

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
22 June 2020

Overview

- Recent observations depict a noisy Wave-1 pattern with enhanced convection due to a Kelvin wave over the East Pacific during Week-1 and forecast over the western Atlantic during Week-2.
- This enhanced convection is likely to result in tropical cyclone formation in the East Pacific during Weeks-1 and -2,
- There is no clear indication of an MJO event in the dynamical model guidance at this time.

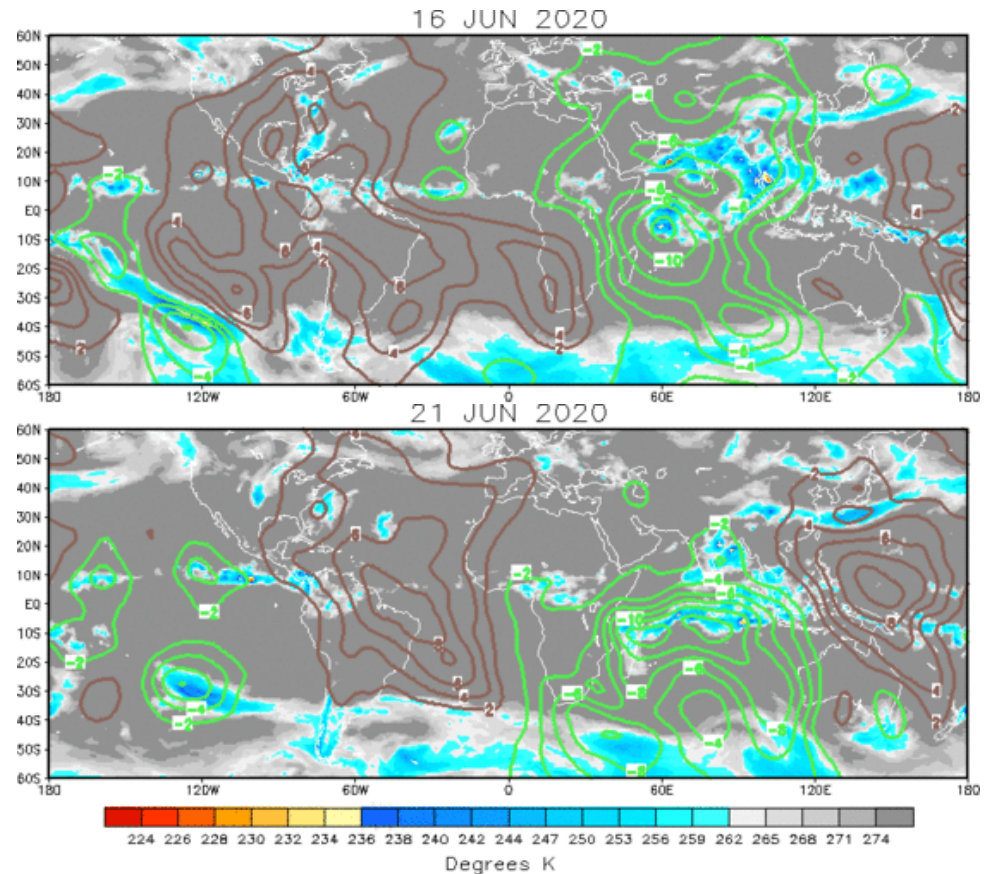
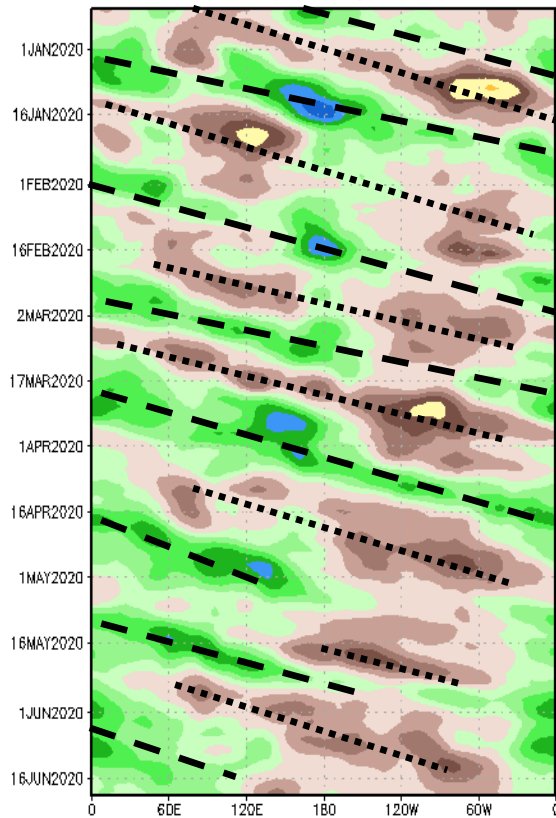
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

