

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



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

Overview

- During late August, the enhanced phase of the MJO propagated east over the eastern Indian Ocean with the suppressed phase over the Pacific Ocean.
- Dynamical model forecasts indicate a continued eastward propagating MJO over the Indian Ocean and Maritime Continent during early September. Compared to previous guidance, models are in better agreement relative to weakening its amplitude in RMM space during the next two weeks.
- The ongoing MJO, low-frequency base state, and climatology support continued tropical cyclone development across the main development region of the Atlantic basin through early September.

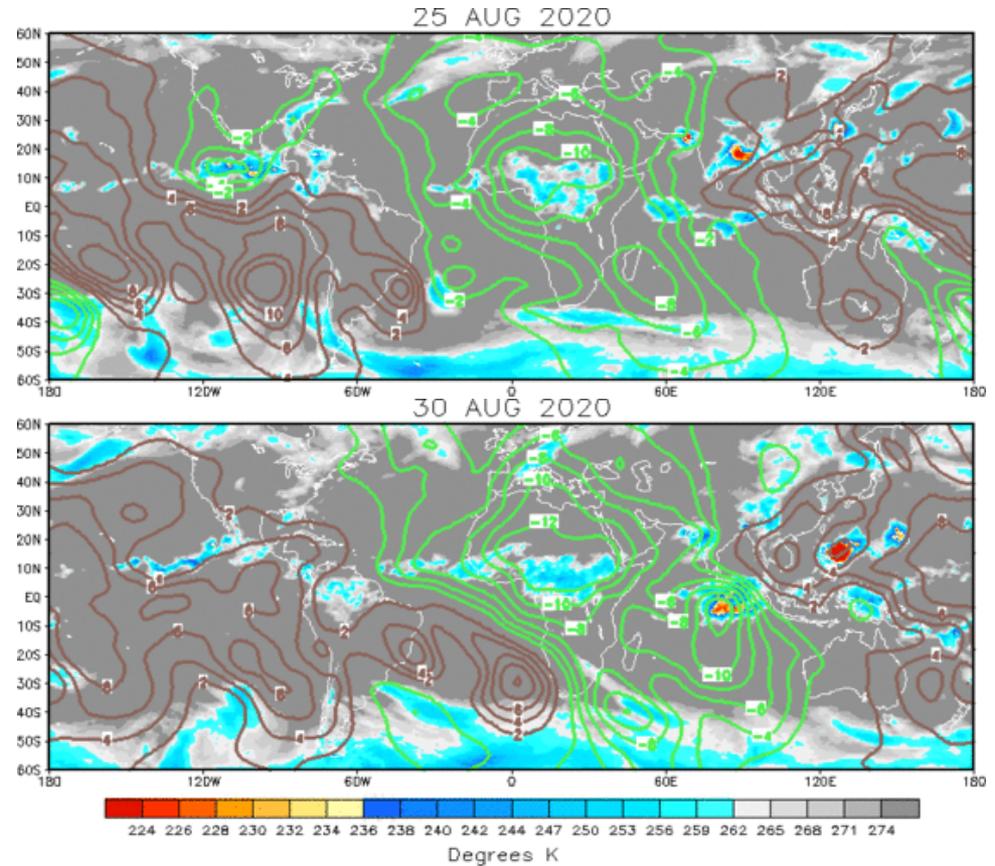
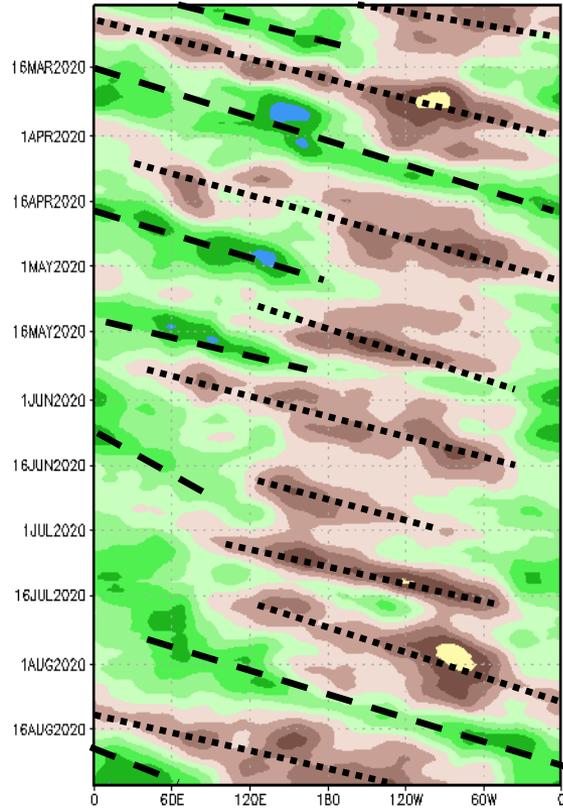
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

