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

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
6 December 2021

Overview

- Both velocity potential based MJO and RMM indices indicate a strengthening MJO, as enhanced convection shifted east to the West Pacific since late November.

- Dynamical model solutions continue to depict an eastward propagating MJO over the Pacific during early to mid-December.

- A Pacific MJO event is likely to destructively interfere with La Niña, and there remains uncertainty as to whether the MJO will maintain an organized structure, as evidenced by large ensemble spread in the RMM forecasts through mid-December.

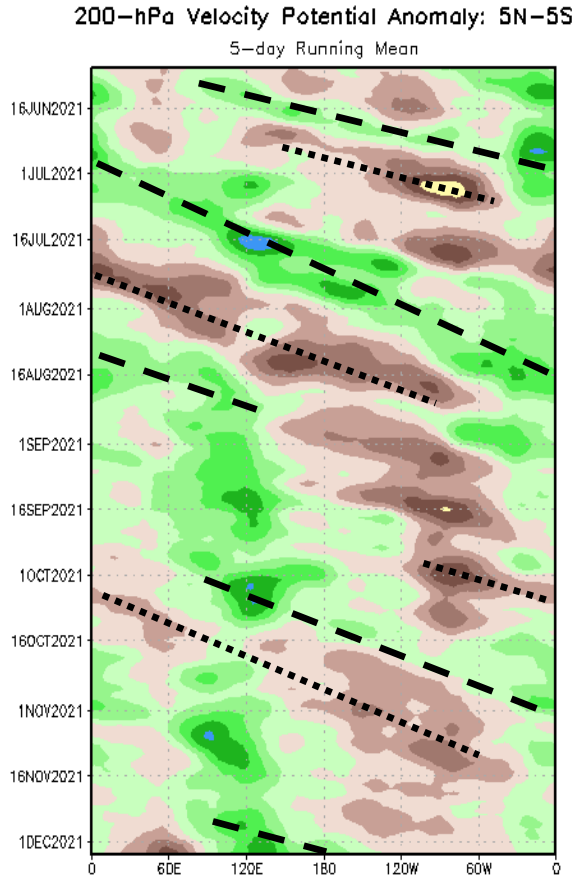
- The MJO is expected to provide a large-scale environment for tropical cyclone development over the West Pacific, Southwest Pacific, and near northern Australia during the next two weeks.

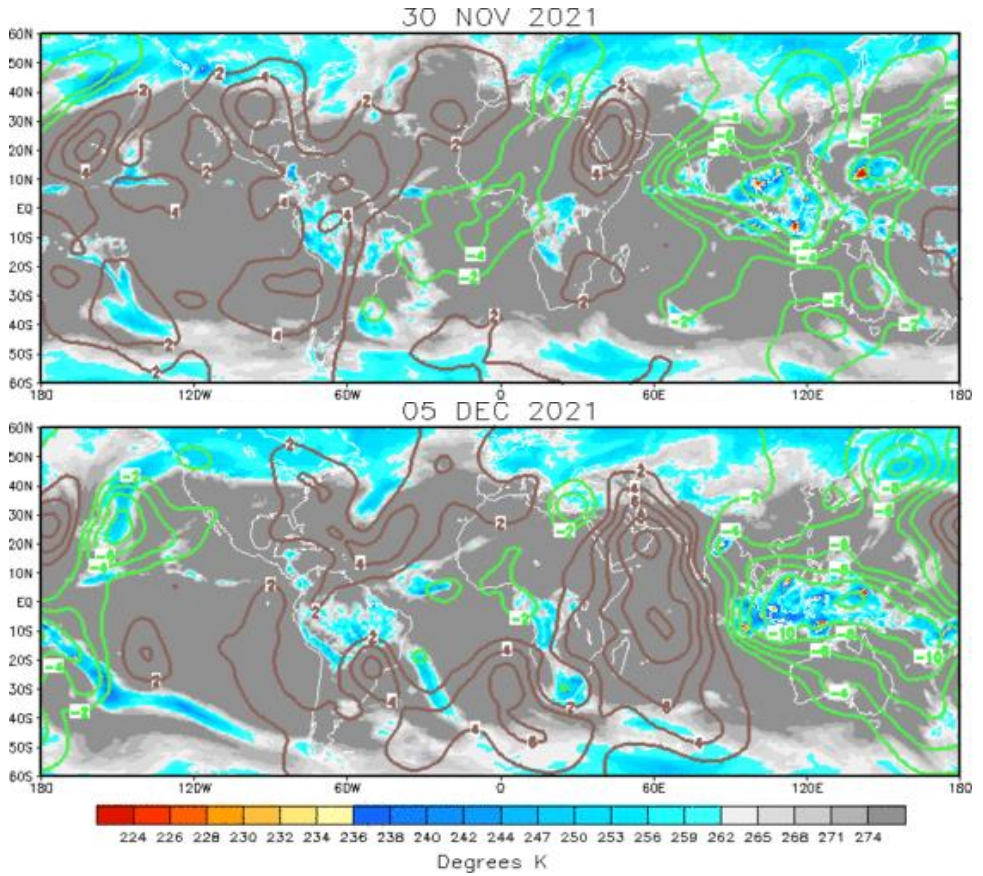
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

