

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
16 June 2025

Overview

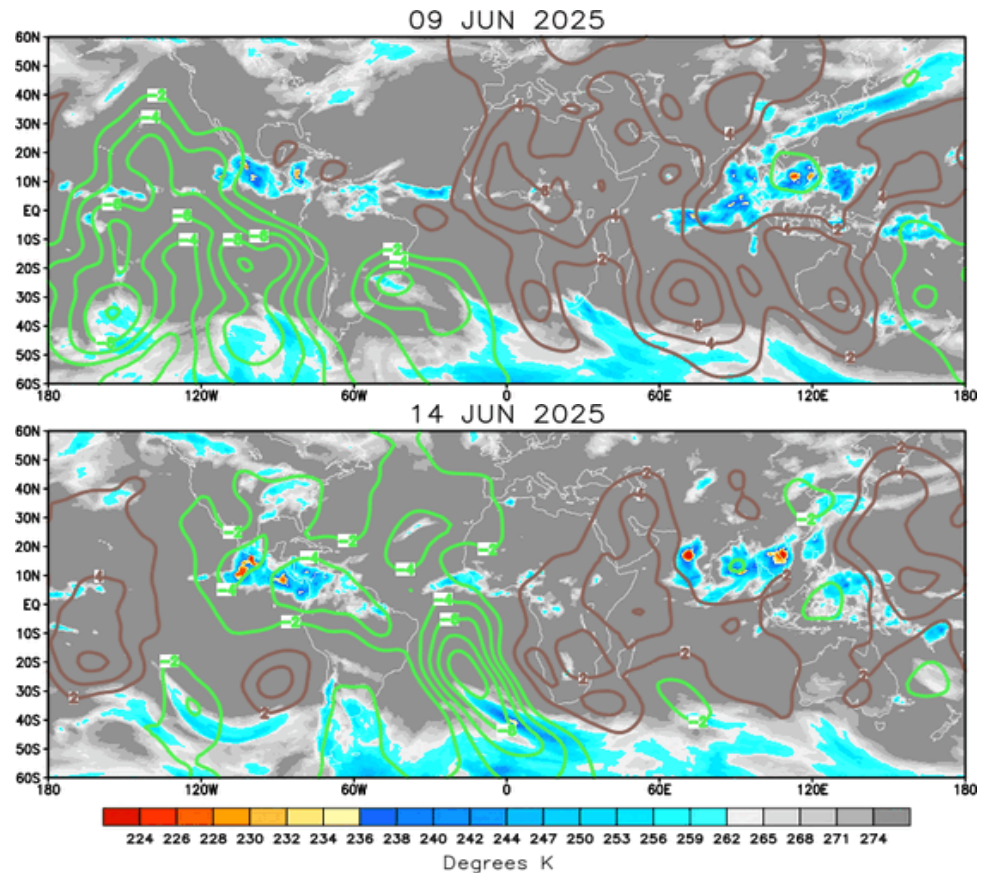
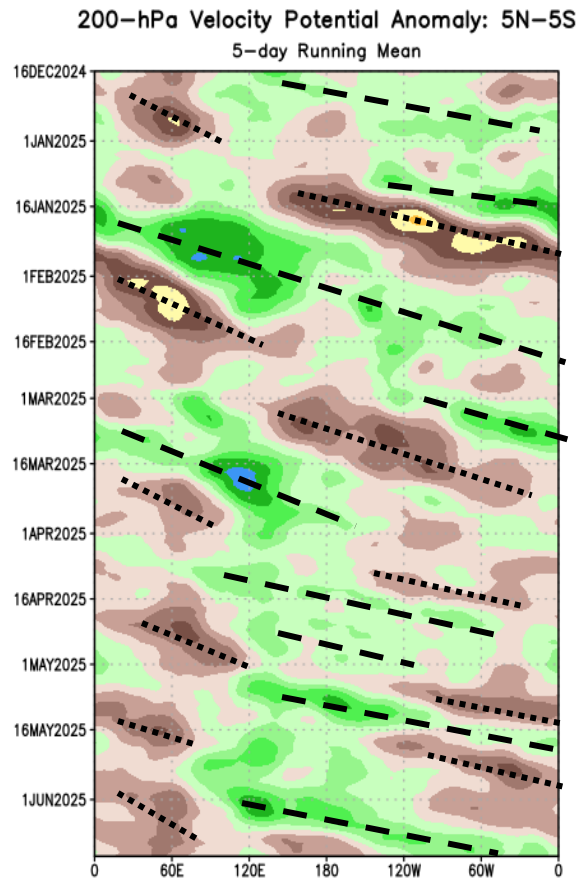
- The RMM-based MJO signal rapidly weakened into the unit circle during the past week.
- This is more likely tied to a fast moving Kelvin Wave destructively interfering with the low frequency suppressed convective envelope across the Eastern Hemisphere.
- It appears this process may repeat itself in the coming weeks as models indicate enhanced convection developing across the Western Pacific as the aforementioned Kelvin Wave completes its circumnavigation. This is likely to promote increasing tropical cyclone (TC) activity across the Western North Pacific.
- The Eastern North Pacific Hurricane Season has gotten off to a fast start. Additional TC activity is likely, especially if Kelvin Wave activity continues across the region during the next 2 weeks.

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)

