

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



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

Overview

- The MJO was active during the past week, with upper-level analyses depicting a slow evolution from the Indian Ocean to the Maritime Continent.
- Equatorial Rossby wave activity over the far West Pacific and eastern Maritime Continent contributed to the development of two tropical cyclones.
- Dynamical models depict very different MJO evolutions, with the GEFS favoring continued eastward propagation to the West Pacific and the ECWMF rapidly weakening the signal and showing Week-2 enhancement over the Western Hemisphere, likely due to differences in forecast Kelvin wave activity.
- The MJO would support a brief period of reduced tropical cyclone activity across the Atlantic basin, with a potential for renewed activity near mid-August.

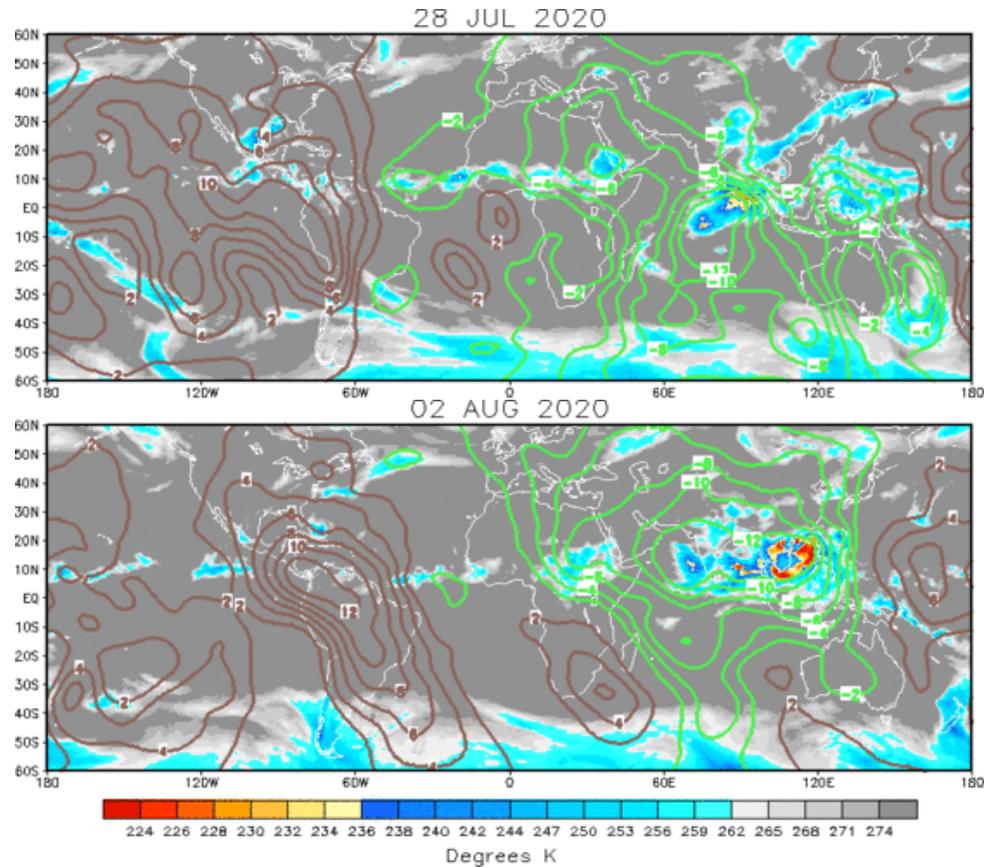
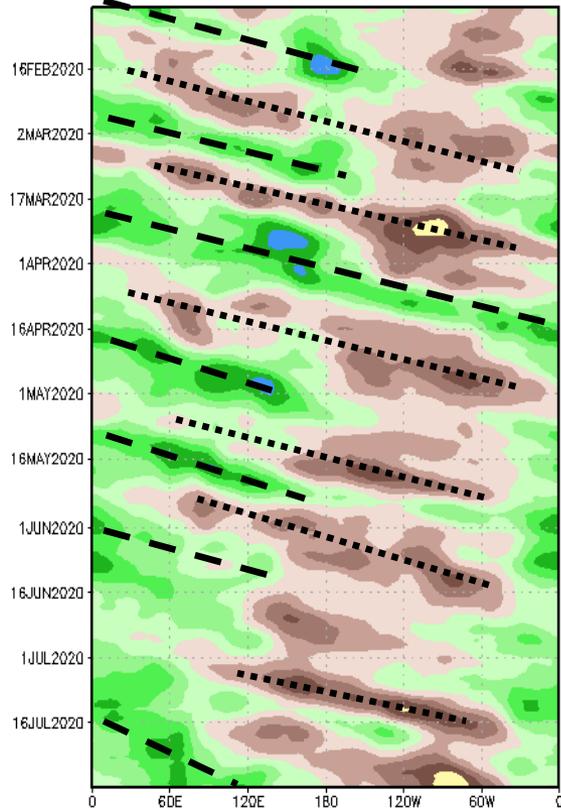
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

