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



Update prepared by the Climate Prediction Center Climate Prediction Center/NCEP 7 December 2020

#### Overview

- The MJO is currently over the West Pacific. Destructive interference with the low frequency state is causing difficulty in traditional MJO indices to characterize its strength.
- Spread in model forecasts is large during the next two weeks, as initially the enhanced phase of the MJO is propagating east over the Pacific where La Niña favors suppressed convection.
- The remnant MJO slightly elevates chances of tropical cyclone development across the West Pacific and South China Sea during early to mid-December.

#### 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 strengthened during mid-November as it propagated east over the Indian Ocean.
- A wave-1 pattern in the upper-level circulation has been prominent since late November, but eastward propagation of this dipole recently ended.

#### 200-hPa Wind Anomalies

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



- Anomalous easterlies (westerlies) strengthened aloft over the western Indian Ocean (Maritime Continent and West Pacific) during late November, providing a favorable environment for Eastern Hemisphere tropical cyclone formation.
- Westerly anomalies have strengthened to the east of the Date Line since the beginning of December.

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- Low-level anomalous westerlies have continued to expand east to the Maritime Continent and West Pacific since late November, which is associated with the MJO.
- Enhanced trades persist across the equatorial Pacific, tied to the ongoing La Niña.

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

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



- Enhanced convection continued to shift east from the Indian Ocean to the Maritime Continent since mid-November.
- The "horseshoe" of suppressed convection over the Tropical Pacific continues to persist, characteristic of the ongoing La Niña.
- Convection became enhanced over the South Pacific during mid to late November, tied to the MJO approaching the Maritime Continent.



- Following destructive interference with the base state by a downwelling Kelvin wave during July, the subsequent upwelling phase has pushed the Pacific into La Niña conditions.
- Each of the ENSO regions has cooled slightly since a brief recovery in SSTs during early November.

- The RMM index depicts a weakening MJO since late November.
- This weakening and lack of eastward propagation are likely due to interference with the low-frequency base state.



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>

#### **MJO Index: Forecast Evolution**



- The GEFS and ECMWF models continue to depict large ensemble spread, which is likely due to destructive interference between a remnant MJO and the ongoing La Niña.
- However, there are a number of ensemble members that feature a strengthening of the MJO signal with eastward propagation resuming.

### **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

9ÔE

120E

150E

180

150W

120W

9ÔW

6ÓW

3Ó₩

### **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 outlook during the next ten days depicts small anomalies due to destructive interference between the MJO and low-frequency base state.
- Later in week-2, anomalies increase as La Niña becomes the major contributor.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm<sup>-2</sup>) Period:06-Jun-2020 to 06-Dec-2020 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.

