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

Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
4 December 2023

Overview

- The RMM-based MJO signal continues to remain amplified, with the enhanced convective envelope approaching the Maritime Continent. Dynamical models depict continued eastward propagation during the next 2-3 weeks.

- The dominance of low-frequency modes (ENSO, IOD) has been declining over the last few weeks, while the MJO has become stronger and more coherent.

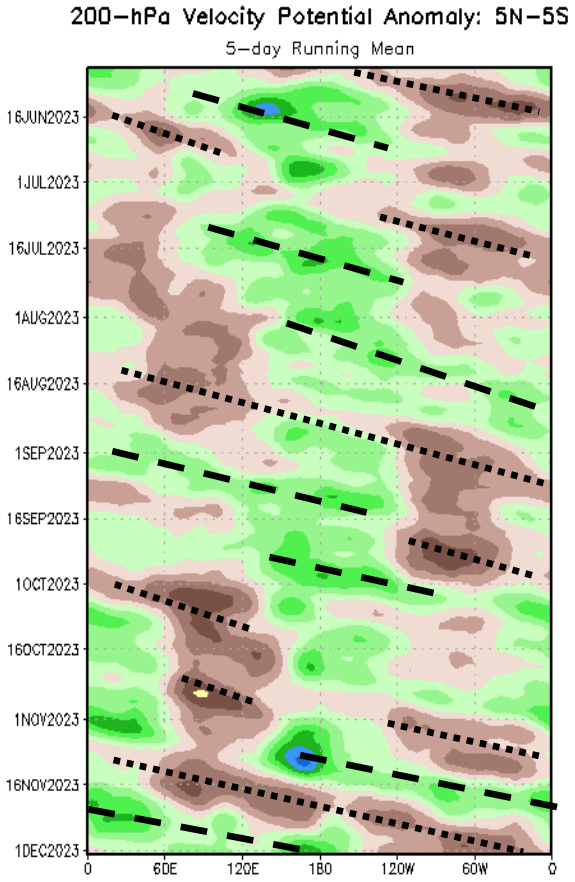
- Dynamical models indicate a generally quiet period for tropical cyclone (TC) development, with enhanced TC activity favored for the South Pacific only during the coming forecast period.

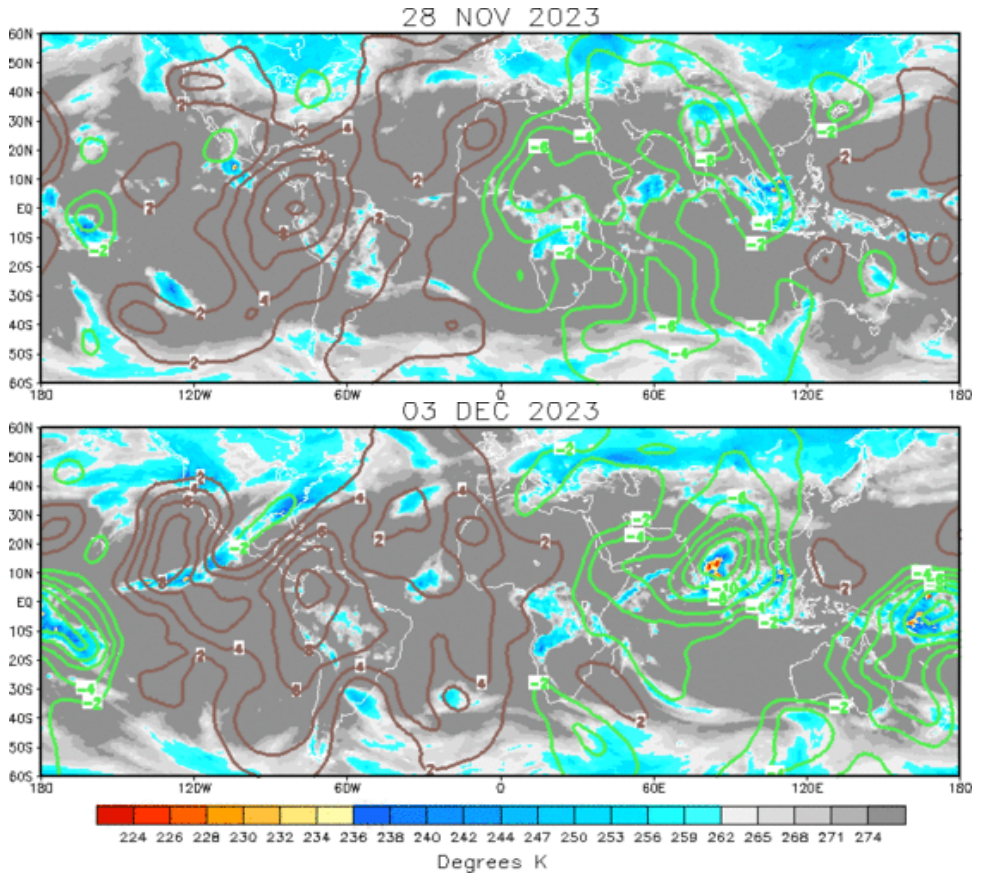
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

