

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



Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
4 October 2021

Overview

- The RMM index depicts the initial strengthening of a MJO over the Maritime Continent with slight eastward propagation since late September.
- Dynamical models are in good agreement that the MJO continues to shift eastward over the West Pacific. Large uncertainty exists on its strength as the MJO destructively interferes with the emerging La Niña.
- The most likely areas for tropical cyclone (TC) development during early October are forecast across the West Pacific, South China Sea, and Bay of Bengal. A lull in TC activity is expected over the Atlantic basin.
- Beyond the week-2 period, chances for TC development are expected to increase across the western Caribbean Sea if the MJO continues propagating eastward.

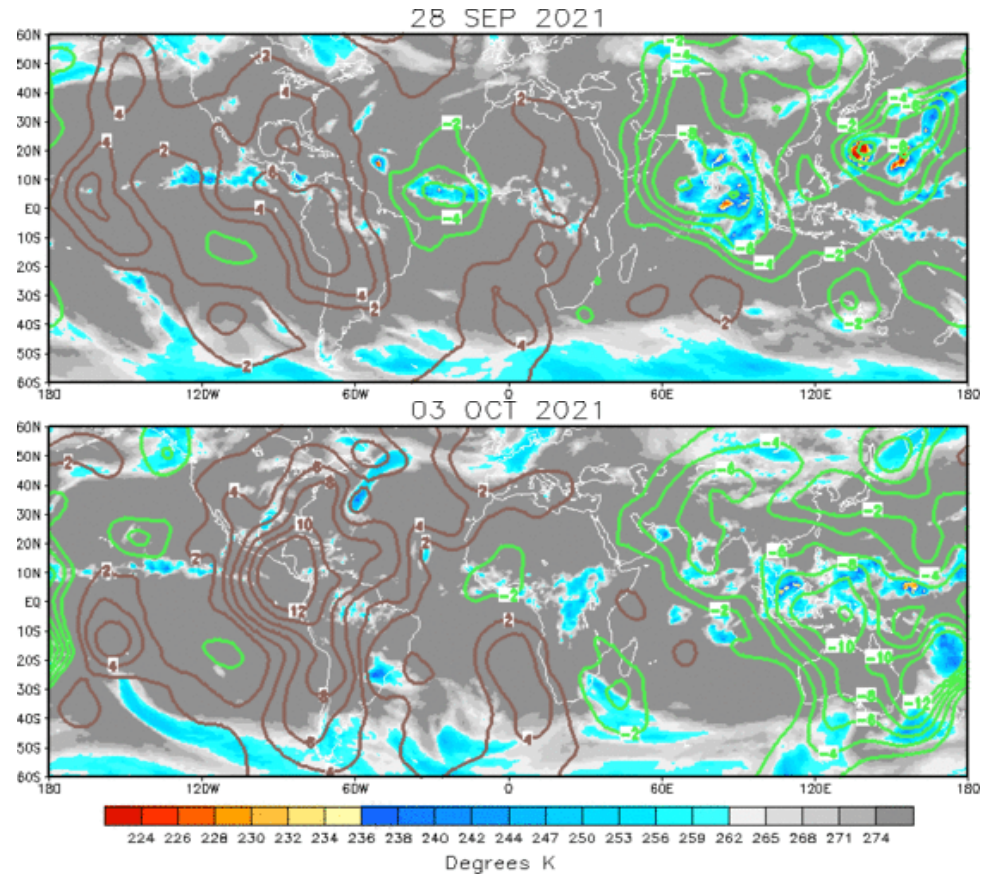
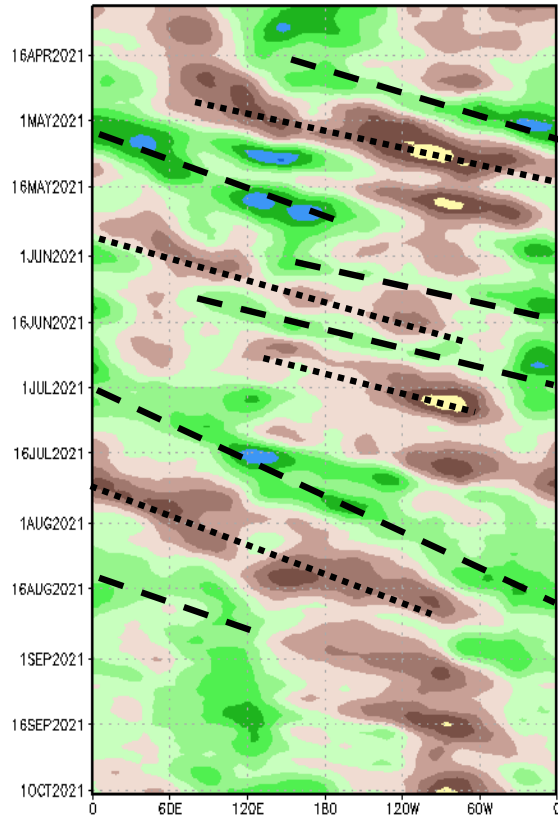
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

