

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



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

Overview

- The RMM index and upper-level velocity potential anomaly analyses indicate a weakened and incoherent MJO during the past week.
- Although weak, continued eastward propagation of the intraseasonal signal is evident in both the observation and forecast fields, where dynamical models depict a potential strengthening of the MJO over the western Hemisphere, Africa and Indian Ocean during the outlook period.
- Should the MJO become better reorganized as it reenters the eastern Hemisphere, large scale conditions would be favorable for tropical cyclone (TC) development over the eastern Pacific and the Atlantic through late September. Additional TC formation is also favored in the western Pacific tied to Rossby wave activity during the outlook.

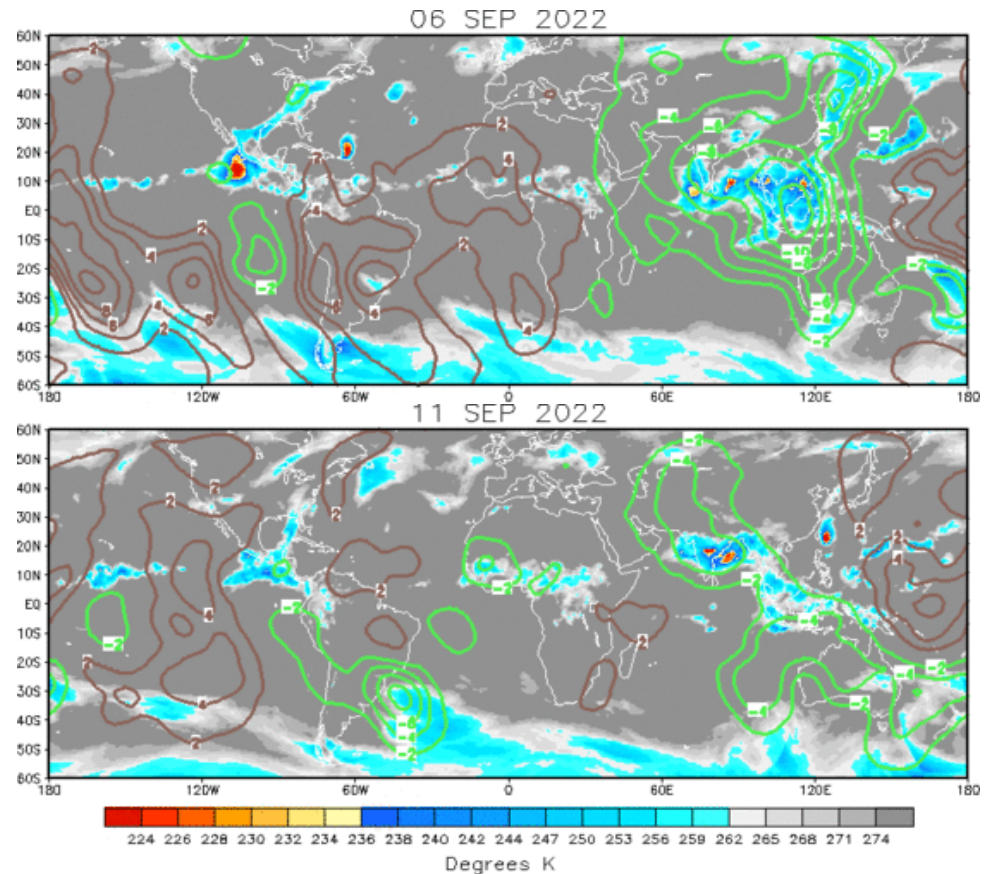
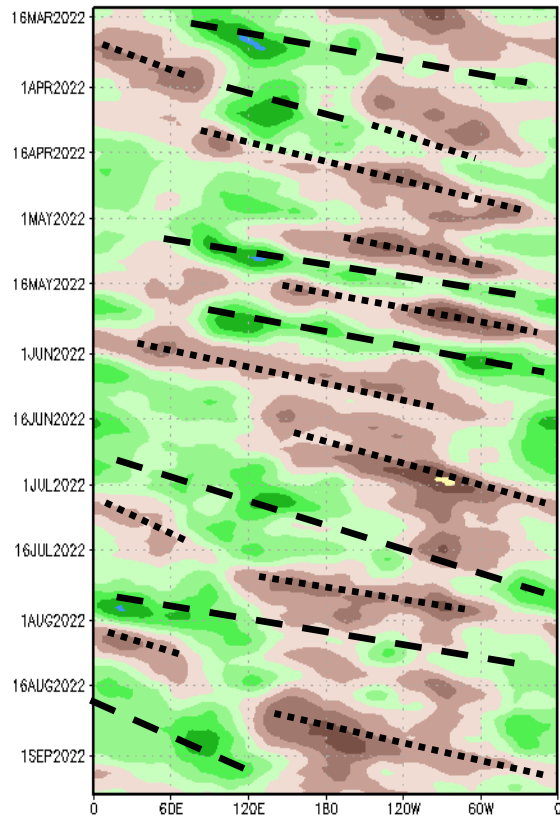
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

