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

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

Overview

- During the past week, the MJO shifted slightly eastward into Phase 3 over the Indian Ocean while slowly gaining in RMM amplitude.

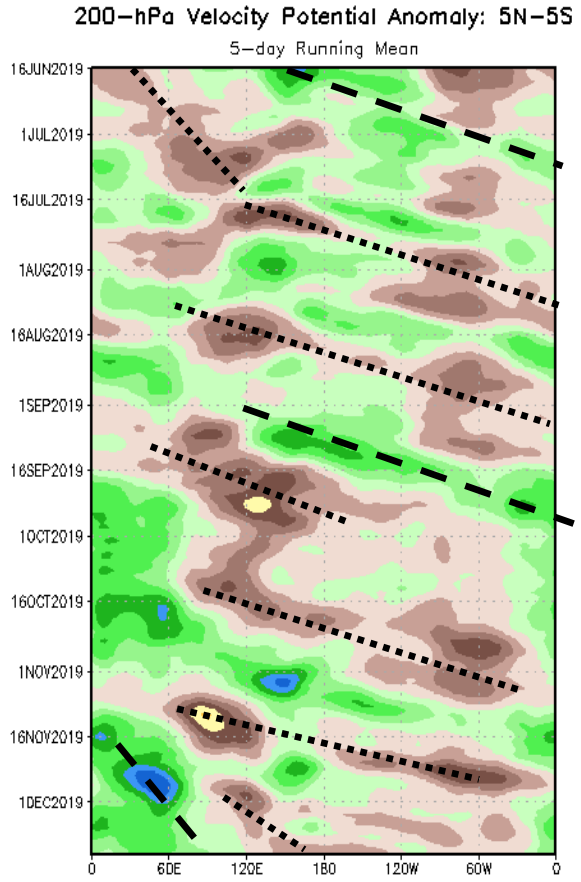
- Statistical and dynamical model forecasts are in fair agreement with a weakening MJO signal most likely associated with destructive interference with the positive phase of the Indian Ocean dipole followed by reemergence and eastward propagation in the Western Pacific during Week-2.

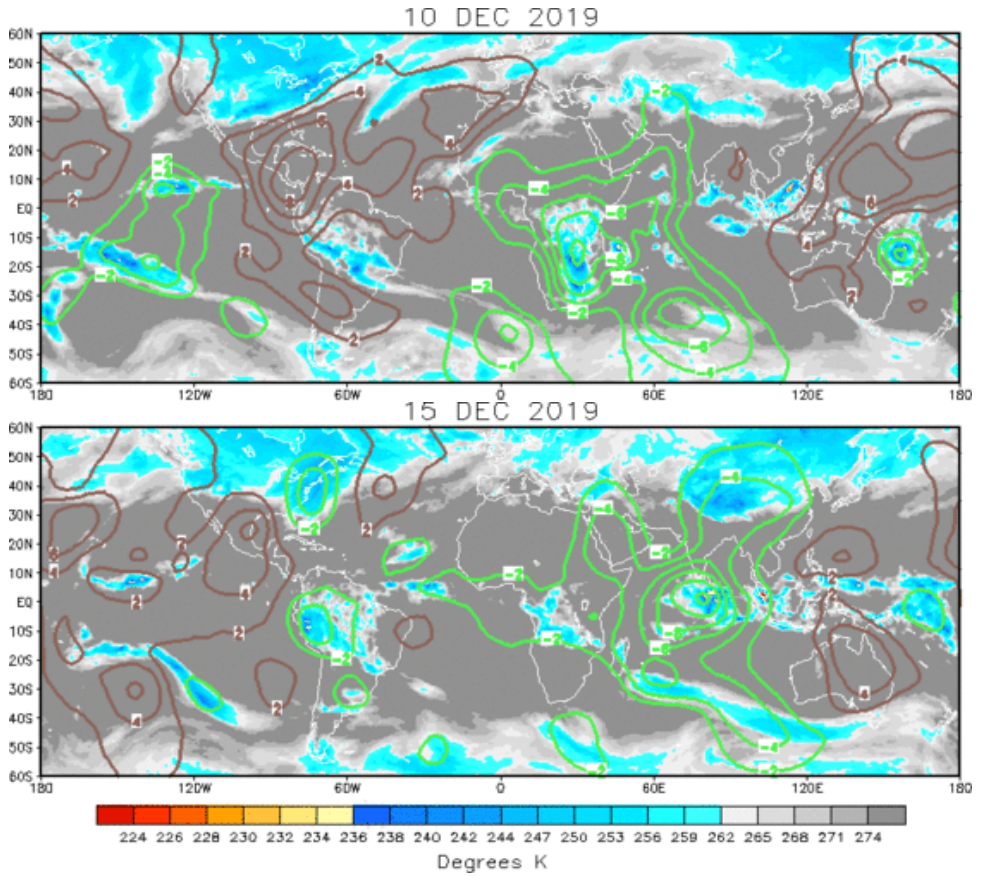
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

