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

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

Overview

- After moving steadily around the edge of the unit circle over the last few weeks, the RMM-based MJO signal has weakened over the last few days but continues to propagate eastward.

- Probabilities of TC formation over the Western Pacific are increasing with enhanced convection over the region and environmental conditions that favor development.

- There is some uncertainty into the MJO evolution during the next 2 weeks with the GEFS and ECMWF disagreeing on how far east the MJO will progress during the forecast period, but both models seem to agree that the signal will strengthen over the next 2 weeks.

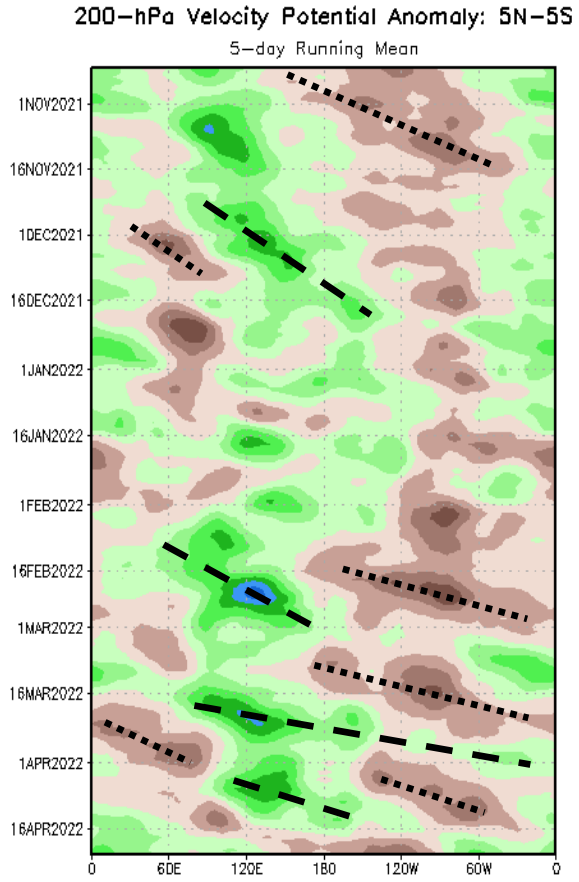
- La Niña conditions are expected to continue for the near future, although the evolution of the MJO over the coming months will be a significant player in the long-term picture and could temporarily interrupt the persistent La Niña event as we move out of the Boreal spring and into summer.

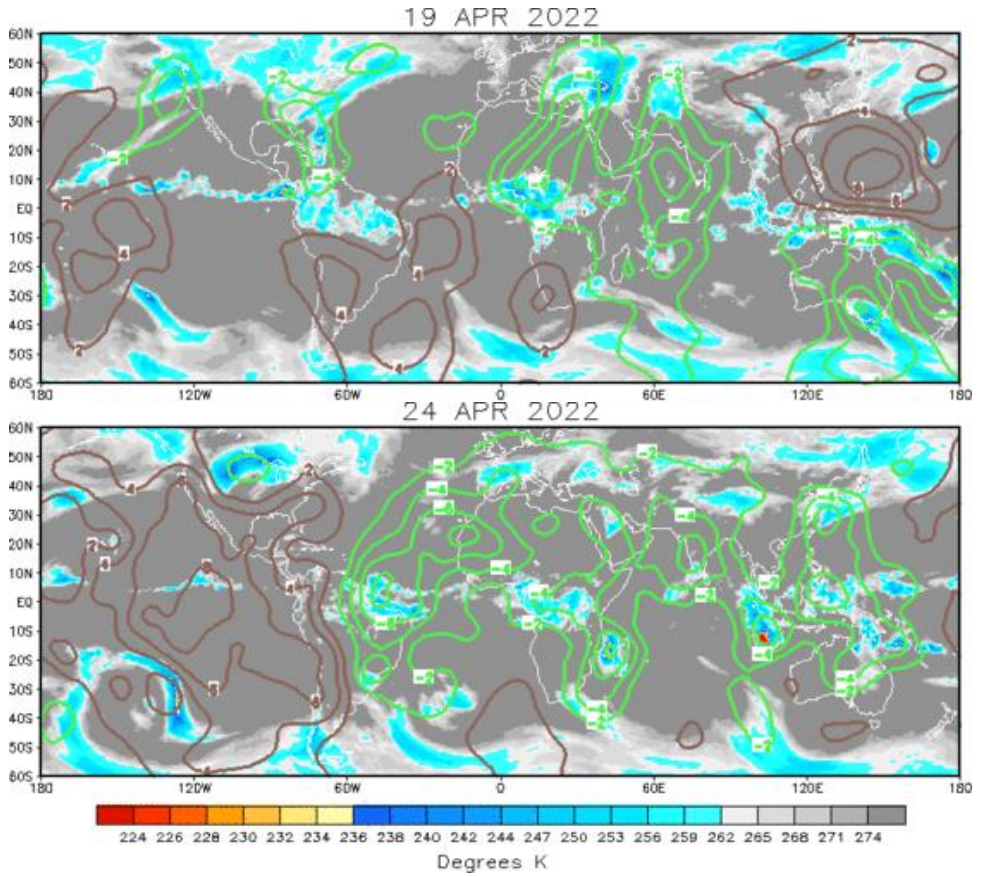
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

