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

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

Overview

- The RMM index and the upper-level velocity potential anomaly field are showing at least a brief reemergence of a MJO, but El Nino has become the major influence on tropical rainfall.

- Dynamical model RMM forecasts feature large ensemble spread during the next two weeks. However, the GEFS depicts anomalous upper-level divergence (convergence) overspreading the Eastern (Western) Hemisphere during weeks two and three.

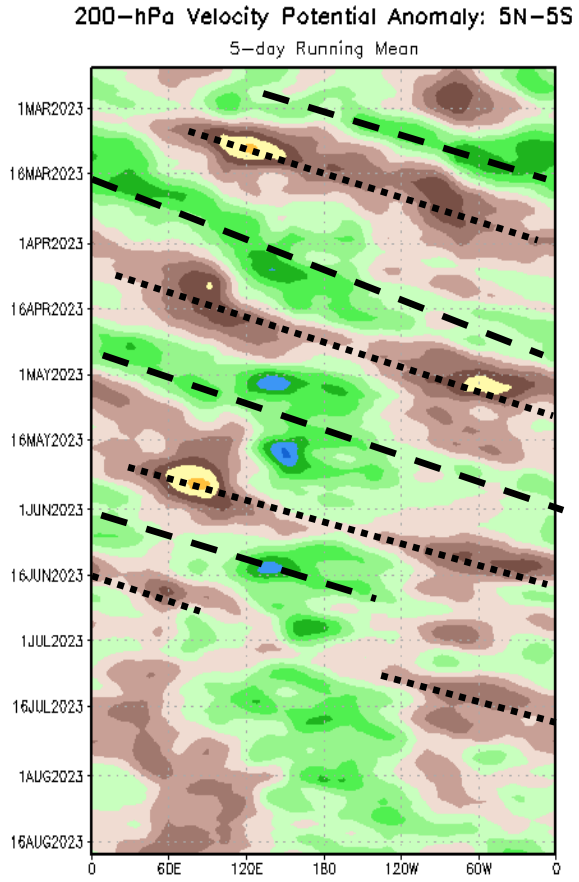
- The West Pacific is expected to become increasingly favorable for tropical cyclone (TC) development from late August into early September. Conversely, chances for TC formation across the East Pacific may begin to diminish by the beginning of September.

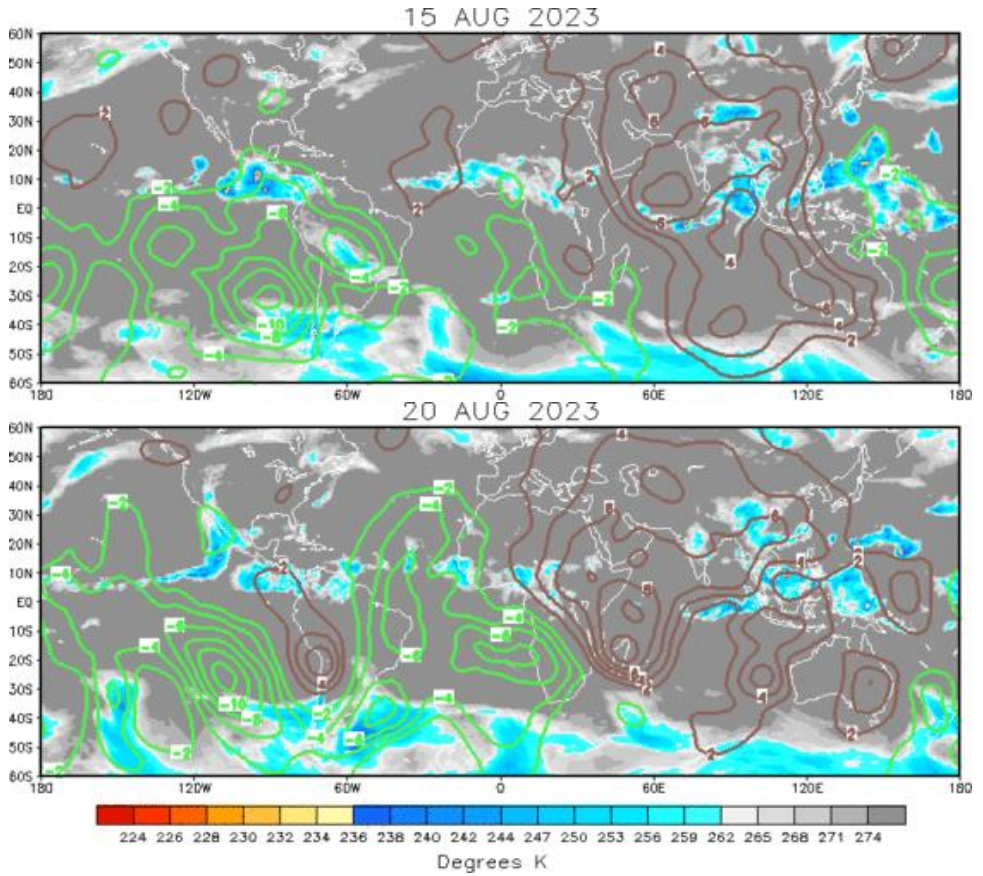
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