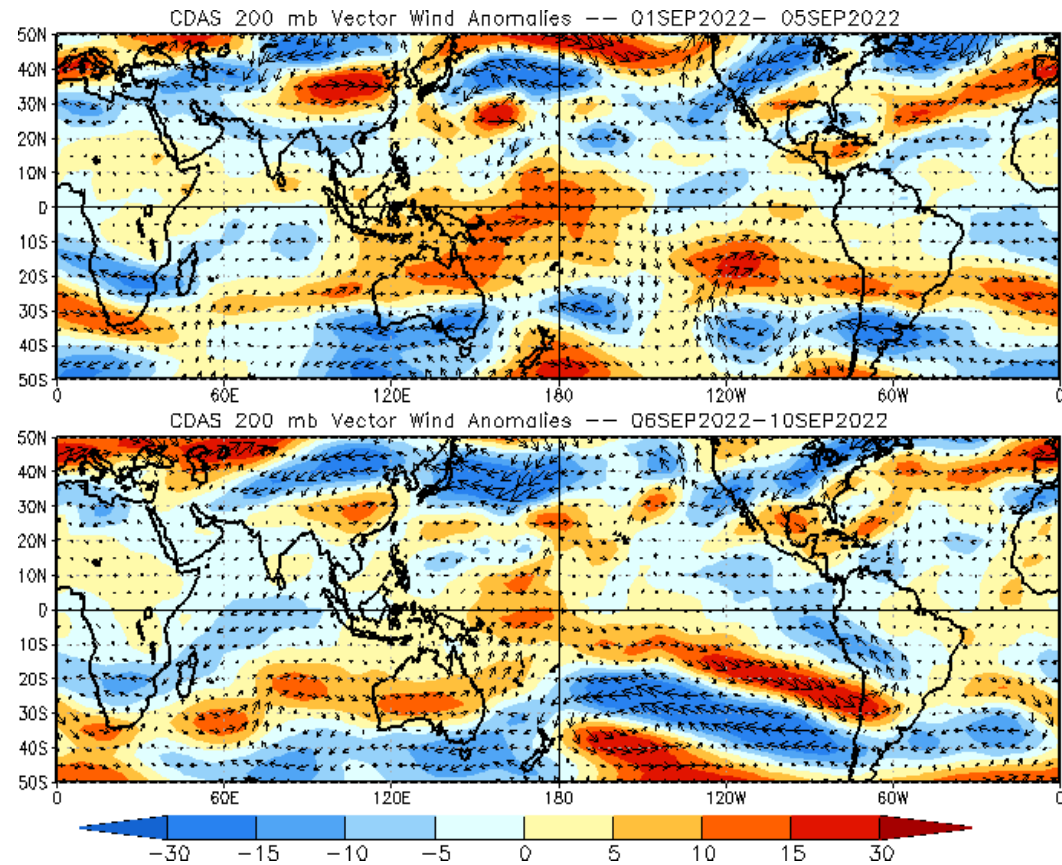
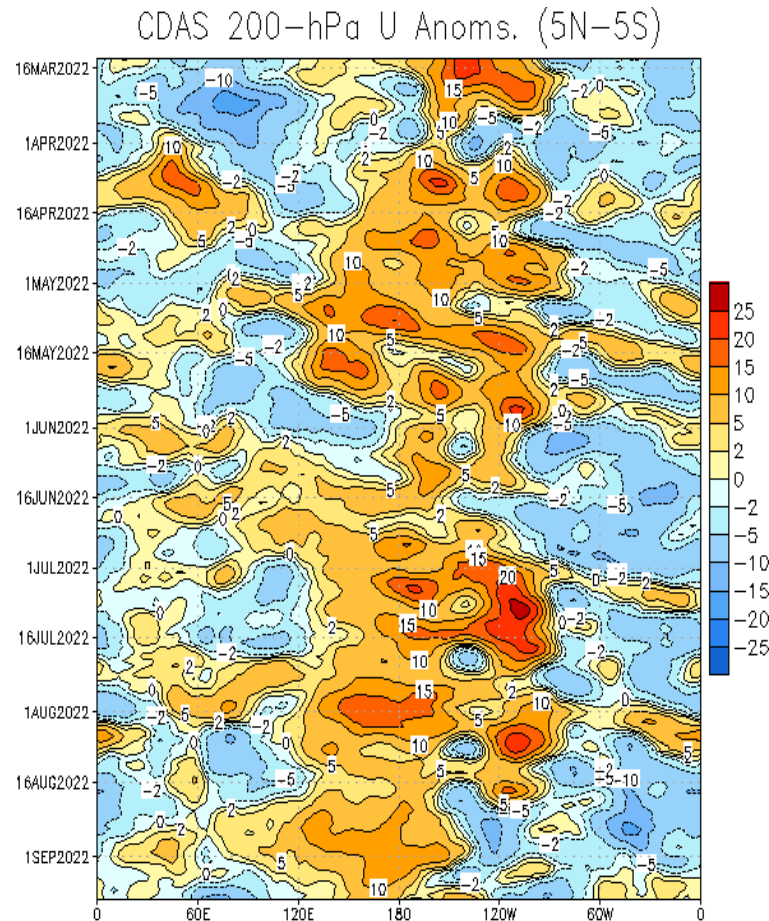
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- The upper-level velocity potential pattern has become weak and incoherent.
- Enhanced convection remains entrenched across parts of the Maritime Continent and the Indian Ocean, with suppressed upper-level conditions anchored near the Date Line.

200-hPa Wind Anomalies

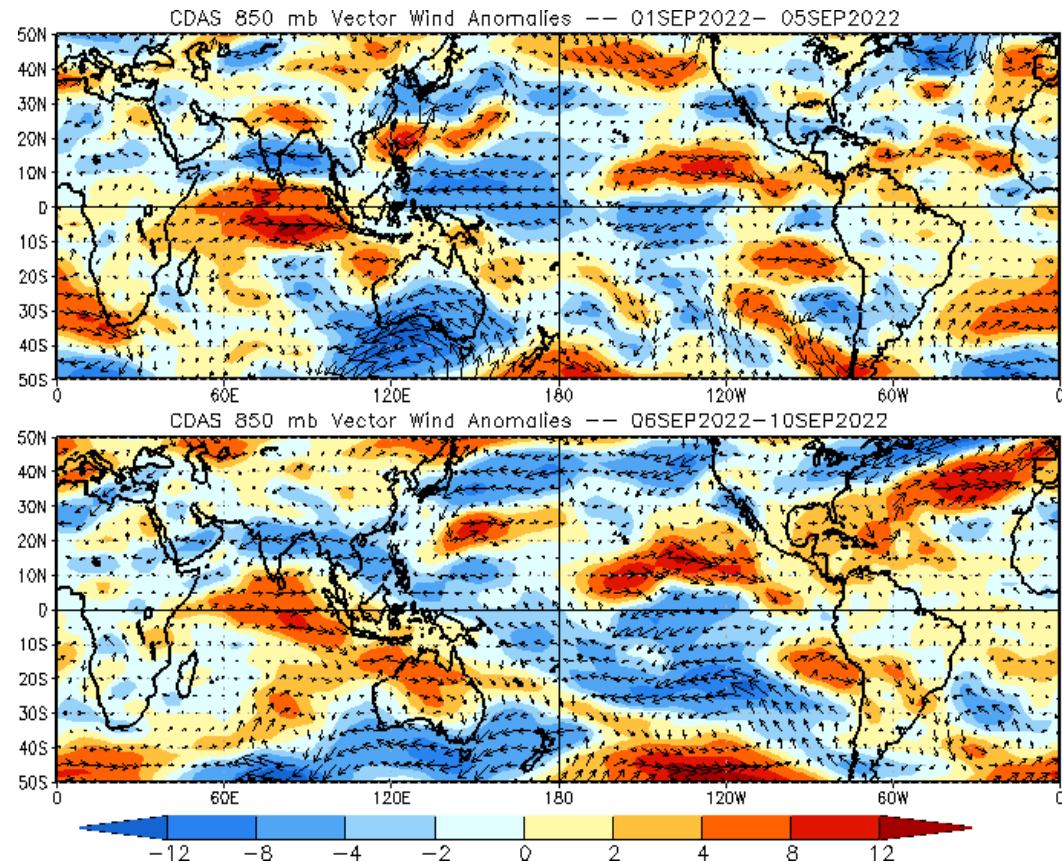
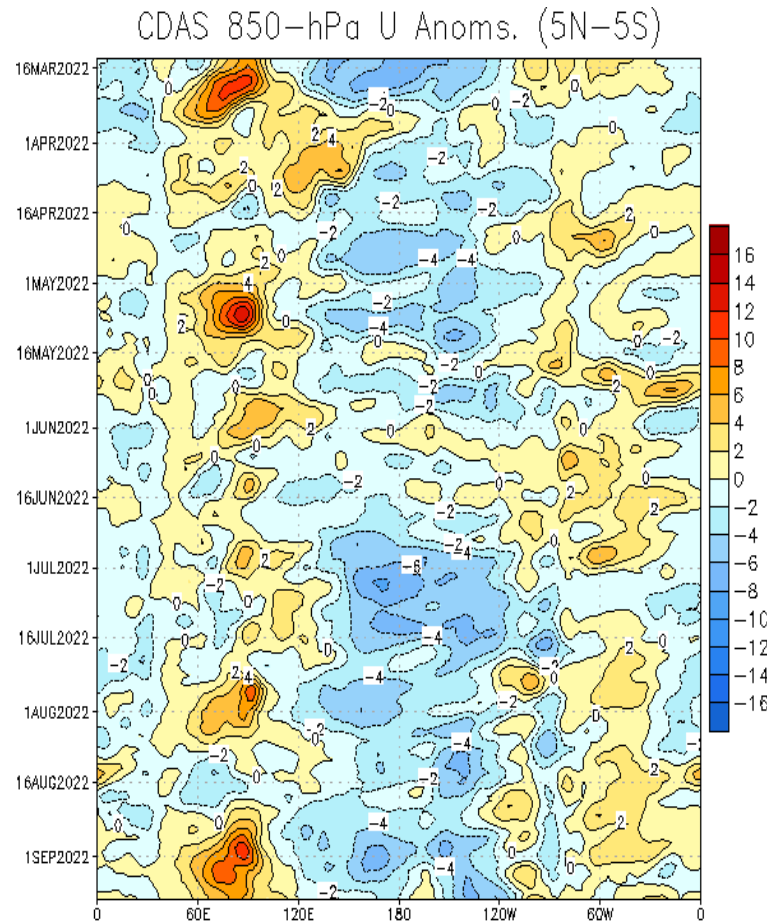
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Anomalous upper-level westerlies continue to be observed along the equatorial Pacific, but are mainly confined to the west of 120W.
- Anomalous easterlies aloft have strengthened across the equatorial Indian Ocean.
- Anomalous westerlies developed over the tropical Atlantic, resembling a series of eastward propagating features observed earlier this year in Time/Lon space.