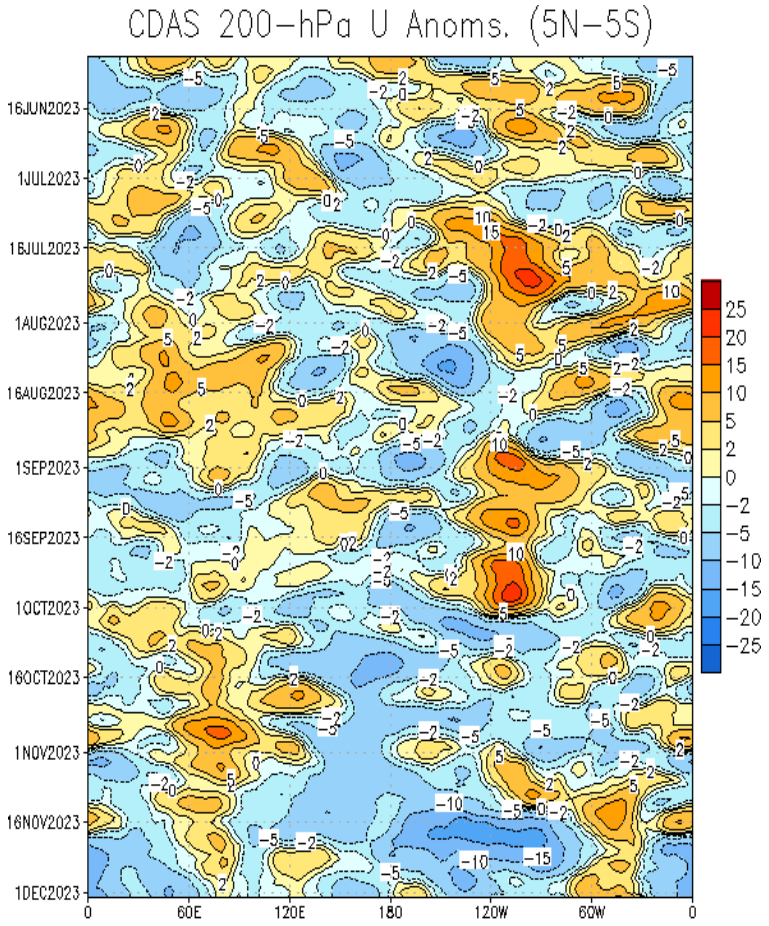


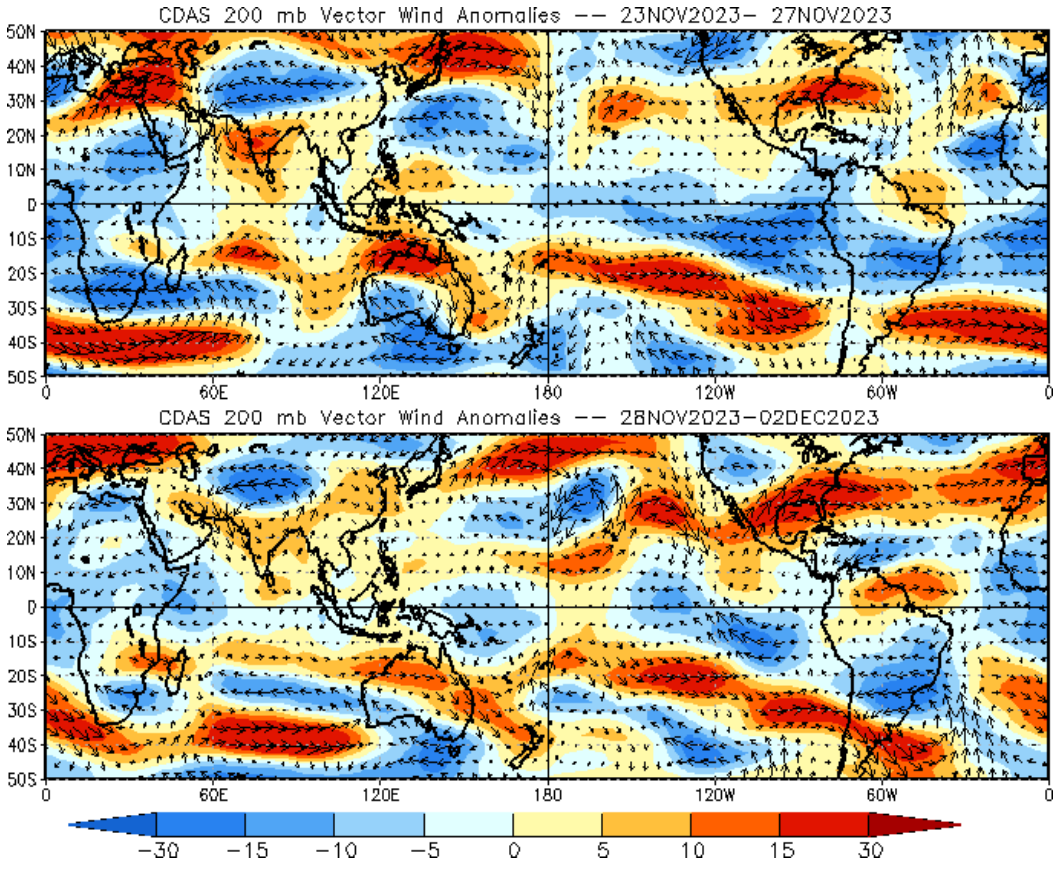


- Coherent MJO activity is becoming much more apparent in Hovmoller diagram as both wet and dry phases are holding together through interference from the ENSO/+IOD footprint.
- Wave-1 pattern is also evident in recent velocity potential anomaly maps. Enhanced convective envelope has moved from Africa across the Indian Ocean and into the Maritime Continent over the last week.