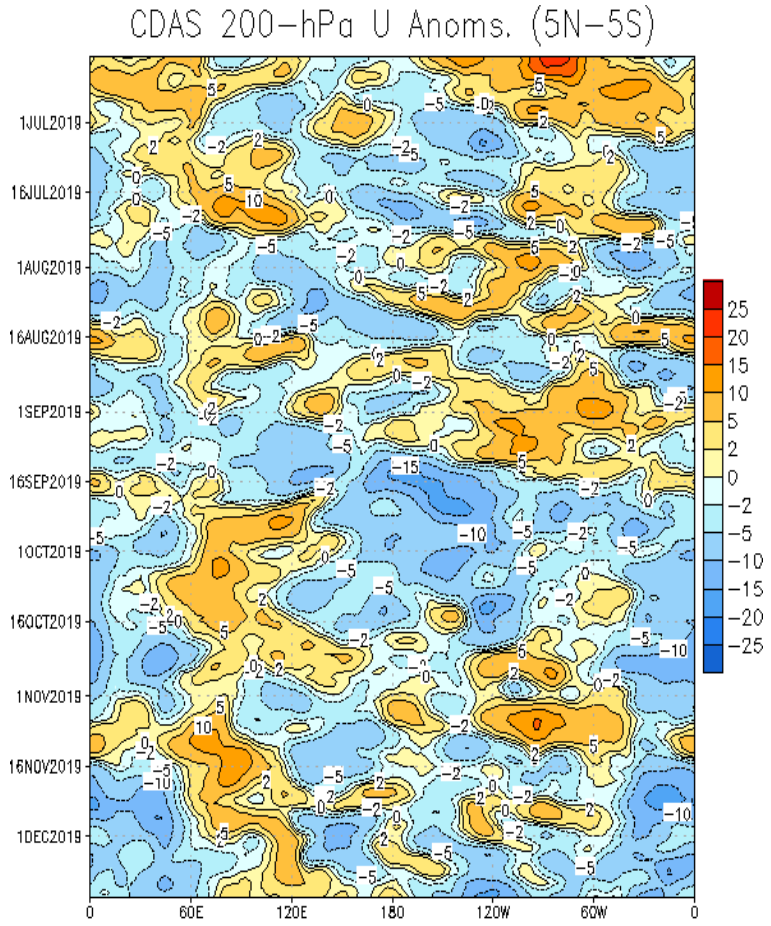


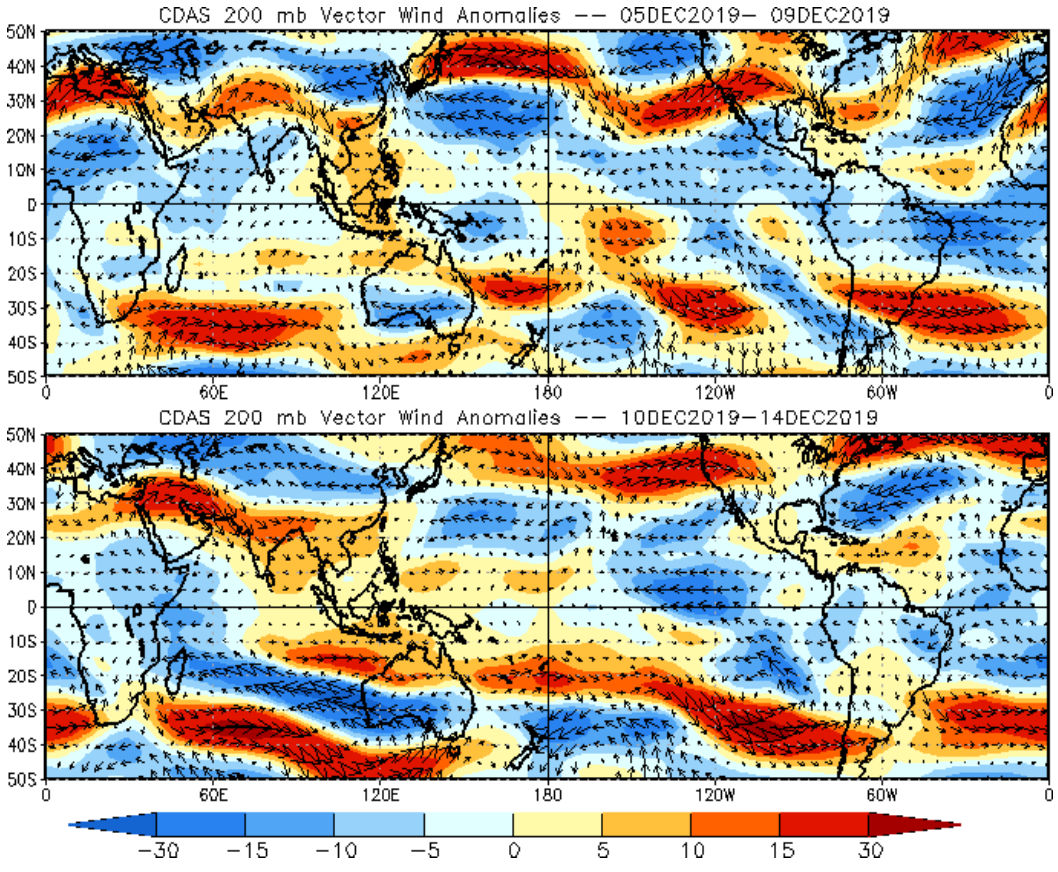


- The latest upper-level velocity potential anomaly field reflects a weaker pattern compared to early December, with enhanced convection shifted further east into the eastern Indian Ocean and broadly suppressed convection over parts of the Maritime Continent and throughout the Western Hemisphere.
- Weakening upper-level convergence over the Maritime Continent may be associated with destructive interference with the Indian Ocean Dipole (IOD).

200-hPa Wind Anomalies

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



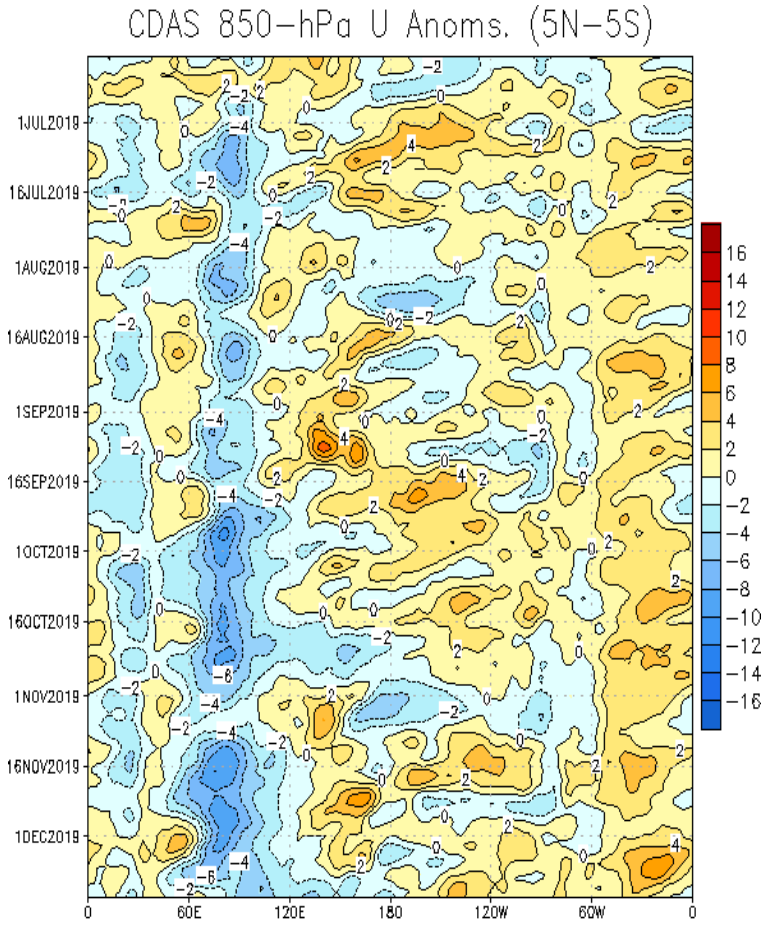


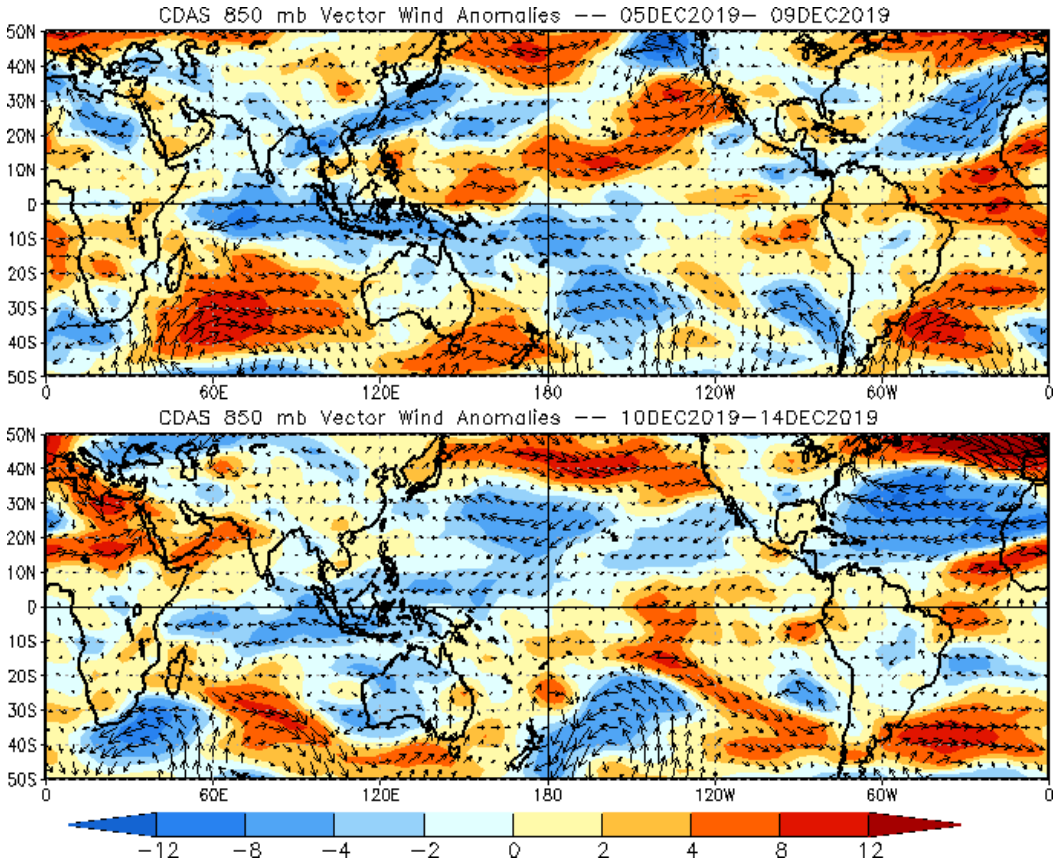
- Upper-level divergence tied to the ongoing IOD remain centered over the western Indian Ocean, with anomalous westerlies expanding eastward into the West Pacific and strengthening easterlies observed across the eastern Pacific.

