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

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
19 October 2020

Overview

- The MJO has shown signs of strengthening as it has begun to propagate eastward over the Maritime Continent during the last week.

- Dynamical models indicate a continued eastward propagation of the MJO with varying degrees of amplitude and phase progression over the next two weeks.

- Destructive interference between the MJO and the strengthening La Niña background state over the West Pacific remains a concern, increasing uncertainty over the next two weeks.

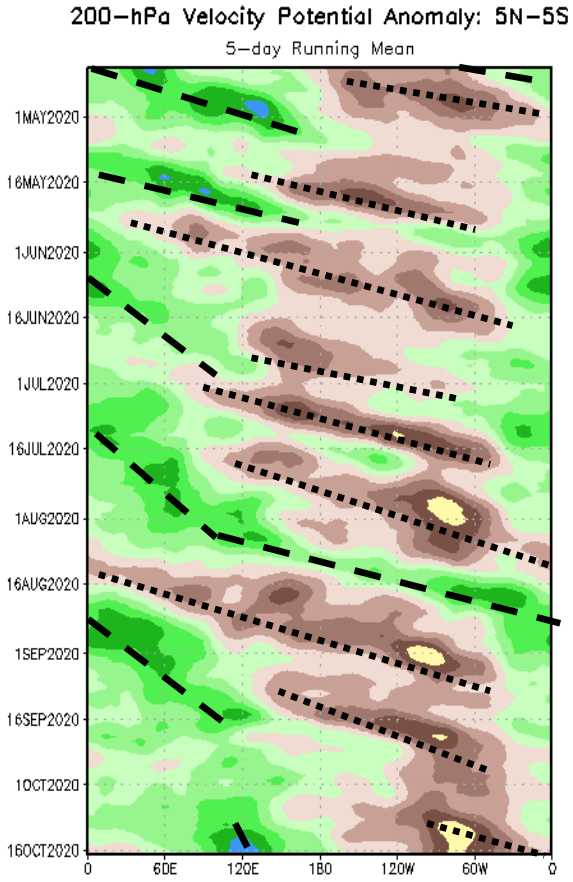
- If the MJO does propagate eastward as fast as some ensemble members suggest, increased tropical cyclone activity over the East Pacific and Caribbean is to be expected during late October. However, if the signal is slow to propagate, continued tropical cyclone activity is anticipated over the West Pacific.

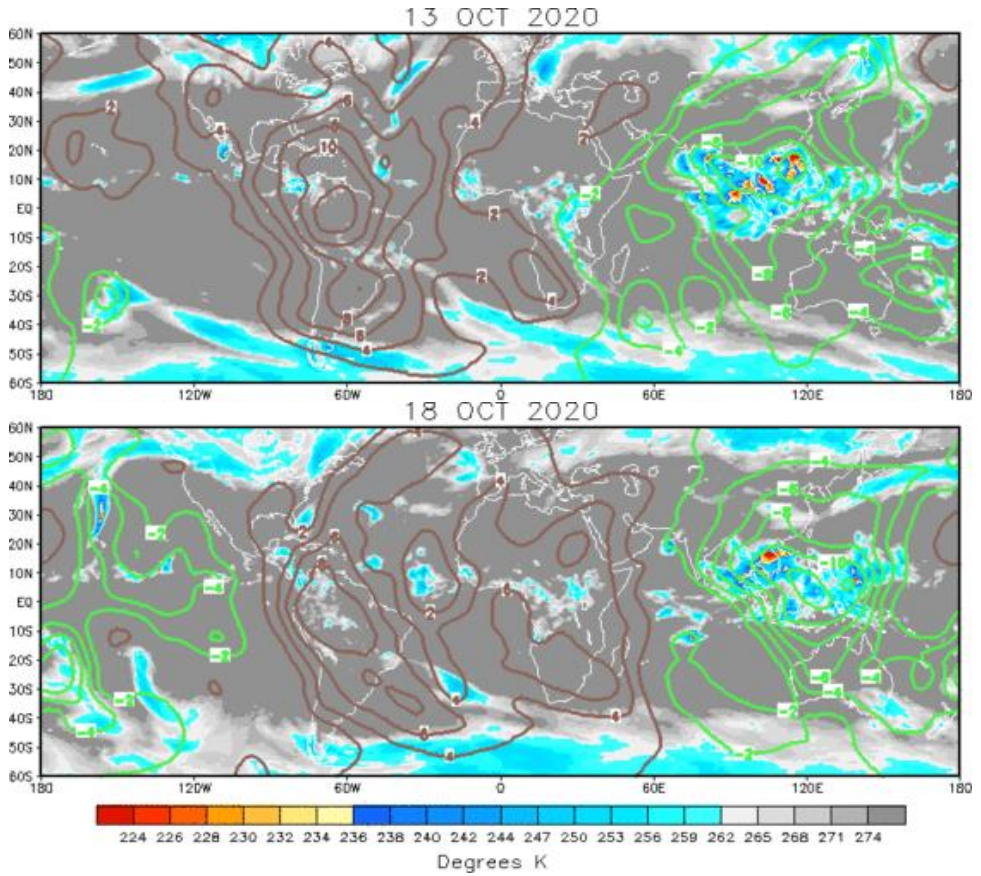
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

