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

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
2 November 2020

Overview

- The MJO is over the West Pacific. Dynamical models forecast it to continue its way around the globe, but are roughly evenly split regarding its amplitude.

- Anomalous low level easterlies across the east Pacific are consistent with the current La Niña.

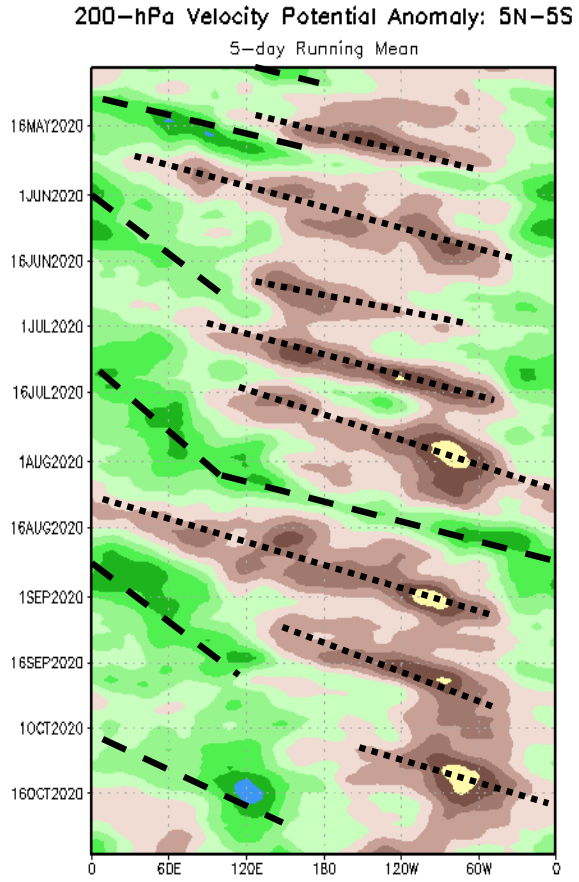
- Kelvin wave activity throughout the West Pacific, combined with the lower frequency La Niña pattern, has contributed to enhanced tropical cyclone activity.

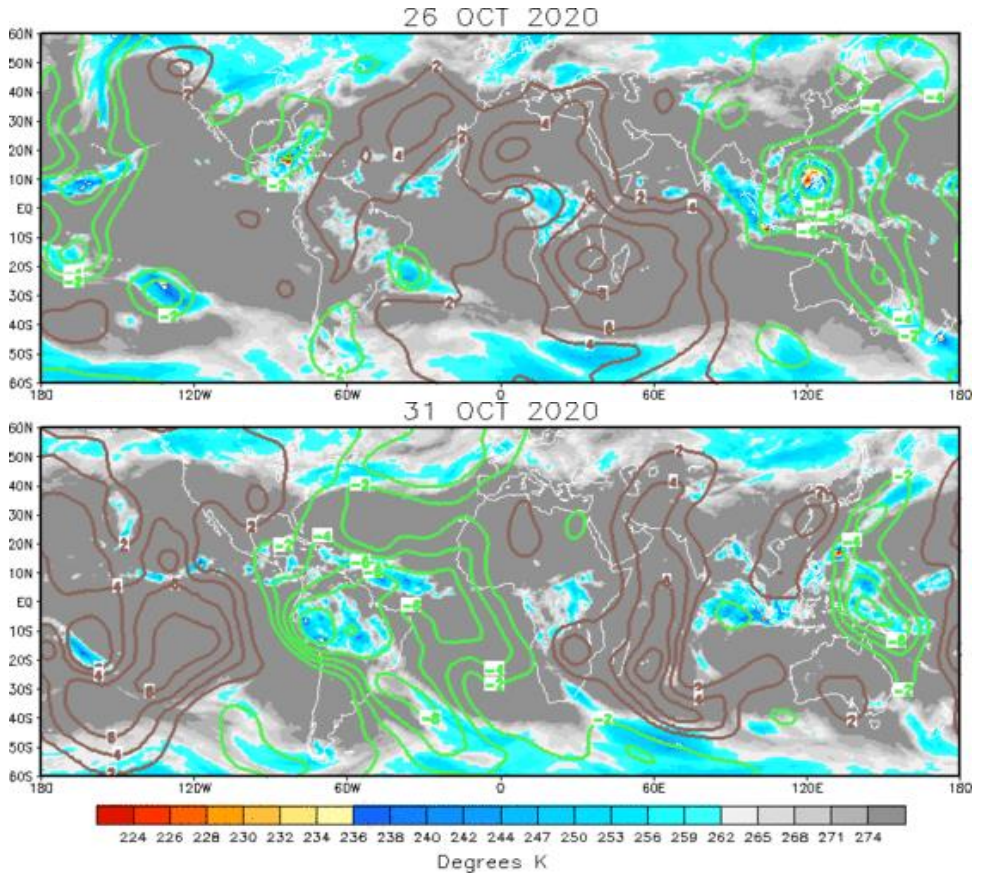
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).



