

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



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

Overview

- The MJO continues to be disorganized with other tropical modes continuing to prevail throughout the global tropics.
- Upper-level velocity potential anomalies reveal more of a wave-1 pattern during late June, however there is little to no sign of eastward propagation characteristic of a reorganizing MJO, with this pattern remaining stationary but growing stronger.
- A low-frequency response has emerged, with some model guidance strengthening a stationary envelope of enhanced convection over the Maritime Continent and West Pacific, and suppressed convection favored from the equatorial Pacific to the western Indian Ocean during July.
- Save for additional equatorial Kelvin wave passages to incite tropical cyclone (TC) development in western Hemisphere, the large scale environment looks to become less favorable for tropical cyclogenesis in the eastern Pacific and Atlantic basins during the next several weeks
- Conversely, there are increased chances for TC formation in the western Pacific following a sluggish start of the season this year.

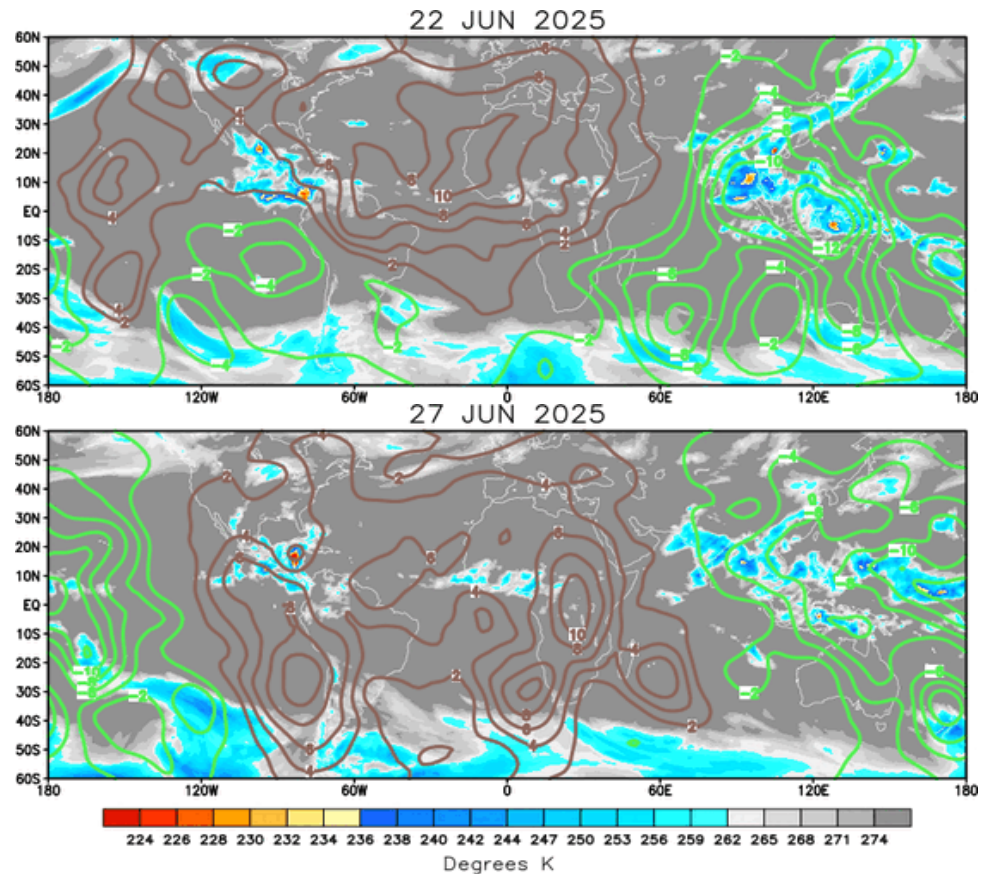
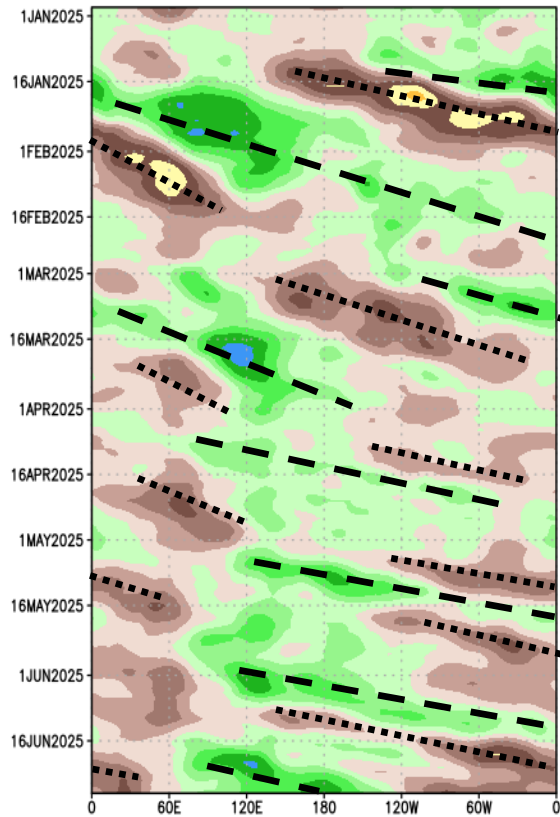
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

