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

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

Overview

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

- Dynamical model forecasts consistently show a strengthening MJO event but are split on whether the signal will propagate eastward, and if so, how quickly.

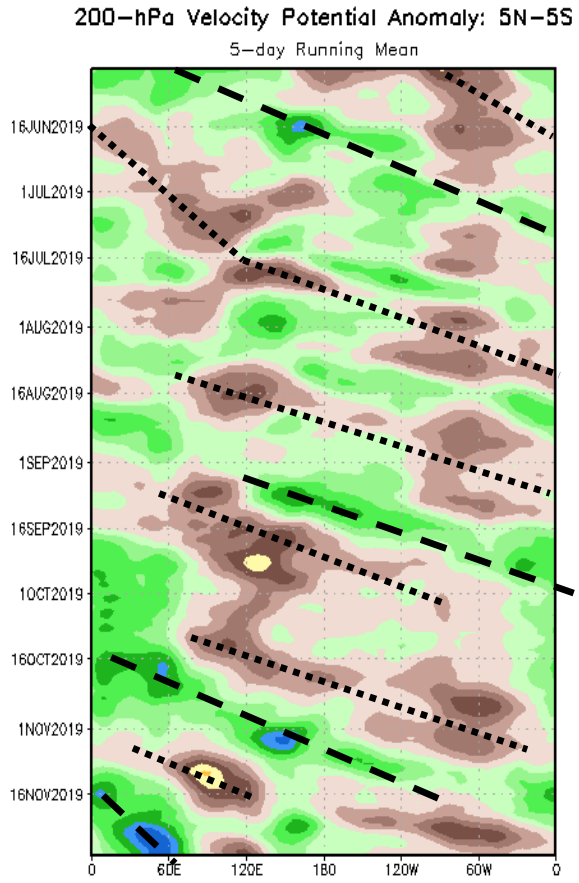
- If the MJO does propagate eastward during Week-2 that would yield destructive interference with the low frequency Indian Ocean Dipole event. This would decrease confidence in tropical precipitation patterns and any resulting extratropical impacts.

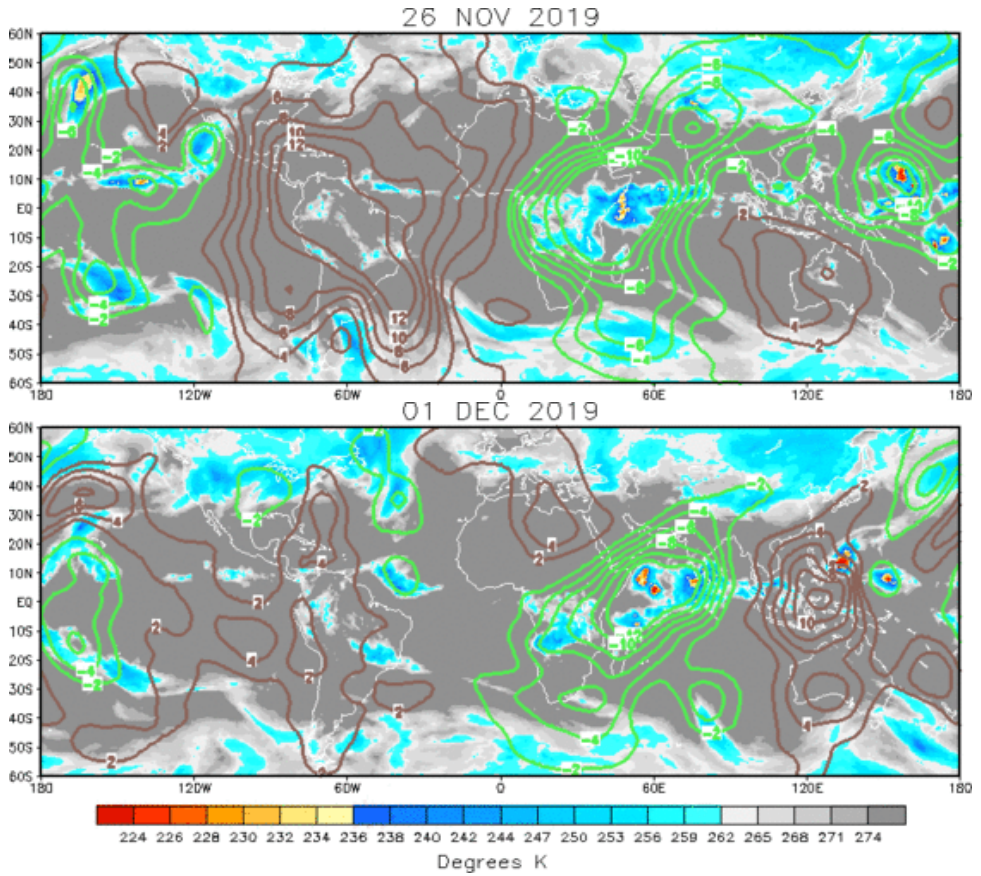
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