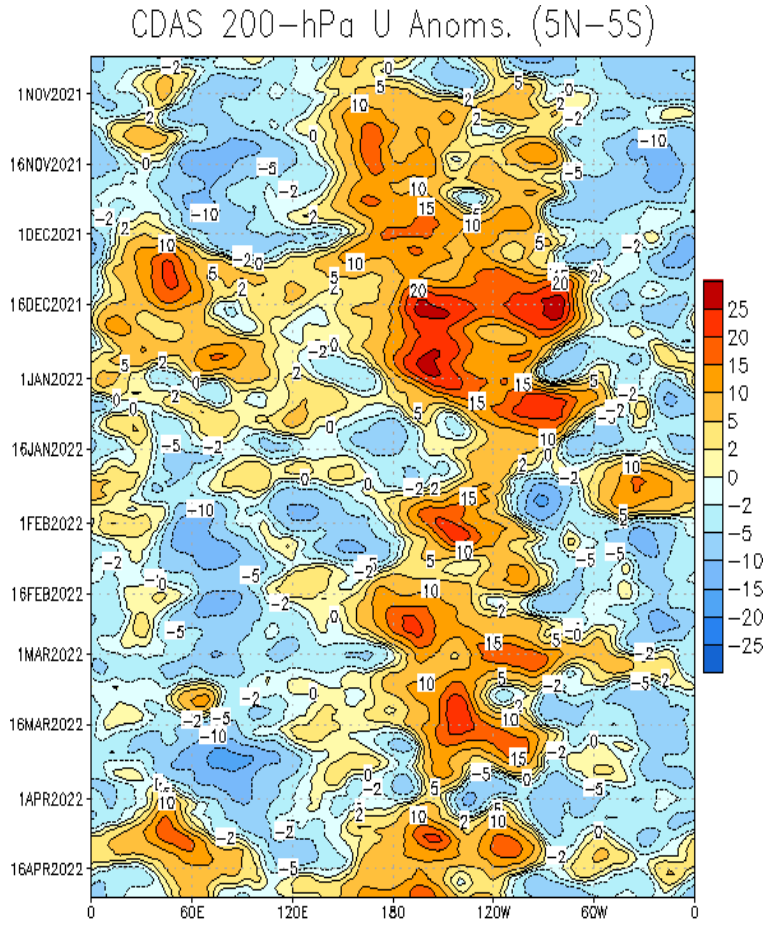


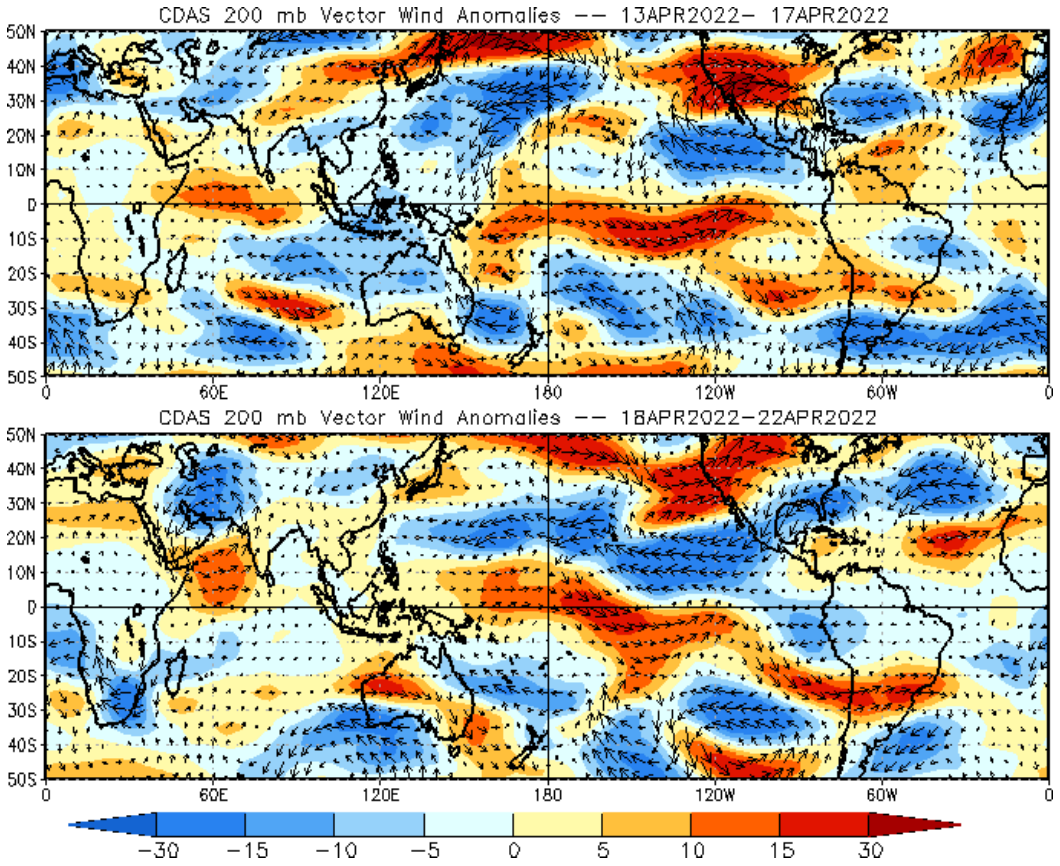


- Wave-1 pattern emerged and became more coherent in the last week.
- Enhanced divergence has become the dominant feature in the tropics, extending from eastern South America to the Western Pacific, just a few weeks after anomalous convergence was the primary feature for the global tropics.

200-hPa Wind Anomalies

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



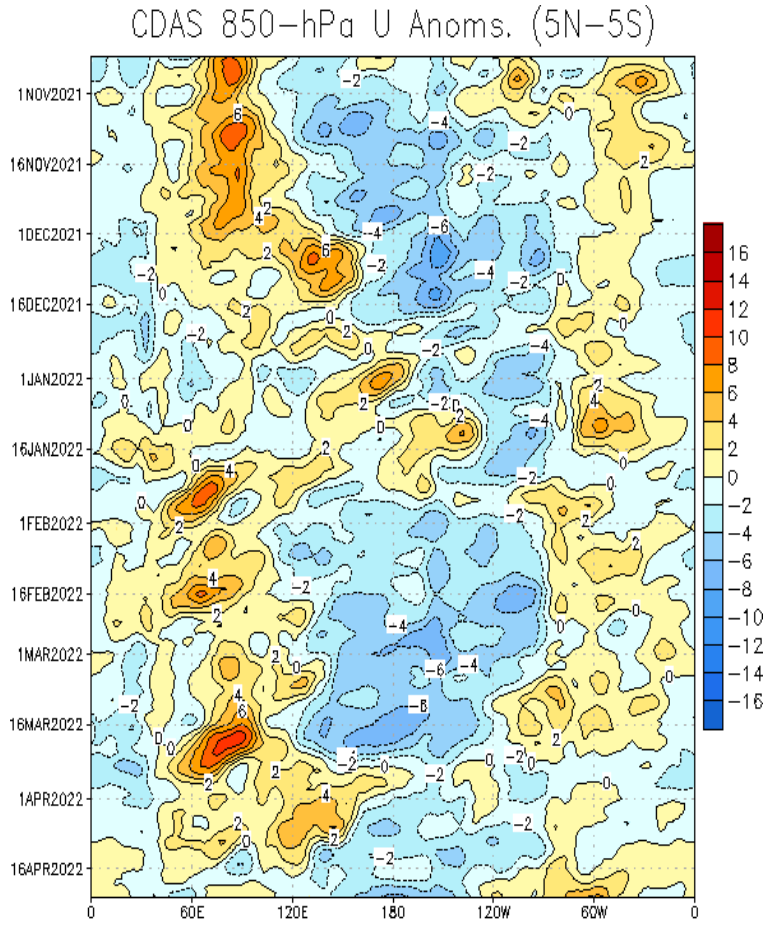


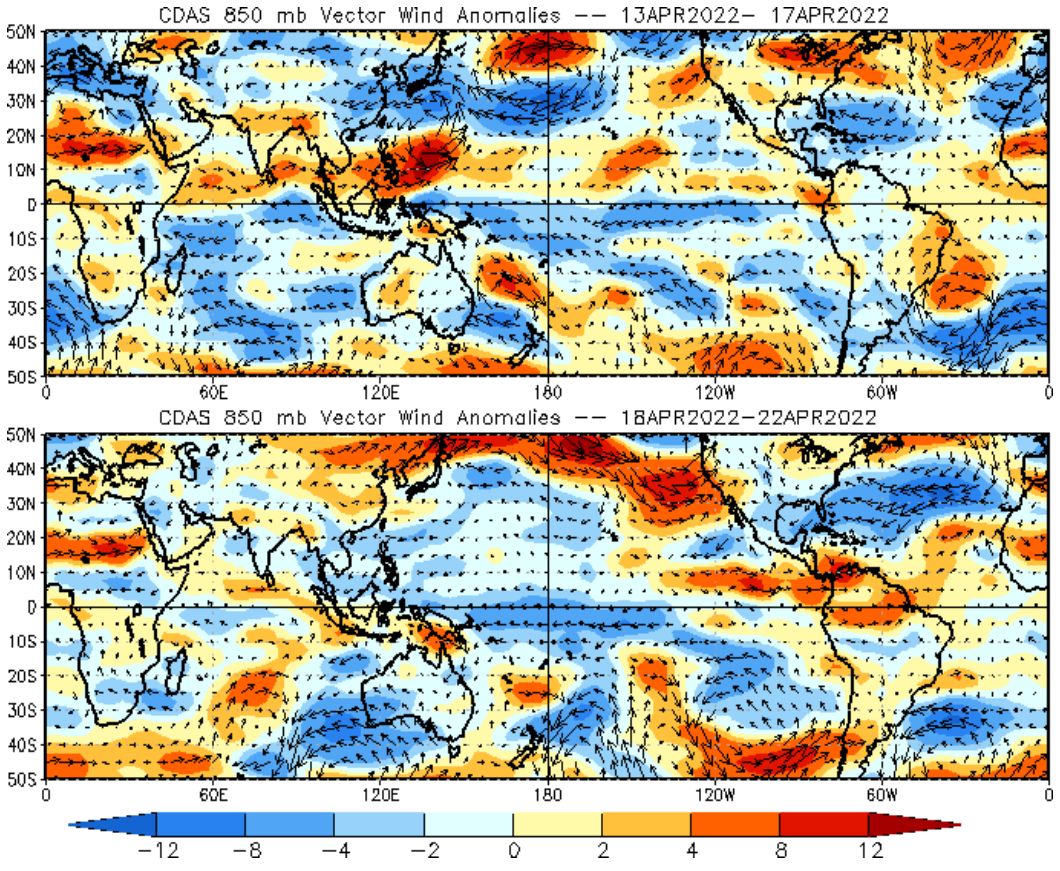
- Anomalous upper-level westerlies continued across the Equatorial Pacific tied to ongoing La Niña conditions, while increasing easterlies expanded and strengthened north of the Equator across the Pacific Ocean.

