

# **Madden-Julian Oscillation:**

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



**Update prepared by the Climate Prediction Center**  
**Climate Prediction Center / NCEP**  
**29 June 2020**



# Overview

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- A pair of Kelvin waves are currently circumnavigating the tropics and roughly 180 degrees out of phase, with one approaching the Date Line and another the Prime Meridian.
- There is some suggestion of a lower frequency intraseasonal signal over the Indian Ocean which may grow into a MJO event in conjunction with the Kelvin wave that is approaching the Prime Meridian.
- Model guidance supports a growing intraseasonal signal over the western Indian Ocean during the next week, with this feature pushing toward the eastern Indian Ocean by mid-July.
- Extratropical impacts from the MJO, should it develop, appear unlikely at this time.

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>

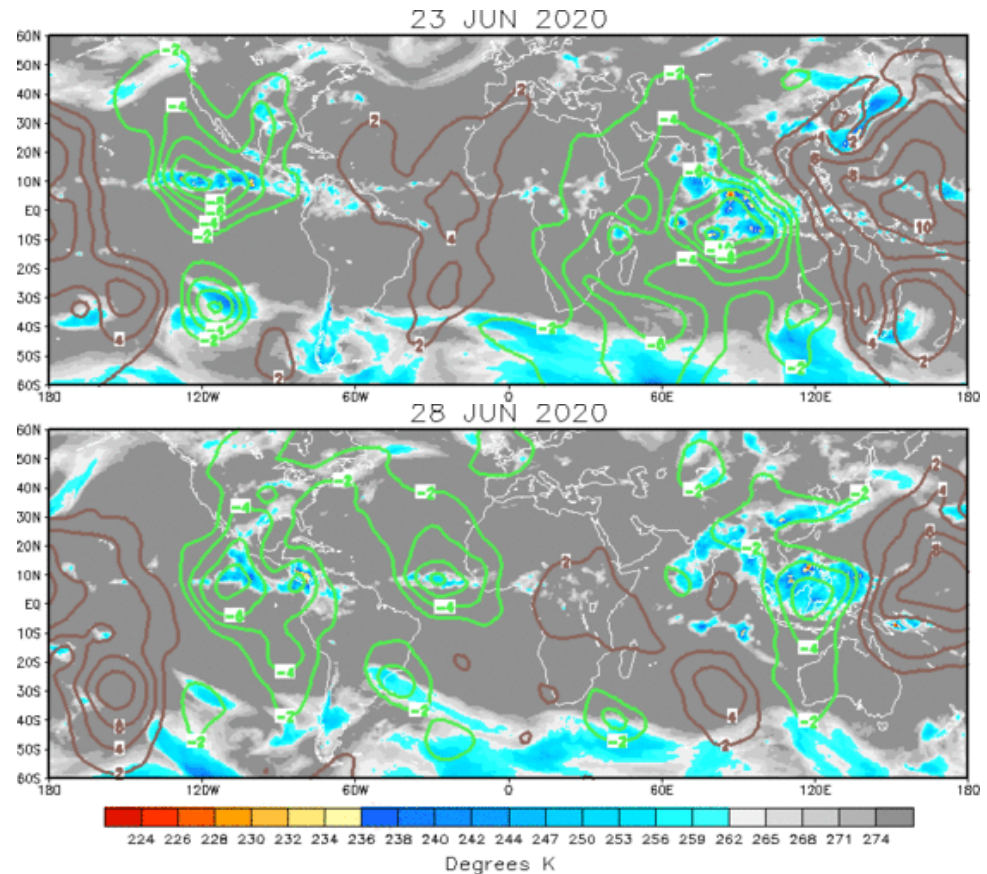
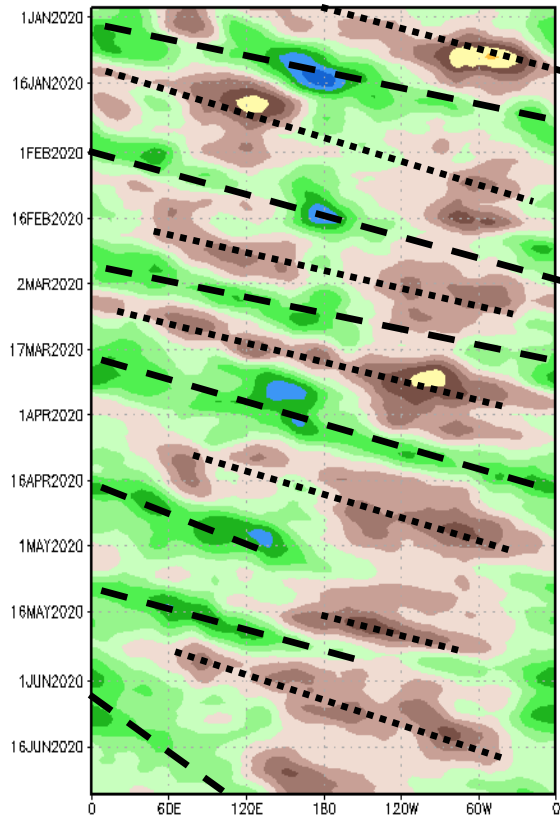


