

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



**Update prepared by the Climate Prediction Center**  
Climate Prediction Center / NCEP  
1 June 2020

# Overview

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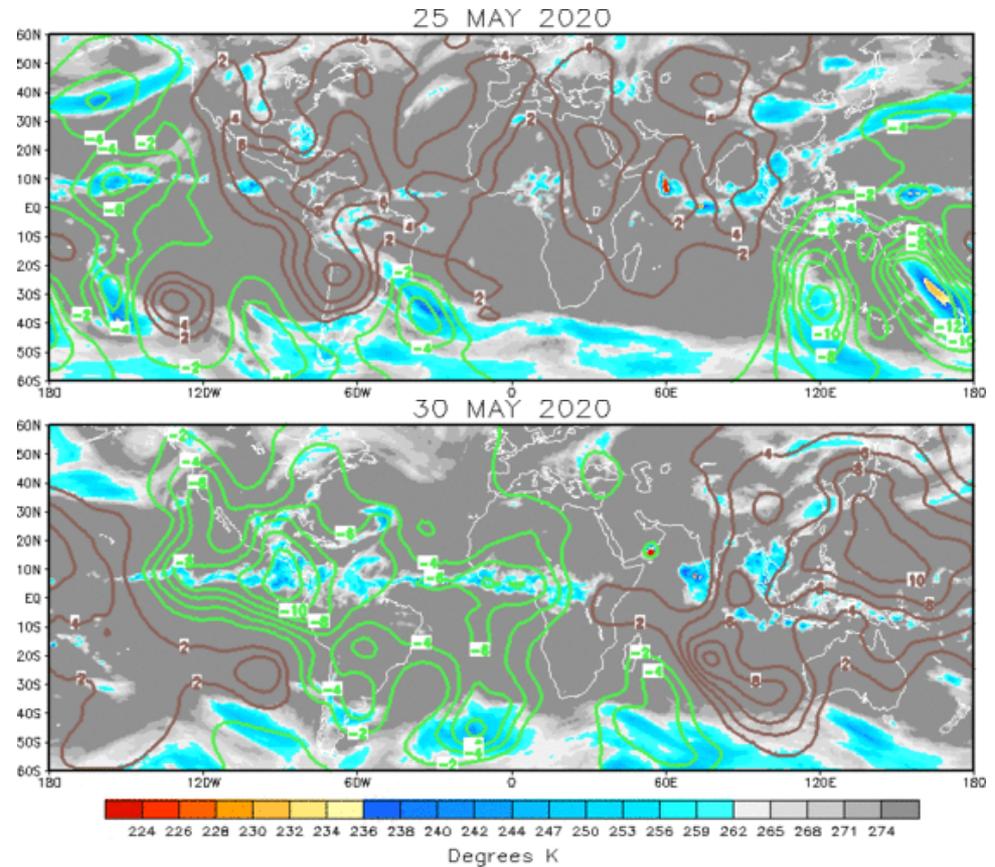
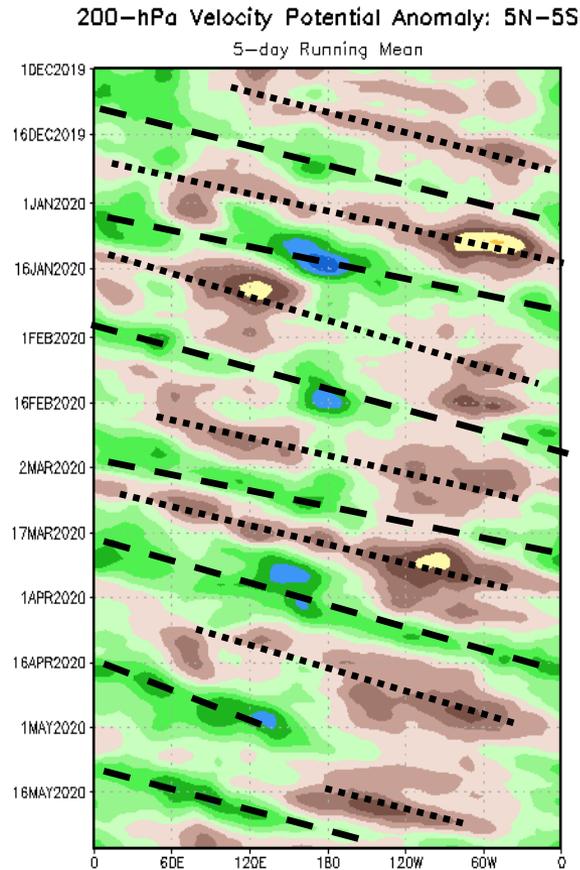
- Recent observations show the most coherent signal in the tropics remains the robust, convectively coupled Kelvin wave now over the Western Hemisphere.
- The Kelvin wave activity helped in the formation of the first named tropical cyclone of the 2020 East Pacific season.
- Low-level wind response to the Kelvin wave has been robust, but confined mostly to the northern tropics.
- Additional tropical cyclogenesis over the Bay of Campeche is likely early in the period.
- Forecast models present diverging solutions for the continued evolution of the pattern. The GEFS slows the signal over the Western Hemisphere in response to tropical cyclone activity, while the ECMWF continues fast eastward propagation of a much weaker signal across the Indian Ocean. Statistical tools show the development of a more robust Indian Ocean MJO signal.

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).

