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

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
25 March 2019

Overview

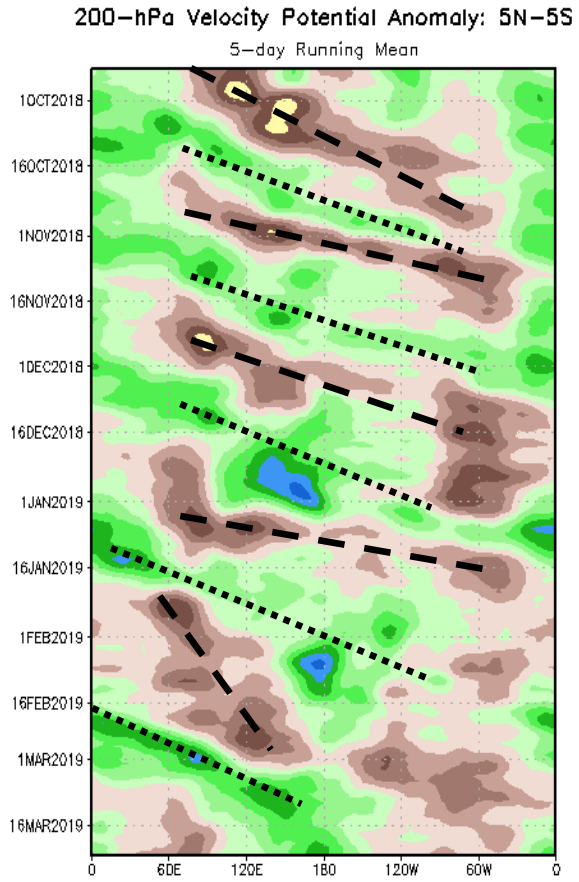
- The Madden Julian Oscillation has weakened over the past week.
- Other modes, such as the ENSO state, Rossby wave activity over the East Pacific, and Kelvin wave activity are strongly influencing the pattern.
- Forecast guidance favors continued weak MJO activity during Week-1, and some models depict renewed MJO activity over the Western Hemisphere or Indian Ocean by the end of Week-2. Other models, such as the ECMWF, show a continued weak signal throughout the period.
- Based on recent observations and these tools, the MJO is not anticipated to play a substantial role in the global tropical convective pattern over the next week, and there is considerable uncertainty regarding further progression of the signal beyond Week-1.

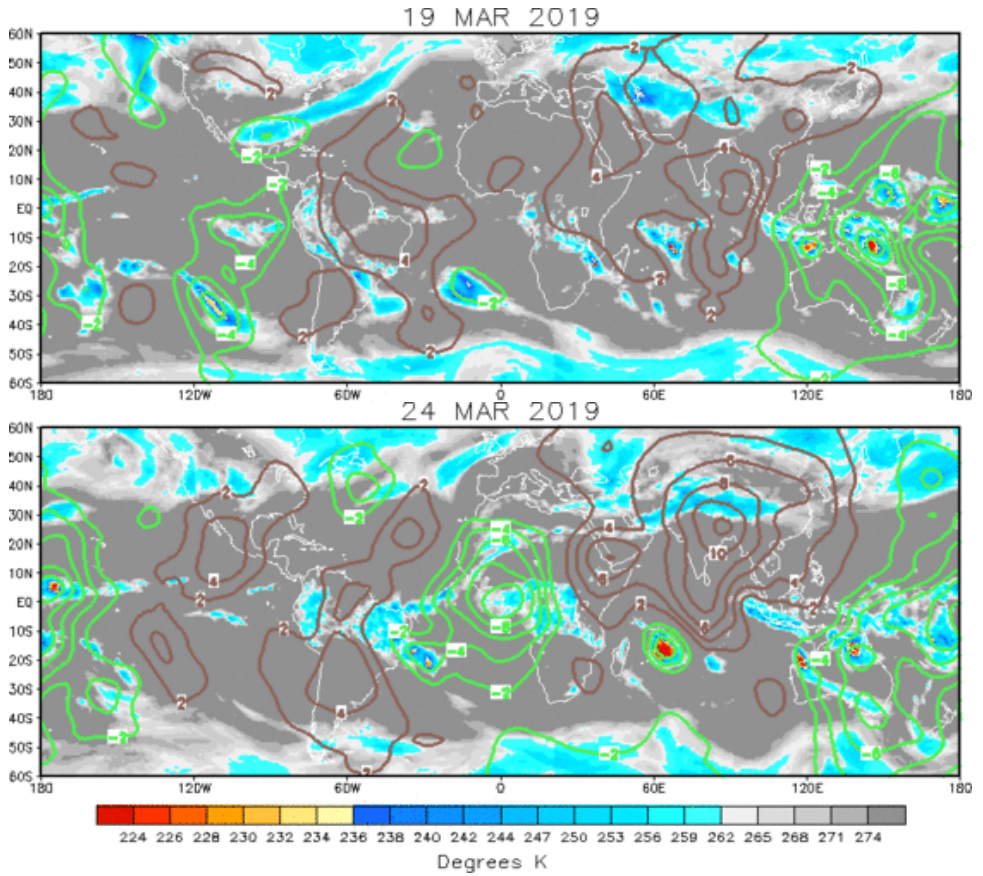
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

