

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



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

Overview

- The RMM index depicts a fairly stationary enhanced MJO envelope over the Maritime Continent throughout October to date.
- Models generally agree that this signal will begin to push across the Pacific during the coming two weeks, although a handful of GEFS members focus instead on the building La Niña. The interplay of the MJO and the background state bears monitoring and increases uncertainty in the outlook.
- The intraseasonal state favors the Eastern Hemisphere remaining the likely focus for tropical cyclogenesis in the near-term, with increasingly favorable large-scale conditions possible over the East Pacific during Week-2 and potentially the Atlantic by the last week of October.

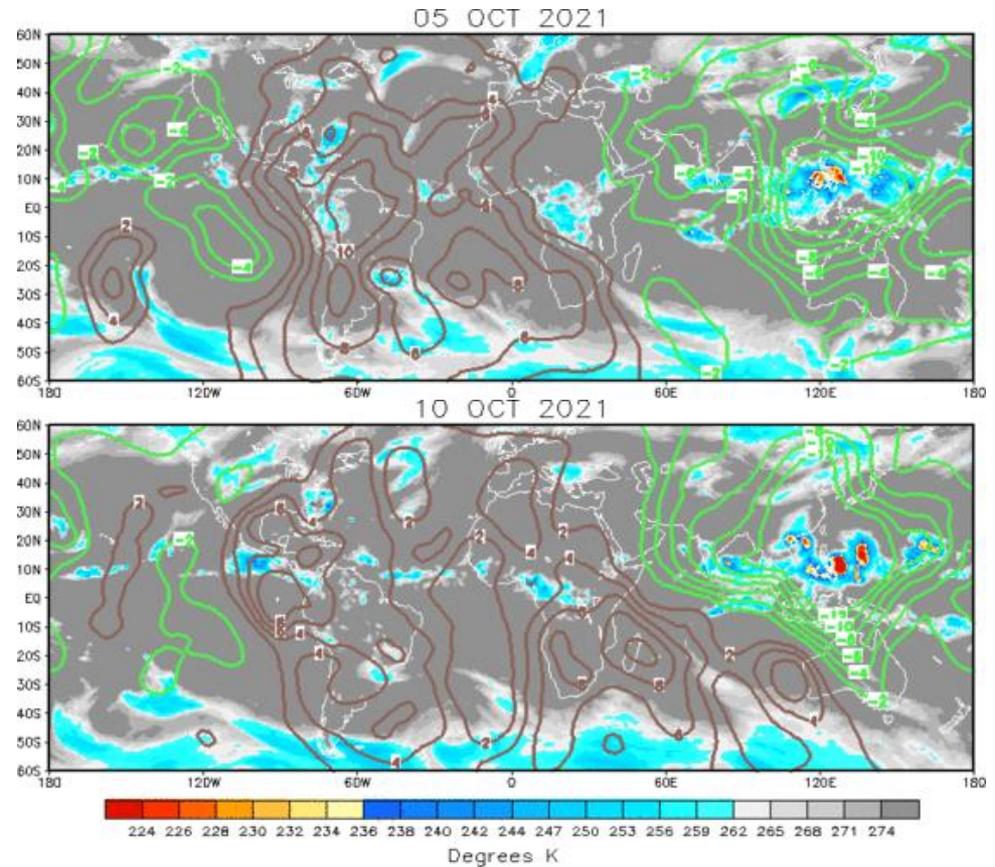
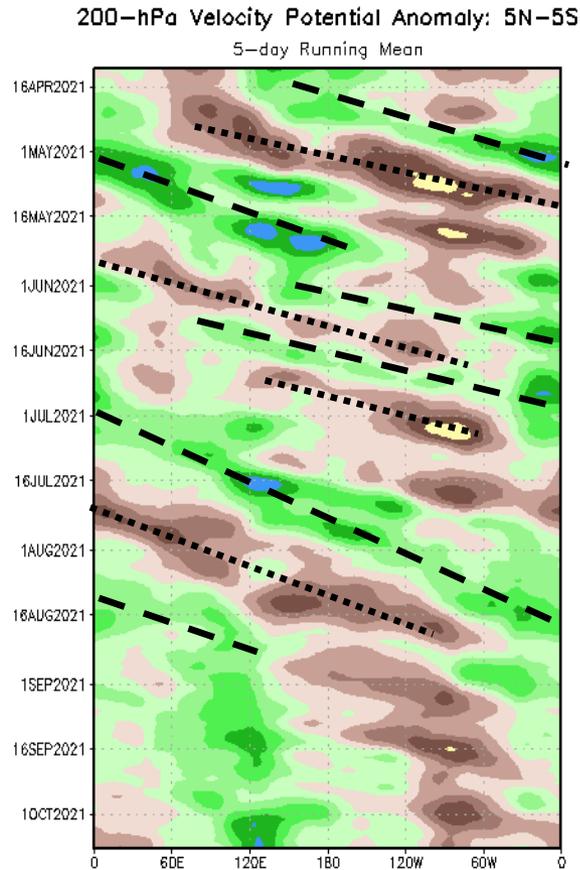
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:

