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

Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
10 July 2023

Overview

- The MJO has continued to be largely disorganized since mid-June, with other modes of variability contributing to the convective anomalies throughout the global tropics.

- Dynamical models remain consistent on the MJO potentially reemerging over the Indian Ocean and propagating eastward into West Pacific during the next few weeks. Any renewed MJO activity is expected to constructively interfere with the developing El Nino base state.

- The large scale environment is expected to become increasingly favorable for tropical cyclone (TC) formation in the western Pacific, with decreasing chances across the eastern Pacific during the period

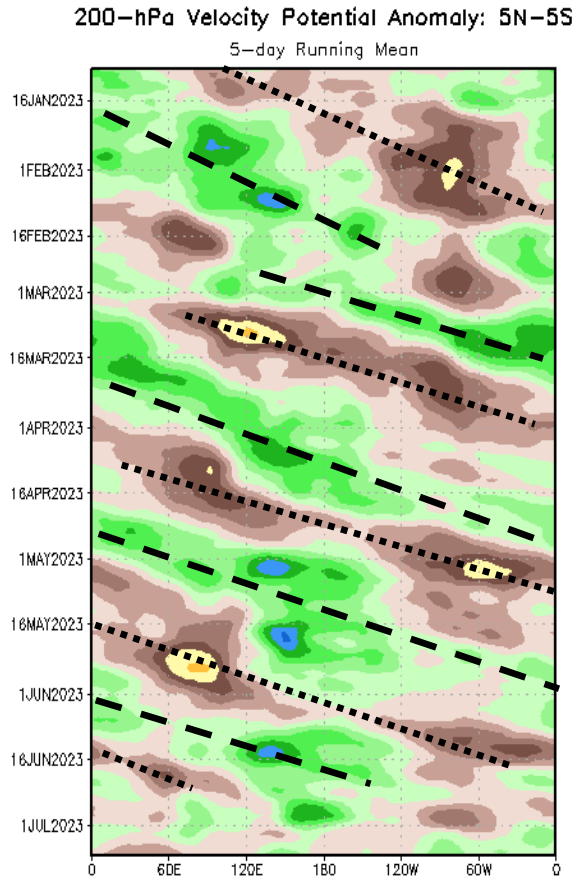
- Increased chances for TC formation are also anticipated over the Main Development Region of the Atlantic possibly tied to forecast Kelvin and/or Rossby wave activity.

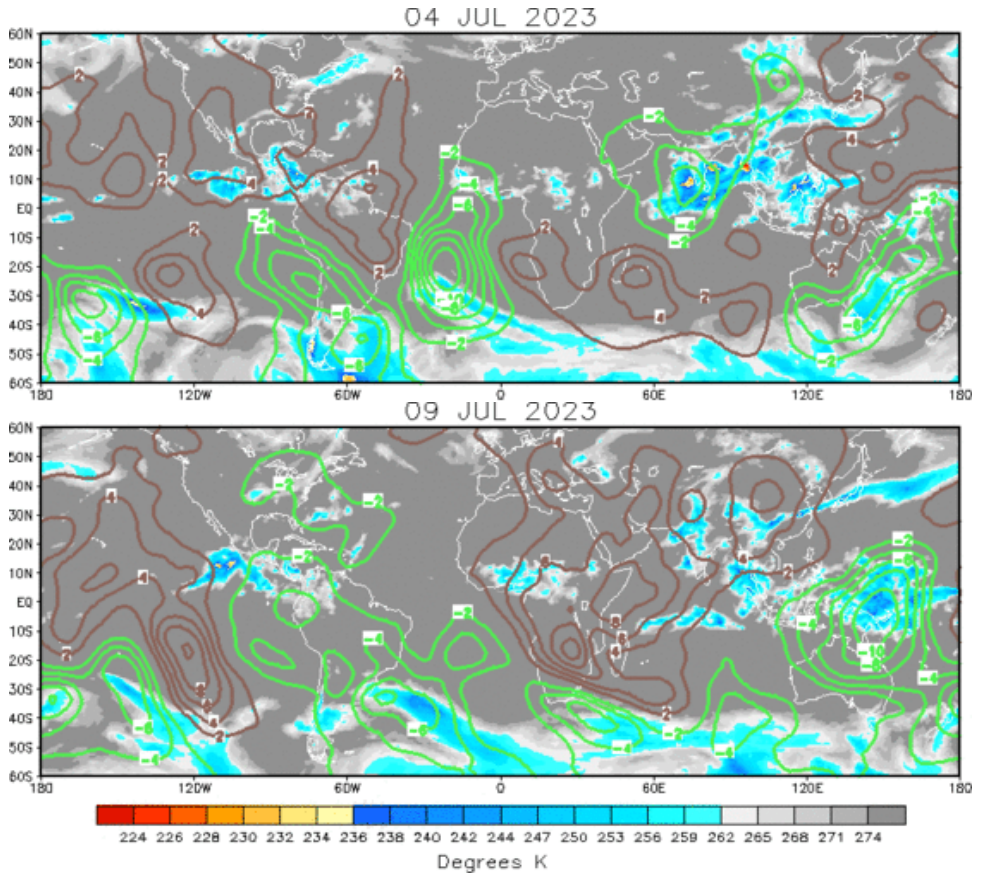
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