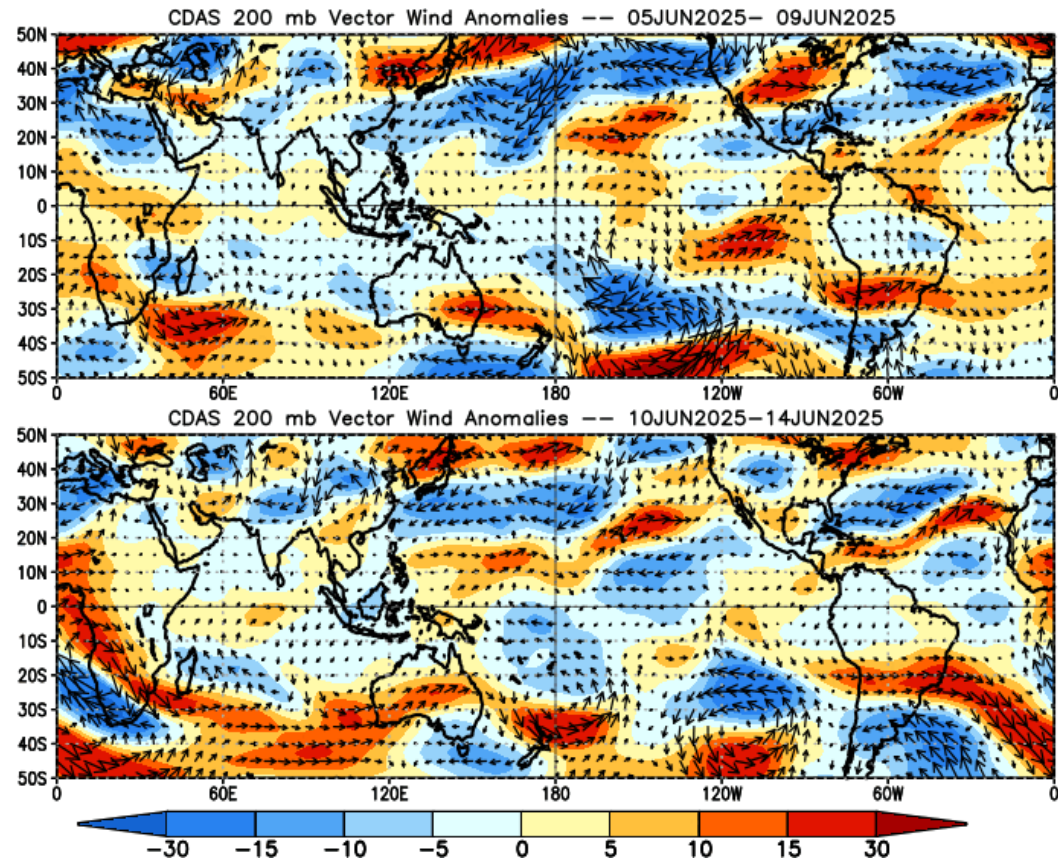
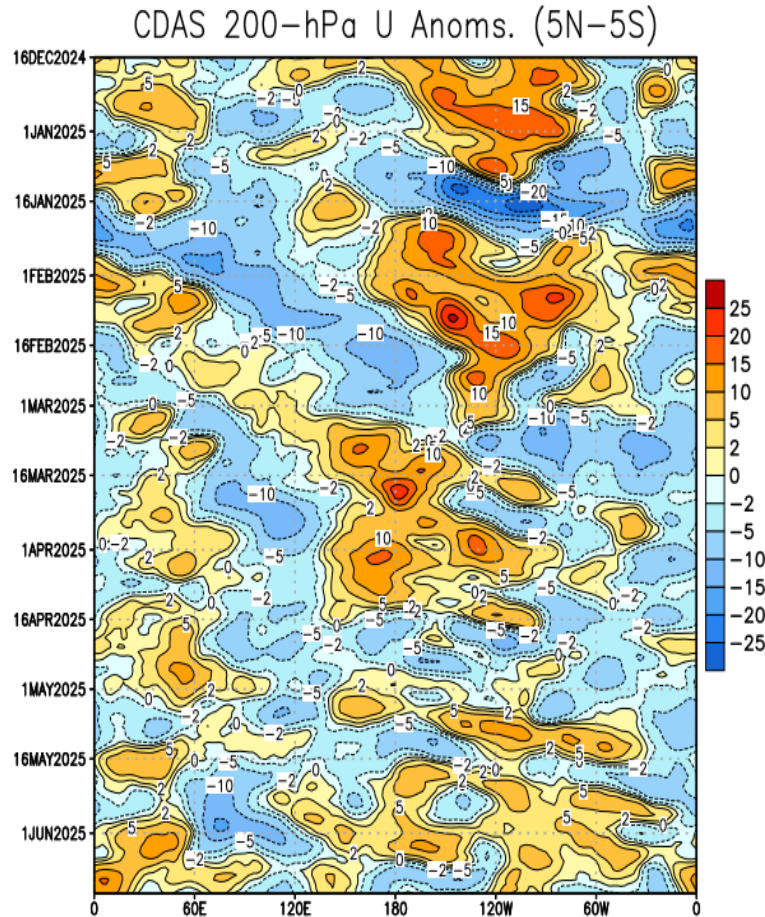
Brown shades: Anomalous convergence (unfavorable for precipitation)



- A fast-moving enhanced convective envelope is noted in the spatial upper-level velocity potential field, shifting from the eastern Pacific into the Atlantic during the past week.
- An area of anomalous convergence aloft remained nearly stationary across Africa and Eurasia resulting in destructive interference with the eastward propagating enhanced convection upstream and a less organized global pattern overall relative to the week prior.

