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

Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
25 July 2022

Overview

- The MJO signal weakened through mid-July due to destructive interference with the La Niña base state.

- Convectively-coupled Kelvin wave activity crossed the Pacific and is helping to generate enhanced convection across the Western Hemisphere and an enhanced African monsoon.

- Dynamical model RMM forecasts suggest enhanced convection over the Western Hemisphere will continue to evolve and propagate eastward across the Indian Ocean and Maritime Continent over the next two weeks.

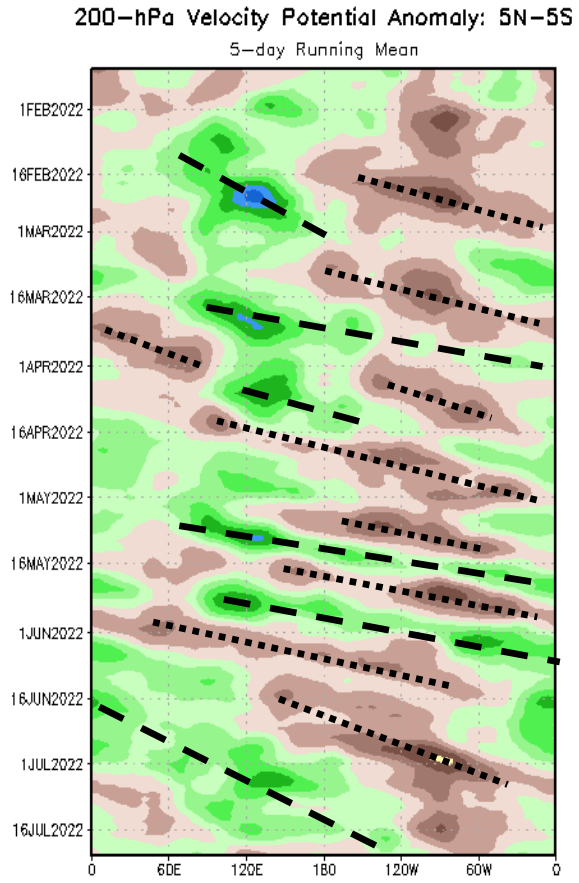
- Kelvin wave activity supports additional East Pacific tropical cyclone development. Conditions may become more favorable for early formations over the Atlantic “Main Development Region” (MDR) by Week-2.

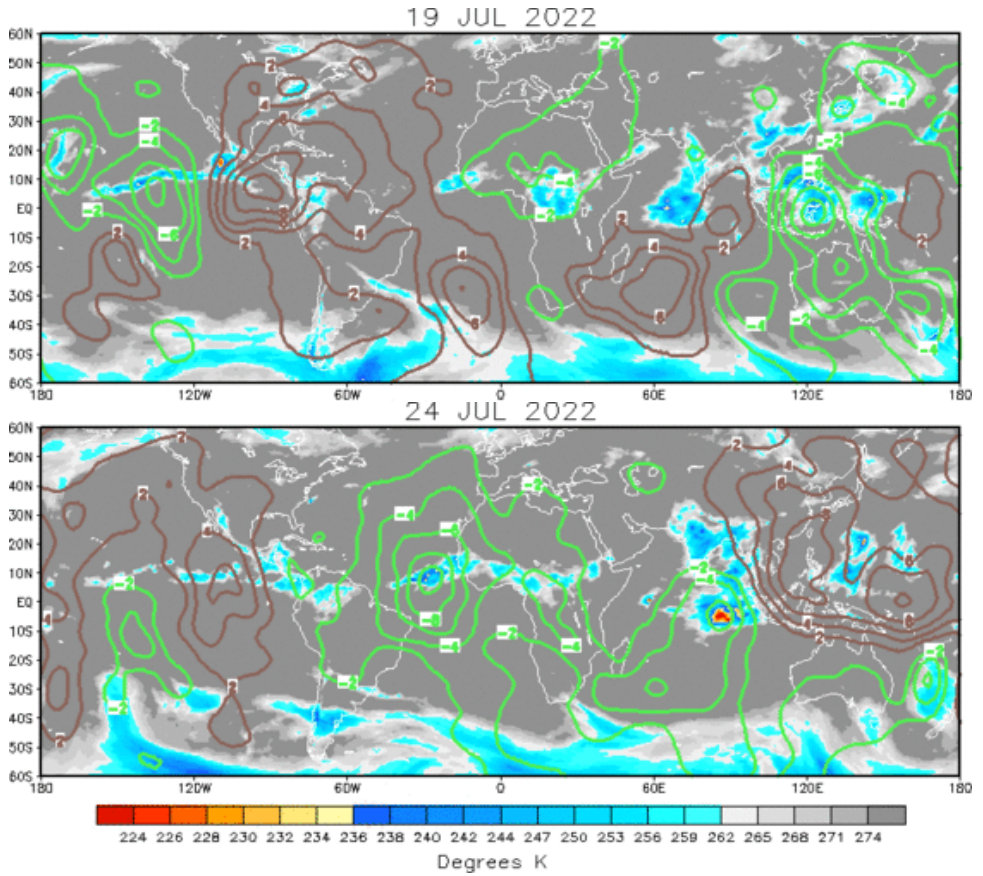
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