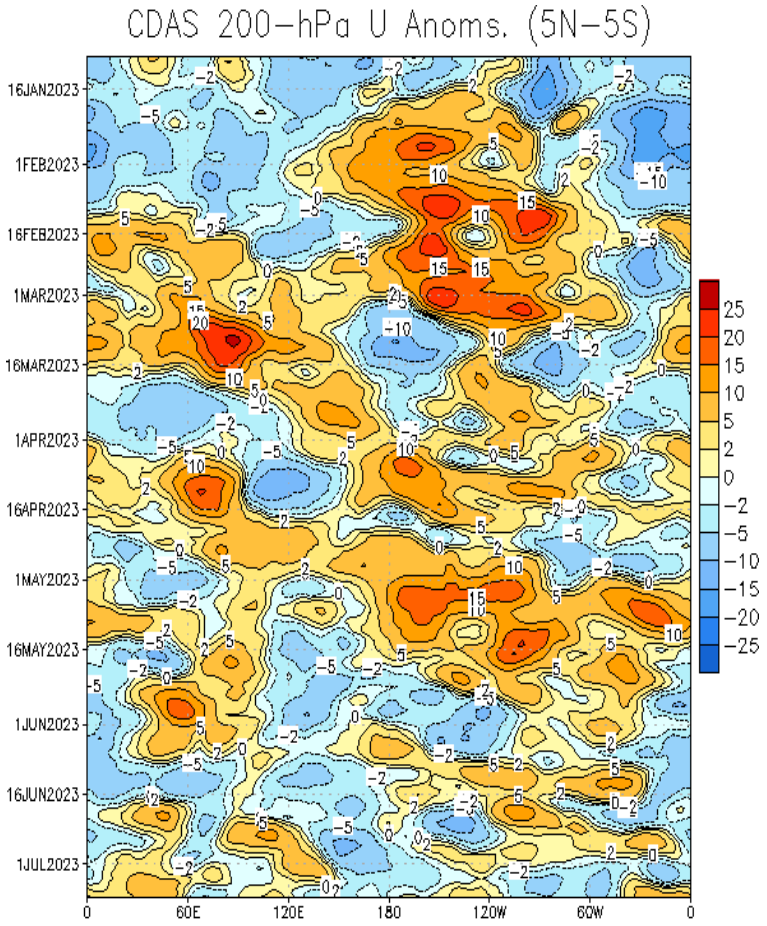


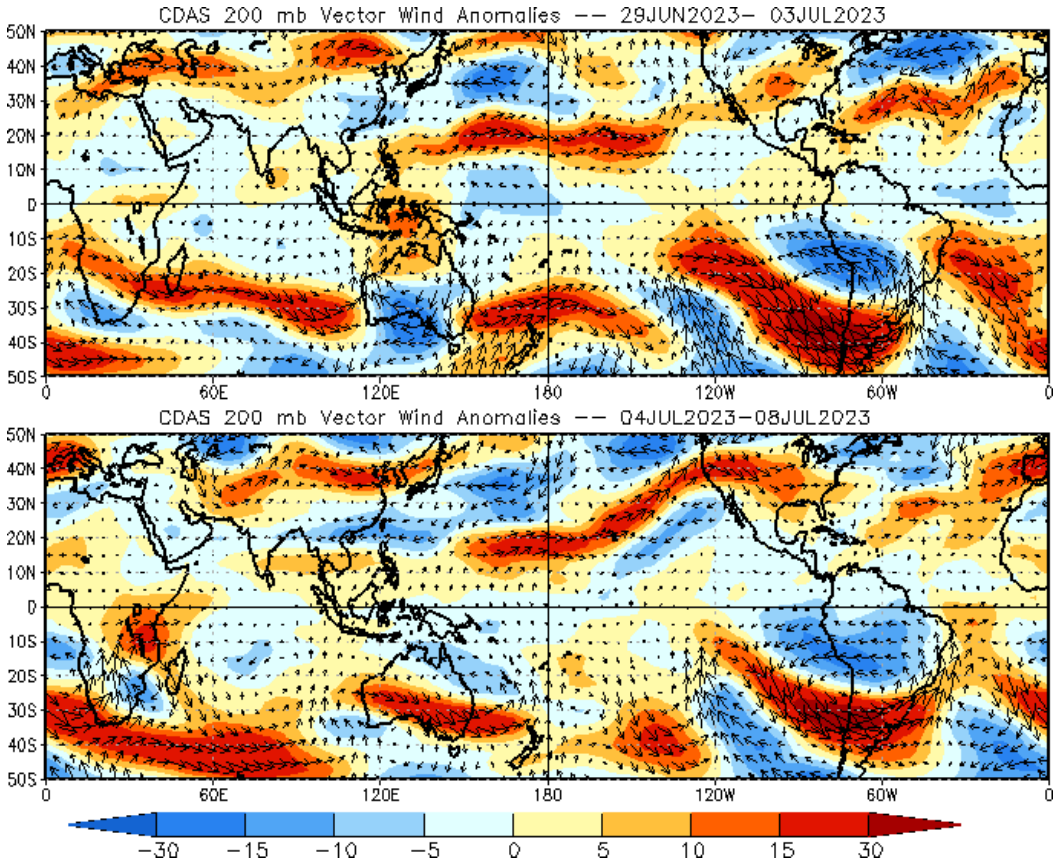


- Since mid-June, the upper-level velocity potential pattern continues to be incoherent, with enhanced convection remaining entrenched across the western Pacific tied to the low frequency footprint.
- Kelvin and Rossby wave activity appear to be contributing to an uptick in anomalous divergence aloft over the Americas and the Atlantic more recently.

