

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



Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
1 April 2019

Overview

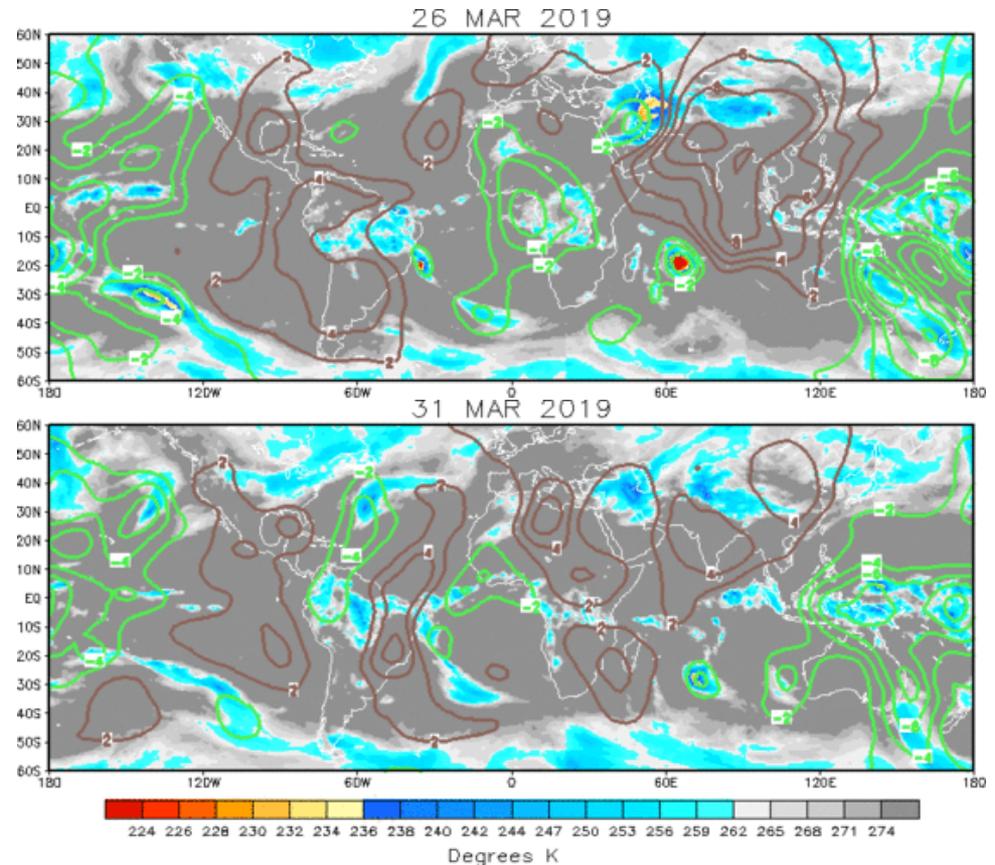
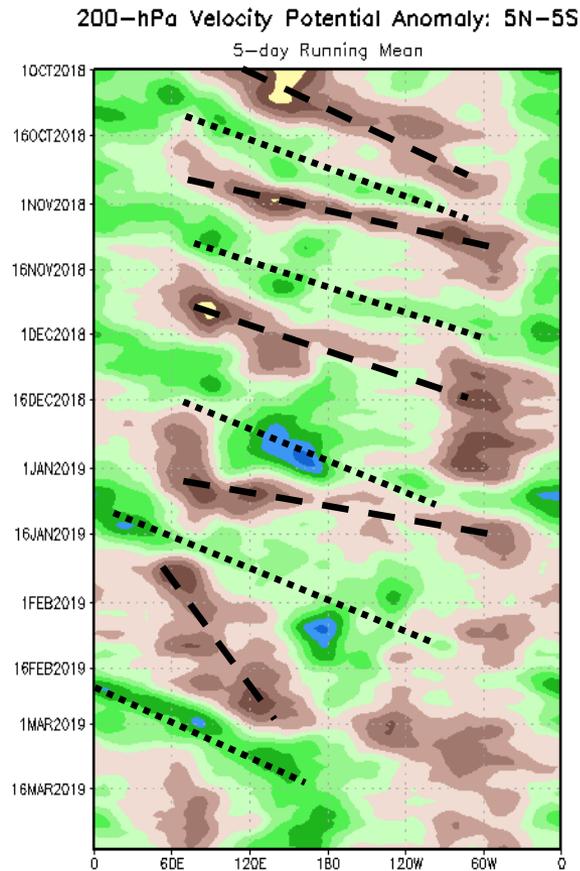
- The MJO remains weak and is not forecast to amplify during the next couple of weeks.
- Some GEFS ensemble members indicate that there is an outside chance of the MJO re-emerging at the end of two week period, but most of its members and none of the ECMWF ensemble members support this outcome.
- The CFS indicates the potential for Kelvin and equatorial Rossby wave activity to remain high during the next couple of weeks.
 - The convergence of these tropical waves is likely to increase the probability of a tropical cyclone off the northwest coast of Australia during the next week.

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).

