

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



Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
8 February 2021

Overview

- The RMM index continues to portray an active intraseasonal signal over the West Pacific. Some observational guidance suggests this could be the case, given some observed weakening of persistent suppressed convection near the Date Line due to La Niña.
- Model guidance varies on the evolution of this intraseasonal signal during the next two weeks, but is consistent in showing some westward progression that would be uncharacteristic of the MJO but more in line with equatorial Rossby wave activity. The ECMWF ensemble mean and some GEFS members also portray the MJO as weakening over the next two weeks.
- Given the lack of characteristic propagation of any intraseasonal signal, and the potential for the MJO to weaken as it interferes with other modes of tropical variability, the tropics appear unlikely to drive significant extratropical teleconnection activity to the higher latitudes during the next two weeks. The forecast circulation pattern over the Americas the next two weeks bears little resemblance to what would be expected for an active MJO event over the West Pacific, and is instead likely a mix of La Niña influences and high-latitude teleconnections.

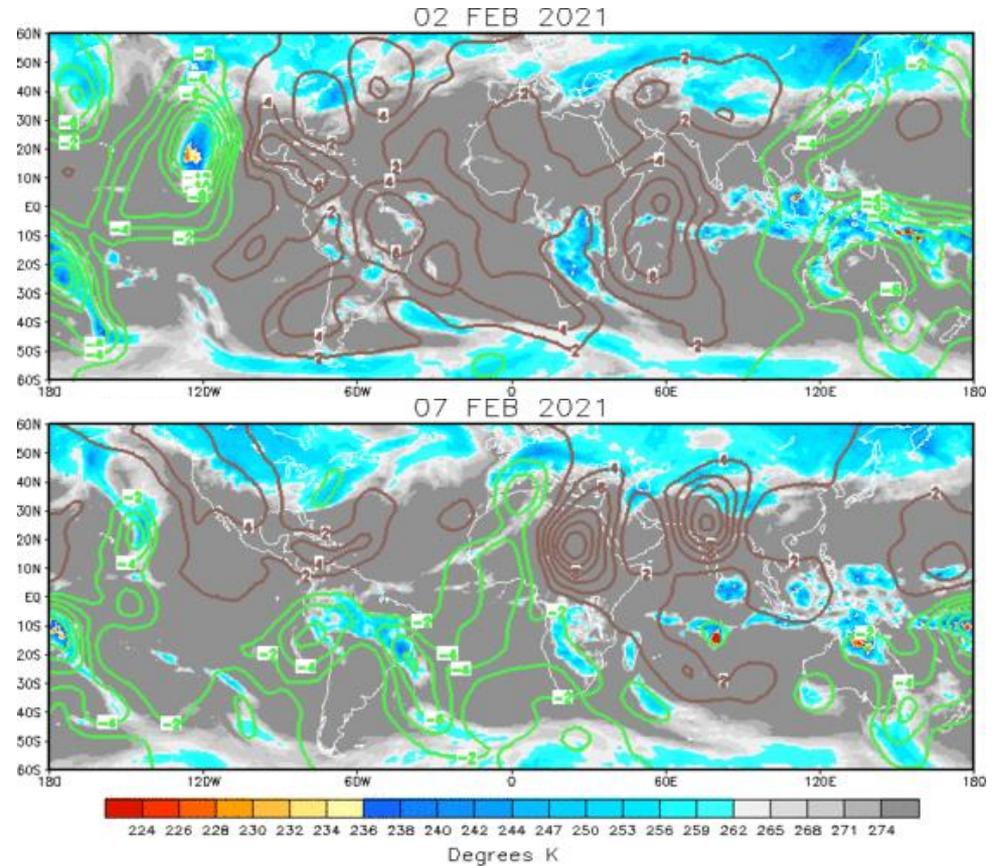
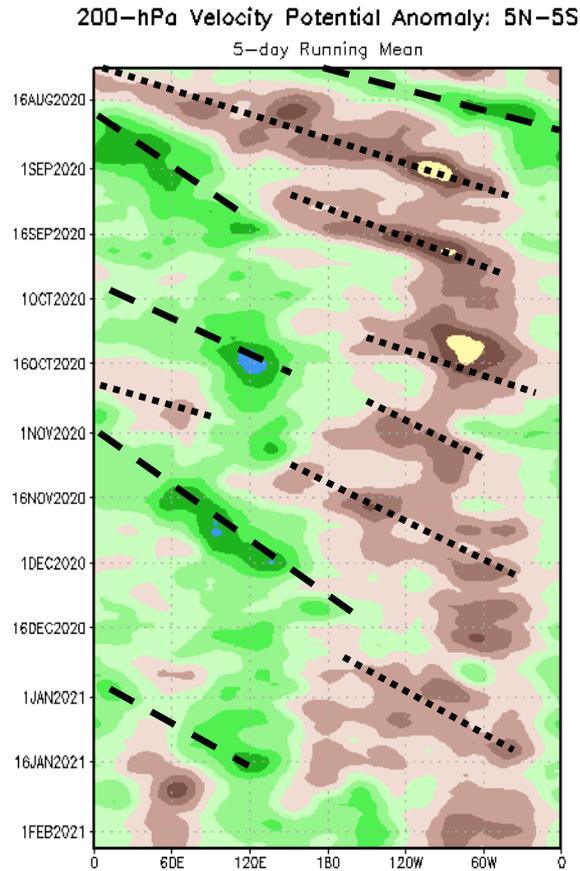
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:

