

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
14 April 2025

Overview

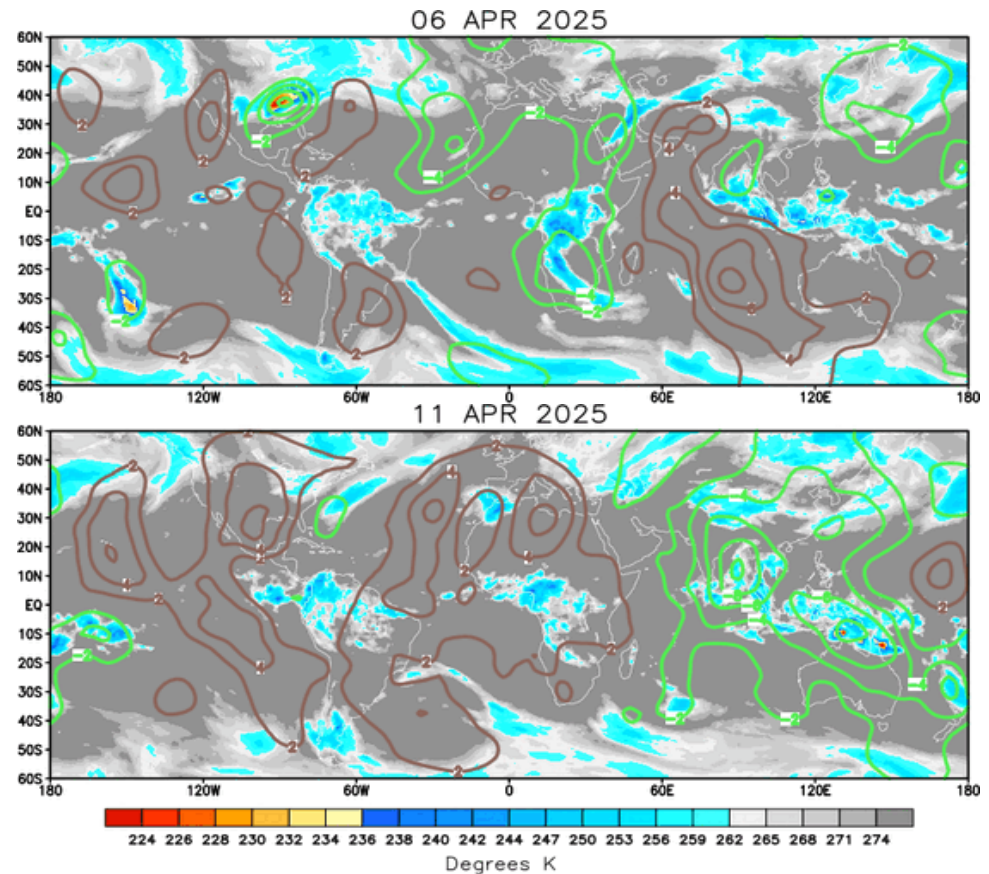
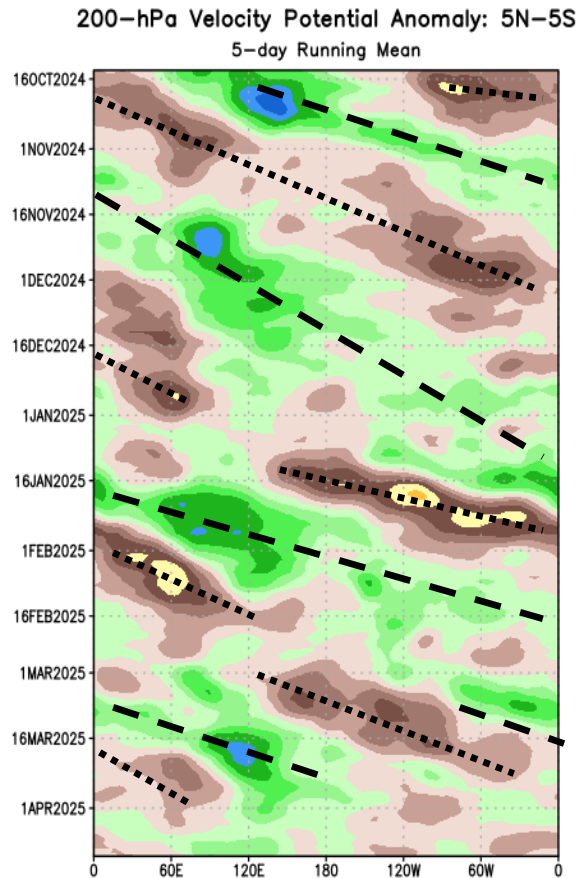
- Tropical forcing is largely incoherent, with the MJO inactive and La Niña officially being declared over (ENSO-neutral per CPC update on April 10).
- RMM-based forecasts depict some re-emergence of the MJO across the Western Pacific by late April, although this may be more related to constructive interference between a low frequency convective signal and a Convectively Coupled Kelvin Wave (CCKW).
- Tropical cyclone climatology is at its yearly minimum during late April. TC development is most likely to the north of Australia and over the western North Pacific during week-2. Lack of tropical forcing reduces confidence for week-3 formation areas.

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)

