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

Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
14 August 2023

Overview

- The RMM index has been stronger lately than in July, but upper-level velocity potential anomaly fields and a lack of eastward propagating features continue to reflect disorganized intraseasonal activity.

- The recent uptick in RMM amplitude may be more in response to tropical cyclone activity in the central Pacific, and/or a low frequency atmospheric circulation developing in the equatorial Pacific.

- Dynamical model RMM forecasts generally favor weakened MJO activity during the next several weeks. Some extended range solutions point to possible reemergence over the western Pacific or the western Hemisphere later in August, however ensemble spread remains very high and forecast confidence is limited.

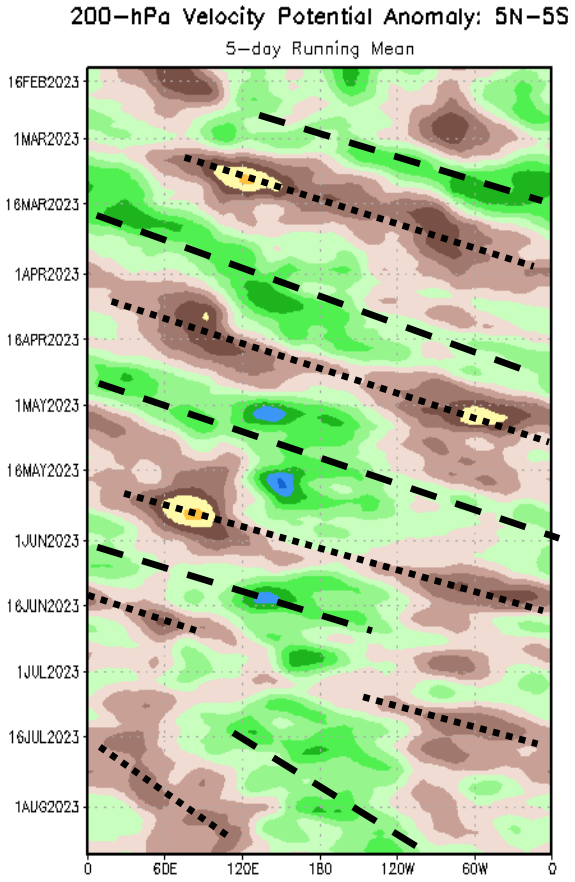
- Even without a coherent MJO, upper-level velocity potential anomaly forecasts feature a large-scale environment conducive for tropical cyclone (TC) development in the eastern Pacific and Atlantic, while the West Pacific is favored to be relatively quiet during the period.

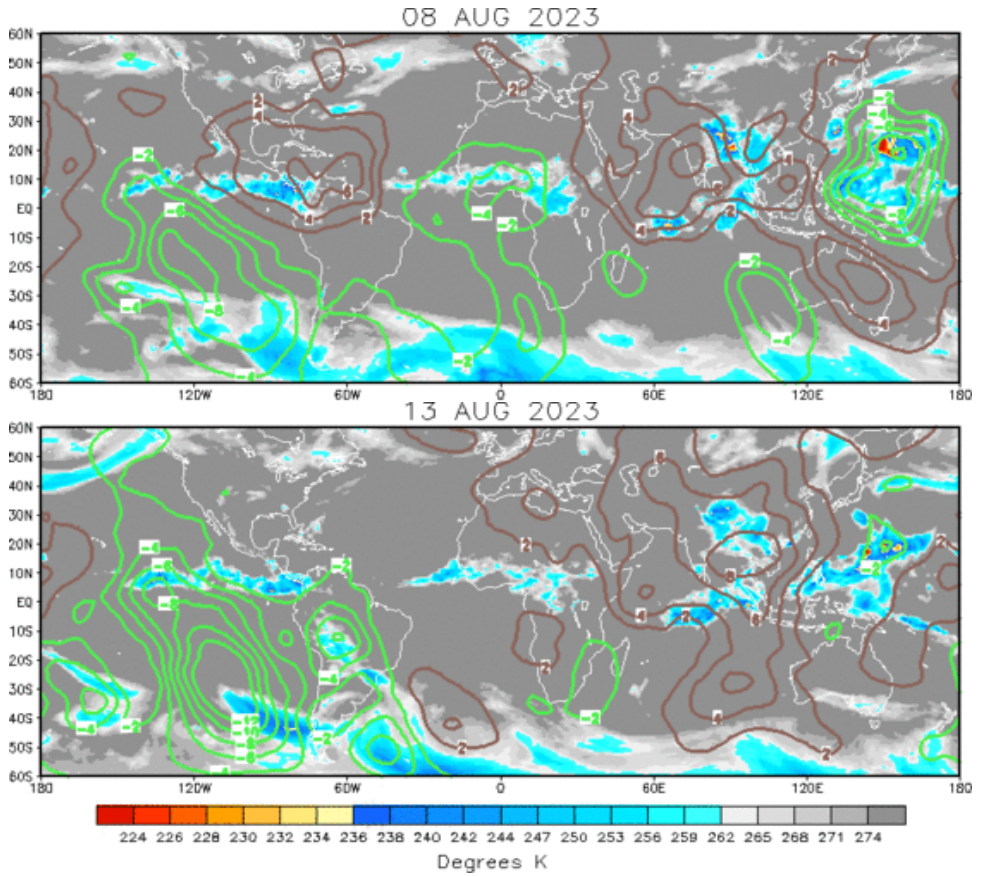
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