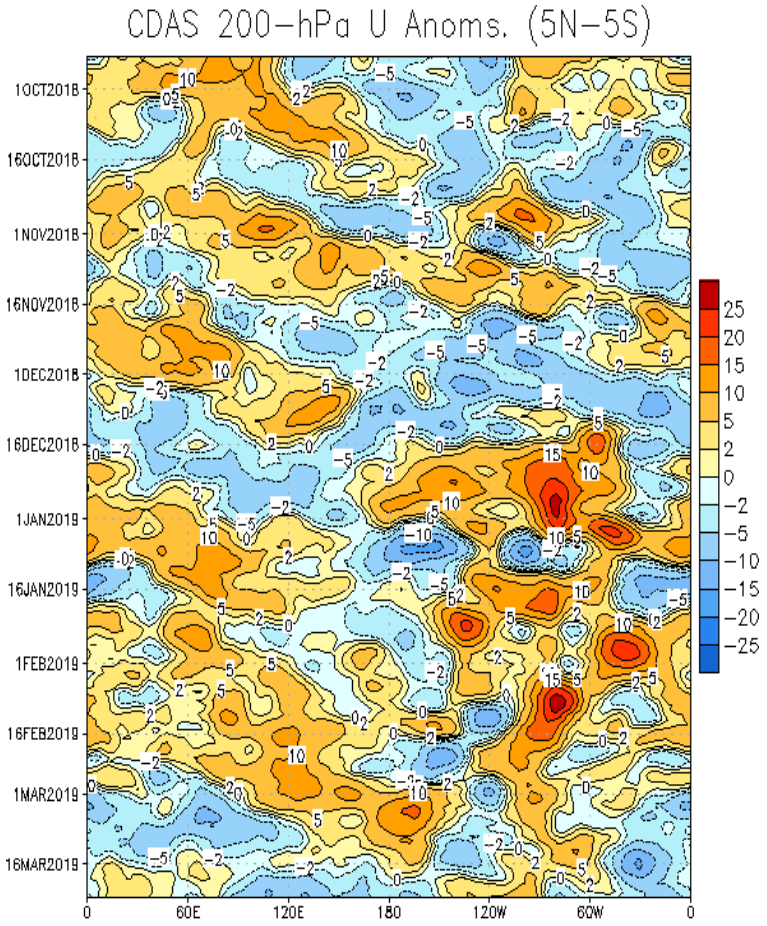


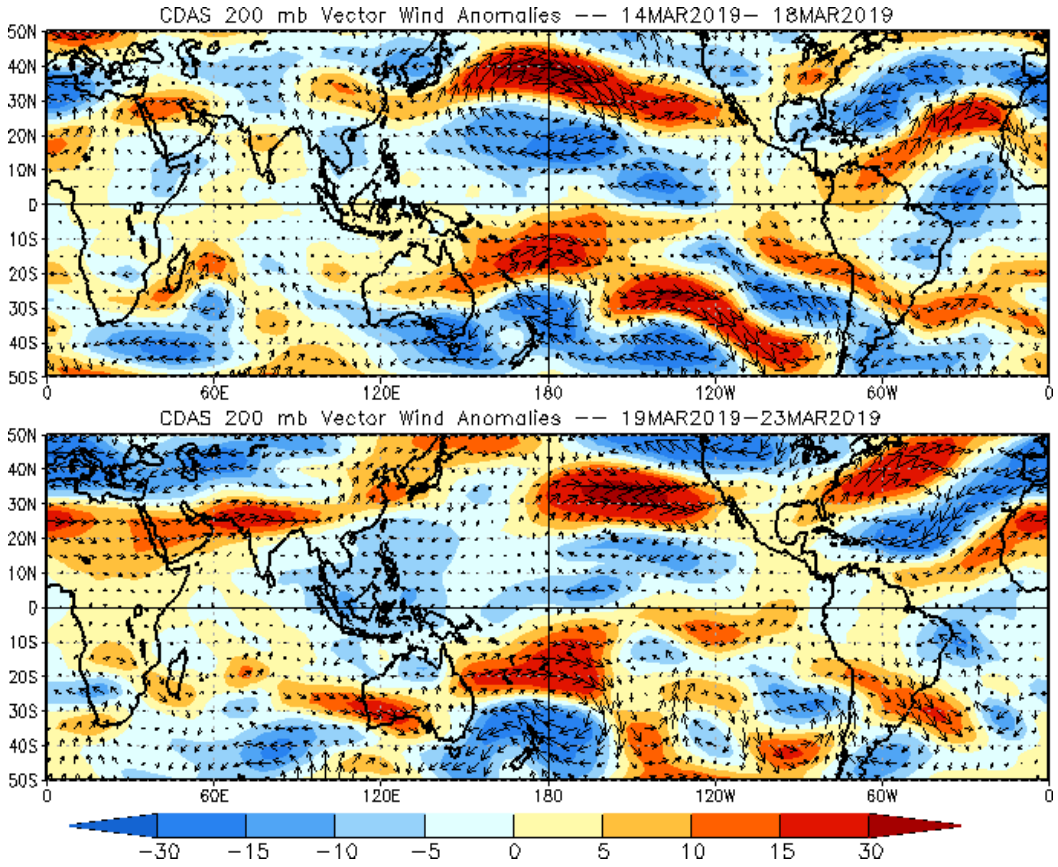


- The MJO has been active since September.
- The upper-level velocity potential pattern has broken down into a Wave-2 pattern. Although the strongest divergent signal is over the Pacific, consistent with constructive interference between the MJO and ENSO, the anomalies are zonally limited and confined primarily to the far West Pacific. Interference with Rossby wave/midlatitude influences over the East Pacific may be to blame.
- Constructive interference between a Kelvin wave and low-frequency enhanced convection near the Prime Meridian is also evident.