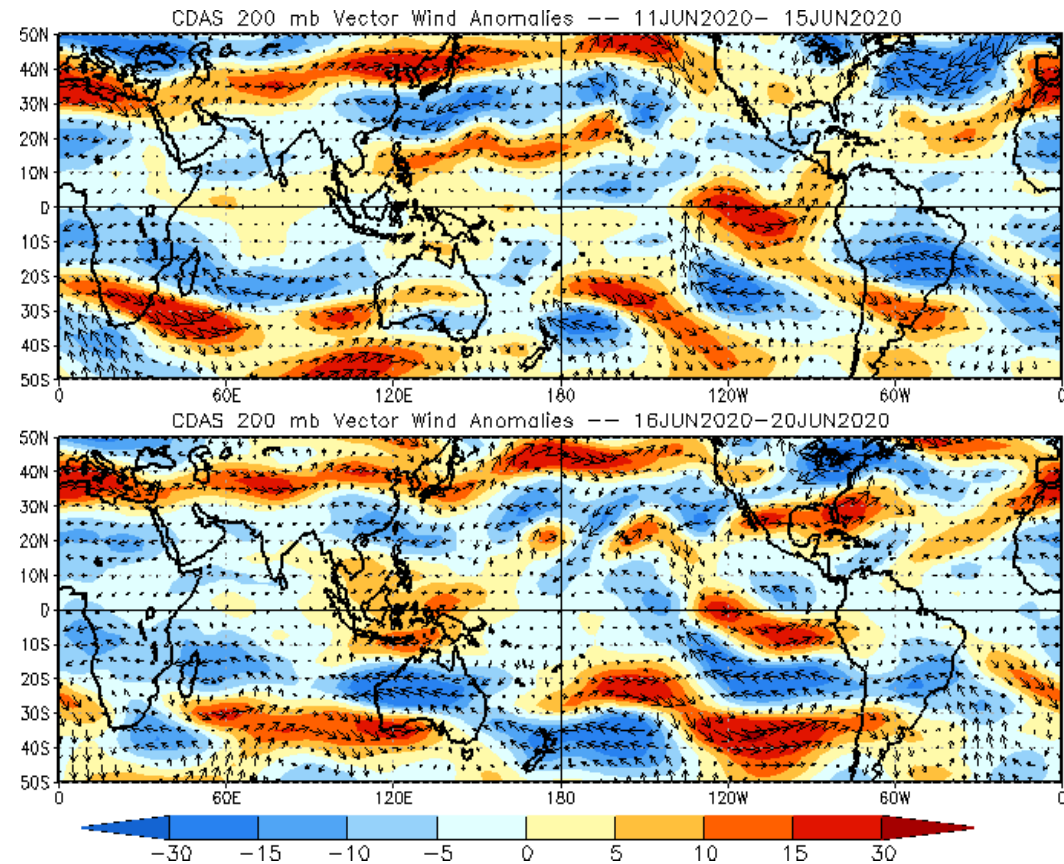
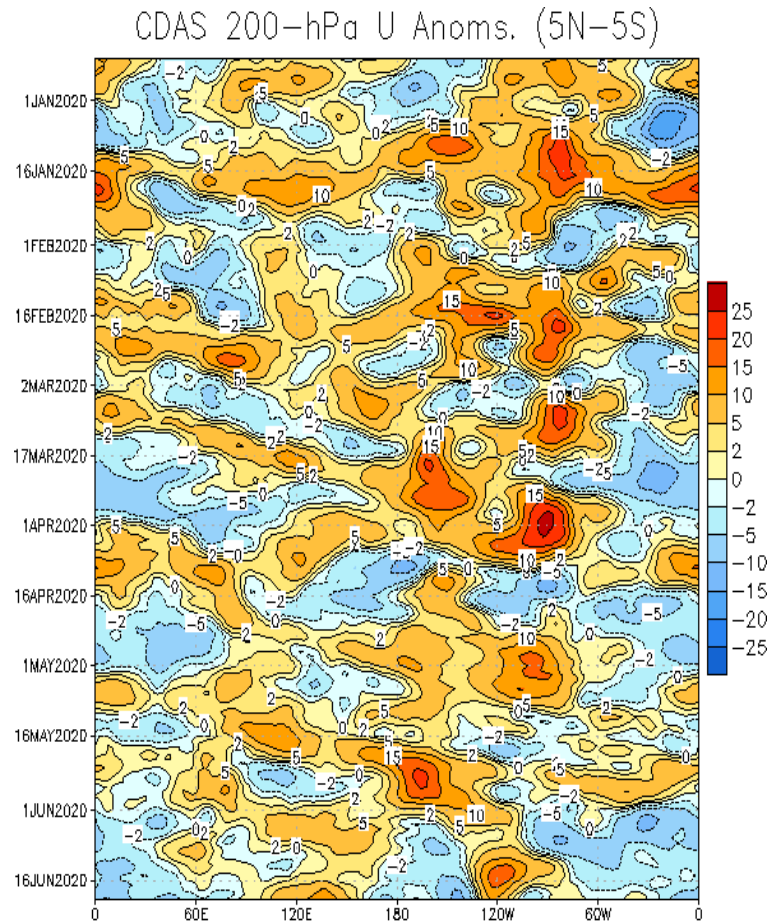
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- The Wave-1 pattern evident in the June 16 spatial map has propagated east and weakened a bit as high frequency “noise” related to tropical cyclone and equatorial Rossby wave convection built over the East Pacific.
- The pattern is most likely driven by a relatively slow, but strong, Kelvin wave that has propagated around the equator in an MJO-like fashion.

200-hPa Wind Anomalies

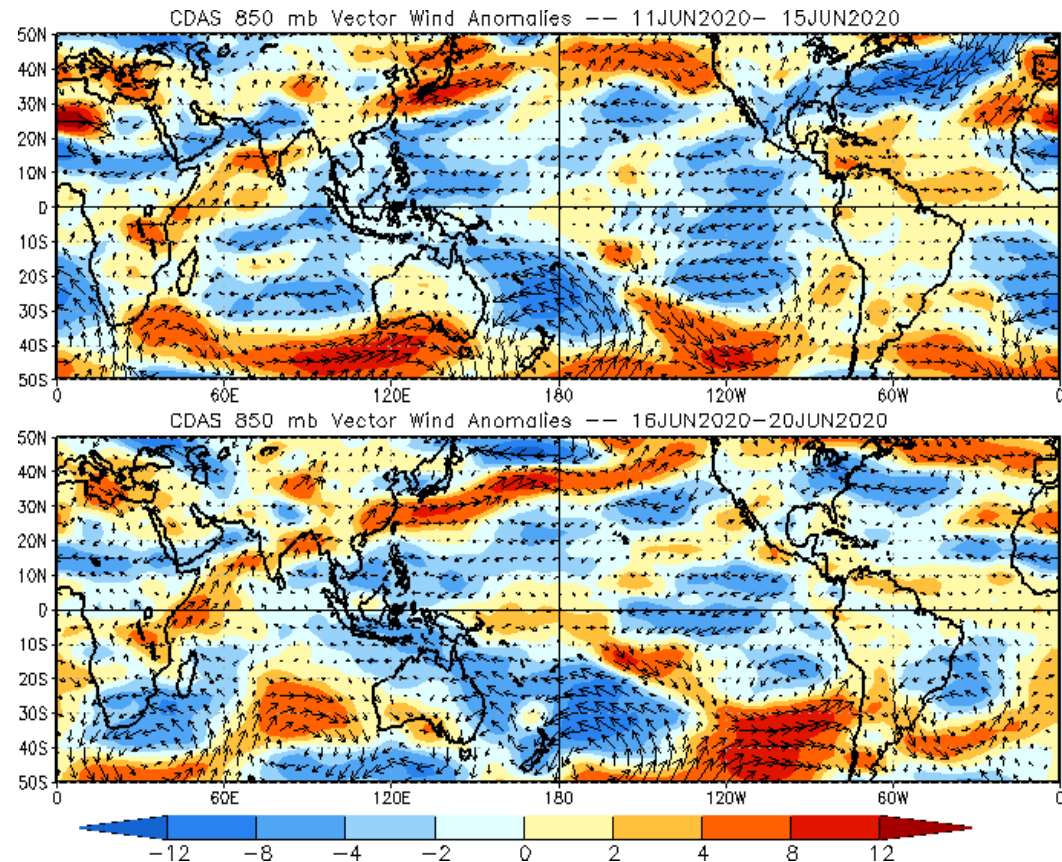
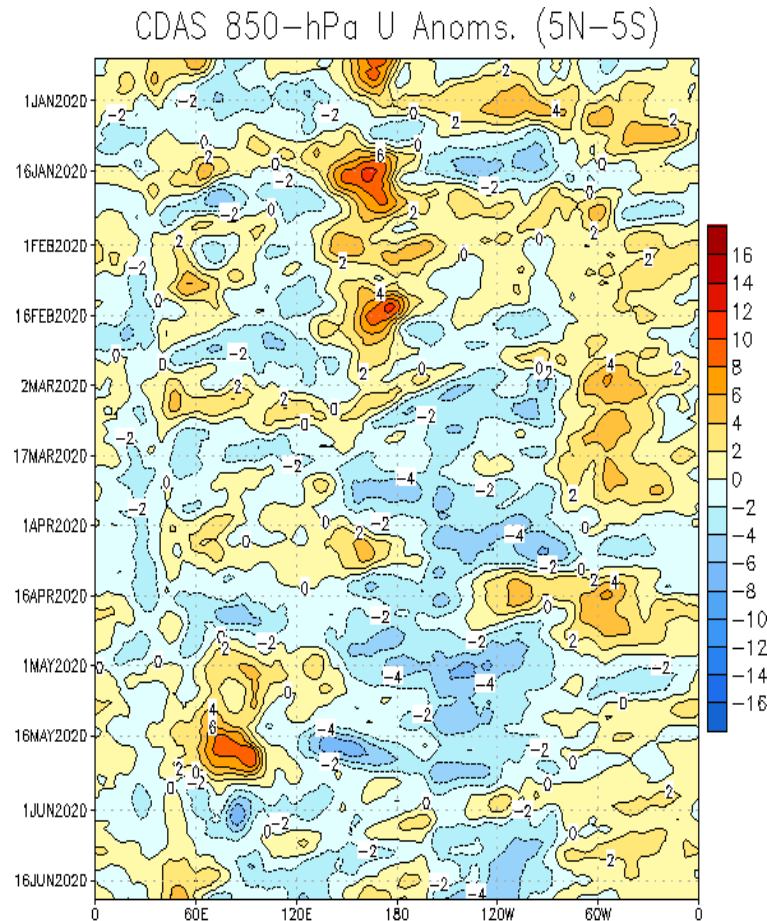
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Rossby wavebreaking continues over the North Pacific. This redistribution of potential vorticity from the mid-latitudes to the tropics contributes to the strength and propagation of the aforementioned Kelvin wave.

