

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



Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
10 August 2020

Overview

- The MJO had its enhanced envelope over the Maritime Continent during the past week.
- Dynamical models depict the MJO as reaching the Western Hemisphere but vary dramatically on the speed and magnitude of the event. The faster/stronger GEFS almost certainly emphasizes Kelvin Wave activity, whereas the slower/weaker ECMWF appears more closely tied to the MJO envelope although the model exhibits substantial spread.
- Kelvin wave activity is likely to increase Tropical Cyclone activity over the East Pacific during Week-1, with the MJO's approach during Week-2 extending the active period. The Atlantic is likely to be fairly quiet the next two weeks, although the Kelvin wave could increase chances for something forming in late August. The very end of the month is likely to be more active in the wake of the Kelvin wave and with the MJO's approach.

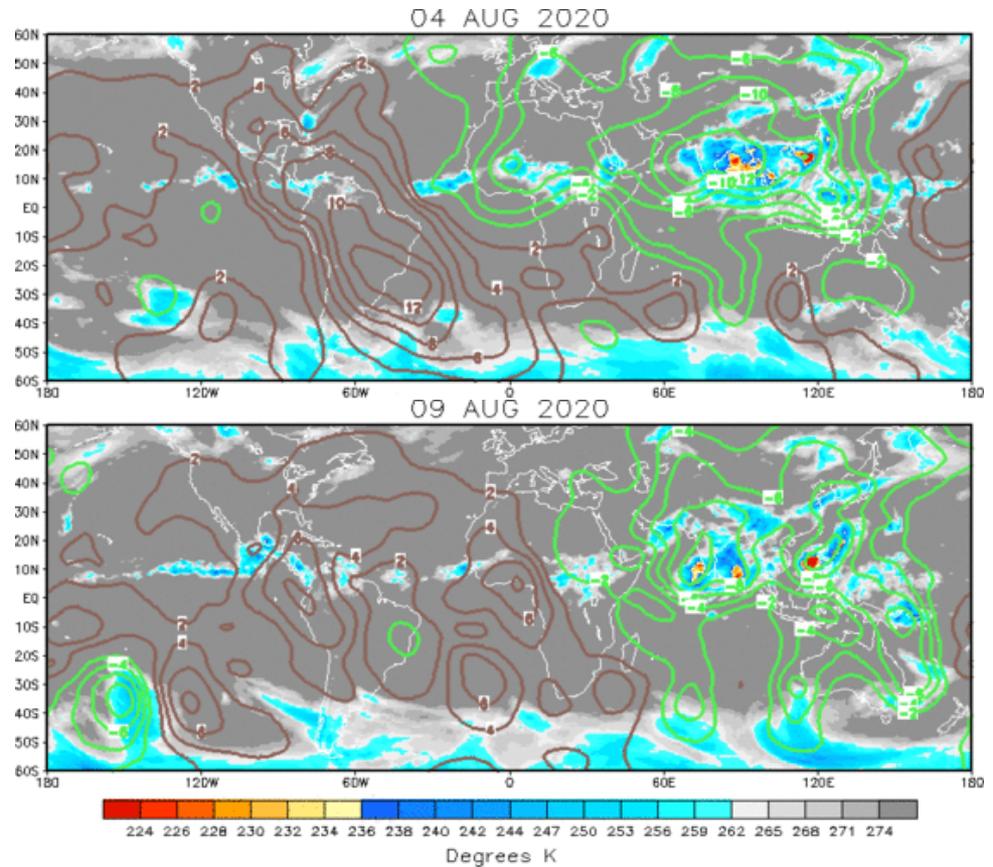
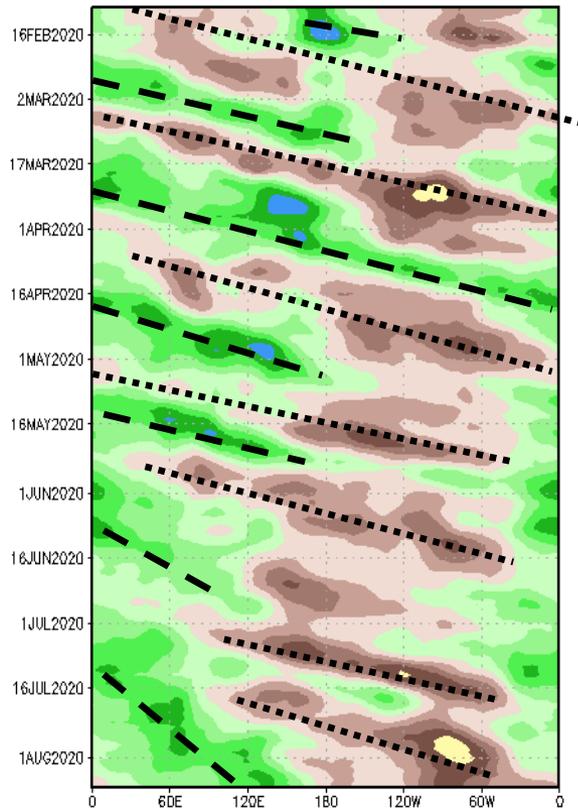
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

