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

Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
13 May 2024

Overview

- Both RMM index observations and upper-level velocity potential anomaly fields show MJO activity becoming increasingly disorganized since the start of May, with other modes of tropical variability playing more of a role in the global tropics.

- There is support in the model guidance for renewed MJO activity, with the enhanced phase gaining amplitude over the Indian Ocean during the next week, and propagating eastward into the Maritime Continent through the end of May.

- The reemerging MJO signal favored may be tied to a constructively interfering low frequency response over the Indian Ocean and Kelvin wave activity traversing the basin. As a result, there is still some question as to the eventual coherence of the MJO with other modes of tropical variability favored to remain at play during the next several weeks.

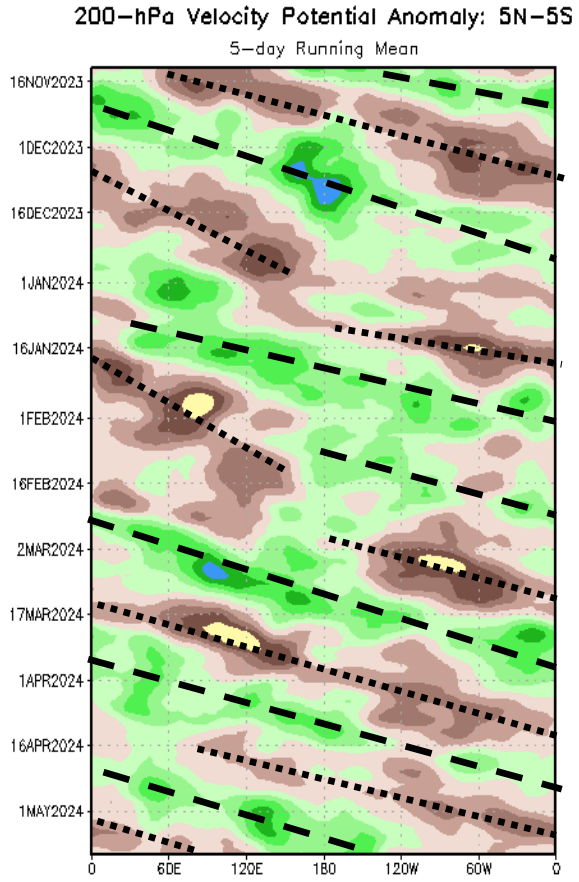
- The large scale environment and climatology favors increased chances for tropical cyclogenesis in the northern Indian Ocean and Western Pacific. Conversely, more unfavorable conditions are anticipated over the Eastern Pacific following a potentially early start to the Hurricane season.

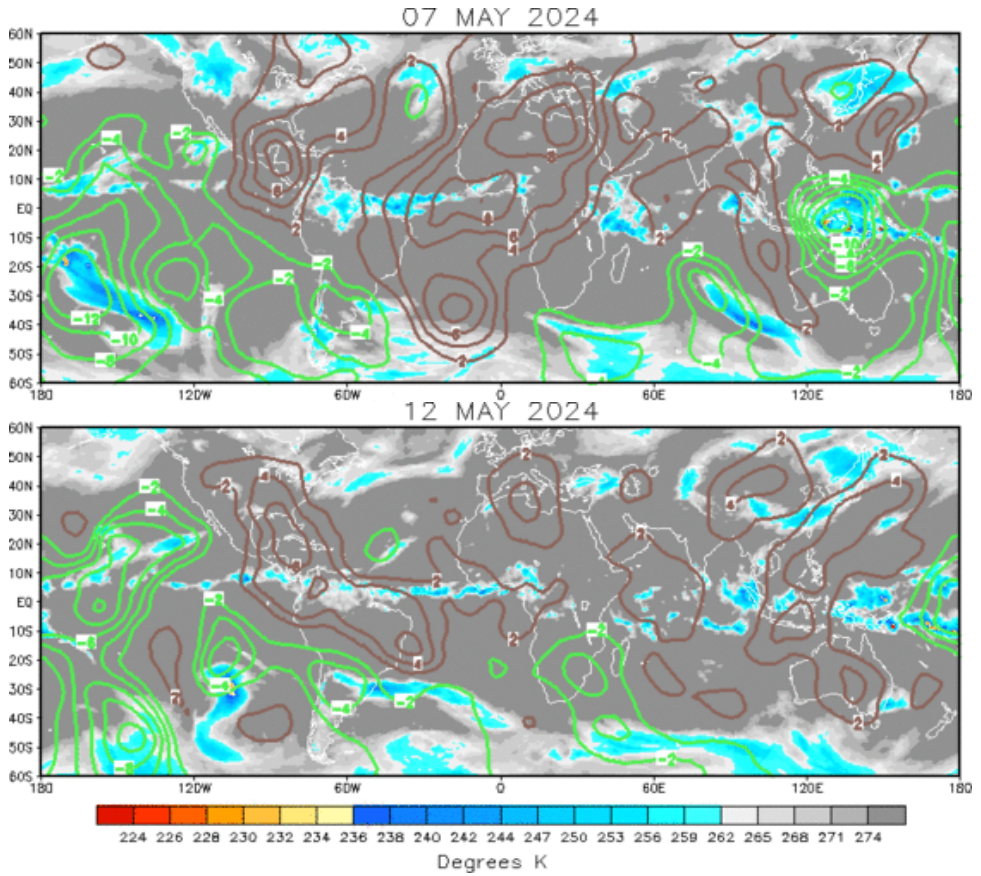
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

