

# **Madden-Julian Oscillation:**

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



**Update prepared by the Climate Prediction Center**  
**Climate Prediction Center / NCEP**  
**8 April 2019**

# Overview

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- The MJO has remained weak since late March.
- GEFS and ECMWF ensemble members indicate that the MJO could re-emerge over the Indian Ocean during Week-2.
- El Niño is likely to be the major influence on anomalous tropical convection during mid to late April.

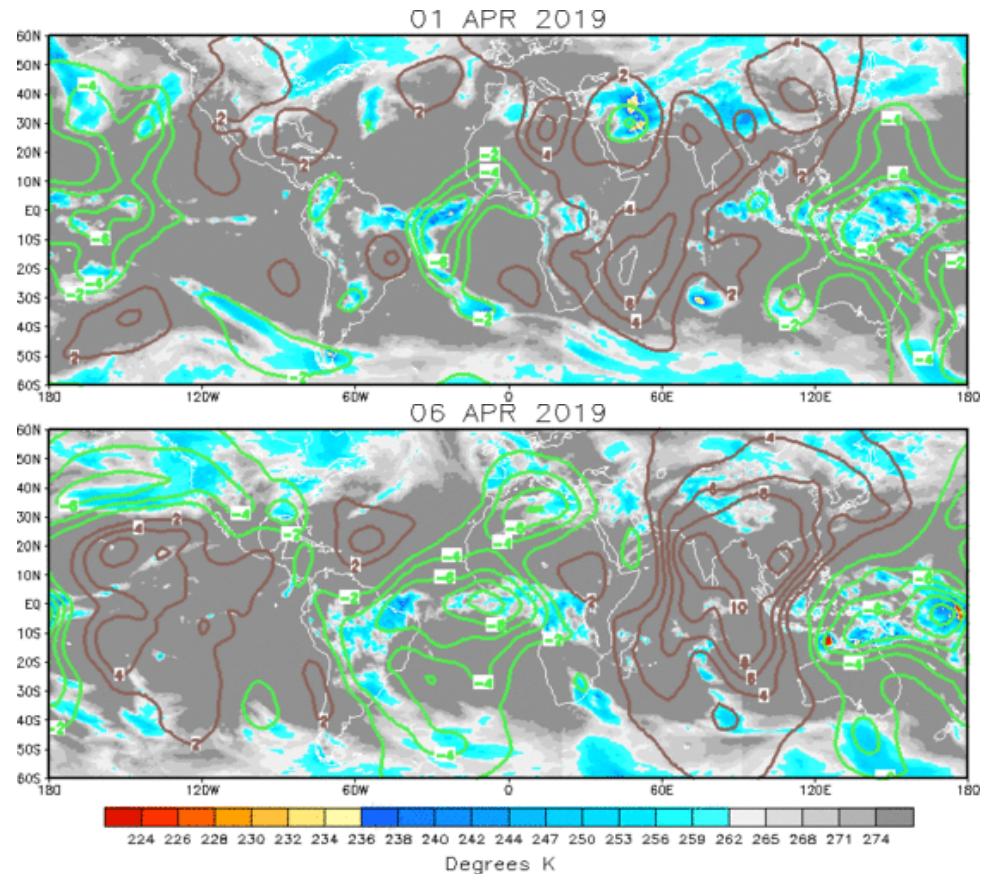
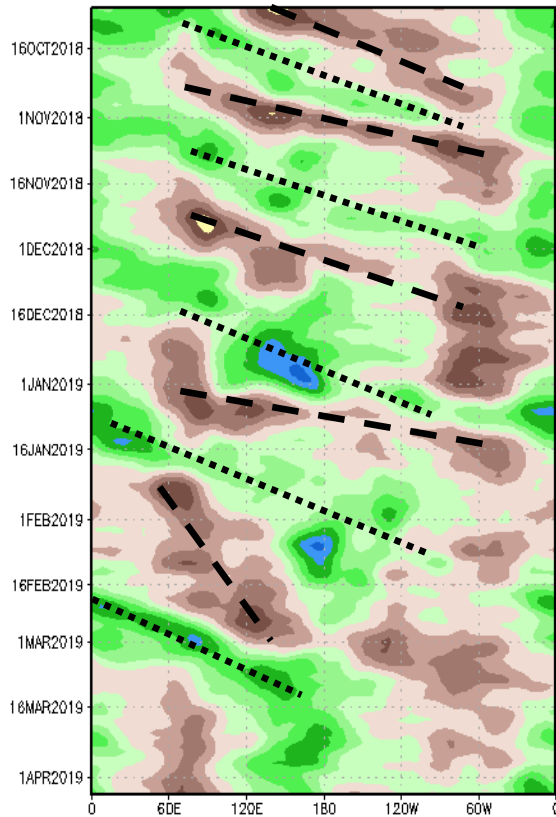
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:  
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