# 200-hPa Velocity Potential Anomalies

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

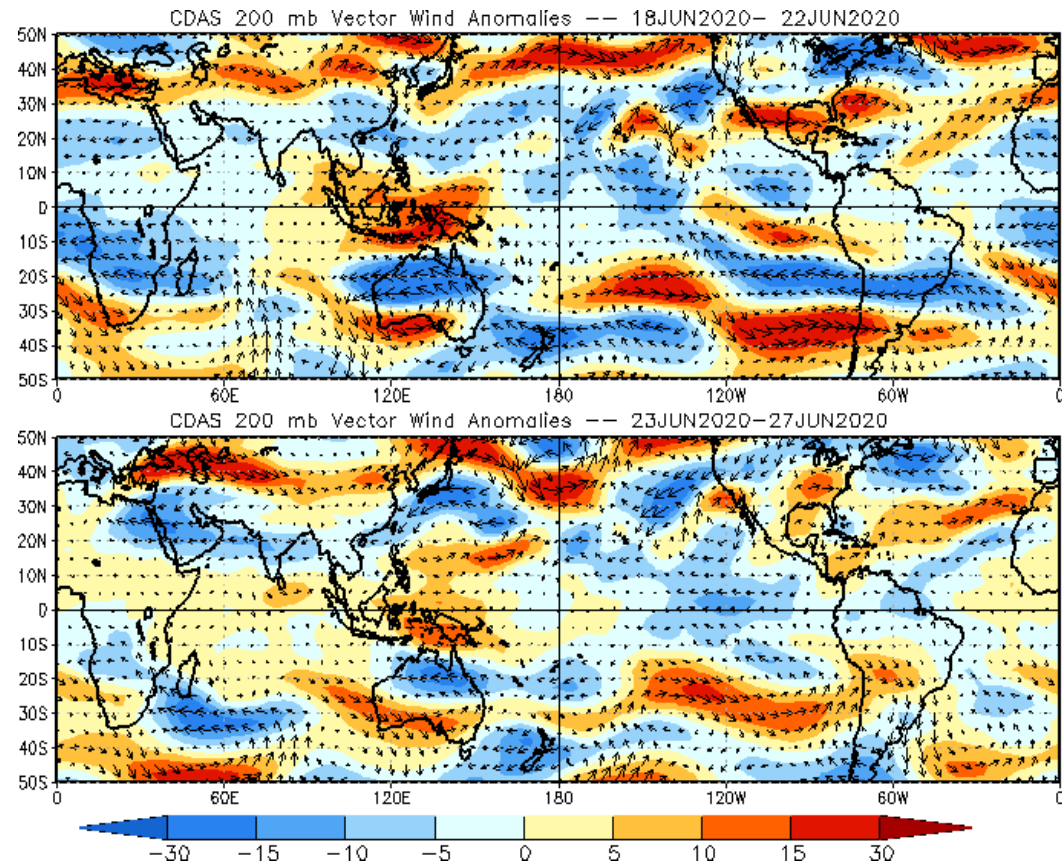
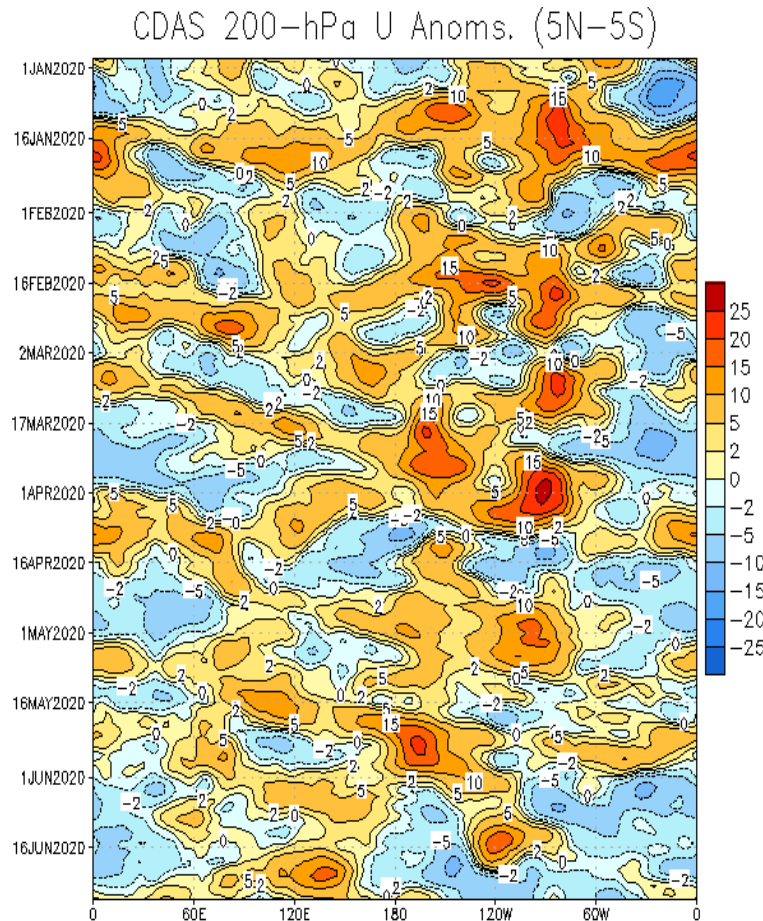


- The wavenumber two pattern from June 23<sup>rd</sup> has shifted eastward as of the 28<sup>th</sup>, with enhanced (suppressed) convection over the Americas/Atlantic and Maritime Continent (Africa and Western/Central Pacific).
- There appears to be two components to the enhanced convective centers, with the one over the Maritime Continent being at a lower frequency than that over the Americas.



# 200-hPa Wind Anomalies

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

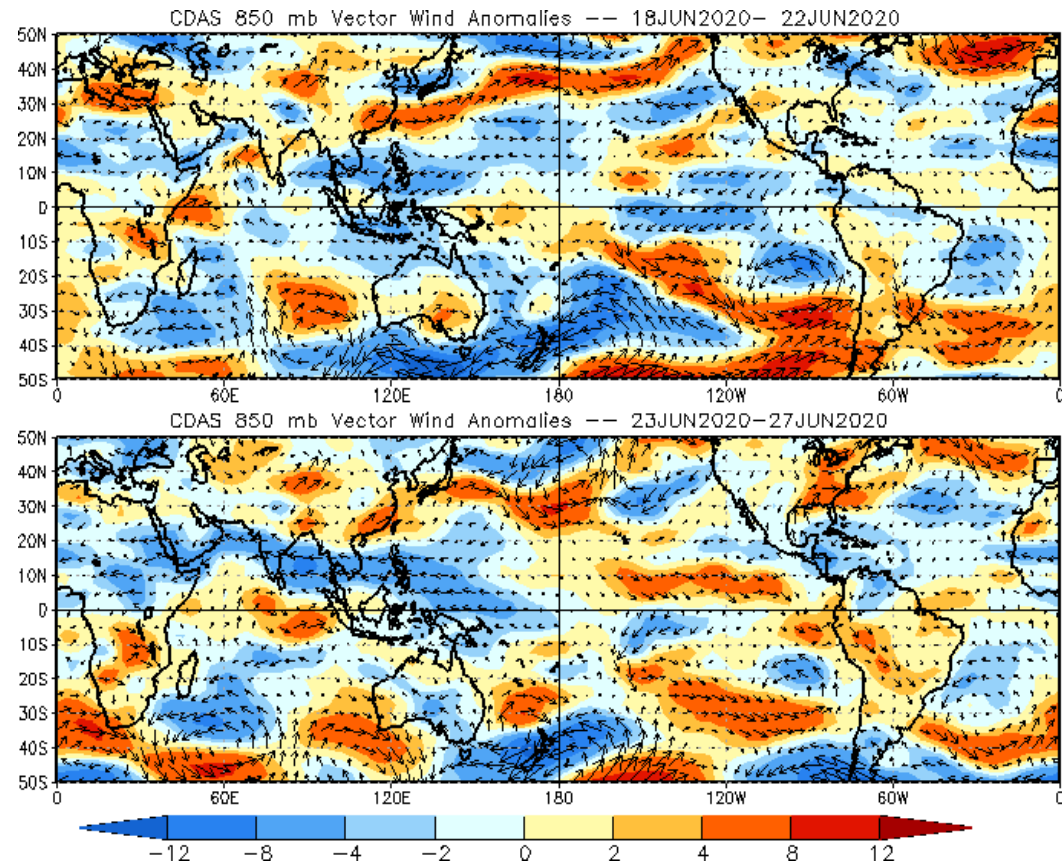
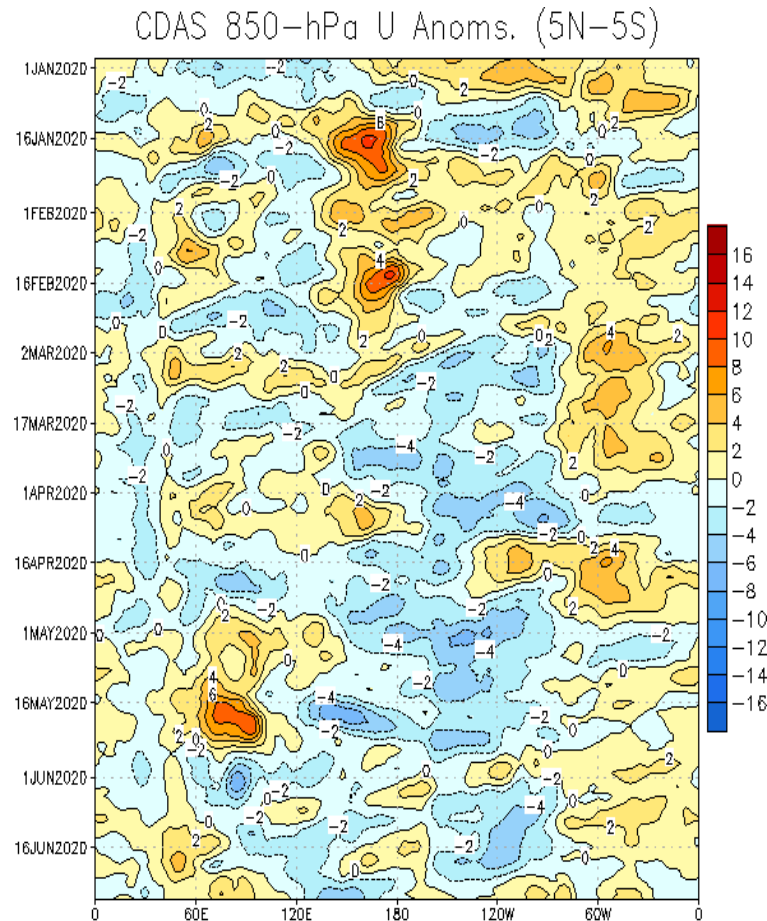