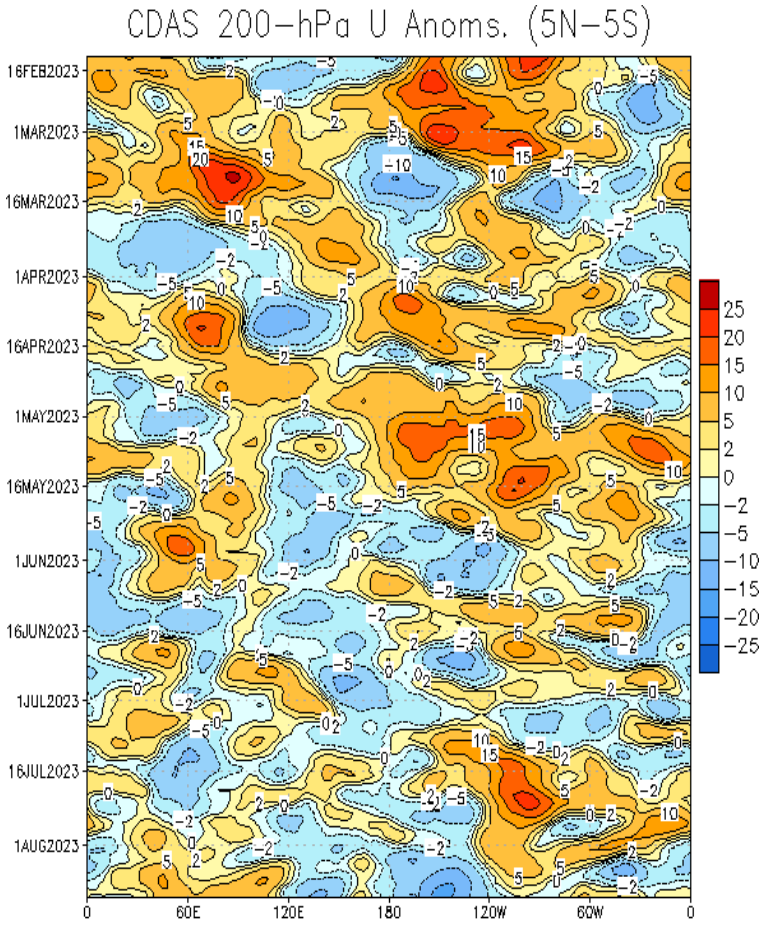


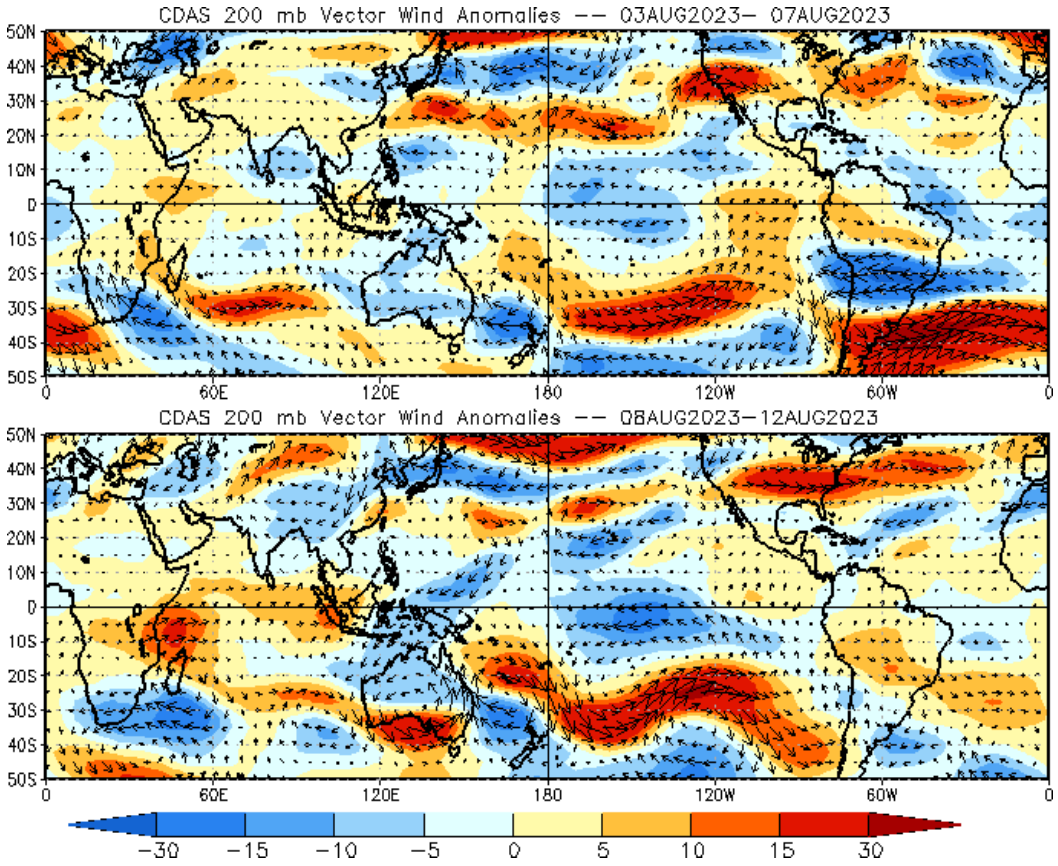


- Since early August, multiple envelopes of enhanced divergence aloft have emerged in the global tropics, suggestive of a disorganized MJO.
- An envelope of suppressed convection remained nearly stationary over the Indian Ocean and Maritime Continent.

