

# **Madden-Julian Oscillation:**

## **Recent Evolution, Current Status and Predictions**



**Update prepared by the Climate Prediction Center**  
**Climate Prediction Center / NCEP**  
**3 February 2020**

# Overview

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- The MJO's RMM signal has weakened quite a bit since mid-January. It is currently within the circle of inactivity (amplitude  $< 1$ ).
- There have been Kelvin and equatorial Rossby wave activity near the Indian Ocean during the past week. The signal from these high frequency waves might be interfering with the models' ability to forecast the RMM index.
- The GEFS forecasts a strong MJO by Week-2, but the ECMWF forecasts the MJO to remain much weaker throughout the next two weeks.

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>

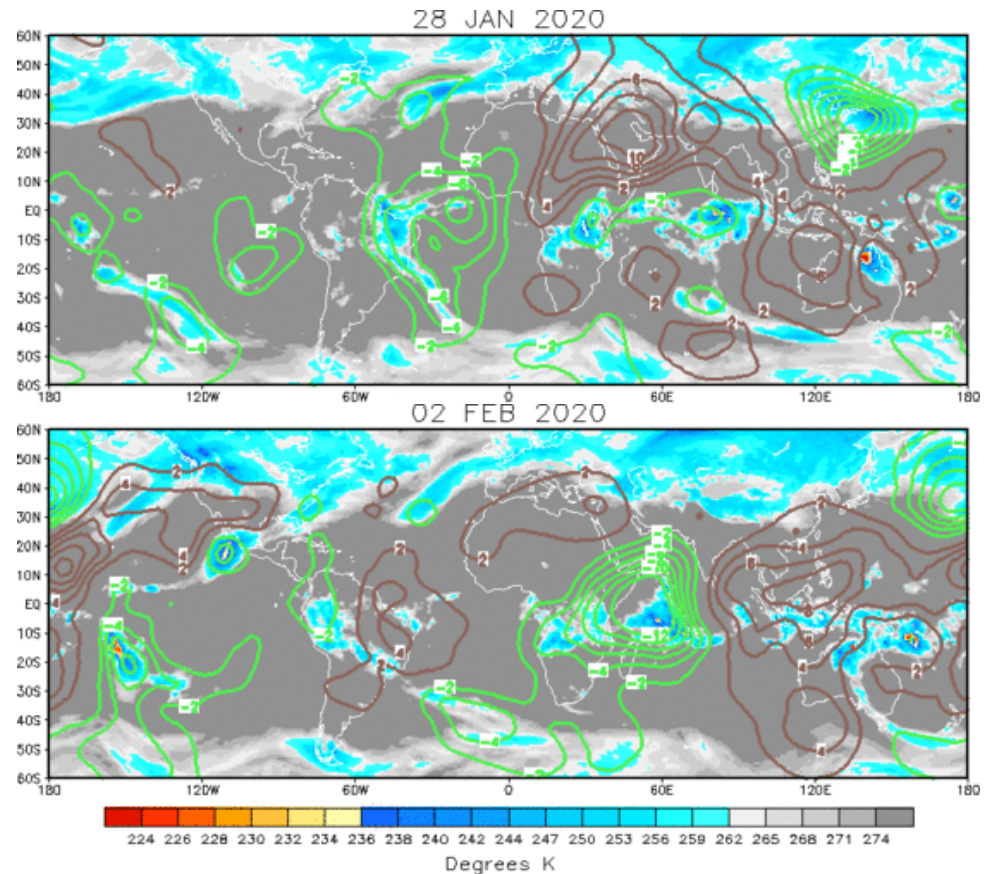
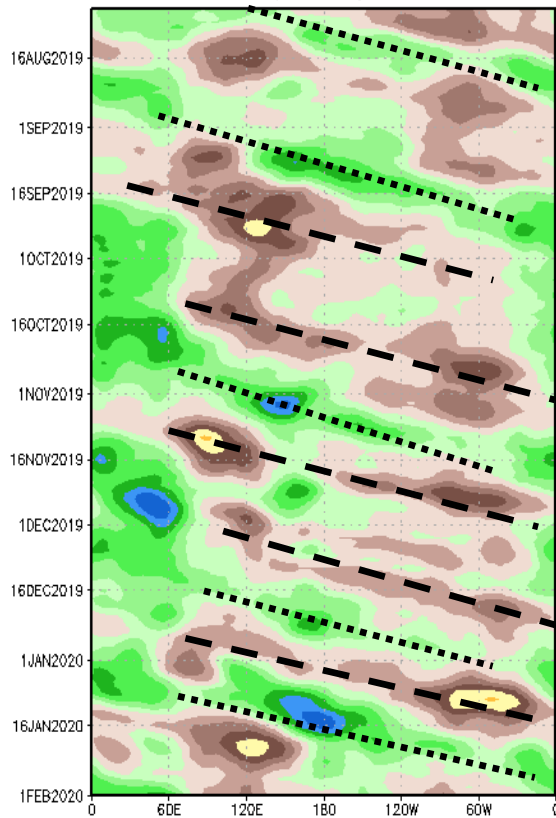
# 200-hPa Velocity Potential Anomalies

