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

Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
12 December 2022

Overview

- While the amplitude of the RMM-based MJO index has weakened during December, eastward propagation remains well established, with the enhanced phase of the MJO crossing the Indian Ocean.

- The MJO is currently constructively interfering with the La Niña base state.

- Dynamical model MJO index forecasts are split, with the GEFS depicting an amplifying signal over the Indian Ocean before a resumption of eastward propagation, while the ECWMF shows the eastward propagation materializing more quickly.

- The MJO may contribute to increased chances of tropical cyclone formations over the entire southern Indian Ocean basin during Week-2.

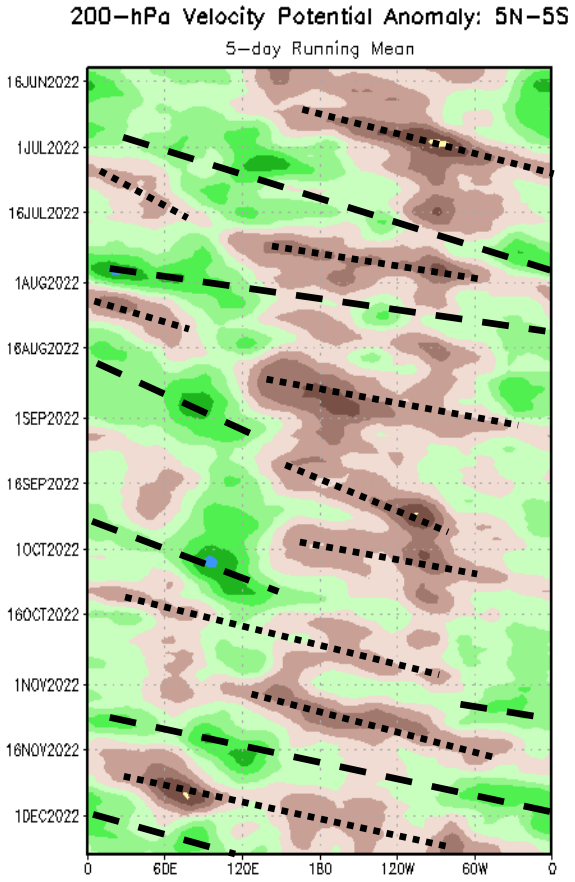
- MJO activity teleconnects well to the Northern Hemisphere extratropical pattern this time of year, and therefore the MJO may contribute to a pattern change over North America. Strong blocking over the North Atlantic reduces confidence in this scenario.

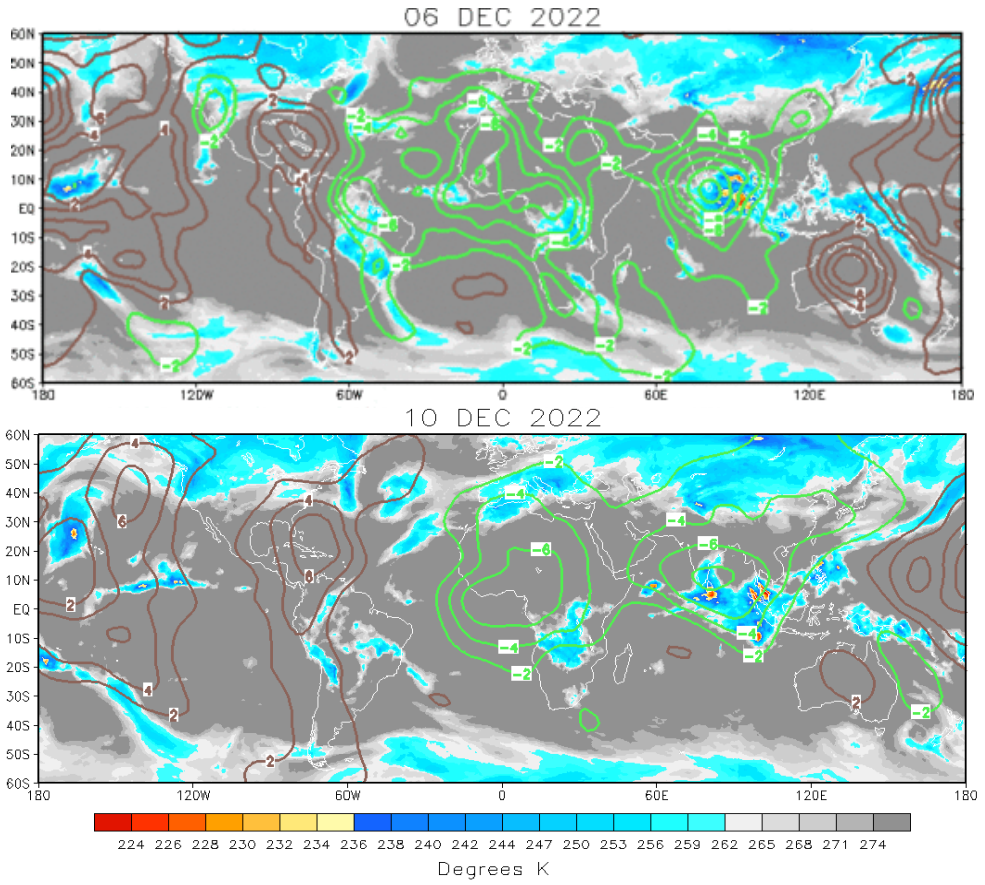
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)



