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

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
23 May 2022

Overview

- An eastward propagating Kelvin Wave moving over the Pacific Ocean last week has diminished in strength, with the main convective envelope now situated over western Africa.

- Forecasts for the RMM-based MJO index show an increase in signal strength, suggesting the emergence of MJO over the Western Pacific in the coming week.

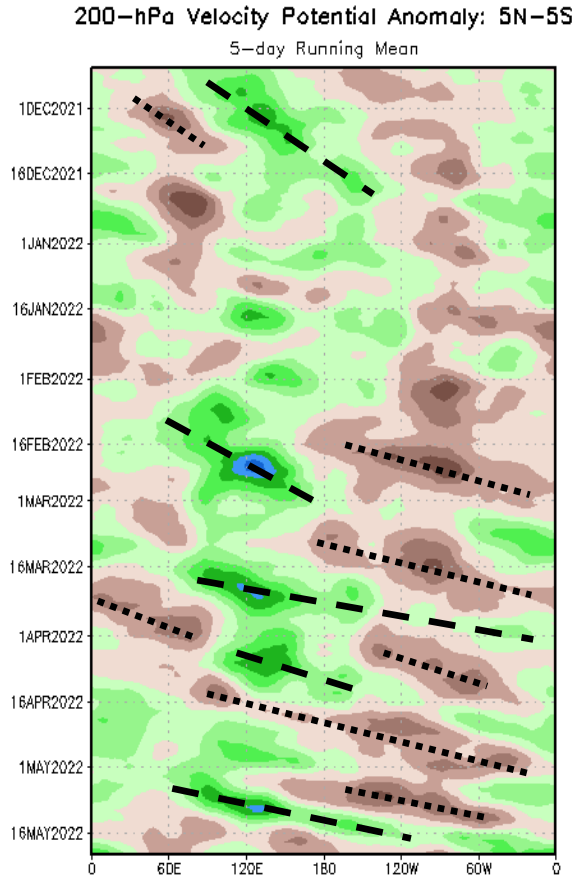
- This Kelvin Wave is forecast to continue to propagate quickly across the Pacific, possibly enhancing the potential for TC formation in the East Pacific for late week 1/early week 2 period.

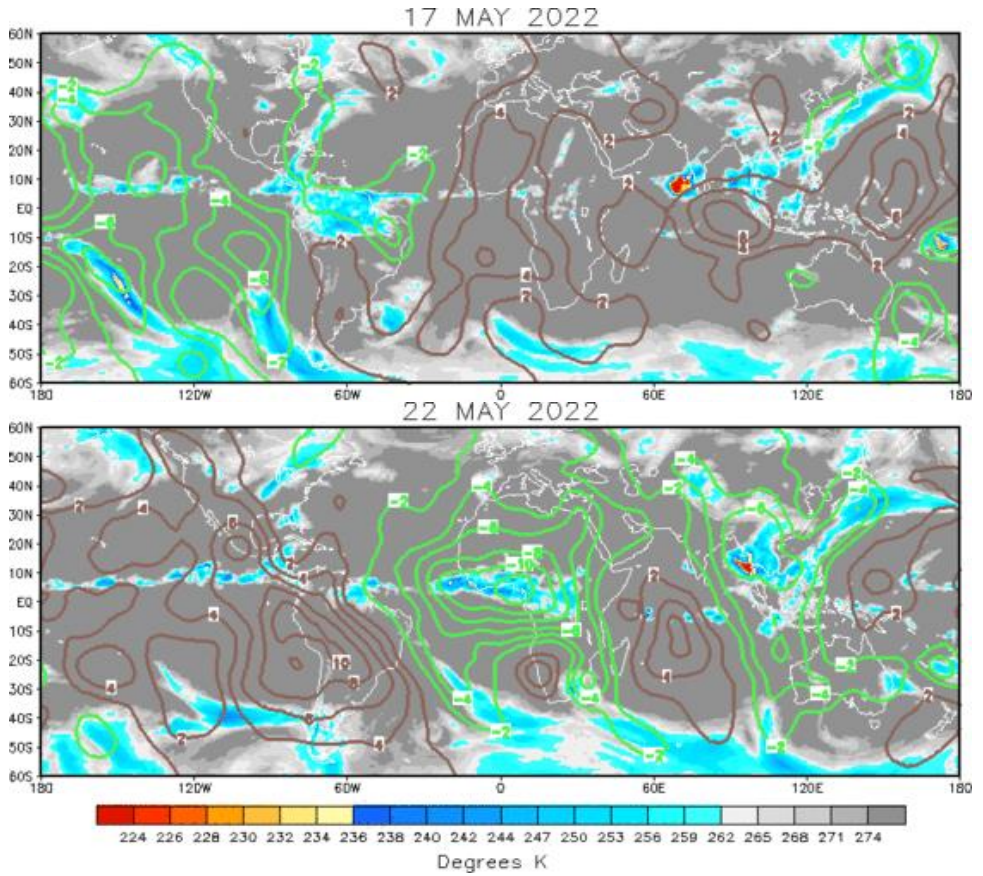
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)



