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

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

Overview

- The MJO remains active, though at low amplitude, with the enhanced phase persisting over the Western Indian Ocean.

- Most statistical and dynamical model forecasts indicate the MJO signal will remain weak, with the MJO convective envelope remaining over Phases 2 and 3 (Indian Ocean). Competing modes of tropical variability (for example, the MJO, equatorial Rossby waves, Kelvin waves, and the underlying low frequency IOD state), and any westward-moving tropical cyclones, all contribute towards significant uncertainty regarding the MJO outlook over the next two weeks.

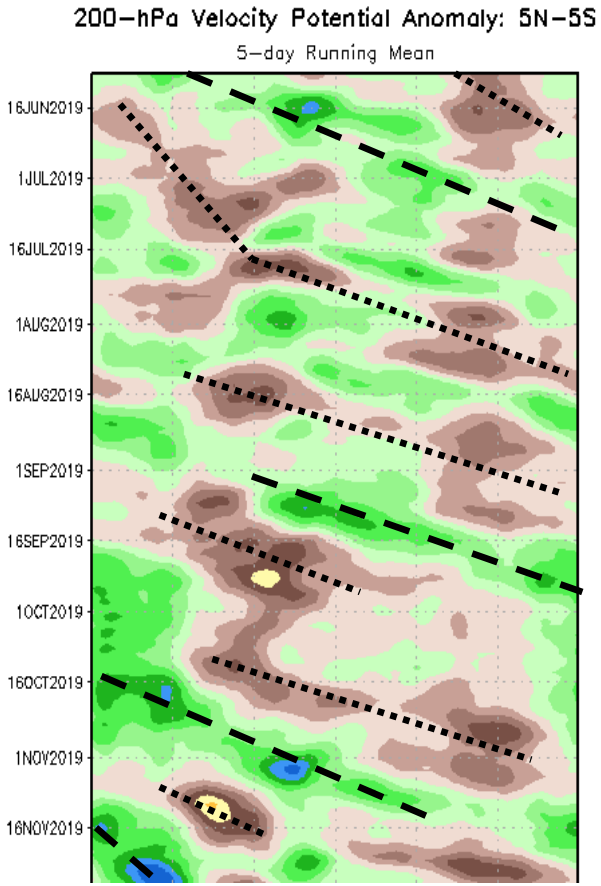
- If the MJO does propagate eastward during Week-2 that would yield destructive interference with the low frequency Indian Ocean Dipole event. This would decrease confidence in tropical precipitation patterns and any resulting extratropical impacts.

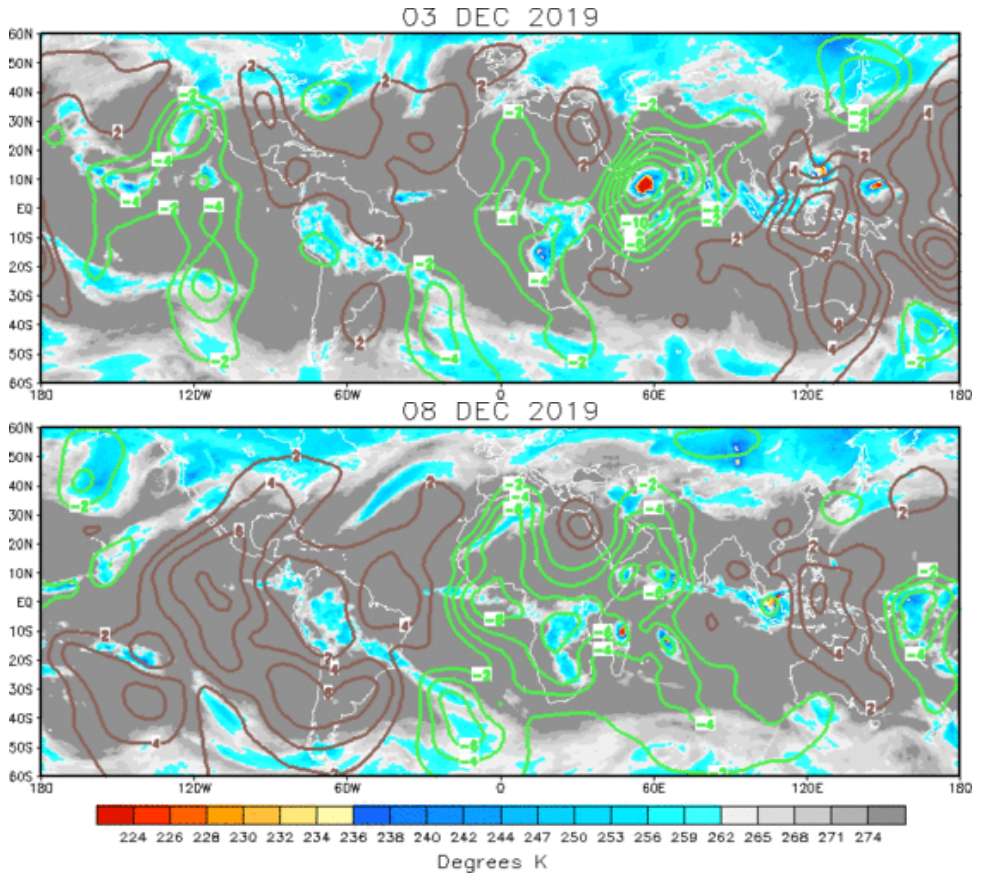
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