200-hPa Wind Anomalies

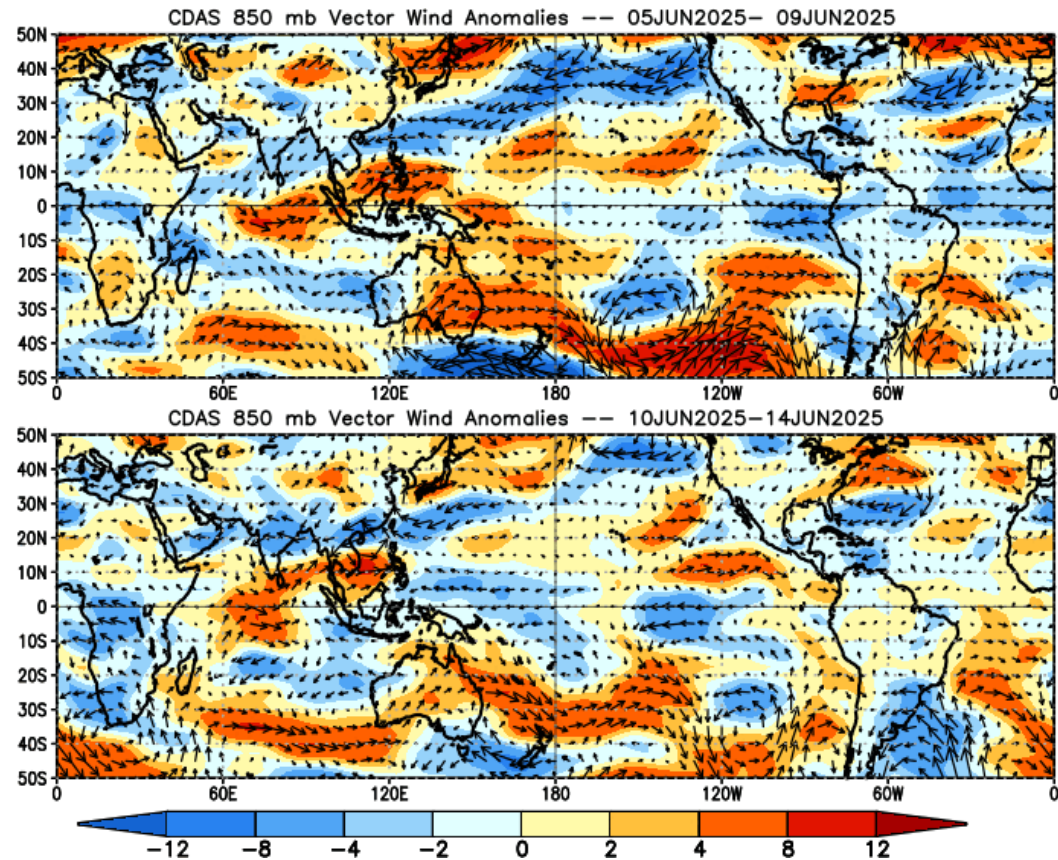
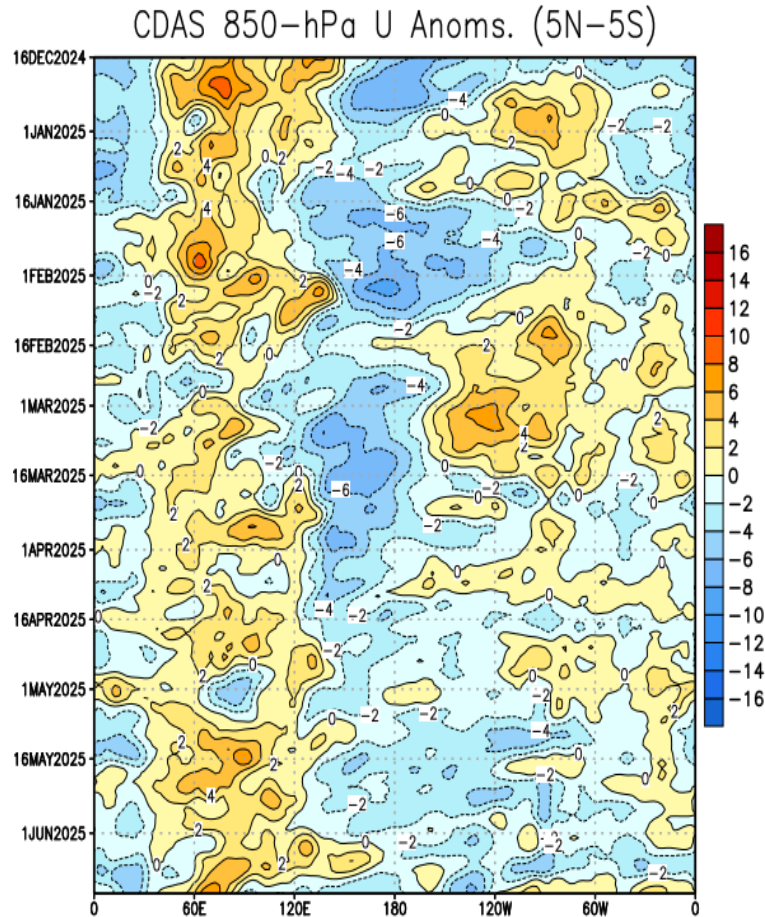
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- The spatial upper-level wind anomaly field is largely incoherent, with stronger magnitude anomalies in the extratropics, decreasing closer to the Equator.
- There is some evidence of an eastward propagating band of anomalous upper-level westerlies in the time-lon plot from the Date Line to around 60°E in the past 2 weeks.

850-hPa Wind Anomalies

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

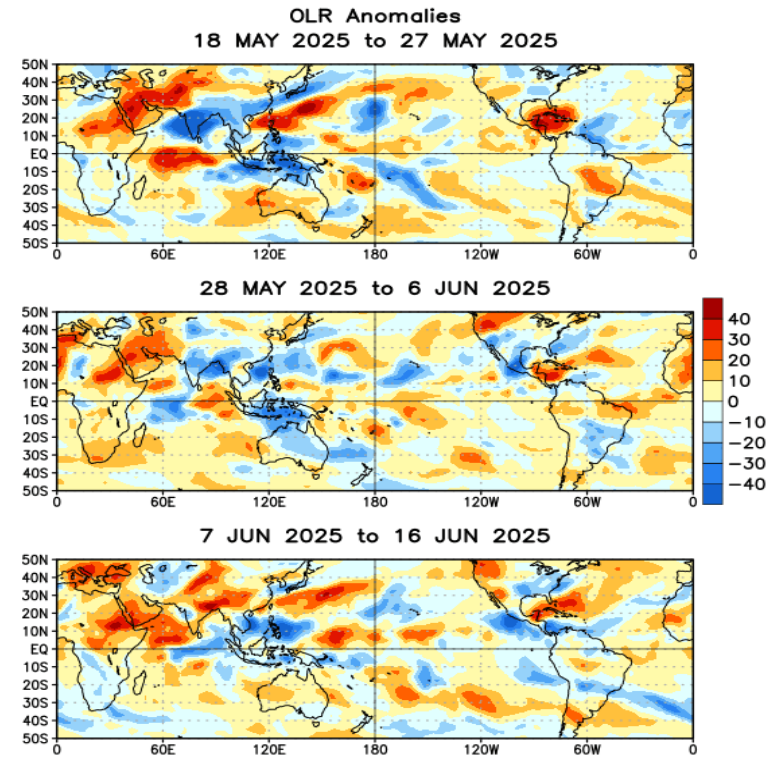
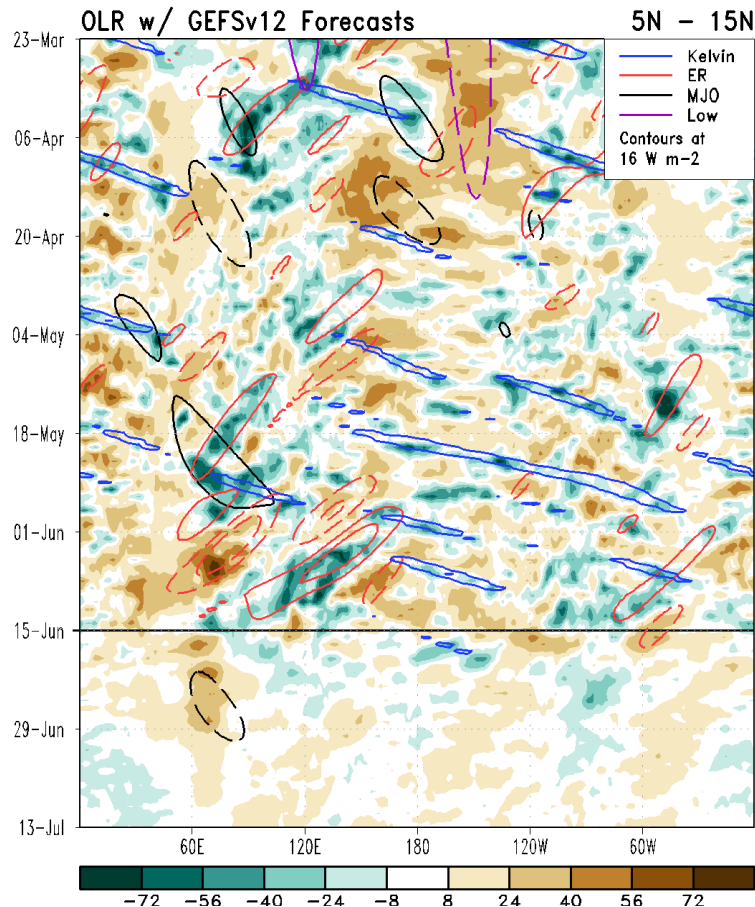