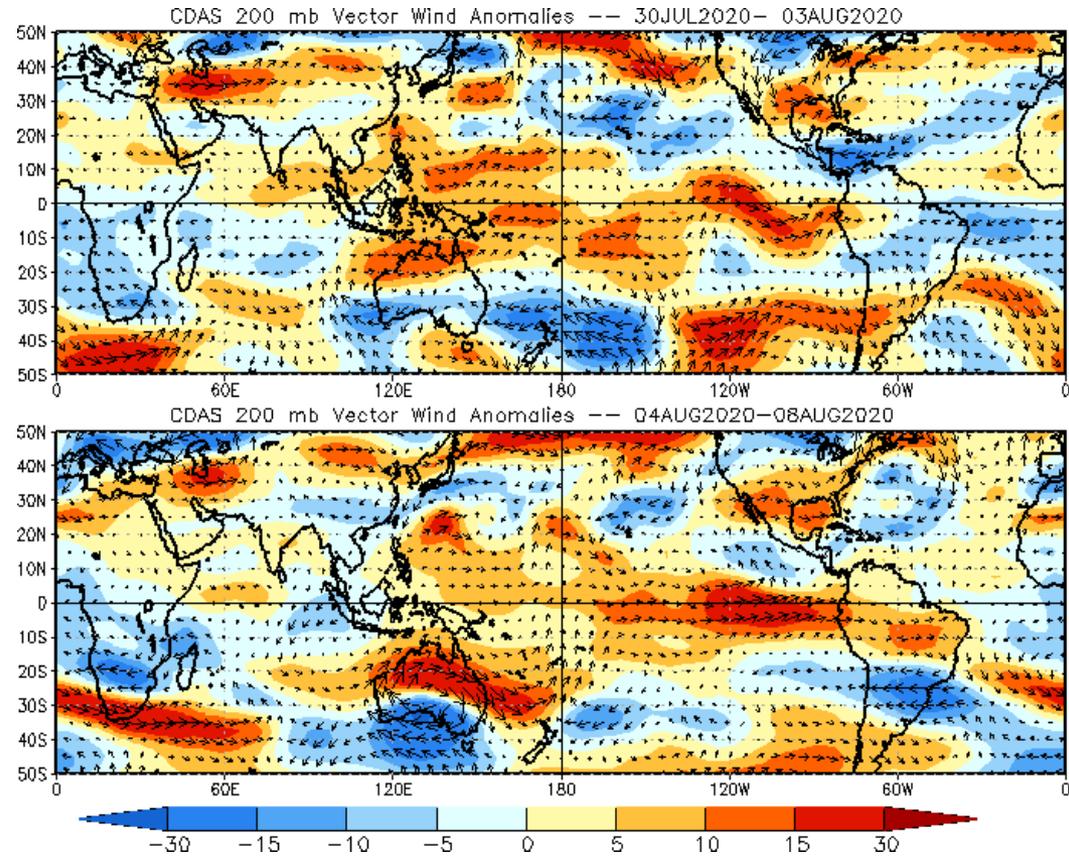
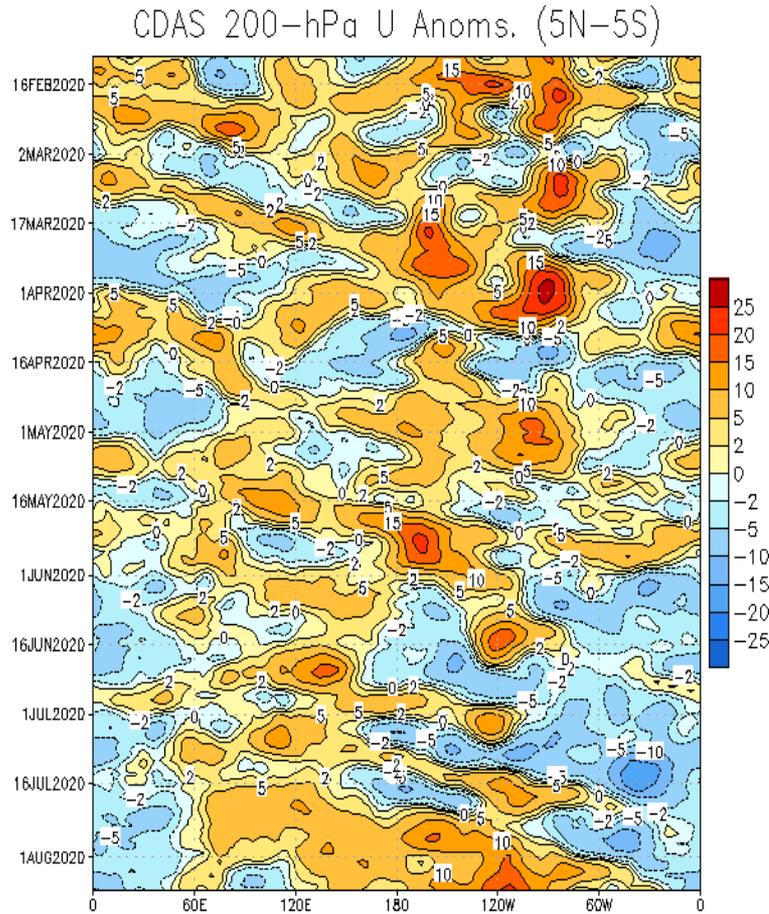
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- Throughout 2020 the base state has seen a westward shift of conditions favorable for enhanced (suppressed) convection from near the Date Line (Americas) to the Indian Ocean (Central Pacific). This has been interspersed with periodic intraseasonal activity.
- Most recently, a slower propagating intraseasonal envelope has transited from Africa to near the Maritime Continent. This envelope has a phase speed consistent with the MJO.