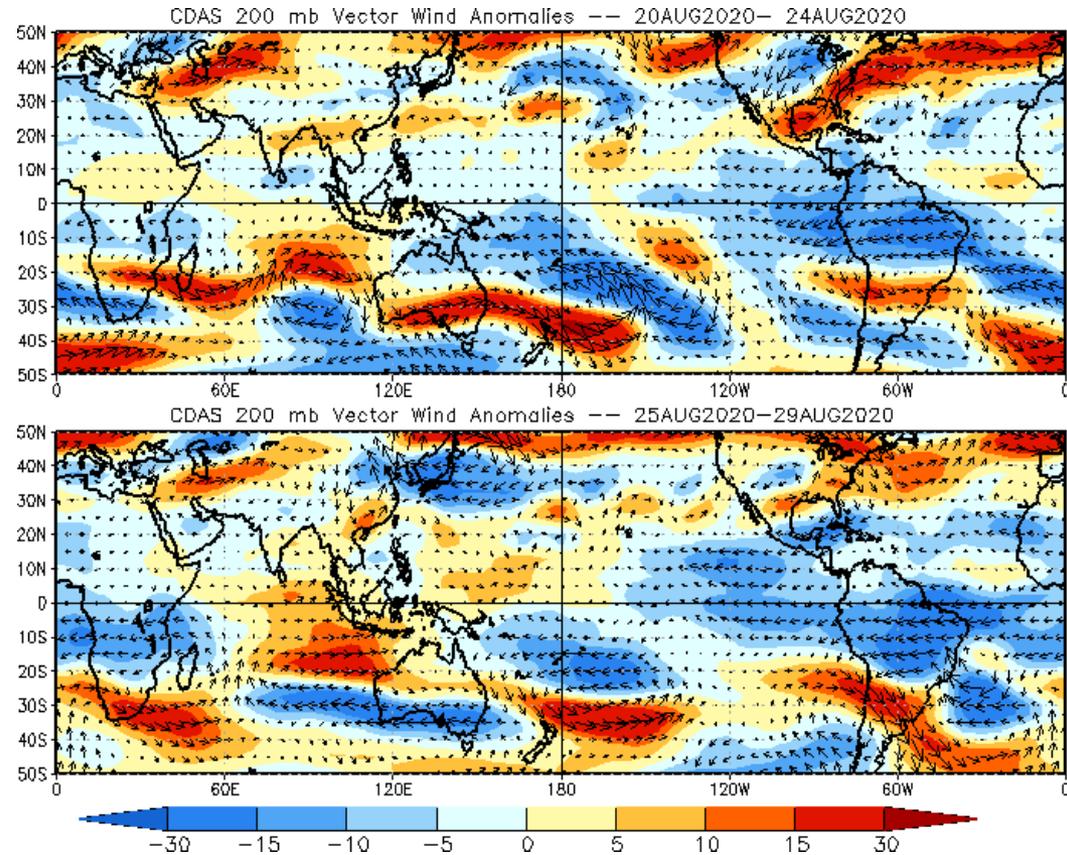
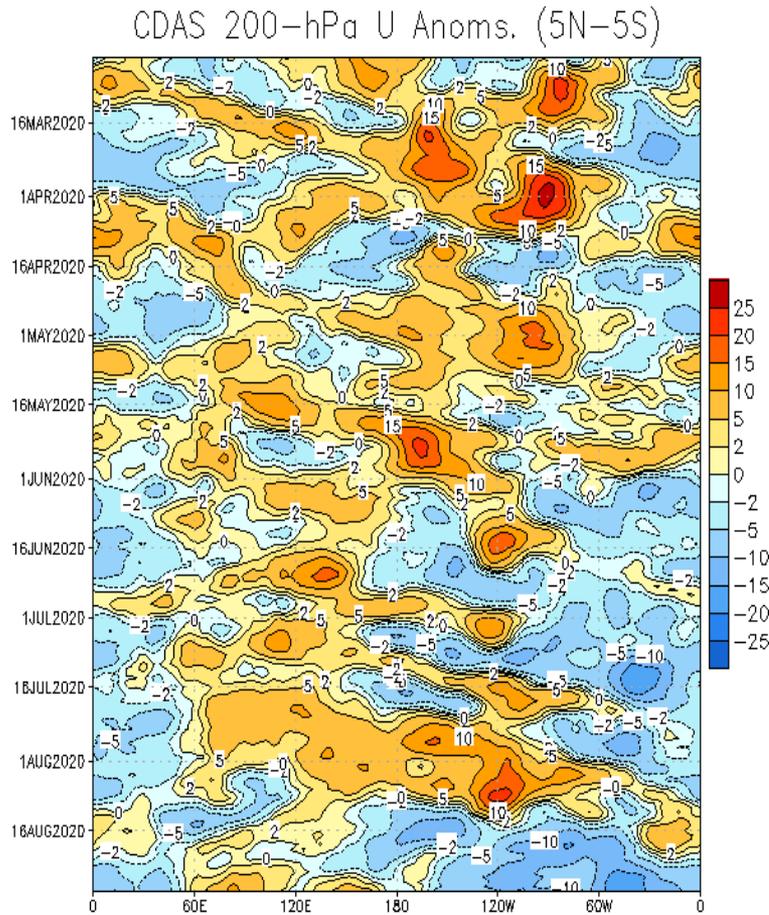
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- An envelope of anomalous upper-level divergence has circumnavigated the globe since late July, with the strongest upper-level anomaly signal currently centered over Africa.
- Since earlier this year, a westward shift of suppressed convection continues across the Pacific.
- A well-defined Wave-1 pattern persists, as anomalous upper-level convergence has expanded throughout the Pacific since last week.

200-hPa Wind Anomalies

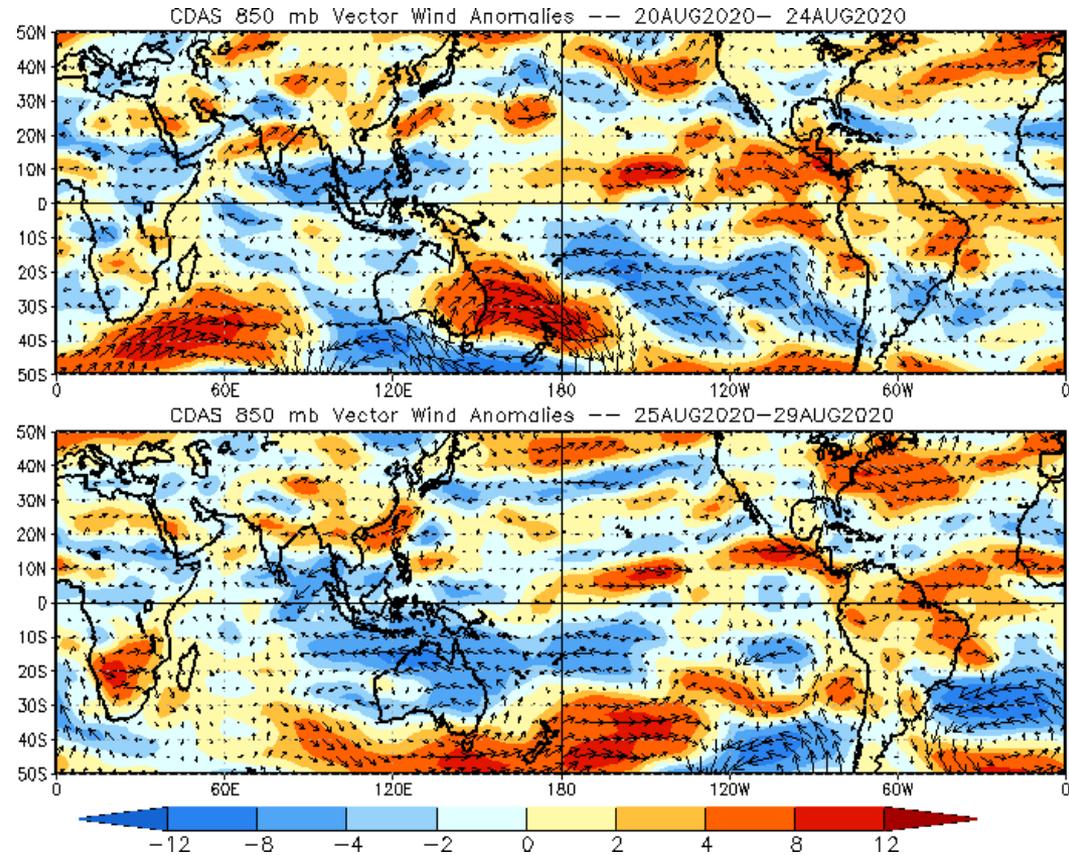
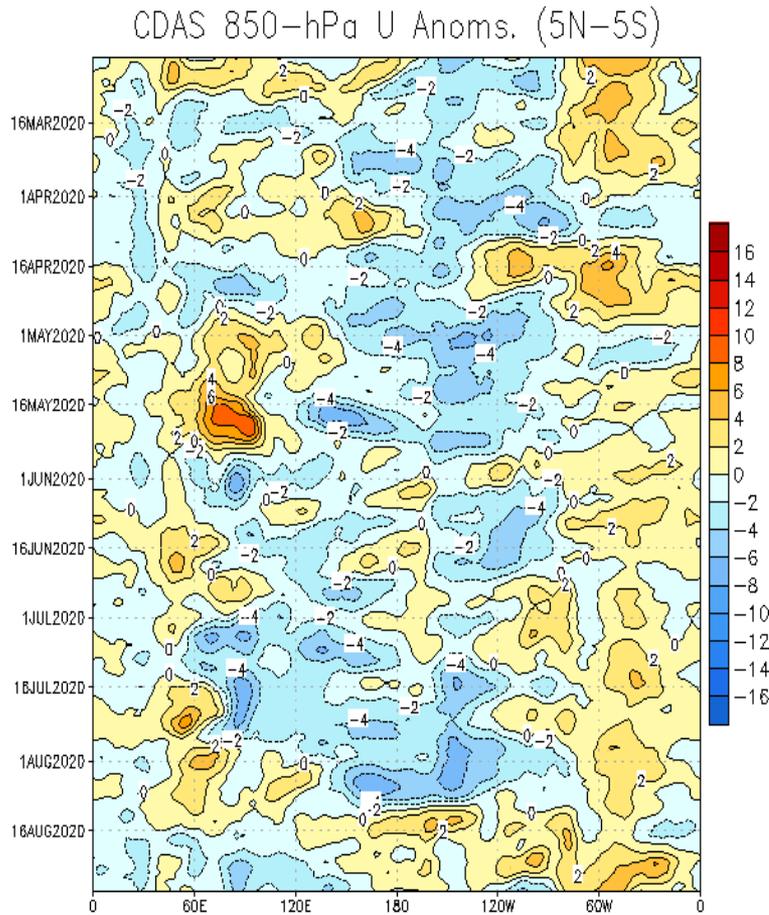
Shading denotes the zonal wind anomaly. **Blue shades: Anomalous easterlies.** **Red shades: Anomalous westerlies.**



