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

Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
28 November 2022

Overview

- The RMM index indicates the MJO has increased in amplitude over the last week and the signal has continued to steadily propagate eastward across the Western Pacific.

- There is generally good agreement among the dynamical model RMM forecasts favoring rapid eastward propagation of the signal that decreases in amplitude during week-1, followed by the potential reemergence of the MJO with the enhanced convective envelope developing over the Indian Ocean and Maritime Continent during weeks 2 and 3.

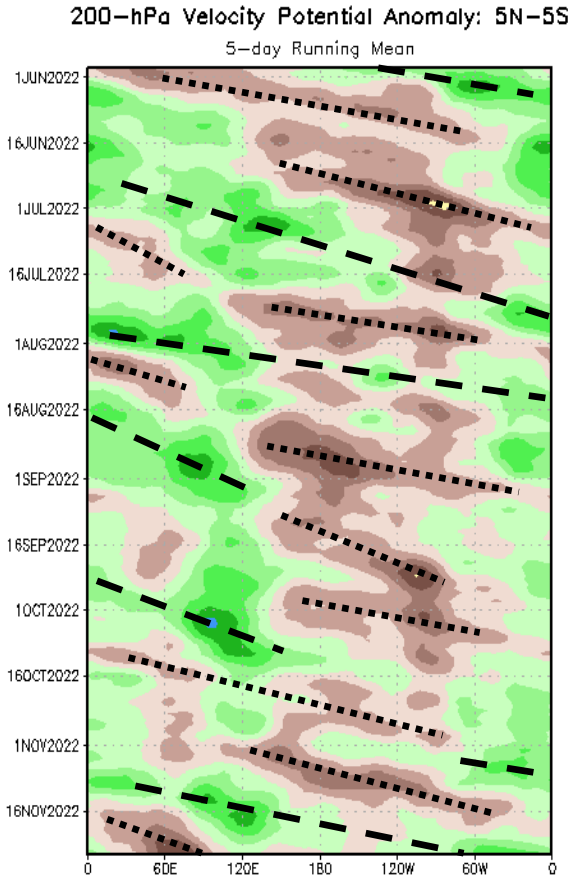
- Strong La Nina base state will continue provide a favorable environment for tropical cyclone (TC) genesis around the Maritime Continent for both weeks 2 and 3.

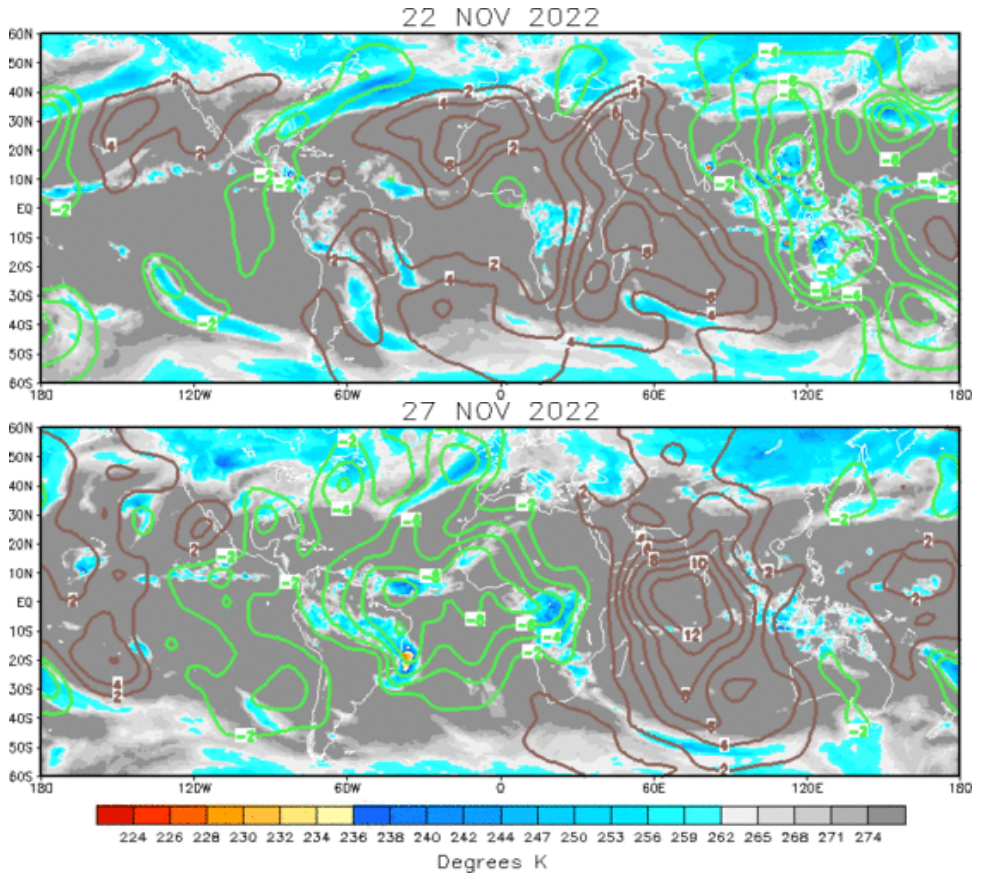
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

