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

Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
29 May 2023

Overview

- The MJO remains active, with recent observations showing the enhanced convective phase now over the Western Hemisphere.

- The MJO signal has become more coherent over the past week after destructive interference and an apparent reduction in phase speed due to interactions with the strong Typhoon Mawar.

- Dynamical model MJO index forecasts are mixed, with models generally agreeing on continued propagation of MJO signal while disagreeing on the amplitude.

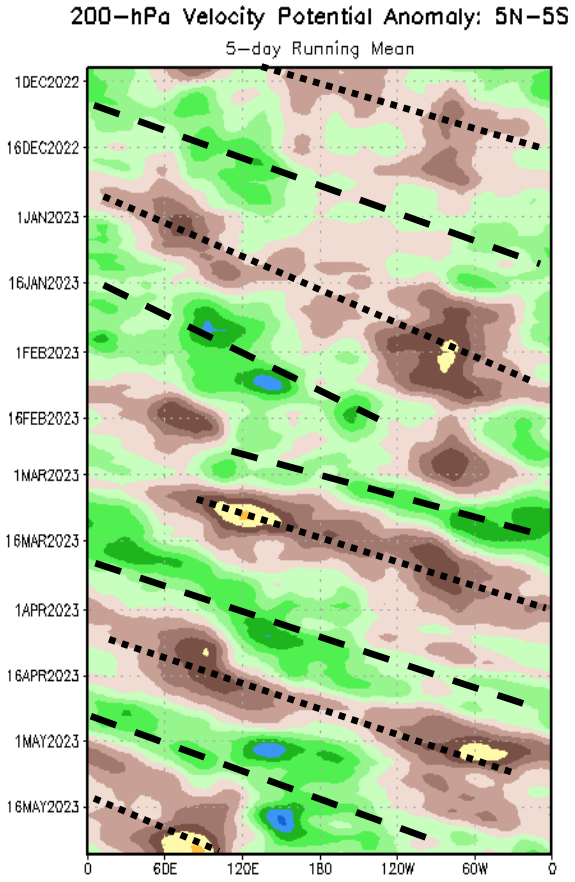
- The MJO may provide an opportunity for early season tropical cyclone formation across the East Pacific basin.

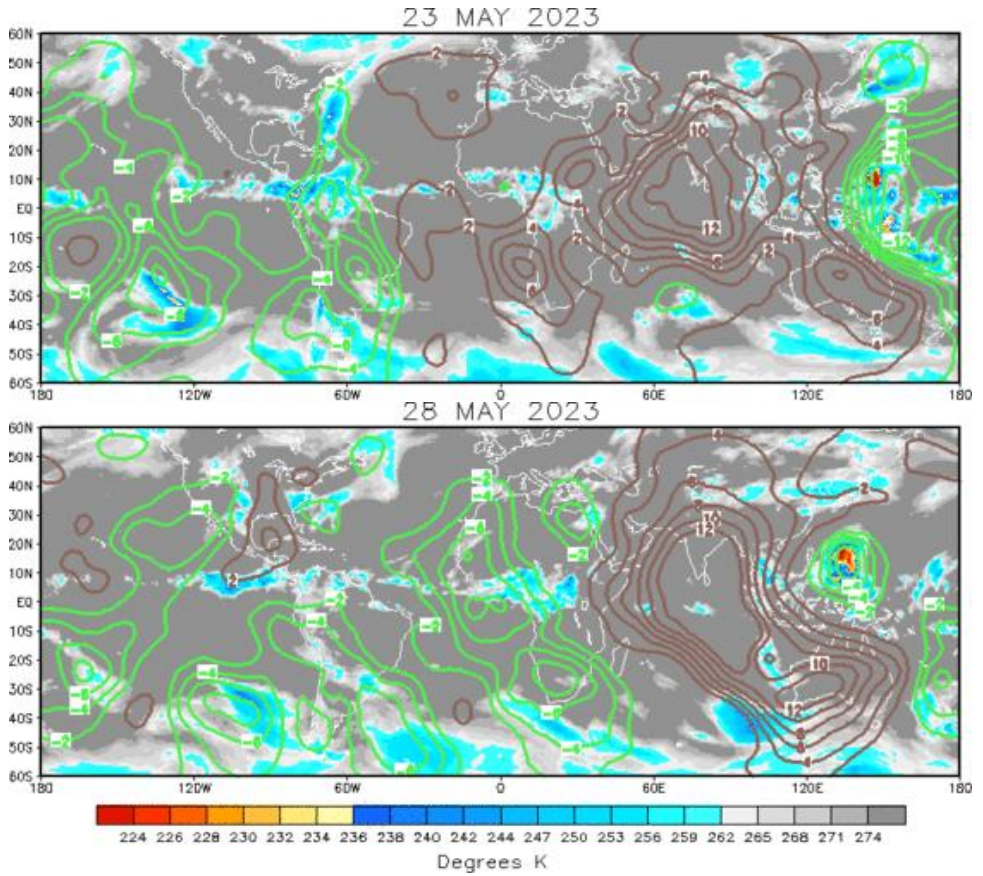
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)



