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

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
23 December 2019

Overview

- The MJO has been largely incoherent over the past several weeks, with the positive phase of the Indian Ocean Dipole (IOD) dominating the tropical convective pattern. The IOD has weakened substantially during mid-December.

- More recently, a weak easterly propagating signal is apparent in the upper-level velocity potential field, and dynamical model MJO index forecasts show the potential for renewed MJO activity over the West Pacific.

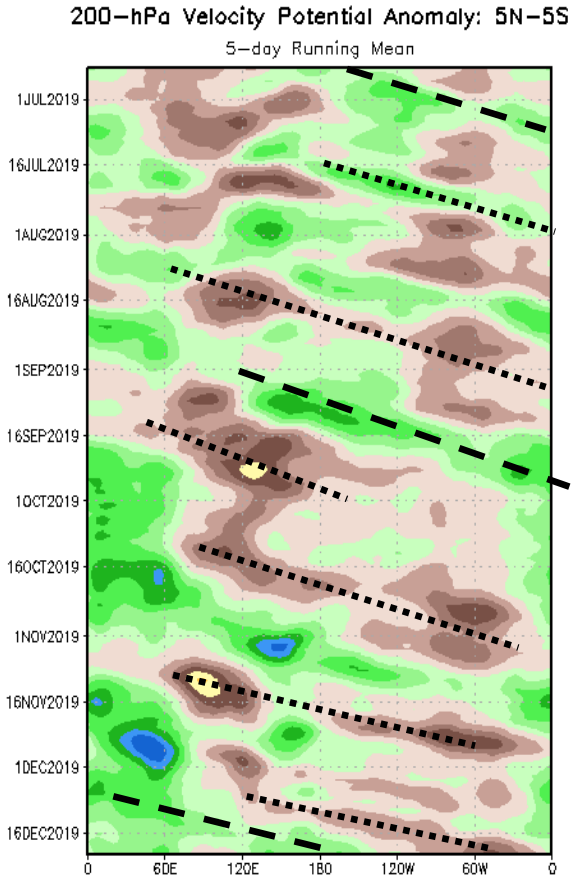
- Dynamical model MJO index forecasts also depict interference from Rossby wave activity during Week-2. Therefore, while an emerging intraseasonal signal may influence the tropical convective pattern, further evolution of this signal and subsequent impacts on the tropics and extratropics remains highly uncertain.

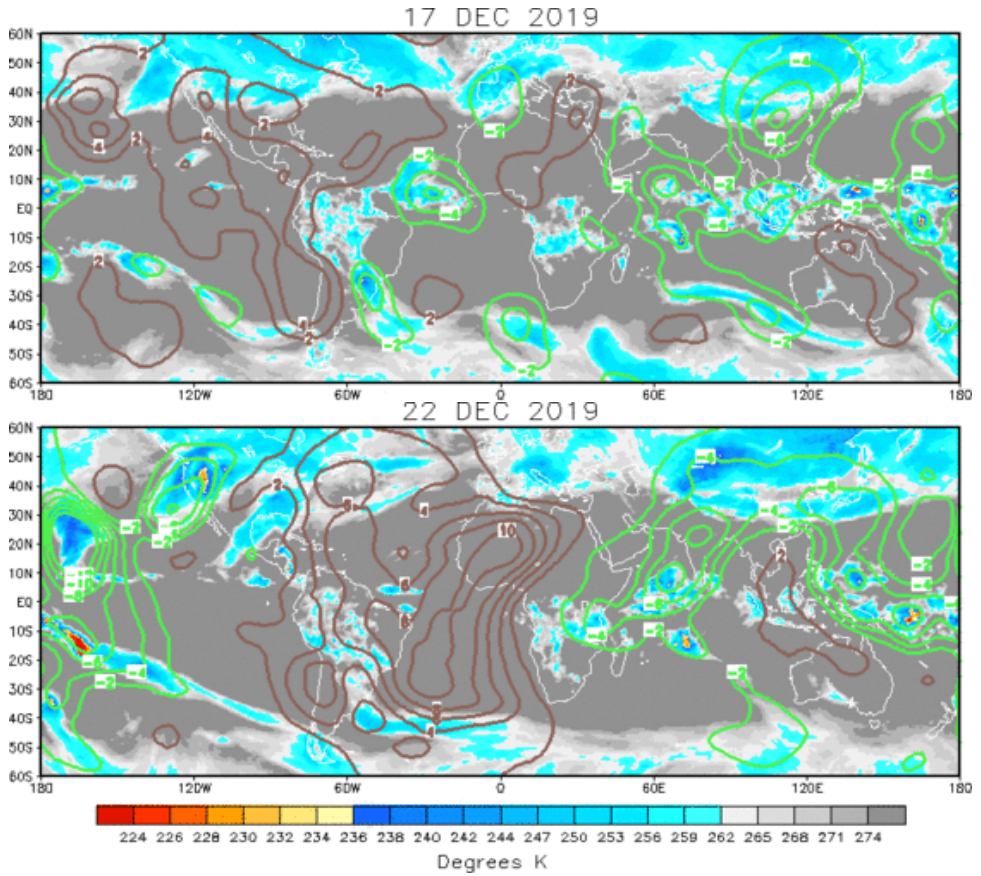
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

