

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



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

Overview

- A robust Wave-1 asymmetry characteristic of the MJO remains prominent in the global tropical wind field; however, there has been little eastward propagation of this signal over the past several days.
- Rossby wave activity over the West Pacific, and increasing destructive interference with the La Niña base state may be playing a role in the slower evolution of the signal.
- Despite the recent slowdown of the intraseasonal signal, dynamical models continue to favor robust propagation of the MJO across the Pacific over the next two weeks. The GEFS brings the index to the Western Hemisphere by Week-2.
- Due to the ongoing destructive interference, confidence in robust MJO activity over the next two weeks is low; however, should the signal reach the Western Hemisphere, it could help generate late season tropical cyclones across the East Pacific or Atlantic basins.

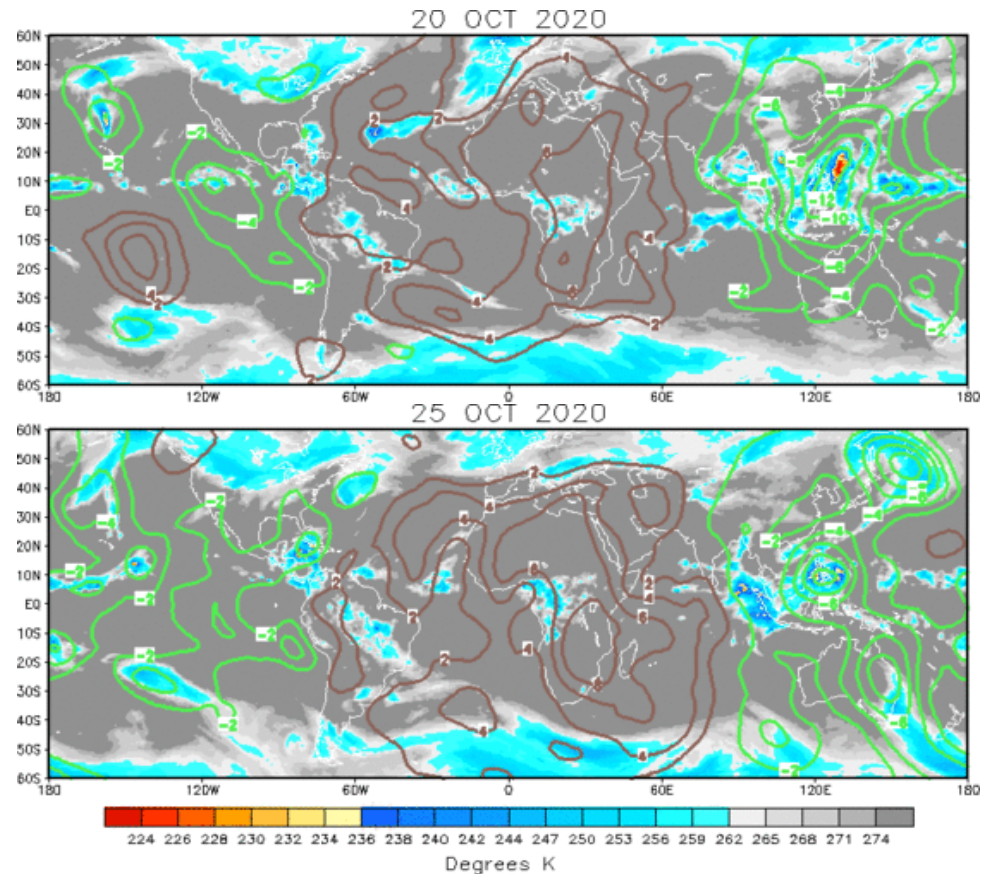
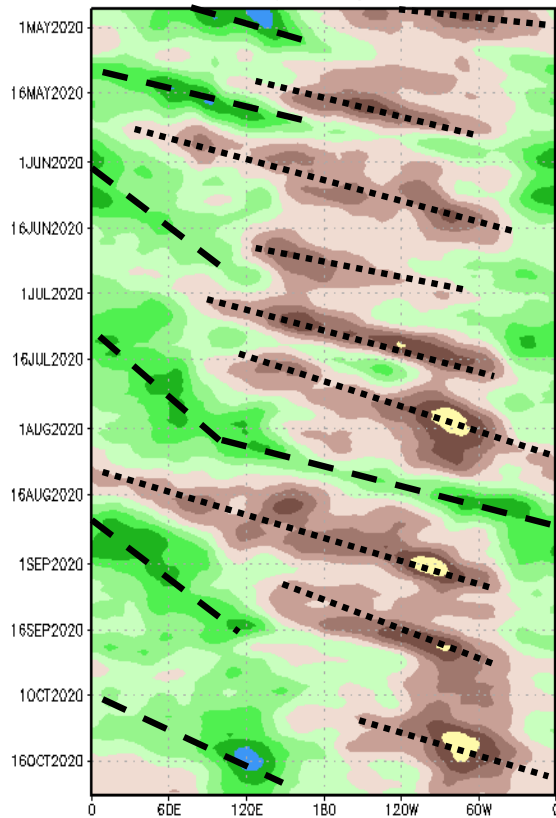
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

