

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
3 October 2022

Overview

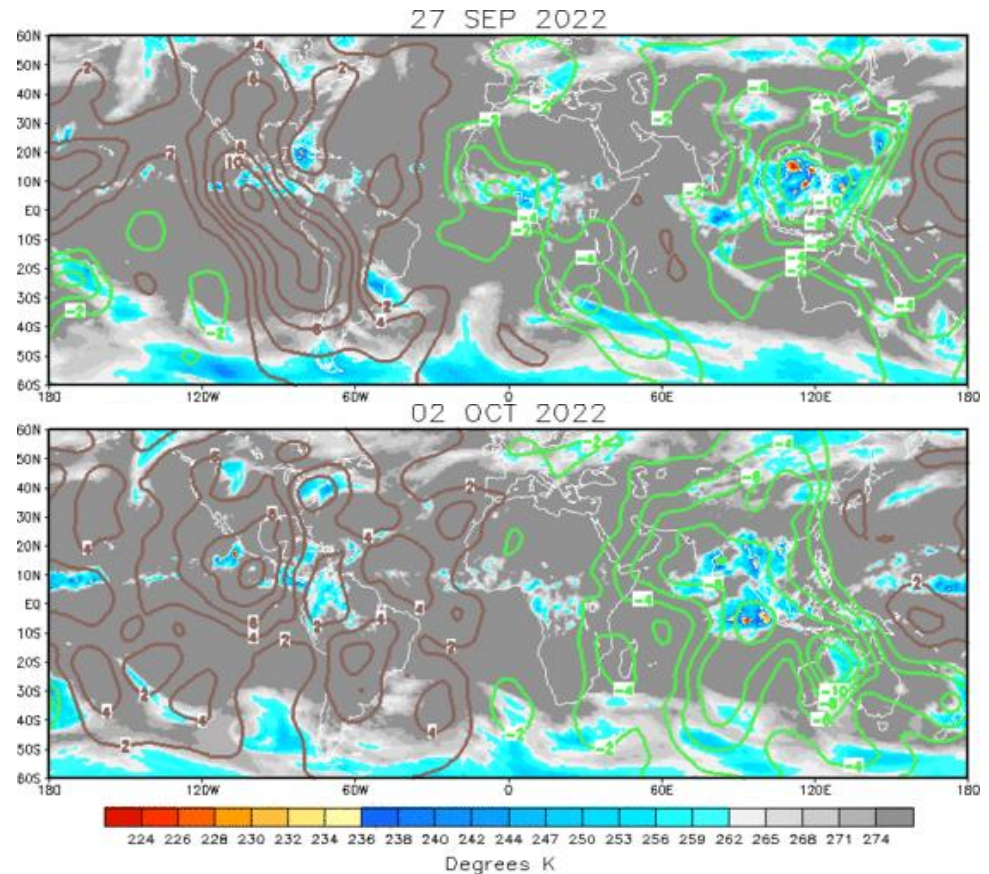
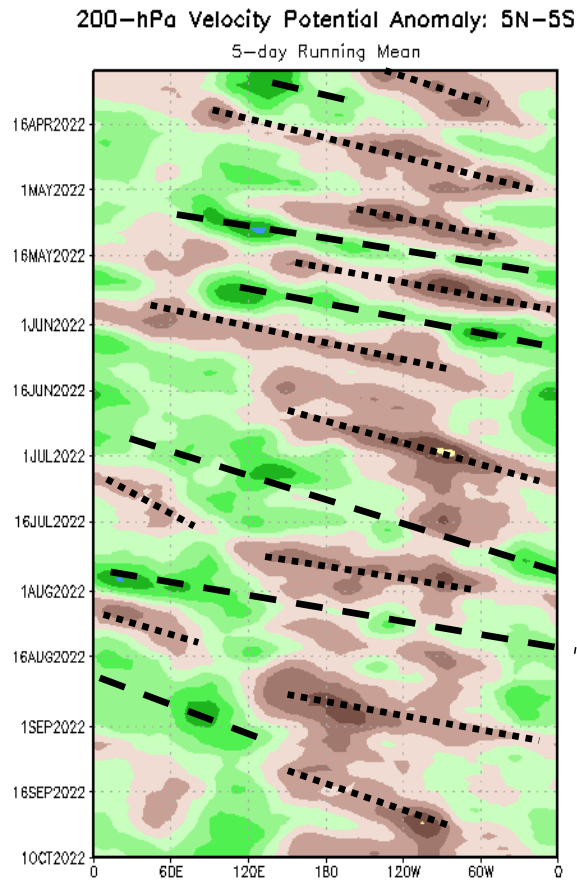
- MJO activity has been weak during the month of September, but model ensembles indicate renewed activity over the Maritime Continent and Western Pacific during the next 2 weeks.
- La Niña remains dominant across the equatorial Pacific and there is uncertainty as to how the renewed MJO will interact with the established low frequency signal.
- Tropical cyclone (TC) activity is forecast to increase across the Western Pacific by week-2 tied to the renewed MJO.

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)

