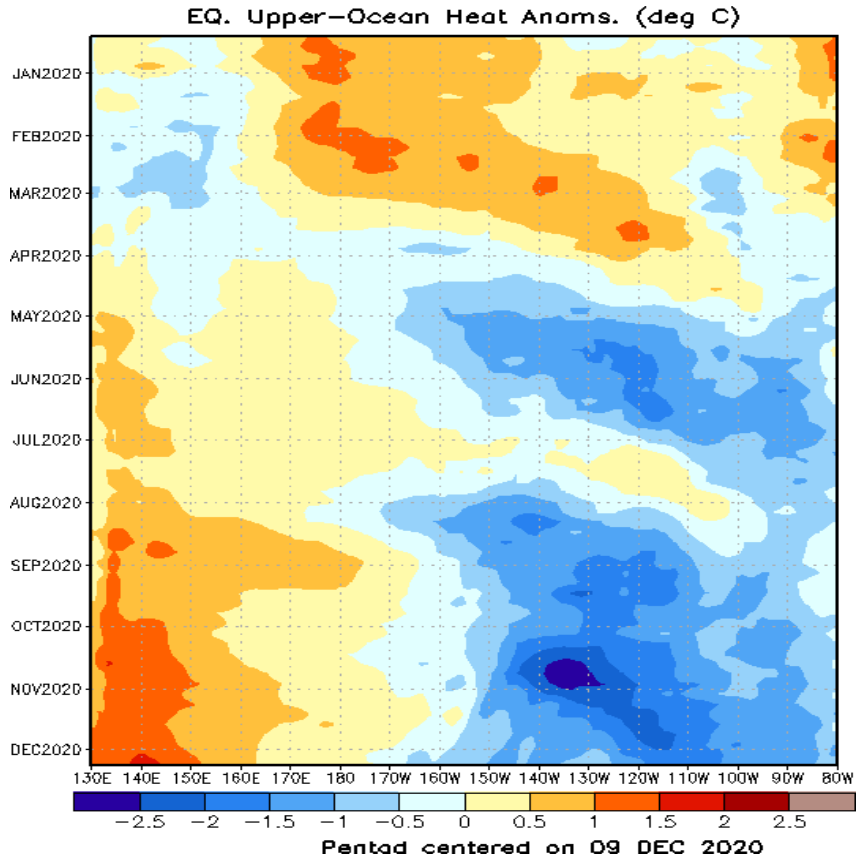




- Suppressed convection has expanded westward across the equatorial West Pacific during early December, tied to Rossby wave activity.
- Enhanced convection over the southern Indian Ocean and South Pacific is associated with TC activity.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

