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

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

Overview

- During the past week, the RMM index depicts a nearly stationary pattern which is also reflected in the 200-hPa velocity potential anomaly field.

- Dynamical model RMM forecasts feature an increasing chance of a developing MJO over the Indian Ocean during late June.

- The predicted northwest track of tropical cyclone Celia in the East Pacific is likely to result in a northward surge of moisture from the Gulf of California into northern Mexico and the southwestern United States. This is forecast to maintain the early robust North American monsoon from late June into the beginning of July.

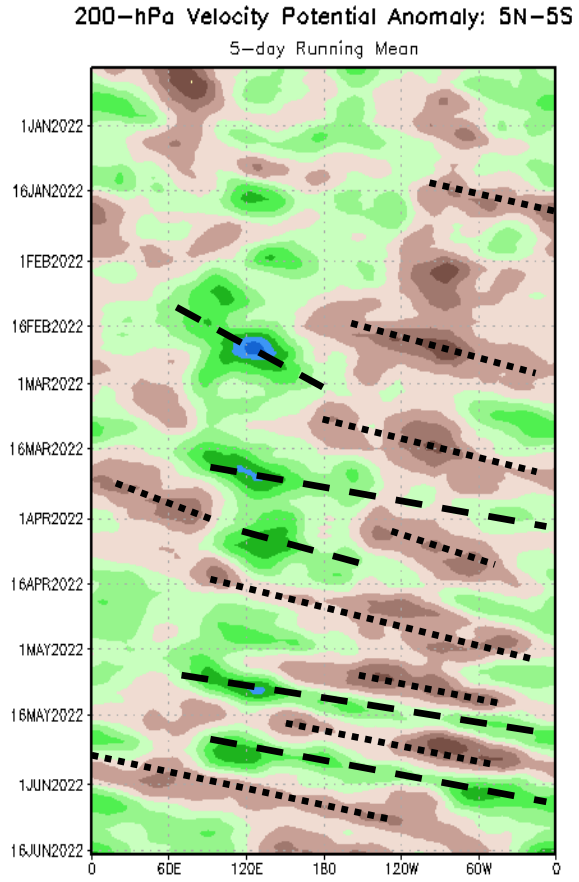
- If a MJO strengthens over the Indian Ocean, this favors a lull in tropical cyclone activity across the East Pacific

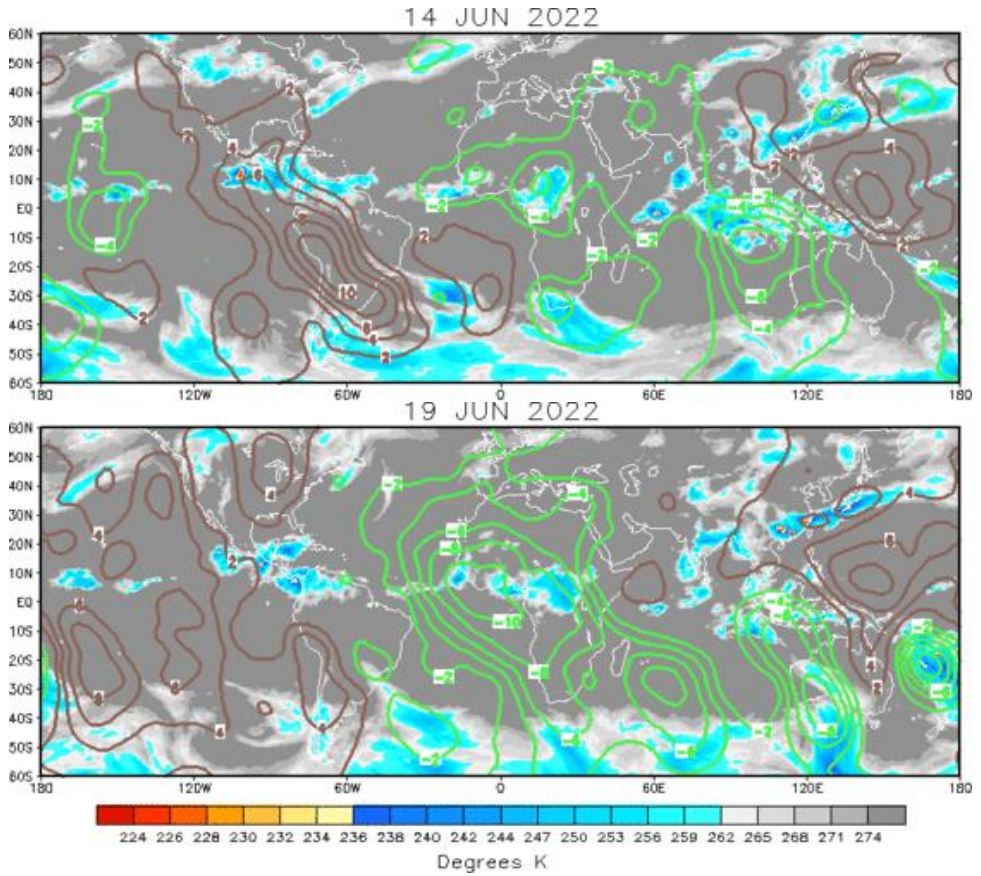
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

