

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
23 September 2019

Overview

- The MJO has been present primarily in the upper-level wind field during the past few weeks, with little apparent convective response.
- More recently, a more coherent MJO signal emerged, with the enhanced phase currently over the Western Hemisphere.
- Dynamical and statistical model guidance show little eastward propagation of this signal during the next two weeks, which may be due to interference from the IOD, Rossby wave or Western Hemisphere tropical cyclone activity.
- The MJO may contribute to a continuation of enhanced tropical cyclone activity over the Atlantic basin.
- A strong low-level westerly wind burst continues over the central Pacific, which may result in a new downwelling oceanic Kelvin wave.

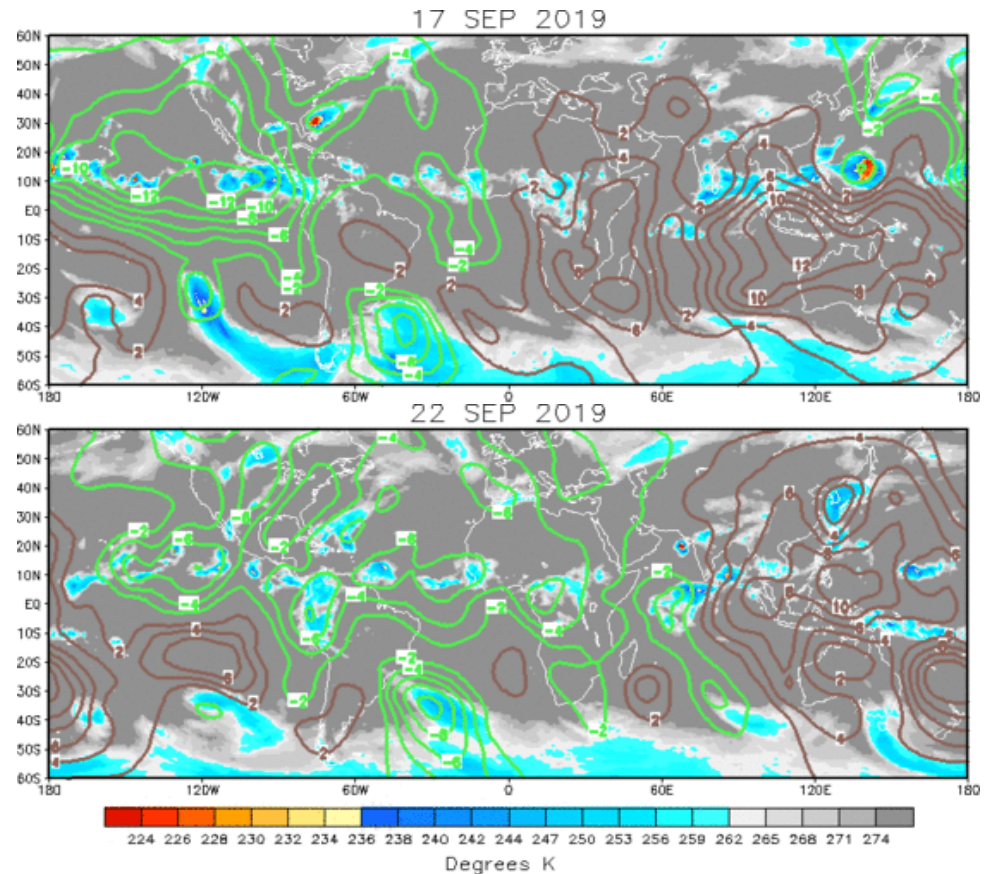
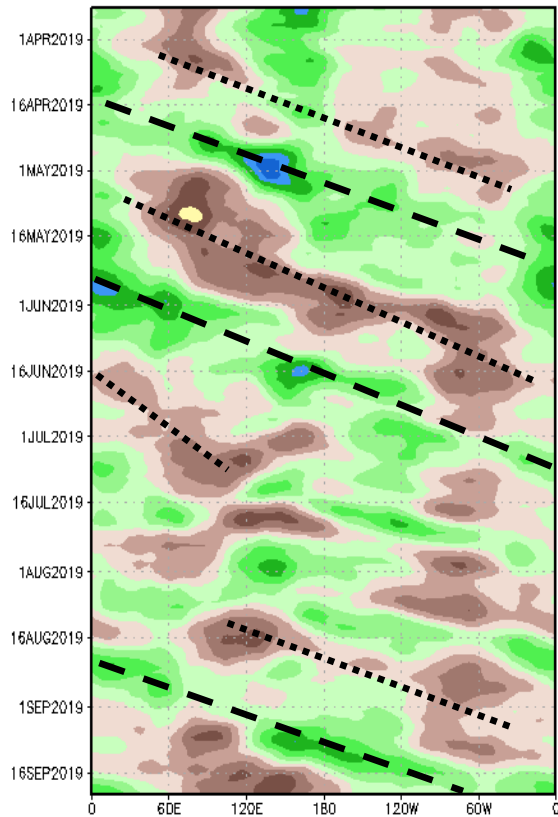
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

