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

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

Overview

- Recent observations are consistent with more canonical MJO activity, with the enhanced convective envelope propagating across the Pacific Ocean.

- Other modes, including strong Rossby wave activity over the Maritime Continent and Kelvin waves are also influencing the pattern.

- Dynamical model MJO index forecasts do not depict a long-lived event, with both the GEFS and ECMWF showing both fast propagation and pronounced weakening as the nascent MJO signal reaches the eastern Pacific and Western Hemisphere.

- Pacific MJO events tend to have a suppressive effect on Atlantic tropical cyclogenesis due to strong upper-level westerly winds. As the signal evolves and potentially weakens, the suppressive influence would also tend to weaken, but further MJO influence on early season tropical cyclone activity through the end of June across the Western Hemisphere is uncertain.

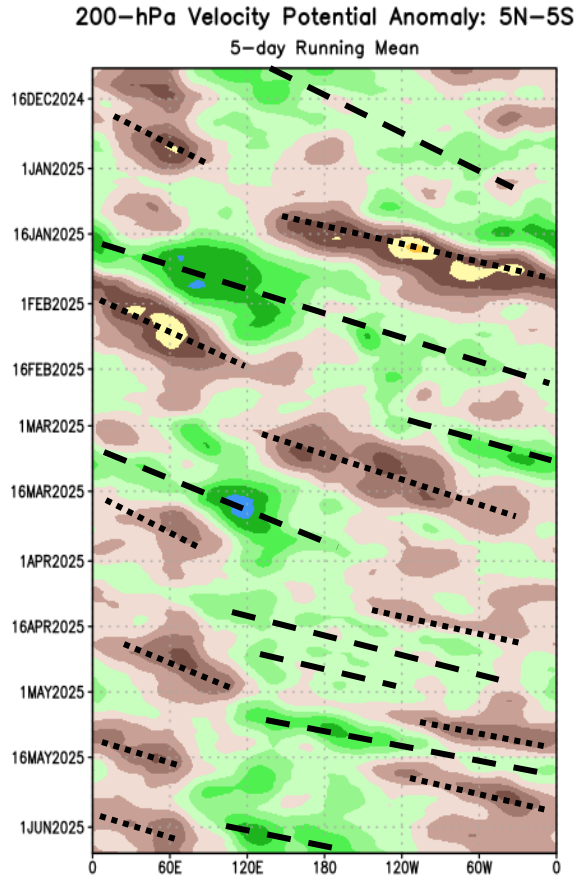
- Other modes, including Kelvin wave activity, may have a stronger influence on any specific TC development than the broader subseasonal pattern.

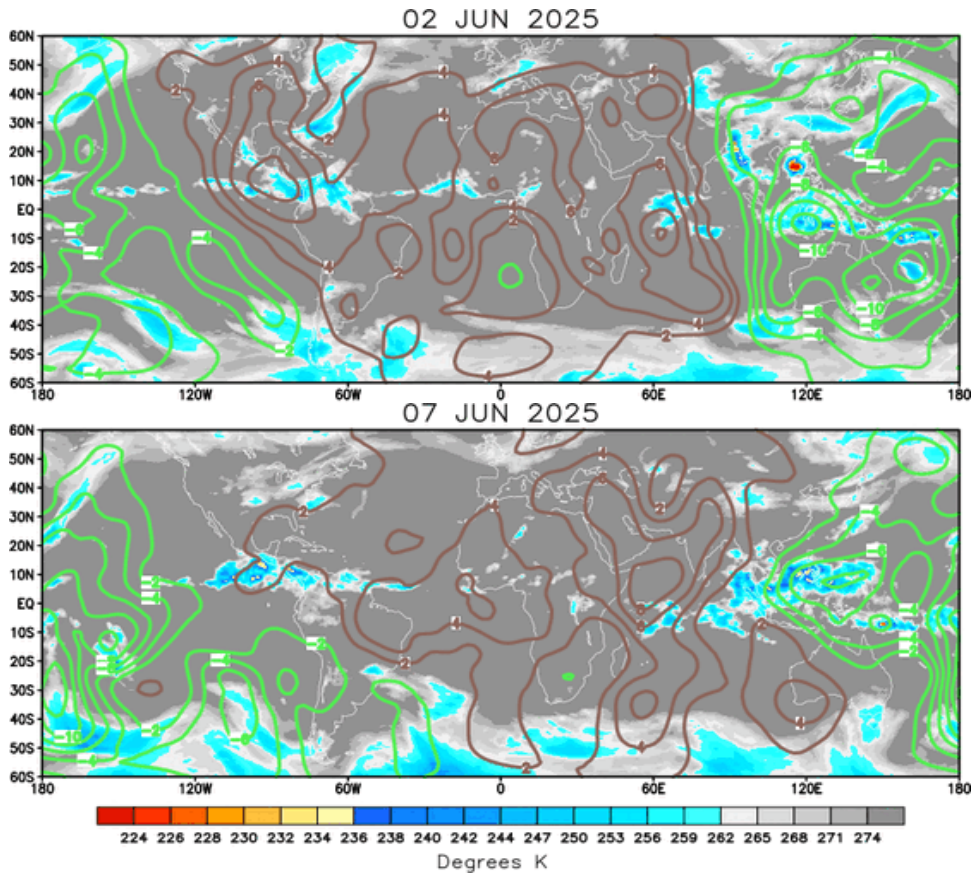
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