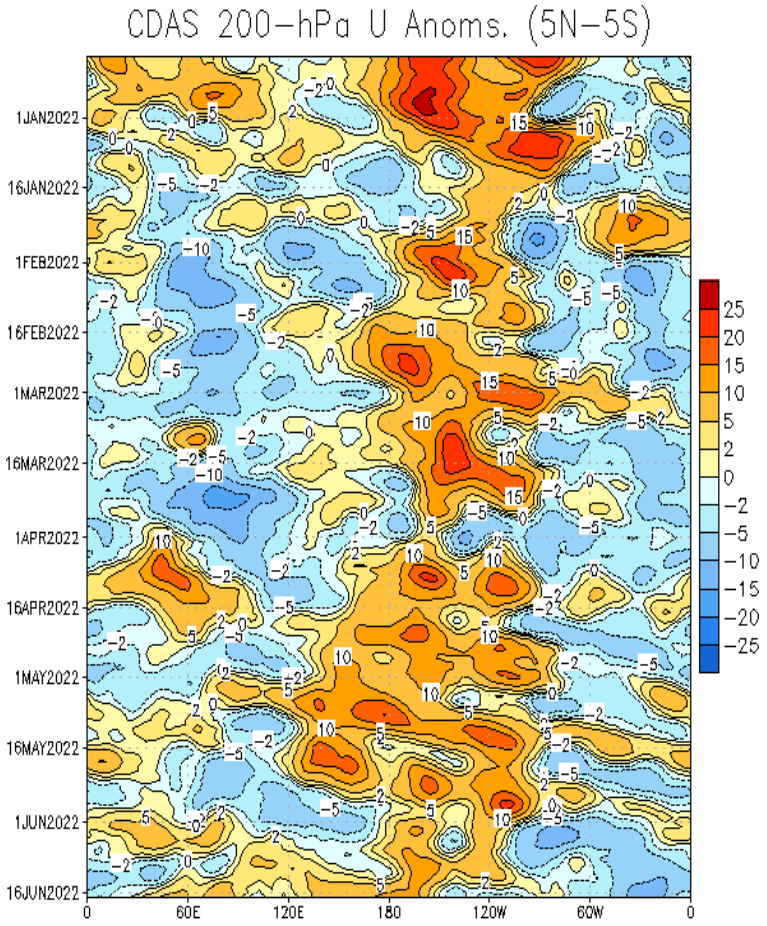


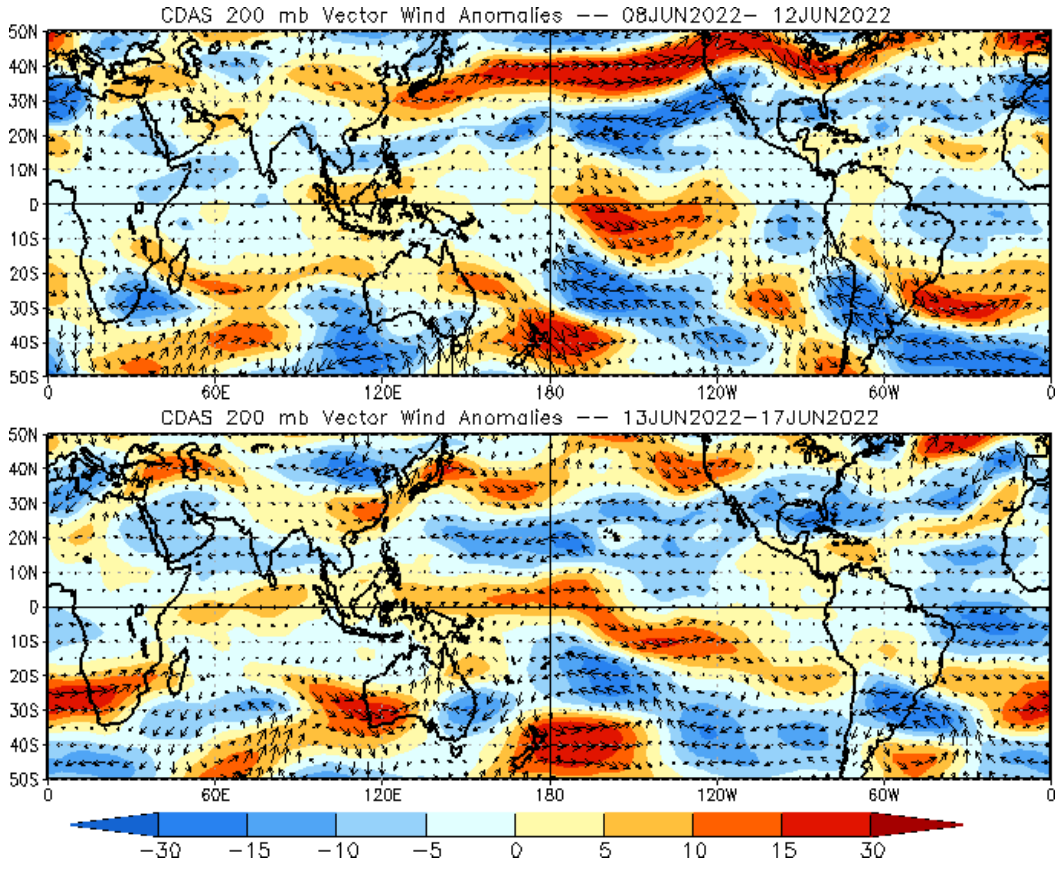


- Multiple atmospheric Kelvin waves propagated rapidly eastward over the global tropics during the spring.
- More recently, a more stationary pattern of anomalous divergence (convergence) aloft has become centered over Africa, the Indian Ocean, and western Maritime Continent (Pacific).

200-hPa Wind Anomalies

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



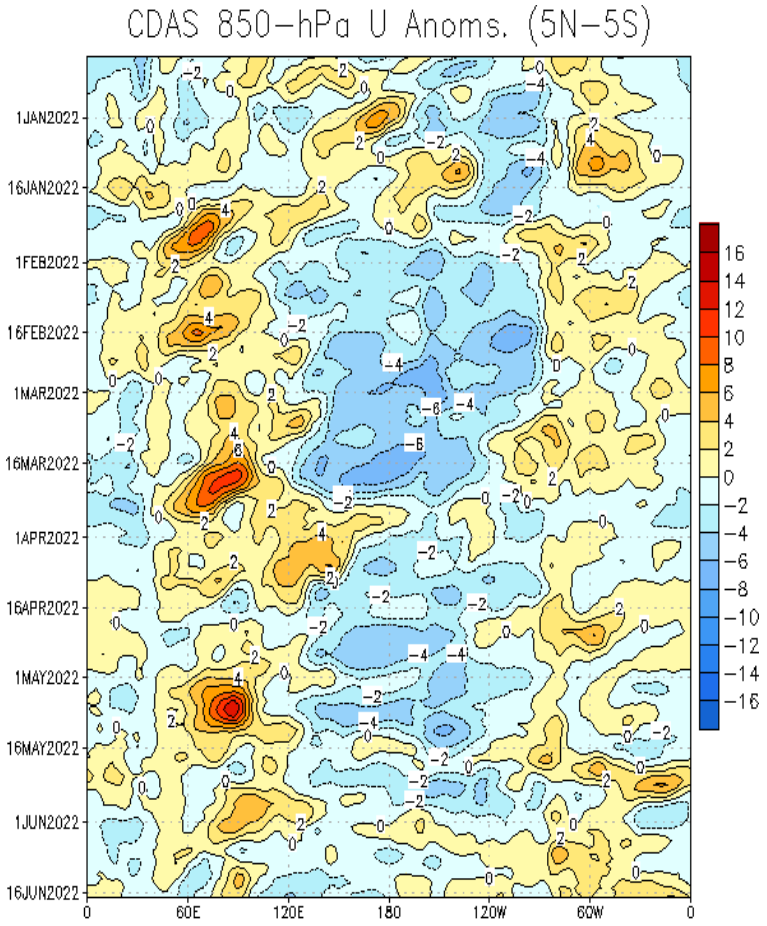


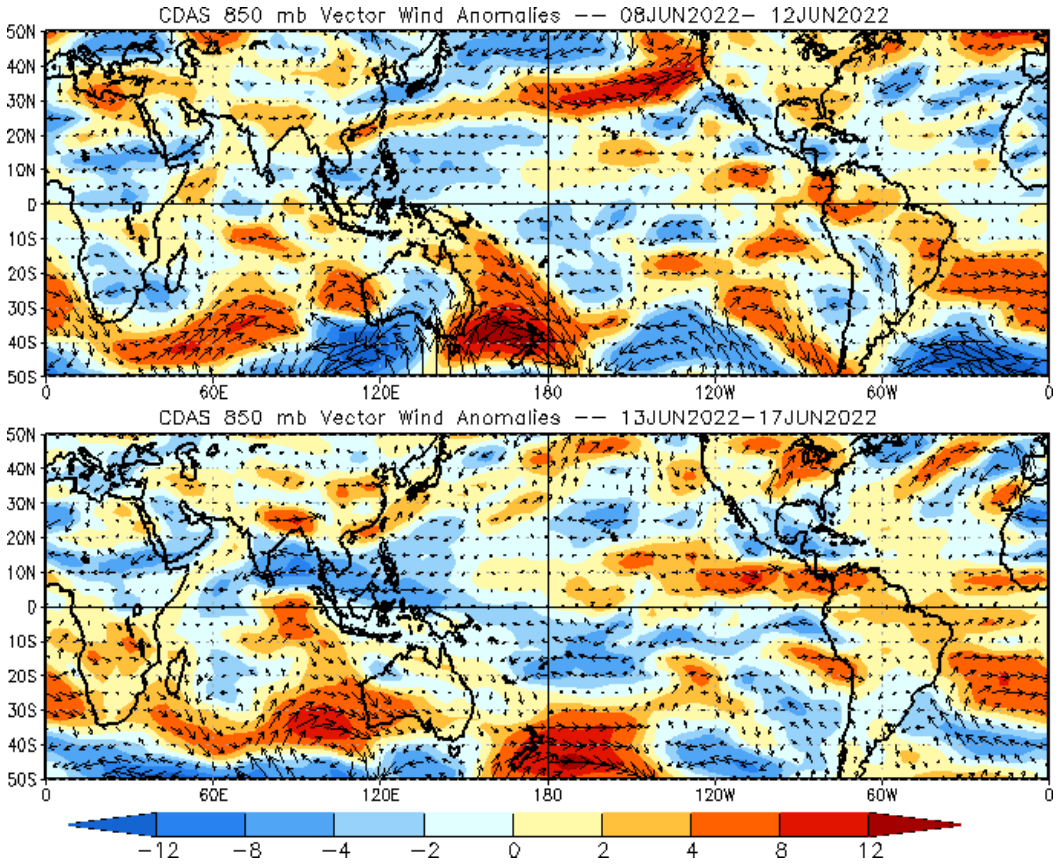
- During April and May, rapidly eastward shifting westerly anomalies were likely tied to Kelvin wave activity.