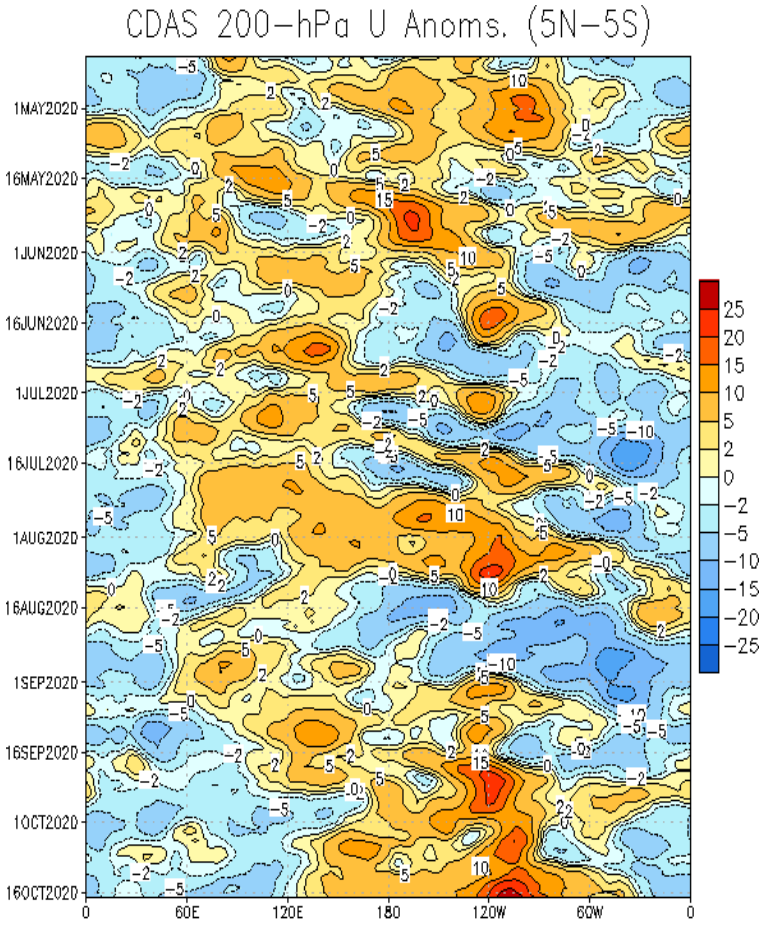


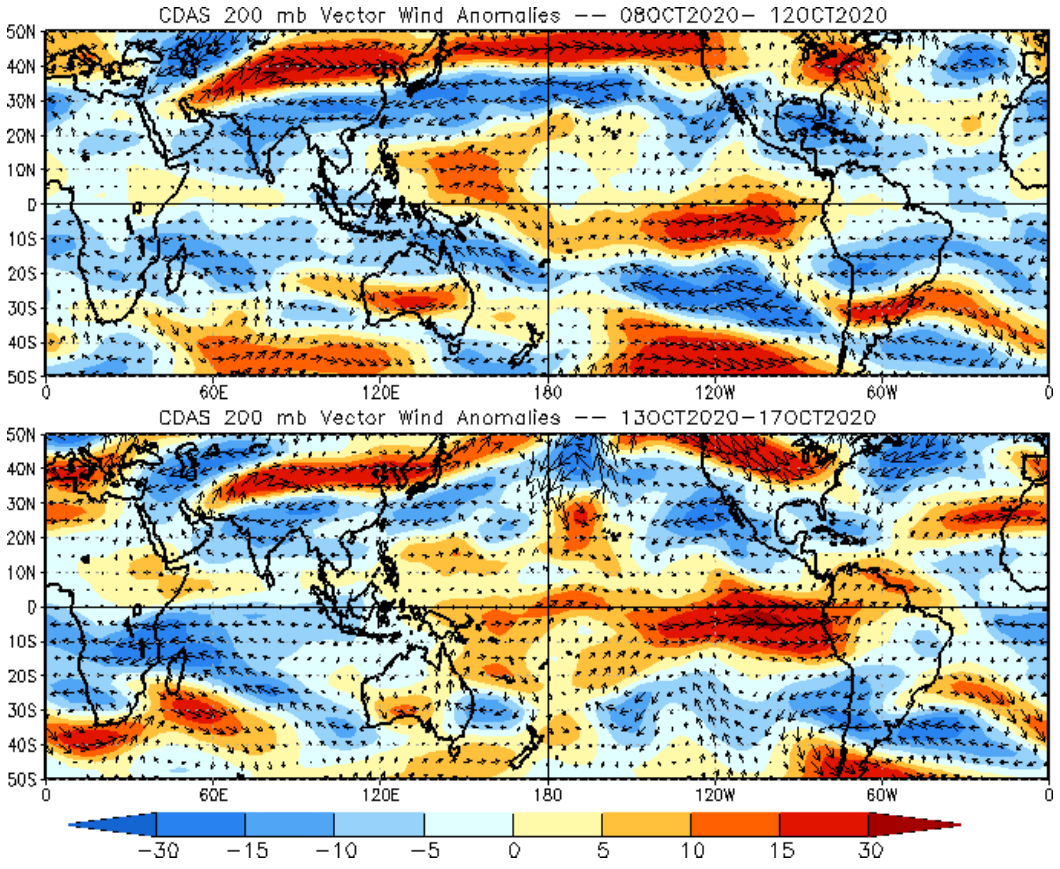


- Following a stationary pattern since mid-September, the MJO is showing signs of propagating eastward while amplifying during the last several days.
- A wave-1 pattern persists, as the envelope of anomalous upper-level divergence has recently expanded into the Western Hemisphere.
- Westward shifts in anomalous upper-level divergence (and related enhanced convection) over the Indian Ocean and West Pacific suggest destructive interference from equatorial Rossby waves/tropical cyclones