200-hPa Wind Anomalies

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

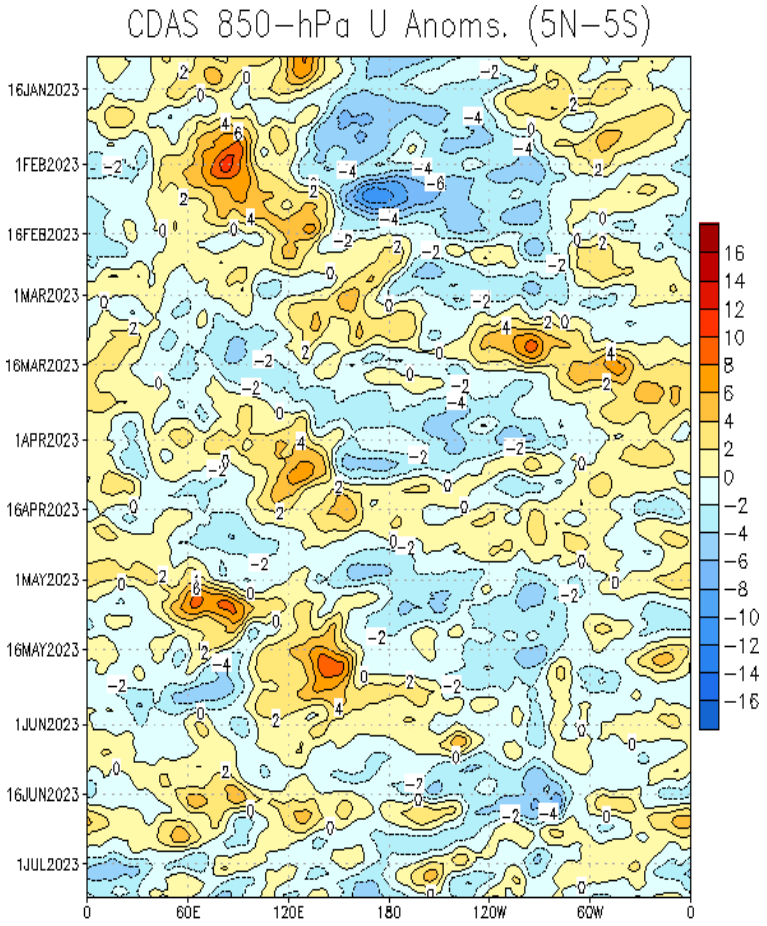


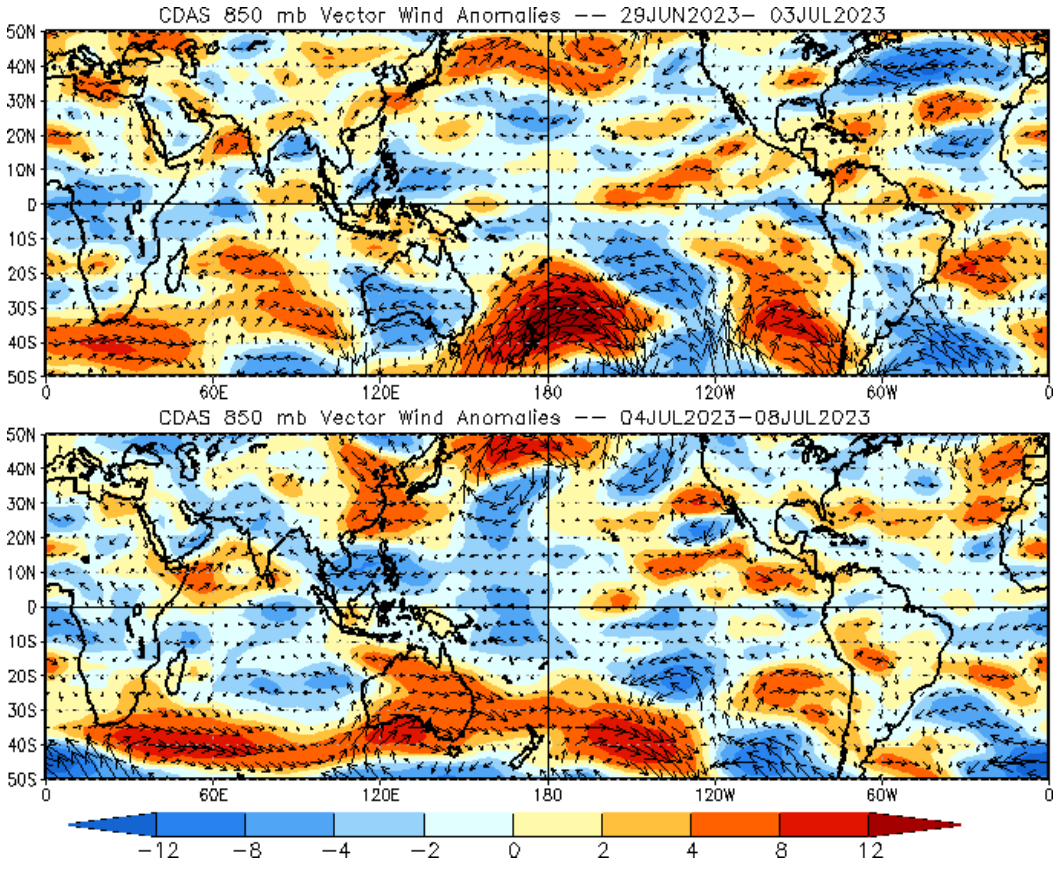


- Anomalous upper-level westerlies emerged over equatorial Africa and the Indian Ocean.
- Zonal wind anomalies are fairly muted throughout the equatorial Pacific, with the exception of enhanced easterlies in the east tied to an amplified anomalous anticyclonic circulation over South America.
- An enhanced subtropical jet remains evident across the Pacific and western North America, where strong ridging has shifted westward across the southern tier of the CONUS.

850-hPa Wind Anomalies

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

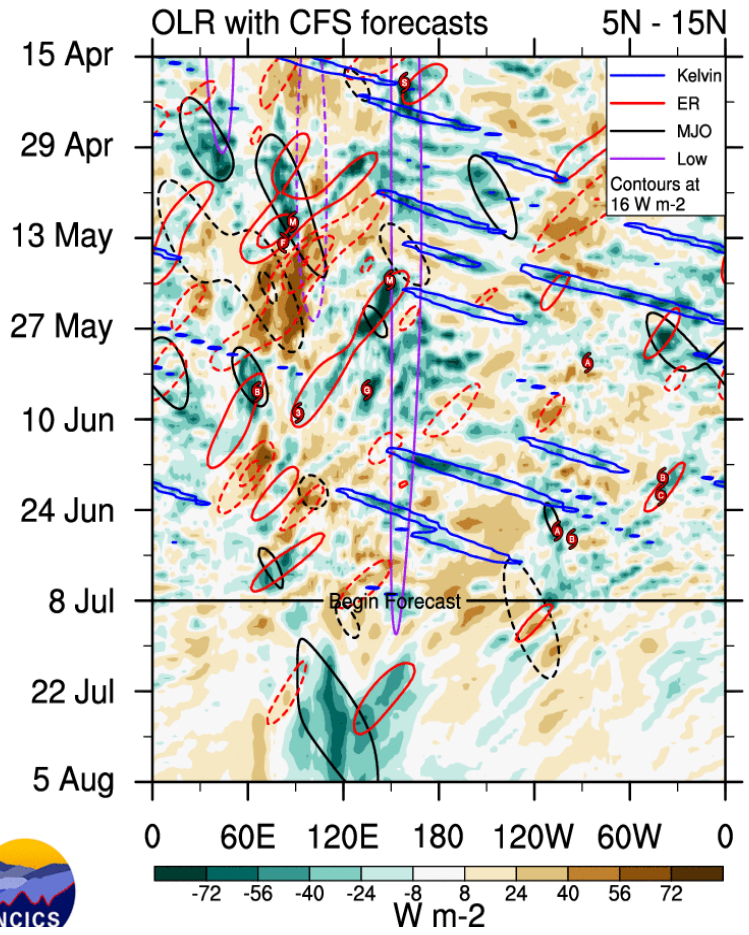


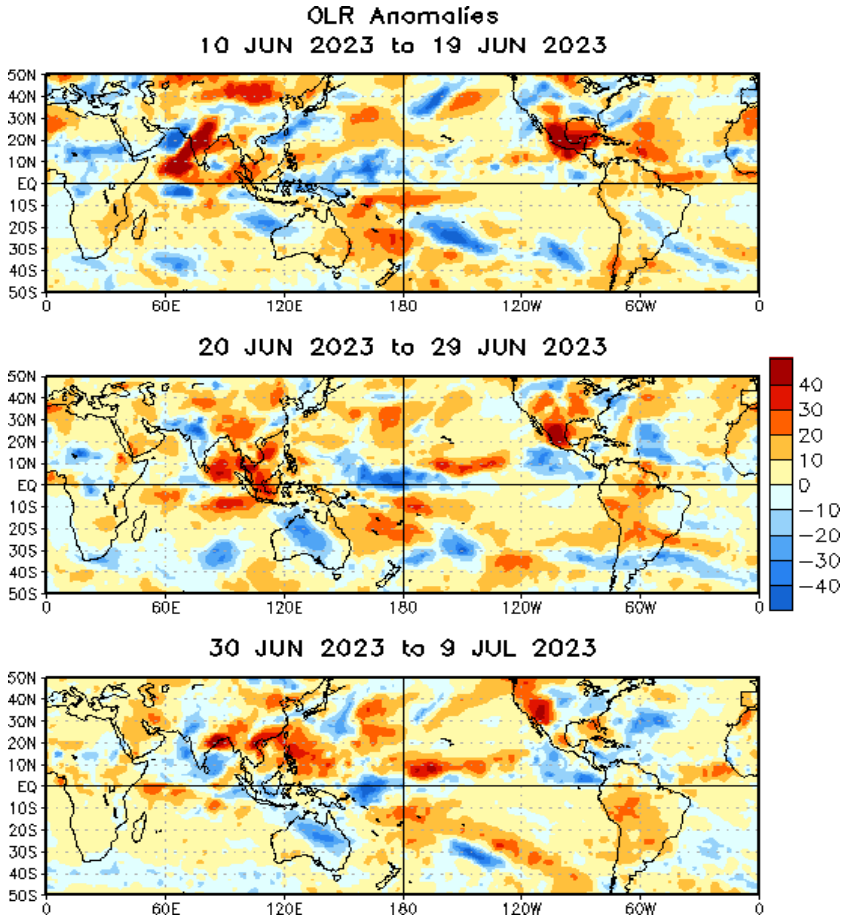


- Anomalous westerlies emerged over the Indian Ocean mainly north of the equator.
- Enhanced trades persisted over the central equatorial Pacific suggesting a continued interruption in the atmospheric response to El Niño.
- Anomalous westerlies continued over eastern Pacific north of the equator to provide a favorable environment for tropical cyclone formation.