- Consistent with the ongoing La Nina, anomalous westerlies aloft persist over the equatorial Pacific and have expanded to west of the Date Line during June.

850-hPa Wind Anomalies

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



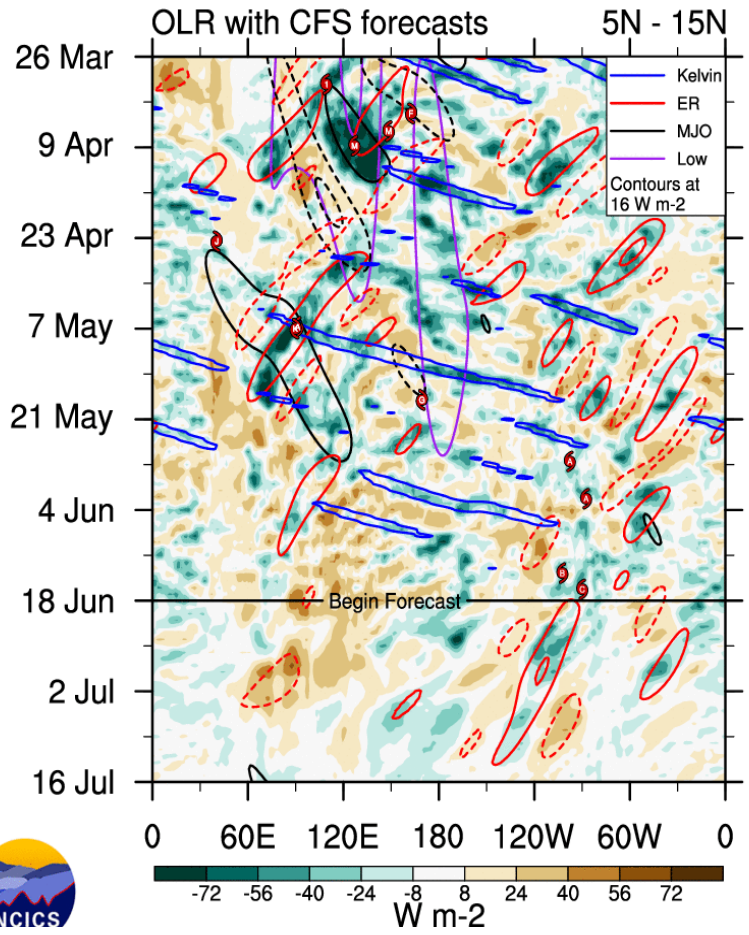


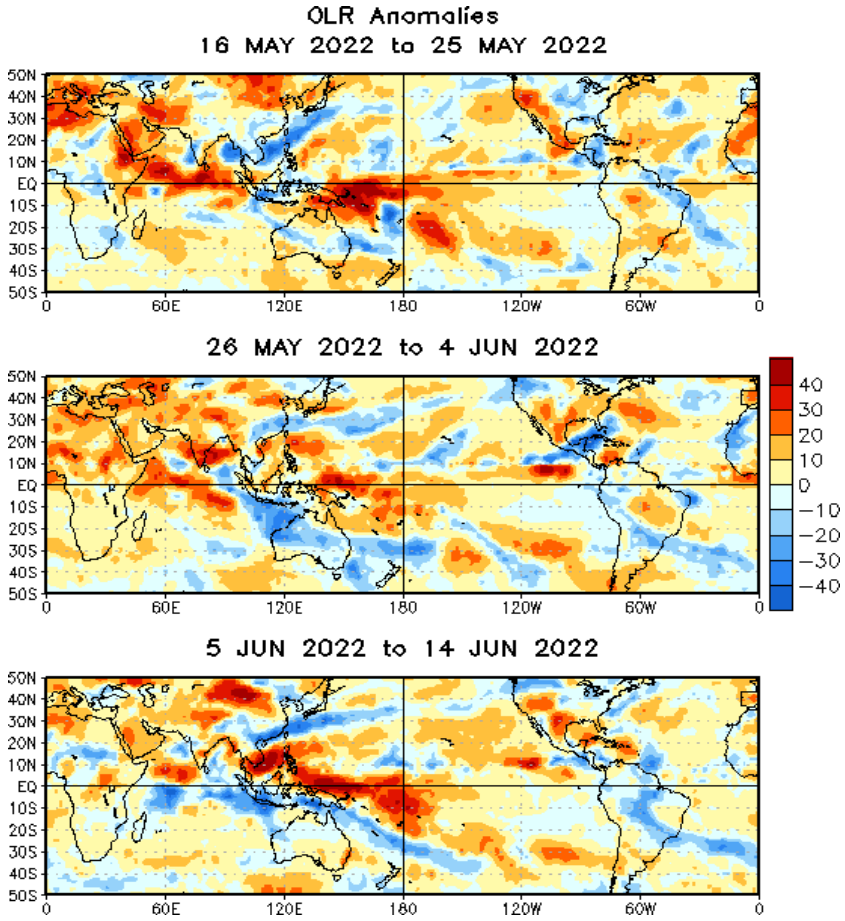
- Enhanced trades have returned over the central equatorial Pacific, with anomalous westerlies persisting across the eastern Pacific conducive for tropical cyclone activity.

- During mid-June, anomalous southeasterly flow began across the Rio Grande Valley, increasing moisture into the North American Monsoon region.