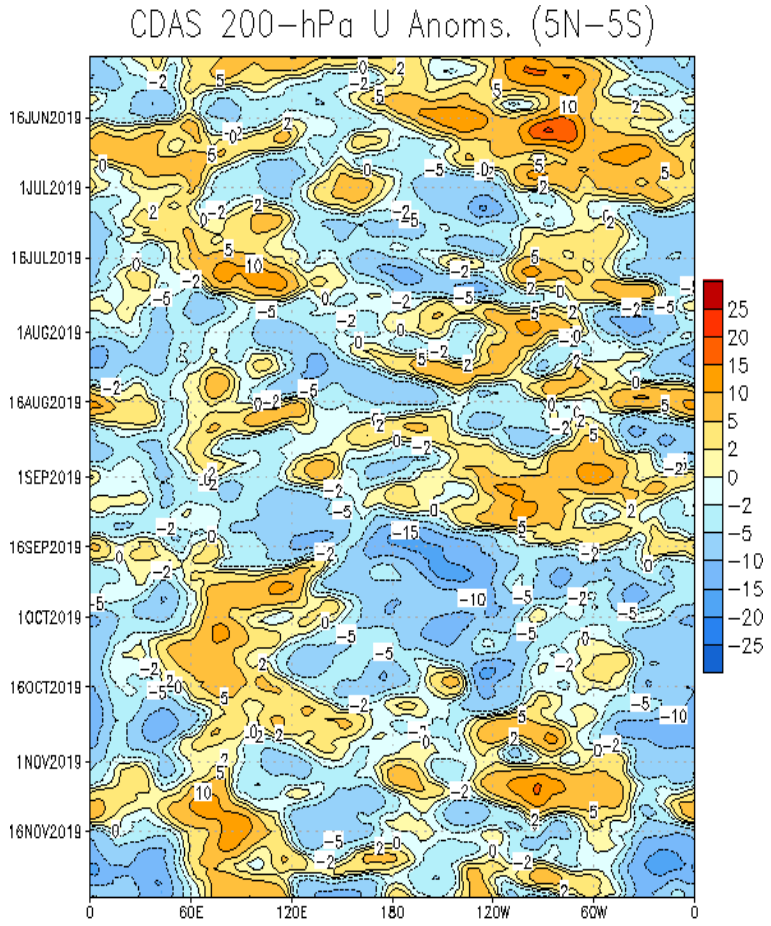


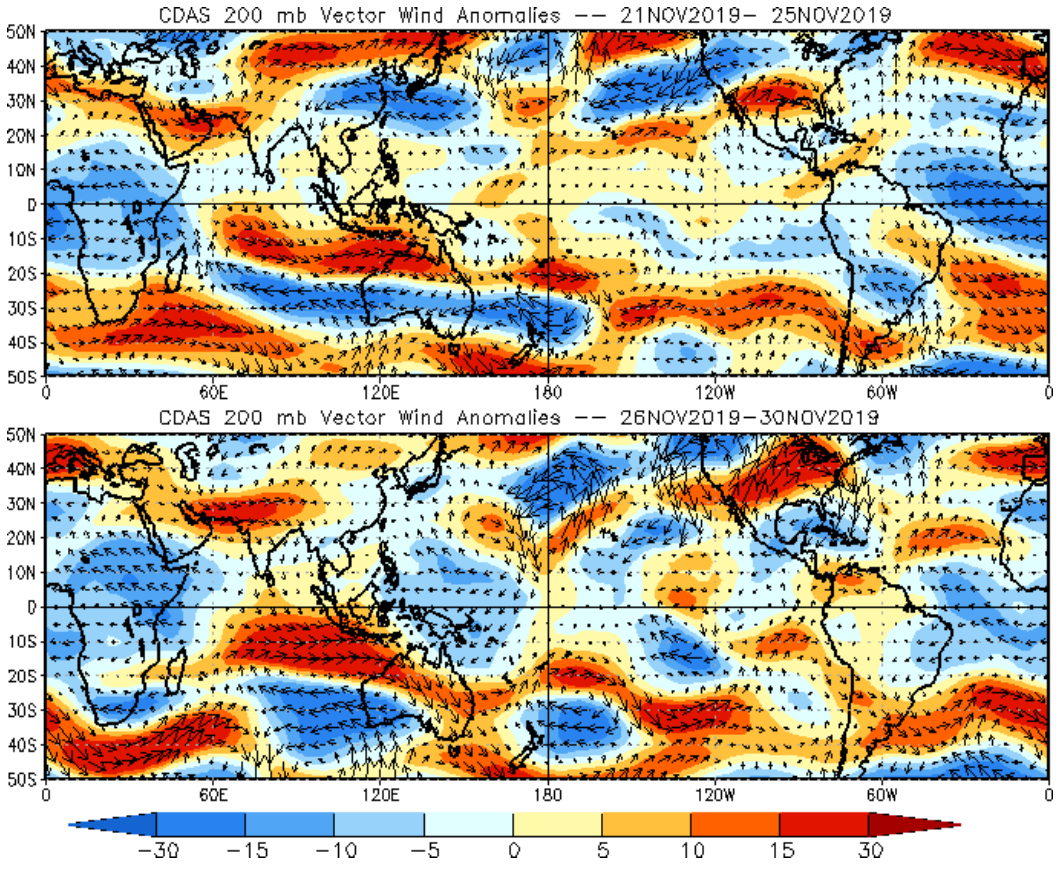


- Over the past 5 days there has been a nuanced eastward shift of the enhanced anomalous divergence over the Eastern Hemisphere while the suppressed convection over the Maritime Continent has been reinvigorated. This is a reflection of constructive interference between subseasonal MJO footprint and the low frequency state of the Indian Ocean Dipole (IOD).

200-hPa Wind Anomalies

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



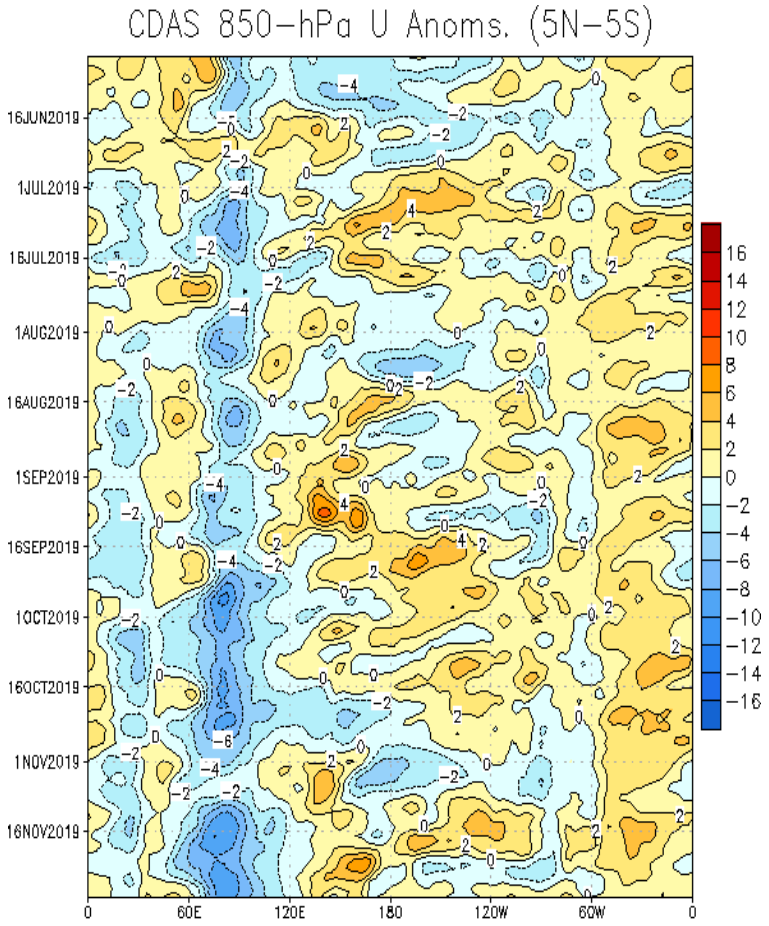


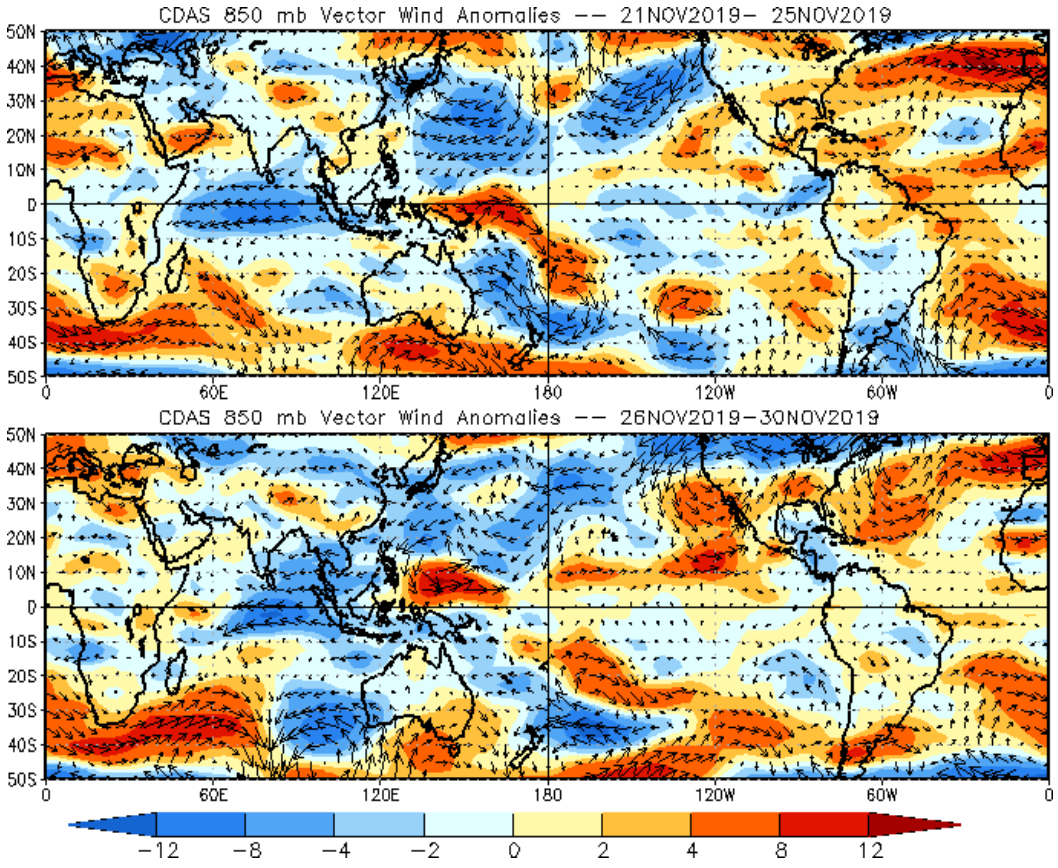
- Upper-level convergence (divergence) over the Maritime Continent (western Indian Ocean) is consistent with an atmospheric response to the low frequency state of the IOD and active MJO.