- Anomalous upper-level easterlies (westerlies) have strengthened over the central/eastern Pacific and Africa (Indian Ocean/ Maritime Continent) over the past 10 days consistent with the ongoing MJO.
- Rossby wave-breaking is evident over the Southern Hemisphere, helping to reinforce the return of anomalous westerlies over the western Indian Ocean and Maritime Continent.

850-hPa Wind Anomalies

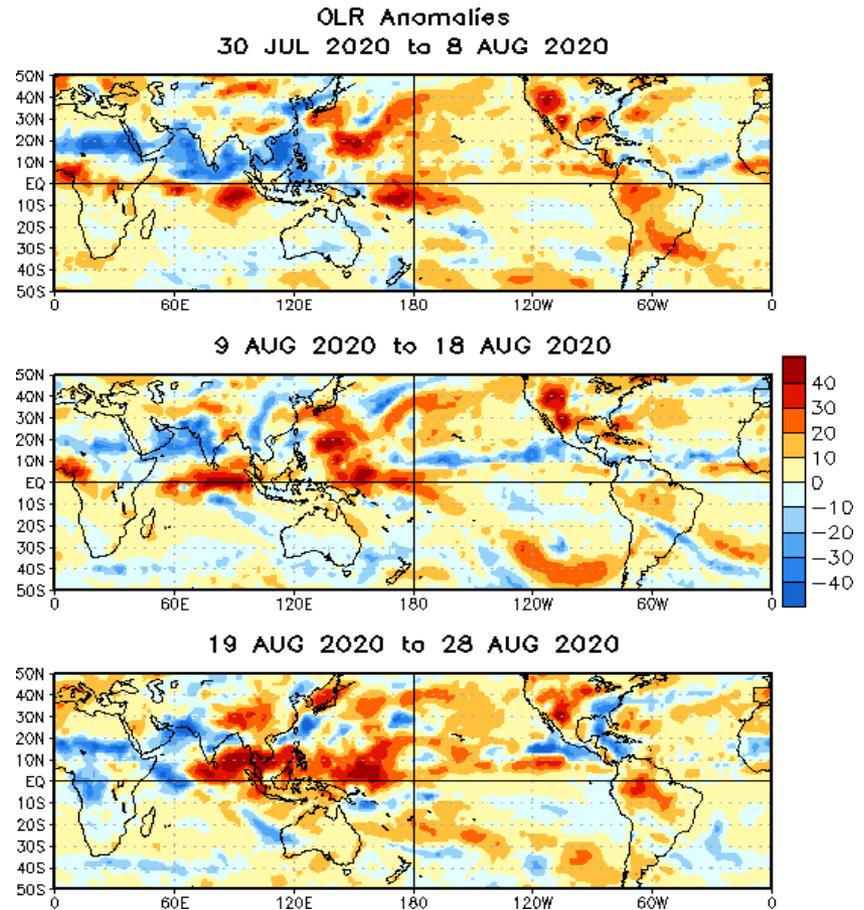
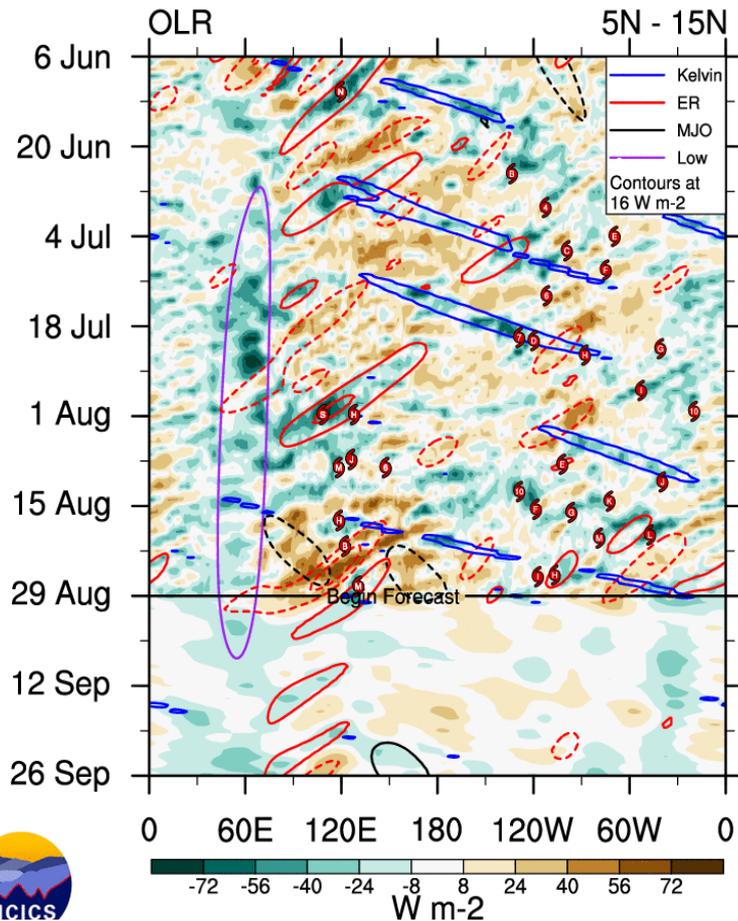
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Anomalous low-level easterlies along the equator have strengthened and shifted eastward across the western Indian Ocean and Maritime Continent since mid-August.
- Anomalous low-level westerlies have strengthened across the tropical Atlantic and into West Africa, reducing vertical wind shear favorable for TC development.

