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

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

Overview

- The MJO has weakened and slowed down since late September, with its enhanced convective phase centered over the Maritime Continent.

- Model guidance generally shows the MJO strengthening and slowly pushing to the West Pacific by late October, although some signs of the signal pushing more rapidly to over the Western Hemisphere exist.

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

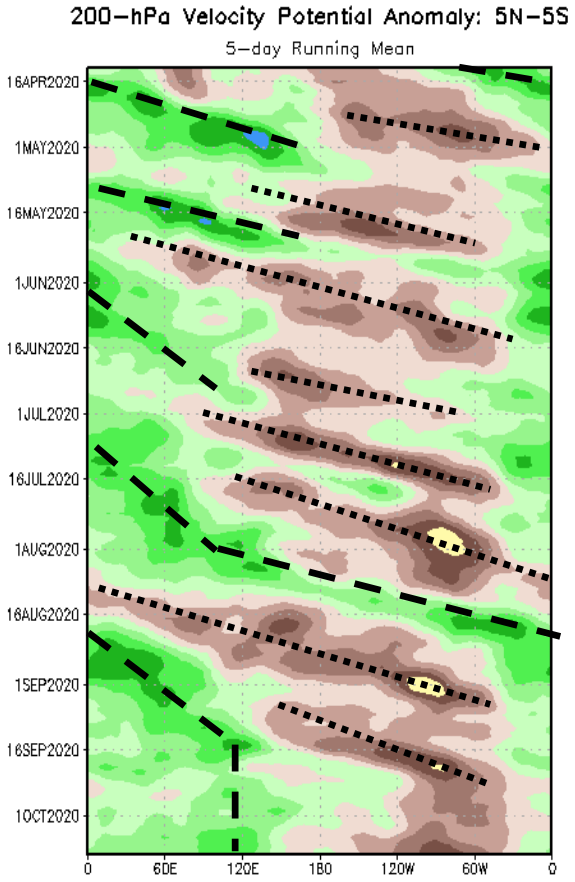
- Tropical cyclone activity may pick up over the East Pacific and western Caribbean during Week-2 if the MJO does slide eastward more quickly in line with some of the ensemble members. Should the signal linger over the Maritime Continent, continued tropical cyclone activity over the West Pacific would be more likely.

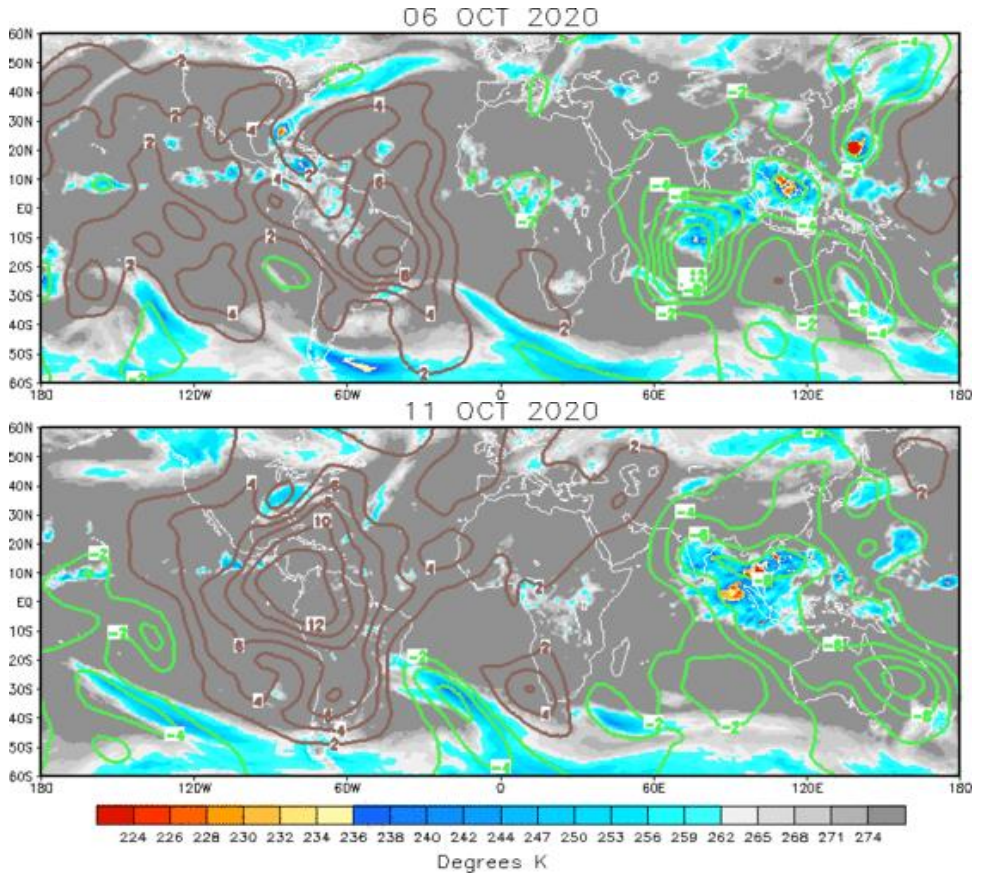
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

