

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



Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
29 August 2022

Overview

- Following a period where the MJO has been incoherent during much of August, the RMM index and upper-level velocity potential index both reflect a reemergence of intraseasonal activity with the MJO gaining amplitude over the Indian Ocean during the past week.
- Despite this recent uptick, dynamical models are in good agreement favoring a gradual weakening of the MJO signal while propagating eastward across the Indian Ocean and into the Maritime Continent during the next two weeks.
- There are increased chances for tropical cyclogenesis over the eastern Pacific and tropical Atlantic during week-1, with this potential shifting over the western Pacific during the later period.

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

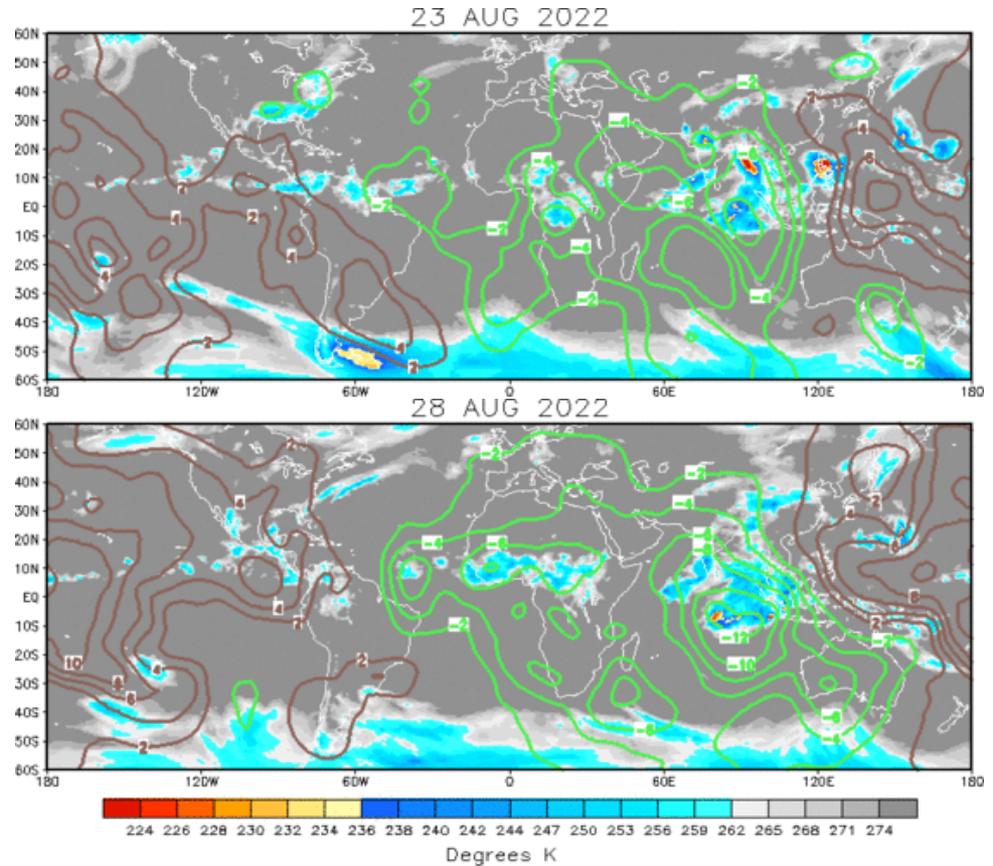
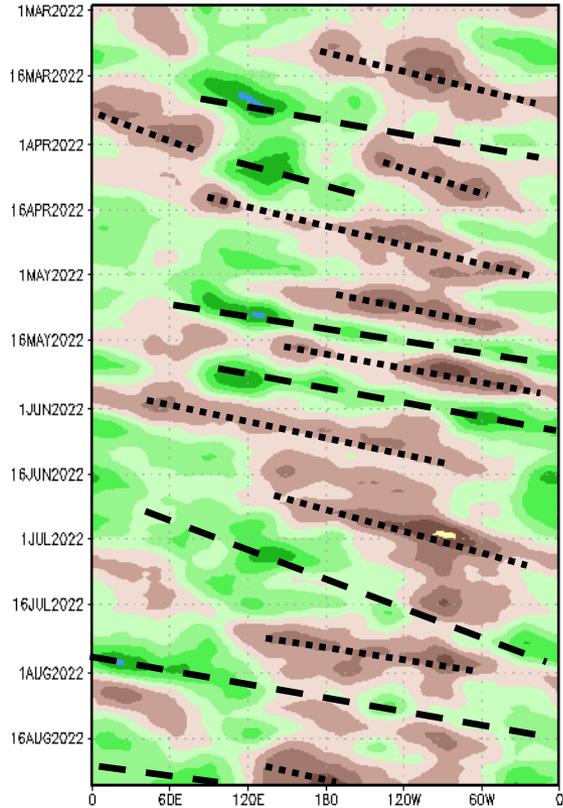
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