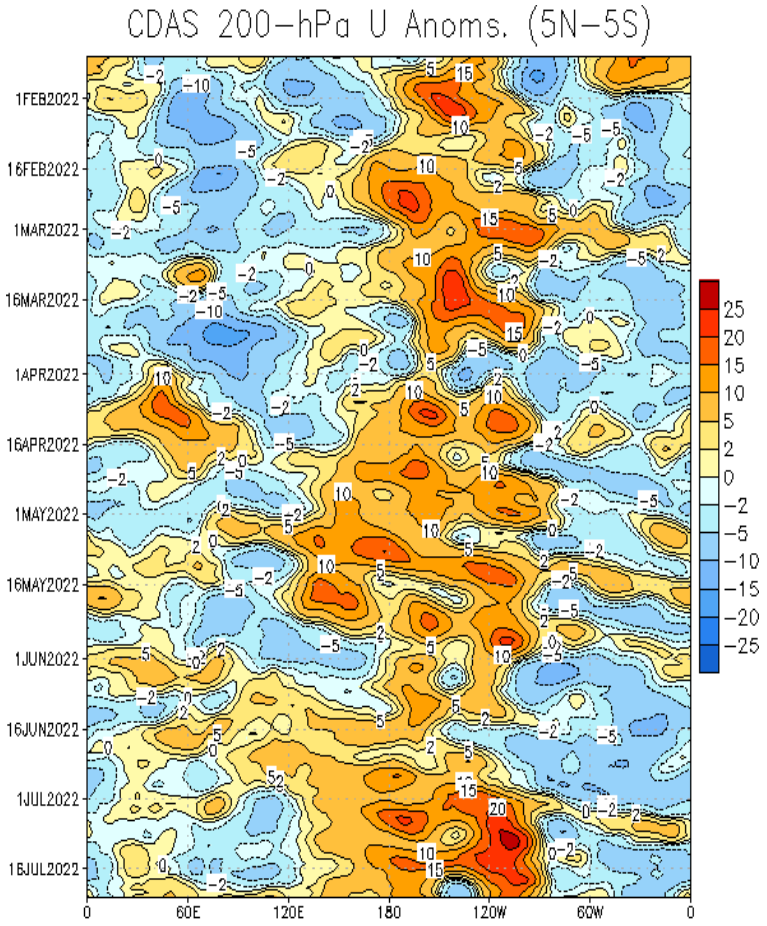


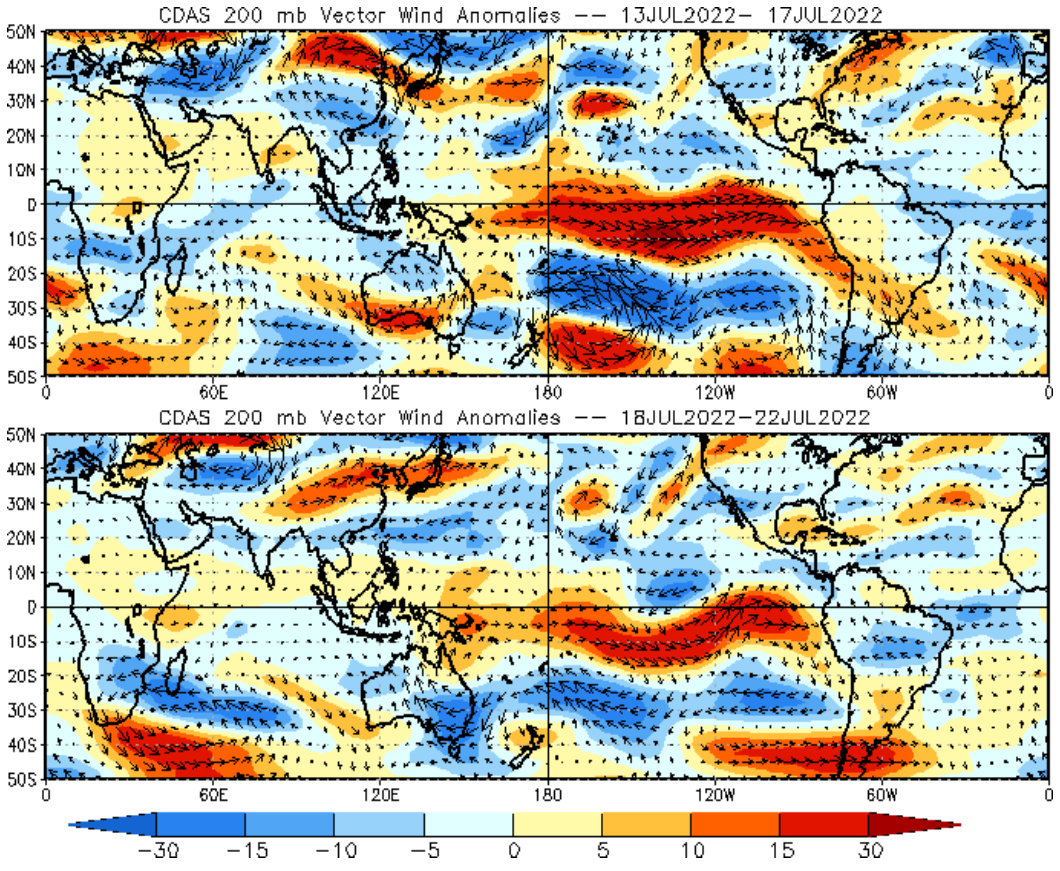


- The MJO became active during June, propagating across the Indian Ocean and Maritime Continent.
- Destructive interference between the MJO and a robust La Niña signal that is atypical for this time of year resulted in weakening of the intraseasonal signal.
- More recently, Kelvin wave activity has produced a coherent convective response over the Western Hemisphere and western Indian Ocean.

200-hPa Wind Anomalies

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



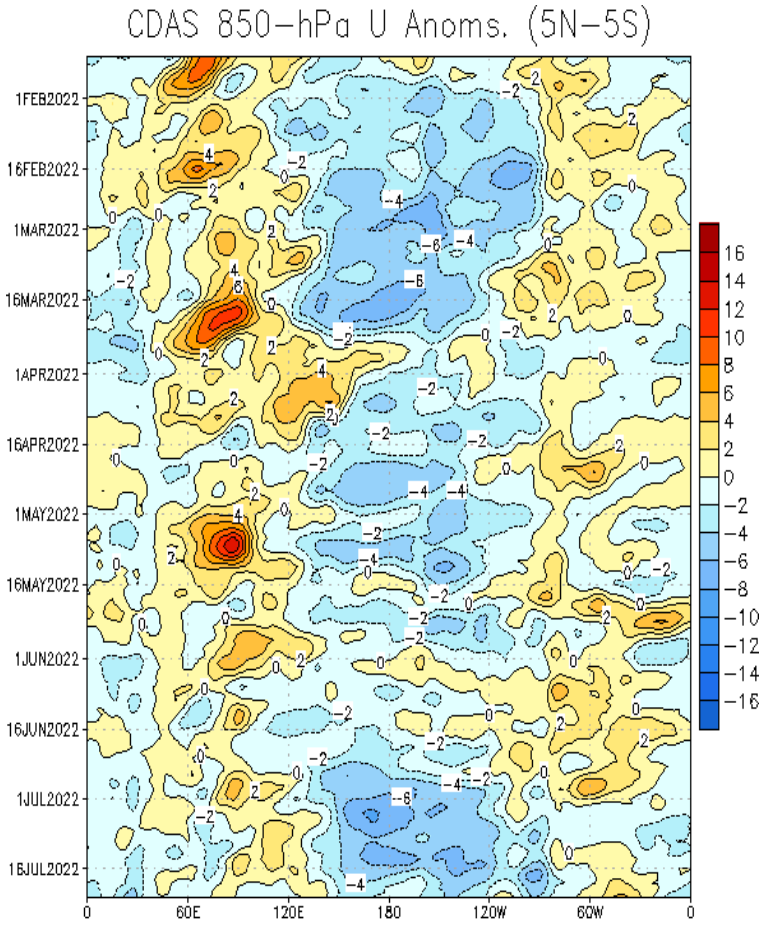


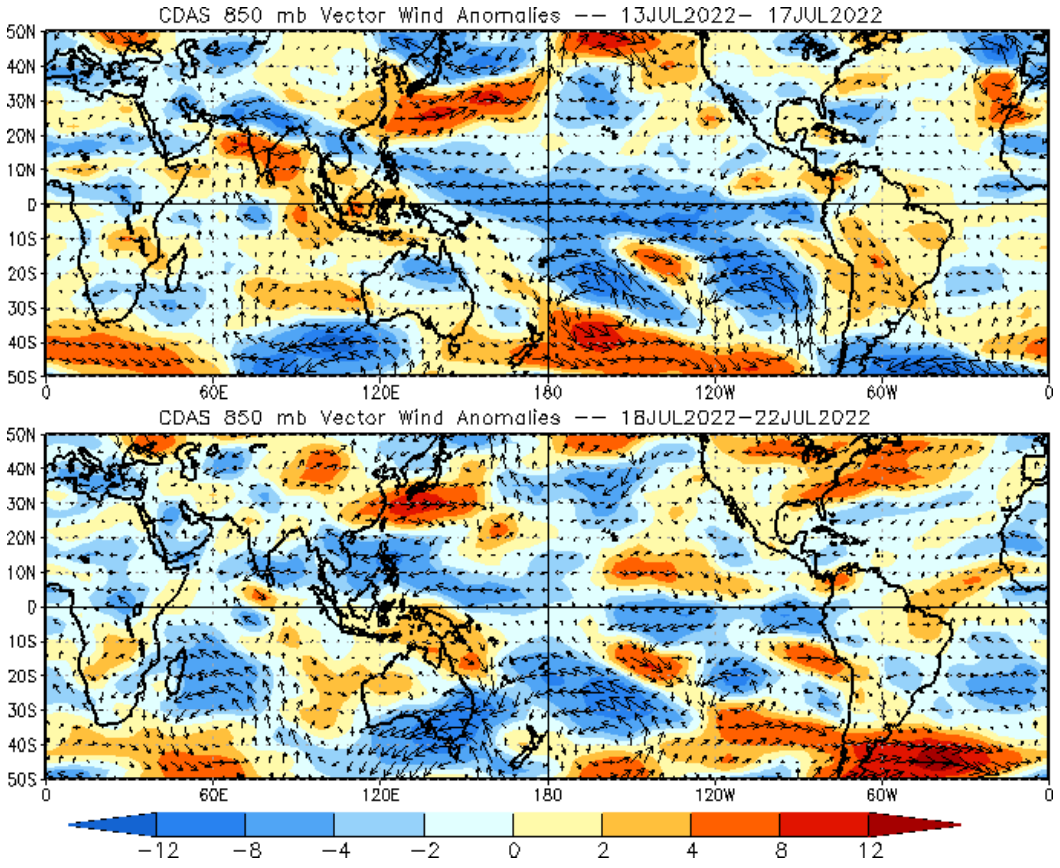
- Unusually strong westerly anomalies remained entrenched across much of the equatorial central and eastern Pacific.