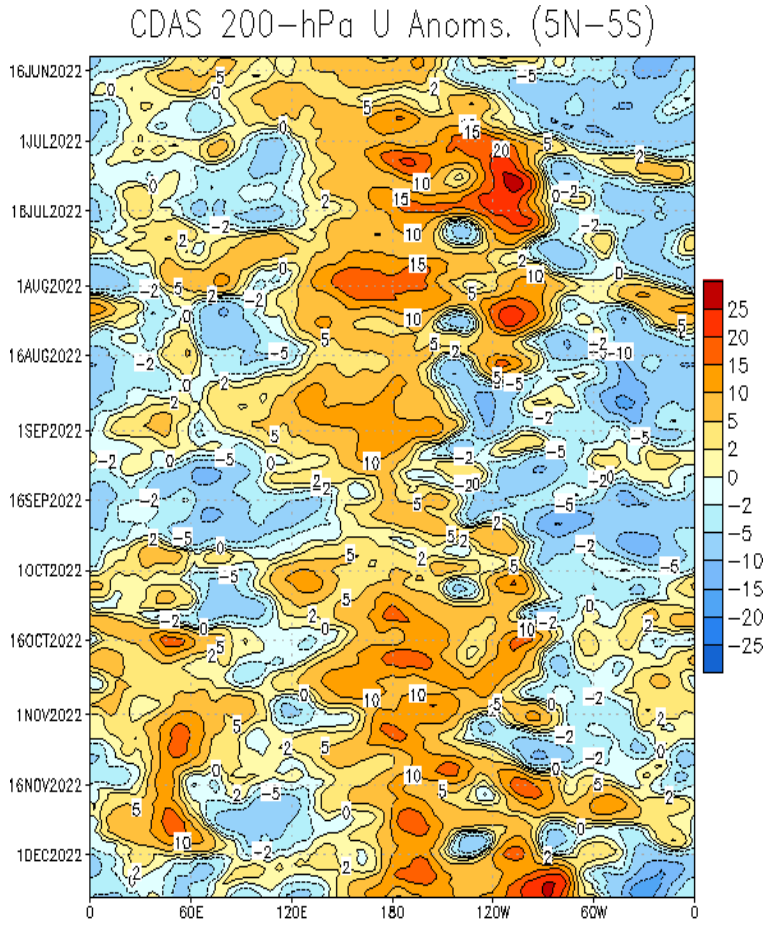


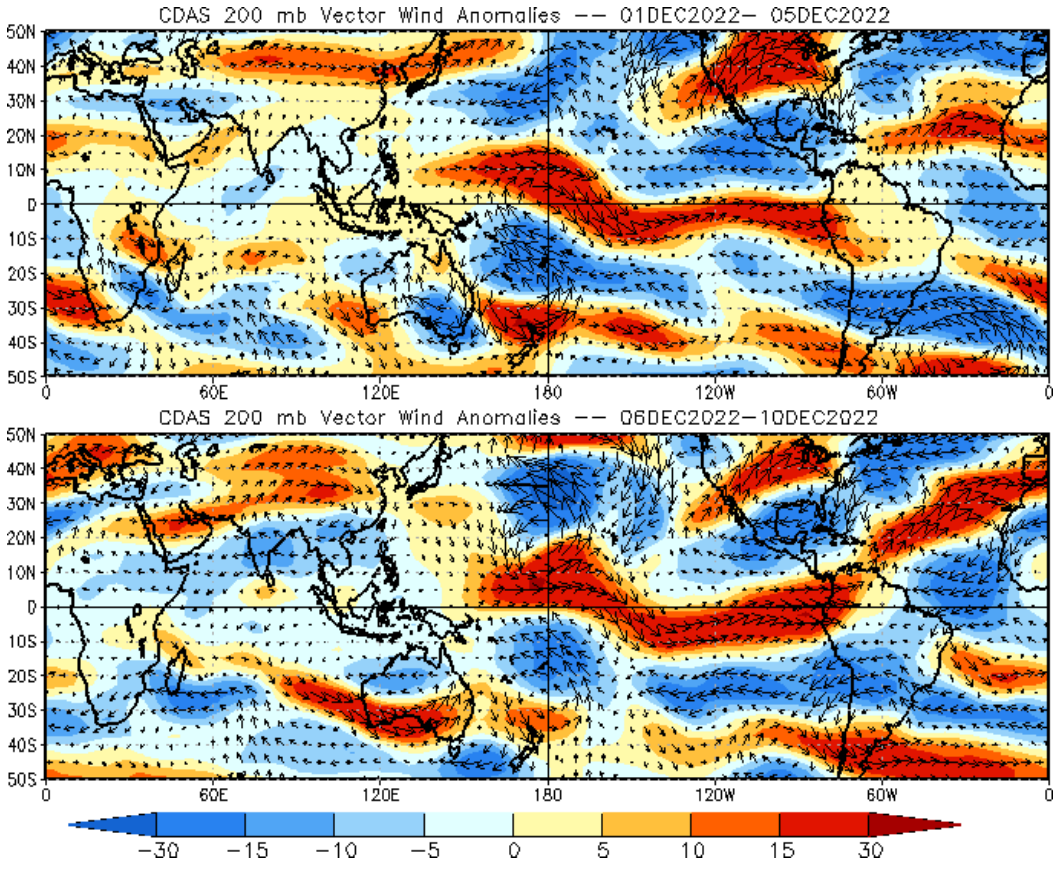
- The upper-level velocity potential pattern continues to reflect an active intraseasonal signal with a phase speed on the high end of the MJO climatology.

- An envelope of enhanced divergence aloft crossed the Indian Ocean during early December.

