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

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
2 August 2021

Overview

- The RMM index indicates the intraseasonal signal propagated eastward to the Western Hemisphere during the past week.
  - As seen earlier in July, the phase speed of the signal in RMM space is more consistent with Kelvin wave activity which may be embedded within the main convective envelope.
  - The rapid decrease in RMM1 values is likely tied to a reversal of anomalous lower-level winds observed over the equatorial central and eastern Pacific at the end of July.

- There is a consensus in the dynamical models which feature the continued eastward propagation of the MJO over the Western Hemisphere while decreasing in amplitude during week-1. Despite large spread in the ensembles, some models favor the reemergence of a coherent MJO over Africa and the Indian Ocean later in week-2.

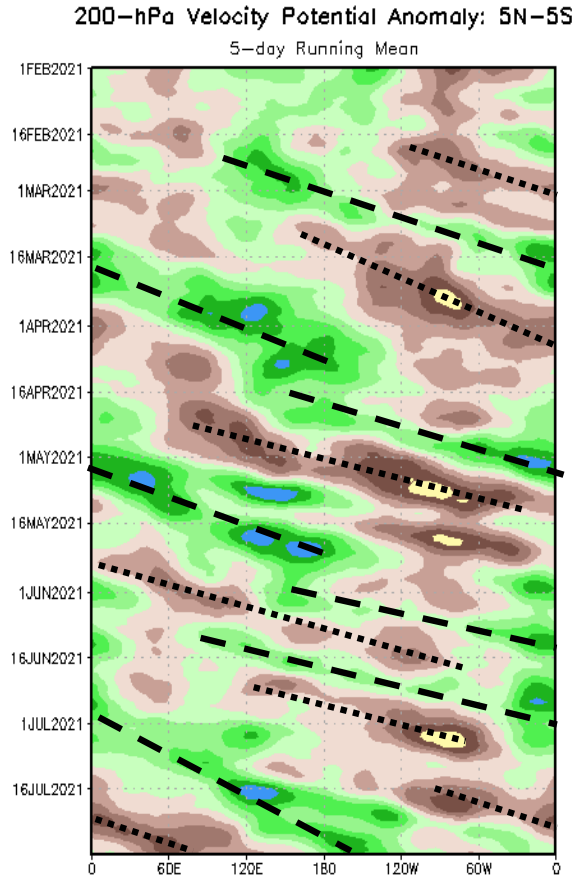
- The large scale environment is expected to be conducive for continued (weakening) tropical cyclone activity over the East (West) Pacific, with increasing chances for development in the tropical Atlantic during the outlook period.

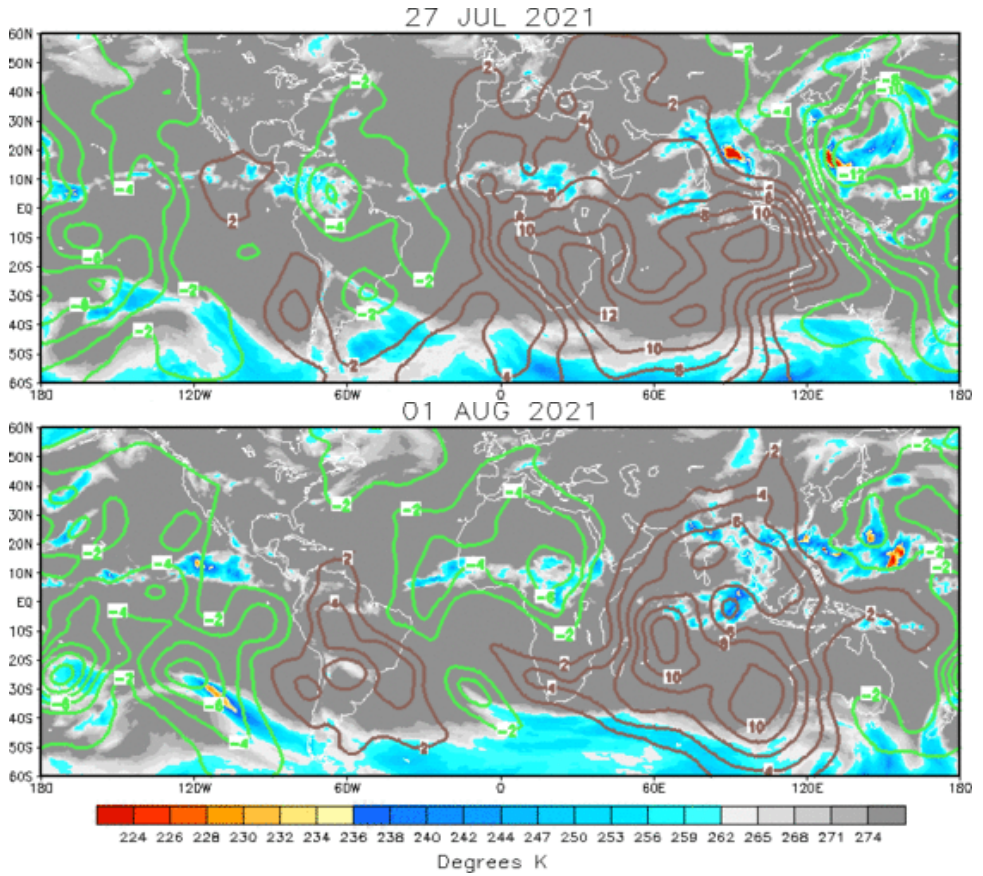
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).



