

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



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

# Overview

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- The MJO is weak right now. There are indications from dynamical models that the MJO will strengthen during Week-2 over the Maritime Continent.
- The South Pacific Convergence Zone (SPCZ) has strengthened during the past week.
- Tropical cyclone activity north of Australia is responsible for enhanced convection throughout the region, but it is not strong enough to anchor the upper-level velocity potential pattern.

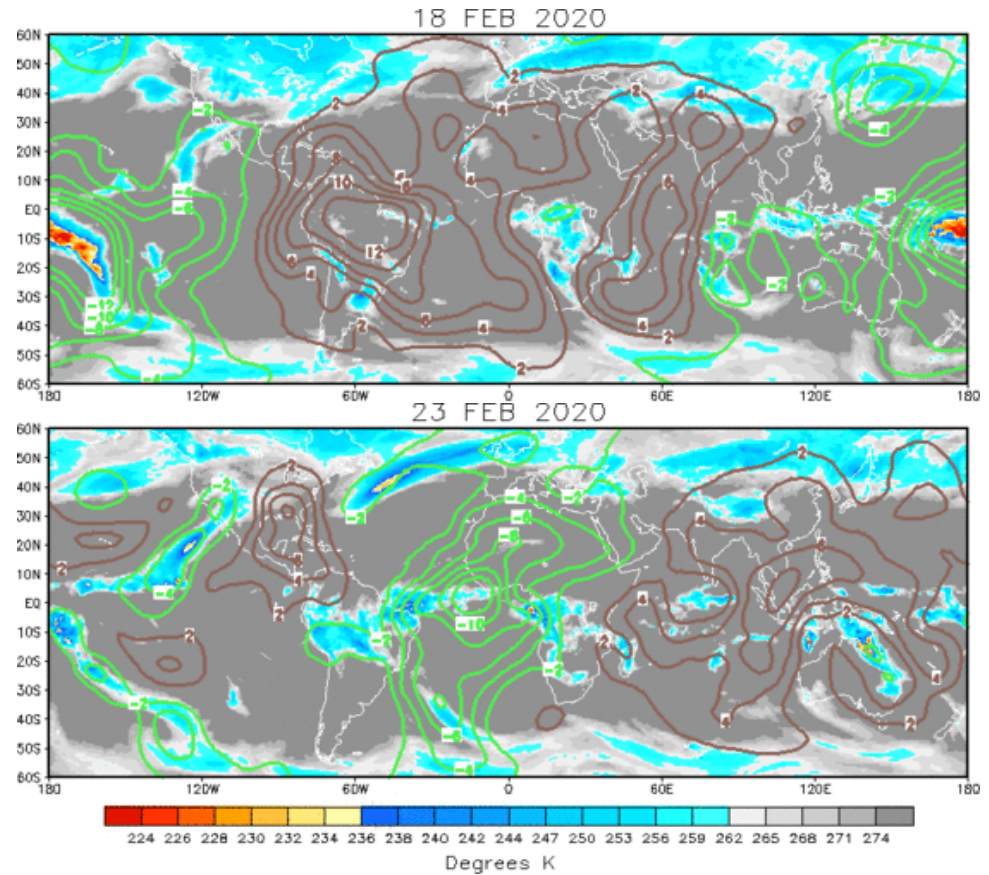
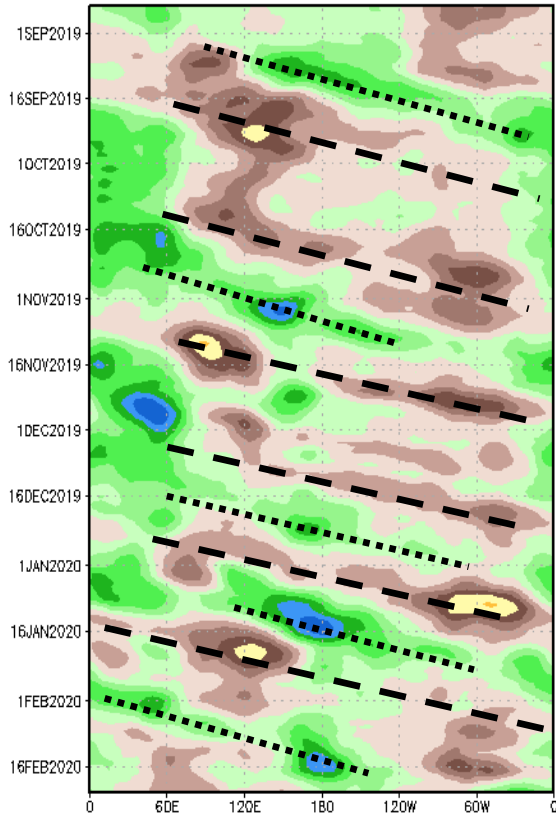
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:  
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