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

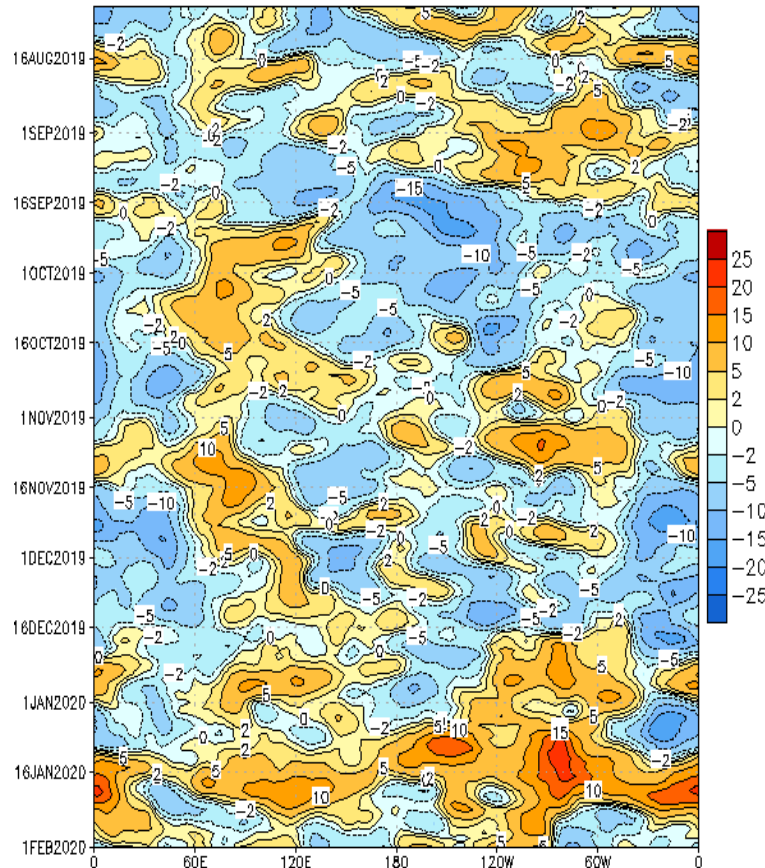


- The MJO signal was strong during early- to mid-January, but has since weakened.
- This is evident in the upper-level velocity potential (VP) field where there is no global wave-1 pattern.
  - The VP dipole over the Indian Ocean is the result of a strong atmospheric Kelvin wave.
  - There is also an equatorial Rossby wave in the area. The superposition of these two waves is causing the RMM forecasts to appear weak, however it is possible that the MJO will strengthen as the higher-frequency waves move away during the next week.

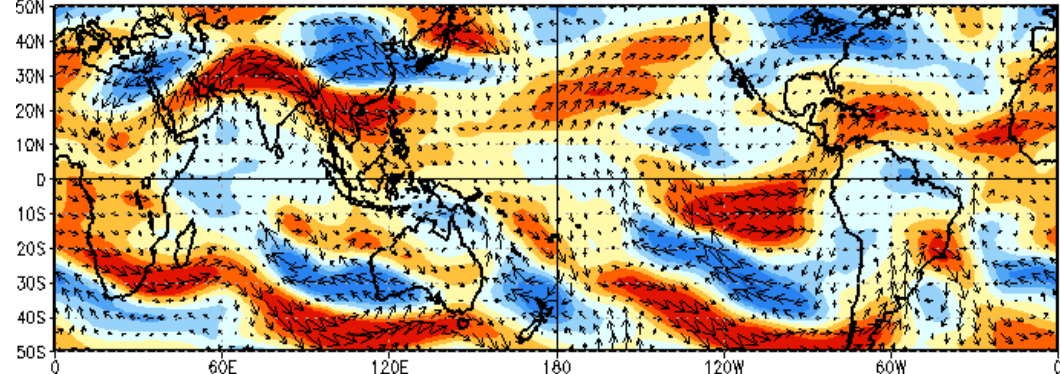
# 200-hPa Wind Anomalies

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

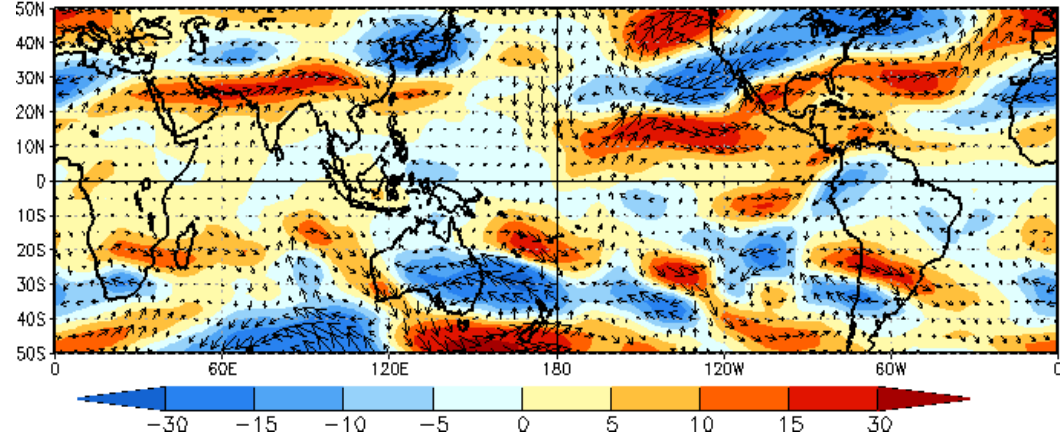
CDAS 200-hPa U Anoms. (5N-5S)