200-hPa Wind Anomalies

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

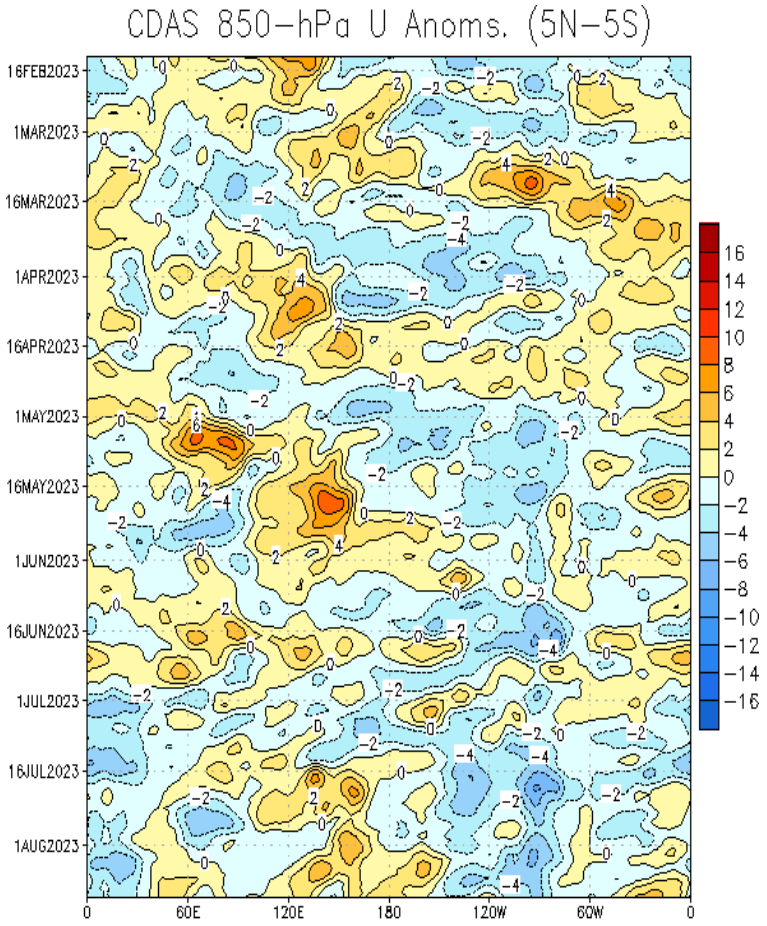


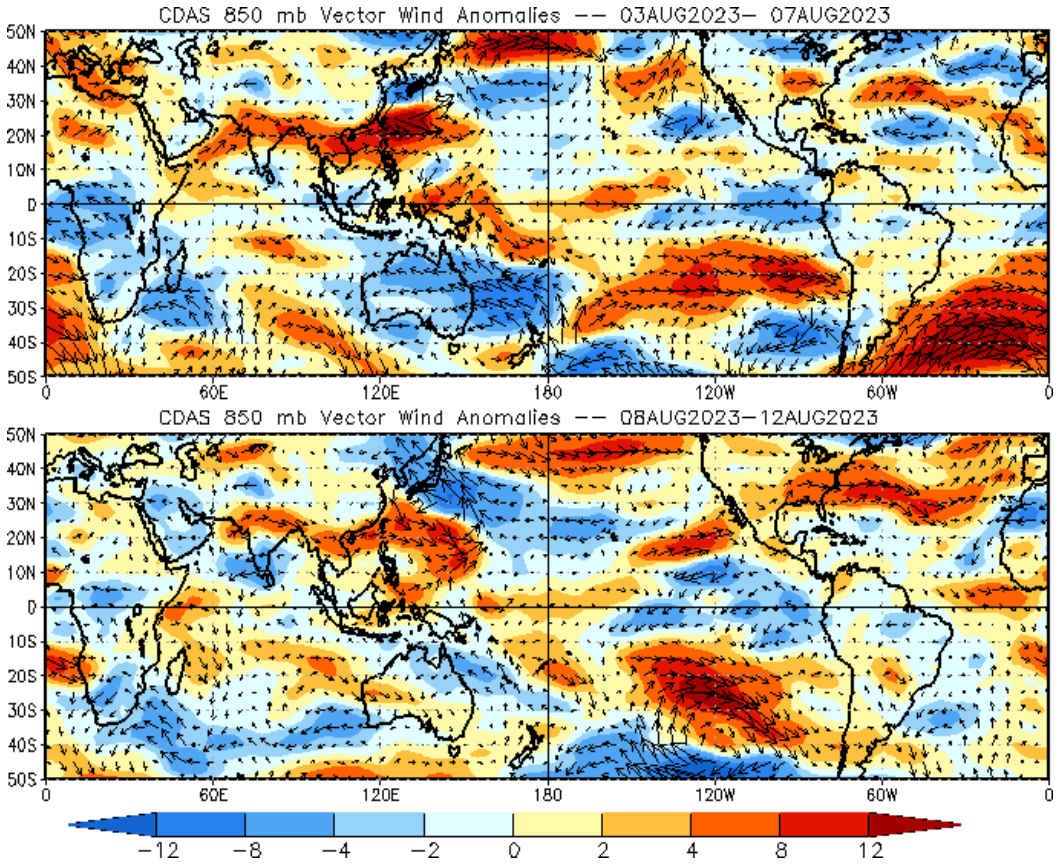


- Anomalous easterlies developed over the equatorial Pacific at the beginning of August and are becoming more consistent with a classic response to the ongoing El Nino.
- Anomalous westerlies over the eastern equatorial Pacific tied to persistent wave breaking in the Southern Hemisphere have eased off.
- Strong upper-level ridging remains entrenched over the CONUS, resulting in continued excessive heat conditions.

850-hPa Wind Anomalies

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

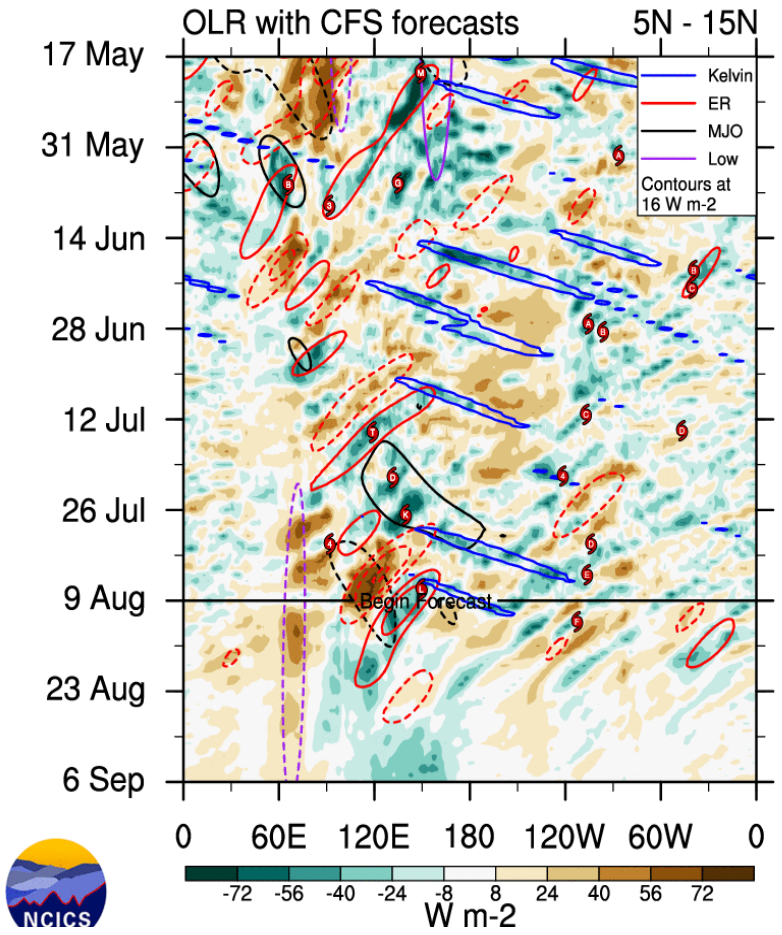


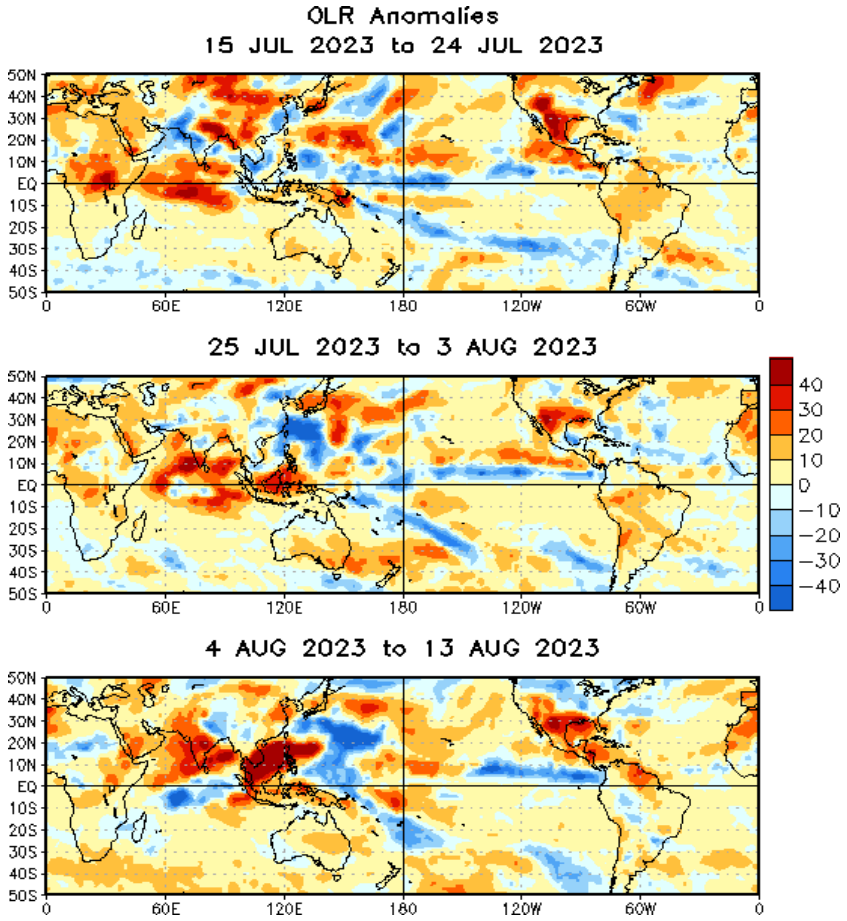


- Similar to the upper-level zonal wind response to El Nino in the equatorial Pacific, a more continuous field of anomalous lower-level westerlies developed from approximately 130E to 150W.
- Erratic lower-level wind anomalies continue over the equatorial Indian Ocean.
- Anomalous westerlies strengthened to the north of the equator over the eastern Main Development Region.