# 200-hPa Velocity Potential Anomalies

**Green shades:** Anomalous divergence (favorable for precipitation).

**Brown shades:** Anomalous convergence (unfavorable for precipitation).

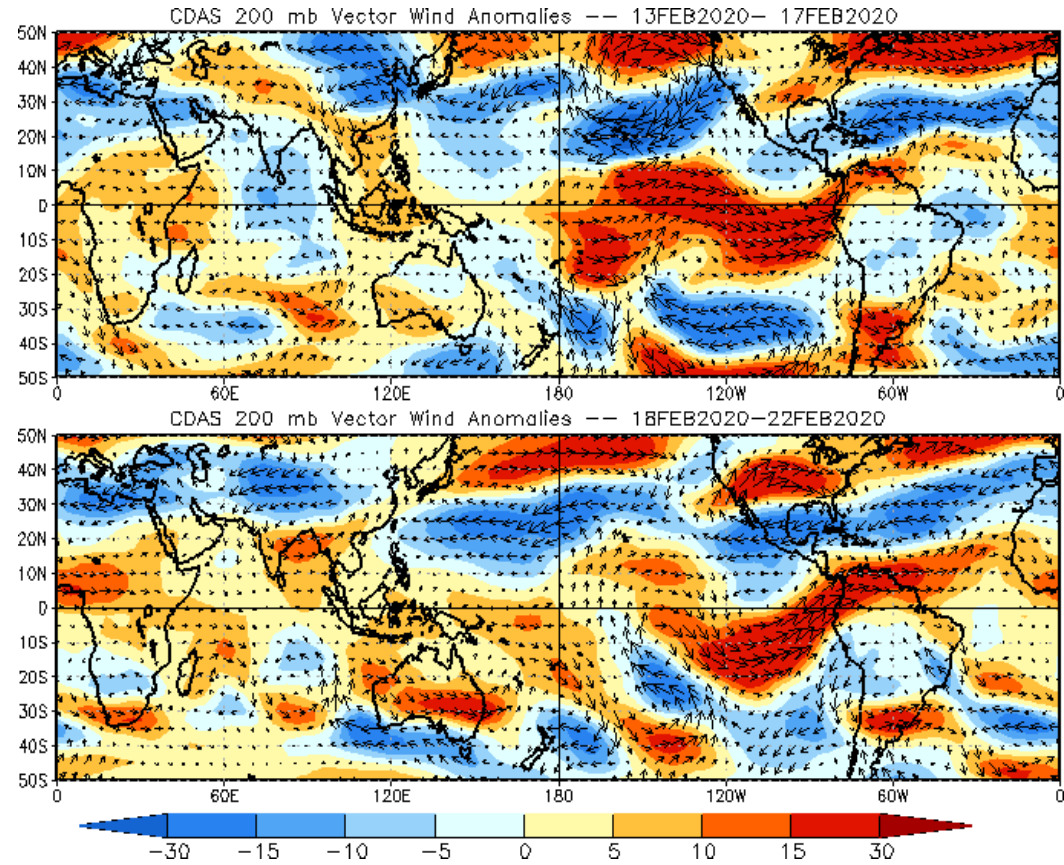
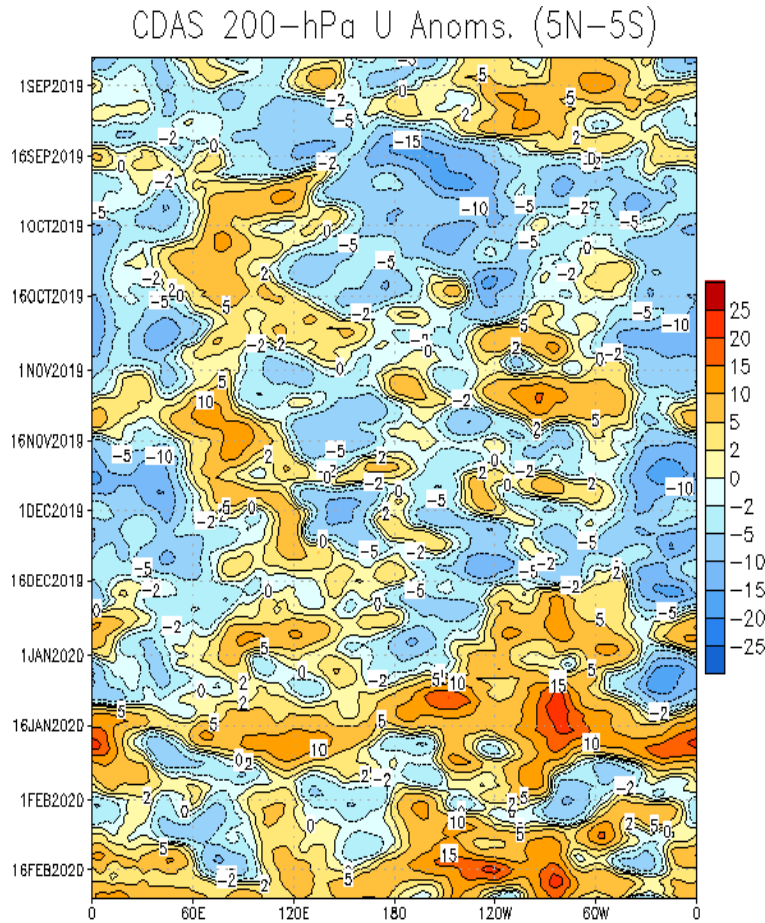
200-hPa Velocity Potential Anomaly: 5N-5S  
5-day Running Mean



- The upper-level velocity potential pattern is noisy this week. The strongest convective signal is over northeastern South America and there are no strong tropical waves to anchor the pattern elsewhere.
- There is enhanced convection around northern Australia due to tropical cyclones Ferdinand and Esther.

# 200-hPa Wind Anomalies

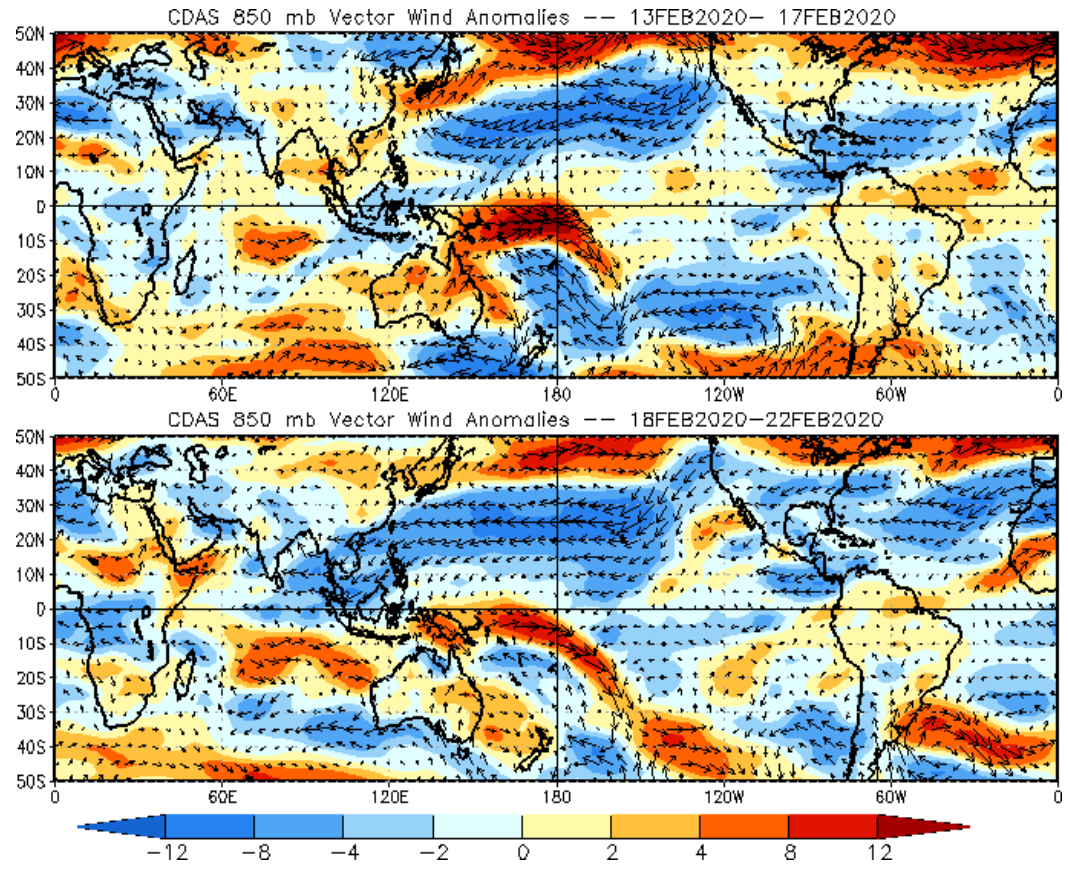
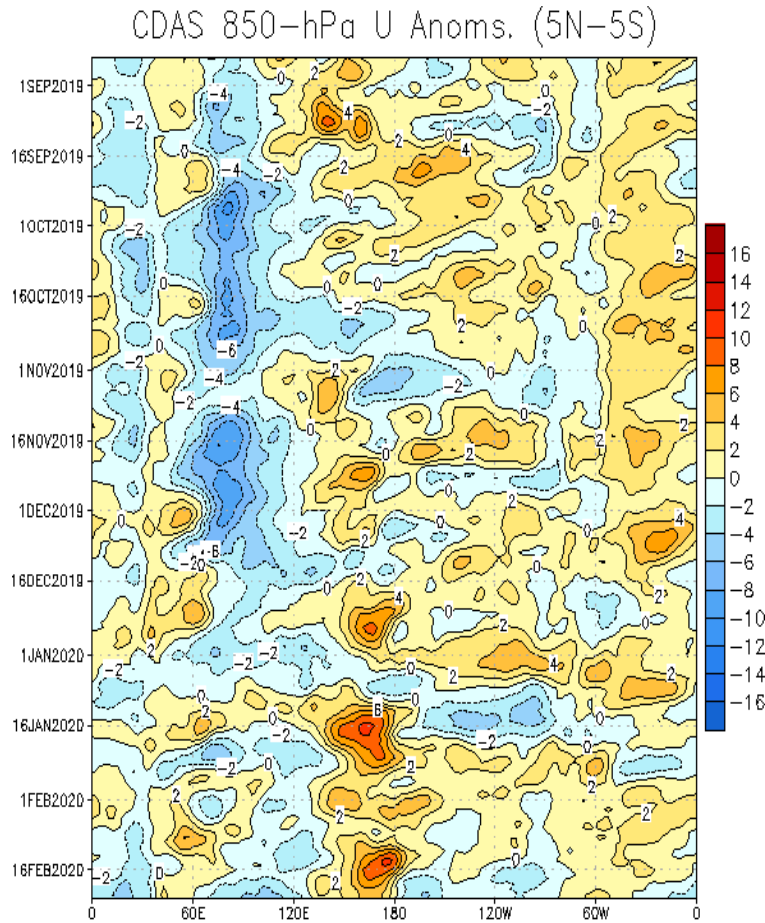
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- There is anomalous cross-equatorial upper-level flow just east of the Date Line.
- The mid-latitude flow over the North Pacific remains amplified, but the anomalous ridge has moved west away from the West Coast.

