

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



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

Overview

- The Indian Ocean Dipole has weakened substantially during the last couple of weeks.
- The MJO was weak throughout much of December. There are indications in the models that it will strengthen during the end of Week-1 or beginning of Week-2.
- Most of the recent tropical convective signal comes from tropical cyclone activity.

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>

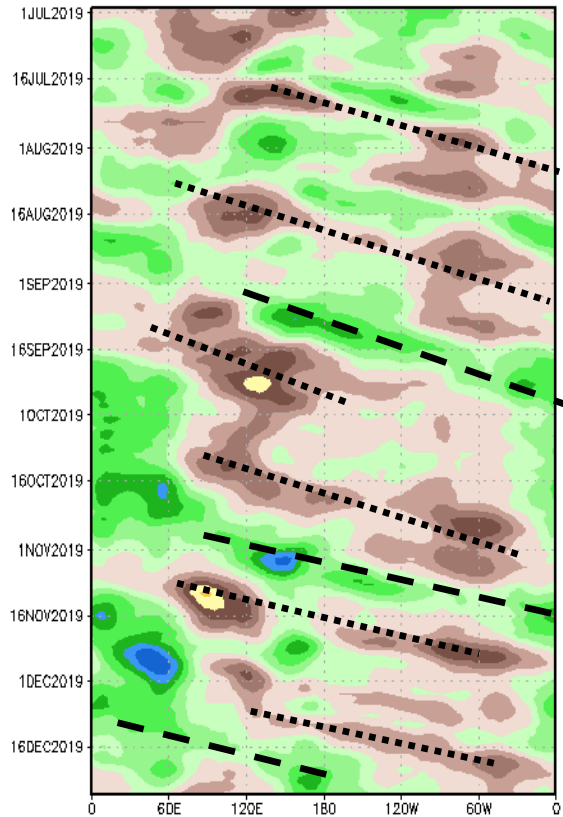
200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

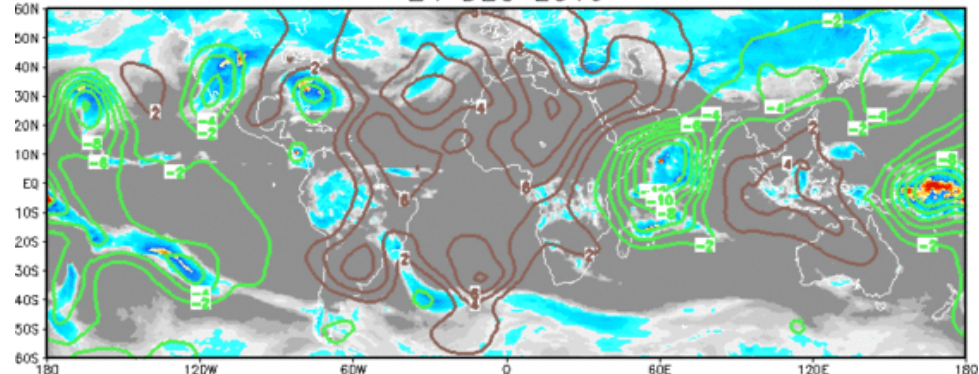
Brown shades: Anomalous convergence (unfavorable for precipitation).