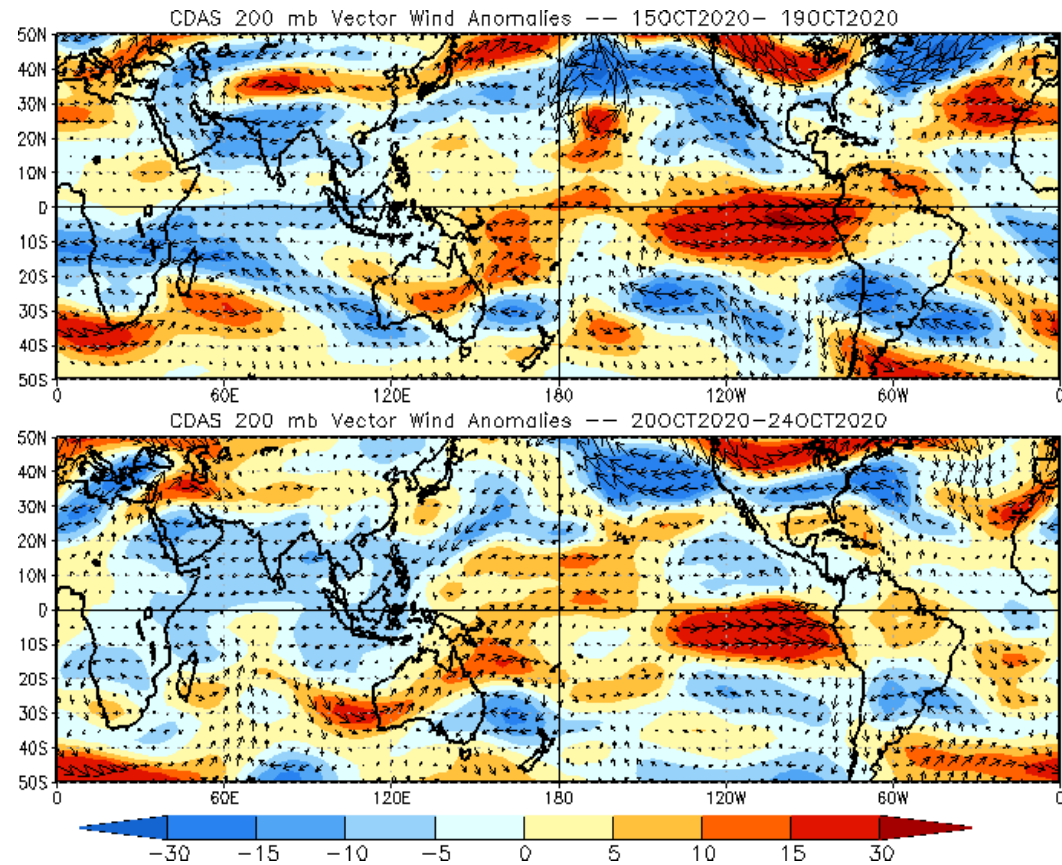
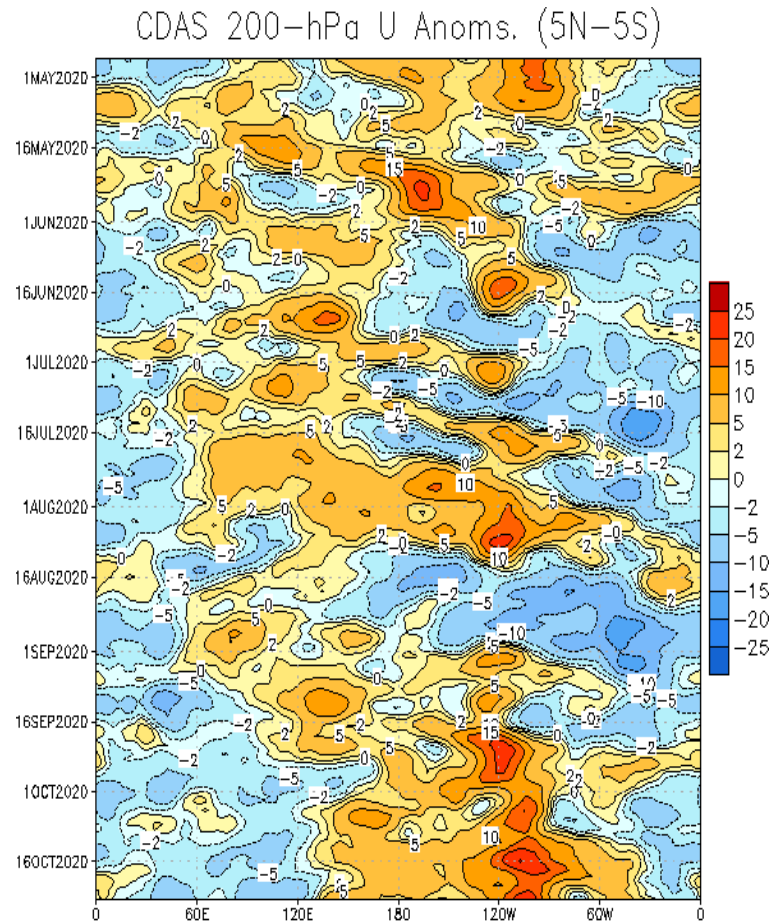
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- The MJO increased in amplitude during October, with pronounced eastward propagation observed across the Maritime Continent.
- Recently, a more stationary pattern emerged as the MJO signal began to interfere with the La Niña base state.
- Some destructive interference between the base state and the MJO (or Kelvin wave activity ahead of the MJO envelope) is evident over the central Pacific.

200-hPa Wind Anomalies

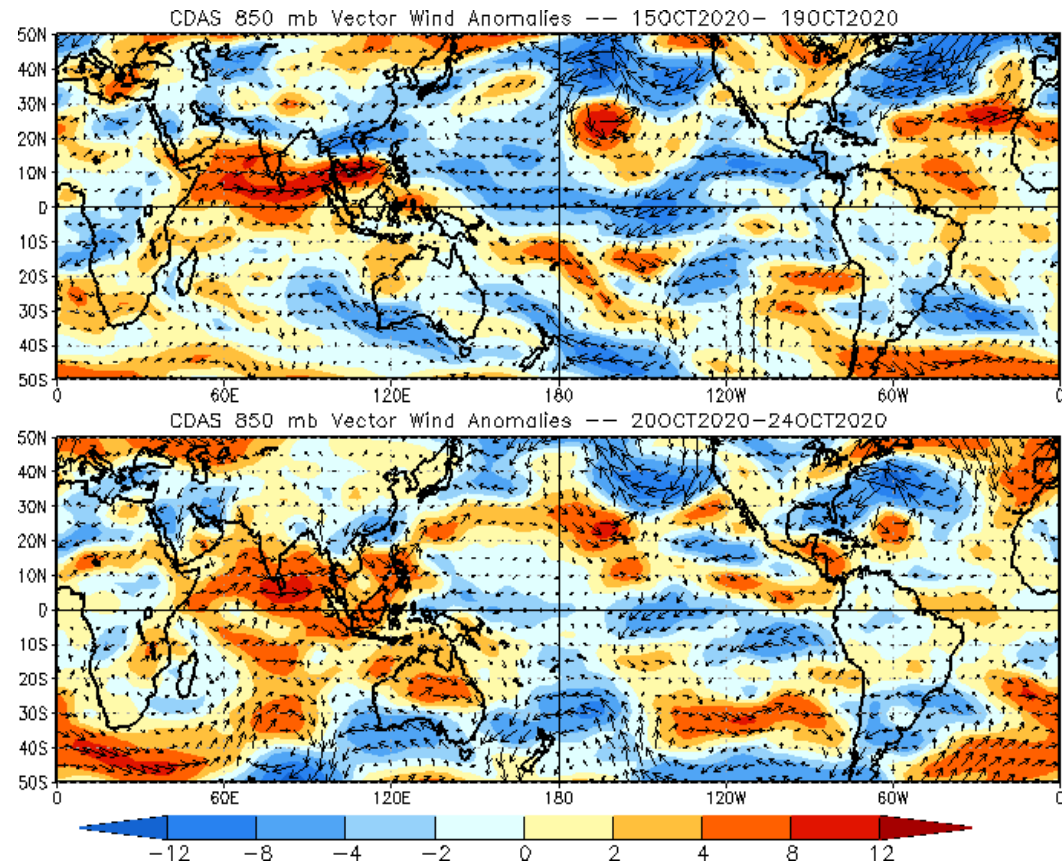
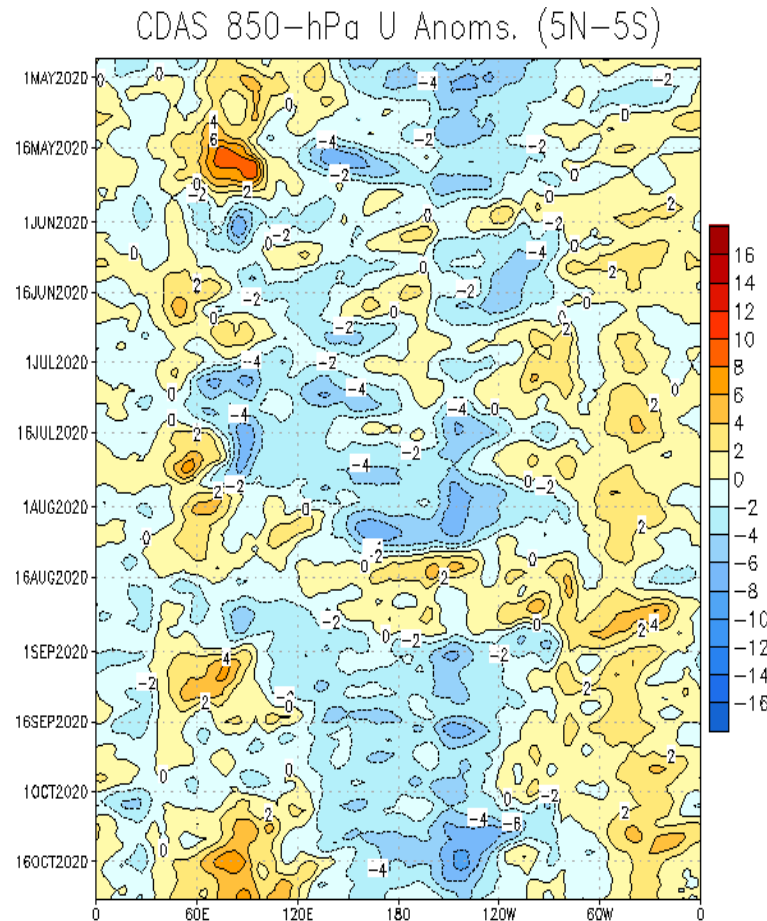
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Anomalous westerlies (easterlies) persist across the eastern equatorial Pacific (Indian Ocean/ Maritime Continent), consistent with La Niña conditions.
- Rossby wave activity over the West Pacific may be interfering with the intraseasonal signal.

