

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



Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
30 September 2024

Overview

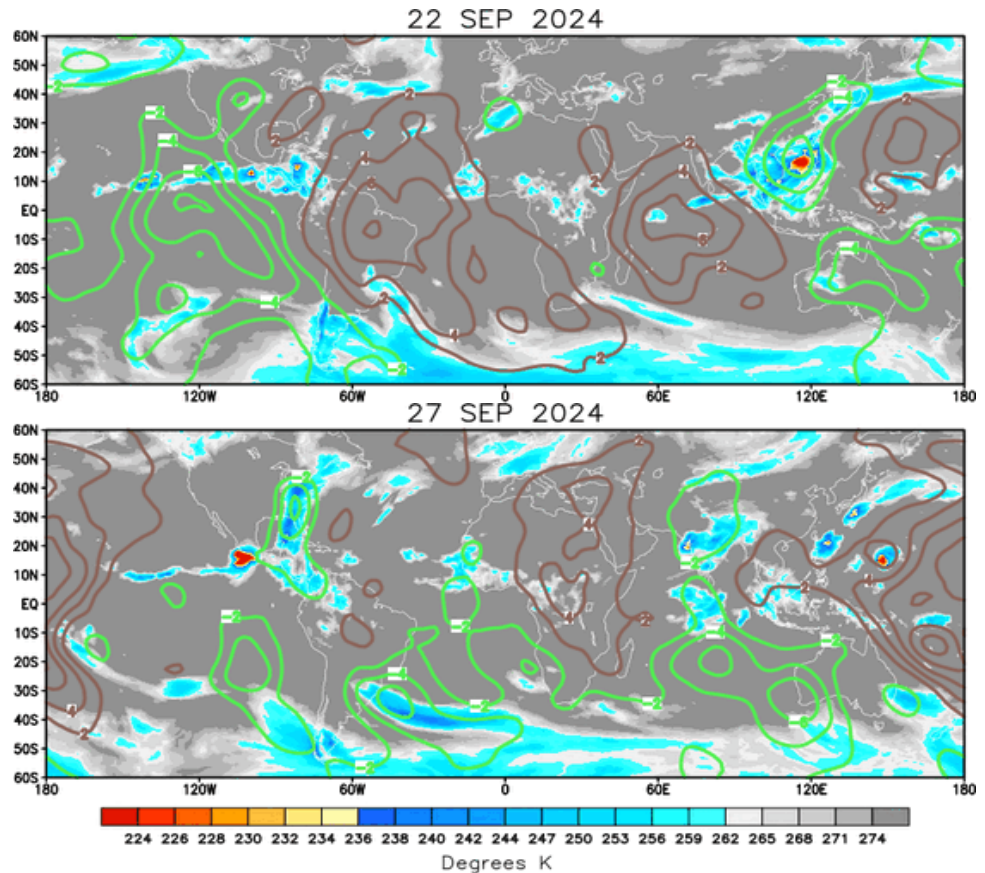
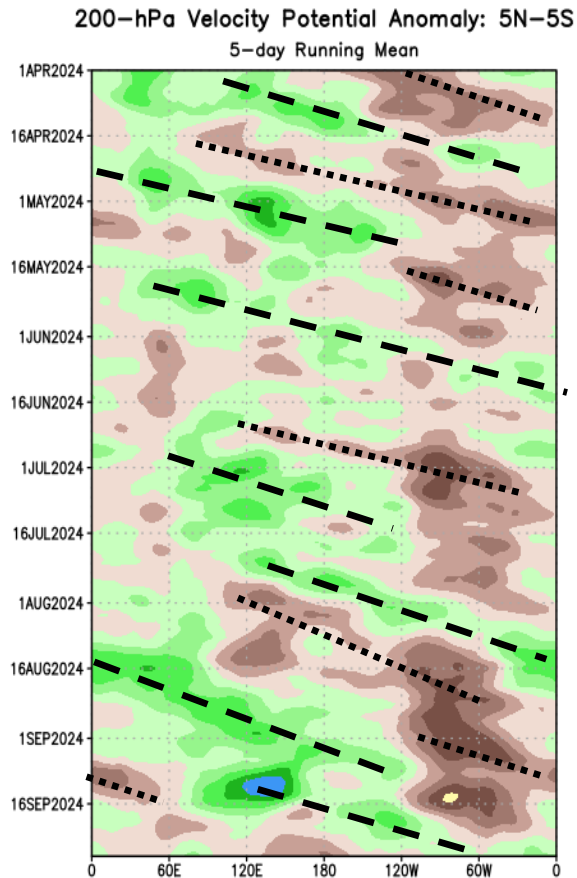
- The MJO is currently active across the Western Hemisphere leading to a pronounced uptick in tropical cyclone (TC) activity across the eastern Pacific and Atlantic.
- Dynamical model MJO forecasts depict a continued eastward propagation of the intraseasonal signal to the Indian Ocean and Maritime Continent during the next 2 weeks, with a more suppressed convective pattern developing across North America in the wake of the MJO.
- While the TC formation chances are forecast to eventually increase across the Western North Pacific tied to the MJO, a Convectively Coupled Kelvin Wave may destructively interfere with the suppressed phase of the MJO, favoring enhanced TC development chances over the climatologically favored regions of the eastern North Pacific and North Atlantic during 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)