850-hPa Wind Anomalies

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

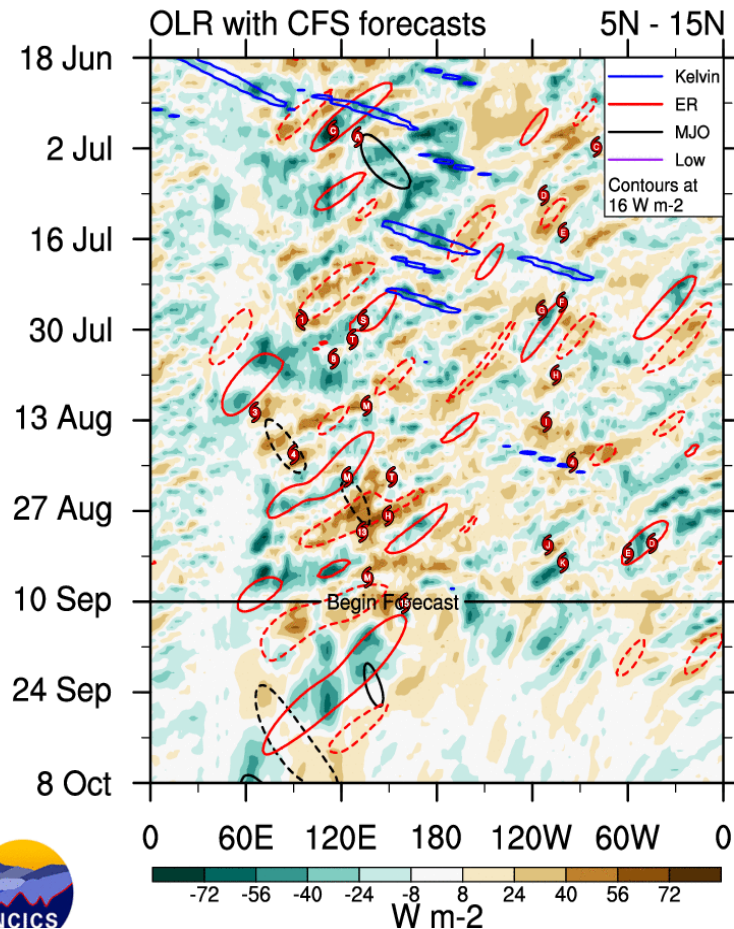


- Strong low-level anomalous westerlies persist over the equatorial Indian Ocean, with enhanced trades over the much of equatorial Pacific consistent with the La Niña footprint.
- North of the equator, anomalous westerlies persist across much of the eastern Pacific and the Main Development Region, relaxing shear for tropical cyclone development.

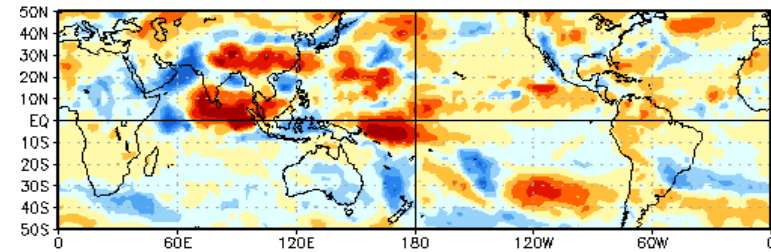
Outgoing Longwave Radiation (OLR) Anomalies

Green shades: Anomalous convection (wetness)

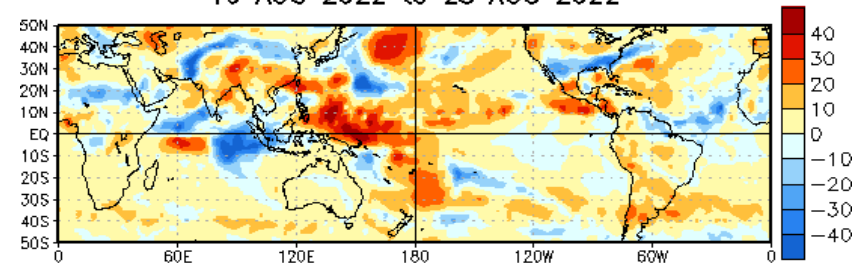
Brown shades: Anomalous subsidence (dryness)



