

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
7 September 2020

Overview

- Following a well-defined MJO since late July, it recently weakened slightly during the first week of September.
- Dynamical model forecasts depict a much weaker MJO during September compared to August.
- The low-frequency base state and climatology support continued tropical cyclone development across the main development region of the Atlantic basin, especially during the next week.

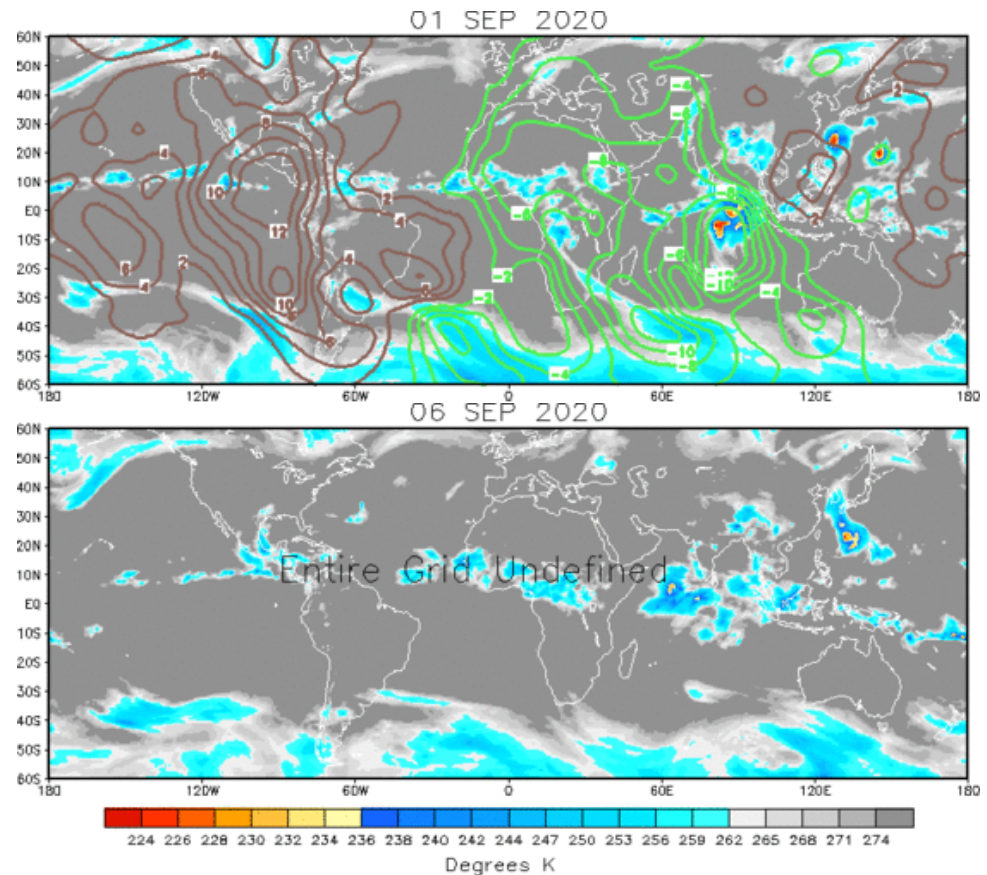
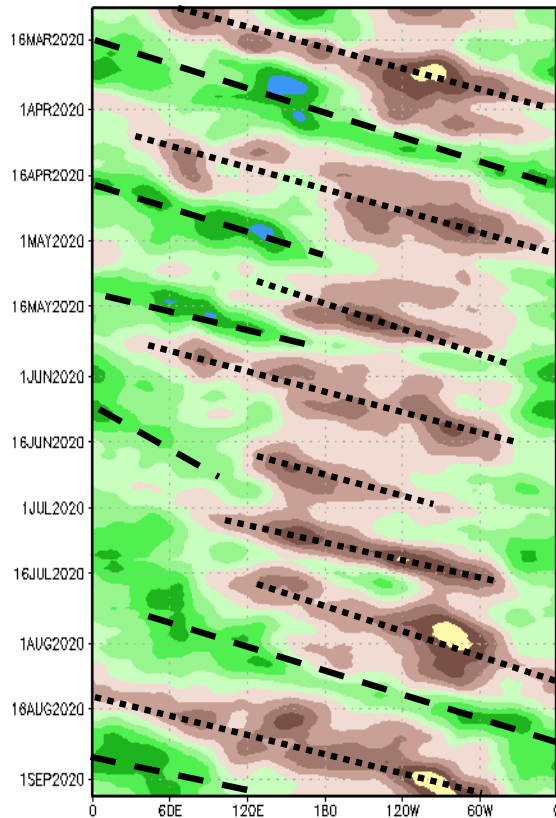
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

