

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
11 April 2022

Overview

- The MJO signal remains within the RMM-based unit circle.
- Enhanced Rossby Wave activity is contributing to increased convection and tropical cyclone development across the Western Pacific.
- There is uncertainty into the MJO evolution during the next 2 weeks, with the ECMWF ensemble depicting some reemergence of the signal across the Western Hemisphere, but remaining weak due to the continued influence from La Niña.

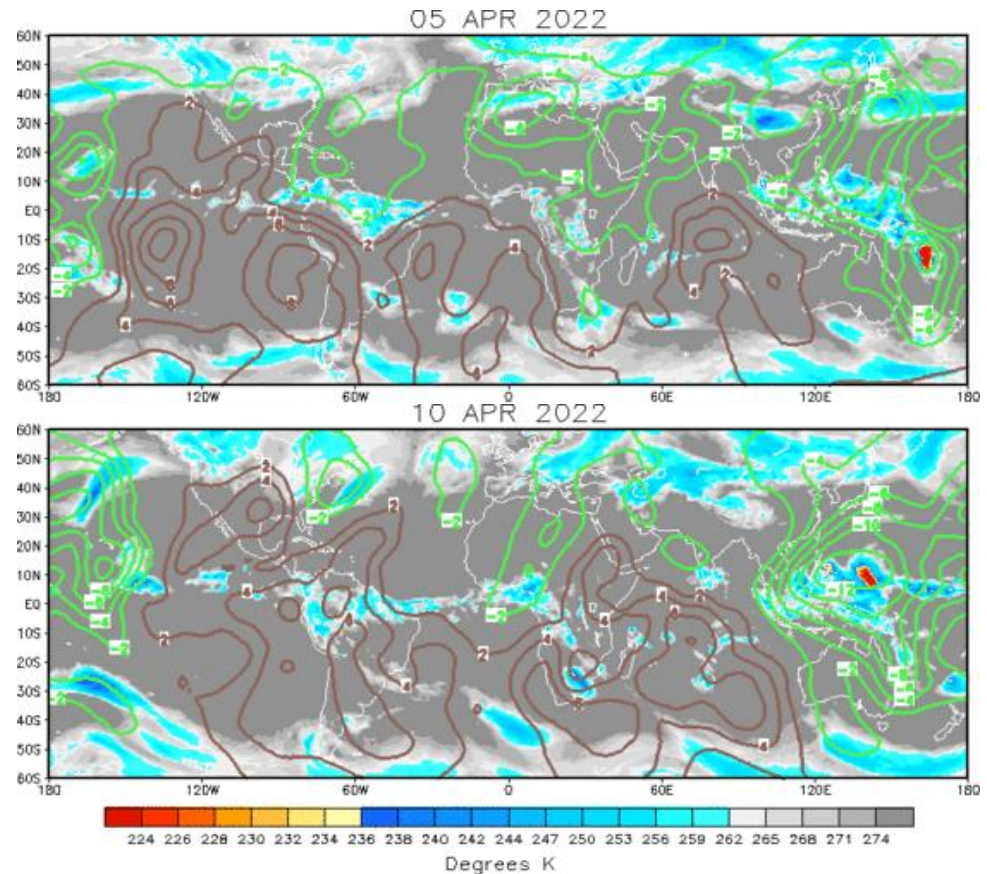
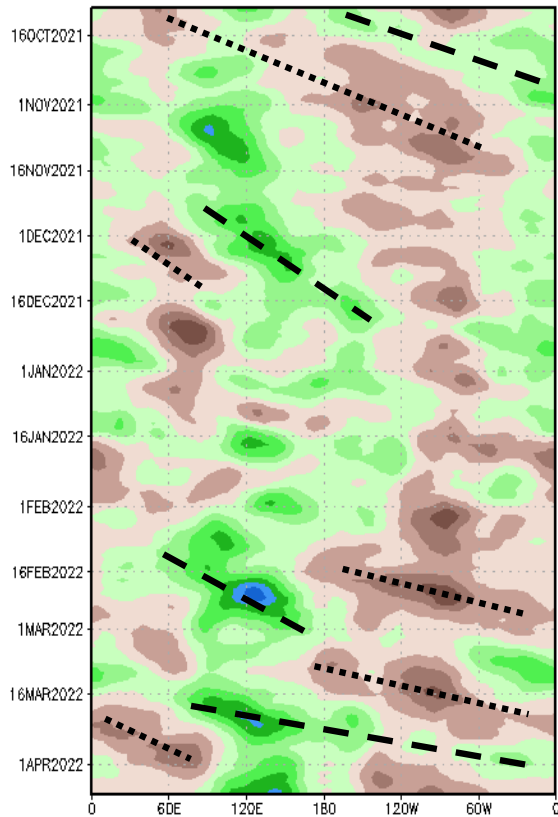
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