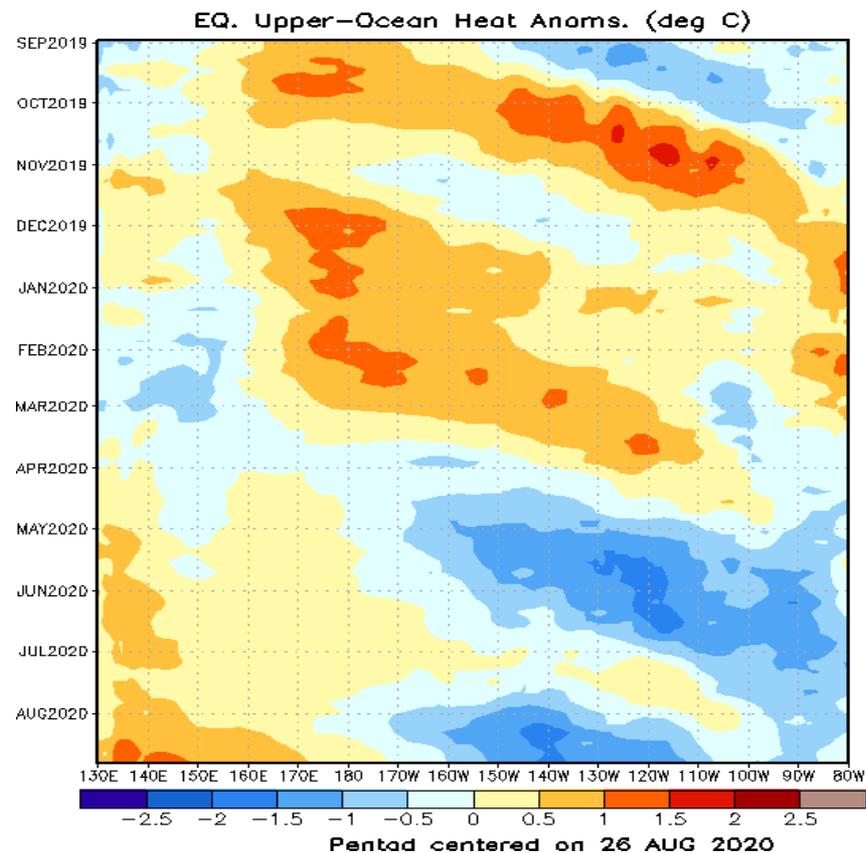
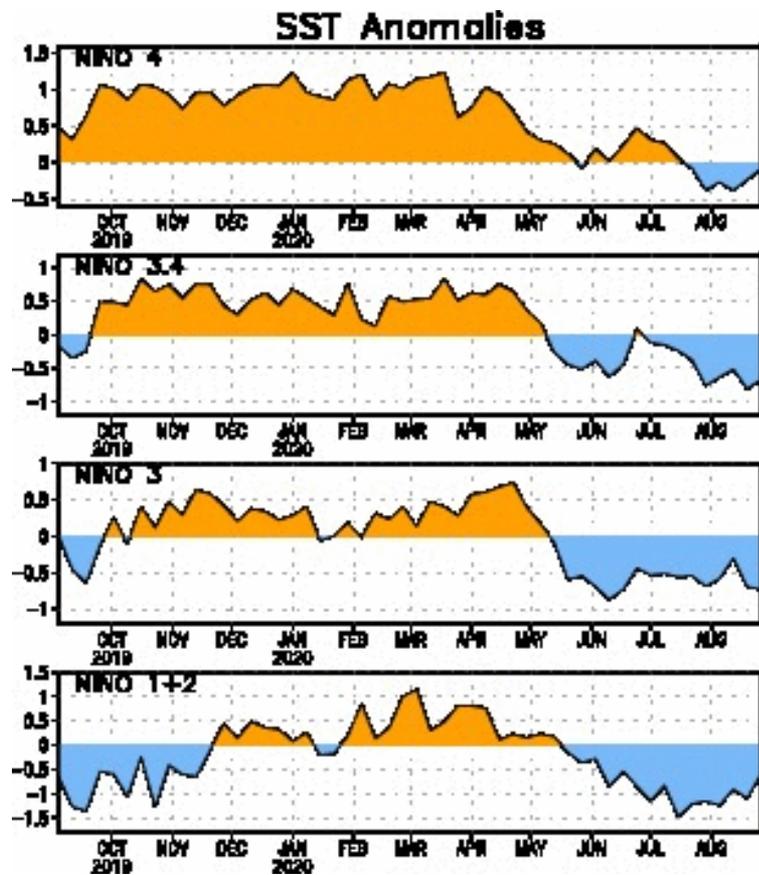
Outgoing Longwave Radiation (OLR) Anomalies

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



- Enhanced convection associated with the MJO shifted east from the eastern Pacific and into the Atlantic during mid to late August. Suppressed convection has been observed to the west of the Date Line since late July.
- Currently, enhanced convection associated with the MJO may be constructively interfering with a low frequency signal over the eastern Indian Ocean north of the equator.

