

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



Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
19 August 2019

Overview

- The MJO has remained incoherent during the past week, with what remains of its active envelope currently near the Prime Meridian.
- Model guidance suggests the remnants of the MJO could see some marginal strengthening over the next two weeks while it shifts over the Indian Ocean, although the bulk of guidance keeps the feature relatively weak.
- Tropical cyclone activity is anticipated to remain active over the Pacific in Week-1, before the East Pacific quiets down during Week-2. While large-scale conditions have been generally detrimental for tropical cyclone formation chances over the Atlantic, the MJO crossing the Indian Ocean would support increased potential any disturbances across the tropical Atlantic to become tropical cyclones over at least the next 10 days or so.

A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:

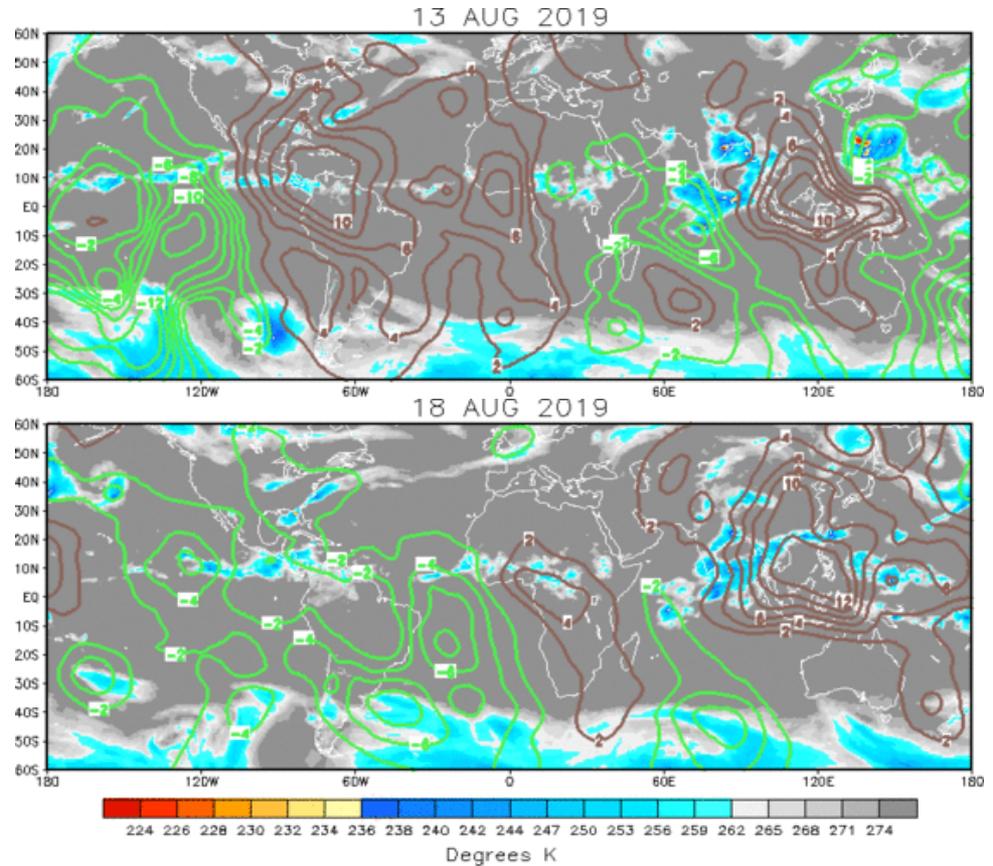
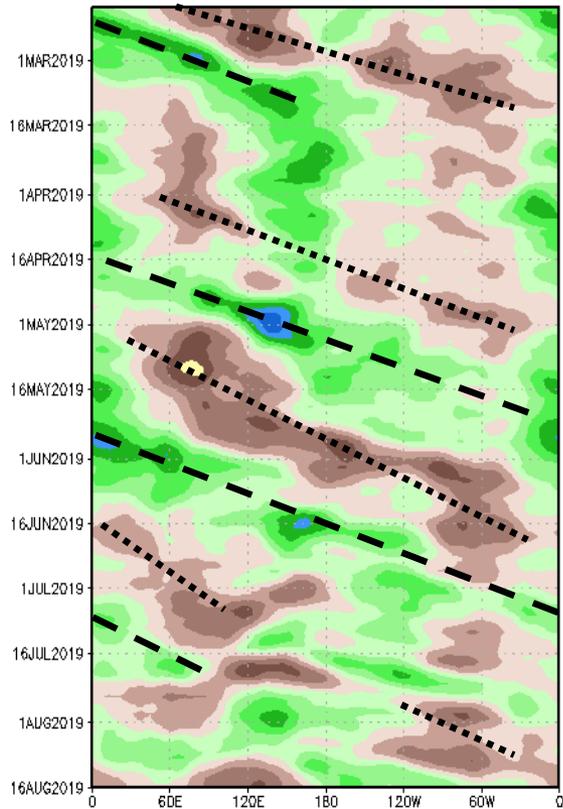
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

