

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



Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
5 September 2022

Overview

- There was a brief resurgence of the MJO signal across the Indian Ocean during late August, but it quickly weakened by early September with La Niña remaining the dominant mode of tropical variability.
- The enhanced convective envelope remains situated across the Indian Ocean, Maritime Continent, and far Western Pacific, with limited eastward propagation forecast, supporting continued heavy rainfall in these regions, and possible tropical cyclone development.
- Kelvin Wave activity may support additional tropical cyclone formation across the Eastern Pacific and Atlantic Basins during the next 2 weeks.

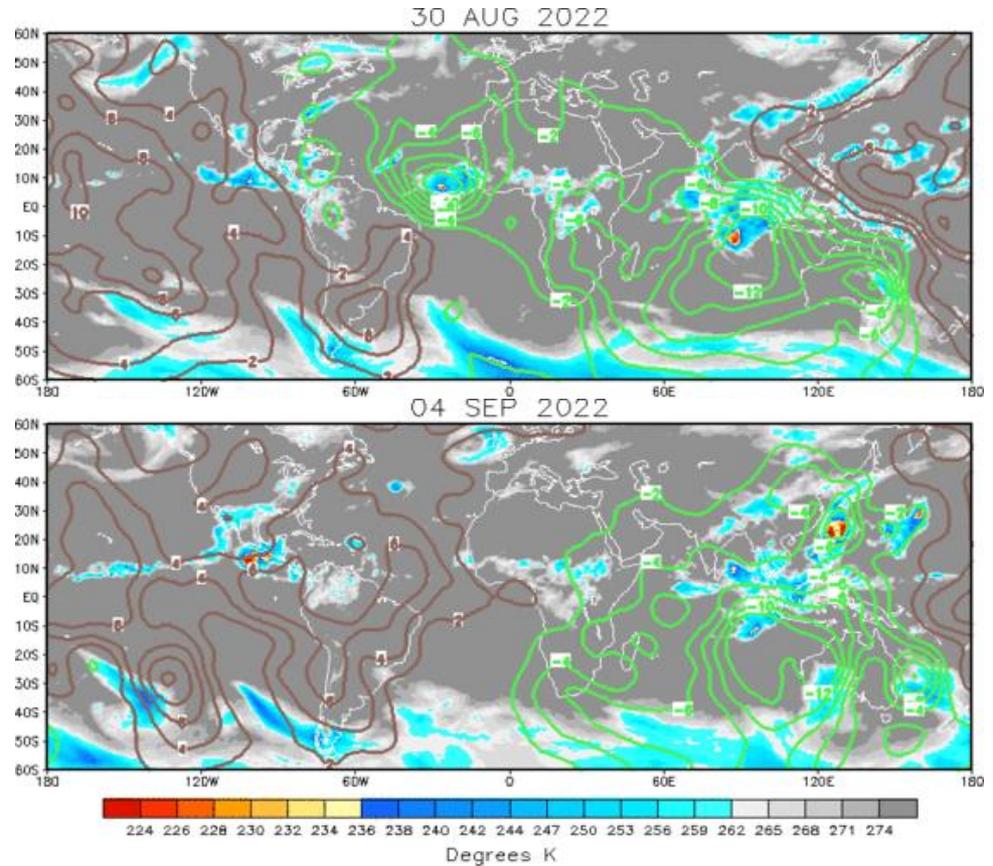
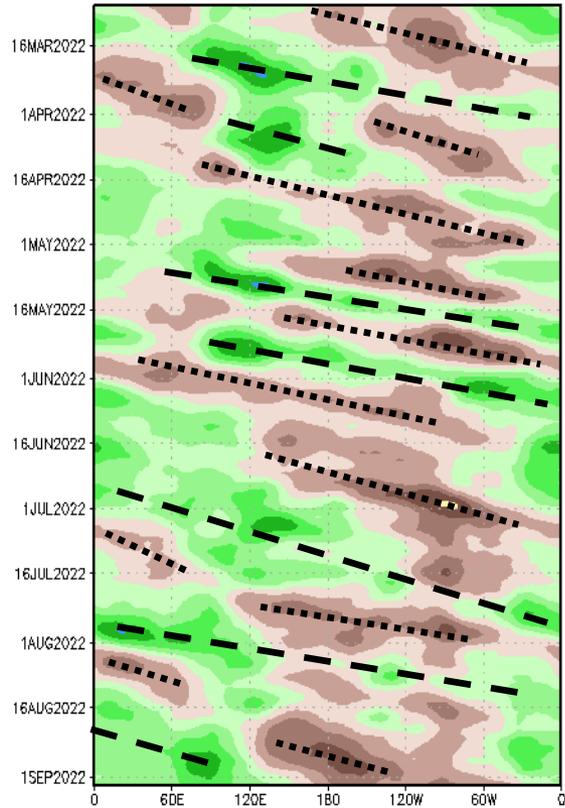
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

