

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



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

Overview

- The MJO began to weaken during mid-June as the low frequency El Niño state becomes more dominant.
- RMM-based forecasts depict a continued weak MJO through late June and into the beginning of July.
- Tropical cyclogenesis is most favored across the East Pacific during week-2.
- The North American monsoon is forecast to be suppressed at least through the beginning of July with a persistence of above-normal temperatures across northern Mexico and the south-central United States.

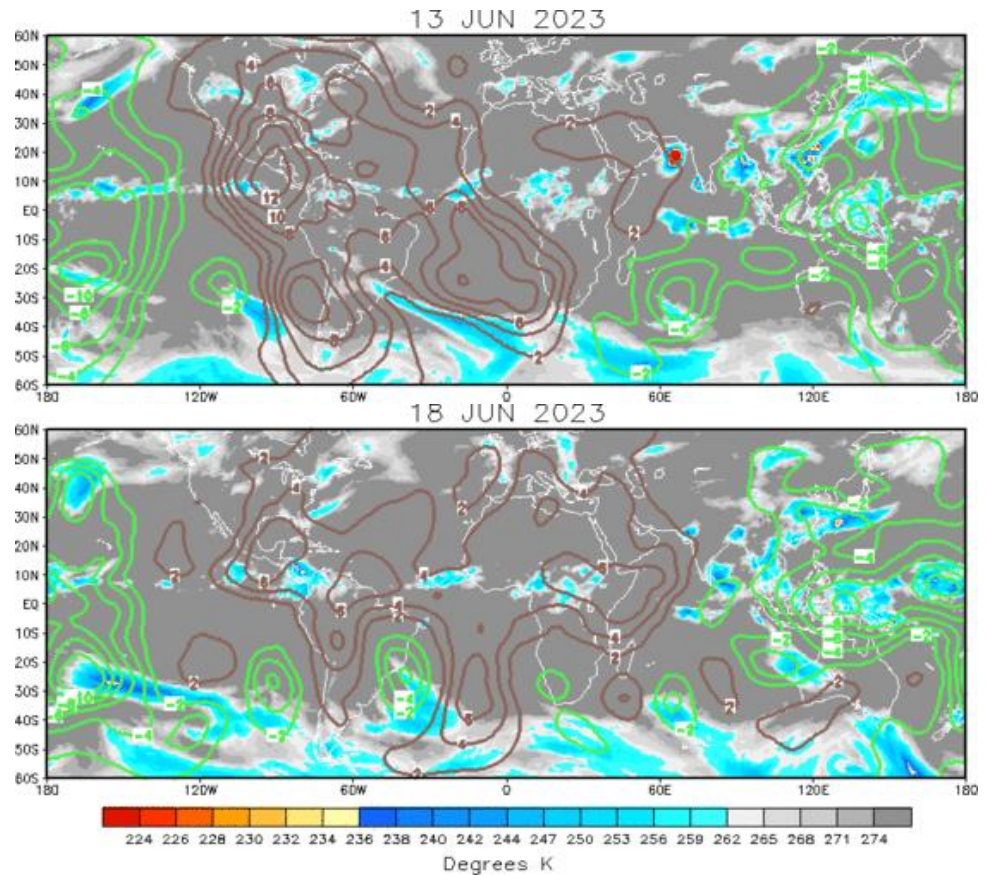
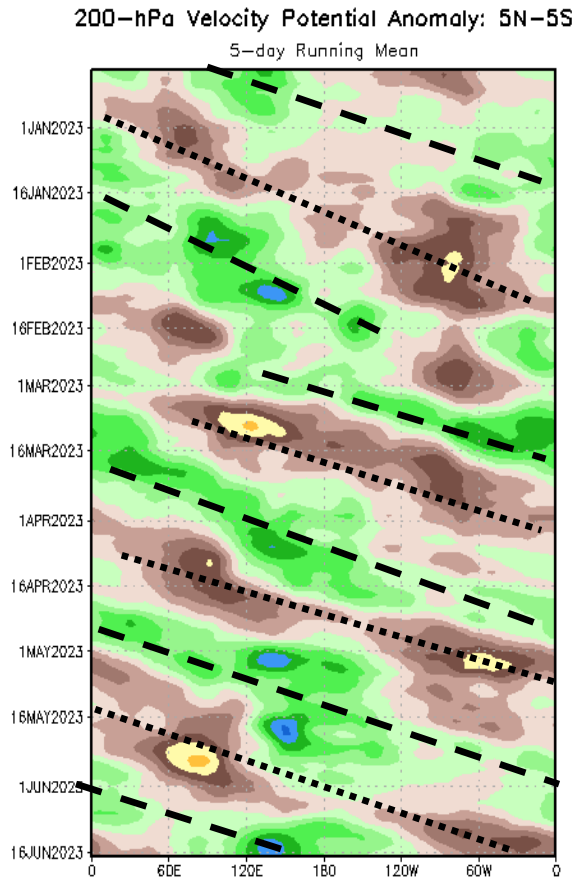
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:

<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

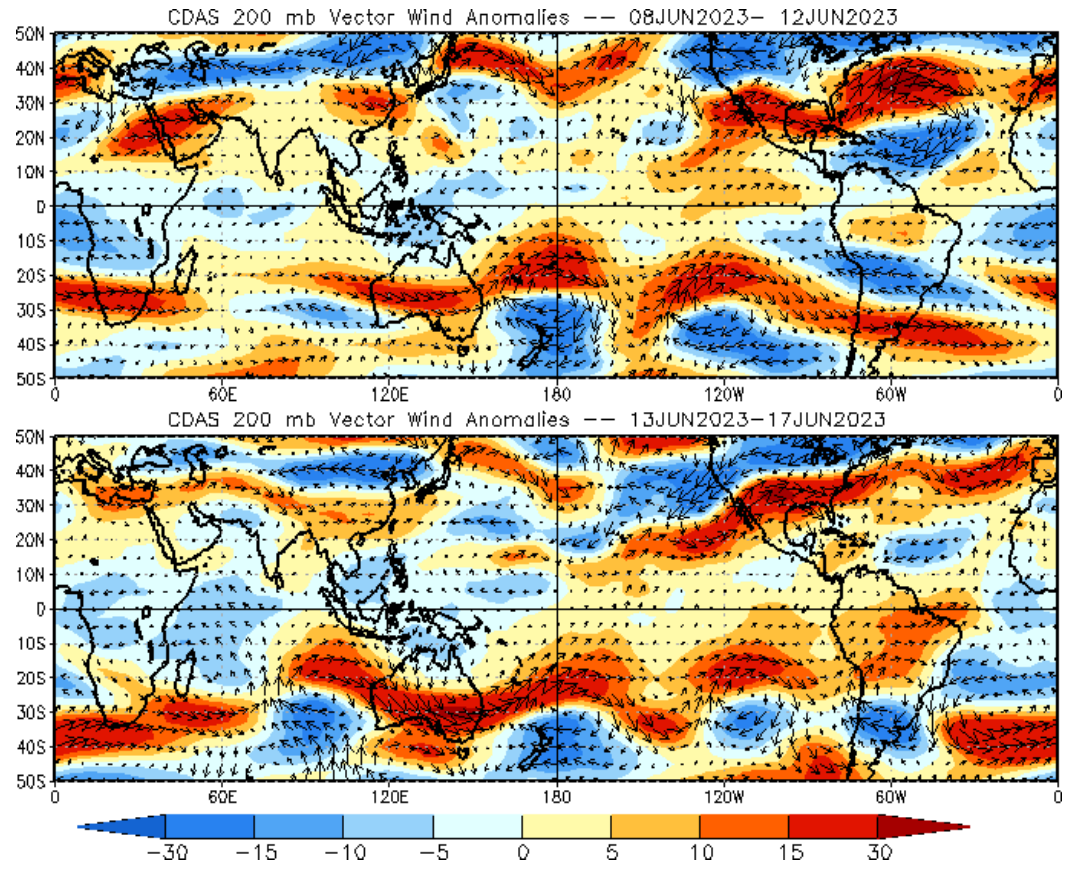
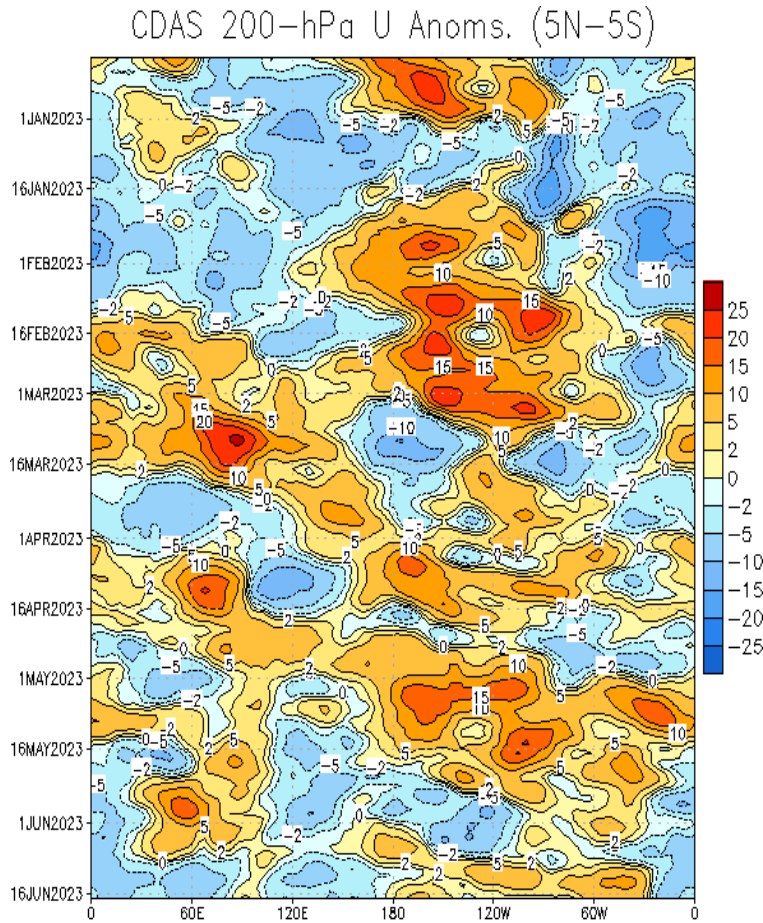
Brown shades: Anomalous convergence (unfavorable for precipitation)



- Anomalous upper-level convergence expanded across the Americas, Atlantic, and Africa during the past week in the wake of the departing MJO.
- Recently the MJO began to constructively interfere with the developing El Niño with strong anomalous upper-level divergence west of the Date Line.

200-hPa Wind Anomalies

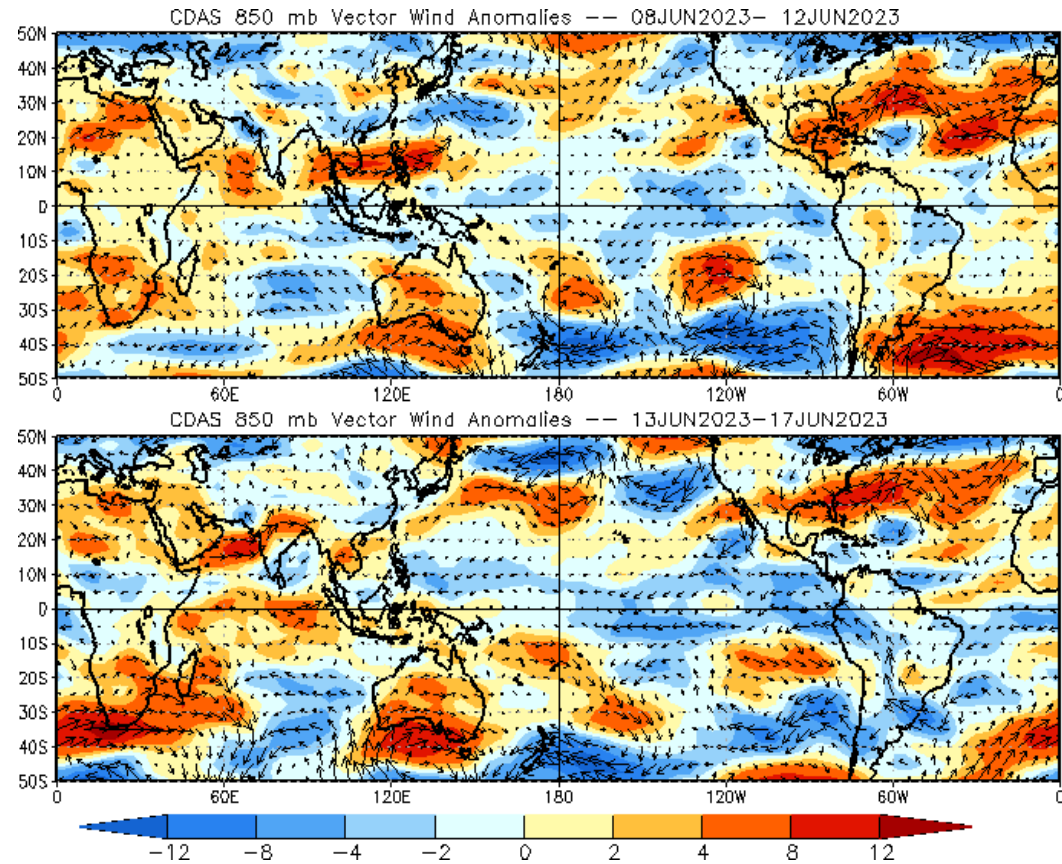
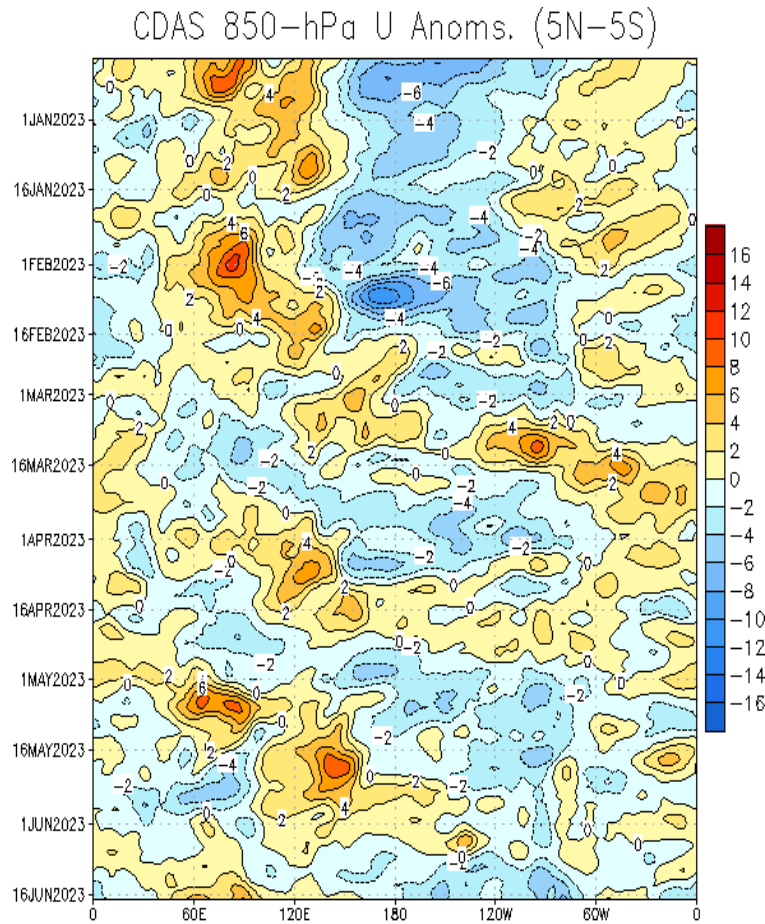
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- An enhanced subtropical jet continues to be present across the eastern Pacific, extending across Mexico and into the Atlantic.
- Easterly upper-level anomalies became more prevalent over Africa, the Indian Ocean, and Maritime Continent during early to mid-June.