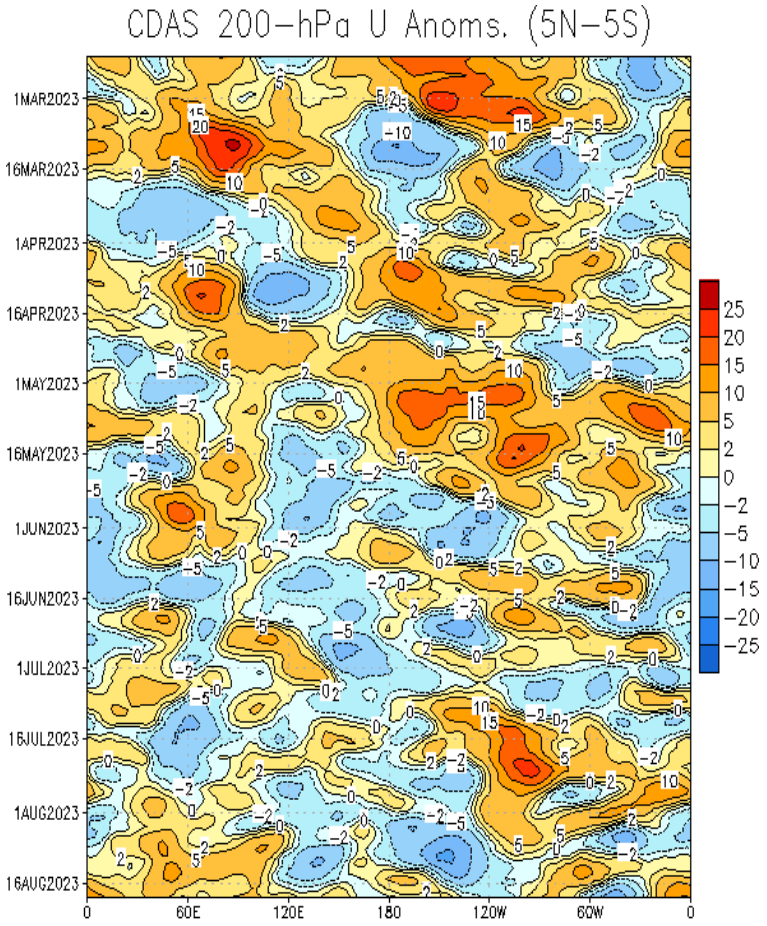


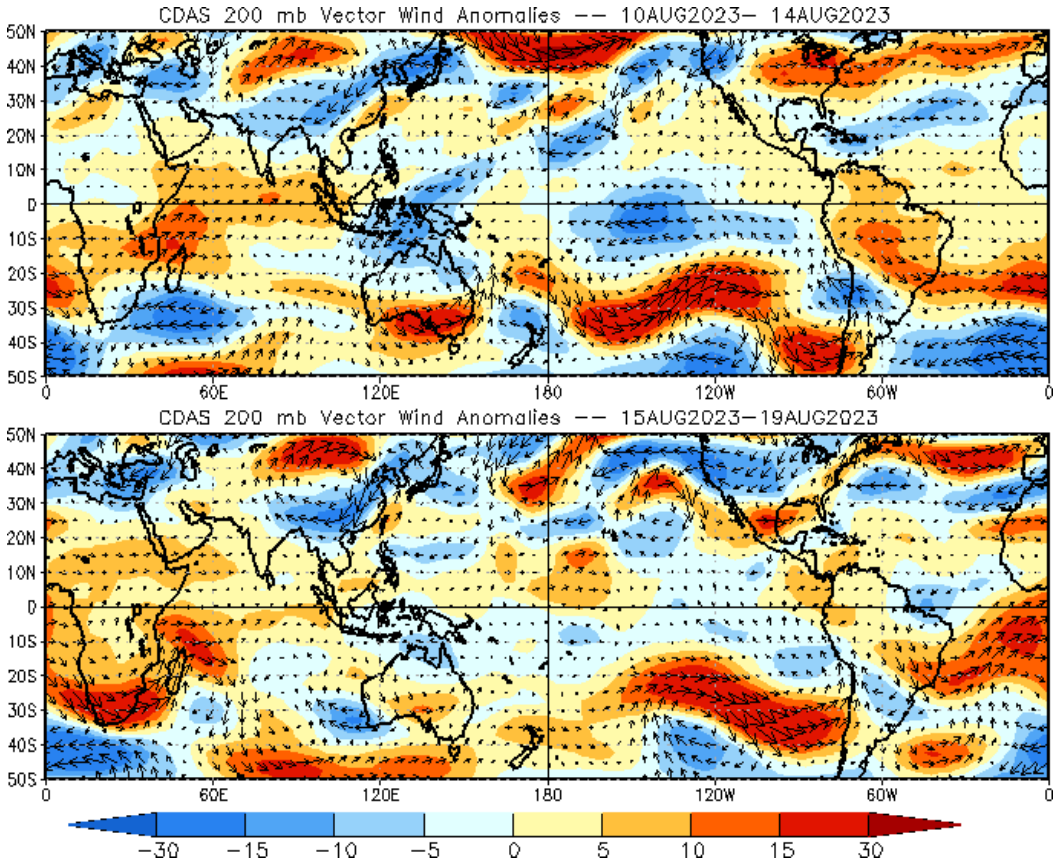


- Since mid-July, a more stationary pattern persisted as the MJO was weak and El Nino began to provide more influence.
- Recently, eastward propagation resumed with anomalous upper-level divergence shifting east over the Western Hemisphere and anomalous upper-level convergence overspreading the Maritime Continent.