- A pocket of equatorward-moving easterly anomalies has disrupted this pattern between 120W and 150W.

850-hPa Wind Anomalies

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



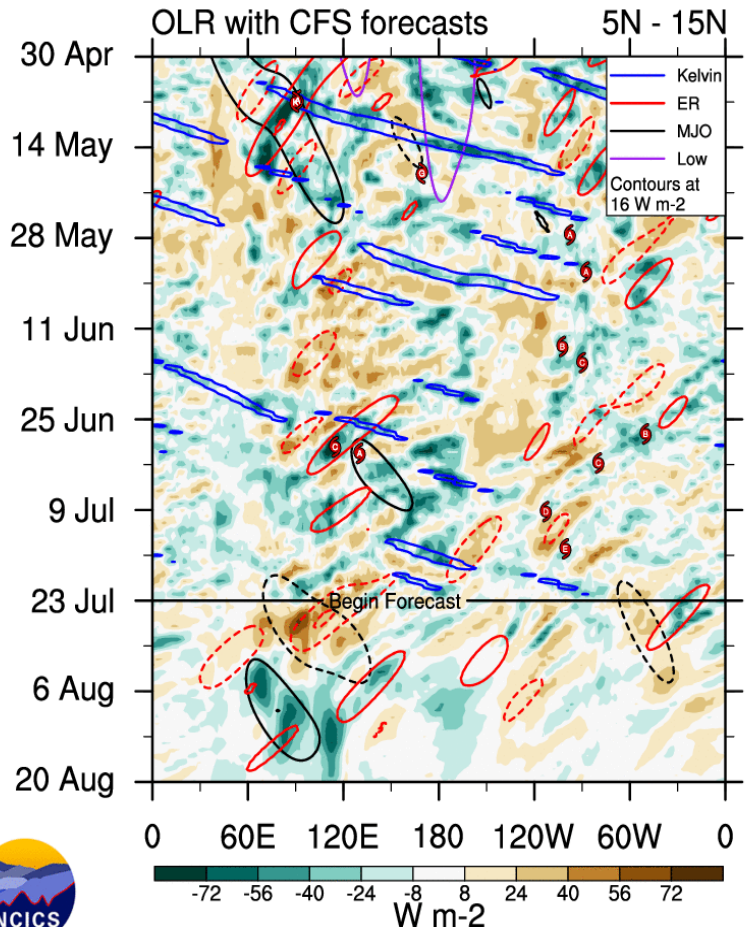


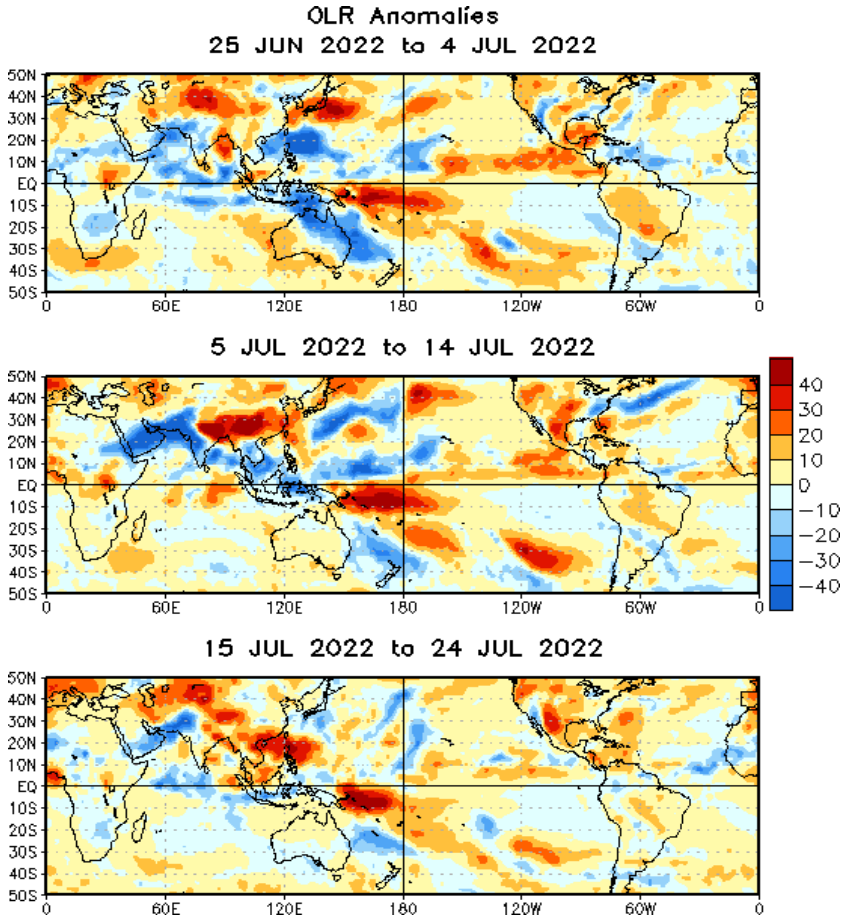
- Trade winds remain enhanced across most of the tropical Pacific; however, the pattern has weakened somewhat recently, possibly reflecting destructive interference from the remnant intraseasonal signal.

- The monsoon signal has weakened somewhat across South and Southeast Asia, as convection increased closer to the Equator.