- Upper-level wind anomalies have subsided for the Maritime Continent and much of the Indian Ocean, while anomalous westerlies that were off the East Coast of Africa have shifted north and coupled with easterlies over Asia Minor, forming a large area of cyclonic circulation.

850-hPa Wind Anomalies

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



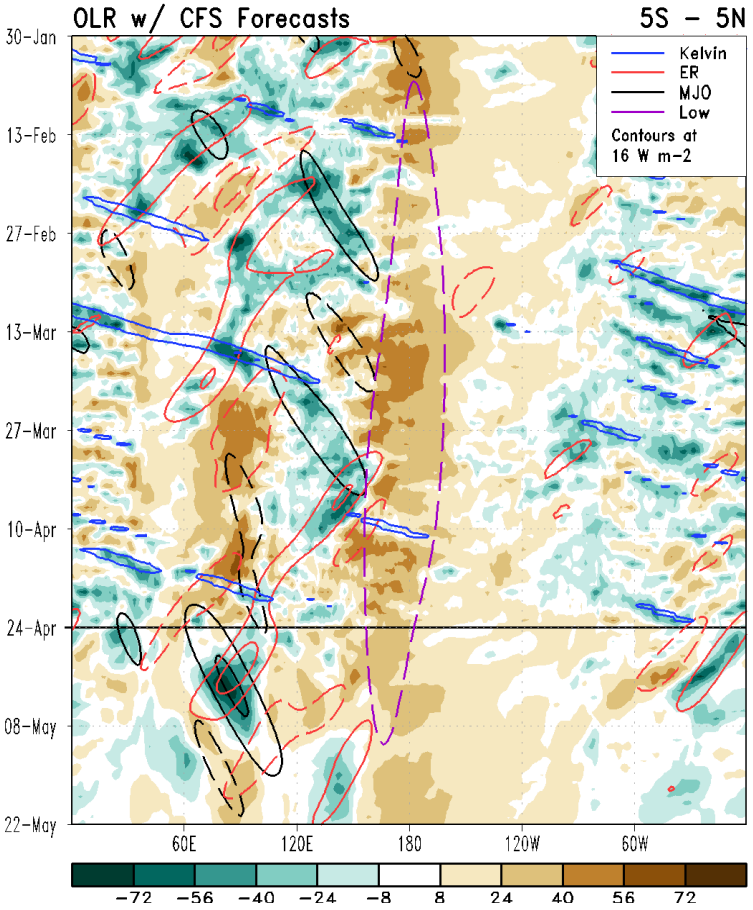


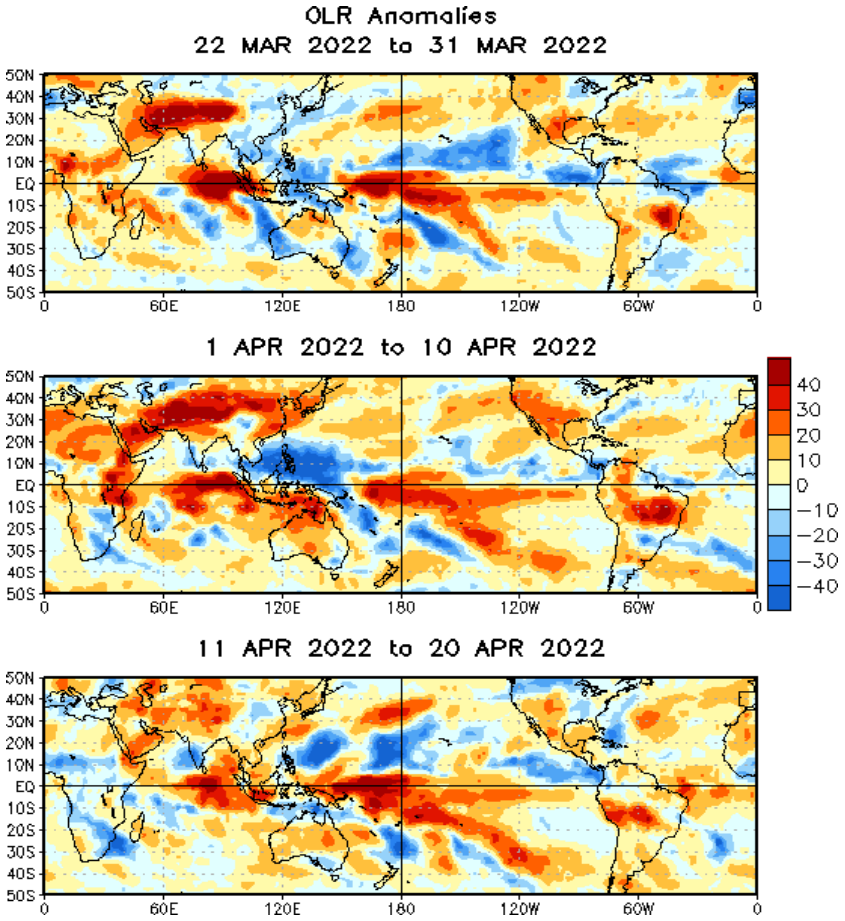
- Stronger trade winds continue for the central and western Pacific Ocean, while slight westerly anomalies continue and strengthen for the tropical Eastern Pacific.