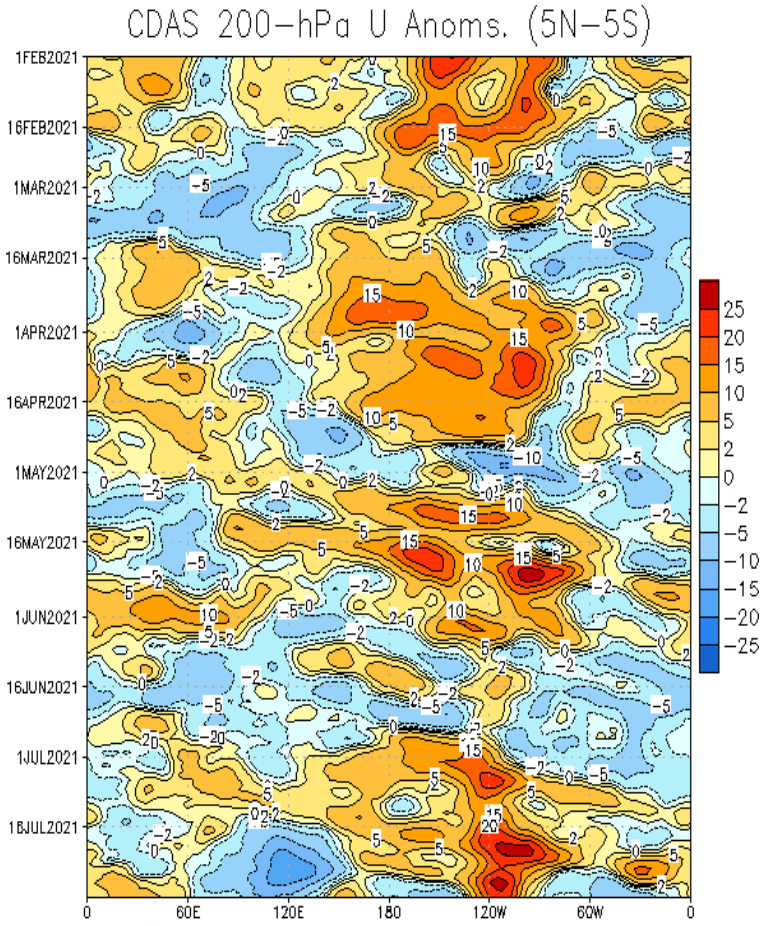


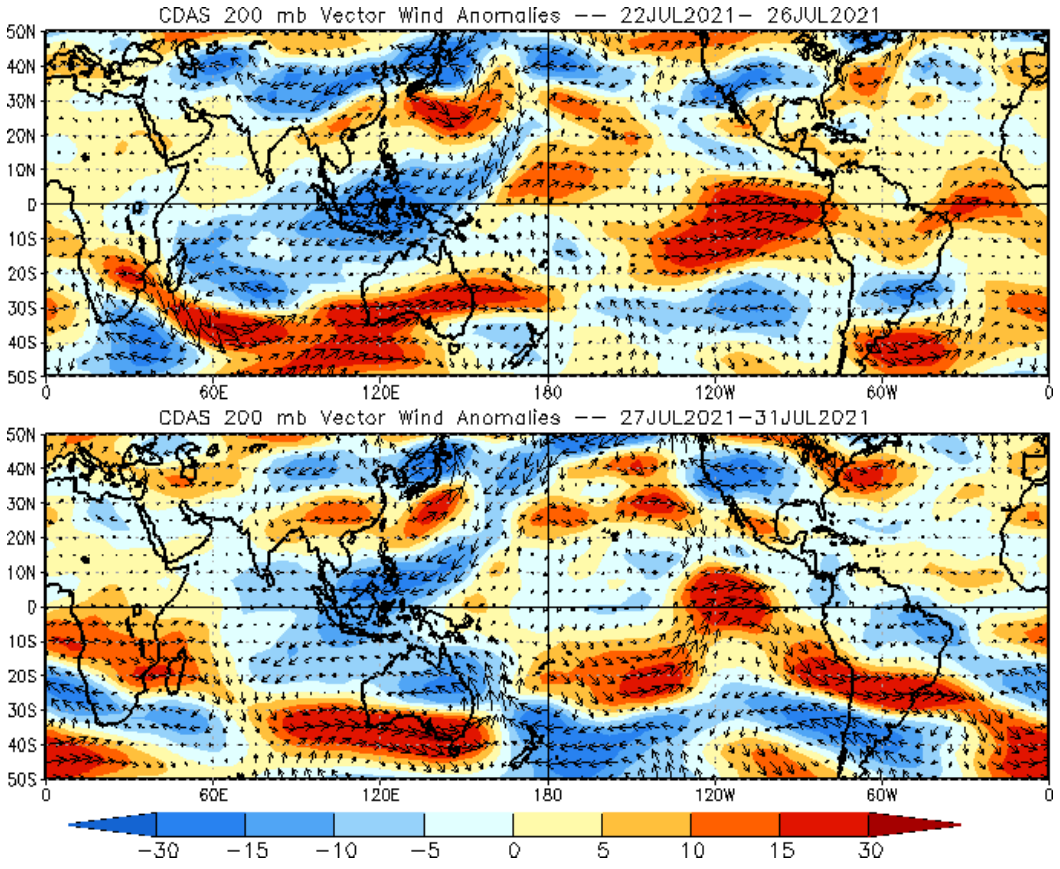
- Since last week, the upper-level velocity potential fields evolved from a wave-1 to wave-2 pattern likely tied to a Kelvin Wave that separated from the primary envelope and is now over Africa.

- Time-Longitude analysis shows a clear eastward propagation of the intraseasonal signal during July, with the strongest anomalous divergence aloft extending east of the Date Line in recent days.