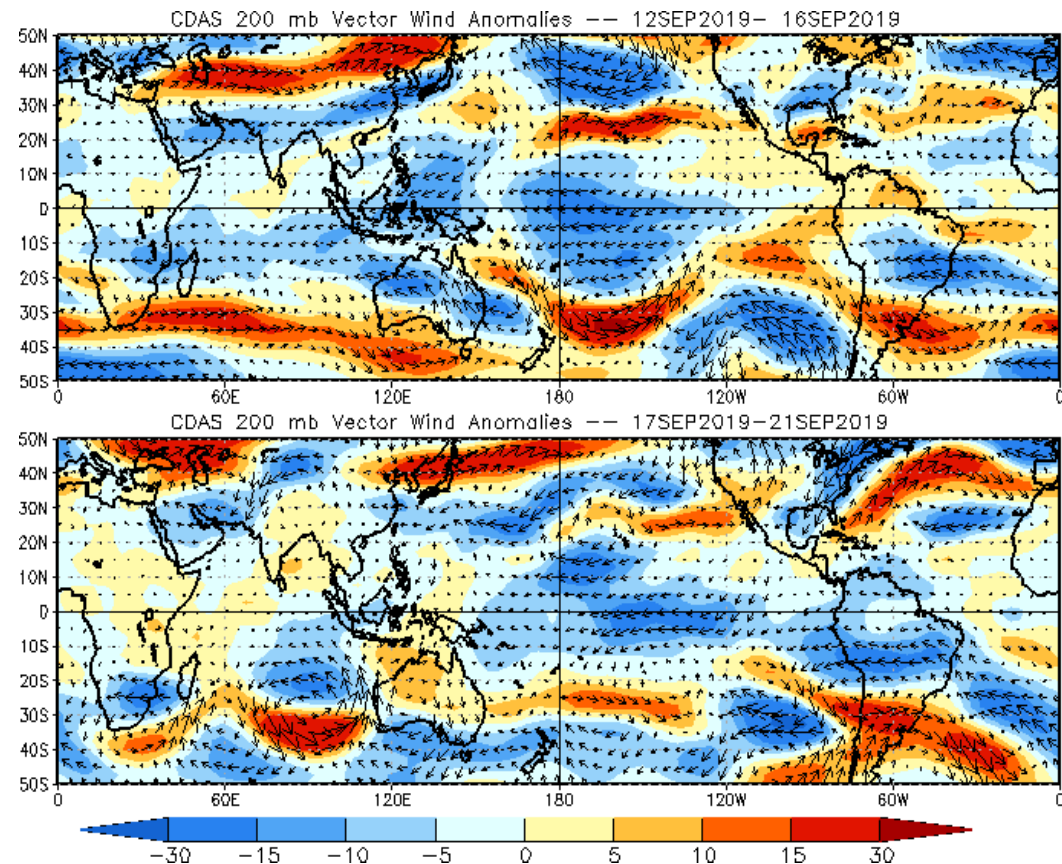
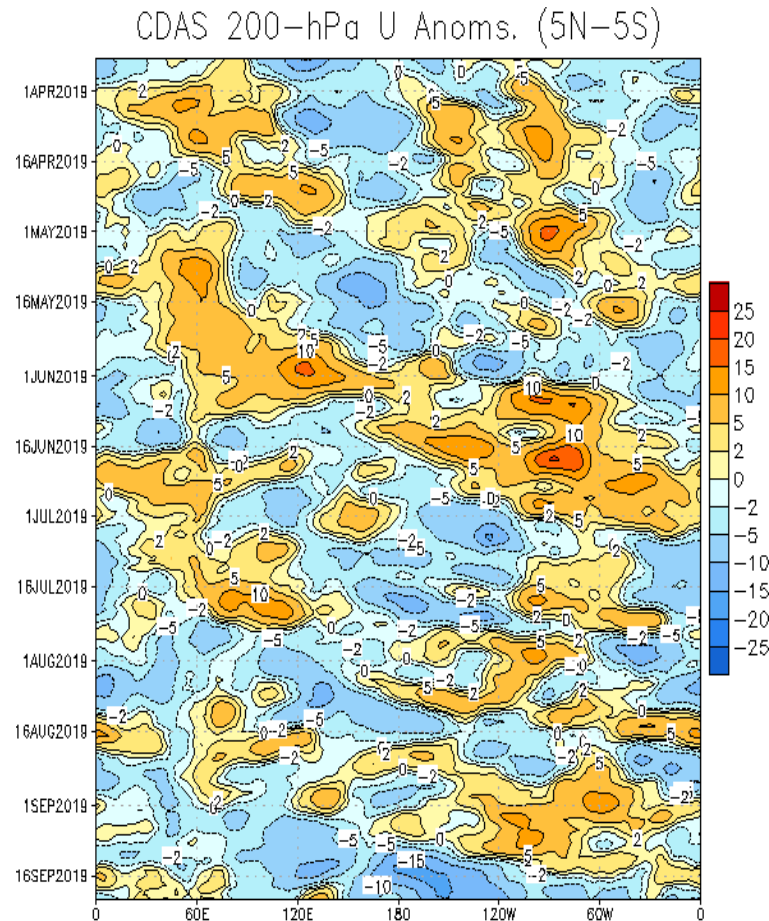
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- A developing subseasonal signal has been apparent in the upper-level velocity potential field for the past several weeks, despite a less coherent signal at the lower levels.
- This signal is generally consistent with, but further east than, recent strong low-level westerly anomalies over the central Pacific.
- This upper-level pattern may help keep vertical shear weak over the Atlantic basin as peak hurricane season continues.

200-hPa Wind Anomalies

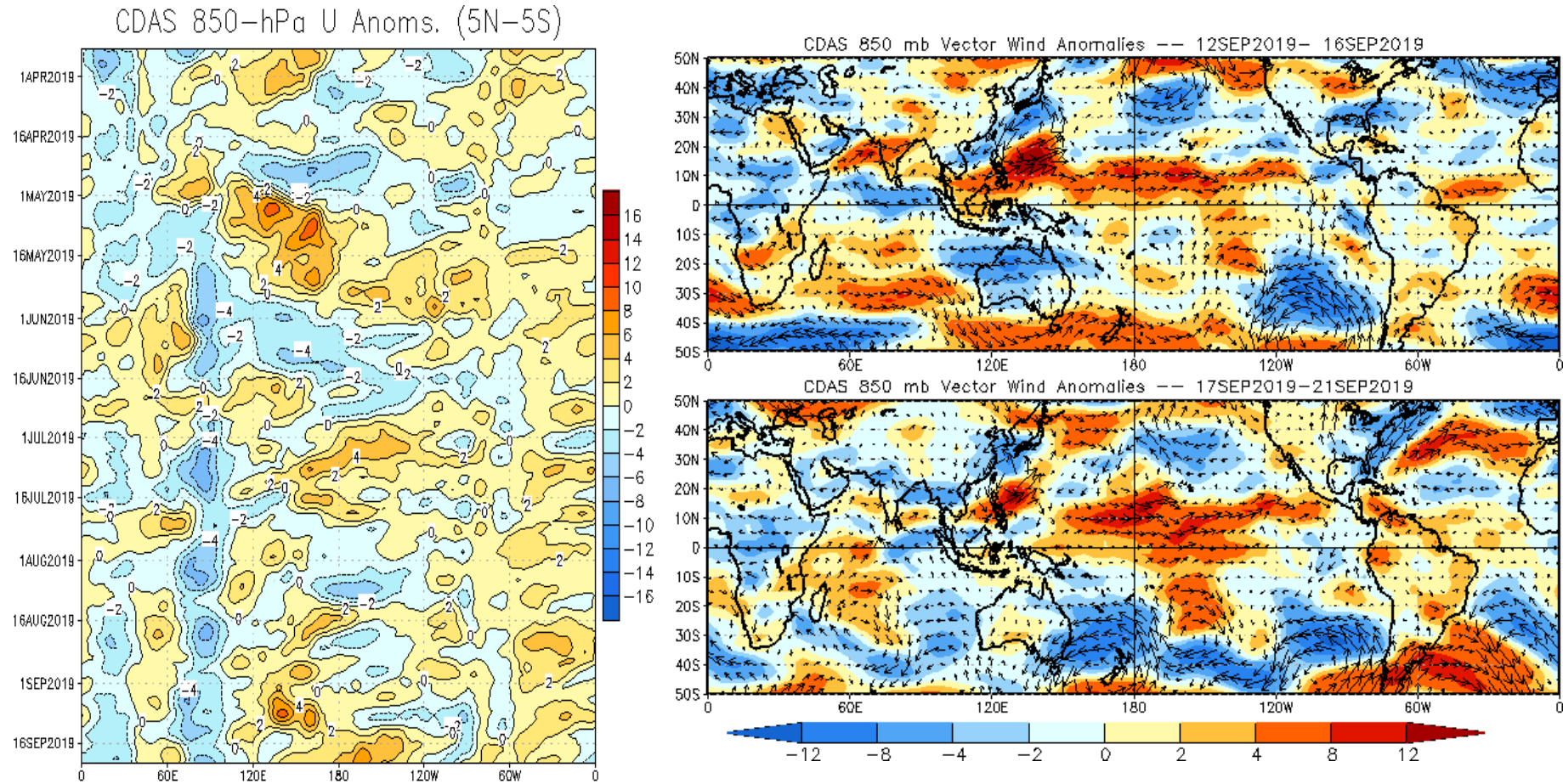
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- A robust belt of easterly anomalies shifted eastward over the Pacific, consistent with an organizing MJO signal over the Western Hemisphere.
- The upper-level wind field was generally weak elsewhere near the Equator.