Outgoing Longwave Radiation (OLR) Anomalies

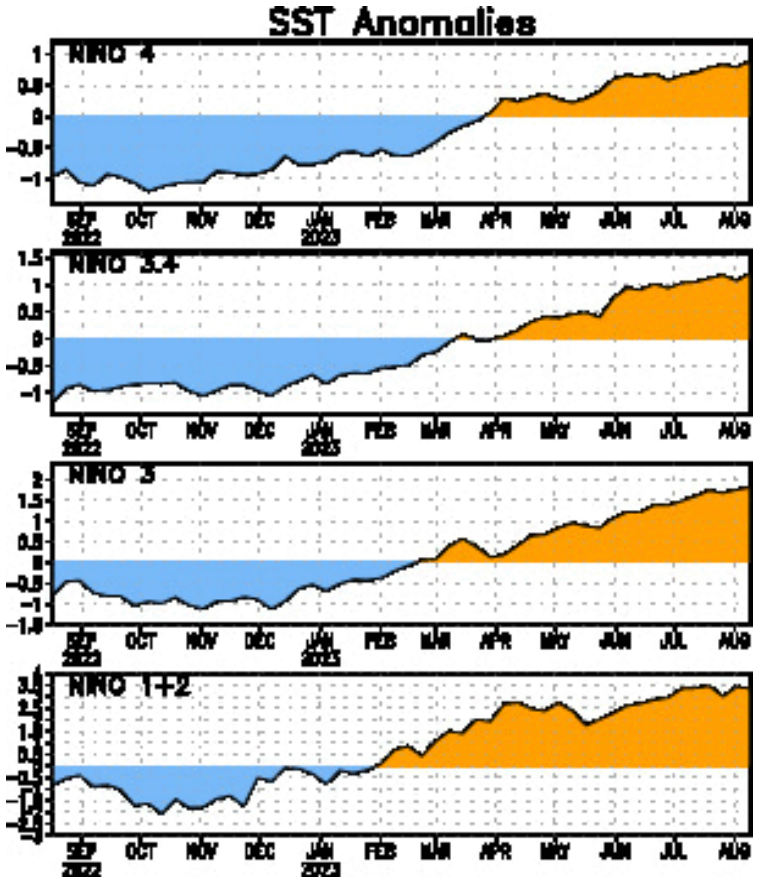
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

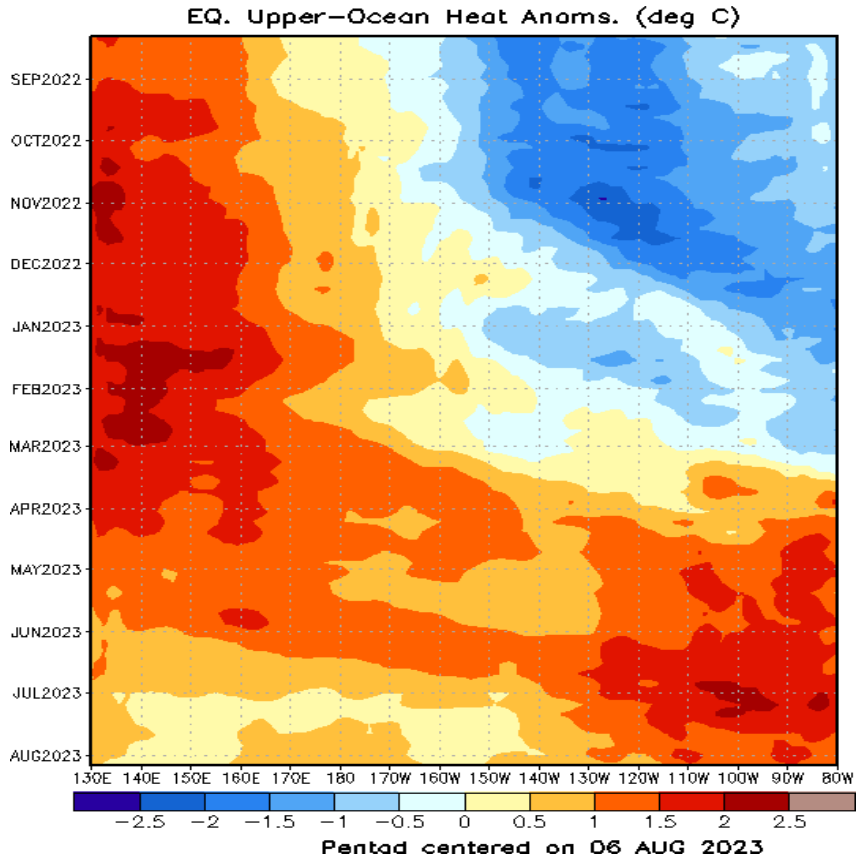




- Since late July, suppressed convection has been present over the Indian Ocean and has expanded eastward into the Maritime Continent.
- Suppressed convection persists across the southern CONUS, aiding in the continued heat waves
- Filtered OLR forecasts show little (if any) MJO signal, with mostly Rossby wave activity favored north of the equator.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

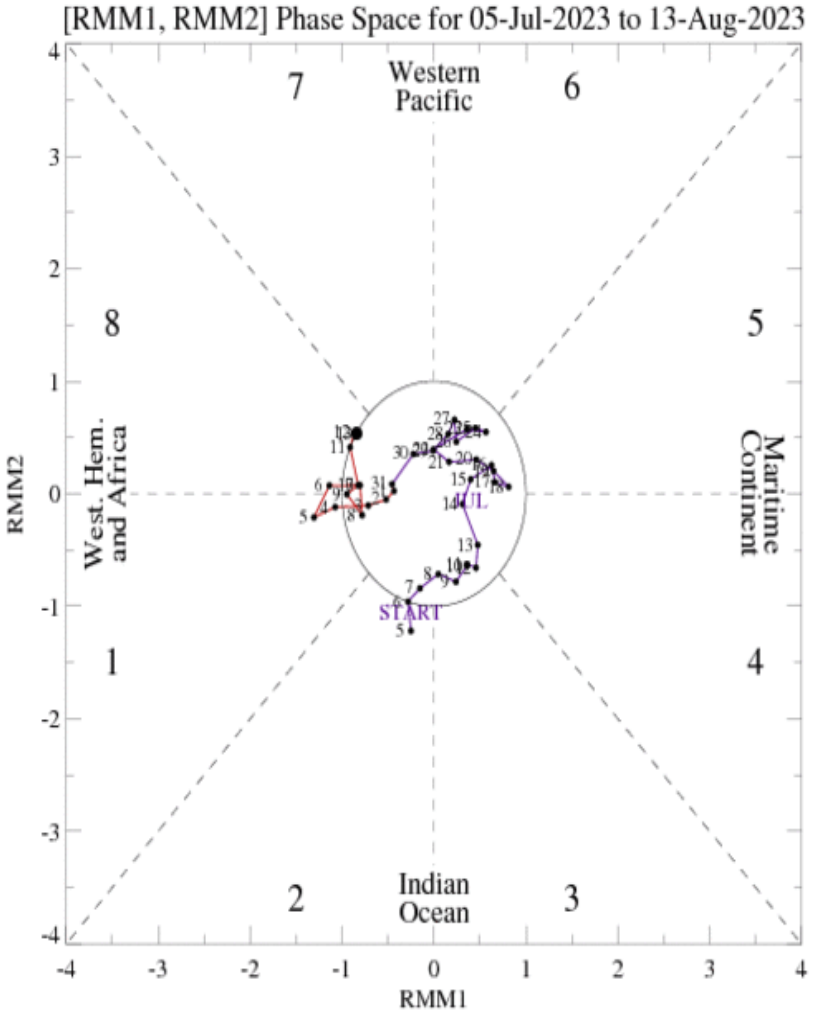




- El Niño conditions are present across the equatorial Pacific as SST anomalies continue to climb throughout the Nino regions.
- Above-normal subsurface temperatures are present across the entire equatorial Pacific. Since early July, the warmest anomalies have weakened somewhat in the eastern Pacific, while a slight resurgence of warm waters is observed along and near the Date Line.