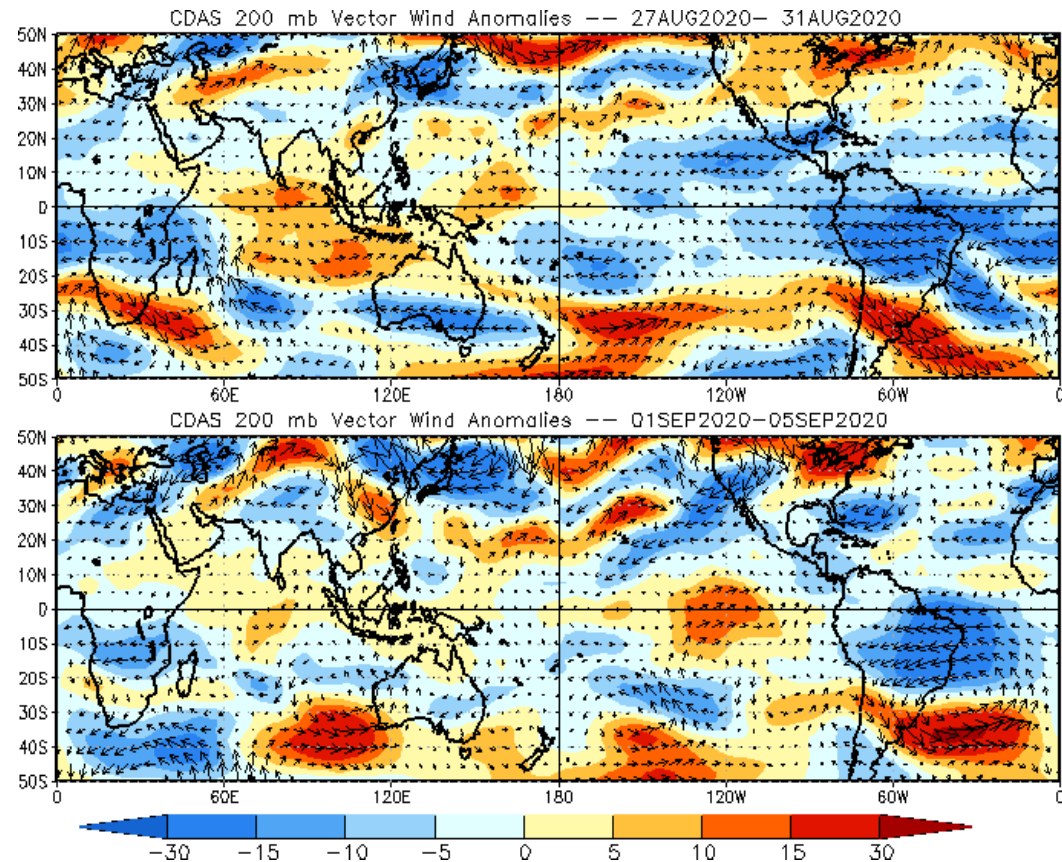
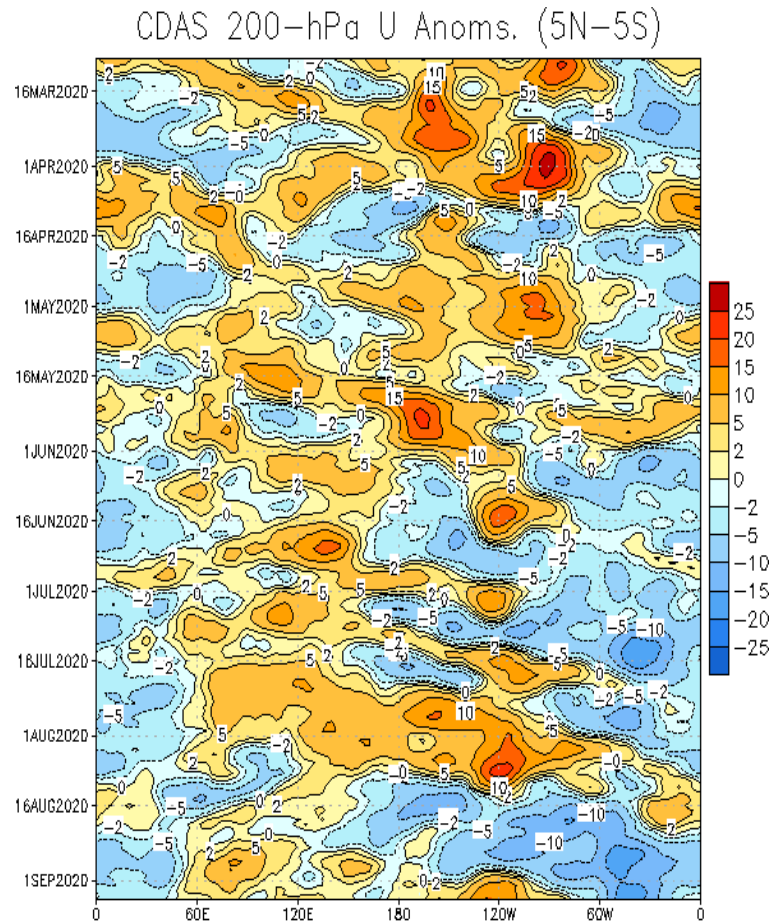
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- Since earlier this year, a westward shift of suppressed convection continues across the Pacific.
- An envelope of anomalous upper-level divergence circumnavigated the global tropics from late July to the end of August, representing a well-defined MJO.
- Recently, a more stationary pattern has emerged as the MJO weakened and the low-frequency base state becomes a larger contributor.

200-hPa Wind Anomalies

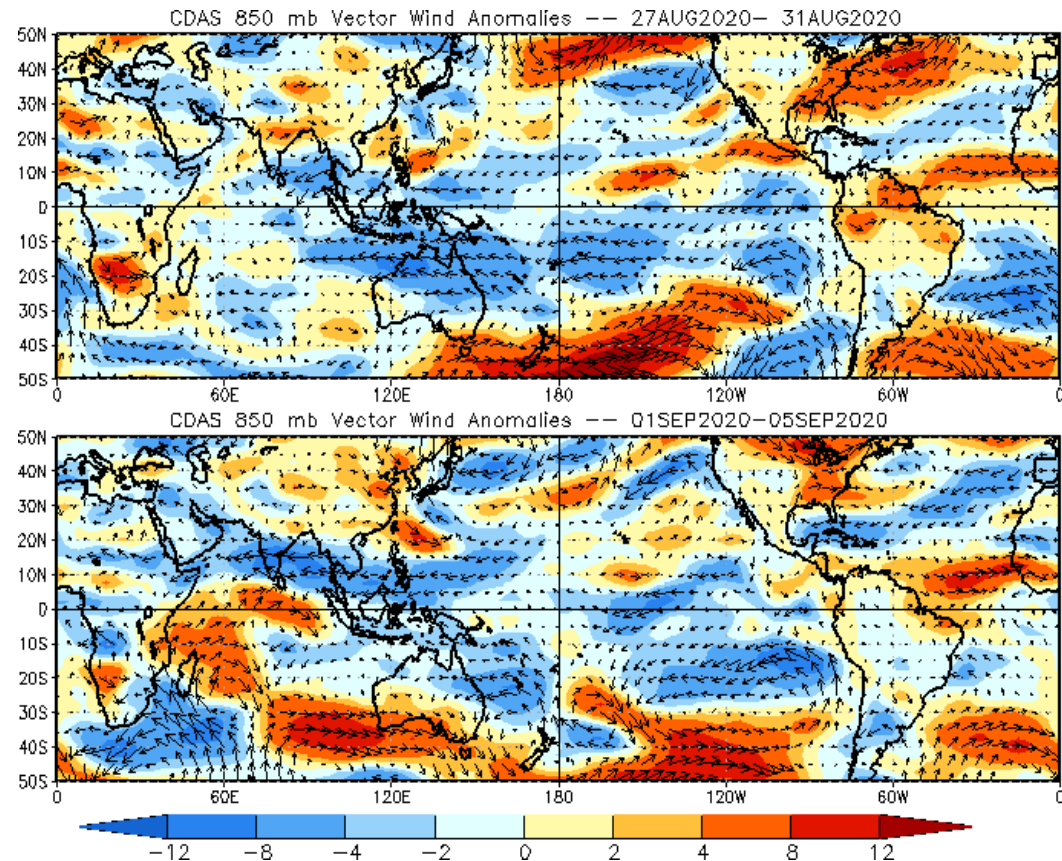
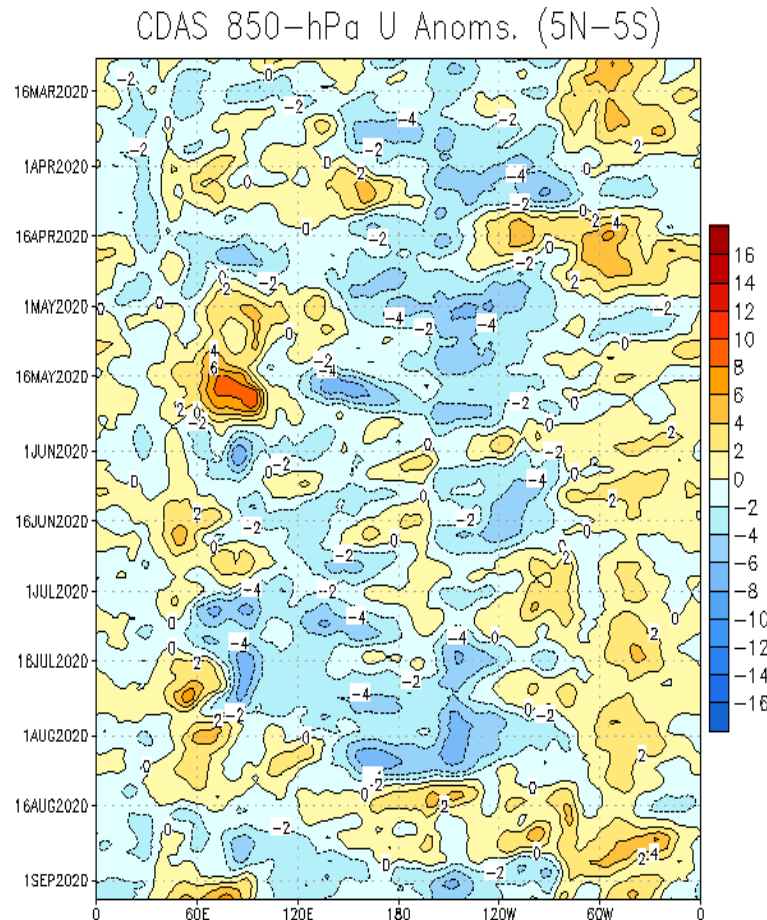
Shading denotes the zonal wind anomaly. Blue shades: Anomalous easterlies. Red shades: Anomalous westerlies.



