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

Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
18 September 2023

Overview

- The RMM index currently indicates incoherent intraseasonal activity, with the MJO signal retreating westward to the Indian Ocean at a low amplitude during the past week.
  - The disorganization is likely associated with destructive interference with the ongoing El Nino and other modes of tropical variability.

- Dynamical model RMM forecasts generally favor the resumption of an eastward propagating MJO signal over the Maritime Continent, but remain divided in regards to its eventual amplitude with large ensemble spread.
  - A heathier presentation of the MJO is evident in upper-level velocity potential anomaly forecasts. These favor a reemerging wave-1 pattern with the enhanced envelope shifting eastward across the Maritime Continent and western Pacific through early October.

- A reorganizing MJO over the eastern Hemisphere would favor increasing chances for tropical cyclogenesis over the western Pacific.

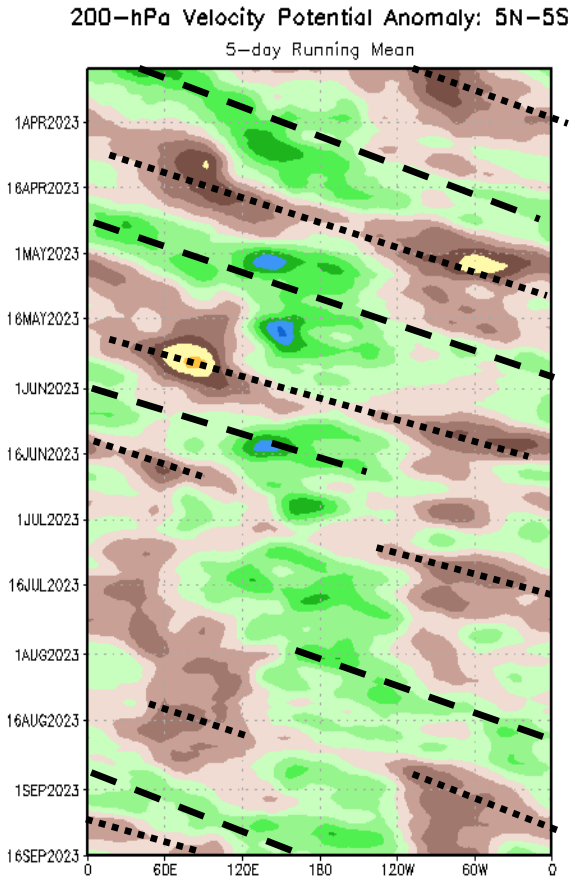
- Conversely, decreased chances for tropical cyclone development would exist over the eastern Pacific and Atlantic. However, this is likely to be countered by an active climatology in both basins, as well as potential Kelvin and/or Rossby wave passages to incite formation.

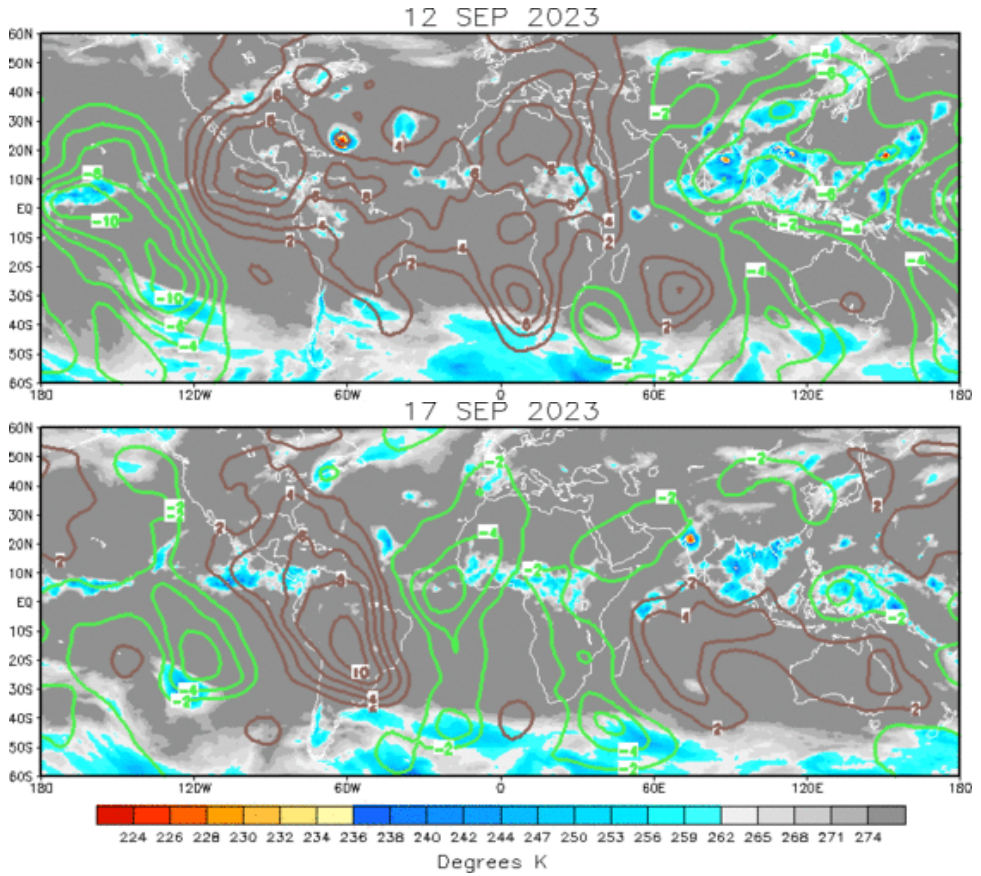
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)