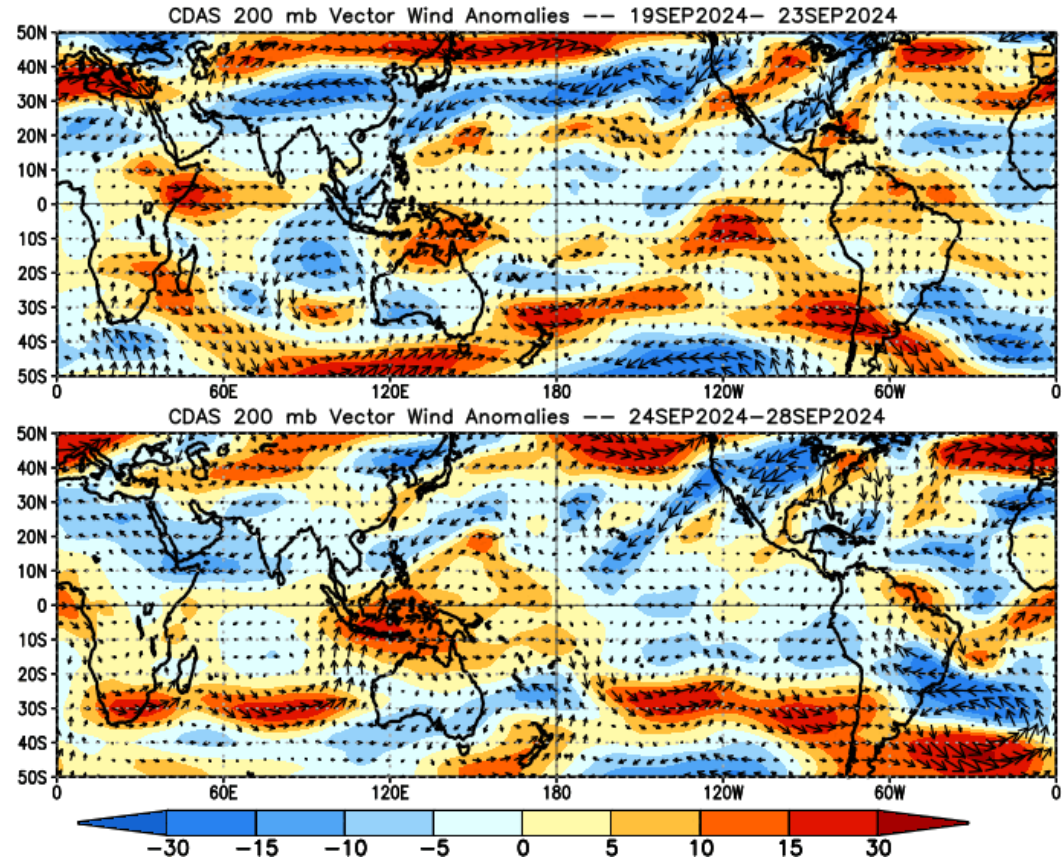
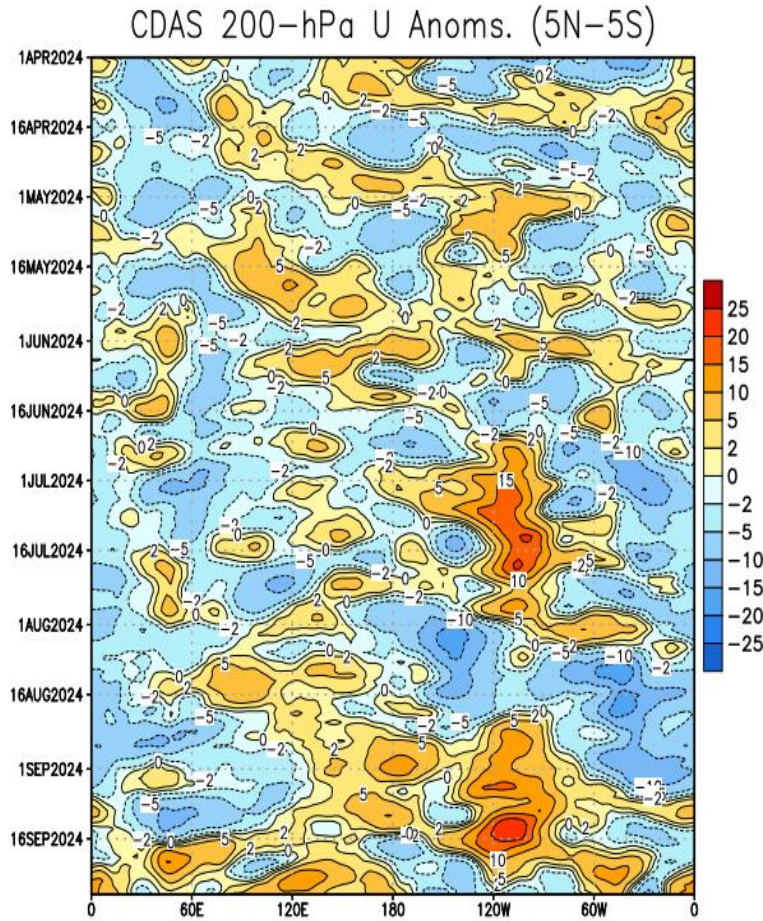
Brown shades: Anomalous convergence (unfavorable for precipitation)



- Several competing modes of variability resulted in a disorganized spatial upper-level velocity potential pattern across the globe during late September.
- Some areas of anomalous divergence are noted across the Americas consistent with the MJO moving across the region.