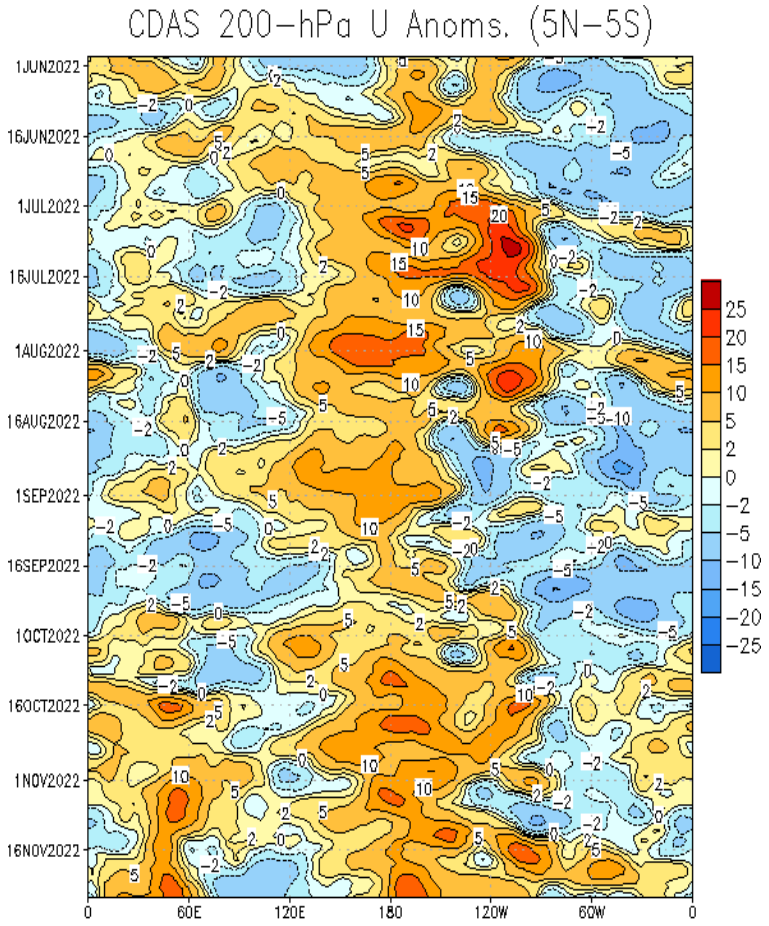


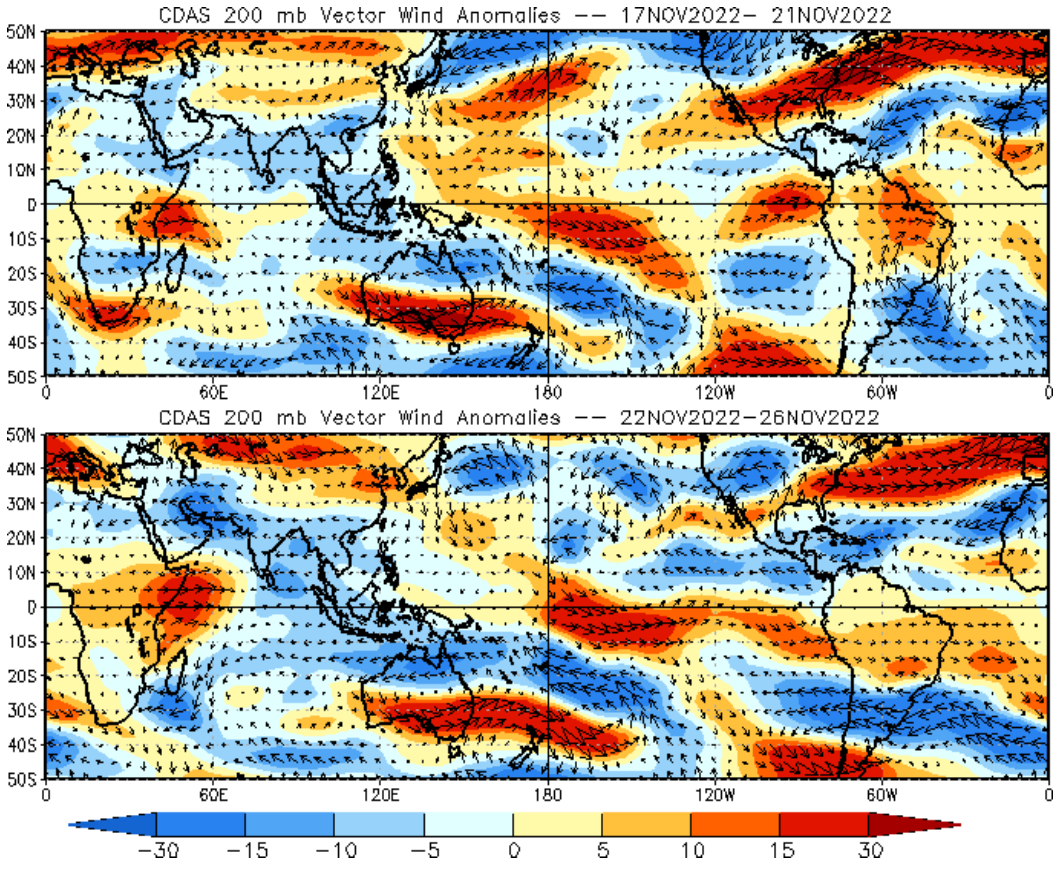


- Velocity potential pattern is becoming more coherent with a return of wave-1 symmetry in the last week.
- There has been a slight eastward propagation of suppressed phase over the Indian Ocean last week, while enhanced convection has rapidly moved from the Maritime Continent to the Americas.