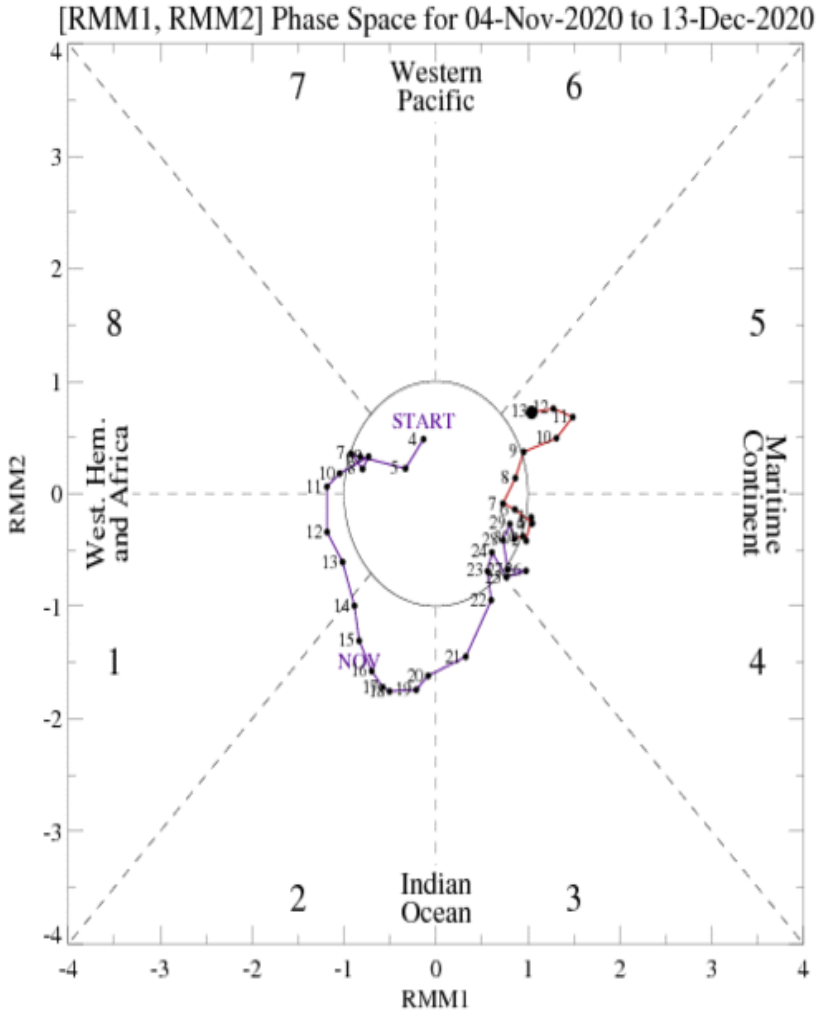




- Following destructive interference with the base state by a downwelling Kelvin wave during July, the subsequent upwelling phase has pushed the Pacific into La Niña conditions.
- While Niño 4 has cooled, negative SST anomalies in the other Niño regions have weakened during late November.

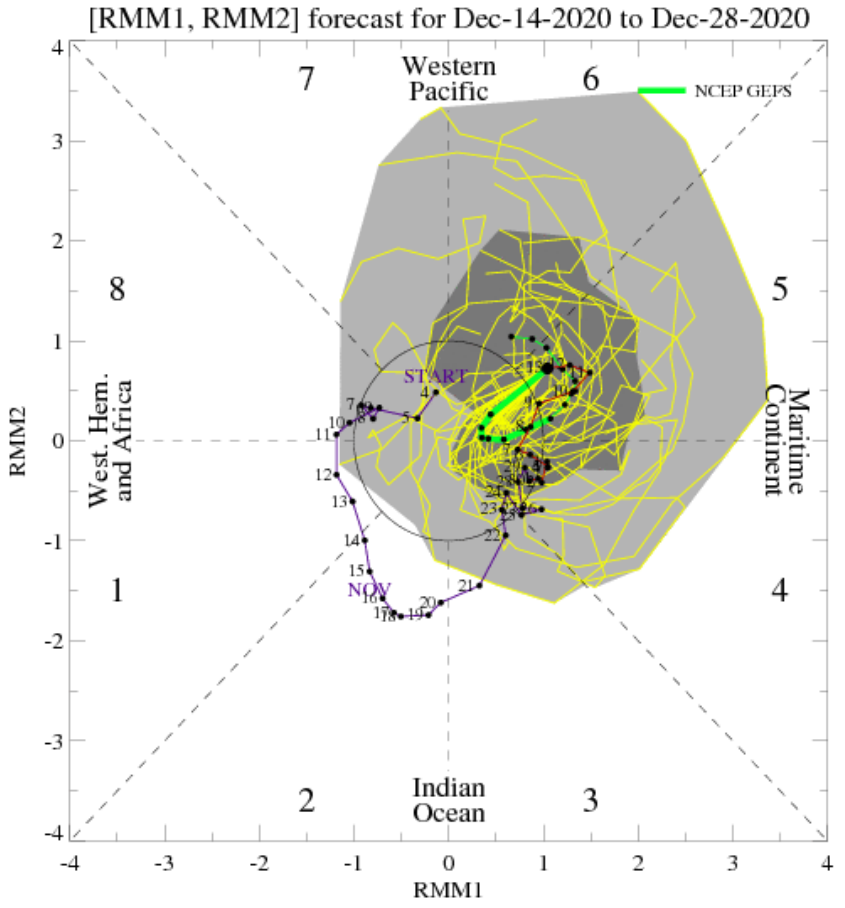
MJO Index: Recent Evolution

- The RMM index depicts an eastward propagating and strengthening MJO during the past week.
- The recent weakening of the signal likely tied to destructive interference with the low frequency footprint.