850-hPa Wind Anomalies

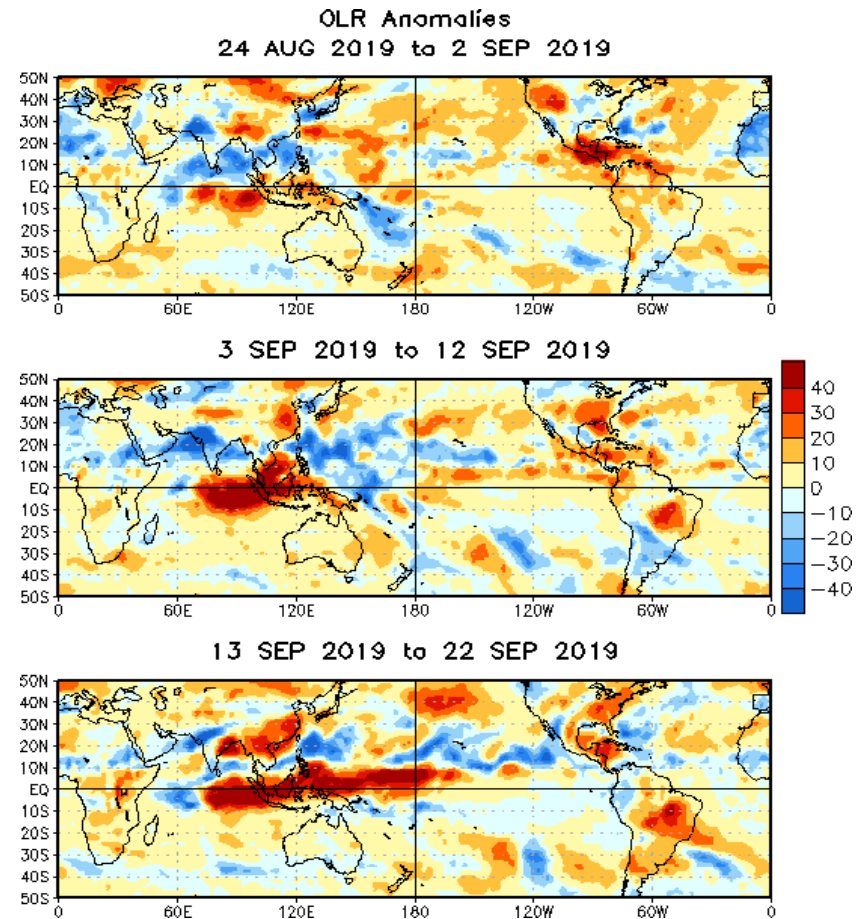
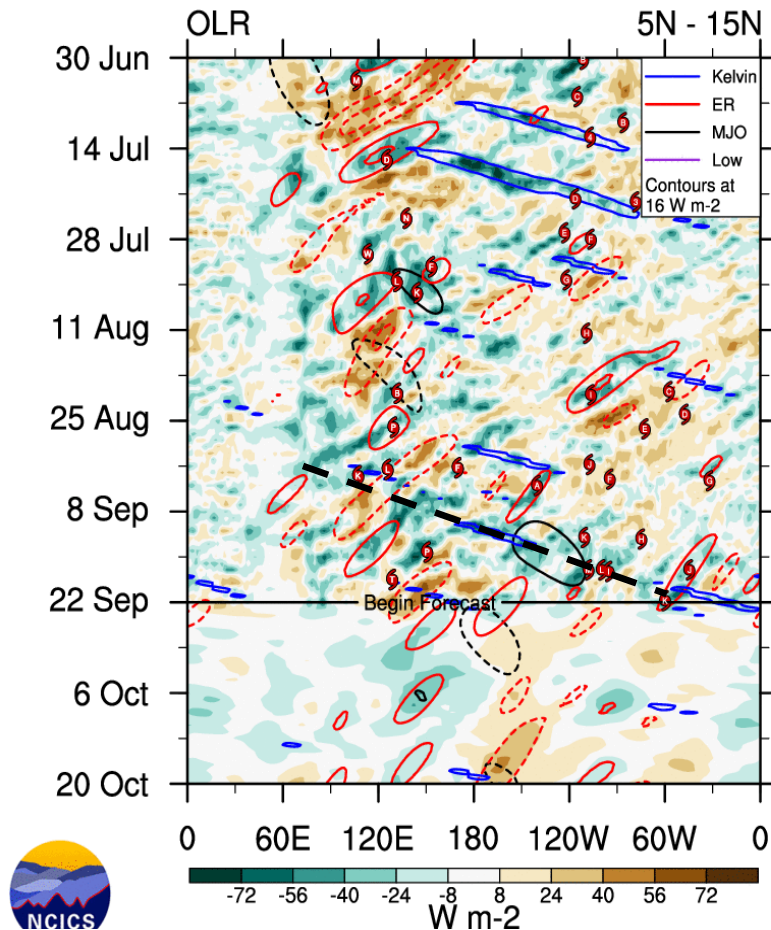
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- A robust westerly wind burst is ongoing in the Pacific, with the trade winds disrupted over much of the central Pacific.
- Easterly anomalies weakened over the equatorial Indian Ocean, with increasing low-level convergence, although the broader pattern remains fairly incoherent.