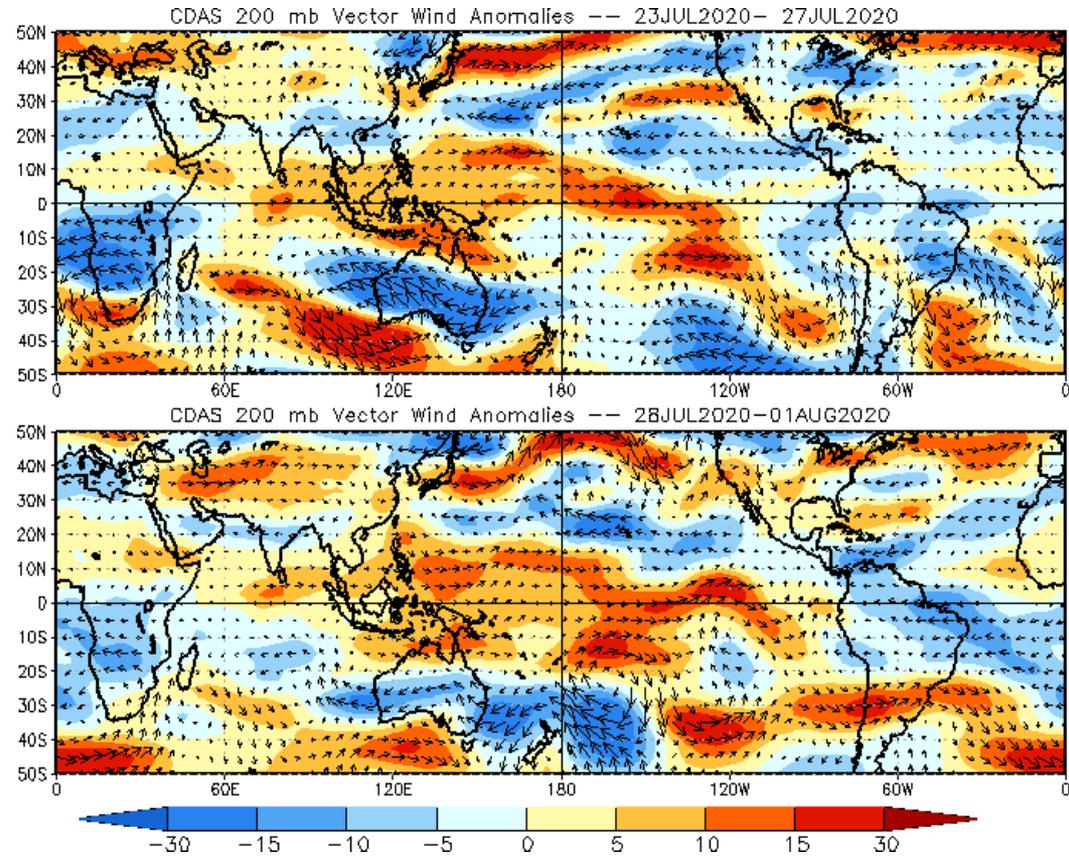
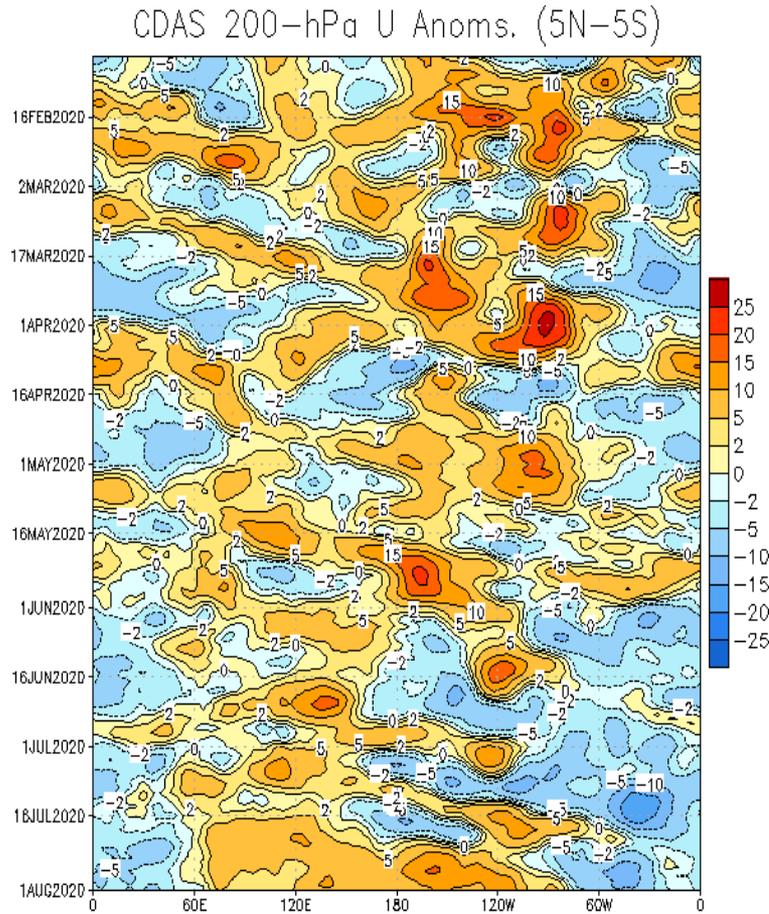
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- Throughout most of 2020 to date, the upper-level signal has been dominated by a slowly evolving base state interspersed with robust Kelvin wave activity.
- More recently, a more canonical MJO signal is apparent, with the enhanced phase now crossing the Maritime Continent

