

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



**Update prepared by the Climate Prediction Center**  
Climate Prediction Center / NCEP  
18 May 2020

# Overview

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- Following a weakening of the MJO since early May, recent RMM indices indicate a strengthening of the intraseasonal signal over the Indian Ocean. Currently, much of enhanced convection appears to be tied to tropical cyclone Amphan peaking as Category 5 system over the Bay of Bengal.
- Dynamical models indicate a rapid propagation of this feature over the eastern Indian Ocean and the Maritime Continent during Week-1, with some decay in amplitude in RMM space over the West Pacific during Week-2.
- Given the rapid phase speed of enhanced convective envelope in the forecast, extratropical impacts appear unlikely at this time.

A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:

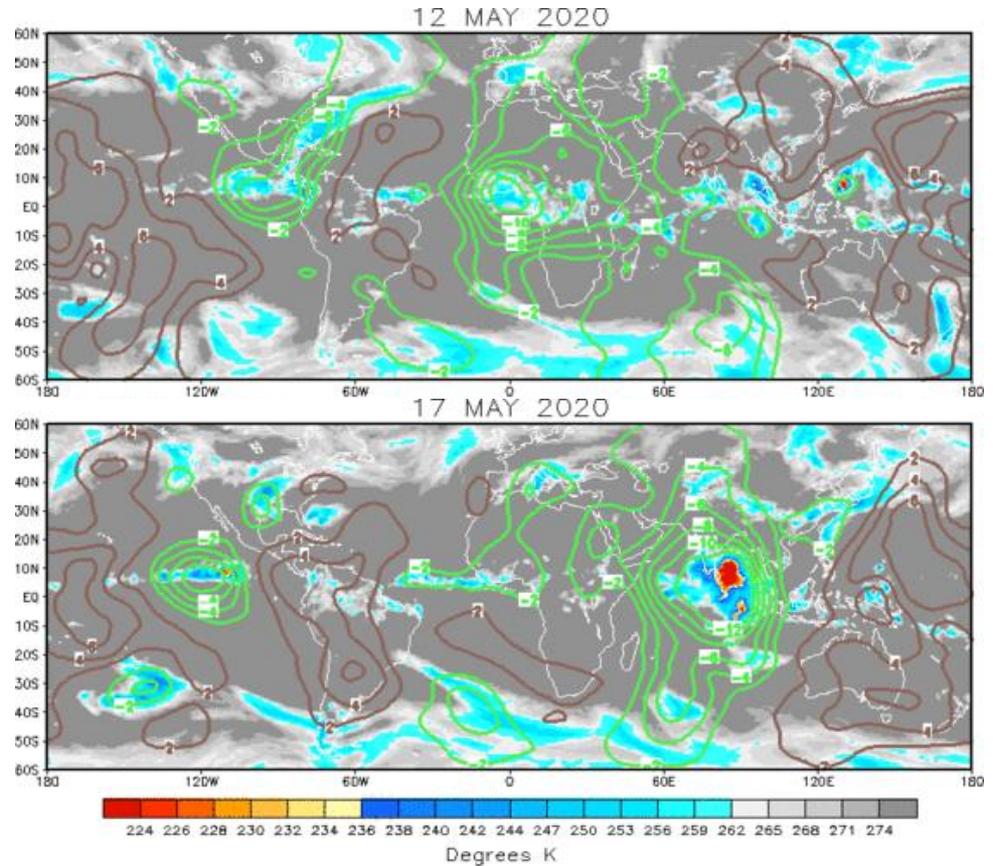
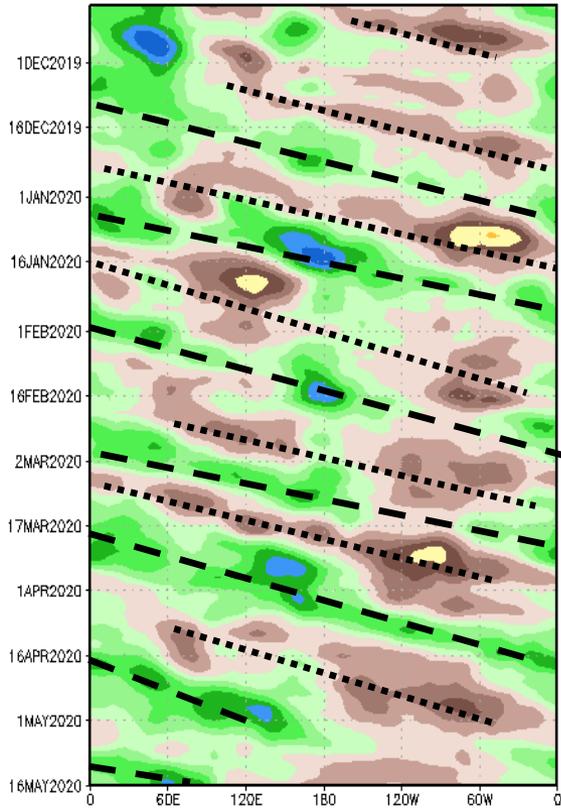
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