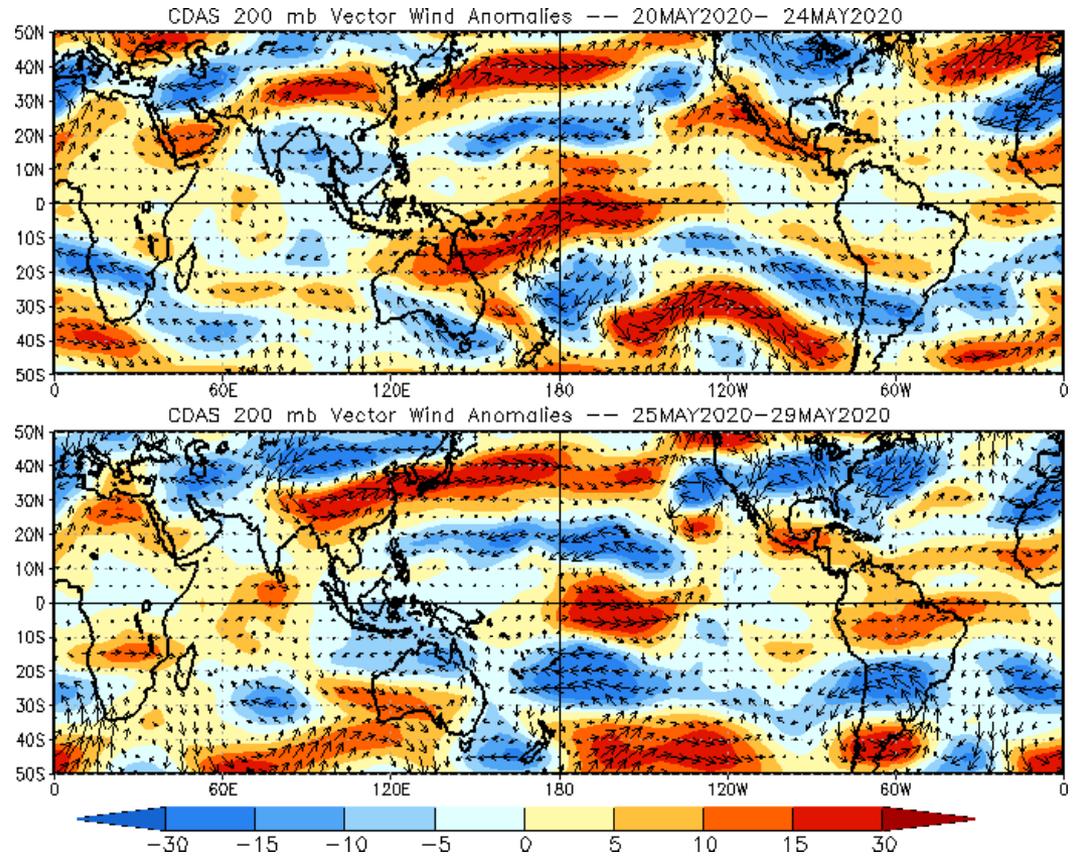
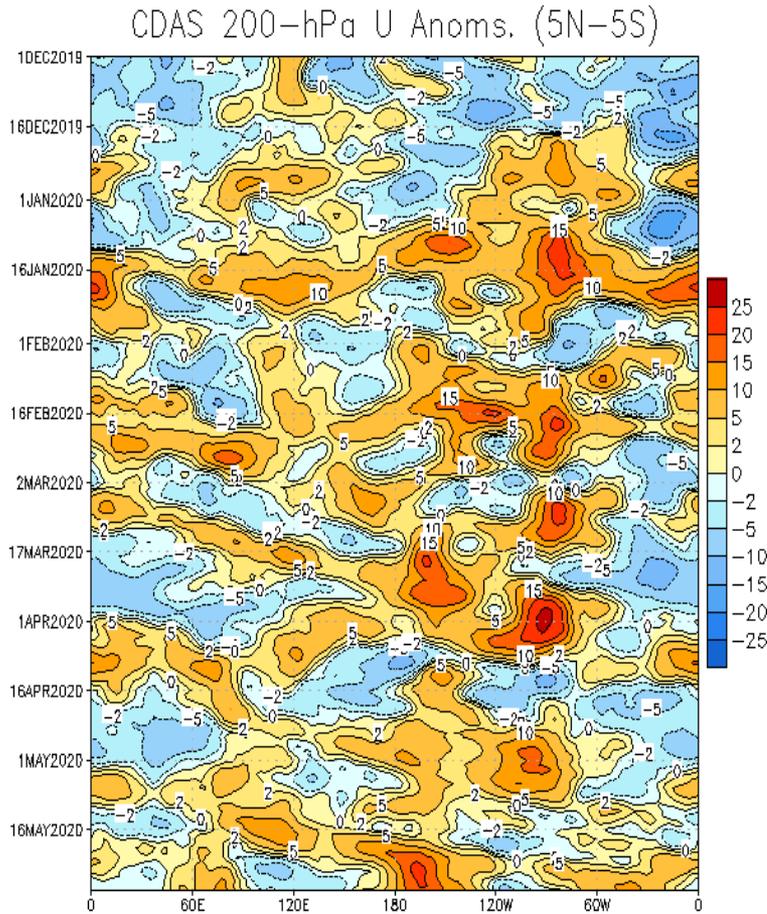
**Brown shades:** Anomalous convergence (unfavorable for precipitation).



- The upper-level convective field responded to enhanced convection over the Western Hemisphere tropical basins in conjunction with a robust Kelvin wave.
- A large-scale suppressed signal returned to the West Pacific, resulting in a signal that resembles a coherent MJO-like signal.

