

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



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

Overview

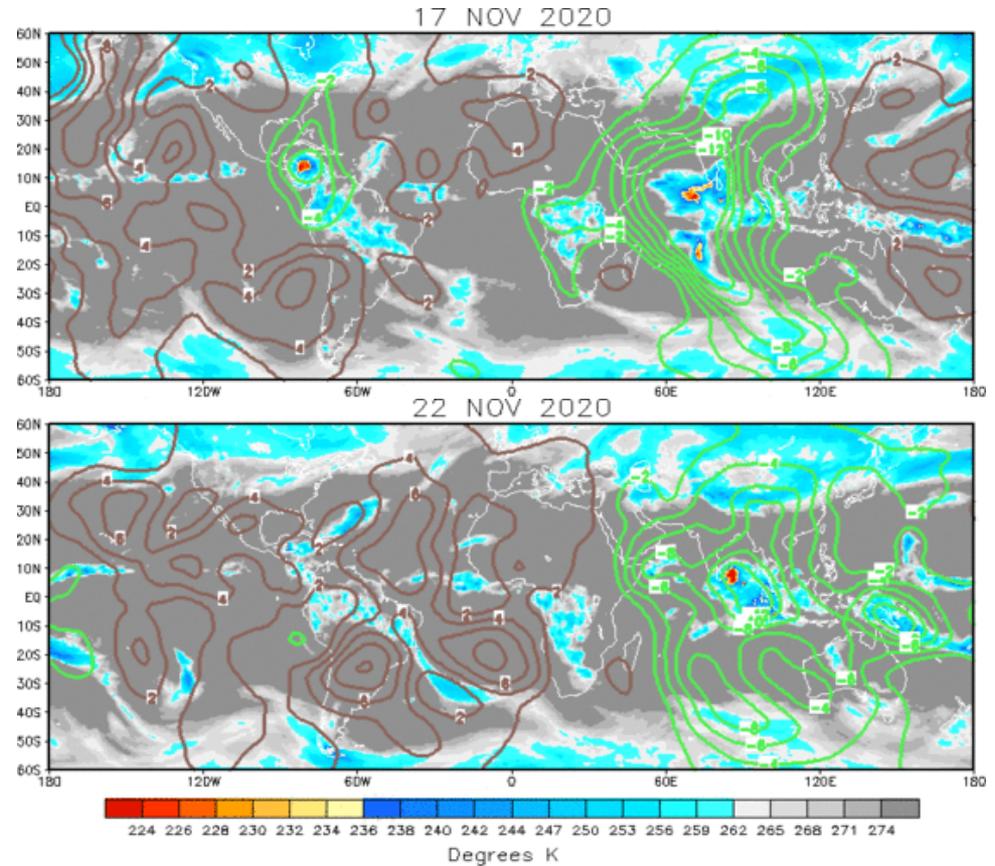
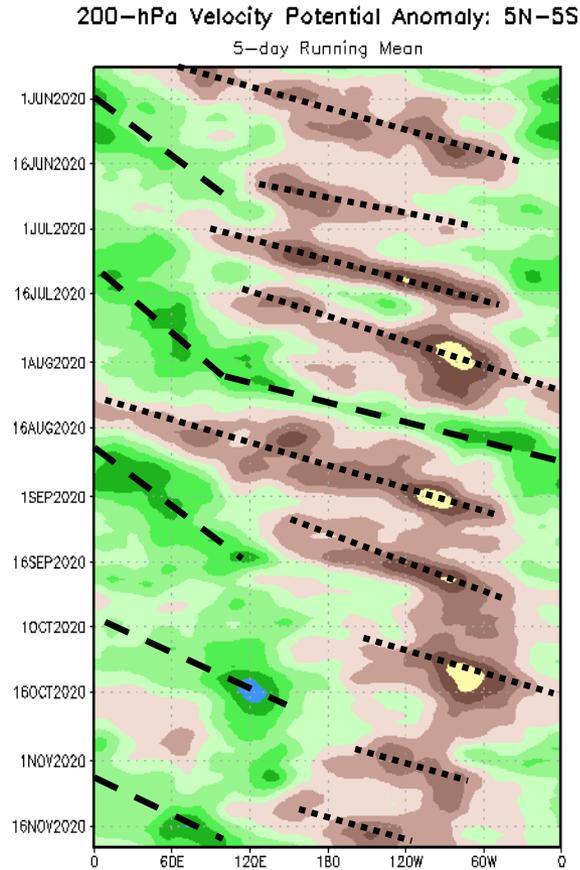
- Following a period of destructive interference with the La Nina base state, the MJO has strengthened during mid-November and has continued to propagate eastward over the Indian Ocean during the last several days.
- Dynamical model spread remains quite high, as ensemble means continue to suggest a decline of the intraseasonal signal over the Indian Ocean/Maritime Continent during late November. As a result, there remains increased uncertainty with the predicted evolution of the MJO and its associated extratropical impacts.
- Despite this, the enhanced phase of the MJO is anticipated to favor increased (decreased) chances for TC activity in the Eastern (Western) Hemisphere during the next two weeks as supported by model guidance.

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).