- Much of the divergent circulation response from the center of action over the Western Indian Ocean appears to manifest across the Southern Hemisphere. Wavebreaking across the North Pacific is imparting some momentum from the higher latitudes onto the tropics in the most recent observations.

850-hPa Wind Anomalies

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



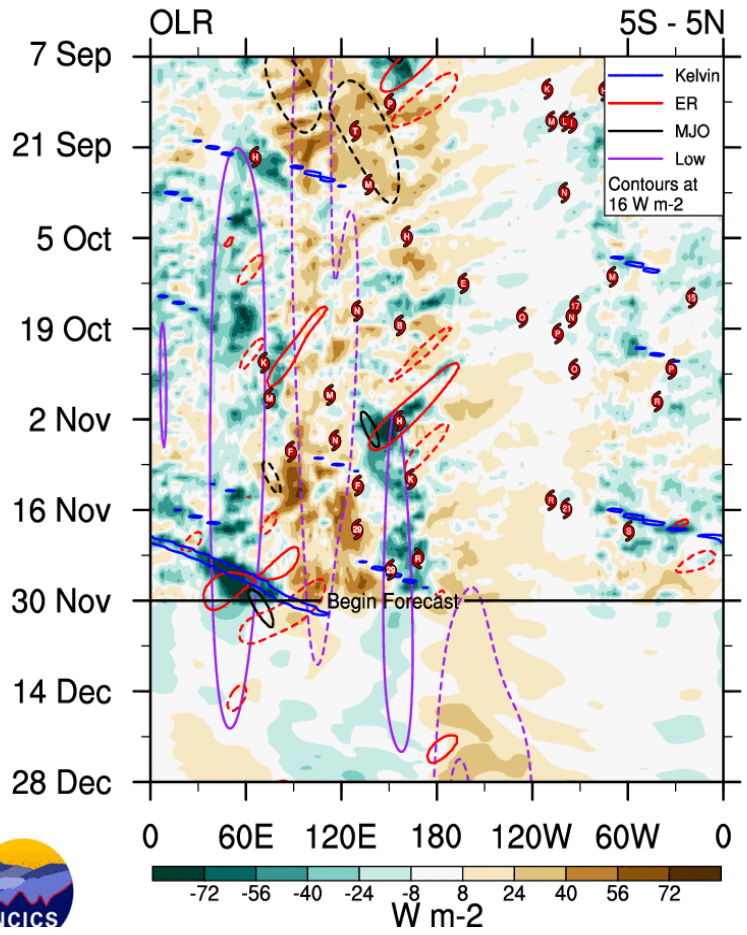


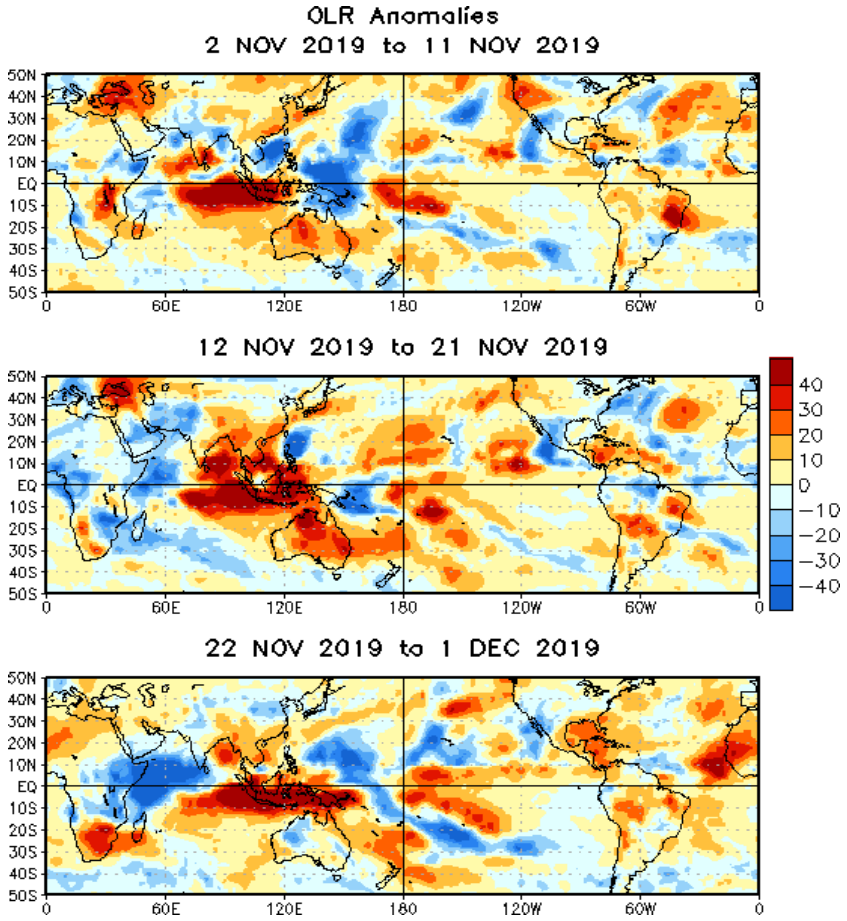
- Easterlies tied to the ongoing IOD event remained across the Indian Ocean, with the exception of some westerlies most recently to the east of the Horn of Africa, possibly tied to the enhanced MJO envelope.

- Weakened trade winds exist across much of the tropical Pacific, with anomalous westerlies most robust in association with the circulation of Typhoon Kammuri east of the Philippines in late November.