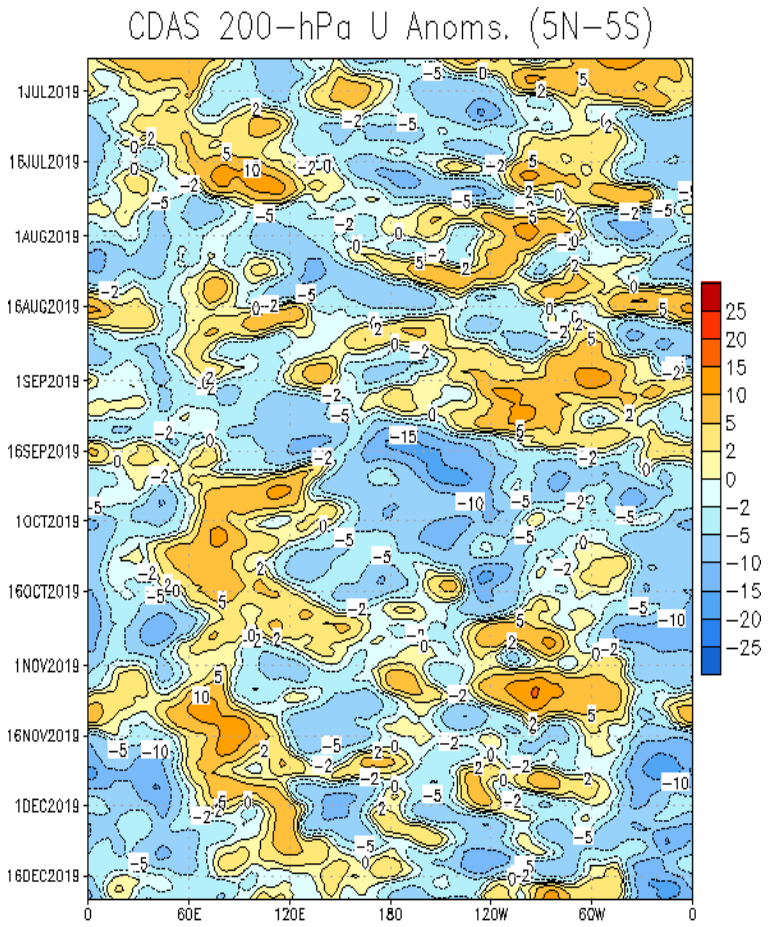


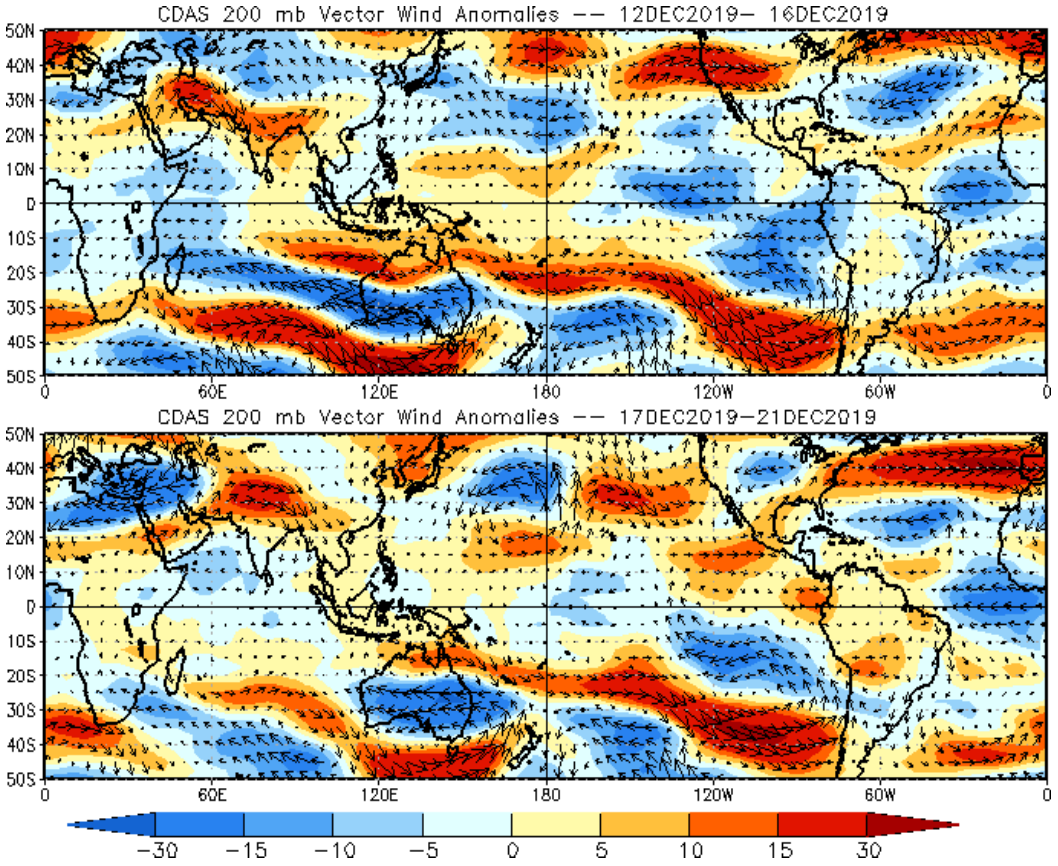


- The upper-level pattern since mid-November has been largely dominated by the strongly positive Indian Ocean Dipole (IOD) event.
- A slowly eastward propagating low frequency signal seems apparent over the far West Pacific, creating a tri-pole of activity.
- More recently, a more robust eastward propagating signal is apparent over the eastern Maritime Continent and West Pacific as the IOD amplitude decreases.