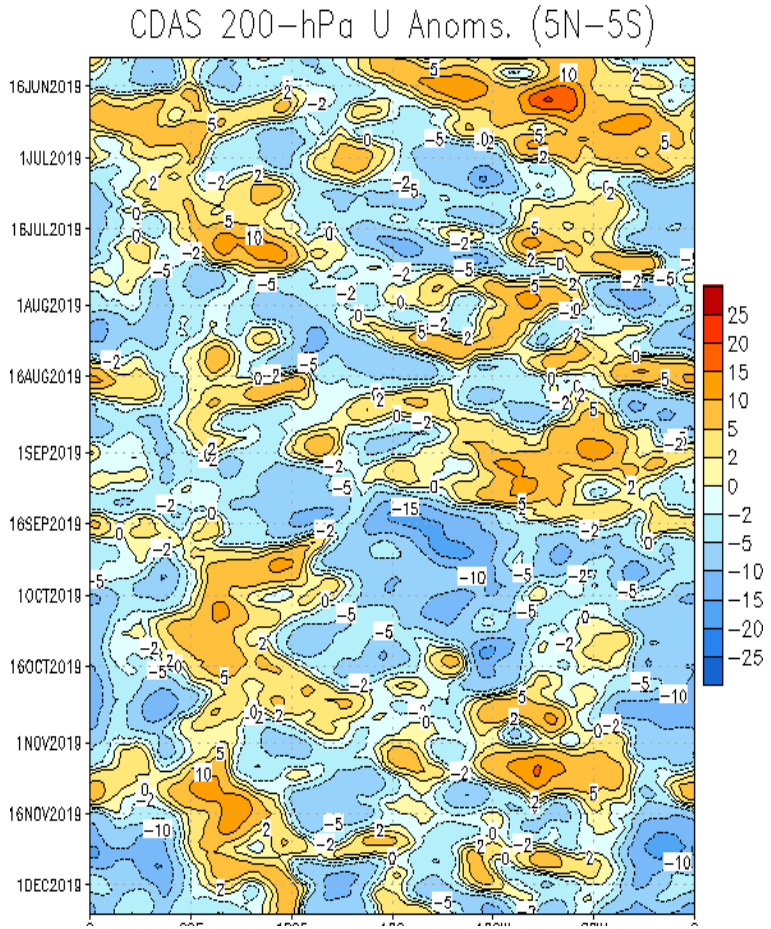


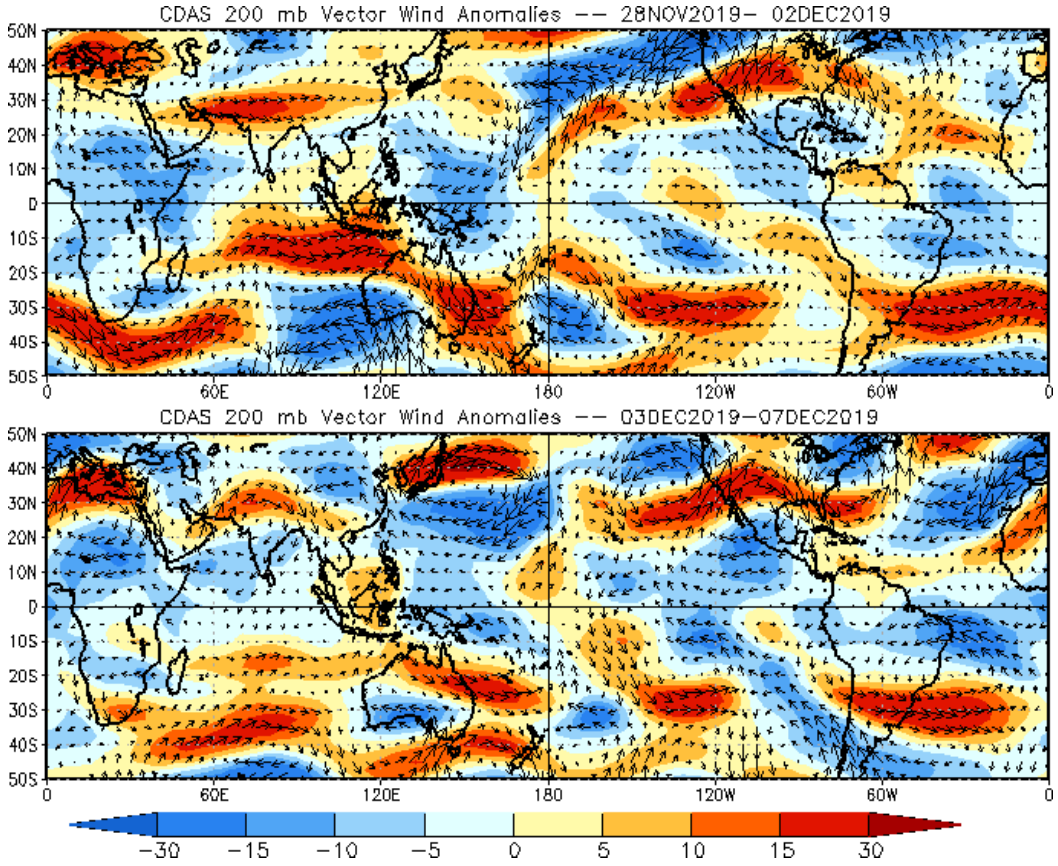


- Over the past 5 days, enhanced anomalous divergence was located over Africa, the Arabian Sea, and India, while the signal for suppressed convection over the Maritime Continent weakened. This is related to the interaction between the subseasonal MJO footprint and the low frequency state of the Indian Ocean Dipole (IOD); constructive interference over Africa/Arabian Sea/India, and some destructive interference over the Maritime Continent.