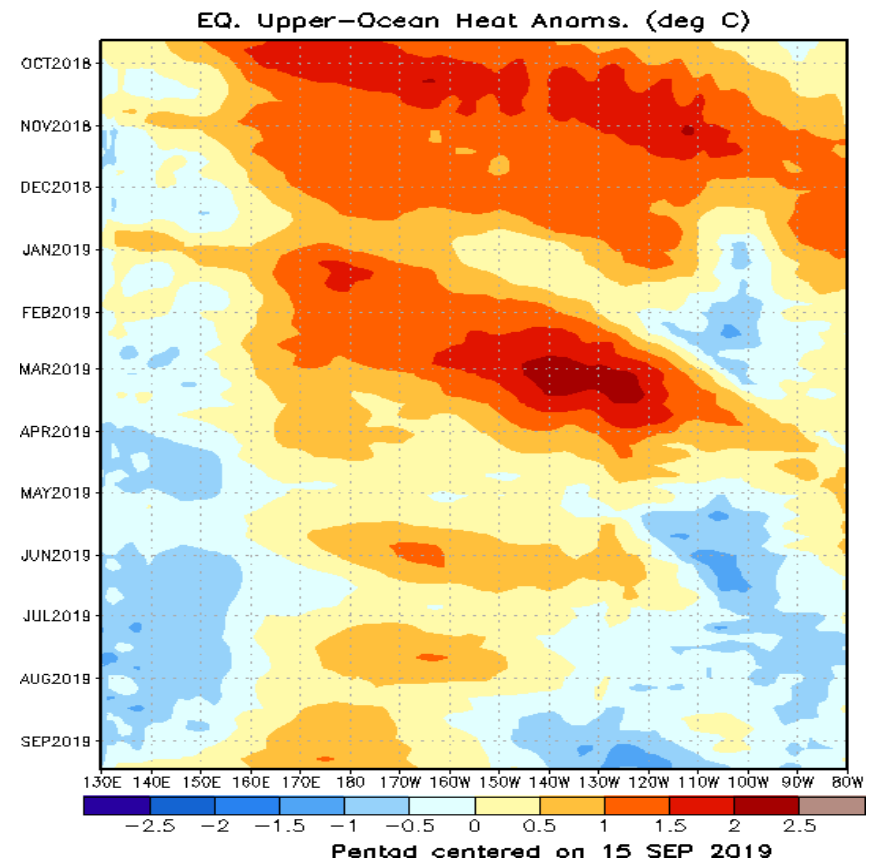
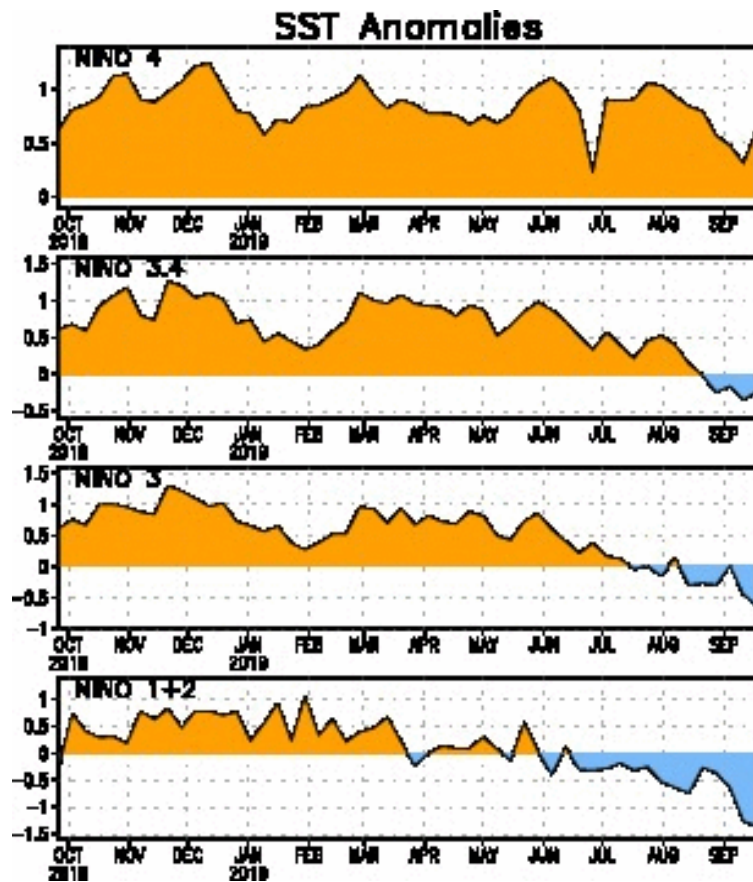
Outgoing Longwave Radiation (OLR) Anomalies

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



- The Northern Hemisphere pattern has been dominated by Kelvin and Rossby wave (tropical cyclone) activity.
- Although not analyzed by the filtering algorithms, the shift from negative to positive OLR anomalies near the Date Line, corresponding with an increase in negative anomalies over the East Pacific, may be related to organizing MJO activity (dashed line).

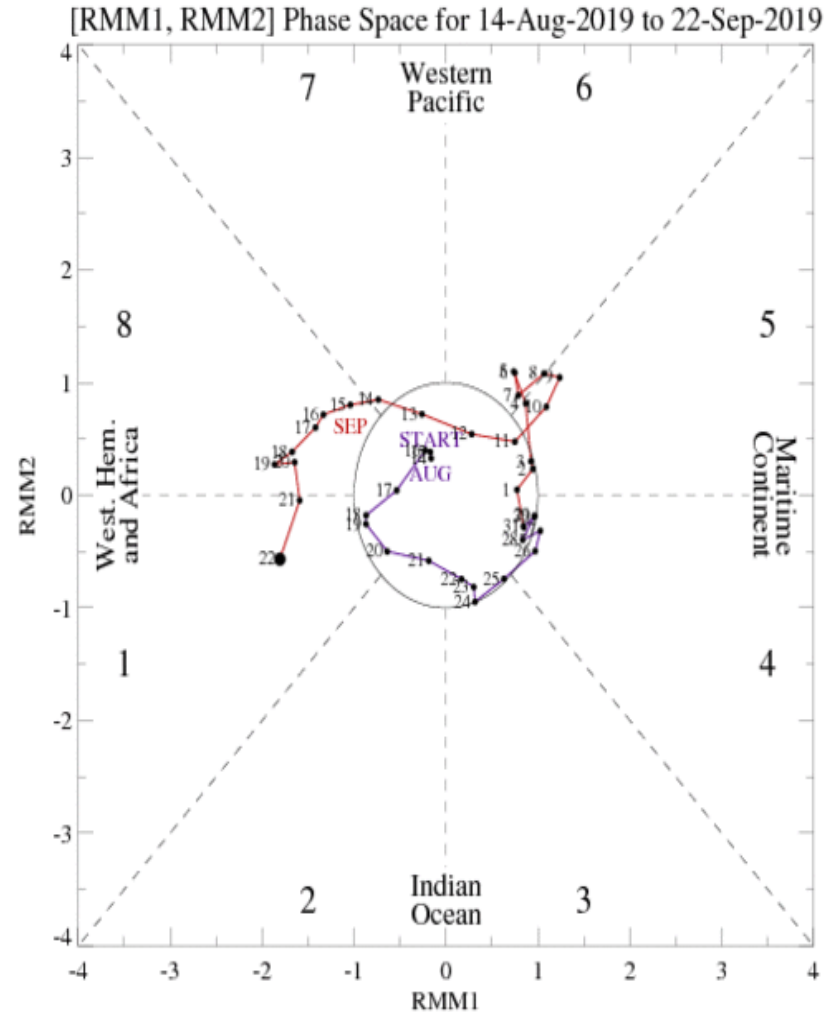
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Negative anomalies associated with the upwelling phase of an oceanic Kelvin wave increased over the East Pacific, resulting in a negative Niño 3.4 index for the first time in over a year.
- Upper-oceanic heat content remains above-average over the west-central Pacific.
- A recent strong westerly wind burst over the central Pacific may help initiate a new downwelling Kelvin wave event.