Outgoing Longwave Radiation (OLR) Anomalies

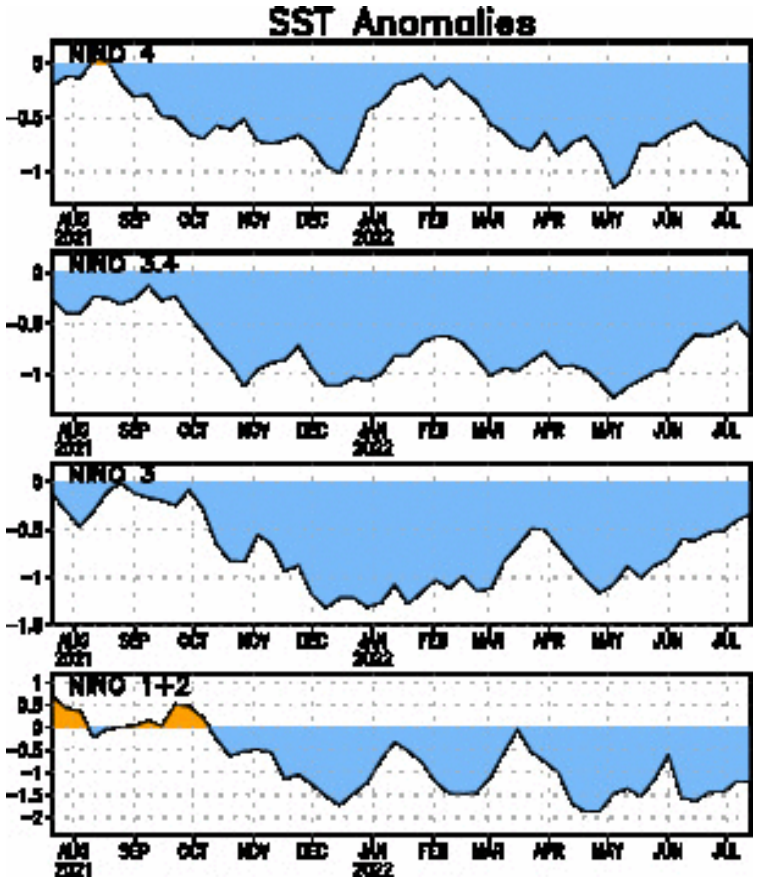
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

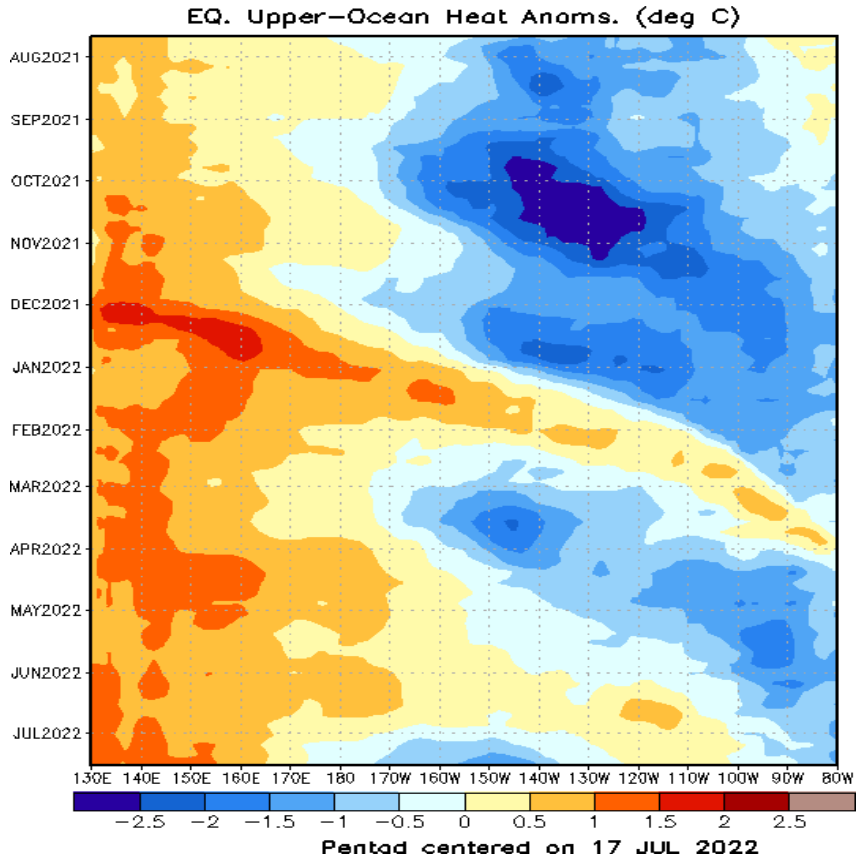




- Reduced South and Southeast Asia activity is apparent during late July, as the overall pattern globally became more incoherent.
- CCKW activity is apparent crossing the Western Hemisphere.
- The CFS forecast with wave filtering indicates a potential for renewed MJO activity in early August across the Indian Ocean.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



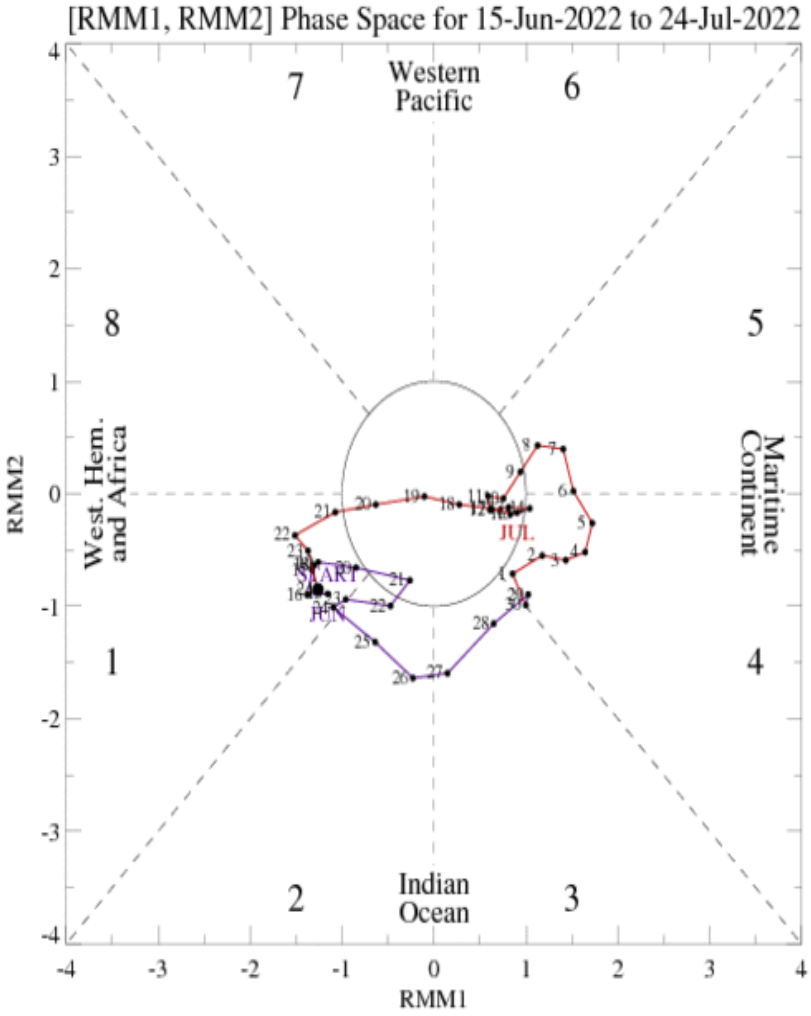


- Strongly enhanced trade winds through much of July have resulted in an upwelling oceanic Kelvin wave following the passage of the downwelling phase in June.

- Despite the warmer water in the upper-ocean, SSTs remained below average across all Niño basins, allowing for a continuation of the atmospheric response.

