

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



Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
27 June 2022

Overview

- The 200-hPa velocity potential anomaly field and RMM index over the last week show a continuation of a nearly stationary pattern that was observed the previous week.
- Dynamical model RMM forecasts favor increasing chances of a developing MJO over the Indian Ocean as we move into early July.
- Tropical Storm Celia in the East Pacific is weakening while continuing its northwest track, and is expected to become an extratropical system in the coming week. Moisture surging northward as a result of Celia is helping to maintain an active North American Monsoon.
- Enhanced convection favored in the tropical Atlantic tied to an increased potential for tropical cyclone (TC) formation over the basin in the coming week.

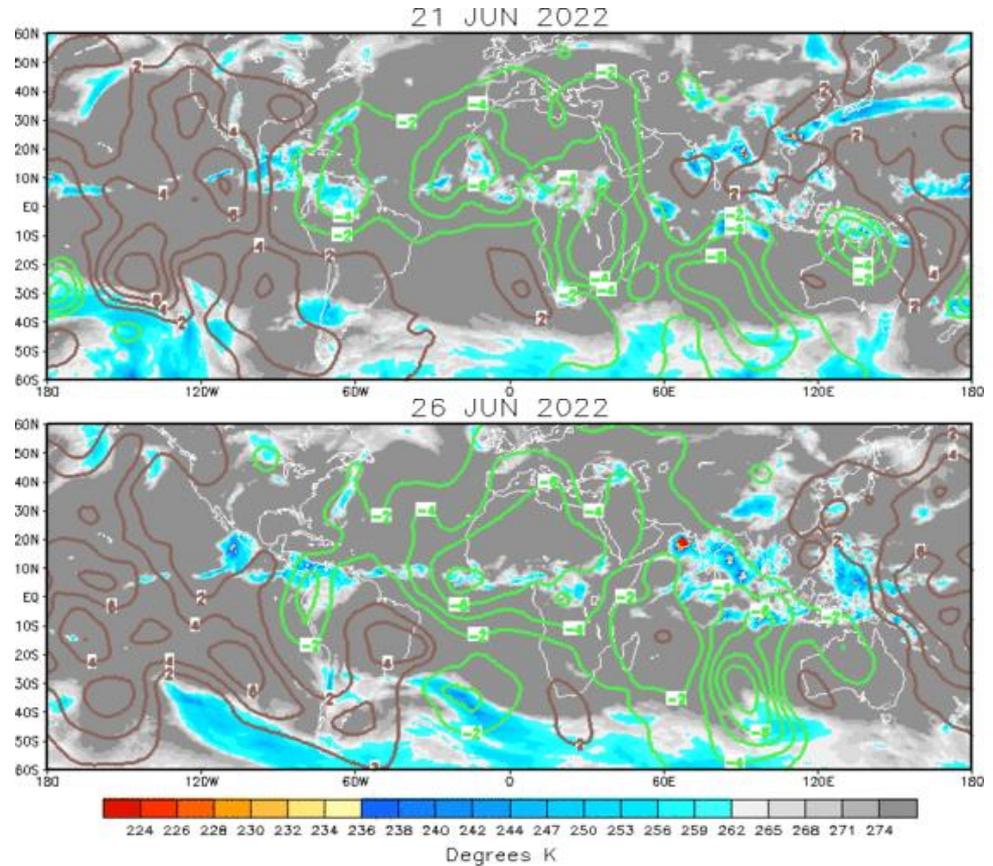
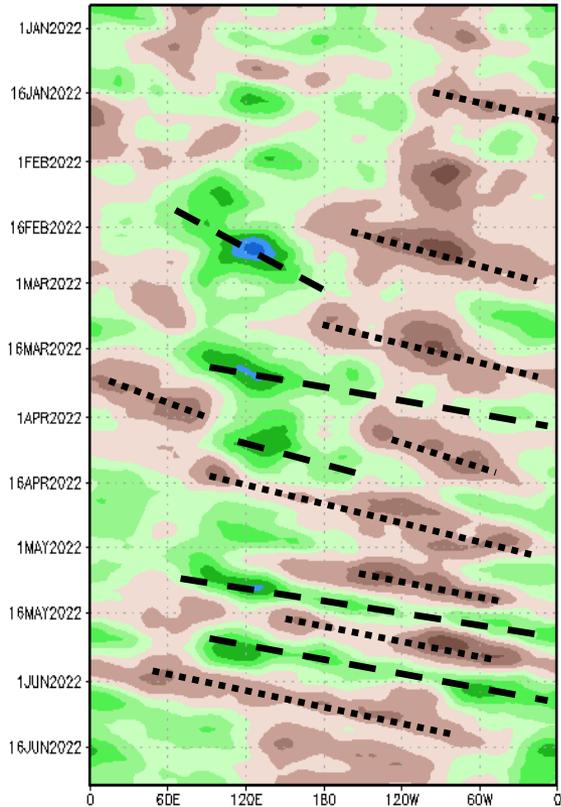
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