200-hPa Wind Anomalies

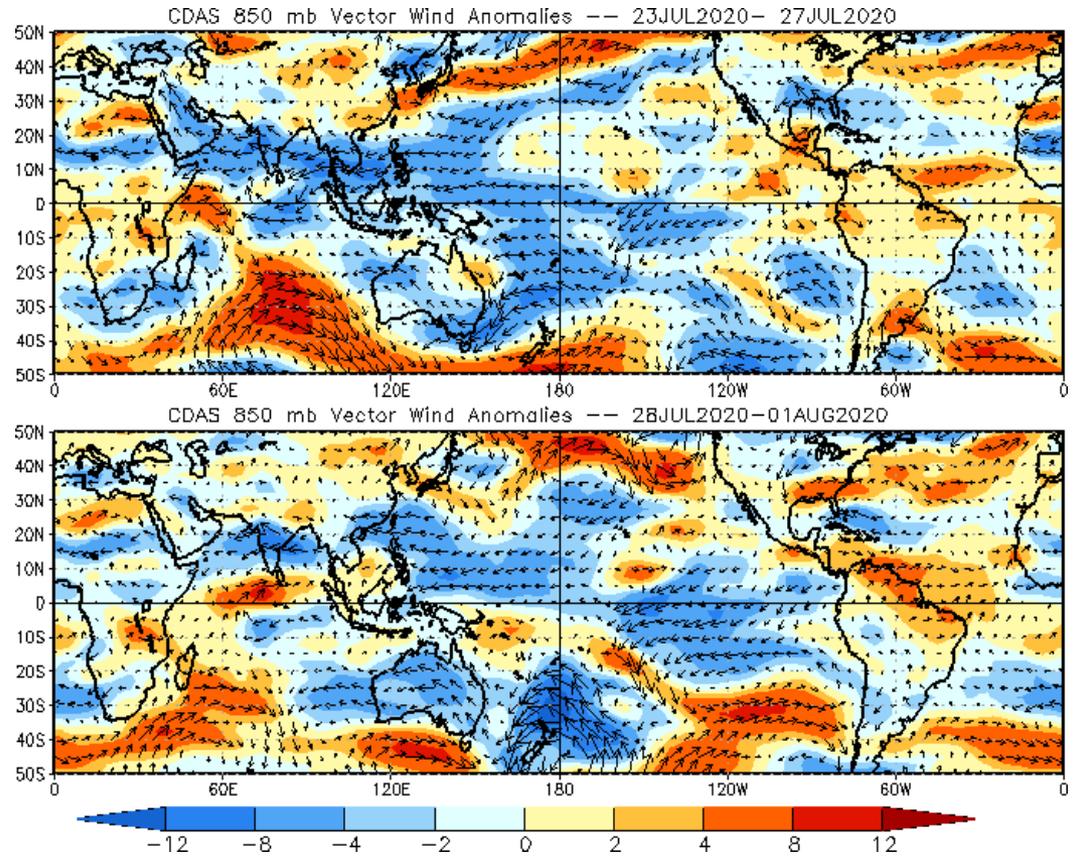
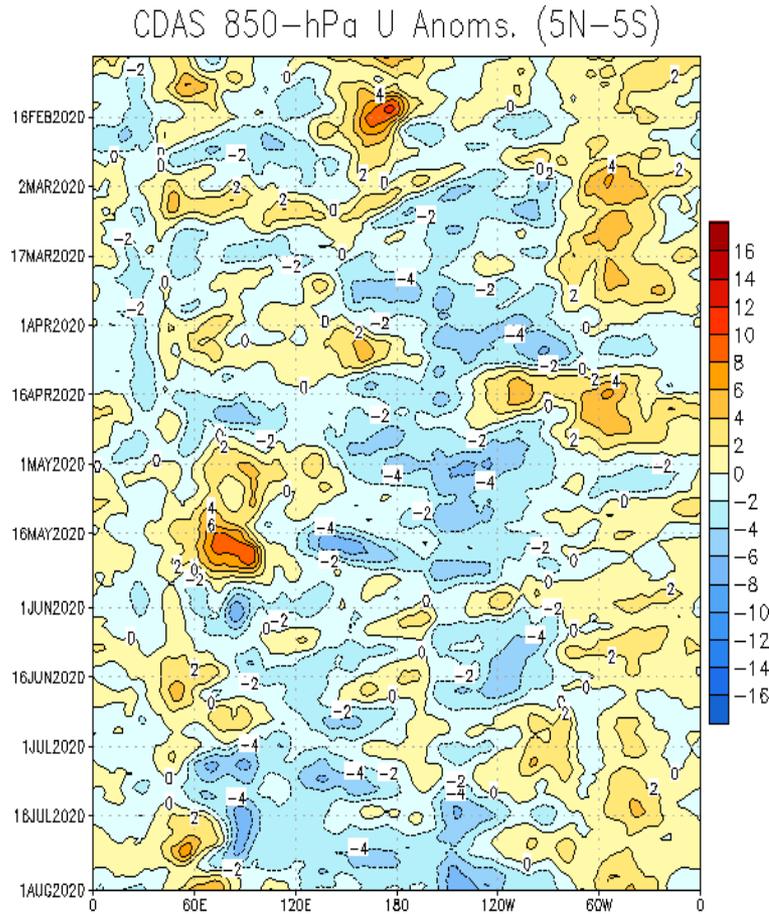
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Across the tropics, a Wave-1 asymmetric pattern of westerly anomalies extending across the Indian Ocean through the west-central Pacific, and easterly anomalies extending from the Americas through Africa has developed, which is consistent with current MJO activity.
- There is little eastward propagation of the upper-level anomaly field, suggesting the possibility of a low-frequency response.