# 200-hPa Wind Anomalies

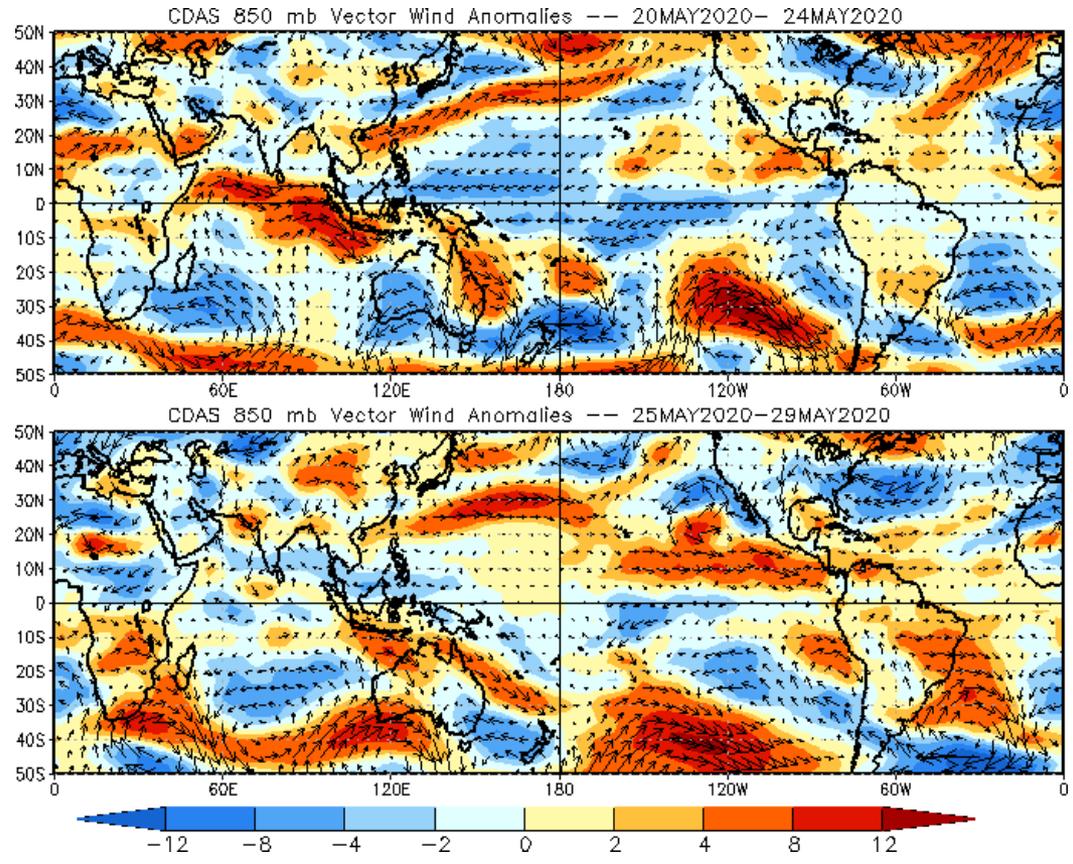
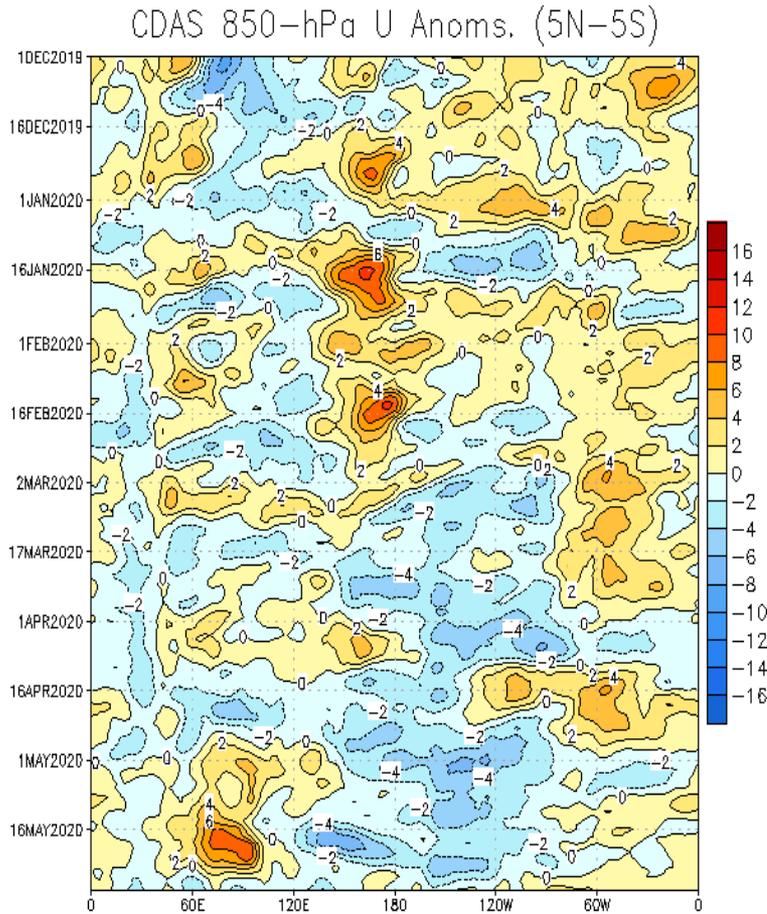
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- 200-hPa westerly anomalies strengthened just east of the Date Line, with upper-level lows just north and south of the Equator over the central Pacific.
- Westerly anomalies increased over the Atlantic basin, consistent with robust Kelvin wave activity now over the Western Hemisphere.