- Anomalous westerlies have drifted westward from near the antimeridian to over the Maritime Continent during the past 2-3 months, where they have stalled. Anomalous easterlies are common elsewhere across the Pacific. This yields anomalous convergence and subsidence near the Date Line.
- An amplified circulation pattern is evident over the Northern Hemisphere extratropics, with substantial wavebreaking across the North Pacific exhibiting some linkages to the lower latitudes.



# 850-hPa Wind Anomalies

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

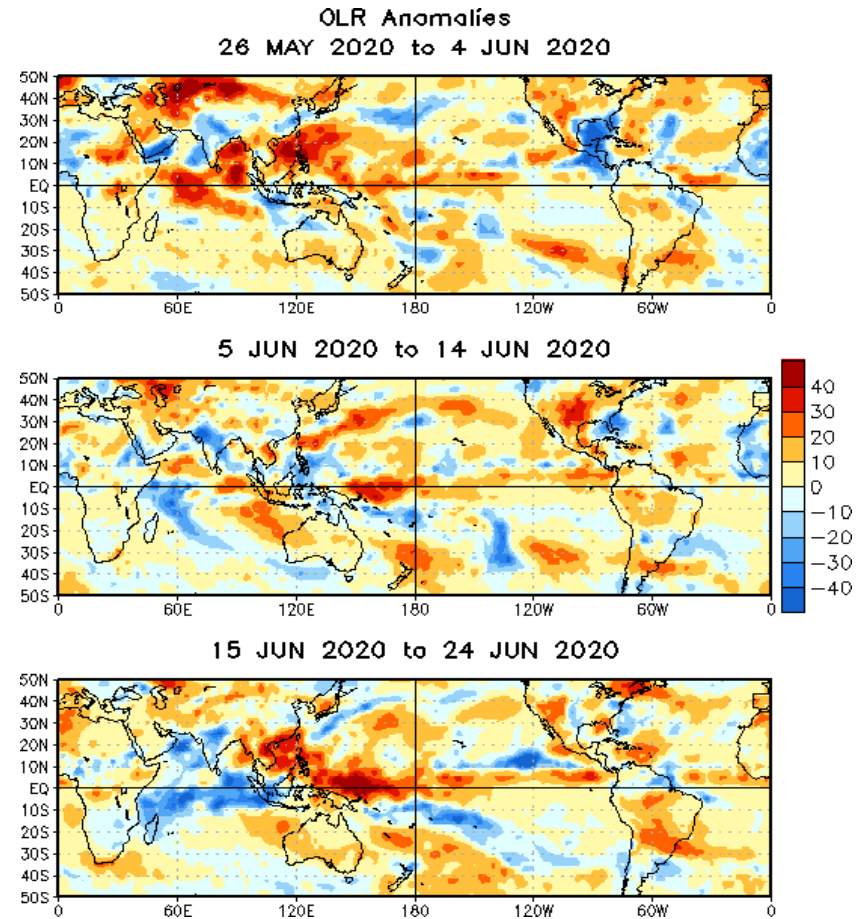
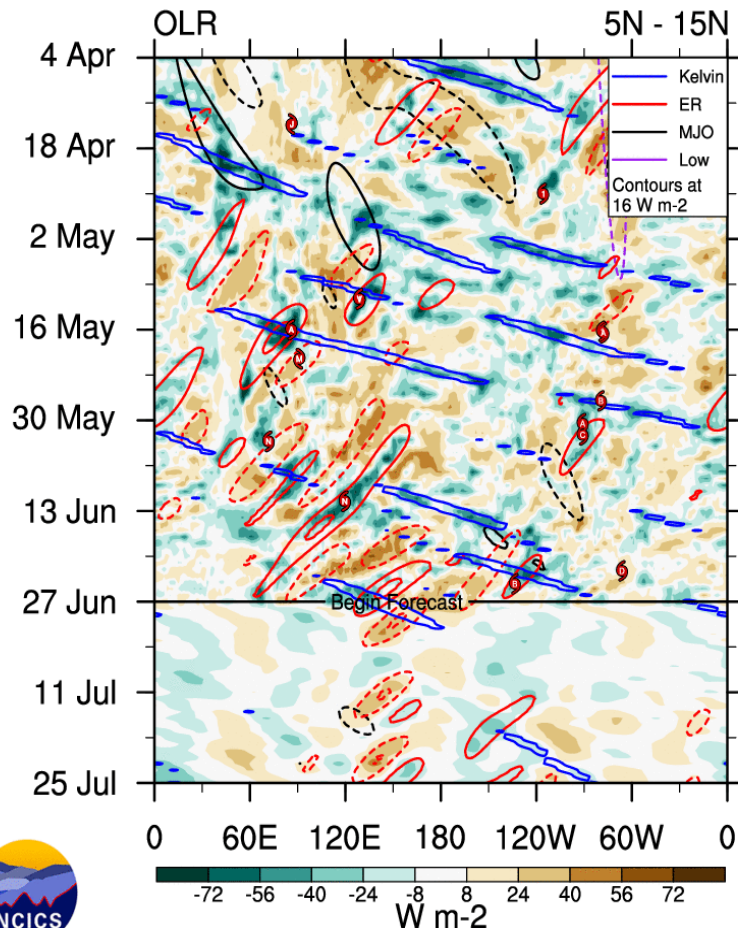


- Recent anomalous low-level cyclonic flow is apparent over much of the East Pacific, representing a favorable state for tropical cyclone development (while also a feature of the circulation of these systems themselves).
- Anomalous divergence is apparent near the Date Line, further reinforcing the anomalous subsidence within the Walker Circulation.
- Low-level anomalous westerlies pushed eastward across the Indian Ocean in late June.