- In the extratropics, upper-level anticyclones are featured across the Southern Indian Ocean and over the northern Pacific Ocean.

850-hPa Wind Anomalies

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

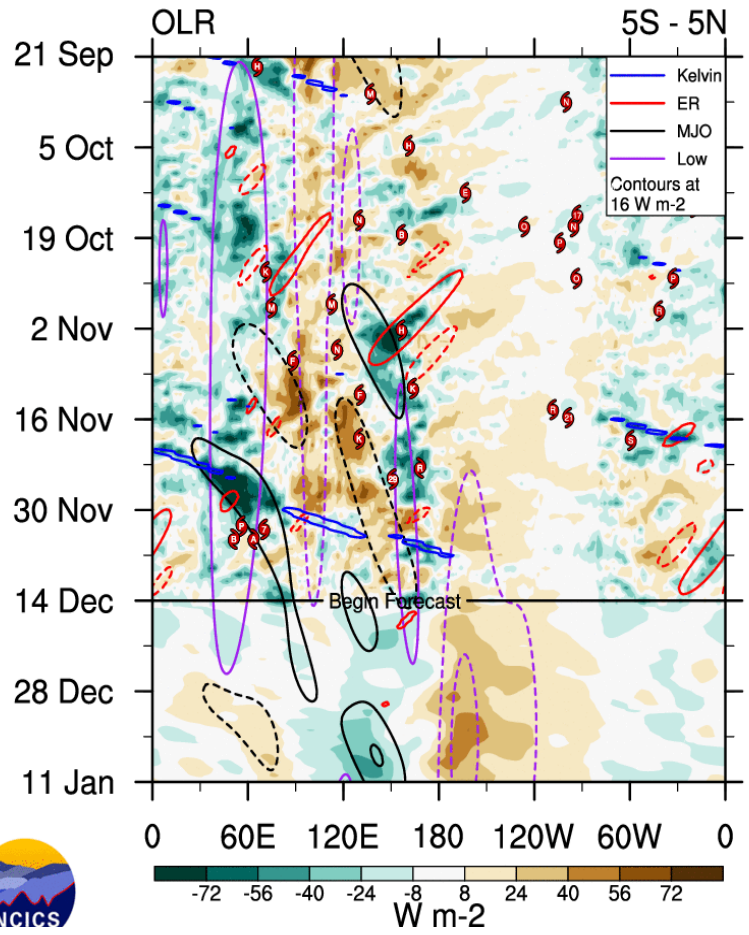


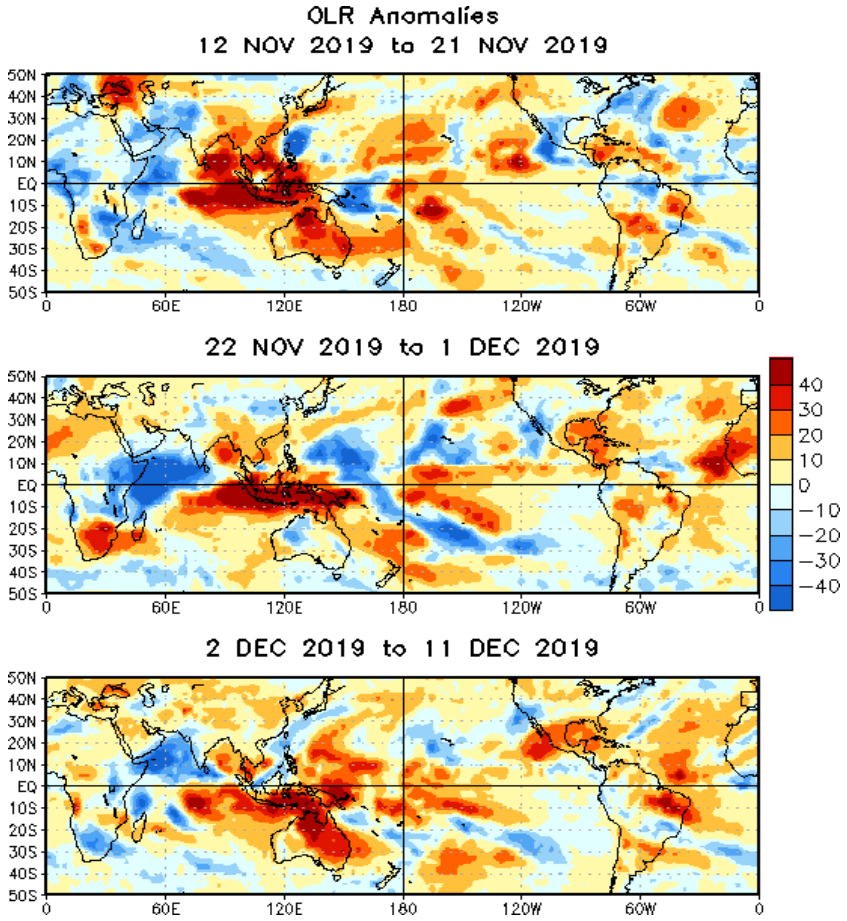


- Anomalous lower-level easterlies appear to have weakened (strengthened) over the Indian Ocean (Maritime Continent)
- Stronger anomalous westerlies are evident across the central and eastern Pacific.

