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

Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
17 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 Maritime Continent 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 be favorable for tropical cyclone (TC) formation in the western Pacific, while chances across the eastern Pacific during the period remain elevated despite the presence of a suppressed convection regime.

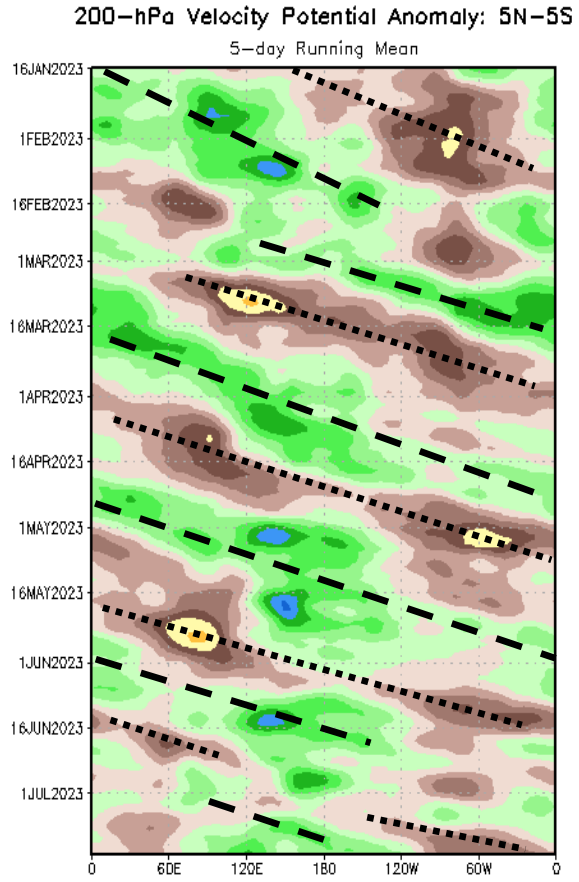
- Increased chances for TC formation are also anticipated over the Main Development Region of the Atlantic with very warm SSTs and a reasonable shear environment.

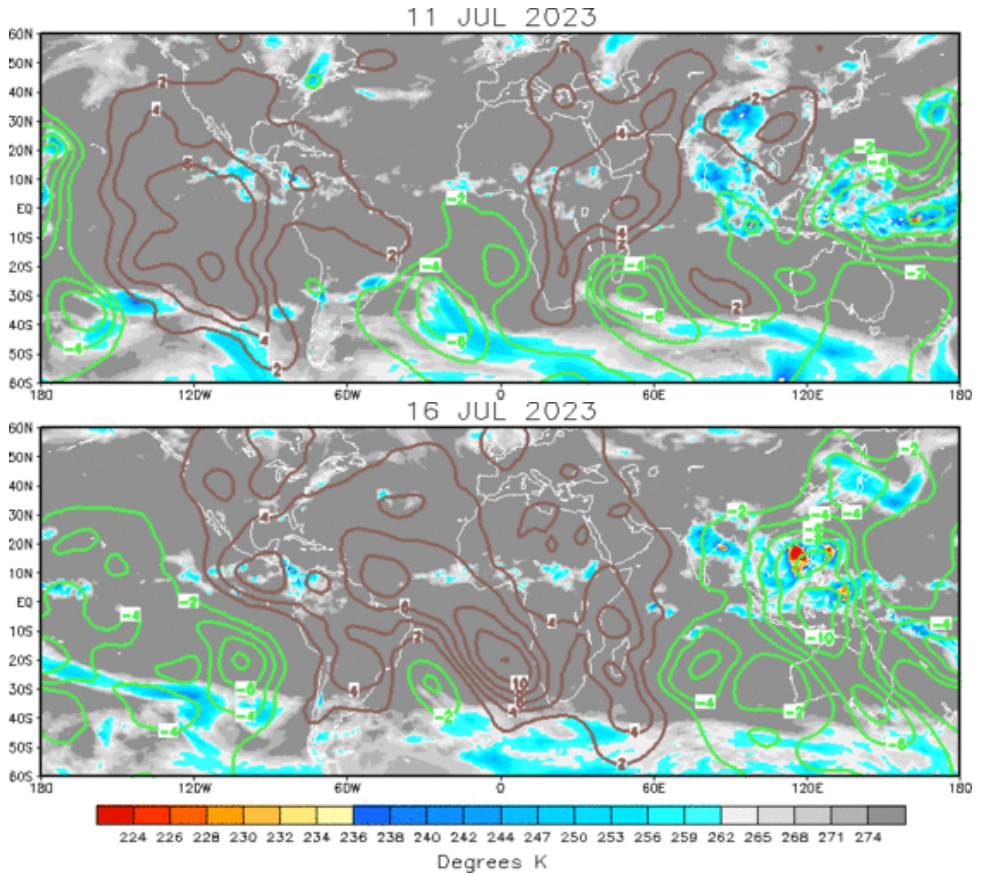
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

