

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
16 August 2021

Overview

- The RMM index and CPC velocity potential index both depict an active MJO during early August with the enhanced phase propagating eastward over the Western Hemisphere.
- Rossby wave activity is becoming increasingly apparent in the wind and OLR fields, and will interfere with the MJO during the next two weeks.
- Dynamical model MJO index forecasts favor the MJO to decrease in amplitude as it propagates east over the Indian Ocean.
- The MJO is expected to maintain a favorable large-scale environment for tropical cyclone development across the tropical Atlantic during week-1.

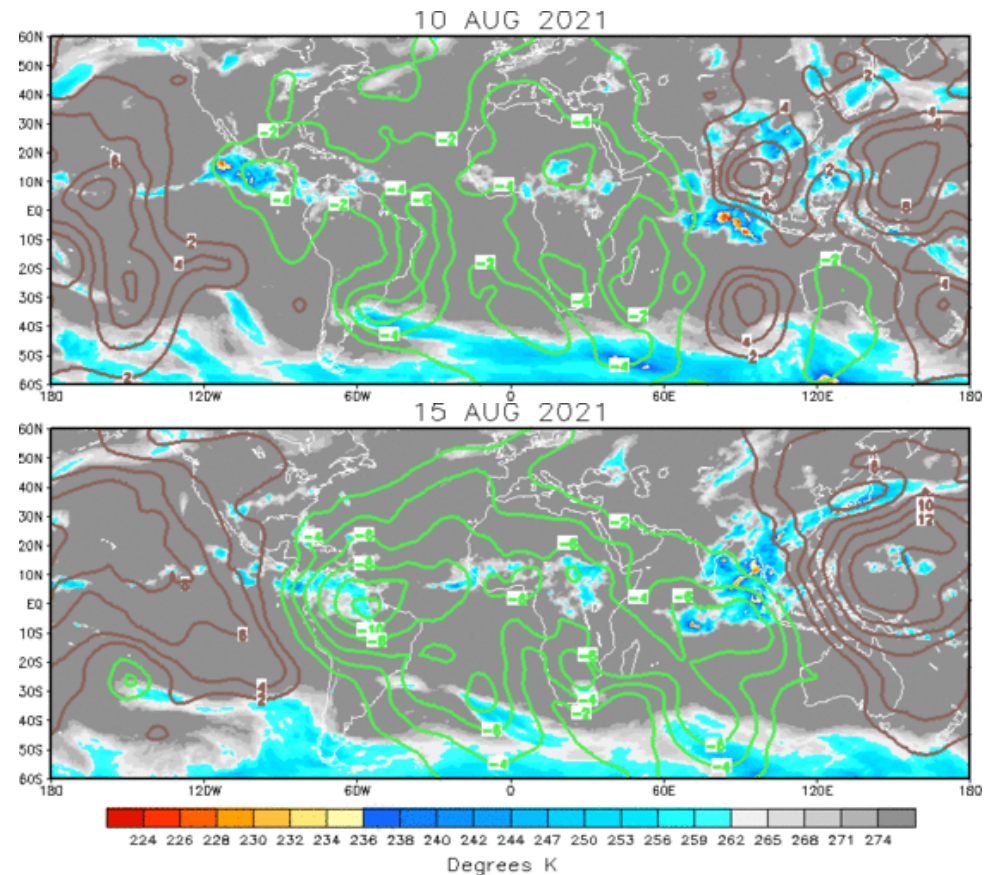
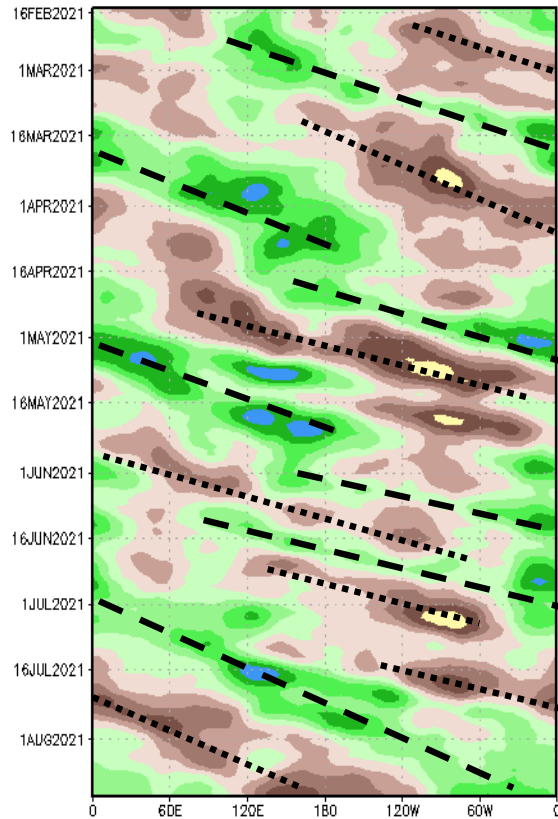
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