200-hPa Wind Anomalies

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

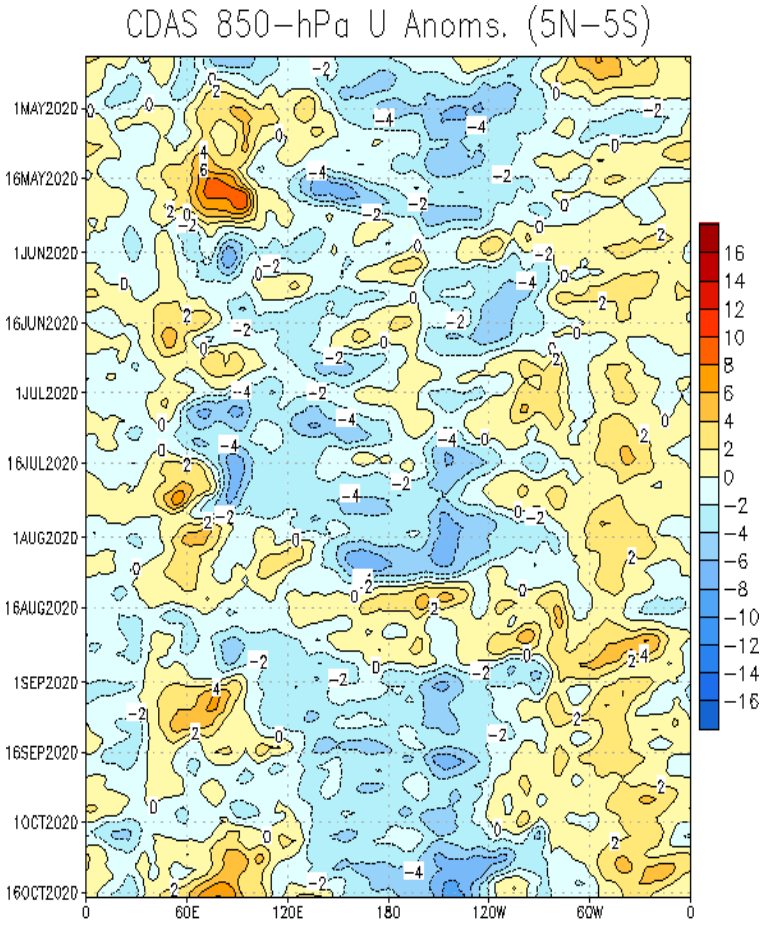


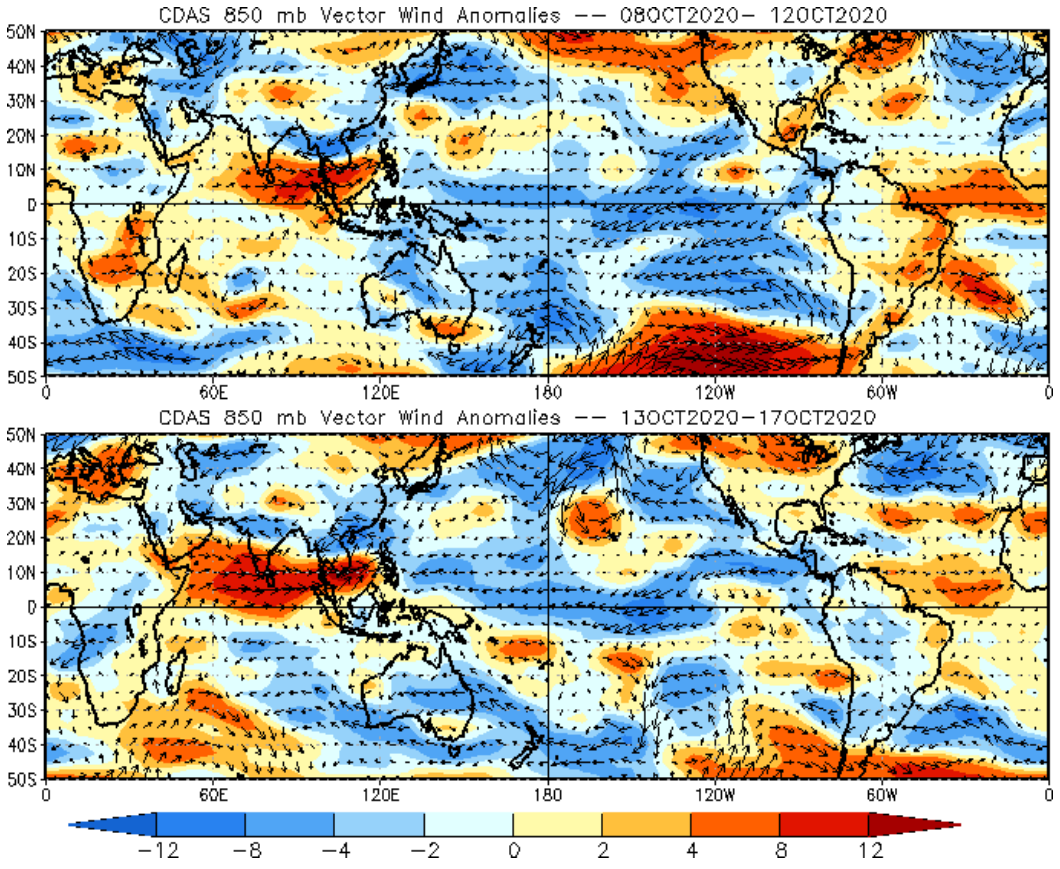


- Anomalous westerlies (easterlies) have strengthened across the eastern equatorial Pacific (Indian Ocean/ Maritime Continent).
- Stronger anticyclonic circulation aloft has been observed over the southwestern Indian Ocean.
- Wave-breaking is more evident over the Northern Hemisphere, helping to reinforce anomalous westerlies east of the Date Line along the equator.

850-hPa Wind Anomalies

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

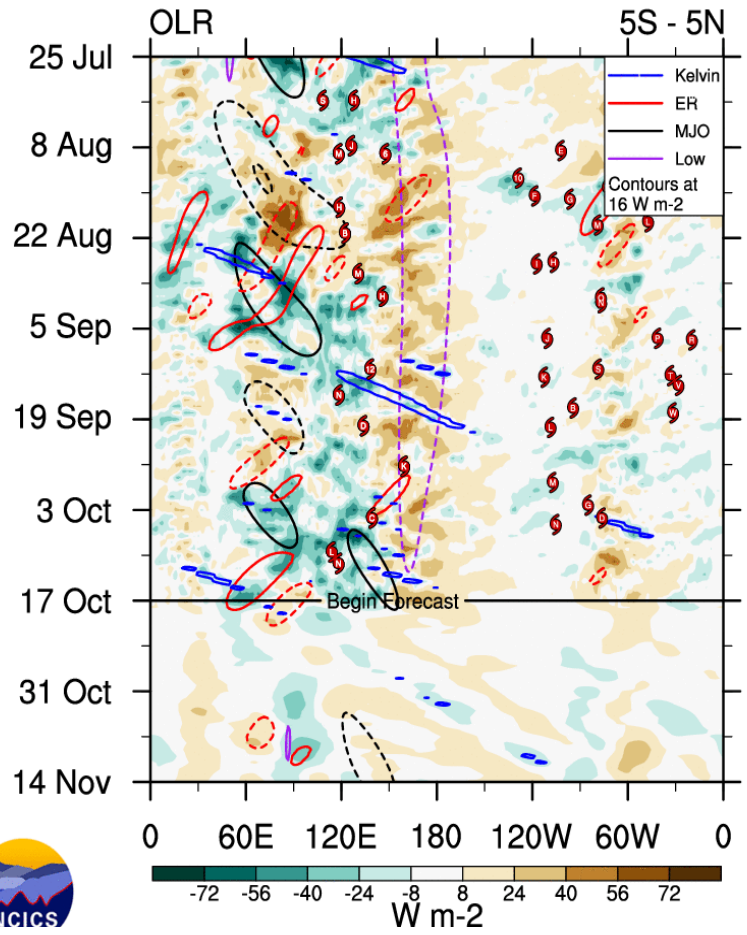


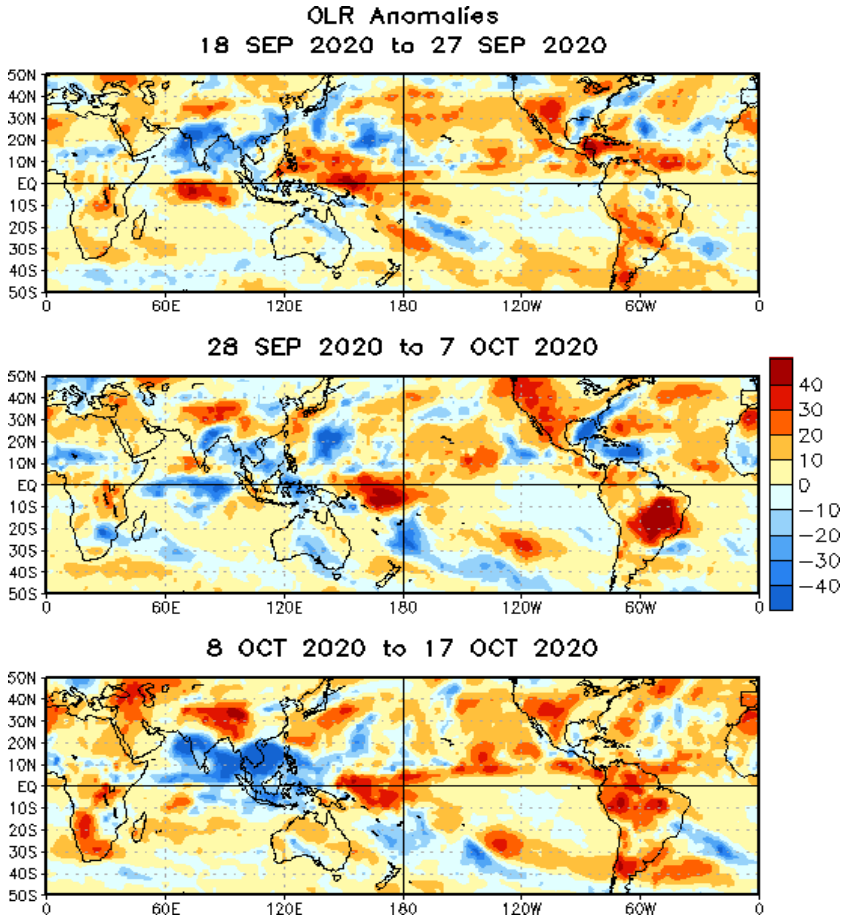


- Enhanced trades are apparent across the tropical Pacific in association with the active La Niña. However, anomalous westerlies have recently developed east of 120W along the equator.
- A considerably stronger band of anomalous westerlies is seen across the Northern Indian Ocean, with two cyclonic circulation centers tied to Tropical Storm Nangka and Rossby wave activity.