CDAS 200 mb Vector Wind Anomalies -- 23JAN2020- 27JAN2020



CDAS 200 mb Vector Wind Anomalies -- 28JAN2020-01FEB2020

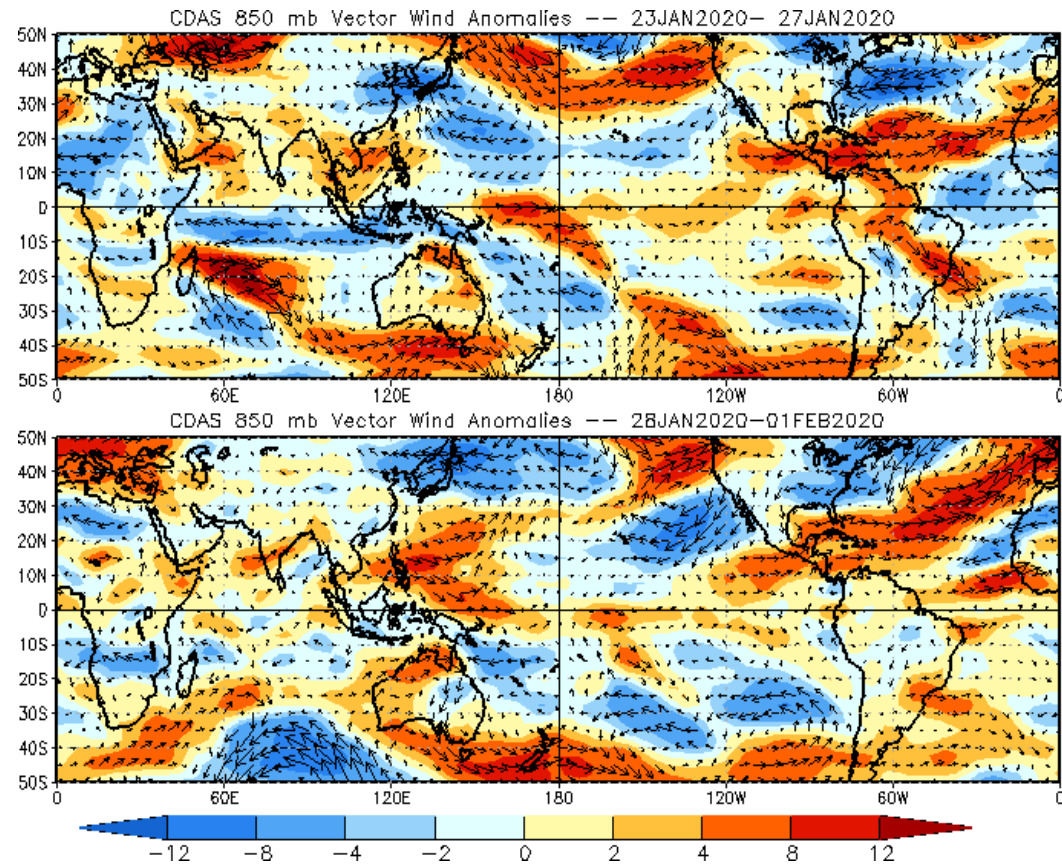
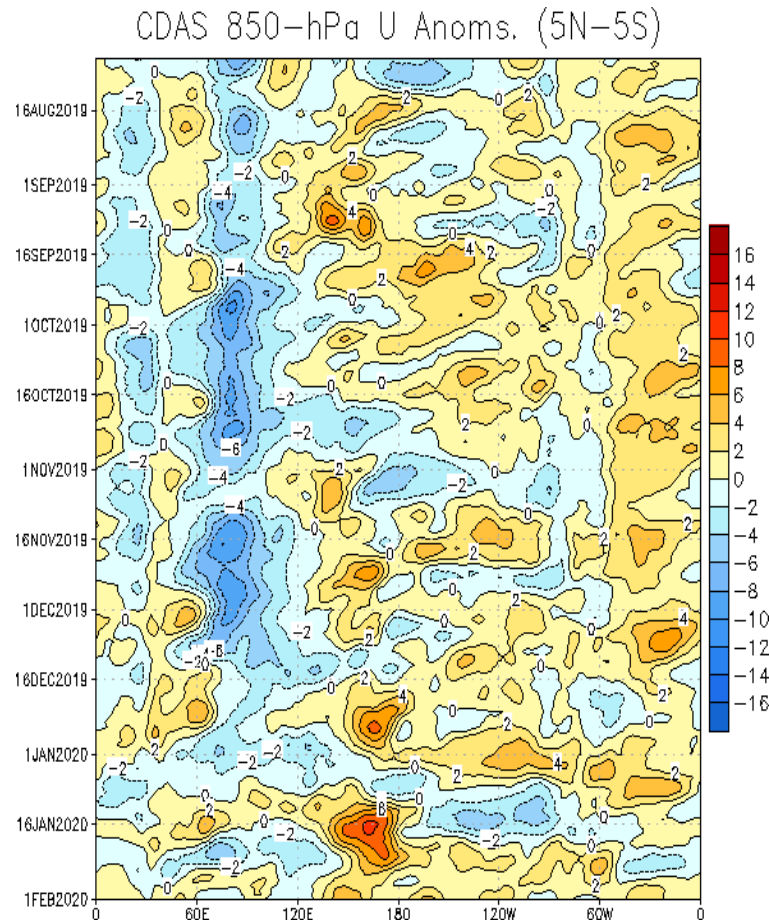


- The upper-level pattern is amplified over the Northern Hemisphere; a Rossby wave train reaches from the Indian Ocean over the Pacific to the west coast of North America.
- Anomalous equatorial westerlies reached all the way across the globe for much of mid-January. This pattern has broken down over the past week and there are now near-normal conditions over much of the equatorial Pacific and Indian Oceans.



# 850-hPa Wind Anomalies

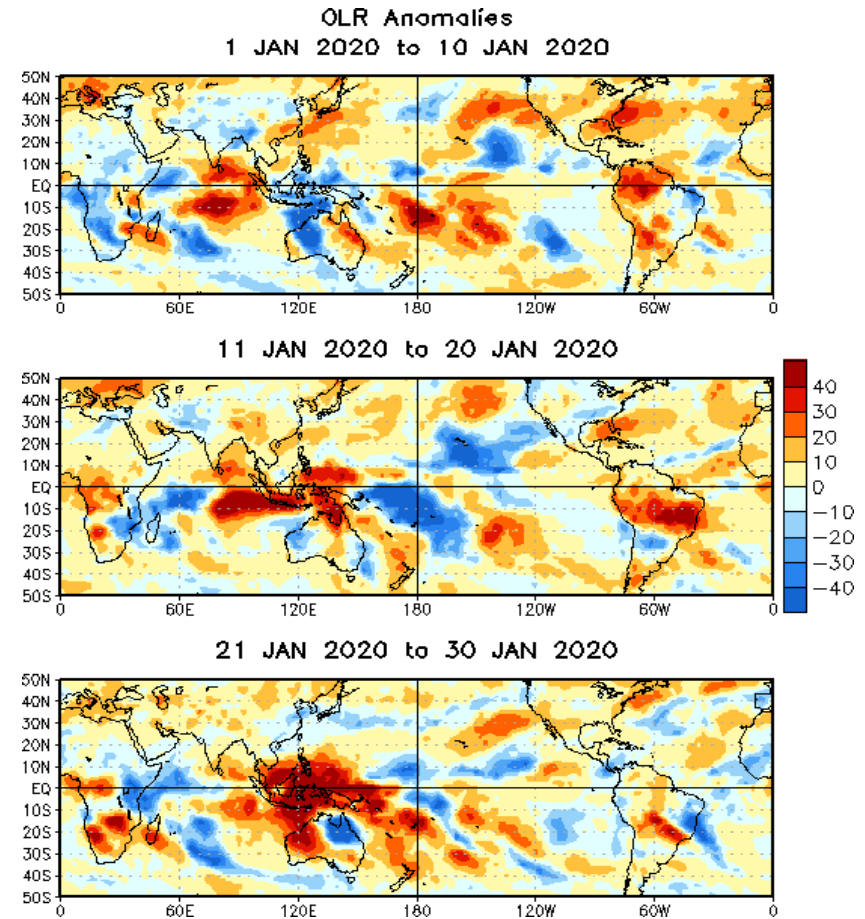
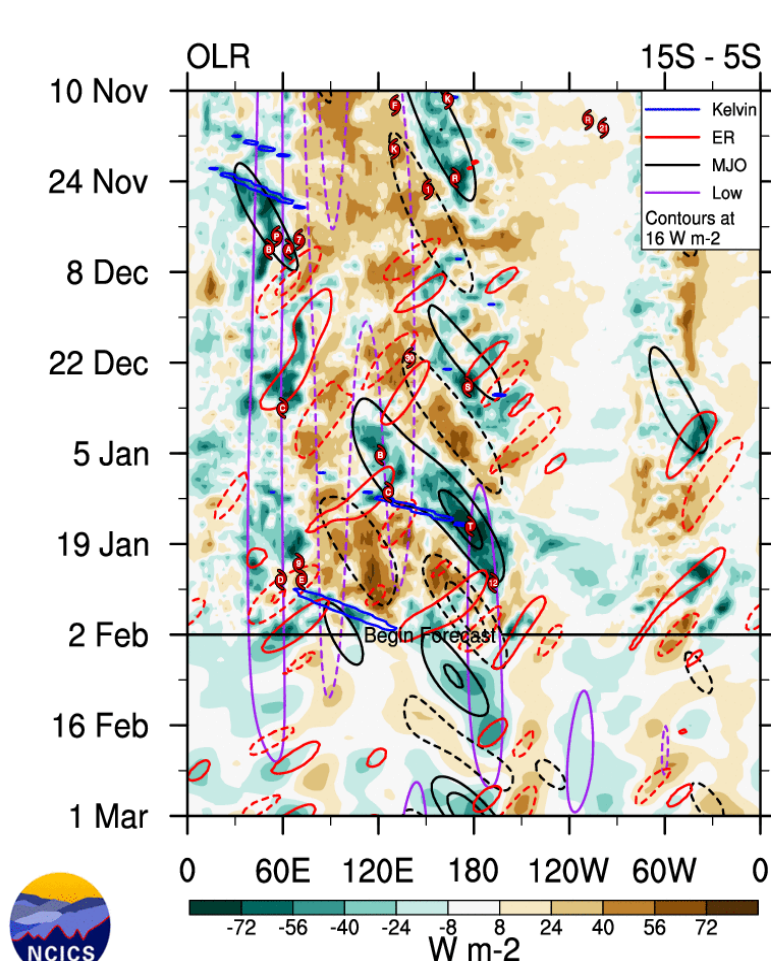
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Weak anomalous westerlies encompass most of the Tropics in the lower levels of the atmosphere.
- Most of the low-level wind signal is associated with mid-latitude synoptic variability in the Northern Hemisphere. There are no strong tropically forced signals evident this week.