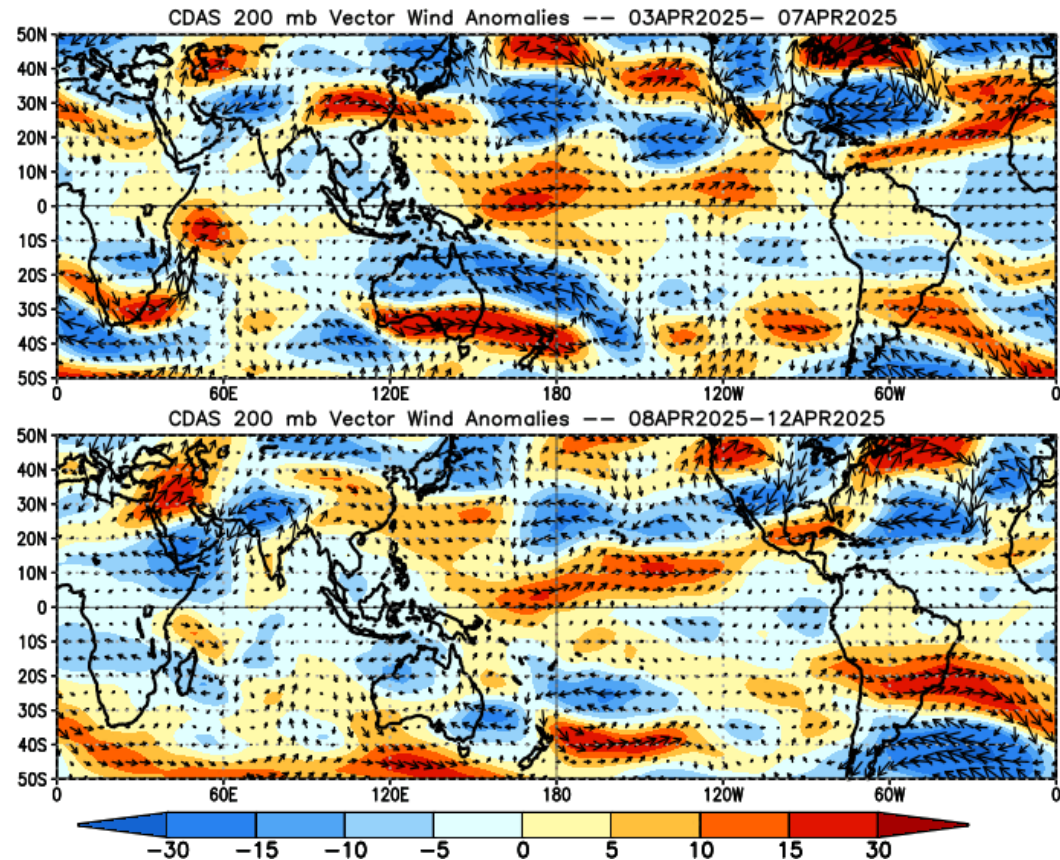
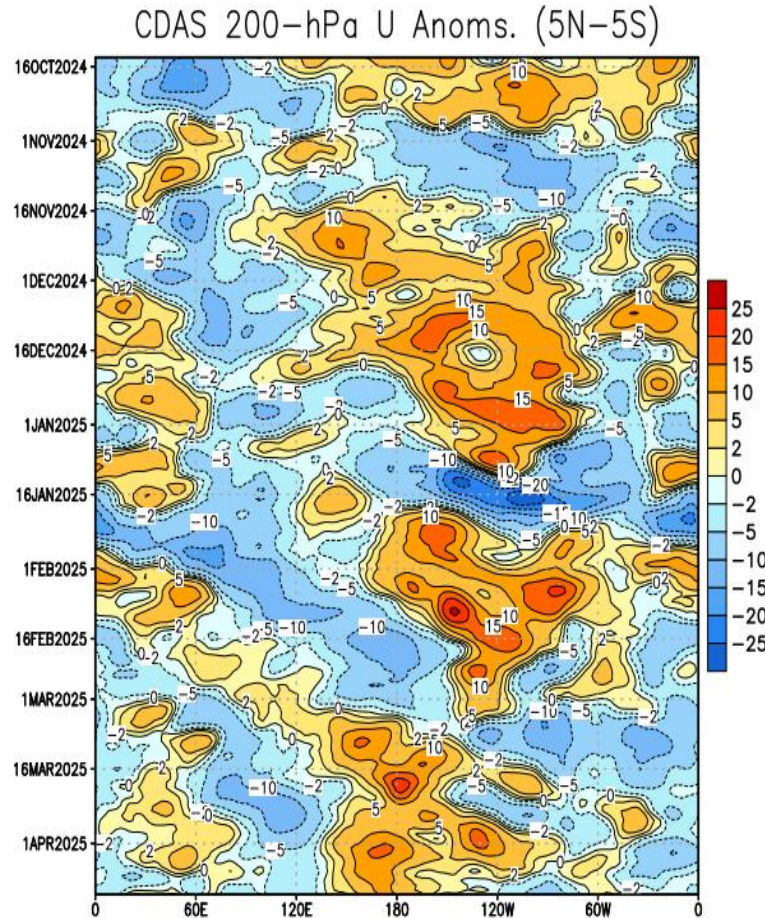
Brown shades: Anomalous convergence (unfavorable for precipitation)



- Despite the incoherent MJO signal, the global upper-level velocity potential pattern has become more organized and resembles a wave-1 pattern.
- Anomalous upper-level divergence is noted across portions of Asia, the Indian Ocean, Australia, and the western Pacific, while upper-level anomalous convergence is observed across the eastern Pacific, Americas, Atlantic, and Africa.

200-hPa Wind Anomalies

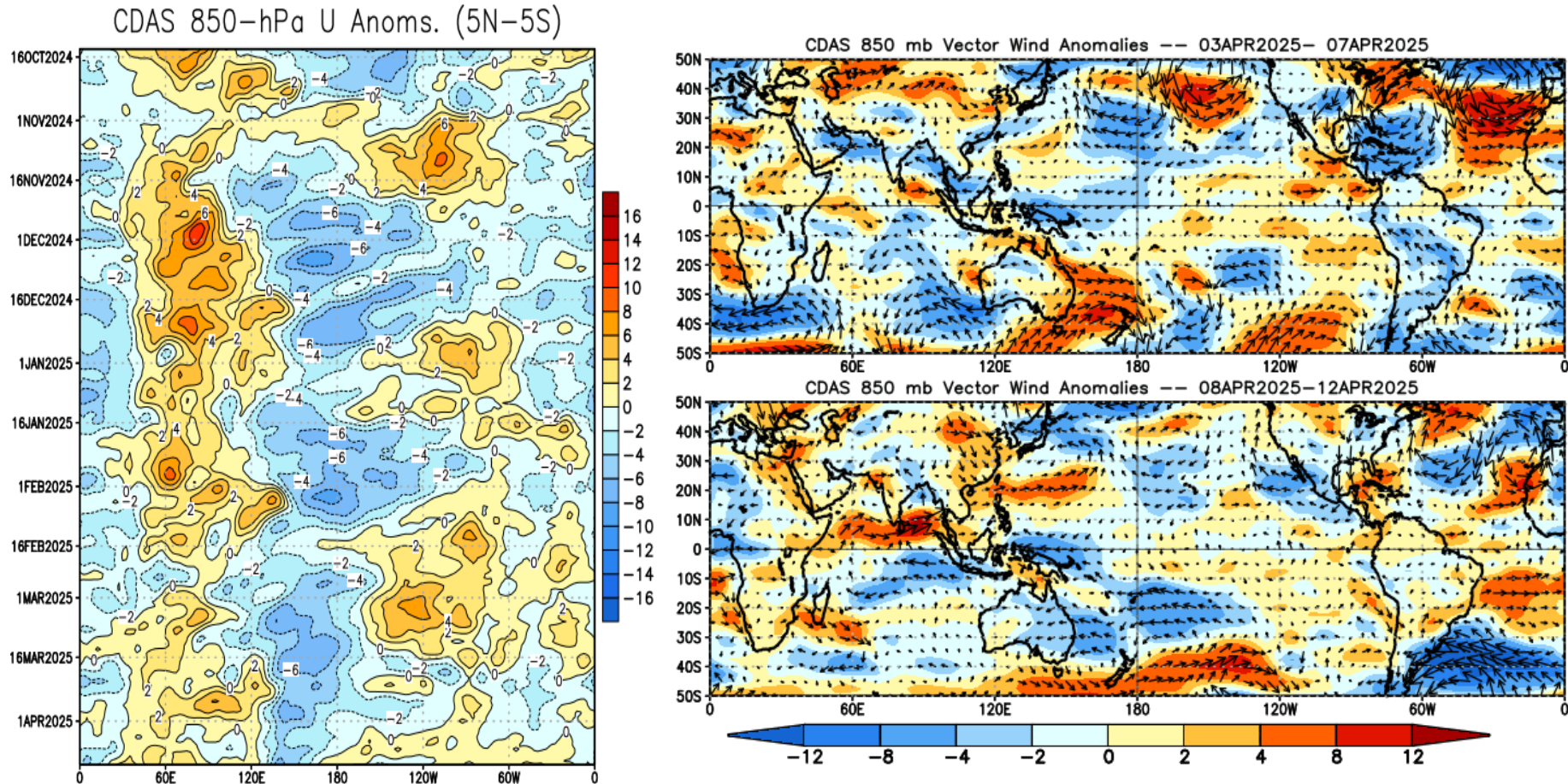
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- A persistent area of anomalous upper-level westerlies remains established across the equatorial central Pacific, with an associated extension of the jet across southern North America.
- Anomalous westerlies aloft have weakened across Africa and the western Indian Ocean, with an increase in anomalous upper-level easterlies over these areas.