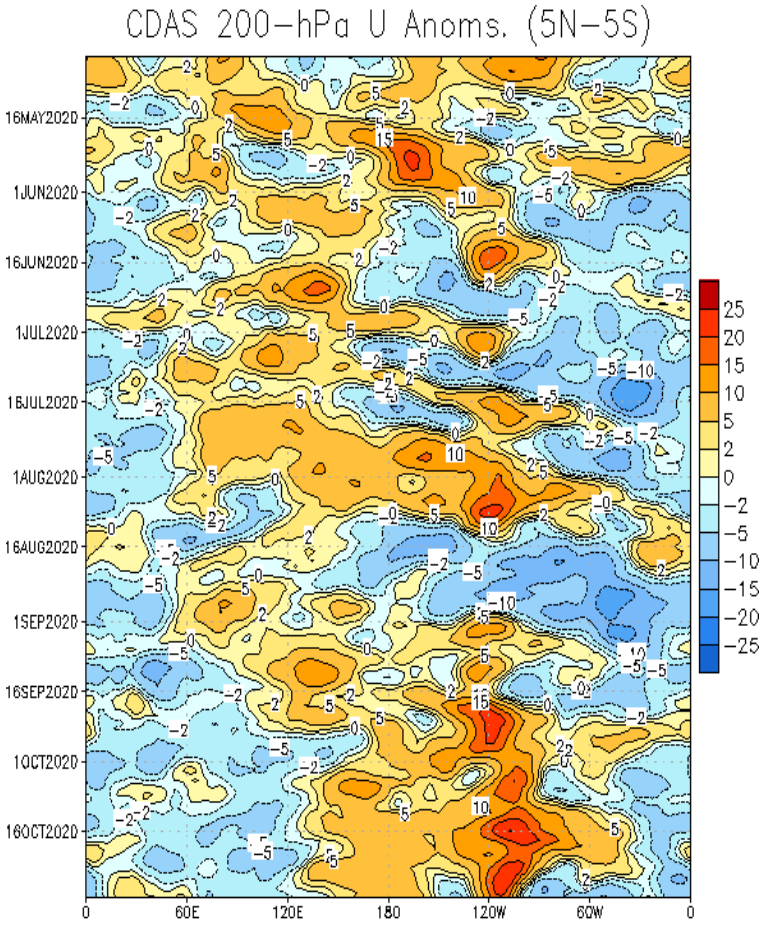


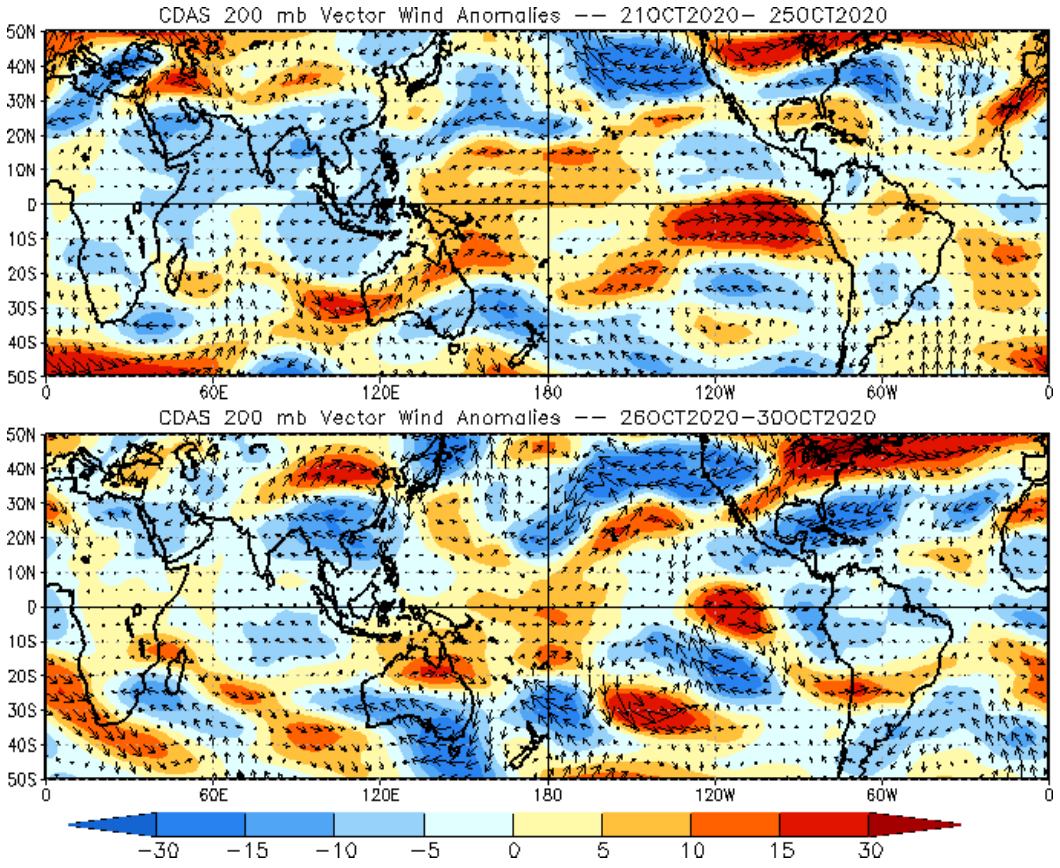
- The MJO was weak and poorly defined during early October but emerged over the Maritime Continent during the middle of the month and is now heading eastward over the Pacific.

- Some Kelvin wave and tropical cyclone activity has created a noisy Wave-2 pattern.