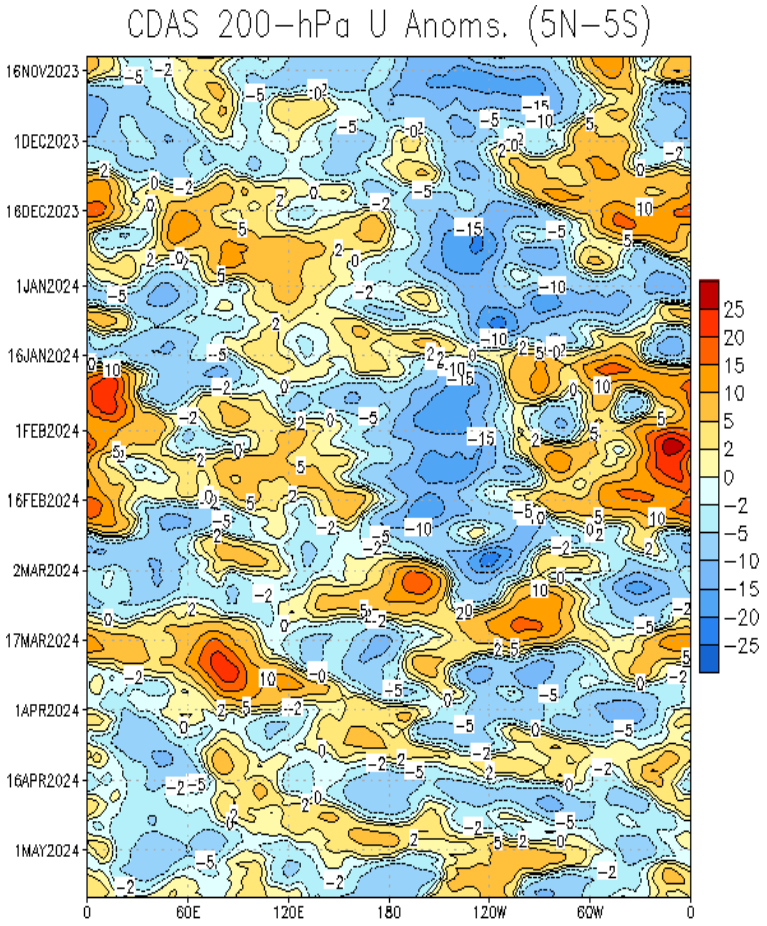


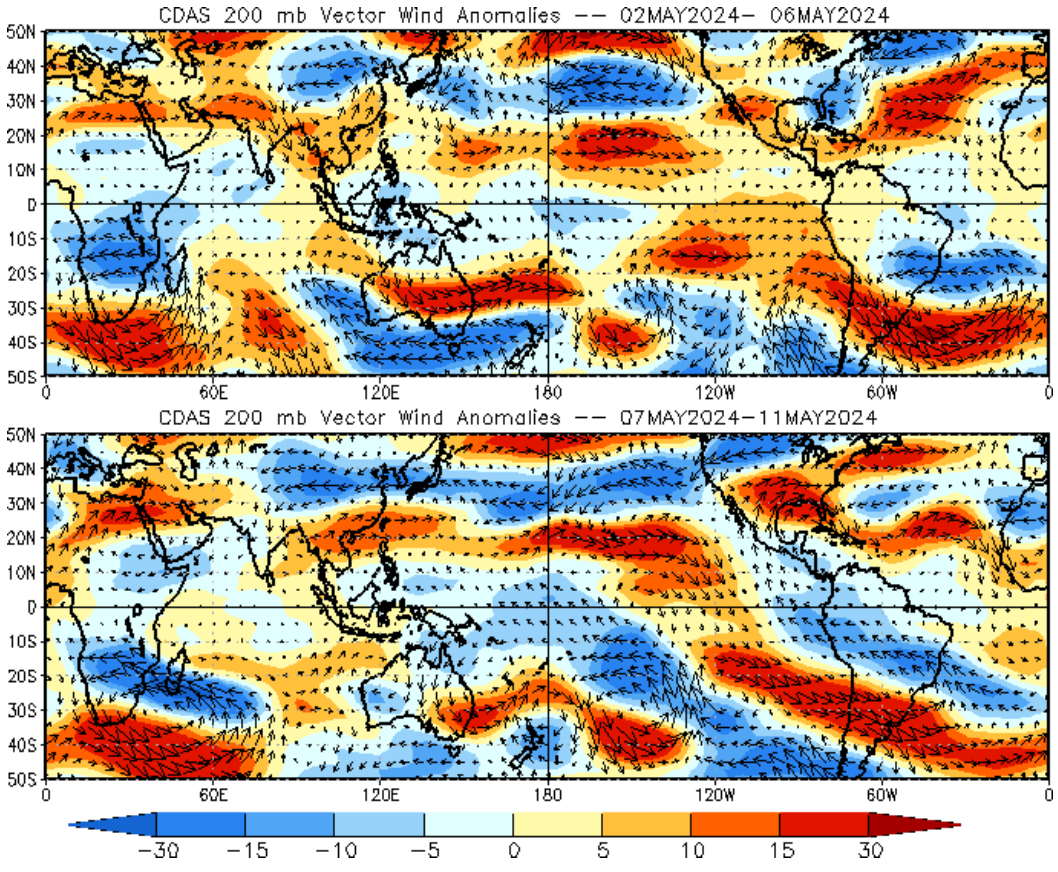


- Time/longitude plots of upper-level velocity potential anomalies show enhanced (suppressed) phase of the MJO crossing into Western Hemisphere (Indian Ocean) while weakening in strength.
- Spatially, the pattern has become quite disorganized since start of May, with remnant MJO activity located to the east of the Date Line in the Equatorial Pacific.

