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

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

Overview

- The MJO crossed the Western Hemisphere during early November, resulting in favorable atmospheric conditions for the development and rapid intensifications of Hurricanes Eta and Iota.

- At present, the enhanced MJO envelope is over the western Indian Ocean, where it is constructively interfering with the low frequency state. This location should help to gradually weaken favorable conditions for Atlantic tropical cyclone activity.

- Model forecasts of the MJO's evolution the next two weeks are wildly divergent, resulting in limited confidence for any extratropical outcomes. In general, a slow eastward progression that is accompanied by gradual decay is favored.

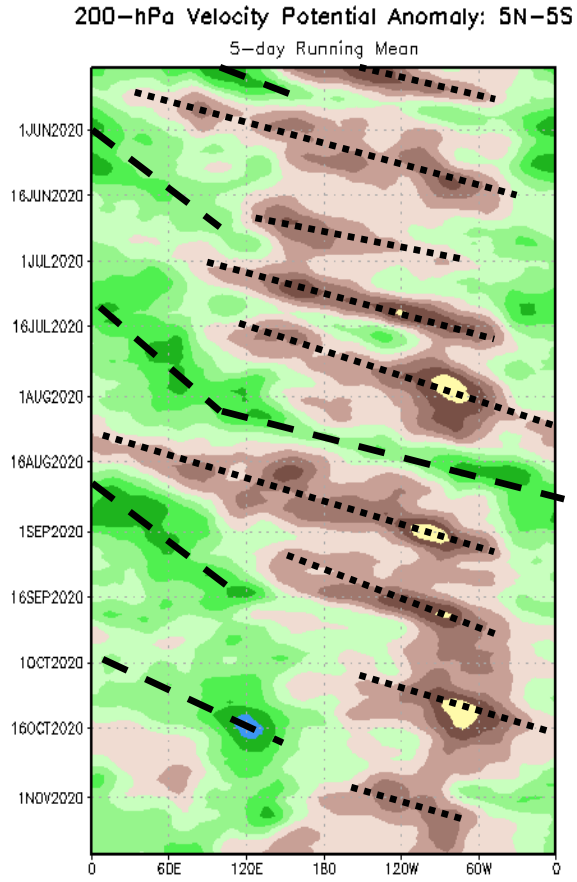
- Typically the MJO crossing the Indian Ocean results in an anomalous wavetrain resulting in above-normal temperatures focused over the Great Lakes 3-4 weeks afterward, with a slight tilt toward below-normal temperatures over the West. It remains to be seen if the tropical convection can force such a response given its forecasted weakening and uncertain propagation.

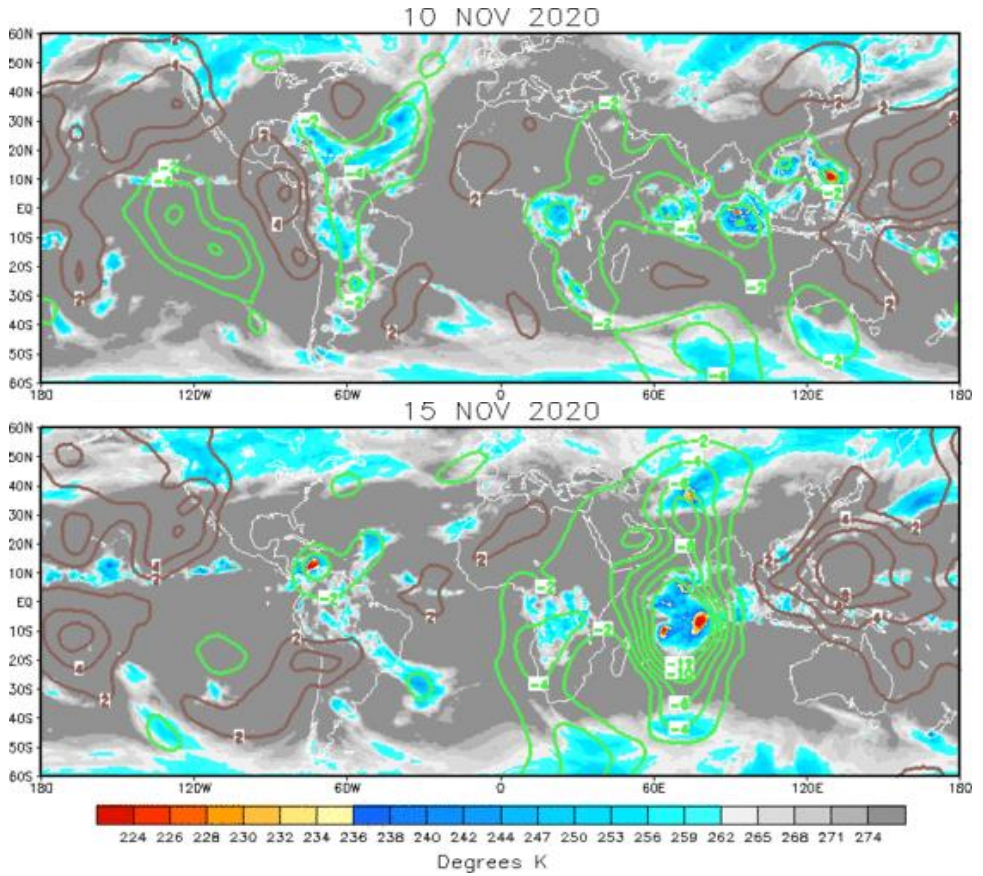
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).