# 200-hPa Velocity Potential Anomalies

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

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

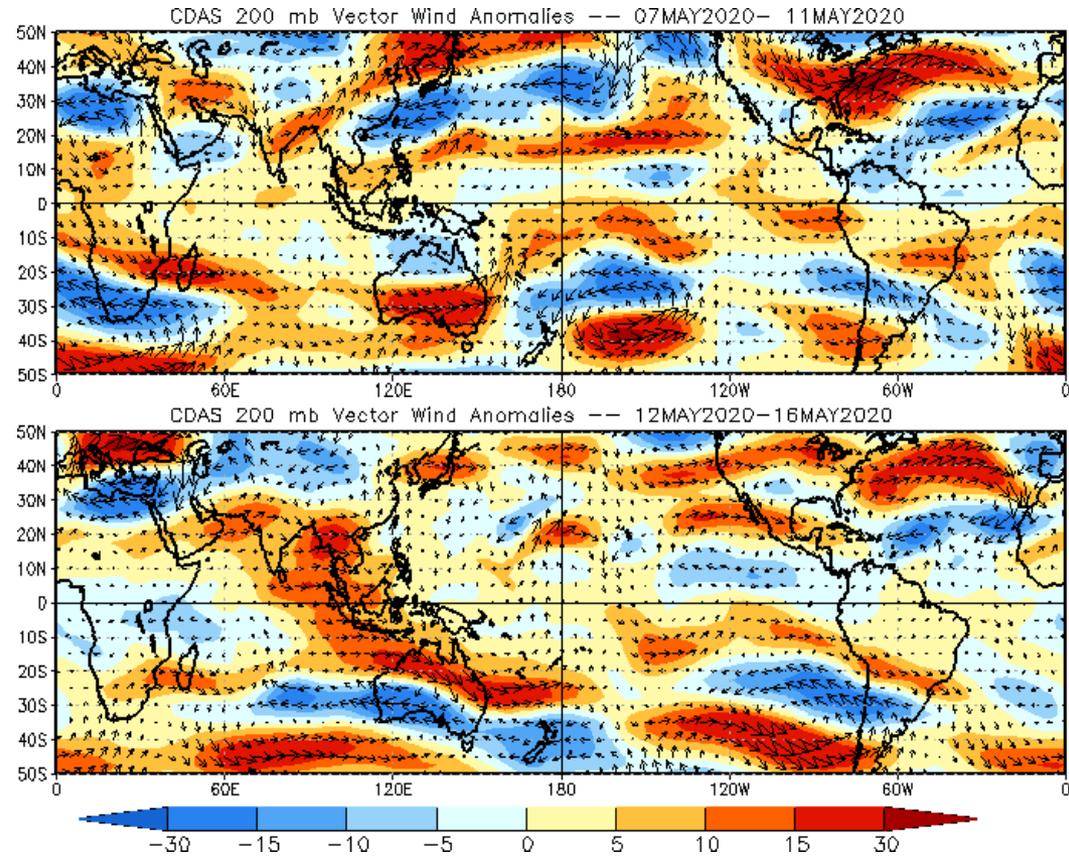
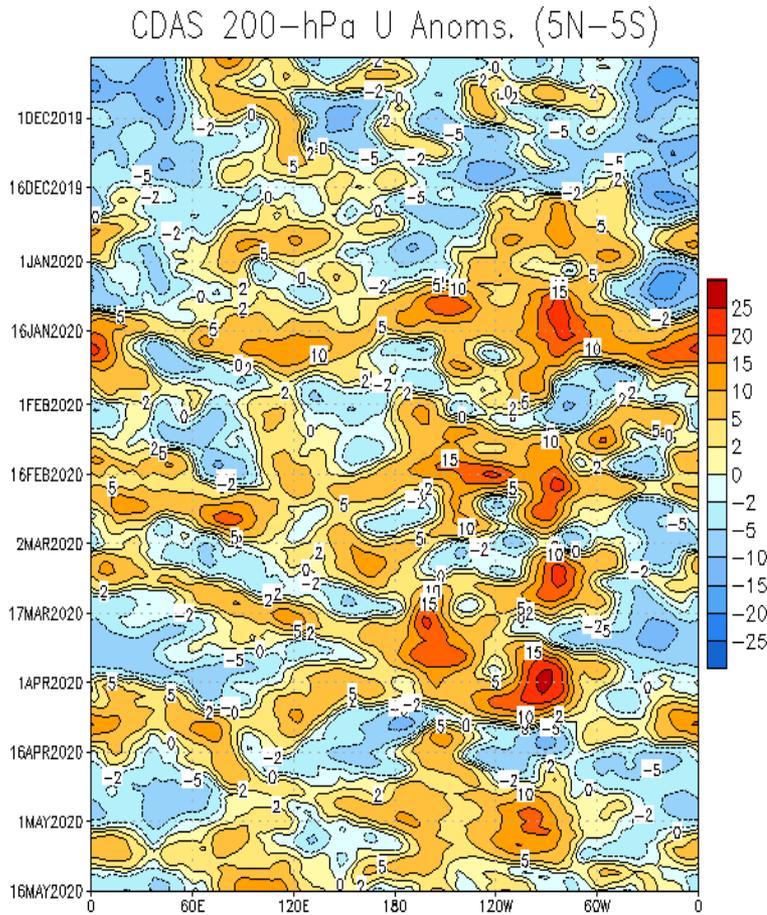
200-hPa Velocity Potential Anomaly: 5N-5S  
5-day Running Mean



- An envelope of enhanced convection is apparent from Africa to the eastern Indian Ocean, with tropical cyclone Amphan embedded within a favorable environment with the strongest signals for divergence aloft.
- Suppressed convection has prevailed throughout much of the western Pacific.

# 200-hPa Wind Anomalies

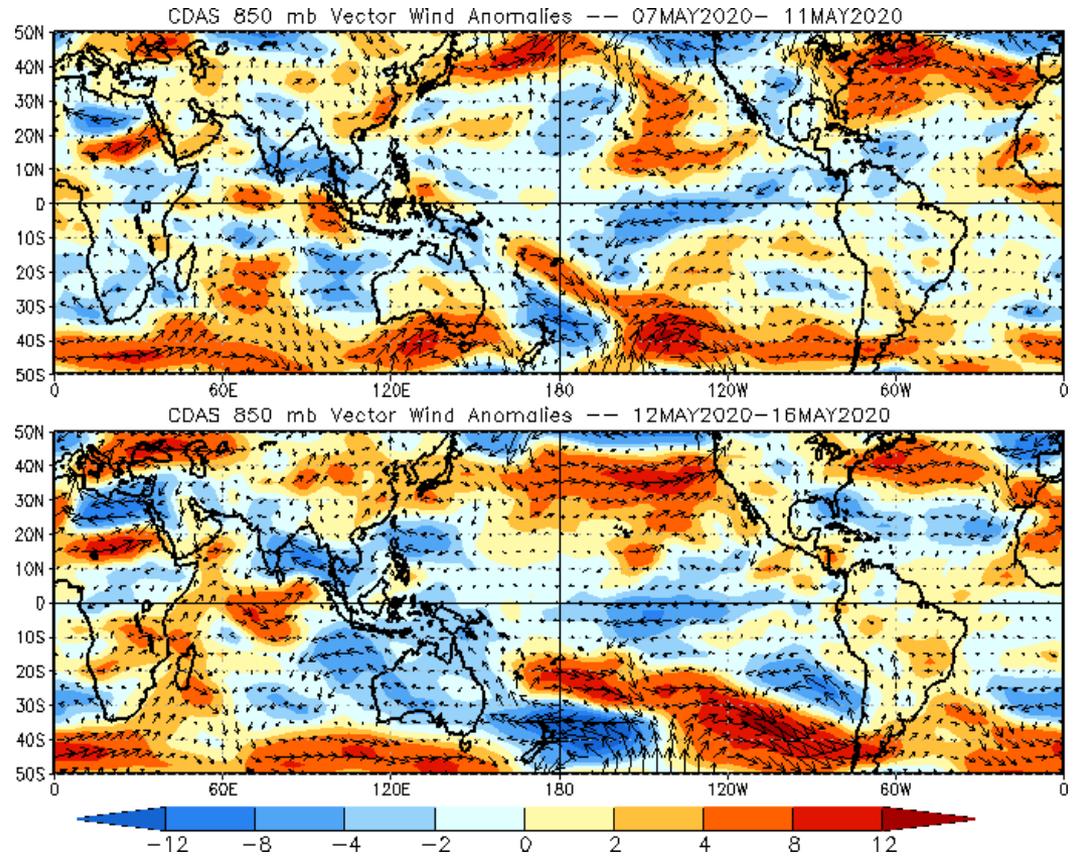
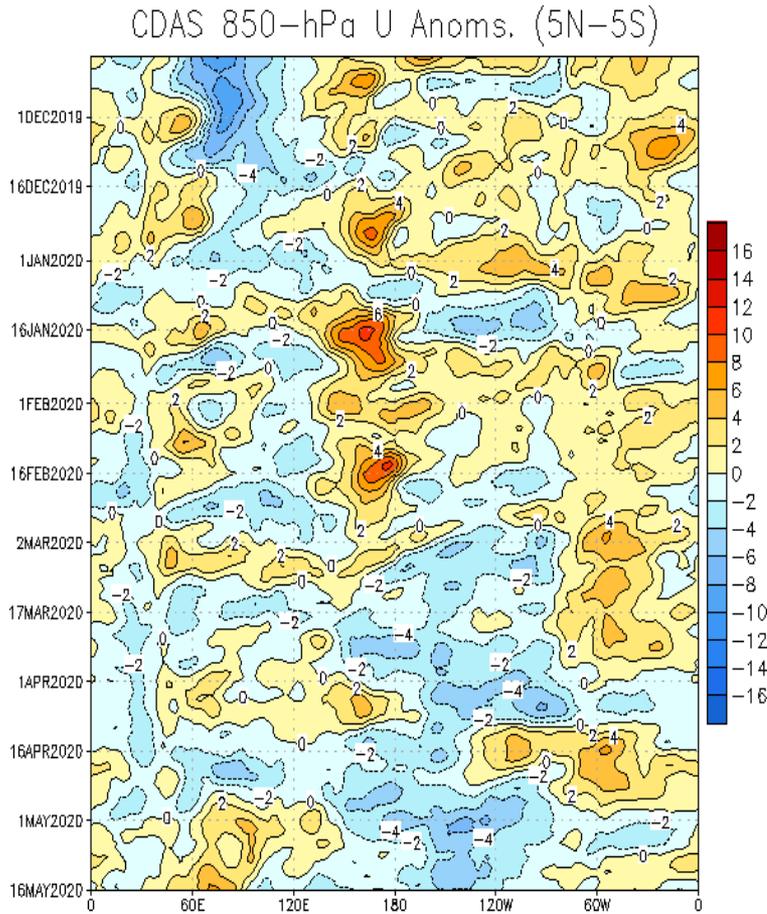
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Anomalous westerlies have strengthened (weakened) over the eastern Indian Ocean (eastern equatorial Pacific) since early May.
- Cross-equatorial flow aloft is observed near the Antimeridian, and equatorward of an anticyclonic circulation to the west of Central America.