200-hPa Wind Anomalies

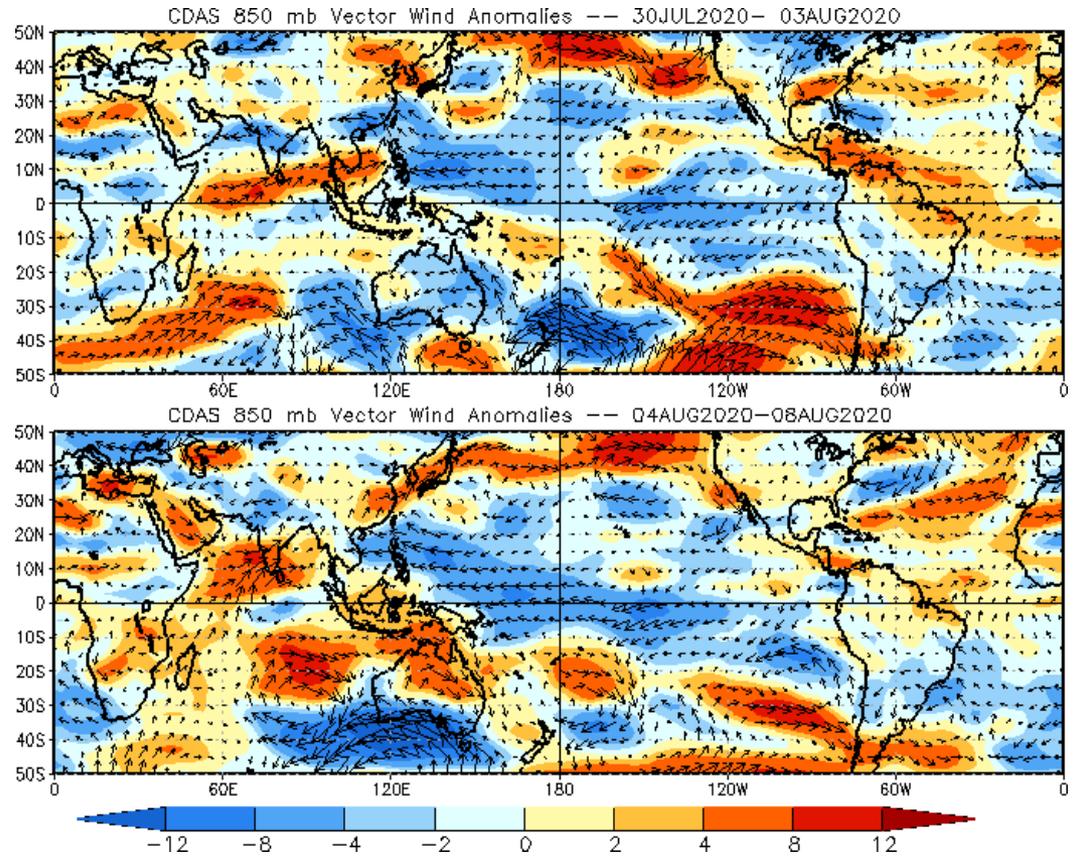
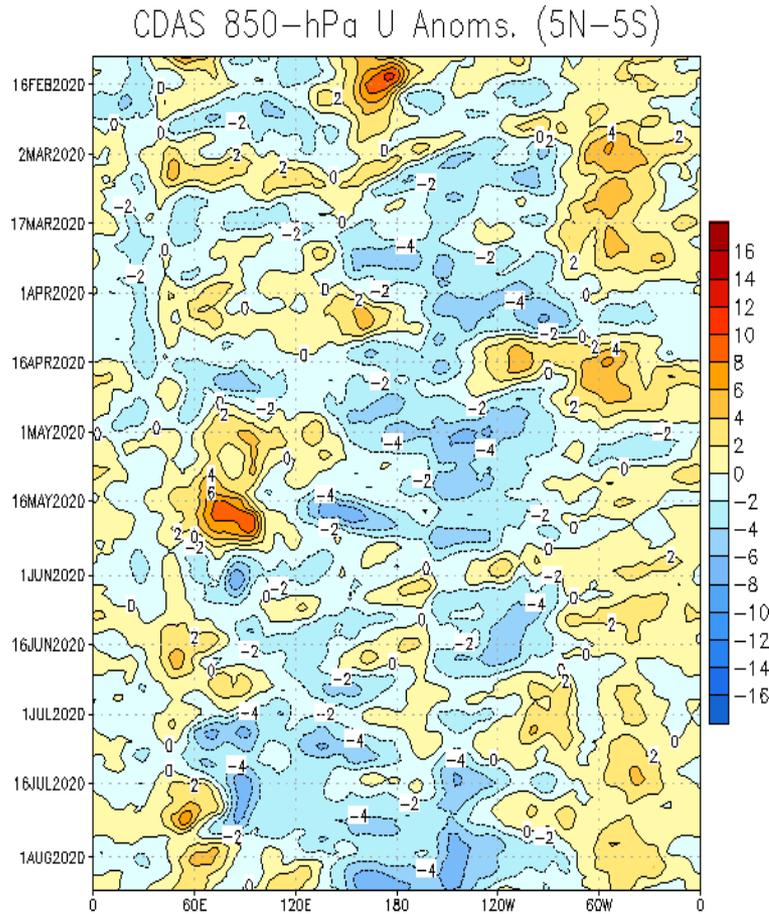
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Anomalous upper-level westerlies have been generally present across the Pacific since late June, with the exception of brief breaks tied to anomalous easterlies propagating rapidly eastward.
- The subtropical circulation is driving mass onto the equator east of the Date Line in both hemispheres, giving rise to the most prominent anomalous westerlies along the equator being situated over the East Pacific.