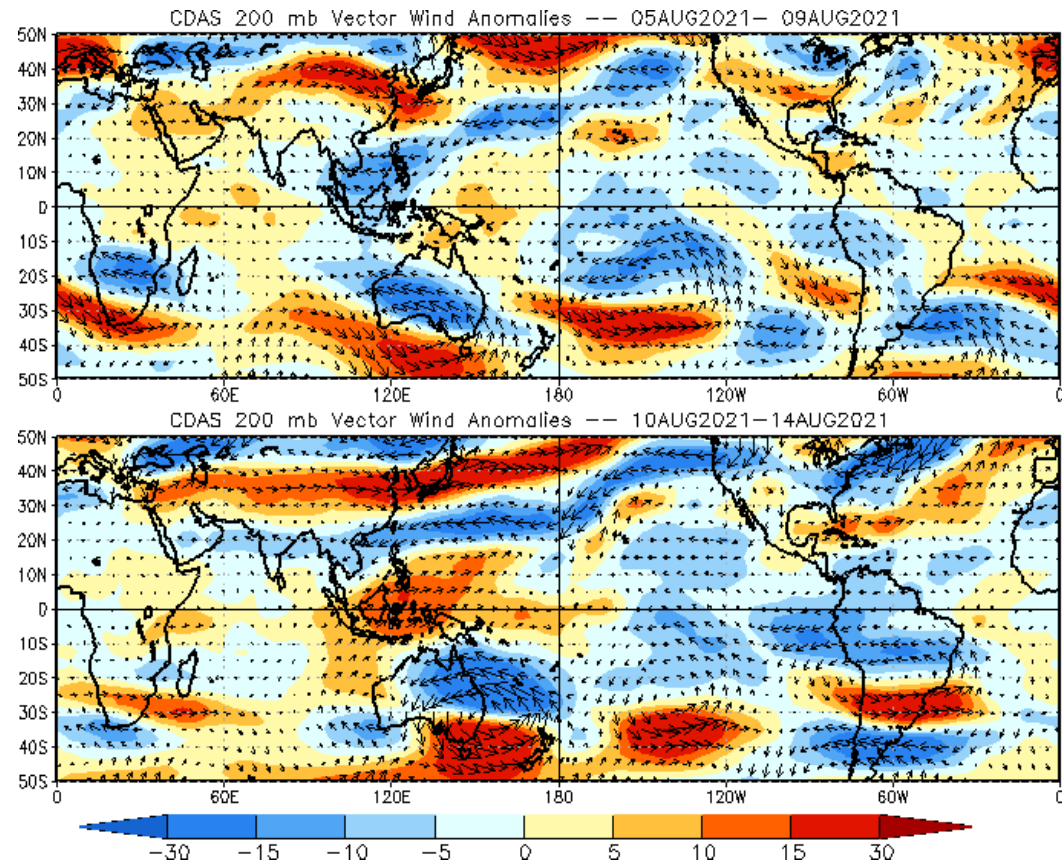
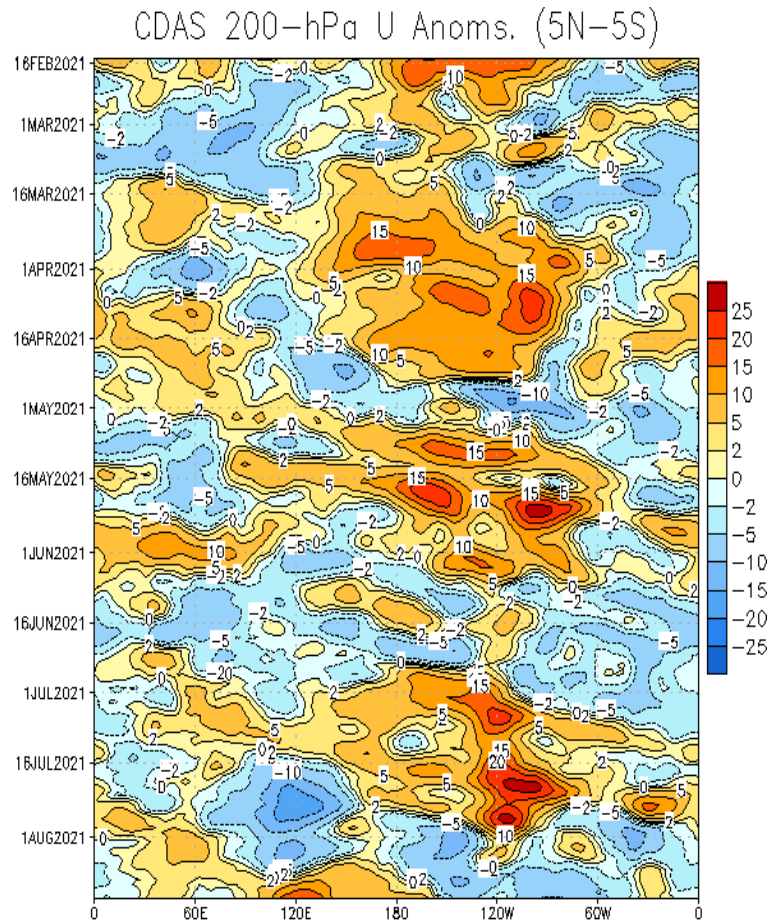
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- A robust intraseasonal signal was apparent in the upper-level velocity potential field during early August, with the enhanced convective phase now over the Western Hemisphere.
- Other modes of tropical variability (equatorial Rossby wave entering the Indian Ocean and Kelvin wave over the Western Hemisphere) are interfering with the MJO.

200-hPa Wind Anomalies

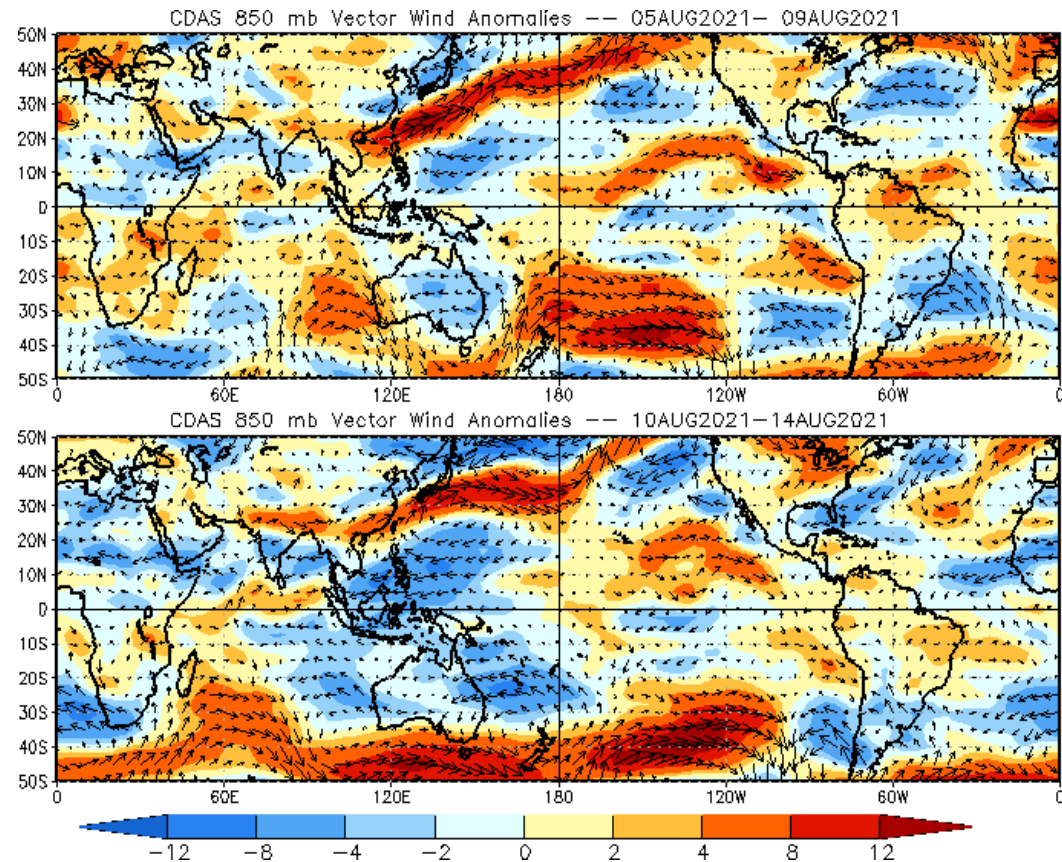
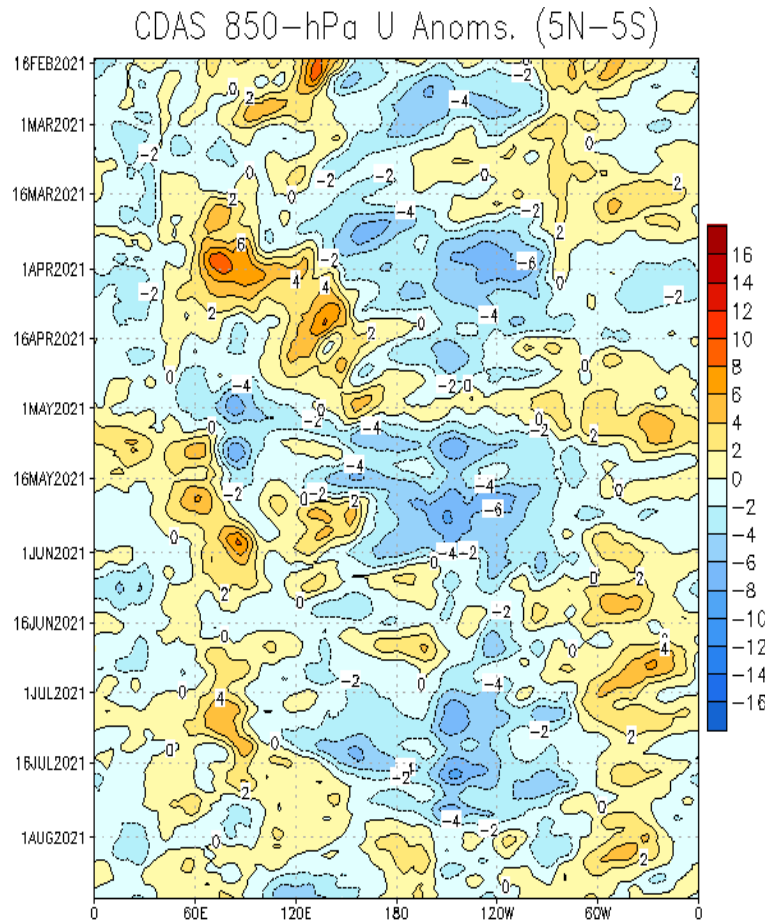
Shading denotes the zonal wind anomaly. Blue shades: Anomalous easterlies. Red shades: Anomalous westerlies.