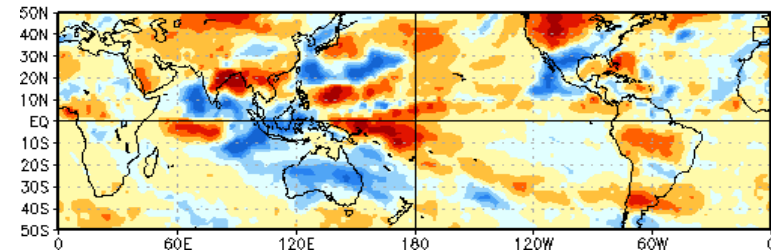
OLR Anomalies
9 AUG 2022 to 18 AUG 2022



19 AUG 2022 to 28 AUG 2022

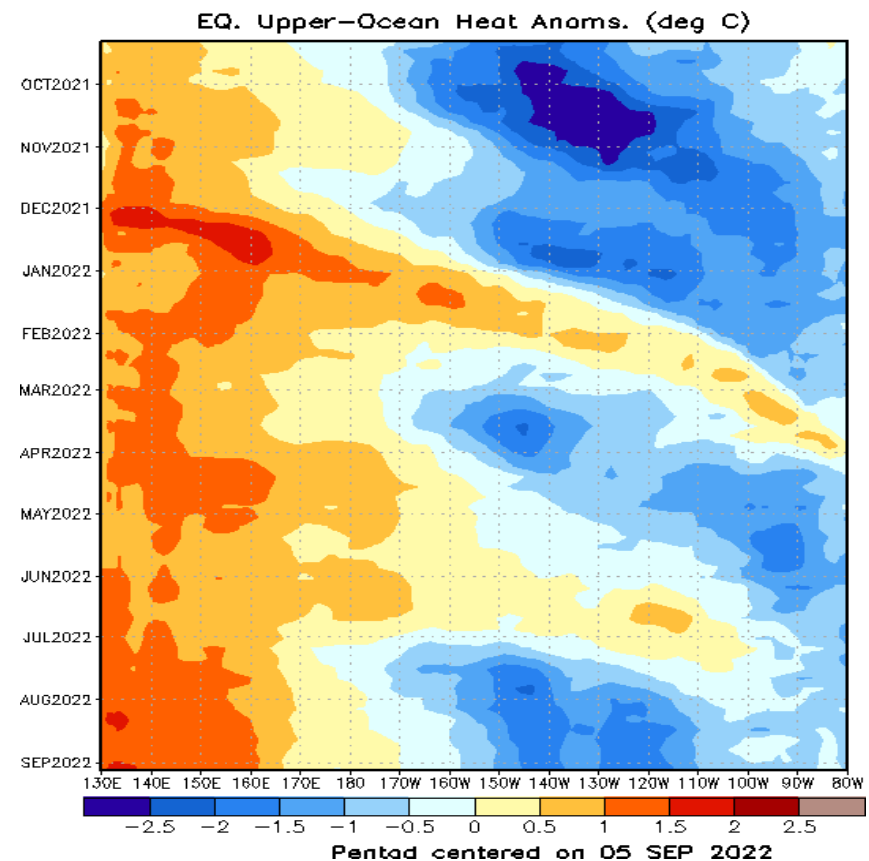
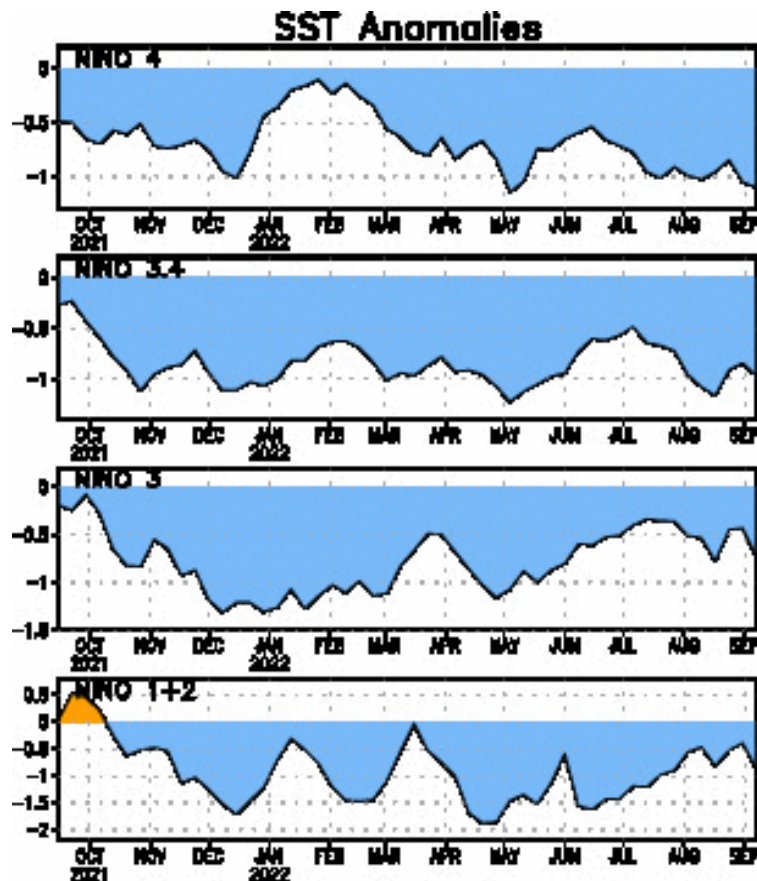


29 AUG 2022 to 7 SEP 2022



- Enhanced convection became more widespread over the Indian Ocean and Maritime Continent coinciding with an uptick in intraseasonal activity during late August and early September.
- Objective filtering of the CFS OLR forecasts reveal Rossby wave activity contributing to the enhancement of convection over the western Pacific and Maritime Continent through late September.