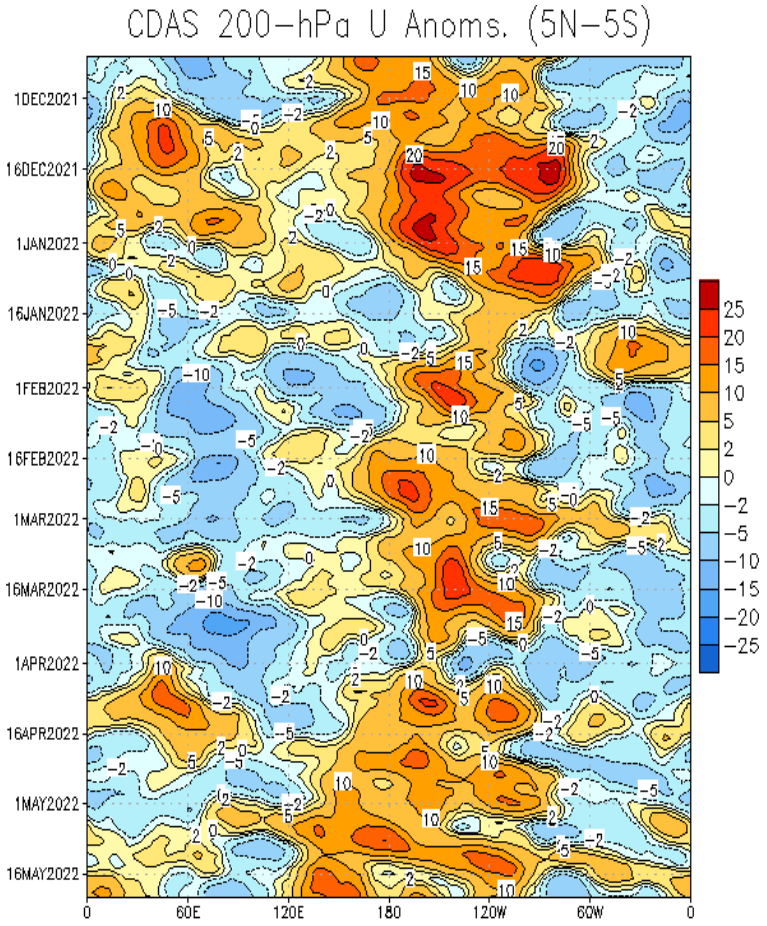


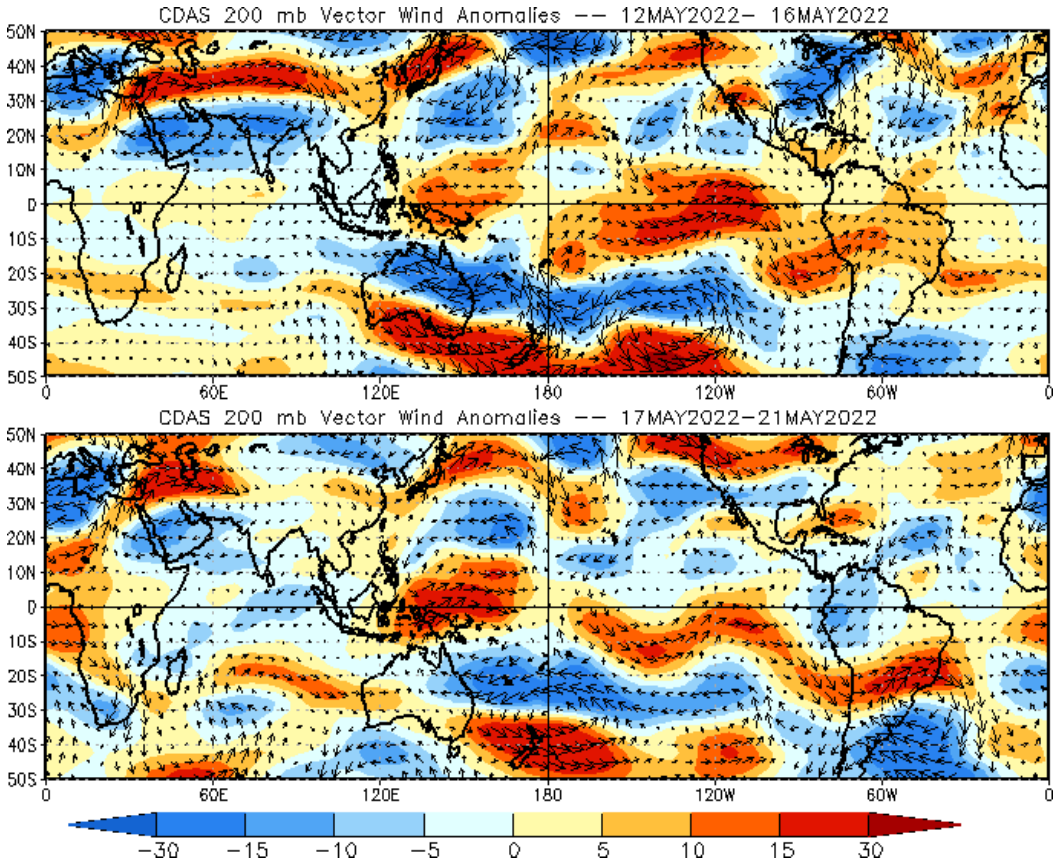
- A wave-1 pattern last week appears to be evolving into a wave-2 pattern, with anomalous divergence noted over Africa and the Maritime Continent, and convergence over the Indian Ocean and much of the Pacific.

- Kelvin Wave that was moving over the Pacific last week diminished somewhat as it moved over the Americas but is now re-strengthening as it moves over Africa.