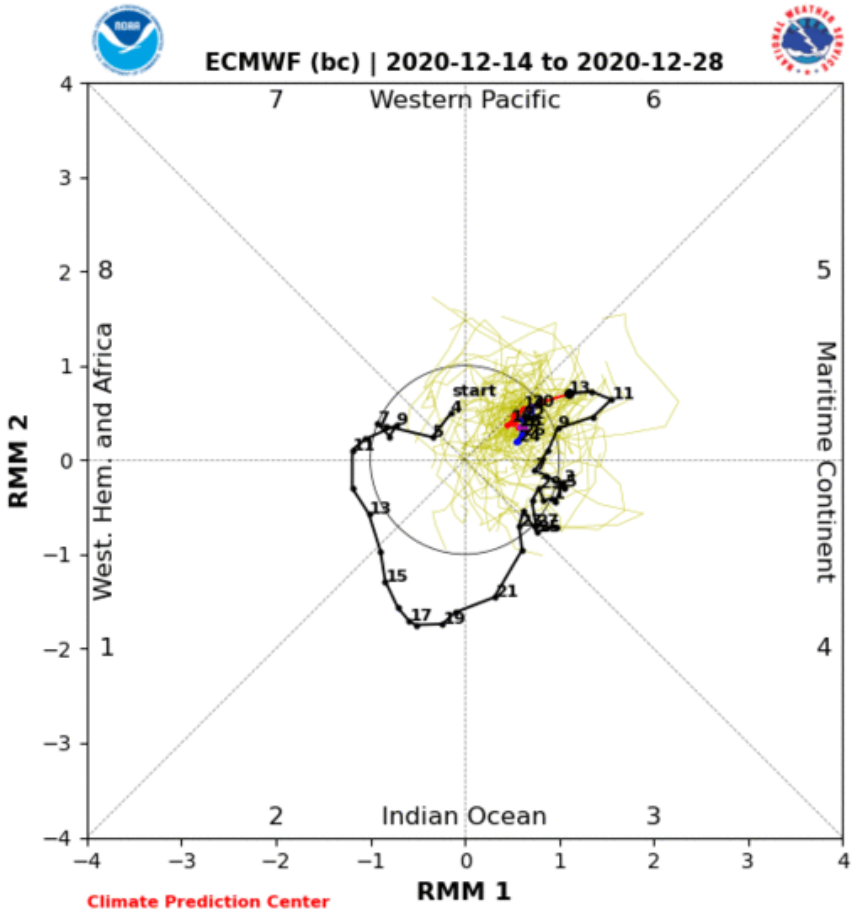


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

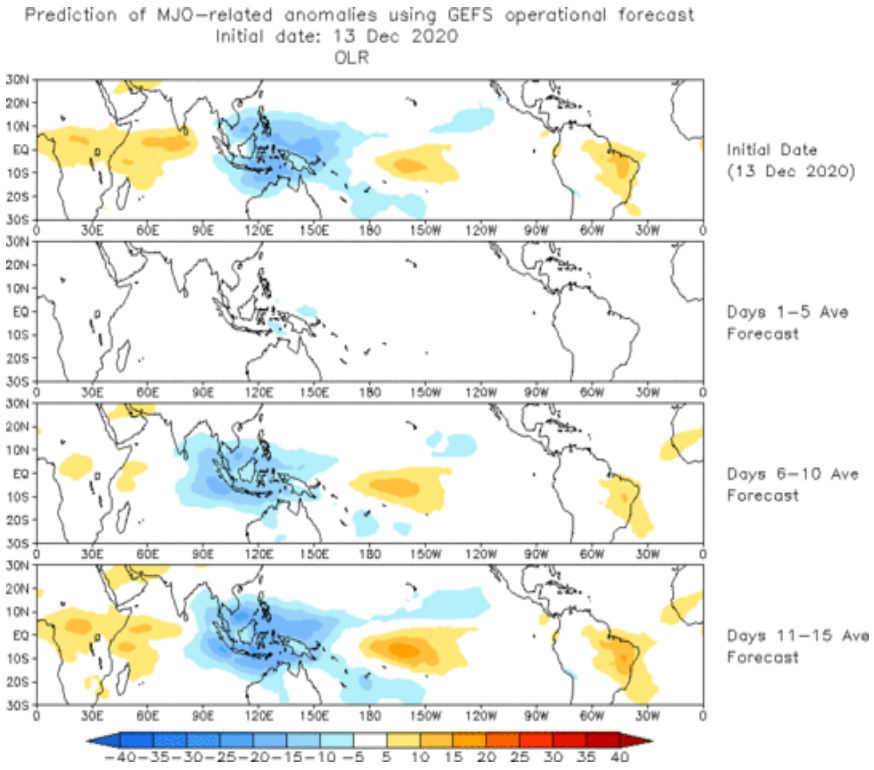


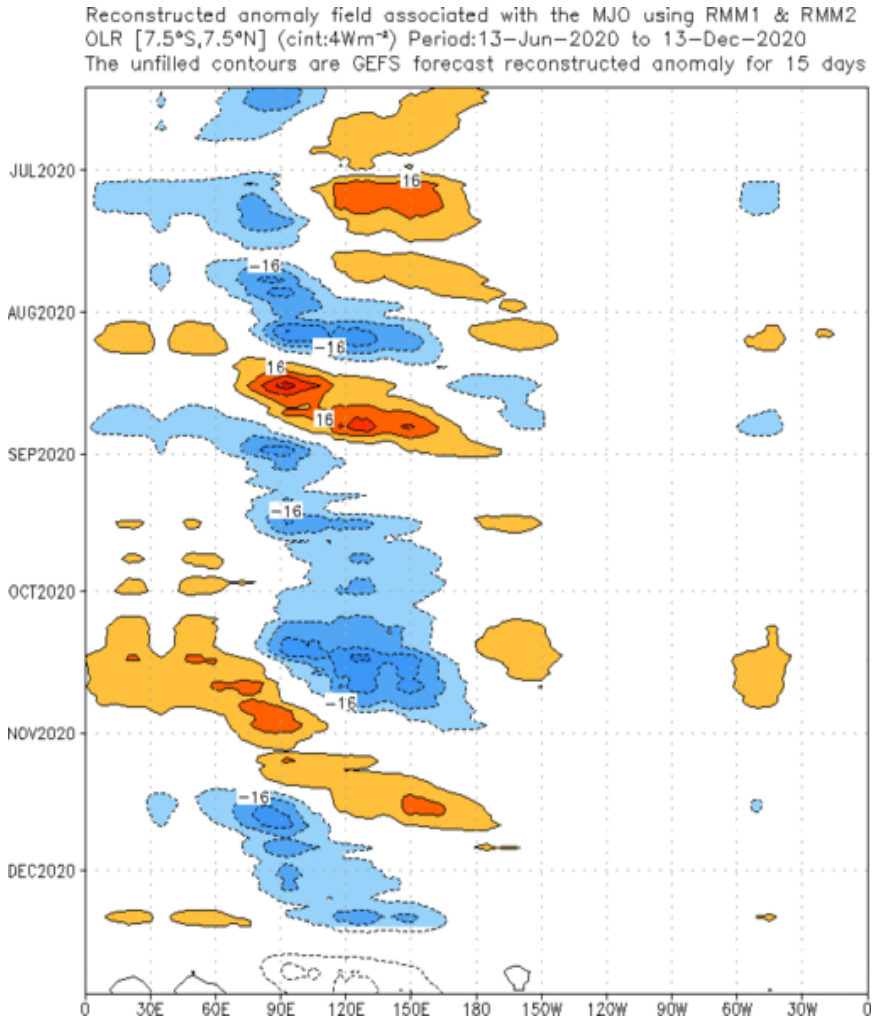
ECMWF Forecast

- A continued weakening is favored by both the GEFS and ECMWF models with the signal falling within the unit circle during the next week.
- Although spread remains large, several ensemble members in the GEFS suggest reemergence of the signal during week-2.
- Although not pictured here, the CFS remains far more progressive with the MJO compared to other models.

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.)