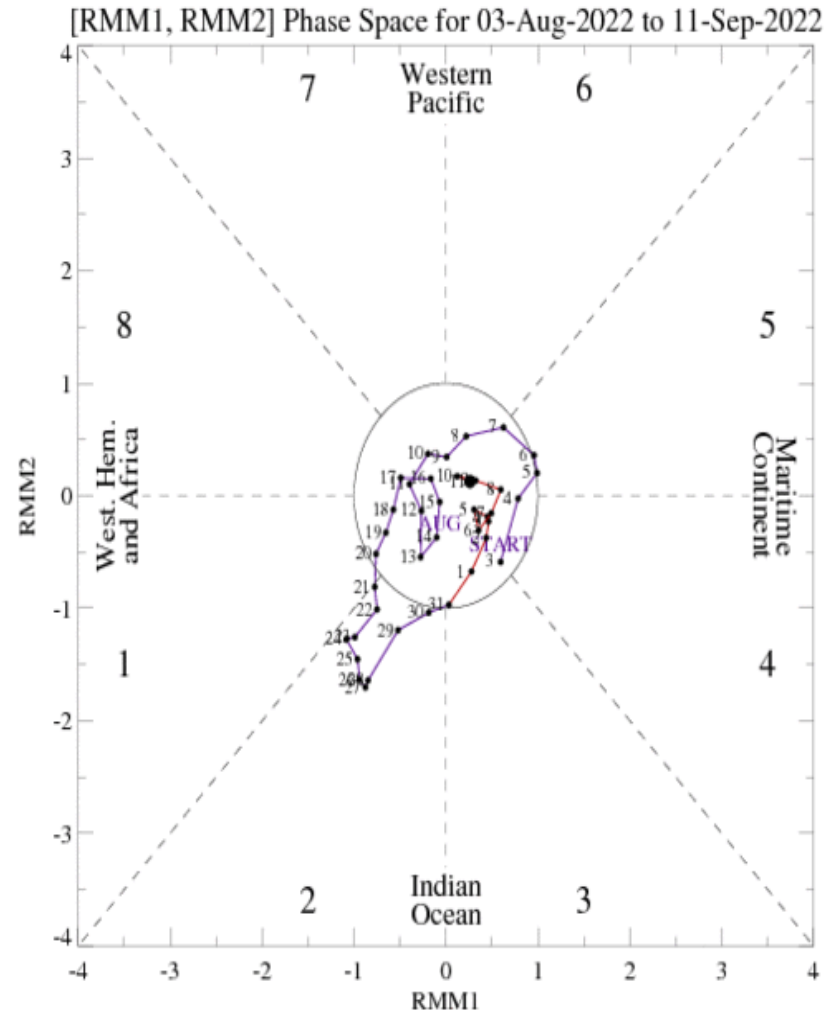
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Following a warming trend in subsurface temperatures over the equatorial Pacific in May and June, enhanced trades tied to the ongoing La Niña have led to continued subsurface below-normal heat content mainly east of the Date Line since July.
- 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

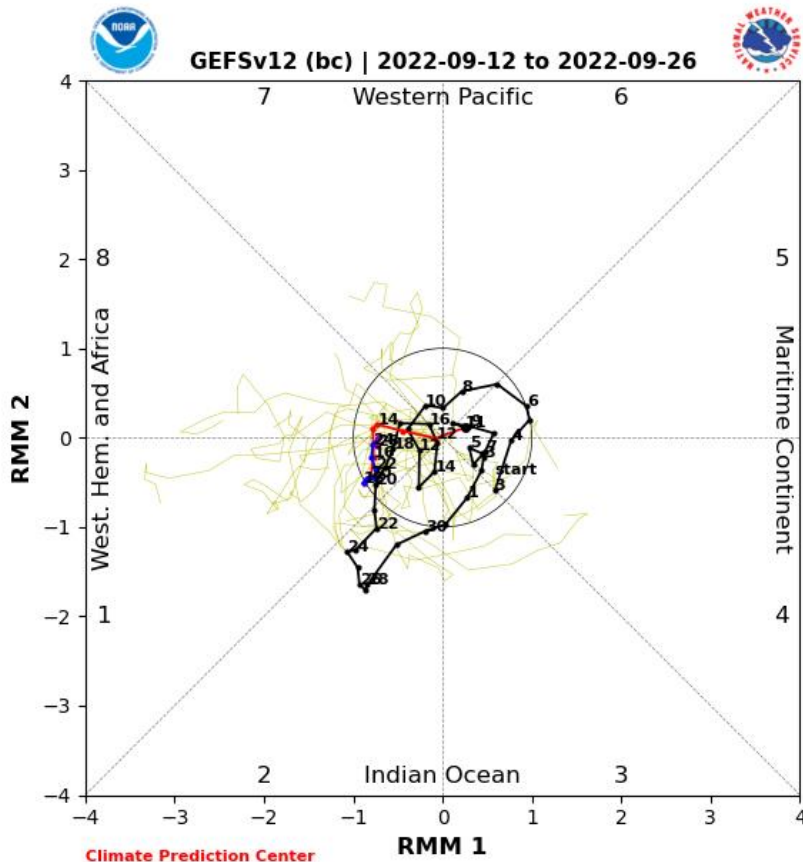
MJO Index: Recent Evolution

- The RMM index shows the intraseasonal signal continuing to propagate eastward across the Maritime Continent and western Pacific, but at a very low amplitude while approaching the origin in RMM space during the past week.