- During late August, anomalous westerlies aloft over the Maritime Continent coupled with anomalous easterlies over the East Pacific constructively interfered with the low-frequency base state.
- Anomalous upper-level easterlies are more prominent across the Atlantic basin since late August, resulting in reduced vertical wind shear.

850-hPa Wind Anomalies

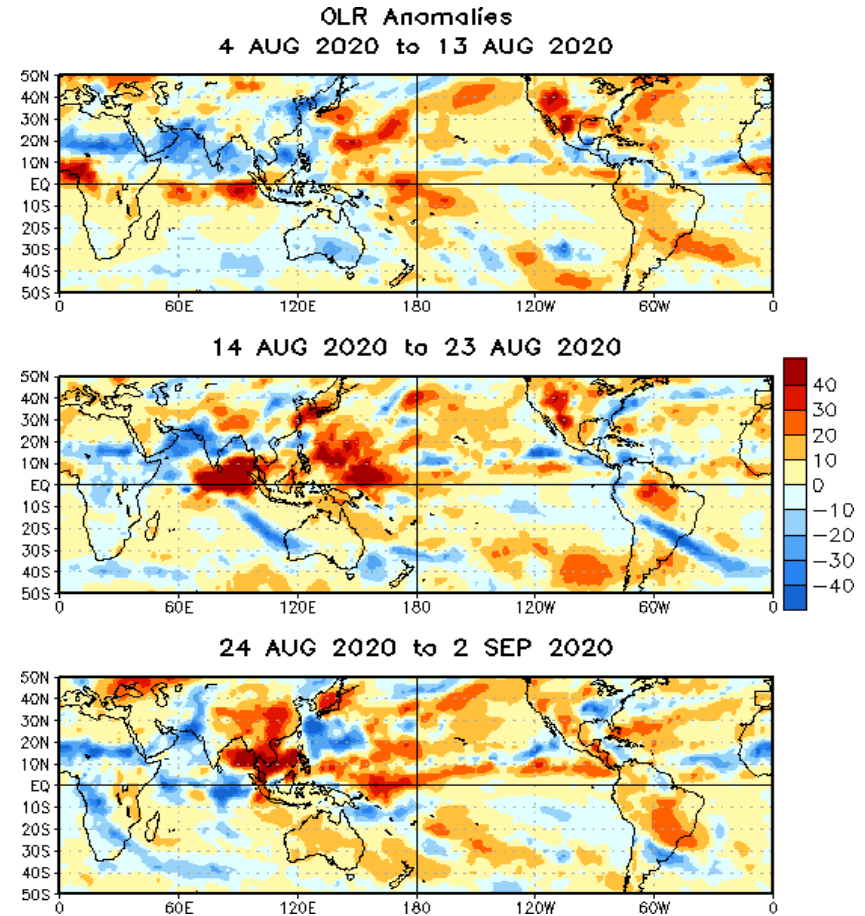
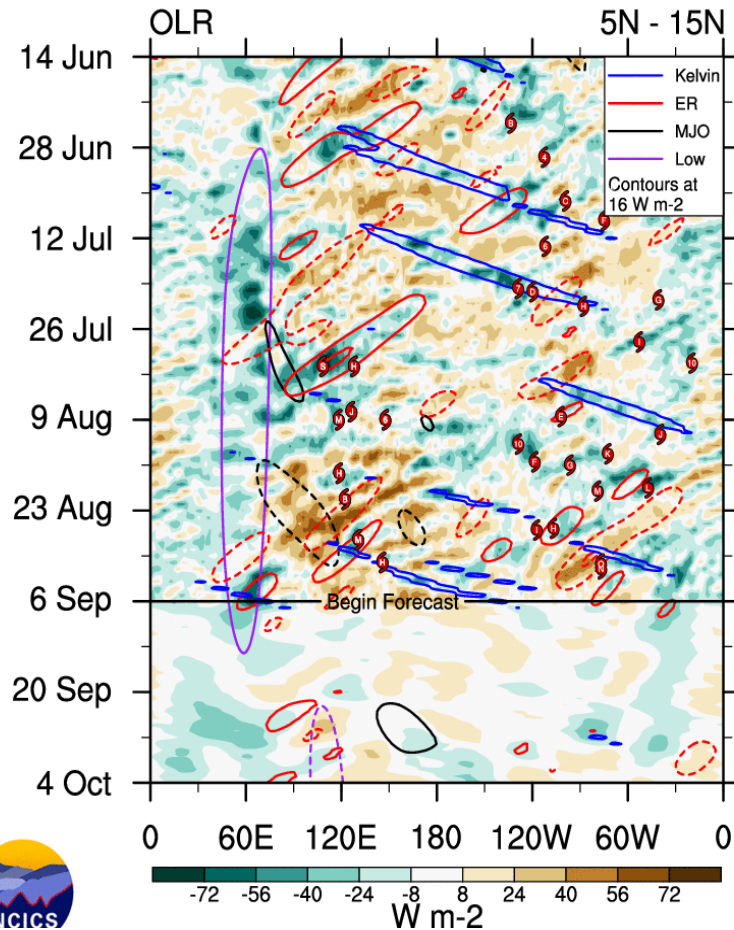
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Anomalous low-level returned to the equatorial central Pacific by the beginning of September.
- Anomalous low-level westerlies continue to persist over the Main Development Region of the Atlantic Basin, evidence of the low-frequency base state remaining a dominant factor.