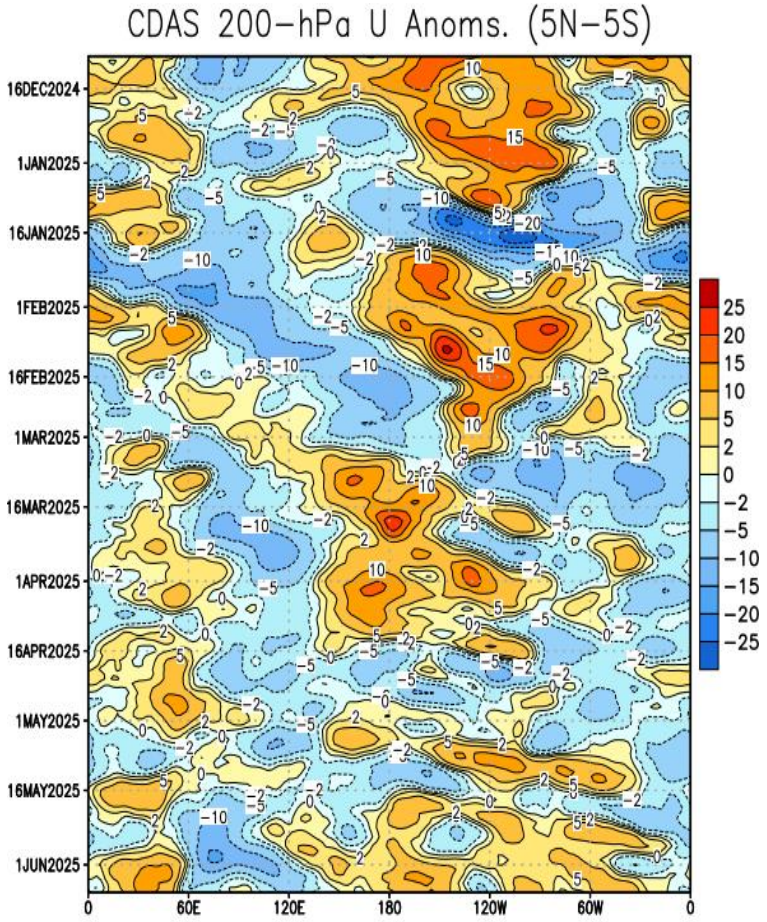


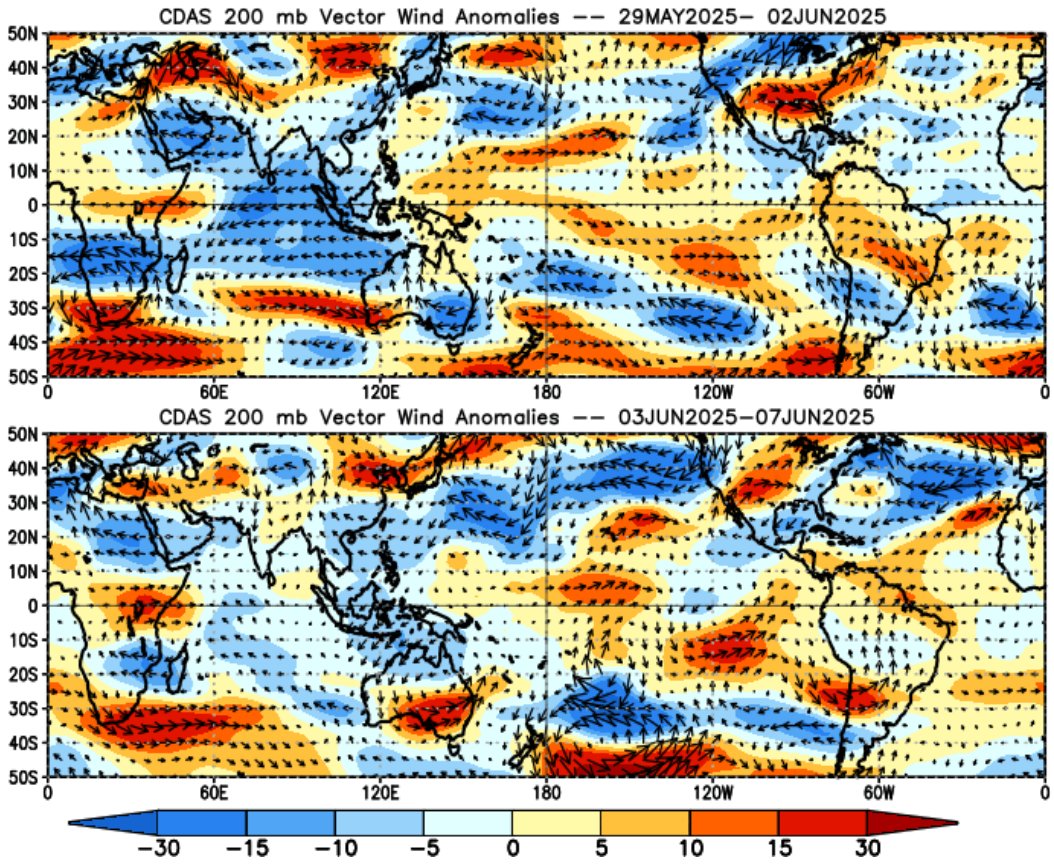


- The upper-level velocity potential anomaly field continues to reflect faster propagating Kelvin wave activity; however, there seems to be a slower eastward evolution of large-scale anomalies that may reflect MJO activity.
- Enhanced (suppressed) divergence aloft over the Pacific (Western Hemisphere) is broadly unfavorable for Atlantic tropical cyclogenesis.