850-hPa Wind Anomalies

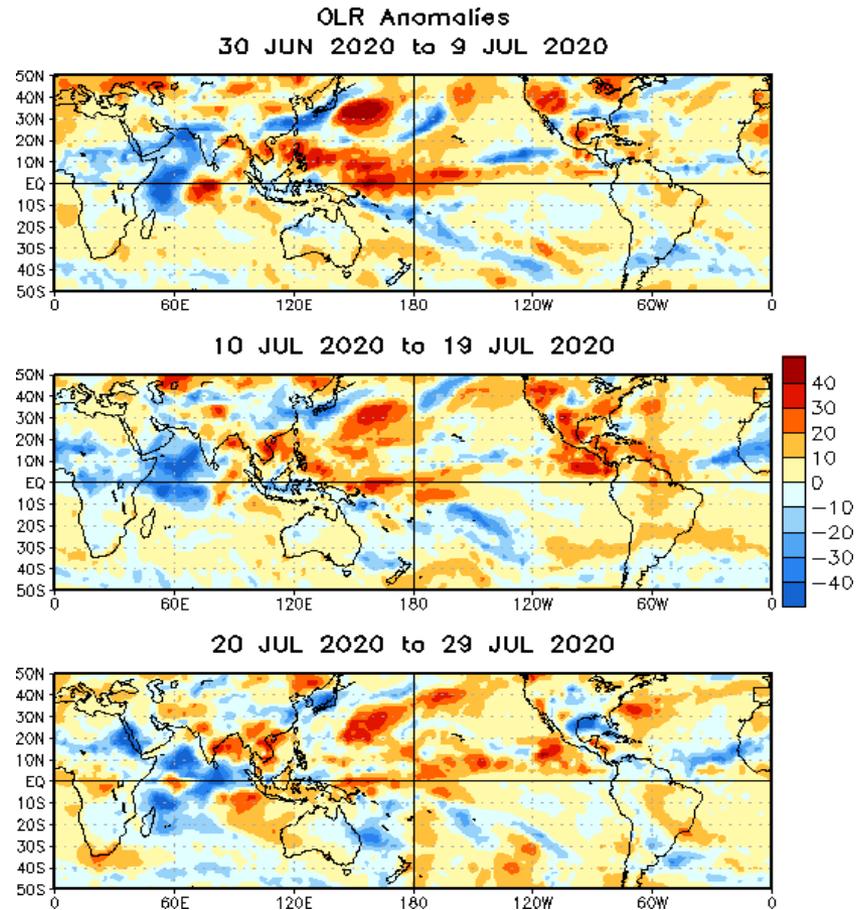
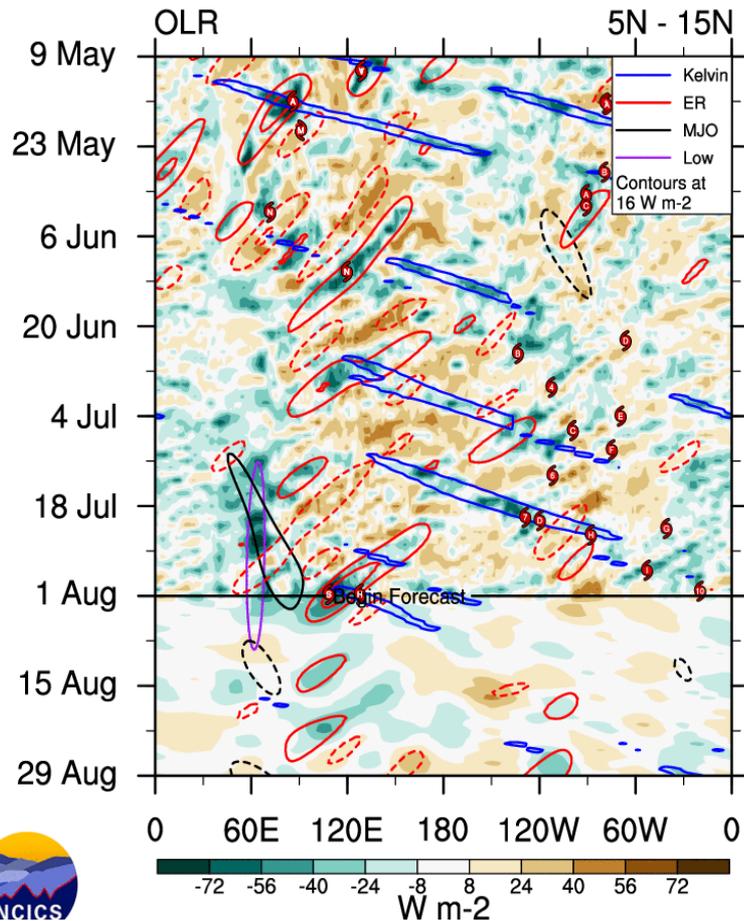
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Easterly anomalies have increased over the east-central Pacific, and remain persistent across the Northwest Pacific.
- Troughing over the eastern CONUS contributed to a weakening of the Atlantic midlatitude ridge, allowing Hurricane Isaias to eventually turn northward just east of the Florida Peninsula.

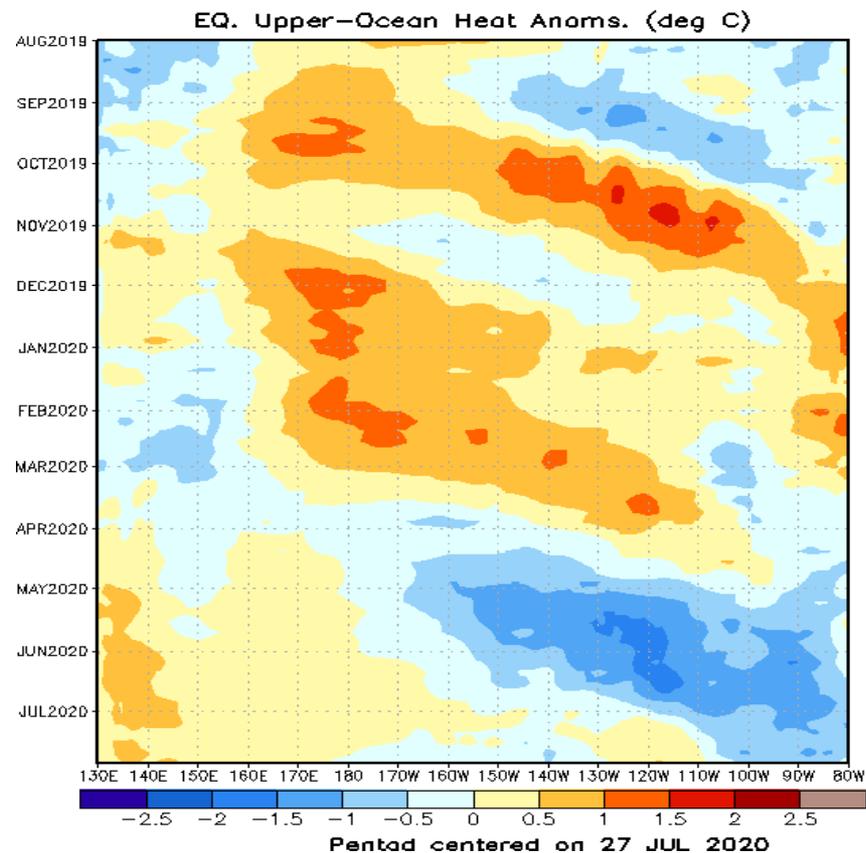
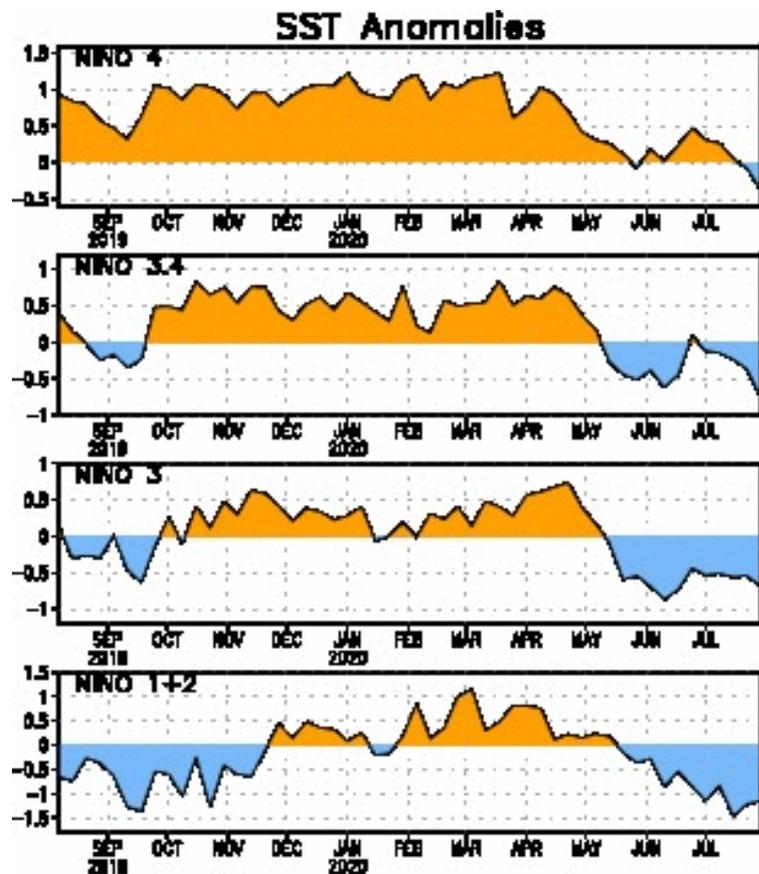
Outgoing Longwave Radiation (OLR) Anomalies