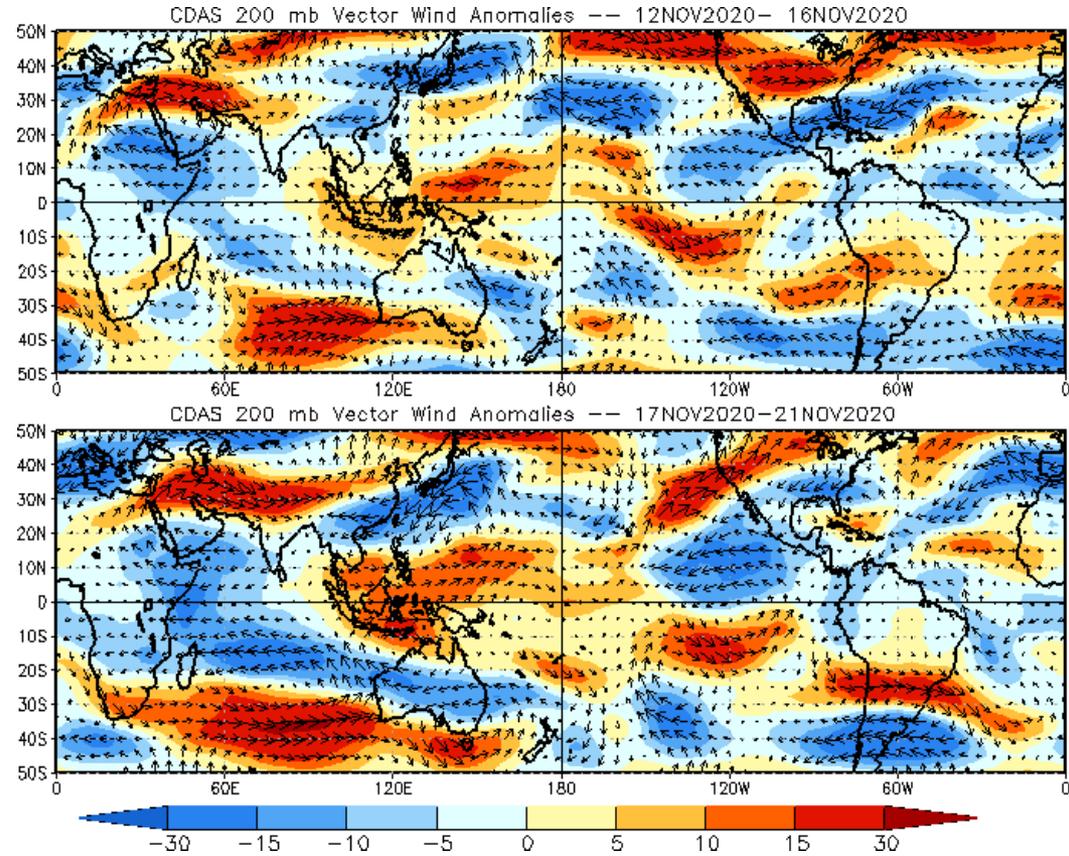
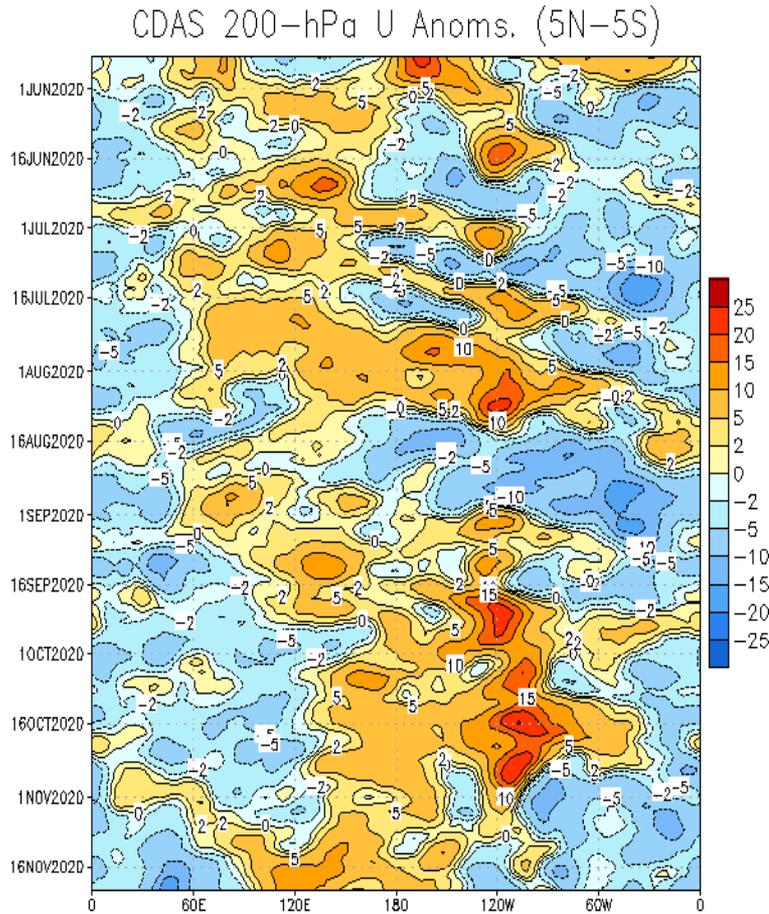
Brown shades: Anomalous convergence (unfavorable for precipitation).



- Following a period of destructive interference between the MJO and La Niña over the Western Hemisphere, the MJO has continued to show signs of strengthening since mid-November.
- A wave-1 pattern has become better defined during the last week with enhanced upper-level divergence recently extending into the Maritime Continent and West Pacific.

200-hPa Wind Anomalies

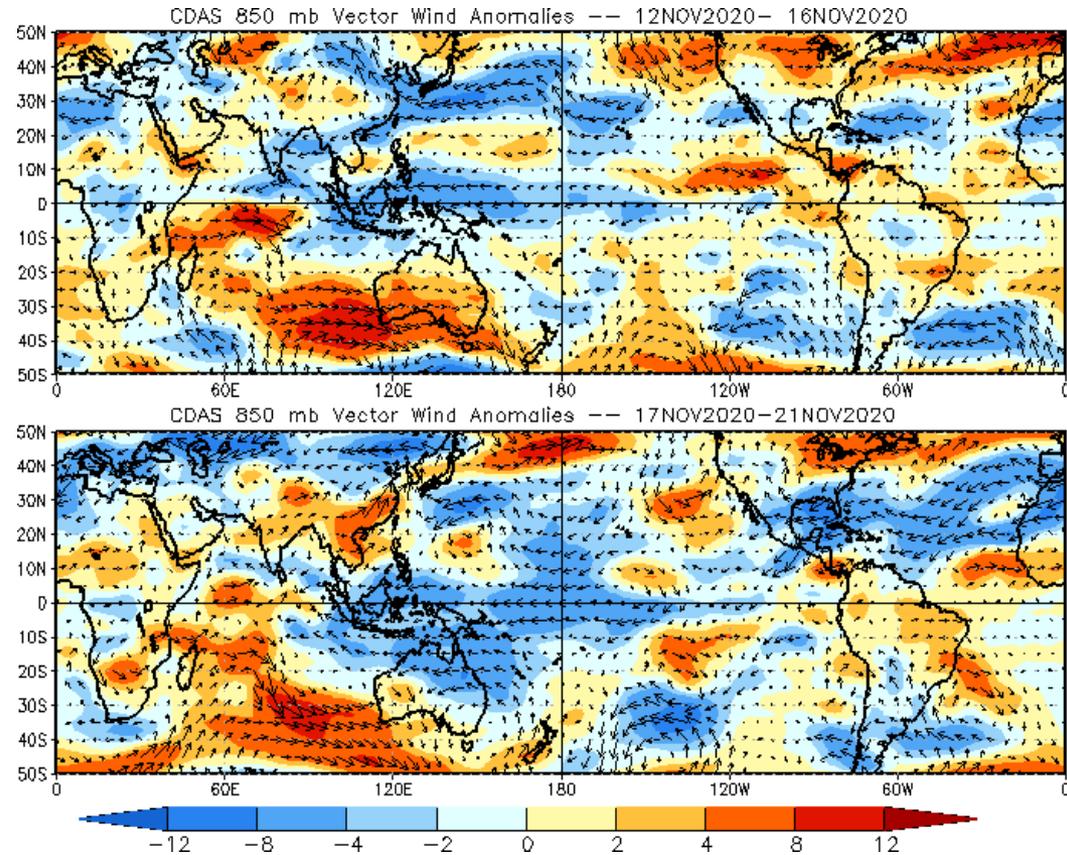
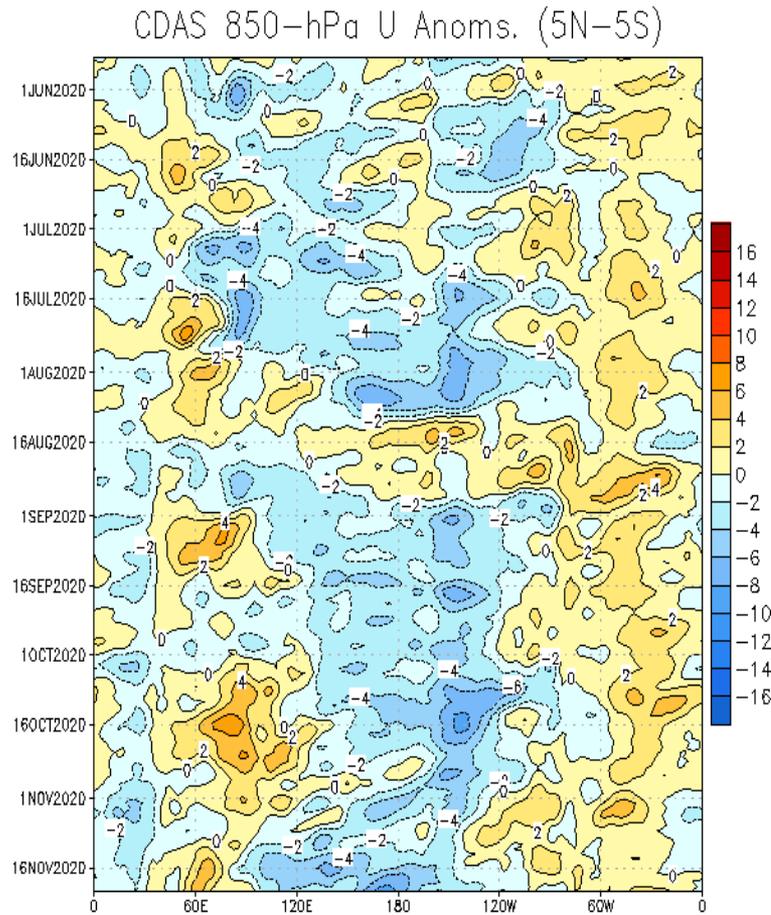
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Anomalous easterlies (westerlies) have strengthened aloft over the western Indian Ocean (Maritime Continent and West Pacific) helping to create a favorable environment for TC formation in the eastern Hemisphere.
- A stronger and broader anomalous anticyclonic circulation is evident across the southern Indian Ocean helping to reinforce anomalous easterlies into eastern Africa.
- Wave breaking continues to show extratropical influences on the equatorial circulation.