Outgoing Longwave Radiation (OLR) Anomalies

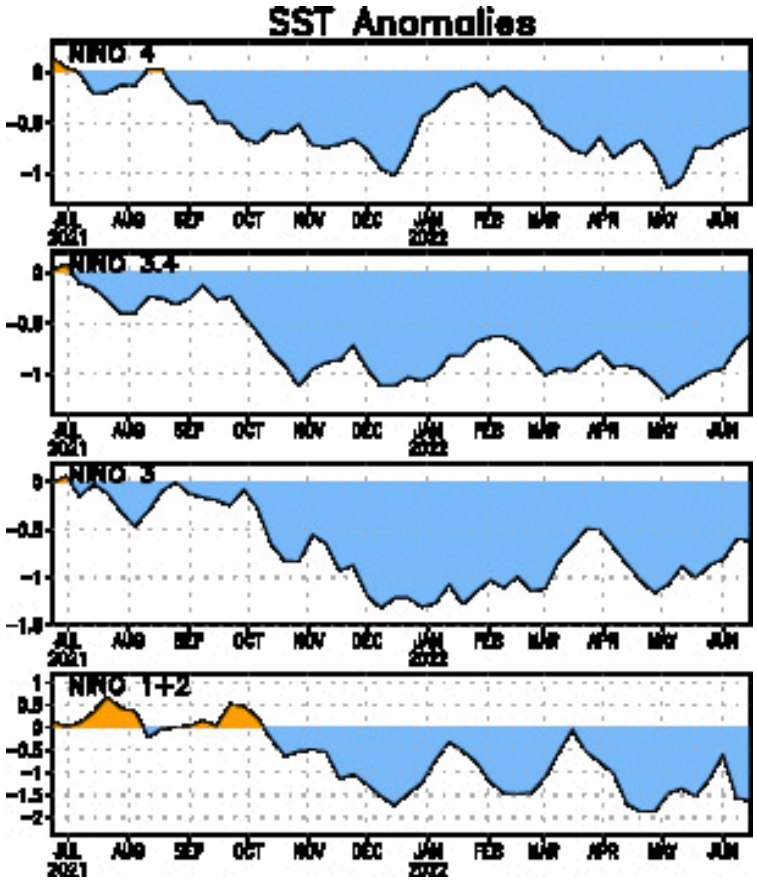
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

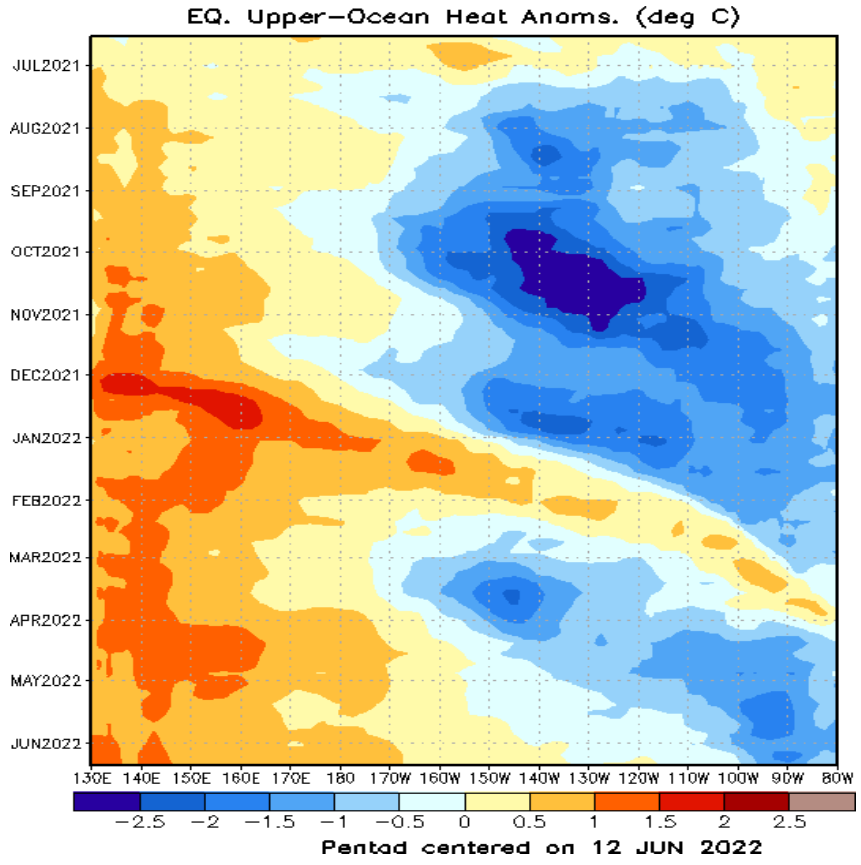




- Suppressed convection to the west and along the Date Line has remained the most predominant feature in the OLR field during the last several months, with much of this suppression expanding westward across the Maritime Continent during early June.
- OLR forecasts focused north of the equator are favoring enhanced convection and Rossby wave activity in the objective filtering between 120W and 60W.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

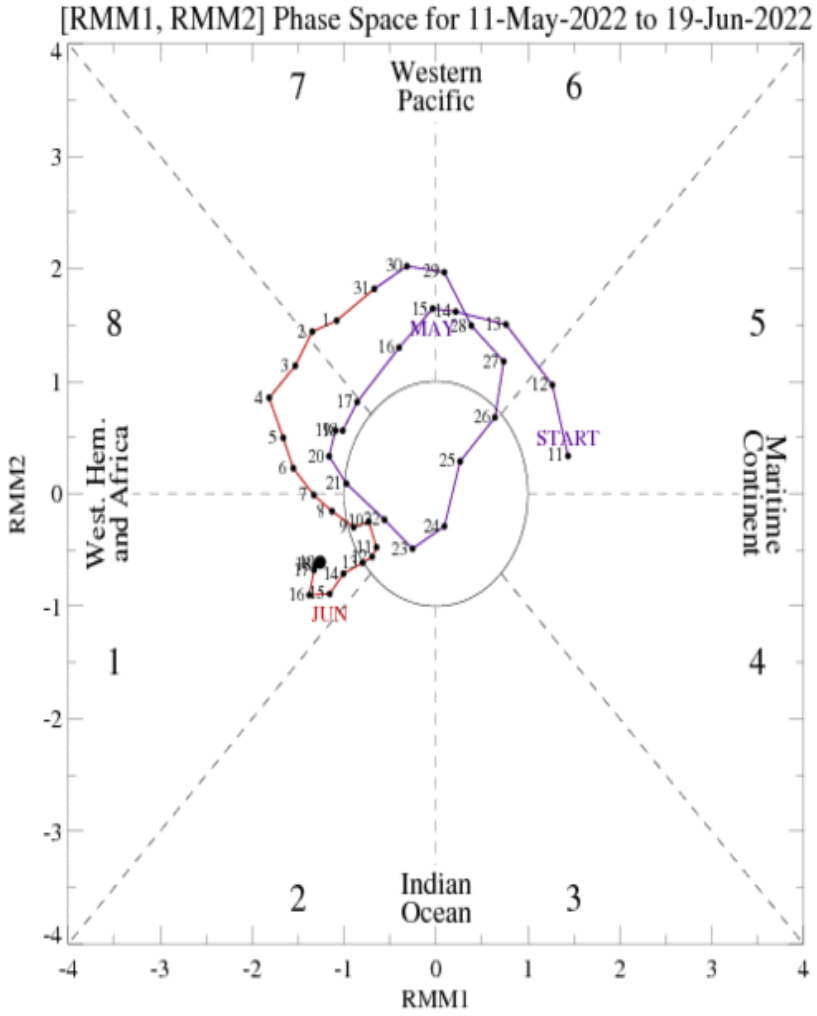




- Increased low level westerly wind bursts tied to Kelvin Wave activity has resulted in an increase in sea surface temperatures across the Niño Regions during the past several weeks, although anomalies remain largely negative.
- Positive subsurface temperature anomalies continue to the west of 140°W, though the eastward extent and magnitude of these anomalies are quite weaker compared to the downwelling event observed earlier in the year.