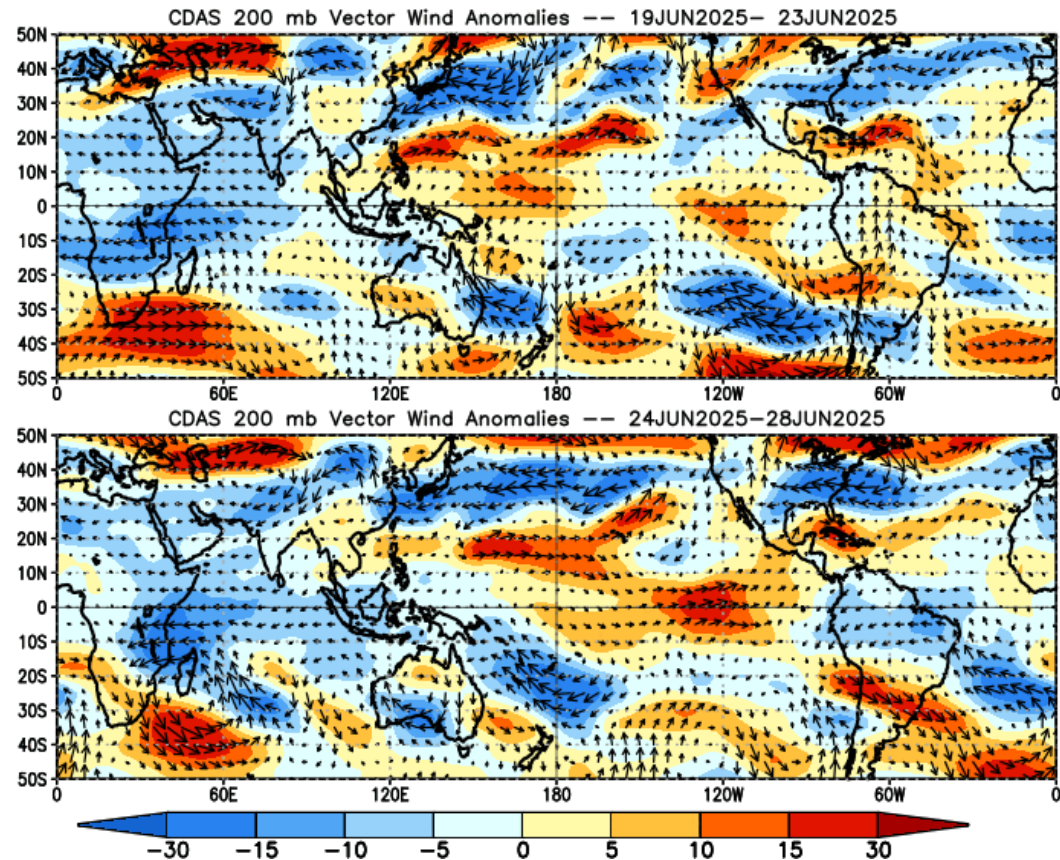
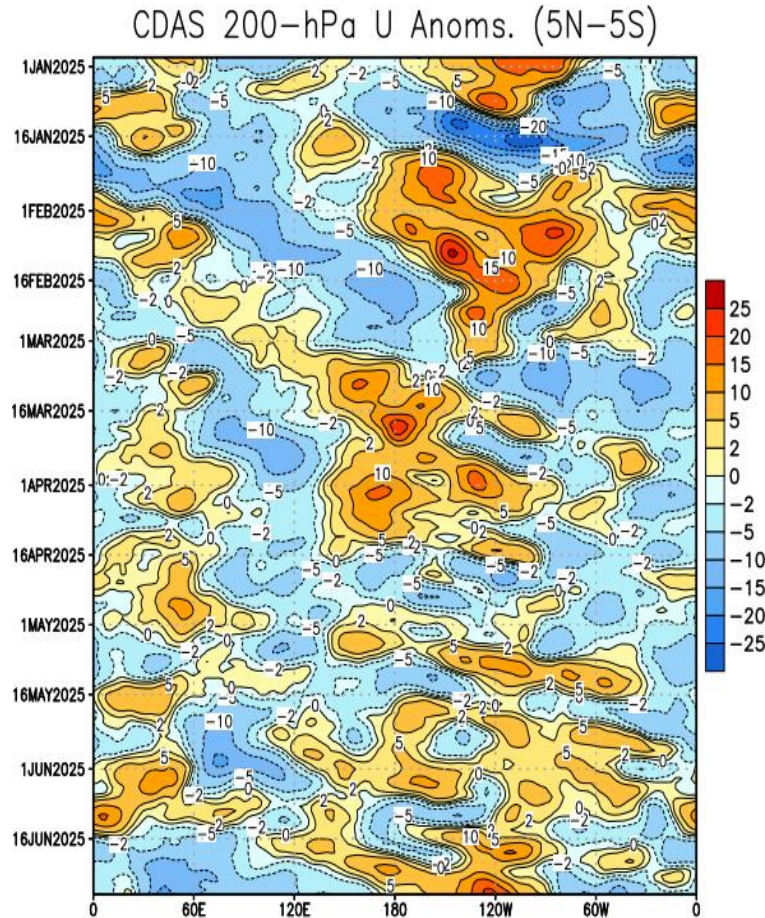
200-hPa Velocity Potential Anomaly: 5N–5S
5-day Running Mean



- The upper-level pattern became more wave-1 like in appearance during late June, but there is little to no sign of eastward proration characteristic of coherent MJO activity.
- Fast moving equatorial Kelvin Wave activity has prevailed throughout the global tropics, though low frequency variability appears to be amplifying as a portion of the variability.