<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

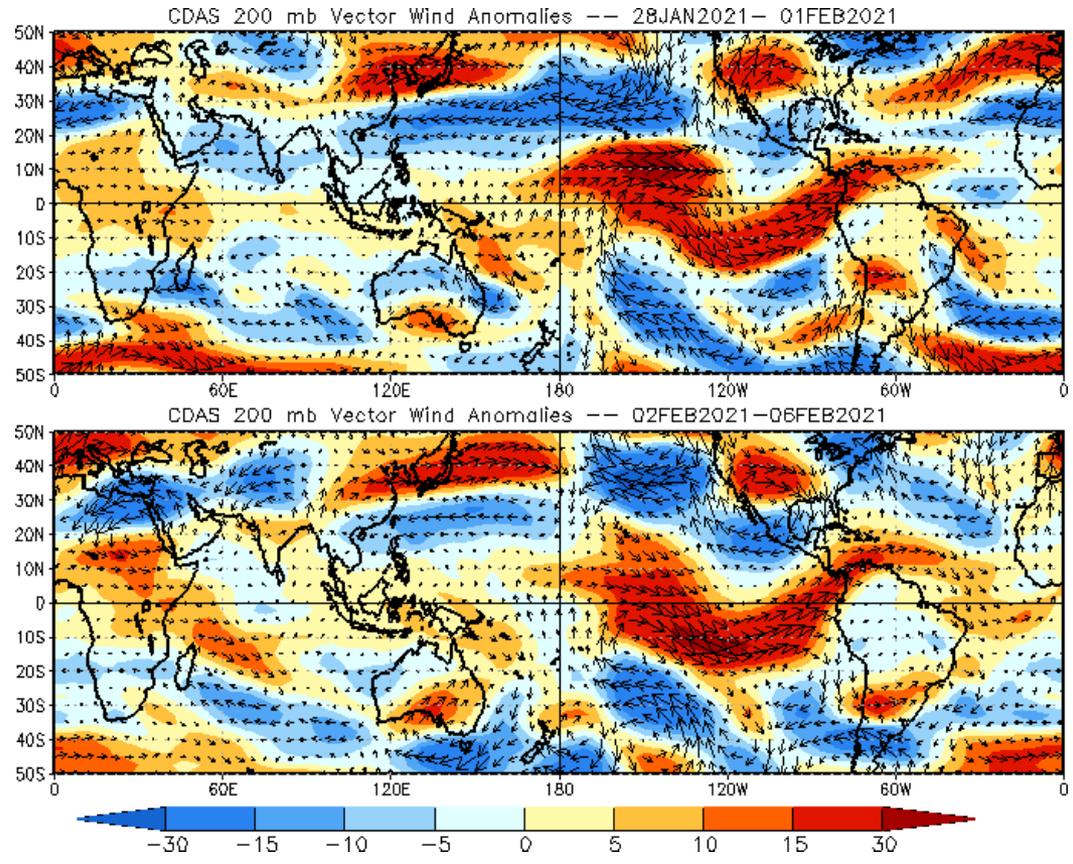
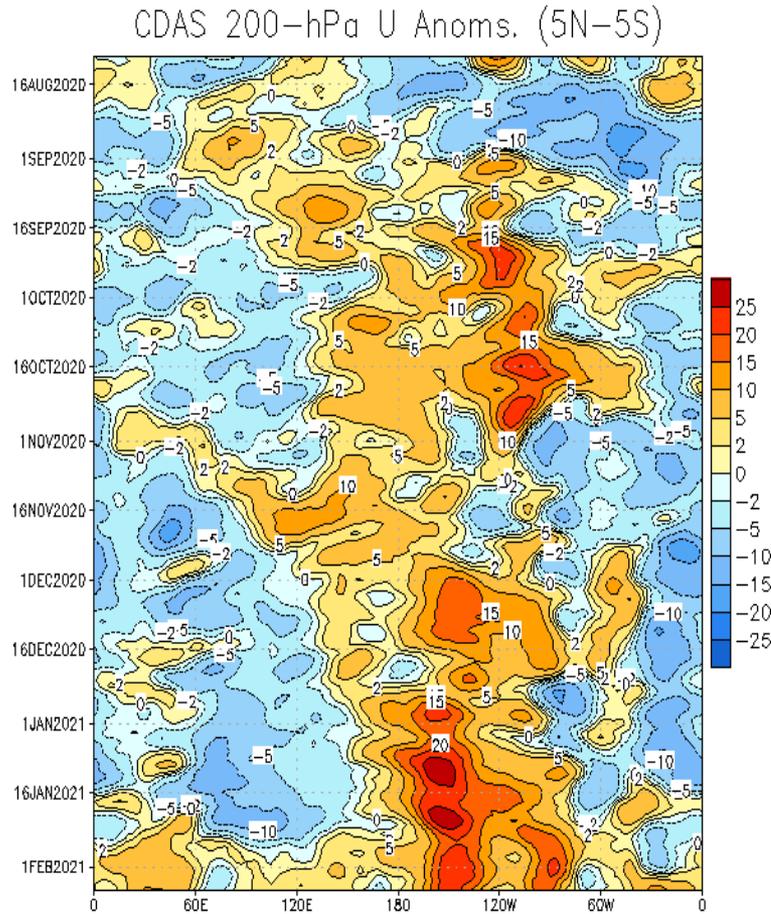
Brown shades: Anomalous convergence (unfavorable for precipitation).



- Upper-level velocity potential anomalies have become more stationary following an eastward shift of the pattern during late January.
- Enhanced convection persists across much of the South Pacific, while the Indian Ocean is experiencing suppressed convection with the notable exception of Tropical Cyclone Faraji.

