

# **Madden-Julian Oscillation:**

## **Recent Evolution, Current Status and Predictions**



**Update prepared by the Climate Prediction Center**  
**Climate Prediction Center / NCEP**  
**22 July 2019**

# Overview

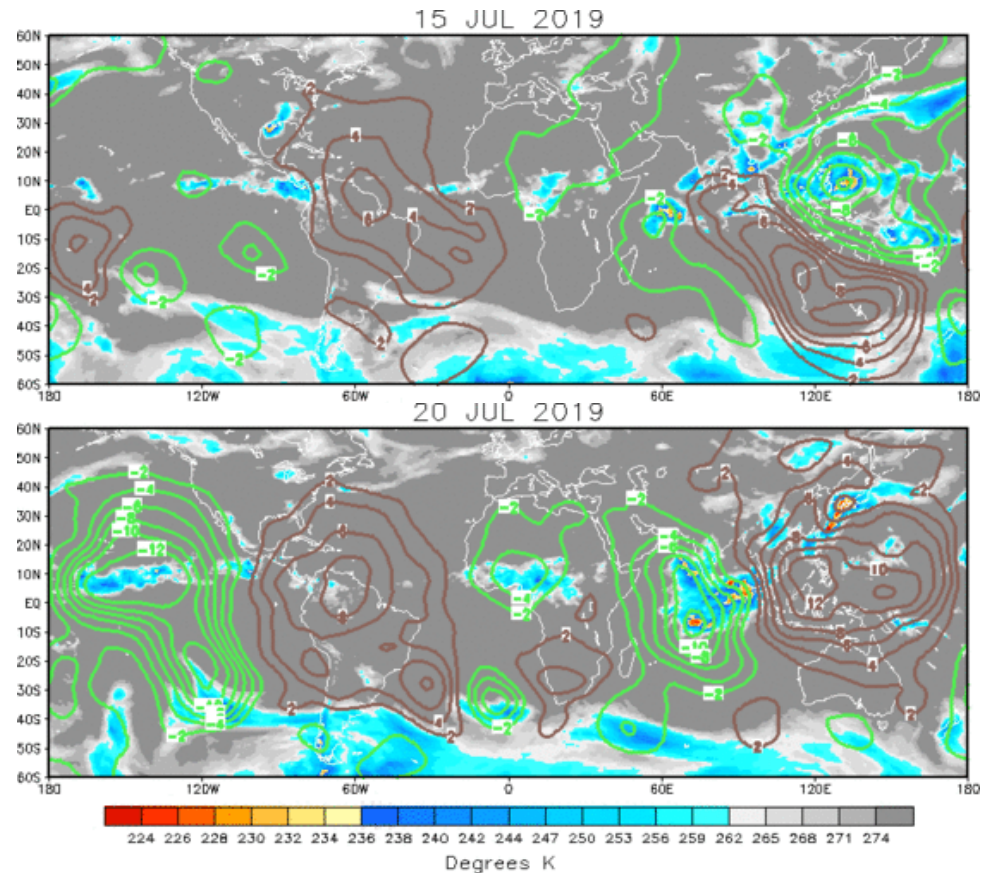
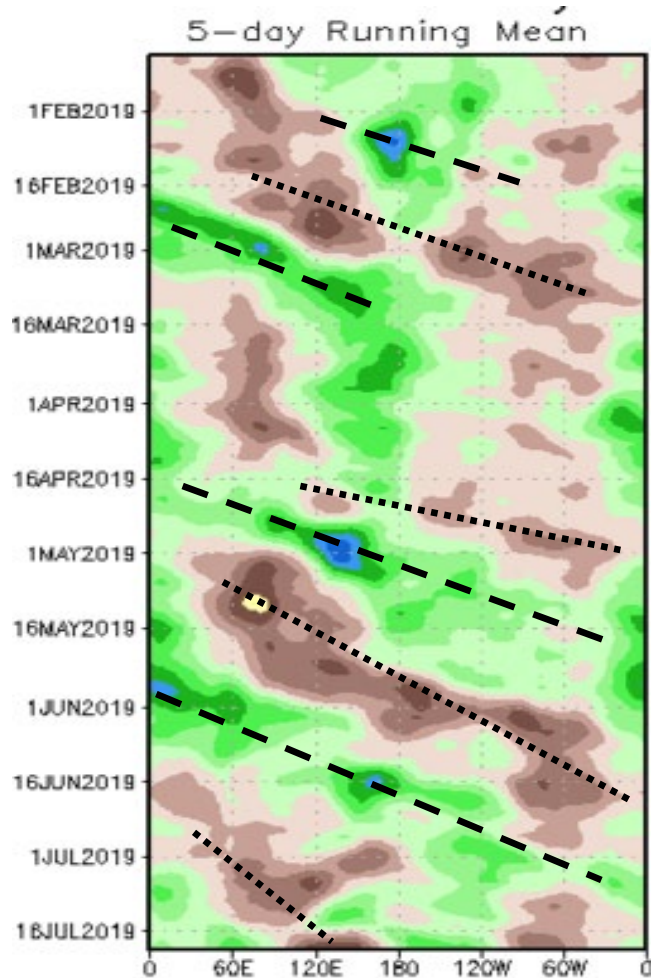
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- The MJO continues to be incoherent this week. The enhanced phase of the MJO is broadly located over the Western Hemisphere and western Indian Ocean. Equatorial Rossby waves have interfered with the eastward-propagating MJO over the Indian Ocean in recent weeks. The suppressed phase is located over the Maritime Continent.
- There is a wide range of possibilities predicted by the various dynamical models during the next two weeks, with the enhanced phase of the MJO expected to be located anywhere between Phase 1 and Phase 5. An atmospheric Kelvin wave moving across the Western Hemisphere may spark the development of a more coherent MJO signal over the Indian Ocean during Week-2.
- Tropical Cyclone (TC) activity is expected to ramp up over the East Pacific during the next two weeks as a strong Kelvin wave transits the Western Hemisphere. There is some chance that the tropical Atlantic may also become more active during Week-2.