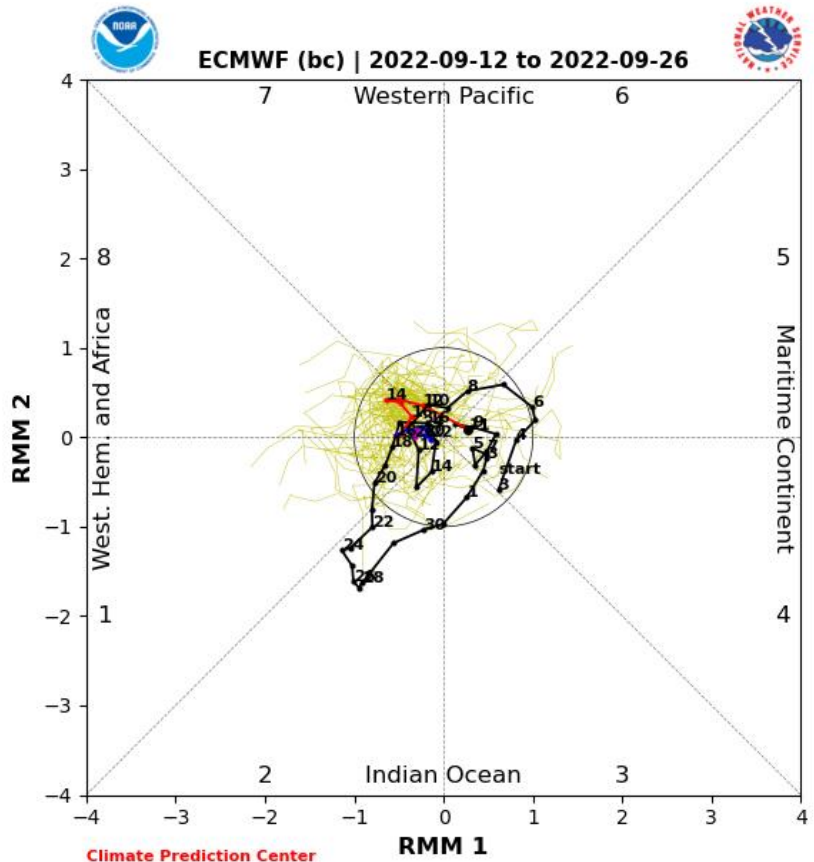


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



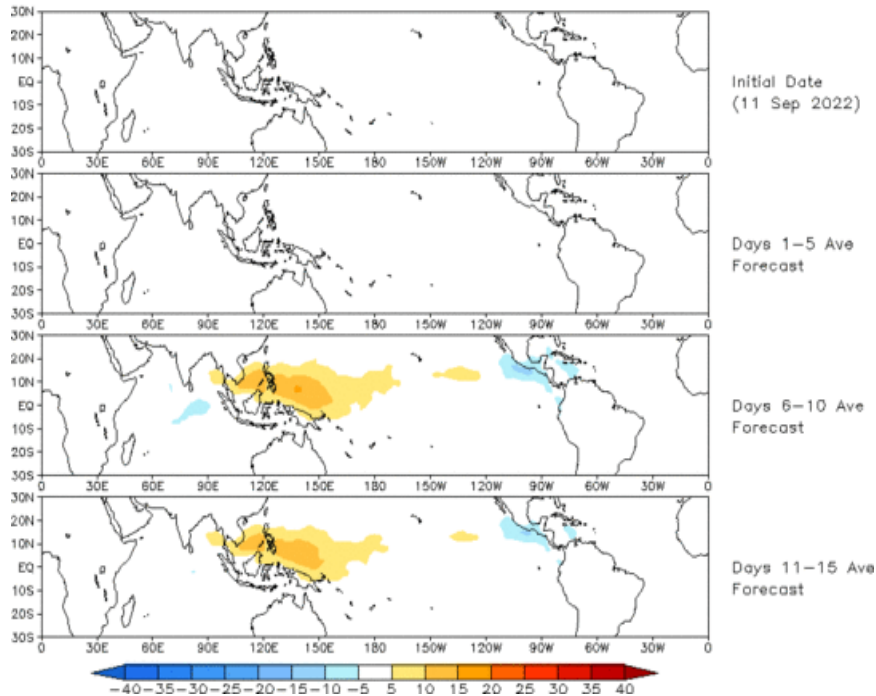
ECMWF Forecast

- RMM forecasts from the GEFS and ECMWF depict the MJO continuing to shift eastward into the Western Hemisphere and Africa, but maintain a low amplitude during the next two weeks.
- The GEFS appears more robust than the ECMWF in potentially developing a more coherent signal (several ensemble members indicating a high amplitude event over the western Hemisphere). However, there have been indications of a westward retreating signal in the RMM forecasts.

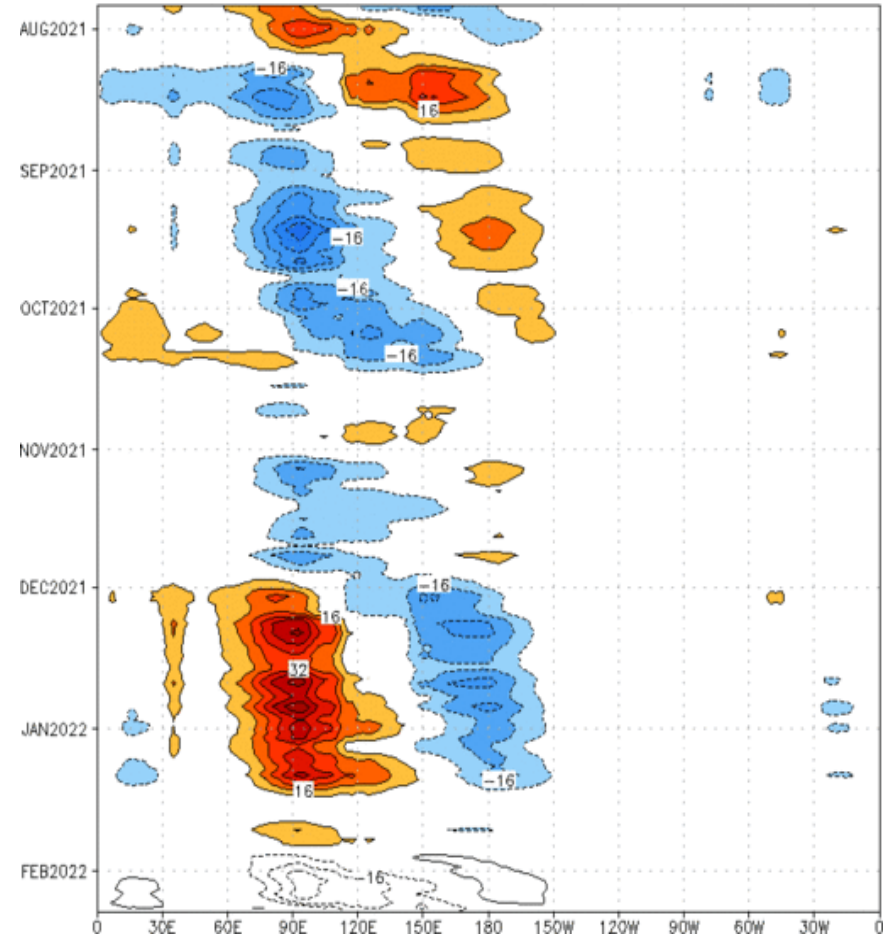
MJO: GEFS Forecast Evolution

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: 11 Sep 2022
OLR



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

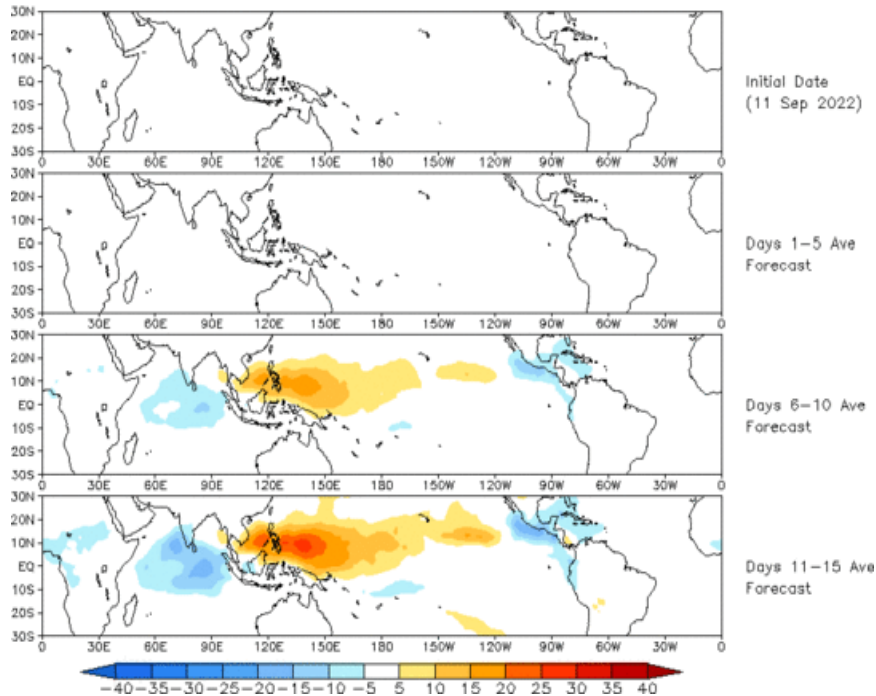


- The GEFS-based OLR anomaly fields favor the development of suppressed (enhanced) convection over the western (eastern Pacific) during the next two weeks.