200-hPa Wind Anomalies

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

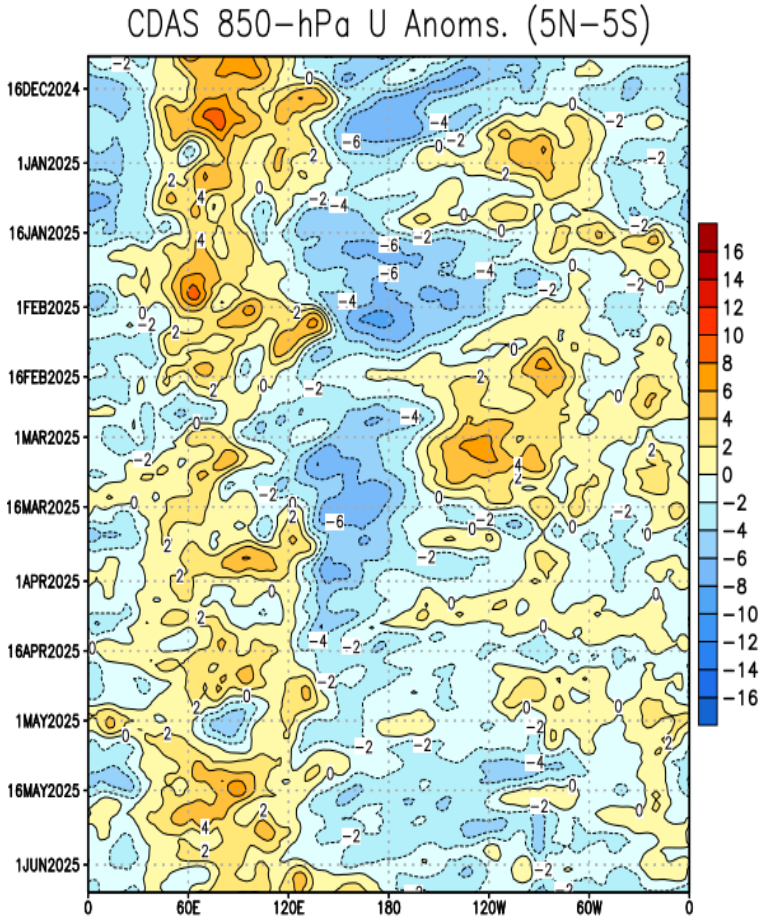


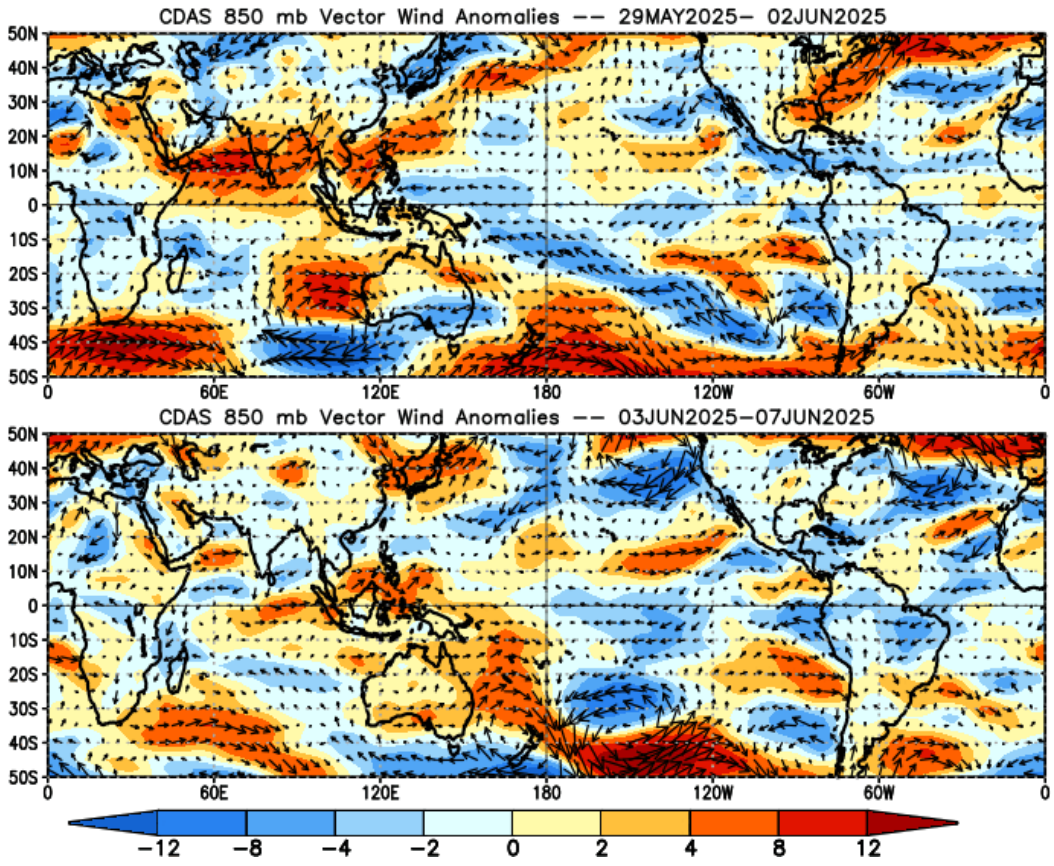


- Strong easterly anomalies aloft weakened over the Indian Ocean, with some eastward propagation across the Maritime Continent evident.
- Westerly anomalies persisted across the eastern half of the Pacific and the Western Hemisphere, with faster moving modes evident

850-hPa Wind Anomalies

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

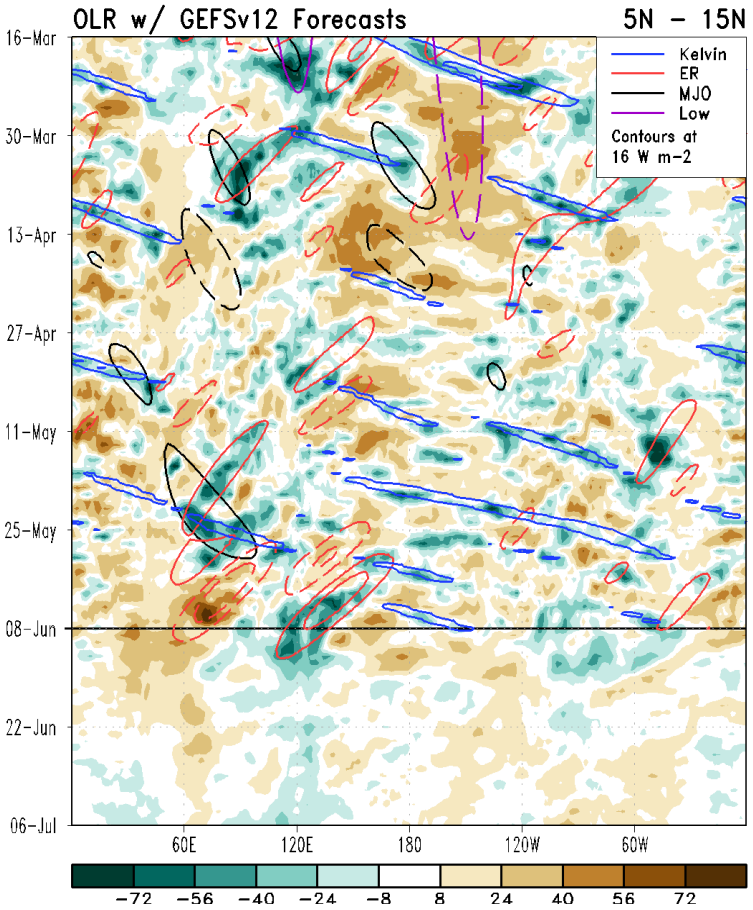


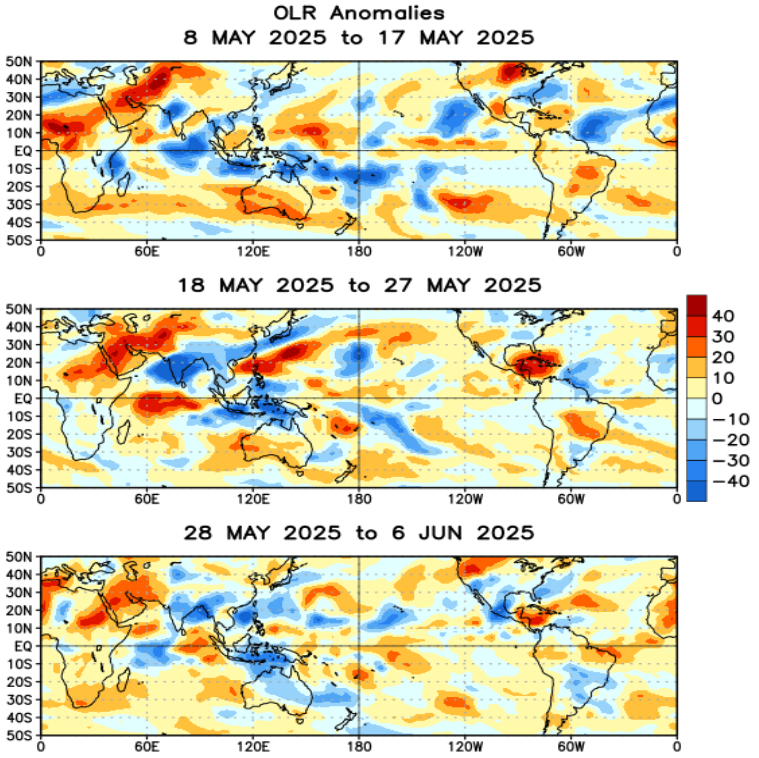


- Enhanced westerlies (easterlies) have persisted for several months over the Indian Ocean and western Maritime Continent (Pacific basin).
- More recently, some eastward propagation of westerly anomalies to the western Pacific was observed, which may be consistent with MJO activity.
- A weak field overall exists across the East Pacific and Western Hemisphere, though Kelvin wave activity may be helping support East Pacific tropical cyclogenesis.