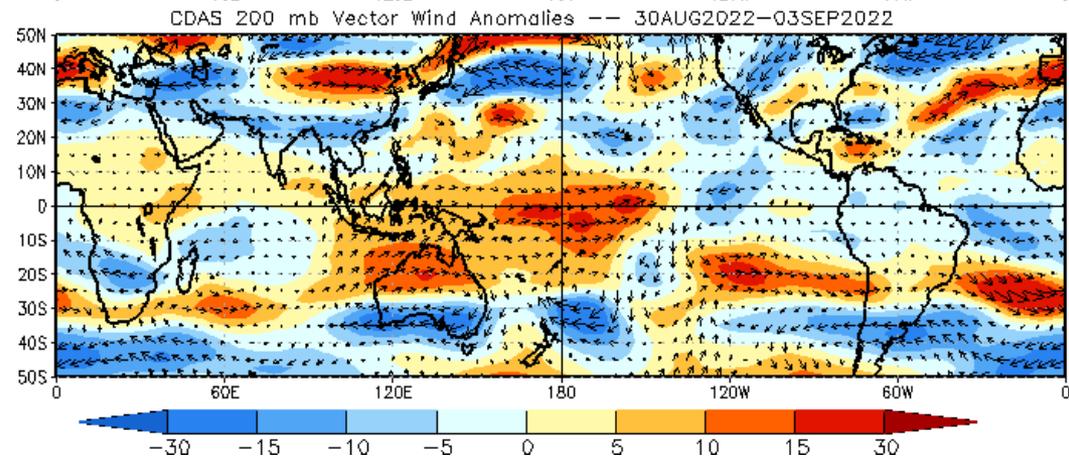
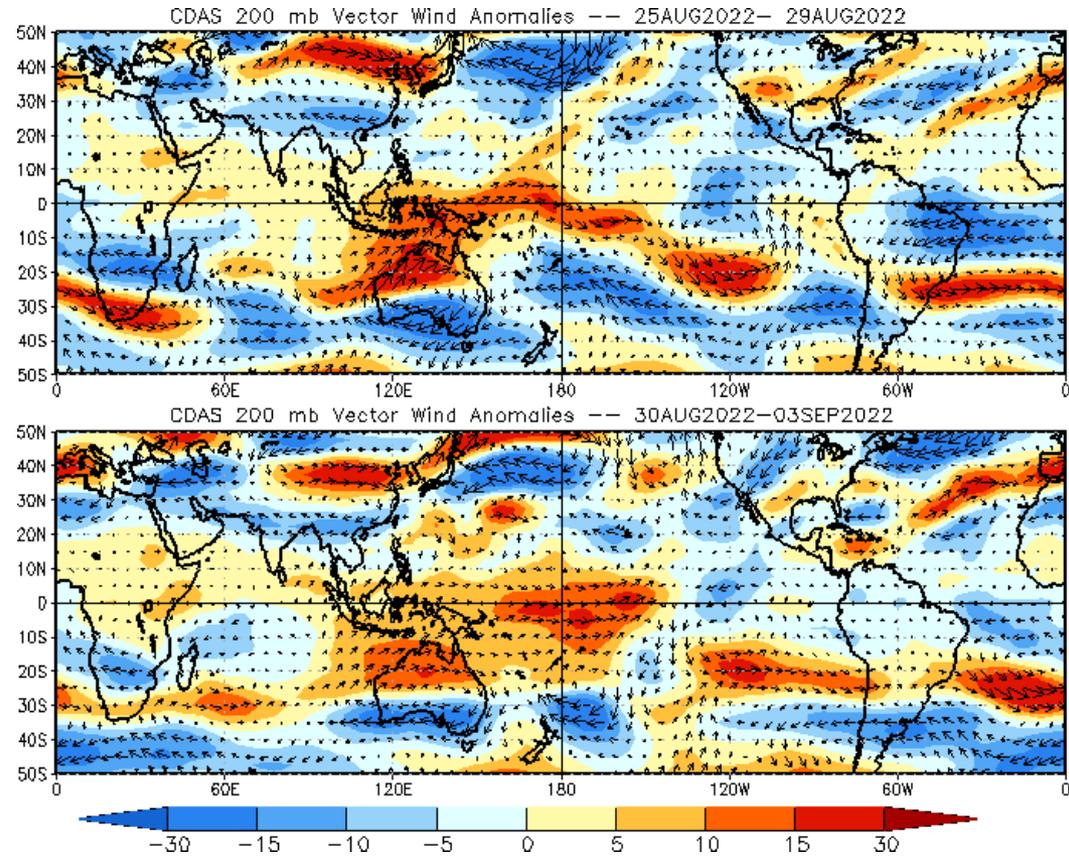
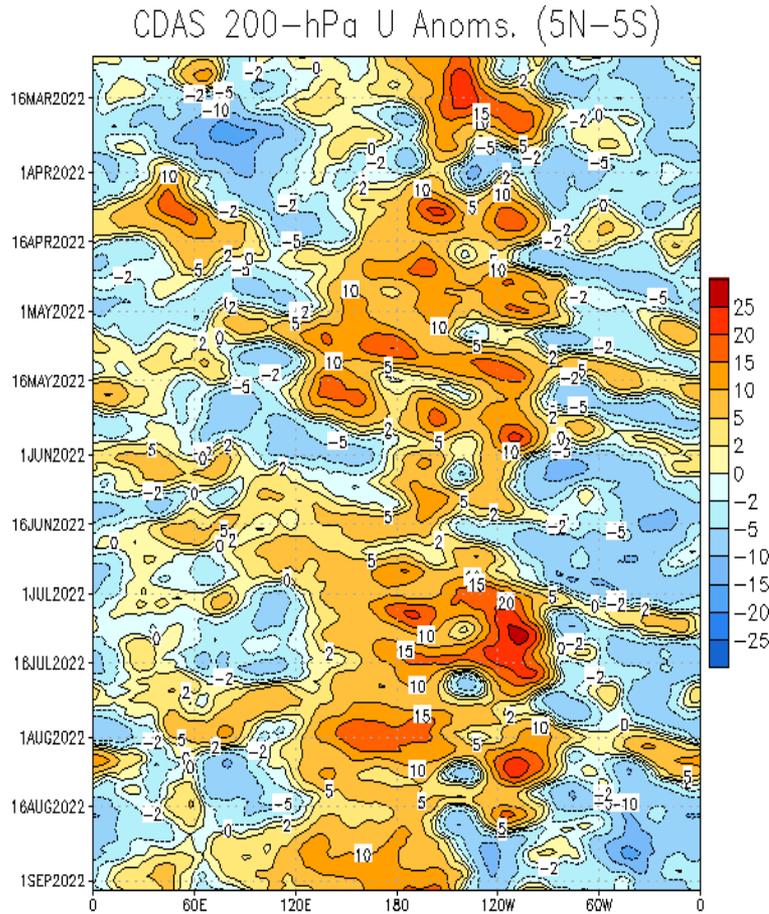
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- A coherent wave-1 asymmetry pattern has emerged in the spatial upper-level velocity potential field in early September, consistent with a decaying MJO and a stable low frequency La Niña signal remaining intact.
- The enhanced convective envelope is located across the Indian Ocean, Maritime Continent, and far Western Pacific, with suppressed convection over much of the Western Hemisphere.