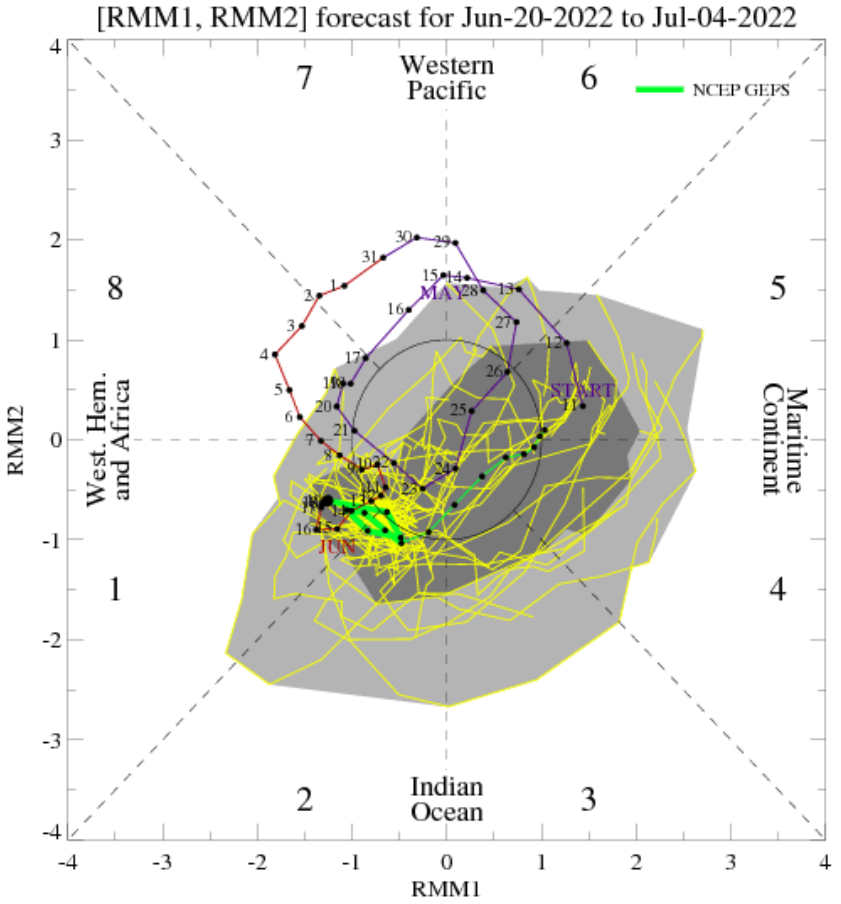
MJO Index: Recent Evolution

- Following eastward propagation earlier in June, the RMM index depicts a stationary signal over Africa during the past week.