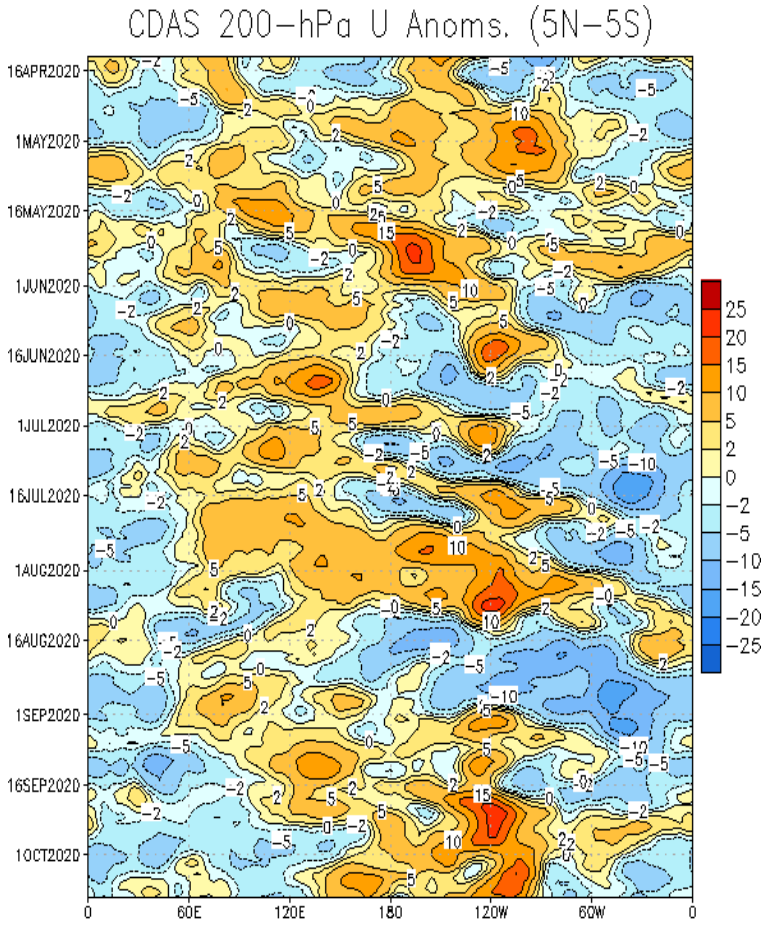


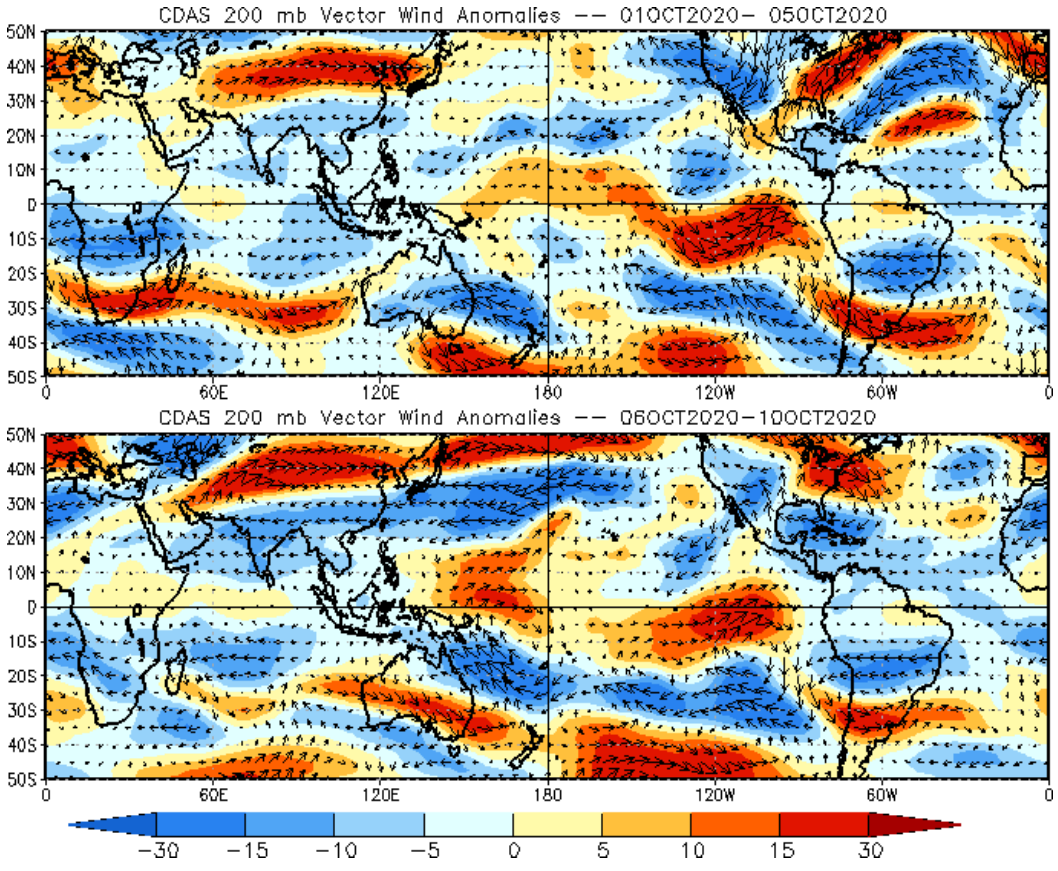


- Robust MJO activity weakened over the Indian Ocean from mid-August to mid-September and became stationary over the Maritime Continent shortly thereafter.
- Westward shifts in anomalous upper-level divergence (and related enhanced convection) over the Indian Ocean and West Pacific suggest destructive interference from equatorial Rossby waves/tropical cyclones.
- While the wave-1 pattern has remained prominent, its lack of propagation points to the importance of the low frequency state rather than intraseasonal variability.