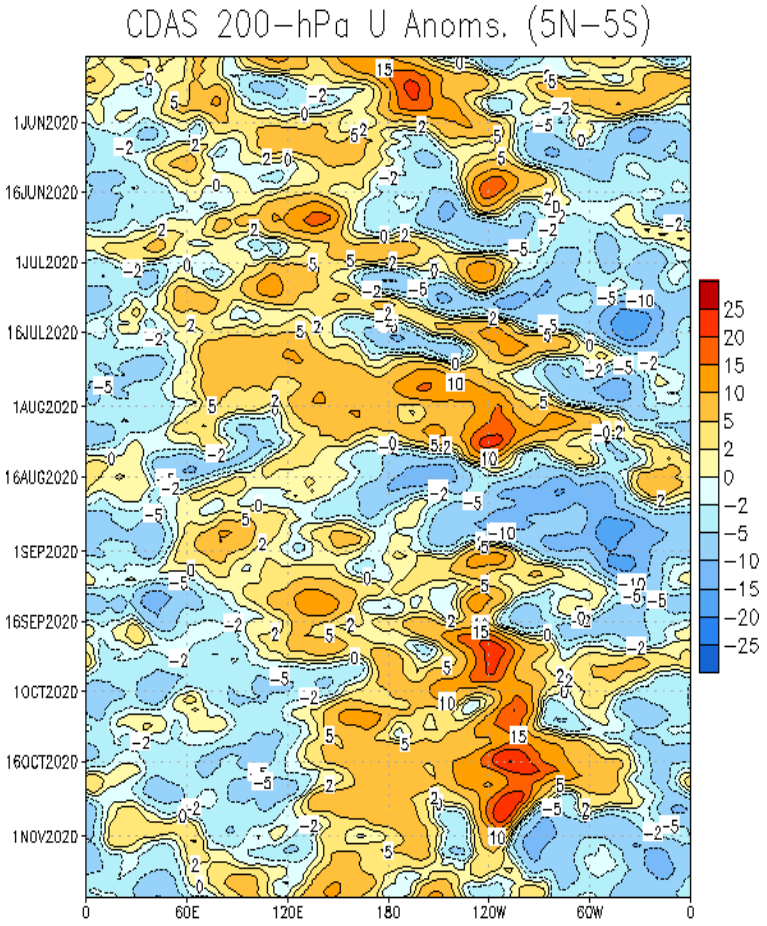


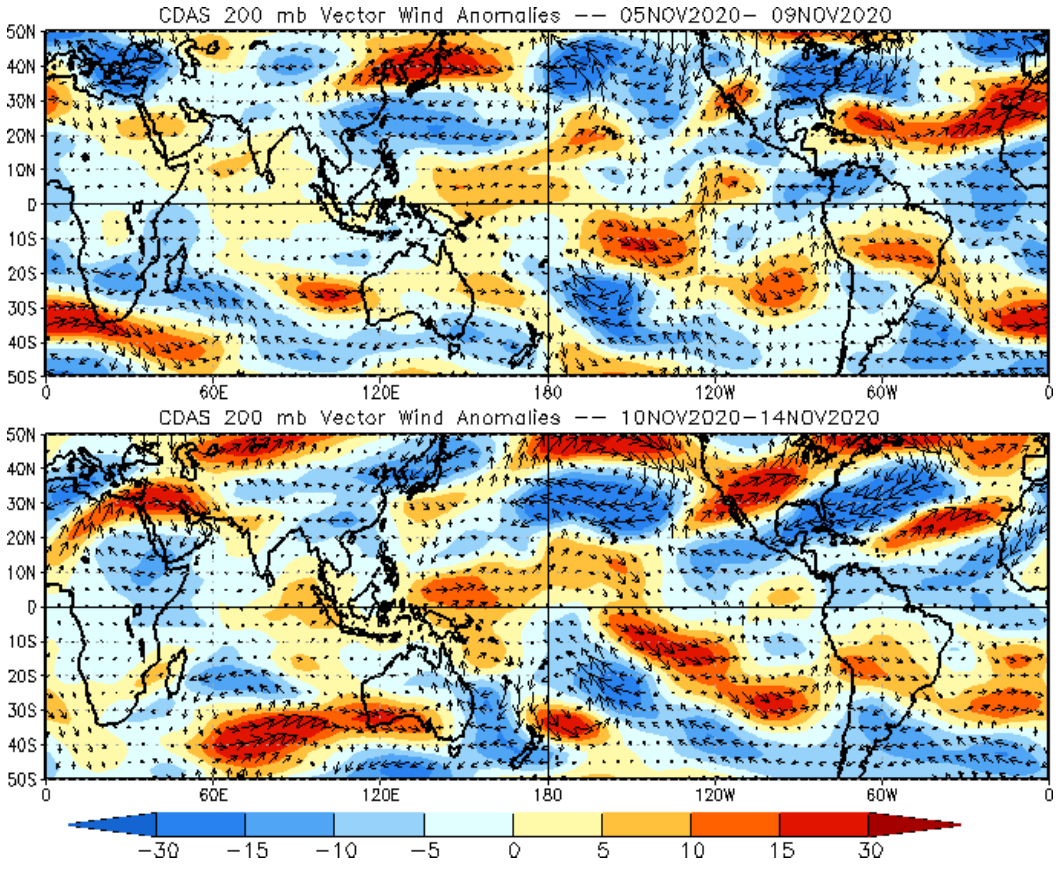
- The first half of November saw a generally opaque perspective for large-scale tropical modes, tied to destructive interference between the active MJO over the Western Hemisphere and La Niña.

- By mid-month, the perspective increased in clarity, with a general wave-1 perspective with the MJO emerging over the Indian Ocean, constructively interfering with enhanced convection from the base state.

