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



Update prepared by the Climate Prediction Center Climate Prediction Center / NCEP 5 October 2020

Overview

- The MJO has weakened and slowed down over the past 1-2 weeks, with its enhanced convective phase centered over the Maritime Continent.
- Most dynamical and statistical models forecast a fairly weak MJO during the next 2 weeks, with its enhanced convective phase remaining centered over the Maritime Continent region.
- The global tropics are expected to be very active during the next two weeks, with tropical cyclone development already occurring, or forecast to occur across the Atlantic, East and West Pacific, South China Sea, Bay of Bengal, and central South Indian Ocean basins.
- Enhanced convection over the Maritime Continent is associated with warmer-than-normal temperatures over the western contiguous U.S.

200-hPa Velocity Potential Anomalies



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



- Robust MJO activity over the Indian Ocean from mid-August to mid-September weakened and became stationary over the Maritime Continent shortly thereafter.
- Westward shifts in anomalous upper-level divergence (and related enhanced convection) over the Indian Ocean suggest destructive interference from equatorial Rossby waves.
- The general Wave-1 pattern of the past 1-2 weeks has become even less organized in recent days.

200-hPa Wind Anomalies

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



- Active wave breaking is evident over the central North Pacific, which is common during this time of the year as the Polar jet speeds up.
- An area of anomalous westerlies has continued to expand over the eastern Pacific, consistent with a shifted Walker Circulation that characterizes the atmospheric response to oceanic La Niña conditions.

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- The aforementioned shift in the Walker Circulation is weaker in the lower levels of the atmosphere, but is still evident through the enhanced trades east of the Dateline.
- Westerly anomalies in place over the tropical Atlantic main development region are being displaced southward towards the equator by a very broad area of easterlies over much of the mid-latitude Atlantic.

Outgoing Longwave Radiation (OLR) Anomalies

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



- The OLR forecast field is weak throughout most of the Tropics.
- The anomalous convection pattern is consistent with a La Nina, featuring enhanced convection in the vicinity of the Maritime Continent/Indonesia, and suppressed convection in the vicinity of the Date Line.



- Following destructive interference with the base state by a downwelling Kelvin wave, the subsequent upwelling
 phase has pushed the Pacific into La Niña conditions.
- Heat content anomalies in the Niño 3.4 region have become strongly negative since July.
- A second downwelling Kelvin wave is evident over the central Pacific.

• The RMM index is just outside of the unit circle in Phase 5.



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



• There is much uncertainty in the dynamical model forecasts, which is not surprising given the low predictability associated with a developing La Niña and strengthening general circulation.

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.)



30E

6ÔF

9ÔE

120E

150F

180

150W

120W

9ÓW

6ÓW

3ÓW

seasonal signal, with the enhanced convection between the eastern Indian Ocean and the western North Pacific.

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 model predicts a similarly phased pattern as the GEFS.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm^{-s}) Period:04-Apr-2020 to 04-Oct-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.