Outgoing Longwave Radiation (OLR) Anomalies

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

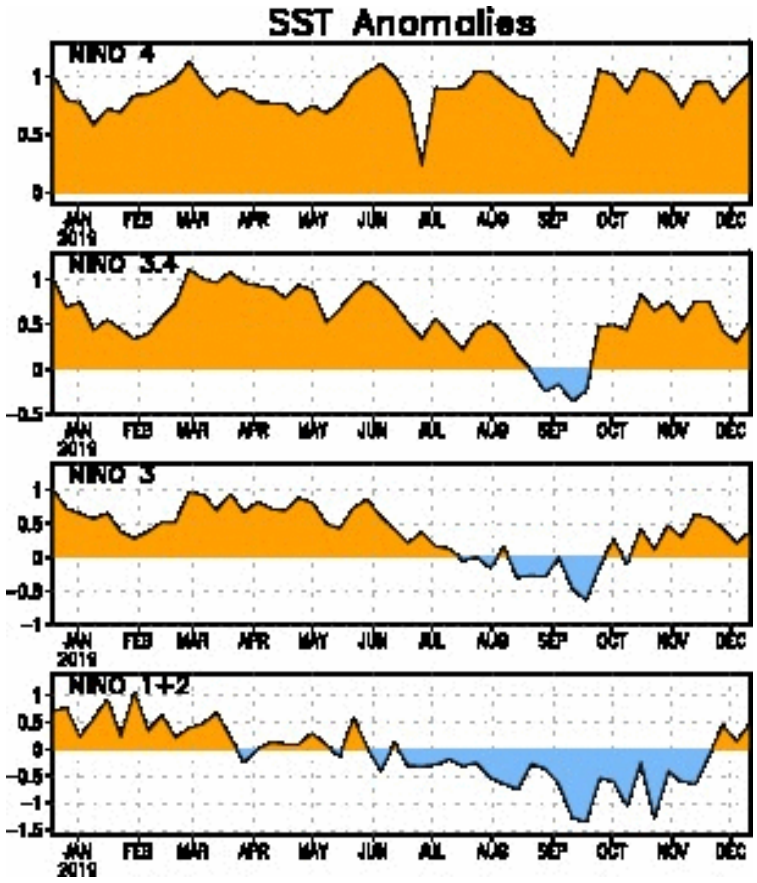


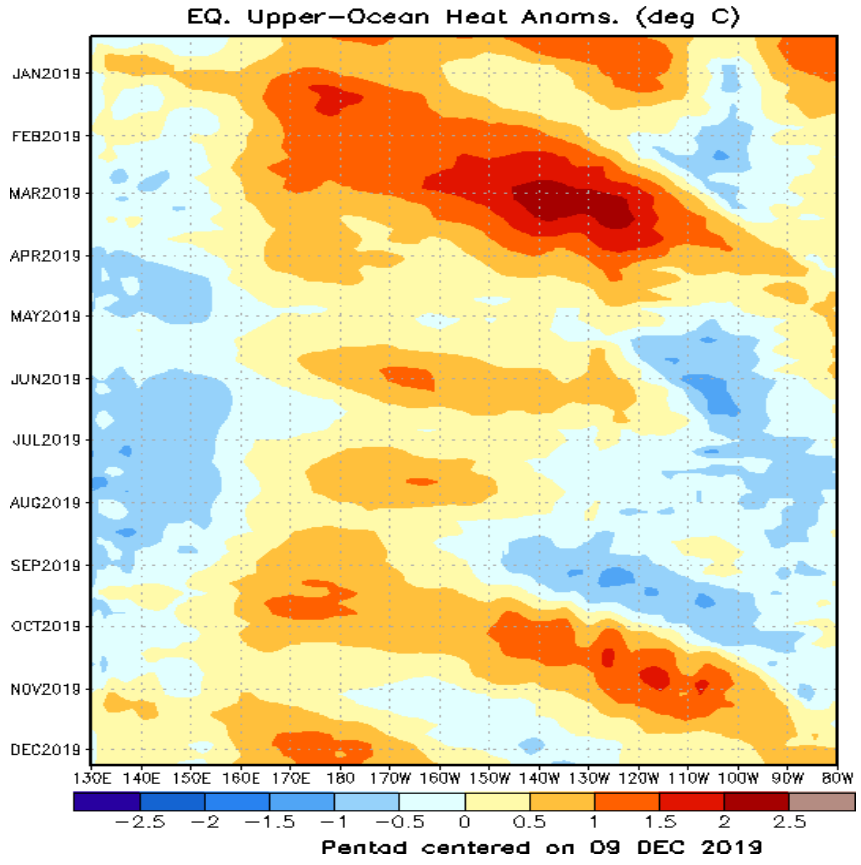


- Since late November, the superposition of the IOD, equatorial Rossby wave activity, and enhanced envelope of the MJO led to continued enhanced convection over the western Indian Ocean.

- Suppressed convection observed further east into the Western Pacific tied to stronger anomalous upper-level westerlies and decreased TC activity in the region.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



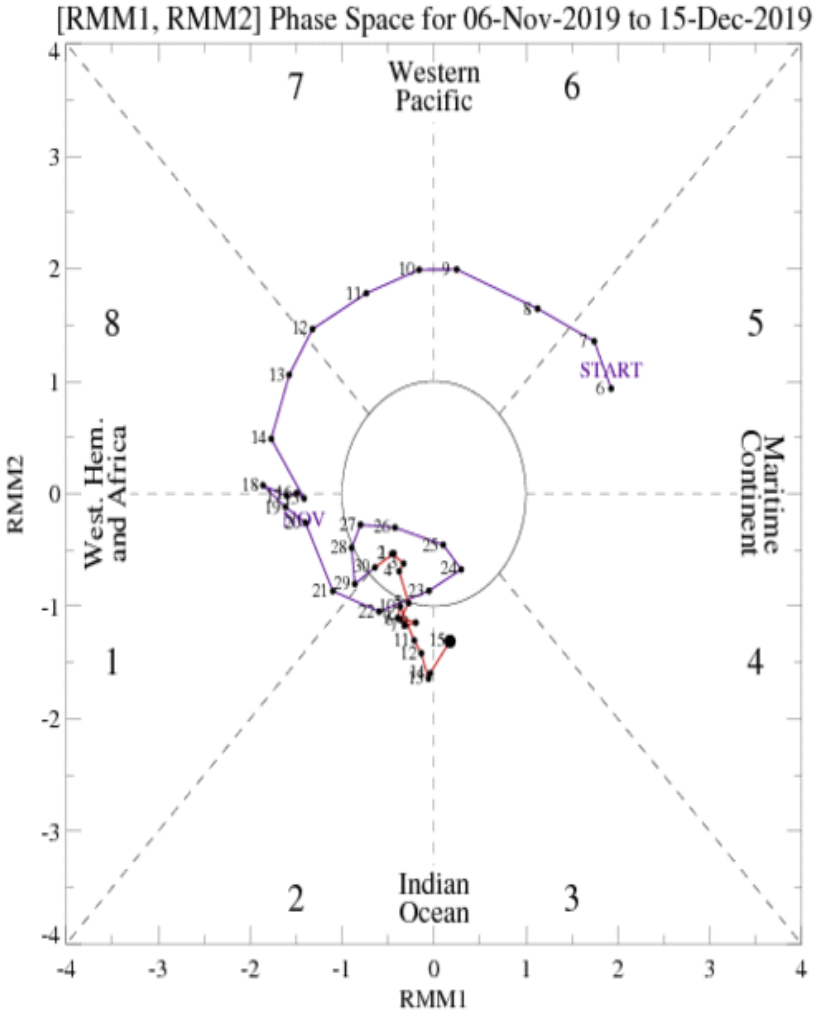


- Following a weakening Pacific Niño 3.4 region SST anomalies during late November, SST anomalies have slightly increased since early December.

- A westerly wind burst observed east of the Dateline during late November may have triggered another downwelling Kelvin wave event.