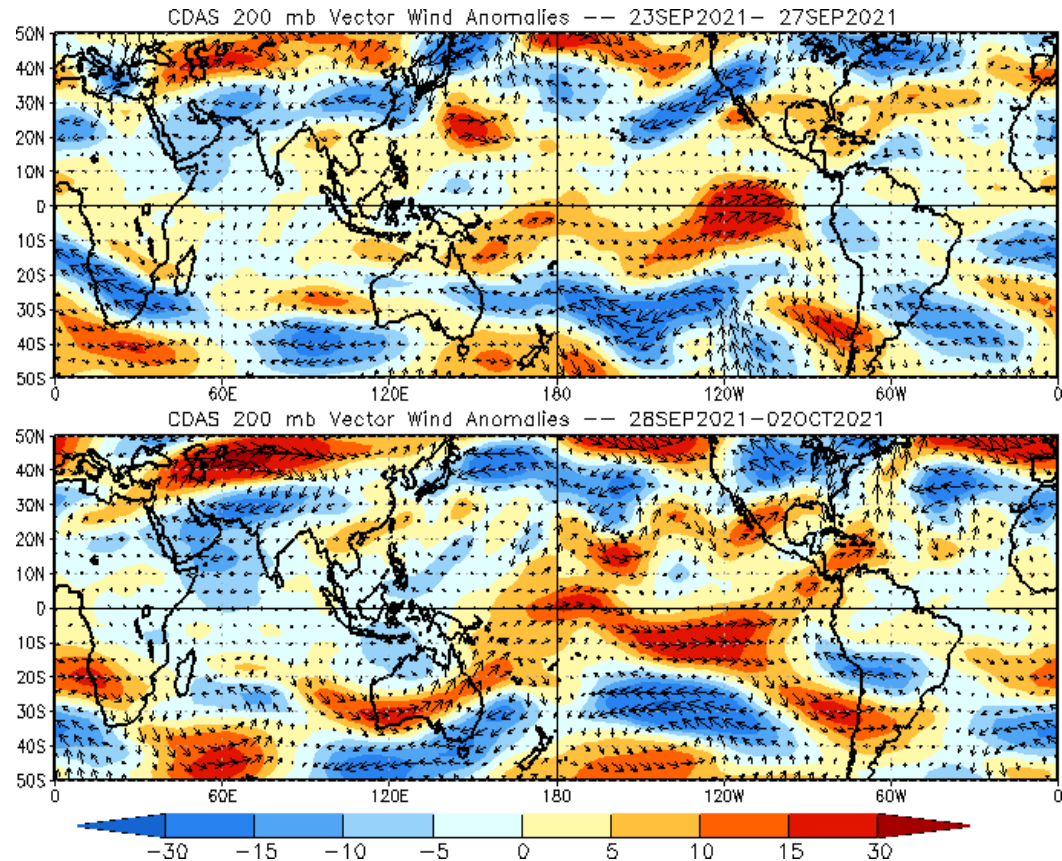
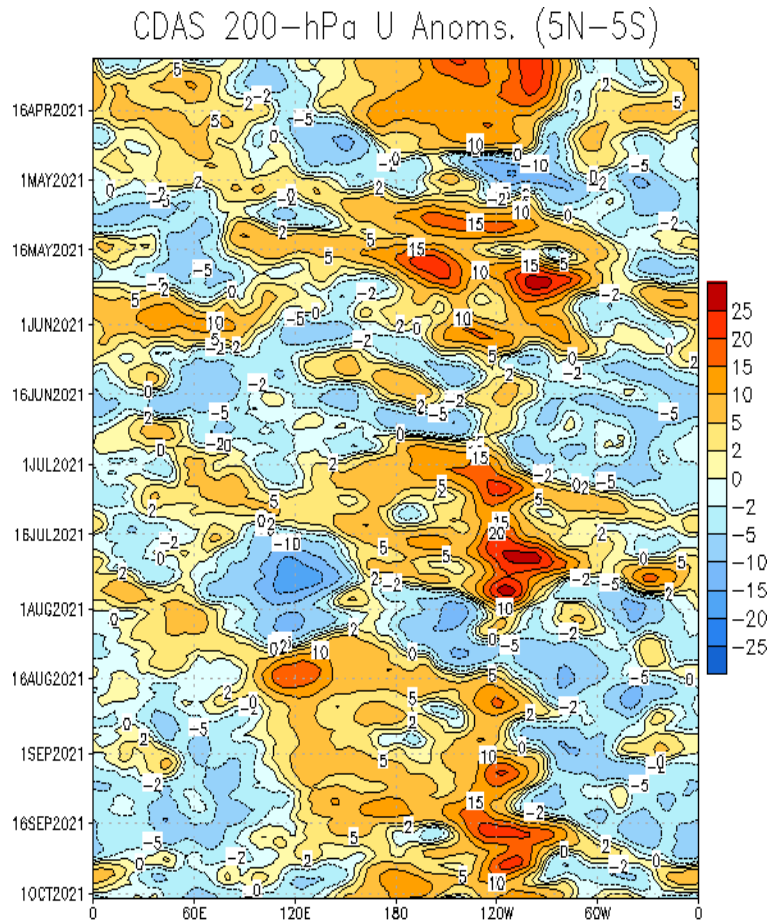
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- Following an extended period of MJO activity during the late spring and summer, a stationary pattern has persisted since late August.
- A more coherent wave-1 pattern recently developed with anomalous upper-level divergence shifting east to the Date Line.

200-hPa Wind Anomalies

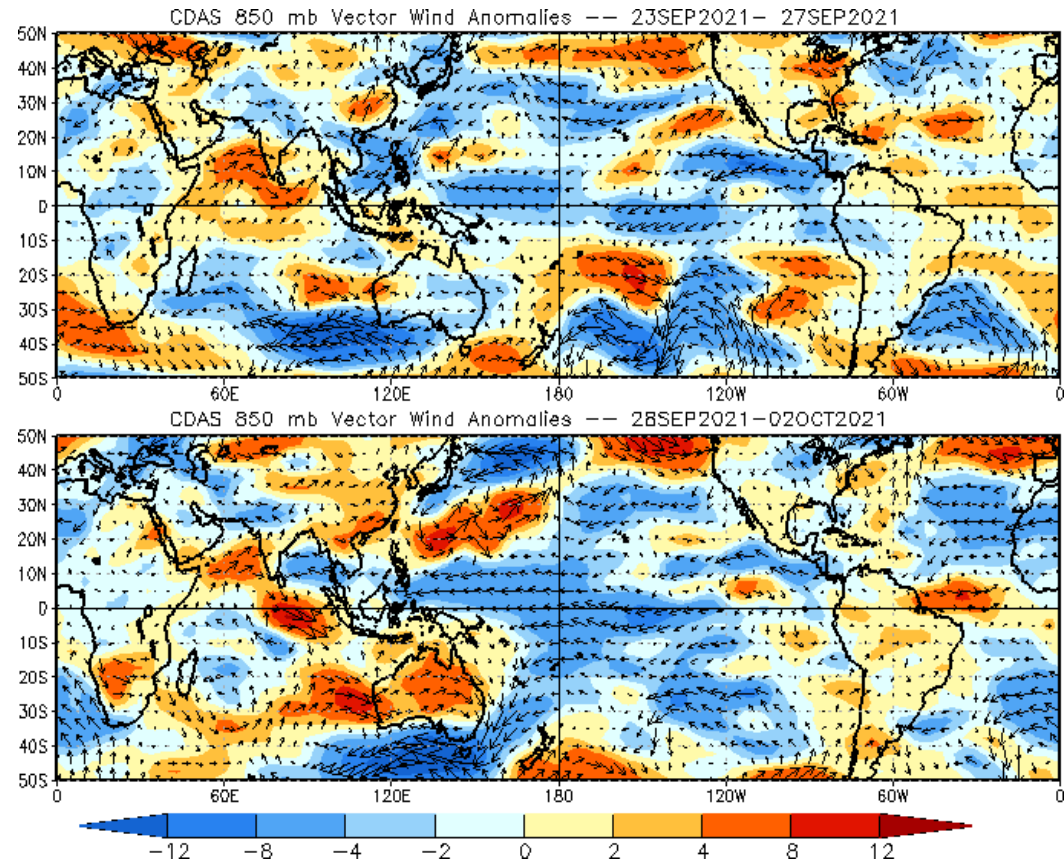
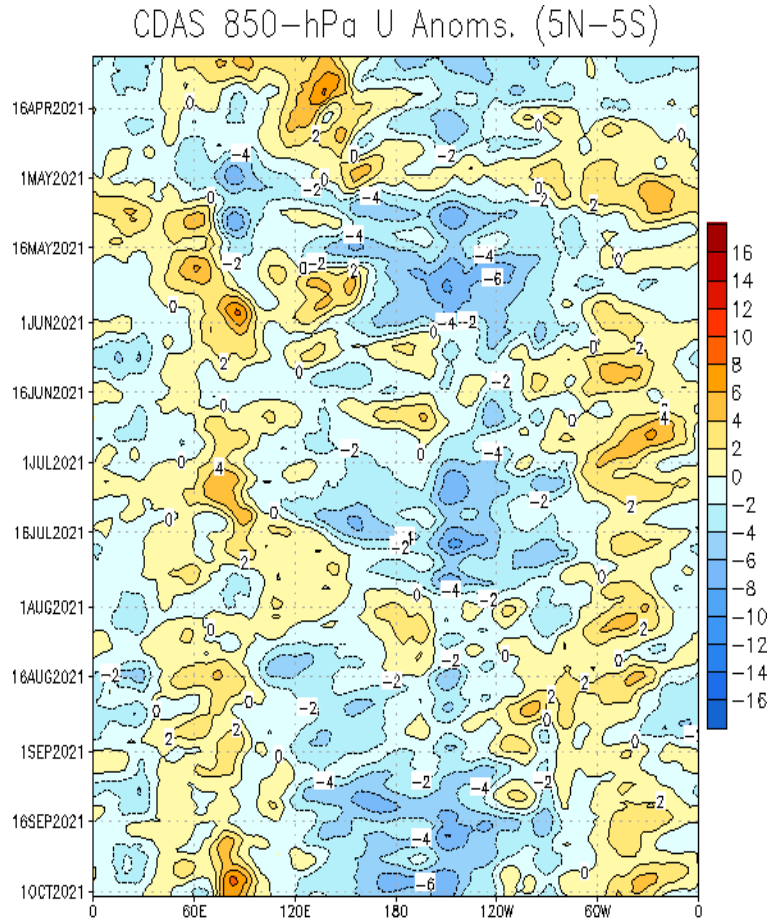
Shading denotes the zonal wind anomaly. **Blue shades: Anomalous easterlies.** **Red shades: Anomalous westerlies.**