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



- A superposition of the slowly-evolving convective signal over the Indian Ocean and Rossby wave activity over the far West Pacific (including TC activity) may be contributing to the broader MJO-like appearance.
- The CFS forecast depicts a weak eastward propagating MJO signal across the West Pacific, modulated by additional Rossby waves.

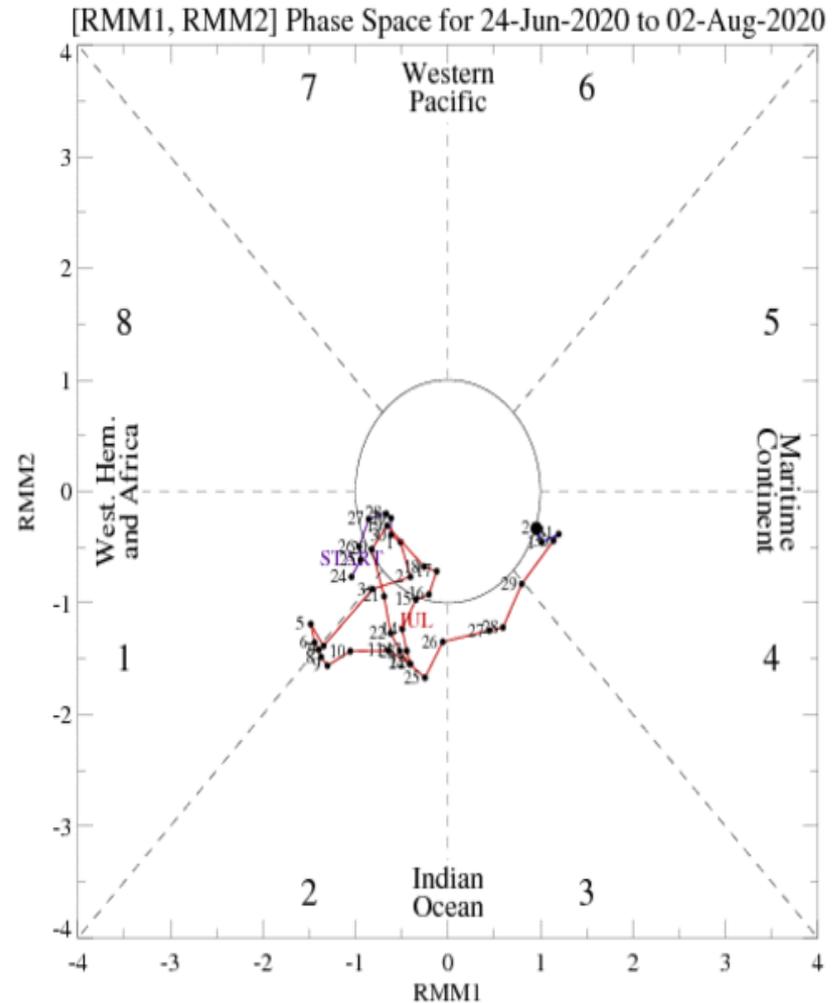
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- 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.
- Upper-ocean heat content anomalies have weakened over the central and eastern Pacific in recent weeks following the robust upwelling phase of a Kelvin wave that moved during May and June.

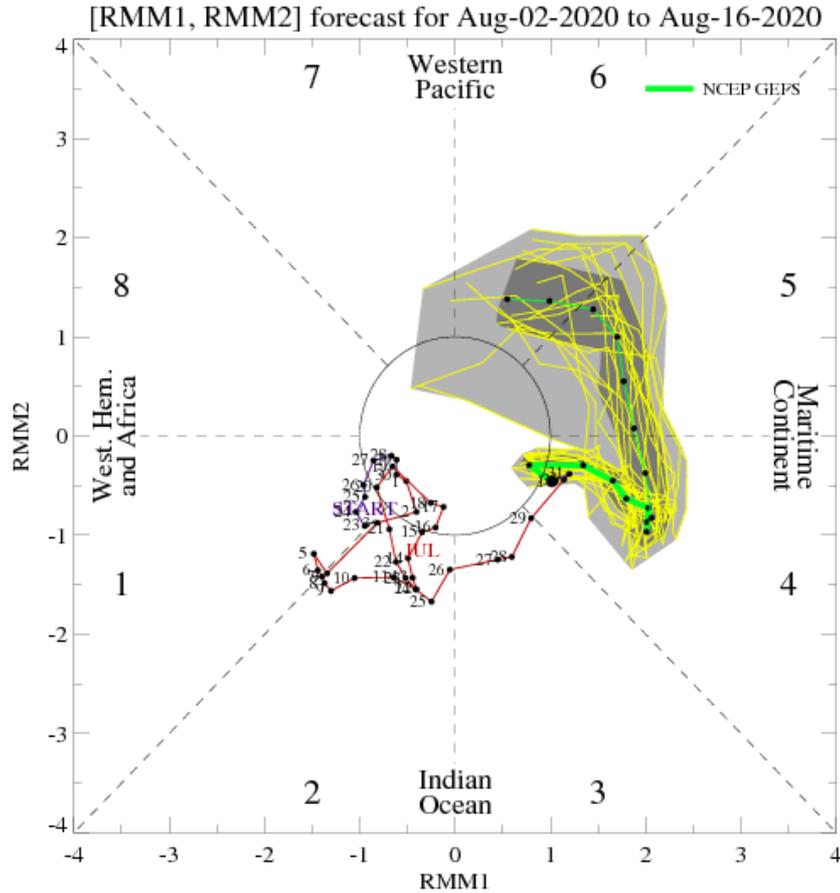
MJO Index: Recent Evolution

- The RMM-based MJO index depicted eastward propagation of a signal from the Indian Ocean to the Maritime Continent during the past week.
- The index has slowed and weakened more recently, possibly due to Rossby wave influence.