200-hPa Wind Anomalies

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

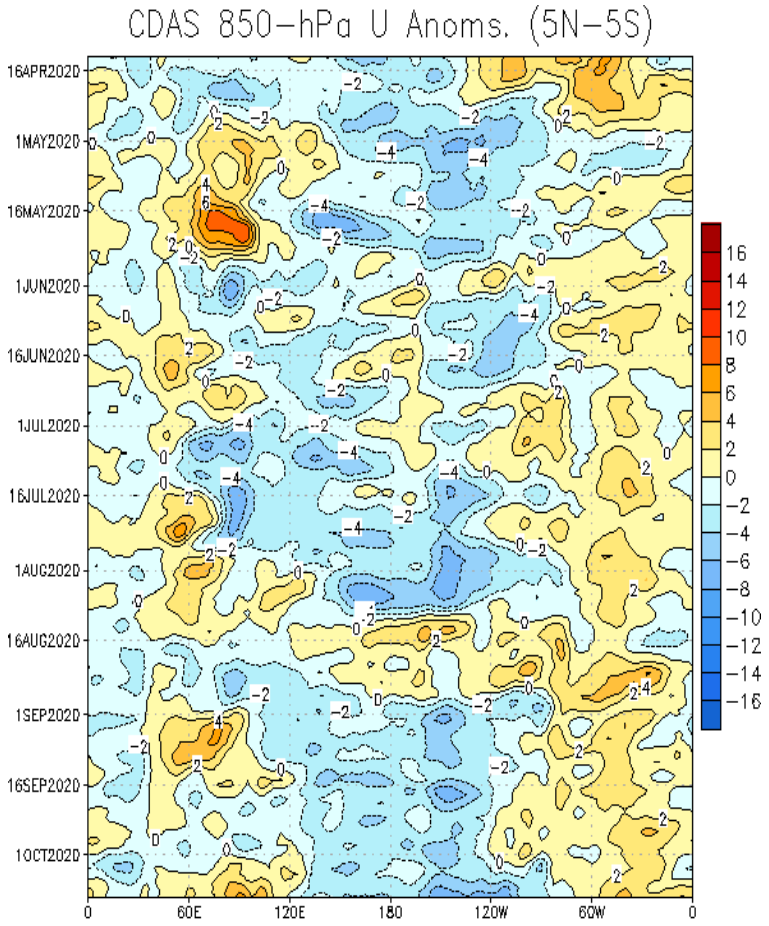


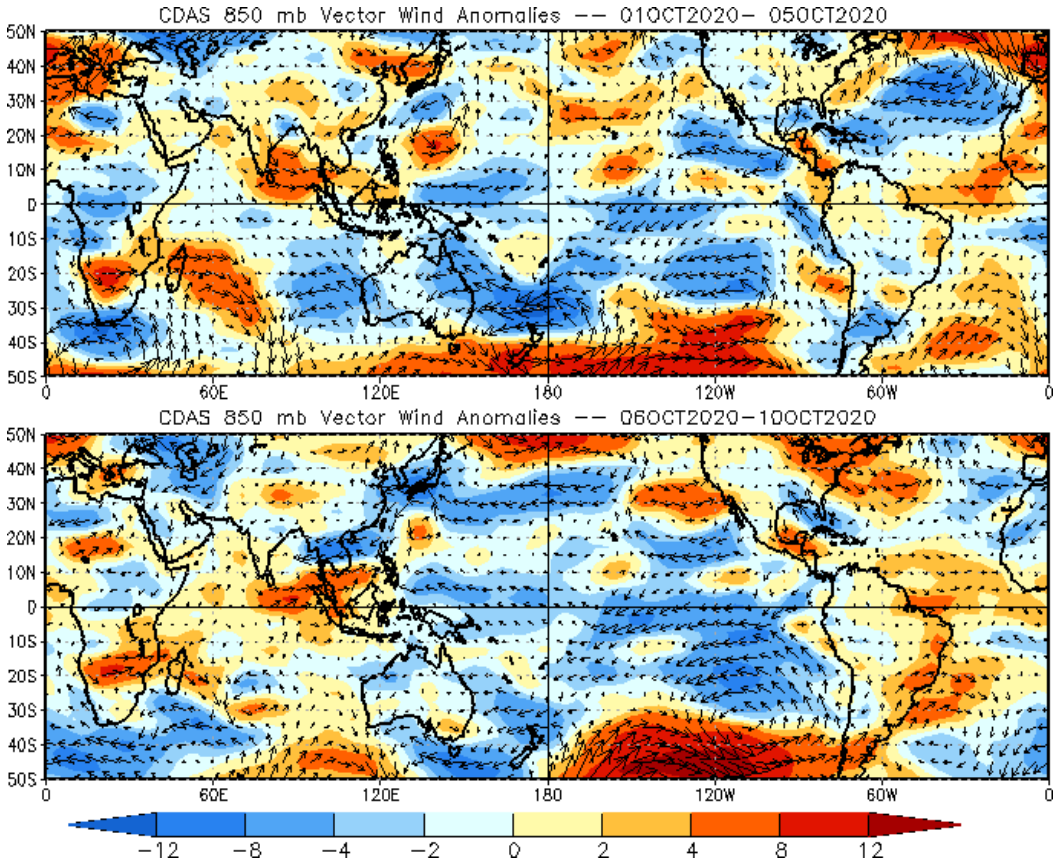


- Anomalous westerlies are pronounced over the West Pacific, tied to anomalous cyclones off the equator in the northern and southern hemispheres.
- A robust, zonally oriented mid-latitude jet extends across Eurasia through the North Pacific, in line with the transition toward boreal winter.

850-hPa Wind Anomalies

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

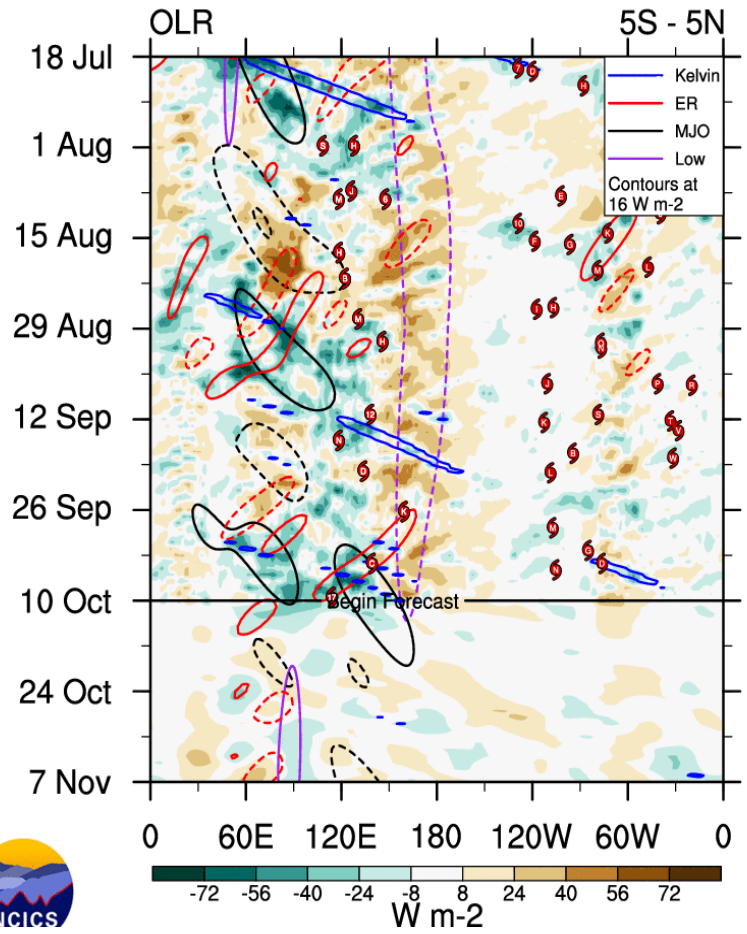


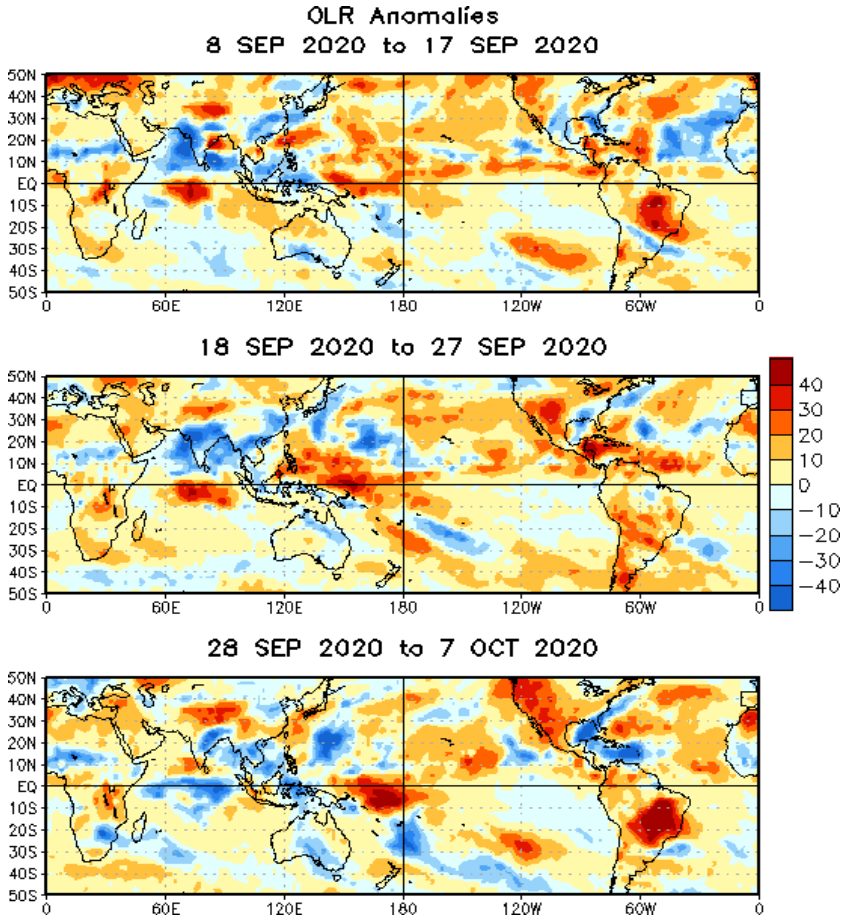


- Enhanced trades are apparent across the tropical Pacific, in association with the active La Niña.
- Cyclonic circulation across the South China Sea is tied to equatorial Rossby wave activity and Tropical Storm Nangka.
- A low-level cyclonic circulation over the Gulf of Mexico is likely associated with Hurricane Delta.

