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

Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
26 June 2023

Overview

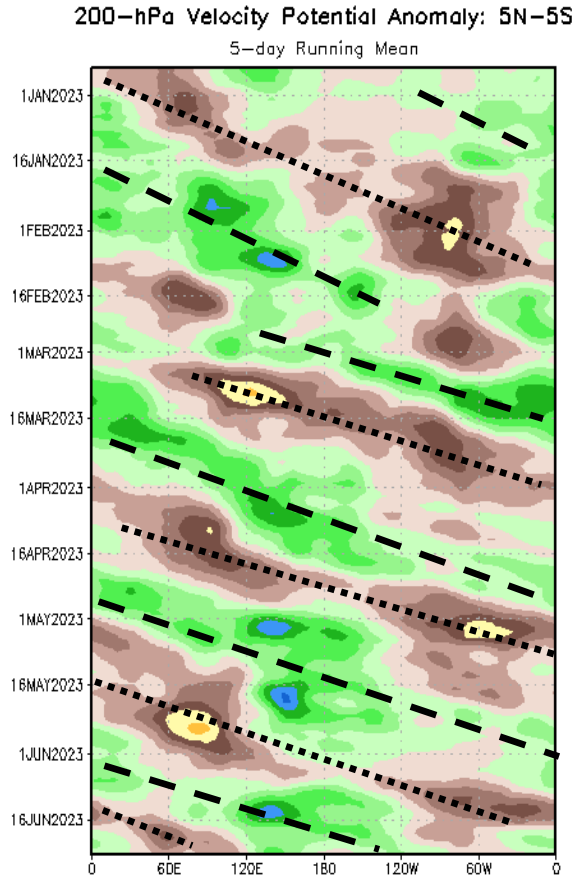
- The MJO signal remains weak, with the El Niño base state becoming more dominant.
- Dynamical model forecasts are generally incoherent in terms of MJO propagation through early July.
- Following a burst of early season activity in the Main Development Region of the Atlantic, the global tropics are forecast to be generally quiet during the next 2 weeks, with some elevated potential for tropical cyclone development across climatologically favored areas of the Eastern and Western Pacific basins.

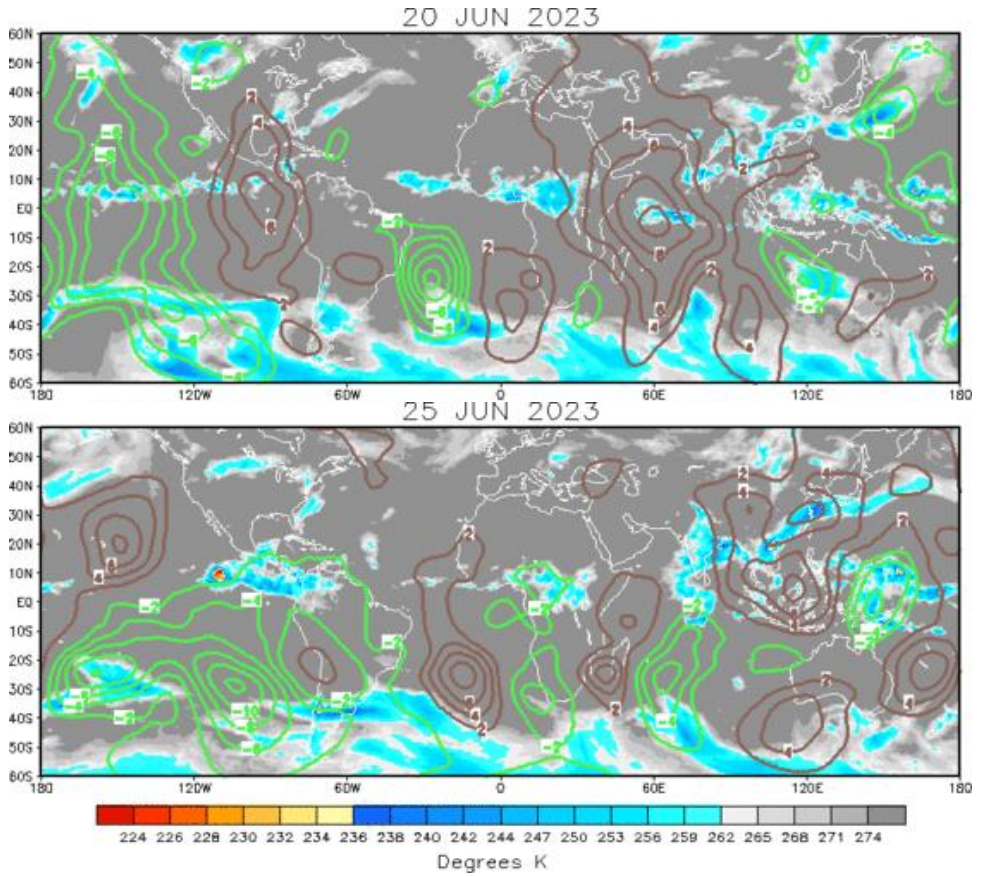
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