- Low-level winds are near normal for the northern Indian Ocean and Maritime Continent, as well as much of the western and central Pacific north of the Equator

Outgoing Longwave Radiation (OLR) Anomalies

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

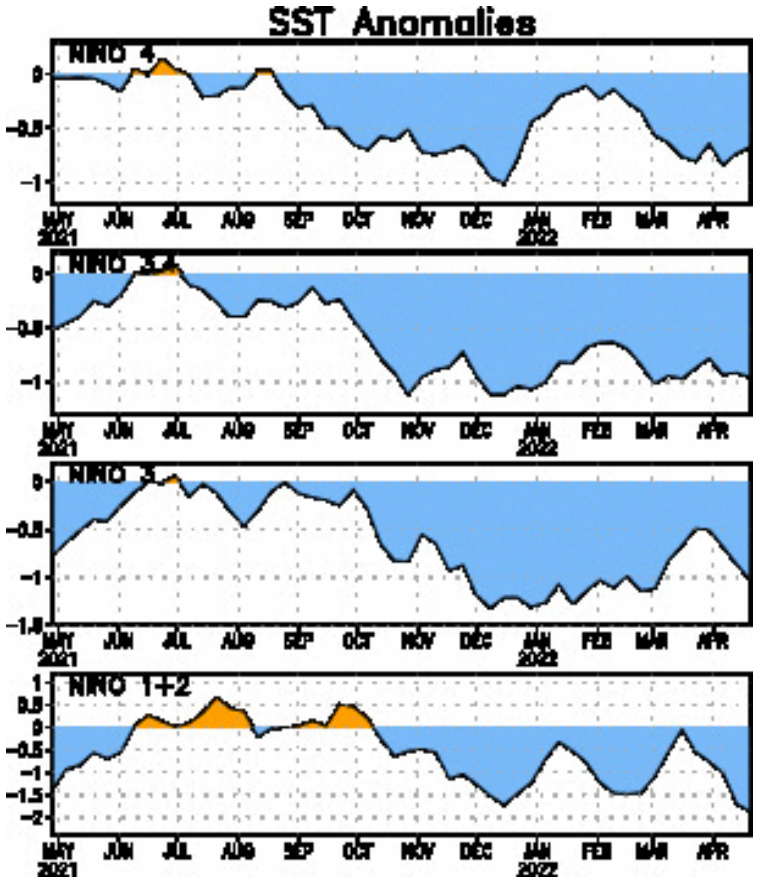


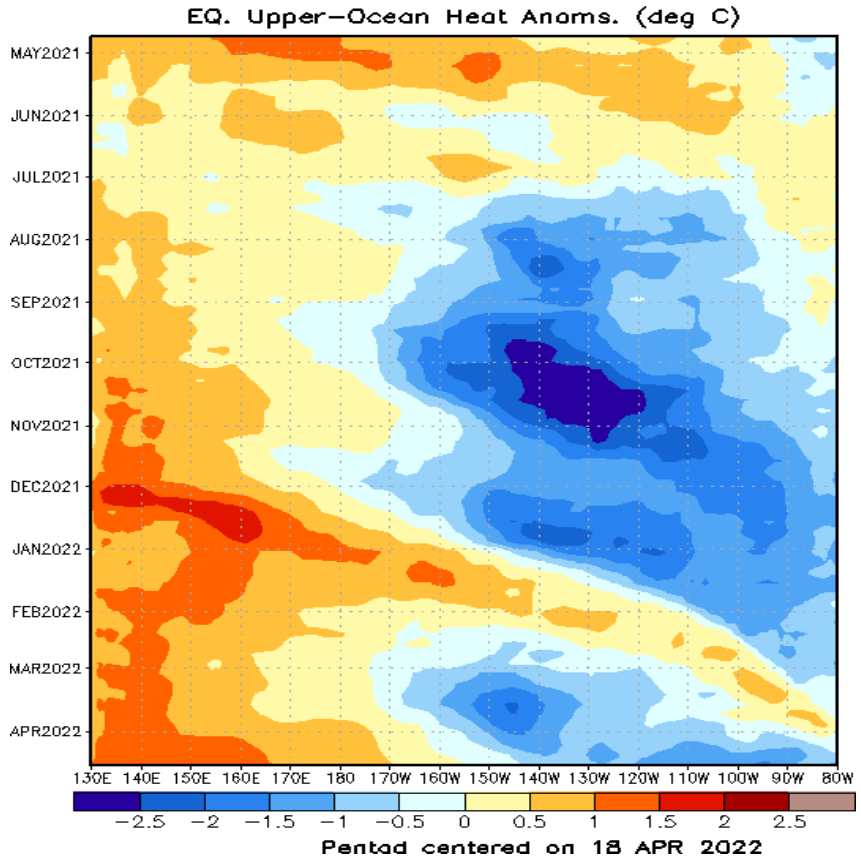


- Suppressed convection over the Pacific associated with the ongoing La Niña remains the most prominent feature in the OLR field over the past several months, and enhanced convection over the Maritime Continent has been considerably reduced and shifted northward over the last few weeks.

- Recent Kelvin wave activity is becoming less apparent, but over the next few weeks a convective outbreak over the Indian Ocean is forecast due to increasing MJO and Equatorial Rossby wave activity.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific





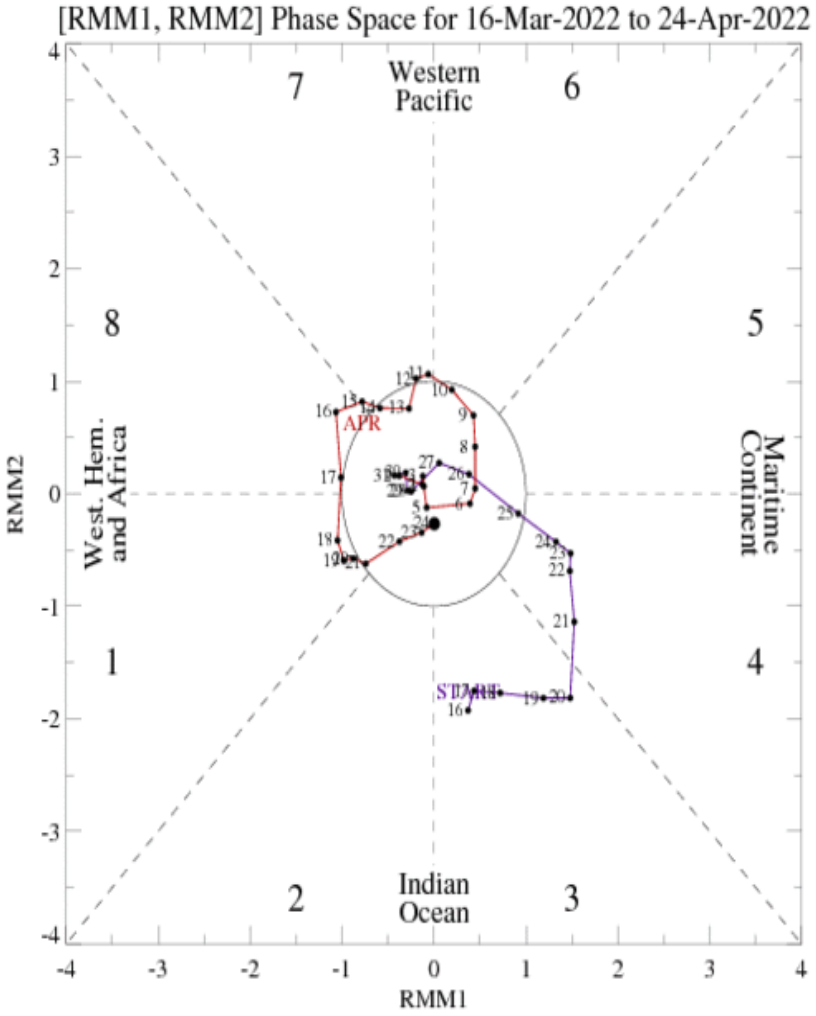
- Sea surface temperatures (SSTs) have remained anomalously low over all Niño regions during the past week.

- A new lobe of warm anomalies is expanding from the western Pacific towards the Date Line and bears close monitoring in the coming weeks as the MJO signal is forecast to re-emerge and the RMM index moves towards phase 6 in the coming two week period.