850-hPa Wind Anomalies

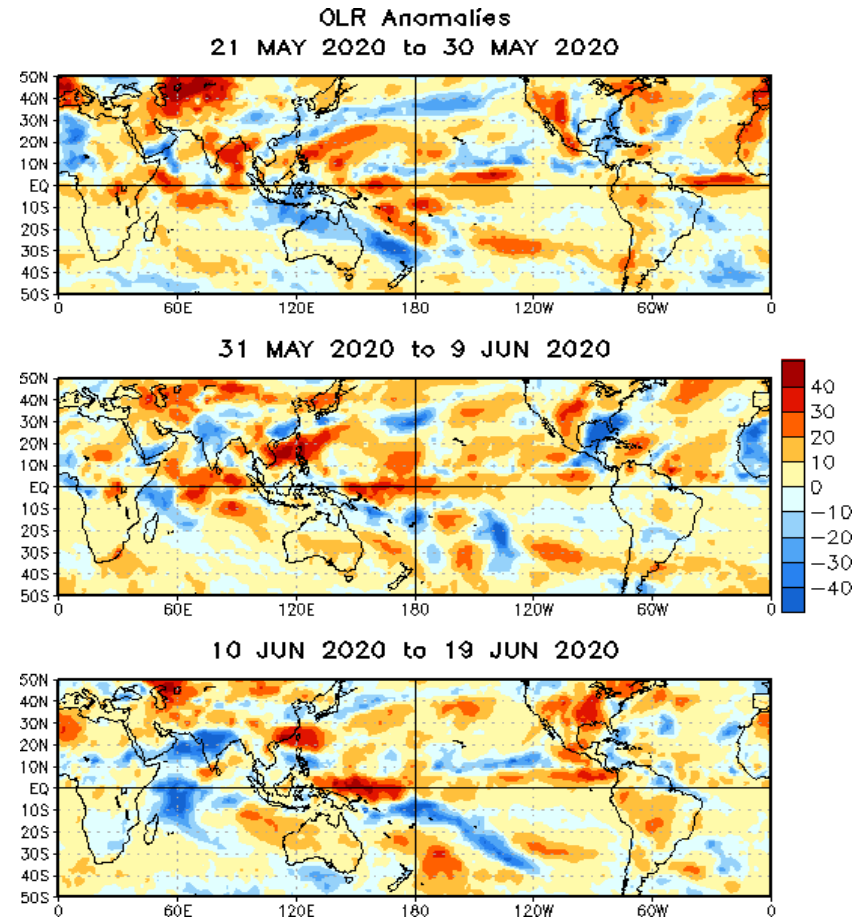
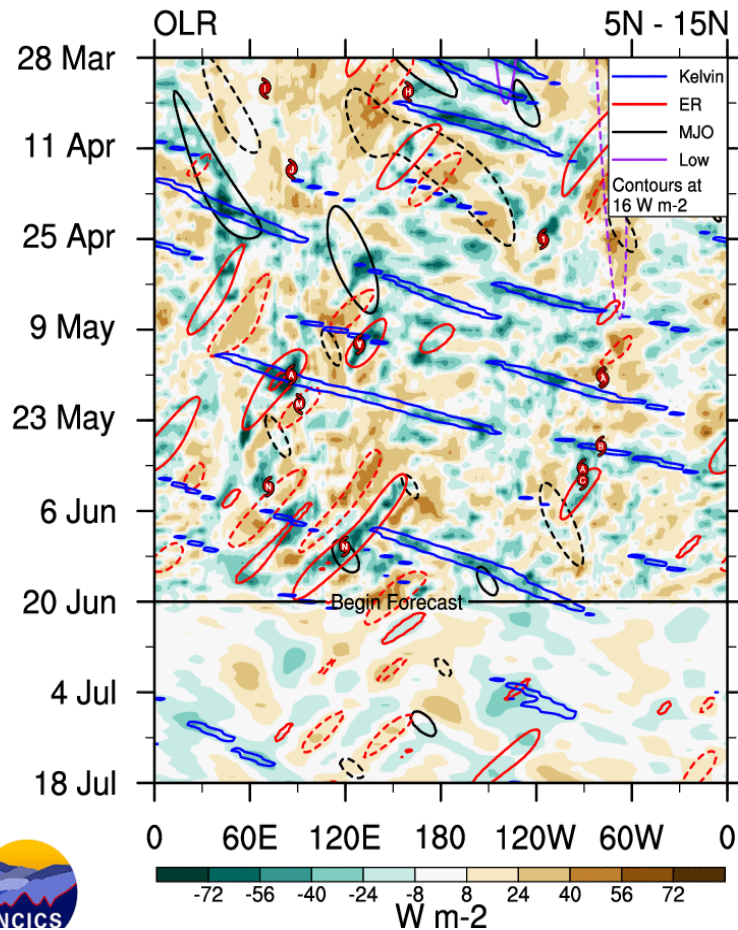
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Trade winds throughout the east Pacific are enhanced over climatology, which is consistent with observed negative SST anomalies in the Nino regions.