850-hPa Wind Anomalies

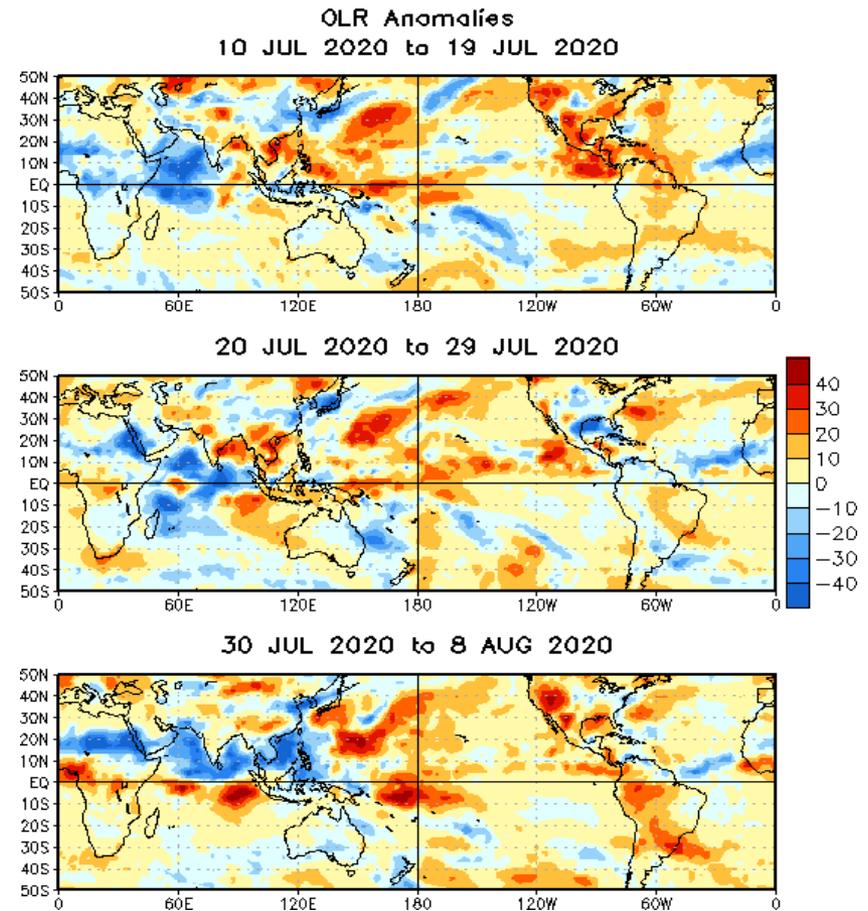
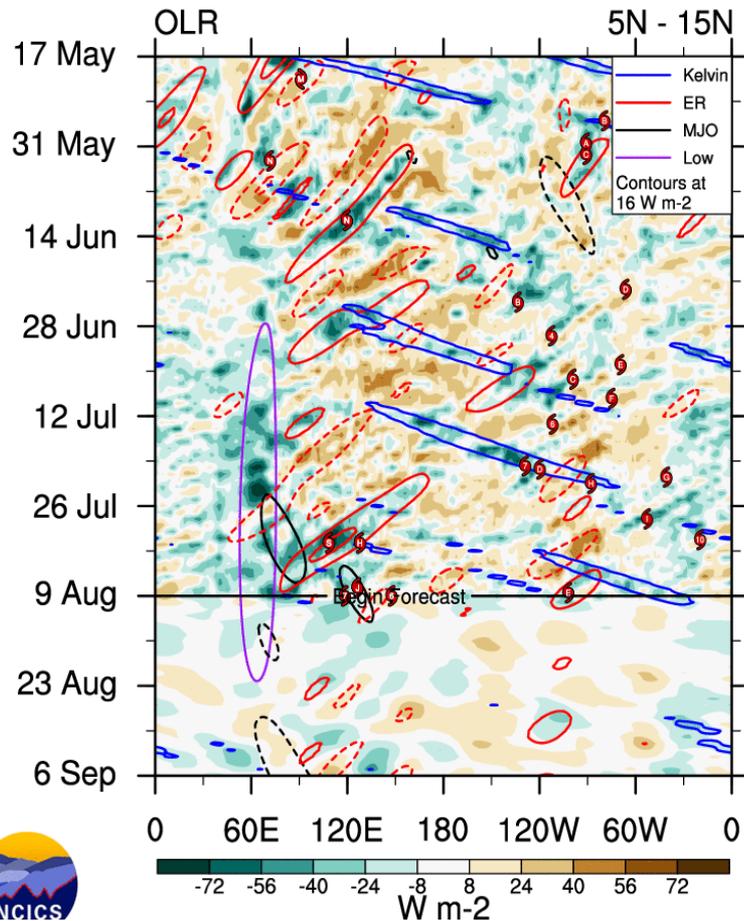
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Anomalous easterlies have been present across the equatorial Pacific for much of 2020, tied to the low frequency state's potential evolution toward La Niña.
- Anomalous cross-equatorial flow has recently built across the western Indian Ocean, associated with a strengthening of the Indian Monsoon circulation.

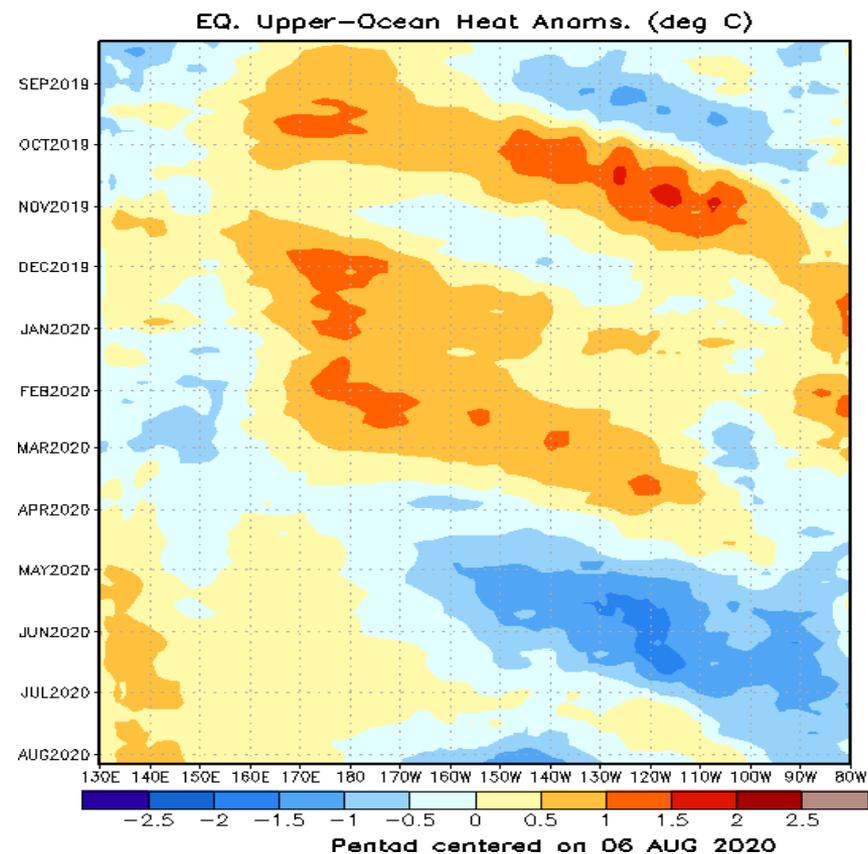
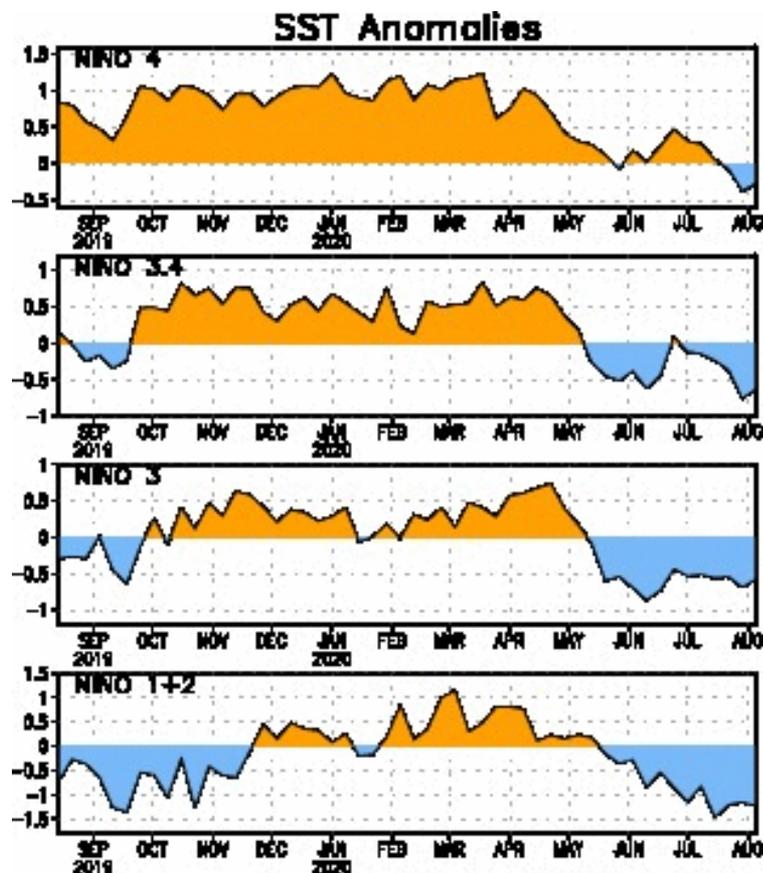
Outgoing Longwave Radiation (OLR) Anomalies