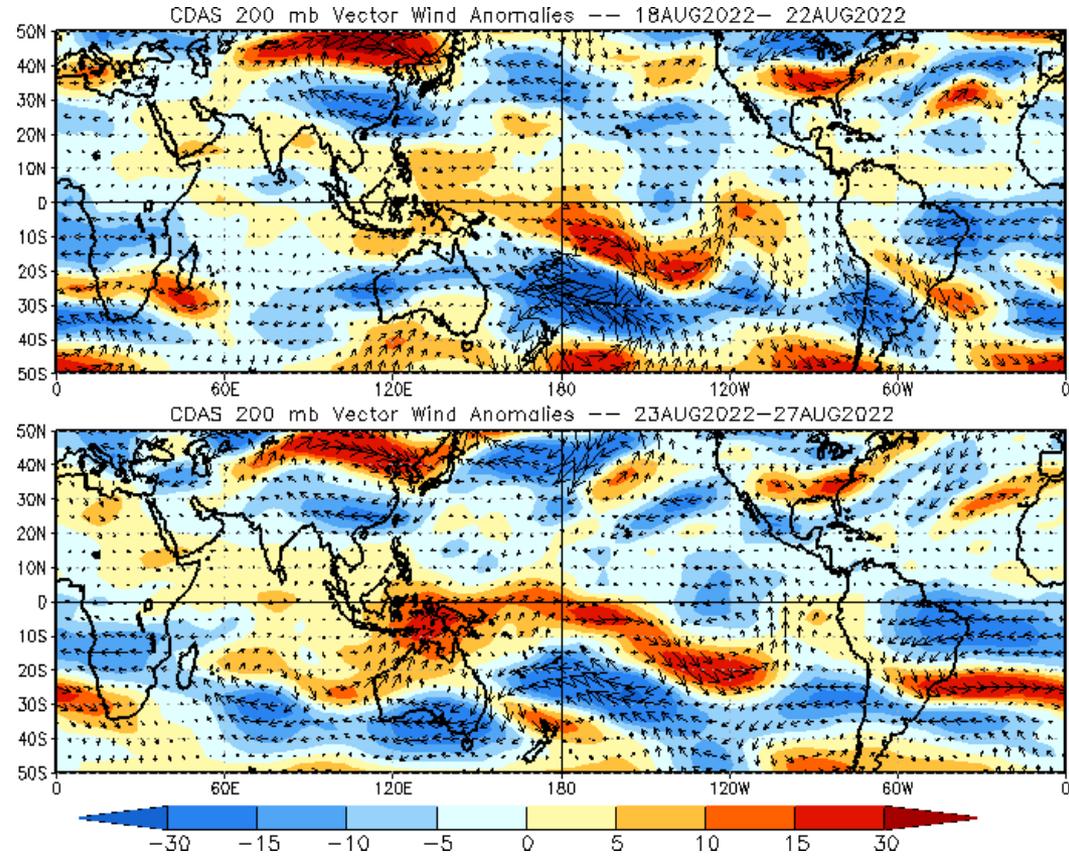
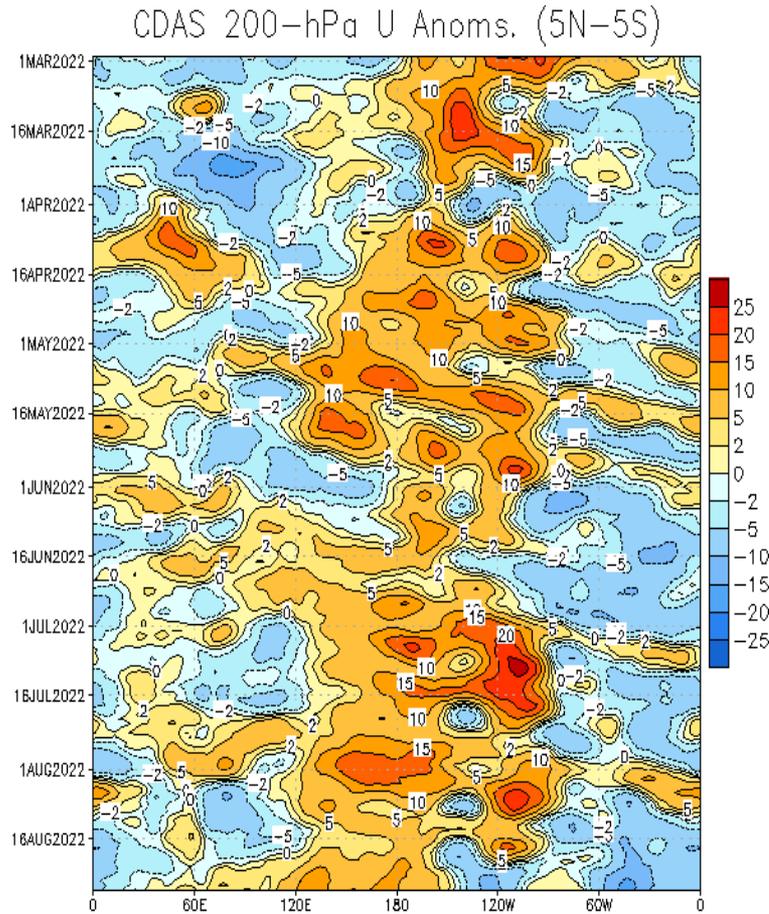
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- A better defined wave-1 pattern emerged across the global tropics, indicative of renewed MJO activity.
- While the enhanced envelope has been slow shifting eastward over the Indian Ocean, there is a more uniform distribution of suppressed conditions overspreading the eastern Pacific and the Americas.

200-hPa Wind Anomalies

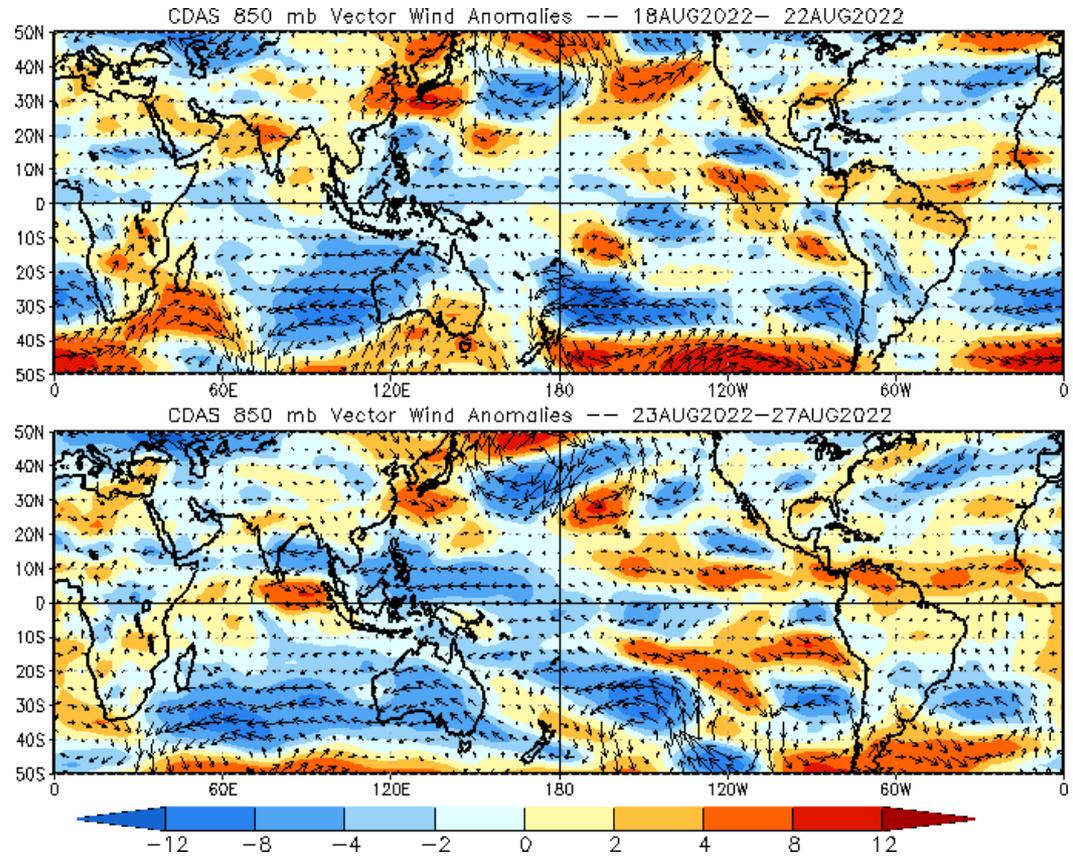
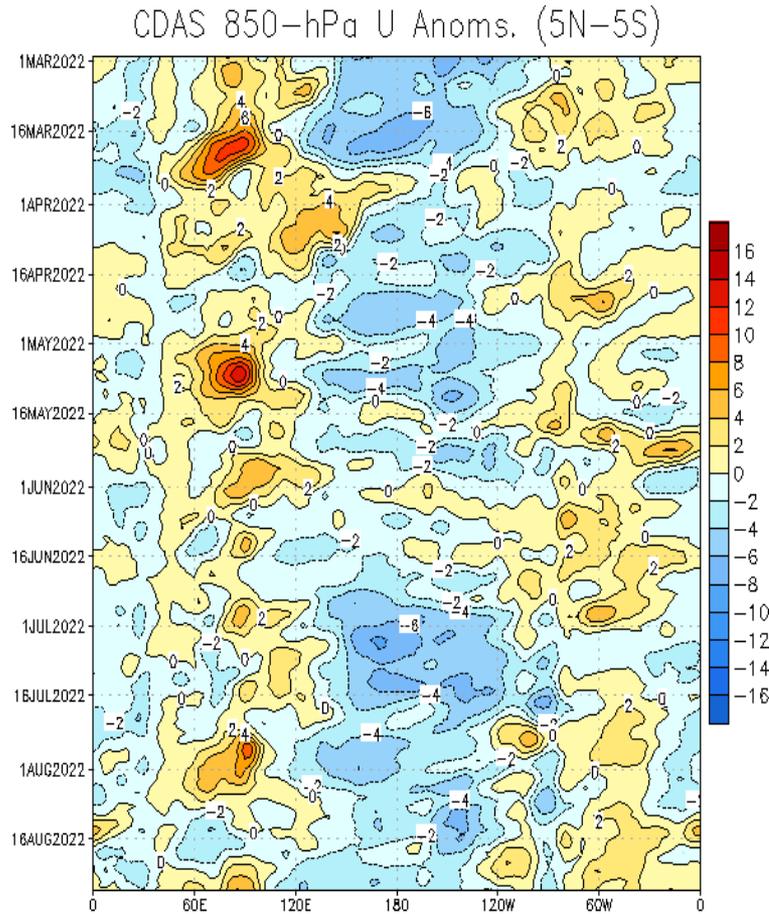
Shading denotes the zonal wind anomaly. **Blue shades: Anomalous easterlies.** **Red shades: Anomalous westerlies.**