850-hPa Wind Anomalies

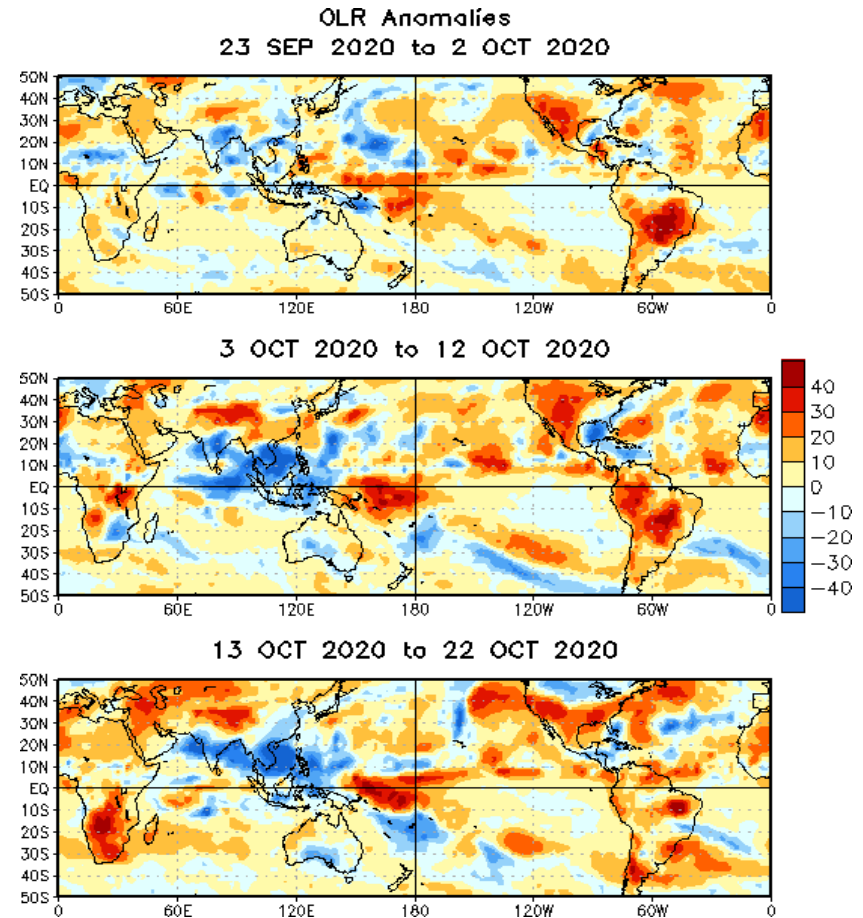
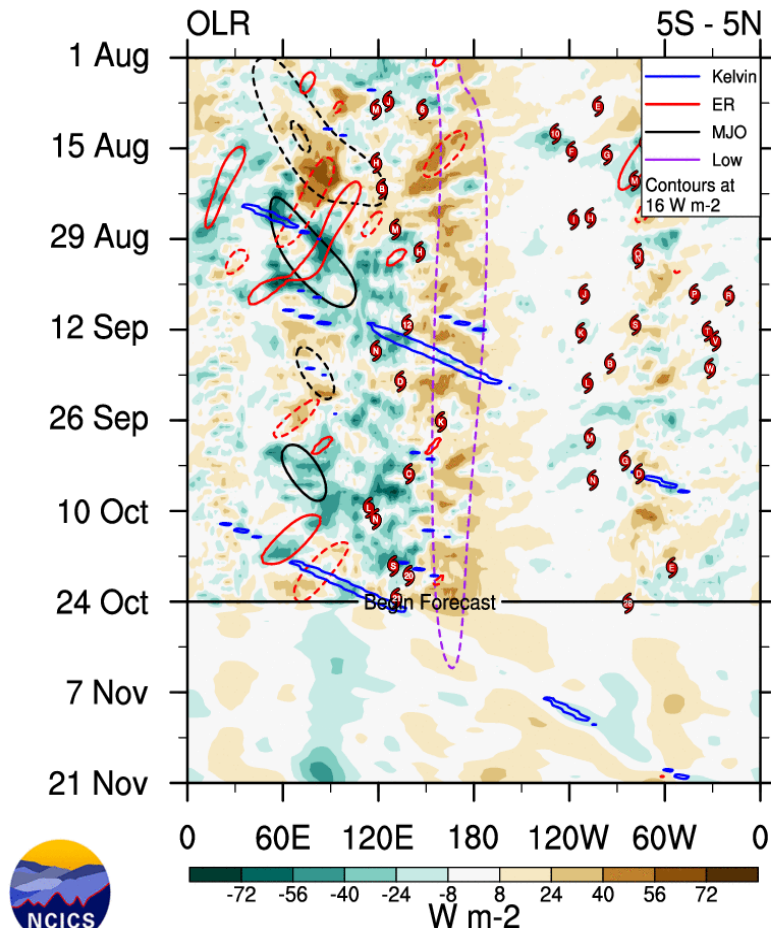
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- A gradual eastward propagation of westerly anomalies associated with the MJO was observed over the far West Pacific basin; however, Rossby wave activity near the equator is interfering with the signal.
- Easterly anomalies (enhanced trades associated with the La Niña response) continue over the Pacific, but have weakened near the Date Line.