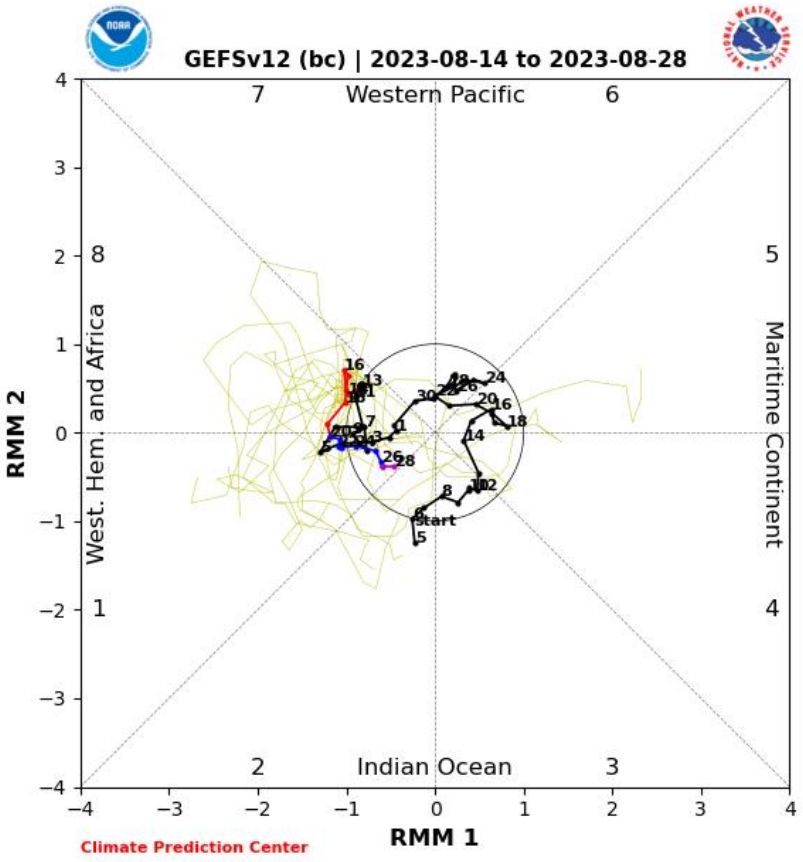
MJO Index: Recent Evolution

- The RMM index suggested renewed MJO activity over the Western Hemisphere early in August, having been outside the unit circle for the first time since early July. The signal still remains weak however, and there has been very little movement of the enhanced convective envelope lately.

