

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



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

Overview

- The MJO signal remains mostly within the RMM-based unit circle, but has emerged over the Western Hemisphere during the last few days.
- TC formation will be diminished in the near future due to widespread upper-level convergence over the Indian Ocean and only moderate upper-level divergence over the Western Pacific.
- There is some uncertainty into the MJO evolution during the next 2 weeks with the GEFS and ECMWF disagreeing on the strength of the MJO over the next week, but both models depict a much weaker MJO signal by week 2.
- La Niña conditions are expected to continue for the next several months, with a third La Niña winter beginning to become a distinct possibility.

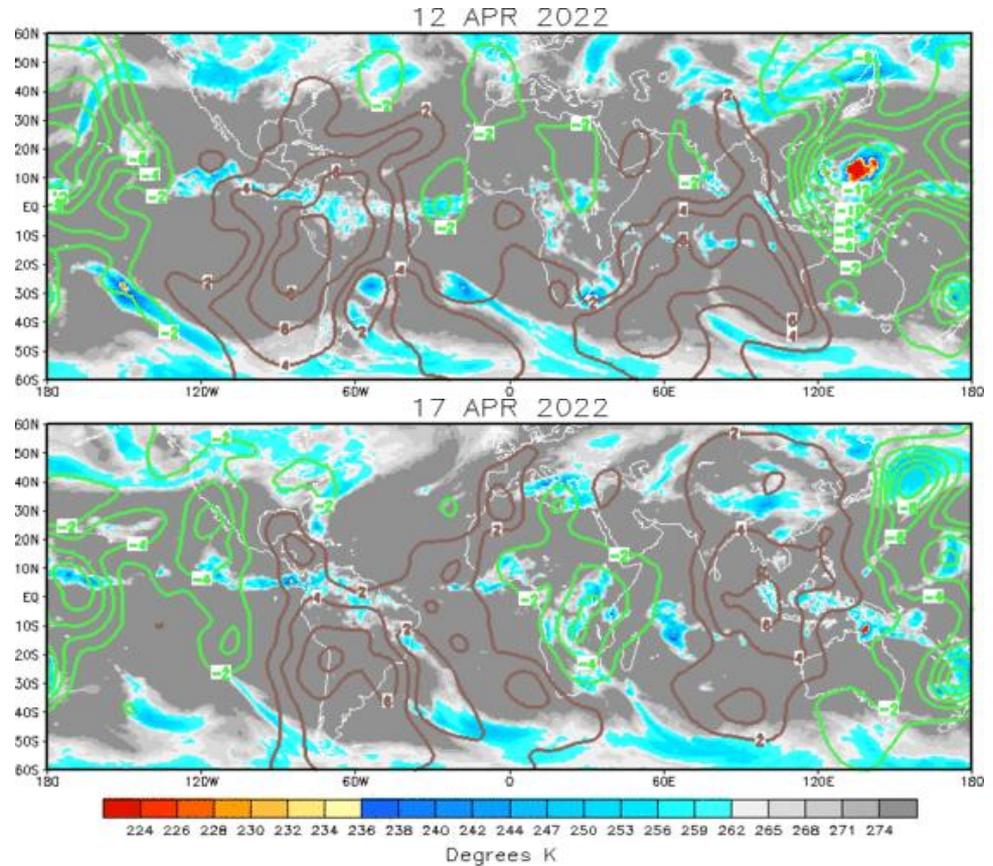
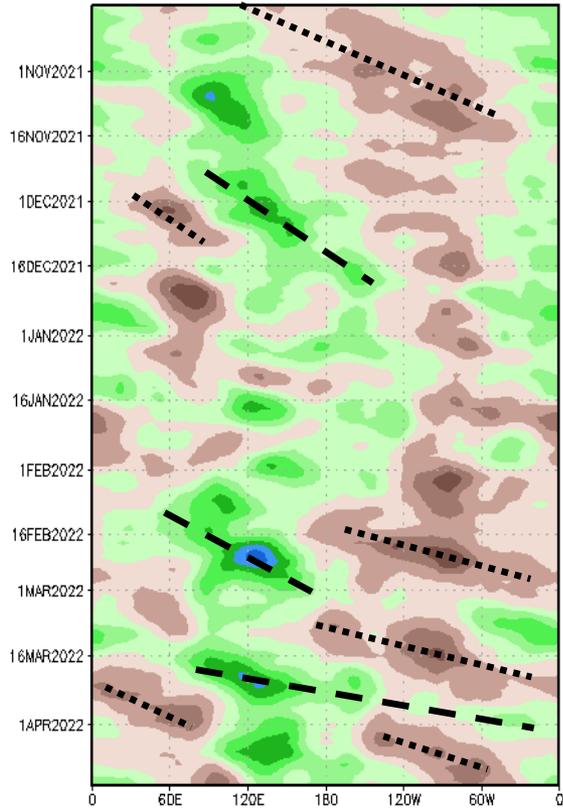
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