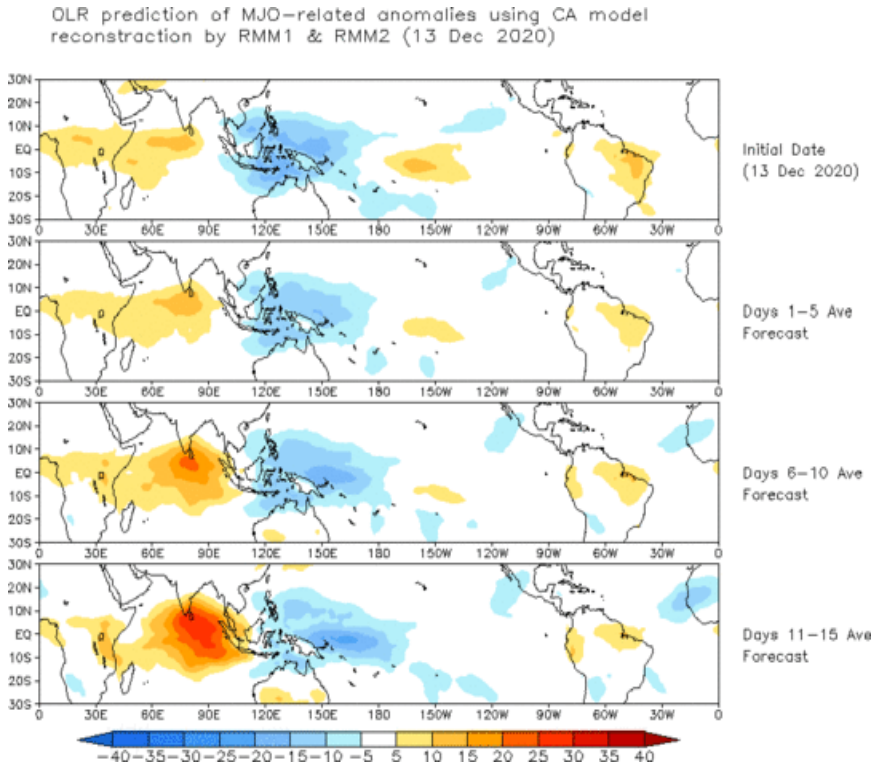


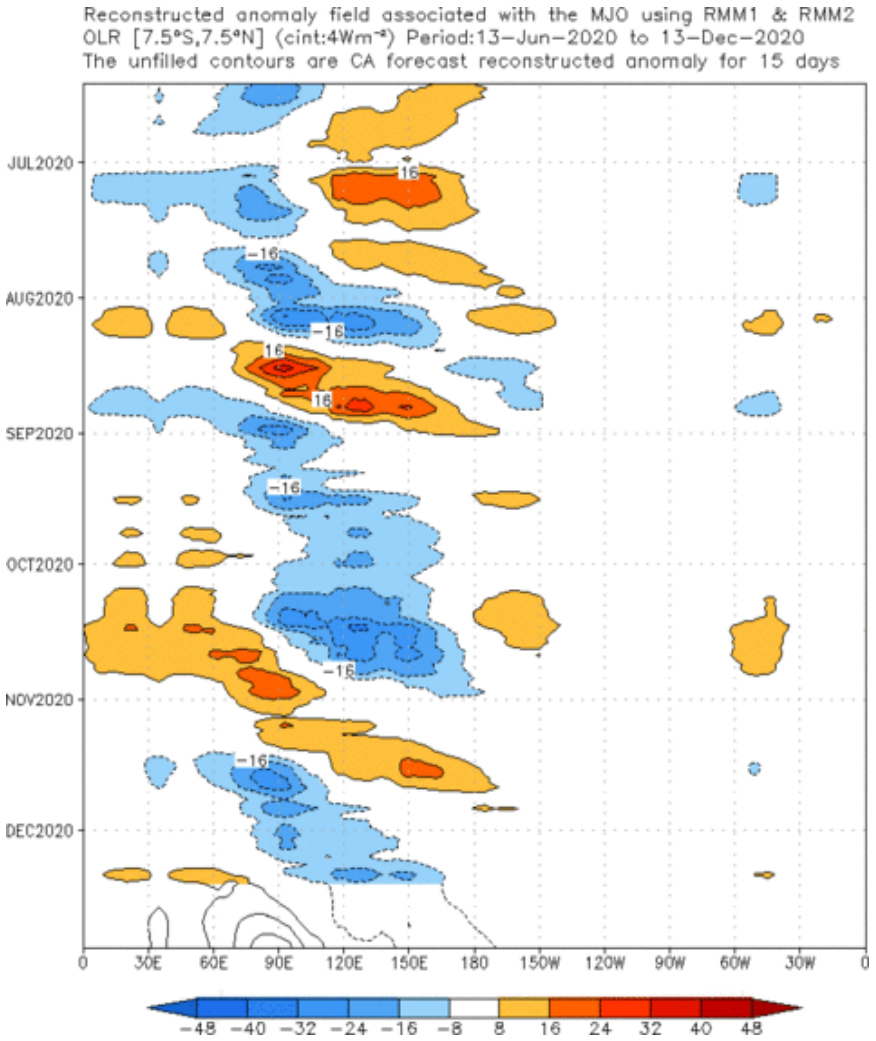


- The GEFS forecasts indicate a stationary pattern with weak signals for enhanced convection developing over the central and eastern Pacific.

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.)