200-hPa Wind Anomalies

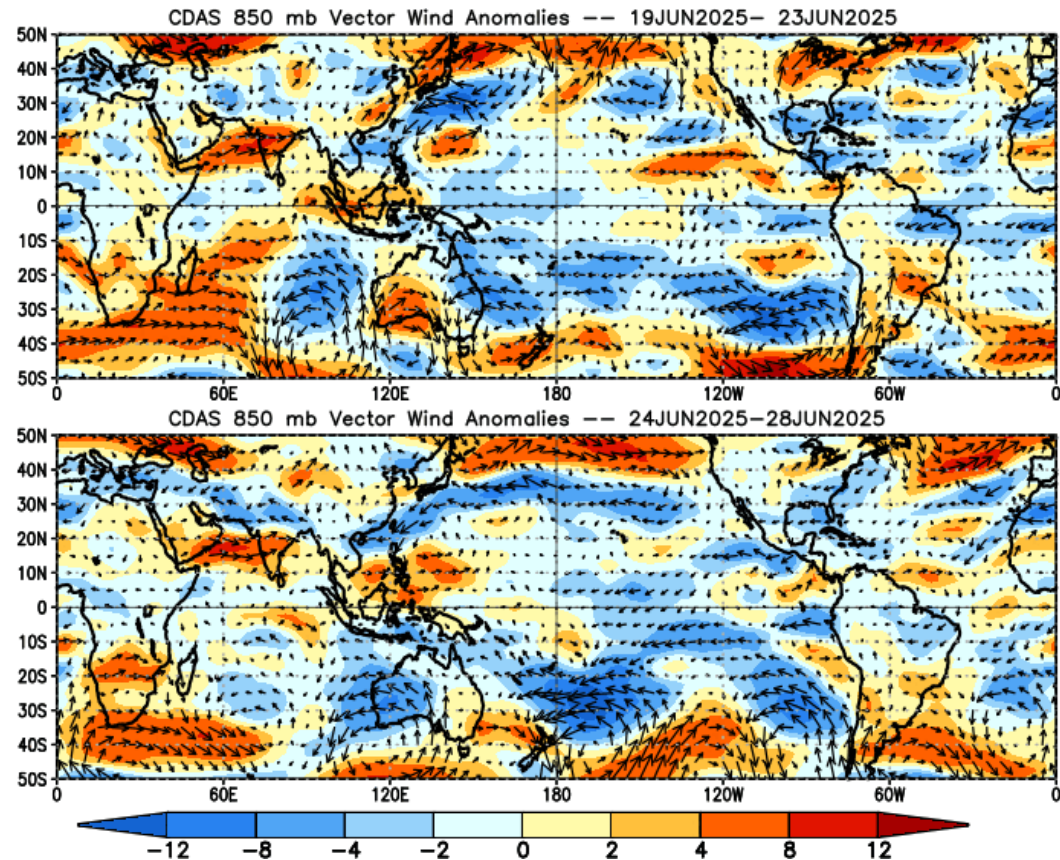
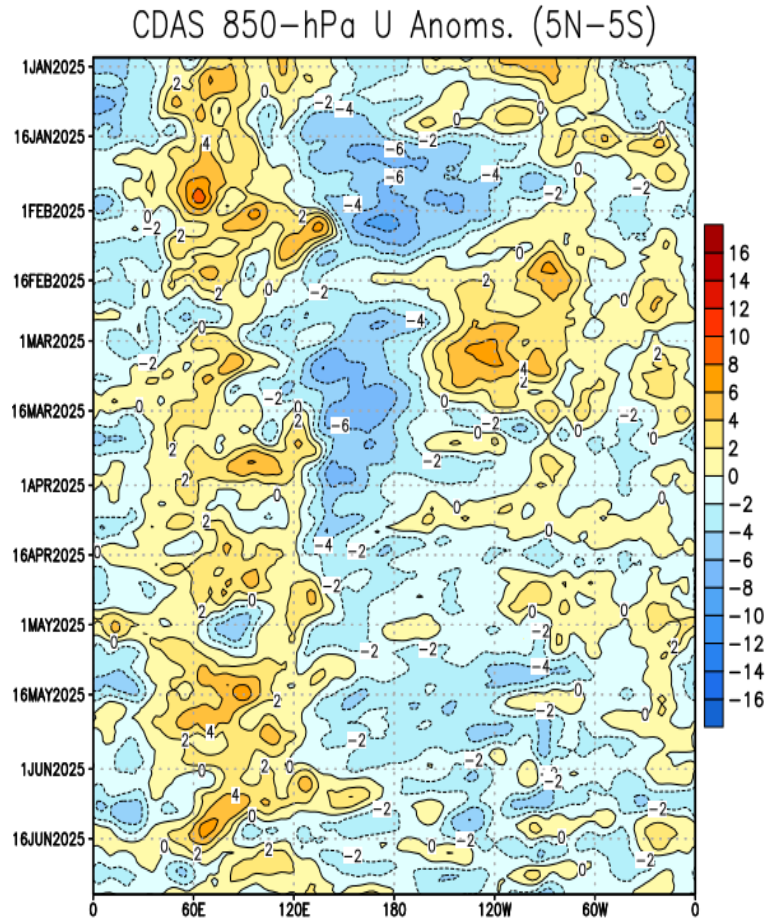
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Since mid-June, anomalous upper-level easterlies became more widespread across the eastern Hemisphere.
- Westerly anomalies aloft reside mainly east of the Date Line, and became more pronounced near 120W likely tied to constructive interference between an equatorial Kelvin and Rossby Wave.
- The anomalous westerlies are favored to become quite robust and extend eastward beyond the Prime Meridian in the GEFS and ECMWF forecasts (not pictured).

850-hPa Wind Anomalies

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

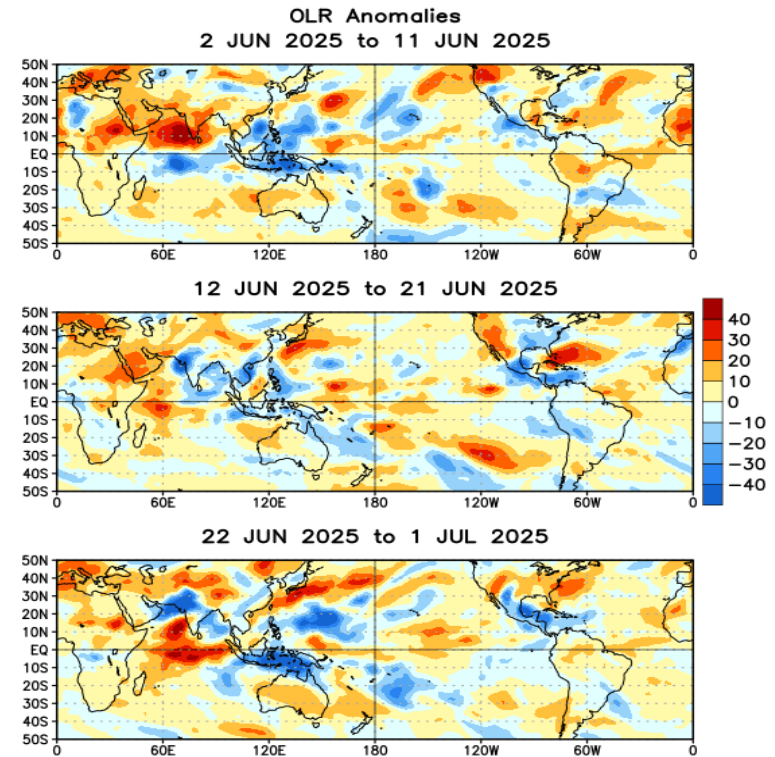
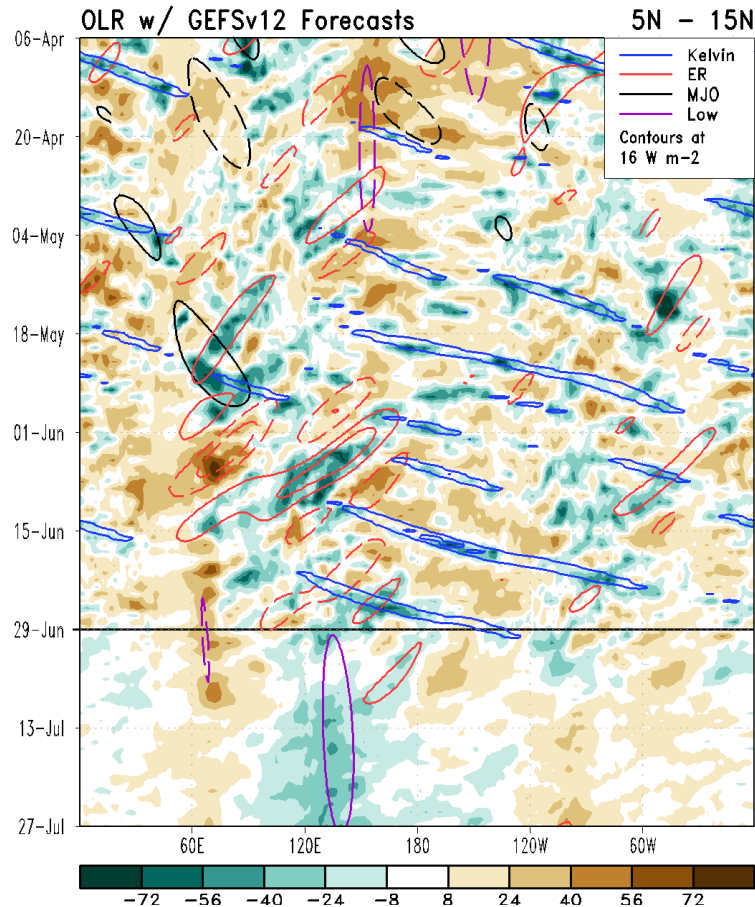