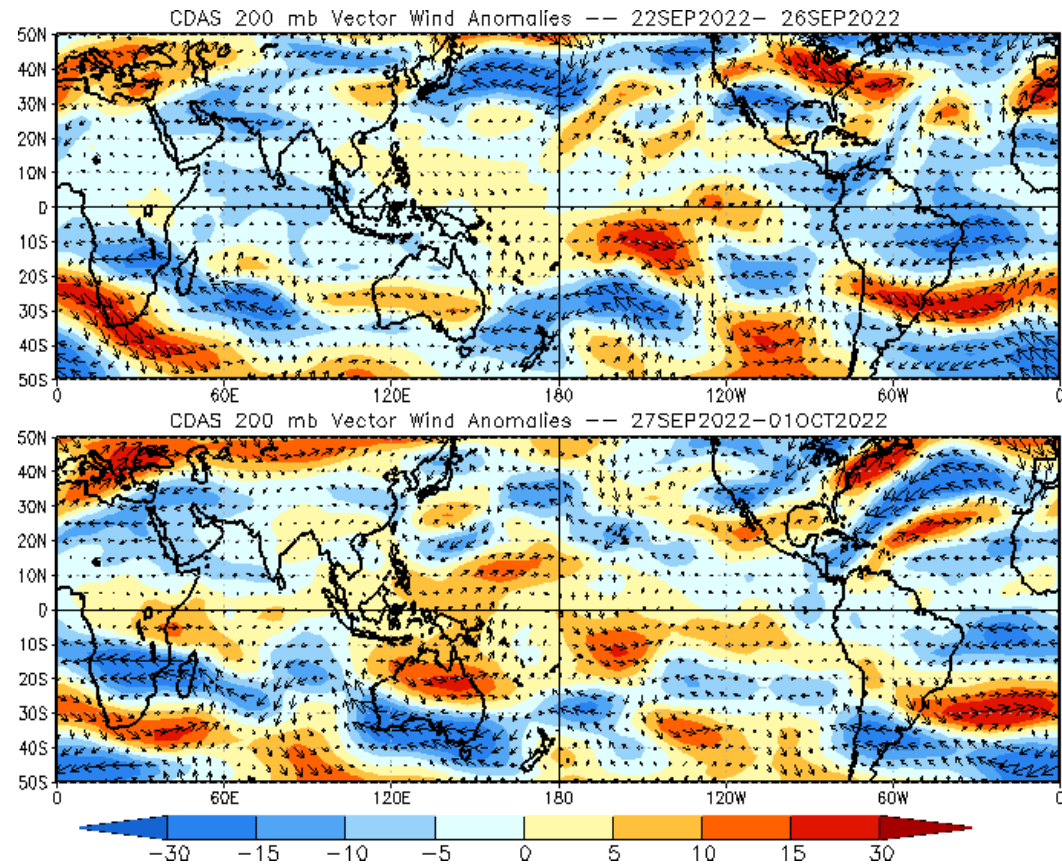
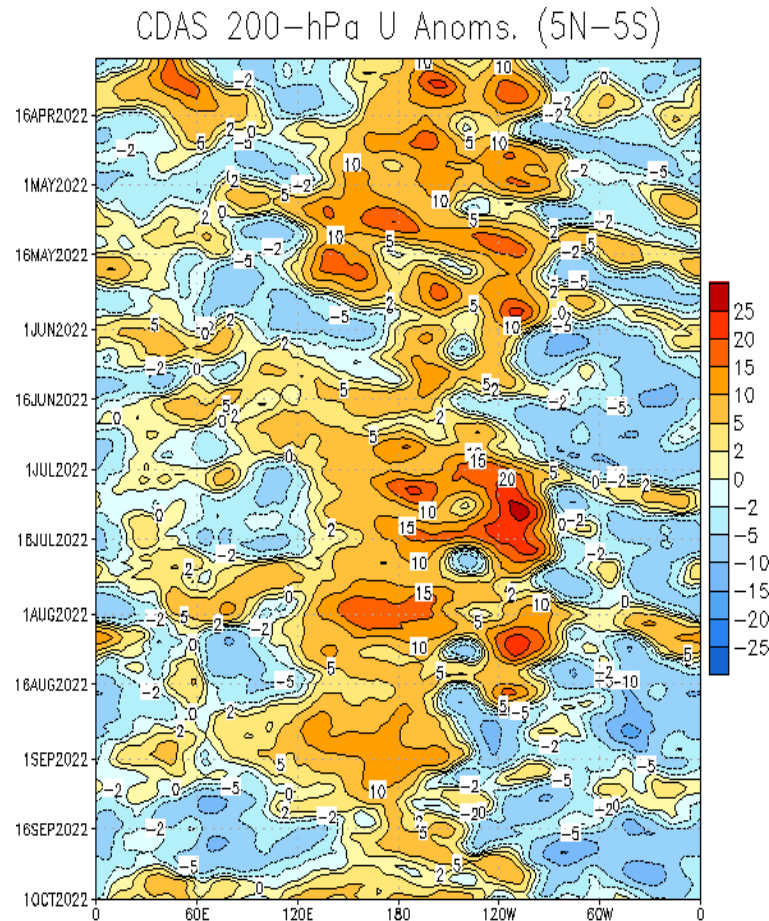
Brown shades: Anomalous convergence (unfavorable for precipitation)



- The global upper-level velocity potential field remains nearly stationary, but evolving more toward a wave-1 asymmetry pattern.
- Anomalous divergence aloft is evident across the Indian Ocean, Maritime Continent, and far western Pacific, with anomalous convergence aloft across much of the Western Hemisphere.

200-hPa Wind Anomalies

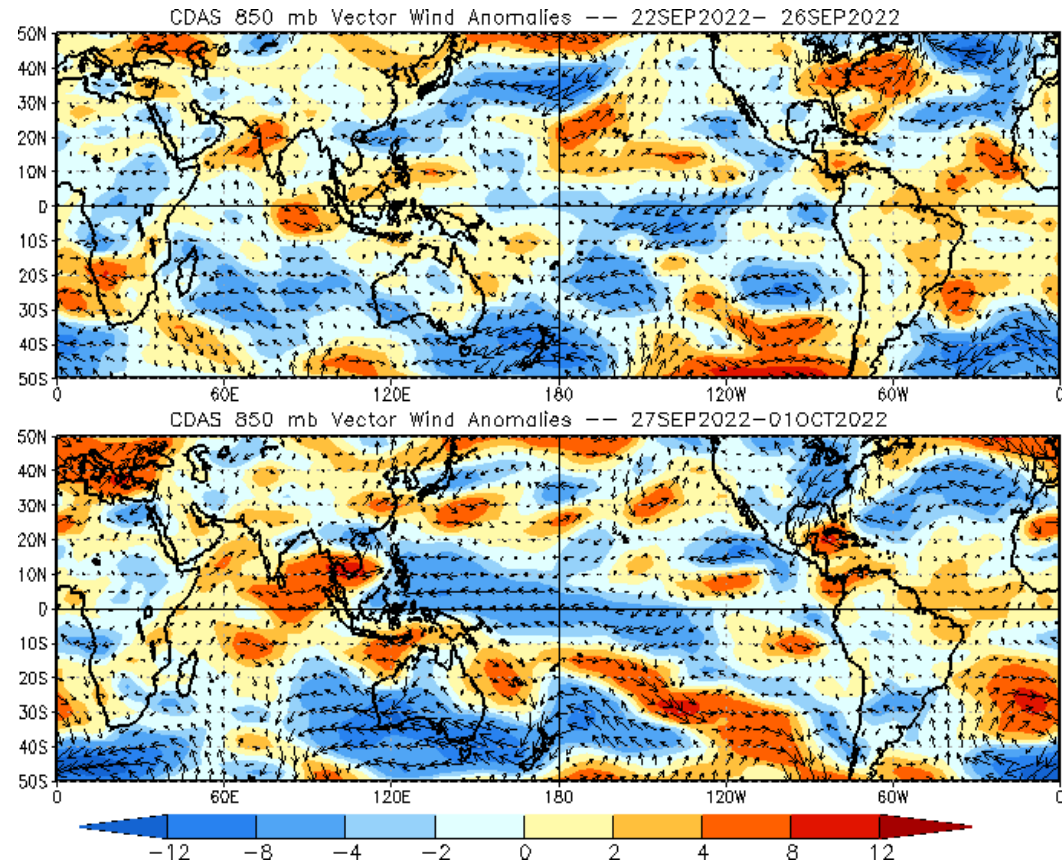
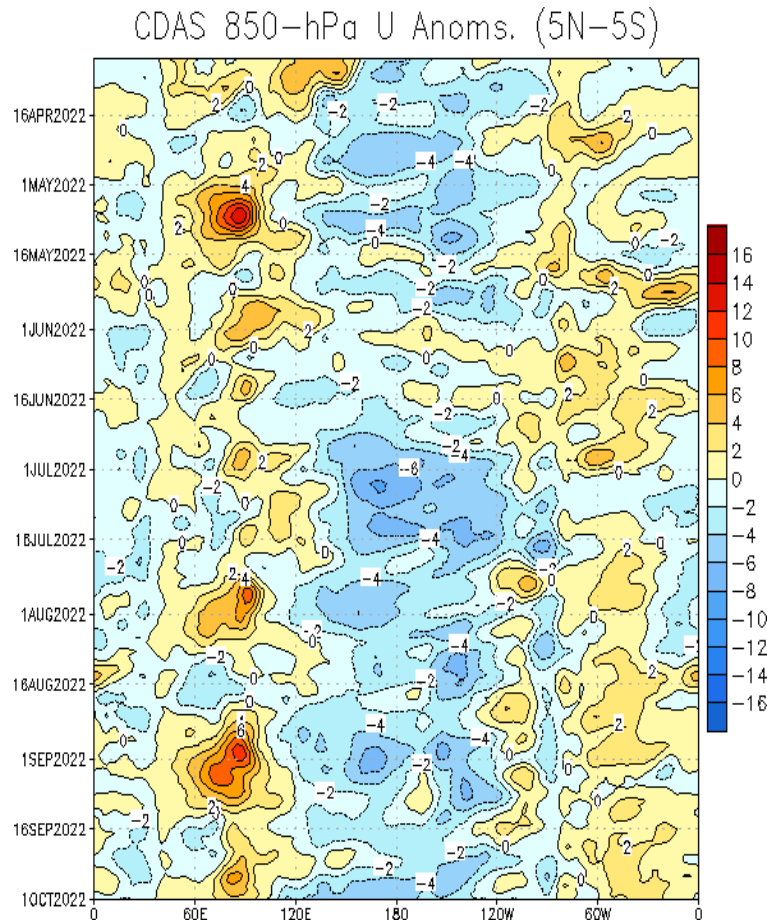
Shading denotes the zonal wind anomaly. **Blue shades: Anomalous easterlies.** **Red shades: Anomalous westerlies.**