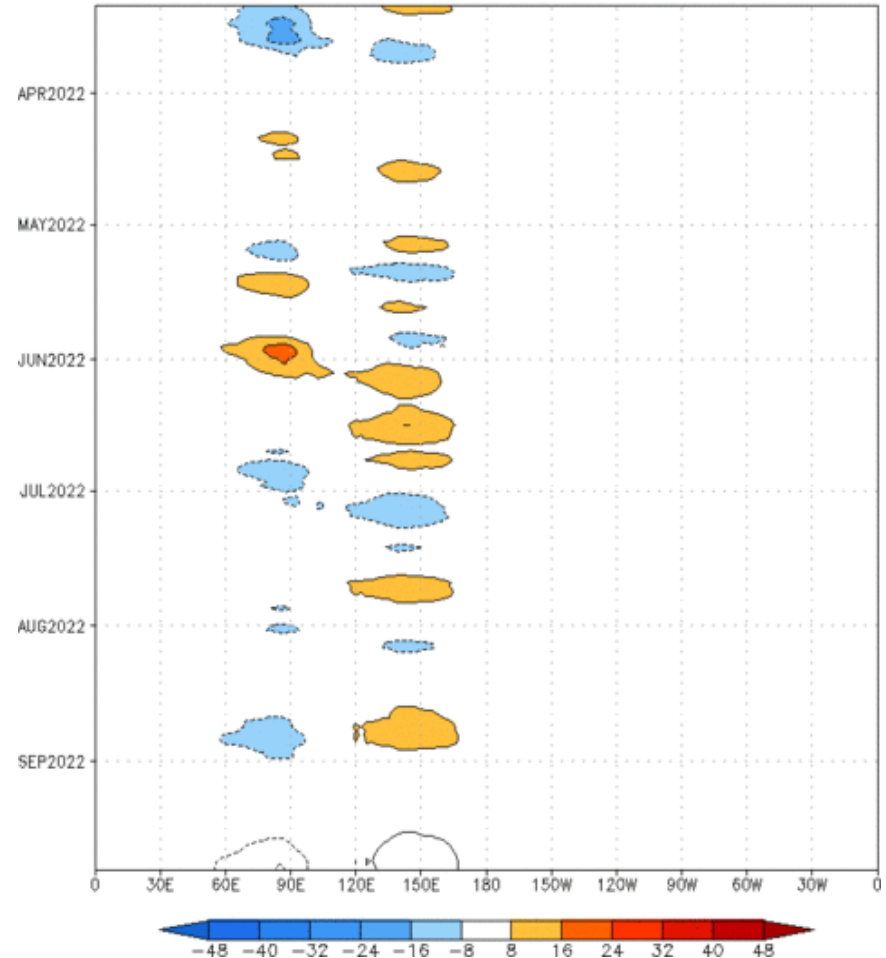
MJO: Constructed Analog Forecast Evolution

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 (11 Sep 2022)



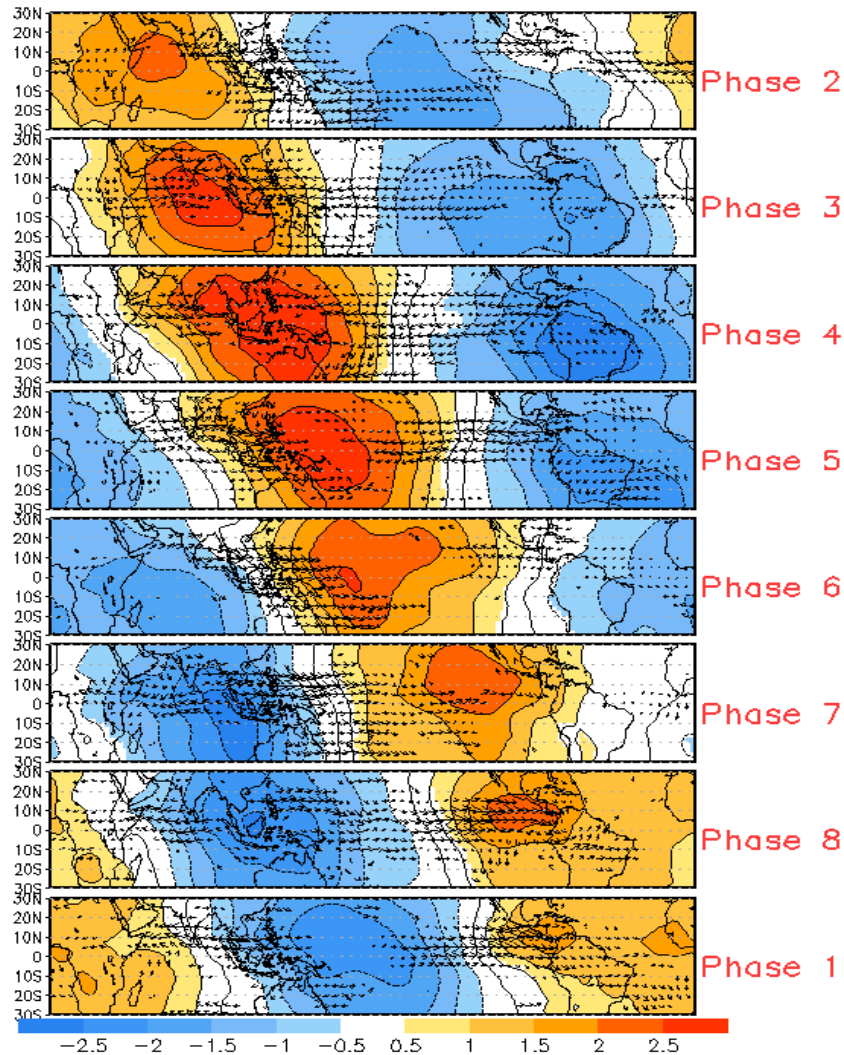
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:12-Mar-2022 to 11-Sep-2022
The unfilled contours are CA forecast reconstructed anomaly for 15 days