200-hPa Wind Anomalies

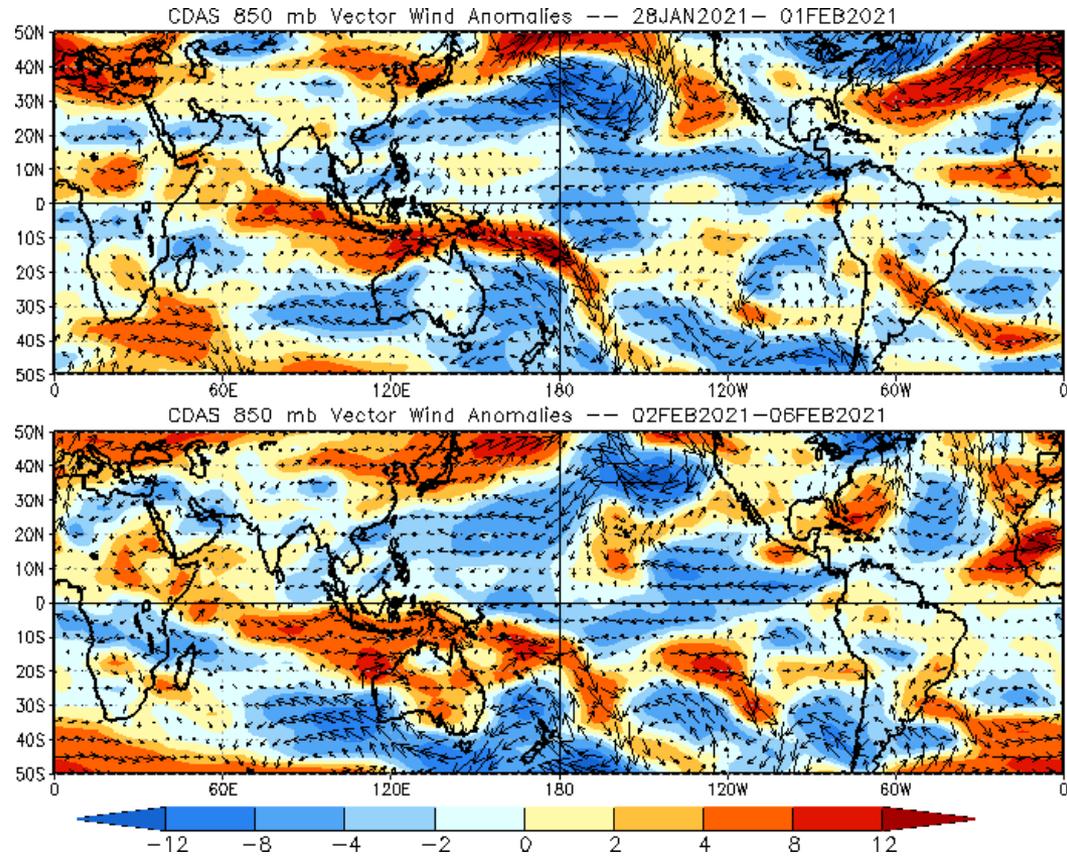
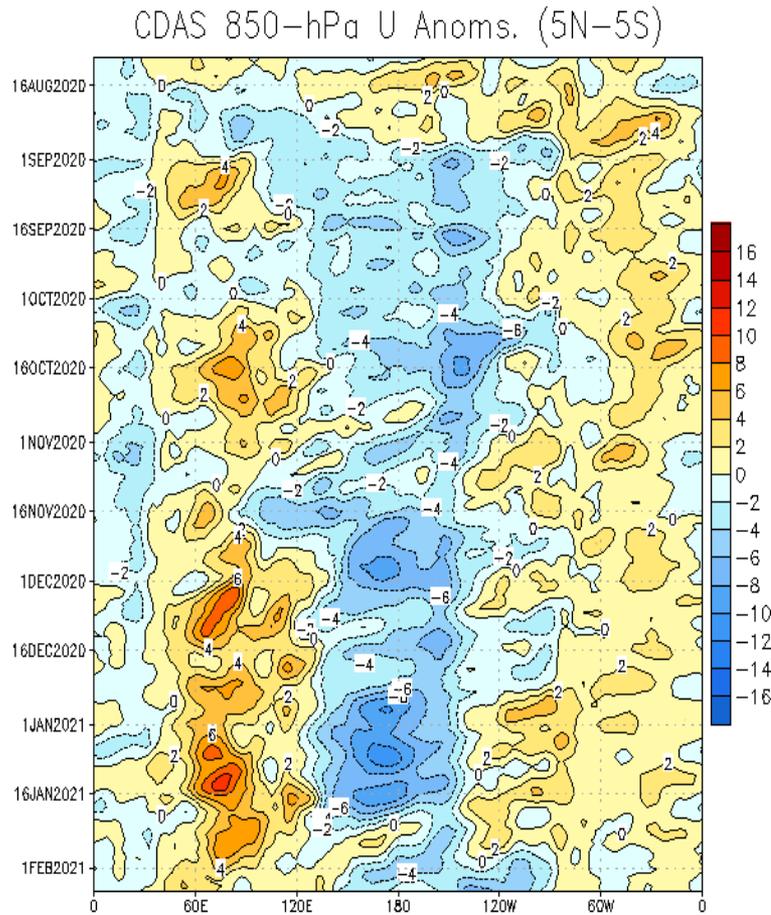
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- The North Pacific jet retracted slightly from late January and early February through recently, now confined to generally west of the Date Line.
- Wave breaking continues to inject mass from the higher latitudes of both hemispheres of the Pacific into the tropics to help reinforce robust anomalous westerlies to the east of the Date Line.

850-hPa Wind Anomalies

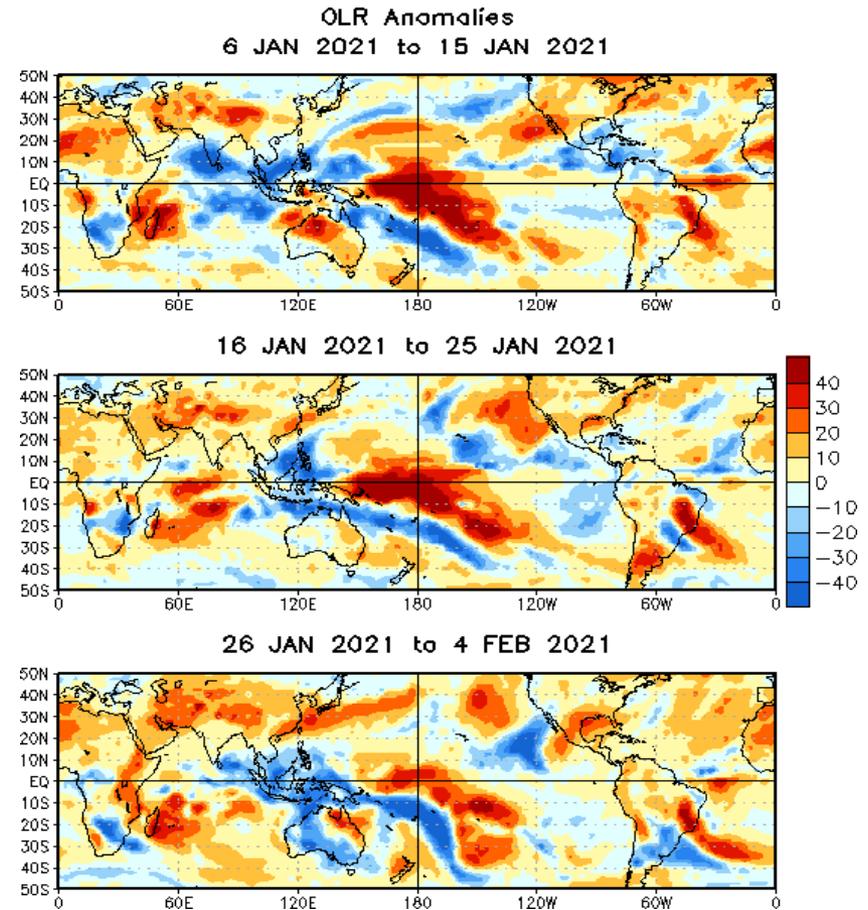
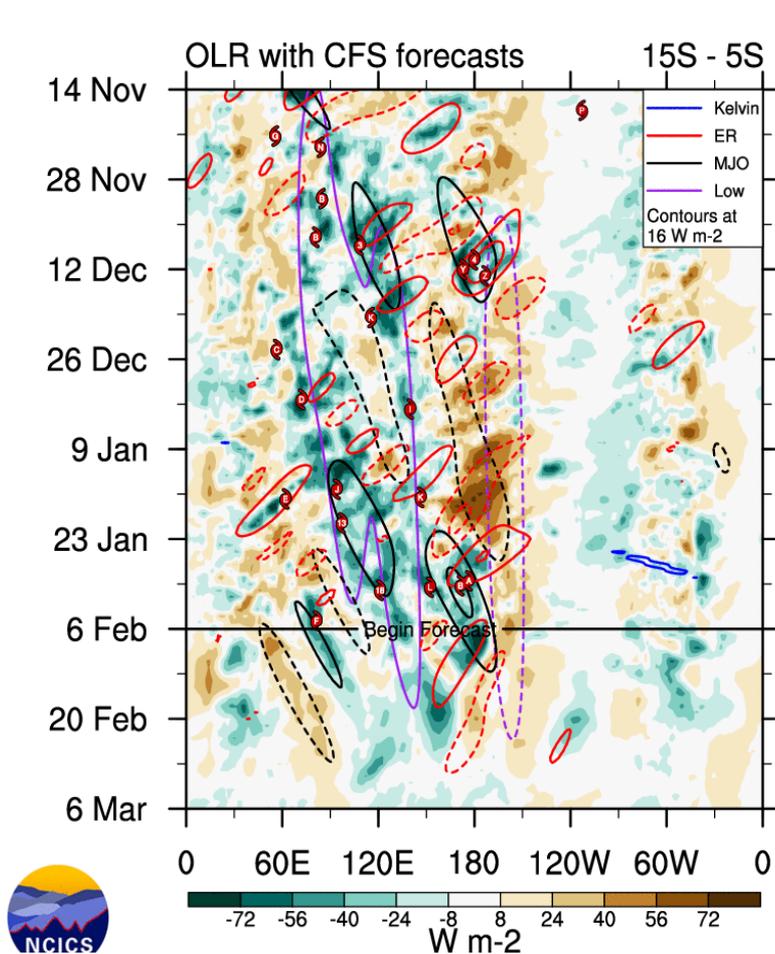
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- A strong band of anomalous westerlies are observed extending from the Horn of Africa east-southeastward through the South Pacific, associated with Tropical Cyclone Faraji and another possible system forming over the South Pacific.
- Trades have slightly picked up across the Pacific since late January.