Outgoing Longwave Radiation (OLR) Anomalies

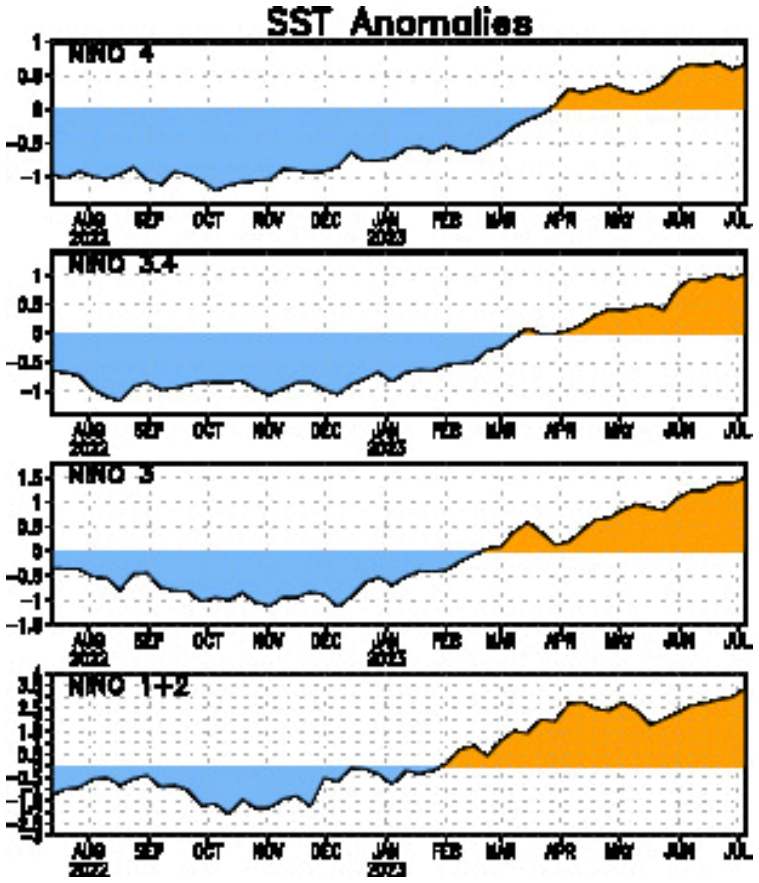
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

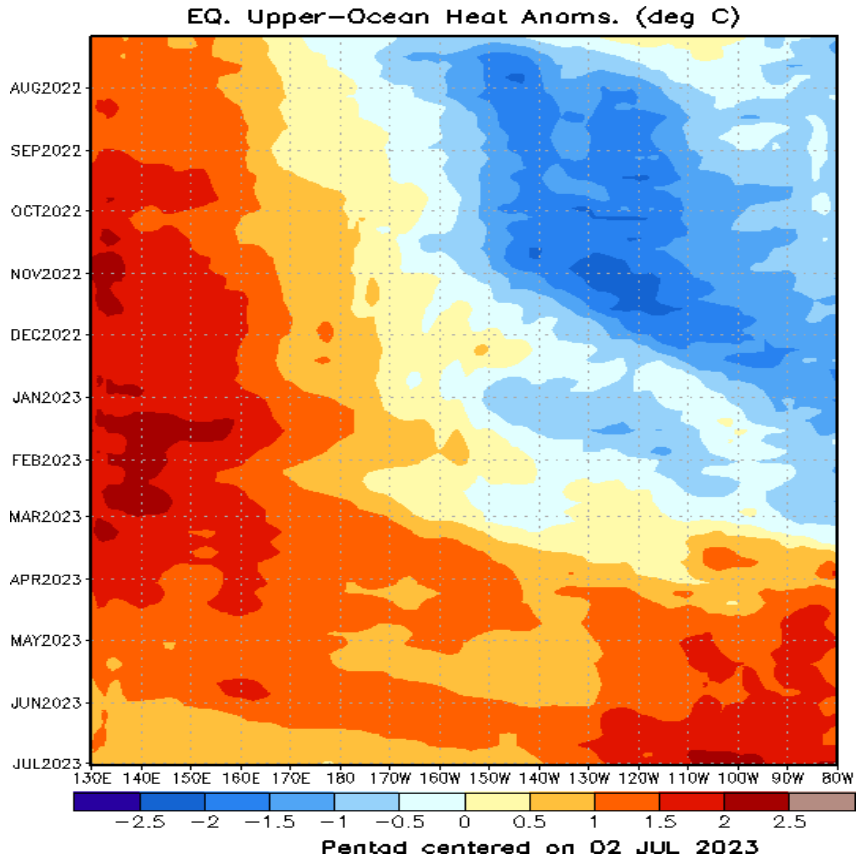




- Enhanced convection continues along the Date Line, while suppressed convection is persisted over the Maritime Continent and West Pacific associated with a hiatus in tropical cyclone activity.
- OLR forecasts favor a robust uptick in convection between 90E and 150E with MJO activity coming through the filtering later in July.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

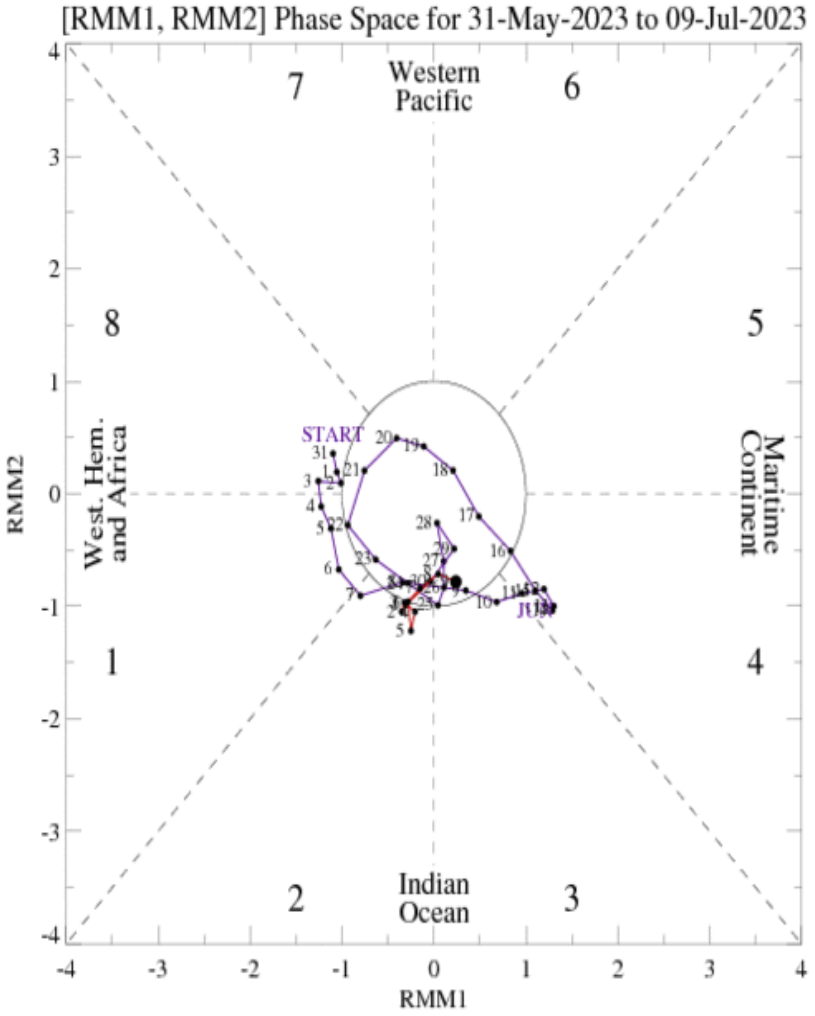




- El Niño conditions are now present across the equatorial Pacific.
- Above-normal oceanic subsurface temperatures are present across the entire equatorial Pacific, with the largest positive anomalies (>2 degrees C) between 110W and 100W.
- Much of the recent subsurface warming was likely reinforced by an oceanic downwelling Kelvin Wave triggered by a westerly wind burst event in mid-May.