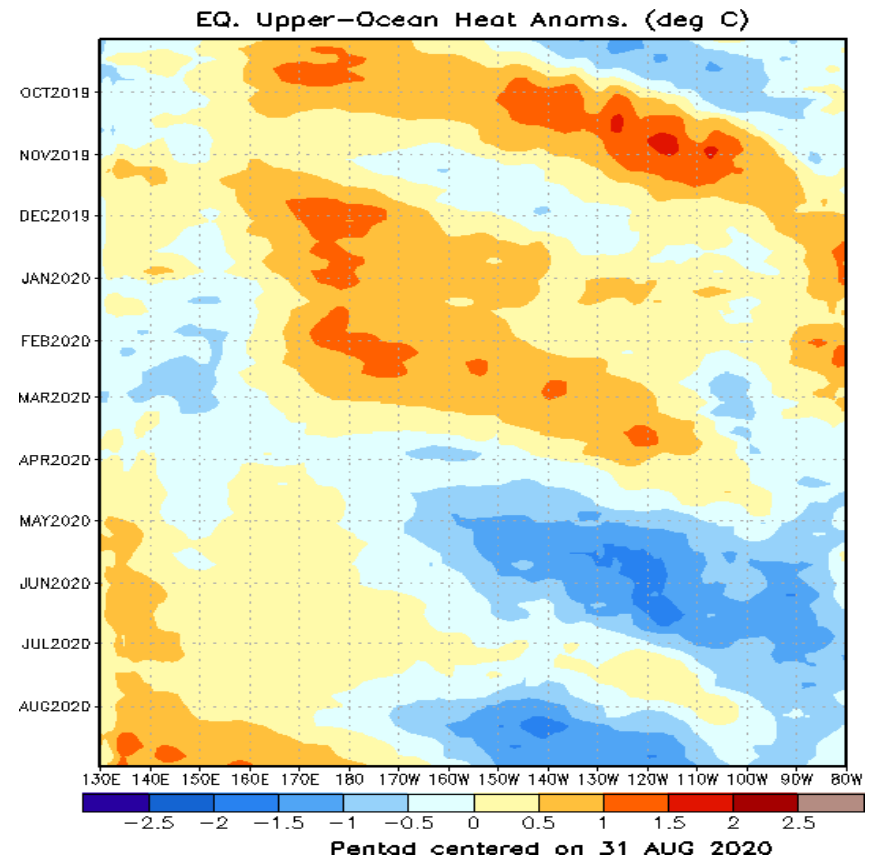
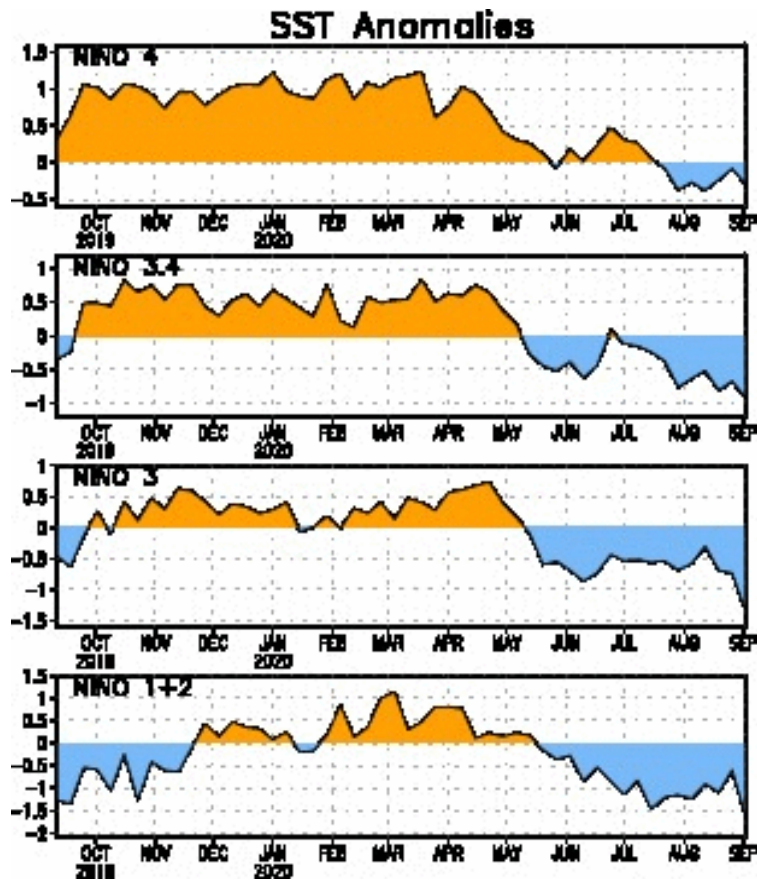
Outgoing Longwave Radiation (OLR) Anomalies

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 continues to persist across the equatorial central Pacific.
- Enhanced convection over the sub-tropics led to flooding rainfall across Pakistan and multiple tropical cyclones in the Northwest Pacific.