200-hPa Wind Anomalies

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

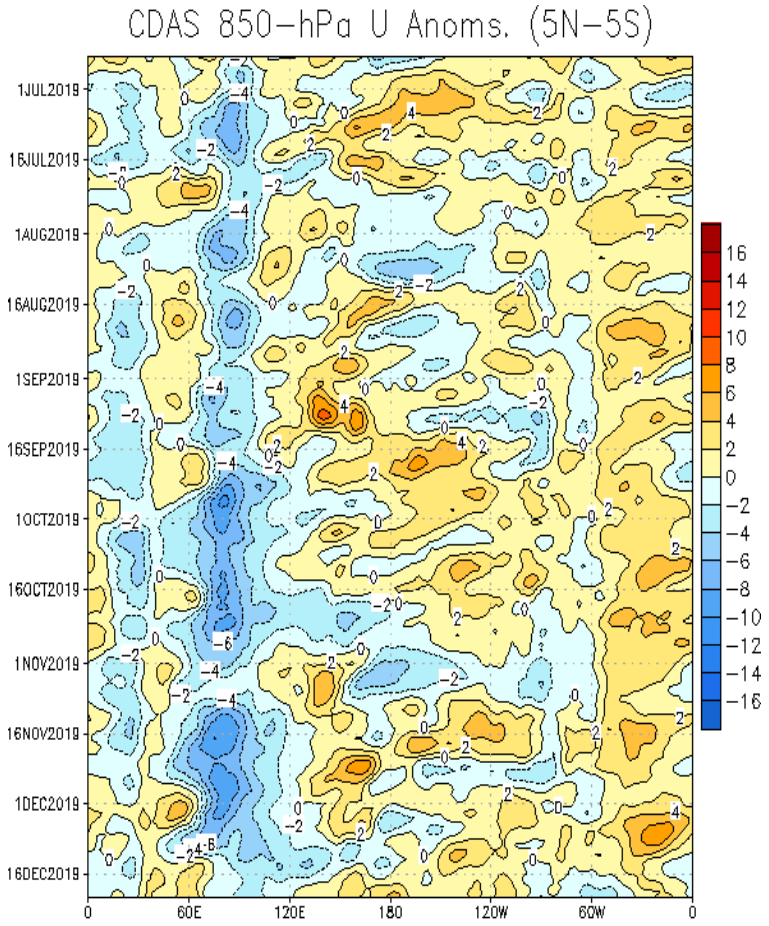


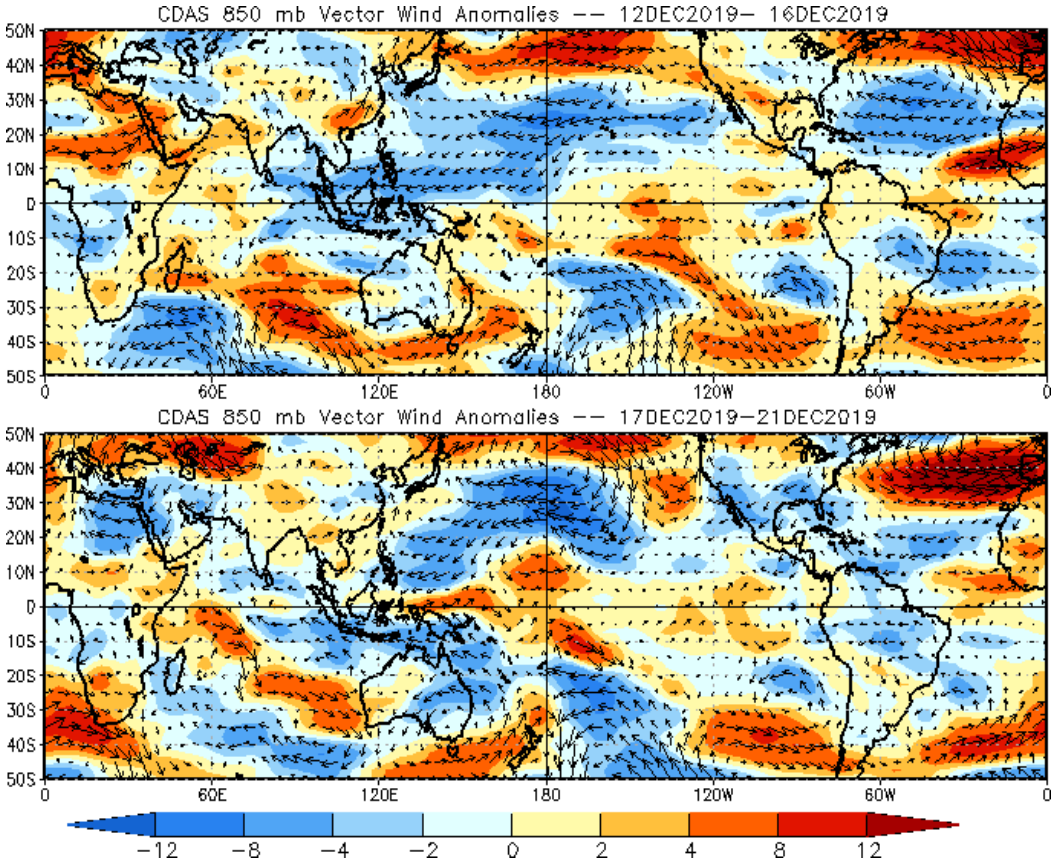


- The upper-level footprint of the IOD has weakened substantially over the Indian Ocean.
- Outside of strong easterly anomalies over the eastern Atlantic, the anomaly field is generally weak throughout the tropics, consistent with weak MJO activity.
- Extratropical forcing is impacting the East Pacific and North American pattern.

850-hPa Wind Anomalies

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

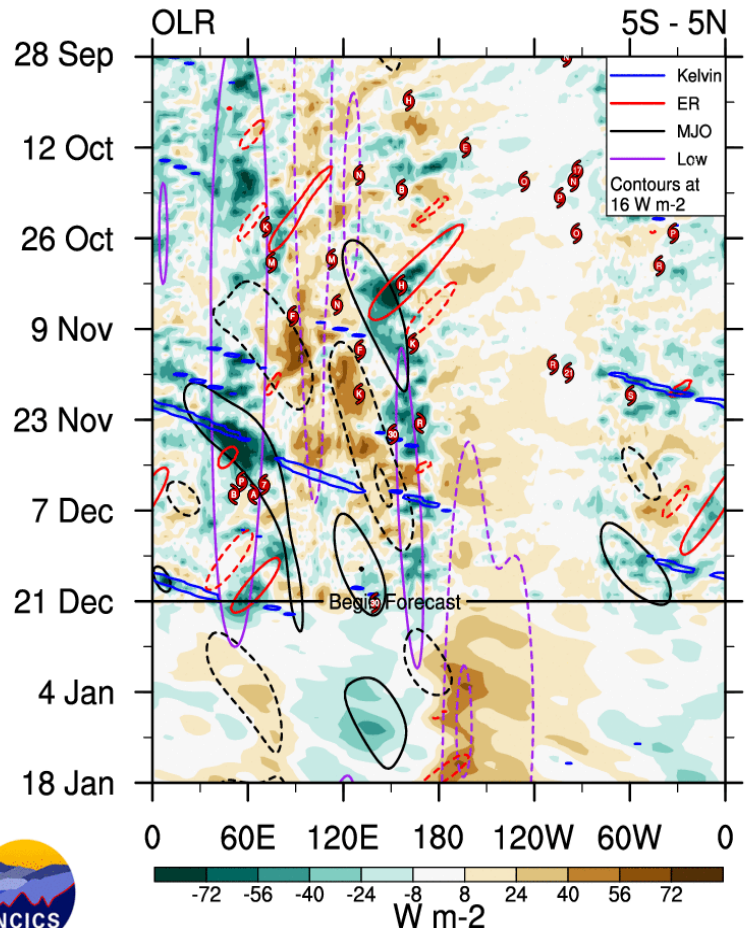


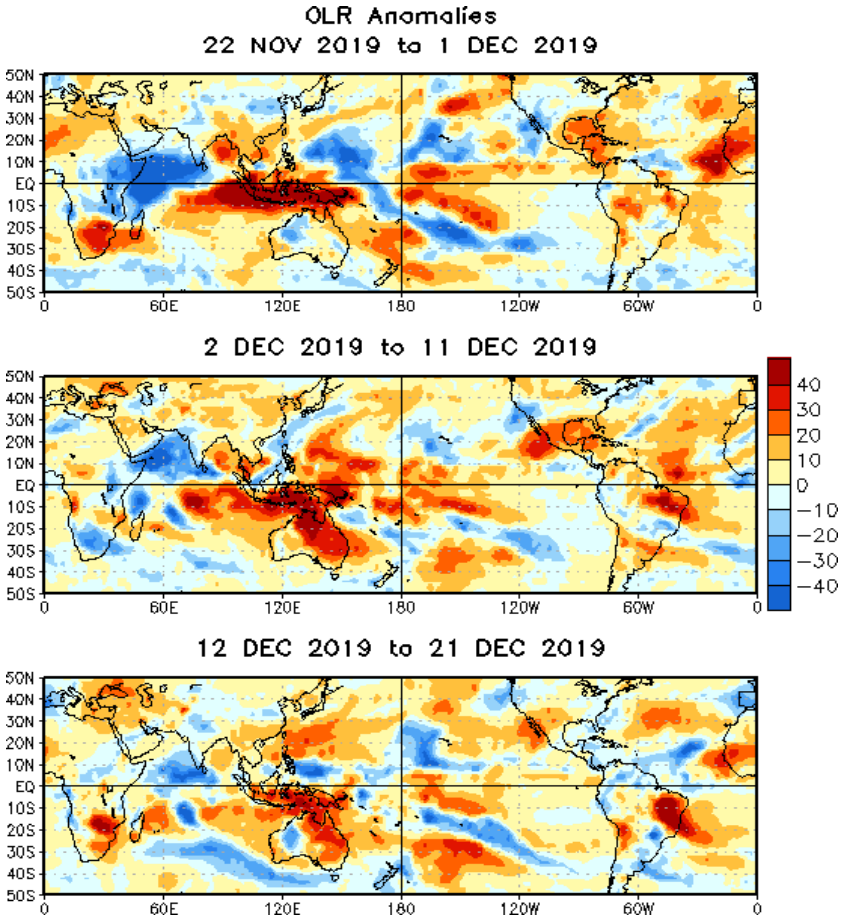


- The IOD-driven anomalies have weakened during mid-December.
- A narrow belt of strong westerly wind anomalies is apparent along the Equator north of New Guinea, associated with tropical cyclone activity.