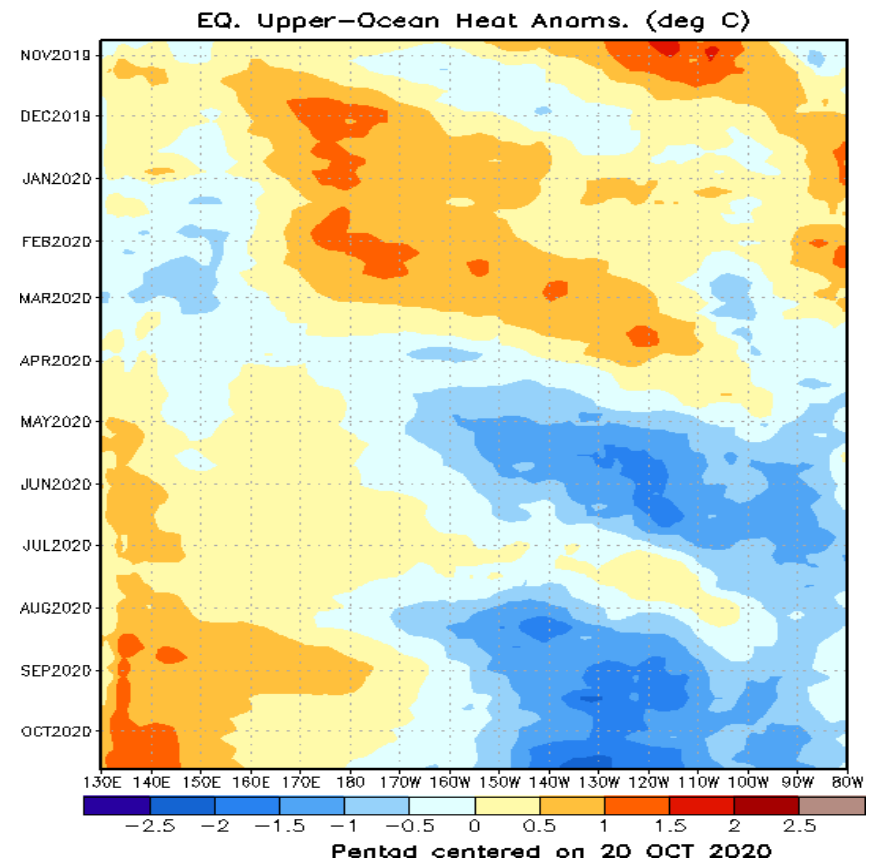
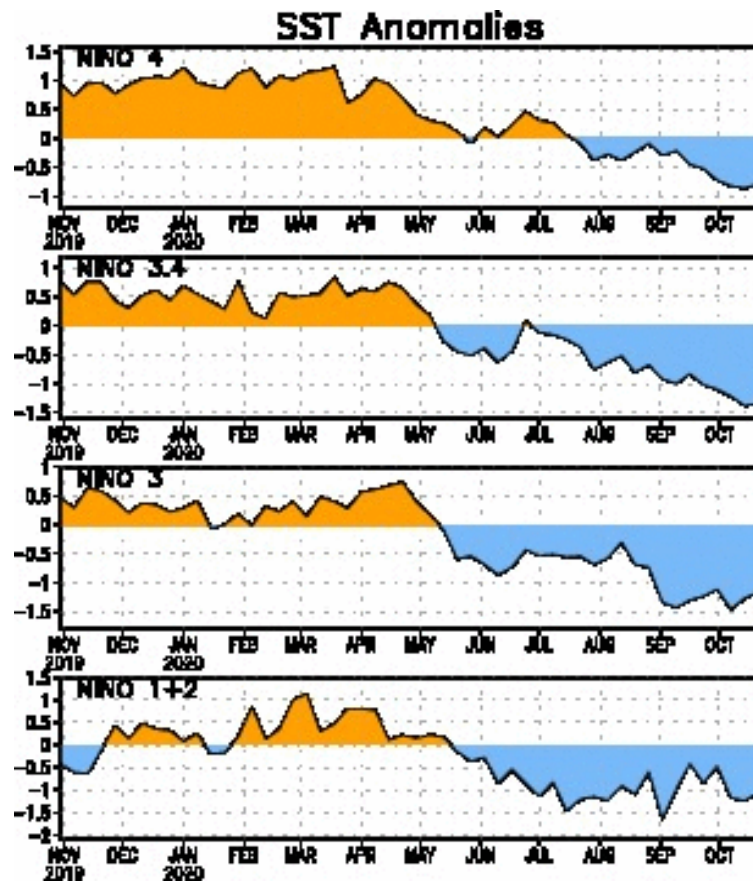
Outgoing Longwave Radiation (OLR) Anomalies

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



- The most prominent OLR feature over the tropics is the dipole of suppressed (enhanced) convection west of the Date Line (over the Indian Ocean) in association with La Niña conditions.
- Enhanced convection associated with the MJO has not progressed over the Pacific basin. Strong suppression remains entrenched along the Equator west of the Date Line.