200-hPa Wind Anomalies

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

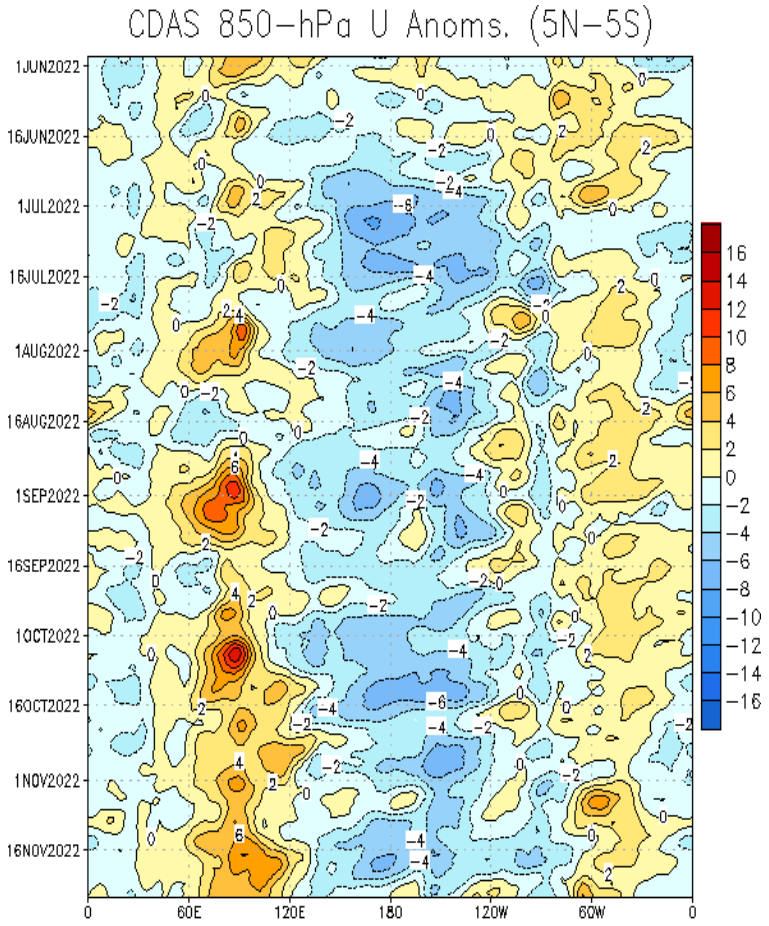


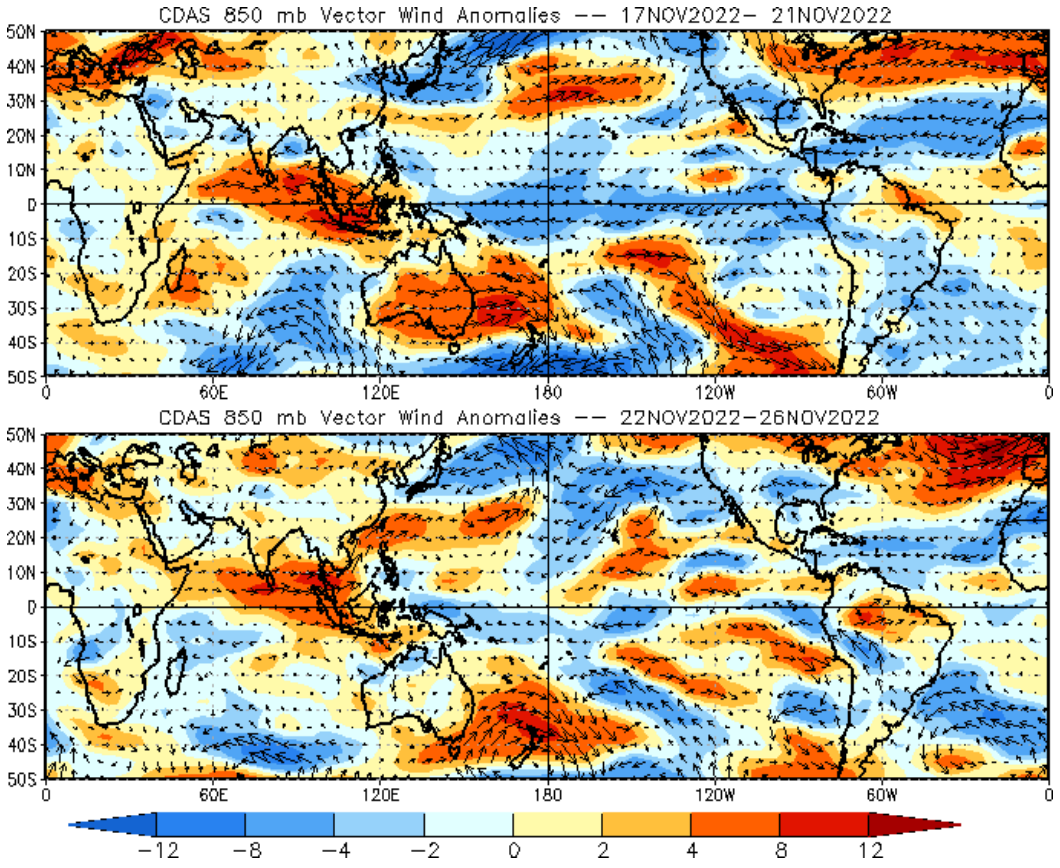


- Consistent with La Niña, anomalous upper-level westerlies continued across equatorial Pacific but have decreased in areal coverage after a recent emergence of anomalous easterlies over the Maritime Continent.
- Anomalous upper-level westerlies persist offshore of equatorial East Africa tied to an anomalous cyclonic circulation aloft over the southwestern Indian Ocean.

850-hPa Wind Anomalies

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



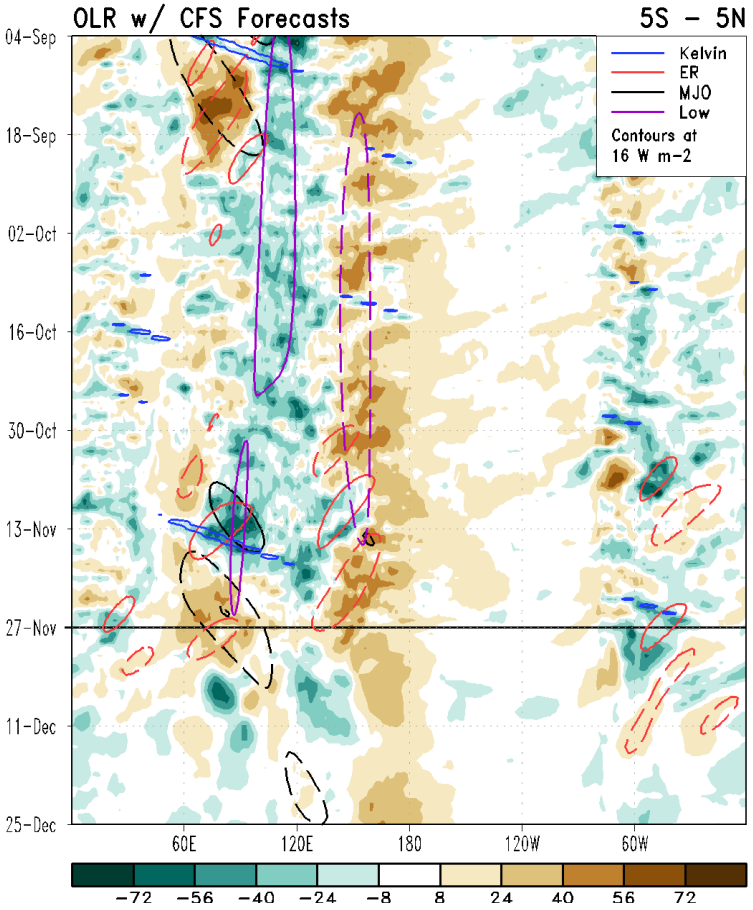


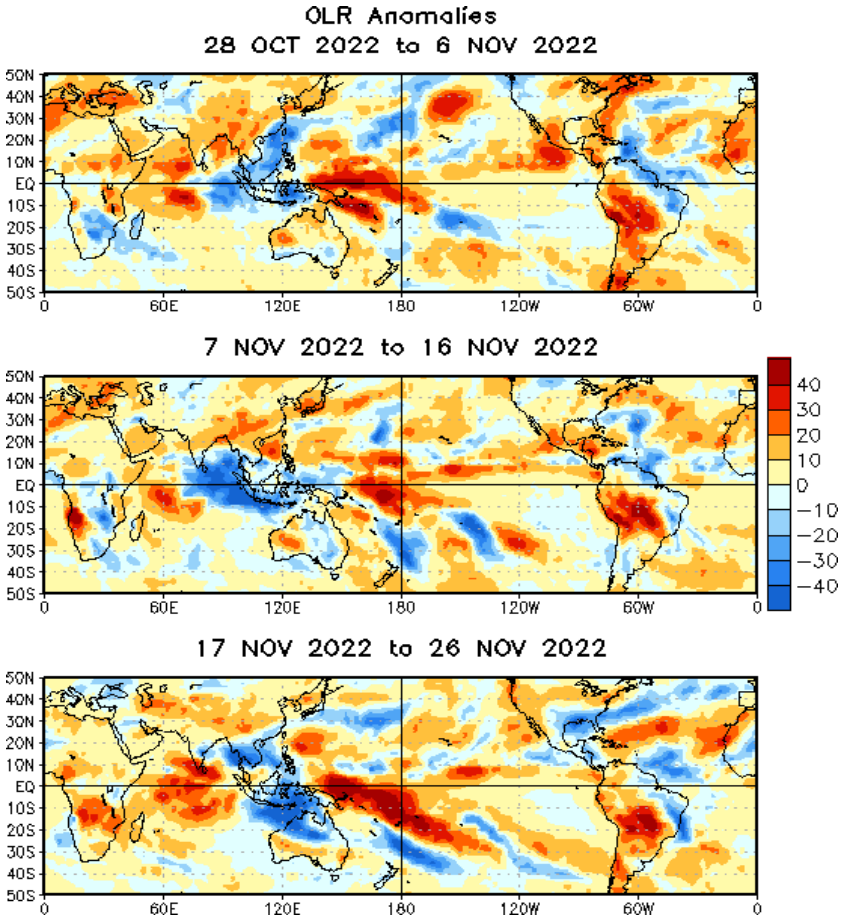
- Enhanced trades have weakened significantly over the last week, with areas of anomalous westerlies beginning to emerge east of the Date Line.

- Anomalous westerlies persist across the eastern Indian Ocean and Maritime Continent, resulting in lower-level convergence near New Guinea.