# 850-hPa Wind Anomalies

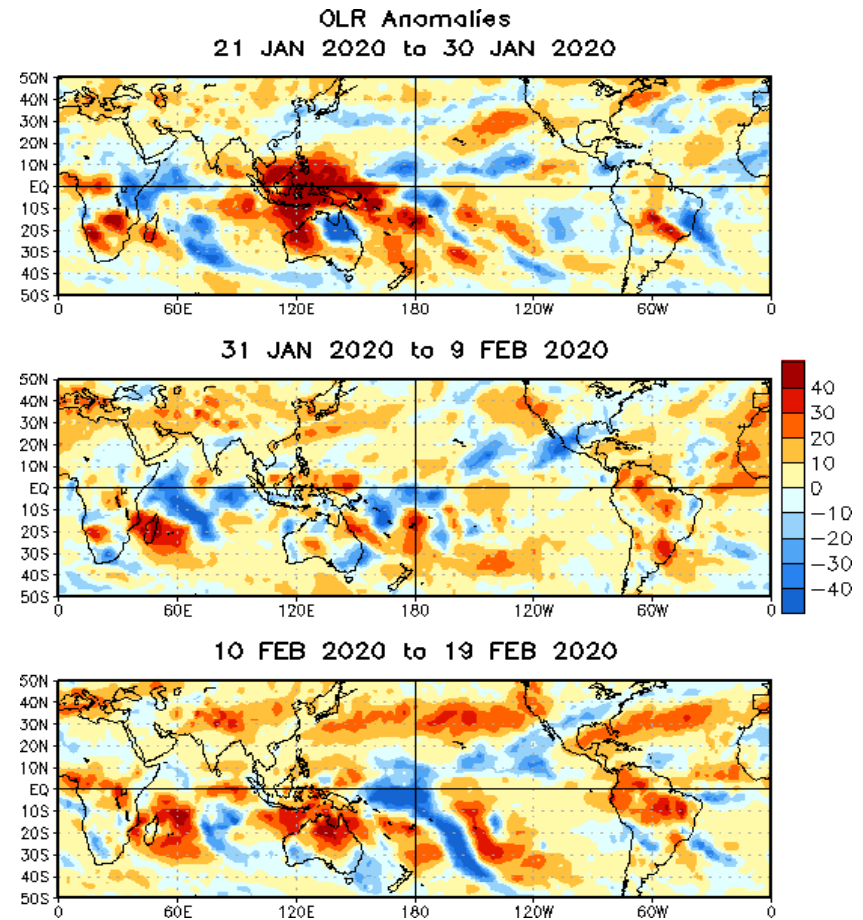
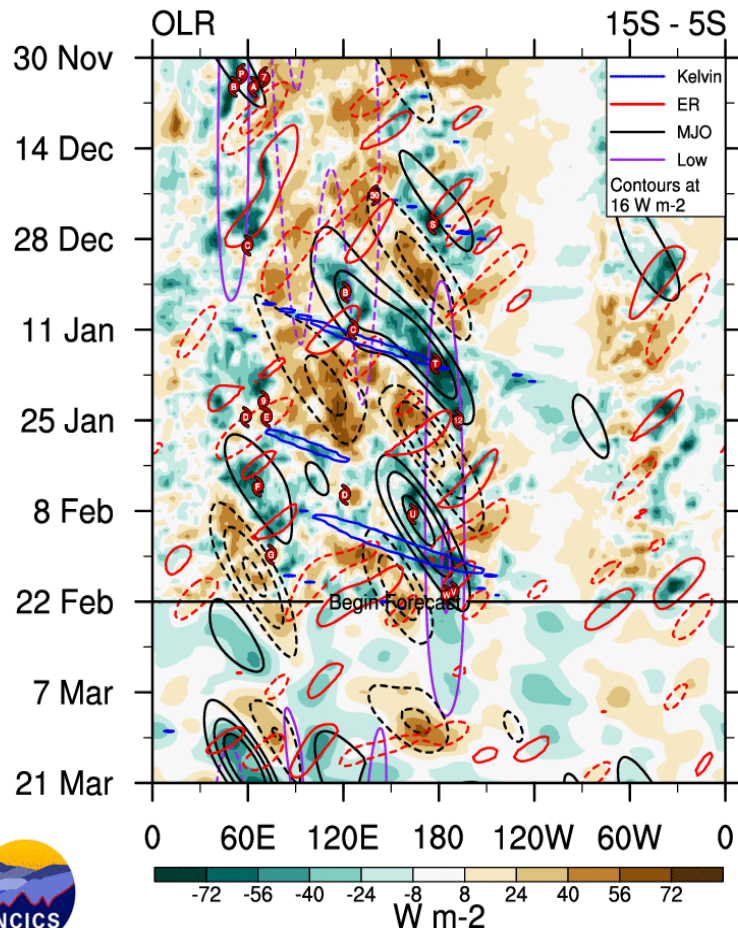
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Low-level anomalous westerlies remain over the equatorial Pacific, just west of the Date Line.
  - The westerlies have weakened in amplitude and size during the most recent pentad.
- The low-level SPCZ wind signature has strengthened during the past pentad.