200-hPa Velocity Potential Anomaly: 5N-5S

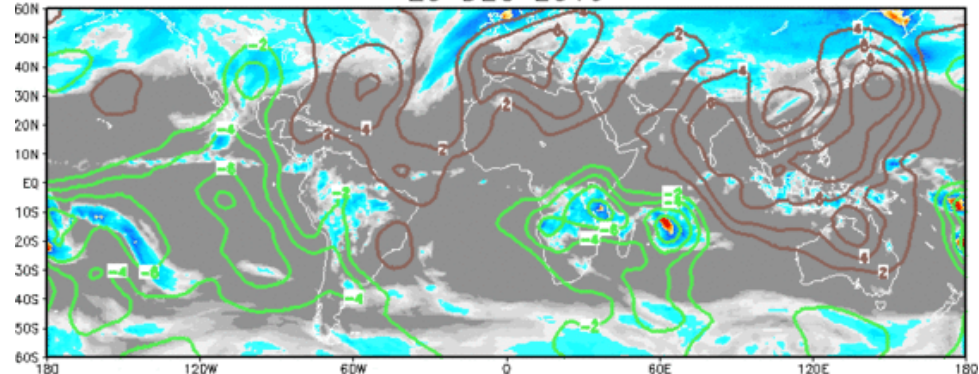
5-day Running Mean



24 DEC 2019



29 DEC 2019

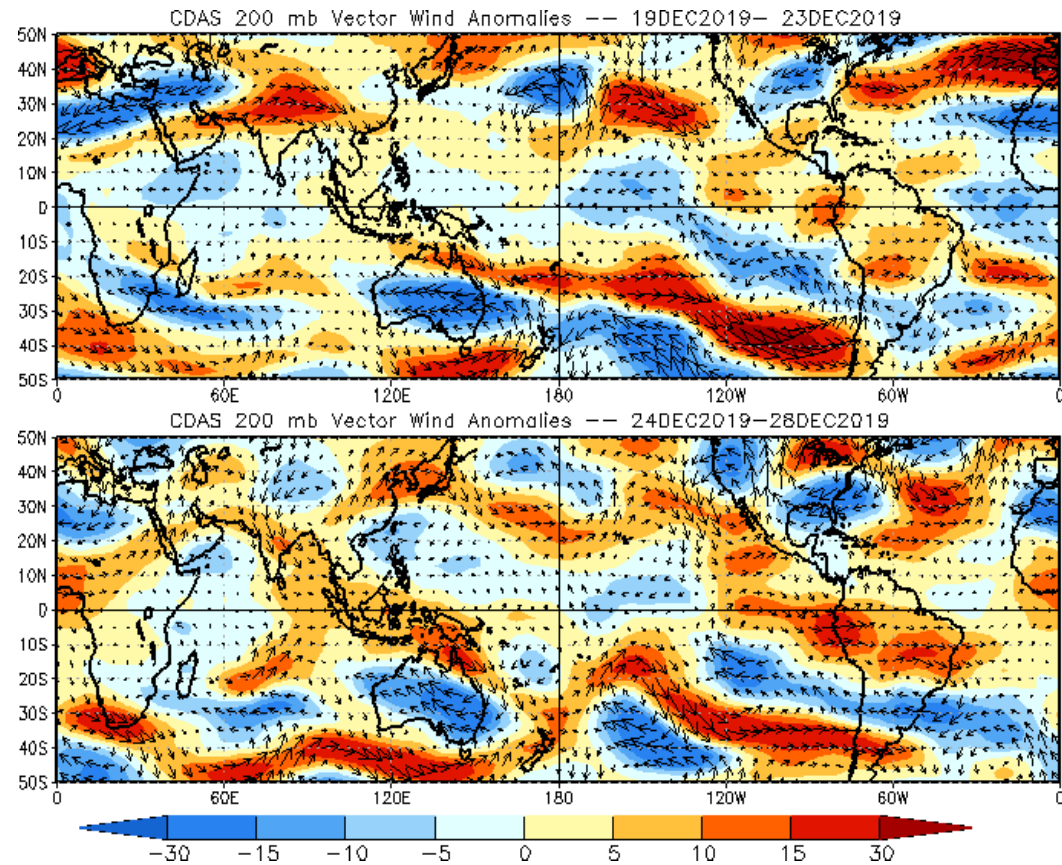
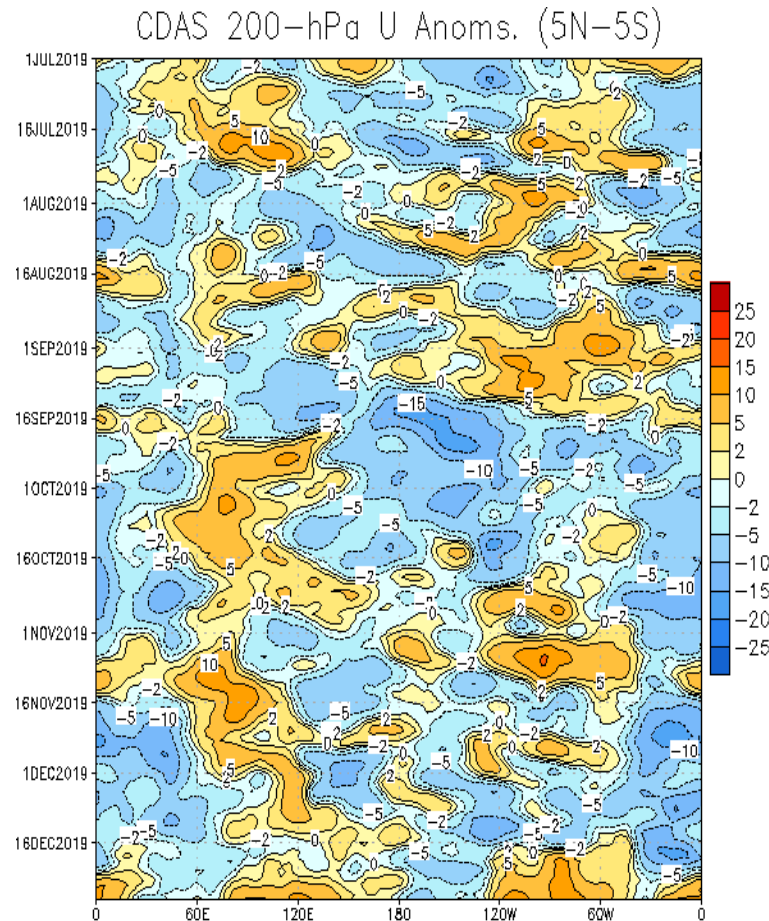


Degrees K

- For the first time since September, there are indications that the positive Indian Ocean Dipole (IOD) is not anchoring the upper-level pattern over the western Indian Ocean. However, suppressed convection remains evident over the Maritime Continent.
- Anomalous convection over the western Indian Ocean is mainly due to a weak MJO projection and a tropical cyclone over the western Indian Ocean.

200-hPa Wind Anomalies

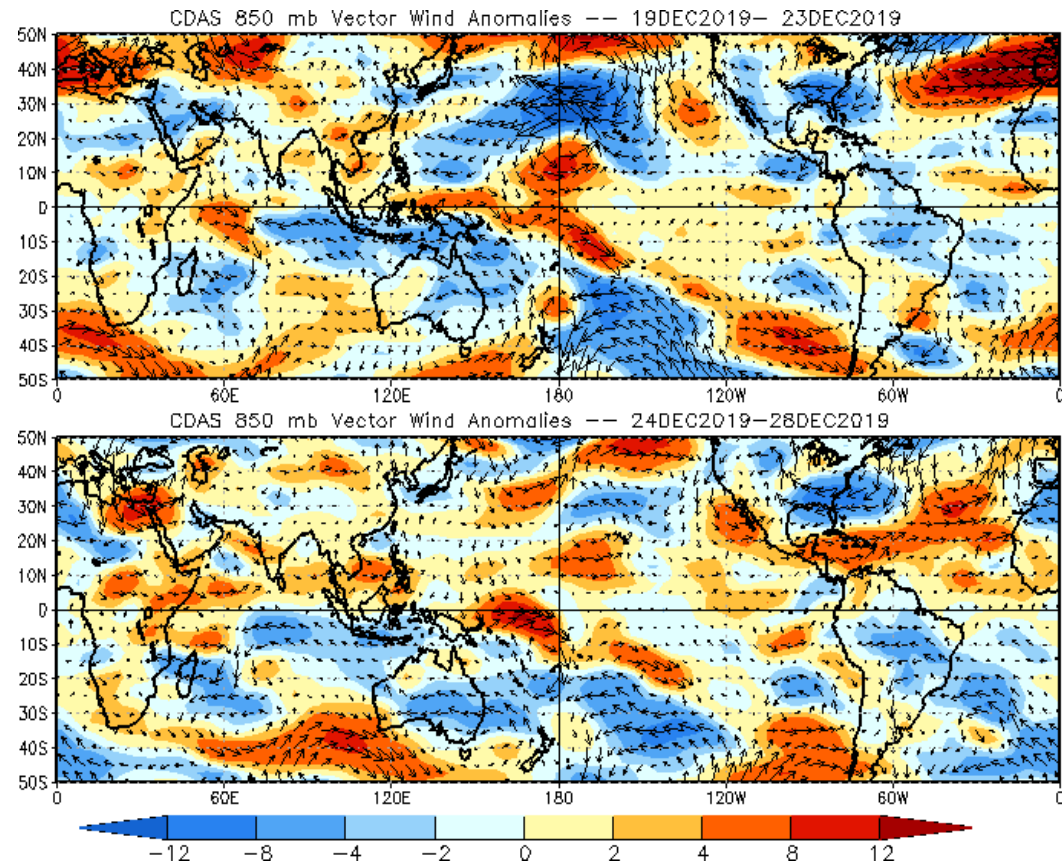
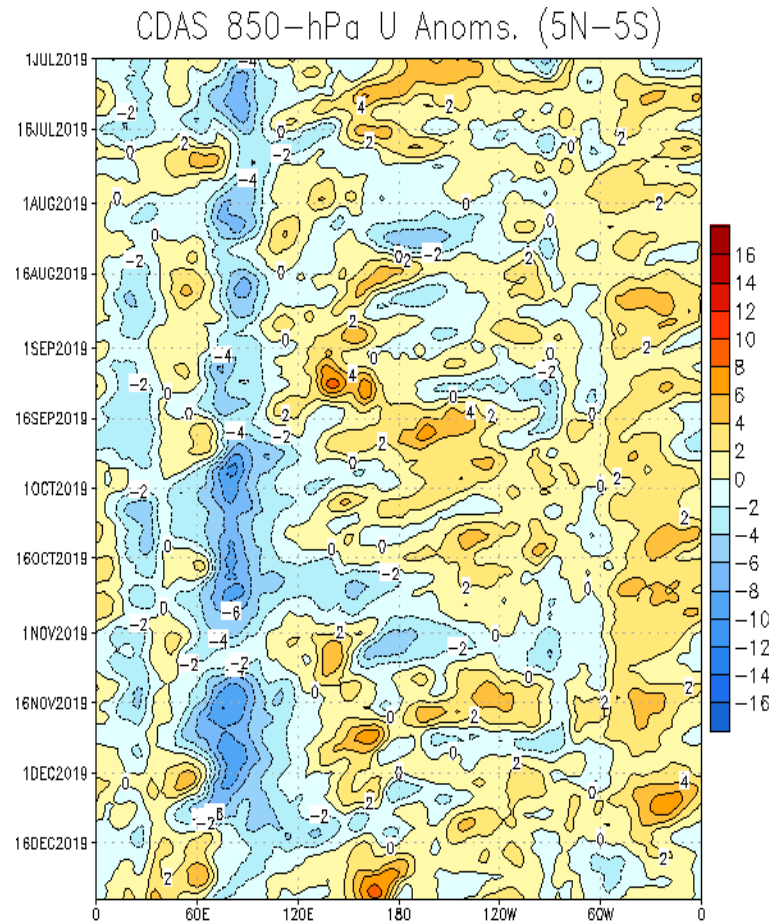
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- The upper-level footprint of the IOD has weakened substantially over the Indian Ocean.
- Upper-level wind anomalies are generally weak throughout the Tropics, but there are strong Rossby wave trains in both hemispheres.
- Rossby wave breaking is evident over the eastern Pacific from Rossby waves in both hemispheres.