200-hPa Wind Anomalies

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

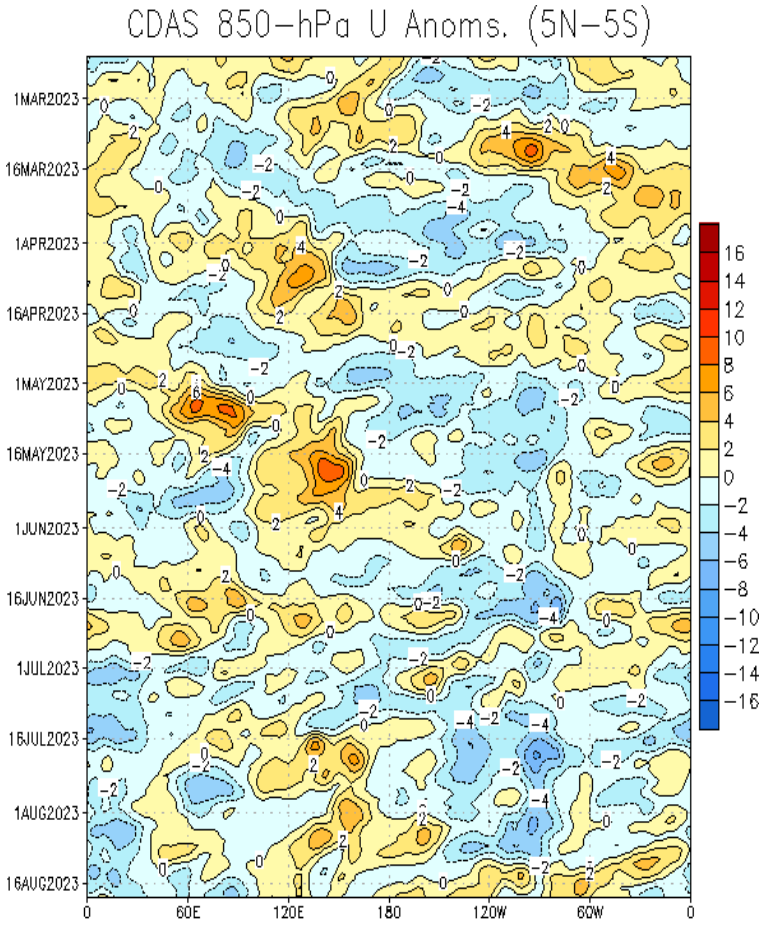


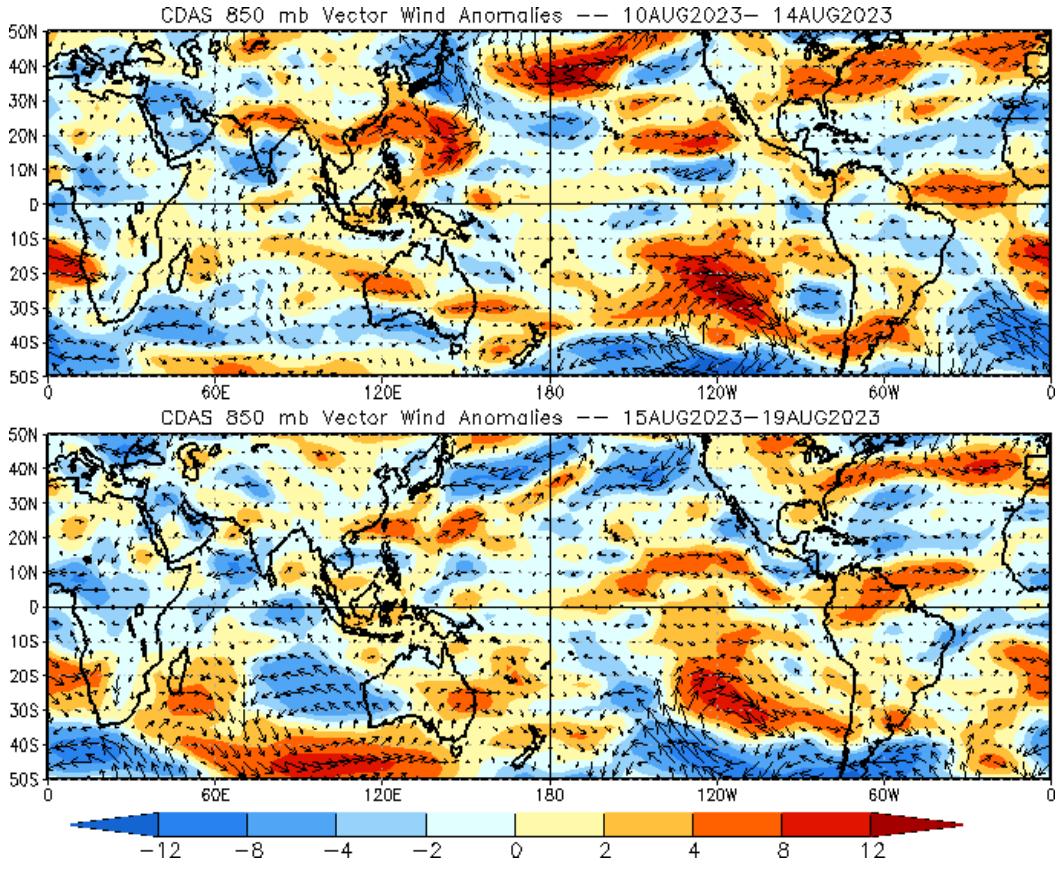


- Anomalous easterlies developed over the equatorial Pacific during July which is consistent with a classic response to the ongoing El Nino.
- Strong upper-level ridging remains entrenched over the CONUS, resulting in continued excessive heat conditions.

850-hPa Wind Anomalies

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

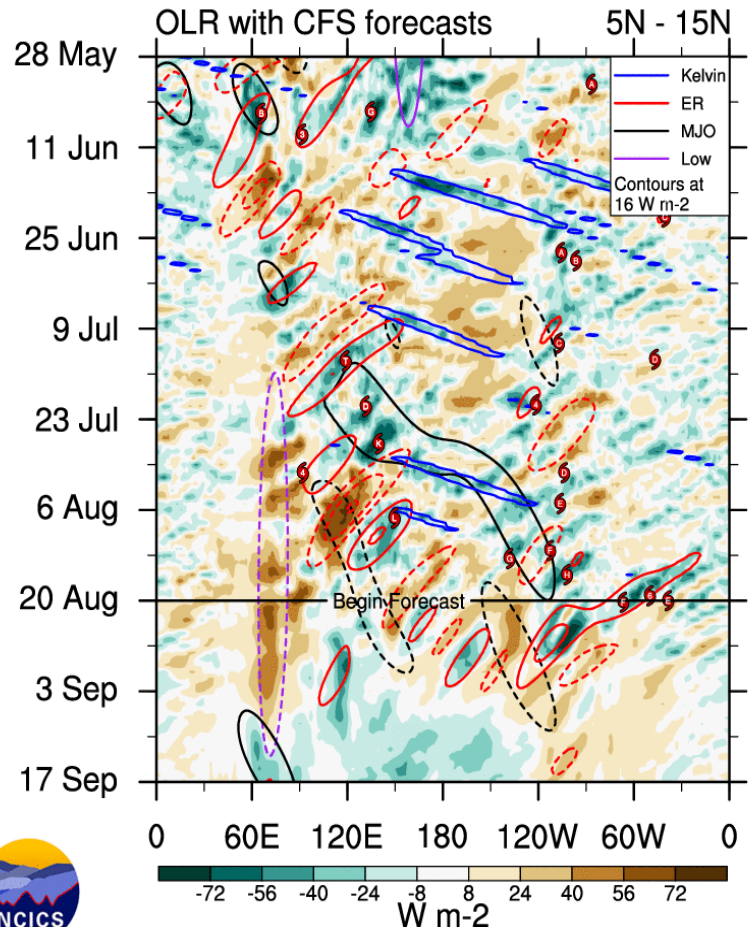


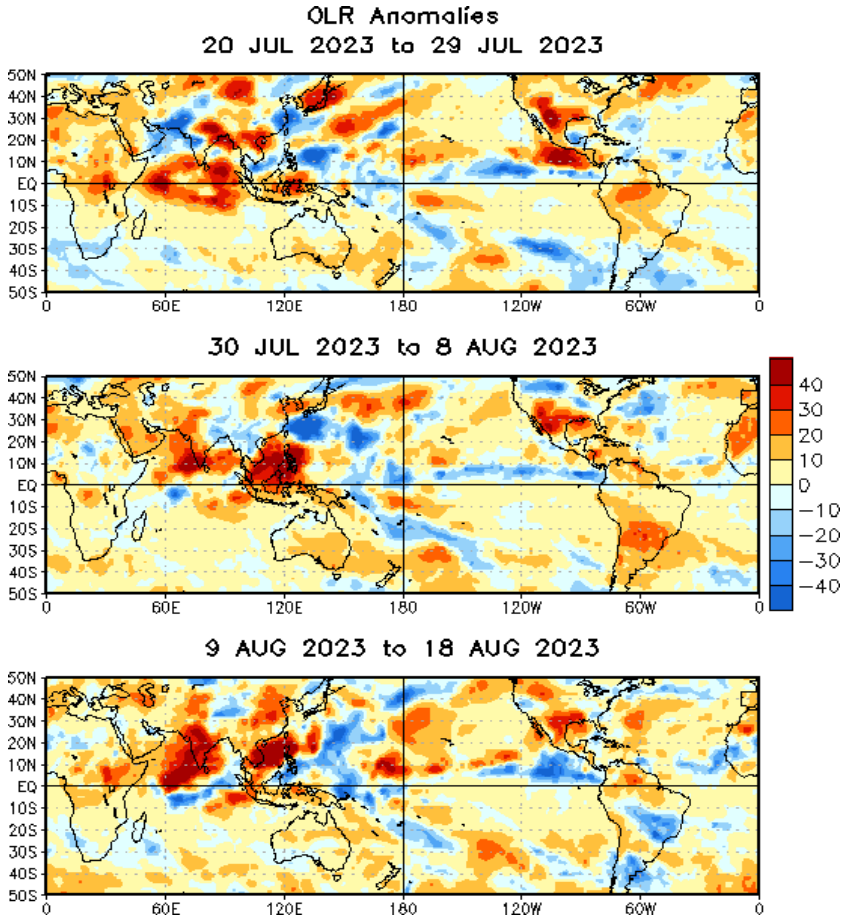


- Similar to the upper-level zonal wind response to El Nino in the equatorial Pacific, a more continuous field of anomalous lower-level westerlies developed from approximately 130E to 150W.
- Erratic lower-level wind anomalies continue over the equatorial Indian Ocean.
- Anomalous westerlies strengthened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