200-hPa Wind Anomalies

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

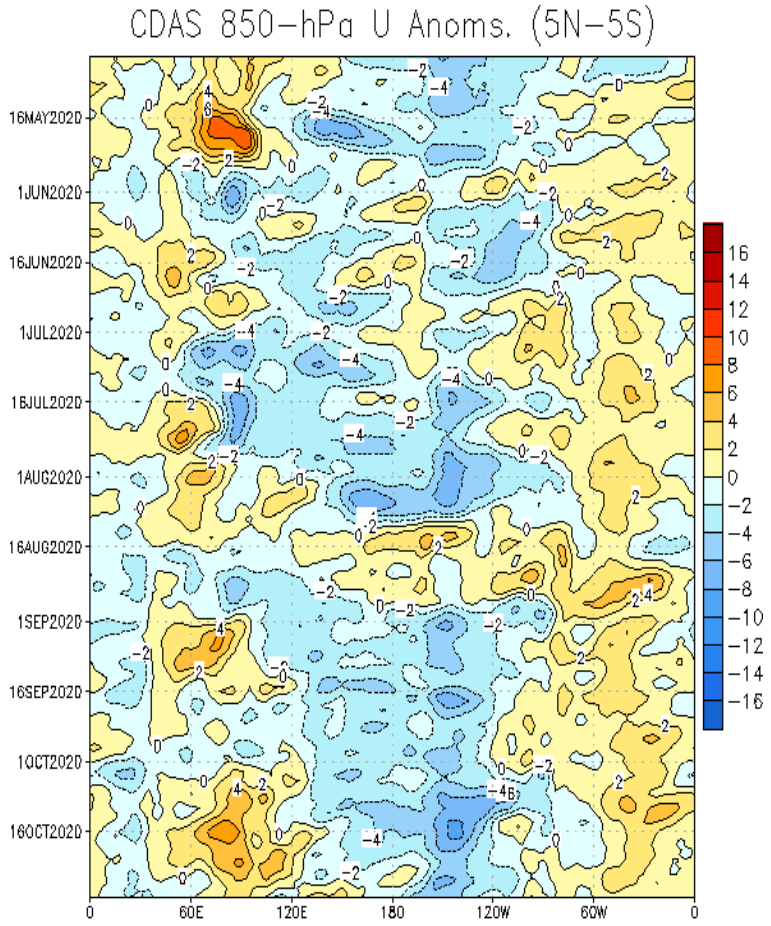


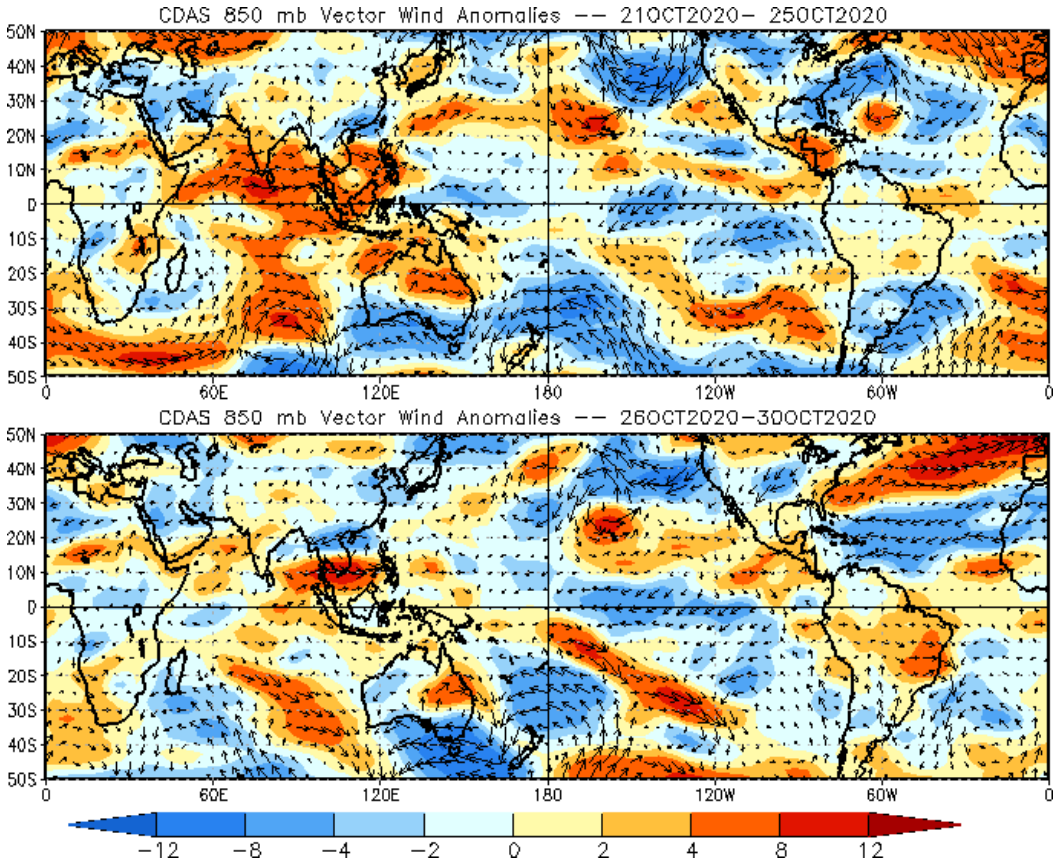


- Anomalous westerlies (easterlies) persist across the eastern equatorial Pacific (Indian Ocean/ Maritime Continent), consistent with La Niña conditions.
- An amplified mid-latitude flow over the Pacific has resulted in Rossby wave breaking into the tropics. There is evidence of resulting cross equatorial flow around 120W.

850-hPa Wind Anomalies

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

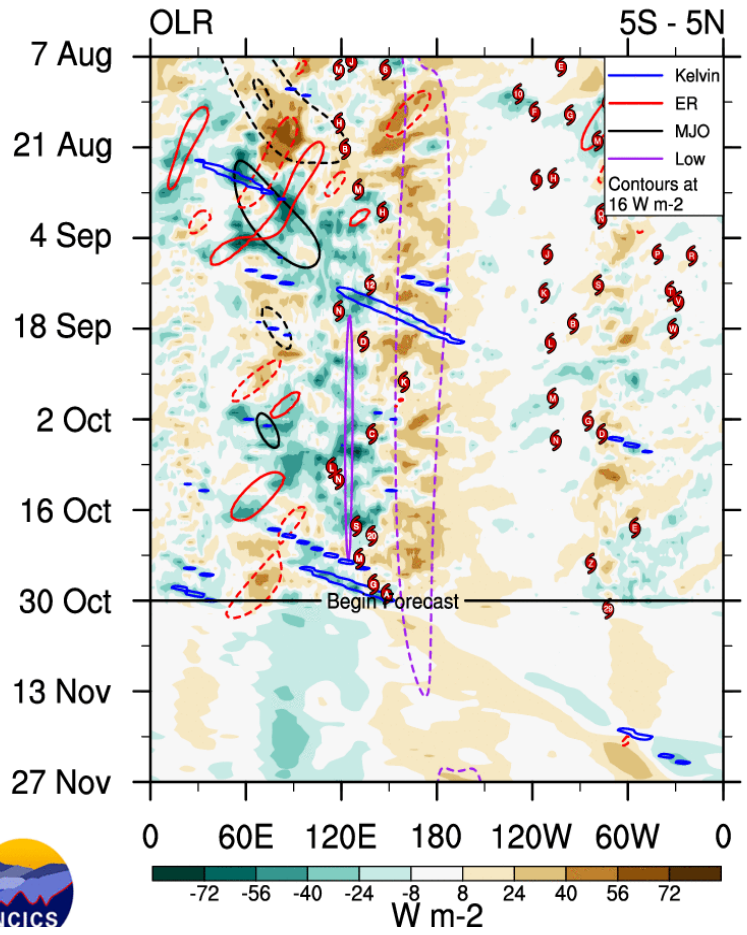


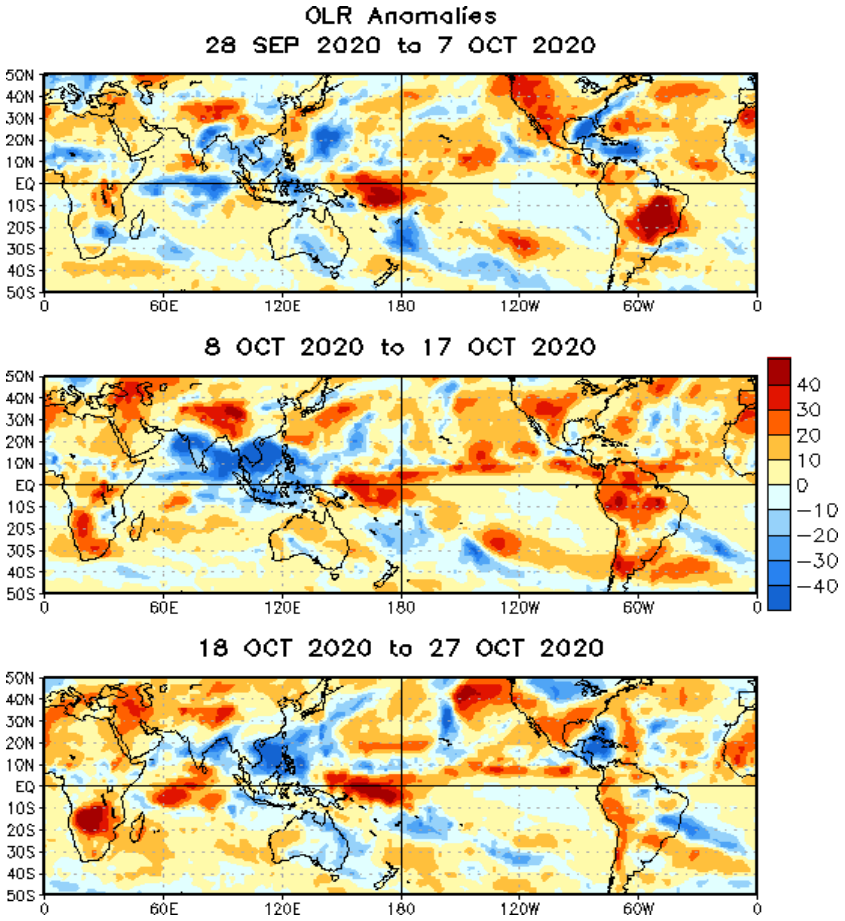


- The aforementioned extratropical wave breaking is also evident in the lower levels of the atmosphere over the eastern Pacific.
- Anomalous easterlies along the Date Line are consistent with the current La Niña status.