Outgoing Longwave Radiation (OLR) Anomalies

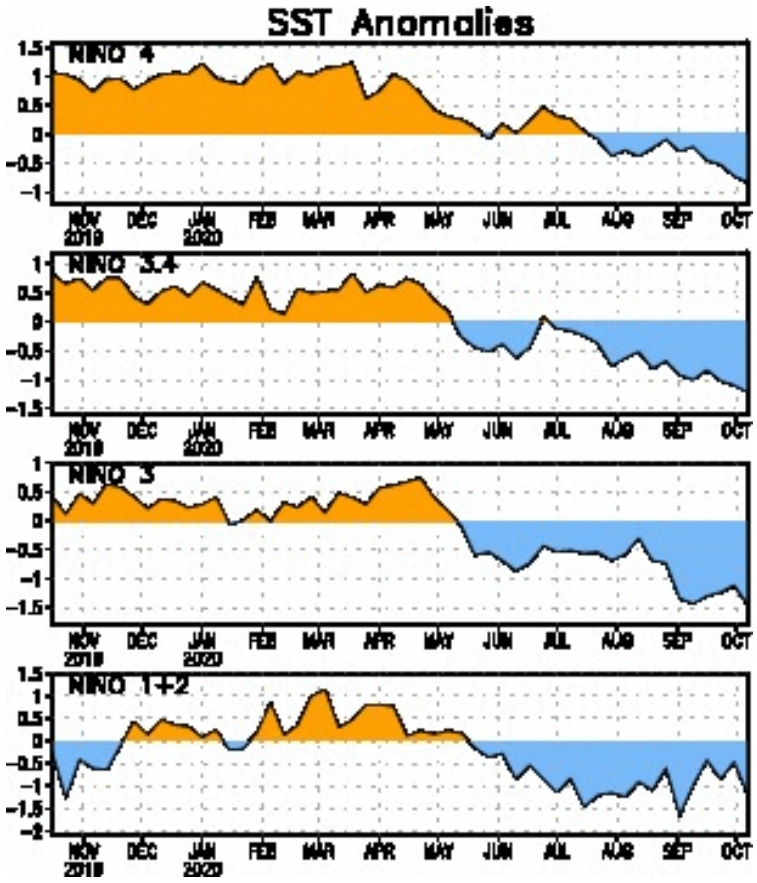
Blue shades: Anomalous convection (wetness). Red shades: Anomalous subsidence (dryness).

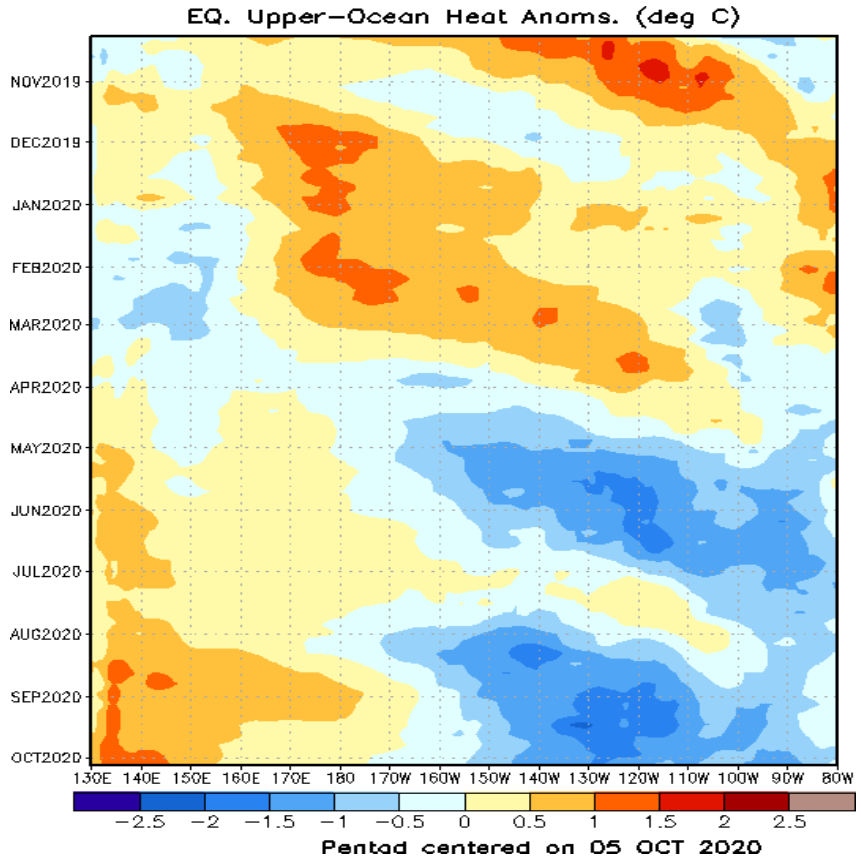




- The most prominent OLR features over the tropics are the dipole of suppressed (enhanced) convection west of the Date Line (over the Indian Ocean) in association with La Niña conditions.
- Some limited propagation of enhanced convection over the Maritime Continent is apparent in recent analyses, although it appears likely to destructively interfere with the low frequency state in the near-term.
- Tropical cyclone activity is also apparent over the South China Sea, West Pacific, and western Caribbean in recent observations.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

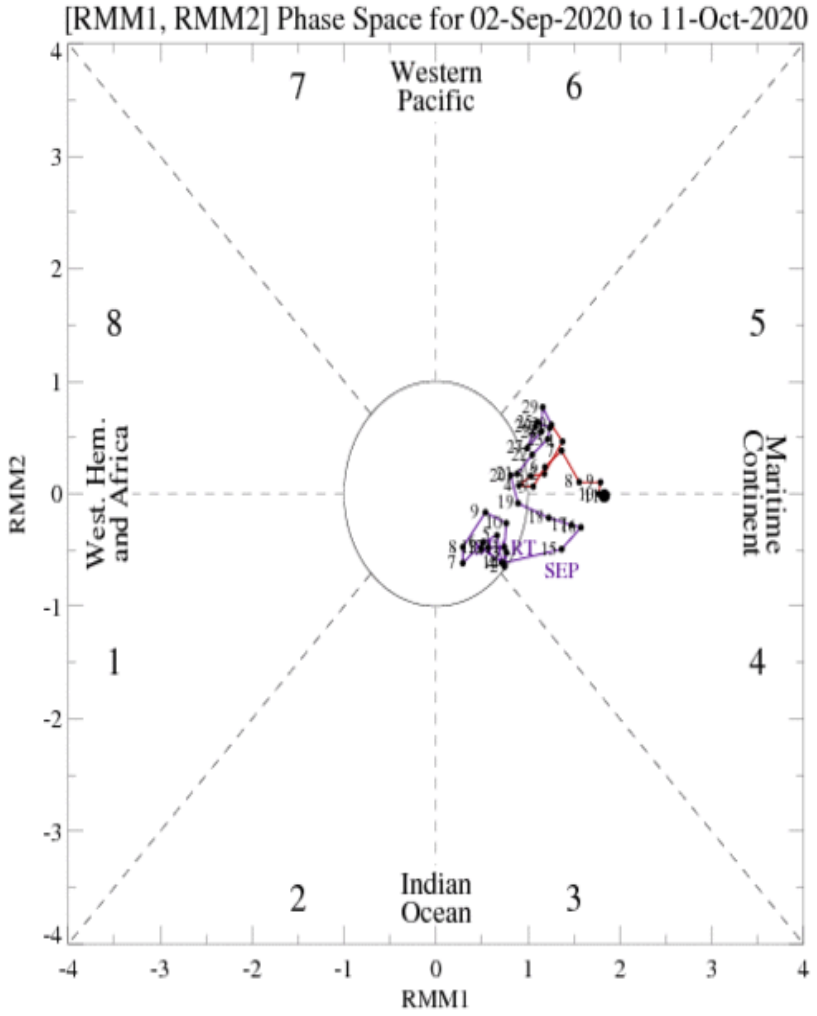




- Following destructive interference with the base state by a downwelling Kelvin wave, the subsequent upwelling phase has pushed the Pacific into La Niña conditions.
- Sea surface temperatures anomalies in the Niño 3.4 region have continued their downward trend since late June.
- A second downwelling Kelvin wave is evident east of the Date Line.