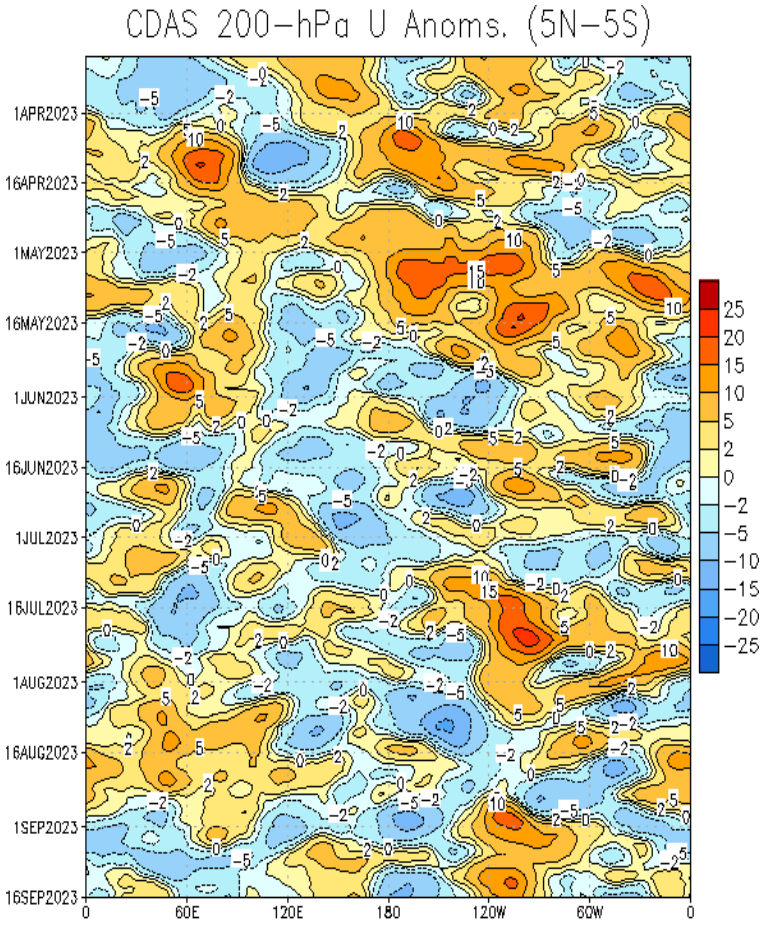


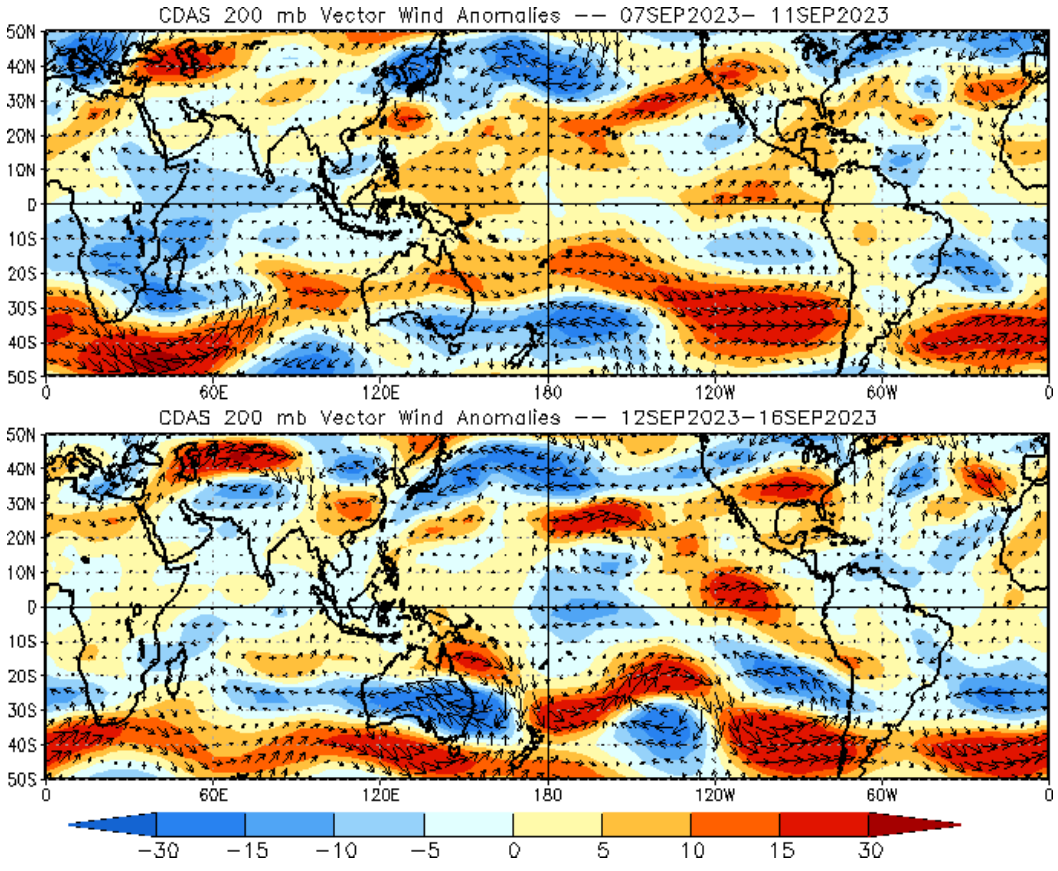
- Since earlier this summer, an anomalous upper level divergence footprint is evident over the equatorial Pacific tied to the ongoing El Nino.

- Spatially, the upper-level velocity potential pattern has become less organized since last week, however suppressed conditions shifted eastward into the Maritime Continent, suggestive of ongoing intraseasonal activity .