200-hPa Wind Anomalies

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

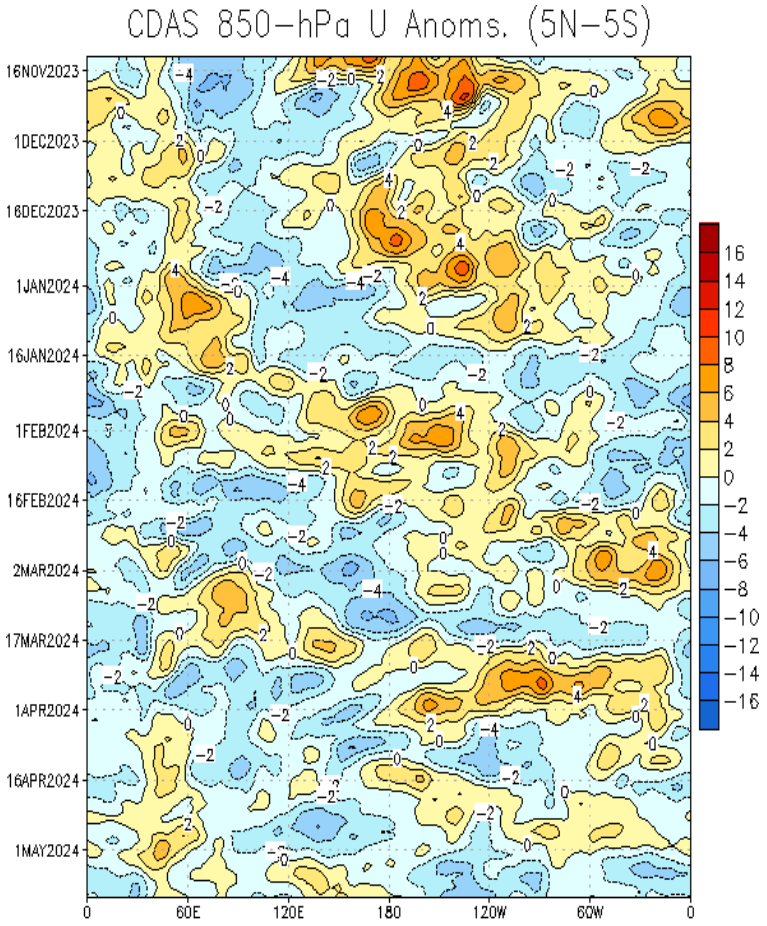


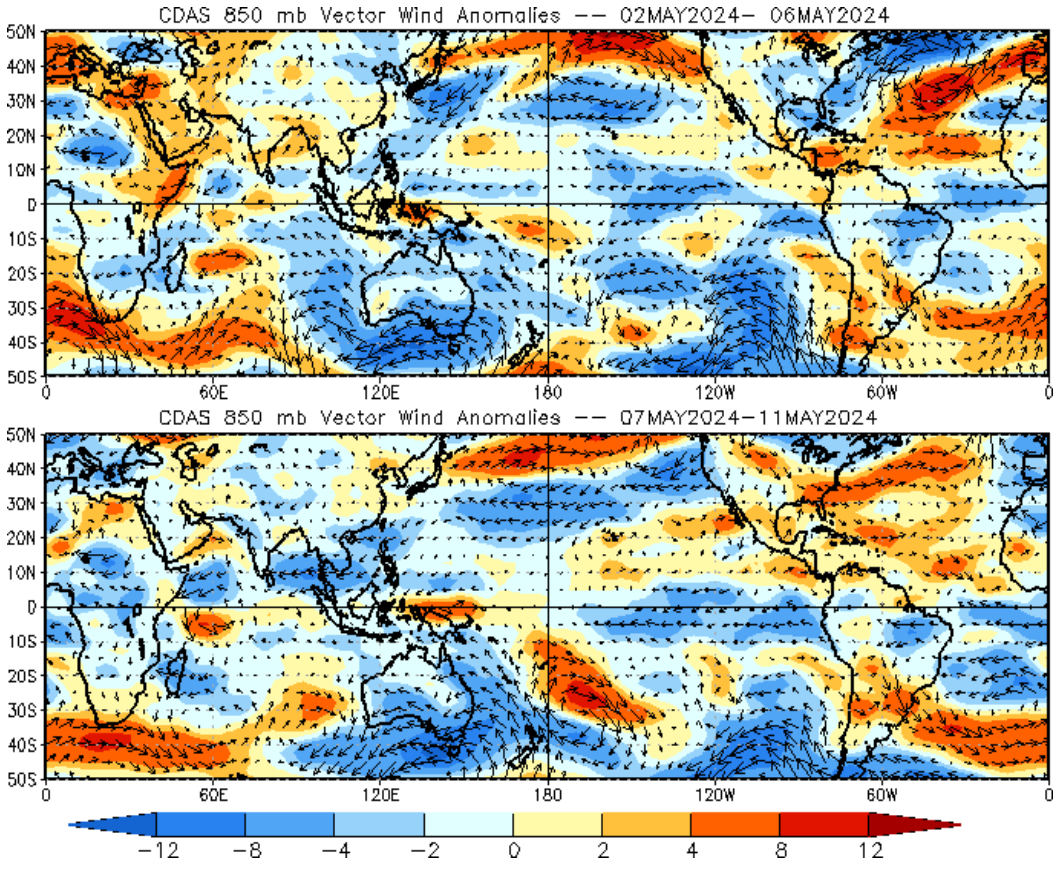


- Enhanced easterlies aloft propagated eastward into the Equatorial Pacific, and encountered a band of strong westerlies likely tied to Rossby wave activity in the Eastern Pacific.
- The westerly phase of the MJO appears to be surfacing in parts of the Indian Ocean.
- An anomalous cyclonic circulation aloft is observed over the western CONUS, contributing to the continued severe weather risks for the Great Plains and Midwest through early May.

850-hPa Wind Anomalies

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

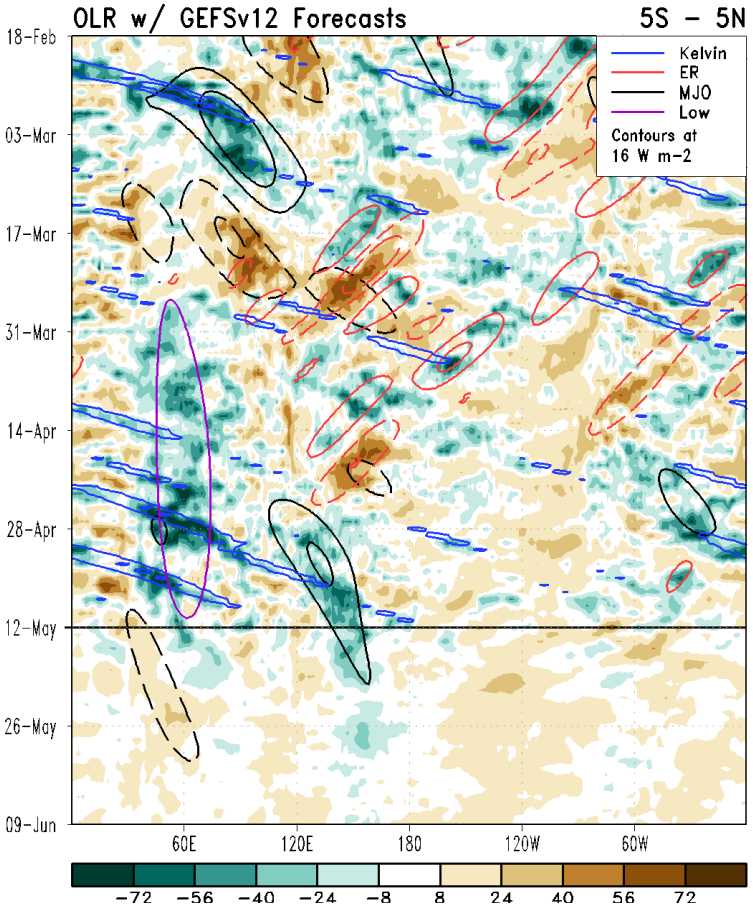


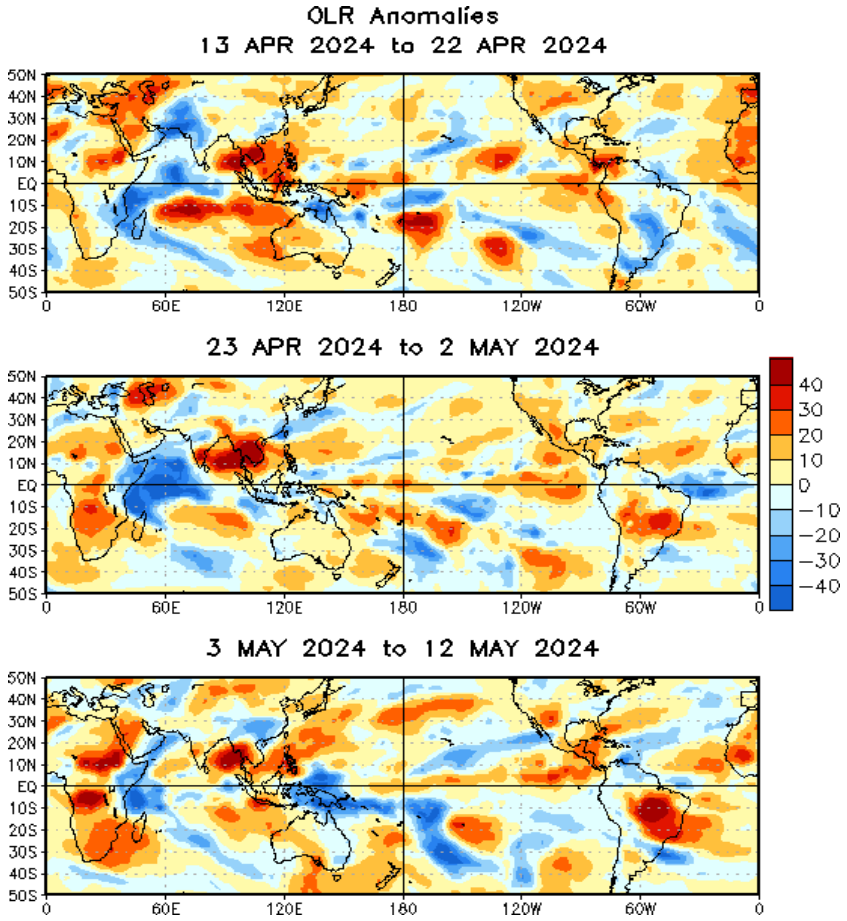


- Anomalous lower-level westerlies propagated eastward from Africa into the Maritime Continent since late April, with anomalous easterlies overspreading the eastern Equatorial Pacific consistent with continued intraseasonal activity.
- North of the Equator, anomalous westerlies persist to south of Mexico favorable for early season tropical cyclone development.