MJO Index: Recent Evolution

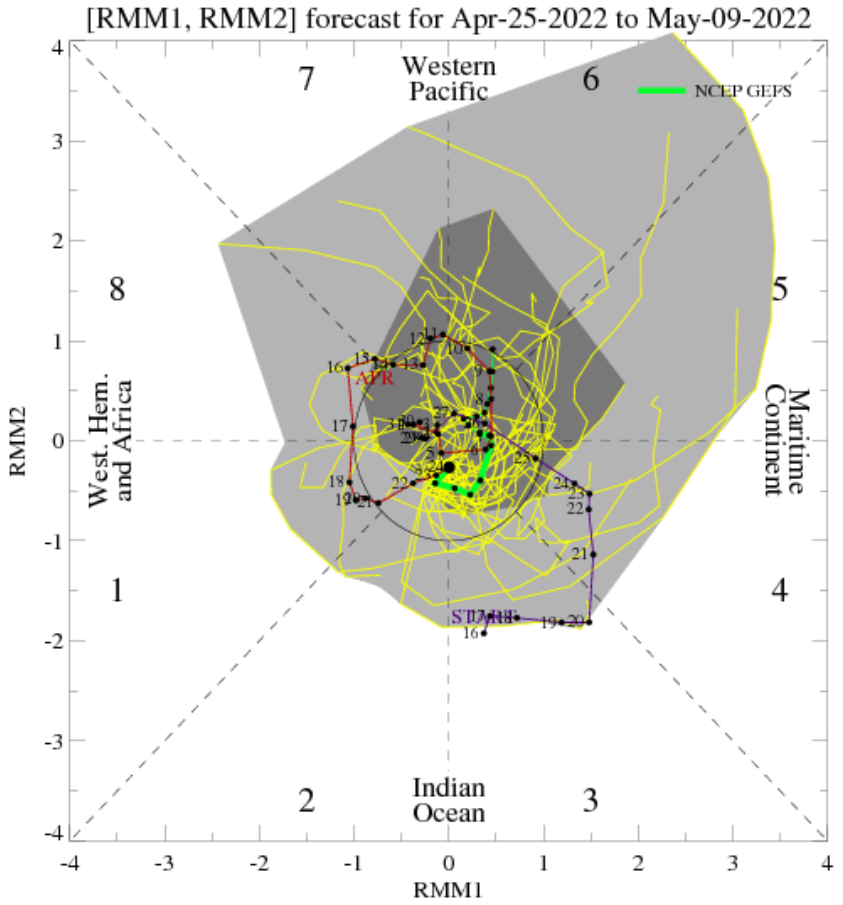
- In early April the RMM index had low amplitude, but in mid- to late-April it has steadily indicated eastward propagation of a weak signal.

- As predicted last week, the RMM index has once again moved quickly towards the center of the unit circle in the last week or so but has done so in a line cutting across phases 1 through 3, suggesting that the MJO propagation is continuing normally in spite of the much-reduced signal strength.