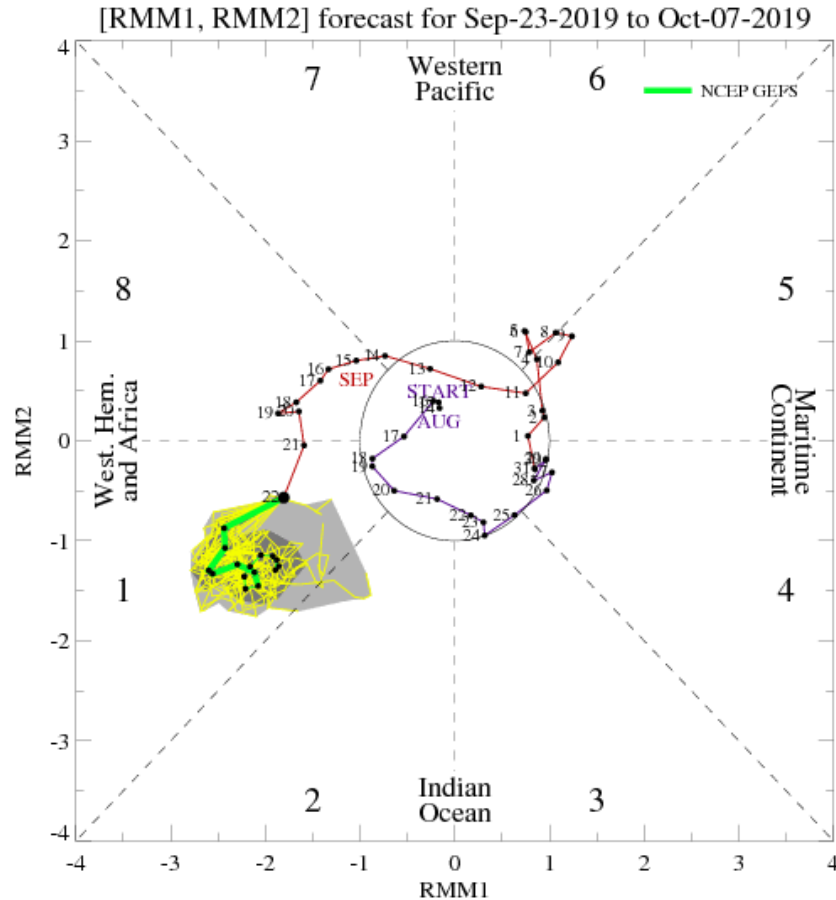
MJO Index: Recent Evolution

- The RMM index reflects the recent increase in coherent subseasonal activity, with the enhanced convective phase of the MJO moving across the Western Hemisphere.