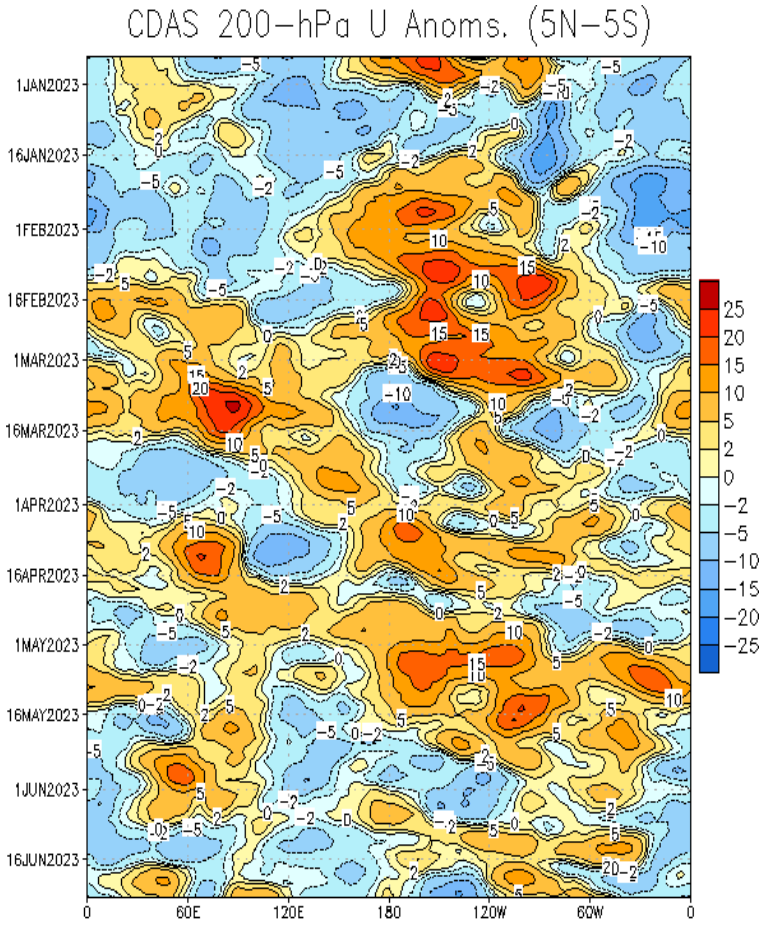


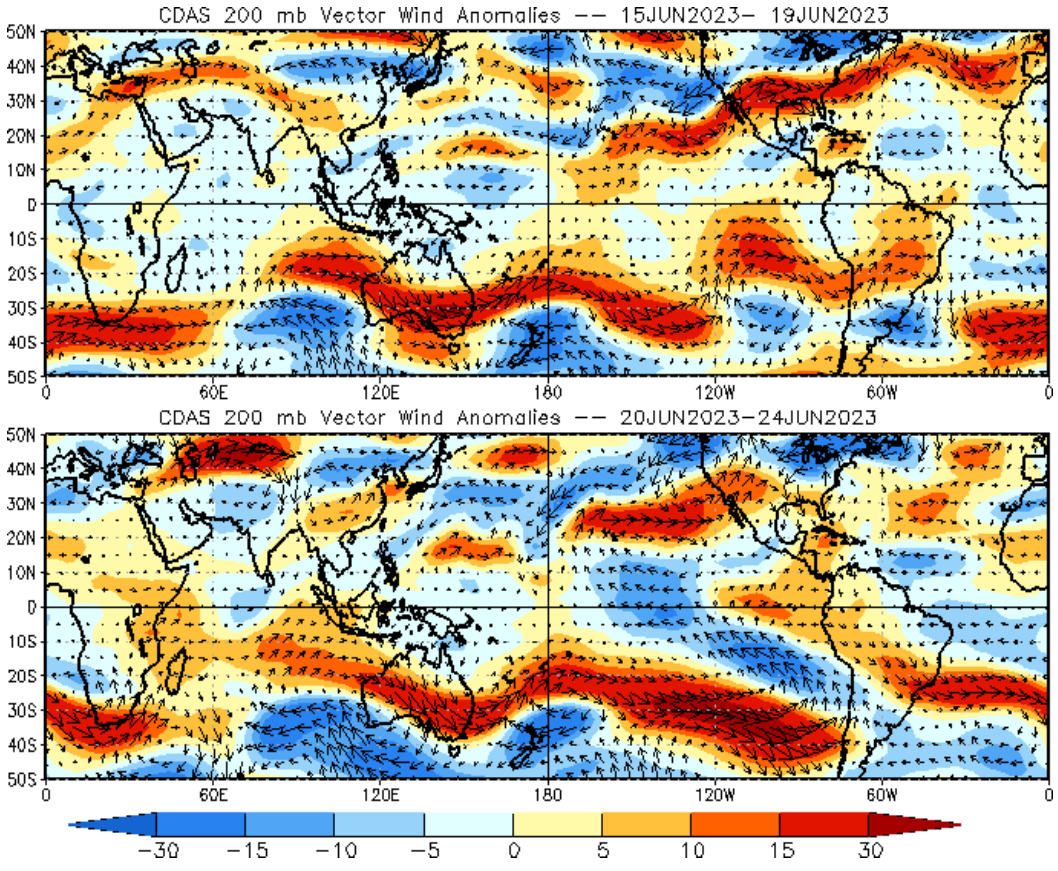


- Anomalous upper-level convergence increased across eastern Asia and the Pacific during the past week.
- Elsewhere across the tropics, the upper-level velocity potential pattern has become largely incoherent, with the strongest signals in the extratropical Southern Hemisphere.