200-hPa Wind Anomalies

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

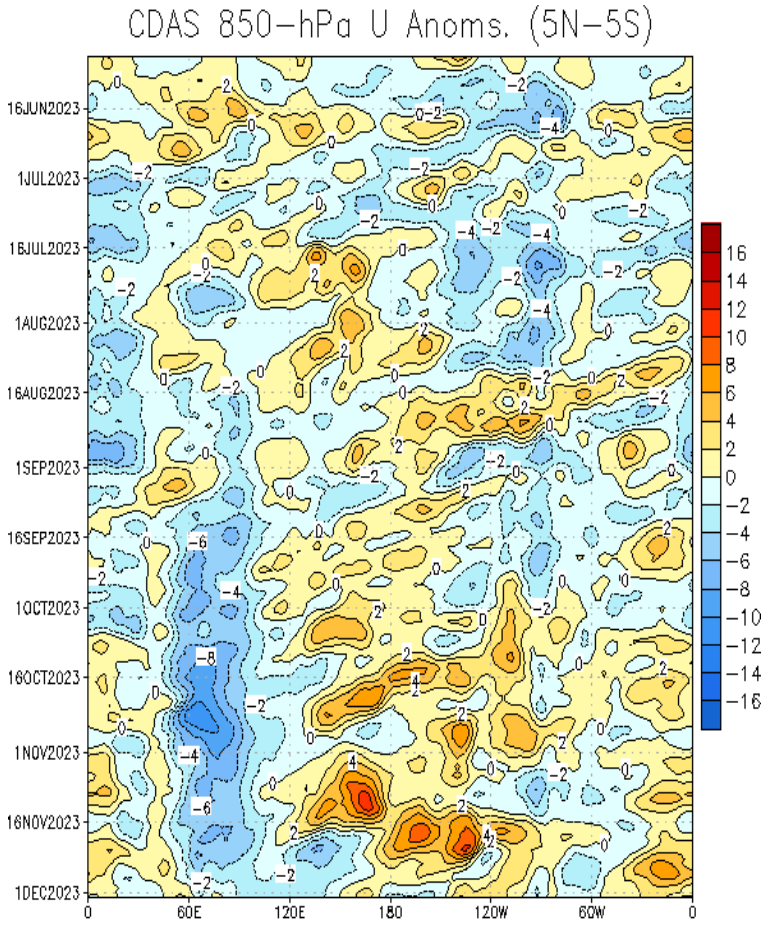


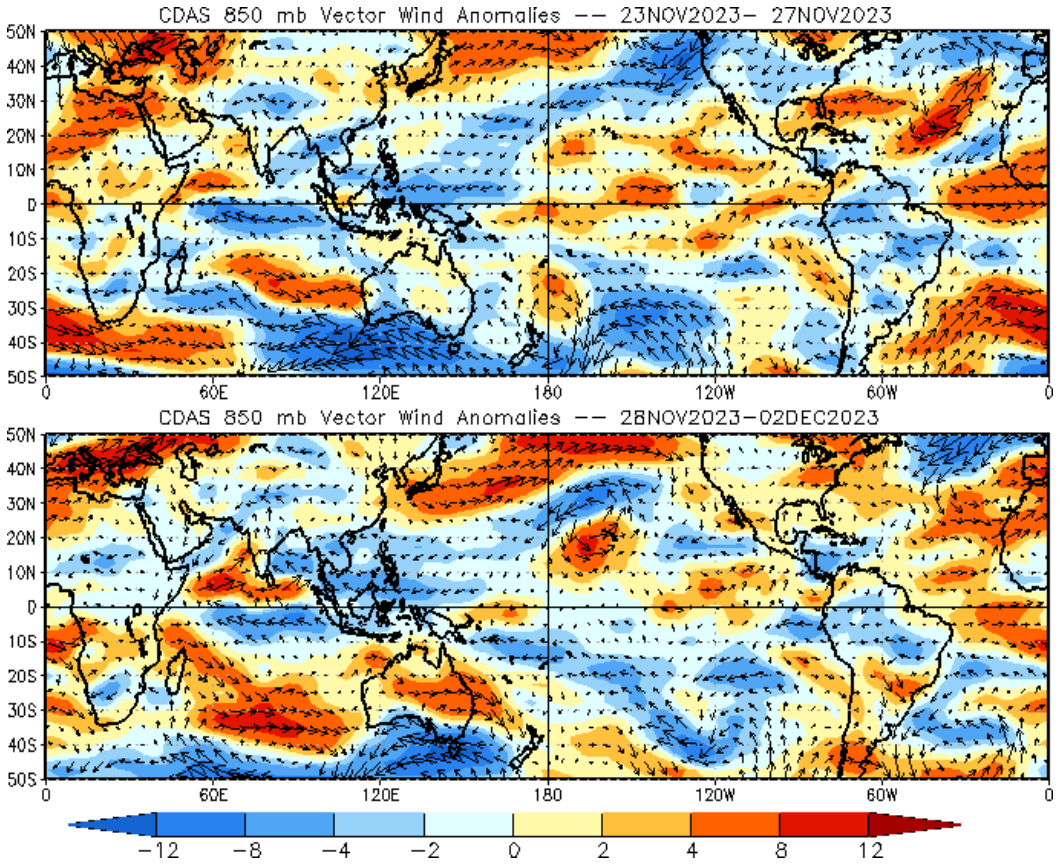


- Although weakened from its peak both in terms of area and intensity in mid-November, anomalous easterlies continue over the Eastern Pacific. Anomalous westerlies over the Indian Ocean have also continued to subside after peaking in late October.
- The jet stream in the Northern Hemisphere has become stronger in the last week, with an active subtropical branch over the Eastern Pacific.

850-hPa Wind Anomalies

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

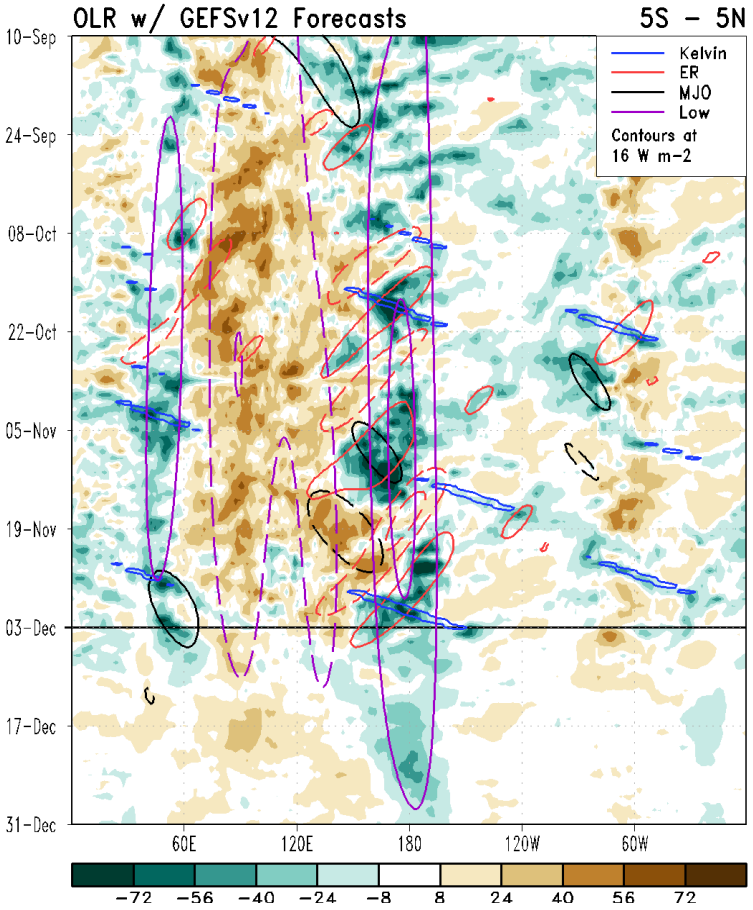


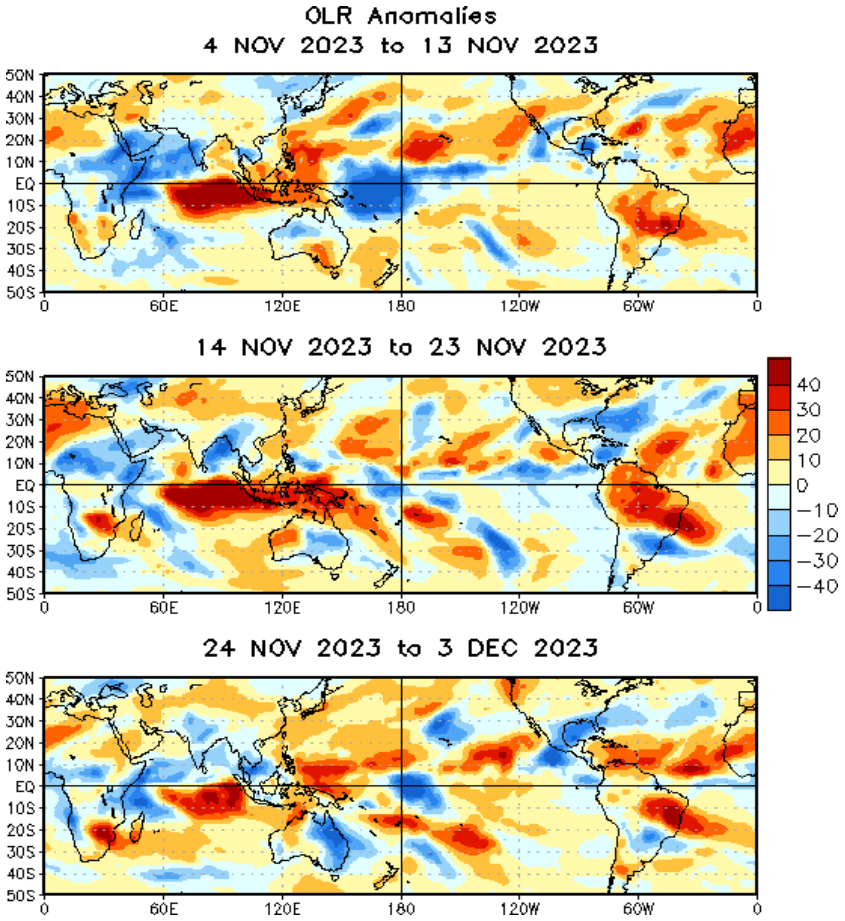


- Similar to what has been observed at the upper levels, anomalous tropical lower level winds have reduced in intensity relative to recent months.
- Trade winds over the Central Pacific have picked back up after significant weakening or reversal of winds seen during most of November.
- Similarly, enhanced easterlies over the Indian Ocean due to +IOD have reduced in intensity in recent weeks.