- A pronounced shift from anomalous upper-level easterlies to anomalous upper-level westerlies occurred across much of the Indian Ocean and Maritime continent during the past week.
- Robust wave train noted across North America with anomalous troughing situated over the eastern U.S. corresponding to anomalous upper-level westerlies along the East Coast and Gulf of Mexico.

850-hPa Wind Anomalies

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

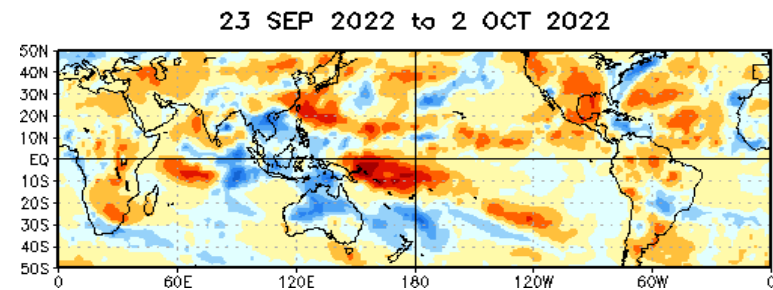
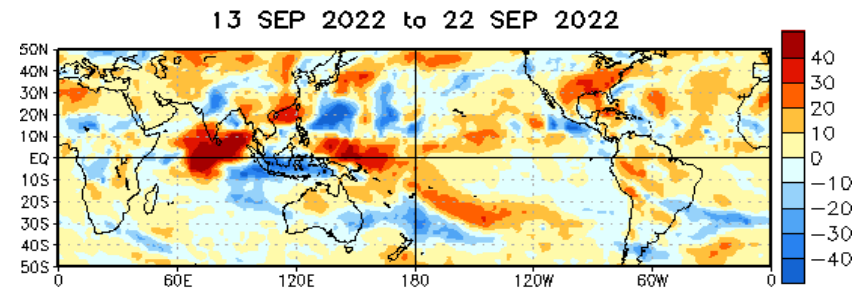
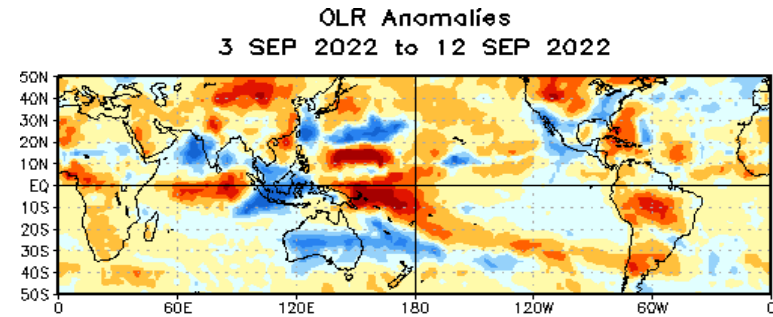
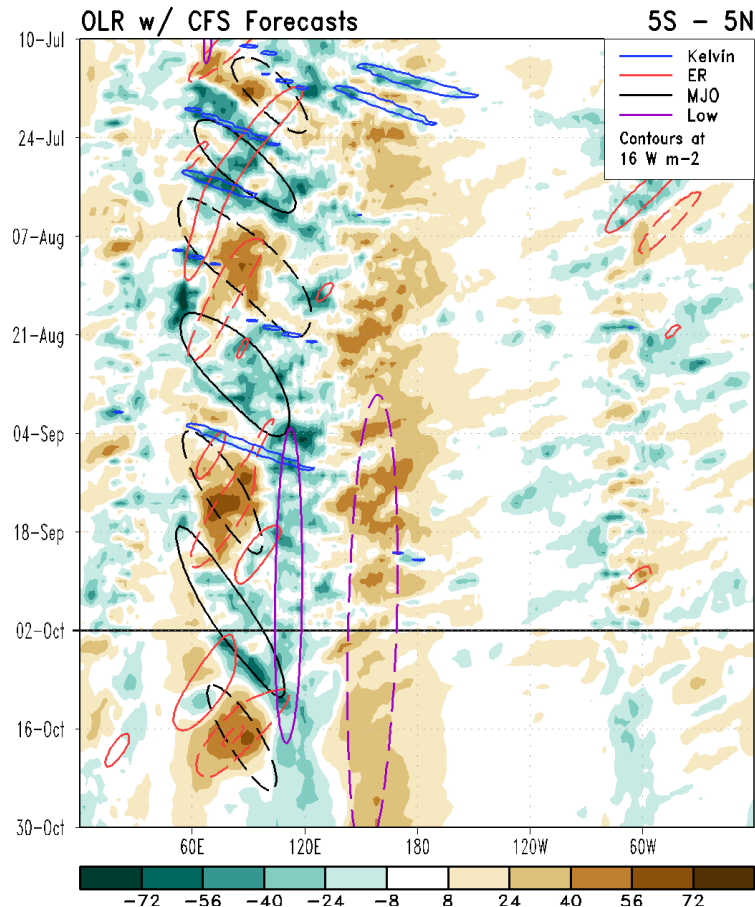


- Easterly trades have strengthened across the equatorial Pacific in the past week, while weakening across the Indian Ocean.
- Anomalous low-level easterlies have developed over much of the eastern U.S. mainly due to the track of Hurricane Ian and its remnant low.