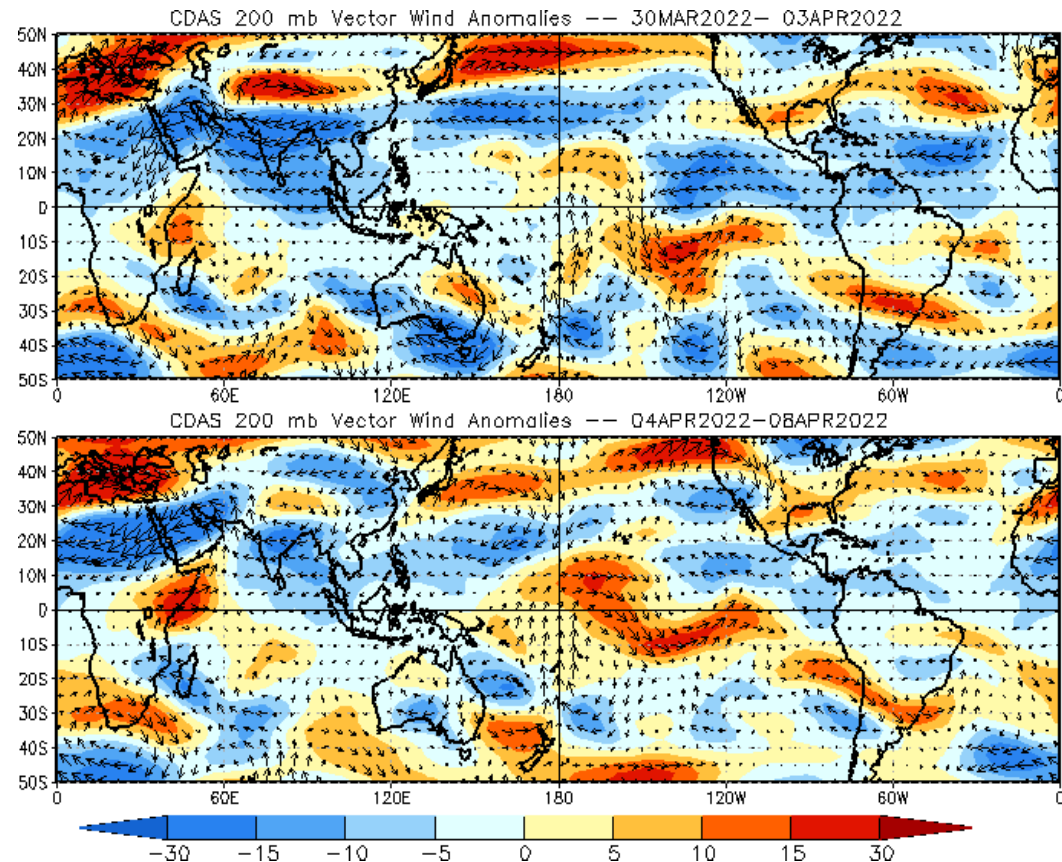
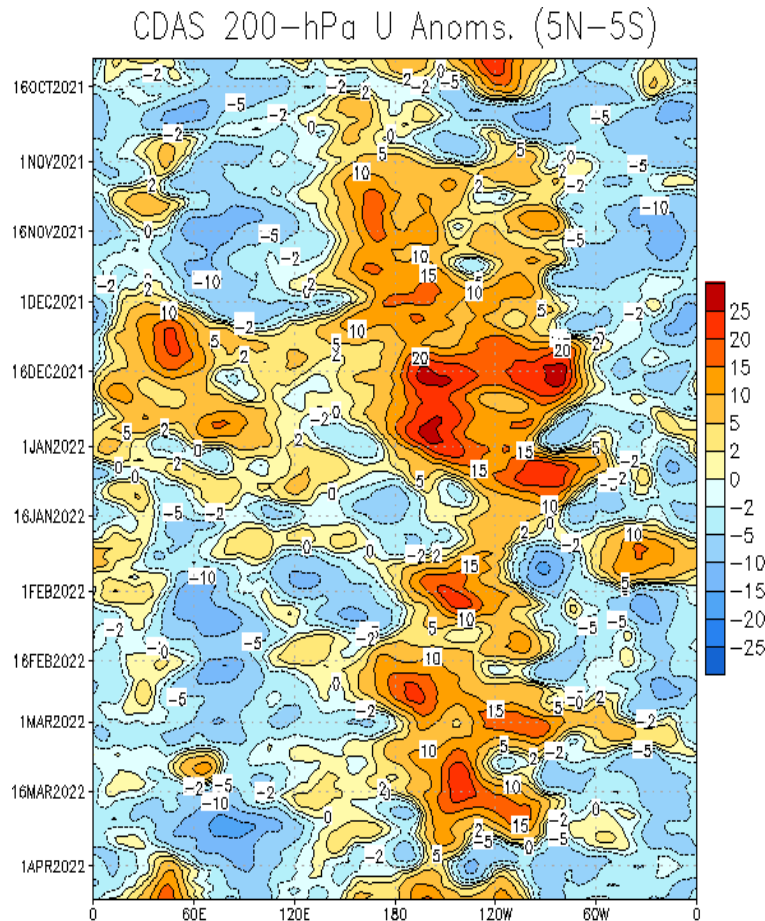
200-hPa Velocity Potential Anomaly: 5N–5S
5-day Running Mean



- The spatial velocity potential field still somewhat resembles a wave-2 asymmetry.
- Enhanced divergence is depicted across much of the Western and Central Pacific, and anomalous convergence is noted across much of the Americas as well as over eastern Africa and the Indian Ocean.
- The increased convection over the Western Pacific is likely more tied to the La Niña base state and increased Rossby Wave activity rather than the MJO.

200-hPa Wind Anomalies

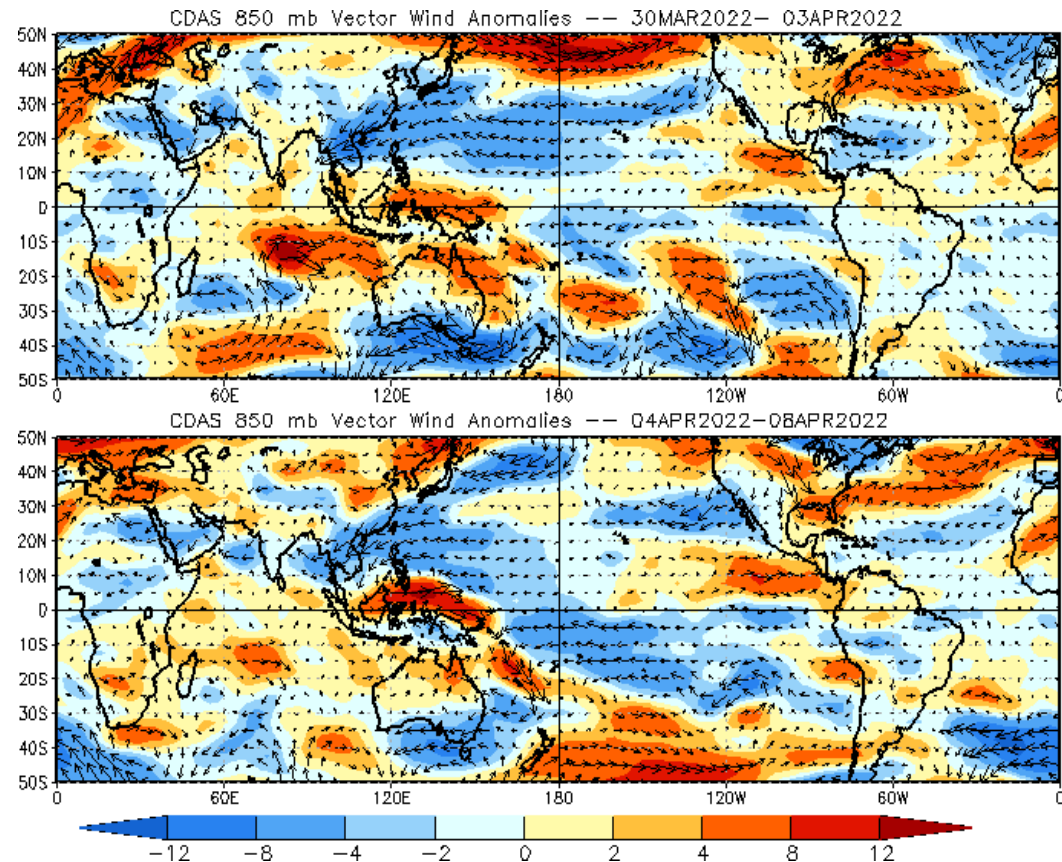
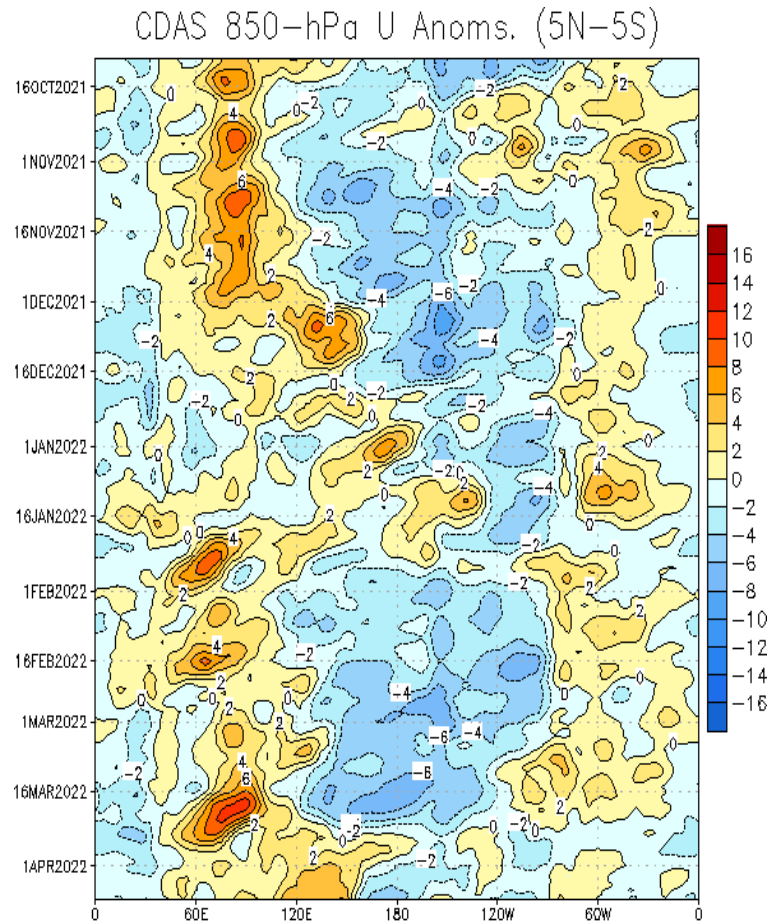
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Anomalous upper-level westerlies have increased across the Equatorial Pacific following a weakening during late-March, tied to a decaying MJO and La Niña conditions.
- Enhanced Kelvin Wave activity resulted in an increase in anomalous upper-level westerlies along the east coast of Africa and over the southern Indian Ocean, with anomalous upper-level easterlies persisting across portions of northern Africa and the northern Indian Ocean.