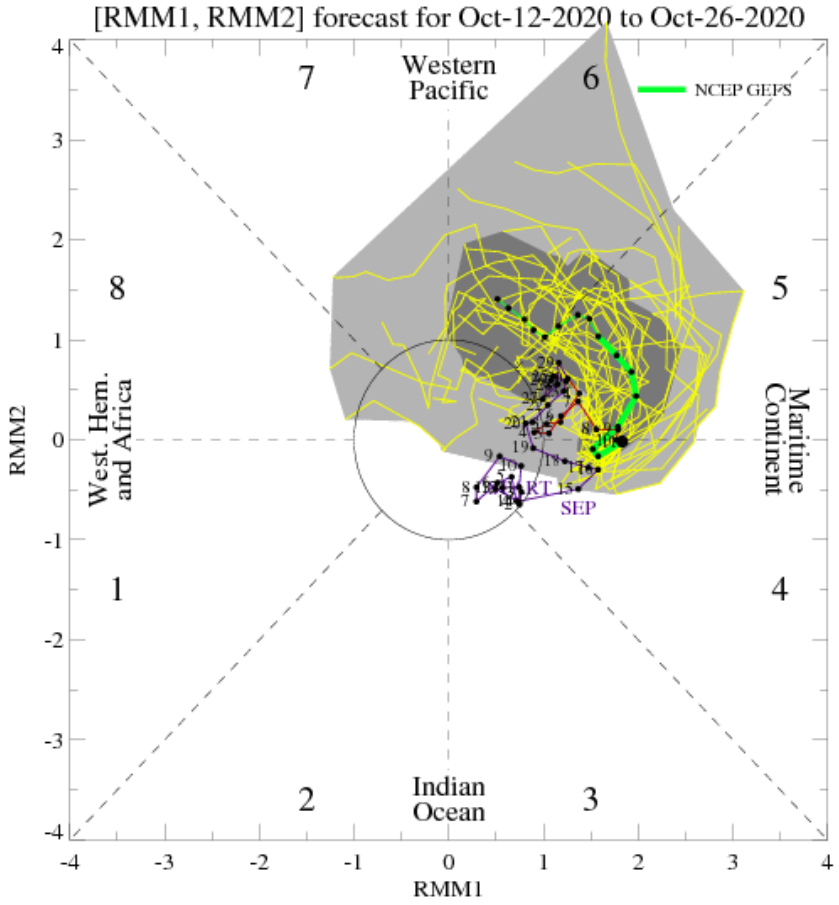
MJO Index: Recent Evolution

- The RMM index is just outside of the unit circle in Phase 5.