Outgoing Longwave Radiation (OLR) Anomalies

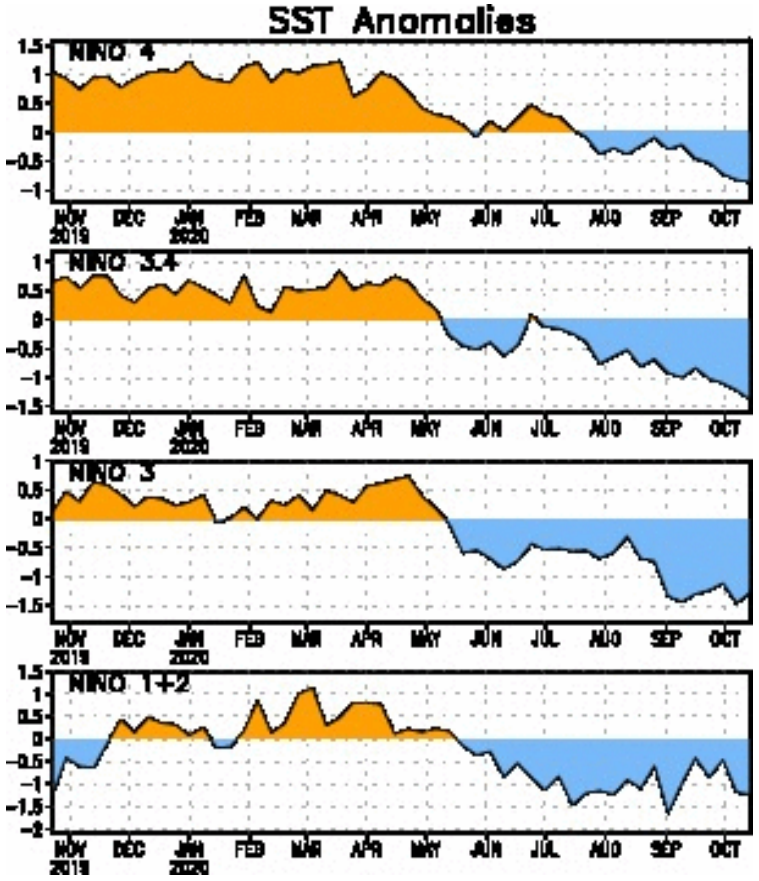
Blue shades: Anomalous convection (wetness). Red shades: Anomalous subsidence (dryness).

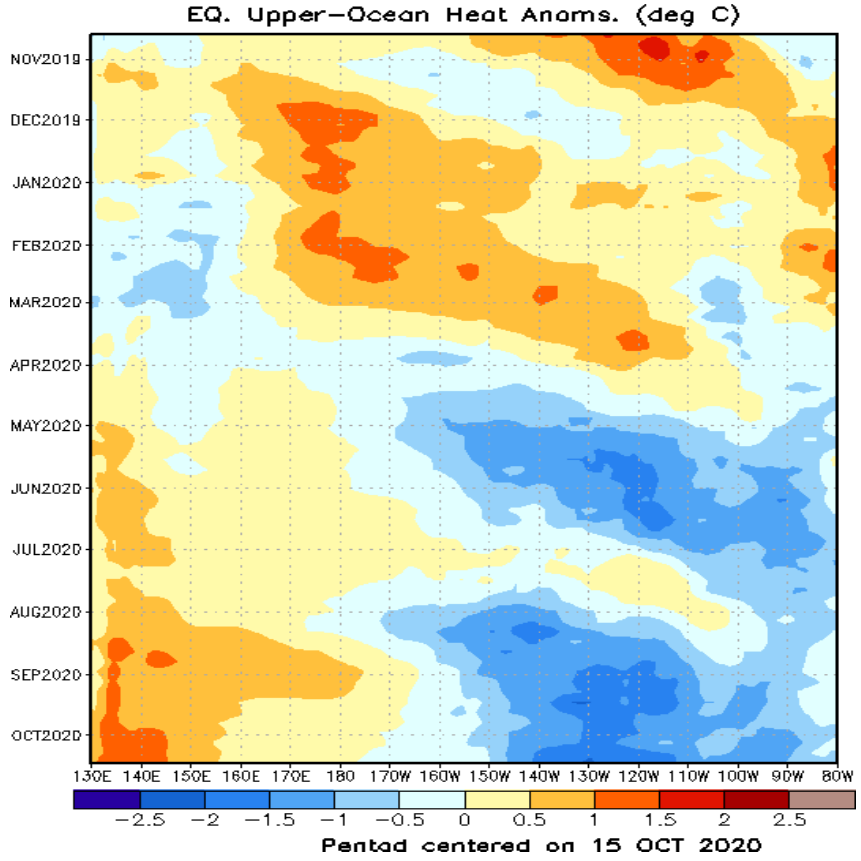




- The most prominent OLR features over the tropics are the dipole of suppressed (enhanced) convection west of the Date Line (over the Indian Ocean) in association with La Niña conditions.
- Enhanced convection has shifted into parts of the West Pacific, with a strong area of suppressed convection remaining firmly in place west of the Date line.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

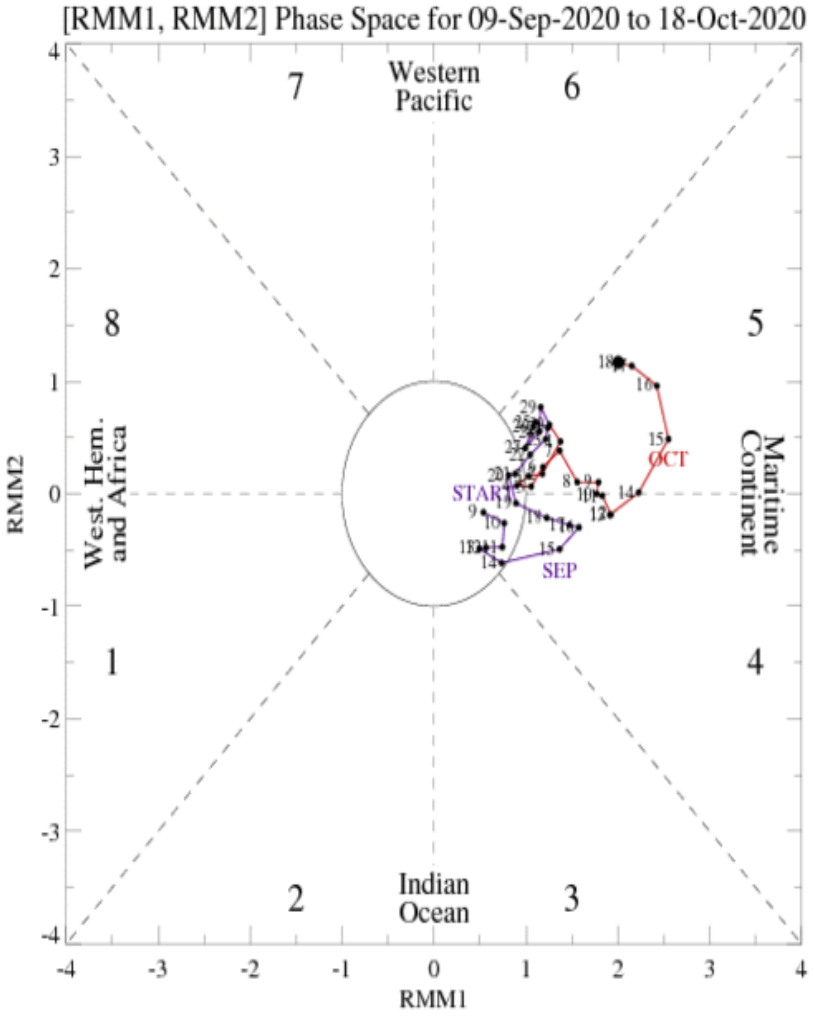




- Following destructive interference with the base state by a downwelling Kelvin wave, the subsequent upwelling phase has pushed the Pacific into La Niña conditions.
- Negative sea surface temperatures anomalies in all 4 Niño regions have continued to strengthen, with the greatest declines observed in the Niño 4 and 3.4 regions since September.