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

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

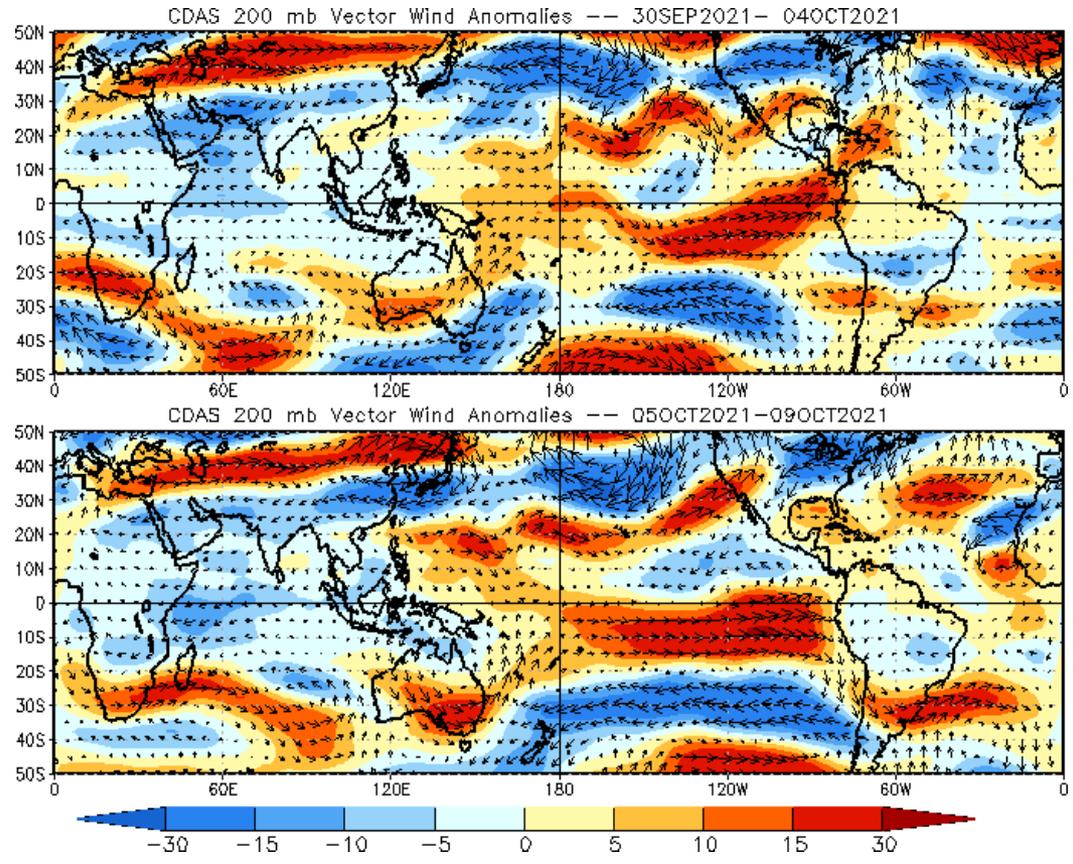
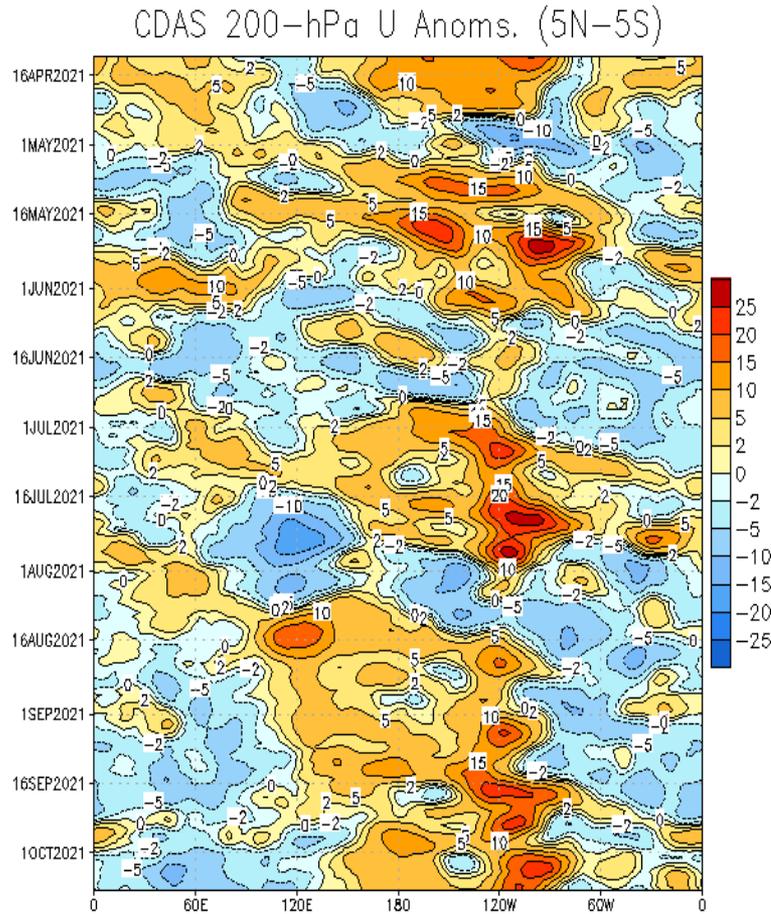
Brown shades: Anomalous convergence (unfavorable for precipitation).



- 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 has been prominent since early October, through anomalous divergence has been slow to propagate east of the Date Line.