# 850-hPa Wind Anomalies

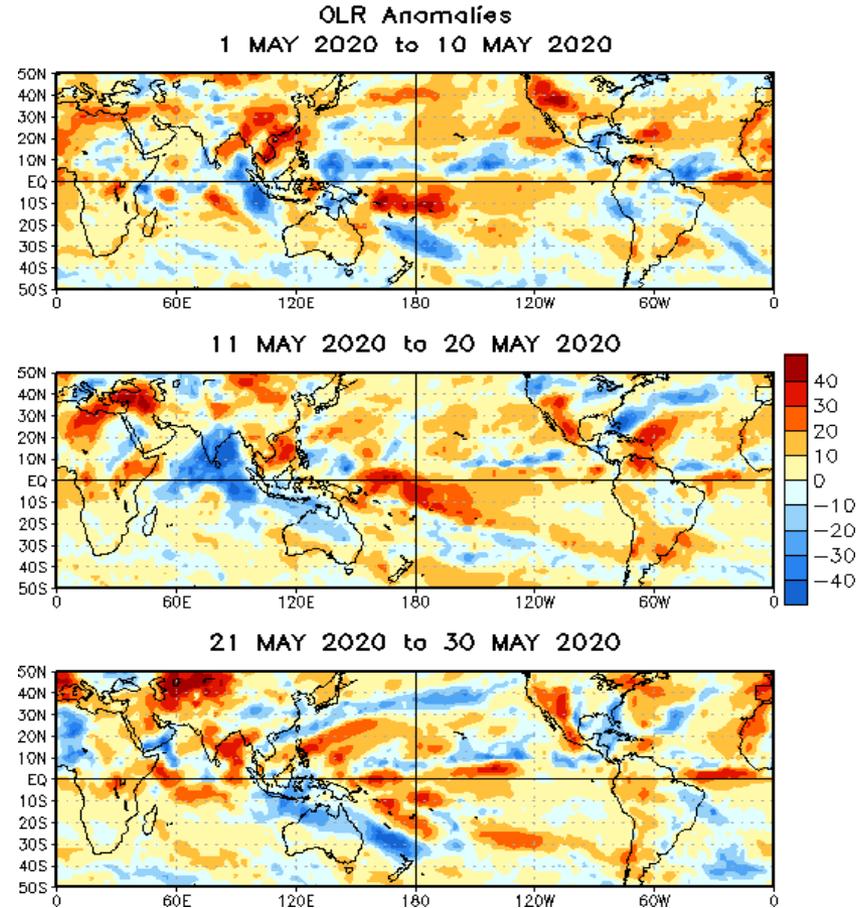
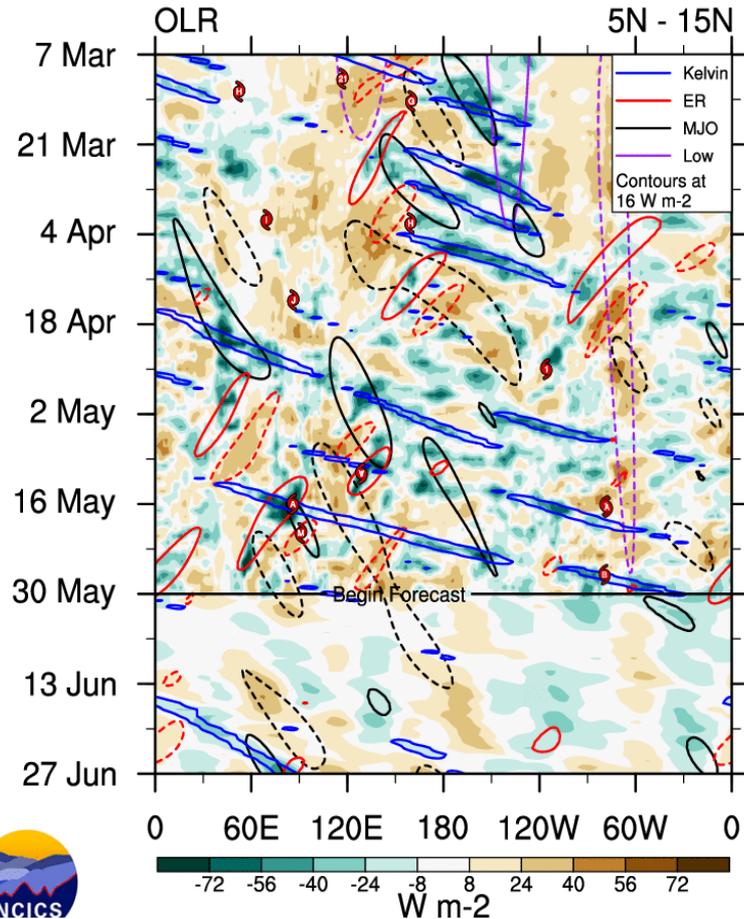
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- The robust westerly-easterly couplet over the Maritime Continent broke down over the last five days.
- A robust Kelvin wave that crossed the Pacific is evident in the wind field, although the belt of westerlies is centered north of the Equator over the East Pacific.
- The enhanced trade winds over much of the Pacific basin decreased due to the Kelvin wave activity.