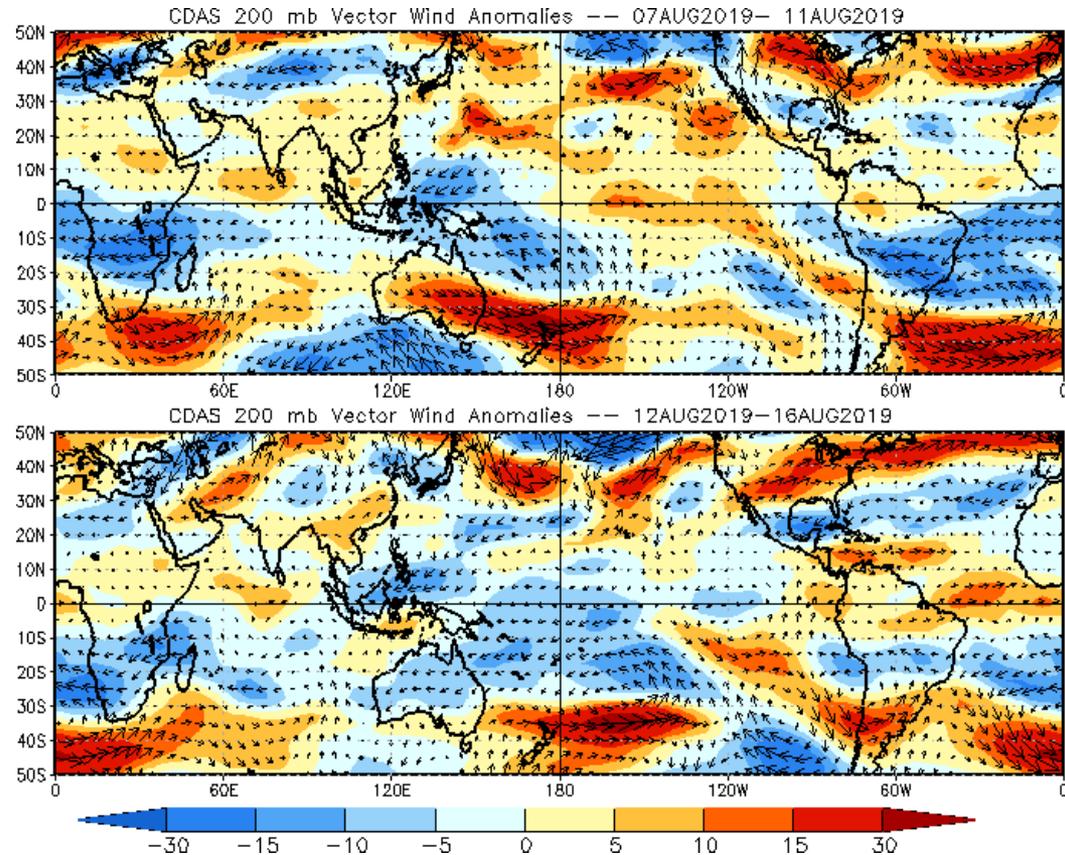
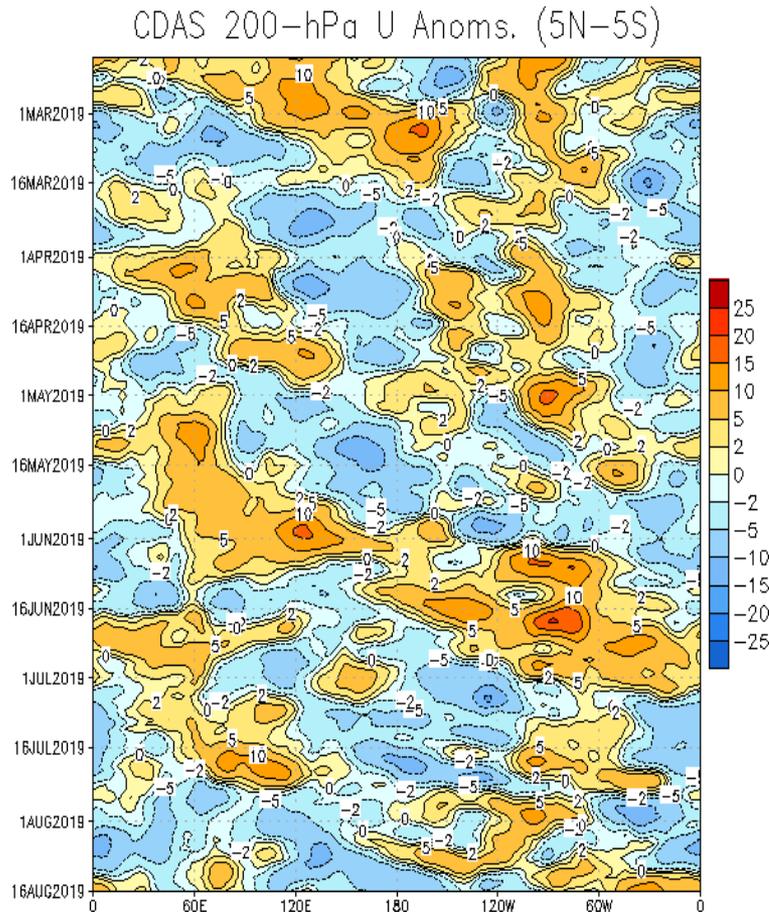
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- Following two months of robust MJO activity, the intraseasonal signal has been less well defined in August due to Rossby wave interference.
- The upper-level velocity potential field has a fairly wavenumber-1 appearance, supporting the active phase of the MJO being situated over the Western Hemisphere during the past week.

200-hPa Wind Anomalies

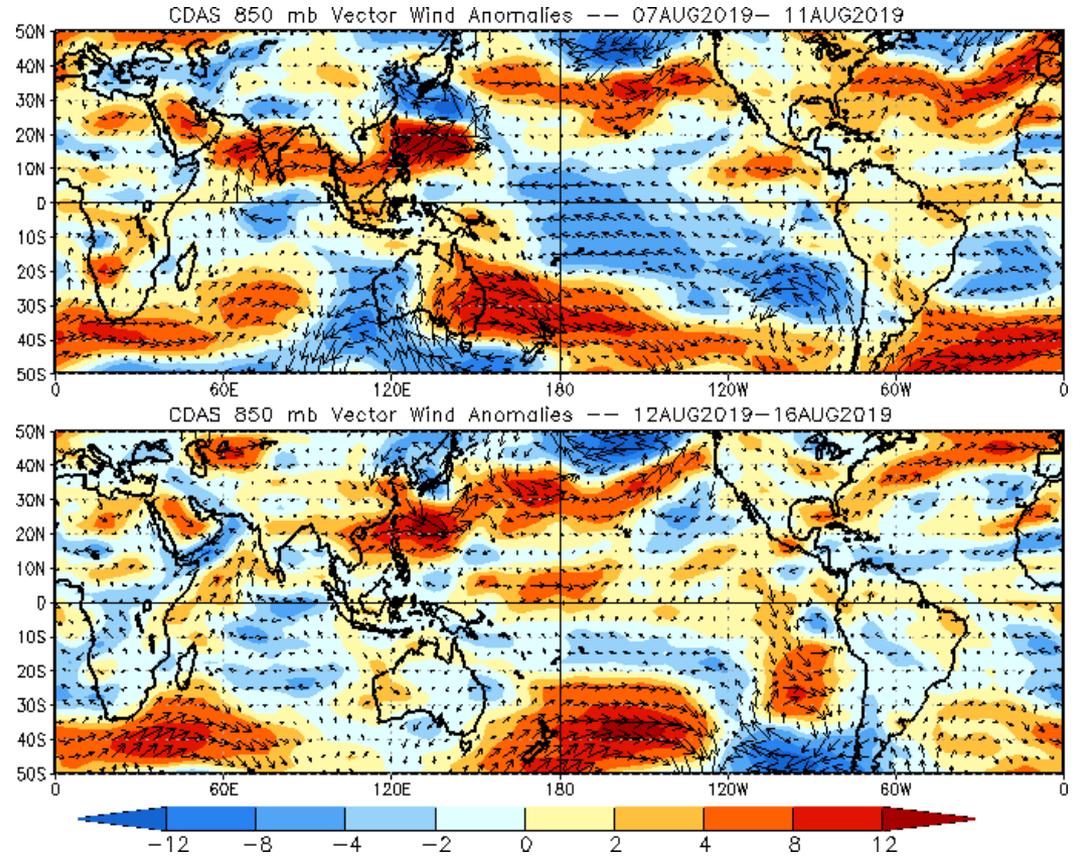
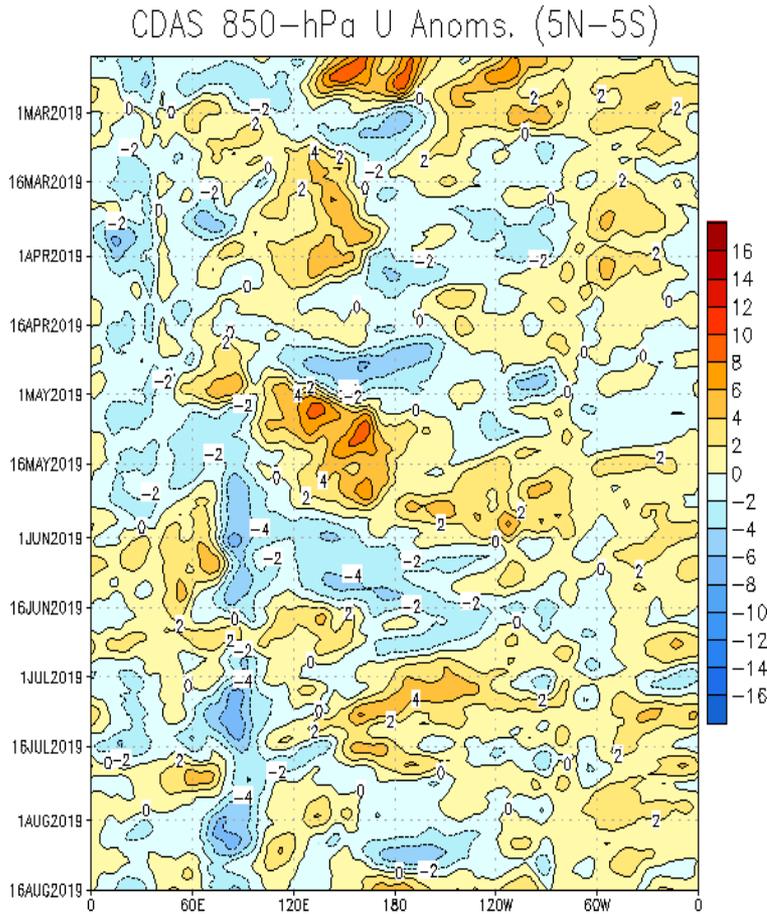
Shading denotes the zonal wind anomaly. **Blue shades: Anomalous easterlies.** **Red shades: Anomalous westerlies.**