850-hPa Wind Anomalies

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

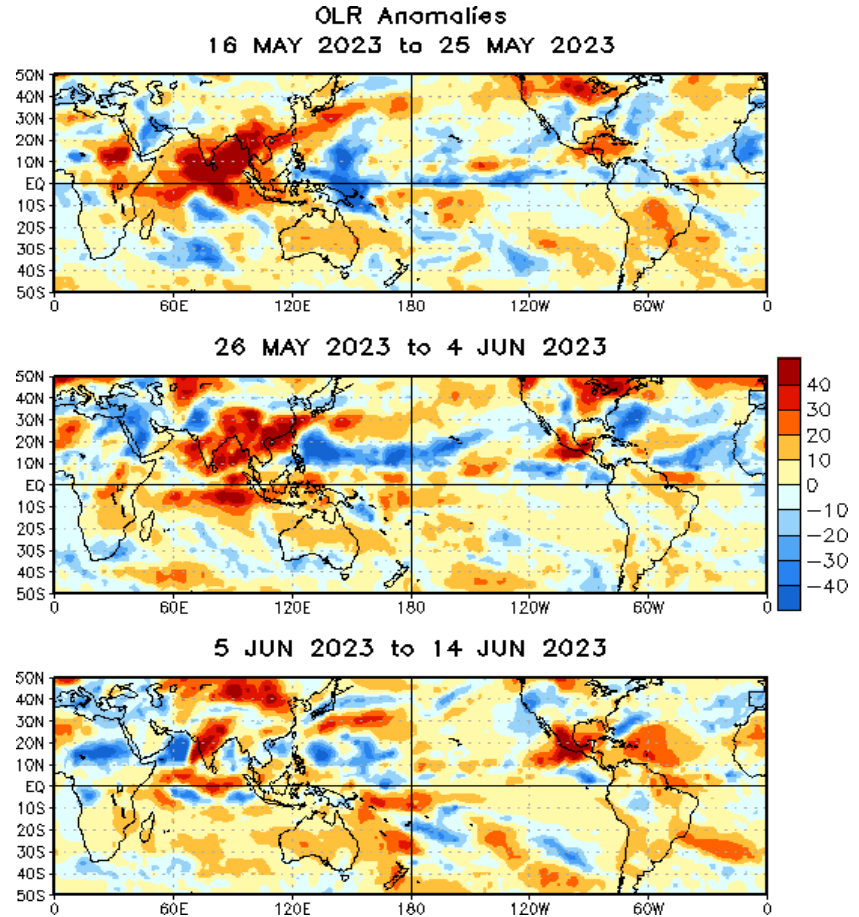
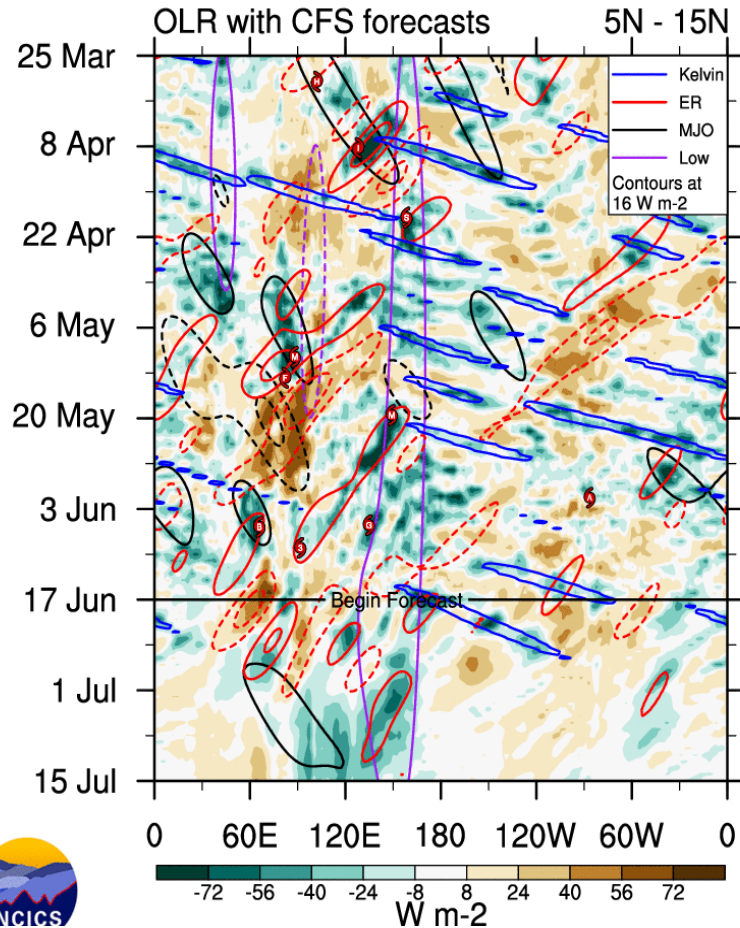