- Anomalous westerlies persist across much of the equatorial Pacific, consistent with the atmospheric response to the developing La Niña state.
- After nearly two months of anomalous westerlies over the Maritime Continent, anomalous easterlies recently developed across that region which is consistent with a strengthening MJO.

850-hPa Wind Anomalies

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



- Enhanced trades continue throughout the much of the Pacific, making it difficult for propagation of the intraseasonal signal.
- Anomalous westerlies remain evident near 60°E which may be tied to a negative Indian Ocean Dipole circulation since earlier in boreal summer.

Outgoing Longwave Radiation (OLR) Anomalies

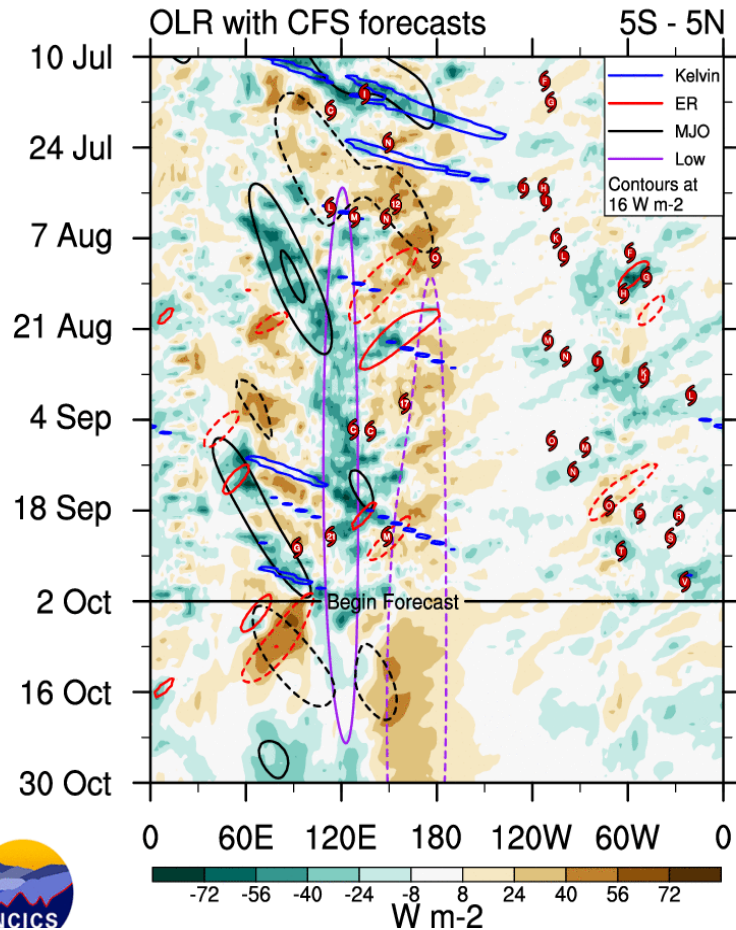
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)

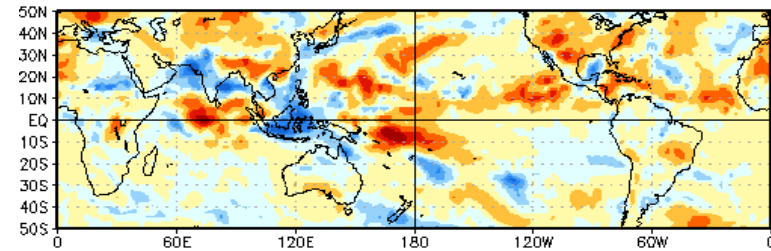
Blue shades: Anomalous convection (wetness)

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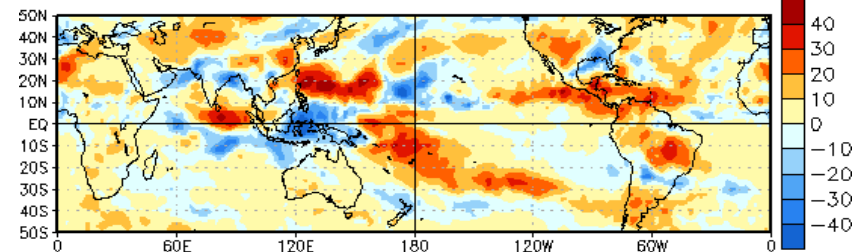
OLR Anomalies



