

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



Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
18 November 2024

Overview

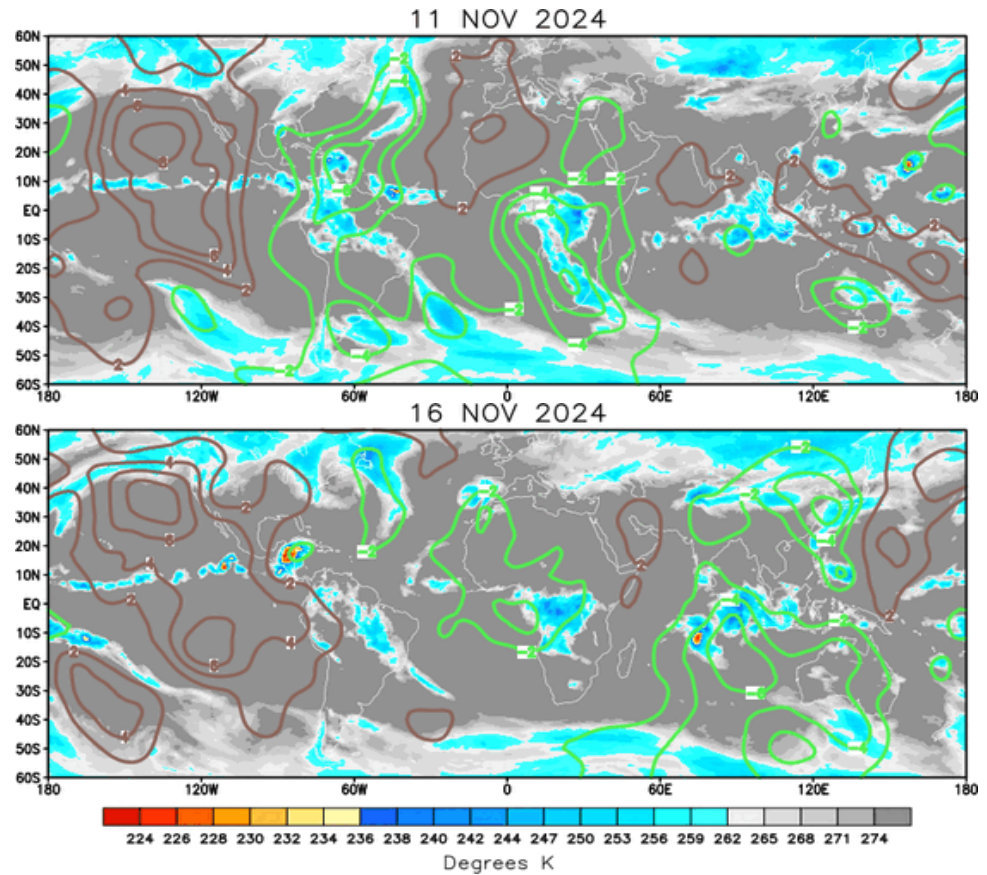
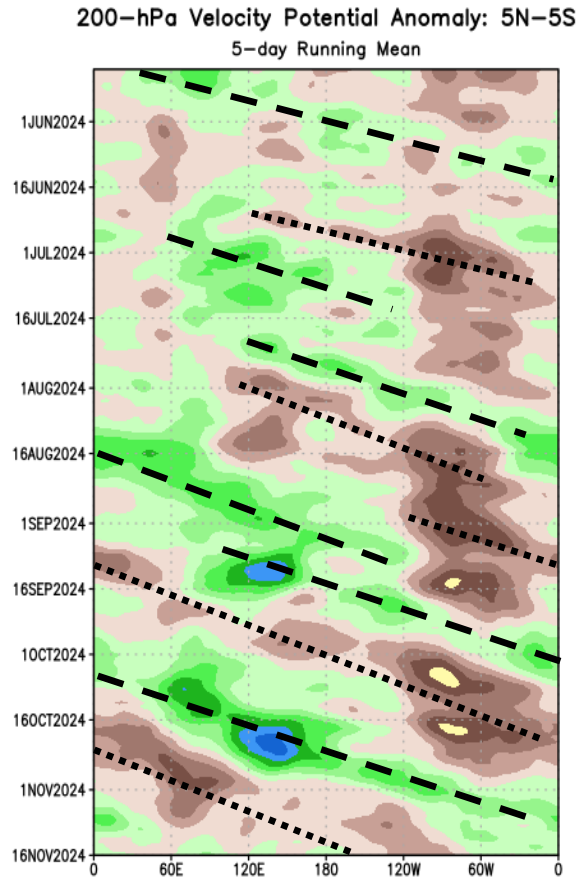
- The MJO has been quite active over the last month, completing a full circumnavigation of the globe during that period, and at a high amplitude as the enhanced convective envelope moved over the Maritime Continent and Western Pacific.
- The MJO has slowed and weakened somewhat as the enhanced convective envelope moved over the Indian Ocean during the last week, likely the result of interactions with the emerging La Nina footprint and other modes of tropical variability.
- This forecast slowing of the enhanced convective envelope is likely to promote enhanced TC activity across the Southern Indian Ocean and Bay of Bengal. TC activity is also possible in week-3 over the Western Pacific due to MJO forcing despite the basin being less active in December.

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)