850-hPa Wind Anomalies

Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.

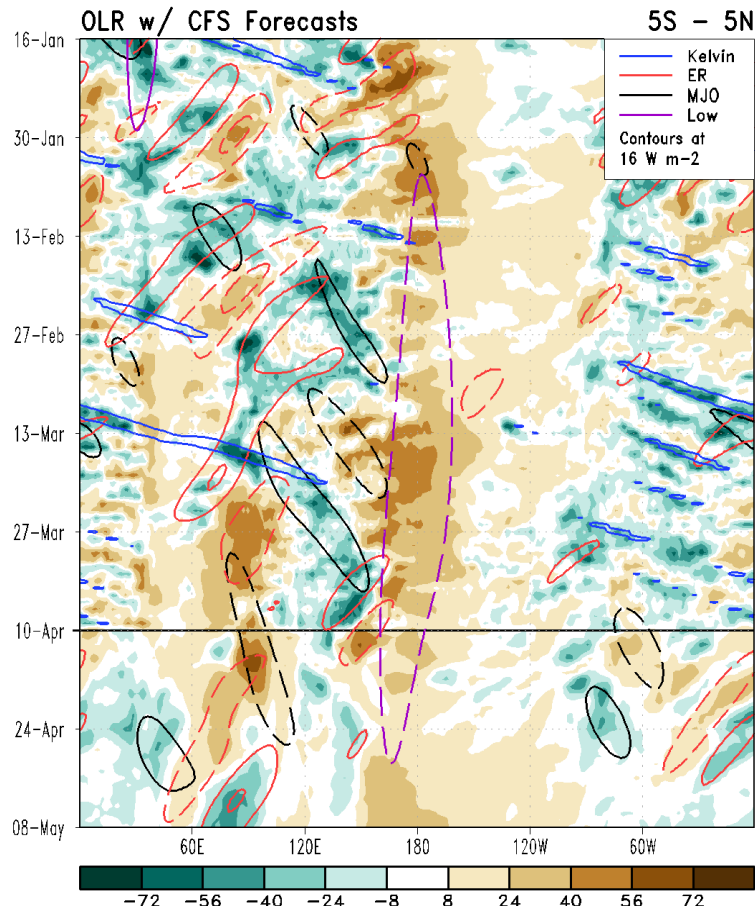


- Low-level cyclonic circulation is noted over the Western Pacific, with strong westerly wind anomalies along the Equator, tied to enhanced Rossby Wave activity, and increased easterlies further north.
- It is uncertain if there will be continued eastward propagation of the westerly wind anomalies through the Pacific given the weak MJO. Nonetheless, some warming over the western Niño regions is possible.

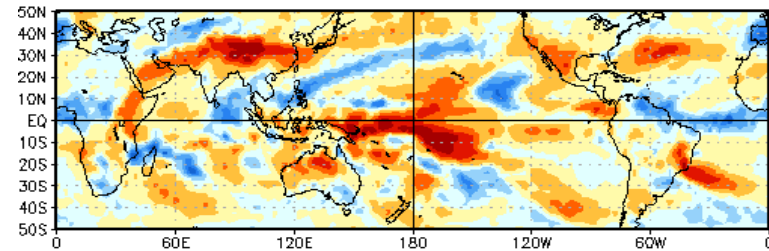
Outgoing Longwave Radiation (OLR) Anomalies

Green shades: Anomalous convection (wetness)

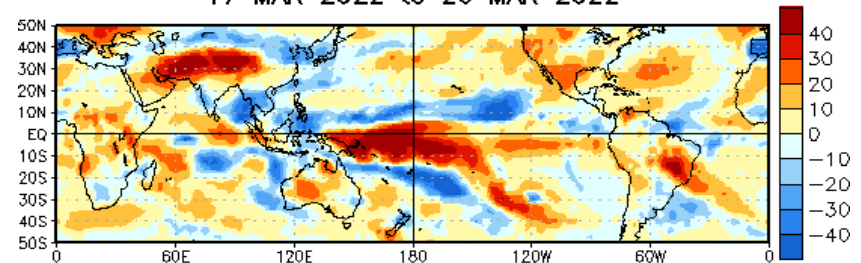
Brown shades: Anomalous subsidence (dryness)