- Anomalous low-level westerlies persist across portions of southeastern Asia and the western-north Pacific.
- Cyclonic circulations lead to increased onshore flow and enhanced rainfall across southwestern Australia.
- Surface low pressure over the North Atlantic resulted in continued anomalous northerly flow across the eastern United States, resulting in below-normal temperatures.

Outgoing Longwave Radiation (OLR) Anomalies

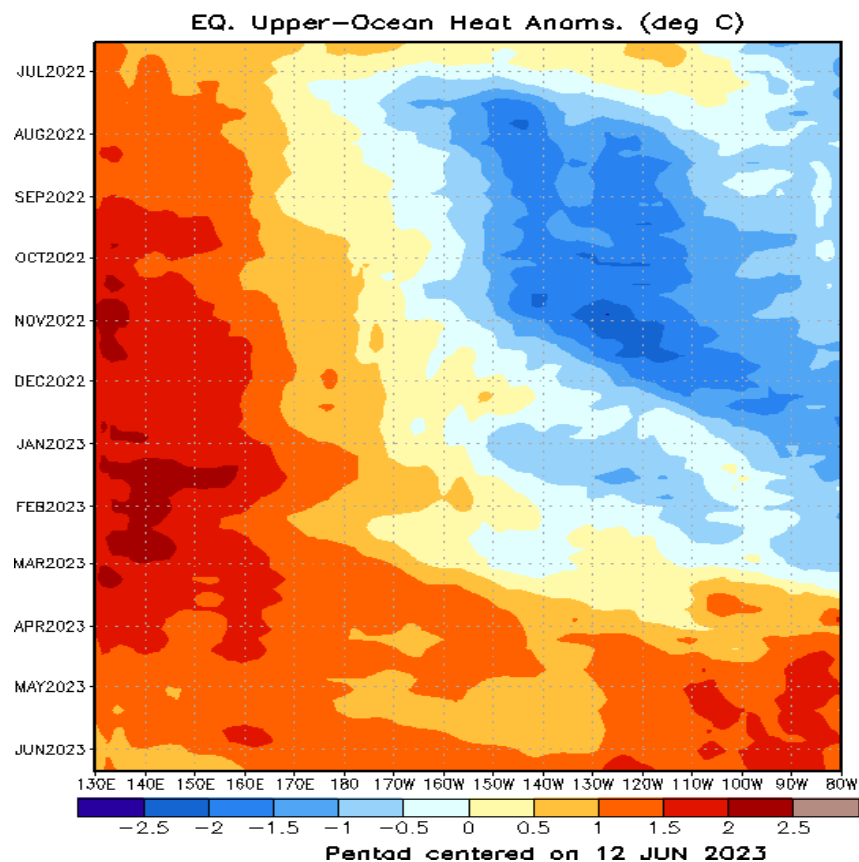
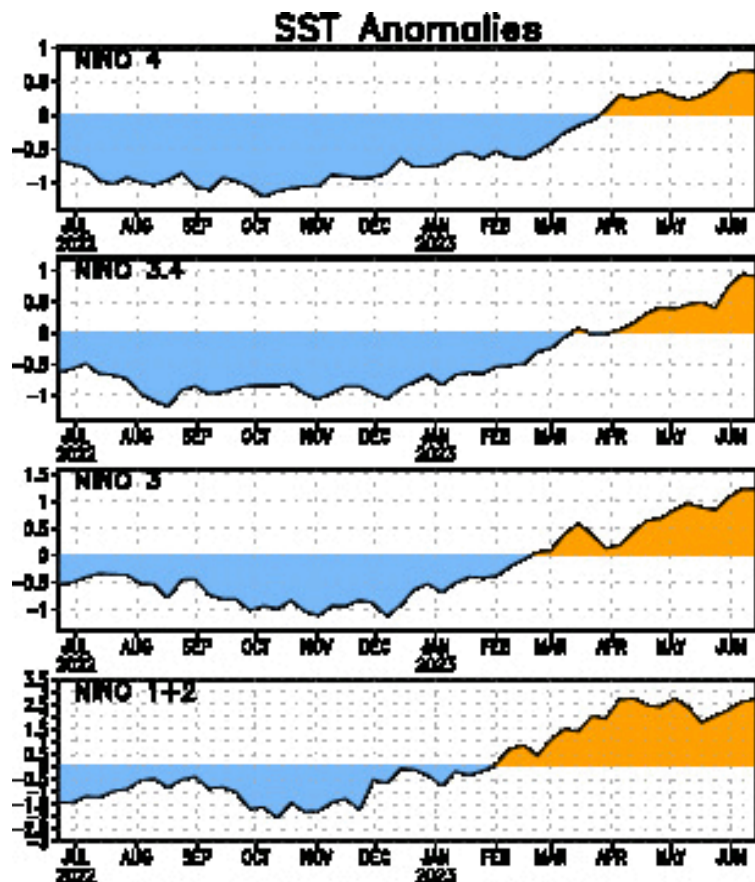
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- Positive OLR anomalies have weakened across the North Indian Ocean in early June, tied to the MJO and the development of Cyclone Biparjoy (Arabian Sea) and Tropical Cyclone 03B (Bay of Bengal).
- Enhanced Rossby Wave activity and the low frequency El Niño state are expected to result in negative OLR anomalies persisting across the western-north Pacific through early July.
- The suppressed phase of the MJO recently led to positive OLR anomalies across Mexico and the Caribbean Sea.