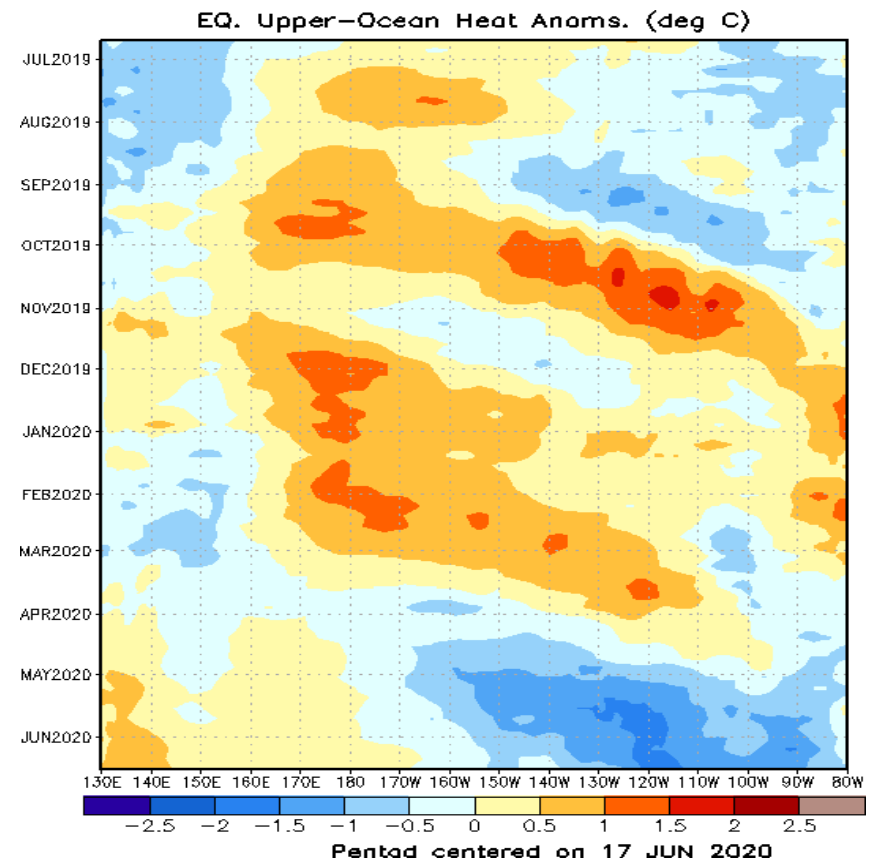
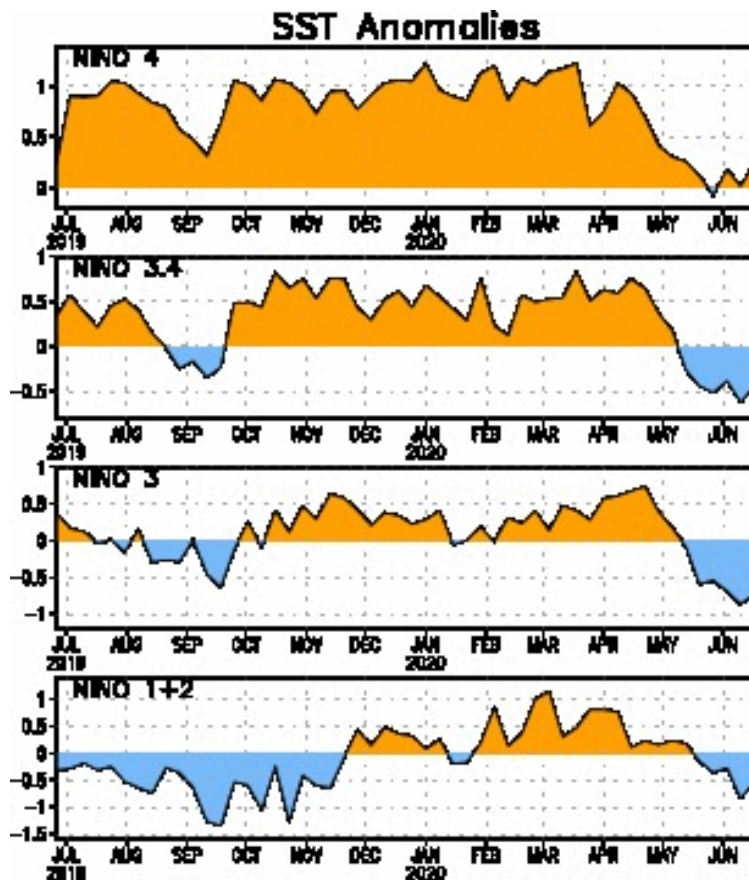
Outgoing Longwave Radiation (OLR) Anomalies

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



- Much of the recent enhanced tropical convection is associated with Rossby and Kelvin wave activity.
- The large area of negative OLR anomalies over the western Indian Ocean is primarily due to an equatorial Rossby wave that appears to have been the result of Rossby wave breaking over Europe.