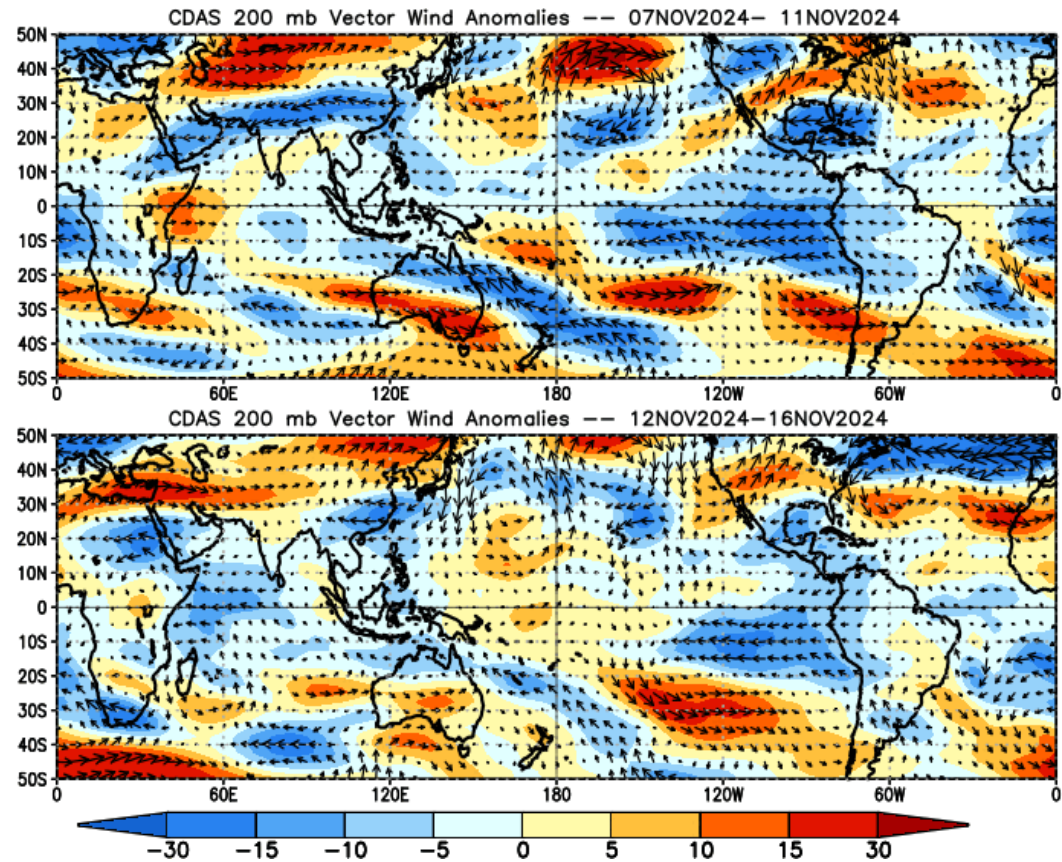
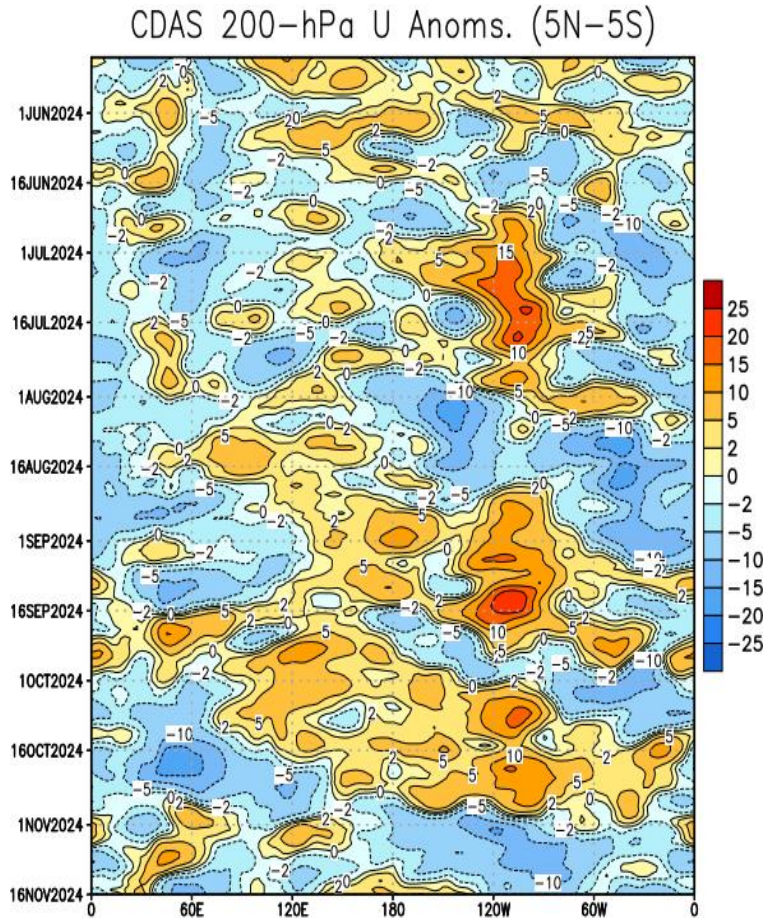
Brown shades: Anomalous convergence (unfavorable for precipitation)



- Though partly still evident, wave-1 asymmetry has not been quite as amplified or coherent over the last week.
- The enhanced convective envelope is shifting away from the Western Hemisphere, moving over eastern Africa and into the Indian Ocean.