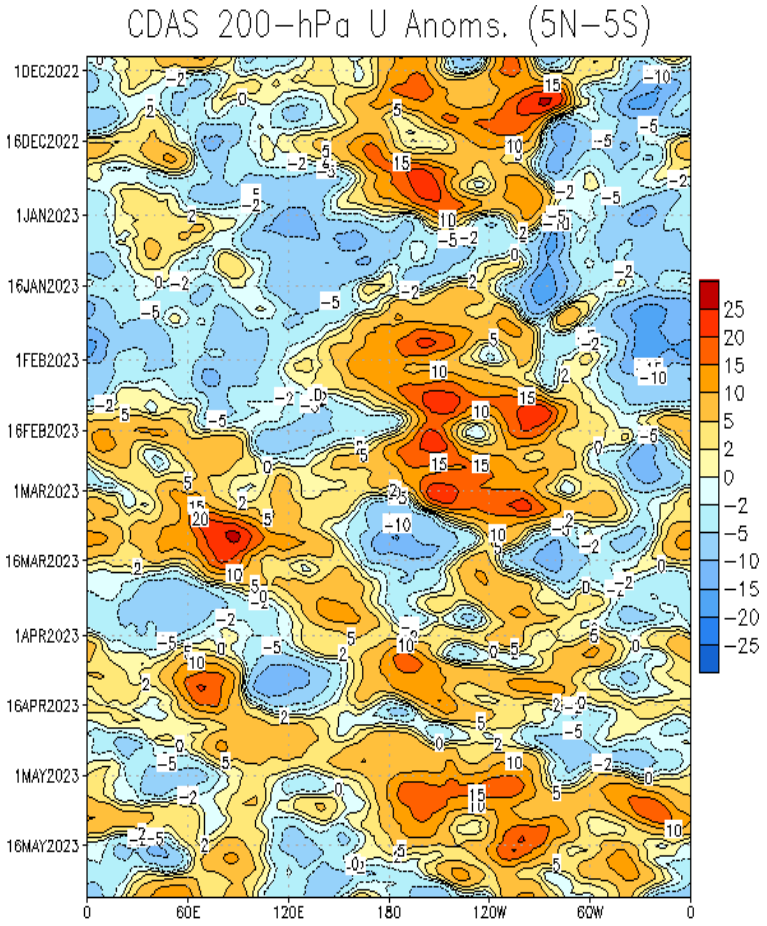


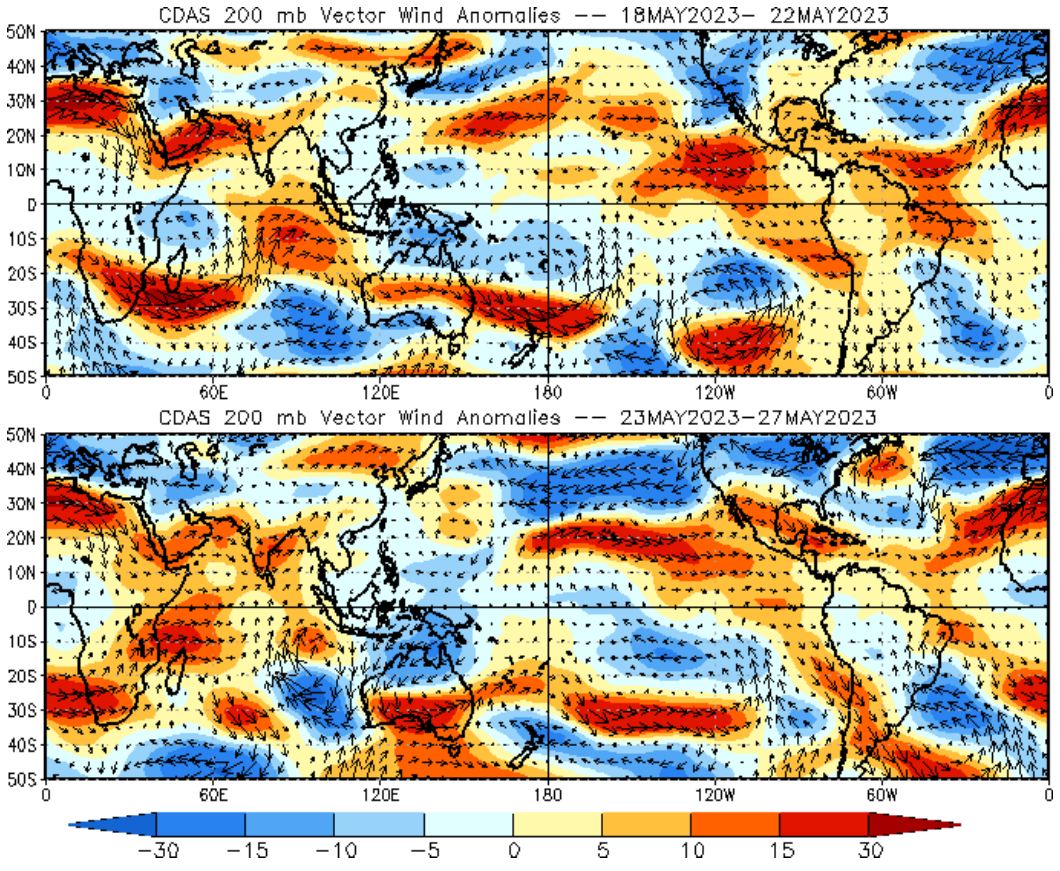
- Robust MJO activity has been observed over the past several months. The enhanced convective phase of the intraseasonal signal is currently over the Western Hemisphere.

- Intense and large scale circulation associated with Typhoon Mawar is evident west of the Date Line and is interfering with suppressed phase of MJO, which is moving into the Maritime Continent.