- The low frequency response remains evident, but has become more confined between the West Pacific and near the Date Line, with anomalous easterlies observed near 120W tied to an anomalous anticyclonic circulation south of the equator.
- Although weak, anomalous westerlies are now observed throughout the equatorial Indian Ocean, similar to the last uptick in intraseasonal activity during late July.

850-hPa Wind Anomalies

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

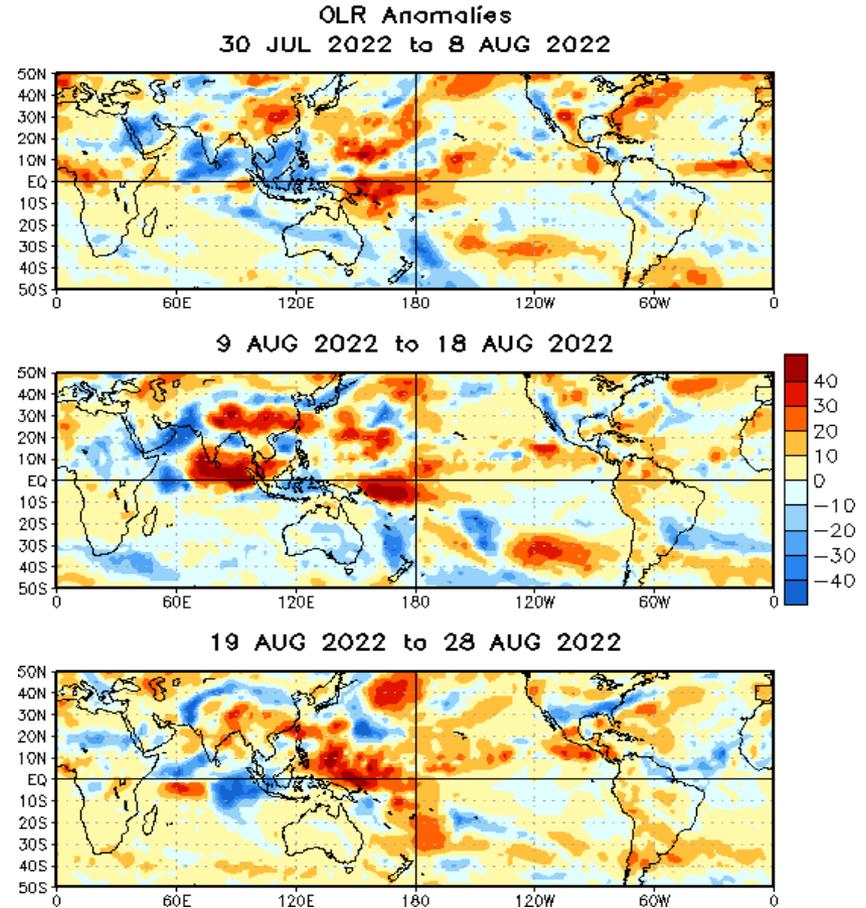
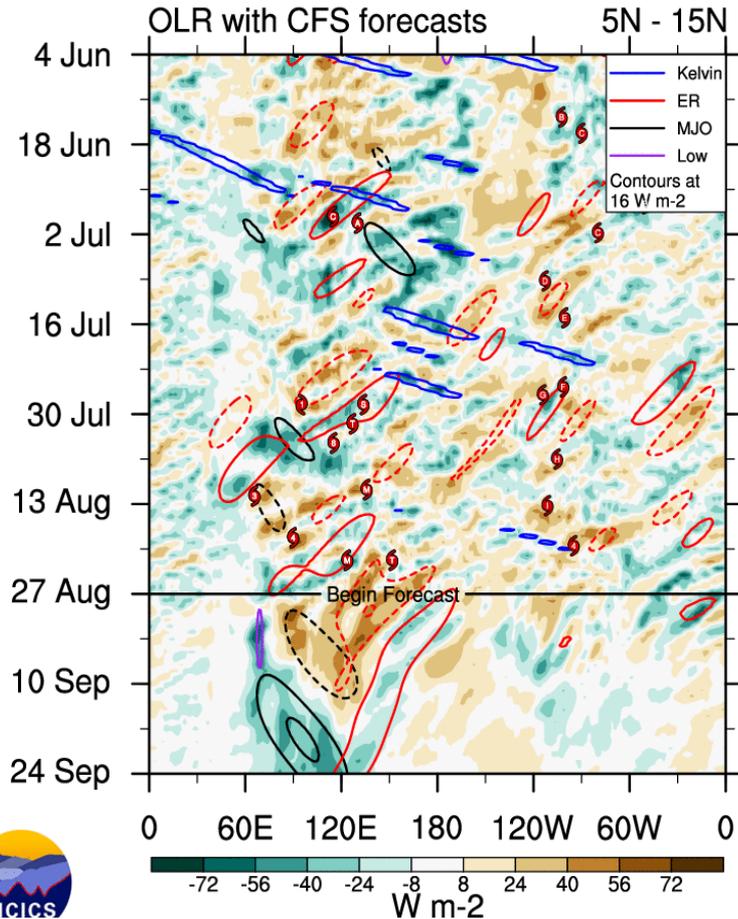


- A band of anomalous westerlies persisted north of the equator in the eastern Pacific, and continues to disrupt the enhanced trade wind regime associated with La Nina mainly east of 120W.
- Anomalous low-level westerlies have reemerged across the equatorial Indian Ocean, where strengthening anomalies near 90E may be signaling another wind burst event taking shape, similar previous events during July and May. Both of these prior events triggered TC formation despite the latter being out of season.