Outgoing Longwave Radiation (OLR) Anomalies

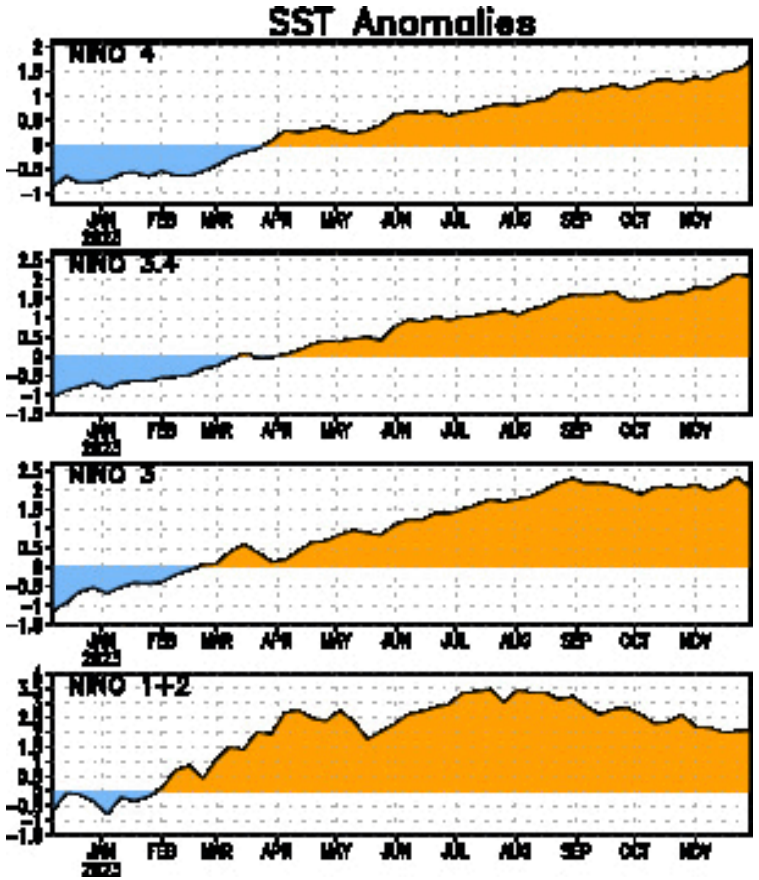
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

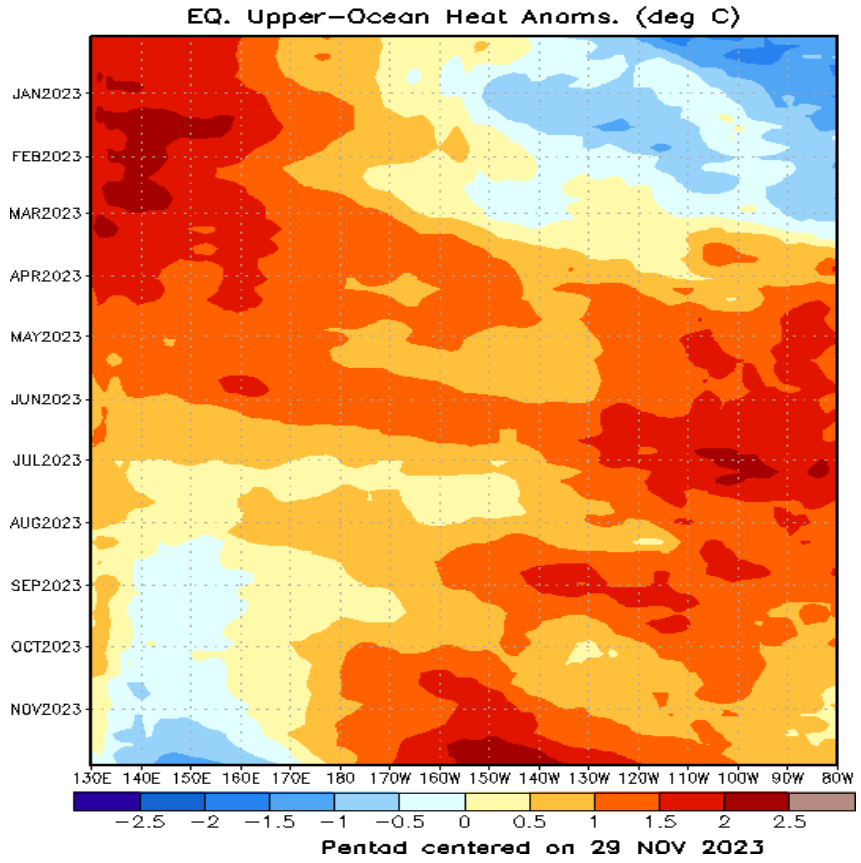




- The +IOD, MJO, El Niño, and enhanced Rossby Wave activity have contributed to substantial interference with each other in the overall convective pattern across the tropics in the past week.
- On the whole, the dominance of low frequency factors (ENSO,IOD) has reduced somewhat over the last month as the IOD weakens and the MJO has become more of a player.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

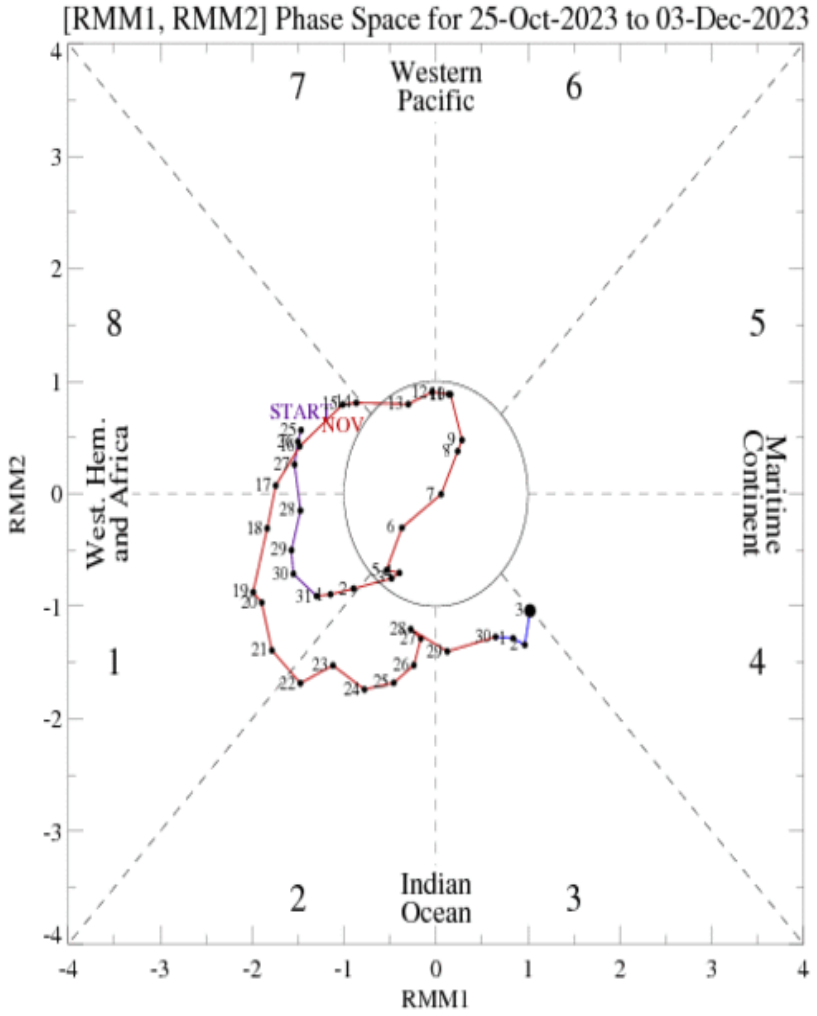




- Low-level westerly wind burst activity across the Pacific during November have resulted in rising SSTs across the Central Pacific, with the NINO 3.4 region now indicating SST anomalies greater than +2.0°C.
- Negative upper-ocean heat content anomalies have increased across the Western Pacific.