200-hPa Wind Anomalies

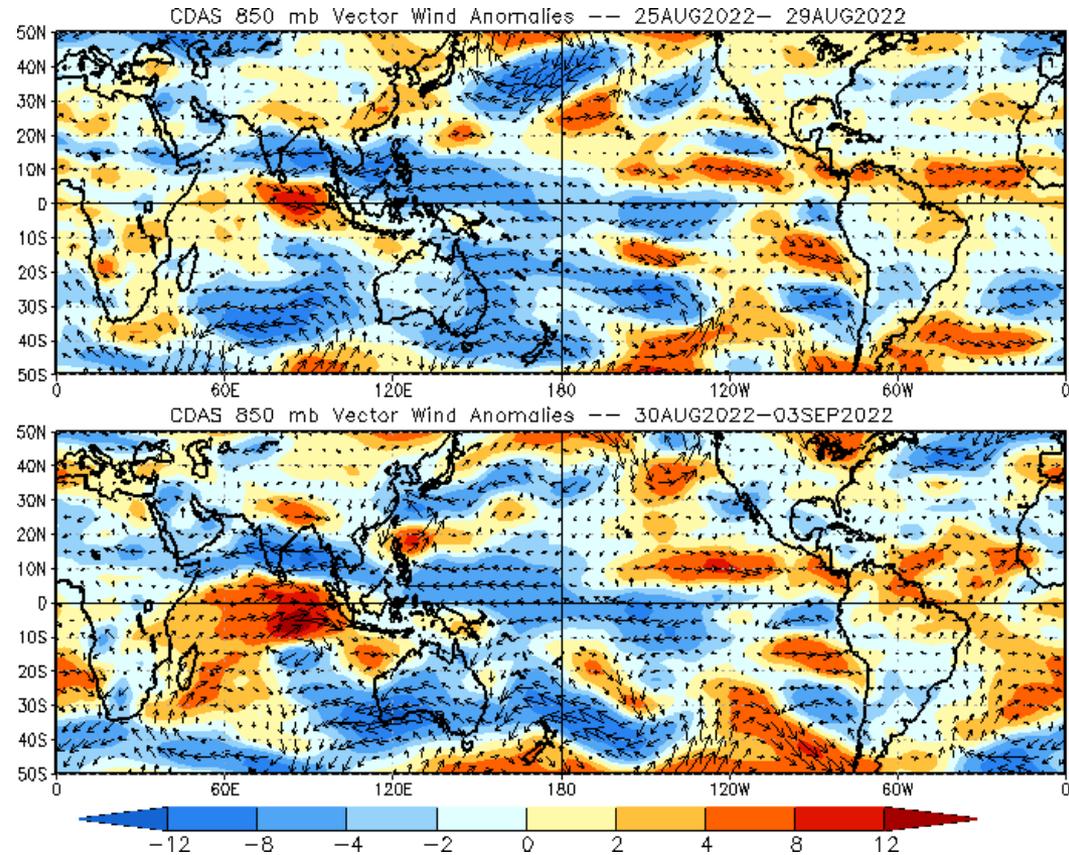
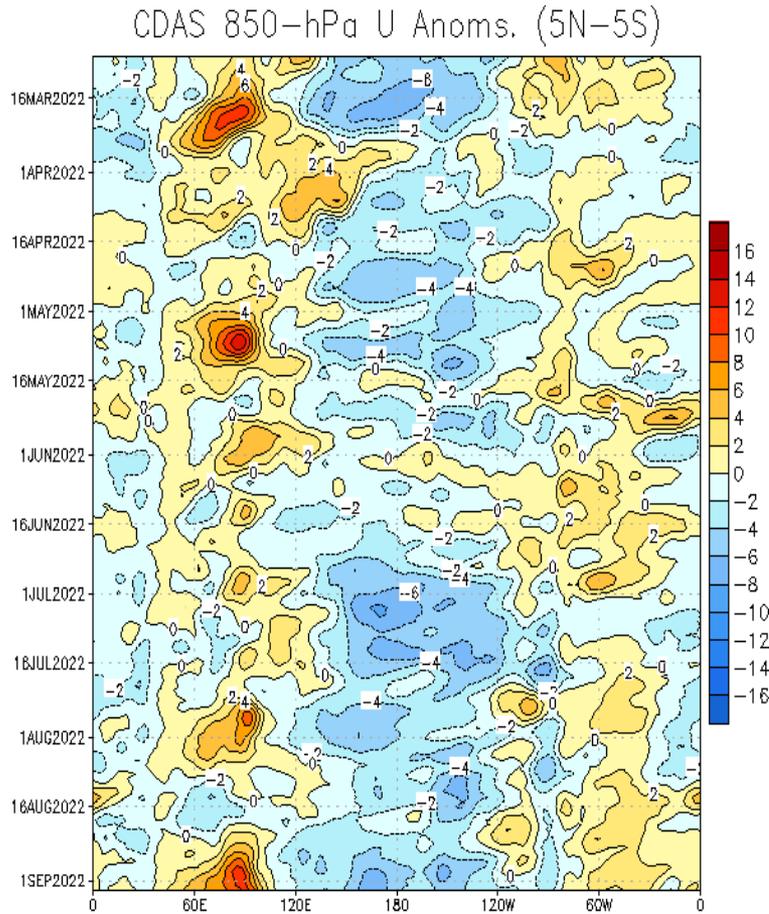
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Anomalous upper-level westerlies remain prevalent across the western and central equatorial Pacific as a result of the enhanced La Niña.
- Anti-cyclonic circulation to the south of the equator led to anomalous upper-level easterlies over the equatorial eastern Pacific, thereby promoting a more west-based La Niña response during the past couple of weeks.

850-hPa Wind Anomalies

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

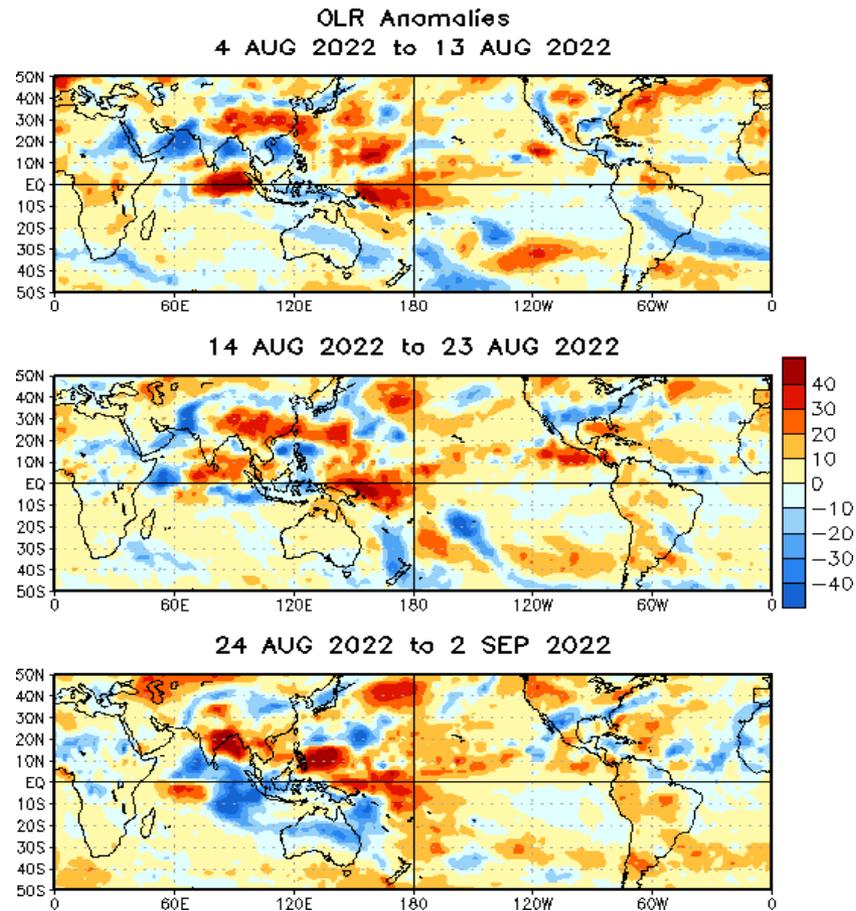
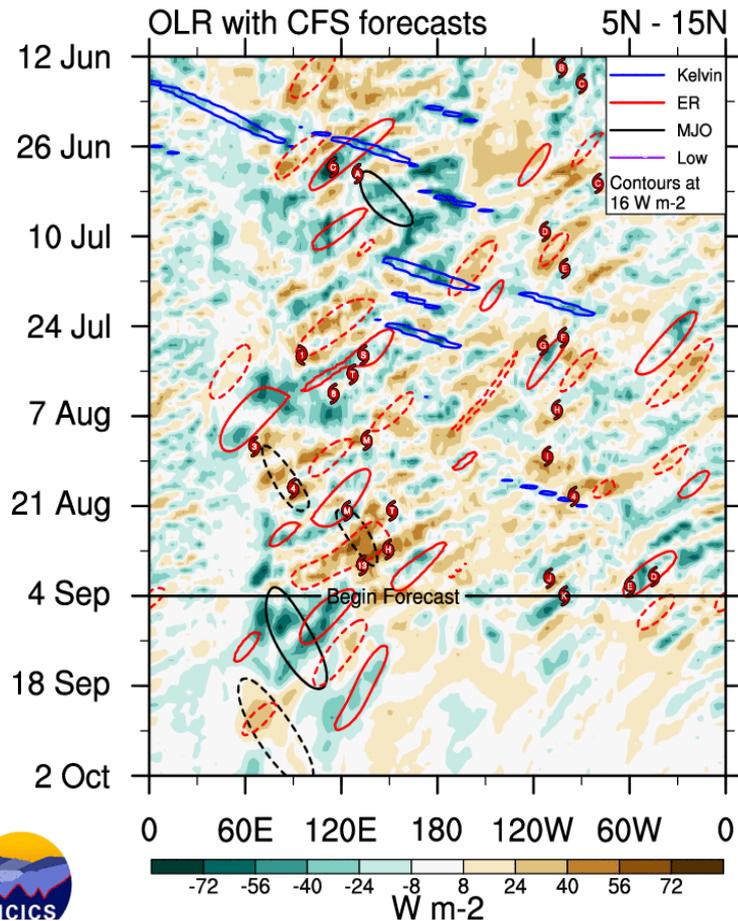