850-hPa Wind Anomalies

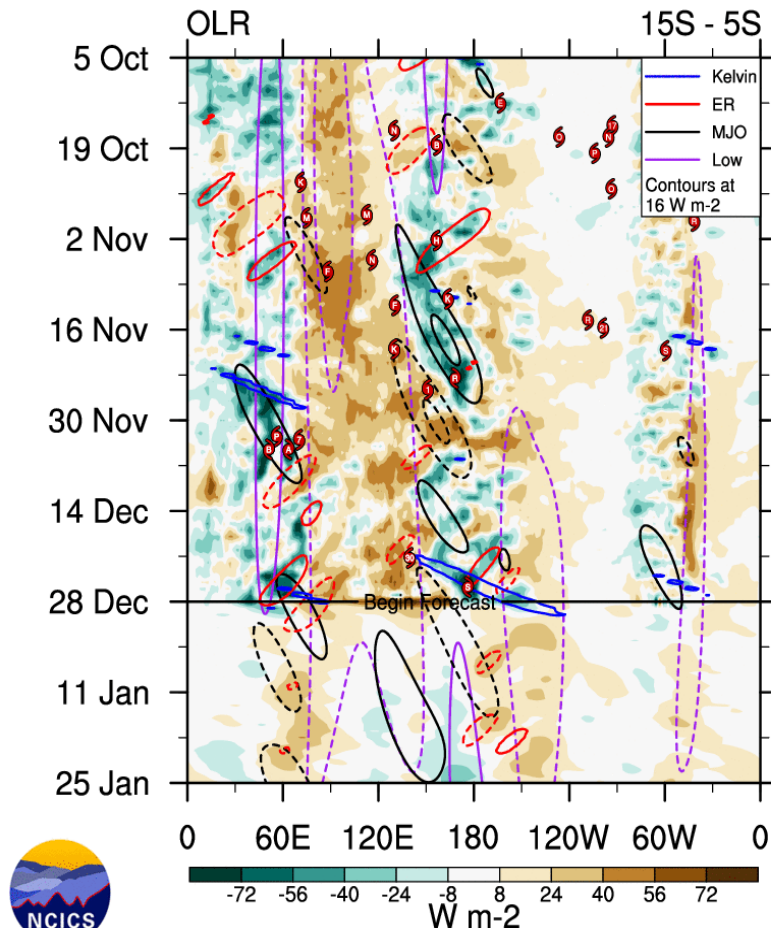
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



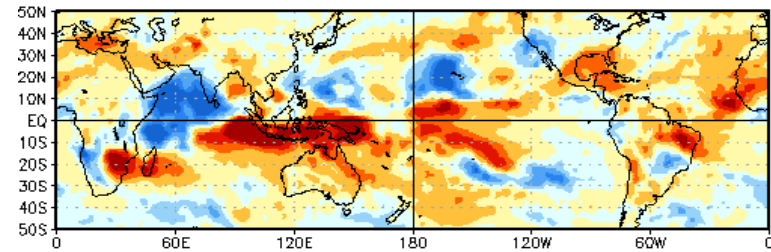
- The IOD-driven anomalies weakened during mid-December, roughly in-line with the declining IOD index itself.
- Rossby wave breaking is apparent in the lower atmosphere around the Date Line and may partially explain the weak MJO Phase 7 projection.

Outgoing Longwave Radiation (OLR) Anomalies

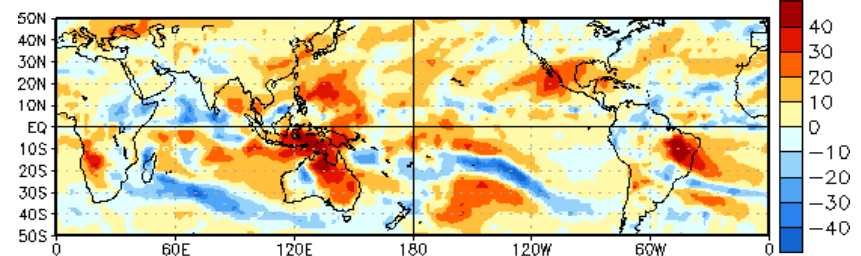
Blue shades: Anomalous convection (wetness). Red shades: Anomalous subsidence (dryness).