Outgoing Longwave Radiation (OLR) Anomalies

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

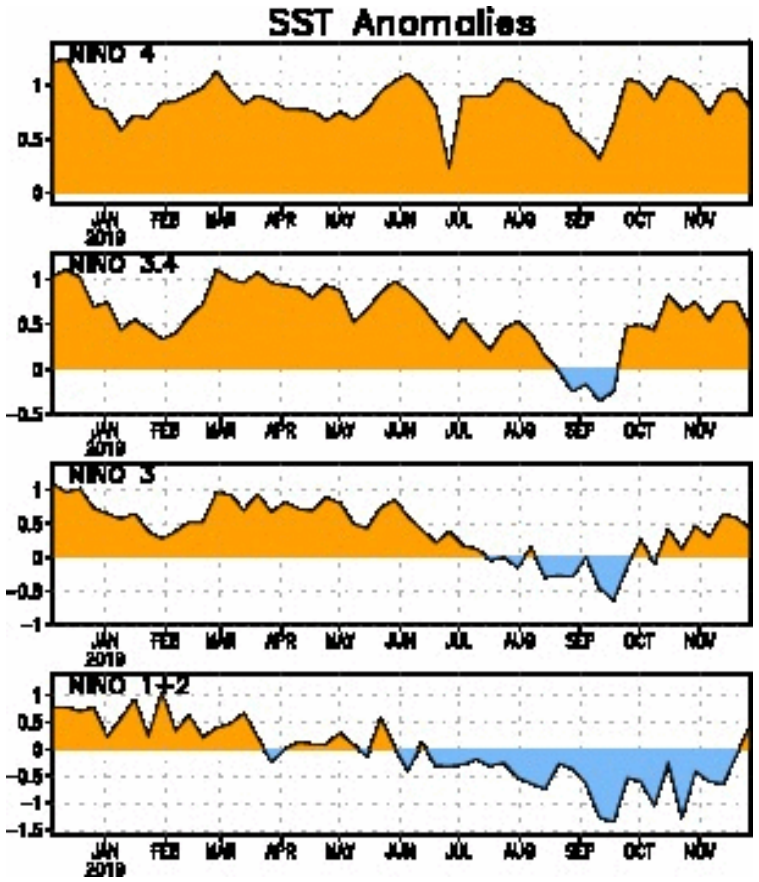


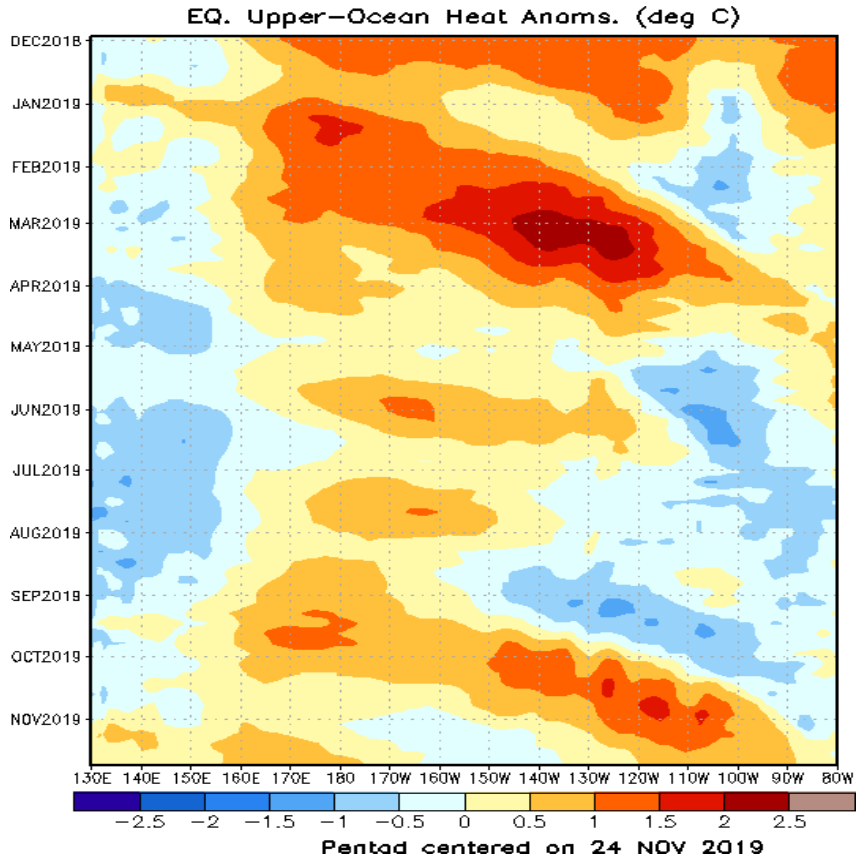


- The superposition of the low frequency IOD, equatorial Rossby wave activity, the enhanced MJO envelope, in addition to a Kelvin wave resulted in a flare of enhanced convection over the Western Indian Ocean during late November.

- 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



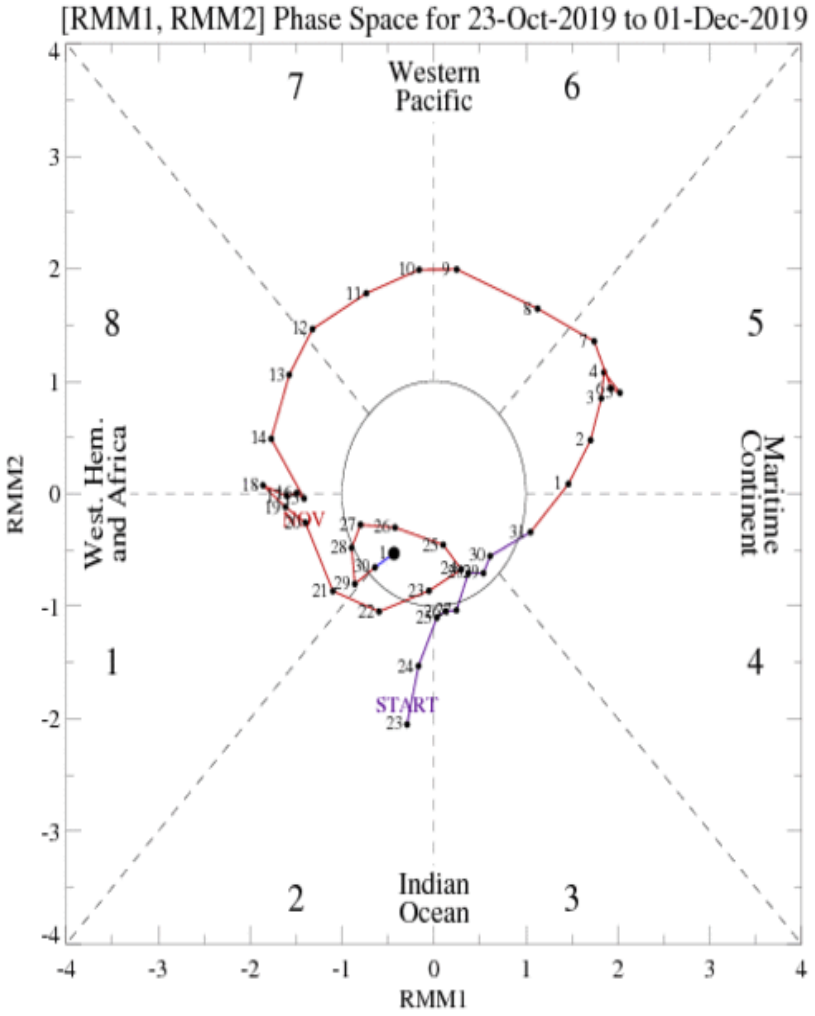


- Little change has been observed with SSTs in the East Pacific and Pacific Niño 3.4 regions, which remain above normal following a downwelling Kelvin wave event that initiated in September.