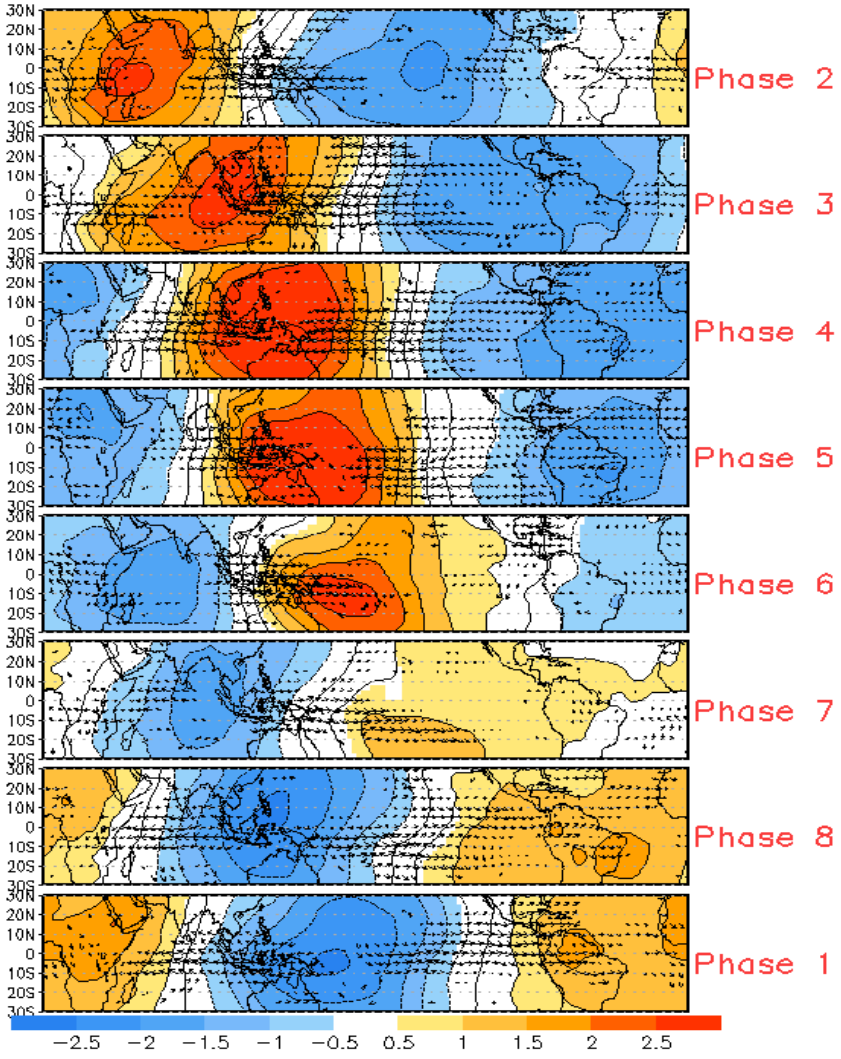




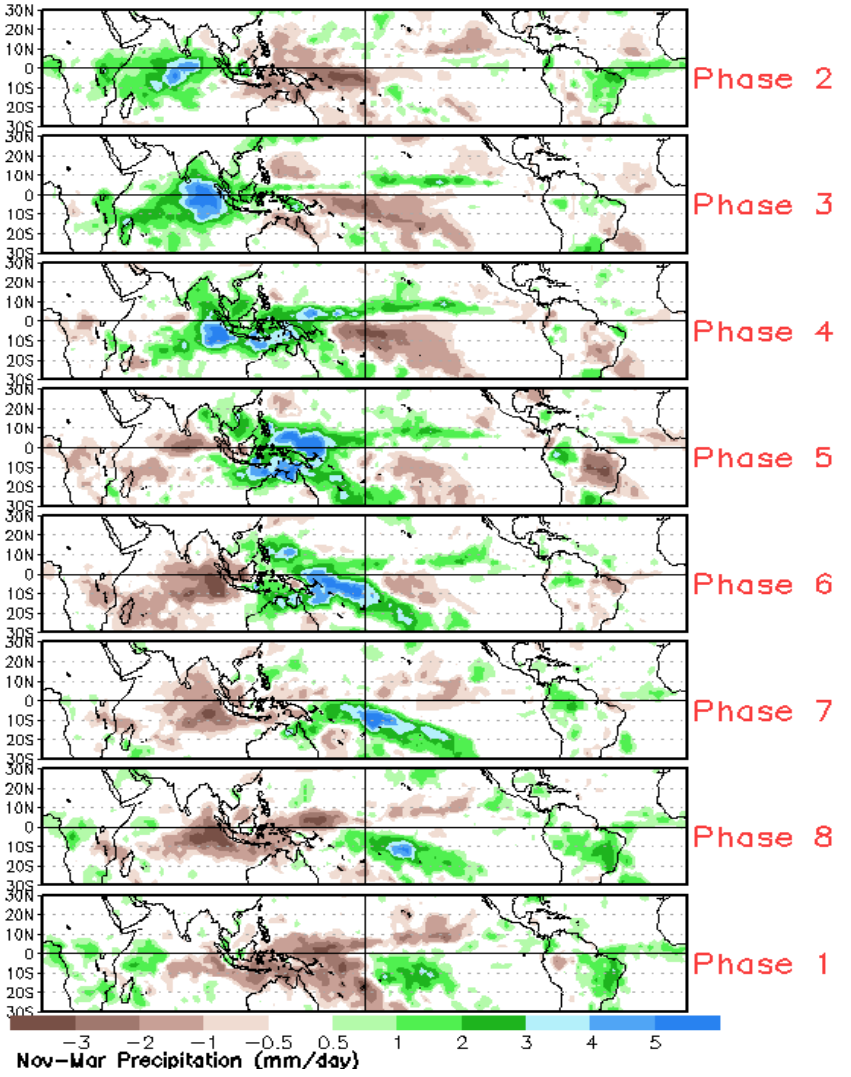
- The constructed analog outlook strongly favors suppressed convection developing across the Indian Ocean, with enhanced convection slightly shifting eastward into the Pacific.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