200-hPa Wind Anomalies

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

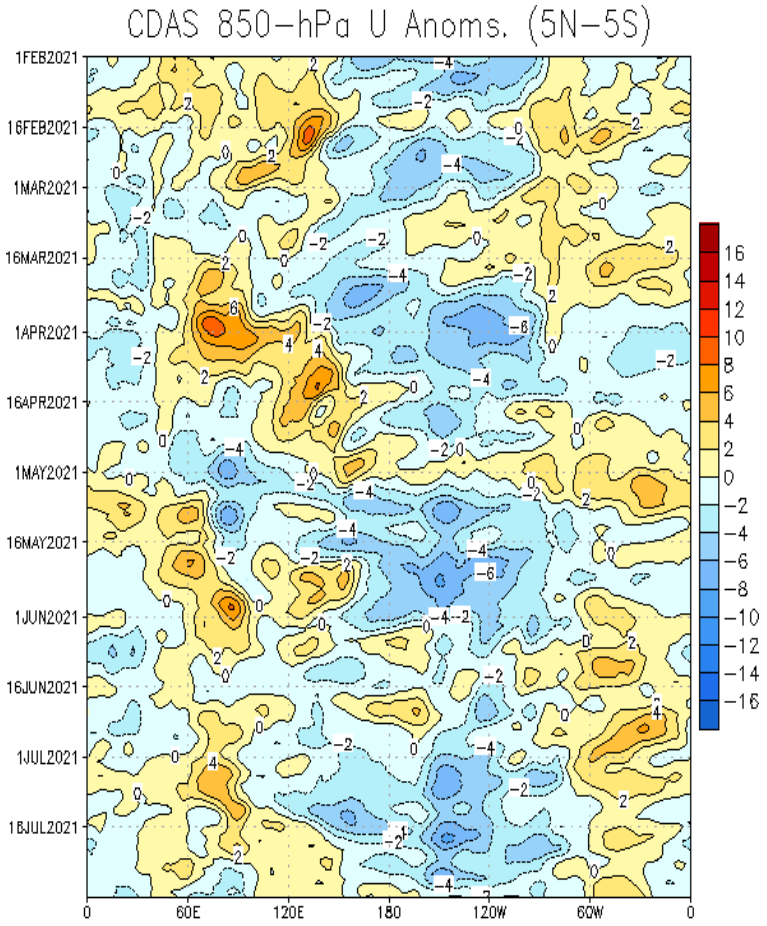


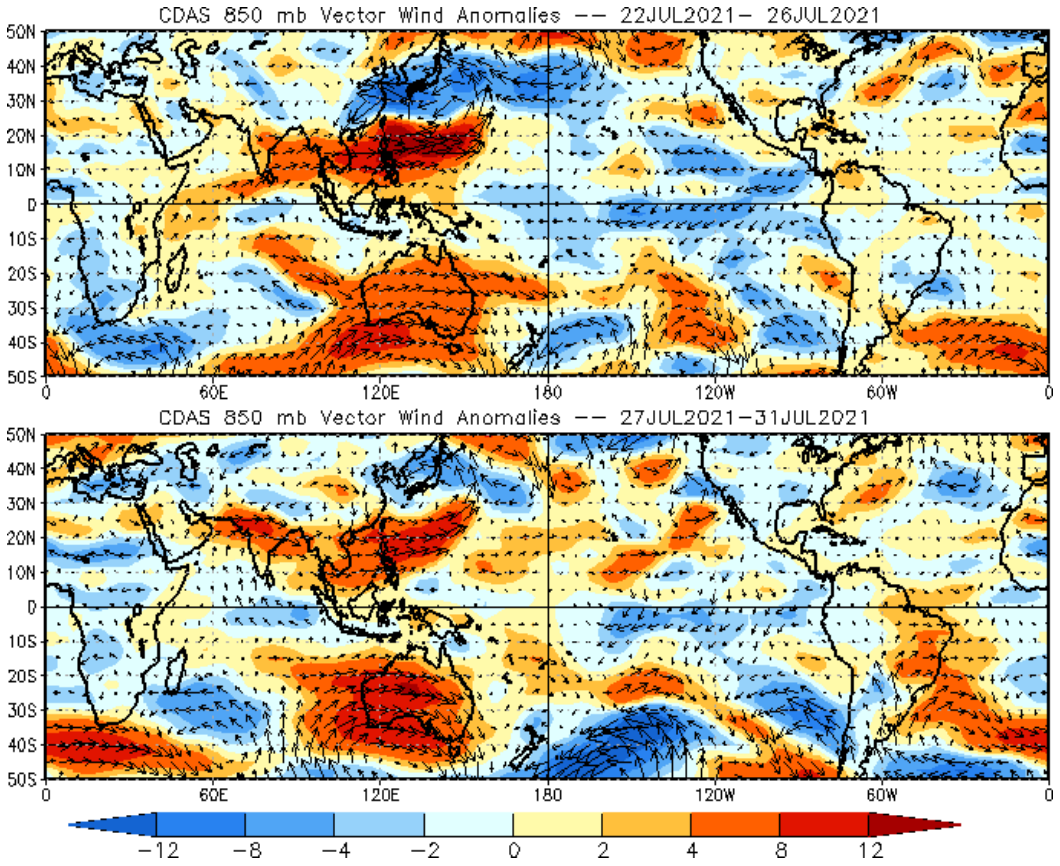


- The upper-level zonal wind anomalies continue to reflect an organized intraseasonal event, with anomalous easterlies (westerlies) shifting eastward to the Western Hemisphere (Africa and the western Indian Ocean).
- Strong westerly anomalies remain centered over the equatorial Pacific near 120W and are also consistent with a low frequency footprint established since earlier this year.