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

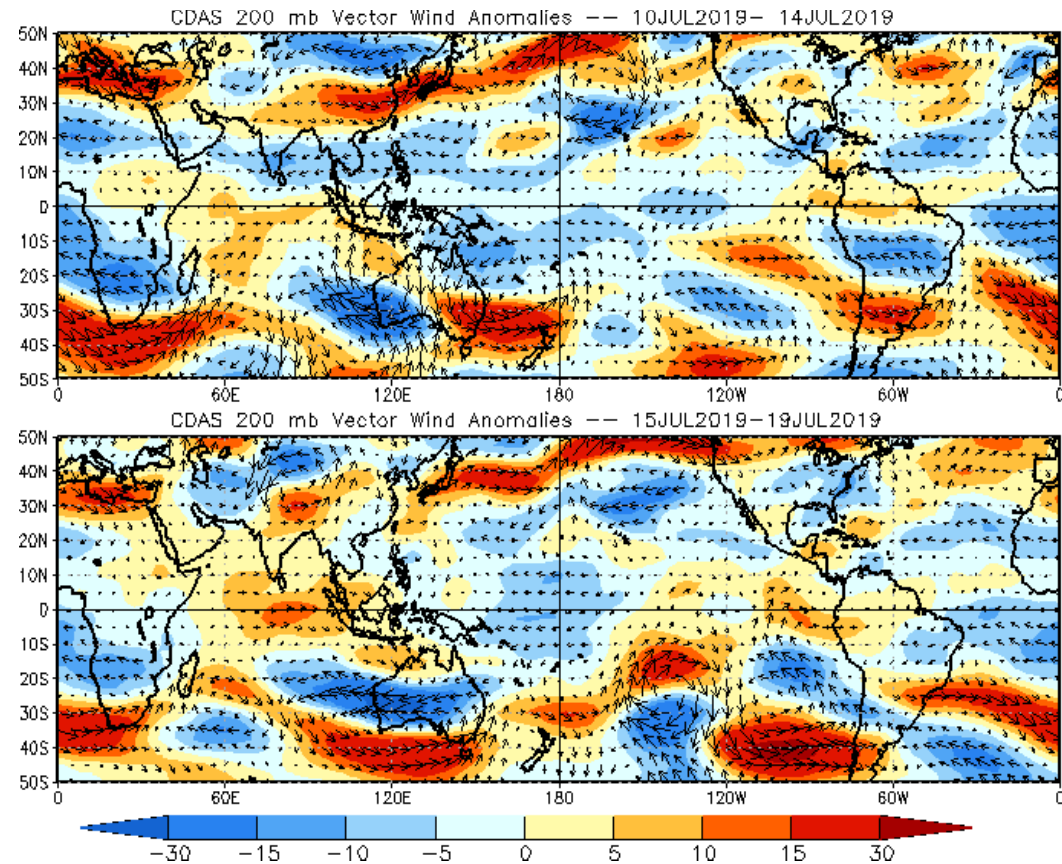
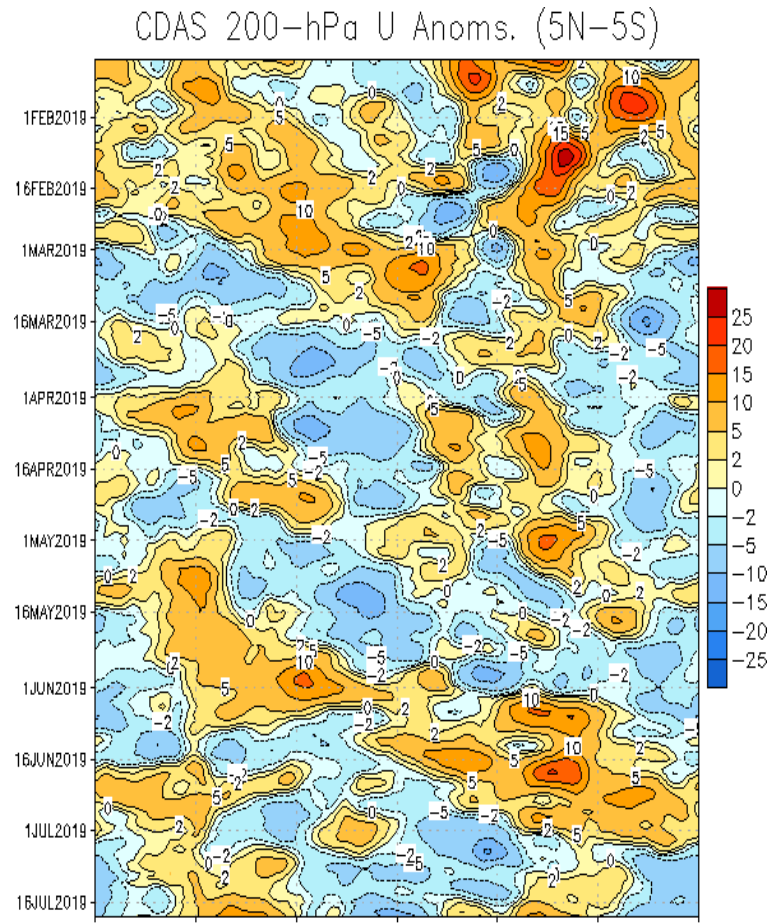
**Green shades:** Anomalous divergence (favorable for precipitation).  
**Brown shades:** Anomalous convergence (unfavorable for precipitation).



- The MJO has been active since January except for a 1.5 month pause during March and early April.
- The latest MJO event began in mid-April and was influenced by westward moving features over the Indian Ocean in early June before returning to the Maritime Continent and West Pacific.
- A strong Kelvin wave is expected to move across the Eastern Pacific, Central America, and the Atlantic during Week-1. As this wave moves out over the Indian Ocean during Week-2, it is expected to strengthen.
- A pronounced wave-2 pattern is indicated over most of the globe recently.

