

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



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

Overview

- The MJO remains weak as Equatorial Rossby and Kelvin Waves continue to be the primary influences on anomalous rainfall across the global tropics.
- A low-frequency signal has emerged and is forecast to persist into July with suppressed (enhanced) rainfall over parts of the Indian Ocean and South Asia (Maritime Continent and West Pacific).
- Model guidance supports an elevated chance for tropical cyclone development across the East Pacific through July 2-8 and the West Pacific from July 2-15.

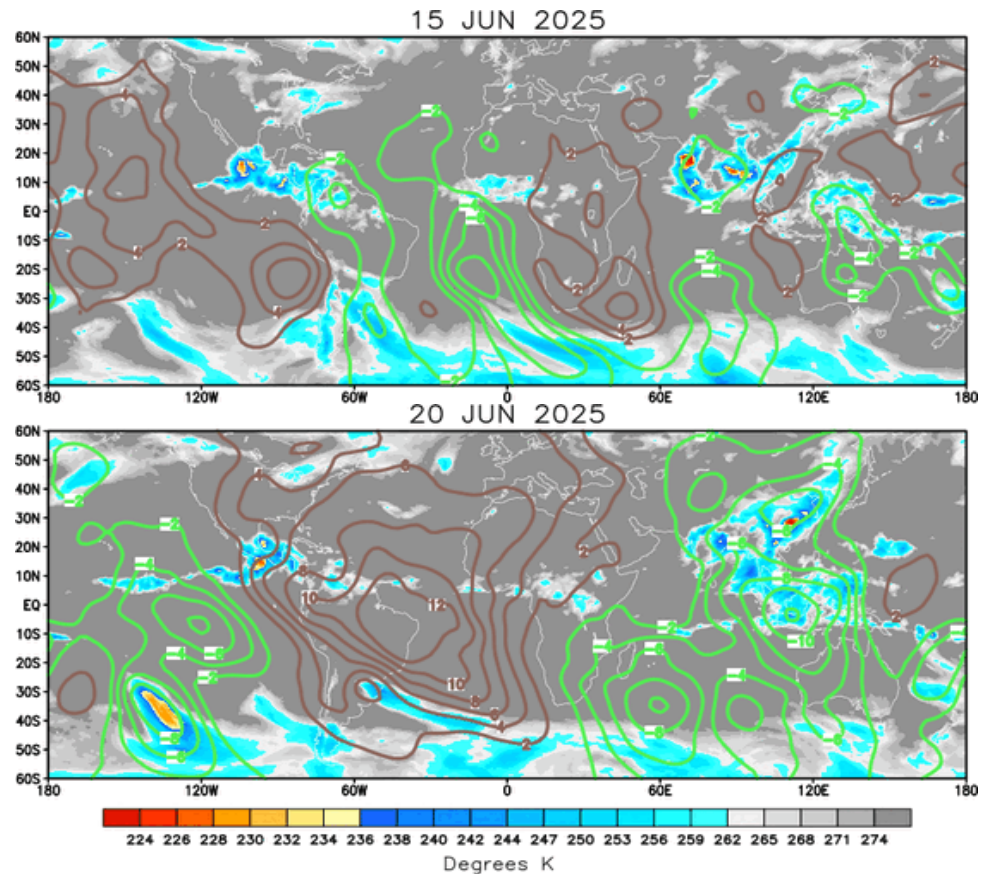
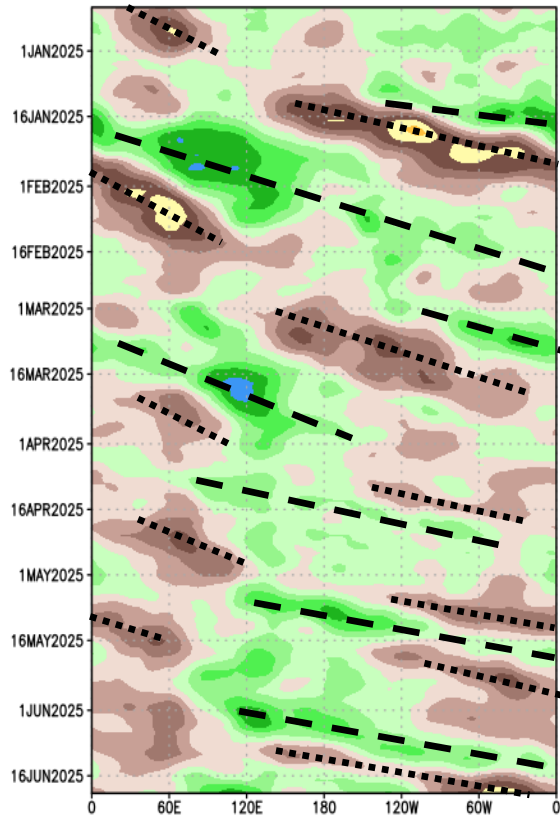
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