200-hPa Wind Anomalies

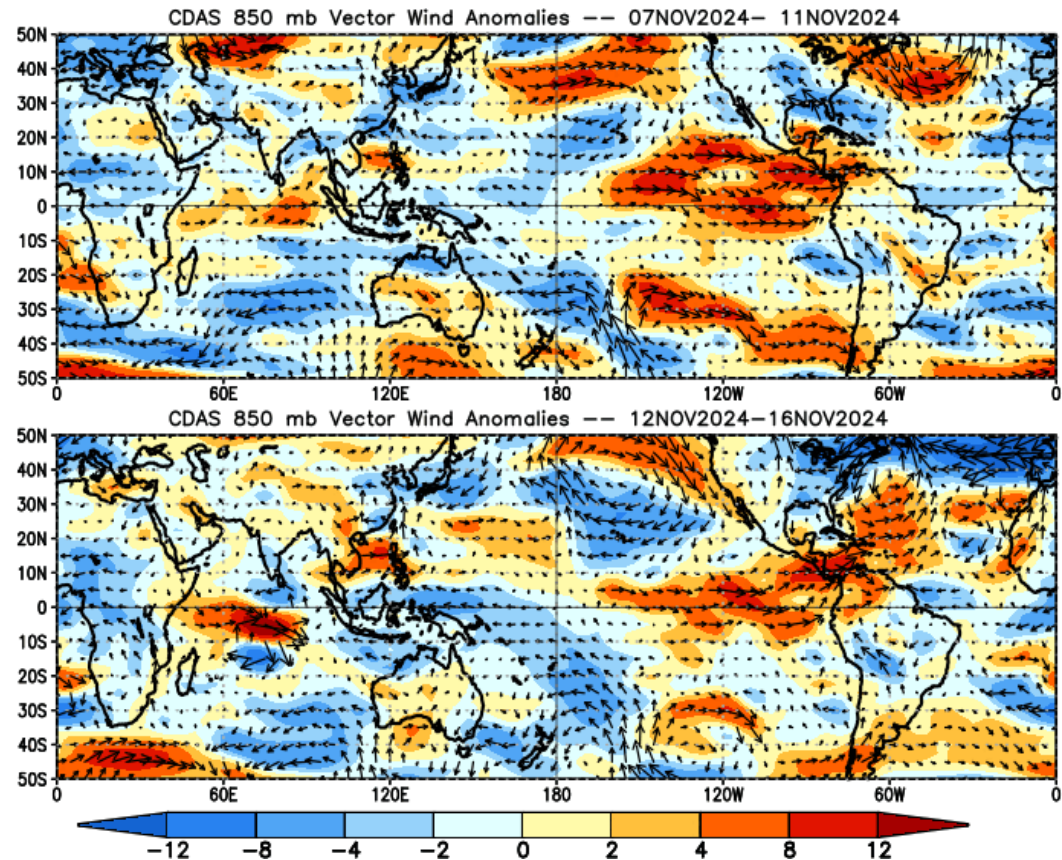
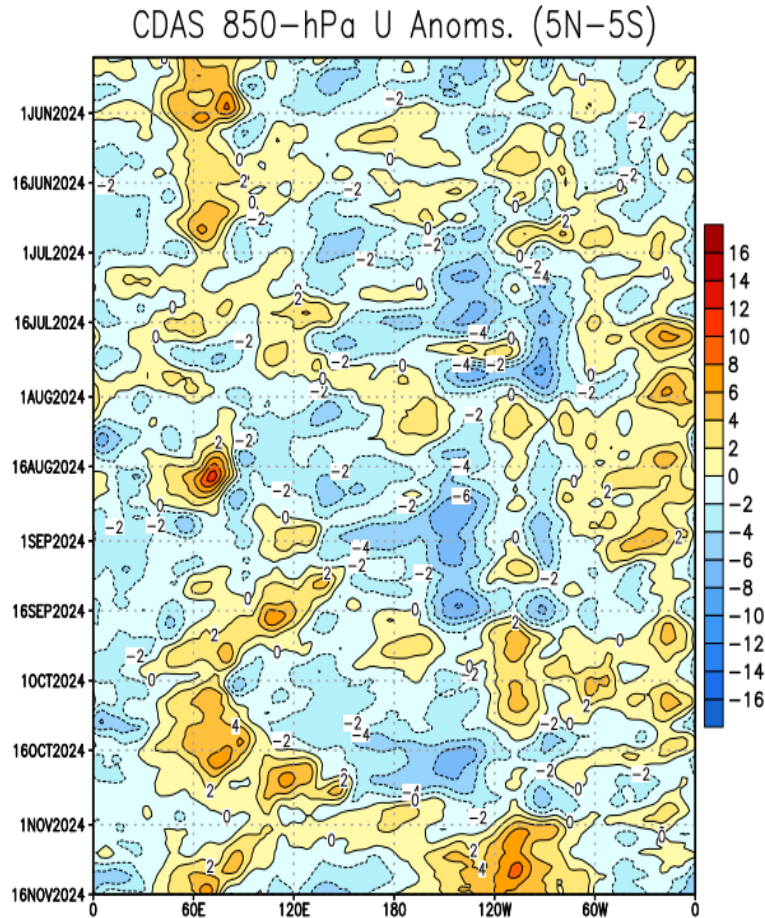
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- There is a clear progression of anomalous upper-level easterlies across the globe tied to the MJO, with some disruption of the upper-level westerlies emerging over the Maritime Continent as the MJO begins to propagate back toward the region.
- An enhanced subtropical jet is noted over the U.S. West Coast and extending into the interior of the continent.

850-hPa Wind Anomalies

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

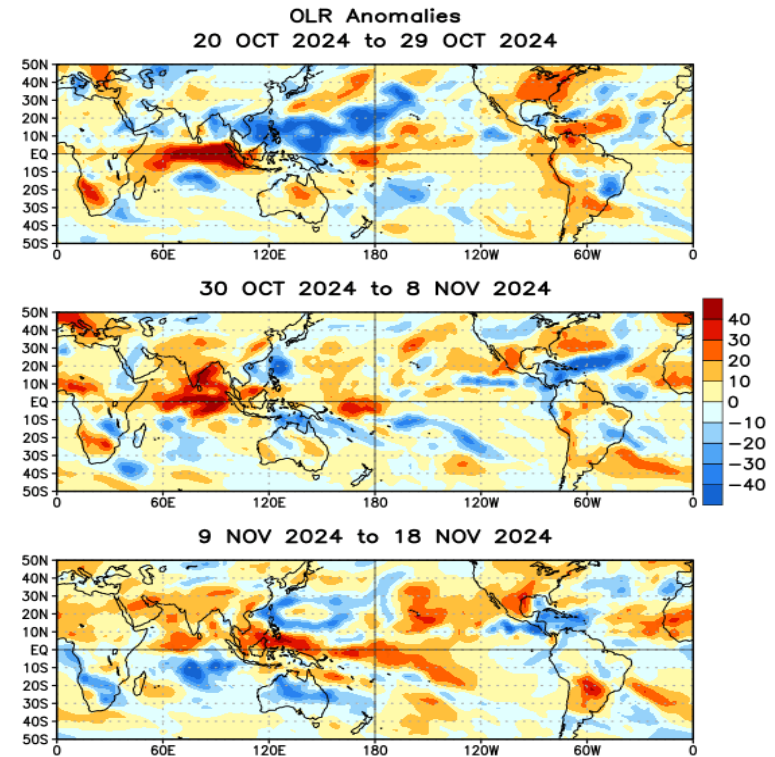
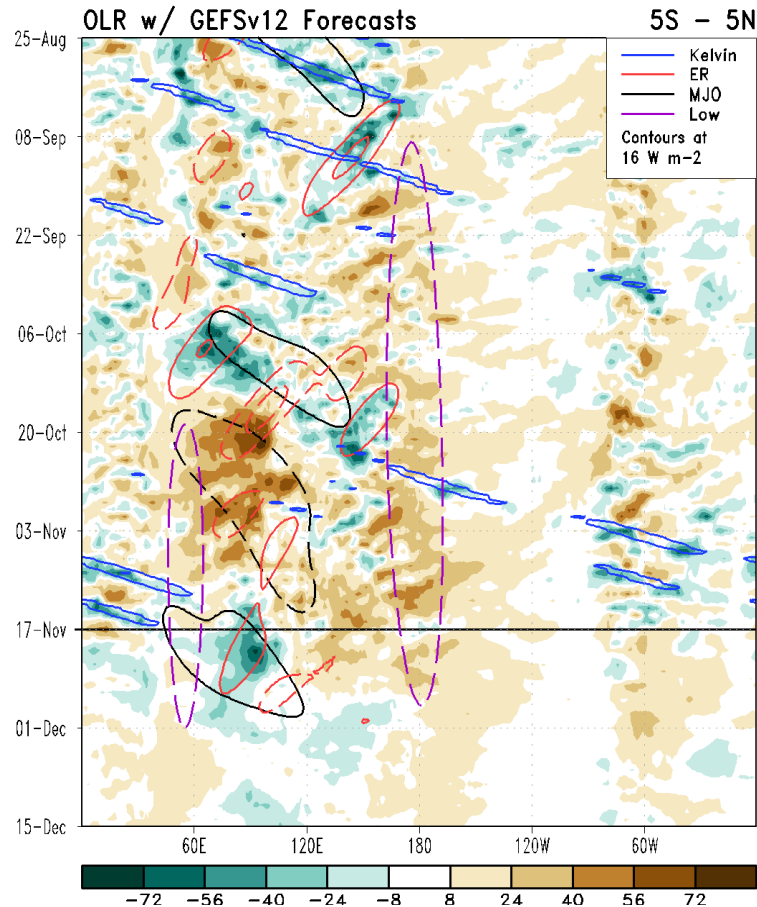


- Low-level westerlies have been propagating across the globe, becoming very enhanced over the Eastern Pacific and Central America during the past few weeks as propagation speed has slowed.
- Enhanced low-level westerlies continued over the Indian Ocean, creating a twin vortex south of India that likely contributed to the formation of Tropical Cyclone Bheki.