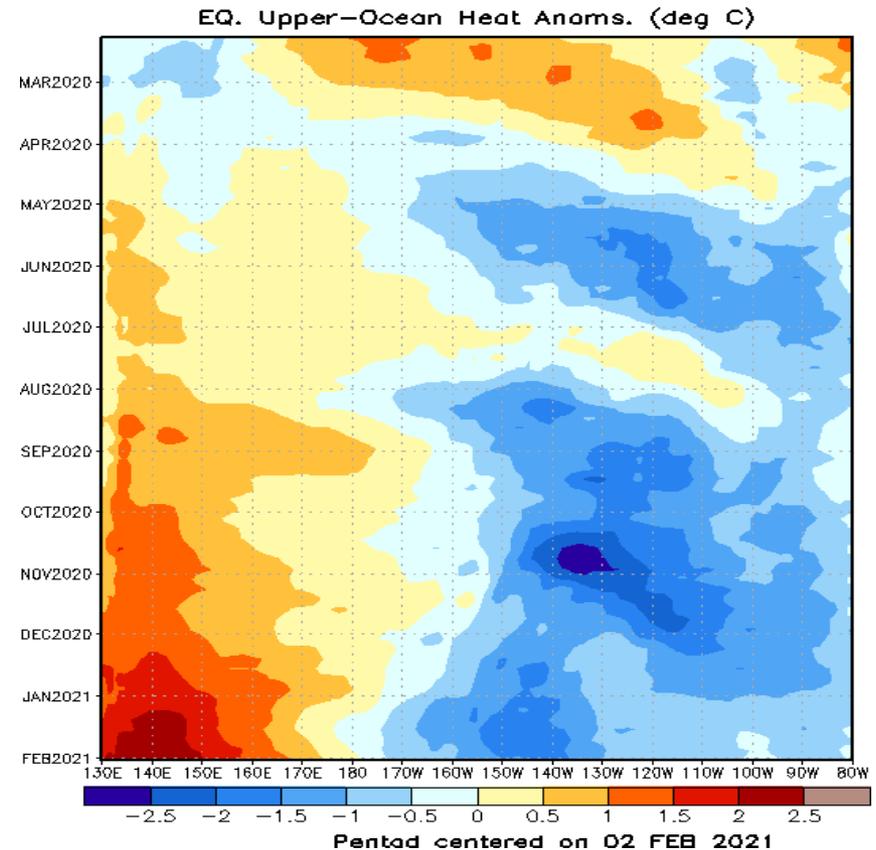
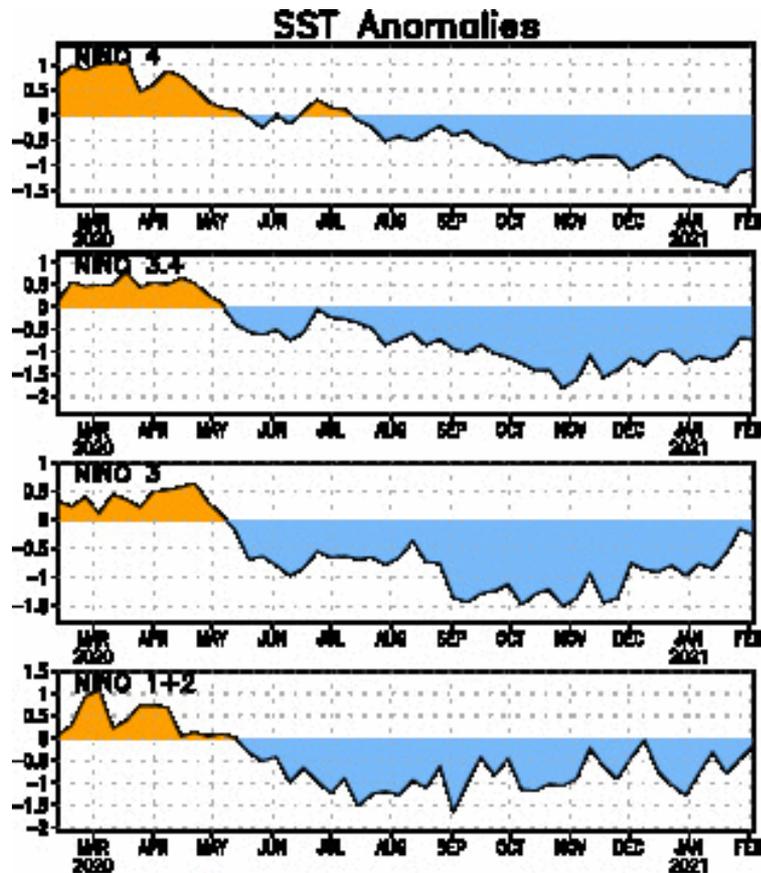
Outgoing Longwave Radiation (OLR) Anomalies

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



- Enhanced (suppressed) convection has been established over the Maritime Continent (Central Pacific) since mid-December in association with warm (cold) sea surface temperatures and the ongoing La Niña.
- There has been some weakening of suppressed convection near the Date Line in late January/early February, likely tied to destructive interference from the MJO.