200-hPa Wind Anomalies

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

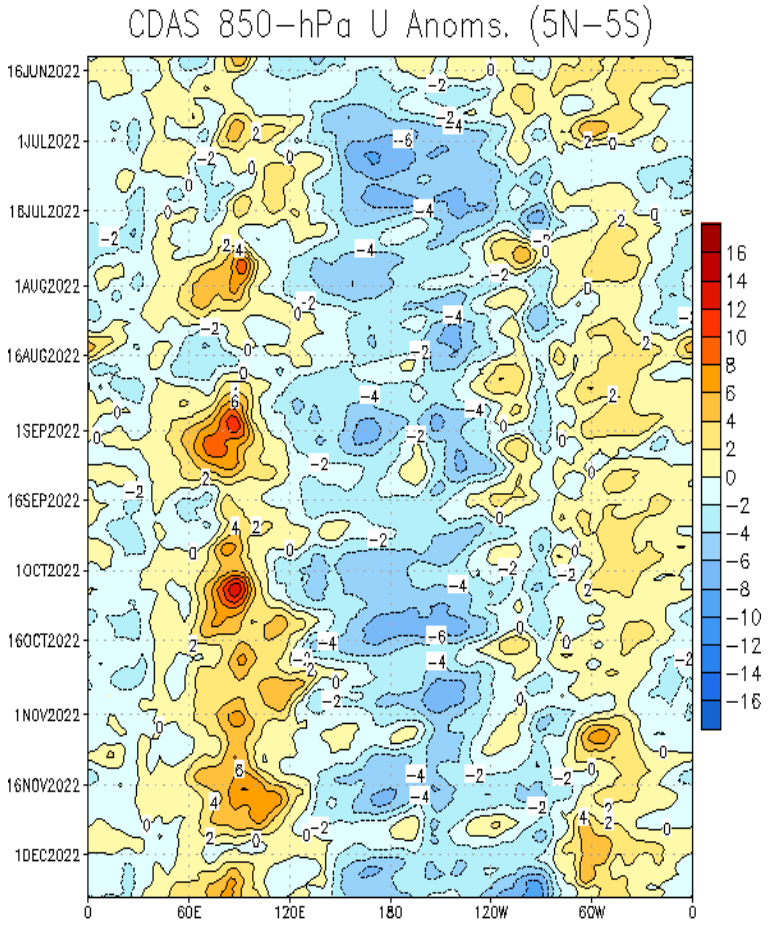


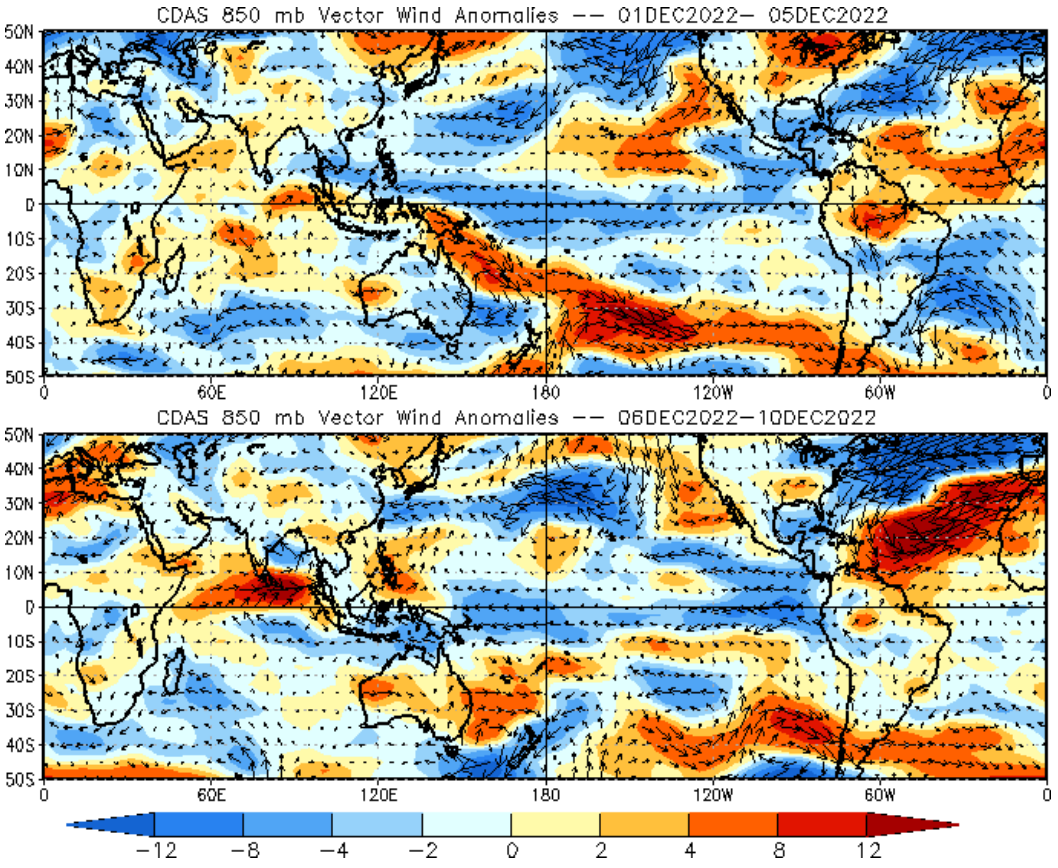


- Strong westerly anomalies aloft continue to dominate the tropical Pacific.
- Anti-cyclonic circulation centered over the Date Line over the South Pacific midlatitudes has persisted since early December.

850-hPa Wind Anomalies

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

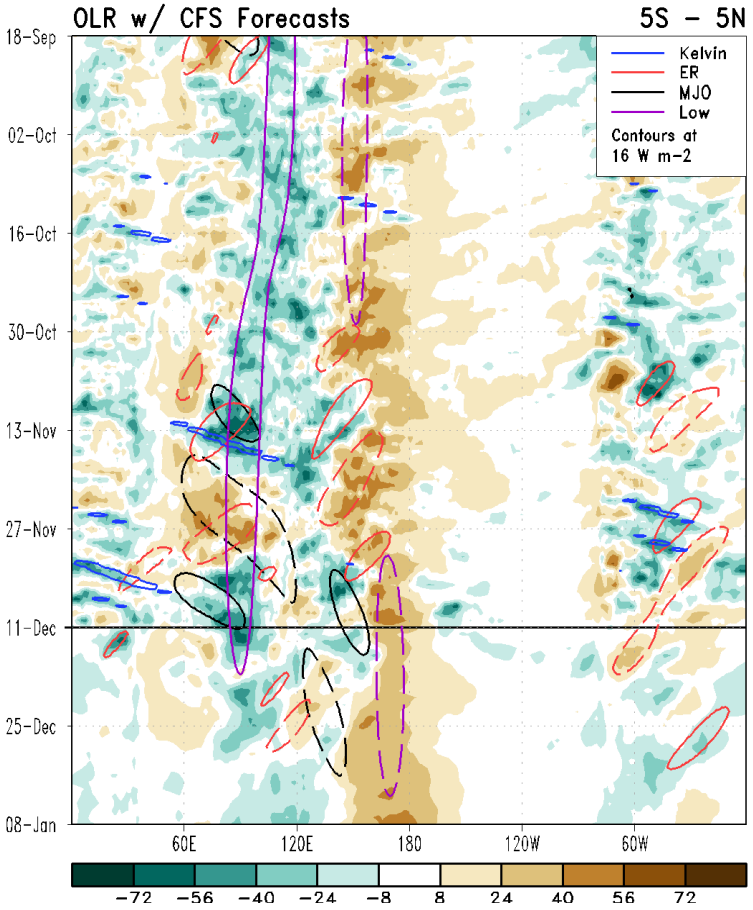


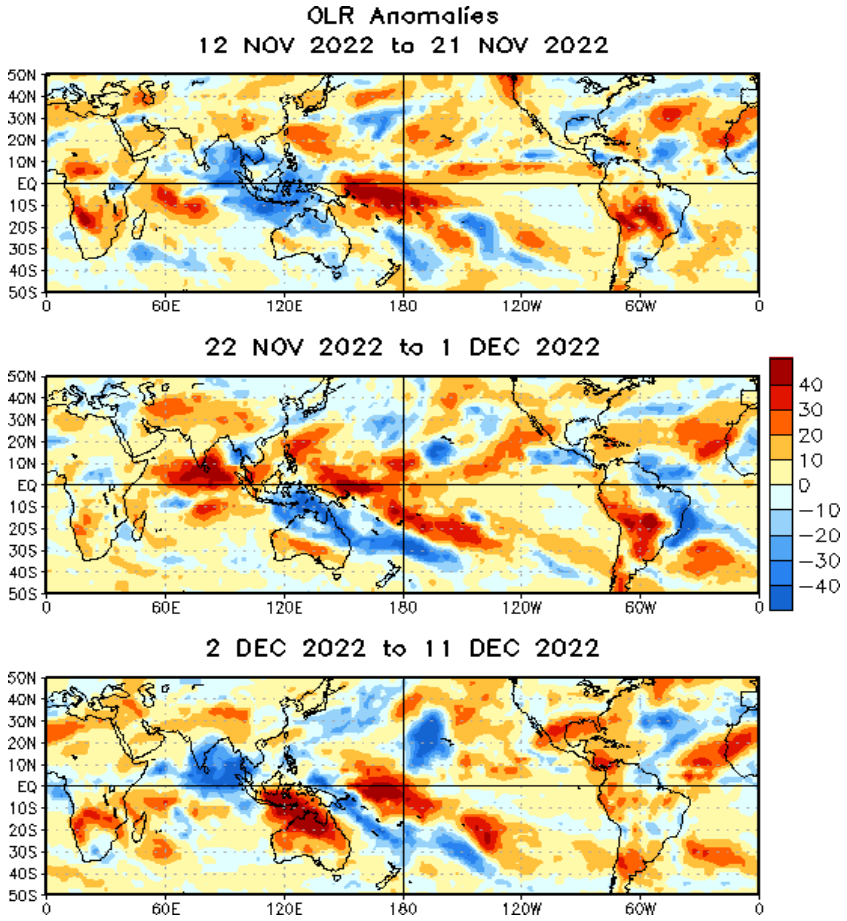


- Enhanced trades remain entrenched over much of the equatorial Pacific basin.
- Anomalous low-level westerlies that developed near and east of the Philippines during the second week of December may be related to TC Pakhar.
- A blocking pattern over the North Atlantic increased in strength.