- The upper-level wind pattern has become more complex, with midlatitude wavebreaking onto the Equator generating Rossby wave activity over the east-central Pacific and the Maritime Continent.
- Upper-level westerly anomalies recently shifted eastward to the Maritime Continent and West Pacific.

850-hPa Wind Anomalies

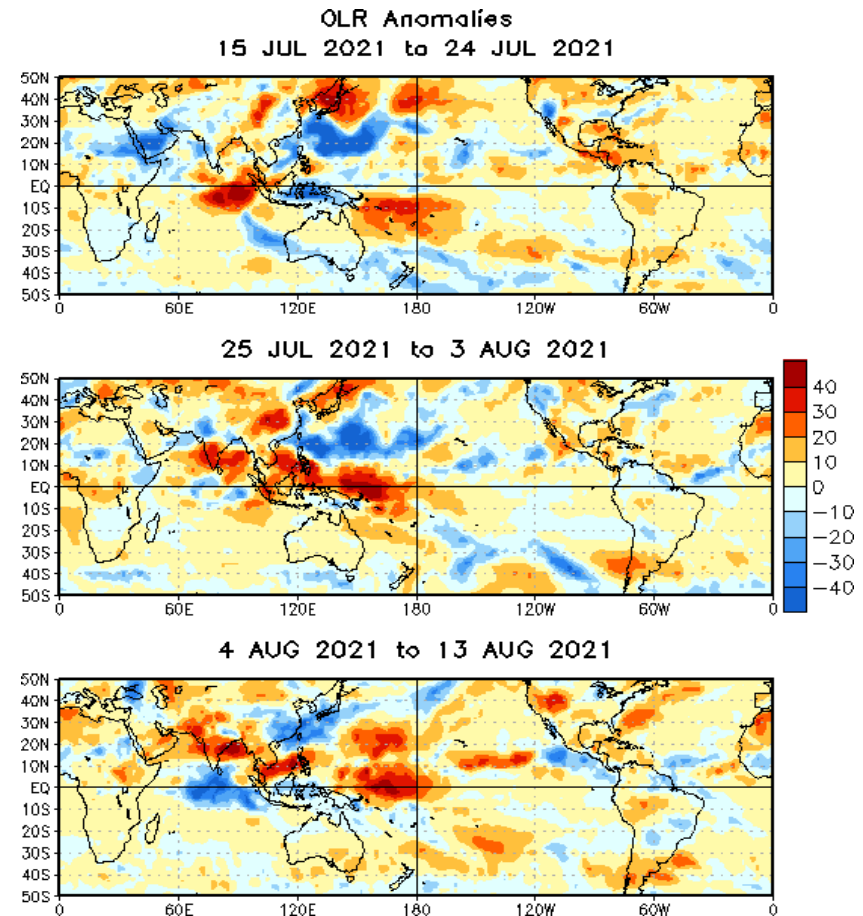
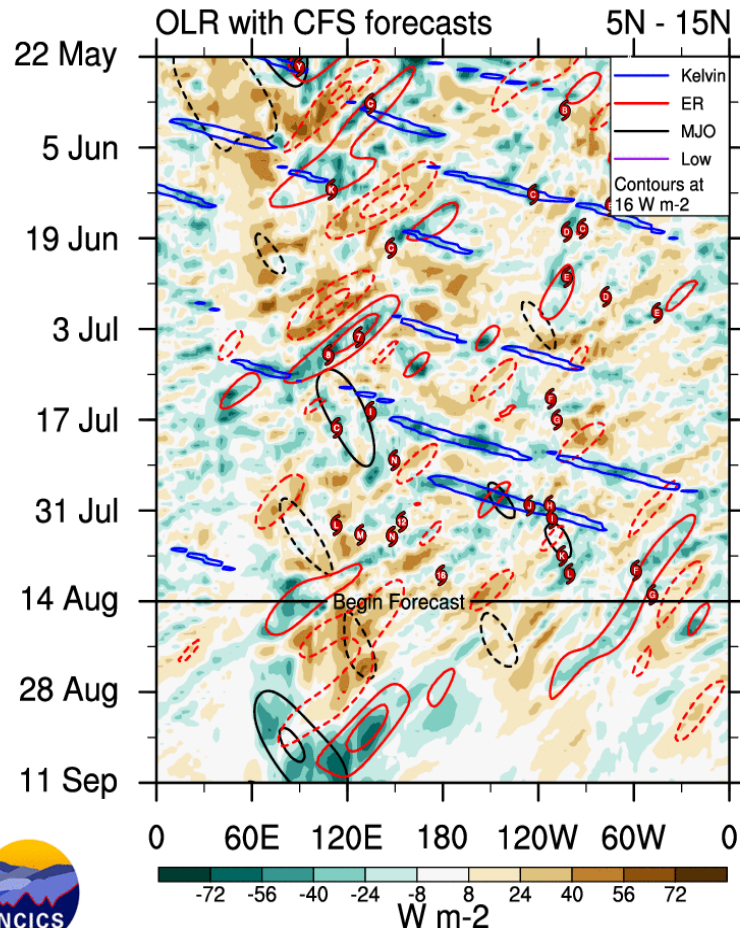
Shading denotes the zonal wind anomaly. Blue shades: Anomalous easterlies. Red shades: Anomalous westerlies.