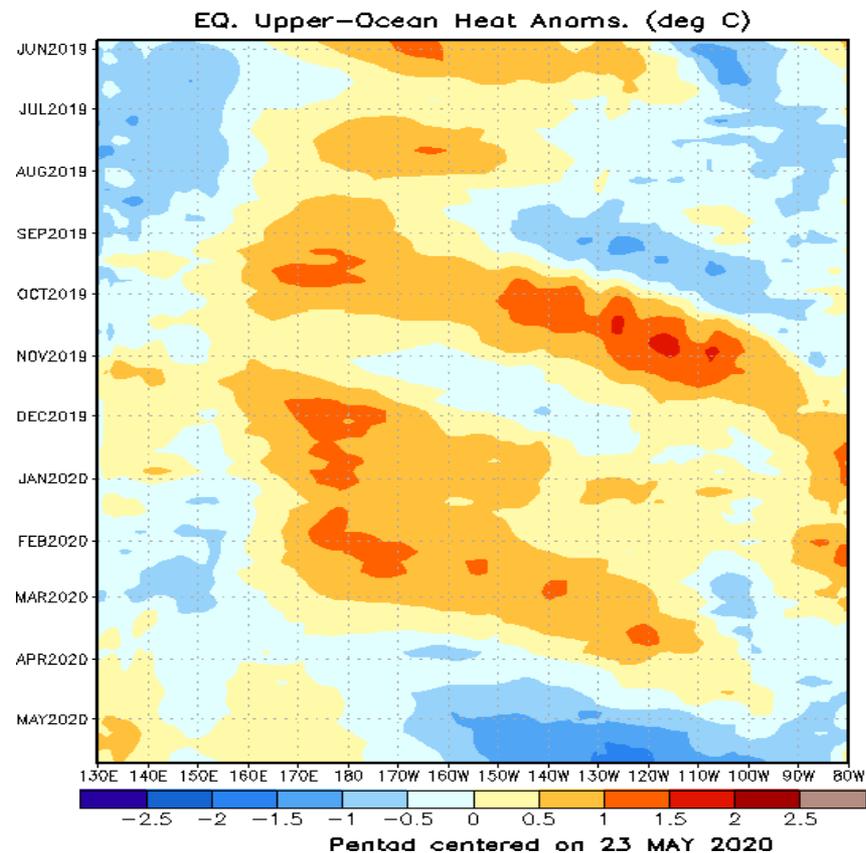
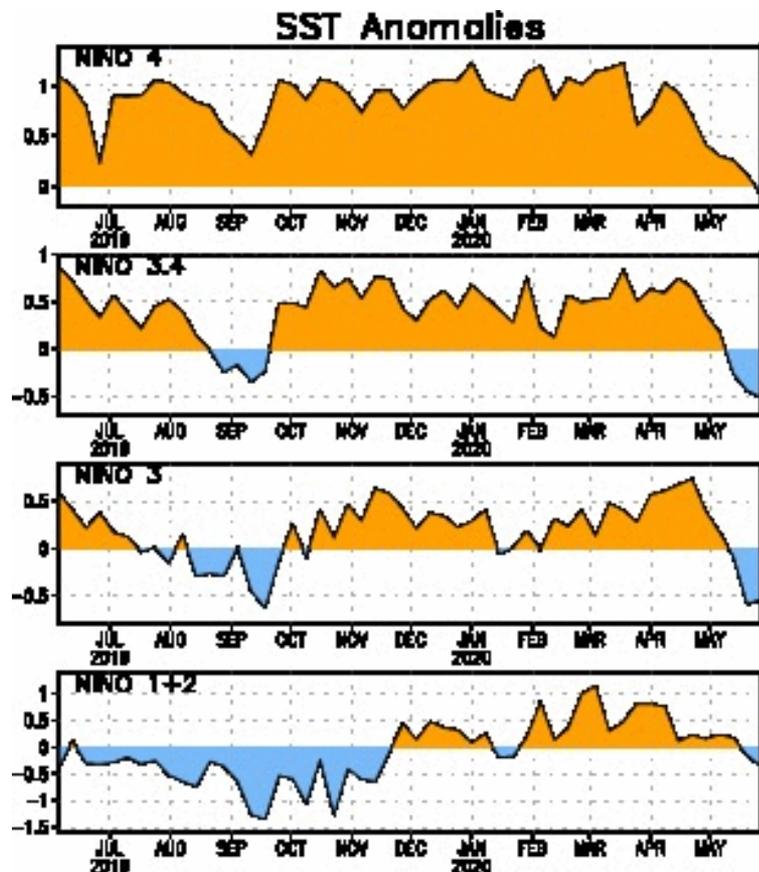
# Outgoing Longwave Radiation (OLR) Anomalies

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



- Robust Kelvin wave activity continues over the Western Hemisphere.
- A suppressed convective signal built over the northwestern Pacific.

# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Enhanced trade winds during May have generated an oceanic response, with negative upper-ocean heat content anomalies intensifying across much of the east-central Pacific.
- SST anomalies in the Niño 3.4 region have become negative for the first time since mid September 2019.
- SSTs are now below-average in all of the Niño basins.