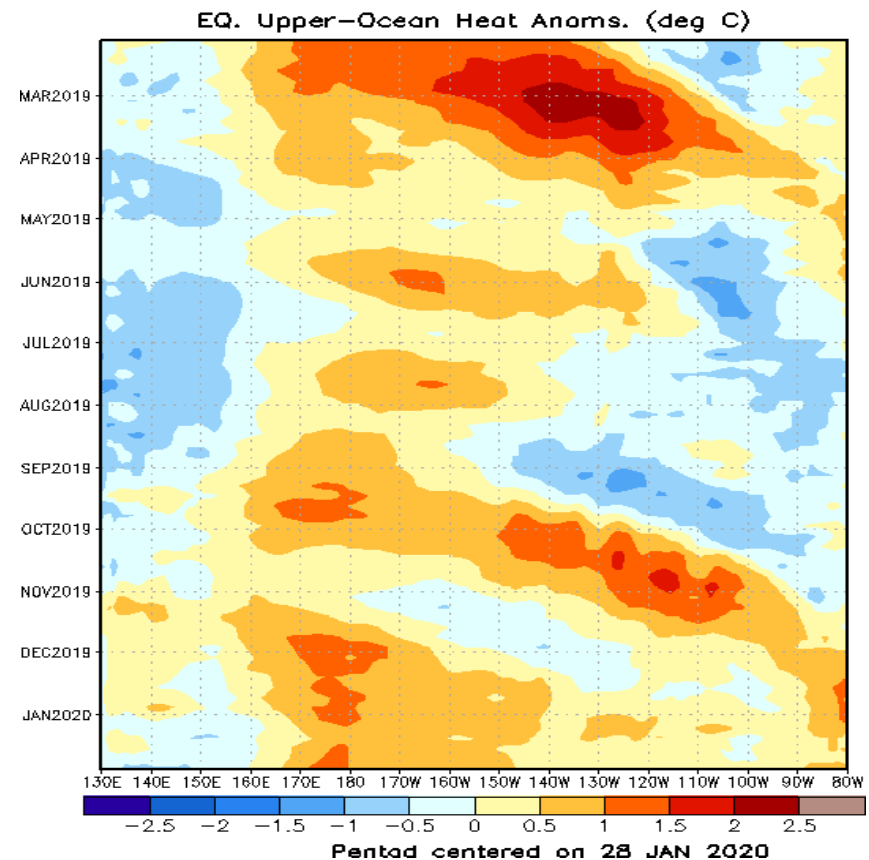
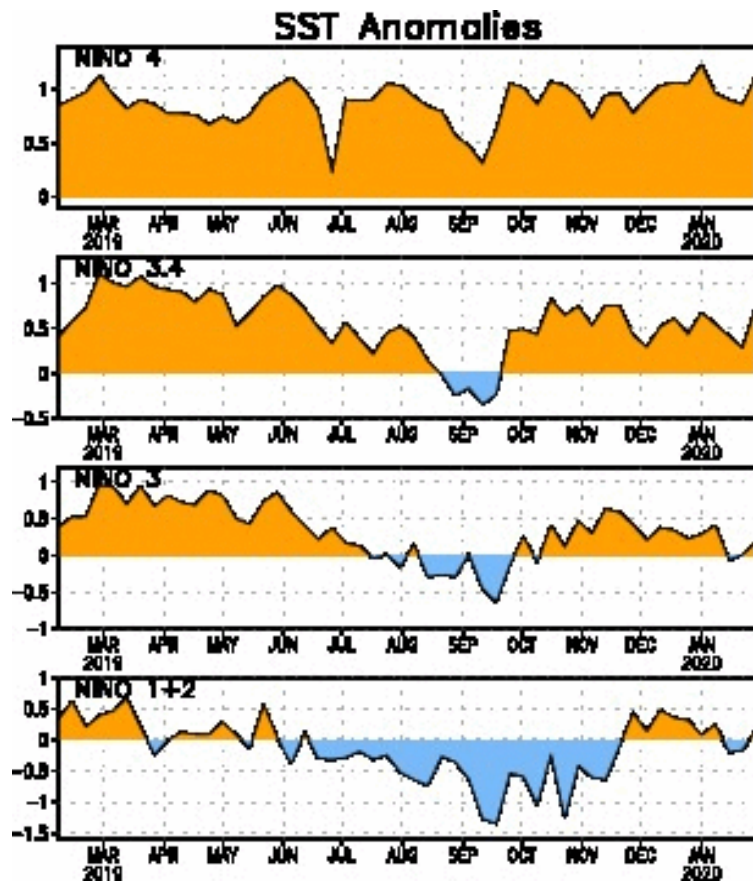
# Outgoing Longwave Radiation (OLR) Anomalies

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



- MJO activity was the main source of tropical OLR variability during most of January, but Kelvin wave activity dominated during the last few days over the Indian Ocean.