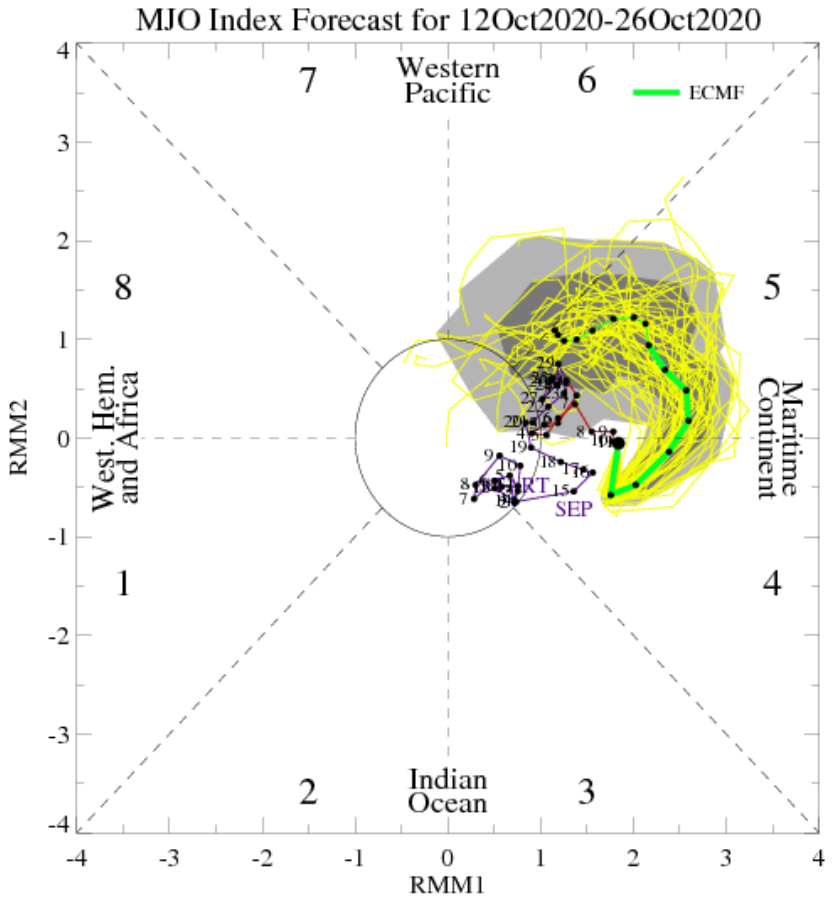


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

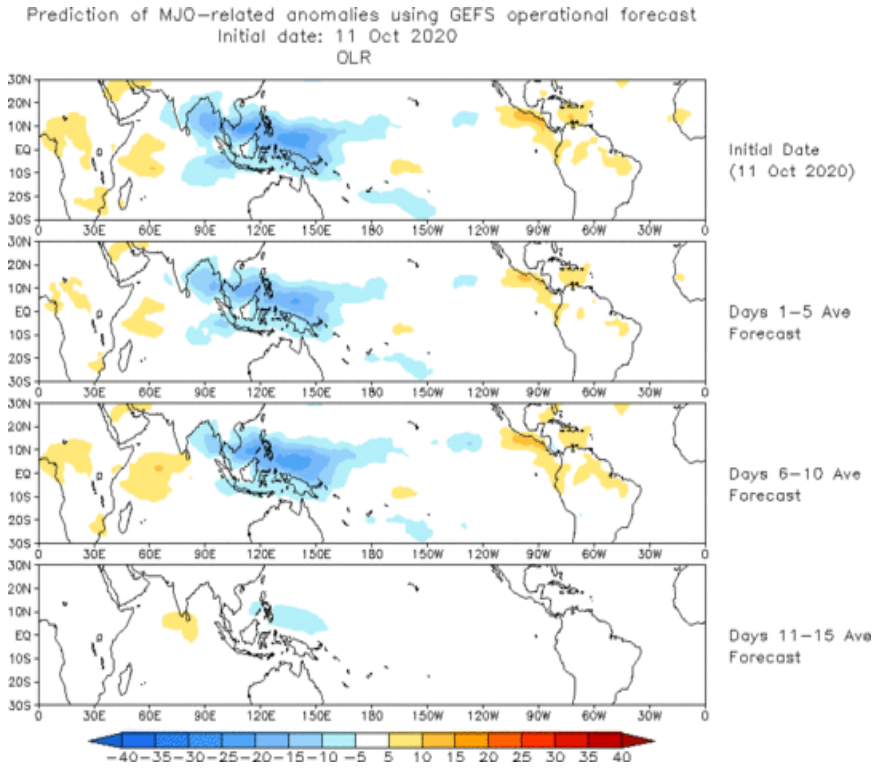


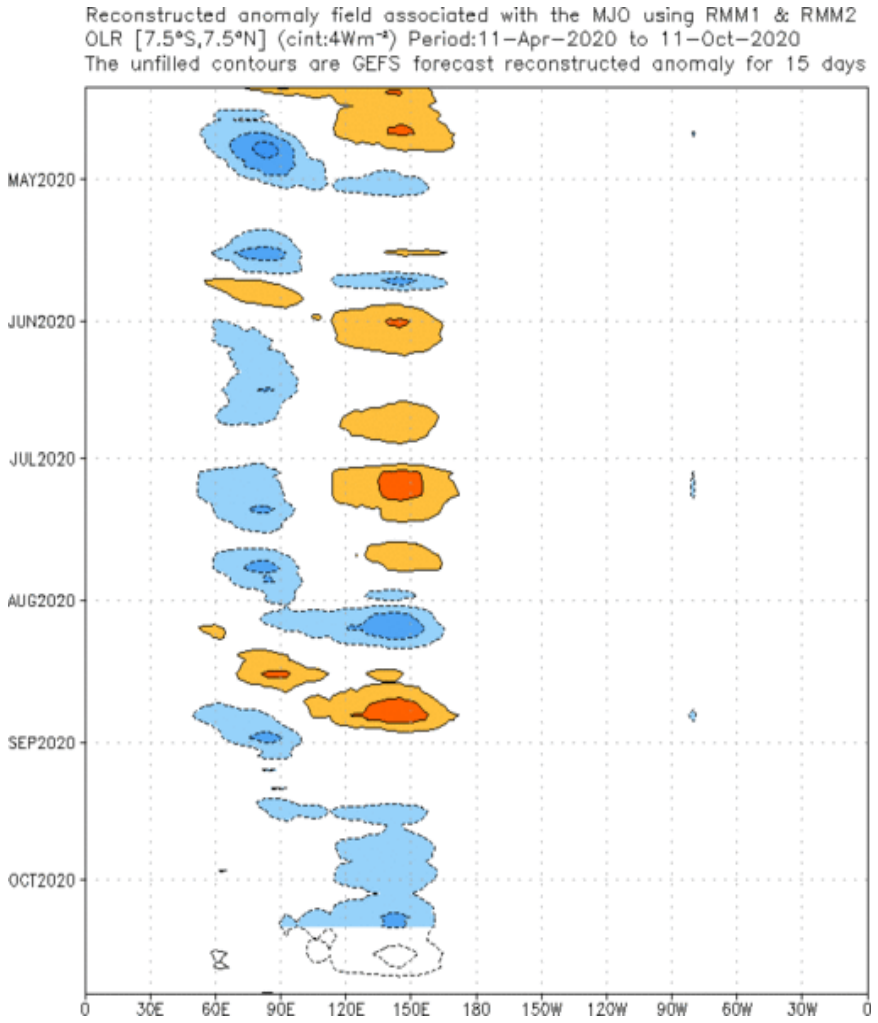
ECMWF Forecast

- Both the GEFS and ECMWF strengthen the MJO signal over the next two weeks with slow eastward propagation into the West Pacific during that time.
- Some members push the signal across to Phases 8/1 in both models, with this likely tied to the 200-hPa velocity potential field component of the RMM index.

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.)

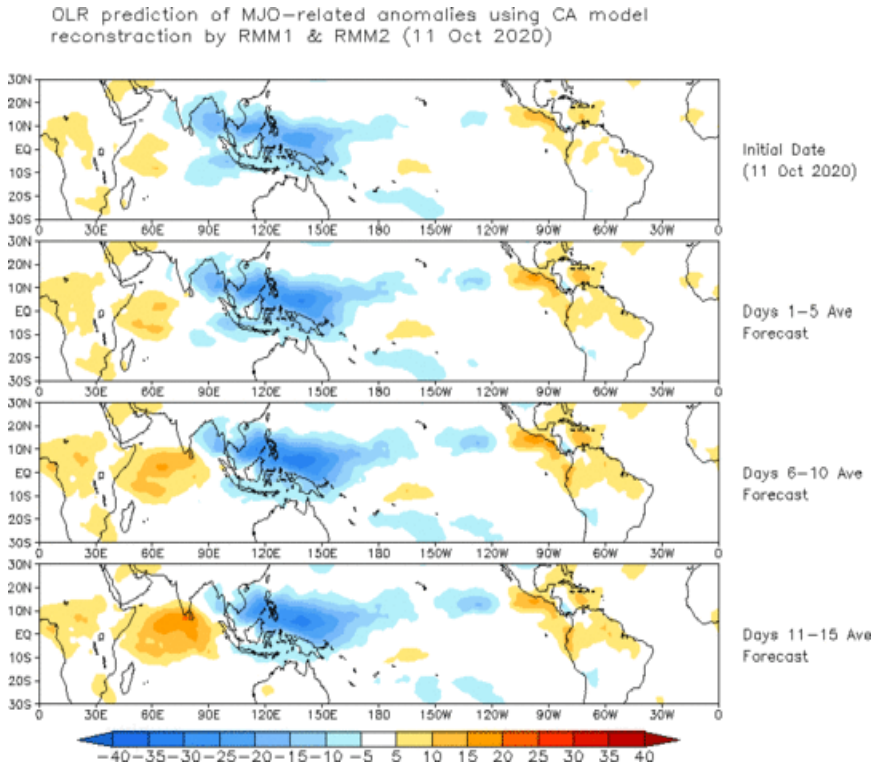


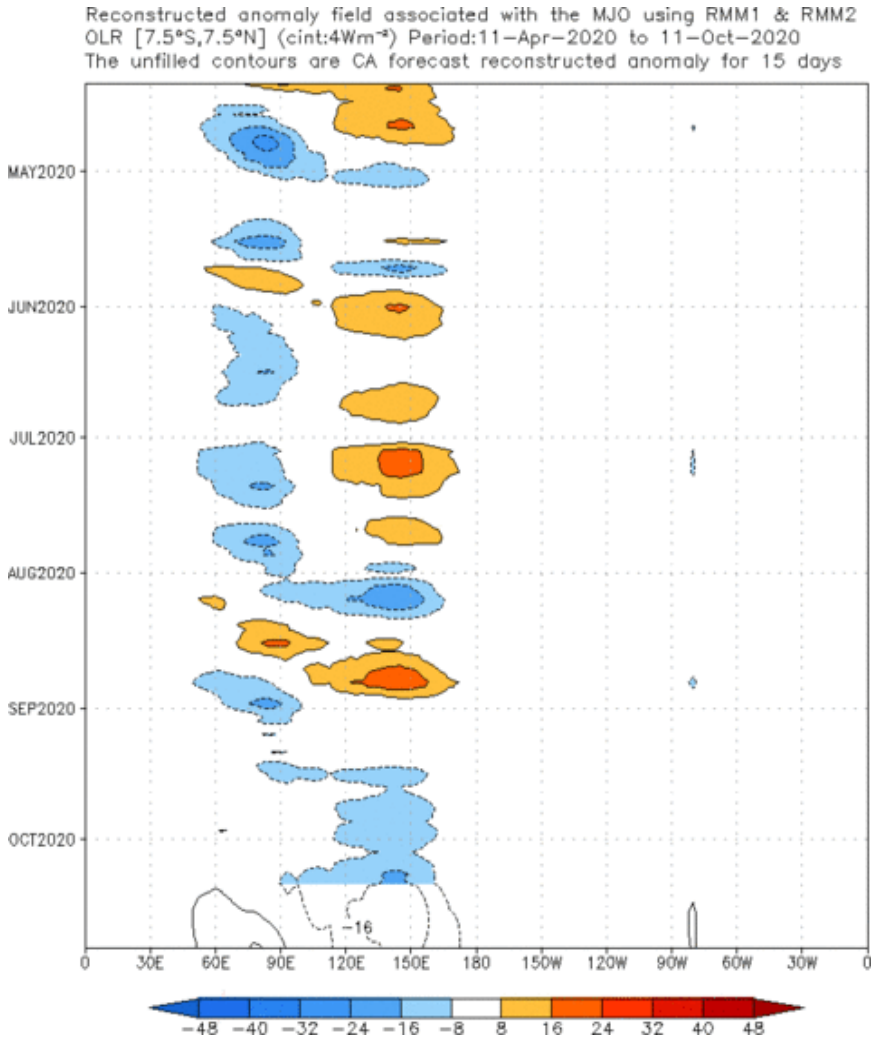


- The GEFS predicts a relatively stationary MJO event that generally weakens in place through late October.