# 850-hPa Wind Anomalies

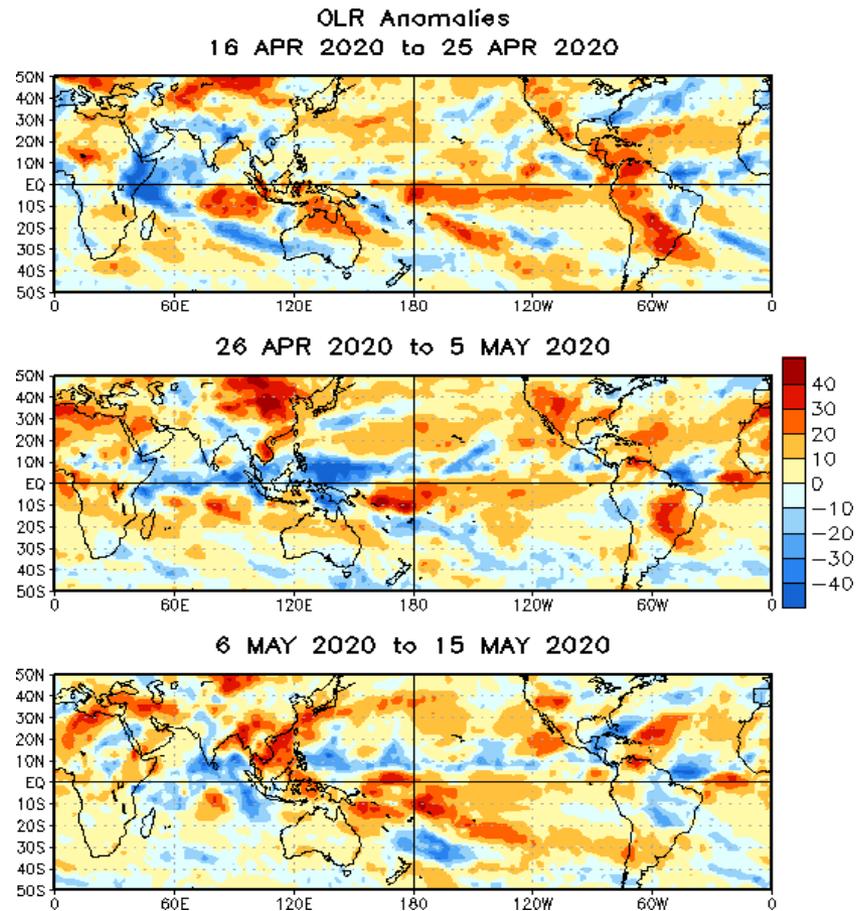
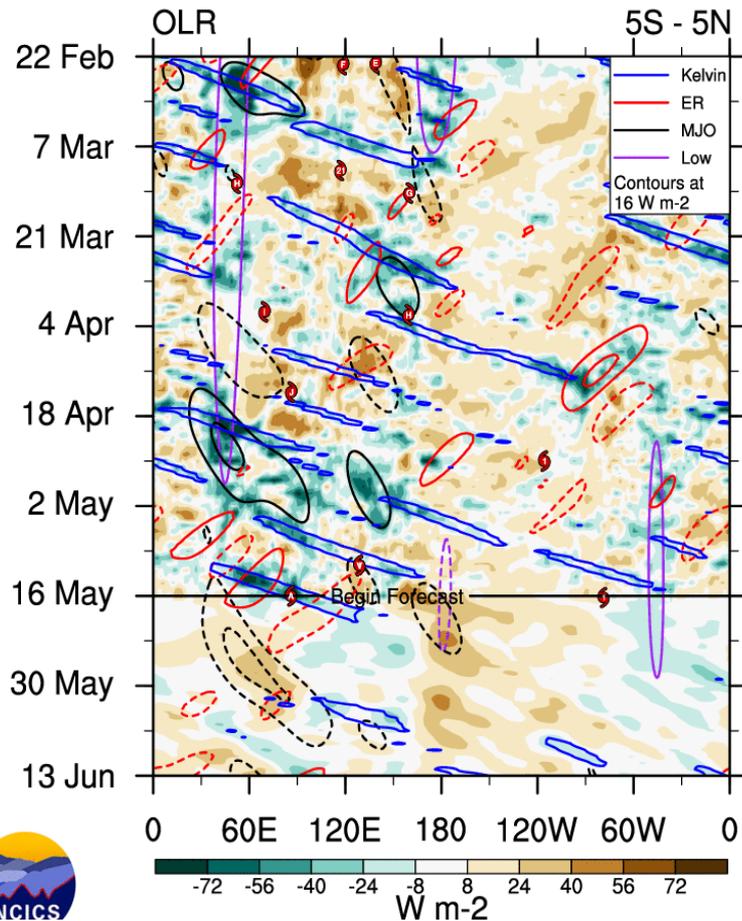
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Enhanced trades persist across the equatorial Pacific, supporting the continued decrease of heat content in the upper layers of the ocean.
- Anomalous westerlies (easterlies) strengthened across the western Indian Ocean (Maritime Continent).
- A well defined anticyclonic circulation is observed over the Atlantic basin with enhanced easterlies across the tropics.