# 200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

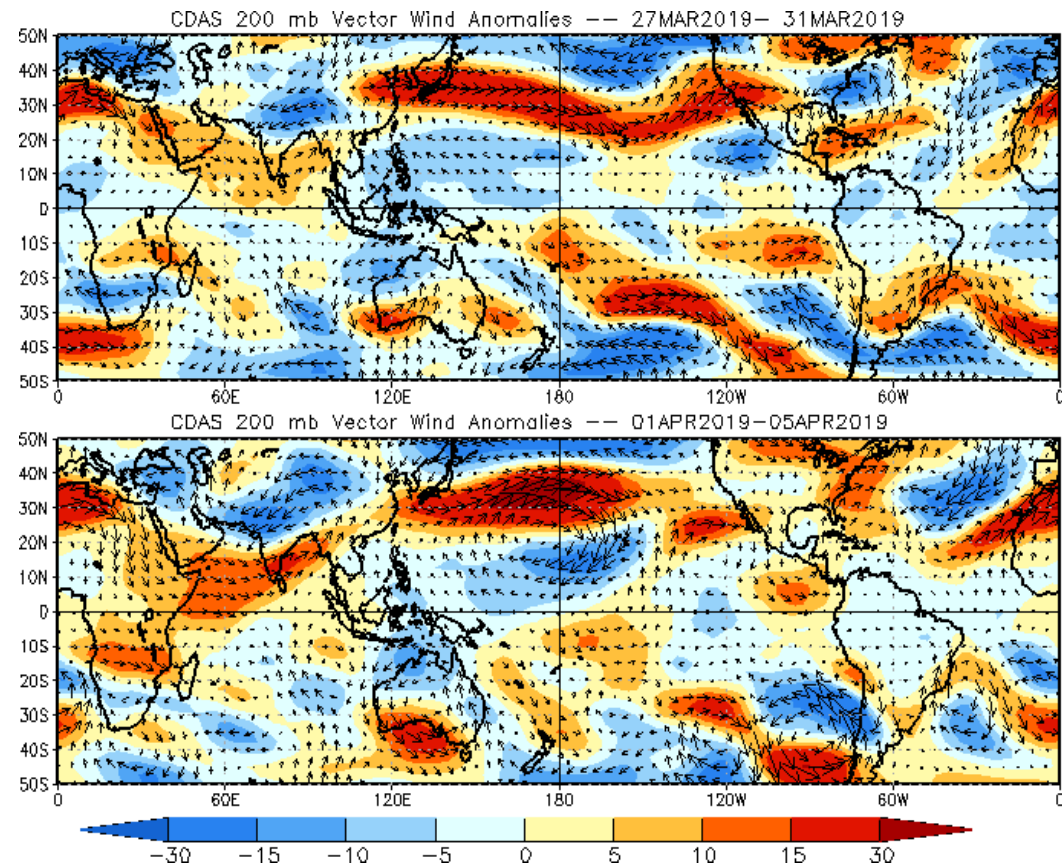
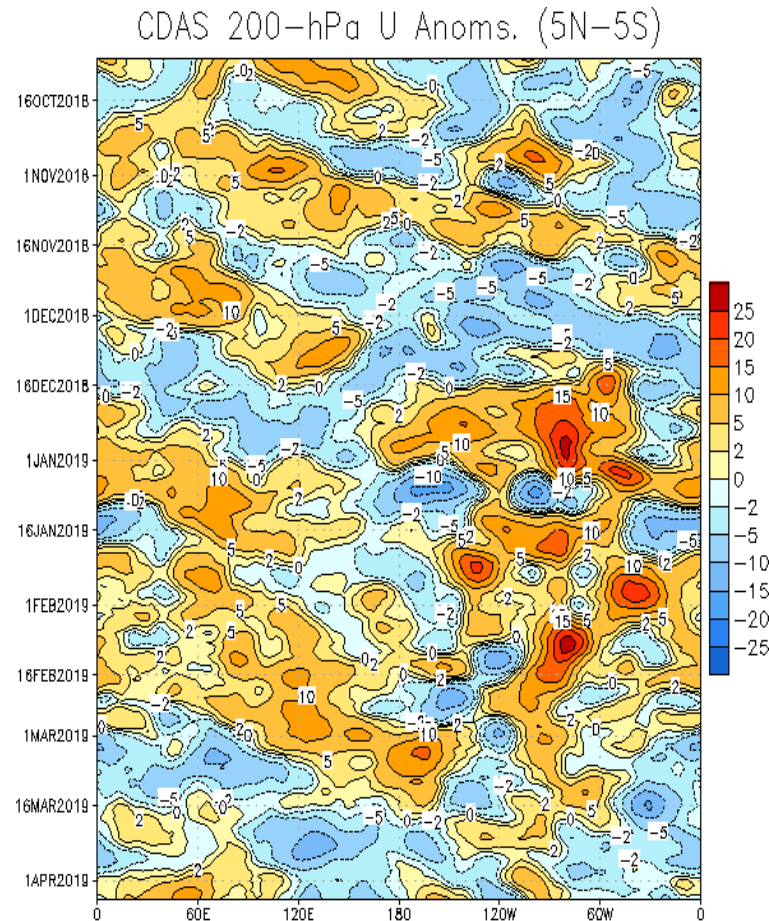
200-hPa Velocity Potential Anomaly: 5N-5S  
5-day Running Mean



- The MJO, which was consistently active throughout the fall and winter, became inactive during mid-March.
- There is evidence of equatorial Rossby wave activity throughout the hovmöller diagram. During late March, an ER wave is evident moving westward across the Date Line and into the West Pacific.
- A Wave-2 pattern in the upper-level VP field developed during early April with El Niño contributing to enhanced convection over the west-central Pacific.

# 200-hPa Wind Anomalies

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

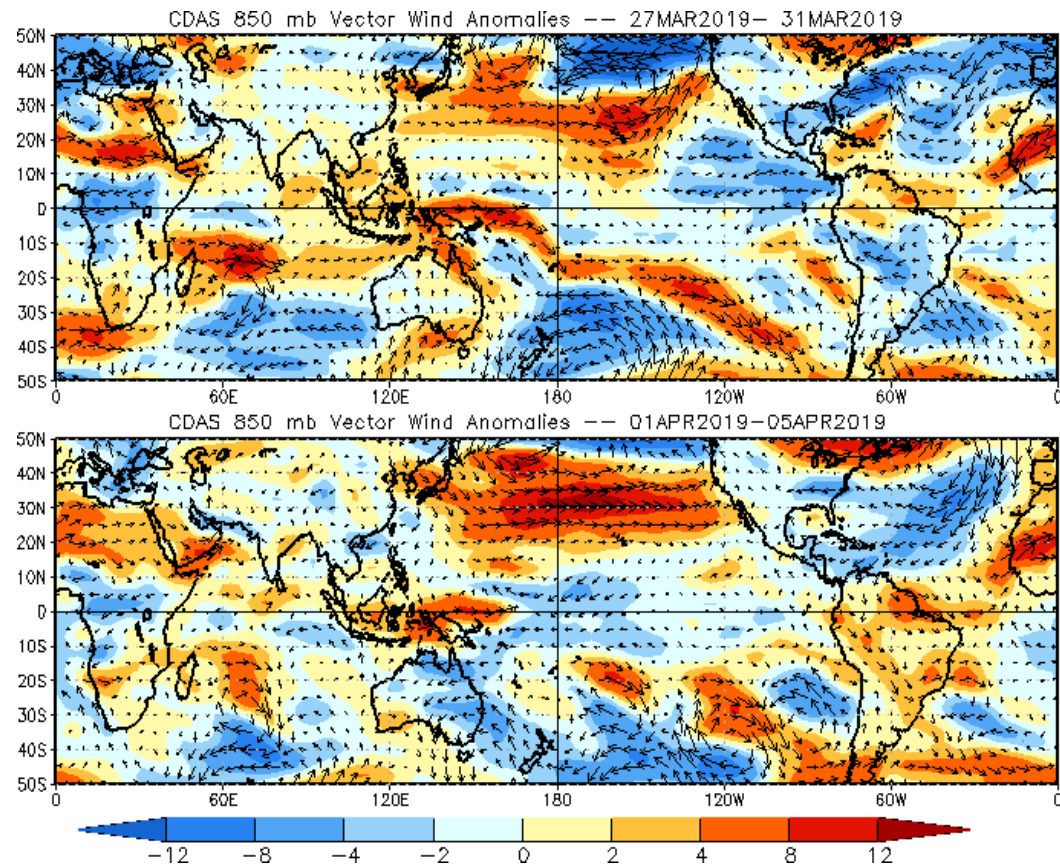
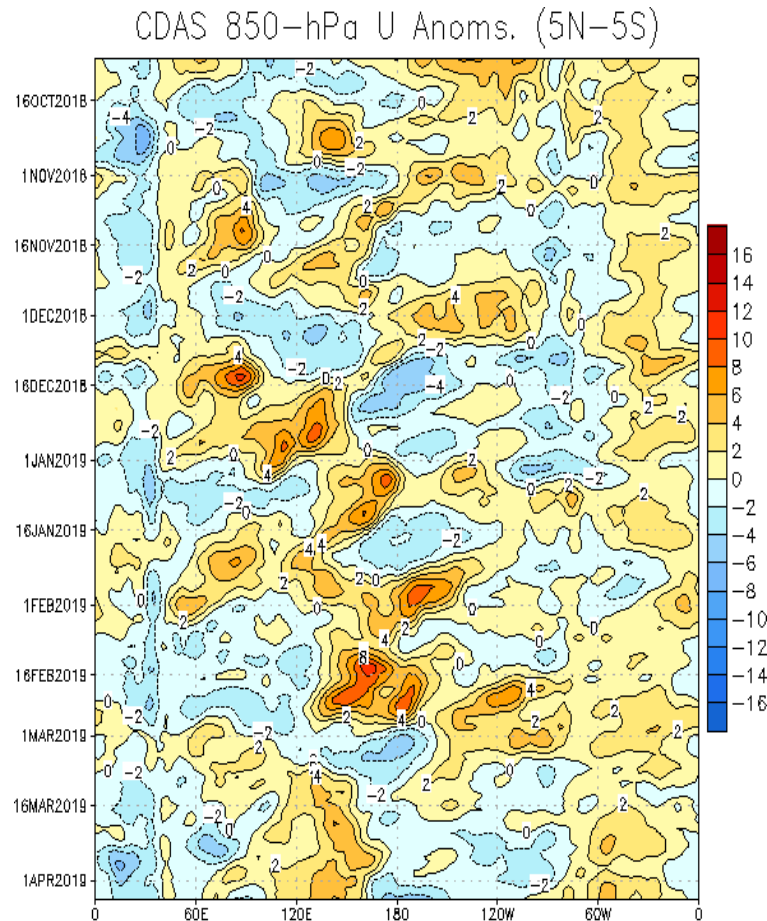