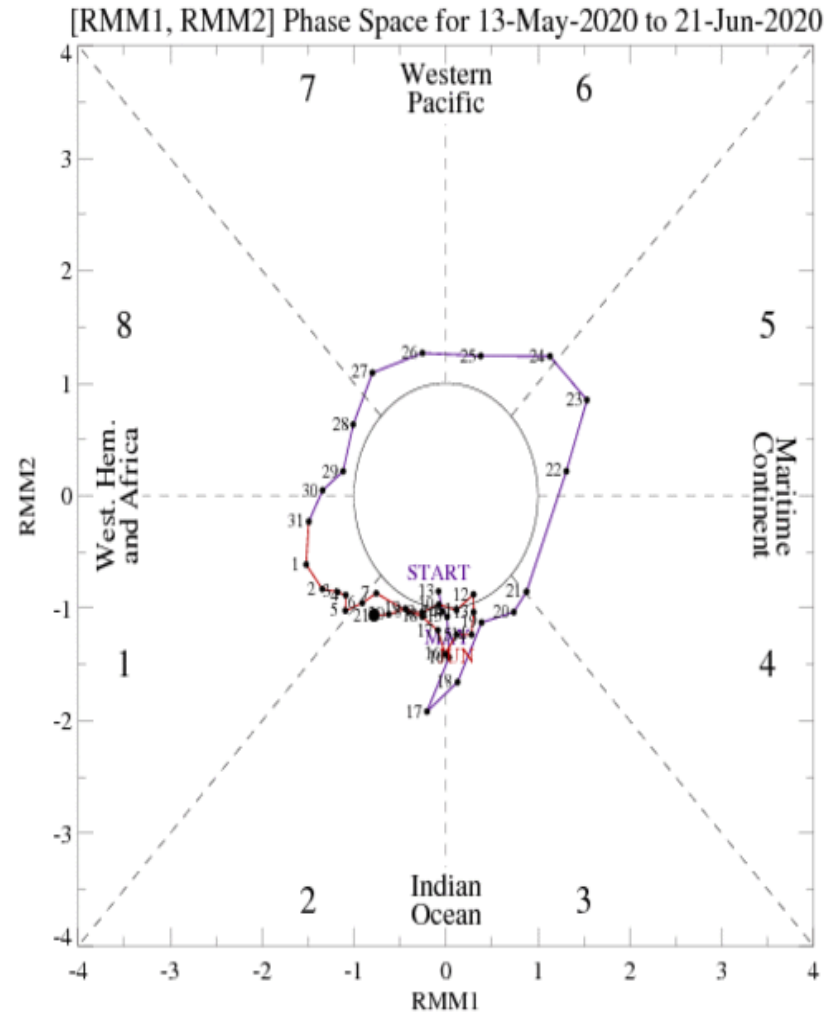
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- 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 figure on the right.

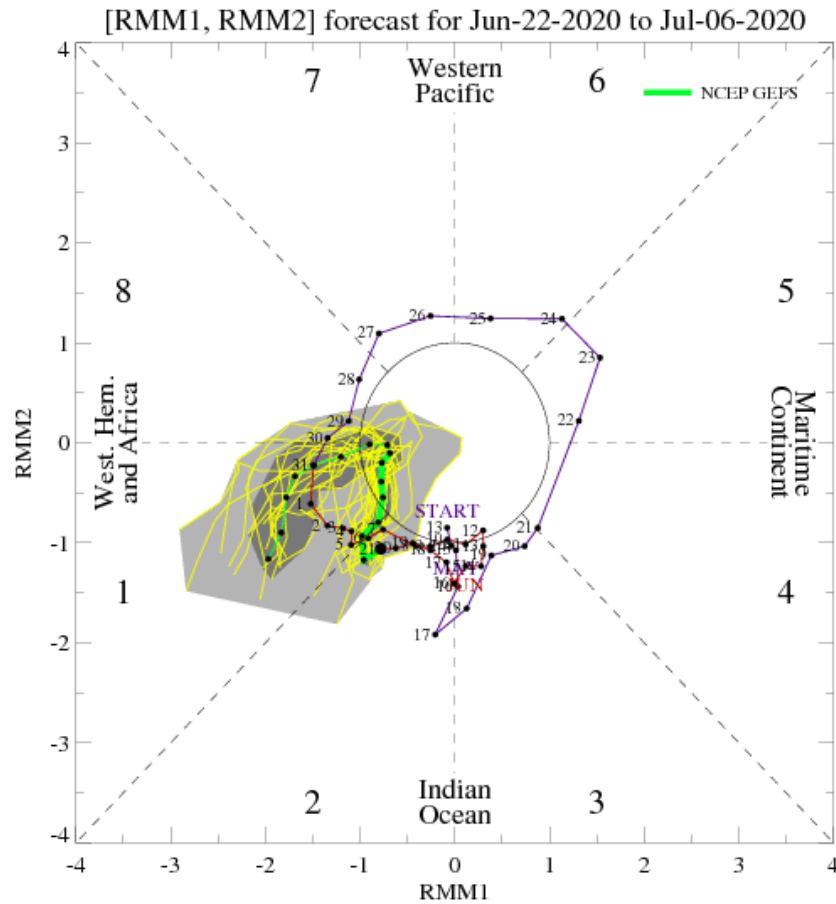
MJO Index: Recent Evolution

- There has not been a coherent MJO signal in the RMM index over the last couple of weeks.