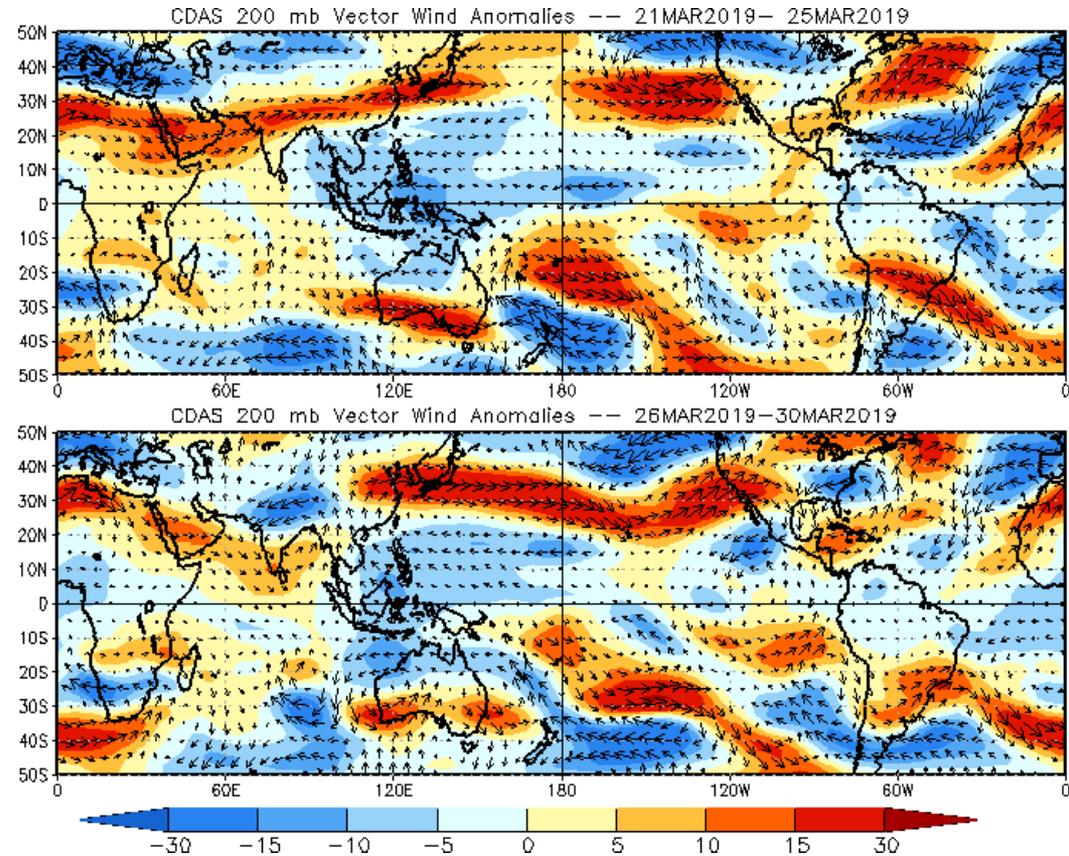
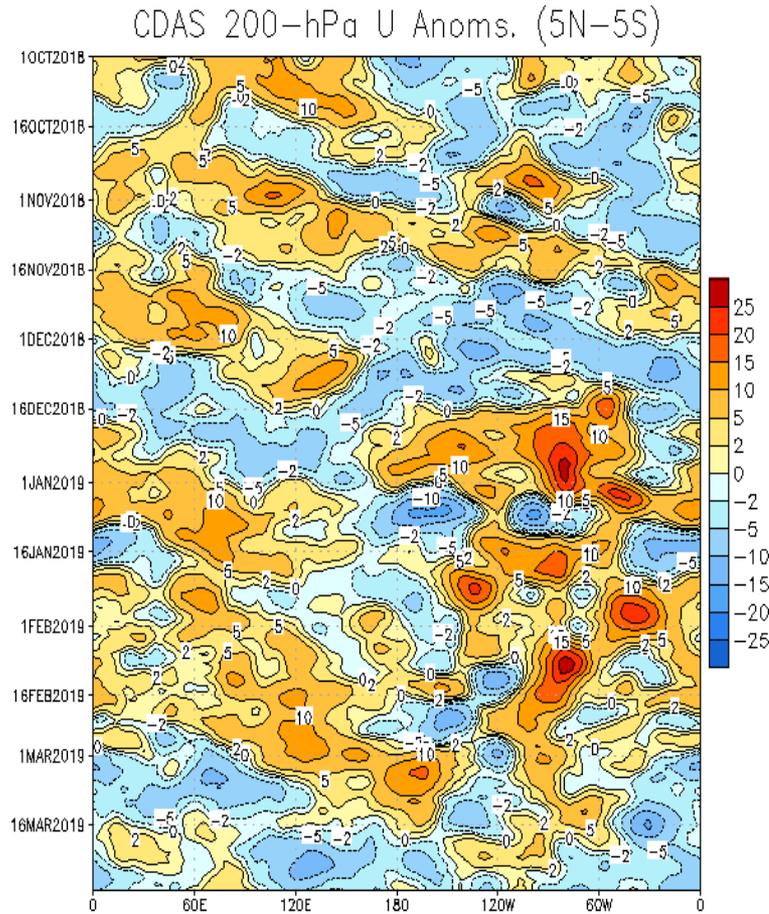
Brown shades: Anomalous convergence (unfavorable for precipitation).



- The 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. Most recently, an ER wave is evident moving westward across the Date Line and into the West Pacific.
- The upper-level VP pattern became noisy during the end of March since anomalous MJO convection wasn't around to anchor it.

200-hPa Wind Anomalies

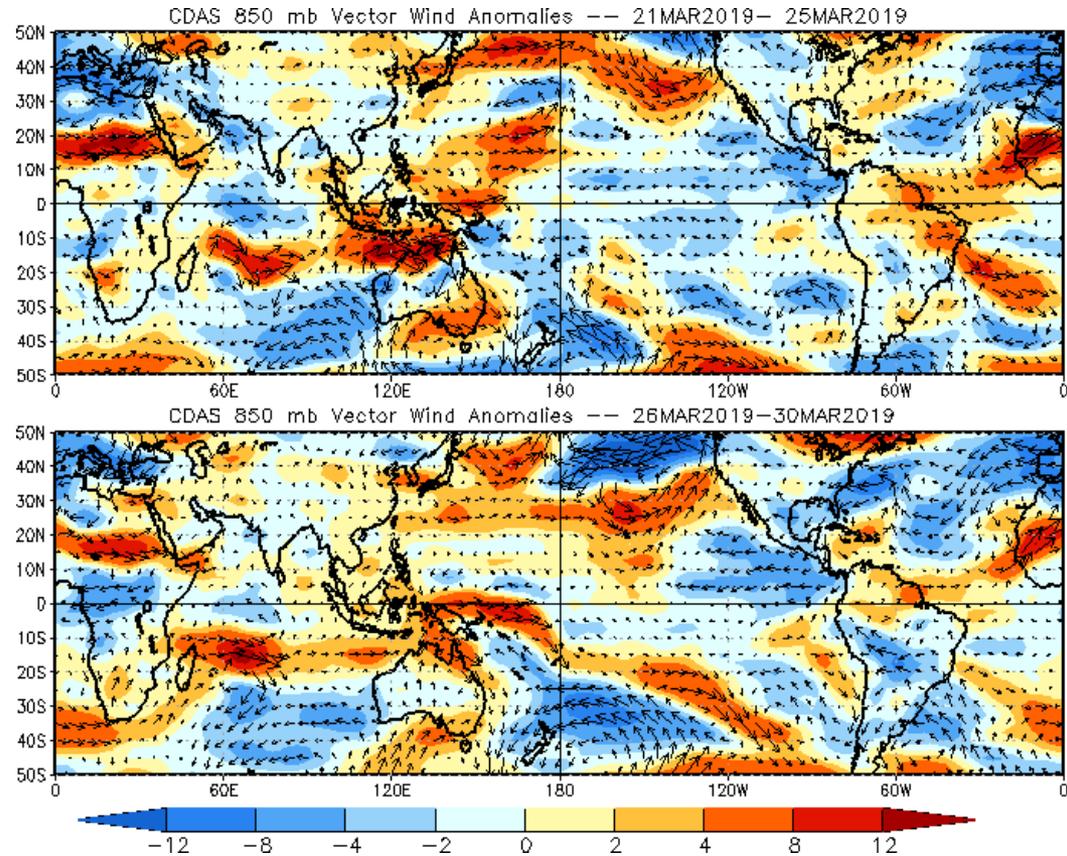
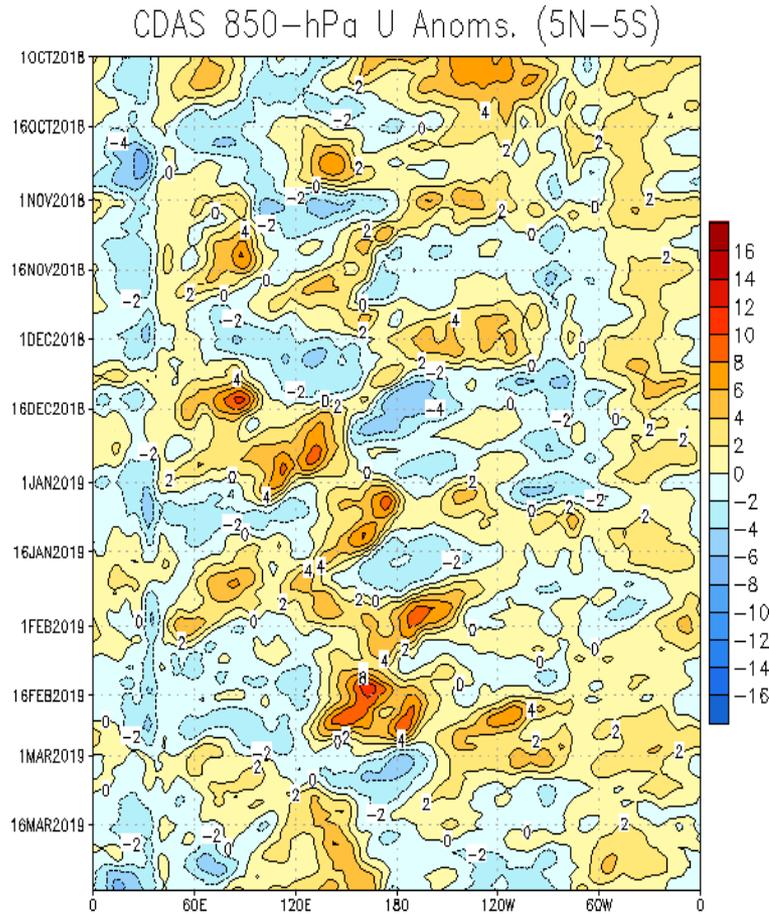
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- 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.
- There was an anomalous flow across the northern Pacific into California during the past week, which helped to bring precipitation to northern parts of California.