850-hPa Wind Anomalies

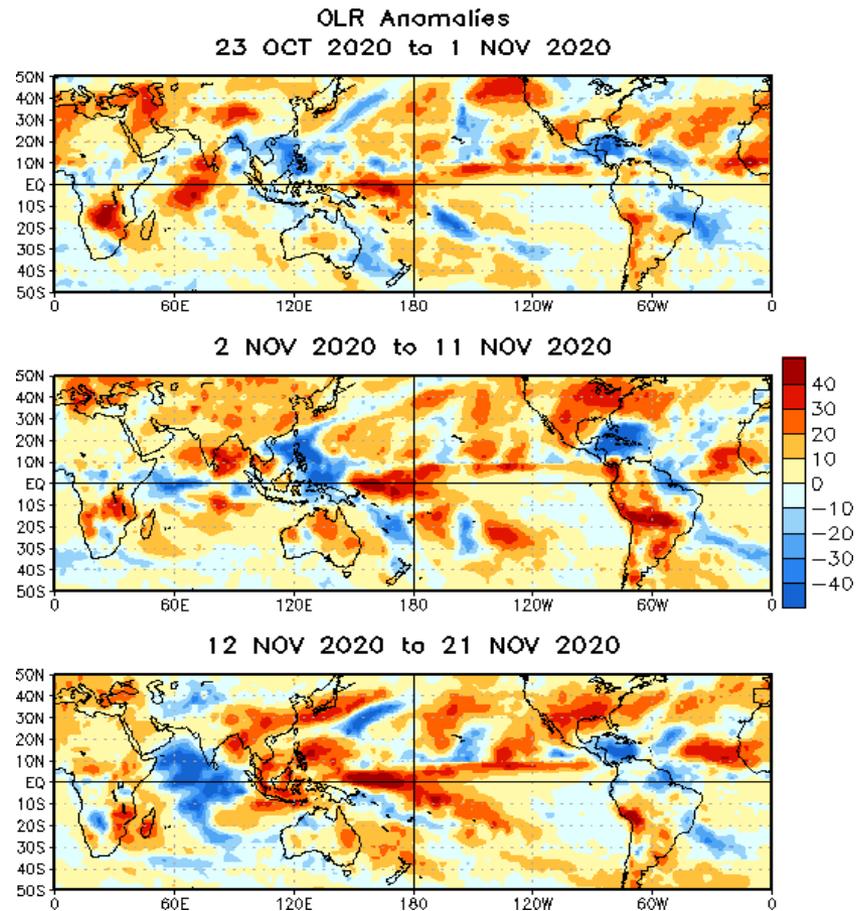
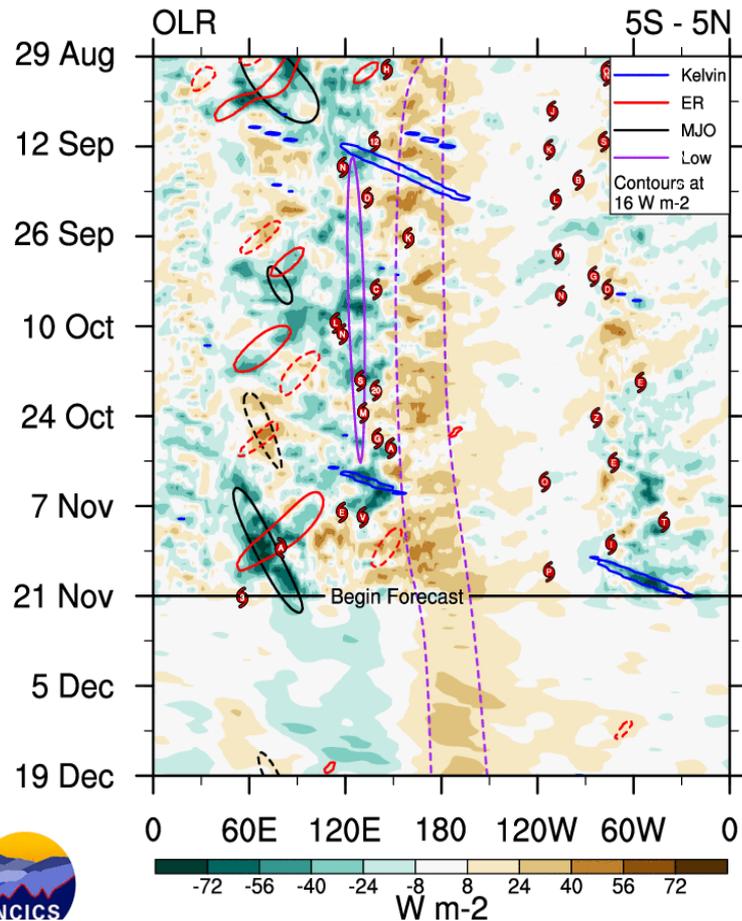
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Anomalous low-level westerlies have strengthened in the western Indian Ocean, also aided by a TC Gati in the Arabian Sea.
- The return of enhanced trades across the Pacific associated with La Nina is evident and has been stronger west of the Date Line recently.
- The expansion of anomalous easterlies across the Atlantic and Caribbean during late November is unfavorable for late season TC activity, and is likely to bring an end to a record breaking Hurricane Season in the basin.