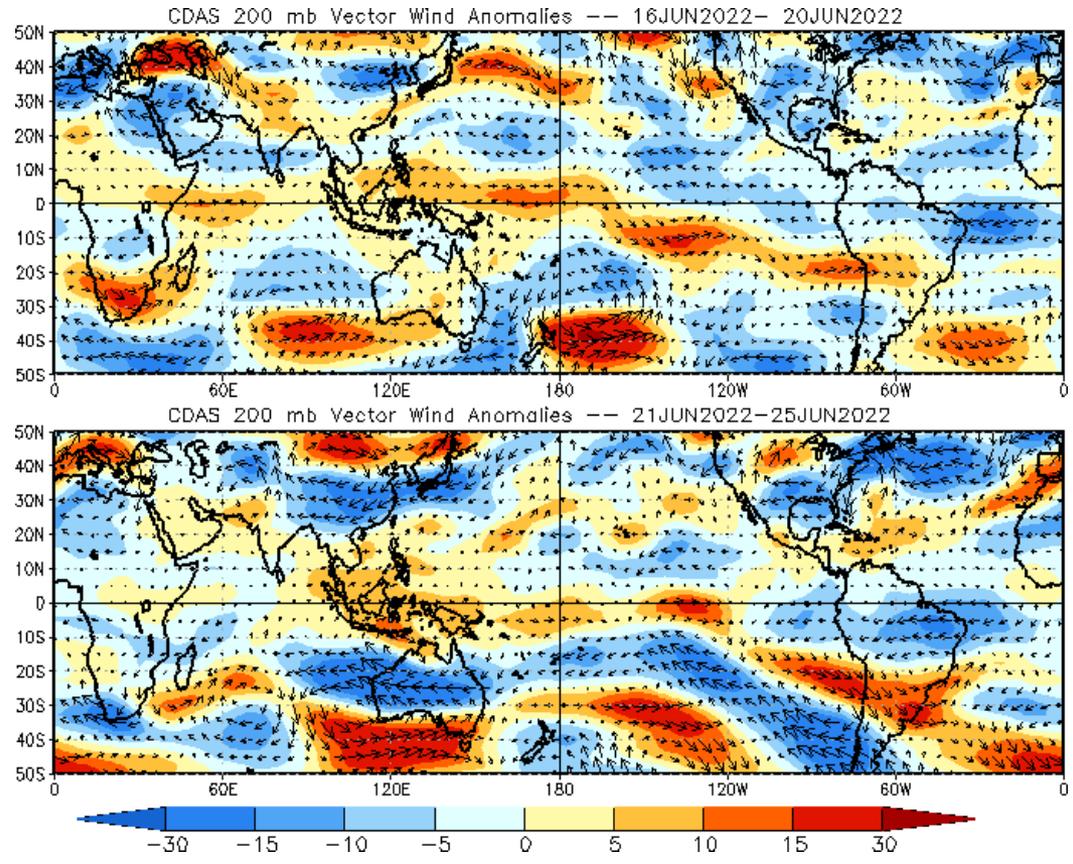
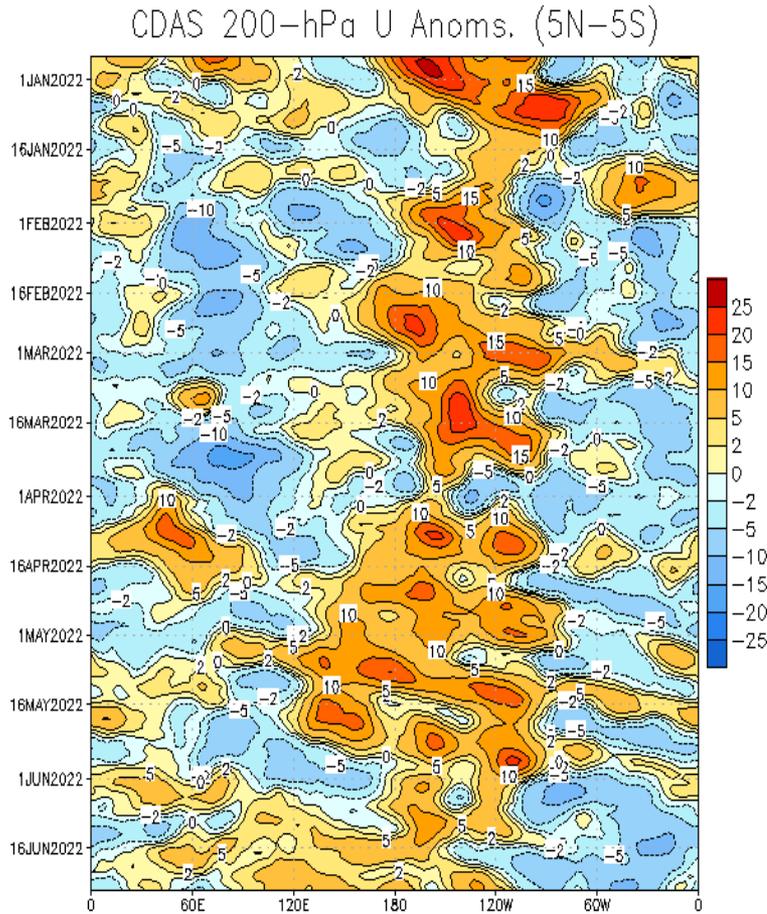
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- Frequent Kelvin waves were a key feature in the global tropics during the spring, but Kelvin Wave activity has subsided recently, replaced with a nearly stationary pattern over the last few weeks.
- This persistent stationary pattern of anomalous divergence (convergence) aloft has remained in place from Africa eastward to the western Maritime Continent (Pacific).

200-hPa Wind Anomalies

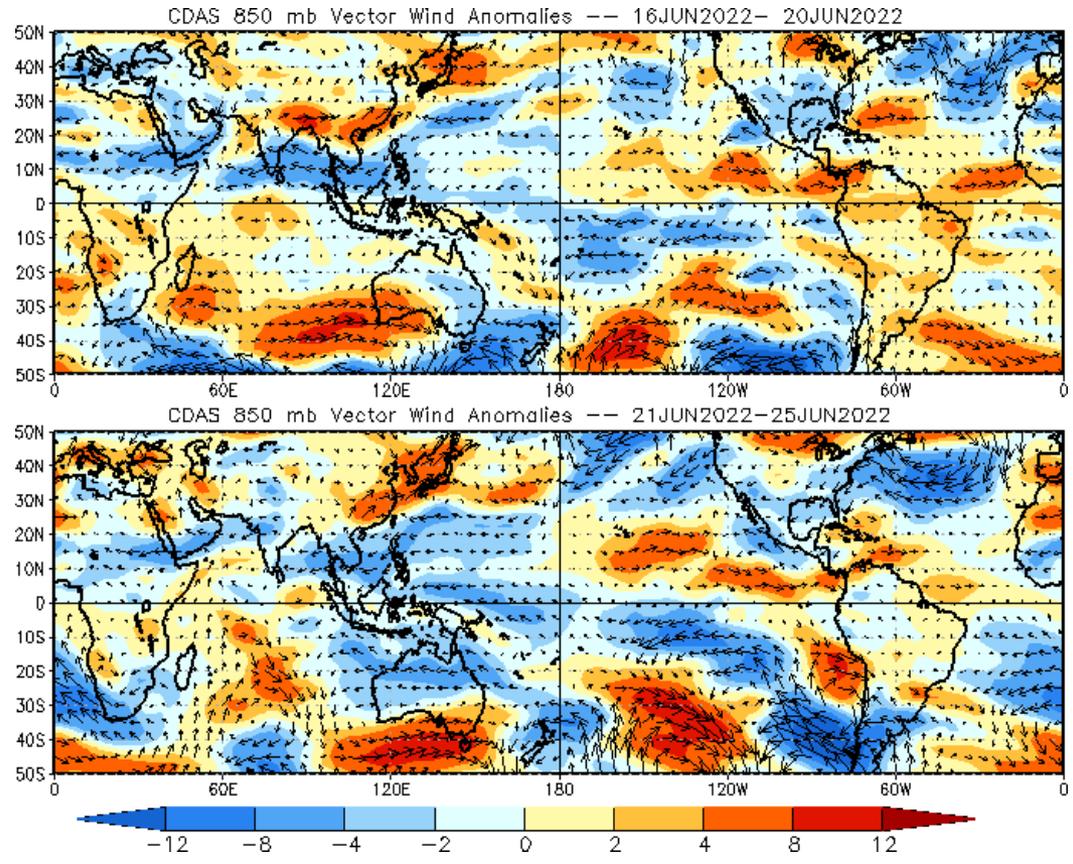
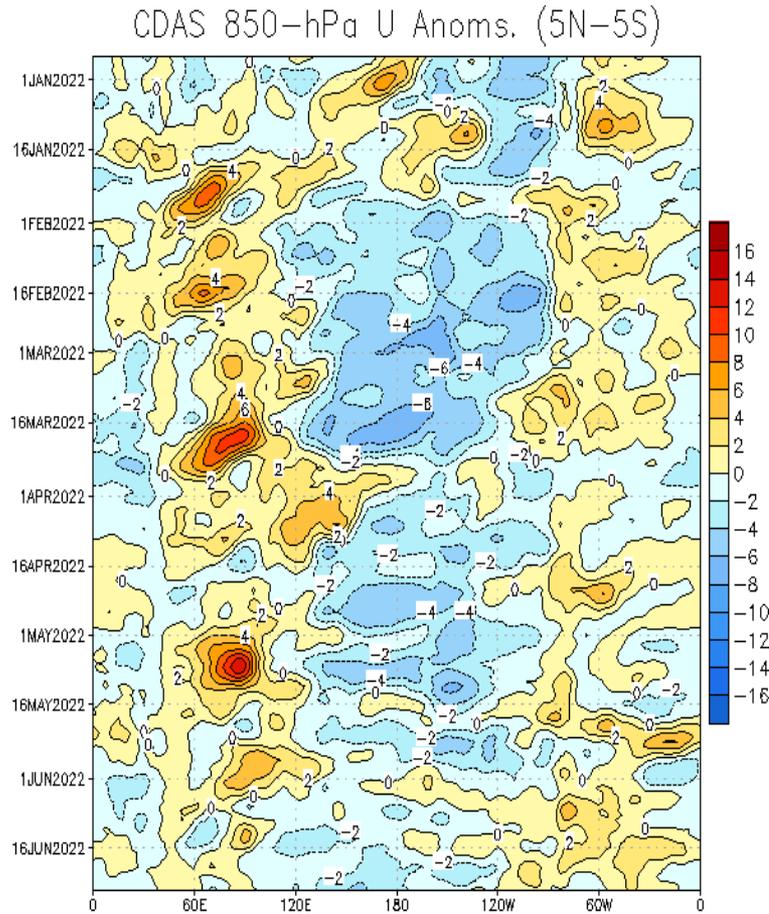
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Rapidly eastward shifting westerly anomalies seen in April and May likely tied to Kelvin wave activity have subsided, replaced by a more stable pattern of anomalous easterlies (westerlies) near the Date Line (eastern Pacific).
- The anomalous westerlies near the Date Line are consistent with the ongoing La Nina conditions and have expanded westward into the Maritime Continent over the last few weeks.