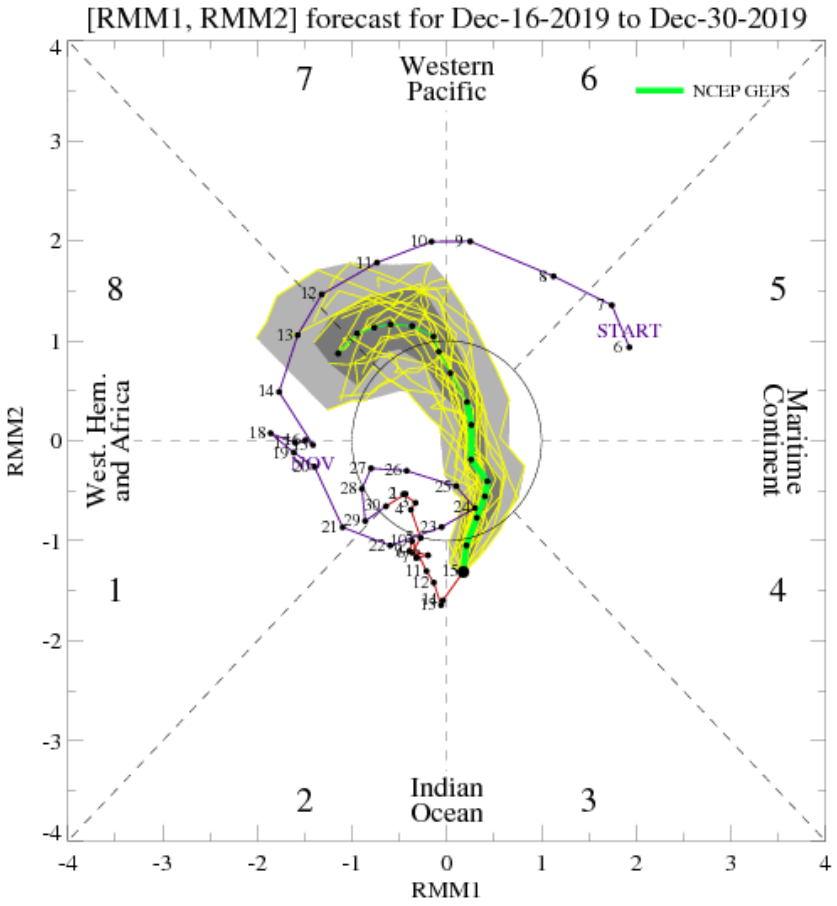
MJO Index: Recent Evolution

- The MJO shifted slightly eastward into Phase 3 over the Indian Ocean while slowly gaining amplitude during the past week.