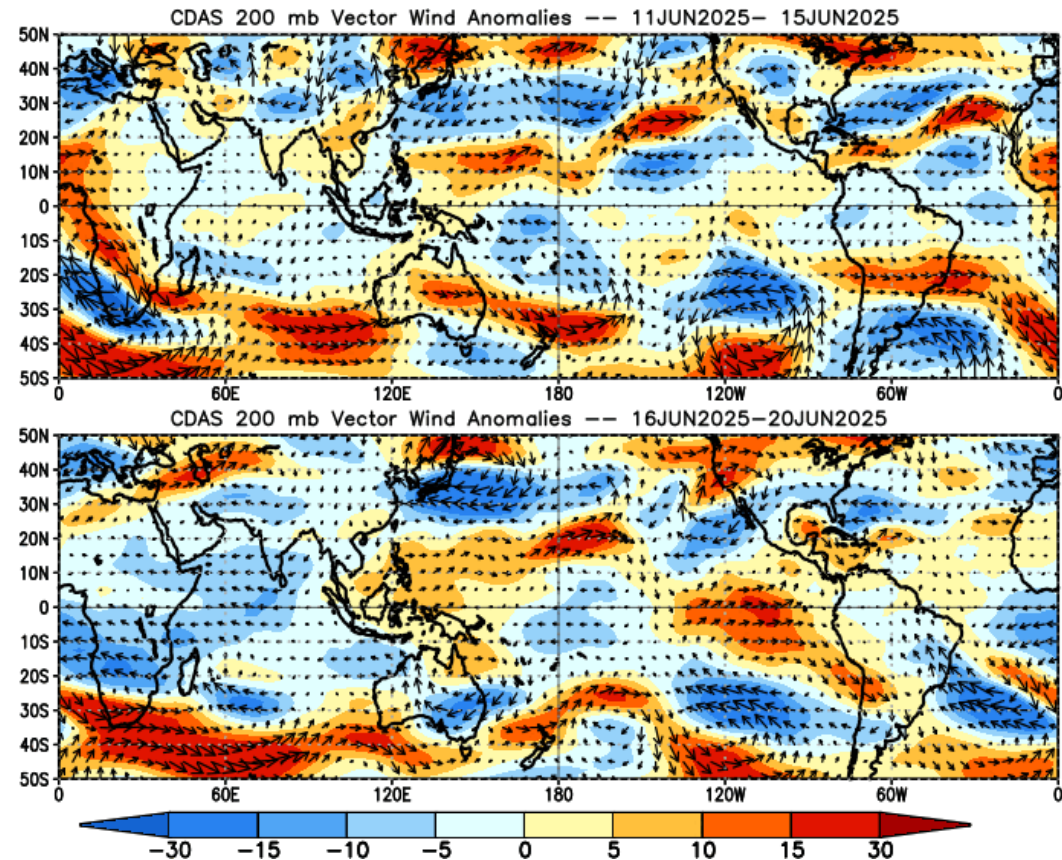
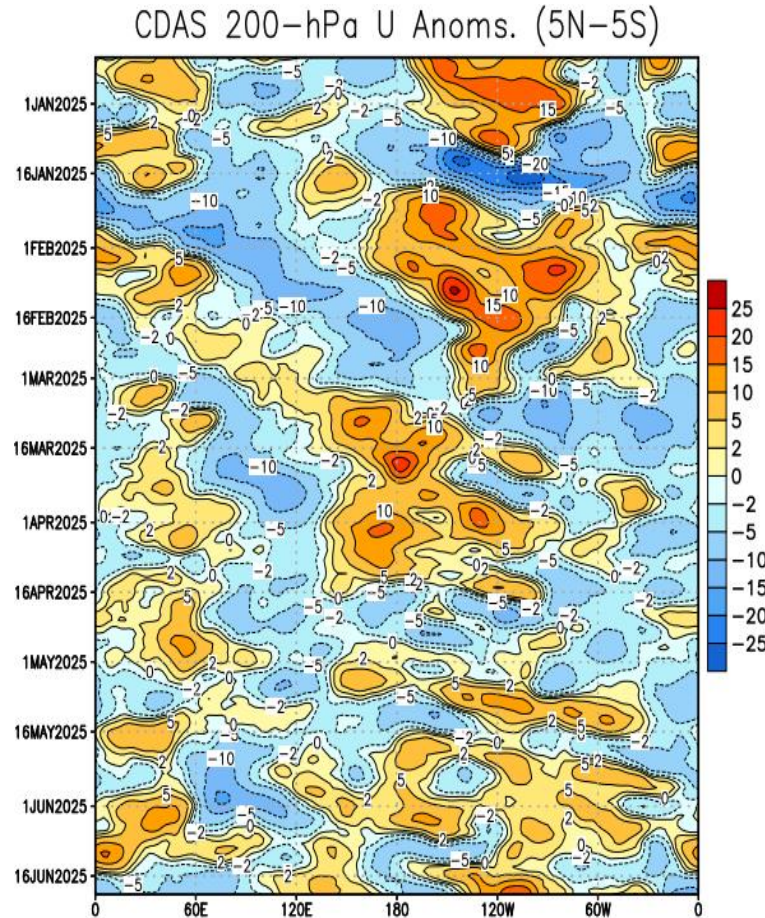
200-hPa Velocity Potential Anomaly: 5N–5S
5-day Running Mean



- A fast-moving enhanced convective envelope is noted in the spatial upper-level velocity potential field, shifting over the Western Hemisphere during mid-June. The faster movement is more associated with a Kelvin wave.
- Recently, strong upper-level anomalous convergence resumed across the tropical Atlantic.

200-hPa Wind Anomalies

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

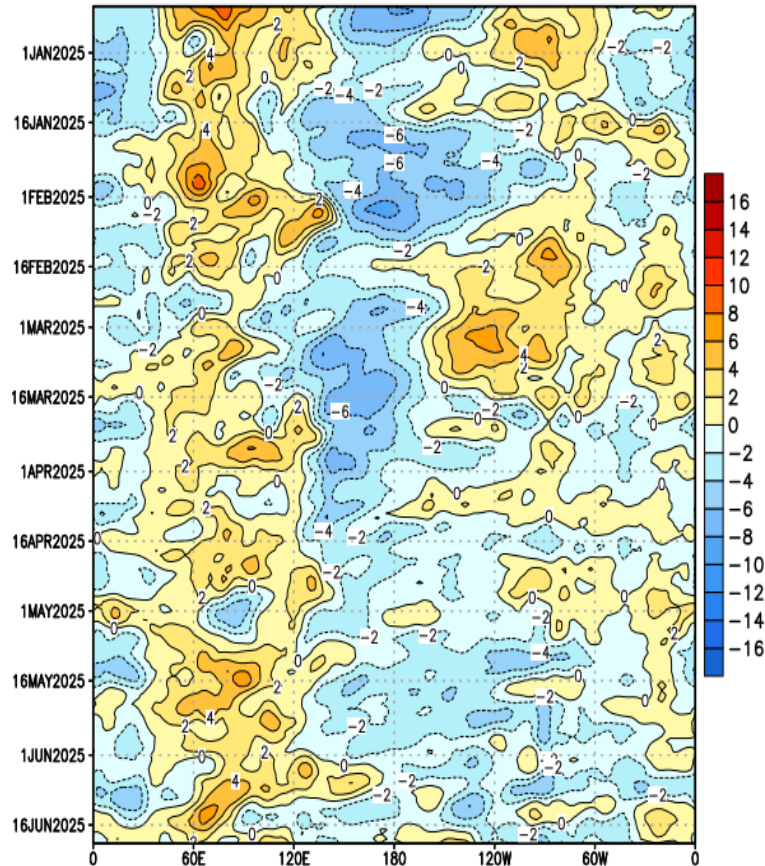


- The spatial upper-level wind anomaly field is largely incoherent, with stronger magnitude anomalies in the extratropics, decreasing closer to the Equator.
- Westerly anomalies aloft persist across the Caribbean Sea where wind shear remains high and is an inhibiting factor to any early season tropical cyclone development.