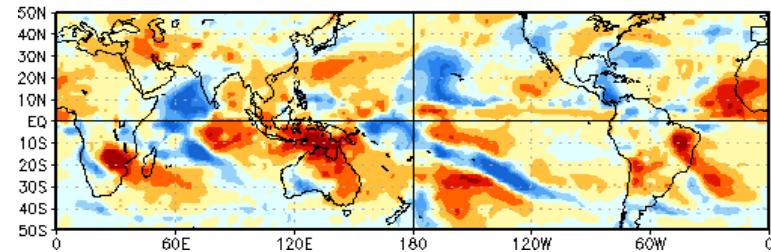
OLR Anomalies
27 NOV 2019 to 6 DEC 2019



7 DEC 2019 to 16 DEC 2019

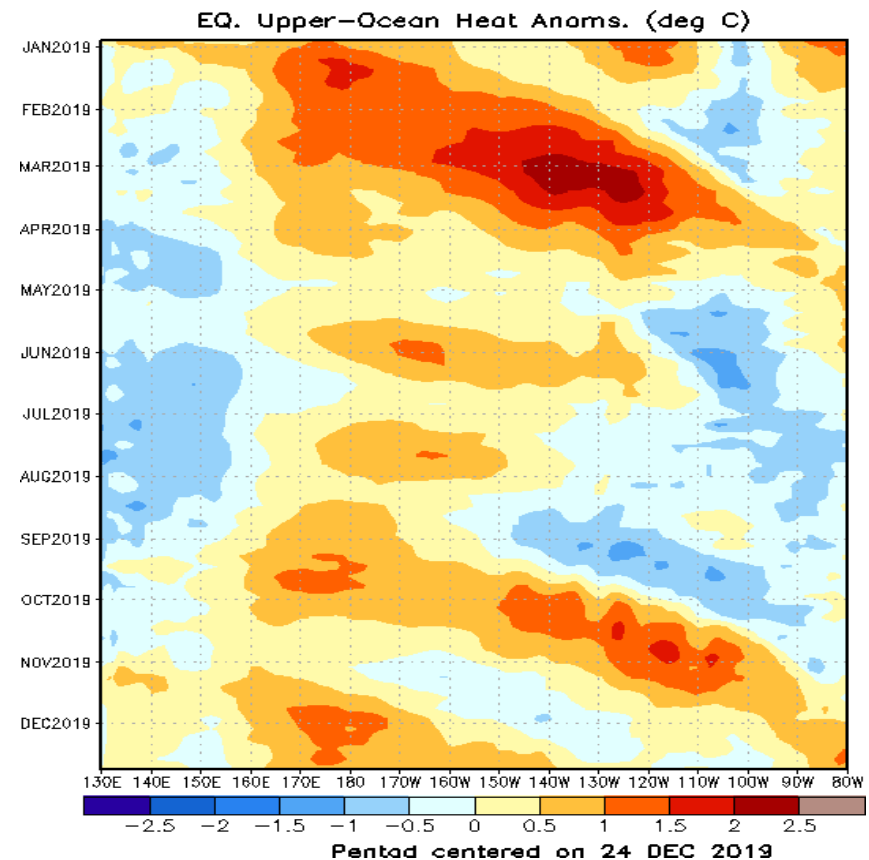
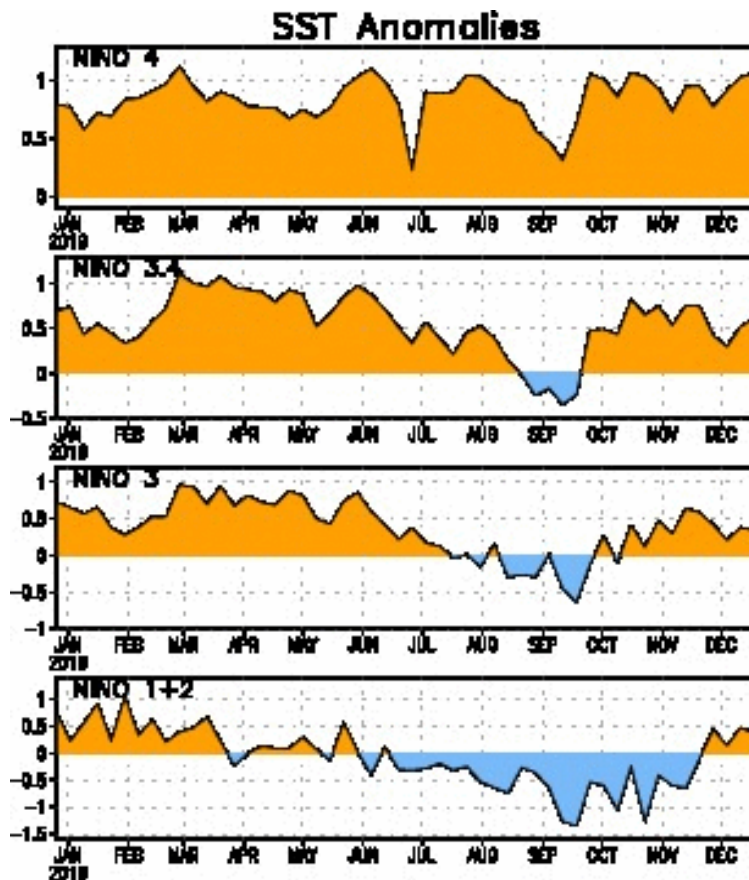


17 DEC 2019 to 26 DEC 2019



- The subseasonal OLR field is weak. There is evidence of a weak Kelvin wave over the central Pacific during the past couple of weeks, but otherwise, the OLR field is dominated by TC and other high-frequency variability.