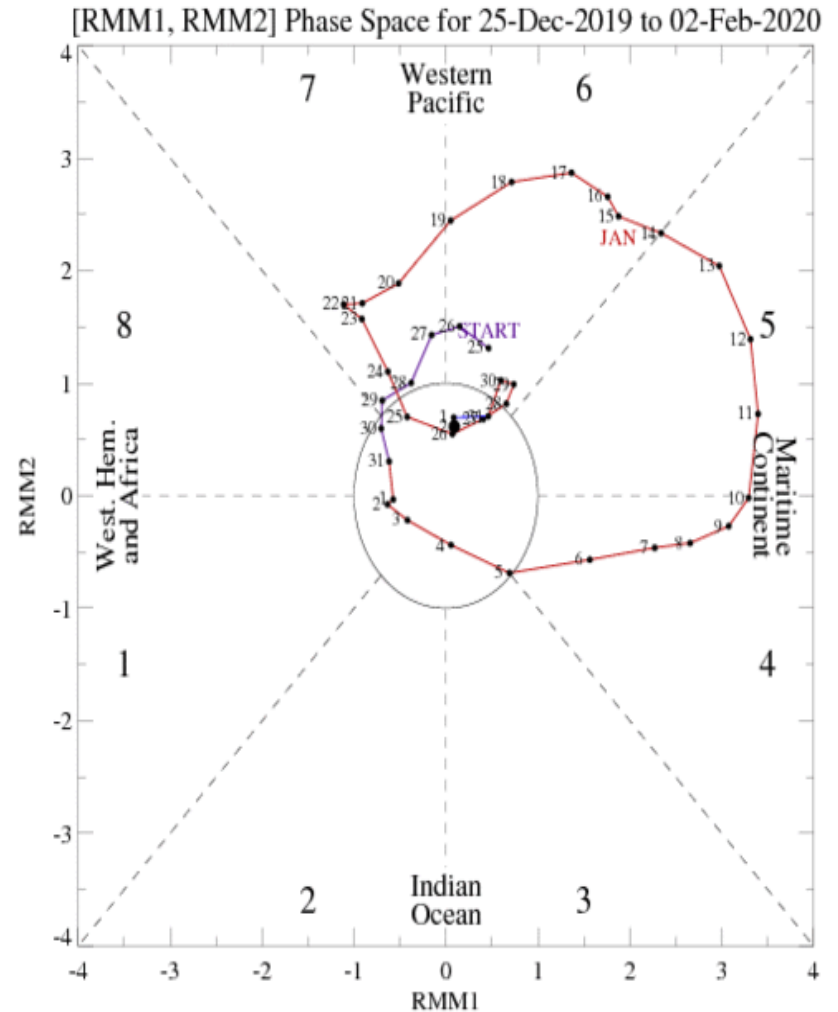
# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- The Niño 3, 4, and 3.4 indices are all above normal this week.
- There has been an increased warming around the Dateline, which was likely the response to the MJO activity in mid-late January.

# MJO Index: Recent Evolution

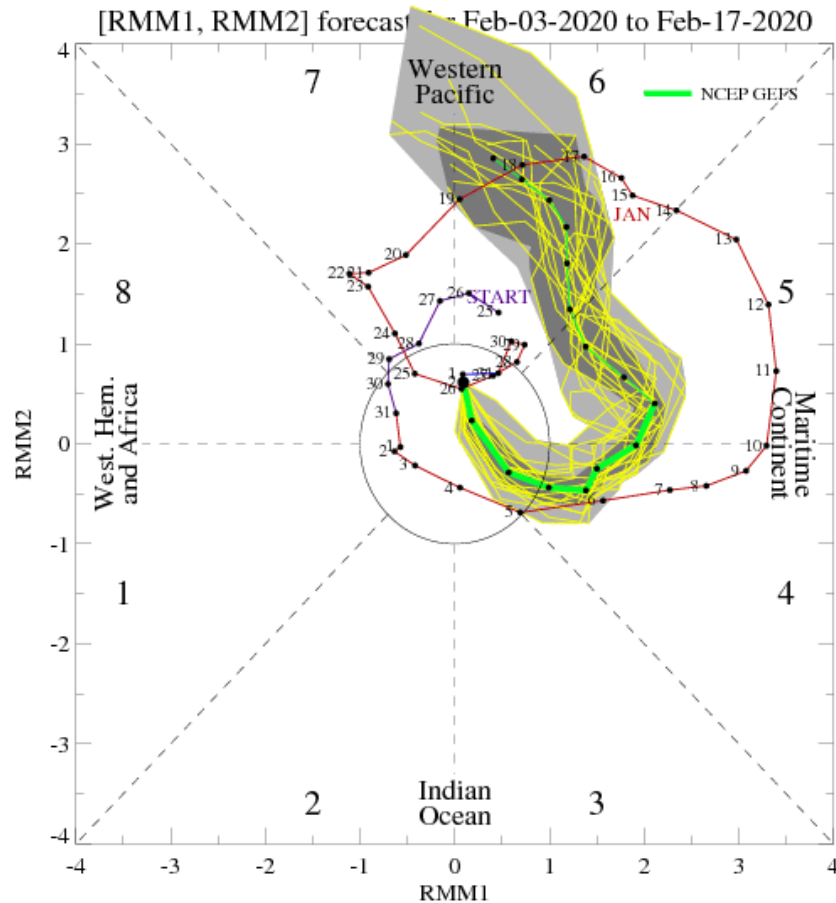
- The RMM index shows a weak MJO signal during the past week.