200-hPa Wind Anomalies

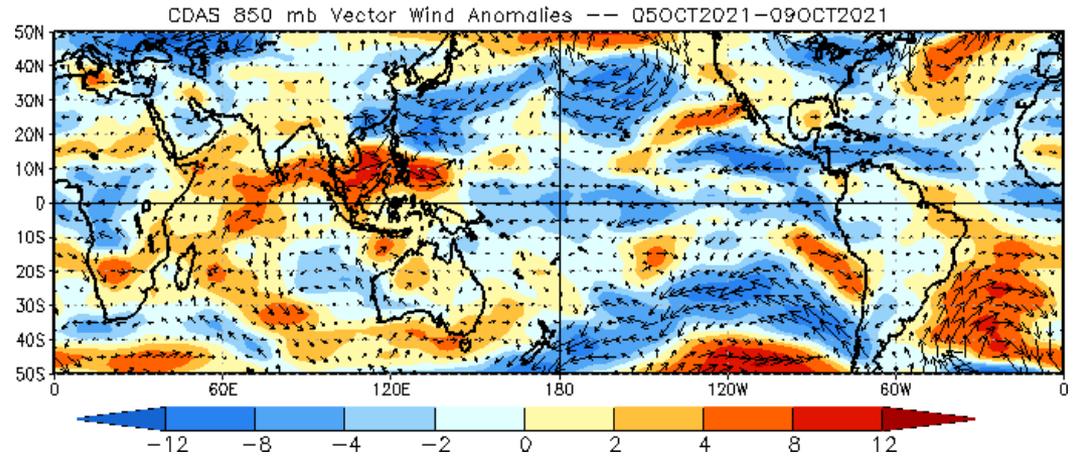
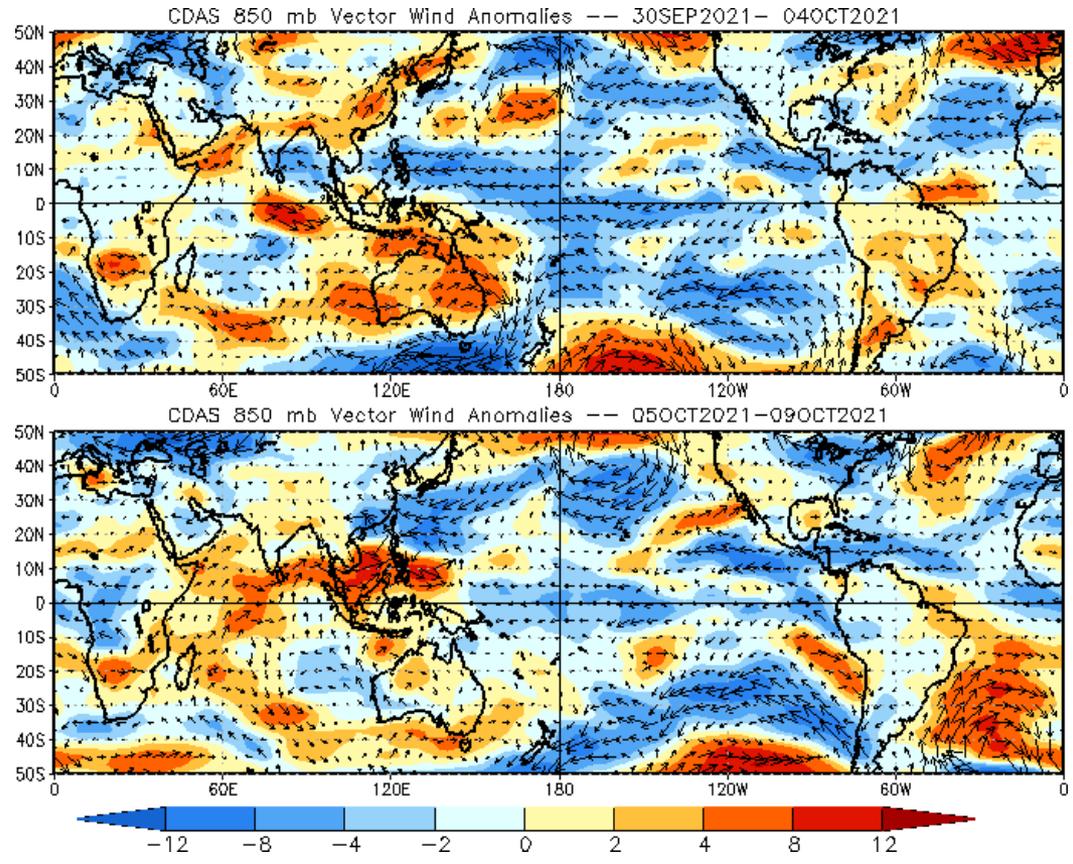
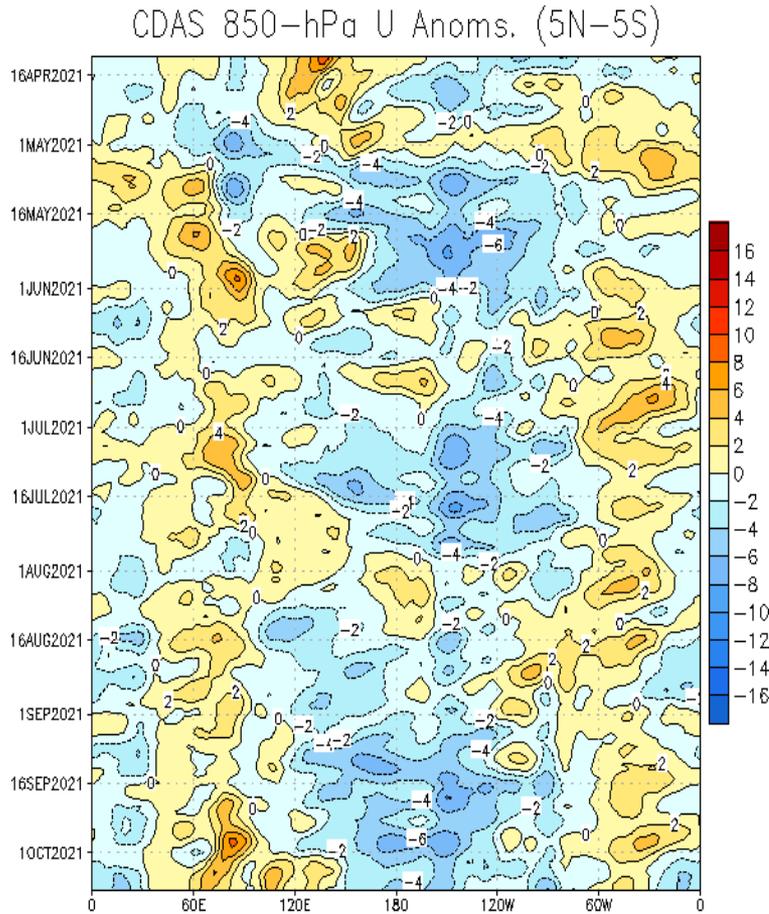
Shading denotes the zonal wind anomaly. **Blue shades: Anomalous easterlies.** **Red shades: Anomalous westerlies.**



- Anomalous upper-level westerlies persist across much of the equatorial Pacific, consistent with the atmospheric response to the developing La Niña.
- Anomalous easterlies aloft have been present across the Maritime Continent since the beginning of October, more likely tied to the low frequency background state.

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, slowing the propagation of any intraseasonal signal.
- Anomalous westerlies strengthened over the Bay of Bengal, South China Sea, and West Pacific during early October, likely tied to the superposition of the MJO with equatorial Rossby wave and tropical cyclone activity.

Outgoing Longwave Radiation (OLR) Anomalies

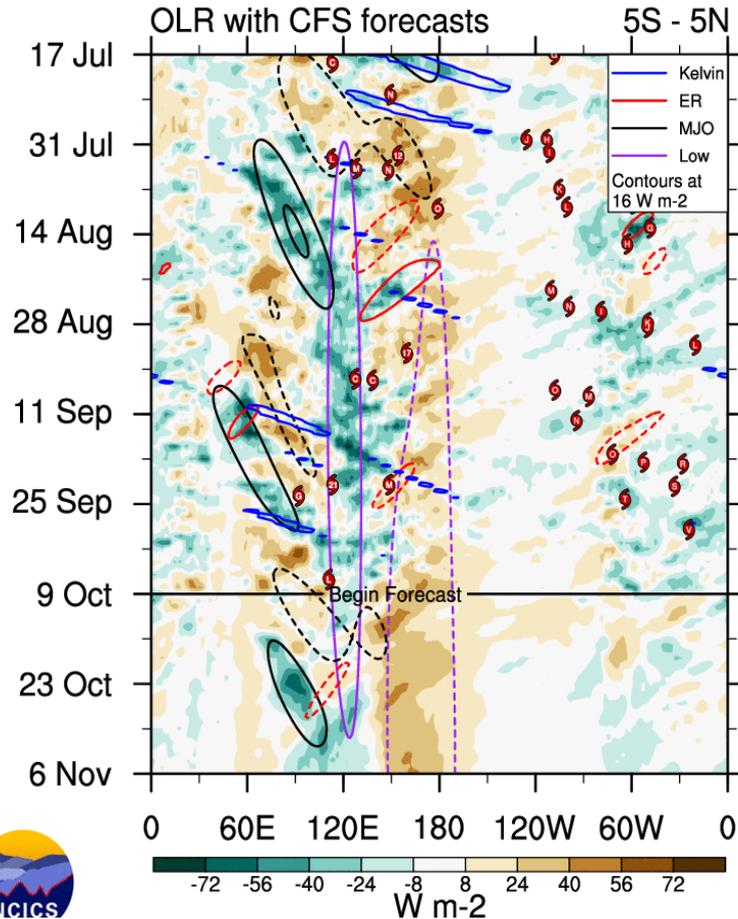
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)

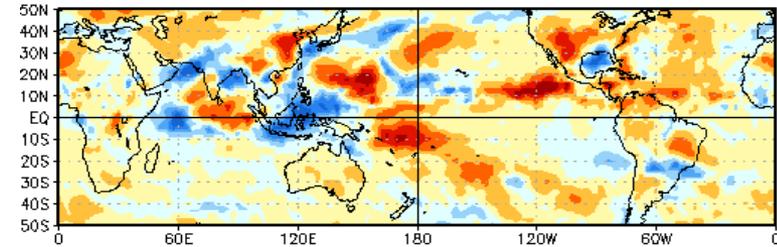
Blue shades: Anomalous convection (wetness)