# 200-hPa Wind Anomalies

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

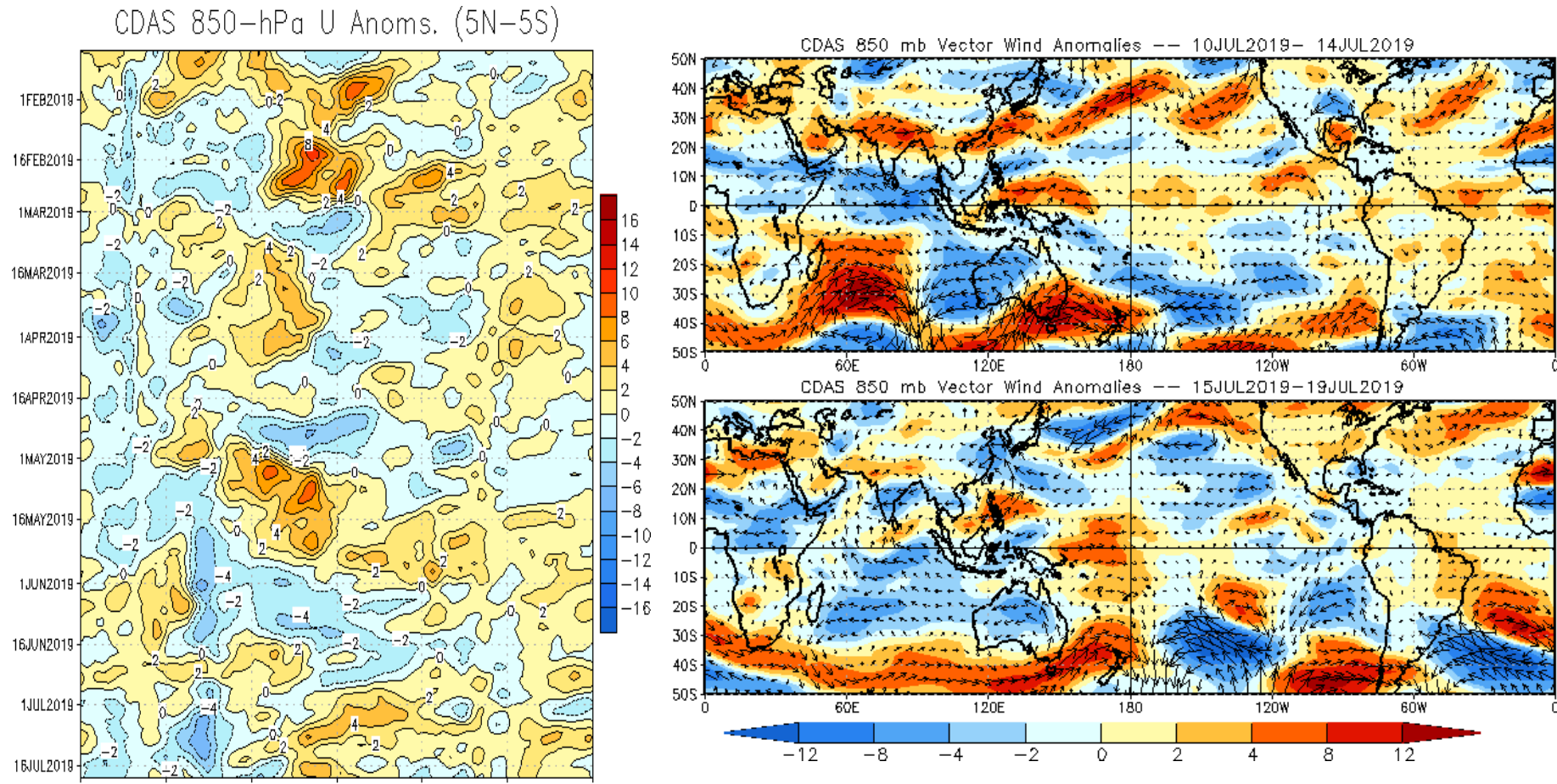


- An envelope of westerly anomalies associated with the MJO continued propagating eastward across the Pacific to the Atlantic during late June.
- Anomalous upper-level easterlies have propagated eastward through the Pacific during the past several weeks.
- Anomalous westerlies along the equator over the Indian Ocean appear to be sourced from the extratropics in the Southern Hemisphere (10-14 July).



# 850-hPa Wind Anomalies

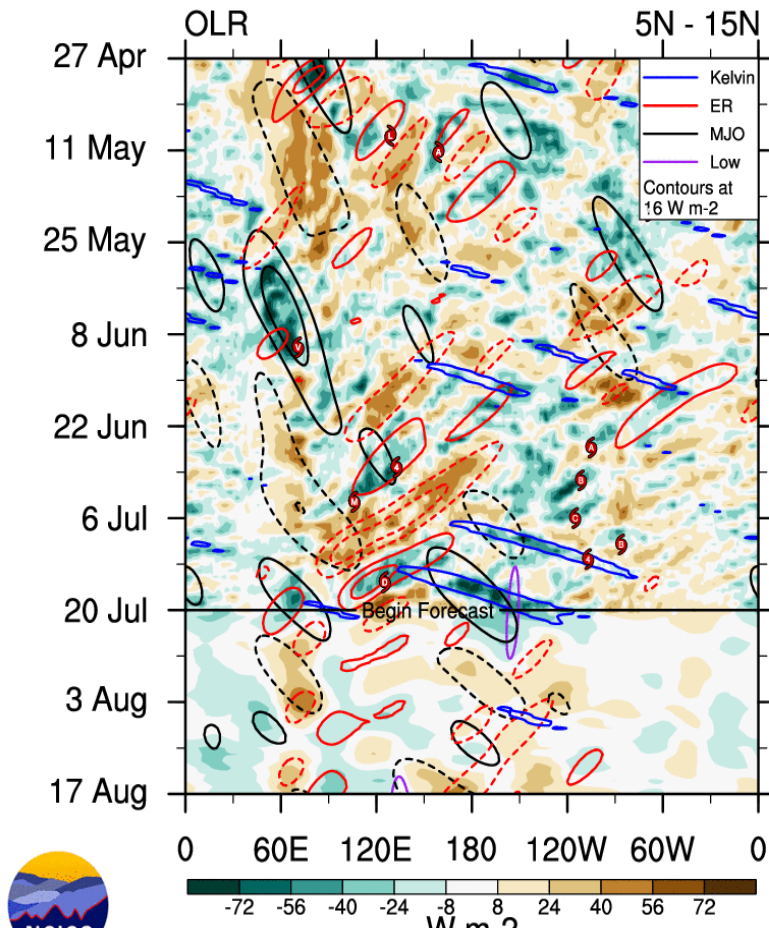
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



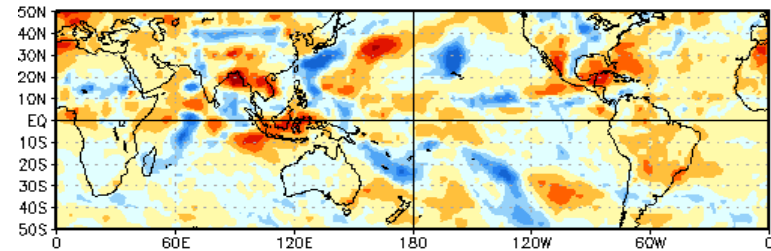
- Equatorial Rossby wave activity across the West and Central Pacific has resulted in the most robust anomalous westerlies north of the equator becoming focused north of New Guinea.
- Low frequency westerlies persist near the Date Line in the Pacific as El Niño continues to wane.
- The circulation from Hurricane Barry is present across the coastline of the Central Gulf of Mexico.

# Outgoing Longwave Radiation (OLR) Anomalies

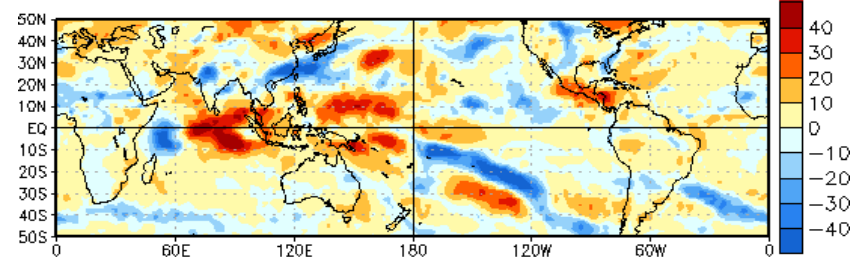
**Blue shades:** Anomalous convection (wetness). **Red shades:** Anomalous subsidence (dryness).