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

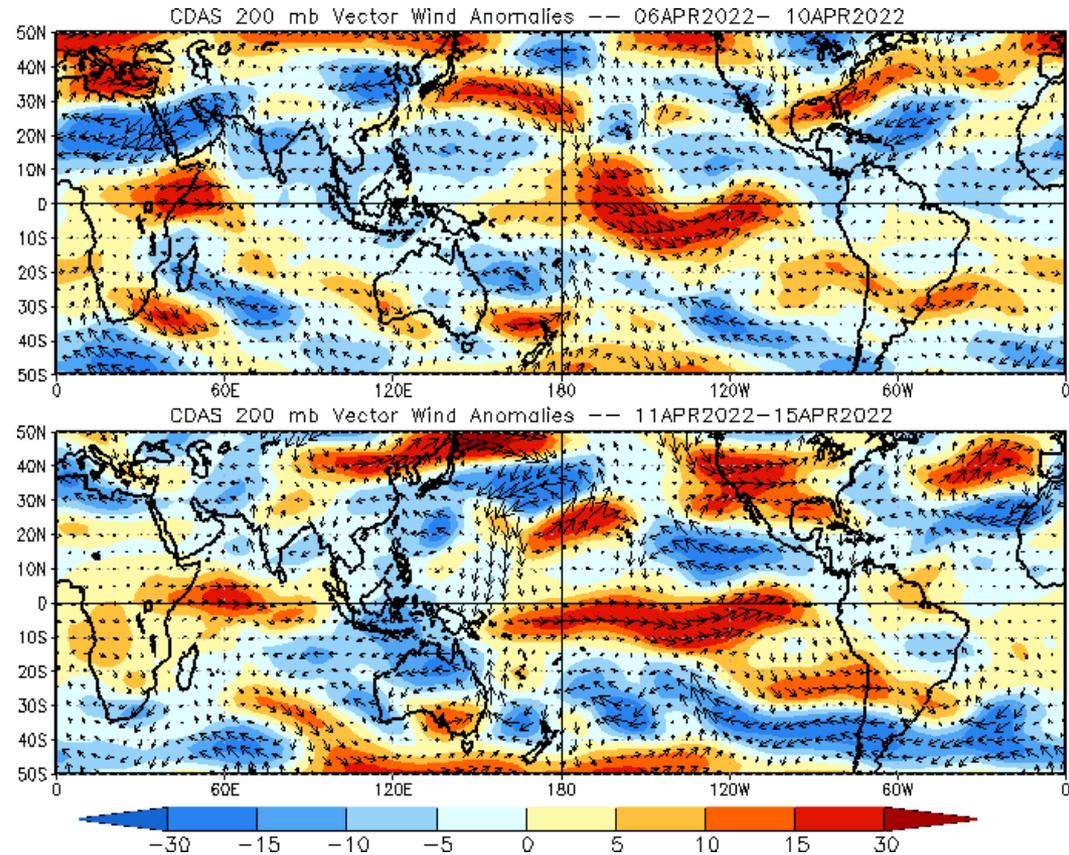
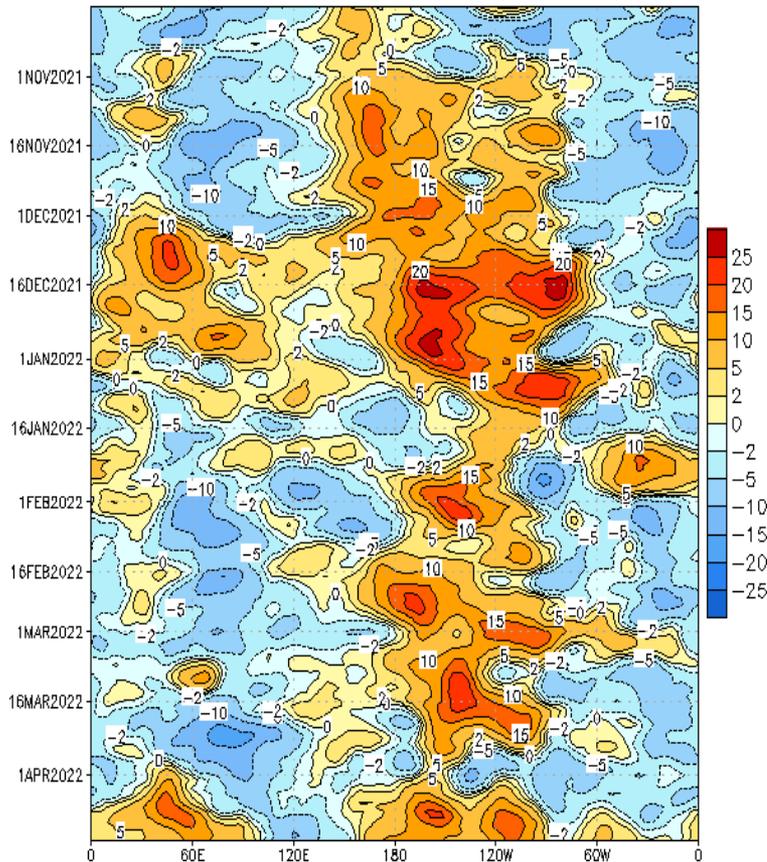


- Wave-2 pattern continues and has become a little more coherent in the last week.
- Enhanced divergence is currently over across much of the Central Pacific and Eastern Africa, and anomalous convergence is noted across South America as well as over the eastern Indian Ocean and Maritime Continent.

200-hPa Wind Anomalies

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

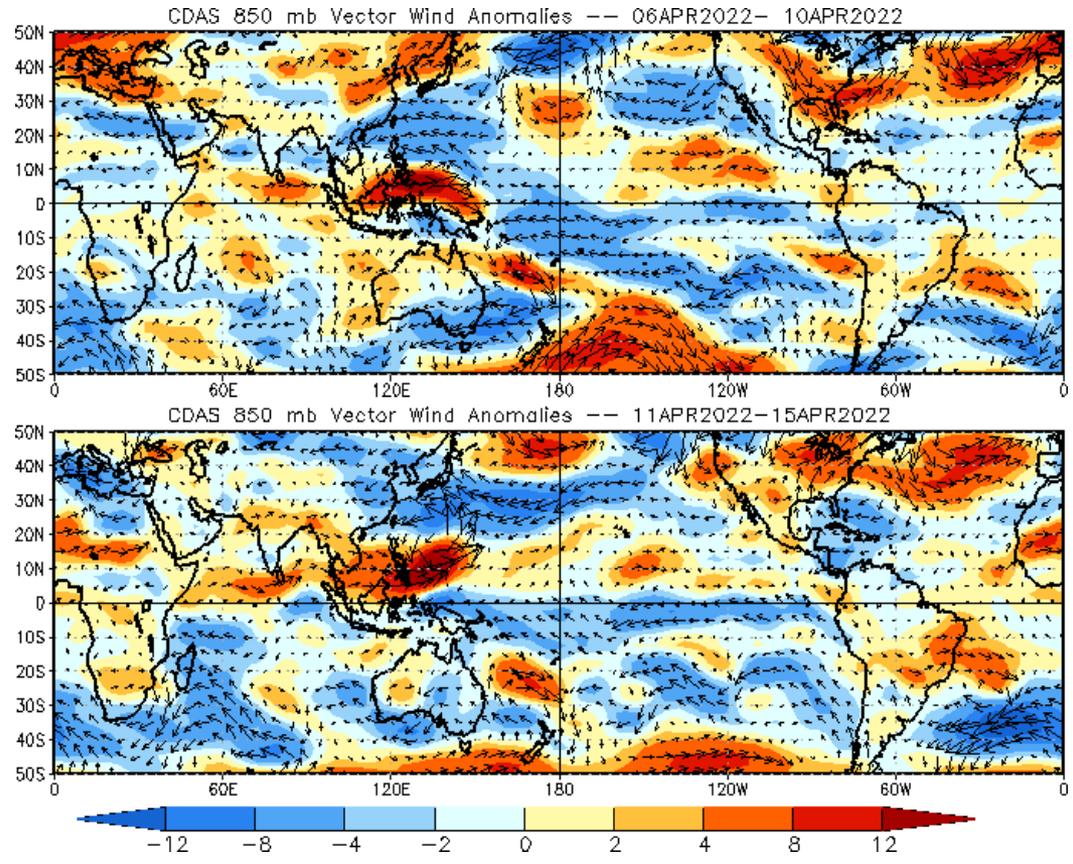
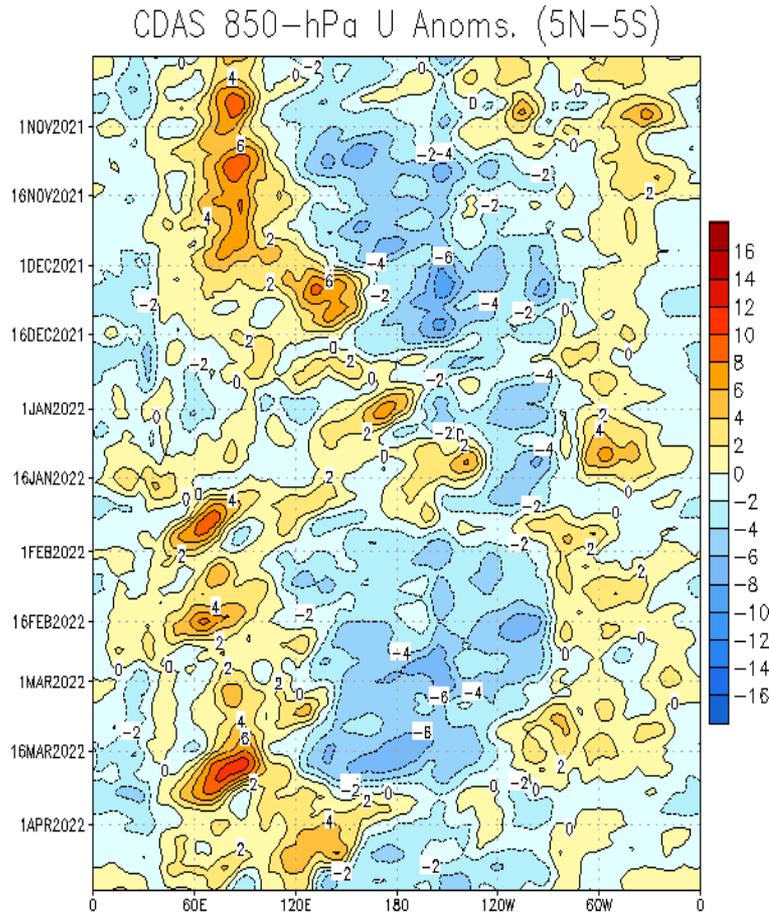
CDAS 200-hPa U Anoms. (5N-5S)