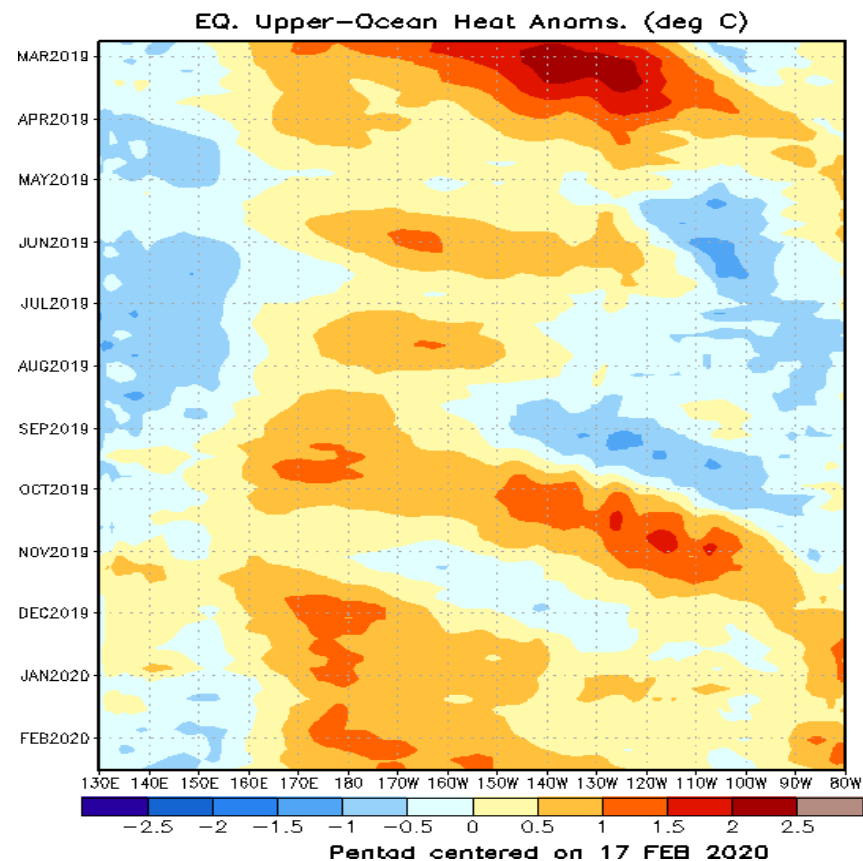
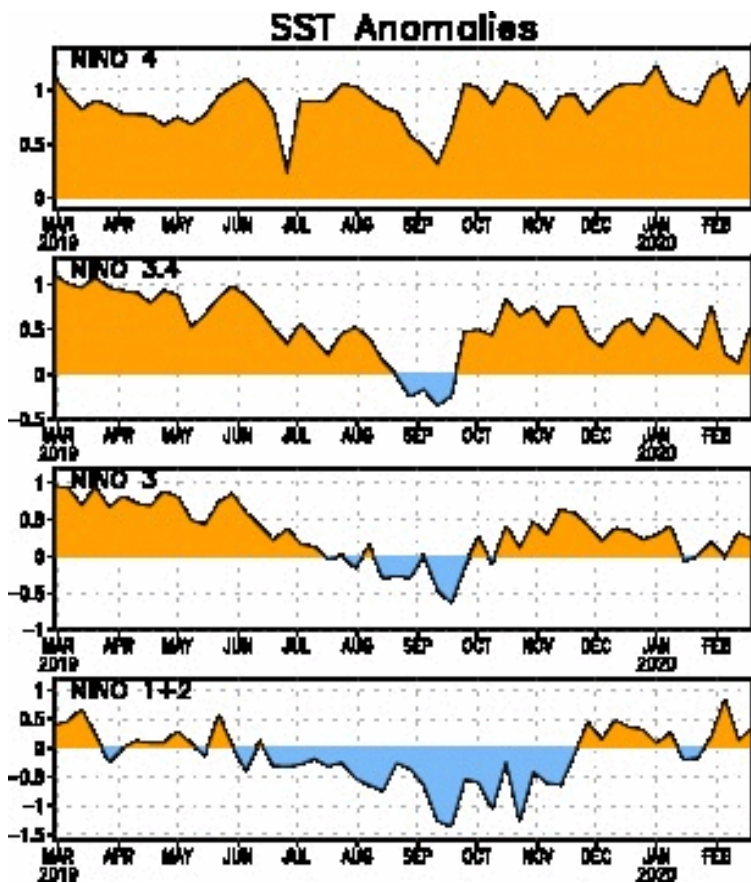
# Outgoing Longwave Radiation (OLR) Anomalies

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



- There is no coherent MJO signal.
- There is a Kelvin wave apparent in the most recent velocity potential fields over Africa, but there is not enough convection associated with it to appear in this OLR hovmöller diagram.
- Enhanced convection associated with the aforementioned strengthened SPCZ is apparent between Feb 10-19.