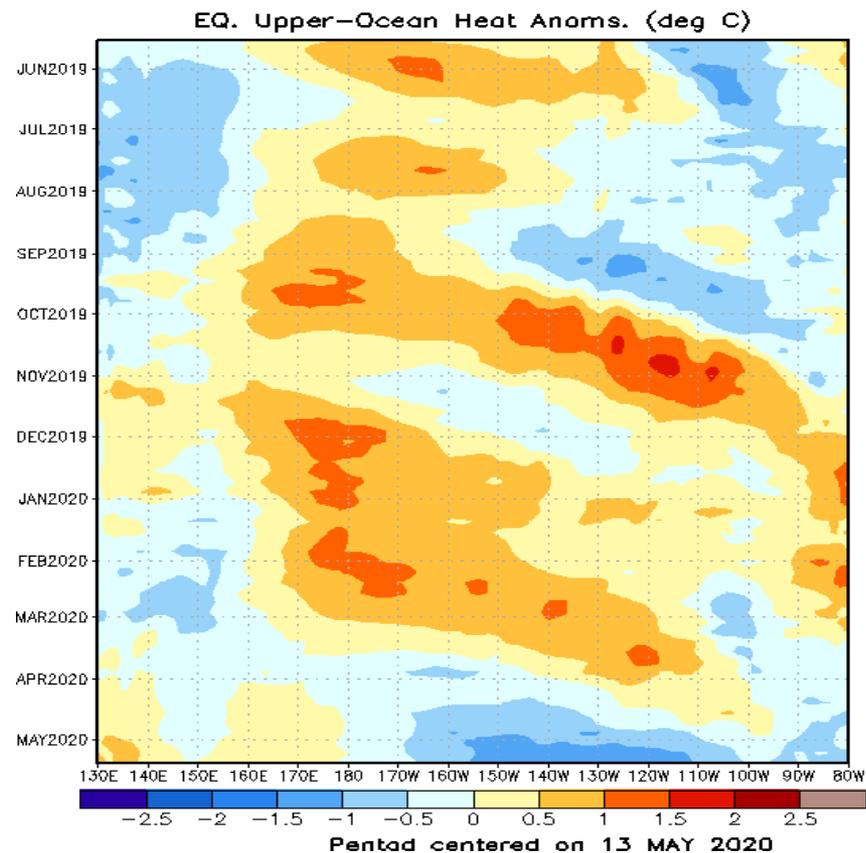
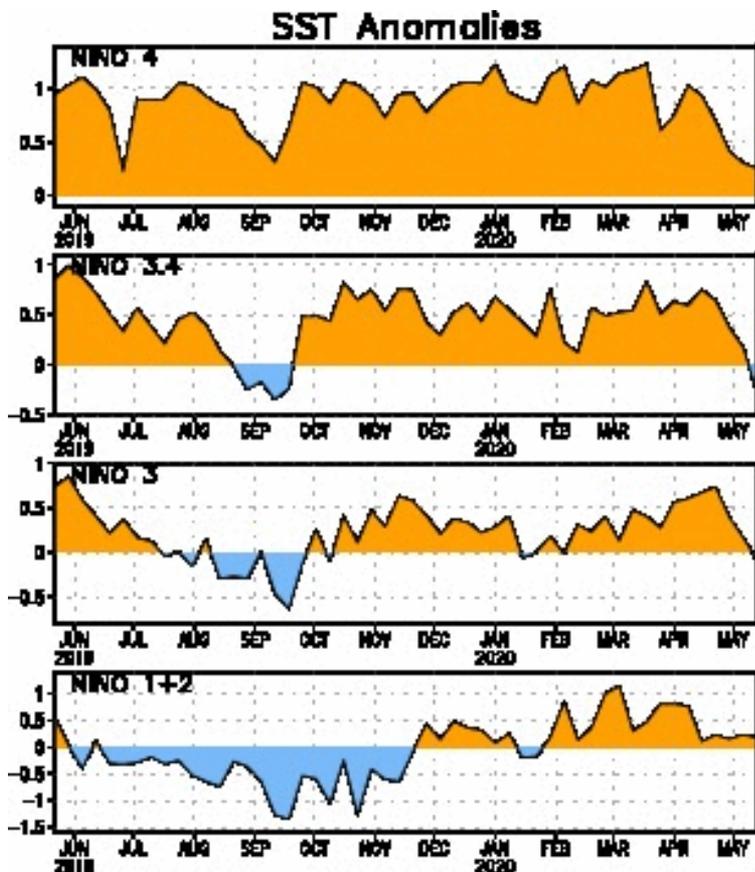
# Outgoing Longwave Radiation (OLR) Anomalies

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



- Enhanced convection recently continued over the Indian Ocean linked to Kelvin, Rossby wave activity, and TC Amphan over the Bay of Bengal.
- OLR forecast favors the persistence of suppressed precipitation along the Antimeridian.