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

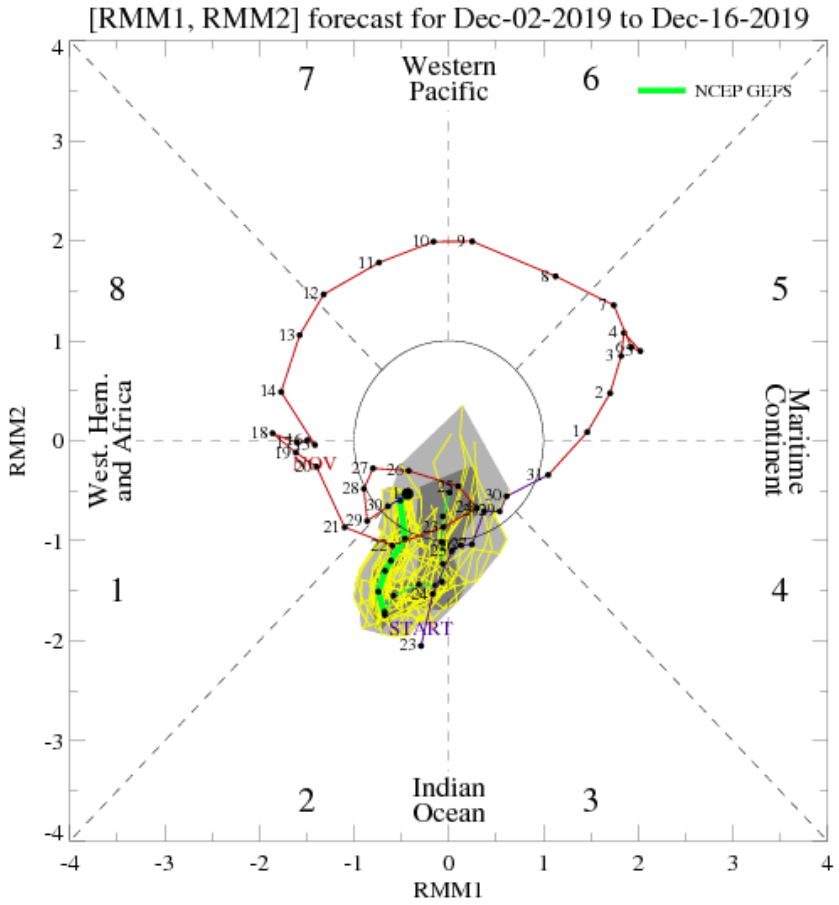
MJO Index: Recent Evolution

- During the past week the MJO remained relatively weak while drifting westward before a recent resumption of its easterly movement. This looping pattern is characteristic of equatorial Rossby wave interference muddying the MJO perspective.