Outgoing Longwave Radiation (OLR) Anomalies

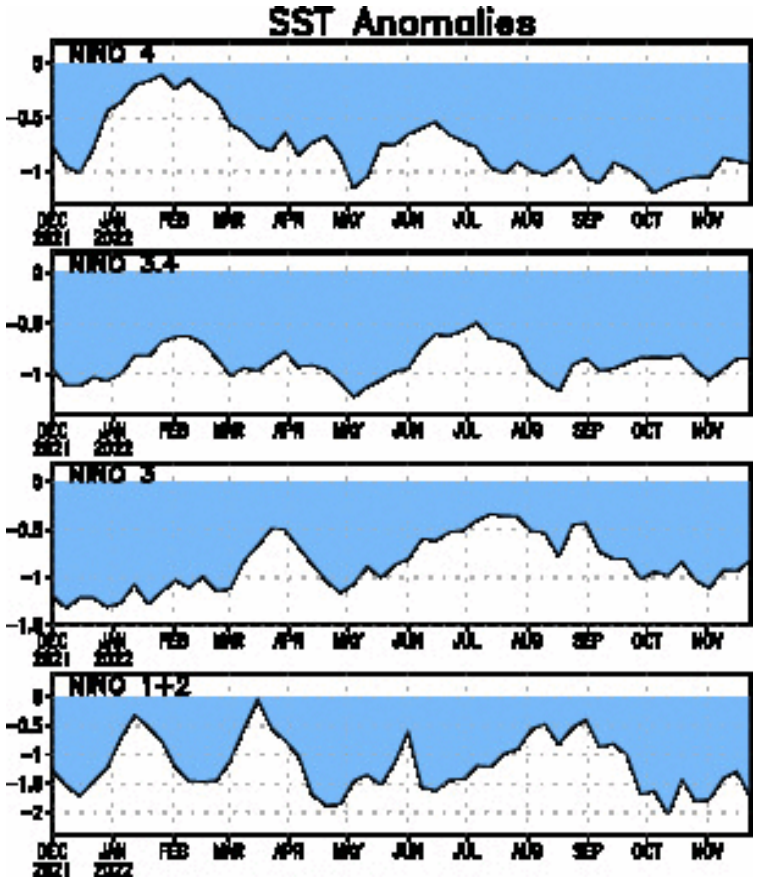
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

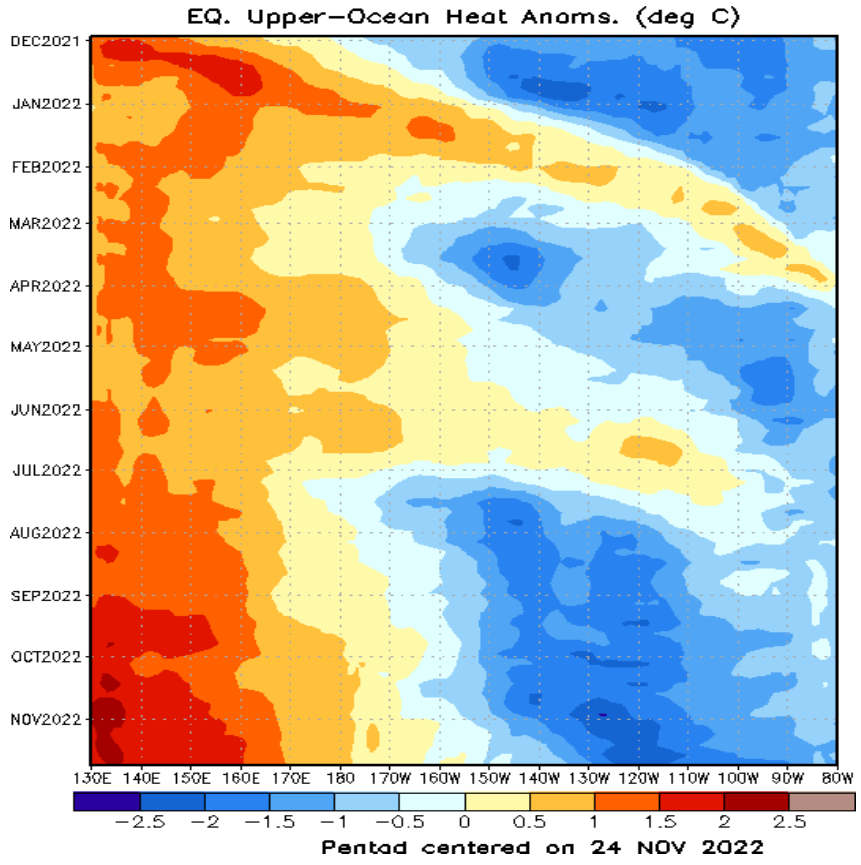




- Suppressed convection over the western Indian Ocean has intensified and spread, briefly overcoming the long-standing enhanced convection over the Maritime Continent.
- Enhanced convection is favored to return to Indian Ocean and Maritime Continent during week 2 as MJO moves back into Eastern Hemisphere.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

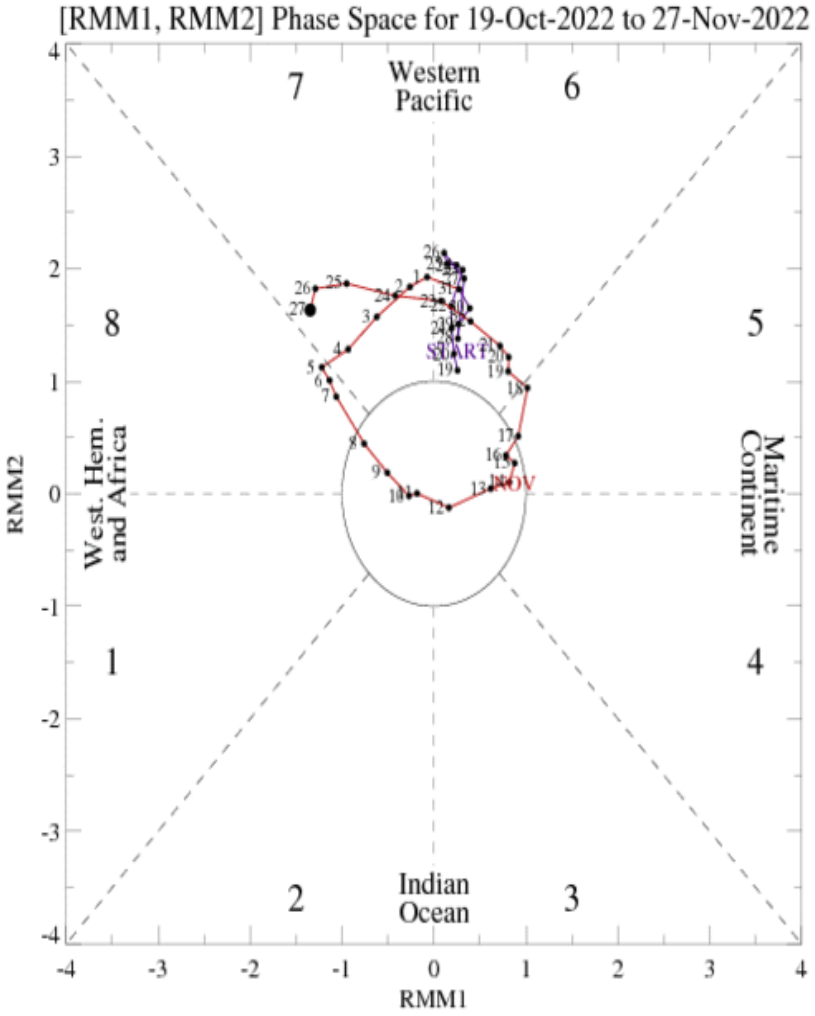




- Zonal gradient of upper-ocean heat anomalies has been increasing over the last month and the westward extent of anomalous cold is beginning to shift eastward.
- SSTs remain well below average across all Niño basins, reflecting robust and persistent cold ENSO conditions.