Outgoing Longwave Radiation (OLR) Anomalies

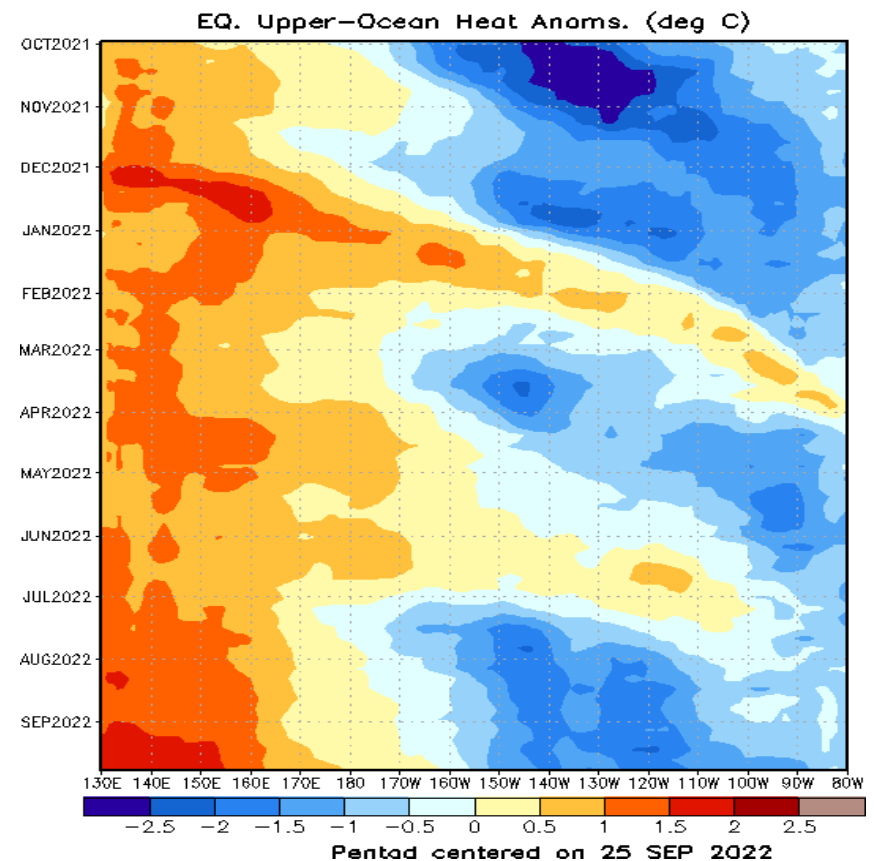
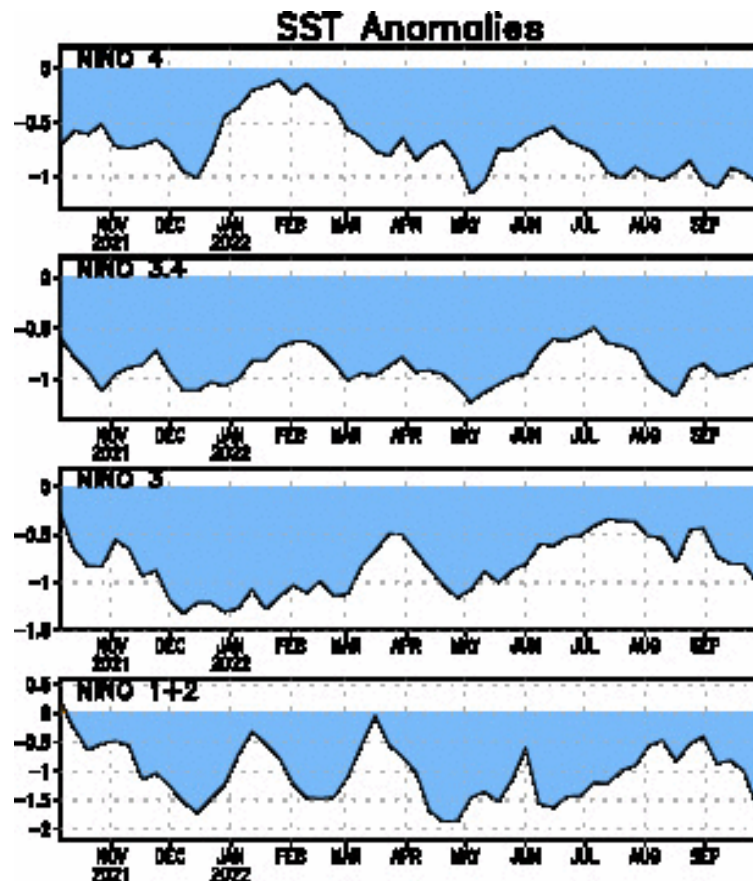
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- Enhanced (suppressed) convection remains anchored over the Maritime Continent (equatorial central Pacific) due to La Niña.
- Convection has increased north of the equator across parts of the Indian Ocean and Maritime Continent, indicative of an organizing MJO event.
- Hurricane Ian track is evident in the OLR field across the Caribbean and eastern U.S.