- Enhanced low-level westerlies have persisted across the Indian Ocean and Maritime Continent for the past several months.
- A transition to anomalous low-level westerlies across the Eastern North Pacific promoted increased tropical cyclone activity across the basin.

Outgoing Longwave Radiation (OLR) Anomalies

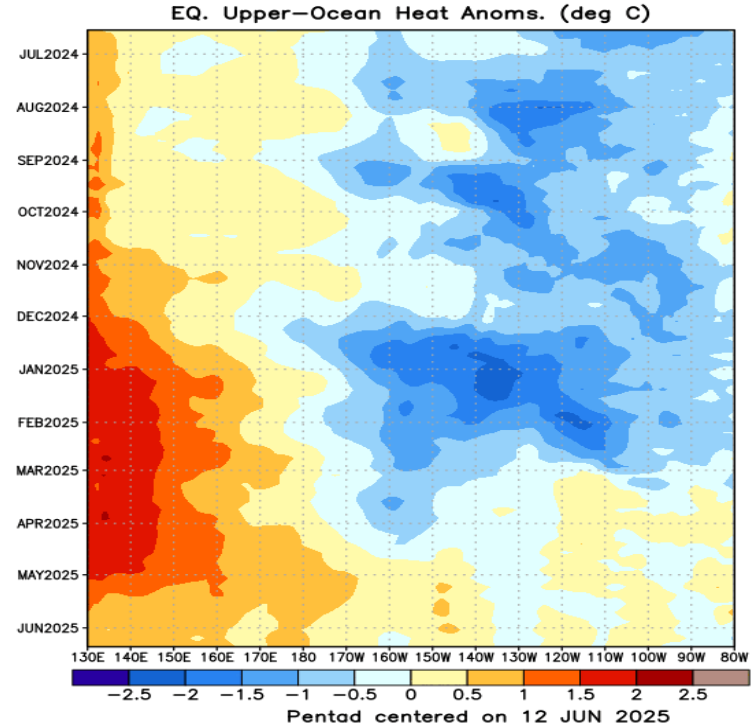
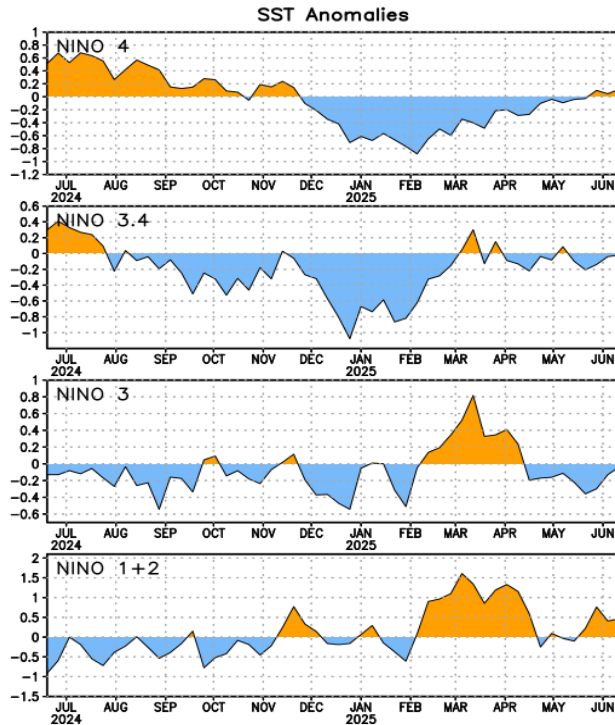
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- Enhanced Equatorial Rossby Wave activity coming through the OLR objective filtering contributed to negative OLR anomalies across the Maritime Continent earlier this month.
- This has since relaxed, with the GEFS indicating a more stationary suppressed convective pattern emerging over that area, with some evidence of another Kelvin Wave moving across the Pacific during late June.

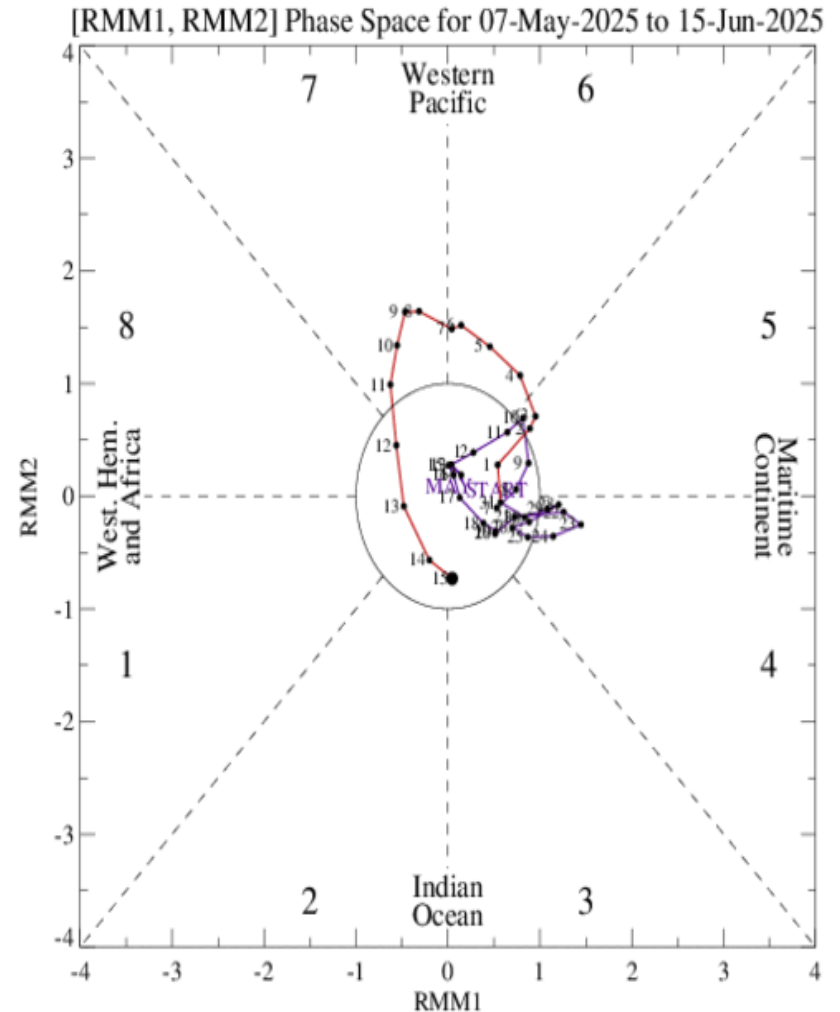
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Positive subsurface upper-ocean heat content anomalies are observed across the Pacific west of 140°W, becoming more variable and decreasing in magnitude further to the east.
- During the past several months, there has been an upward trend in SST anomalies across Nino 4.
- Other regions have been more variable, but anomalies generally remain close to 0° with no clear trend in either direction.