200-hPa Wind Anomalies

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

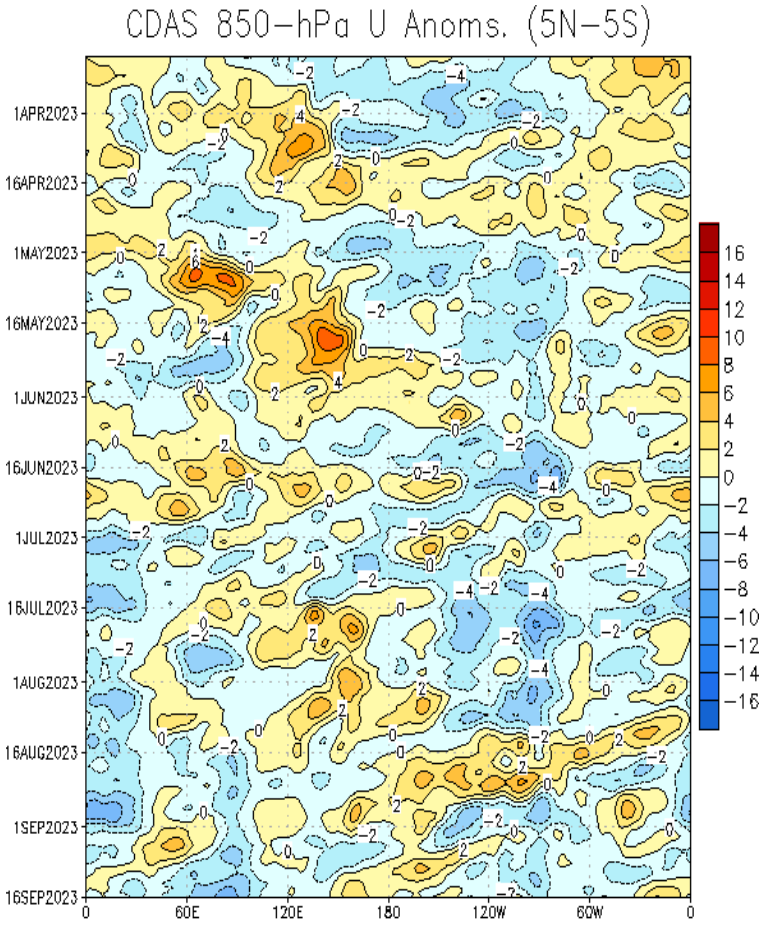


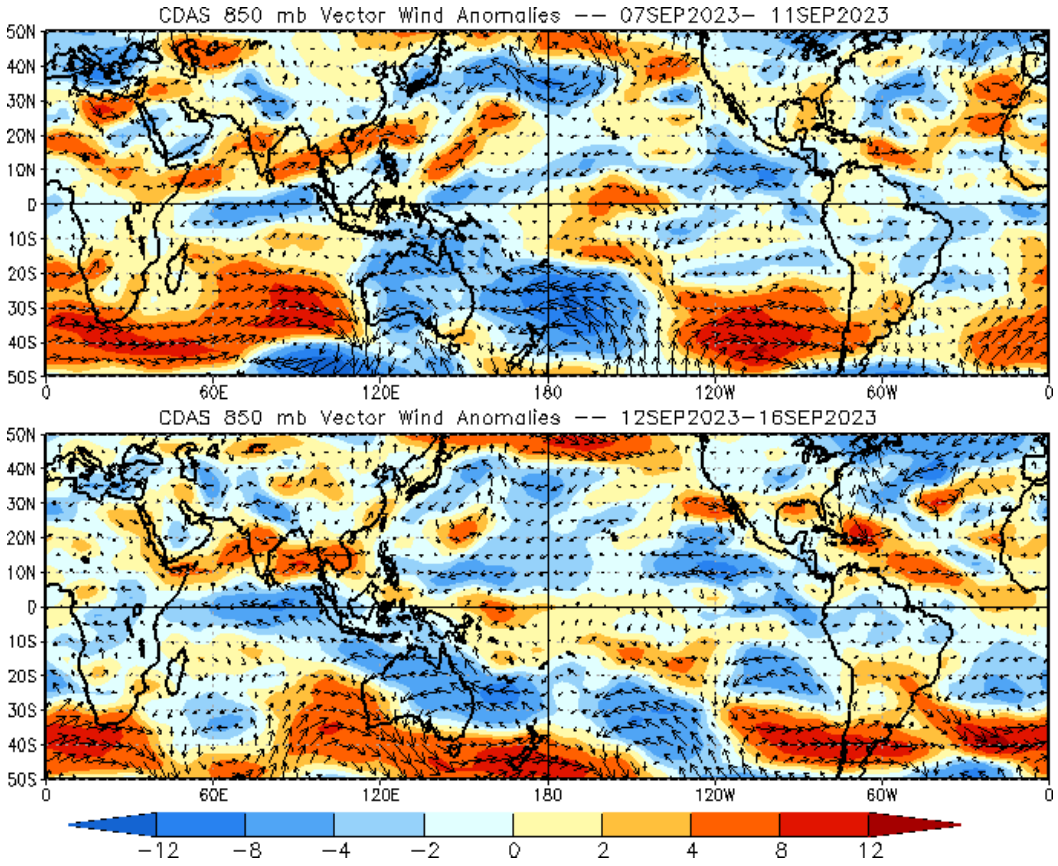


- Anomalous upper-level easterlies emerged along and to the east of the Date Line during mid-September.
- Since early September, anomalous cross-equatorial flow aloft strengthened over the eastern Pacific associated with a strong anticyclonic circulation to the west of South America.
- Anomalous easterlies aloft have relaxed across the equatorial Indian Ocean, with anomalous westerlies developing over equatorial Africa.

850-hPa Wind Anomalies

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

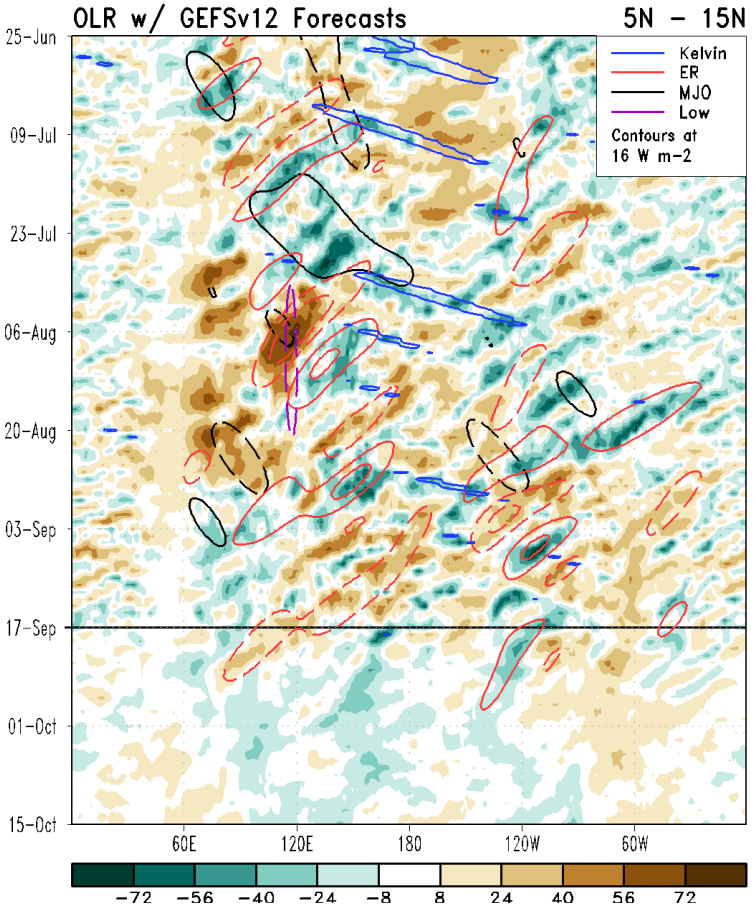


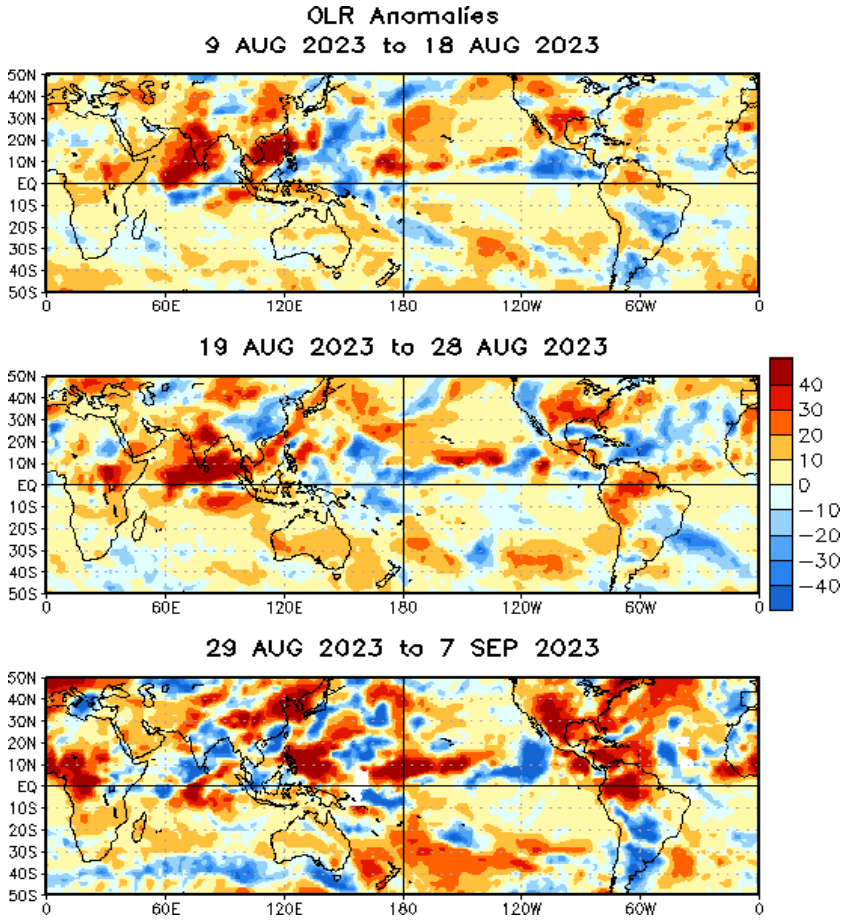


- Anomalous westerlies expanded across the equatorial Pacific, becoming more in-line with the canonical atmospheric response to El Nino.
- Anomalous easterlies strengthened throughout the equatorial Indian Ocean. North of the equator, anomalous westerlies became more negatively tilted.
- Anomalous lower-level easterlies strengthened over the eastern Pacific, which has helped inhibit tropical cyclone development since early September.