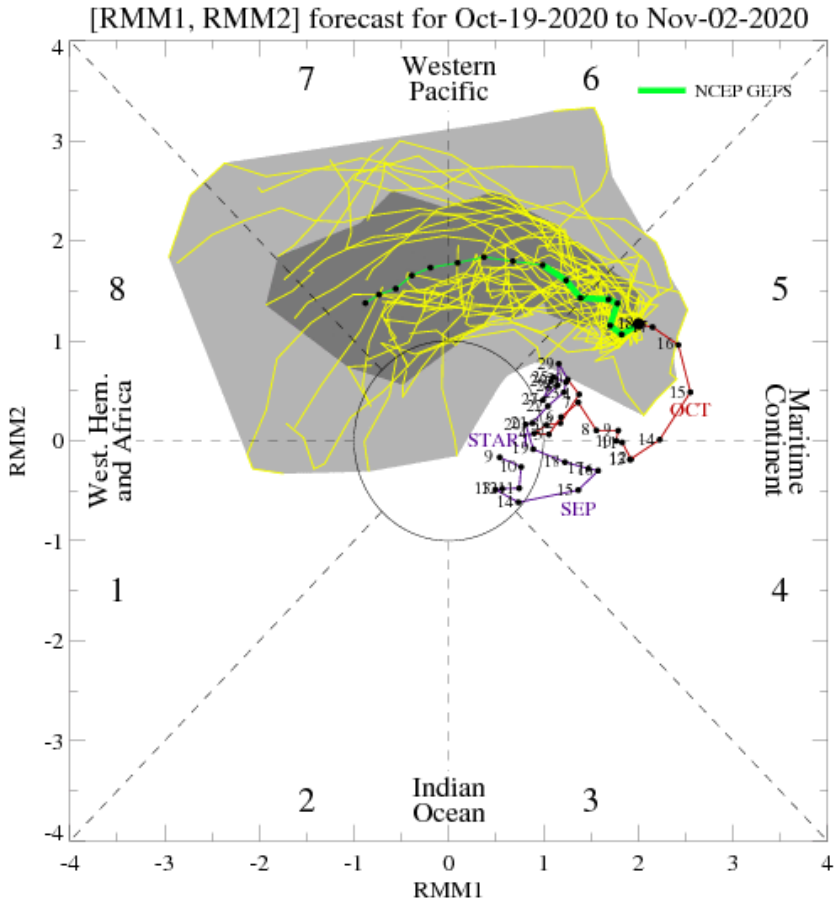
MJO Index: Recent Evolution

- The RMM index indicates the MJO is currently located in Phase 5, and has gained amplitude and continued to propagate eastward during the past week.