200-hPa Wind Anomalies

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



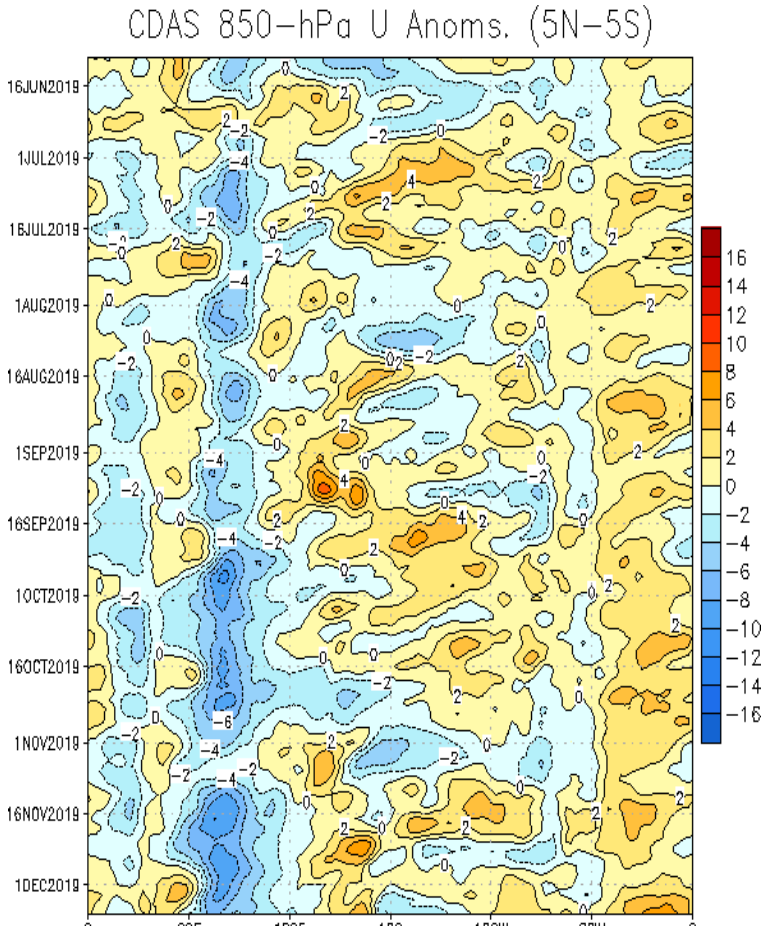


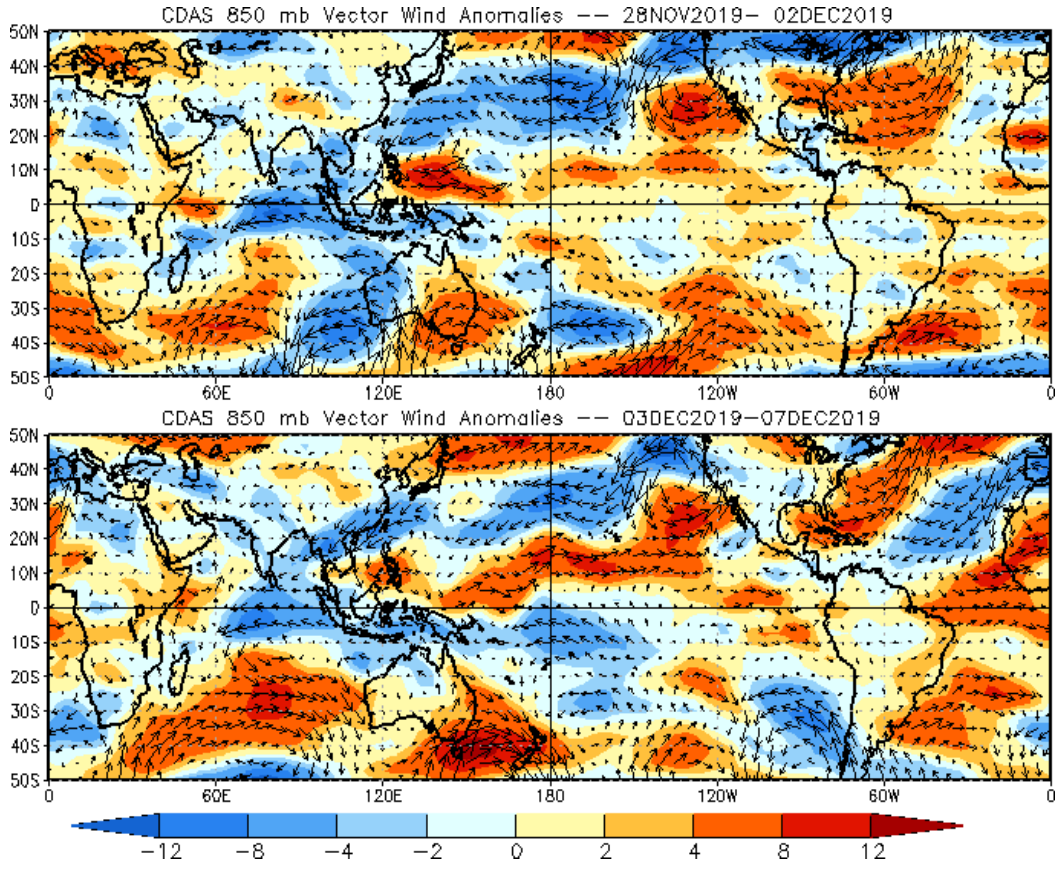
- Anomalous upper-level convergence (divergence) over the Maritime Continent (western Indian Ocean) is consistent with an atmospheric response to the low frequency state of the IOD and active MJO.

- A 200-hPa anticyclone centered over northwest India contributes to upper-level anomalous easterlies across the Indian subcontinent, the Arabian Sea, and adjacent portions of the North Indian Ocean.

850-hPa Wind Anomalies

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



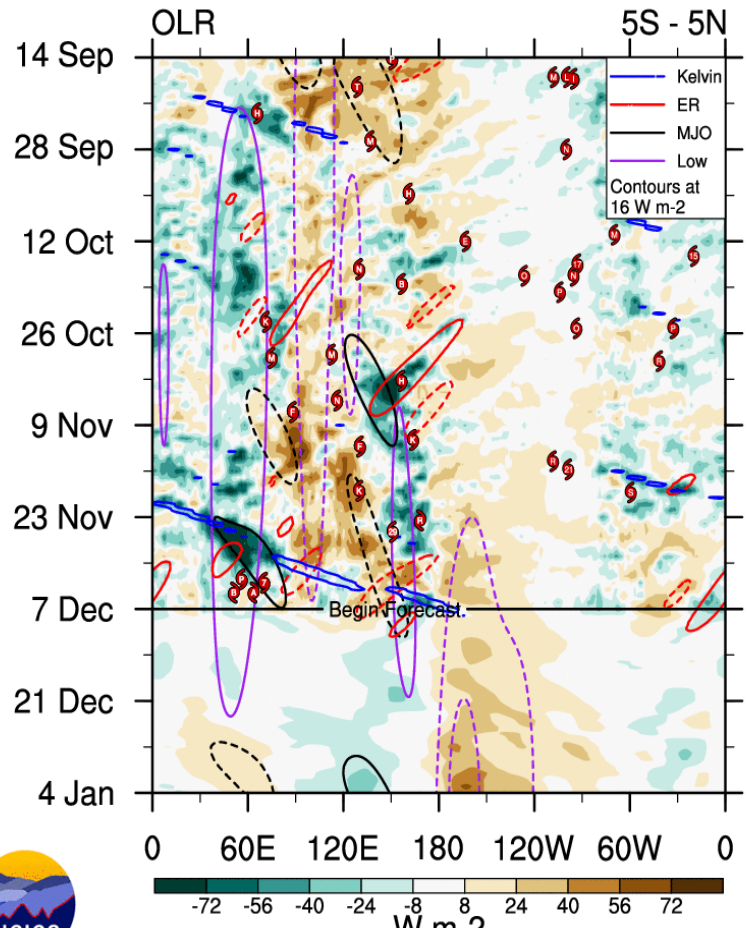


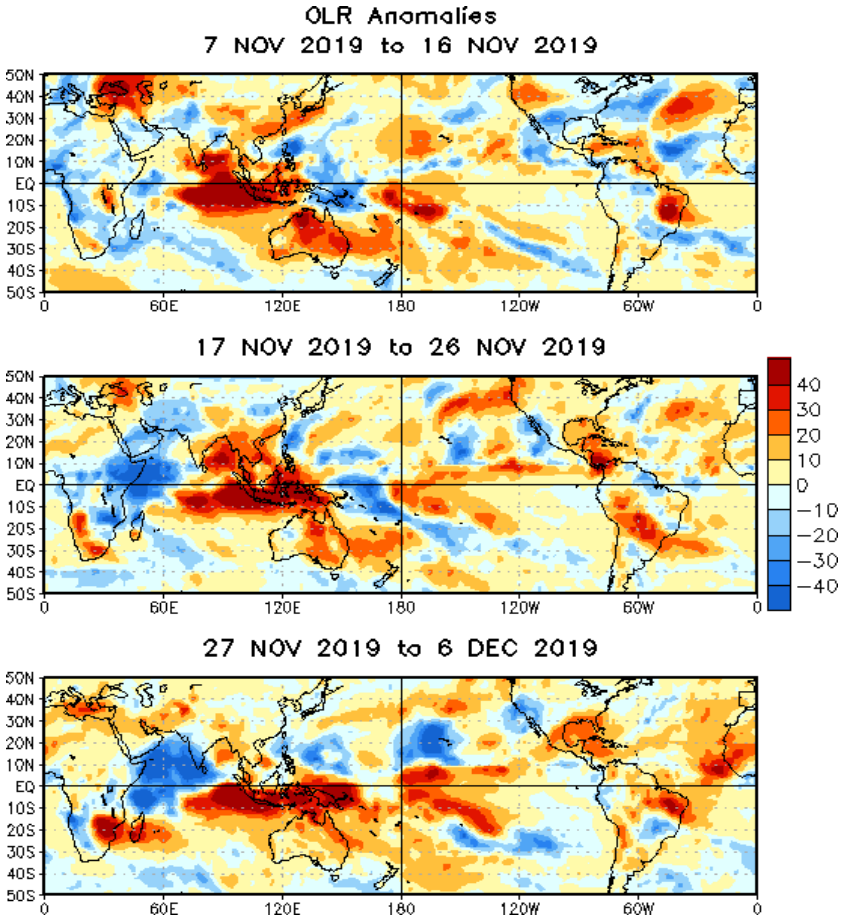
- Anomalous easterlies tied to the ongoing IOD event remained across the Indian Ocean, with the exception of some anomalous westerlies most recently near the Horn of Africa, possibly tied to the enhanced MJO envelope.

- Weakened trade winds exist across much of the tropical Pacific.