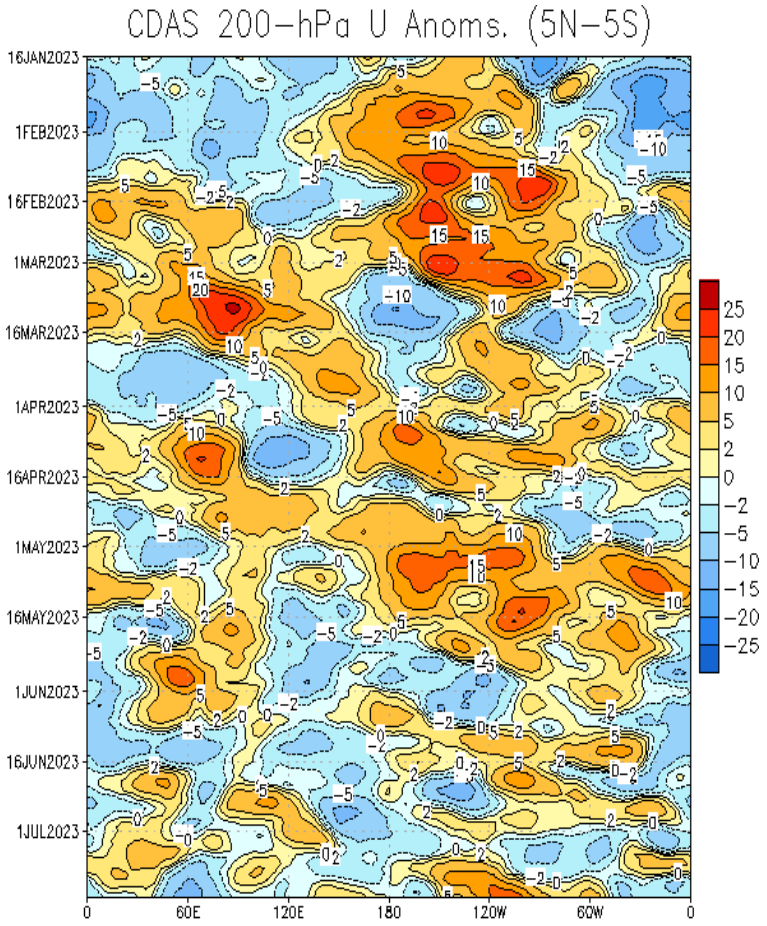


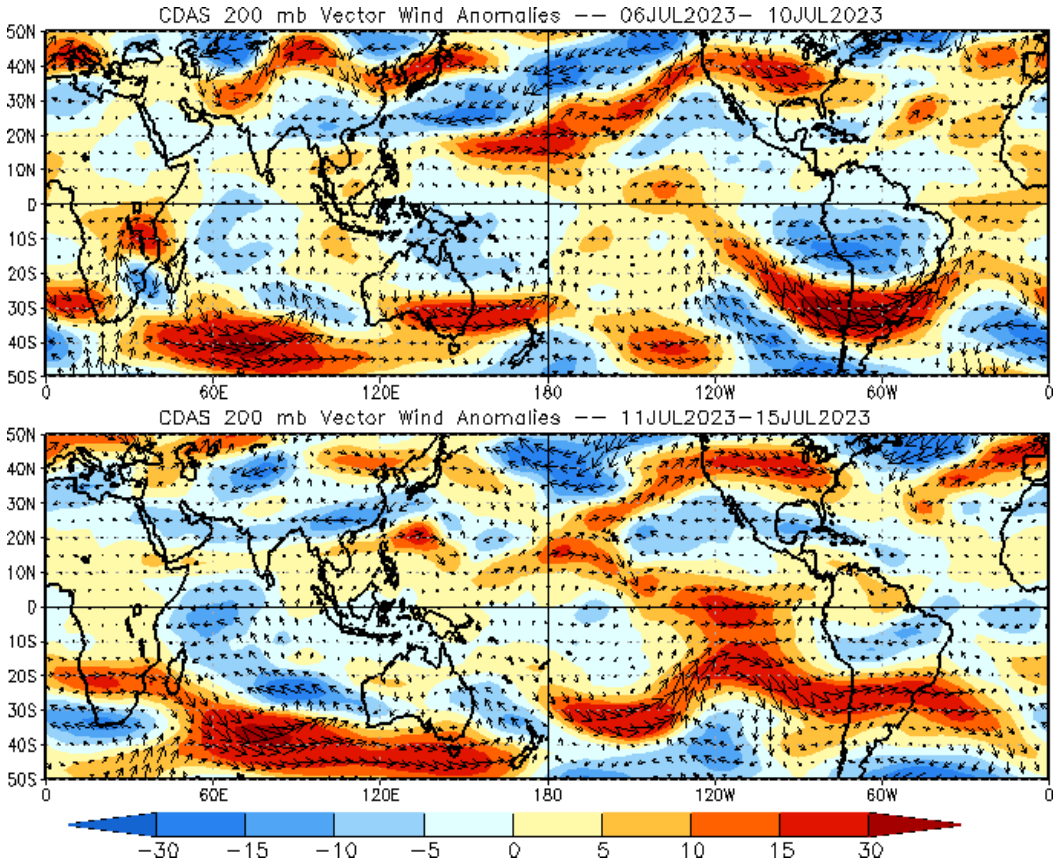


- Since mid-June, the upper-level velocity potential pattern continues to be mostly incoherent, with enhanced convection remaining entrenched across the western Pacific tied to the low frequency footprint.
- In the last few days a more discernable wave-1 pattern has emerged with the enhanced convective envelope over the Maritime Continent, possibly indicating an increase in MJO strength and coherence.