Outgoing Longwave Radiation (OLR) Anomalies

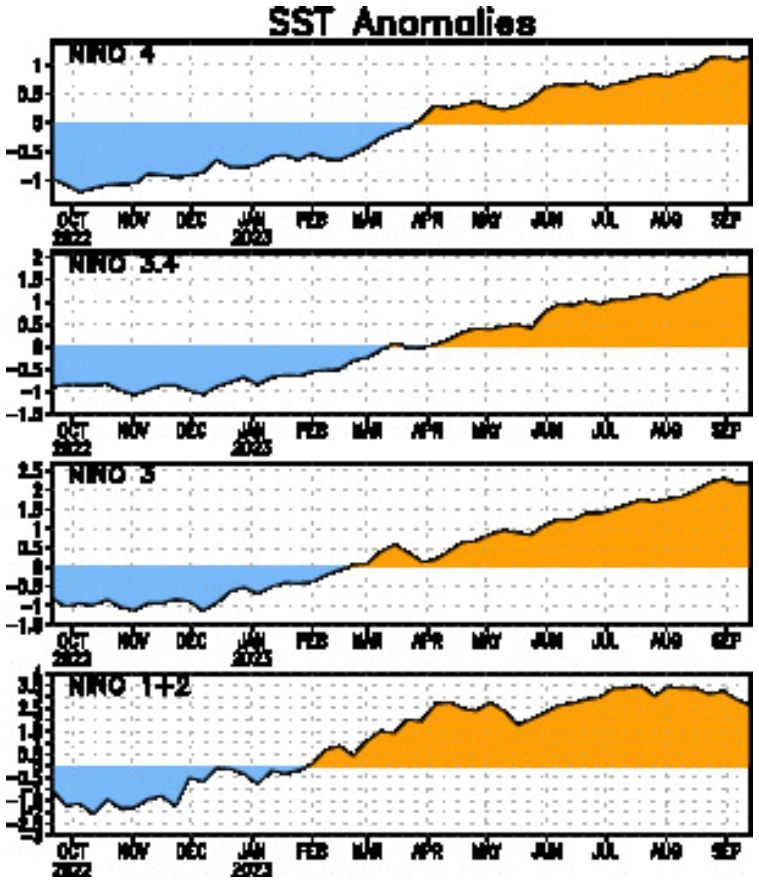
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

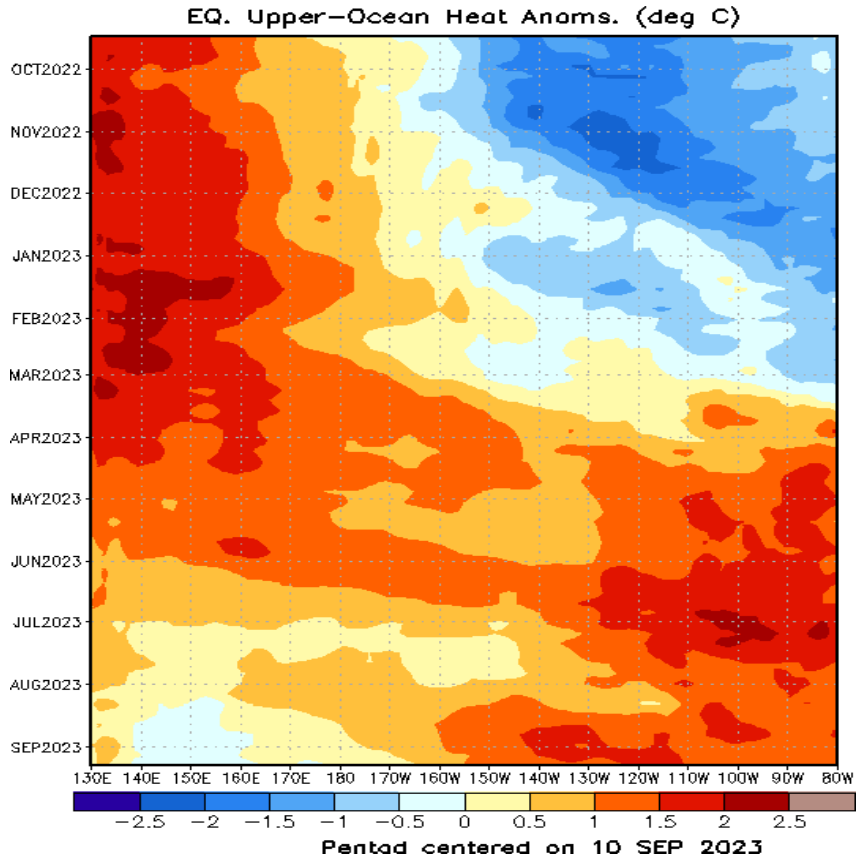




- Following a period of suppressed monsoonal conditions, wetter conditions were observed over India and southeast Asia.
- North of the equator, suppressed convection was observed over the western Pacific and central Pacific, however forecasts favor the return of enhanced convection.
- Suppressed convection prevailed over the tropical Americas and the CONUS. However, anomalies may be erroneously overdone due to recent issues with OLR data.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

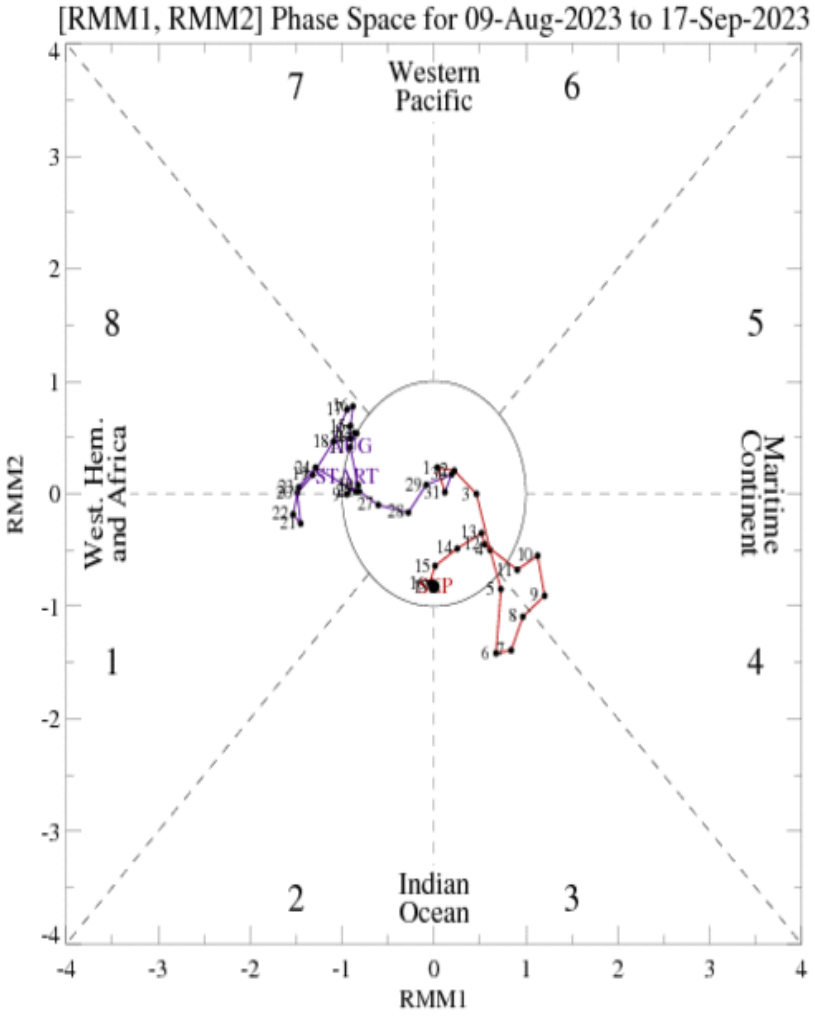




- El Niño conditions are present across the equatorial Pacific as SST anomalies remain strongly positive in all of the Niño basins.
- Tied to a westerly wind event over the western Pacific in August, another surge of warm subsurface ocean water extended eastward across the central Pacific. Negative heat content anomalies are now appearing in the West Pacific Warm Pool.