200-hPa Wind Anomalies

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

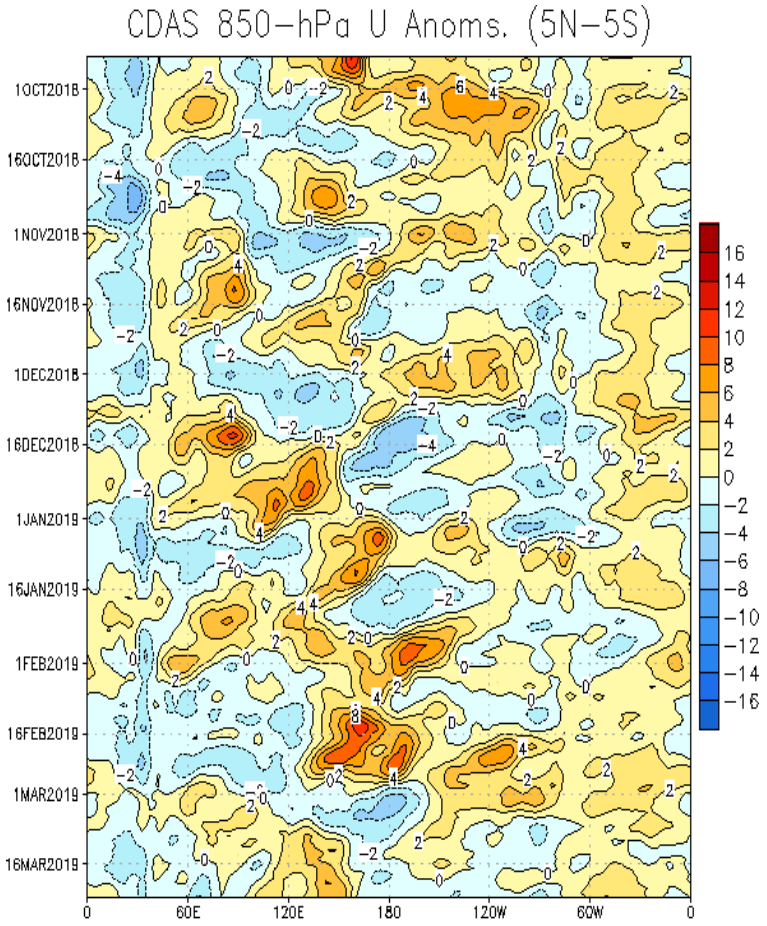


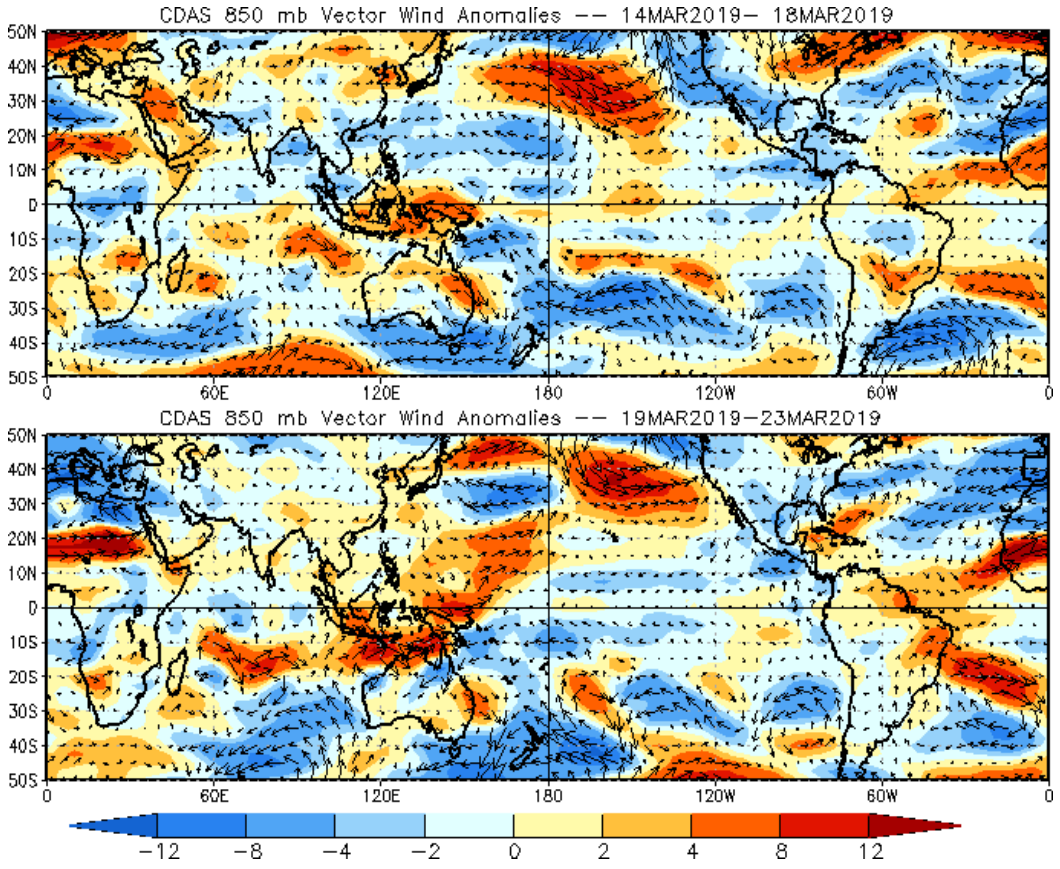


- The MJO has been active since September, and eastward propagating features were evident in the upper-level wind field through early March.
- Easterly anomalies strengthened across the West Pacific, consistent with a divergent (enhanced convective) signal, but there is less evidence of eastward propagation.
- Rossby wave activity over the East Pacific appears due in part to midlatitude influences, and appears to be disrupting both the ENSO and MJO signals.

850-hPa Wind Anomalies

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

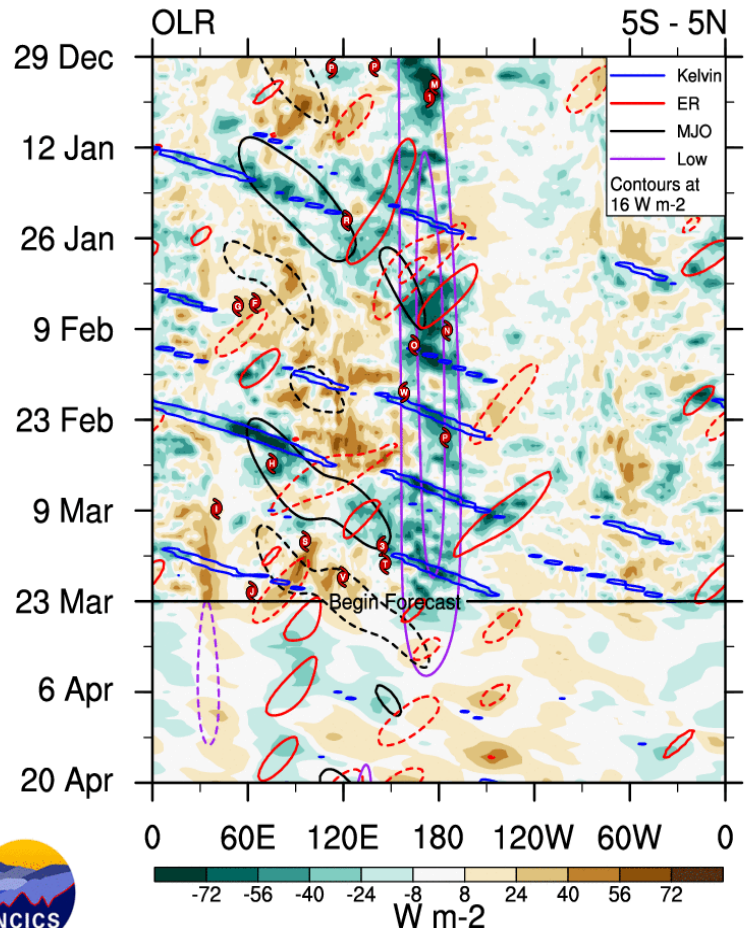


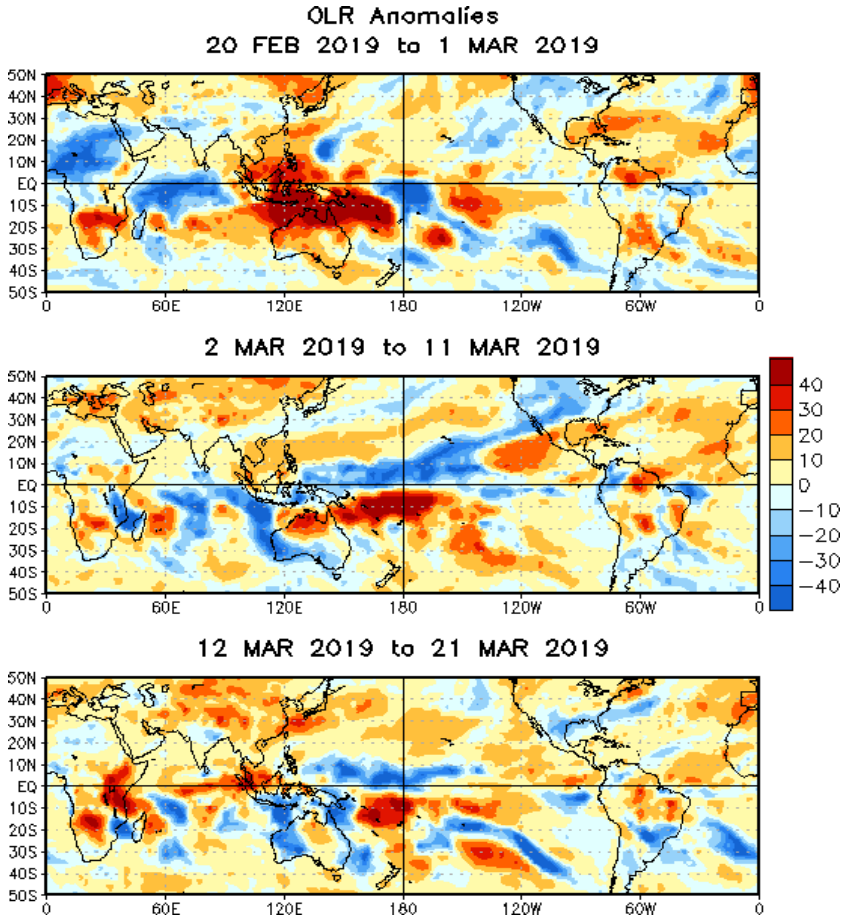


- The MJO has been active since September, interspersed with numerous Pacific Rossby wave events since mid-December.
- Eastward propagation of westerly wind anomalies has slowed over the past few days, and the zonal wind field is weak across the Pacific.