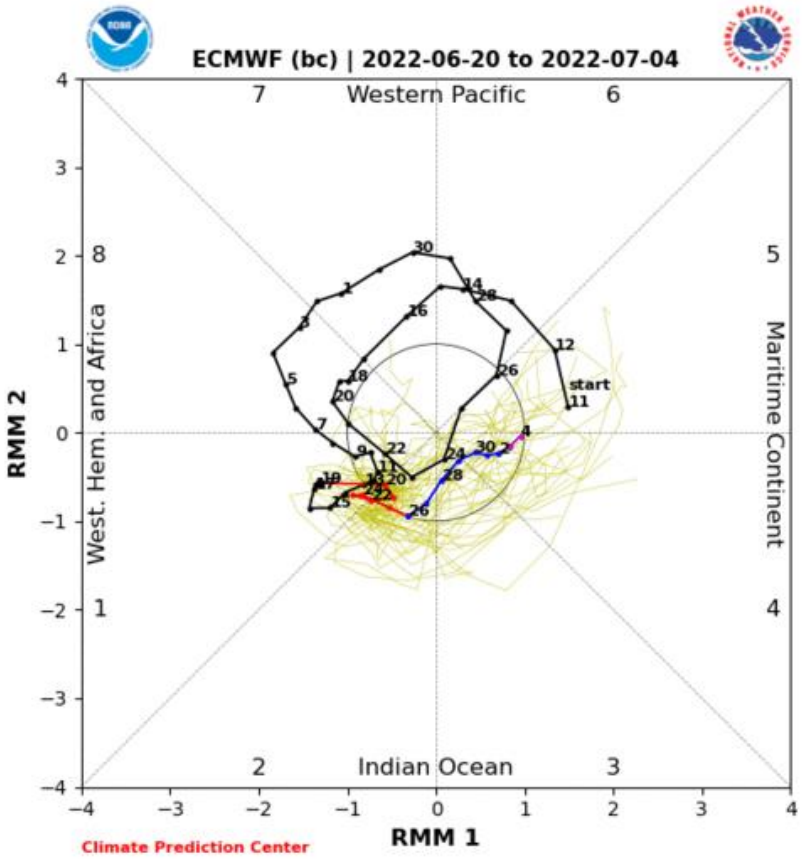


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

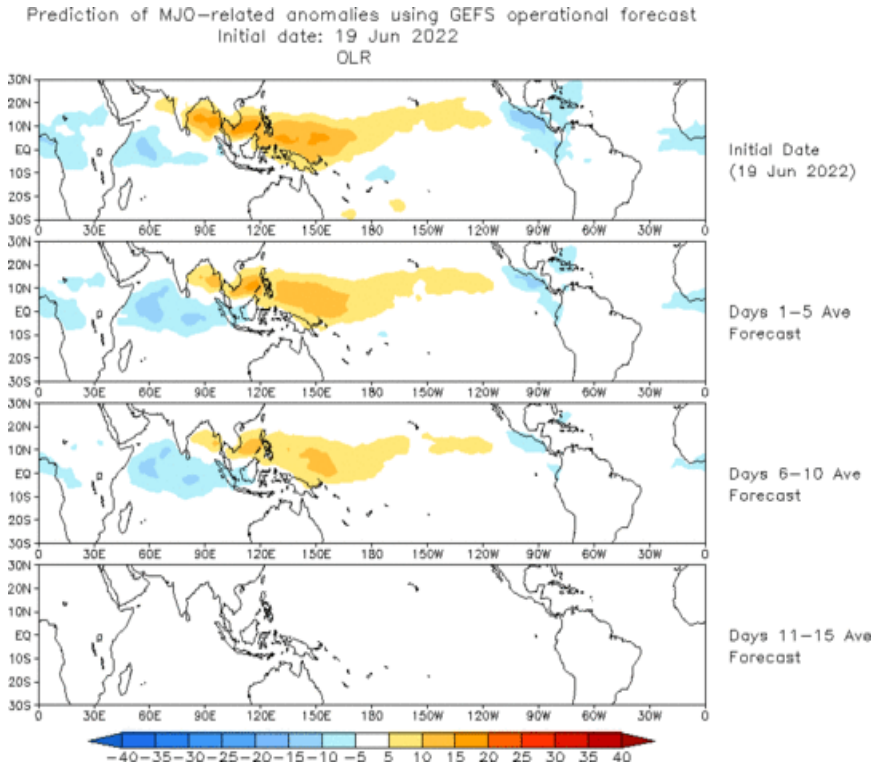


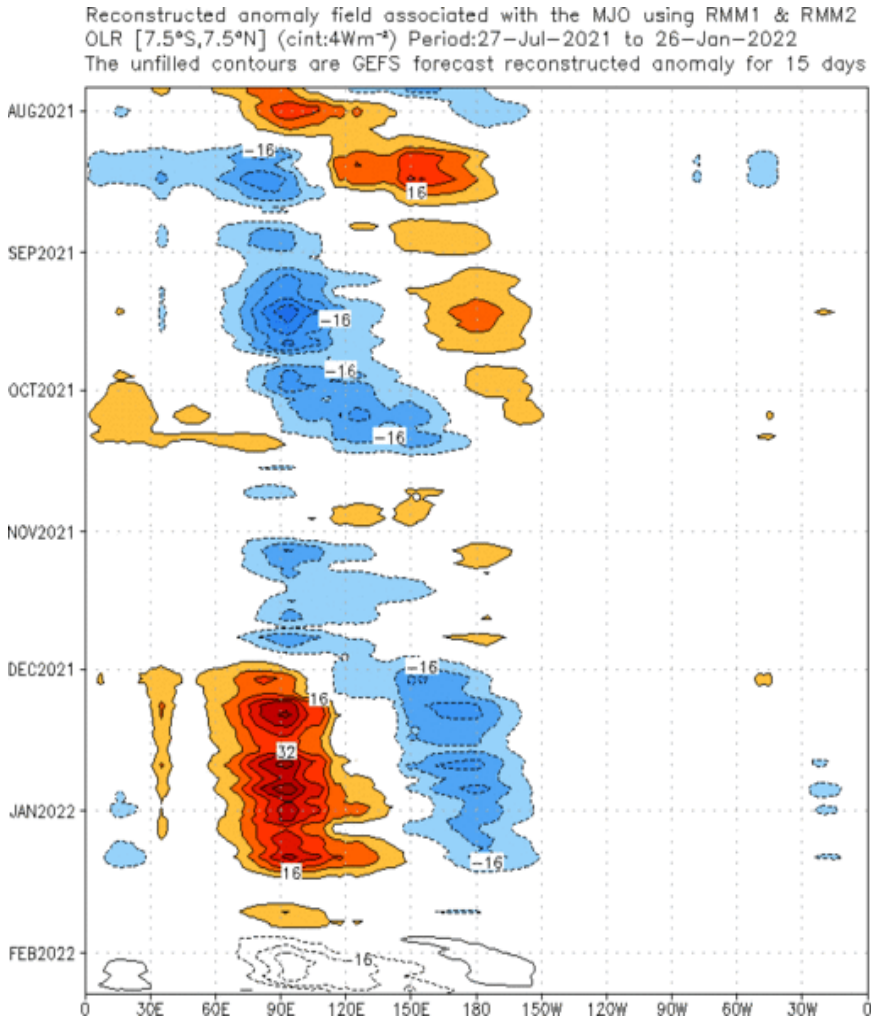
ECMWF Forecast

- Large spread exists among the GFS and ECMWF ensemble members through the next two weeks.
- However, many ECMWF and GFS ensemble members favor eastward propagation resuming during late June with the increasing potential of a developing MJO over the Indian Ocean.

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.)

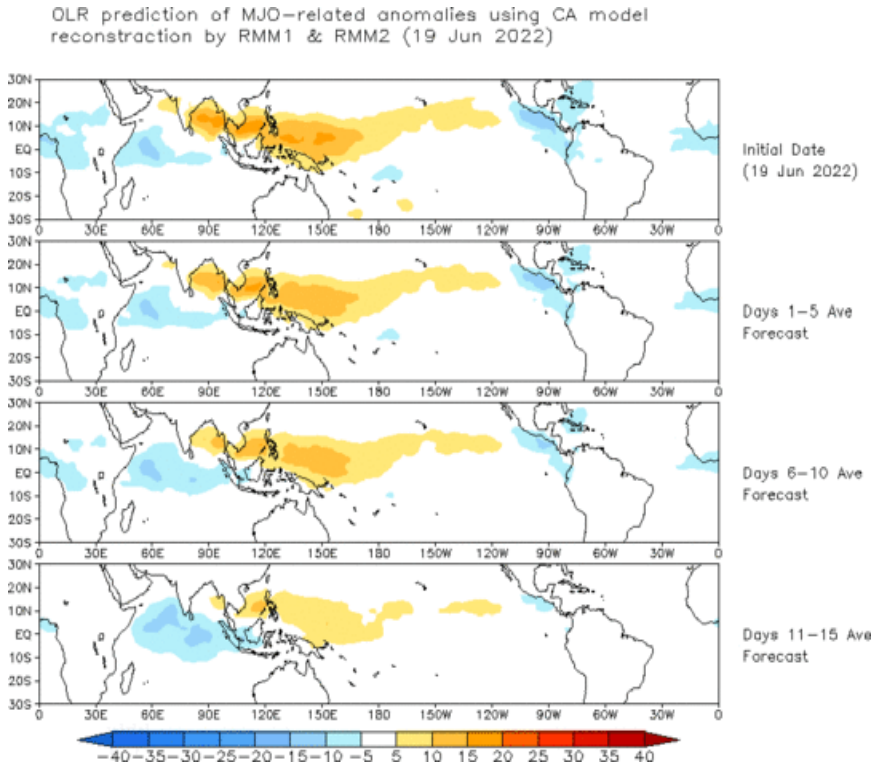


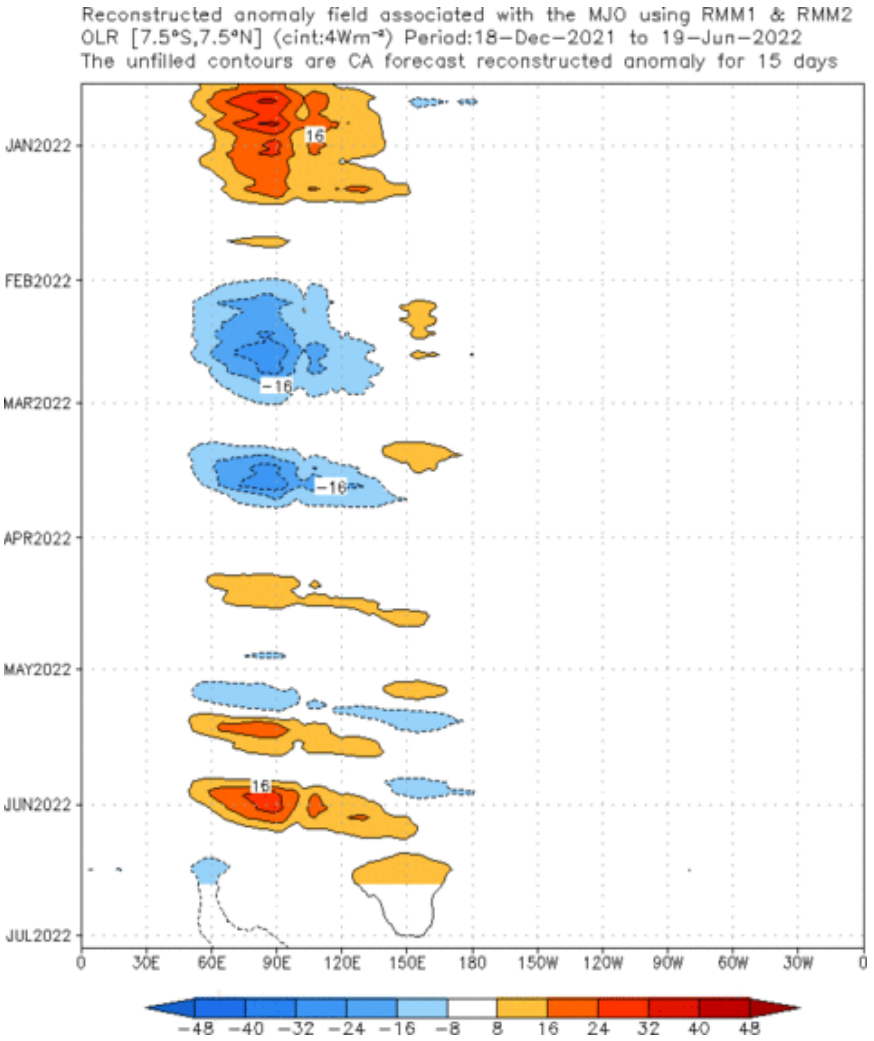


- The GEFS depicts a nearly stationary pattern of OLR anomalies during the next ten days. Later in week-2, anomalies are close to average, likely due to large ensemble spread.