Outgoing Longwave Radiation (OLR) Anomalies

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

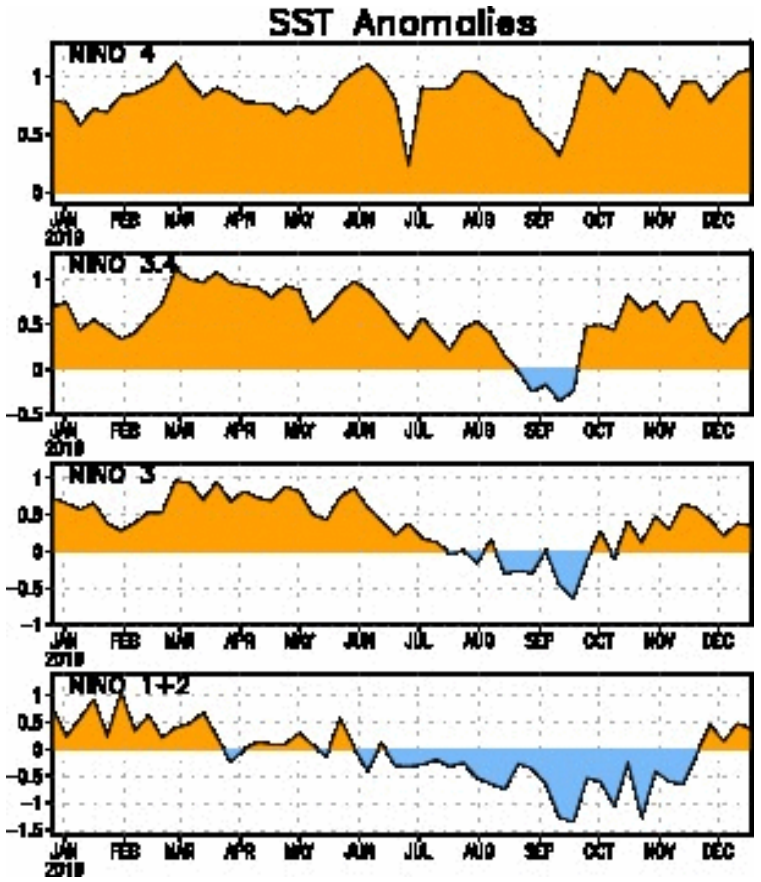


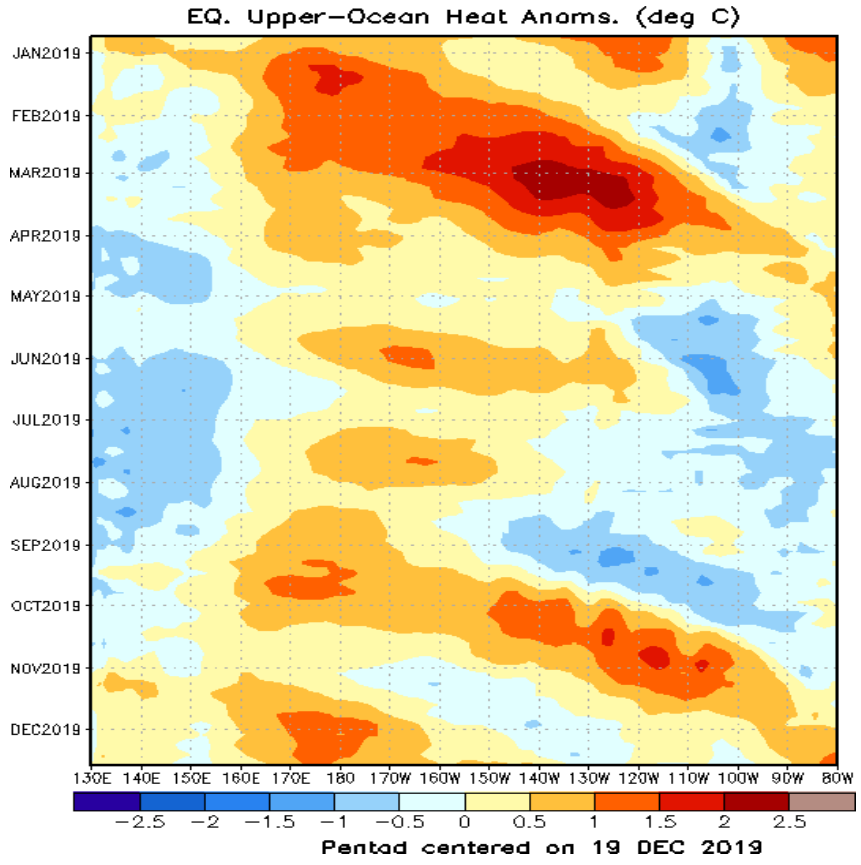


- OLR anomalies associated with the IOD have decreased during December, although suppressed convection continues over the Maritime Continent south of the Equator.

- Tropical cyclone activity east of the Philippines is apparent in mid-December.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



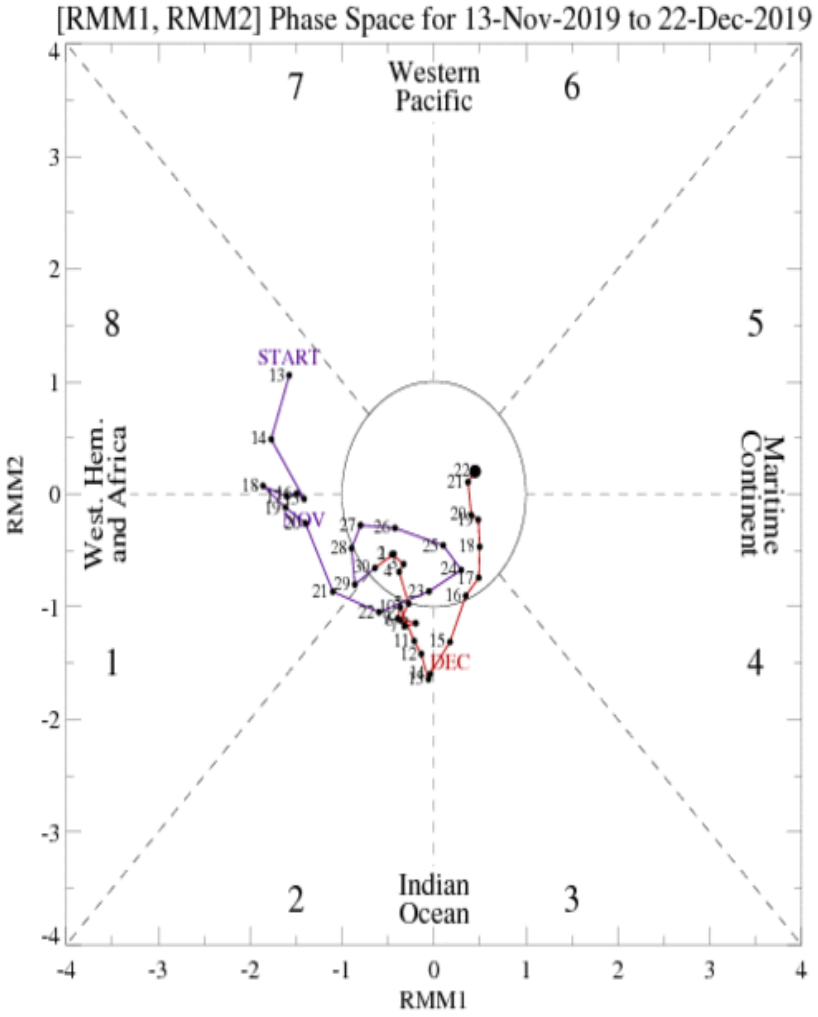


- Upper-oceanic heat content anomalies remain slightly above-normal across most of the basin.

- Several westerly wind bursts over the West Pacific resulted in a new downwelling Kelvin wave activity near the Date Line.