- Low-level westerly anomalies propagated east of the Date Line during early August.
- Trade winds recently increased over the West Pacific as enhanced easterlies overspread that region.

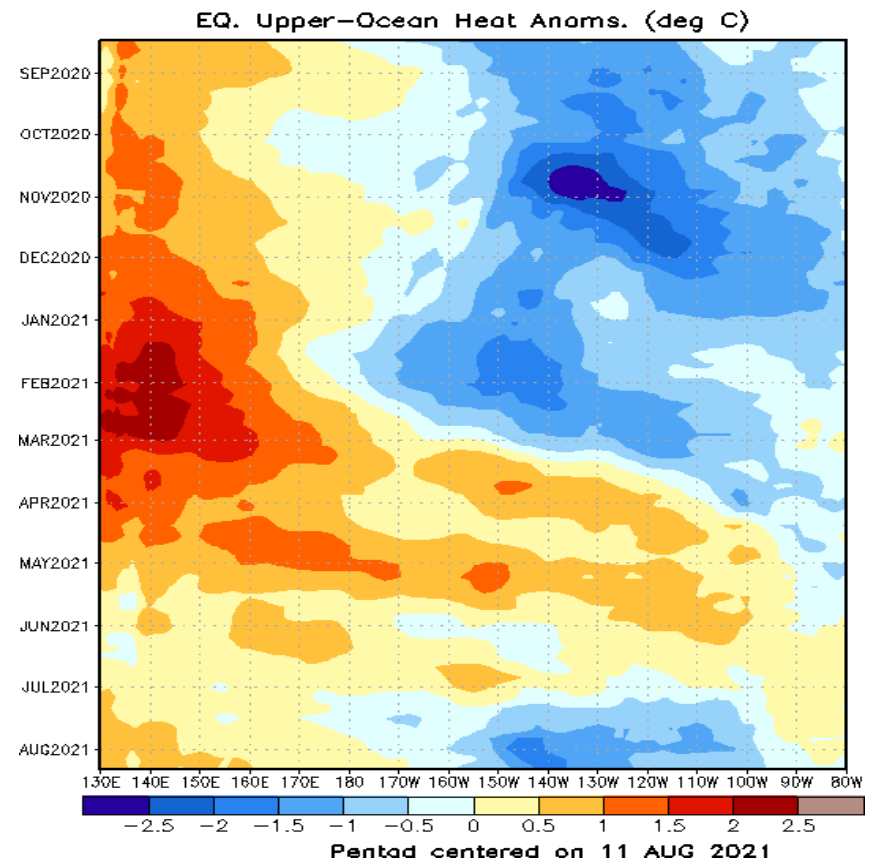
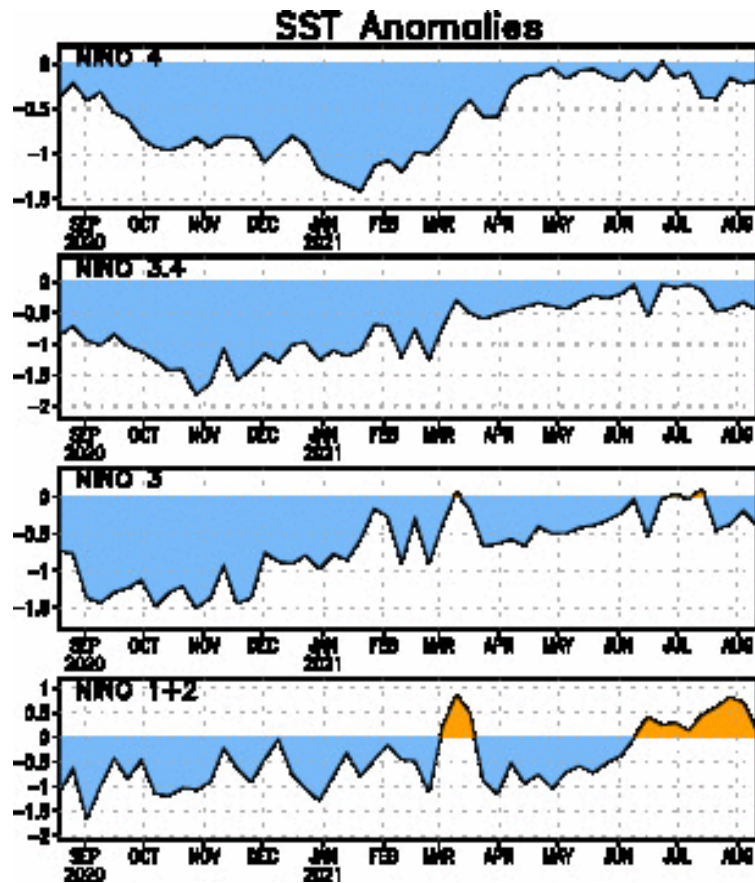
Outgoing Longwave Radiation (OLR) Anomalies

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



- Rossby wave activity became more apparent in the filtering, with enhanced convection observed across the equatorial Indian Ocean.
- As the MJO propagated eastward over the Western Hemisphere, convection increased across the East Pacific and Main Development Region of the tropical Atlantic during early to mid-August.