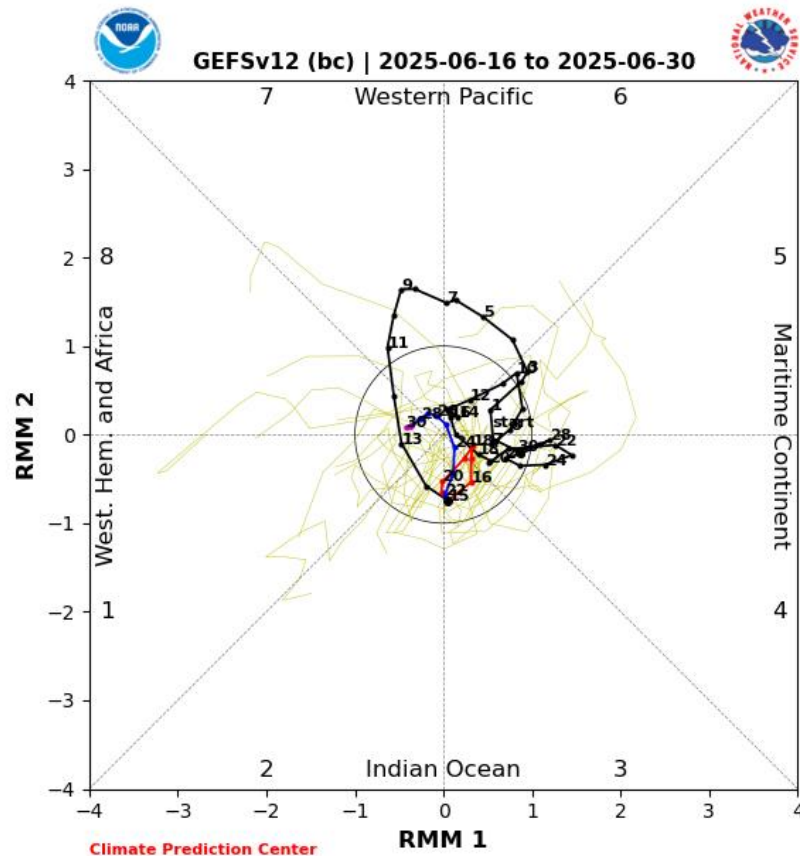
MJO Index: Recent Evolution

- The MJO index rapidly weakened into the RMM-based unit circle following a more amplified signal across the Western Pacific in early June.
- The propagation remained coherent as it moved across the Western Hemisphere, and the fast phase speed is more suggestive of a weakening Kelvin Wave.