200-hPa Wind Anomalies

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

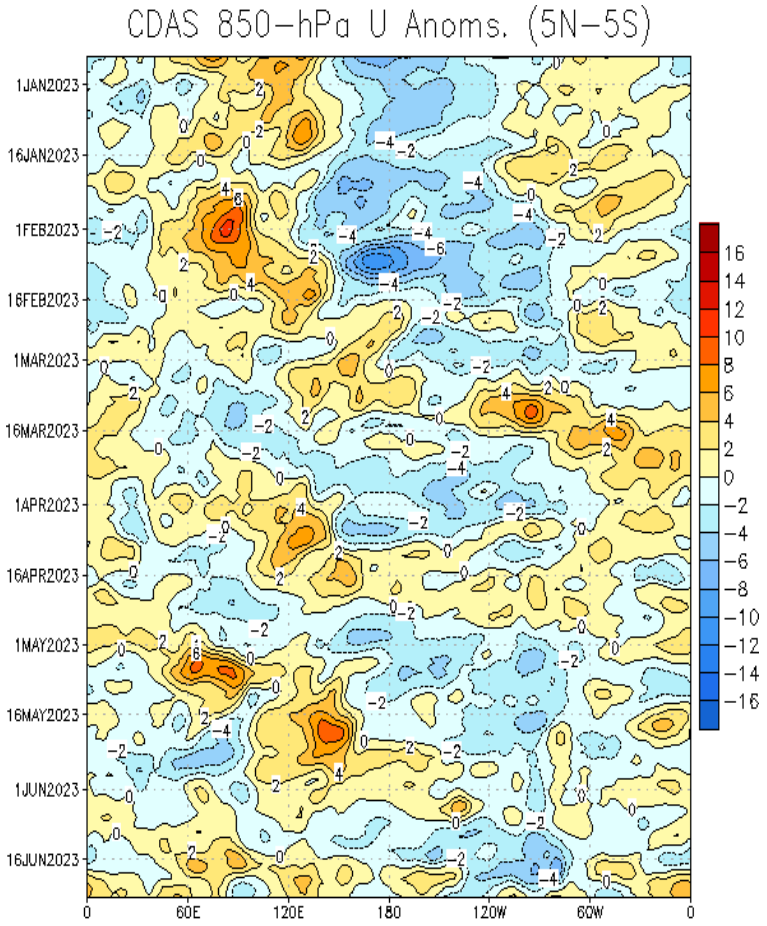


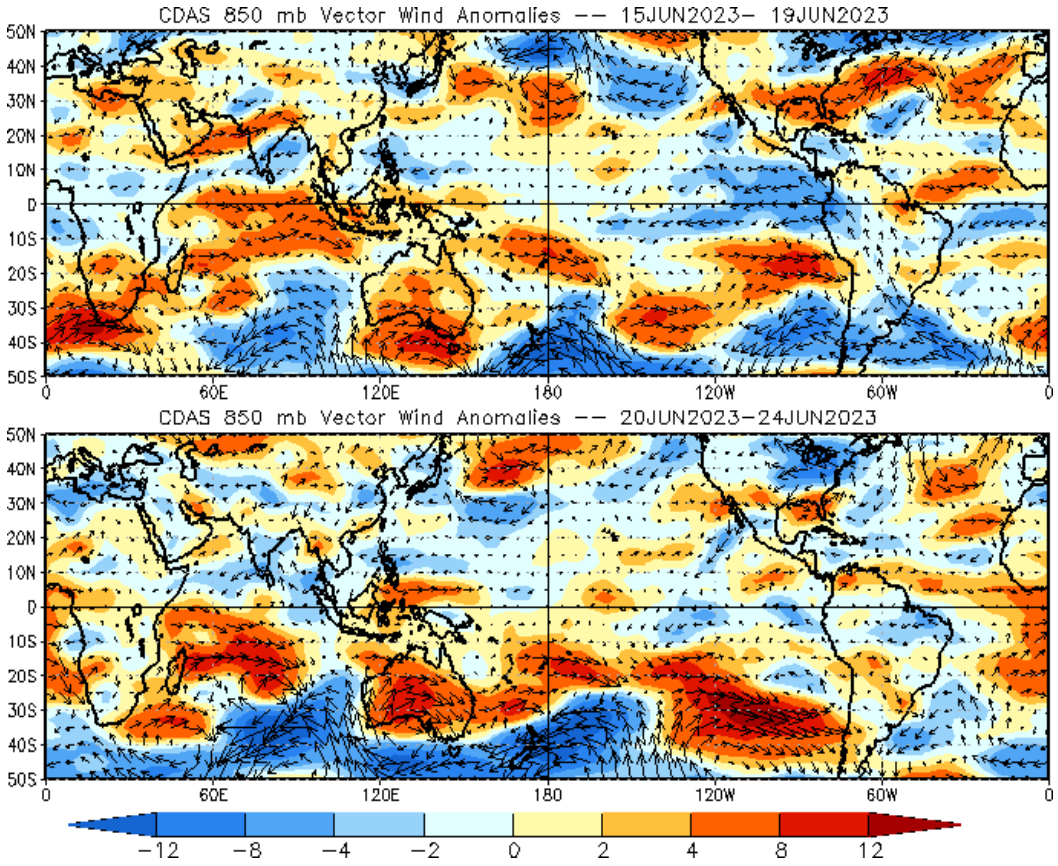


- An enhanced subtropical jet continues to be present across the eastern Pacific and southwestern U.S., but upper-level westerly wind anomalies have weakened across the eastern U.S. and Atlantic compared to last week.
- Anomalous upper-level easterlies have increased across the equatorial Pacific to the west of 120W.

850-hPa Wind Anomalies

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

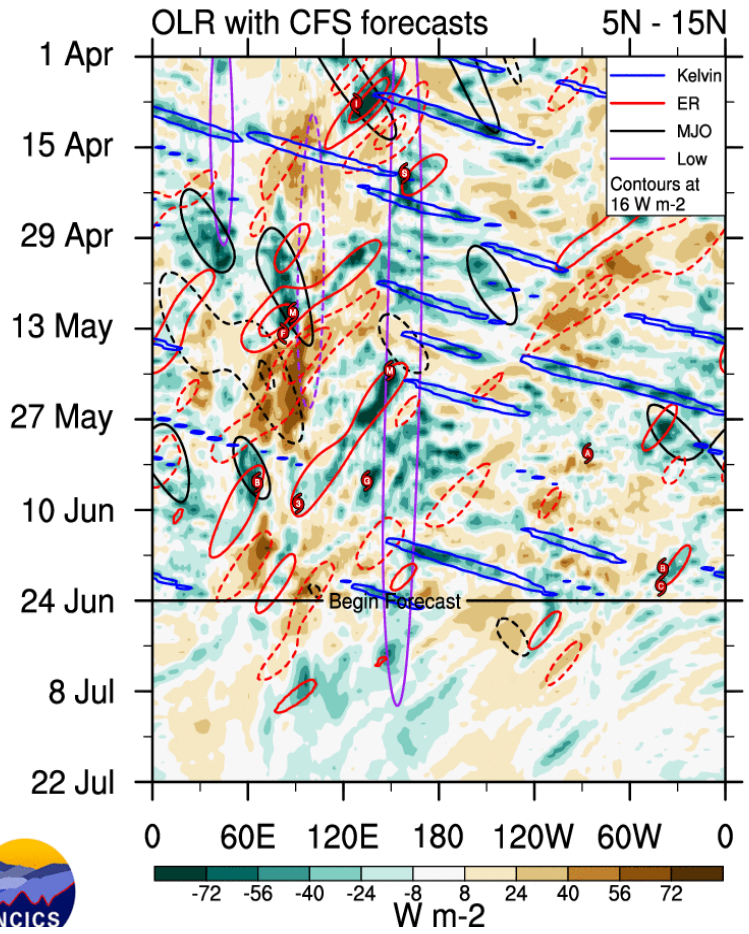


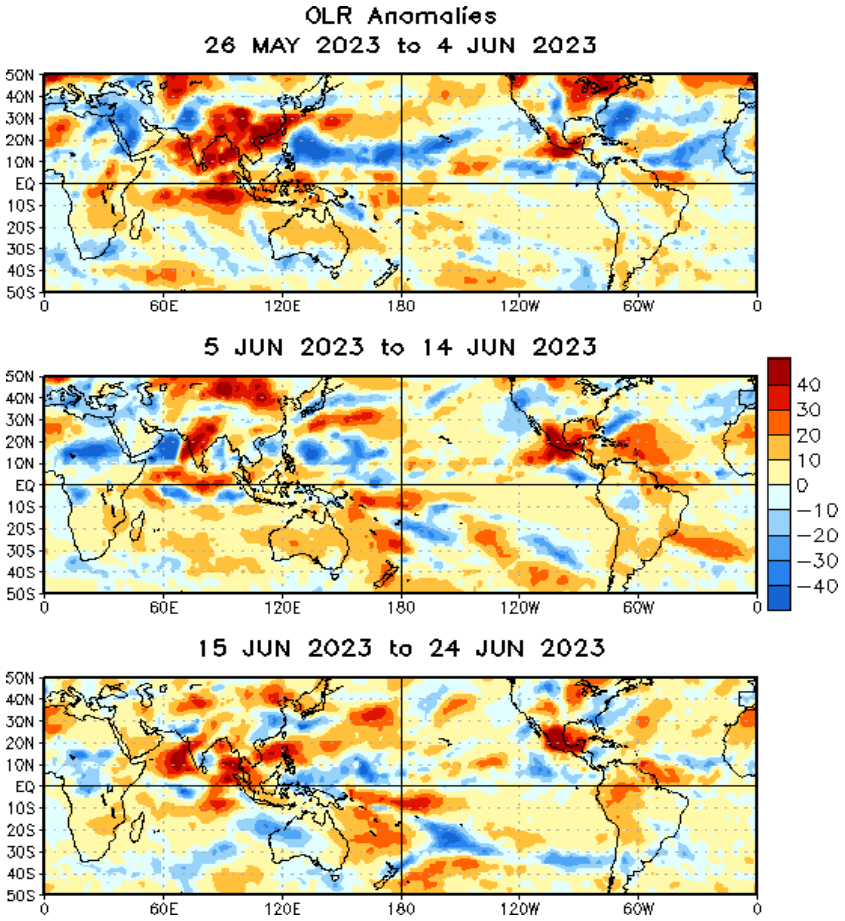


- Anomalous cyclonic flow continues to be present over the eastern U.S., but has weakened compared to last week.
- Low-level easterlies have weakened across the eastern Pacific
- Reduced MJO signal results in limited features within the global surface wind pattern; largest anomalies seen in the higher latitudes of the Southern Hemisphere.