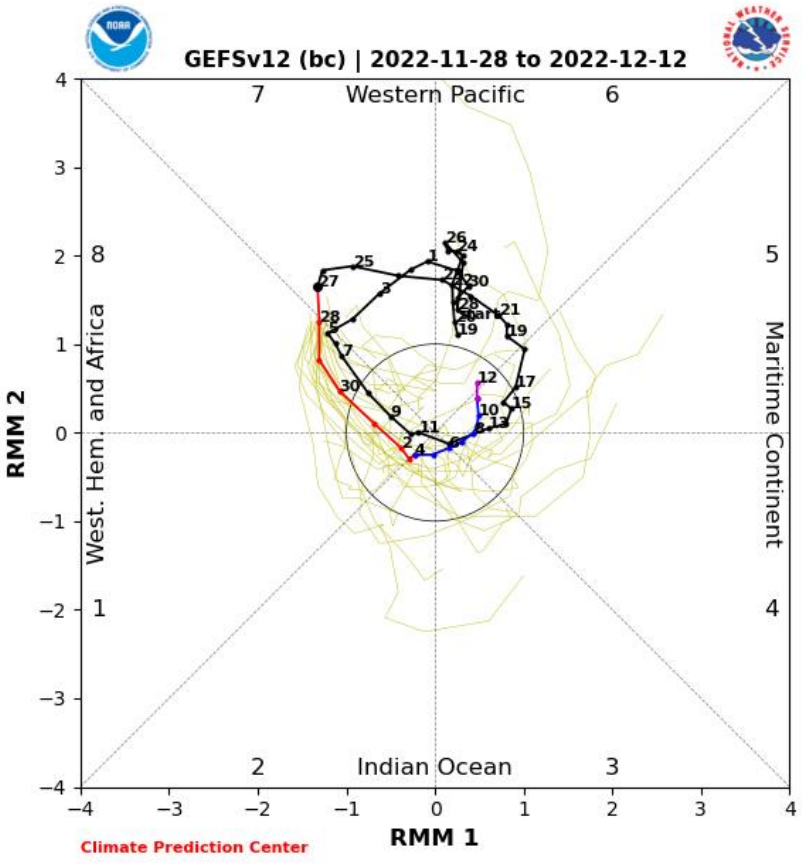
MJO Index: Recent Evolution

- RMM observations show steady eastward propagation and a full circumnavigation of the globe since the beginning of November.
- Latest observations depict a strengthening signal, and the MJO has continued to propagate eastward across Western Pacific and into the Americas, which is well reflected in the observed velocity potential anomaly fields.