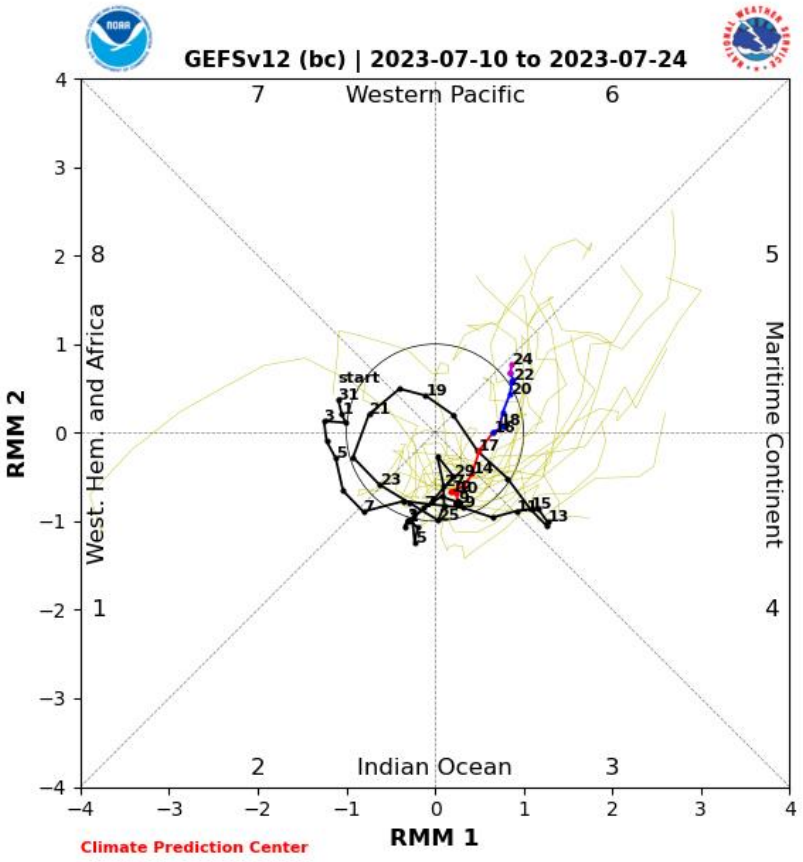
MJO Index: Recent Evolution

- The RMM index shows the MJO signal remaining weak and quasi-stationary during the past few weeks.