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.)

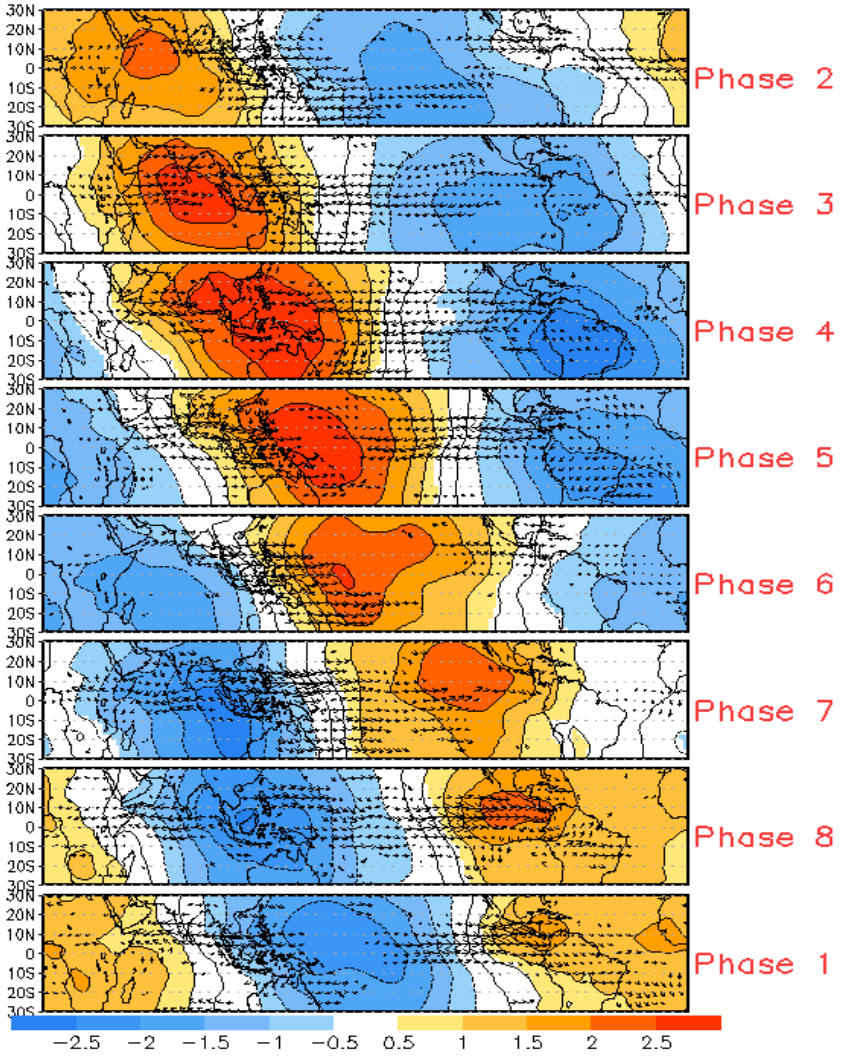




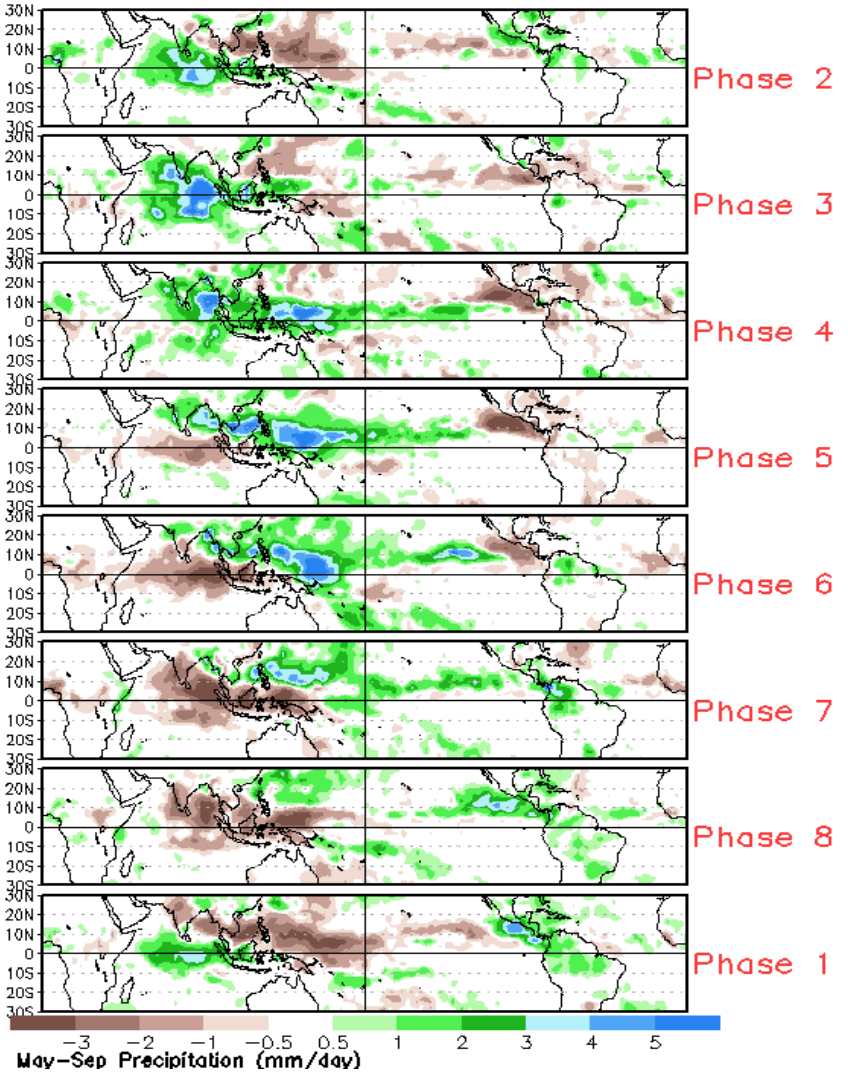
- The constructed analog forecast of RMM-based OLR anomalies is more consistent with a developing MJO over the Indian Ocean with enhanced convection shifting northeast.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