200-hPa Wind Anomalies

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

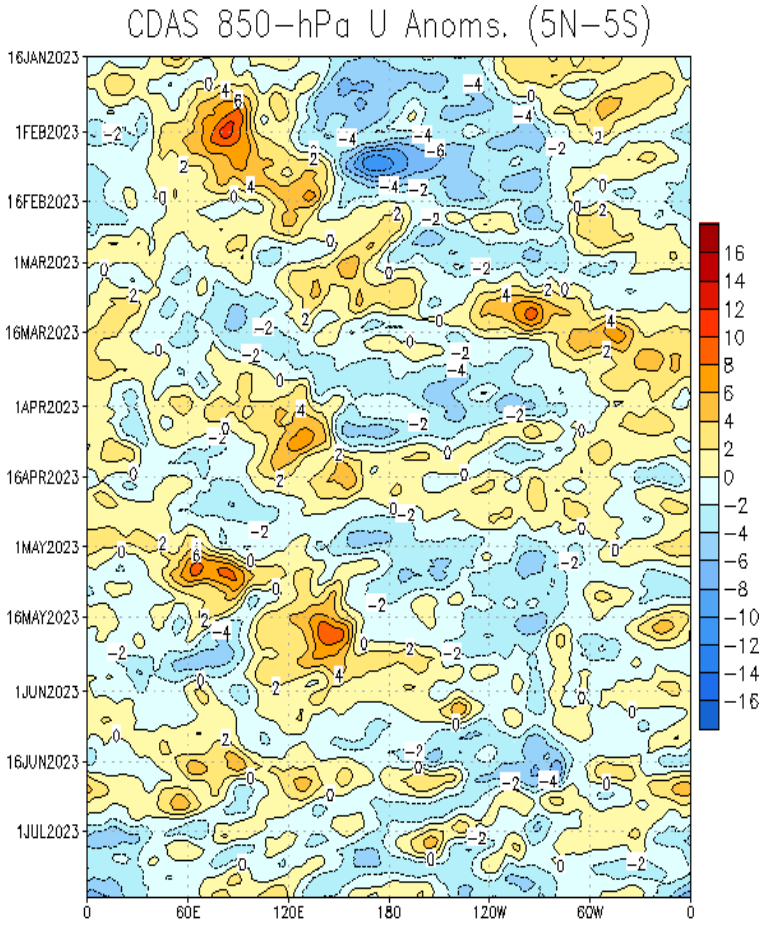


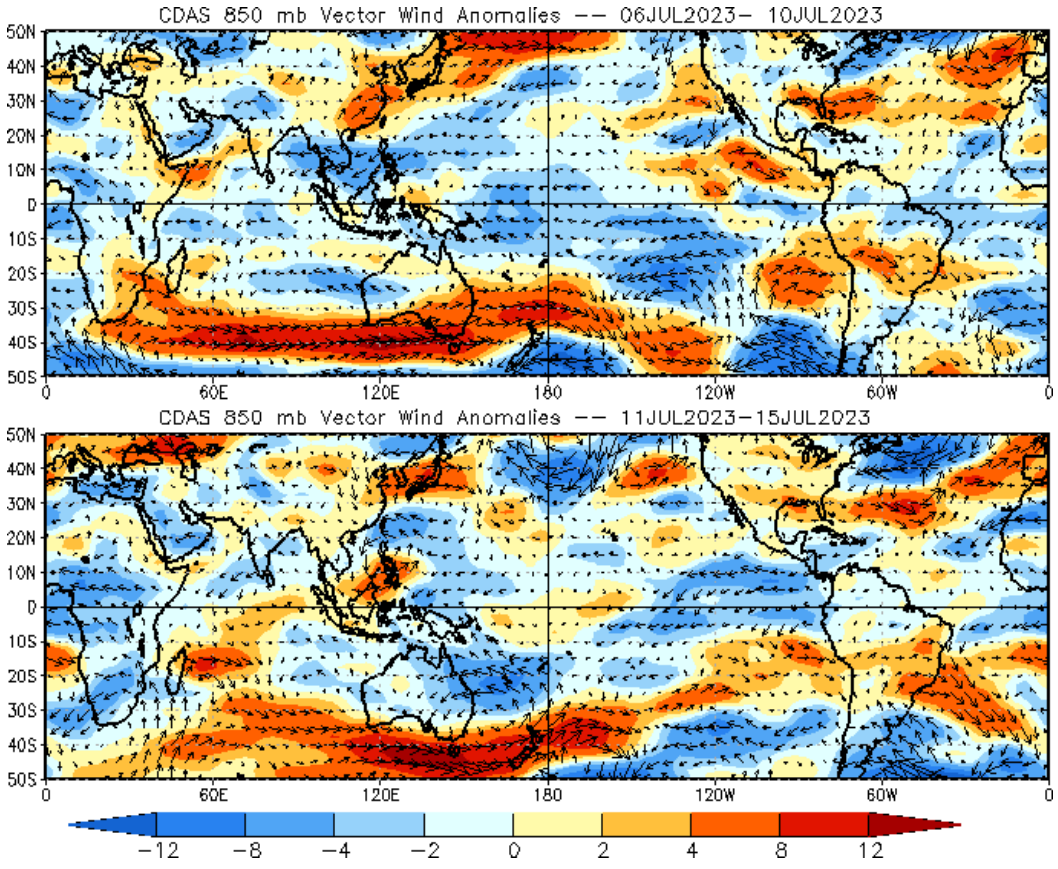


- Anomalous upper-level westerlies emerged over the Eastern Pacific.
- Zonal wind anomalies are fairly muted elsewhere in the global tropics, with the exception of fairly persistent easterly anomalies in the western Indian Ocean, which have strengthened in the last week.
- An enhanced subtropical jet remains evident across the Pacific and western North America, where strong ridging remains over the southern tier of the CONUS.

850-hPa Wind Anomalies

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

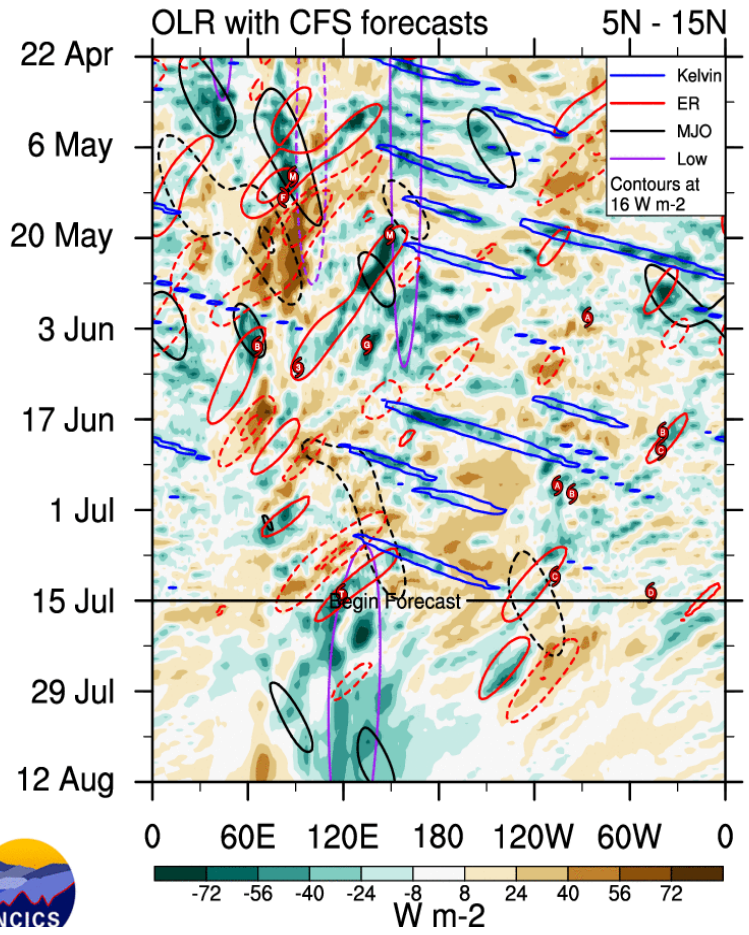


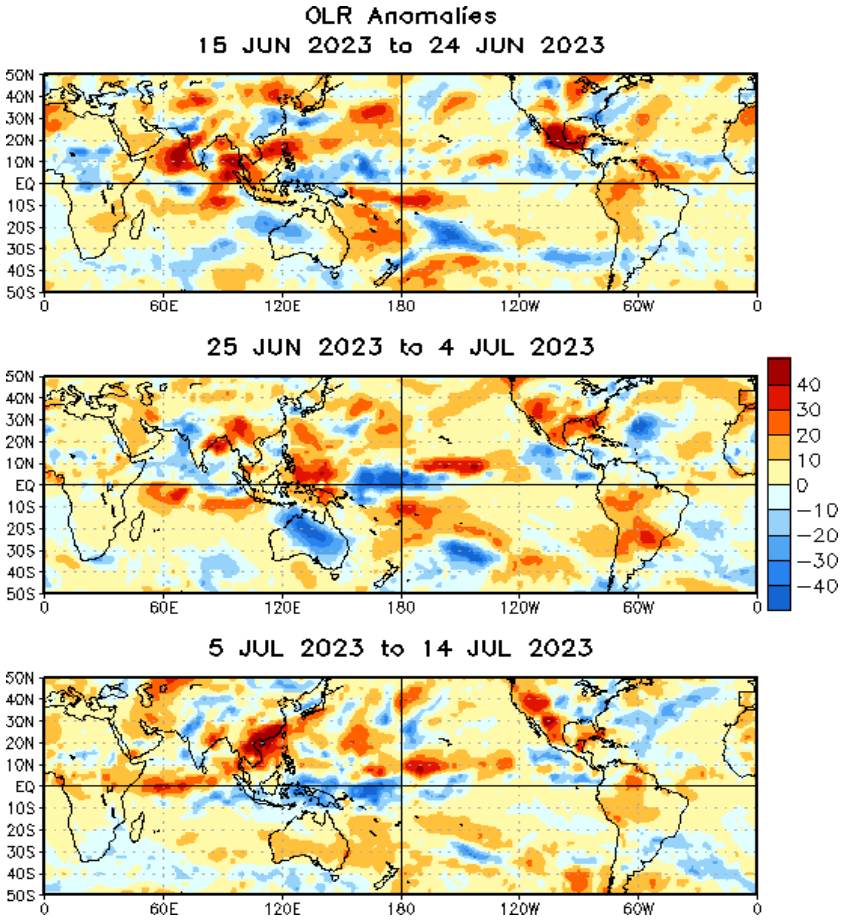


- Weak anomalous westerlies continued over the Indian Ocean and also emerged over the Maritime Continent.
- Enhanced trades over the tropical Pacific continued, although they have weakened substantially near the Date Line where anomalies are weakly westerly.
- Anomalous westerlies have subsided over eastern Pacific north of the equator.