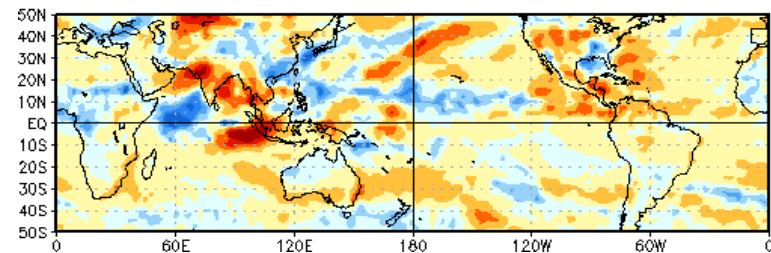
OLR Anomalies  
20 JUN 2019 to 29 JUN 2019



30 JUN 2019 to 9 JUL 2019

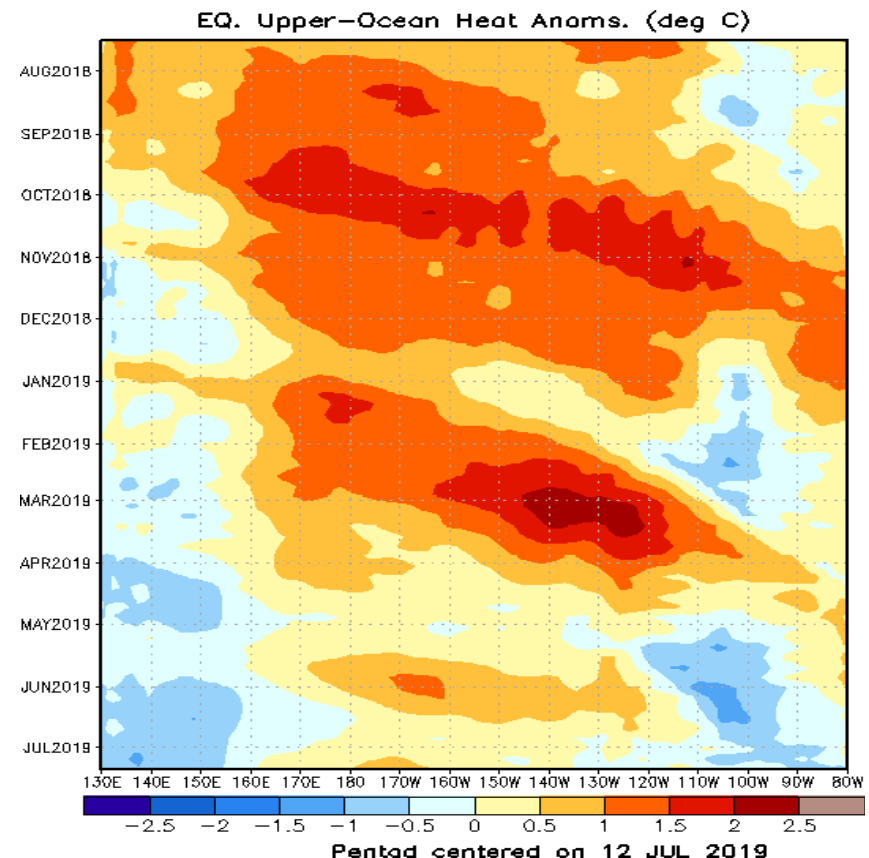
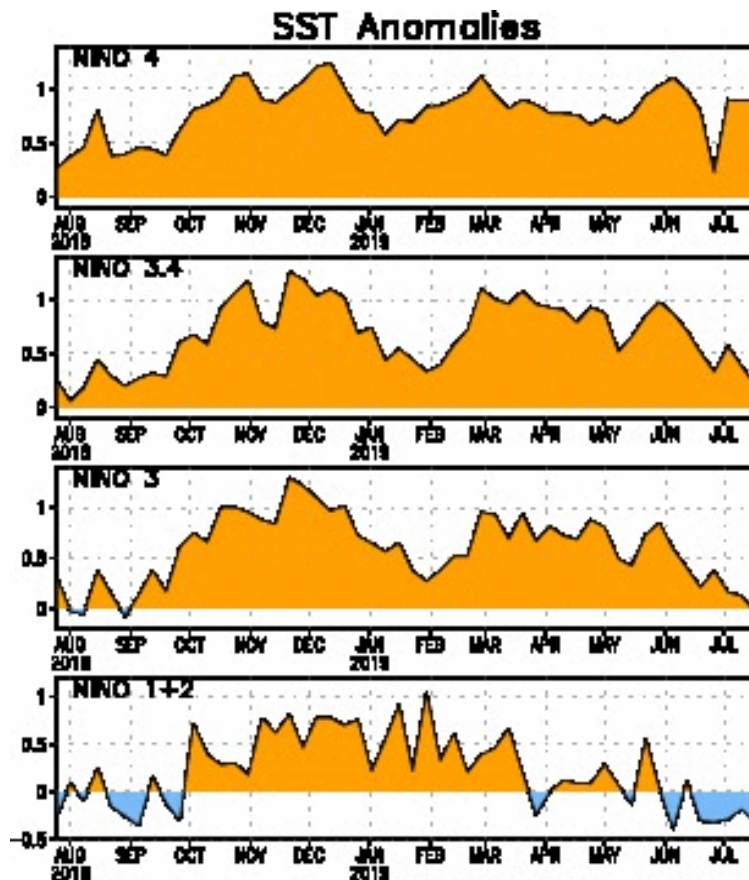


10 JUL 2019 to 19 JUL 2019



- Slow eastward propagation of anomalous dryness across the Indian Ocean and into the South China Sea during late June through mid-July appears tied to the suppressed envelope of the MJO.
- Enhanced convection is depicted over the western tropical Indian Ocean.
- Negative OLR anomalies associated with former Hurricane Barry are indicated along the U.S. Gulf Coast and interior Southeast U.S. in early to mid July.