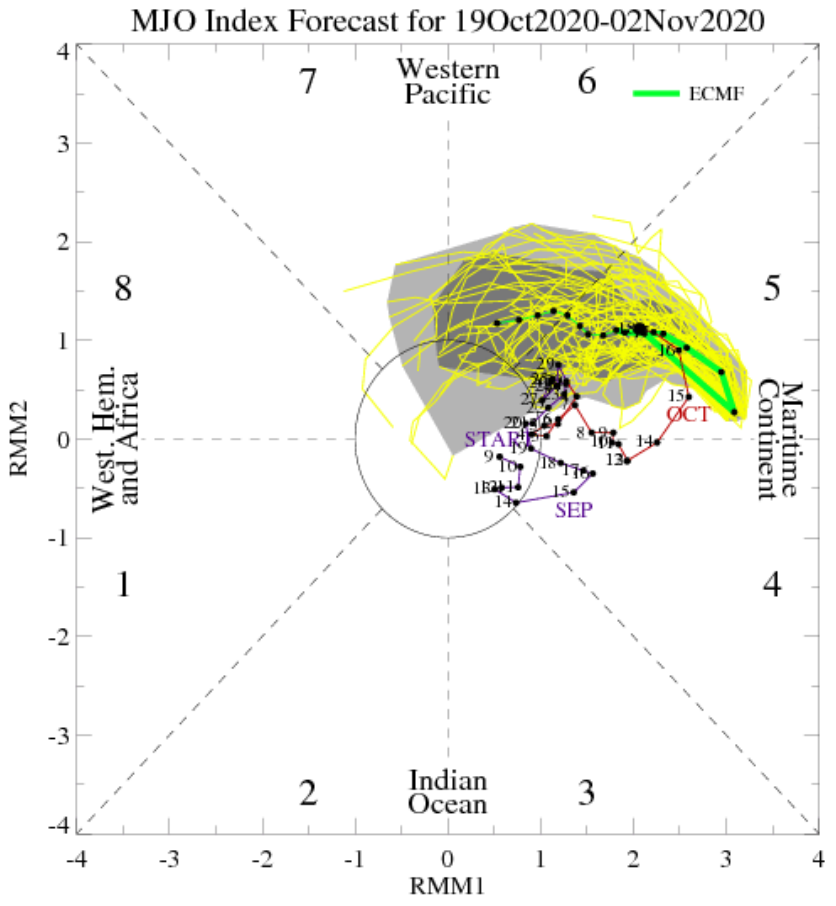


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

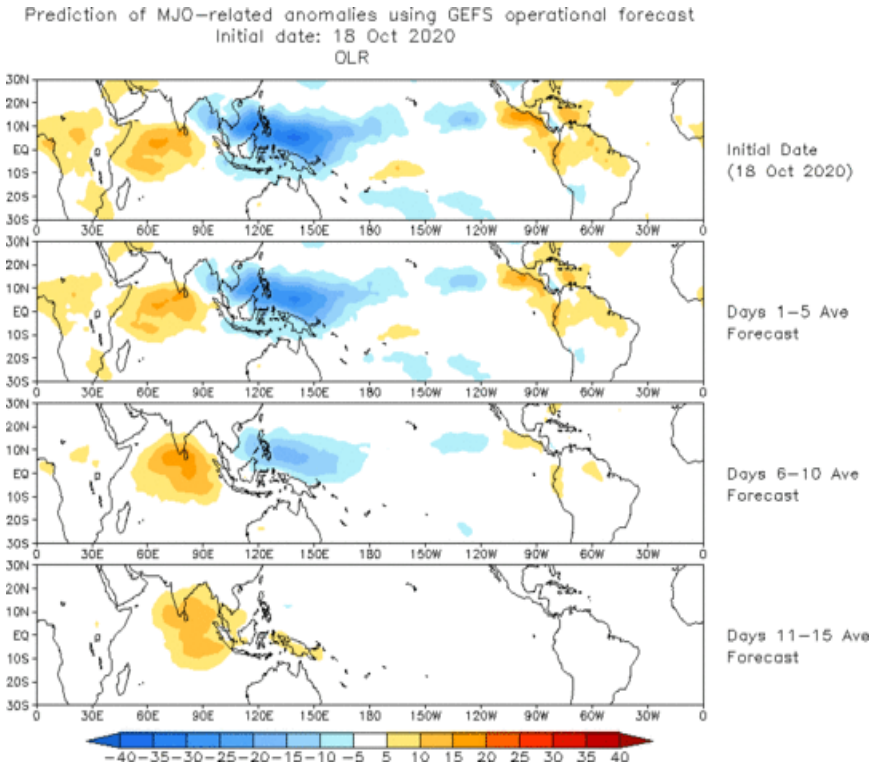


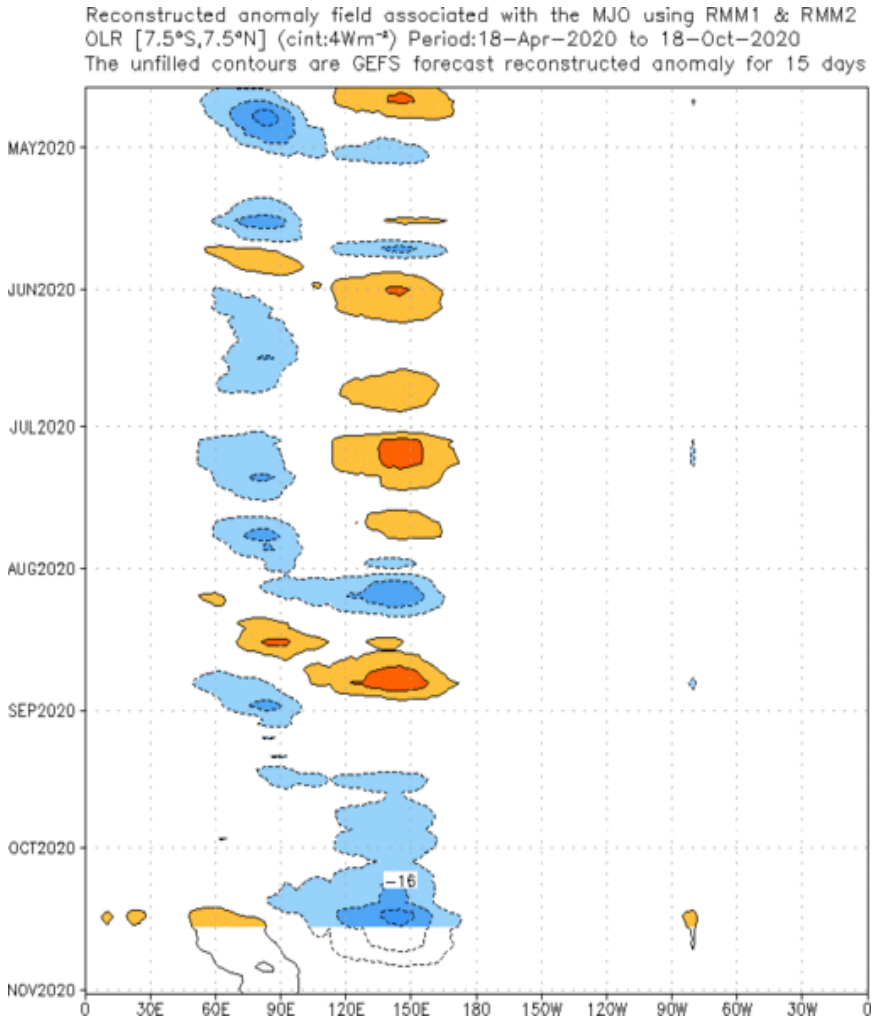
ECMWF Forecast

- Both the GEFS and ECMWF continue to propagate the signal eastward over the next two weeks
- Similar to the RMM projections last week, there is a large degree of spread seen in the GEFS with a faster progression of the signal compared to the ECMWF which depicts westward moving variability in the near term.

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.)