850-hPa Wind Anomalies

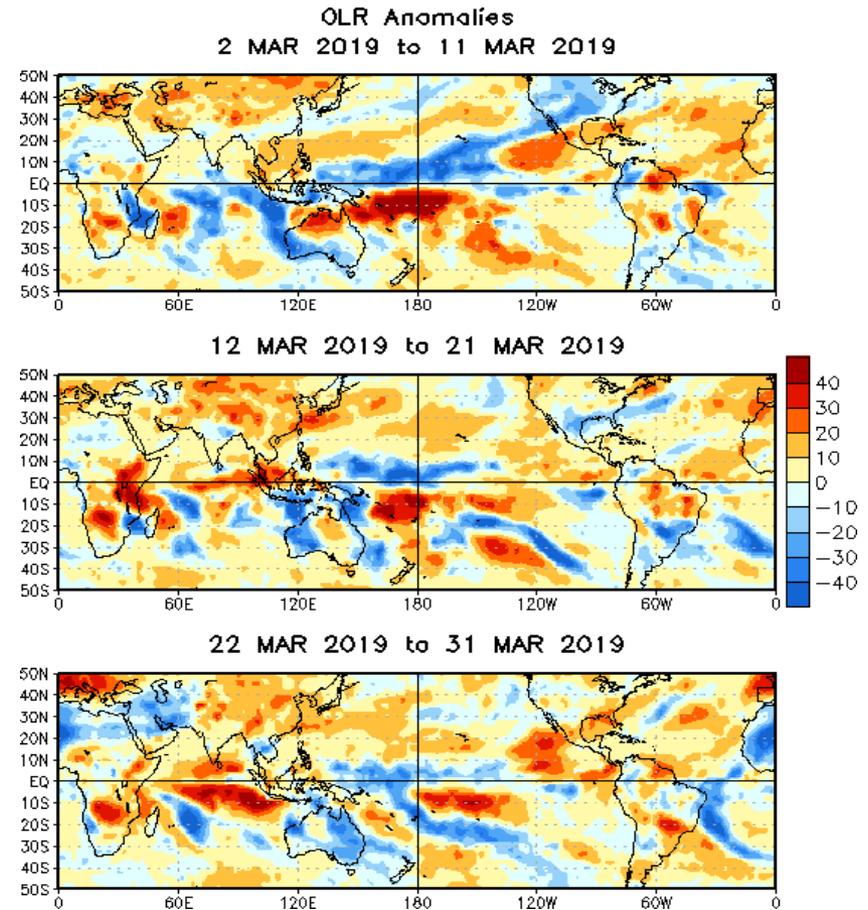
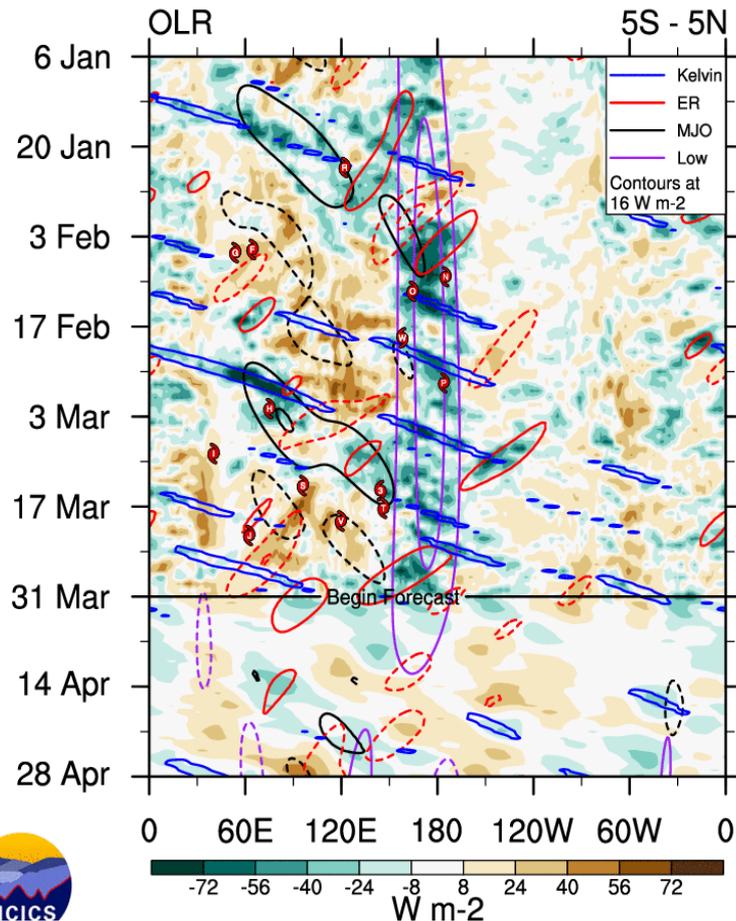
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- The MJO's footprint was generally weaker in the lower levels than in the upper levels, but there is still evidence of eastward moving MJO activity and westward moving equatorial Rossby wave activity.
- There is evidence of mid-latitude Rossby wave breaking in the Northern Hemisphere over the eastern Pacific, which has resulted in anomalous easterlies just north of the equator stretching from the west coast of Central America to around 160W.