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



- Enhanced convection has slowly propagated from the western Indian Ocean to over the West Pacific recently. Rossby wave (tropical cyclone) activity is superimposed with this feature.
- A Kelvin wave currently over the Atlantic may have contributed to the development of Tropical Storm Elida in the East Pacific.

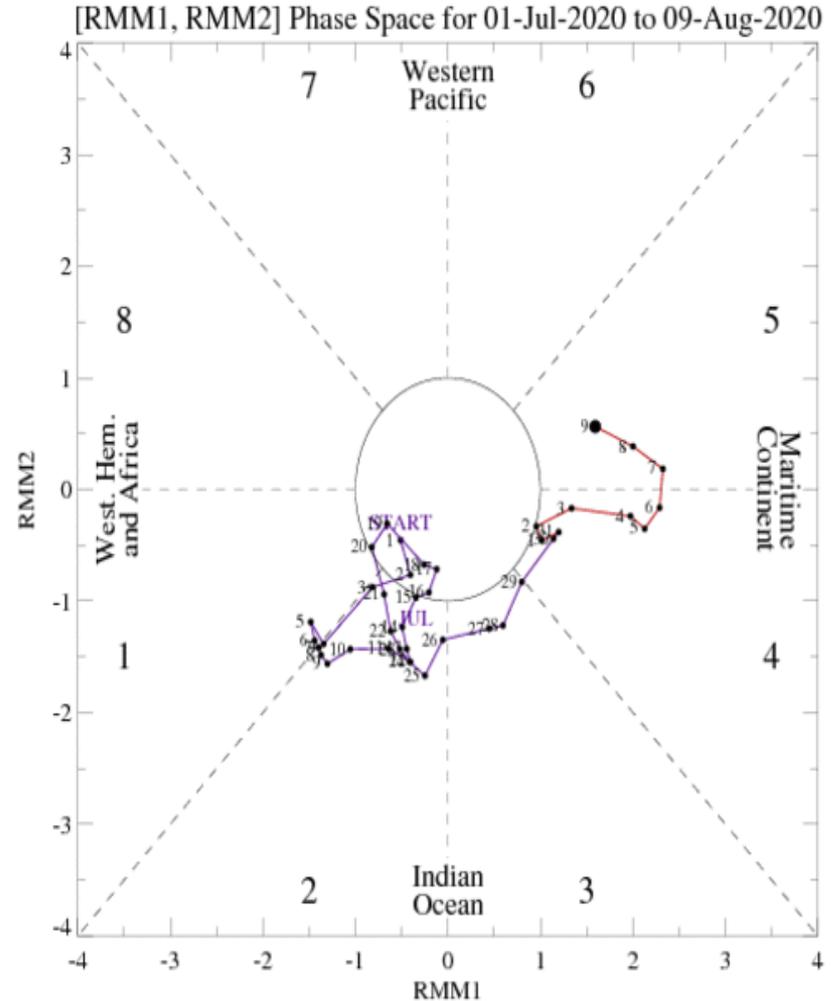
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- A La Niña Watch was issued by CPC during July.
- SST anomalies in the three easternmost Niño regions have been mostly negative since mid-May, with the Niño 4 SST anomalies turning negative in mid-July.
- A pocket of anomalously cool waters near the ocean surface are now observed between the Date Line and roughly 110W.

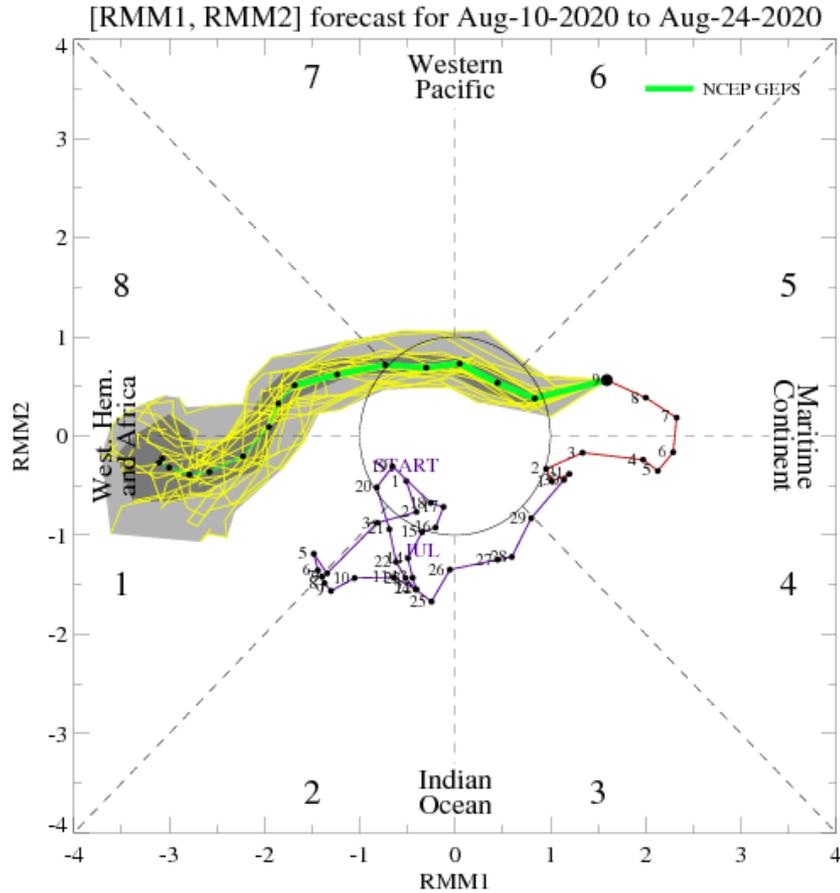
MJO Index: Recent Evolution

- The RMM index shows the MJO pushing eastward over the Maritime Continent over the past week.