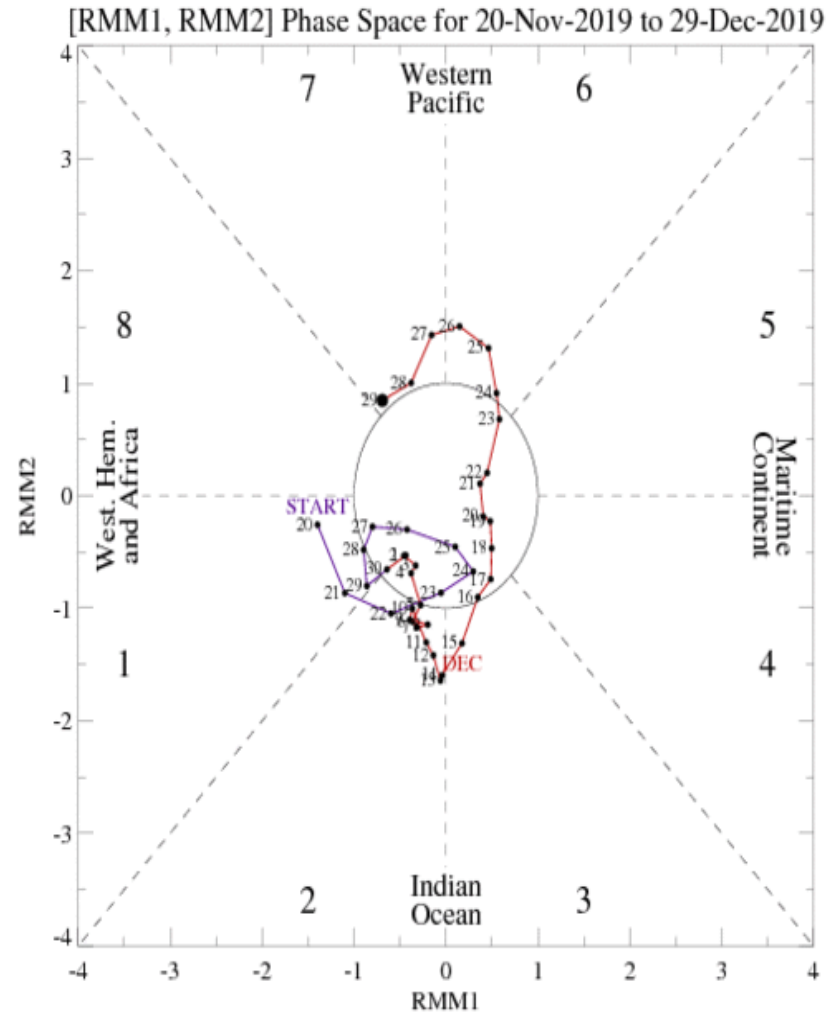
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Upper-oceanic heat content anomalies remain slightly above-normal across most of the basin.
- Several westerly wind bursts over the West Pacific resulted in new downwelling Kelvin wave activity near the Date Line.

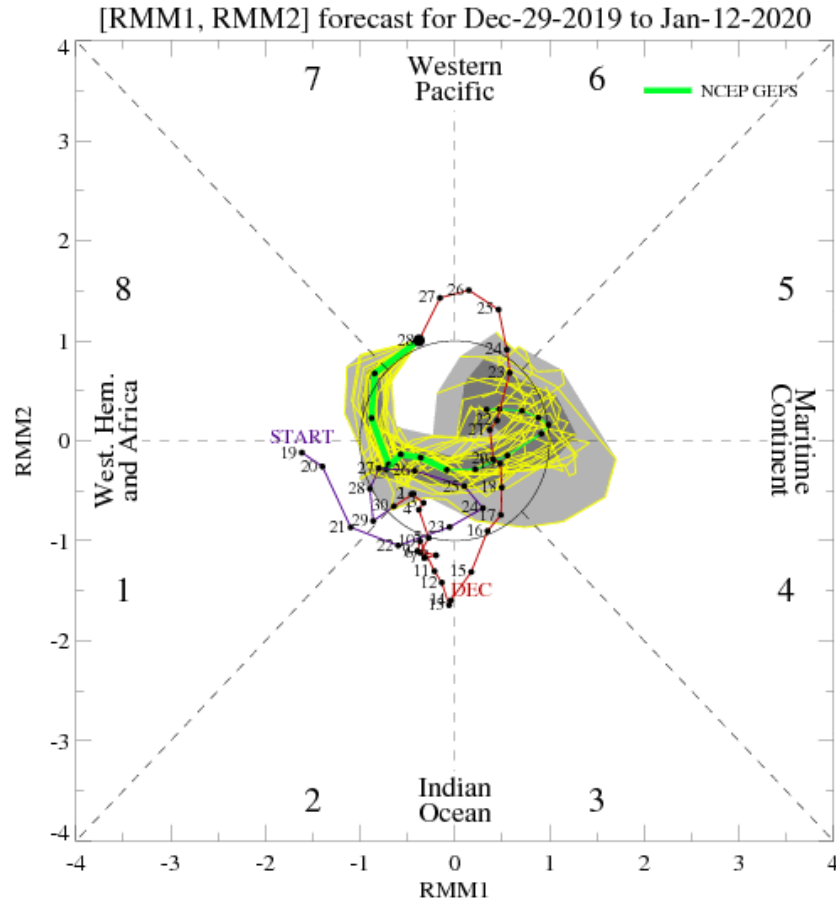
MJO Index: Recent Evolution

- The RMM index shows a weak MJO in Phase 7.
- There hasn't been substantial MJO activity since mid-November.