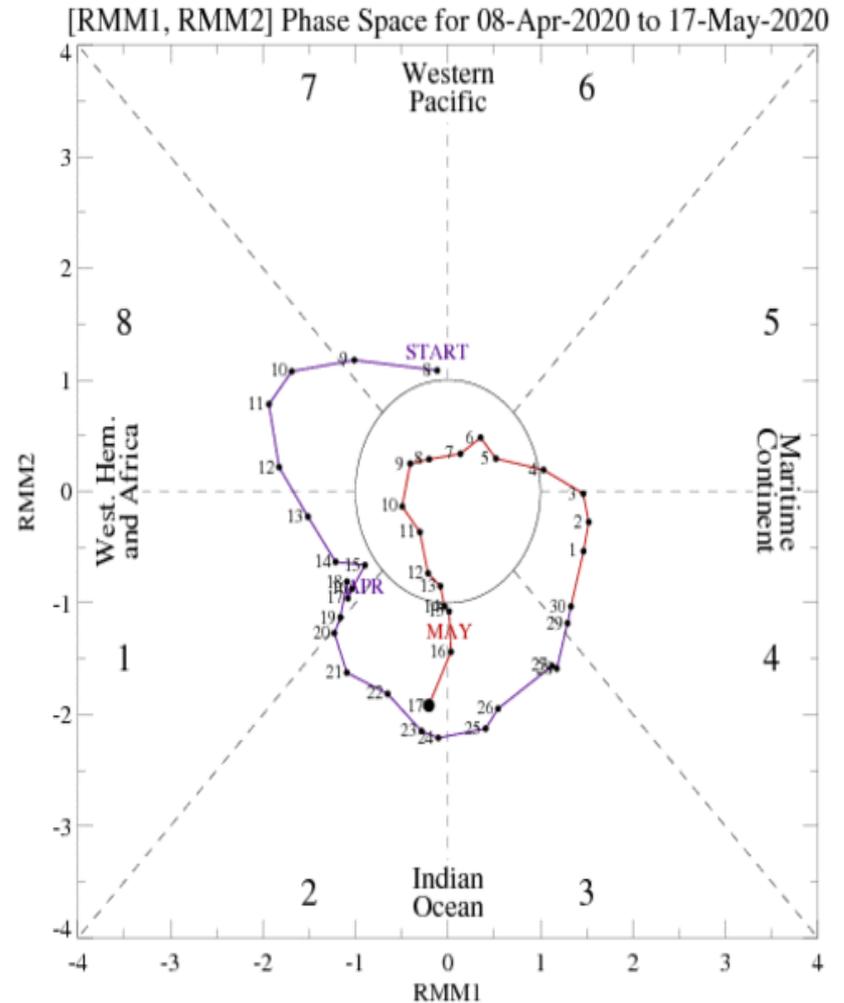
# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Negative upper-ocean heat content anomalies continue to strengthen over much of the equatorial Pacific with the exception of areas west of the Date Line. This cooling trend is likely associated with the persistence of enhanced lower-level trades as illustrated on previous slide 5.
- Above-average SSTs in the Niño 3, 3.4, and 4 regions have continued to weaken since April, with Niño 3 and 3.4 recently falling below-average.

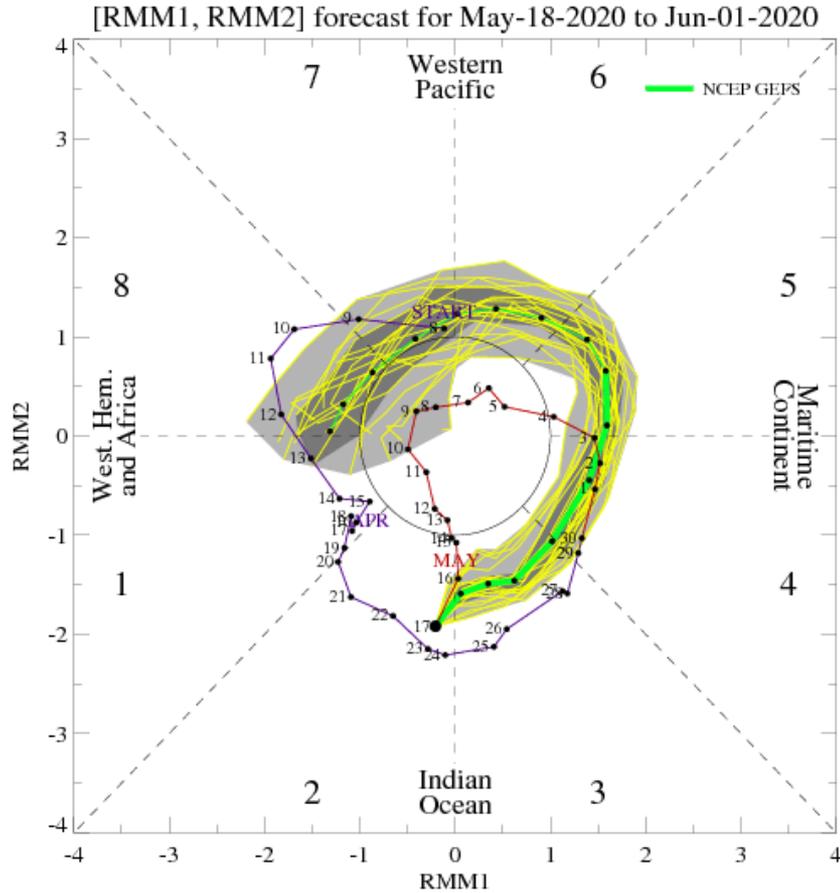
# MJO Index: Recent Evolution

- The RMM index is located along the boundary of Phases 2 and 3 over the Indian Ocean.
- The increase in amplitude with little to no eastward propagation during the past week likely tied to the formation of TC Amphan over the Bay of Bengal.

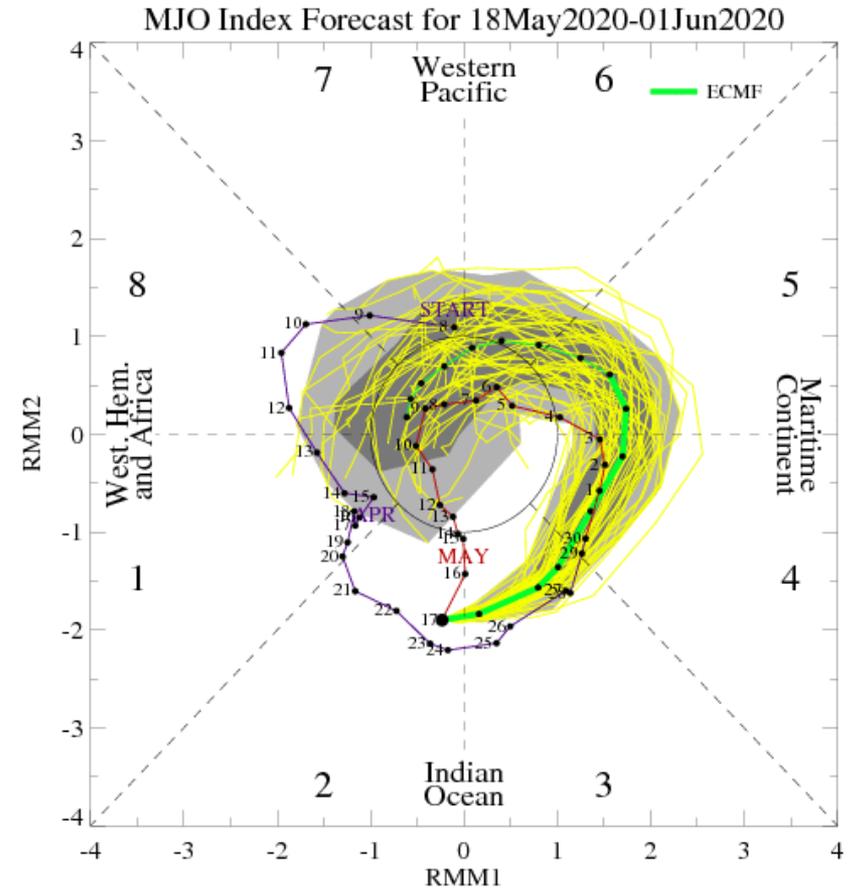


For more information on the RMM index and how to interpret its forecast please see:  
[https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC\\_MJOinformation.pdf](https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf)