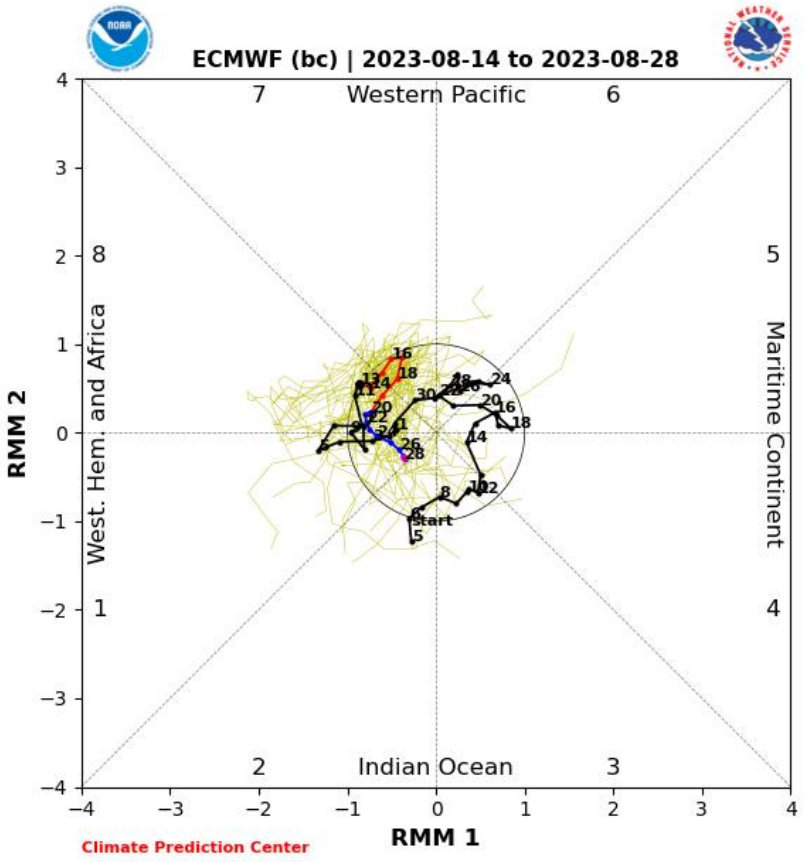


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

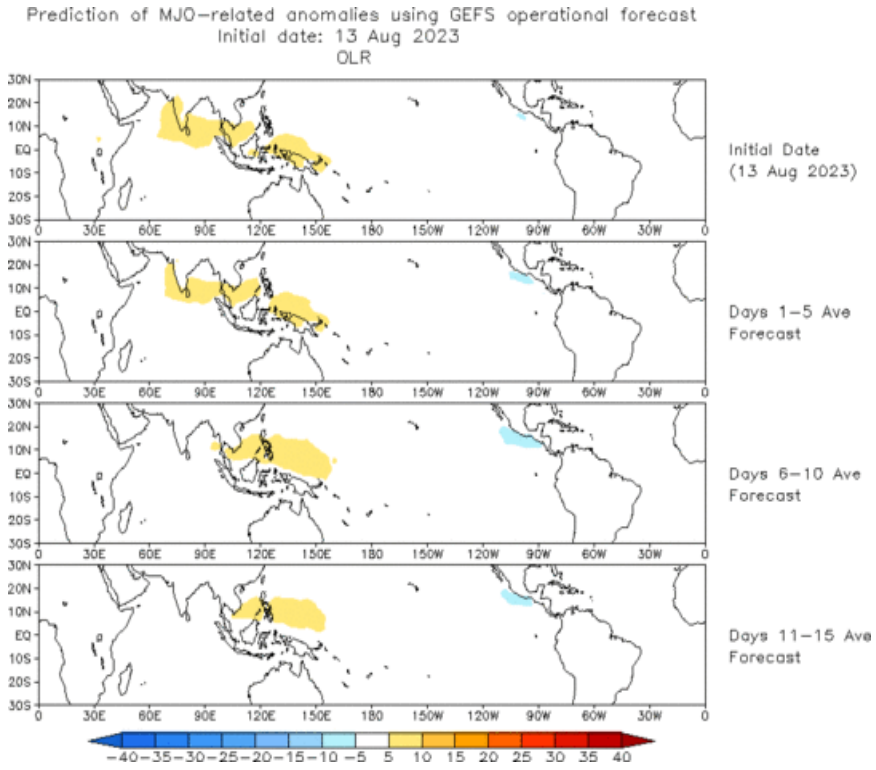


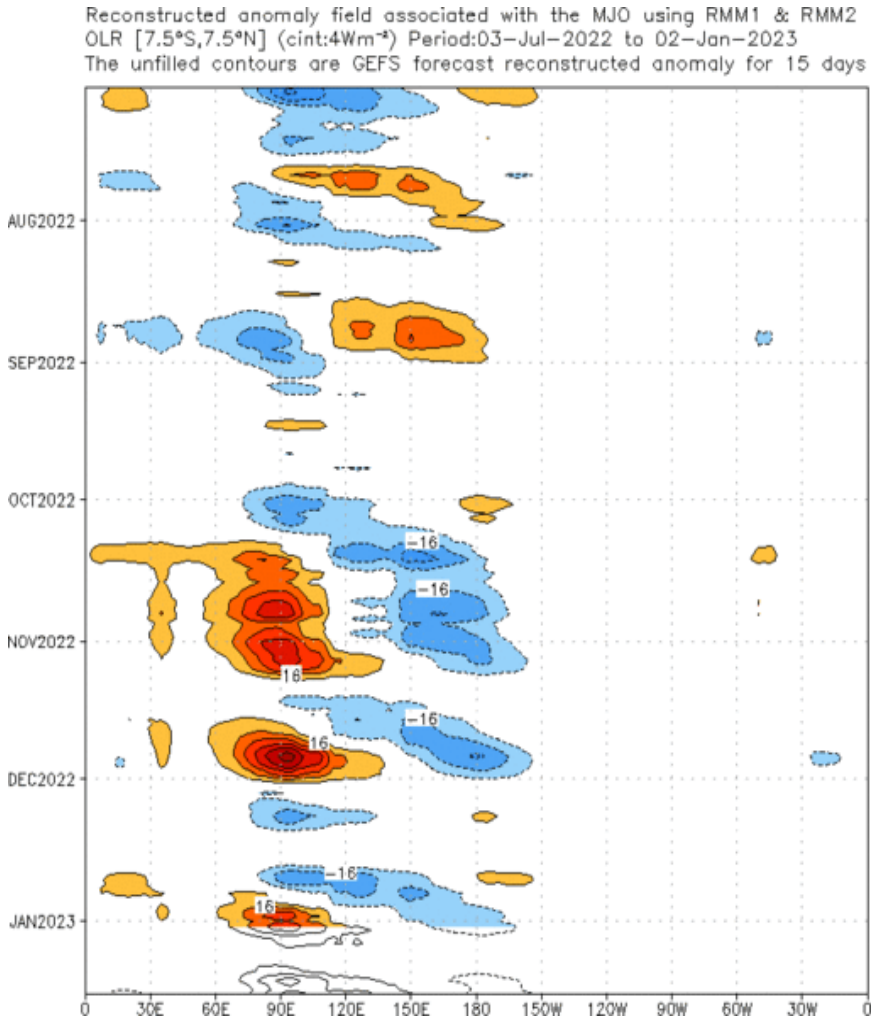
ECMWF Forecast

- RMM forecasts depict a continued weak MJO regime. Both GEFS and ECMWF favor a slight retrogression of enhanced convection over the Western Hemisphere during week-1 before resuming a more typical eastward movement in week-2 and beyond
- While some extended range solutions favor some reemergence of the MJO signal, there is a lot of ensemble spread and the ensemble means remain within the unit circle, limiting forecast confidence later in August.

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.)

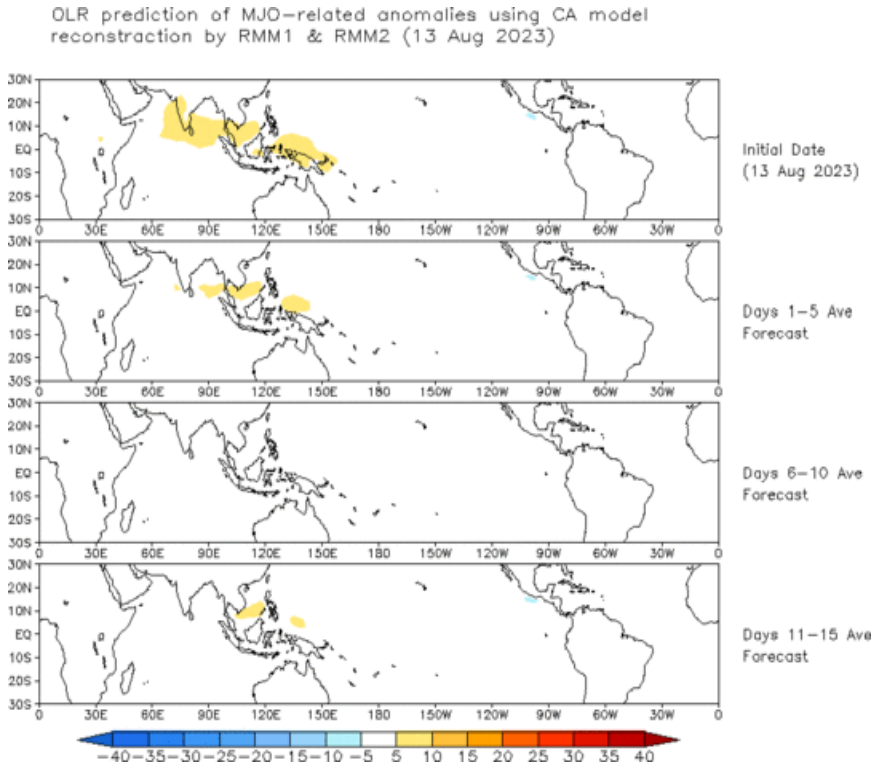


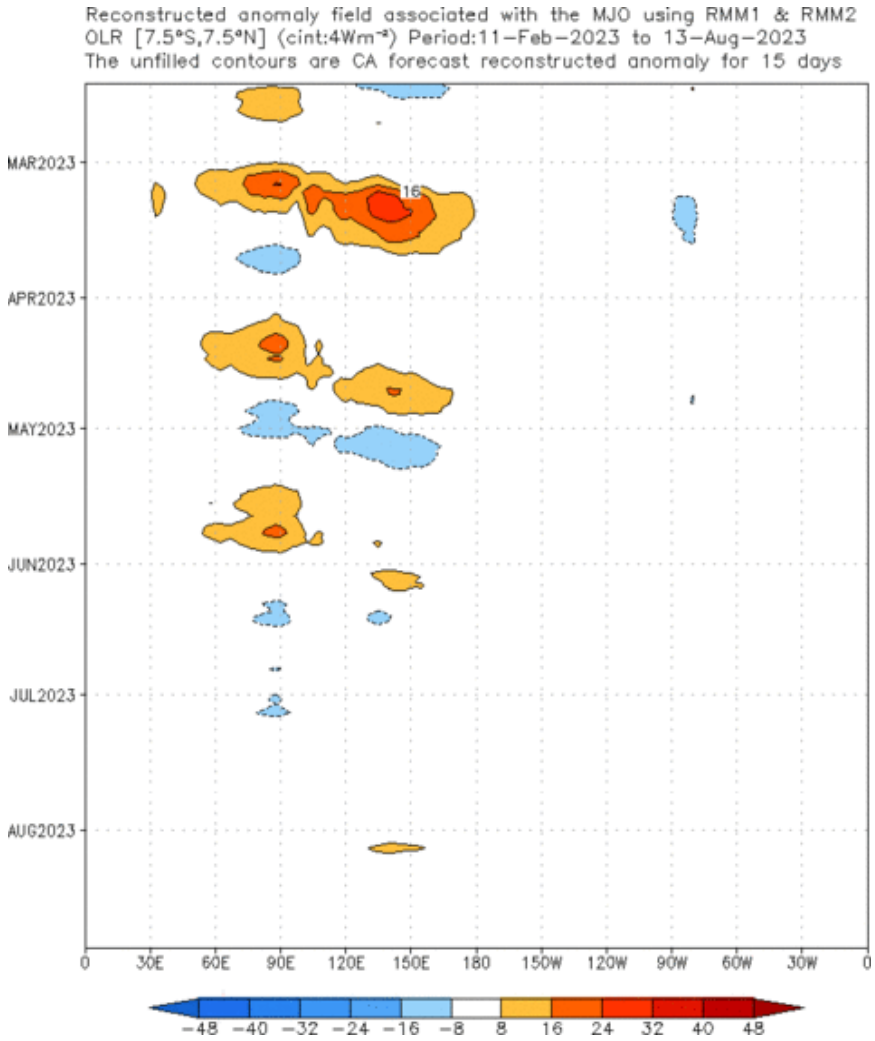


- The GEFS RMM-based OLR forecast shows suppressed (enhanced) convection weakening over the western (eastern) Pacific but very little movement of these features.