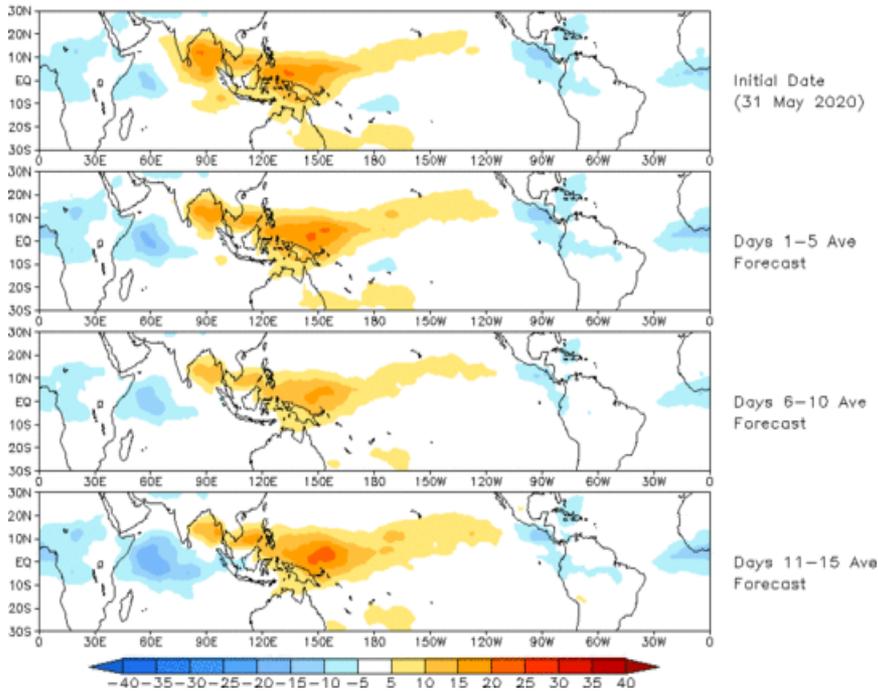




# MJO: GEFS Forecast Evolution

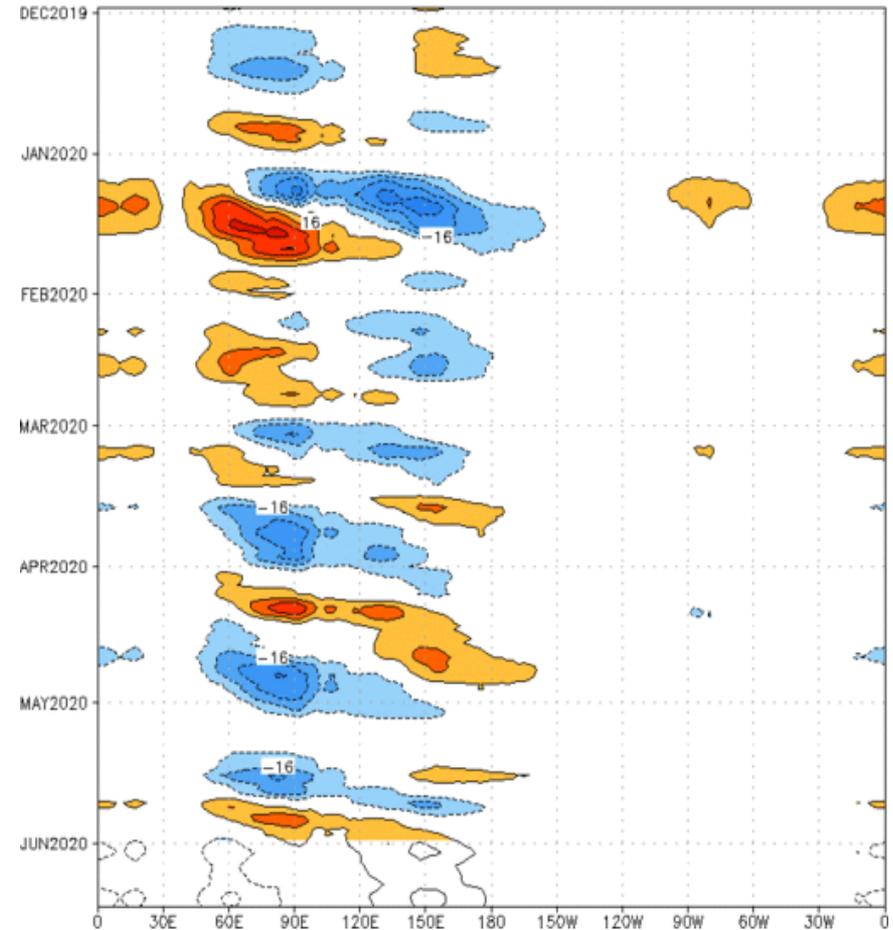
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast  
Initial date: 31 May 2020  
OLR



- OLR anomalies based on the GEFS RMM index forecast depict a slow evolution of the signal over the Western Hemisphere and western Indian Ocean.
- Some amplification of the signal is indicated during Week-2.

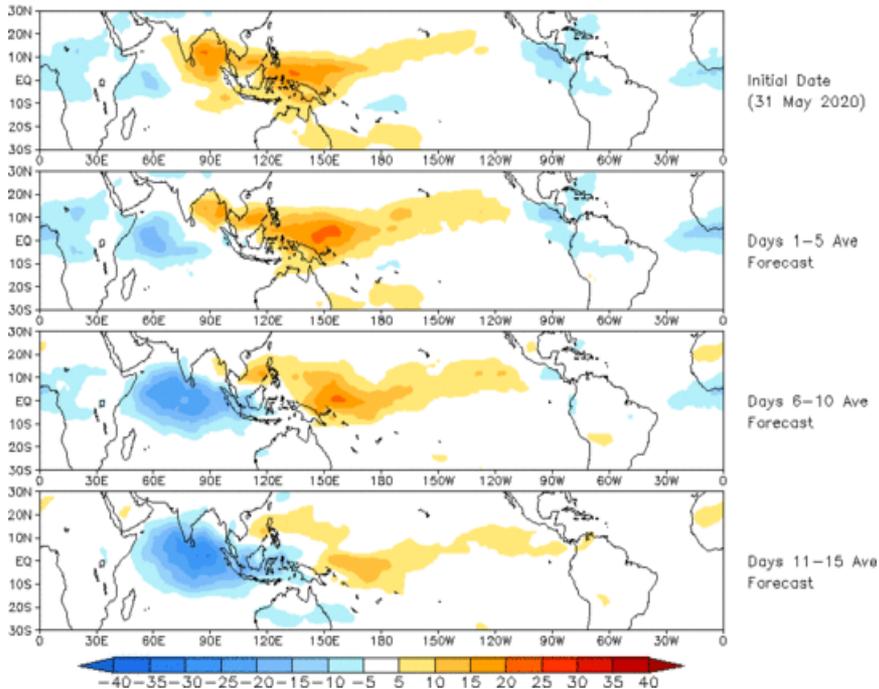
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2  
OLR [7.5°S,7.5°N] (cont:4Wm<sup>-2</sup>) Period:30-Nov-2019 to 31-May-2020  
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