- Persistent low-level anomalous westerlies across the Indian Ocean and Maritime Continent have weakened more recently
- Anomalous westerlies persist north of the equator in the eastern Pacific, and developed in the western Pacific, both favorable for continued tropical cyclone development,
- Overall, the lower-level pattern is inconsistent with MJO activity and consistent with other tropical modes being more prevalent.

Outgoing Longwave Radiation (OLR) Anomalies

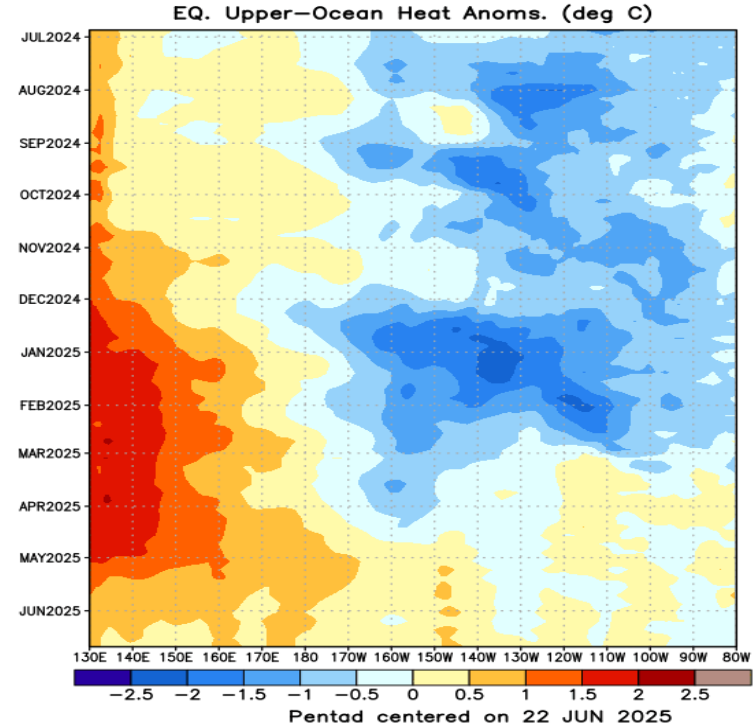
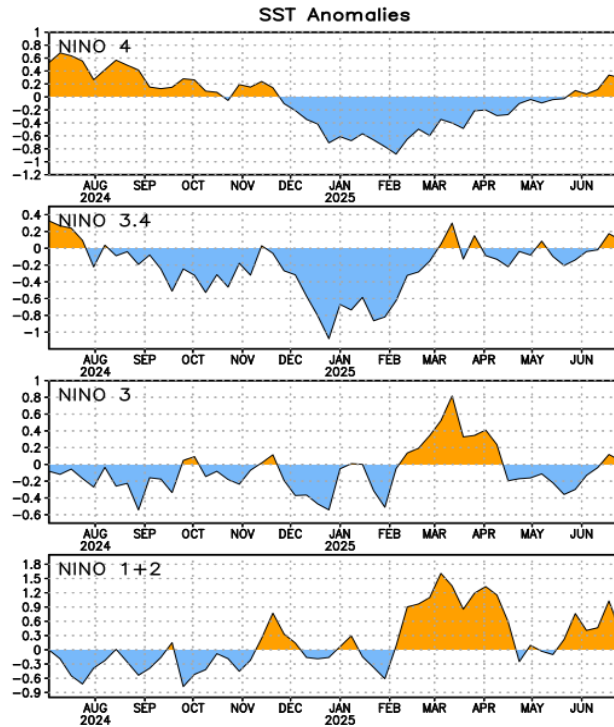
Green shades: Anomalous convection (wetness)

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 and eastern Pacific.
- Following a relaxation of the Indian monsoon, enhanced convection returned later in June.
- OLR forecasts feature strengthening low frequency convective responses along and to the east of 120E and 120W.

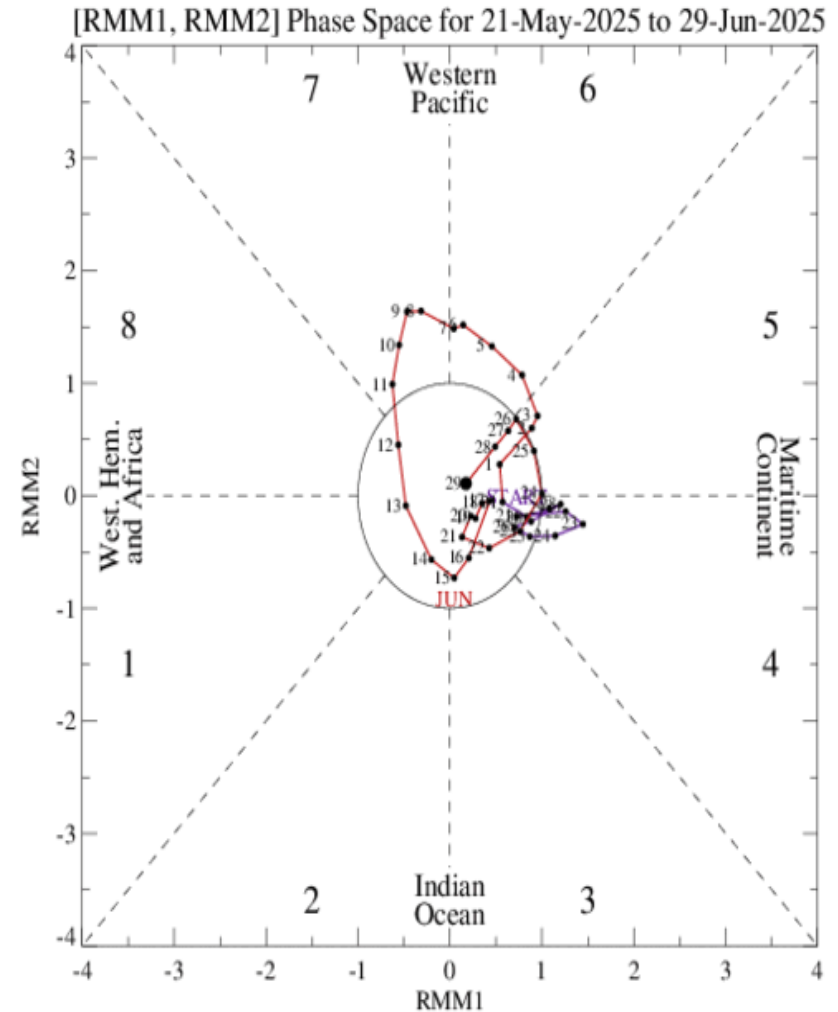
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- During the past few weeks, there has been an upward trend in SST anomalies across all Nino regions, but all remain fairly neutral.
- Much of warm water in the western Pacific has cooled, with marginally positive anomalies now being observed throughout the entire Pacific.