850-hPa Wind Anomalies

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

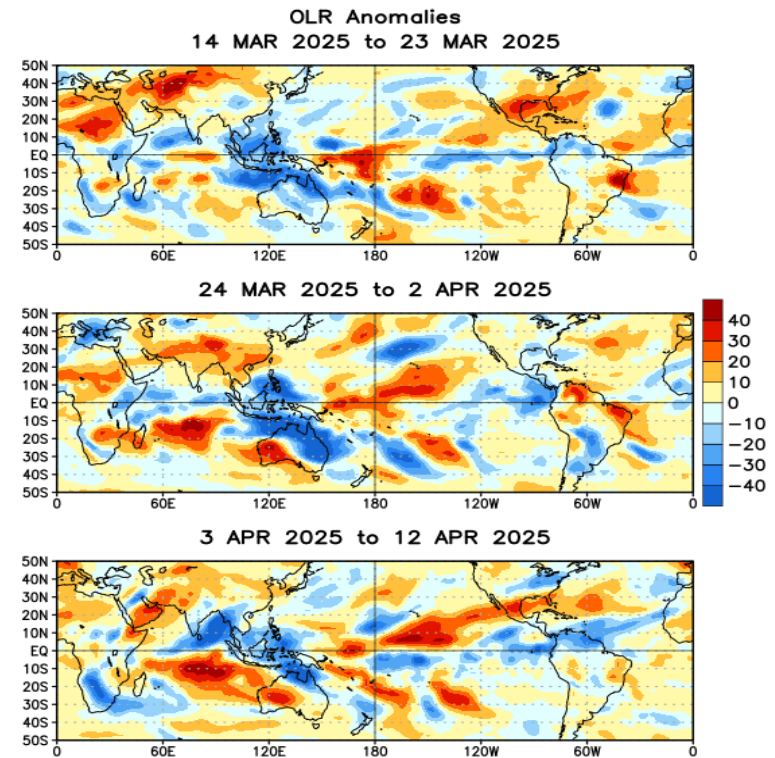
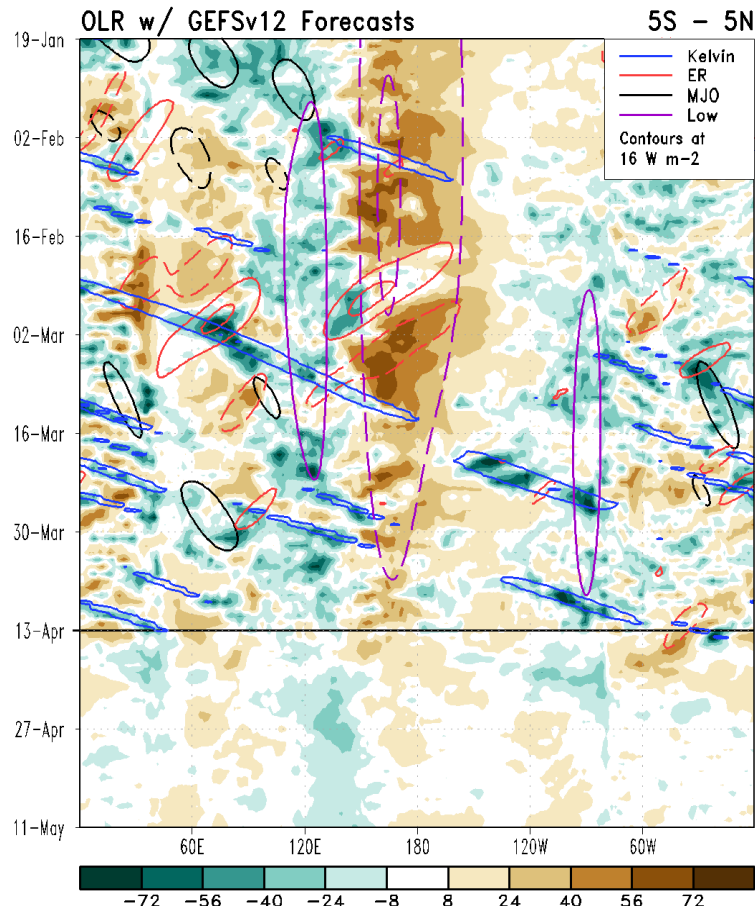


- The low-level wind pattern generally remains disorganized and stationary due to little tropical forcing (MJO or ENSO), with extratropical activity dominating.
- Enhanced trades remain across the equatorial west Pacific but these continue to weaken.
- A switch from anti-cyclonic to cyclonic flow across eastern North America has resulted in a cooler pattern across the eastern U.S.