- As seen in the upper-level VP field on the previous slide, the MJO became inactive during mid-March.
- There are a number of westward moving features, indicative of equatorial Rossby wave activity.
- Upper-level convergence persisted across the eastern Indian Ocean and western Maritime Continent from late March into the beginning of April.
- An upper-level anticyclone became centered near the Date Line during the first pentad of April.



# 850-hPa Wind Anomalies

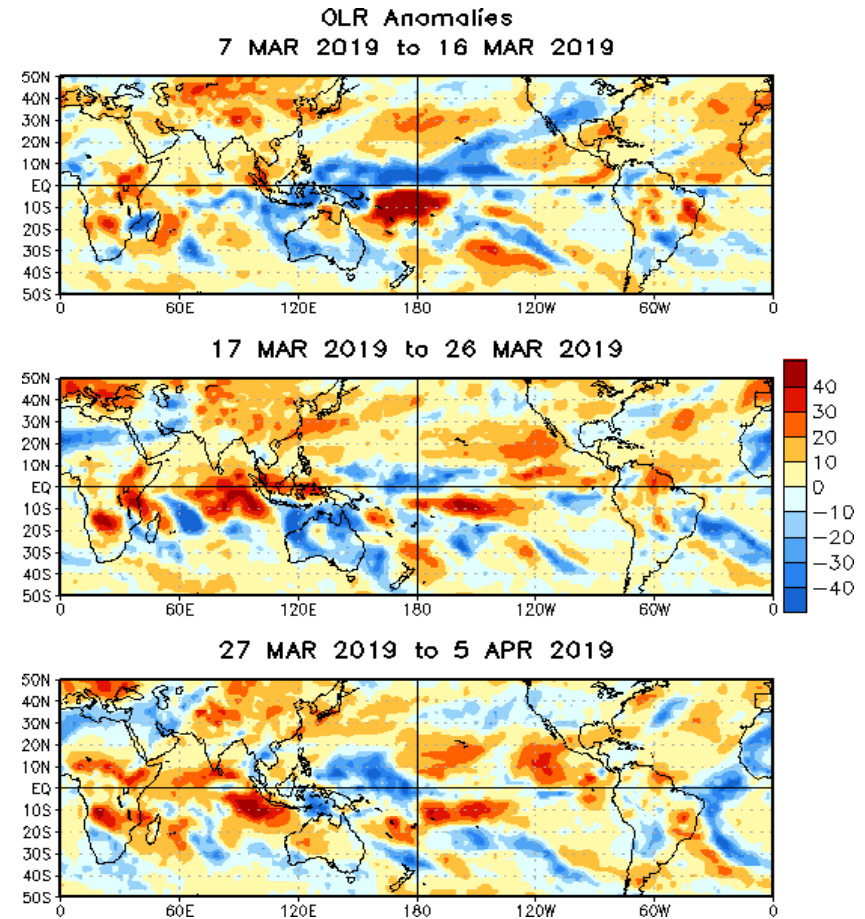
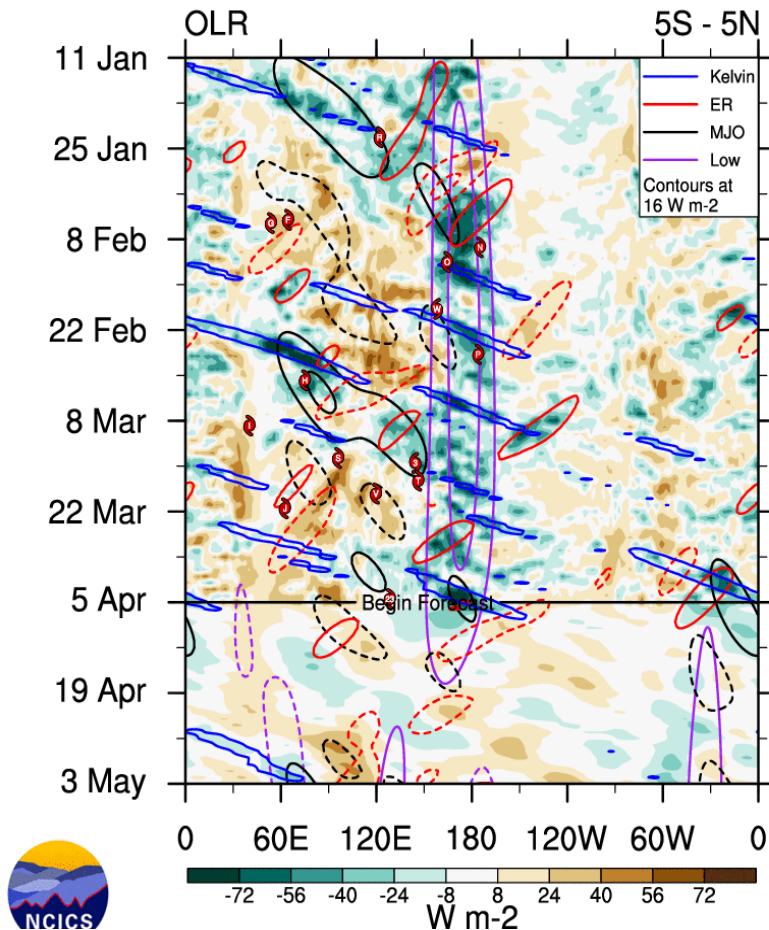
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- The low-level wind field was more diffuse over much of the Eastern Hemisphere since late March.
- Consistent with El Niño, low-level convergence remains enhanced along the equator and just west of the Date Line.
- During the first pentad of April, the subtropical jet strengthened across the East Pacific with an eastward extension towards North America.