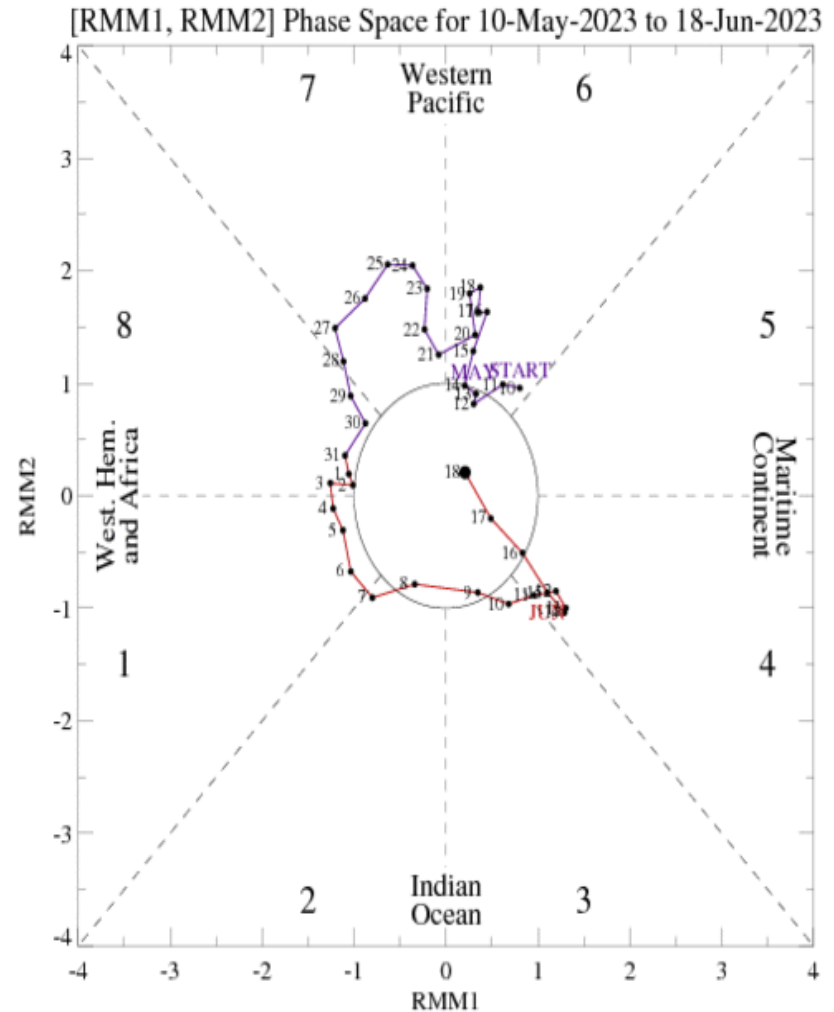
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- 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.
- SSTs in all of the Niño basins continue to trend upward.

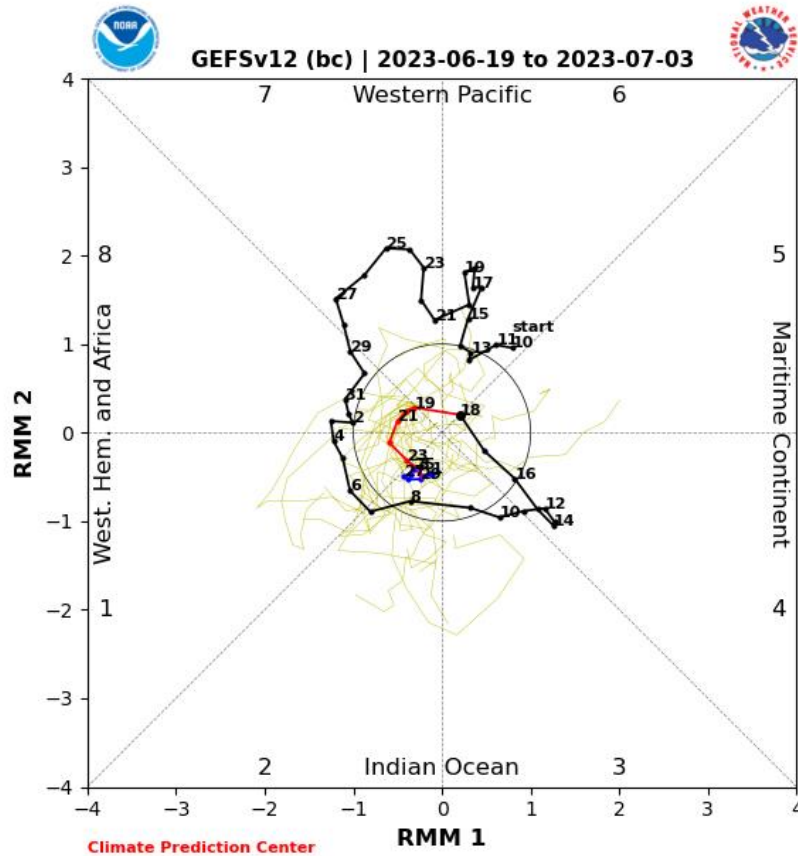
MJO Index: Recent Evolution

- The RMM-based index depicts a weakening MJO as other modes of tropical variability, including El Niño become more dominant.