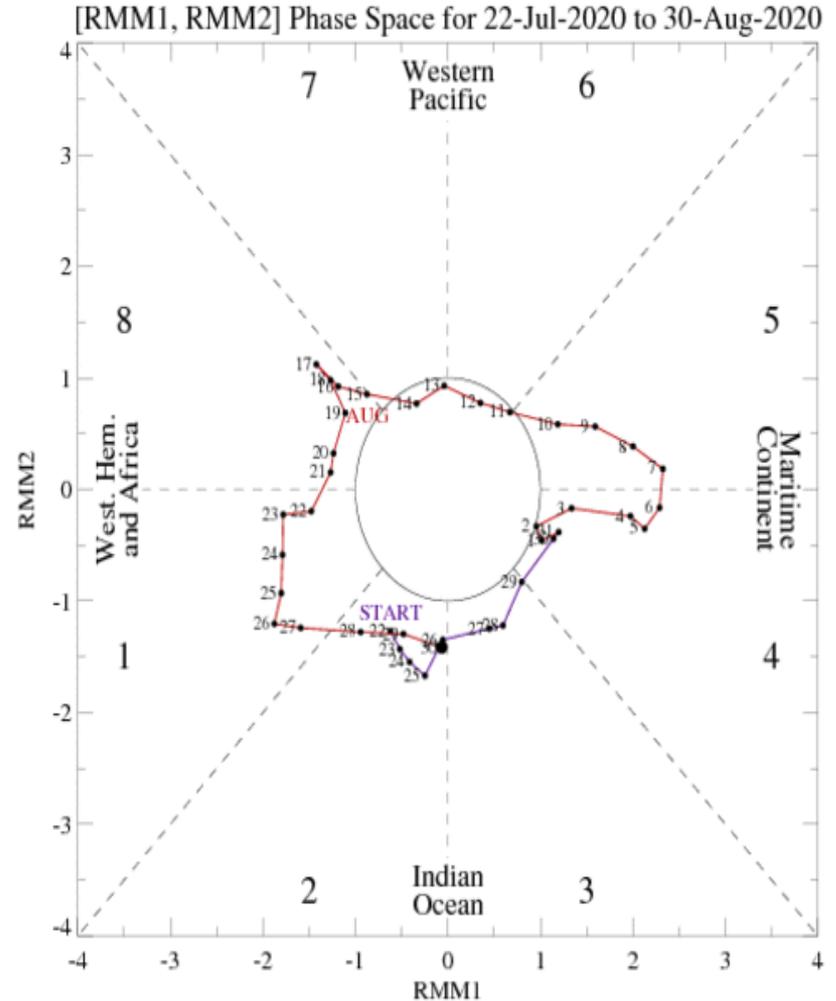
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- A La Niña Watch remains in effect from CPC.
- 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.
- Positive upper-ocean heat content anomalies over the Maritime Continent and West Pacific have strengthened since July, collocated with the persistent suppressed convection in the region.

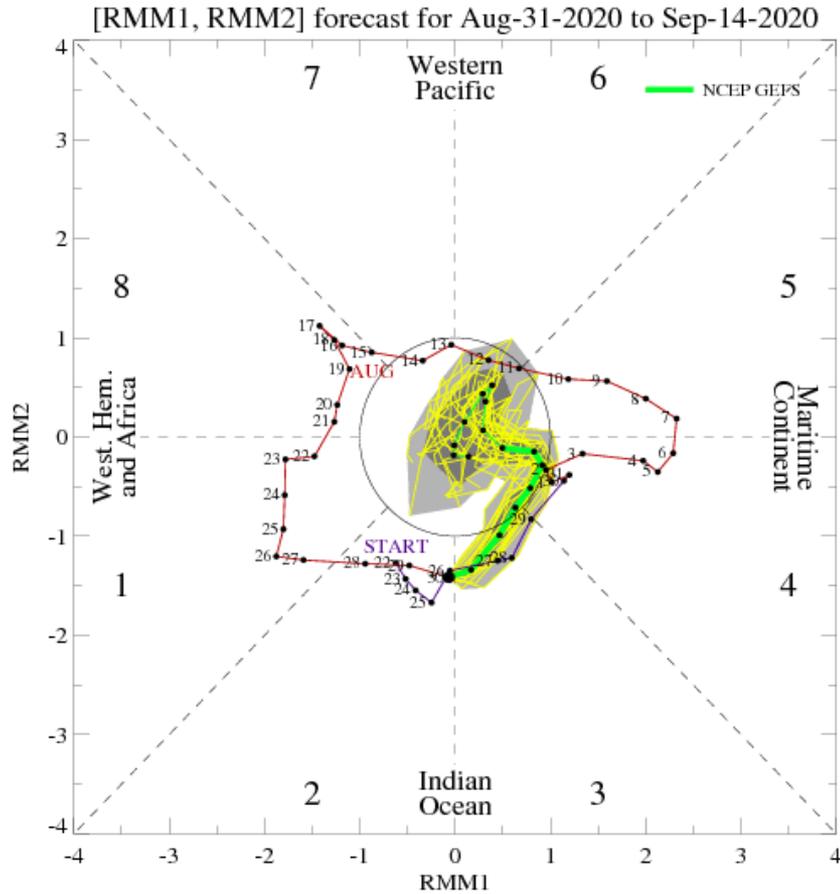
MJO Index: Recent Evolution

- Currently, the RMM index depicts the MJO over the eastern Indian Ocean and has completed a full circumnavigation since late July.