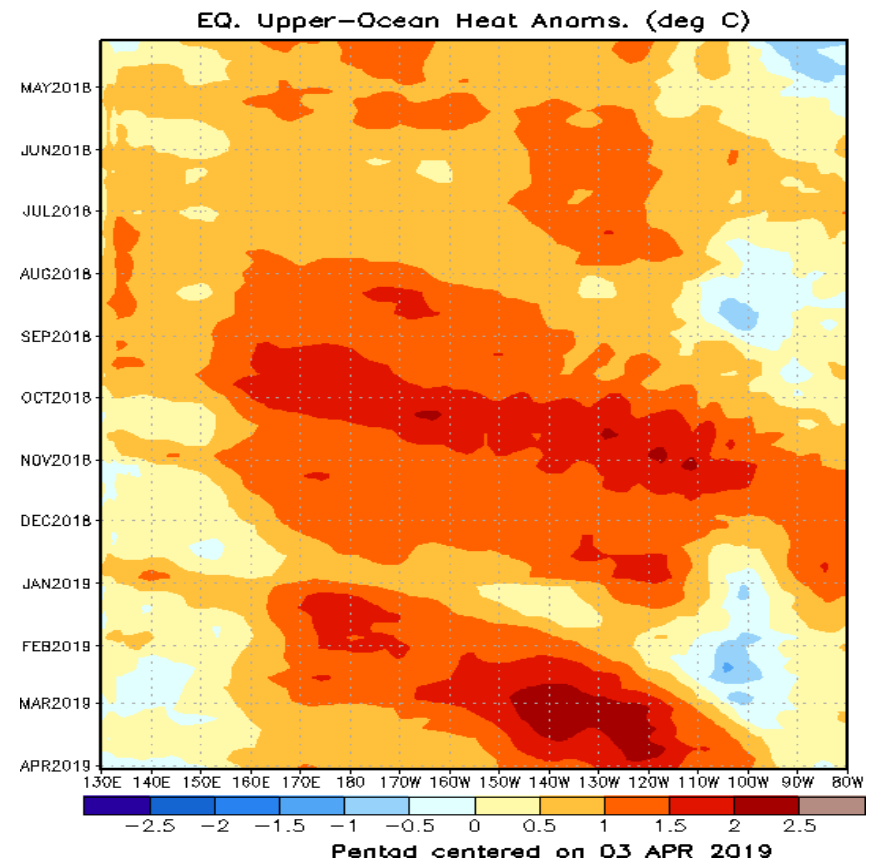
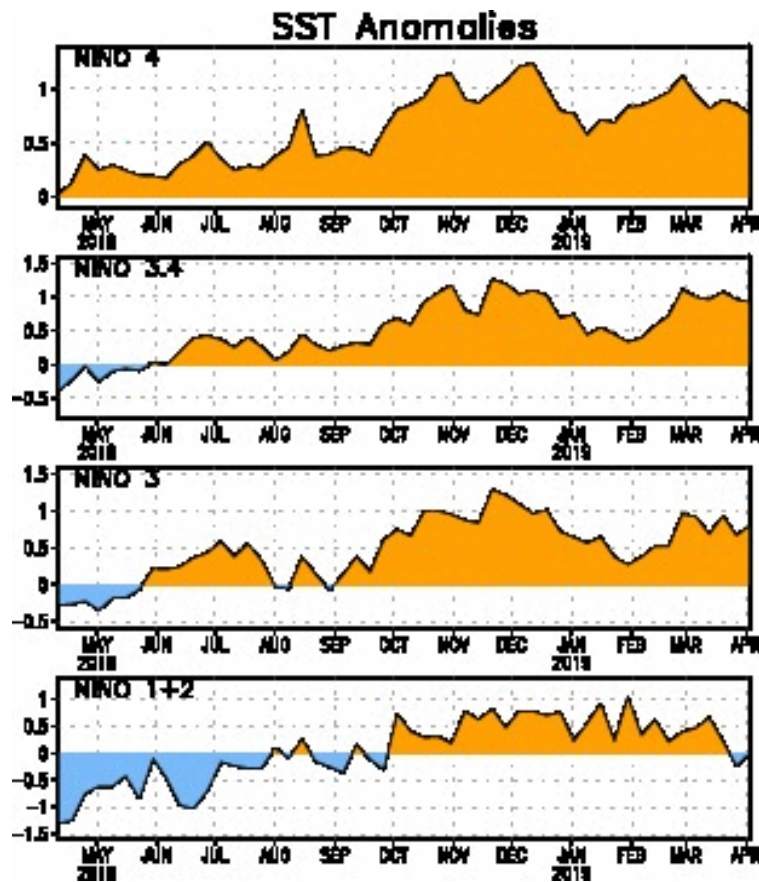
# Outgoing Longwave Radiation (OLR) Anomalies

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



- A consistent series of atmospheric, convectively coupled Kelvin waves, is evident throughout the OLR hovmöller diagram. Most recently, a Kelvin wave shifted east across the West Pacific.
- The low-frequency active convection around the Date Line continued into the beginning of April.