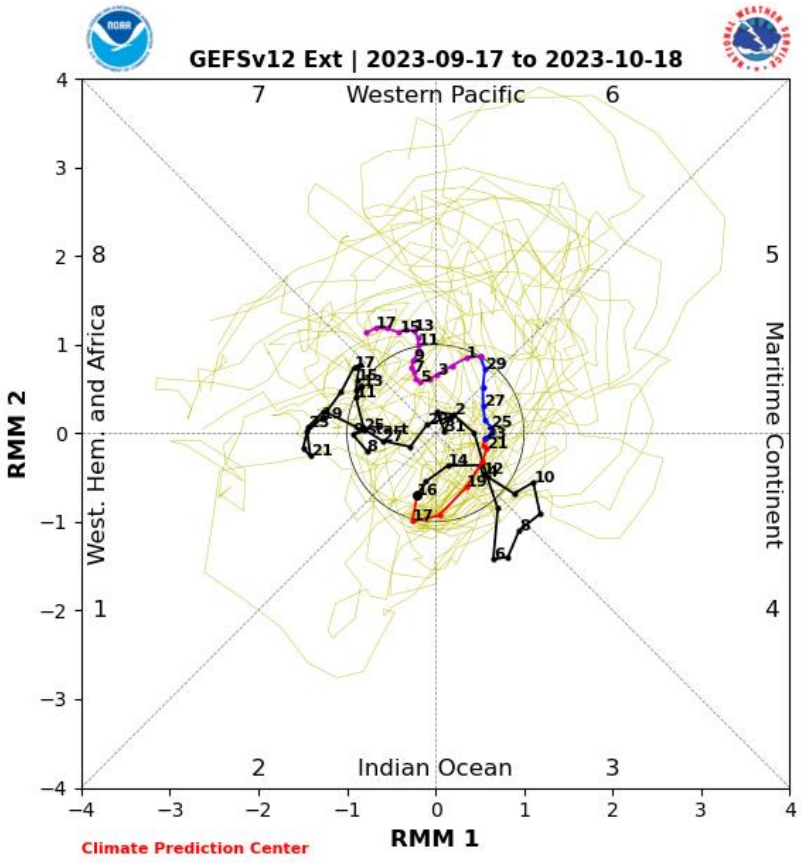
MJO Index: Recent Evolution

- RMM index observations show a westward retreat of the signal, which is likely tied to Rossby wave activity during the past week.
- More recently, an increase in amplitude is observed over the Indian Ocean.