Outgoing Longwave Radiation (OLR) Anomalies

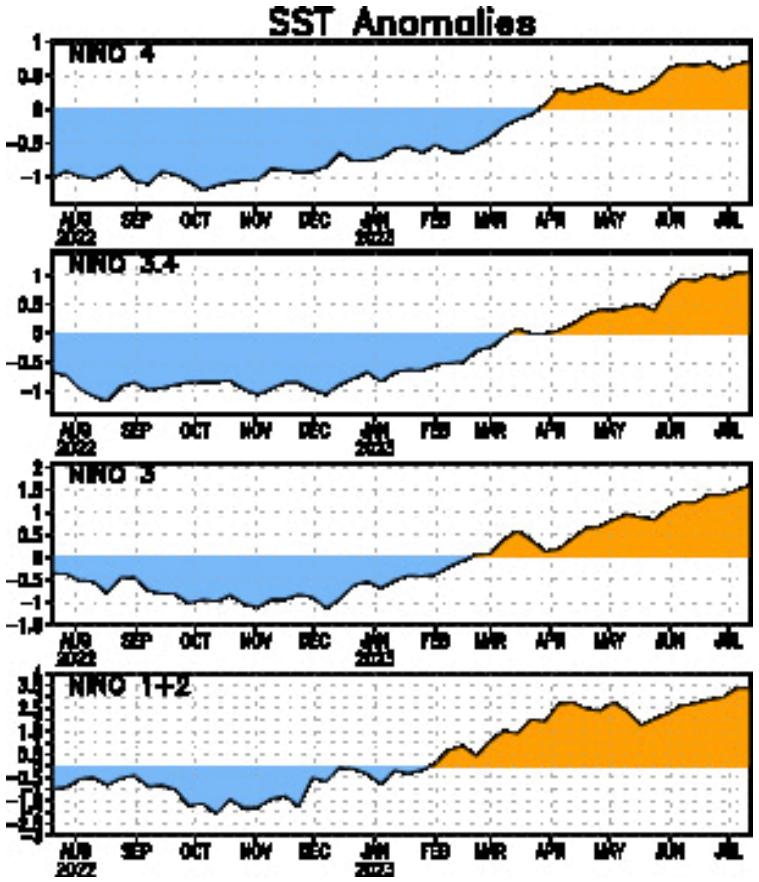
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

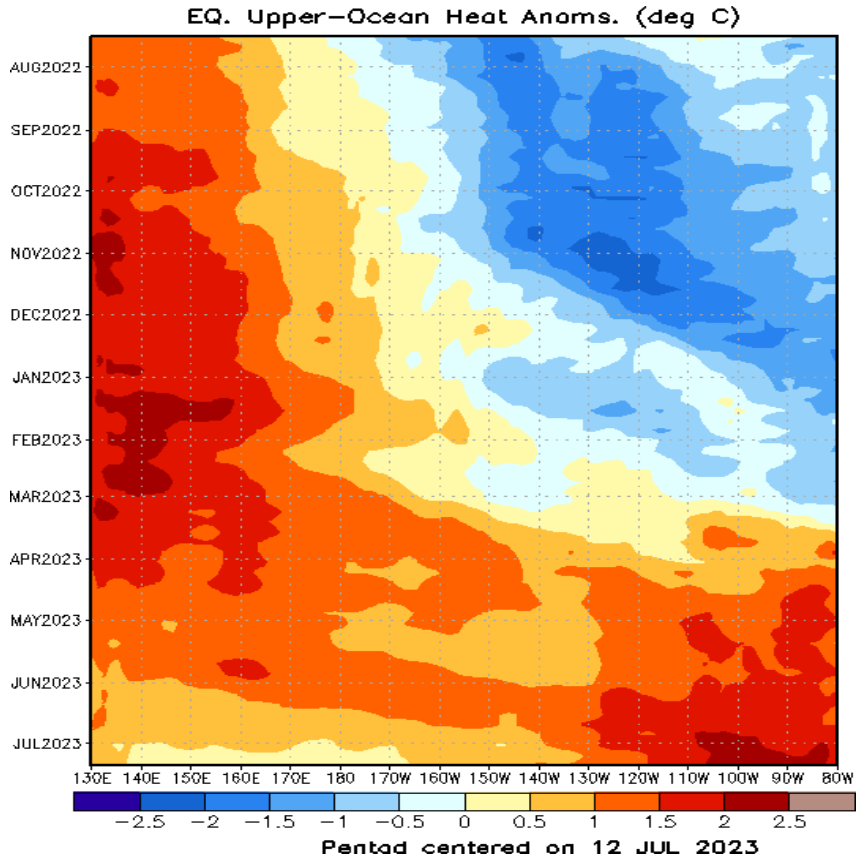




- Enhanced convection continues along and to the west of the Date Line, while suppressed convection over the Maritime Continent has shifted north and west into Southeast Asia.
- OLR forecasts favor a robust uptick in convection between 90E and 150E with MJO and Rossby wave activity coming through the filtering later in July and into August.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

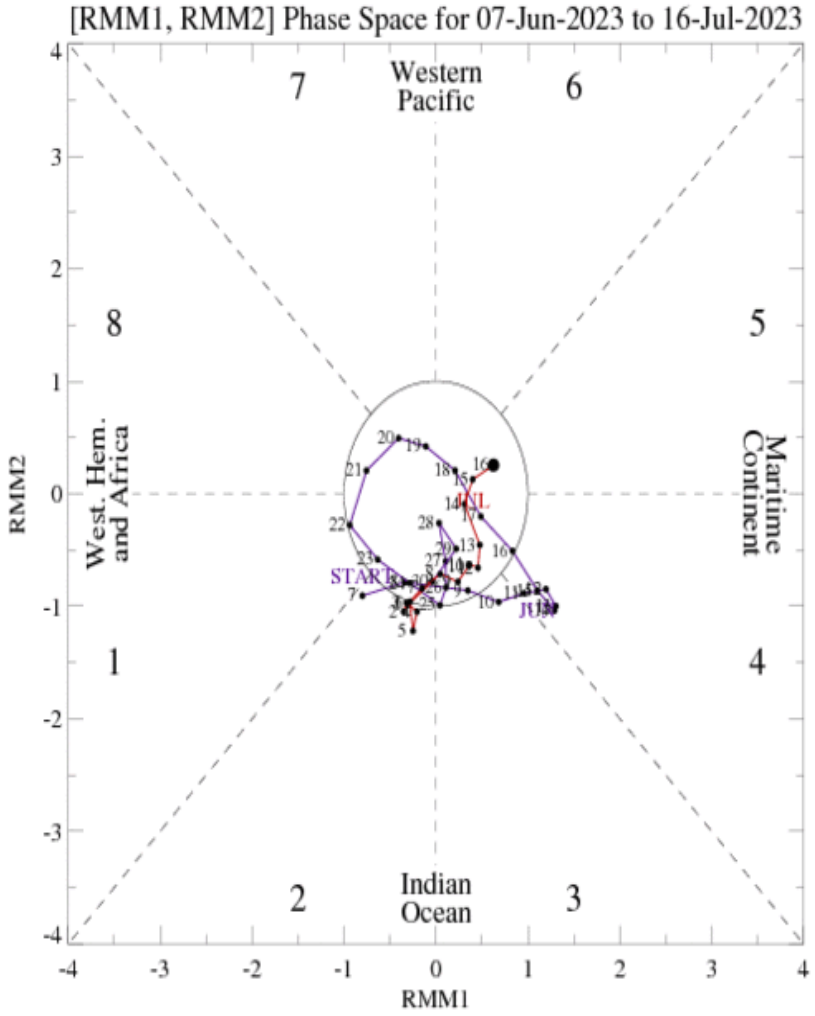




- El Niño conditions are now present across the equatorial Pacific as SST anomalies continue to climb throughout the Nino regions.
- Above-normal oceanic subsurface temperatures are present across the entire equatorial Pacific, with the largest positive anomalies (>2 degrees C) between 110W and 100W.
- Upper-ocean heat content anomalies in the Pacific Warm Pool continue to decline, approaching zero west of the Date Line.