200-hPa Wind Anomalies

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

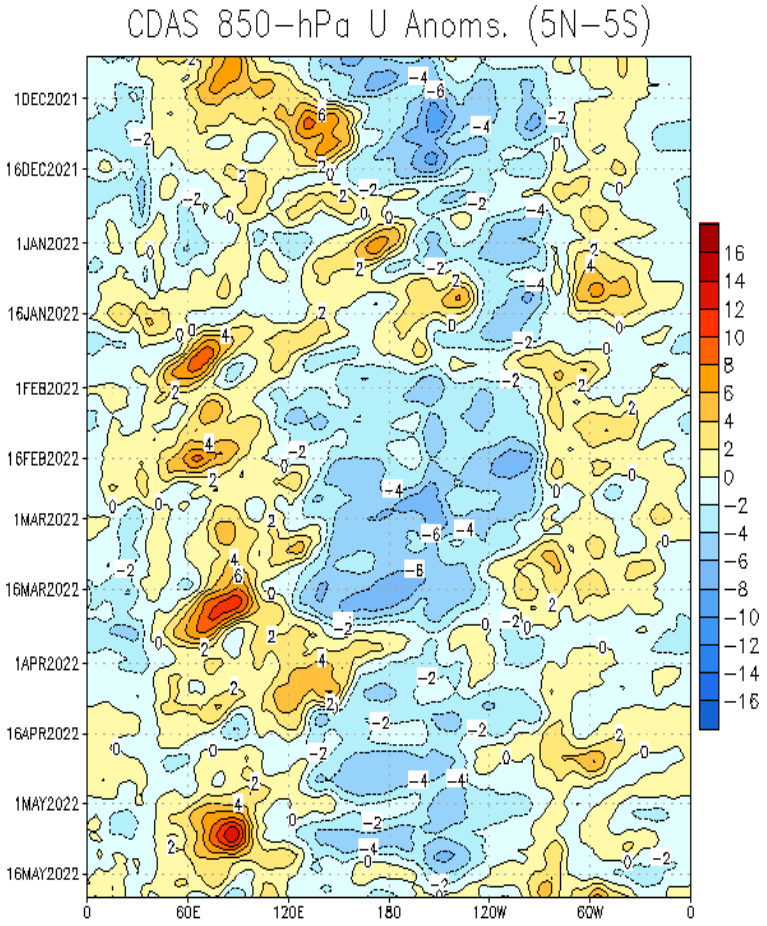


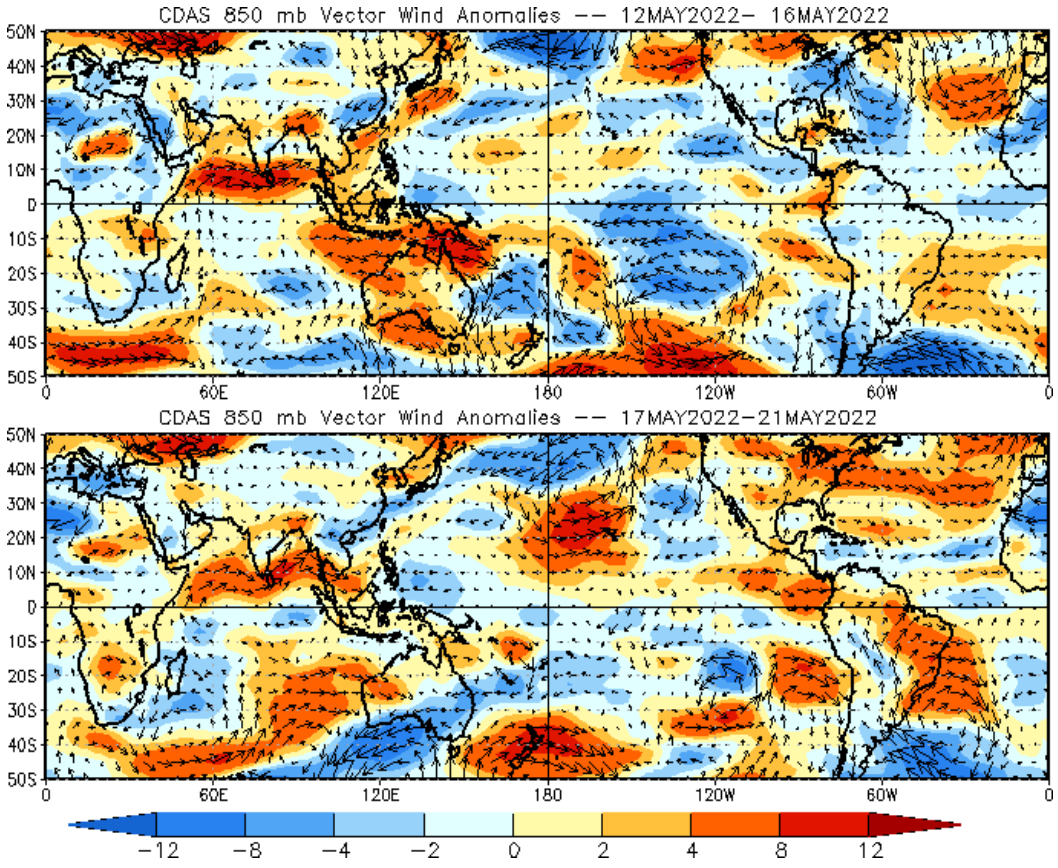


- Anomalous upper-level westerlies persist throughout the equatorial Pacific, consistent with ongoing La Niña conditions.
- Anomalous upper-level easterlies are highlighted across the Northern Indian Ocean and subtropical South Pacific.

850-hPa Wind Anomalies

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

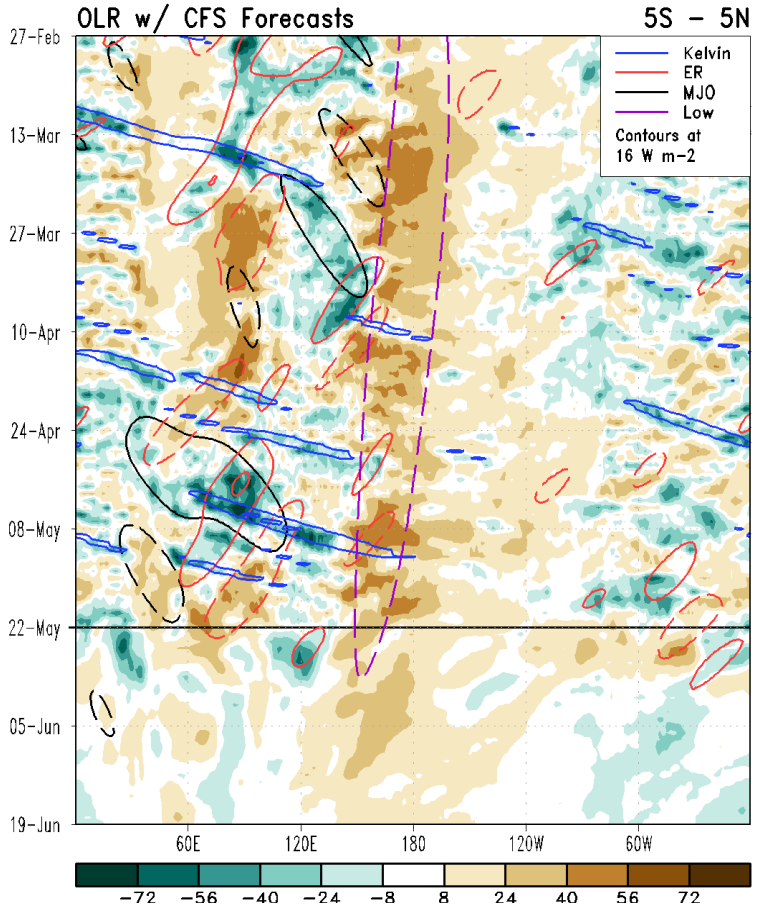


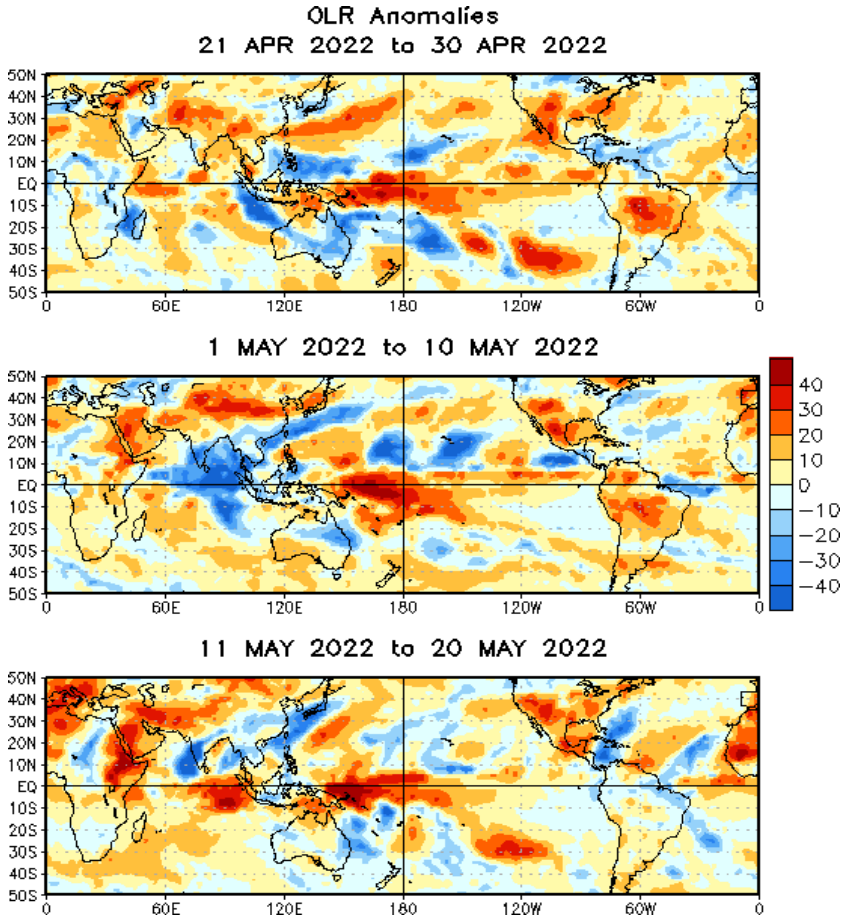


- Enhanced Pacific trade winds due to La Niña conditions have diminished significantly over the last week.
- Low-level westerly anomalies continued across the Indian Ocean north of the equator, but have weakened recently over the Maritime Continent.
- An anomalously strong cyclonic circulation is featured over central North Pacific.