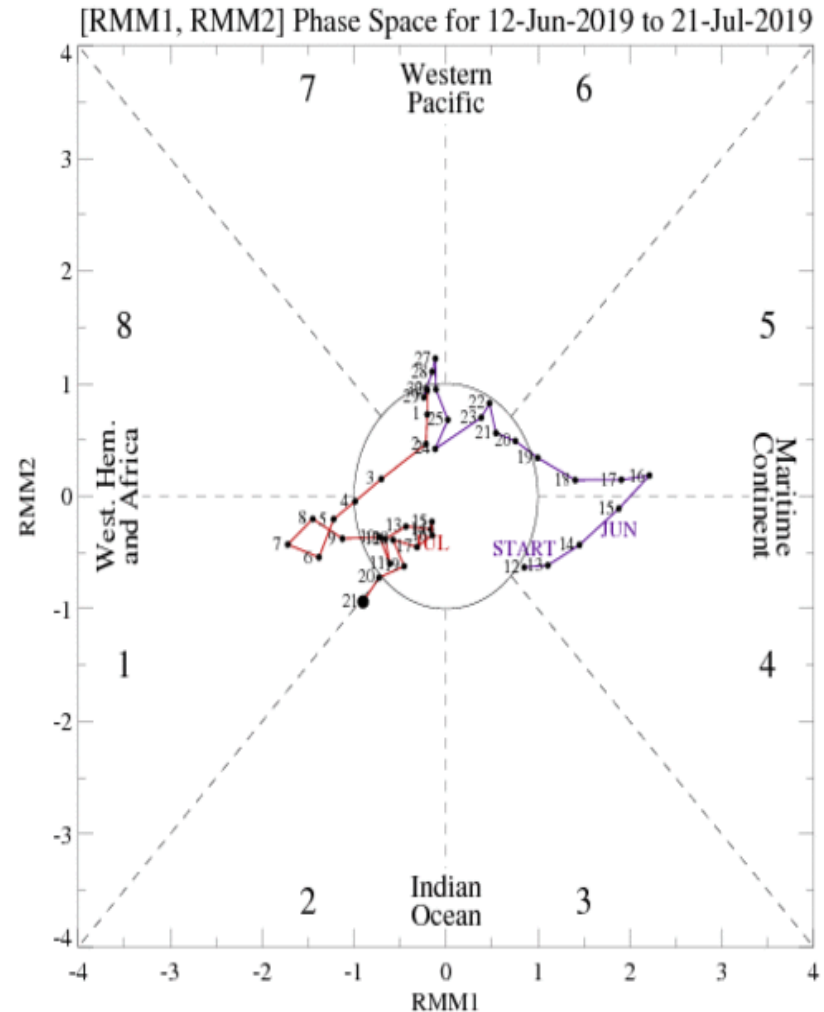
# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Low amplitude SST anomalies remain above climatology across much of the equatorial Central and East Pacific, consistent with what remains of the ongoing El Niño event.
- A downwelling Kelvin wave event is evident over the central and eastern Pacific since mid-May, but its amplitude is weaker than what was observed in previous events. Overall, upper-ocean heat content has continued to steadily decline over the past several months.
- Another weak downwelling wave has developed in response to recent period of anomalous westerlies over the central Pacific.

# MJO Index: Recent Evolution

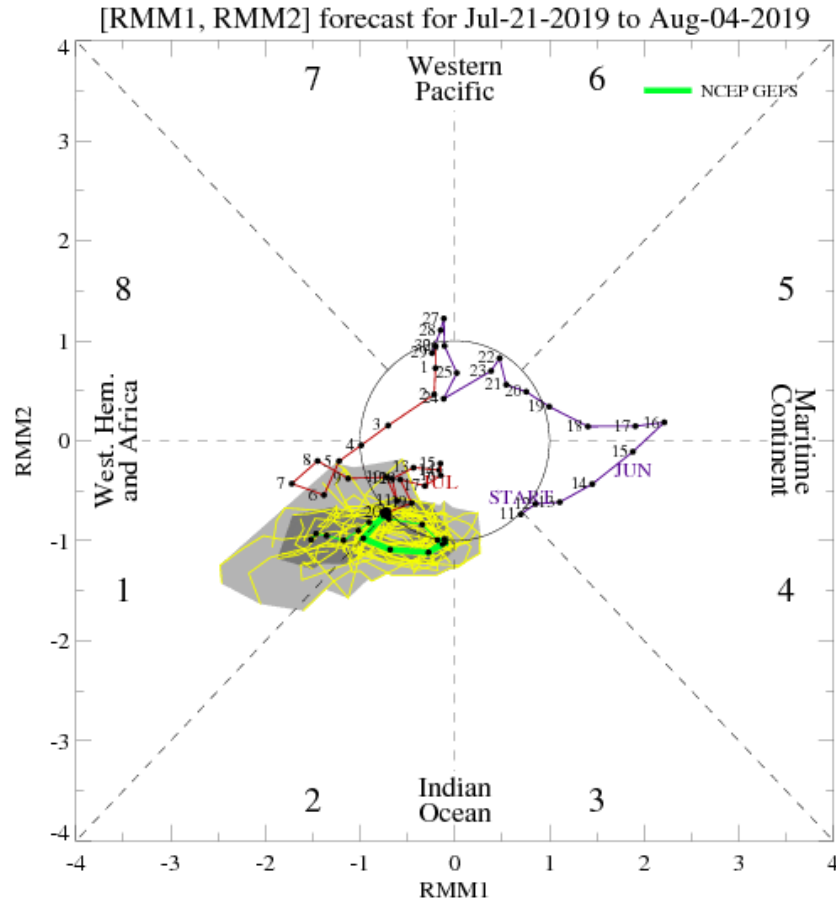
- The center of the enhanced phase of the MJO is near the unit circle, and along the boundary that separates Phase 1 from Phase 2. Equatorial Rossby waves have interfered with the eastward propagation of the MJO signal during the past two weeks.



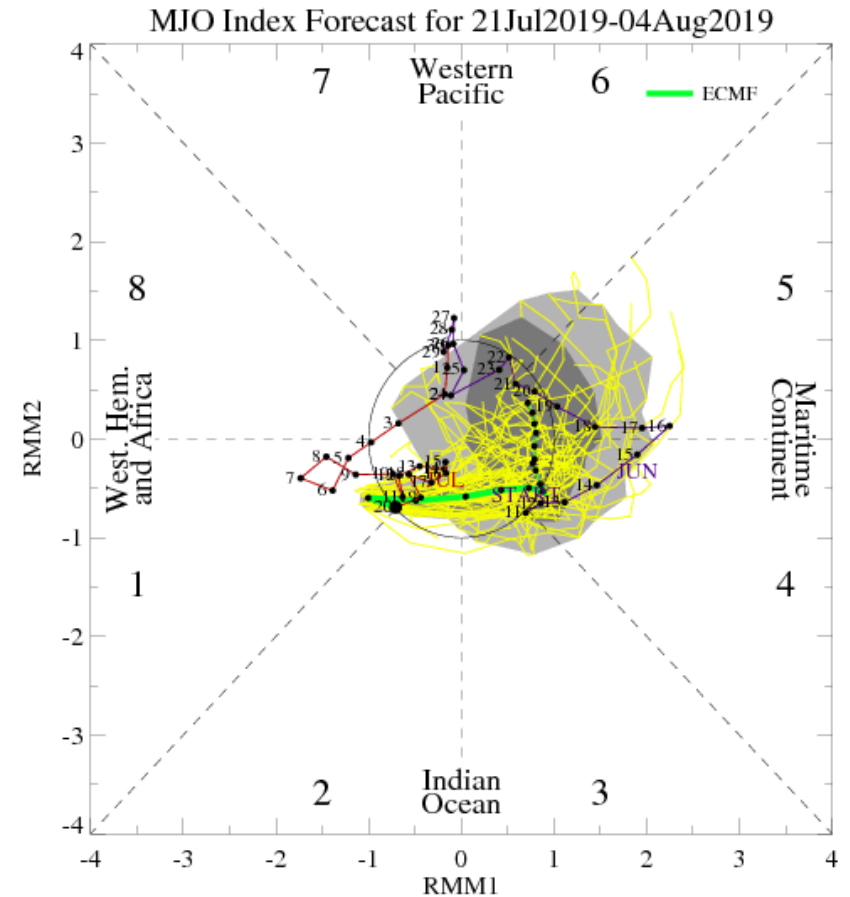
For more information on the RMM index and how to interpret its forecast please see:  
[https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC\\_MJOinformation.pdf](https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf)