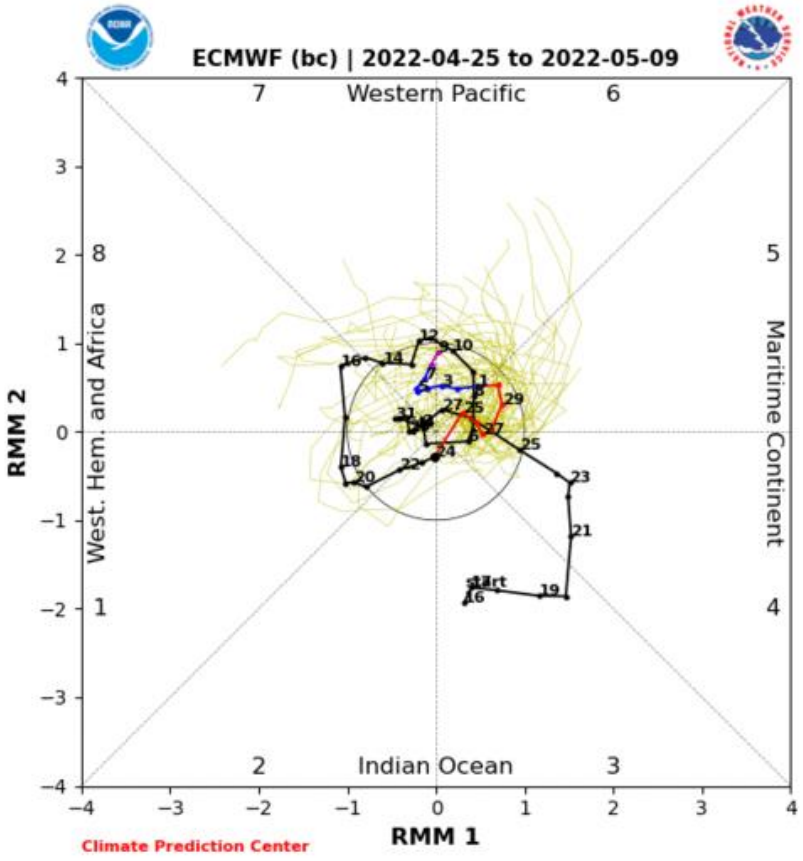


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



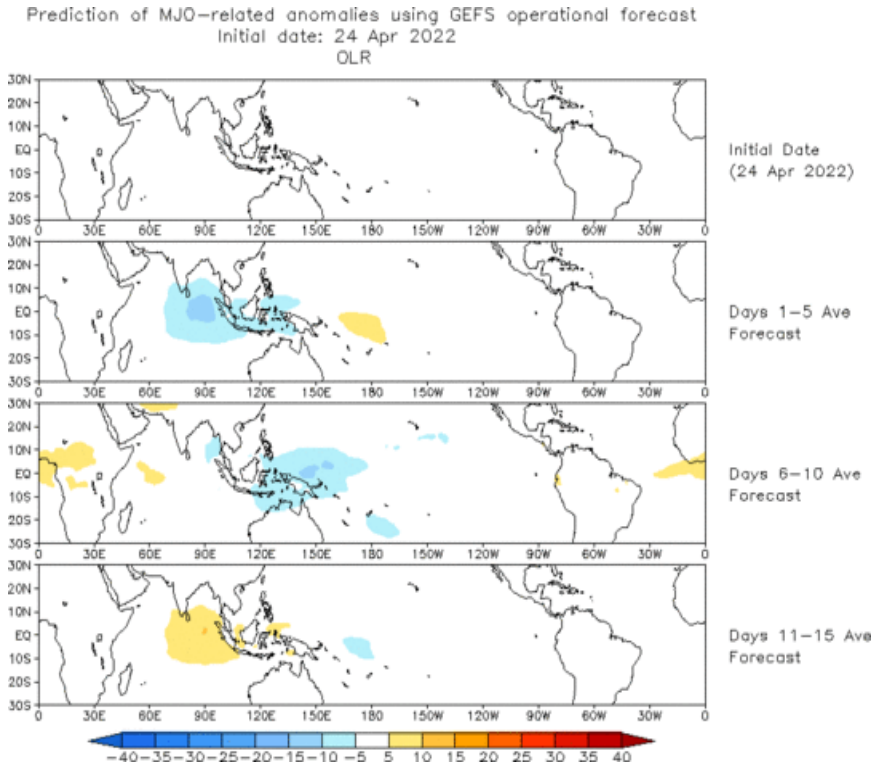
ECMWF Forecast

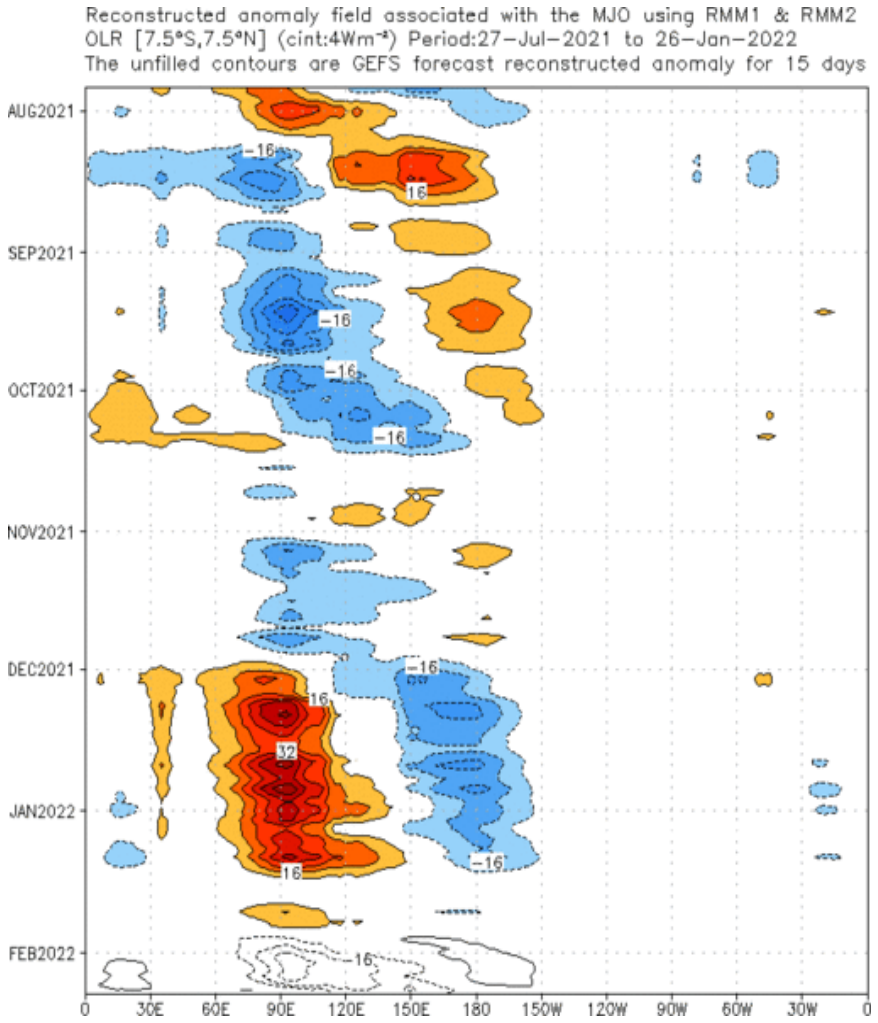
- There is disagreement between GEFS and ECMWF concerning the future evolution of the MJO. The GEFS depicts a continued regular progression of the RMM signal moving from phase 2 to 6 with many members suggesting a strengthening of the MJO as well. The EMCWF ensemble mean is much more erratic, jumping about both in strength and location of the main MJO center of action.

- Most ensemble member in both models push the RMM index outward from the origin in the coming weeks, suggesting that we should anticipate stronger MJO activity in the coming forecast period.

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.)

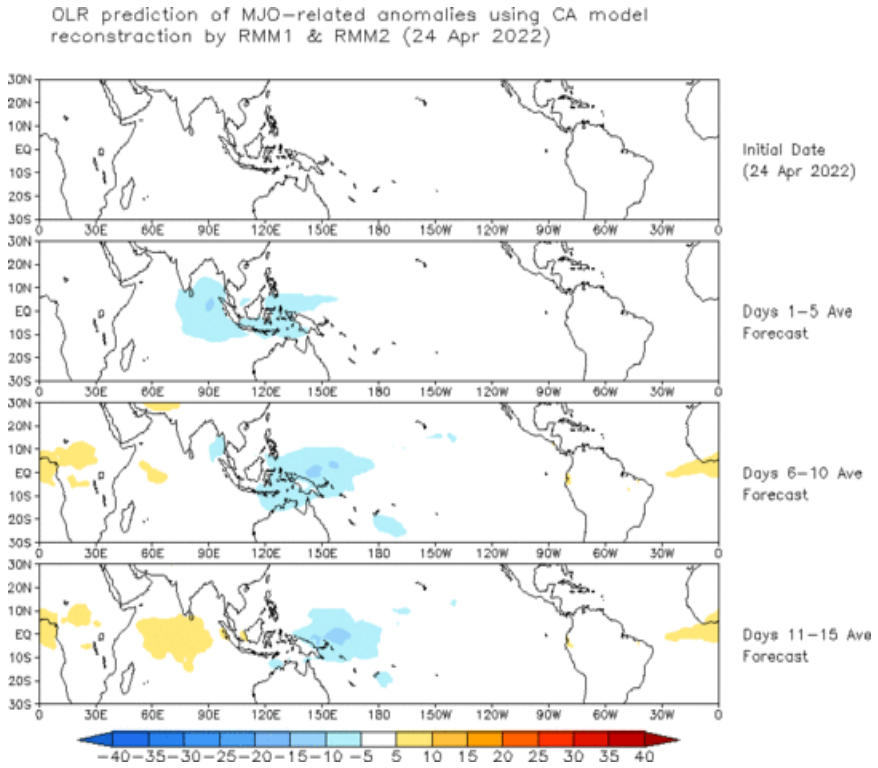


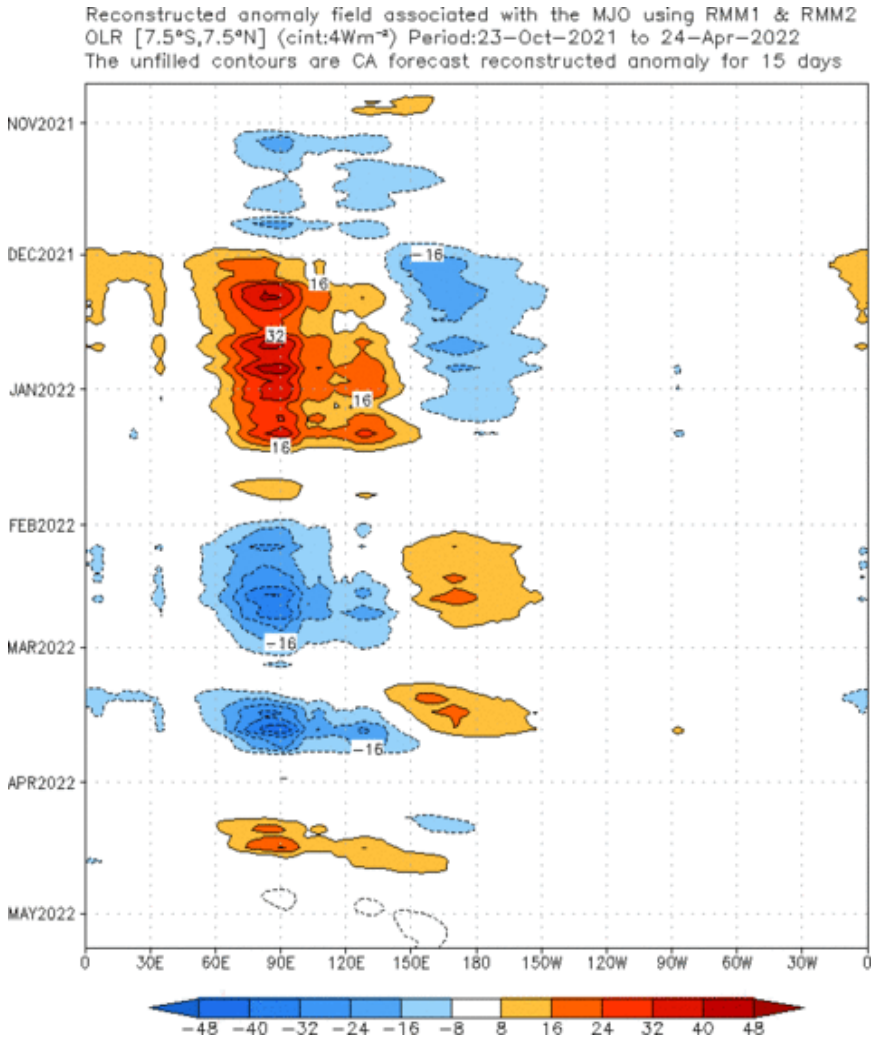


- The GEFS RMM-based OLR field depicts negative OLR anomalies (enhanced convection) moving from the eastern Indian Ocean and into the Maritime Continent before dissipating over the western Pacific, while positive anomalies (suppressed convection) emerge over the eastern IO in the second half of week 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.)