Outgoing Longwave Radiation (OLR) Anomalies

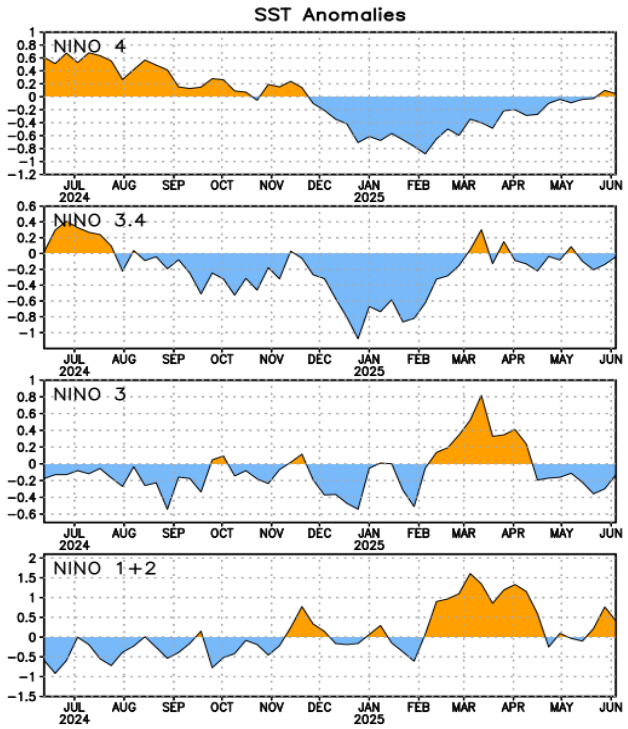
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

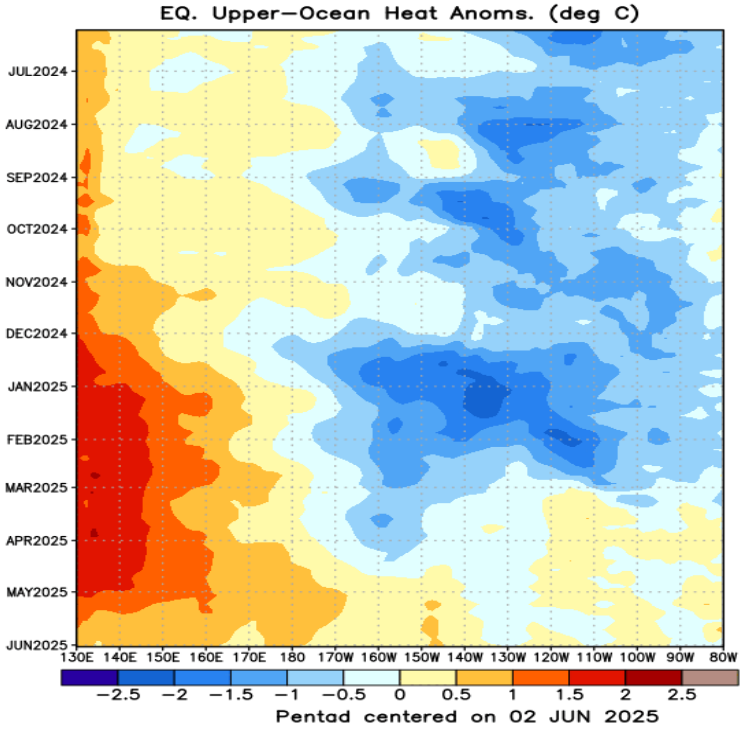




- The strongest signal in the recent OLR anomaly time-longitude field is tied to equatorial Rossby wave activity over the Maritime Continent which is generating enhanced convection.
- Westerly anomalies over the Indian Ocean basin have helped produce an overall enhanced monsoonal response over South and Southeast Asia.
- The GEFS depicts a more stationary pattern evolving over the Indian Ocean and Maritime Continent through early July.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

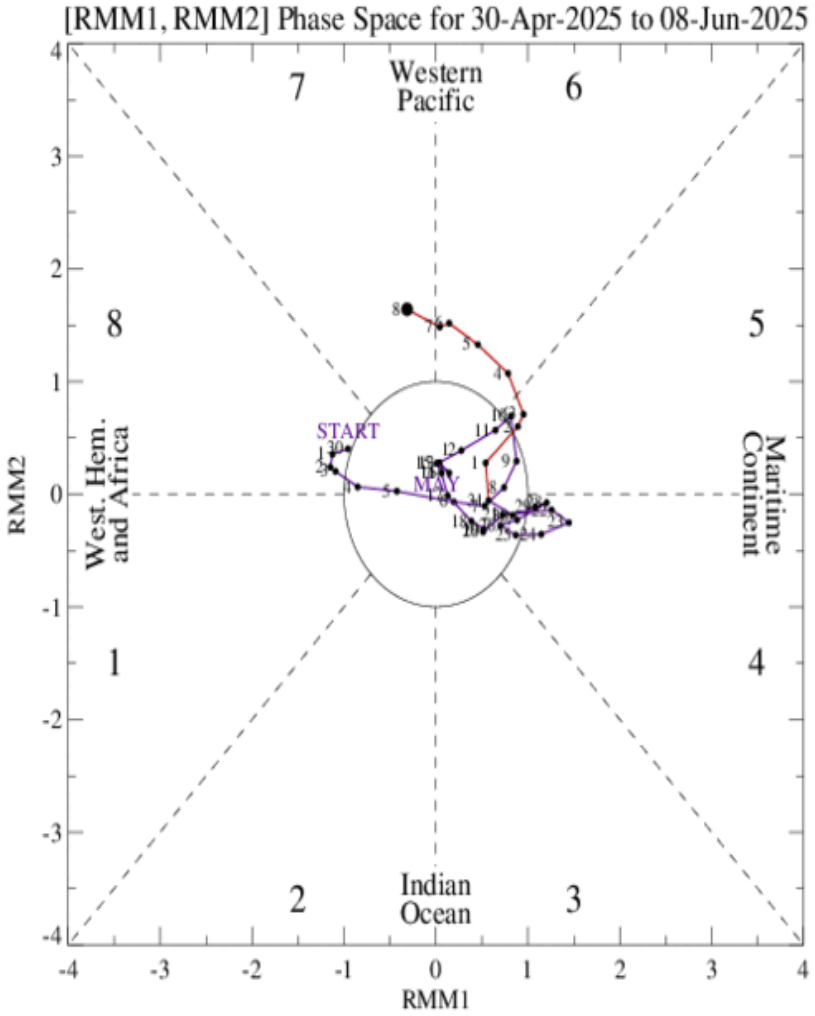




- Since April, positive subsurface anomalies in the Western Pacific expanded eastward beyond the Date Line, with weak anomalies across the eastern Pacific.
- SST anomalies remain near zero across the primary Nino basins. A recent cooling trend in the Nino 3.4 basin has trended back towards zero.