- Anomalous upper-level westerlies continued across the Equatorial Pacific following a weakening during late-March, tied to a decaying MJO and ongoing La Niña conditions.
- Anomalous upper-level westerlies along the east coast of Africa and over the southern Indian Ocean due to Kelvin Wave activity continue, while anomalous upper-level easterlies are weakening across portions of northern Africa and the northern Indian Ocean.
- Anomalous upper-level easterlies over the tropical Eastern Pacific have increased, and anti-cyclonic circulation is noted over subtropical Western Pacific.

850-hPa Wind Anomalies

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

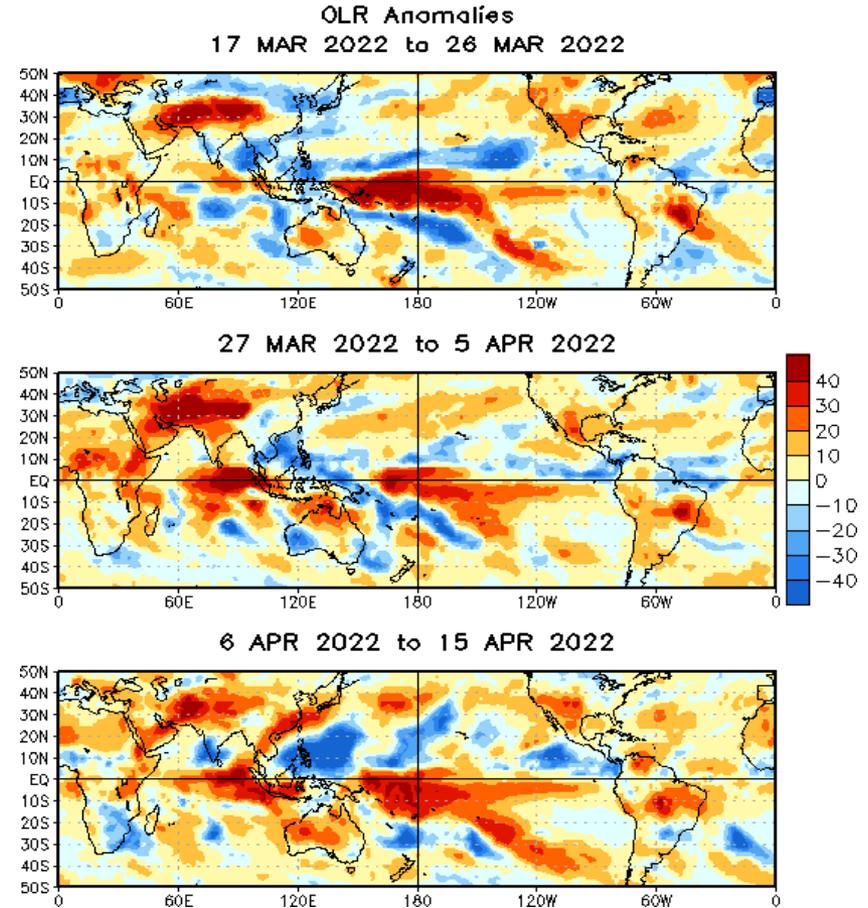
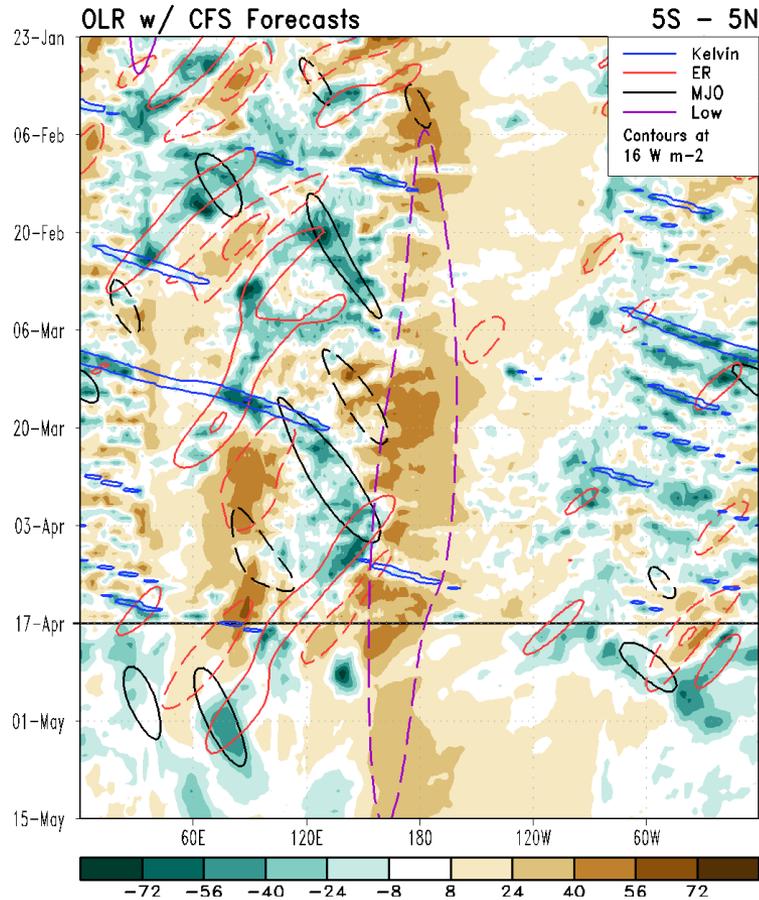


- Low-level cyclonic circulation persists over the Western Pacific, with strong westerly wind anomalies along the Equator, tied to enhanced Rossby Wave activity, and increased easterlies further north.
- Stronger trade winds continue for the tropical Pacific south of the Equator, while slight westerly anomalies continue for the tropical Eastern Pacific.