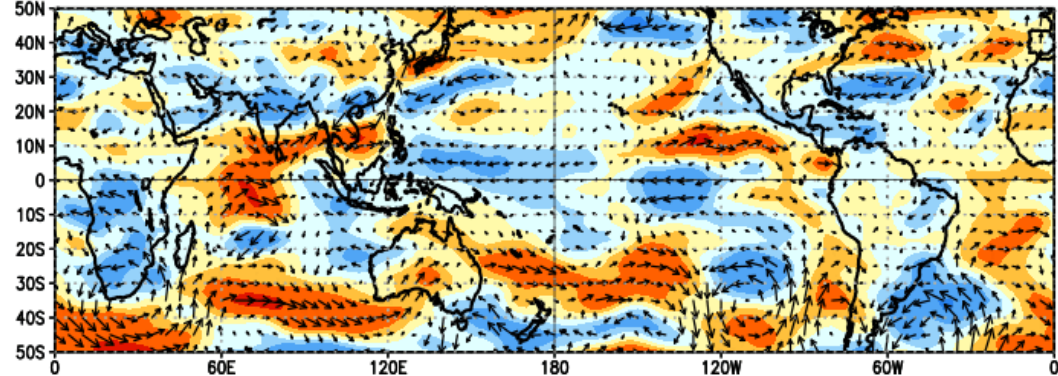
850-hPa Wind Anomalies

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

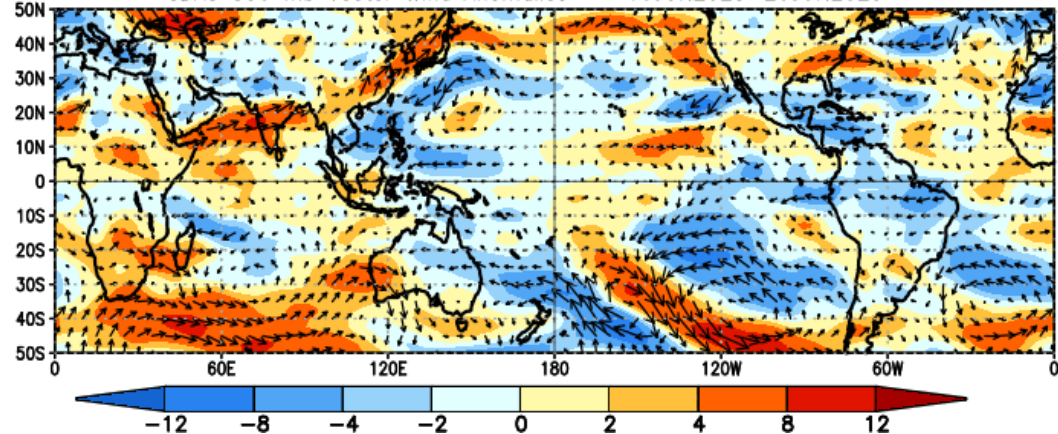
CDAS 850-hPa U Anoms. (5N–5S)



CDAS 850 mb Vector Wind Anomalies -- 11JUN2025– 15JUN2025



CDAS 850 mb Vector Wind Anomalies -- 16JUN2025–20JUN2025

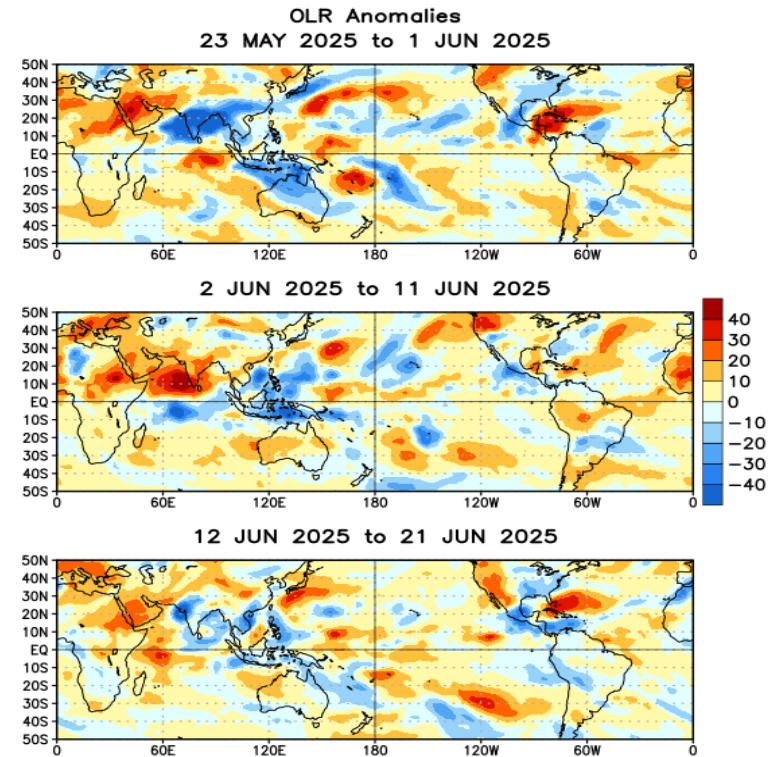
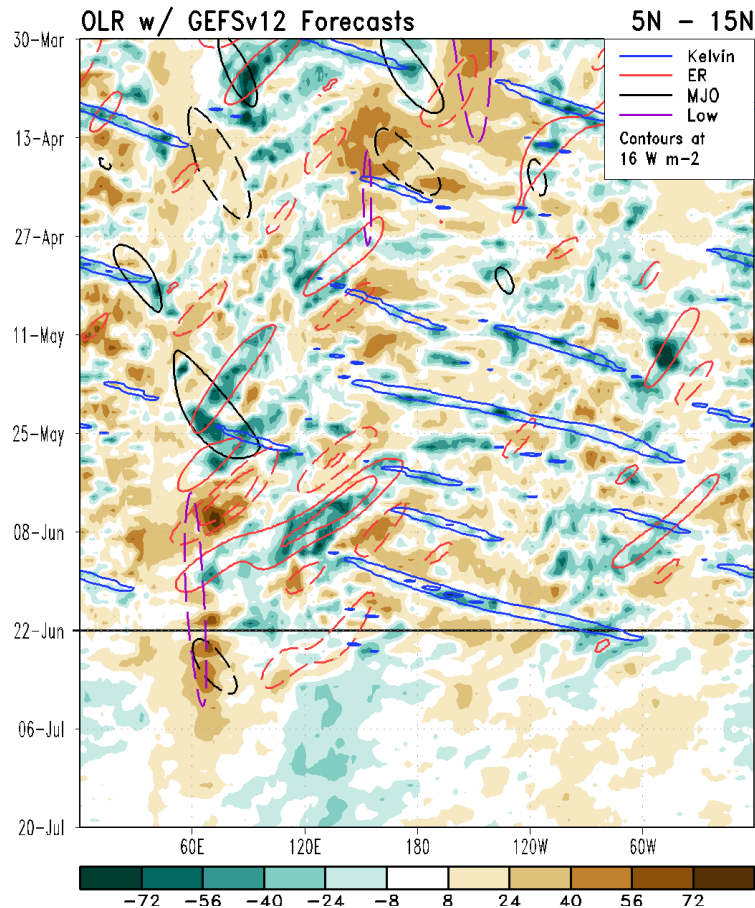