Outgoing Longwave Radiation (OLR) Anomalies

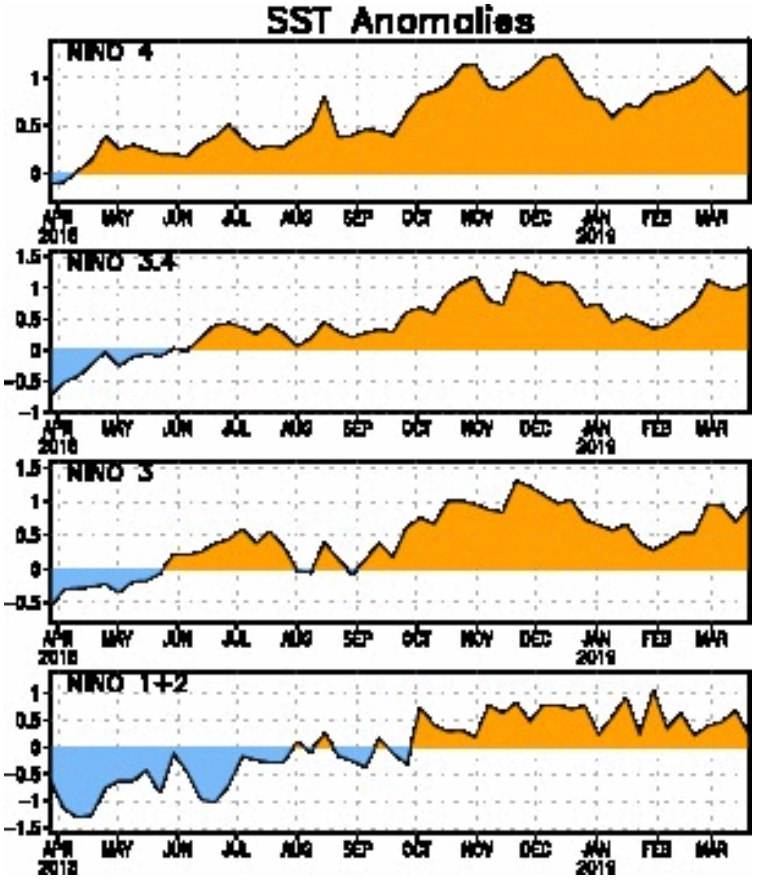
Blue shades: Anomalous convection (wetness). Red shades: Anomalous subsidence (dryness).

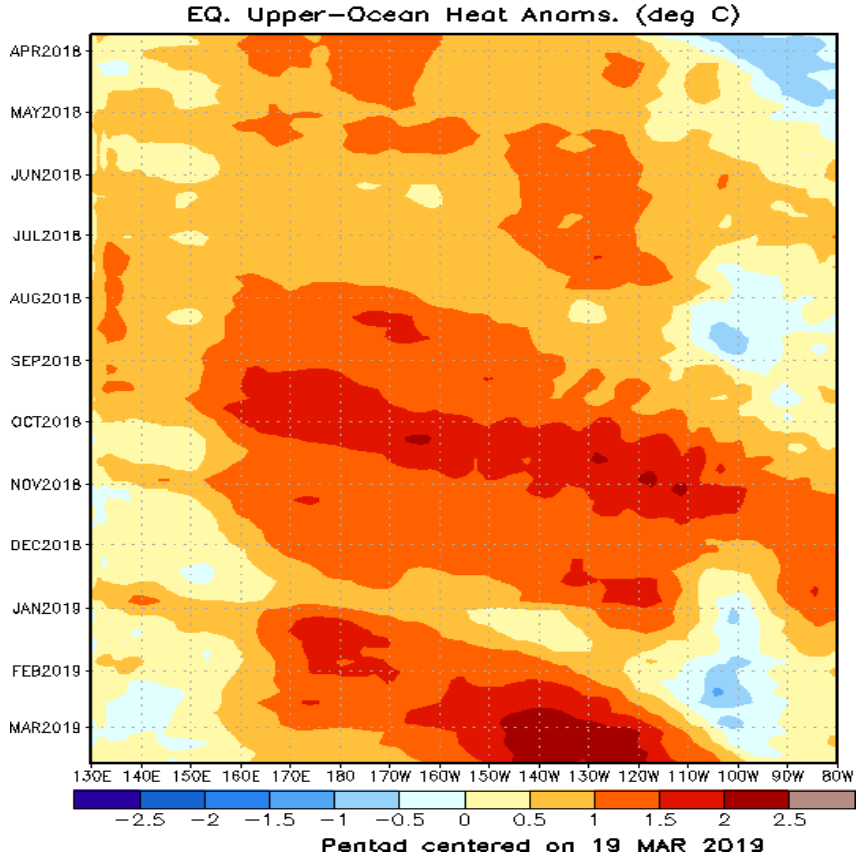




- Low frequency enhanced convection has persisted near the Date Line since the beginning of 2019.
- More recently, enhanced convection over the tropical Pacific has been limited to the northern hemisphere.
- While suppressed convection has overspread the equatorial Indian Ocean and western Maritime Continent, several tropical cyclones are evident in the OLR field near Australia and over the southwestern Indian Ocean.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