Outgoing Longwave Radiation (OLR) Anomalies

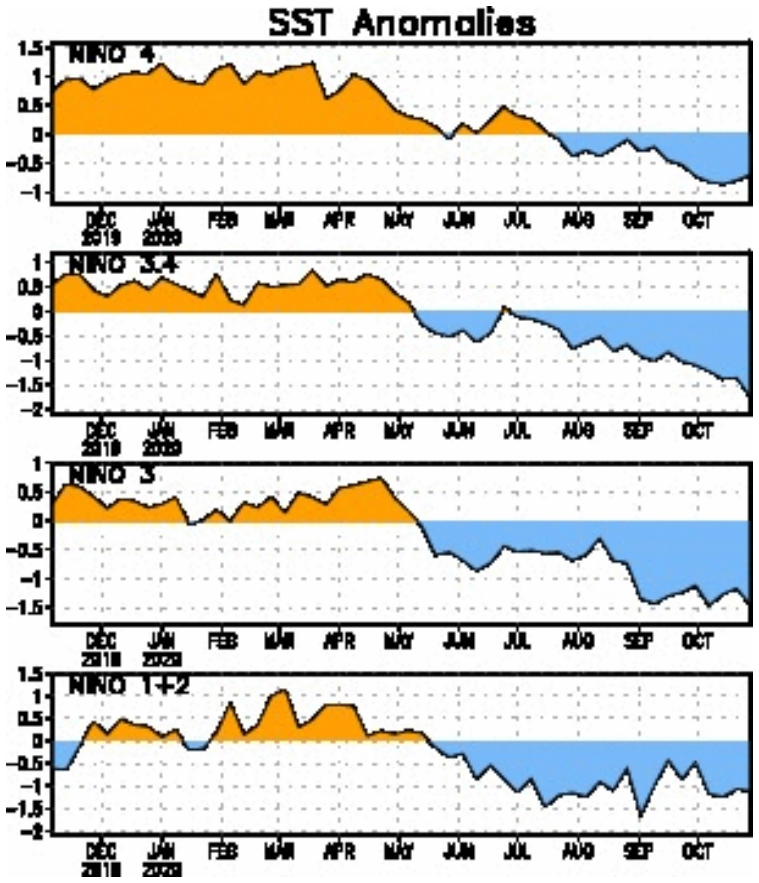
Blue shades: Anomalous convection (wetness). Red shades: Anomalous subsidence (dryness).

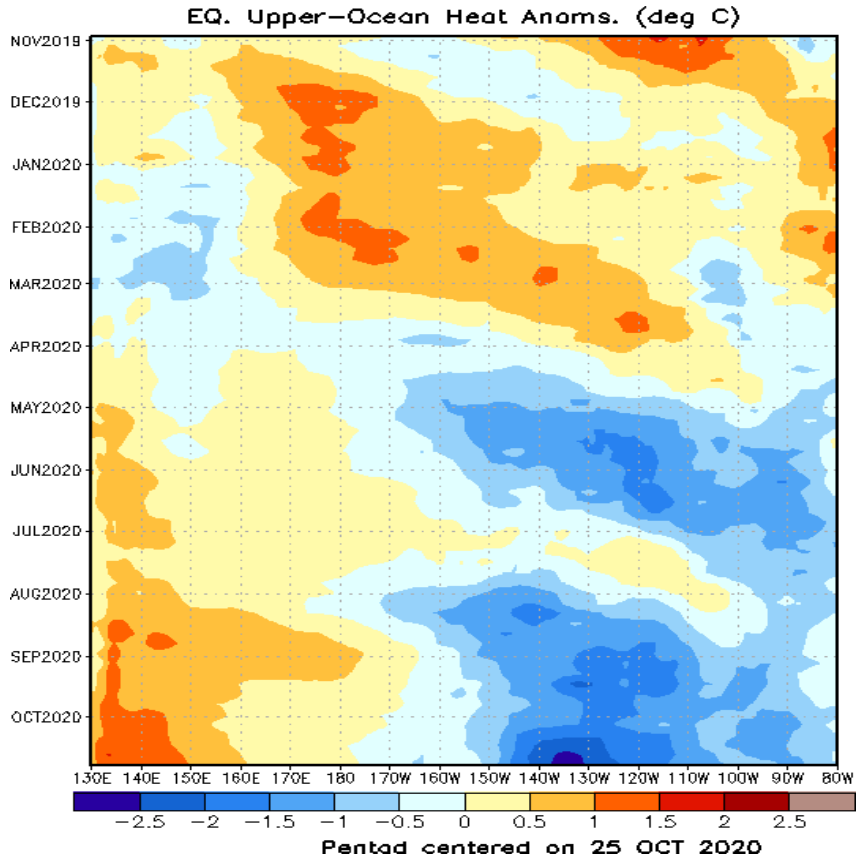




- Anomalous enhanced convection (negative OLR anomalies) have been observed over the Maritime Continent for over a month and is mostly stationary, consistent with a low-frequency La Niña pattern.
- Kelvin wave activity through the West Pacific, superimposed on the aforementioned lower frequency state, has aided tropical cyclone development during the previous several weeks.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

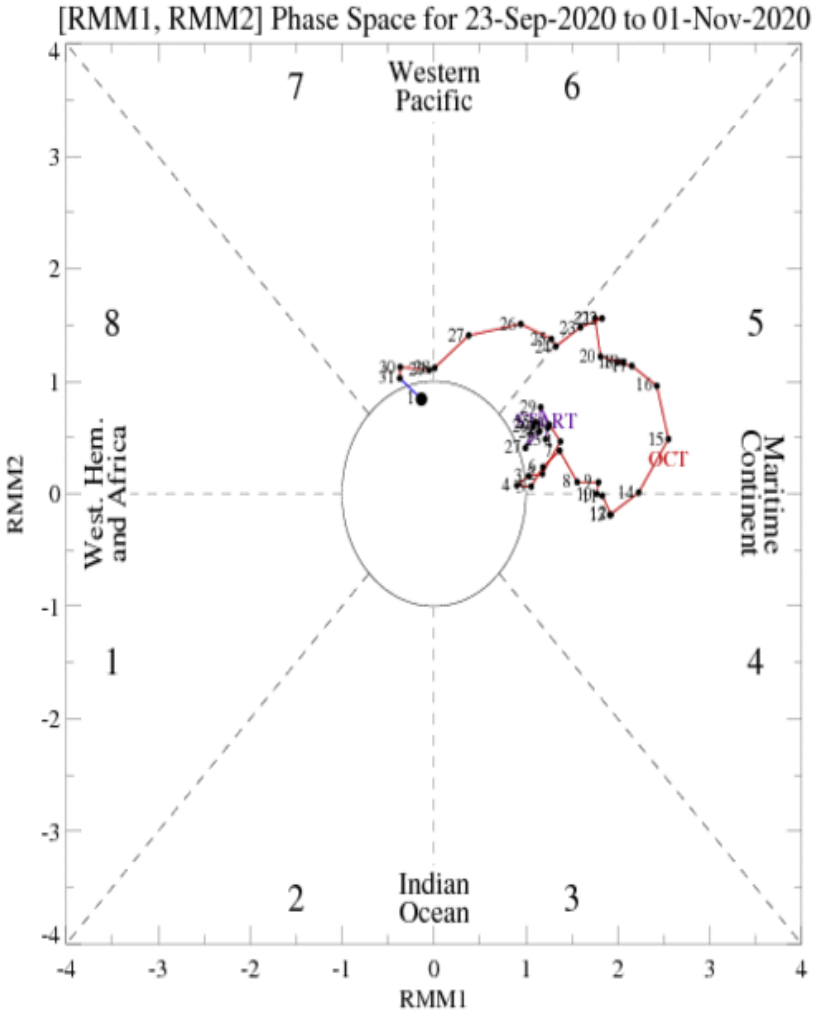




- Following destructive interference with the base state by a downwelling Kelvin wave, the subsequent upwelling phase has pushed the Pacific into La Niña conditions.
- A subsequent downwelling Kelvin wave initiated in late August failed to cross the central Pacific.
- Negative anomalies in all of the Niño regions have continued to strengthen, with the greatest declines observed in the Niño 4 and 3.4 regions since September.