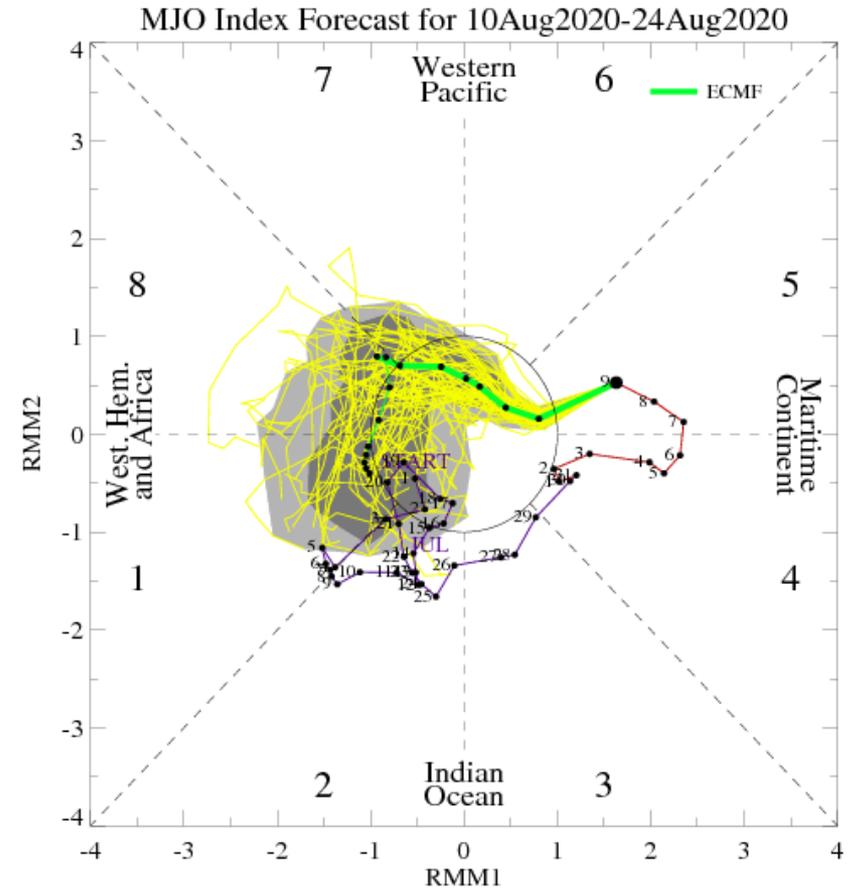


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



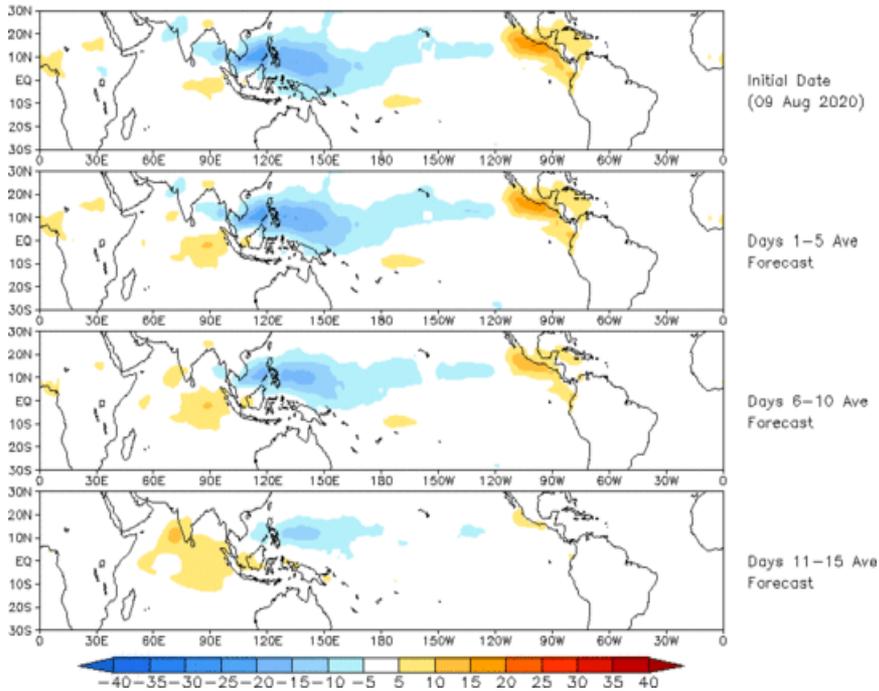
ECMWF Forecast

- Both the GEFS and ECMWF models show a rapid eastward propagation of the convective envelope from over the Maritime Continent to over the Western Hemisphere during the next two weeks.
- The GEFS is very rapid and has a narrow spread among its ensemble members, and is likely emphasizing Kelvin wave activity. Conversely, the ECMWF is slower and has substantial spread among its members. Interestingly, the RMM2 forecasts of the two models are fairly similar, with the differences in RMM1 instead.