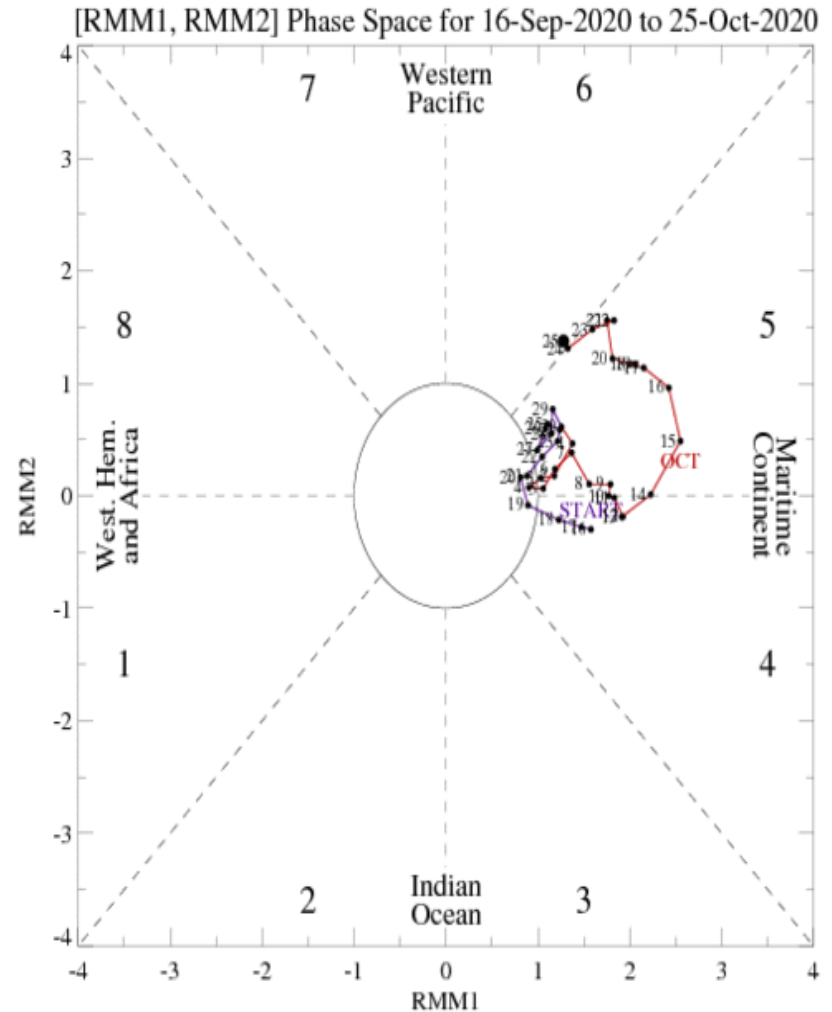
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Following destructive interference with the base state by a downwelling Kelvin wave, the subsequent upwelling phase has pushed the Pacific into La Niña conditions.
- 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.

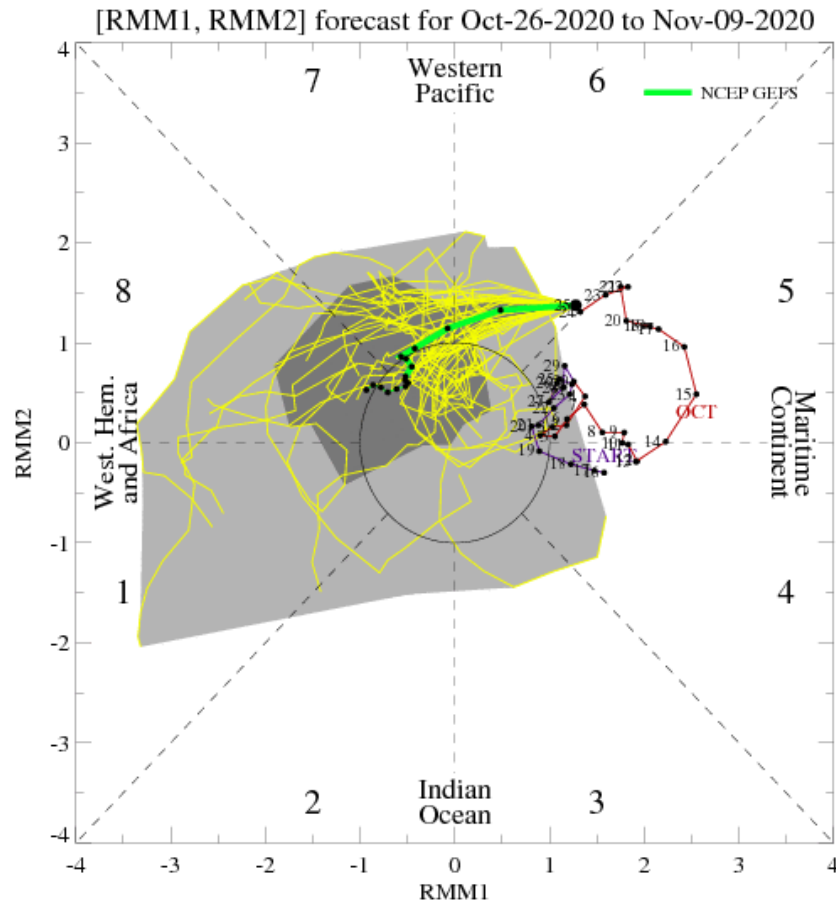
MJO Index: Recent Evolution

- After exhibiting coherent eastward propagation in mid-October, the RMM index has exhibited a more stationary signal over the past several days.