Outgoing Longwave Radiation (OLR) Anomalies

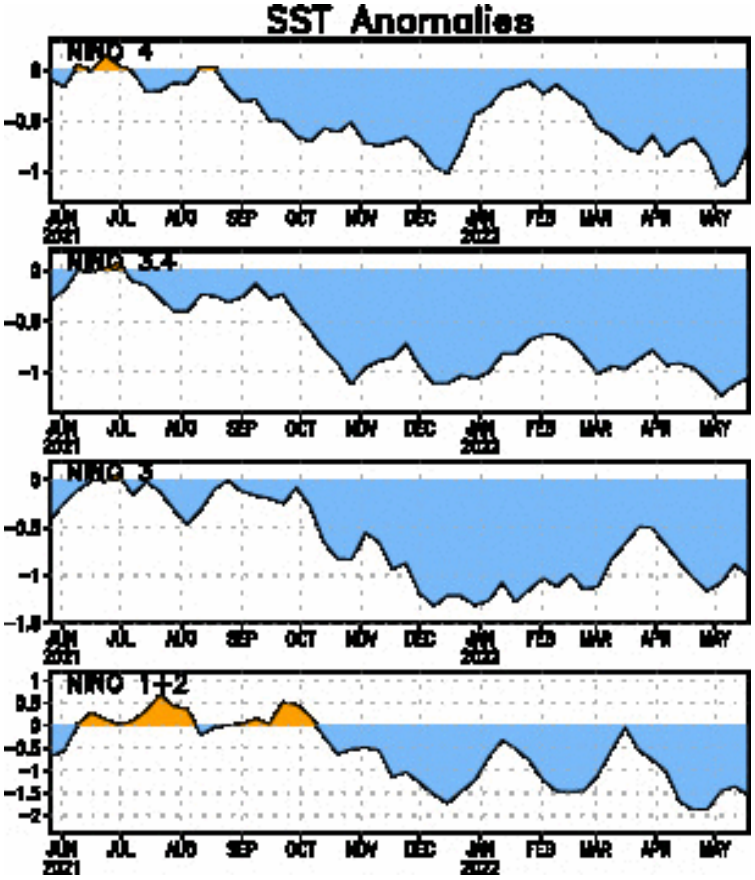
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

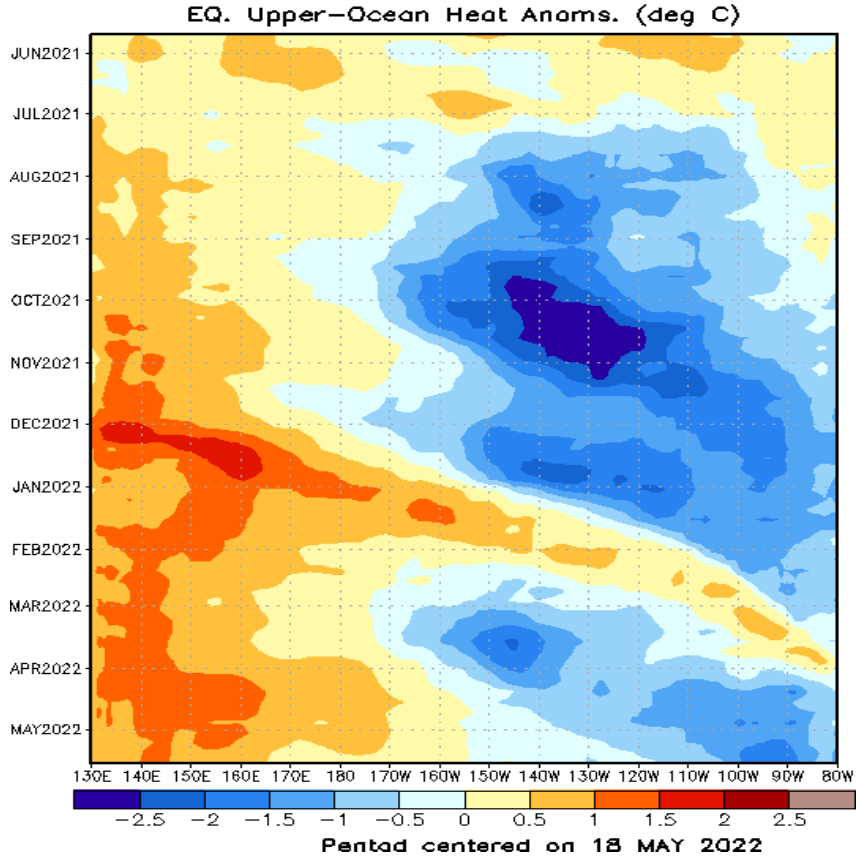




- Tied to the ongoing La Niña, strongly suppressed convection along and to the west of the Date Line remains the most prominent feature in the OLR field over the past several months.
- Though not detected in the filtering, the Kelvin Wave can be noted moving off the Americas and into Africa recently.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

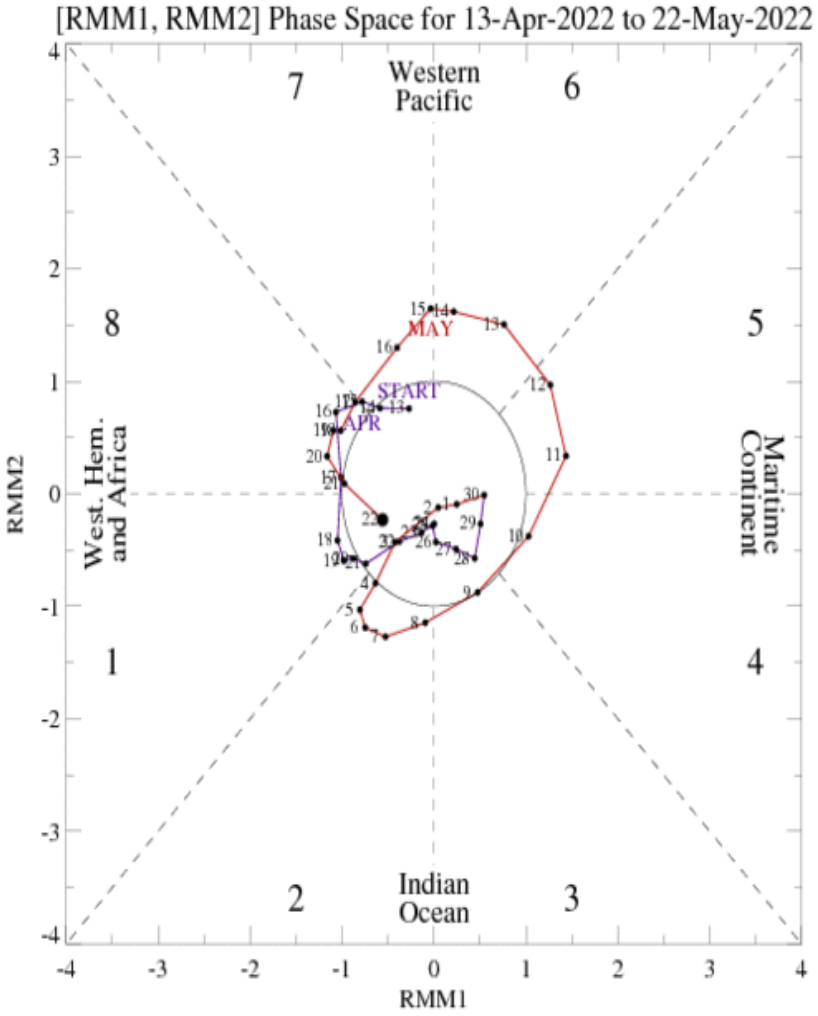




- Persistent La Niña conditions continue, with SSTs staying well below normal after a minor wram-up during the first months of the year.
- An eastward expansion of the warm anomalies around the Maritime Continent, which was associated with eastward propagation of convective envelope, has stalled near the Date Line.