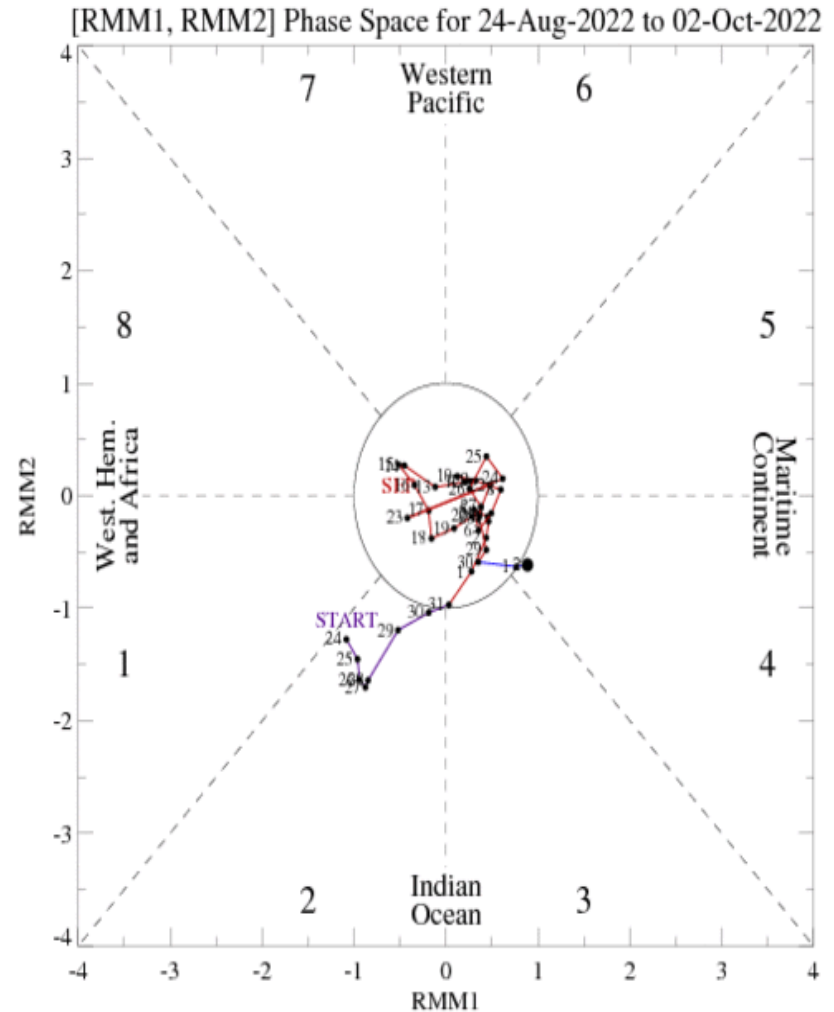
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- 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, with substantial SST decreases noted across the East Pacific (Niño-1+2 and Niño-3)

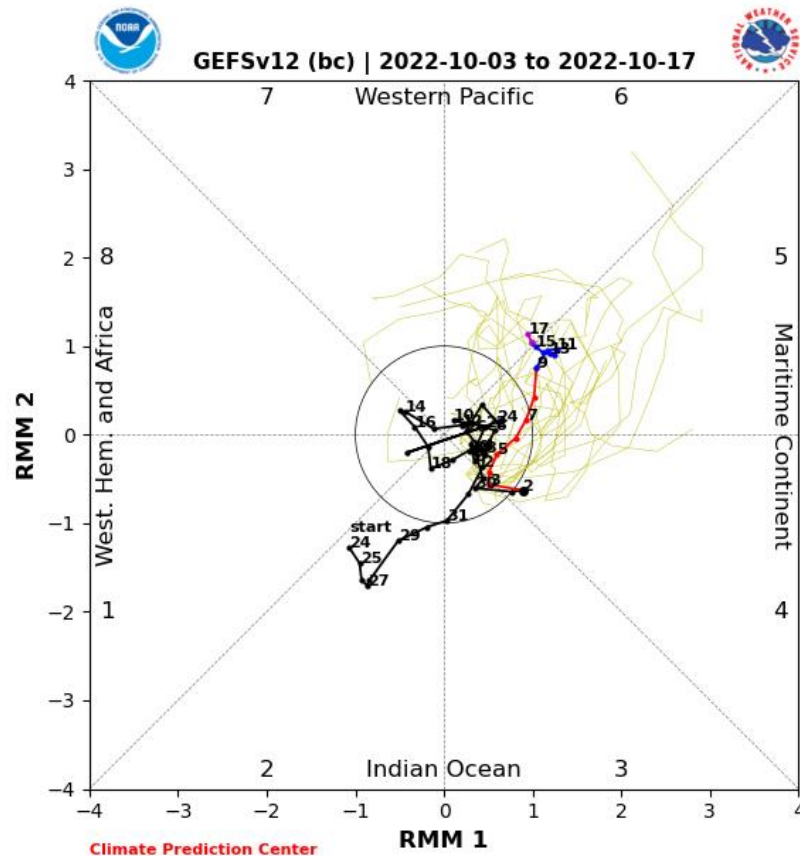
MJO Index: Recent Evolution

- Following in inactive MJO throughout September, the RMM-based index now resides near the edge of the unit circle, with reemergence into the Maritime Continent likely in the coming days.