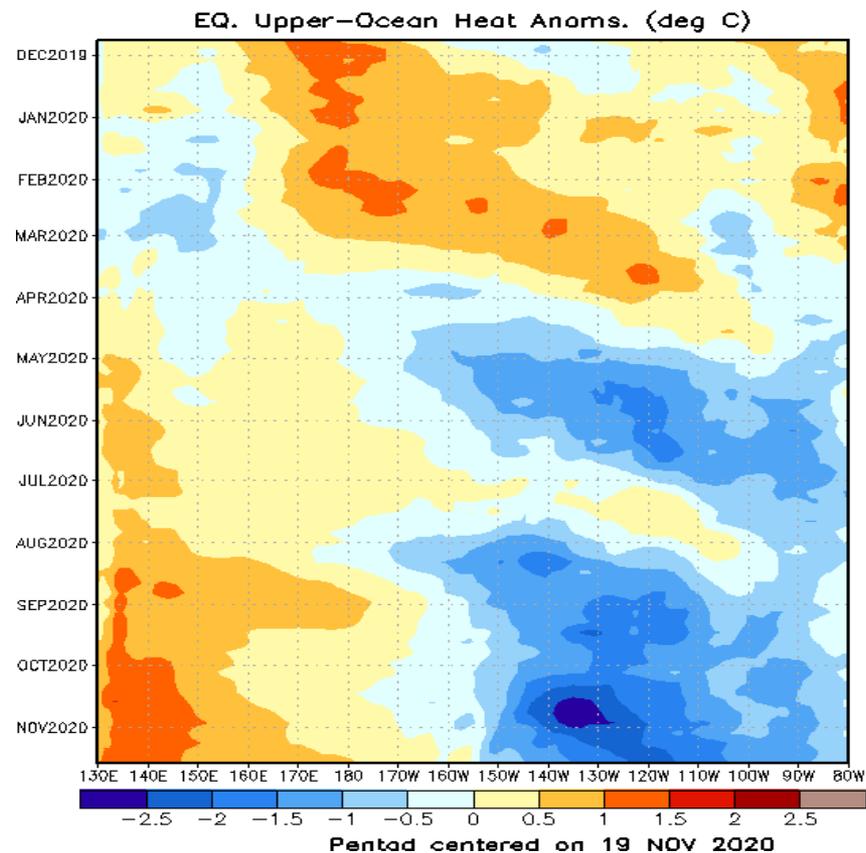
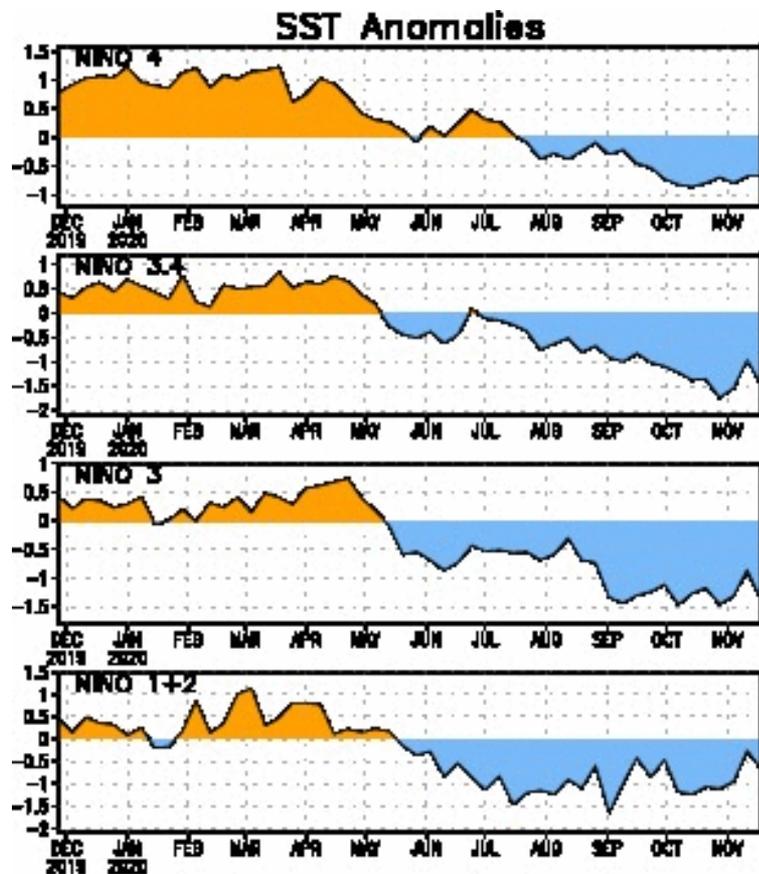
Outgoing Longwave Radiation (OLR) Anomalies

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



- Enhanced convection has prevailed across the western Indian Ocean, with notably more suppressed conditions over the West Pacific following a period of increased TC activity.
- Low frequency suppression of convection remains near the Date Line, although this has shifted slightly eastward in recent weeks.
- Forecasts favor the return of persistent enhanced convection over the Maritime Continent and Indian Ocean.