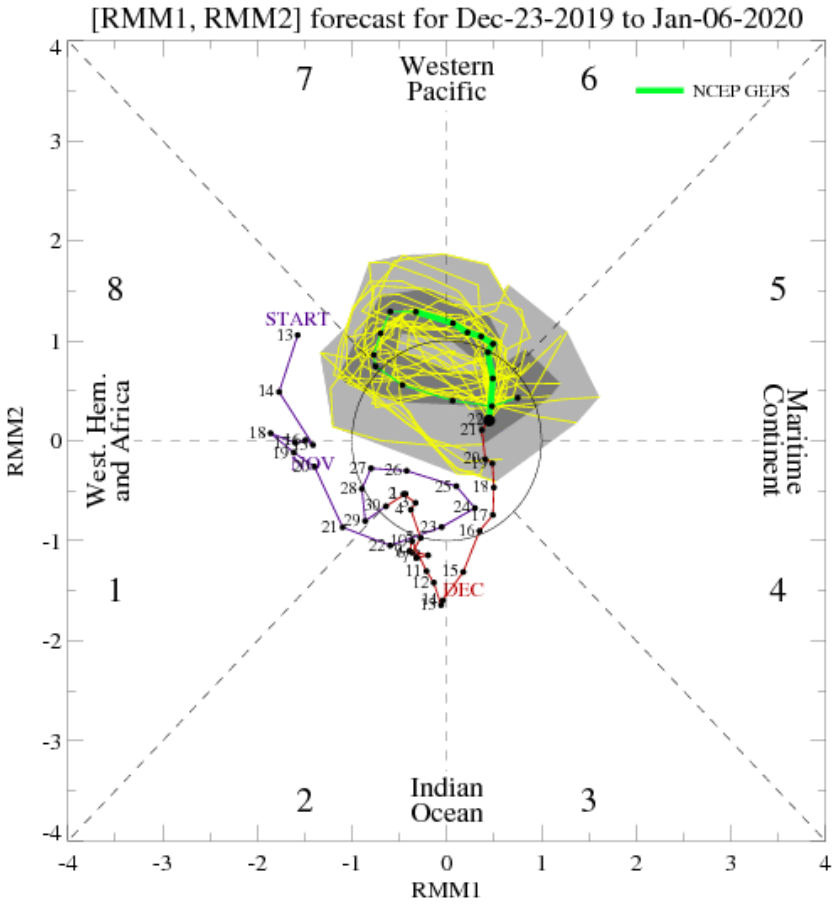
MJO Index: Recent Evolution

- The MJO index is weak, which is consistent with the generally weak wind and OLR fields.
- There is evidence of some eastward propagation of a weak signal, however, this has not been the case since late November.