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.)

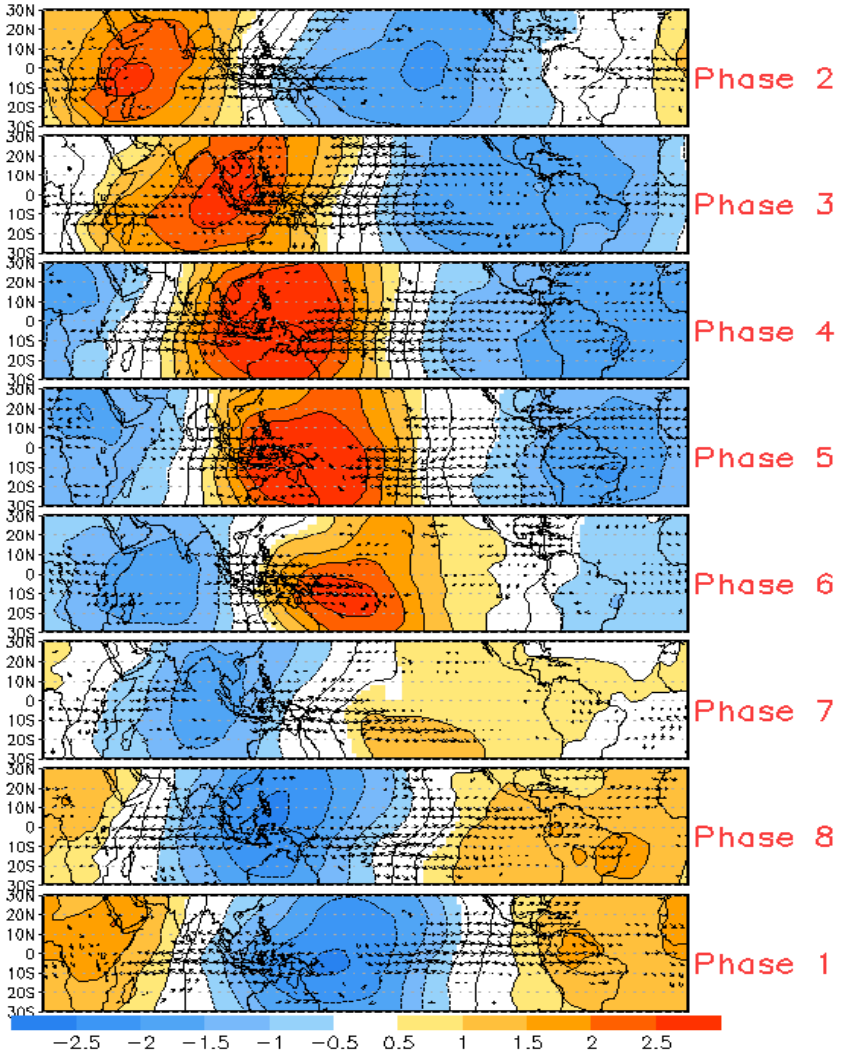




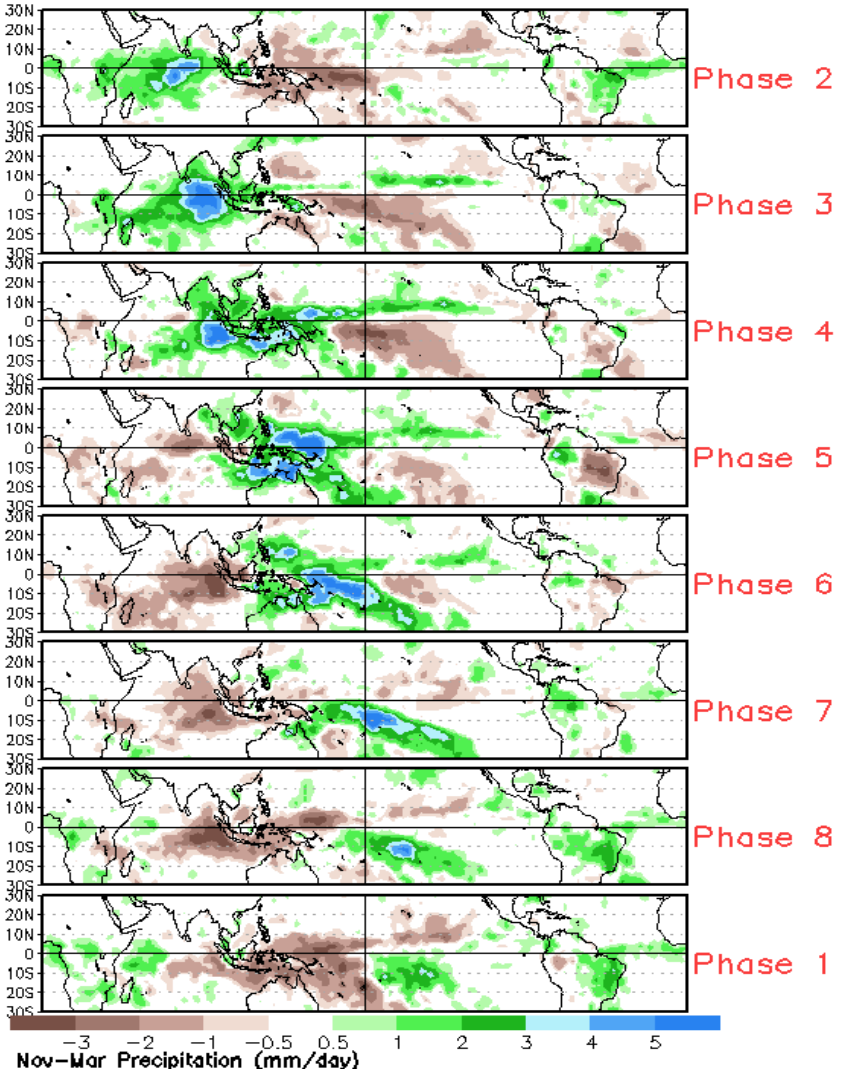
- The constructed analog model is also slow to propagate the MJO, but shows an event that strengthens with time.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



