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

**Update prepared by the Climate Prediction Center**
**Climate Prediction Center / NCEP**
**1 March 2021**

# Overview

- The RMM index remained weak during late February as the ongoing La Niña and a strong Rossby wave were the dominant influences on tropical variability.

- Recent observations indicate that a more coherent Wave-1 pattern of 200-hPa velocity potential anomalies has developed with a slight eastward propagation.

- Dynamical model MJO index forecasts depict a strengthening MJO with eastward propagation from the West Pacific to the Western Hemisphere during early March.

- Based on recent observations and the model forecasts, the MJO is likely to destructively interfere with the ongoing La Niña during the next two weeks. There are increasing chances of heavy rainfall across parts of South America.

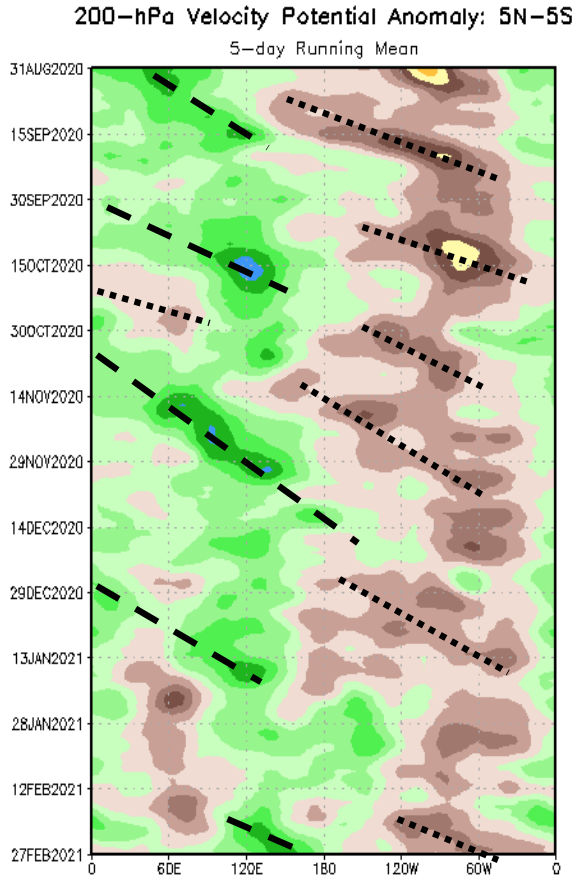
- Tropical cyclone (TC) development is favored for parts of the South Indian Ocean and South Pacific during week-1 with a less favorable pattern for TC genesis becoming established by mid-March.

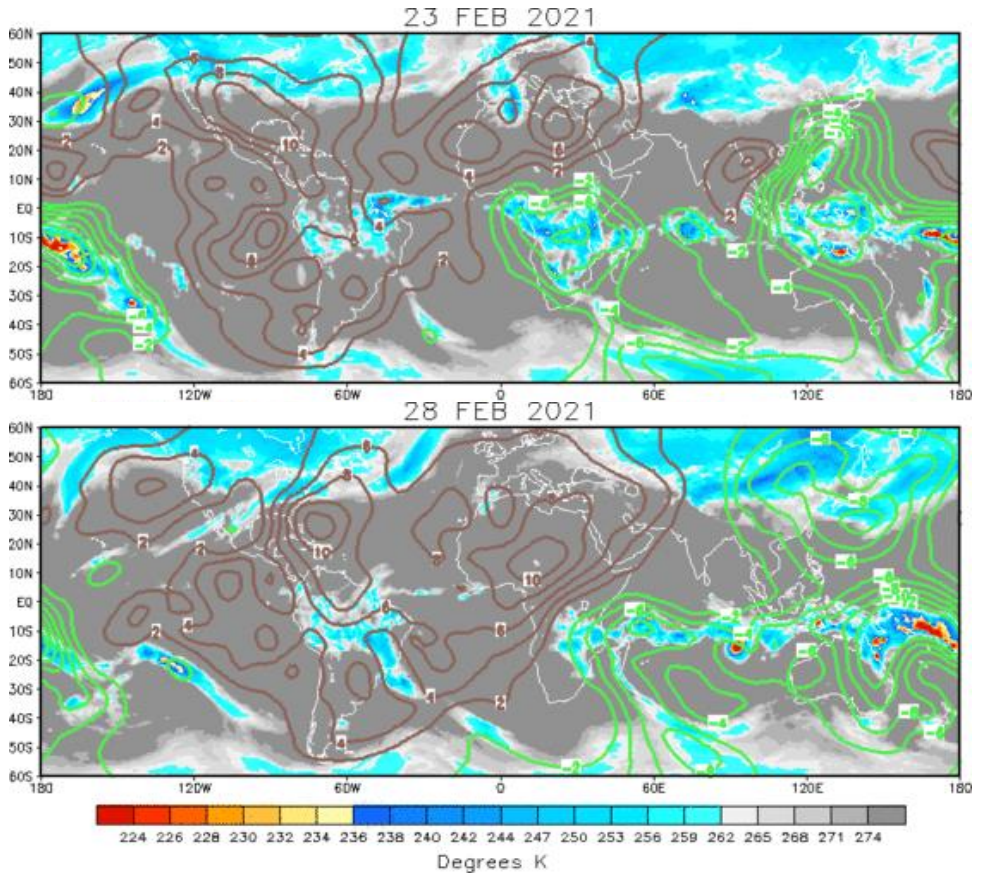
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