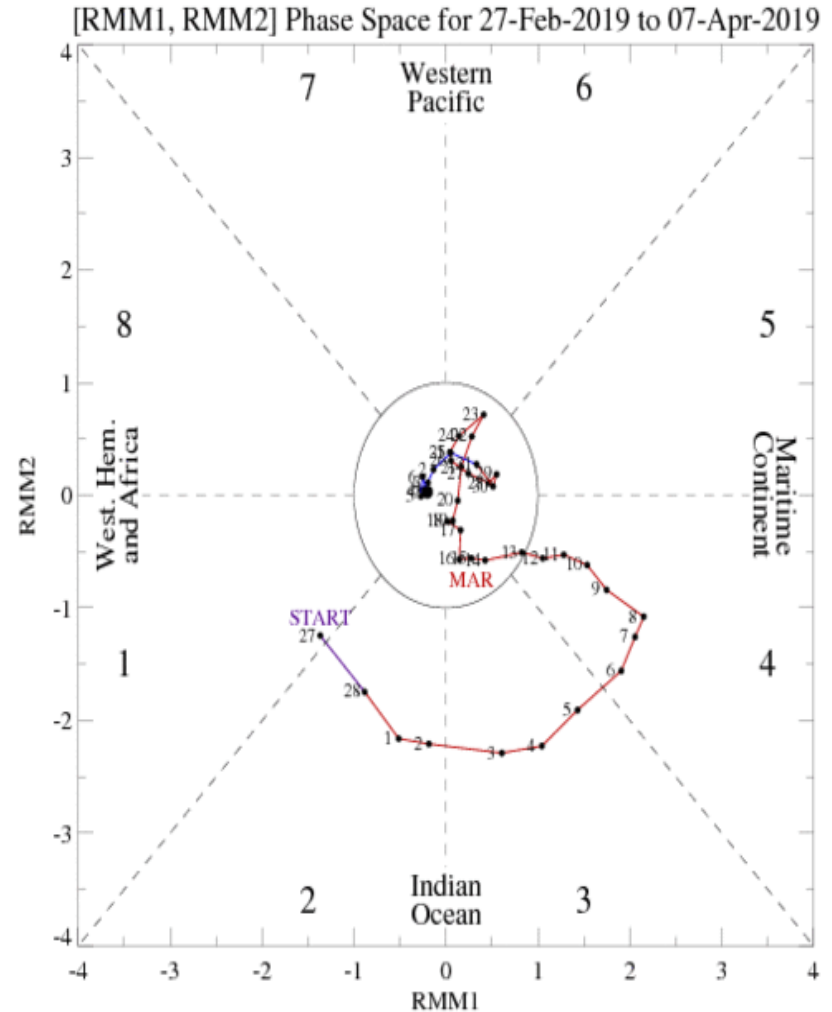
# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- SST anomalies remain above climatology across much of the equatorial central and east Pacific, consistent with an El Niño event.
- Positive oceanic heat content anomalies have been observed over most of the Pacific basin since last April.
- There was a downwelling Kelvin wave last Fall and another that began around the turn of the year. These helped push the thermocline down and develop the current El Niño.

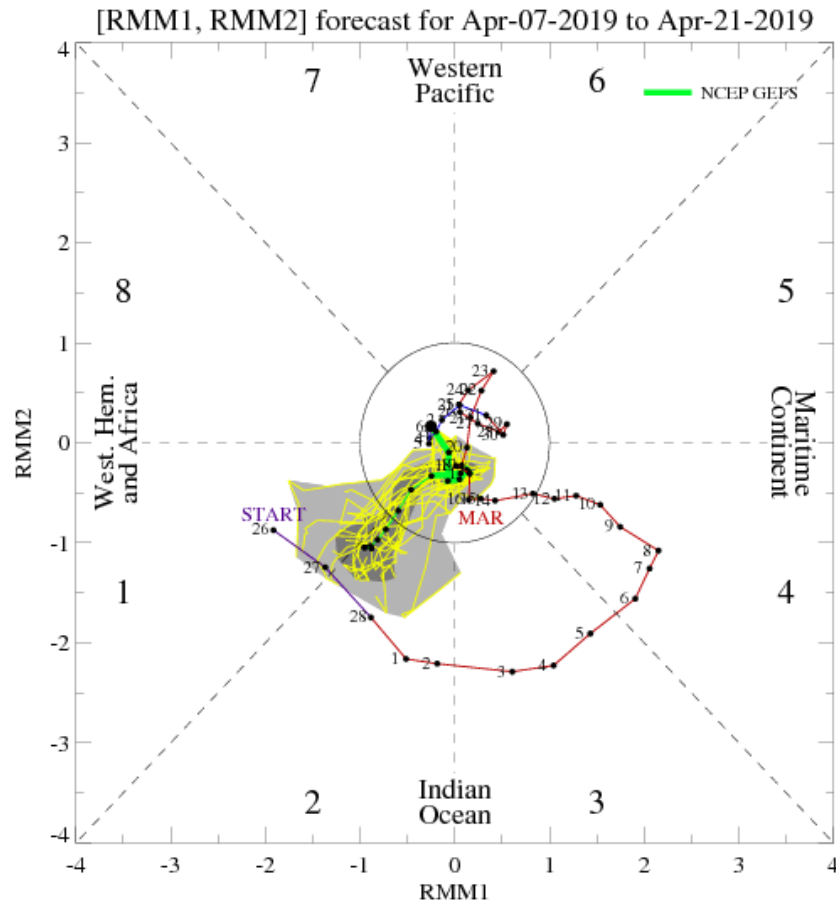
# MJO Index: Recent Evolution

- The RMM index depicts little to no MJO activity since mid-March.
- Destructive interference between the MJO enhanced phase over the Maritime Continent and the El Niño conditions over the Pacific may have led to this recent weakening.