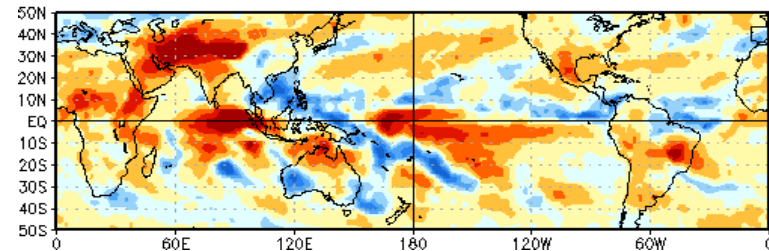
OLR Anomalies
7 MAR 2022 to 16 MAR 2022



17 MAR 2022 to 26 MAR 2022

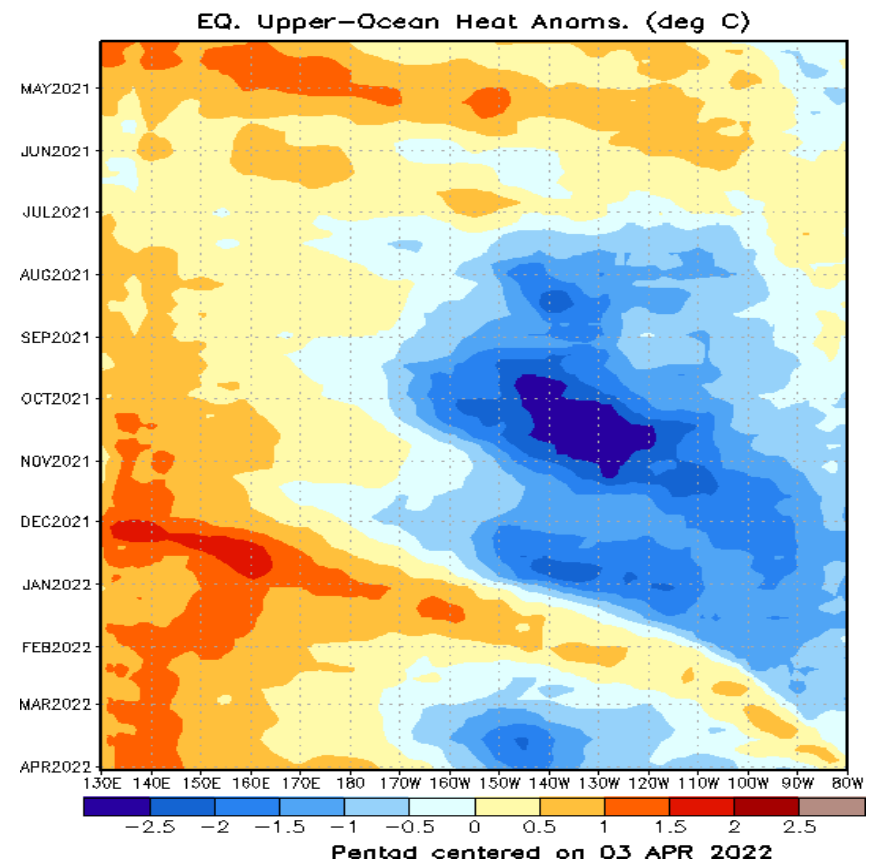
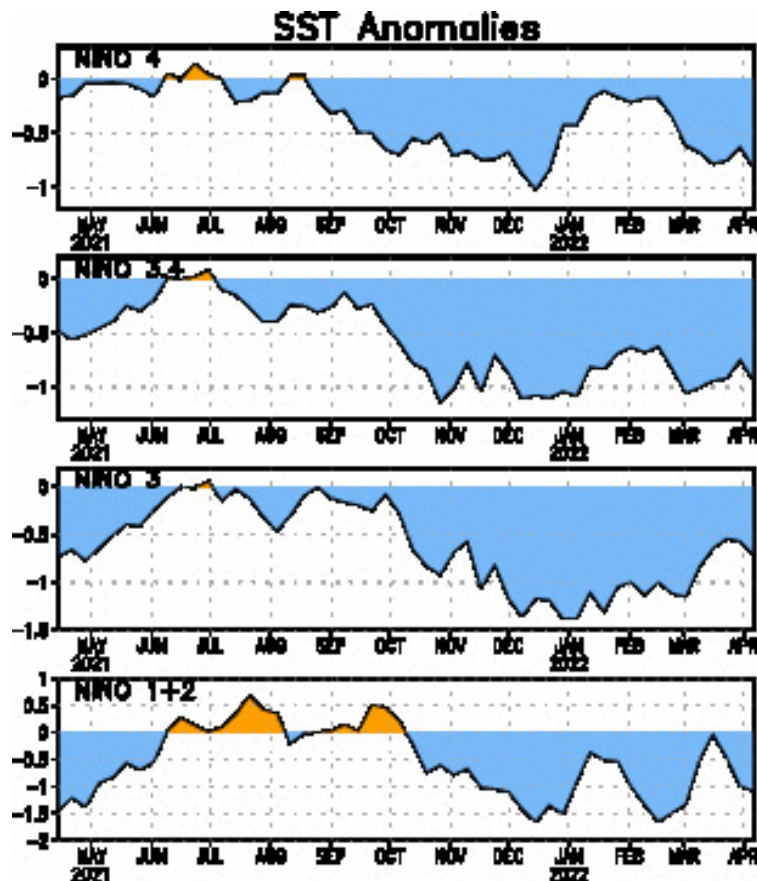


27 MAR 2022 to 5 APR 2022



- Suppressed convection over the Pacific associated with the ongoing La Niña remains the most prominent feature in the OLR field over the past several months. Intraseasonal activity has not been able to overcome this signal.
- Enhanced Rossby Wave activity resulted in an increase in convection across the Western Pacific, with suppressed convection increasing over the Indian Ocean.