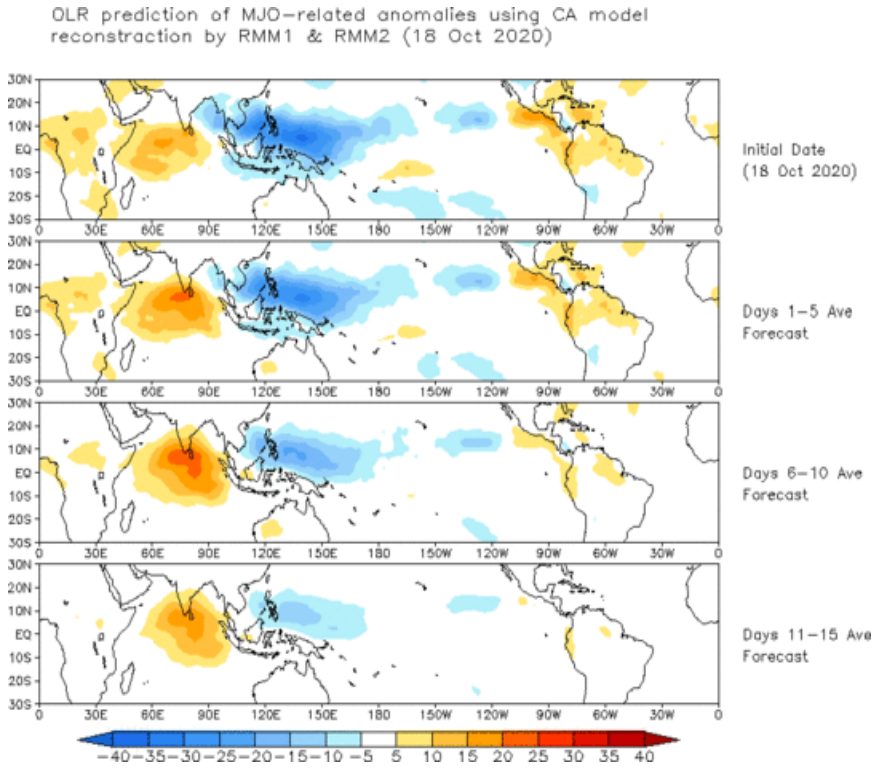


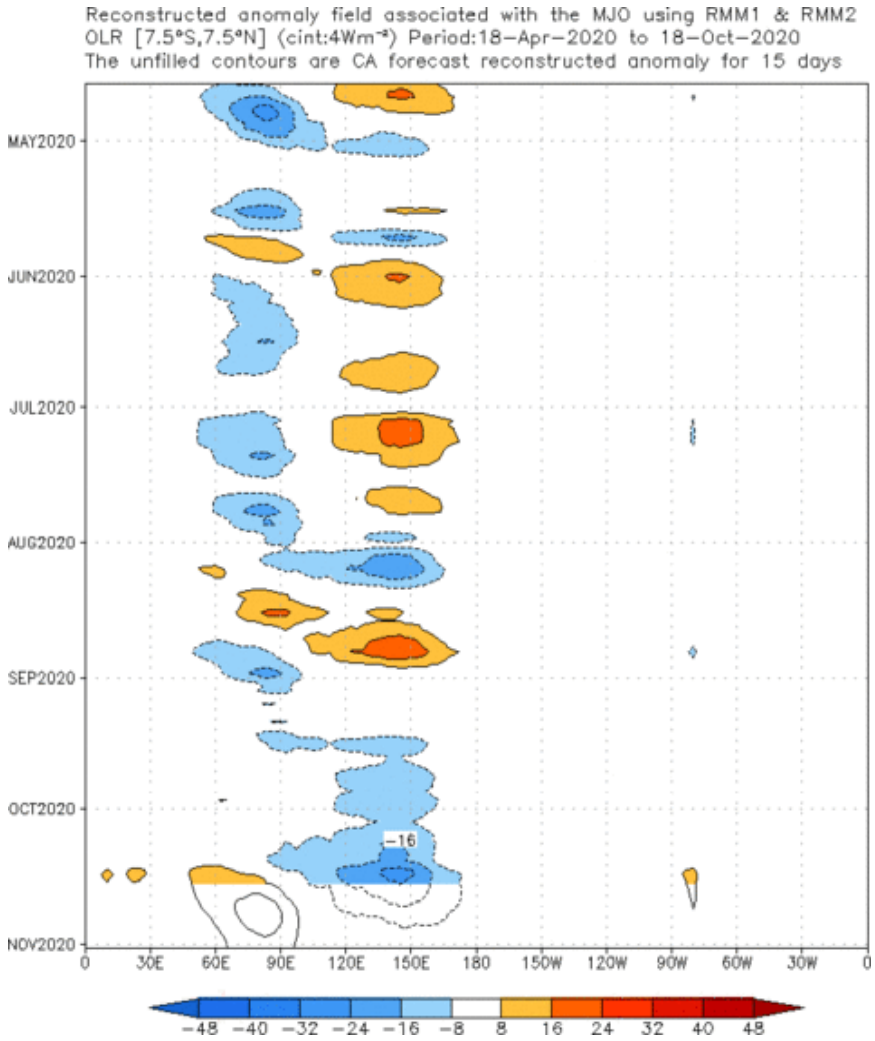


- The GEFS predicts a relatively stationary MJO event with enhanced convection across the Pacific that weakens by late October.

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.)

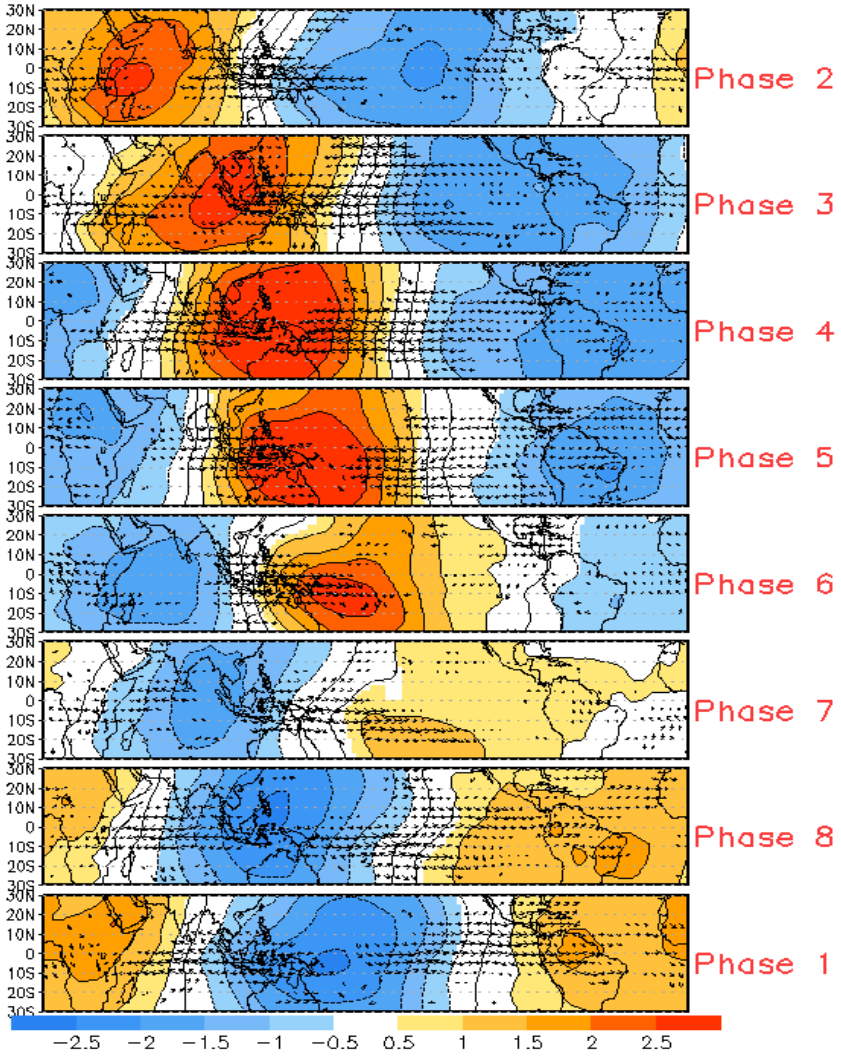




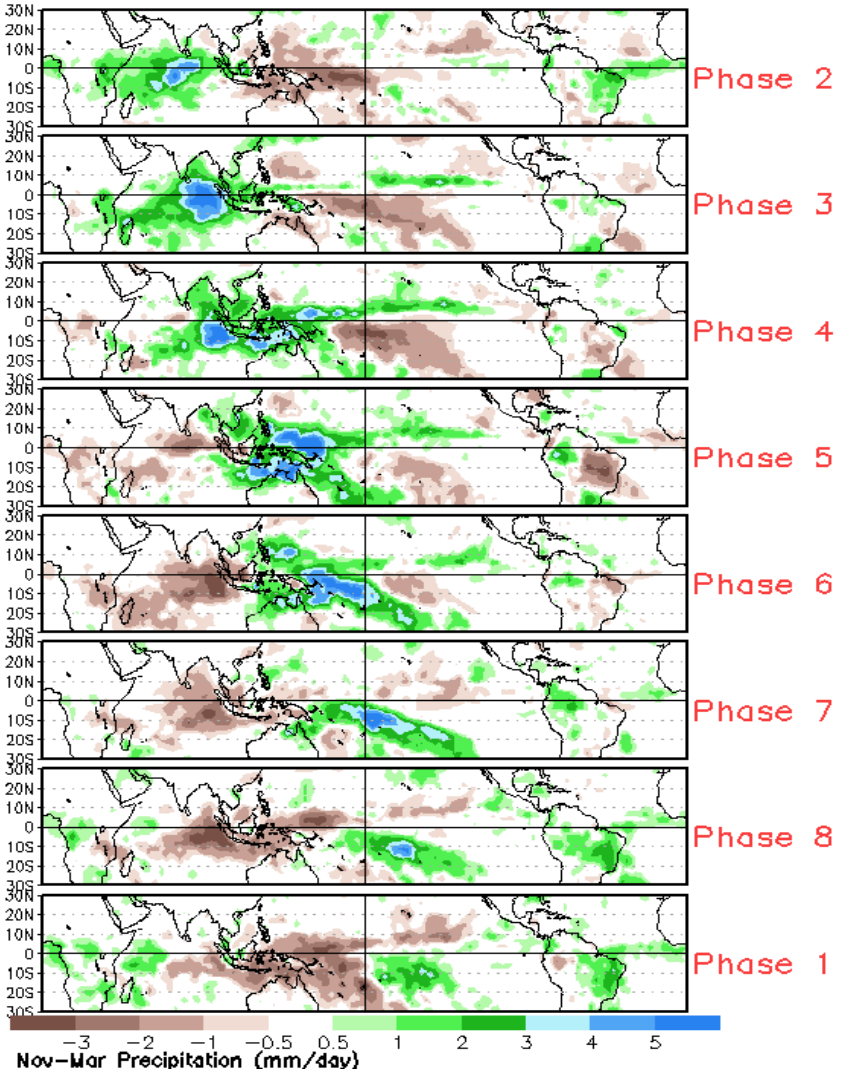
- The constructed analog model is also slow to propagate the MJO, but maintains a stronger convective signal compared to the GEFS.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