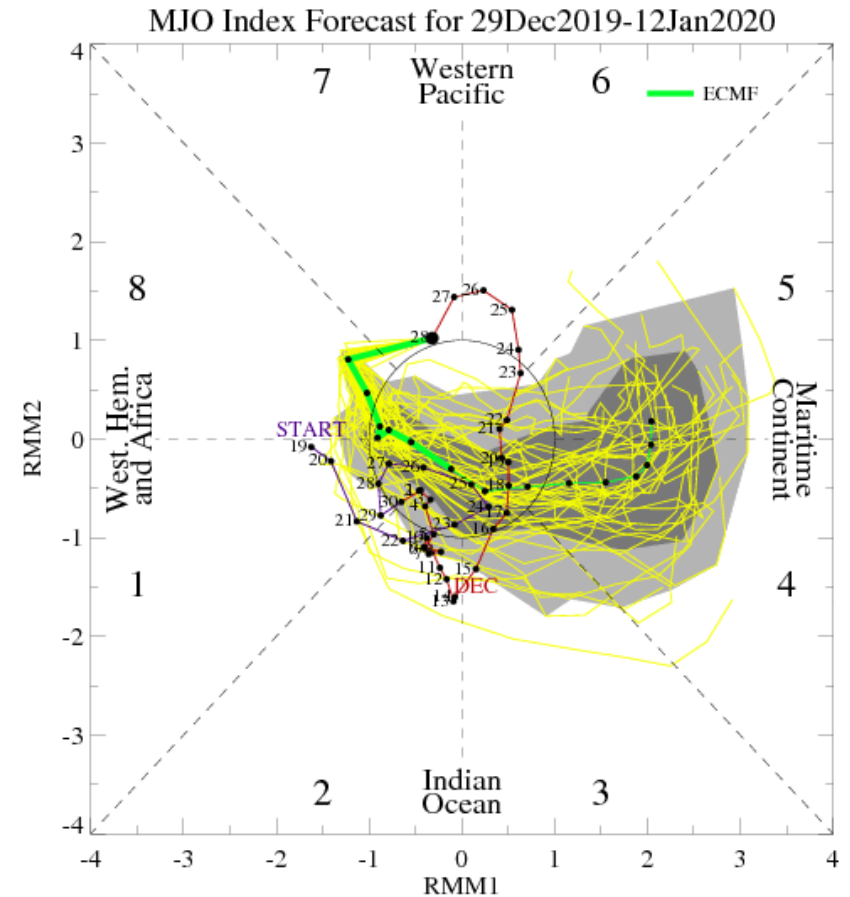


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



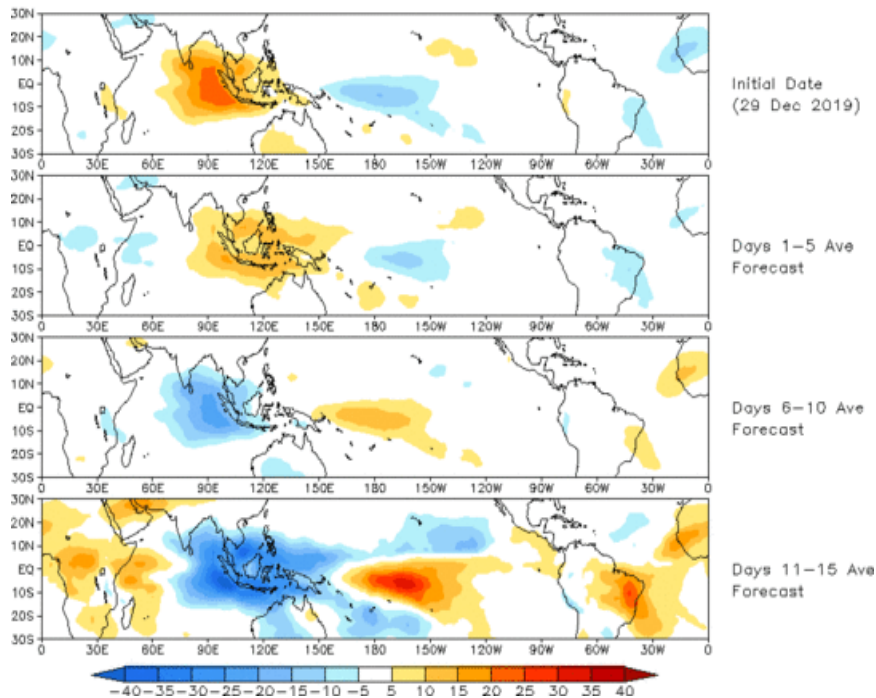
ECMWF Forecast

- The GEFS and ECMWF both forecast a weak MJO to move through the Western Pacific and weaken again as it traverses the Western Hemisphere.
- Most of the ensemble members suggest that the MJO will strengthen and reemerge during Week-2 over the Maritime Continent.

MJO: GEFS Forecast Evolution

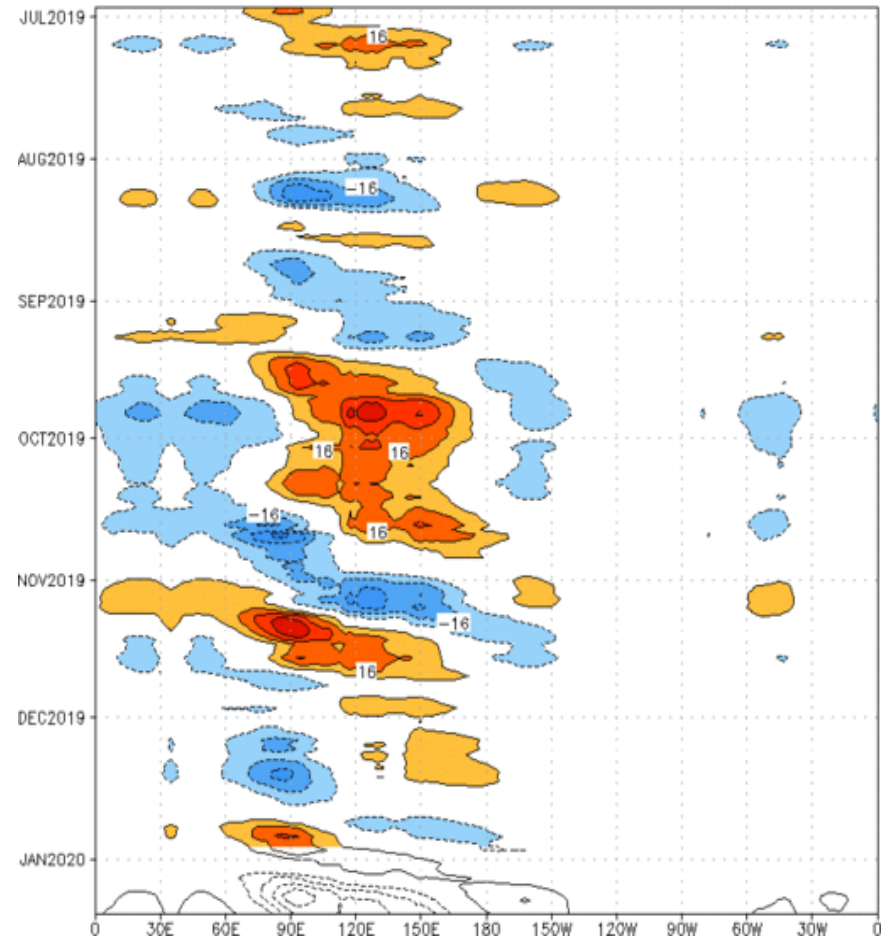
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 29 Dec 2019
OLR



- The GEFS spatial forecast matches its RMM forecast well.
- The GEFS suggests MJO activity around 120°E by the end of Week-1/early Week-2.

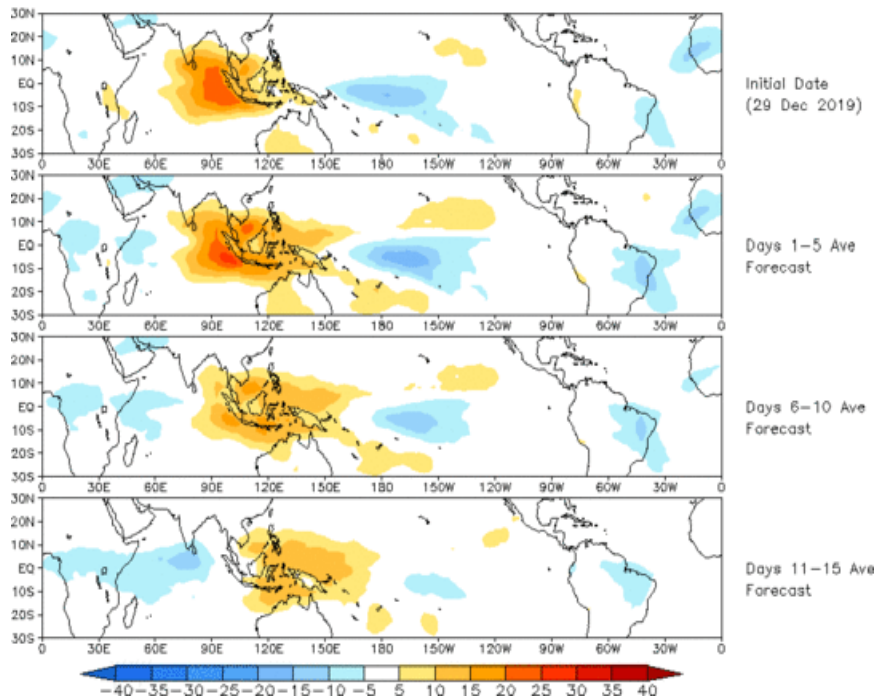
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S, 7.5°N] ($\text{cont: } 4\text{Wm}^{-2}$) Period: 29-Jun-2019 to 29-Dec-2019
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