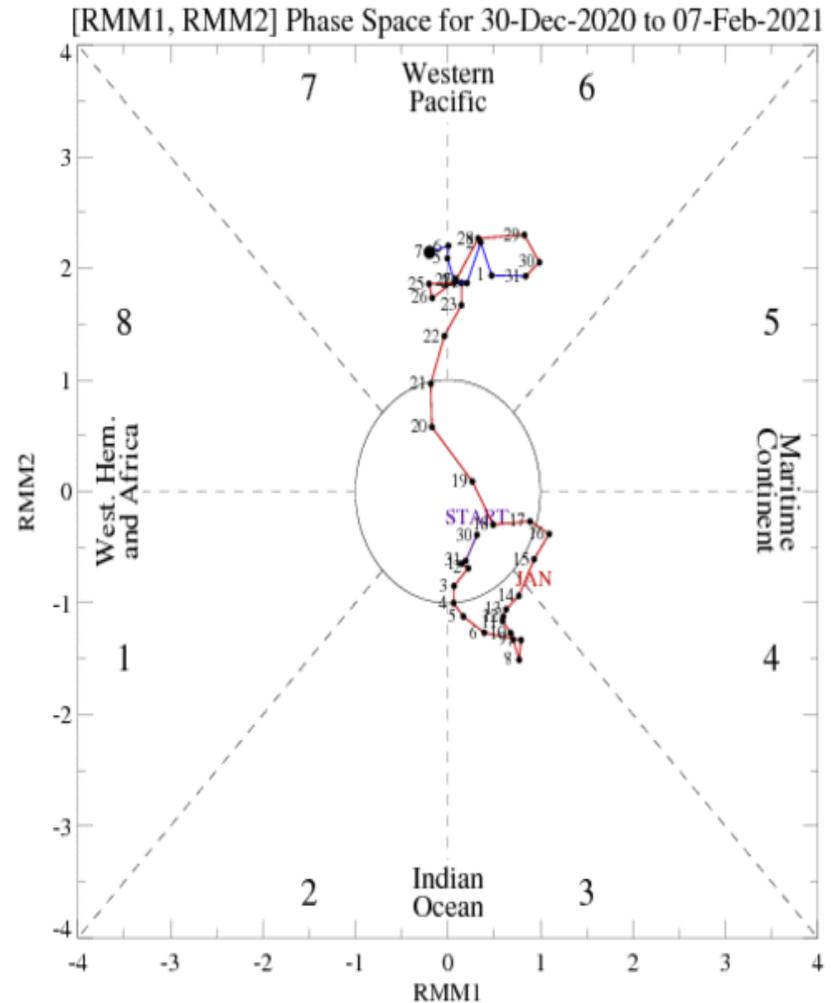
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



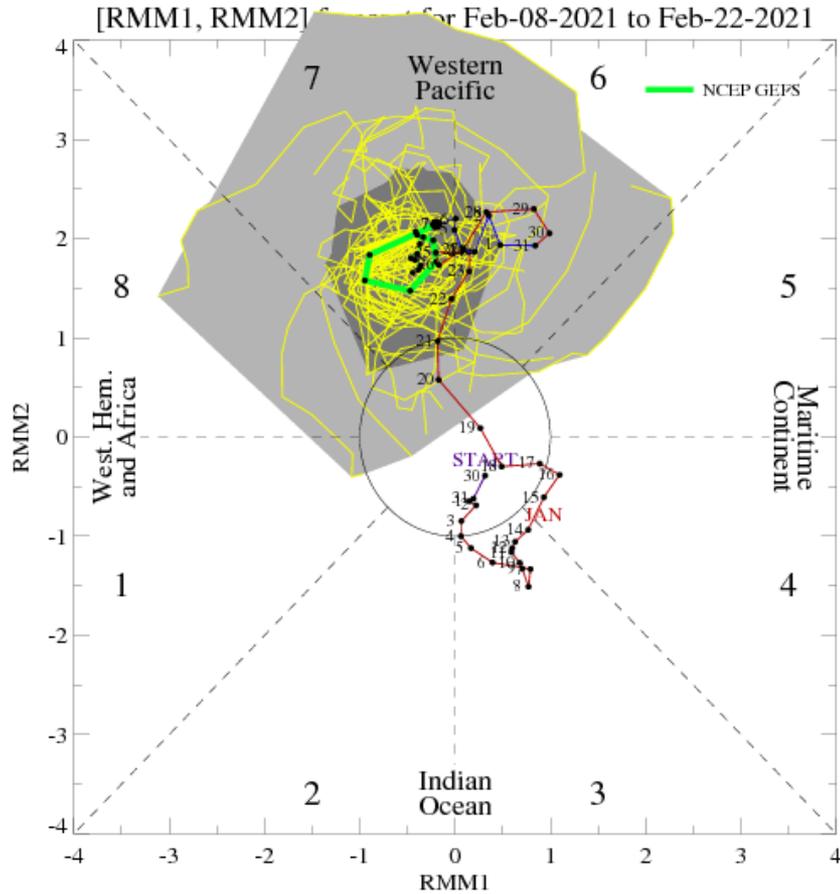
- Following destructive interference with the base state by a downwelling Kelvin wave during July, the subsequent upwelling phase pushed the Pacific into La Niña conditions.
- Anomalous cold conditions have shifted westward across the central Pacific. However, all Niño regions suggest a weakening of the below-normal SST's since mid-January.

MJO Index: Recent Evolution

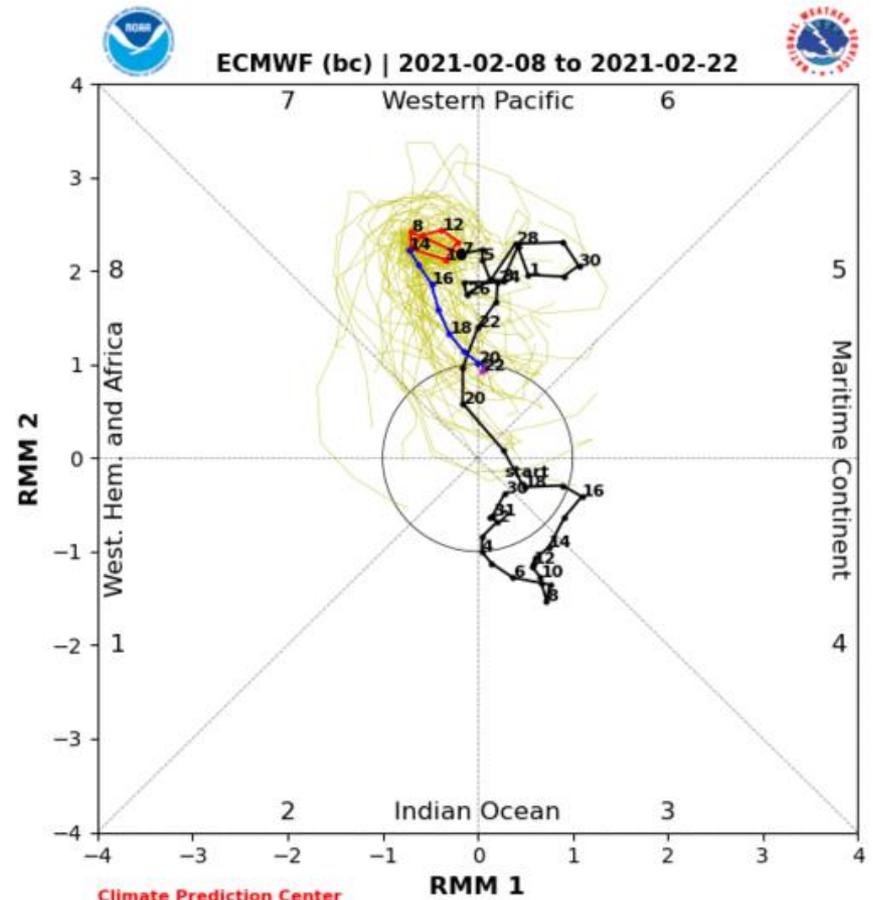
- The tropical convection and wind patterns have continued to project onto the RMM index during late January and early February with the intraseasonal signal meandering over the West Pacific during the past week.