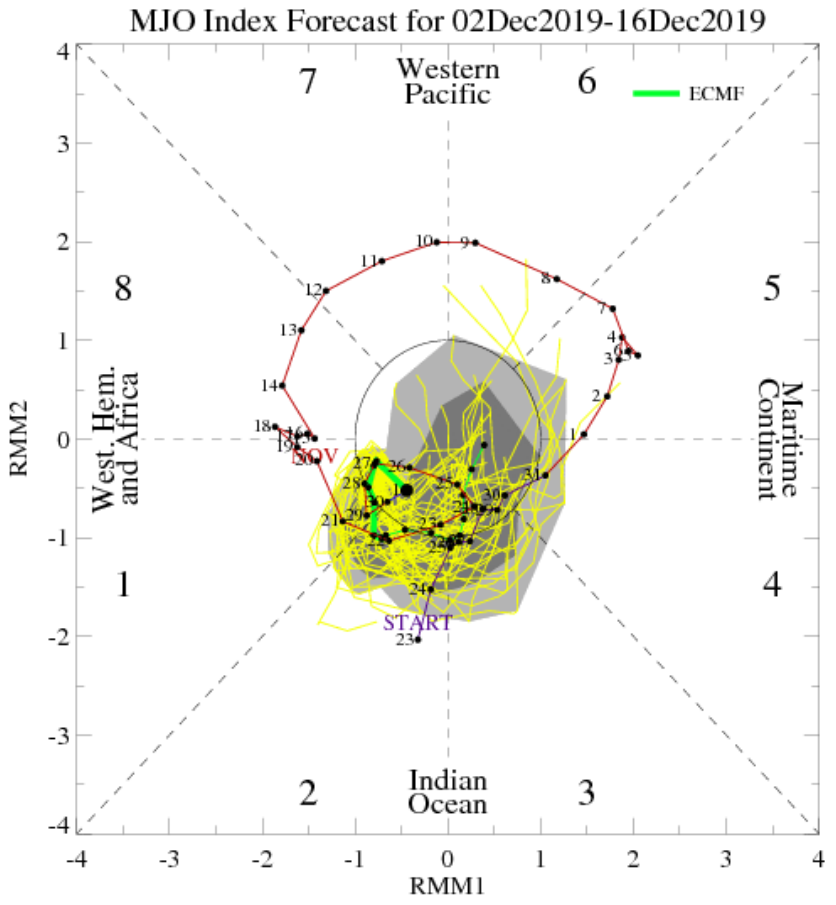


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



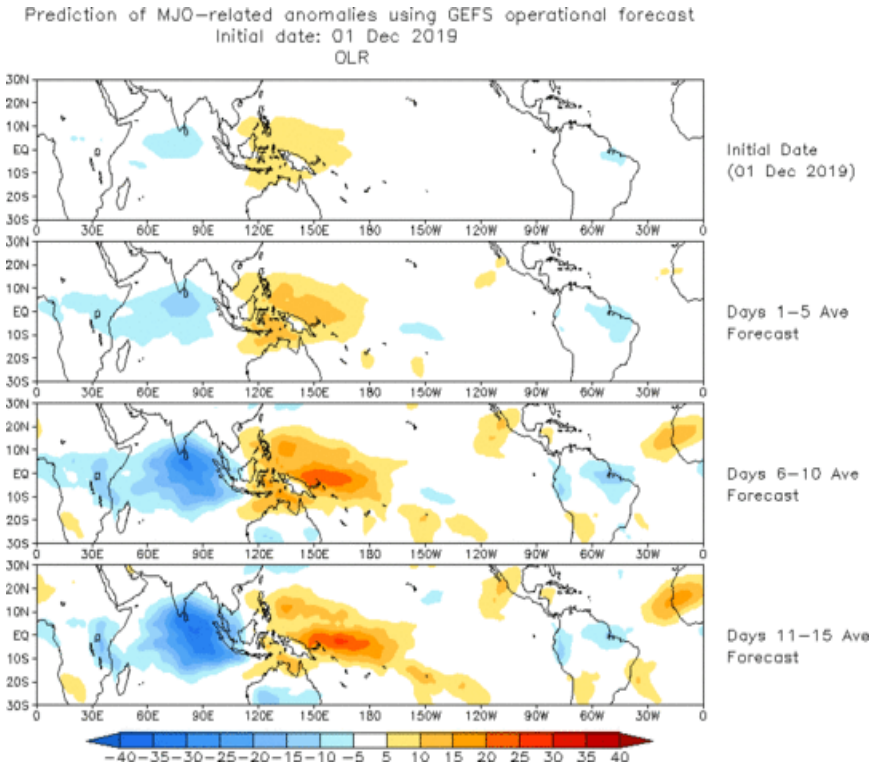
ECMWF Forecast

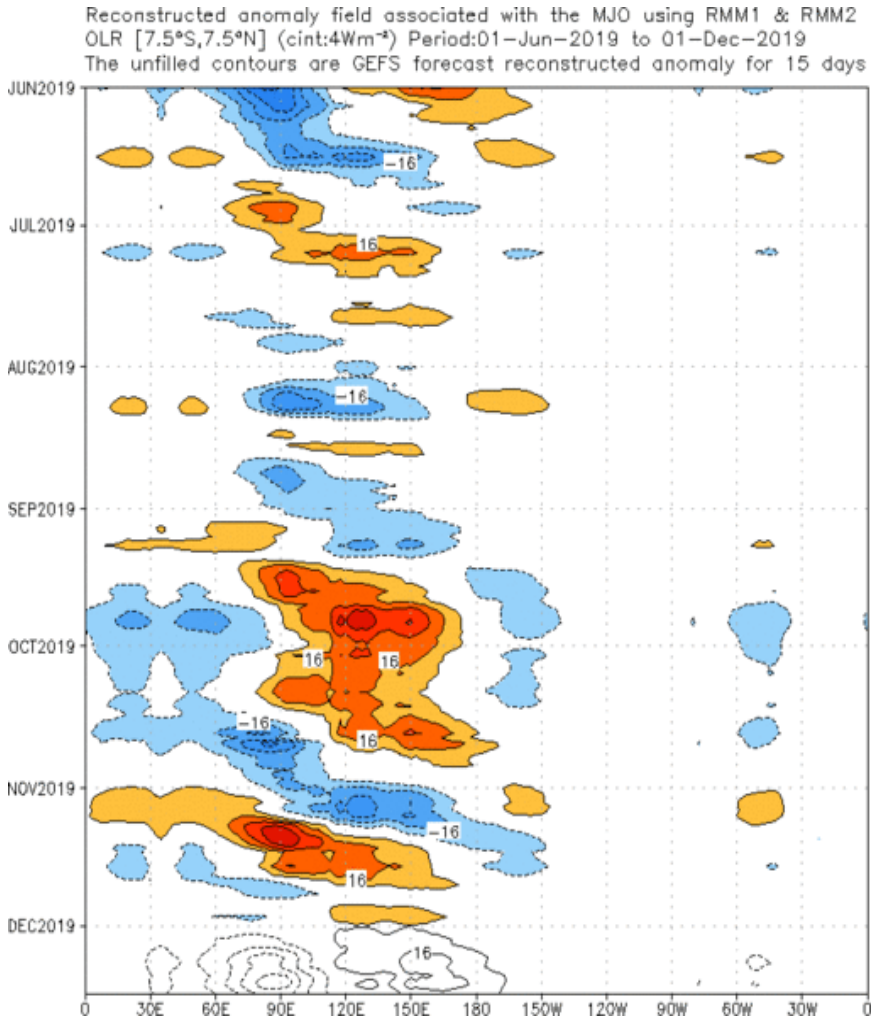
- Models are consistent in bringing the RMM index outside the unit circle during the next week, but differ in how progressive the subseasonal signal will be.

- The GEFS maintains the signal over the Western Indian Ocean during the next two weeks, which could be tied to continued tropical cyclone activity there. The ECMWF highlights Rossby wave activity early, before pushing the signal toward the Maritime Continent by late 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.)

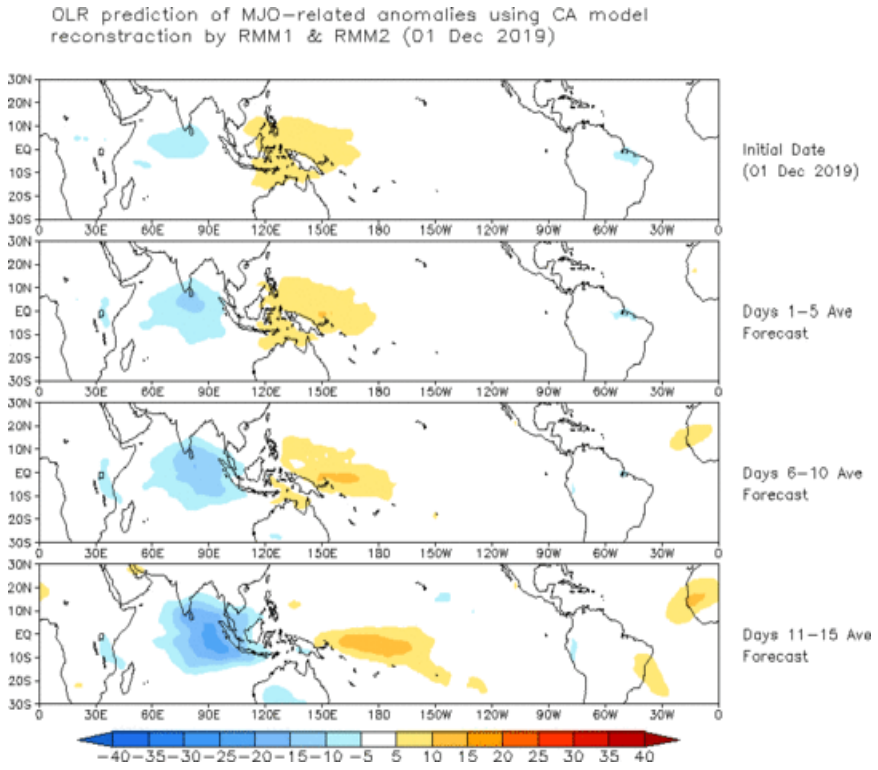


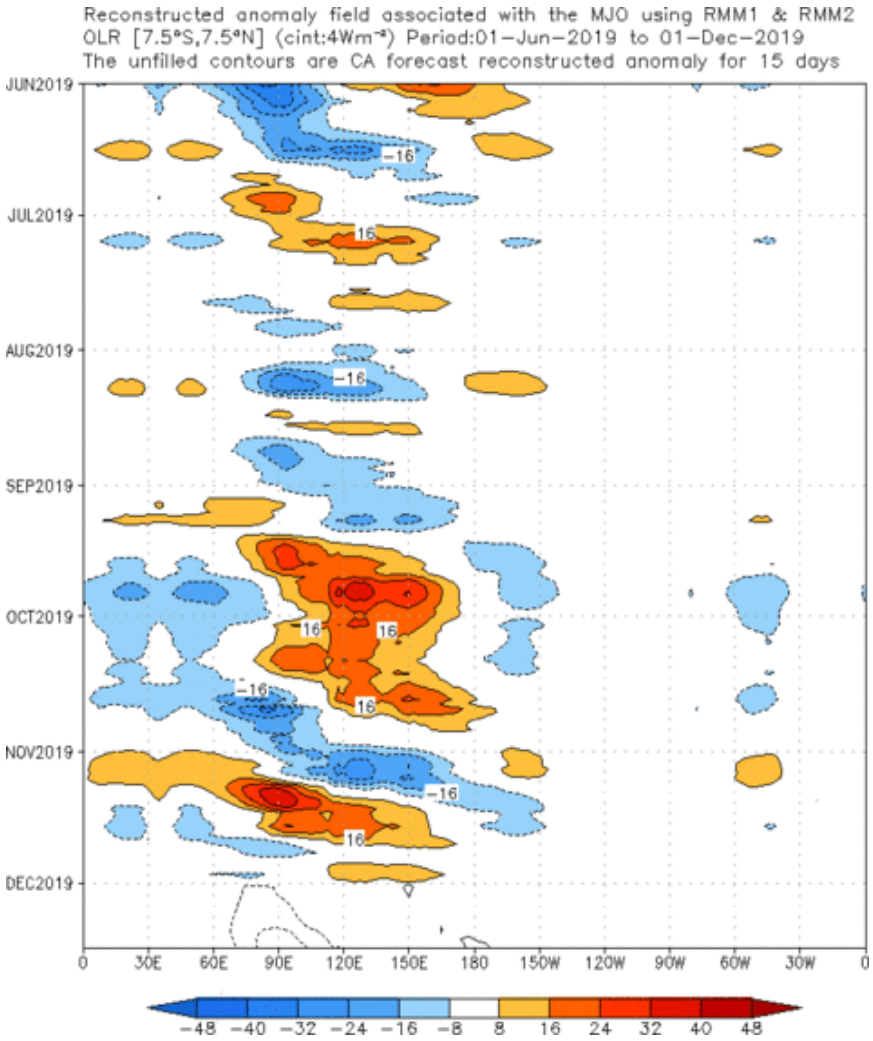


- The GEFS RMM-based OLR anomaly forecast shows a slow eastward propagation of the convective dipole across the Indian Ocean and Maritime Continent/West Pacific during the next two weeks.