Outgoing Longwave Radiation (OLR) Anomalies

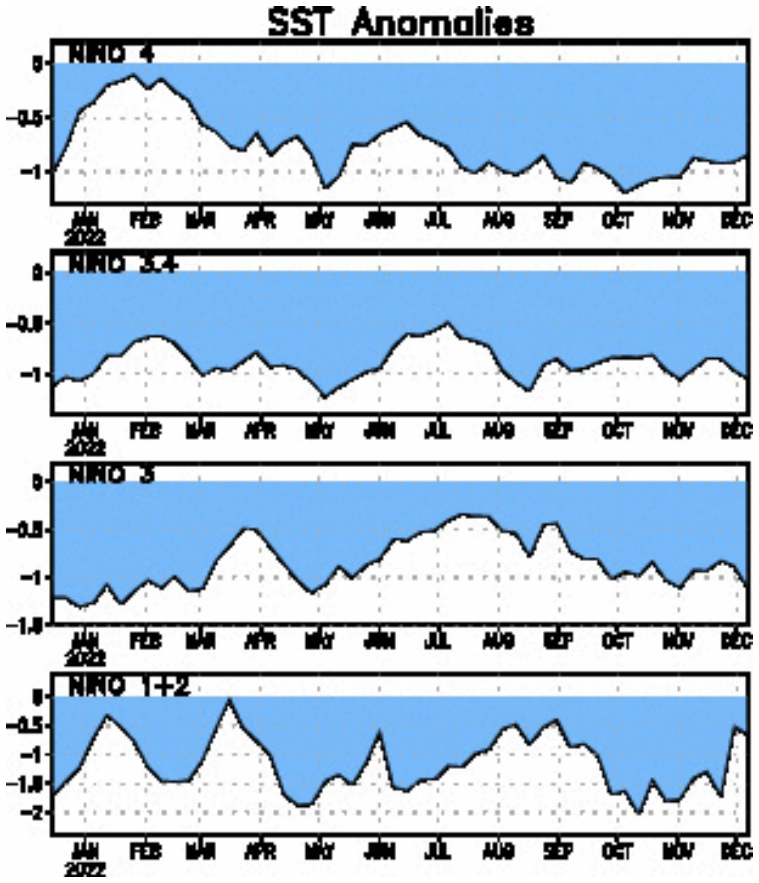
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

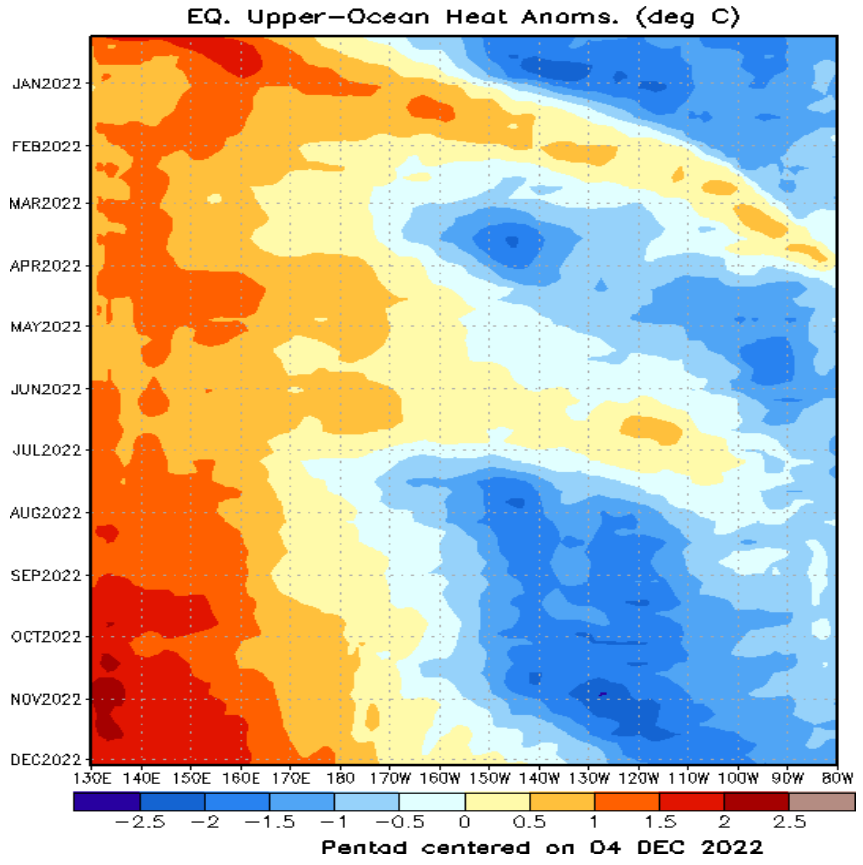




- The low frequency ENSO base state remains the most dominant feature in the OLR field.
- MJO activity during late November briefly disrupted the base state,
- The intraseasonal signal is currently constructively interfering with the base state.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

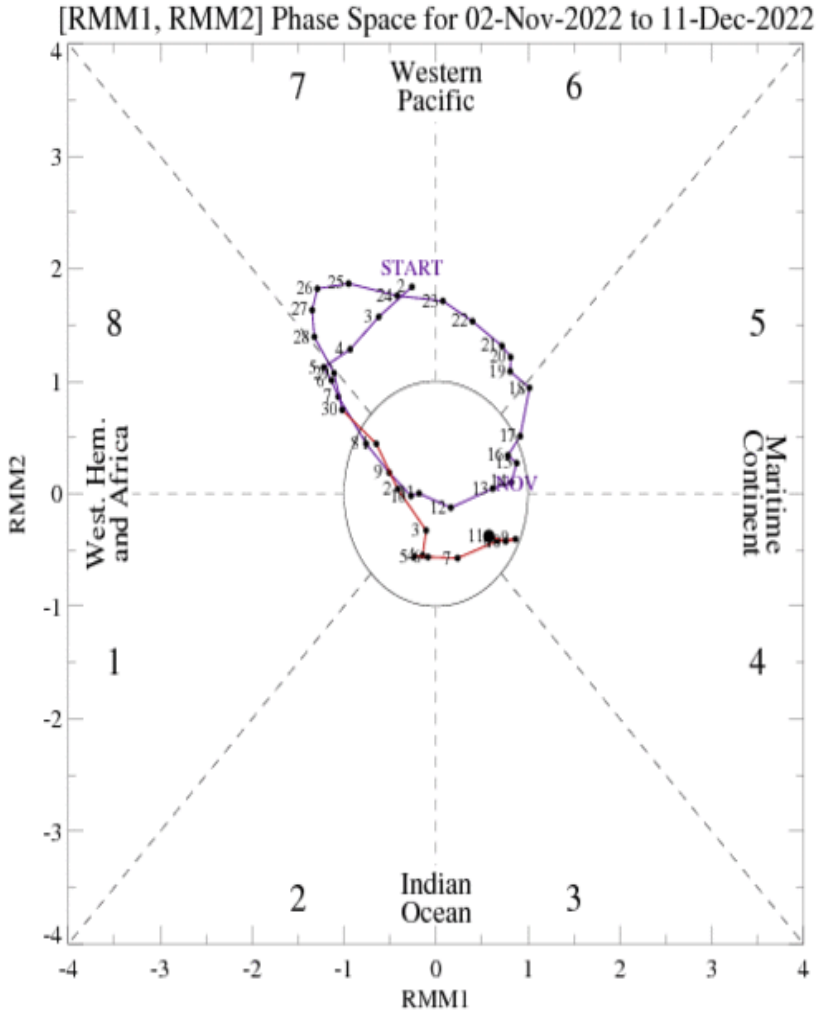




- The zonal gradient of upper-ocean heat anomalies has been increasing over the last month and the westward extent of anomalous cold is beginning to shift eastward, possibly due to recent MJO activity.
- SSTs remain well below average across all Niño basins, reflecting robust and persistent cold ENSO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