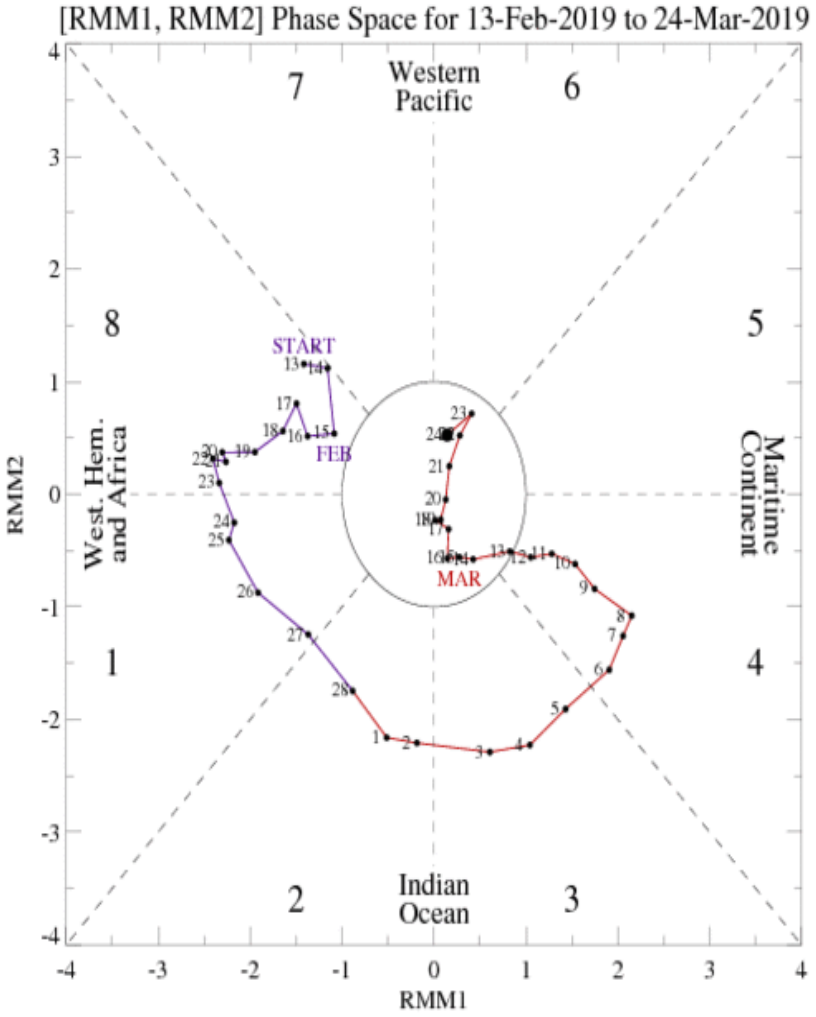




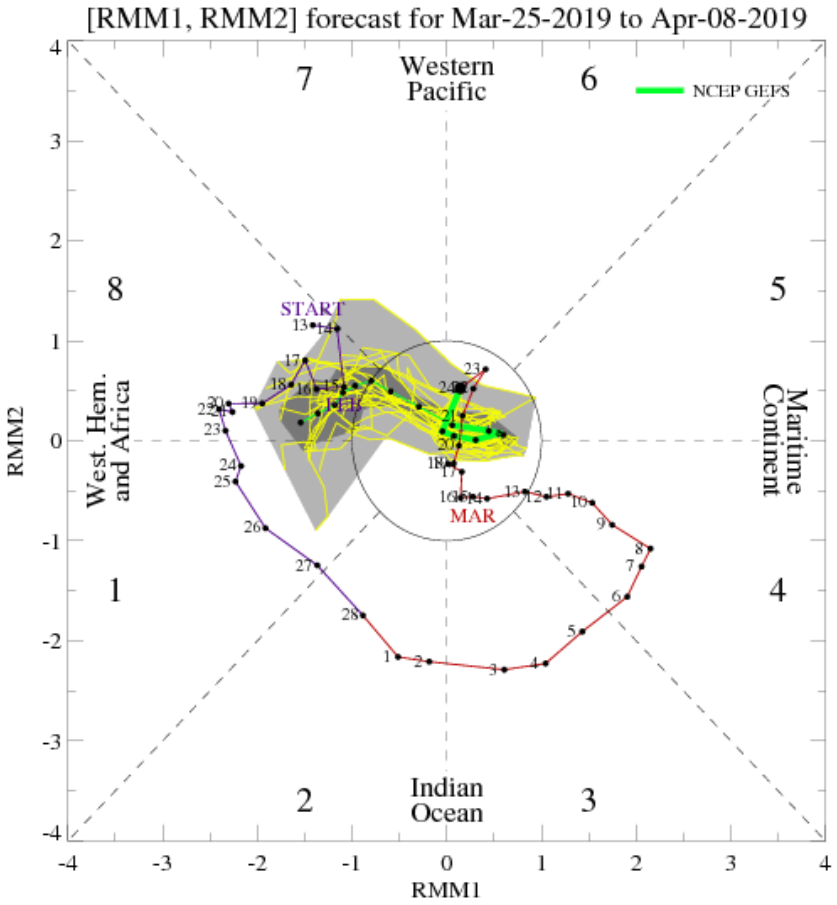
- SST anomalies in all four Niño regions remain above climatology, consistent with an El Niño event.
- Positive oceanic heat content anomalies have been observed over most of the Pacific basin since last April.
- There was a downwelling Kelvin wave last Fall and another that began around the turn of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

MJO Index: Recent Evolution

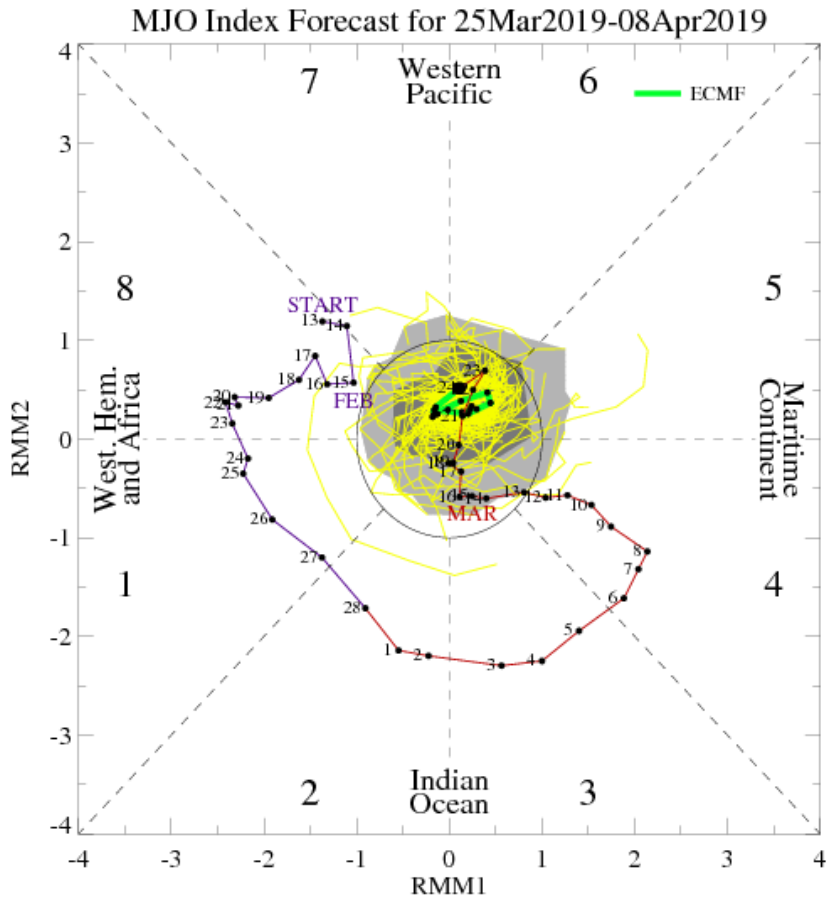
- The RMM Index currently depicts little to no MJO activity.
- The weakening index may have been due in part to destructive interference between the MJO enhanced phase over the Maritime Continent, and the El Niño conditions over the Pacific.
- As any remnant MJO signal approached the Pacific, constructive interference would suggest an enhancement in Phase-6/7; however, this has not occurred.