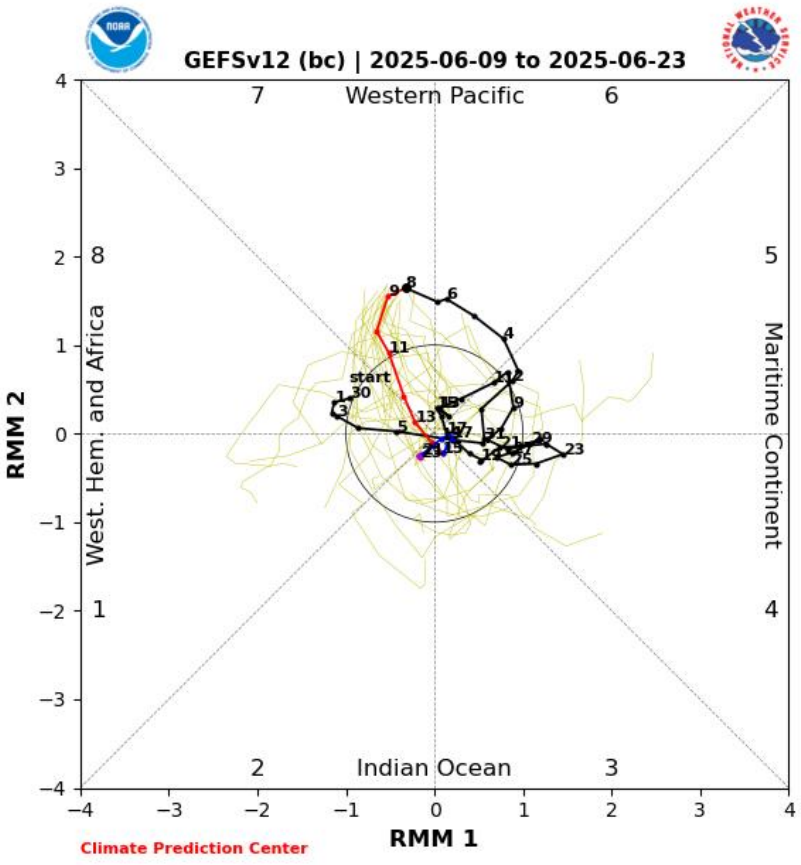
MJO Index: Recent Evolution

- Over the past week, the RMM-based MJO index exhibited pronounced amplification, with eastward propagation evident across the Pacific.
- This is the most MJO-like signal that has been observed over the past several months.