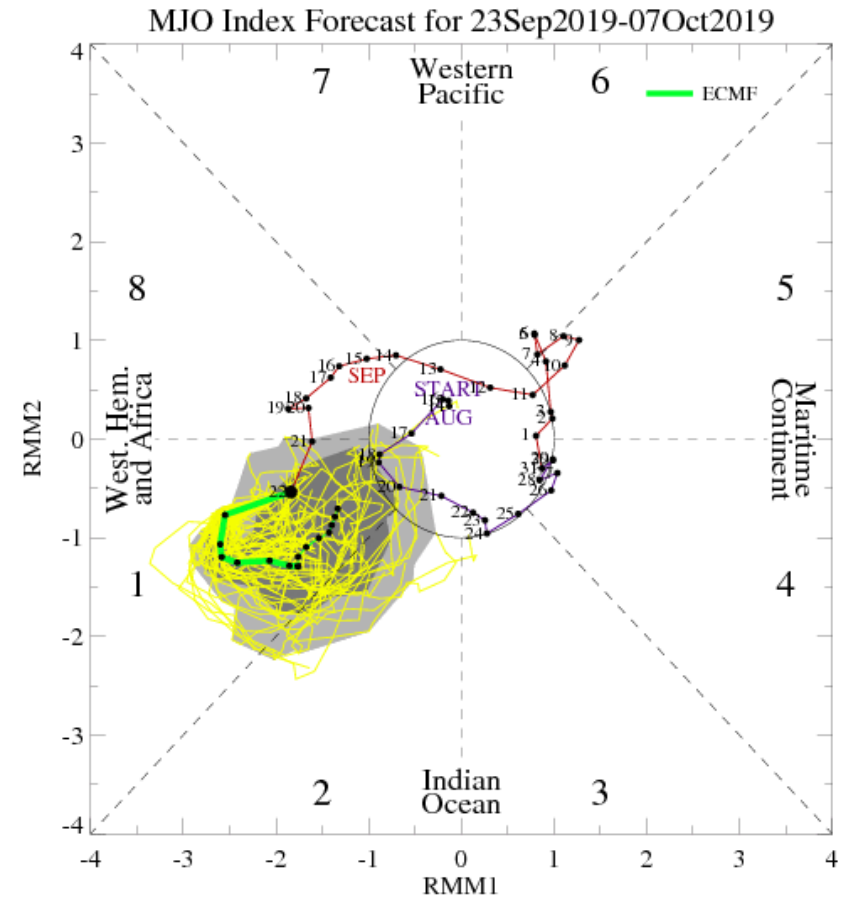


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



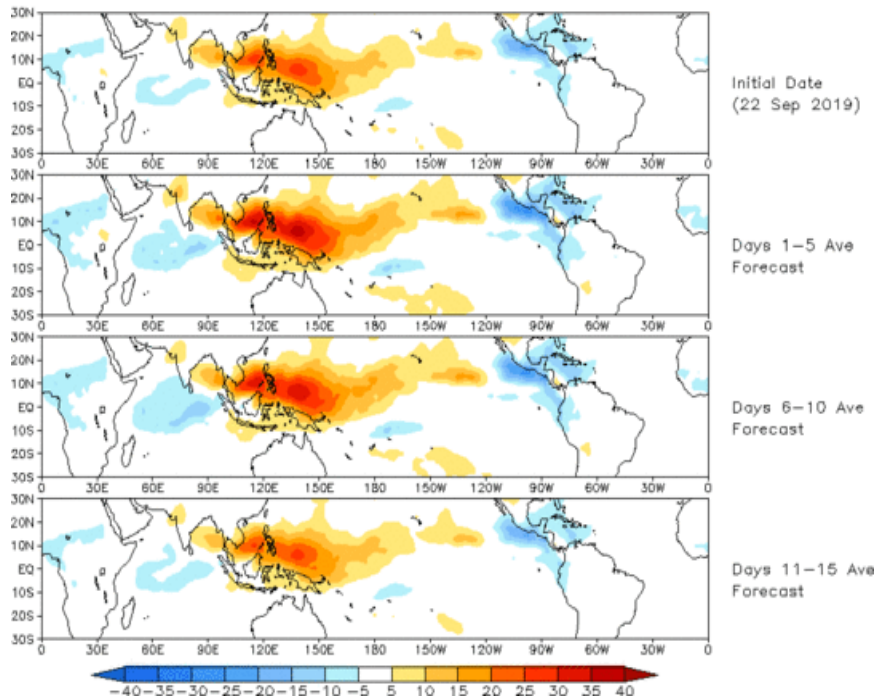
ECMWF Forecast

- Most GEFS and ECMWF ensemble members do not show robust eastward propagation of the signal to the Indian Ocean over the next two weeks.
- Other modes, including Rossby wave or tropical cyclone activity, may be interfering with the RMM index projections in the model forecasts.

MJO: GEFS Forecast Evolution

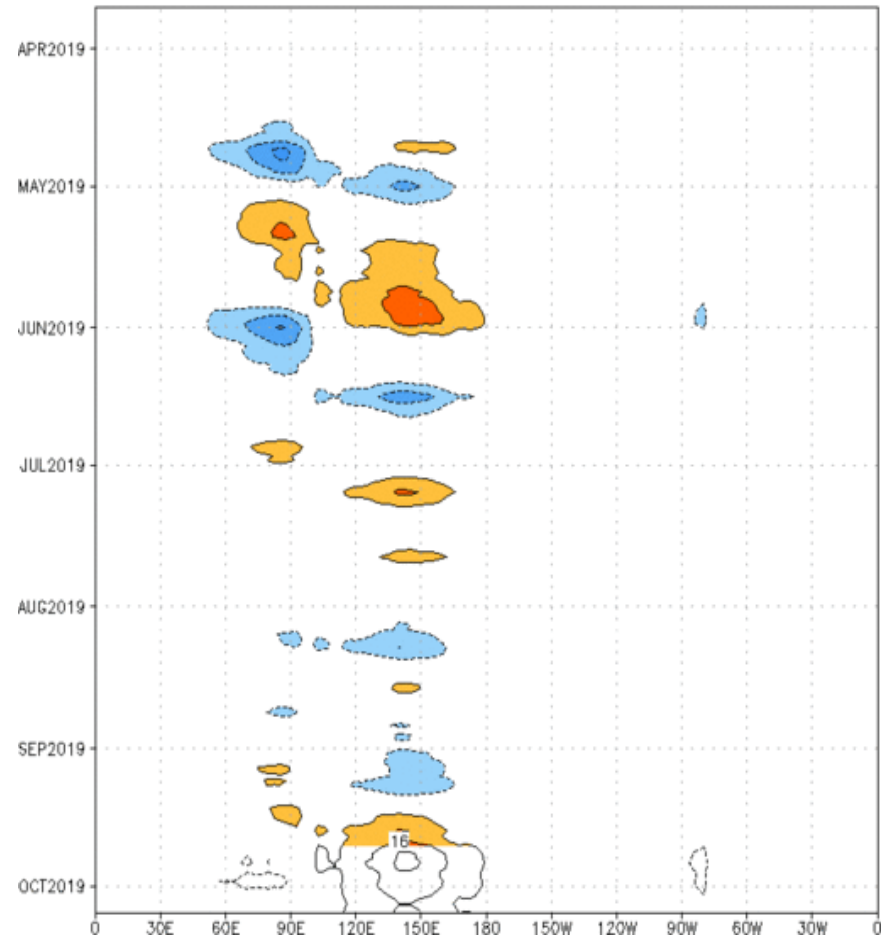
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 22 Sep 2019
OLR



- OLR anomalies based on the GEFS RMM index forecast reflect a fairly stationary pattern favoring Western Hemisphere convective enhancement and suppression over the Maritime Continent and West Pacific.

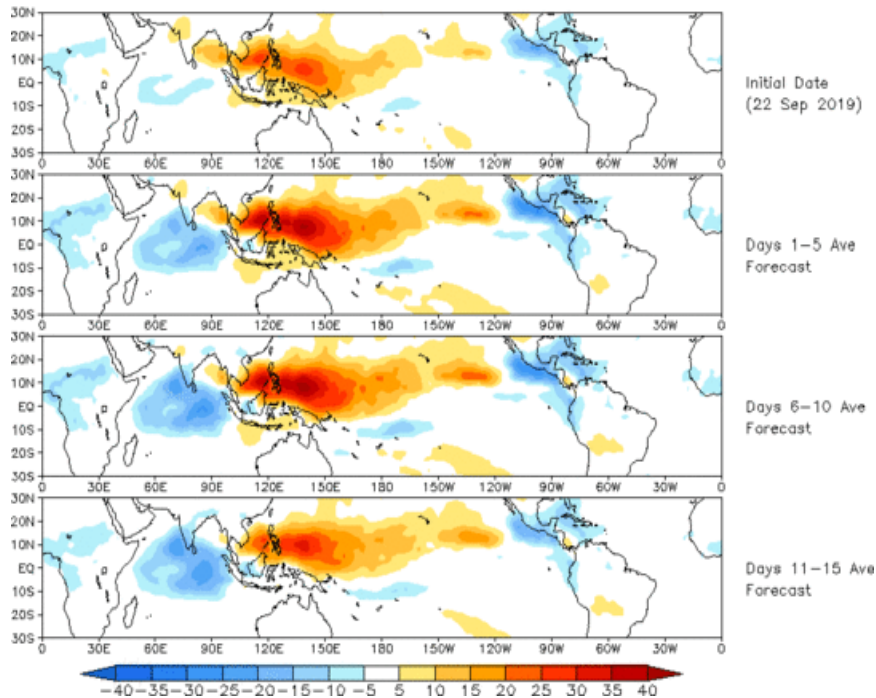
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cint:4Wm^{-2}) Period:23-Mar-2019 to 22-Sep-2019
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