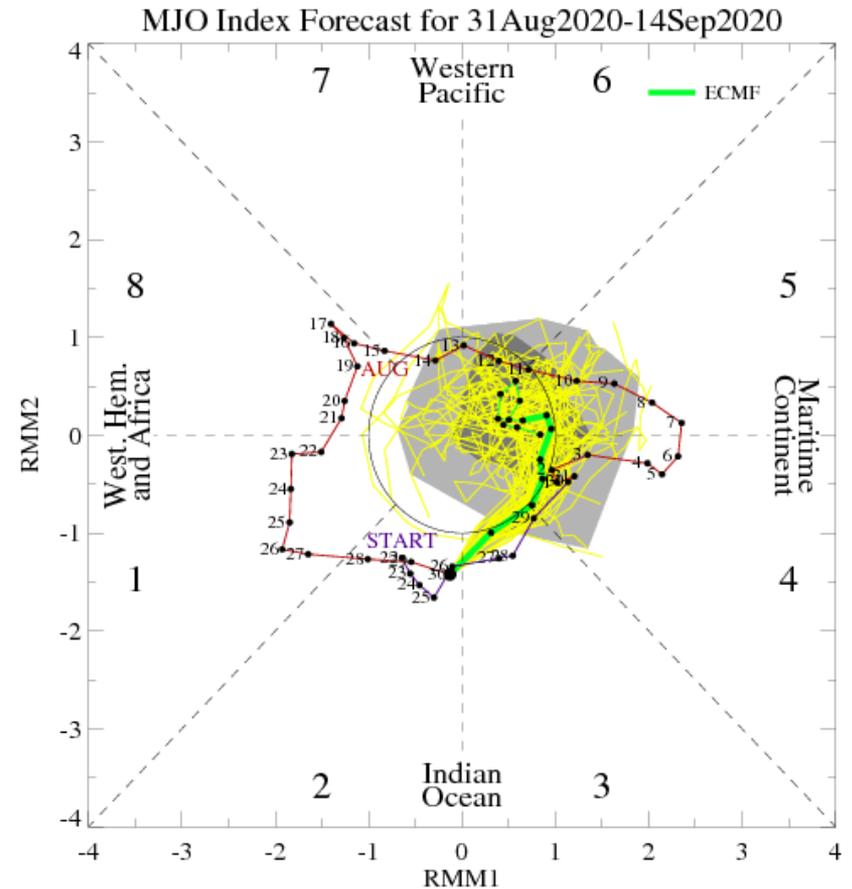


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



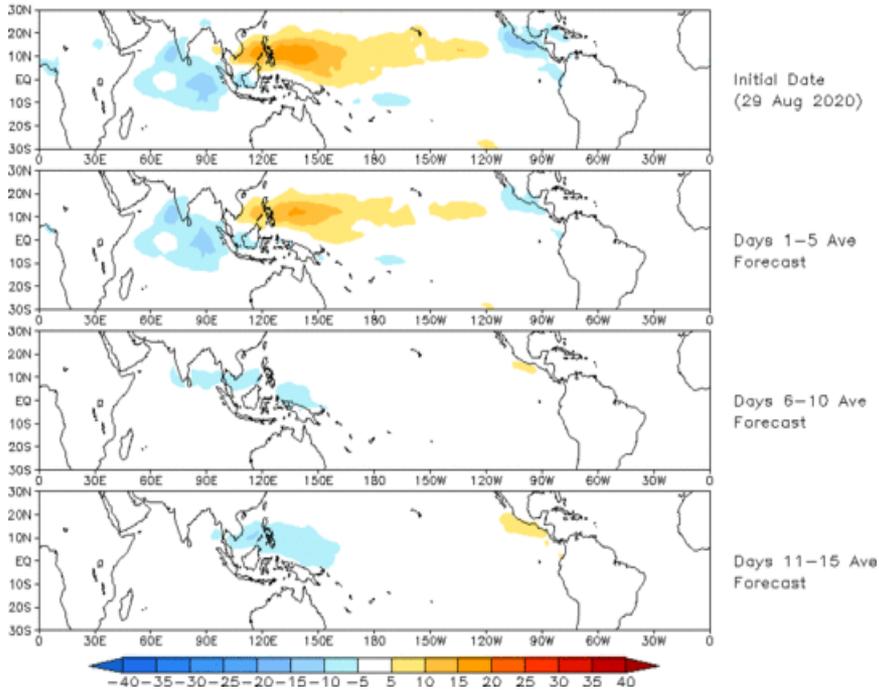
ECMWF Forecast

- Dynamical models indicate a continued eastward propagation of the MJO, while weakening its amplitude over the Maritime Continent.
- Compared to model guidance last week, there is better agreement relative to the predicted weakening in amplitude, however some of the loss in signal in RMM space may be associated with destructive interference with the low frequency signal over the Maritime Continent and Western Pacific.

MJO: GEFS Forecast Evolution

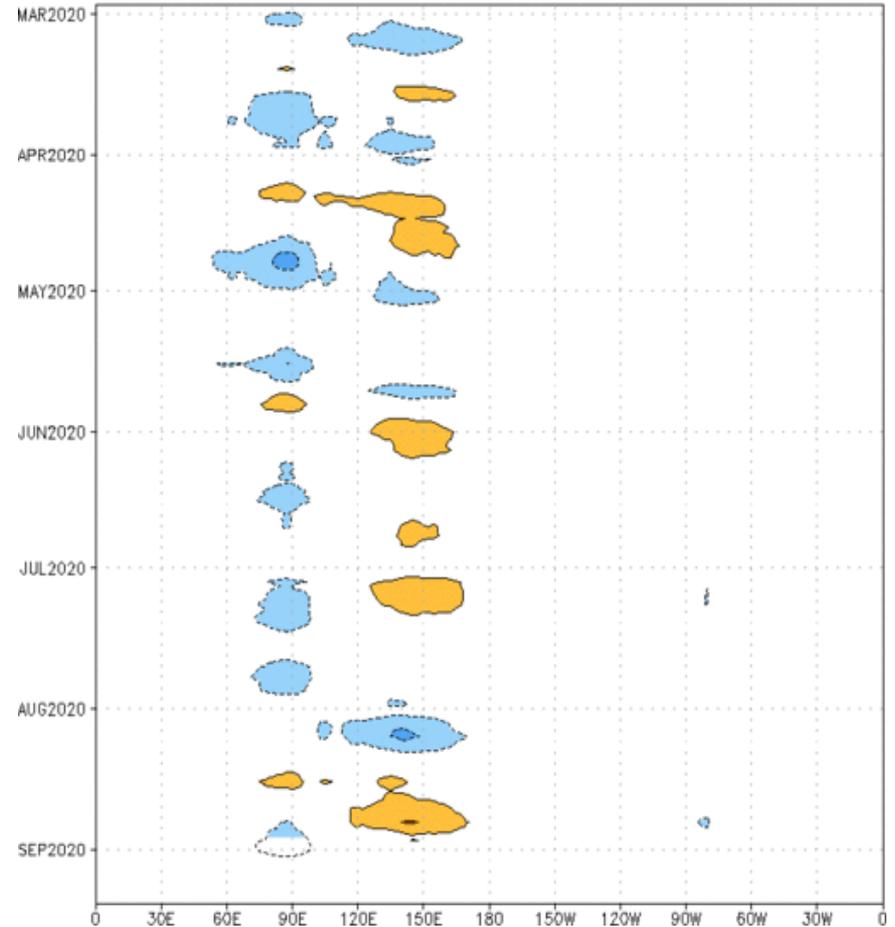
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 29 Aug 2020
OLR



- The GEFS spatial maps show a weakening convective anomaly pattern, while shifting eastward during week-2.

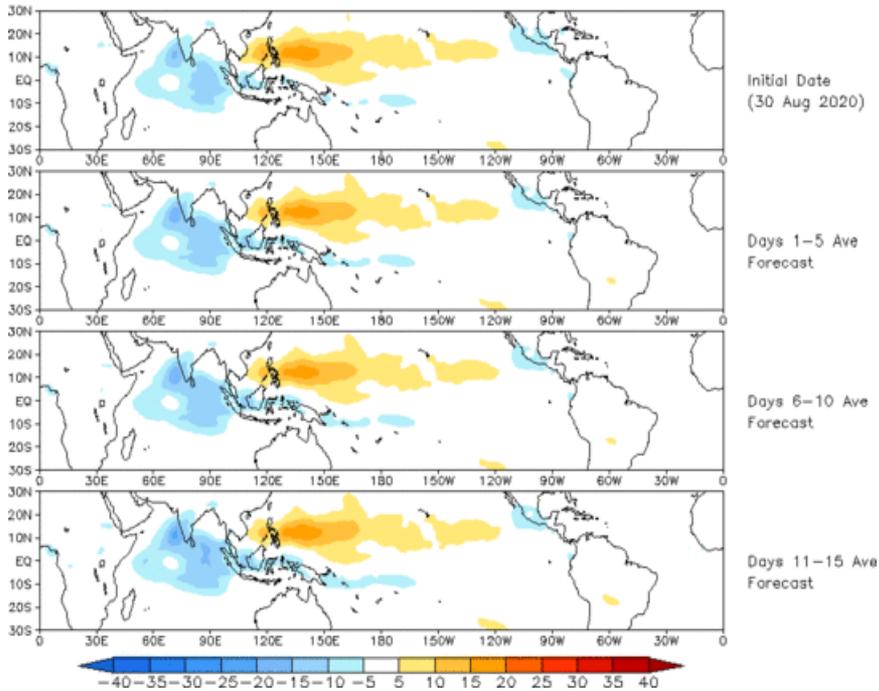
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:28-Feb-2020 to 29-Aug-2020
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