200-hPa Wind Anomalies

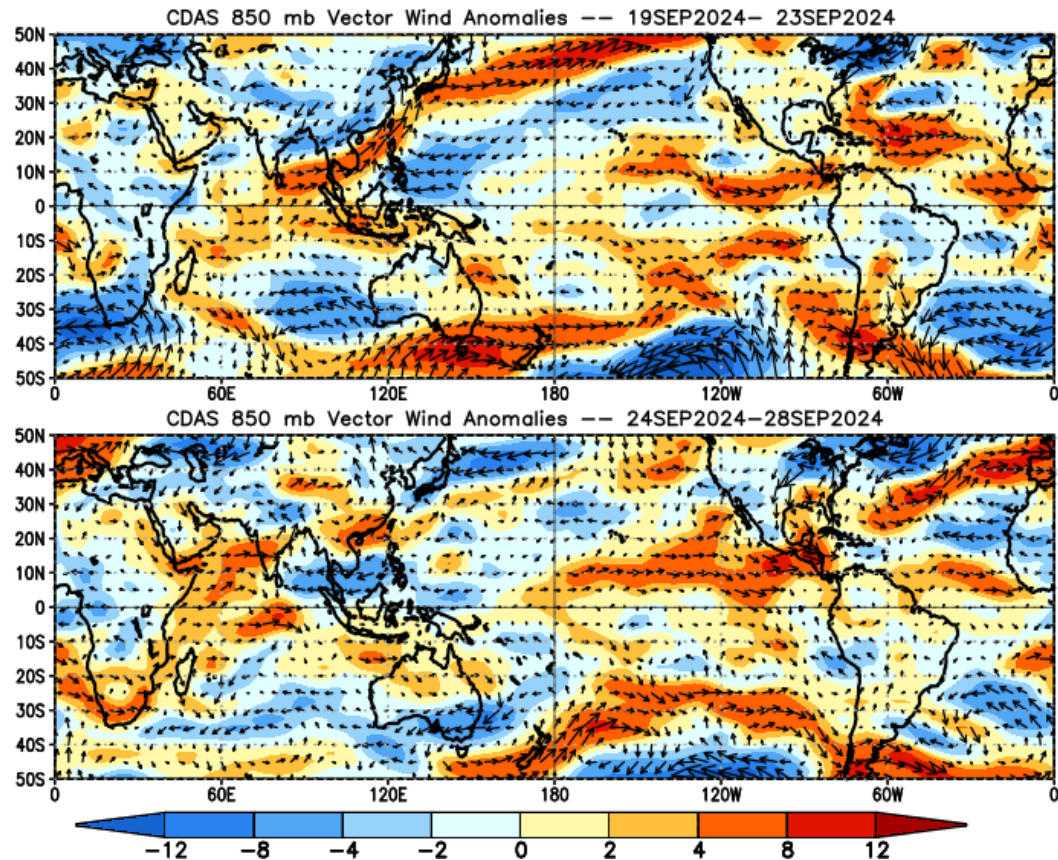
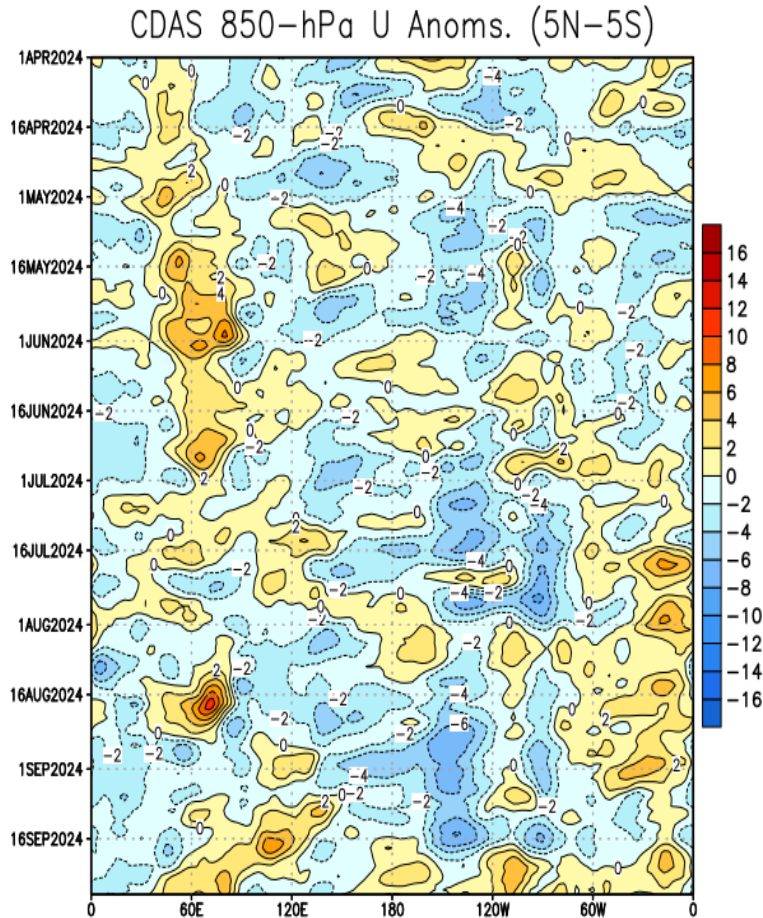
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Based on the time-lon plot, anomalous upper-level westerlies shifted across the Western Hemisphere during the past week.
- Anomalous easterlies over the western U.S. are consistent with a northward shift of the jet stream and warmer than normal temperatures over the region.
- An area of persistent anomalous upper-level westerlies developed across the Maritime Continent, possibly tied to the emerging low frequency La Niña base state.

850-hPa Wind Anomalies

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

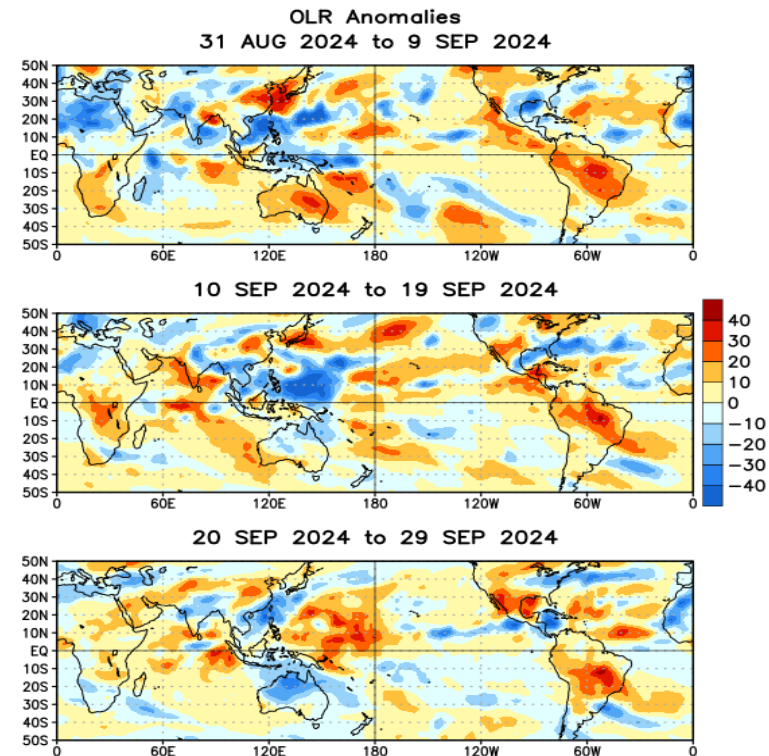
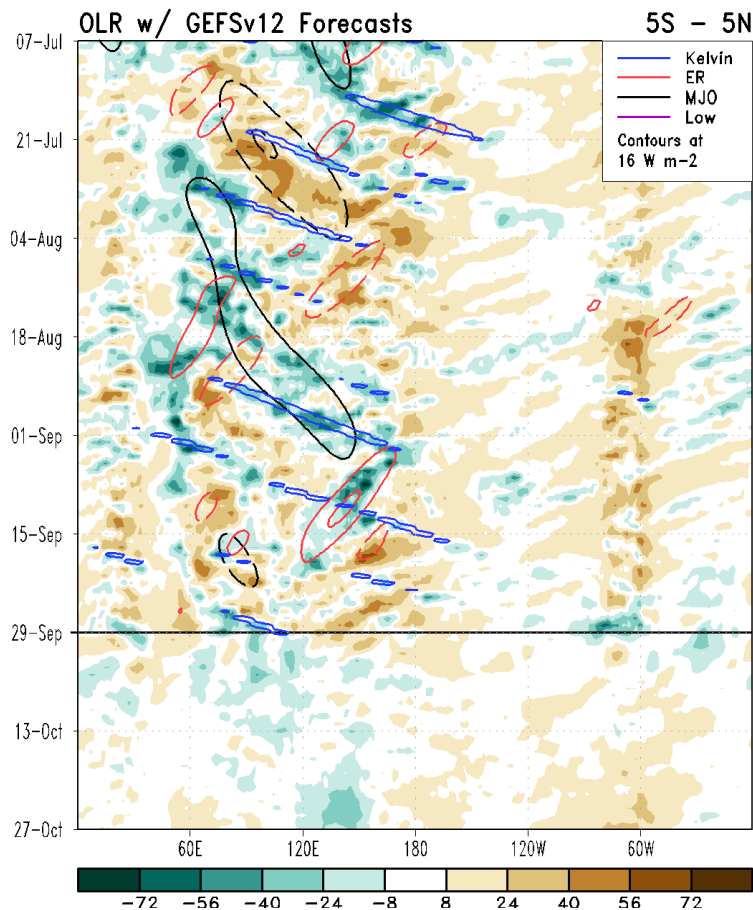


- Low-level westerly wind anomalies dominated most of the global tropics during the past week, particularly across the Eastern North Pacific and North Atlantic.
- Anomalous low-level easterlies are currently present over the northeastern Indian Ocean, with upstream westerlies leading to enhanced convergence across India and surrounding areas.