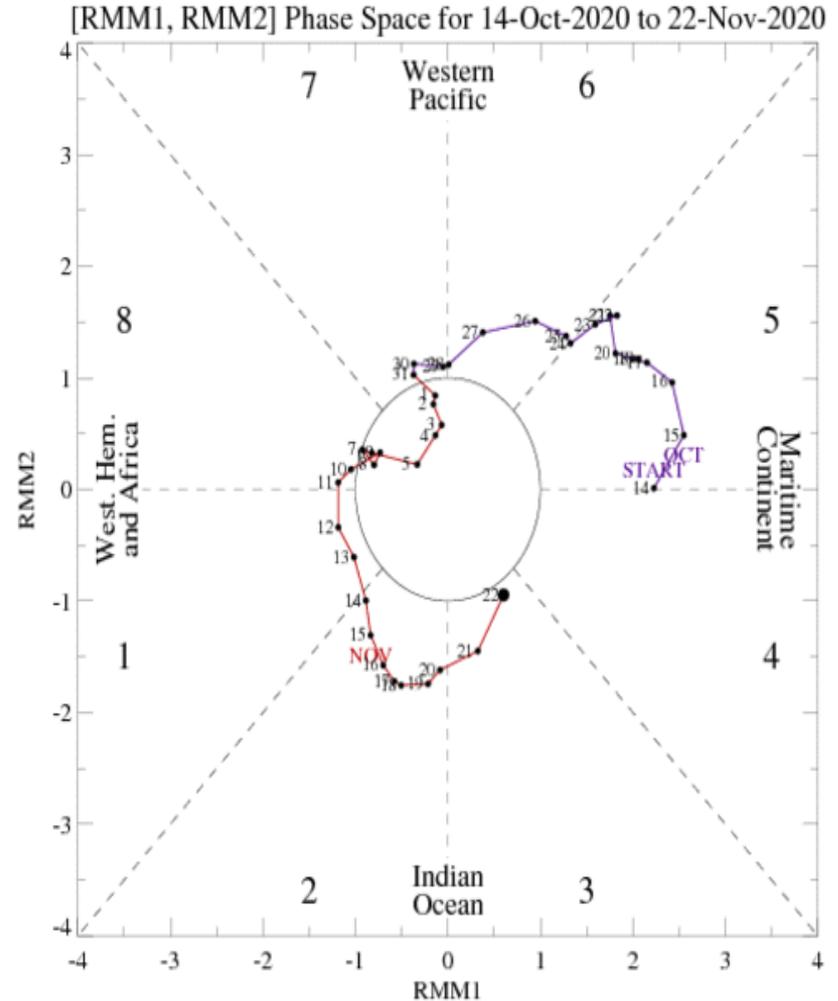
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Following destructive interference with the base state by a downwelling Kelvin wave during July, the subsequent upwelling phase has pushed the Pacific into La Niña conditions.
- Negative SST anomalies weakened during early November. The increased temperatures not as evident in the Niño 4 region where anomalous trades have been most pronounced.

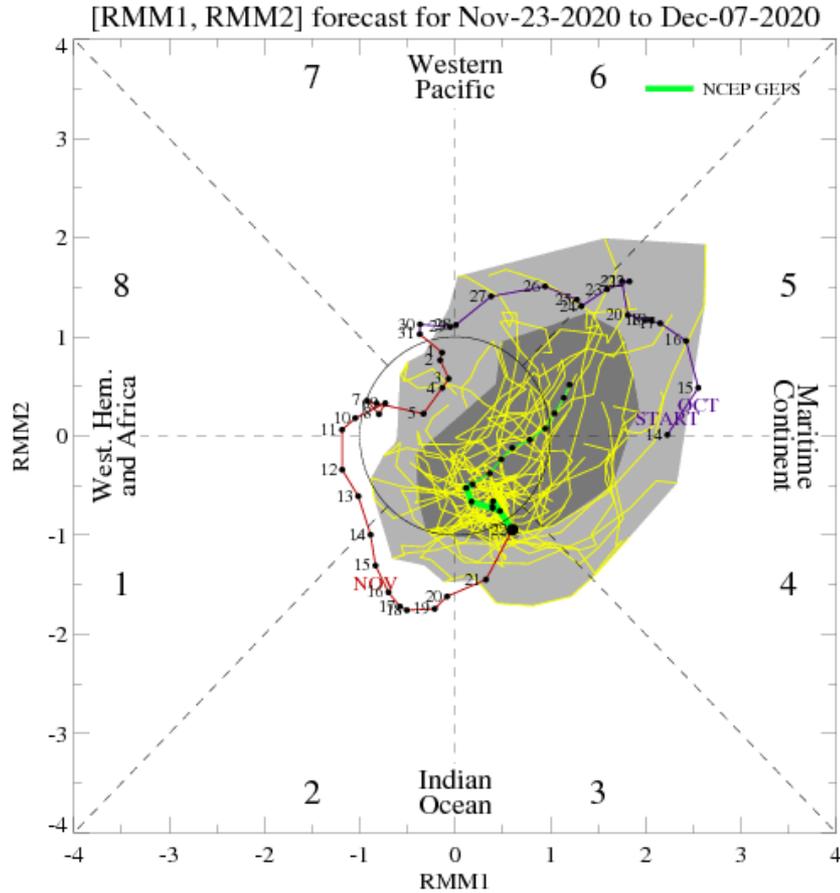
MJO Index: Recent Evolution

- The RMM index shows the MJO gaining amplitude and propagating eastward over the Indian Ocean since mid-November.
- In recent days, there has been a decline in the signal while accelerating eastward over Phase 3.