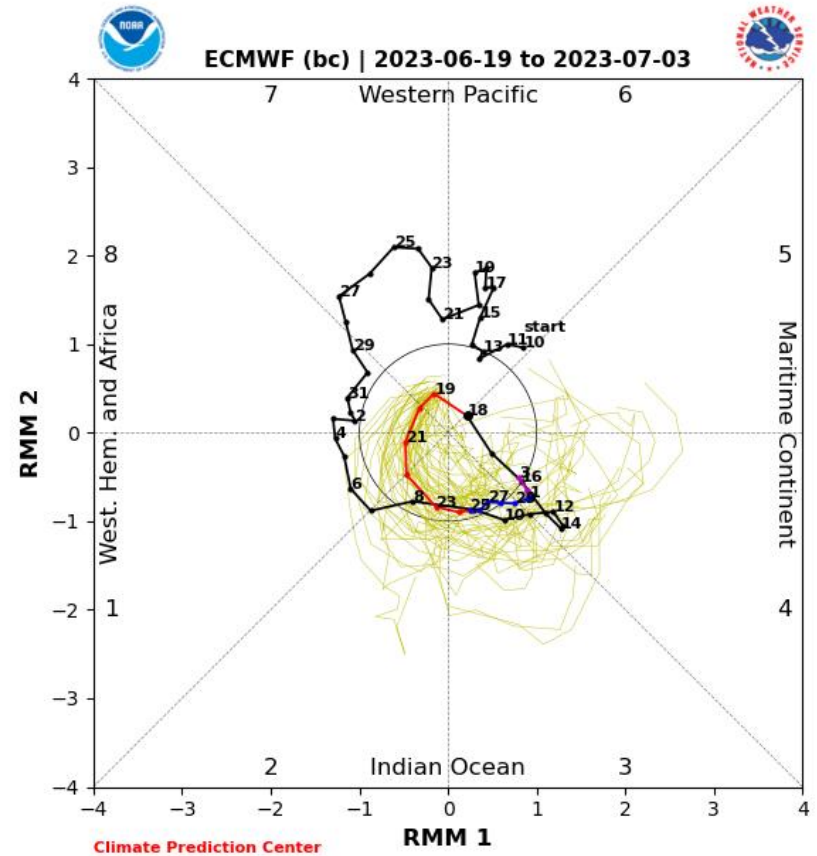


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



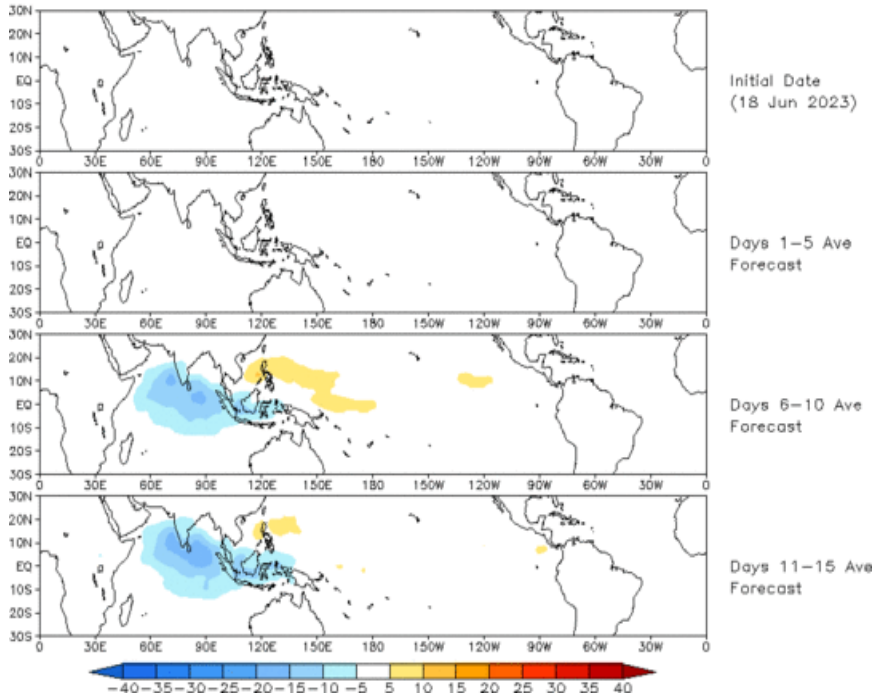
ECMWF Forecast

- Both the GEFS and ECMWF ensembles depict a weak MJO during the next two weeks.
- The ECMWF ensemble mean and many of its ensemble members feature a fast eastward propagation of the RMM index which is consistent with a Kelvin wave.

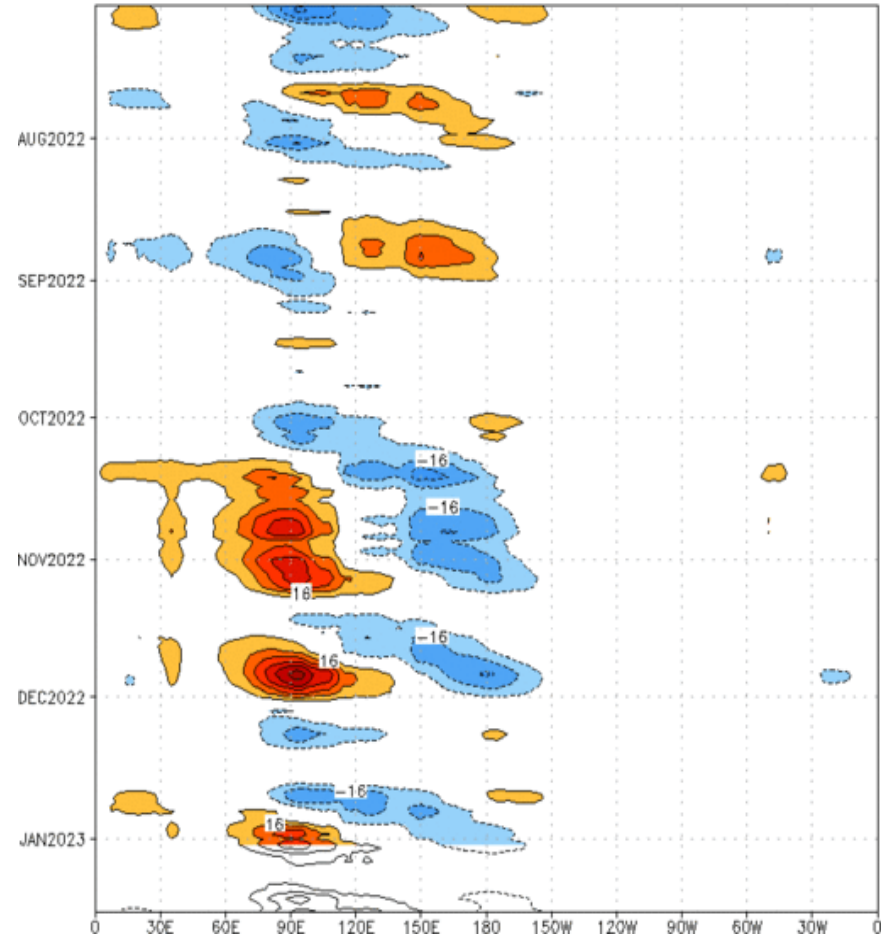
MJO: GEFS Forecast Evolution

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.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 18 Jun 2023
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:03-Jul-2022 to 02-Jan-2023
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

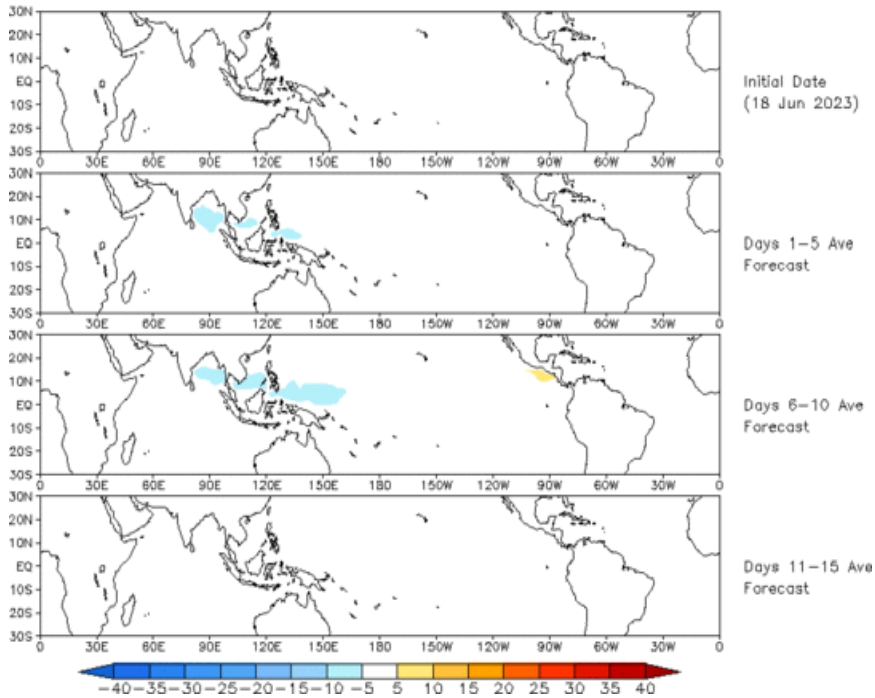


- The GEFS RMM-based OLR forecast depicts negative OLR (enhanced convection) over the Indian Ocean with small or near average anomalies across the remainder of the global tropics.