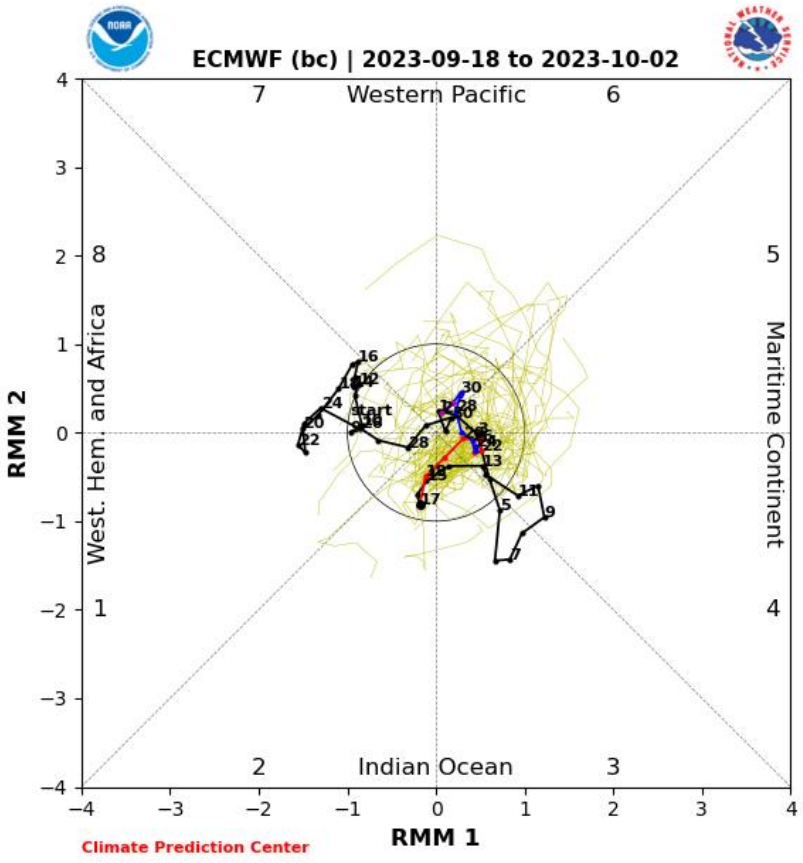


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

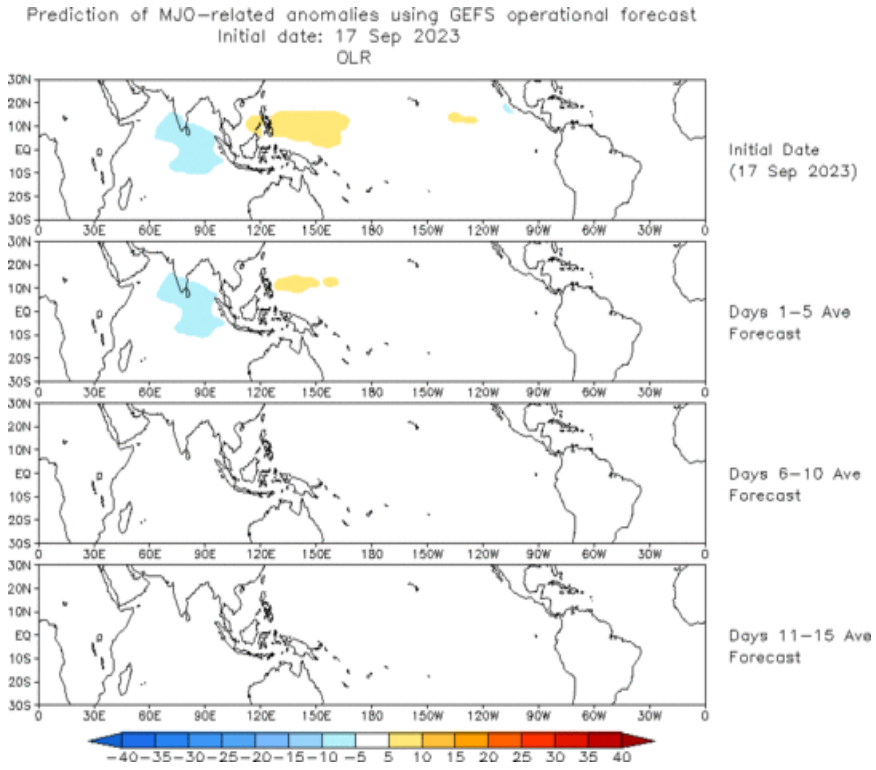


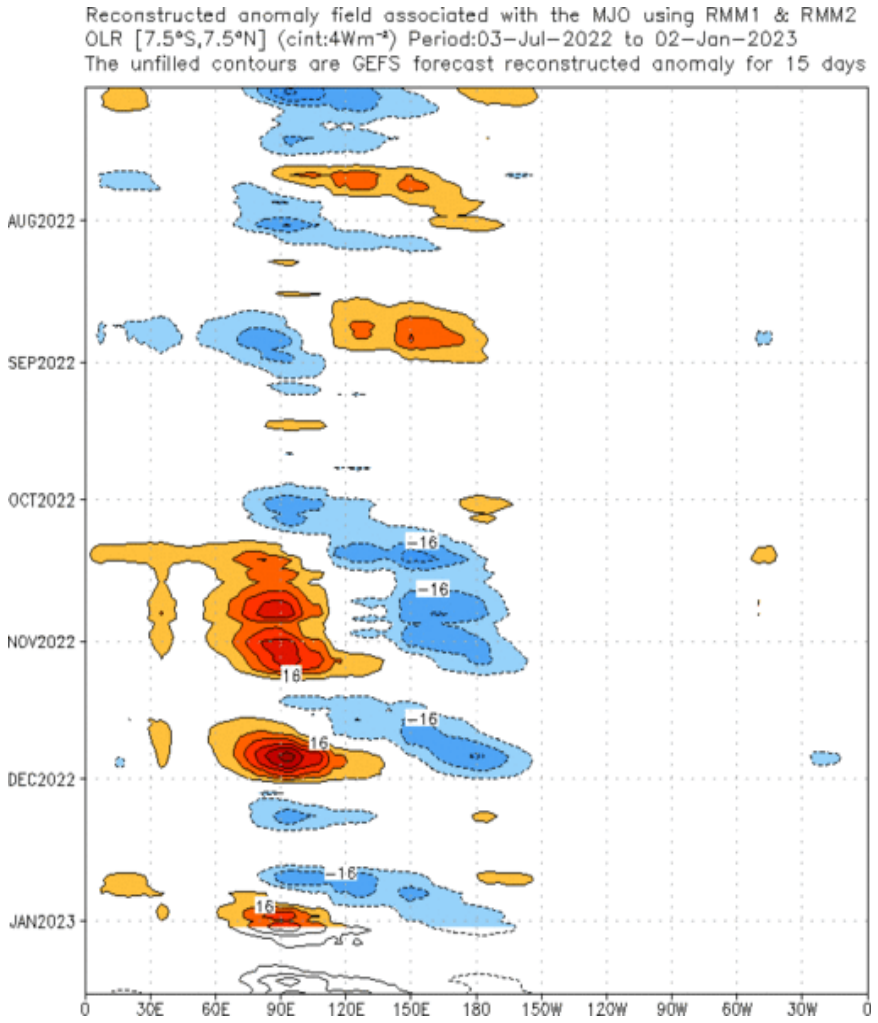
ECMWF Forecast

- Dynamical models favor the resumption of an eastward propagating MJO signal, but maintain a low amplitude through late September.
- Consistent with previous RMM forecasts the ECMWF maintains a weak MJO, while other models show a potentially more coherent MJO reemerging over the Maritime Continent and western Pacific in the extended range.

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.)

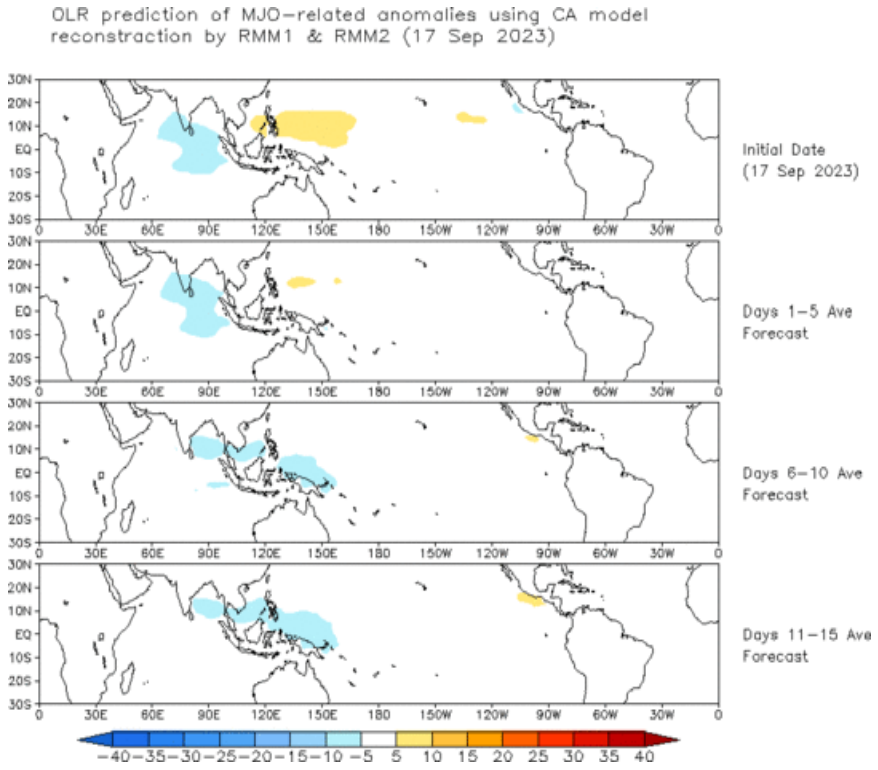


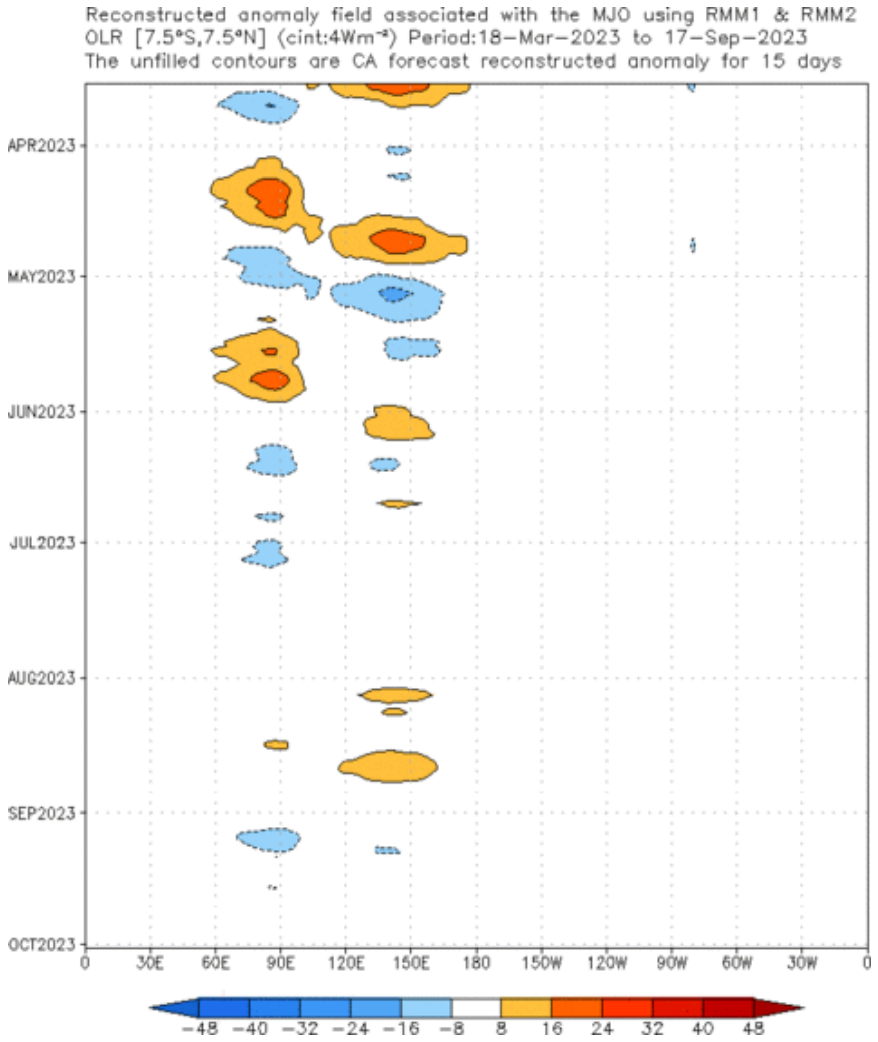


- The GEFS RMM-based OLR forecast initially depicts a weak convective dipole over the eastern Hemisphere, that vanishes in anomaly space by week-2.