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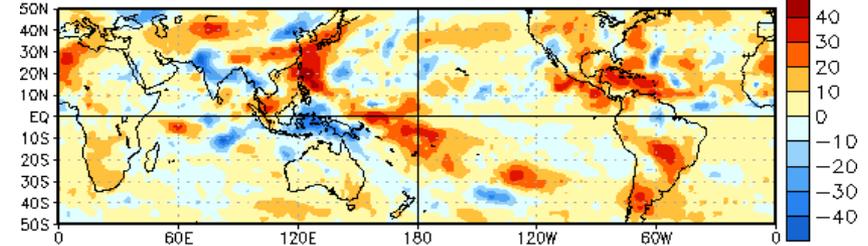
OLR Anomalies



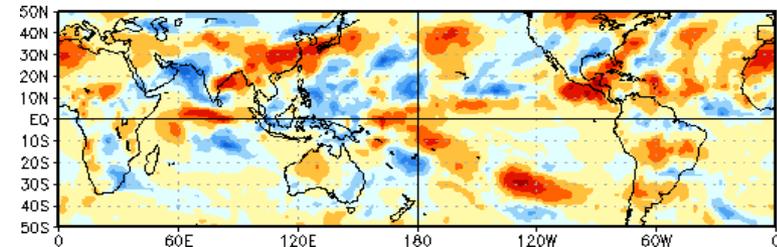
8 SEP 2021 to 17 SEP 2021



18 SEP 2021 to 27 SEP 2021

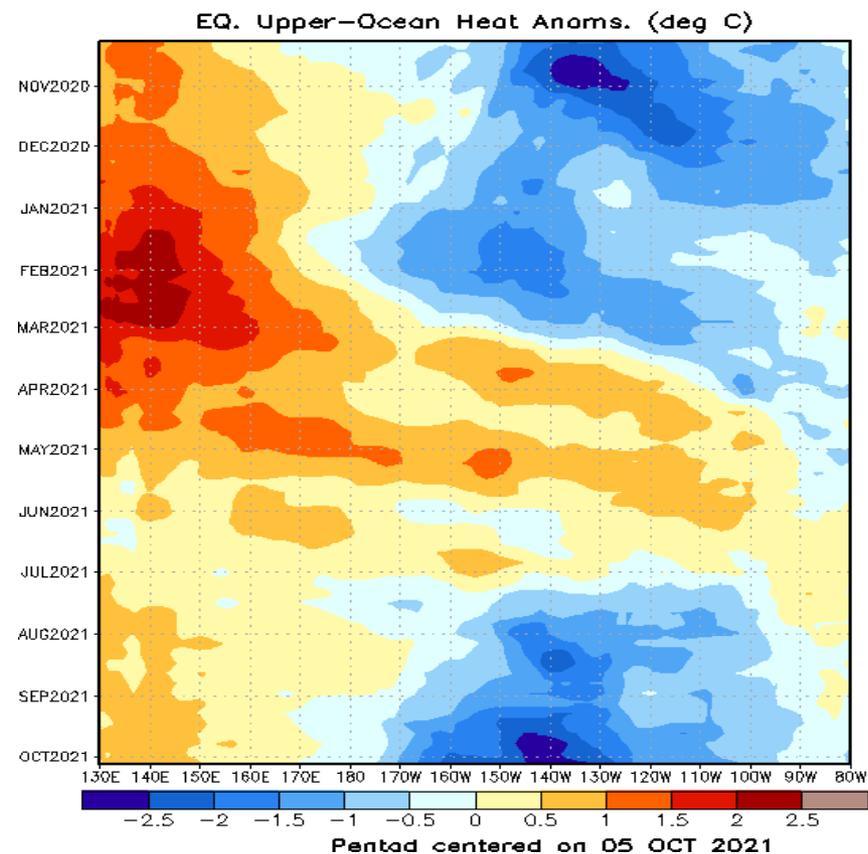
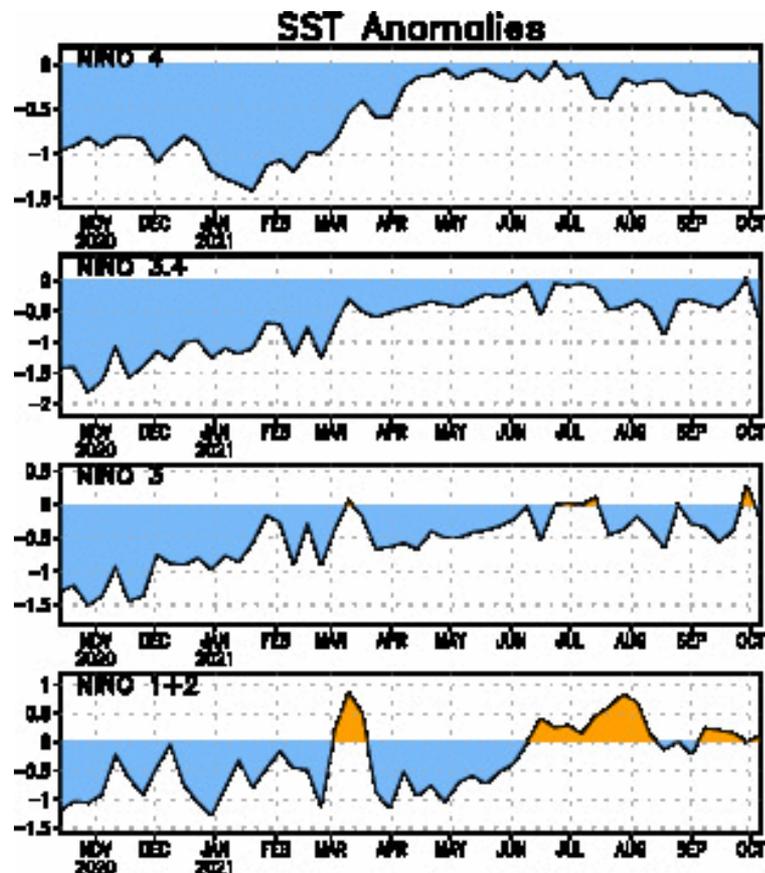


28 SEP 2021 to 7 OCT 2021



- Enhanced (suppressed) convection persists over the Maritime Continent (equatorial Central Pacific) which is associated with the low-frequency state.
- Anomalous convection built across the West Pacific during late September and early October as the enhanced MJO envelope continued pushing eastward.