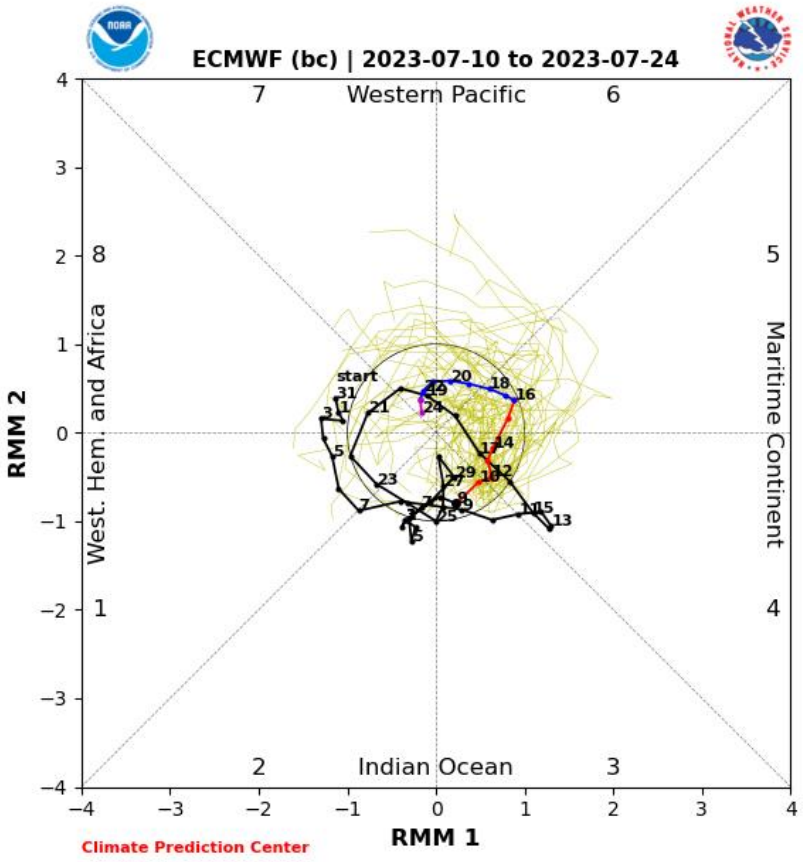


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

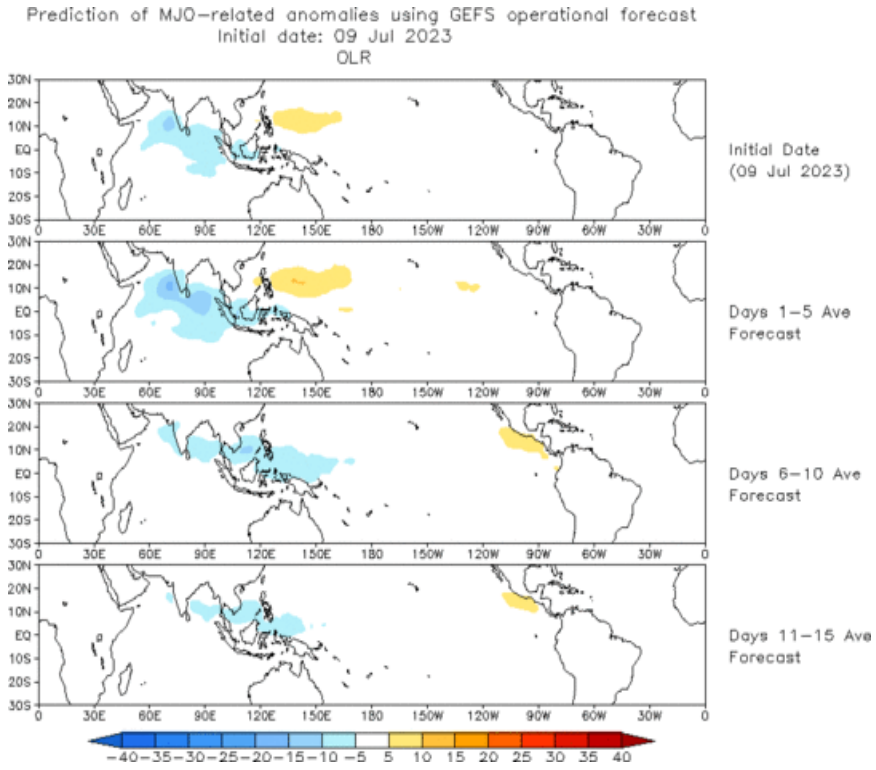


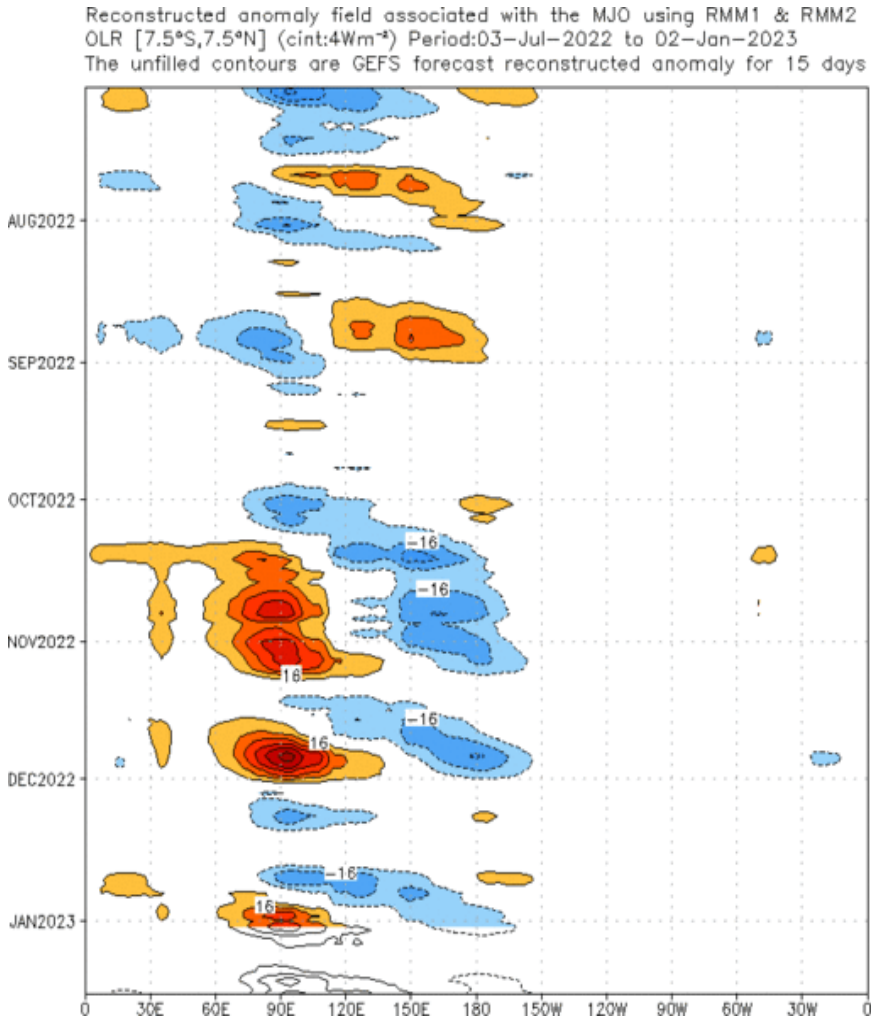
ECMWF Forecast

- Dynamical models continue to suggest possible renewed MJO activity propagating out of the Indian Ocean and into the Maritime Continent and West Pacific during the next several weeks,
- In recent extended runs, several GEFS ensemble solutions show the potential for a robust West Pacific MJO event later in July, however there is some question as to the degree of the developing El Nino footprint projecting onto the RMM index.

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.)

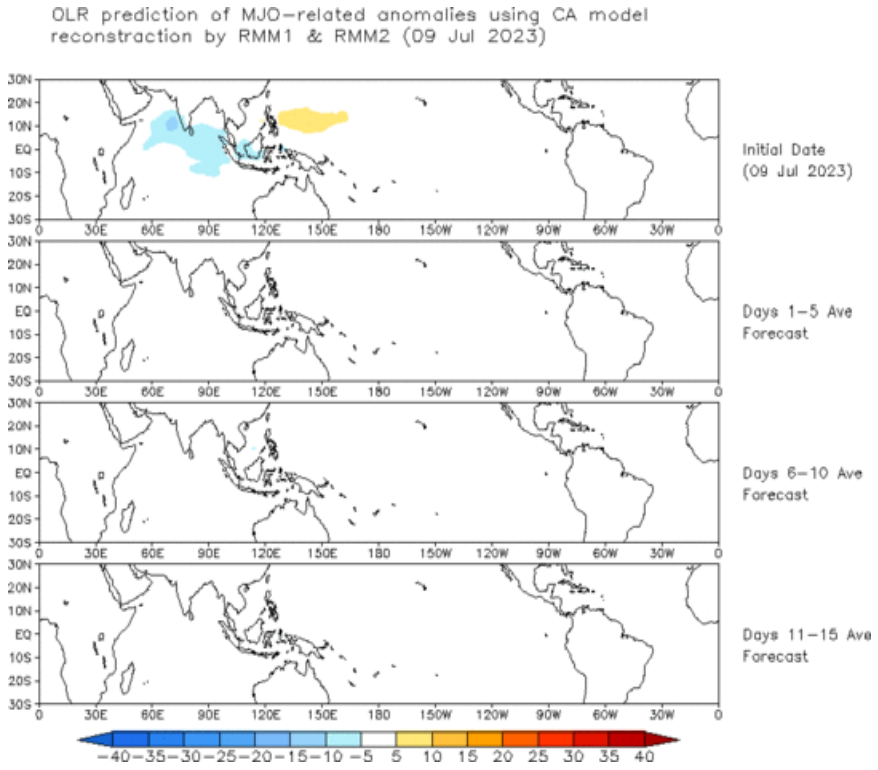


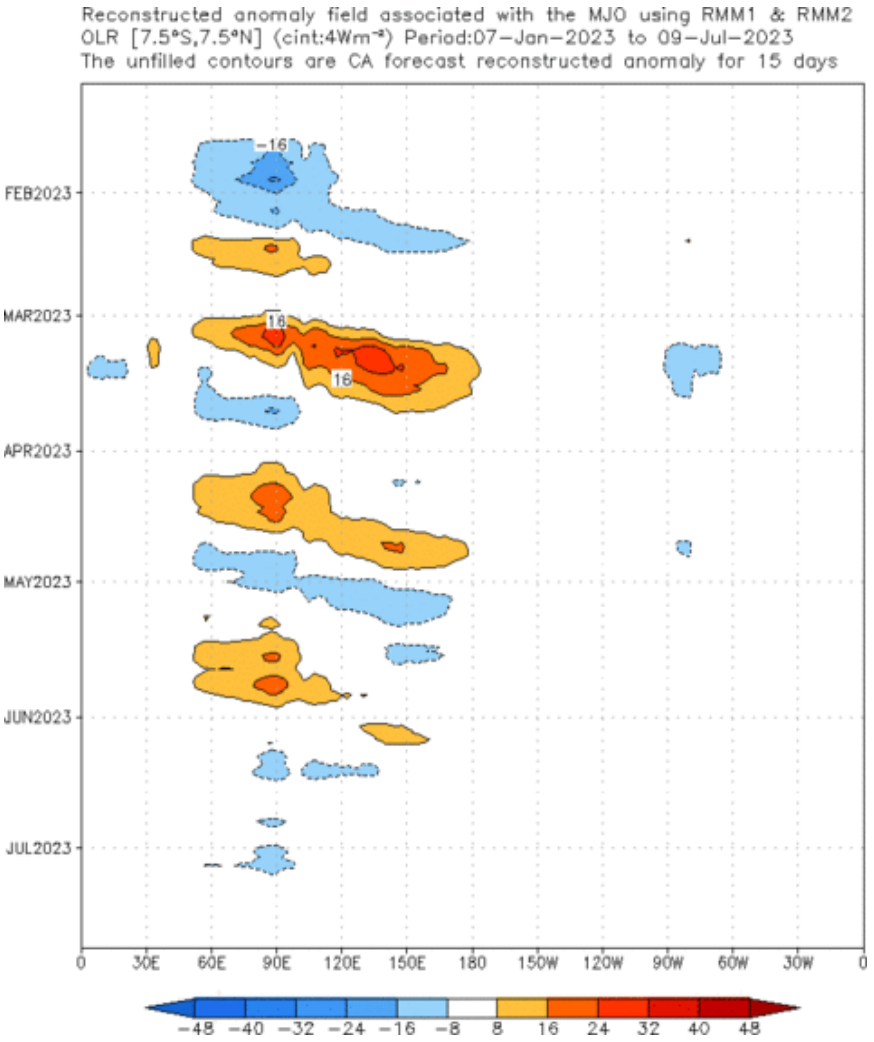


- The GEFS RMM-based OLR forecast shows enhanced convection shifting eastward across the Maritime Continent and West Pacific, with suppressed convection emerging over the East Pacific during the next two weeks.