- Enhanced low-level westerlies have persisted across the Indian Ocean and Maritime Continent for the past several months.
- A transition to anomalous low-level westerlies across the Eastern North Pacific promoted increased tropical cyclone activity across the basin.
- Conversely, easterly anomalies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

Outgoing Longwave Radiation (OLR) Anomalies

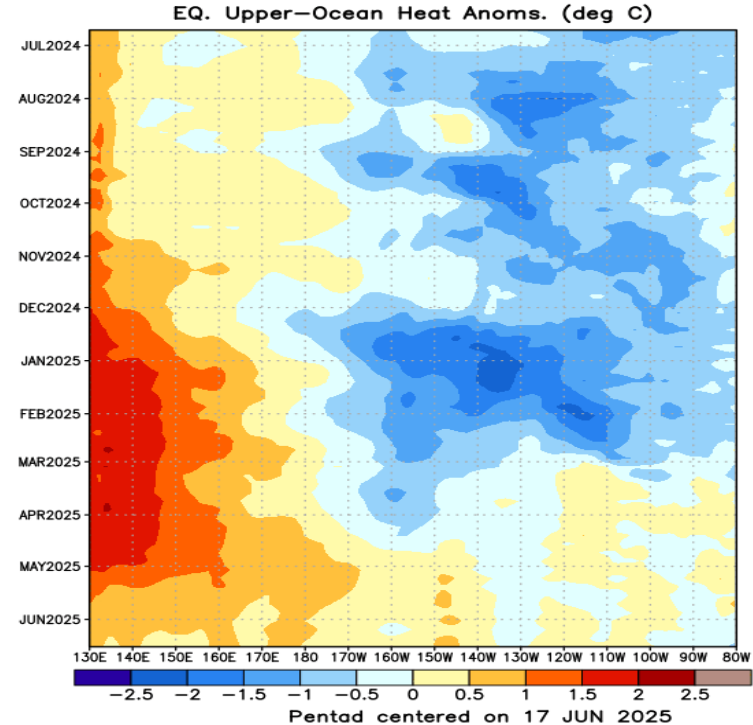
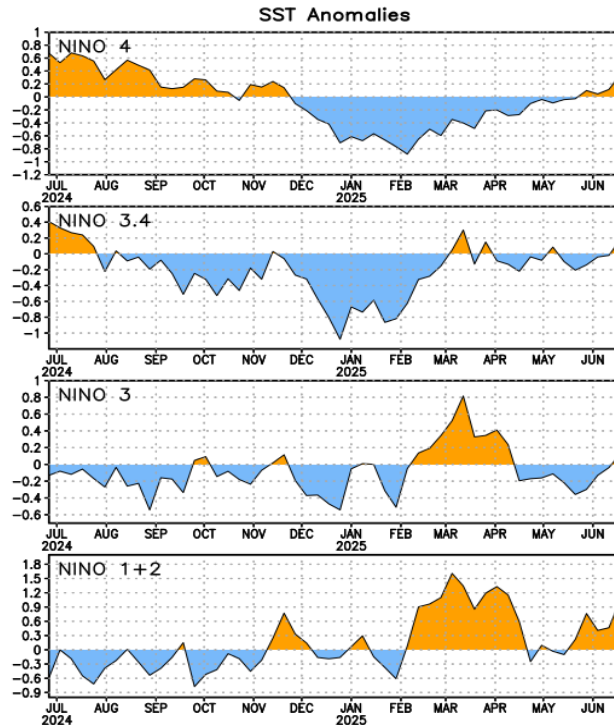
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- Frequent Equatorial Rossby Wave and Kelvin waves, coming through the OLR objective filtering, contributed to negative OLR anomalies (enhanced rainfall) across the Maritime Continent.
- Although this enhanced rainfall eased during mid-June, the GEFS depicts a low-frequency signal of enhanced (suppressed) rainfall over the Maritime Continent (western Indian Ocean) through mid-July.

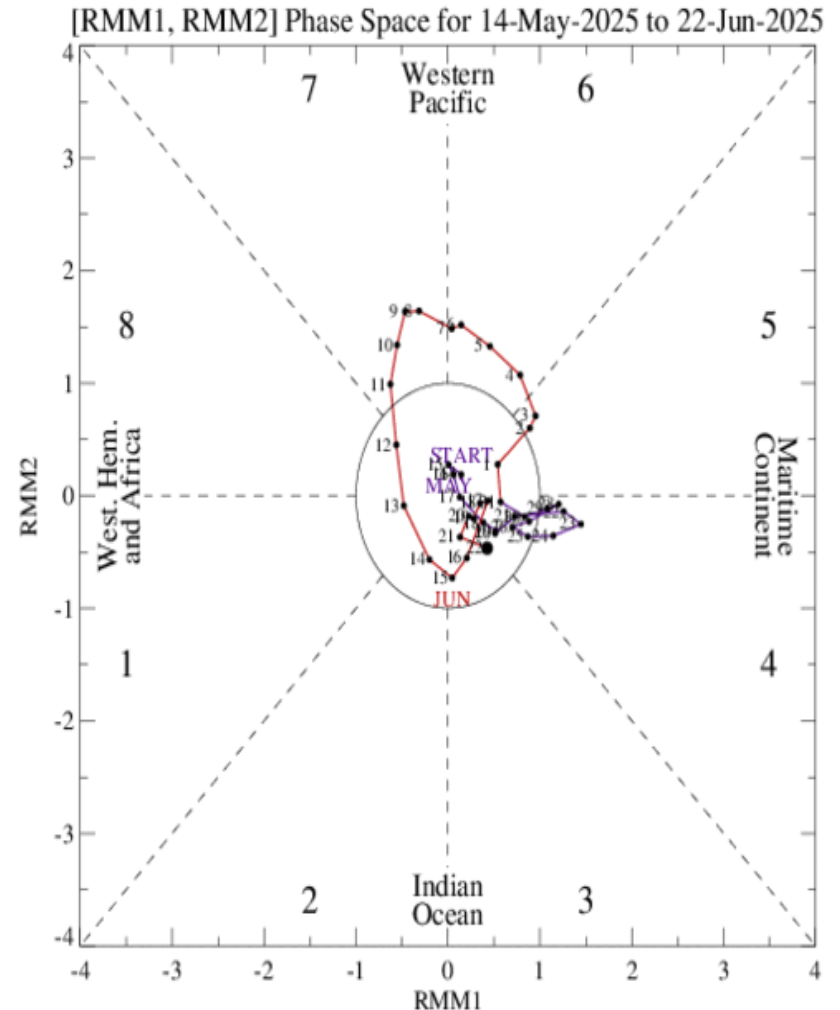
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- 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.
- SST anomalies have been more variable across Nino 3 and Nino 3.4, but generally remain close to 0° with no clear trend in either direction.