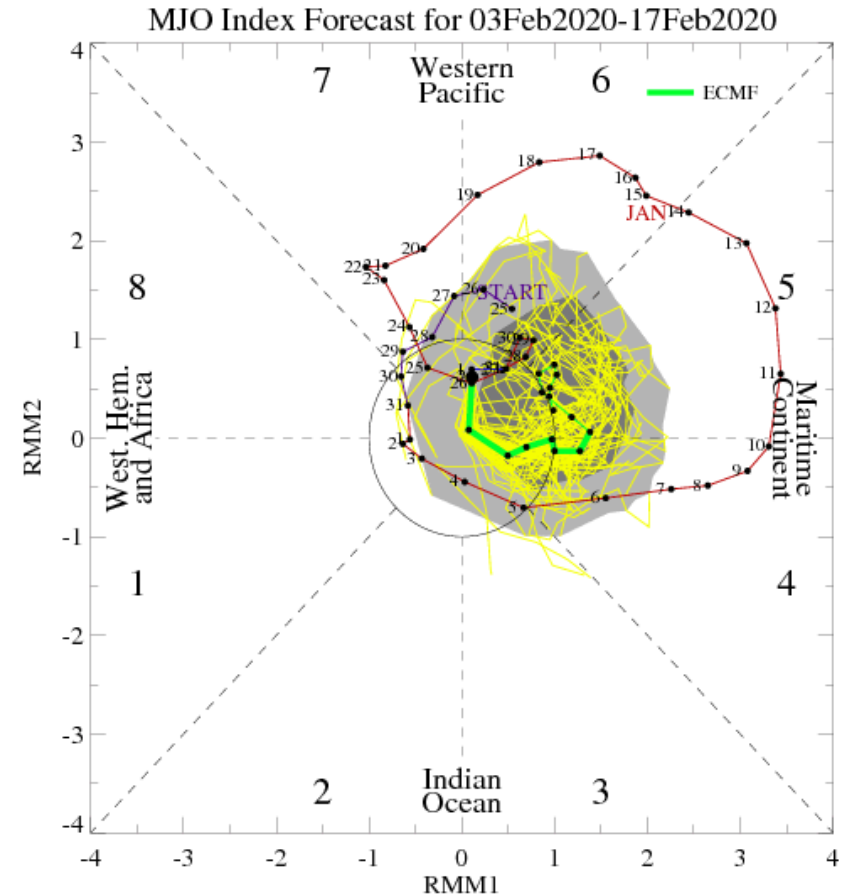
For more information on the RMM index and how to interpret its forecast please see:  
[https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC\\_MJOinformation.pdf](https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf)



# MJO Index: Forecast Evolution



**GEFS Forecast**



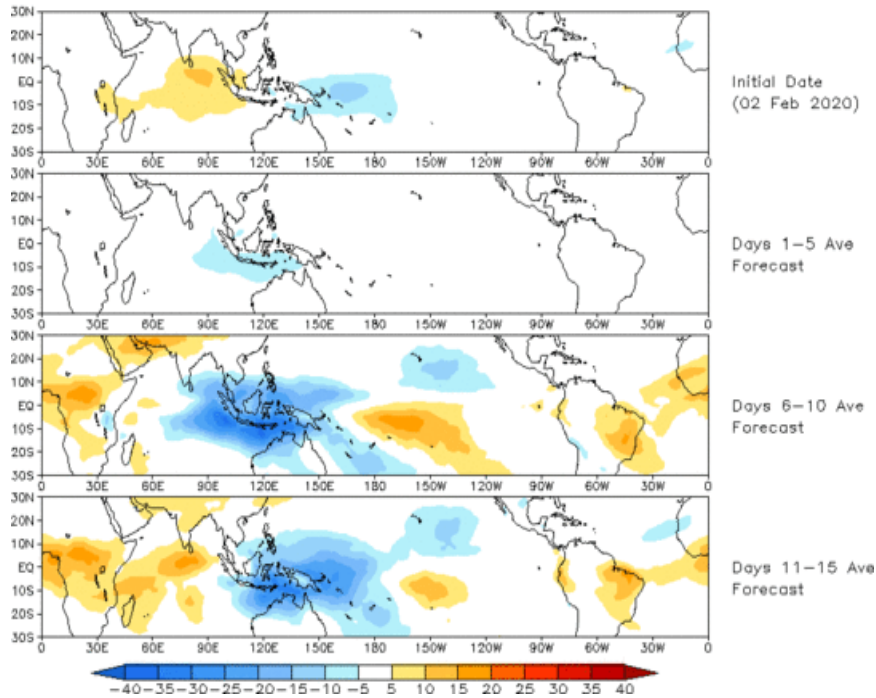
**ECMWF Forecast**

- The GEFS forecasts a strong MJO during Week-2 whereas the ECMWF's forecast is much weaker.
- The models might have clearer MJO forecasts later this week as the aforementioned Kelvin and equatorial Rossby waves propagate away from each other and stop interfering with the RMM index.

# MJO: GEFS Forecast Evolution

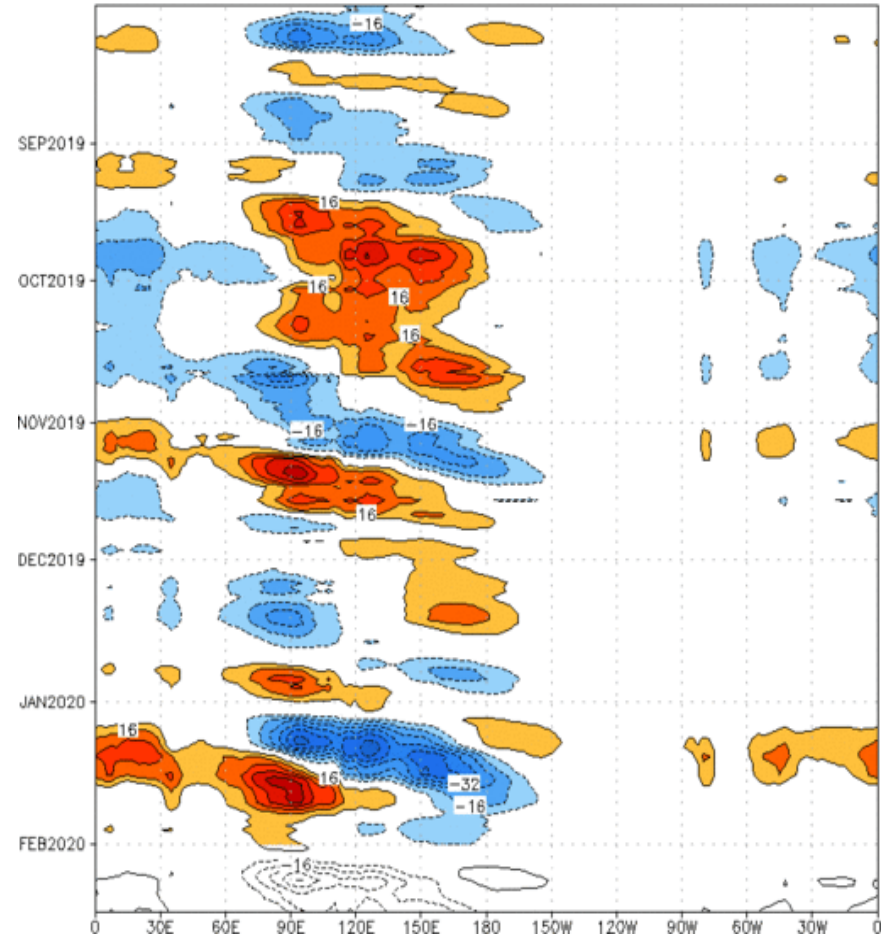
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast  
Initial date: 02 Feb 2020  
OLR



- The GEFS spatial MJO forecast features MJO development near the beginning of Week-2.