MJO: Constructed Analog Forecast Evolution

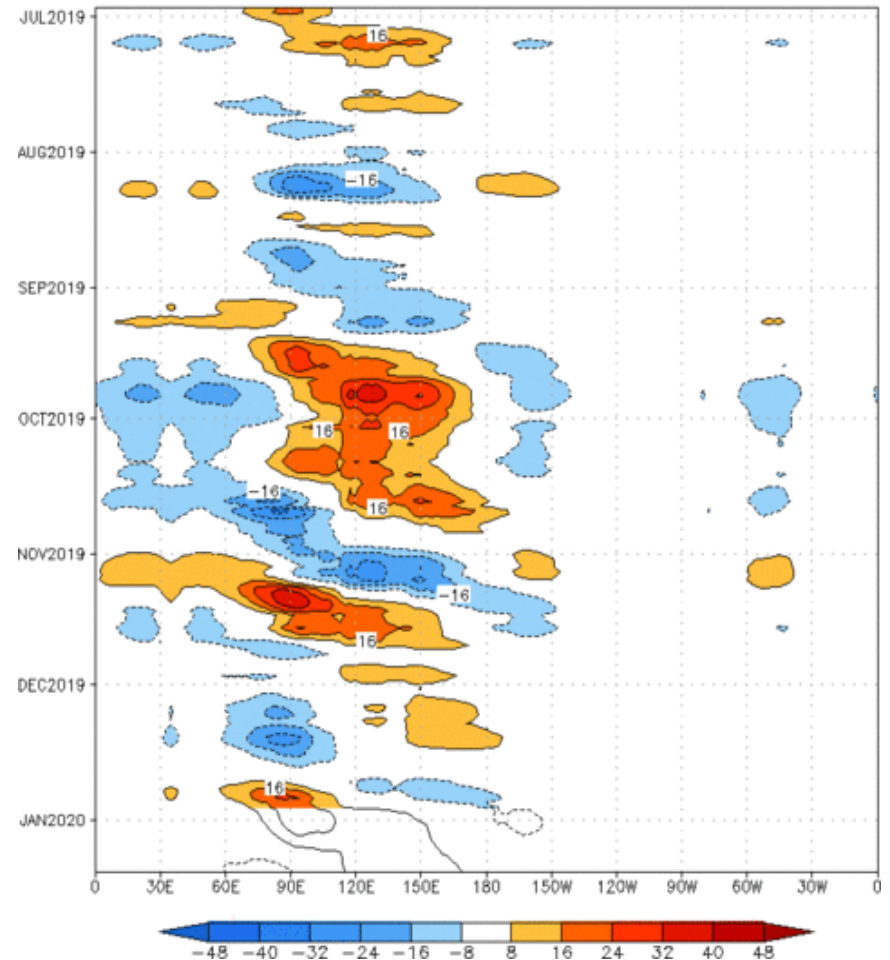
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (29 Dec 2019)



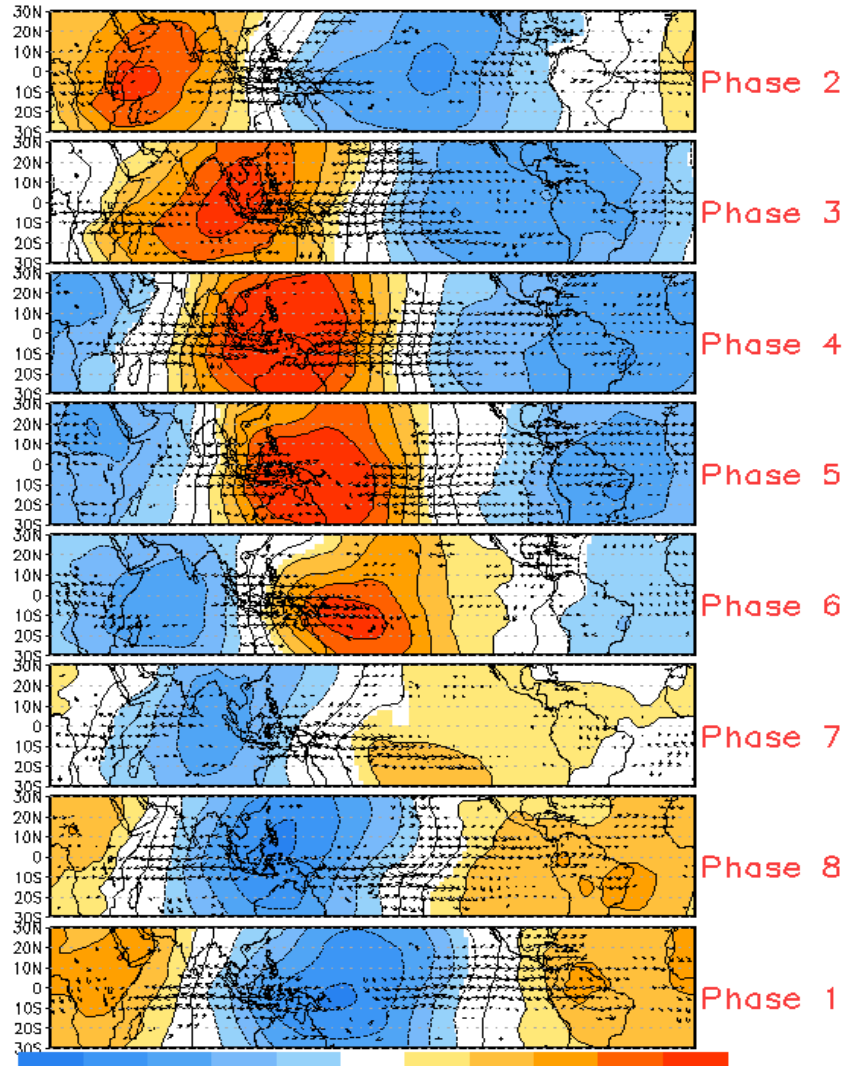
- The constructed analog forecast is much slower than the GEFS.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:29-Jun-2019 to 29-Dec-2019
The unfilled contours are CA forecast reconstructed anomaly for 15 days