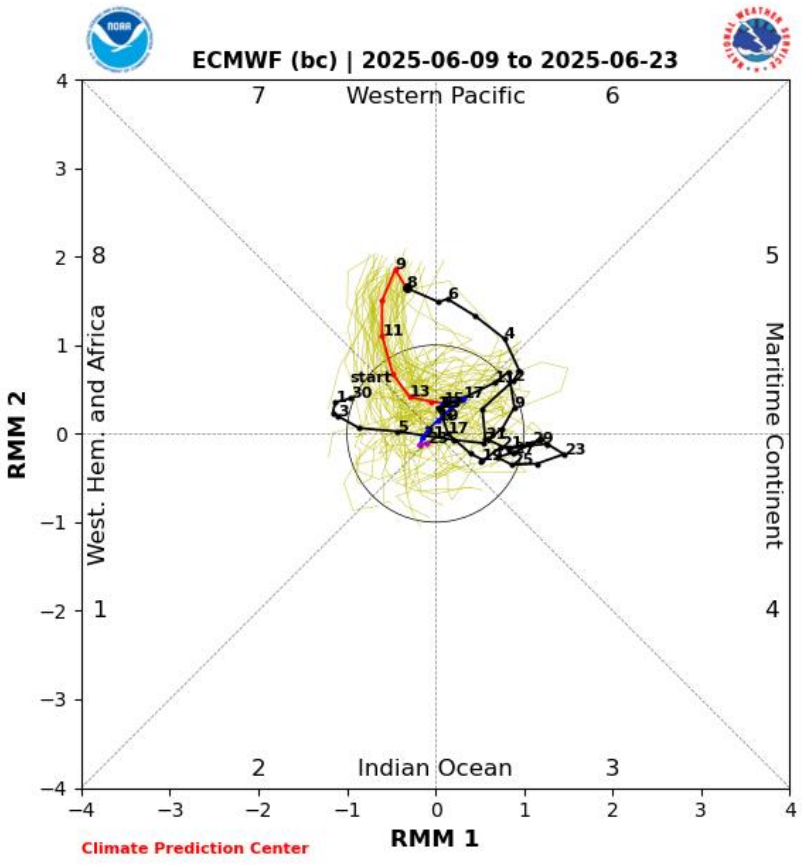


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

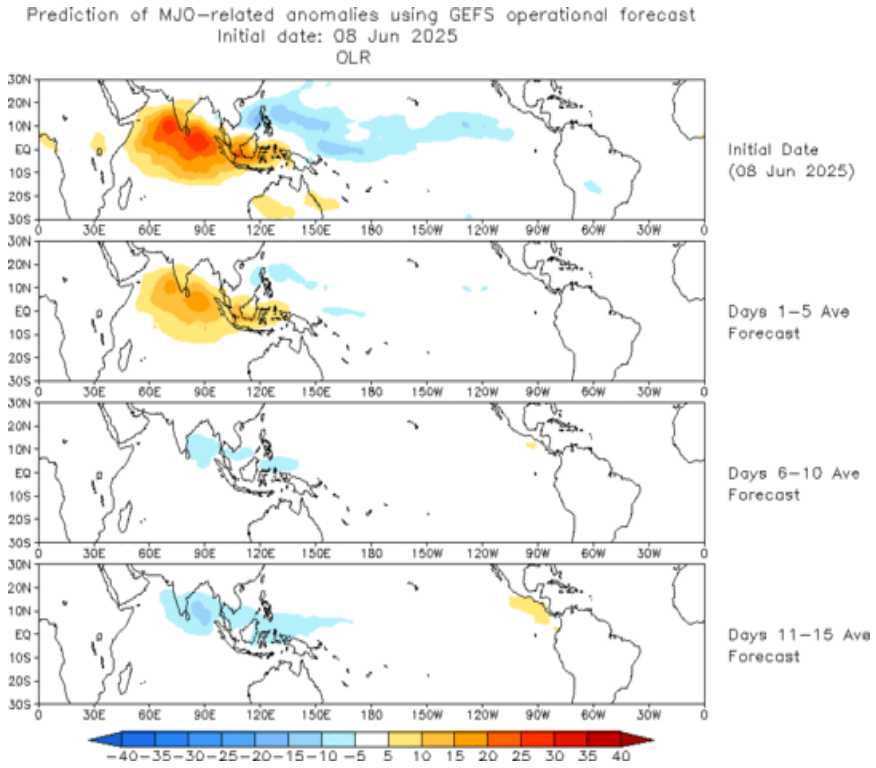


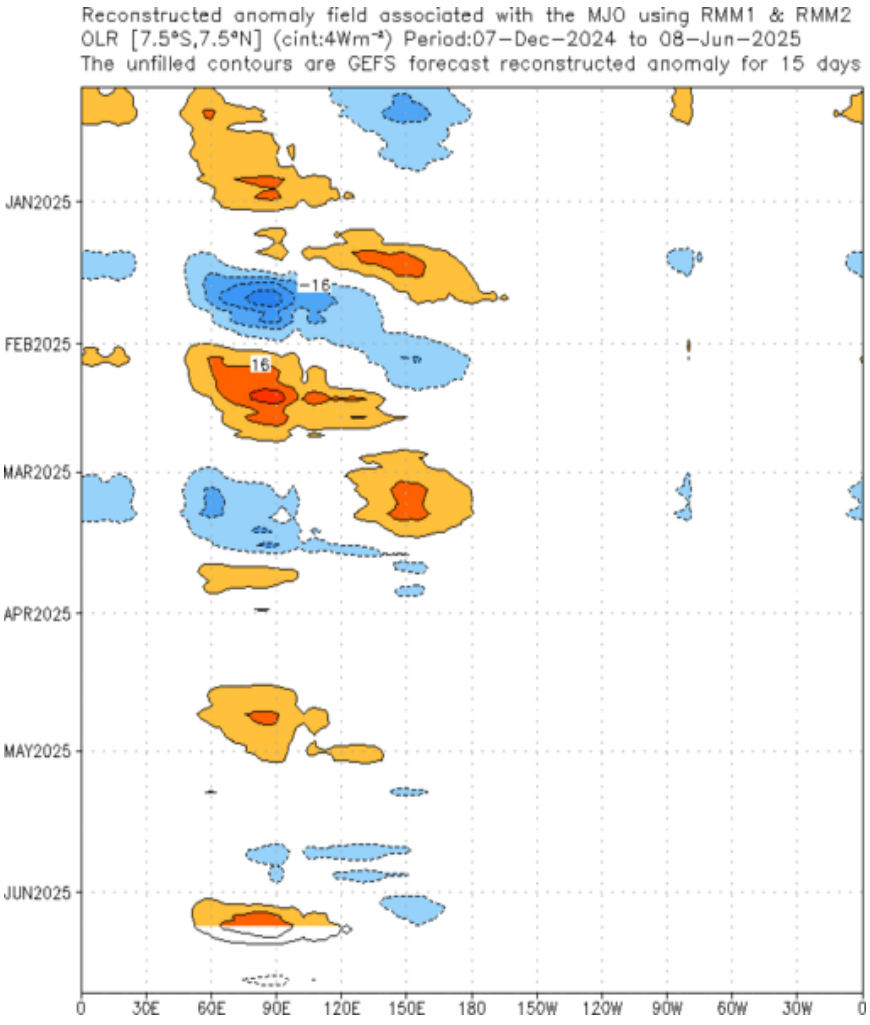
ECMWF Forecast

- Dynamical model MJO index forecasts reflect considerable uncertainty regarding the continued evolution of this subseasonal signal.
- Both the GEFS and ECMWF show rapid eastward propagation and weakening of the signal as it crosses the eastern Pacific and Western Hemisphere, with little evidence of an Indian Ocean event materializing.

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.)

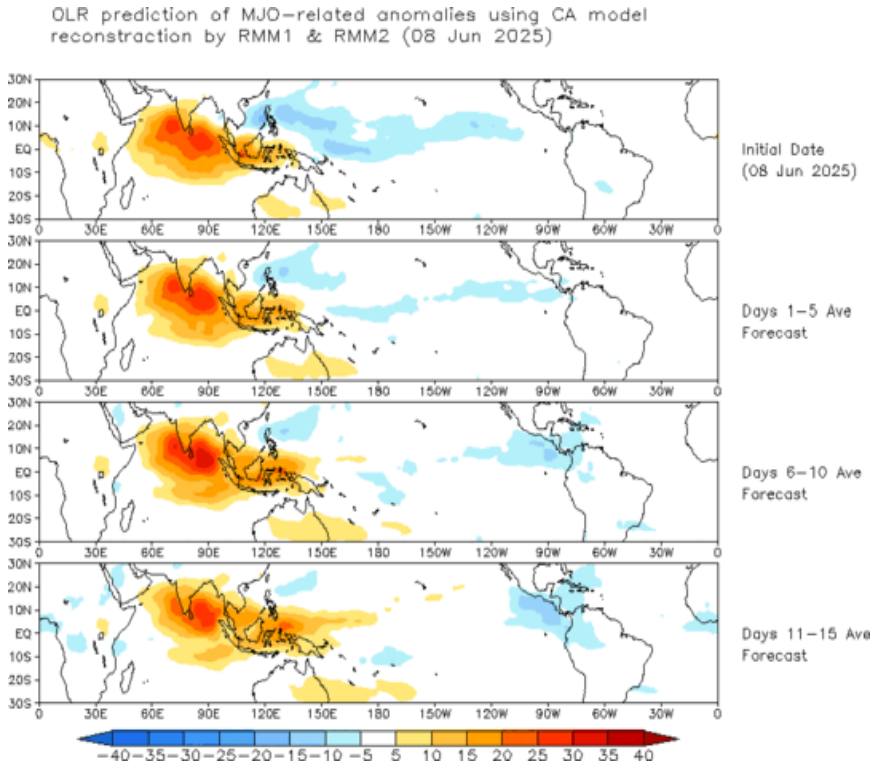


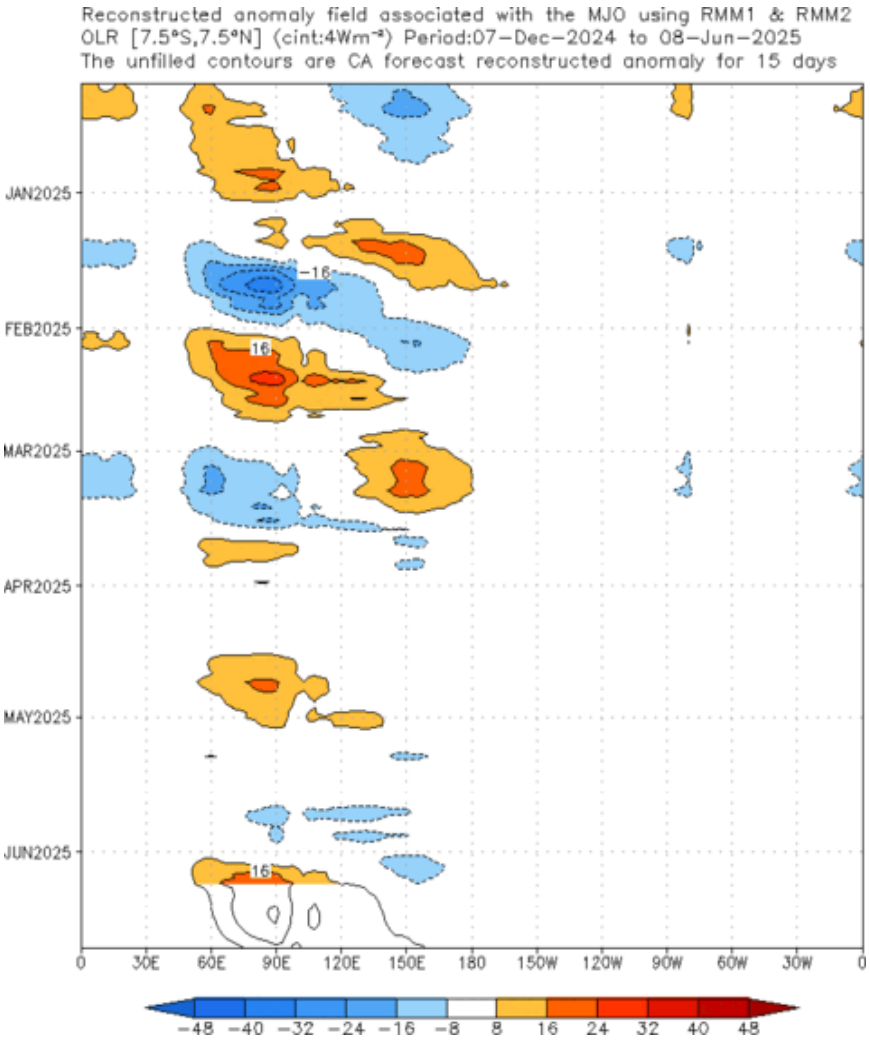


- The GEFS OLR forecast shows a well-defined Pacific MJO pattern that weakens rapidly by the end of Week-1, followed by a return to weak enhancement over the Maritime Continent (with enhanced monsoon activity over South Asia) by the end of Week-2.