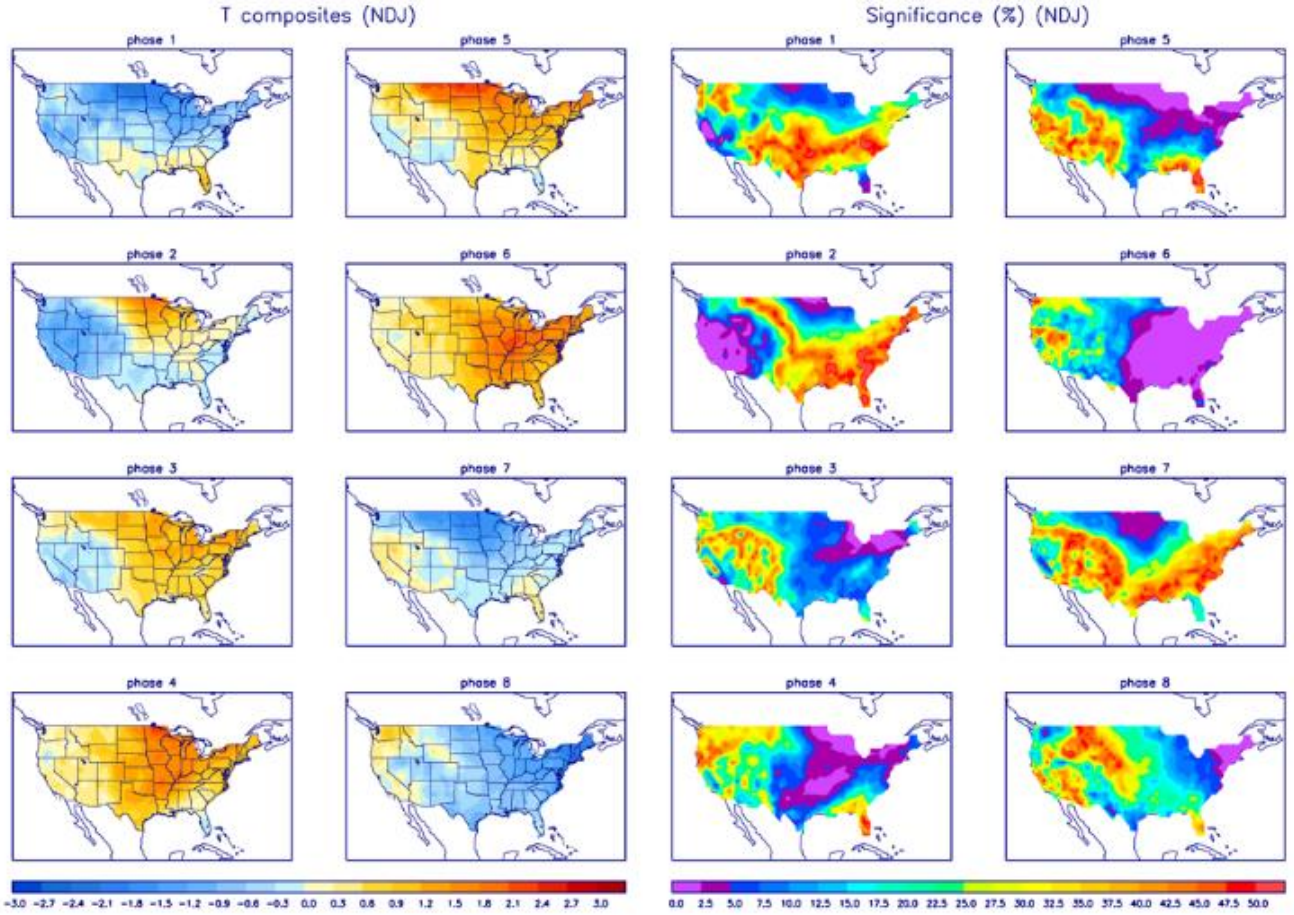
Precipitation Anomalies



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.