Outgoing Longwave Radiation (OLR) Anomalies

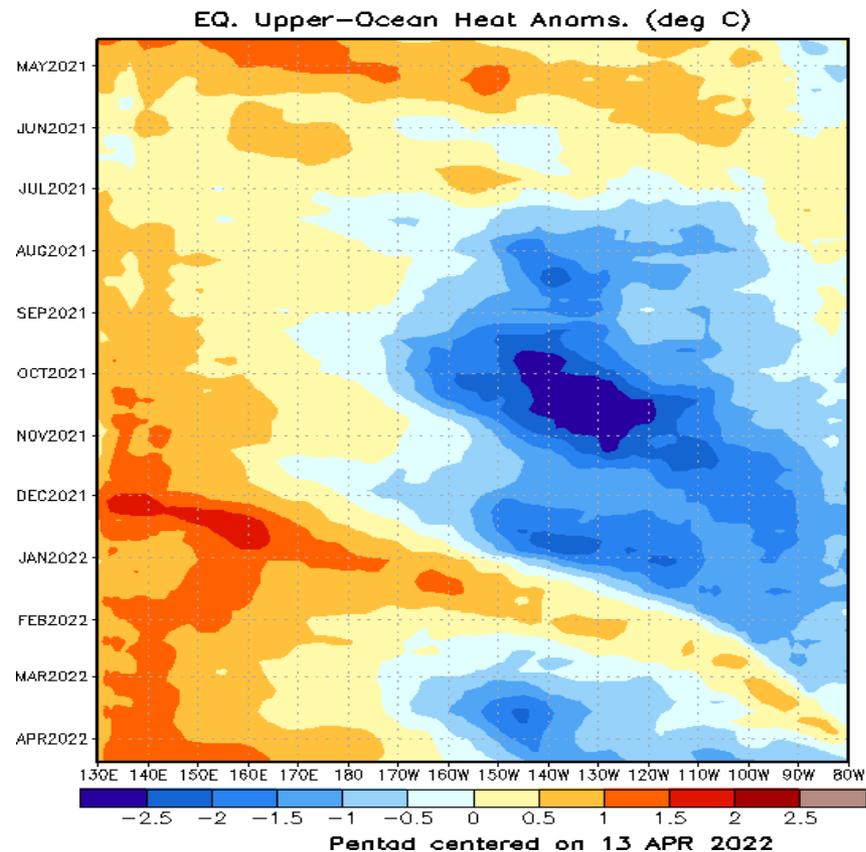
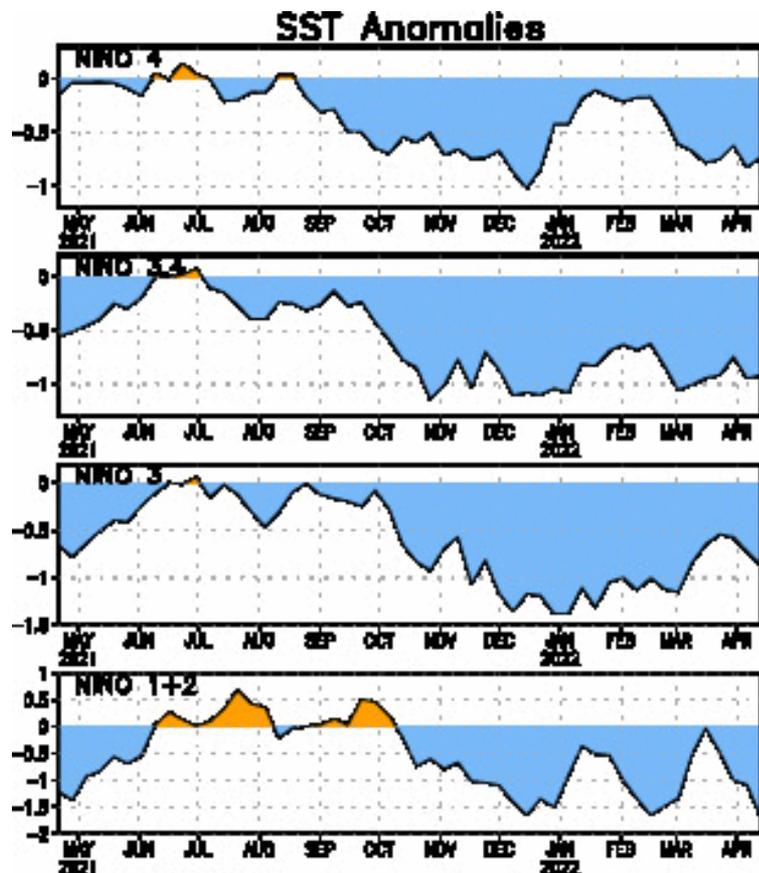
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- 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.
- Rossby Wave activity that resulted in an increase of convection across the Western Pacific has diminished, while a small Kelvin Wave has brought a slight increase in convective activity to the east coast of Africa.