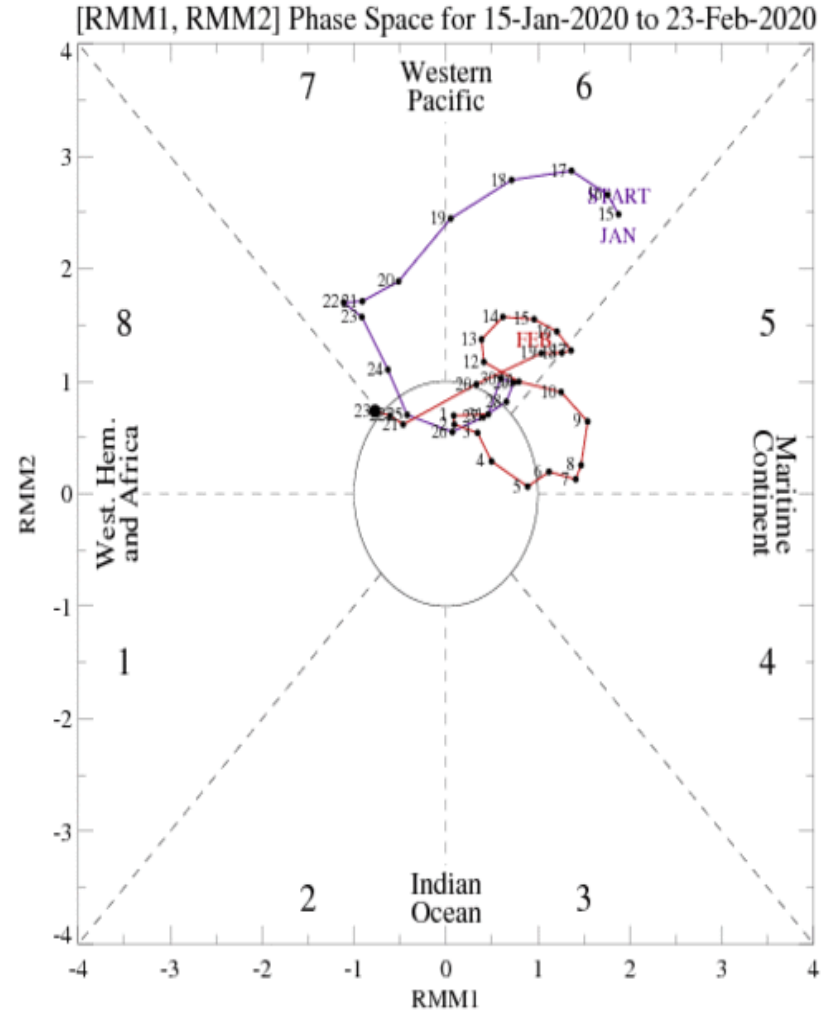
# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Upper-oceanic heat content anomalies remain slightly above-normal across most of the basin.
- Several episodes of westerly wind bursts west of the Date Line have contributed toward a downwelling event that has been ongoing since mid-December. The ongoing event seems to be contributing to a push of the highest temperature anomalies further east across the basin.

# MJO Index: Recent Evolution

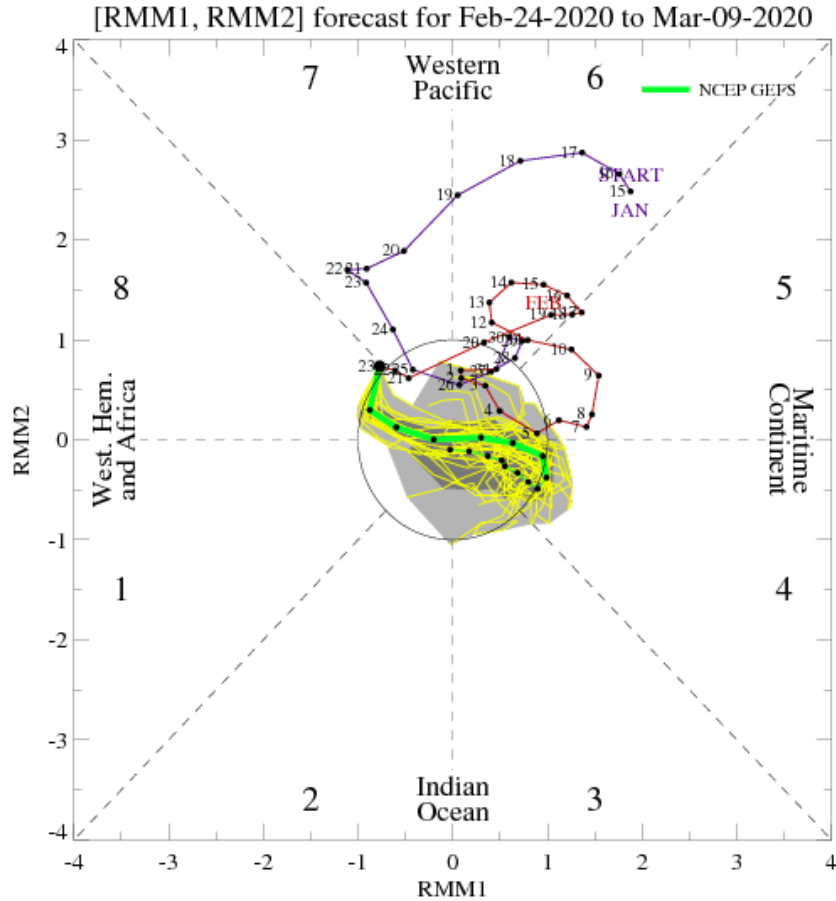
- The MJO signal remains very weak. The weak Phase 8 signal shown in this diagram is more likely to be the result of Kelvin and equatorial Rossby wave activity instead of an actual MJO event.



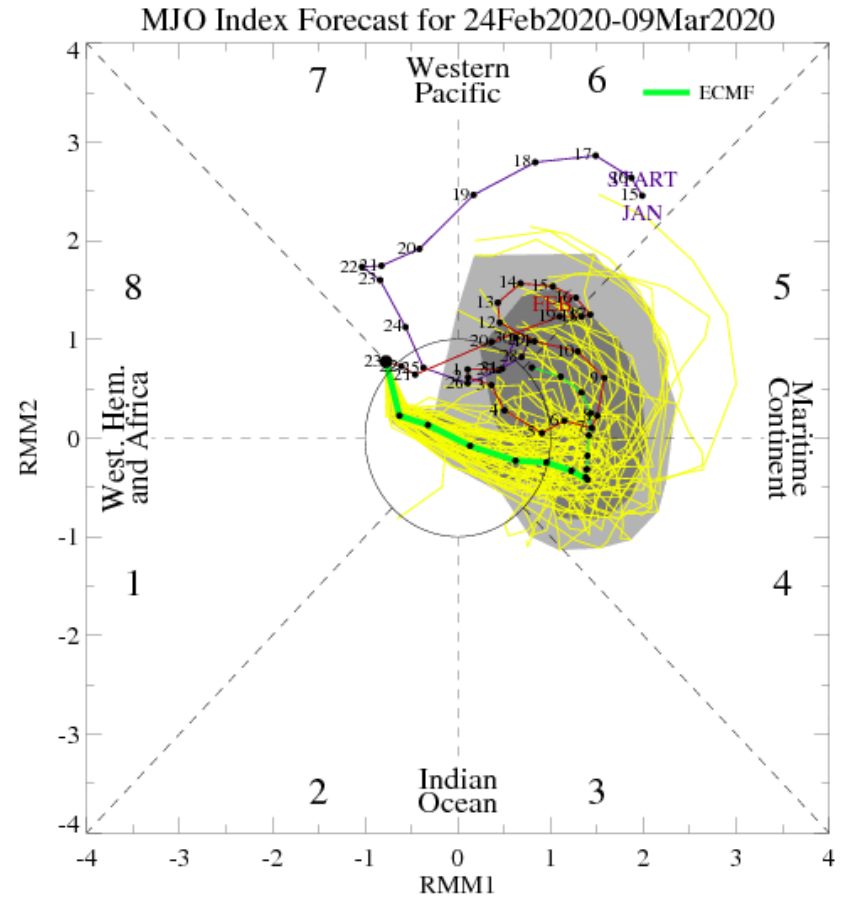
For more information on the RMM index and how to interpret its forecast please see:  
[https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC\\_MJOinformation.pdf](https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf)