Outgoing Longwave Radiation (OLR) Anomalies

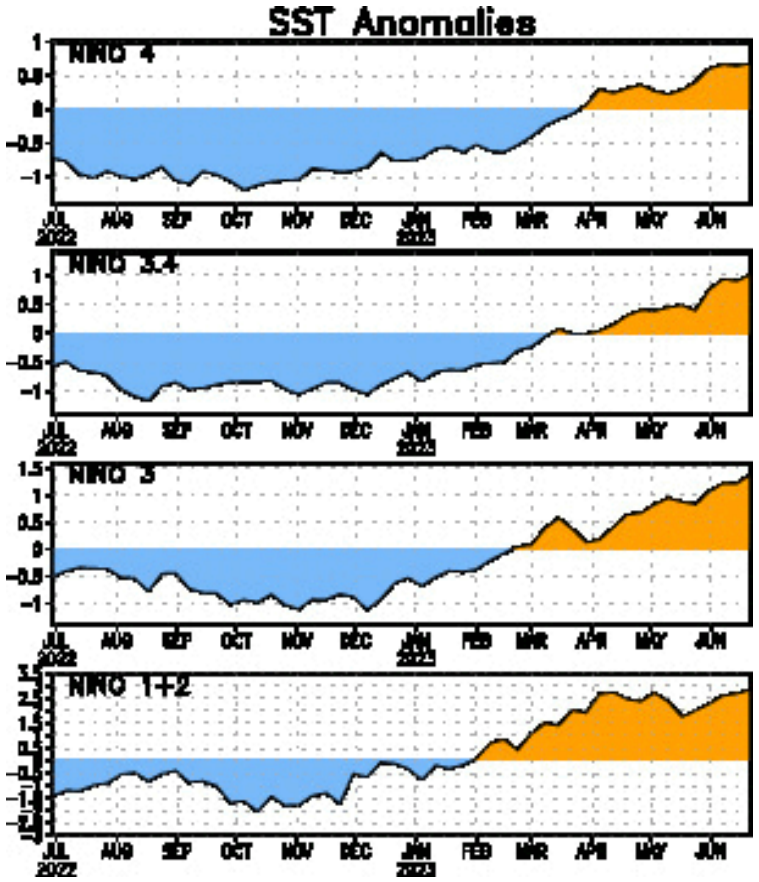
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

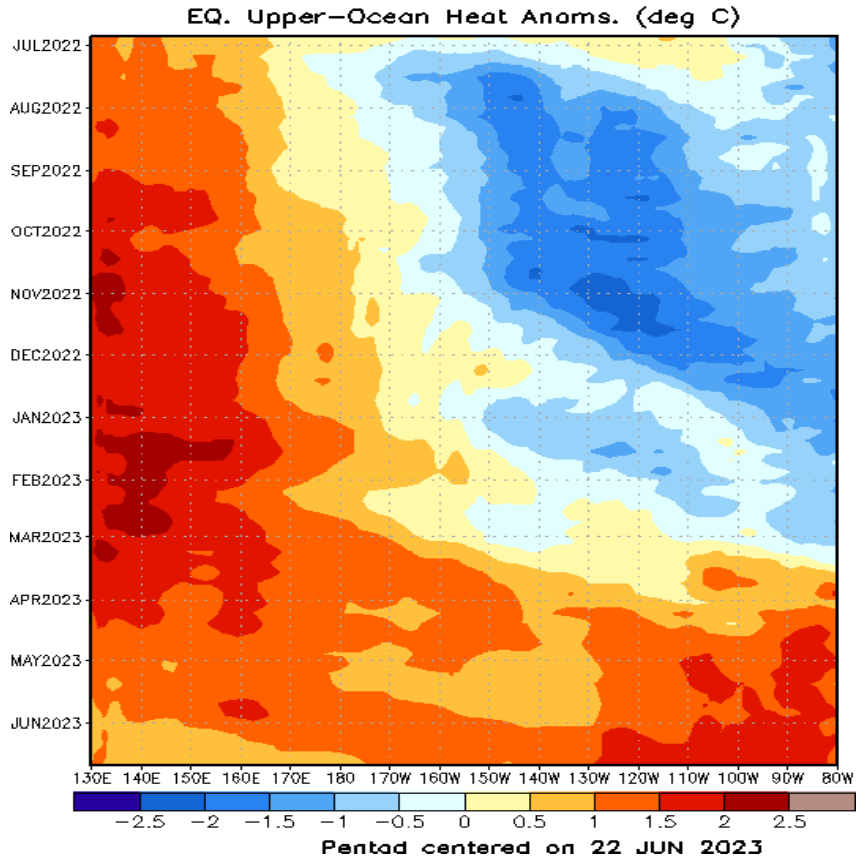




- Positive OLR anomalies have expanded across parts of the north Indian Ocean and western Pacific, consistent with a reduction in tropical cyclone activity across these areas.
- Enhanced Rossby Wave activity and the low frequency El Niño state are expected to result in a transition to negative OLR anomalies over some of these areas.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

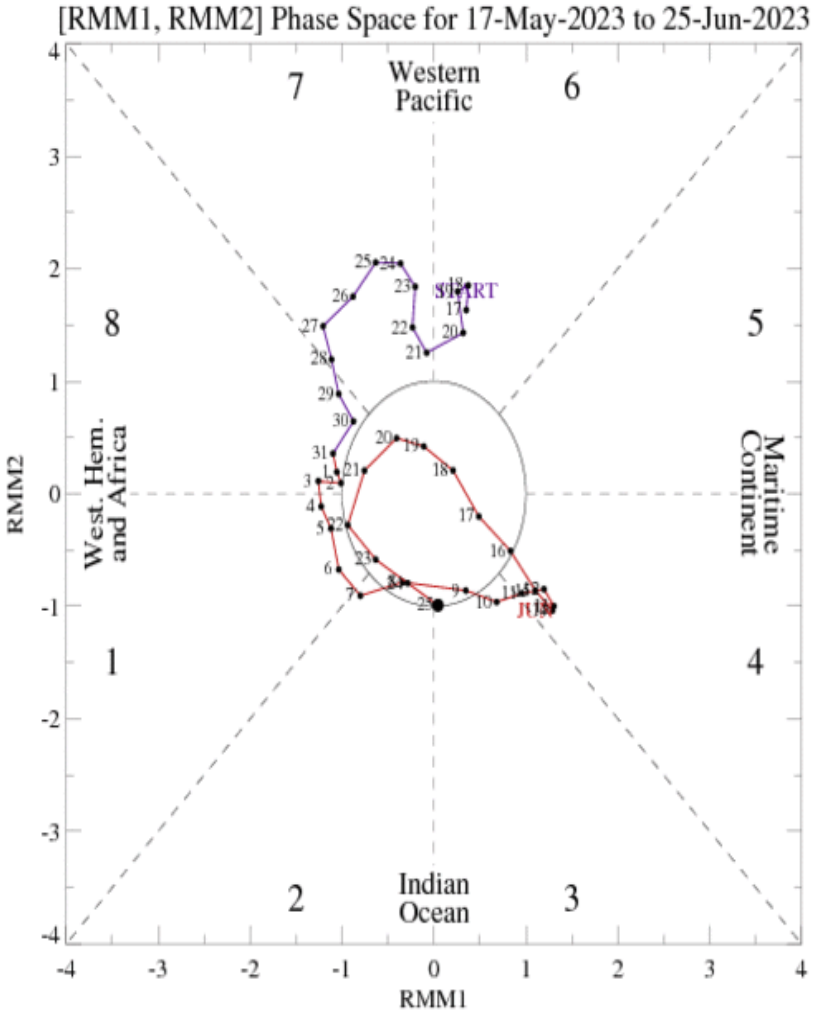




- Per the June 8, 2023 update, El Niño conditions are now present across the equatorial Pacific.
- Above-normal oceanic subsurface temperatures are present across the entire equatorial Pacific, with the largest positive anomalies over the eastern Pacific, representing a rapid transition since late 2022.
- Positive SST anomalies exist in all Niño regions.