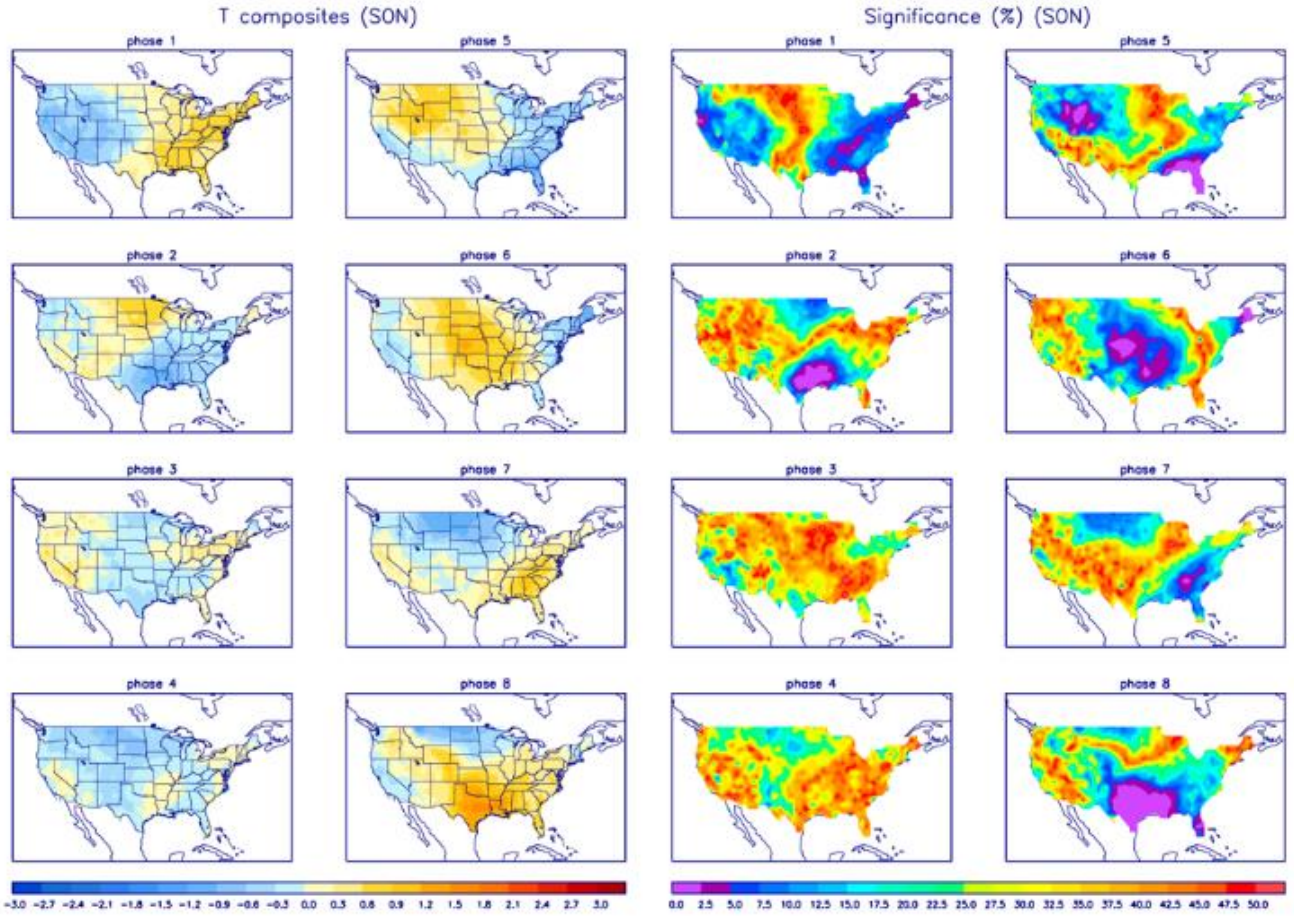
Precipitation Anomalies



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.

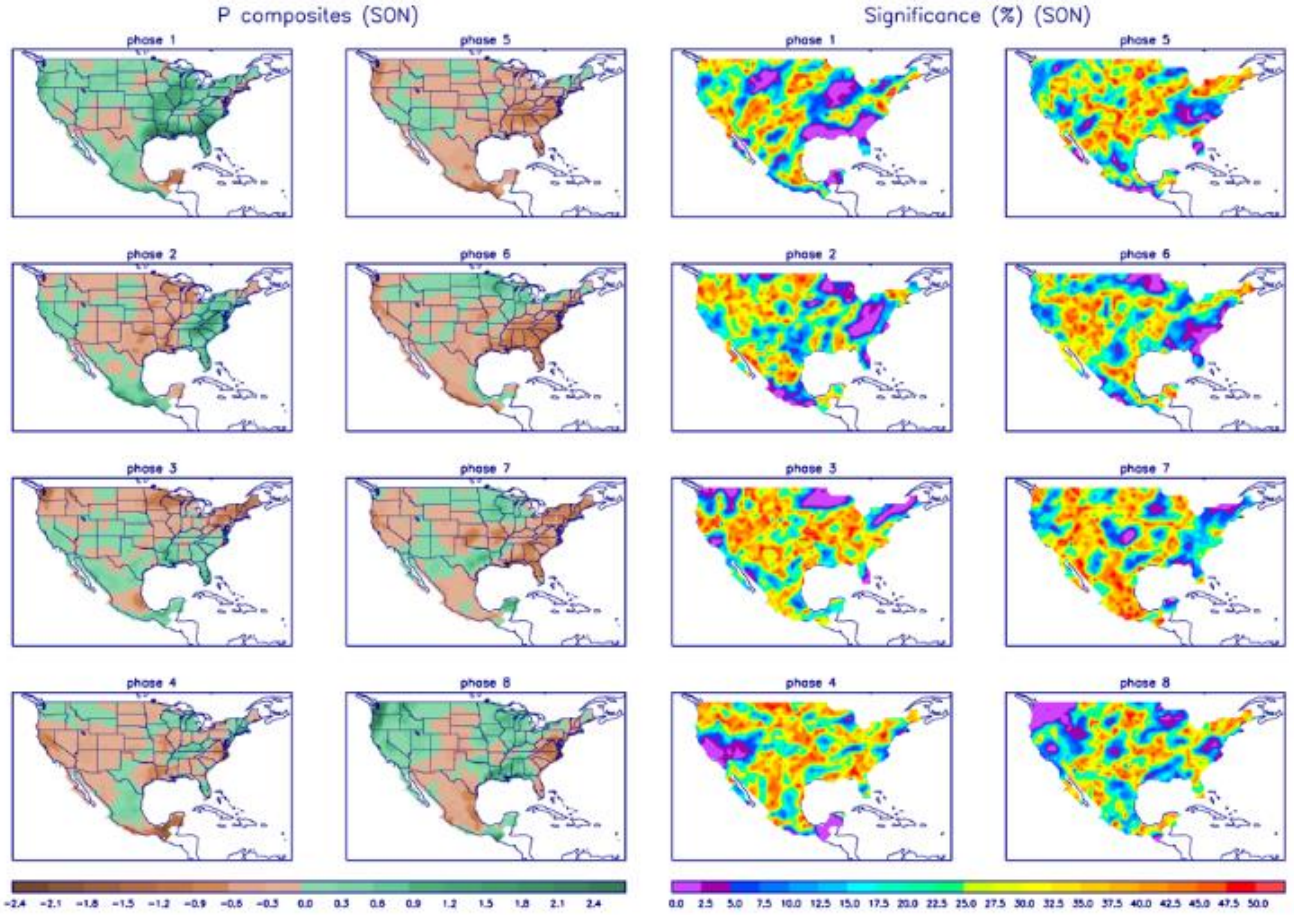


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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.



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