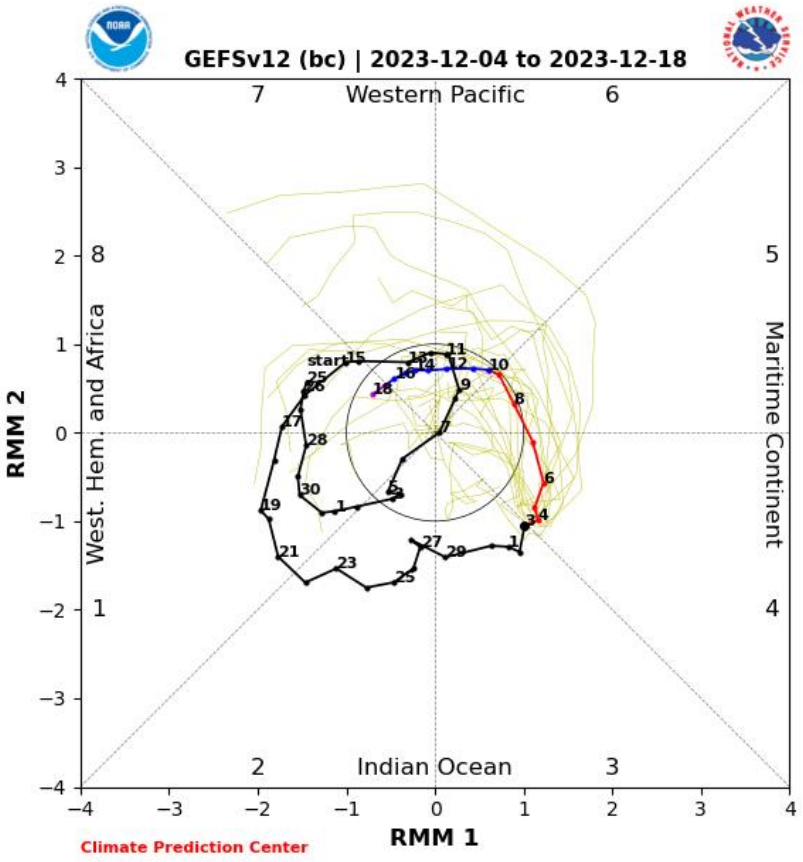
MJO Index: Recent Evolution

- The RMM-based MJO index has remained amplified during the past week, with eastward propagation approaching the Maritime Continent.