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.)

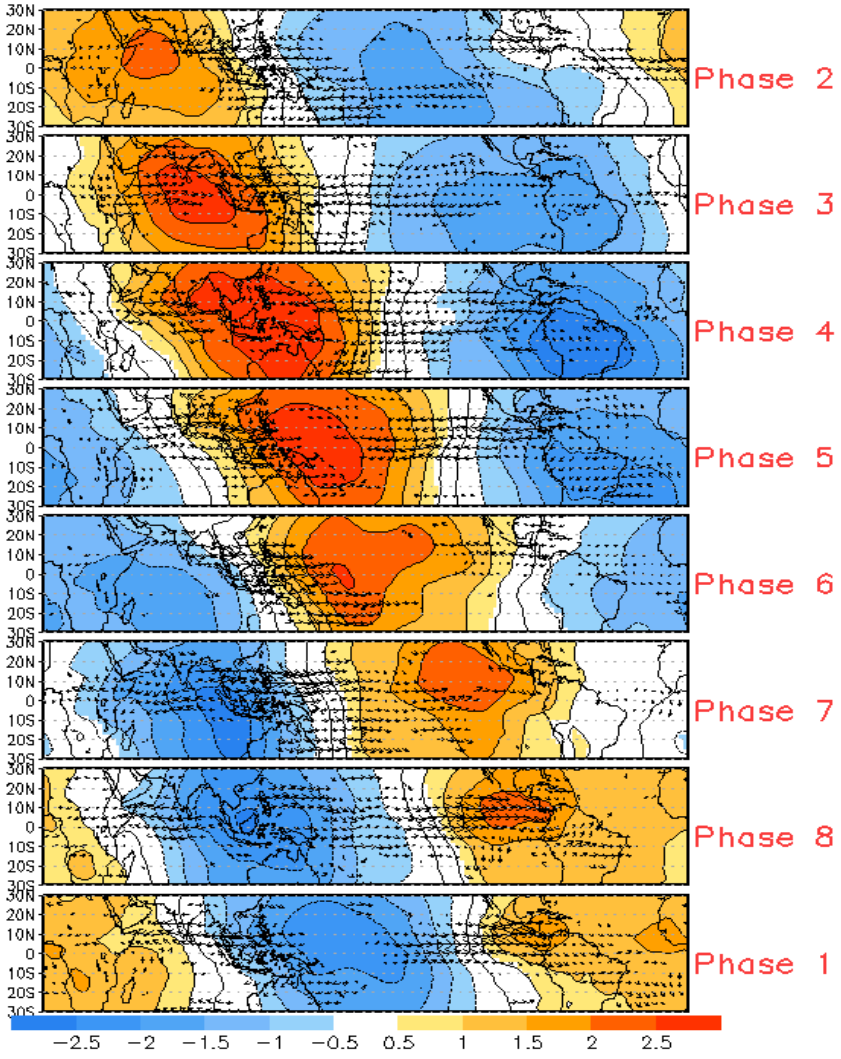




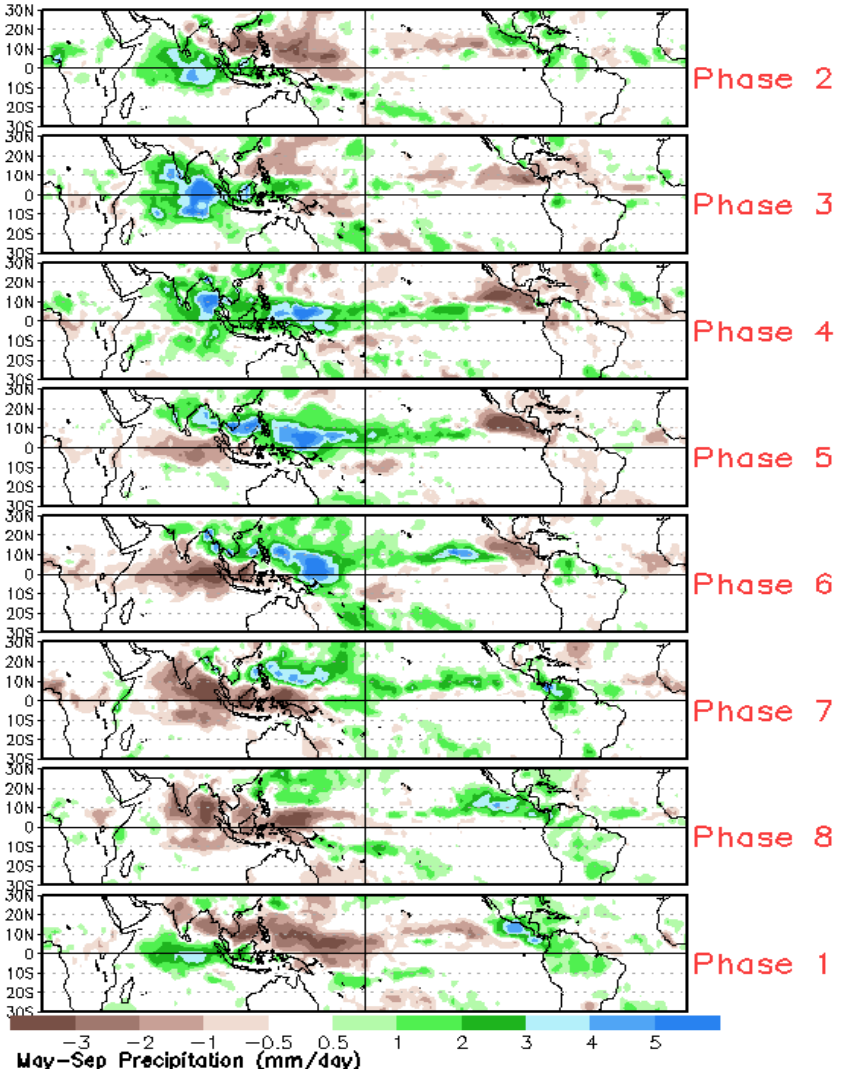
- The constructed analog RMM-based forecast is considerably more muted than the GEFS, with virtually no convective anomalies during the next two weeks.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