MJO Index: Forecast Evolution



GEFS Forecast



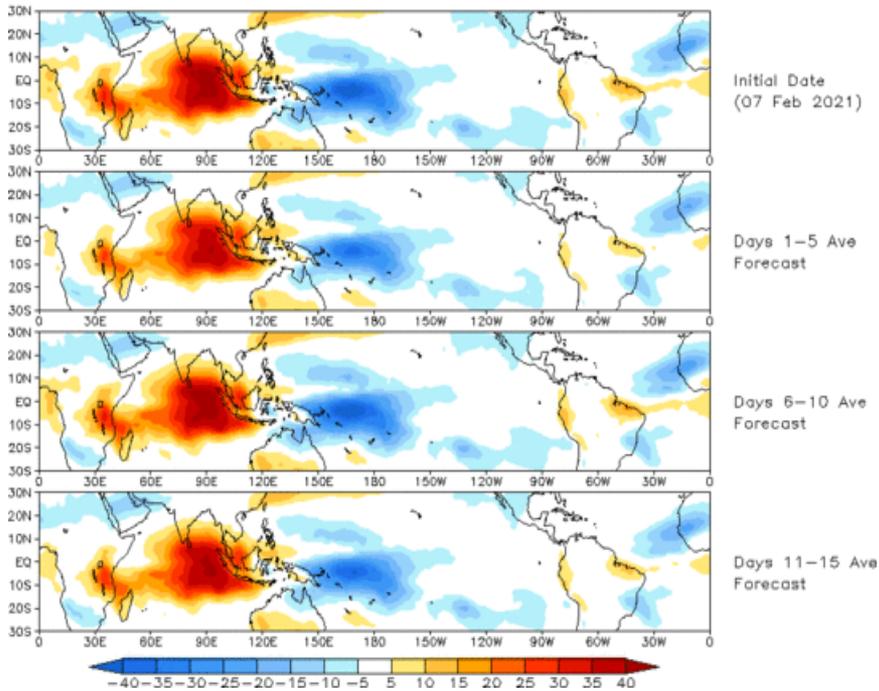
ECMWF Forecast

- Ensemble guidance varies in their forecasts of the MJO the next two weeks.
- The GEFS generally shows eastward progression through the weekend, before a westward loop that is likely tied to equatorial Rossby wave activity. Spread in the GEFS is large, with individual members at the end of Week-2 residing in any of RMM Phases 5 through 1.
- The ECMWF is more tightly clustered around a weakening MJO event over the West Pacific the next two weeks, which also advertises somewhat of a westward shift.

MJO: GEFS Forecast Evolution

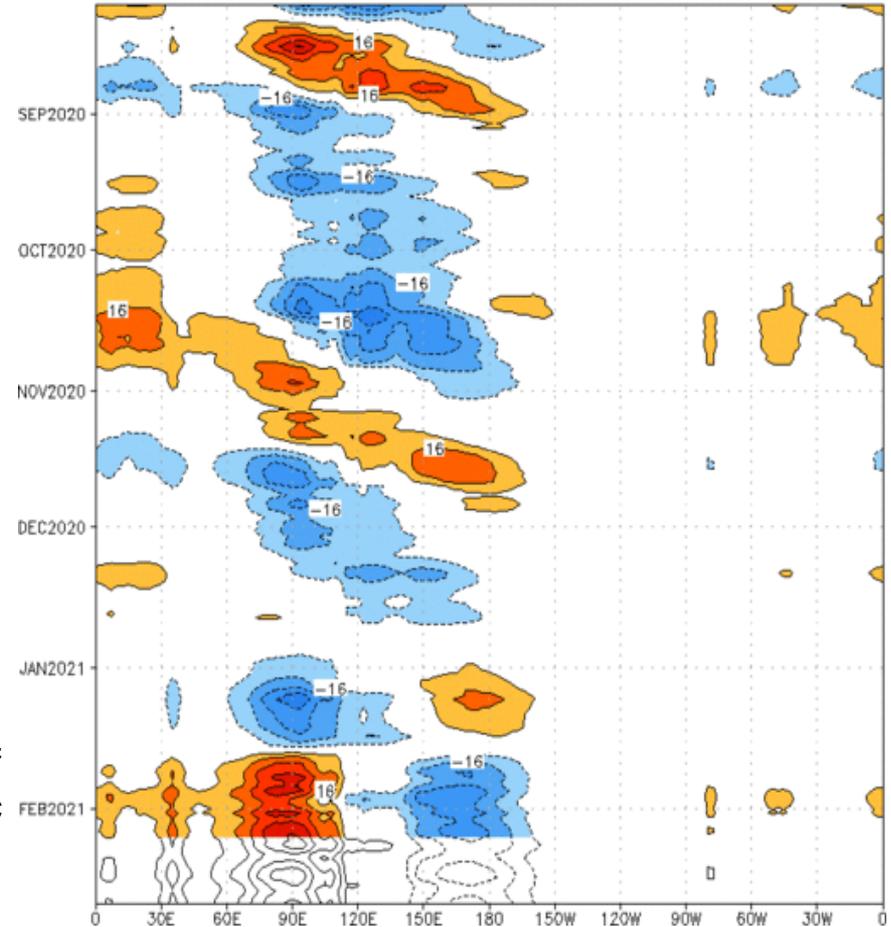
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 07 Feb 2021
OLR



- The GEFS predicts a relatively stationary pattern of enhanced (suppressed) convection over the Pacific (Indian Ocean) during the next two weeks.