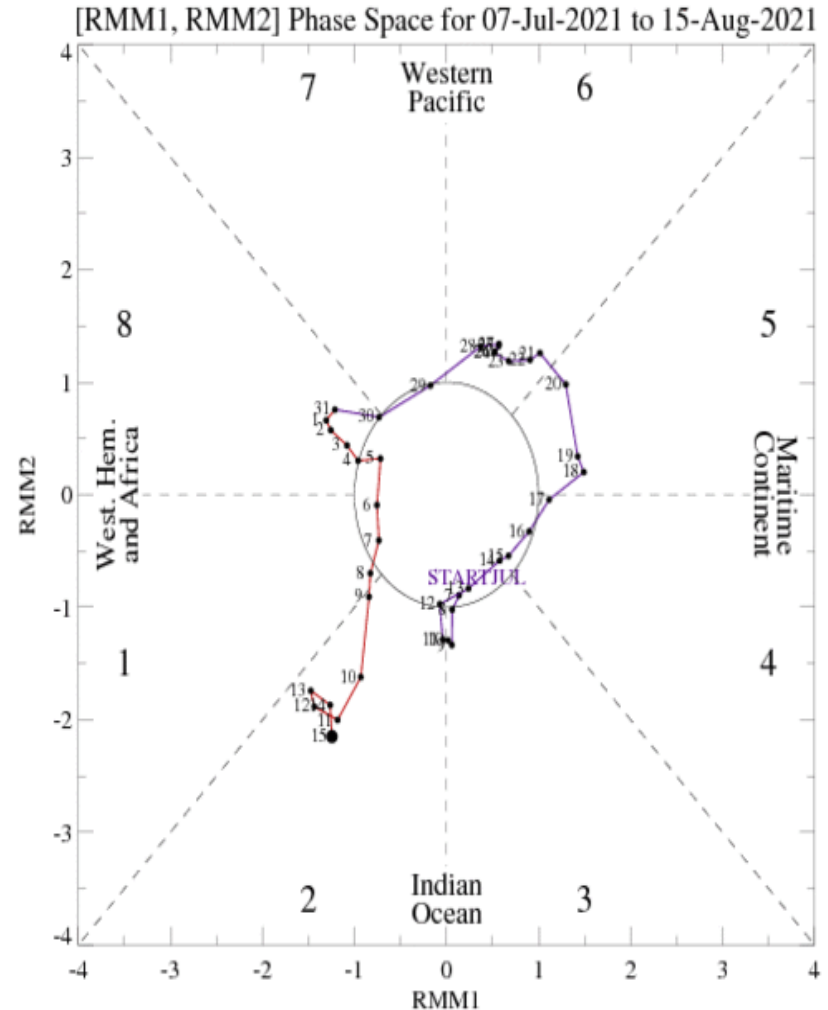
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Multiple episodes of oceanic Kelvin wave activity led to a strengthening of upper-ocean heat content during this past spring. However, these positive anomalies weakened during June, and negative anomalies have been strengthening across much of the Pacific during the past month.
- Except for the Niño 1+2 region of the far East Pacific, indices are slightly negative.

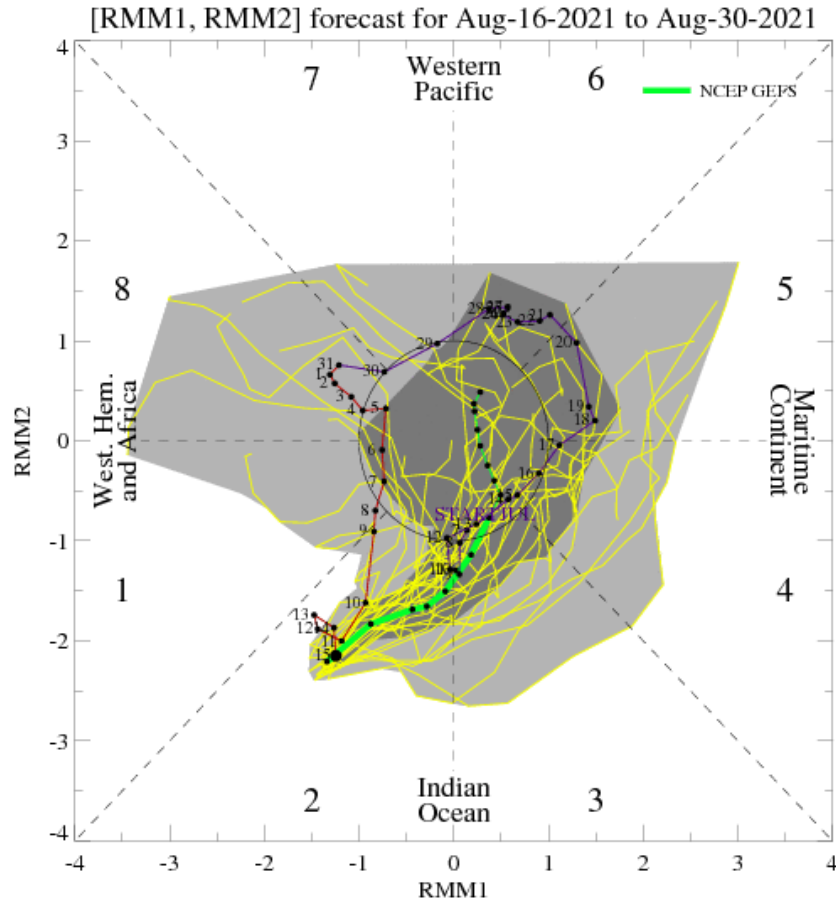
MJO Index: Recent Evolution

- The RMM index depicted eastward propagation across the Western Hemisphere during late July and early August, consistent with a well-established MJO.
- However, recently the index stalled in Phase 2 due to influence from an equatorial Rossby wave.