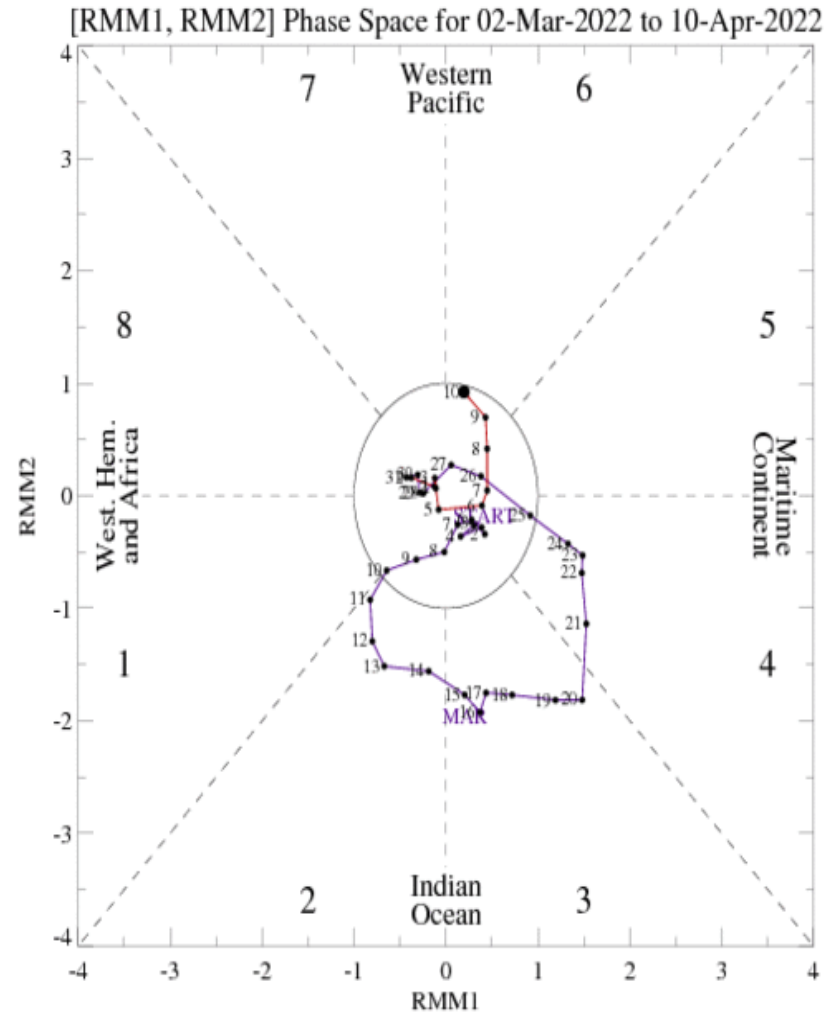
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Sea surface temperatures (SSTs) have decreased over all Niño regions during the past week.
- Positive upper-ocean heat content anomalies have expanded across the Western Pacific, with uncertainty in regards to how far to the east these anomalies propagate given the lack of an MJO.

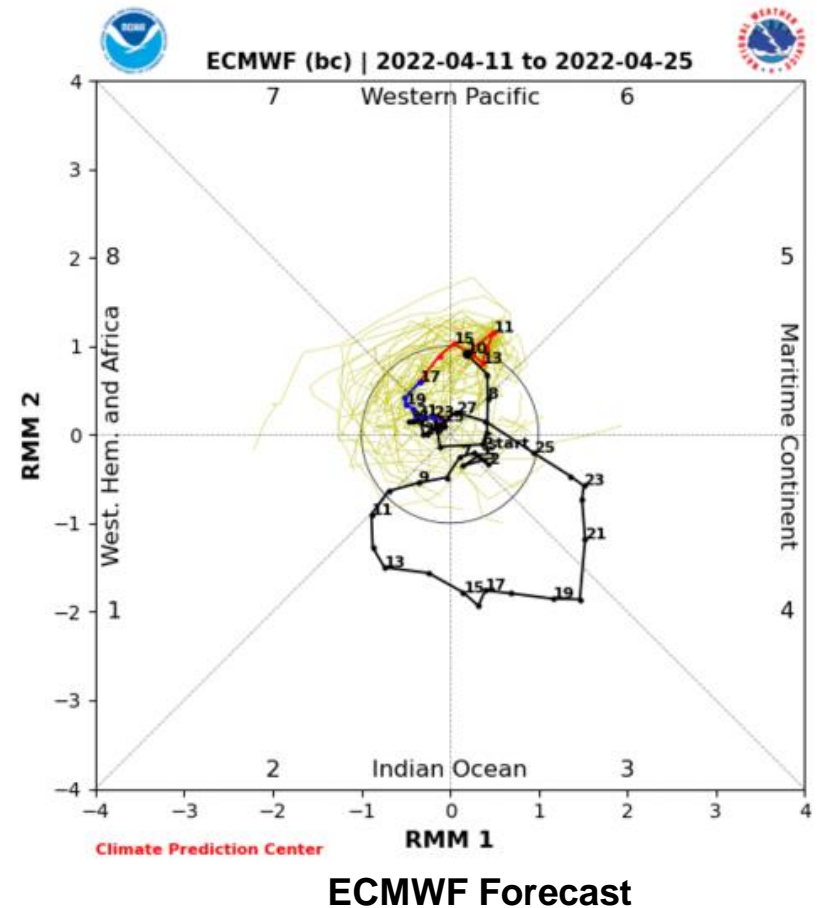
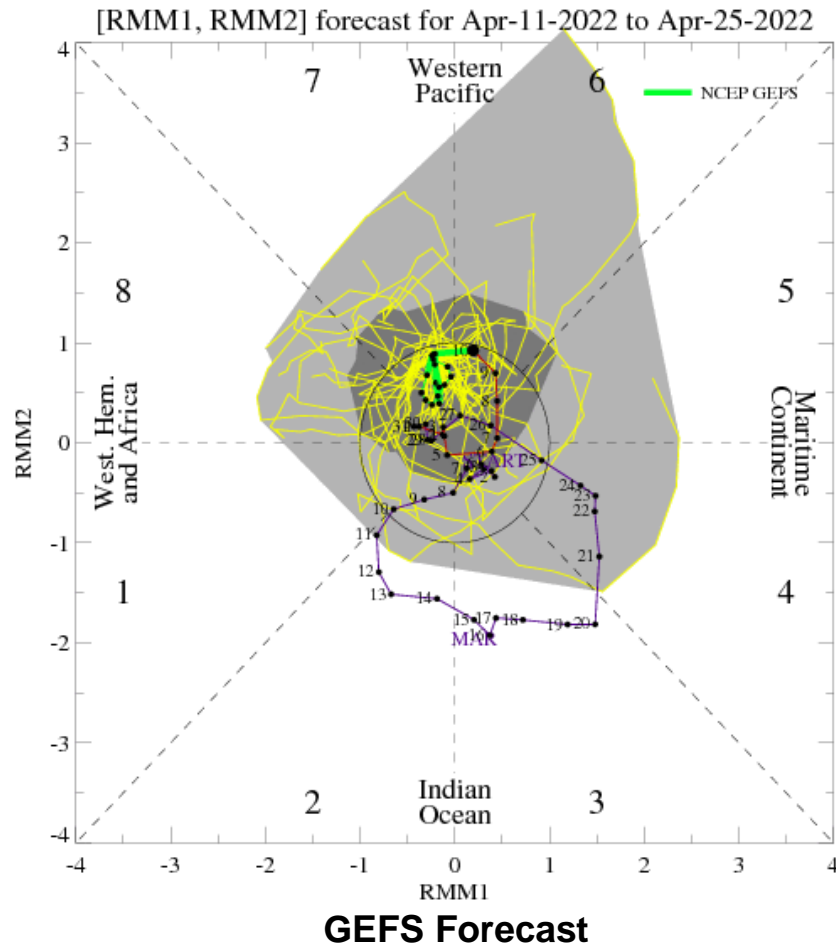
MJO Index: Recent Evolution

- Following an active MJO across the Indian Ocean and Maritime Continent during March, the intraseasonal signal has since retreated into the RMM-based unit circle.
- Some amplification of the RMM-based signal is noted over the Western Pacific in the past week, likely due to Rossby Wave activity. This led to an uptick in tropical cyclone development across the Western North Pacific.