- Strong low-level anomalous westerlies developed over the Indian Ocean associated with increased convective activity across the region and a brief resurgence of the MJO signal.
- The eastward propagation of this low-level wind burst appears to have stalled as anomalous low-level easterlies persist over much of the western and central equatorial Pacific associated with La Niña.

Outgoing Longwave Radiation (OLR) Anomalies

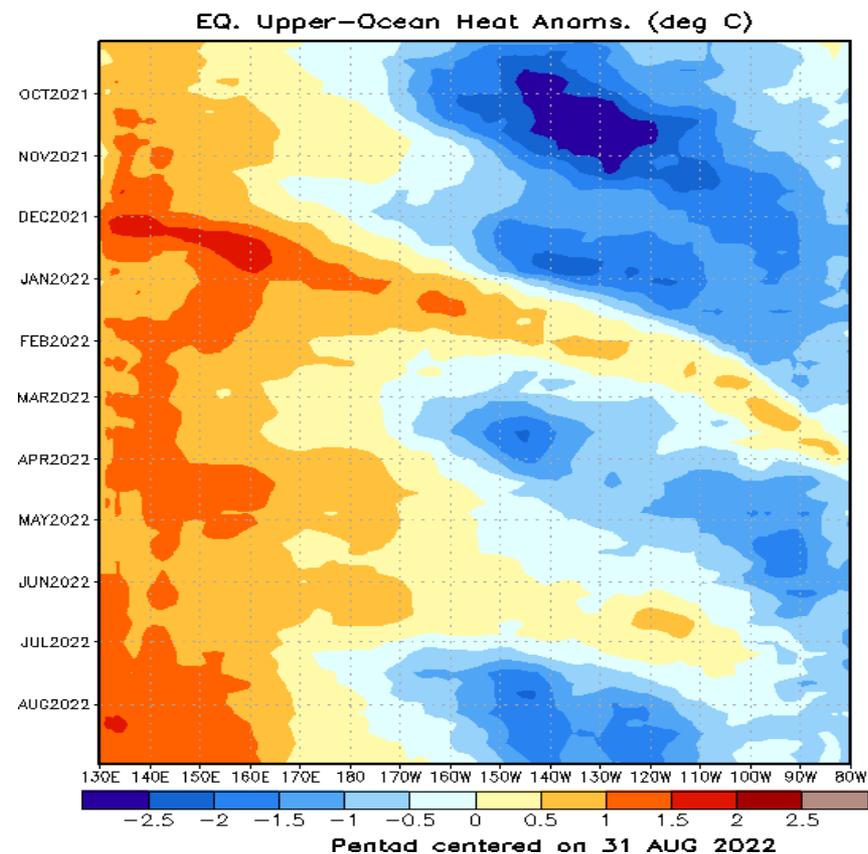
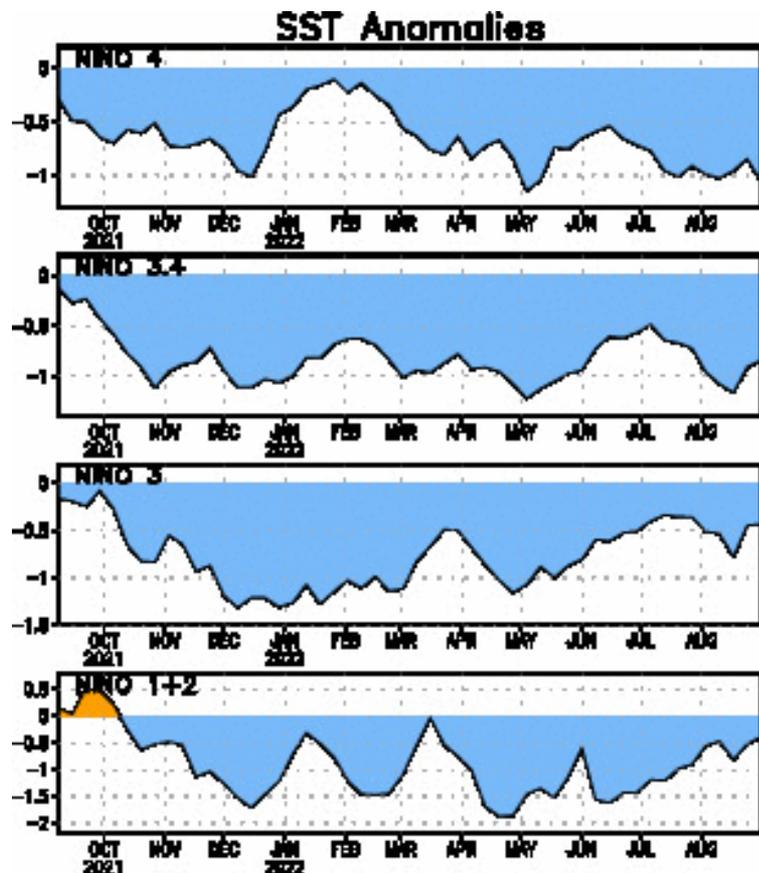
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- During the past week, negative OLR anomalies expanded across the Indian Ocean and Maritime Continent signaling an uptick in convection over the region.
- OLR filtering through the CFS forecast depicts some eastward propagation of this signal in the next 2 weeks along with constructive interference with Rossby Wave activity, favoring increasing convection across the far western Pacific and continued increased chances for tropical cyclone development.