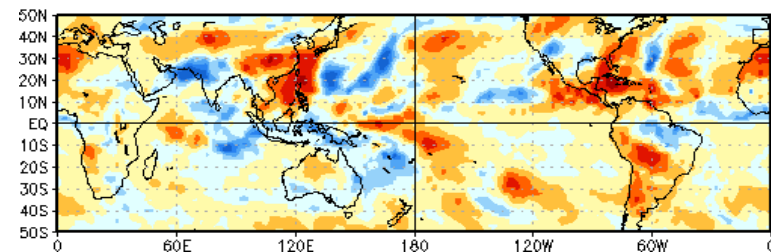
3 SEP 2021 to 12 SEP 2021



13 SEP 2021 to 22 SEP 2021

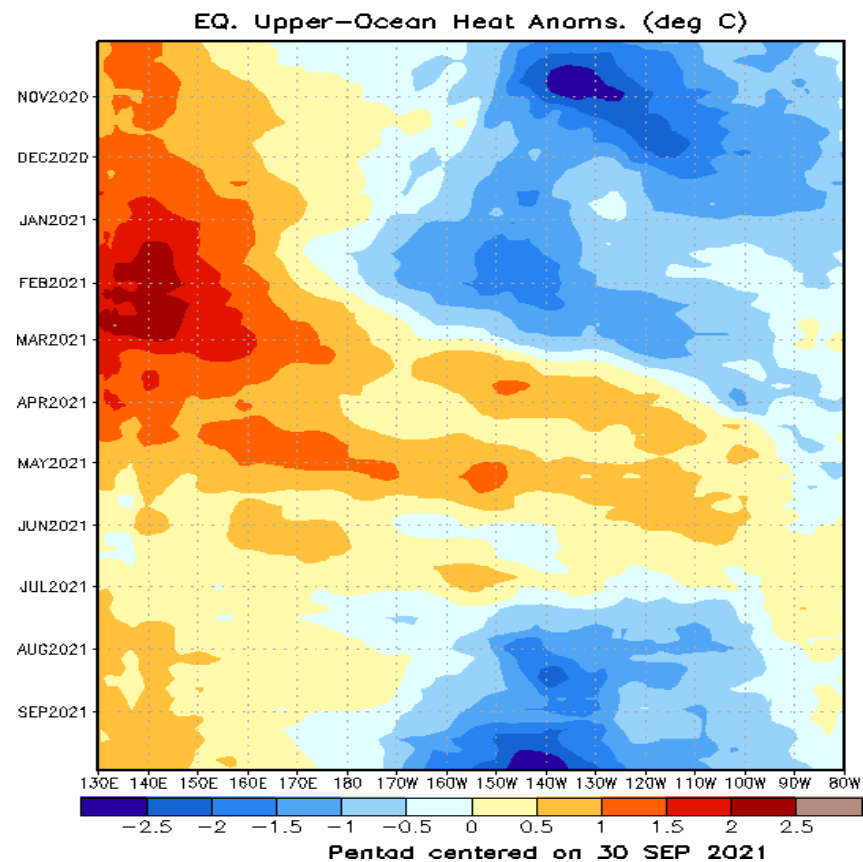
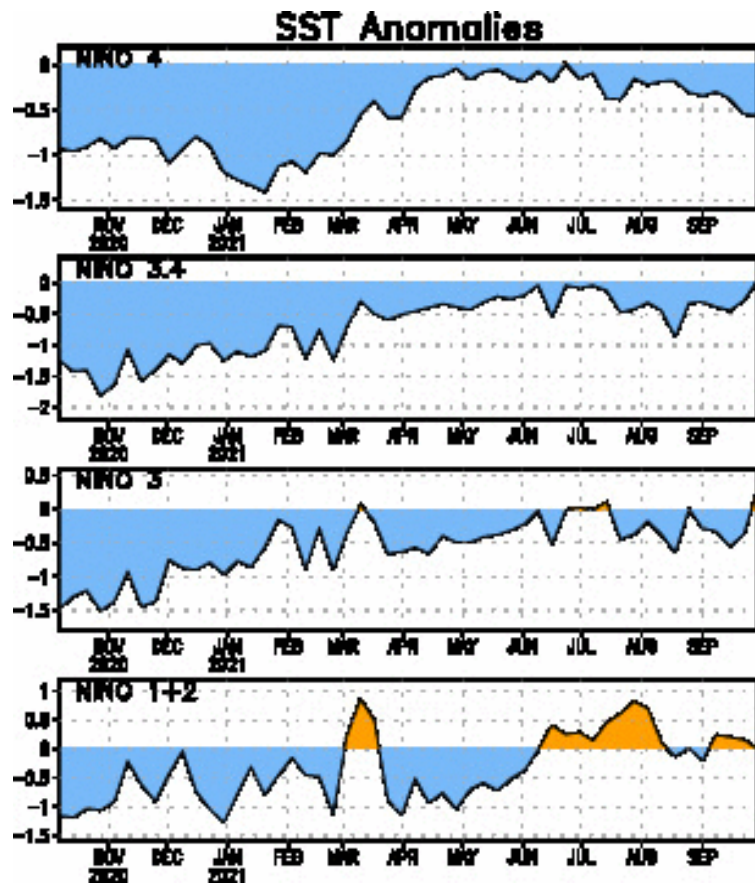


23 SEP 2021 to 2 OCT 2021



- Enhanced (suppressed) convection persists over the Maritime Continent (equatorial Central Pacific) which is associated with a low-frequency base state.
- The suppressed convection near the Date Line has recently waned as an intraseasonal signal began to shift eastward.