850-hPa Wind Anomalies

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



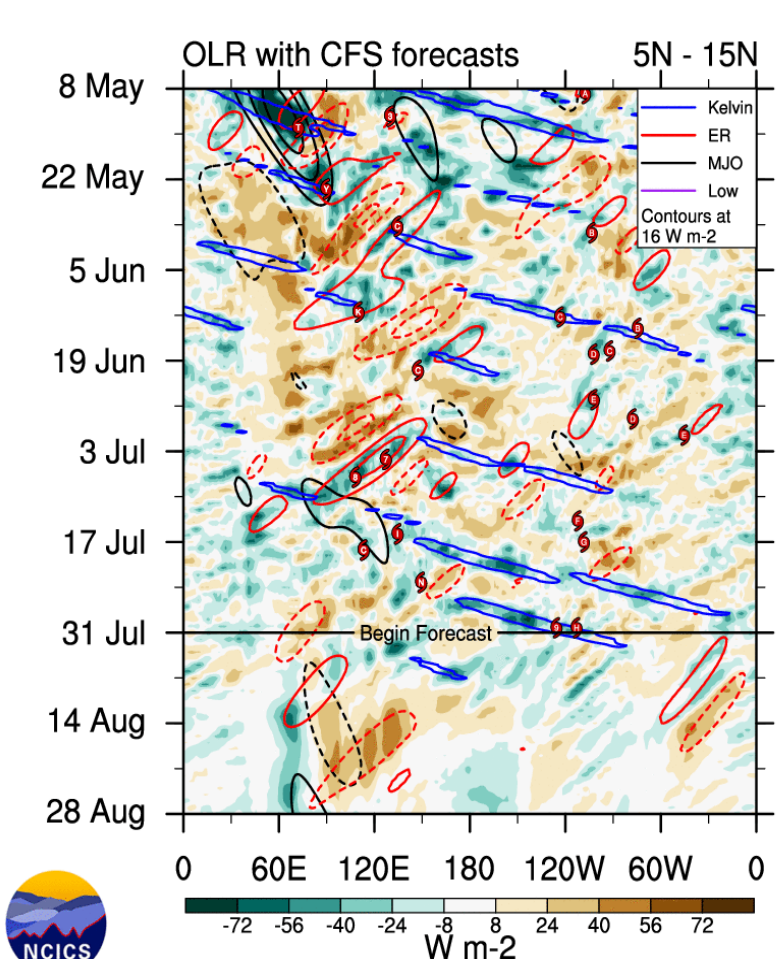


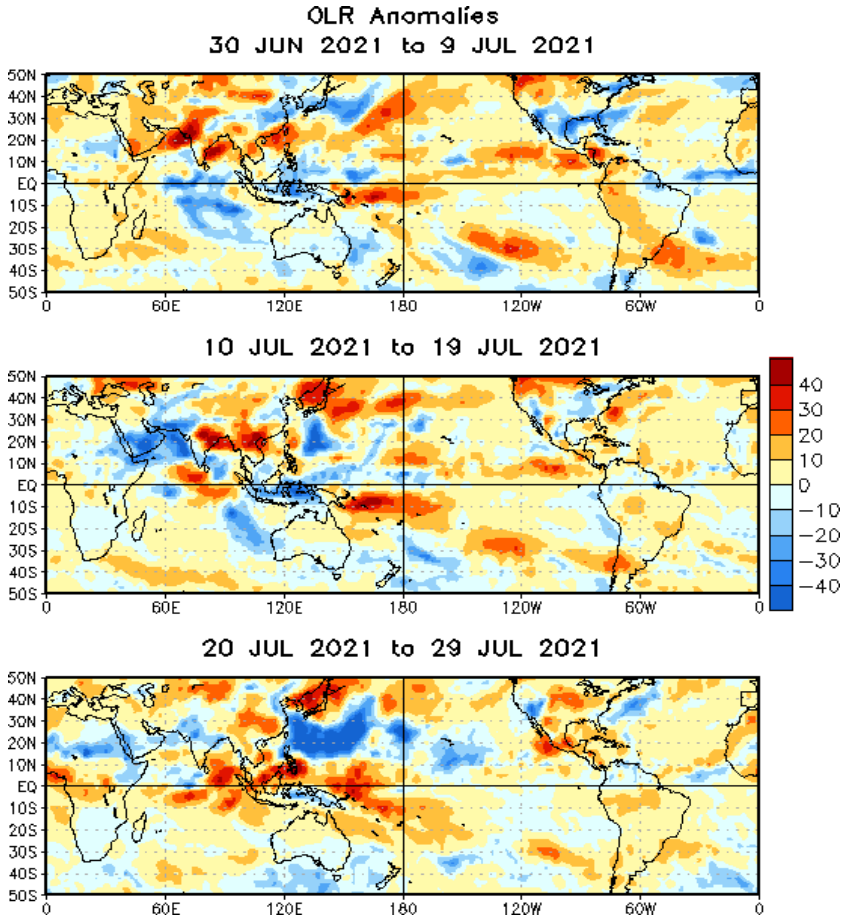
- Anomalous westerlies are observed to the east of the Date Line as enhanced trades persist across the eastern equatorial Pacific.

- A broad anomalous cyclonic circulation is evident in the northwestern Pacific associated with ongoing TC activity, and appears to have slightly weakened in the more recent analysis.

Outgoing Longwave Radiation (OLR) Anomalies

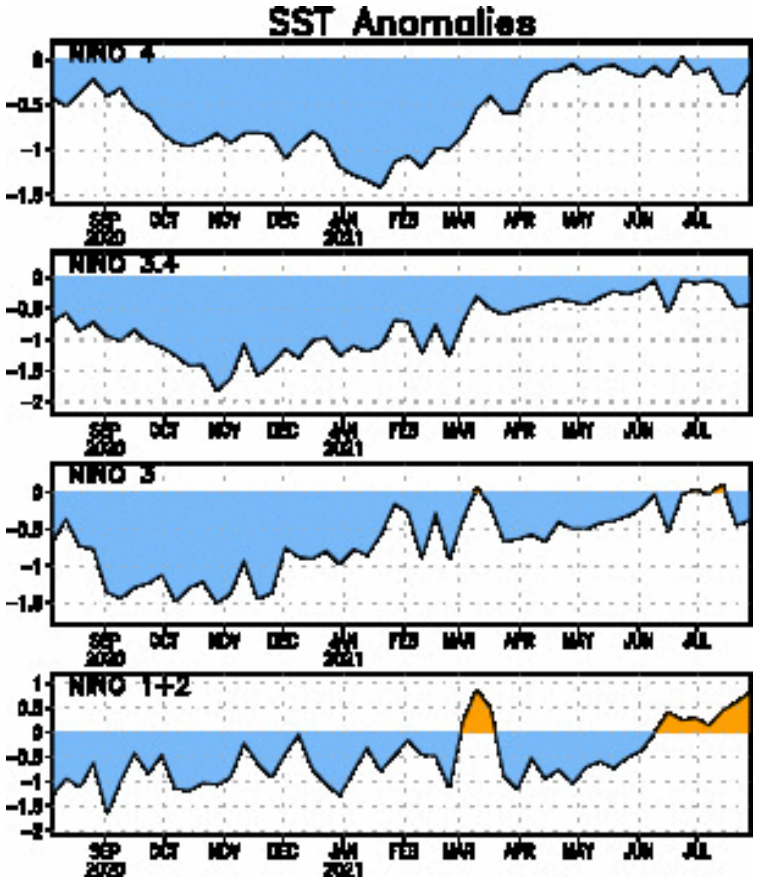
Blue shades: Anomalous convection (wetness). Red shades: Anomalous subsidence (dryness).