850-hPa Wind Anomalies

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

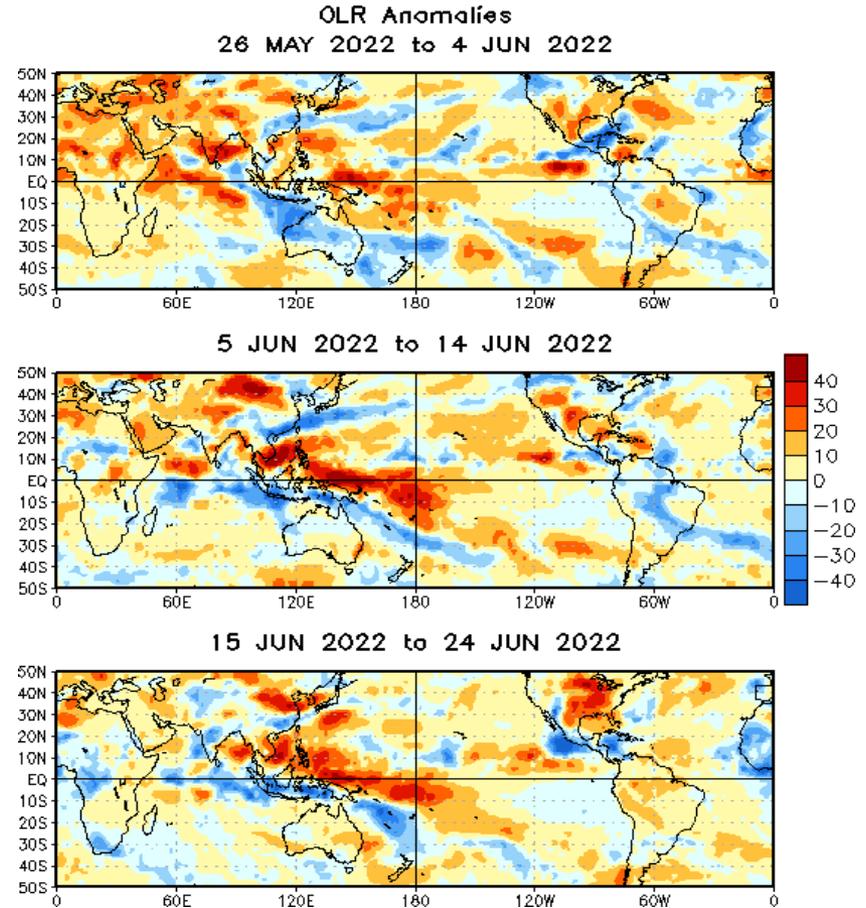
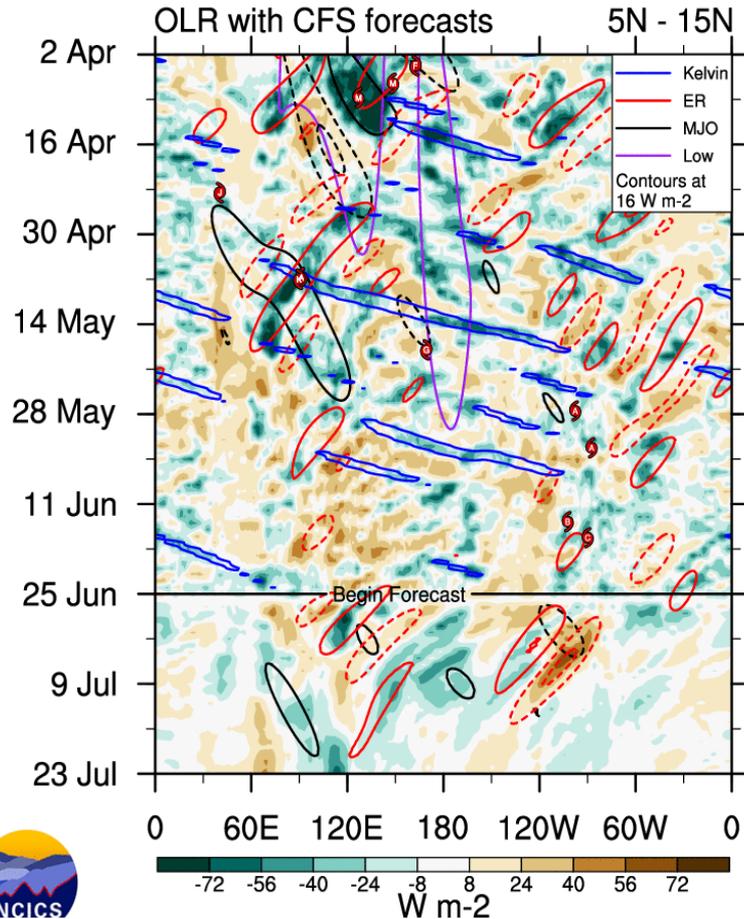


- Enhanced trades over the central equatorial Pacific have strengthened over the past week, while anomalous westerlies over the eastern Pacific have weakened somewhat. Anomalous westerlies have increased across the Caribbean during late June.
- Anomalous southeasterly flow although weakening continues across the Rio Grande Valley, maintaining moisture flux into the North American Monsoon region.