Outgoing Longwave Radiation (OLR) Anomalies

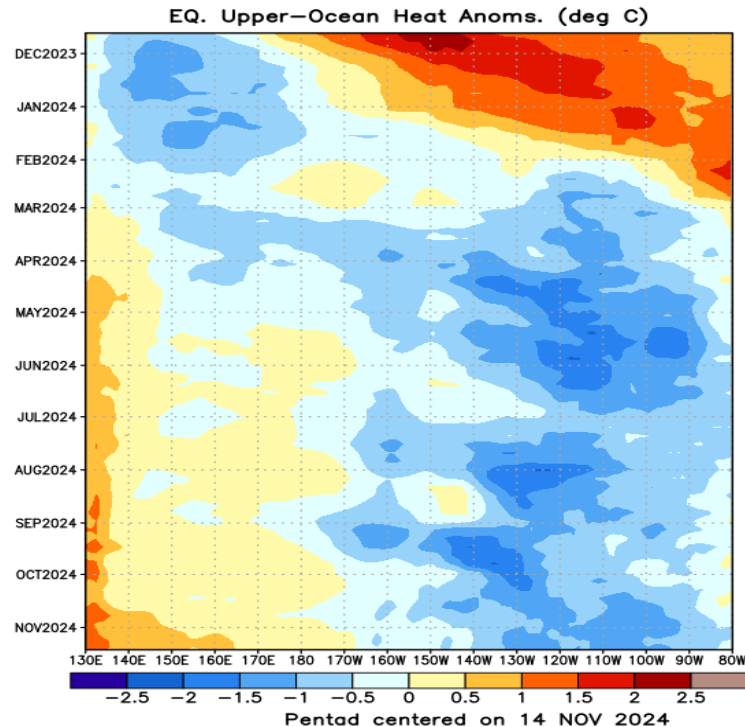
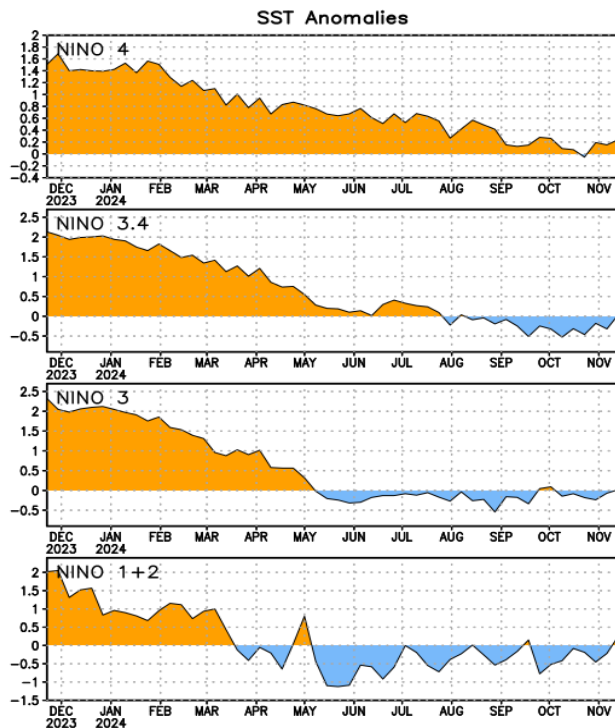
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- MJO activity continues to be evident in the OLR Hovmoller with the clearest signal east of the Date Line. Persistent subsidence over the Date Line has repeatedly interfered with both phases of the MJO as they passed by.
- Suppressed convection has been moving from the Indian Ocean into the Western Pacific over the last few weeks, while enhanced convection has been present over the East Pacific and Caribbean.

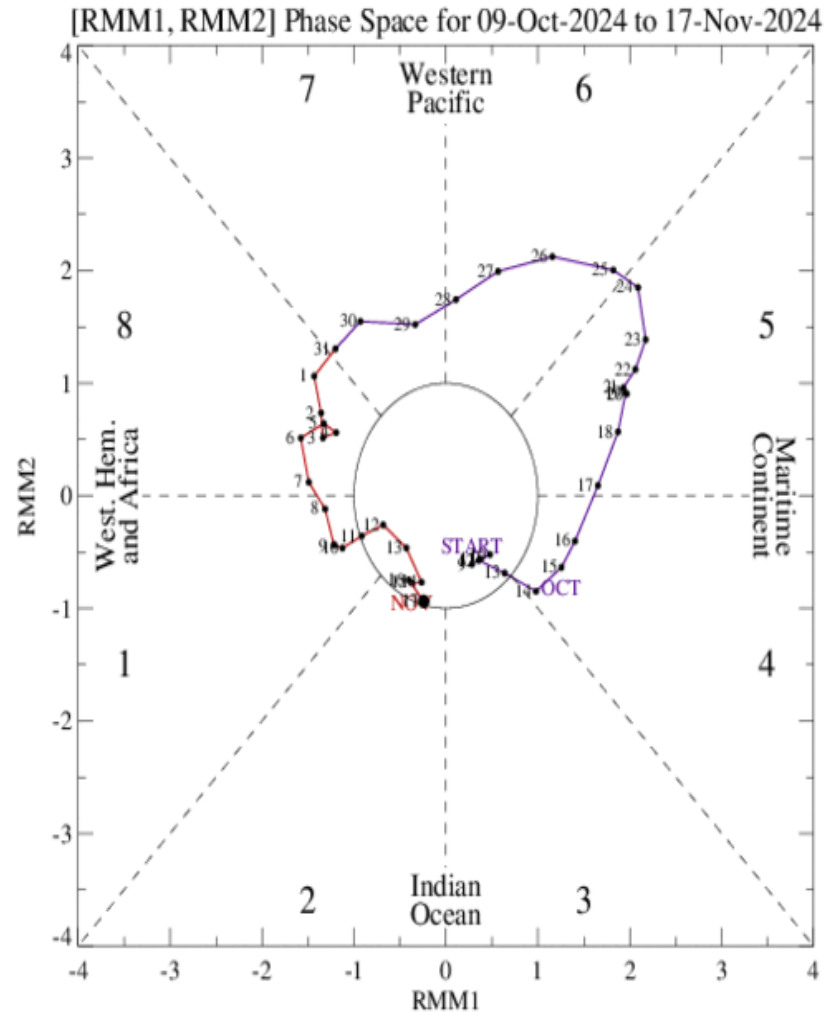
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- SSTs have steadily decreased in all of the NINO regions throughout the past year. NINO 3 cooled quickly, showing negative anomalies by mid-May before flattening out, while NINO 4 has been slow to cool over a longer period of time and has yet to go consistently negative.
- Increased low-level westerlies related to MJO activity likely resulted in an eastward expansion of positive upper-ocean heat content anomalies across the Western Pacific, along with a corresponding uptick in SSTs over the NINO 4 region.