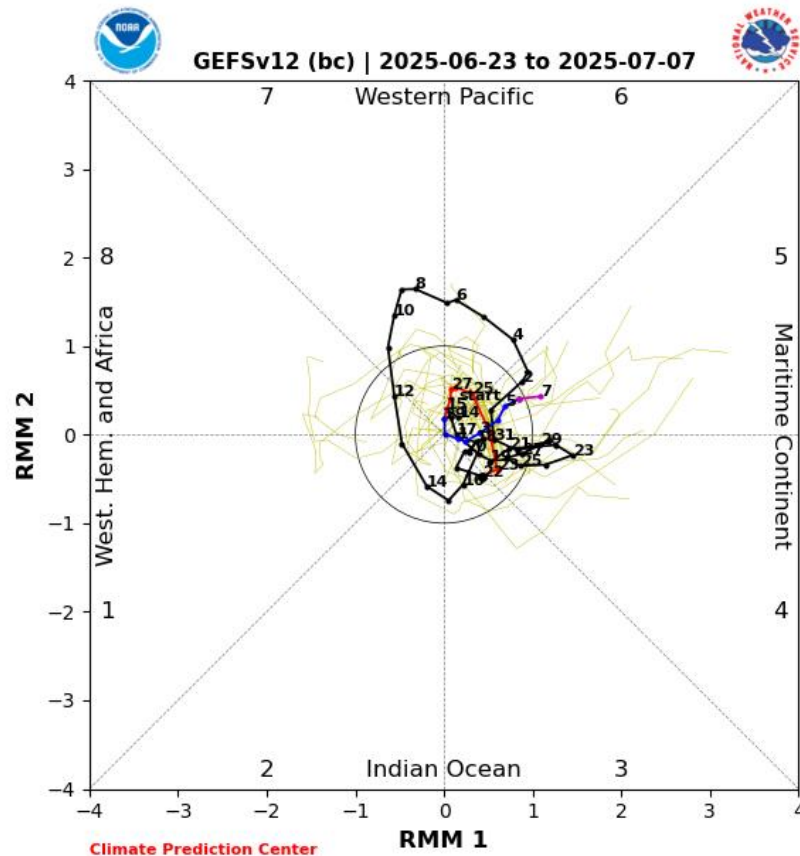
MJO Index: Recent Evolution

- 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.