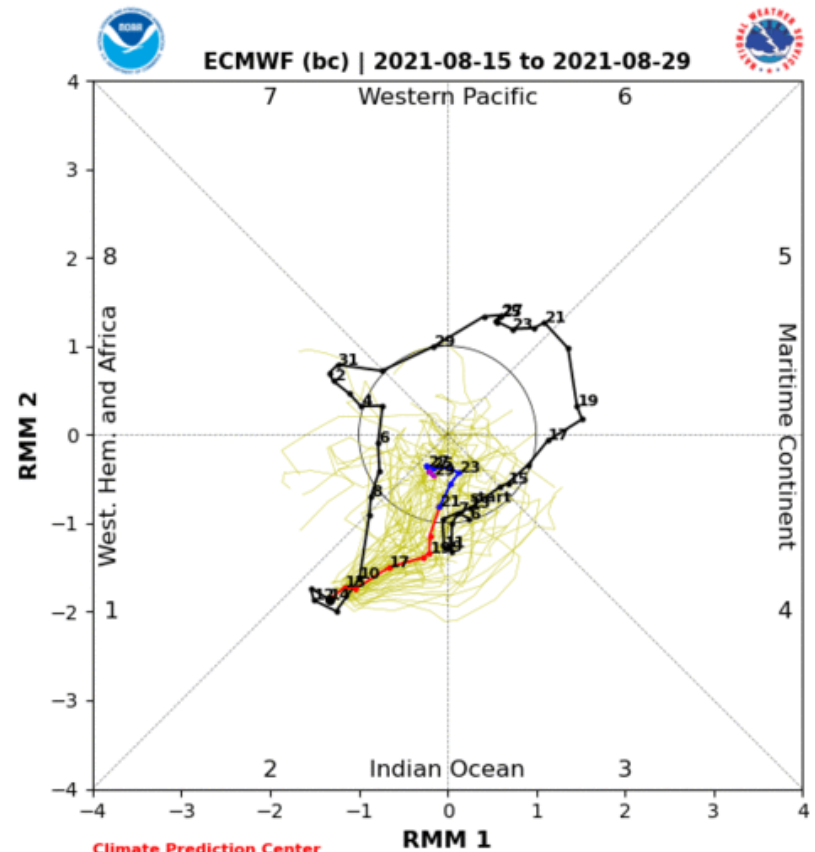


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



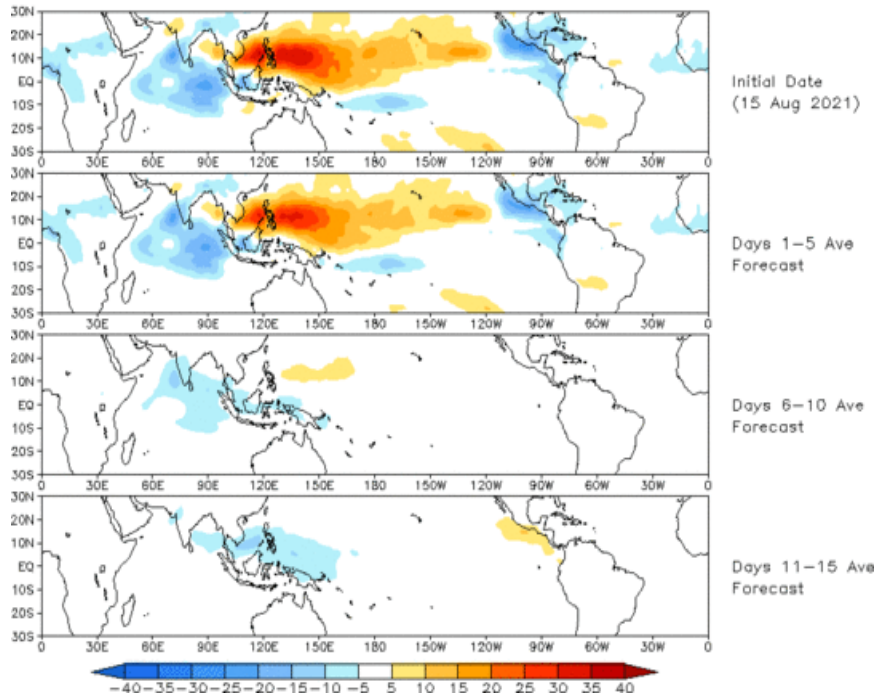
ECMWF Forecast

- Dynamical models are in good agreement and feature renewed eastward propagation from the Indian Ocean to the Maritime Continent during the next week.
- Both the GEFS and ECMWF ensemble mean depict a decrease in the amplitude which is a sign of a weakening MJO. This is likely due to destructive interference with equatorial Rossby waves.
- The GEFS features very large spread among its ensemble members by week-2.

MJO: GEFS Forecast Evolution

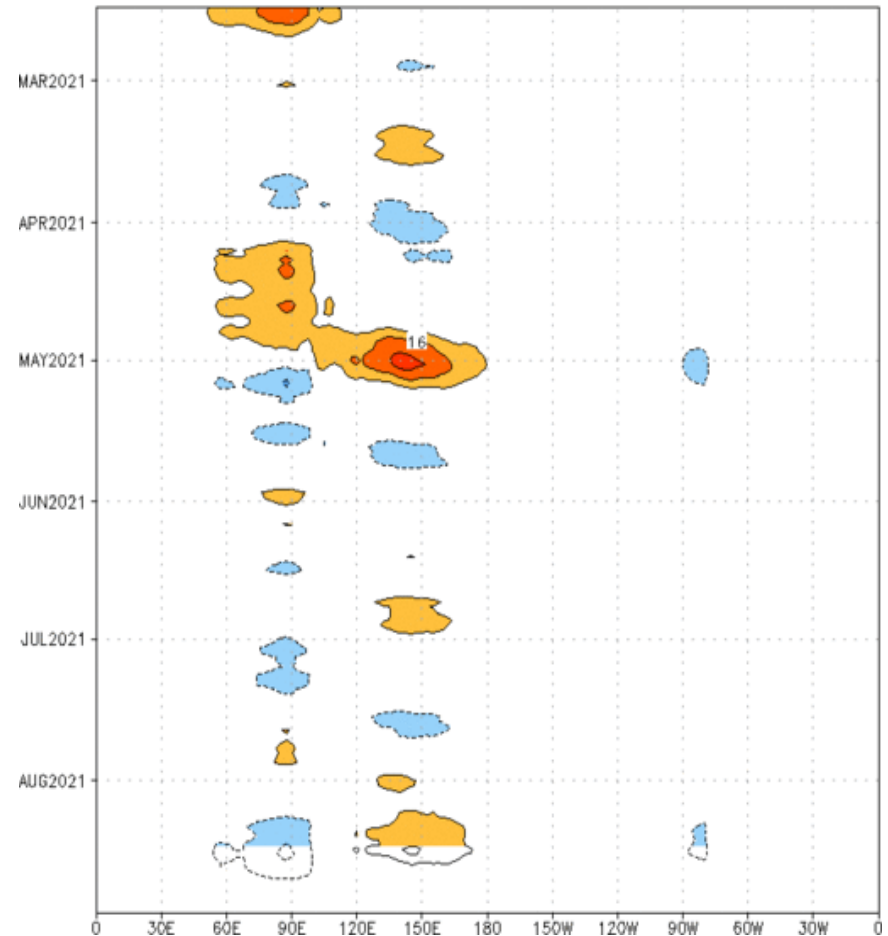
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 15 Aug 2021
OLR



- The GEFS RMM-based OLR anomaly forecast features enhanced convection shifting east to the Maritime Continent with suppressed convection developing over the East Pacific.

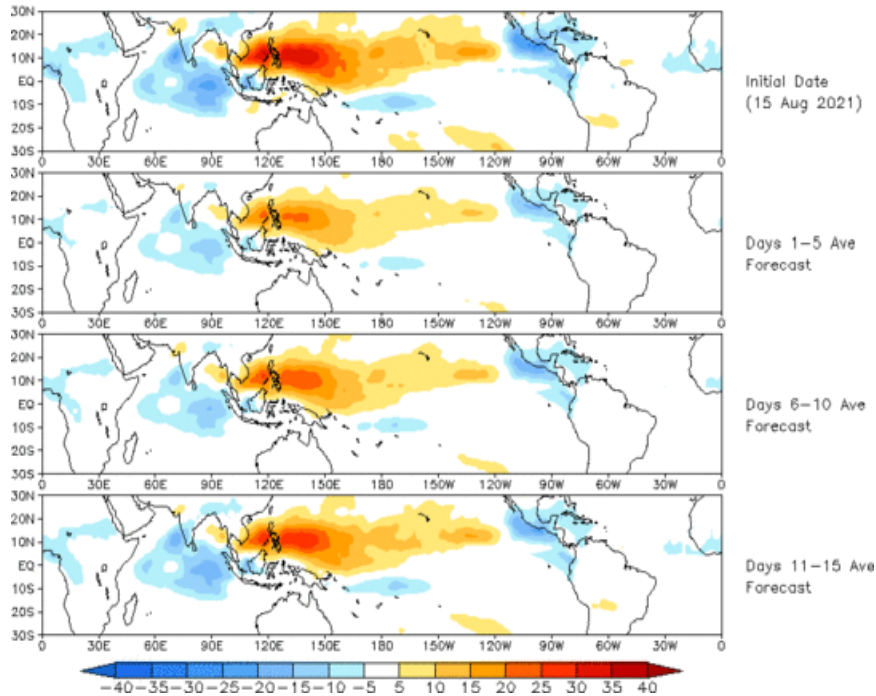
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:13-Feb-2021 to 15-Aug-2021
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