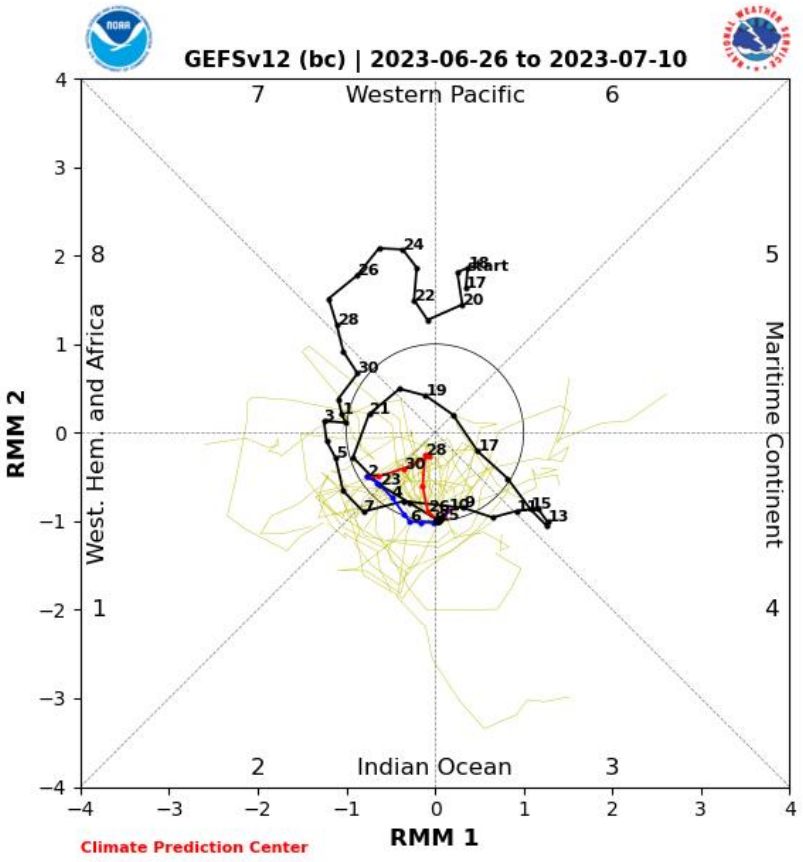
MJO Index: Recent Evolution

- The RMM-based MJO has remained weak and is meandering within the unit circle as the low frequency El Niño state becomes more dominant.