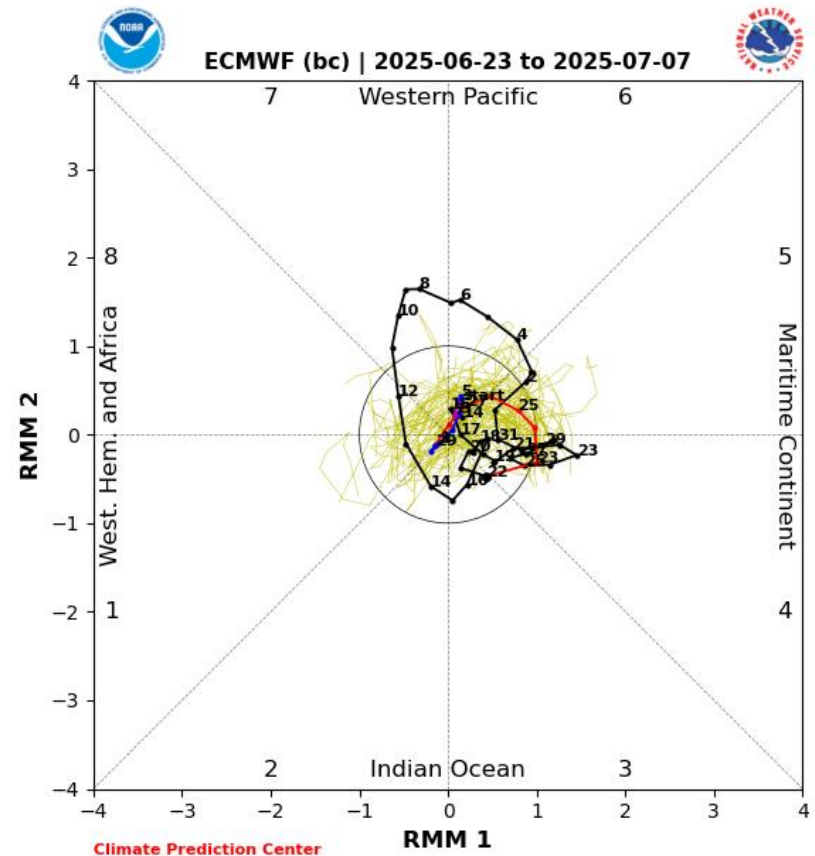


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



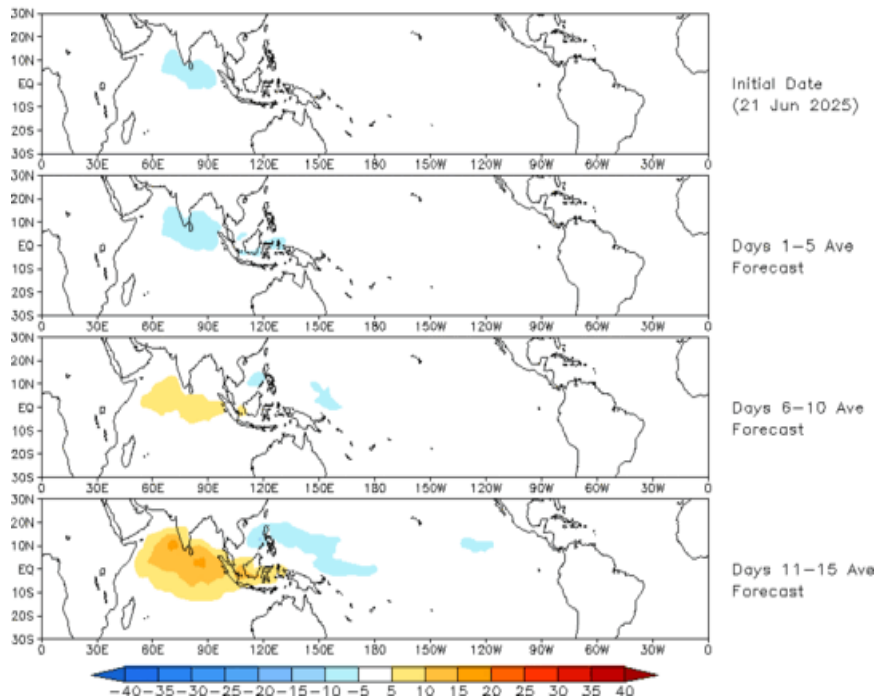
ECMWF Forecast

- 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 spread in the individual members further highlighting the uncertainty.

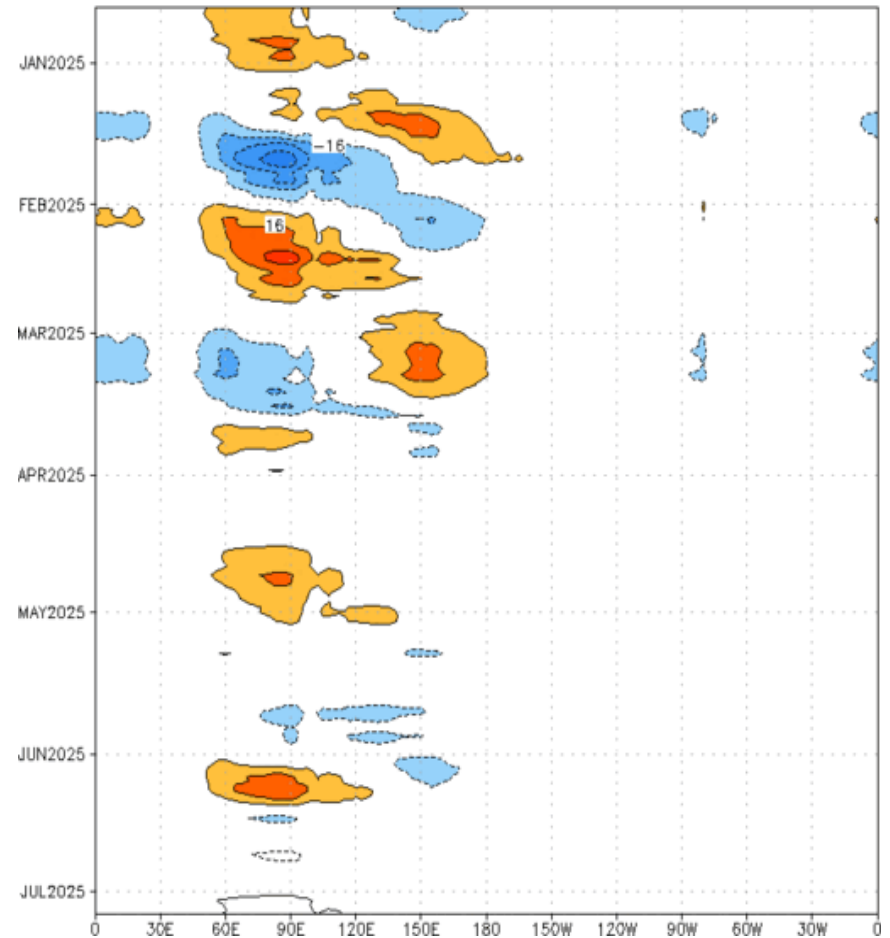
MJO: GEFS Forecast Evolution

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: 21 Jun 2025
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cint:4Wm^{-2}) Period:20-Dec-2024 to 21-Jun-2025
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

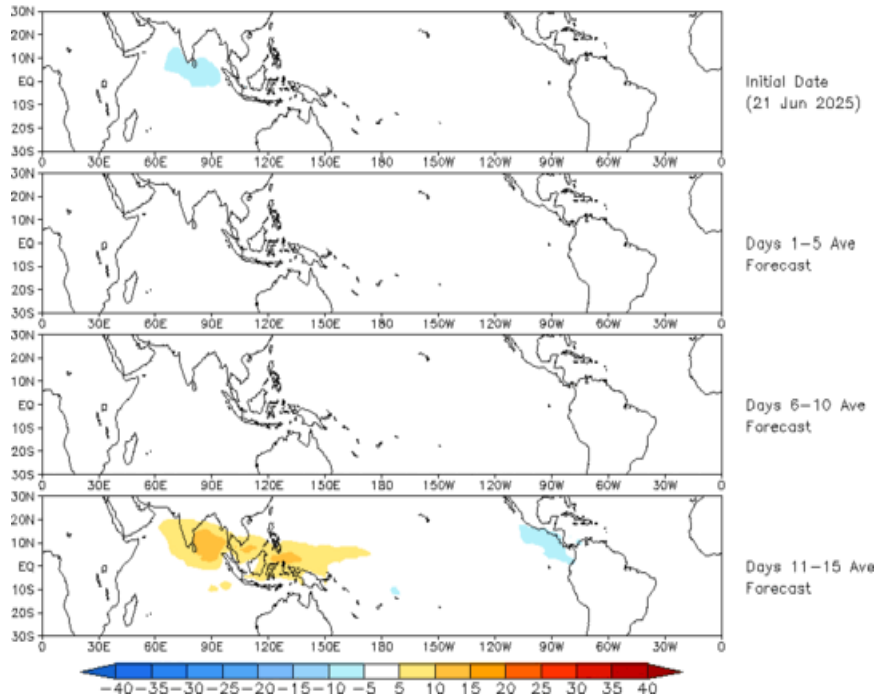


- The GEFS depicts positive OLR anomalies (suppressed rainfall) resuming across the Indian Ocean and shifting eastward later in week-2.
- Anomalies are small (-5 to +5) throughout the Western Hemisphere.