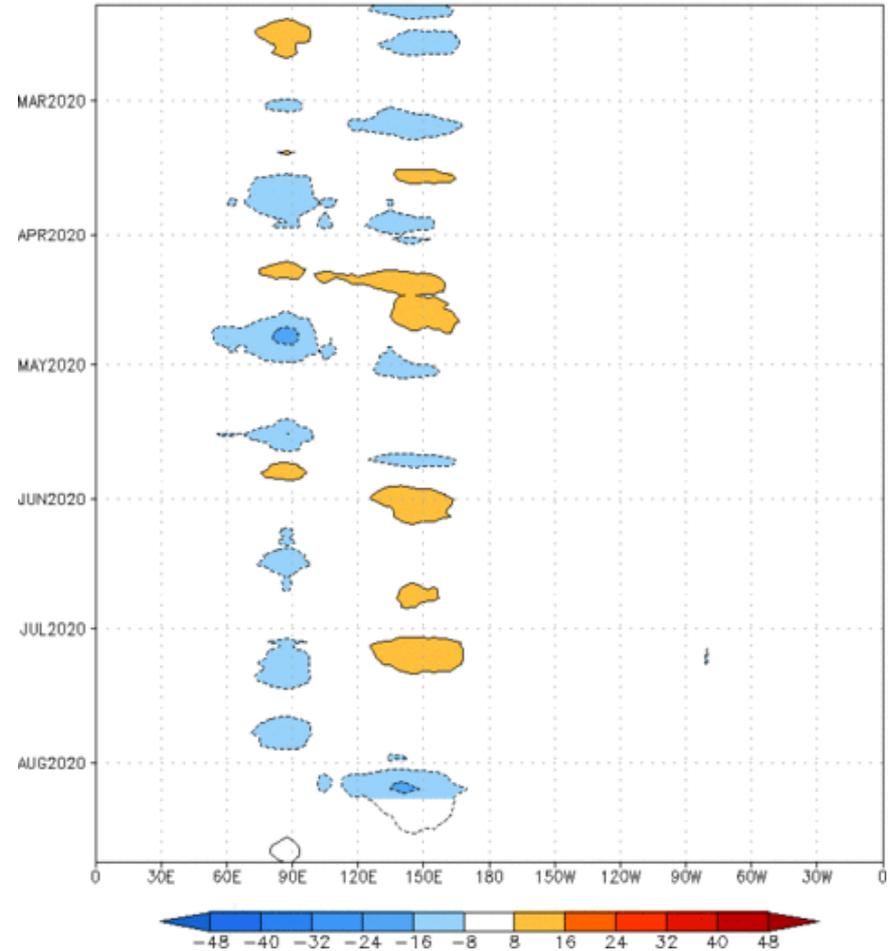
MJO: Constructed Analog Forecast Evolution

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 (09 Aug 2020)



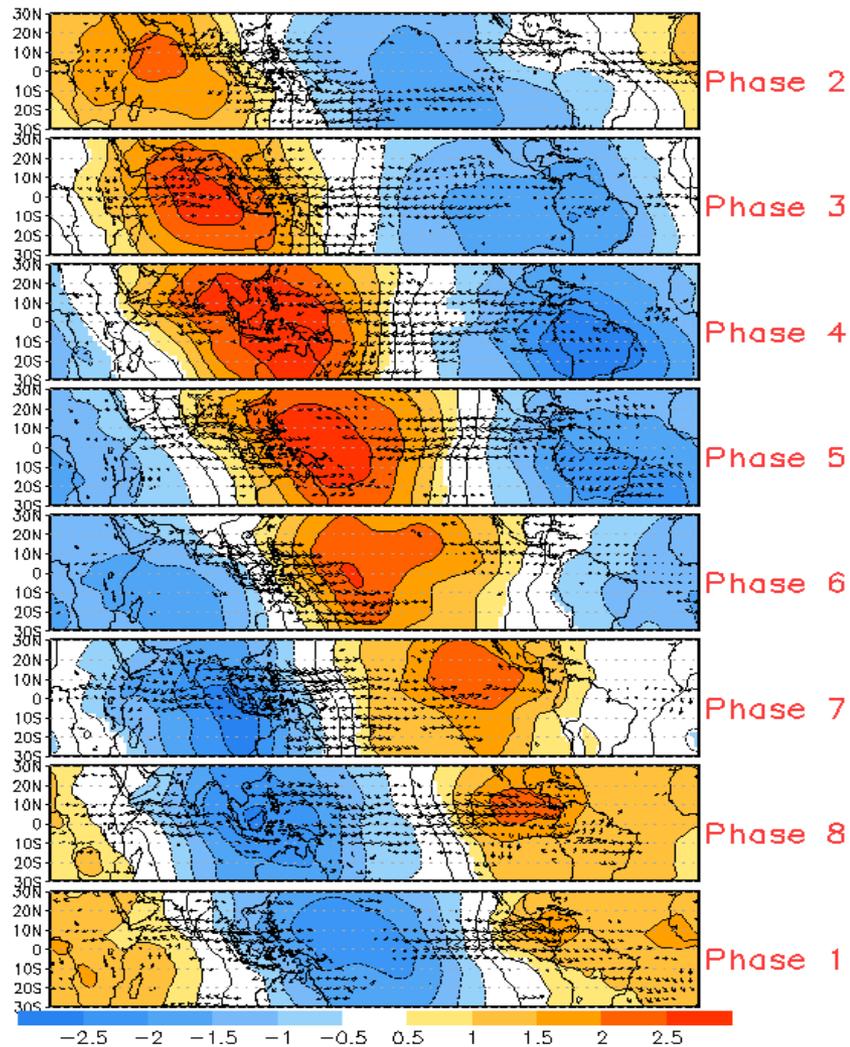
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [$7.5^{\circ}\text{S}, 7.5^{\circ}\text{N}$] ($\text{cint:}4\text{Wm}^{-2}$) Period:08–Feb–2020 to 09–Aug–2020
The unfilled contours are CA forecast reconstructed anomaly for 15 days