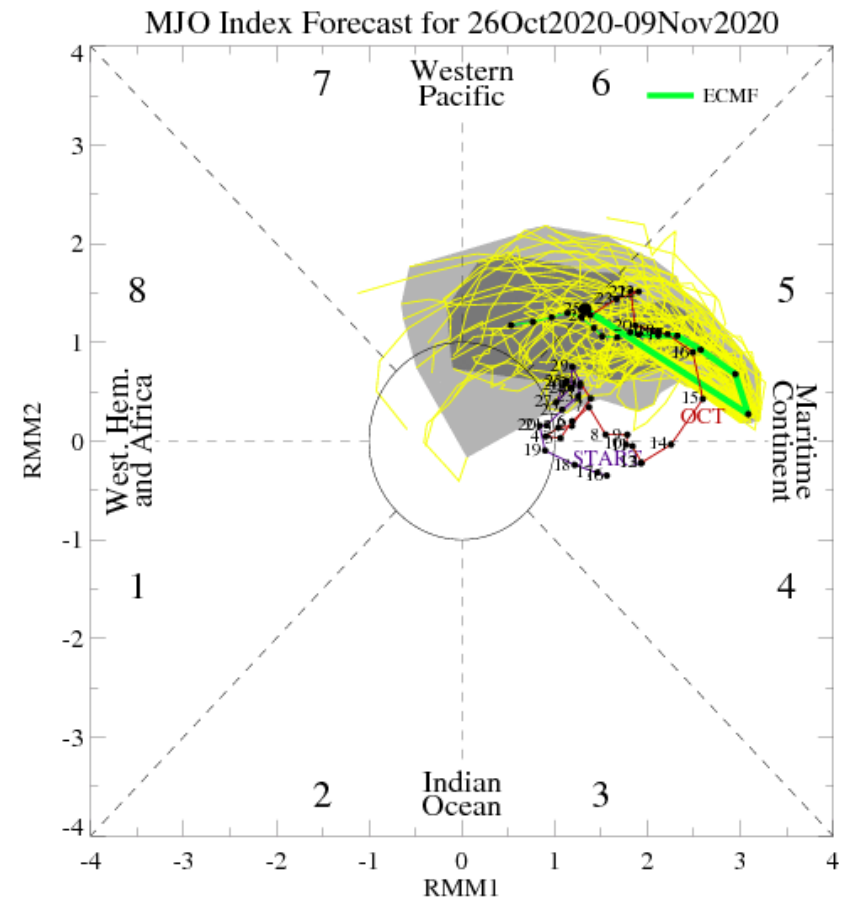


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



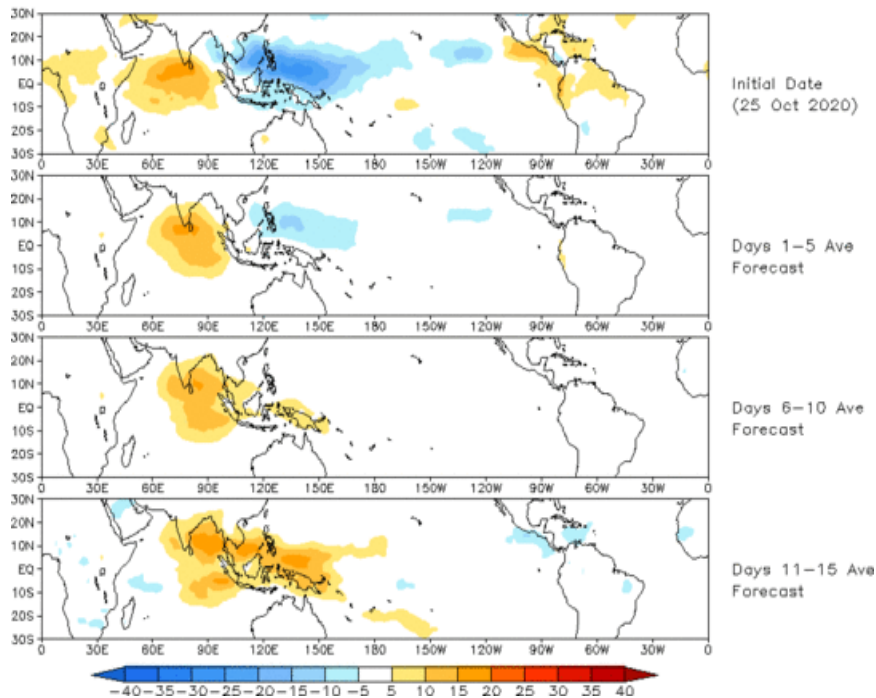
ECMWF Forecast

- Both the GEFS and ECMWF continue to propagate the signal eastward over the next two weeks, although the ECMWF-based plot appears to have an initialization error.
- Given the current lack of substantial eastward propagation, confidence in robust MJO activity crossing the Pacific is low.
- The GEFS depiction is faster, with a larger spread among the ensemble members.

MJO: GEFS Forecast Evolution

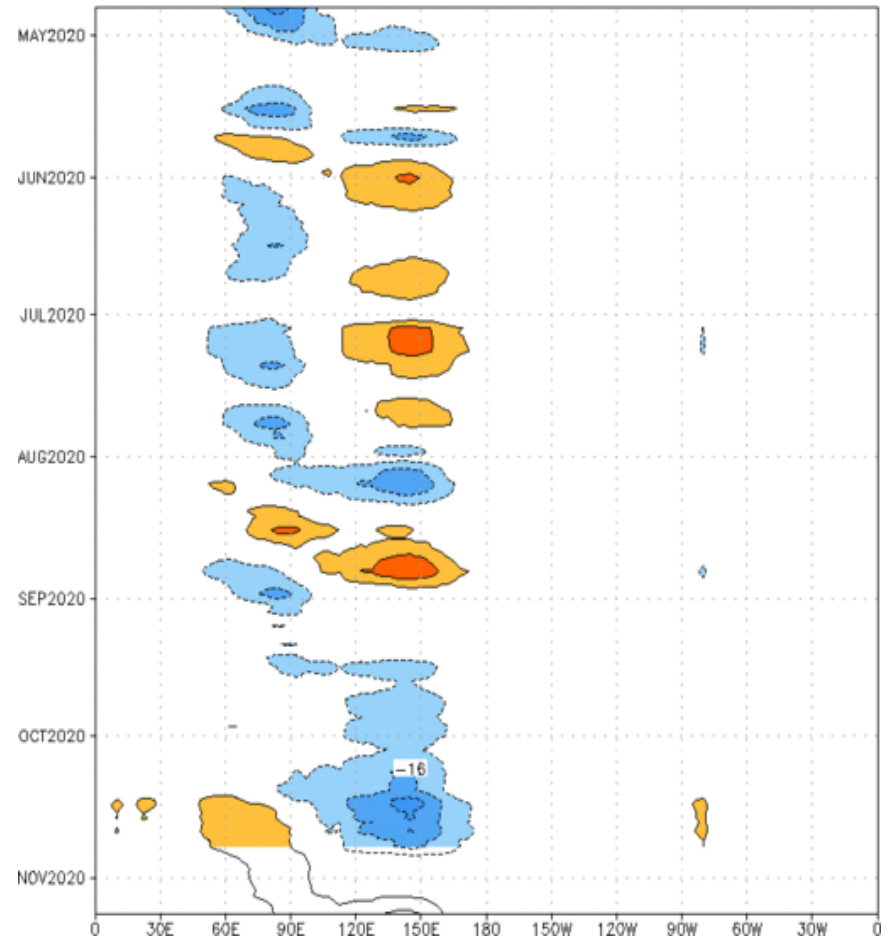
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 25 Oct 2020
OLR



- OLR anomalies based on the GEFS RMM index forecast show a quick transition from a robust West Pacific MJO to a Western Hemisphere event. Note that contributions from the ongoing La Niña base state are not included in this analysis.

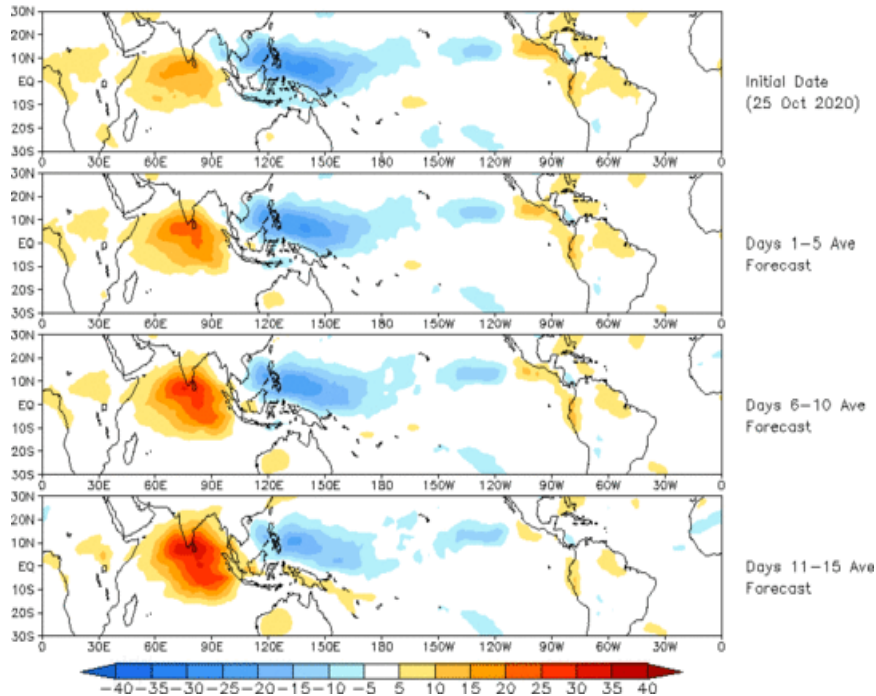
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cint:4Wm^{-2}) Period:25-Apr-2020 to 25-Oct-2020
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