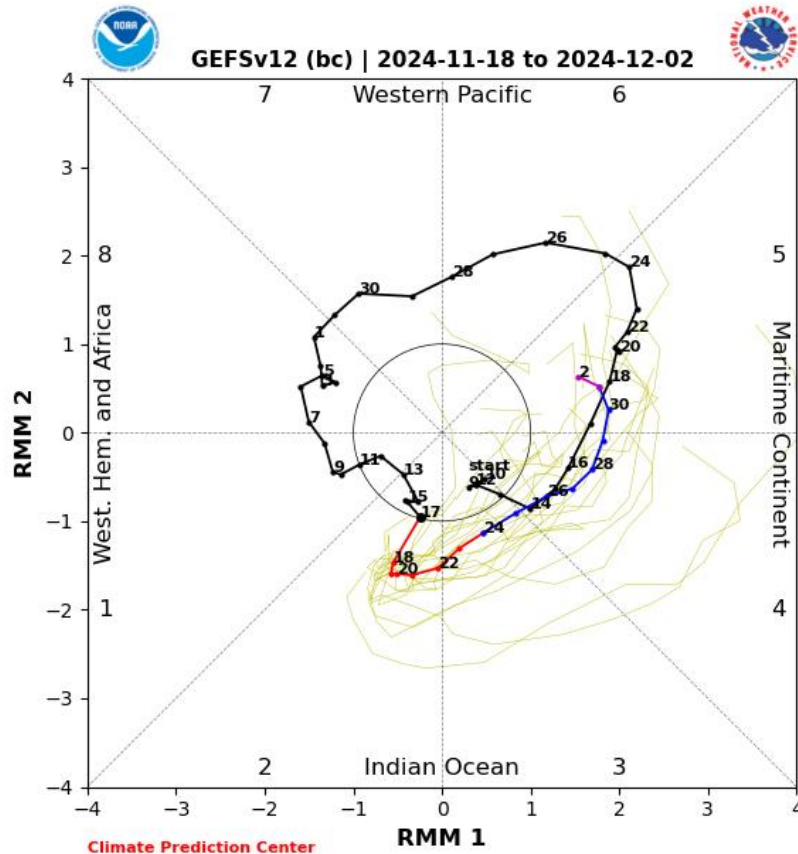
MJO Index: Recent Evolution

- The MJO has been active during the past month, completing a full circumnavigation of the globe, for the most part outside of the unit circle and at high amplitude in phases 5 & 6.
- The intraseasonal signal is now over the Indian Ocean (phase 2) and has been at a lower amplitude over the last few days than it has been in nearly a month.