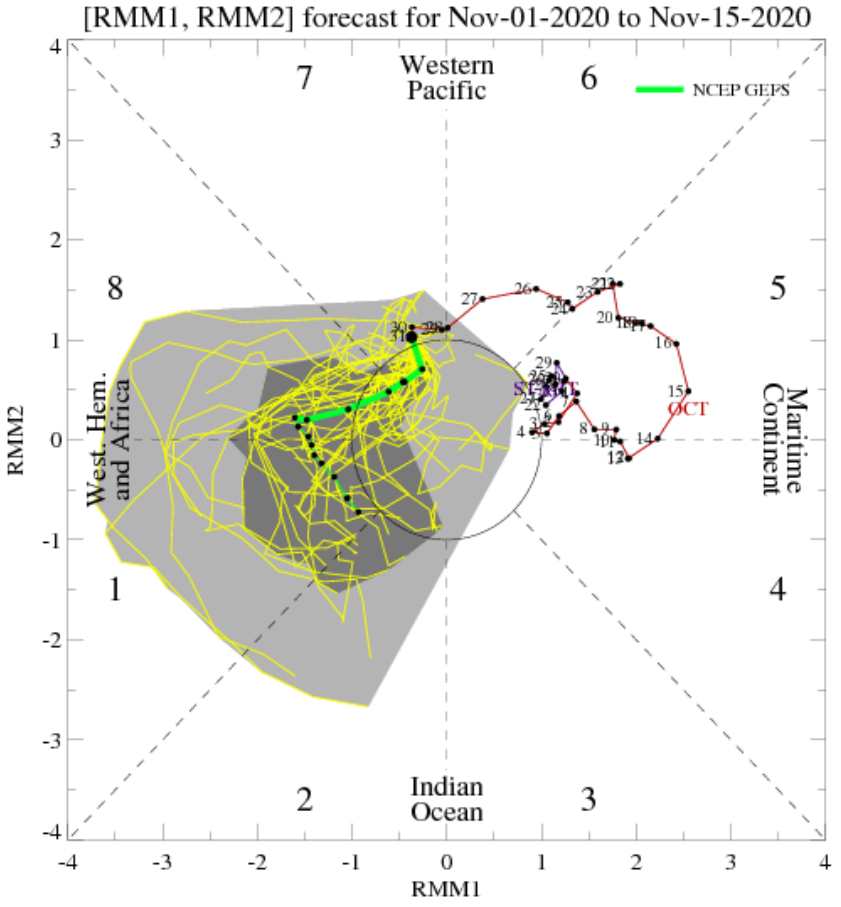
MJO Index: Recent Evolution

- After being inactive for the first half of October, the MJO has emerged from the Maritime Continent and is now propagating eastward over the Maritime Continent and West Pacific.