200-hPa Wind Anomalies

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

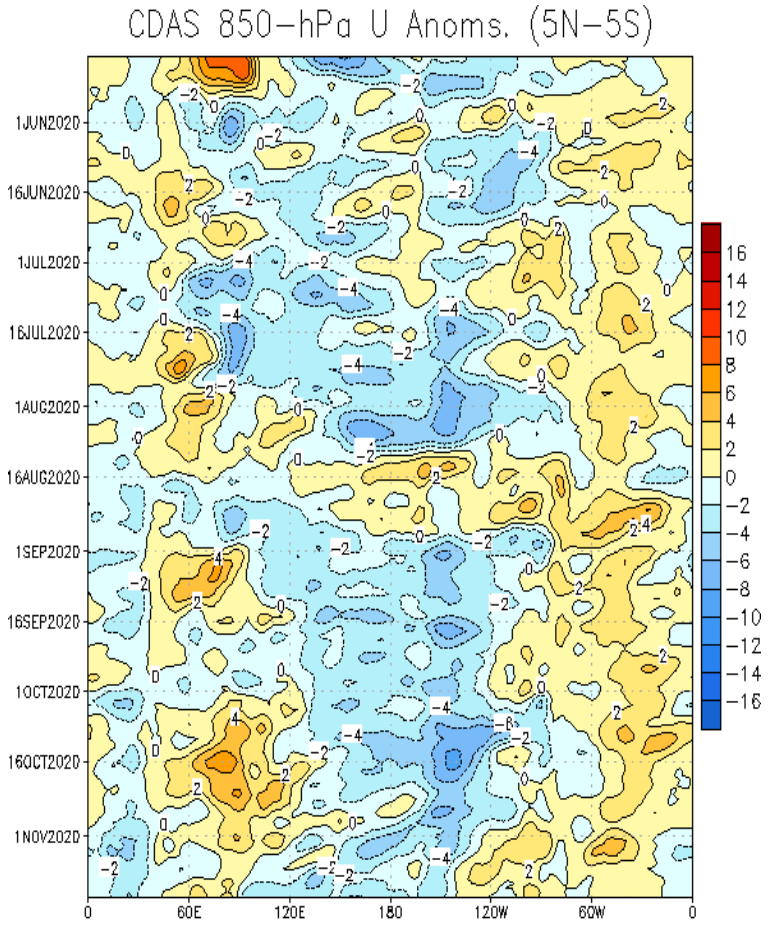


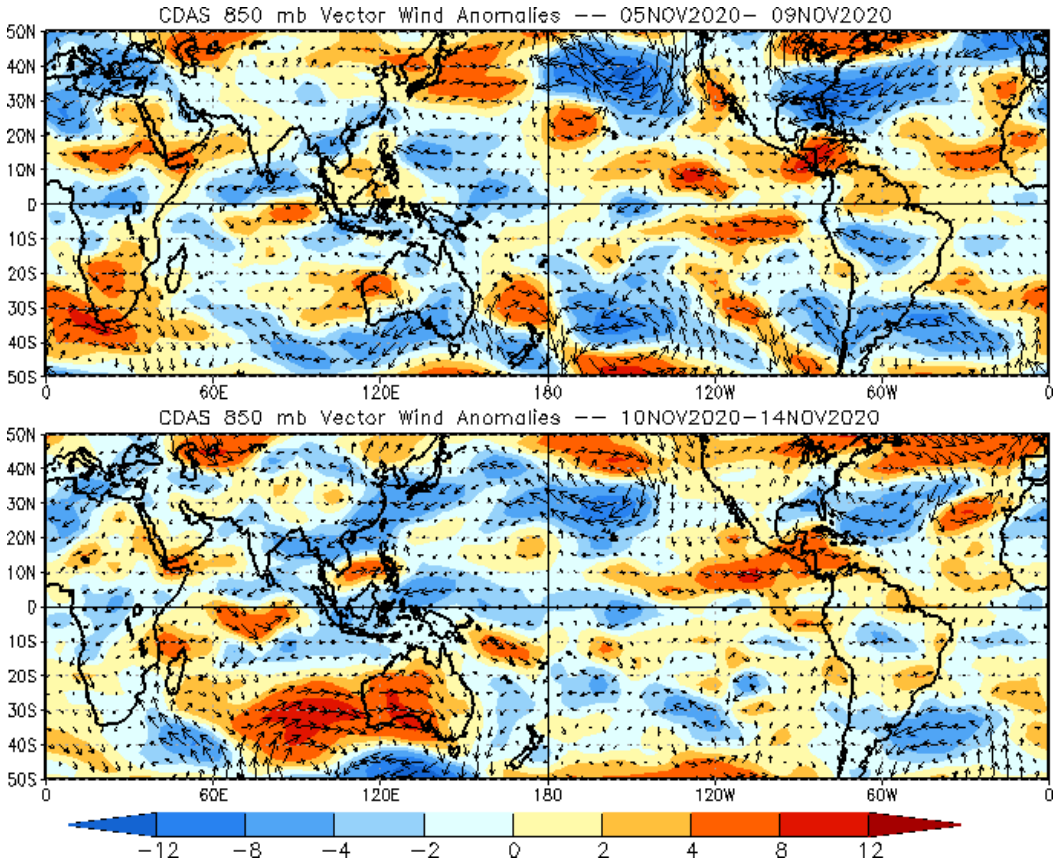


- Anomalous westerlies continue to persist over the Pacific, amidst the ongoing La Niña.
- Cross-equatorial flow is apparent over the Pacific in the Western Hemisphere, tied to twin cyclones on either side of the equator. Wave-breaking continues to show extratropical influences on the equatorial circulation.
- Easterly wind anomalies over much of the Atlantic are helping to maintain the active hurricane season.

850-hPa Wind Anomalies

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

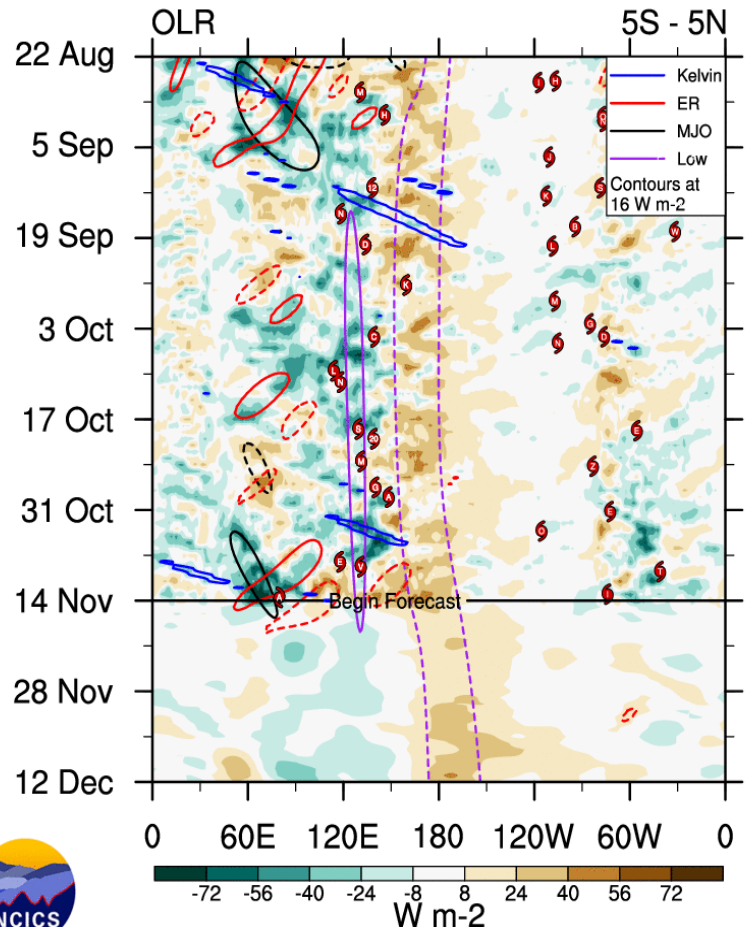


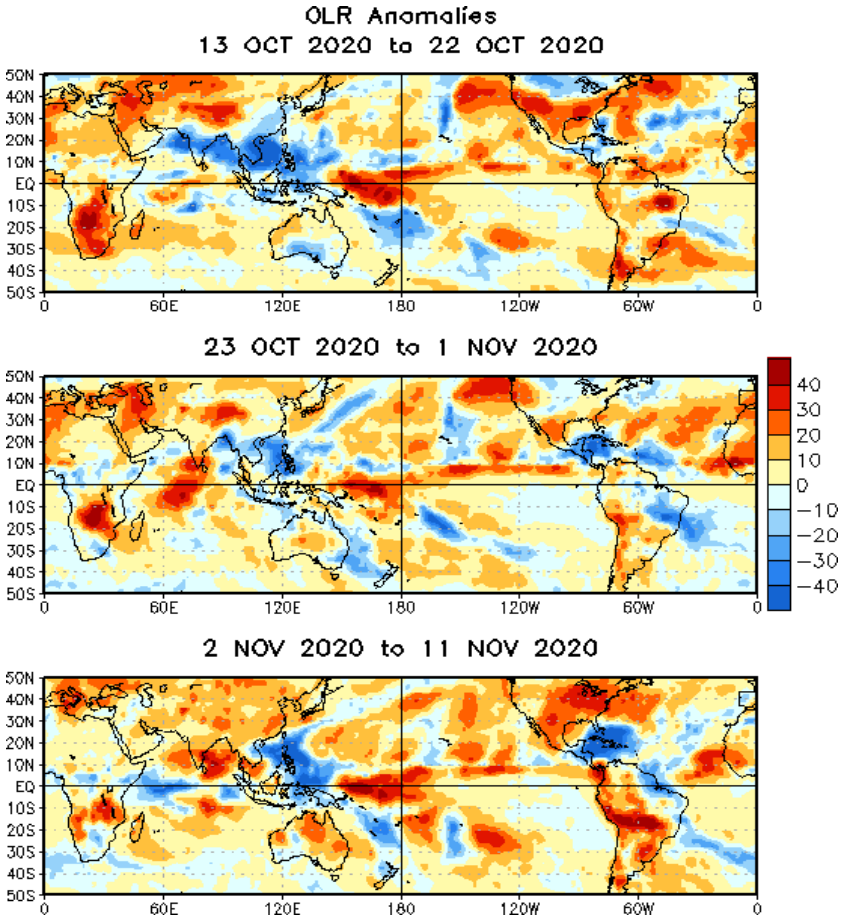


- Anomalous low-level westerlies driven by the MJO pushed eastward across the Pacific over the Western Hemisphere during the first part of November, with strengthened trades tied to La Niña re-emerging in the wake of the subseasonal feature.
- Anomalous westerlies increased over the Indian Ocean during mid-November, associated with the approach of the enhanced MJO envelope.