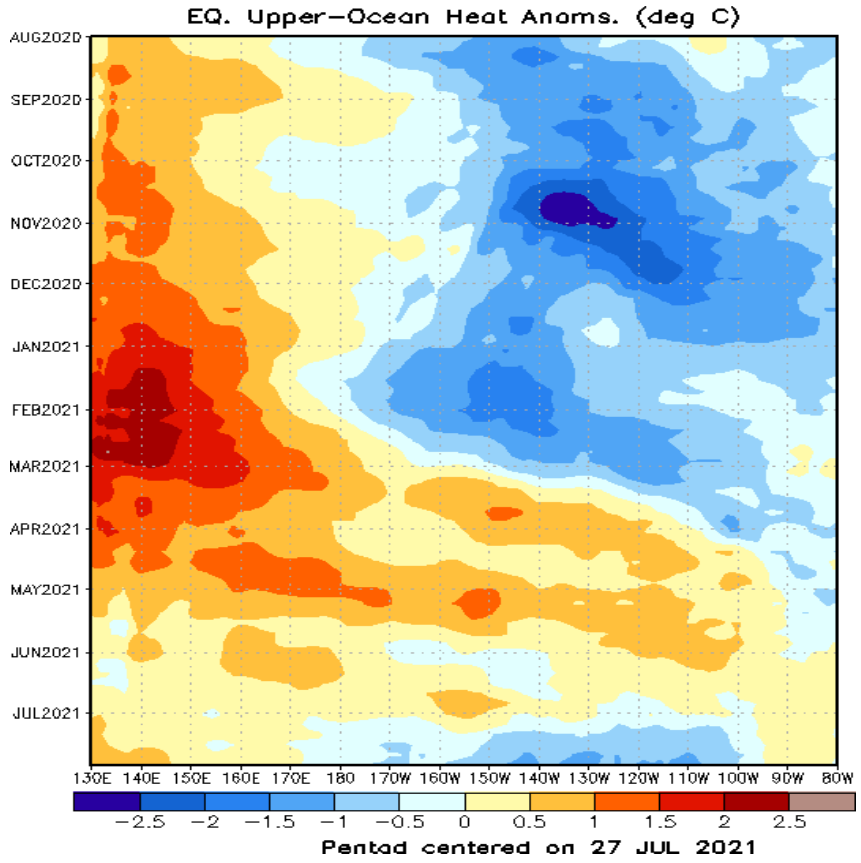




- Suppressed convection returned to portions of the eastern Indian Ocean and the Maritime Continent, while enhanced convection was widespread over the northwest Pacific tied to several tropical cyclones that formed since mid-July .
- The Kelvin wave activity is analyzed near 120W in the OLR field, which likely contributed to an uptick in tropical cyclone activity in the East Pacific.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



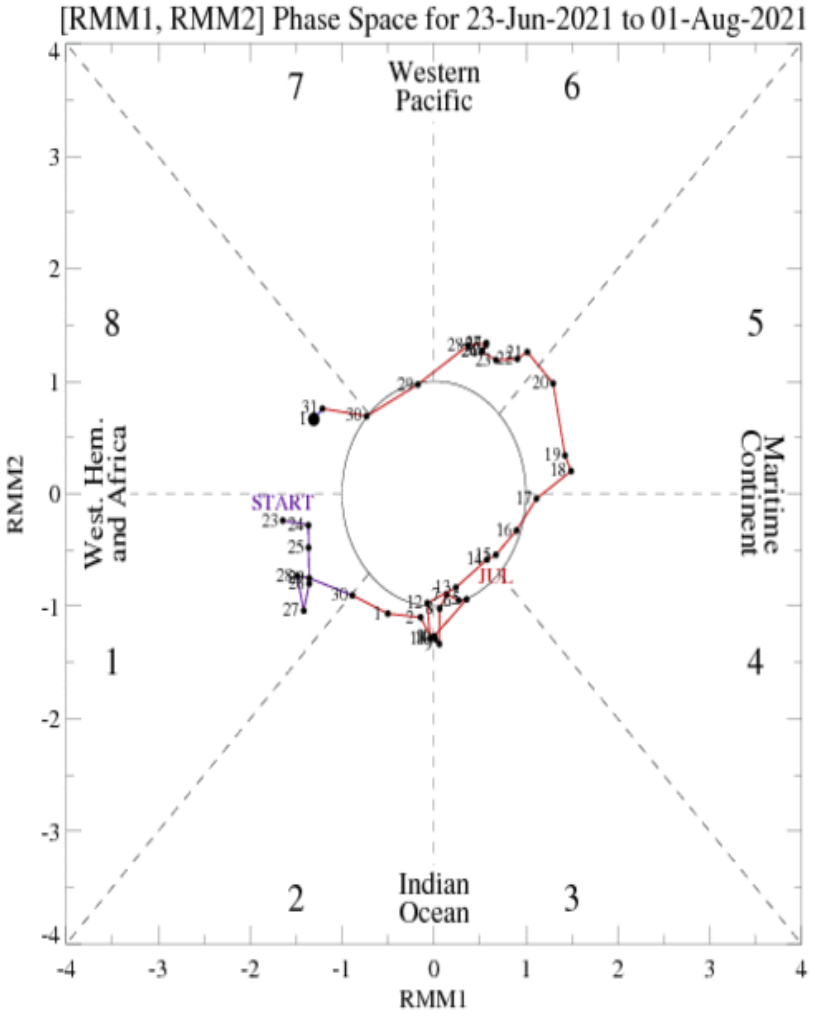


- Multiple episodes of oceanic Kelvin wave activity led to a strengthening of upper-ocean heat content during this past spring. However, these positive anomalies have since weakened, and negative anomalies have been strengthening across much of the Pacific during the past month.
- Since mid-July, there has been a decline in the Niño indices with the exception of the Niño 1+2 region of the far East Pacific, which continues to experience warming.