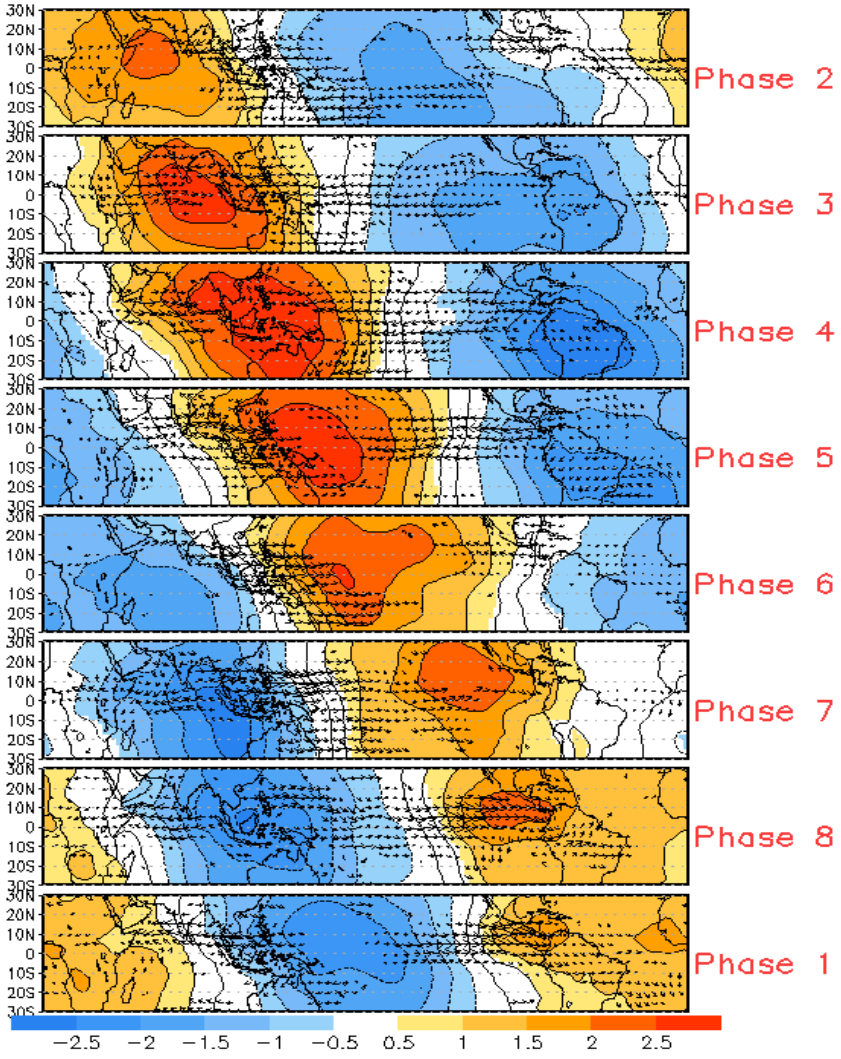




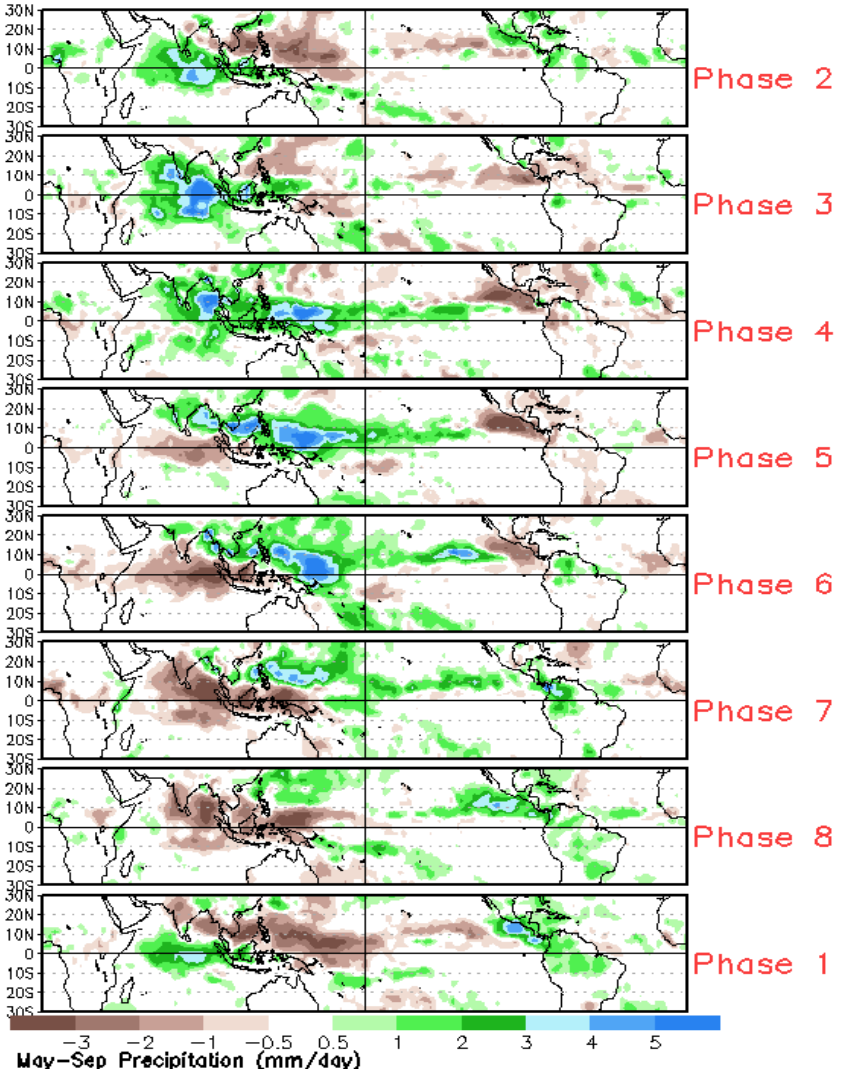
- The constructed analog forecast of RMM-based OLR anomalies shows a similar progression across the Indian Ocean and Western Pacific during the next two weeks.
- TC activity over the western Pacific Ocean will warrant closer monitoring over the next two weeks given the favored enhanced convection forecast.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