Outgoing Longwave Radiation (OLR) Anomalies

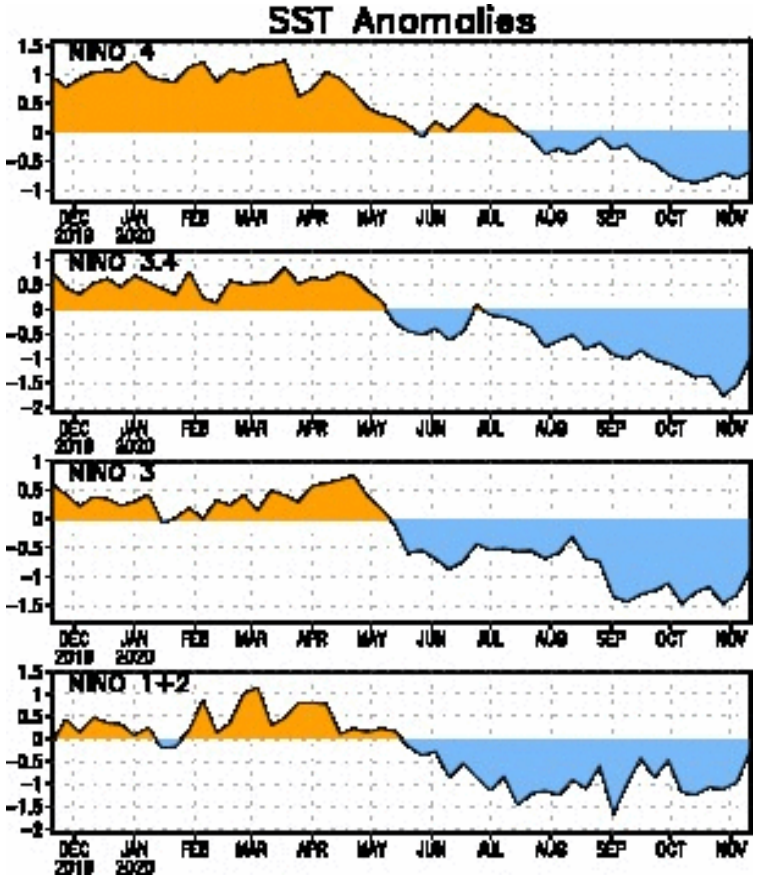
Blue shades: Anomalous convection (wetness). Red shades: Anomalous subsidence (dryness).

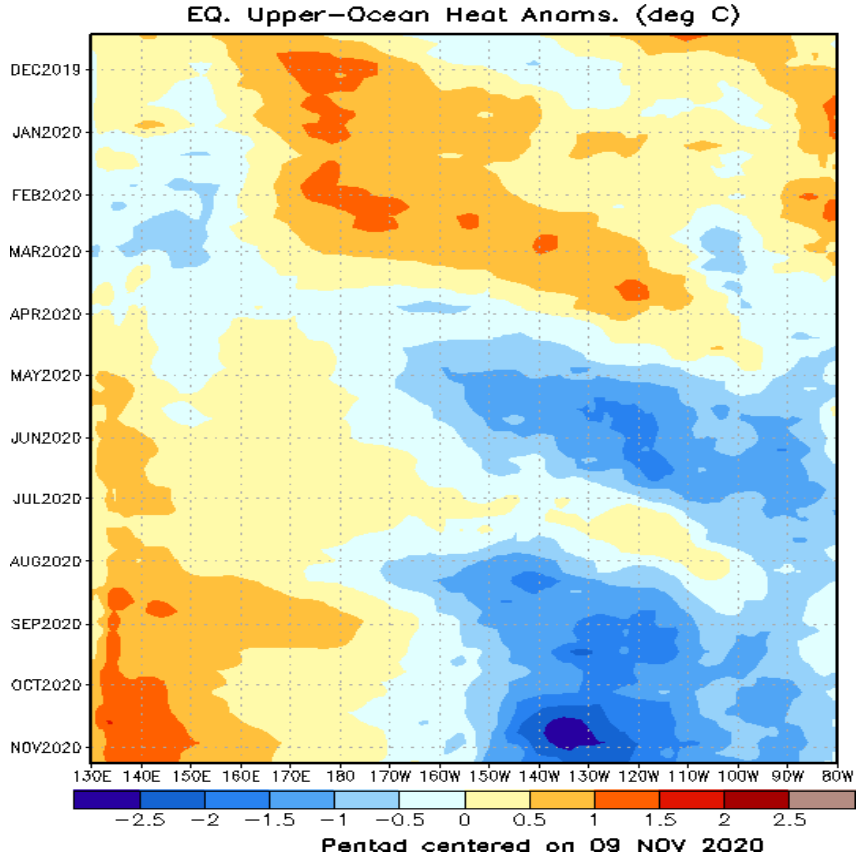




- The MJO crossing the Western Hemisphere may have helped increase convective anomalies and associated tropical cyclone activity over the Caribbean during early November. The latest analysis shows the enhanced convection from the MJO now beginning to fire over the western Indian Ocean.
- Low frequency suppression of convection remains near the Date Line, although this has shifted slightly eastward of late, possibly due to increased Rossby wave and tropical cyclone activity over the West Pacific.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

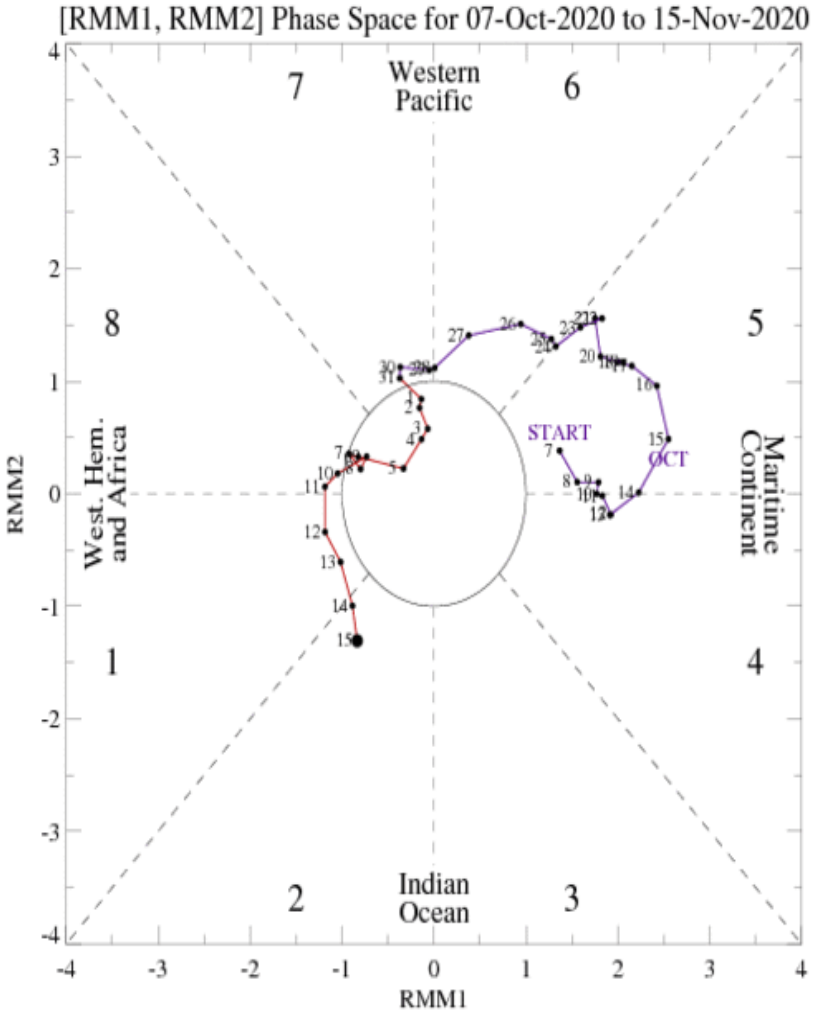




- Following destructive interference with the base state by a downwelling Kelvin wave during July, the subsequent upwelling phase has pushed the Pacific into La Niña conditions.
- A subsequent downwelling Kelvin wave initiated in late August and failed to cross the central Pacific.
- Negative anomalies 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. Some slight recovery of near-surface heat content is observed over the past week.