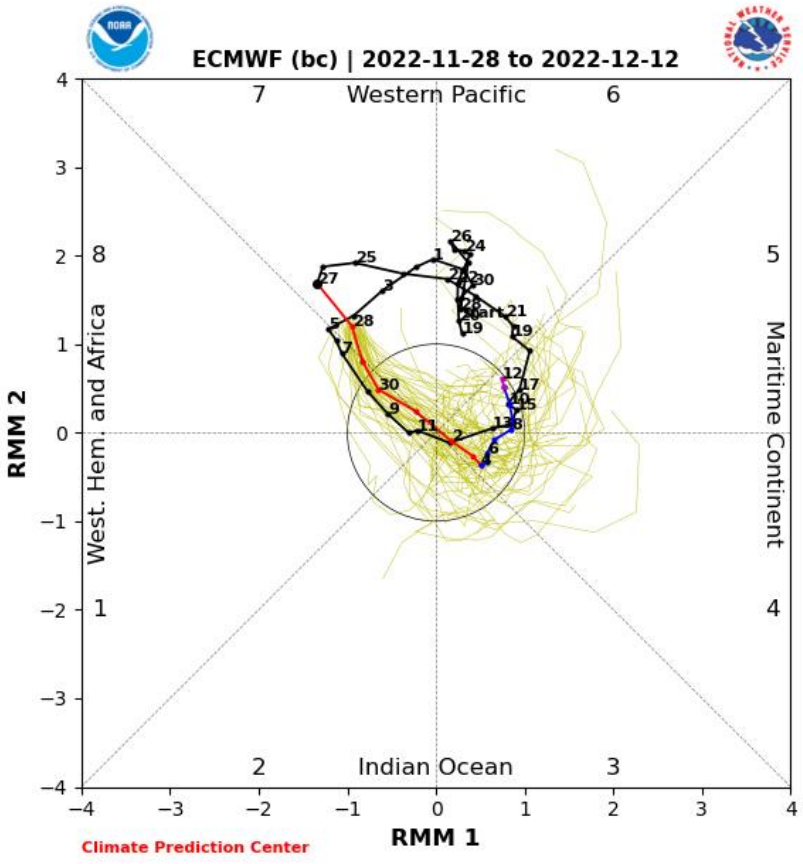


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

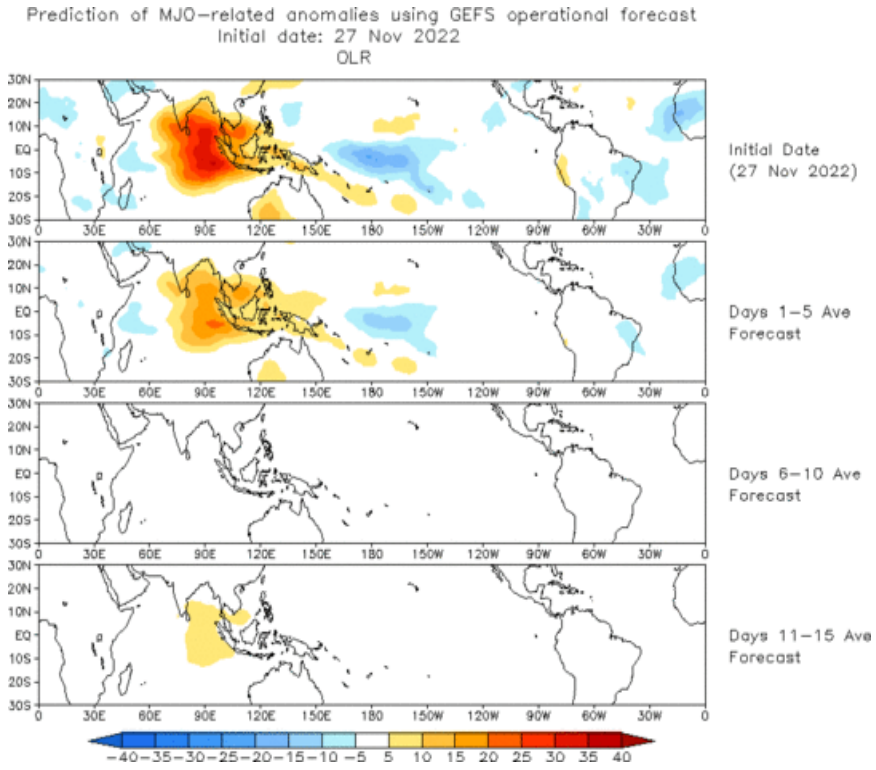


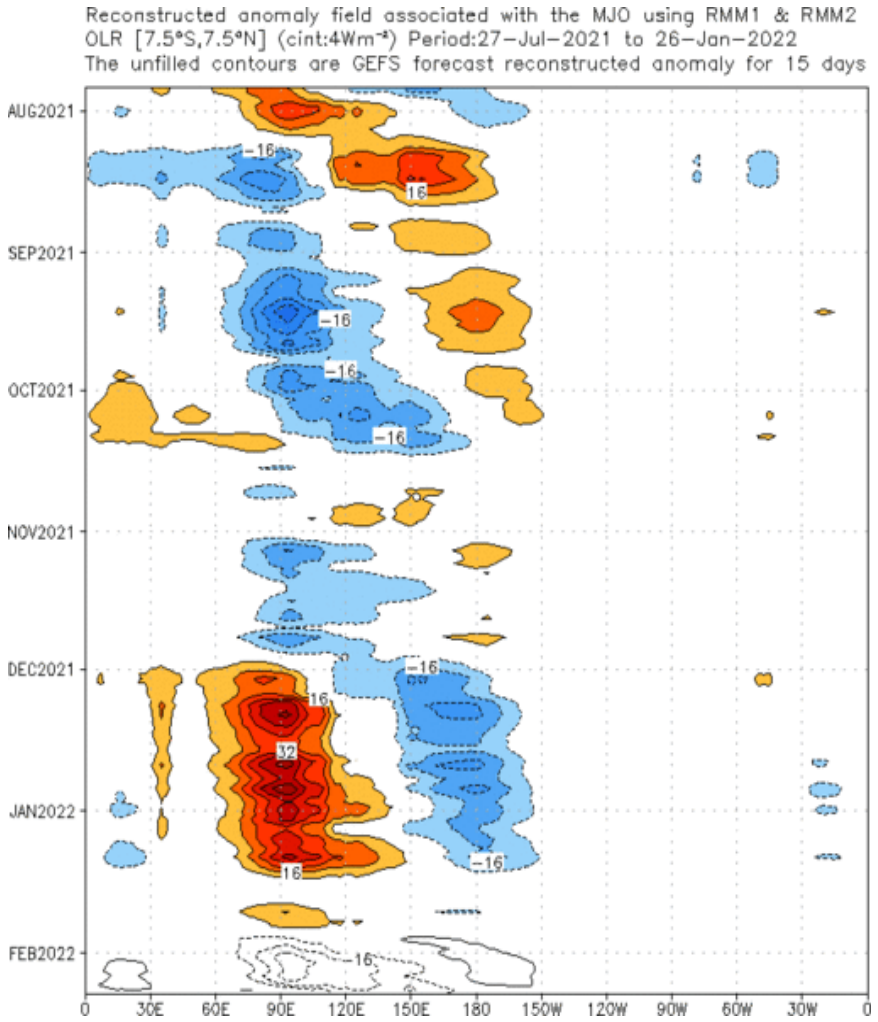
ECMWF Forecast

- Good agreement exists among the dynamical models favoring rapid Kelvin wave-like propagation towards phase 2 with diminishing amplitude during week-1 before the signal picks up again as the signal moves into the right half of the RMM diagram within the unit circle during week 2.
- Model solutions diverge during week 3, but generally depict a continuation of eastward propagation of the singal into Maritime Continent.

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.)

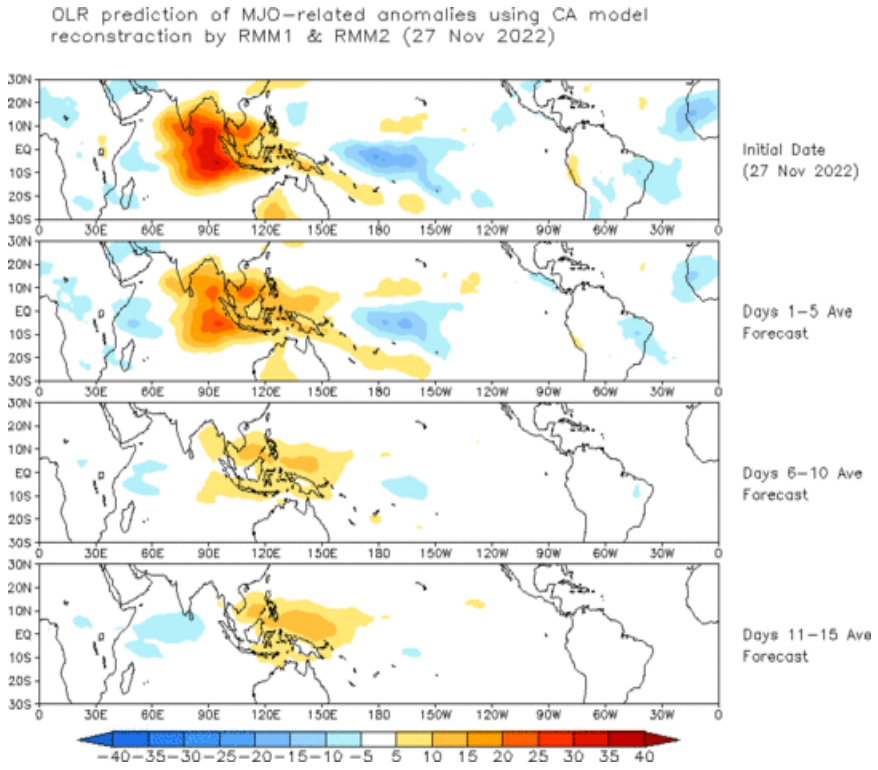


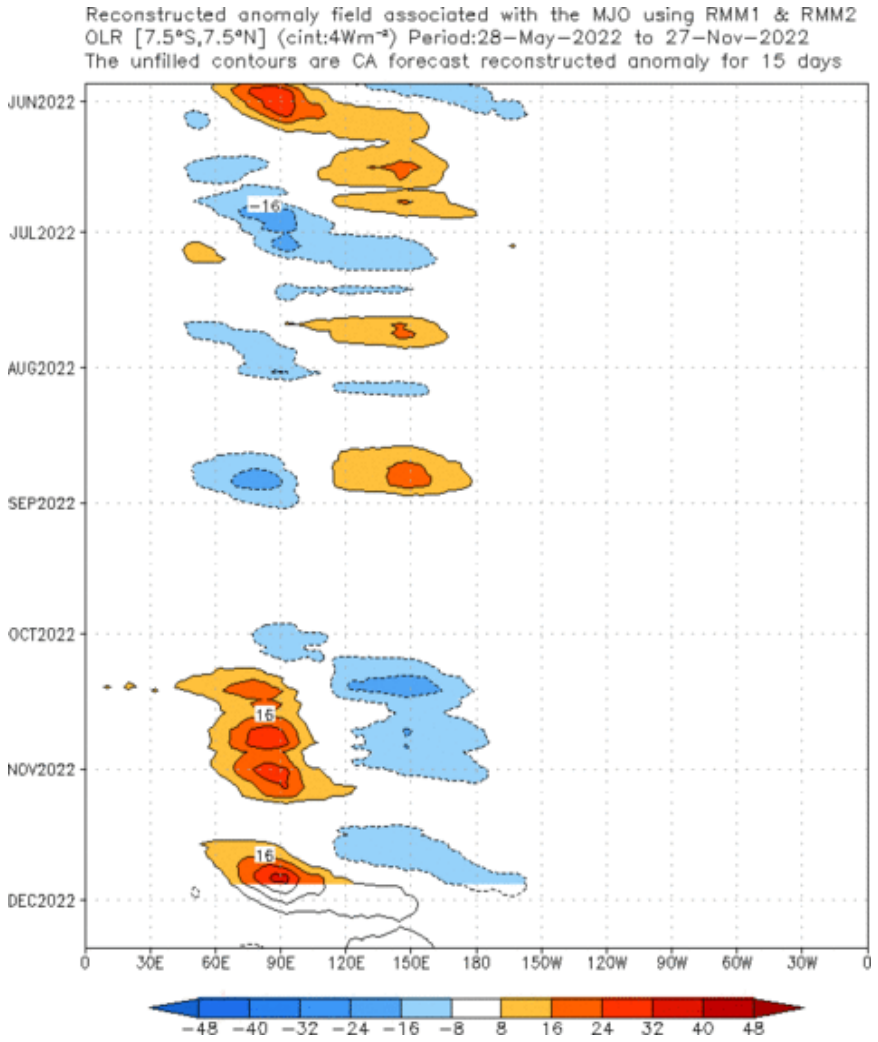


- The GEFS-based OLR anomaly fields depict a strong convective dipole shifting slightly eastward with time before signal washes out, consistent with fading RMM forecast.