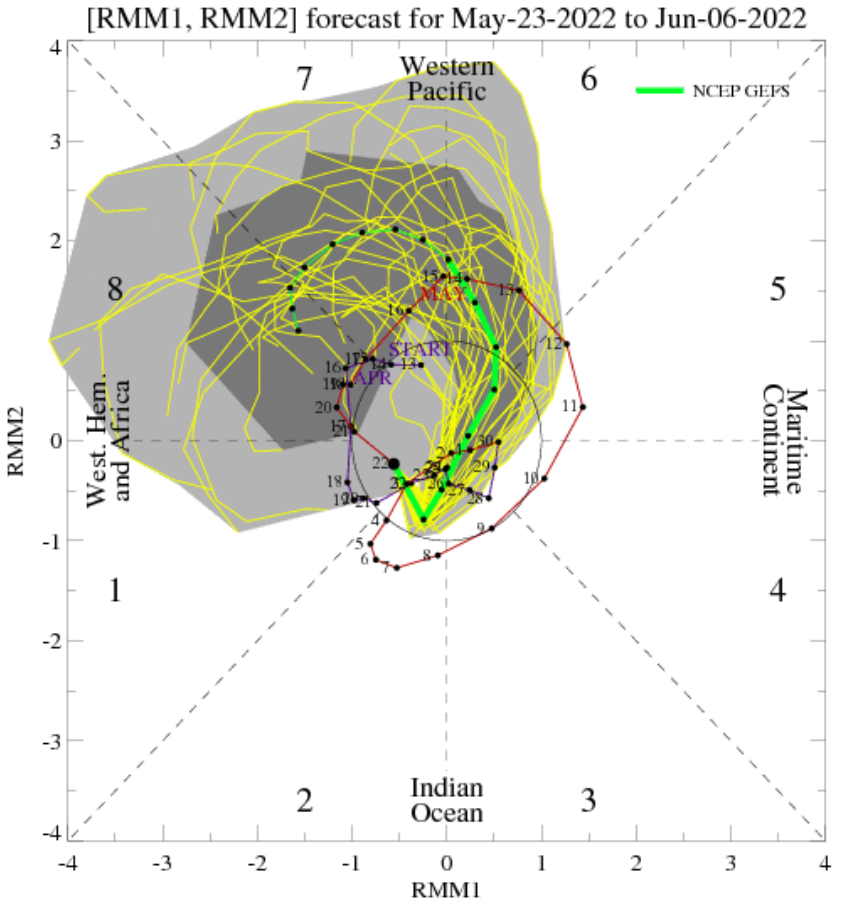
MJO Index: Recent Evolution

- During early to mid-May, the RMM index shows an amplified signal with a propagation speed that is indicative of a Kelvin Wave rather than a canonical MJO.
- The amplitude of the signal has substantially weakened during the last week, and currently resides within the RMM unit circle.