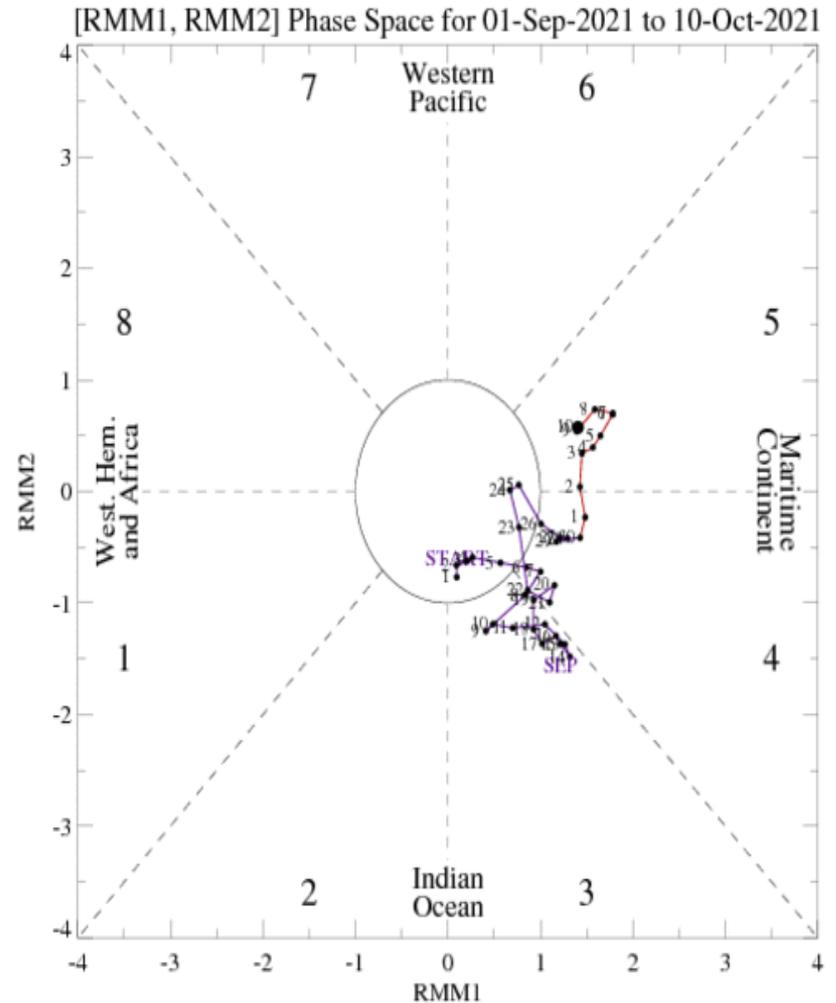
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- 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 through present.
- Below-normal sea surface temperatures are observed within all Niño regions except the far eastern Pacific, consistent with a forecast trend toward La Niña.

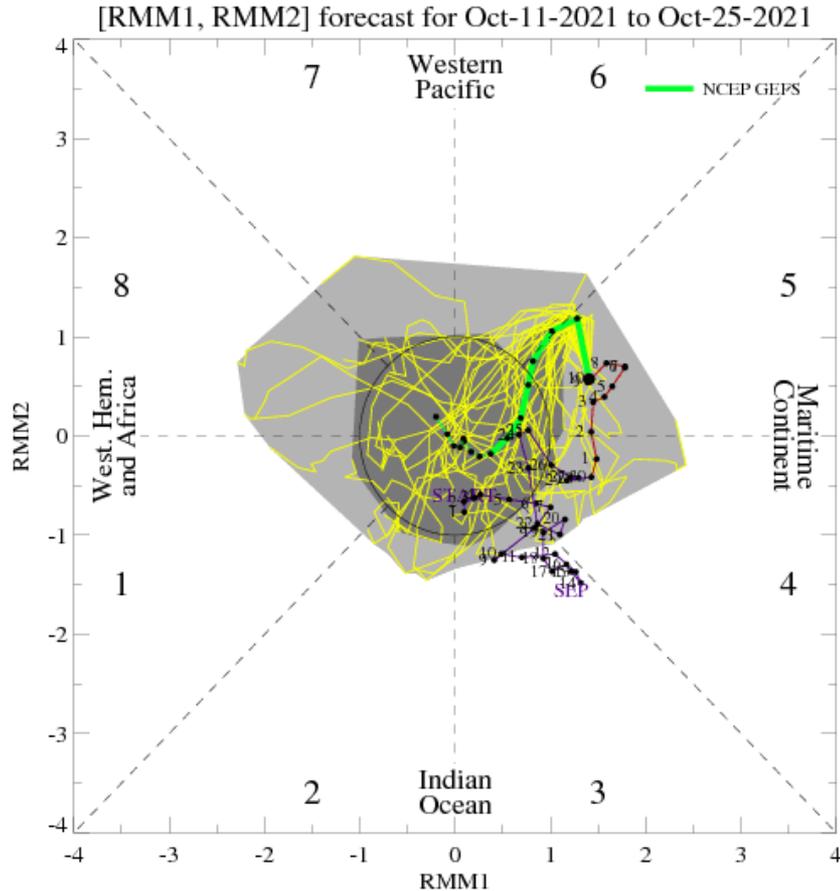
MJO Index: Recent Evolution

- The RMM index depicts a stationary intraseasonal signal over the eastern Maritime Continent.