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.)

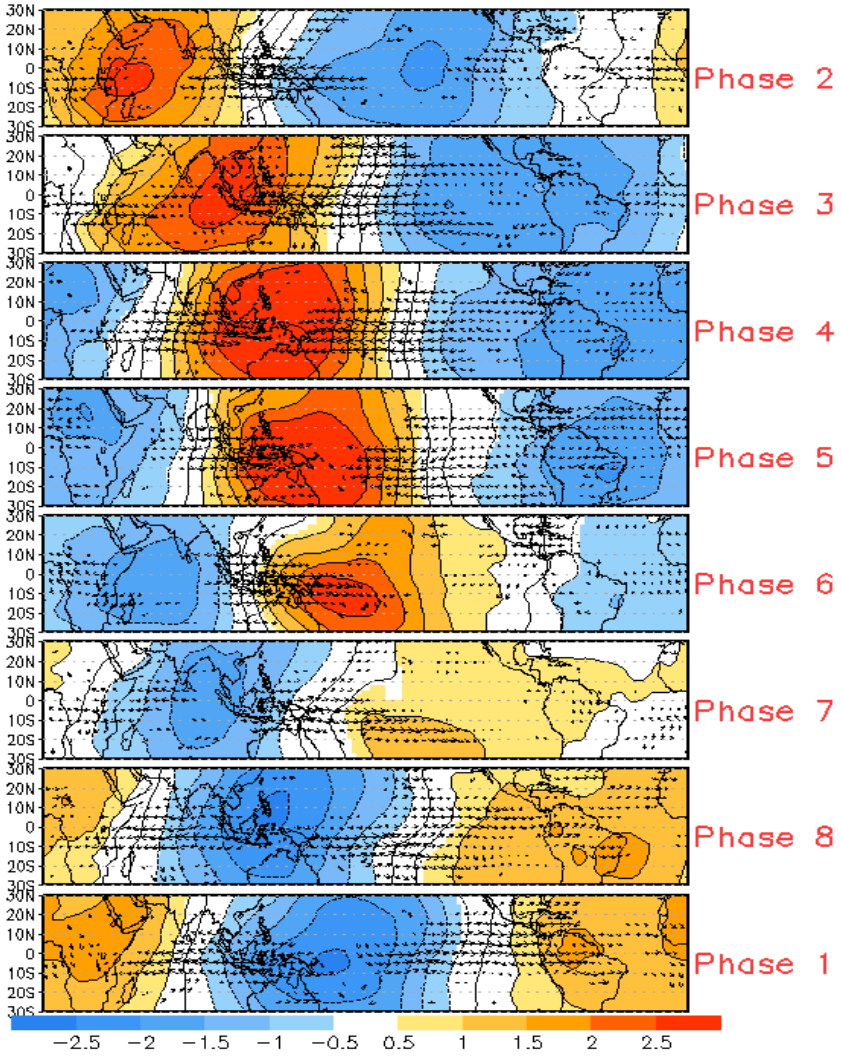




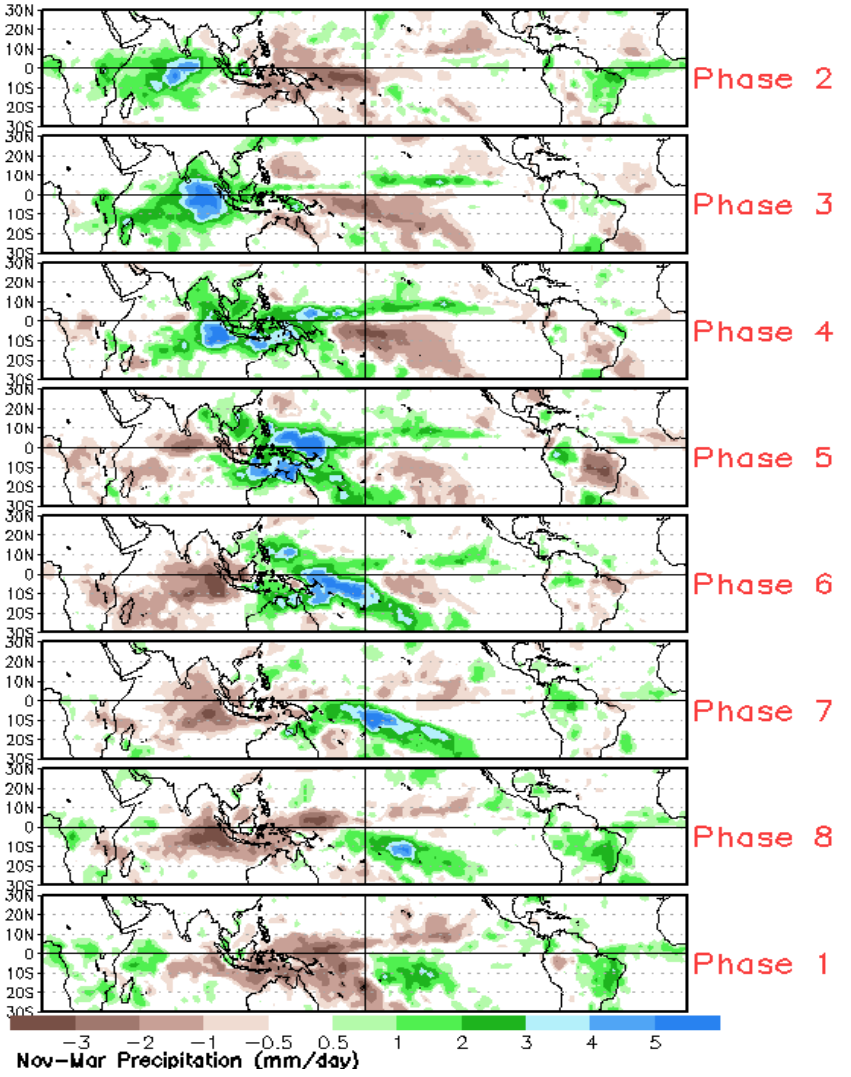
- The constructed analog forecast of RMM-based OLR also favors a propagating convective dipole and maintains it throughout the week-2 period, while also suggesting reemergence of enhanced convection over Africa.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