MJO: Constructed Analog Forecast Evolution

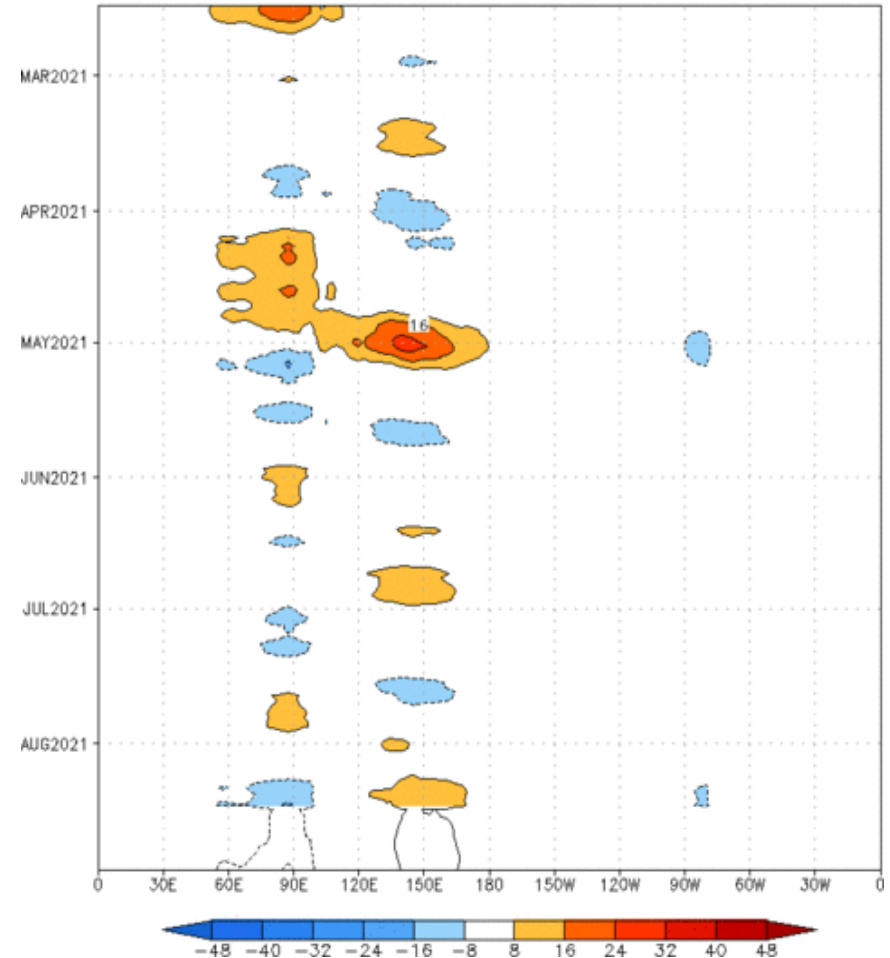
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (15 Aug 2021)



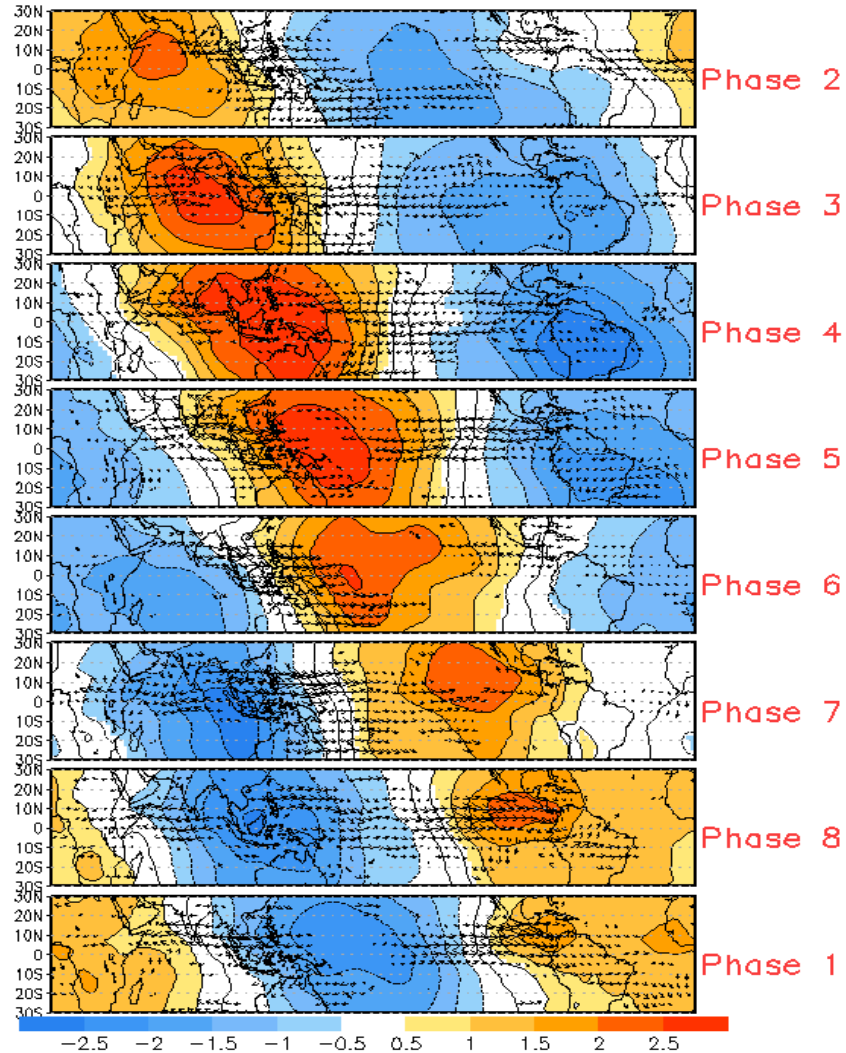
- The constructed analog forecast has a more stationary pattern of anomalous tropical convection, consistent with an evolving low-frequency base state.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm²) Period:13-Feb-2021 to 15-Aug-2021
The unfilled contours are CA forecast reconstructed anomaly for 15 days