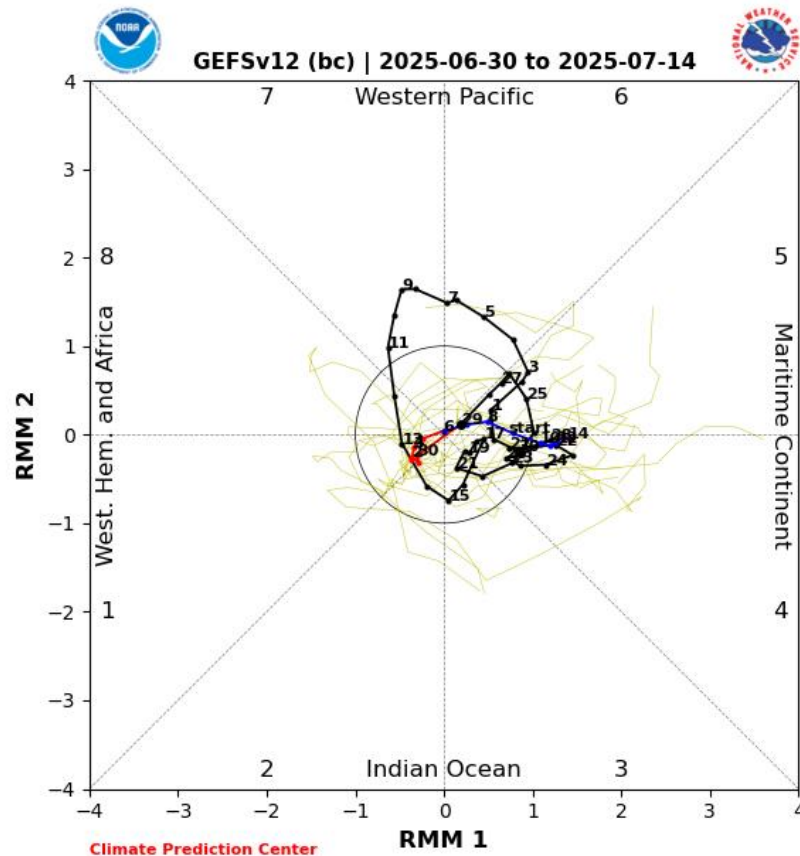
MJO Index: Recent Evolution

- During the second half June, the RMM index has meandered over phases 4 and 5 with the MJO signal losing amplitude more recently.