Outgoing Longwave Radiation (OLR) Anomalies

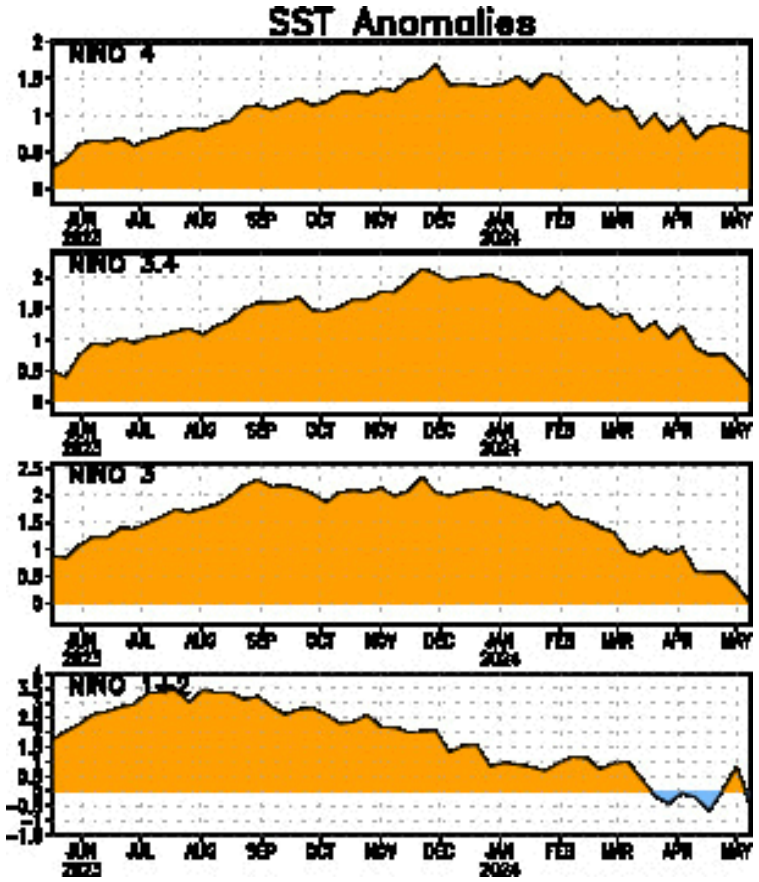
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

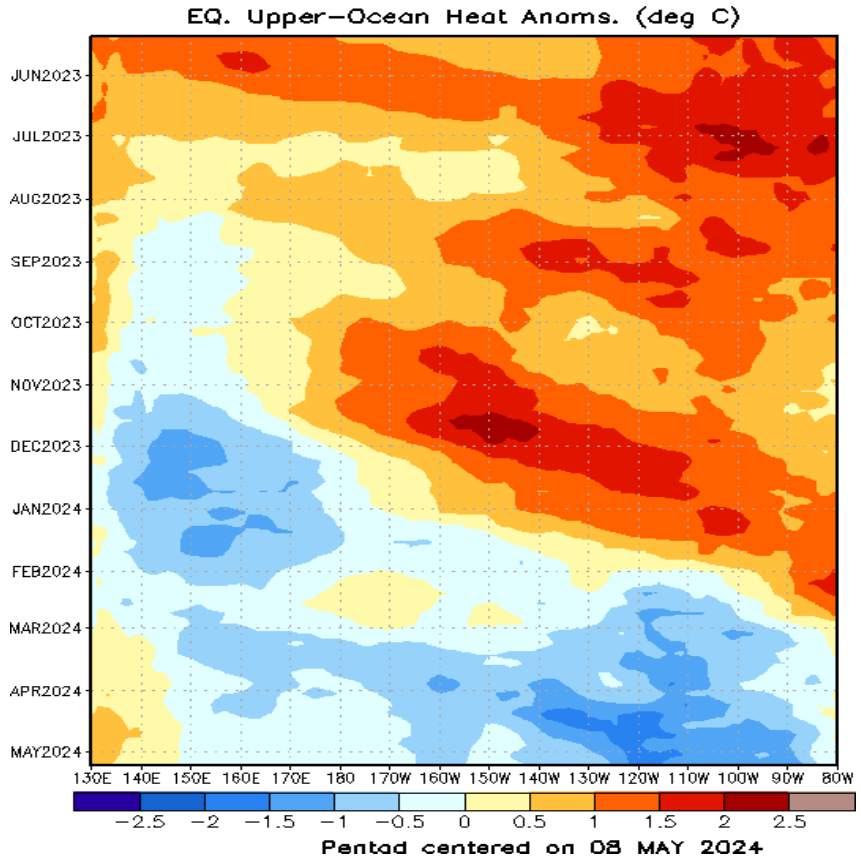




- Enhanced convection persisted over eastern Equatorial Africa and the western Indian Ocean.
- An uptick in convection was observed over the Maritime Continent and to the south of the Equator eastward beyond the Date Line.
- OLR forecasts depict largely suppressed convection for much of the Tropics, suggestive of an emerging (decaying) low frequency response over the Eastern Pacific (western Indian Ocean).

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

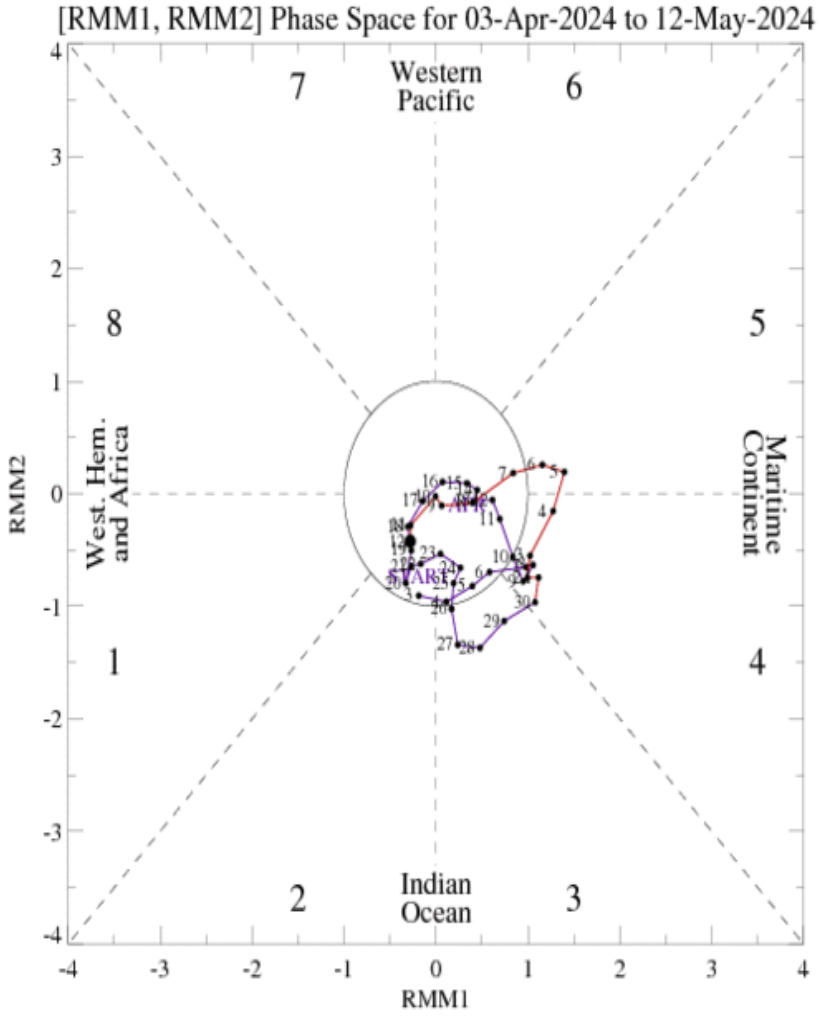




- SSTs in all NINO regions have trended downward since February, indicative of a decaying El Niño.
- Negative subsurface temperature anomalies continue to be observed across nearly the entire Pacific, with continued cooling across the Eastern Pacific.