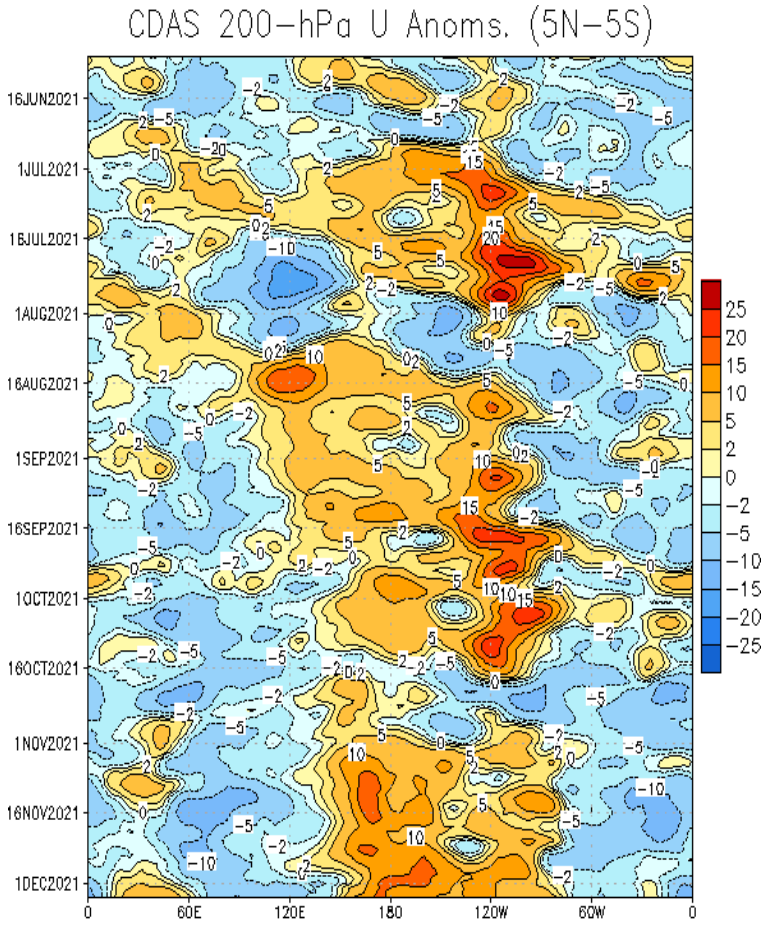


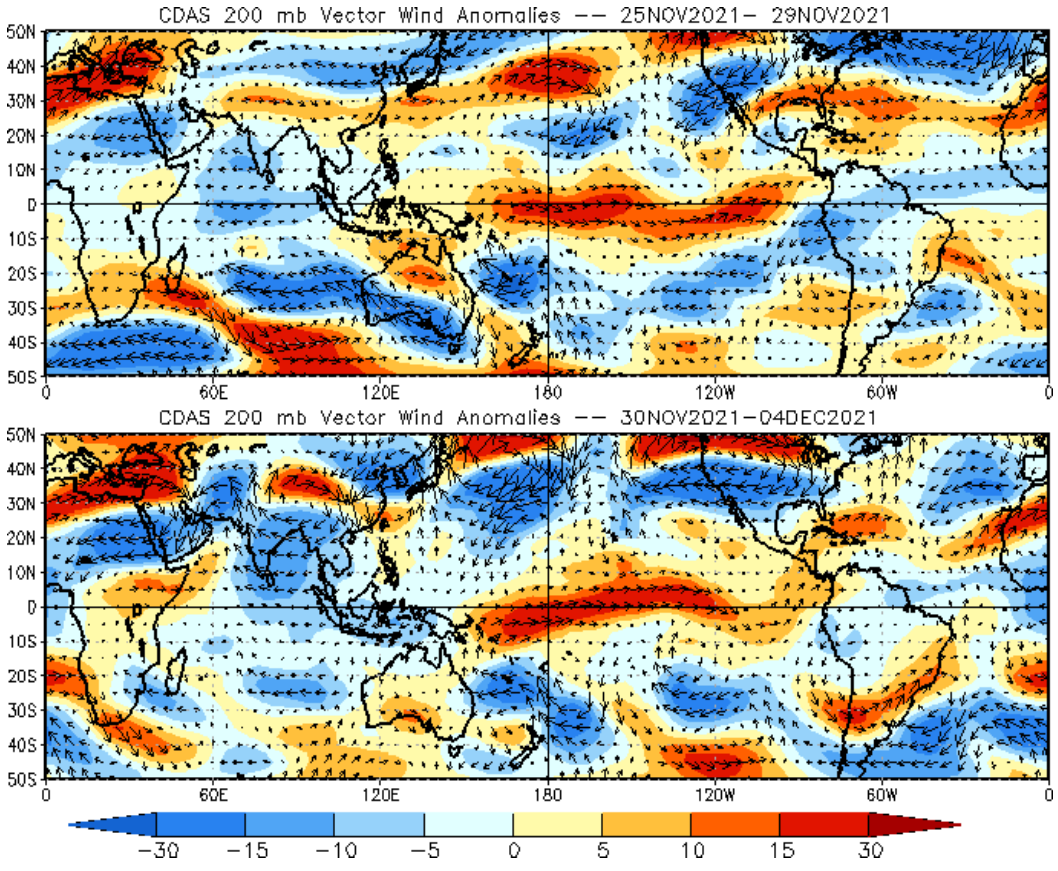


- The velocity potential pattern continues to be primarily driven by low frequency variability since September.
- Anomalous upper-level divergence began to shift and expand eastward from the Maritime Continent to the Date Line during late November and early December.

200-hPa Wind Anomalies

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



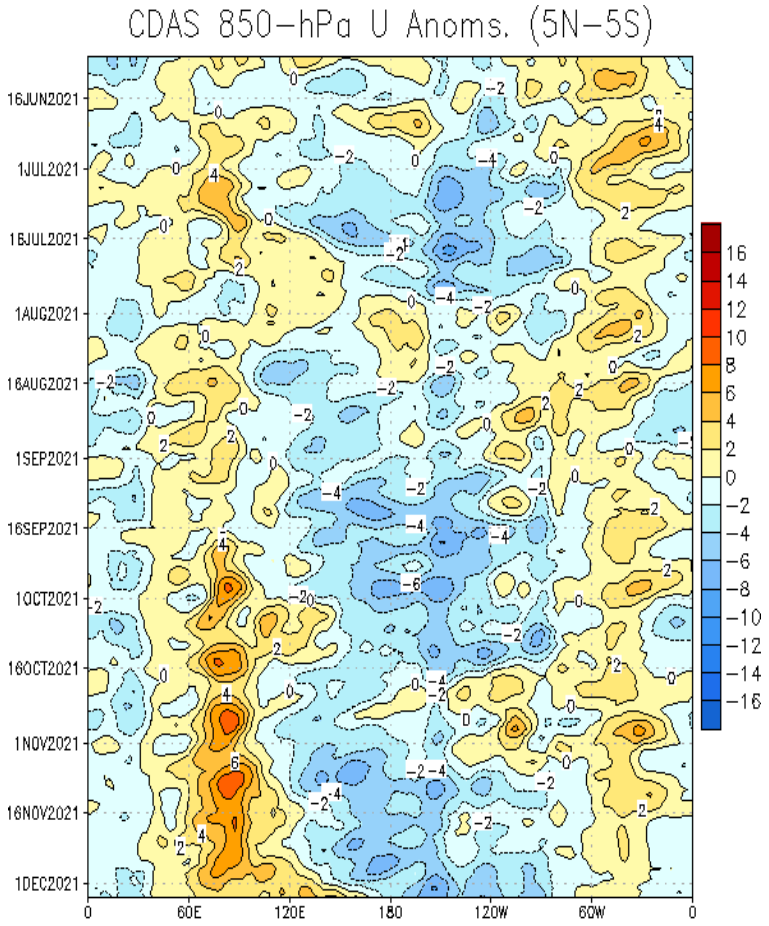


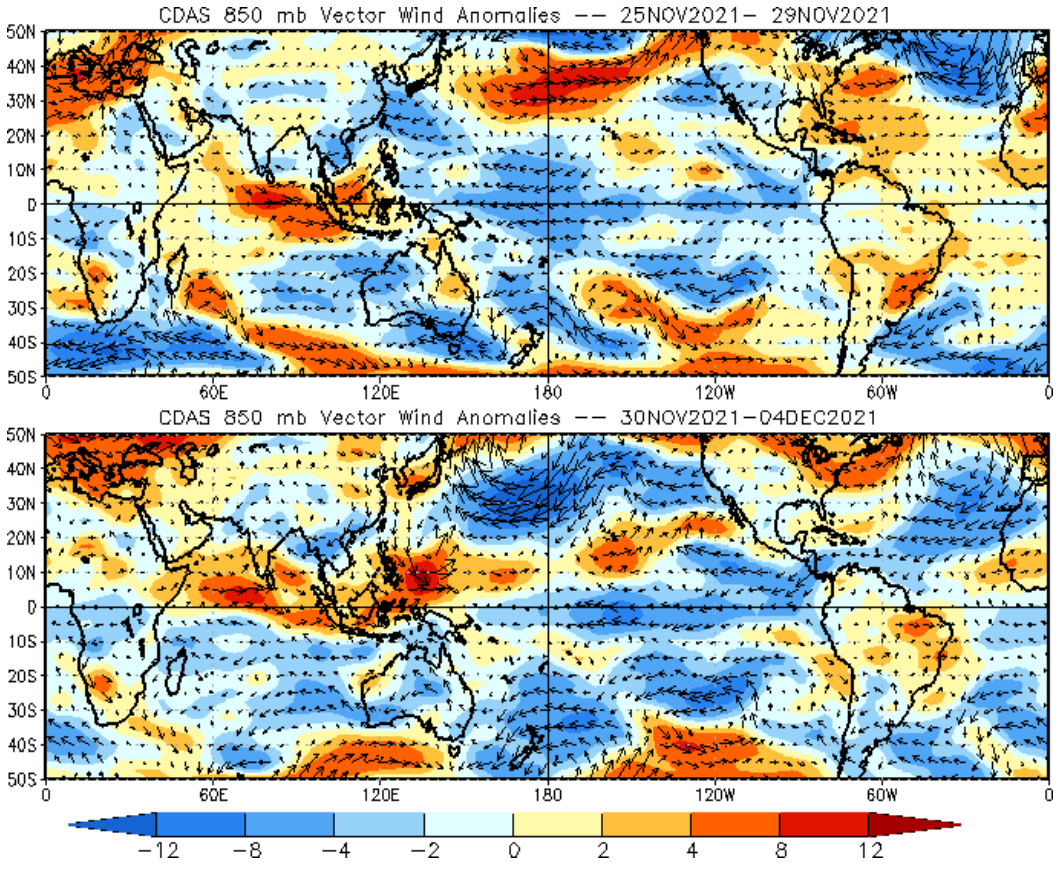
- The upper-level pattern appears to be reflective of the La Niña base state with enhanced easterlies (westerlies) over the Indian Ocean and Maritime Continent (Pacific).