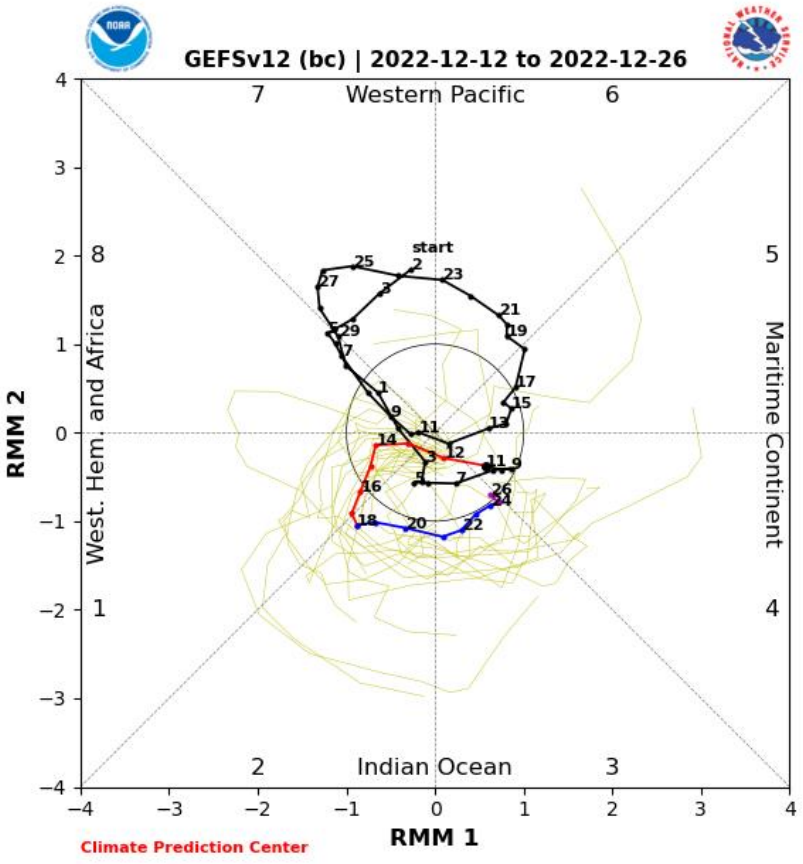
MJO Index: Recent Evolution

- While the amplitude of the RMM index was weak through the first part of December, eastward propagation of the signal remains well established.
- The latest observations depict a sharp “left-turn” of the index, reflective of potential Rossby wave interference.