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.)

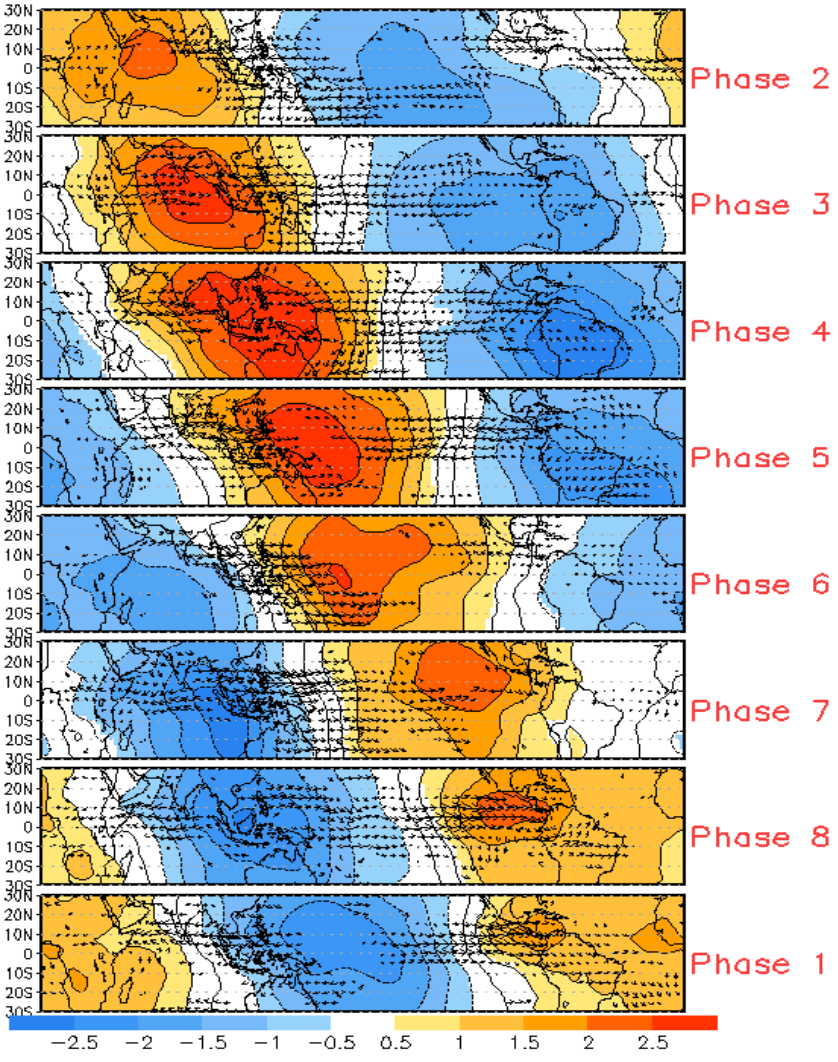




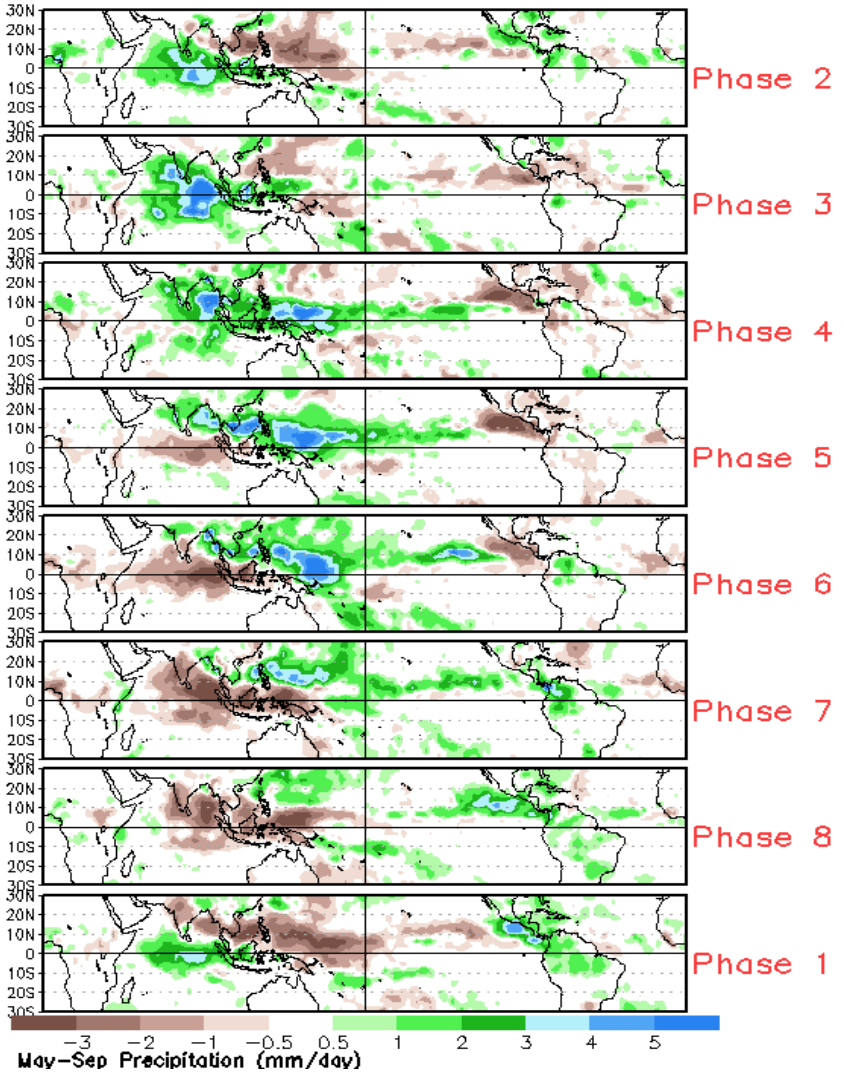
- The constructed analog forecast is quite different from the GEFS, and shows a highly amplified but very slow evolving signal, with enhanced convection building over the East Pacific and Western Hemisphere over the next two weeks.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