Outgoing Longwave Radiation (OLR) Anomalies

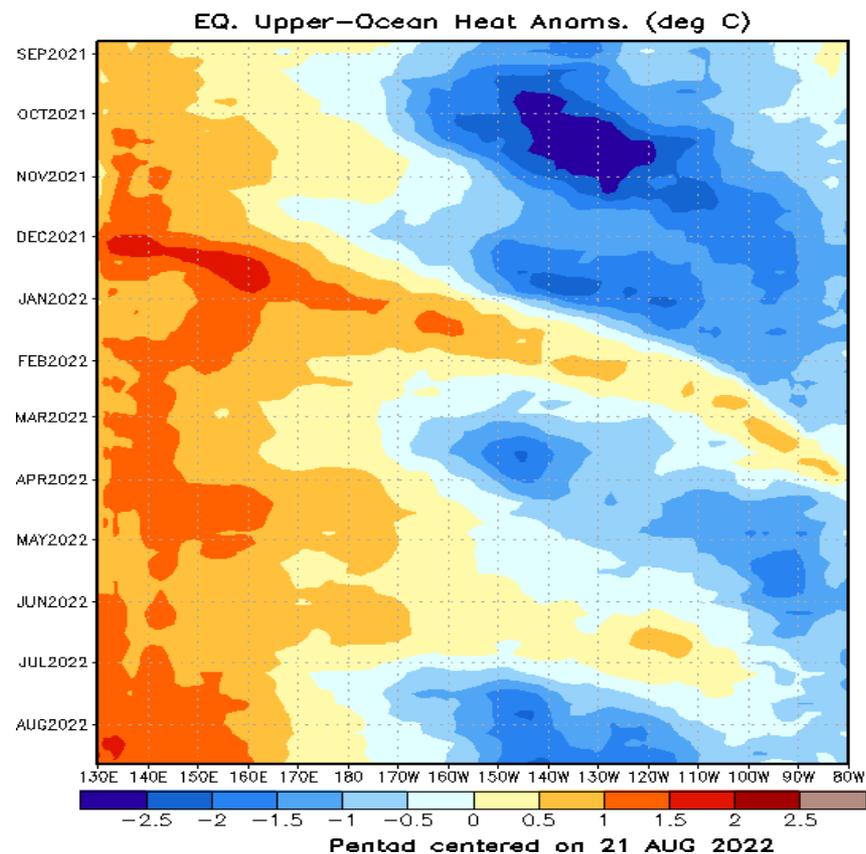
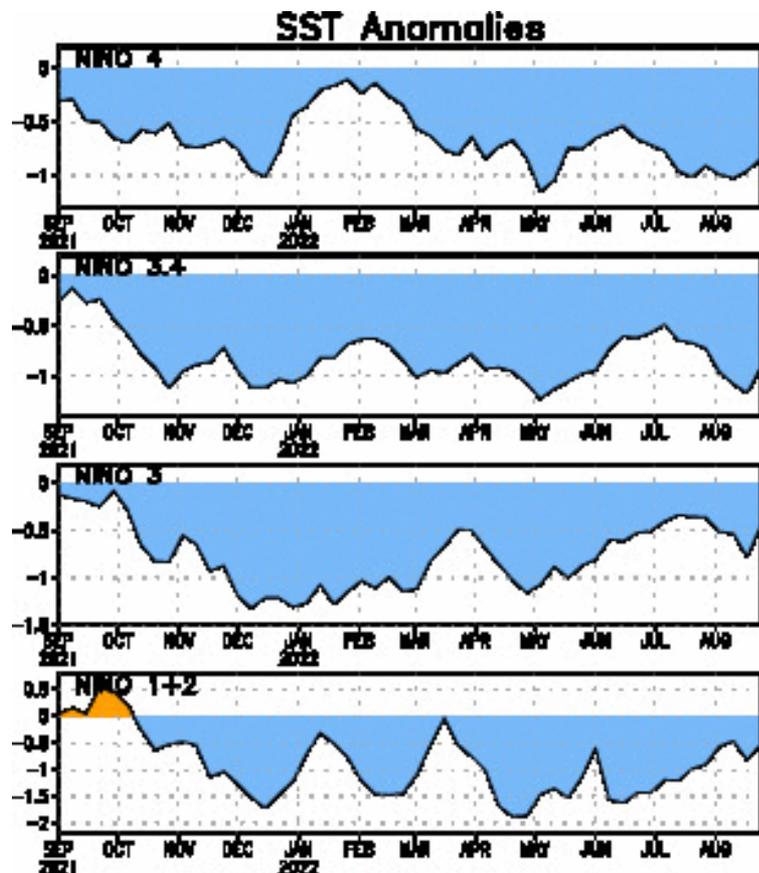
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- A strong atmospheric response to La Niña remains evident in the OLR anomaly field along and to the west of the Date Line.
- Broadly enhanced convection has persisted over parts of Central Asia, Arabian Peninsula and eastern Africa.
- The CFS continues to favor easterly wave activity emerging off of Africa which is likely to sustain tropical cyclone potential over the Main Development Region of the Atlantic into early September.