Outgoing Longwave Radiation (OLR) Anomalies

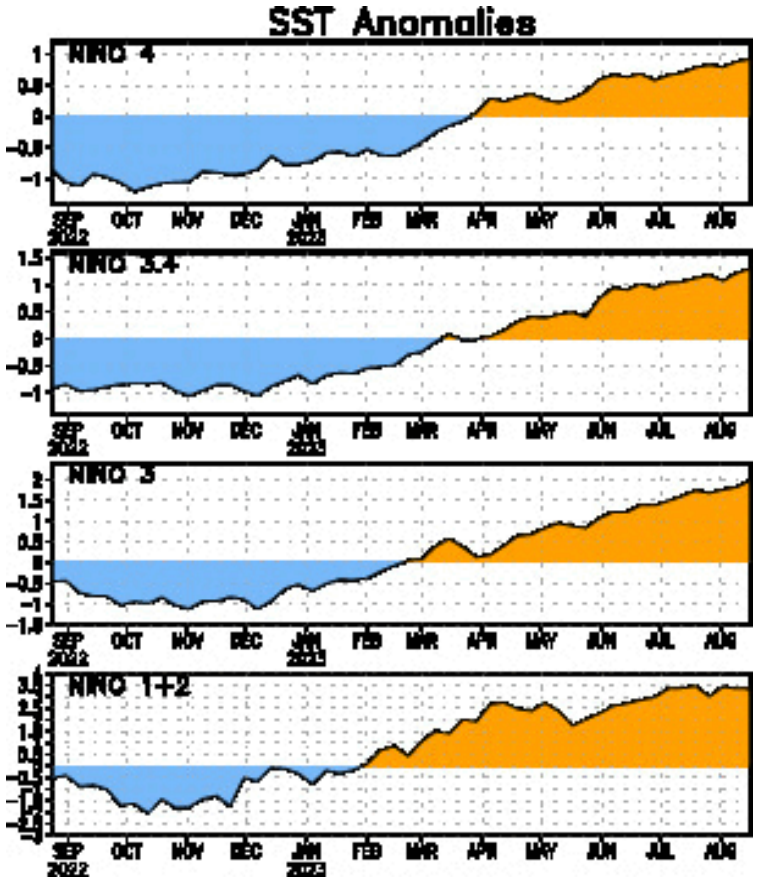
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

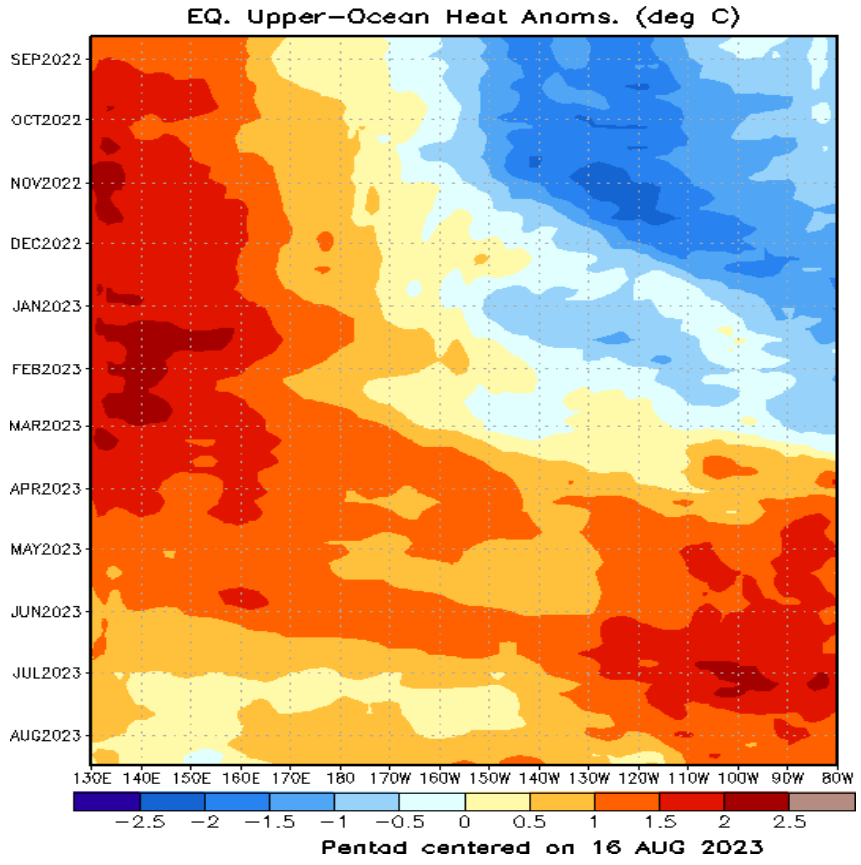




- Since late July, suppressed convection has been present over the Indian Ocean and has expanded eastward into the Maritime Continent.
- Suppressed convection persisted across the North American Monsoon region from late July through early August, but there was a recent increase in enhanced convection across the East Pacific.
- Filtered OLR depicts an equatorial Rossby wave crossing the tropical Atlantic during mid-August.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

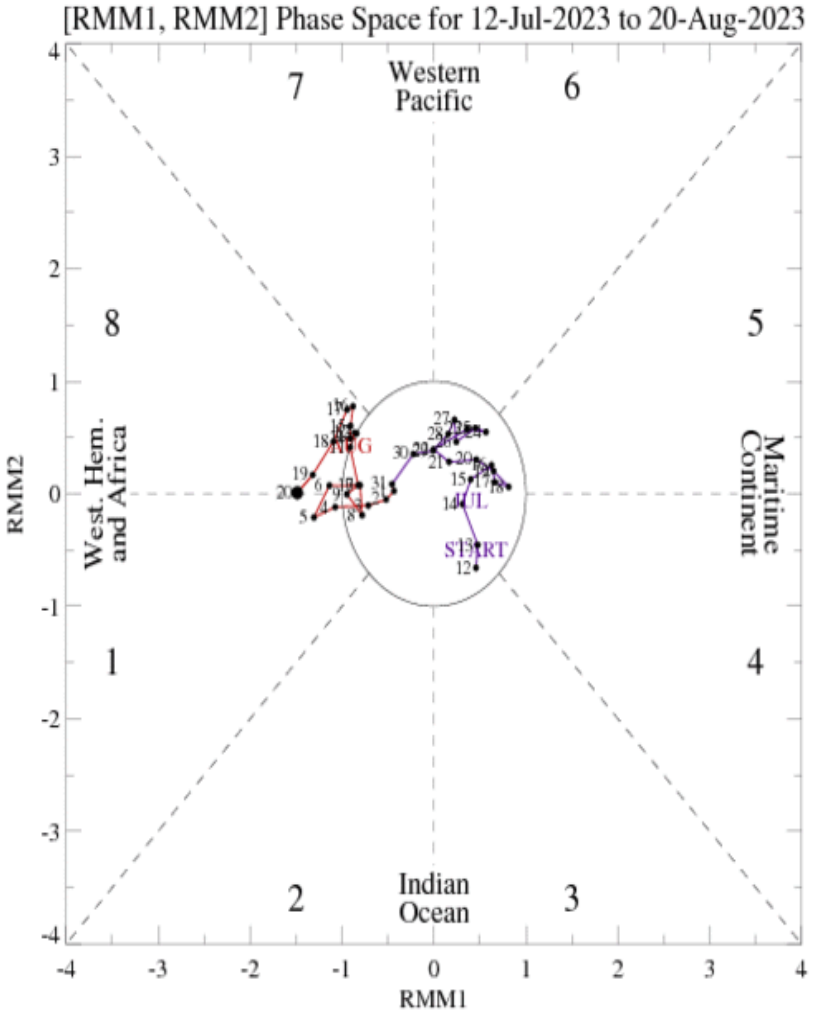




- El Niño conditions are present across the equatorial Pacific as SST anomalies continue to climb throughout the Nino regions.
- Above-normal subsurface temperatures are present across the entire equatorial Pacific. Since early July, the warmest anomalies have weakened somewhat in the eastern Pacific,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