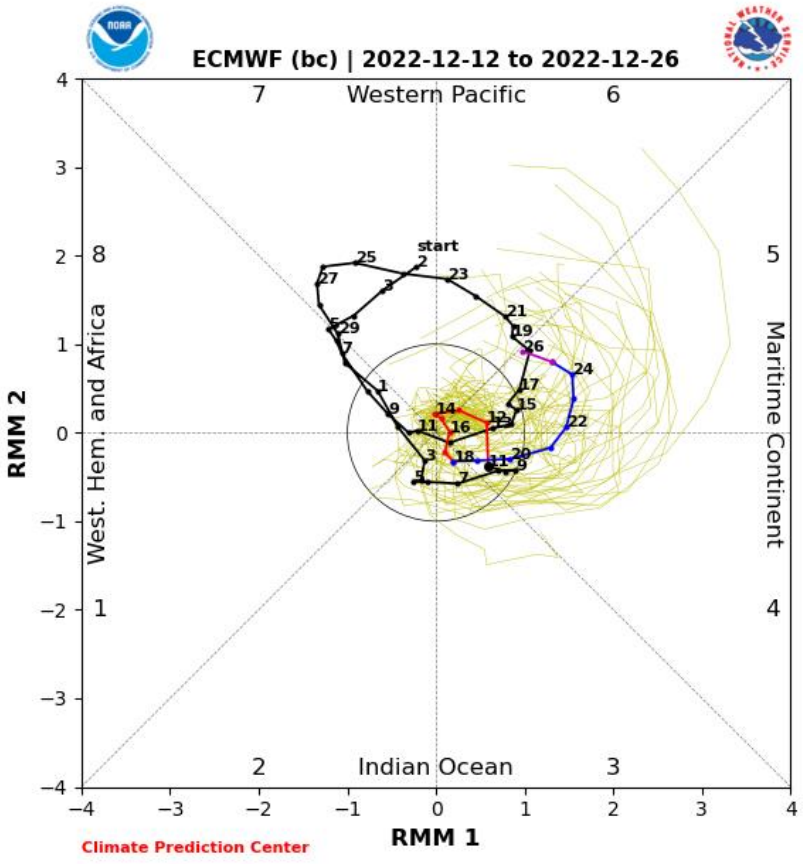


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

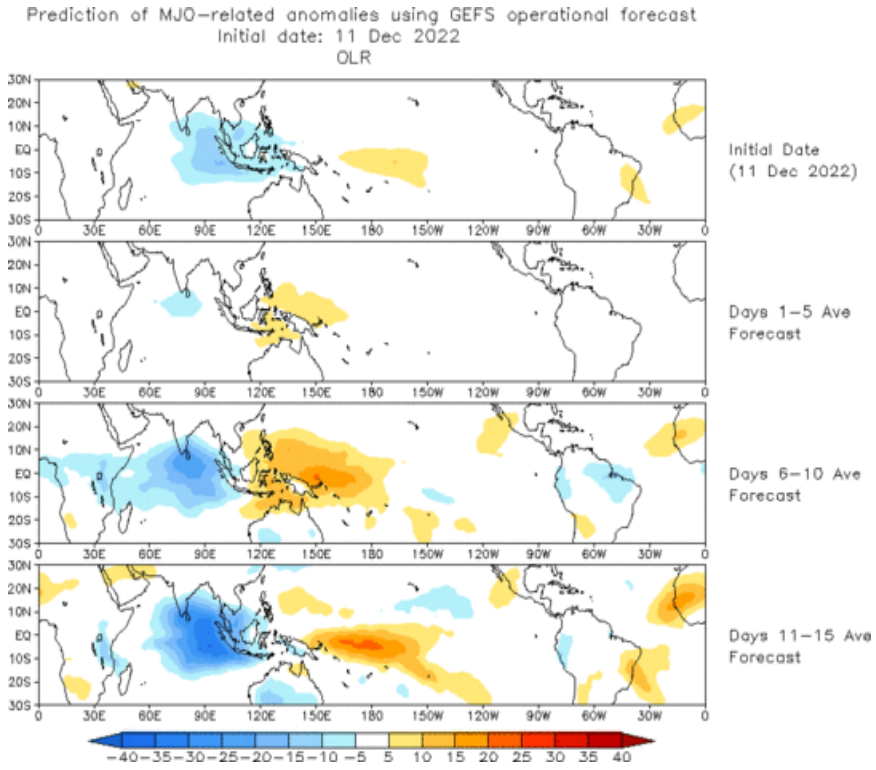


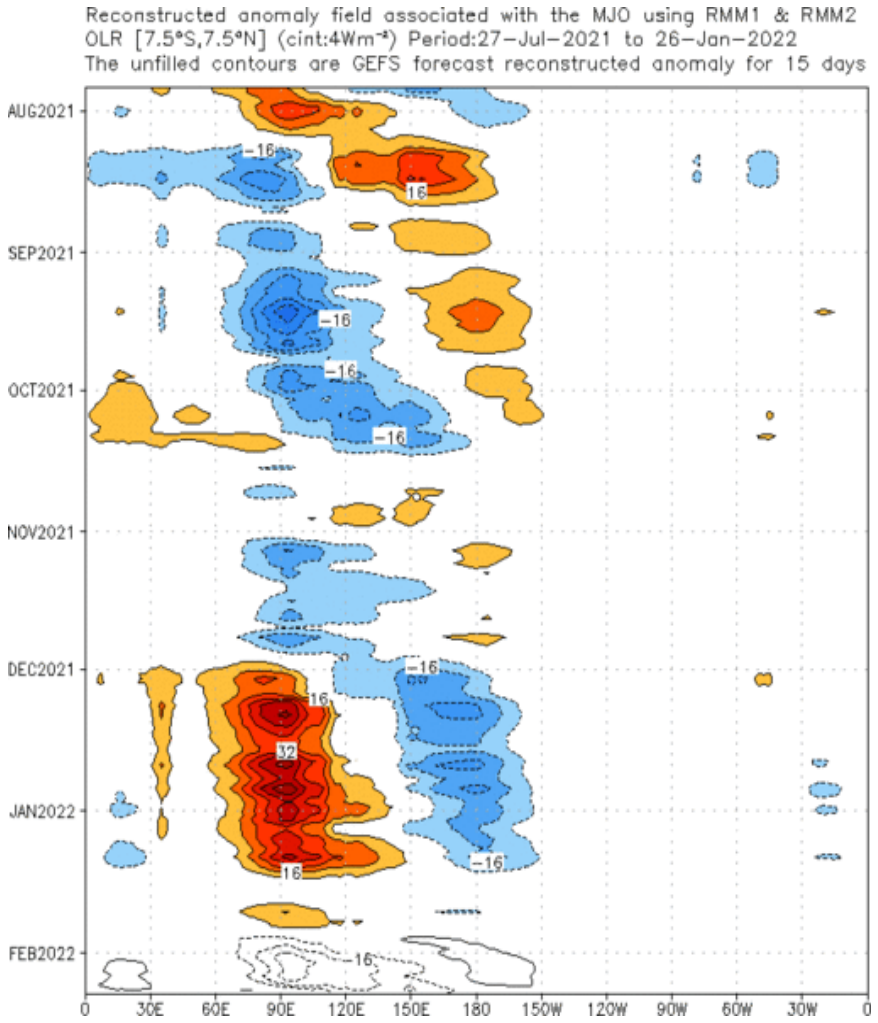
ECMWF Forecast

- Both the GEFS and ECMWF depict eastward propagation of the MJO through Week-2; however, the GEFS has a slower evolution and a pronounced amplification over the Indian Ocean during Week-1.
- It is possible that Rossby wave activity and potential tropical cyclone activity is resulting in the amplification over the Indian Ocean basin.

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.)

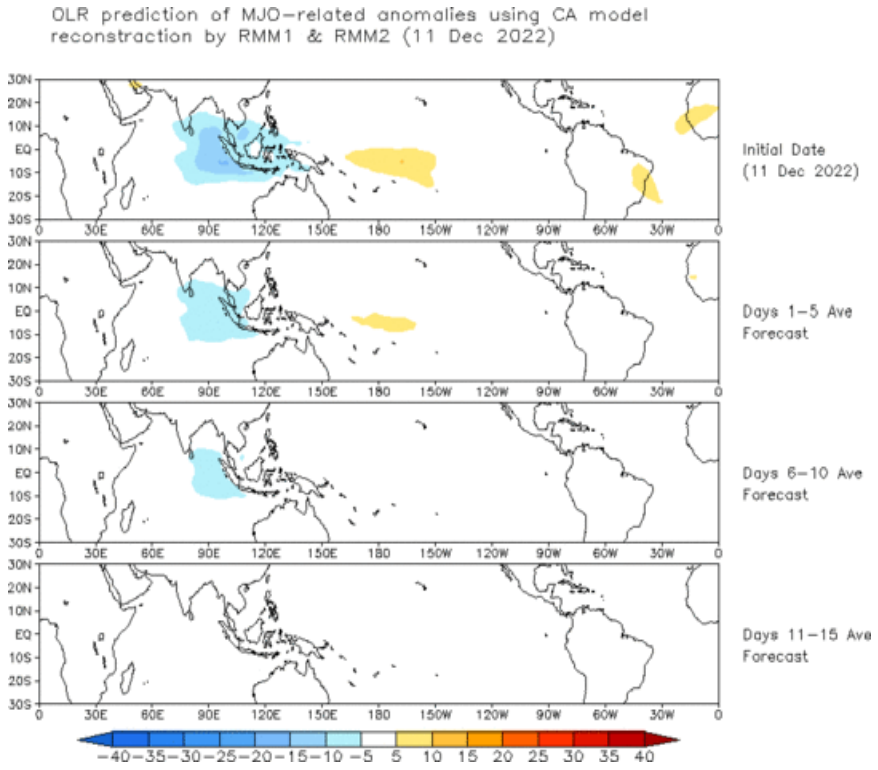


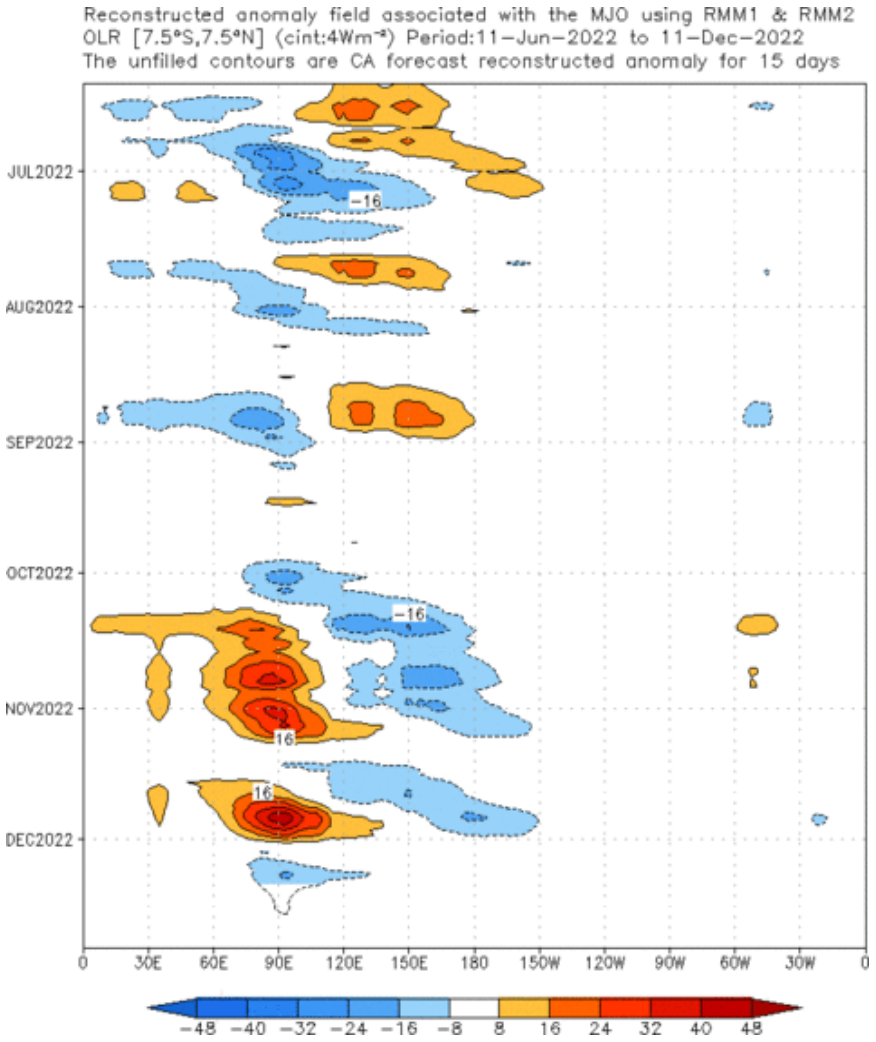


- The GEFS-based OLR anomaly fields depict enhanced convection building over the Indian Ocean basin, which would be consistent with an Indian Ocean MJO event. Eastward propagation is re-established by the end of Week-2.