# 200-hPa Velocity Potential Anomalies

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

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

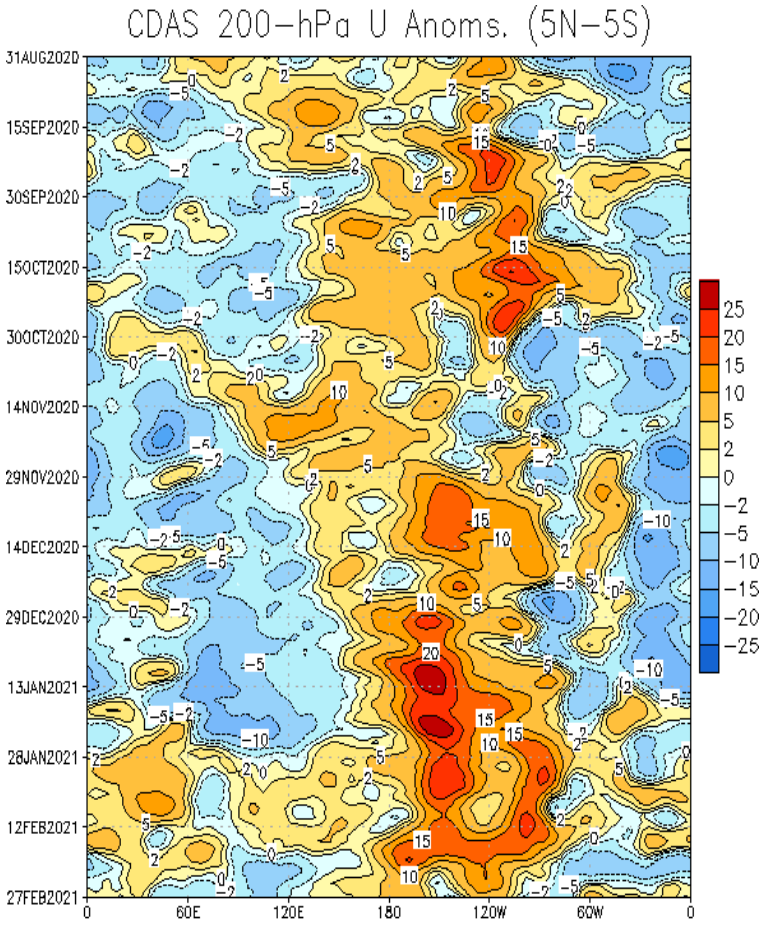


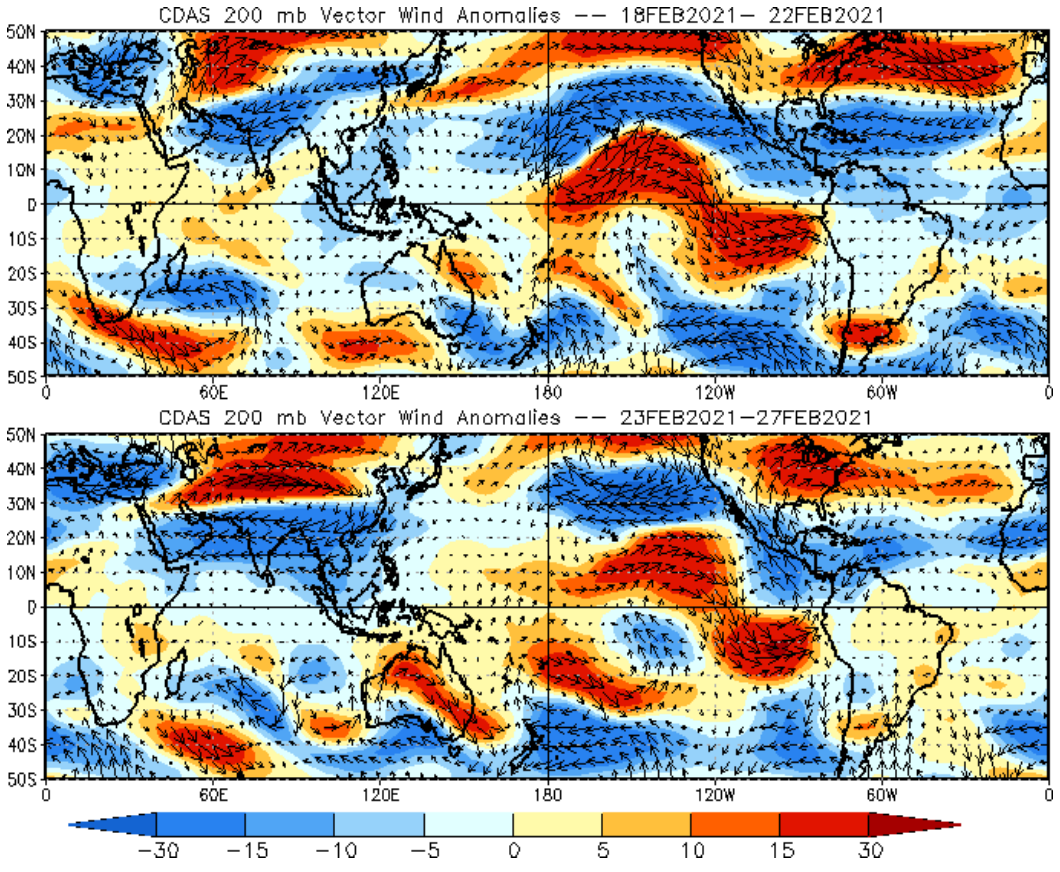




- During much of February, westward propagation of the anomalous divergence signal was evident.
- An eastward propagation of anomalous divergence (convergence) occurred across the Maritime Continent (East Pacific) by the end of February due to a strengthening MJO.