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.)

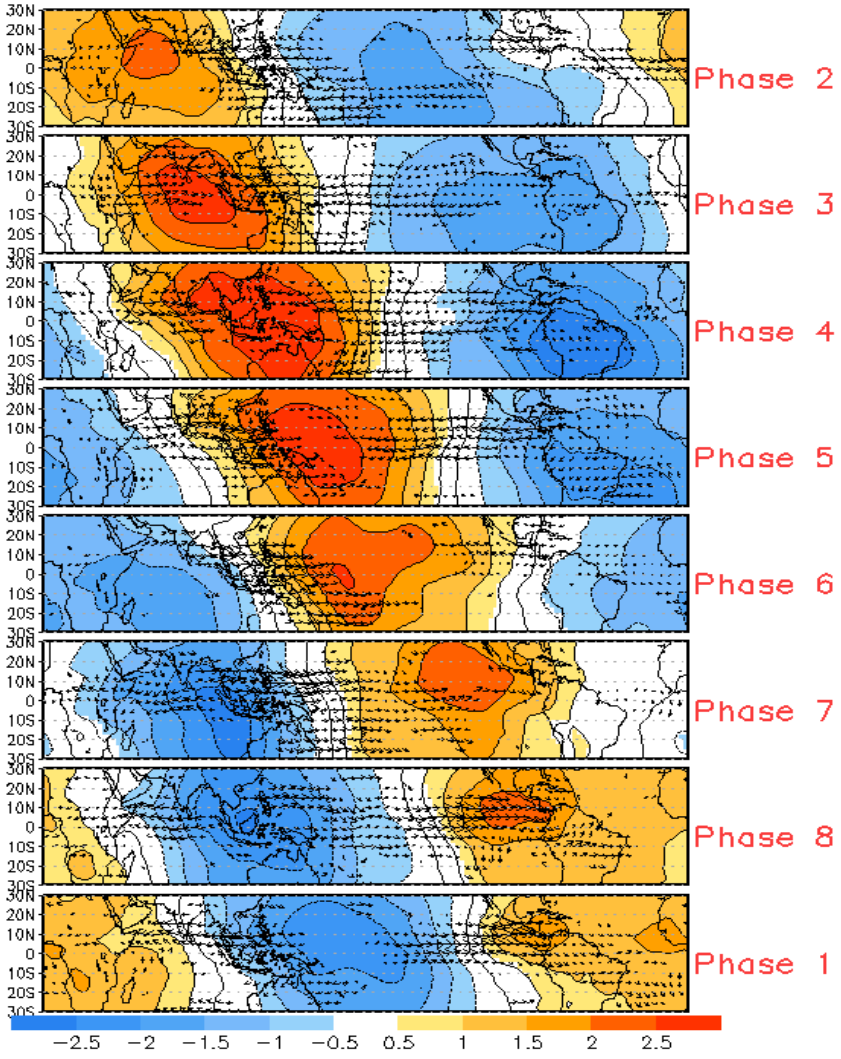




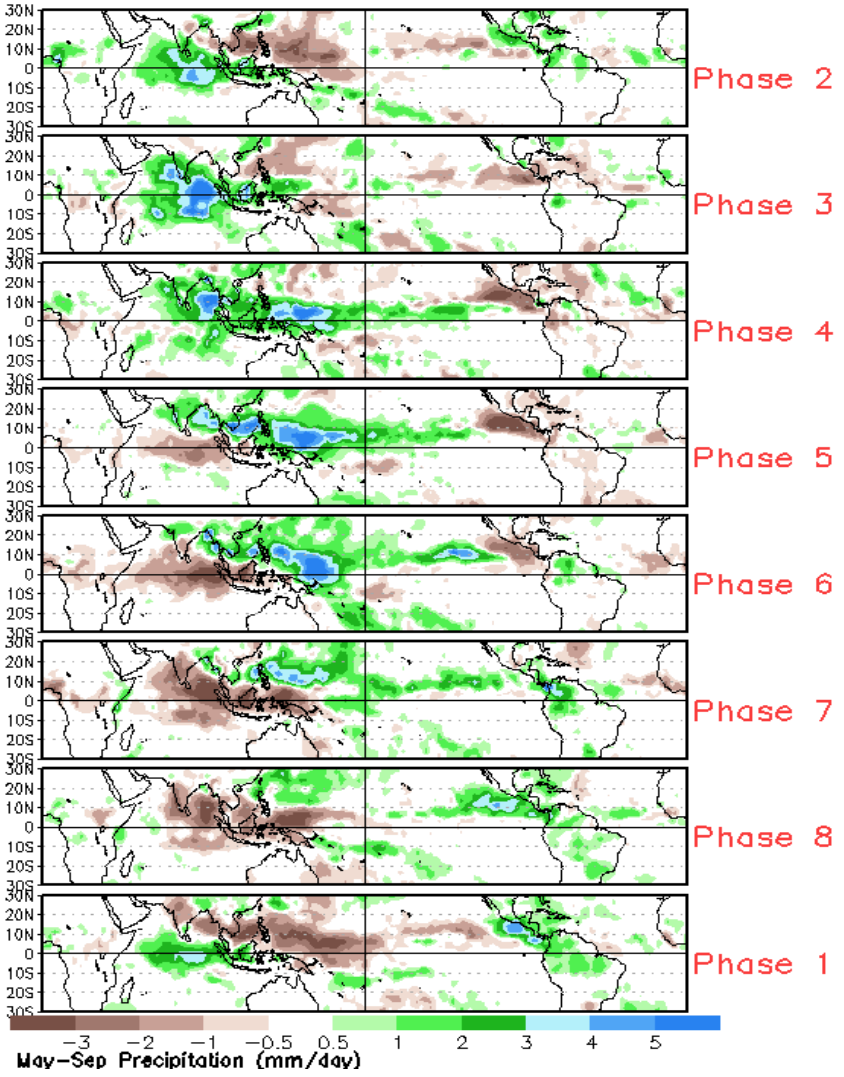
- The constructed analog RMM-based forecast favors a slightly stronger convective pattern compared to the GEFS, with enhanced convection shifting eastward with time.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