- Much of the anomalous westerlies aloft near the Date Line appear to be reinforced by an anomalous cyclonic circulation aloft over the South Pacific.

850-hPa Wind Anomalies

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





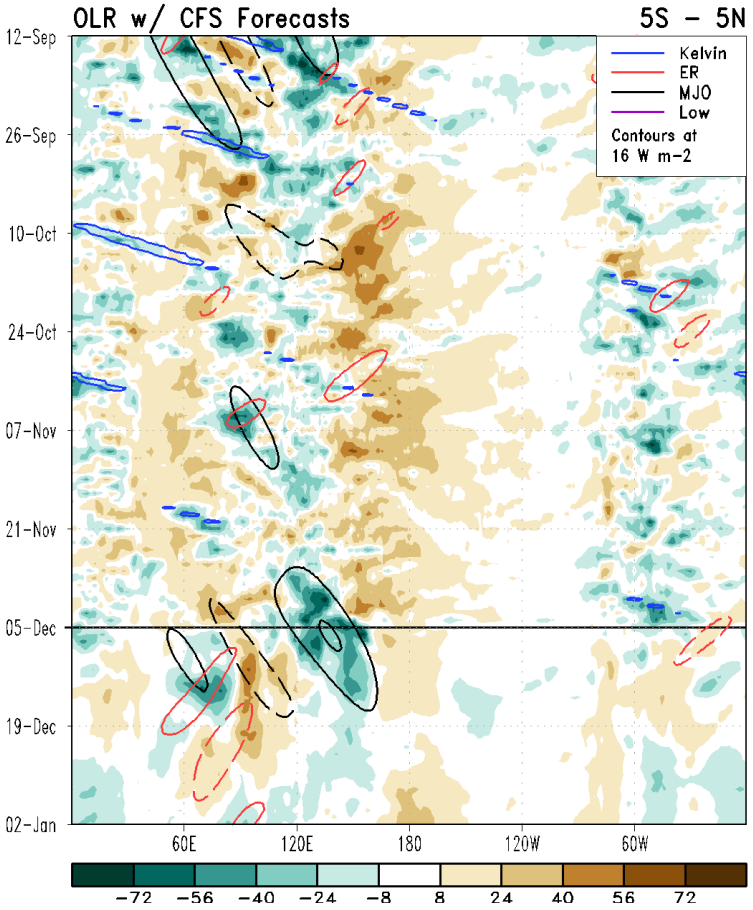
- Enhanced trades persisted over equatorial Pacific, with anomalous westerlies emerging over the northwestern Pacific tied to tropical cyclone activity in the basin since late November.

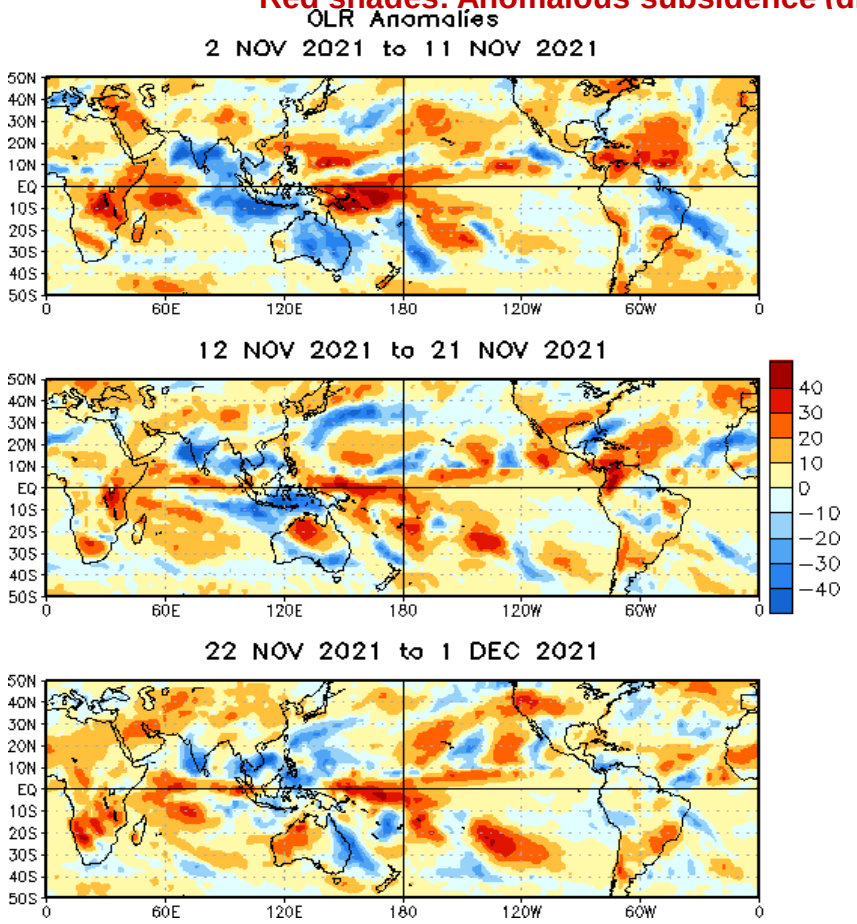
- Along the equator, anomalous westerlies recently shifted eastward over the West Pacific with diminishing enhanced trades along and west of the Date Line.