# 200-hPa Wind Anomalies

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



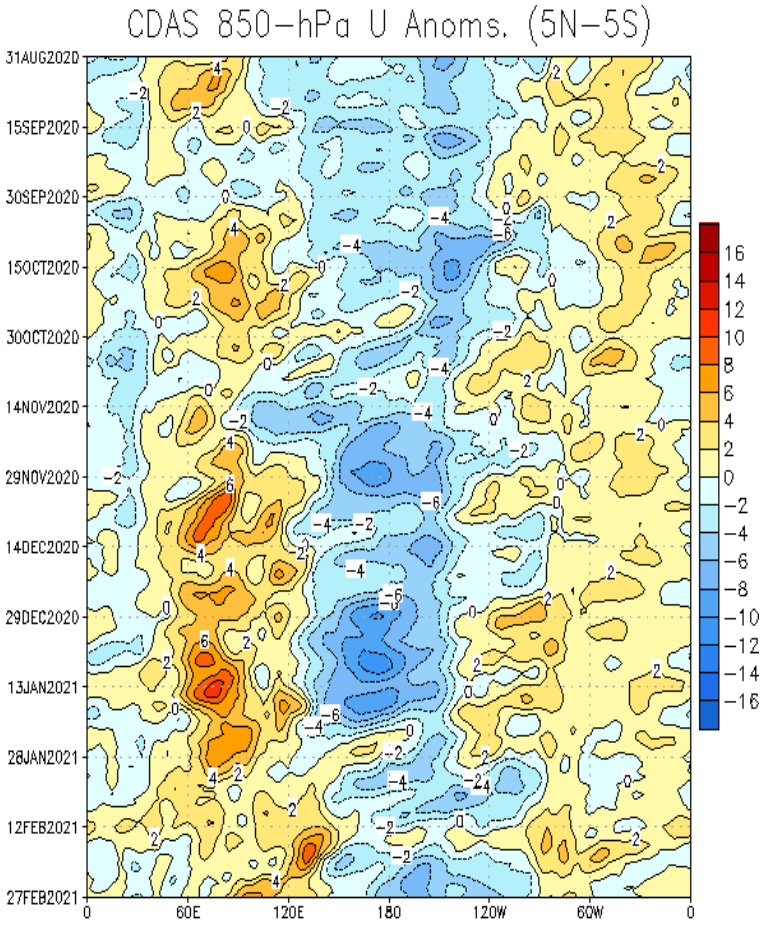



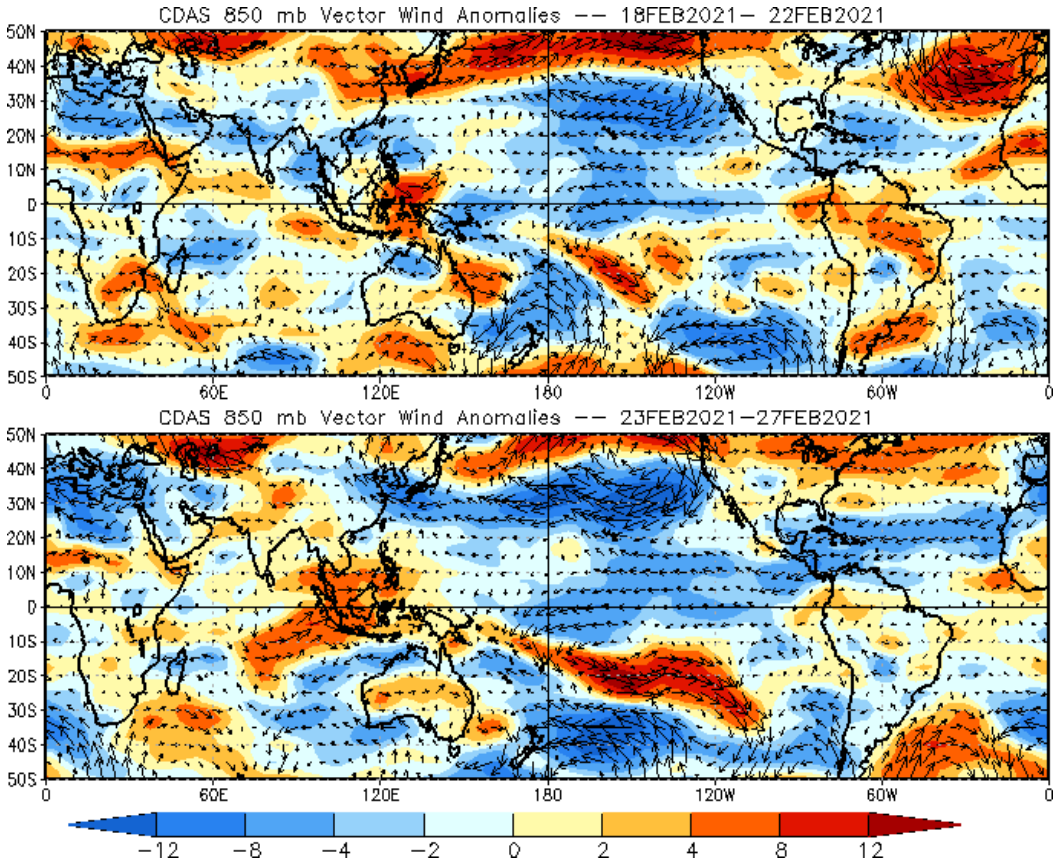

- During mid-Februrary, a robust anticyclonic circulation just east of the Date Line over the North Pacific transported mass towards the Equator, helping to generate strong westerly anomalies. This pattern is consistent with a La Niña response.

- There appears to be a weak Northern Hemisphere mid-latitude response to enhanced convection over the SPCZ region.

# 850-hPa Wind Anomalies

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

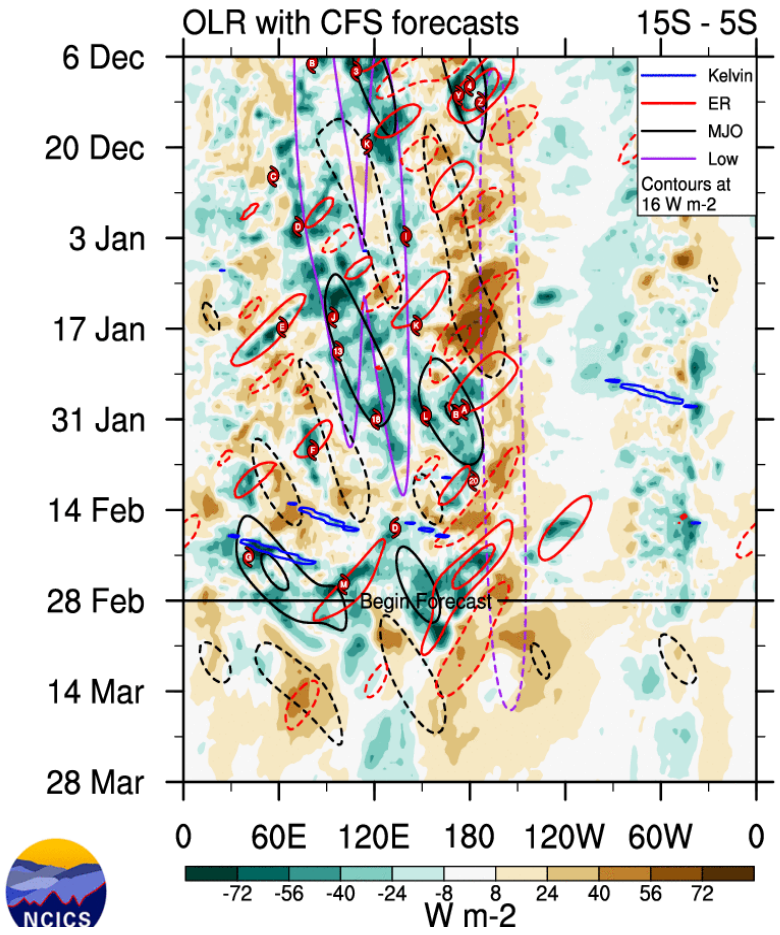


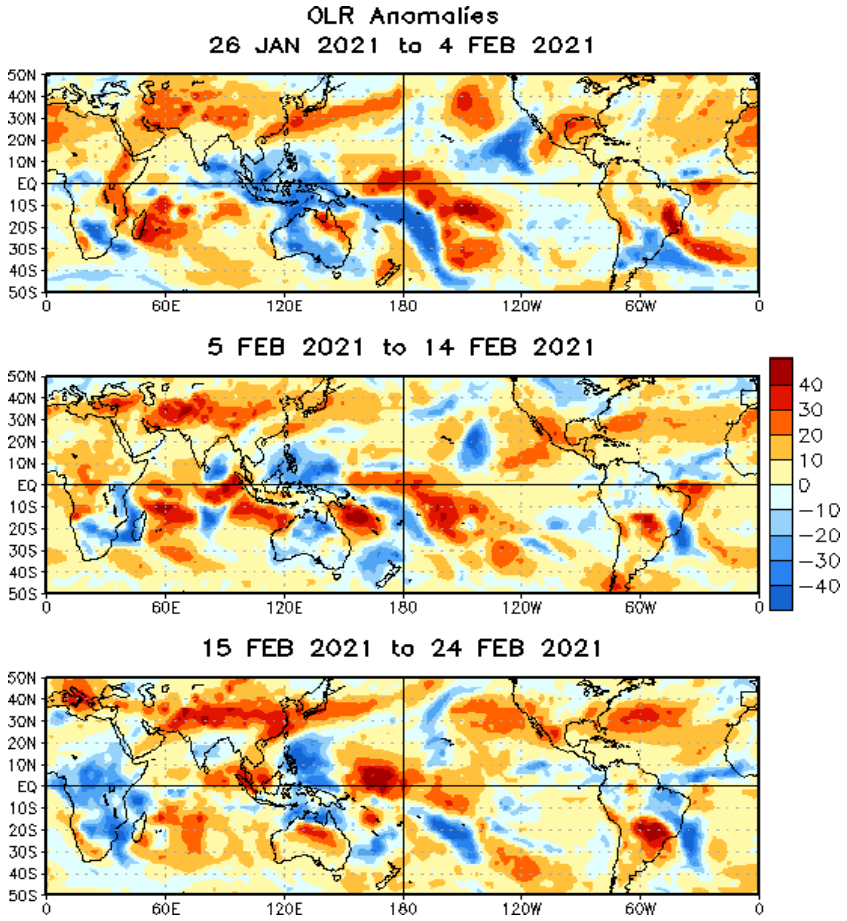




- Enhanced trade winds associated with the ongoing La Niña persisted during the latter half of February.
- Westerly anomalies have recently expanded in spatial extent over the Maritime Continent, while easterly anomalies became more neutral near Papua New Guinea.