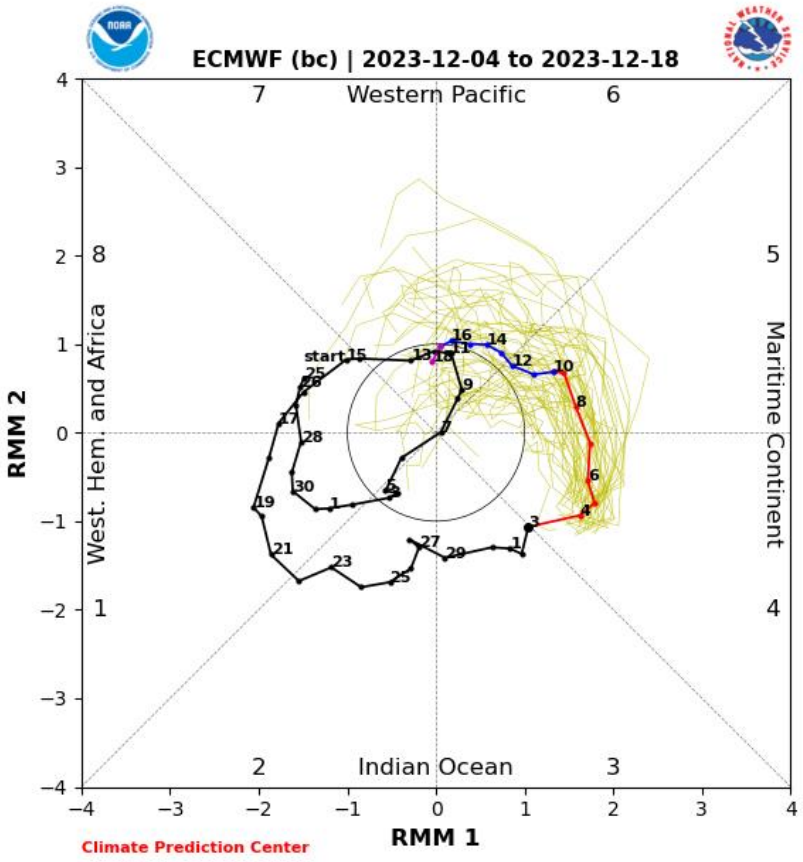


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

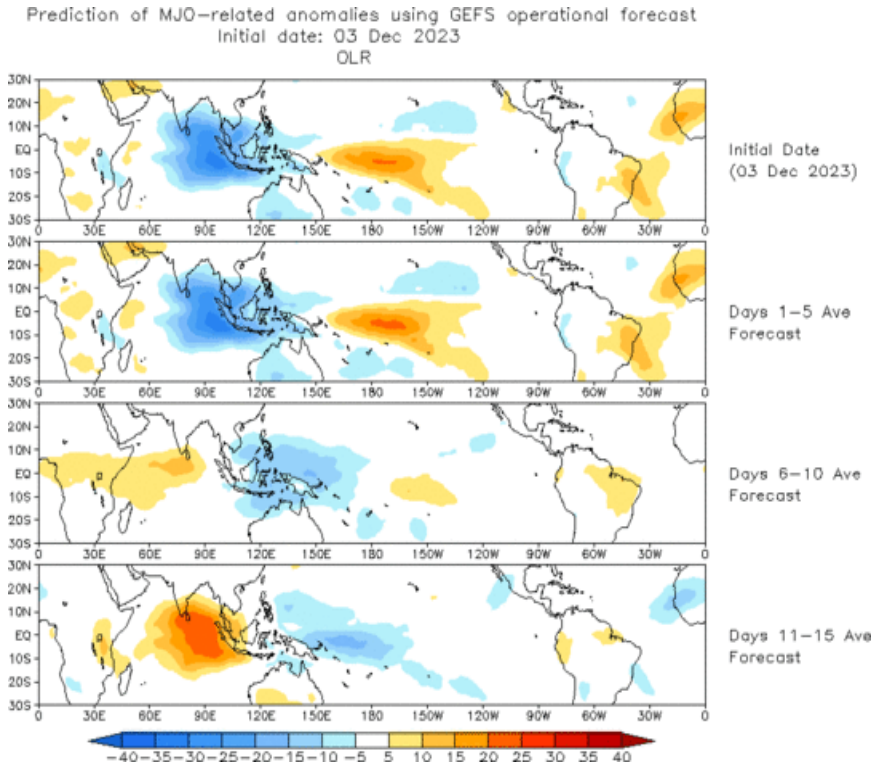


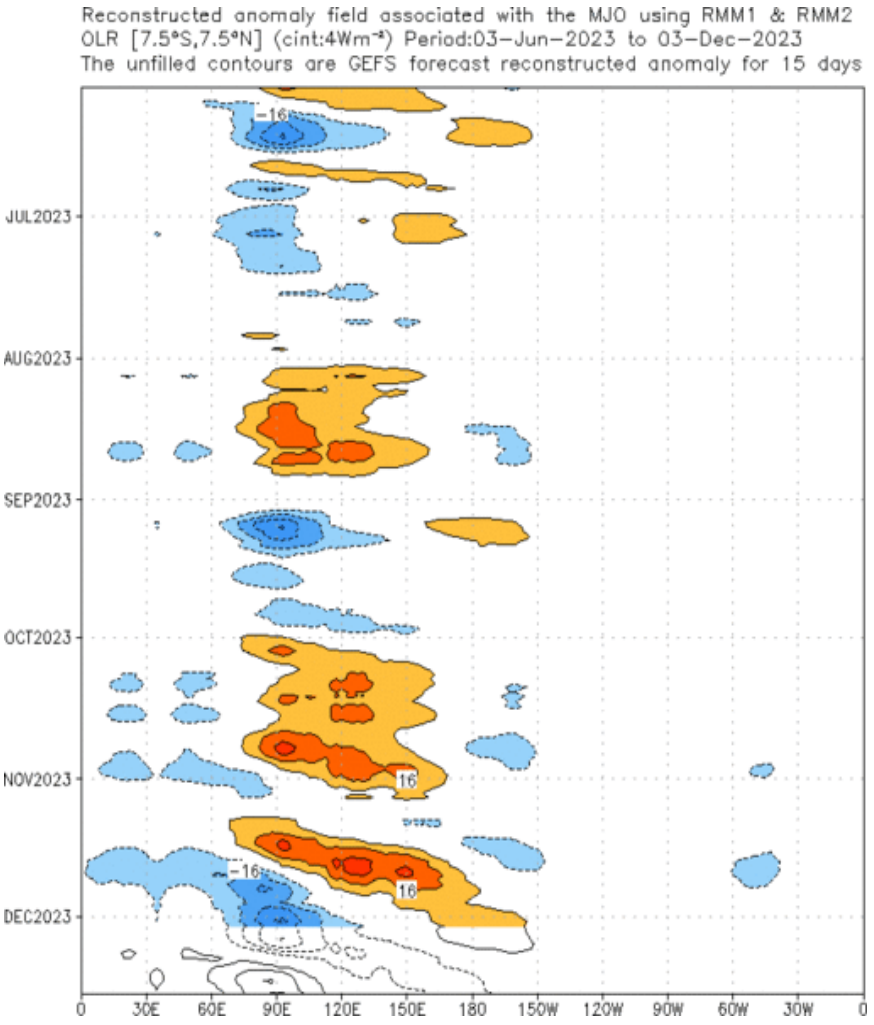
ECMWF Forecast

- The GEFS and ECMWF ensembles are in good agreement that the MJO will remain amplified and propagate eastward across the Maritime Continent and Western Pacific during the next 2 weeks.
- In the near-term, the MJO is forecast to destructively interfere with El Niño, with more constructive interference becoming possible as the intraseasonal signal moves toward the Date Line.

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.)

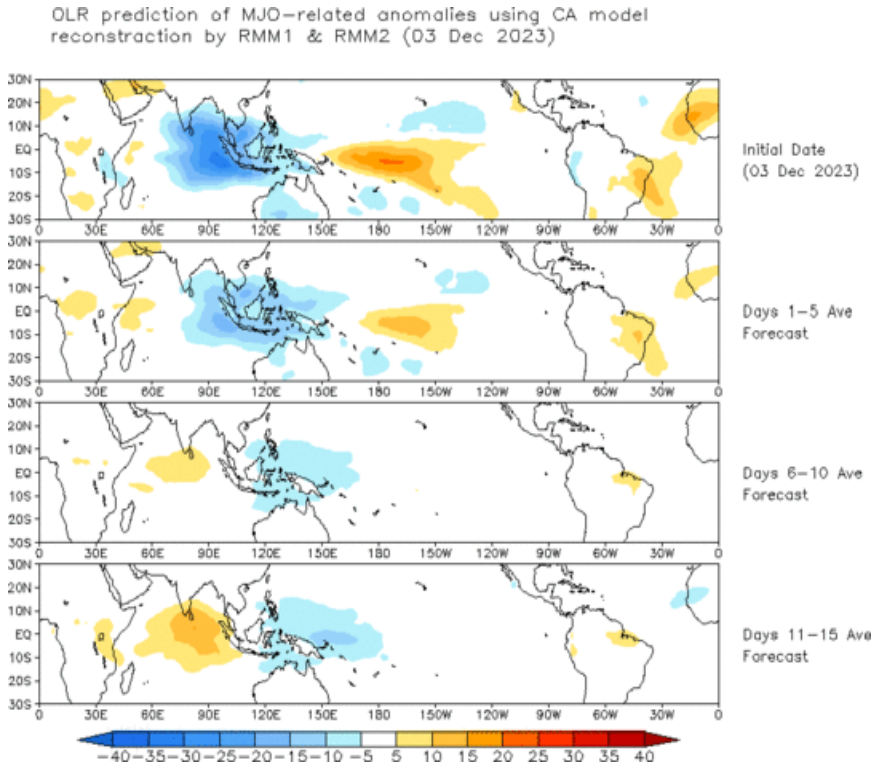


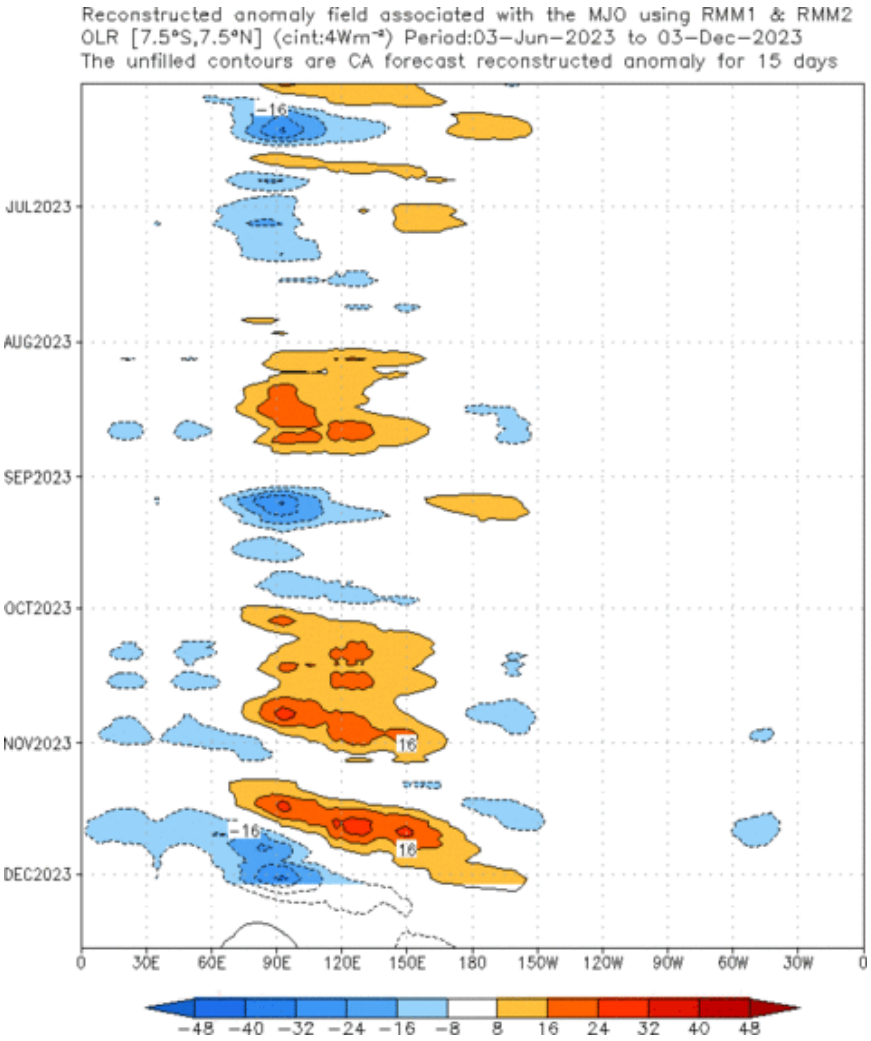


- The GEFS RMM-based OLR forecast depicts negative (positive) OLR anomalies across the Indian Ocean (Western Pacific) during week-1.
- By week-2, negative anomalies over the Indian Ocean weaken and spread into the Western Pacific.