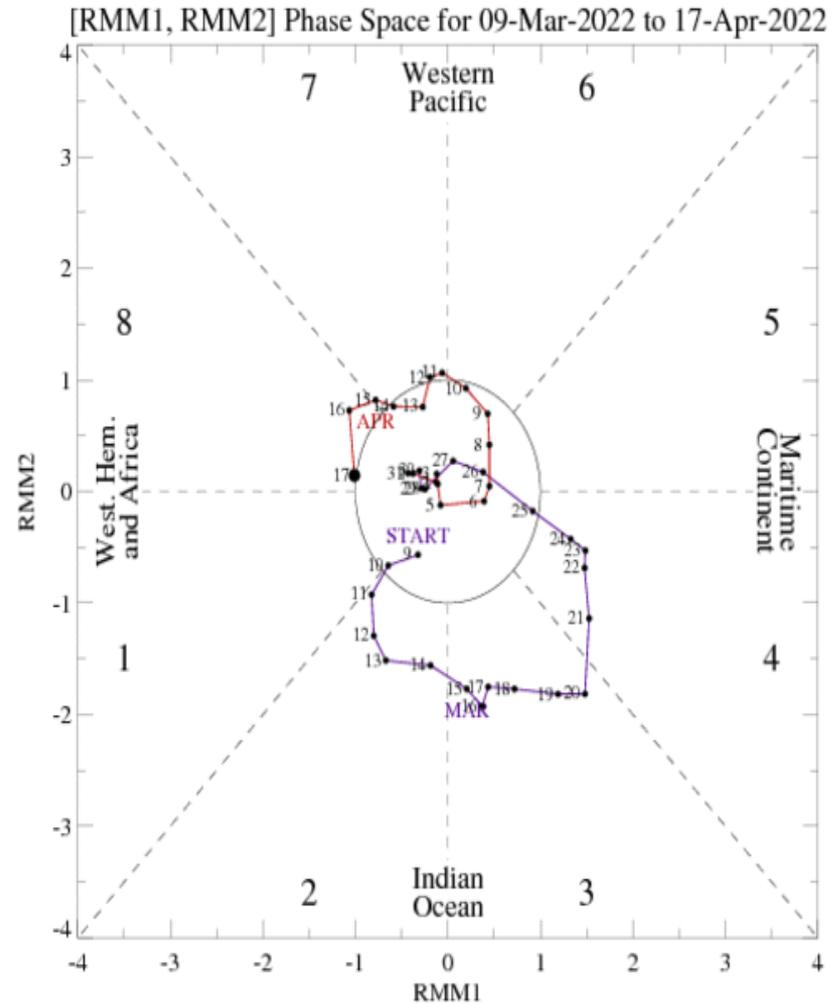
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Sea surface temperatures (SSTs) have remained anomalously low over all Niño regions during the past week.
- Positive upper-ocean heat content anomalies have dissipated across the Western Pacific. A new lobe of warm anomalies is expanding from the western Pacific across the Date Line, but there is uncertainty over how much this will propagate eastward given the current weak state of the MJO.

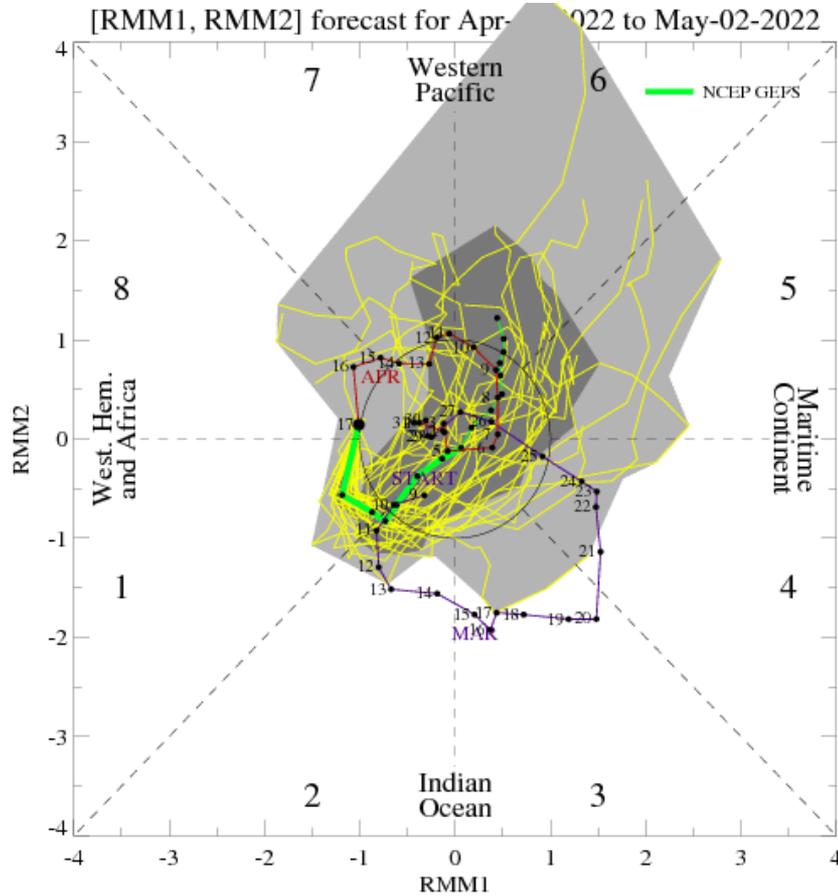
MJO Index: Recent Evolution

- Following an active MJO across the Indian Ocean and Maritime Continent during March, the intraseasonal signal has been confined within the RMM-based unit circle for most of April, only recently emerging out of the circle and into phase 8.
- RMM-based signal has been steadily propagating eastward across the Western Pacific and into the Western Hemisphere over the last week.