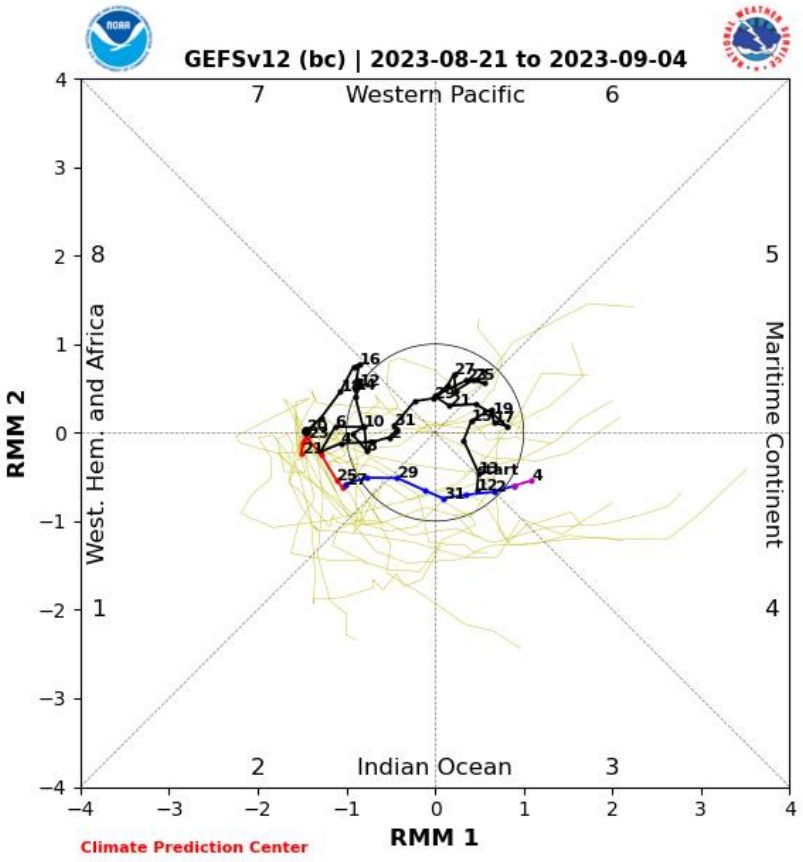
MJO Index: Recent Evolution

- The RMM index depicts a renewed MJO with an increase in amplitude and eastward propagation during the past several days.