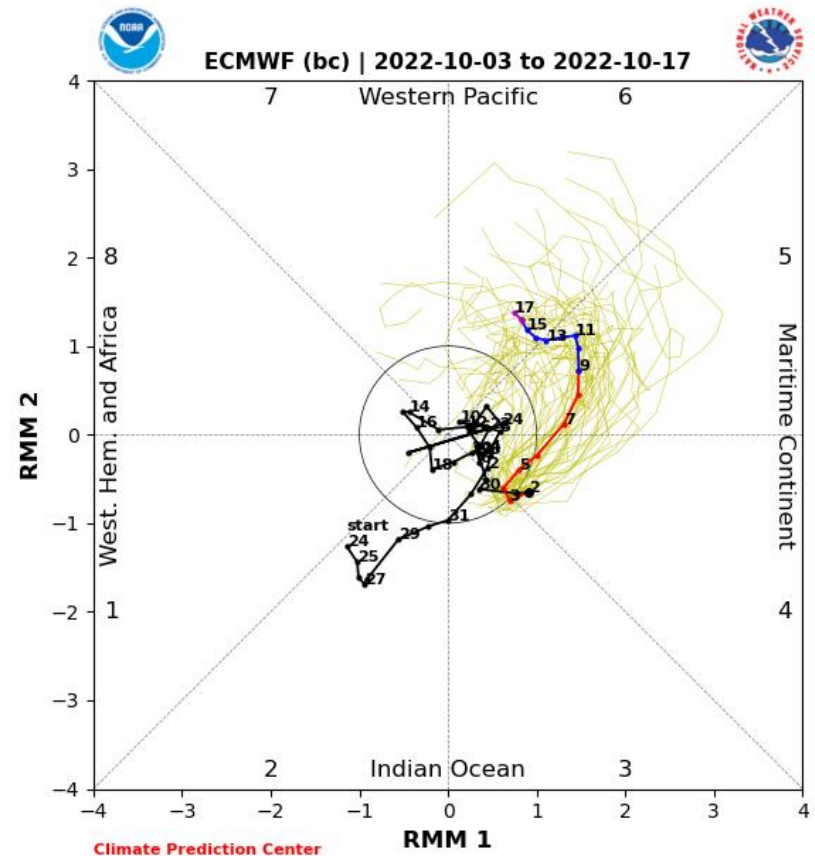


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



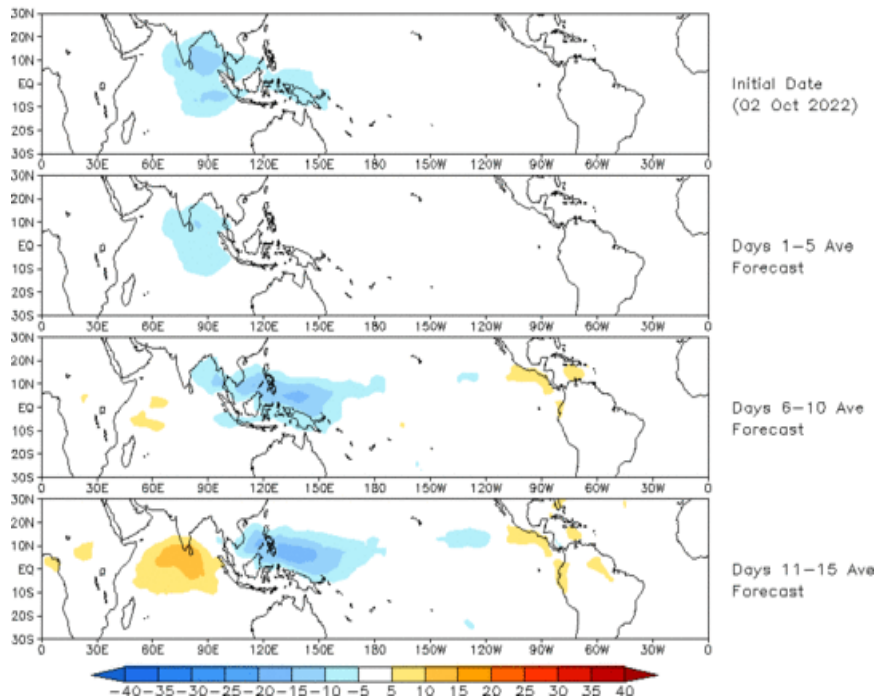
ECMWF Forecast

- The GEFS and ECMWF ensembles support a renewed MJO event emerging across the Maritime Continent and propagating into the western Pacific by week-2.
- Ensemble members differ in terms of the amplitude, with some members from both models indicating the potential for a strong MJO event by mid-October.

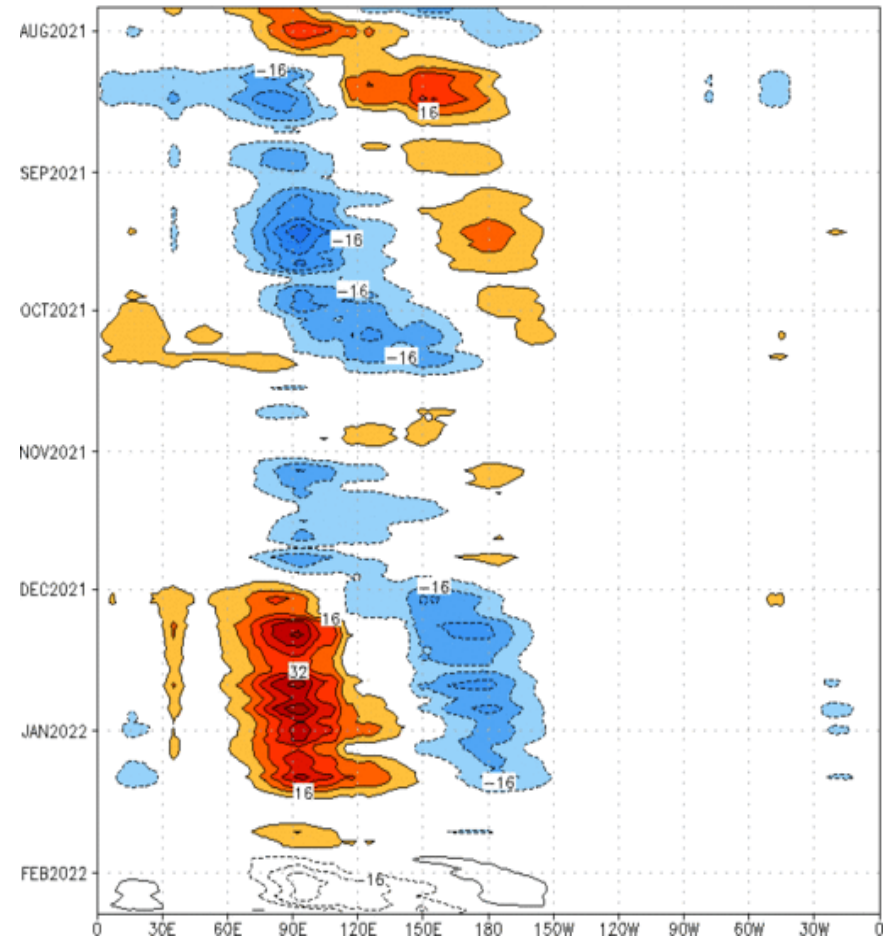
MJO: GEFS Forecast Evolution

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: 02 Oct 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

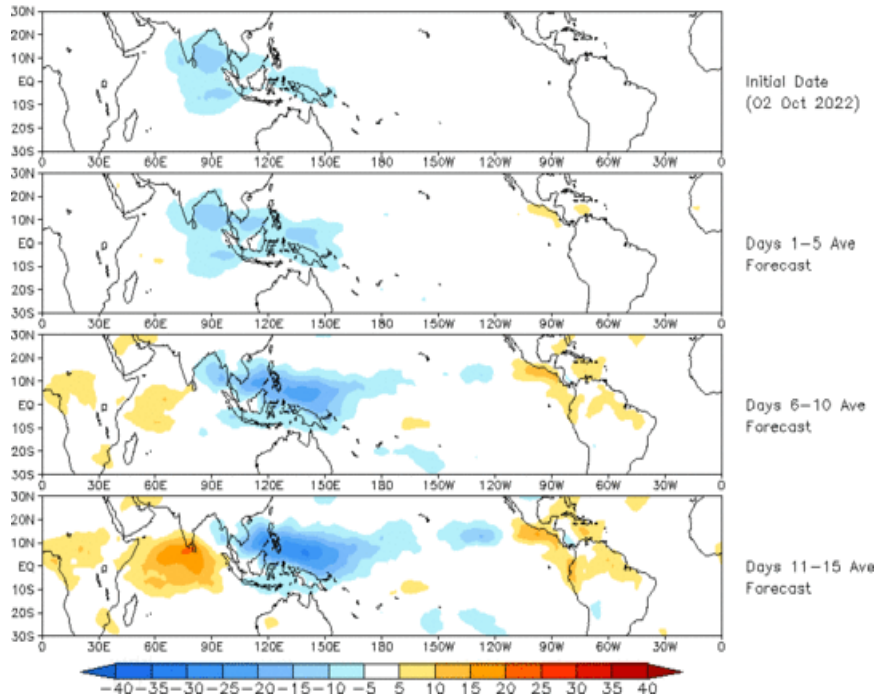


- Consistent with a developing MJO, the GEFS-based OLR anomaly fields favor enhanced convection shifting eastward from the Indian Ocean to the West Pacific during the next 2 weeks, with suppressed convection developing across the Indian Ocean later in week-2.