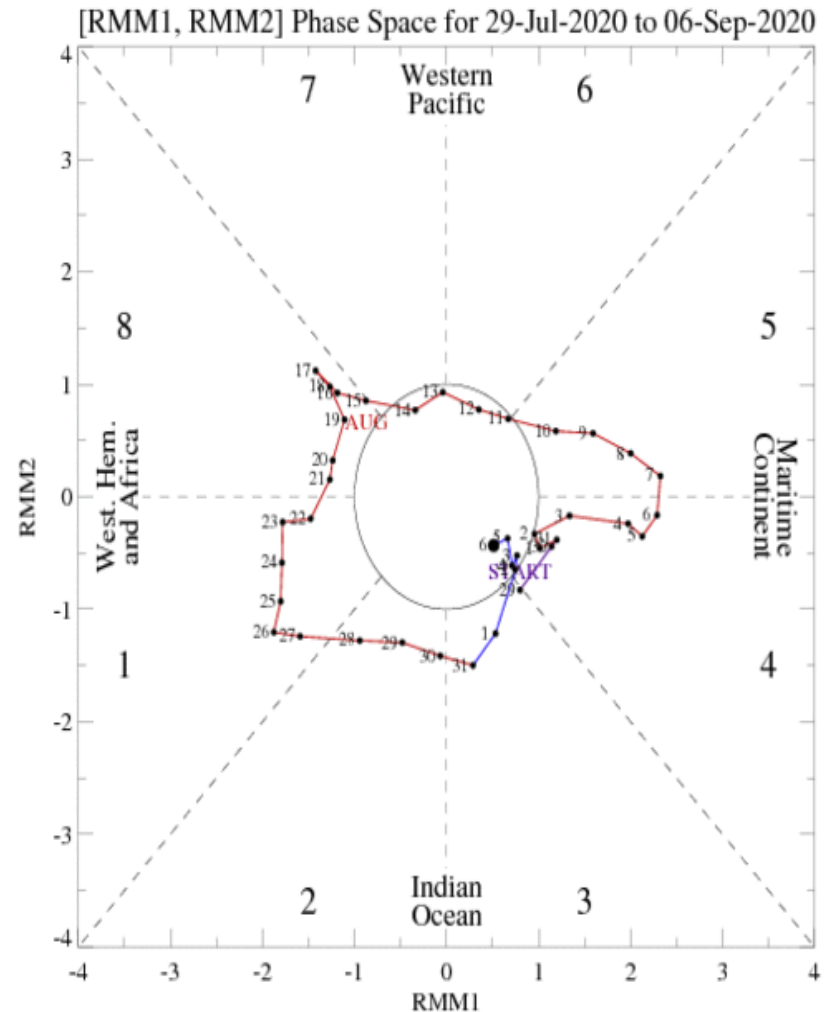
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- 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.

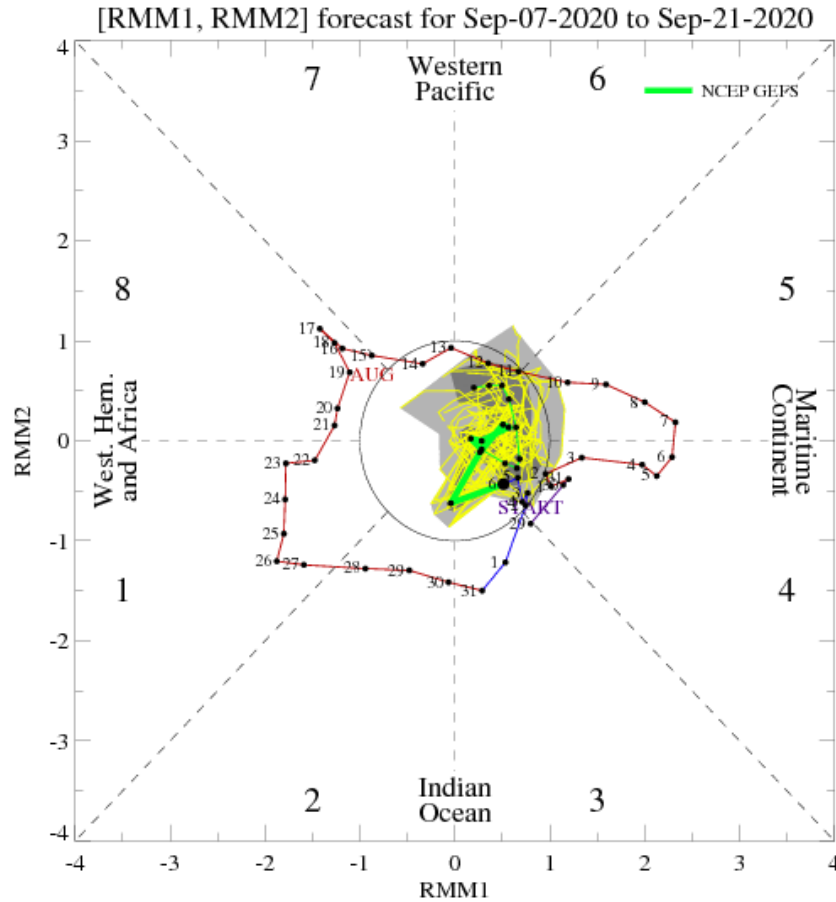
MJO Index: Recent Evolution

- Currently, the RMM index depicts a decrease in the MJO amplitude as it propagated eastward from the Indian Ocean.