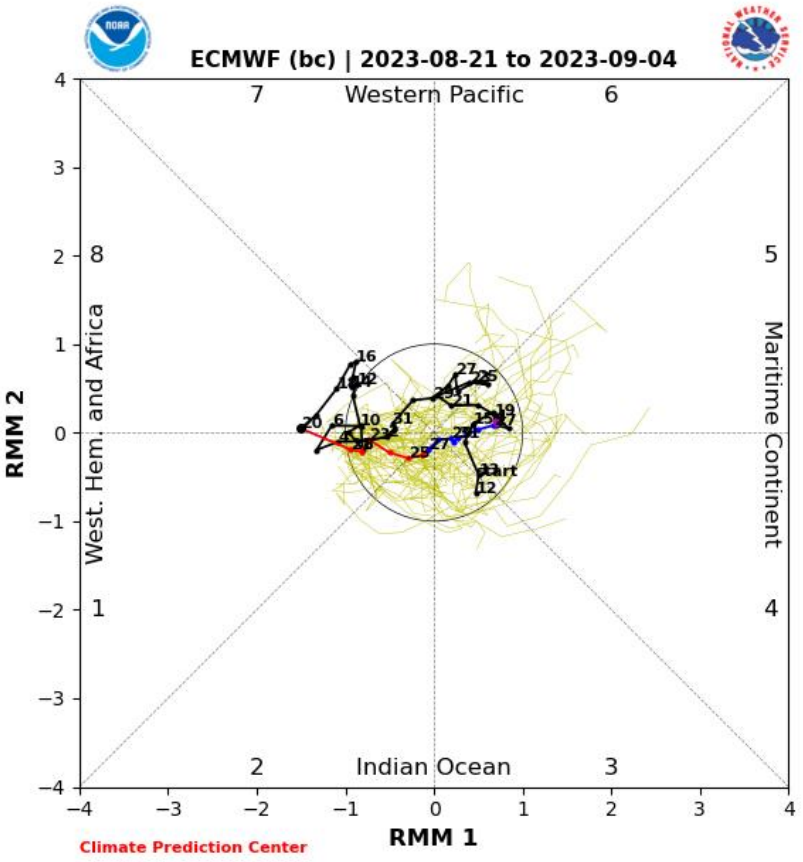


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

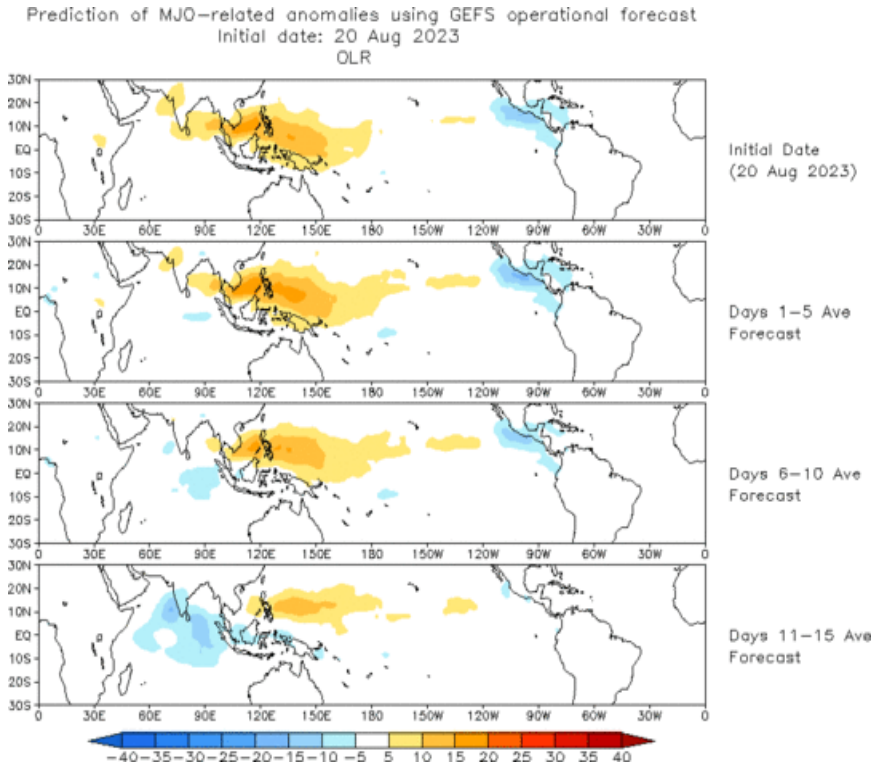


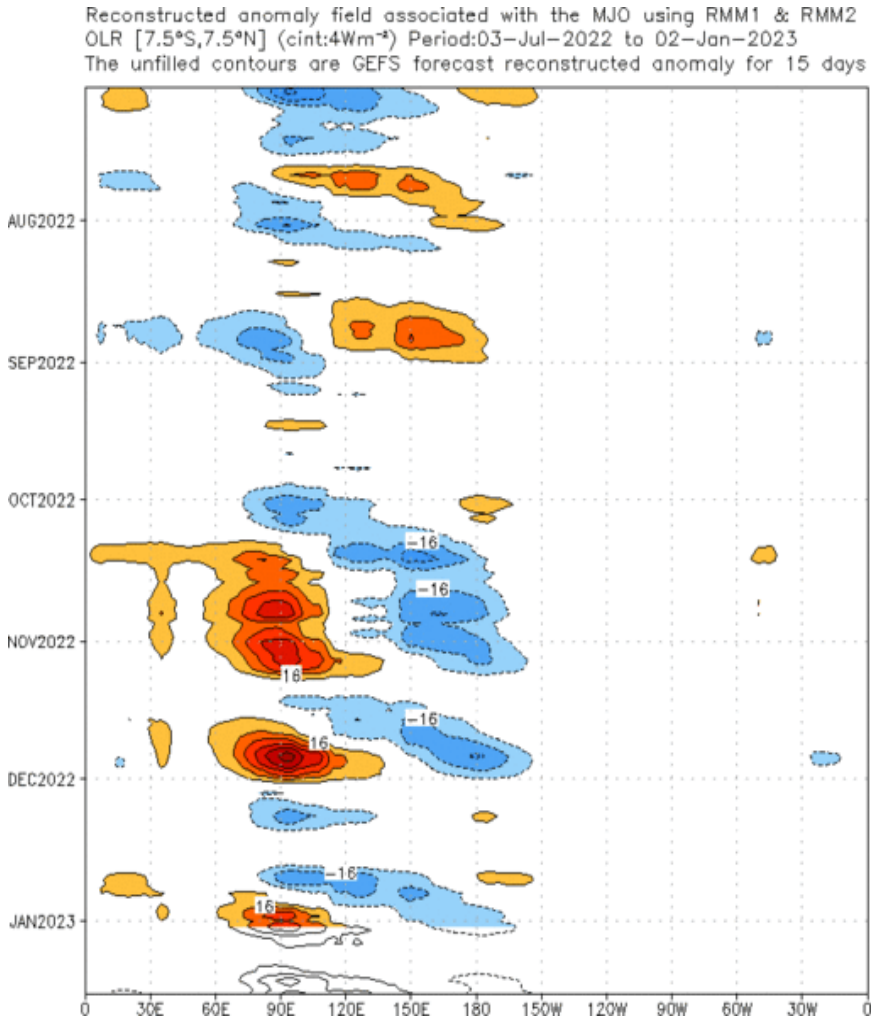
ECMWF Forecast

- RMM forecasts from the GEFS show large ensemble spread with some members depicting a MJO propagation east to the Indian Ocean by the beginning of September. However, other ensemble members favor a faster propagation more in line with a Kelvin wave.
- The ECMWF ensemble members generally support a fast eastward propagation back to the eastern Maritime Continent or West Pacific during early September.

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.)

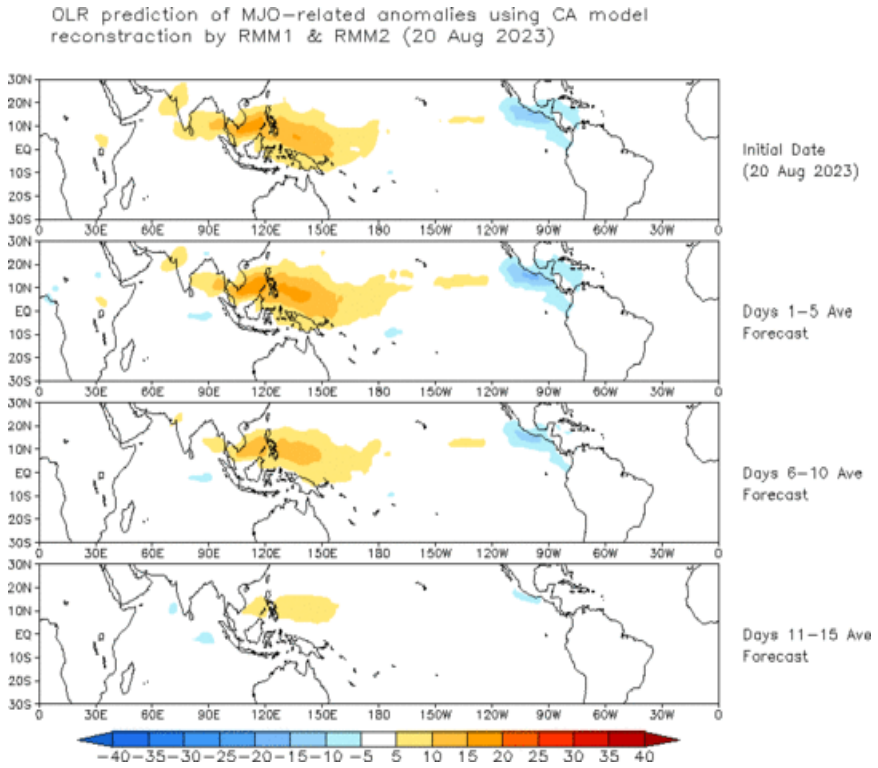


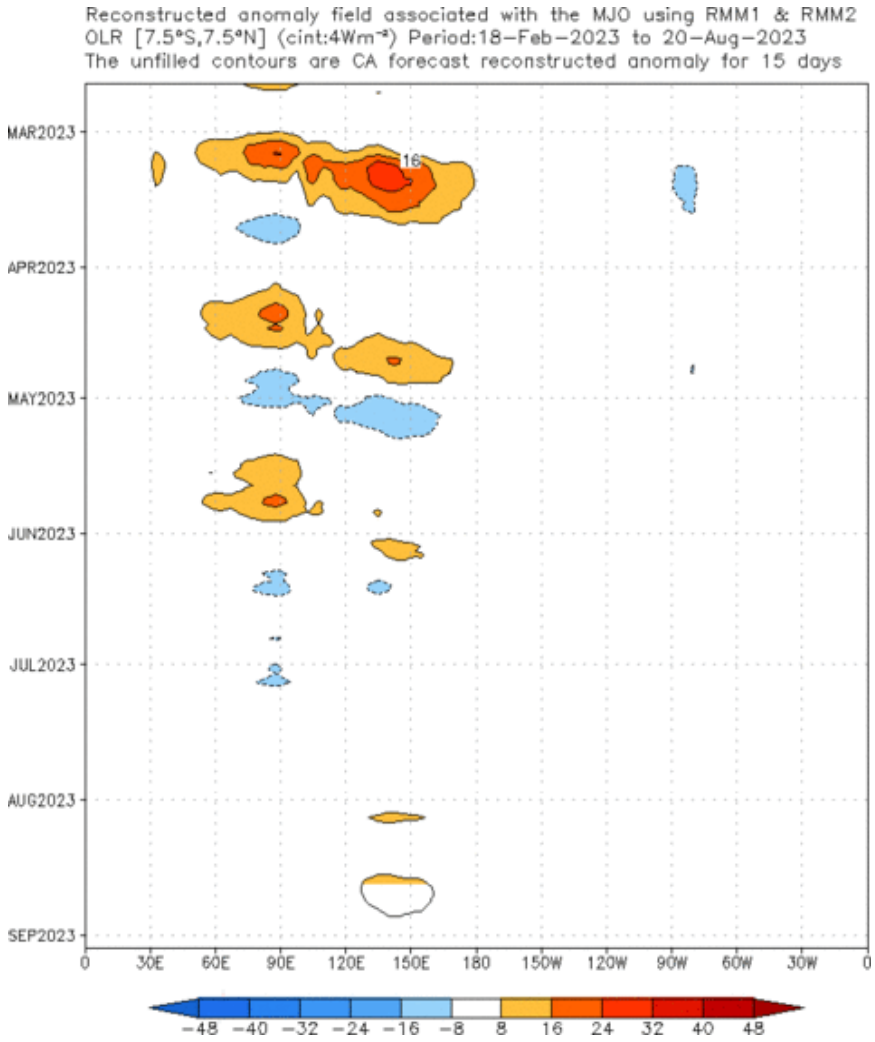


- The GEFS RMM-based OLR forecast shows enhanced convection diminishing across the East Pacific later in week-2, while convection increases over the Indian Ocean.