# MJO Index: Forecast Evolution



**GEFS Forecast**



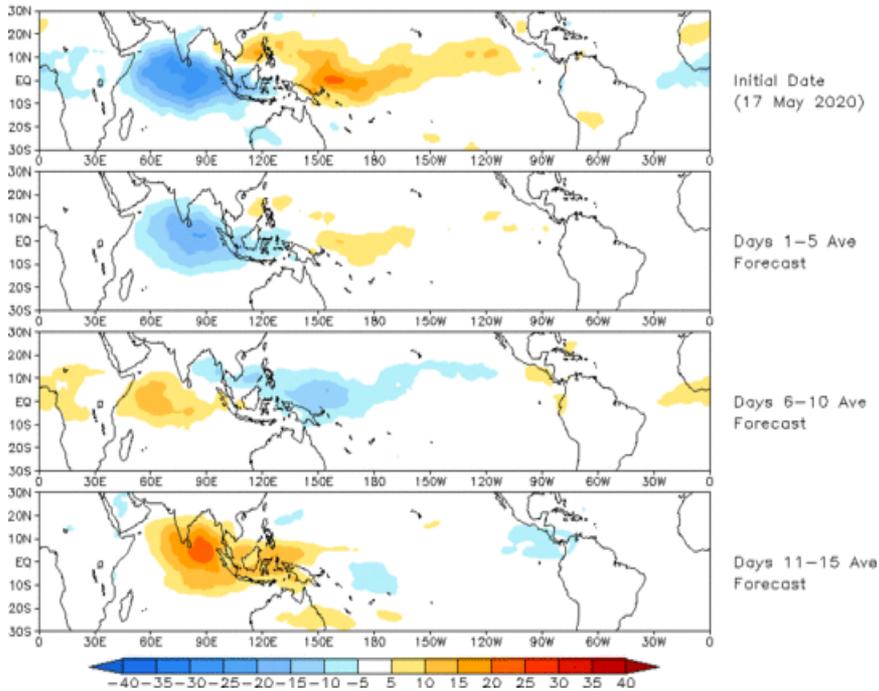
**ECMWF Forecast**

- Both the GEFS and ECMWF indicate a more coherent signal, soon propagating eastward across the Indian Ocean and Maritime Continent during Week-1, and into the Western Pacific during Week-2.
- The rapid phase speed (3-4 days per phase) in the forecasts suggest the predicted enhancement of convection more in line with a convectively coupled Kelvin Wave instead of the MJO.

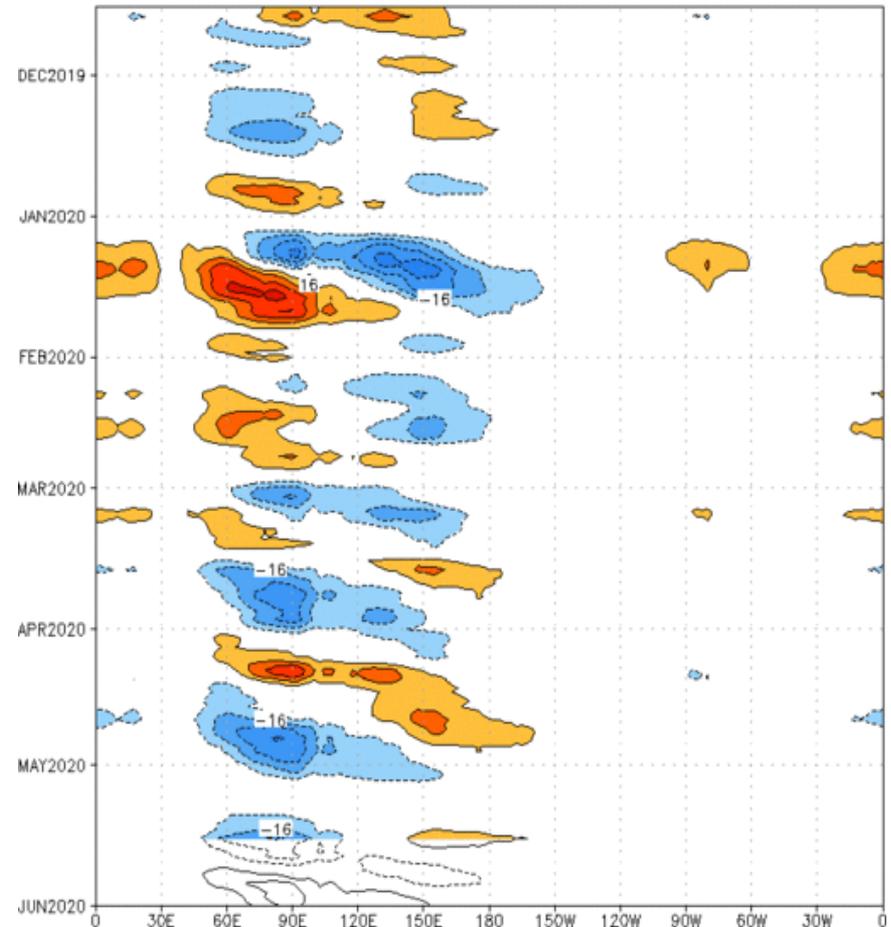
# MJO: GEFS Forecast Evolution

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: 17 May 2020  
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2  
OLR [ $7.5^{\circ}S, 7.5^{\circ}N$ ] ( $cint: 4Wm^{-2}$ ) Period: 16-Nov-2019 to 17-May-2020  
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

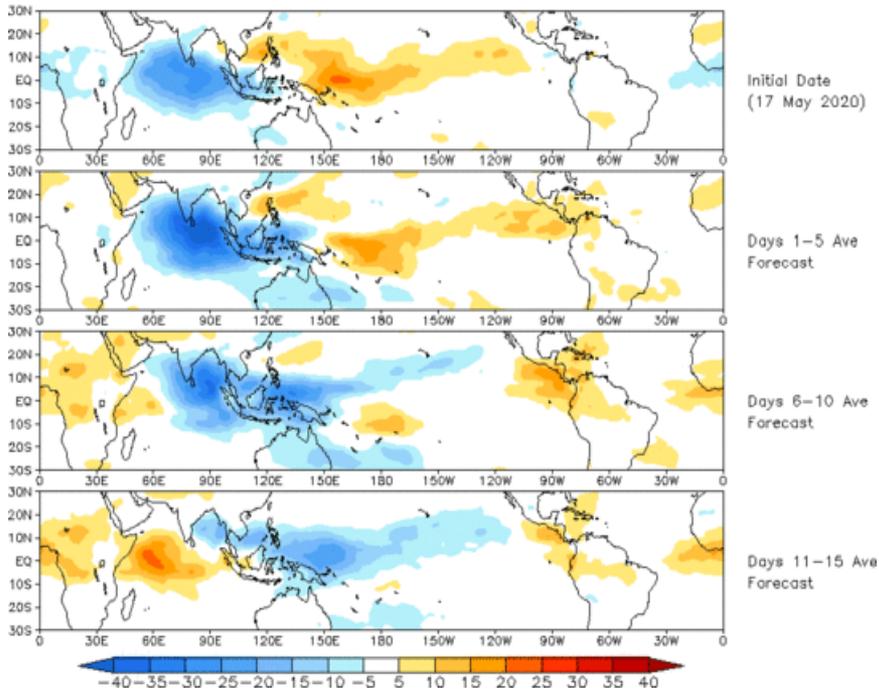


- The GEFS shows enhanced convection propagating from the Indian Ocean into the West Pacific, with suppressed convection developing over Africa and strengthening over the Indian Ocean and Maritime Continent during week-2.
- Limited signals are seen in the Western Hemisphere.