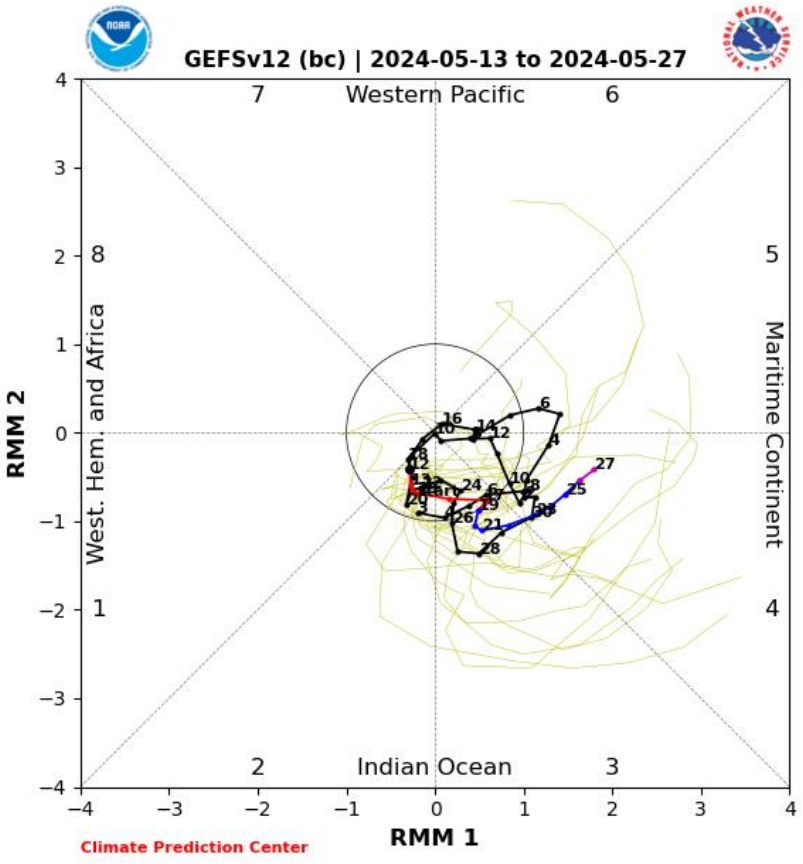
MJO Index: Recent Evolution

- Following a reemergence of MJO activity in late April and early May, the signal has again retreated into the RMM unit circle.