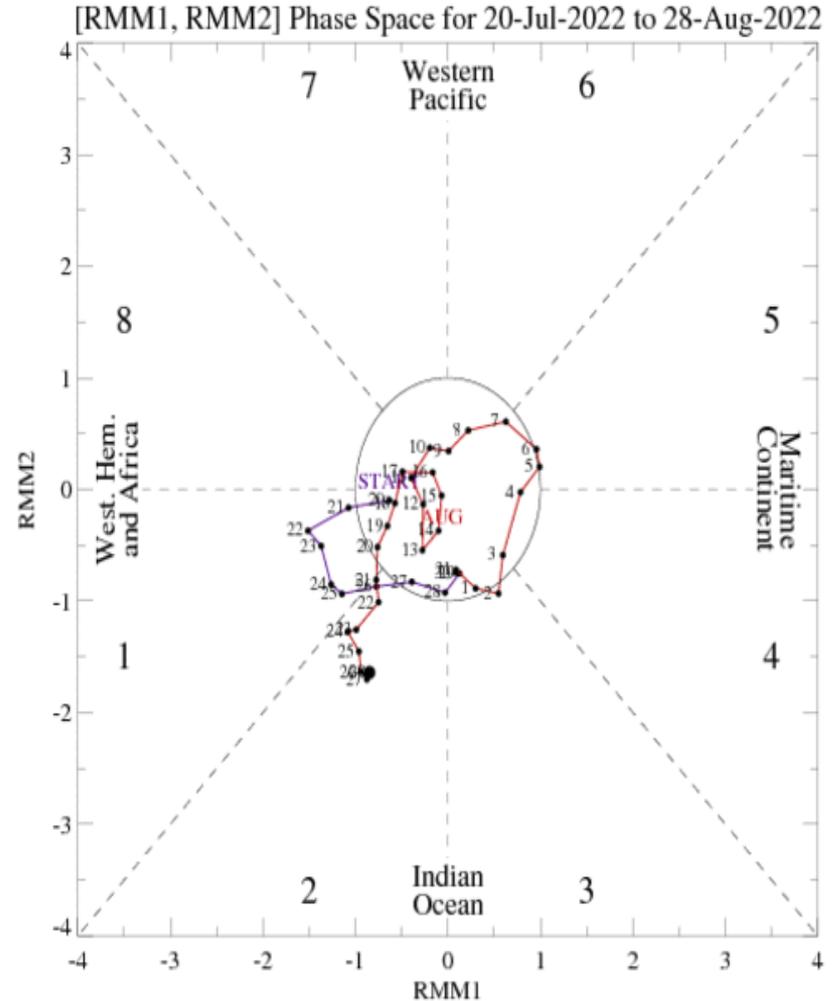
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- 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, with more pronounced cooling observed in the Niño 3 and Niño 3.4 regions during the past 2 weeks.

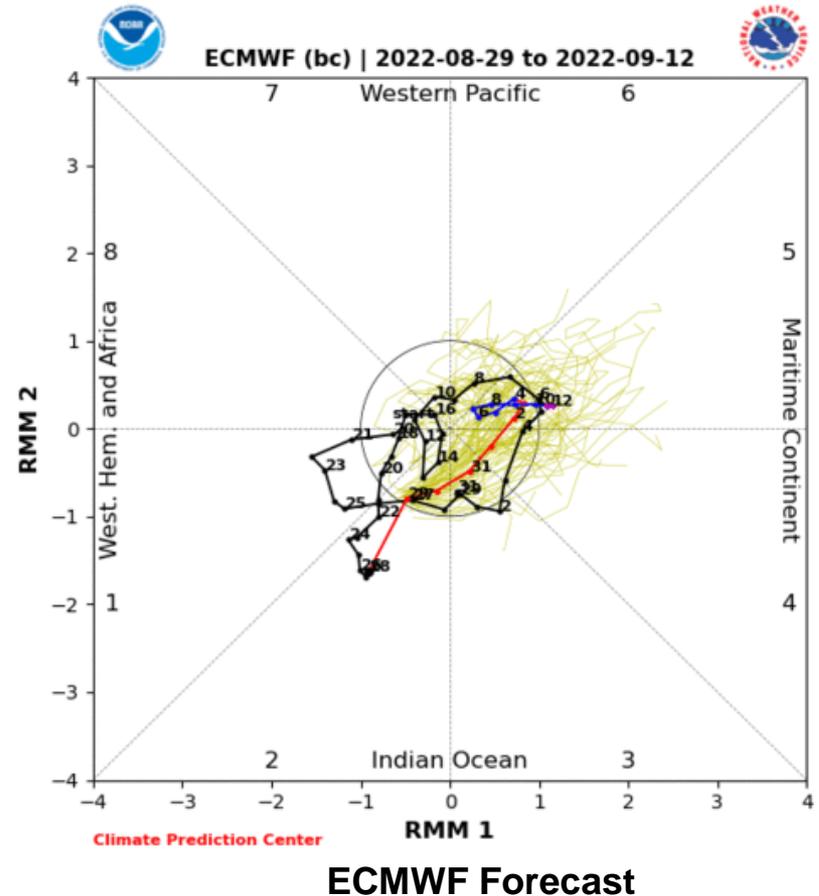
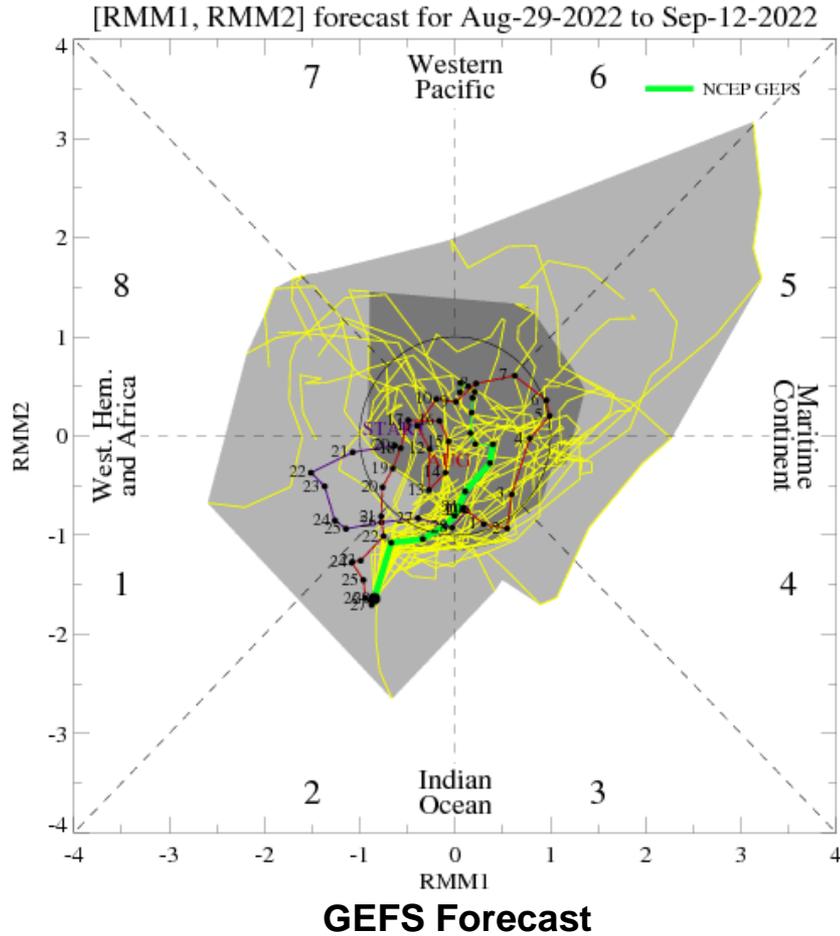
MJO Index: Recent Evolution

- Following a weak MJO for much of August, the RMM index indicates the intraseasonal signal has exited out of the unit circle, gaining amplitude over the Indian Ocean during the past week.