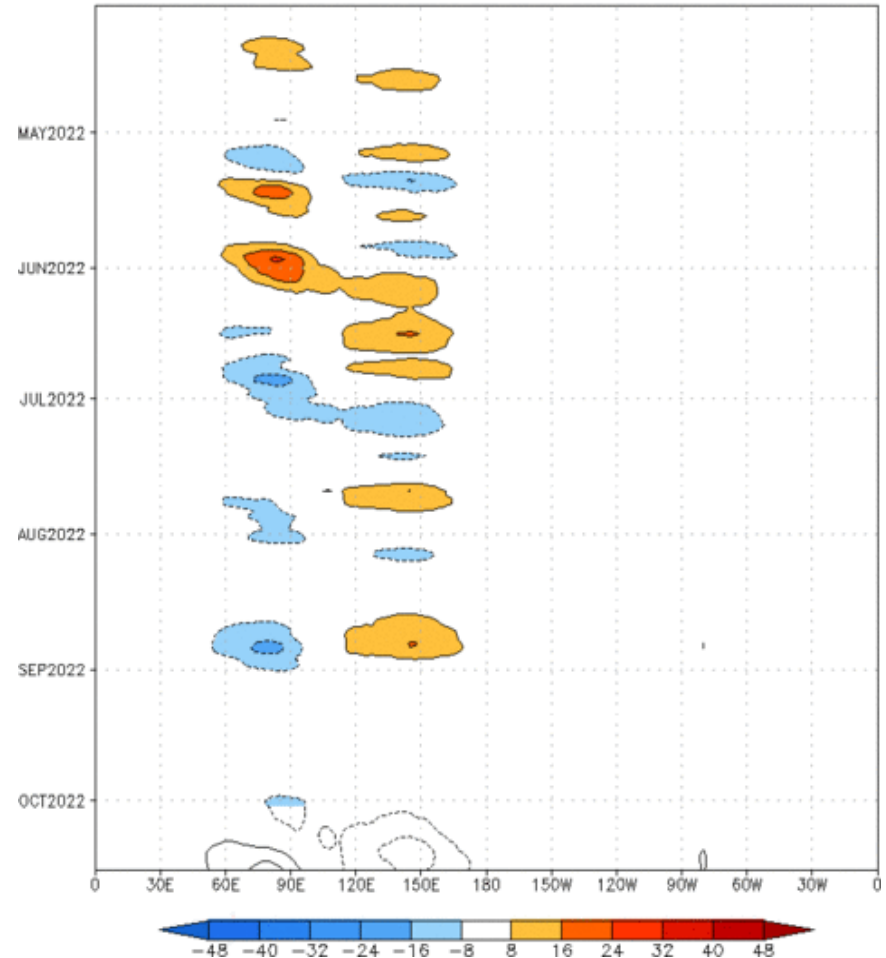
MJO: Constructed Analog Forecast Evolution

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 (02 Oct 2022)



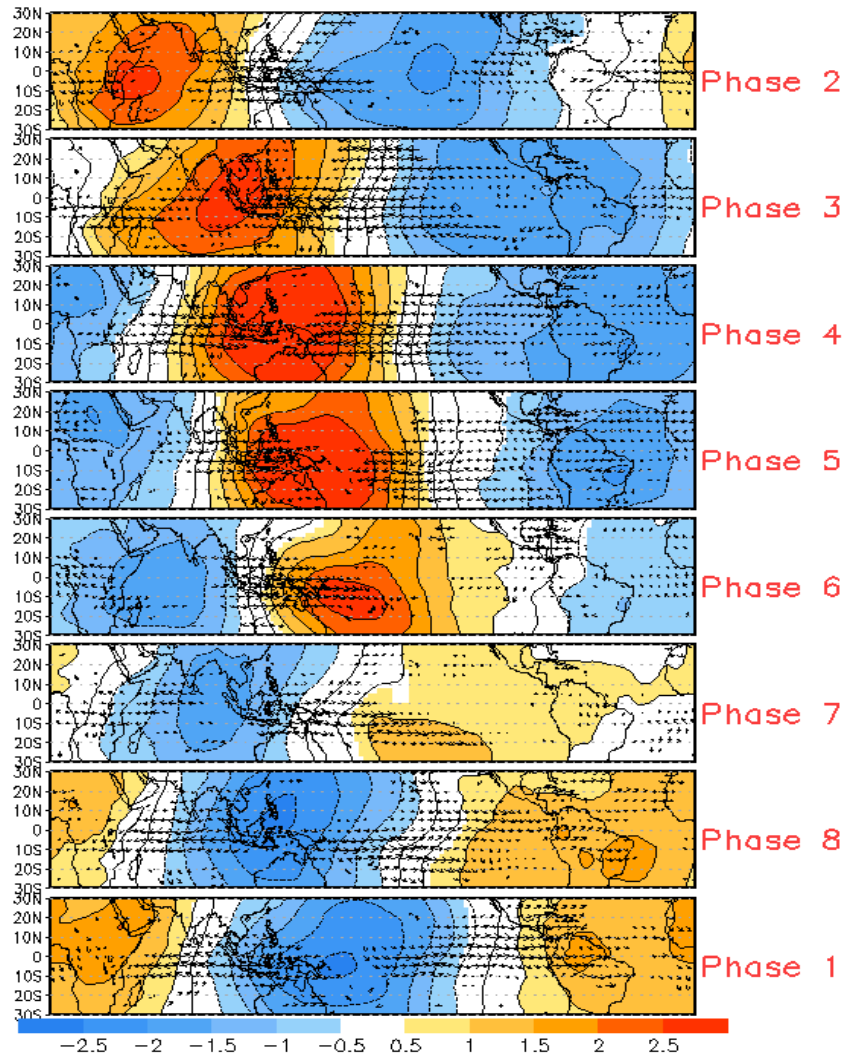
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:02-Apr-2022 to 02-Oct-2022
The unfilled contours are CA forecast reconstructed anomaly for 15 days