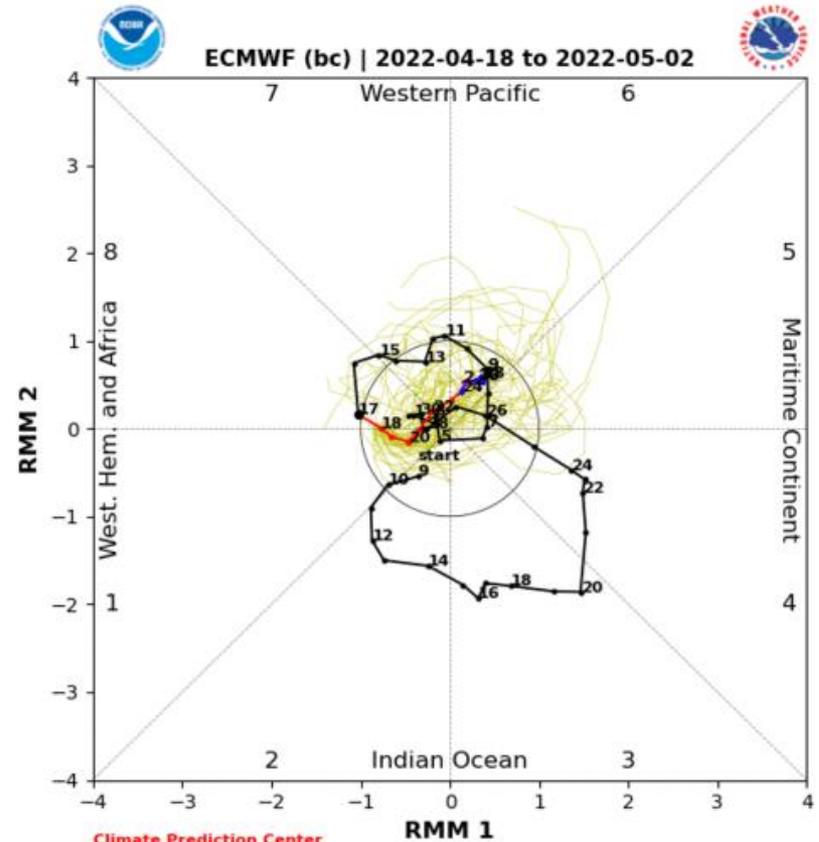


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



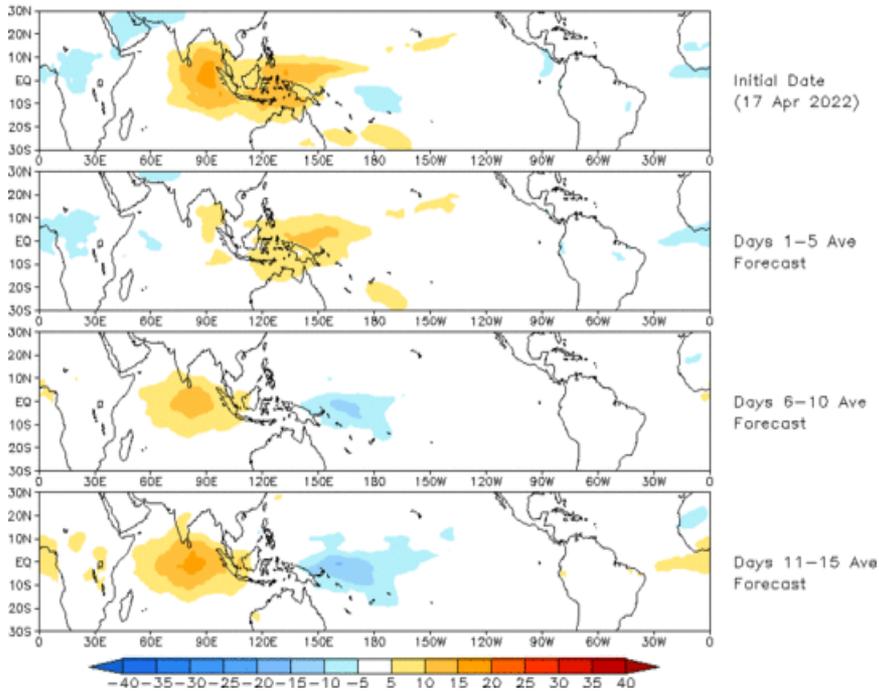
ECMWF Forecast

- There is marked disagreement between GEFS and ECMWF concerning the future evolution of the MJO. The GEFS depicts a weak to moderate MJO moving over Africa and into the eastern Indian Ocean before weakening significantly as it continues across the ocean. On the other hand, the ECMWF favors an immediate weakening of the MJO signal, with the RMM index nearing zero within the next week.
- Both models have quite a bit of spread in their ensemble members, but all ECMWF members stay within the unit circle for the next week, while the GEFS includes members that remain outside the circle for the near future.

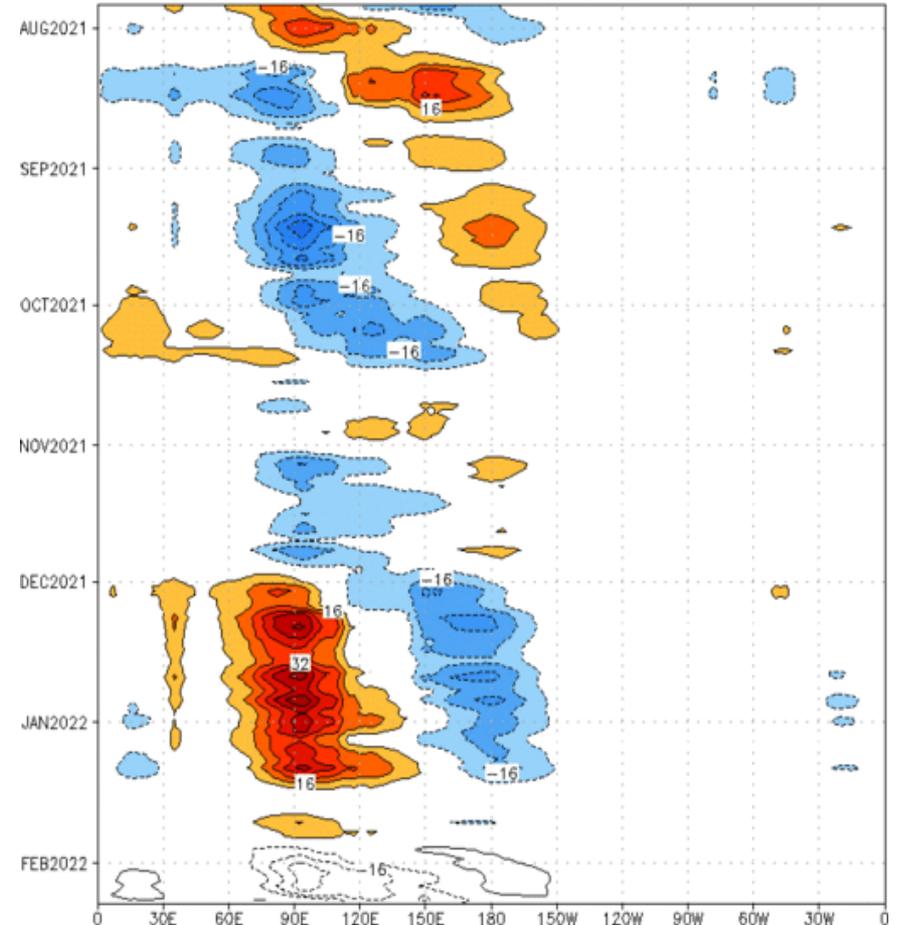
MJO: GEFS Forecast Evolution

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: 17 Apr 2022
OLR



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

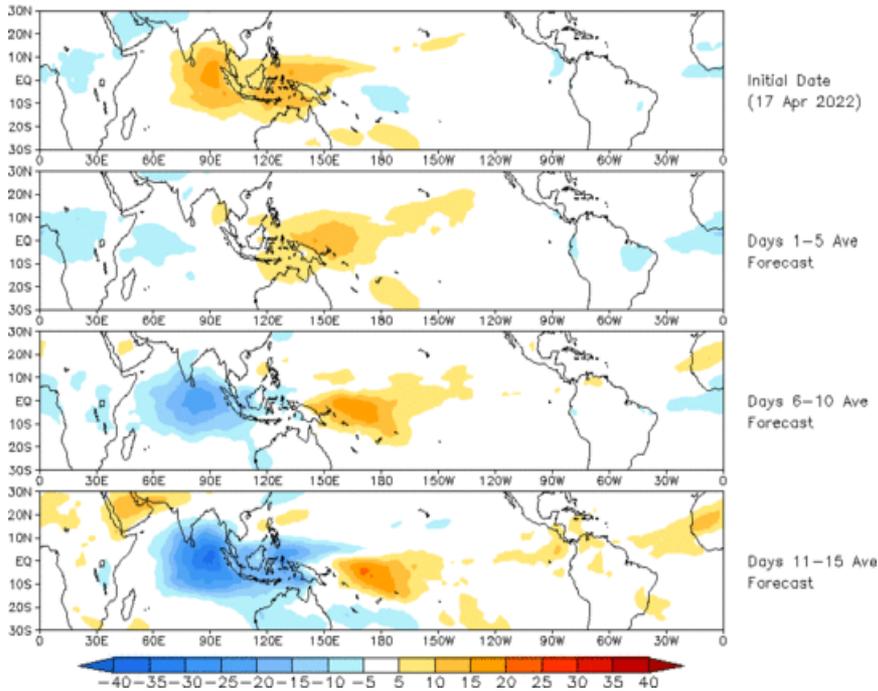


- The GEFS RMM-based OLR field depicts positive OLR anomalies (suppressed convection) expanding across the Indian Ocean and Maritime Continent then reforming over the Indian Ocean, and negative OLR anomalies (enhanced convection) across the west-central equatorial Pacific in week 2 of the forecast period.