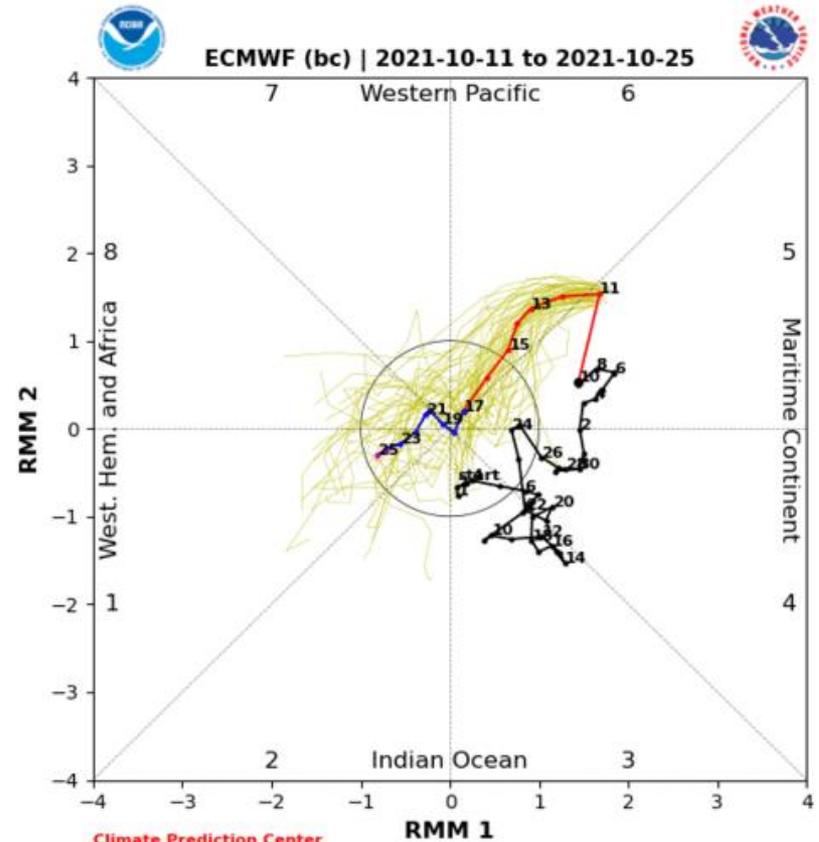


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



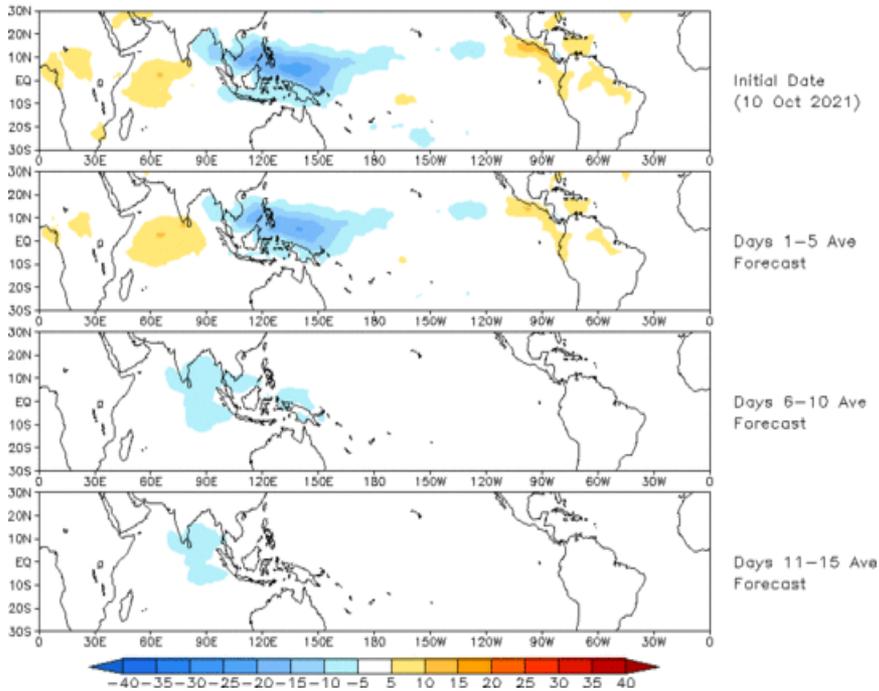
ECMWF Forecast

- Dynamical models are fairly consistent in supporting a shift toward negative RMM1 values, other than a handful of GEFS members, putting the MJO over the Western Hemisphere during late October. Differences in RMM2 are large, resulting in the ensemble means near the abscissa.
- The GEFS appears to have two clusters of members, one highlighting intraseasonal activity crossing the Pacific the next two weeks, and the other instead targeting the transition toward La Niña. The ECMWF ensembles show less favoritism for the background state the next two weeks, and instead focus on the intraseasonal signal crossing the Pacific.

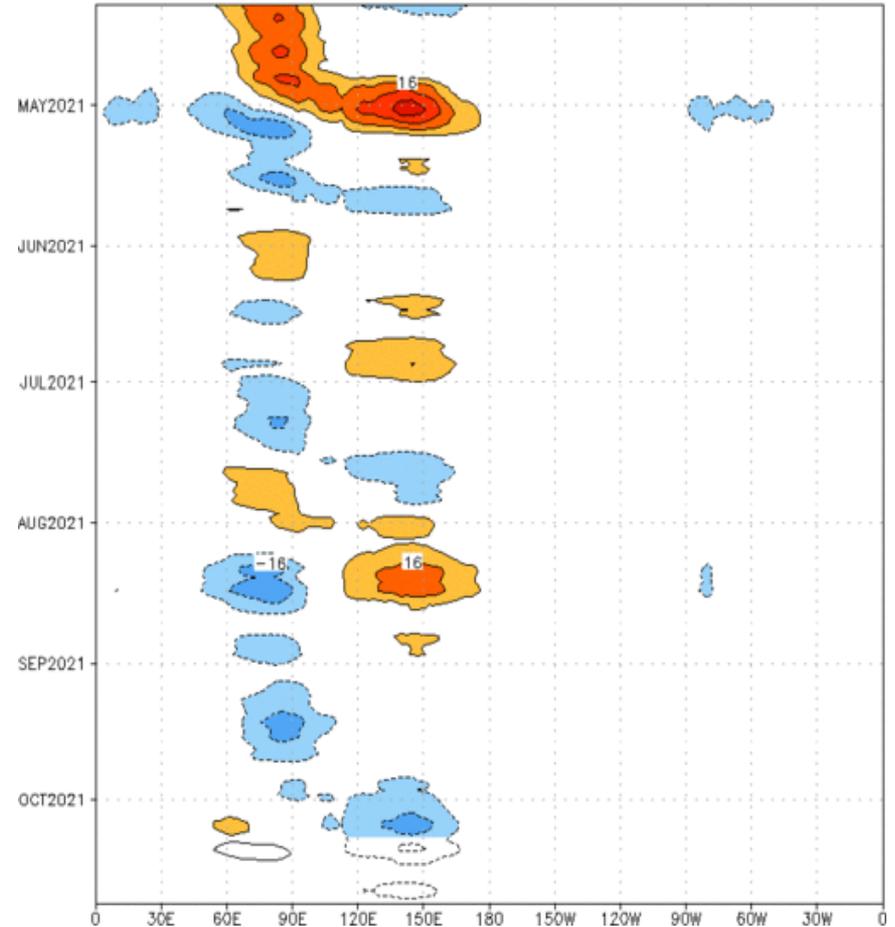
MJO: GEFS Forecast Evolution

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: 10 Oct 2021
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [$7.5^{\circ}S, 7.5^{\circ}N$] (cont: $4Wm^{-2}$) Period: 09-Apr-2021 to 09-Oct-2021
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

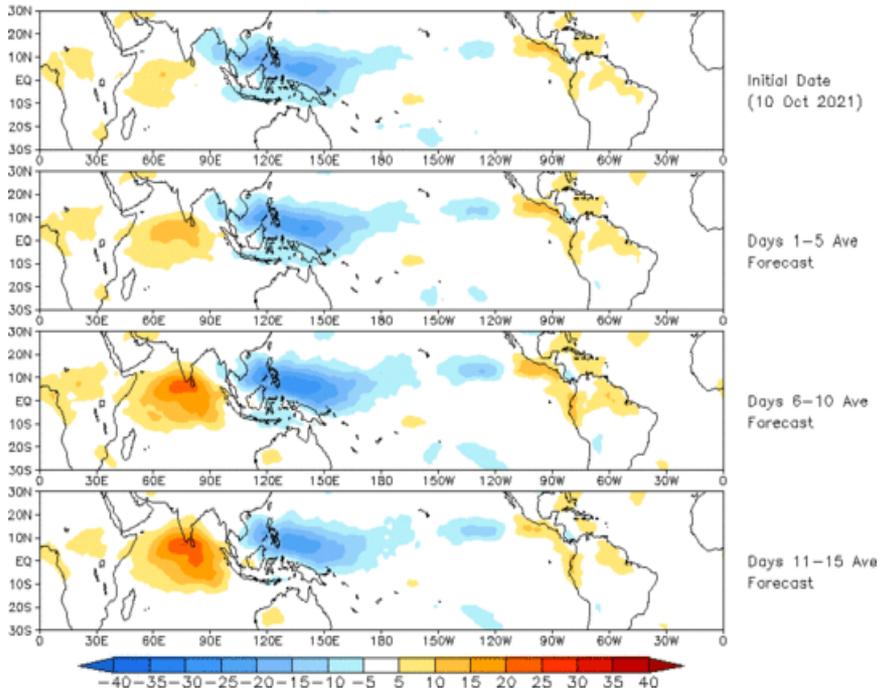


- The GEFS RMM-based OLR anomaly forecast features a stationary pattern through mid-October that favors enhanced (suppressed) convection over the West Pacific (Indian Ocean and Americas). During the second half of October, convection is favored to be enhanced by the MJO across the Indian Ocean.