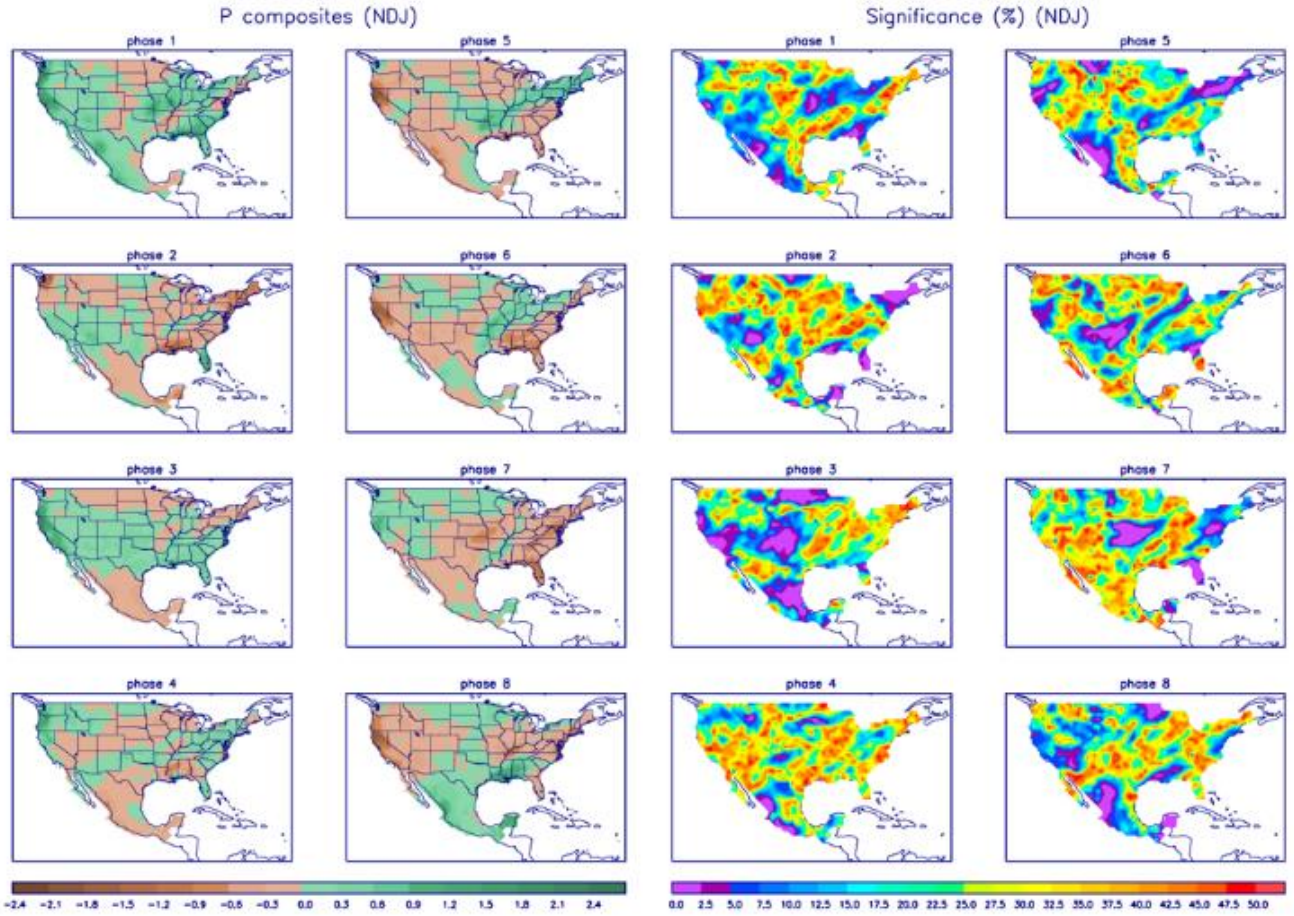


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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.



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