Outgoing Longwave Radiation (OLR) Anomalies

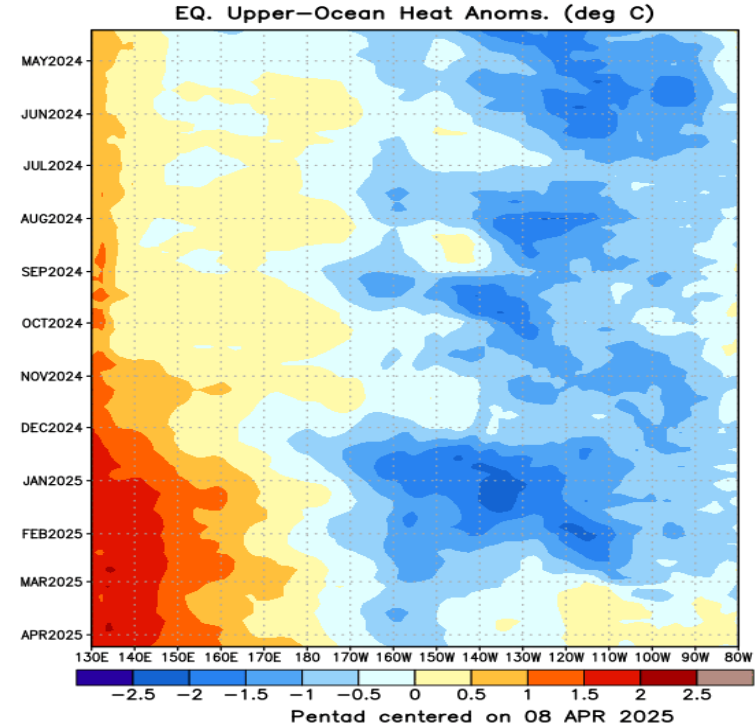
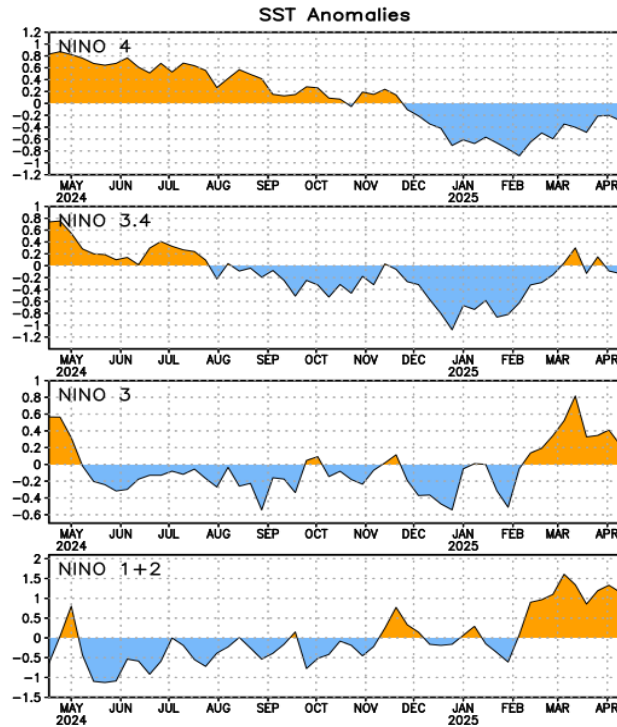
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- Suppressed convection extends from the south-central Pacific through the southern U.S., with enhanced convection emerging to the west of Hawaii.
- A pronounced convective dipole has developed across the Eastern Hemisphere, with enhanced convection across the northern Indian Ocean and Maritime Continent, and suppressed convection across the southern Indian Ocean into western Australia.
- There is little signal in the OLR forecasts from the GEFS.

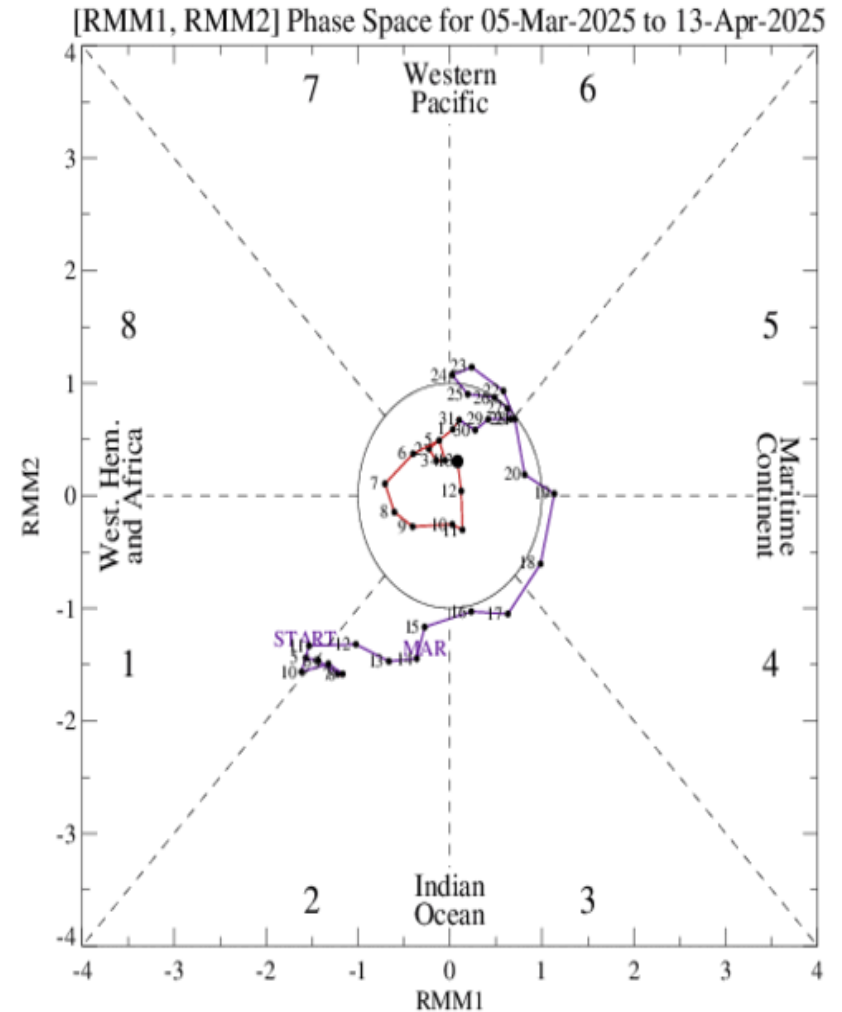
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- SST anomalies in Niño 3.4 region remain variable and near zero, consistent with the return of ENSO-neutral conditions.
- Subsurface negative temperature anomalies continue to weaken across the central and eastern Pacific, with positive anomalies emerging east of 120°W, along with strong positive SST anomalies in the NINO 3 and NINO 1+2 regions.
- Large subsurface positive temperature anomalies remain established west of the Date Line.