MJO Index: Forecast Evolution



GEFS Forecast

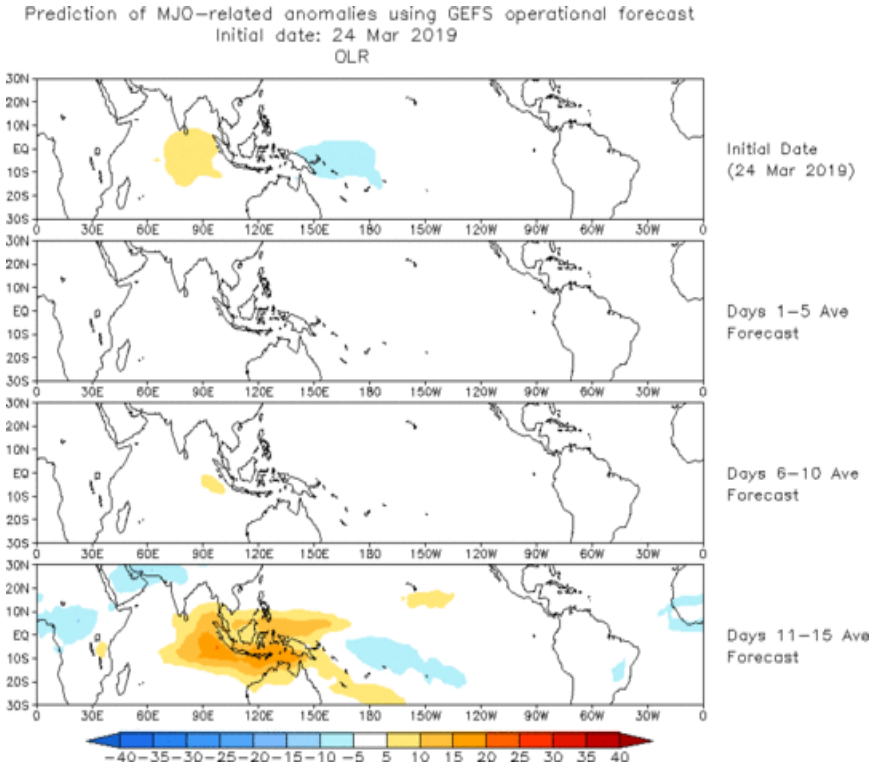


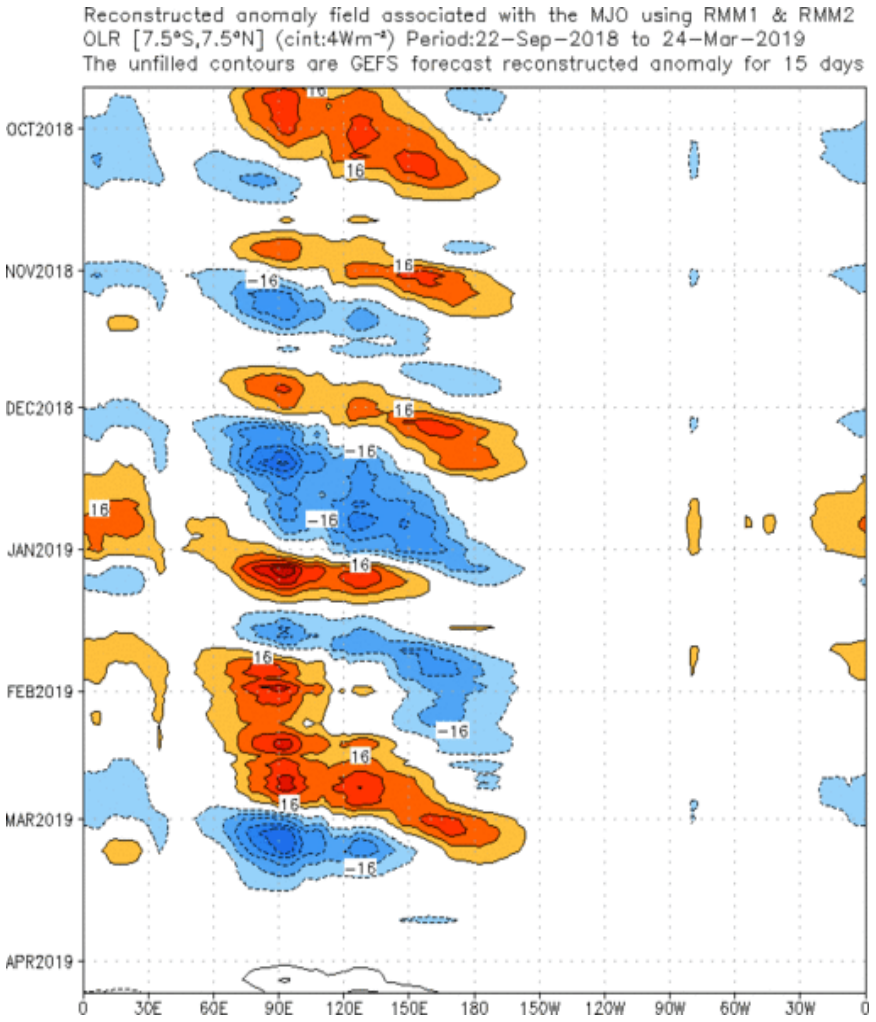
ECMWF Forecast

- The GEFS and ECMWF forecasts suggest that the MJO will remain weak during Week-1.
- The GEFS is more progressive with the MJO, suggesting a re-emerging signal over the Western Hemisphere during Week-2. The ECMWF maintains a more stationary signal slightly favoring Pacific convection.
- There is considerable uncertainty regarding the future evolution of the MJO, and whether any signal will emerge from the Pacific and continue propagating back towards the 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.)



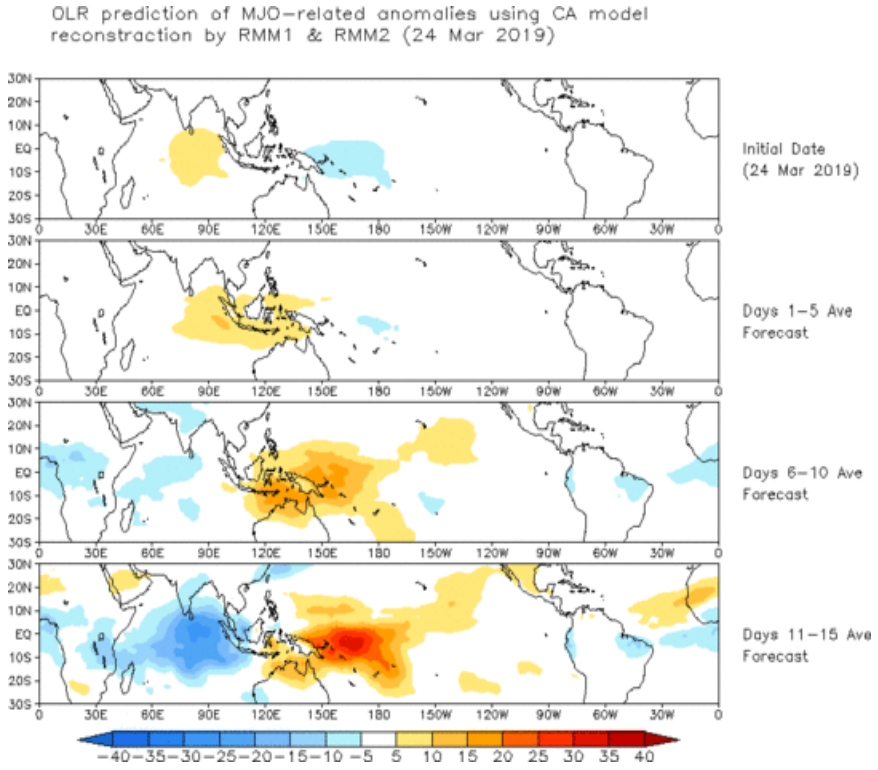


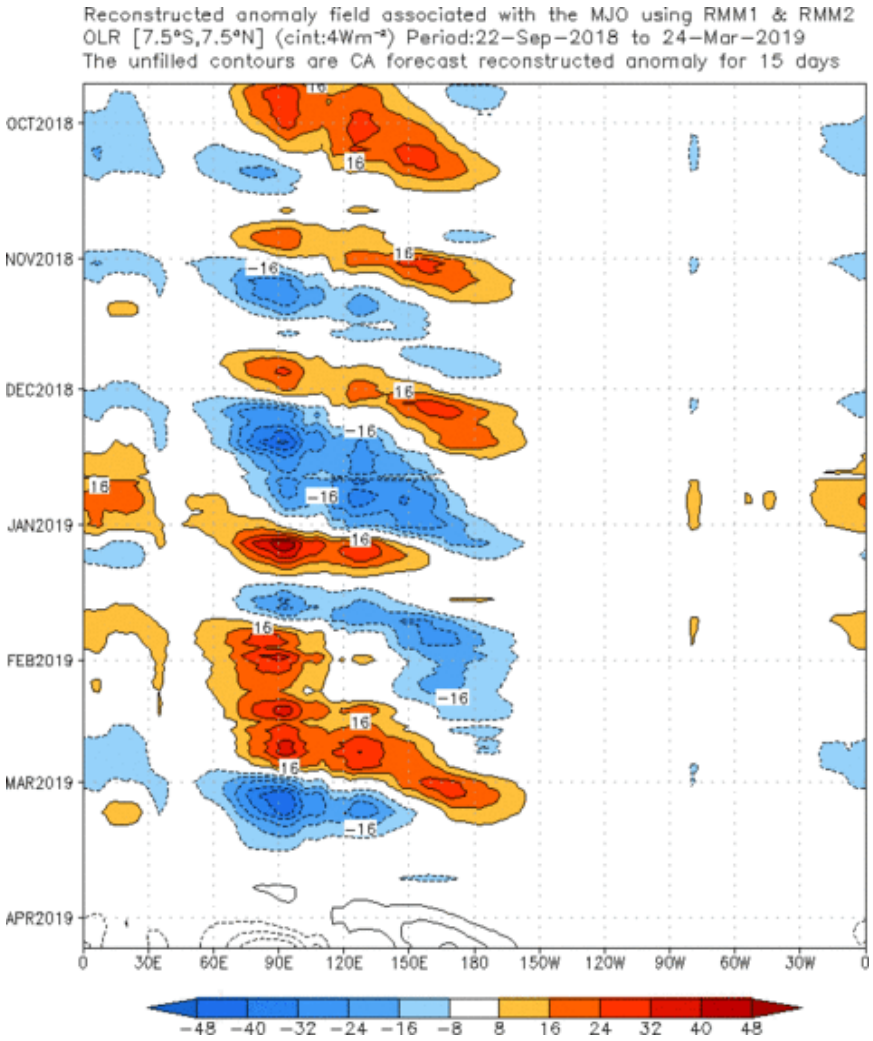
- Very little in the way of MJO-related anomalies are depicted based on the GEFS RMM-index forecast during Week-1.