Outgoing Longwave Radiation (OLR) Anomalies

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

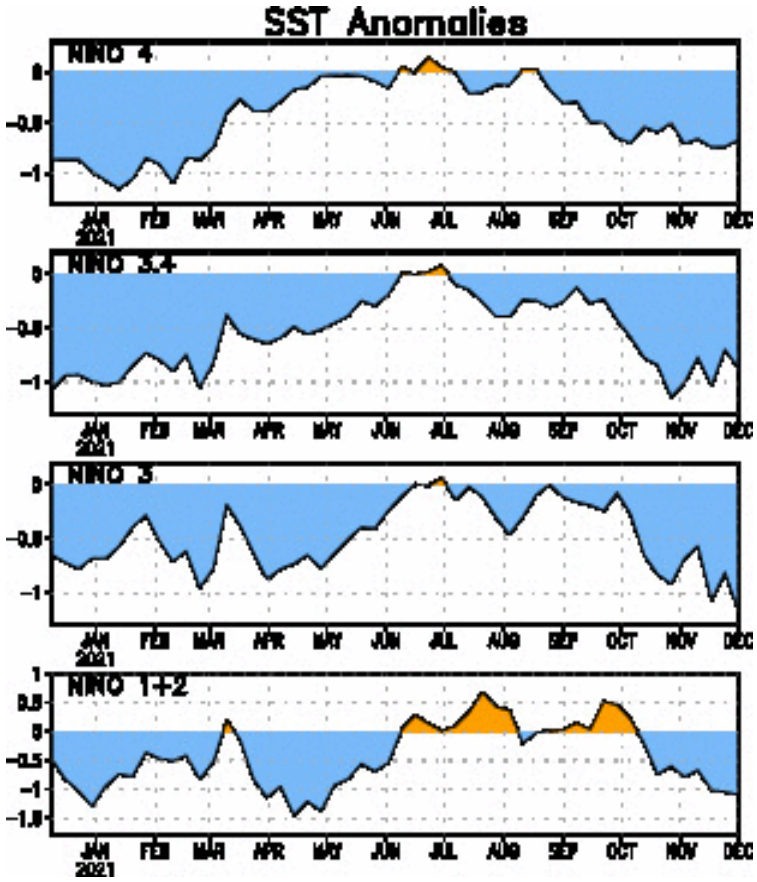
Blue shades: Anomalous convection (wetness)
Red shades: Anomalous subsidence (dryness)

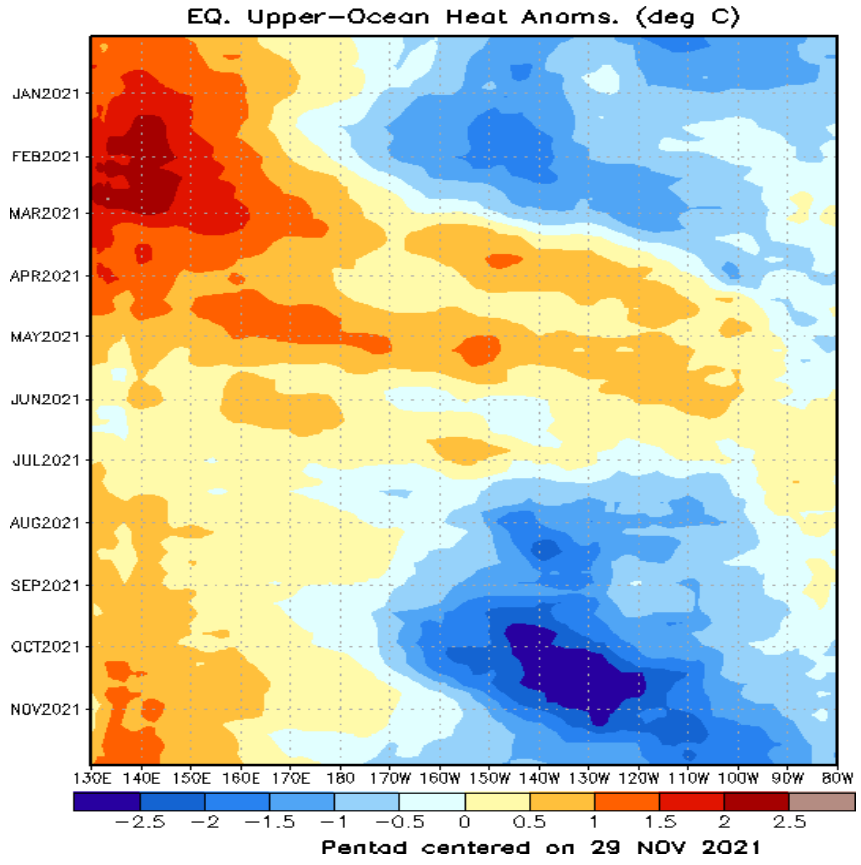




- Convection largely remains suppressed to the west of the Date Line and over the central and eastern Pacific north of the equator.
- However, the CFS model continues to depict enhanced convection overspreading the Central Pacific and destructively interfering with the low-frequency base state.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



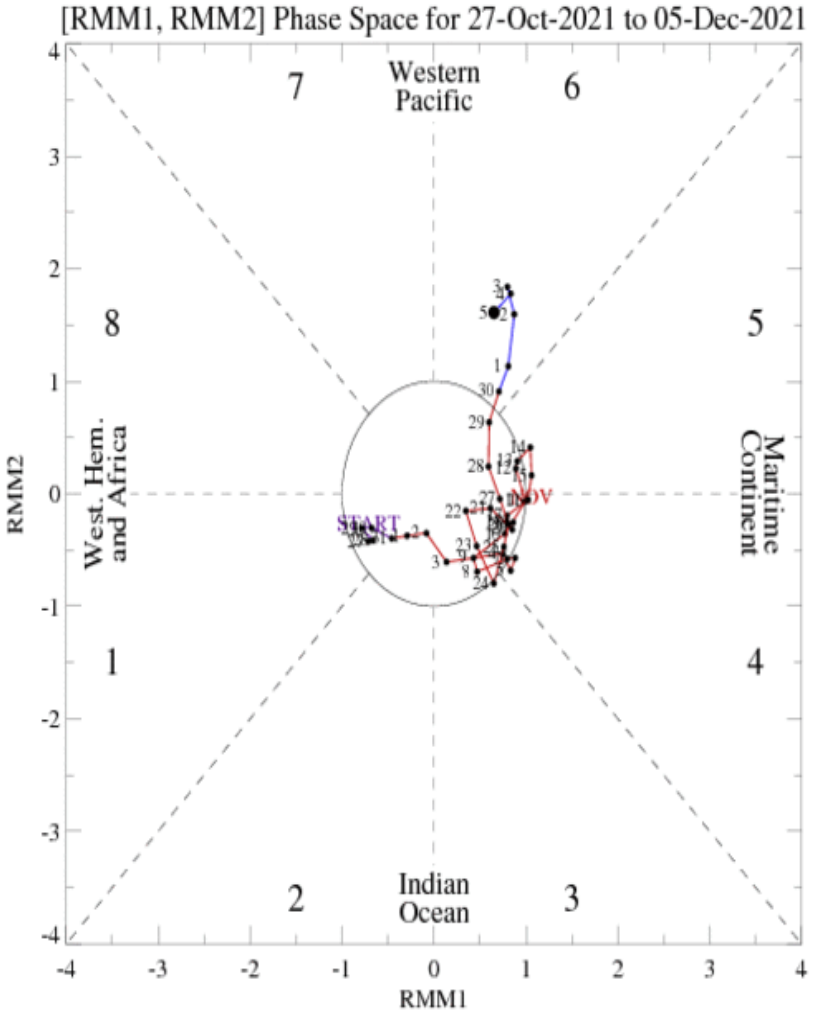


- Negative upper-ocean heat content anomalies have relaxed across the central and eastern equatorial Pacific, with much of the sub-surface cooling continuing to expand eastward since early October.

- Consistent with La Niña, below-normal sea surface temperatures (SSTs) continue to be observed within all Niño regions, with SSTs holding steady or decreasing during November.