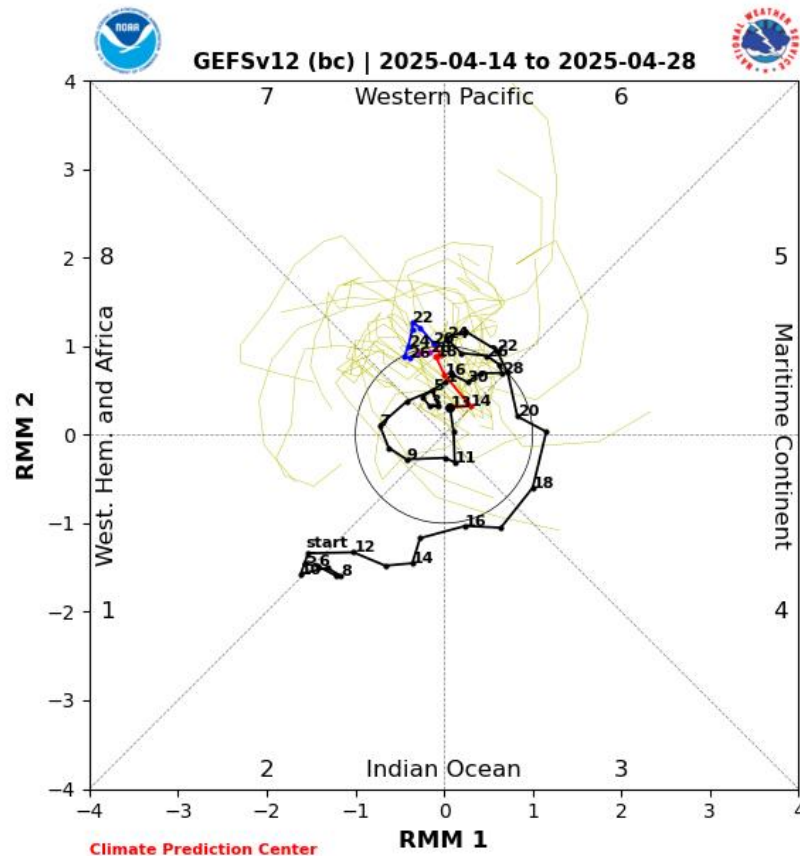
MJO Index: Recent Evolution

- The MJO signal is non-existent, with the RMM-based index meandering within the unit circle since late March.