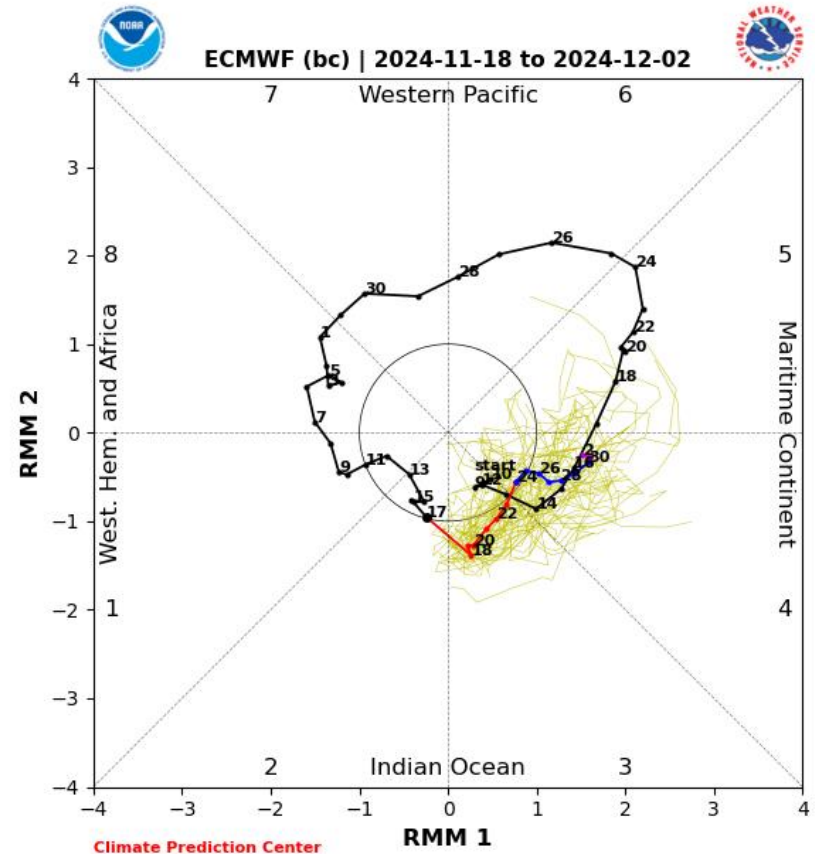


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



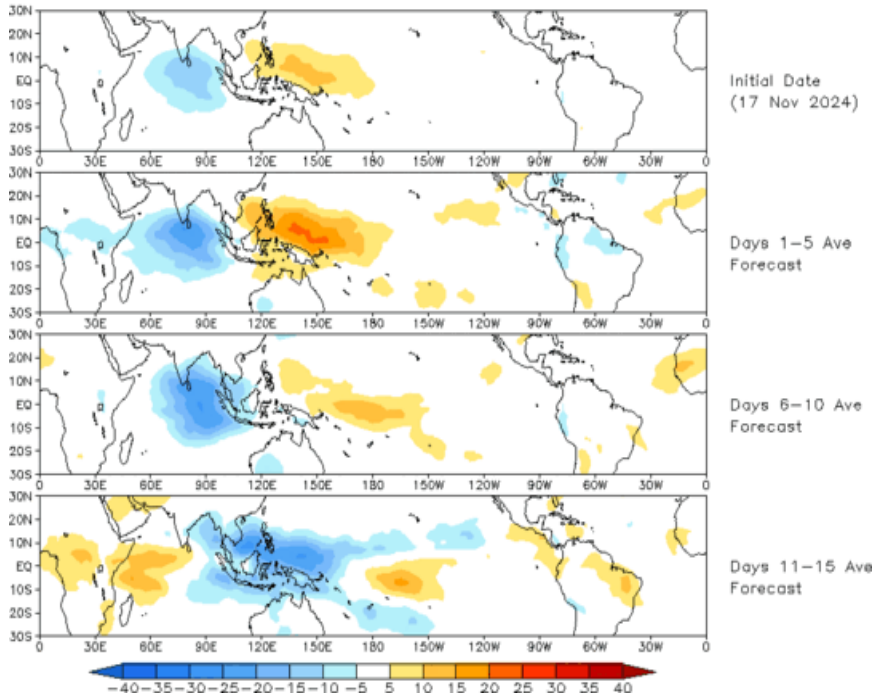
ECMWF Forecast

- The GEFS and ECMWF models both depict the RMM-based MJO index moving slowly over the coming week or two, likely a reflection of the convective envelope beginning to constructively interact with the emerging low-frequency La Nina footprint.
- The ECMWF indicates a faster progression through phases 2 & 3 but is a bit of an outlier in that regard, with model consensus on RMM forecasts more in line with the GEFS solution.

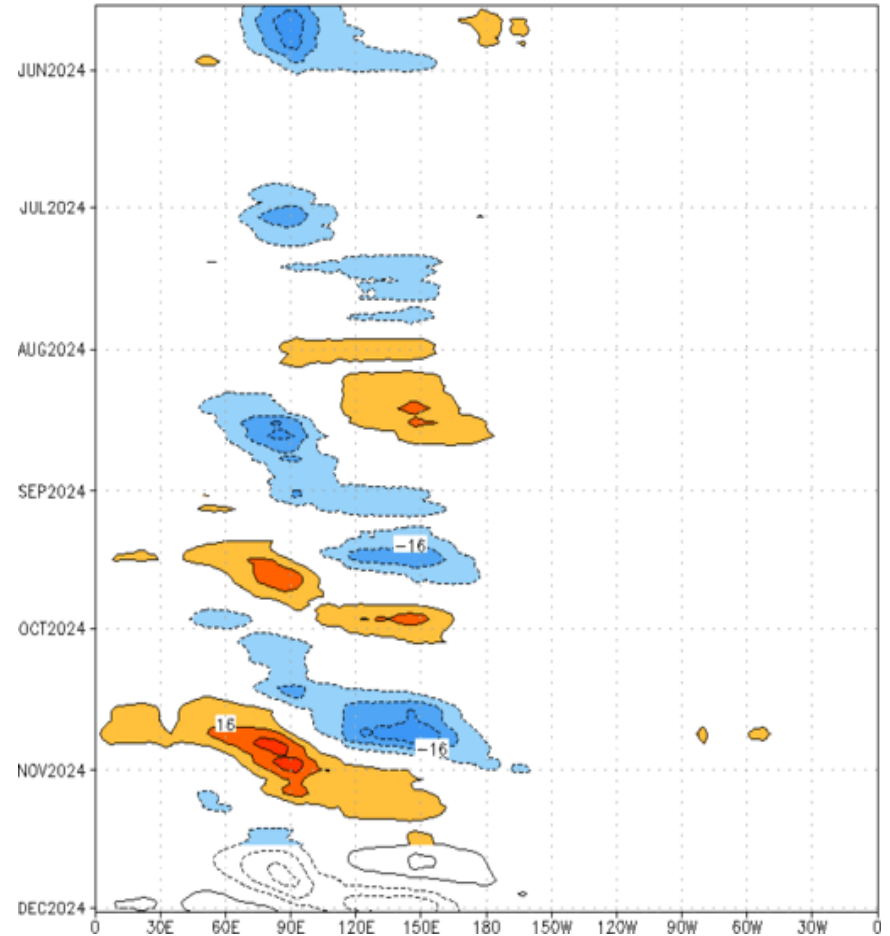
MJO: GEFS Forecast Evolution

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: 17 Nov 2024
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [$7.5^{\circ}S, 7.5^{\circ}N$] (cont: $4Wm^{-2}$) Period: 18-May-2024 to 17-Nov-2024
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

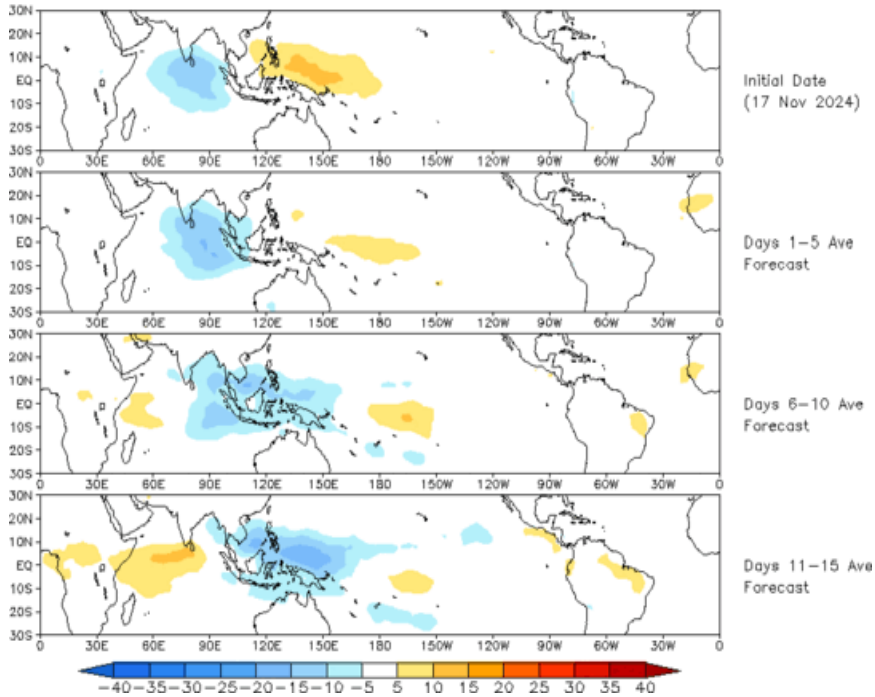


- The GEFS OLR anomaly forecast depicts nearly stationary areas of OLR anomalies for much of the forecast period before the enhanced convective envelope begins to move into the Maritime Continent late in week-2.