MJO: Constructed Analog Forecast Evolution

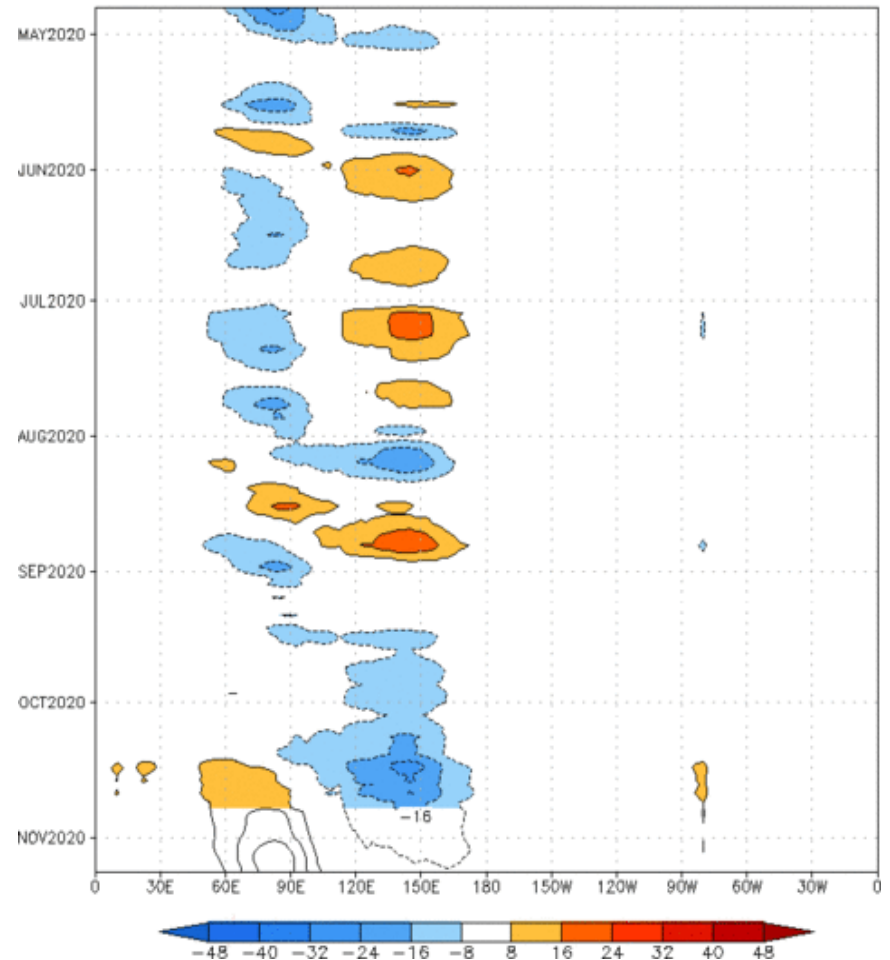
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (25 Oct 2020)



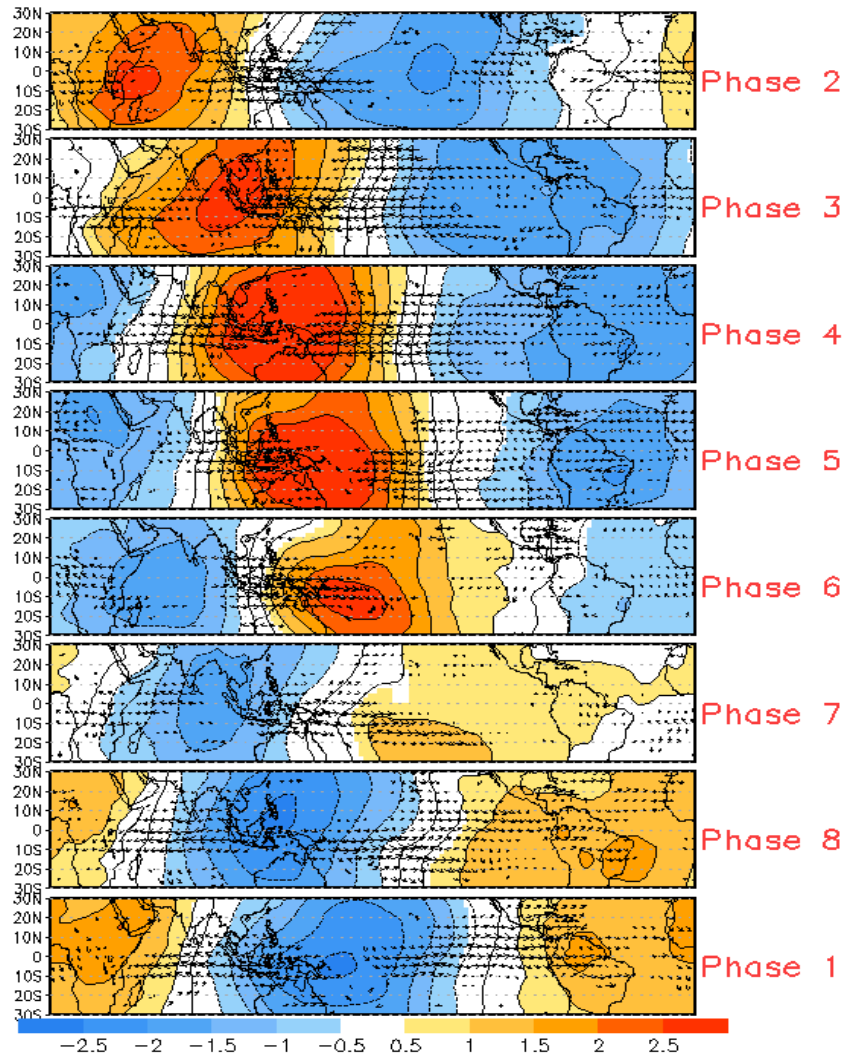
- The constructed analog model depicts a much slower evolution of the signal, but maintains a stronger amplitude than the GEFS.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:25-Apr-2020 to 25-Oct-2020
The unfilled contours are CA forecast reconstructed anomaly for 15 days