# Outgoing Longwave Radiation (OLR) Anomalies

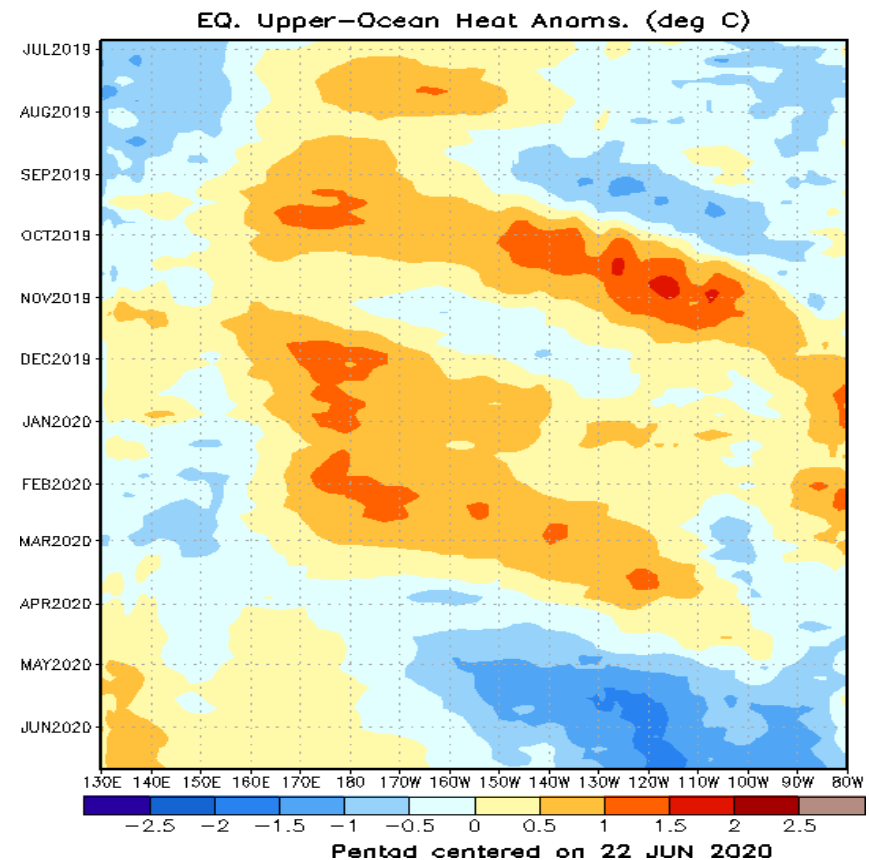
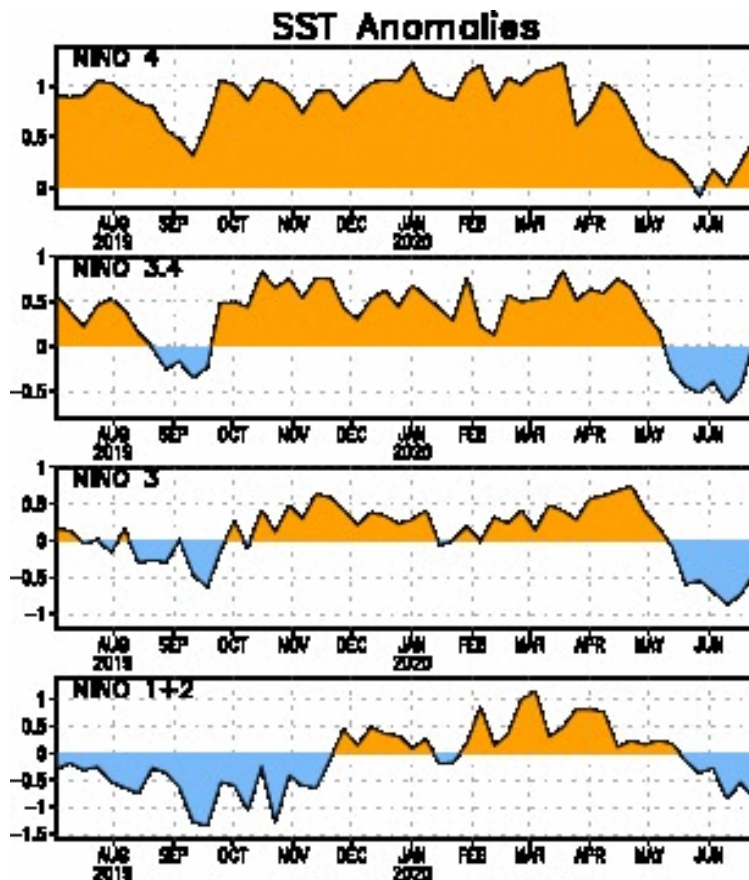
**Blue shades:** Anomalous convection (wetness). **Red shades:** Anomalous subsidence (dryness).



- Objective OLR filtering highlights a pair of Kelvin waves over the West Pacific and Atlantic. One could argue the westernmost of these is analyzed a bit too far east and too fast.
- Periodic Rossby wave activity over the West Pacific has been ongoing since mid-June, with the suppressed phase of a Rossby wave likely to destructively interfere with the westernmost Kelvin wave in early July.



# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

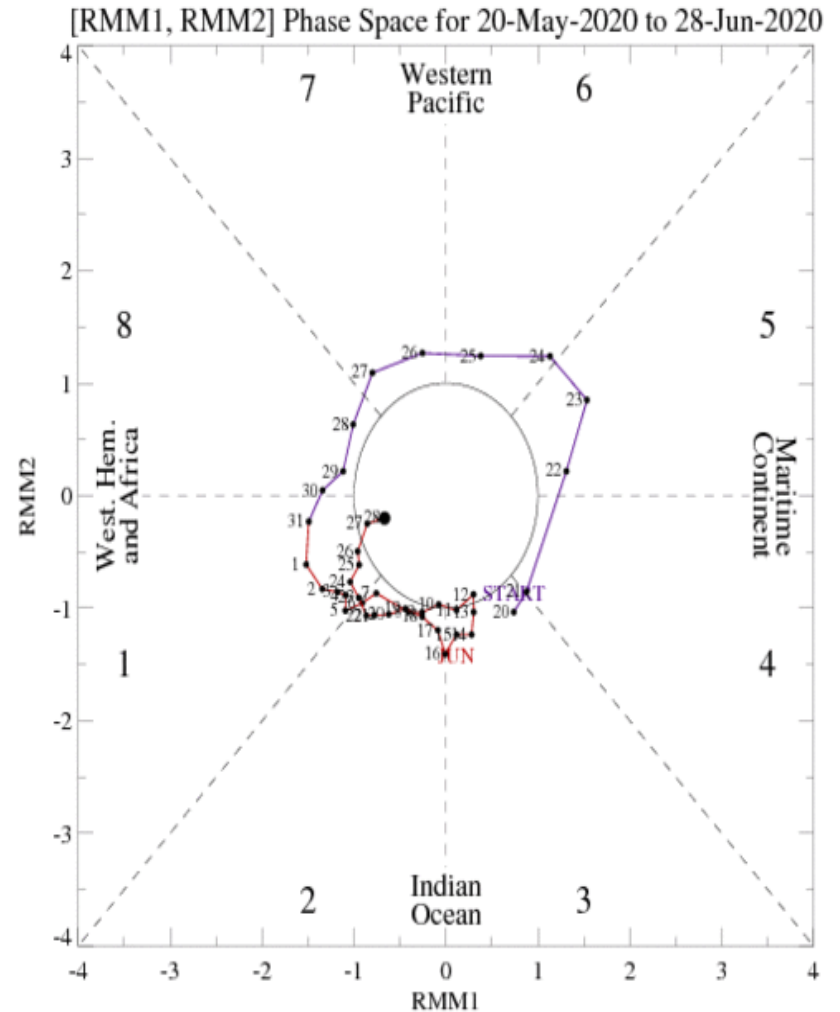


- SST anomalies in the three easternmost Nino regions have been negative since mid-May.
- An upwelling oceanic Kelvin wave is at least partially responsible for this SST reduction, as evident in the time evolution of upper ocean heat content.



# MJO Index: Recent Evolution

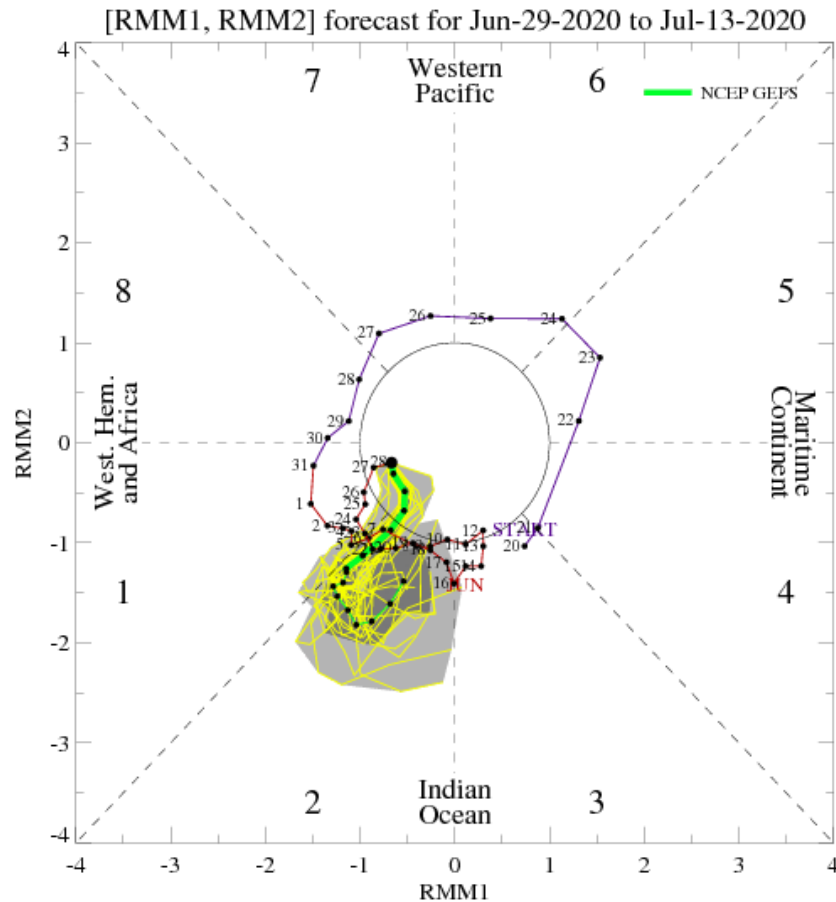
- The RMM index has shifted westward over the past week and reduced in amplitude, which is not characteristic of a singular, robust MJO event.



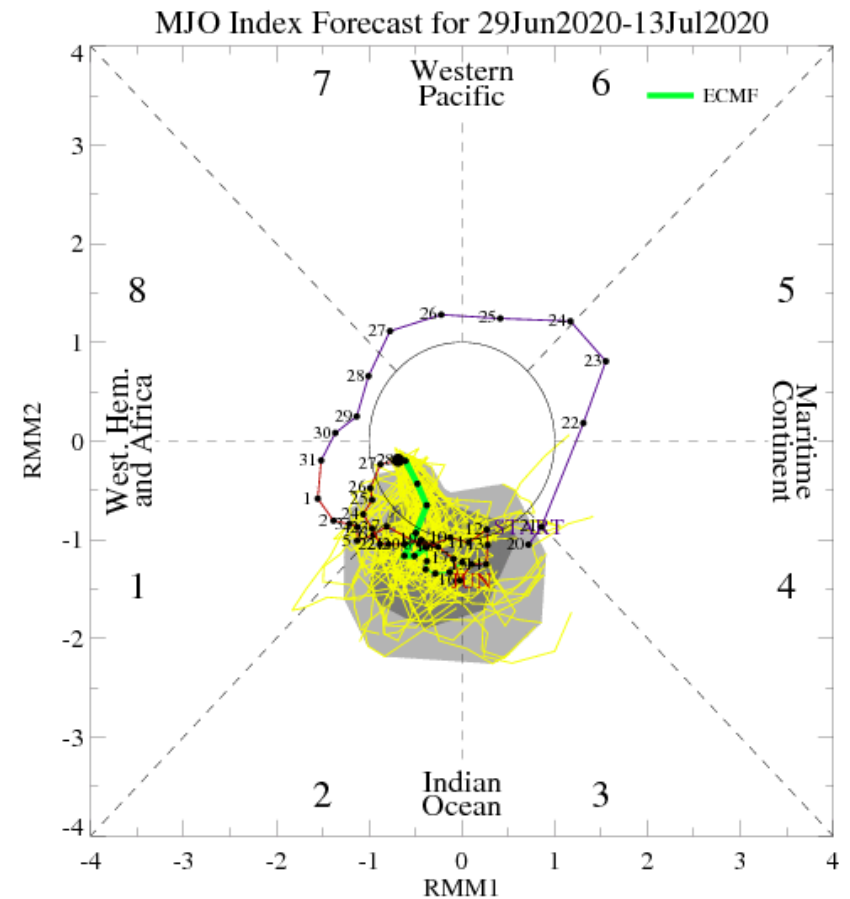
For more information on the RMM index and how to interpret its forecast please see:  
[https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC\\_MJOinformation.pdf](https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf)