Outgoing Longwave Radiation (OLR) Anomalies

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

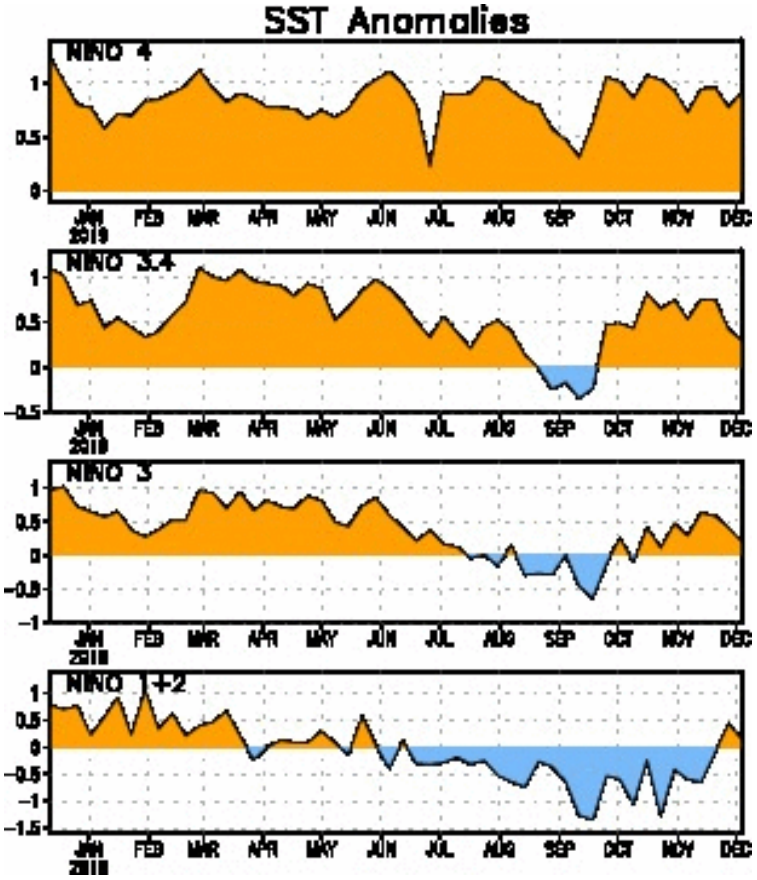


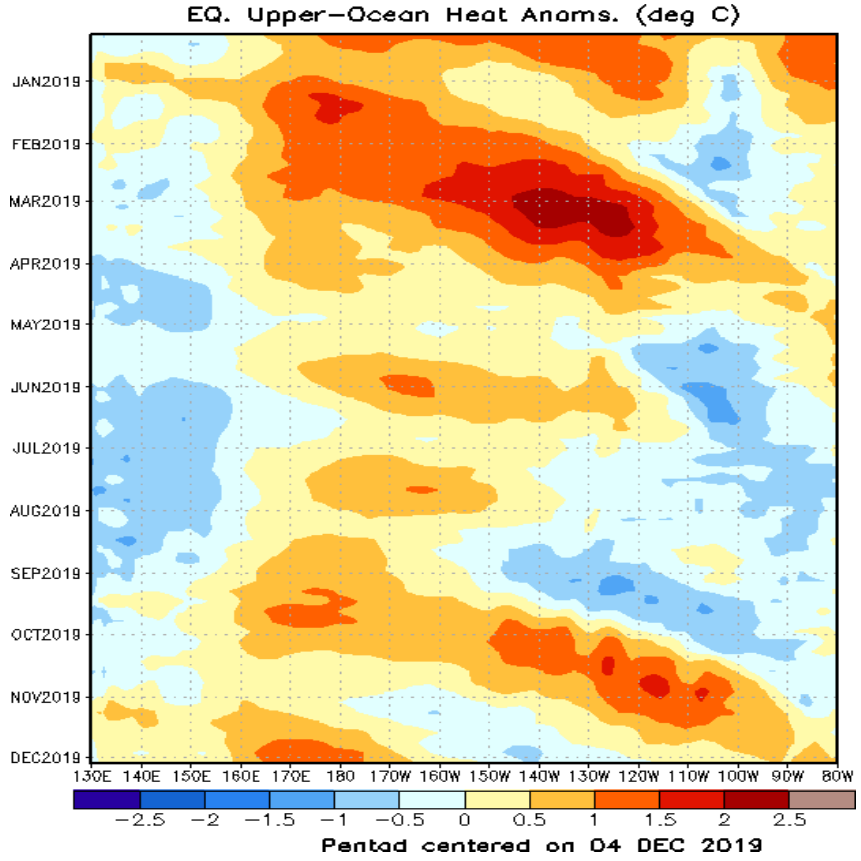


- The superposition of the low frequency IOD, equatorial Rossby wave activity, the enhanced MJO envelope, and a Kelvin wave resulted in a flare of enhanced convection over the Western Indian Ocean during late November and early December.

- Suppressed convection became displaced south of the equator across the Maritime Continent in late November, possibly due to outflow from tropical cyclone activity in the West Pacific influencing the OLR field.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



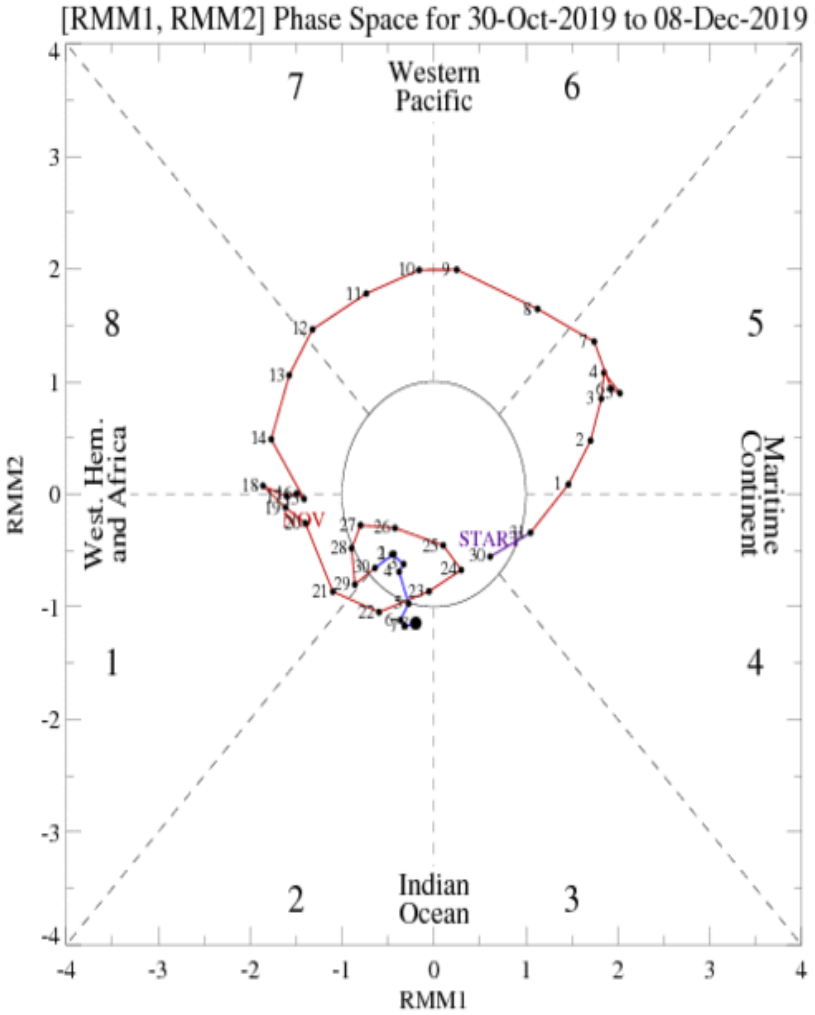


- Little change has been observed with SSTs in the Pacific Niño 3.4 region, which remain above normal following a downwelling Kelvin wave event that initiated in September.

- Another downwelling Kelvin wave event may be occurring west of the Dateline associated with strengthening lower level westerly wind anomalies in the region.