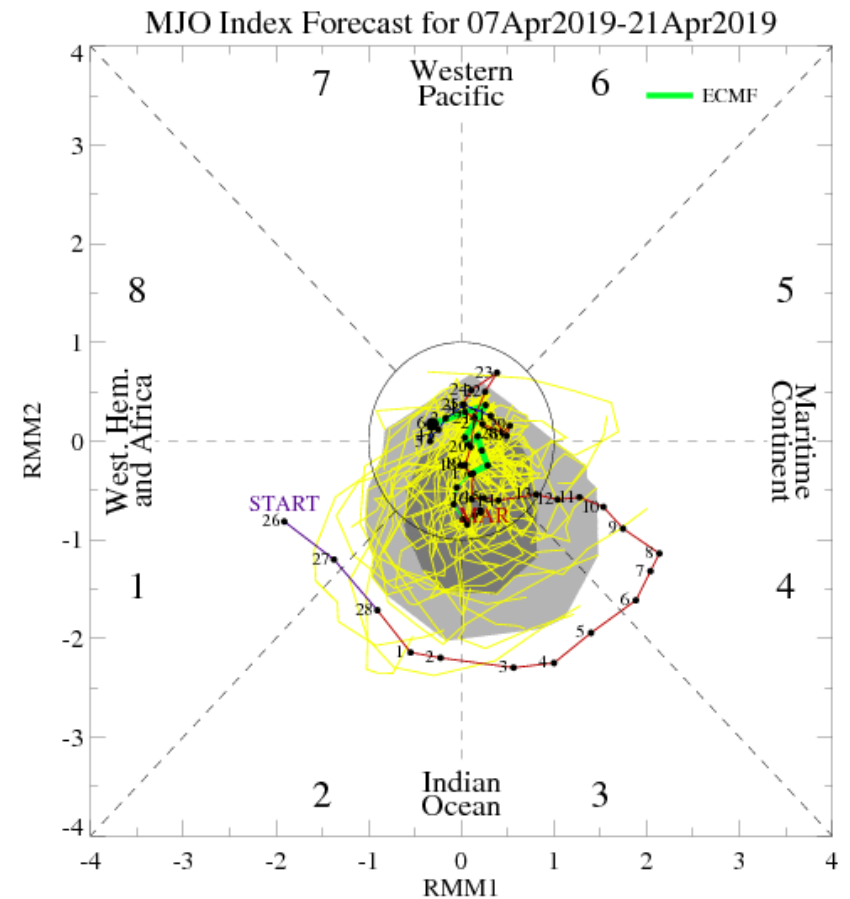




# MJO Index: Forecast Evolution



**GEFS Forecast**



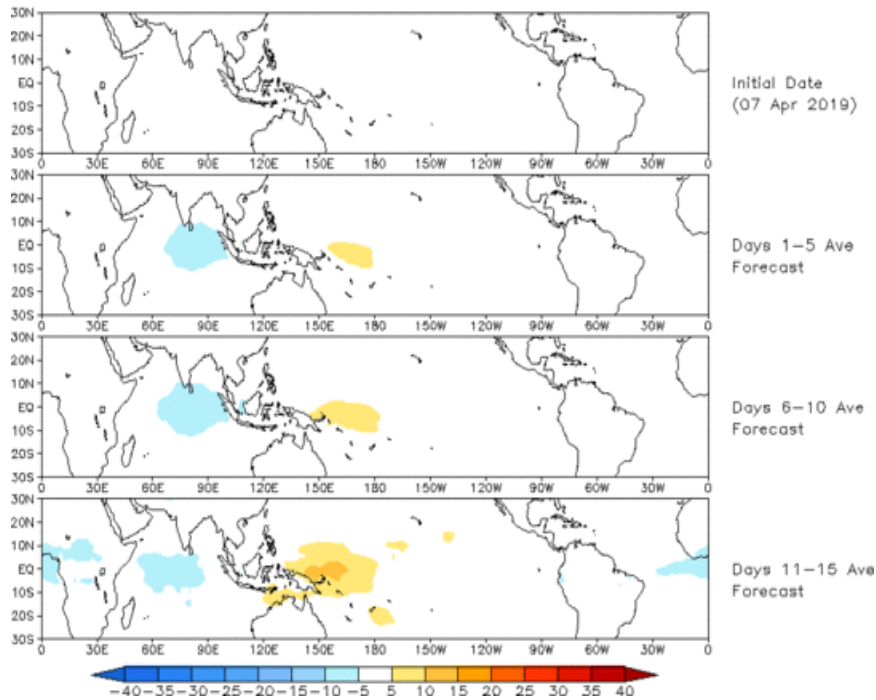
**ECMWF Forecast**

- The GEFS and ECMWF favor a continued weak MJO through mid-April.
- Many of the GFS and ECMWF ensemble members indicate a slow strengthening of the MJO during Week-2 with its enhanced phase over the western Indian Ocean.

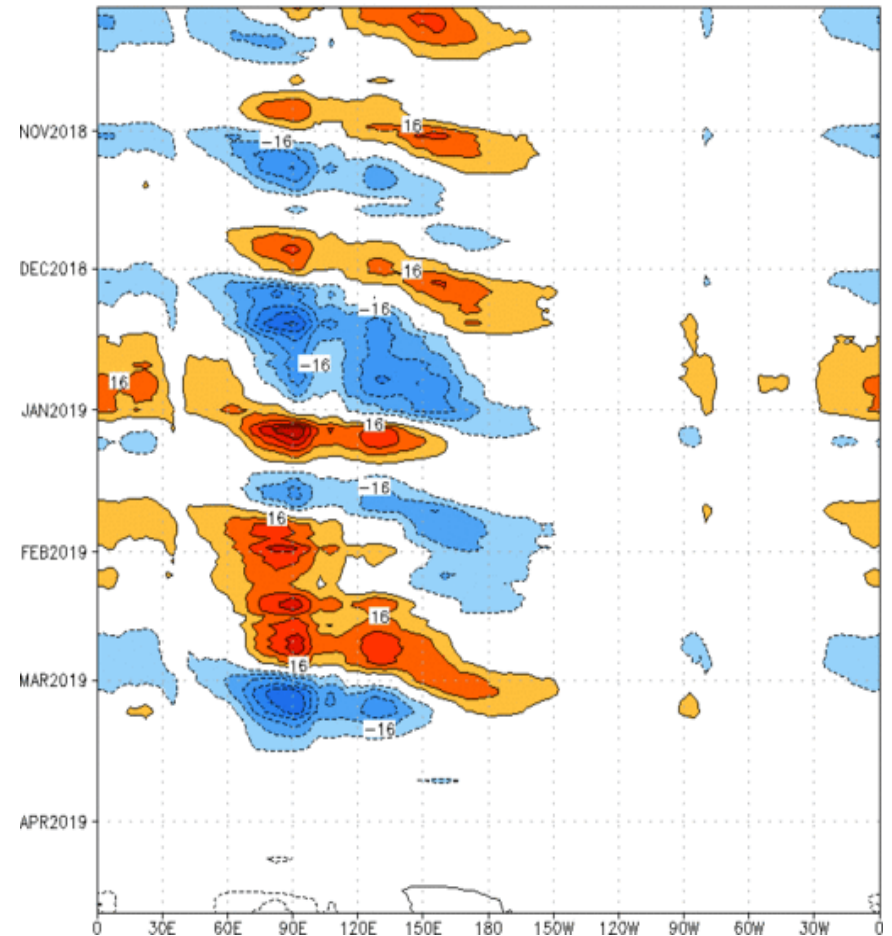
# MJO: GEFS Forecast Evolution

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 Apr 2019  
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2  
OLR [7.5°S,7.5°N] ( $\text{cont: } 4\text{Wm}^{-2}$ ) Period: 05-Oct-2018 to 06-Apr-2019  
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

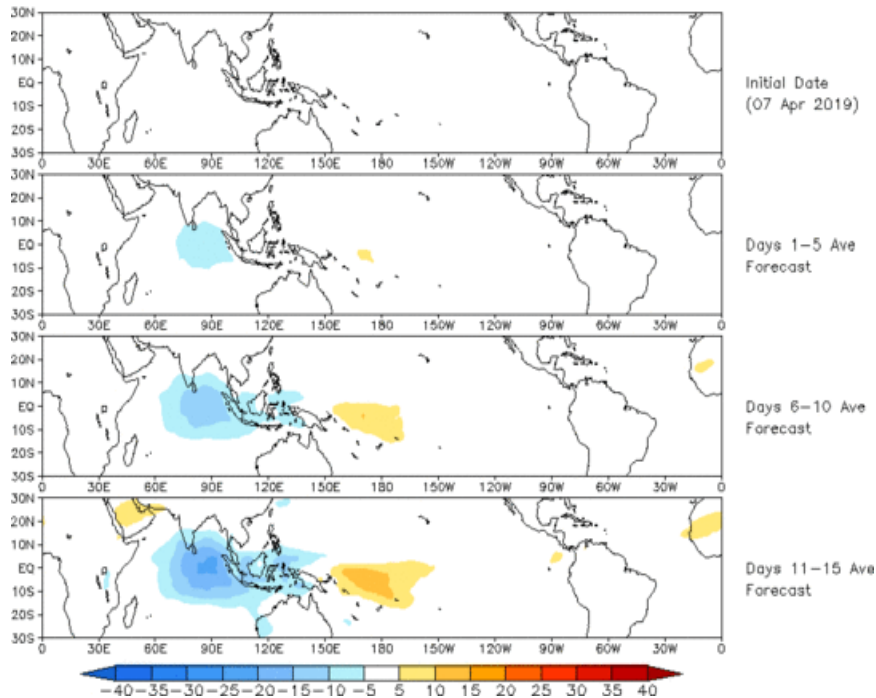


- Consistent with the RMM forecasts, enhanced convection is forecast to develop over parts of Africa and the Indian Ocean during the next two weeks.
- The suppressed convection forecast over the west-central Pacific is inconsistent with the background state.