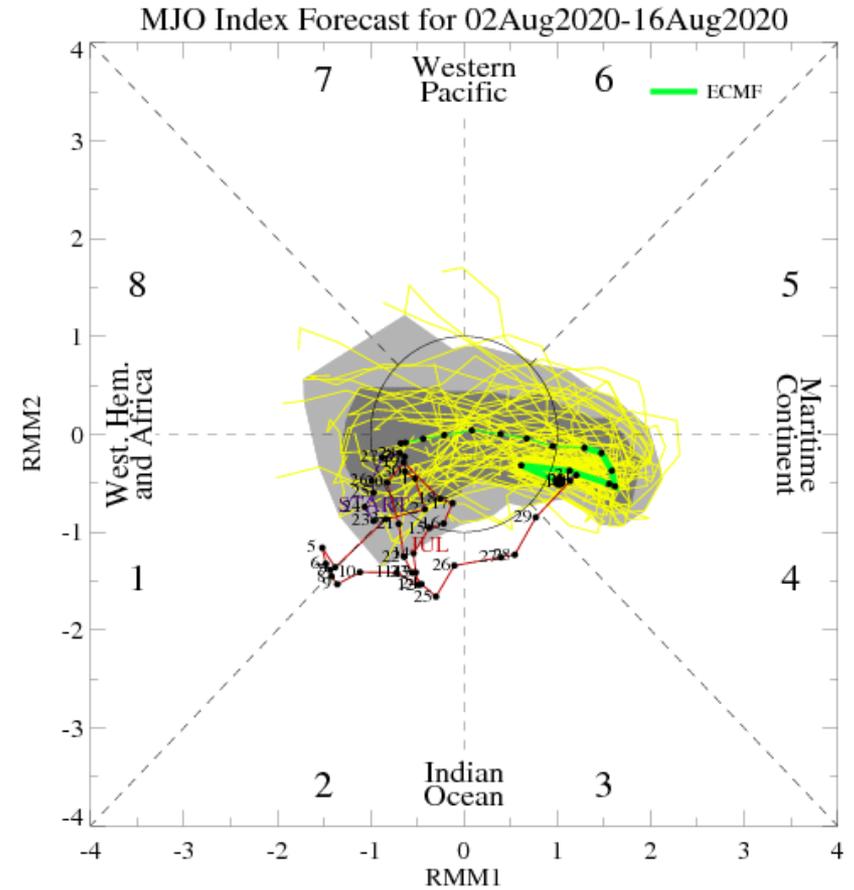


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



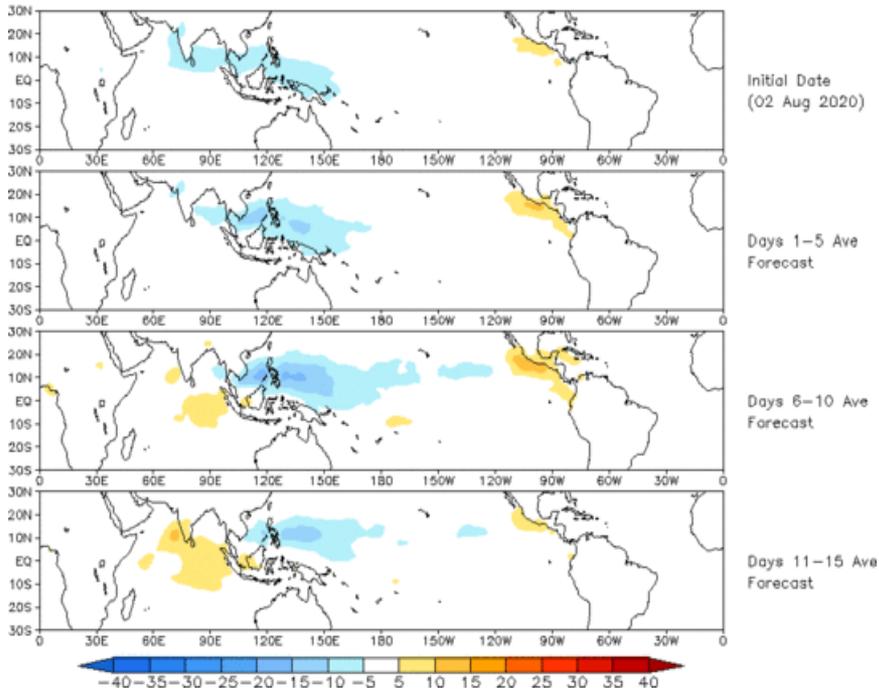
ECMWF Forecast

- The GFS and ECMWF ensemble means feature substantially different outcomes, with the GFS continuing a fast eastward propagating signal to the West Pacific by Week-2, and the ECMWF rapidly weakening the signal.
- The GFS appears more bullish on Kelvin wave activity to emerge from the Maritime Continent and push the RMM index eastward, while the ECMWF emphasizes the low-frequency state which would weaken the RMM index in Phase 4/5 with time.