MJO Index: Recent Evolution

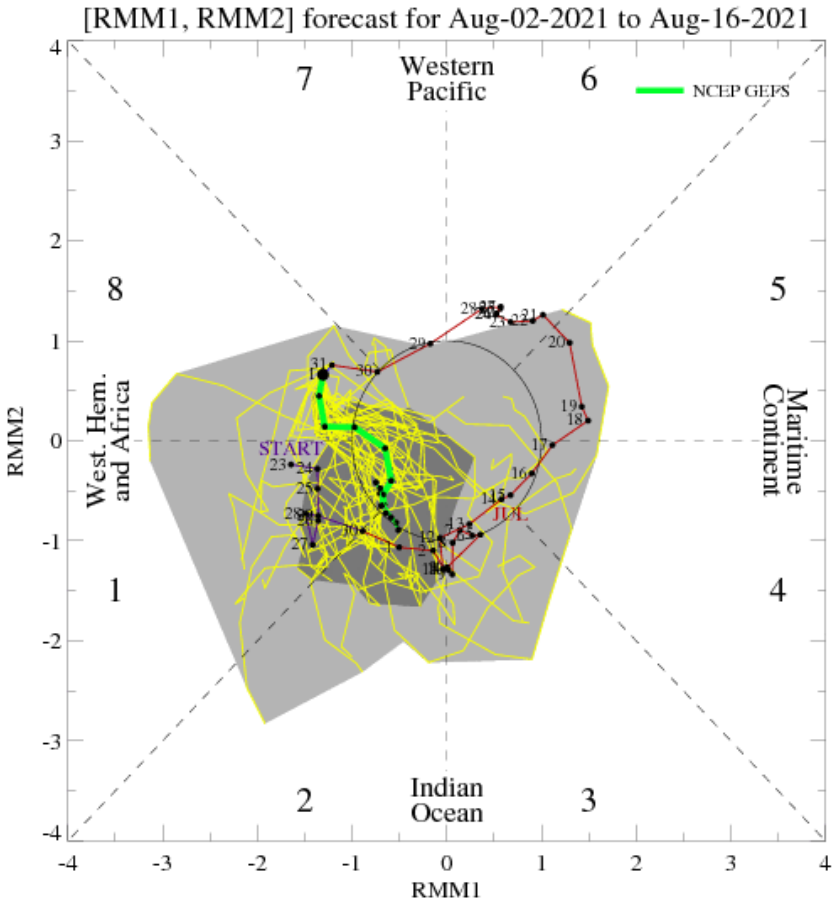
- The RMM index indicates the intraseasonal signal entered the Western Hemisphere during the past week, however it depicts a phase speed more consistent with Kelvin wave activity than a canonical MJO signal (having nearly skipped phase 7).

- The rapid decrease in RMM1 values are likely tied to increase in anomalous lower-level westerlies over central and eastern Pacific at the end of July.