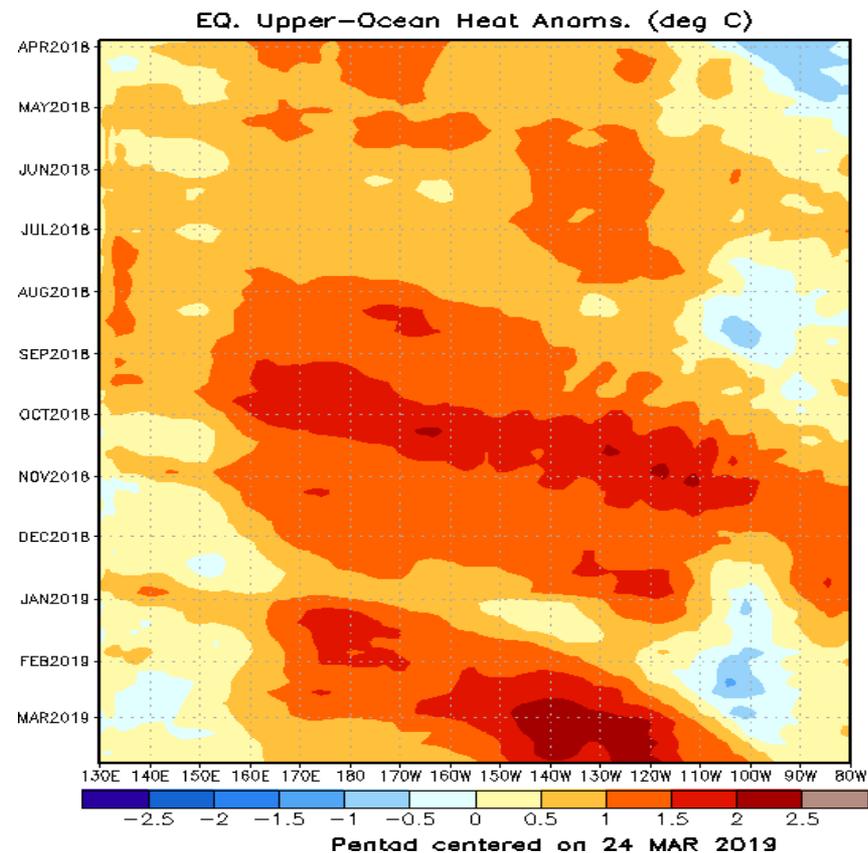
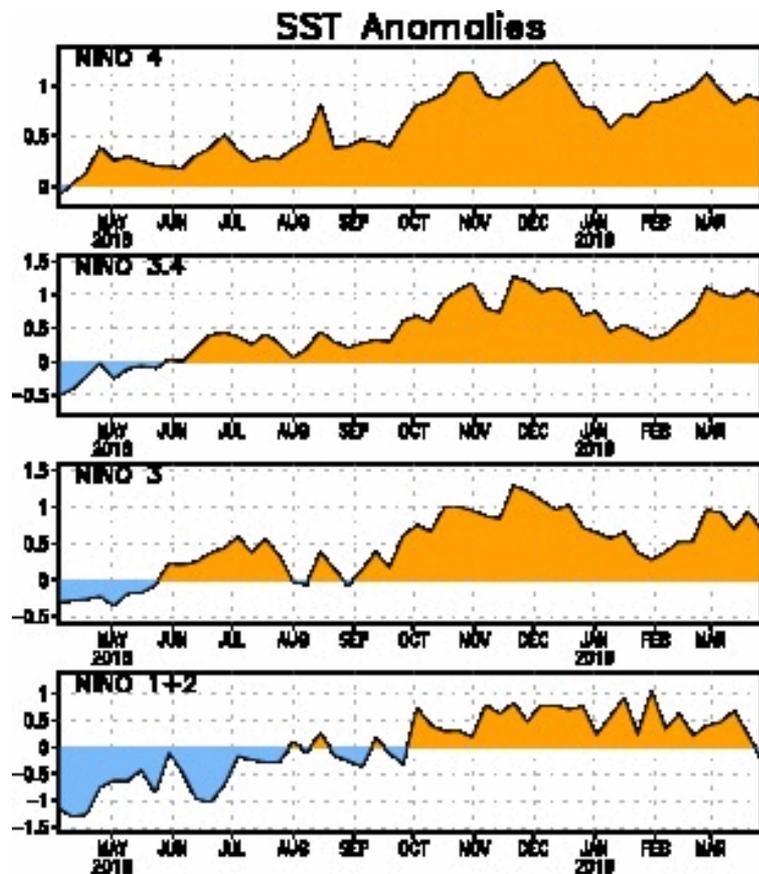
Outgoing Longwave Radiation (OLR) Anomalies

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 moved over the Indian Ocean and intersected with a westward moving equatorial Rossby wave.
- The low-frequency active convection around the Date Line continued through March and is forecast to continue into the Spring in association with the ongoing El Niño.