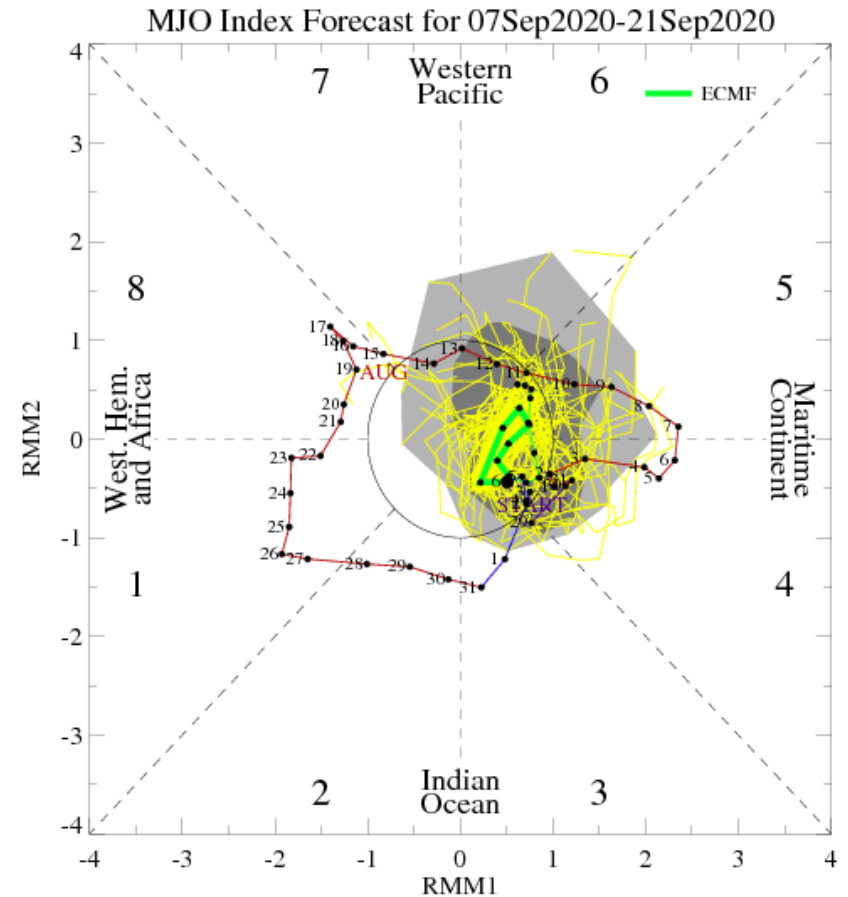


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



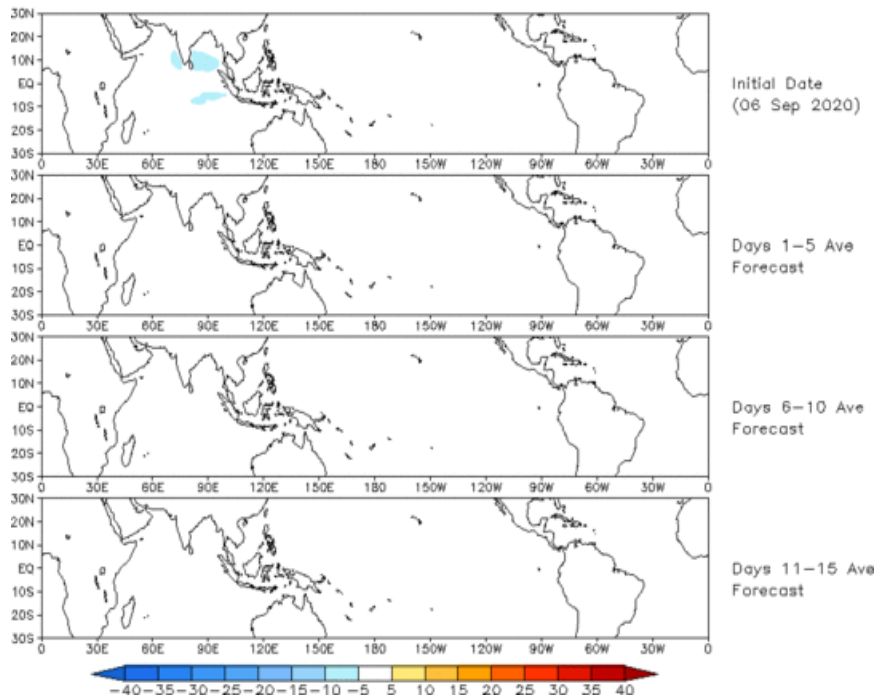
ECMWF Forecast

- Dynamical models indicate a much weaker MJO during mid-September compared to late July and August.
- The weaker MJO may be associated with destructive interference with the low frequency signal over the Maritime Continent and Western Pacific.

MJO: GEFS Forecast Evolution

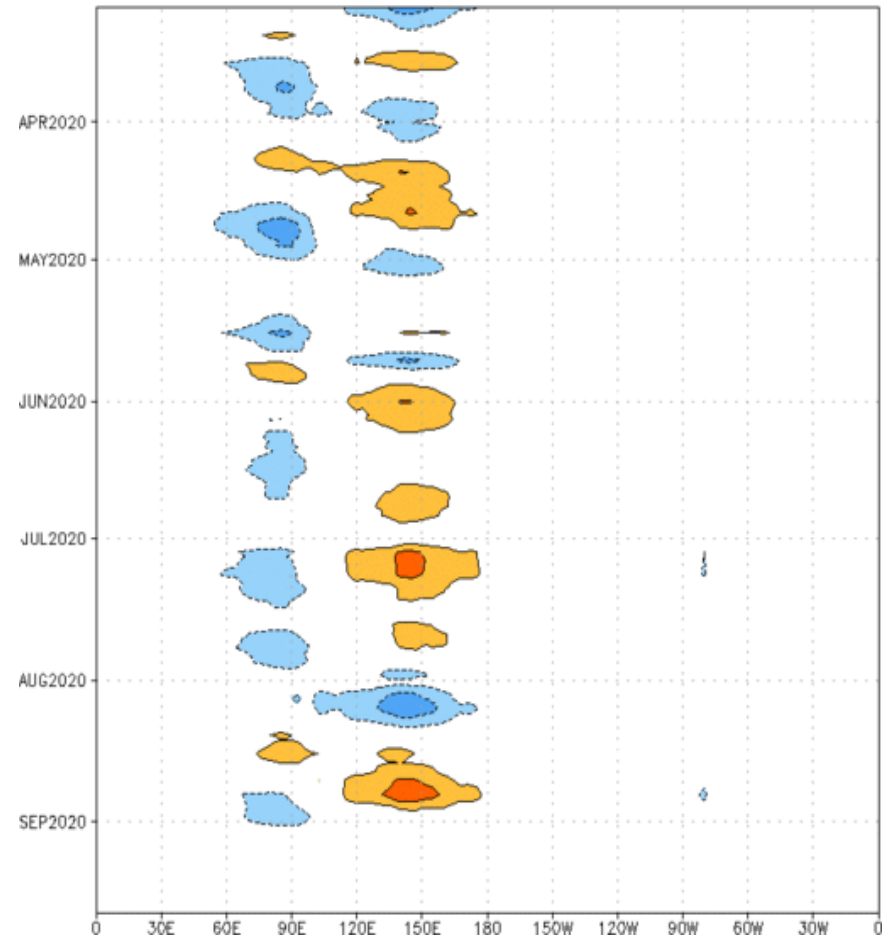
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 06 Sep 2020
OLR



- The GEFS spatial maps show little to no anomalous convection due to its lack of MJO forcing.

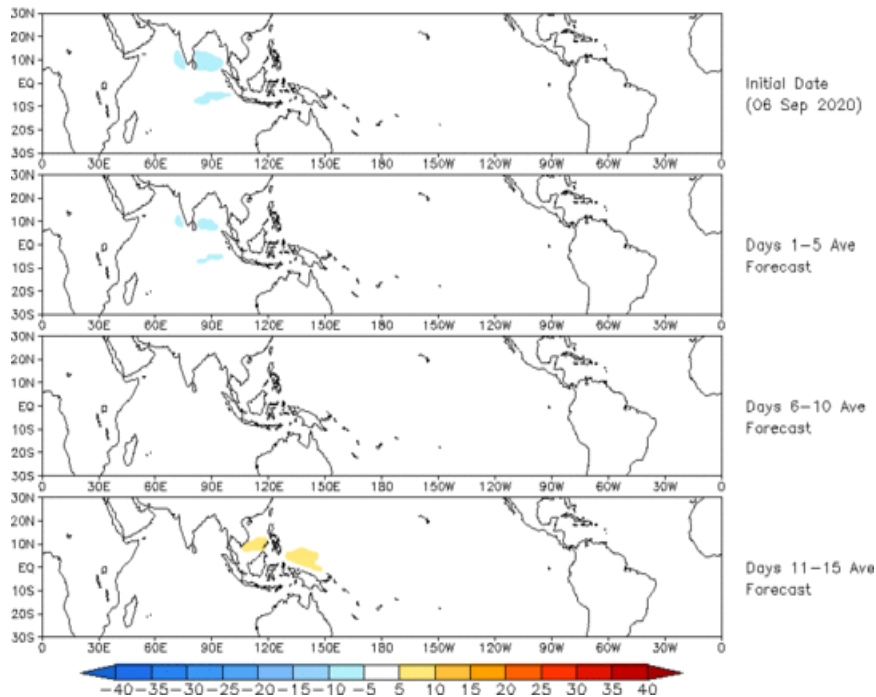
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S, 7.5°N] ($\text{cint: } 4\text{Wm}^{-2}$) Period: 07-Mar-2020 to 06-Sep-2020
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