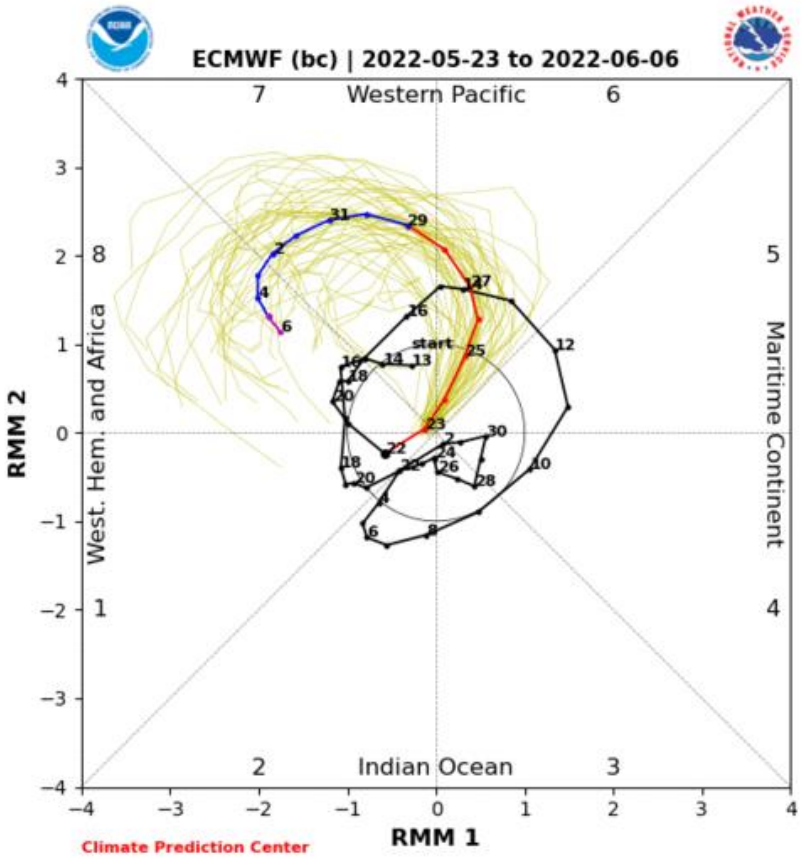


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

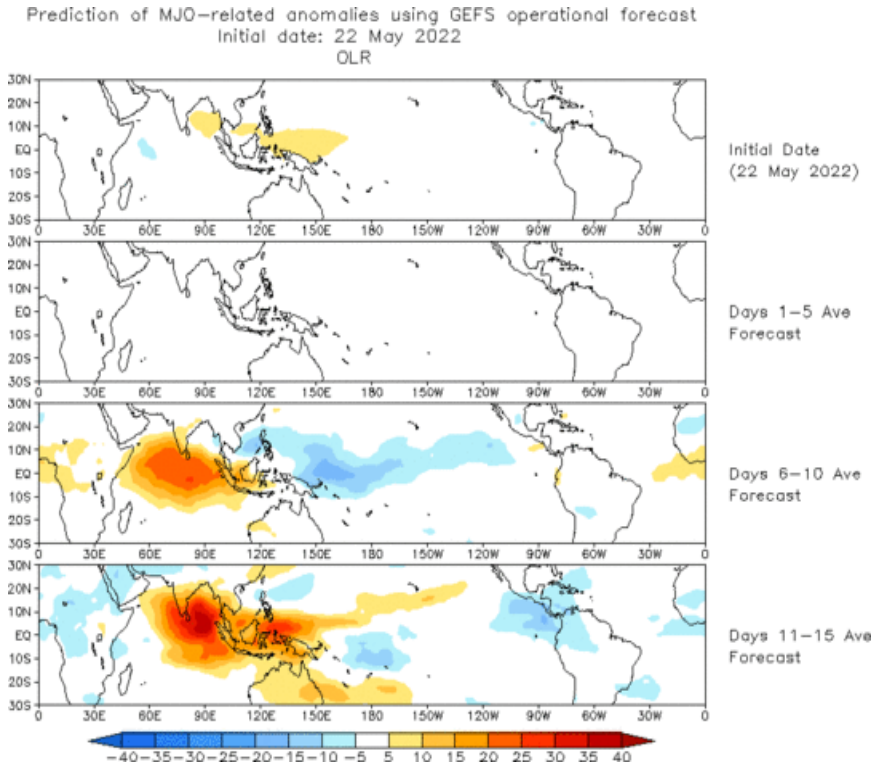


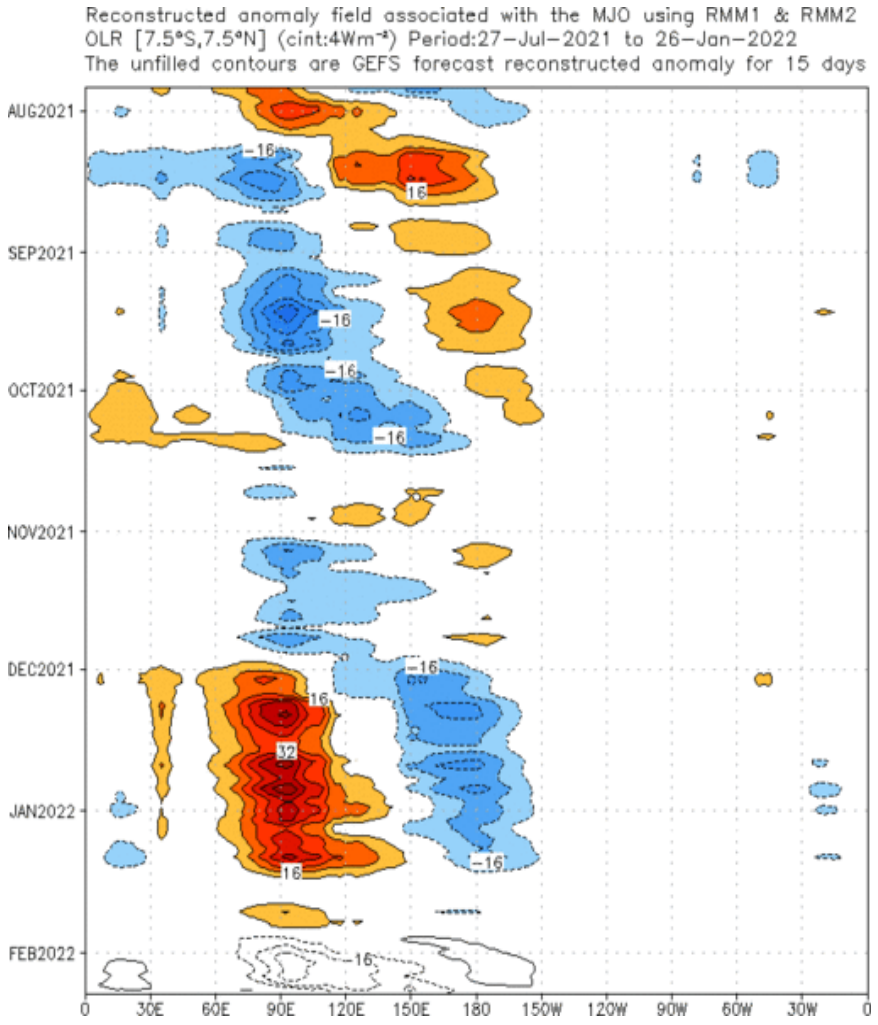
ECMWF Forecast

- Both GEFS and ECMWF depict a rapid strengthening of the RMM index over the coming two-week period with a slower propagation than in prior weeks, suggesting a transition from a dominant Kelvin Wave to more canonical MJO signal.
- There continues to be good model agreement in the evolution and strength of the intraseasonal signal during the next two weeks.

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.)

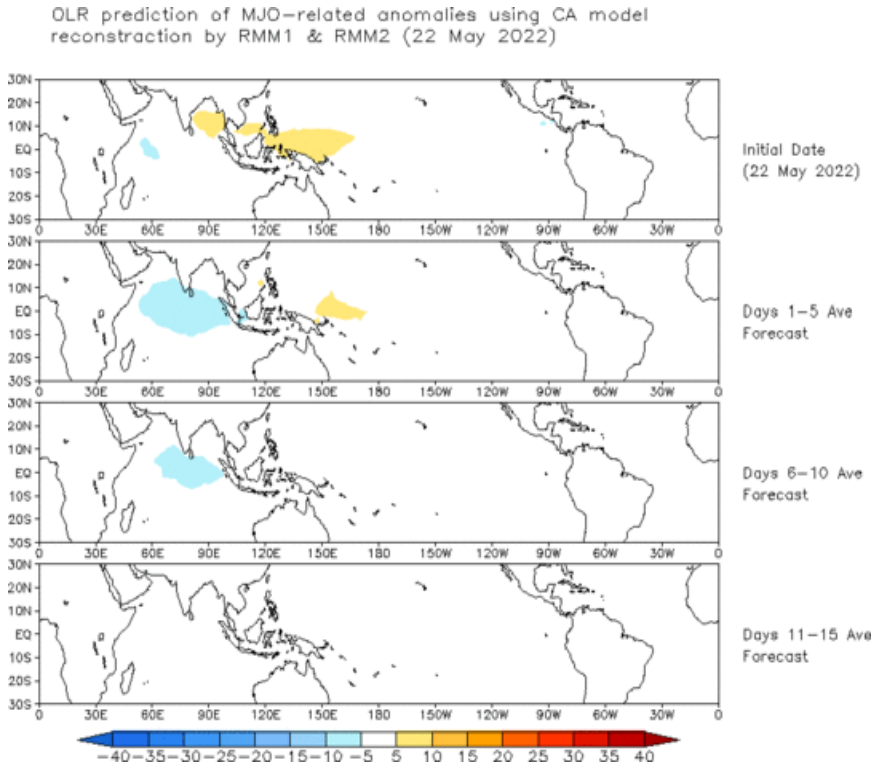


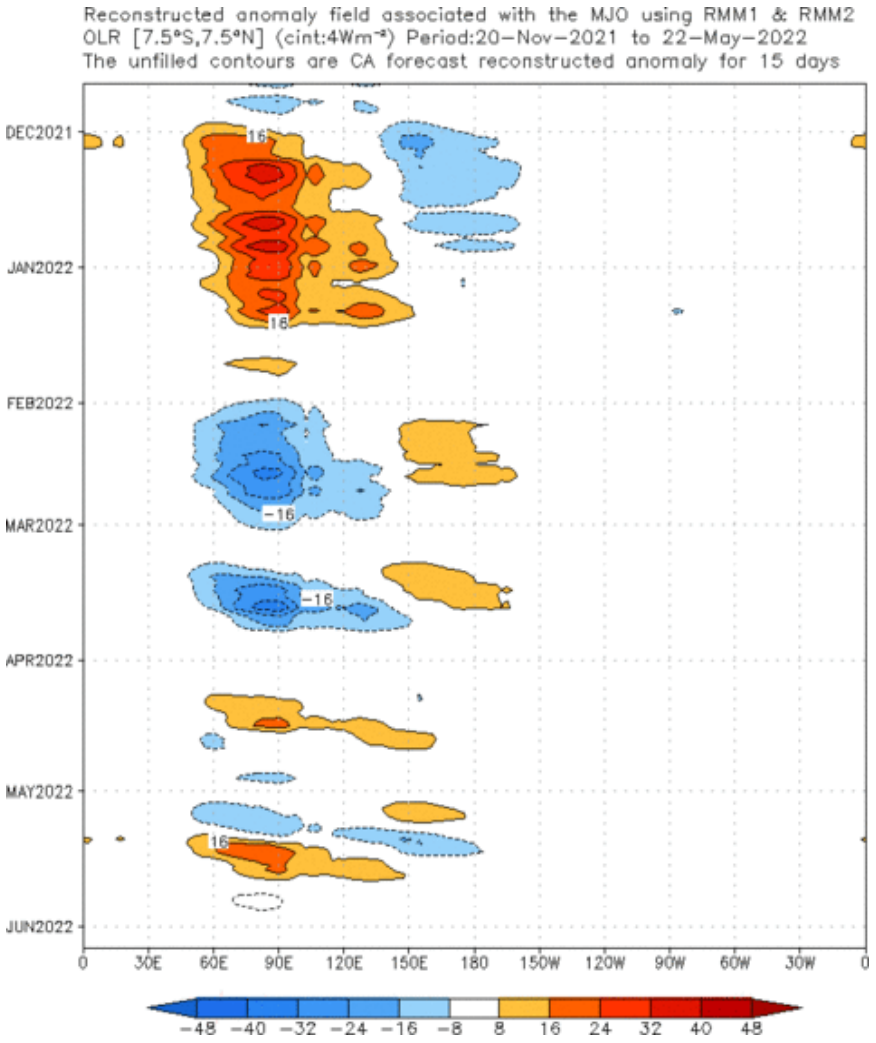


- The GEFS RMM-based OLR field depicts emerging positive OLR anomalies (suppressed convection) across the Indian Ocean, and negative OLR anomalies (enhanced convection) across the equatorial western and central Pacific late in week-1, and across the eastern Pacific and the Americas during week-2.