Outgoing Longwave Radiation (OLR) Anomalies

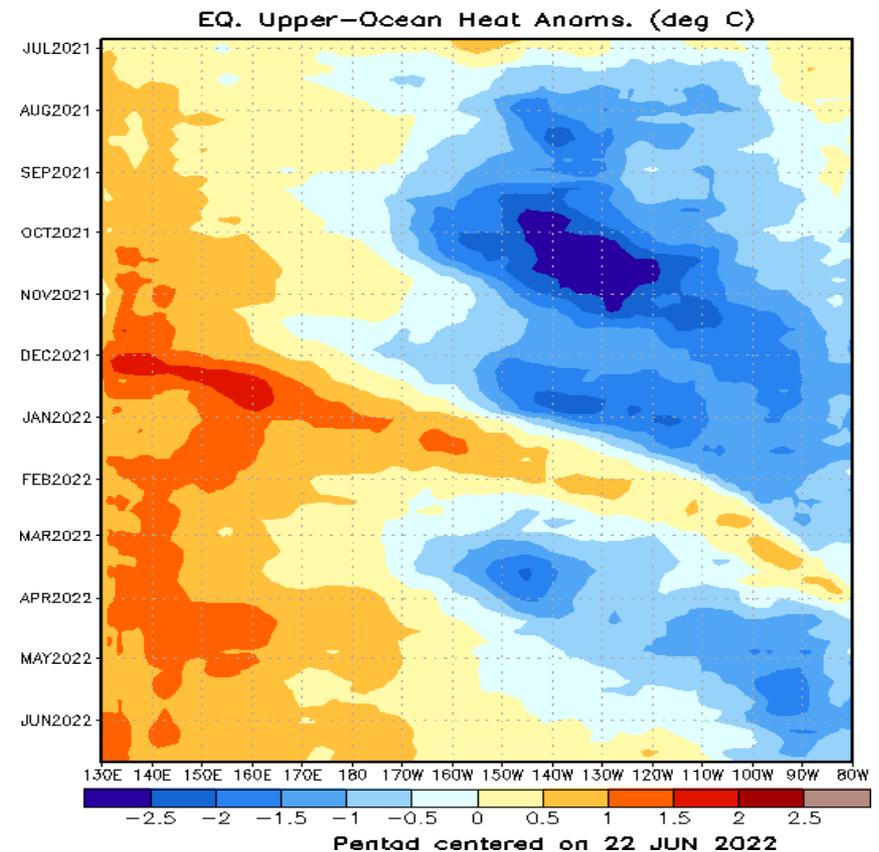
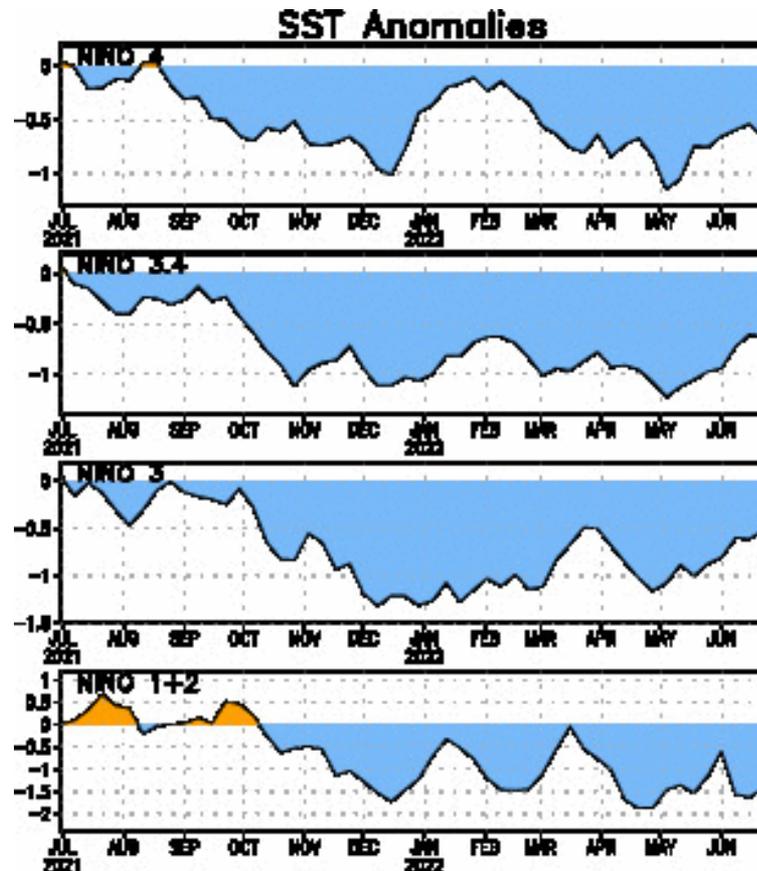
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- Suppressed convection to the west and along the Date Line consistent with ongoing La Nina conditions continues, intensifying and spreading westward across the Maritime Continent during the month of June.
- Objective filtering OLR forecasts focused north of the equator are favoring the emergence of Rossby wave activity on either side of the Date Line in the coming weeks.