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

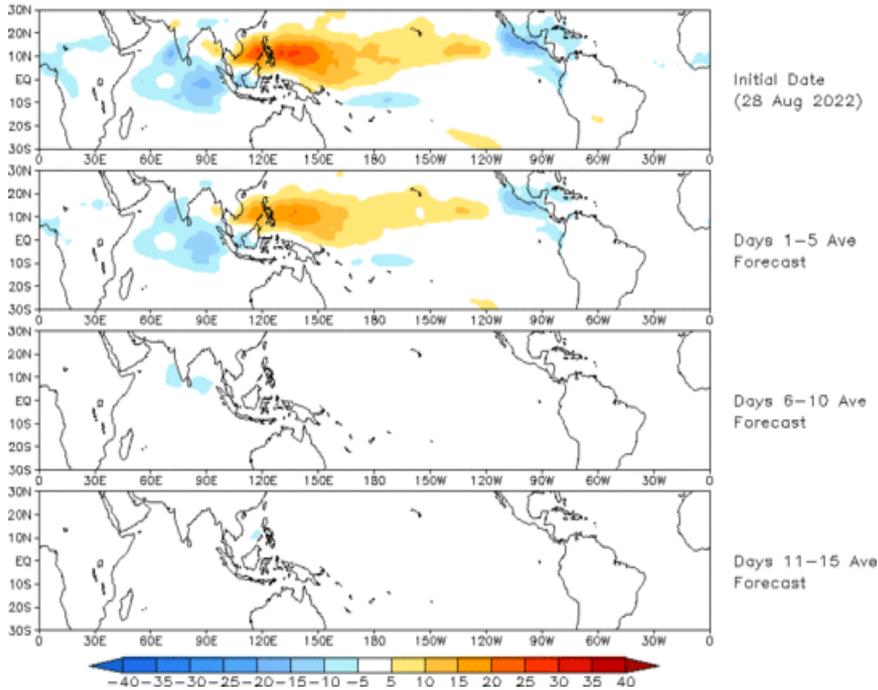


- The reemerging MJO signal is likely to be short-lived, with dynamical models generally favoring a decrease in amplitude as it propagates across the Indian Ocean and Maritime Continent during the next two weeks.
- While some ensemble solutions favor some reemergence of the MJO over the Maritime Continent and western Pacific, forecast confidence is low given the potential for destructive interference with an unusually strong ongoing La Nina.

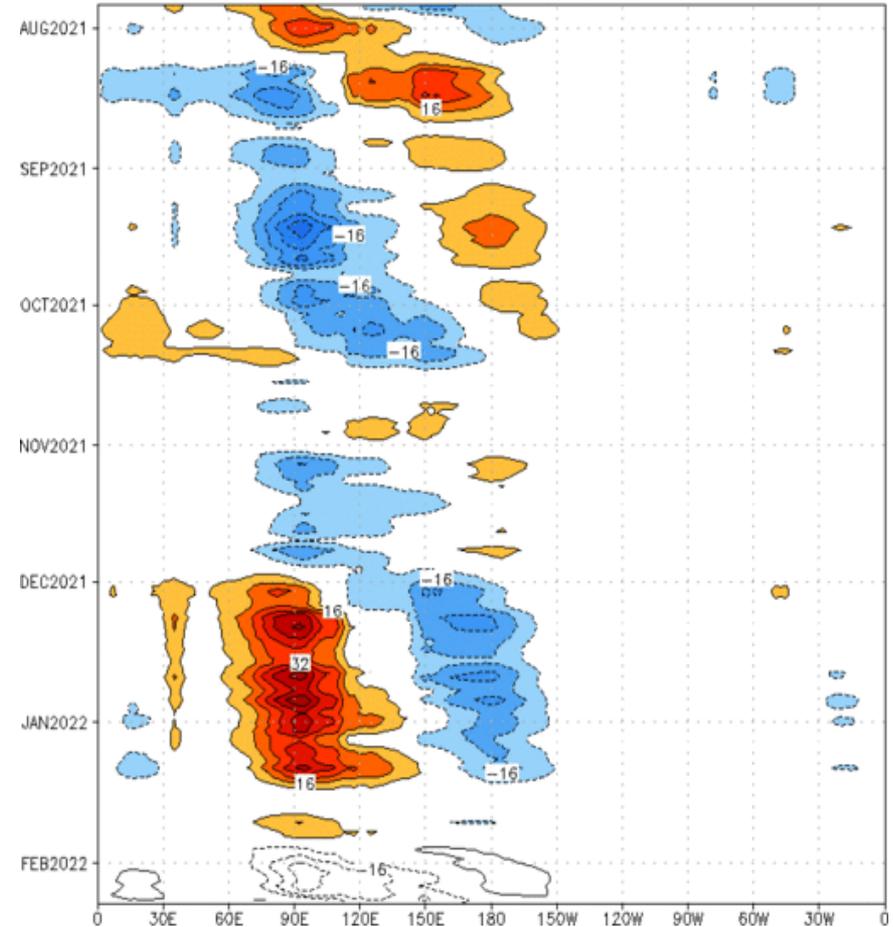
MJO: GEFS Forecast Evolution

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: 28 Aug 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

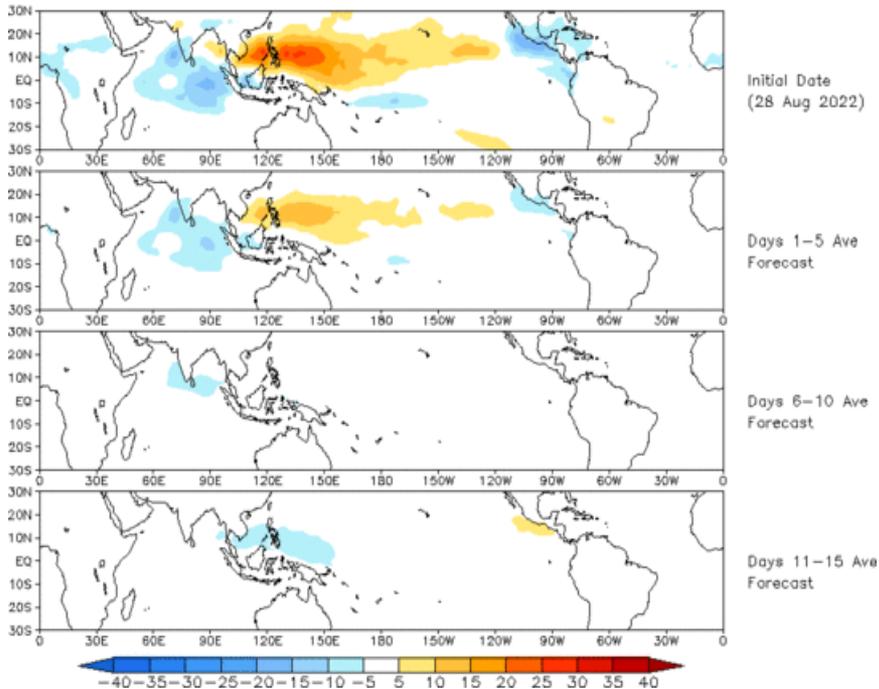


- The GEFS RMM-index based OLR anomaly field favors the convective dipole to gradually weaken over the eastern Hemisphere during the next two weeks. Enhanced convection over the eastern Pacific is forecast to experience the same fate.