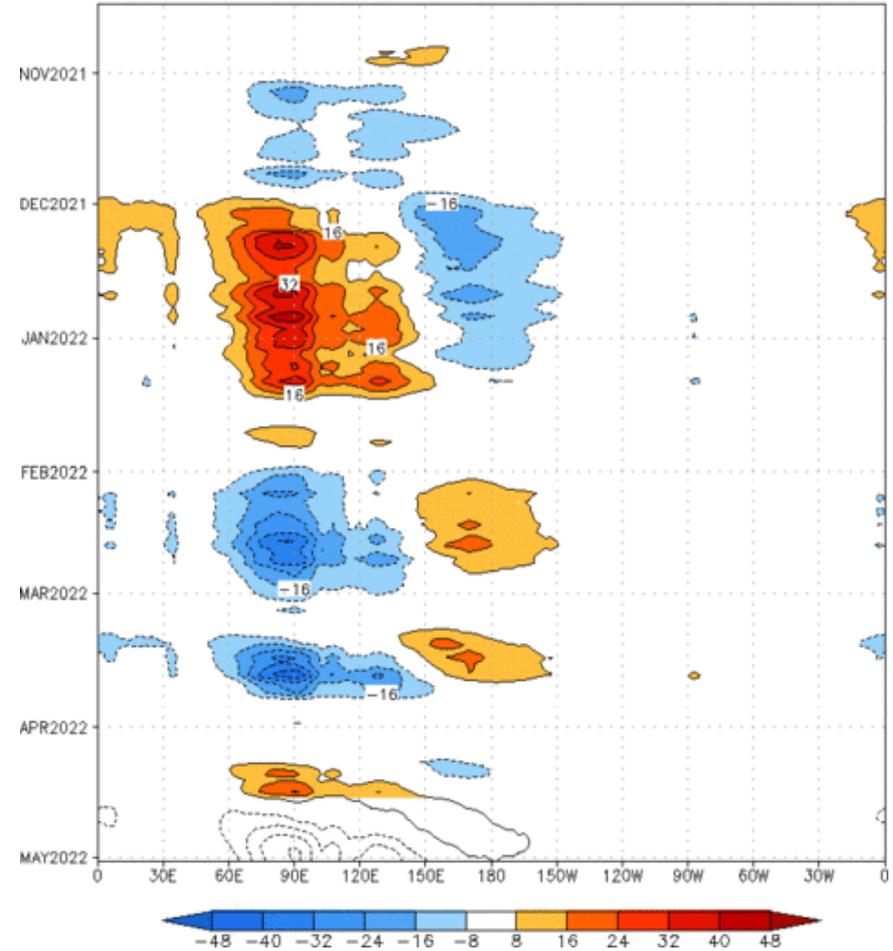
MJO: Constructed Analog Forecast Evolution

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 (17 Apr 2022)



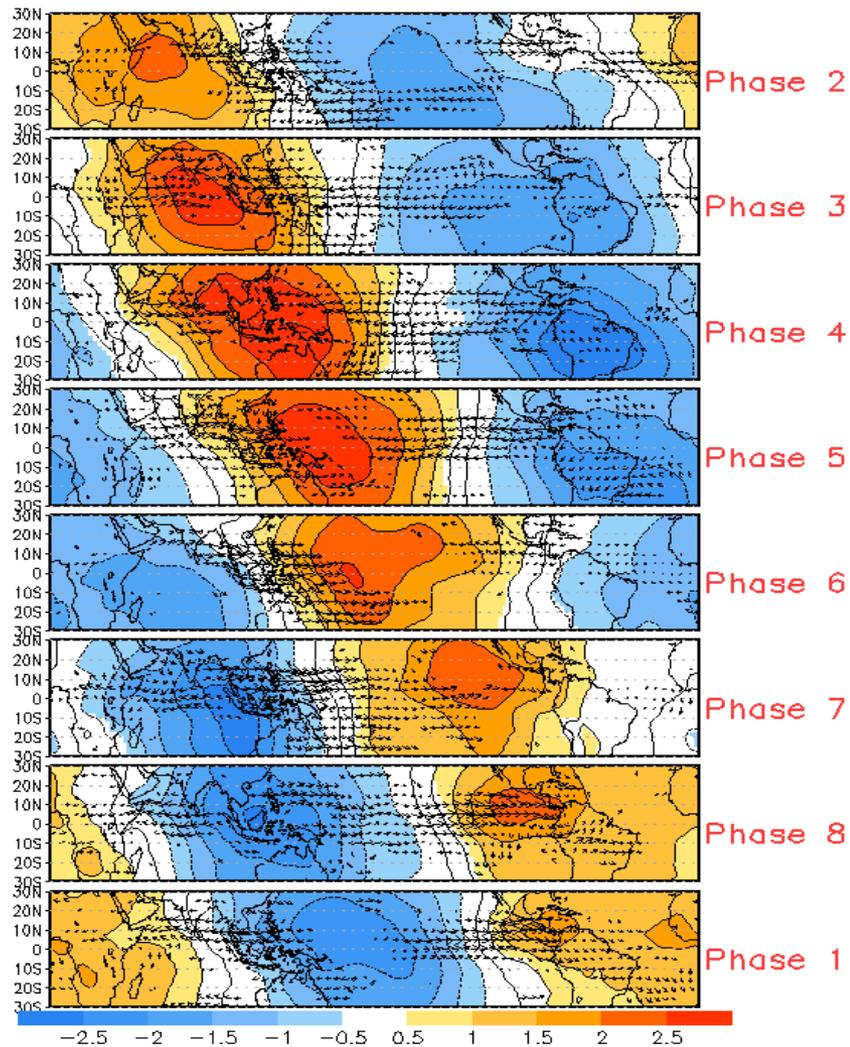
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:16–Oct–2021 to 17–Apr–2022
The unfilled contours are CA forecast reconstructed anomaly for 15 days