200-hPa Wind Anomalies

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

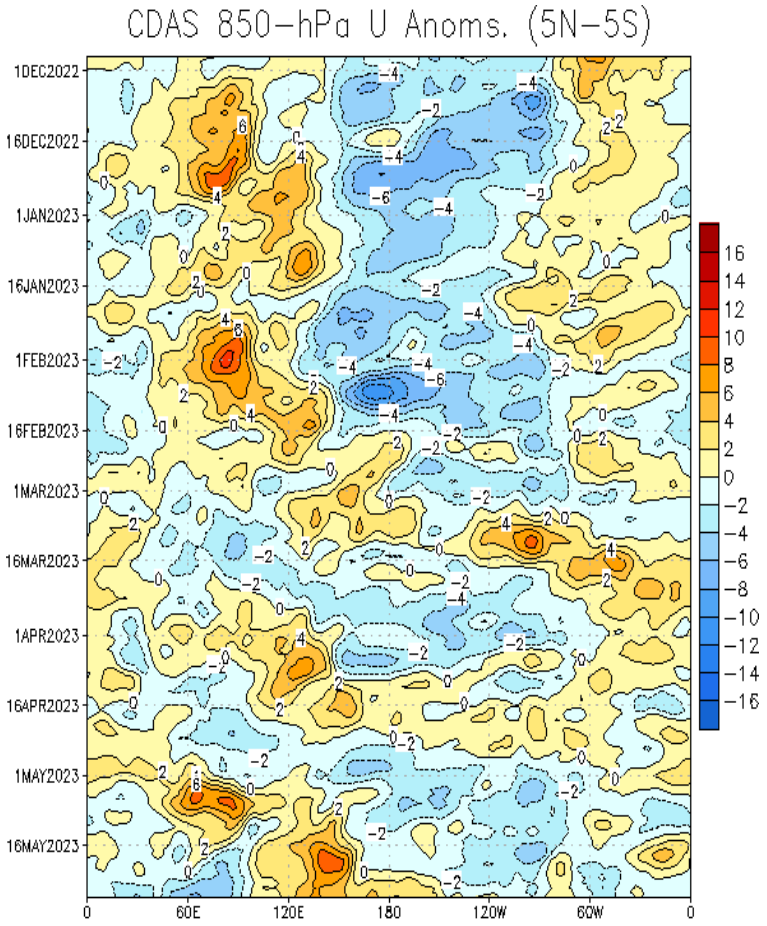


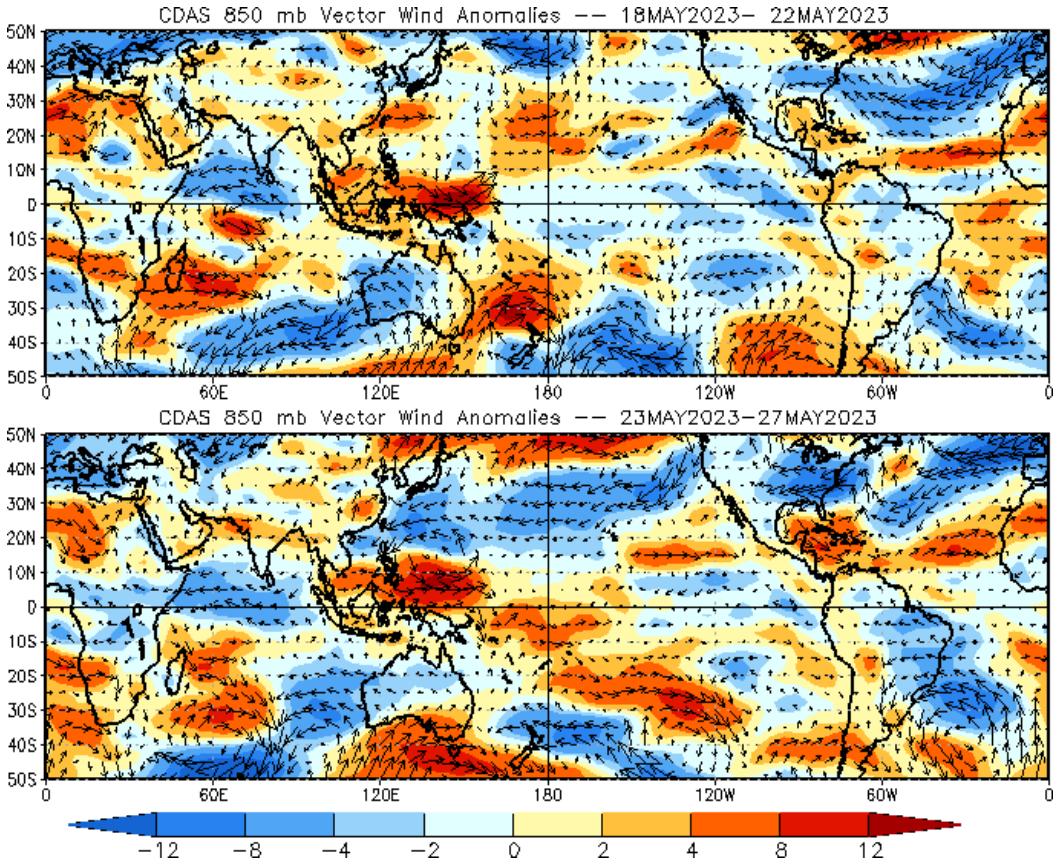


- Although MJO activity is still discernable in the upper-level zonal wind field, with easterlies (westerlies) over the Western Pacific (Western Hemisphere), the pattern has become increasingly incoherent.
- Anomalous westerlies have increased in areal coverage over the Indian Ocean and eastern Equatorial Africa over the last week.

850-hPa Wind Anomalies

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

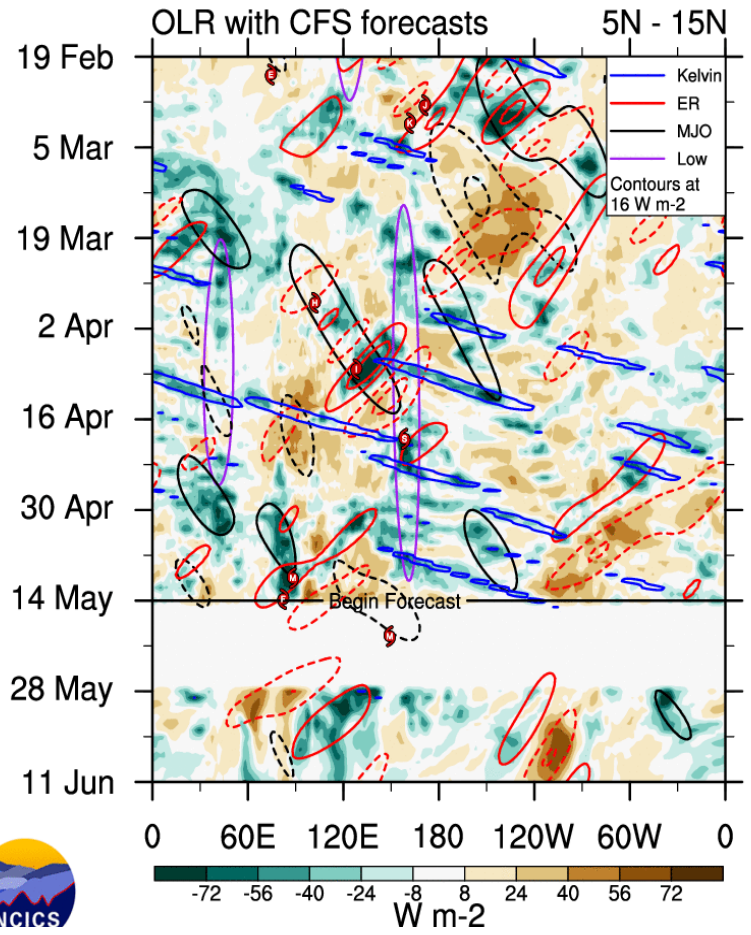


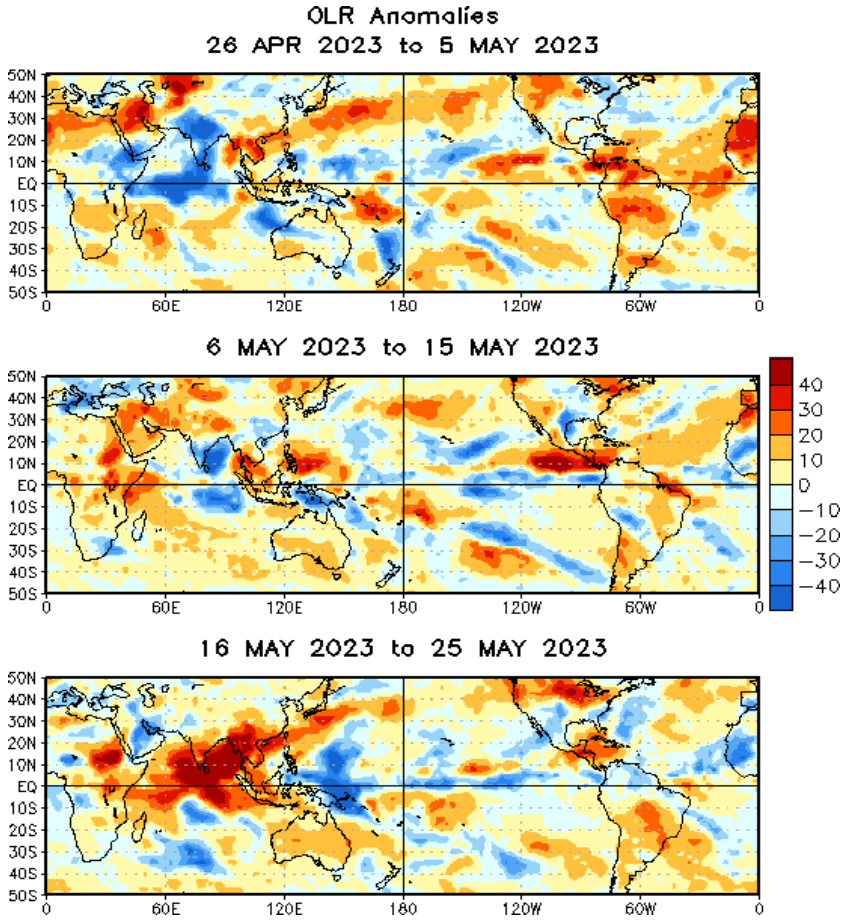


- MJO activity remains apparent in the low-level wind field, with westerly anomalies now spreading east of the Date Line and anomalous easterlies developing over the Indian Ocean.
- Strong cyclonic circulation over the Western Pacific associate with Typhoon Mawar is evident.