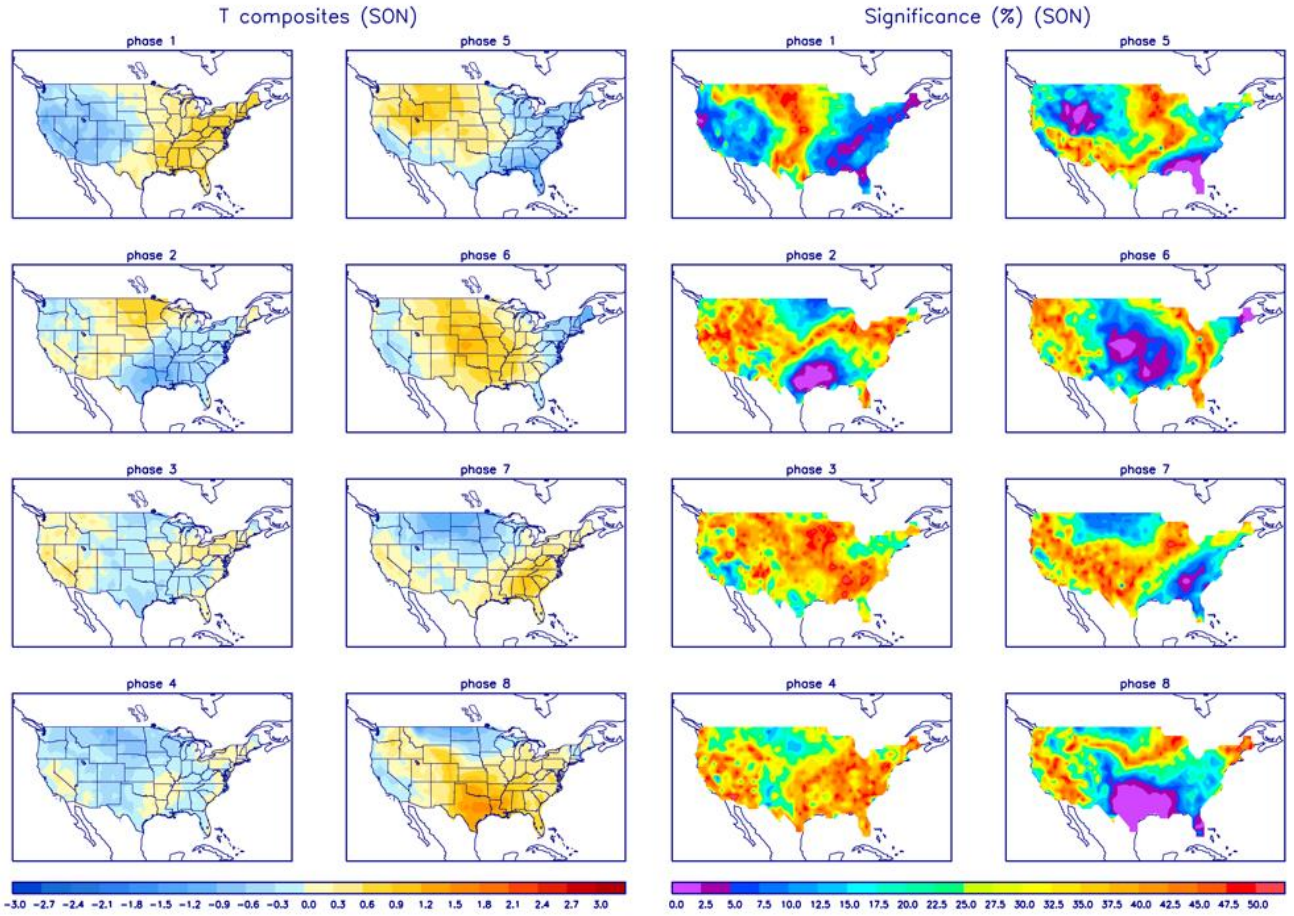
Precipitation Anomalies



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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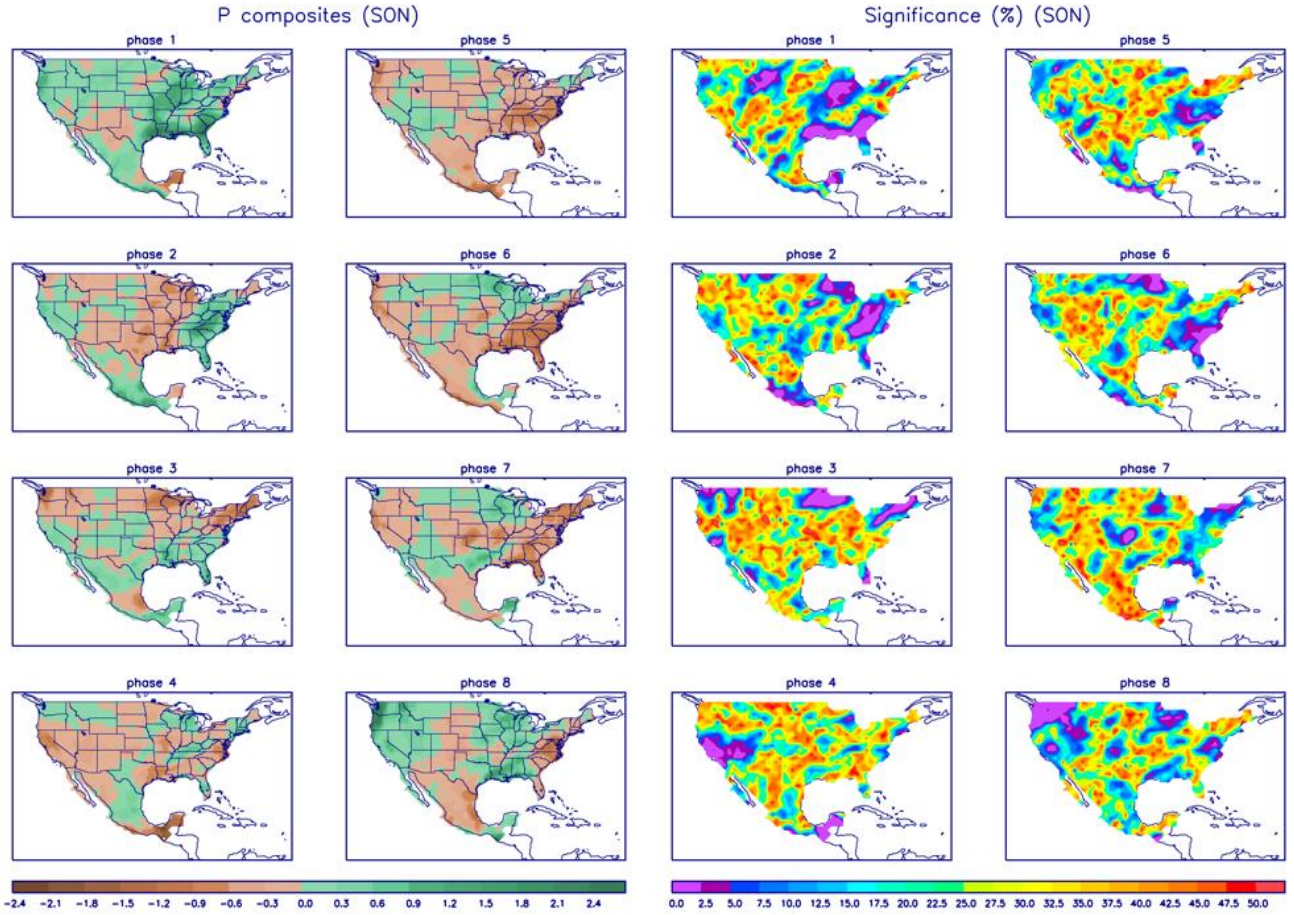

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