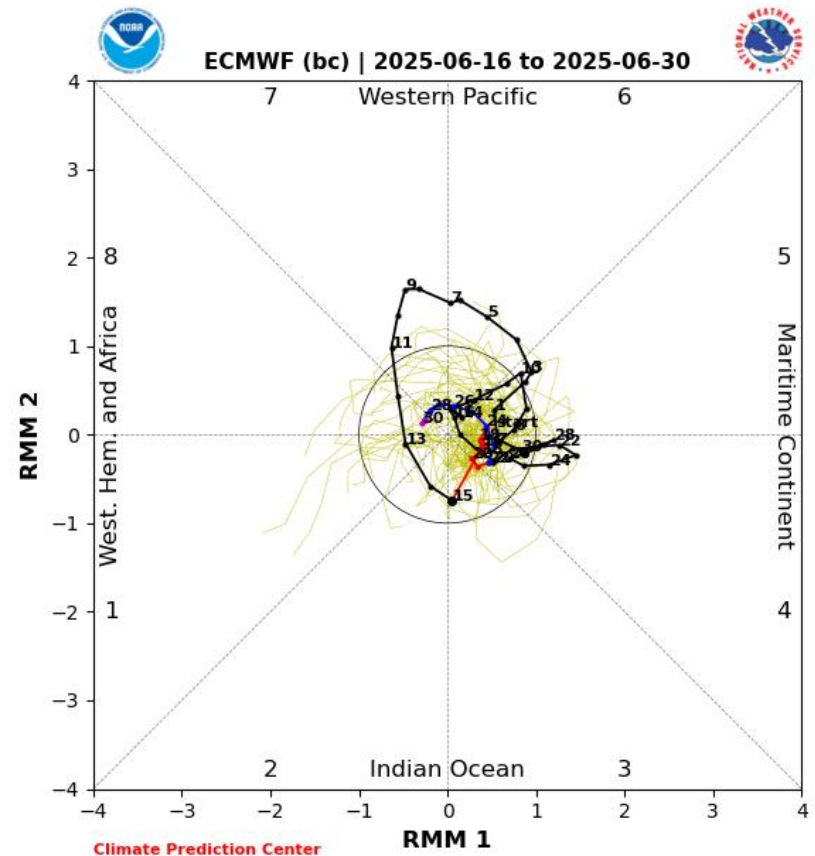


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



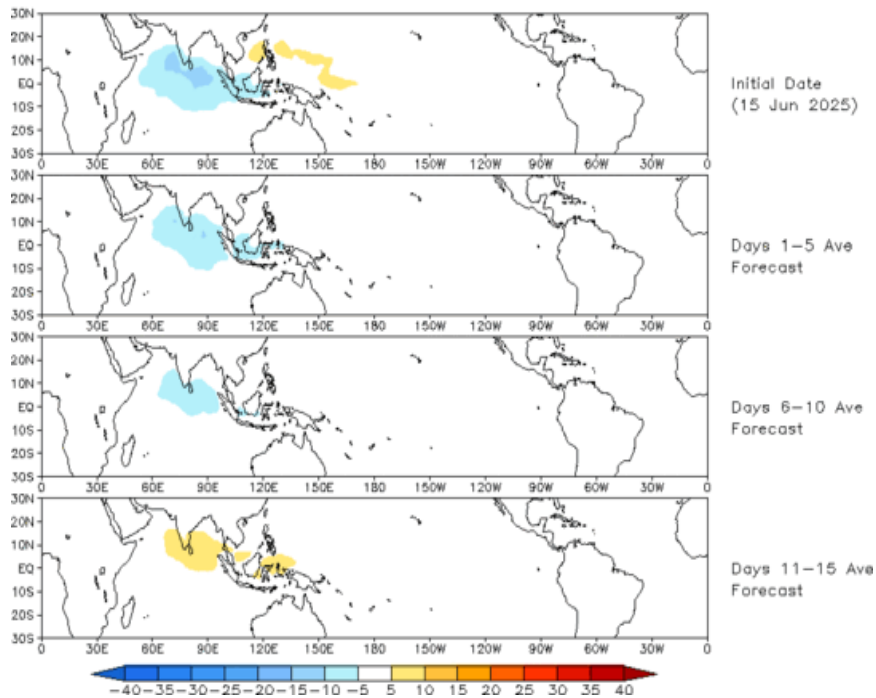
ECMWF Forecast

- The GEFS and ECMWF ensembles do not depict a meaningful MJO signal during the next 2 weeks.
- The ensemble means are skewed toward the Indian Ocean or Maritime Continent but are contained within the RMM unit circle. There is a large variance in the individual members further highlighting the uncertainty, but some from both models show enhancement across the Western Hemisphere during week-2.

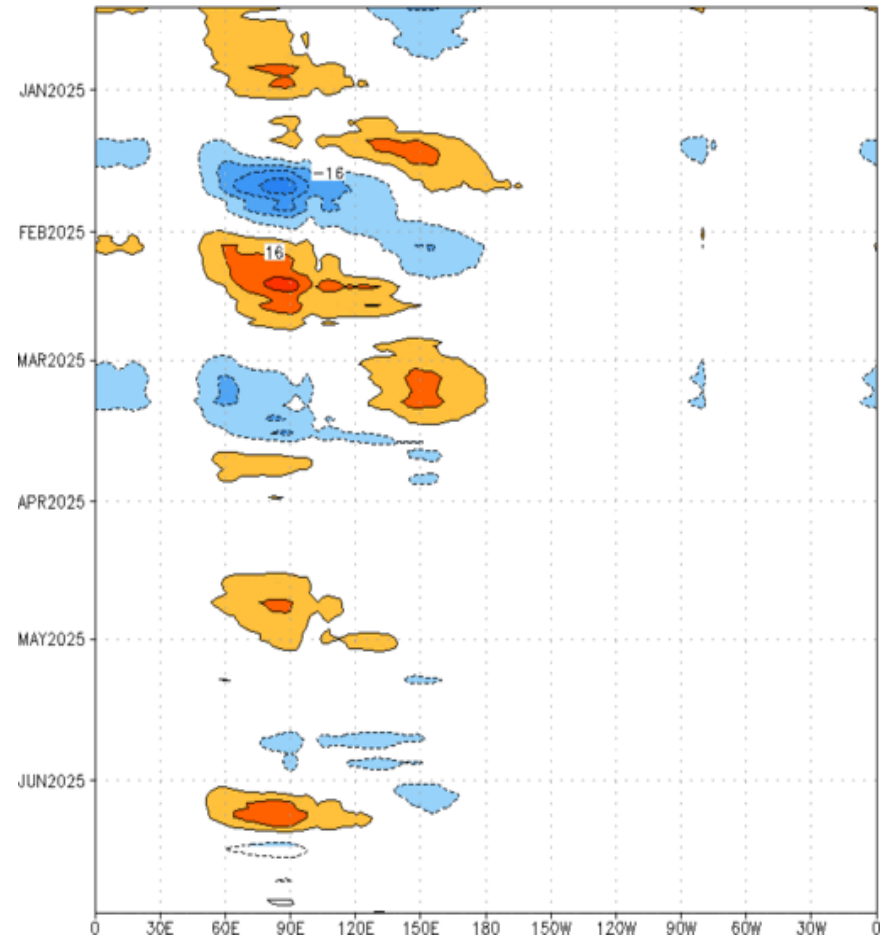
MJO: GEFS Forecast Evolution

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: 15 Jun 2025
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:14-Dec-2024 to 15-Jun-2025
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

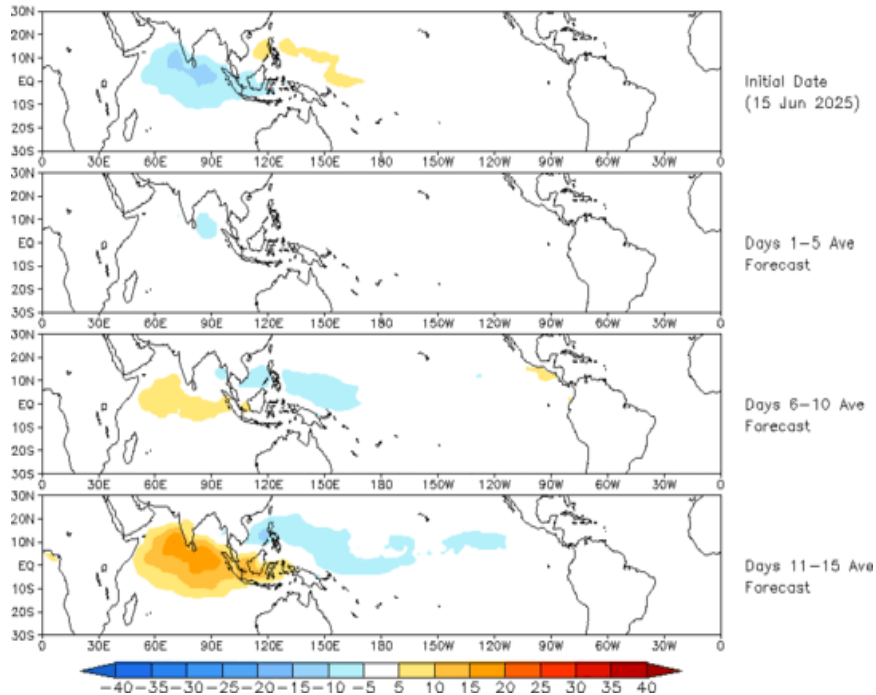


- The GEFS depicts negative OLR anomalies (enhanced convection) across the Indian Ocean during week-1 into early week-2.
- After day-10, there is a transition to weak positive OLR anomalies over this area (suppressed convection).