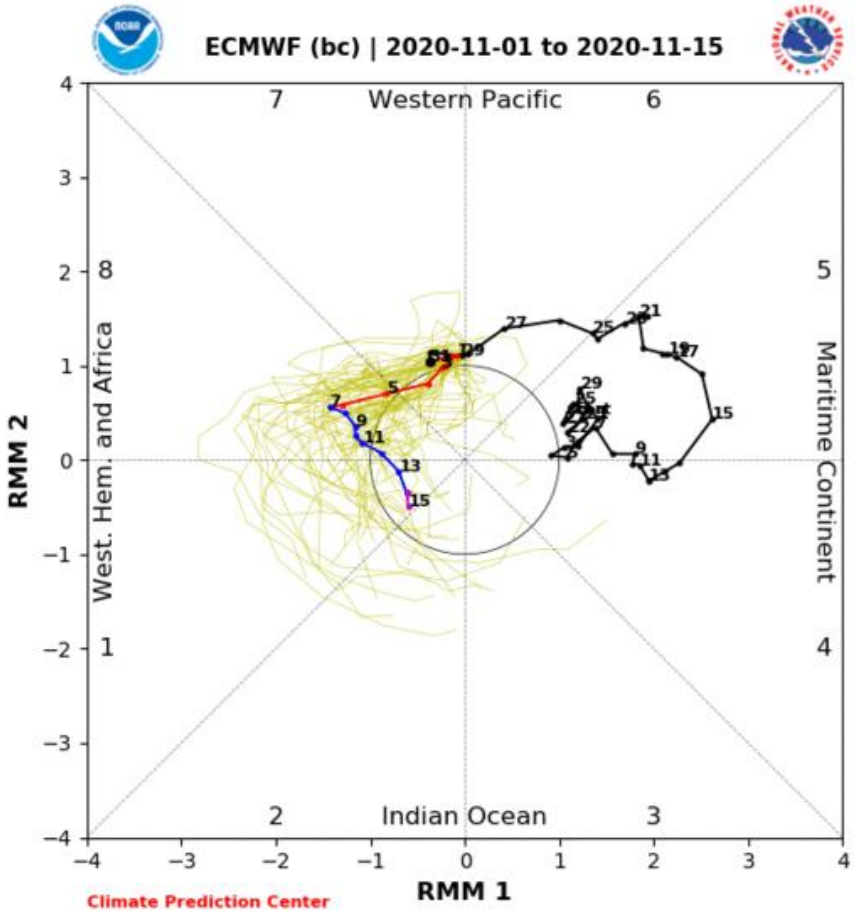


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

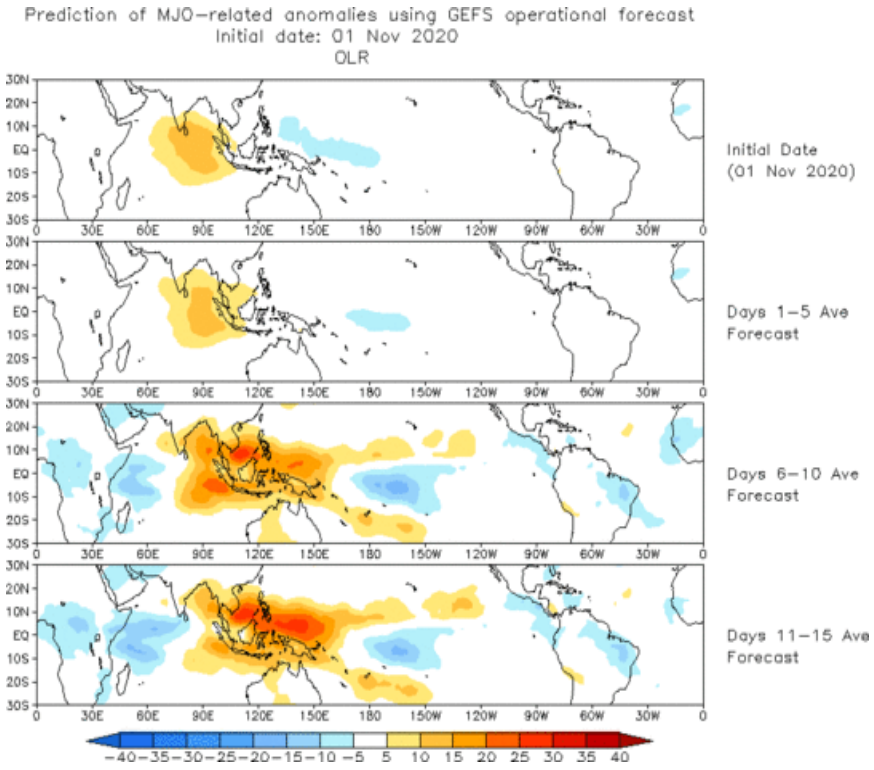


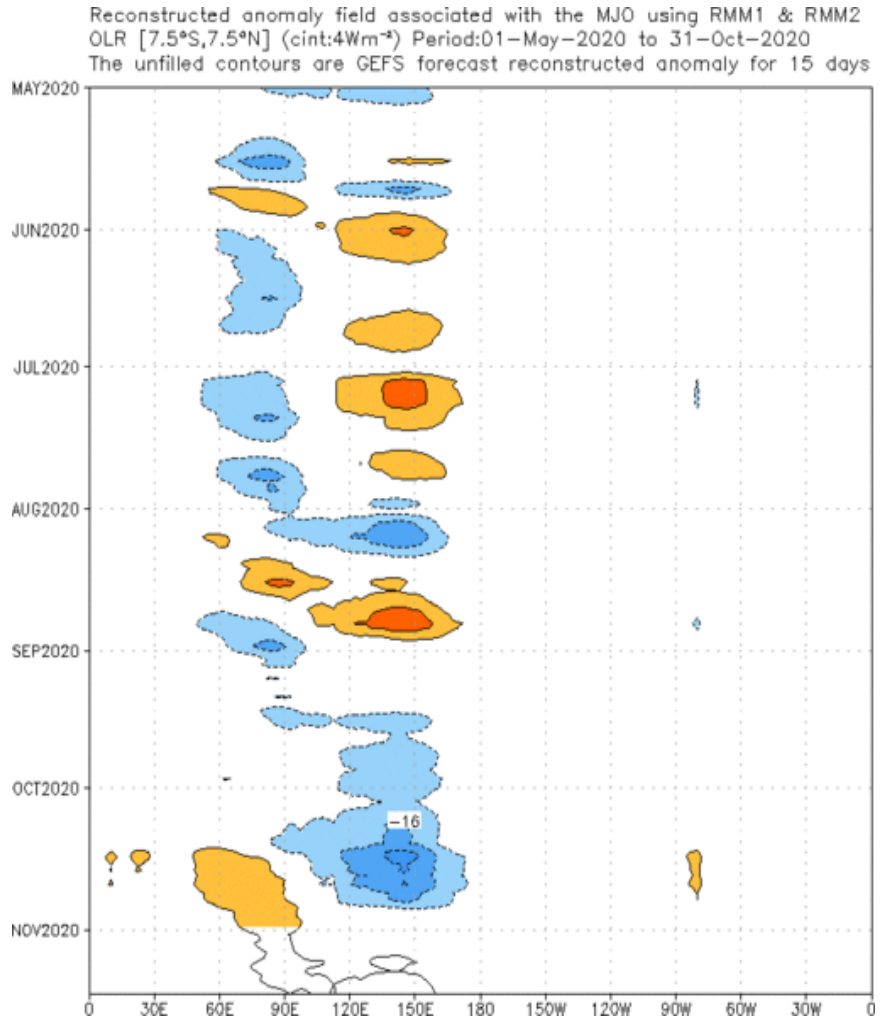
ECMWF Forecast

- Both the GEFS and ECMWF forecast the MJO to weaken over the Western Pacific.
- There is a considerable fraction of both ensemble systems that forecasts the MJO to be active as it moves over the Western Hemisphere during the next two weeks.

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.)

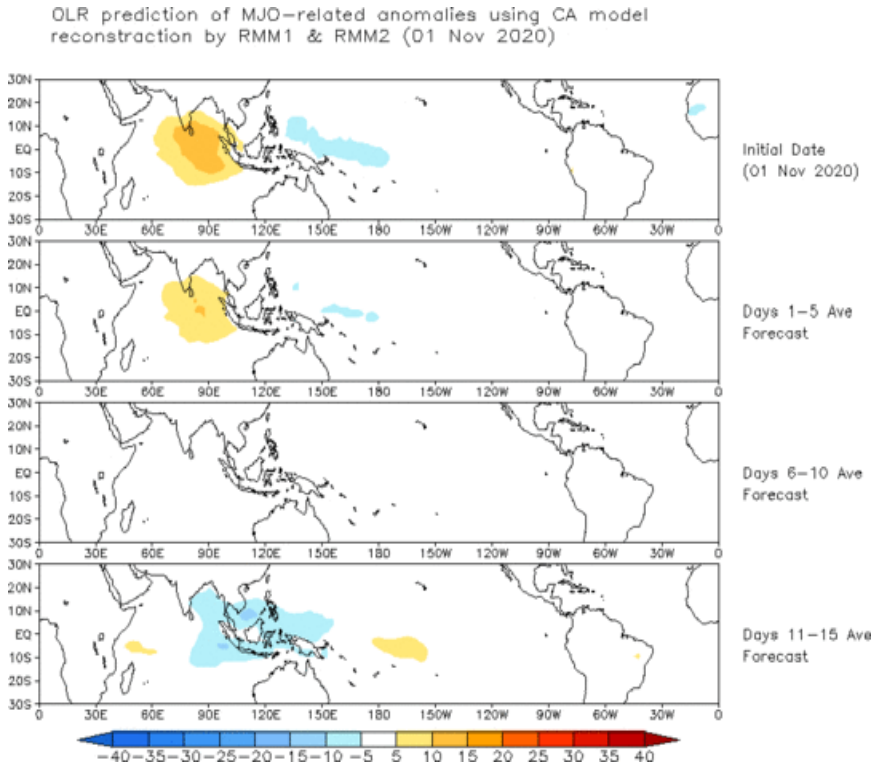


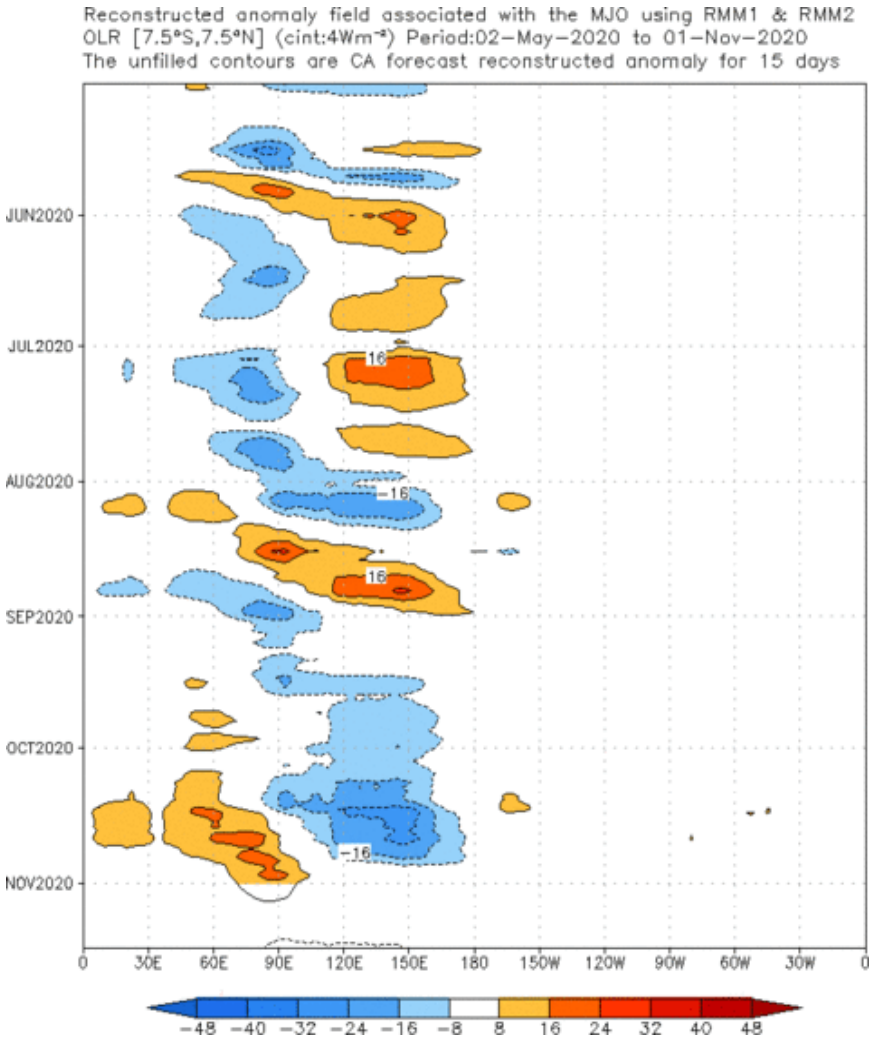


- The GEFS forecasts a slow moving MJO signal that is opposite that expected from La Niña.