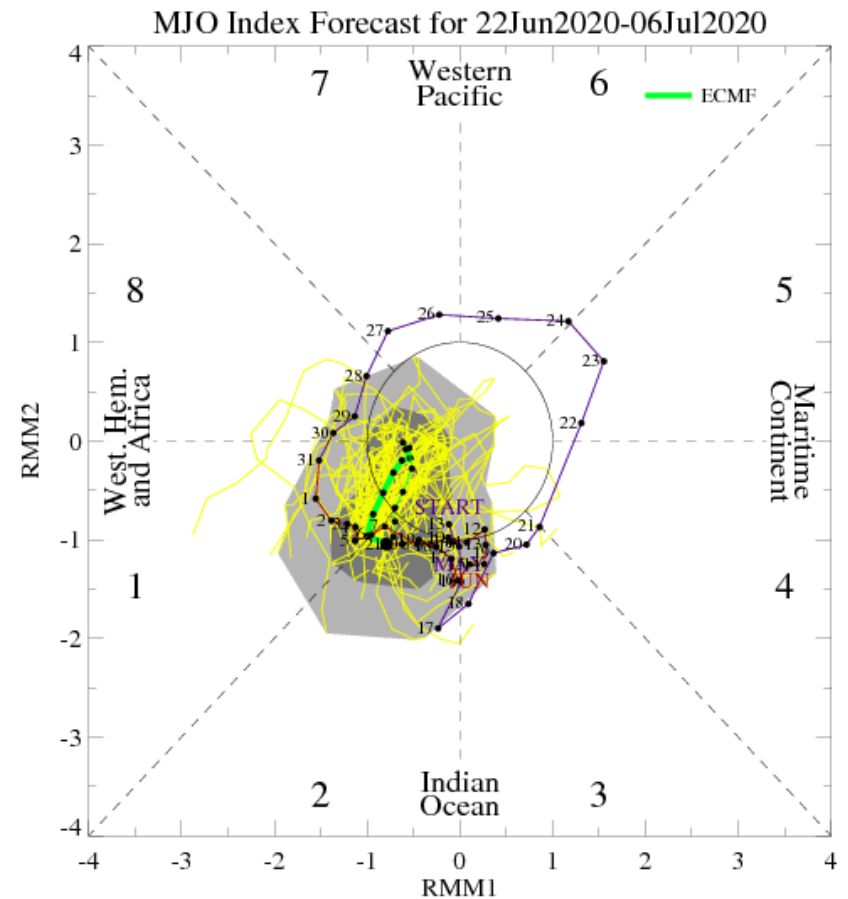


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



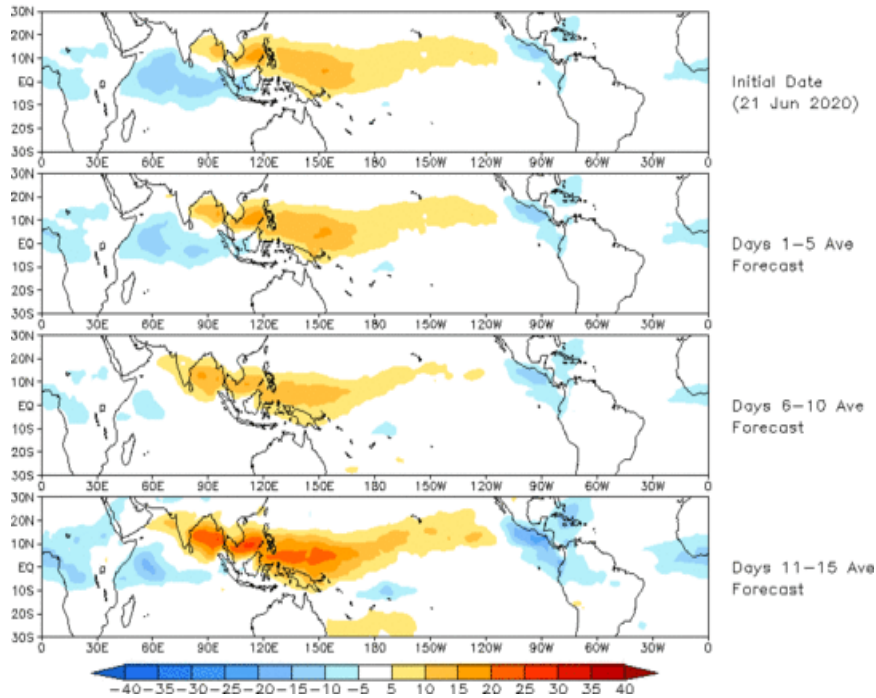
ECMWF Forecast

- Dynamical model guidance does not forecast a coherent MJO during the next two weeks.

MJO: GEFS Forecast Evolution

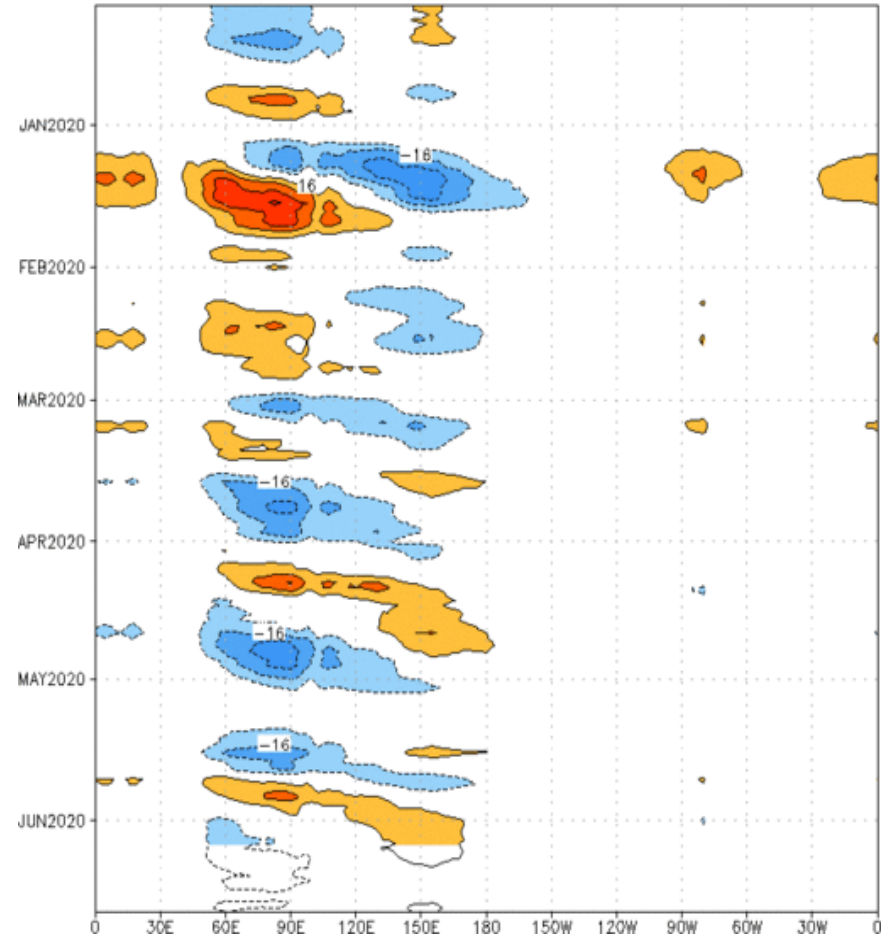
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 21 Jun 2020
OLR



- The GEFS spatial maps show a quasi-stationary tropical convective pattern that lacks MJO propagation characteristics.

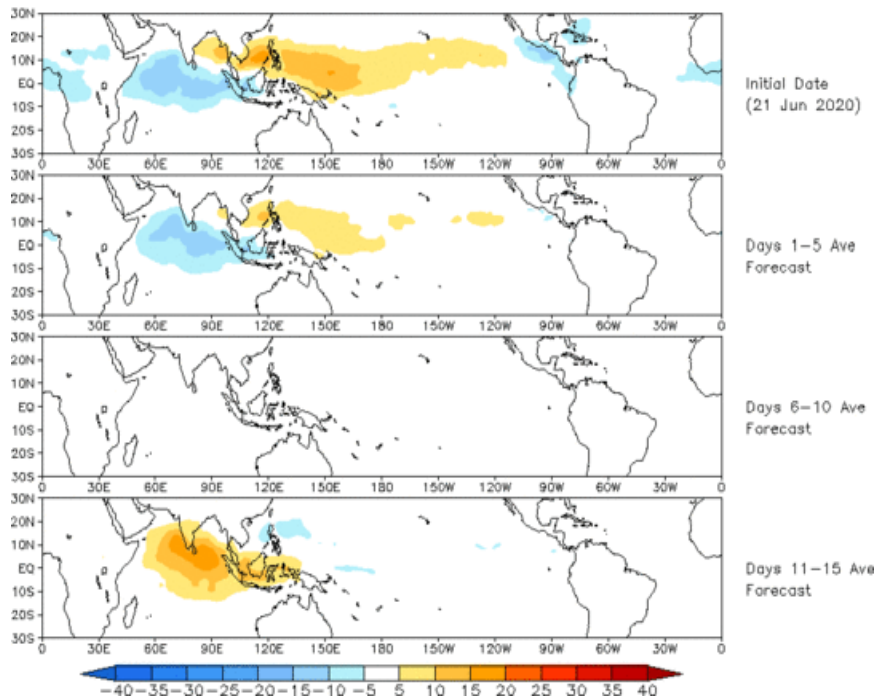
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S, 7.5°N] ($\text{cint: } 4\text{Wm}^{-2}$) Period: 06-Dec-2019 to 06-Jun-2020
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