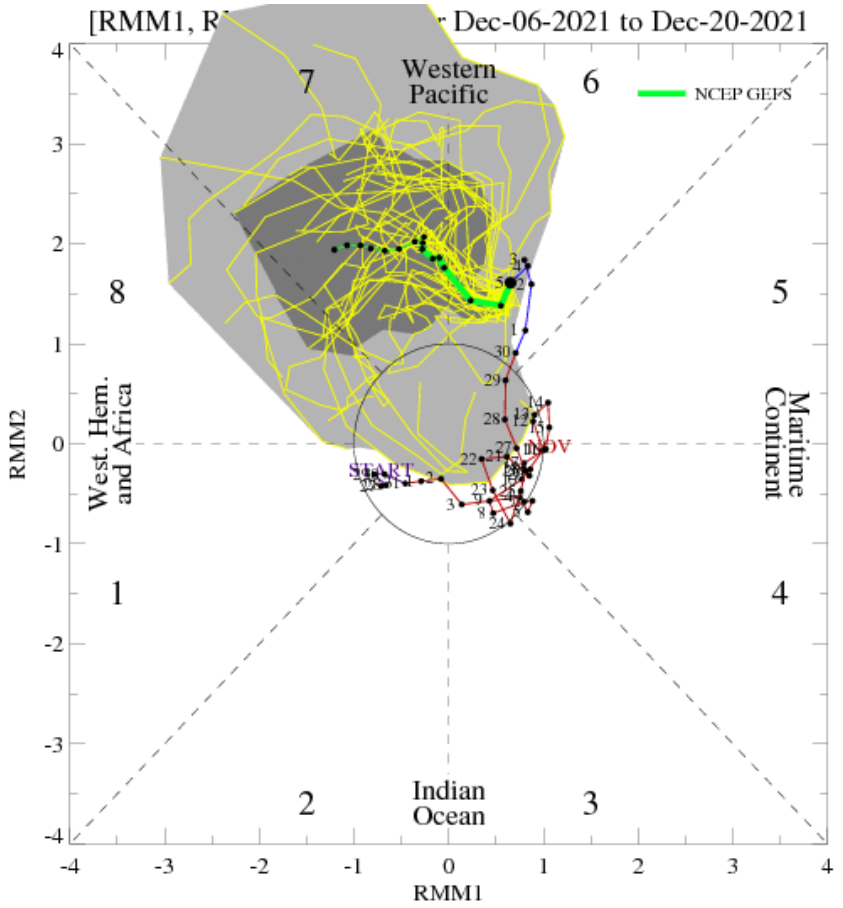
MJO Index: Recent Evolution

- The RMM based MJO index features eastward propagation from the Maritime Continent since late November and an increase in amplitude over the West Pacific.