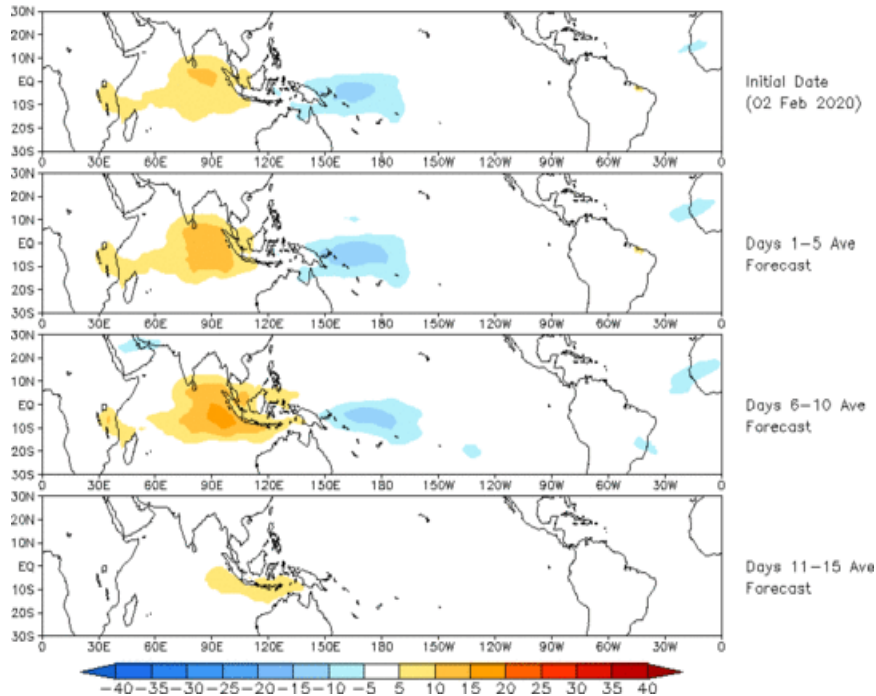
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2  
OLR [ $7.5^{\circ}\text{S}, 7.5^{\circ}\text{N}$ ] ( $\text{cont: } 4\text{Wm}^{-2}$ ) Period: 02-Aug-2019 to 01-Feb-2020  
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



# MJO: Constructed Analog Forecast Evolution

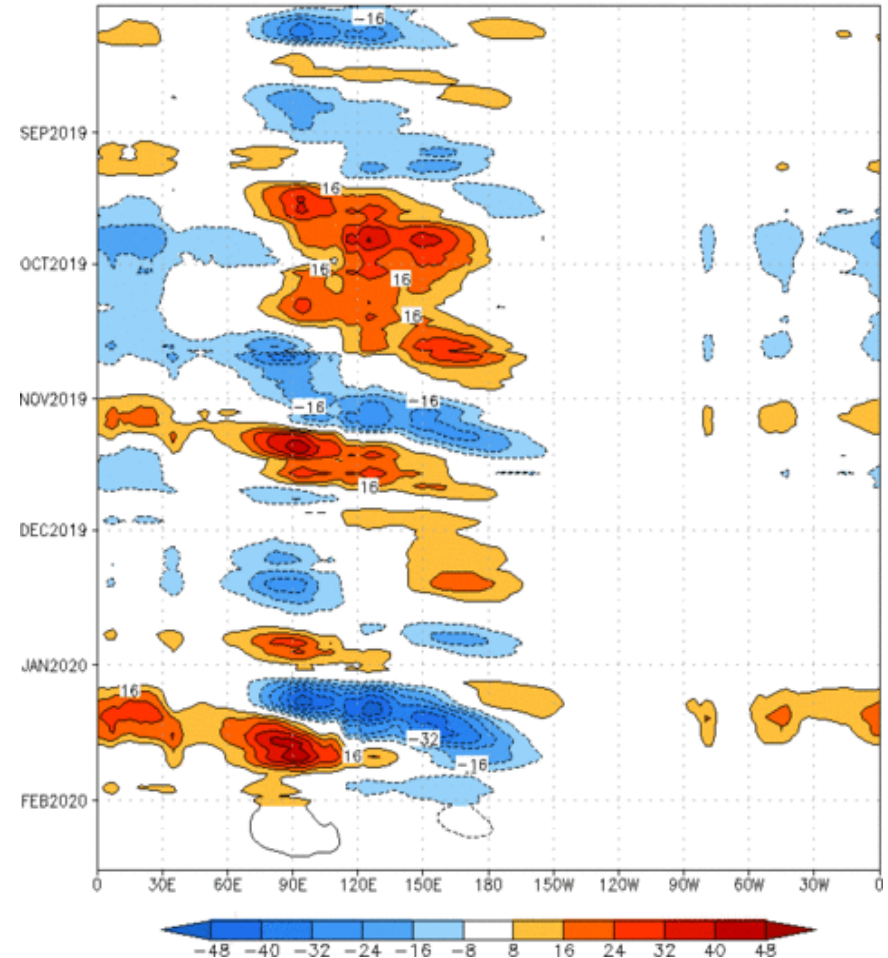
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (02 Feb 2020)