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.)

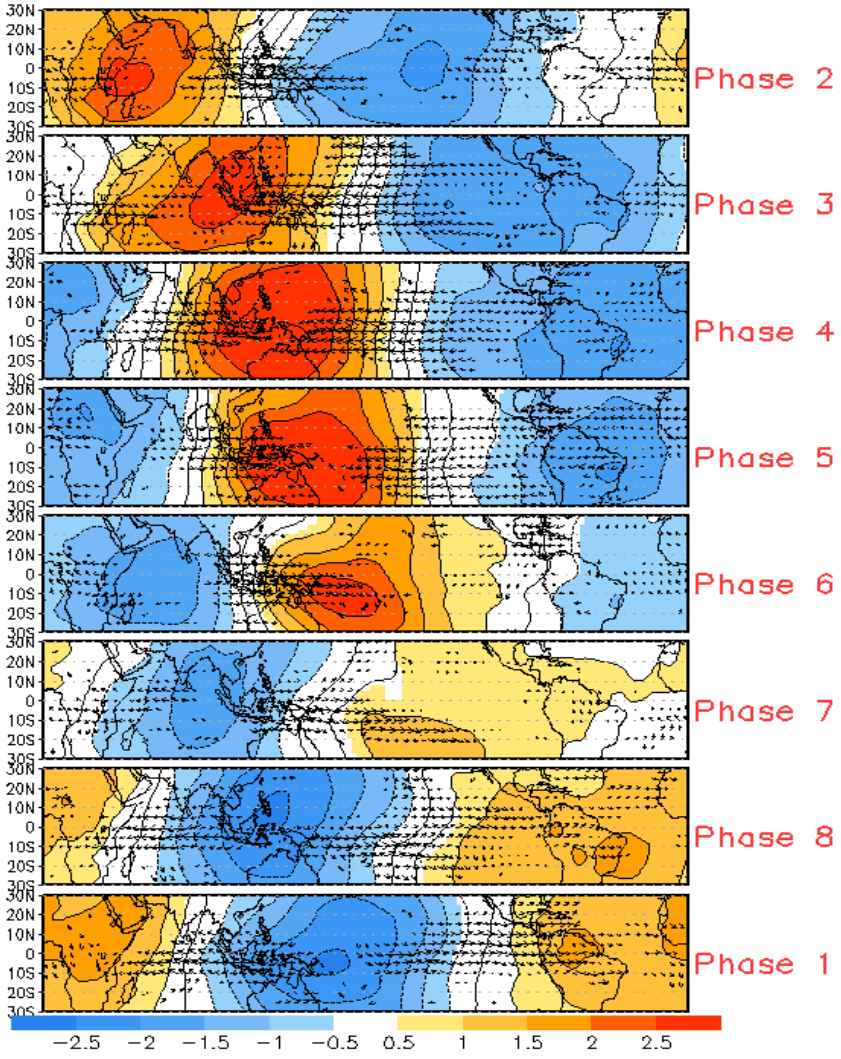




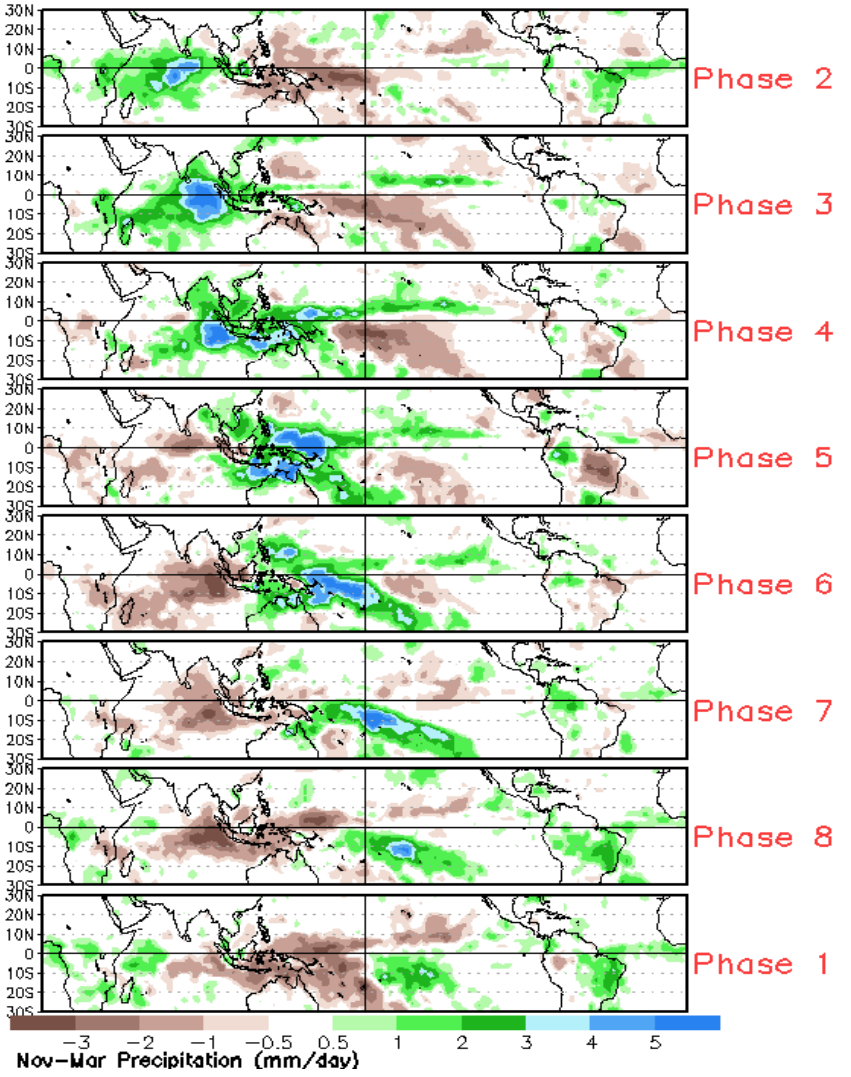
- The constructed analog RMM-based forecast closely matches the GEFS, with a faster weakening of the positive and negative OLR anomalies by week-2.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