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.)

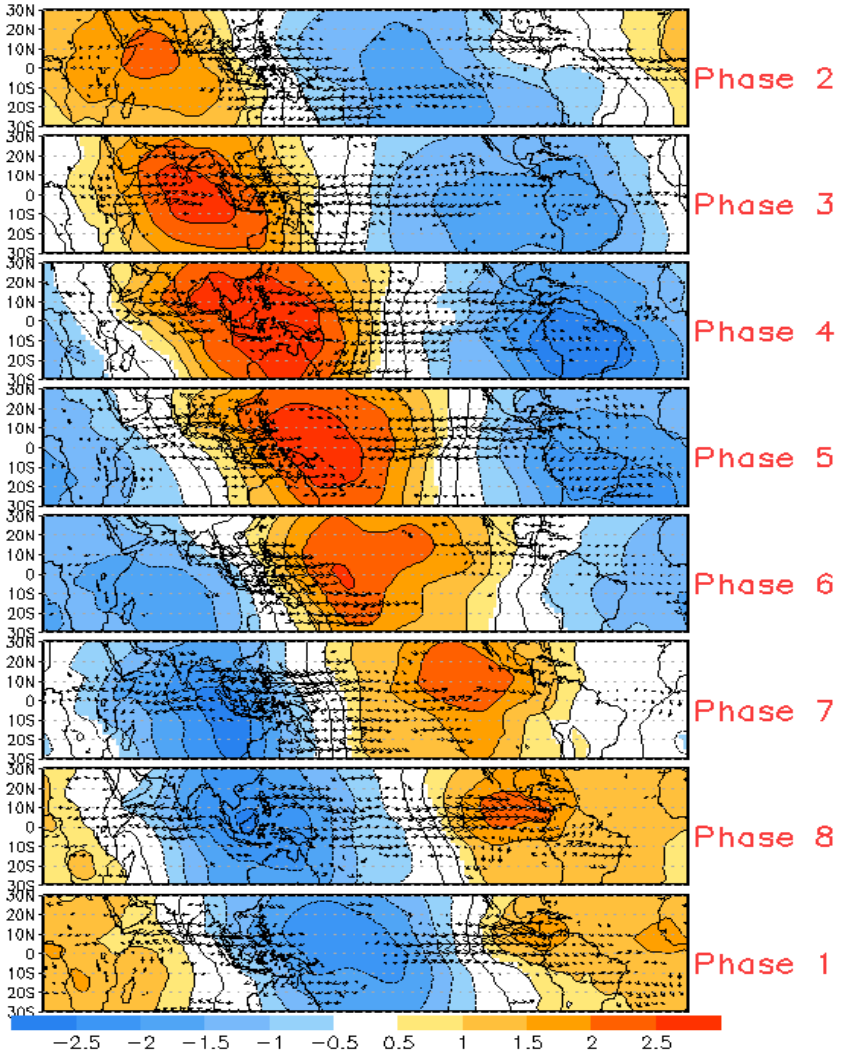




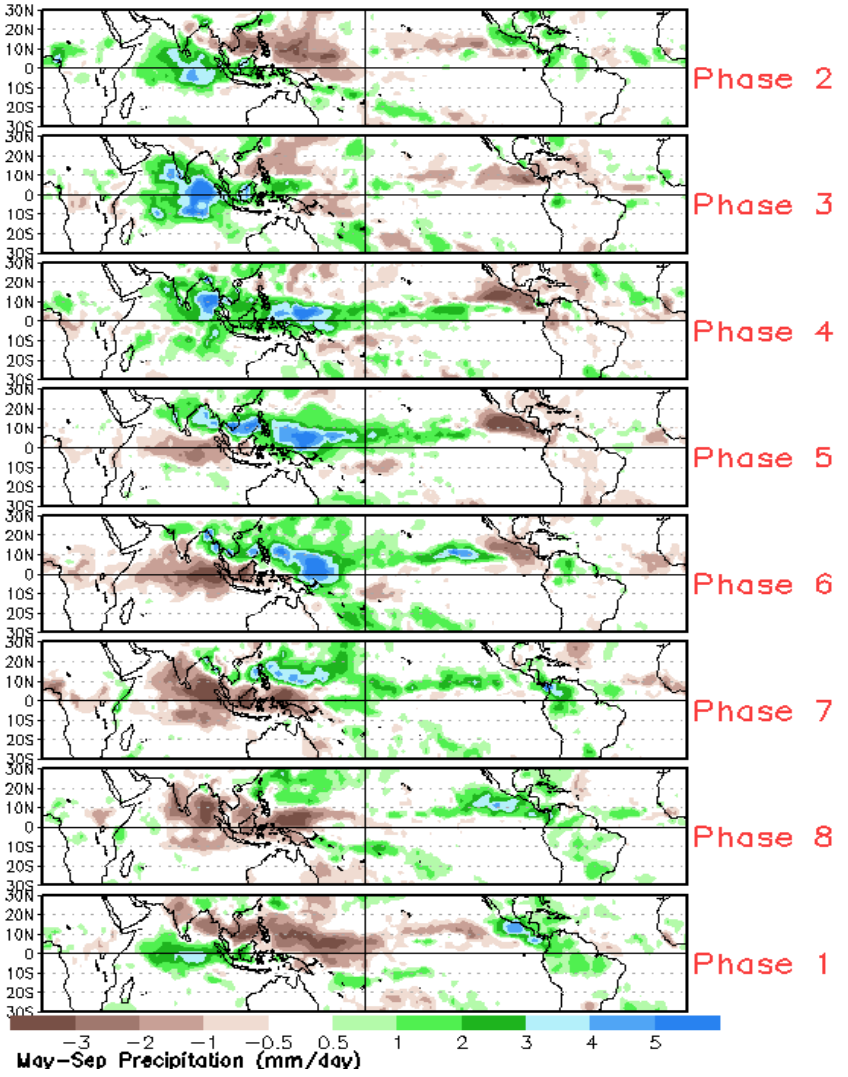
- The constructed analog RMM-based forecast depicts a weakening trend in OLR anomalies by the end of August and into the beginning of September.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