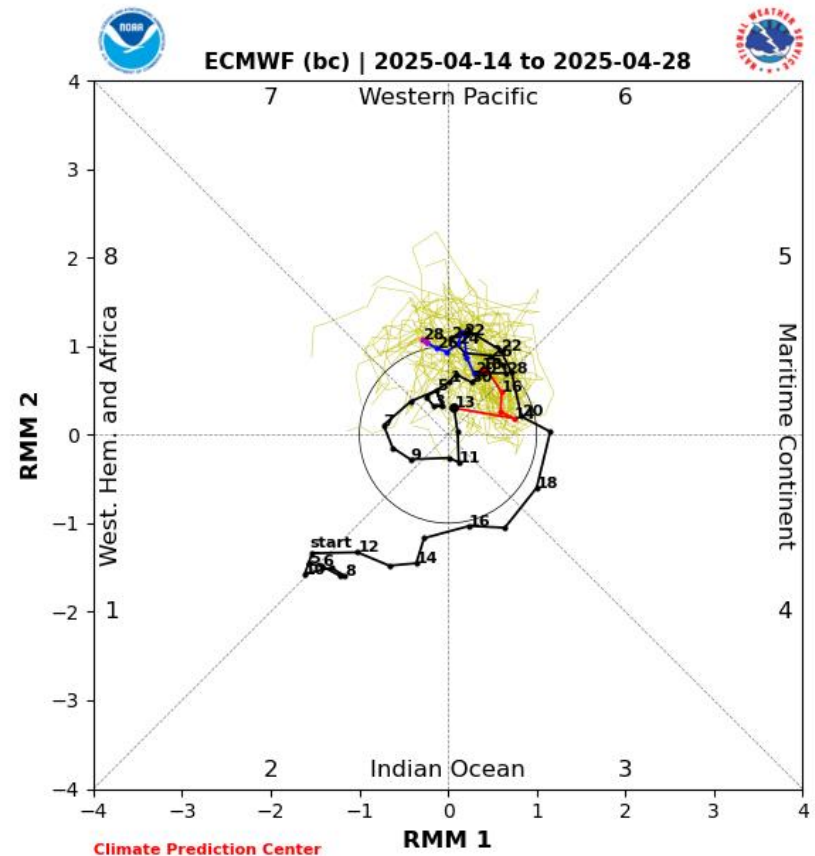


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



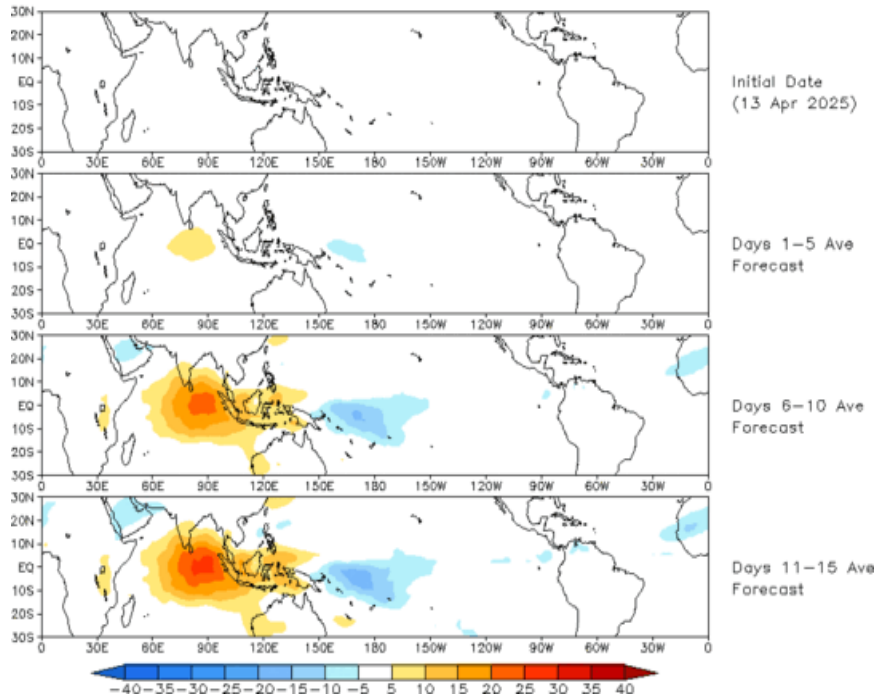
ECMWF Forecast

- By late April, the GEFS and ECMWF ensembles depict the RMM-based MJO index increasing in amplitude across the Western Pacific.
- However, this may be more tied to an emerging low frequency signal along with a Convectively Coupled Kelvin Wave (CCKW) rather than a true MJO event.

MJO: GEFS Forecast Evolution

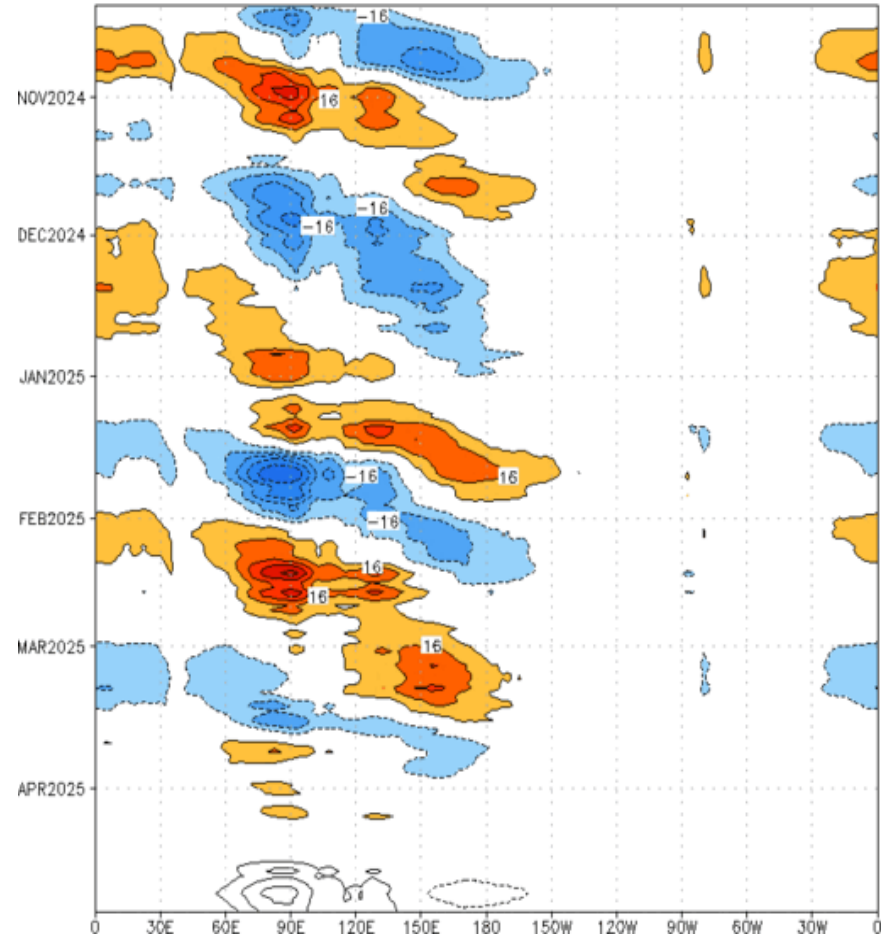
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 13 Apr 2025
OLR



- The GEFS OLR forecast based on the RMM index forecast depicts positive OLR anomalies (suppressed convection) increasing across the Indian Ocean and Maritime Continent during week-2.
- Negative OLR anomalies (enhanced convection) are forecast to increase across the southwestern Pacific.

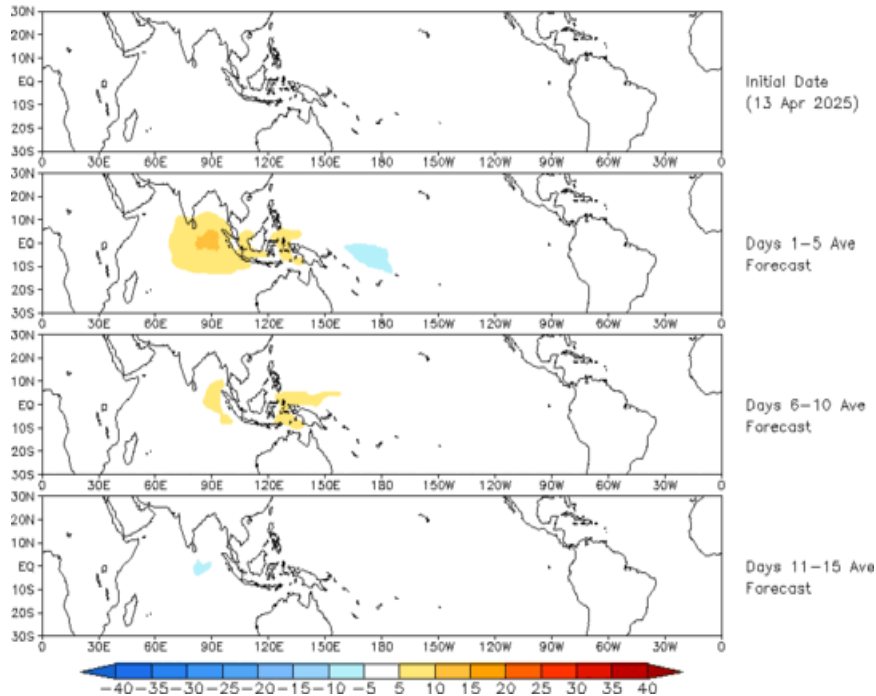
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:12-Oct-2024 to 13-Apr-2025
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