Outgoing Longwave Radiation (OLR) Anomalies

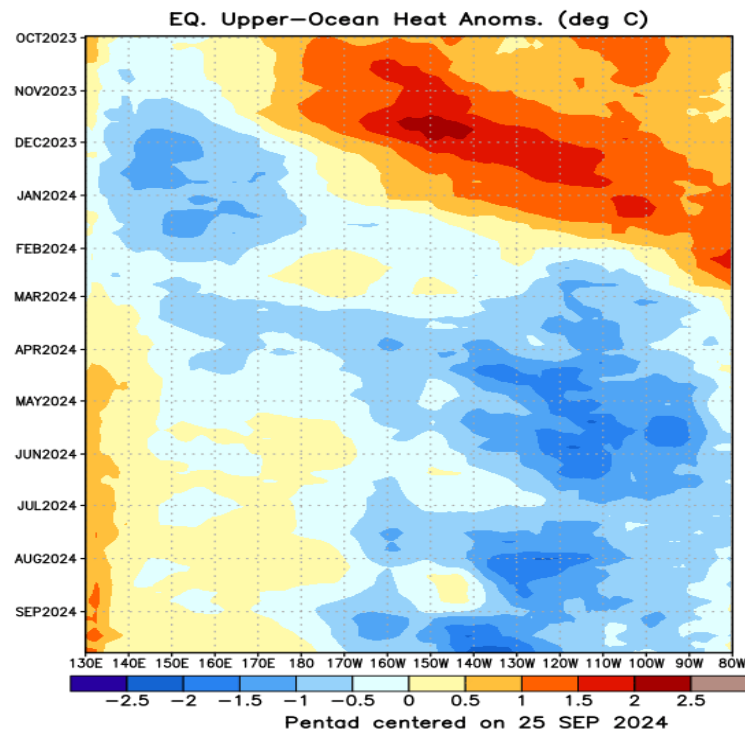
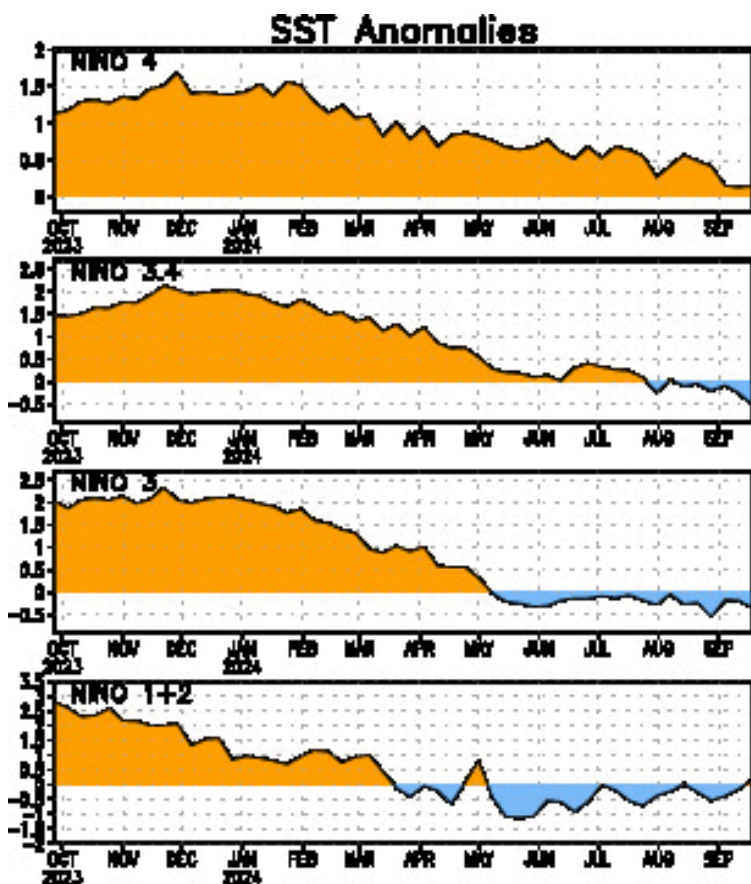
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- Following more activity coming through the OLR filtering during the summer, filtered signals are currently weak or non-existent in the forecast portion of the time-lon OLR plot.
- During the past week, negative OLR anomalies were noted over the western Caribbean (Helene) and the North Atlantic (Issac). Several tropical systems also contributed to anomalous negative OLR anomalies over the Western North Pacific, although there has been a trend toward more positive OLR anomalies building west of the Date Line.