Outgoing Longwave Radiation (OLR) Anomalies

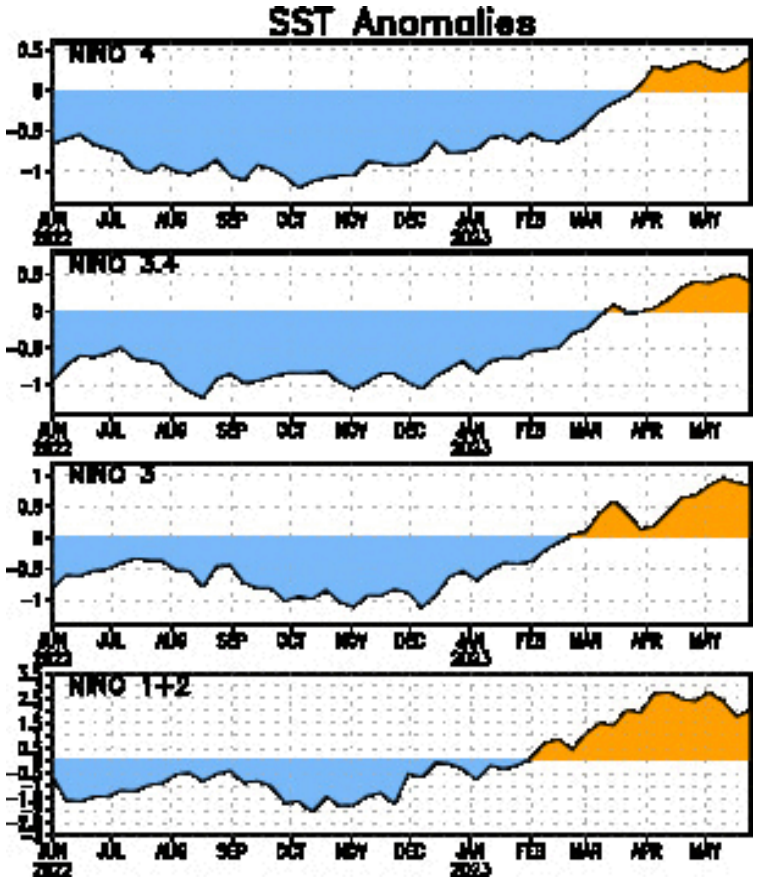
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

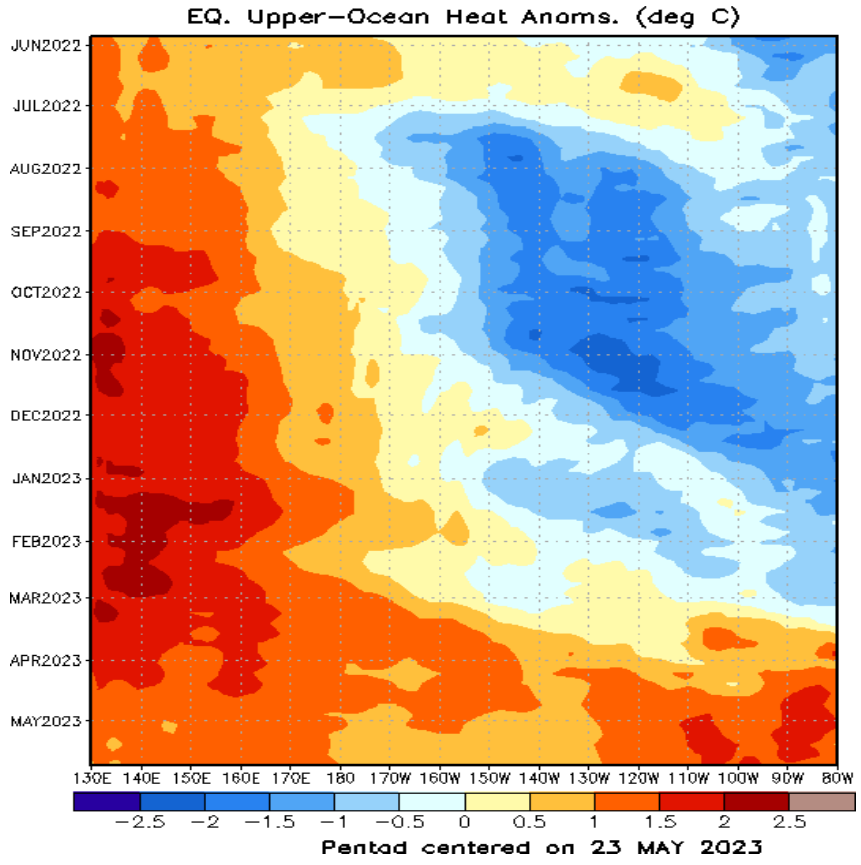




- OLR observations in the time-longitude plot since mid-May are erroneous.
- Very strong positive OLR anomalies have emerged over the Indian Ocean over the last week, while anomalies elsewhere over mostly quite small.
- CFS forecast indicates continued Rossby Wave activity near the Maritime Continent over the next few weeks.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

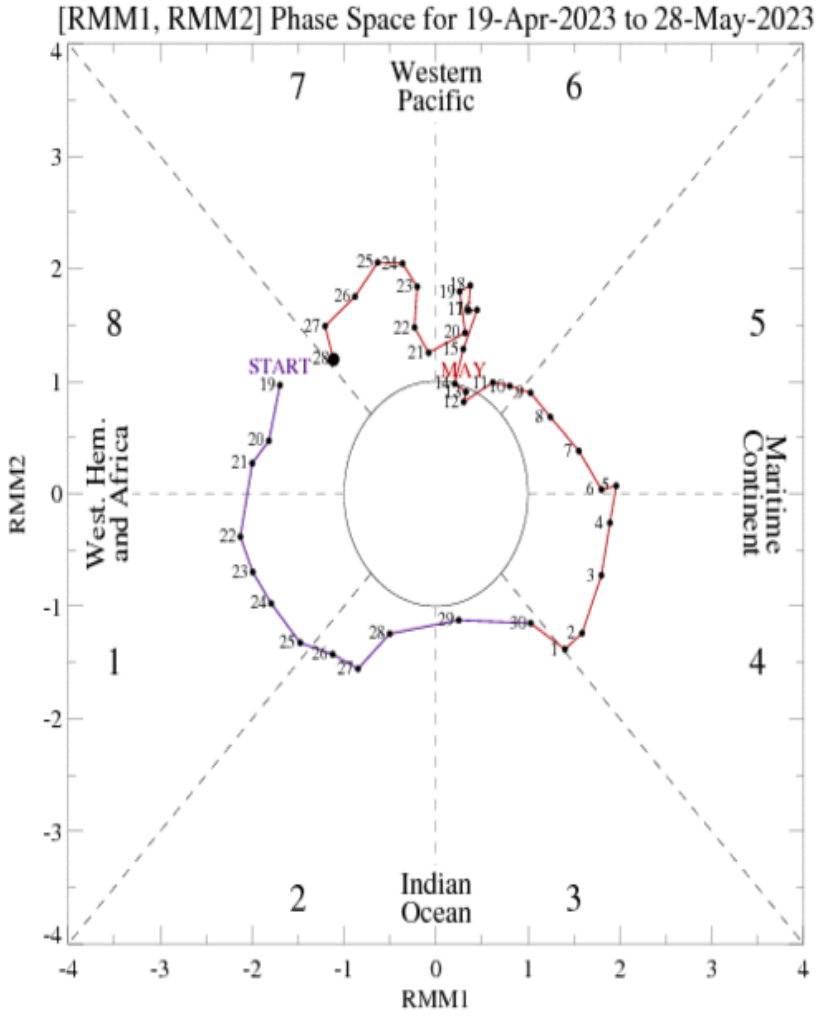




- Increasingly positive subsurface temperature anomalies engulf the entire Pacific, driven by multiple MJO events and subsequent oceanic downwelling Kelvin Waves beginning in March.
- SSTs in all of the Niño basins are now above normal, where the warmest anomalies remain over the eastern Pacific.