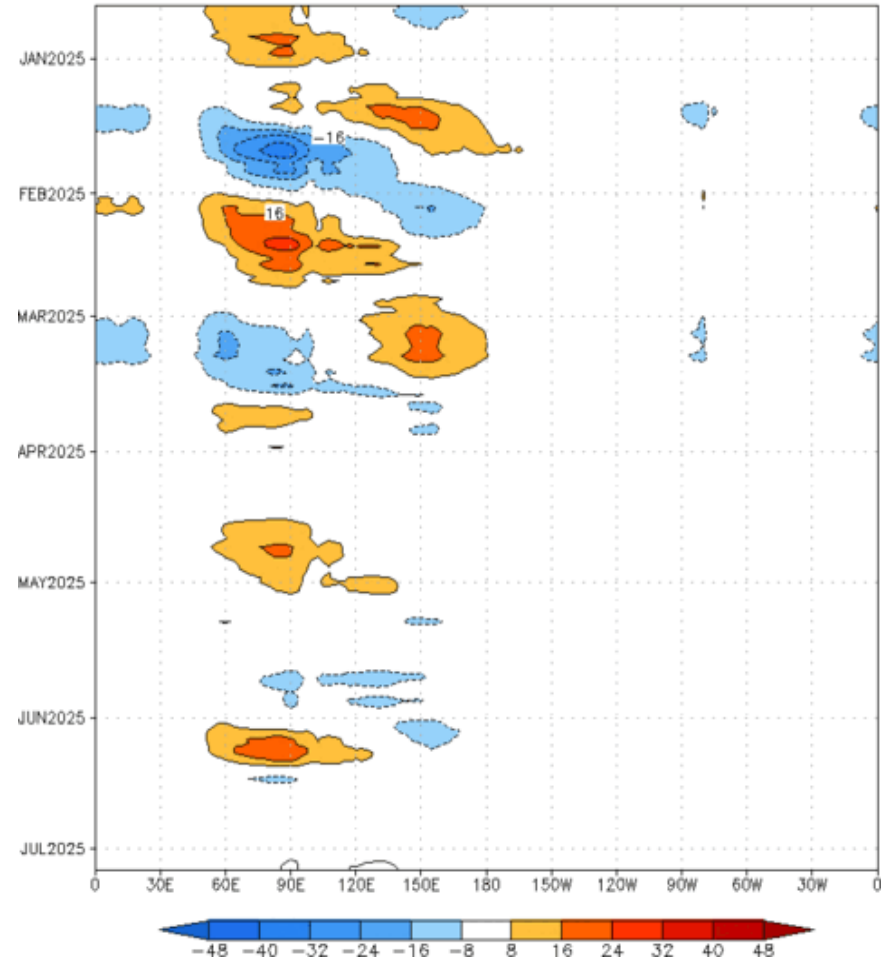
MJO: Constructed Analog Forecast Evolution

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 (21 Jun 2025)



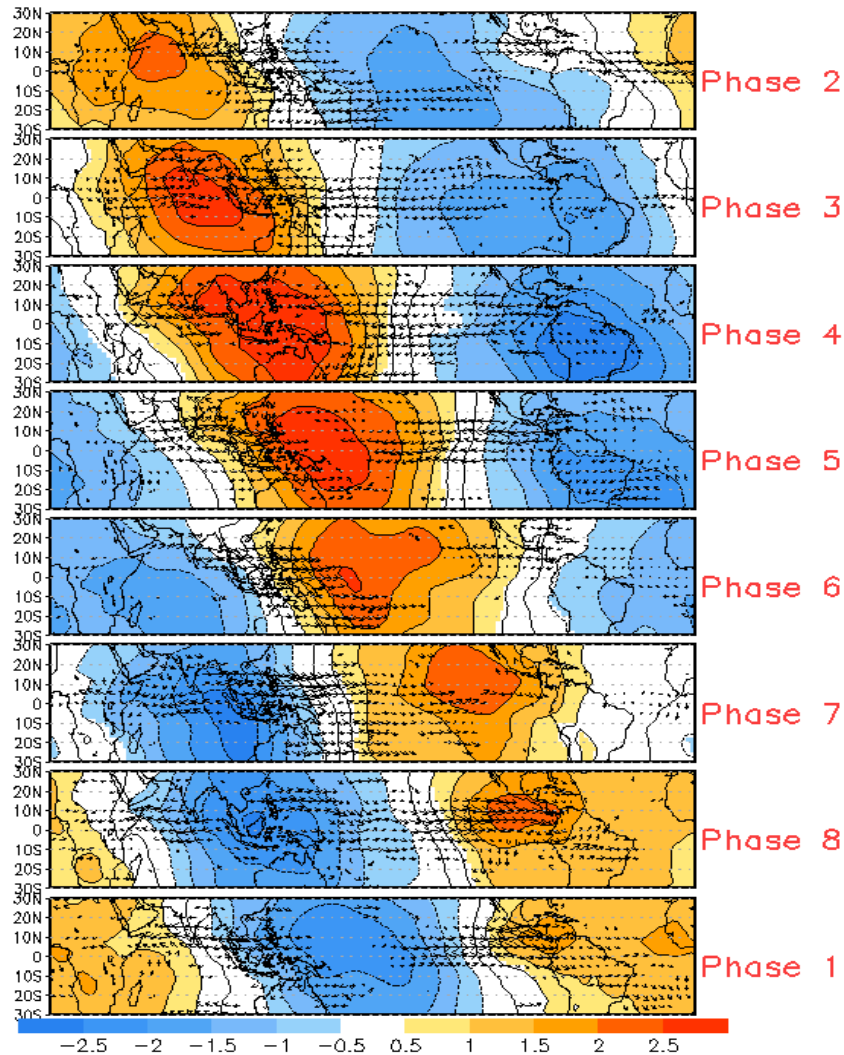
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:20-Dec-2024 to 21-Jun-2025
The unfilled contours are CA forecast reconstructed anomaly for 15 days