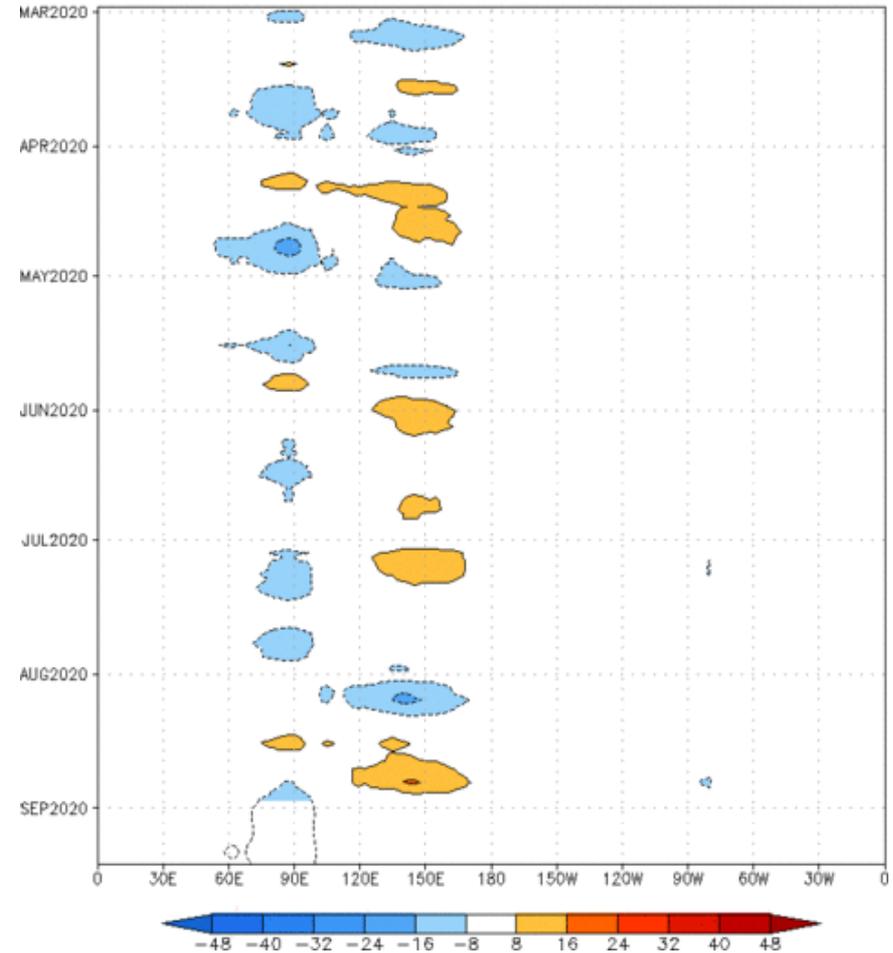
MJO: Constructed Analog Forecast Evolution

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 (30 Aug 2020)



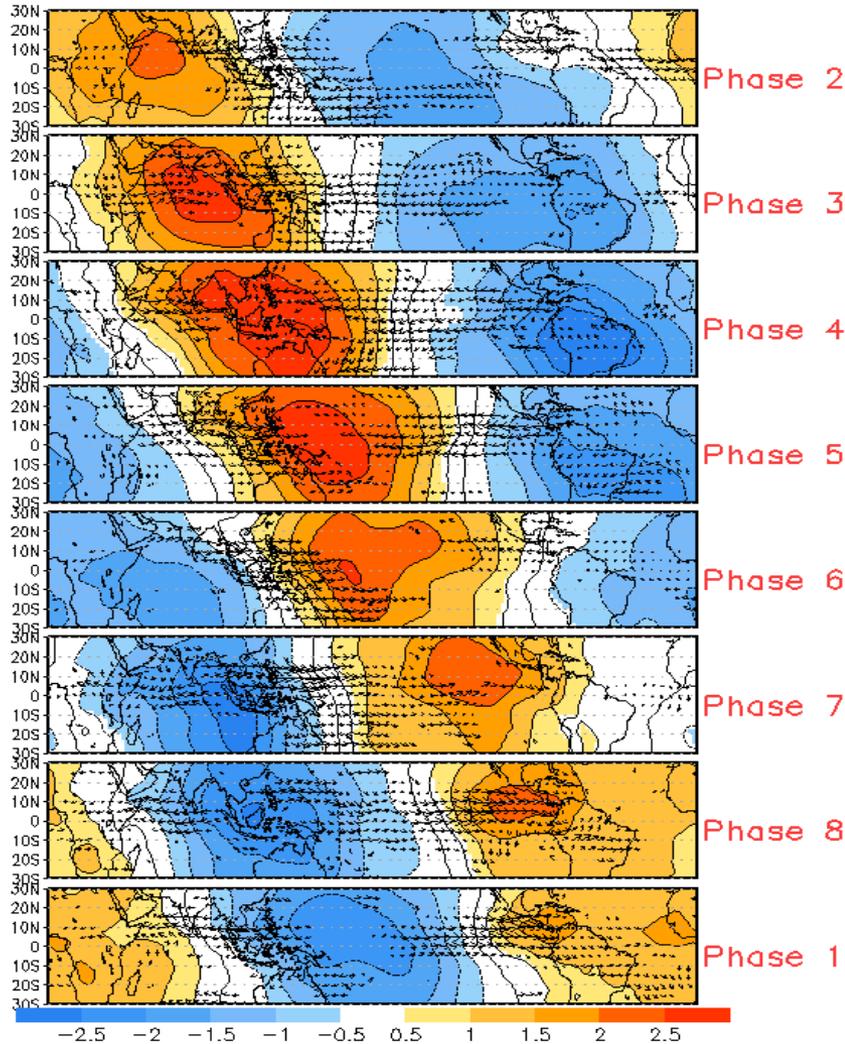
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:29-Feb-2020 to 30-Aug-2020
The unfilled contours are CA forecast reconstructed anomaly for 15 days