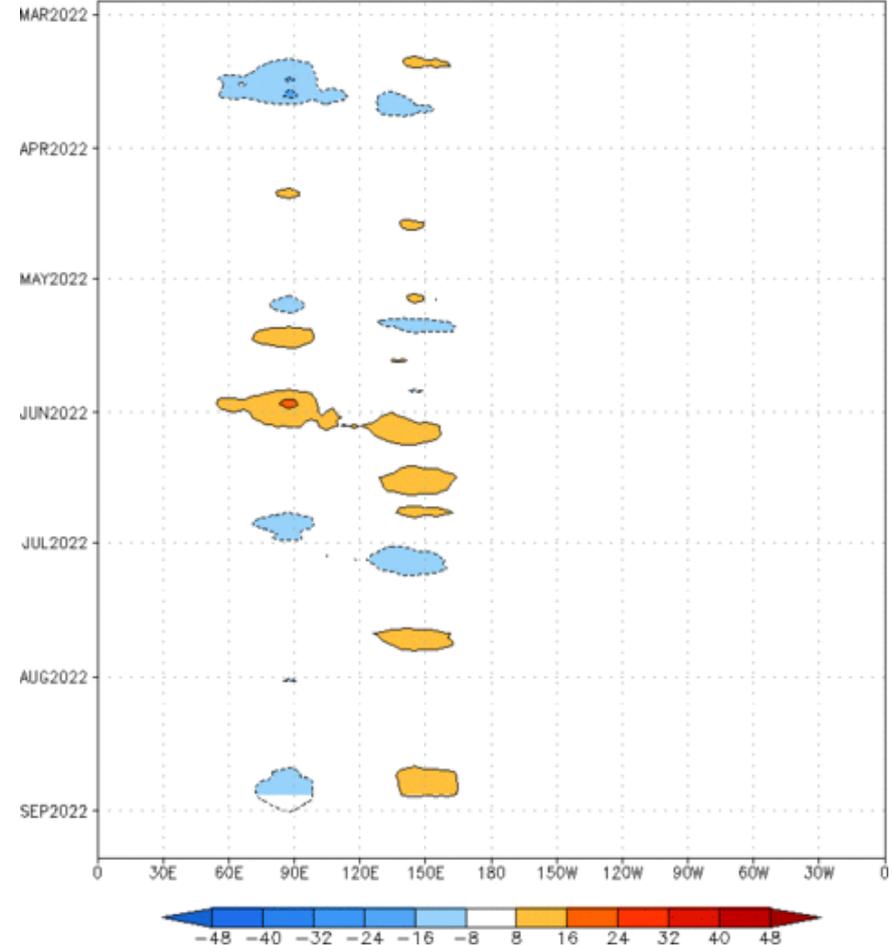
MJO: Constructed Analog Forecast Evolution

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 (28 Aug 2022)



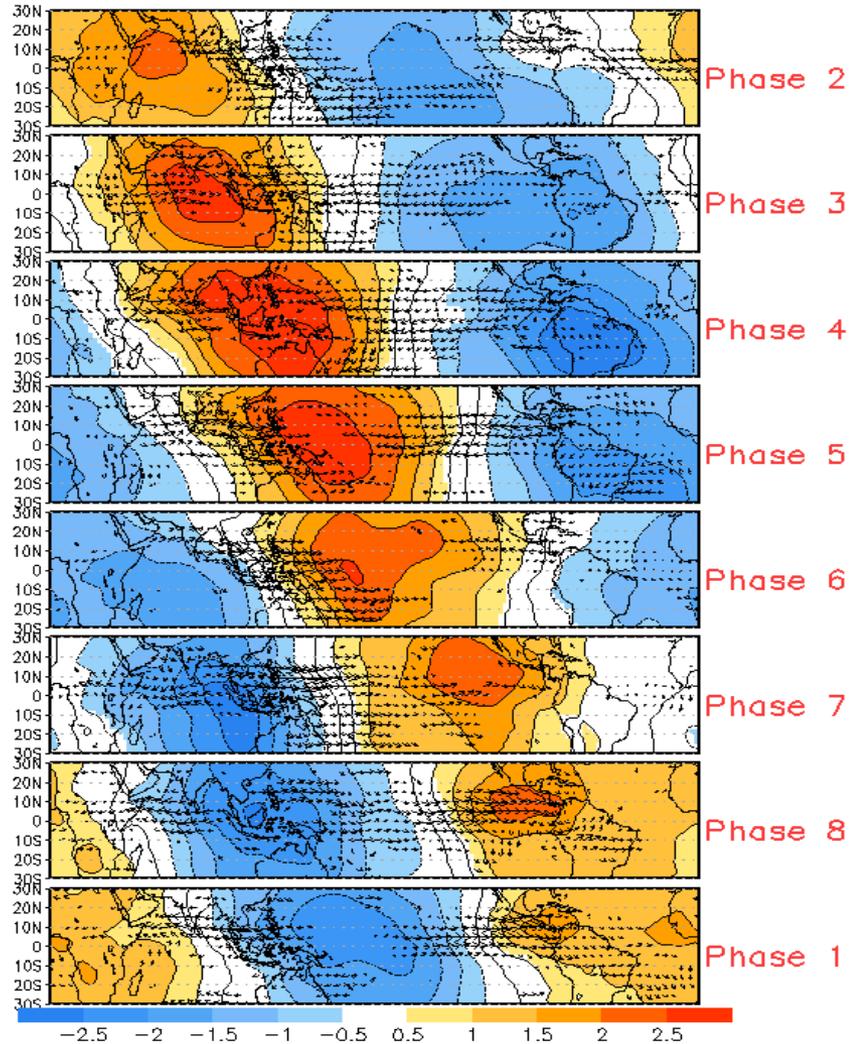
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:26-Feb-2022 to 28-Aug-2022
The unfilled contours are CA forecast reconstructed anomaly for 15 days