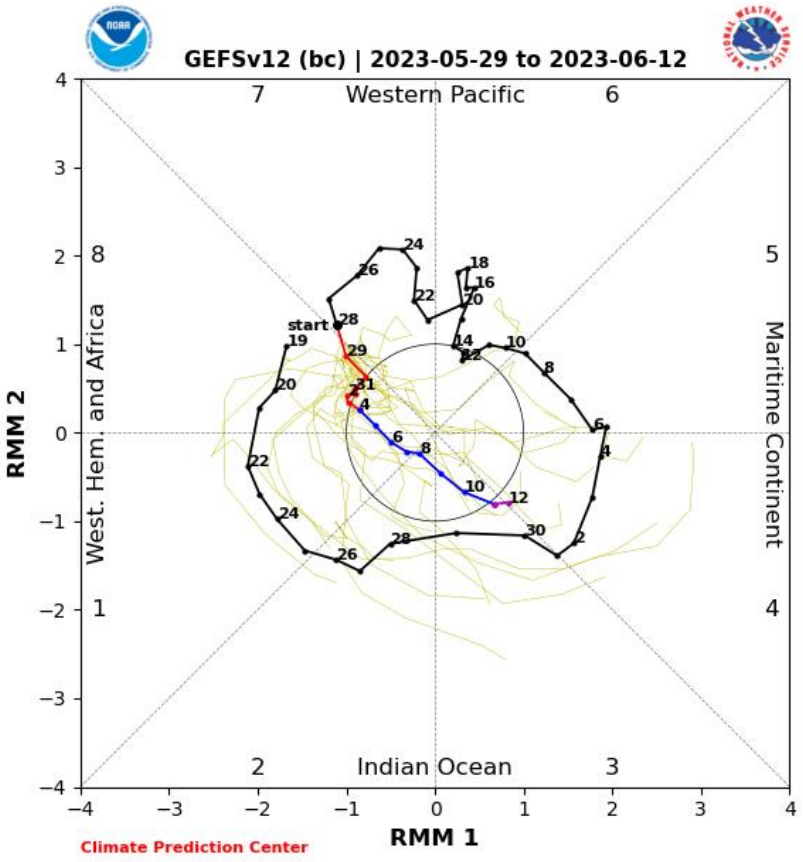
MJO Index: Recent Evolution

- After cleanly circumnavigating the globe since mid-April, the MJO signal stalled in the Western Pacific early in May before resuming eastward propagation.
- The intense Typhoon Mawar has at times benefitted from and also interfered with the MJO during its development and strengthening.
- More recently, RMM signal has re-emerged and is now moving into the Western Hemisphere.

