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



Update prepared by the Climate Prediction Center Climate Prediction Center / NCEP 15 July 2019

#### **Overview**

- The MJO became incoherent over the past week.
- Some enhancement of the RMM index over the Western Hemisphere last week appears tied to equatorial Rossby wave activity constructively interfering with what remained of the enhanced portion of the MJO envelope.
- The upper-level circulation associated with the MJO appears likely to shift into the Indian Ocean for the next two weeks, although equatorial Rossby wave activity may continue to mask any substantial presence of organized eastward-propagating intraseasonal variability.

#### **200-hPa Velocity Potential Anomalies**



<u>Green shades</u>: Anomalous divergence (favorable for precipitation). <u>Brown shades</u>: Anomalous convergence (unfavorable for precipitation).

- The MJO has been active since December except for a 1.5 month pause during March and early April.
- The latest MJO event began in mid-April and was influenced by westward moving features over the Indian Ocean in early June before returning to the Maritime Continent and West Pacific.
- Rossby wave activity over the Western Hemisphere has helped masked the MJO of late, although there is some suggestion its remnant is most recently just east of the Prime Meridian.

#### 200-hPa Wind Anomalies

Shading denotes the zonal wind anomaly. <u>Blue shades</u>: Anomalous easterlies. <u>Red shades</u>: Anomalous westerlies.



- An envelope of westerly anomalies associated with the MJO continued propagating eastward across the Pacific to the Atlantic during late June.
- Anomalous upper-level easterlies have propagated eastward through the Pacific during the past several weeks.
- Anomalous westerlies along the equator over the Indian Ocean appear to be sourced from the extratropics in the Southern Hemisphere.

### 850-hPa Wind Anomalies

Shading denotes the zonal wind anomaly. <u>Blue shades</u>: Anomalous easterlies. <u>Red shades</u>: Anomalous westerlies.



- Equatorial Rossby wave activity across the West and Central Pacific has resulted in the most robust anomalous westerlies north of the equator becoming focused north of New Guinea.
- Some lingering low frequency westerlies persist near the Date Line in the Pacific as El Niño continues to wane.
- The circulation from Hurricane Barry is present across the coastline of the Central Gulf of Mexico.

### **Outgoing Longwave Radiation (OLR) Anomalies**

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



- Slow eastward propagation of anomalous dryness across the Indian Ocean and into the South China Sea during late June through mid-July appears tied to the suppressed envelope of the MJO.
- A recent uptick in convection north of New Guinea appears linked to equatorial Rossby wave activity.



- Low amplitude SST anomalies remain above climatology across much of the equatorial Central and East Pacific, consistent with what remains of the ongoing El Niño event.
- A downwelling Kelvin wave event is evident over the central and eastern Pacific since mid-May, but its amplitude is weaker than what was observed in previous events. Overall, upper-ocean heat content has continued to steadily decline over the past several months.

 The MJO is very near the origin, consistent with the primary eastward propagating mode of intraseasonal variability being masked by equatorial Rossby wave and Kelvin wave activity elsewhere.



For more information on the RMM index and how to interpret its forecast please see: <a href="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</a>



- The GEFS refocuses the MJO envelope, downplaying other modes of tropical variability, with a reemerging signal over the western Indian Ocean by the weekend. This signal continues eastward during Week-2.
- The ECMWF forecast suggests continued masking of the MJO's presence via the RMM index as other tropical modes help to limit any pronounced intraseasonal-driven signals.

### **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.)



3ÔE

6ÔE

9ÔF

120E

150E

150W

180

120W

9ÓW

6ÓW

3ÓW

relatively stationary but strengthen over the course of the next two weeks.

#### **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

 The constructed analog MJO forecast shows a weak signal exhibiting some strengthening and eastward propagation across the Indian Ocean during the next two weeks. Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm<sup>-2</sup>) Period:12-Jan-2019 to 14-Jul-2019 The unfilled contours are CA forecast reconstructed anomaly for 15 days



#### **MJO: Tropical Composite Maps by RMM Phase**

850-hPa Velocity Potential and Wind Anomalies



#### **Precipitation Anomalies**



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.



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.



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