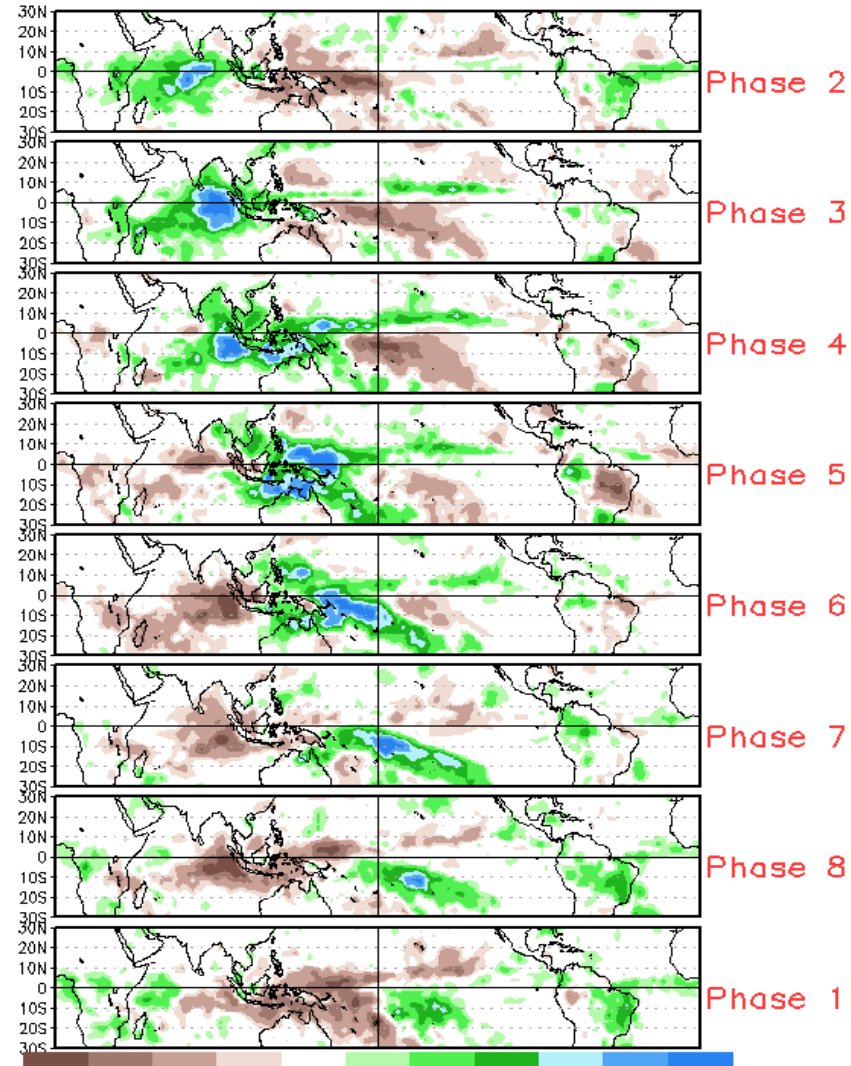


MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



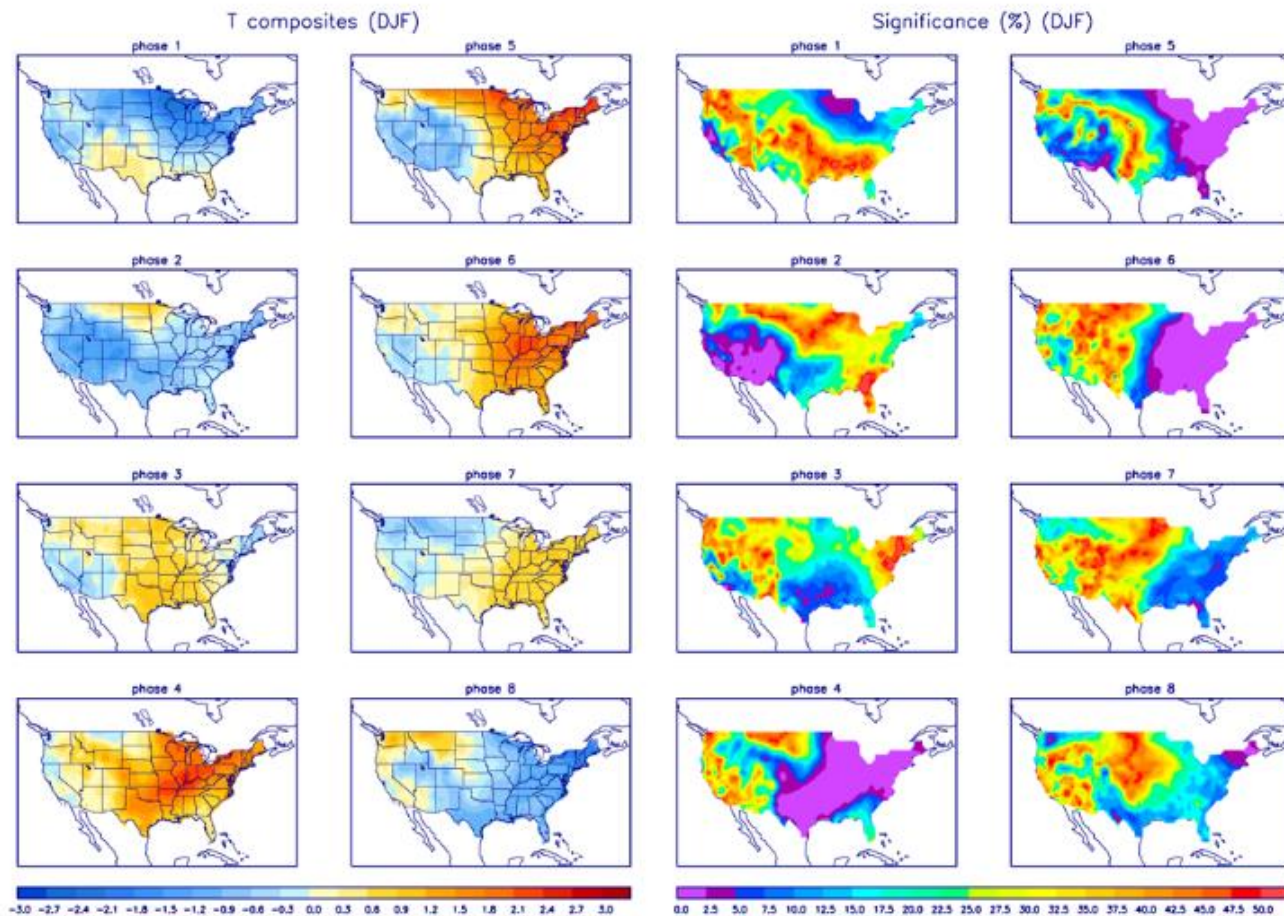
Precipitation Anomalies



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.



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.