- Anomalous westerlies over the tropical Pacific east of the antimeridian shifted to easterlies by mid-month.
- Anomalous westerlies recently strengthened across the tropical Atlantic, further cementing conditions that have been generally unfavorable for tropical cyclone development across the main development region.
- Anomalous easterlies have been shifting eastward across the Pacific in recent weeks, and are associated with the uptick in East Pacific tropical cyclone activity. If/when these easterlies reach the Atlantic, it is likely to increase odds for tropical cyclone formation over the tropical Atlantic.

850-hPa Wind Anomalies

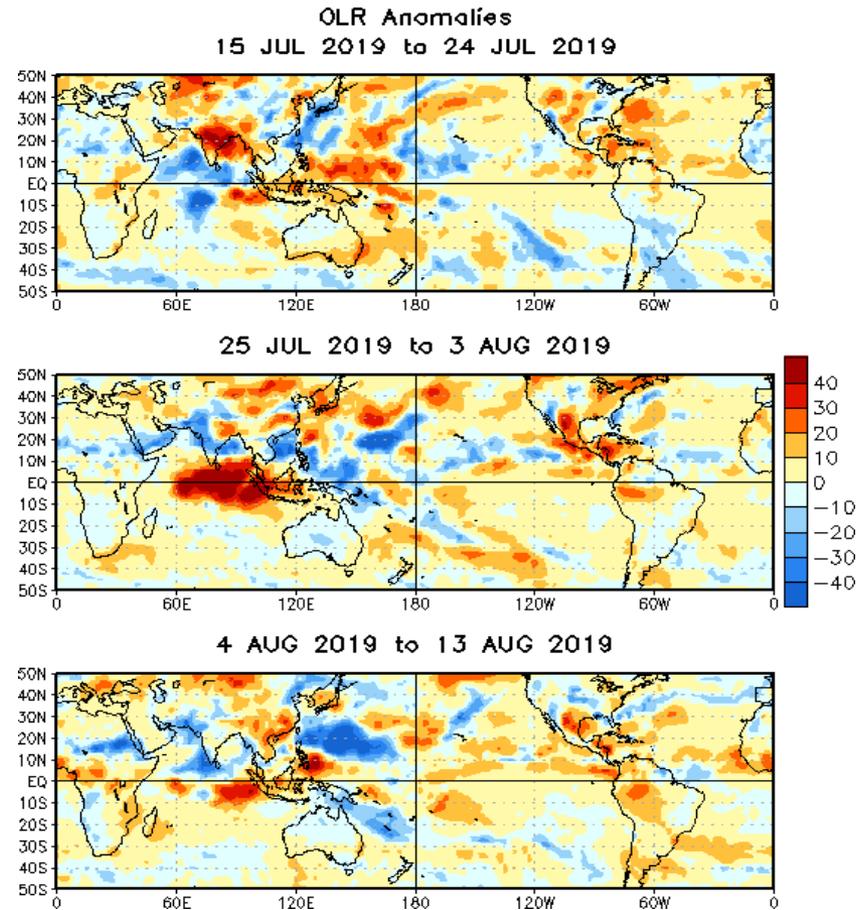
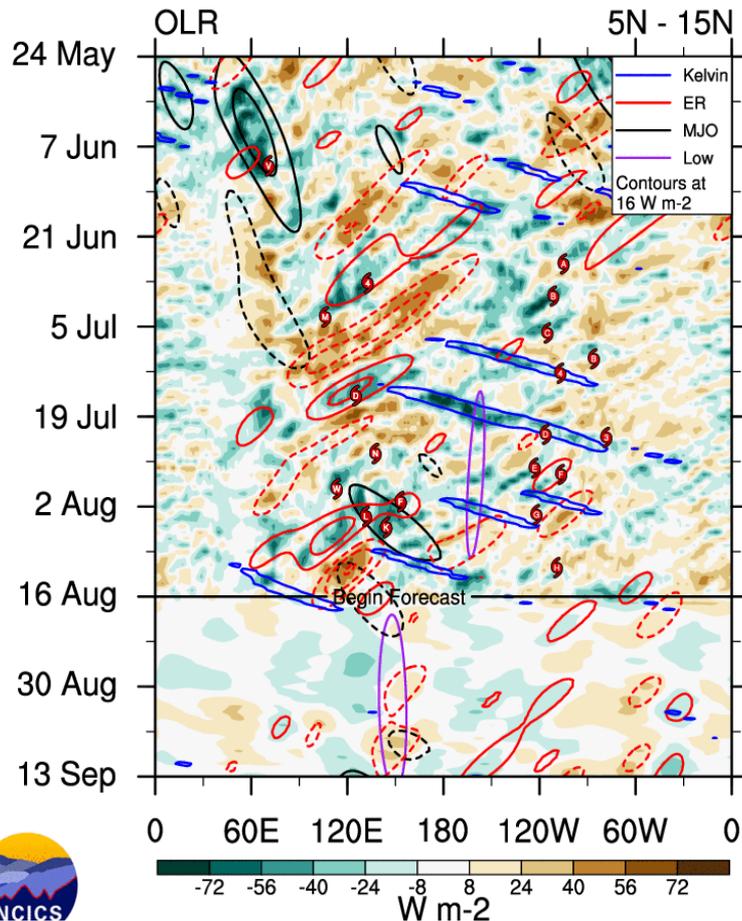
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- The early month surge in the trades across the Pacific was replaced by anomalous westerlies during mid-August.
- Cross-equatorial flow weakened across the western Indian Ocean, limiting moisture availability for the Summer monsoon.