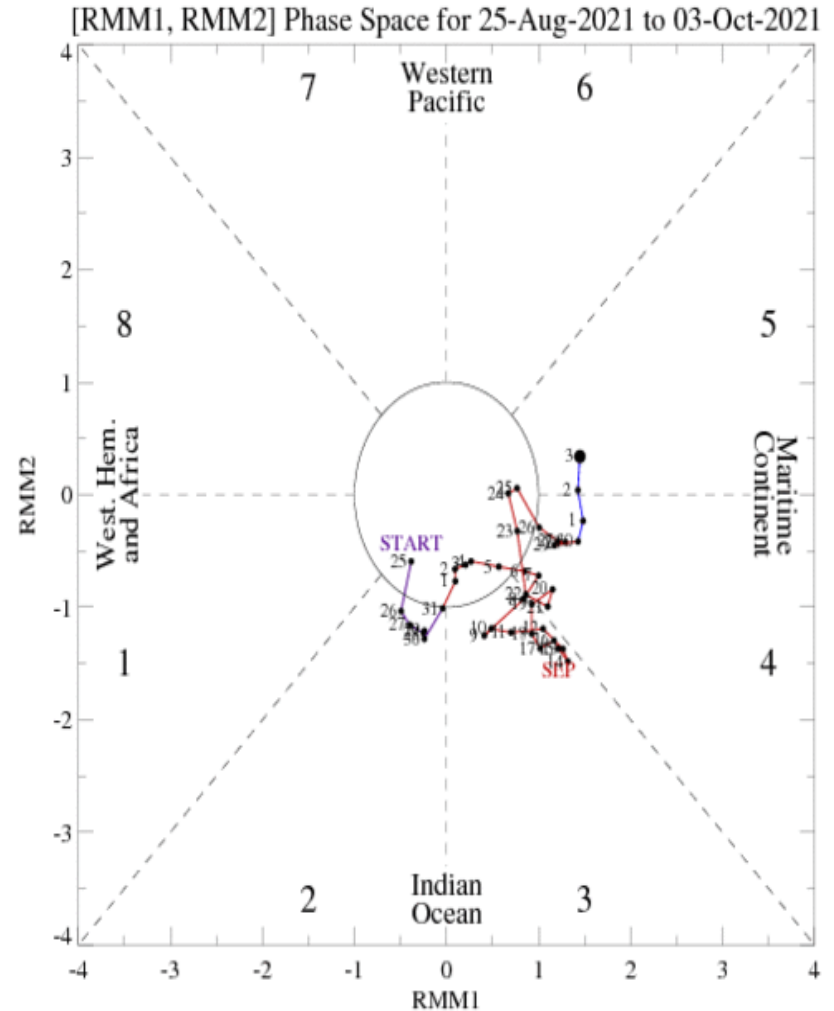
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Negative upper-ocean heat anomalies continue to strengthen across much of the central and eastern equatorial Pacific, with much of this sub-surface cooling expanding westward towards the Date Line during September.
- Below-normal sea surface temperatures are observed over all Niño regions except the east Pacific, consistent with a forecast trend toward La Niña.

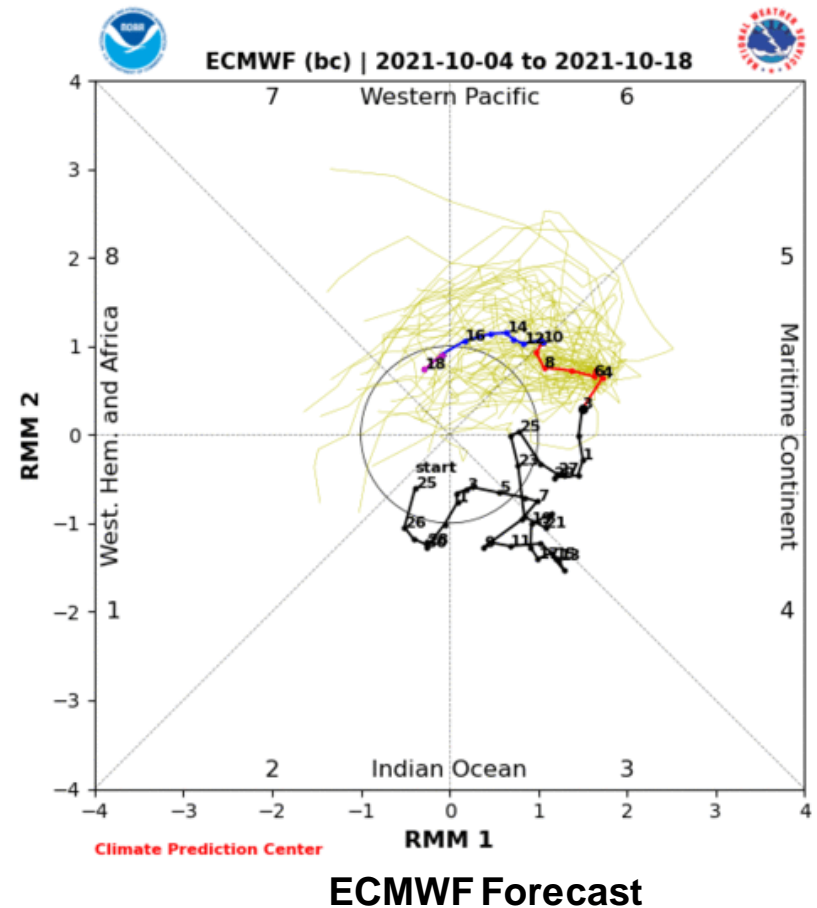
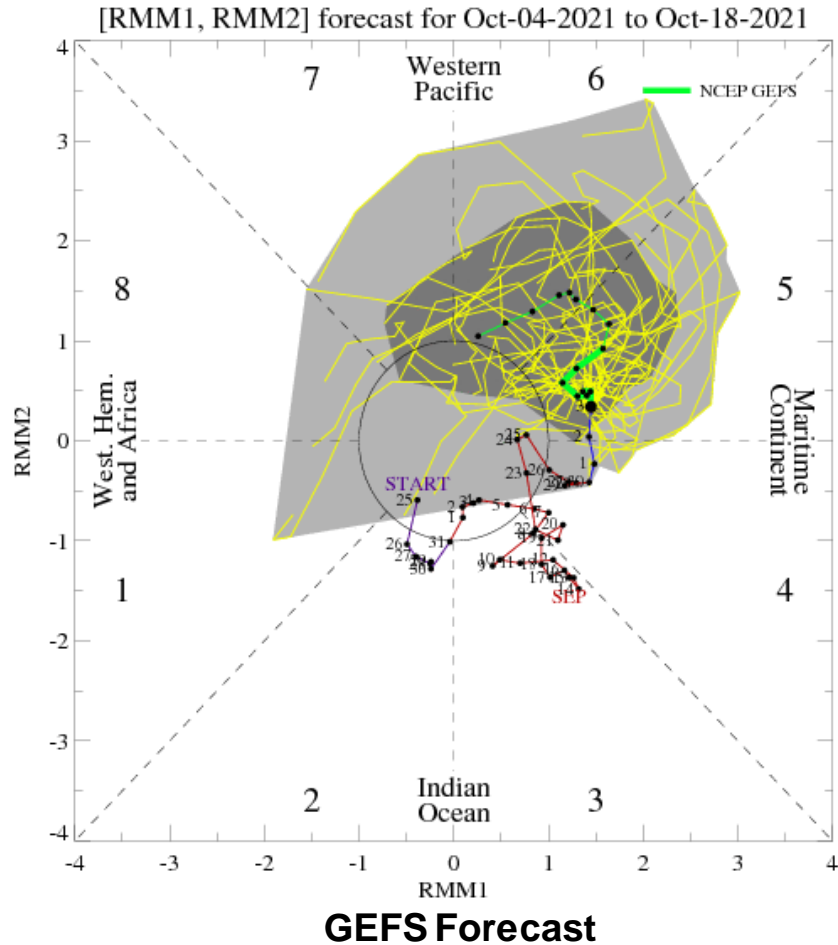
MJO Index: Recent Evolution

- The RMM index depicts an increase in amplitude of a MJO signal with eastward propagation.