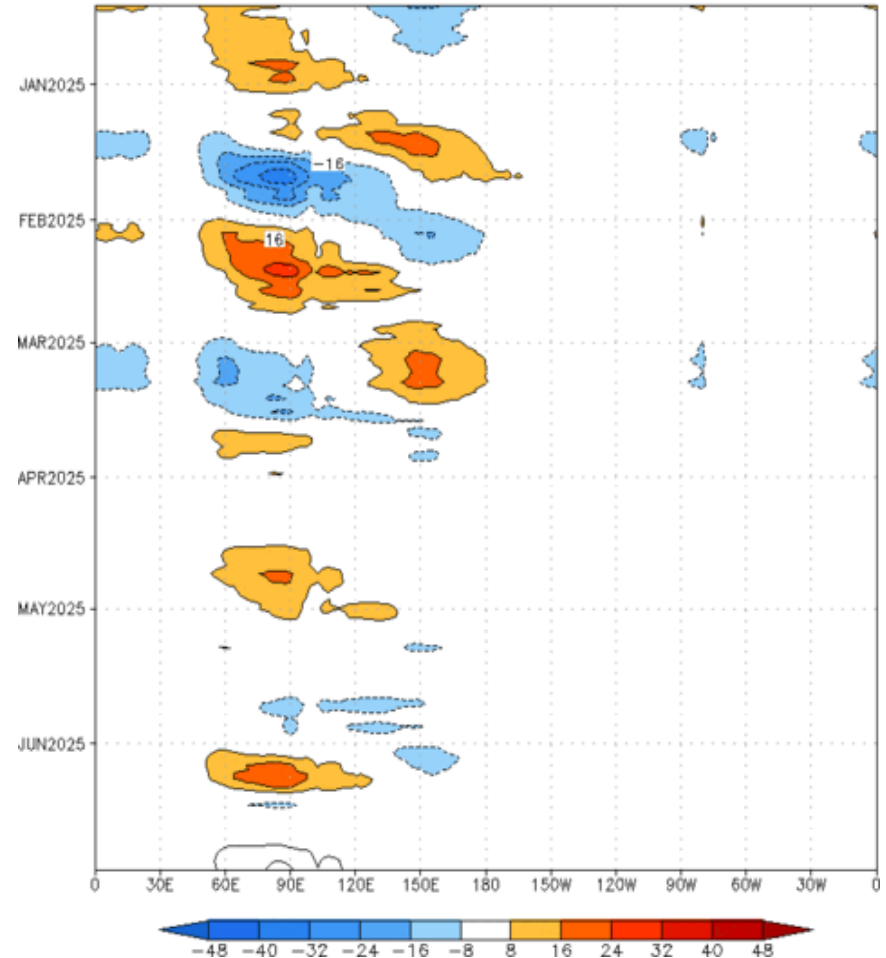
MJO: Constructed Analog Forecast Evolution

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 (15 Jun 2025)



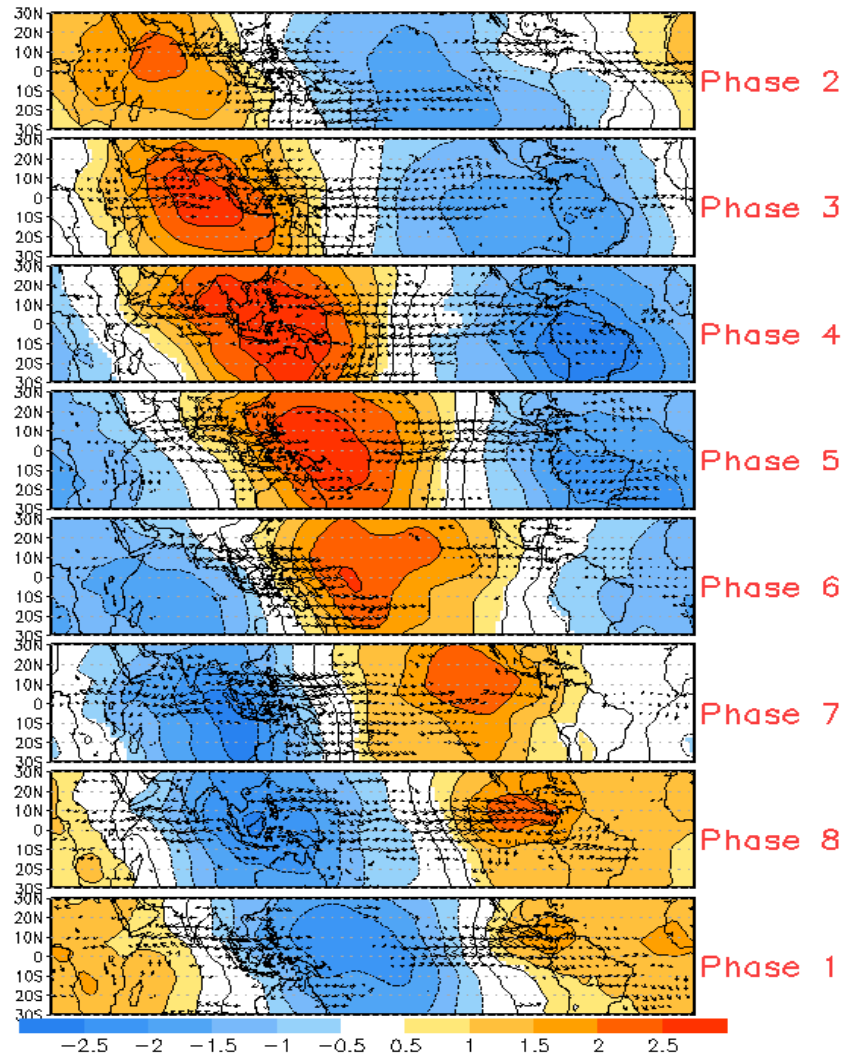
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:14-Dec-2024 to 15-Jun-2025
The unfilled contours are CA forecast reconstructed anomaly for 15 days