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.)

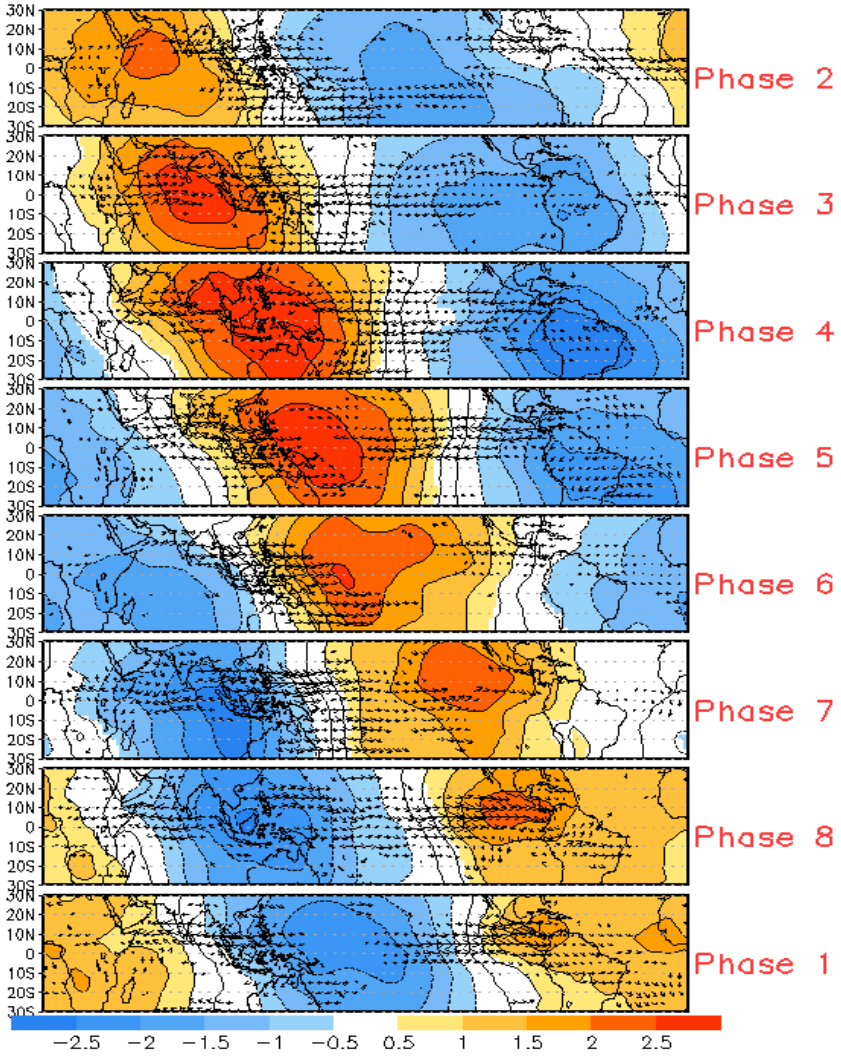




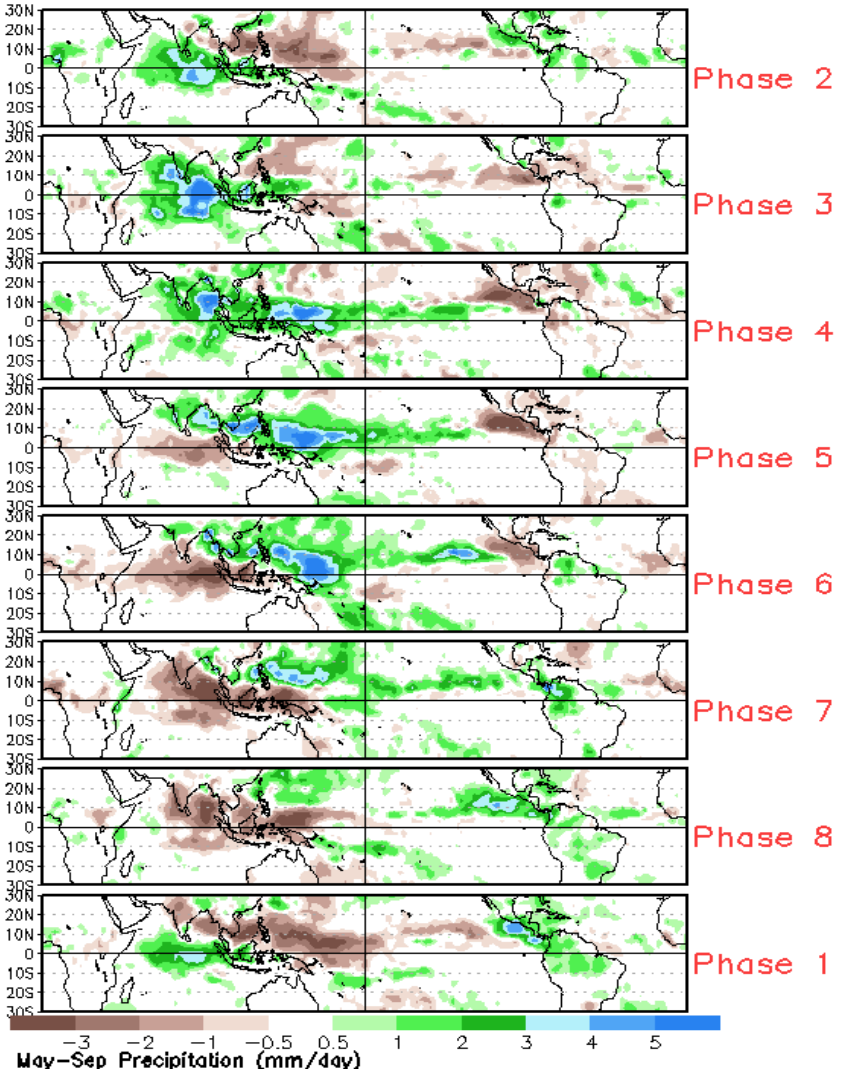
- The constructed analog forecast of RMM-based OLR anomalies indicates a weakening pattern, initially depicting positive OLR anomalies over the Maritime Continent, then negative anomalies over the Indian Ocean during week 1. By week 2 OLR field approaches climatology.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