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.)

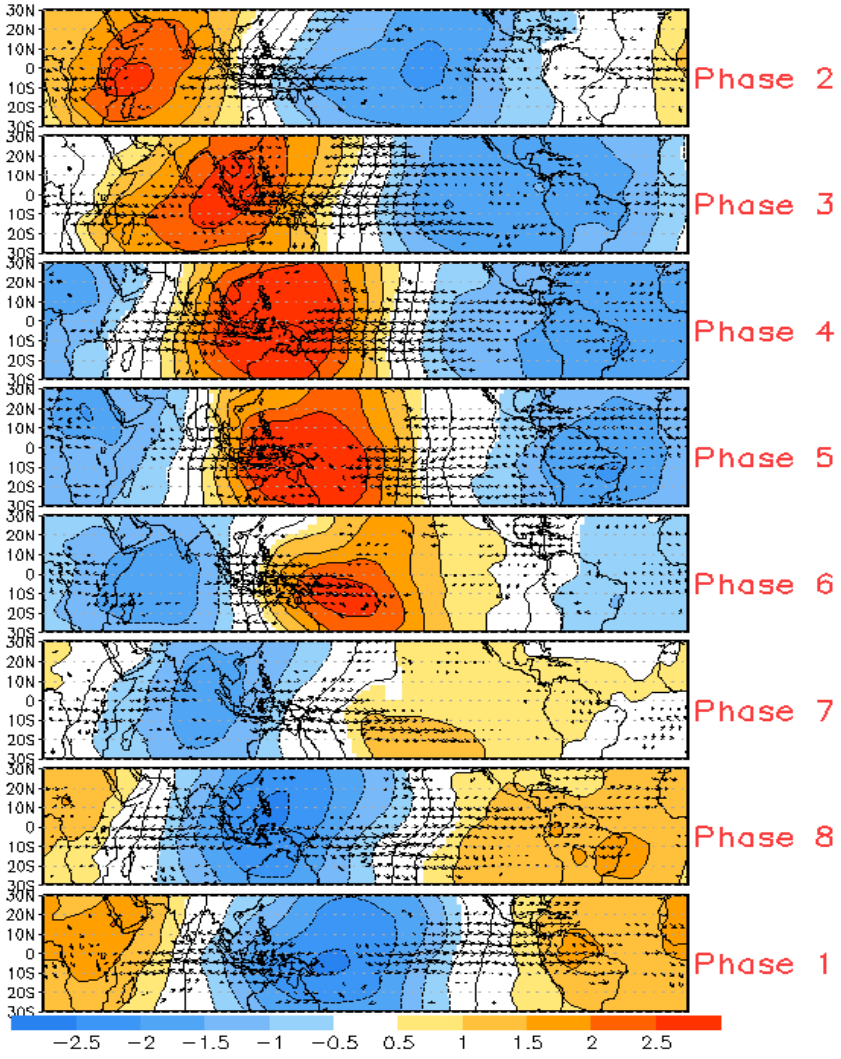




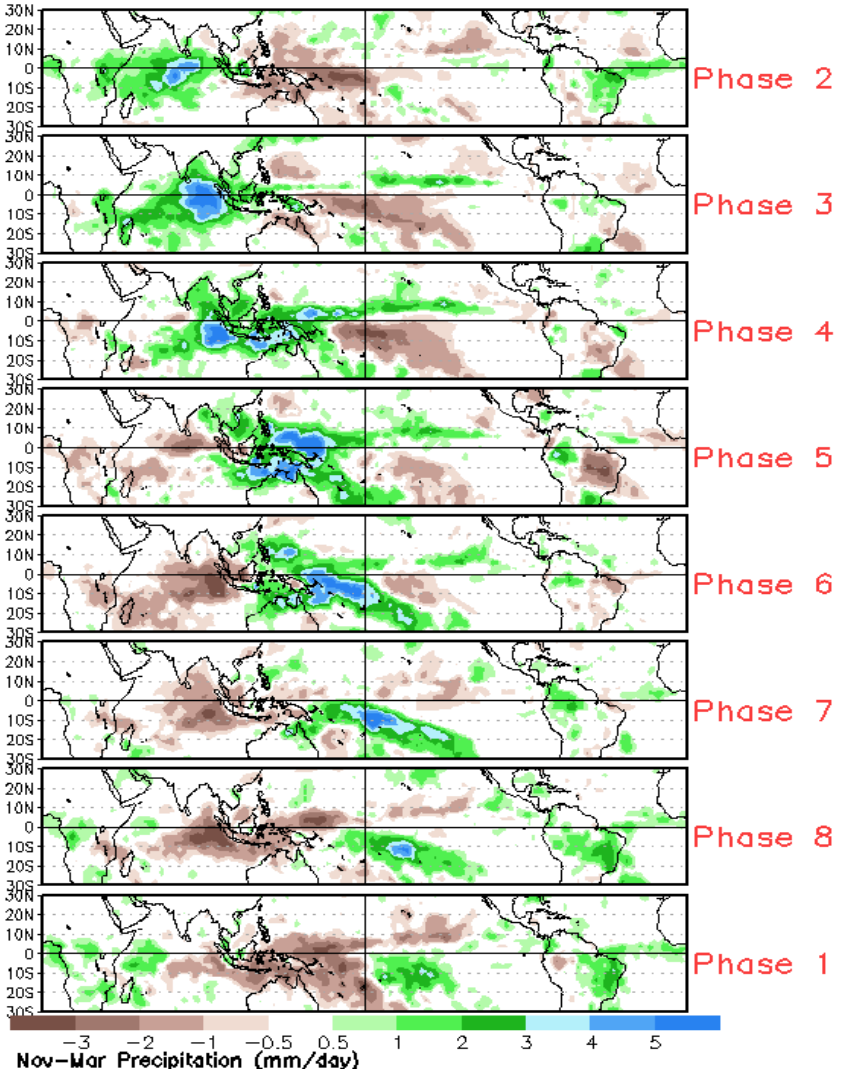
- The constructed analog forecast of RMM-based OLR depicts a more stationary and rapidly weakening pattern.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