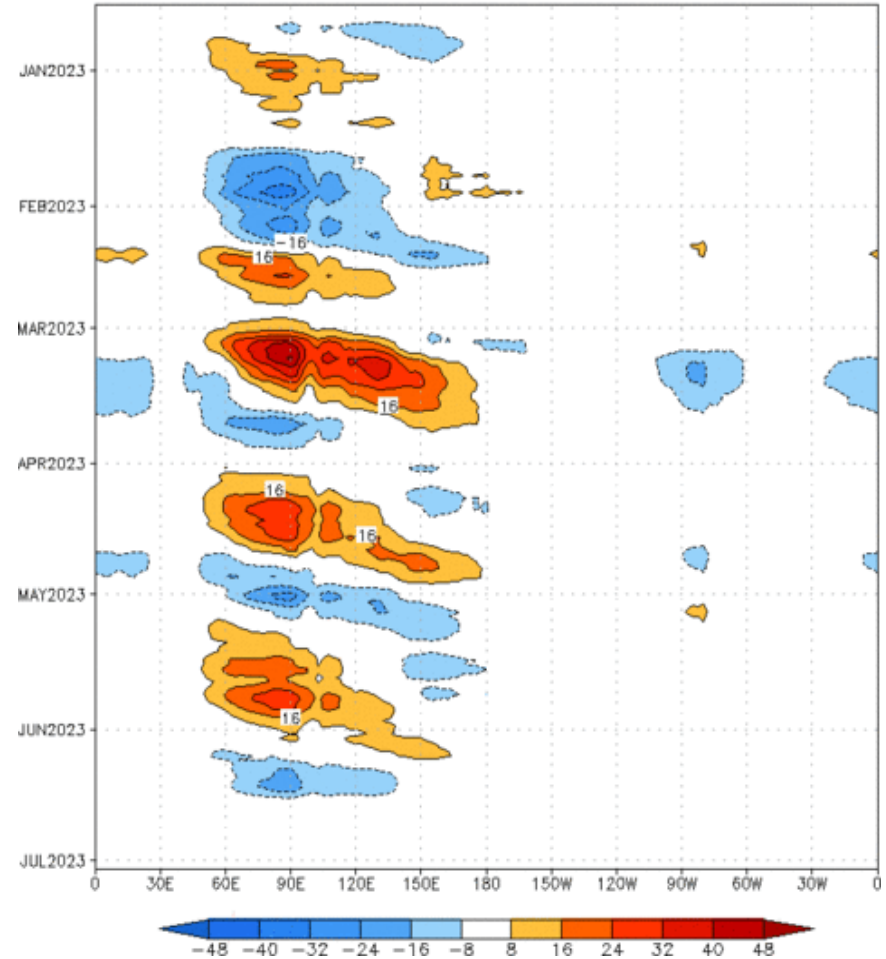
MJO: Constructed Analog Forecast Evolution

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.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (18 Jun 2023)



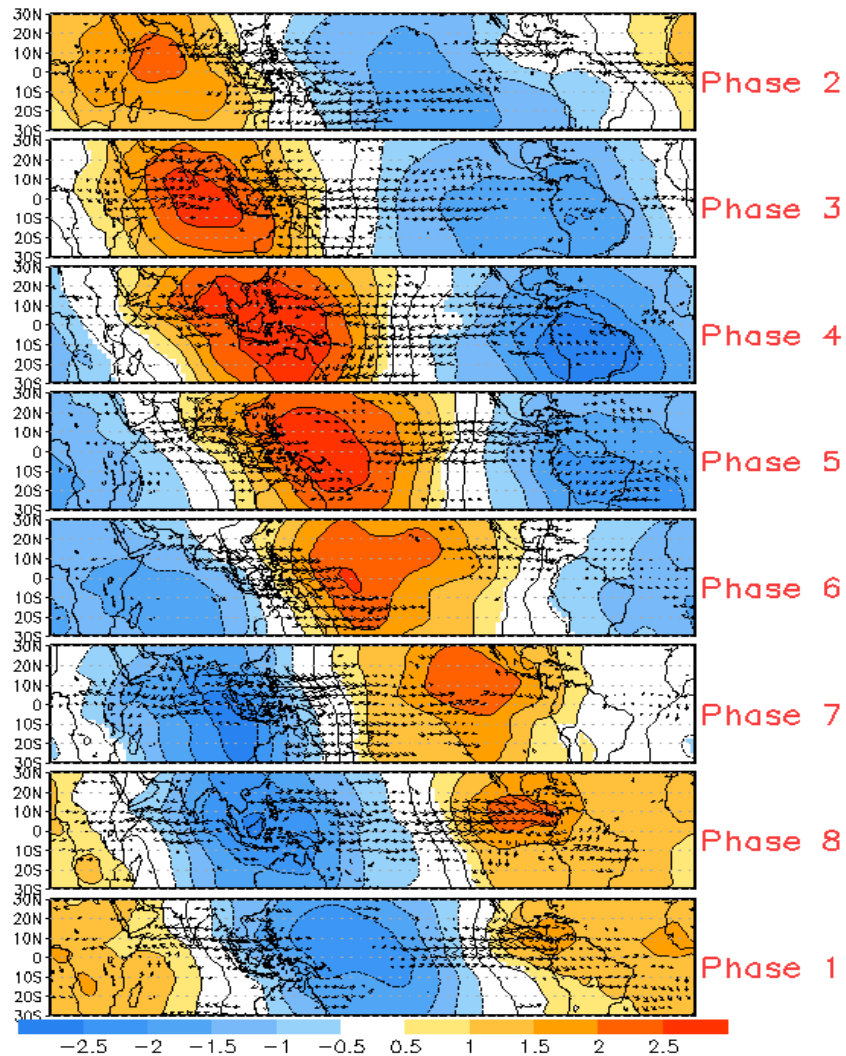
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:17-Dec-2022 to 18-Jun-2023
The unfilled contours are CA forecast reconstructed anomaly for 15 days