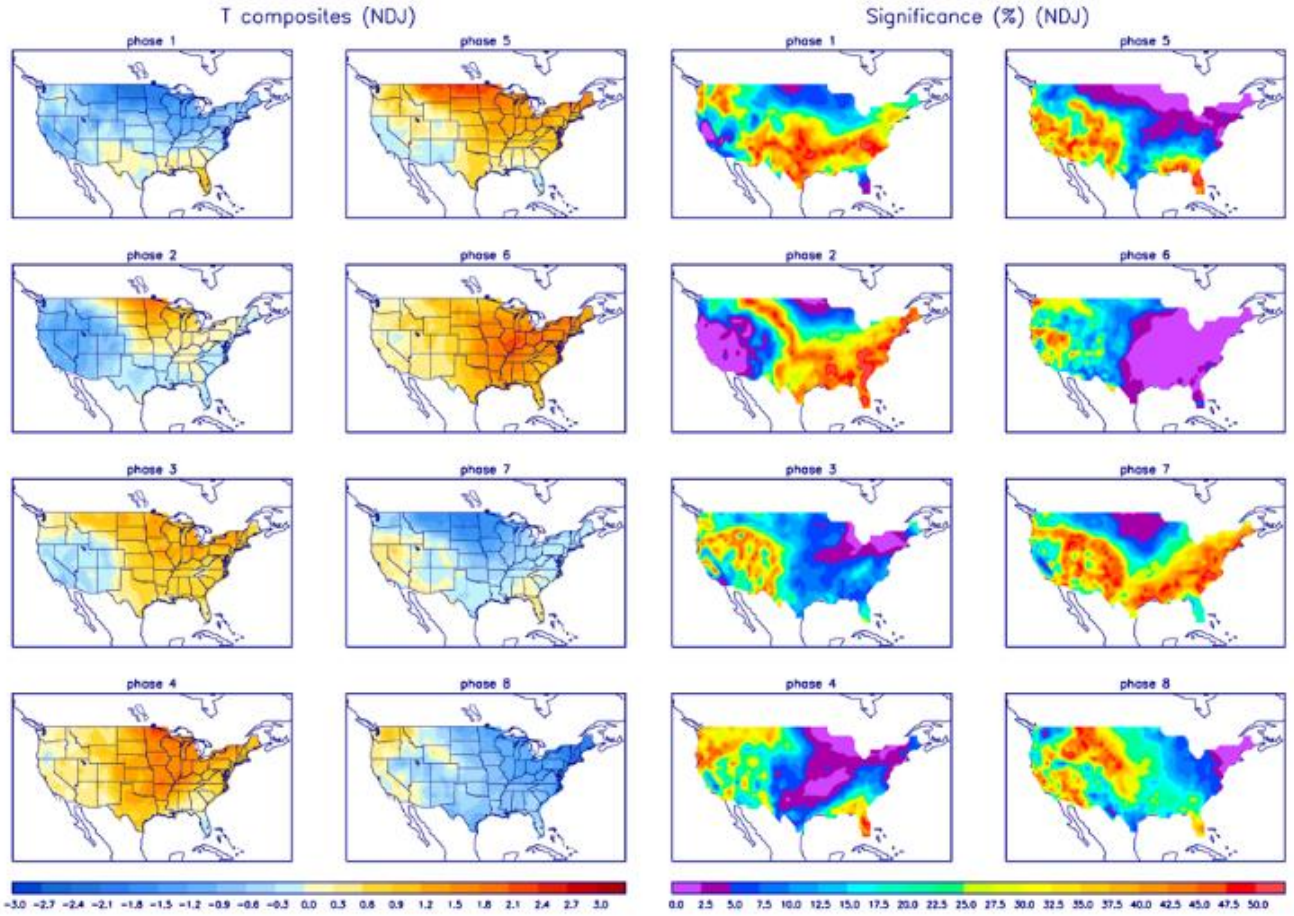
Precipitation Anomalies



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.

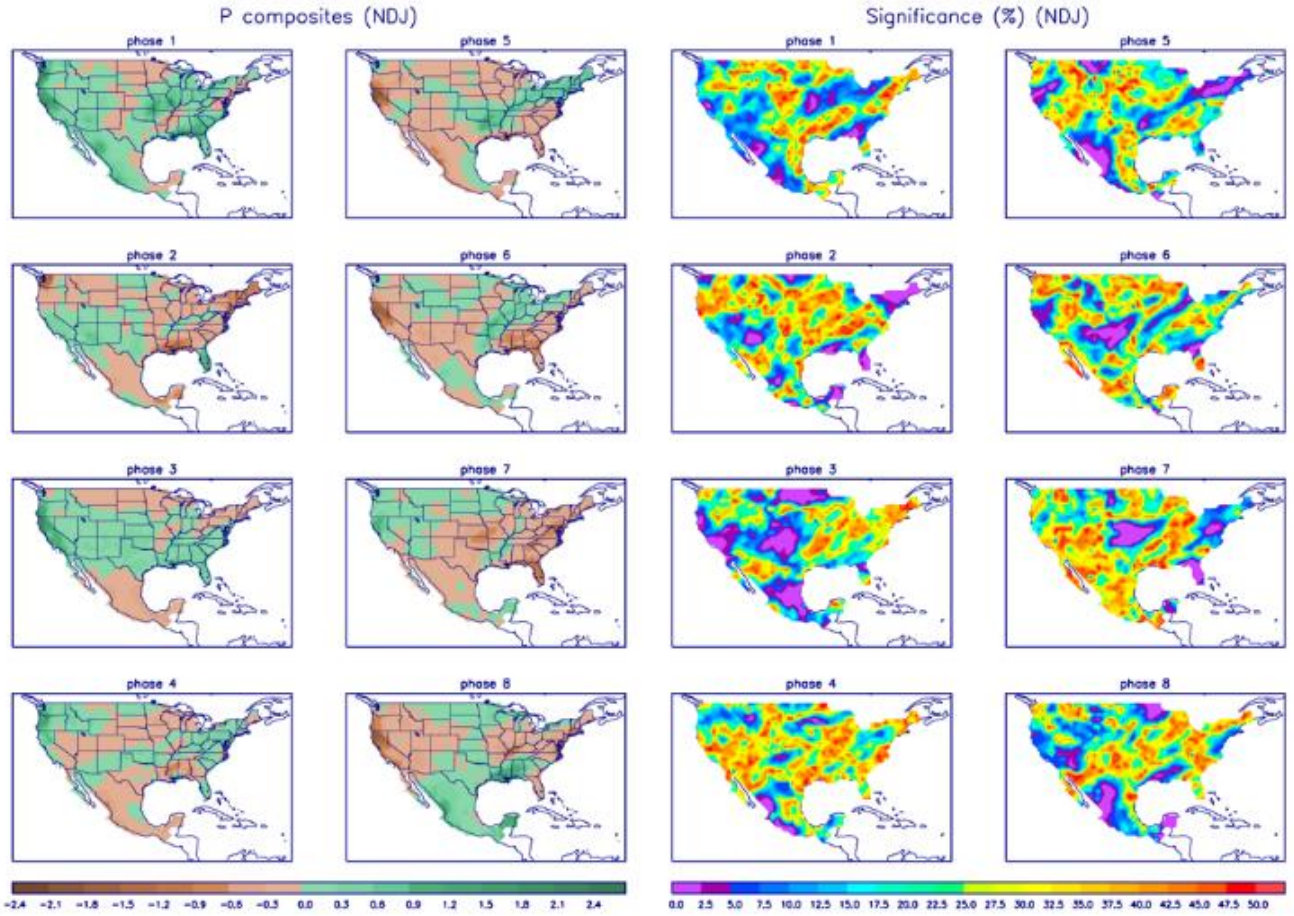


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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