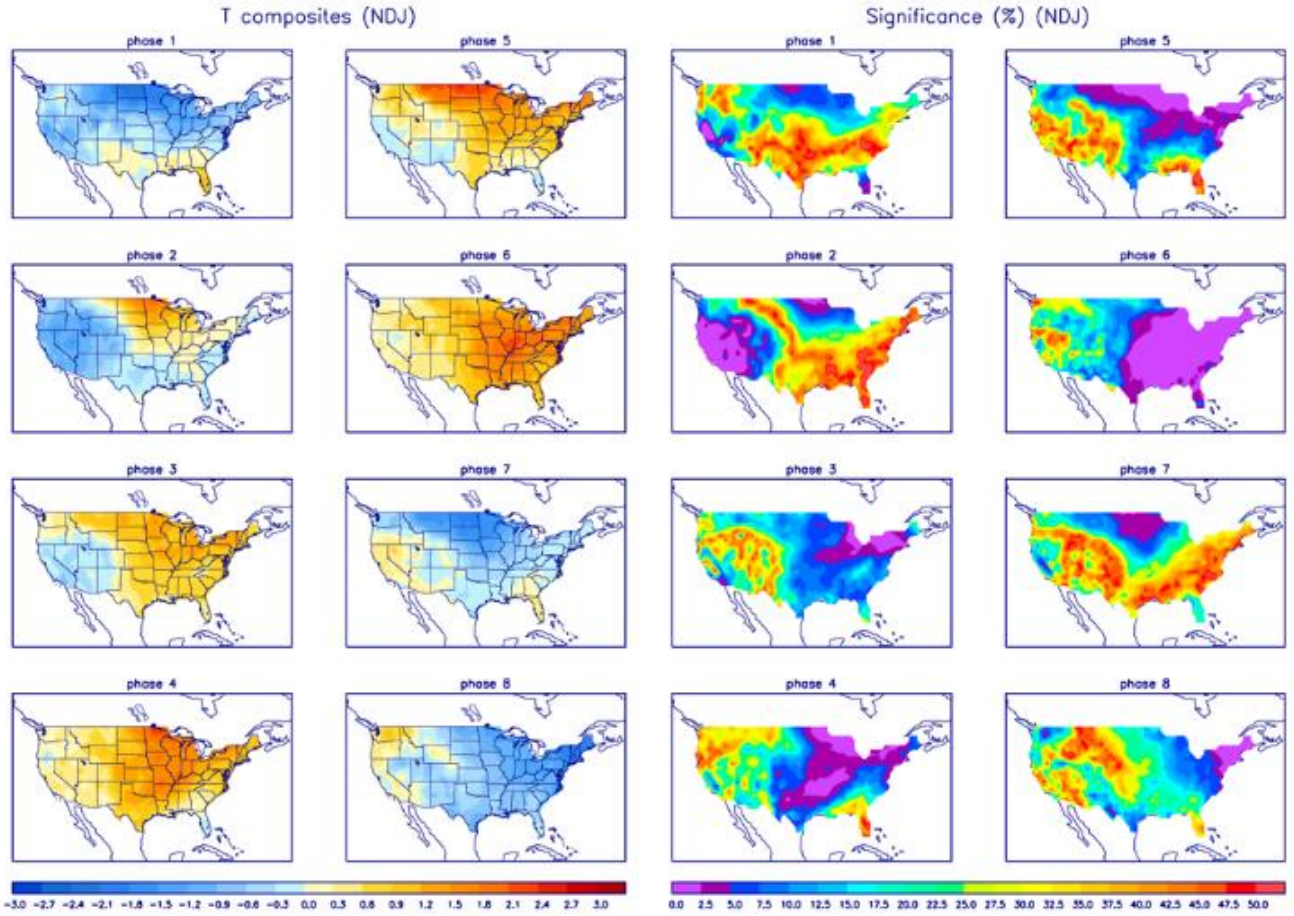
Precipitation Anomalies



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.

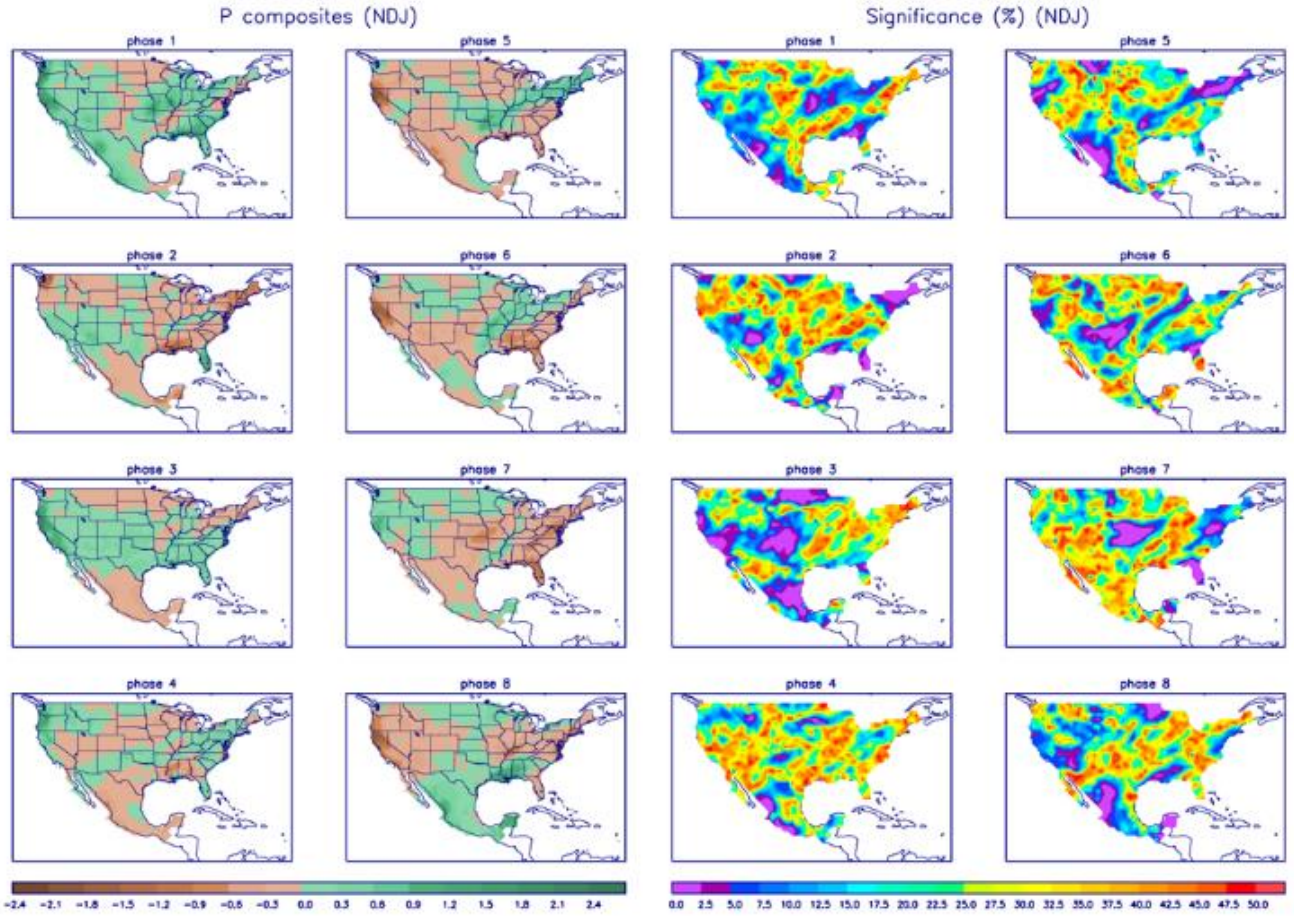


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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