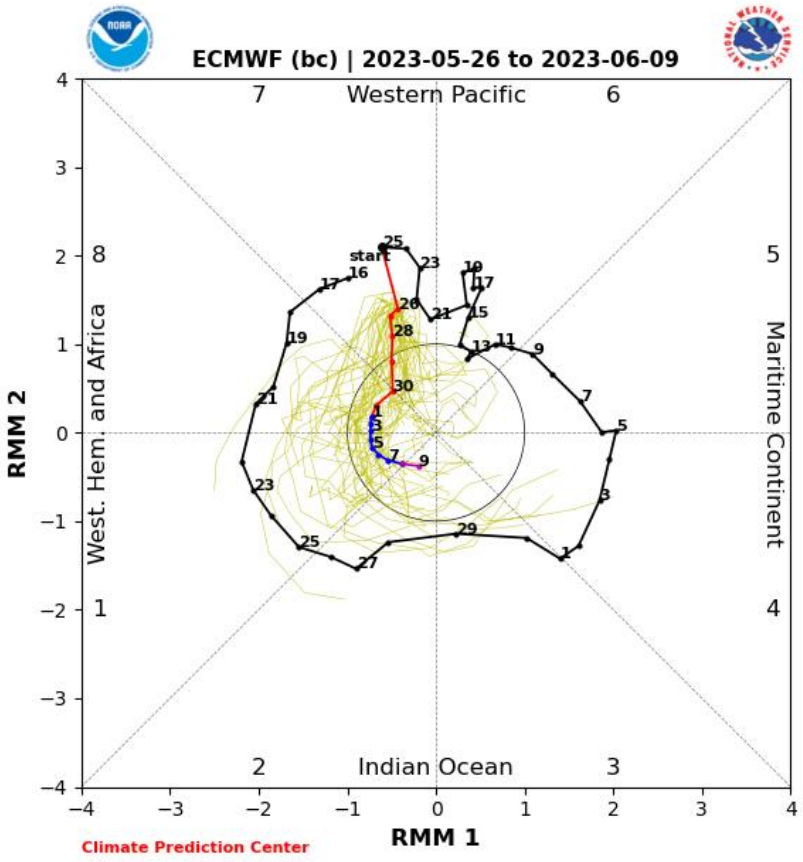


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

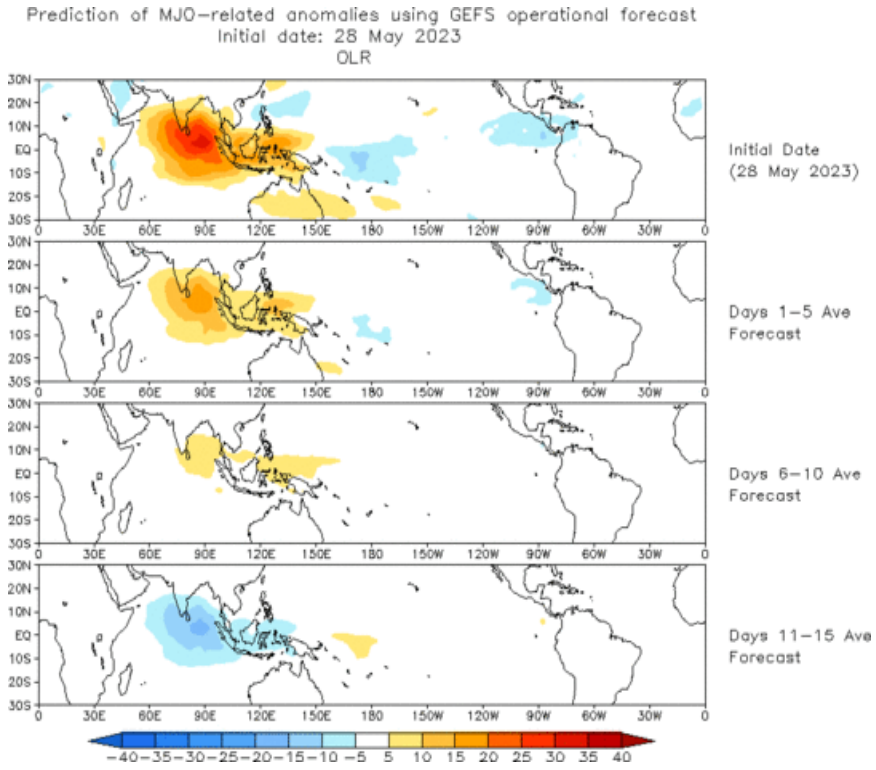


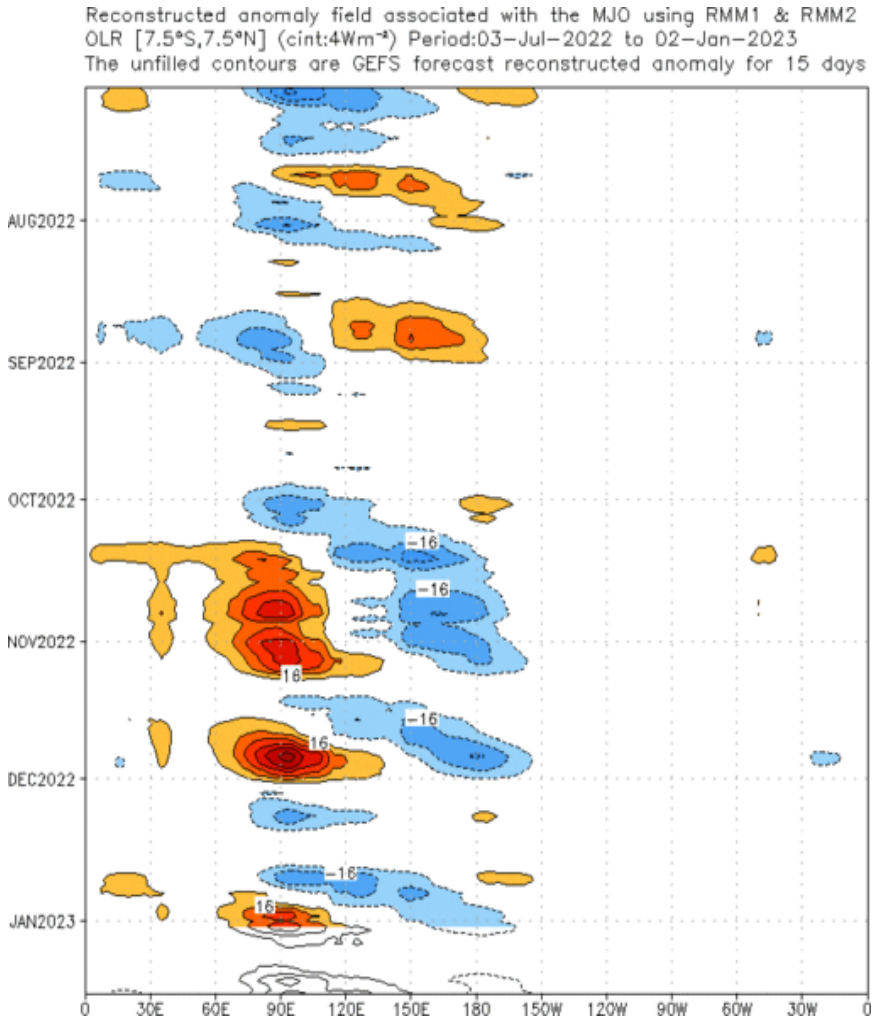
ECMWF Forecast

- Most dynamical models favor a continued eastward propagation of the MJO signal through the week-2 time period, although with a weakening amplitude over time. The BoM and JMA models maintain a stronger signal throughout the forecast period.
- Both the GEFS and Canadian have large ensemble spread while other models such as the ECMWF and BoM have smaller spread.

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.)

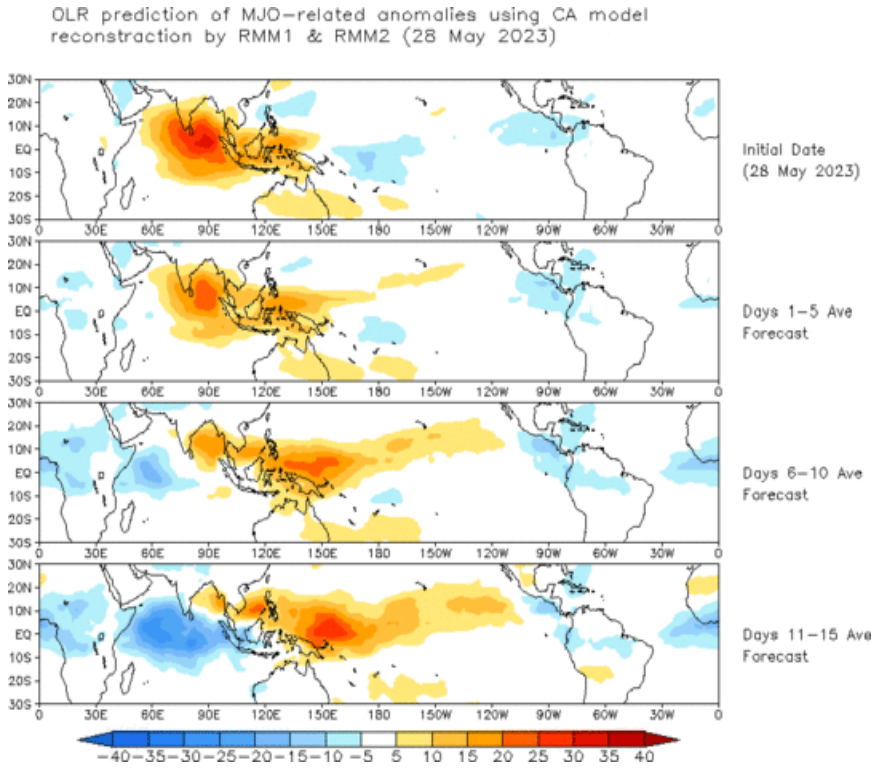


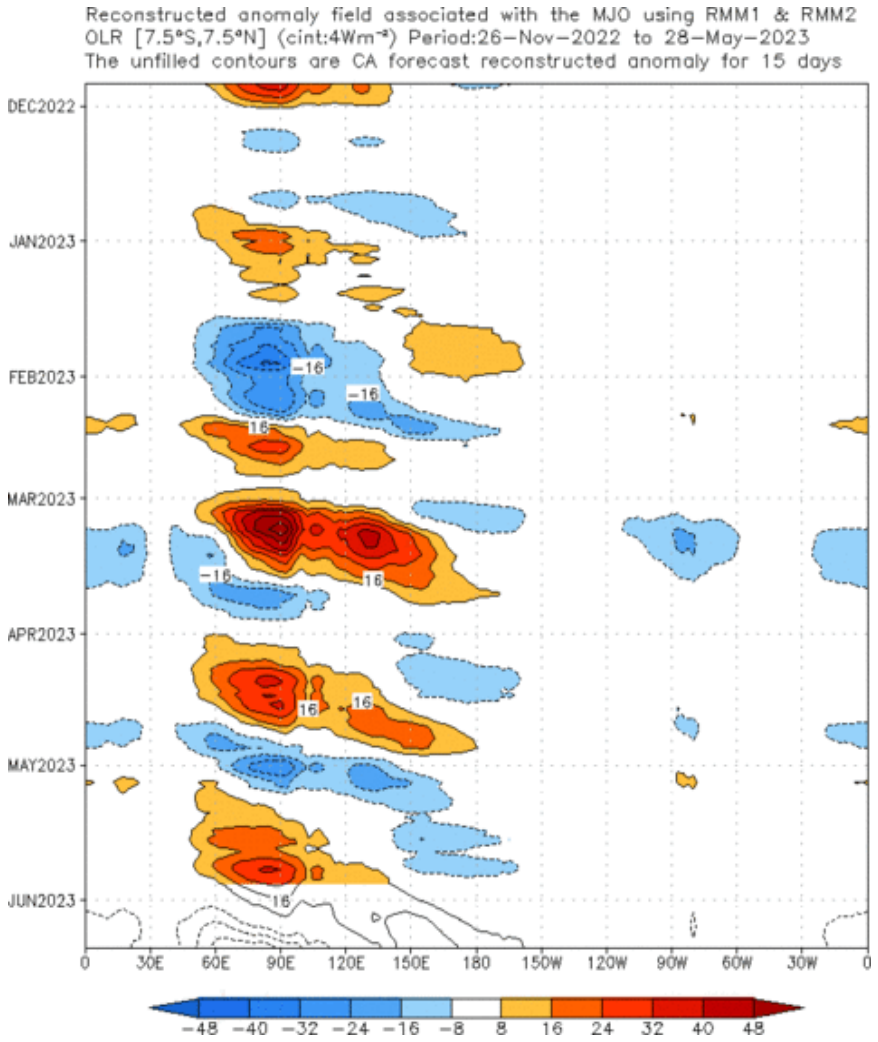


- Similar to last week, the GEFS RMM-based forecast depicts a nearly stationary OLR anomaly pattern, that decreases in magnitude and reverses in polarity later in week-2.