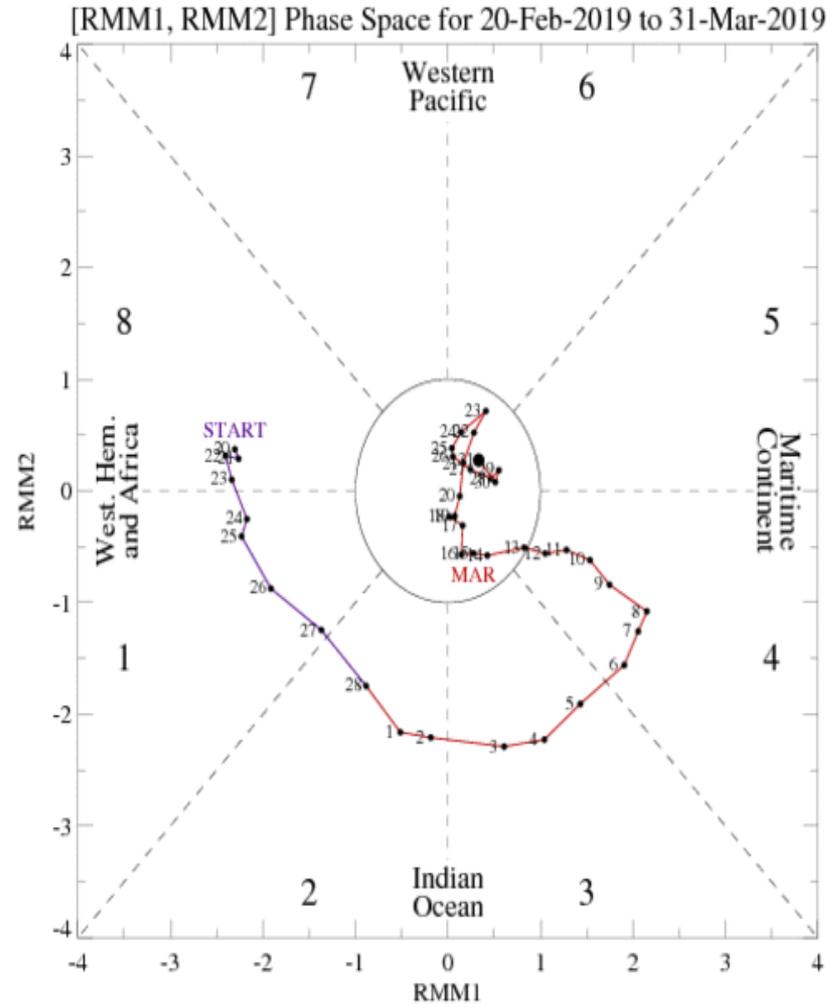
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



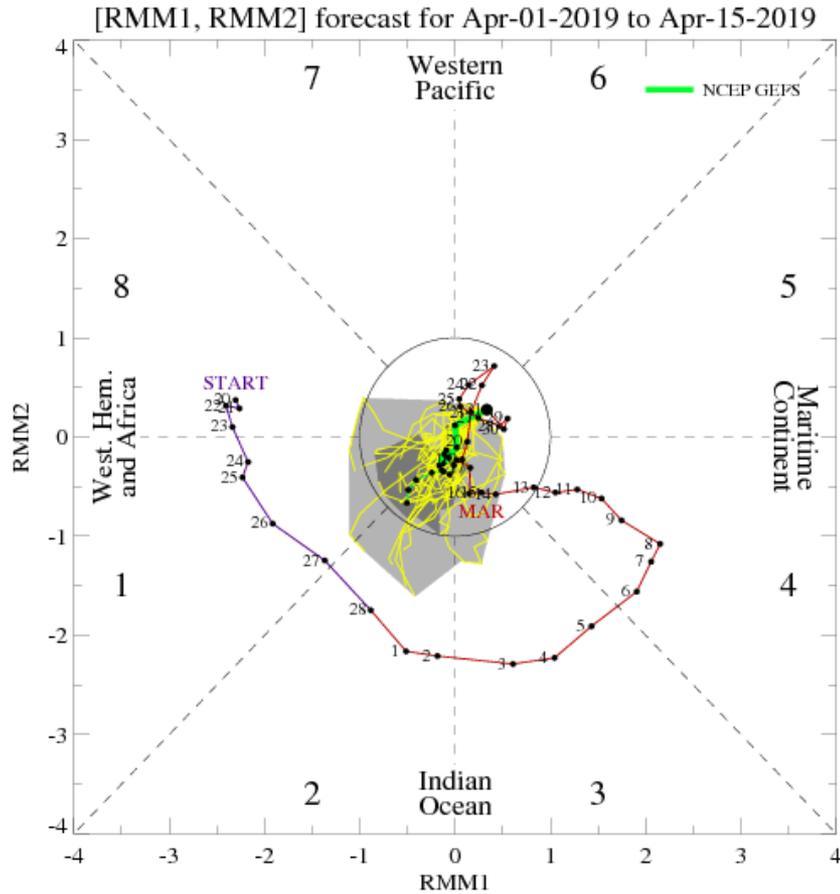
- SST anomalies in all four Niño regions remain above climatology, consistent with an El Niño event.
- Positive oceanic heat content anomalies have been observed over most of the Pacific basin since last April.
- There was a downwelling Kelvin wave last Fall and another that began around the turn of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

MJO Index: Recent Evolution

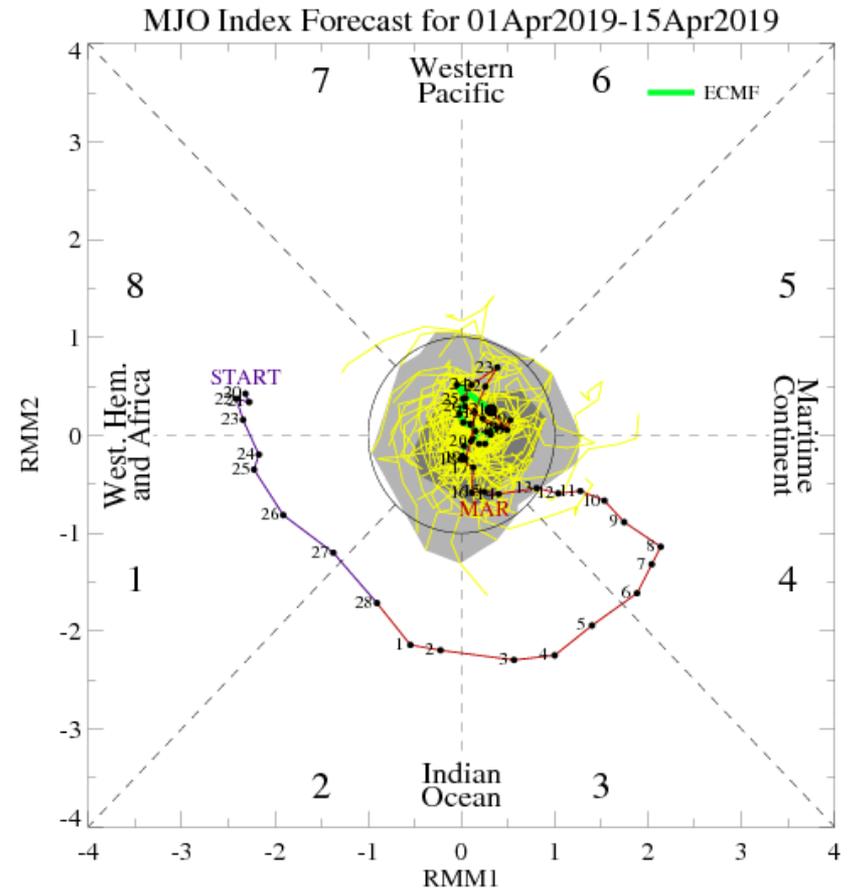
- The RMM index currently depicts little to no MJO activity over the past couple of weeks.
- The weakening index may have been due in part to destructive interference between the MJO enhanced phase over the Maritime Continent, and the El Niño conditions over the Pacific.