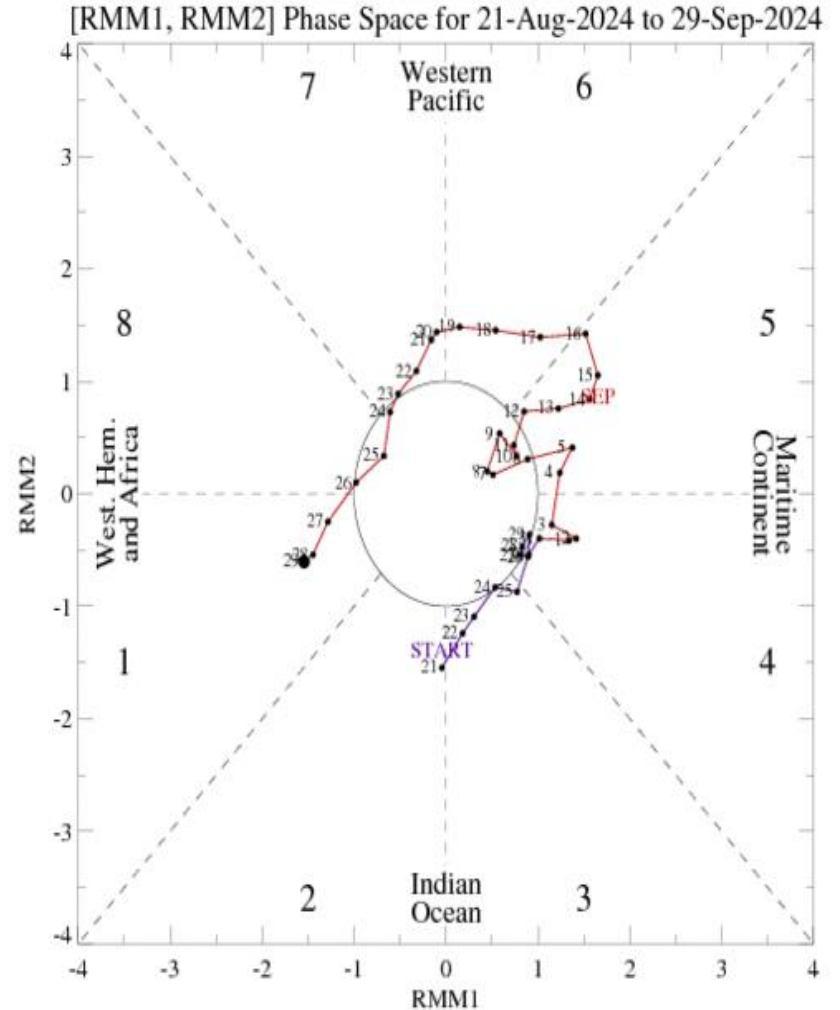
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- There has been a notable downward trend in the SSTs across NINO 3.4 throughout September indicating a transition toward La Niña conditions.
- SSTs are also negative across NINO 3 and continue to trend downward are now only slightly above-normal across NINO 4.
- Subsurface temperature anomalies have continued to cool throughout the equatorial Pacific, with the largest negative anomalies east of the Date Line.

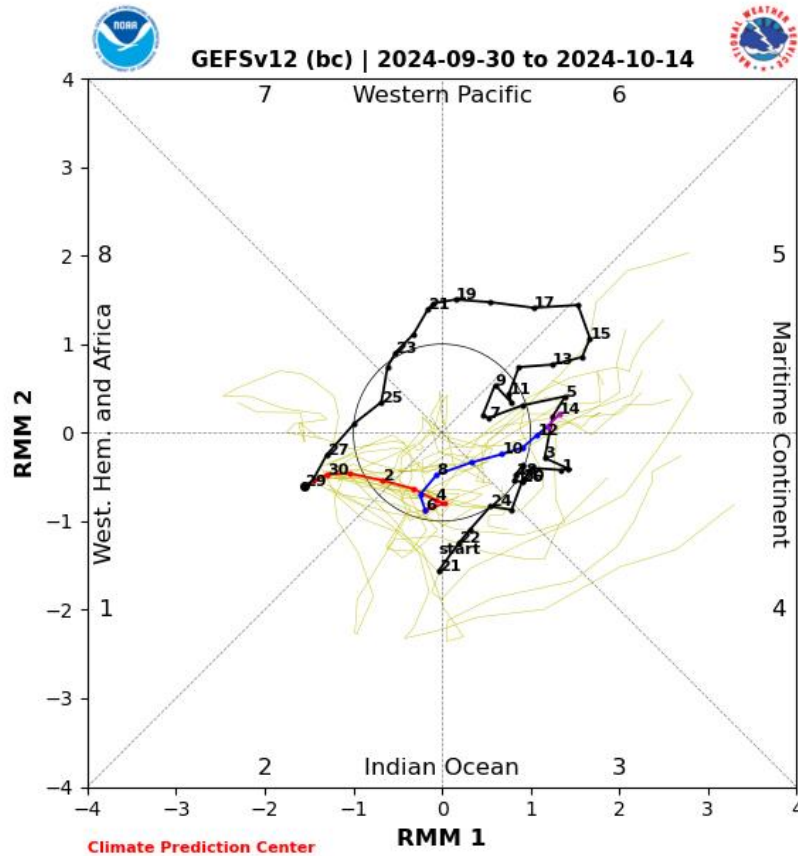
MJO Index: Recent Evolution

- The MJO has been active during the past 2 weeks, with propagation across the Pacific and into the Atlantic.