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.)

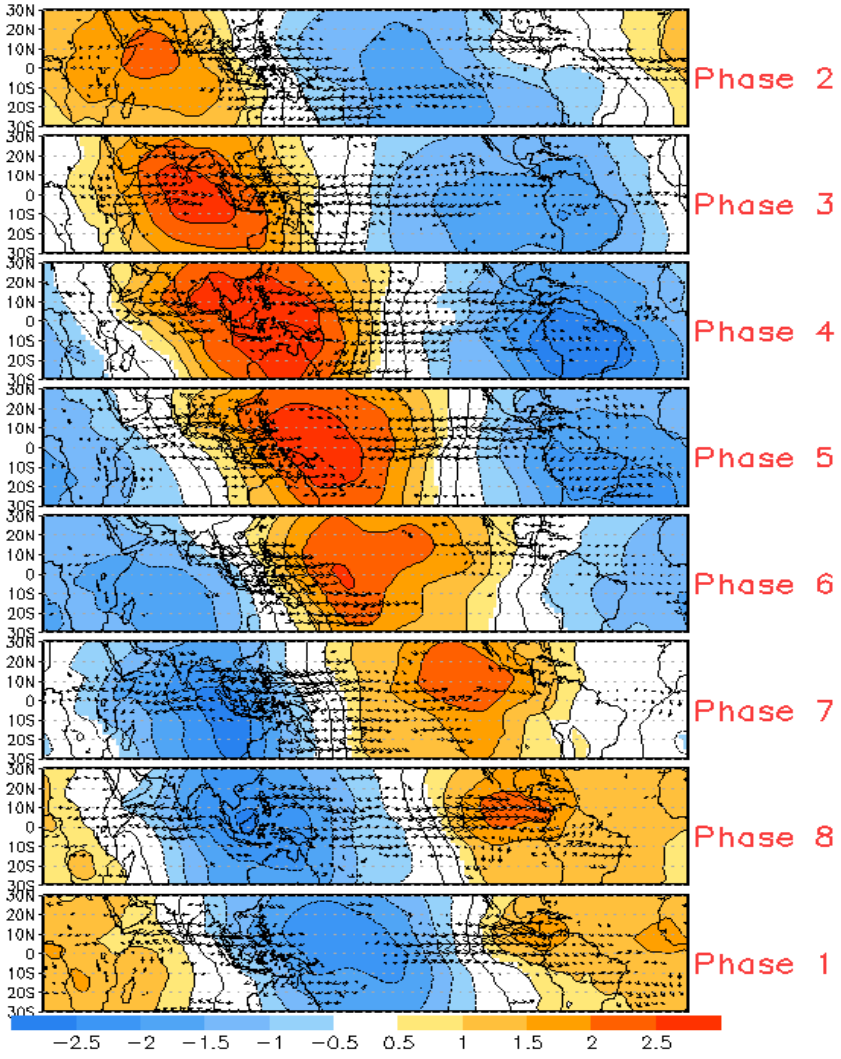




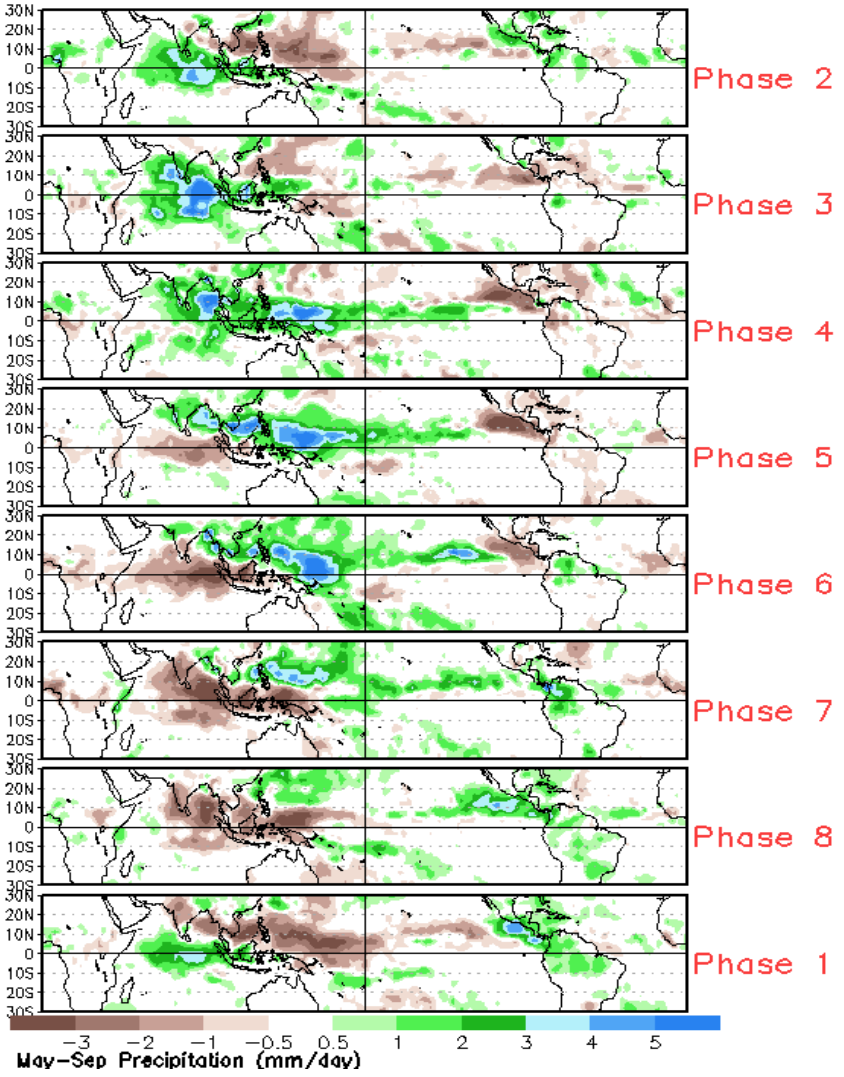
- The constructed analog RMM-based forecast depicts a more progressive and robust MJO signal emerging over Africa and moving into the Indian Ocean during week-2.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