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.)

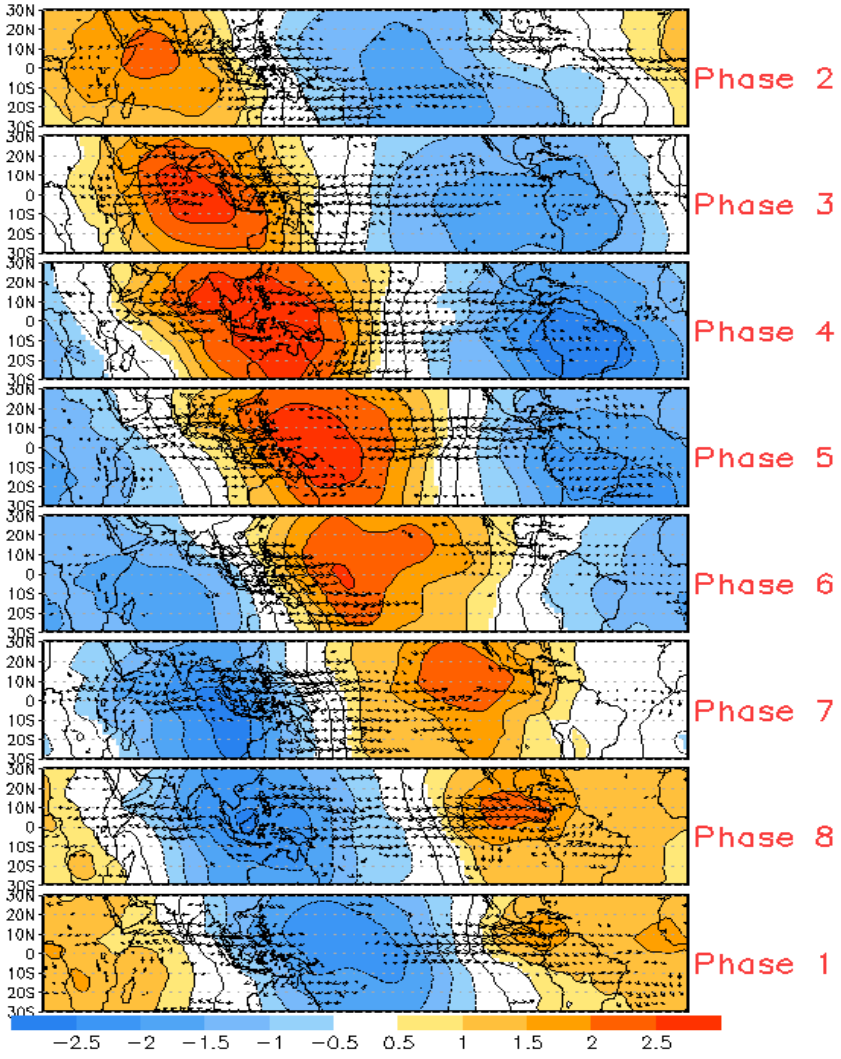




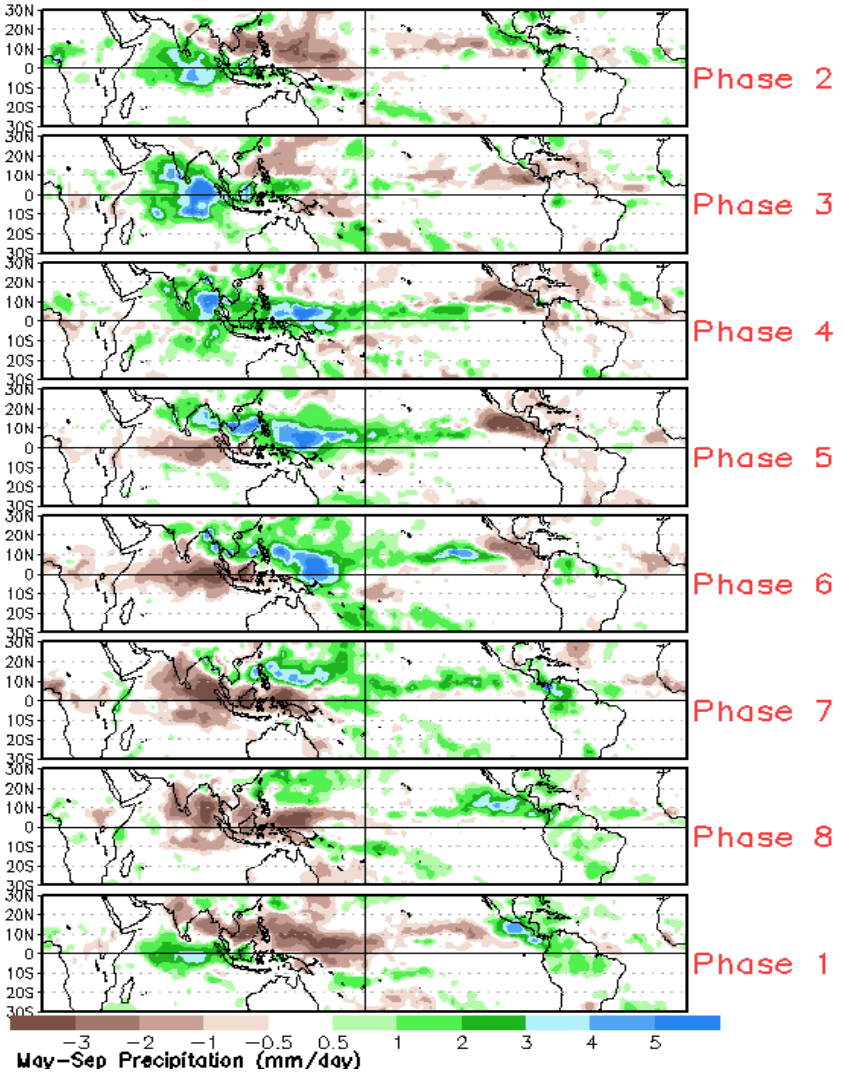
- The constructed analog RMM-based forecast also favors a persistence of the convective pattern, but overall forecast anomalies are quite weak, especially during week-2.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