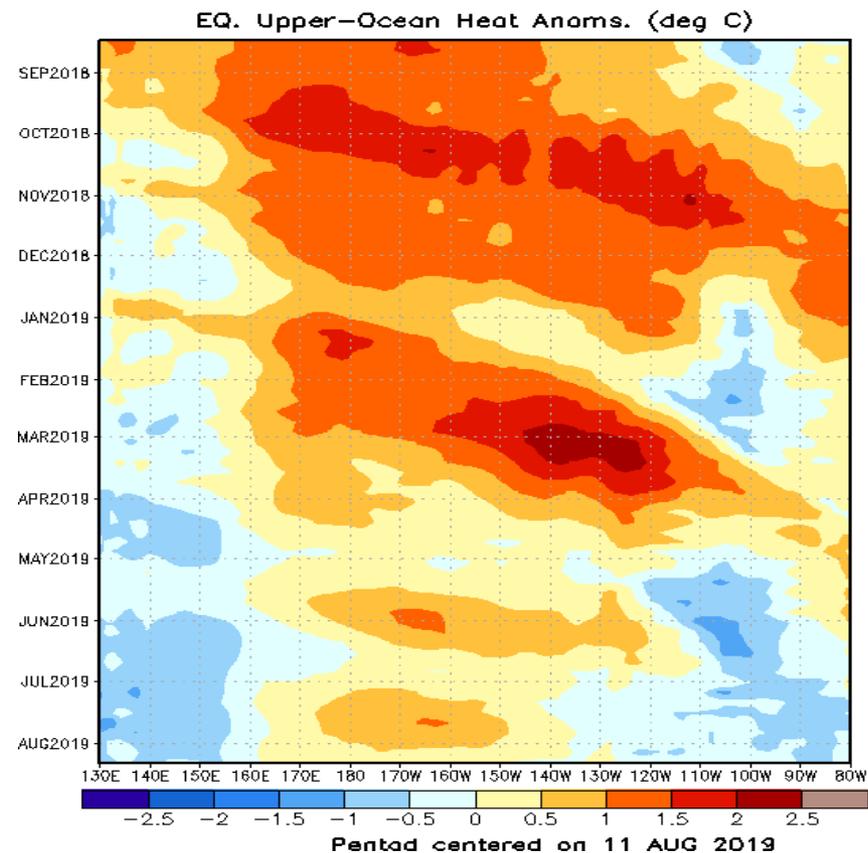
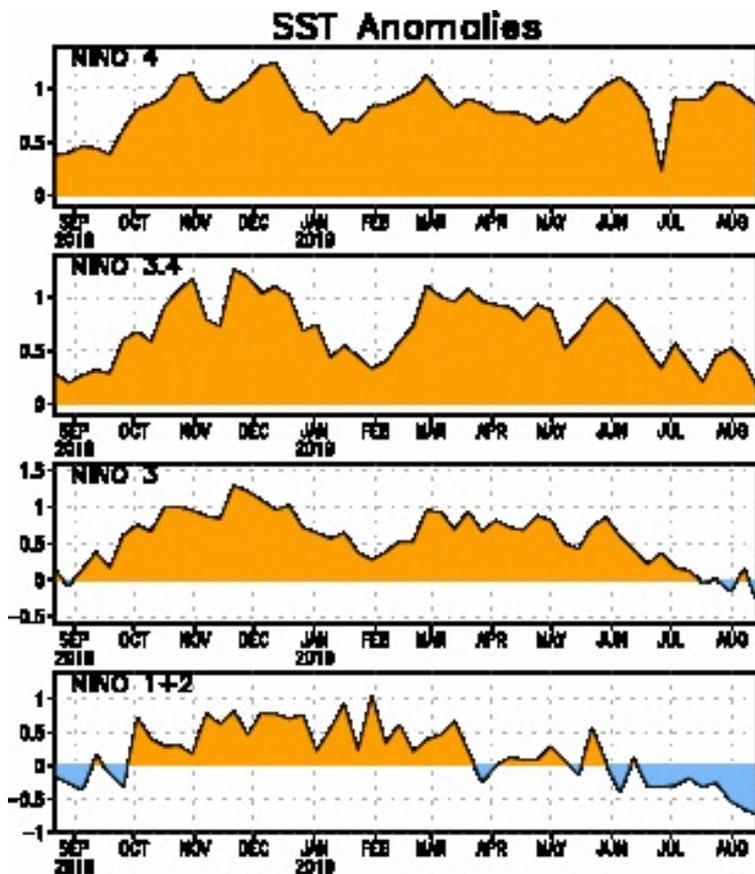
Outgoing Longwave Radiation (OLR) Anomalies

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



- Alternative active/inactive phases of equatorial Rossby wave activity has been persistent across the West Pacific since June.
- More recently, Kelvin wave activity was apparent over the Indian Ocean in addition to a pair of features over the Western Hemisphere.
- The former Kelvin wave is responsible for helping to break down the anomalous dryness over the northern Indian Ocean tied to the suppressed phase of an equatorial Rossby wave.