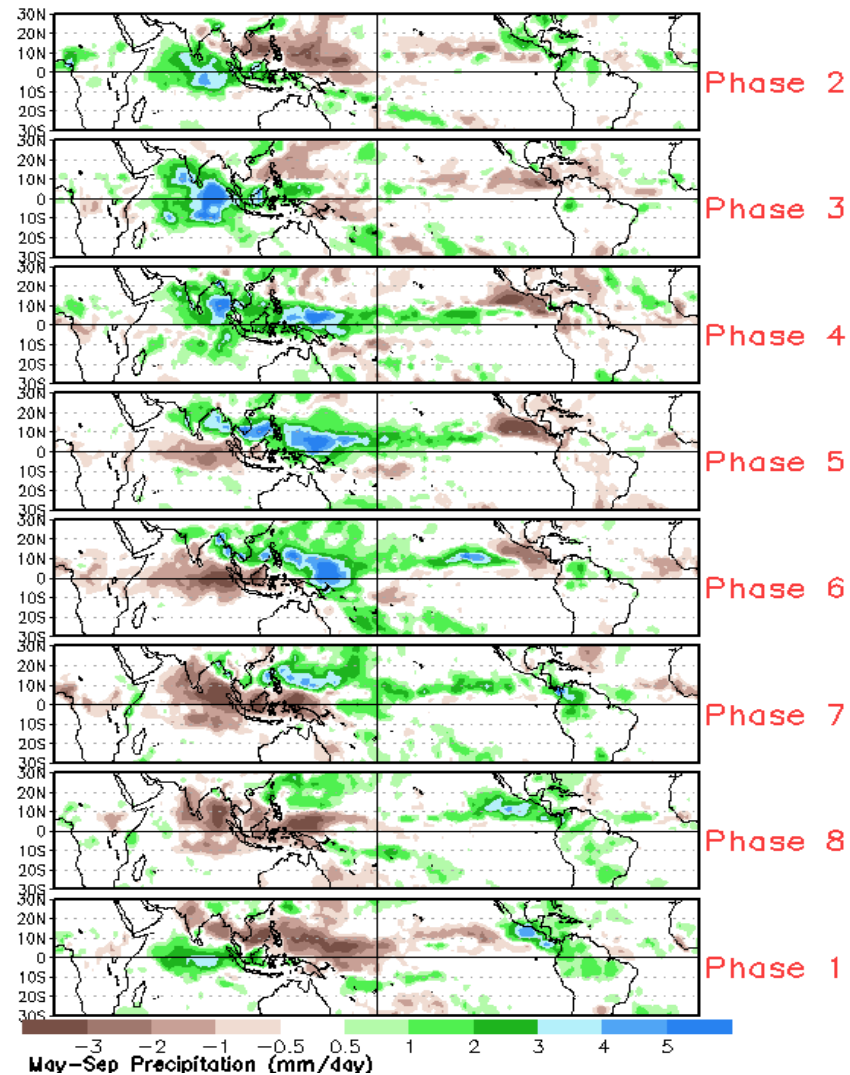
- The constructed analog RMM-based forecast depicts little or signal due to a predicted weak MJO during the next two weeks.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



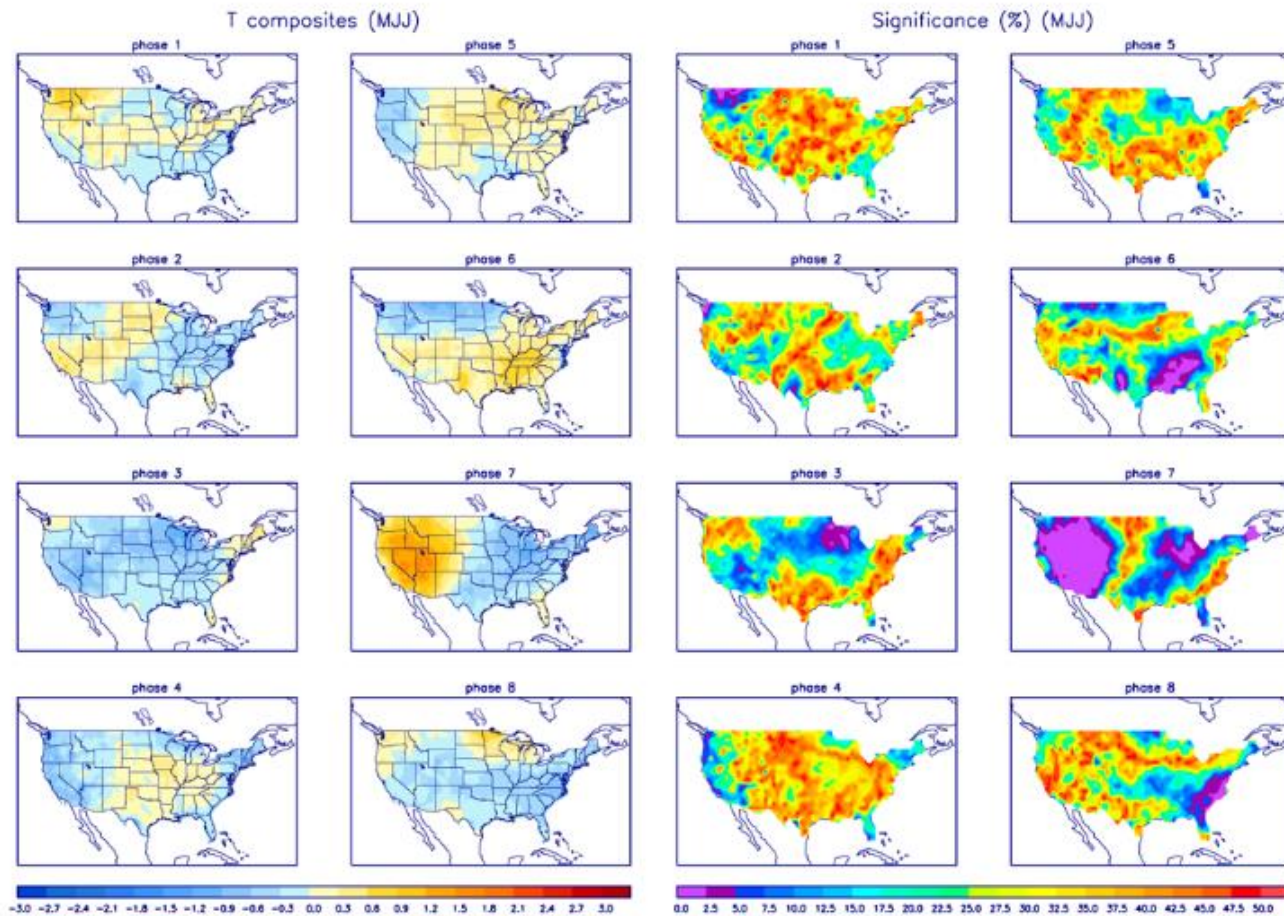
Precipitation Anomalies



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.



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.