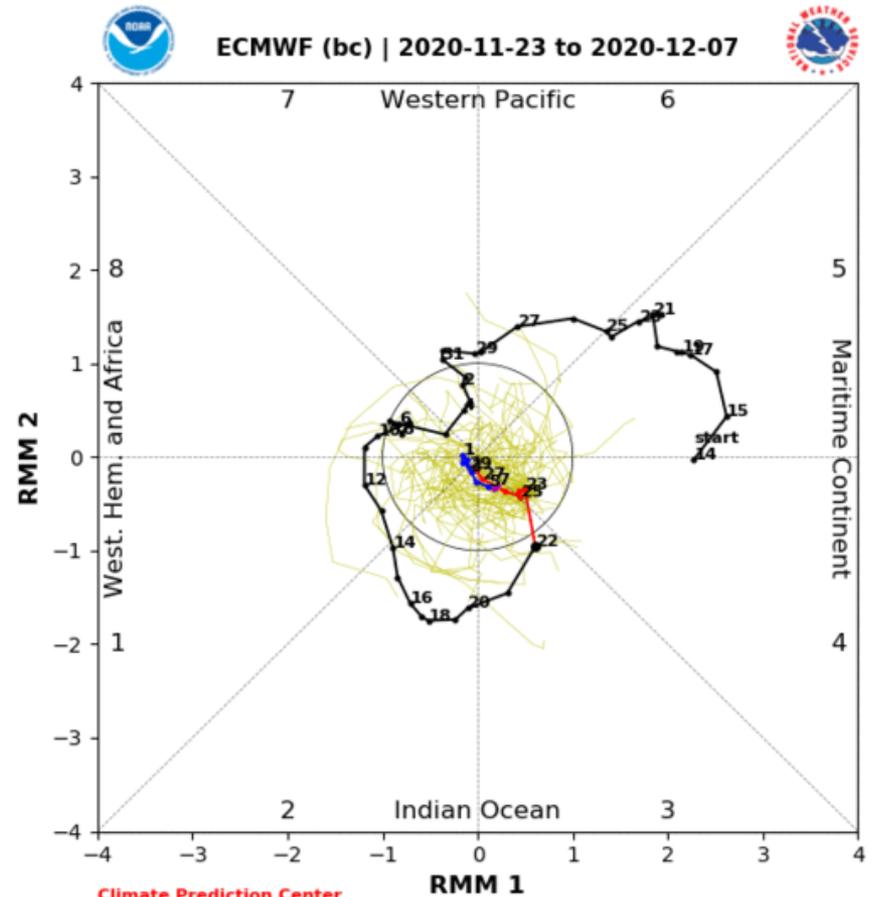


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



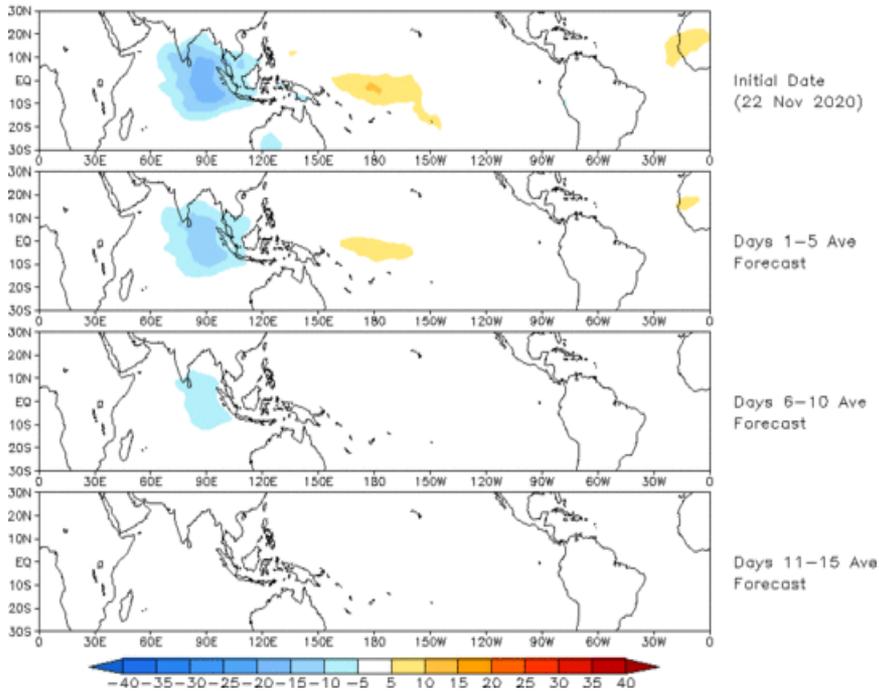
ECMWF Forecast

- Similar to previous model guidance since last week, dynamical models continue to suggest a rapid weakening of the intraseasonal signal during the next week.
- Spread among ensemble members remains high, with the GEFS ensemble mean favoring possible reemergence of the MJO over the Maritime Continent by early December.

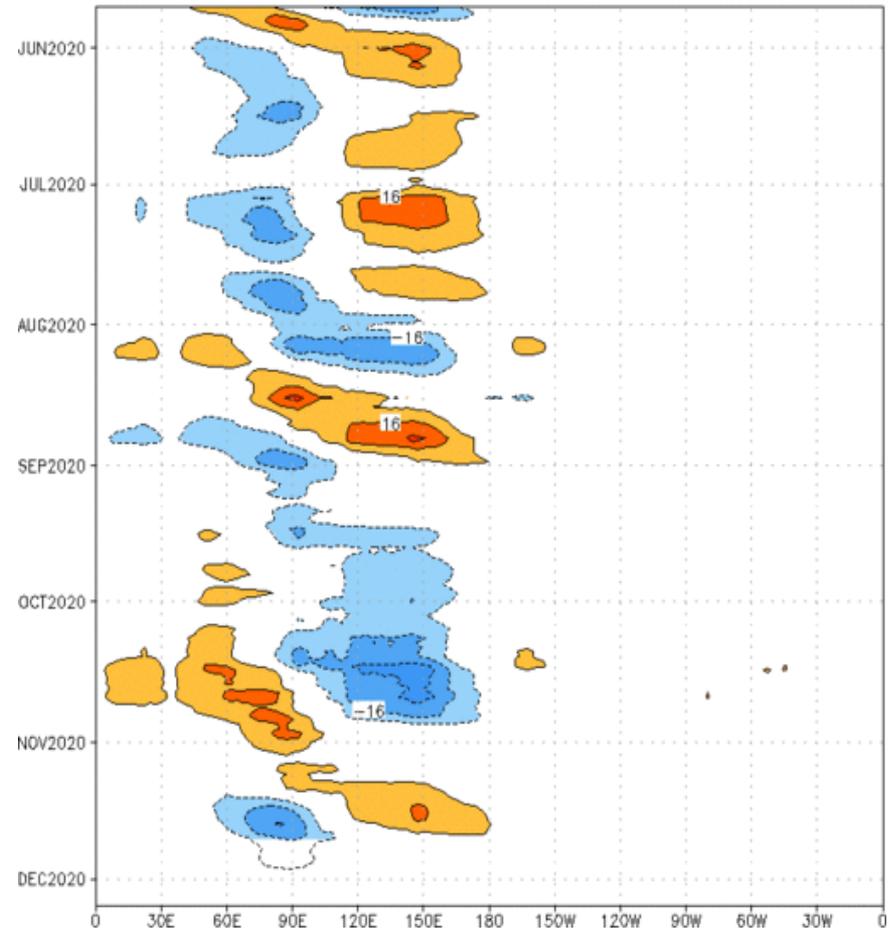
MJO: GEFS Forecast Evolution

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: 22 Nov 2020
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [$7.5^{\circ}\text{S}, 7.5^{\circ}\text{N}$] ($\text{cint:}4\text{Wm}^{-2}$) Period: 23-May-2020 to 22-Nov-2020
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

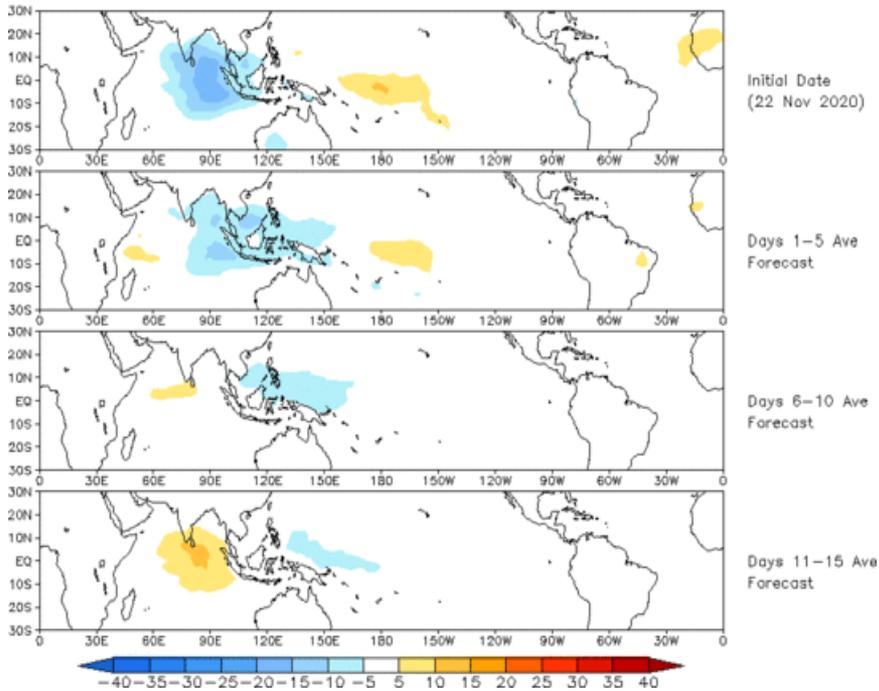


- The GEFS forecasts show the enhanced phase of the MJO remaining stationary and gradually weakening over the Indian Ocean.