MJO: Constructed Analog Forecast Evolution

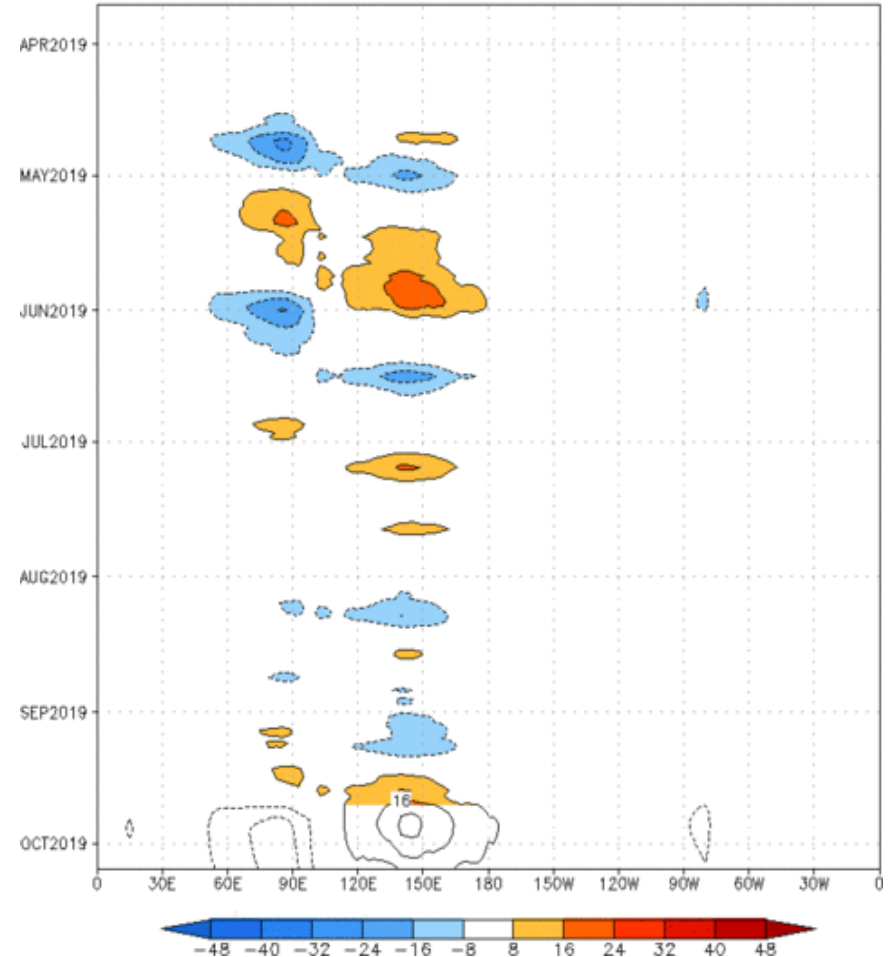
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (22 Sep 2019)



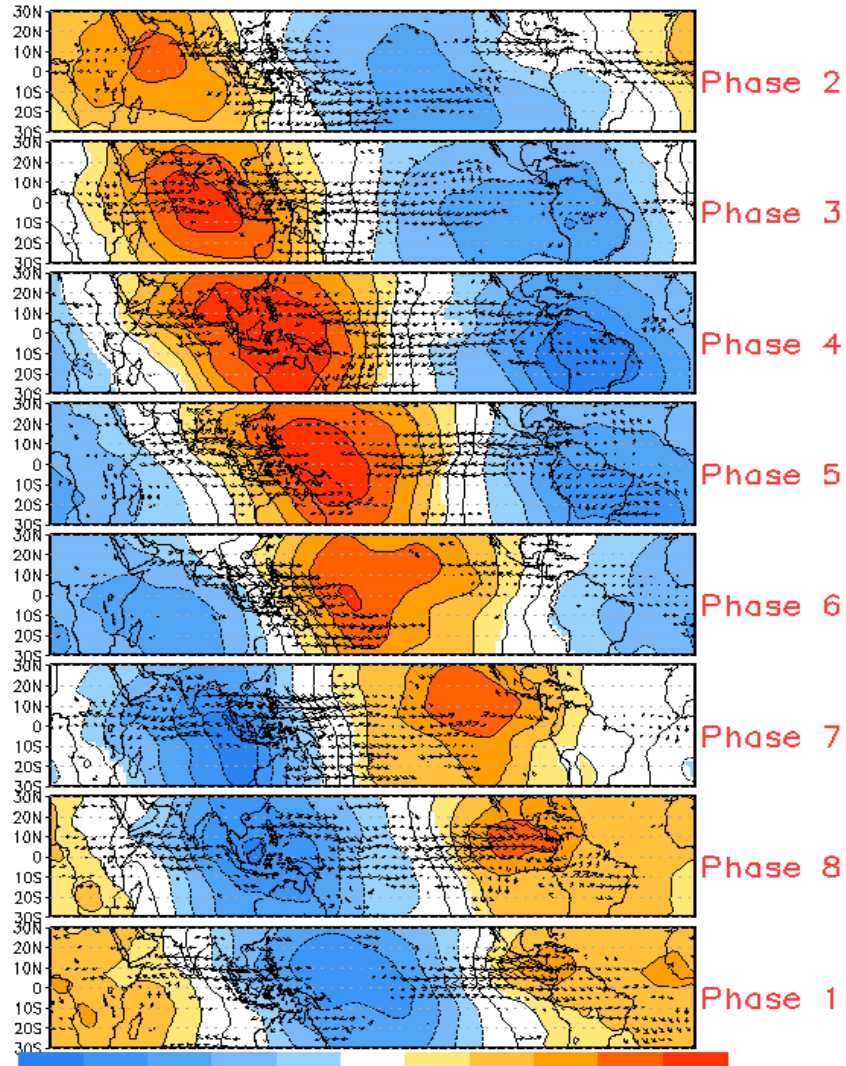
- The constructed analog solution shows a similarly slow evolution to the GEFS and ECMWF, but with greater amplitude.
- The greater amplitude in the statistical tool is primarily seen in the enhanced negative OLR anomalies over the Indian Ocean.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:23-Mar-2019 to 22-Sep-2019
The unfilled contours are CA forecast reconstructed anomaly for 15 days