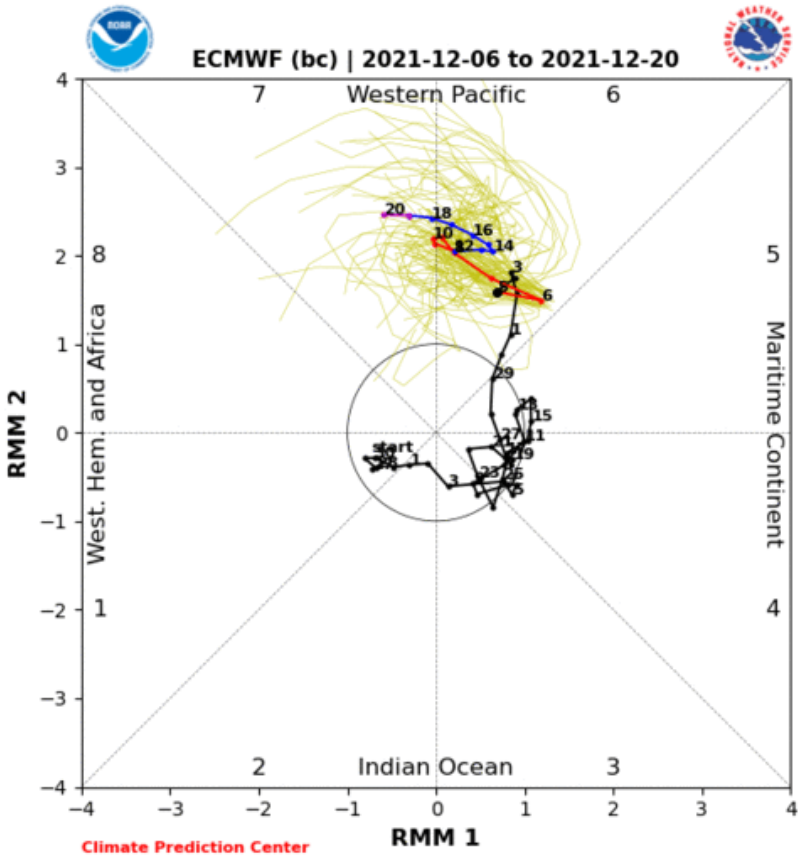


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

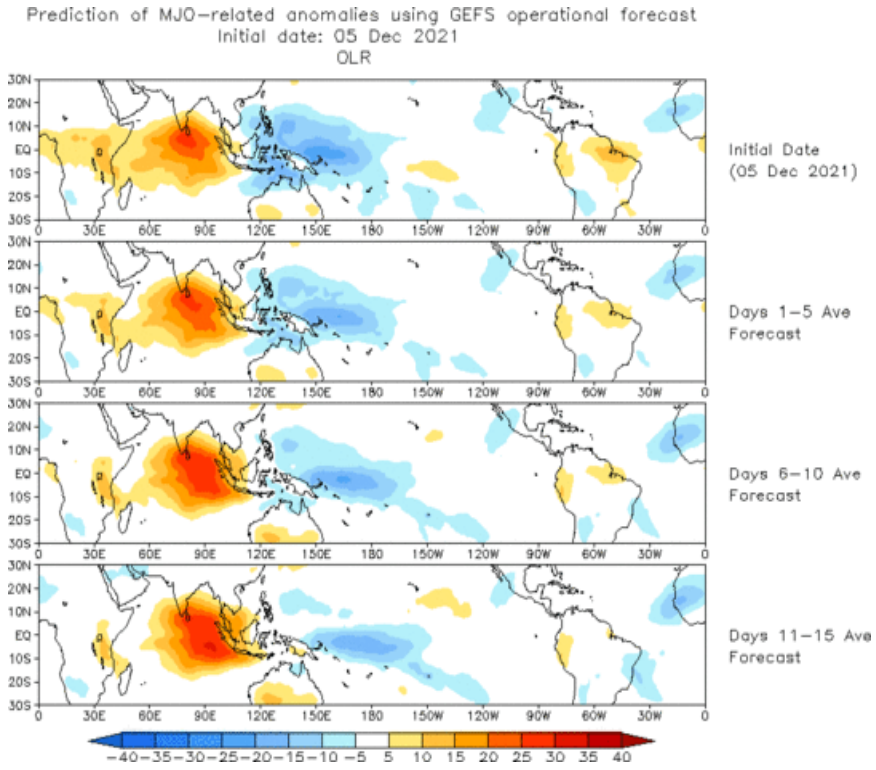


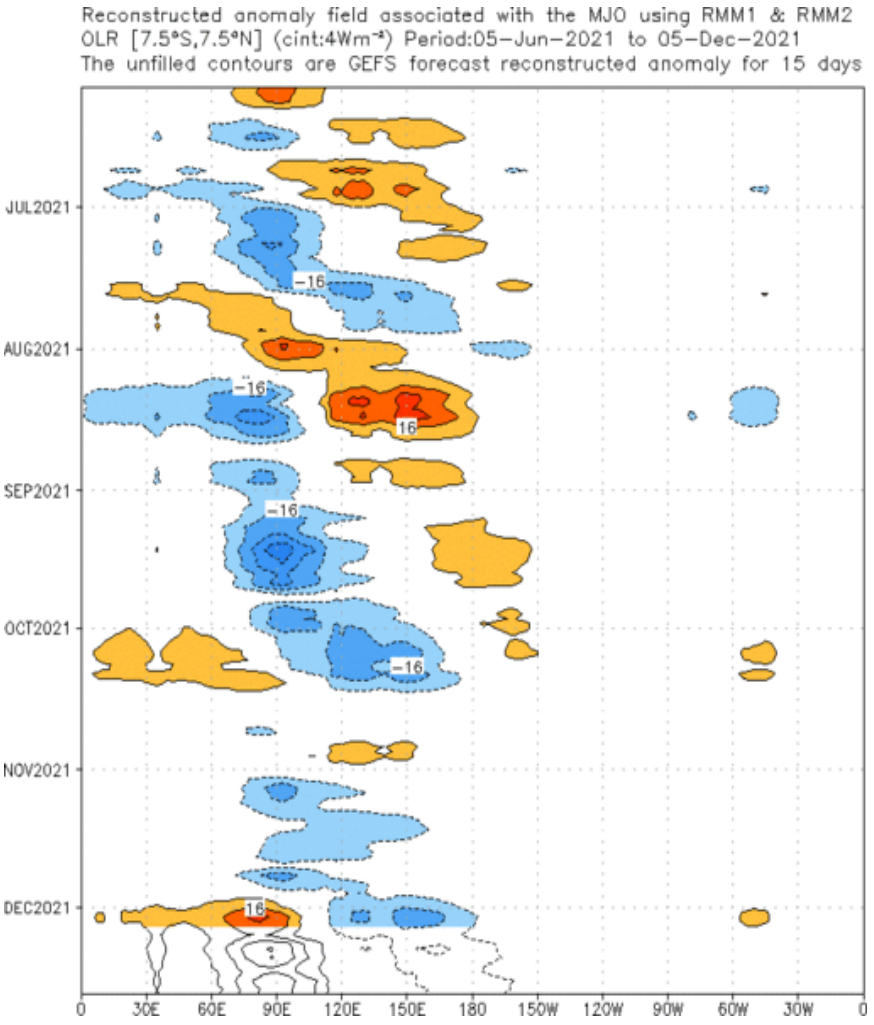
ECMWF Forecast

- Good agreement continues in the dynamical models which depict a coherent MJO propagating eastward over the Pacific (phases 6 and 7) during the next two weeks.
- There is still some question as to whether the MJO will maintain an organized structure due to destructive interference with La Niña over the Pacific, as evidenced by large ensemble spread on its amplitude.

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.)

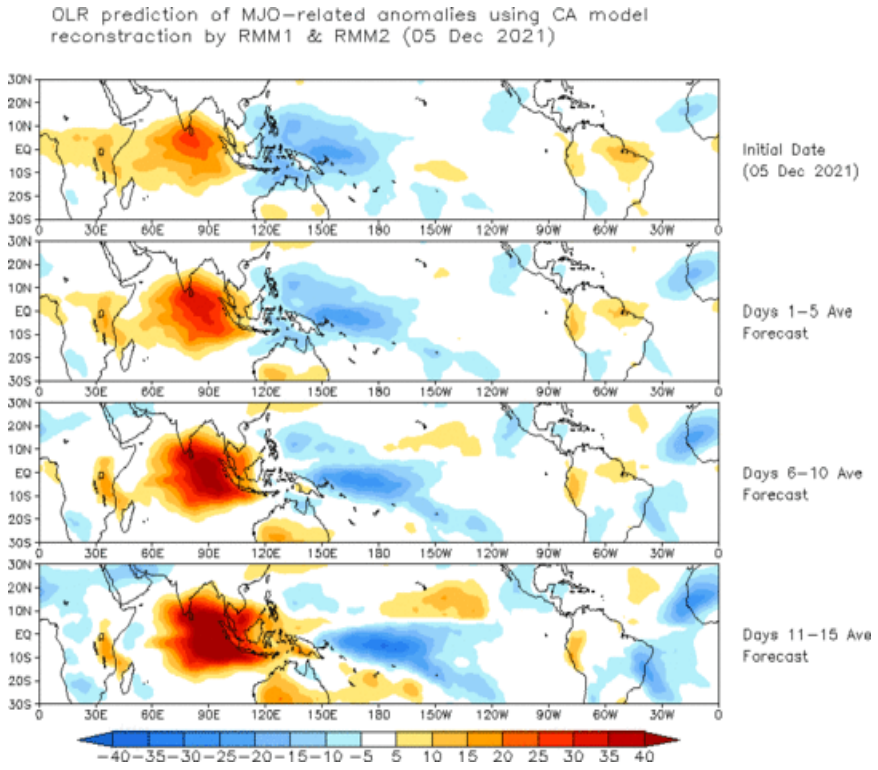


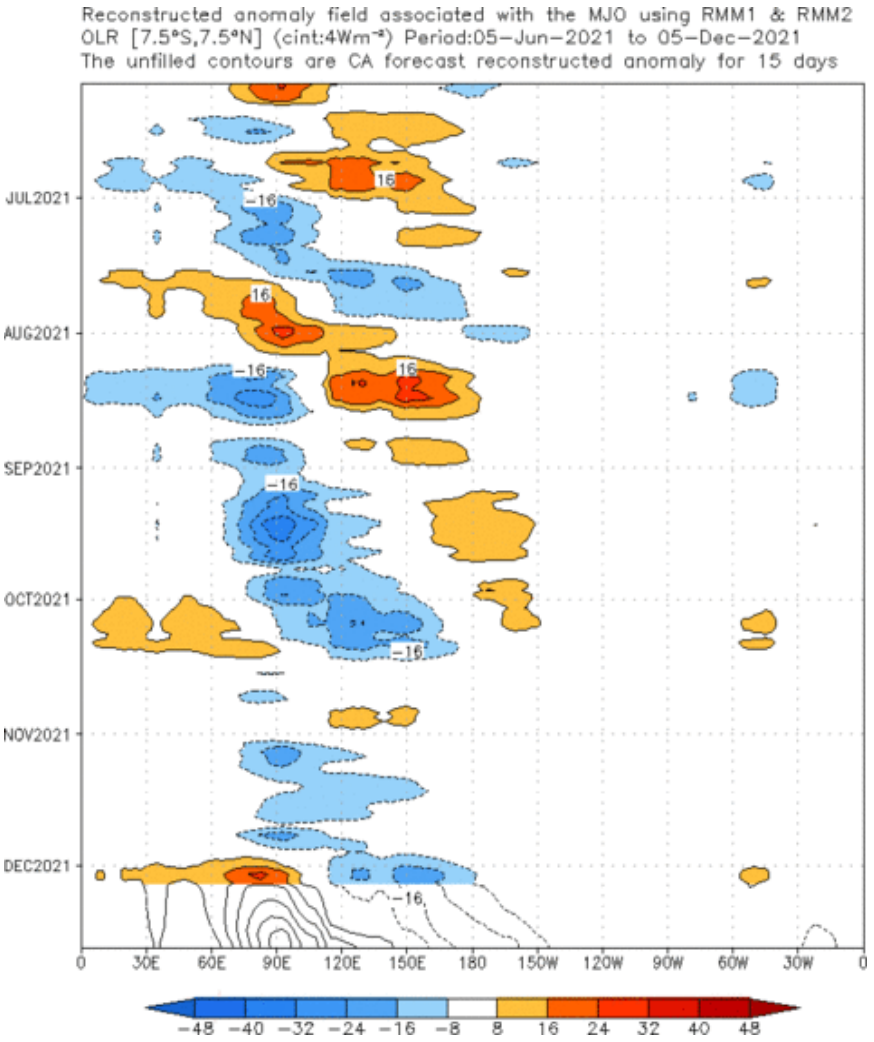


- The GEFS RMM-based OLR anomaly forecast depicts enhanced convection shifting eastward over the Pacific during the next two weeks, while suppressed convection expands east from Indian Ocean to the western Maritime Continent.