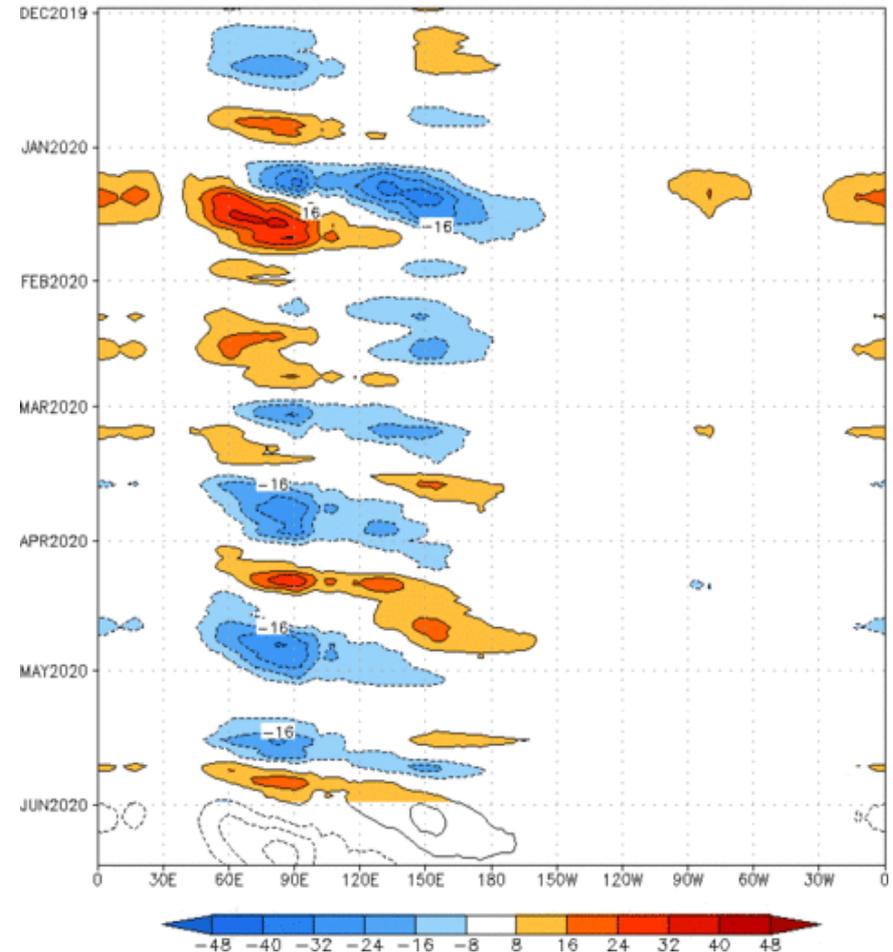
# MJO: Constructed Analog Forecast Evolution

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 (31 May 2020)



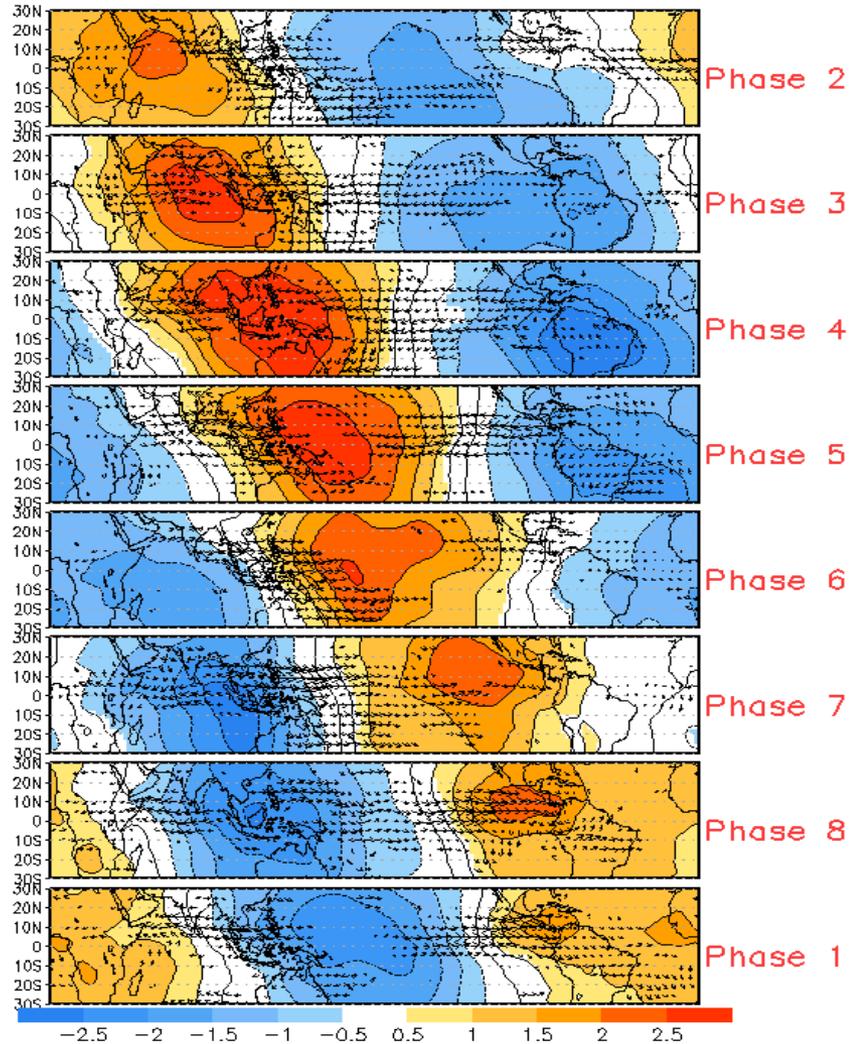
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm<sup>-2</sup>) Period:30–Nov–2019 to 31–May–2020  
The unfilled contours are CA forecast reconstructed anomaly for 15 days