- By Week-2, the anomaly field begins to increase, consistent with an East Pacific/Western Hemisphere MJO signal.

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.)

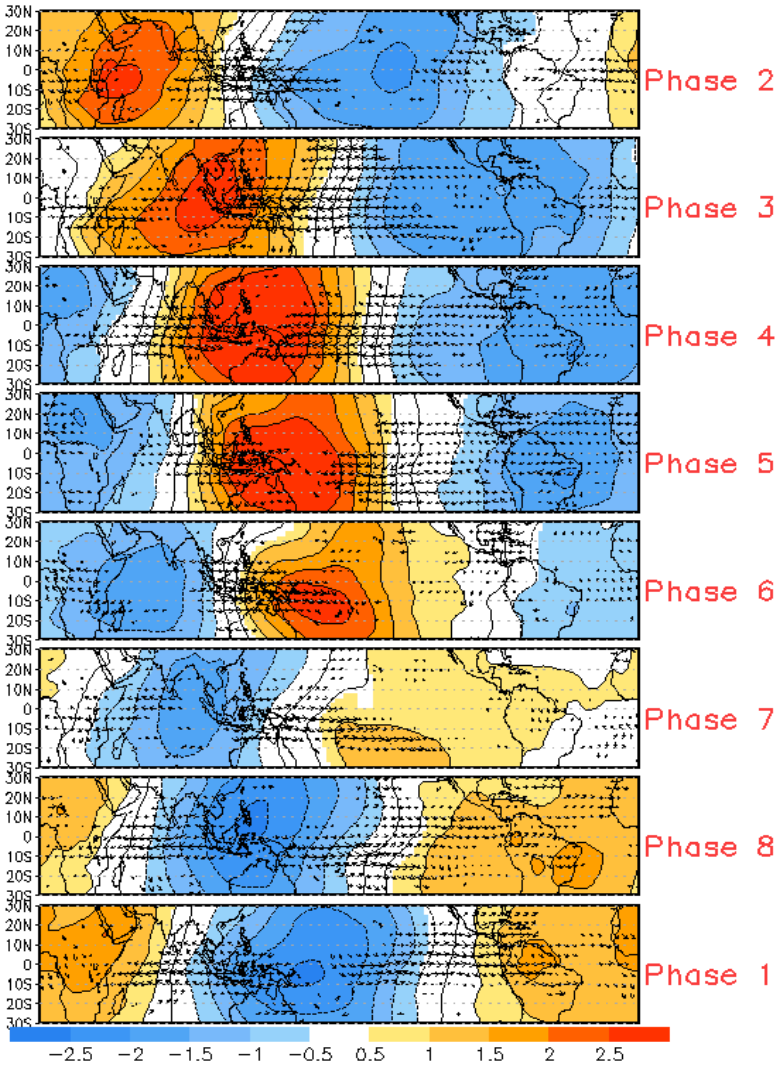




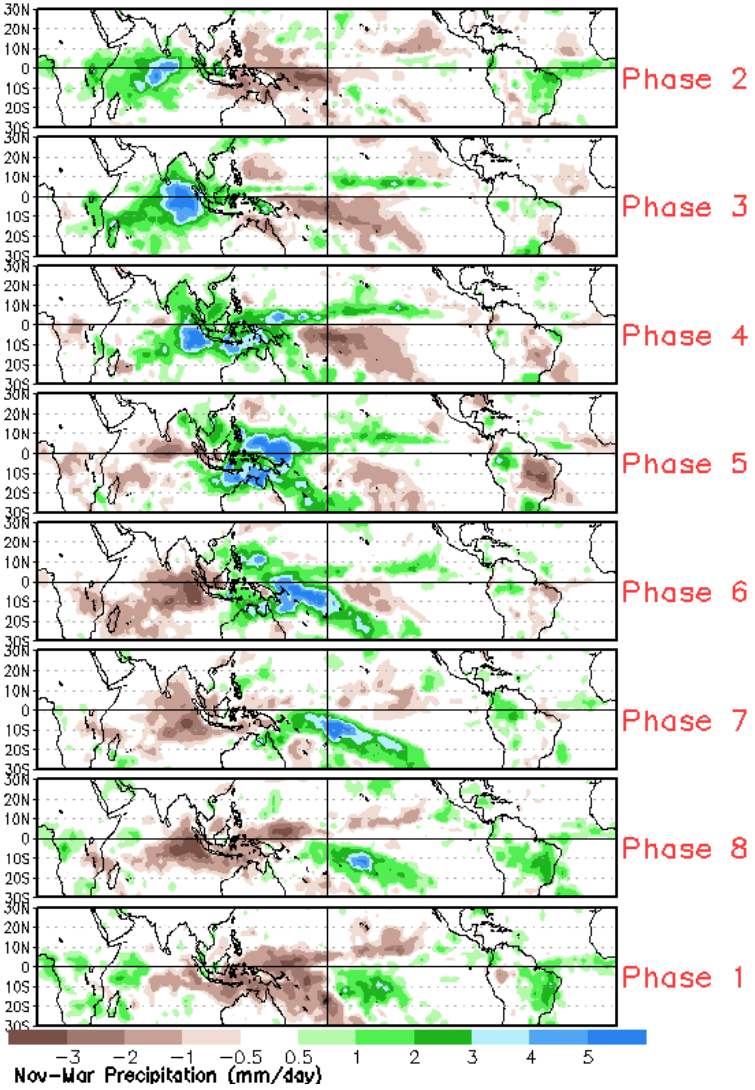
- The constructed analog depicts more robust MJO related anomalies, with a robust Indian Ocean event developing by the end of the 2-week period.