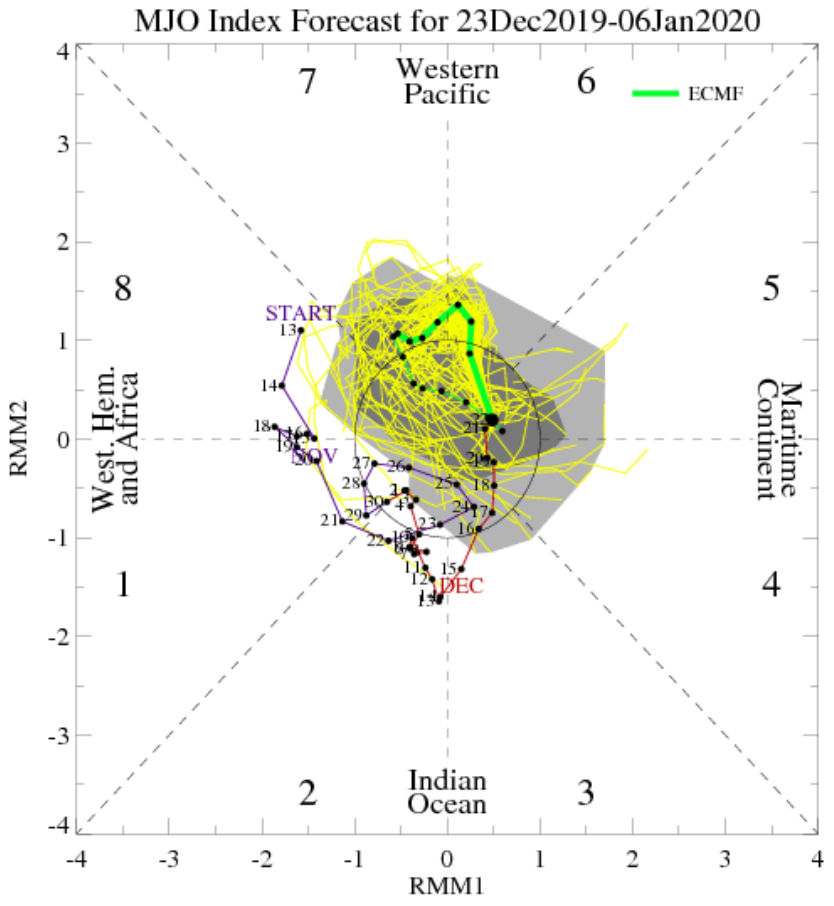


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

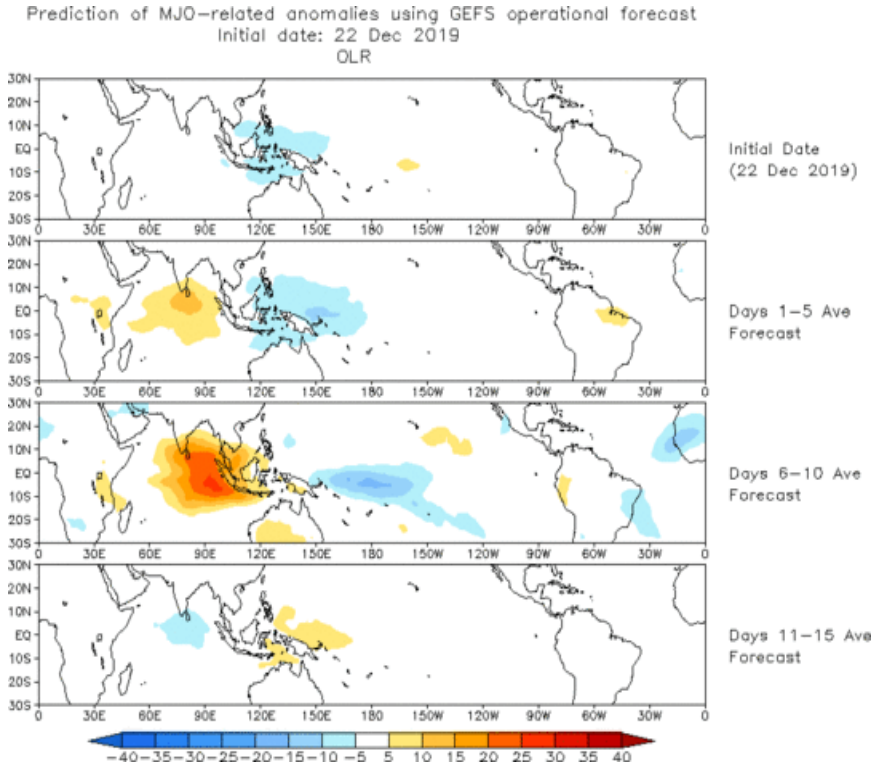


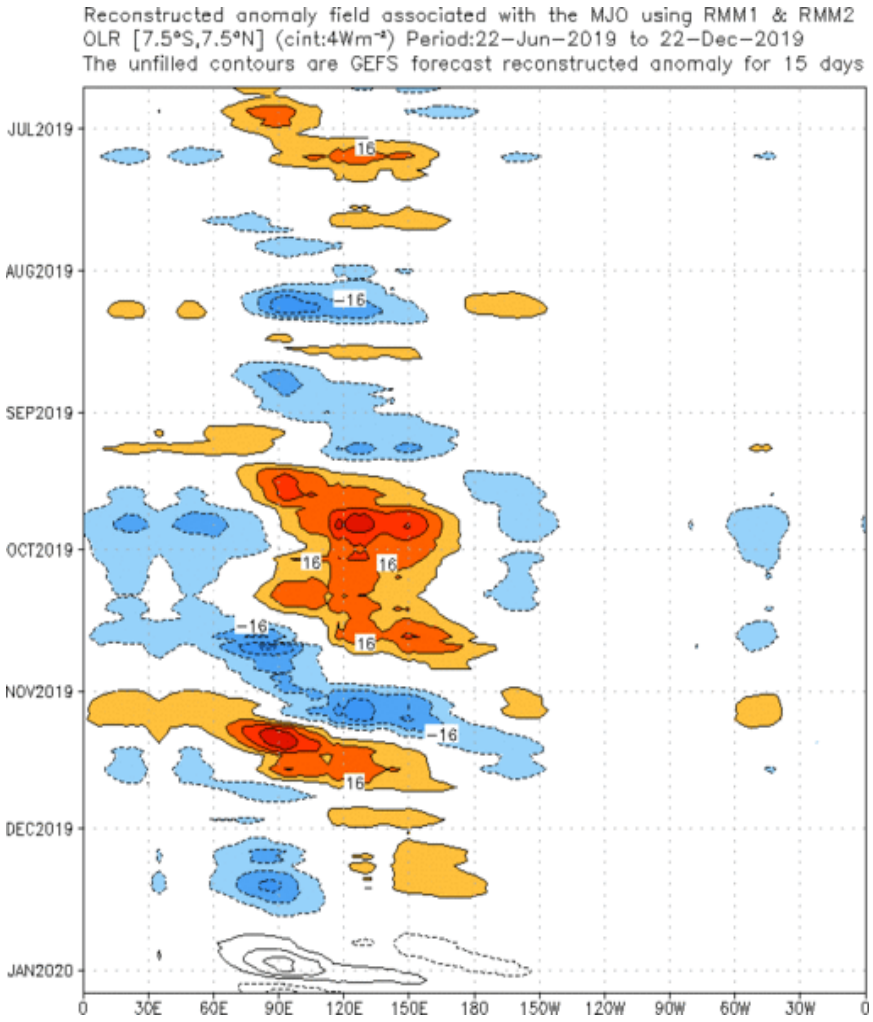
ECMWF Forecast

- The GEFS and ECMWF both show a strengthening MJO signal over the West Pacific during Week-1.
- By Week-2, the signal weakens and makes a sharp left turn, characteristic of interference from Rossby wave activity.

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.)

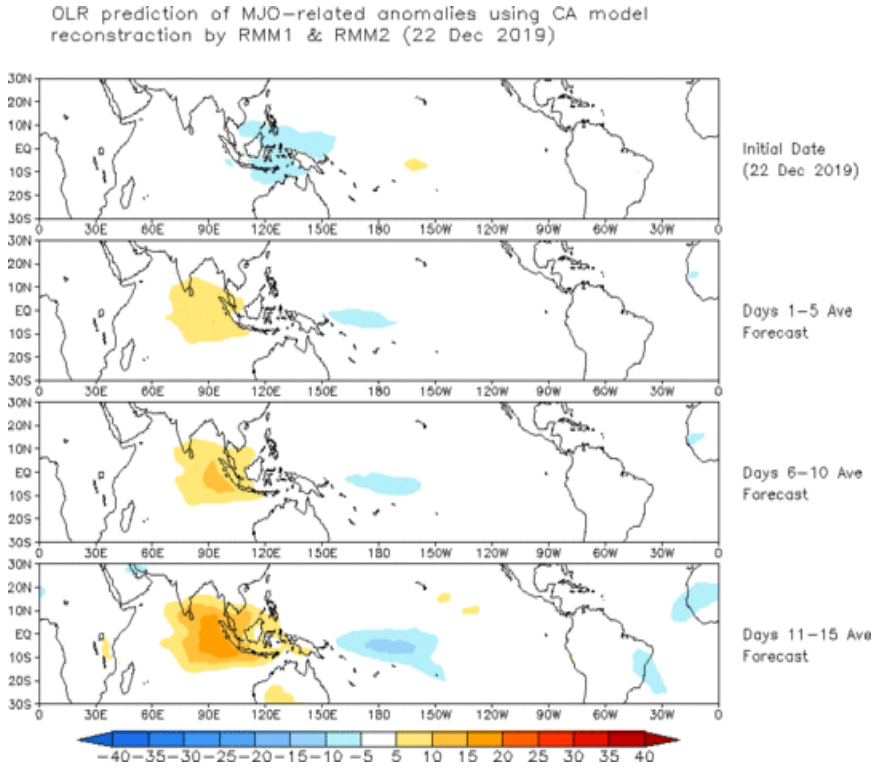


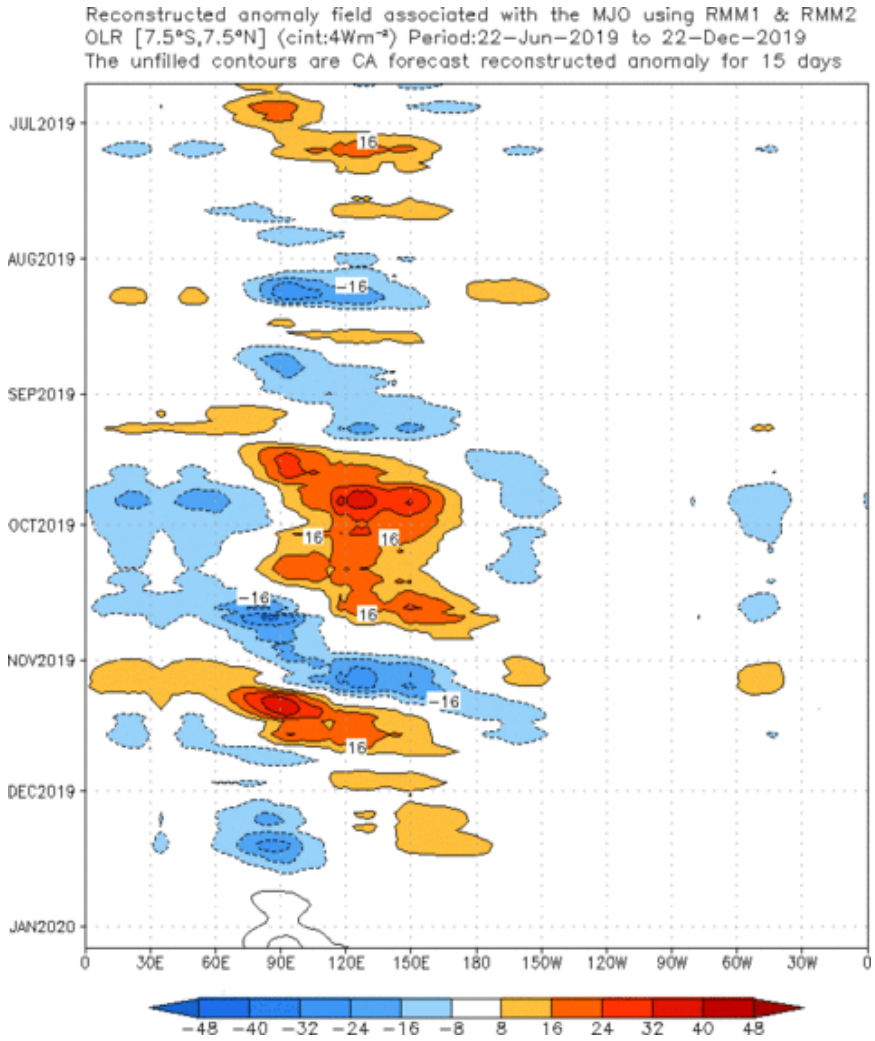


- The GEFS RMM-based OLR anomaly forecast shows a strengthening West Pacific event towards the end of Week-1, followed by rapid weakening into Week-2.