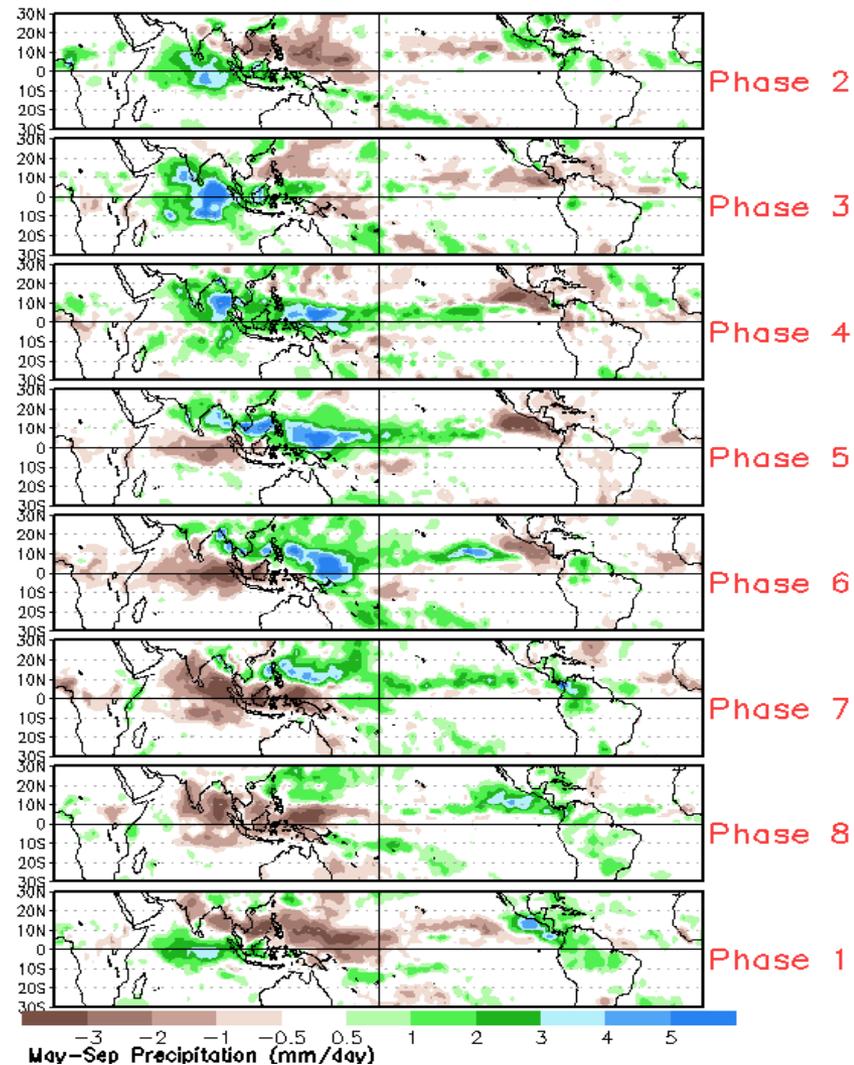
- The constructed analog model depicts the OLR anomalies from the MJO as weakening in place over time.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



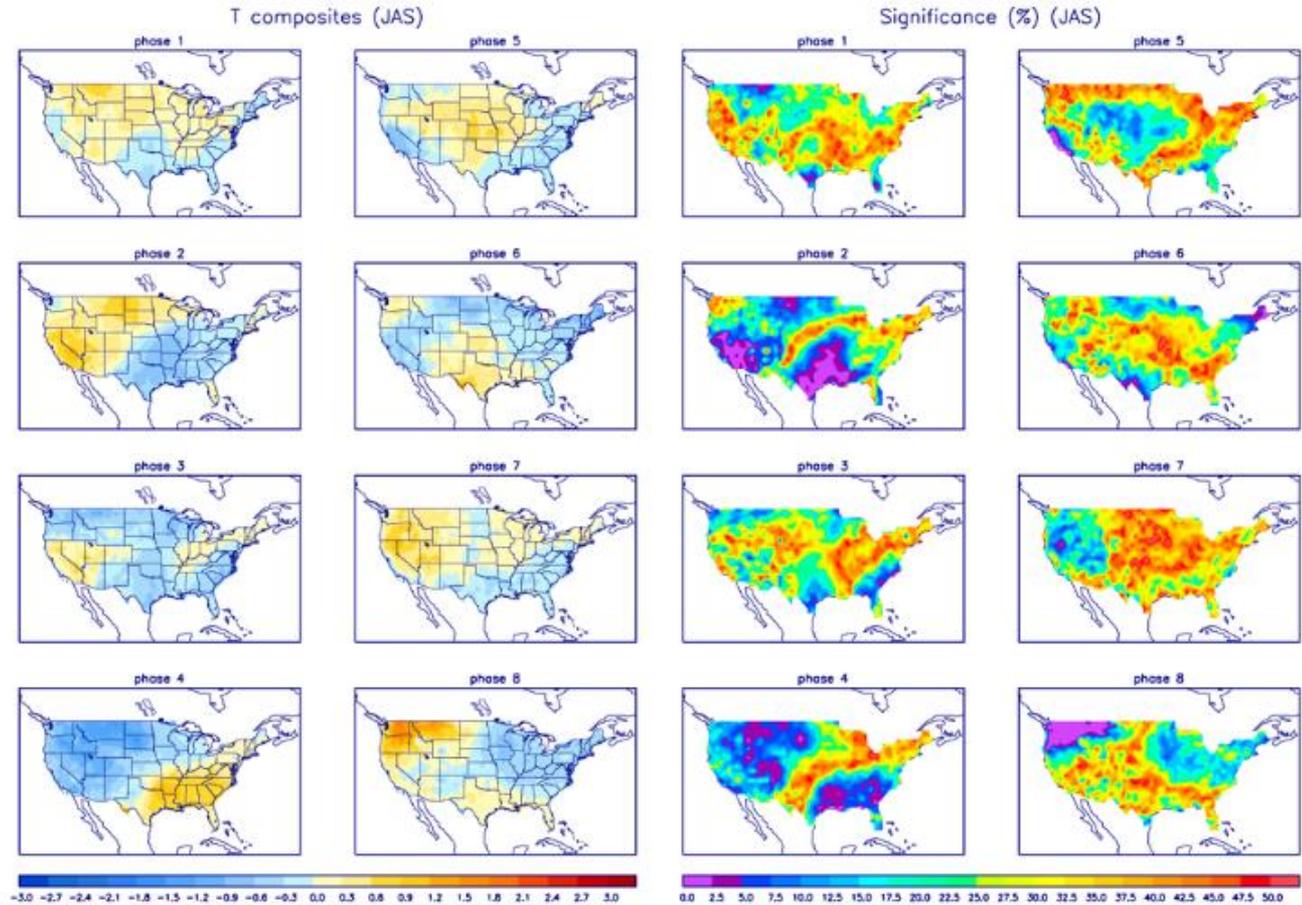
Precipitation Anomalies



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.