MJO: Constructed Analog Forecast Evolution

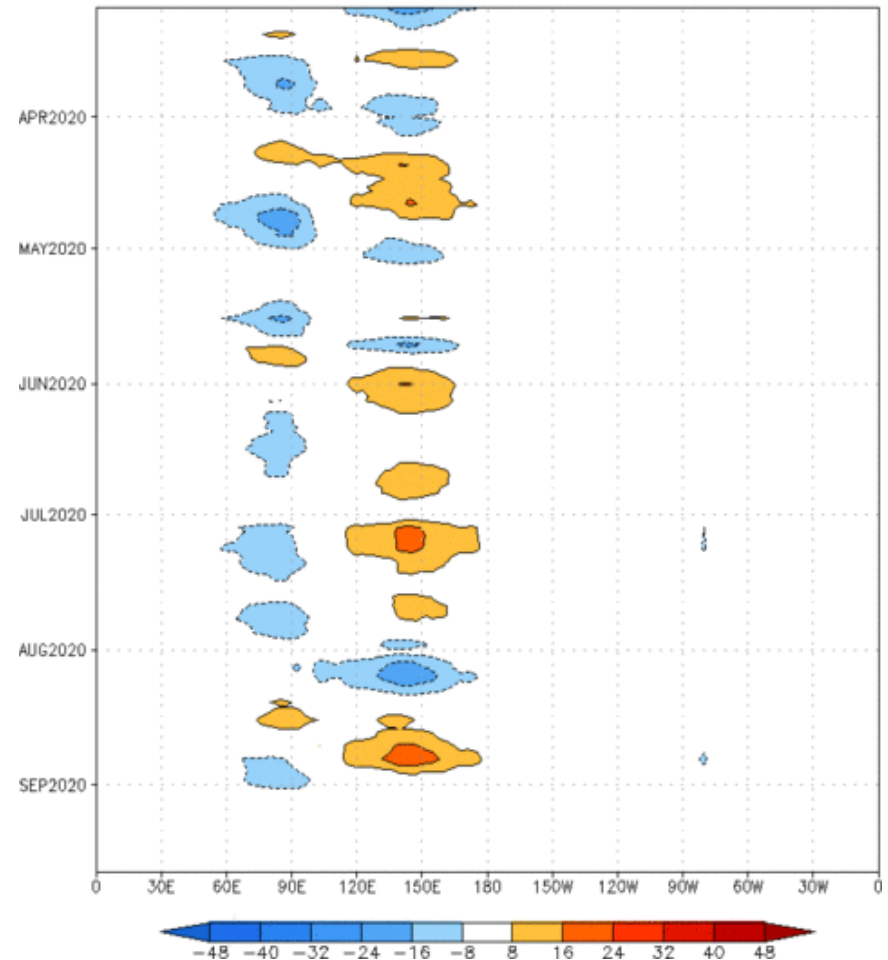
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (06 Sep 2020)



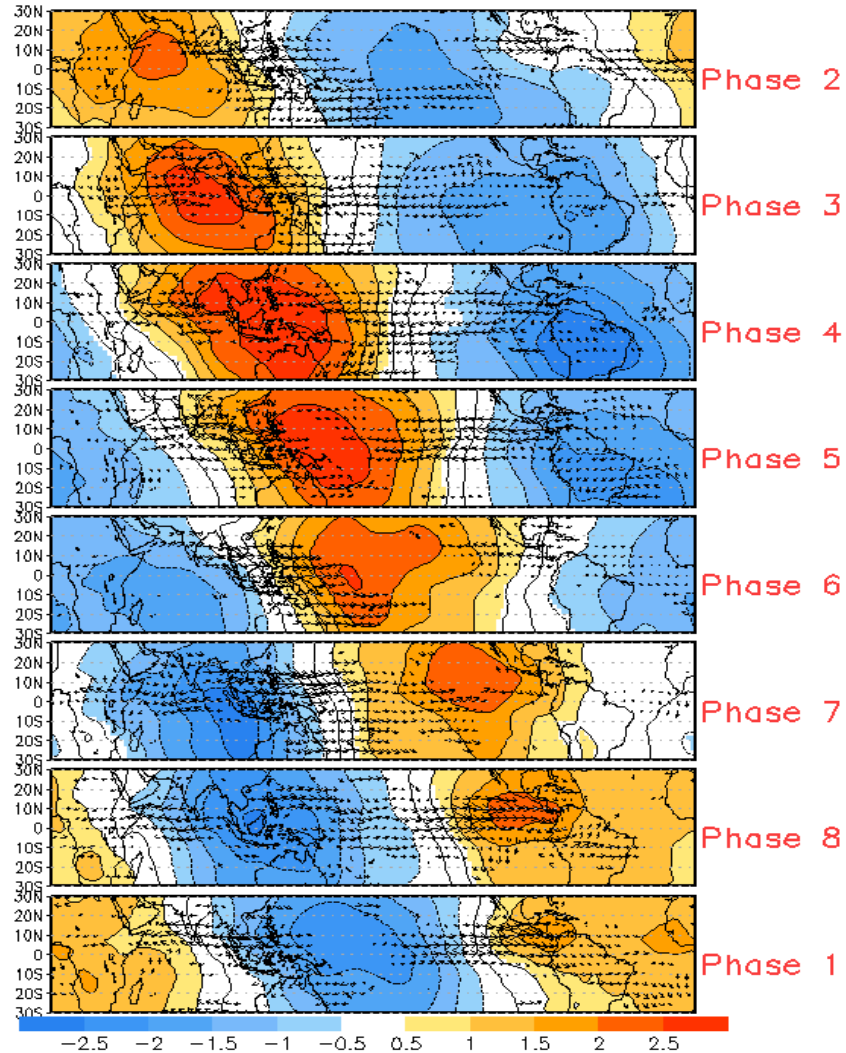
- The constructed analog forecast also depicts a lack of anomalous convection during the next two weeks.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm²) Period:07-Mar-2020 to 06-Sep-2020
The unfilled contours are CA forecast reconstructed anomaly for 15 days