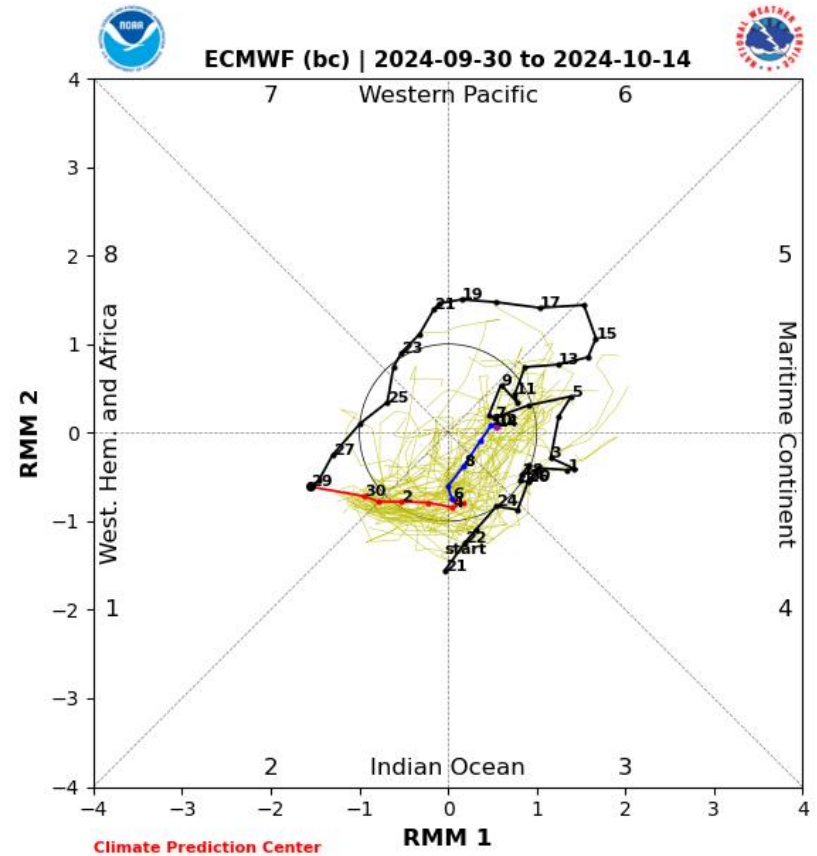


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



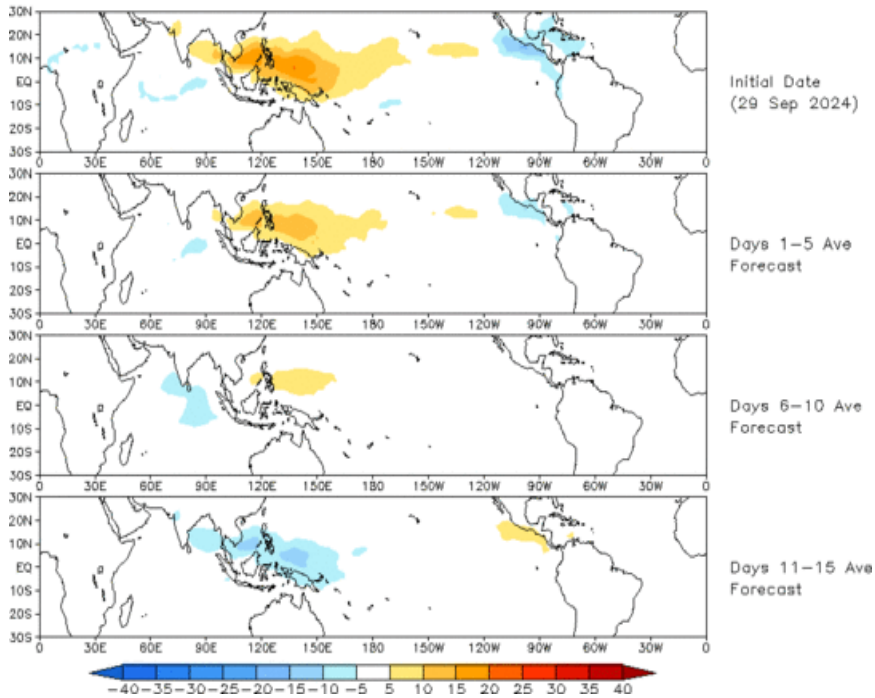
ECMWF Forecast

- Dynamical models favor continued eastward propagation of the MJO into the Indian Ocean and Maritime Continent during the next 2 weeks.
- The ECMWF ensembles are more tightly clustered with the magnitude near the edge of the RMM unit circle. There is more spread in the GEFS, with some members depicting a strong MJO event, possibly tied to constructive interference with the low frequency convective signal across the region.

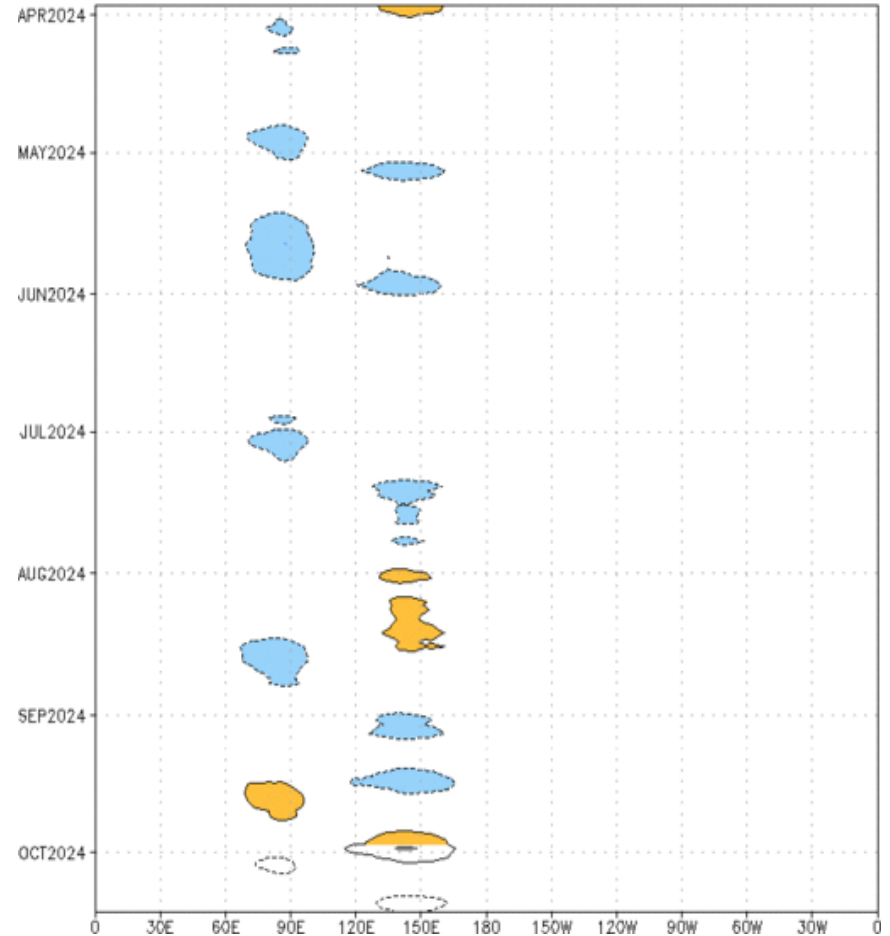
MJO: GEFS Forecast Evolution

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: 29 Sep 2024
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: 30-Mar-2024 to 29-Sep-2024
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

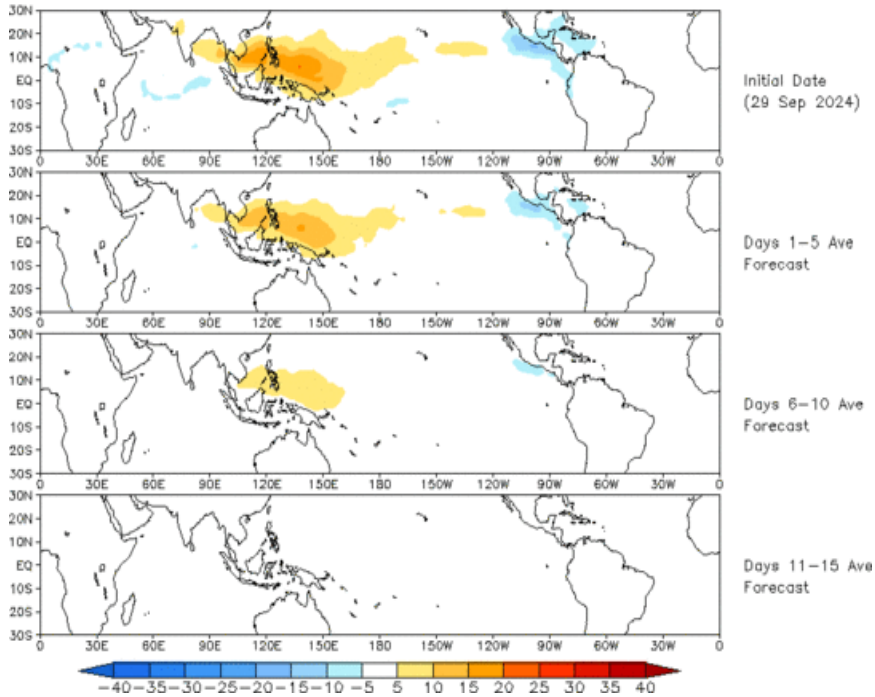


- The GEFS OLR anomaly forecast depicts positive OLR anomalies (suppressed convection) across the Western Pacific during week-1 transitioning to negative anomalies (enhanced convection) by the end of week-2.
- Negative OLR anomalies around Central America during week-1 are favored to weaken.