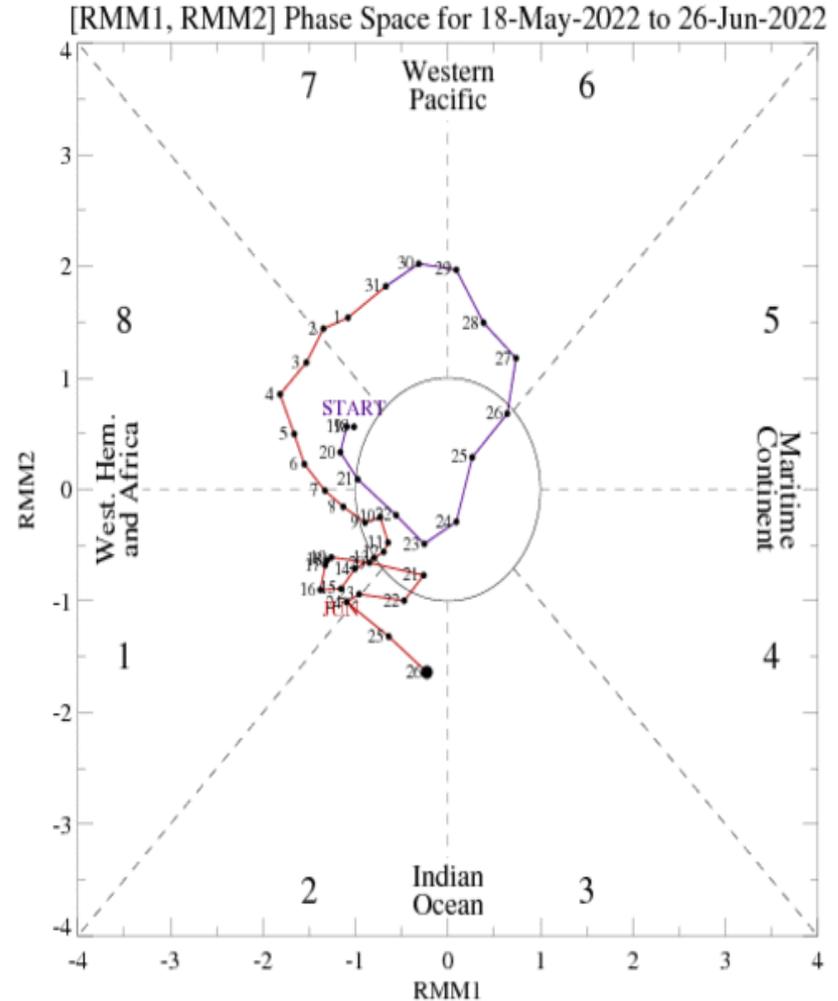
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Increases in equatorial sea surface temperatures due to increased low level westerly wind bursts tied to Kelvin Wave activity appear to be plateauing across the western Niño Regions.
- Positive subsurface temperature anomalies have continued to extend slightly eastward, though the magnitude of these anomalies are quite weaker compared to the significant downwelling event observed earlier in the year.

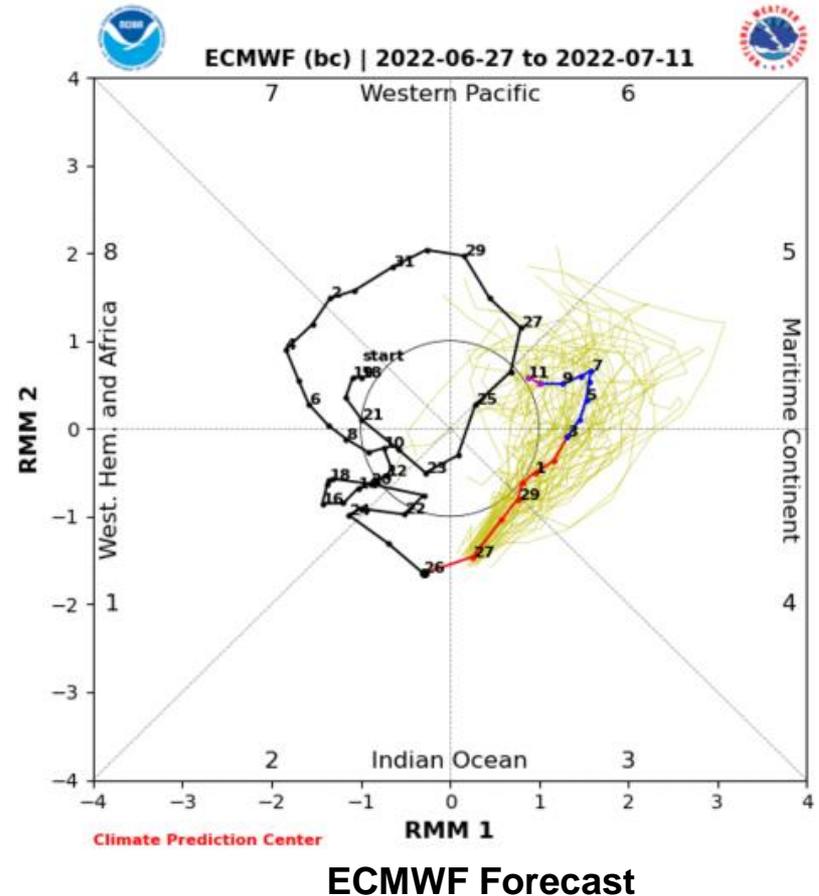
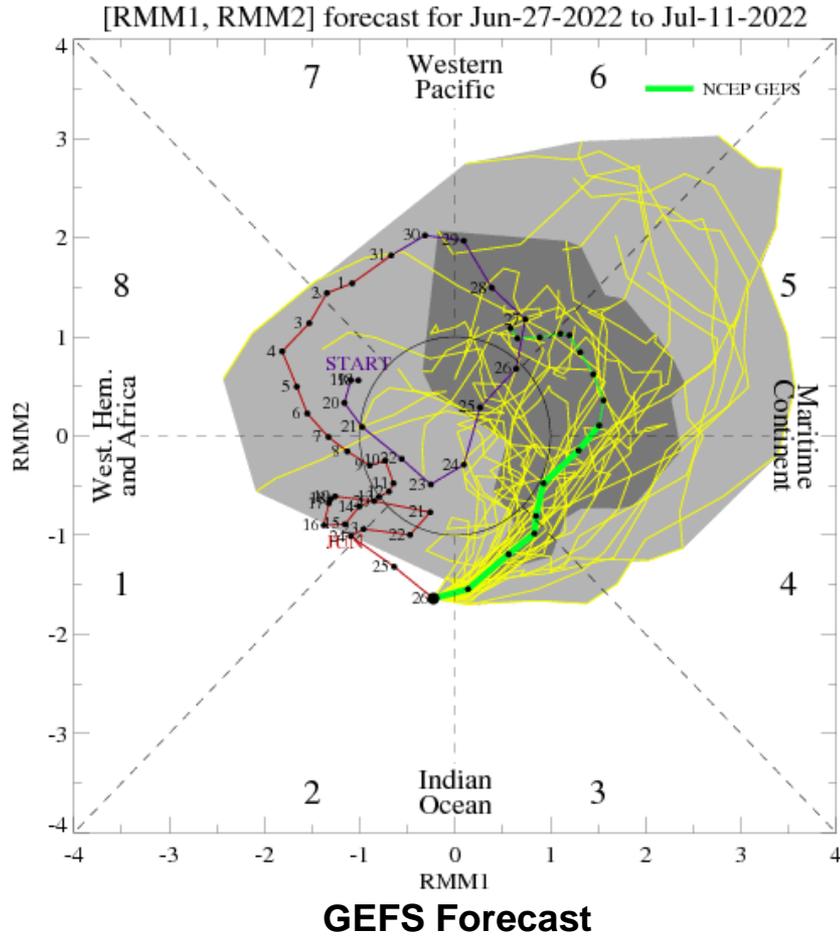
MJO Index: Recent Evolution

- Following eastward propagation during the first half of June, the RMM index meandered between phase 1&2, although there has been a more coherent eastward shift in the last few days.