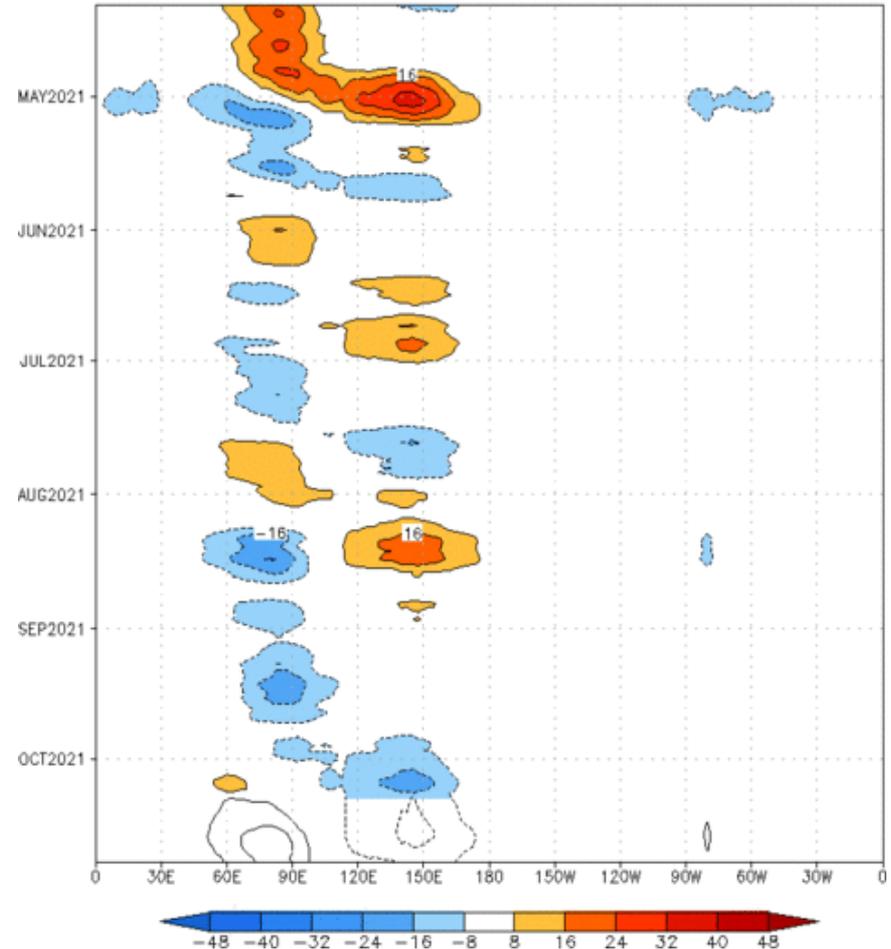
MJO: Constructed Analog Forecast Evolution

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 (10 Oct 2021)



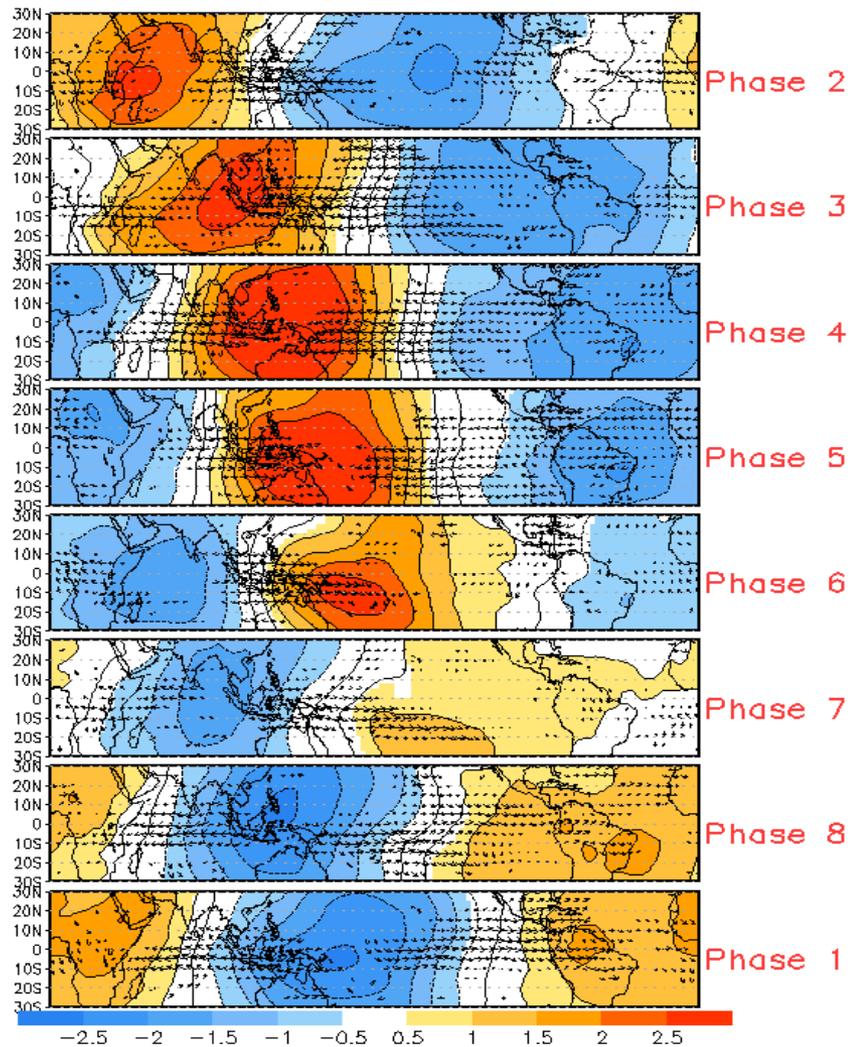
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:10-Apr-2021 to 10-Oct-2021
The unfilled contours are CA forecast reconstructed anomaly for 15 days