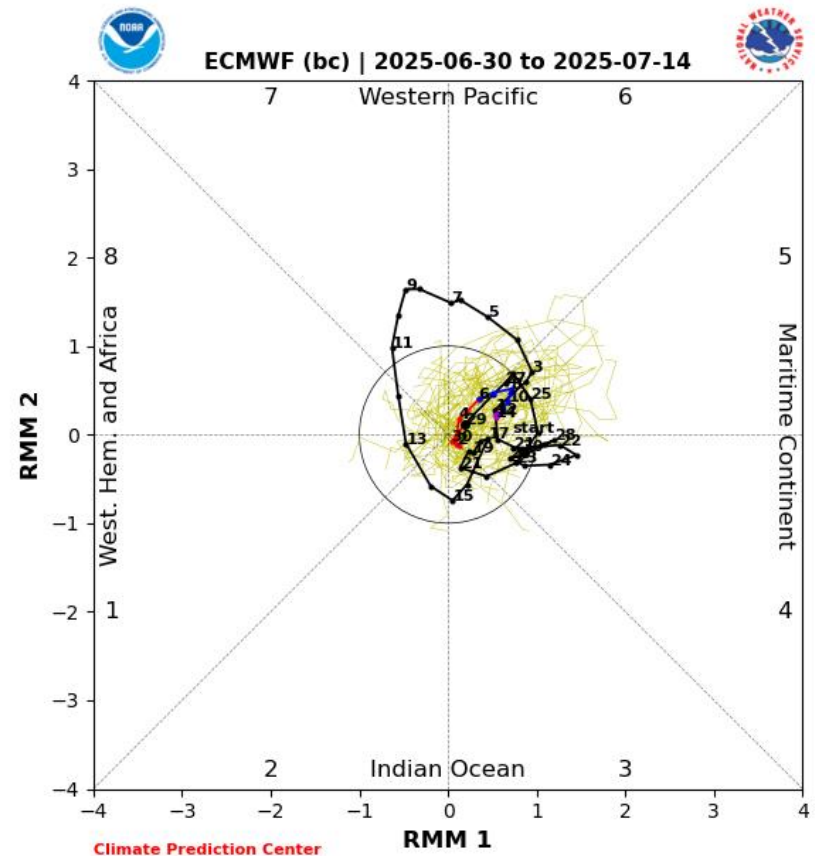


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



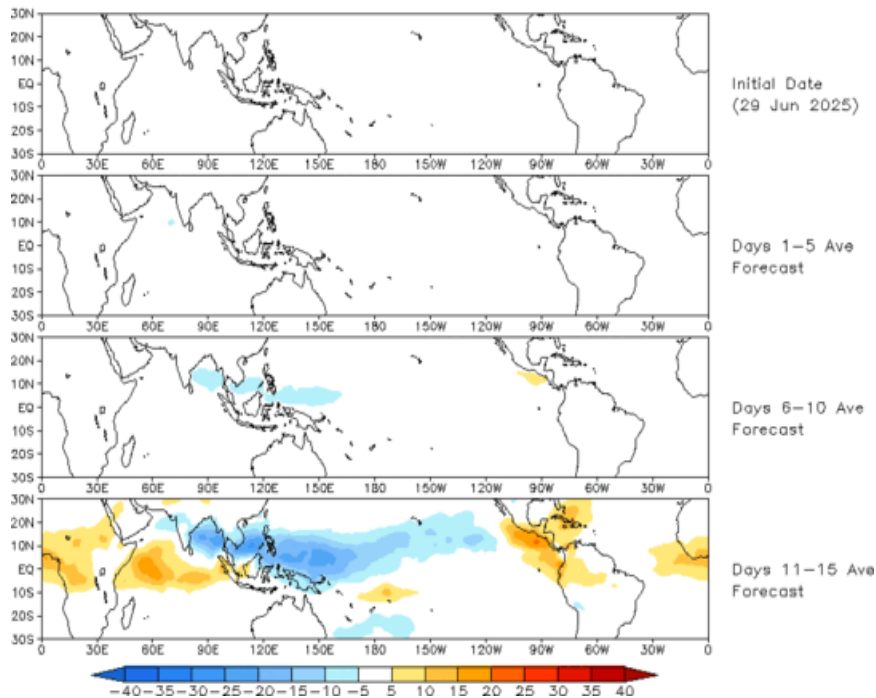
ECMWF Forecast

- The GEFS and ECMWF ensembles do not depict a meaningful MJO signal during the next 2 weeks.
- There is some support in the GEFS for a signal reemerging over the Maritime Continent, with the extended range forecasts (not shown) depicting a high amplitude event over the Western Pacific. However, this signal looks to be more in response to a low frequency footprint strengthening later in July.

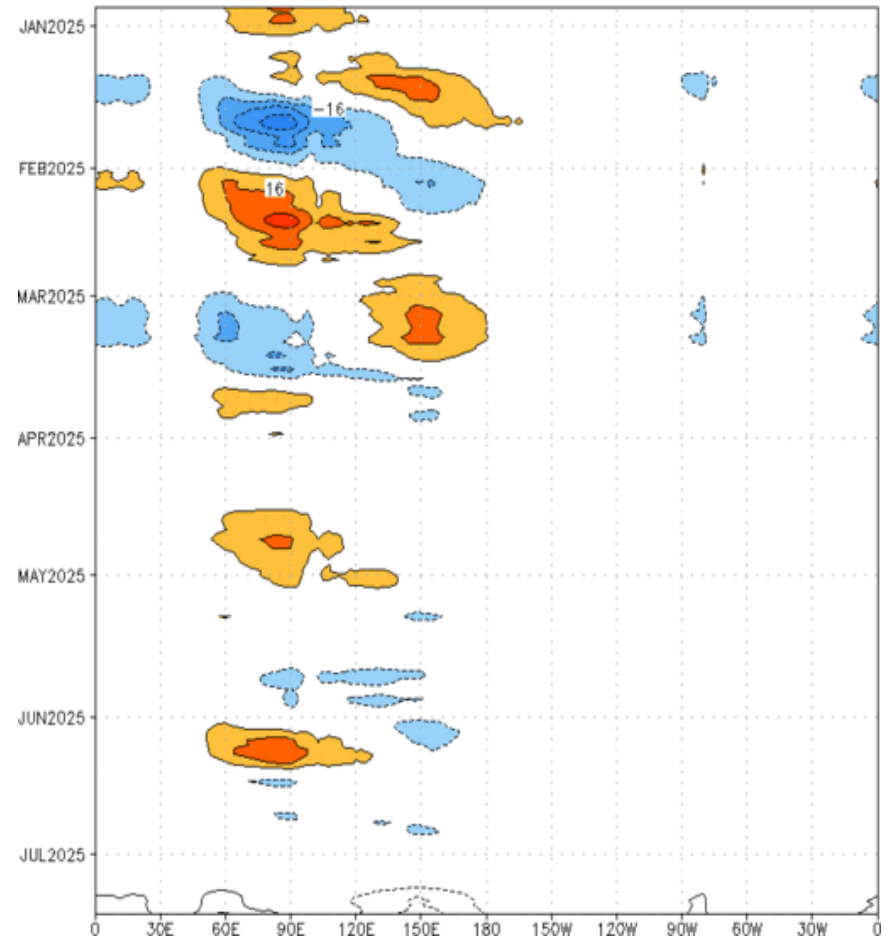
MJO: GEFS Forecast Evolution

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 Jun 2025
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] ($\text{cont: } 4\text{Wm}^{-2}$) Period: 28-Dec-2024 to 29-Jun-2025
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

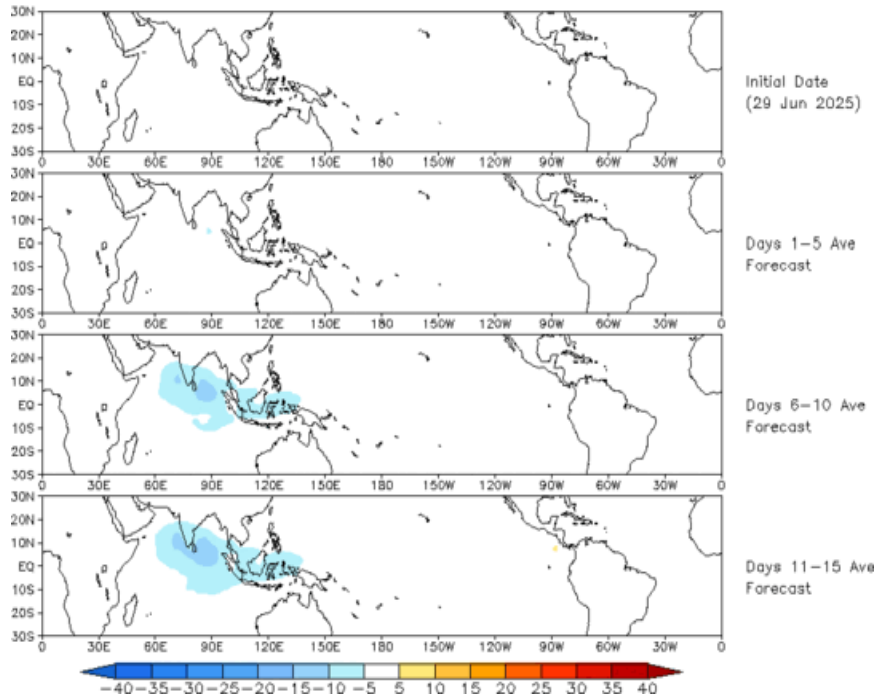


- The GEFS depicts enhanced convection becoming strong and widespread across the western Pacific, with more suppressed convection developing over the tropical Americas, Africa, and the western Indian Ocean.