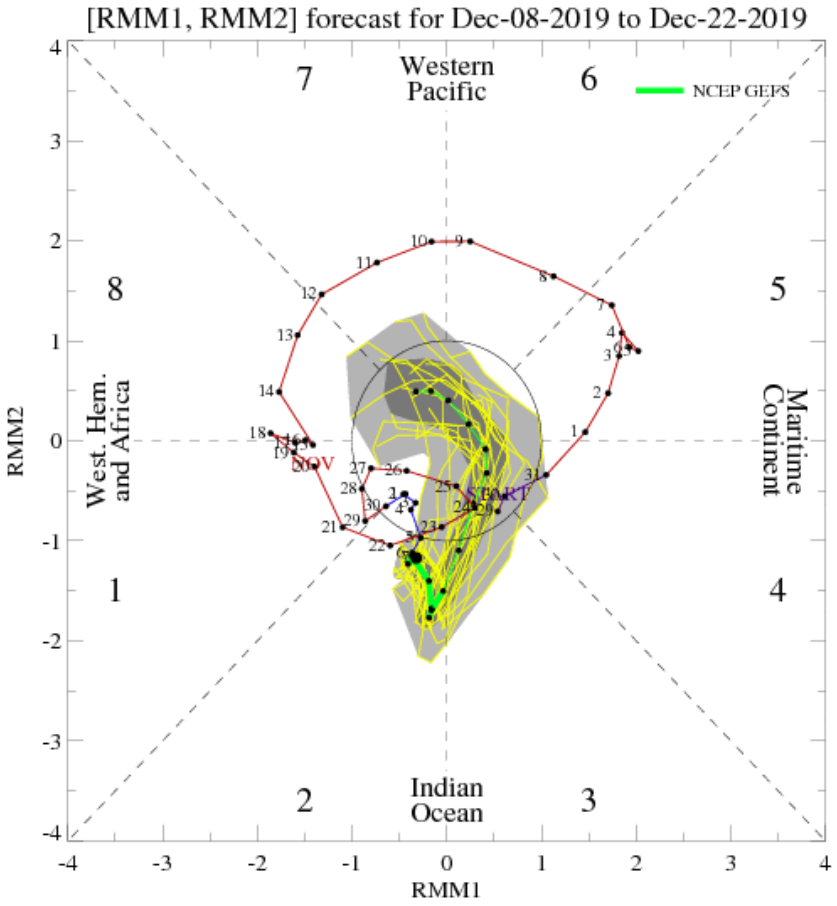
MJO Index: Recent Evolution

- During the past week the MJO remained relatively weak while drifting slowly eastward. This is likely the net result of competing modes of variability across the Western Indian Ocean.