# MJO Index: Forecast Evolution



**GEFS Forecast**



**ECMWF Forecast**

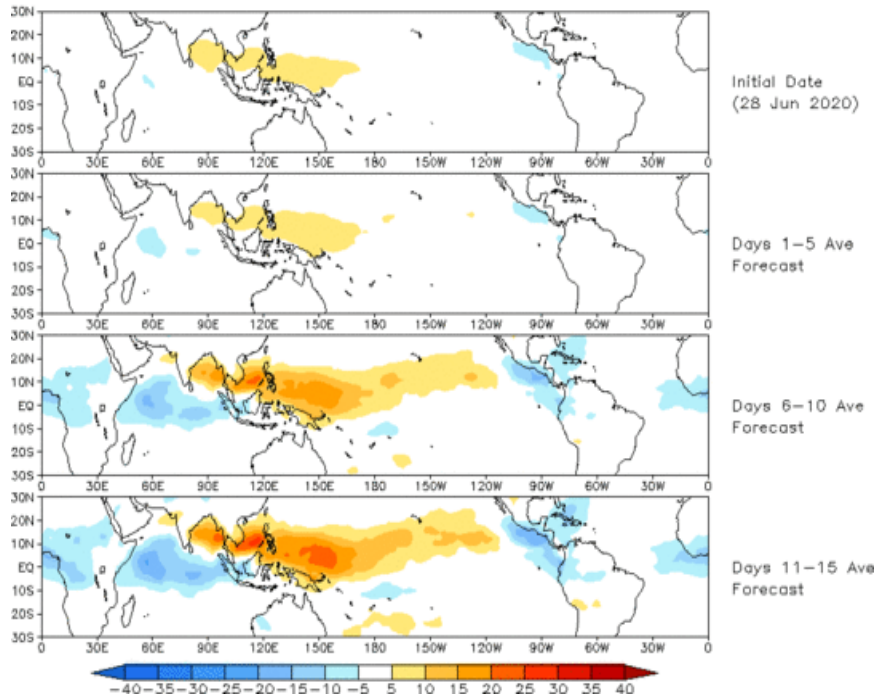
- Dynamical model guidance brings the intraseasonal signal eastward at increased amplitude over the next two weeks. Some weakening and slowing of the signal is possible late in Week-2.
- This pattern is in line with the Kelvin wave over the Western Hemisphere at present slowing and possibly growing into a MJO event, while the Kelvin wave currently approaching the Maritime Continent wanes.



# MJO: GEFS Forecast Evolution

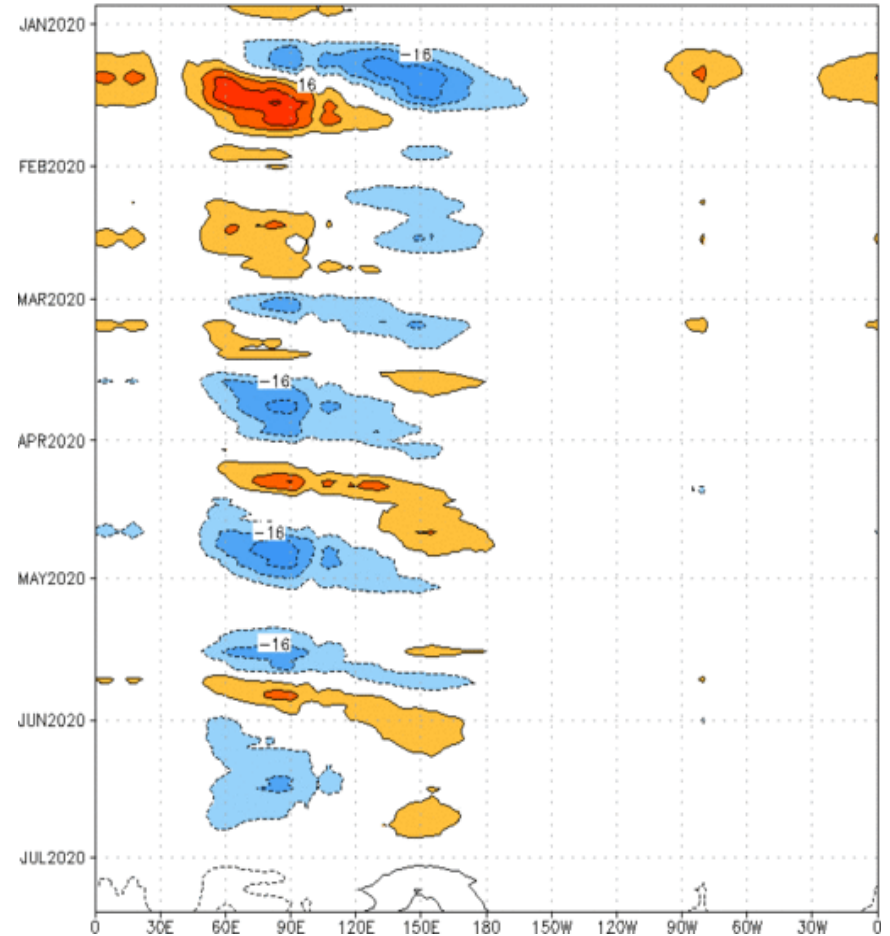
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast  
Initial date: 28 Jun 2020  
OLR



- The GEFS spatial maps show a quasi-stationary tropical convective pattern that grows in amplitude with time.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2  
OLR [7.5°S, 7.5°N] ( $\text{cont: } 4\text{Wm}^{-2}$ ) Period: 28-Dec-2019 to 28-Jun-2020  
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