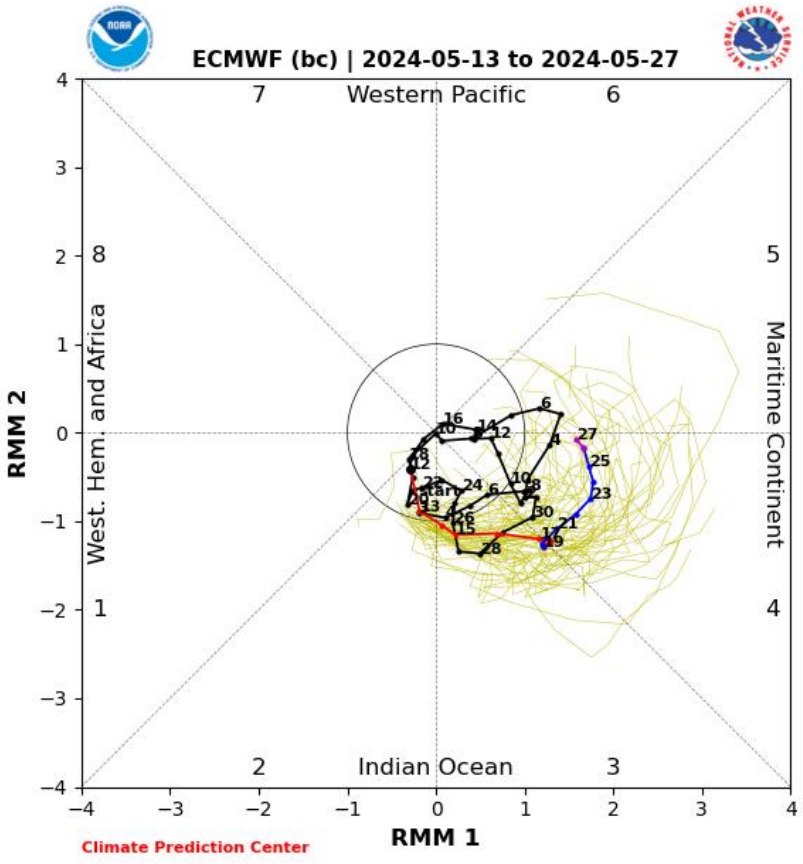


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

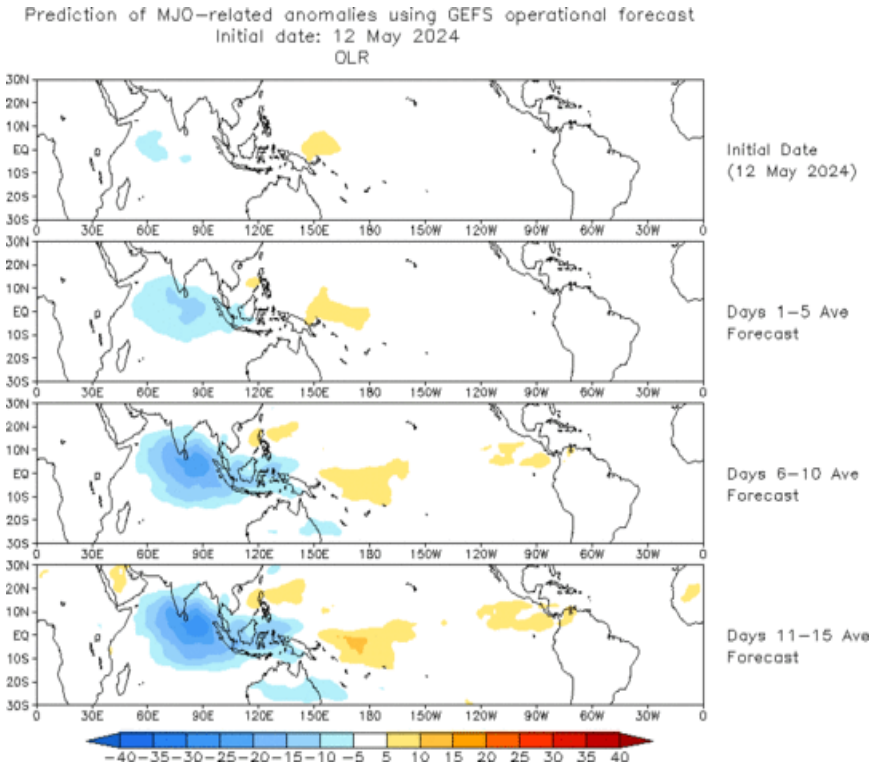


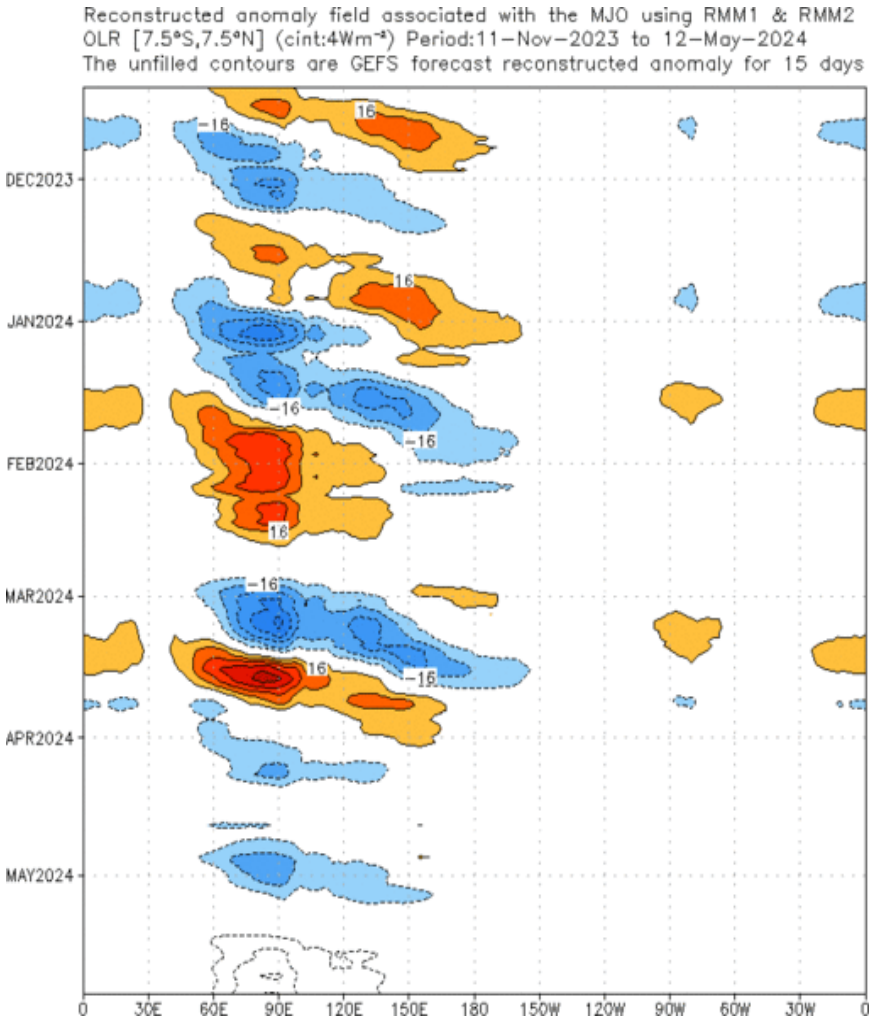
ECMWF Forecast

- While ensemble averages are generally weak, several members from the GEFS and ECMWF favor the potential for renewed MJO activity over the Indian Ocean while propagating the signal eastward into the Maritime Continent at a potentially moderate amplitude.
- The favored uptick in amplitude may be attributed to Kelvin wave activity constructively interfering with the low frequency response in the Indian Ocean.
- Caution should be exercised in the forecasts due to favored shifts in the background state.

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.)

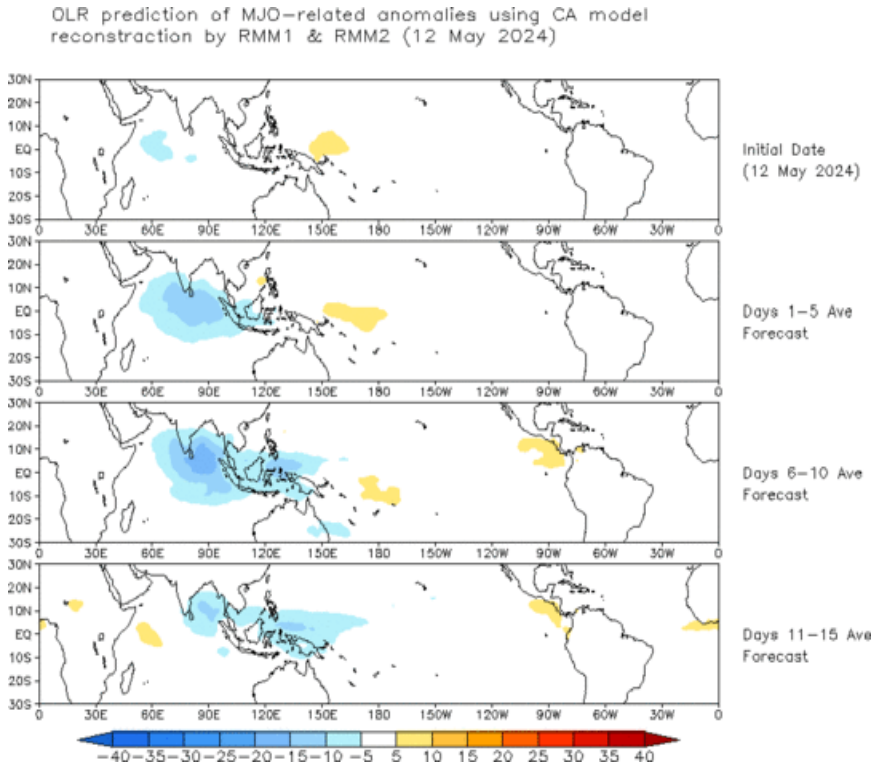


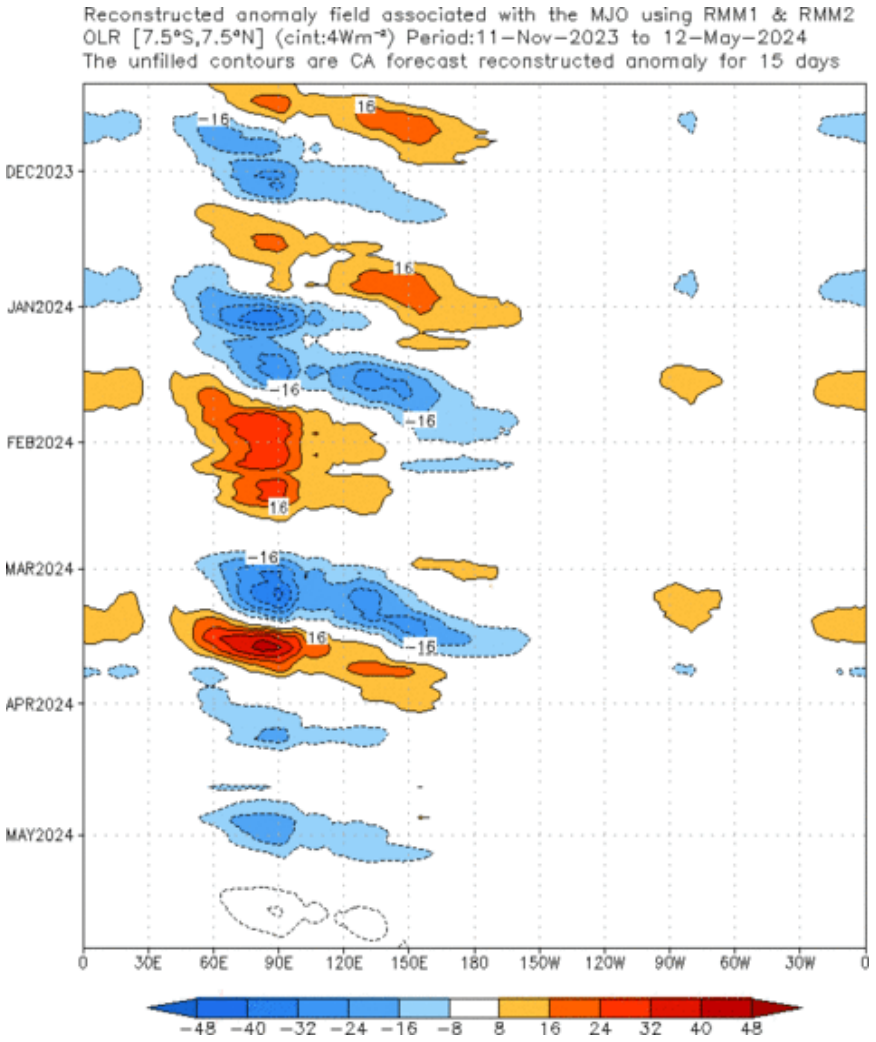


- The GEFS depicts a strengthening convective dipole, with enhanced (suppressed) convection over the Indian Ocean (Equatorial Pacific) during the next two weeks.