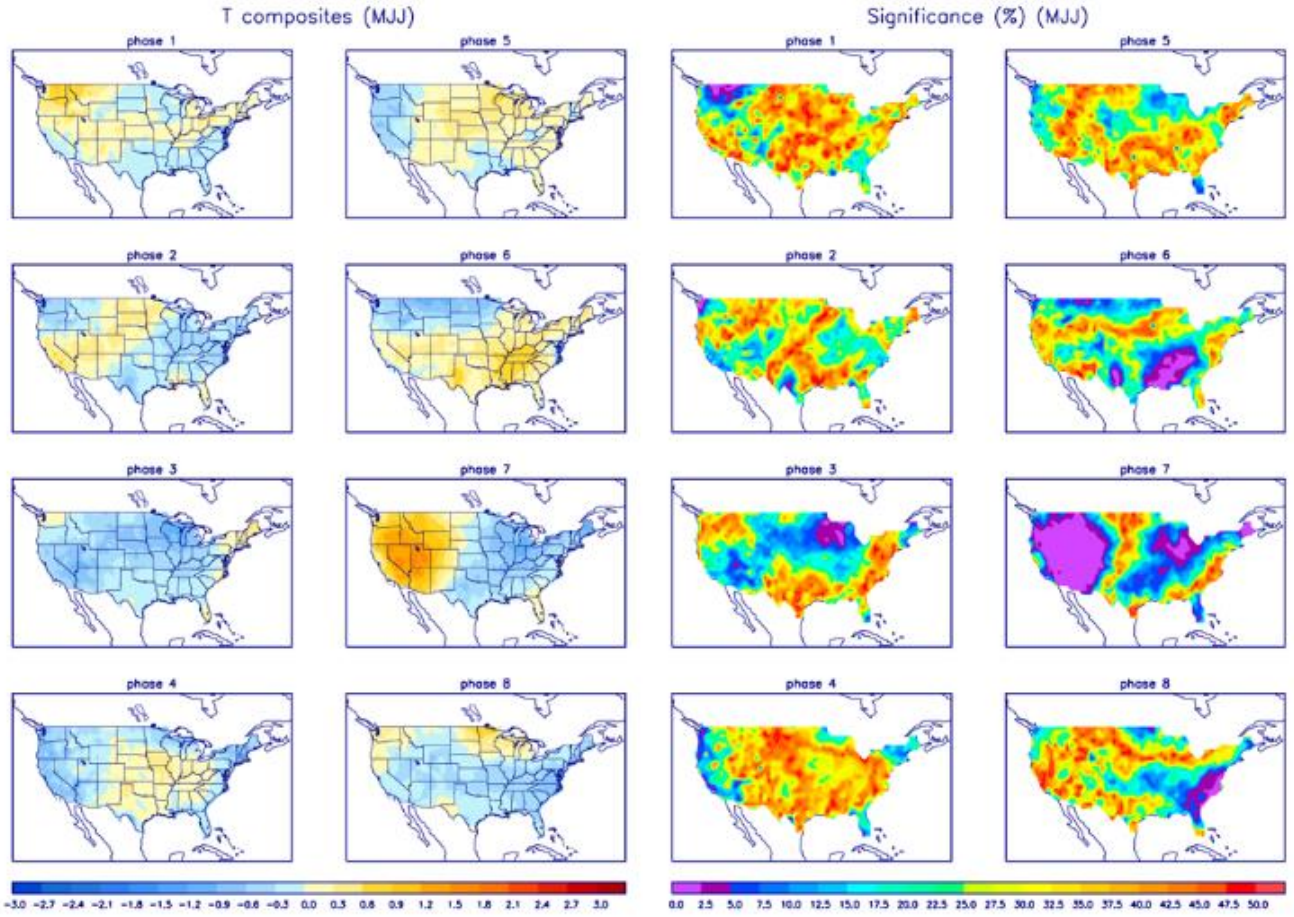
Precipitation Anomalies



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.

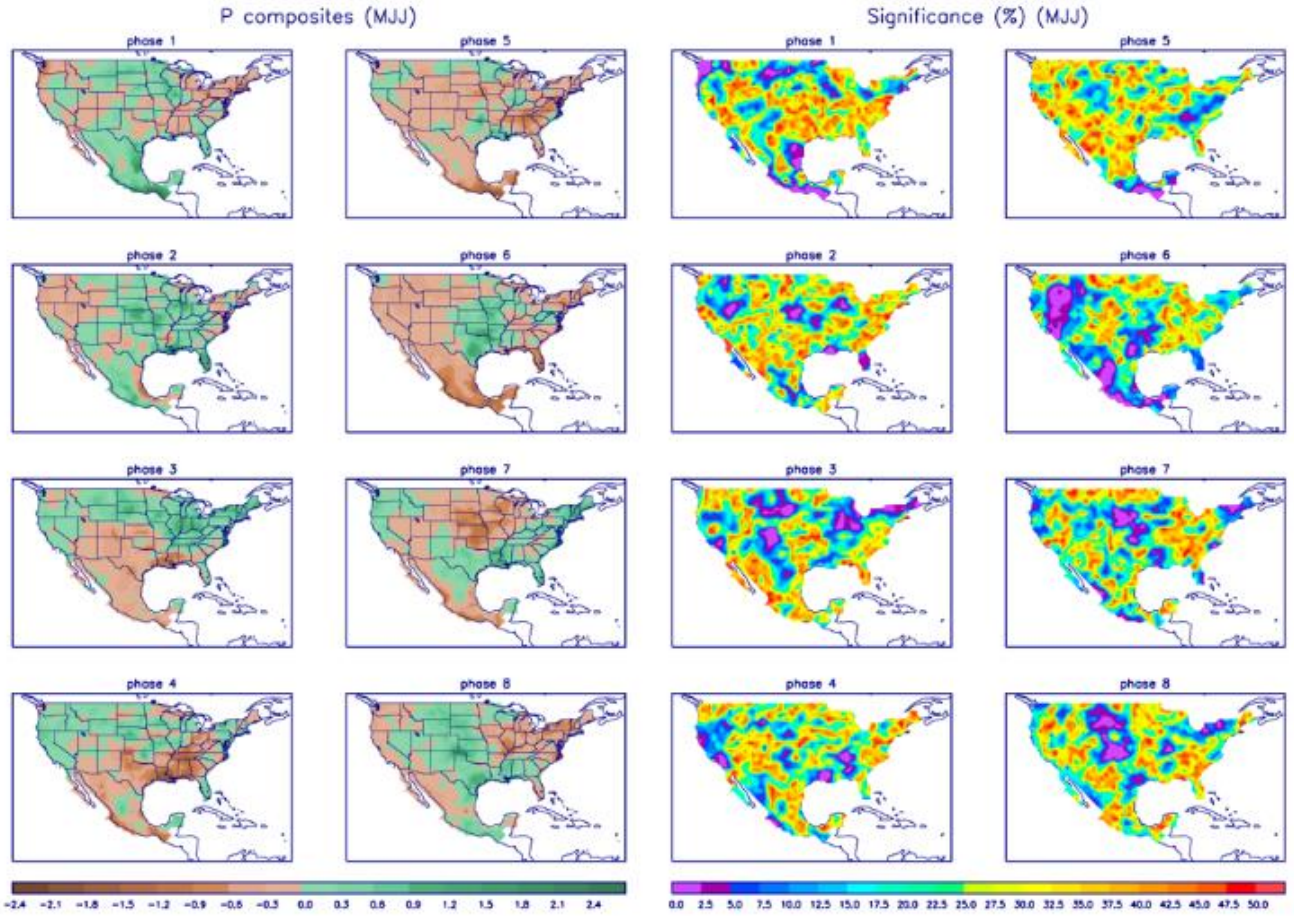


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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