# MJO: Constructed Analog Forecast Evolution

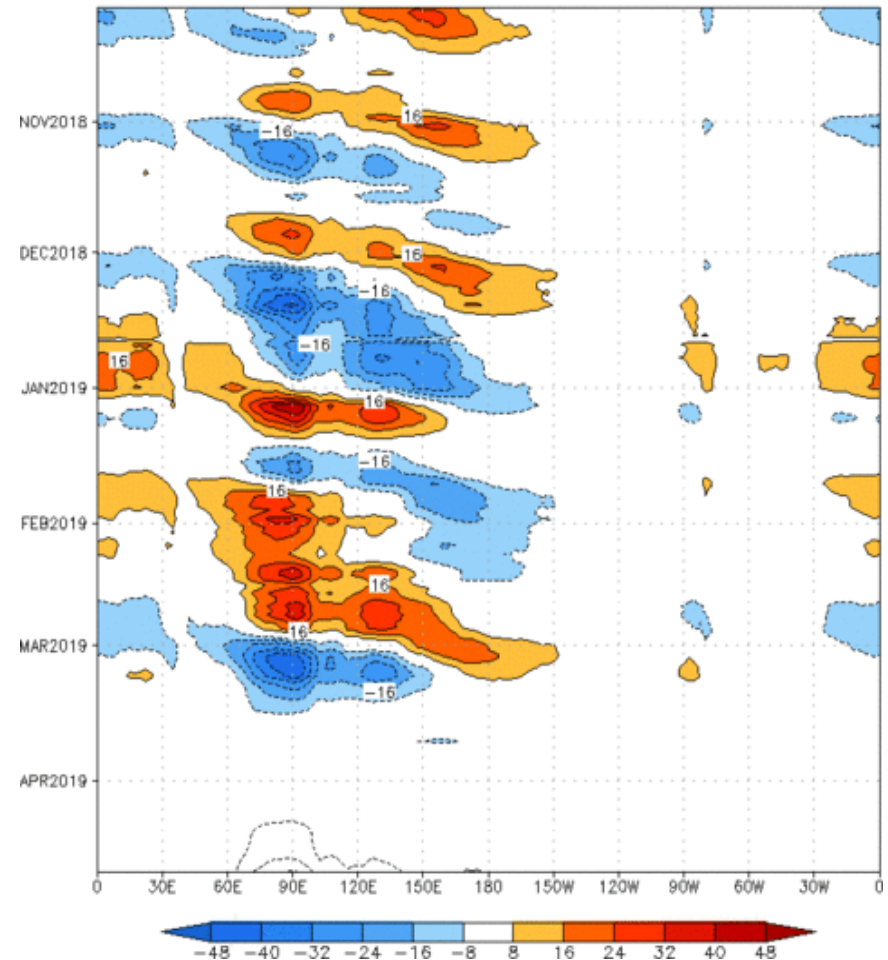
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (07 Apr 2019)



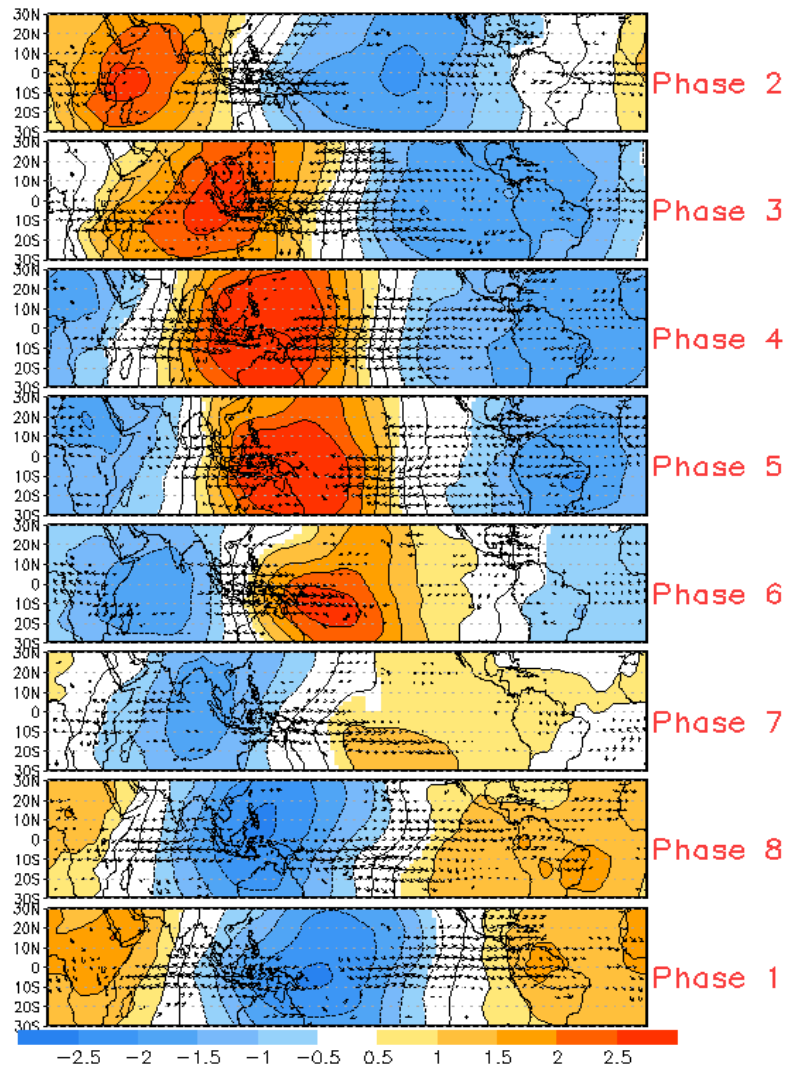
- The constructed analog features enhanced convection strengthening over the eastern Indian Ocean and western Maritime Continent later in Week-2.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm<sup>-2</sup>) Period:06-Oct-2018 to 07-Apr-2019  
The unfilled contours are CA forecast reconstructed anomaly for 15 days