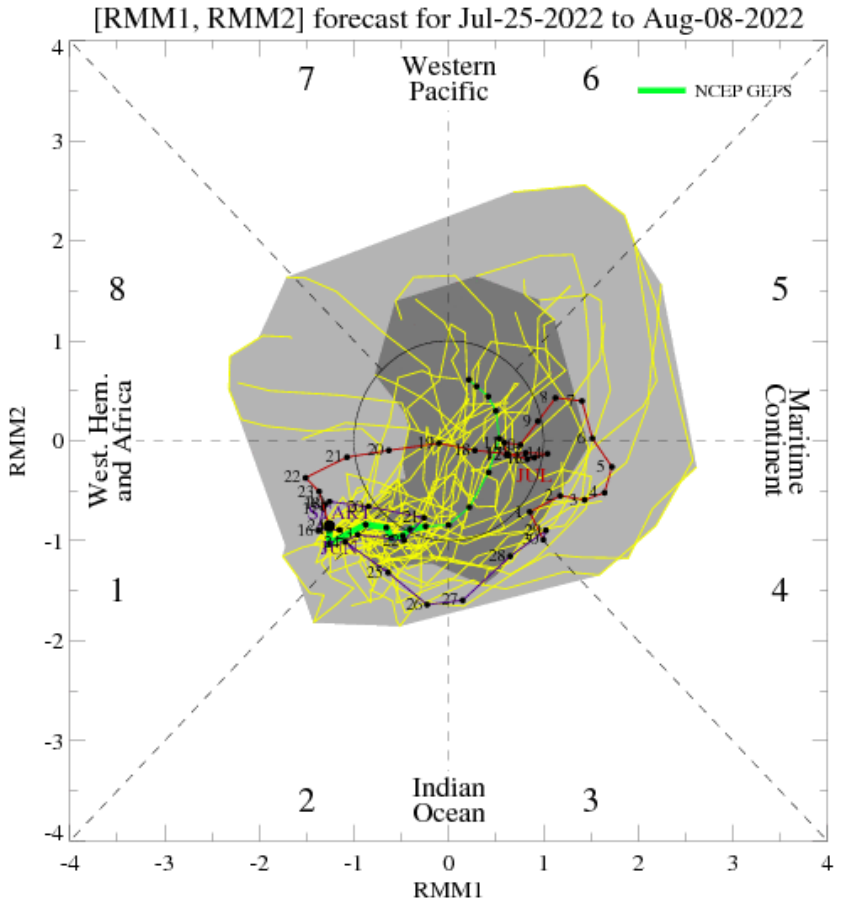
MJO Index: Recent Evolution

- Consistent with recent forecasts, after weakening rapidly over the Maritime Continent, the RMM-based MJO index has exhibited renewed activity over the Western Hemisphere during the past few days..