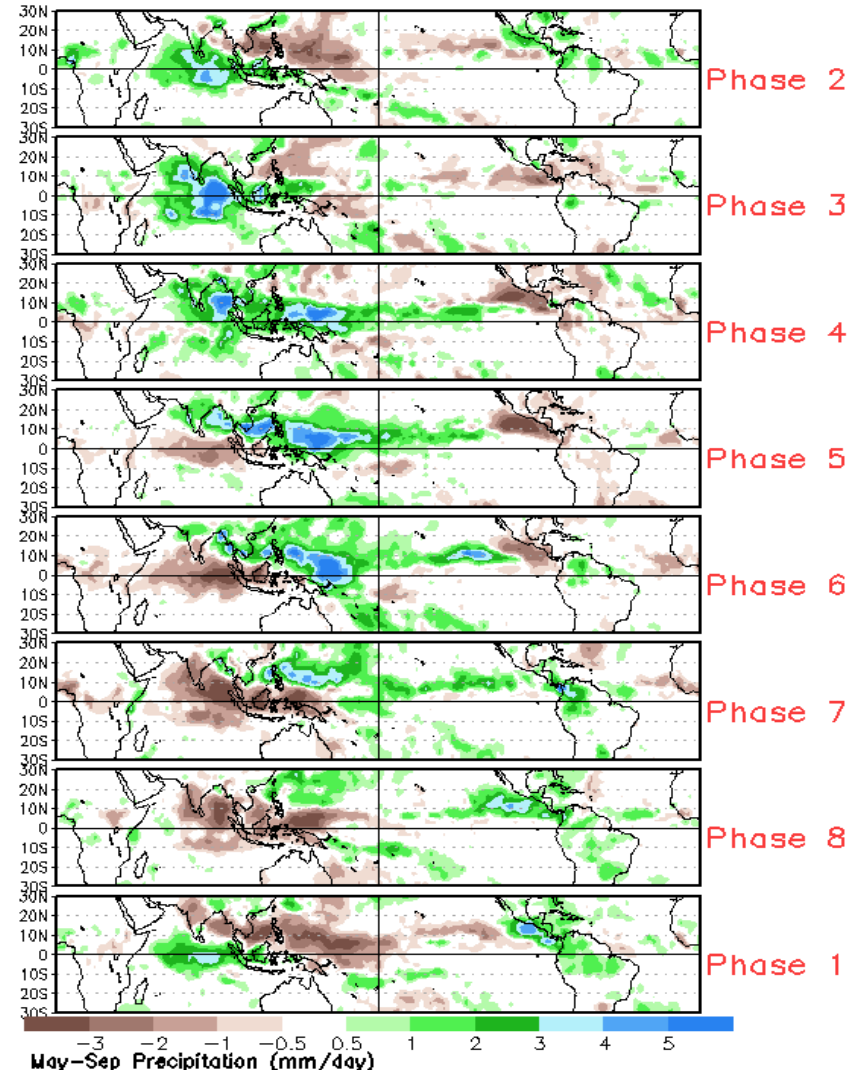


MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



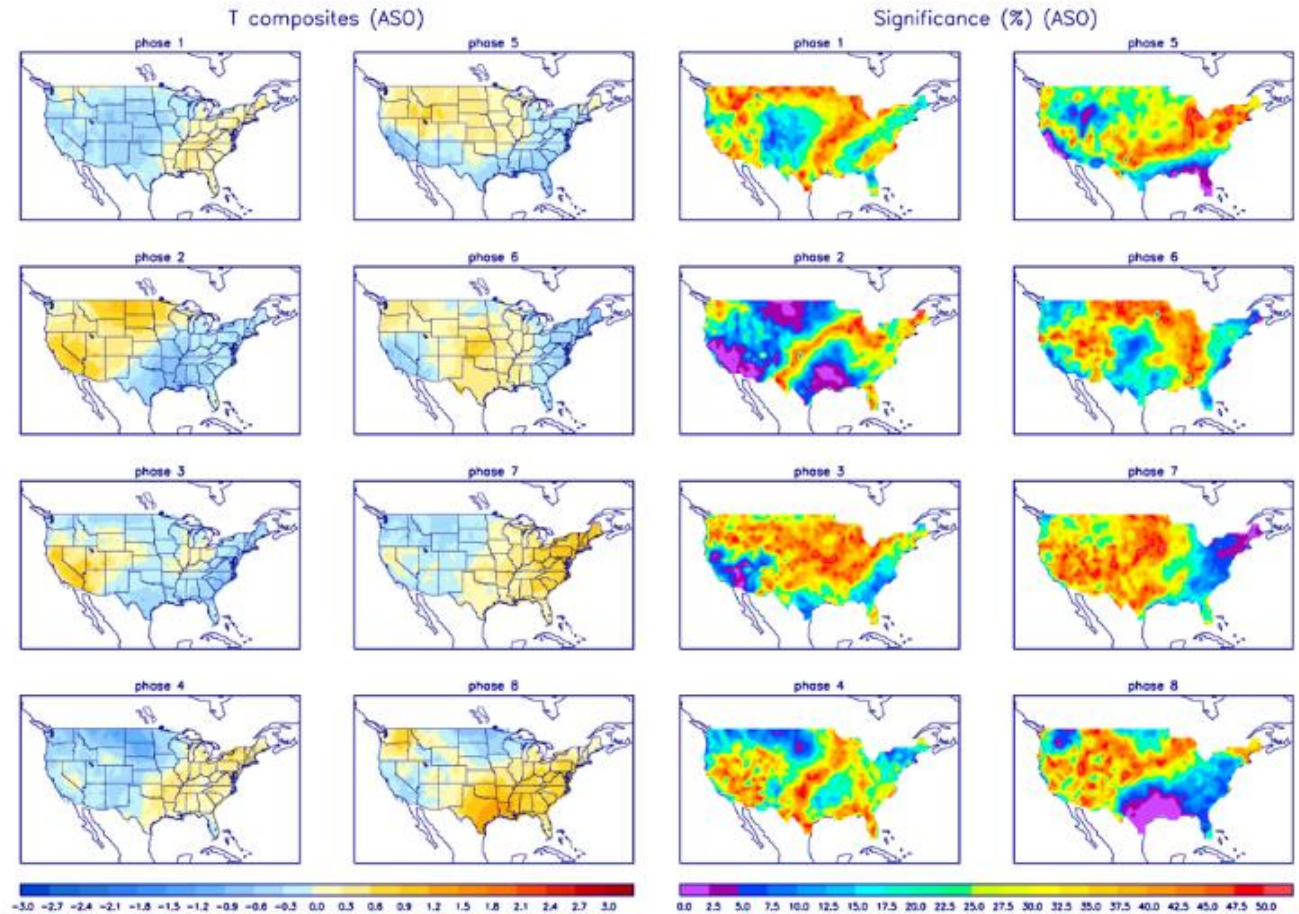
Precipitation Anomalies



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.