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.)

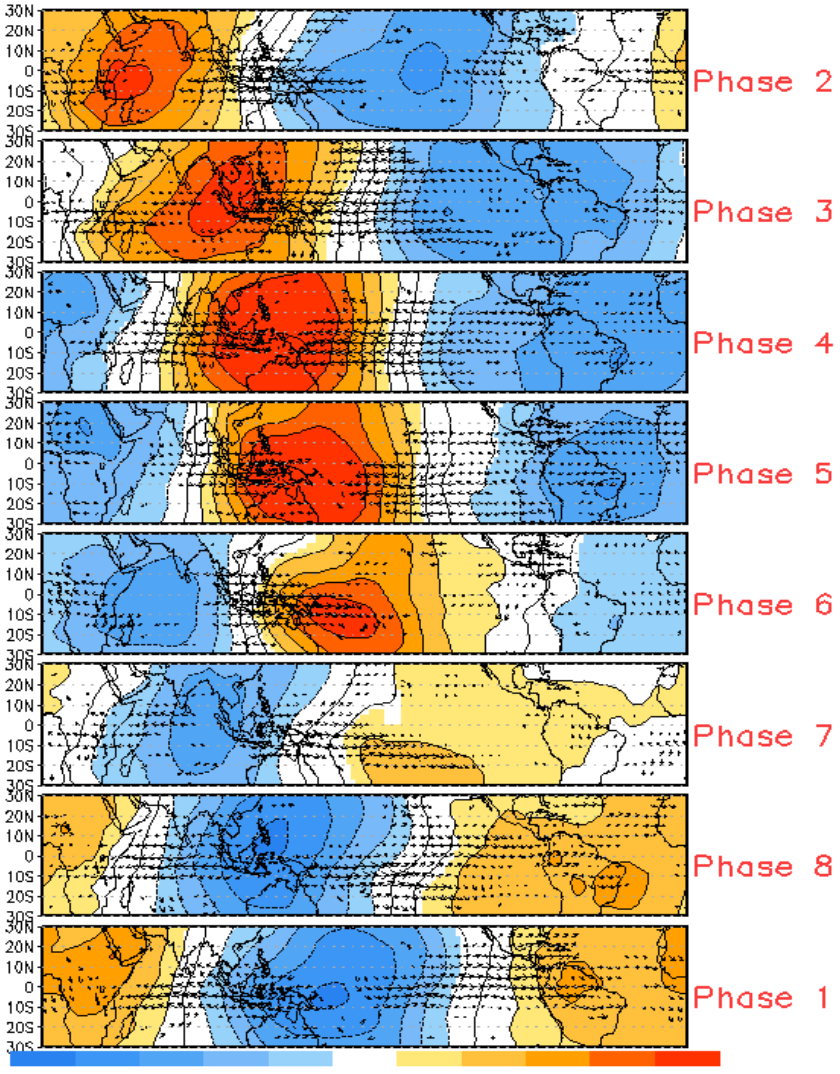




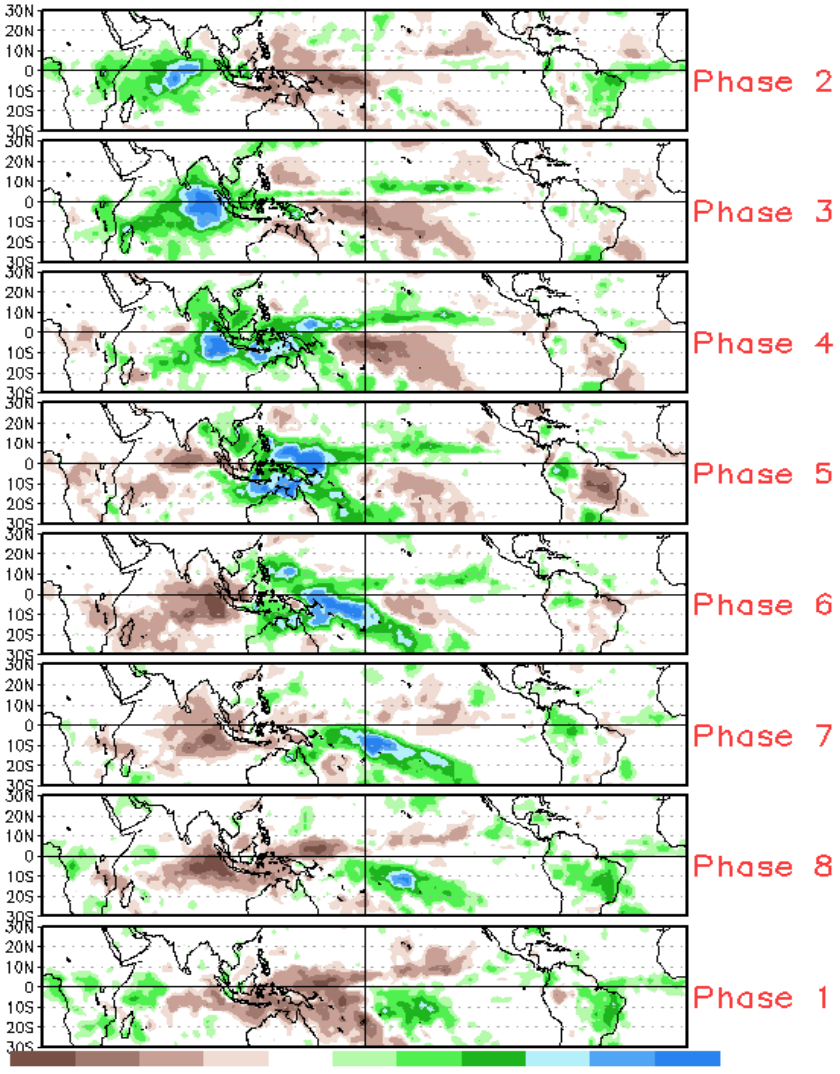
- The constructed analog agrees well with the GEFS forecast, but features less robust convective anomalies compared to the dynamical model guidance.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



