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



Update prepared by the Climate Prediction Center Climate Prediction Center / NCEP 12 April 2021

Overview

- Since early April, the enhanced (suppressed) phase of the MJO shifted east from the Maritime Continent into the West Pacific (Indian Ocean) where it is likely to destructively interfere with the ongoing La Niña.
- Strengthening anomalous lower-level westerlies observed across the Maritime Continent and into the West Pacific point to the initiation of a westerly wind burst event.
- Dynamical models favor the continued eastward propagation of the intraseasonal signal over the Pacific and into the Western Hemisphere during the next two weeks.
- The MJO contributed to the development of a tropical cyclone in the South Pacific during the last week. Elevated chances for TC development exist in the Pacific, while quieter conditions are anticipated over the southern Indian Ocean tied to the suppressed phase of the MJO.

200-hPa Velocity Potential Anomalies



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

- Since March, the MJO has continued to propagate eastward with a well-defined Wave-1 pattern in the velocity potential field.
- Enhanced ascent is observed throughout the West Pacific and Western Hemisphere, while enhanced descent shifted eastward into the Indian Ocean during the last week.

200-hPa Wind Anomalies

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



- Anomalous westerlies strengthened over the equatorial central and eastern Pacific superimposed on the low frequency footprint.
- Consistent with the ongoing intraseasonal event, anomalous easterlies shifted east into the Maritime Continent which was also aided by an anomalous anticyclonic circulation aloft tied to TC Seroja over western Australia.

850-hPa Wind Anomalies

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



- Lower level convergence shifted east from the Maritime Continent into the West Pacific. Rossby wave activity in the West Pacific may be initiating a westerly wind burst event in the region.
- Trades remain enhanced across equatorial central and eastern Pacific but have slightly relaxed compared to early April.

Outgoing Longwave Radiation (OLR) Anomalies

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



- During late March, the superposition of a strong Kelvin wave over the Indian Ocean within the MJO resulted in enhanced convection at 60 degrees E.
- Suppressed convection tied to the low frequency state has been anchored over the equatorial Central Pacific. However, the strength and extent of this signal has considerably weakened since April.



- La Niña conditions have been present since August 2020. Negative SST anomalies in the Nino 4 region have steadily weakened since January.
- Strong Rossby wave activity over the West Pacific in February generated a westerly wind burst that initiated a
 downwelling oceanic Kelvin wave. This Kelvin wave pushed warmer water within the upper-ocean across the
 Central and East Pacific.

- The RMM index depicts the MJO has entered phase 7, completing a global circumnavigation since early March. Continued eastward propagation from the Maritime Continent to the West Pacific has been evident since early April.
- The recent increase in RMM2 values likely tied to robust strengthening of anomalous lower-level westerlies over 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

MJO Index: Forecast Evolution



- The GEFS and ECMWF models predict the MJO to propagate east over the Pacific and into the Western Hemisphere towards late April.
- Compared to the ECMWF, the GEFS weakens and shifts the signal westward into phase 6 during week-1 before re-strengthening and propagating eastward again 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 forecast based OLR anomalies depict enhanced convection overspreading the Pacific and into the Western Hemisphere with strengthening suppressed convection over the Indian Ocean and Maritime Continent by week-2. Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:10-Oct-2020 to 11-Apr-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 reconstruction by RMM1 & RMM2 (11 Apr 2021)



 The constructed analog forecast favors more of a progressive intraseasonal event compared to the GEFS, with suppressed (enhanced) convection shifting eastward over the West Pacific (Western Hemisphere/Africa) by week-2. Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:10-Oct-2020 to 11-Apr-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.