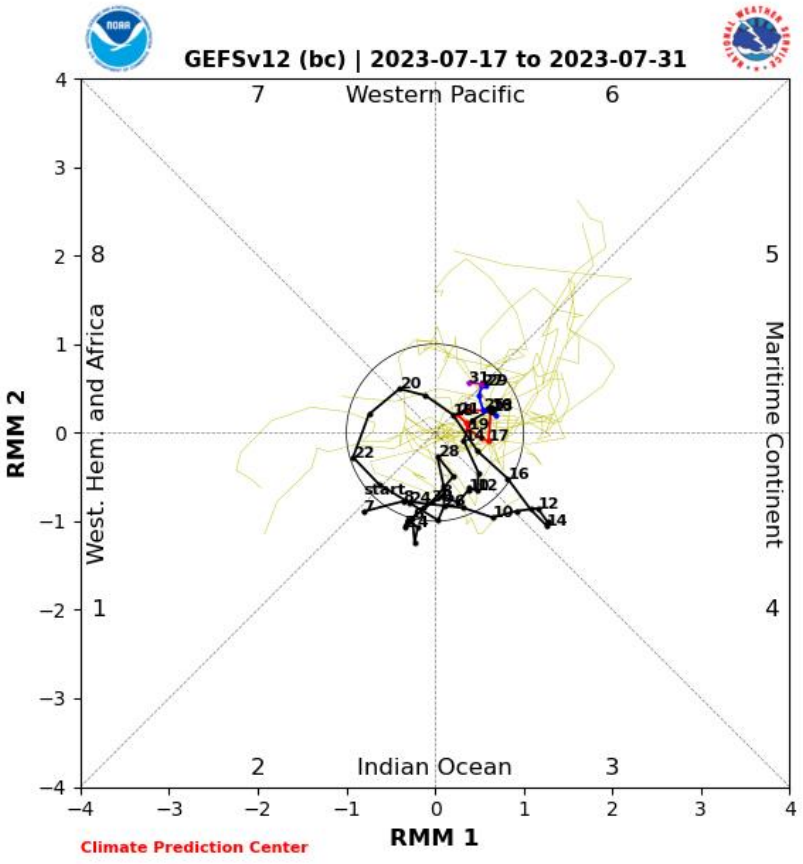
MJO Index: Recent Evolution

- The RMM index shows the MJO signal resuming eastward propagation but remaining weak, with the index still within the unit circle.