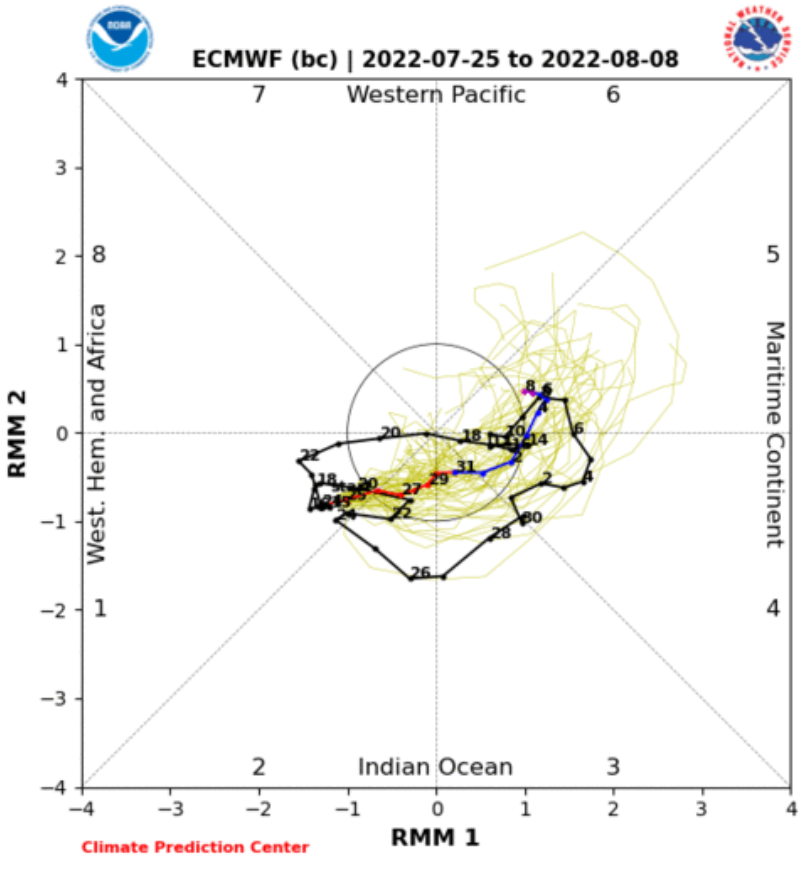


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

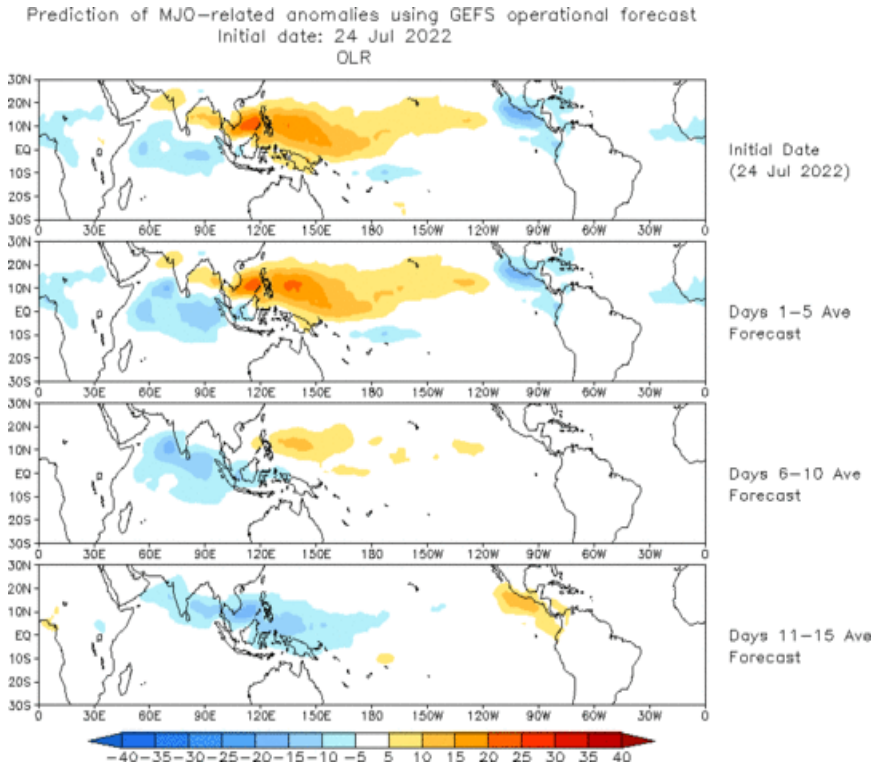


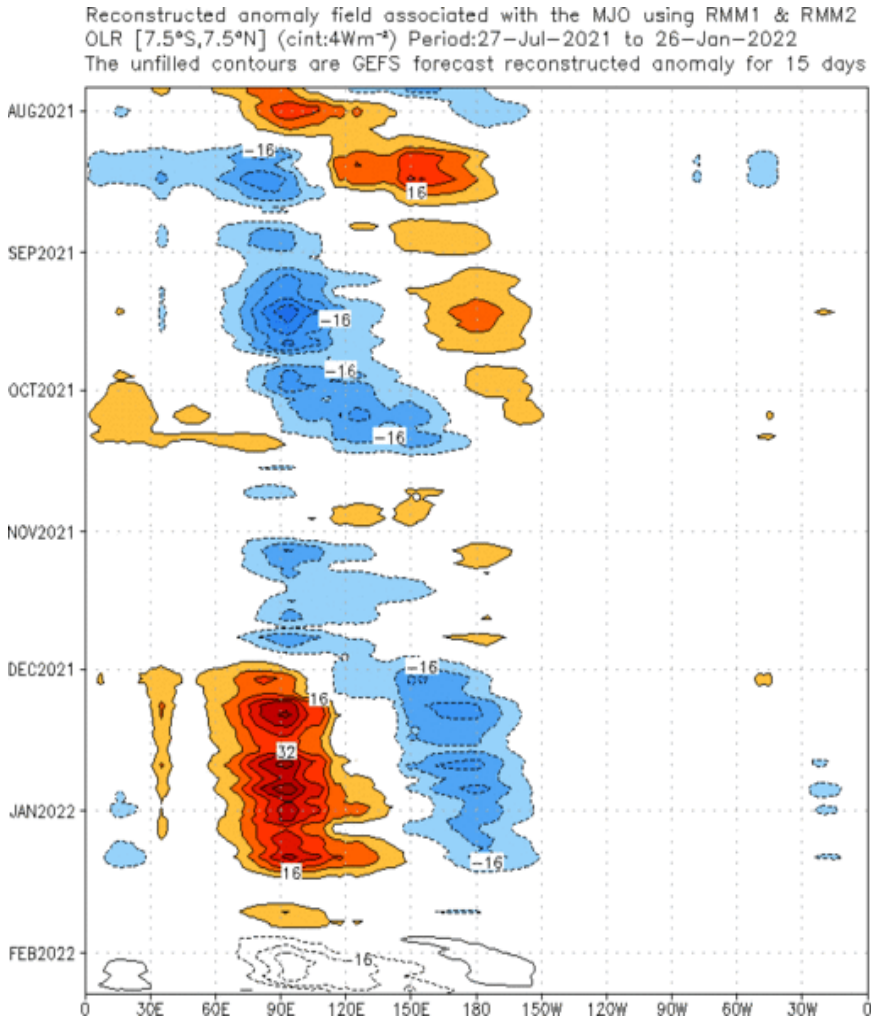
ECMWF Forecast

- Both the GEFS and ECMWF depict an eastward propagating signal during the next two weeks.
- The ECMWF shows fast, weak propagation across the Indian Ocean, suggestive of Kelvin wave activity, followed by a slower and more robust evolution across the Maritime Continent as the signal constructively interferes with the base state.
- The GEFS solutions exhibit a wider range of possibilities than the ECMWF ensemble, with individual ensemble members appearing in every phase of the diagram over 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.)

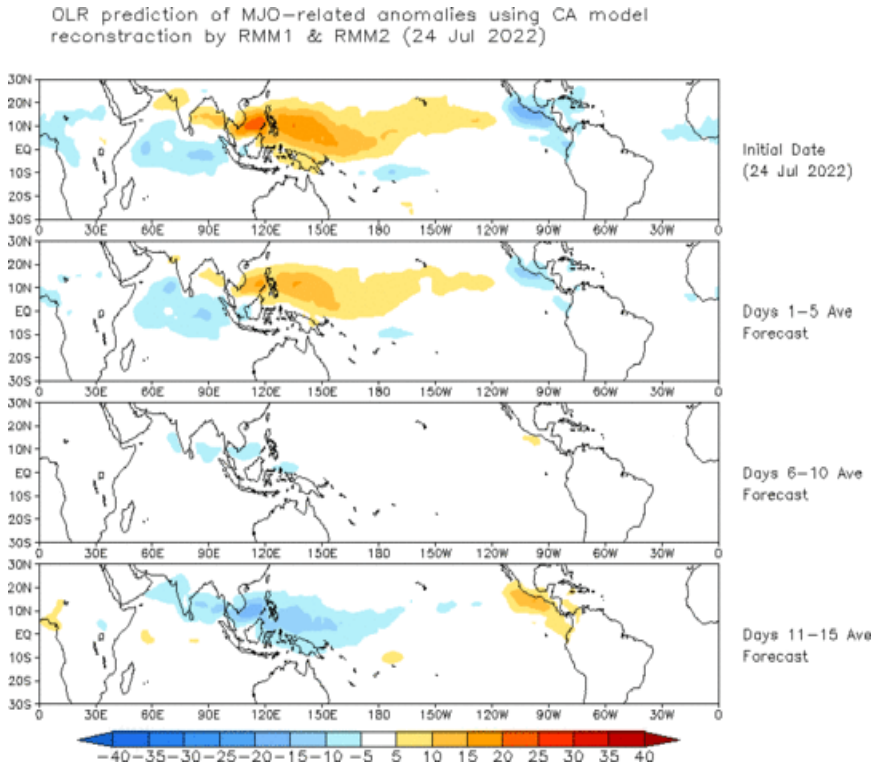


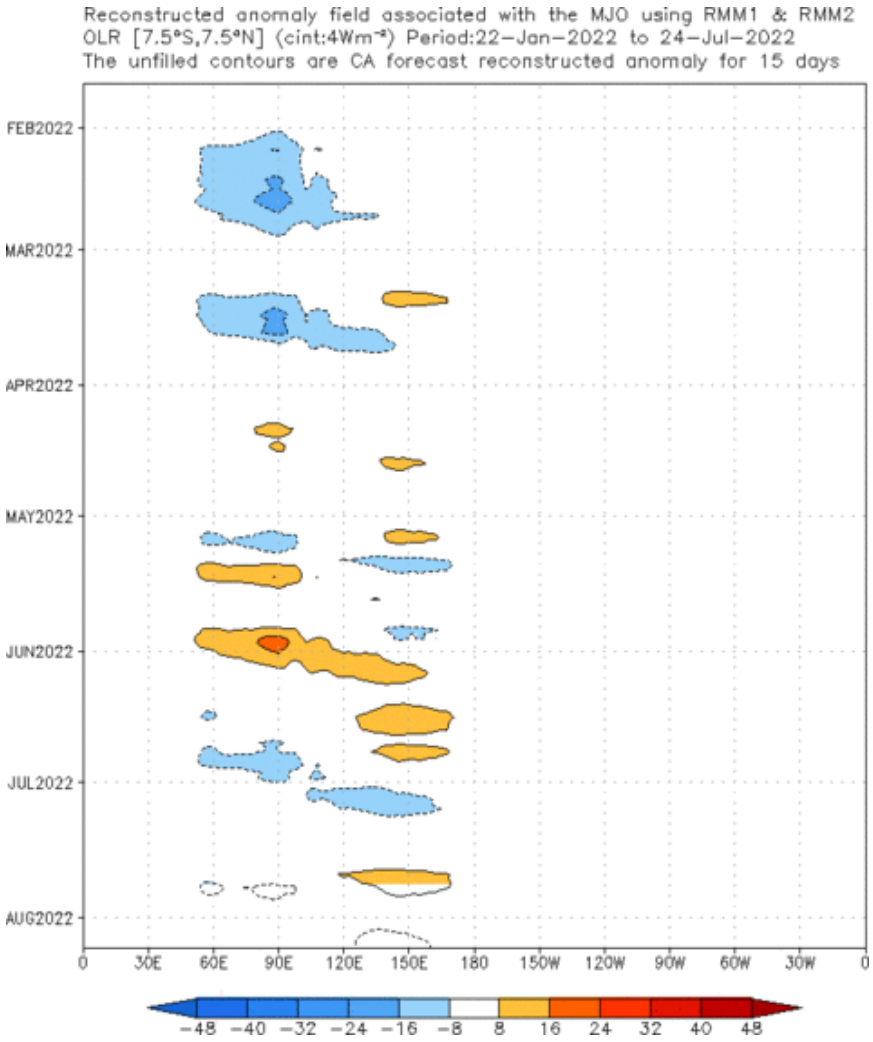


- The GEFS RMM-index based OLR anomaly field depicts a fairly robust MJO-type evolution, with a northwest to southeast tilted envelope of enhancement forming over the Indian Ocean and Maritime Continent that lifts poleward as enhanced convection spreads eastward.