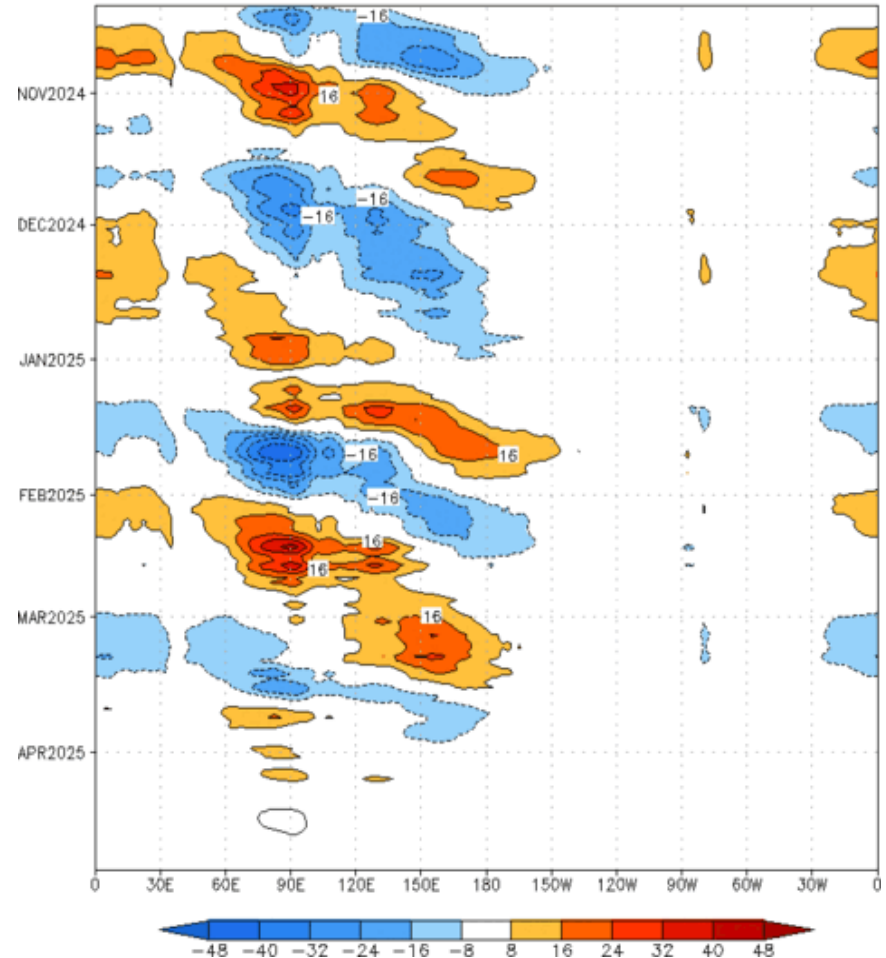
MJO: Constructed Analog Forecast Evolution

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 (13 Apr 2025)



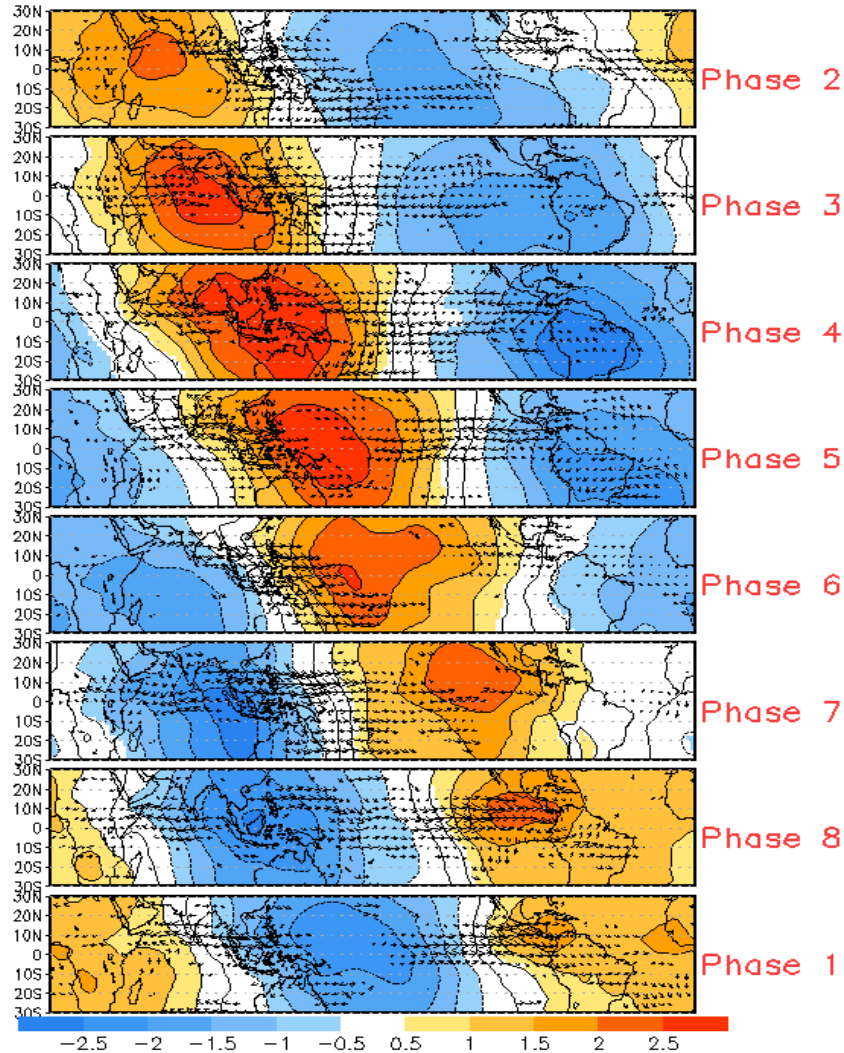
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:12-Oct-2024 to 13-Apr-2025
The unfilled contours are CA forecast reconstructed anomaly for 15 days