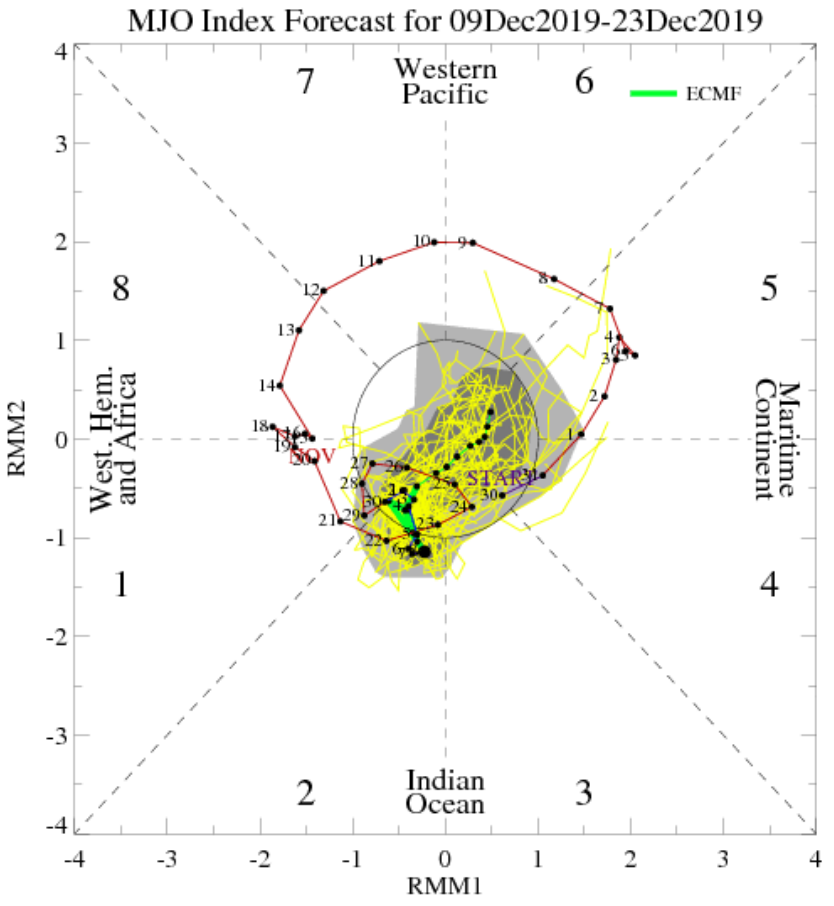


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

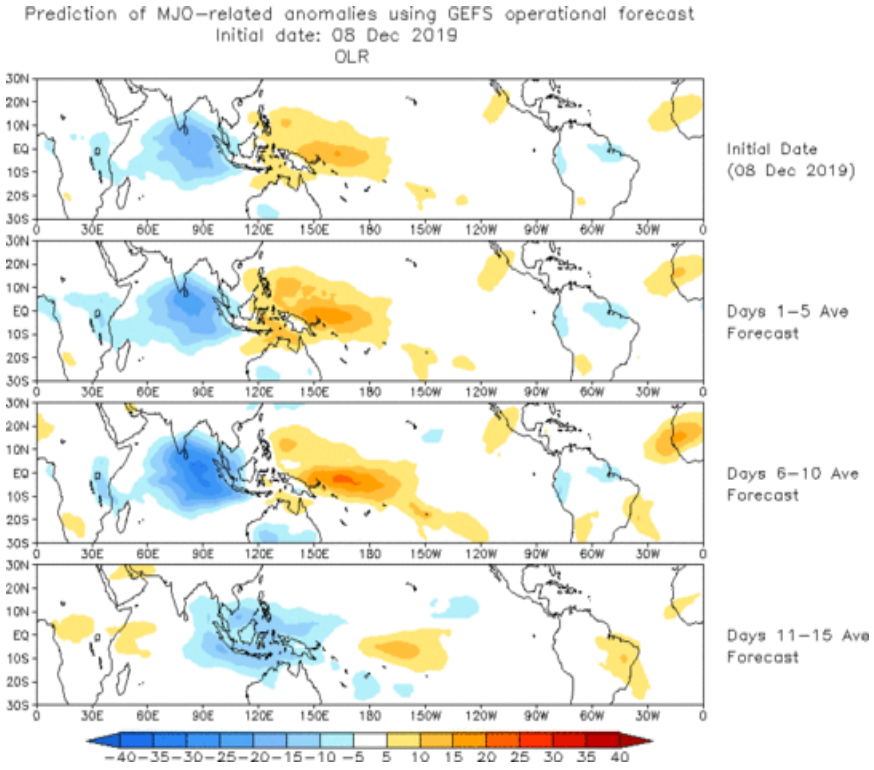


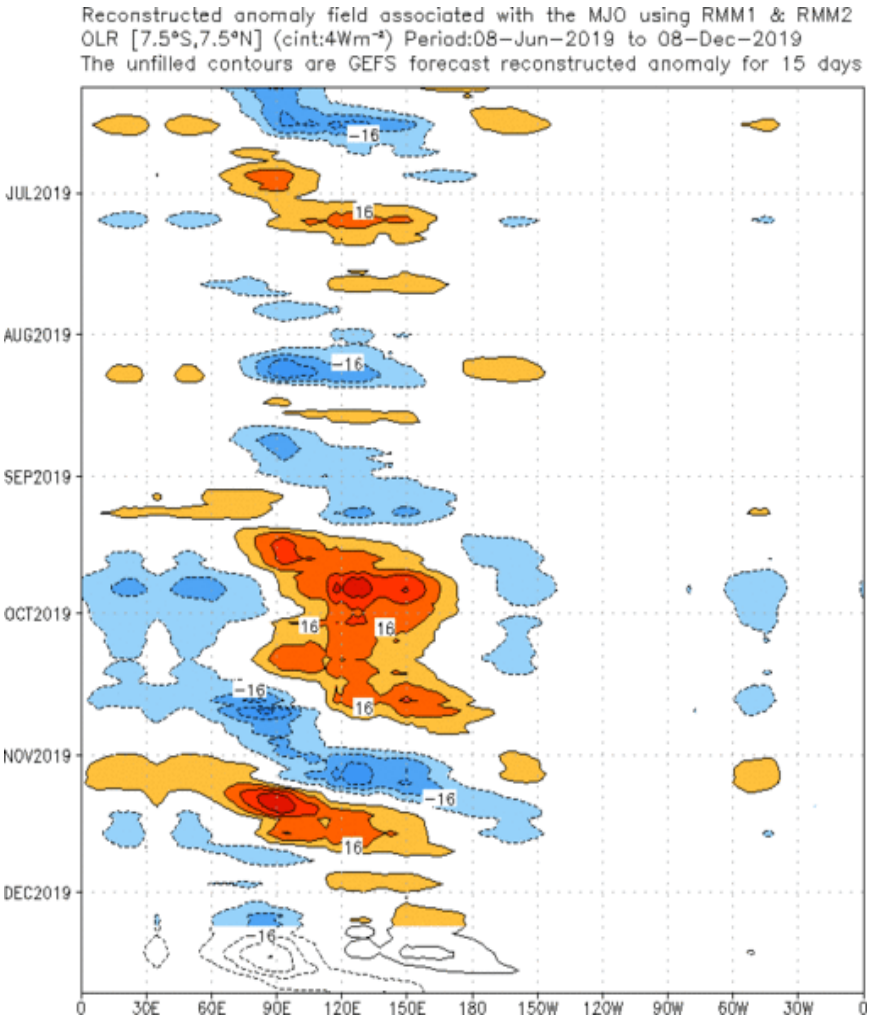
ECMWF Forecast

- Models predict significant differences in MJO amplitude and phase during Week-1, though both models agree on a weak signal during Week-2.
- The GEFS predicts slight eastward progression of the subseasonal signal through Week-1, with ensemble members curving left with time on the RMM plot possibly pointing to Rossby wave interference. The ECMWF may be influenced by Rossby wave activity earlier (Week-1), but more progressive in Week-2.

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.)

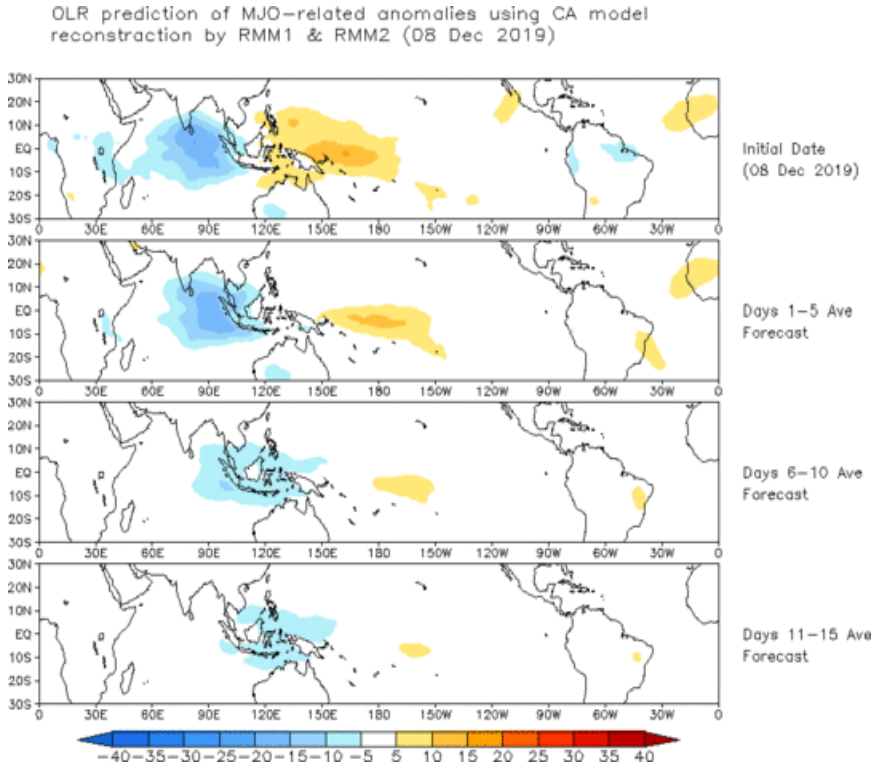


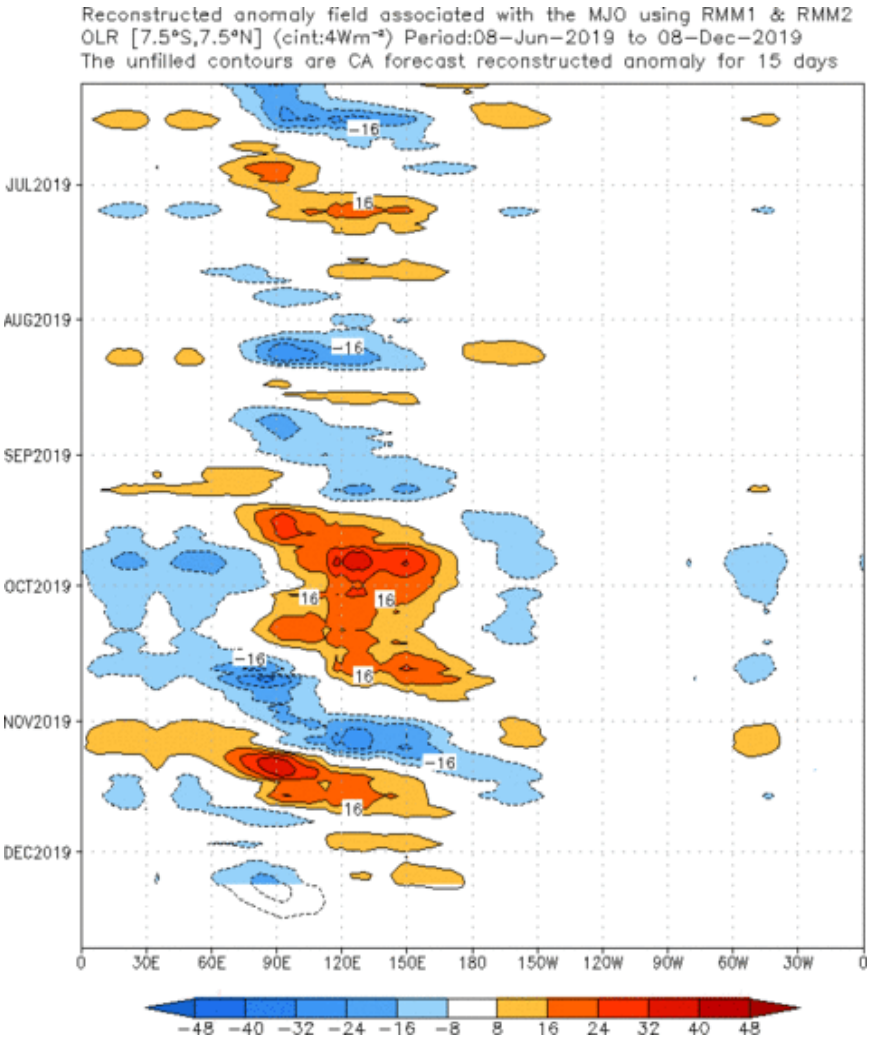


- The GEFS RMM-based OLR anomaly forecast shows a slow eastward propagation of the convective dipole across the Indian Ocean and Maritime Continent/West Pacific during the next two weeks.