# Outgoing Longwave Radiation (OLR) Anomalies

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

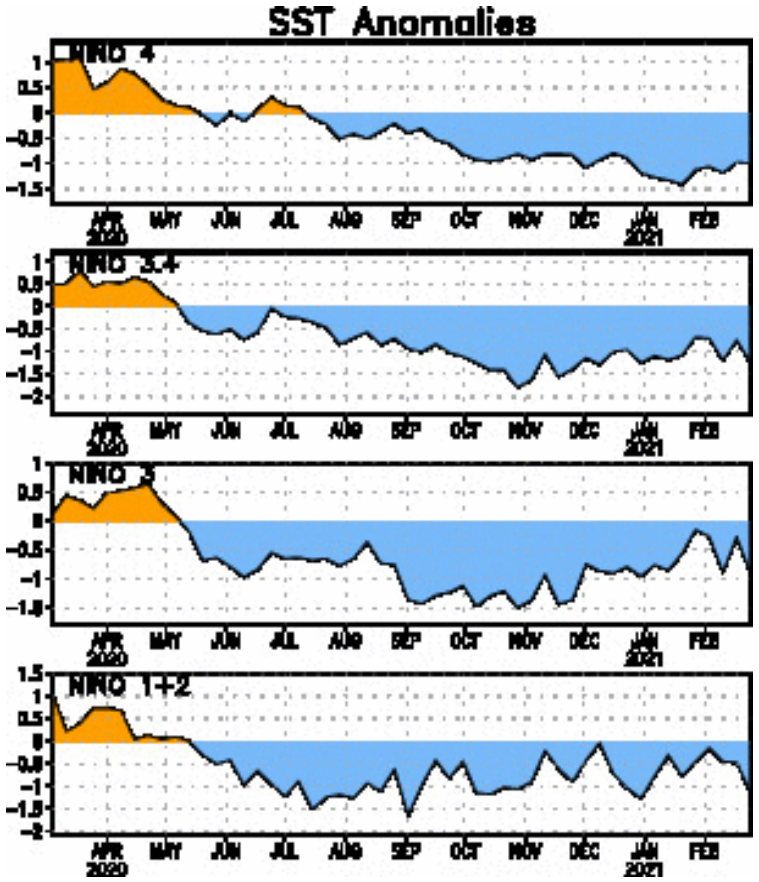


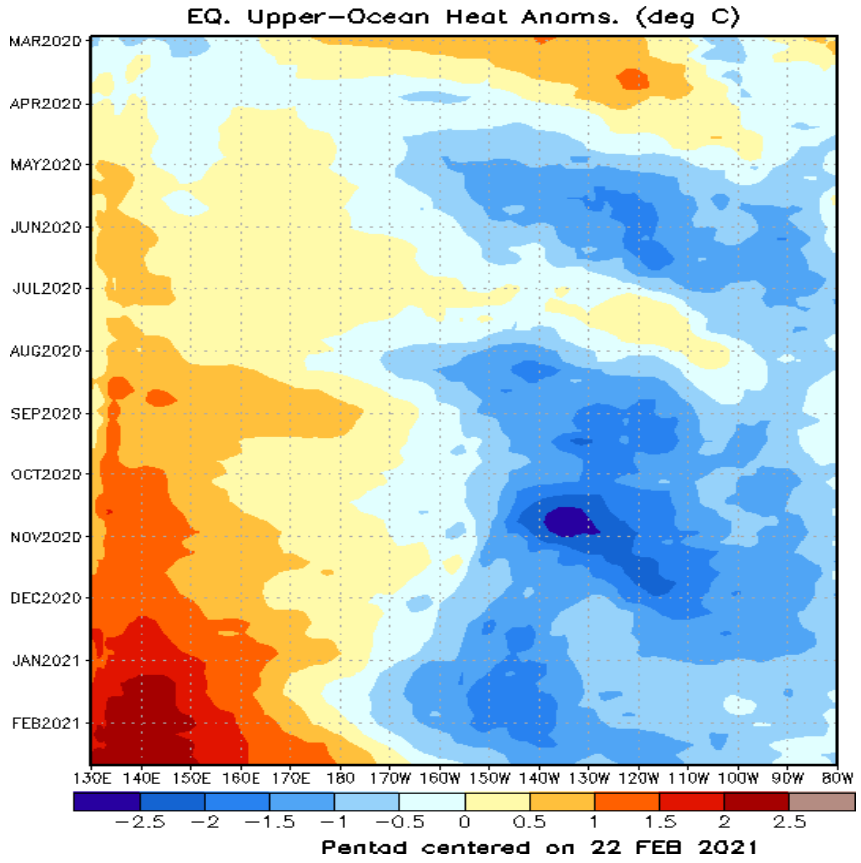




- Since early February, Rossby wave activity appears to be the dominant mode of organized convection over the West Pacific and Maritime Continent.

- Enhanced convection over Africa and the West Pacific show some projection on the MJO-filtered band.

# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



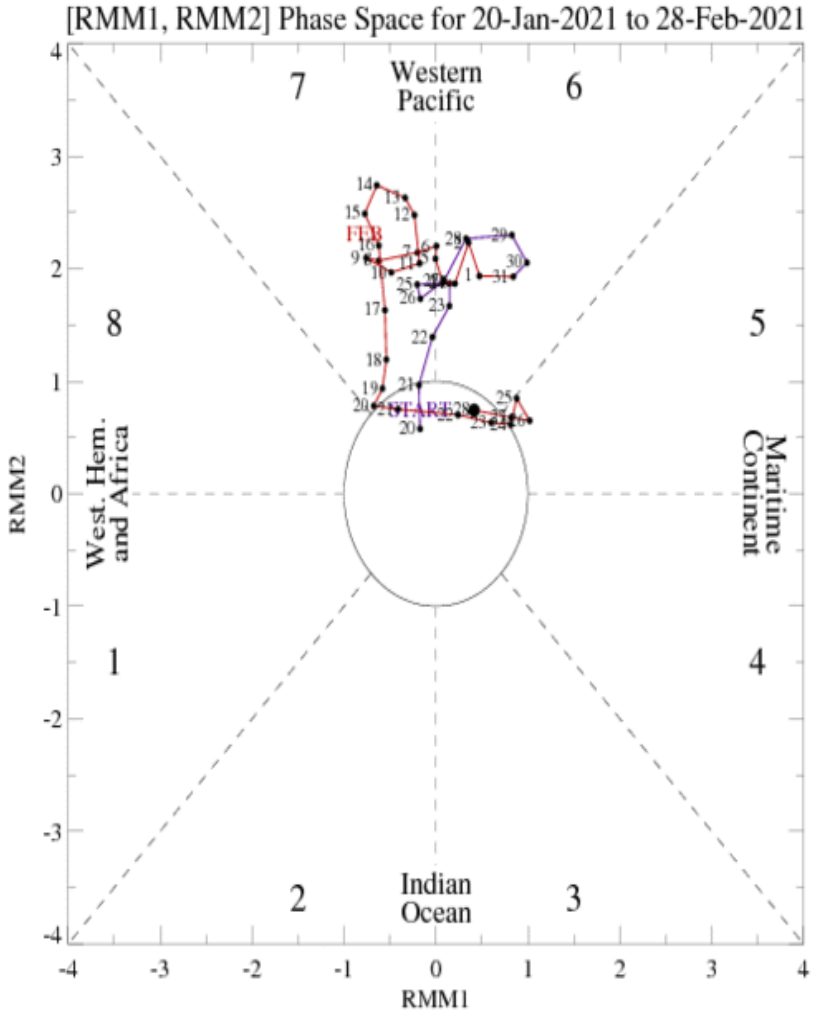




- Following destructive interference with the base state by a downwelling Kelvin wave during July, the subsequent upwelling phase pushed the Pacific into La Niña conditions.