MJO Index: Forecast Evolution



GEFS Forecast



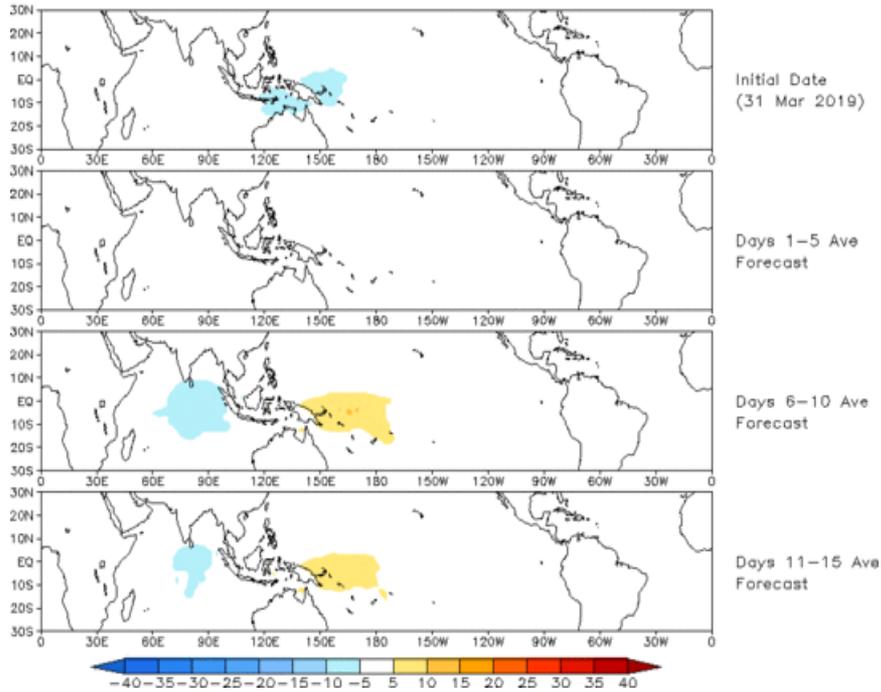
ECMWF Forecast

- Both the GEFS and ECMWF suggest that the MJO is likely to remain weak during the next two weeks.
- There are a few GEFS ensemble members that group together and suggest that the MJO might re-emerge over the Indian Ocean towards the end of Week-2, but the ECMWF does not support this conclusion.

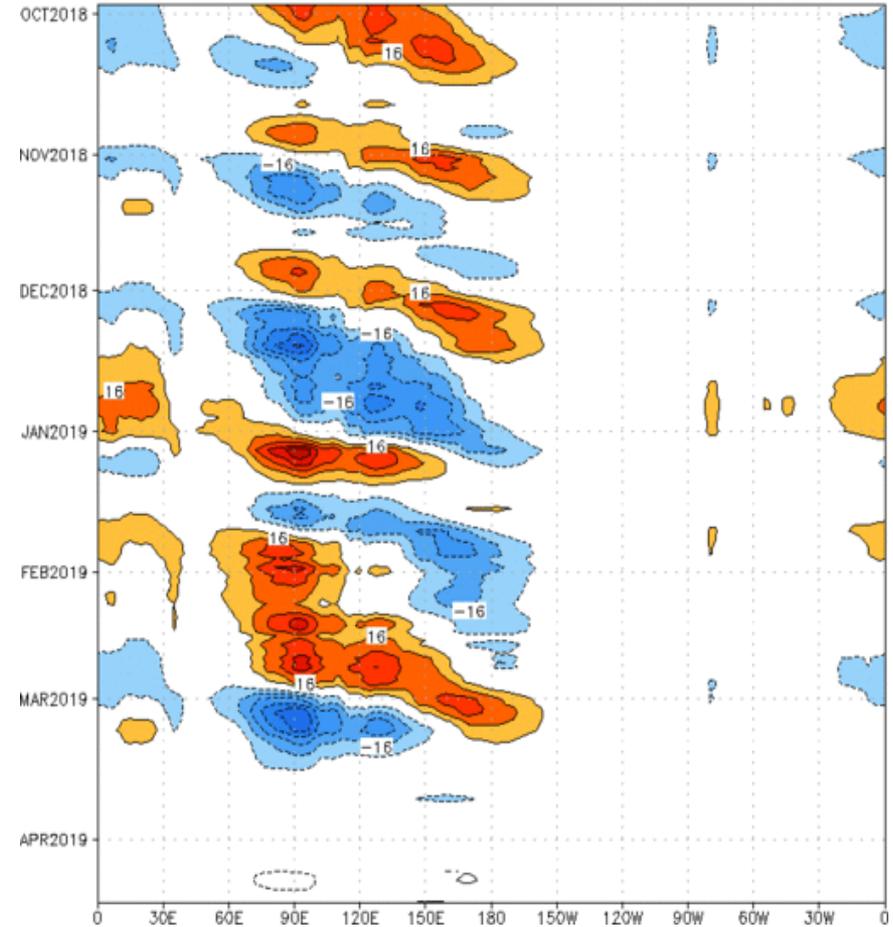
MJO: GEFS Forecast Evolution

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: 31 Mar 2019
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:29-Sep-2018 to 31-Mar-2019
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