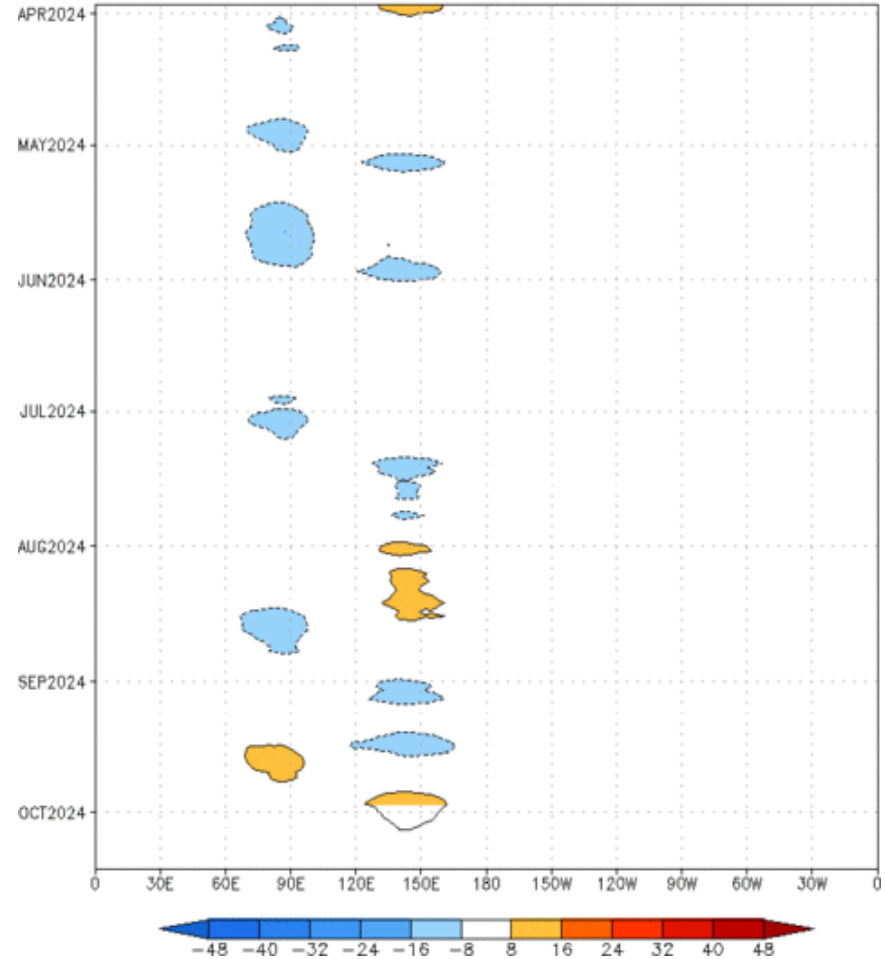
MJO: Constructed Analog Forecast Evolution

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 (29 Sep 2024)



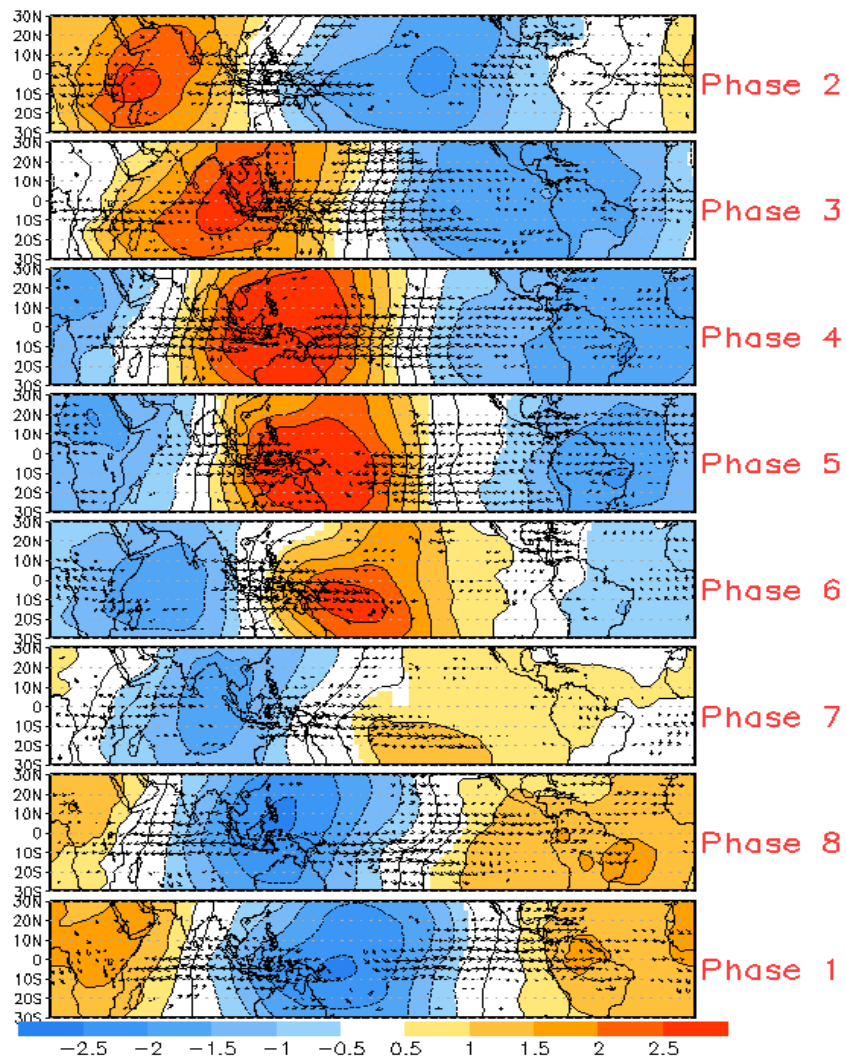
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:30-Mar-2024 to 29-Sep-2024
The unfilled contours are CA forecast reconstructed anomaly for 15 days