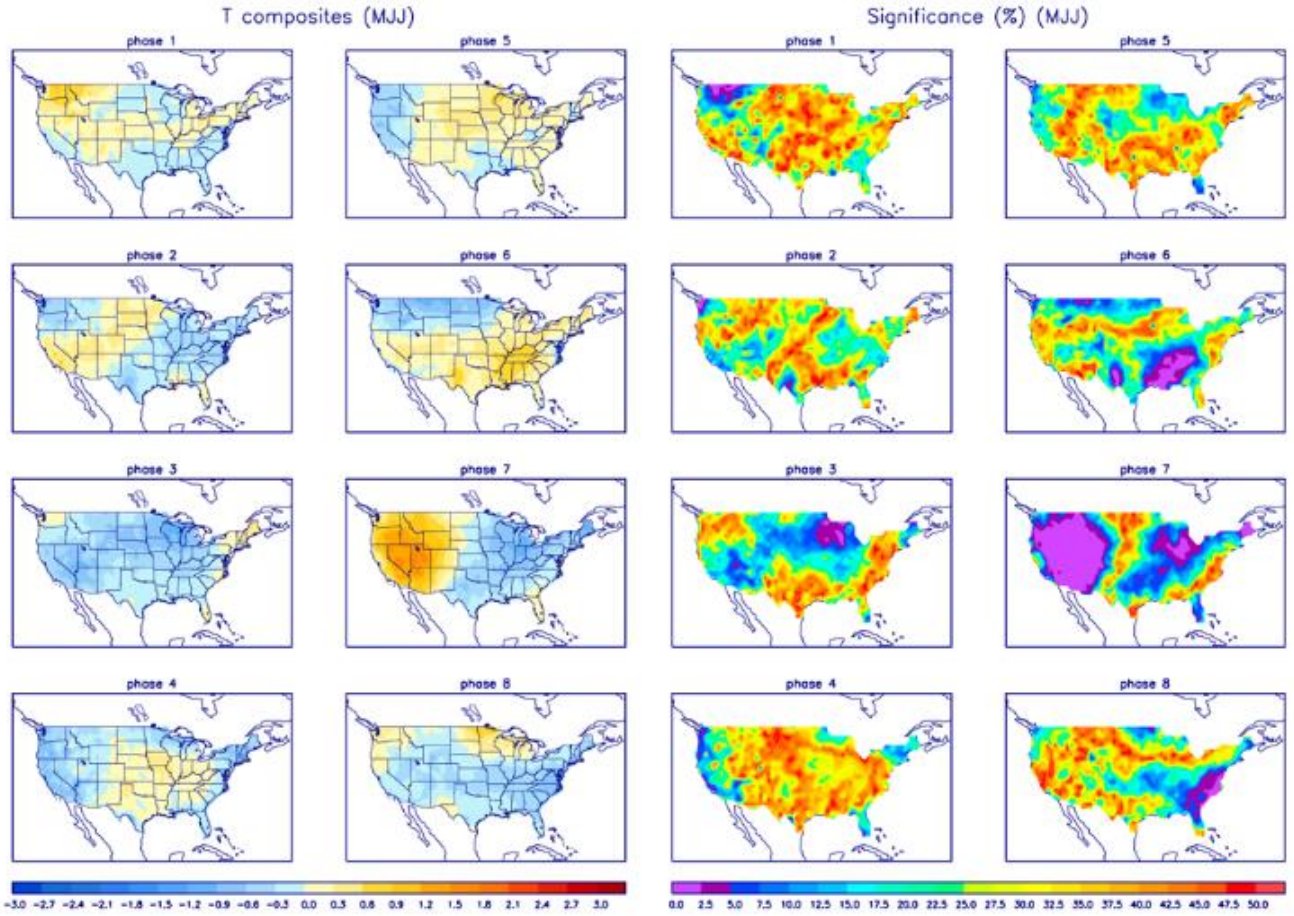
Precipitation Anomalies



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.

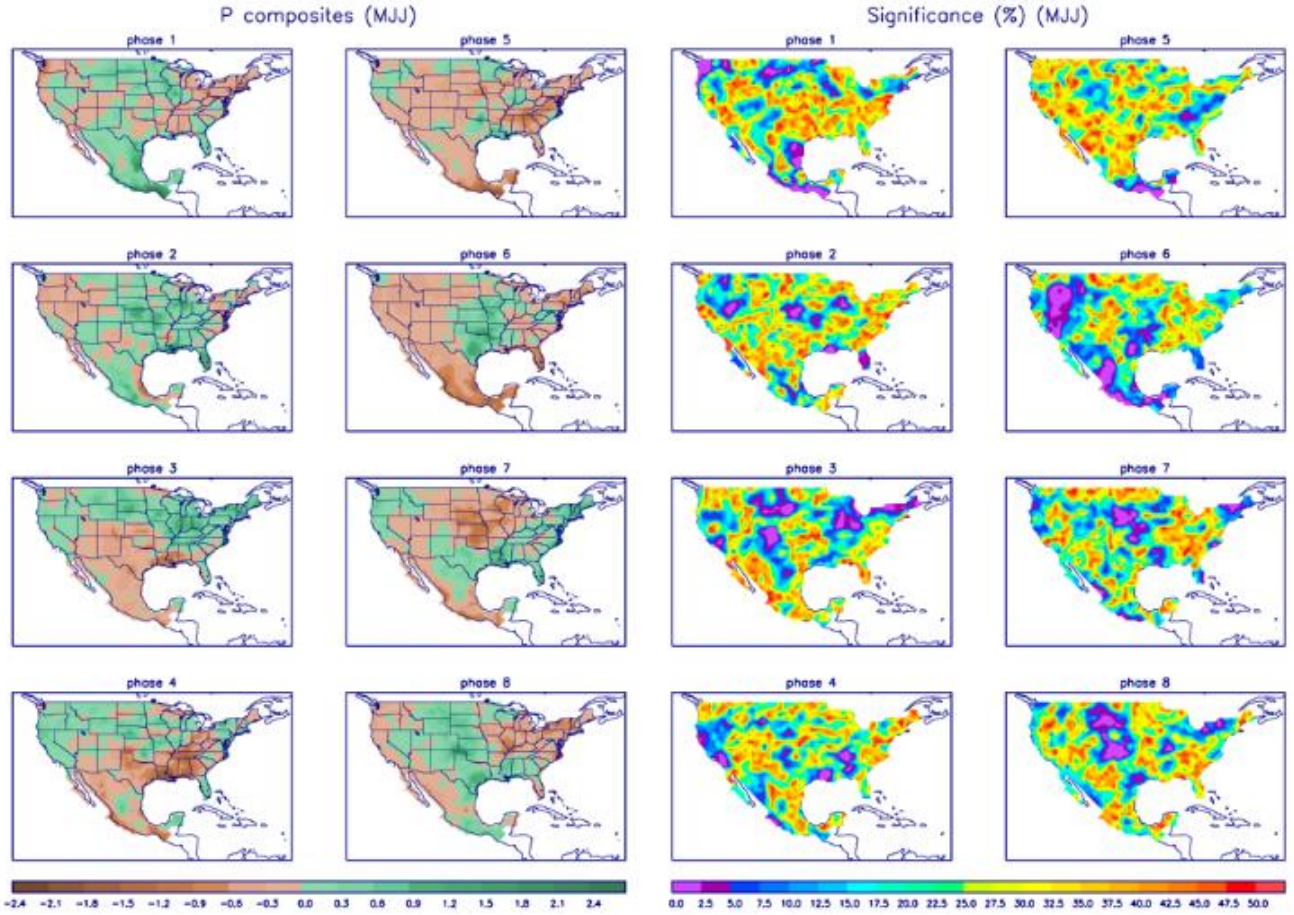


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

MJO: CONUS Composite Maps by RMM Phase - 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.



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