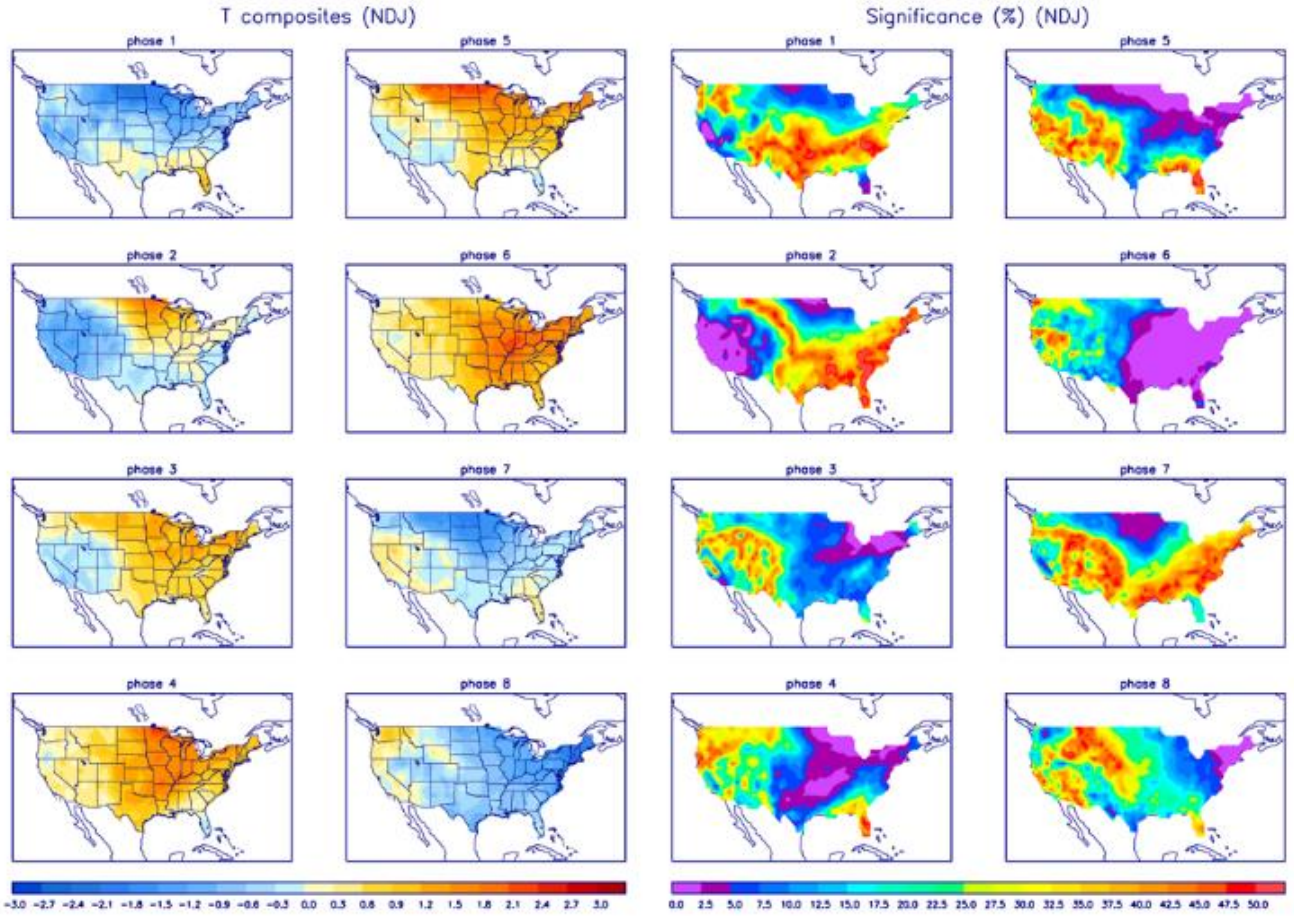
Precipitation Anomalies



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.

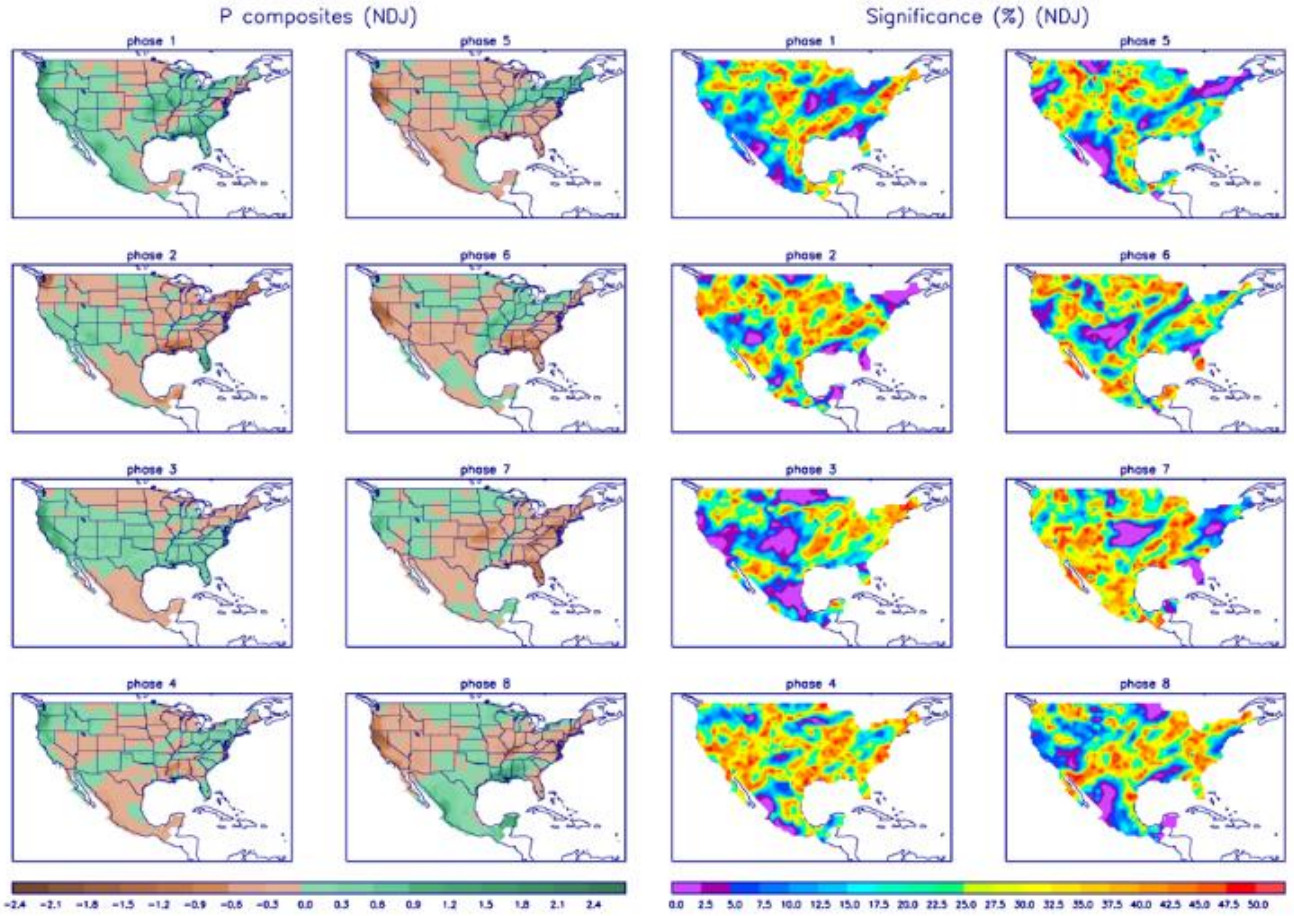


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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