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.)

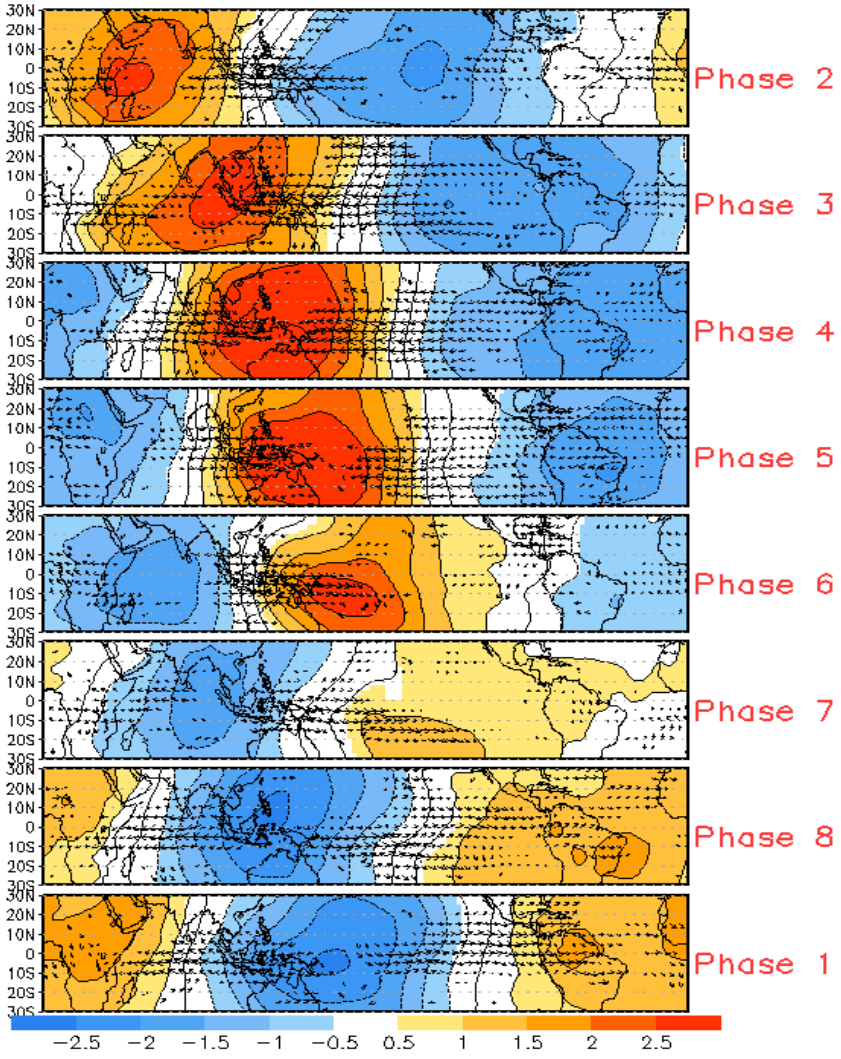




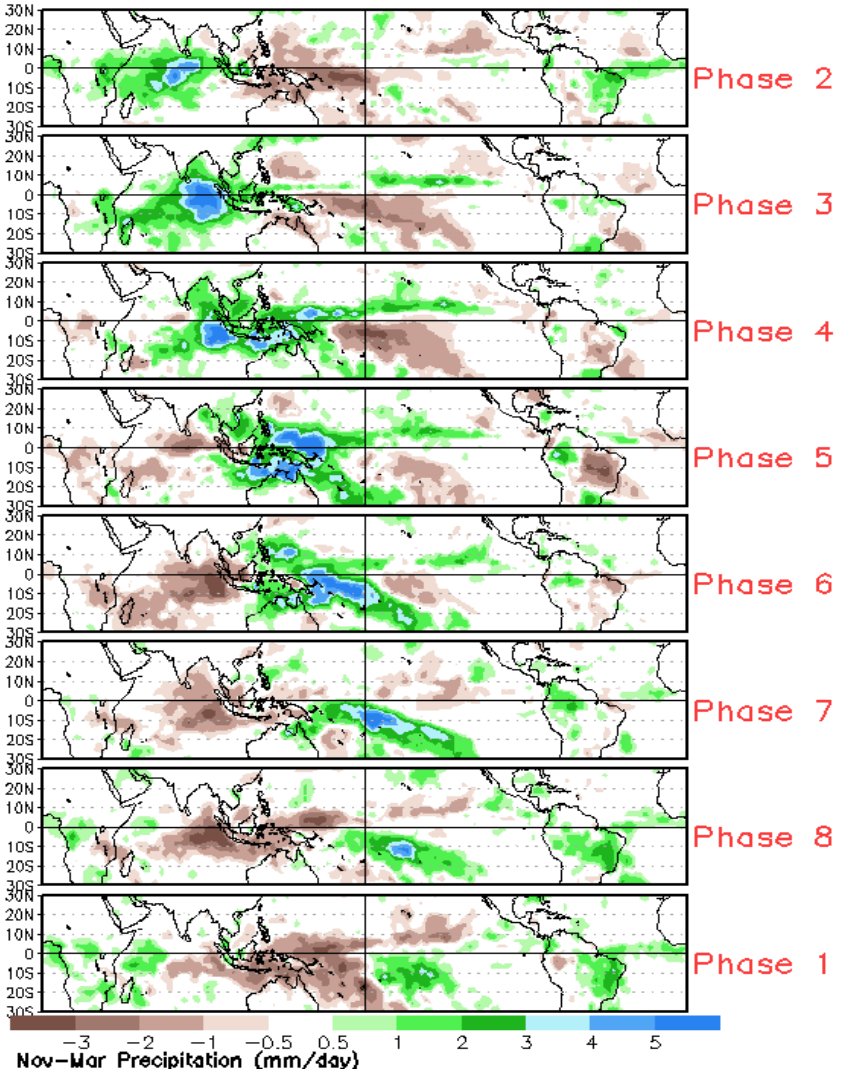
- The constructed analog also depicts a similar evolution with enhanced convection overspreading the Western Hemisphere and drier conditions developing across the Maritime Continent.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