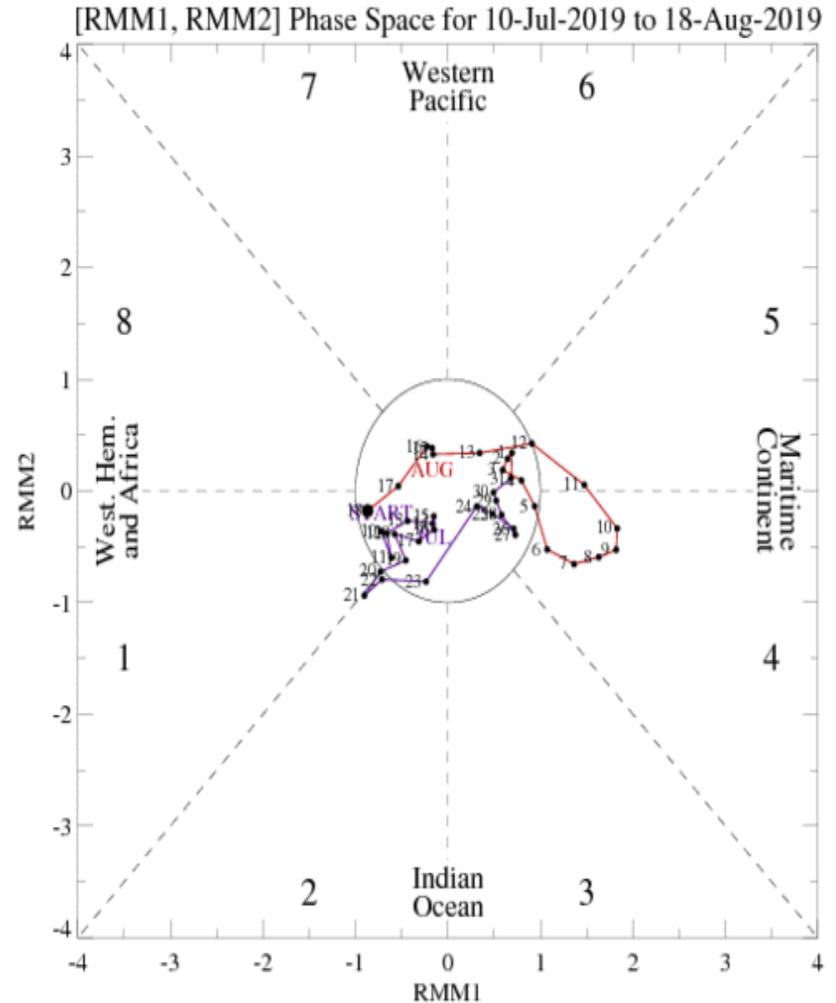
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Equatorial SST anomalies and near-surface heat anomalies continue their slow decline as the transition to neutral ENSO conditions progresses.
- Alternating downwelling (warming) and upwelling (cooling) events tied to Oceanic Kelvin wave activity are apparent in the upper-ocean heat anomalies, with four of each being apparent during the past year.

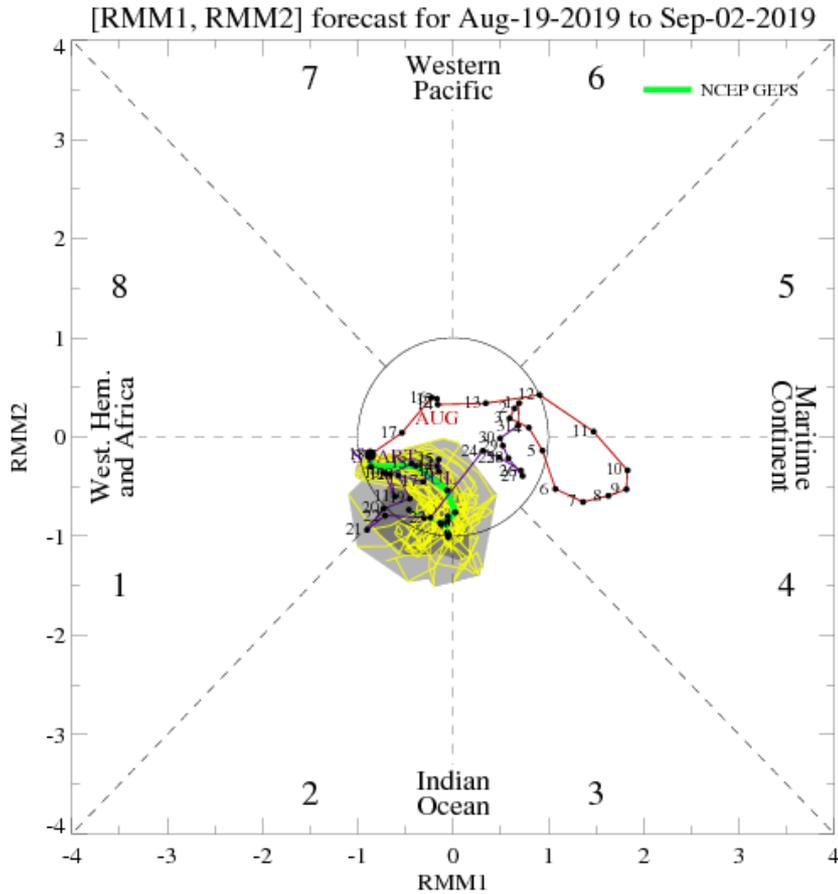
MJO Index: Recent Evolution

- The projection of the intraseasonal signal in RMM space remains weak. What little remains of the active MJO envelope is likely over the Western Hemisphere.

