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



Update prepared by the Climate Prediction Center Climate Prediction Center / NCEP 18 October 2021

Overview

- From a RMM perspective, the MJO has weakened substantially where it has fallen within the unit circle over the Western Pacific likely due to destructive interference with the developing La Nina base state during the past week.
- However, MJO filtered velocity potential based analyses show eastward propagation of the intraseasonal signal over the Pacific, where the enhanced MJO envelope is currently approaching the East Pacific.
- There is fair agreement in the dynamical models favoring an increase in amplitude of the intraseasonal signal over the Western Hemisphere later during week-2, albeit with large ensemble spread contributing to uncertainty in the outlook.
- As the favorable large scale environment shifts eastward, an uptick in tropical cyclone activity
 is anticipated over the East Pacific with increasingly favorable conditions for development over
 the Caribbean and Atlantic during late October and early November. However, cooling sea
 surface temperatures and a less active climatology may limit formation later in the outlook
 period.

A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at: <u>http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php</u>

200-hPa Velocity Potential Anomalies



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

- Following an extended period of MJO activity during the late spring and summer, a stationary pattern has persisted since late August.
- Although the velocity potential field has devolved from a wave-1 pattern since last week, enhanced divergence shifted east of the Date Line, with more convergent conditions observed to the 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.



- Anomalous upper-level westerlies persist across much of the equatorial central and east Pacific, though some weakening over the central Pacific is likely tied to destructive interference between the intraseasonal signal and the developing La Niña base state.
- Anomalous easterlies have been present across the Maritime Continent since the beginning of October, and have recently expanded eastward into the equatorial West Pacific.

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- Enhanced trades continue throughout the much of the Pacific, with some weakening observed near the Date Line and a strengthening in the western Pacific.
- Anomalous westerlies remain robust over the northern Indian Ocean, and have strengthened over the East Pacific, Caribbean and parts of the Atlantic.

Outgoing Longwave Radiation (OLR) Anomalies

17-0ct

31-0ct

14-Nov

60E

-56

-72

120E

-24

-40

180

-8

Green shades: Anomalous convection (wetness) Brown shades: Anomalous subsidence (dryness) OLR w/ CFS Forecasts 5S - 5N 25-Jul 401 Kelvin 30N FR 20N MJO 10N Lo₩ ΕQ 08-Aug Contours at 105 16 ₩ m-2 205 30S 40S 22-Aug 50S-6ÓE 120E 180 120W 28 SEP 2021 to 7 OCT 2021 50N 05-Sep 40N 30N 20N 10N 19-Sep EQ 10S 205 305 40S 03-0ct 50S-60E 120E 180

120W

40

56

72

24

Blue shades: Anomalous convection (wetness) Red shades: Anomalous subsidence (dryness) OLR Anomalies 18 SEP 2021 to 27 SEP 2021

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40

30

20

10

-10

-20

-30

40

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- Suppressed convection strengthened to the west of the Date Line which is associated with the low-frequency state.
- Since early October, enhanced convection is observed across the West Pacific associated with an increase in TC activity as the enhanced MJO envelope shifted eastward.



- Negative upper-ocean heat anomalies continue to intensify across much of the central and eastern equatorial Pacific. A substantial sub-surface cooling is evident near 140W since late September.
- Below-normal sea surface temperatures are now observed within all Niño regions, consistent with a forecast trend toward La Niña.

- The RMM index indicates the intraseasonal signal has weakened, falling within the unit circle during the past week.
- This weakening is likely tied to destructive interference with the developing base state, with a bias towards phases 4 and 5 given the persistence of enhanced convection near the Maritime Continent.



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



 RMM forecasts reflect an incoherent MJO, where dynamical model ensemble means remain in the RMM unit circle during the next two weeks.

 However, there are several ensemble members depicting an increase in amplitude over the Western Hemisphere. The decreasing RMM1 values may be associated with the development of anomalous lower level westerlies forecast over the East Pacific during week-2.

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.)



 The GEFS RMM-based OLR anomaly forecast features the development of suppressed convection over the Maritime Continent and West Pacific, with enhanced convection developing over the Indian Ocean, East Pacific and the Caribbean during week-2. Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:16-Apr-2021 to 16-Oct-2021 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

• The constructed analog depicts a convective pattern that is out of phase with GEFS forecast across the global tropics.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:17-Apr-2021 to 17-Oct-2021 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.