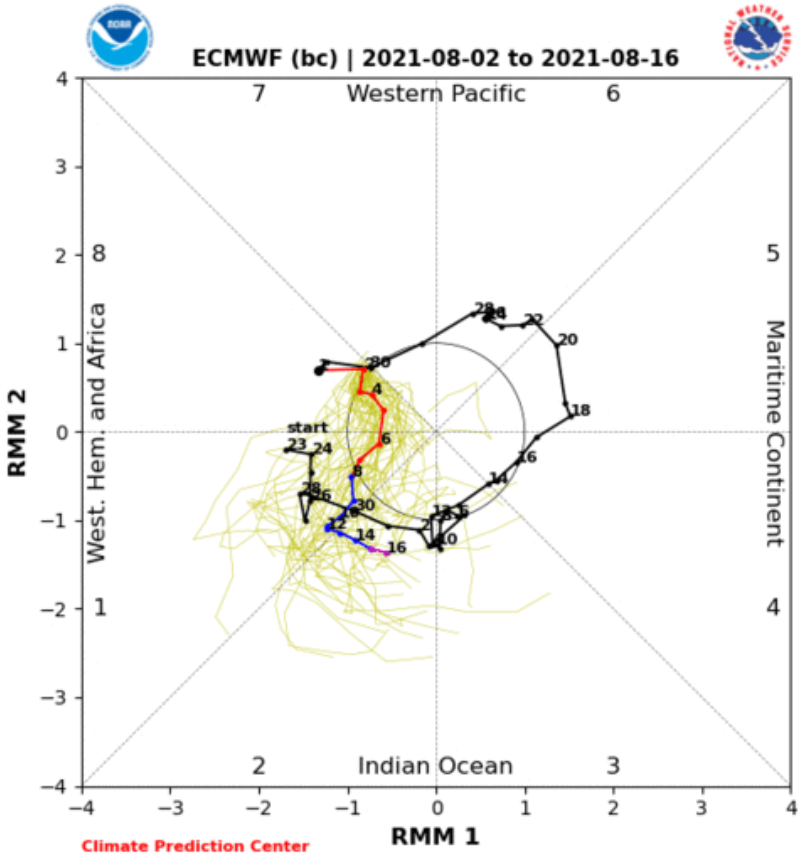


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

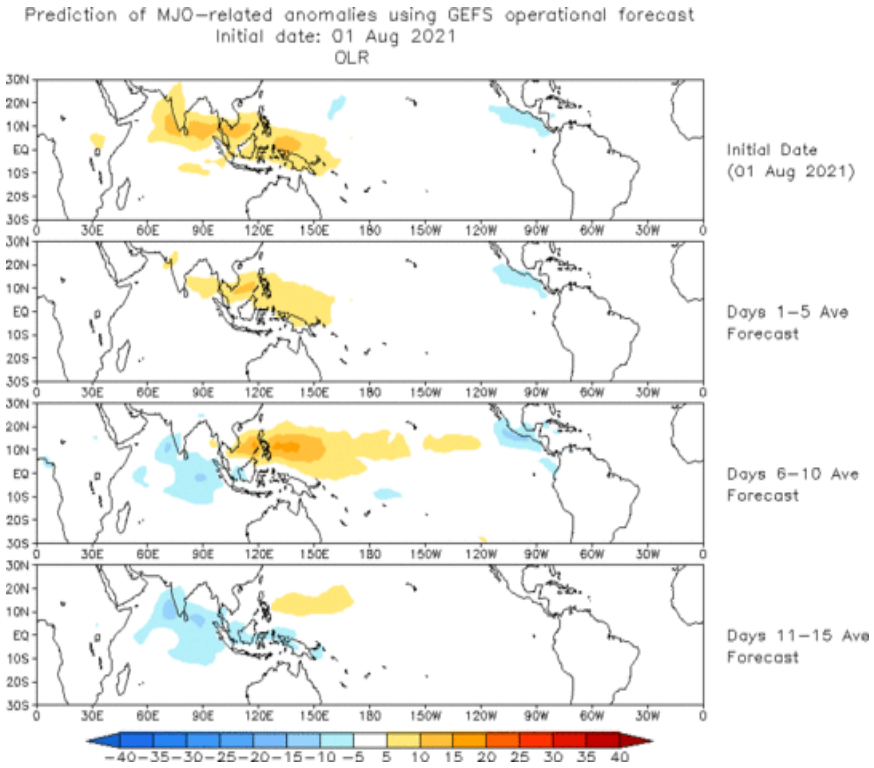


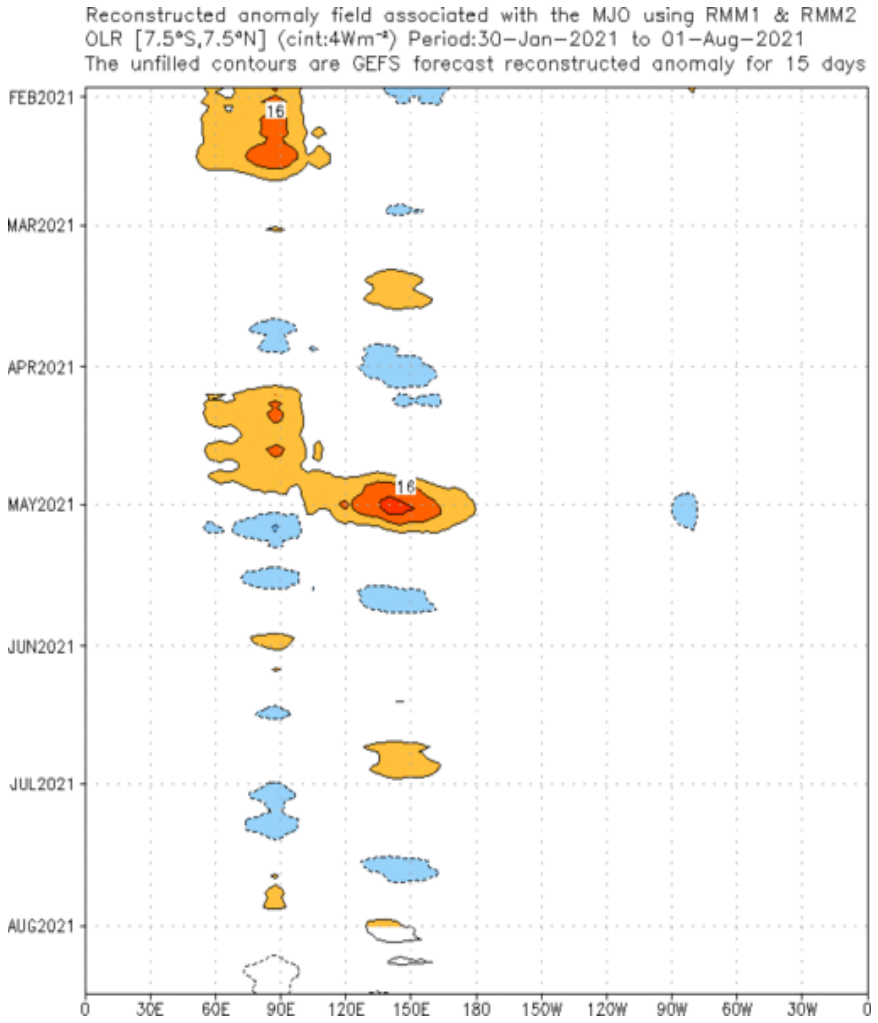
ECMWF Forecast

- Dynamical models generally favor the continued eastward propagation of the intraseasonal signal while weakening over the Western Hemisphere during week-1. This weakening is possibly due to interference with the low frequency footprint over the Pacific.
- Large ensemble spread is indicated by week-2, however some models favor the MJO to reemerge and become more coherent over Africa and the Indian Ocean, with the ECWMF and JMA being the most in-line with this realization.

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.)