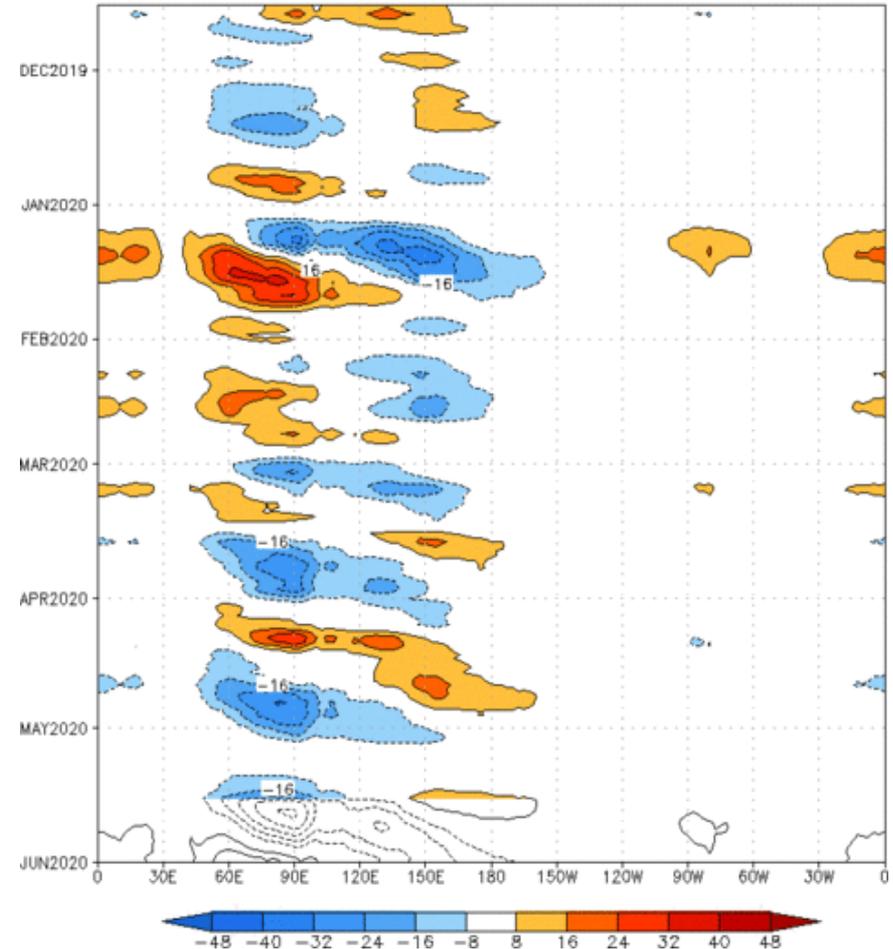
# MJO: Constructed Analog Forecast Evolution

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 (17 May 2020)



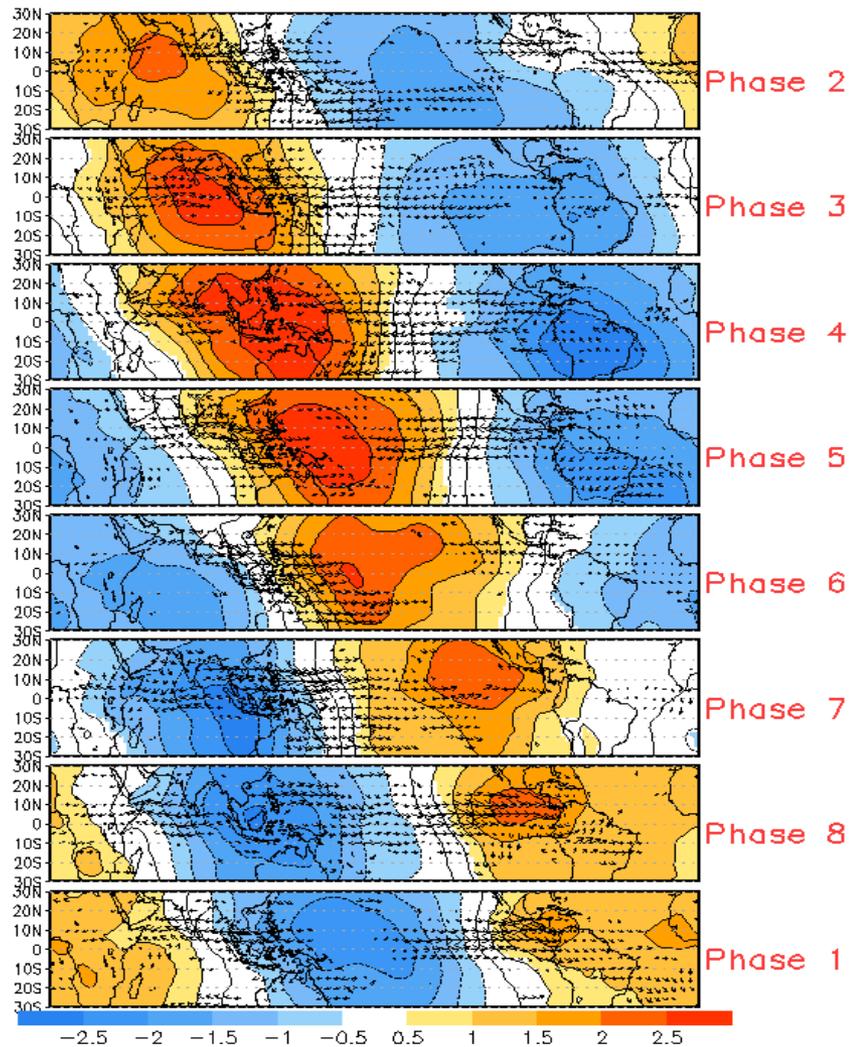
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm<sup>-2</sup>) Period:16-Nov-2019 to 17-May-2020  
The unfilled contours are CA forecast reconstructed anomaly for 15 days