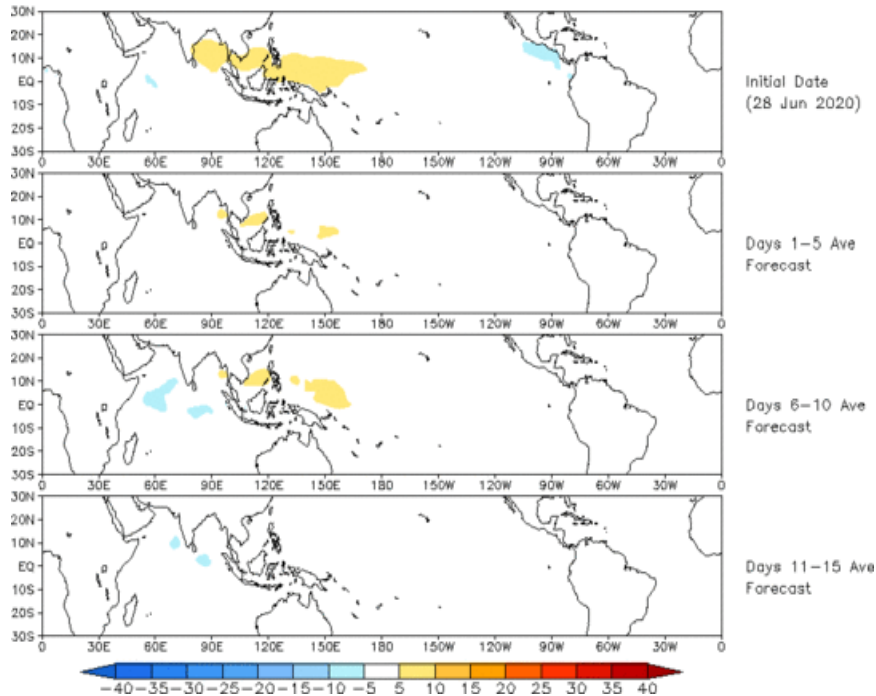




# MJO: Constructed Analog Forecast Evolution

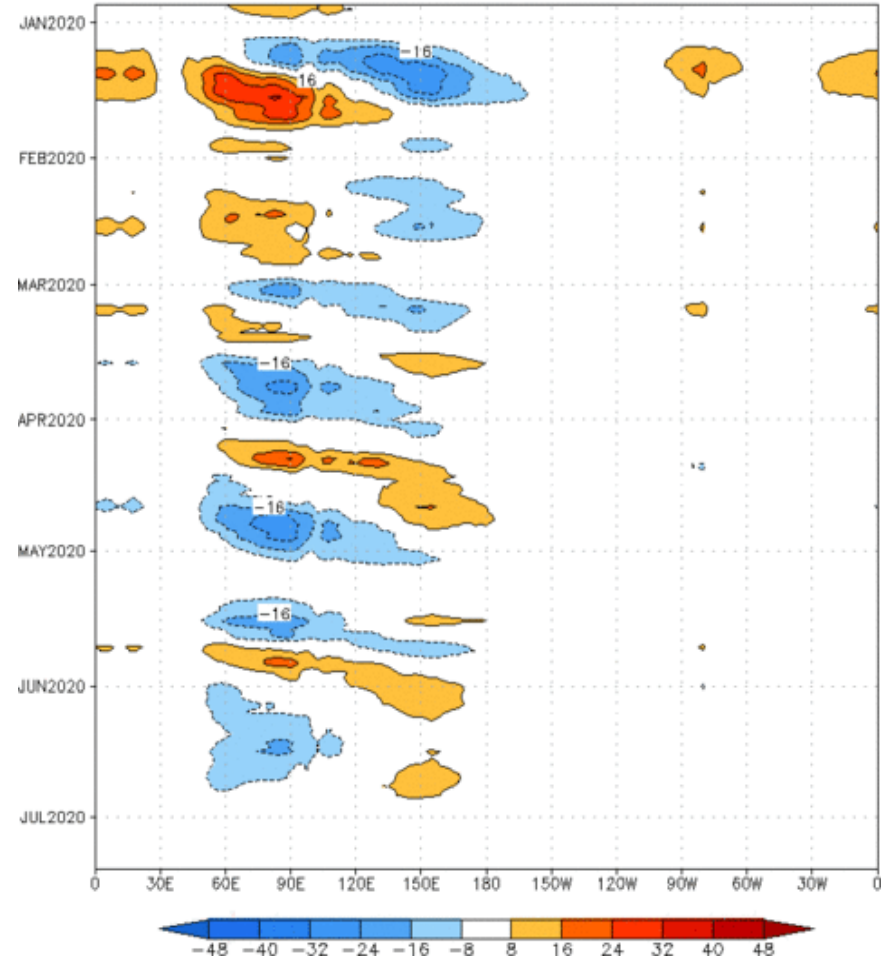
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (28 Jun 2020)



- The constructed analog model depicts a weak convective response to any MJO event and little to no propagation.

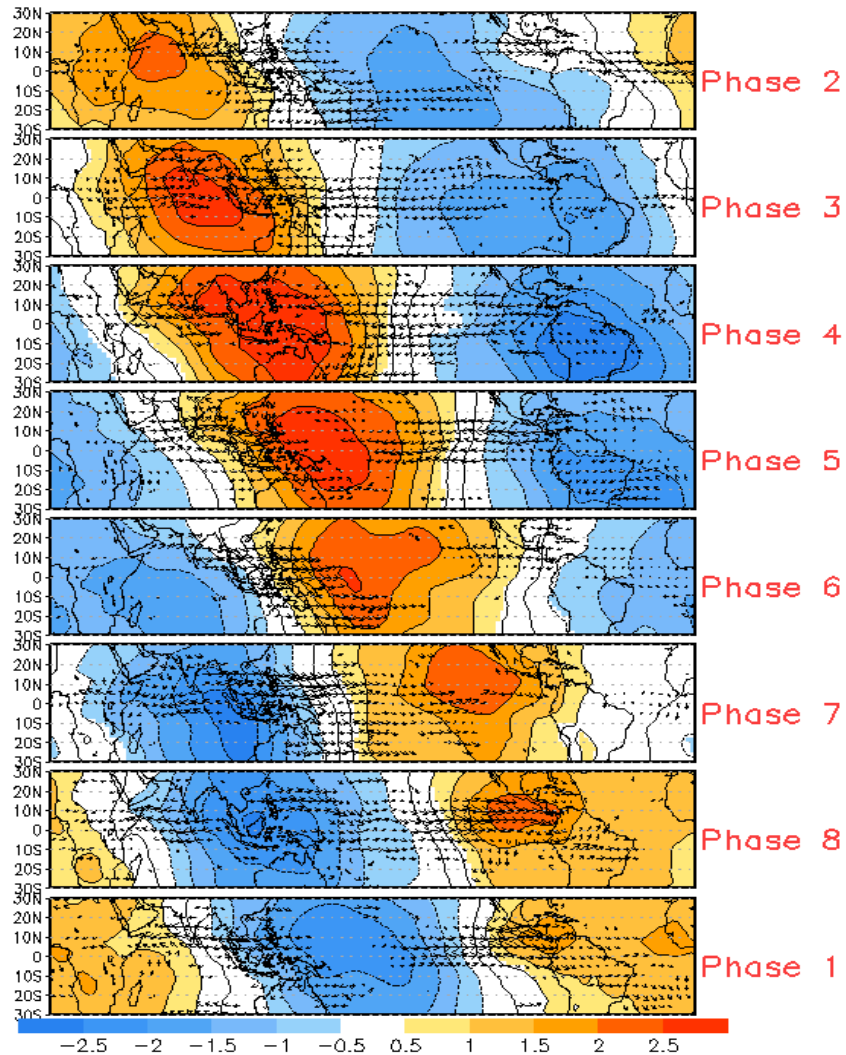
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm<sup>-2</sup>) Period:28-Dec-2019 to 28-Jun-2020  
The unfilled contours are CA forecast reconstructed anomaly for 15 days