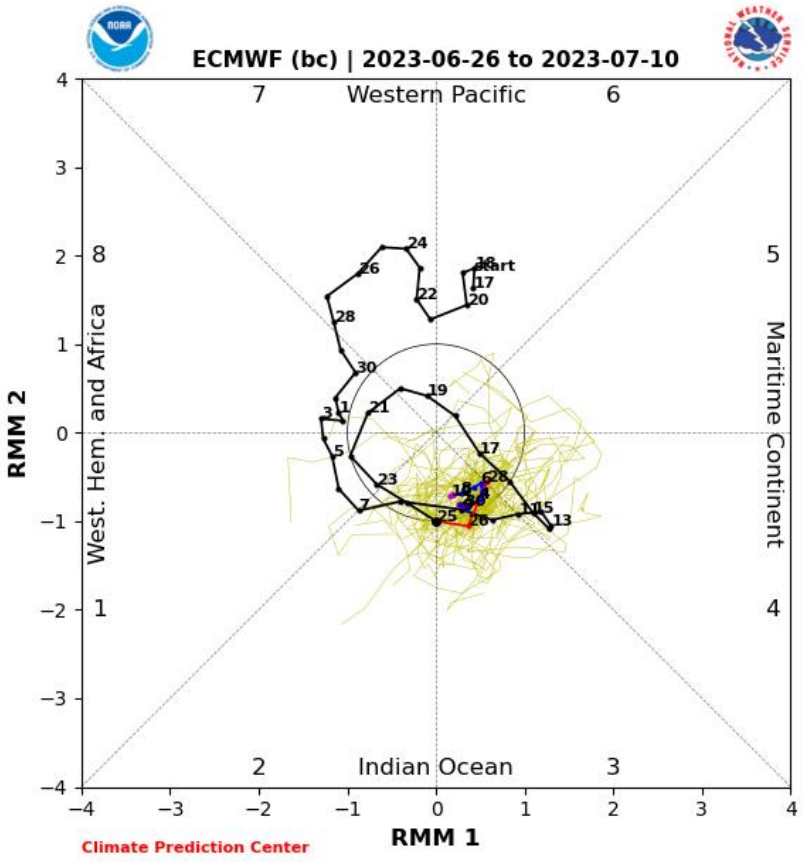


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

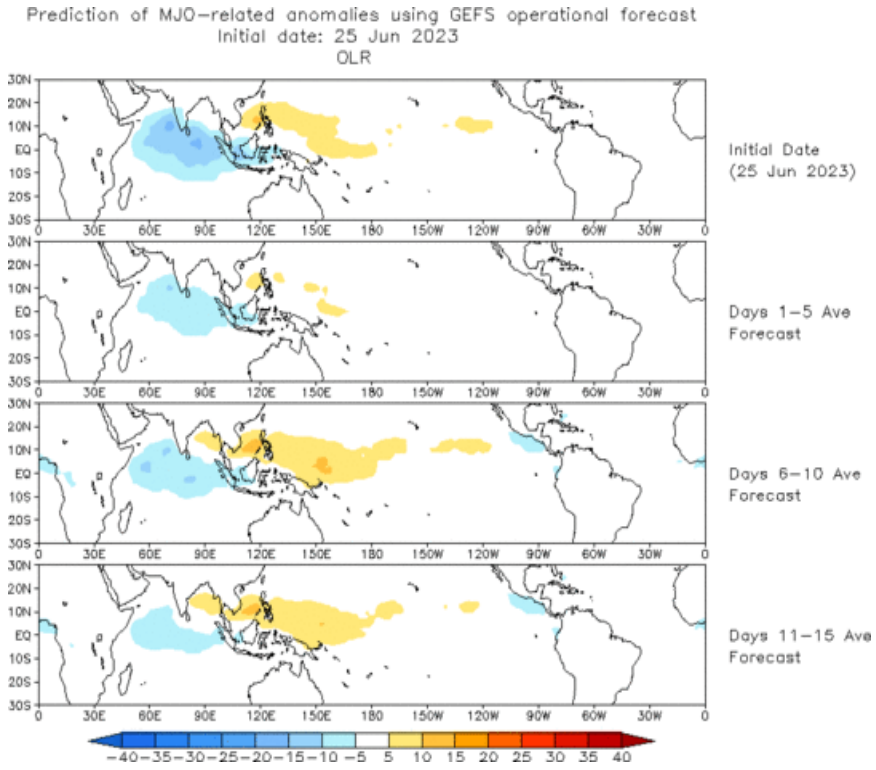


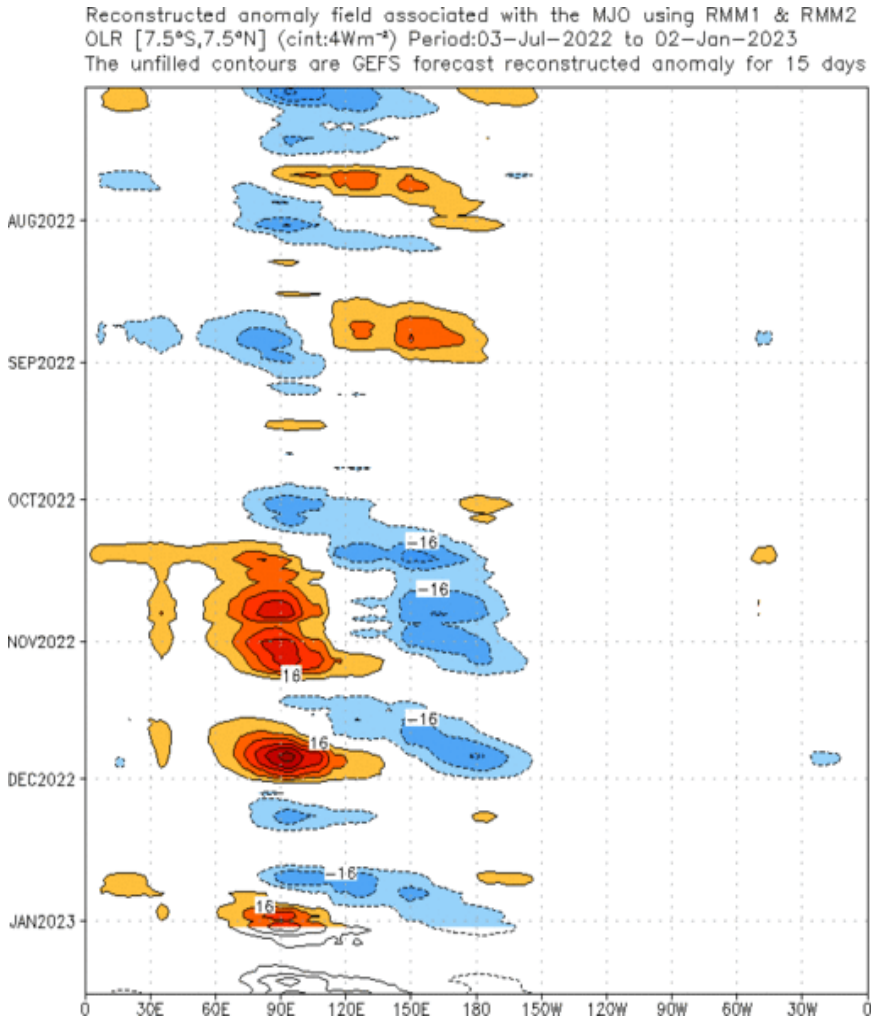
ECMWF Forecast

- Both the GEFS and ECMWF ensembles predict a weak MJO over the next 2 weeks, with a largely incoherent signal amongst individual ensemble members.
- Occasional amplification across Africa and the Indian Ocean could be representative of a projection onto the El Niño base state.

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.)

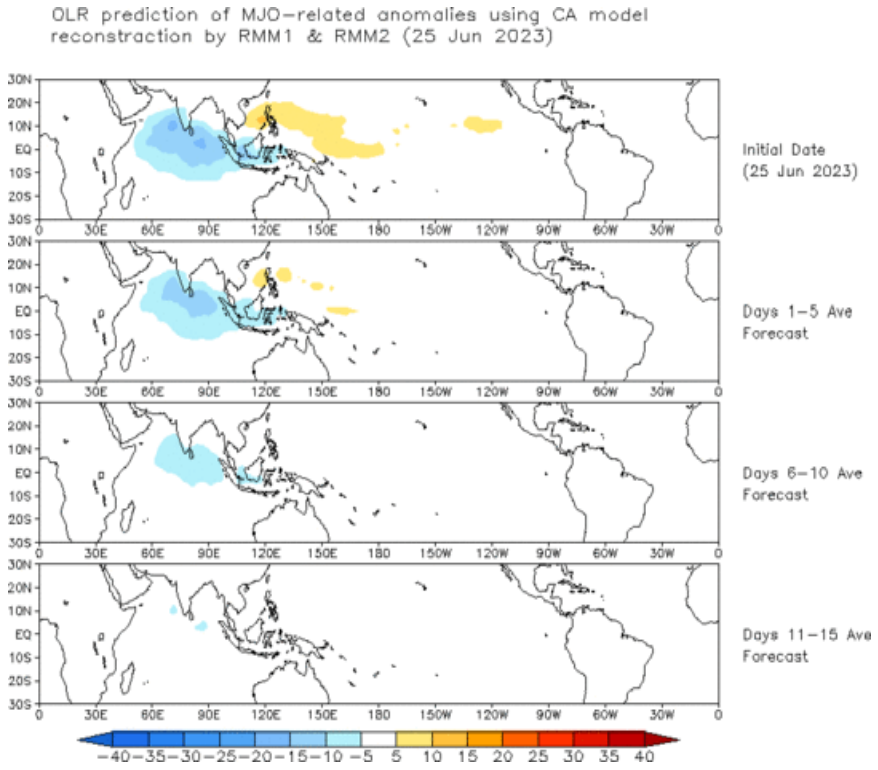


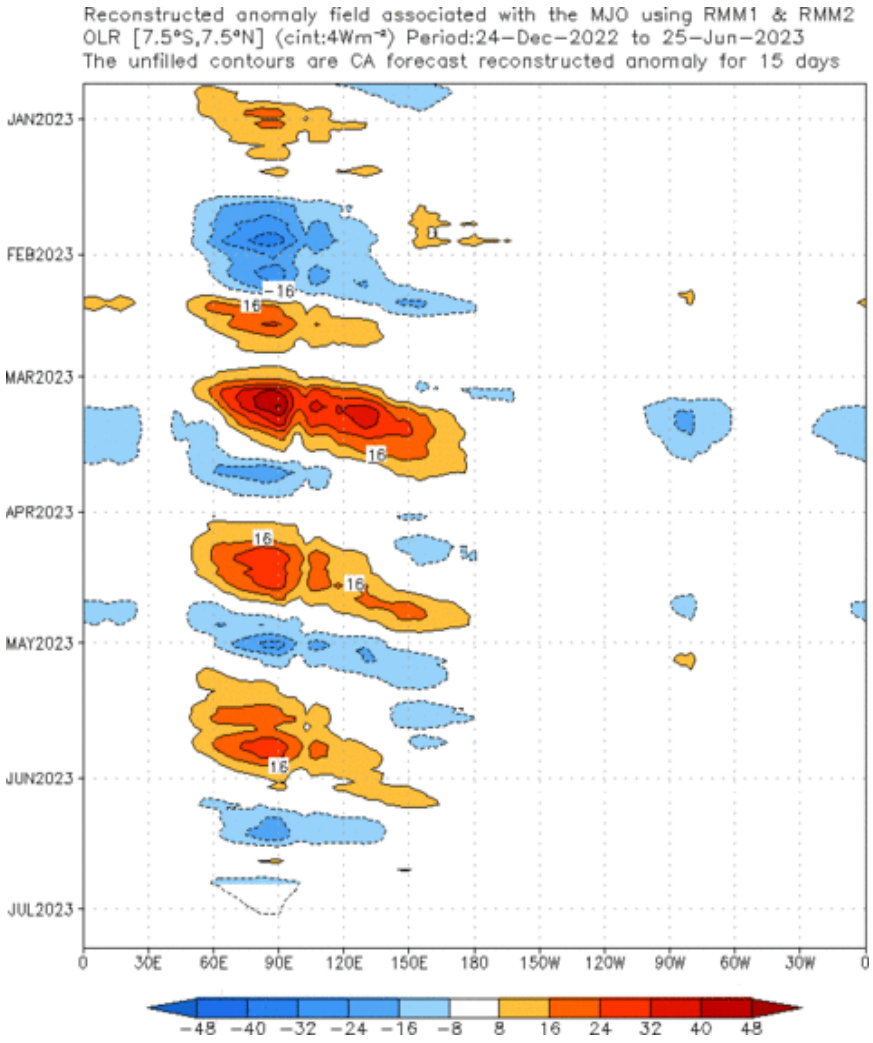


- The GEFS RMM-based OLR forecast depicts negative OLR anomalies (enhanced convection) over the Indian Ocean and positive OLR anomalies (suppressed convection) across the Western Pacific during the next 2 weeks.