MJO: Constructed Analog Forecast Evolution

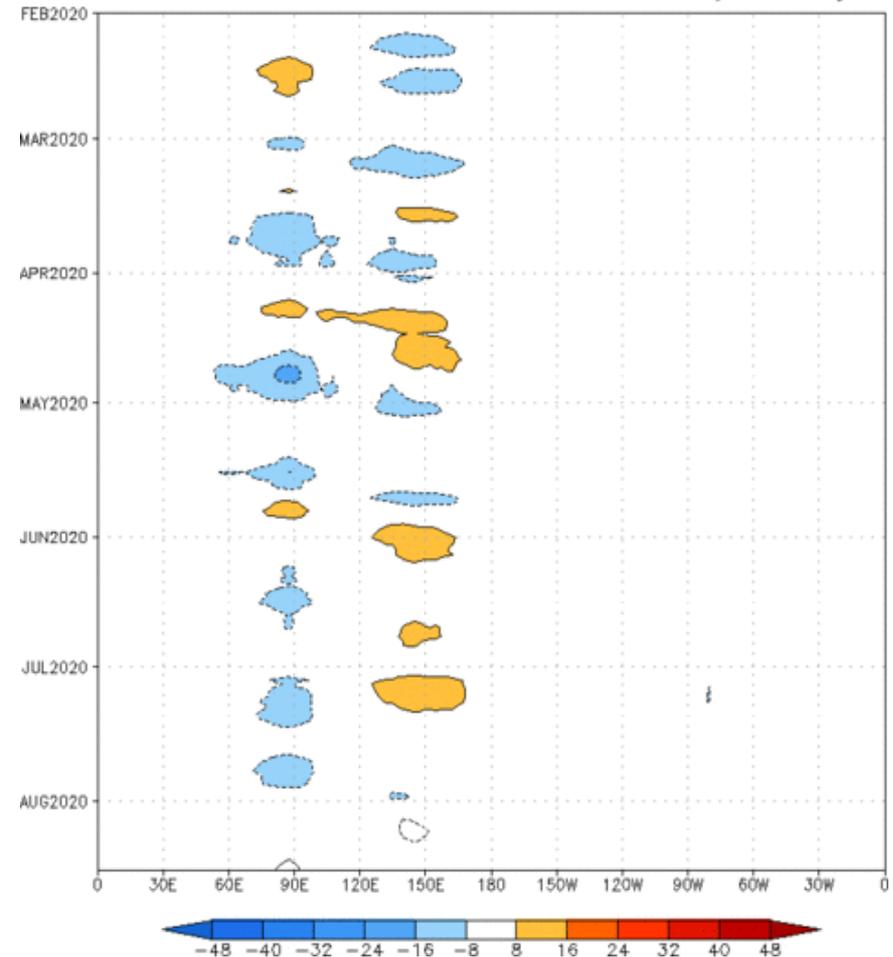
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (02 Aug 2020)



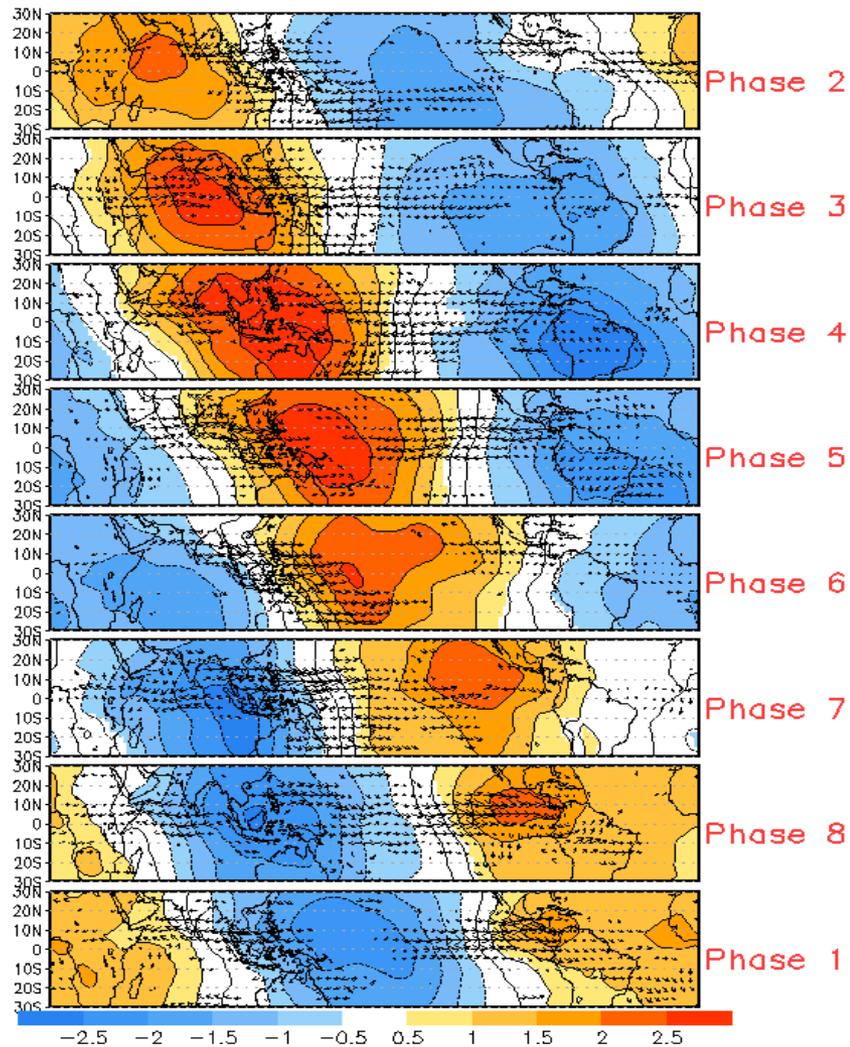
- The constructed analog model depicts a low-amplitude eastward propagating signal, with enhanced convective anomalies shifting northward over the West Pacific and suppressed convection overspreading the central Indian Ocean.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:01-Feb-2020 to 02-Aug-2020
The unfilled contours are CA forecast reconstructed anomaly for 15 days