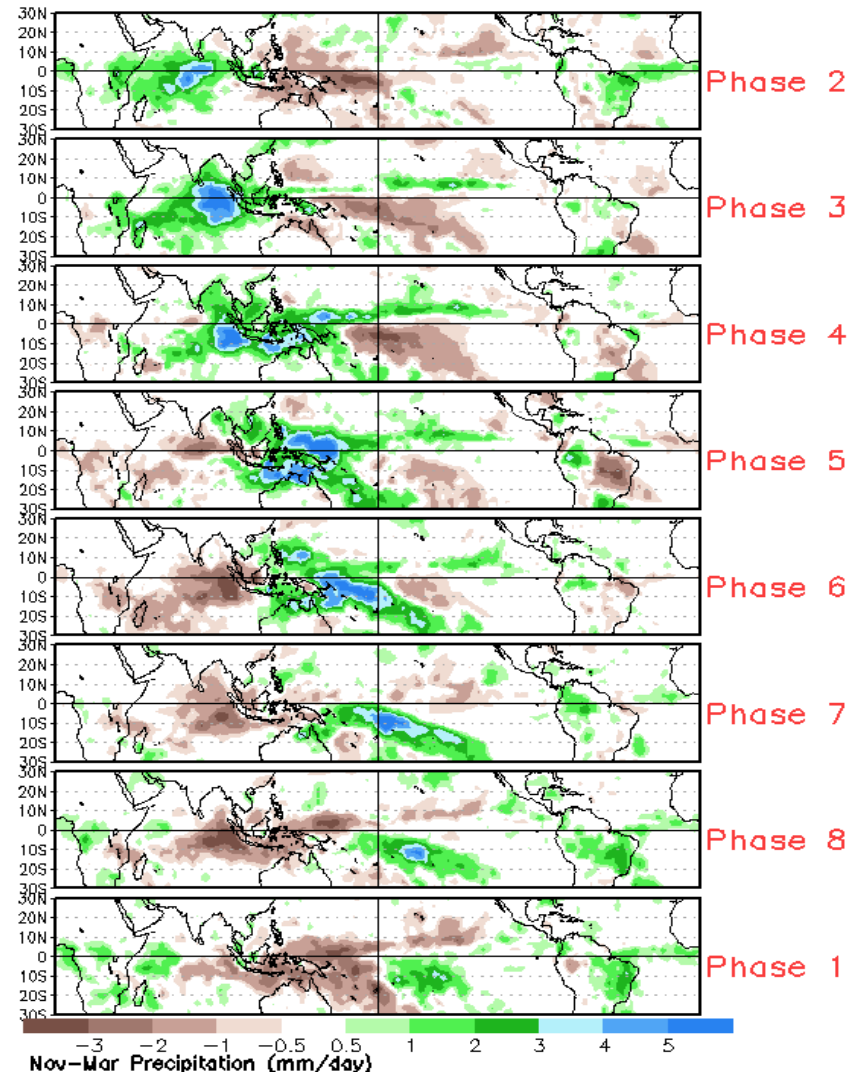


MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



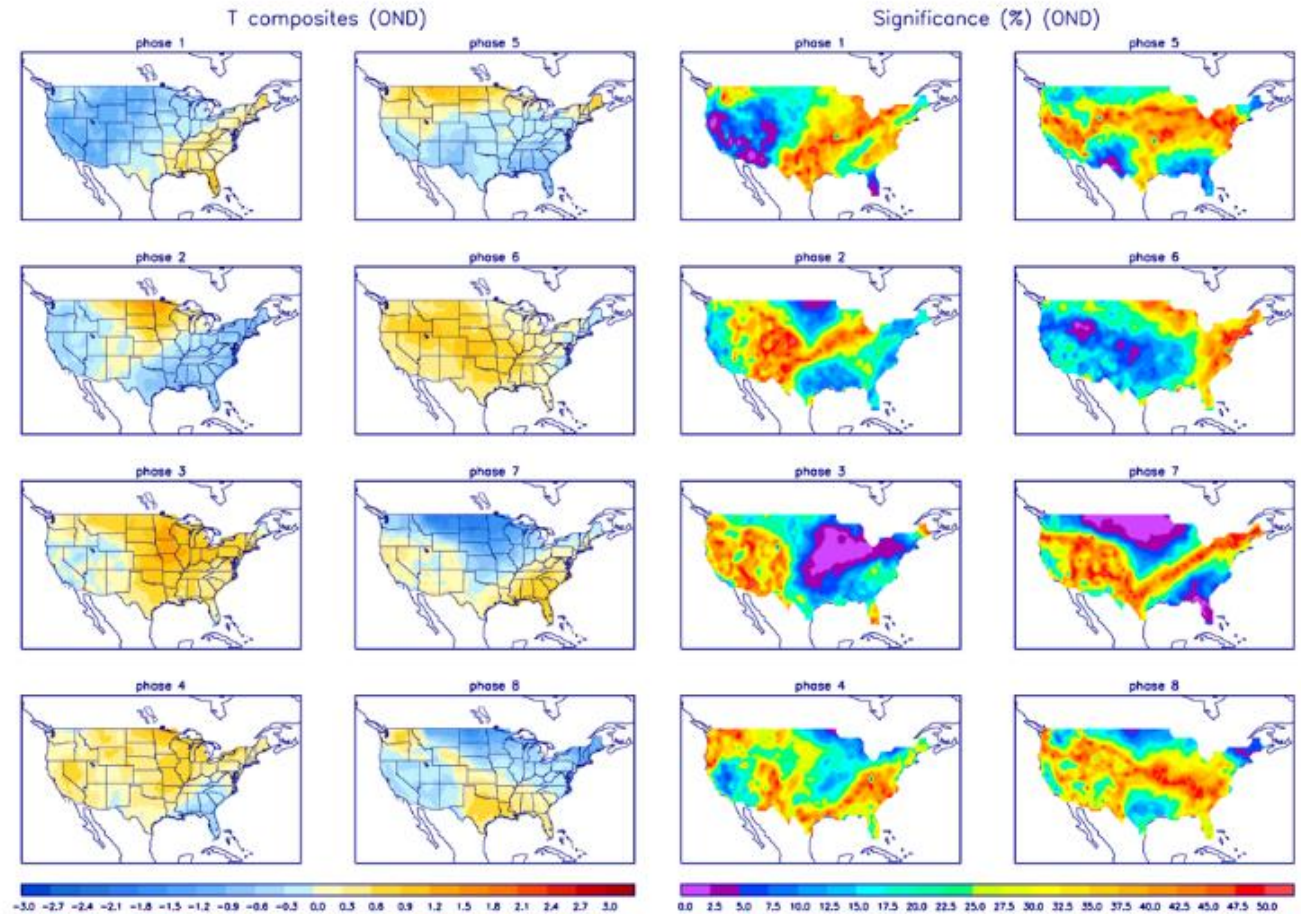
Precipitation Anomalies



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.