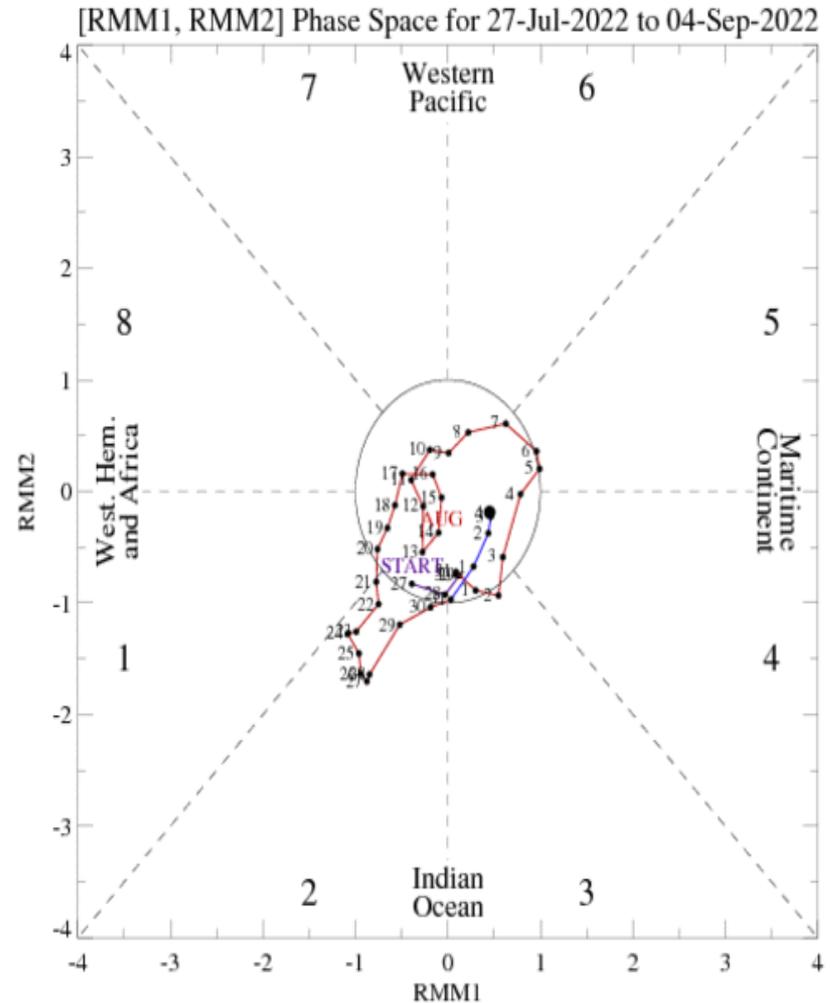
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Following a warming trend in subsurface temperatures over the equatorial Pacific in May and June, enhanced trade winds tied to La Niña resulted in a subsequent upwelling Kelvin Wave leading to a renewed subsurface cooling during July and August.
- SSTs remain below average across all Niño basins, although there has been a slight warming noted in all of the Niño basins except Niño 4, which is furthest west.

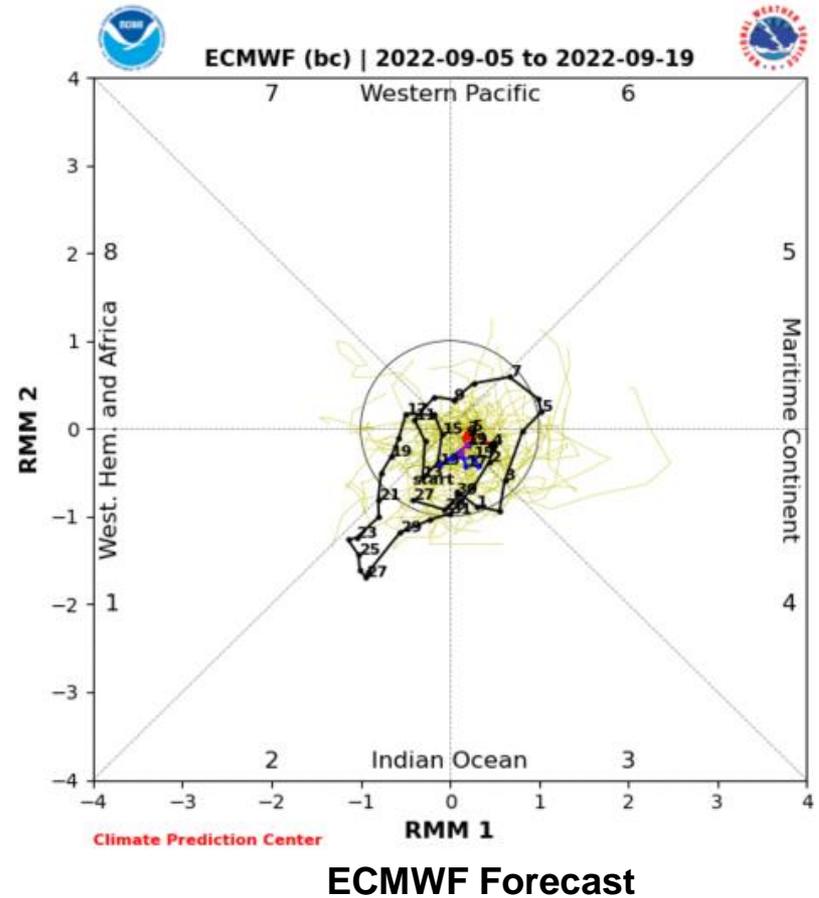
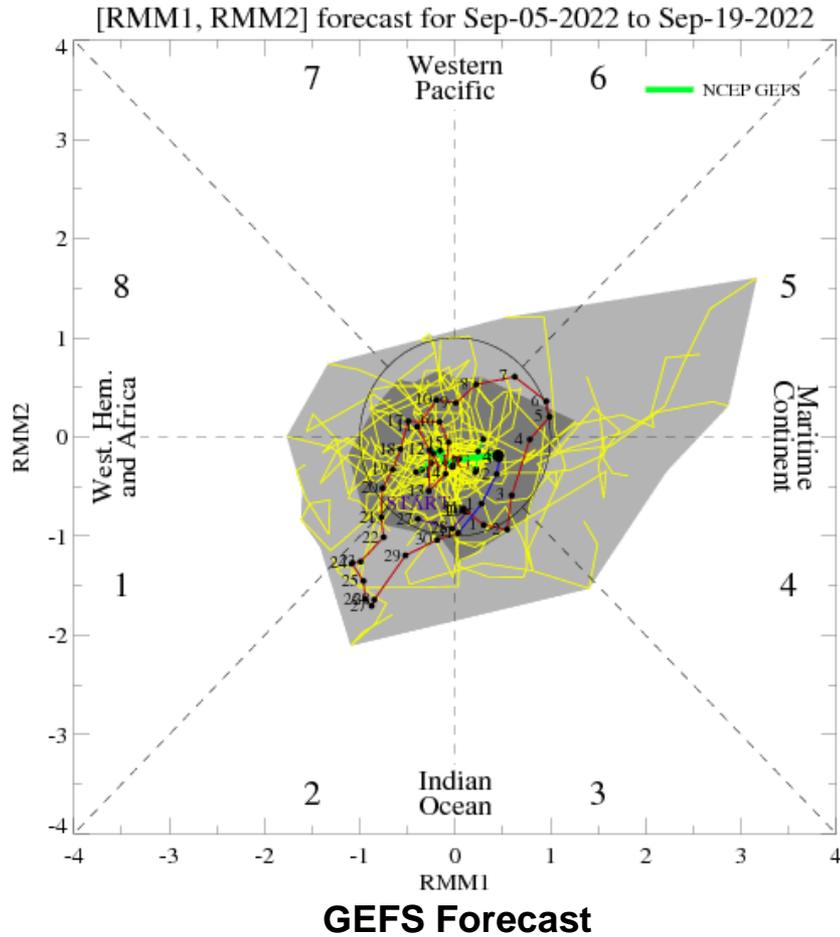
MJO Index: Recent Evolution

- There was a brief amplification of the MJO signal over the Indian Ocean during late August; however, the signal quickly retreated back into the RMM-unit circle in early September.