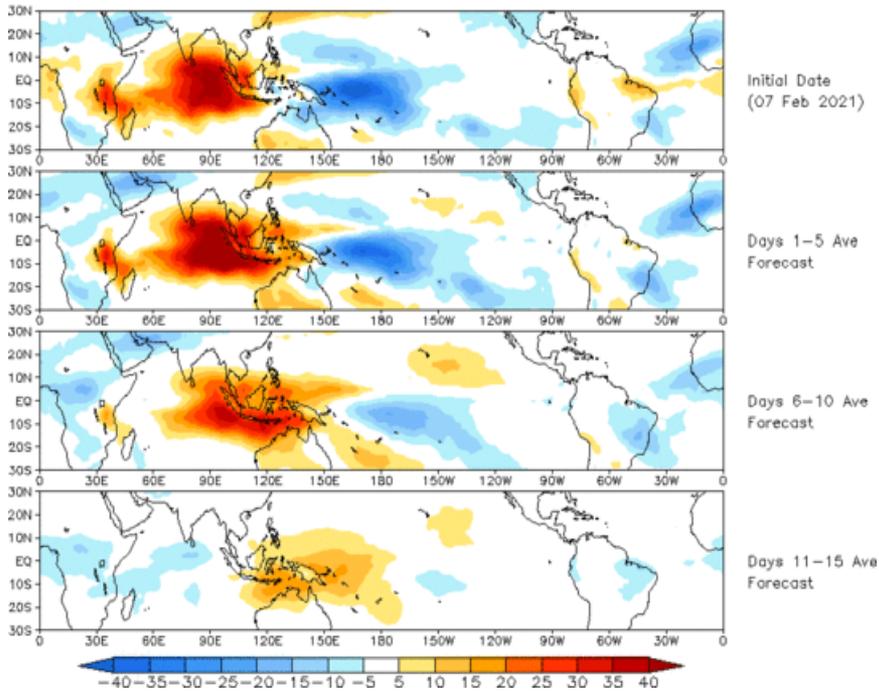
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:08-Aug-2020 to 07-Feb-2021
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



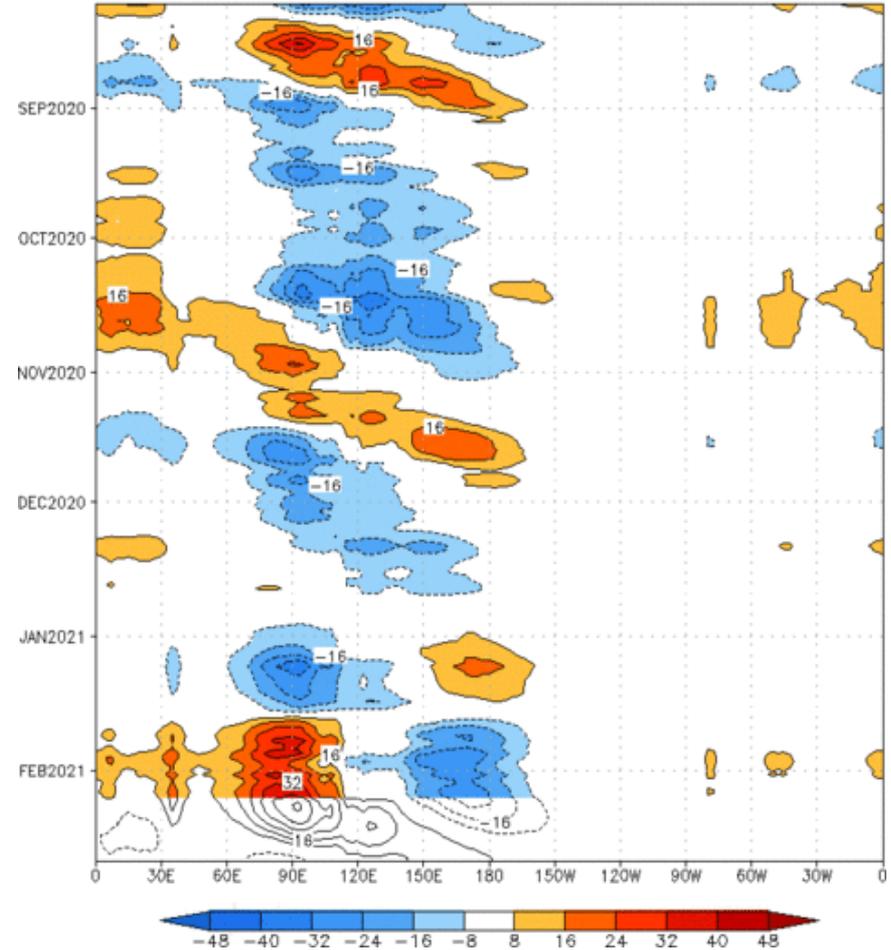
MJO: Constructed Analog Forecast Evolution

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 (07 Feb 2021)



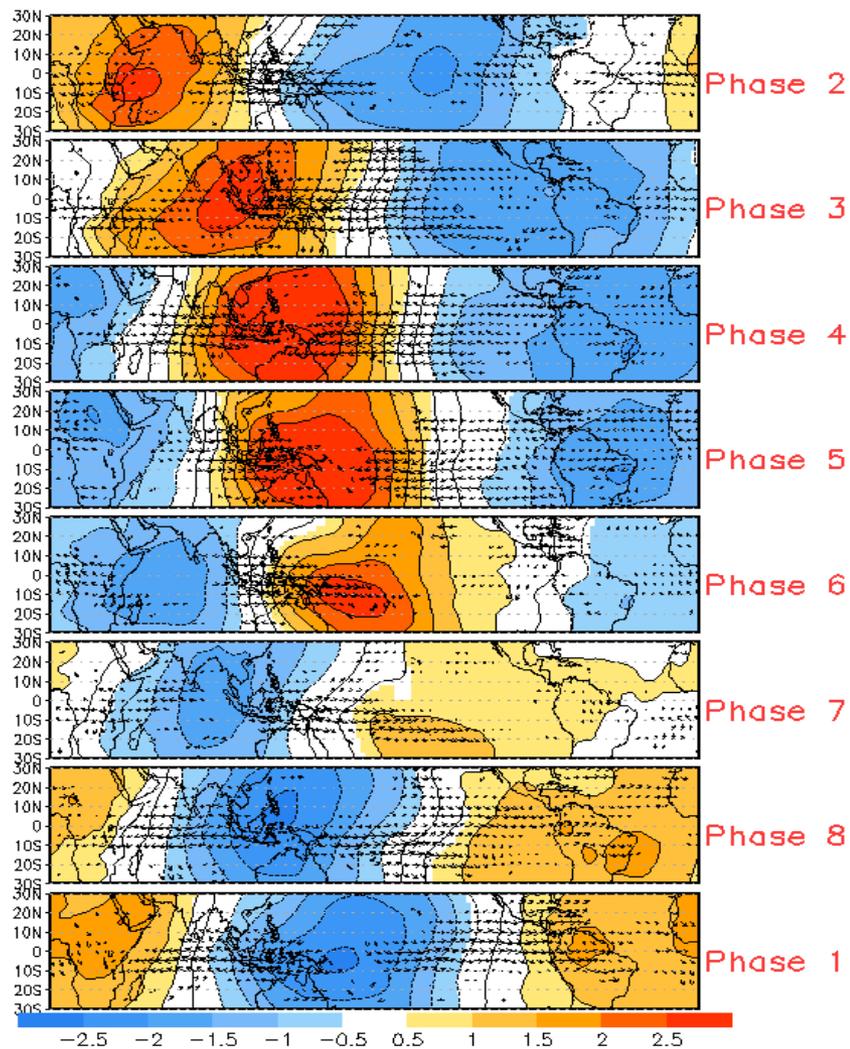
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:08-Aug-2020 to 07-Feb-2021
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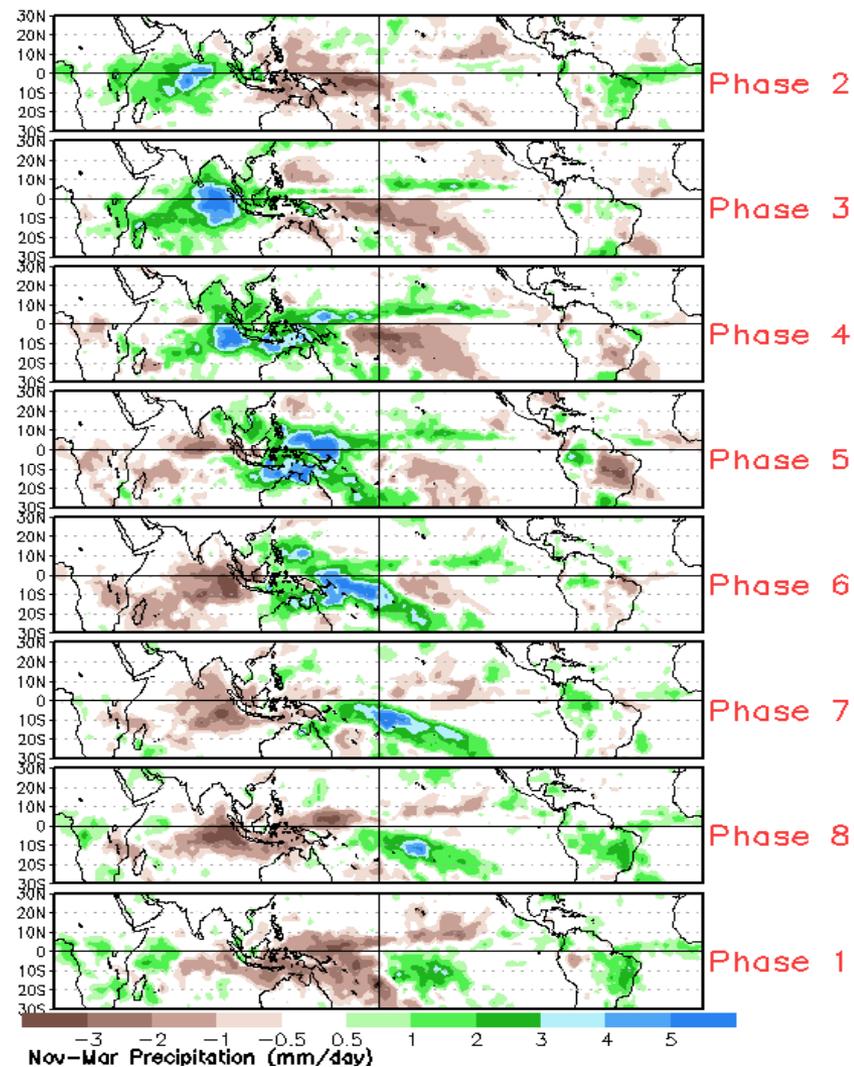
- The constructed analog shows a more canonical MJO with eastward progression during the next two weeks, while the associated convective signals decay with time.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