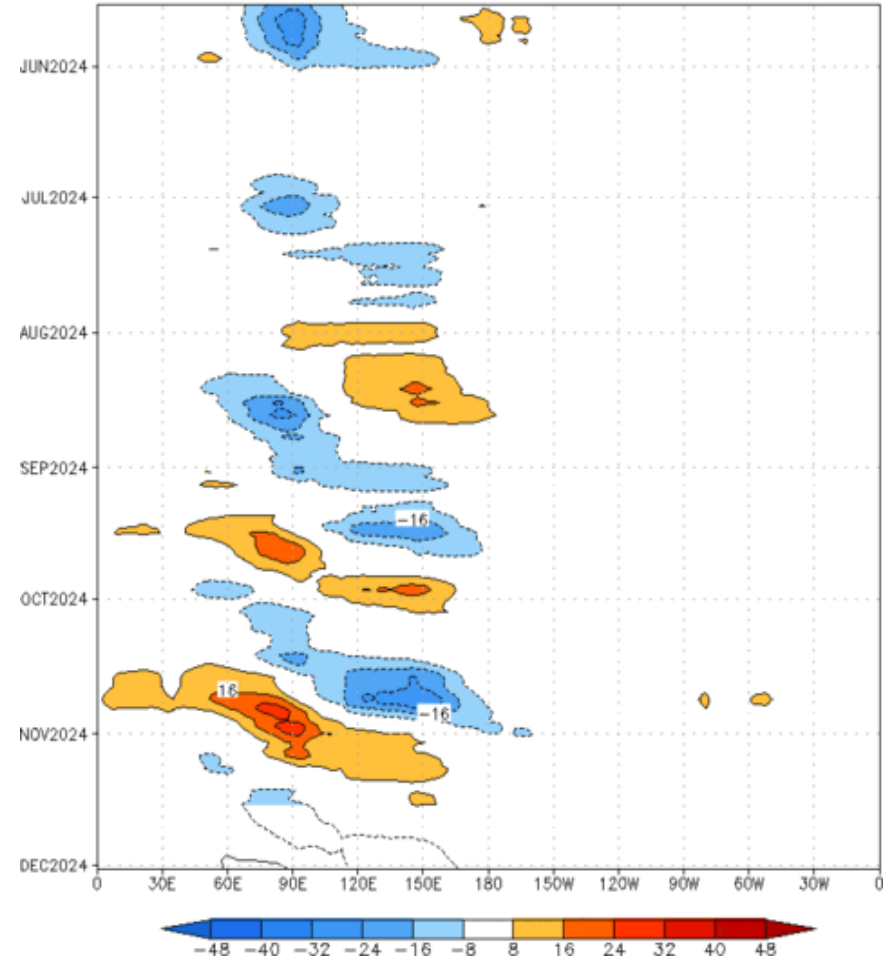
MJO: Constructed Analog Forecast Evolution

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 (17 Nov 2024)



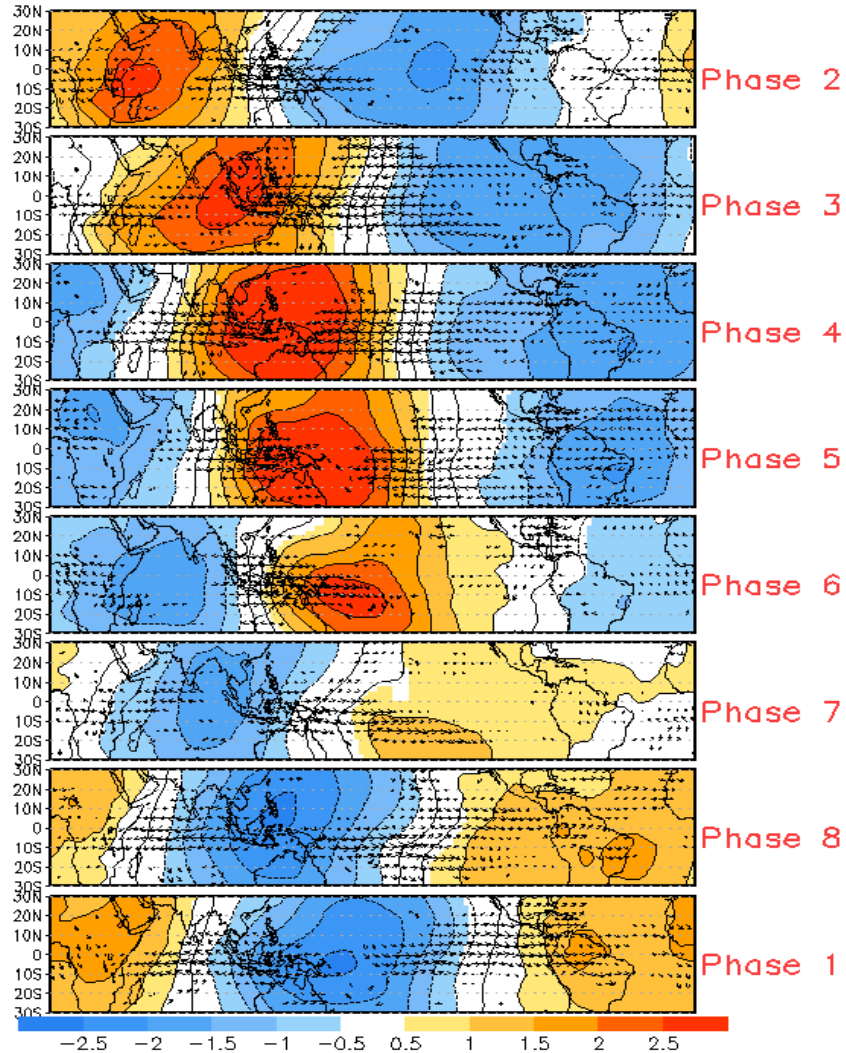
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:18-May-2024 to 17-Nov-2024
The unfilled contours are CA forecast reconstructed anomaly for 15 days