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.)

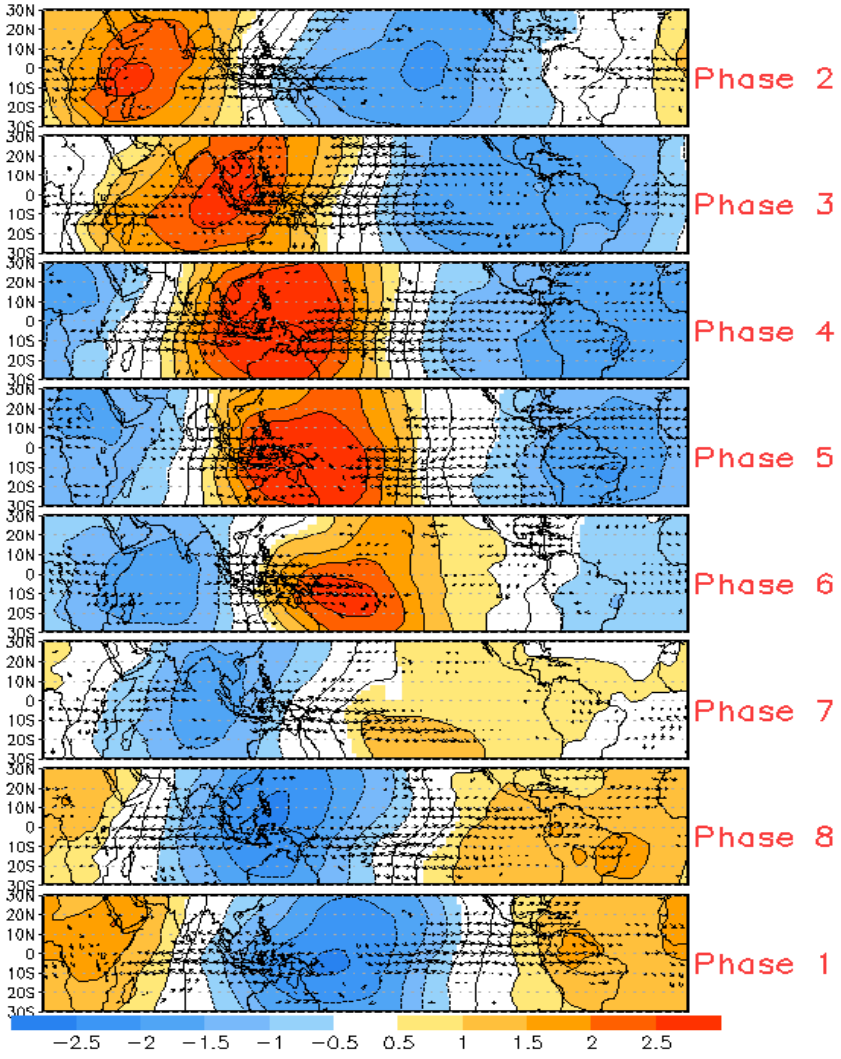




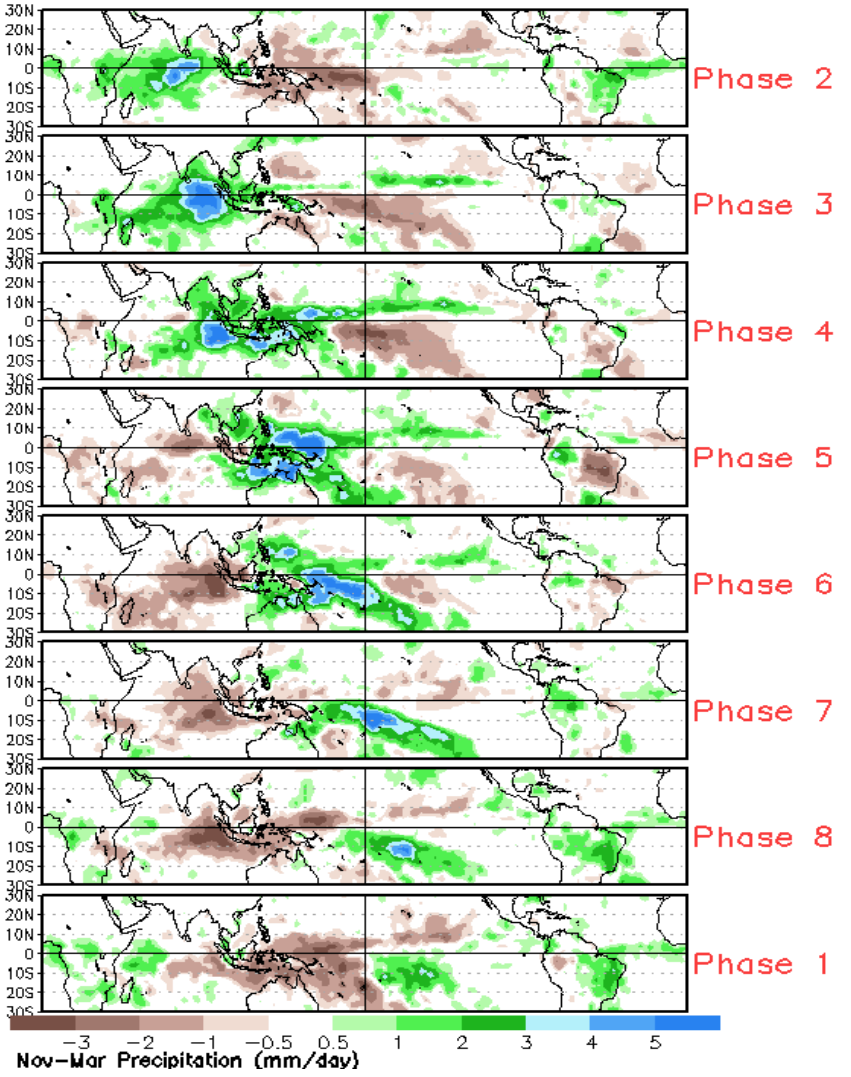
- The constructed analog model depicts a slow MJO signal.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