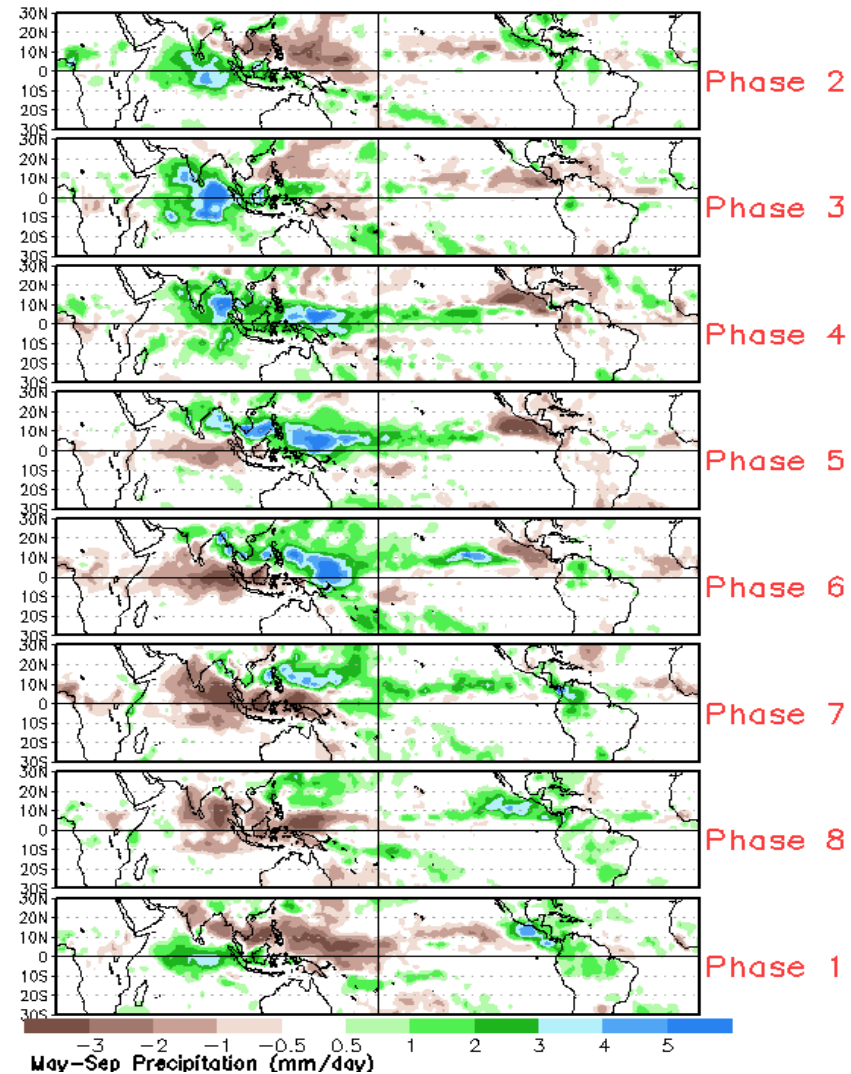
- The Constructed Analog tool indicates weakly negative OLR anomalies shifting from the Indian Ocean in week-1 into the western and central Pacific during week-2.
- The constructed analog forecast depicts a stronger region of positive OLR anomalies developing across the Indian Ocean during week-2 compared to the GEFS.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



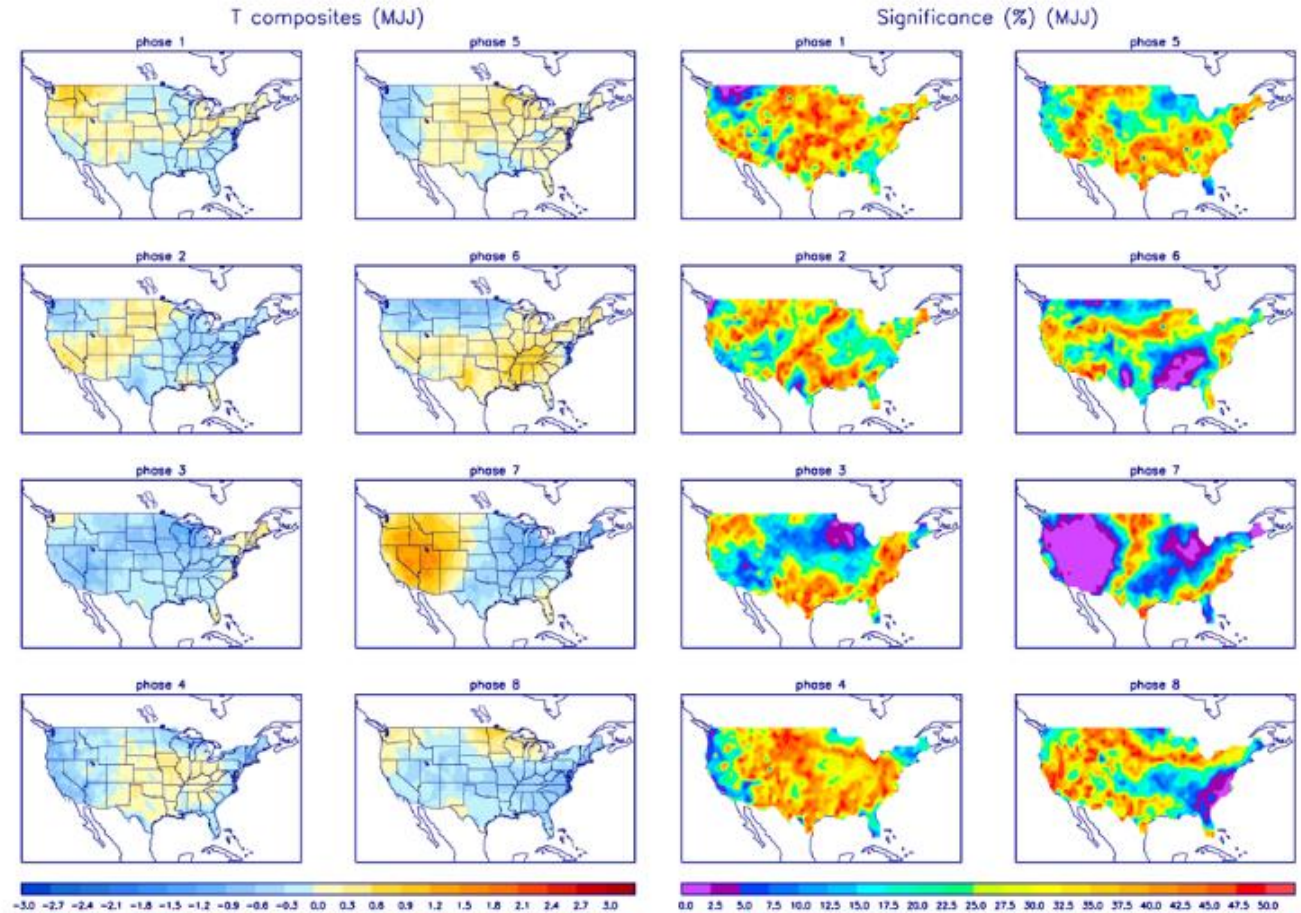
Precipitation Anomalies



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.