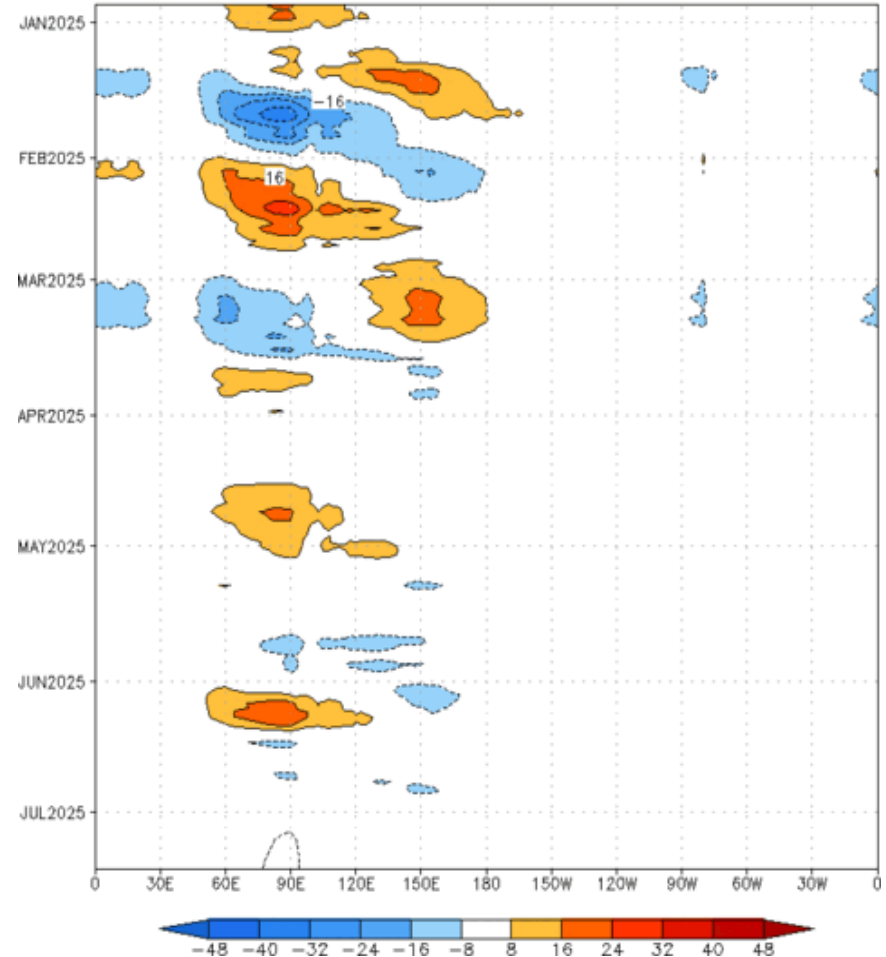
MJO: Constructed Analog Forecast Evolution

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 Jun 2025)



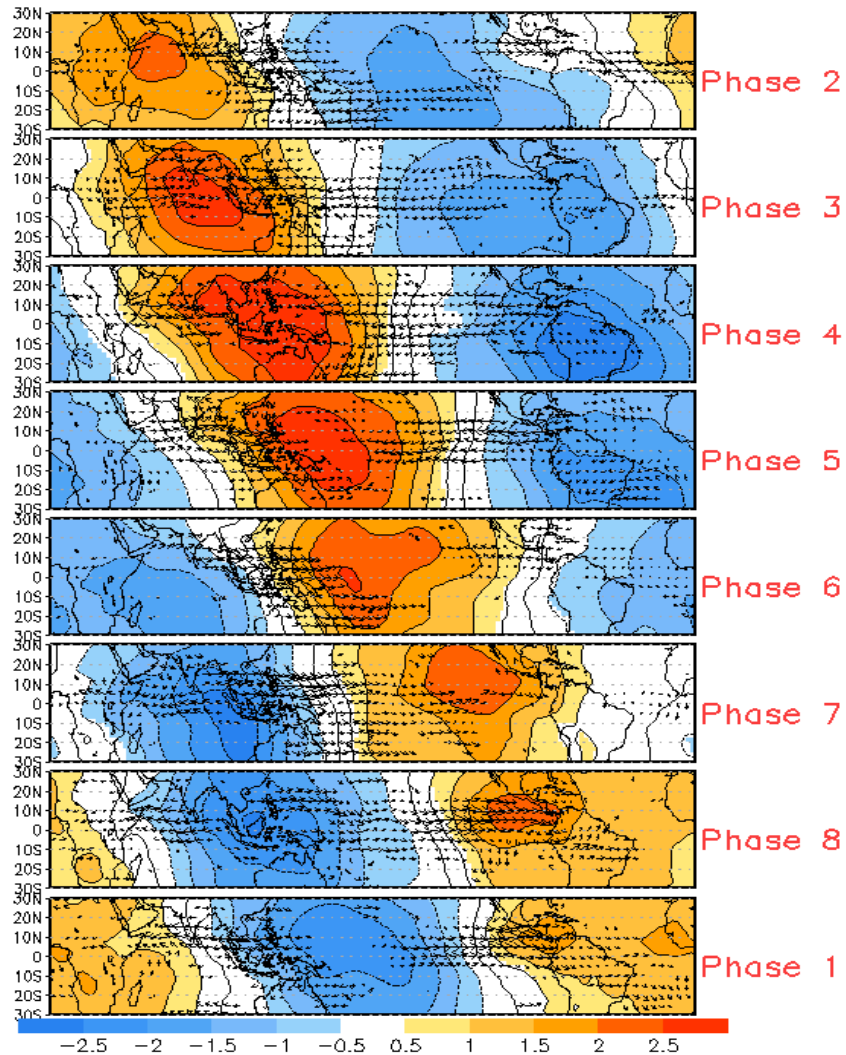
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:28-Dec-2024 to 29-Jun-2025
The unfilled contours are CA forecast reconstructed anomaly for 15 days