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

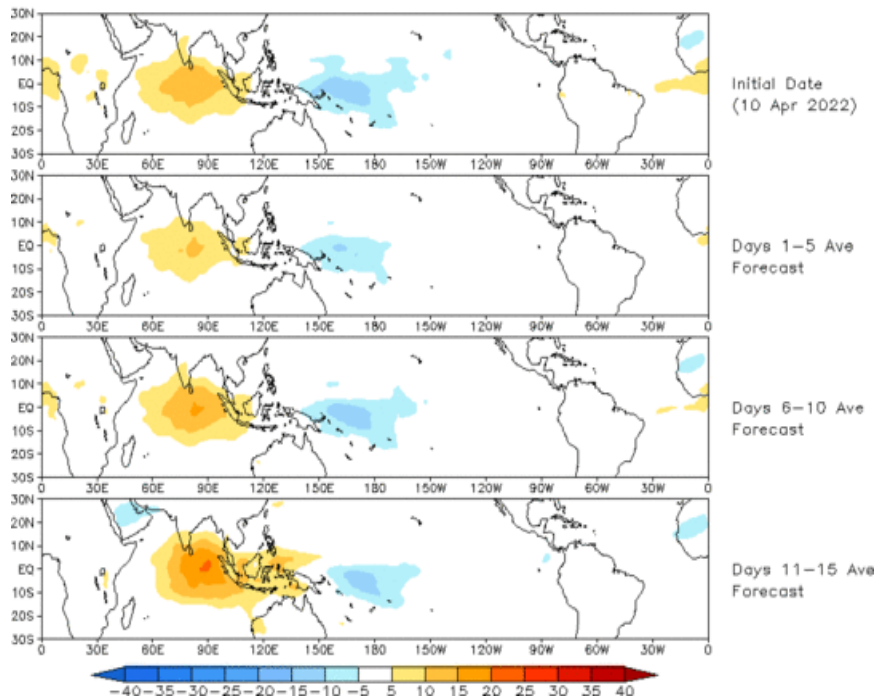


- The GEFS is weak and incoherent with the evolution of the MJO during the next 2 weeks, with some ensemble members reemerging the signal over the Western Hemisphere, and others remaining within the RMM-unit circle.
- The ECMWF ensemble is a bit more coherent, depicting a weak MJO signal propagating along the periphery of the RMM-unit circle into the Western Hemisphere.

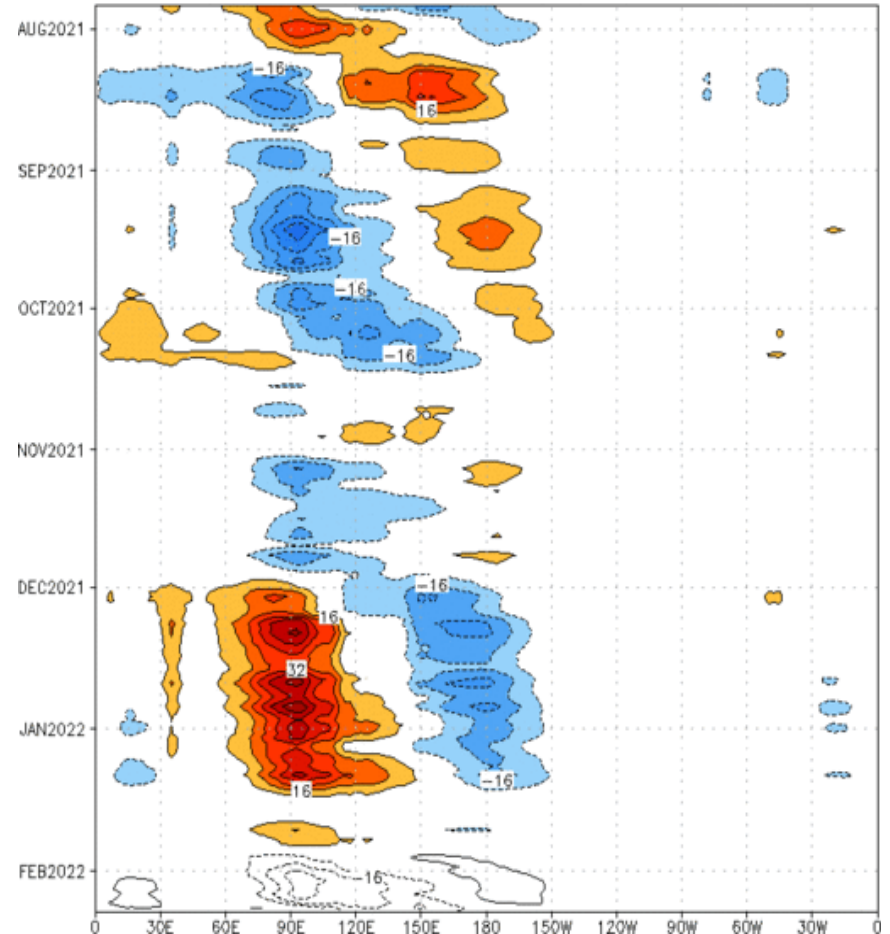
MJO: GEFS Forecast Evolution

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.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 10 Apr 2022
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:27-Jul-2021 to 26-Jan-2022
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

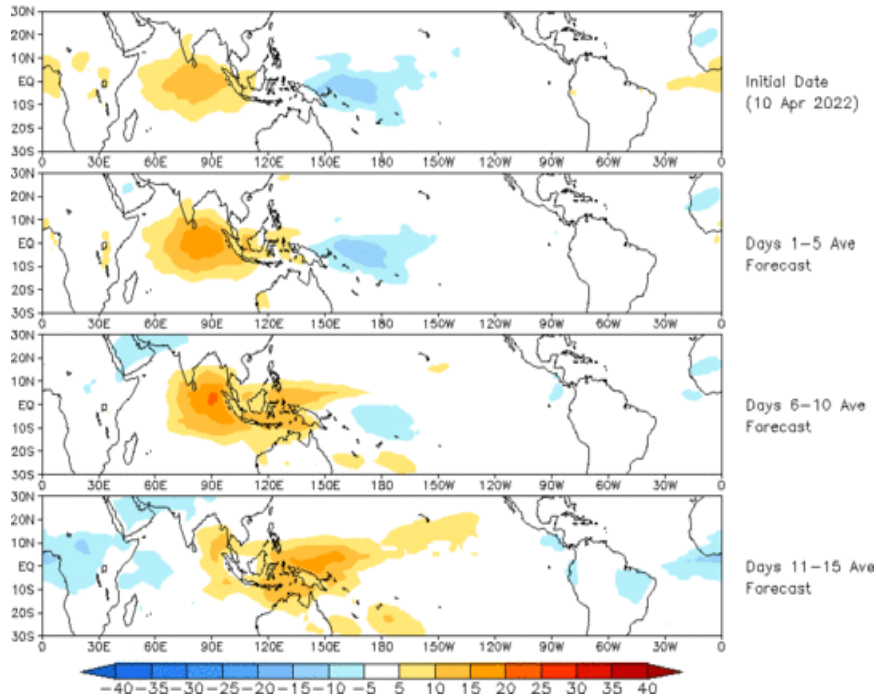


- The GEFS RMM-based OLR field depicts positive OLR anomalies (suppressed convection) expanding across the Indian Ocean and Maritime Continent, and negative OLR anomalies (enhanced convection) across the west-central equatorial Pacific.