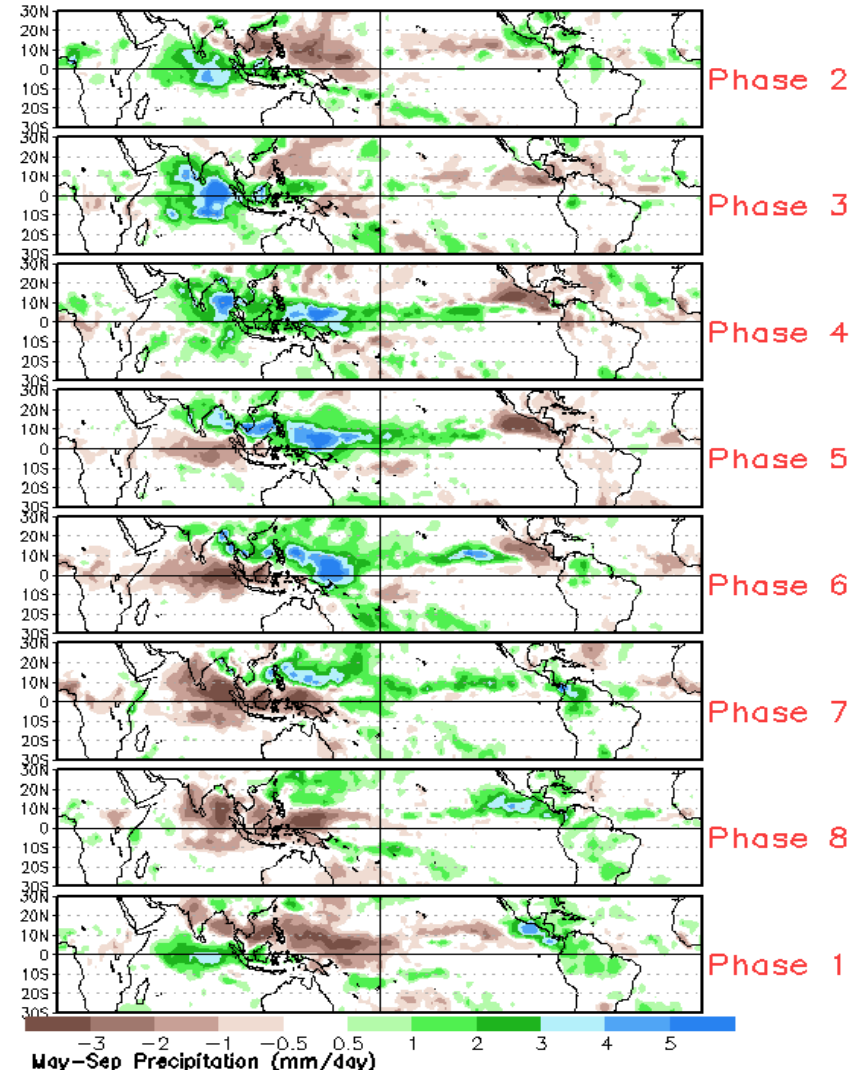
- The constructed analog forecast favors a weaker convective pattern compared to the GEFS.
- There is some signal for positive OLR anomalies (suppressed convection) across the Indian Ocean and Maritime Continent, but not continuing through week-2.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



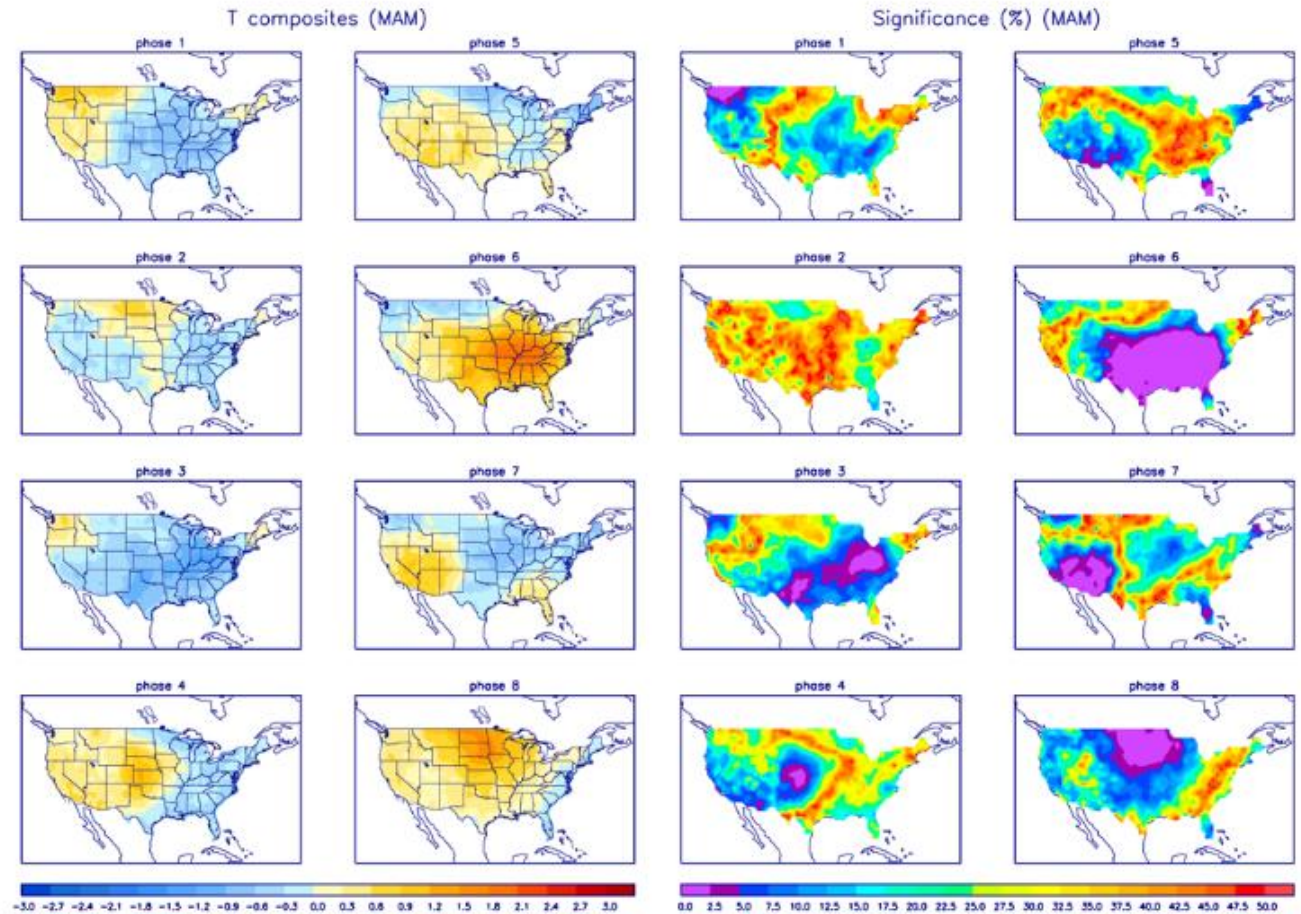
Precipitation Anomalies



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.