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.)

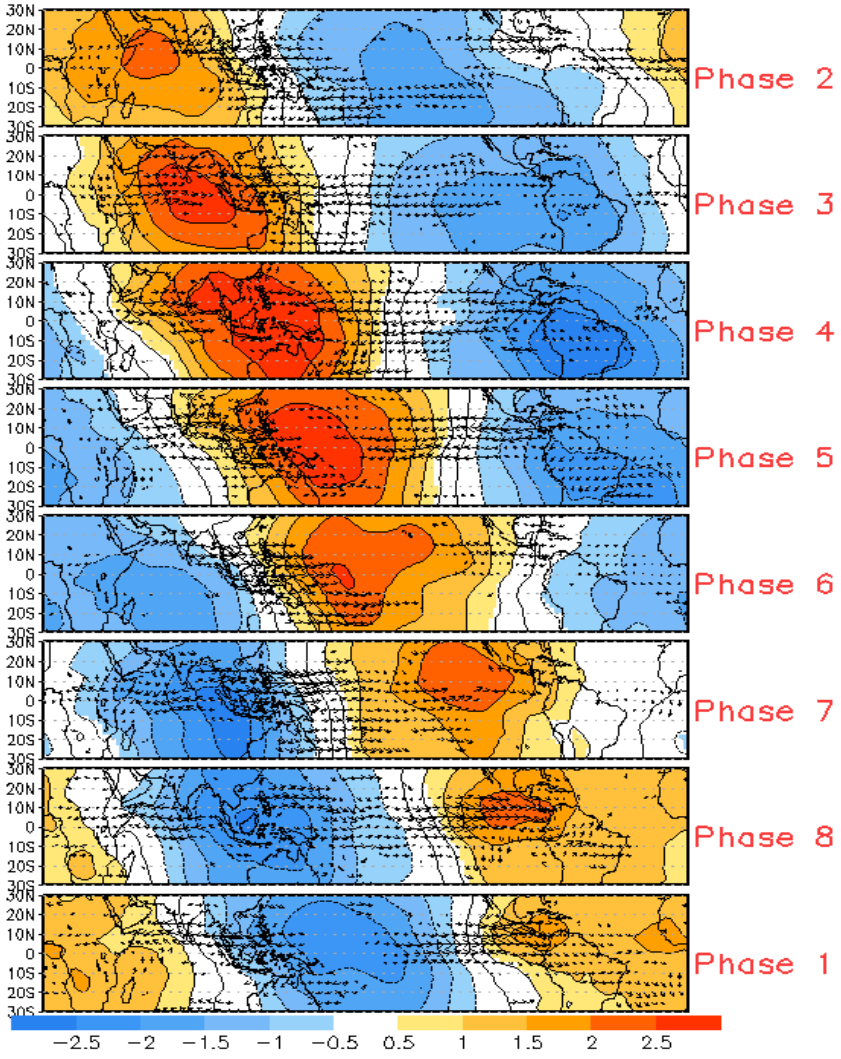




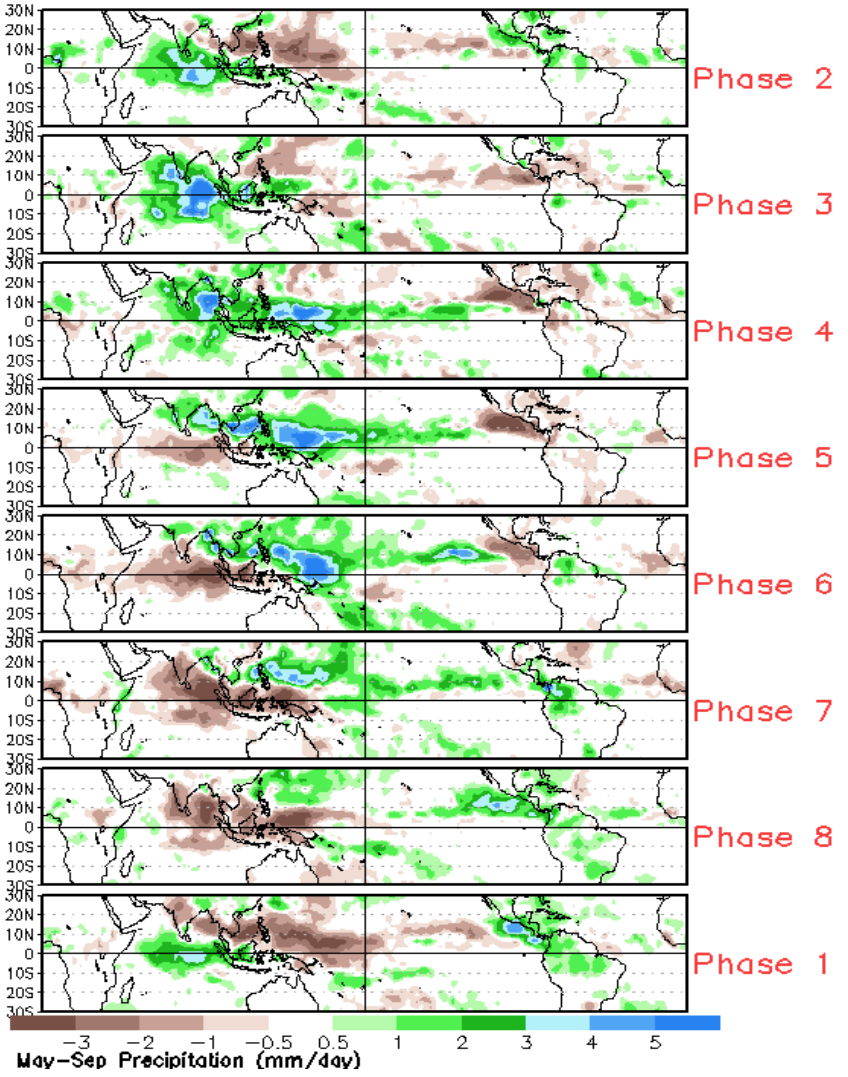
- Compared to the GEFS, the constructed analog tool features a similar evolution of convective anomalies, albeit weaker in strength.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