MJO: Constructed Analog Forecast Evolution

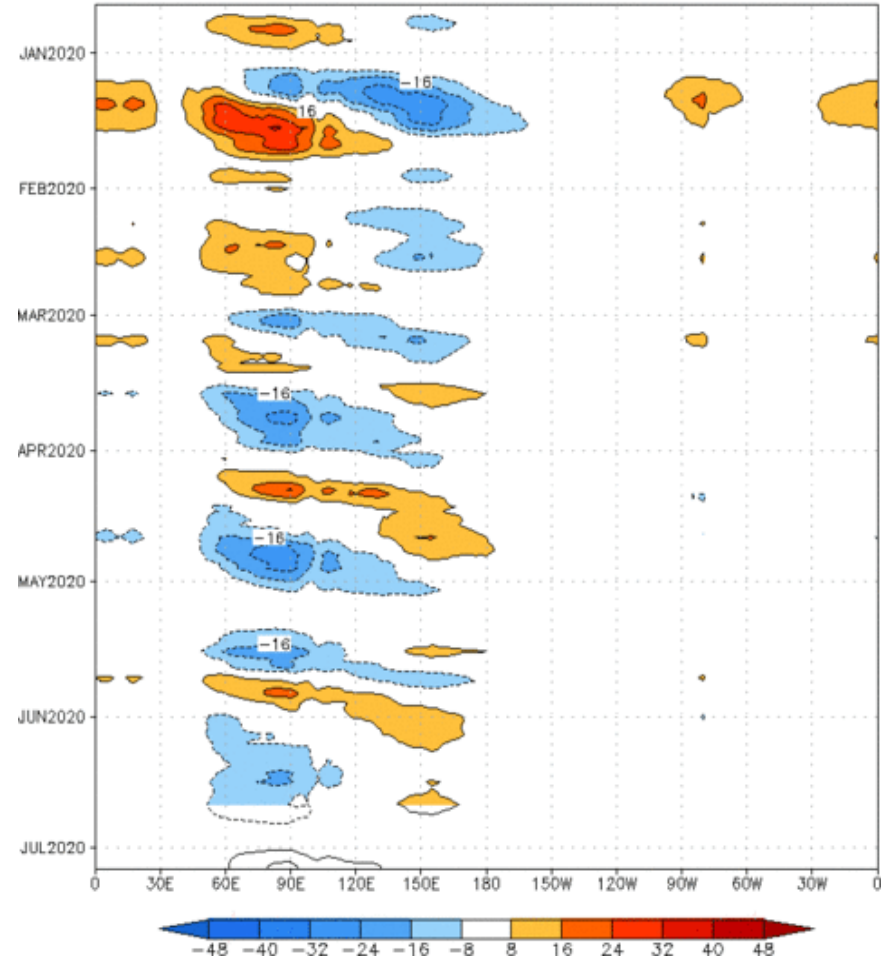
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (21 Jun 2020)



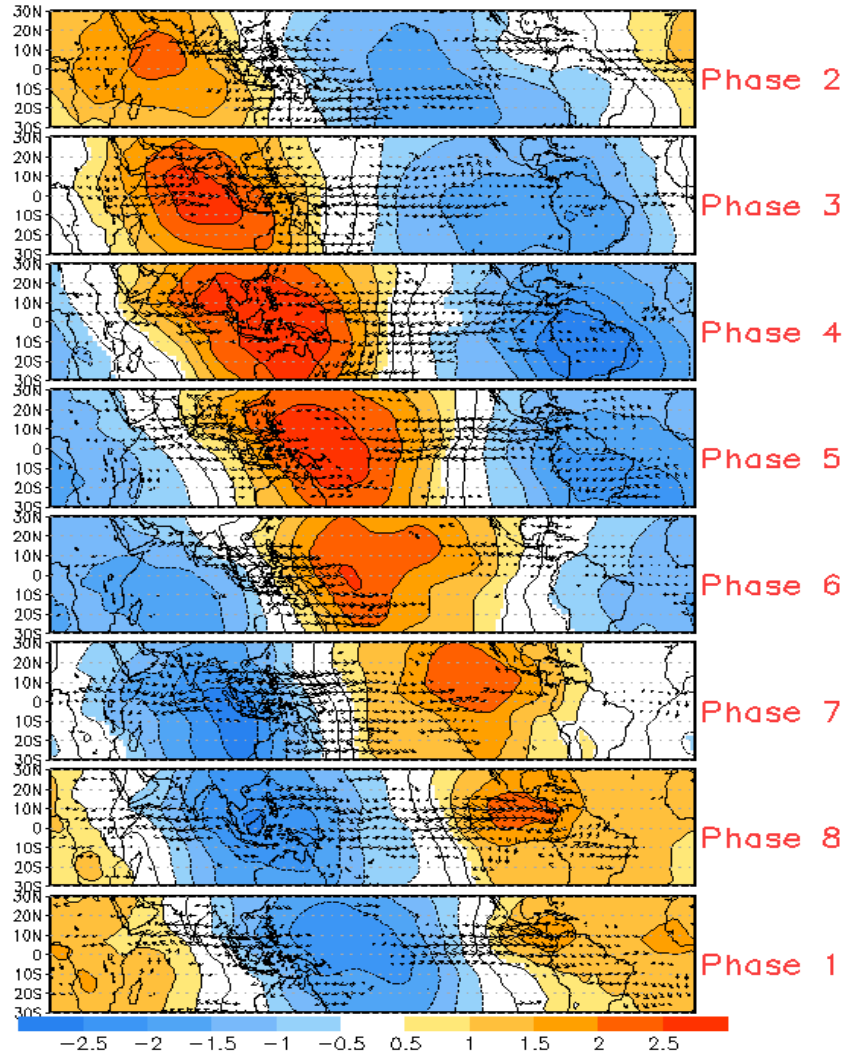
- The constructed analog model shows a weak convective signature with no clear tropical forcing.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:21-Dec-2019 to 21-Jun-2020
The unfilled contours are CA forecast reconstructed anomaly for 15 days