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.)

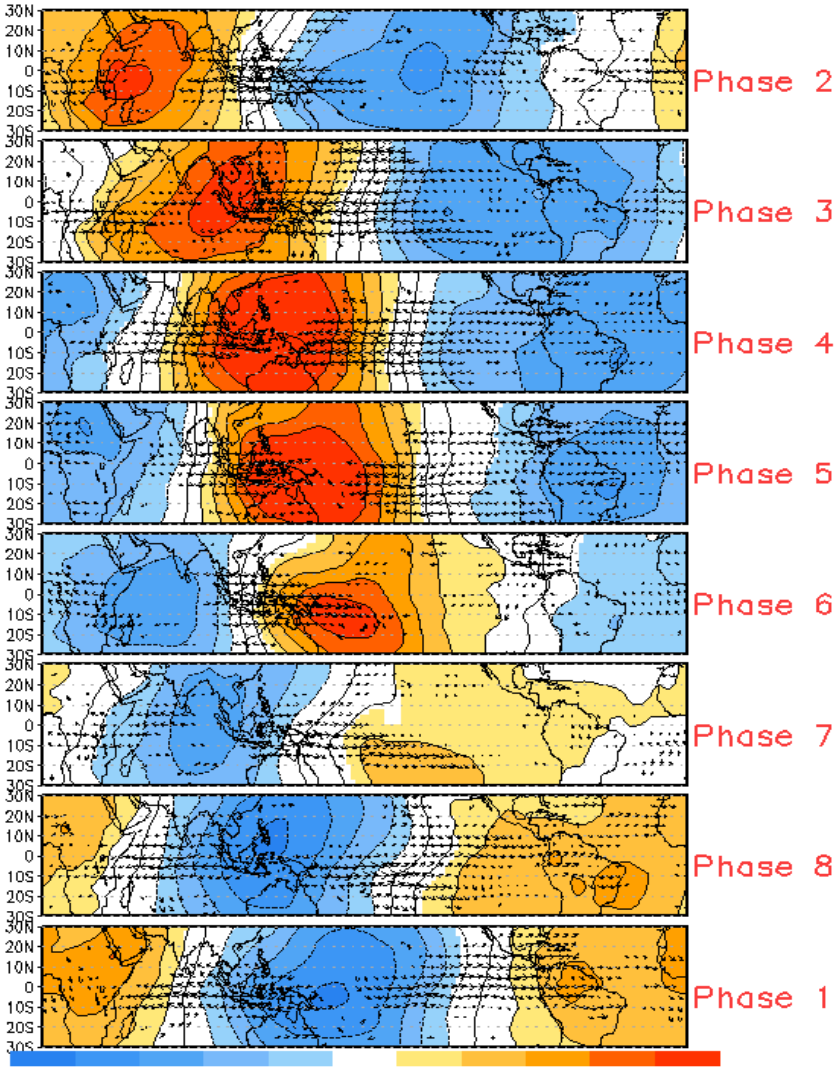




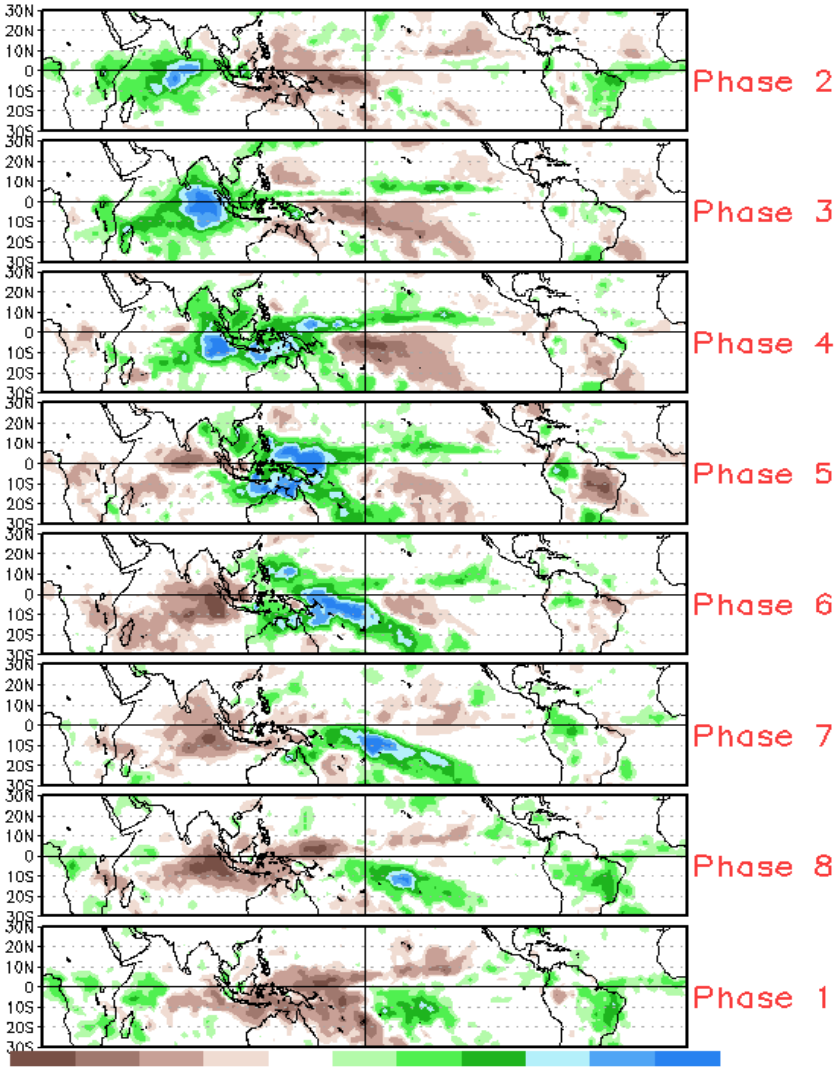
- The constructed analog depicts a slower, eastward propagating event with gradual amplification during Week-2.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