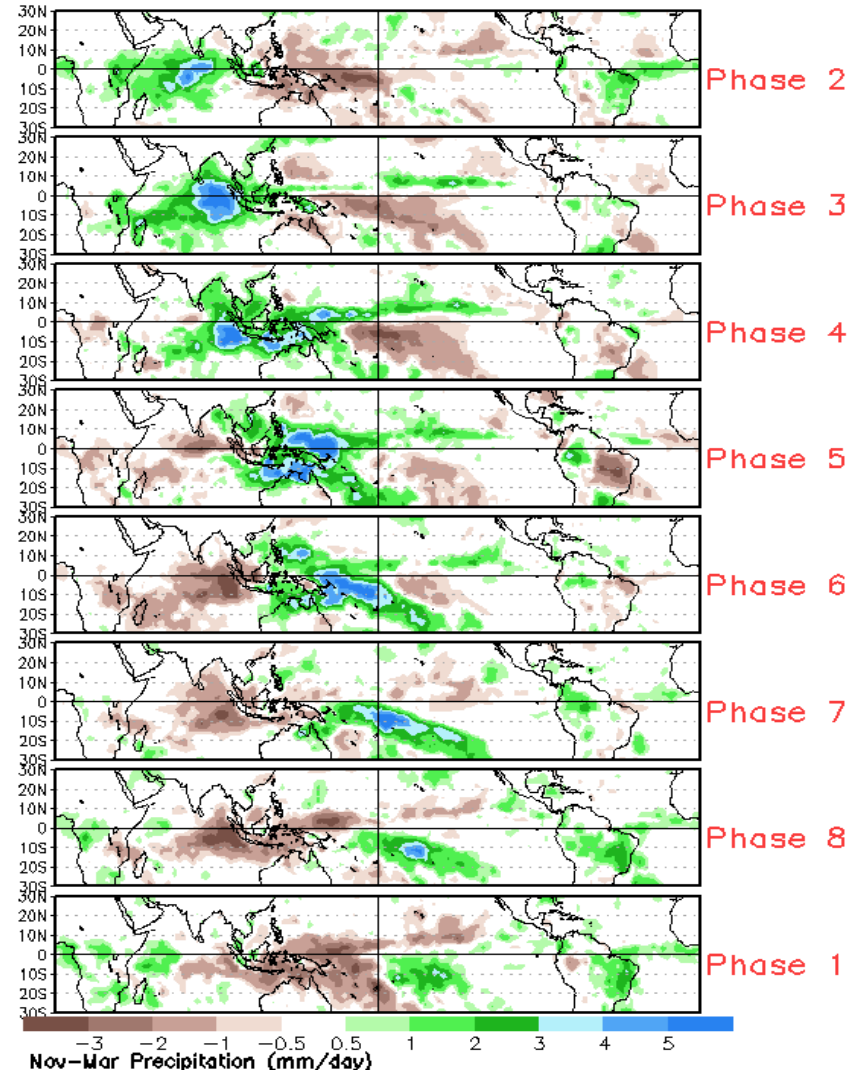
- The constructed analog forecast shows a slightly more progressive solution, with the enhanced convective envelope moving over the Maritime Continent by late in week-1 and into the Western Pacific by the end of week-2.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



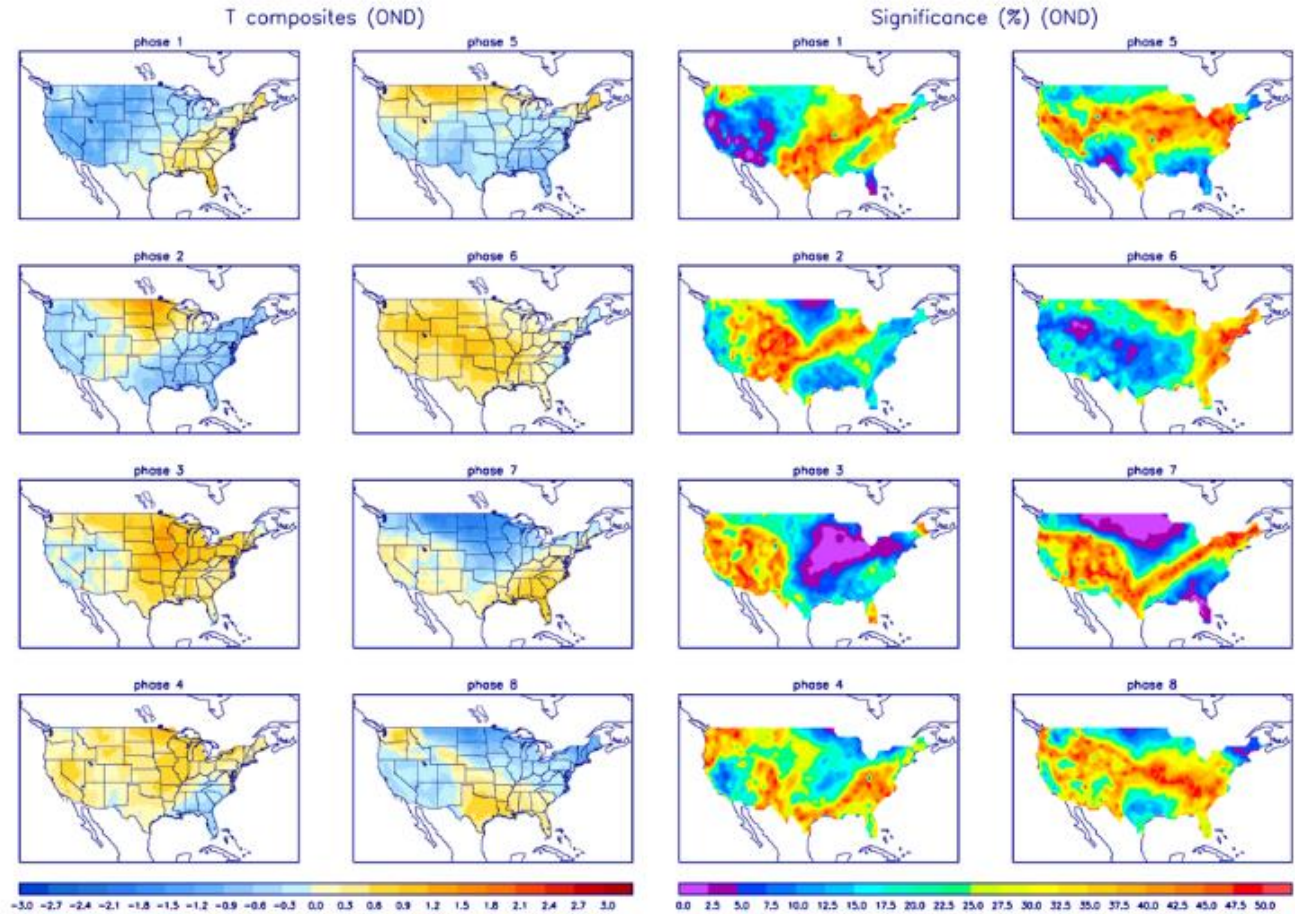
Precipitation Anomalies



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 - 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.