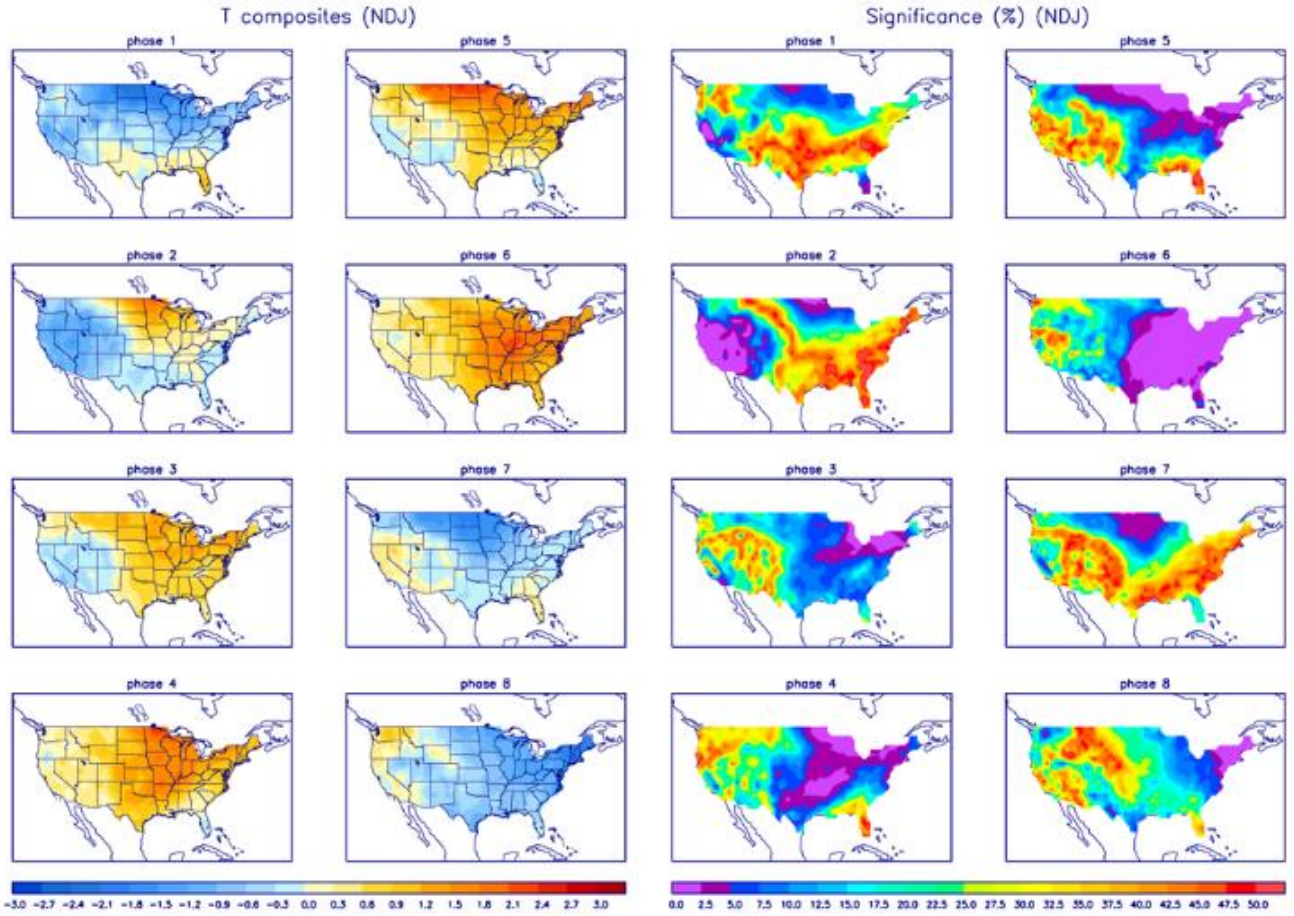
Precipitation Anomalies



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.

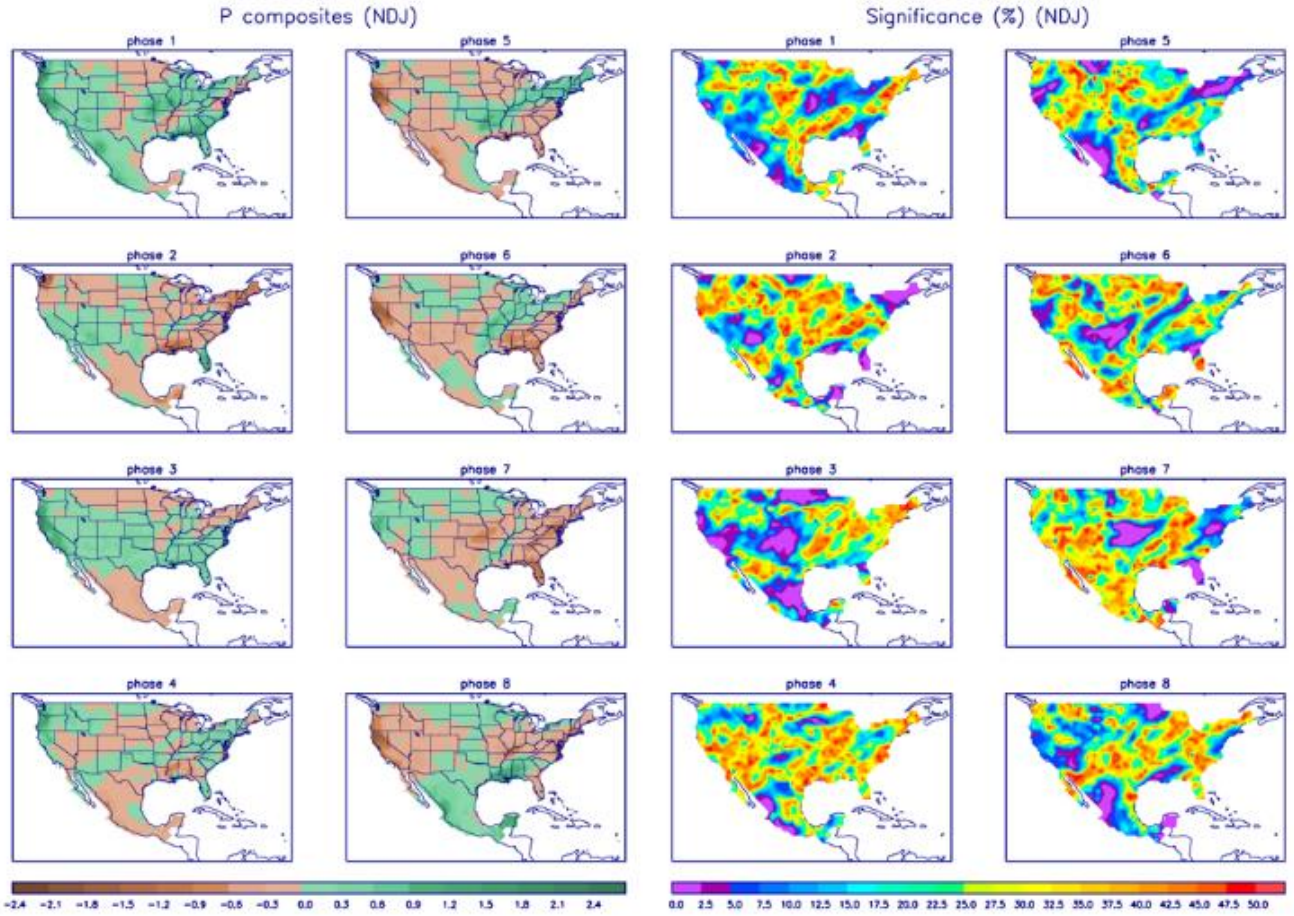


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

MJO: CONUS Composite Maps by RMM Phase - Temperature

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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