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.)

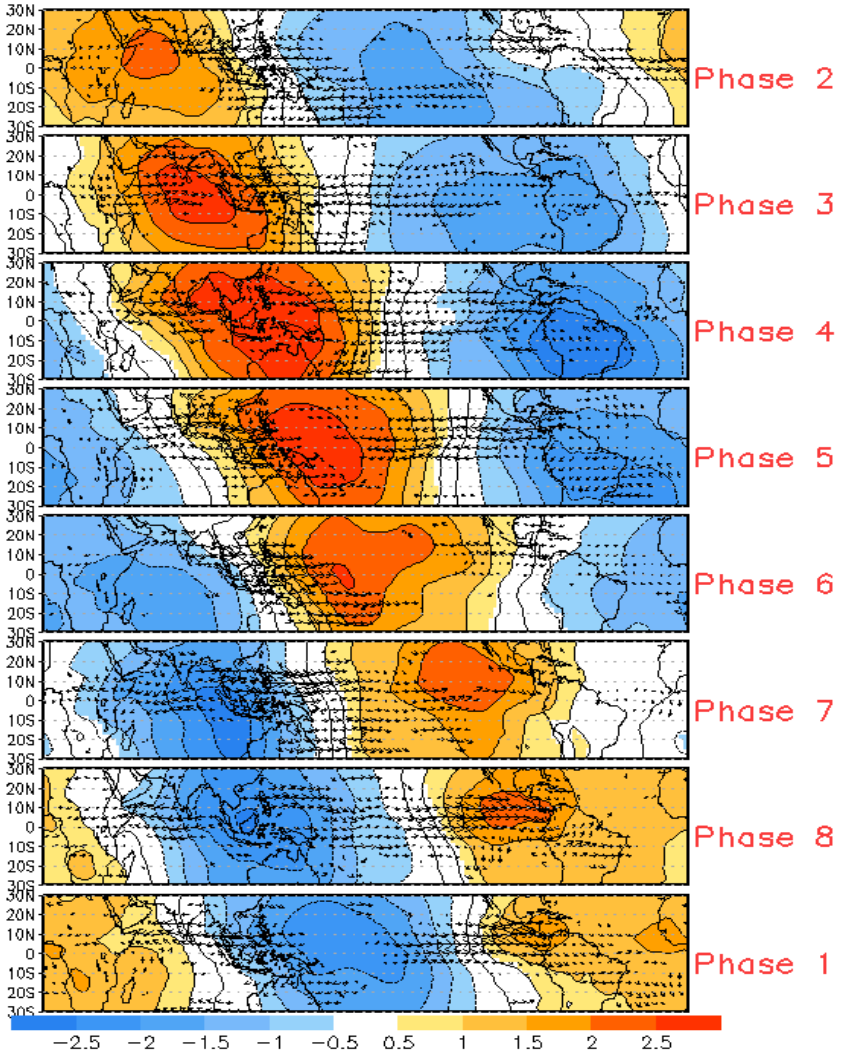




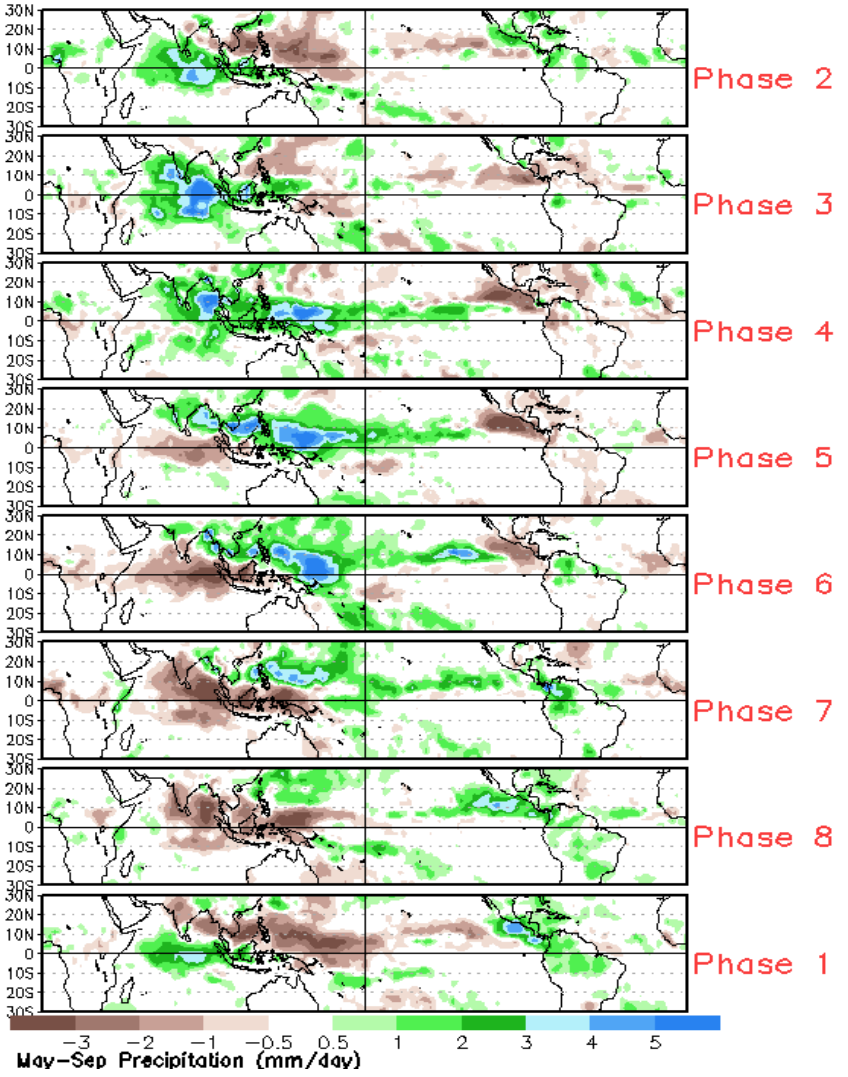
- The constructed analog forecast of RMM-based OLR anomalies is remarkably similar to the GFS solution, albeit with a weaker footprint during the 6-10 day period.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