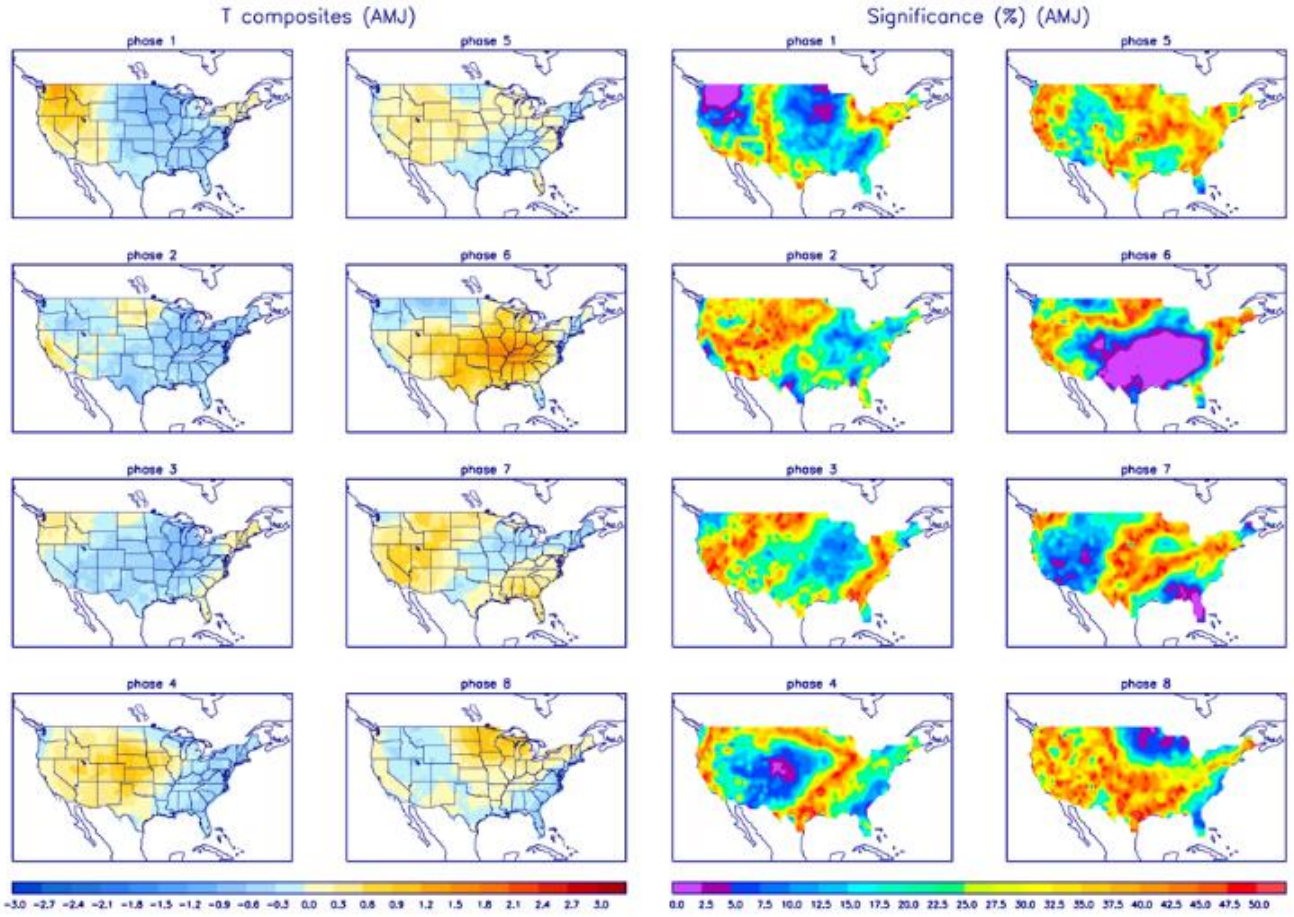
Precipitation Anomalies



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.

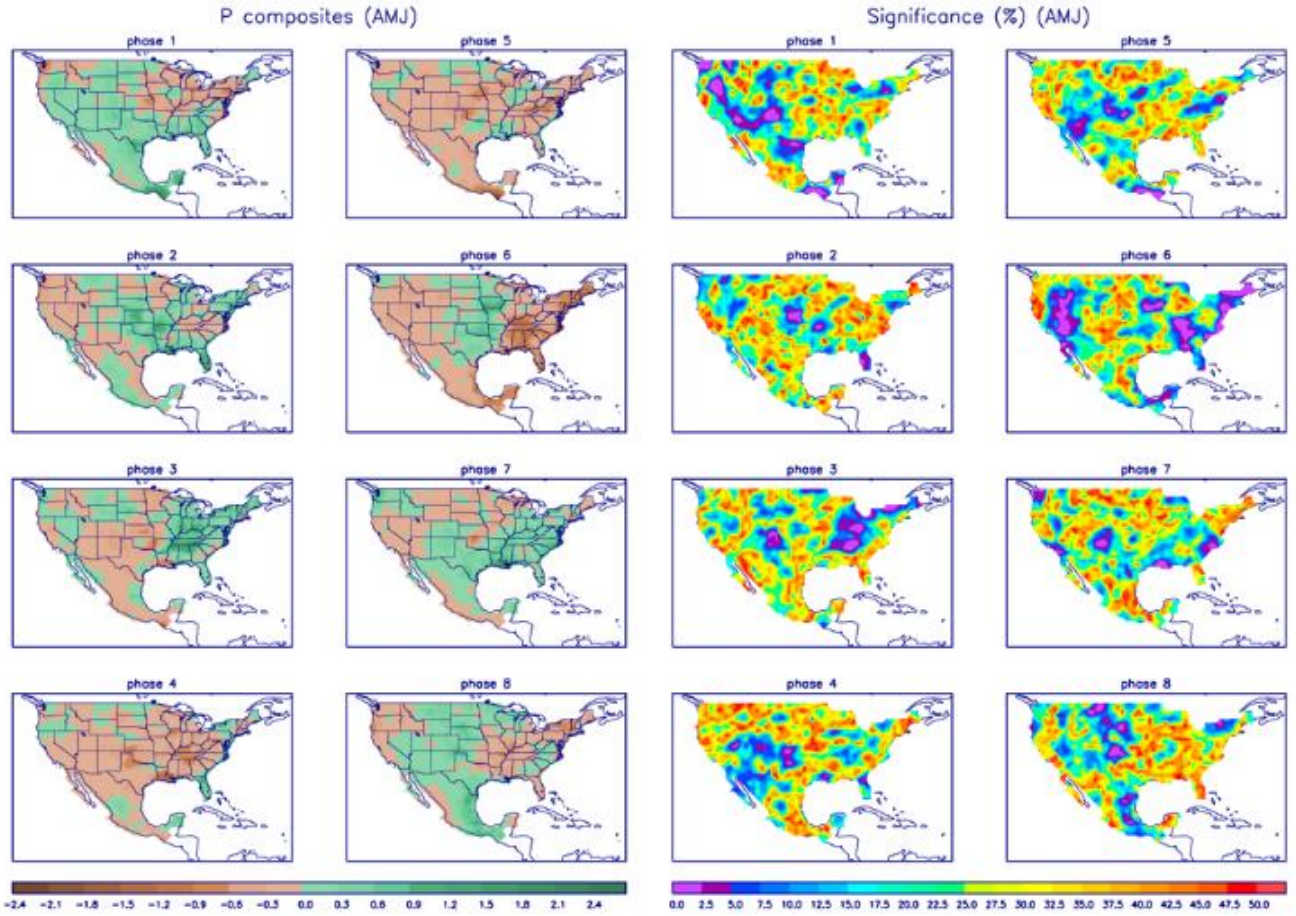


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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