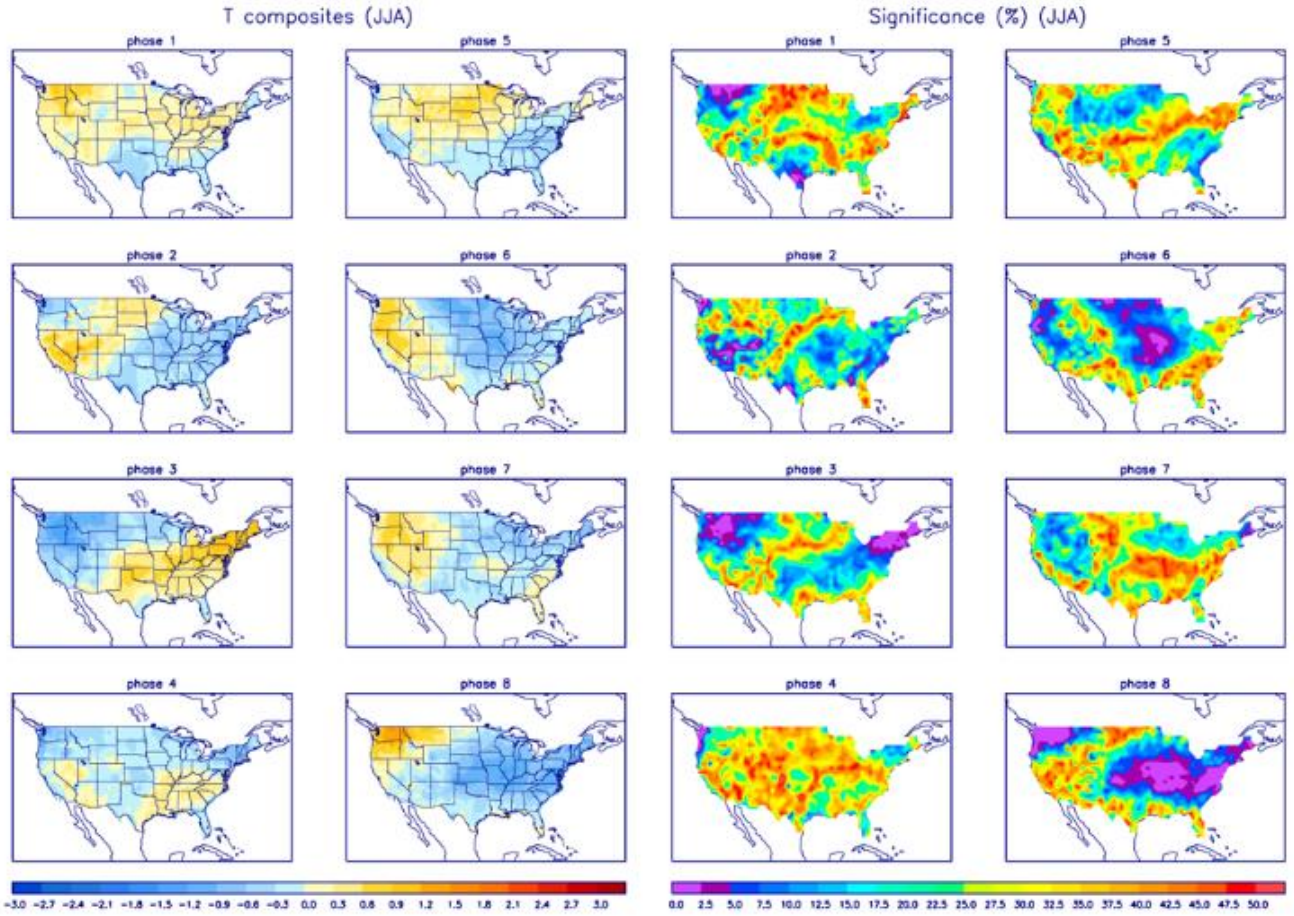
Precipitation Anomalies



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.

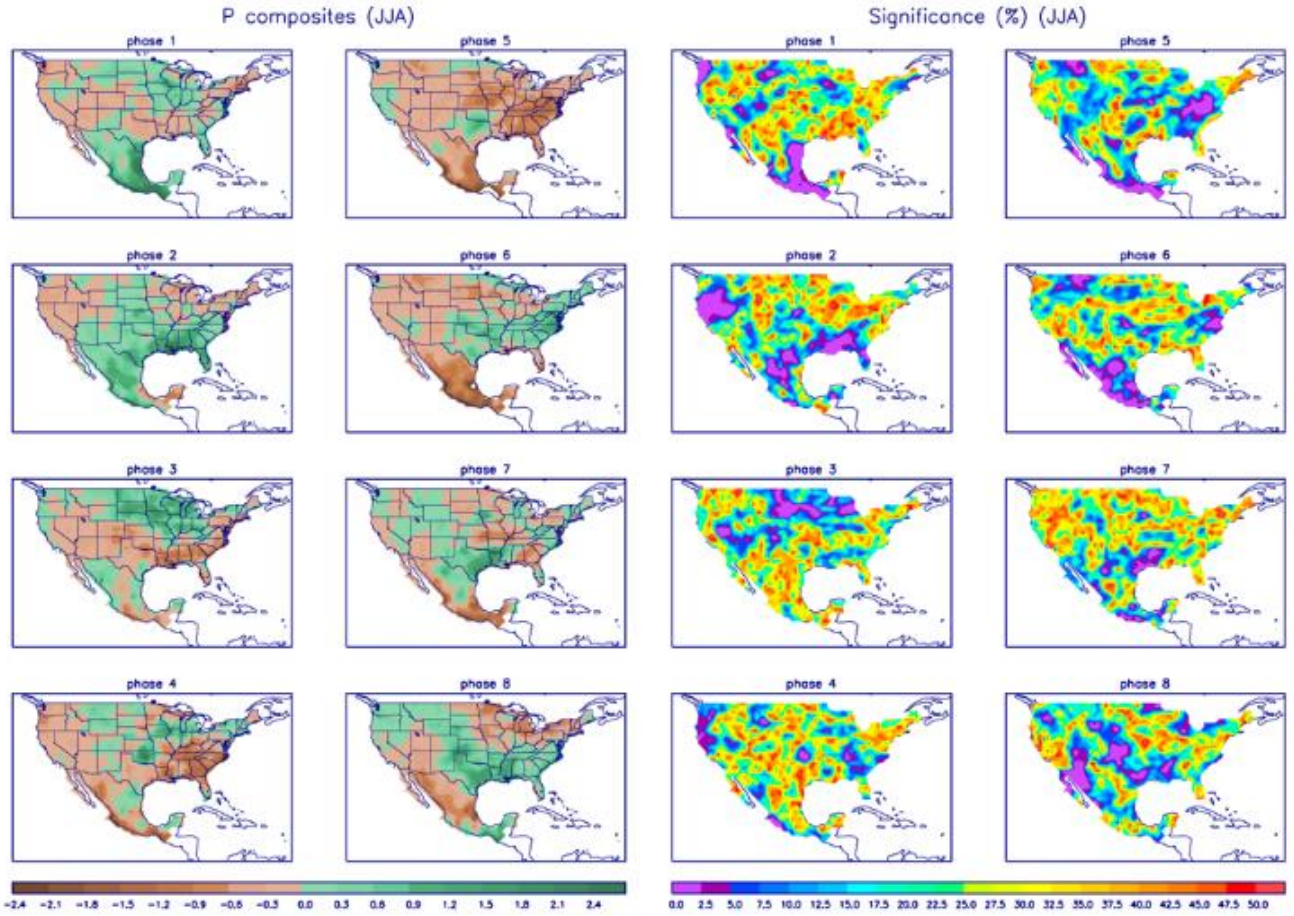


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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