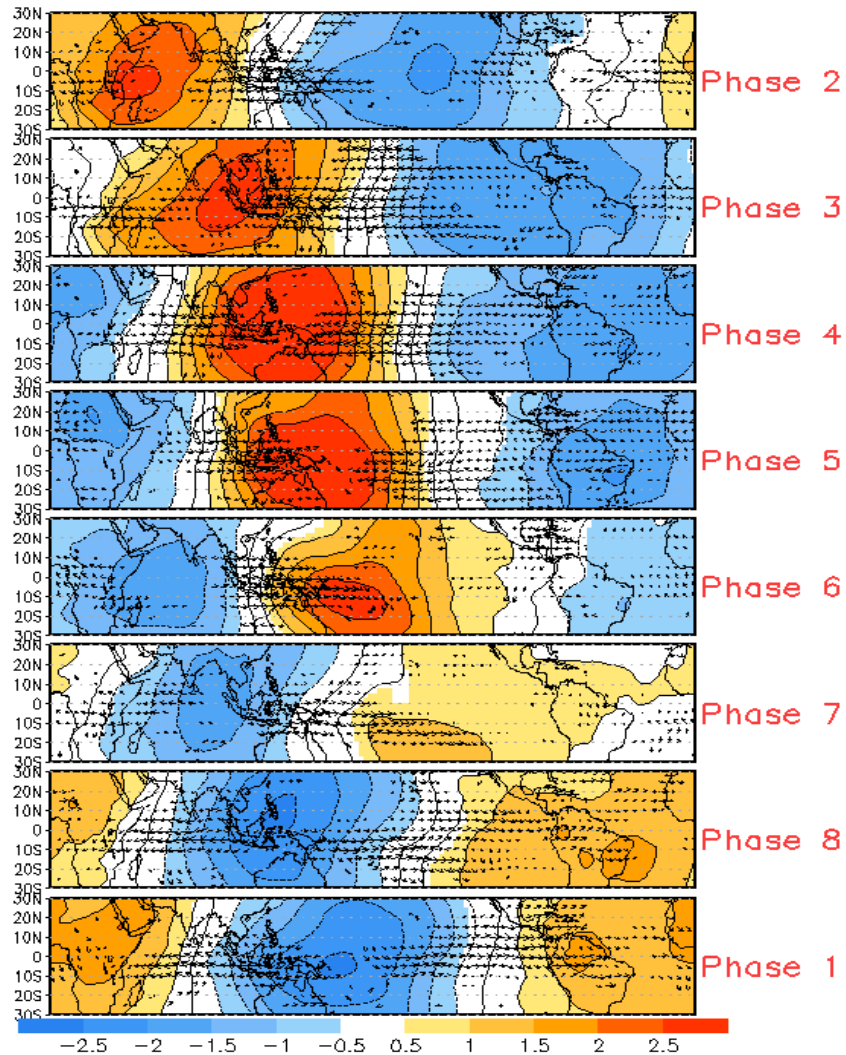
- The constructed analog model forecasts no significant MJO development.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm<sup>-2</sup>) Period:03-Aug-2019 to 02-Feb-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

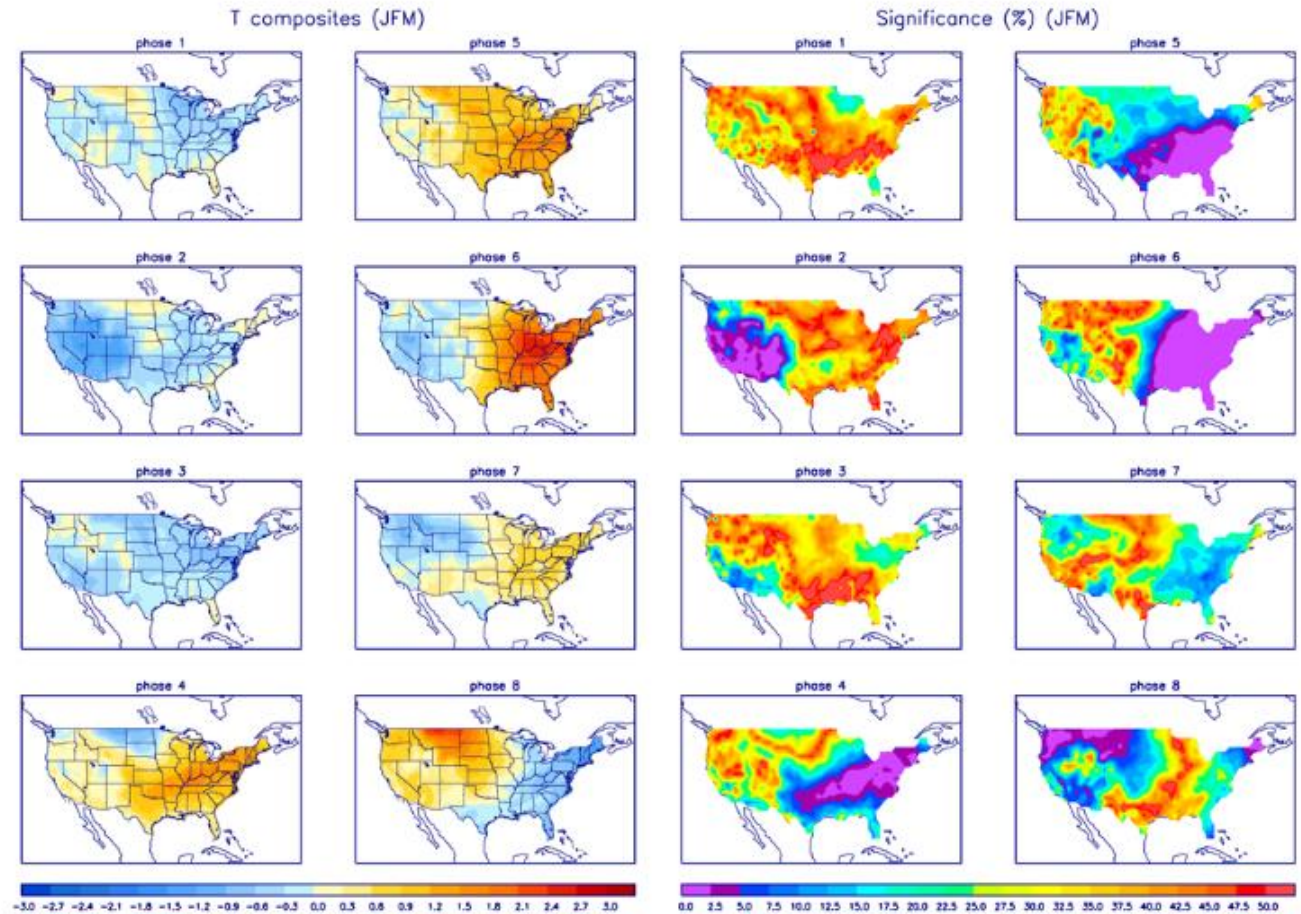




# MJO: CONUS Composite Maps by RMM Phase - Temperature

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.