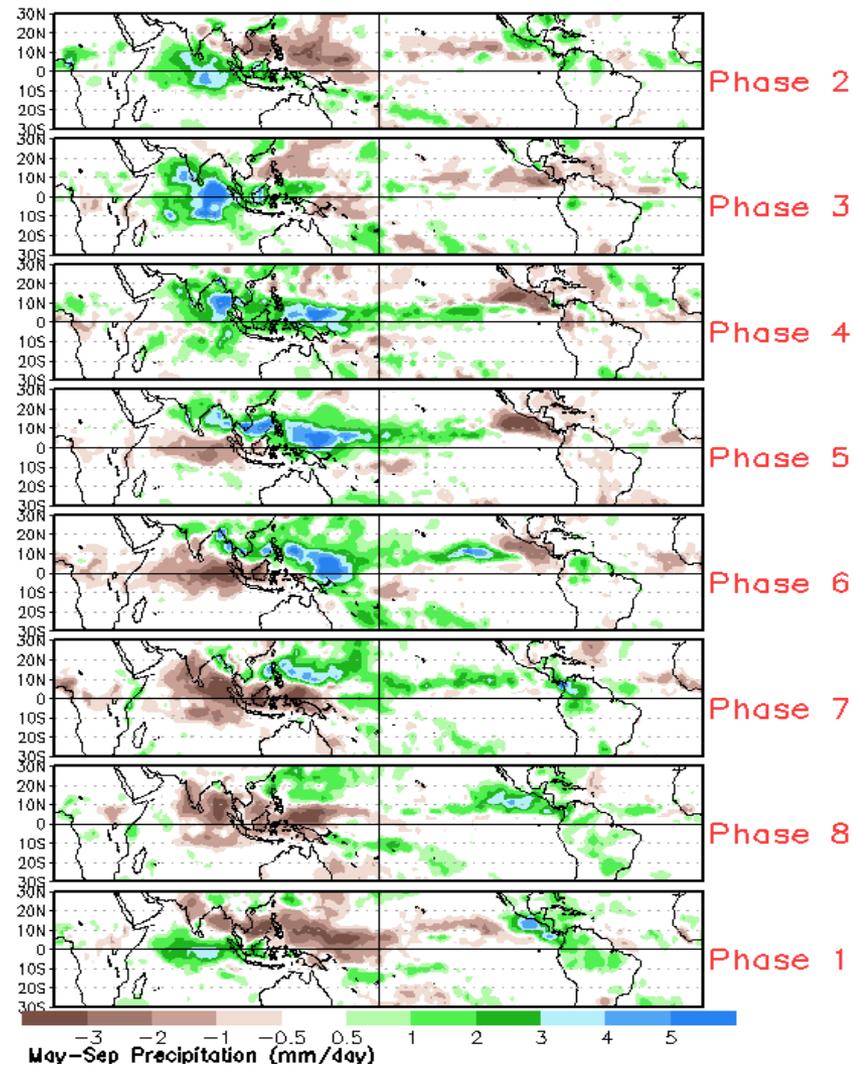
- The constructed analog forecast of RMM-based OLR anomalies shows a more canonical progression across the Indian Ocean and Western Pacific during the next two weeks.
- If negative OLR anomalies for eastern Indian Ocean pan out this could enhance the possibility of TC formation over the region in week 2.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



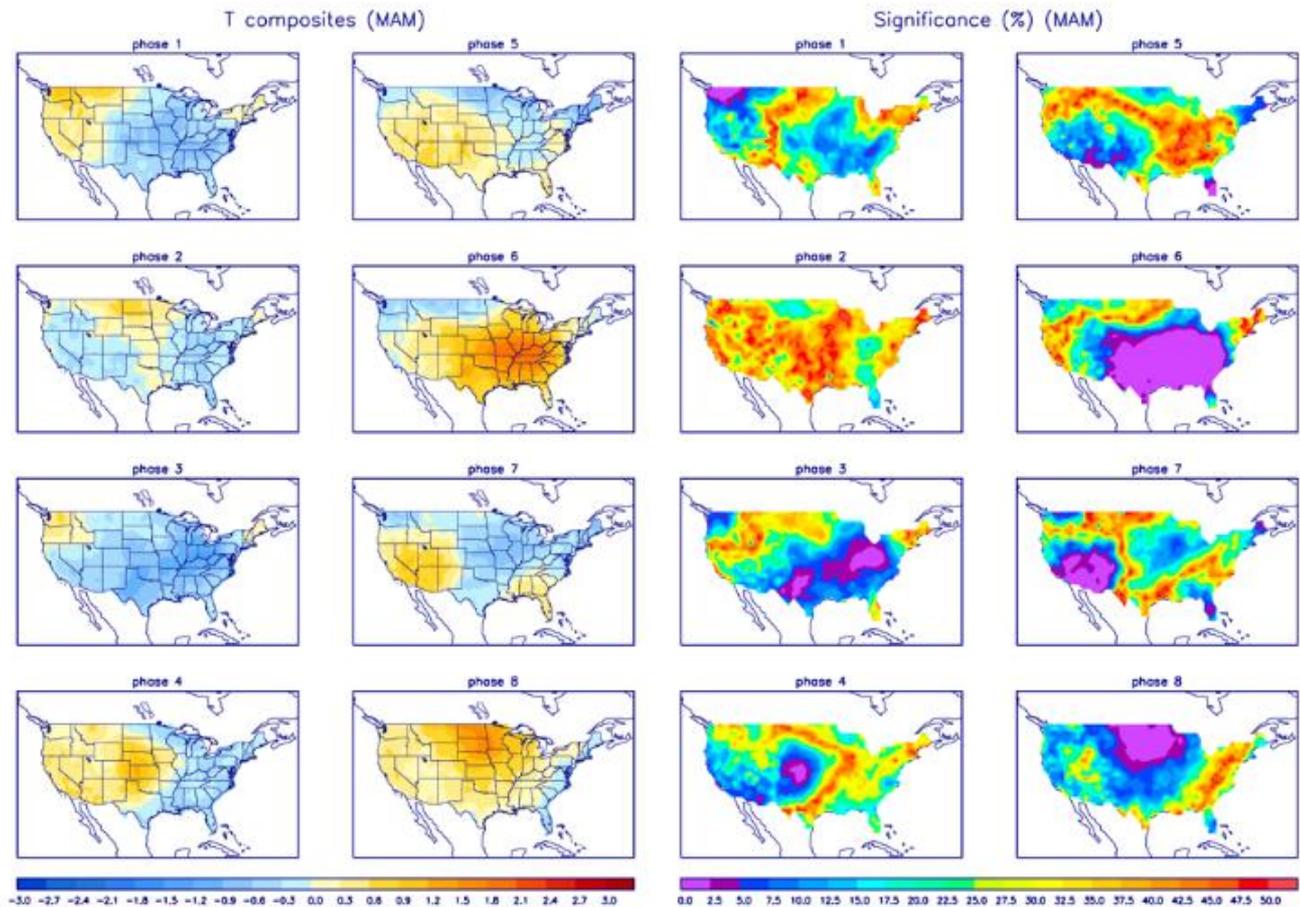
Precipitation Anomalies



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.