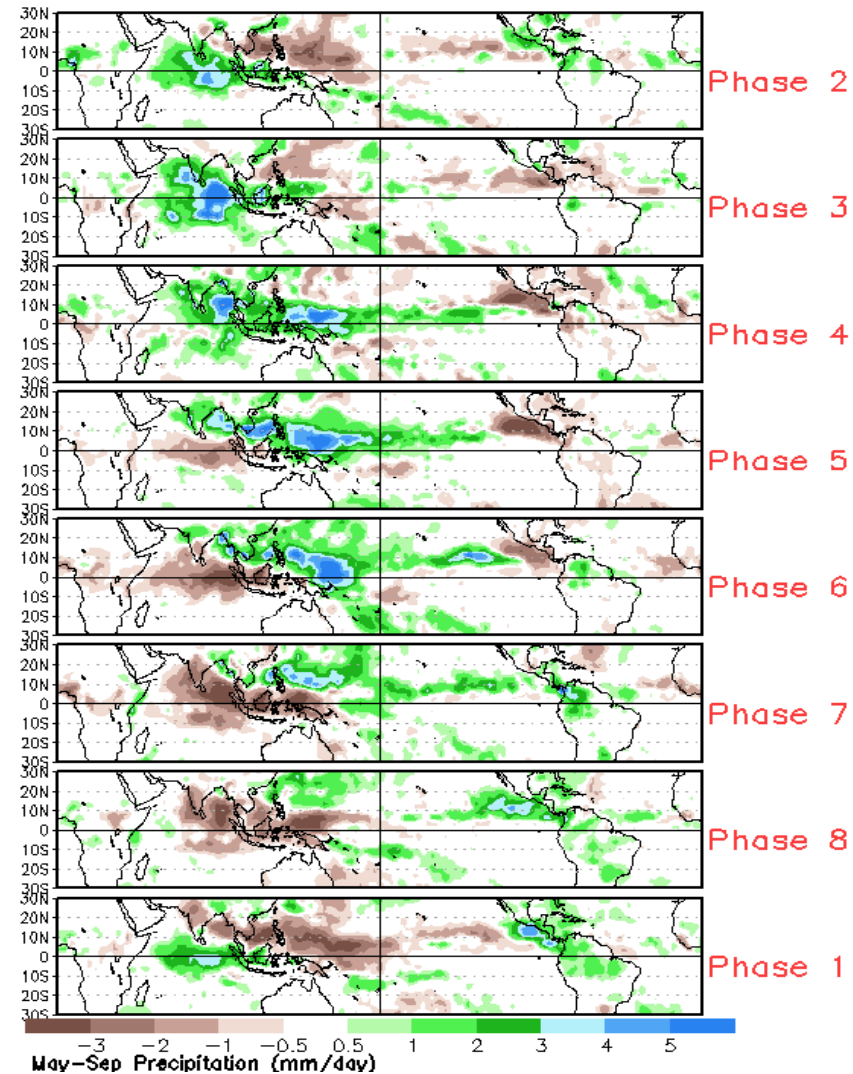


# MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and  
Wind Anomalies



Precipitation Anomalies

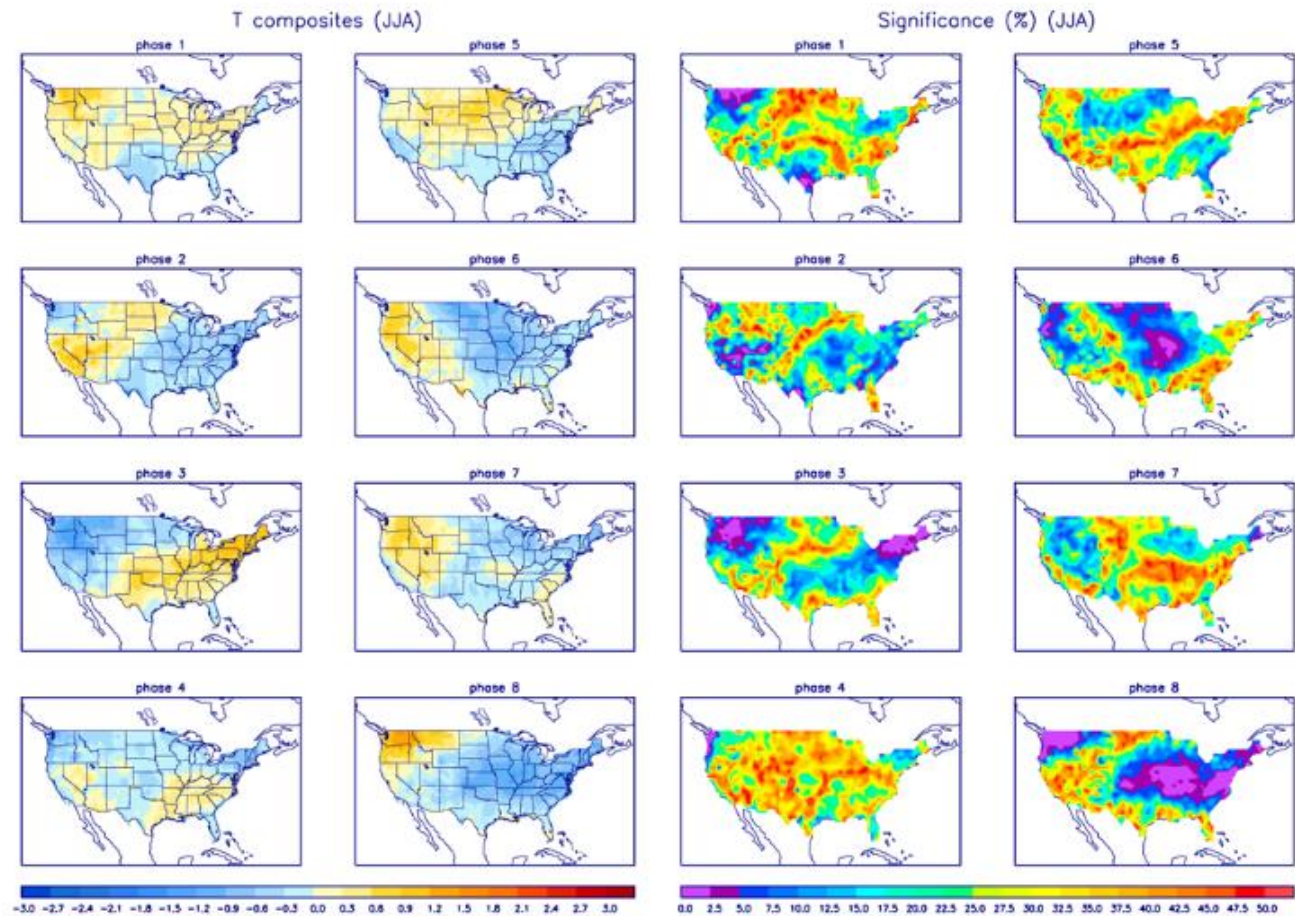




# MJO: CONUS Composite Maps by RMM Phase - Temperature

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.