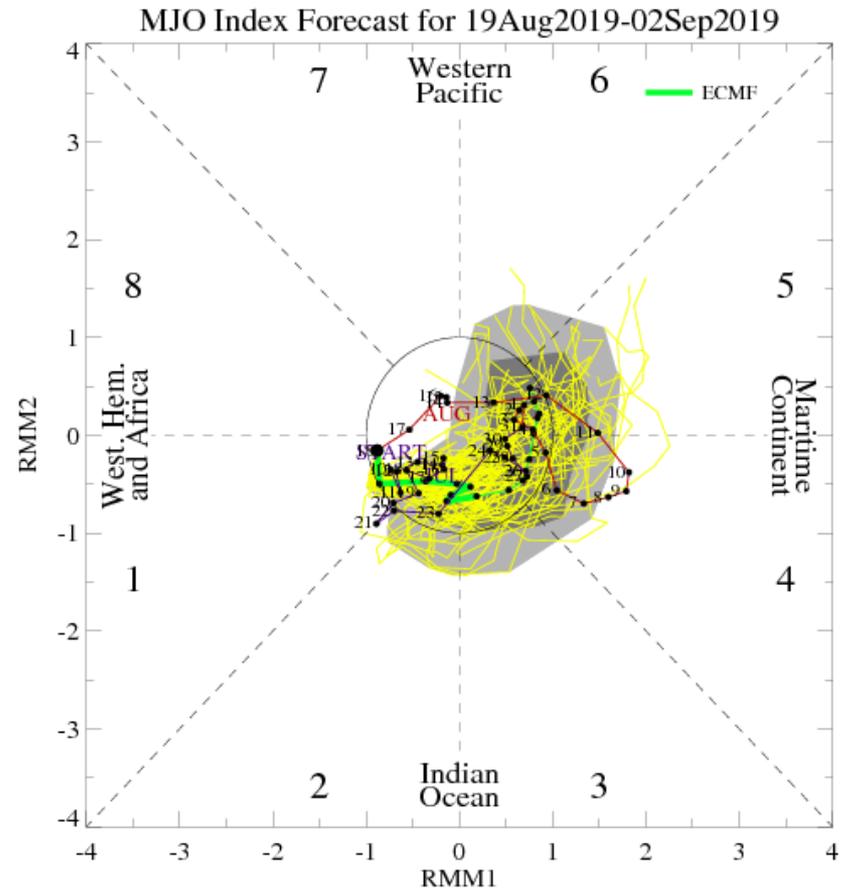


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



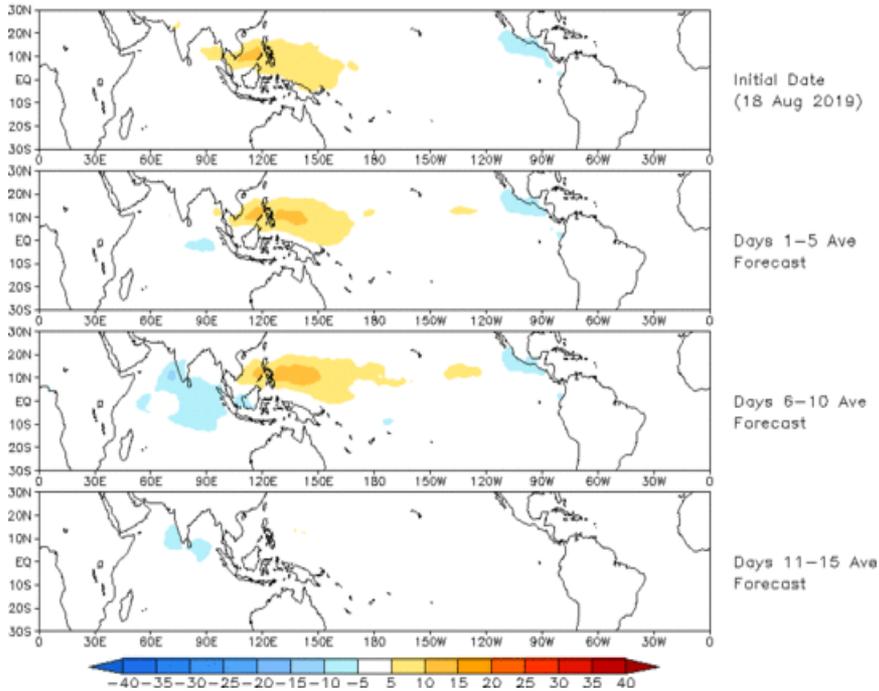
ECMWF Forecast

- Both the GEFS and ECMWF bring the active MJO envelope eastward over the next week, with some signs of strengthening possible.
- The GEFS is far slower and lingers the signal over the Indian Ocean, whereas ECMWF guidance rapidly pushes the signal across the Maritime Continent at a phase speed more characteristic of a Kelvin wave.

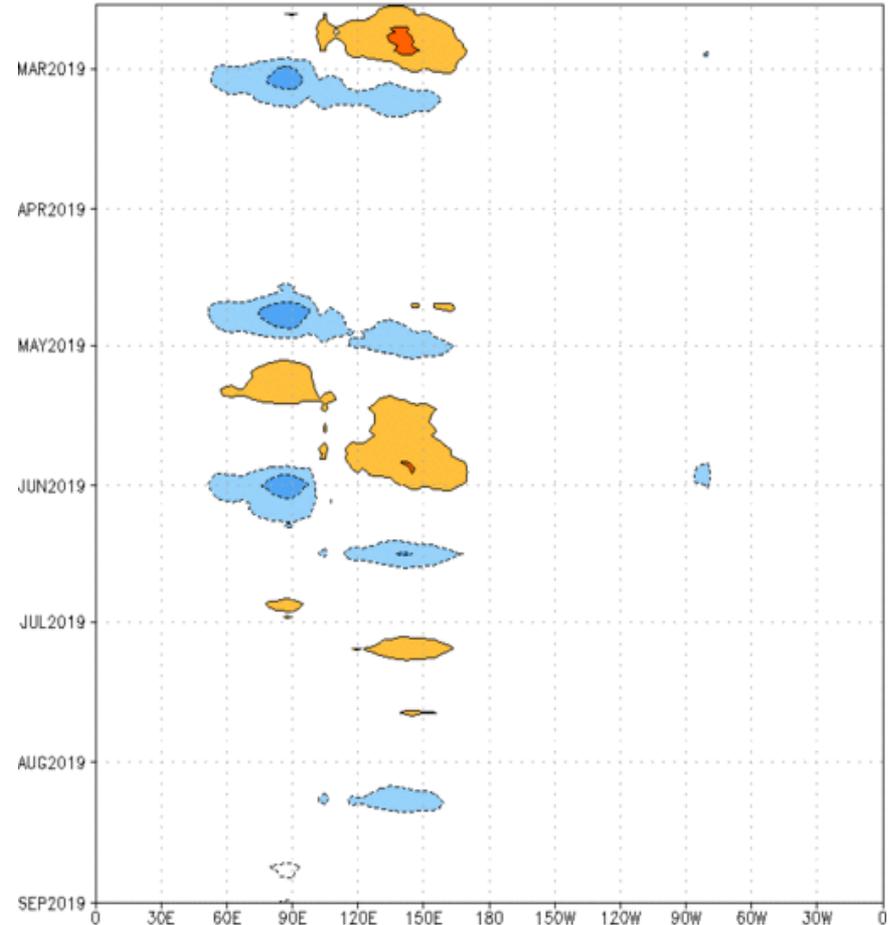
MJO: GEFS Forecast Evolution

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: 18 Aug 2019
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [$7.5^{\circ}S, 7.5^{\circ}N$] (cont: $4Wm^{-2}$) Period: 15-Feb-2019 to 17-Aug-2019
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

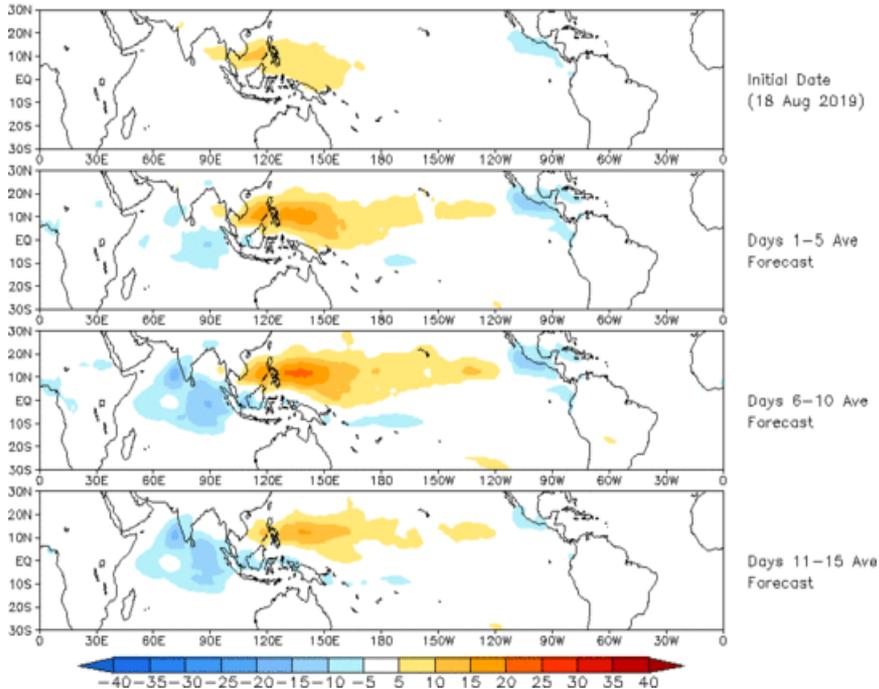


- The spatial depiction of OLR anomalies based on the GEFS RMM index shows slow amplification and eastward propagation of the active and suppressed MJO signal over the next 10 days.