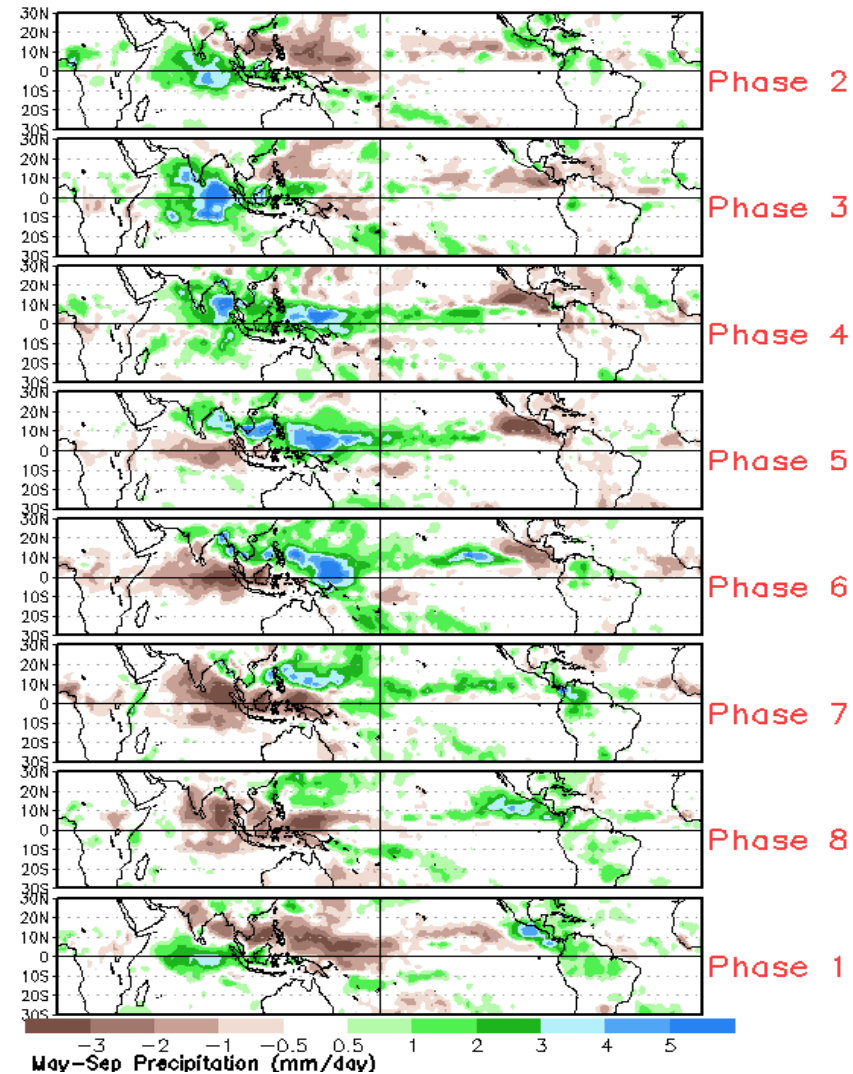
- The Constructed Analog tool also depicts positive OLR anomalies developing across the Indian Ocean later in week-2.
- At the same time, negative OLR anomalies develop across the East Pacific.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



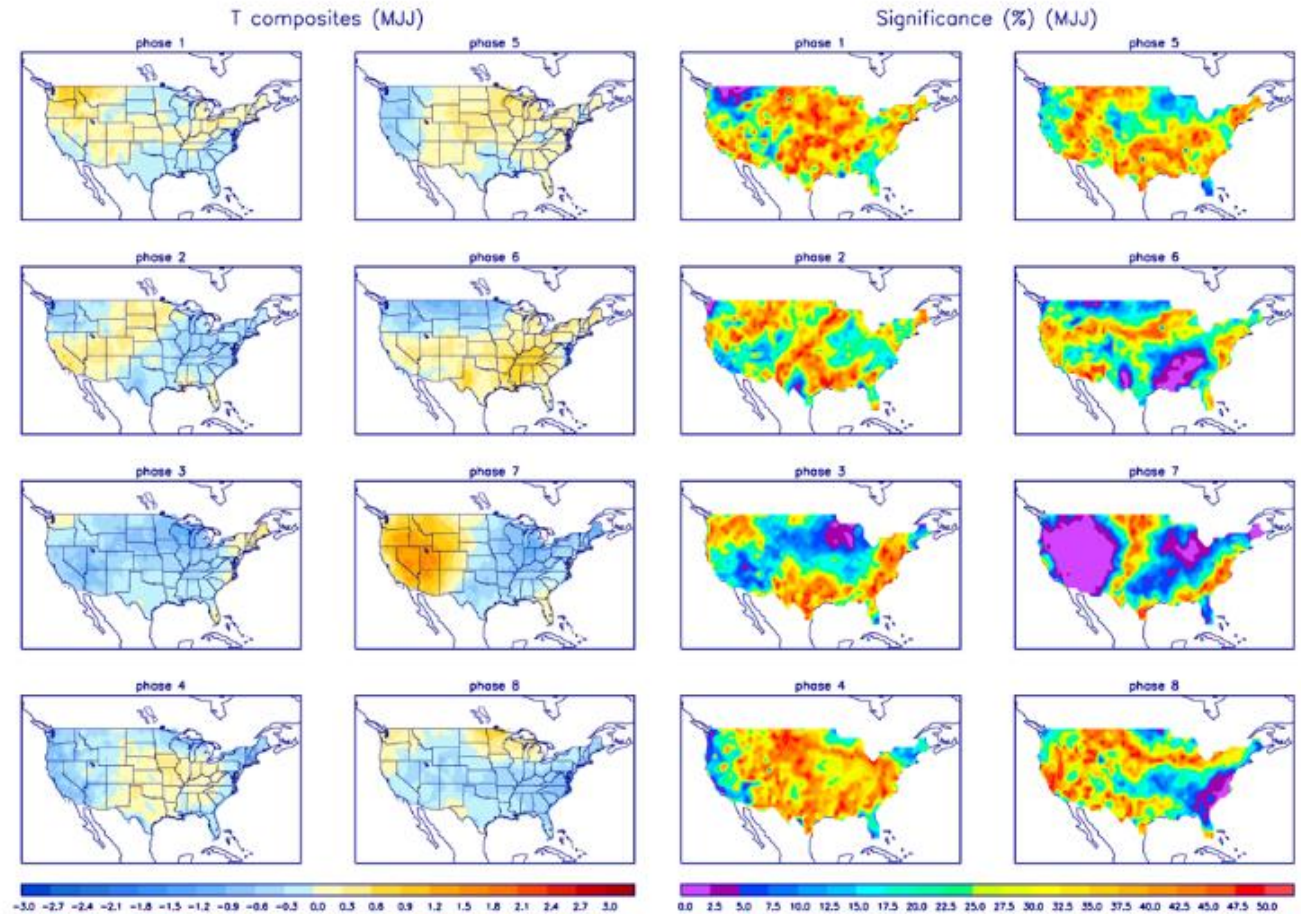
Precipitation Anomalies



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 - 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.