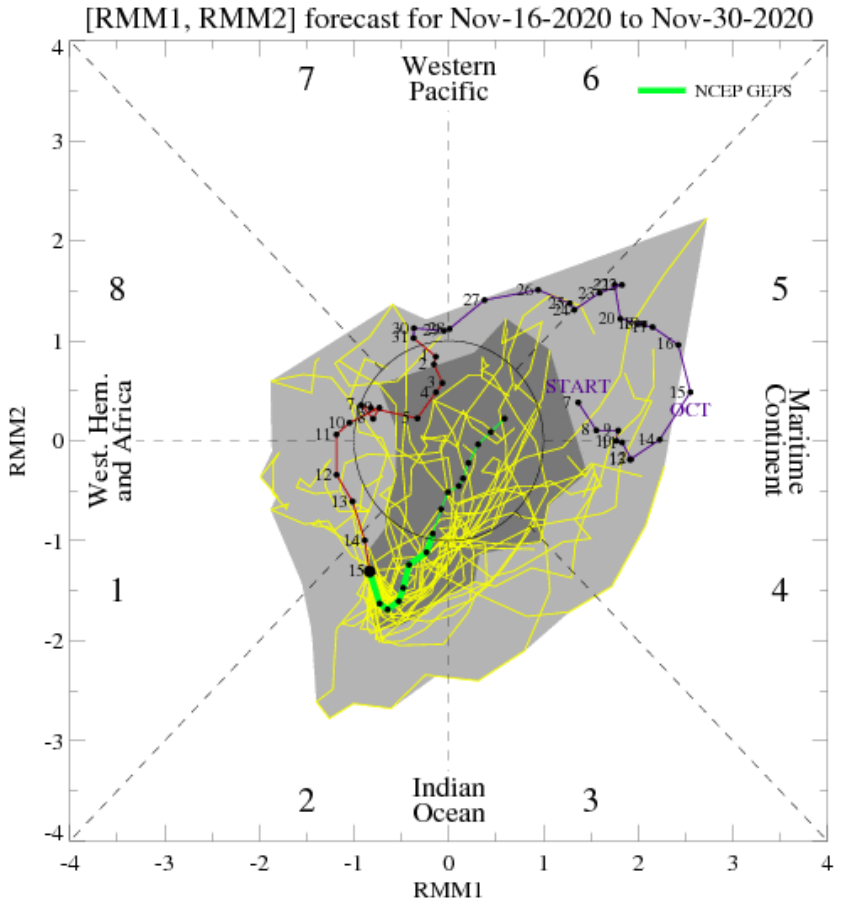
MJO Index: Recent Evolution

- The RMM index tracked the MJO across the Western Hemisphere during the past week.
- The enhanced MJO envelope is currently over the Western Indian Ocean.