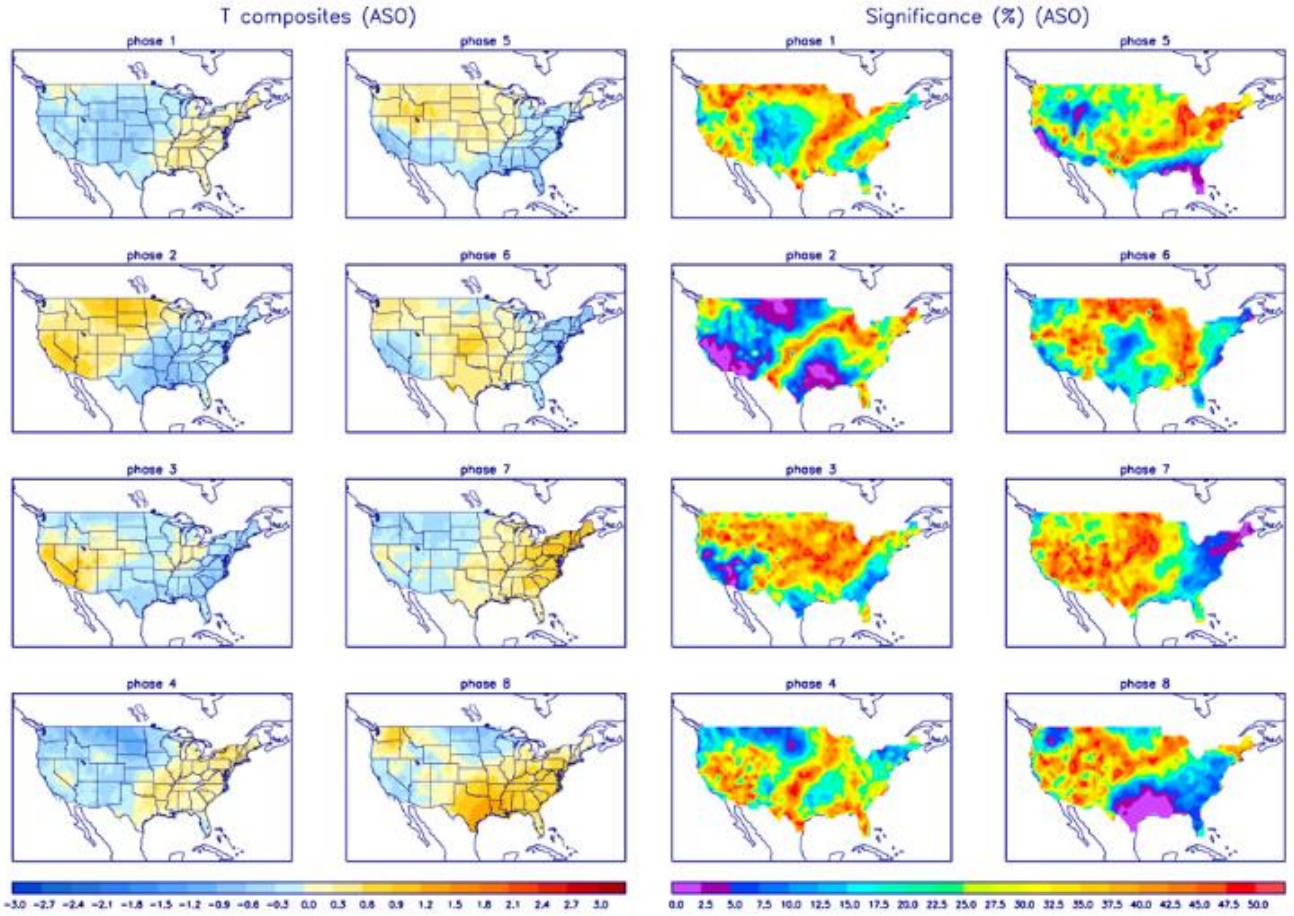
Precipitation Anomalies



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.

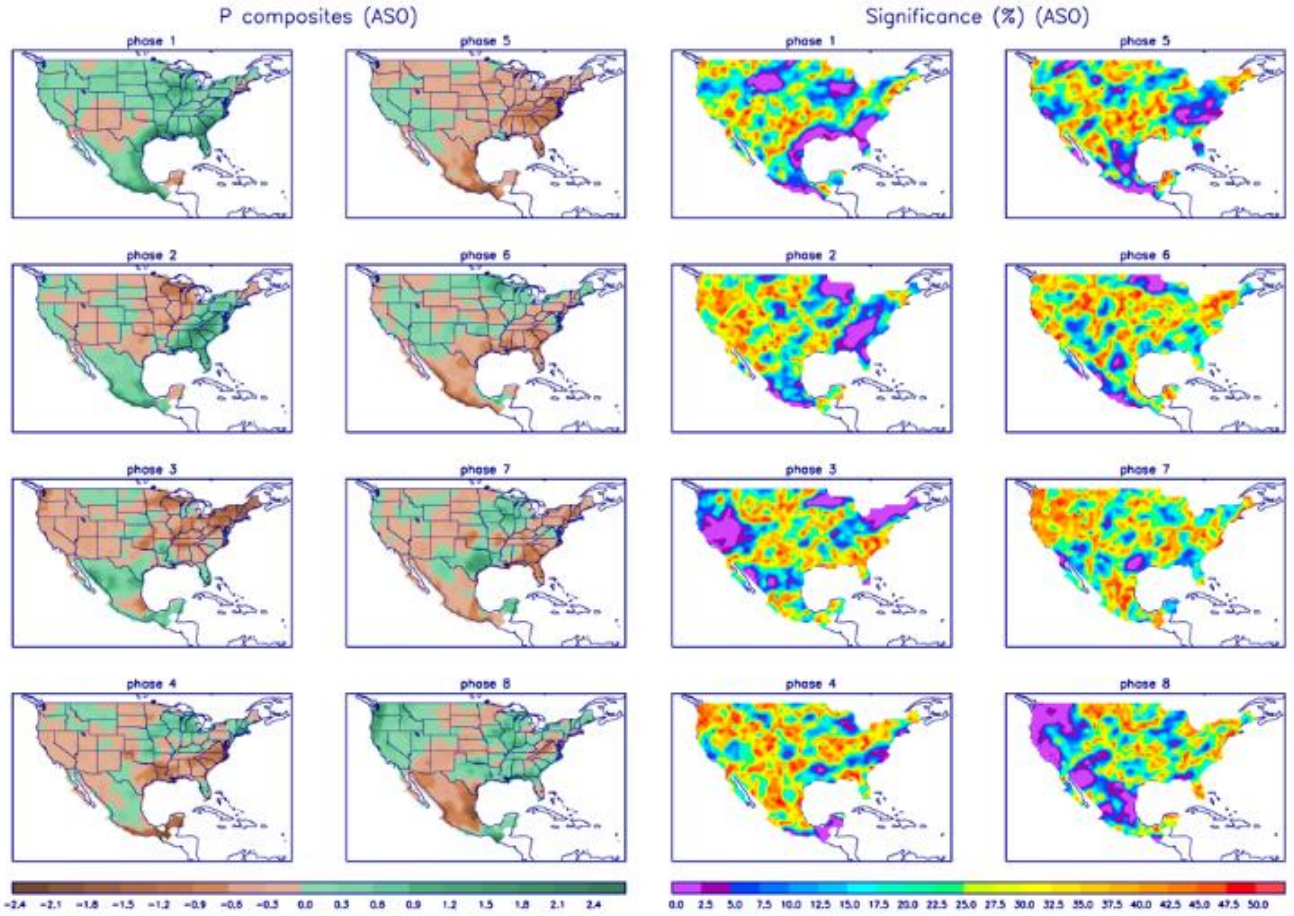


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

MJO: CONUS Composite Maps by RMM Phase - 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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