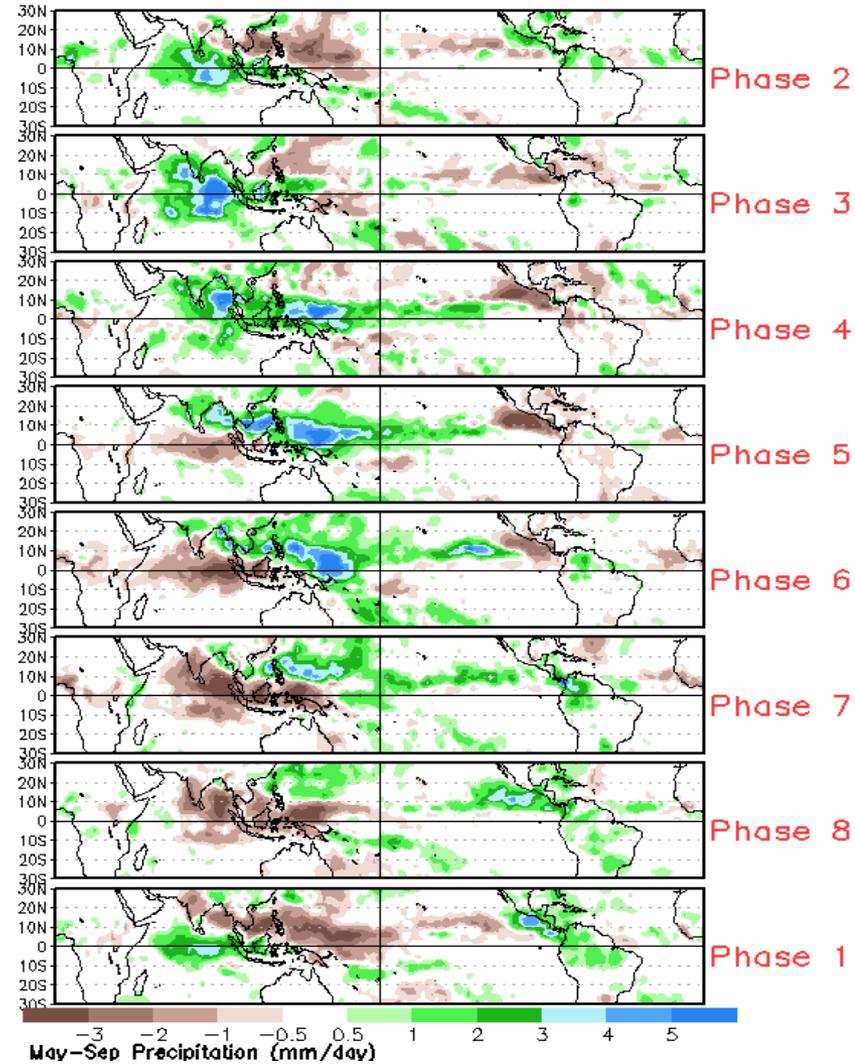
- The OLR anomalies based on the constructed analog forecast depict the development of a robust MJO event, propagating to the western Maritime Continent by the end of Week-2.

# MJO: Tropical Composite Maps by RMM Phase

## 850-hPa Velocity Potential and Wind Anomalies



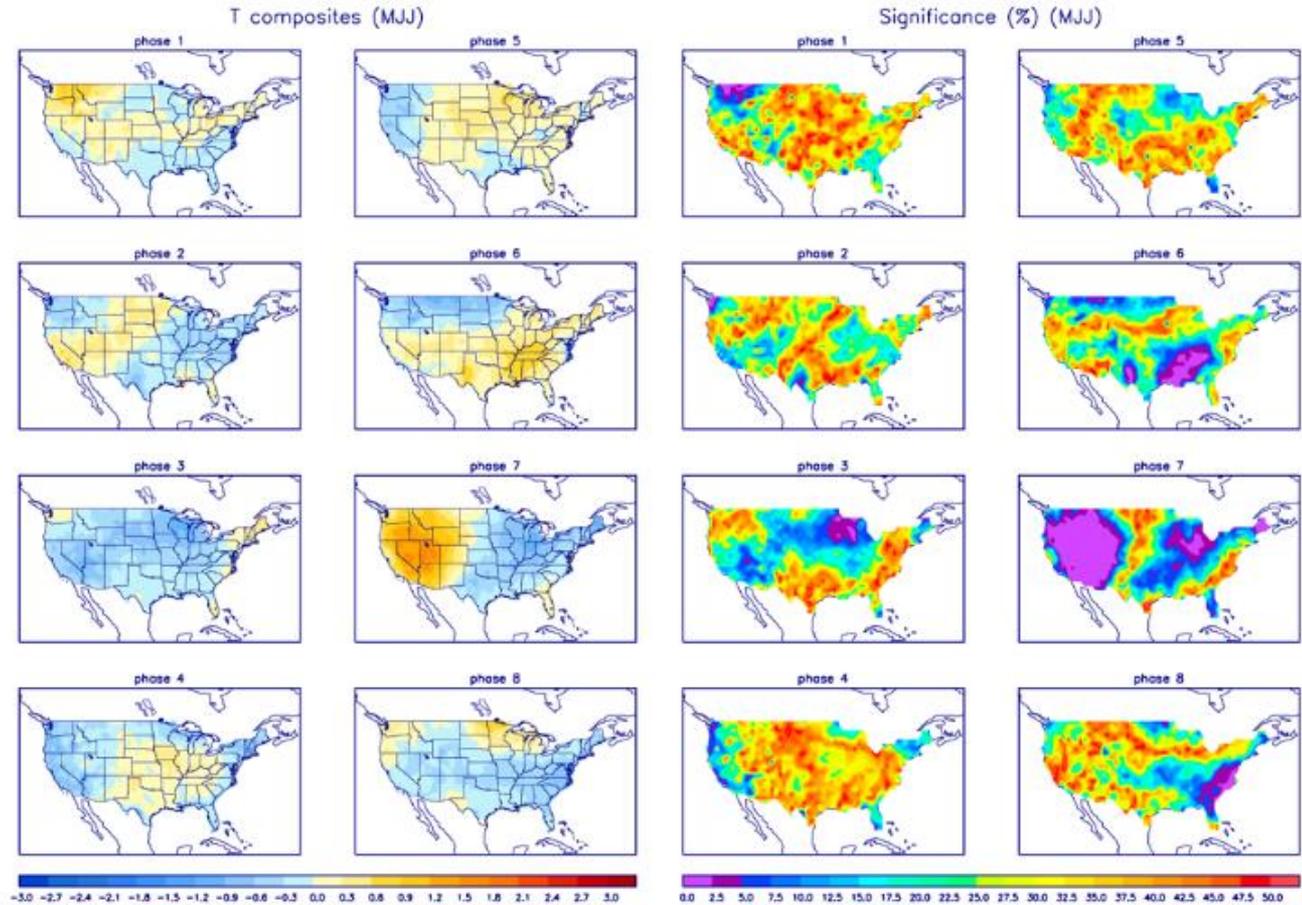
## Precipitation Anomalies



# 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.