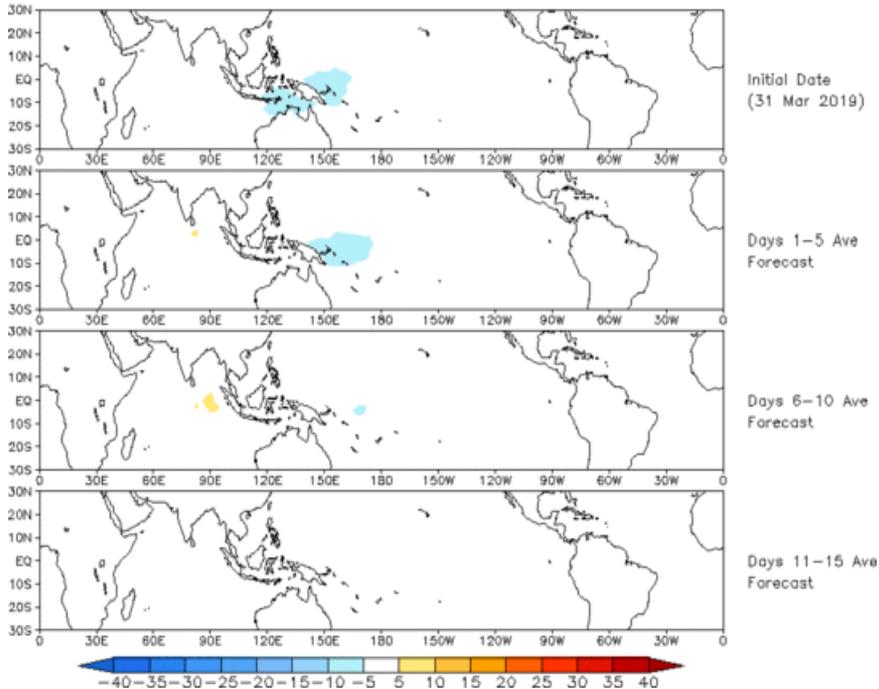


- Consistent with the RMM forecasts, there is very little MJO signal in the GEFS.

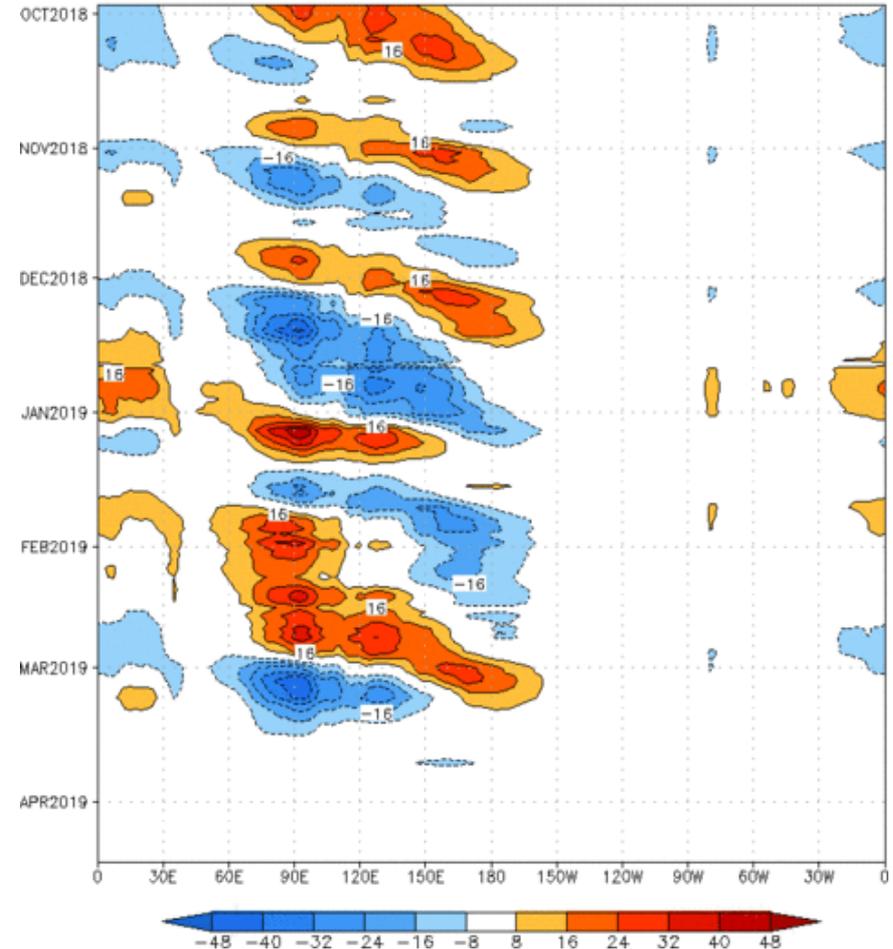
MJO: Constructed Analog Forecast Evolution

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 (31 Mar 2019)



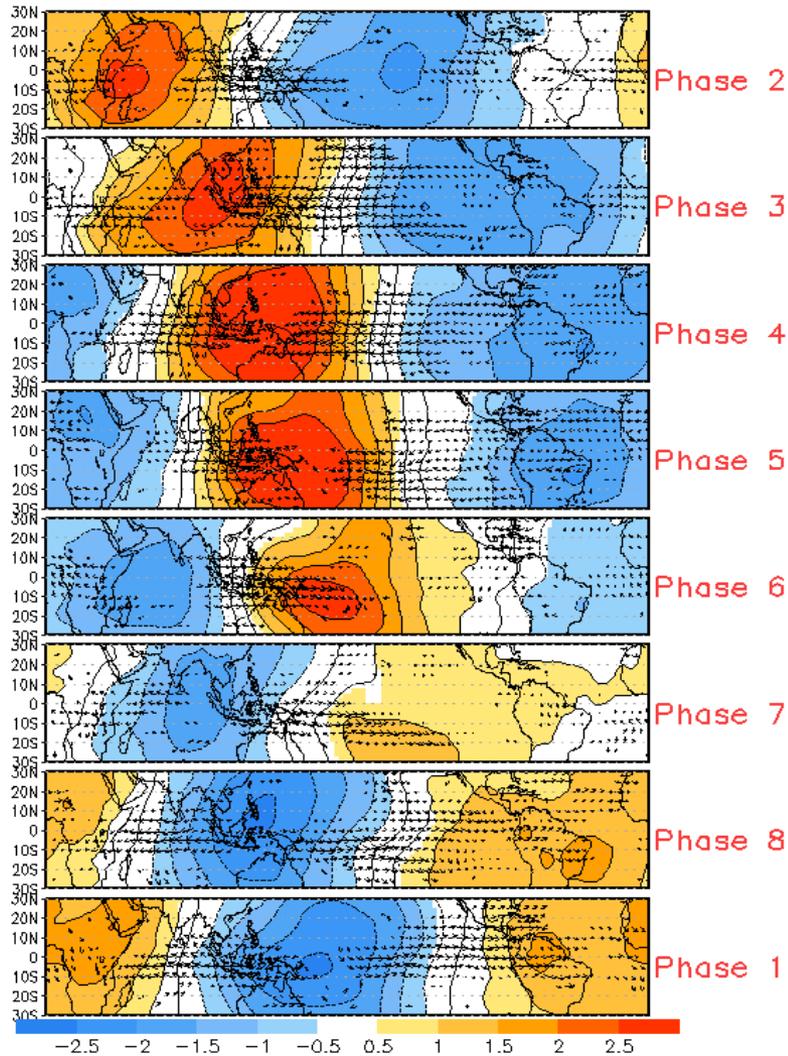
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:29-Sep-2018 to 31-Mar-2019
The unfilled contours are CA forecast reconstructed anomaly for 15 days