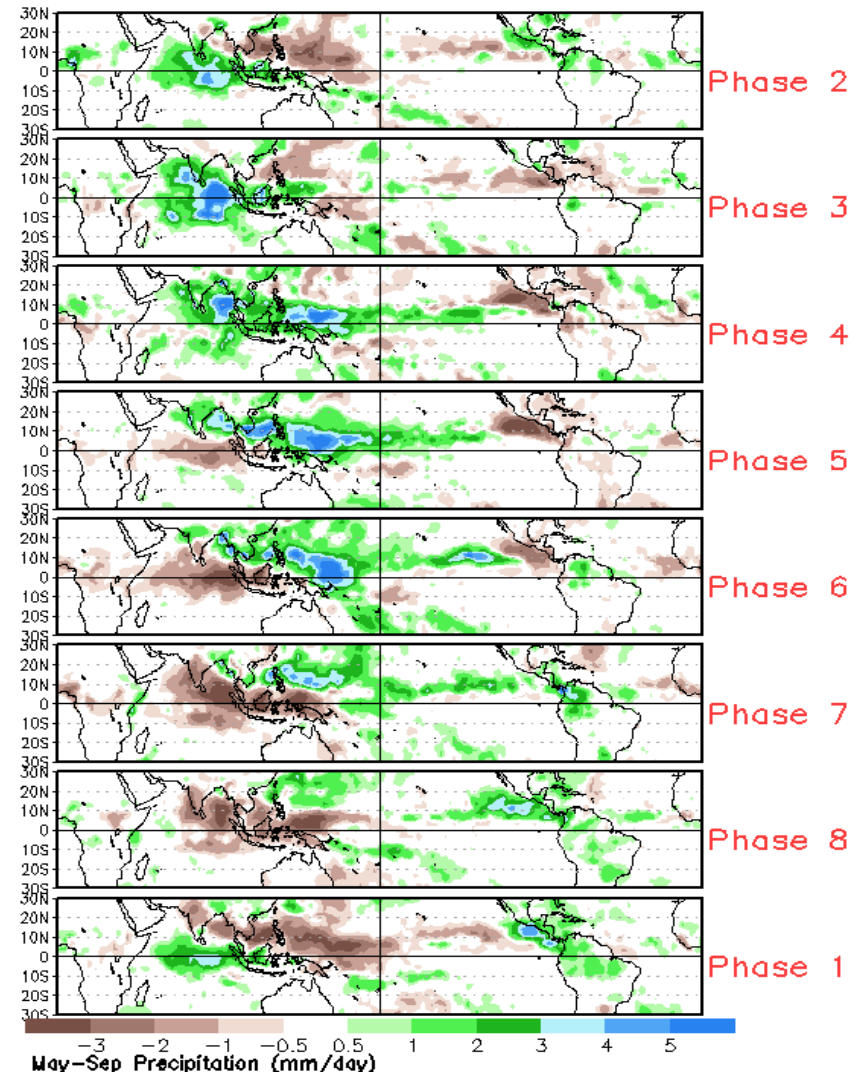
- The constructed analog forecast of RMM-based OLR depicts a convective dipole developing over the eastern Hemisphere, with enhanced convection also emerging over the eastern Pacific.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



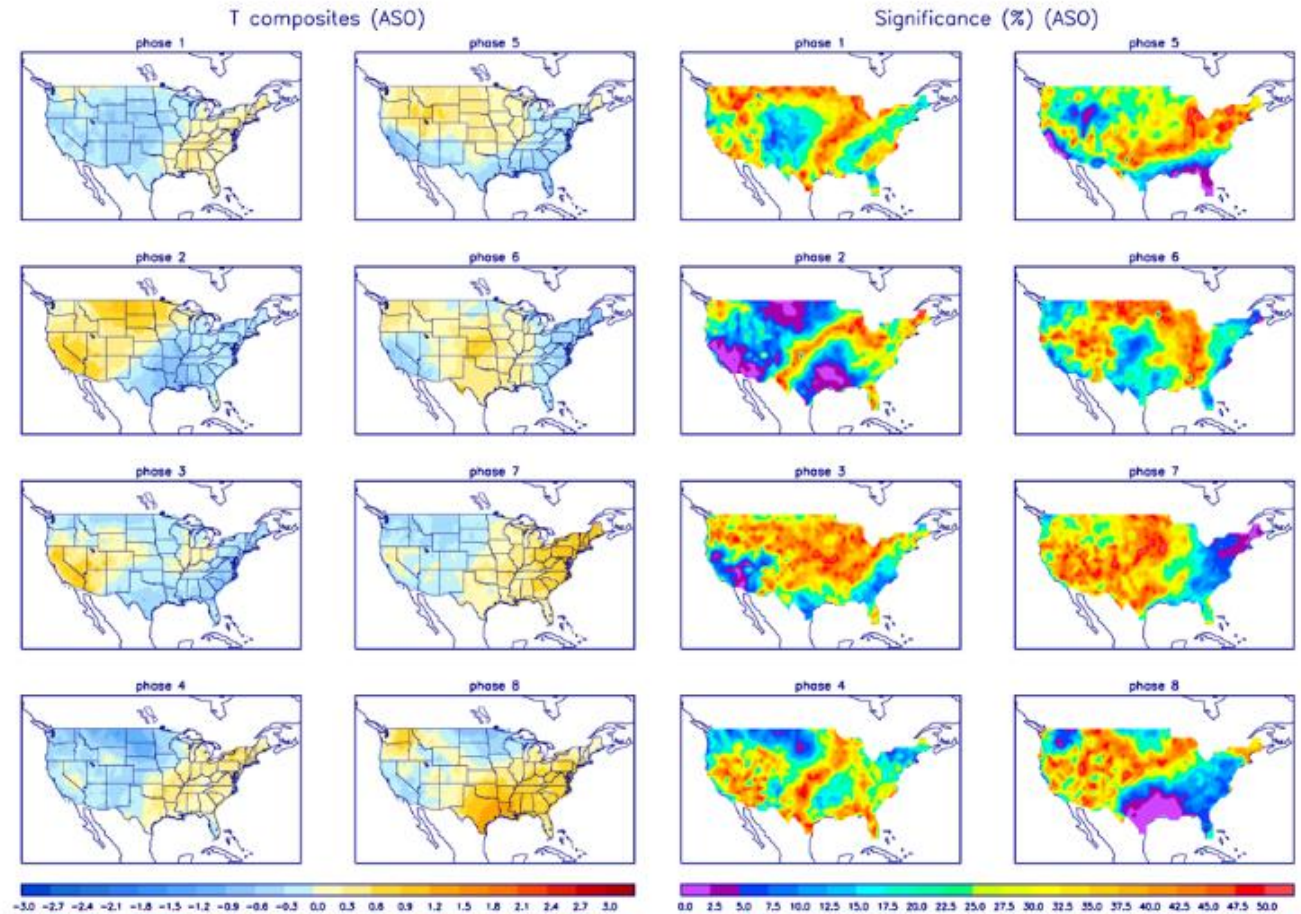
Precipitation Anomalies



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.