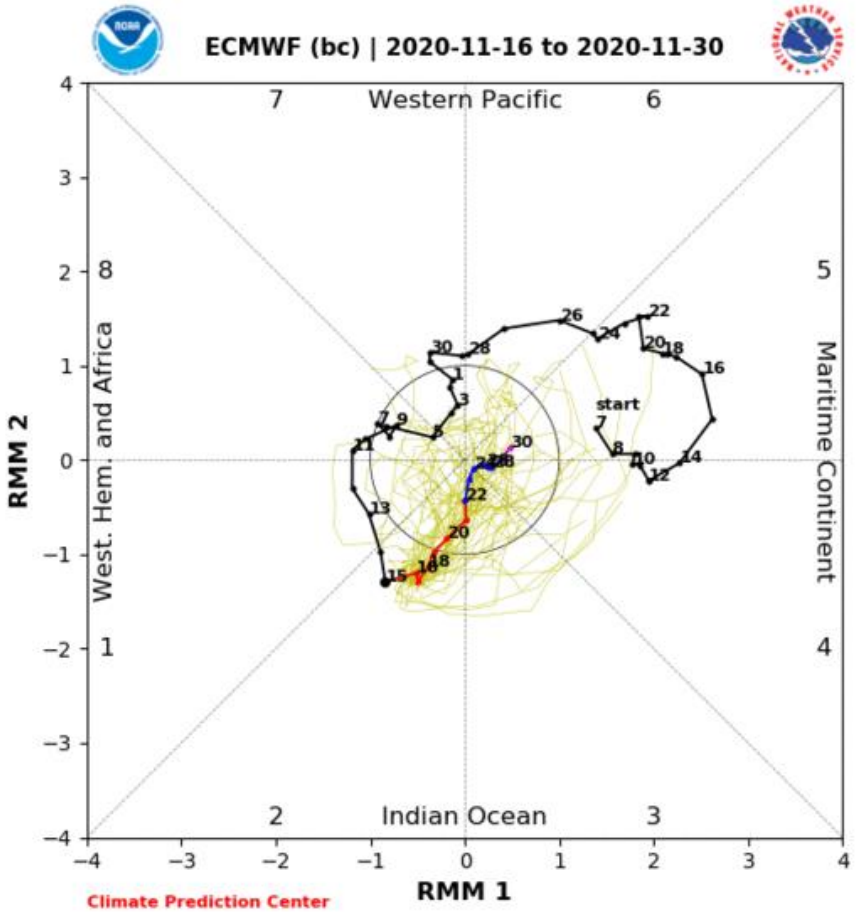


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

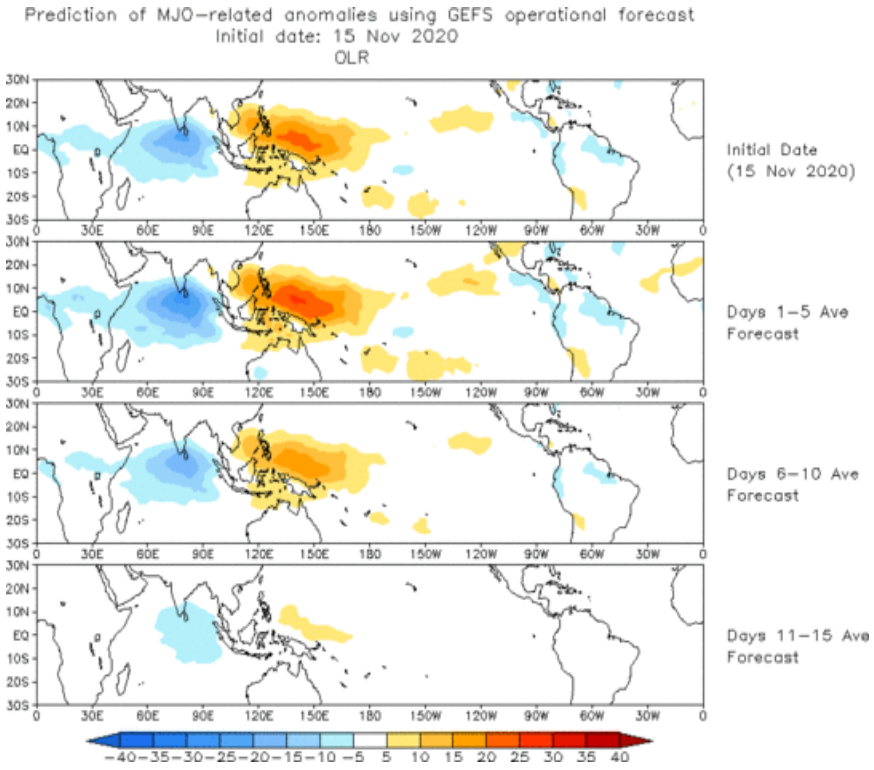


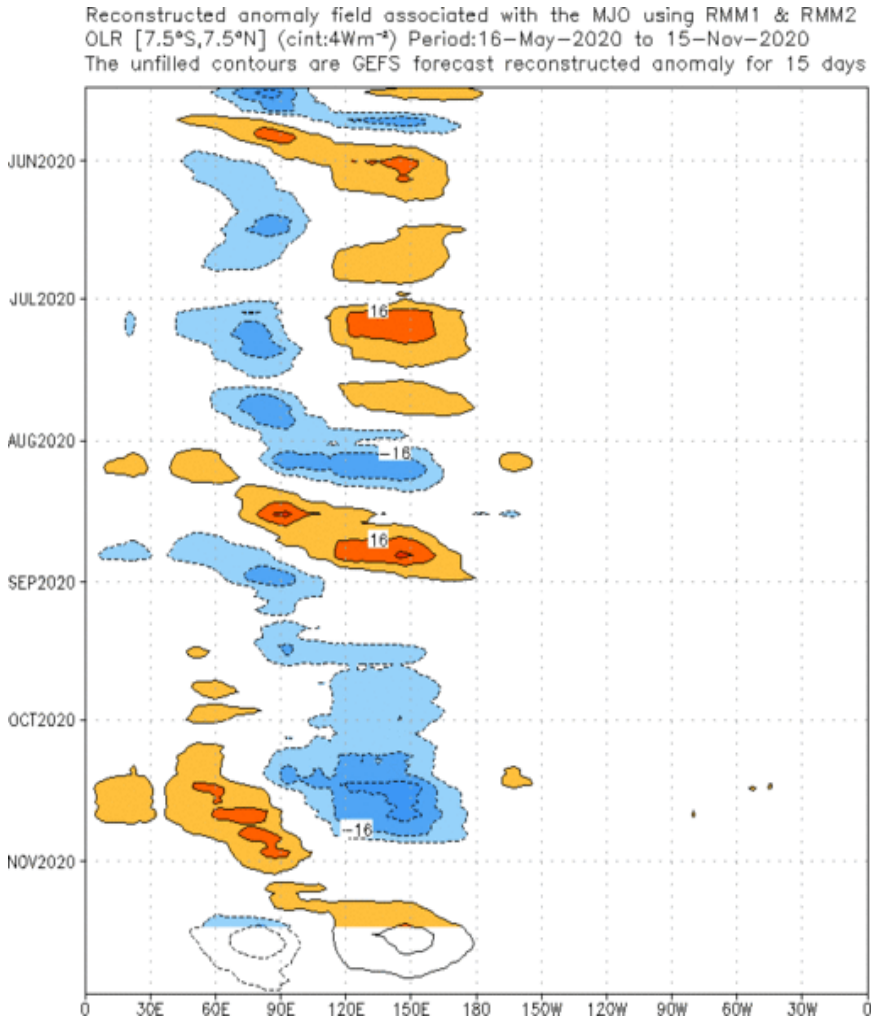
ECMWF Forecast

- Both the GEFS and ECMWF forecast the MJO to propagate eastward over the Indian Ocean during the next week.
- The MJO is forecast to gradually decay beginning around mid-week while pushing eastward at a slightly more rapid pace. Spread among ensemble members is significant, such that the GEFS has members than are in each of the 8 MJO phases by the end of November, thus the overall forecast is highly uncertain.

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.)