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.)

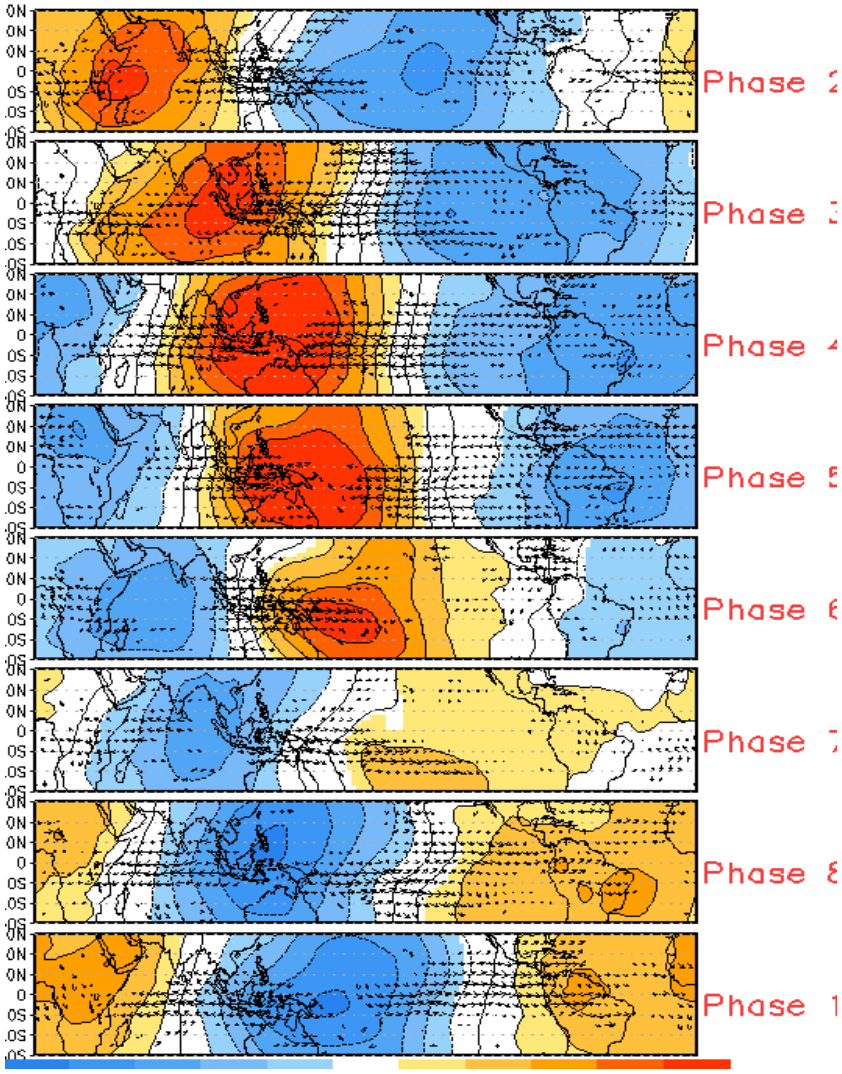




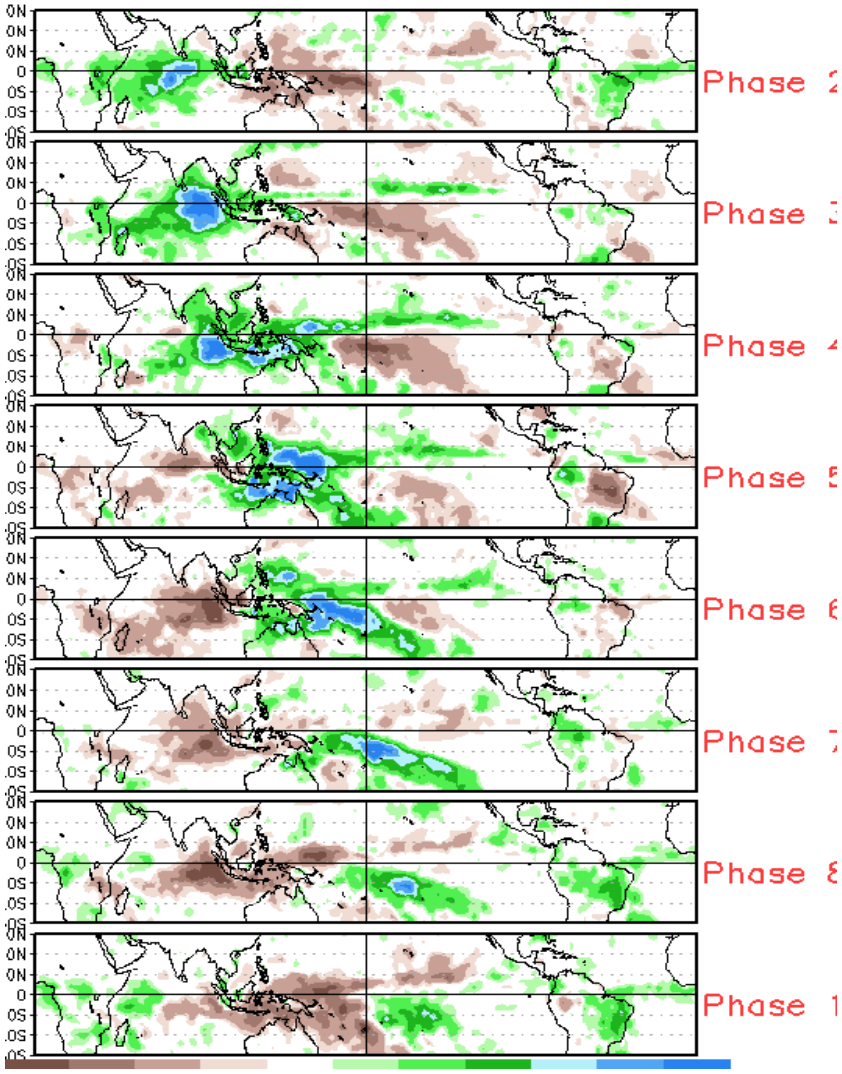
- The constructed analog agrees well with the GEFS forecast, but features less robust convective anomalies compared to the dynamical model guidance.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