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

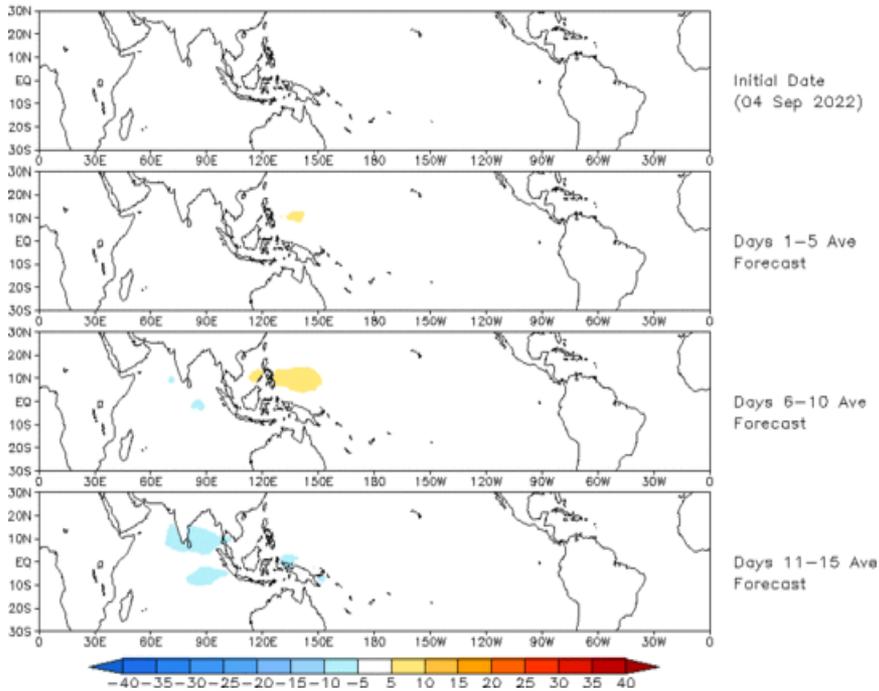


- The GEFS and ECMWF ensembles depict an incoherent signal in regards to MJO propagation during the next 2 weeks, with the ensemble means remaining within the RMM-unit circle and large variability noted among the individual members.

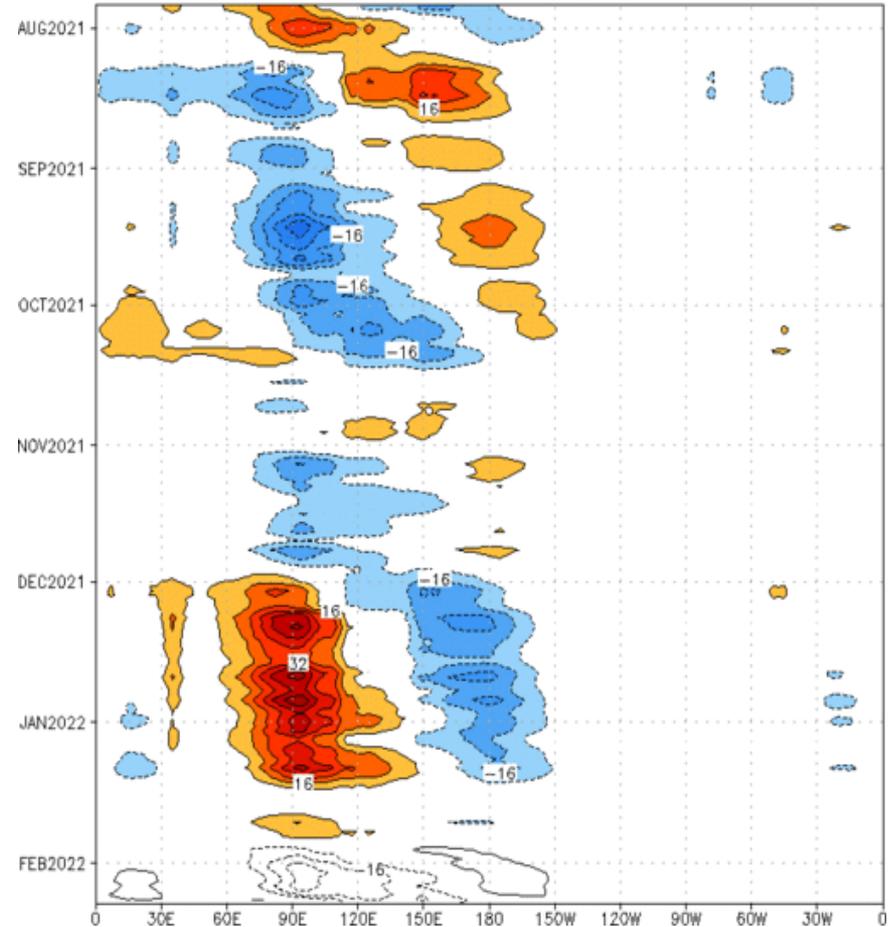
MJO: GEFS Forecast Evolution

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: 04 Sep 2022
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [$7.5^{\circ}\text{S}, 7.5^{\circ}\text{N}$] (cont: 4Wm^{-2}) Period: 27-Jul-2021 to 26-Jan-2022
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