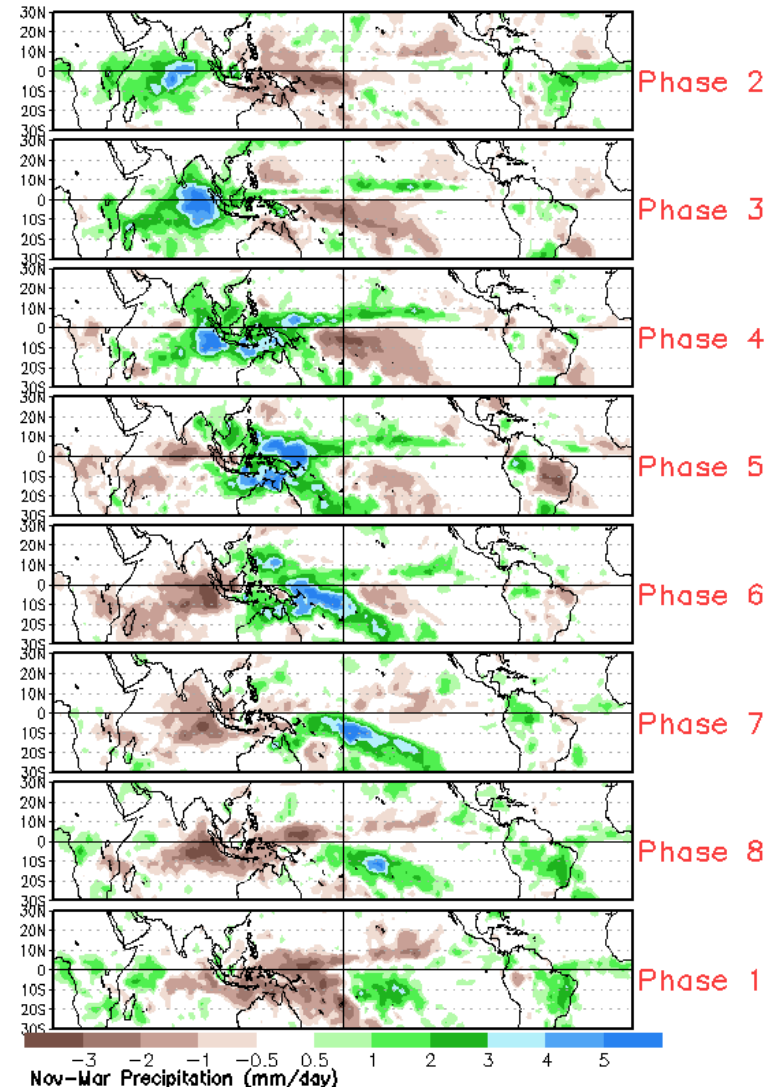


# MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and  
Wind Anomalies (Nov - Mar)



Precipitation Anomalies (Nov - Mar)

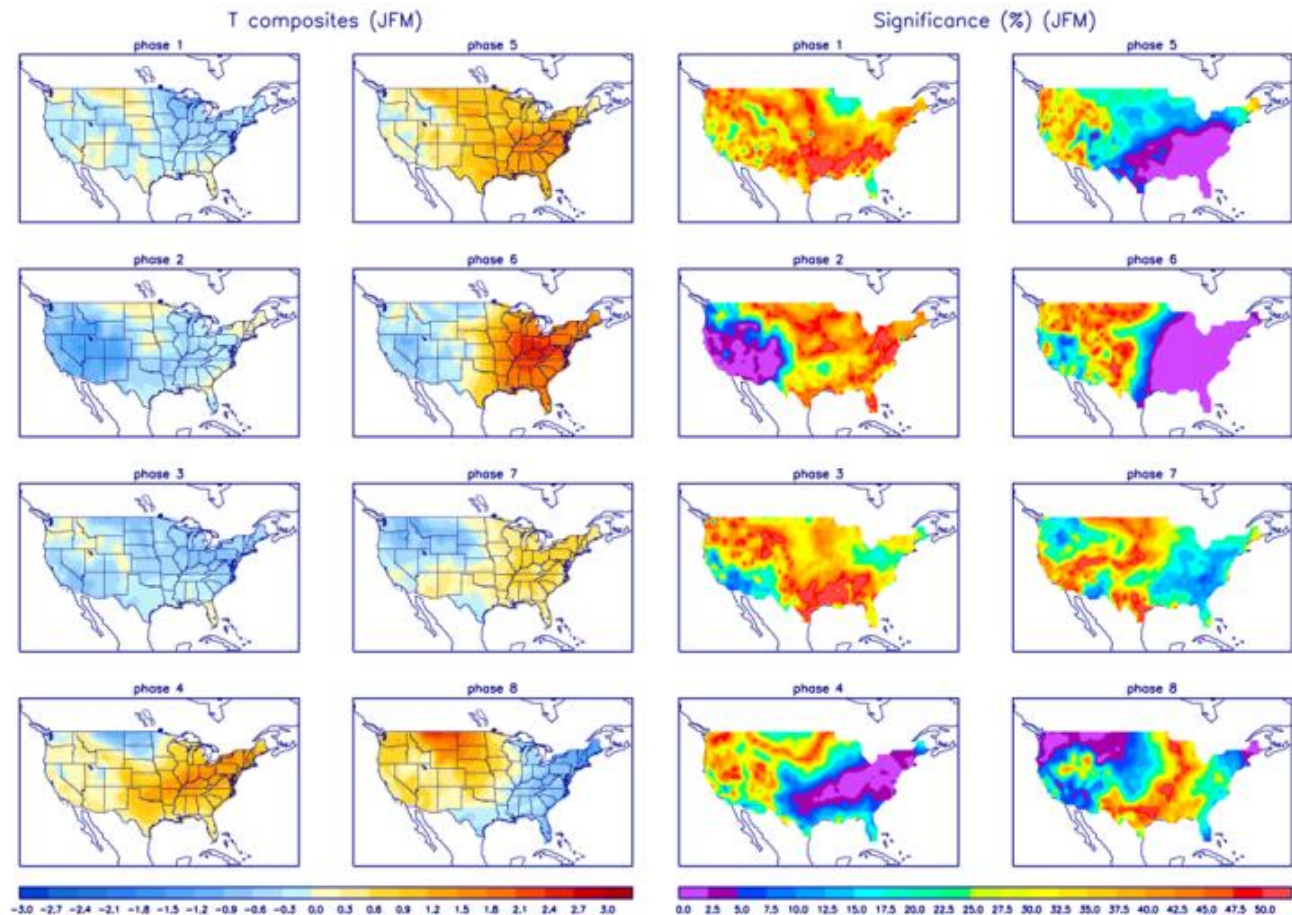




# MJO: CONUS Composite Maps by RMM Phase - Temperature

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 (orange) 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.