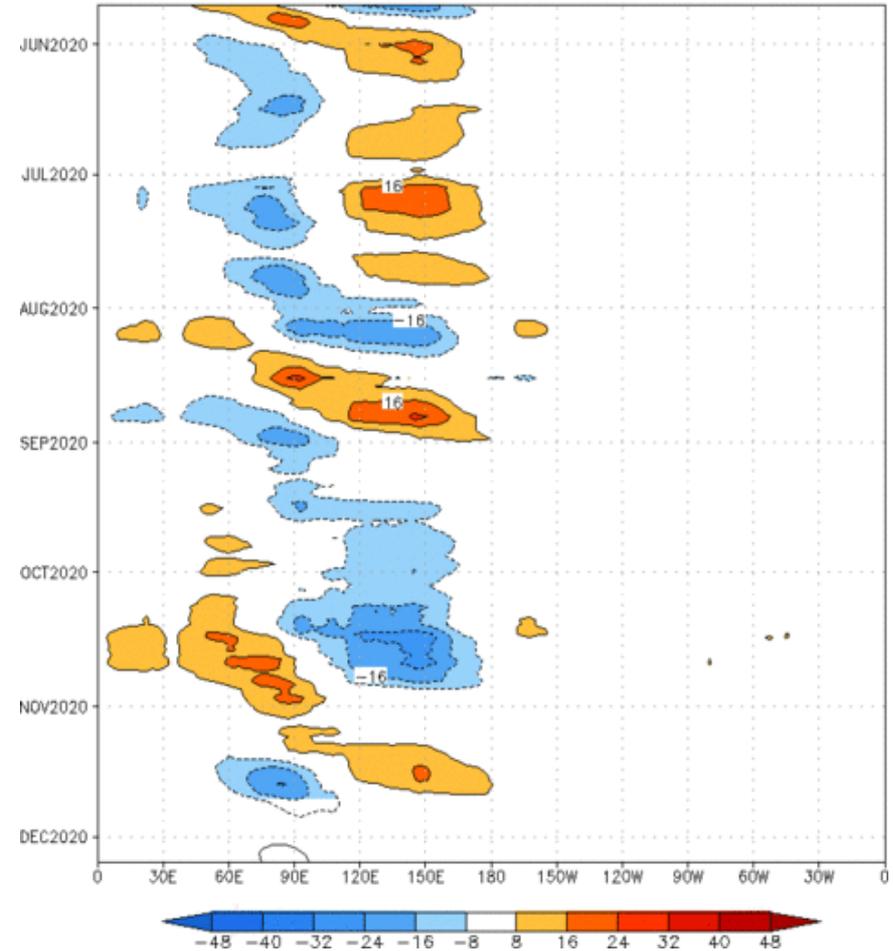
MJO: Constructed Analog Forecast Evolution

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 (22 Nov 2020)



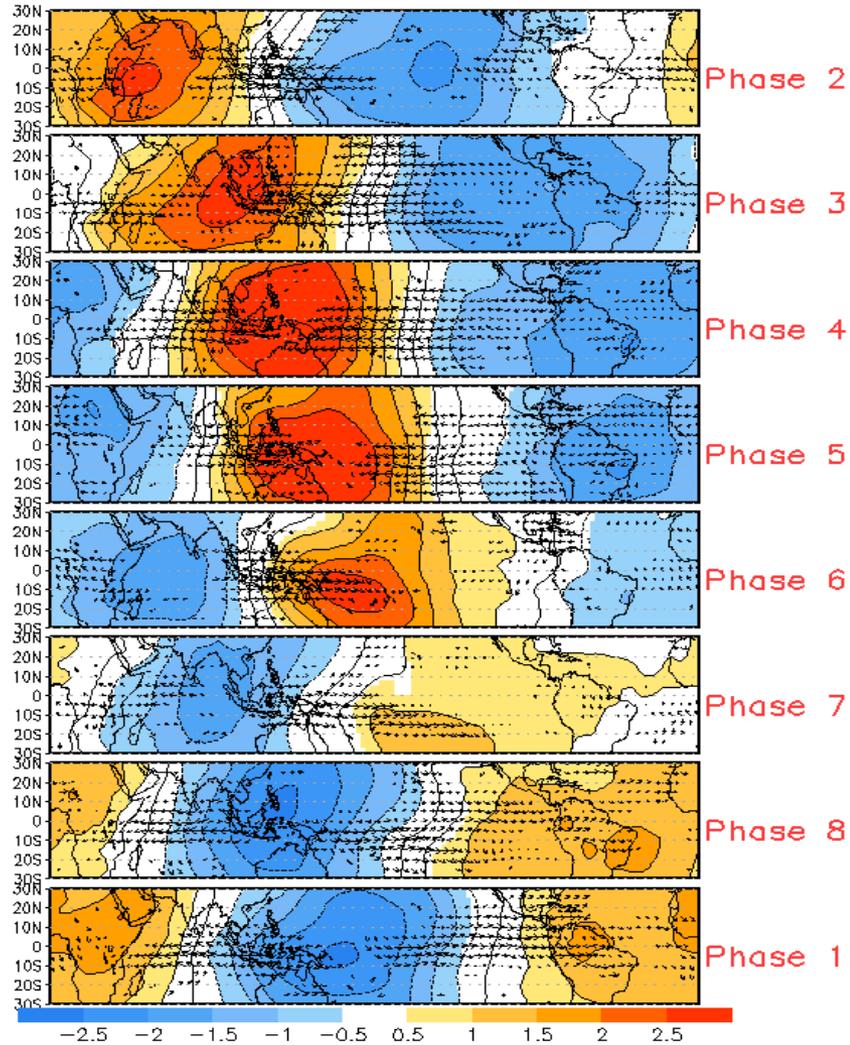
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:23-May-2020 to 22-Nov-2020
The unfilled contours are CA forecast reconstructed anomaly for 15 days