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

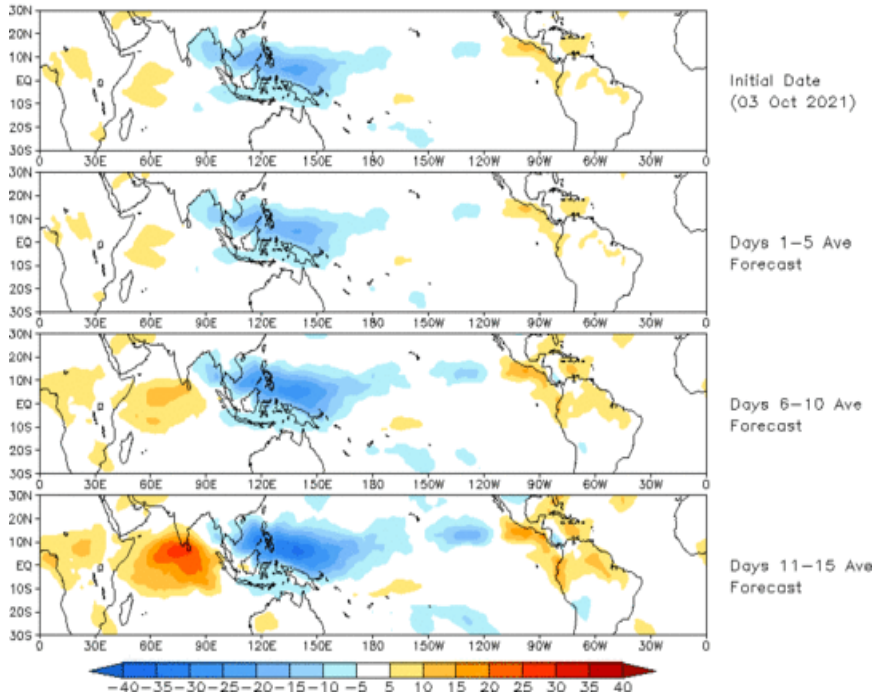


- Dynamical models are in good agreement that a MJO continues to propagate eastward across the West Pacific during the next two weeks.
- However, there is large spread among its ensemble members on its strength as the MJO destructively interferes with the emerging La Niña.

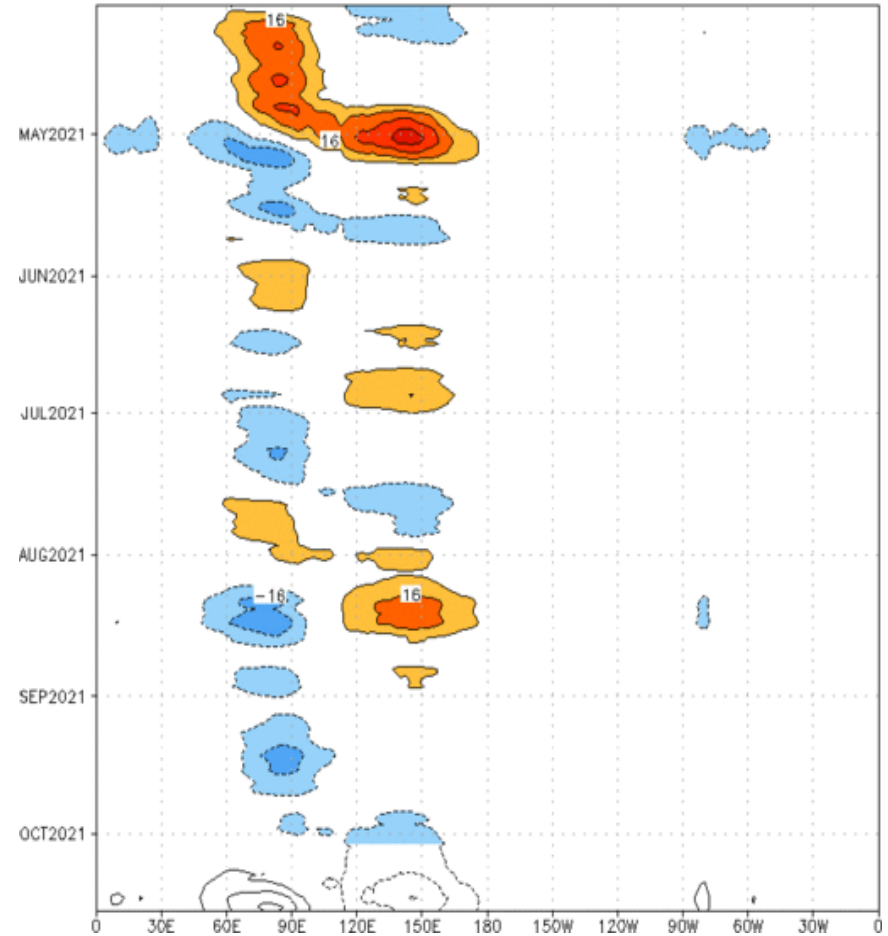
MJO: GEFS Forecast Evolution

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: 03 Oct 2021
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [$7.5^{\circ}\text{S}, 7.5^{\circ}\text{N}$] (cint: 4Wm^{-2}) Period: 03-Apr-2021 to 03-Oct-2021
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

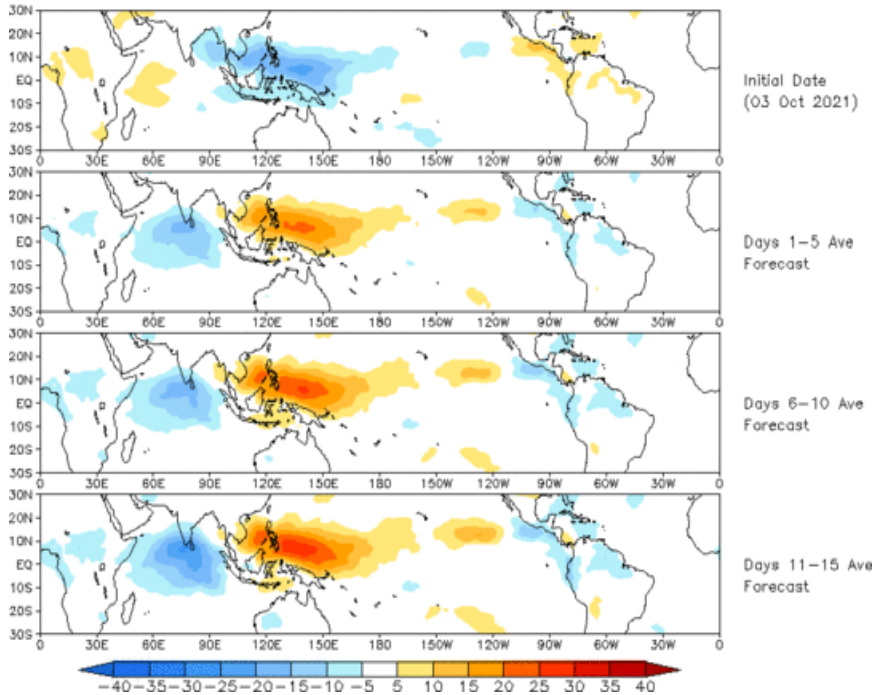


- The GEFS RMM-based OLR anomaly forecast features enhanced (suppressed) convection intensifying over the West Pacific (Indian Ocean) during the next two weeks.