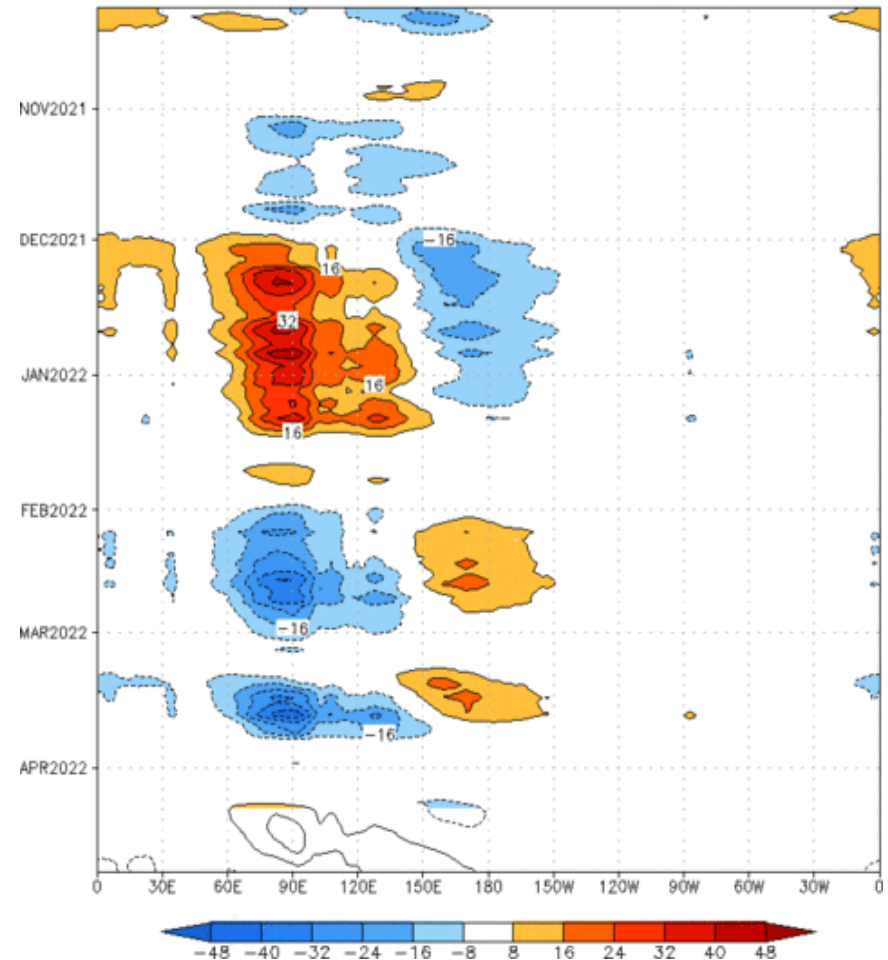
MJO: Constructed Analog Forecast Evolution

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.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (10 Apr 2022)



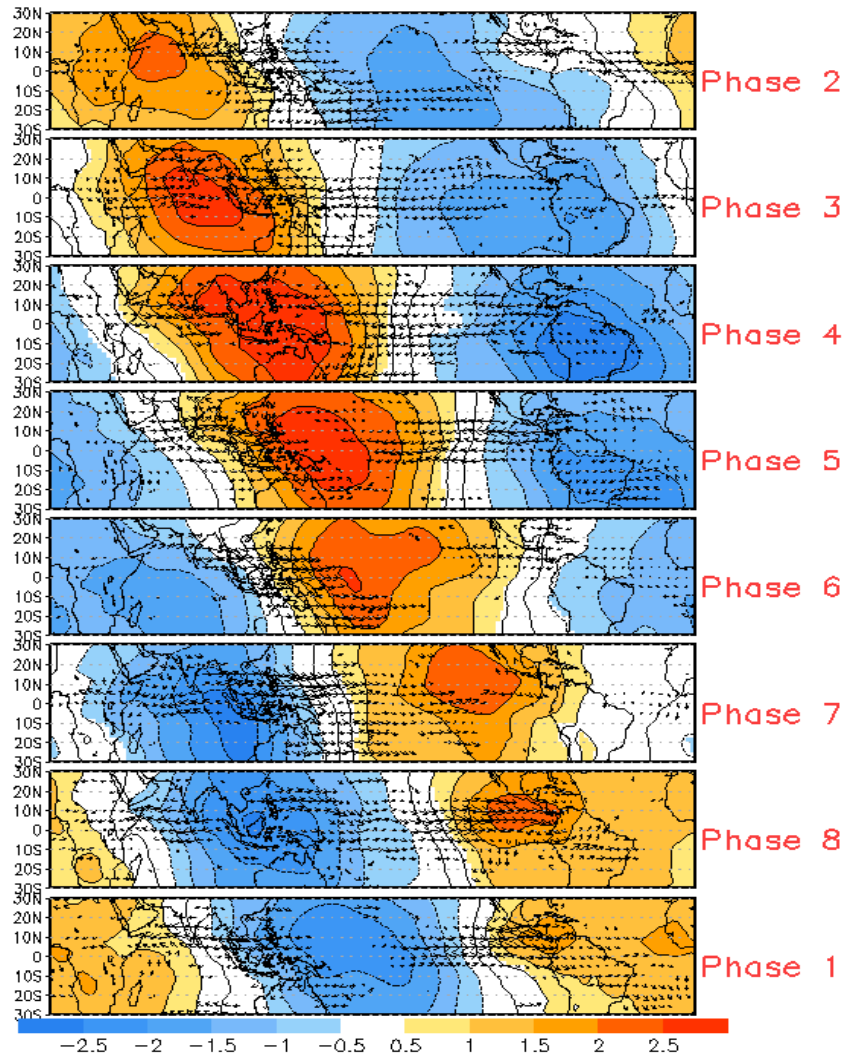
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:09-Oct-2021 to 10-Apr-2022
The unfilled contours are CA forecast reconstructed anomaly for 15 days