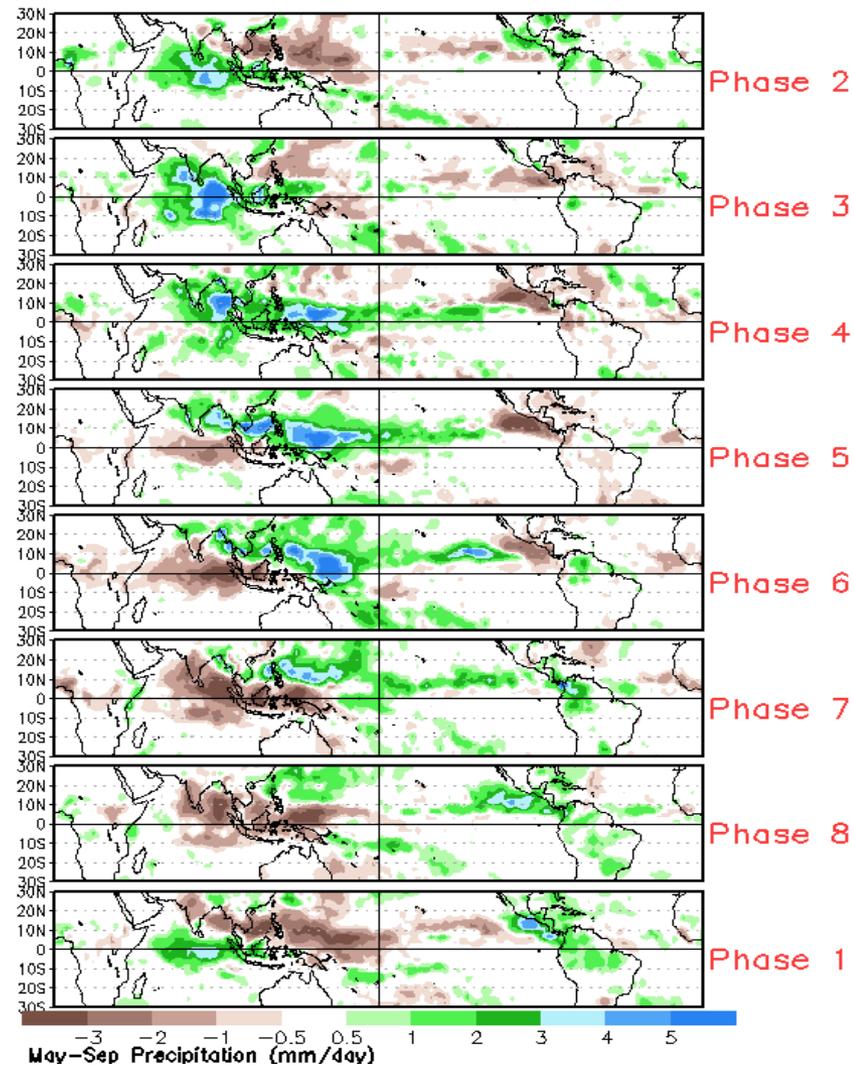
- The constructed analog forecast shows stronger signals than GEFs with a broad envelope of enhanced convection shifting eastward, and suppressed convection developing over Africa and the western Indian Ocean by Week-2. This solution is slower than that anticipated by the GEFs.

# MJO: Tropical Composite Maps by RMM Phase

## 850-hPa Velocity Potential and Wind Anomalies



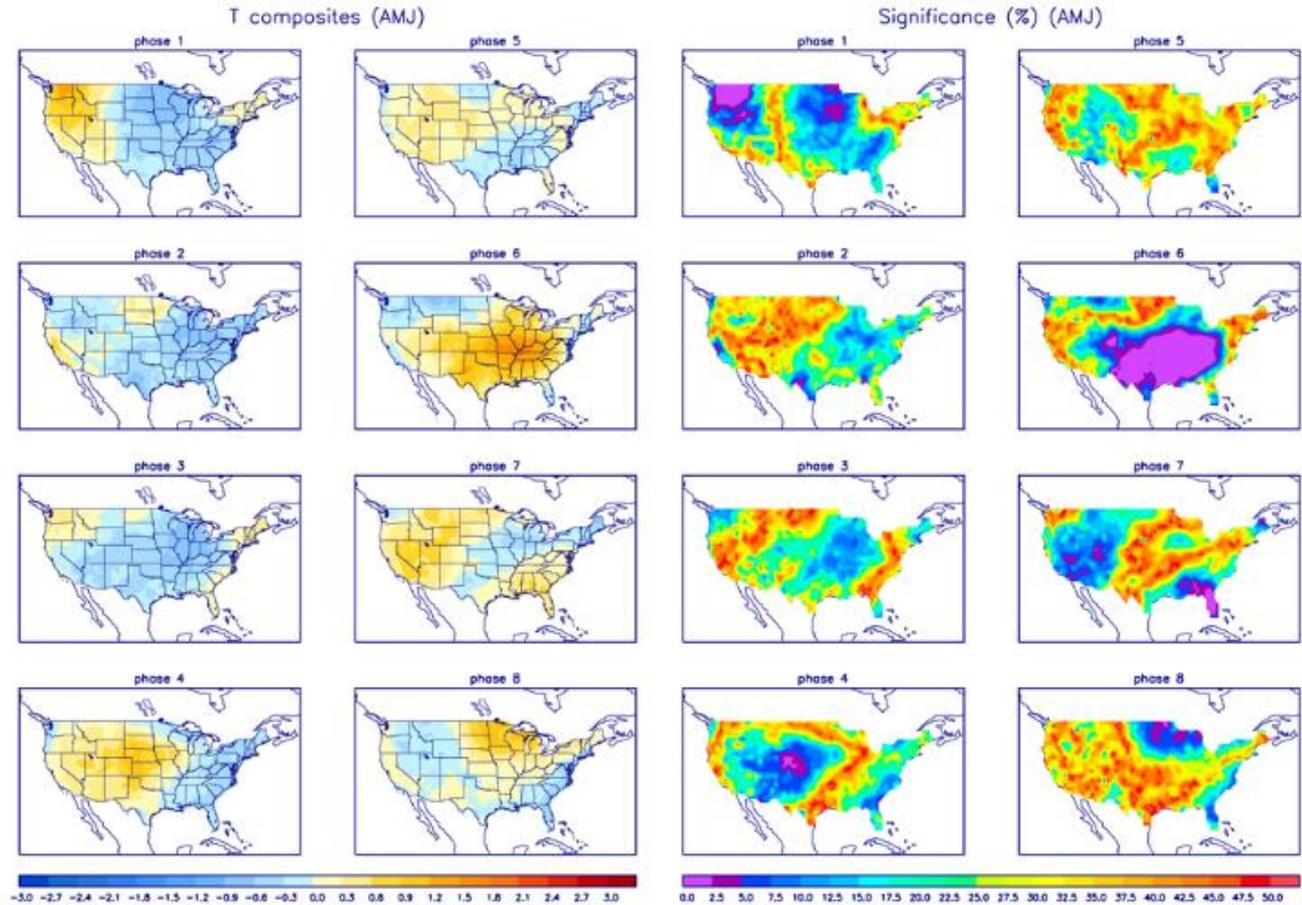
## Precipitation Anomalies



# 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.