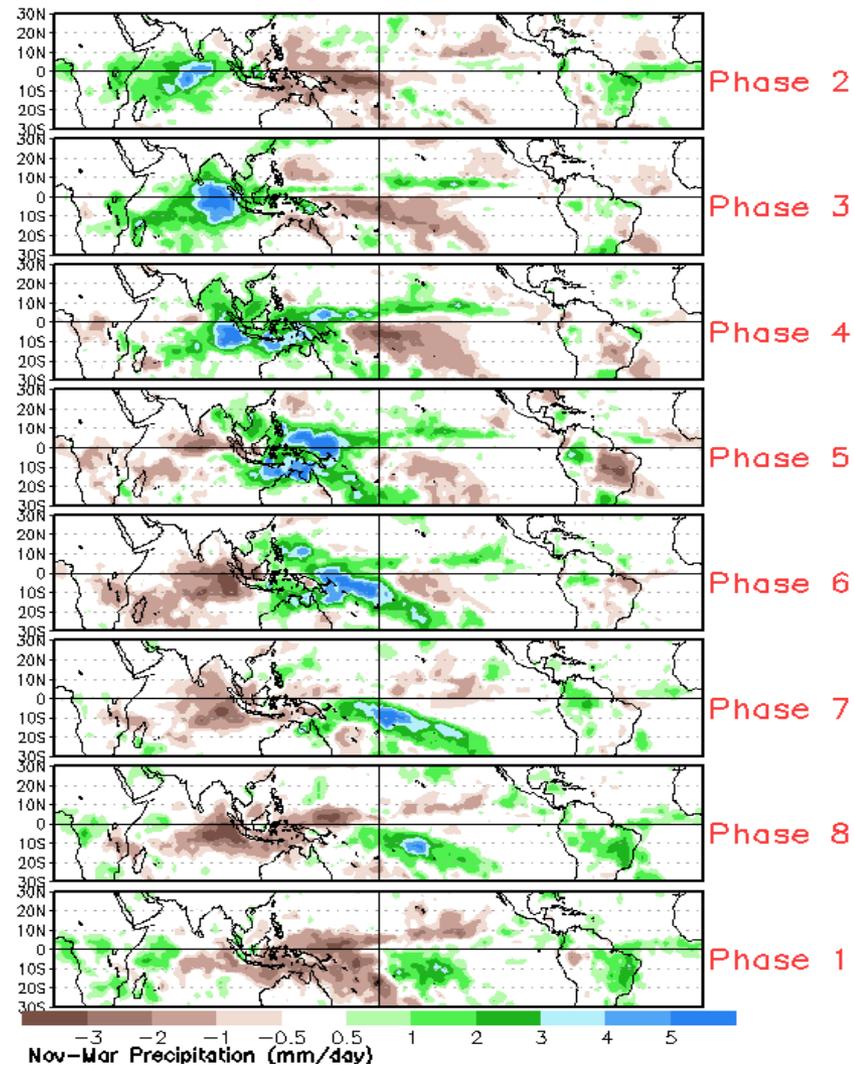
- The constructed analog shows limited eastward progression of the intraseasonal signal the next to weeks, despite some intensification of the convective dipole across the Indian Ocean and West Pacific.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



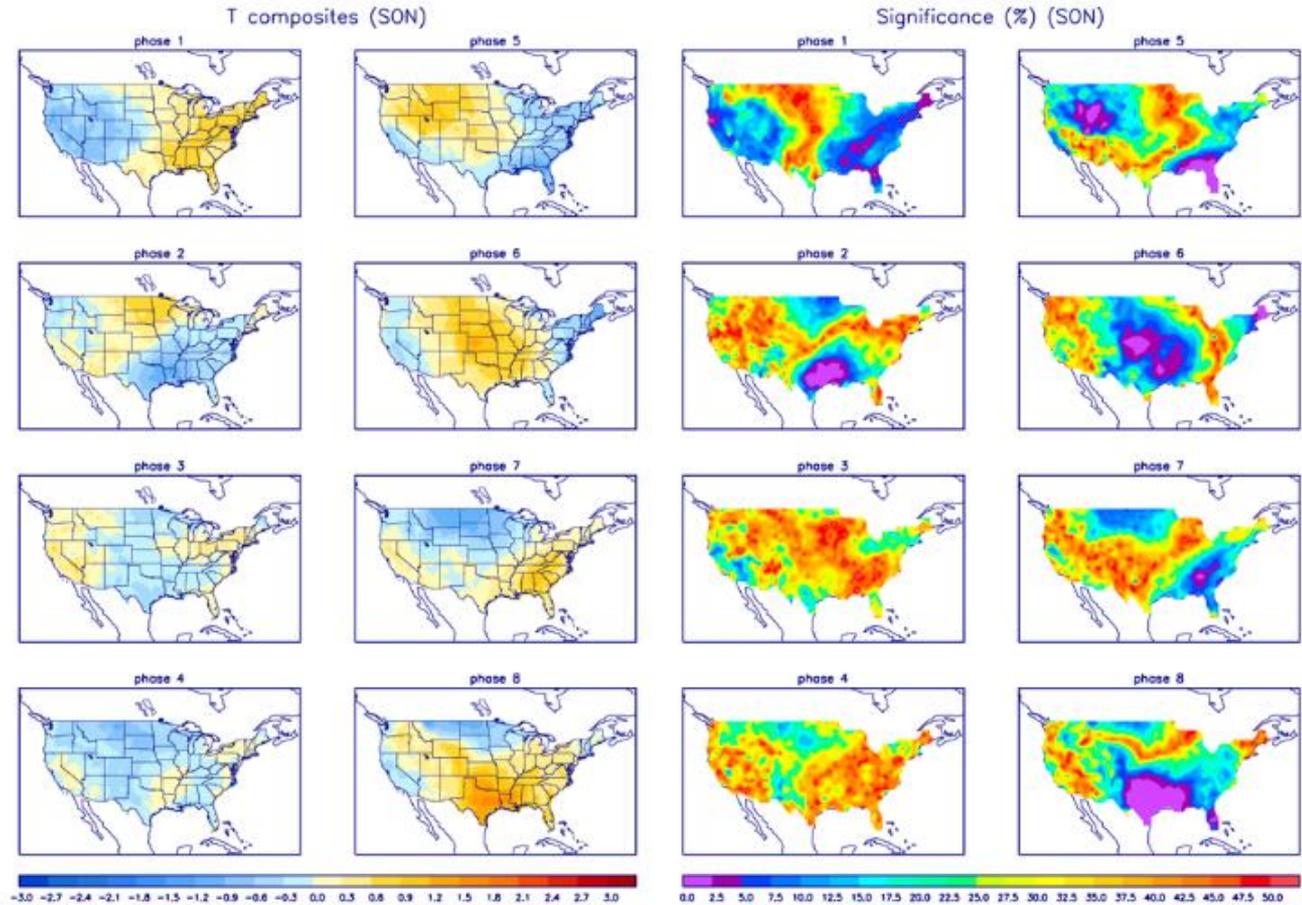
Precipitation Anomalies



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.