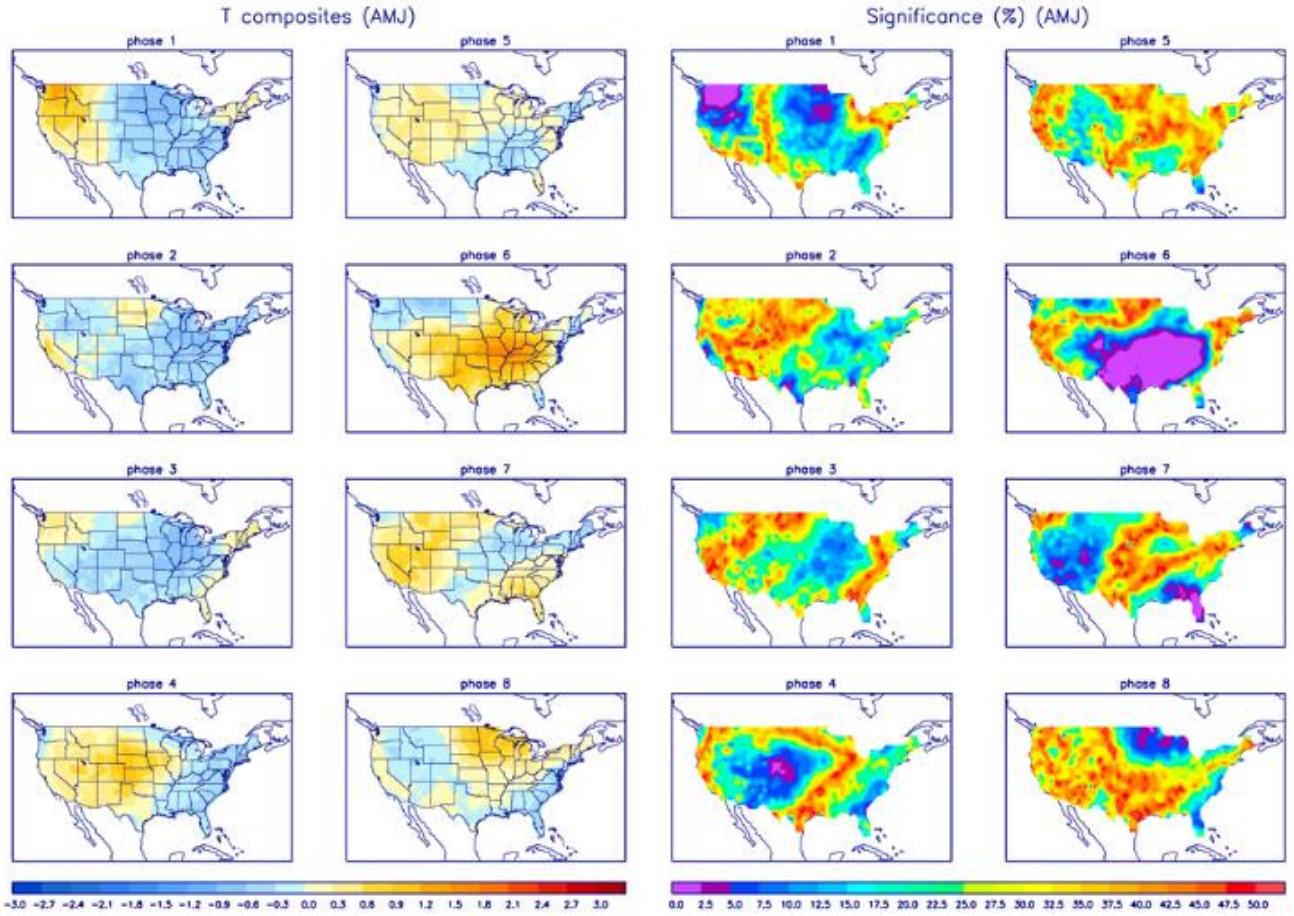
Precipitation Anomalies



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.

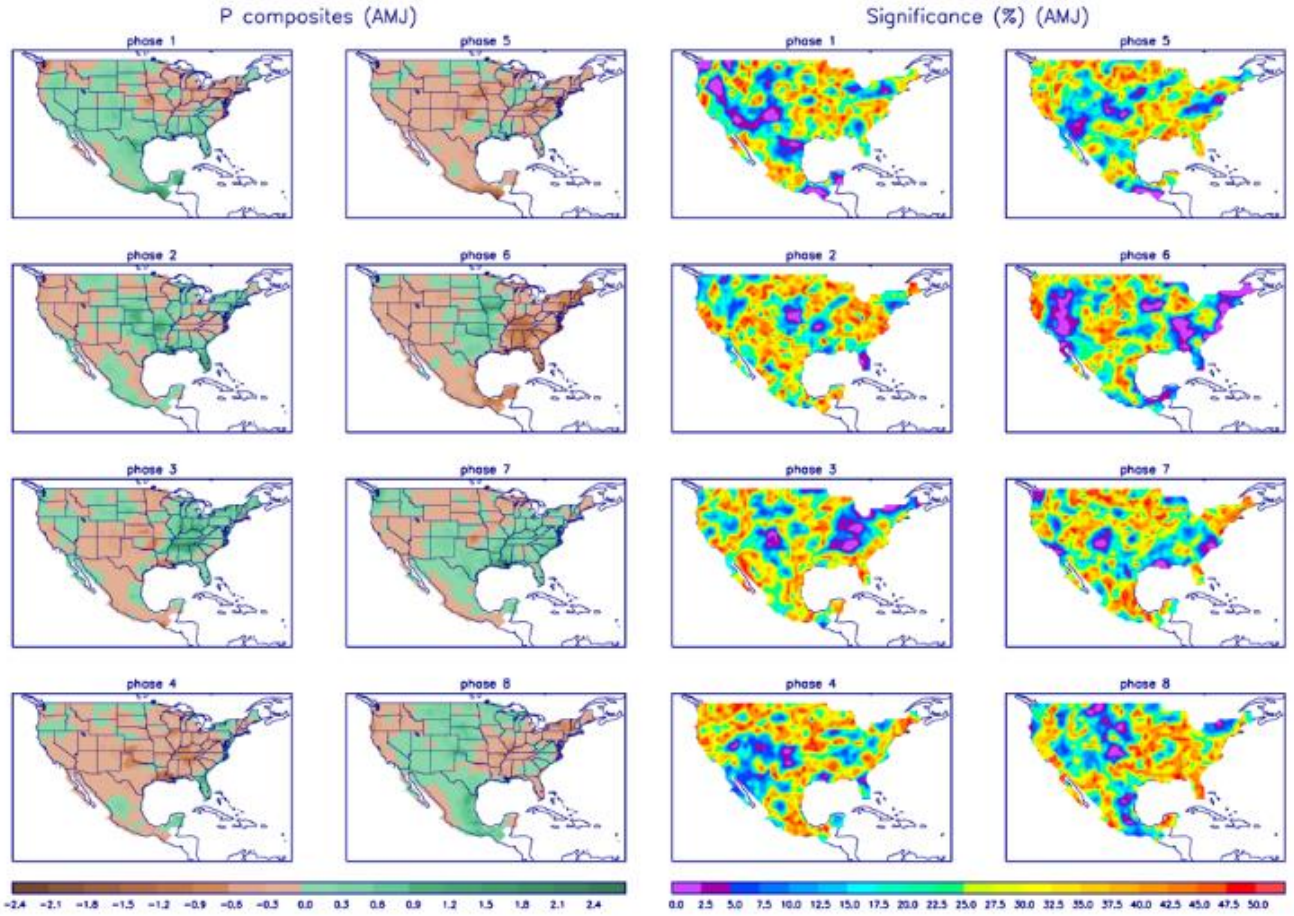


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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