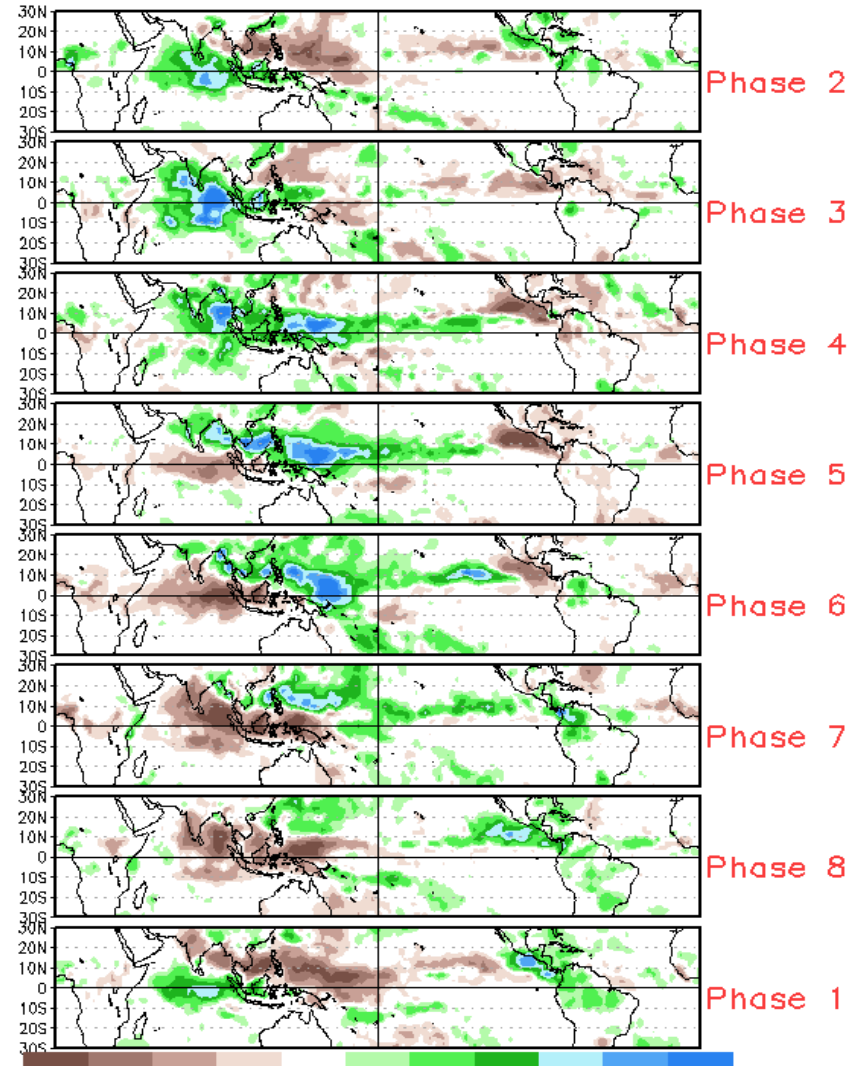


MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



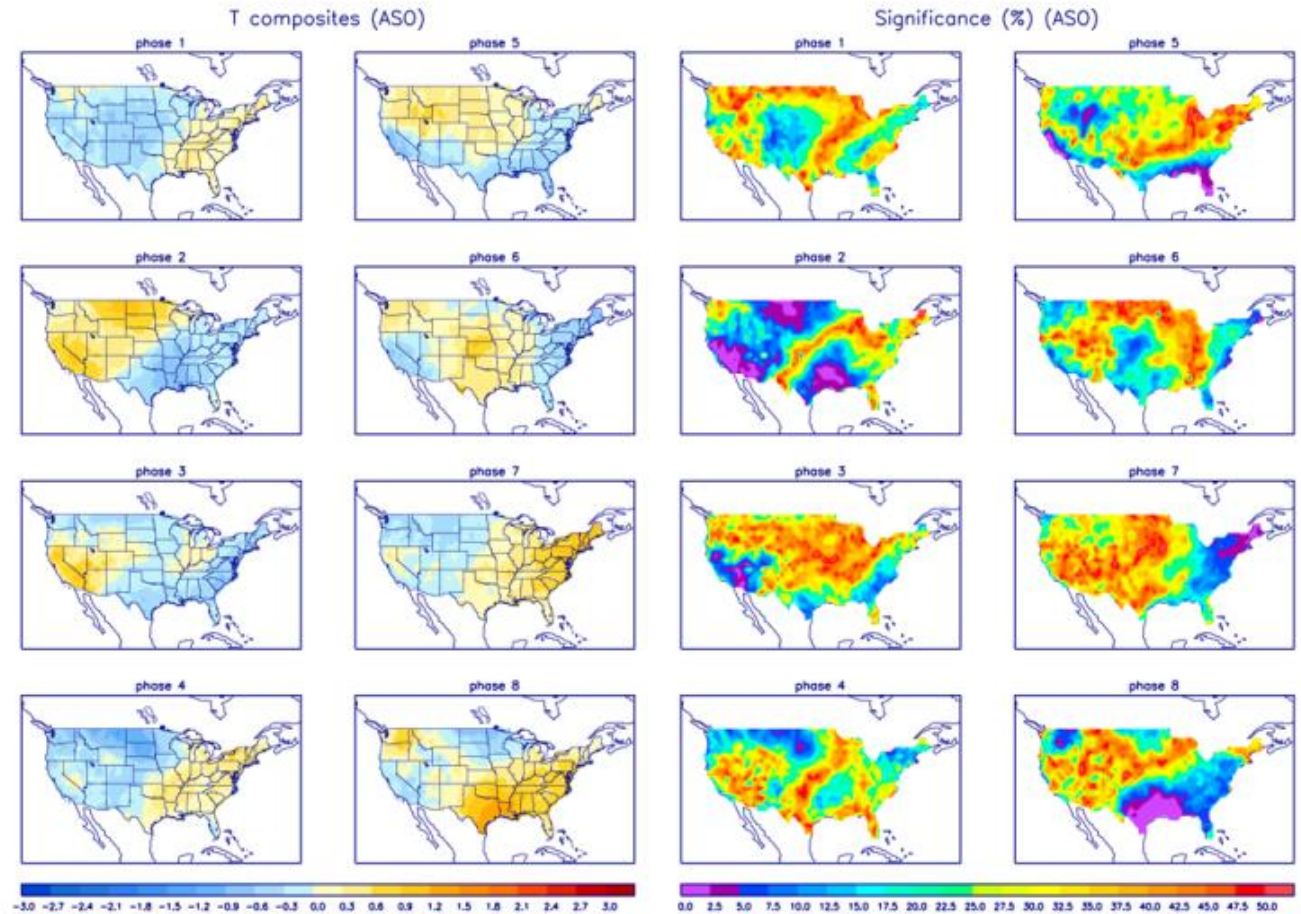
Precipitation Anomalies



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.