# MJO Index: Forecast Evolution



**GEFS Forecast**



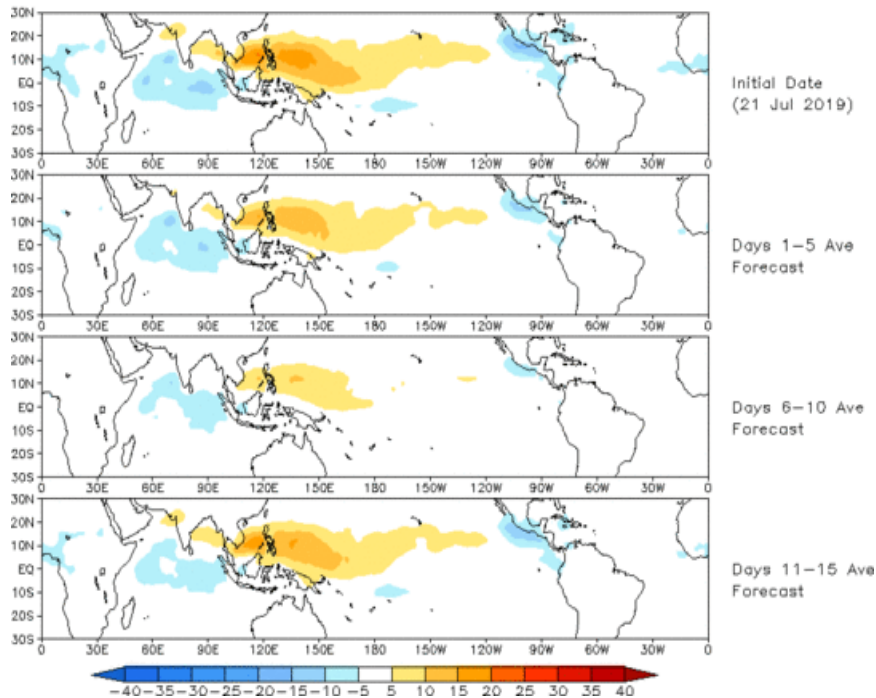
**ECMWF Forecast**

- The GEFS refocuses the MJO envelope over Phases 1 (Western Hemisphere and Africa) and 2 (Western Indian Ocean). Westward-moving variability (equatorial Rossby waves) appears to interfere with eastward propagation of the MJO.
- The ECMWF forecast suggests rapid eastward propagation of a weak subseasonal signal across the Indian Ocean and Maritime Continent during the next two weeks.

# MJO: GEFS Forecast Evolution

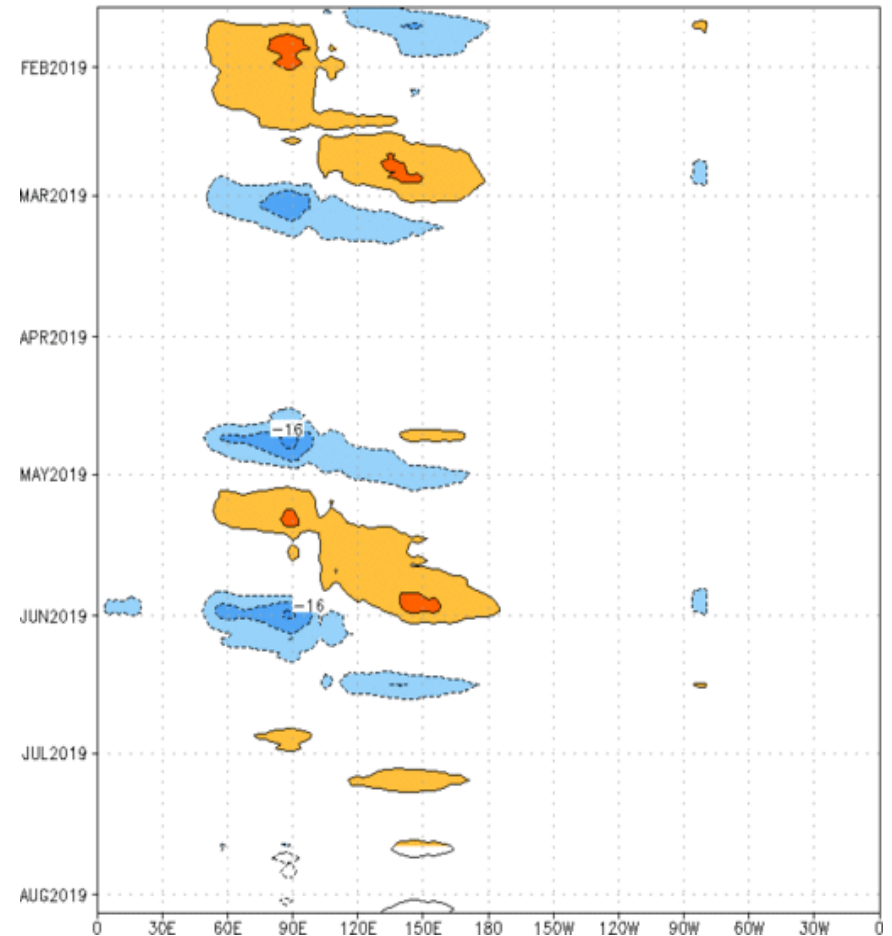
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast  
Initial date: 21 Jul 2019  
OLR



- The spatial depiction of the MJO within the GEFS model suggests that it will remain relatively stationary over the course of the next two weeks.

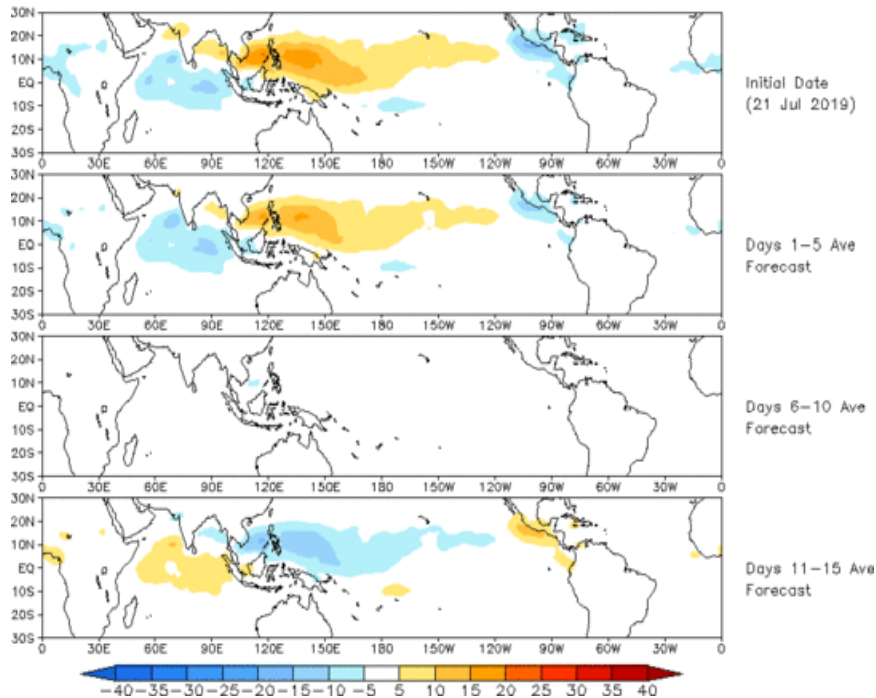
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2  
OLR [7.5°S, 7.5°N] ( $\text{cont: } 4\text{Wm}^{-2}$ ) Period: 19-Jan-2019 to 21-Jul-2019  
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