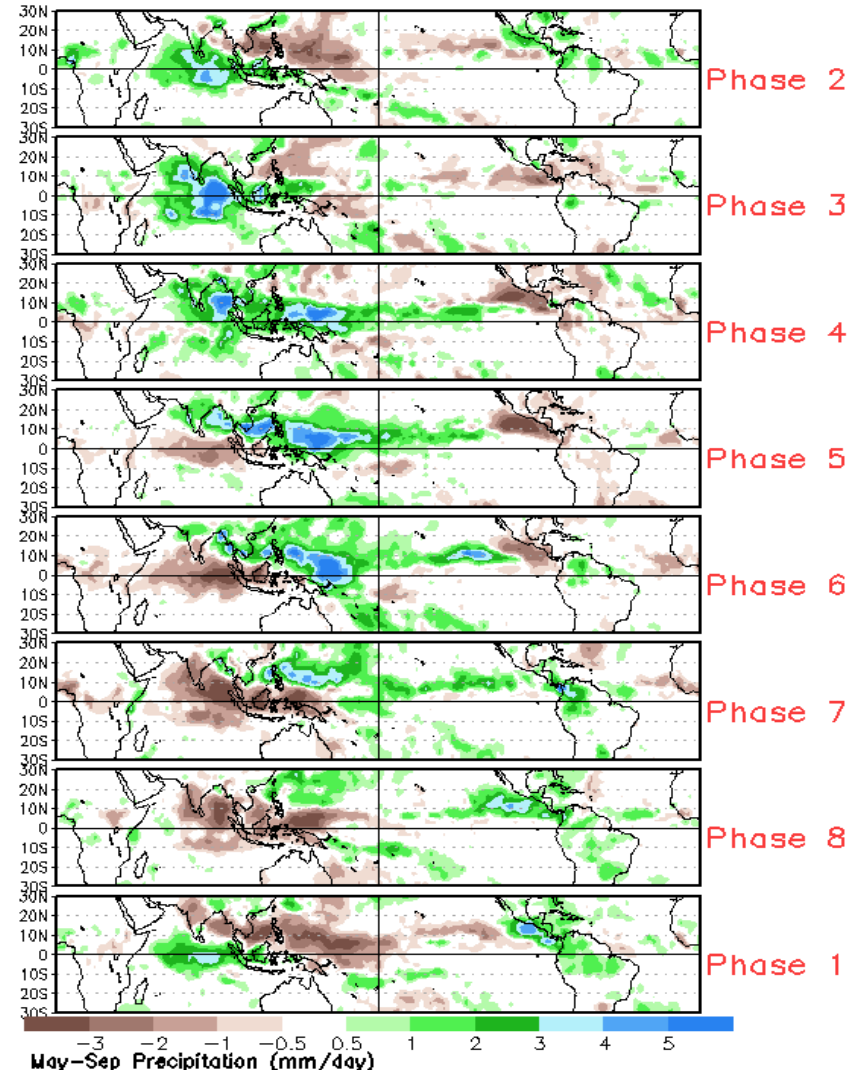


MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



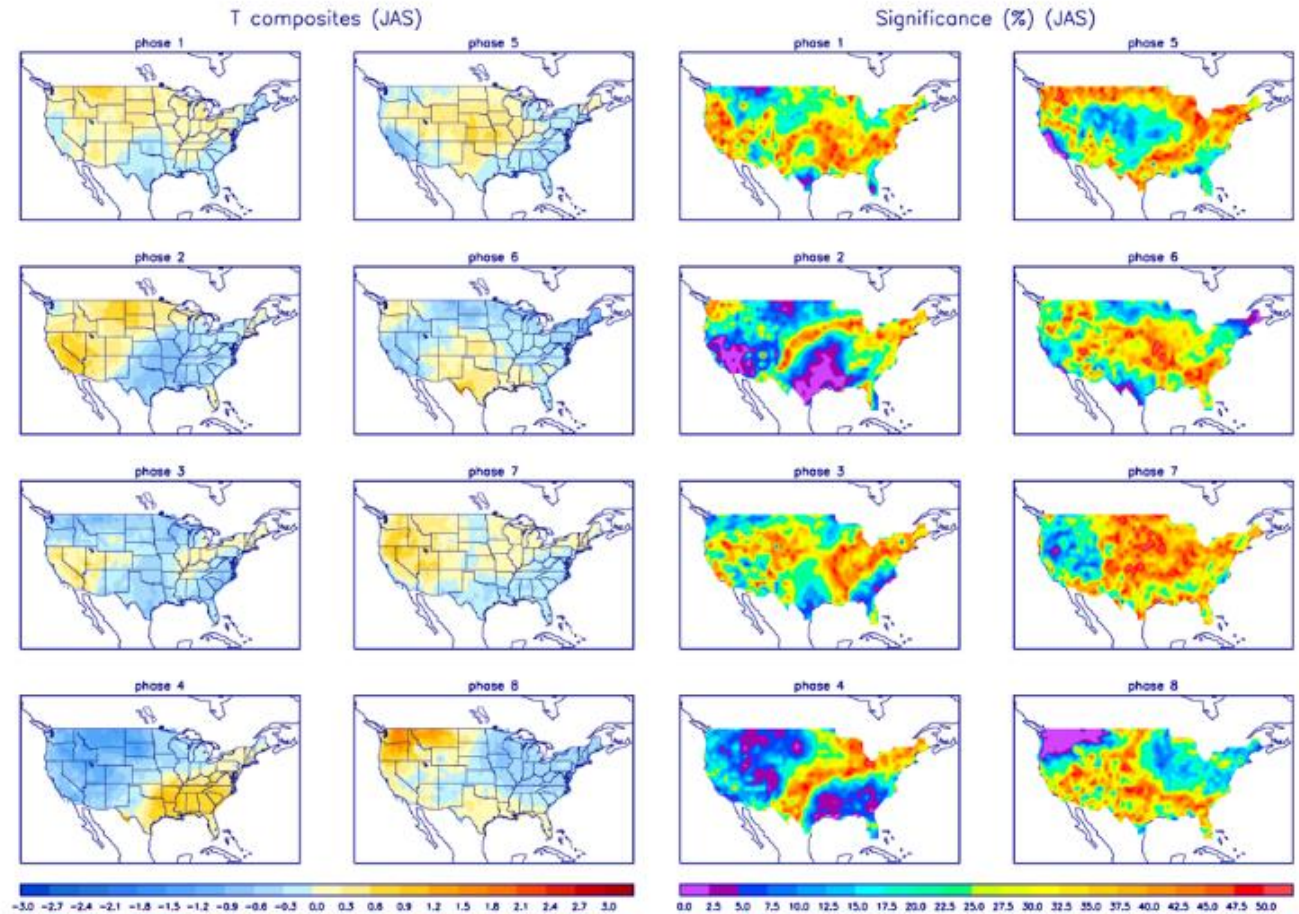
Precipitation Anomalies



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.