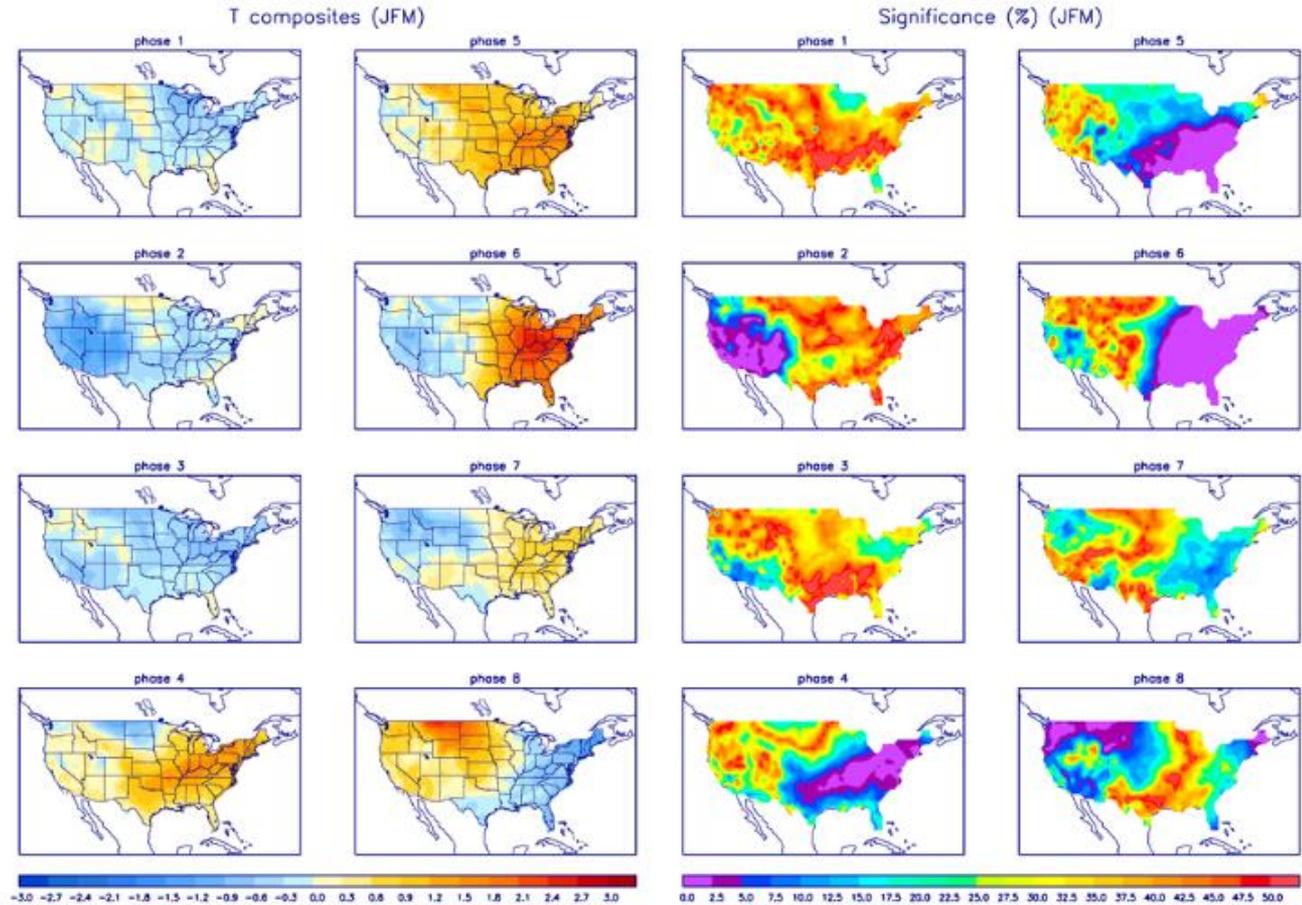
Precipitation Anomalies



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.



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.