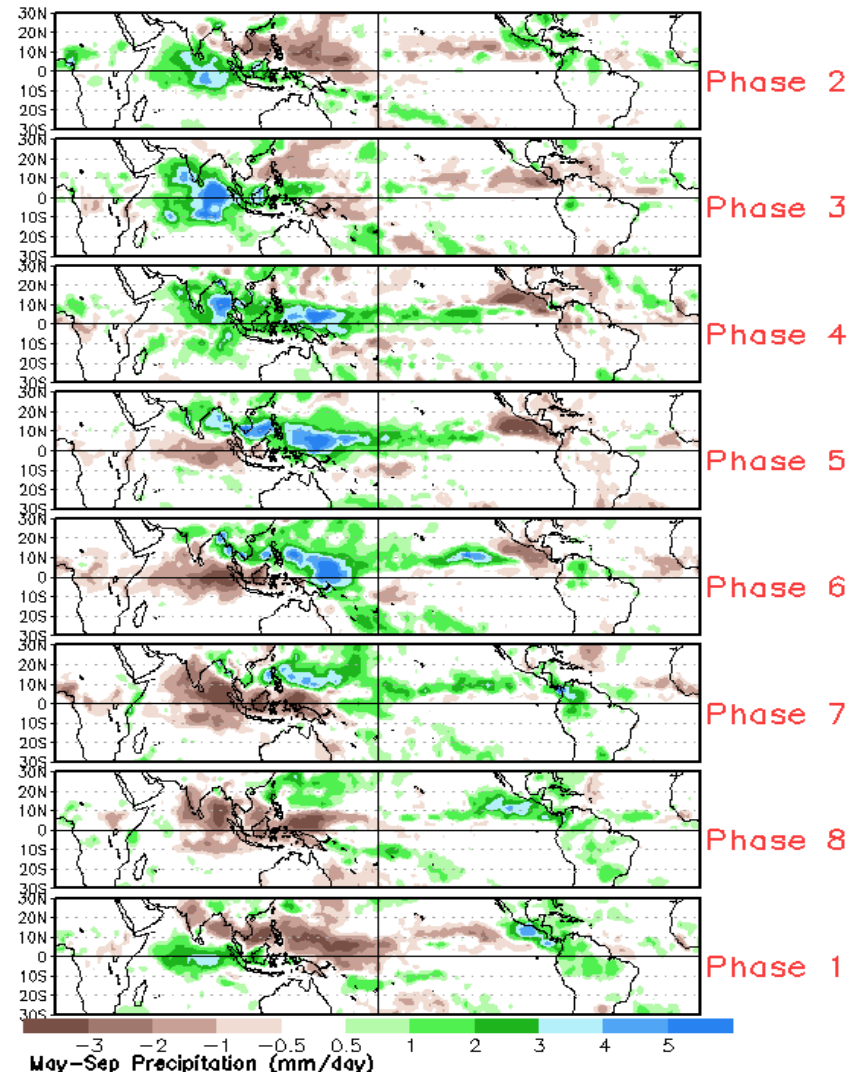
- The Constructed Analog tool favors a more westerly solution of the enhanced convection compared to the GEFS, with little support for the development of suppressed convection.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



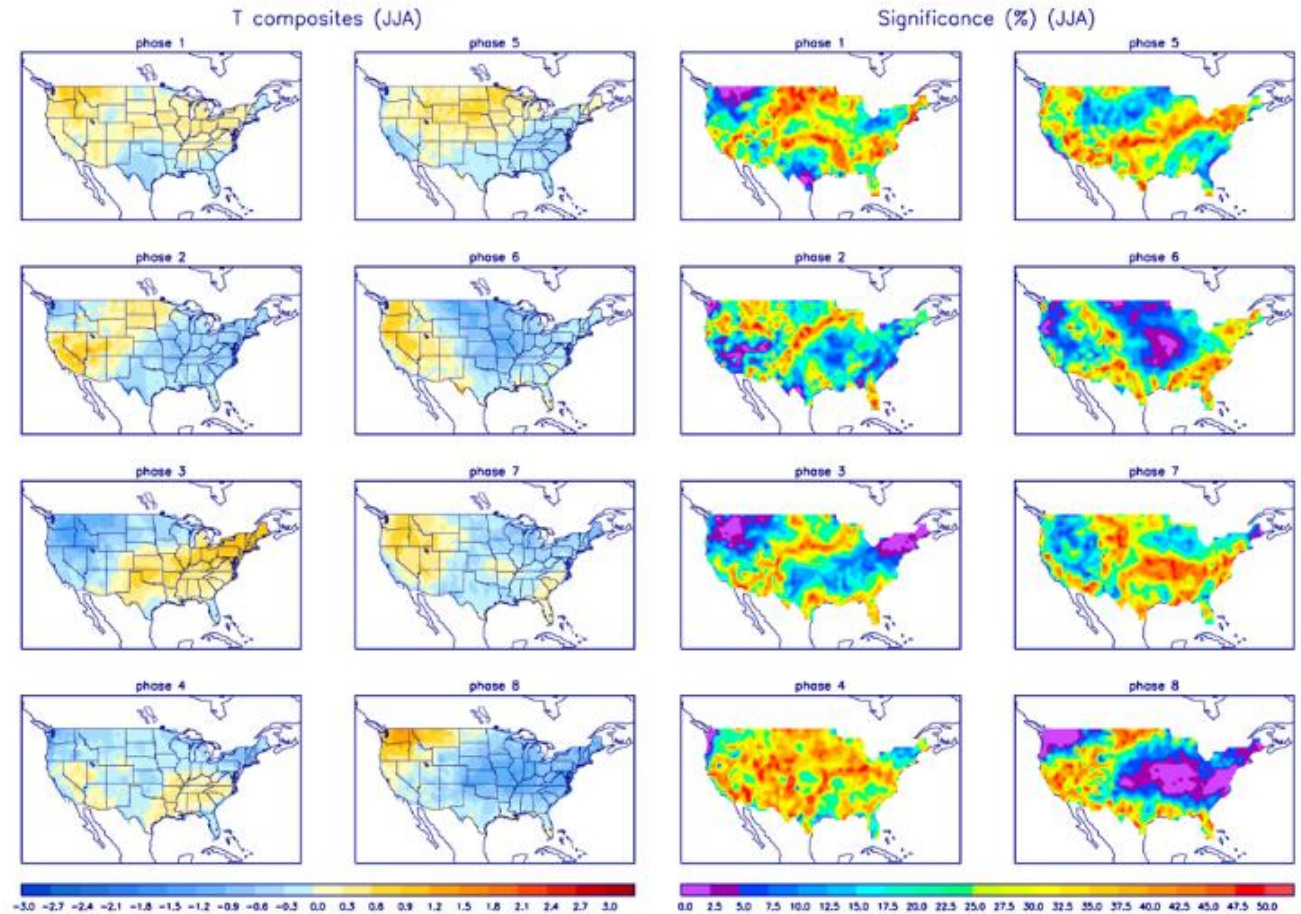
Precipitation Anomalies



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.