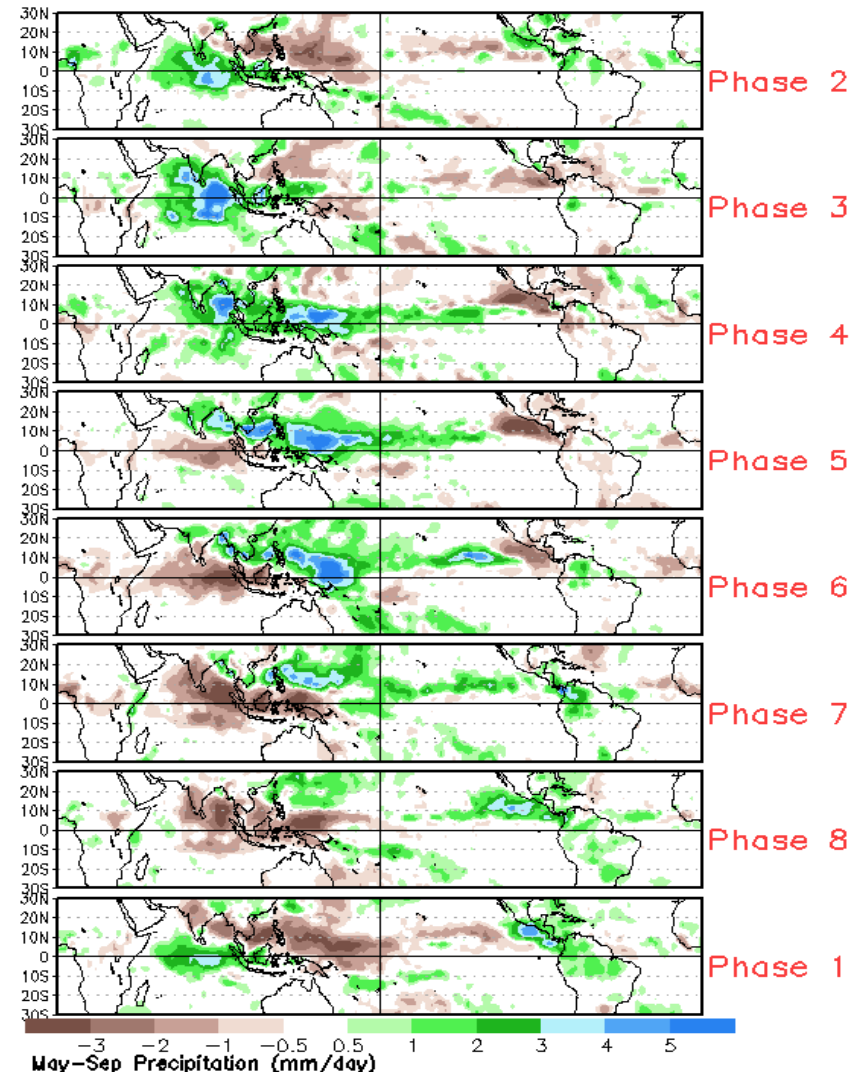
- The constructed analog forecast of RMM-based OLR anomalies is similar to the GEFS, but shows a further expansion of positive OLR anomalies (suppressed convection) across the Pacific during week-2.
- Negative OLR anomalies (enhanced convection) are noted across parts of South America in week-2.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



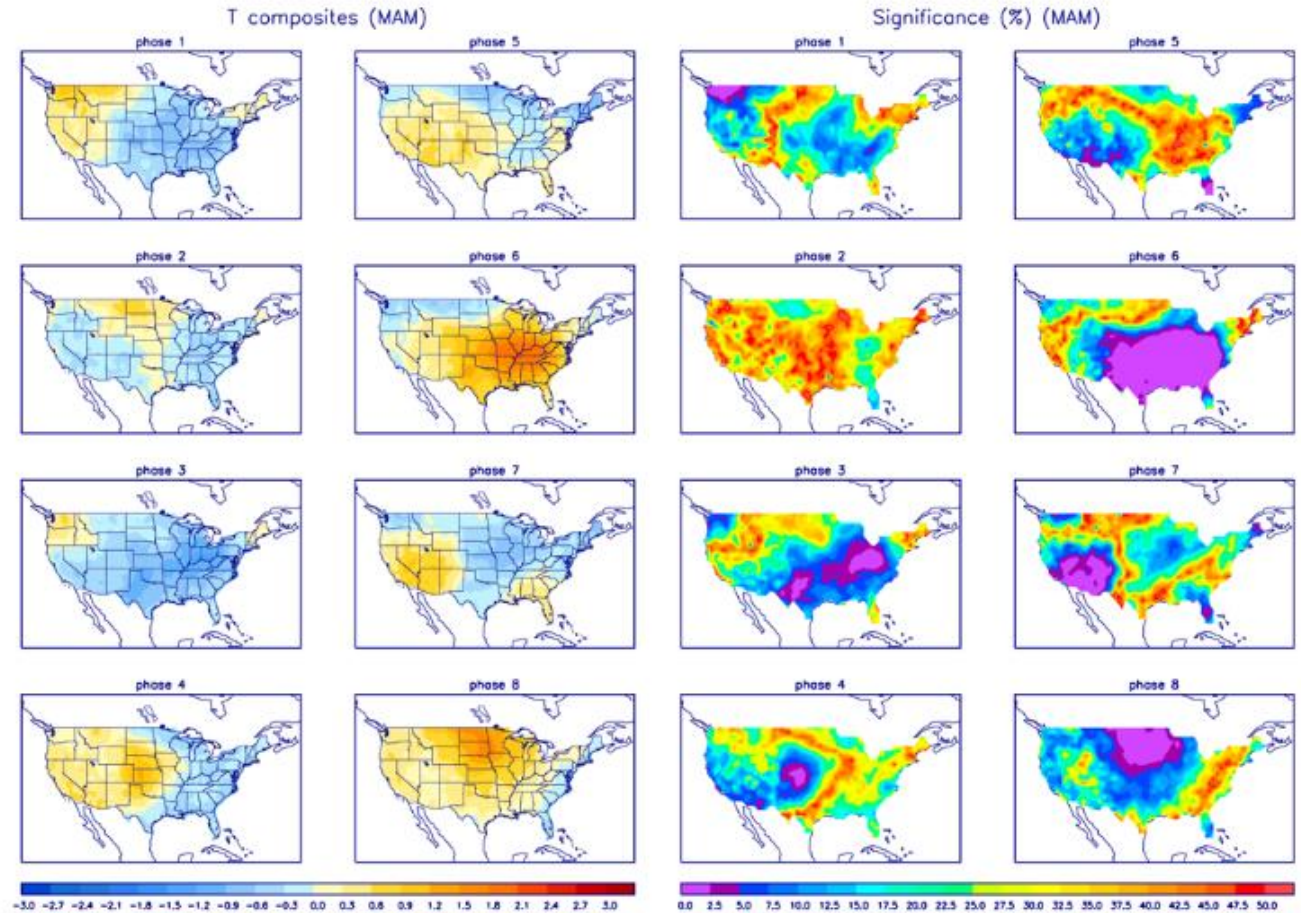
Precipitation Anomalies



MJO: CONUS Composite Maps by RMM Phase - Temperature

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.



MJO: CONUS Composite Maps by RMM Phase - Temperature

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.