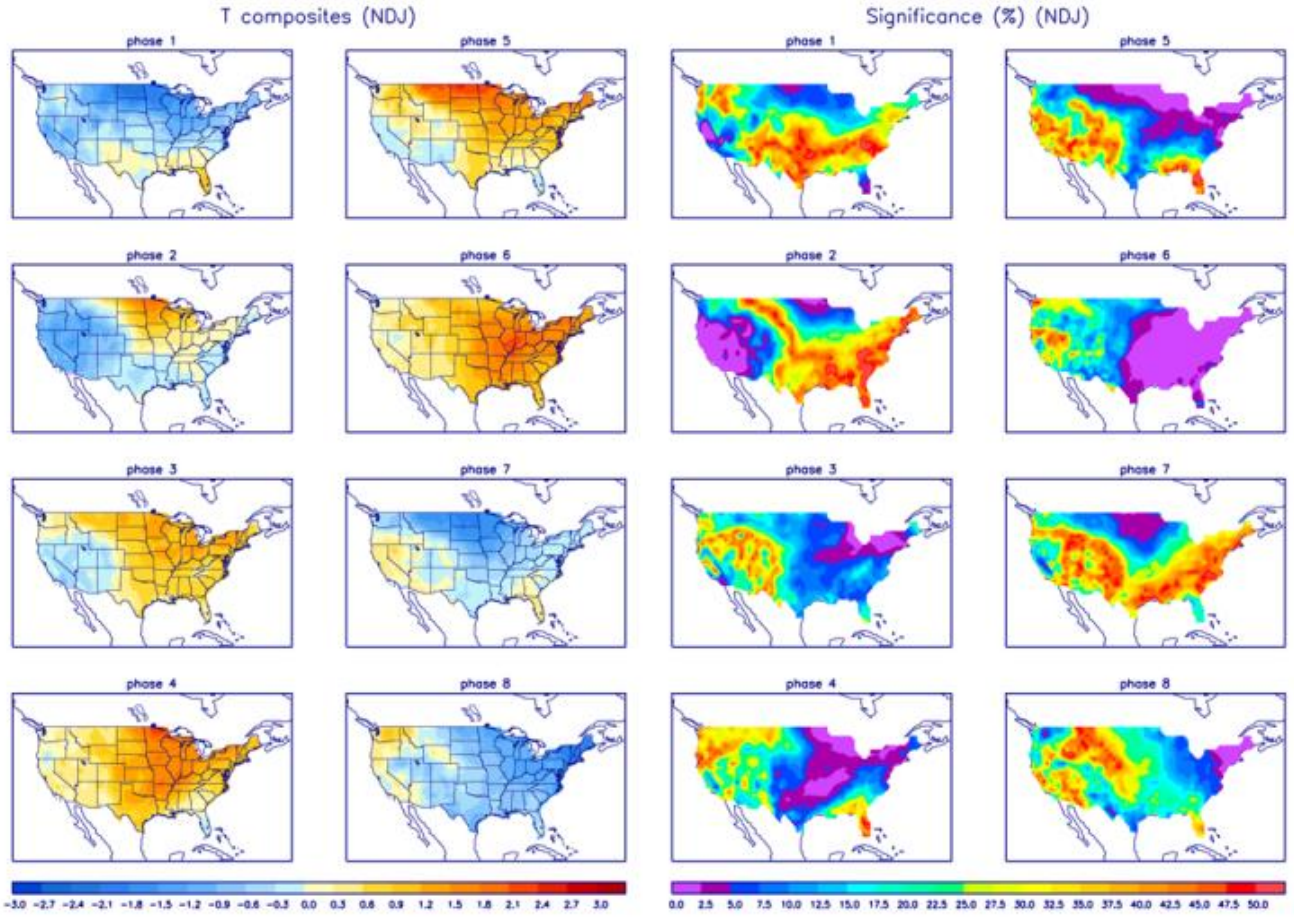
Precipitation Anomalies



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.

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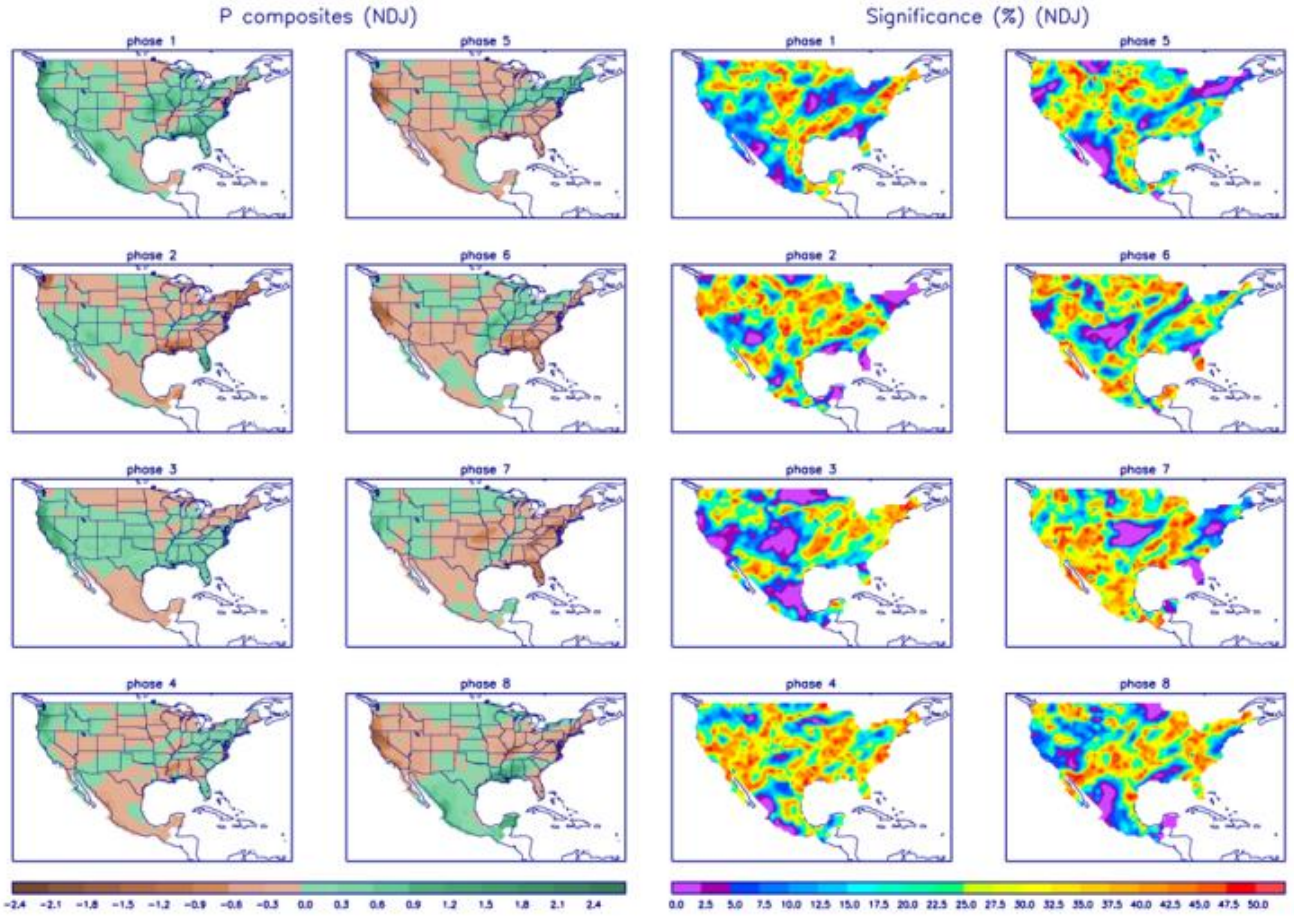

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