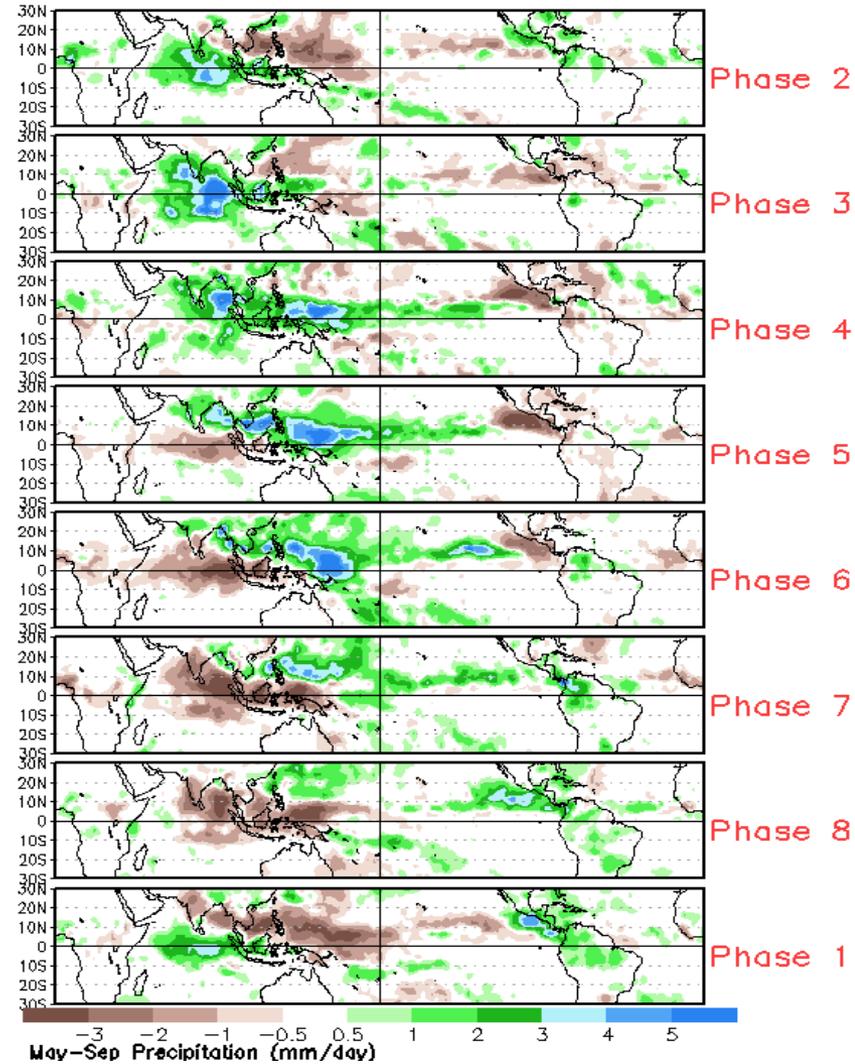
- The constructed analog forecast depicts a quasi-stationary convective pattern, suggesting little eastward propagation of the MJO through mid-September.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



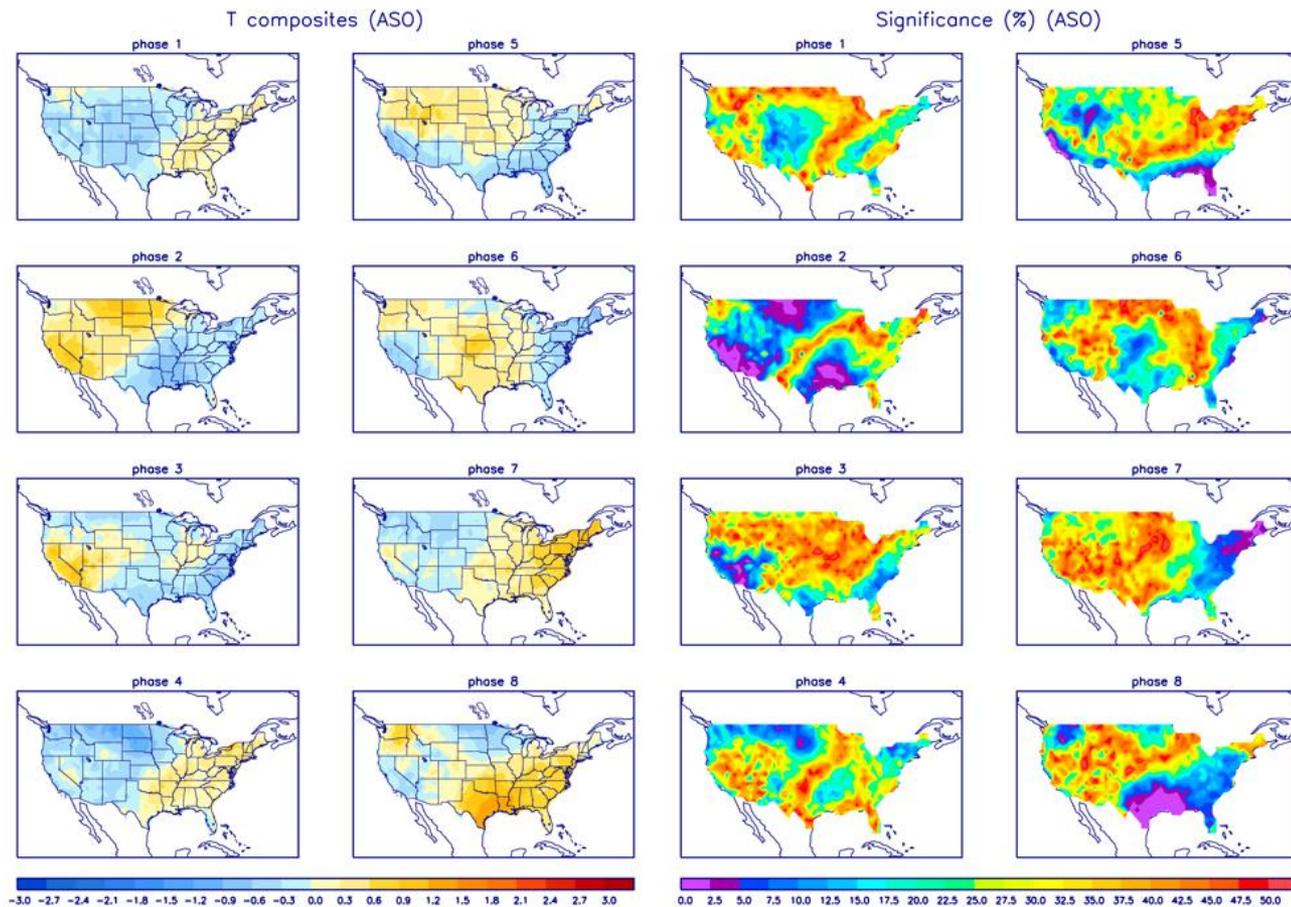
Precipitation Anomalies



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.