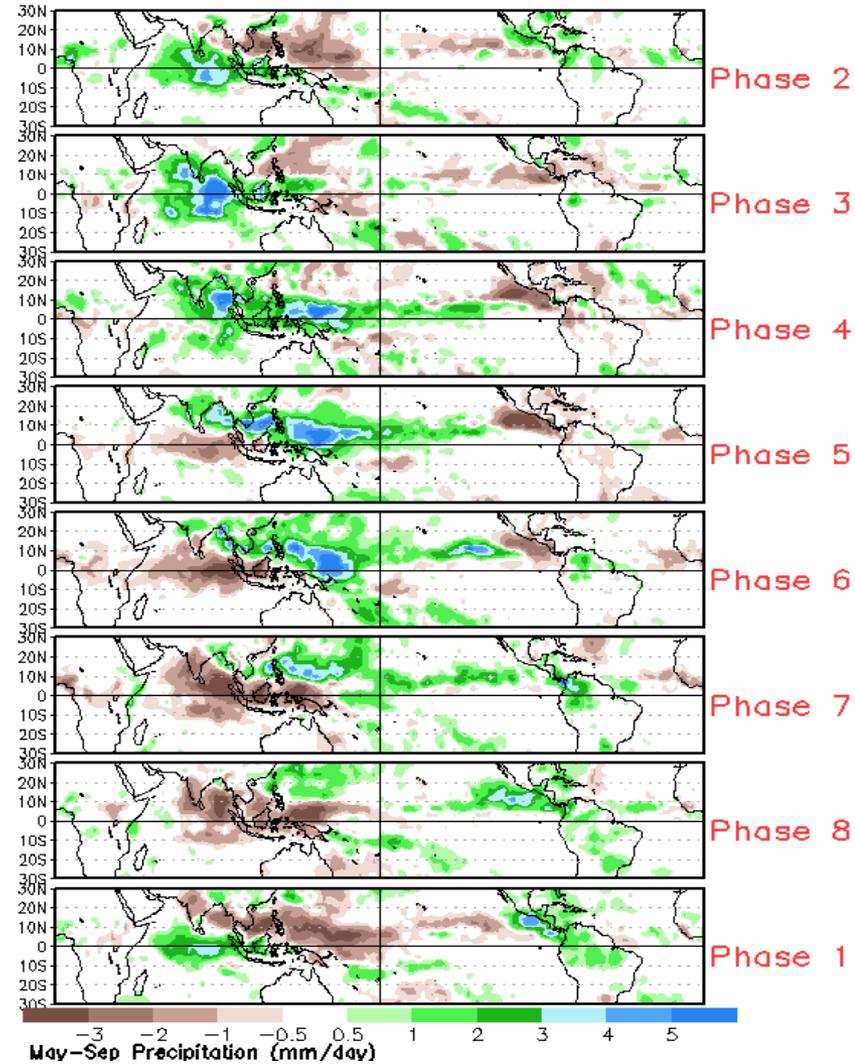
- The constructed analog forecast of RMM-based OLR is similar to the GEFS evolution, but favors enhanced convection redeveloping over the Maritime Continent and western Pacific later in the period.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



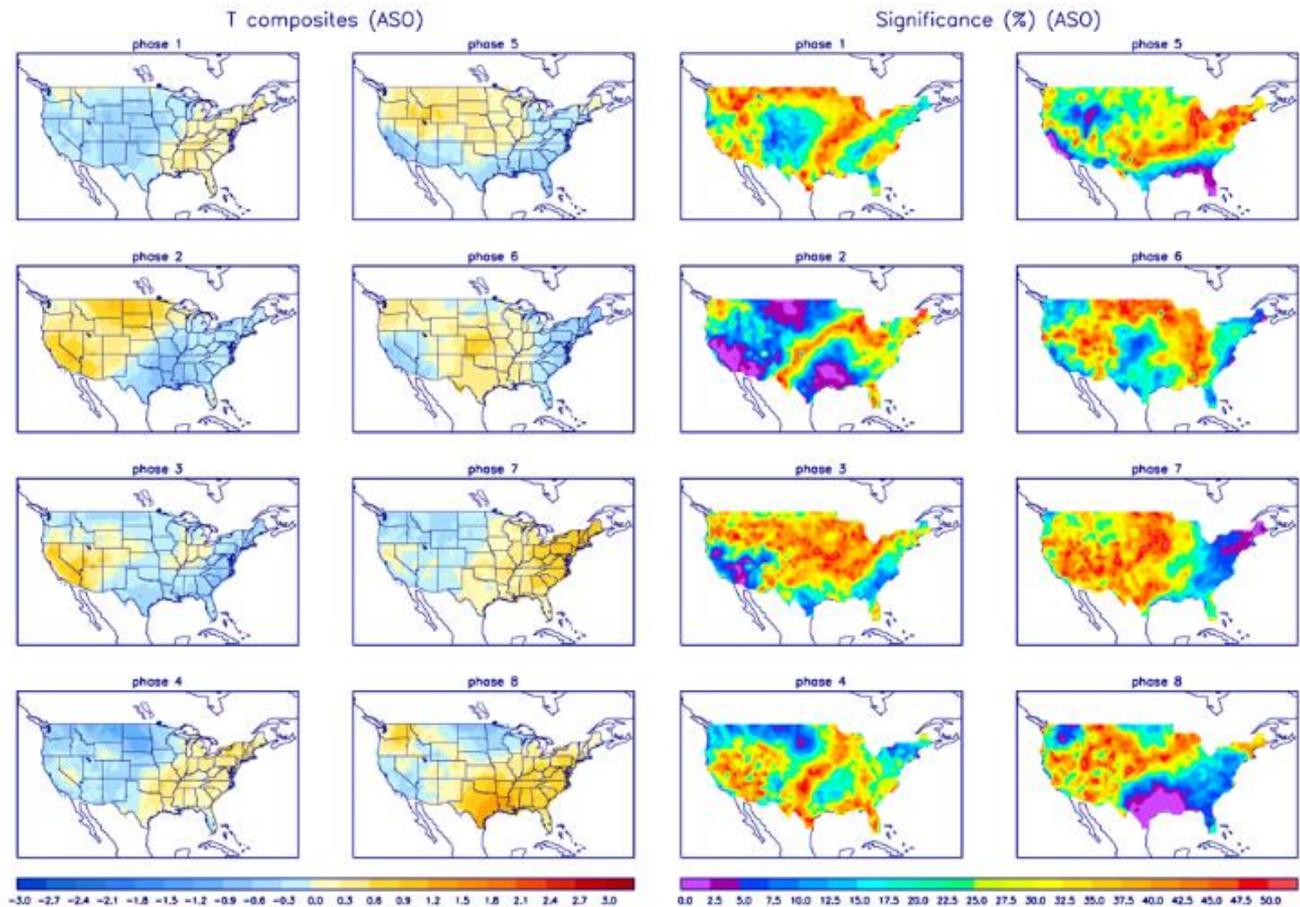
Precipitation Anomalies



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.