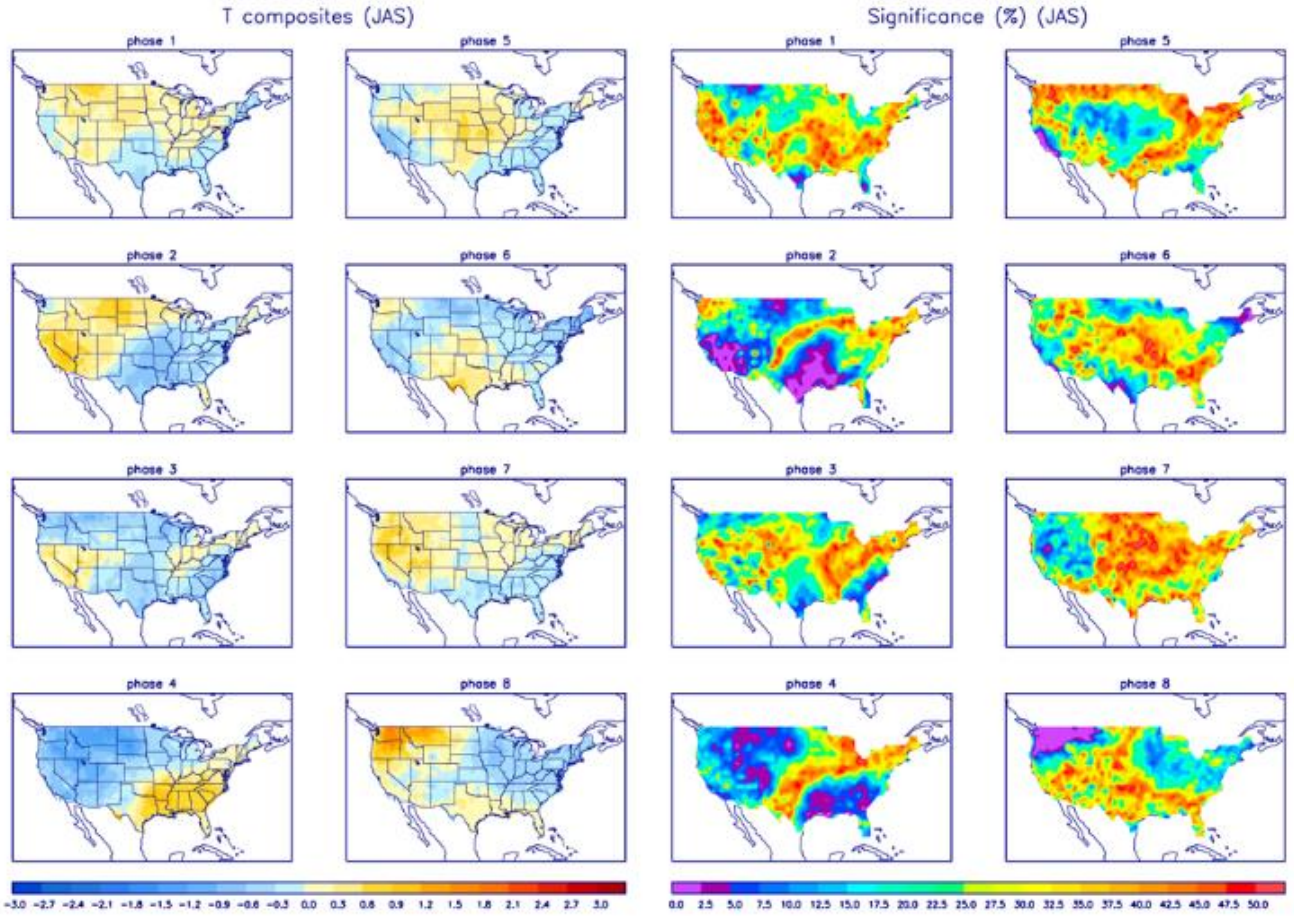
Precipitation Anomalies



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.

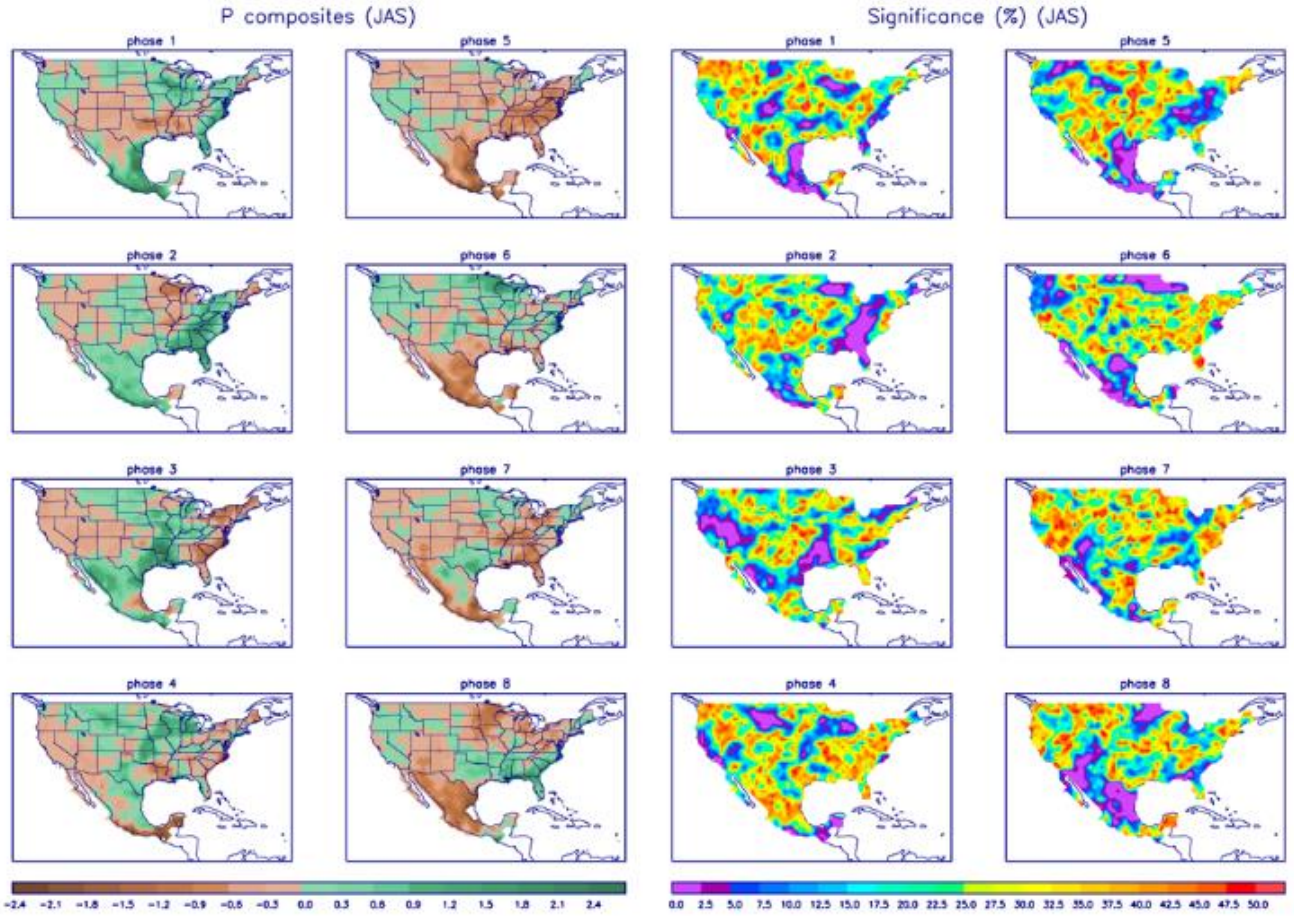


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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