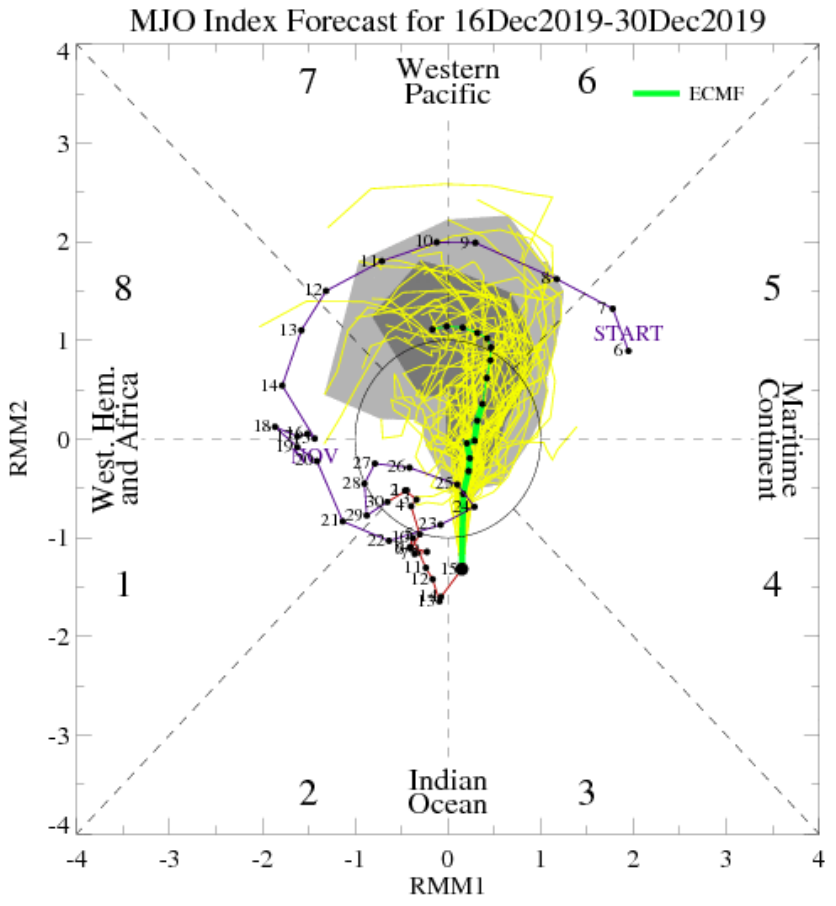


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

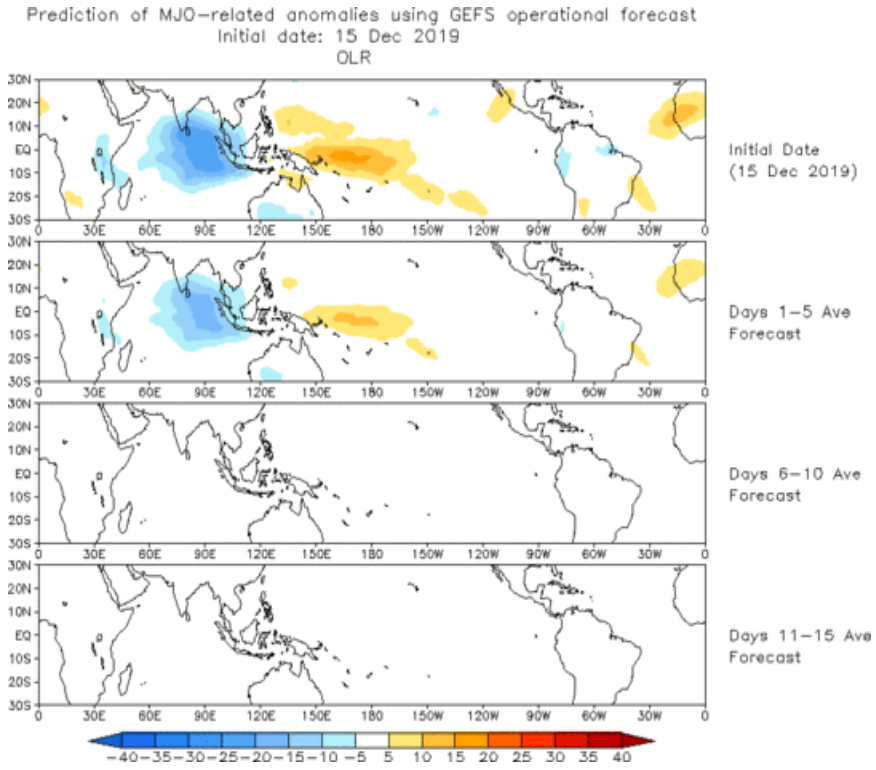


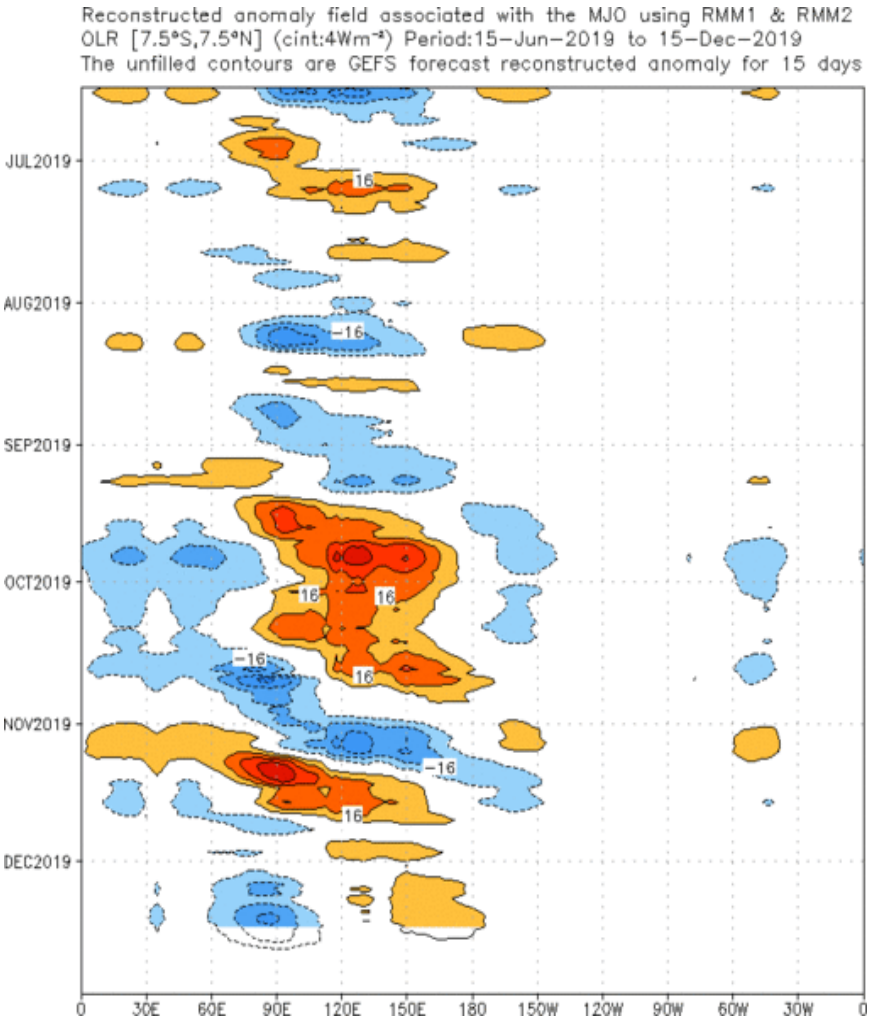
ECMWF Forecast

- Dynamical model MJO index forecasts are in fair agreement with a rapidly weakening MJO while continuing to propagate eastward during Weeks 1 and 2.
- By Week-2, both ensemble means suggest that the MJO will re-emerge in the Western Pacific, with some ECMWF ensemble members suggesting a re-emerging MJO over the Maritime Continent (Phases 4/5)

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.)

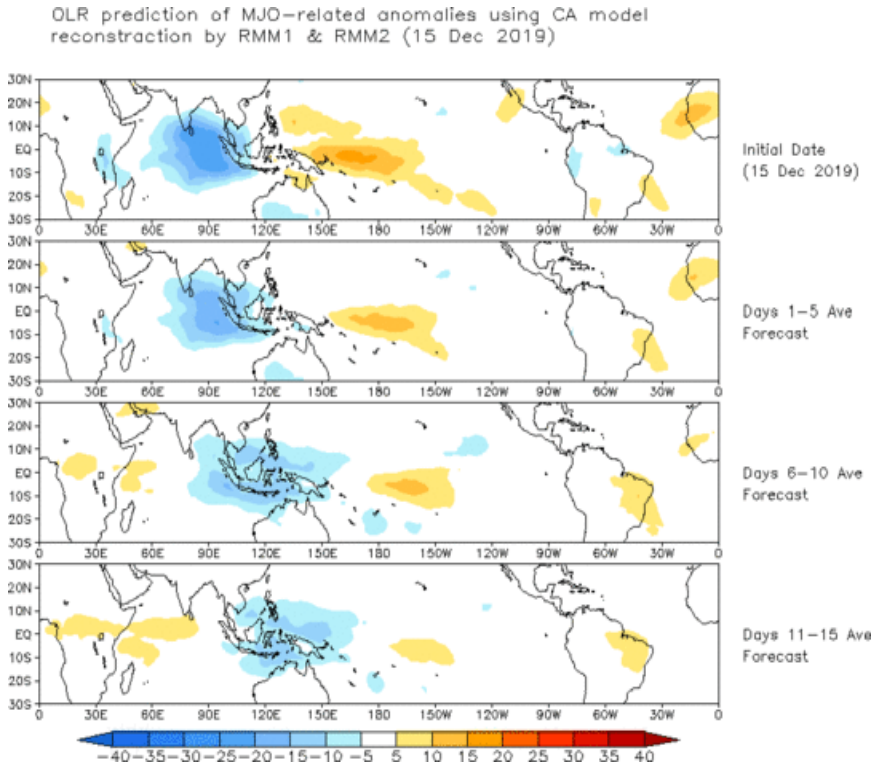


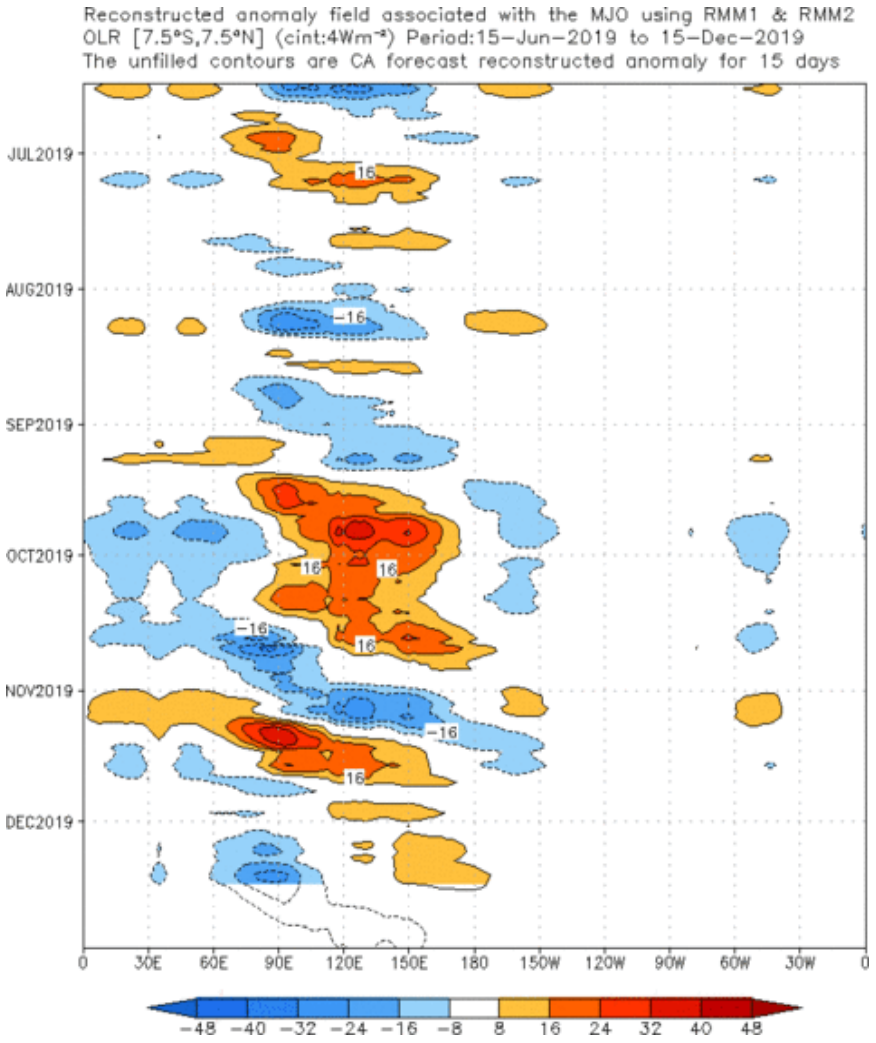


- The GEFS RMM-based OLR anomaly forecast shows a continued weakening during Week-1.