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.)

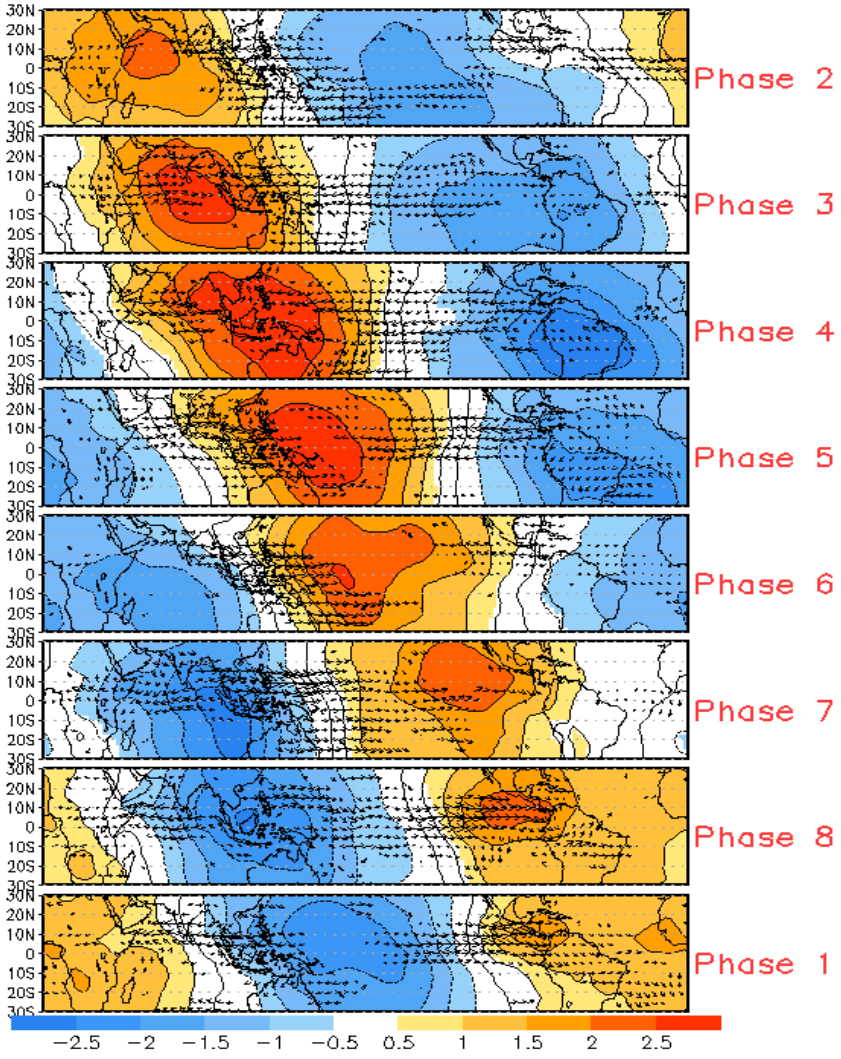




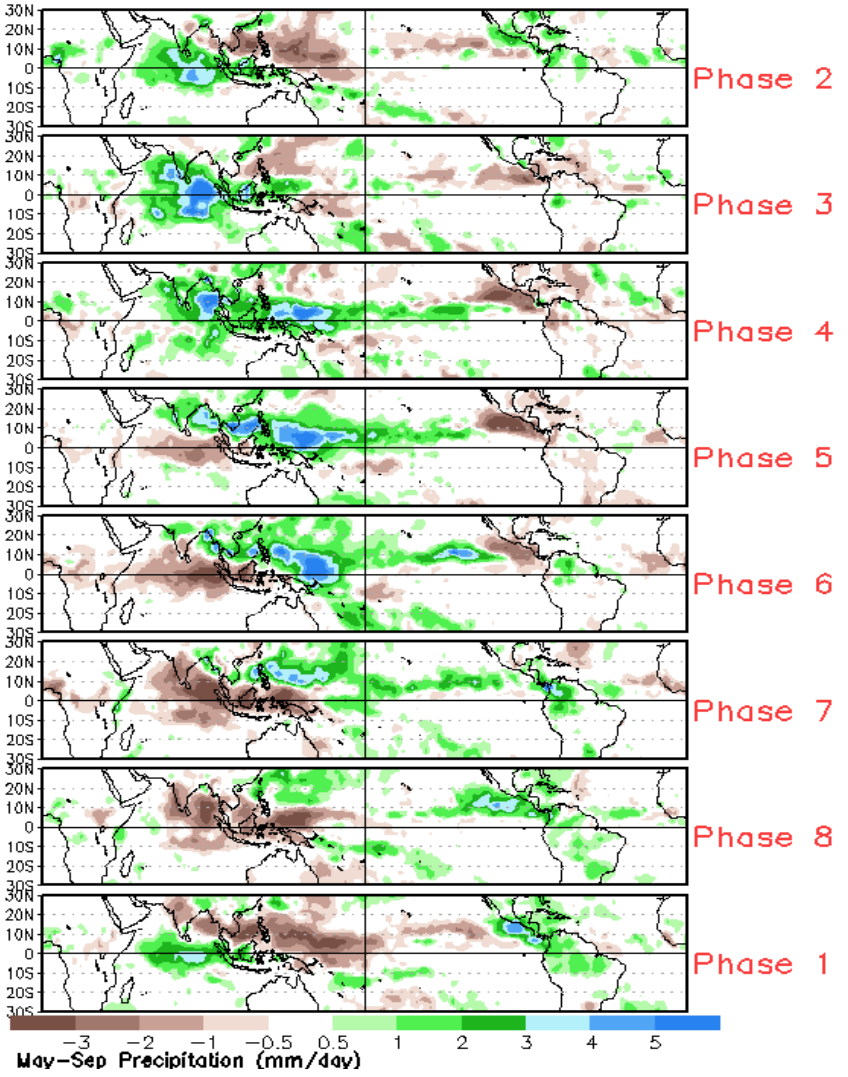
- The constructed analog RMM-based forecast is similar to the GEFS, although weaker with diminishing positive and negative OLR anomalies over the Western Pacific and Indian Ocean respectively by week-2.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