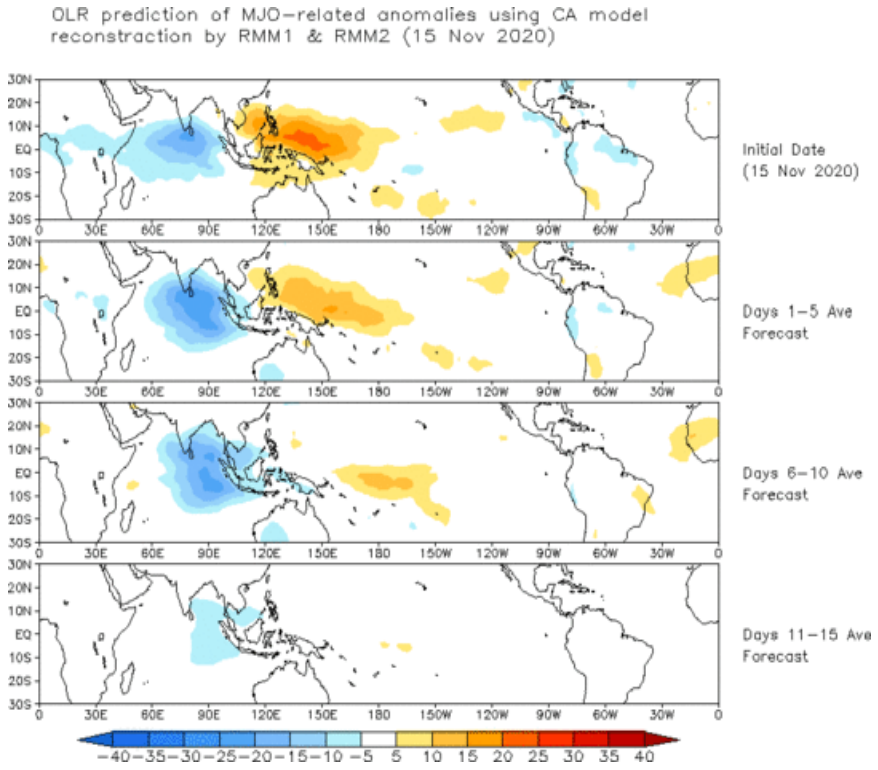


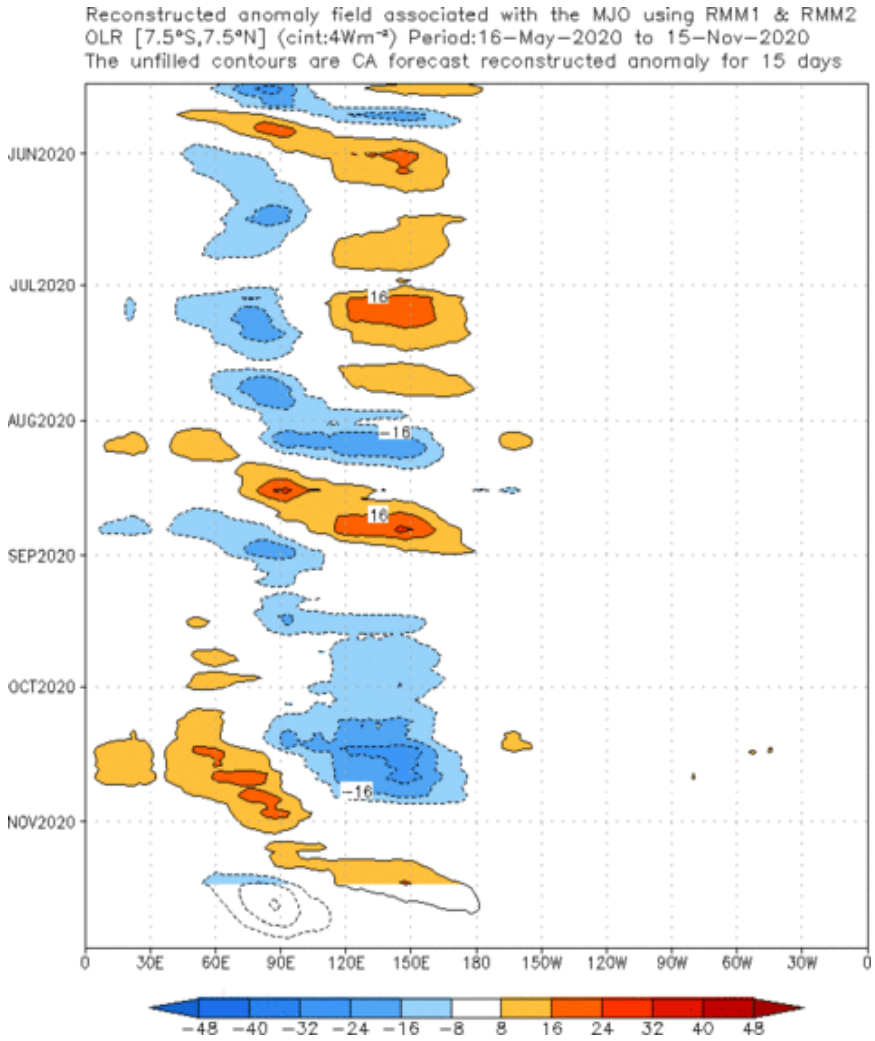


- The GEFS forecasts a slow-moving convective couplet over the Indian Ocean and West Pacific that gradually weakens through the end of November.

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.)

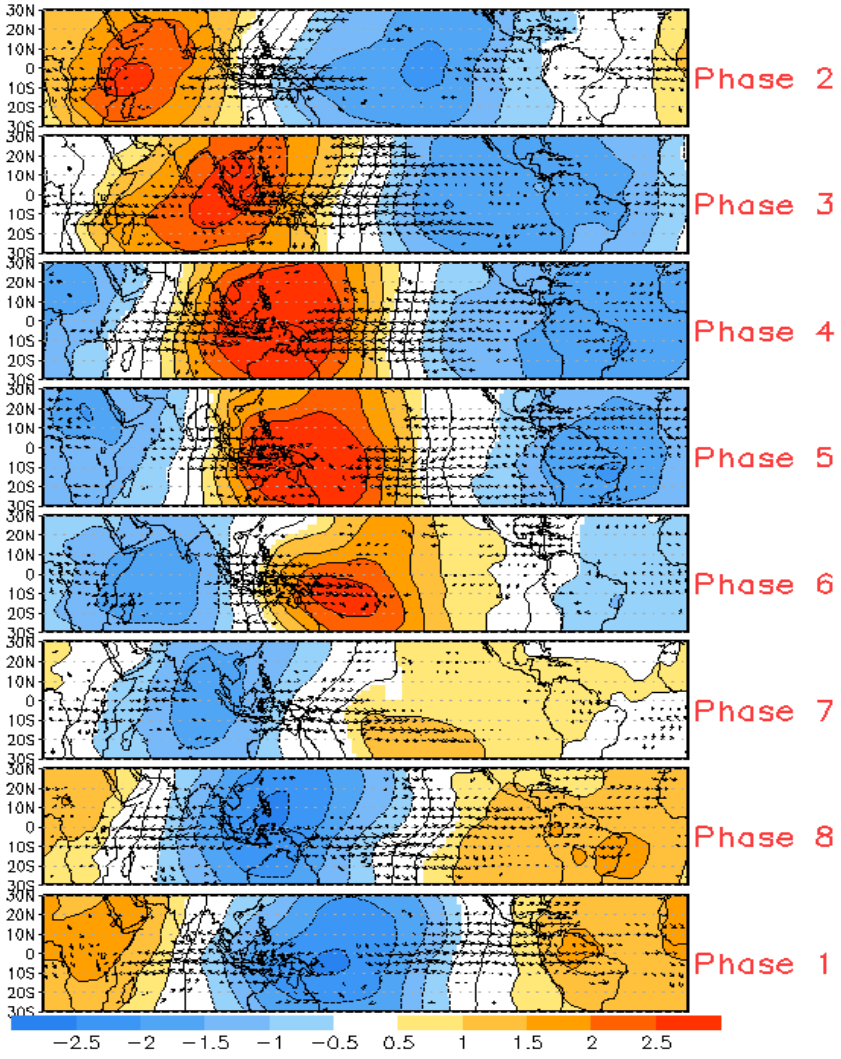




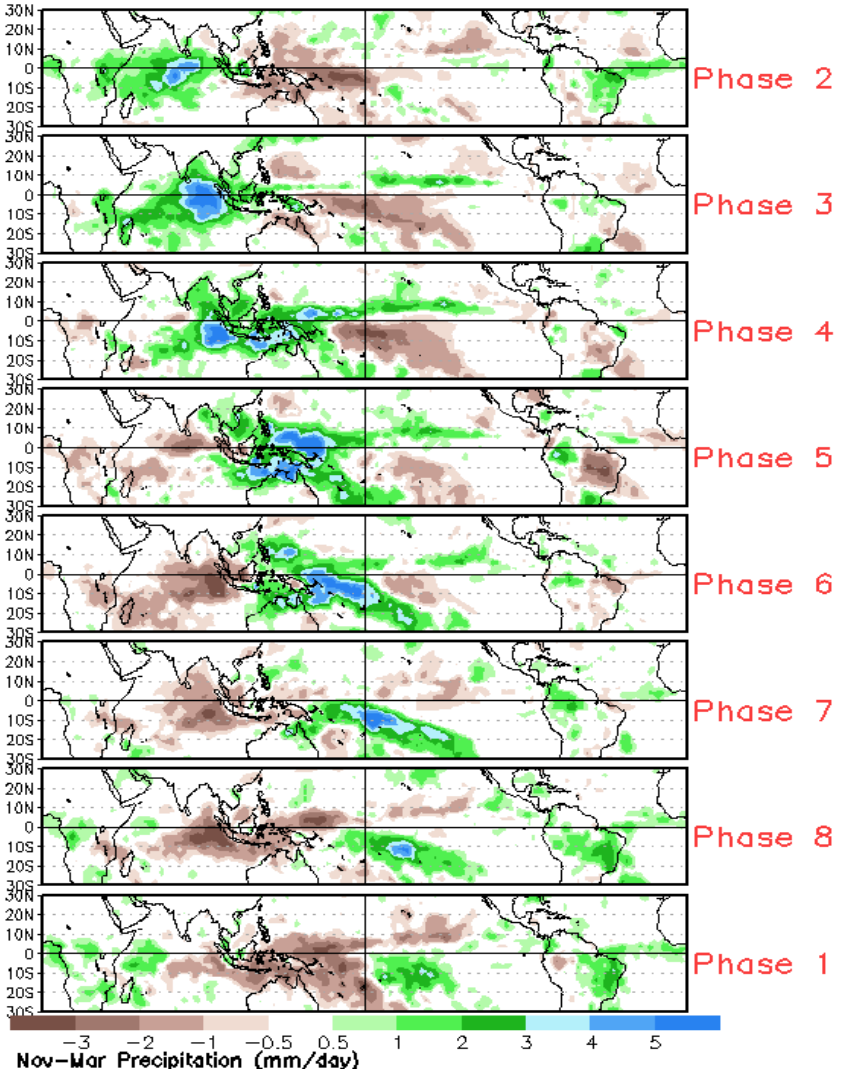
- The constructed analog model is slightly faster than the GEFS, while also supporting the decay of the intraseasonal footprint.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