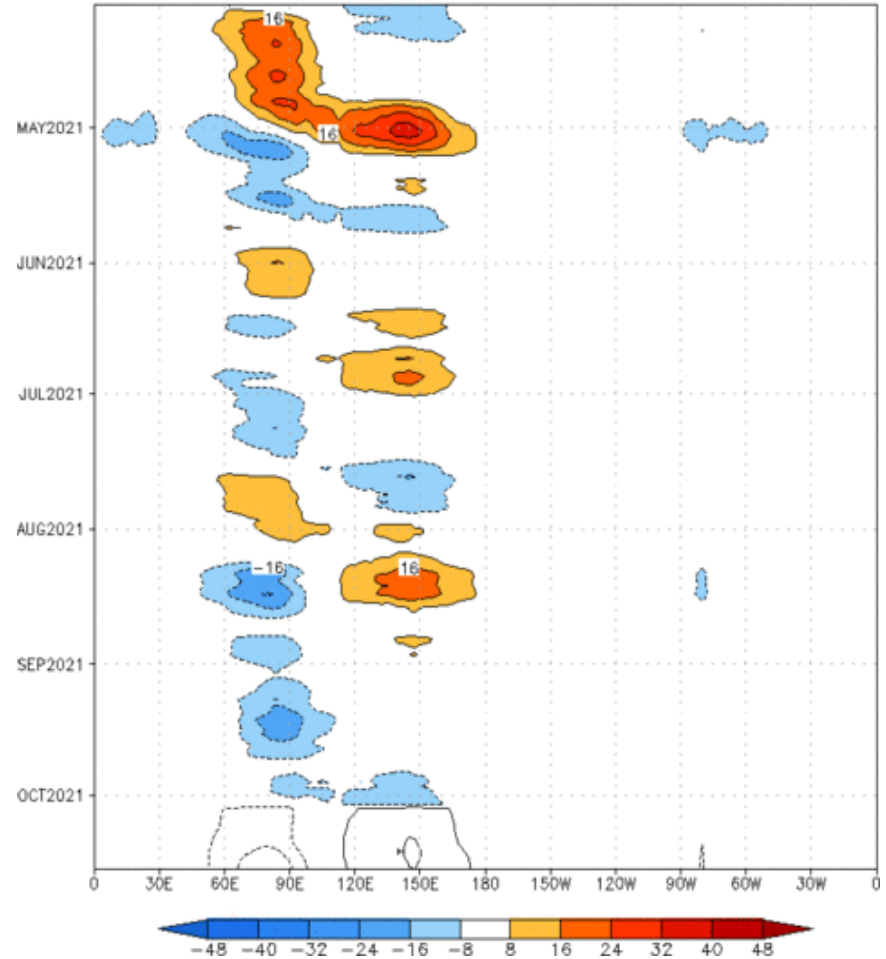
MJO: Constructed Analog Forecast Evolution

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 (03 Oct 2021)



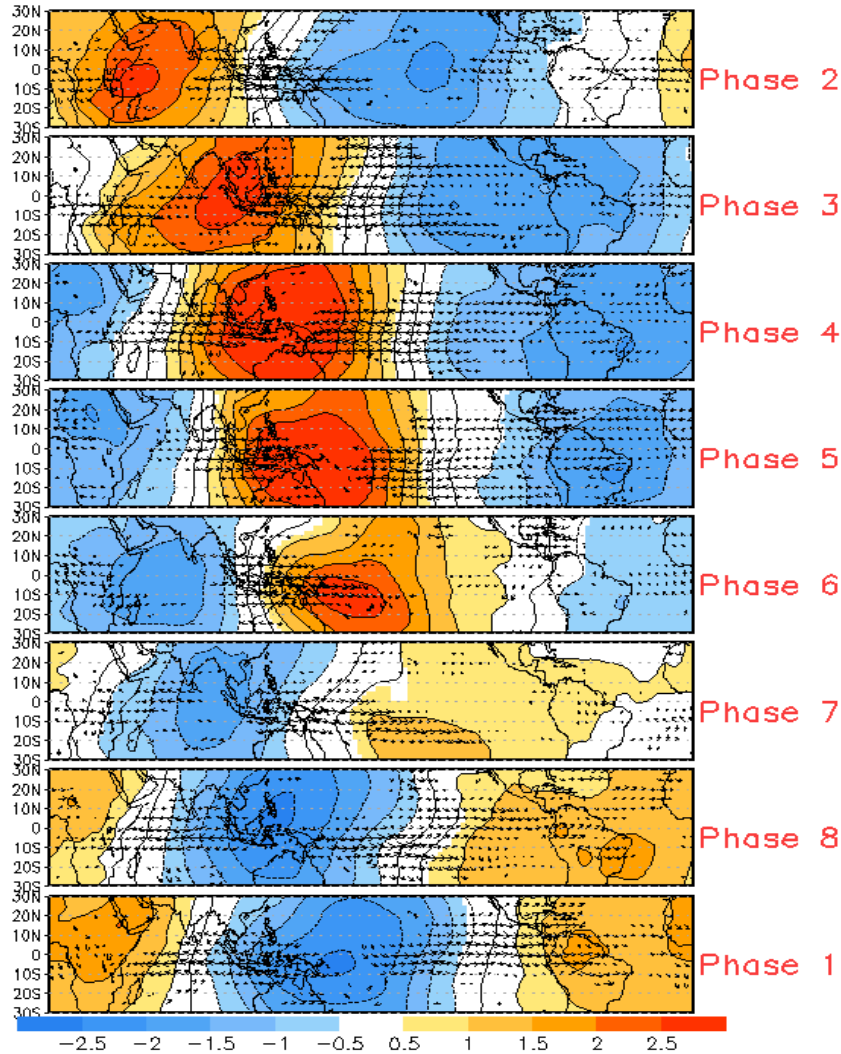
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm²) Period:03-Apr-2021 to 03-Oct-2021
The unfilled contours are CA forecast reconstructed anomaly for 15 days