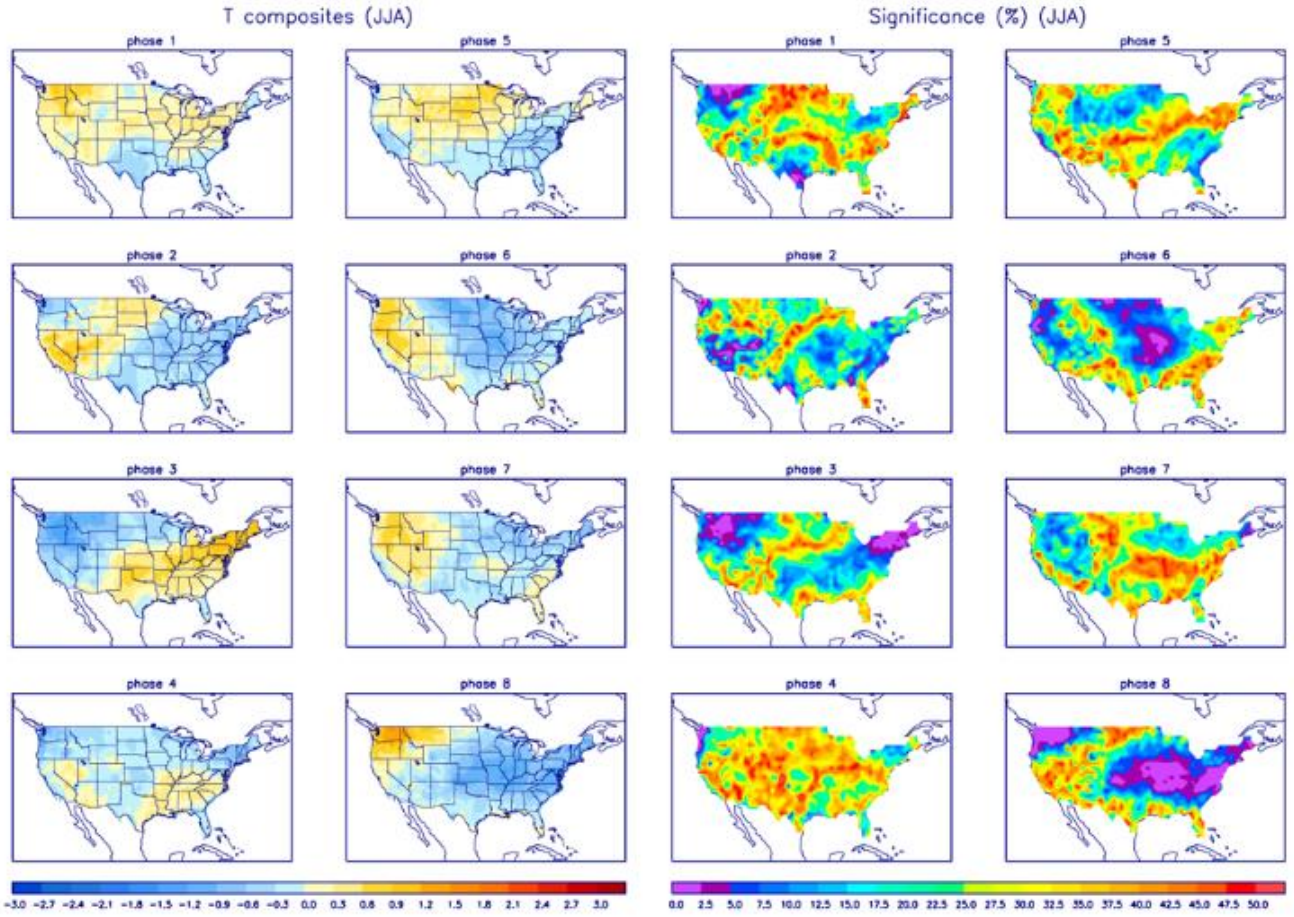
Precipitation Anomalies



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.

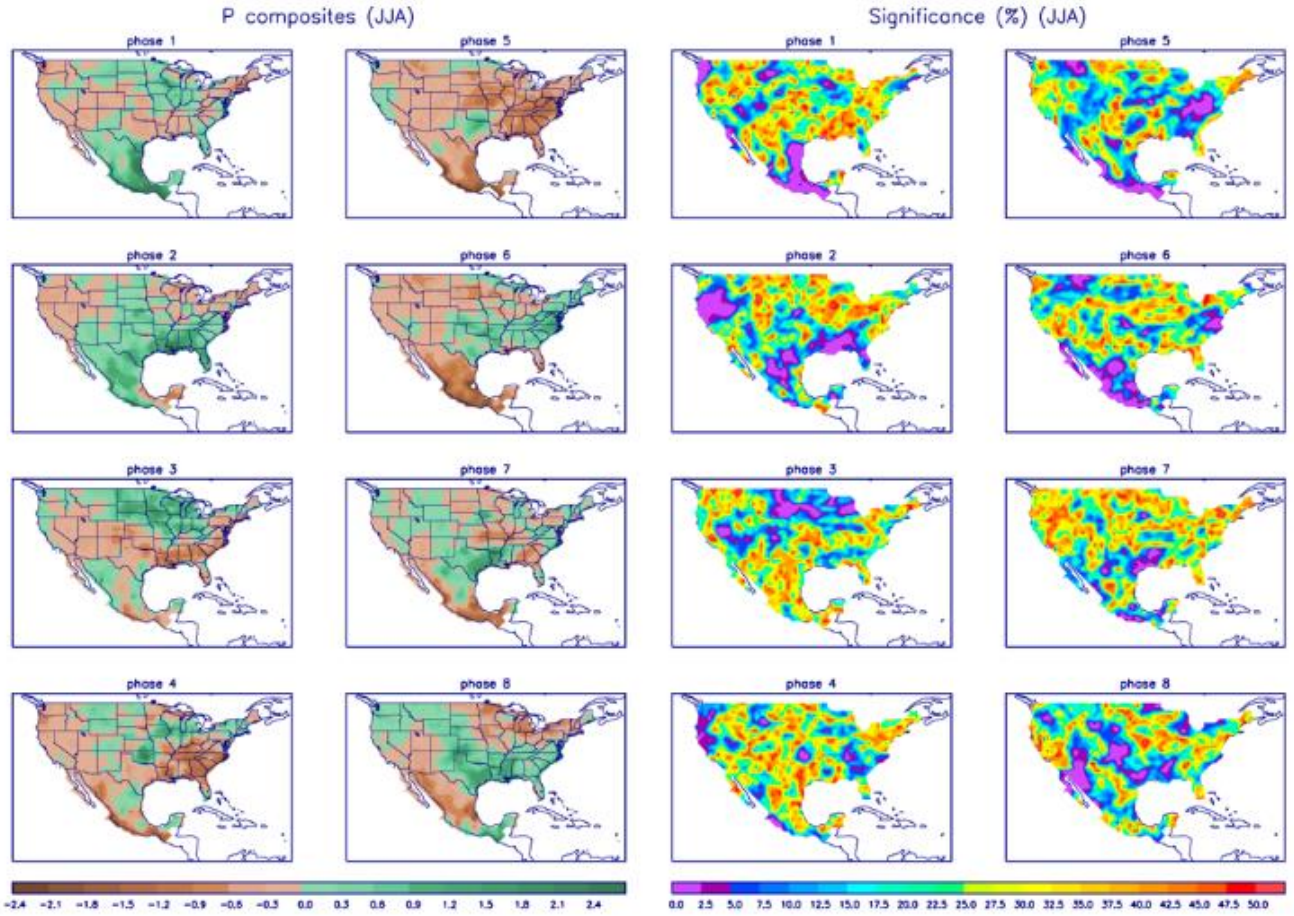


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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.



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