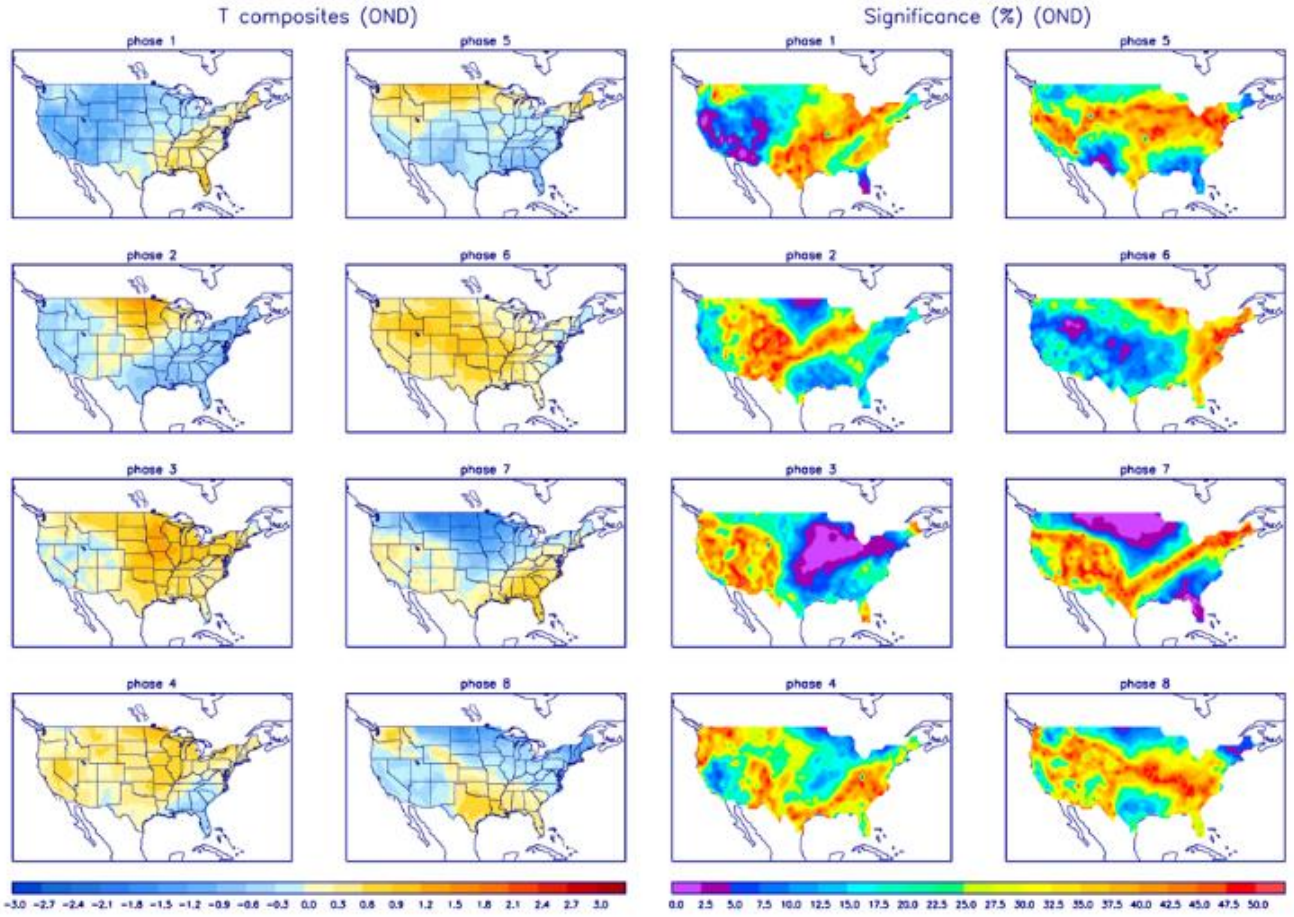
Precipitation Anomalies



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.

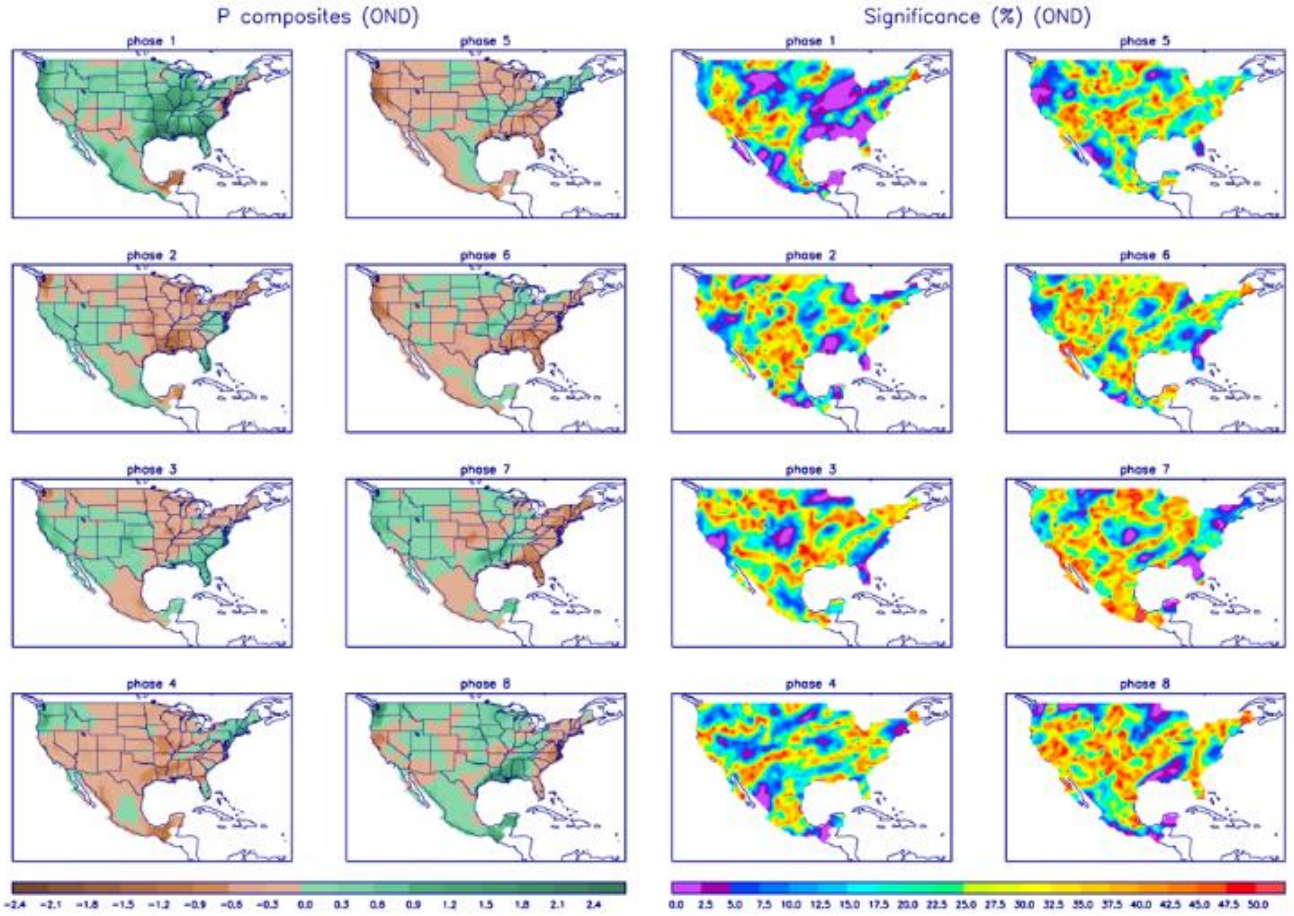


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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