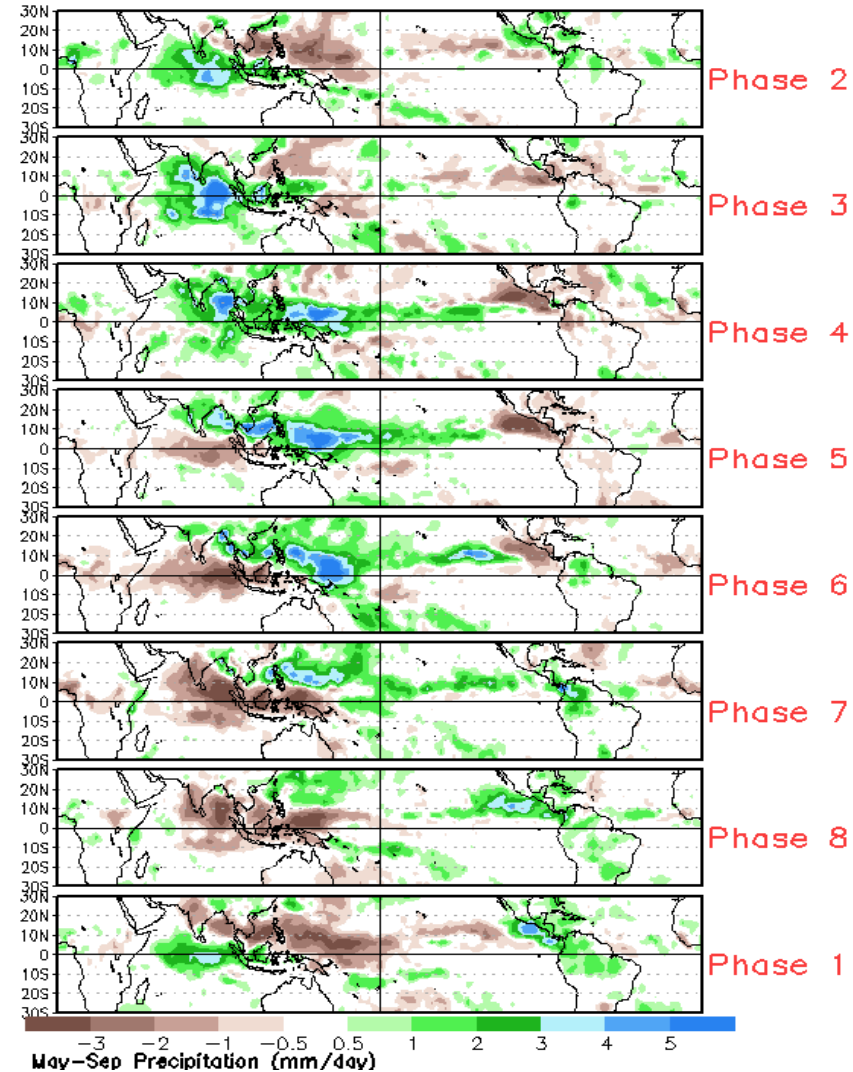


MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



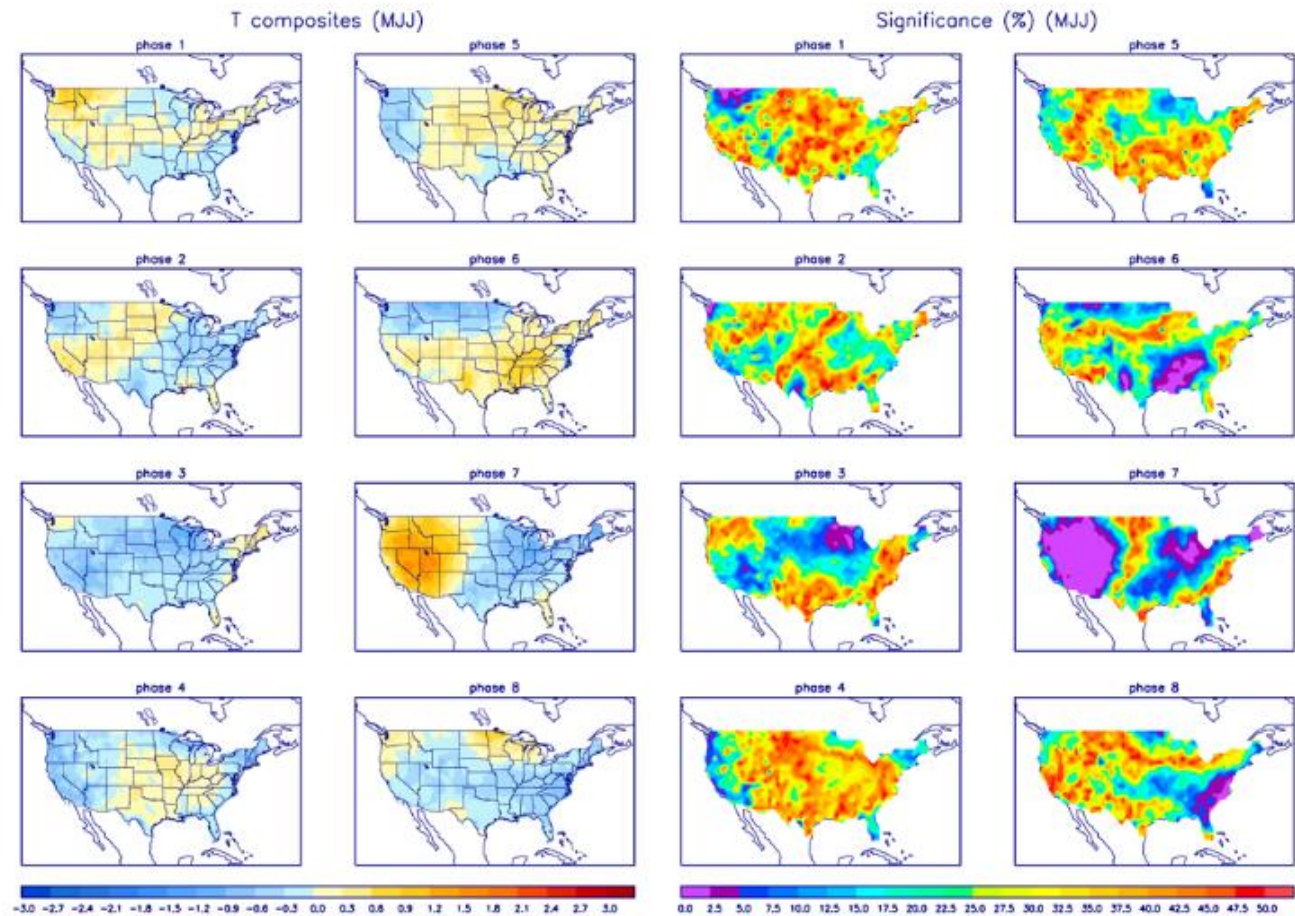
Precipitation Anomalies



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.