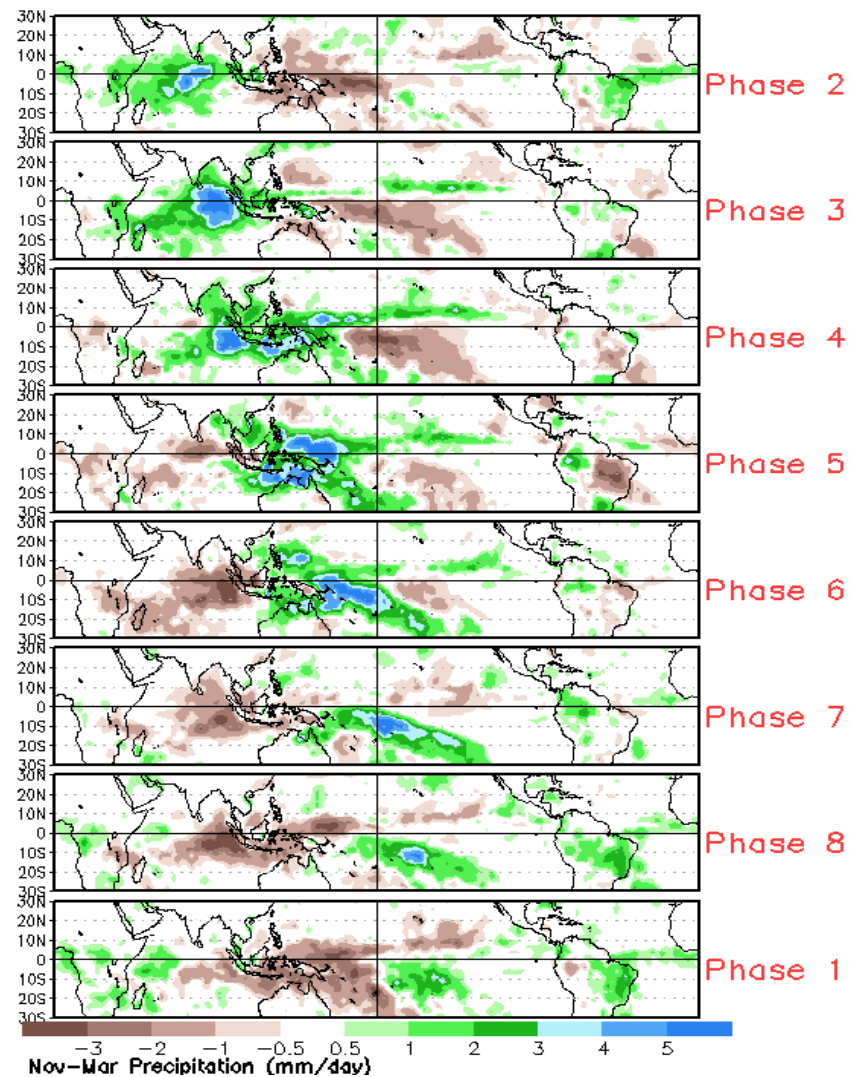
- The constructed analog forecast is similar to the GEFS in terms of positive OLR anomalies over the Western Pacific during week-1, but does not depict a quick transition to negative OLR anomalies.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



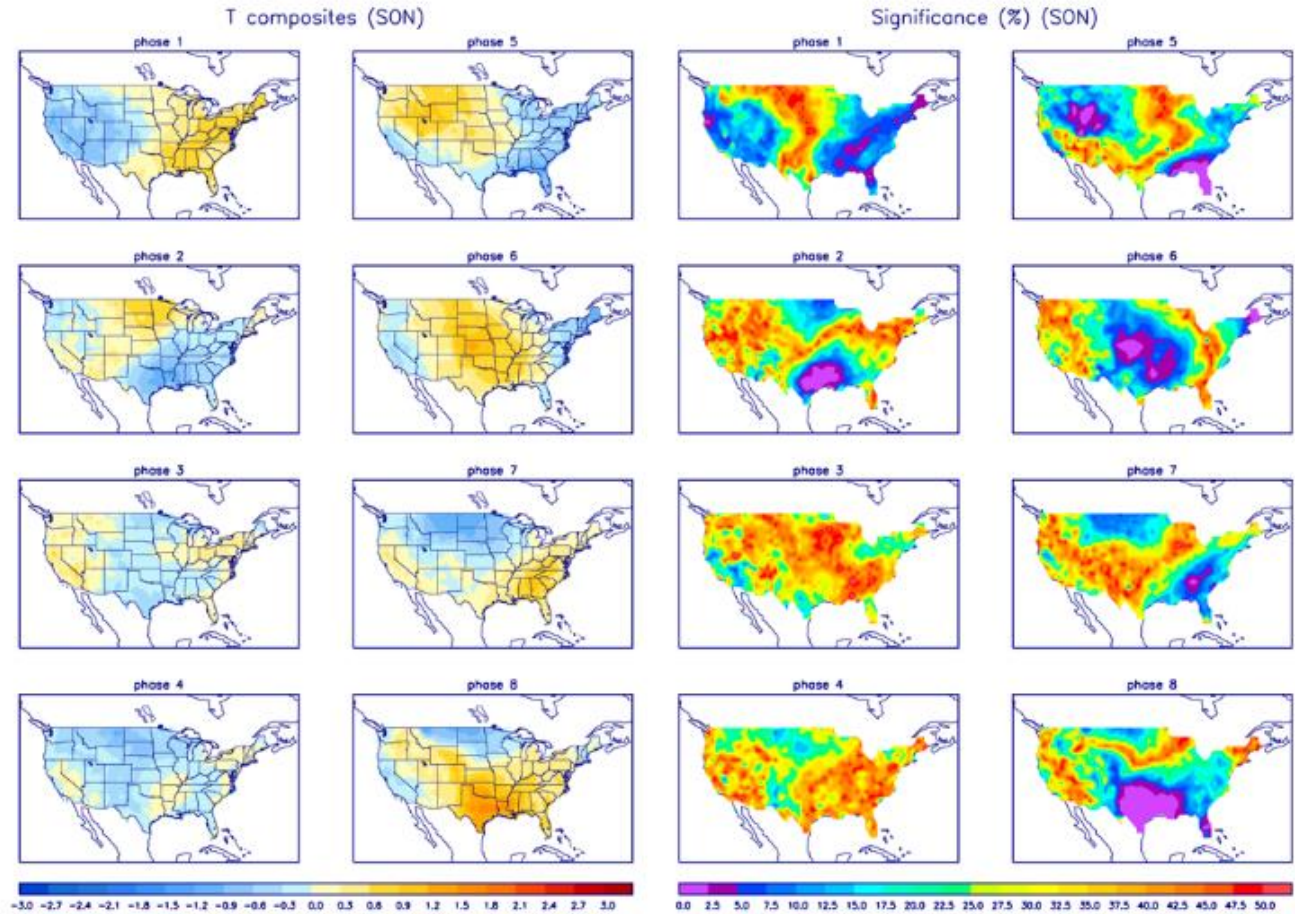
Precipitation Anomalies



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 - Precipitation

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.