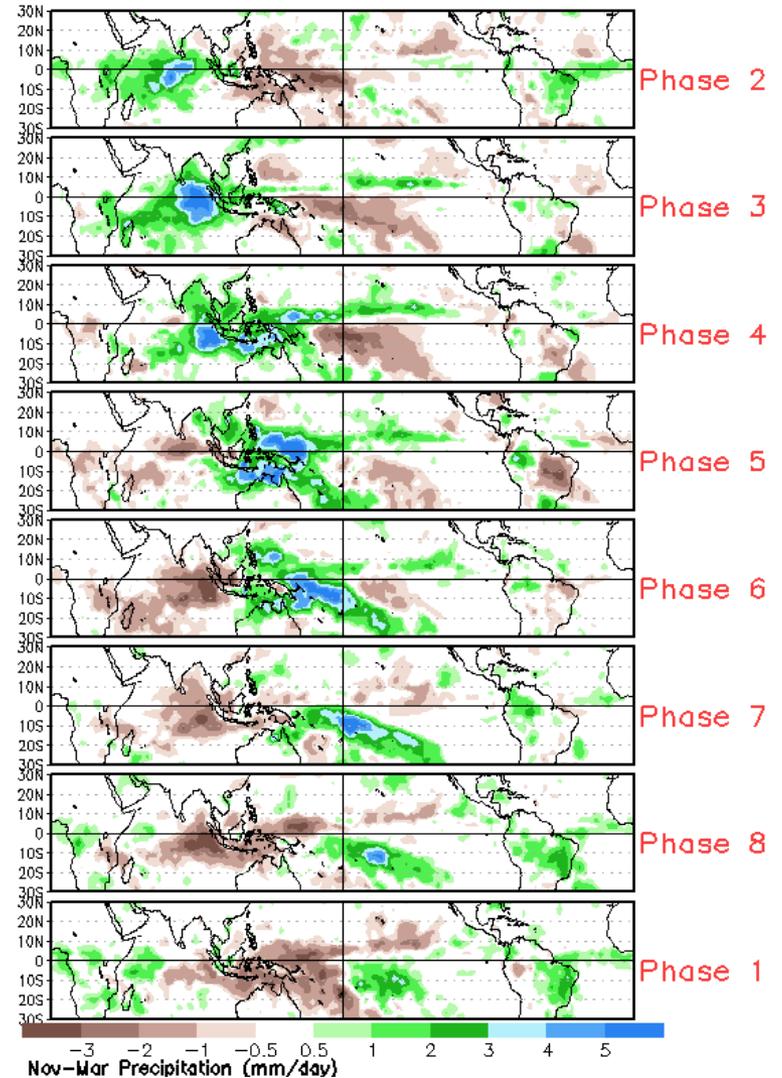
- Again, the MJO is very weak and not forecast to amplify over the next two weeks.

MJO: Tropical Composite Maps by RMM Phase

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



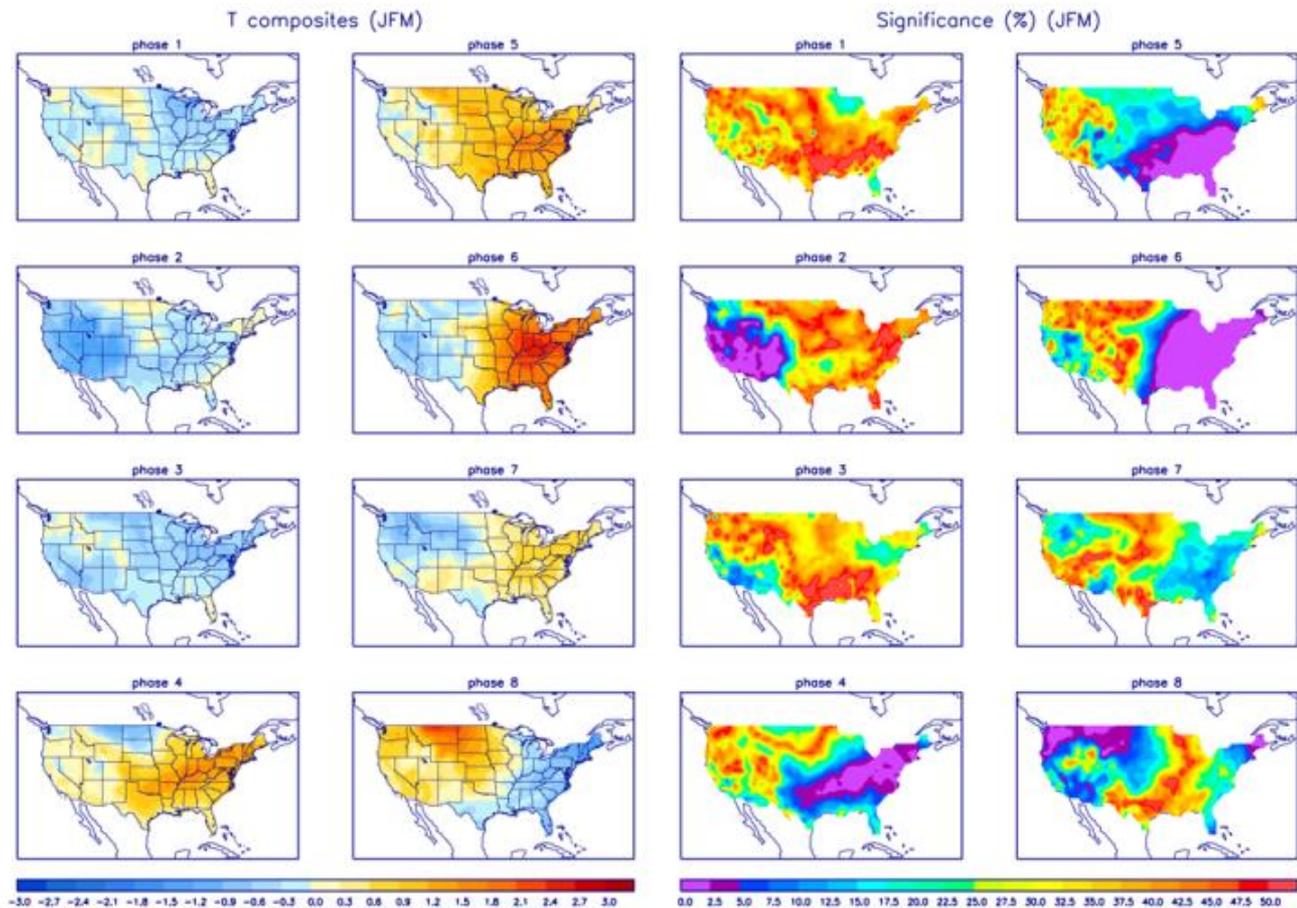
Precipitation Anomalies (Nov - Mar)



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.