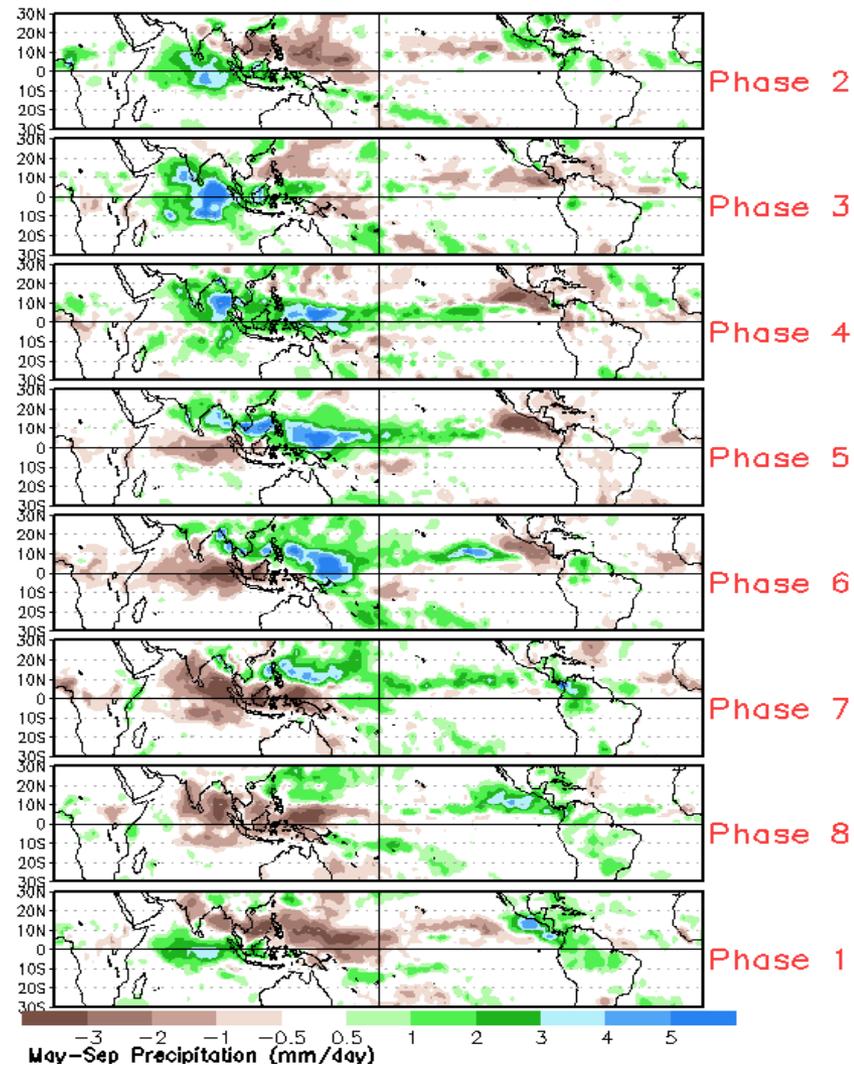


MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



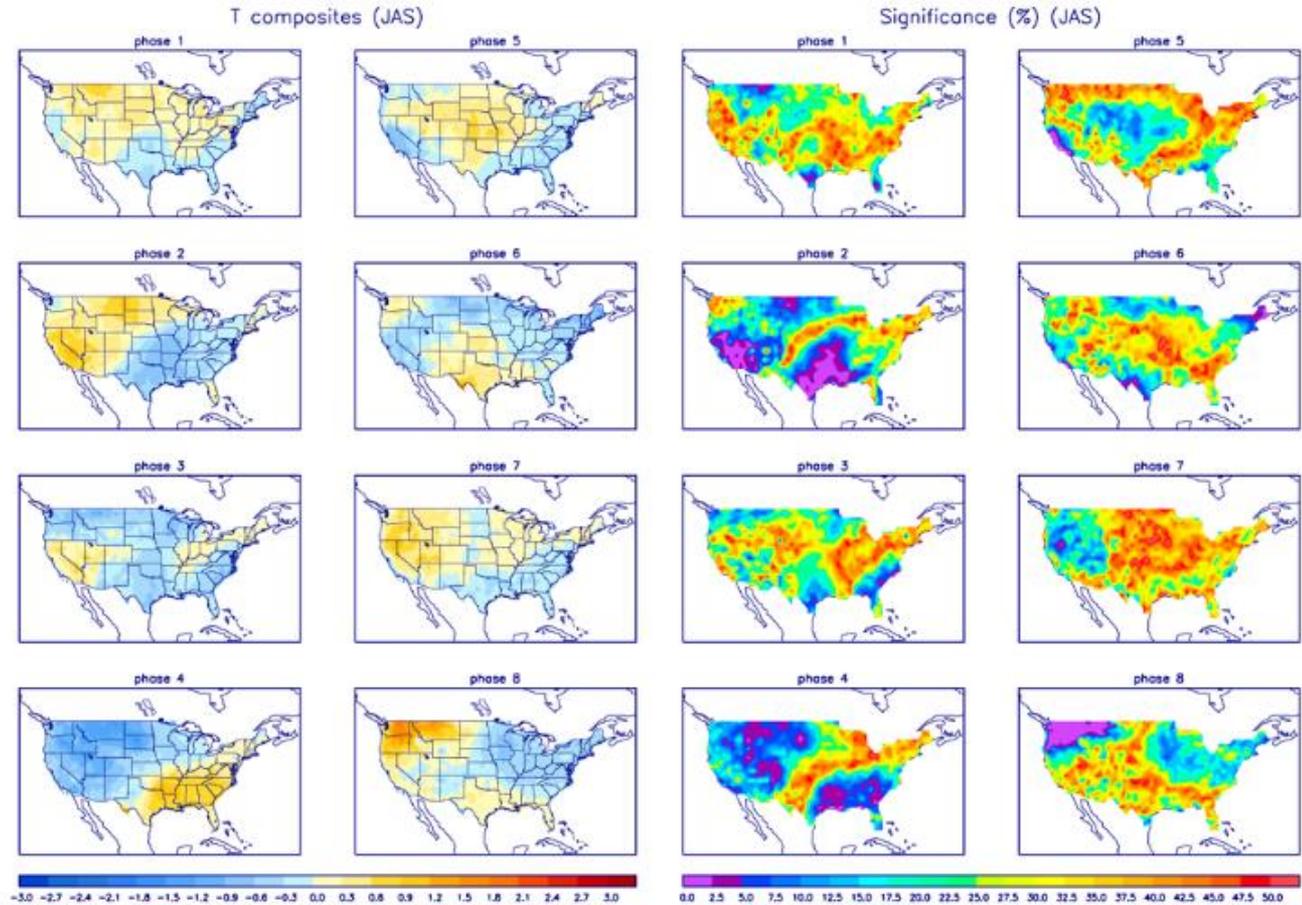
Precipitation Anomalies



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.