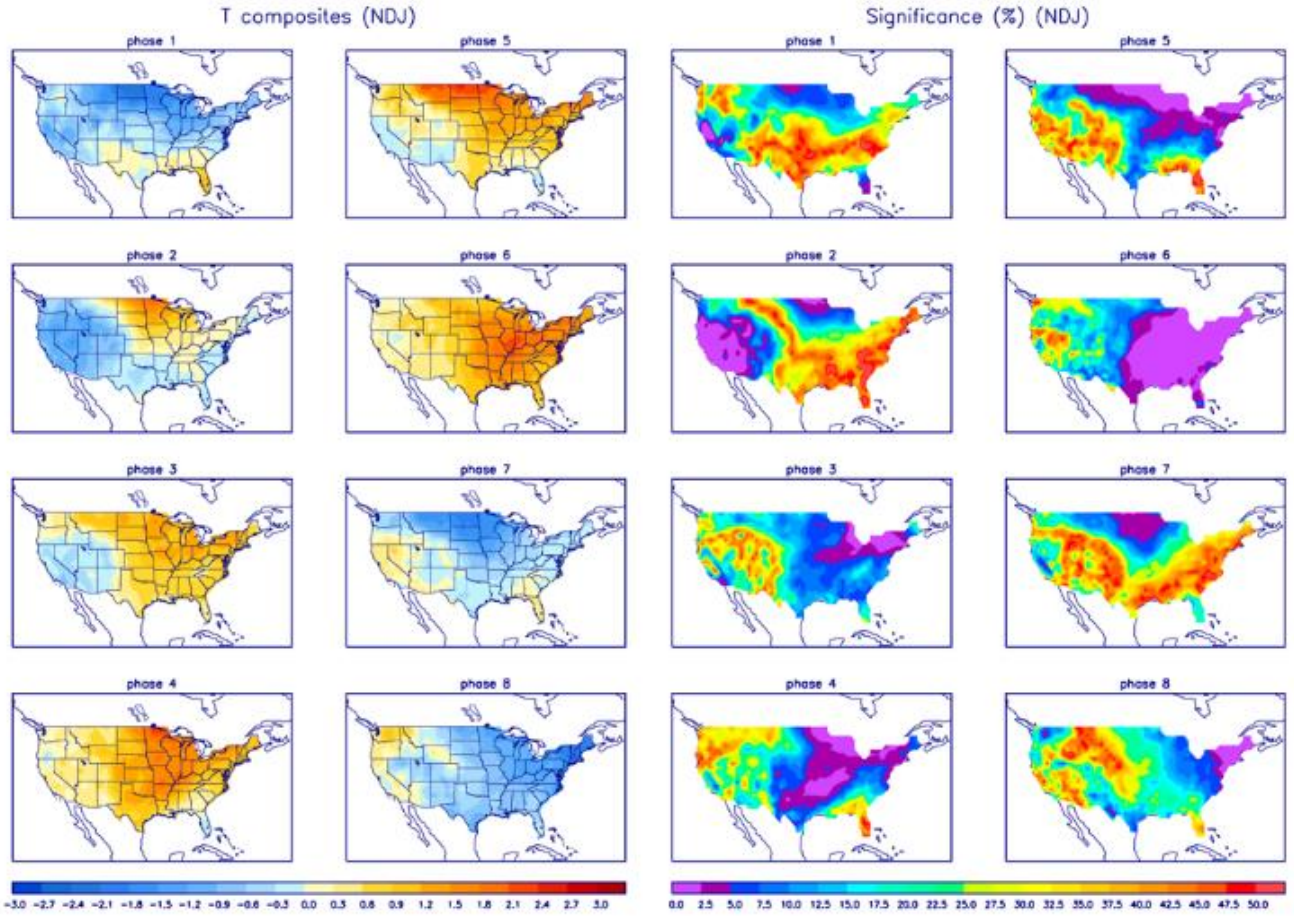
Precipitation Anomalies



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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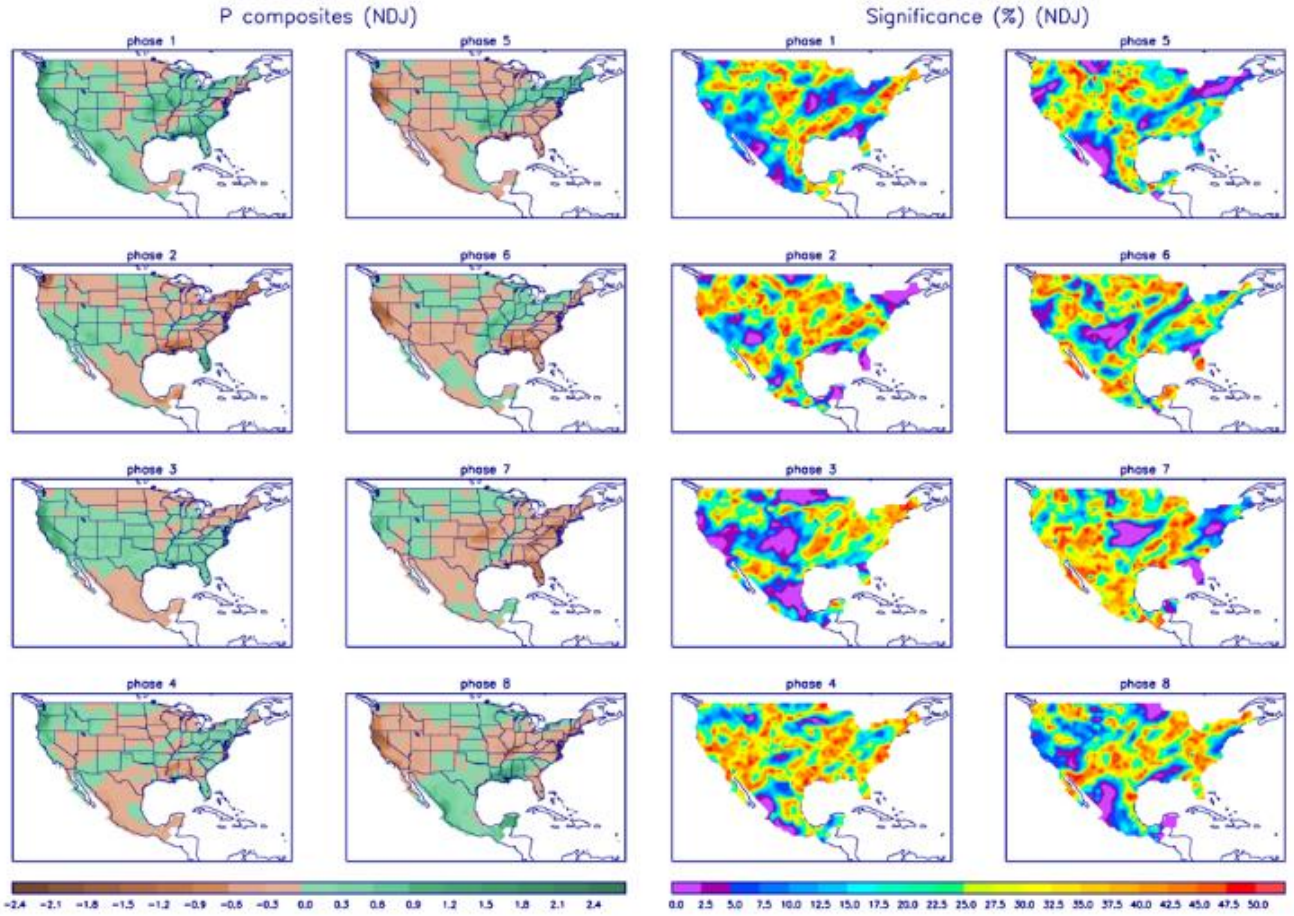

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