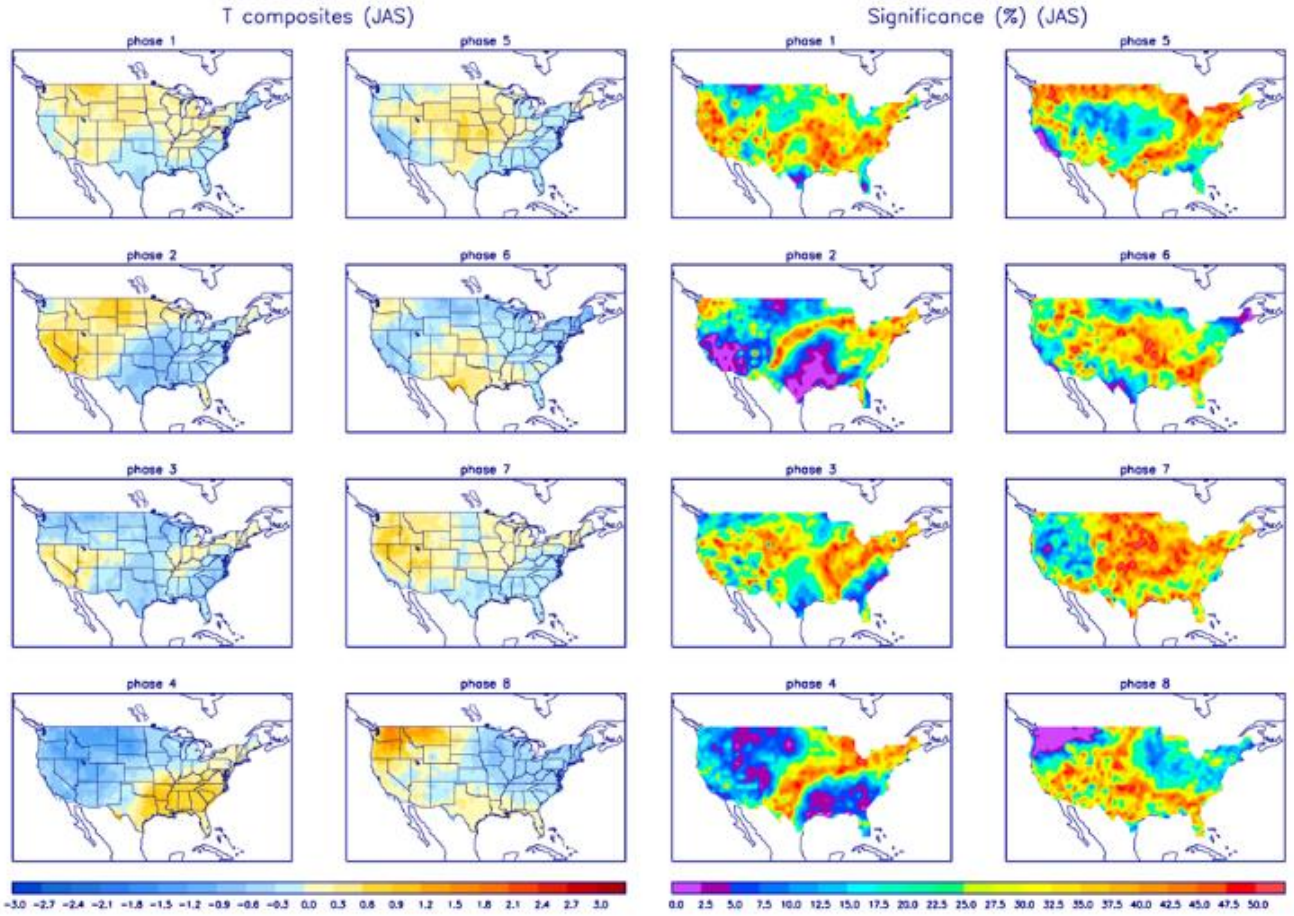
Precipitation Anomalies



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.

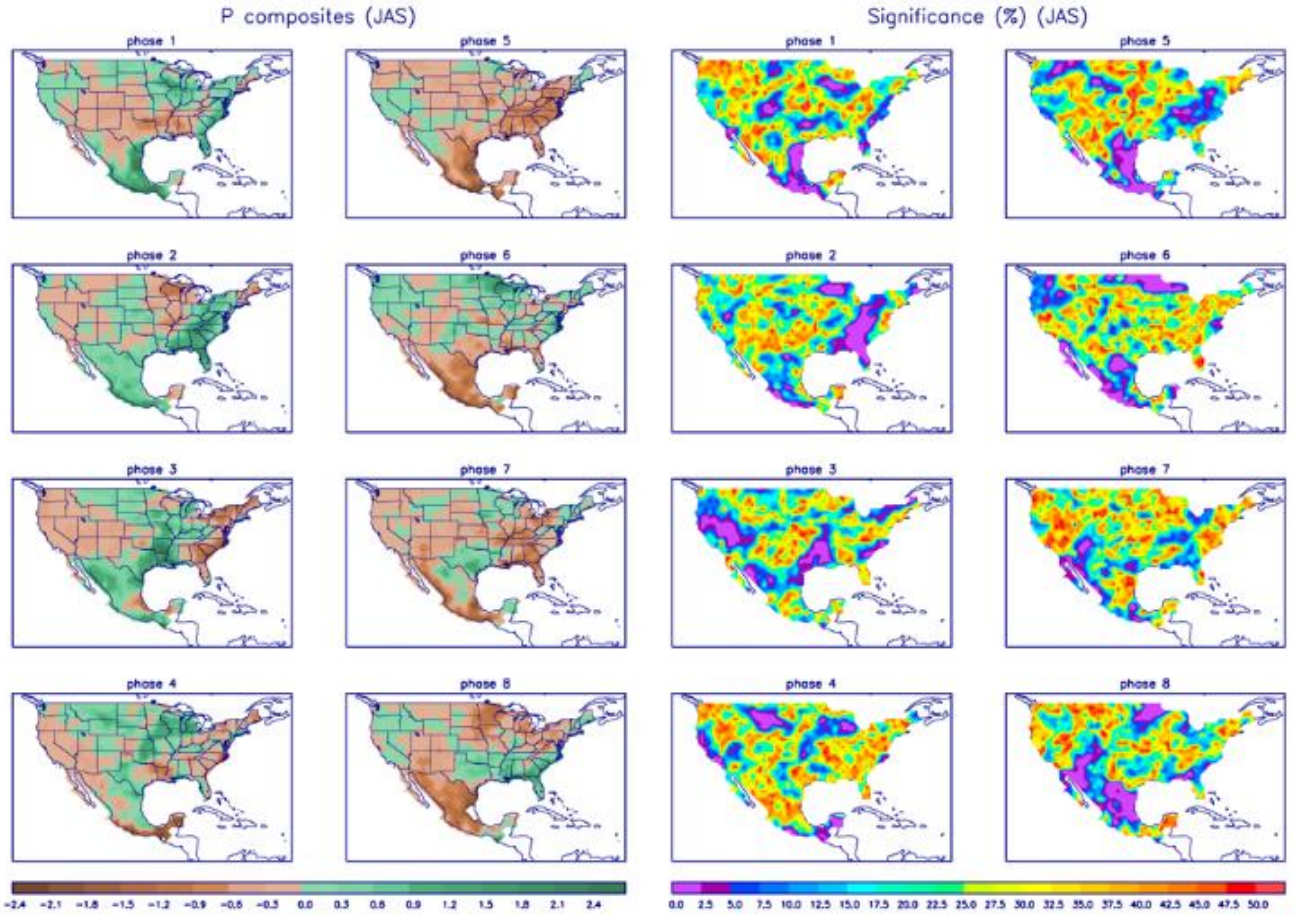


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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