# MJO: Constructed Analog Forecast Evolution

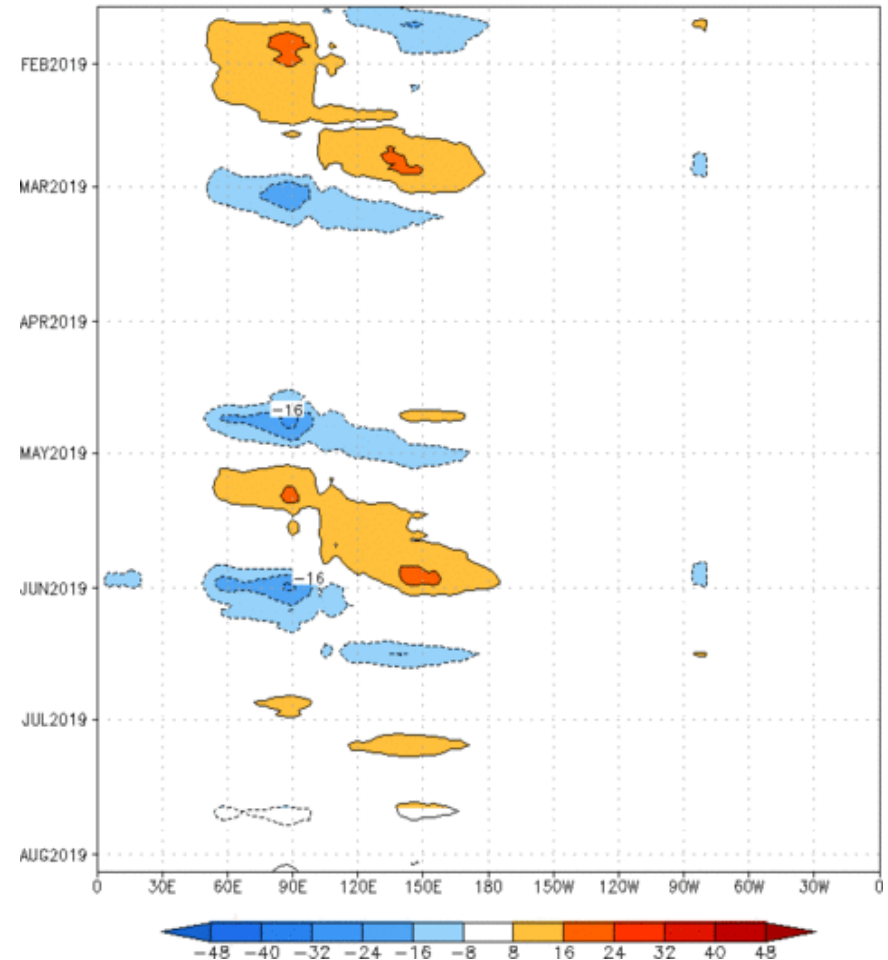
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (21 Jul 2019)



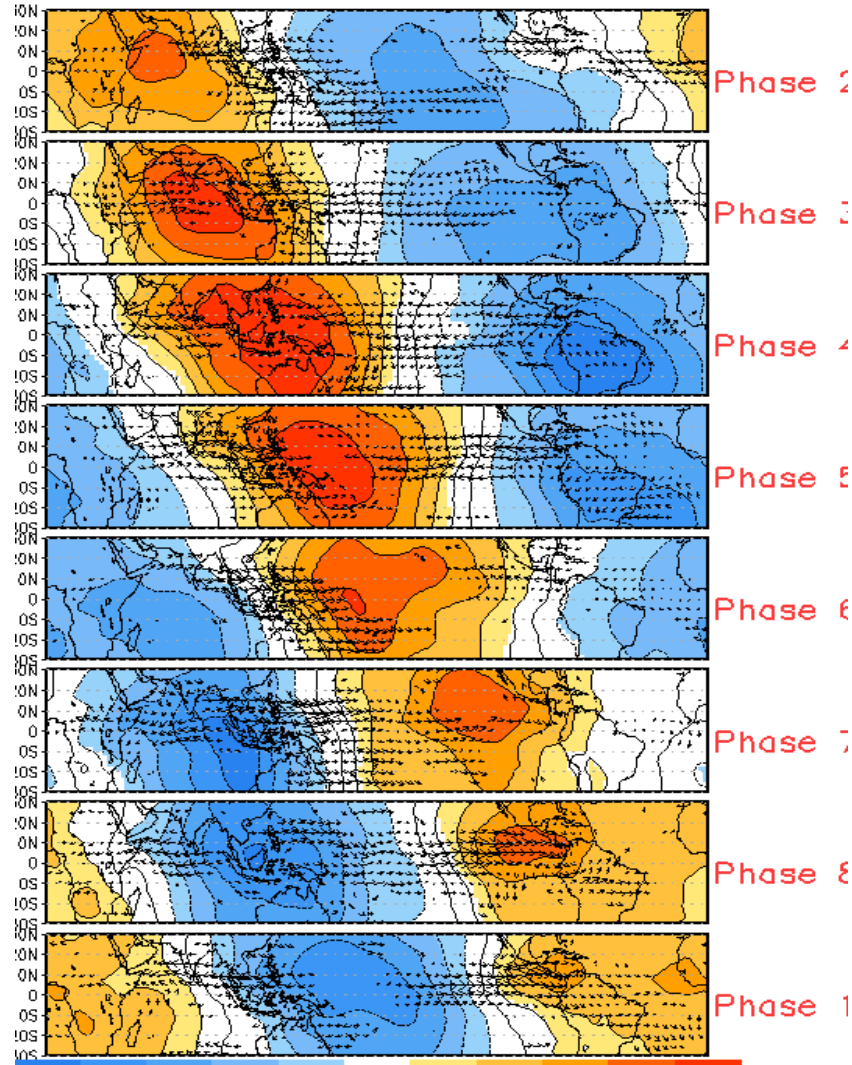
- The constructed analog MJO forecast shows a weak signal over the Indian Ocean that shifts eastward across the Maritime Continent and Western Pacific during the next two weeks.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm<sup>-2</sup>) Period:19-Jan-2019 to 21-Jul-2019  
The unfilled contours are CA forecast reconstructed anomaly for 15 days