MJO: Tropical Composite Maps by RMM Phase

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



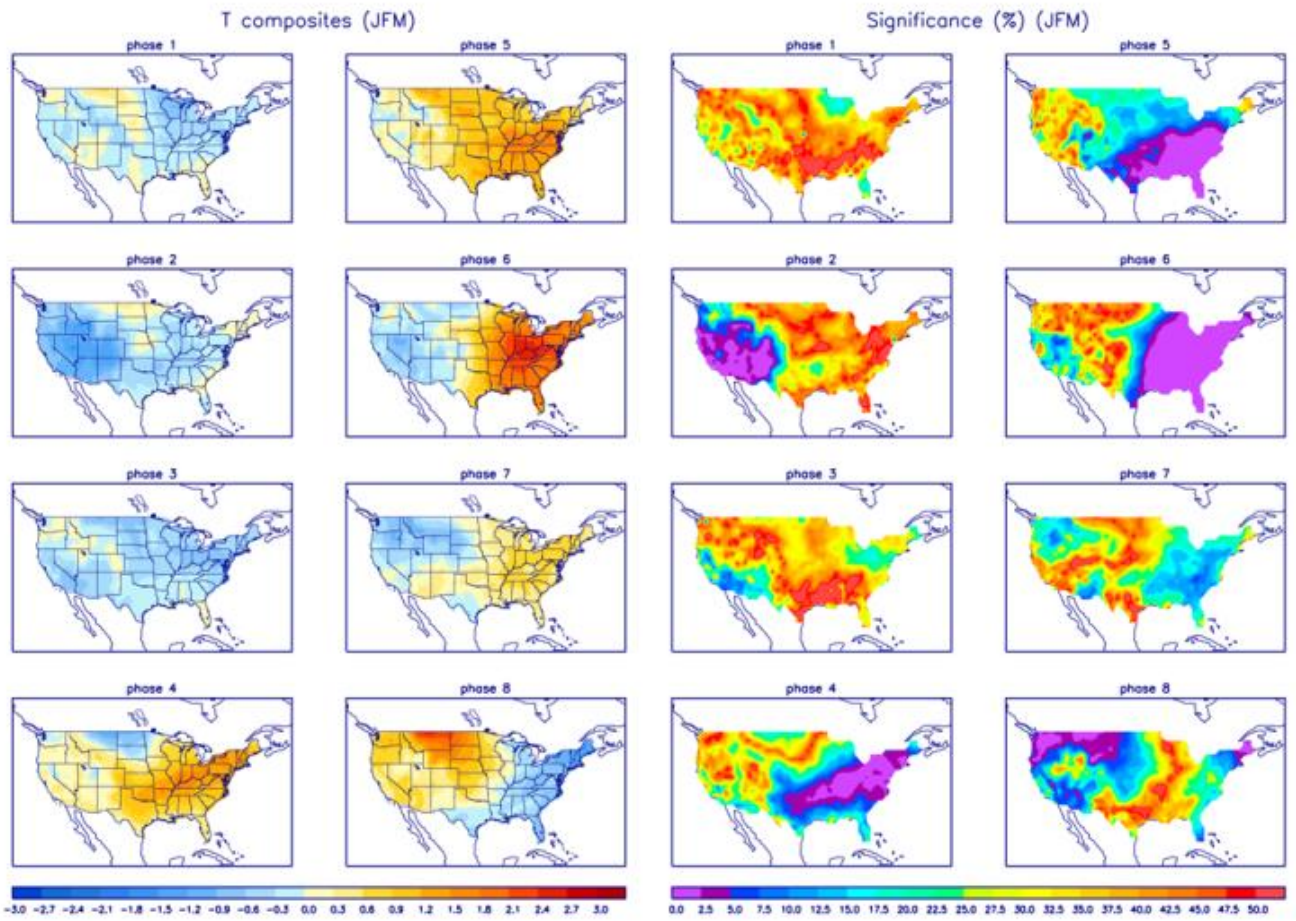
Precipitation Anomalies (Nov - Mar)



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.

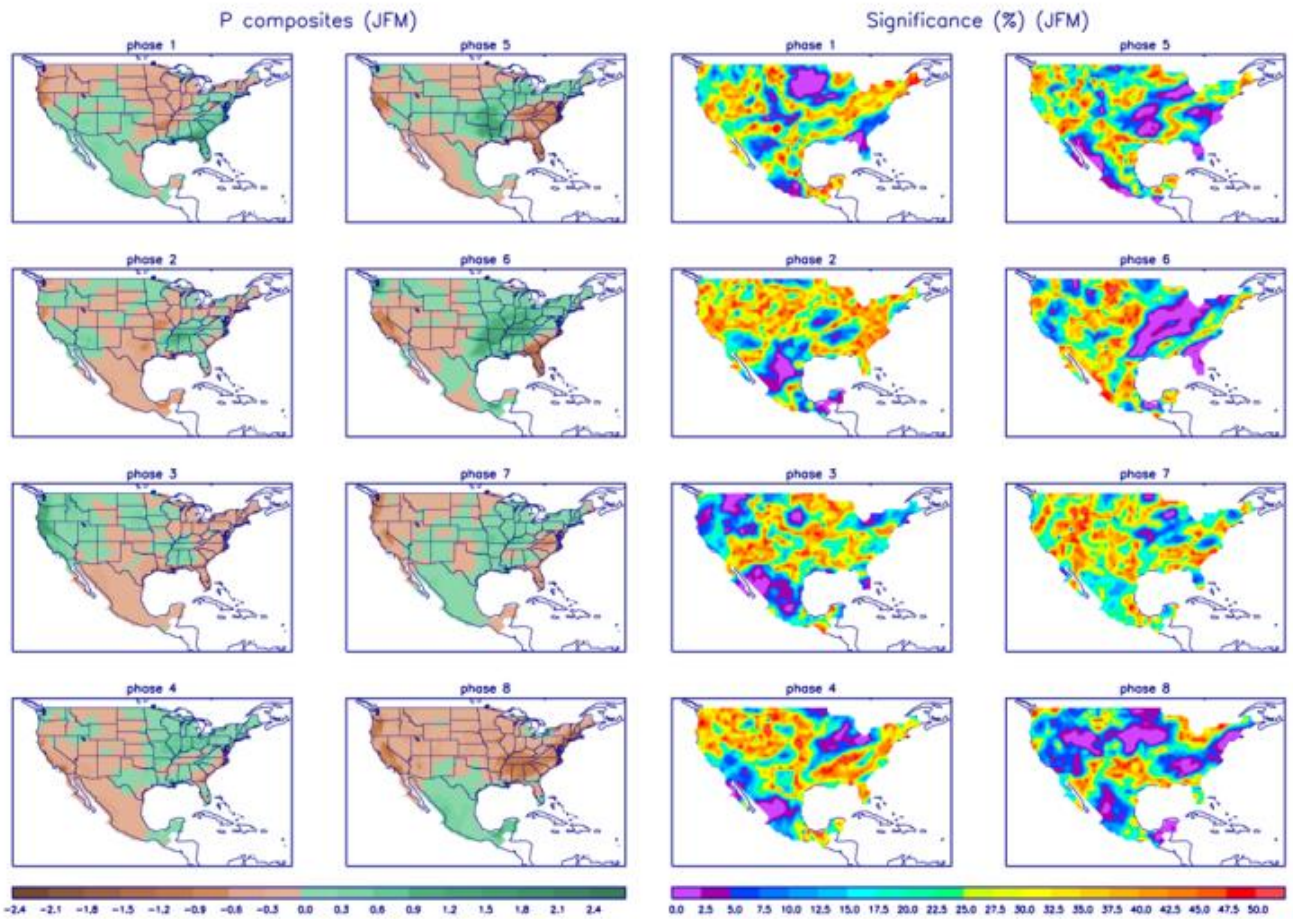


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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.

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.



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