# MJO Index: Forecast Evolution



**GEFS Forecast**



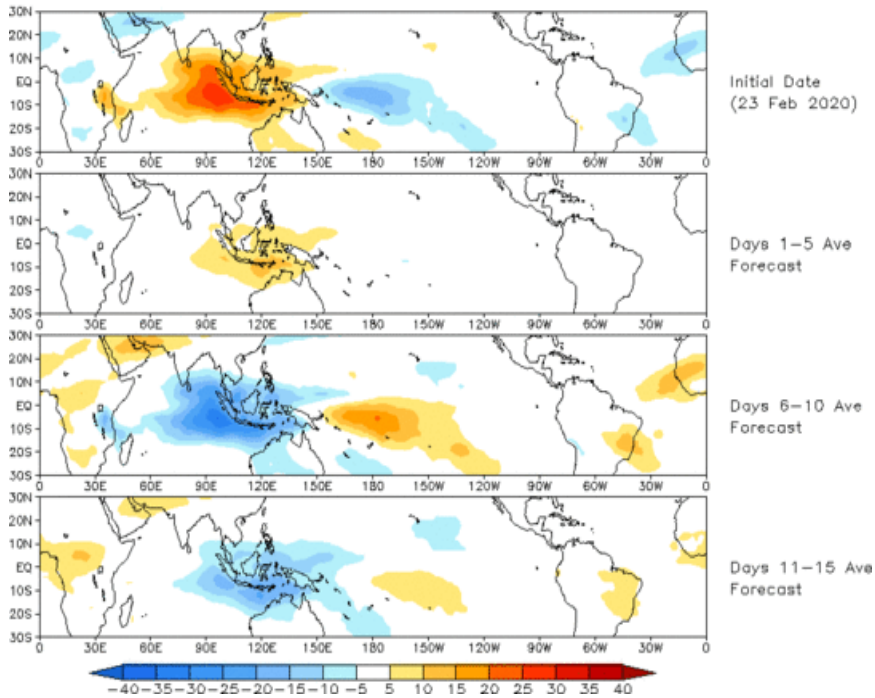
**ECMWF Forecast**

- Dynamical models are forecasting the MJO to remain weak during Week-1.
- The ECMWF forecasts a moderate MJO to emerge over the Maritime Continent during Week-2, while the GEFS keeps the MJO weak.

# MJO: GEFS Forecast Evolution

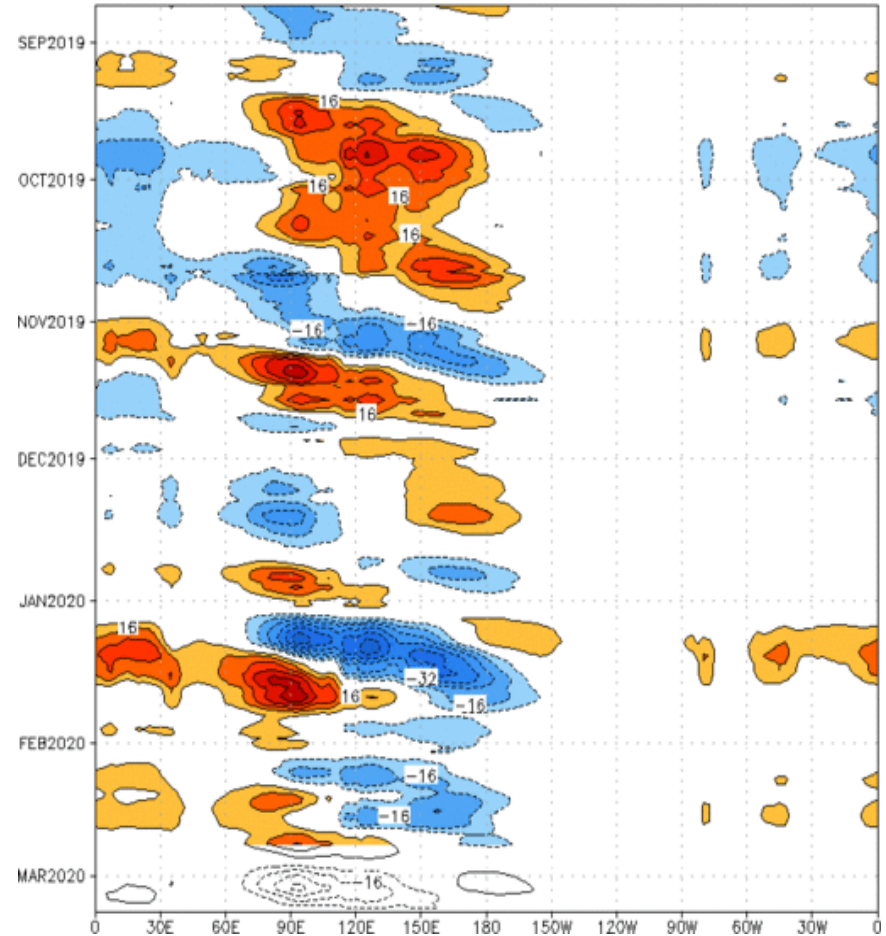
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast  
Initial date: 23 Feb 2020  
OLR



- The GEFS spatial forecast produces a more coherent MJO signal than its RMM forecast would suggest, probably due to tropical wave activity.

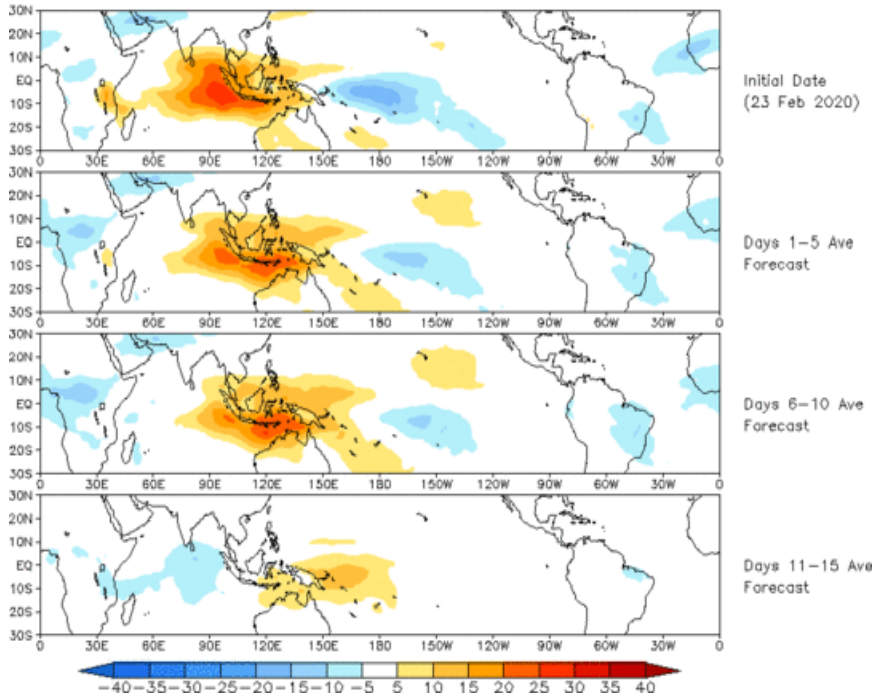
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2  
OLR [7.5°S,7.5°N] (cont:4Wm<sup>-2</sup>) Period:24-Aug-2019 to 23-Feb-2020  
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