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.)

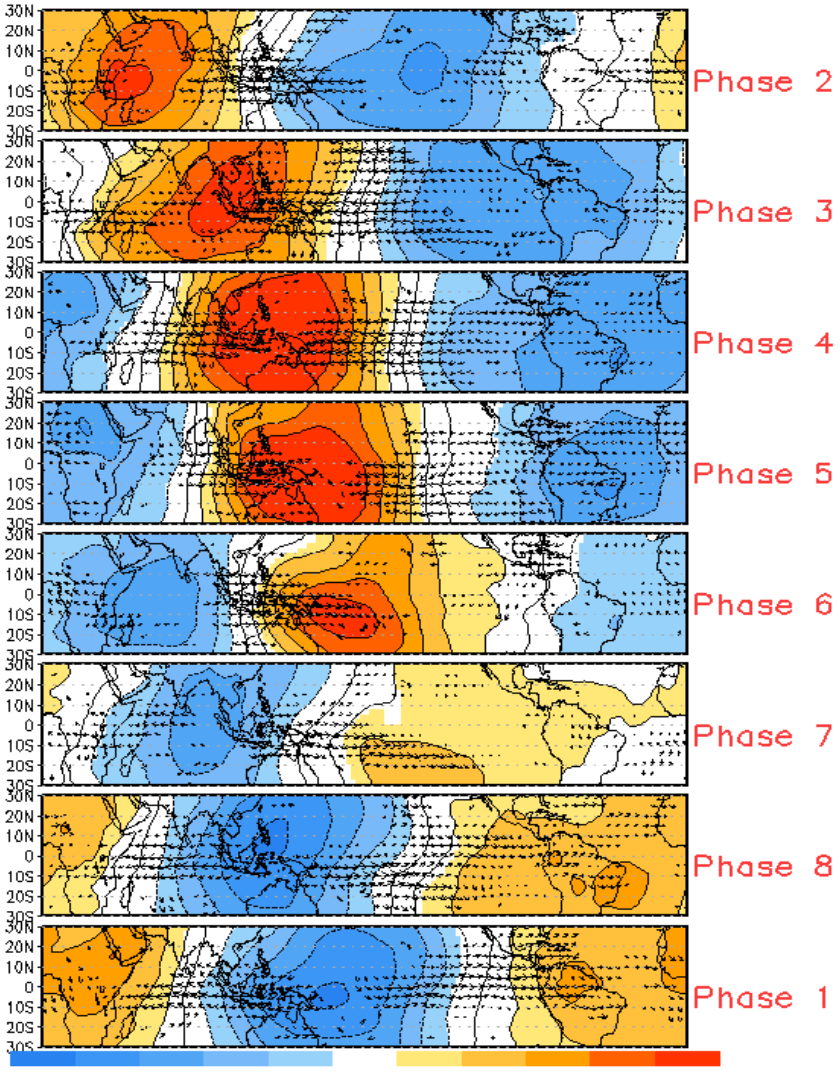




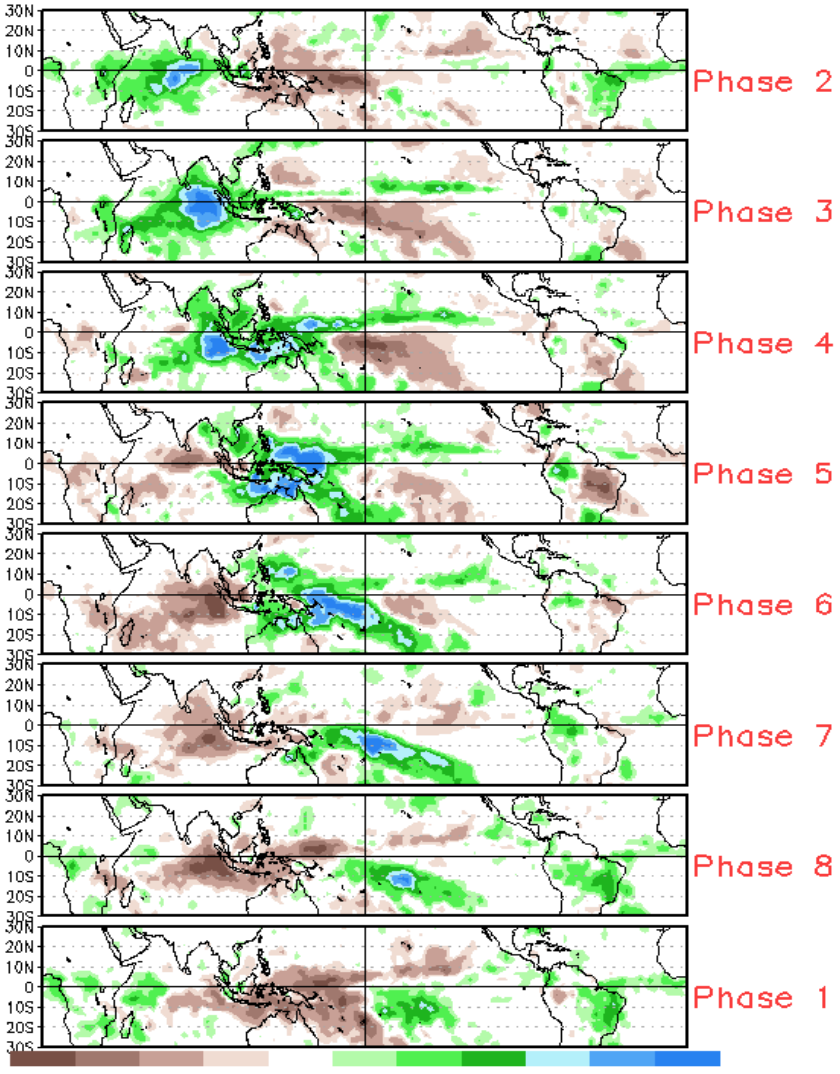
- The constructed analog depicts a more progressive MJO event than the GEFS, with enhanced convection shifting over the Maritime Continent, and suppressed convection developing over Africa and the western Indian Ocean by Week-2.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