- The strong Rossby wave that has moved from the Pacific to the Maritime Continent during February may have helped to initiate a downwelling Kelvin wave, which is allowing warm water to push east of the Date Line.

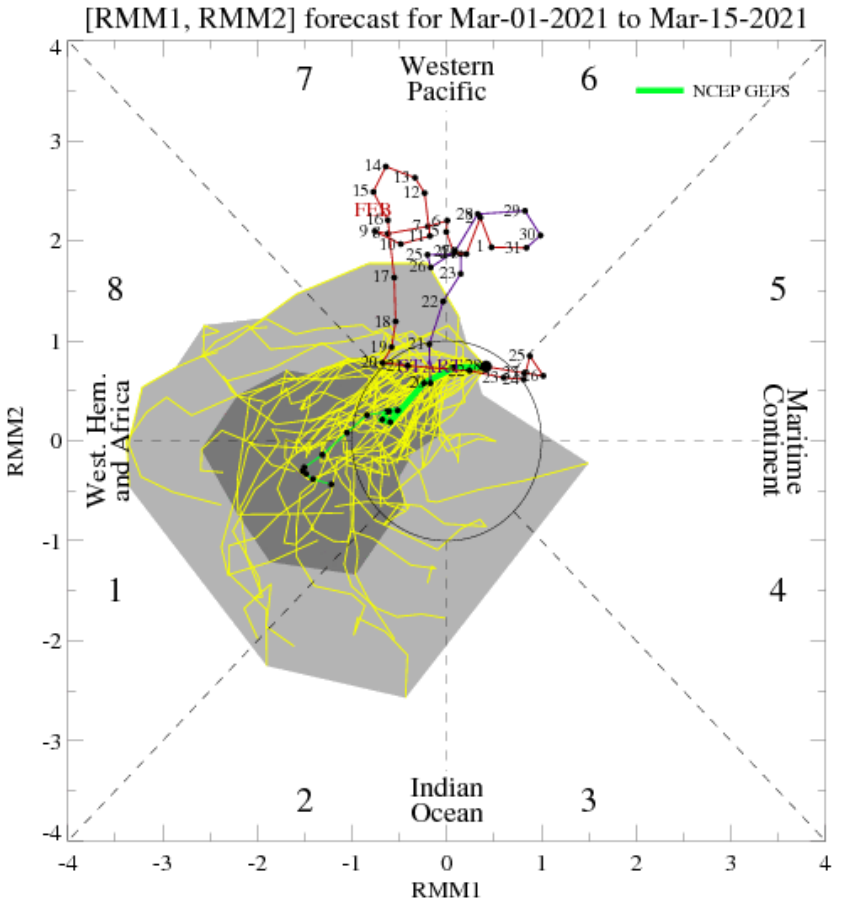
# MJO Index: Recent Evolution

- The RMM index remained weak during late February as a strong Rossby wave was the dominant mode of tropical variability.