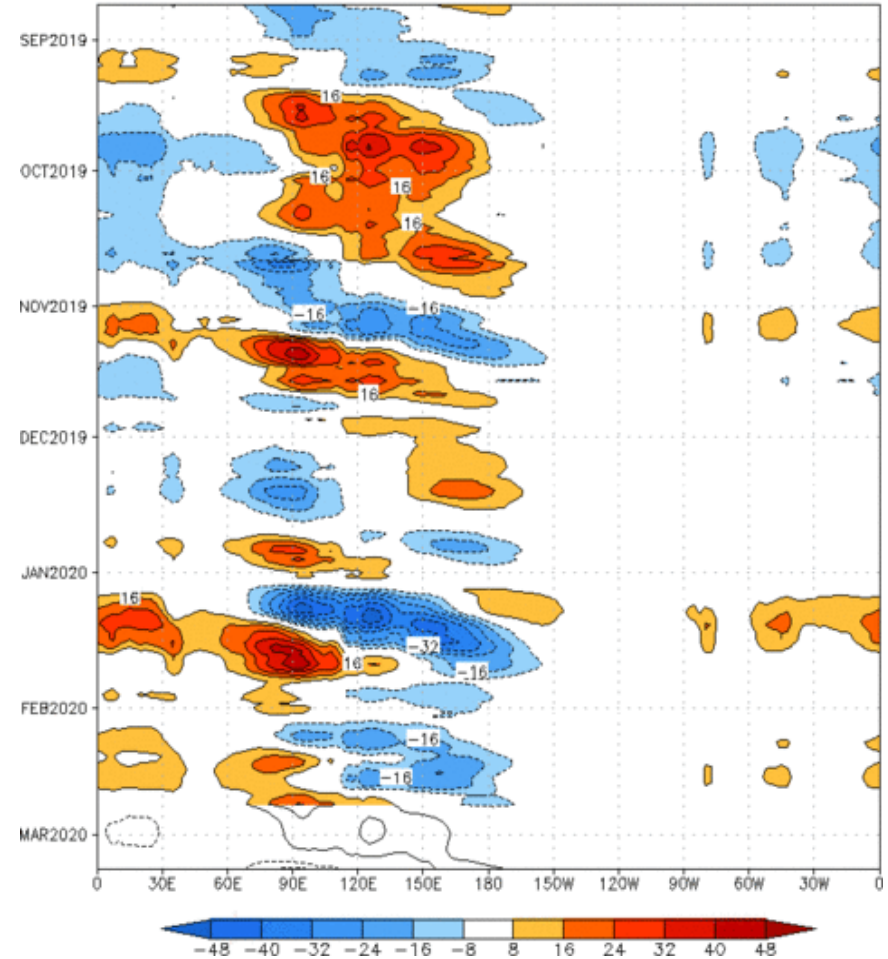
# MJO: Constructed Analog Forecast Evolution

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 (23 Feb 2020)



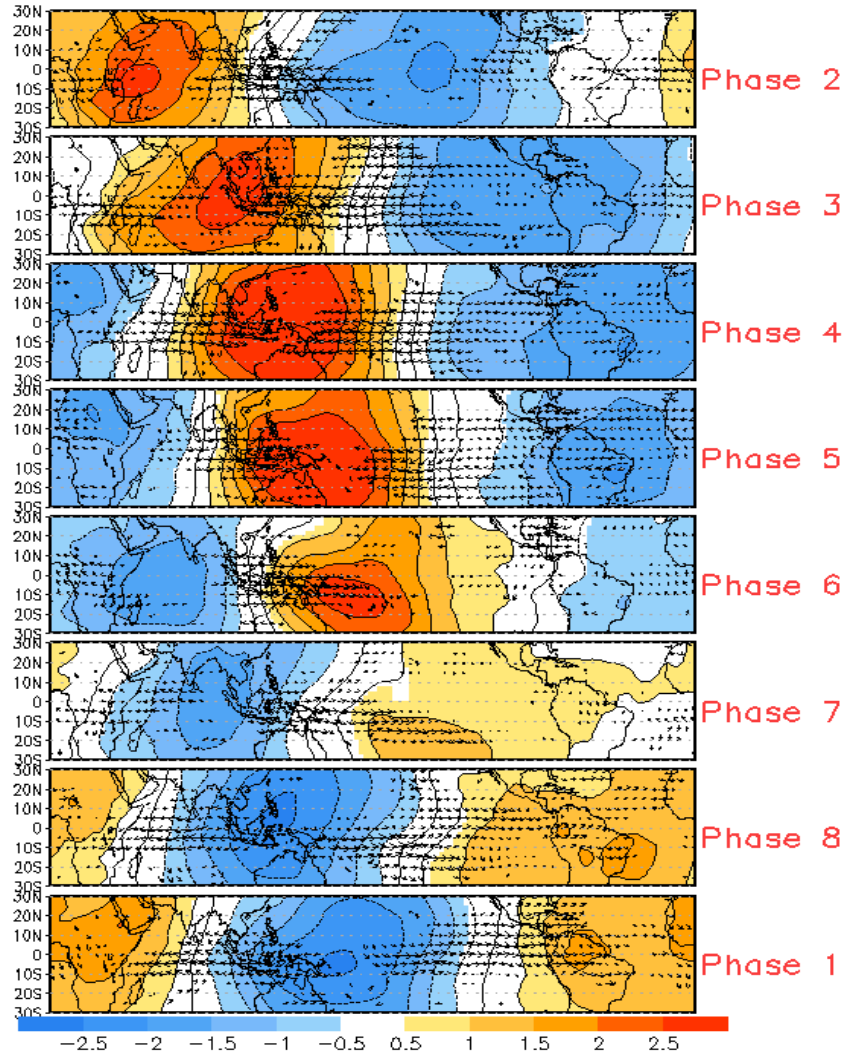
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm<sup>-2</sup>) Period:24-Aug-2019 to 23-Feb-2020  
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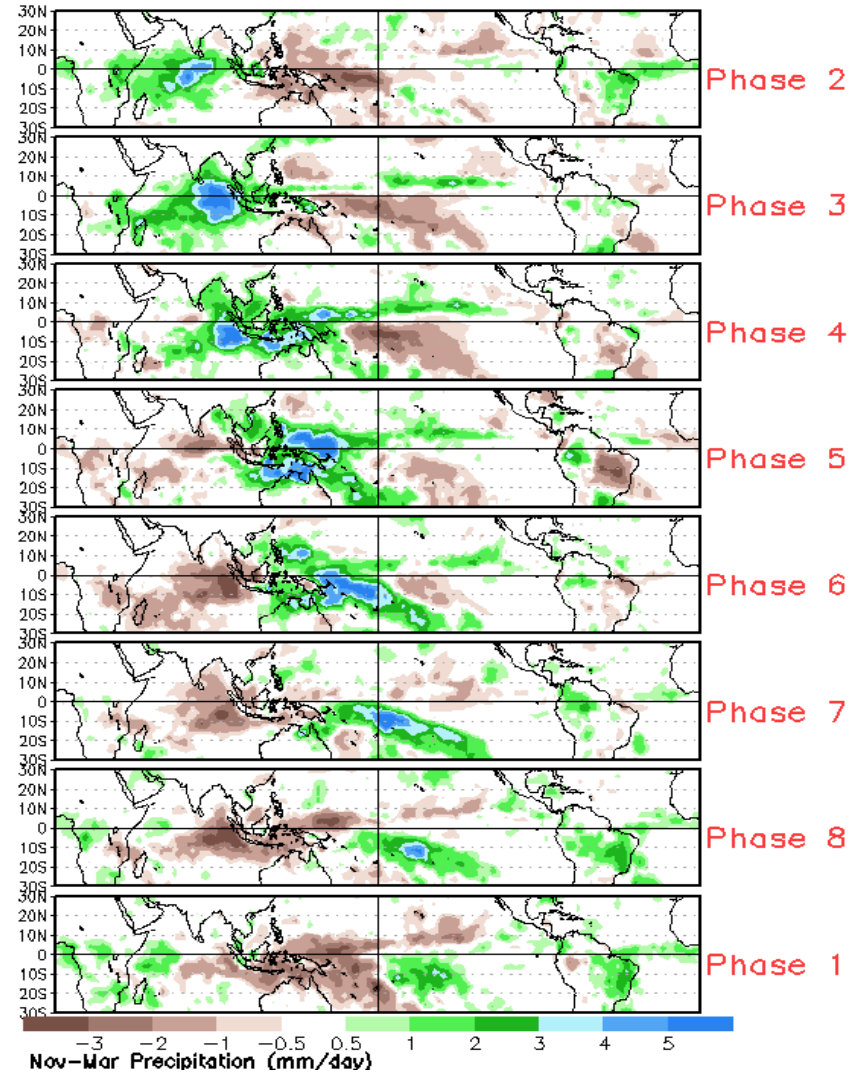
- The constructed analog forecast produces and weakens an MJO event over the Maritime Continent during the next two weeks.