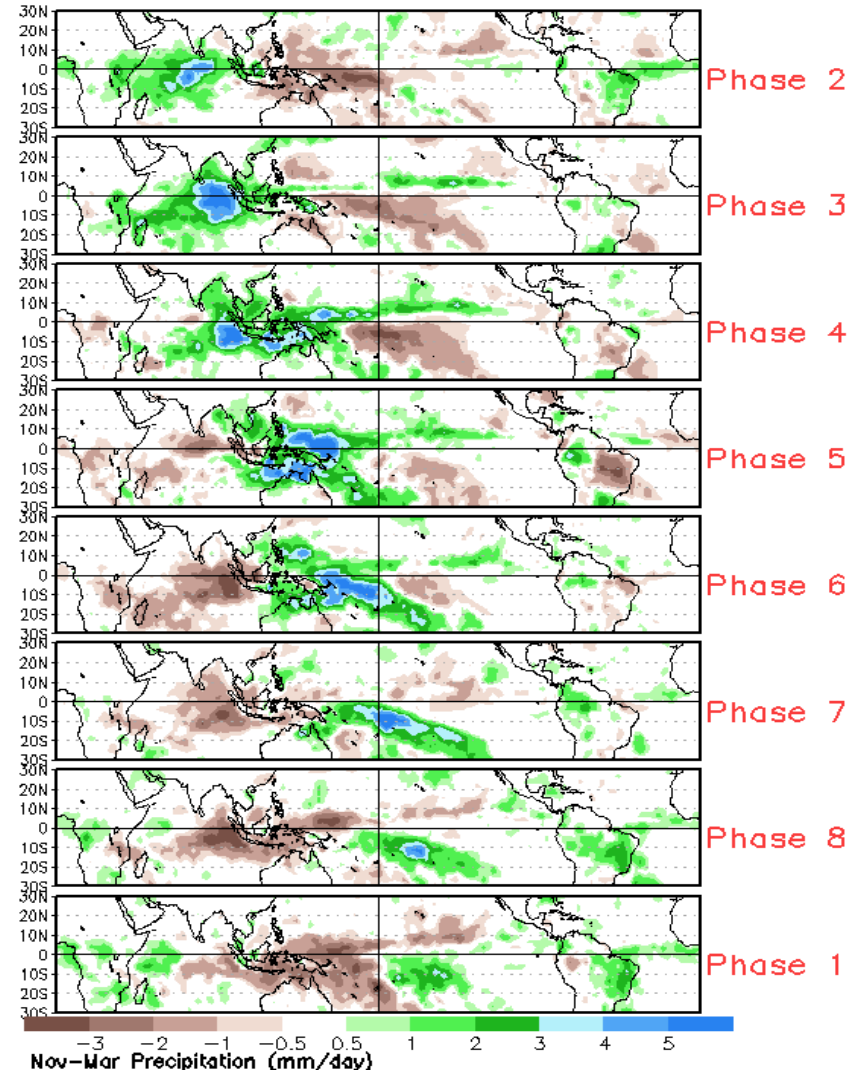
- Please disregard this forecast; a fix will be implemented soon.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



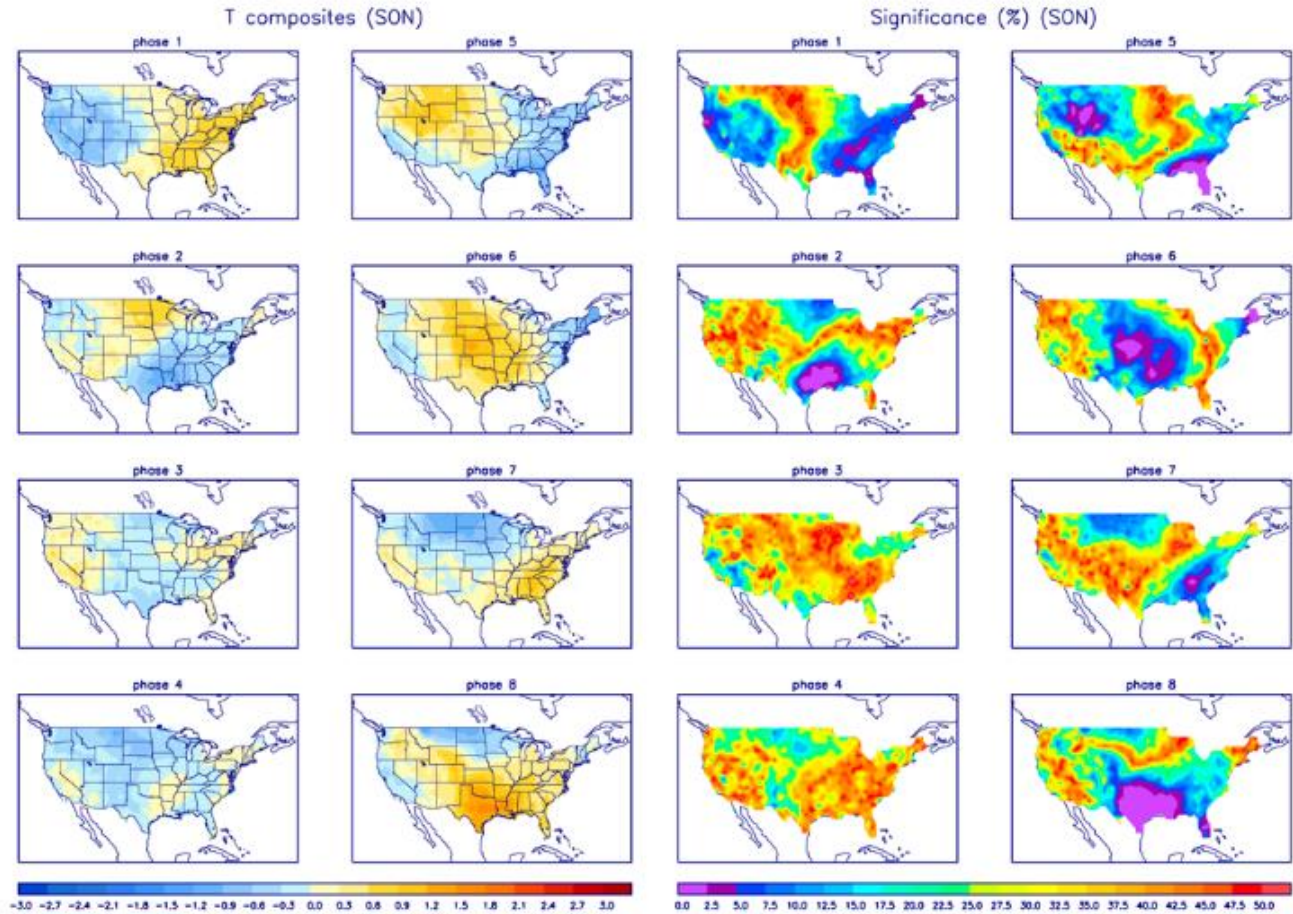
Precipitation Anomalies



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.