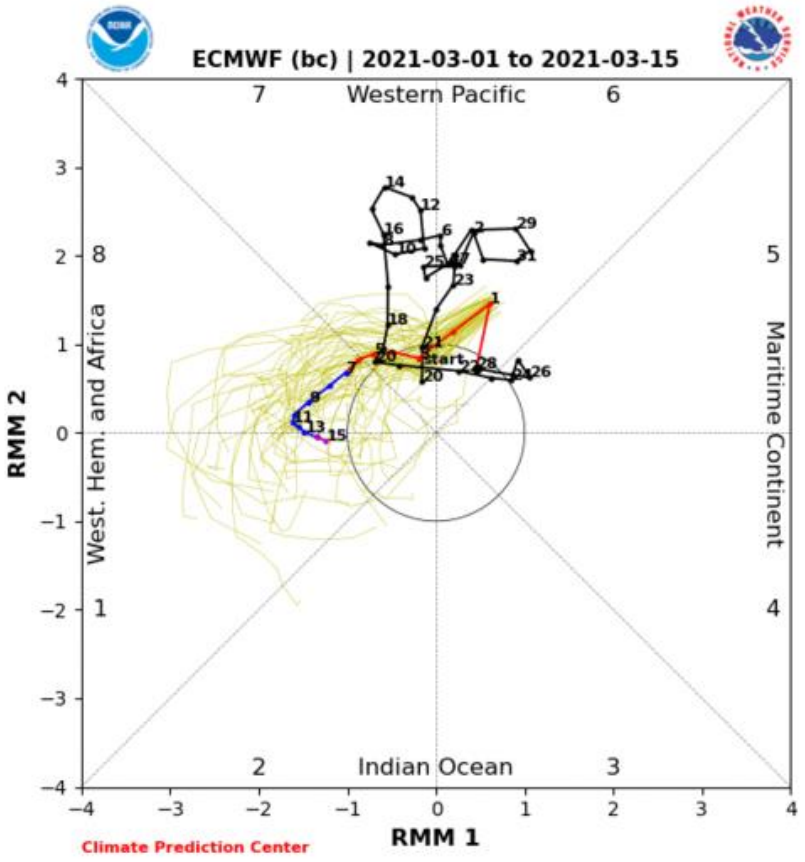



For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

# MJO Index: Forecast Evolution




GEFS Forecast



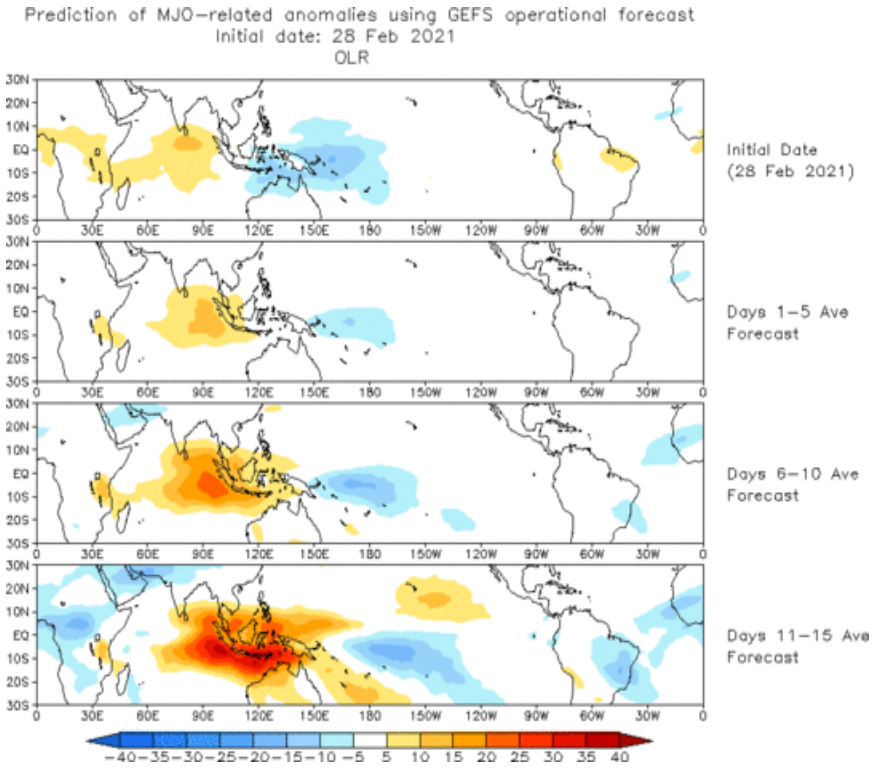

ECMWF Forecast

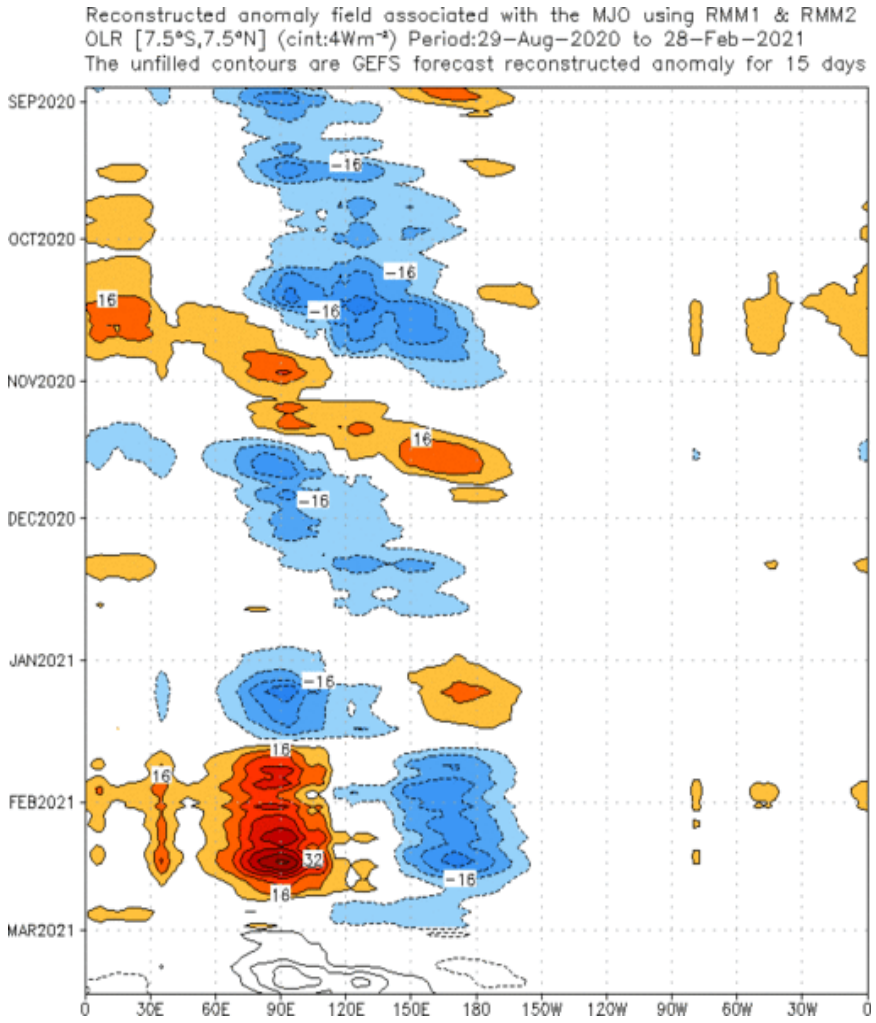
- The GEFS and ECMWF ensemble means are in good agreement and depict a continued strengthening MJO with eastward propagation to the Western Hemisphere during early to mid-March.

- Spread among their ensemble members is lower compared to forecasts during February.

# 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.)

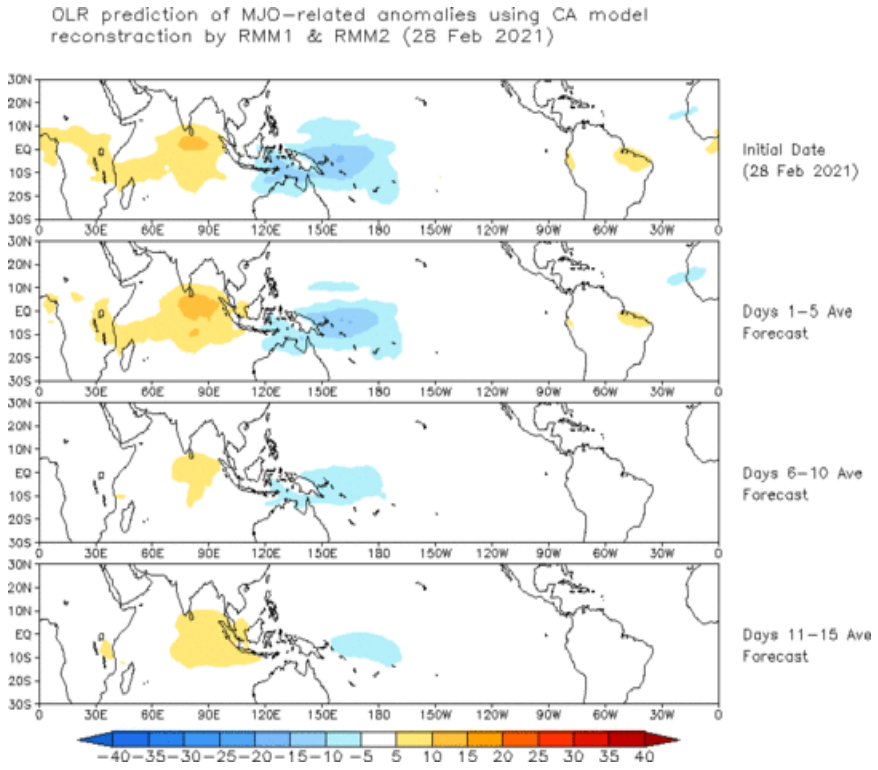


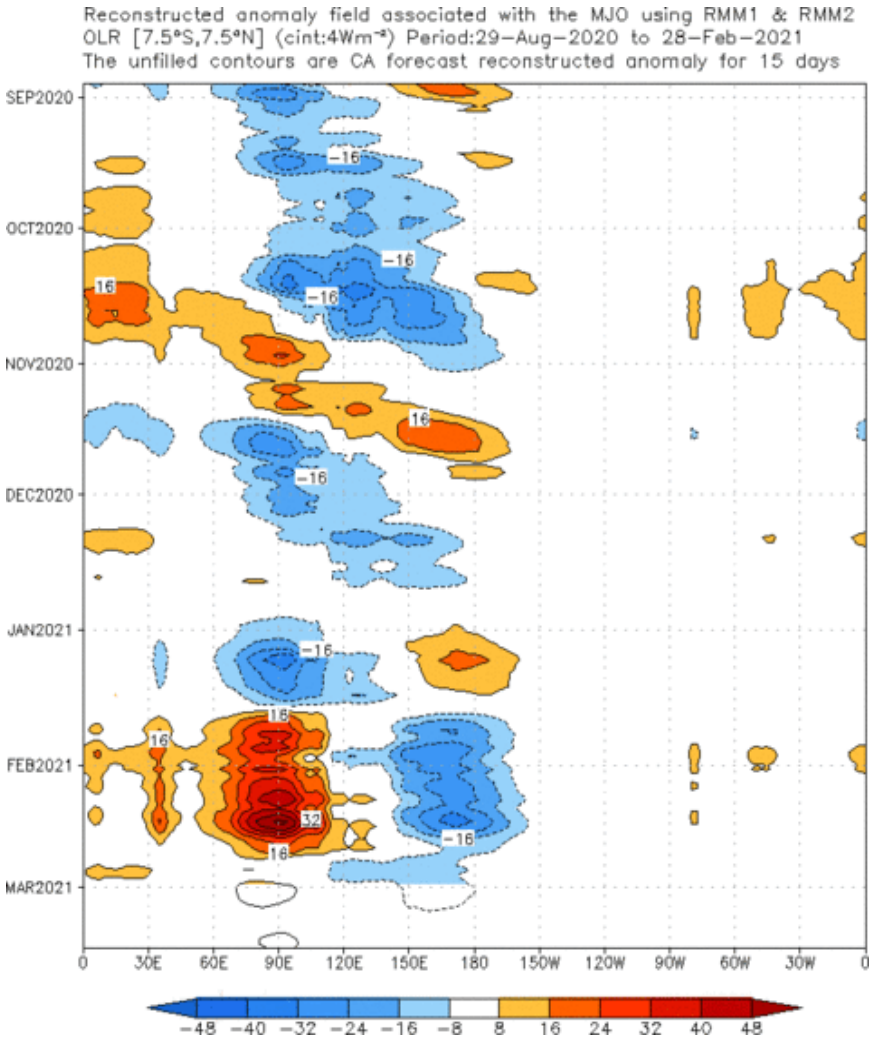




- The GEFS features suppressed convection expanding east from the Indian Ocean to the Maritime Continent and Australia during the next two weeks, while convection increases across South America and Africa.