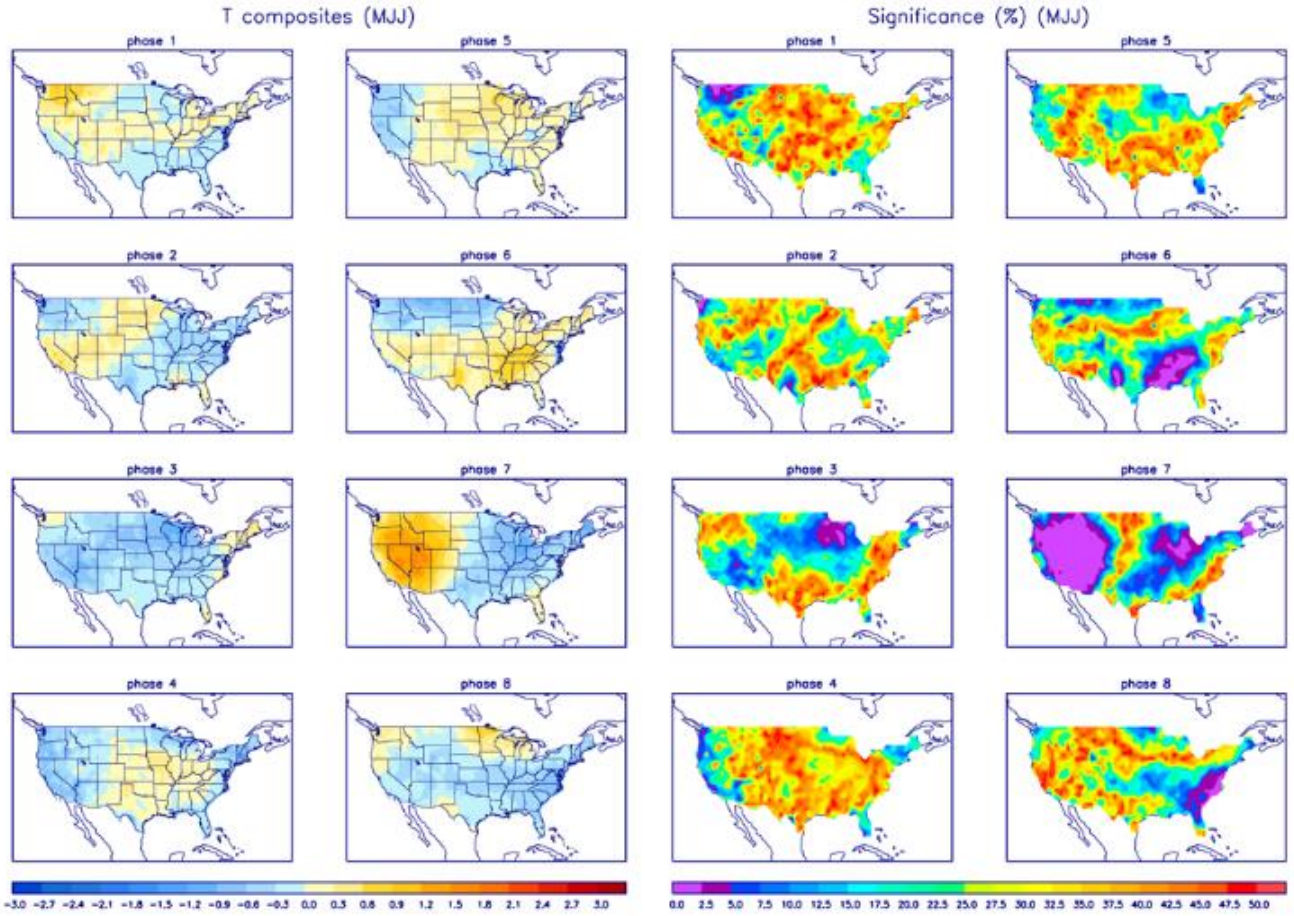
Precipitation Anomalies



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.

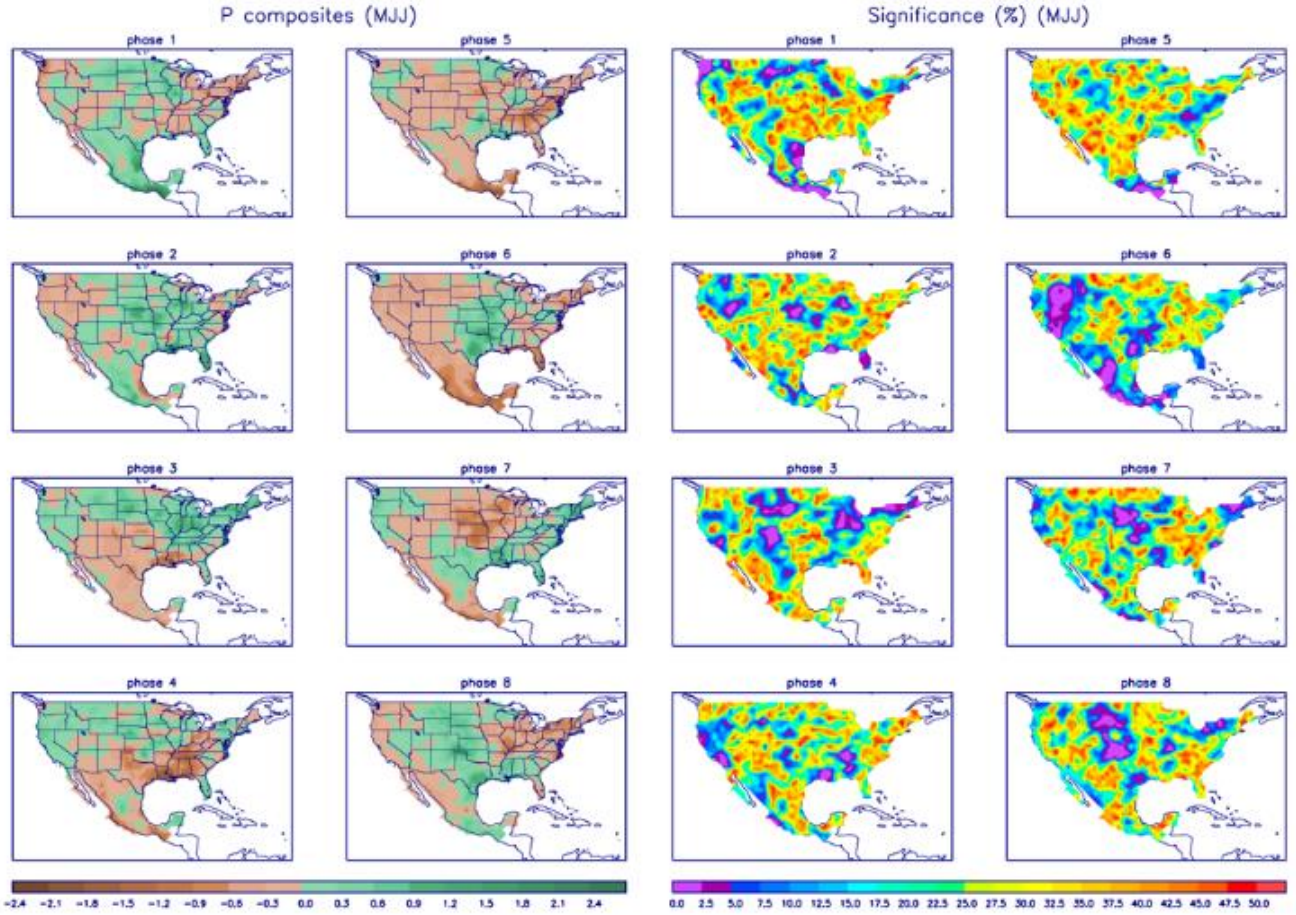


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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.



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