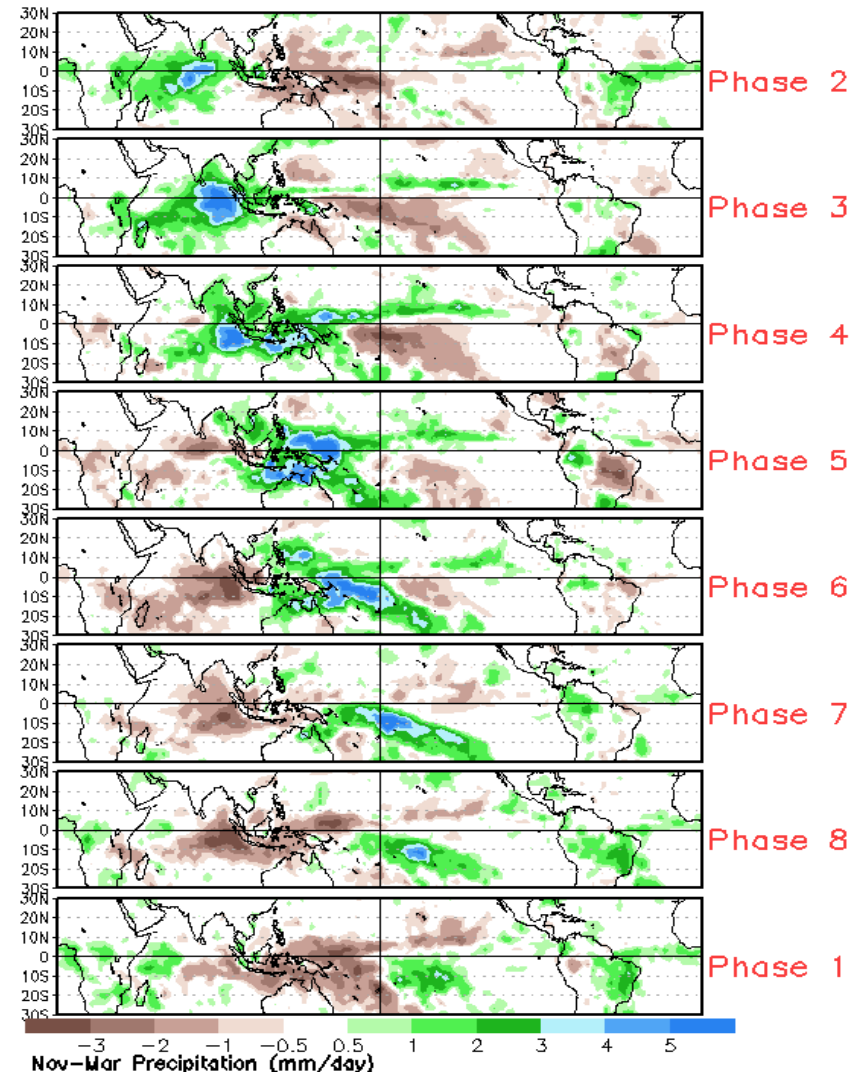
- The constructed analog forecast of RMM-based OLR generally agrees with the GEFS regarding the eastward shift of enhanced convection into the West Pacific during week-2. A stronger area of suppressed convection is noted over Central and South America and Caribbean in week-2.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



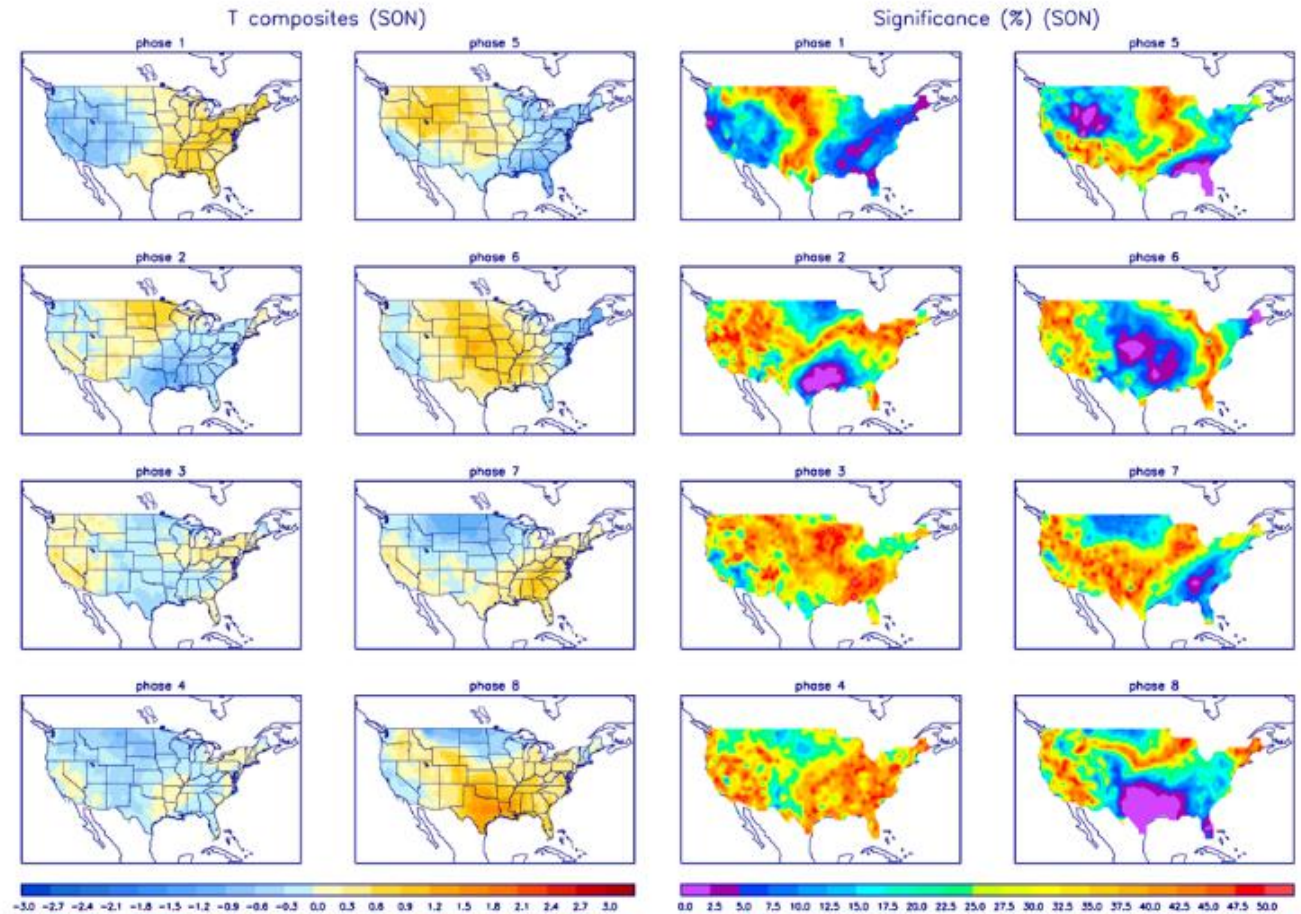
Precipitation Anomalies



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.