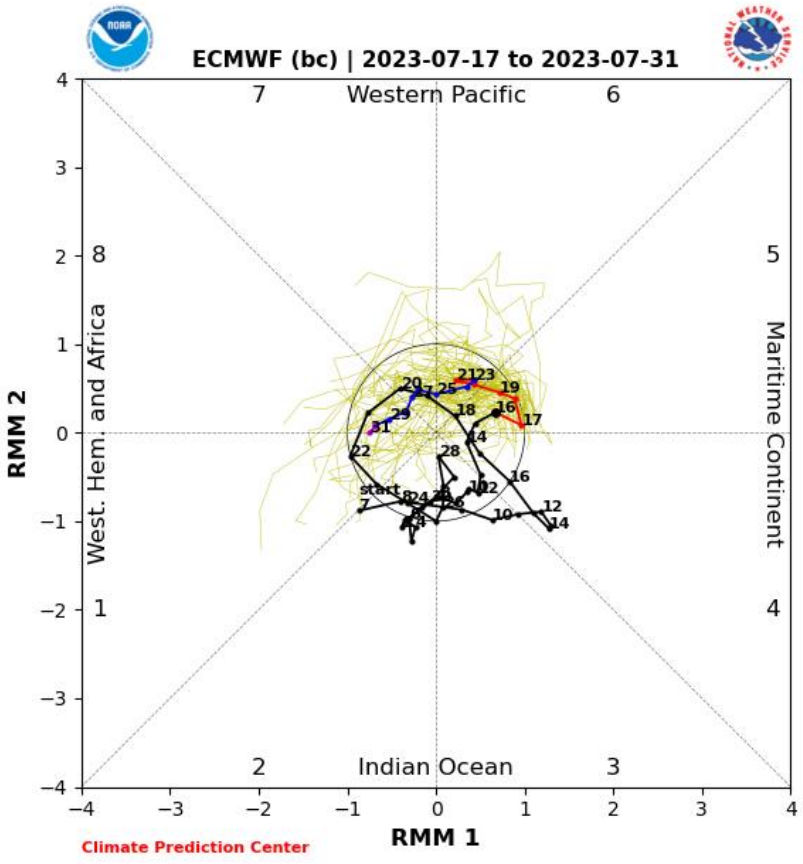


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

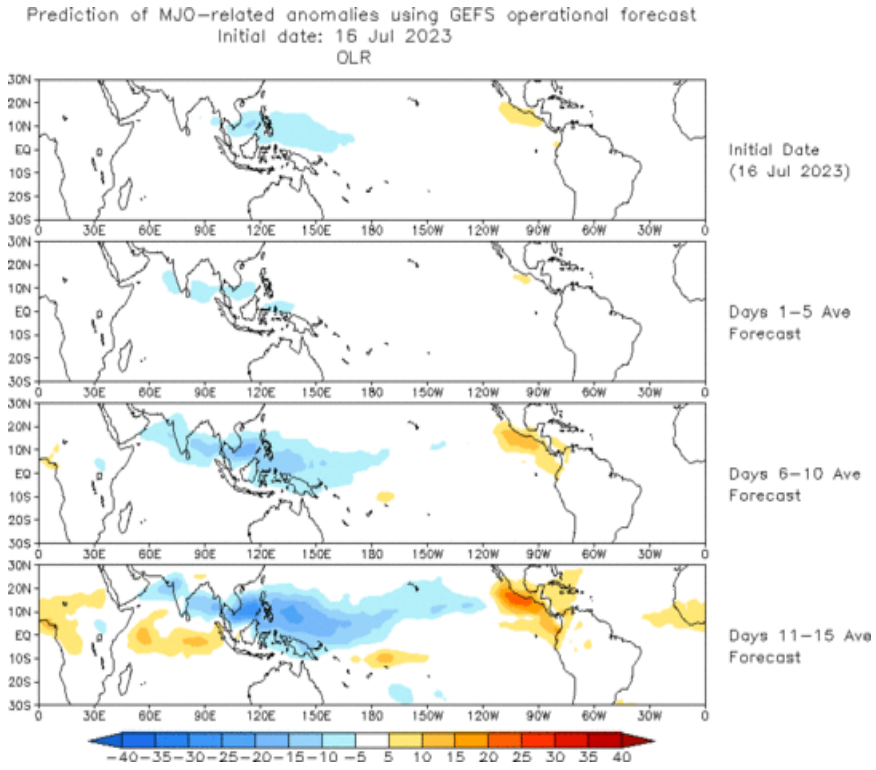


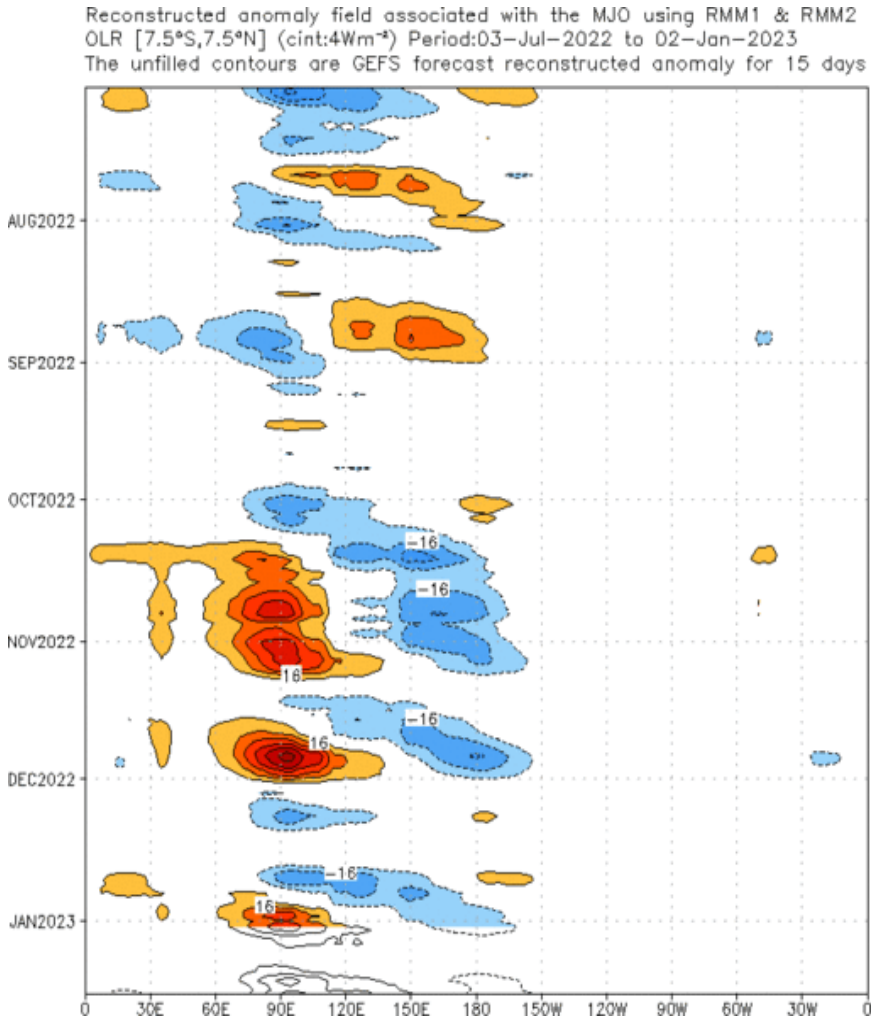
ECMWF Forecast

- Dynamical guidance is mixed, with the GEFS depicting little movement of the RMM index, while the ECMWF favors continued MJO propagation, although with a continued weak signal. Other models are similarly mixed.
- In extended runs, GEFS solutions show a resumption of MJO propagation and an increase insignal strength as well in the week-3 timeframe and beyond, with some ensemble members indicating a strong MJO event in early 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.)

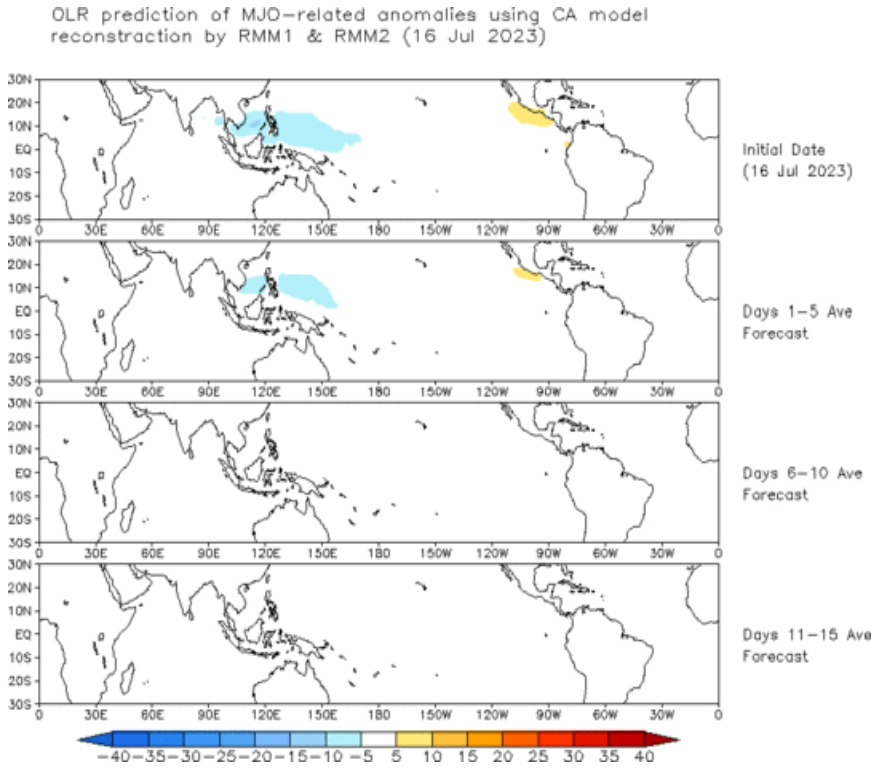


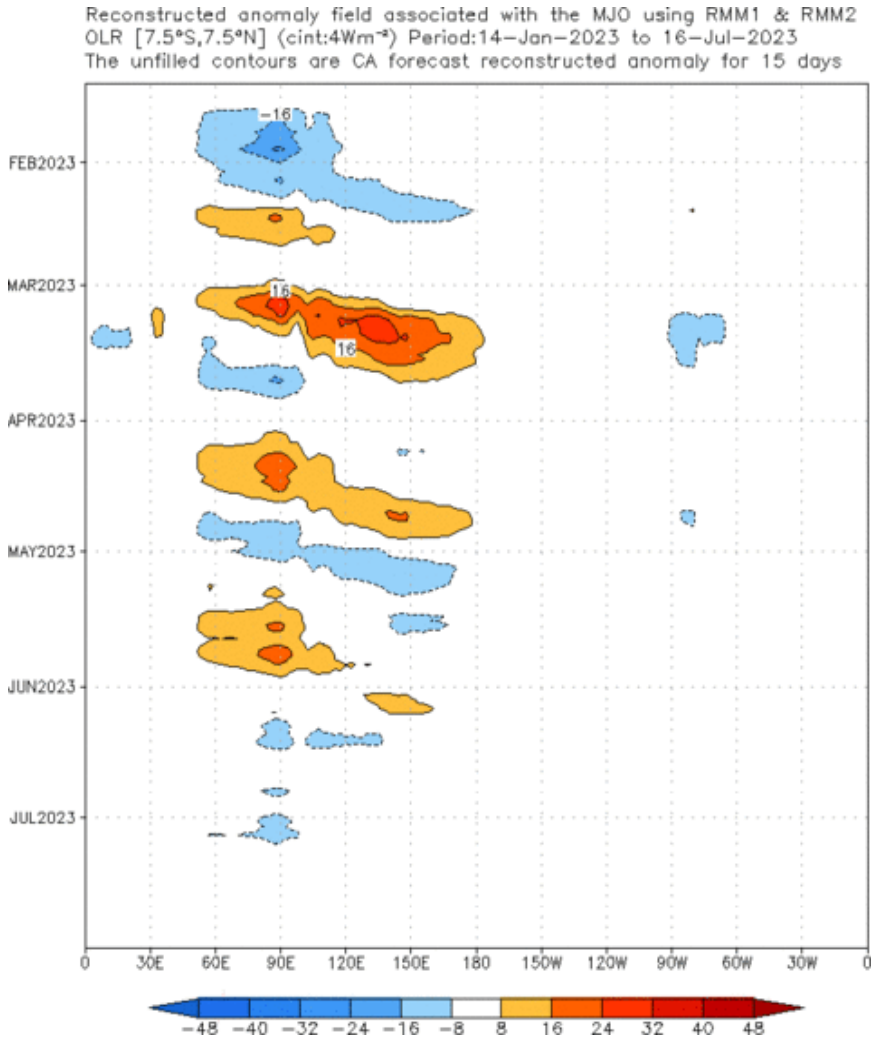


- The GEFS RMM-based OLR forecast shows enhanced convection emerging and shifting eastward across the Maritime Continent and West Pacific, with suppressed convection emerging over the East Pacific during the next two weeks.