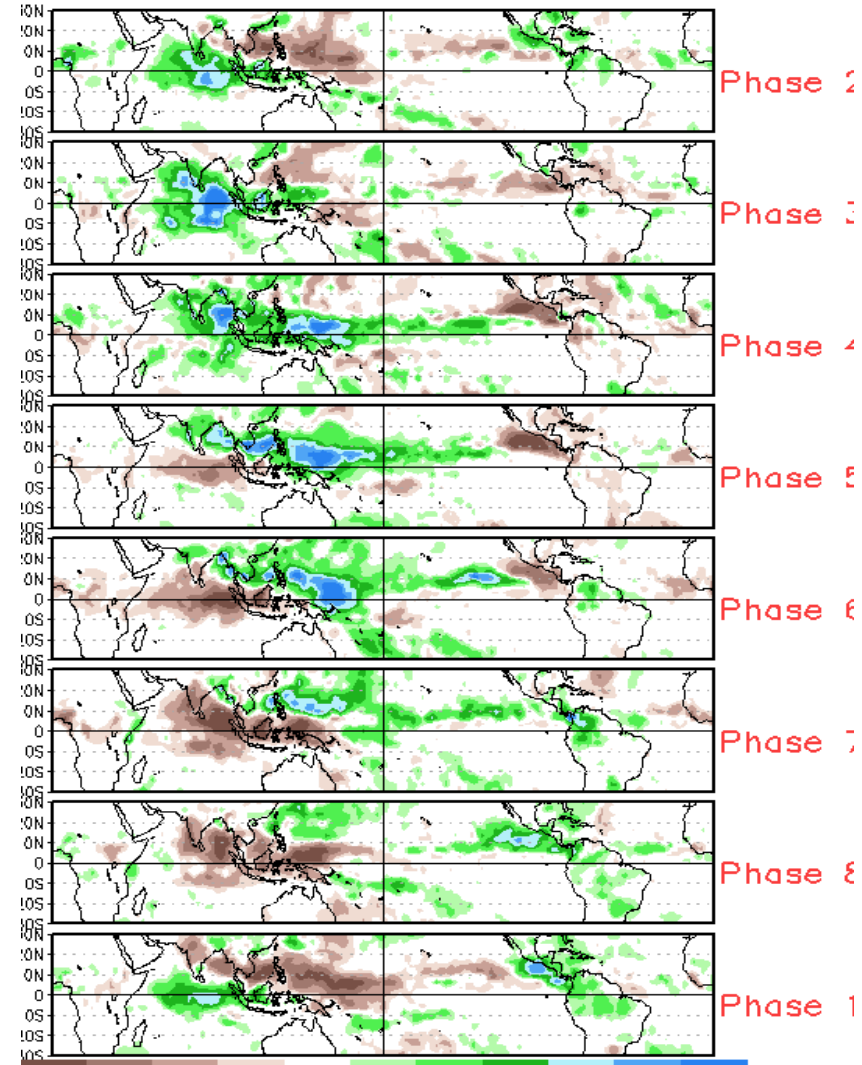


# MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and  
Wind Anomalies



Precipitation Anomalies

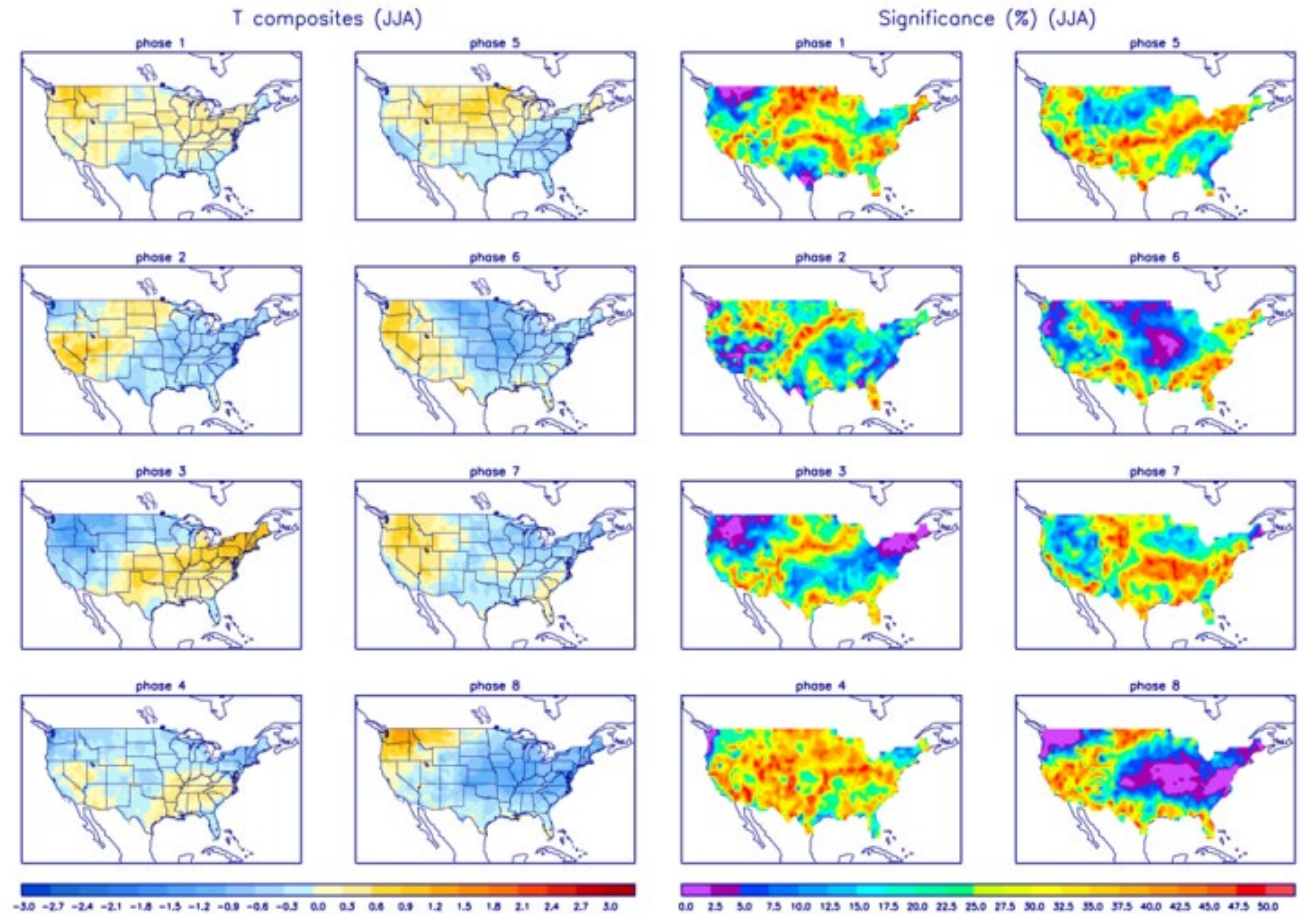




# MJO: CONUS Composite Maps by RMM Phase - Temperature

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.