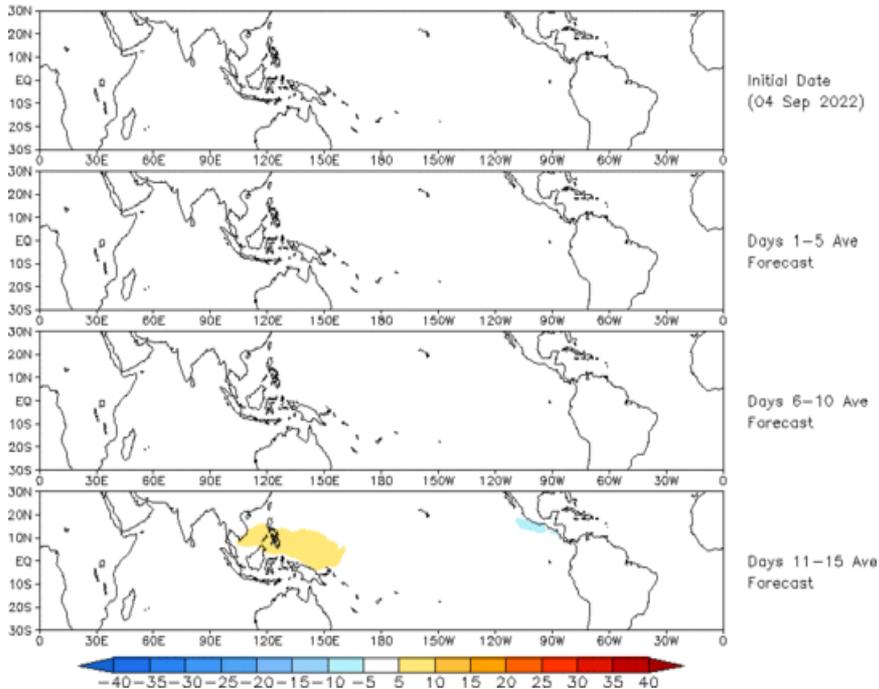


- There is little to no signal in the GEFS-based OLR anomaly field during the next few days, with weak negative OLR anomalies (enhanced convection) emerging across the Indian Ocean, Maritime Continent, and far western Pacific by the end of week-2.

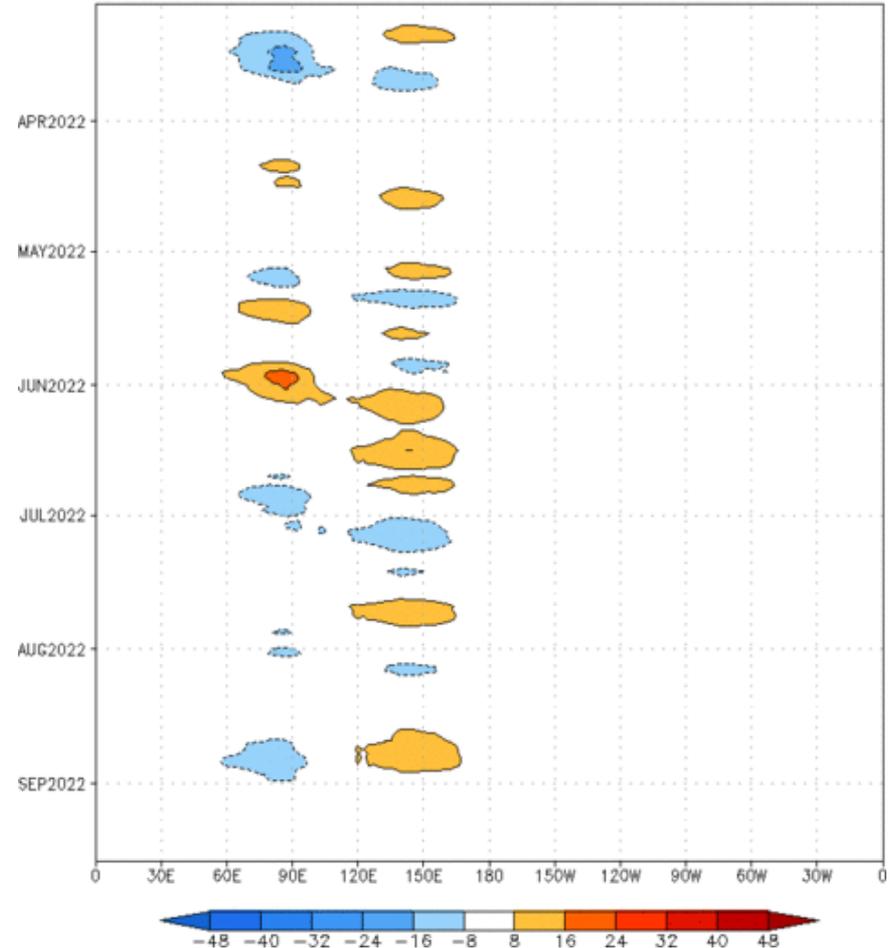
MJO: Constructed Analog Forecast Evolution

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 (04 Sep 2022)



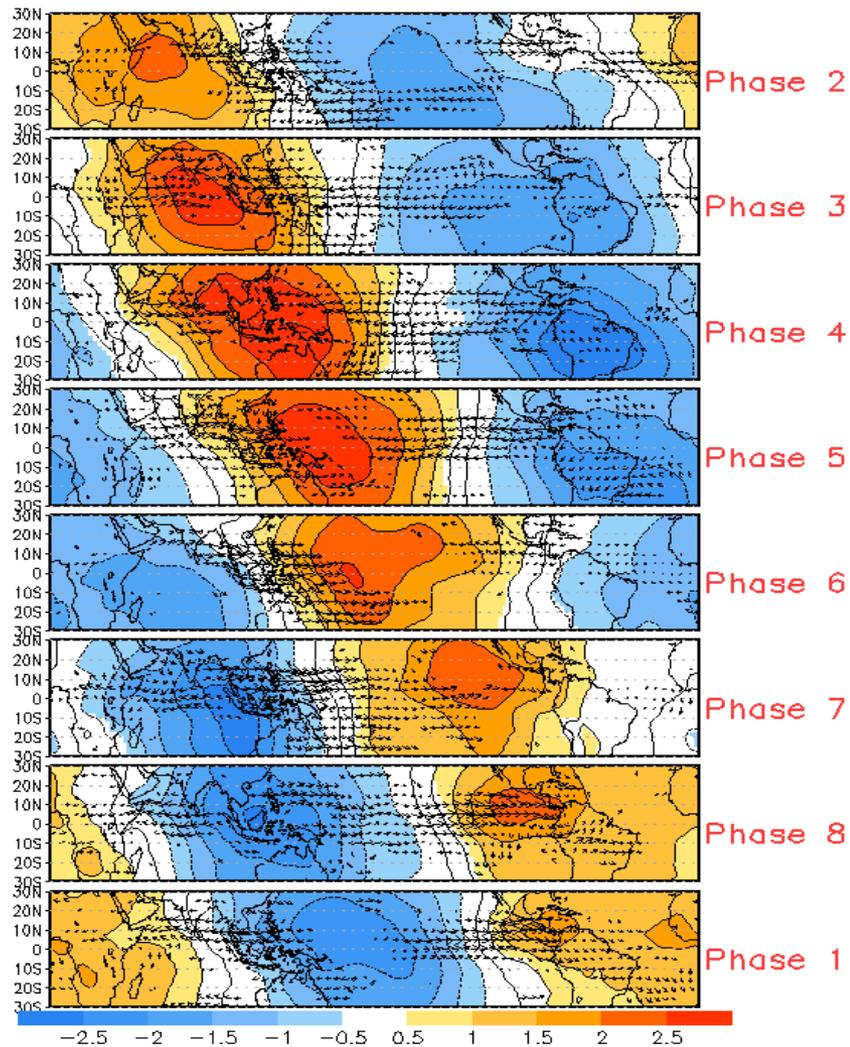
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:05-Mar-2022 to 04-Sep-2022
The unfilled contours are CA forecast reconstructed anomaly for 15 days