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.)

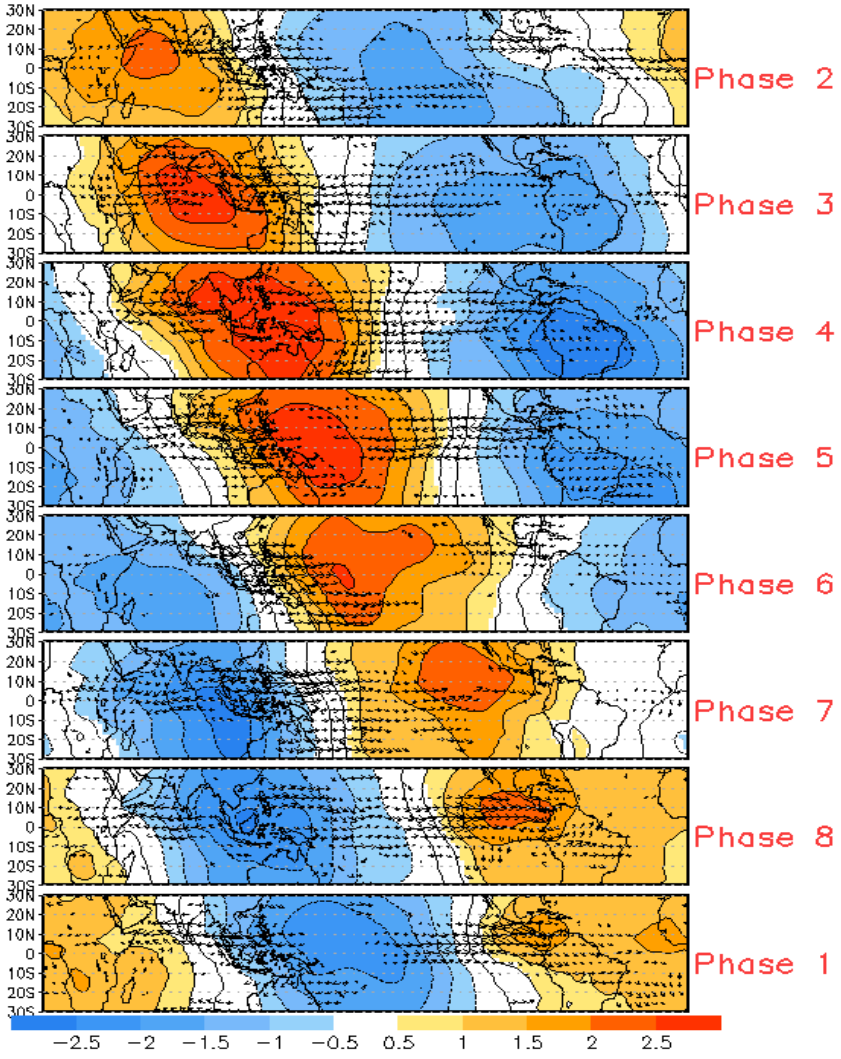




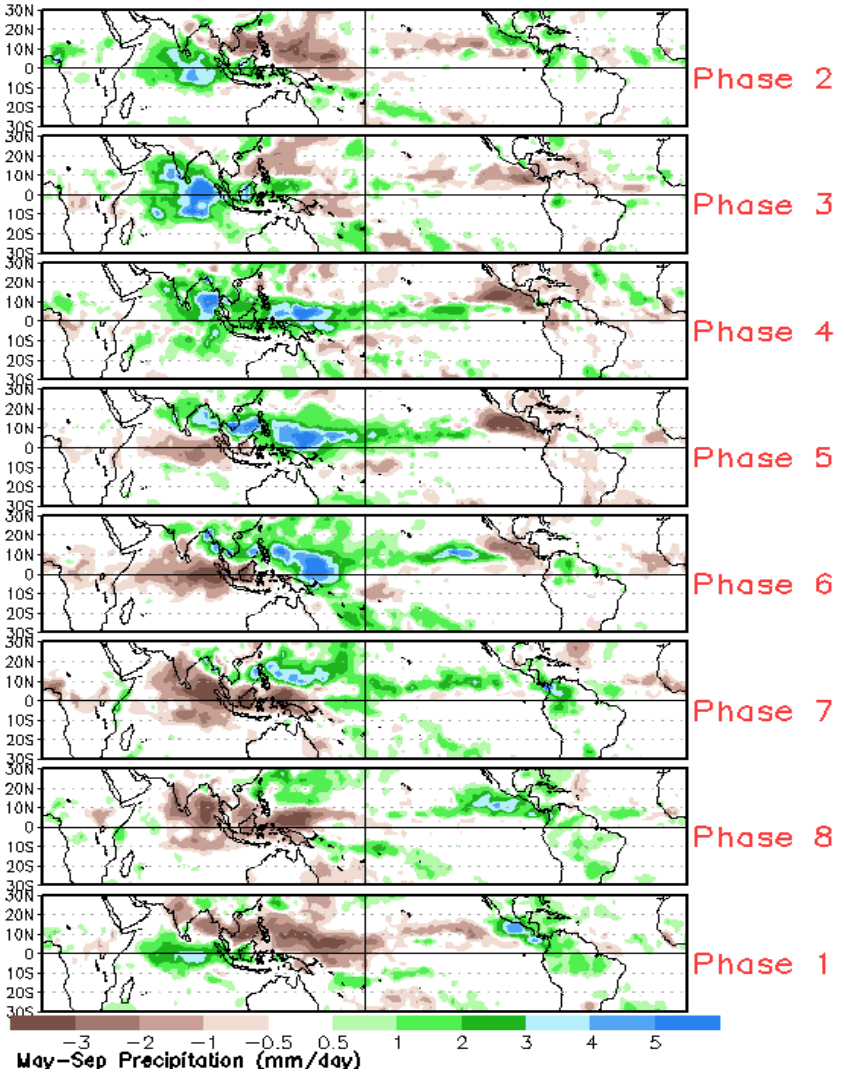
- The constructed analog RMM-based forecast is considerably more muted than the GEFS, with almost no convective anomalies during the next two weeks.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