# MJO: Tropical Composite Maps by RMM Phase

## 850-hPa Velocity Potential and Wind Anomalies



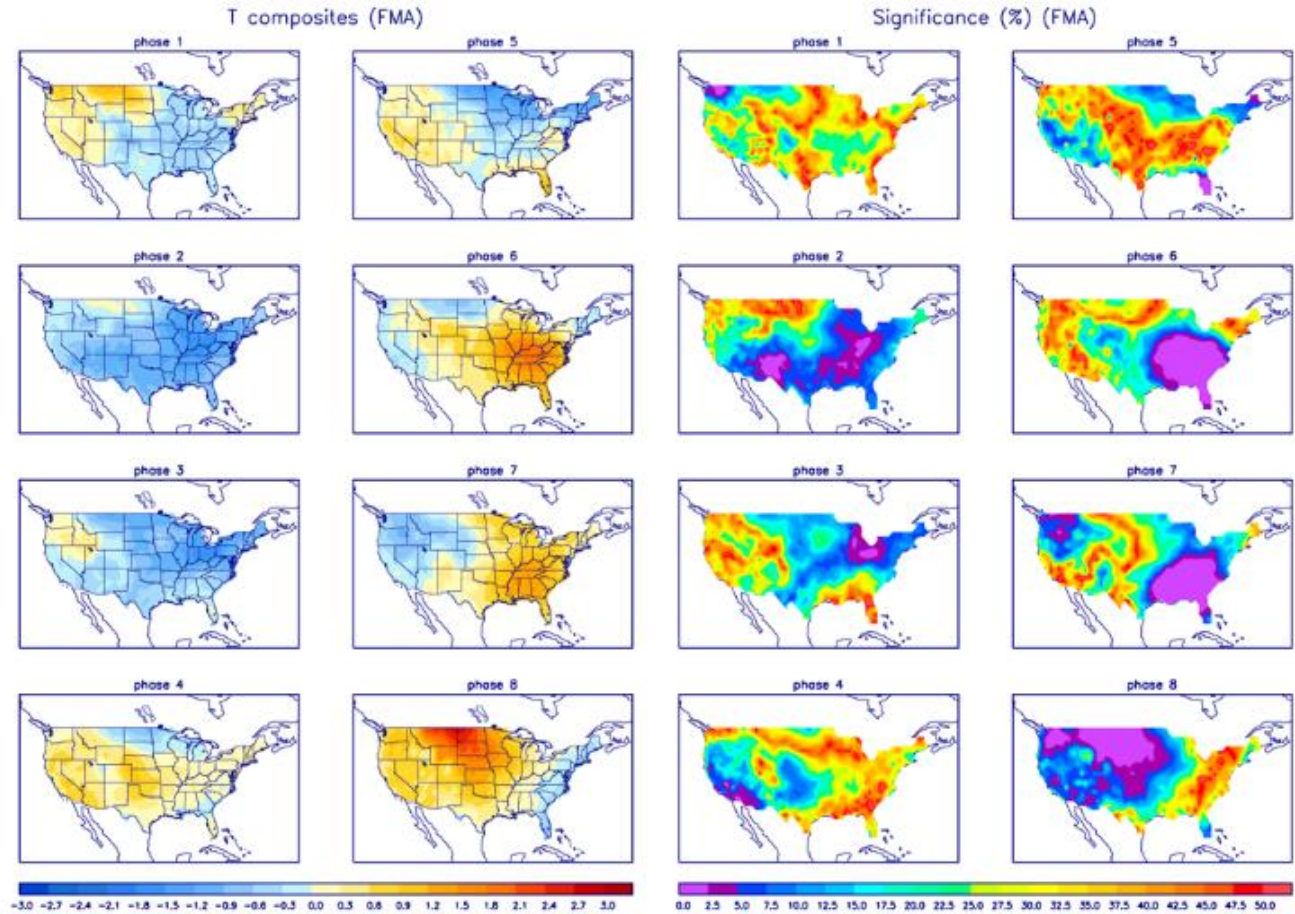
## Precipitation Anomalies



# 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.