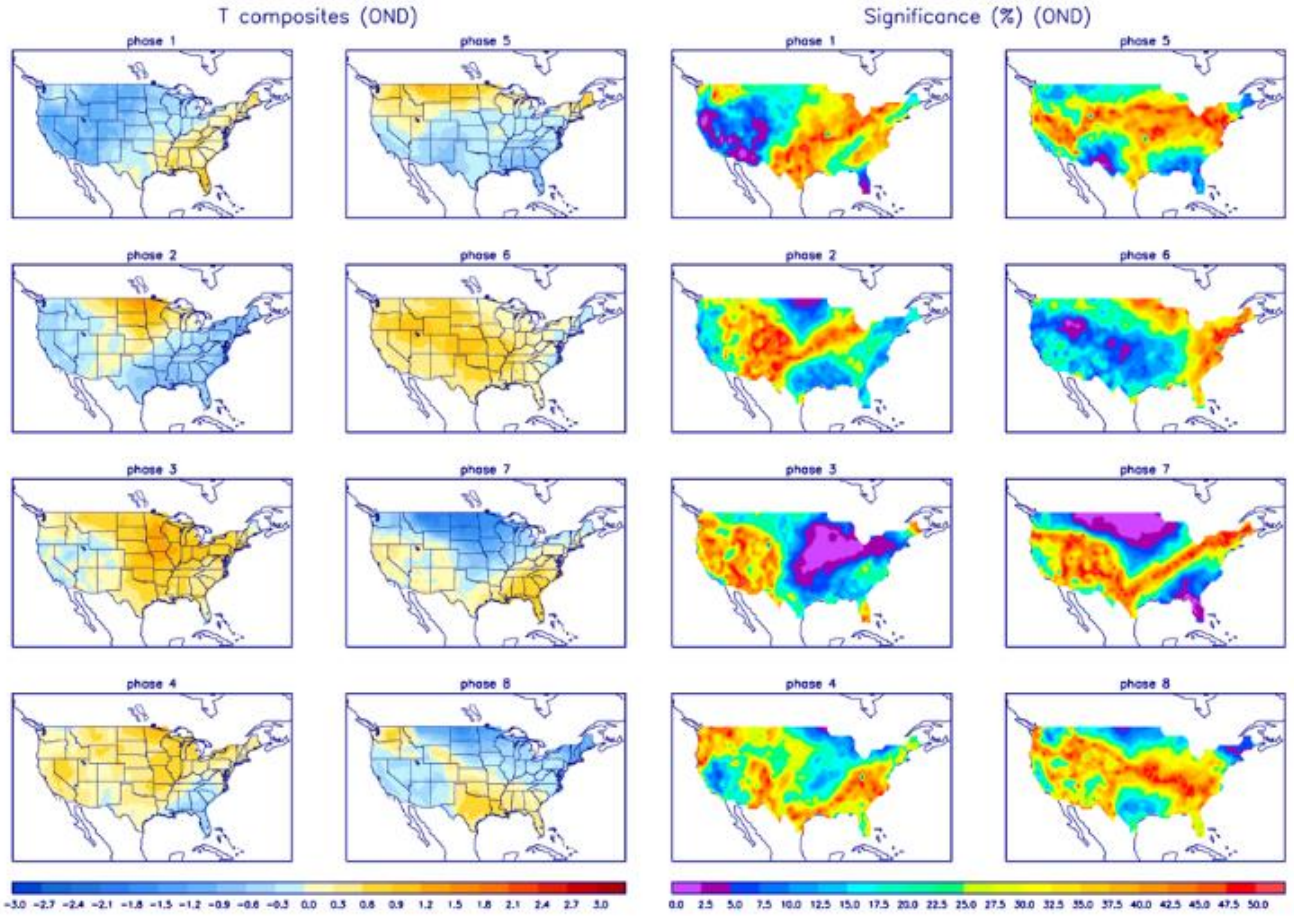
Precipitation Anomalies



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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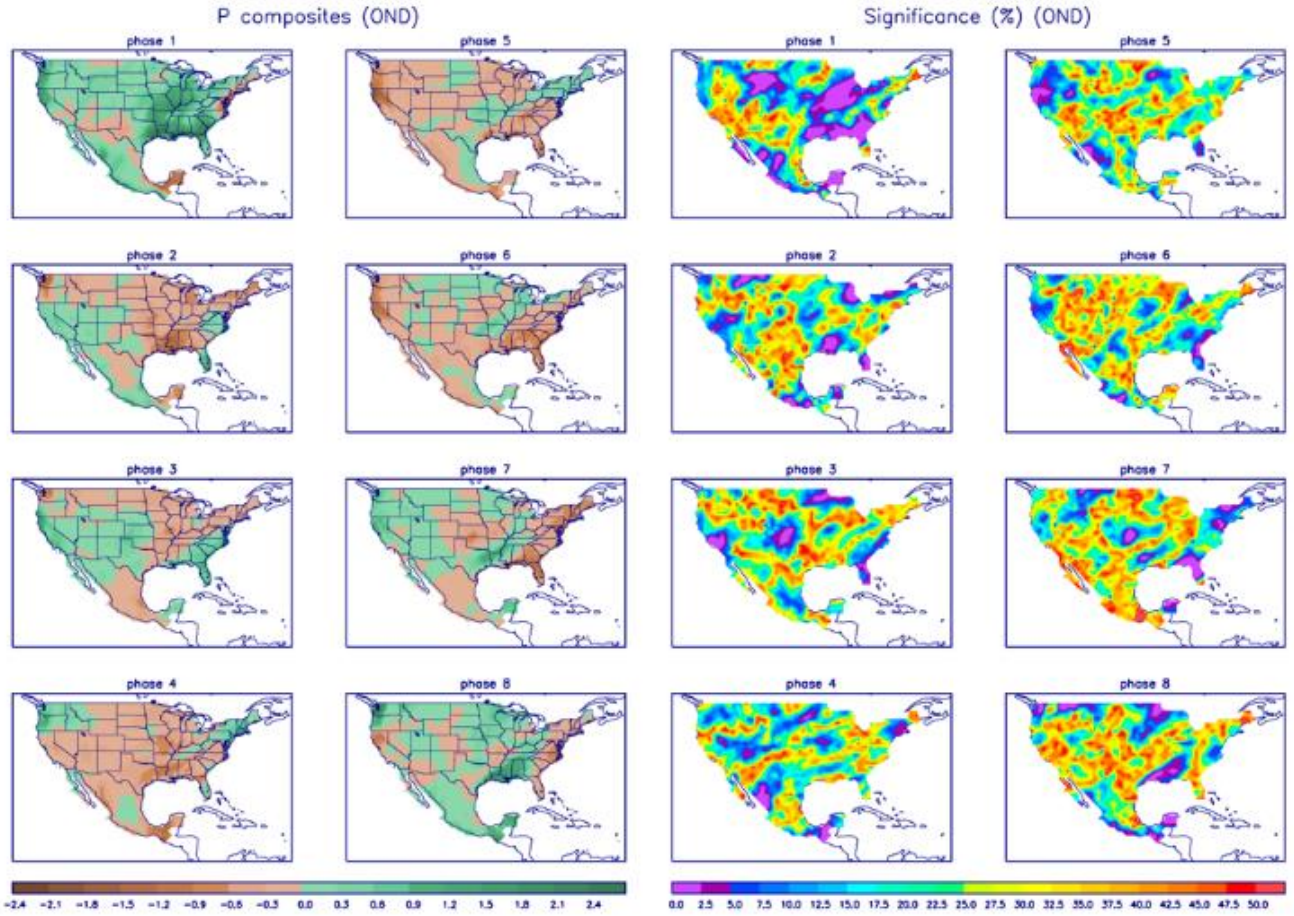

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