# 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.)

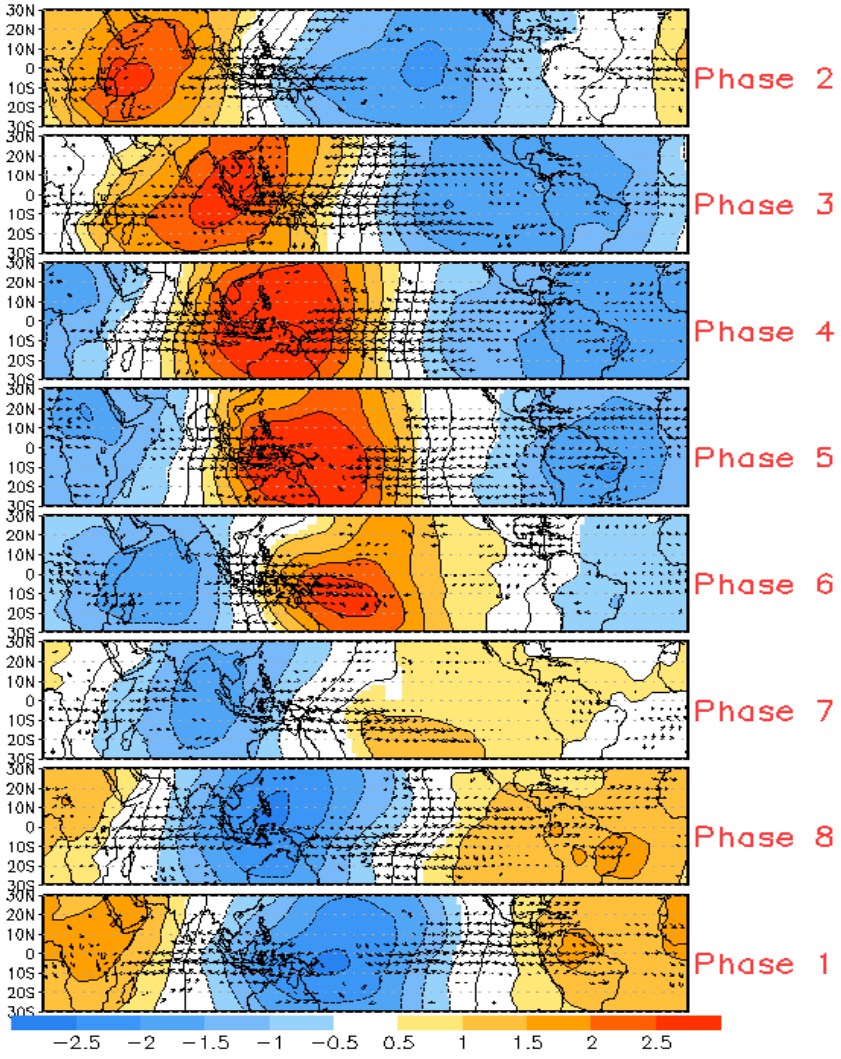


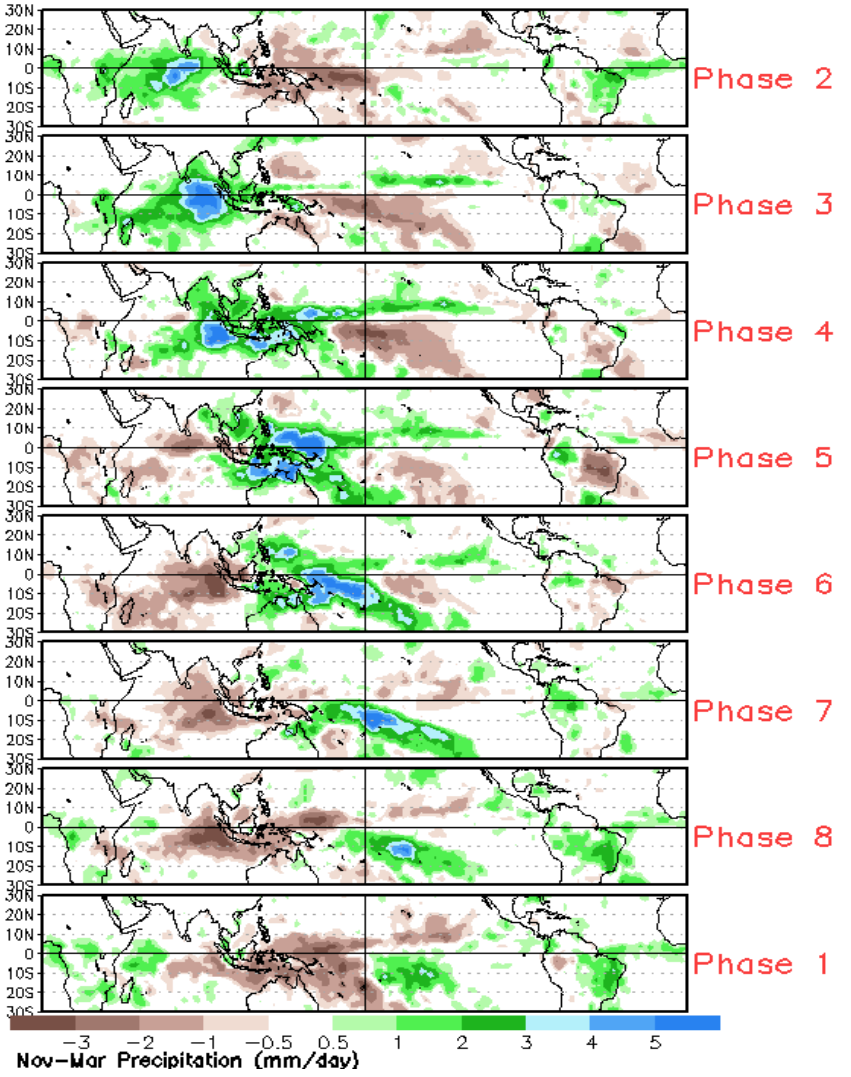

- The constructed analog predicts a slower eastward shift of the suppressed convection, compared to the GEFS (previous slide).

# MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



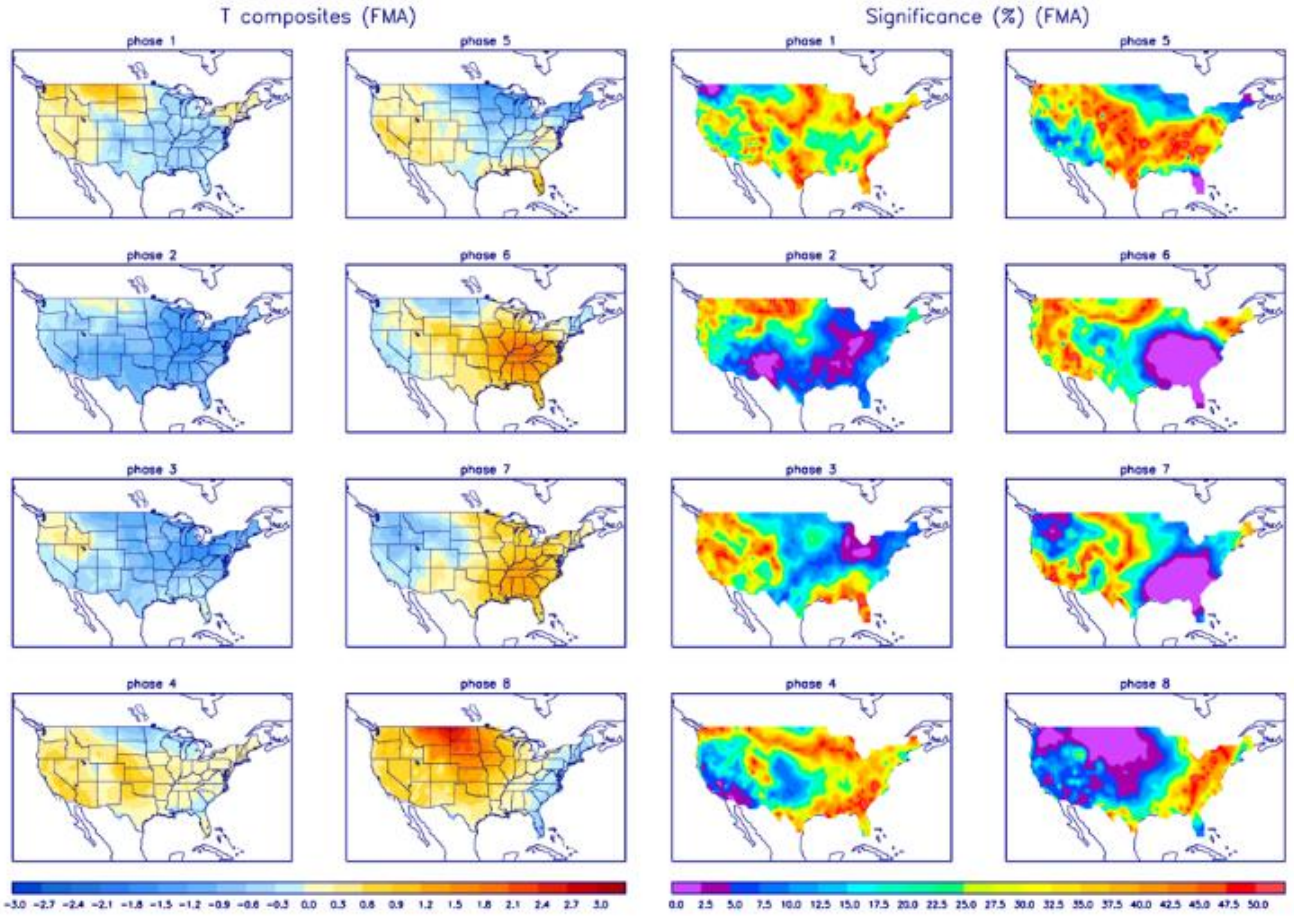

Precipitation Anomalies



# 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.

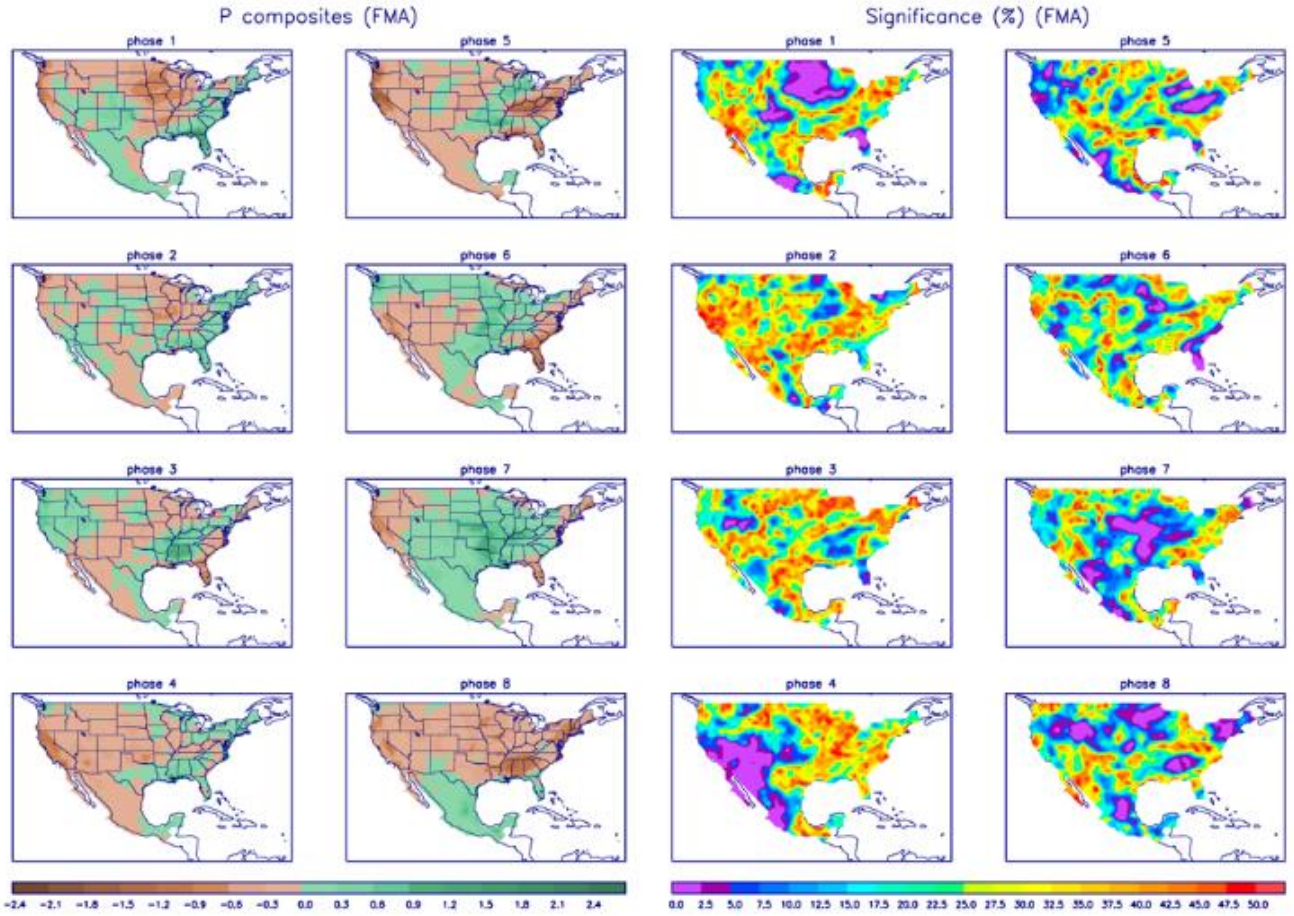



More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

# 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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