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

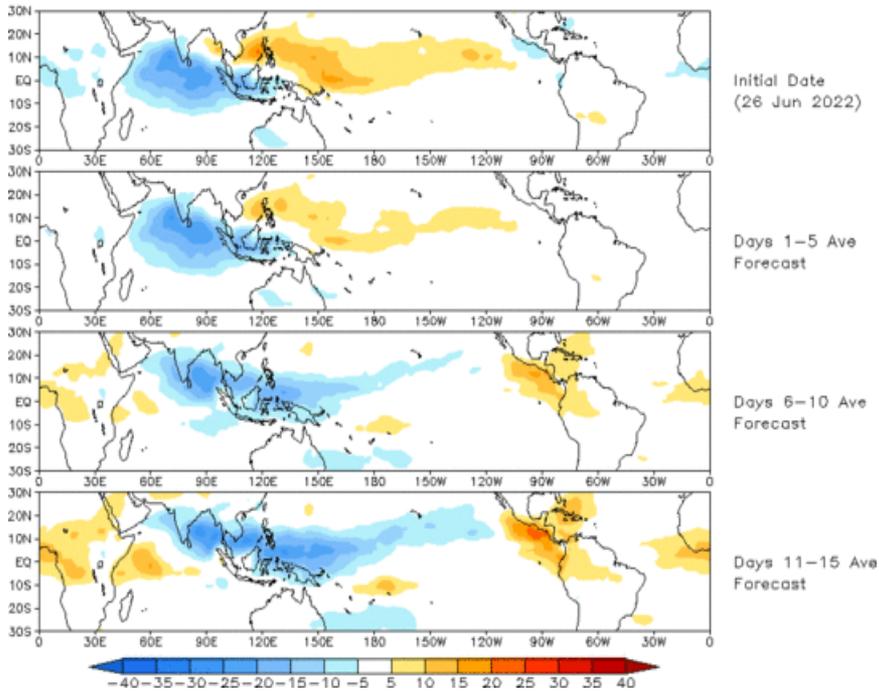


- Both the GEFS and ECMWF forecasts favor a continuance of the recent eastward propagation of the RMM signal, suggestive of a more coherent MJO emerging over the next two weeks.
- The GEFS ensemble members have a lot more spread than the ECMWF, but both ensemble averages depict a RMM signal of increased amplitude.

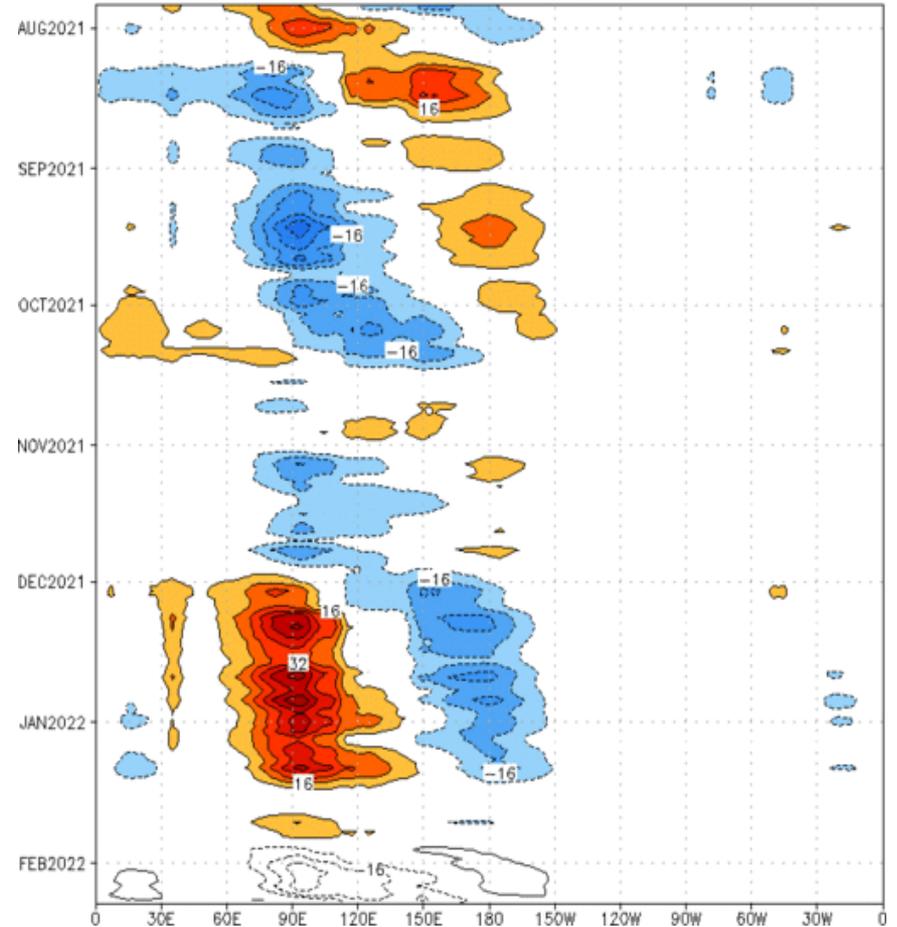
MJO: GEFS Forecast Evolution

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: 26 Jun 2022
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [$7.5^{\circ}S, 7.5^{\circ}N$] (cont: $4Wm^{-2}$) Period: 27-Jul-2021 to 26-Jan-2022
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

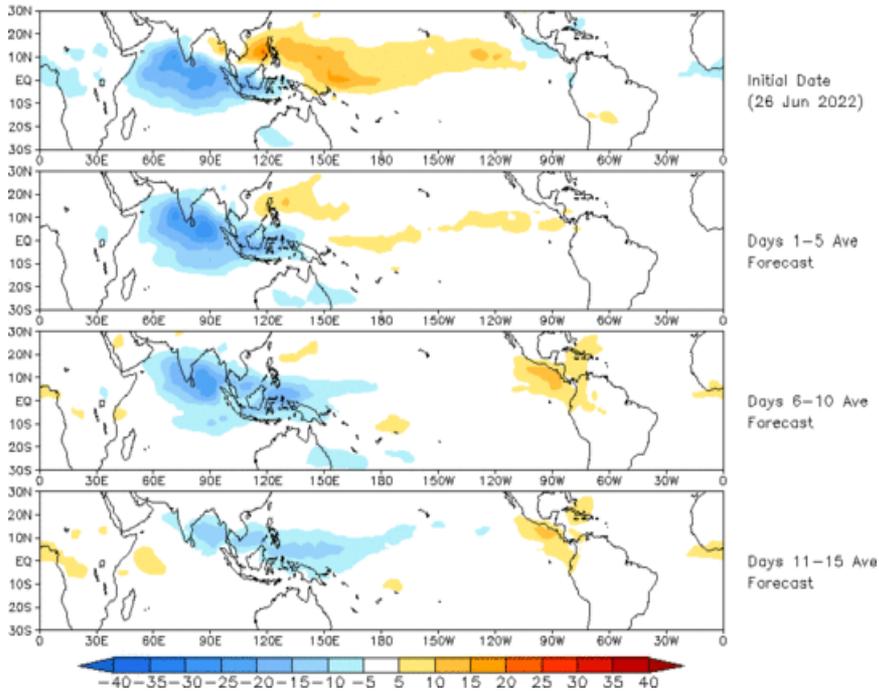


- The GEFS depicts an initially stationary pattern of OLR anomalies, but then begins to favor enhanced convection shifting from the Indian Ocean into the western Pacific during the week 2 period. The development of suppressed convection is favored over the tropical Americas.