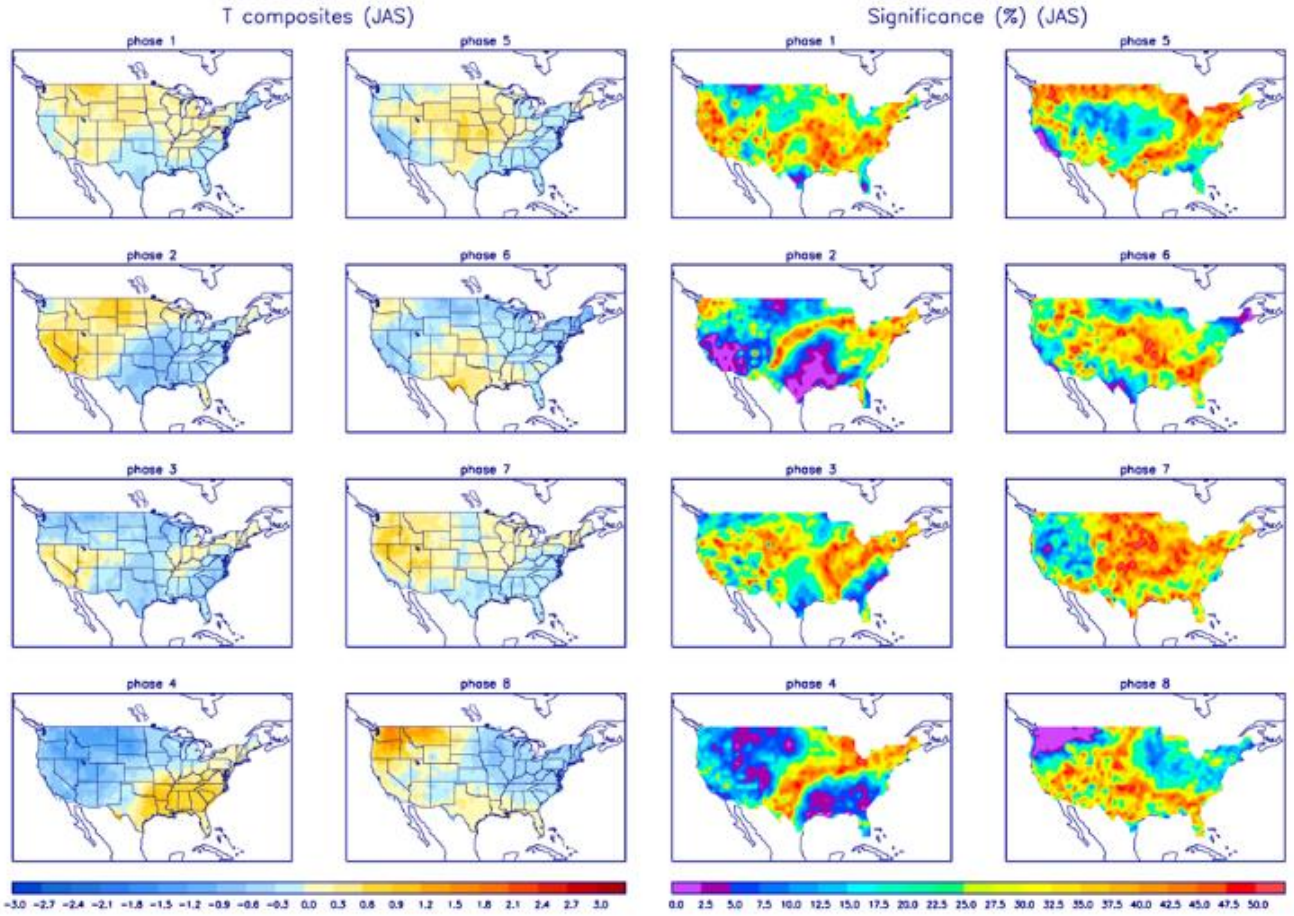
Precipitation Anomalies



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.

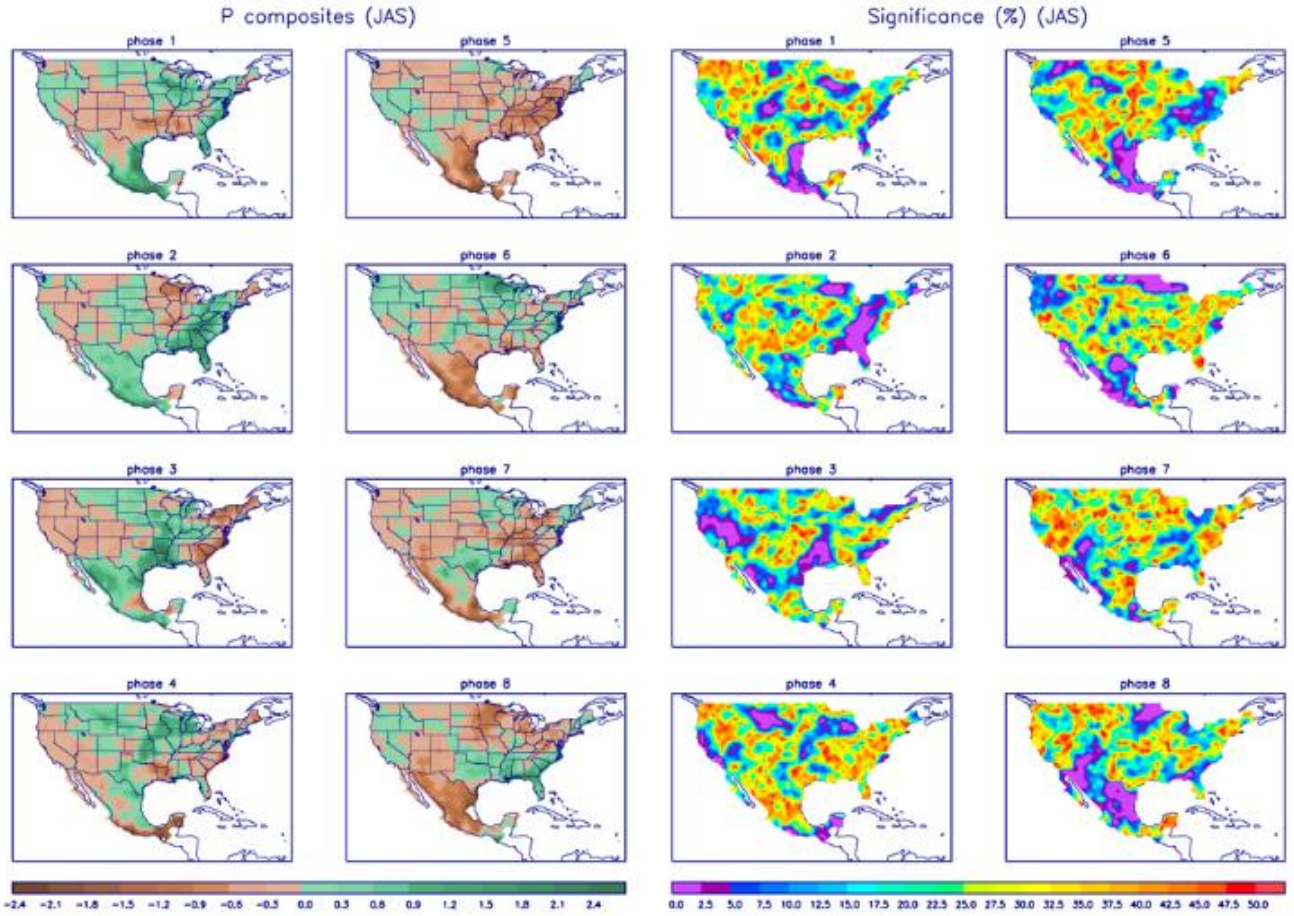


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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