MJO: Constructed Analog Forecast Evolution

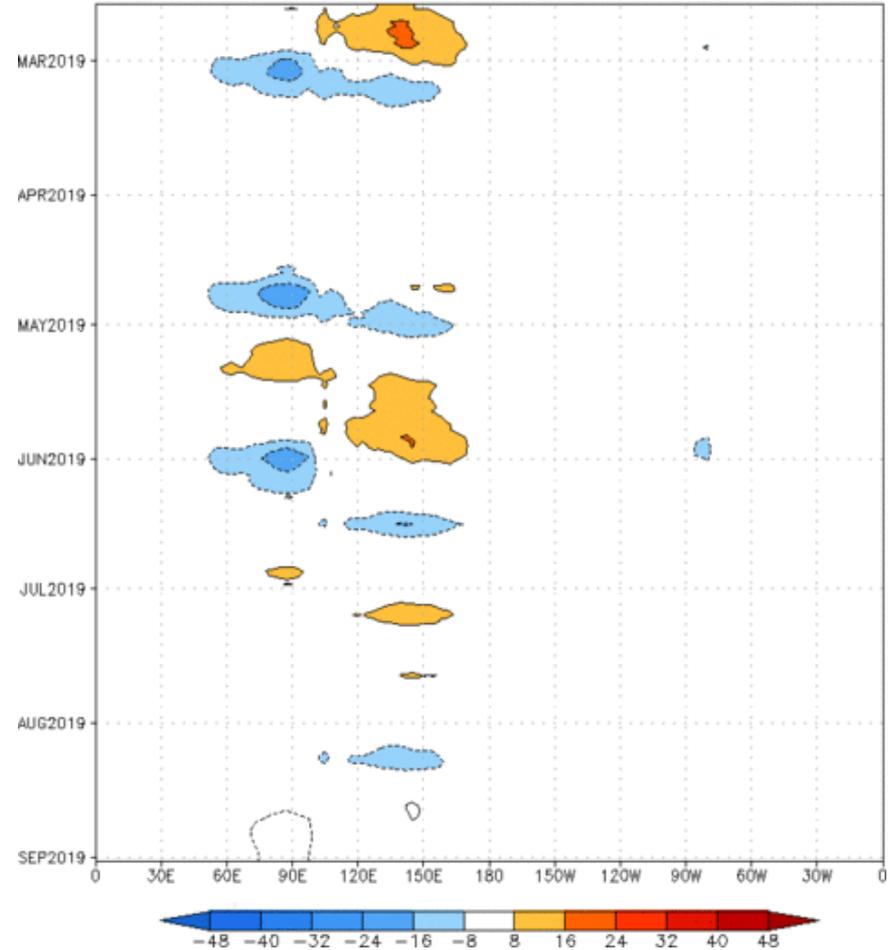
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (18 Aug 2019)



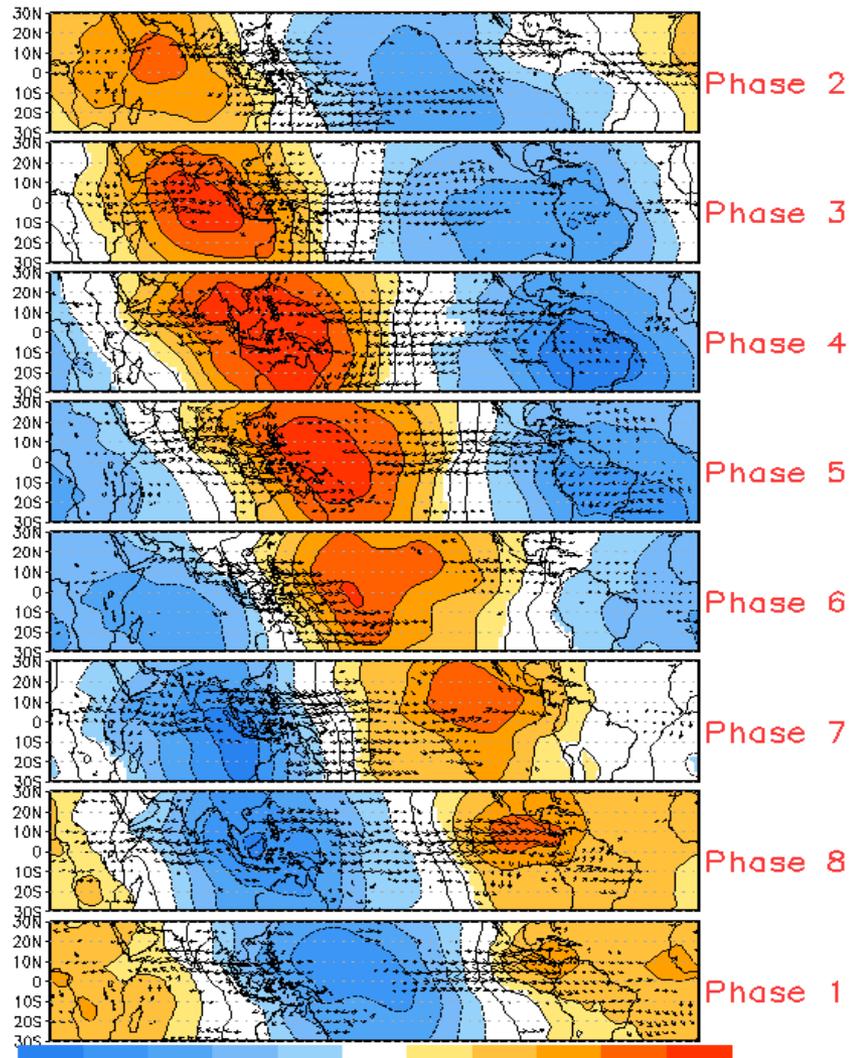
- The constructed analog MJO forecast shows a relatively stagnant pattern with little sign of eastward propagation or change of intensity.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:16-Feb-2019 to 18-Aug-2019
The unfilled contours are CA forecast reconstructed anomaly for 15 days