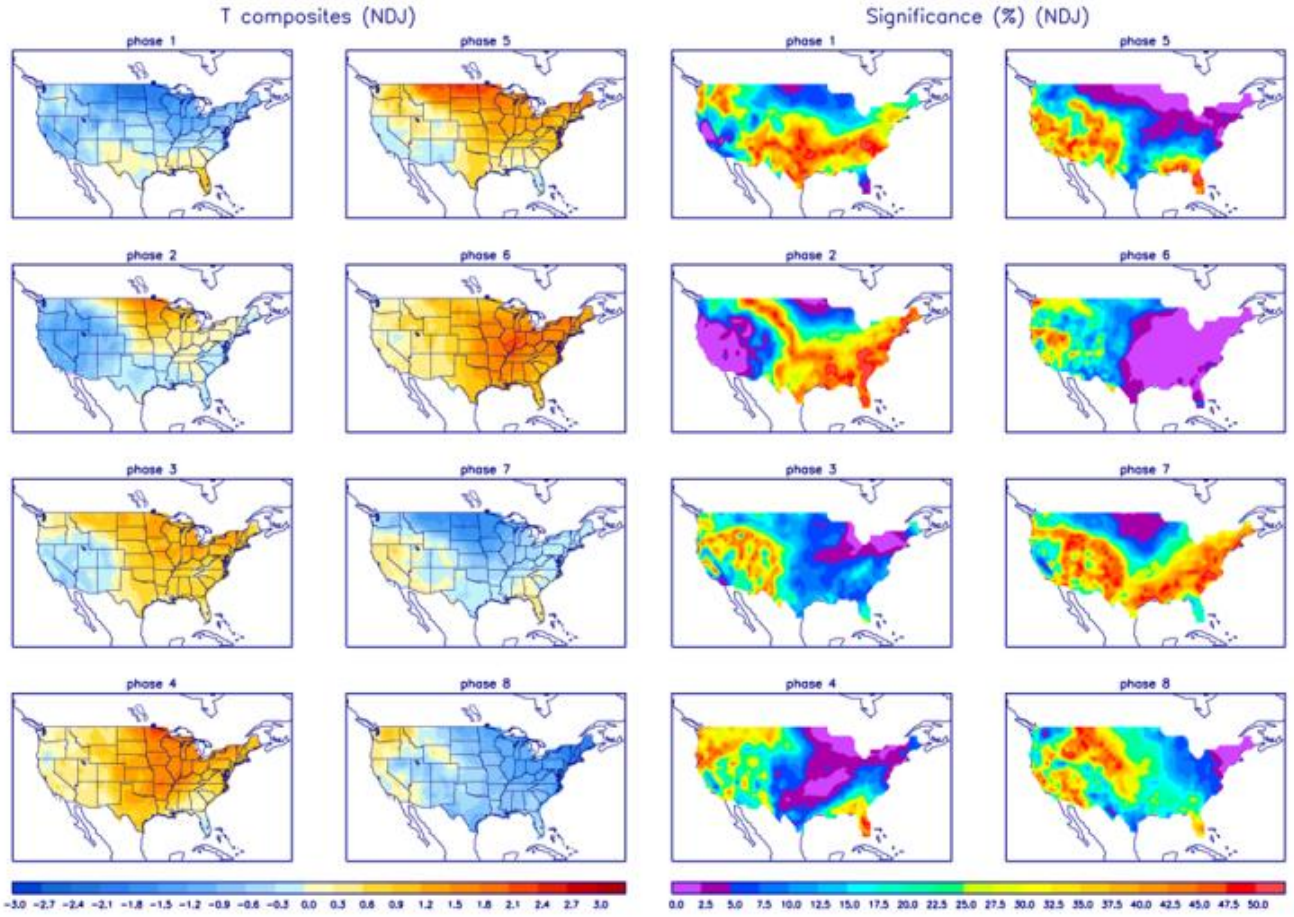
Precipitation Anomalies



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.

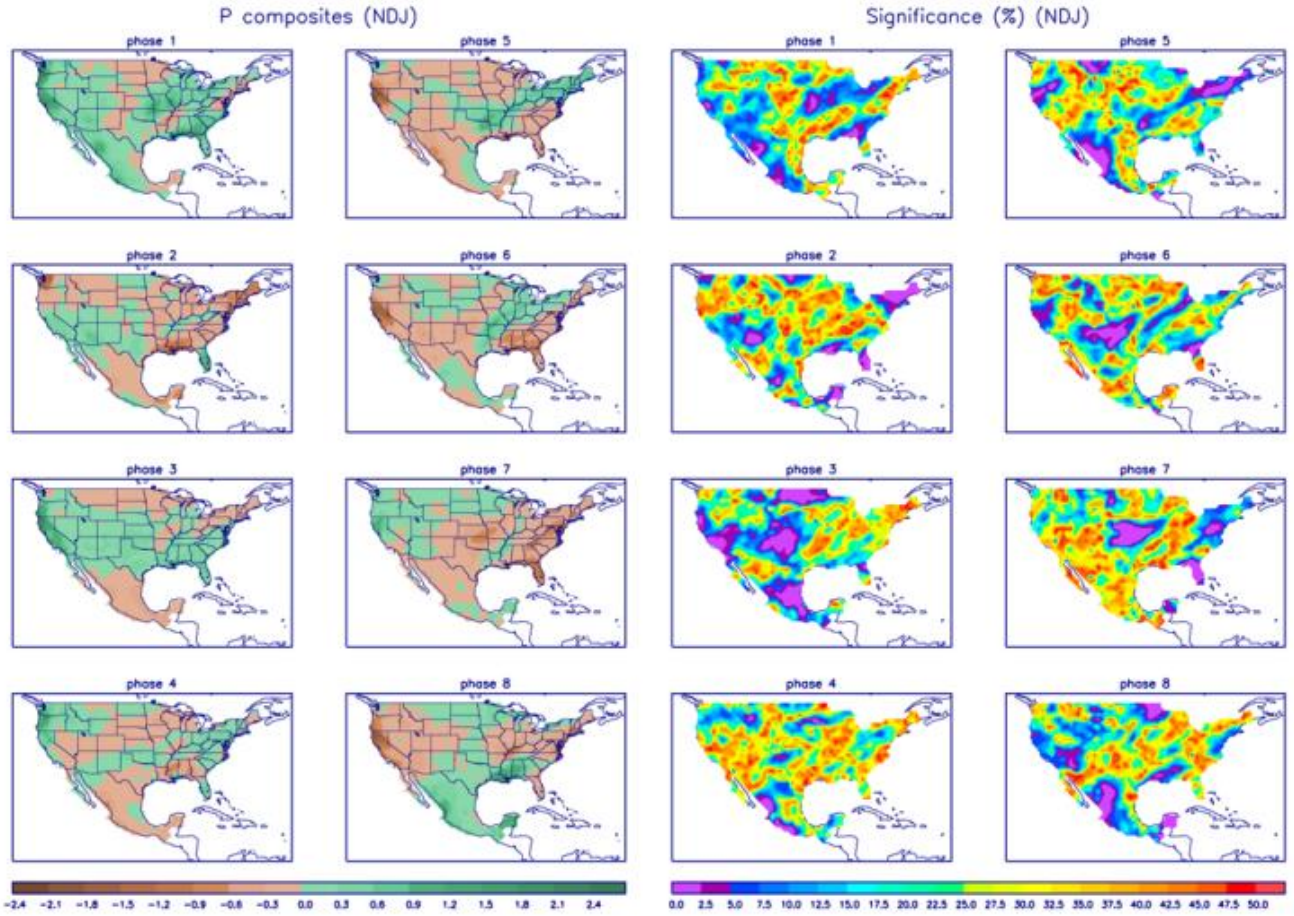


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

MJO: CONUS Composite Maps by RMM Phase - 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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