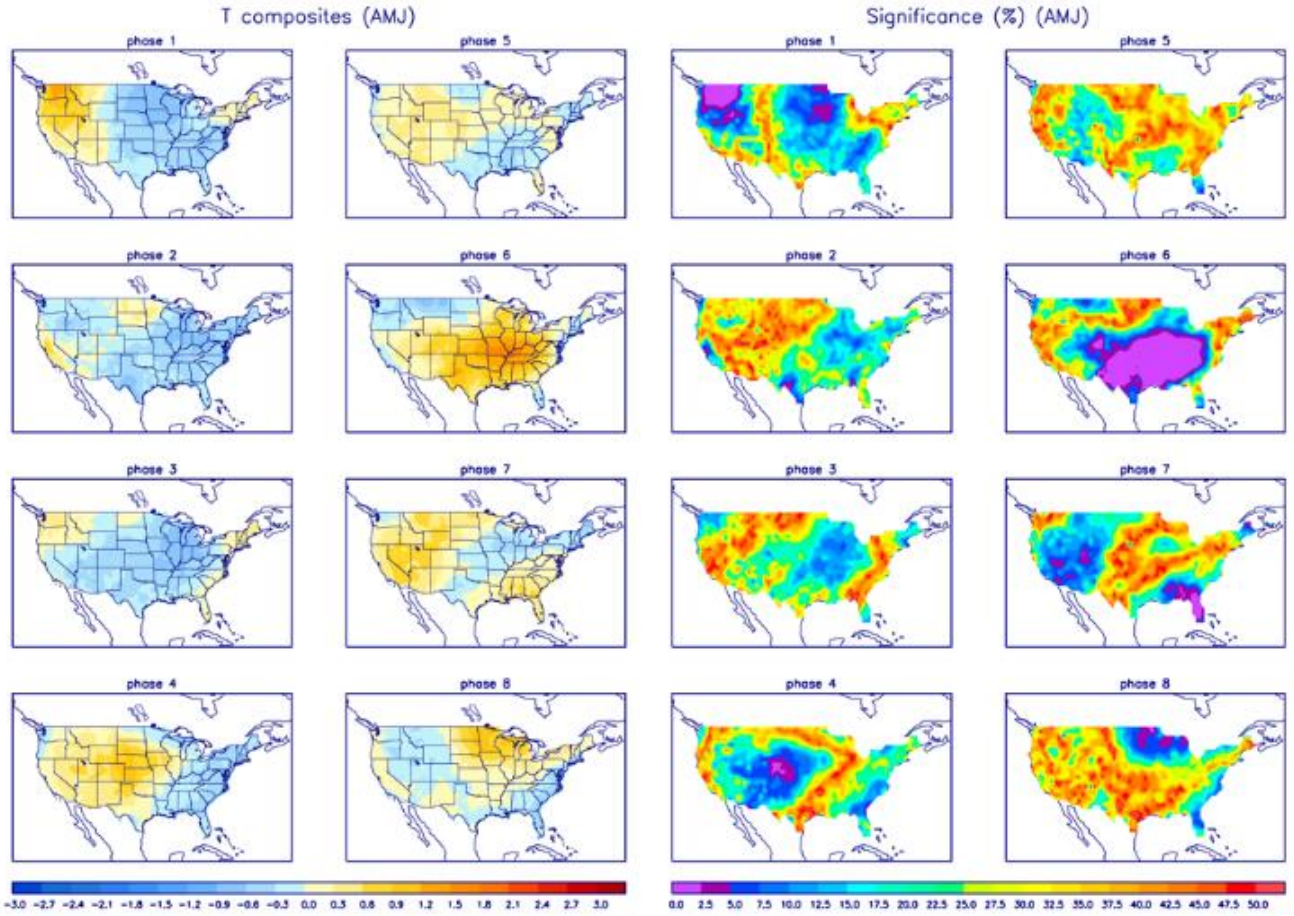
Precipitation Anomalies



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.

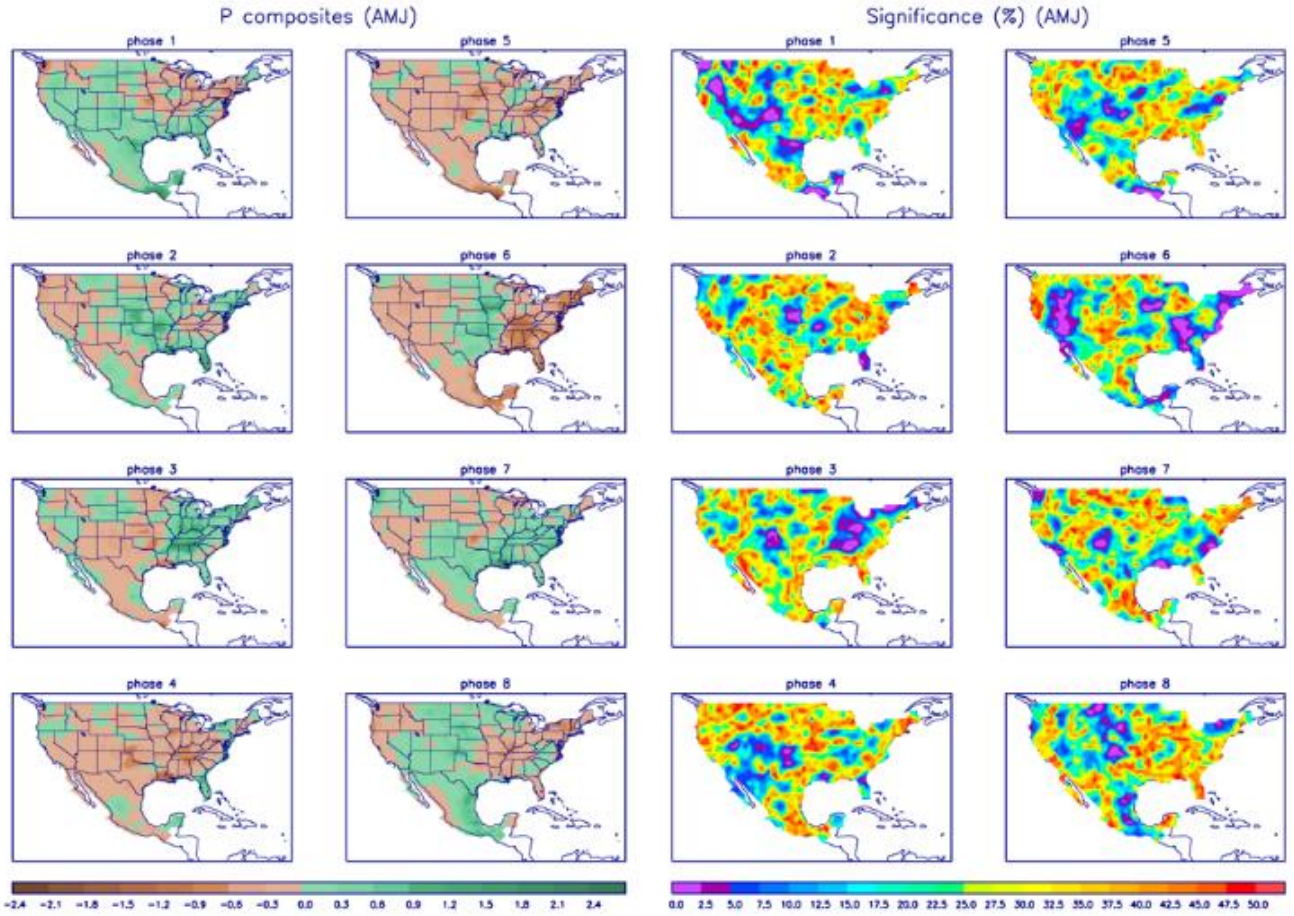


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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.



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