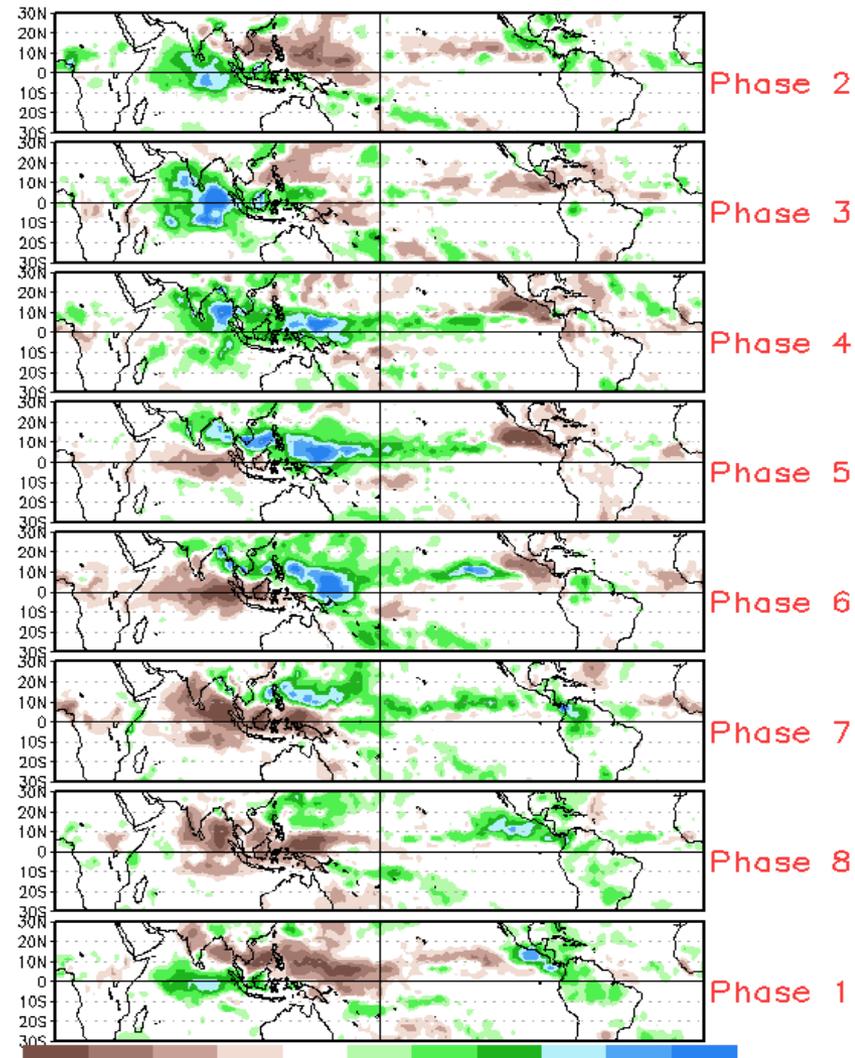


MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



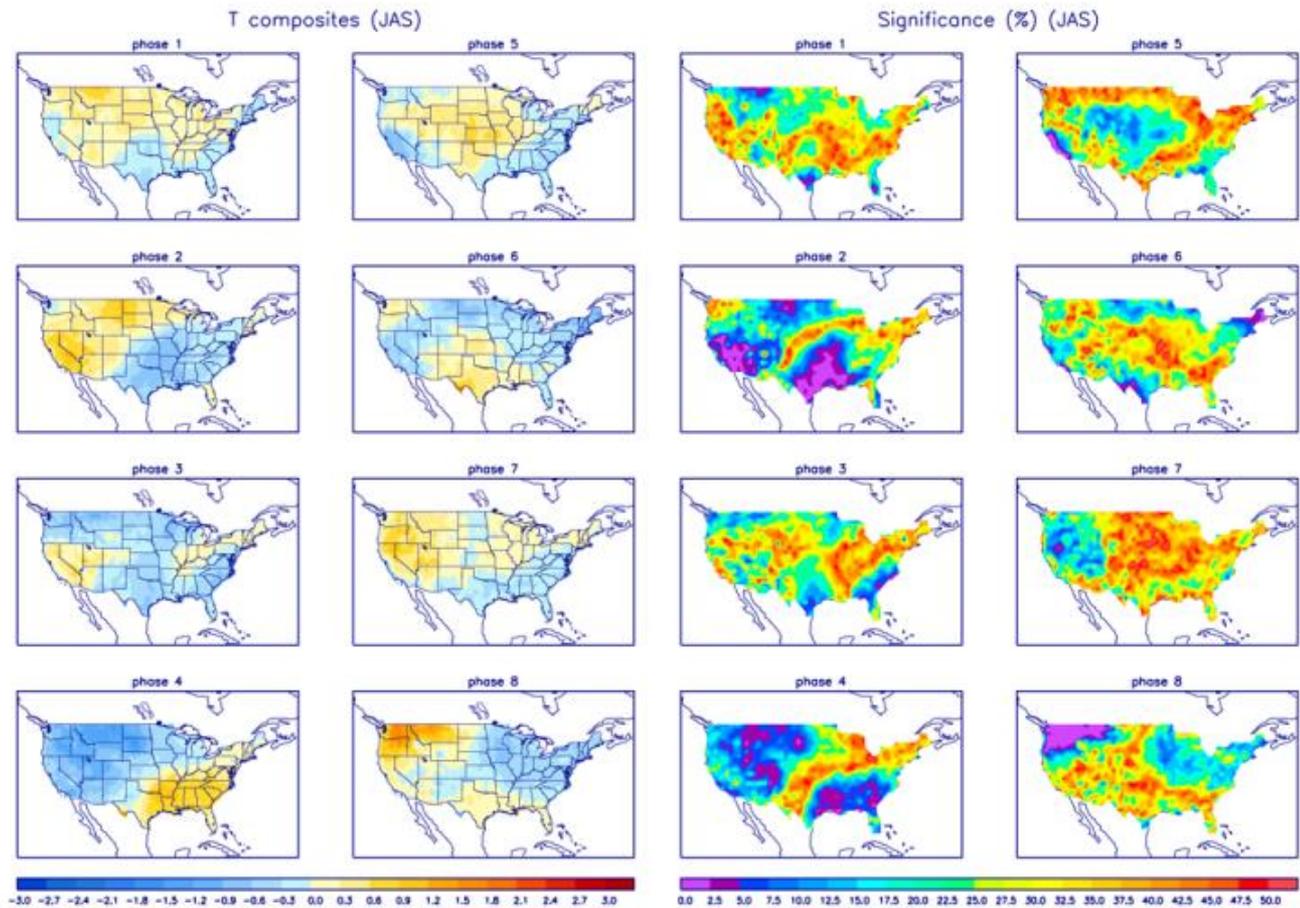
Precipitation Anomalies



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.