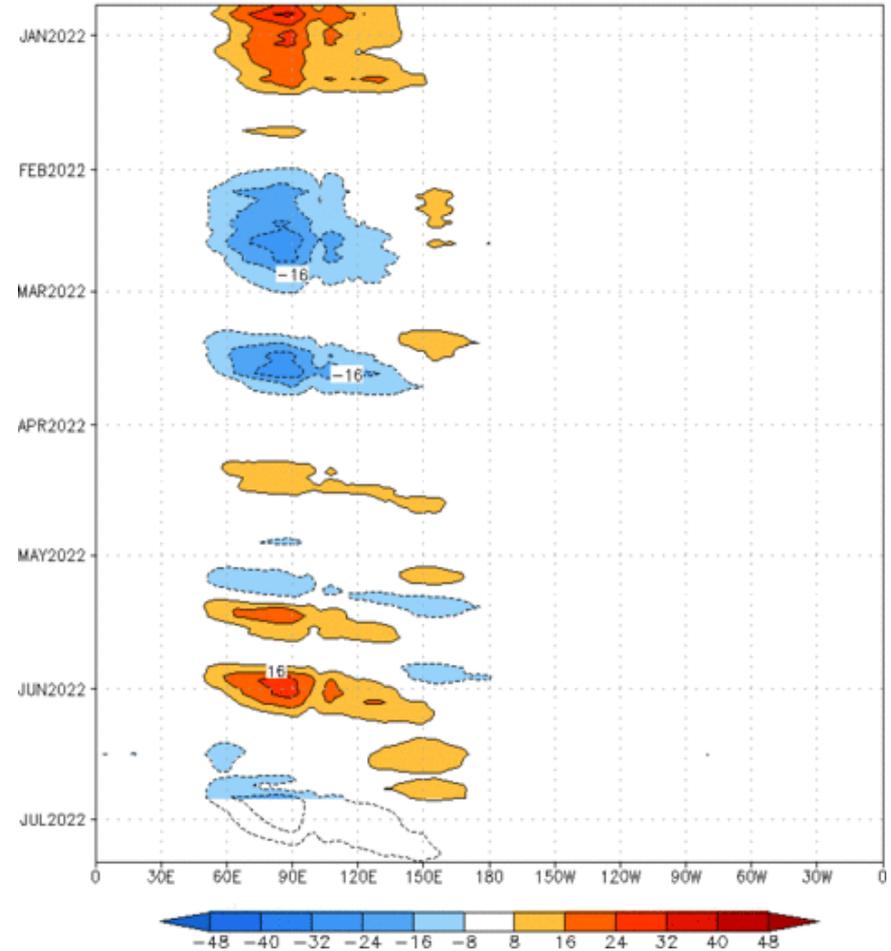
MJO: Constructed Analog Forecast Evolution

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 (26 Jun 2022)



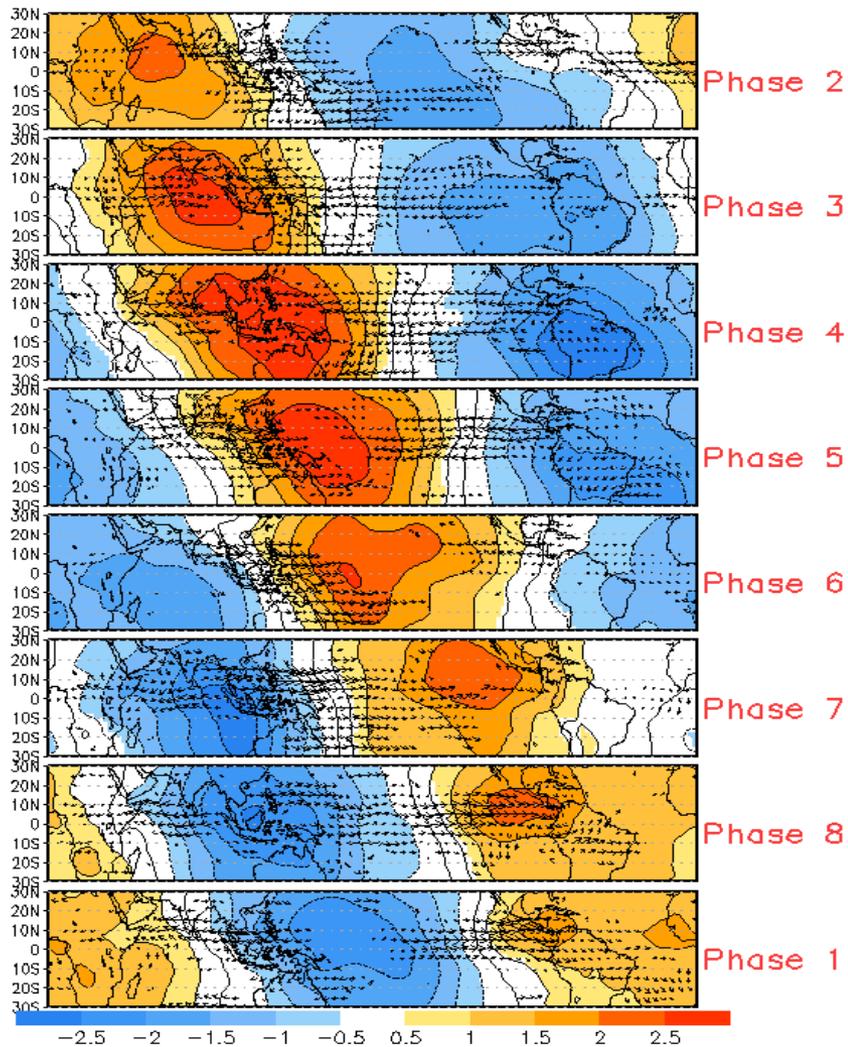
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:25-Dec-2021 to 26-Jun-2022
The unfilled contours are CA forecast reconstructed anomaly for 15 days