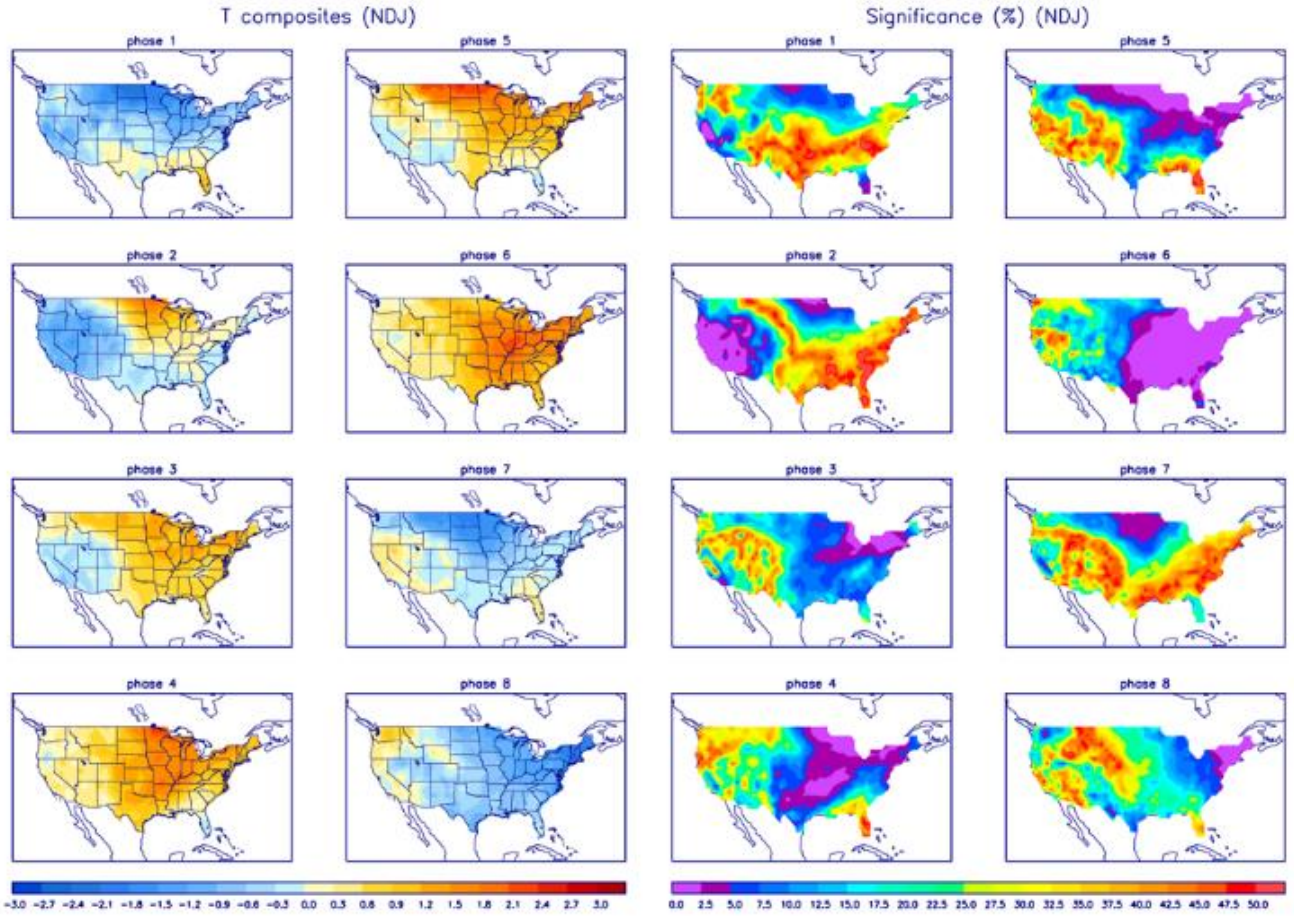
Precipitation Anomalies



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.

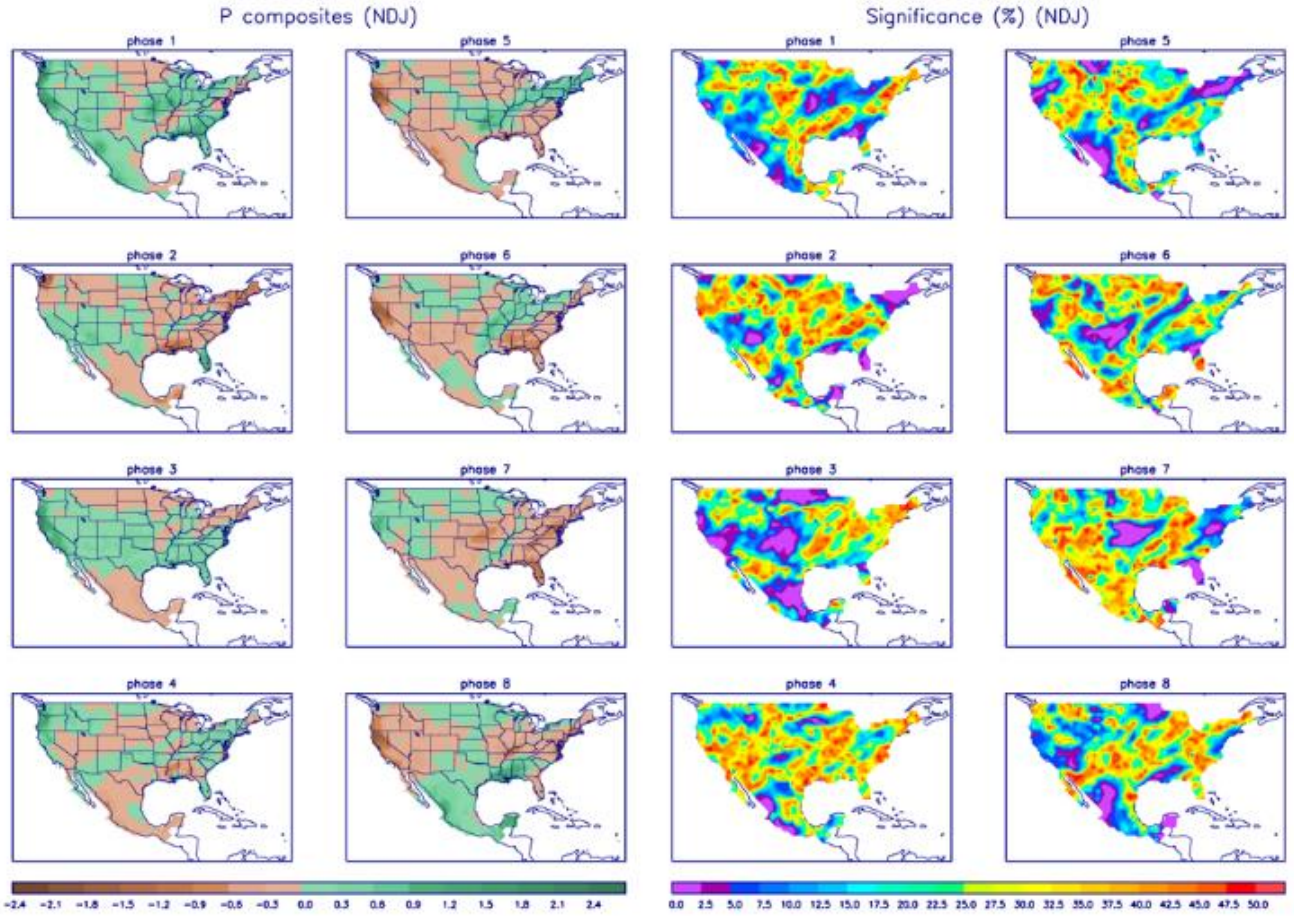


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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.



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