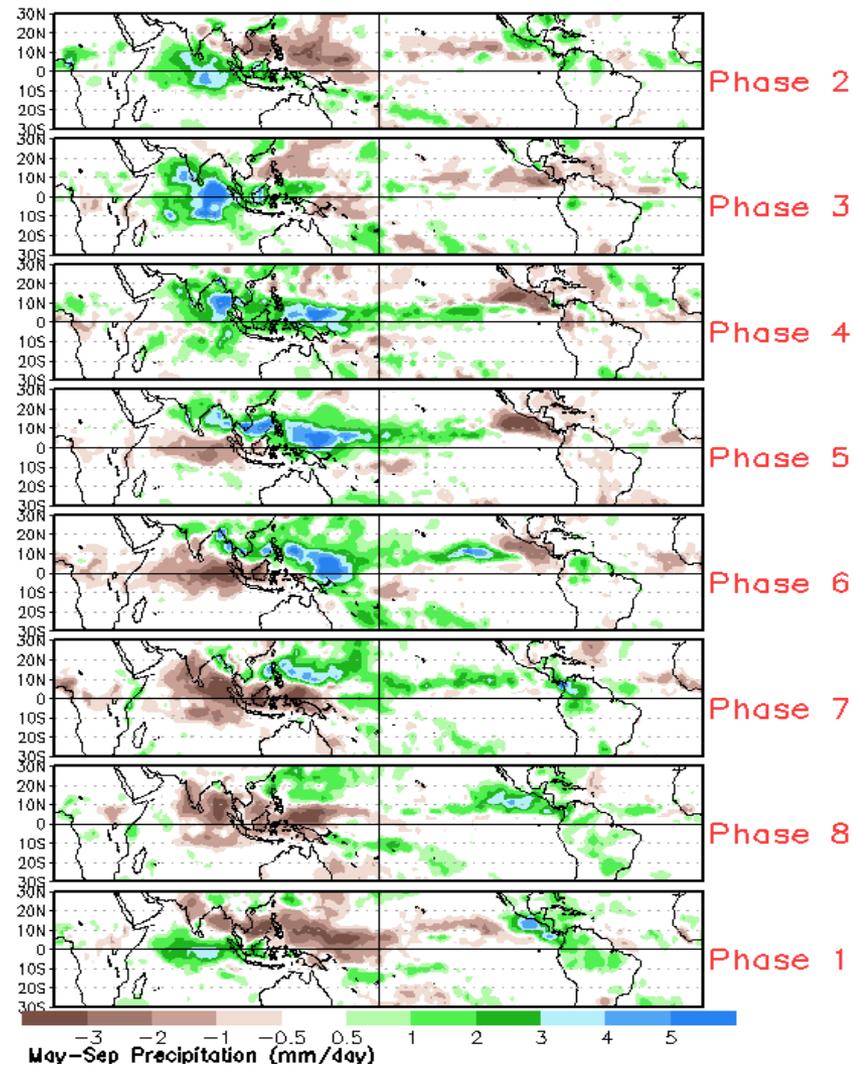
- The constructed analog forecast of RMM-based OLR depicts little signal during the first 10-days of the forecast, with areas of positive OLR anomalies (suppressed convection) developing over the West Pacific toward the end of week-2, indicating some uncertainty in terms of the eastward propagation of the convective signal.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



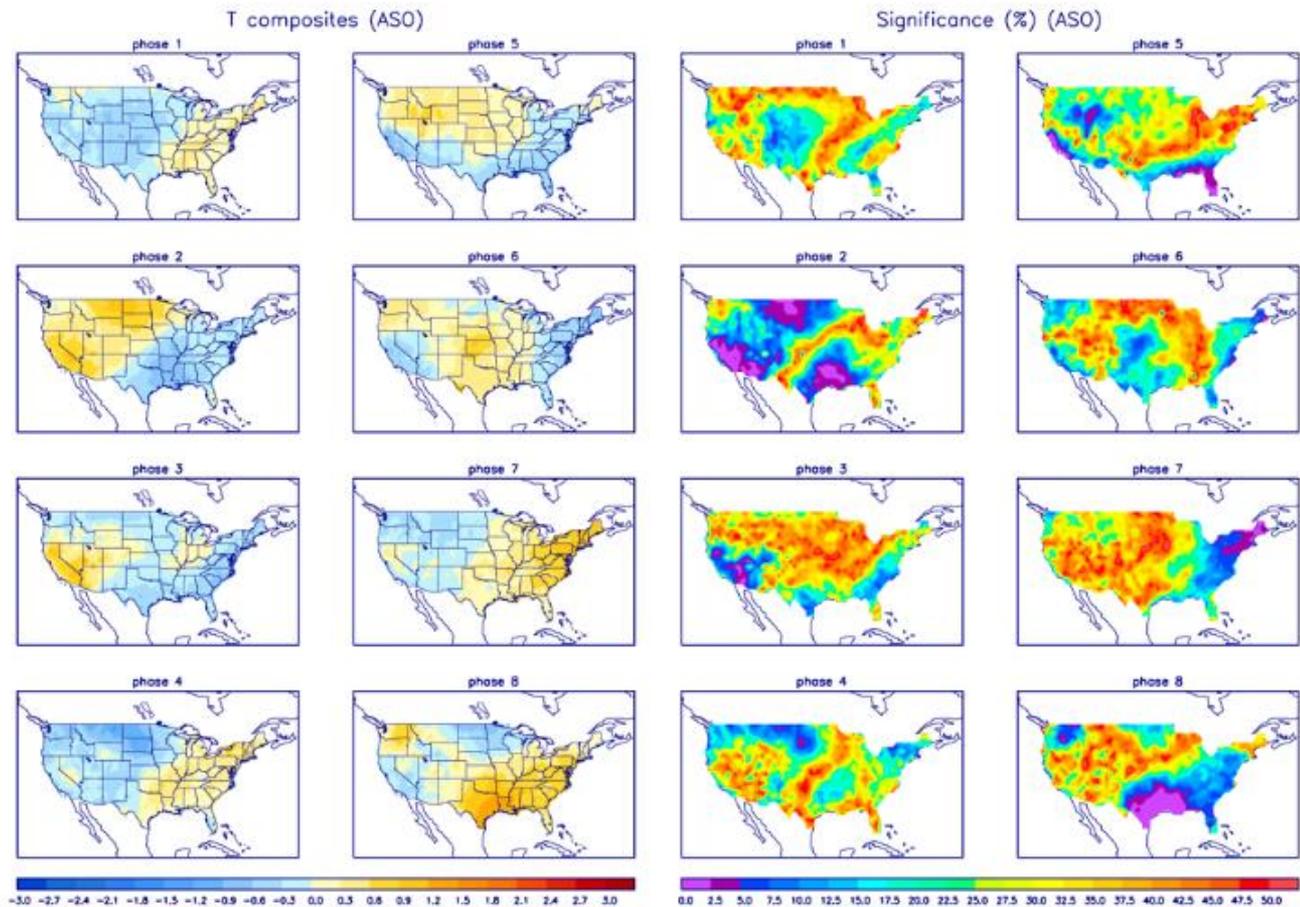
Precipitation Anomalies



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.