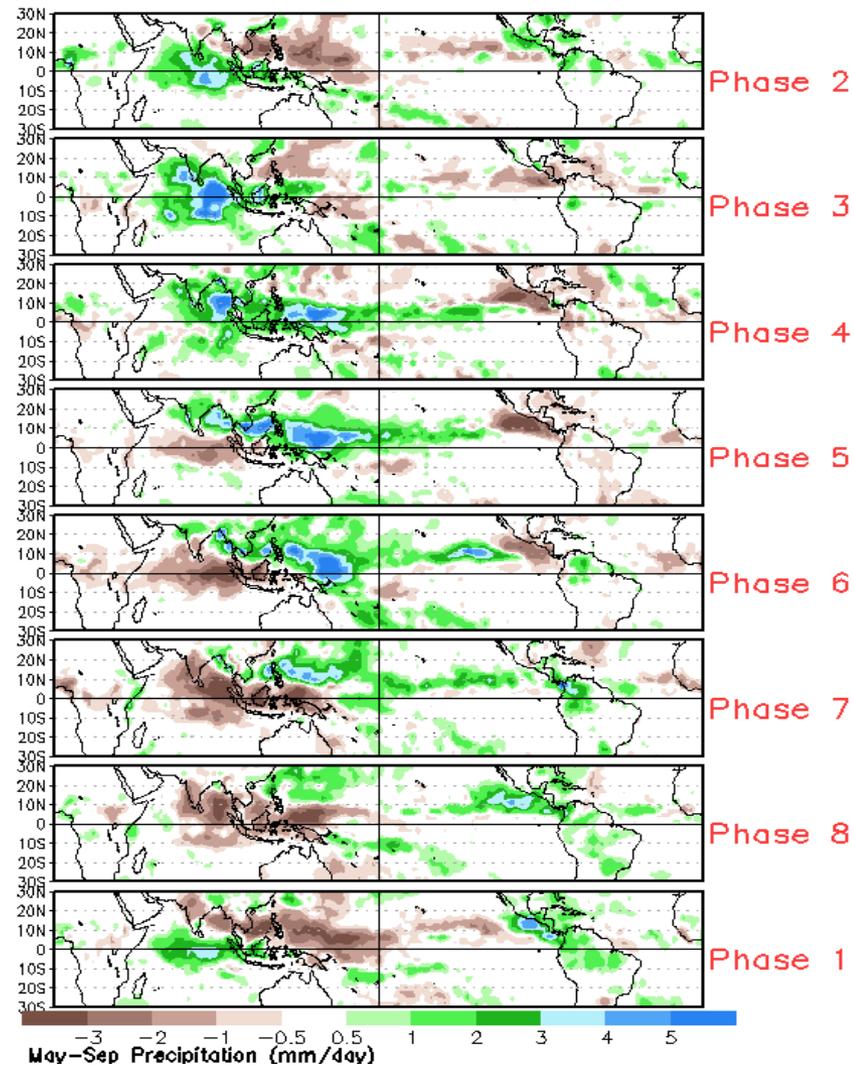
- The constructed analog forecast of RMM-based OLR anomalies is depicting a very similar evolution to the GEFS forecast over the coming two week period.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



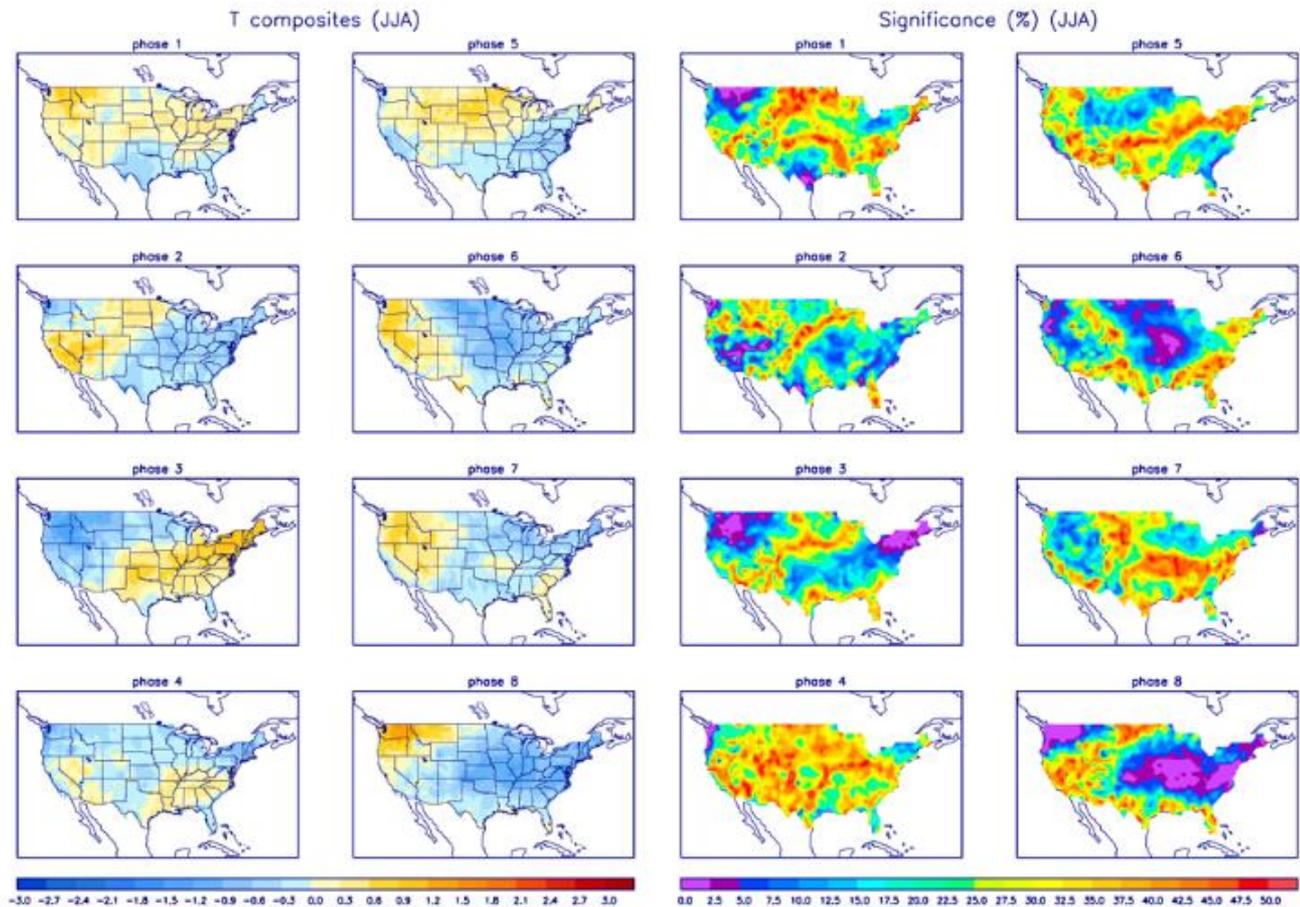
Precipitation Anomalies



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 - Temperature

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.