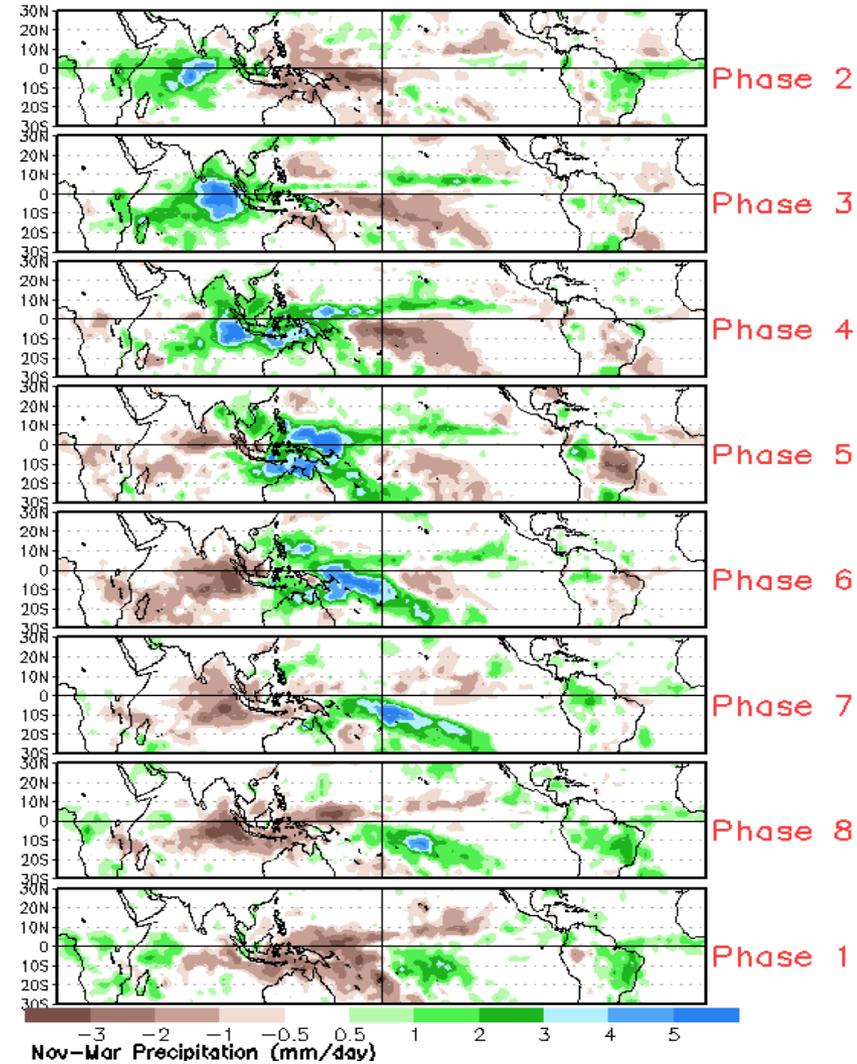
- Compared to the GEFS, the constructed analog is more progressive, suggesting a more eastward propagating signal into the Maritime Continent while weakening over the West Pacific.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



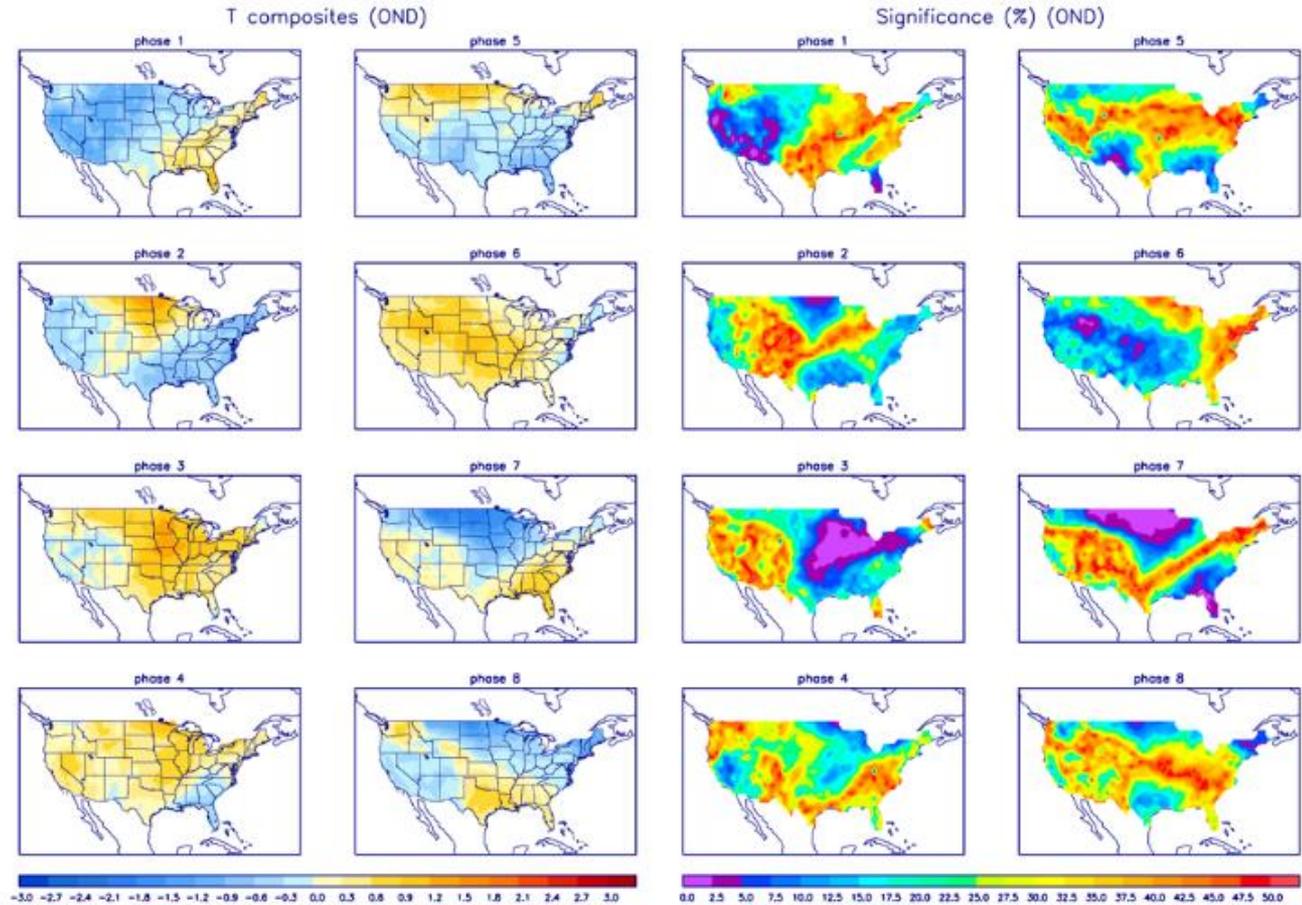
Precipitation Anomalies



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.