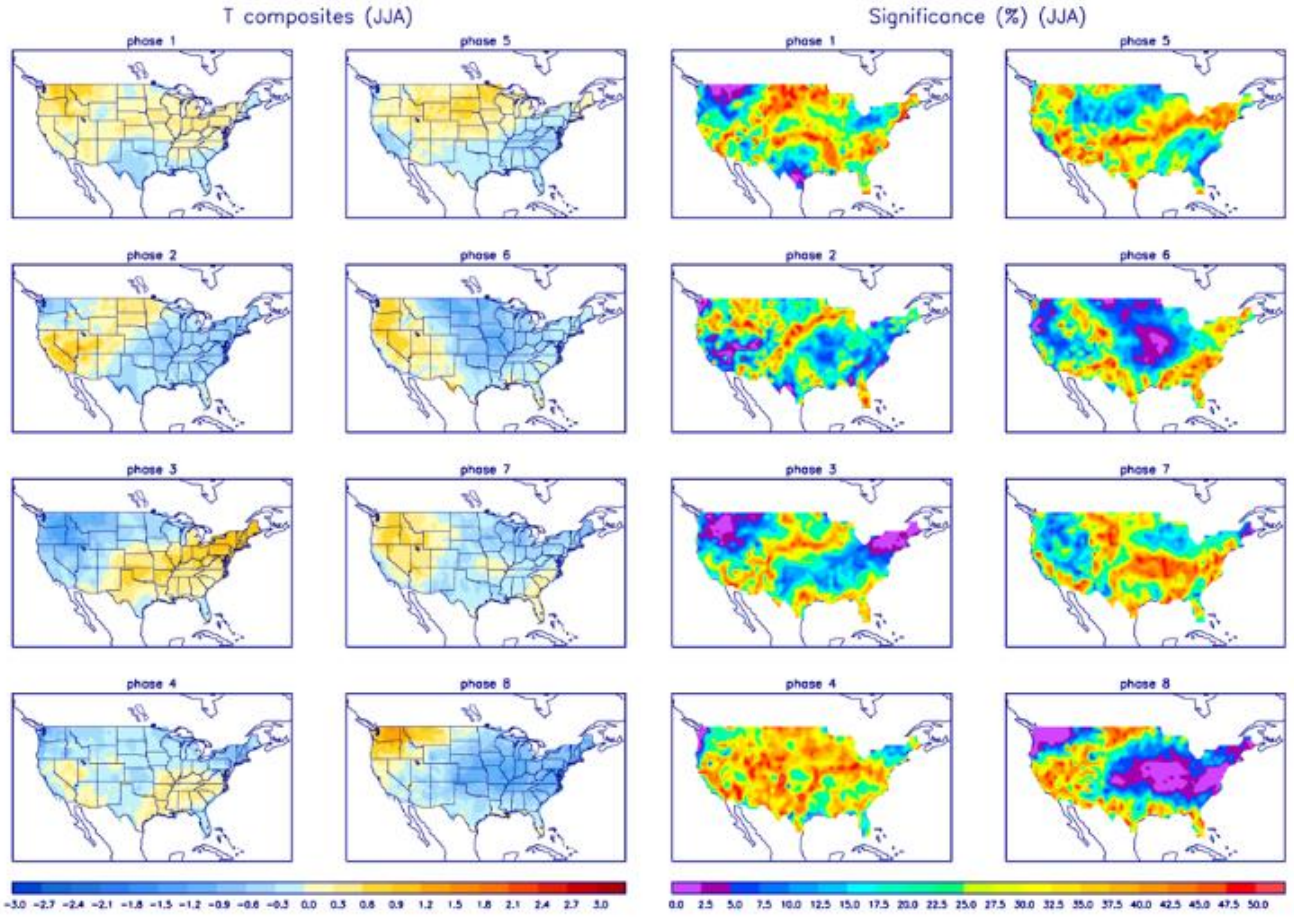
Precipitation Anomalies



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.

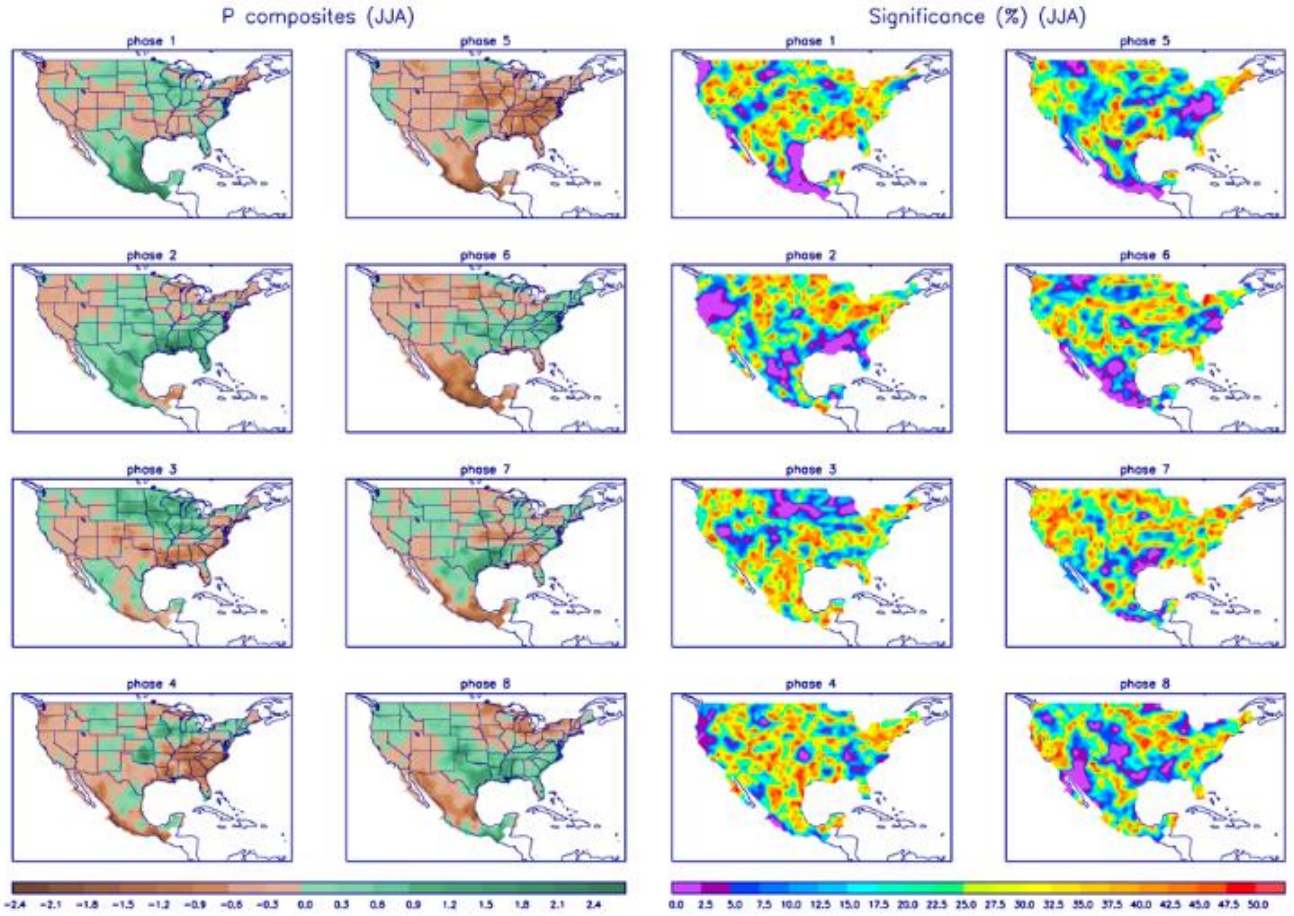


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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