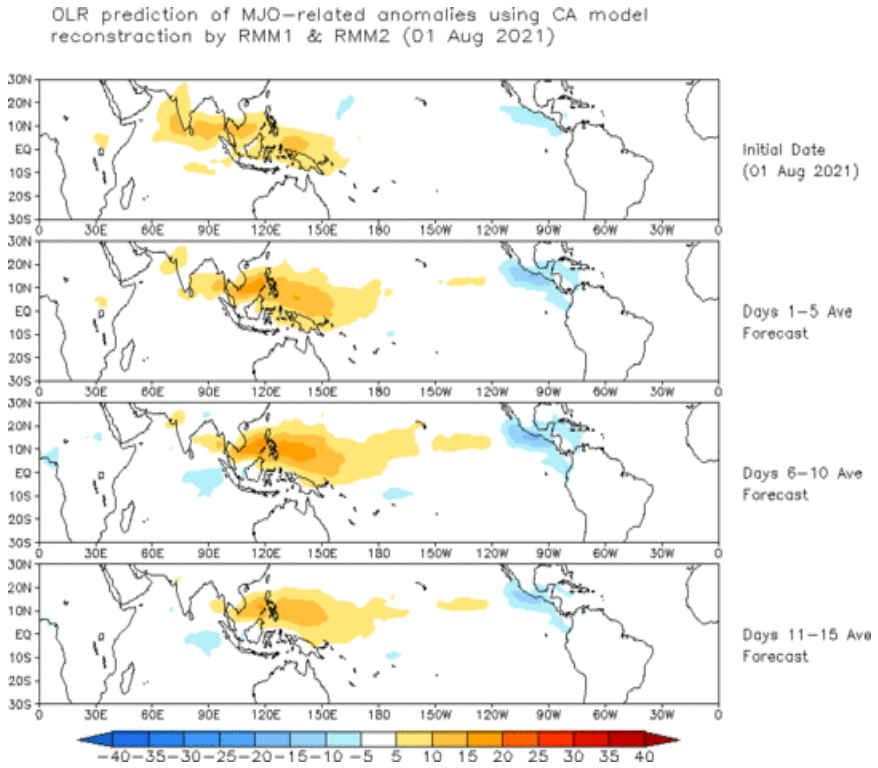


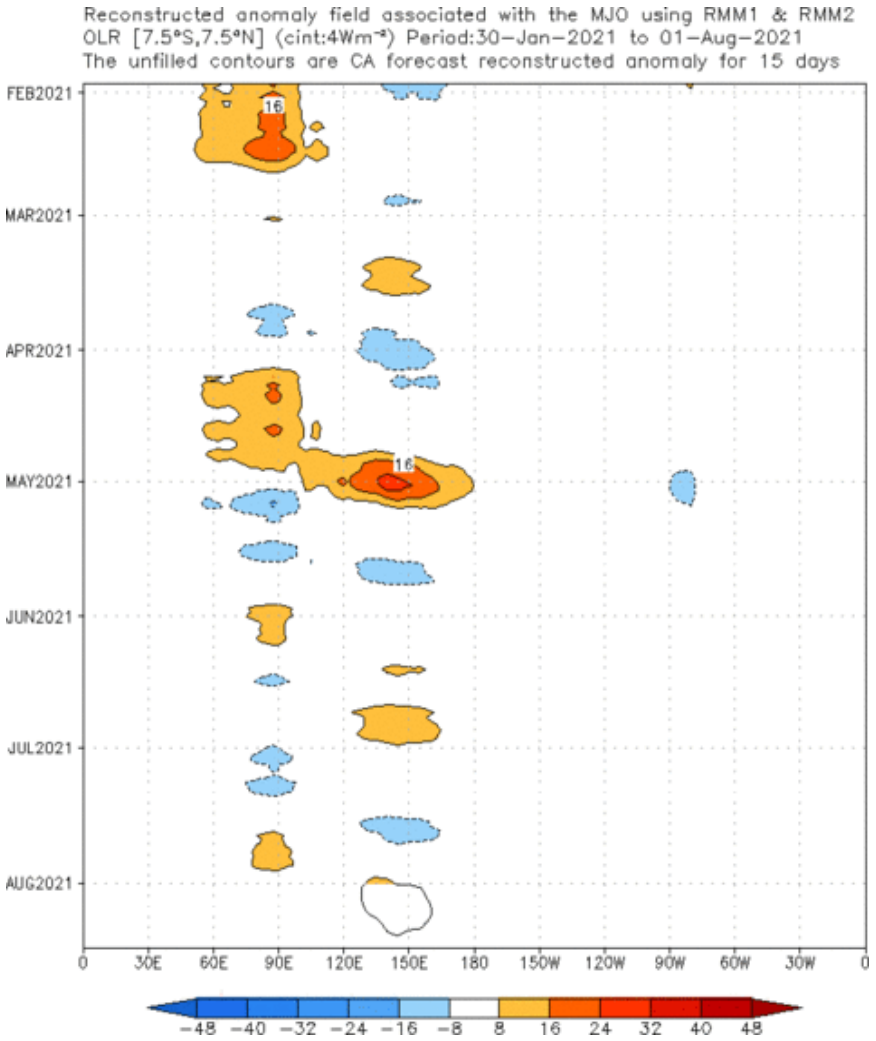


- The GEFS RMM-based OLR anomaly forecast features suppressed (enhanced) convection prevailing across the West (East) Pacific, with enhanced convection developing over the Indian Ocean convection by Week-2.

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.)

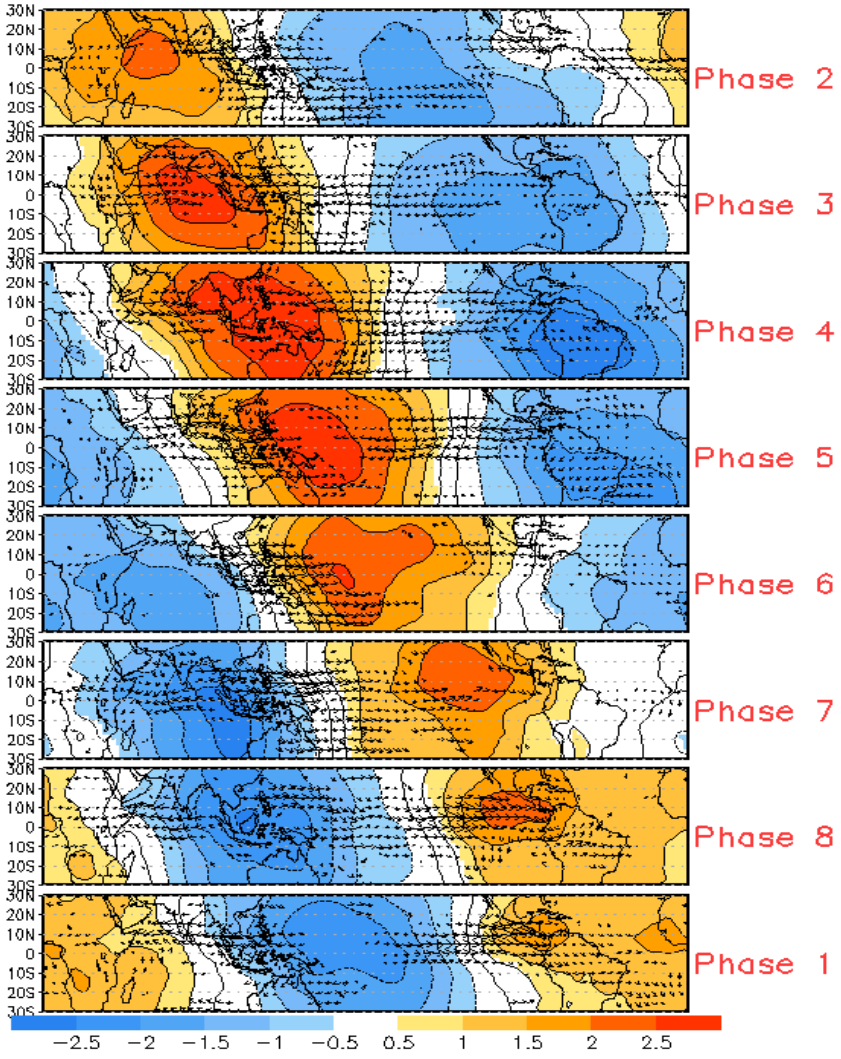




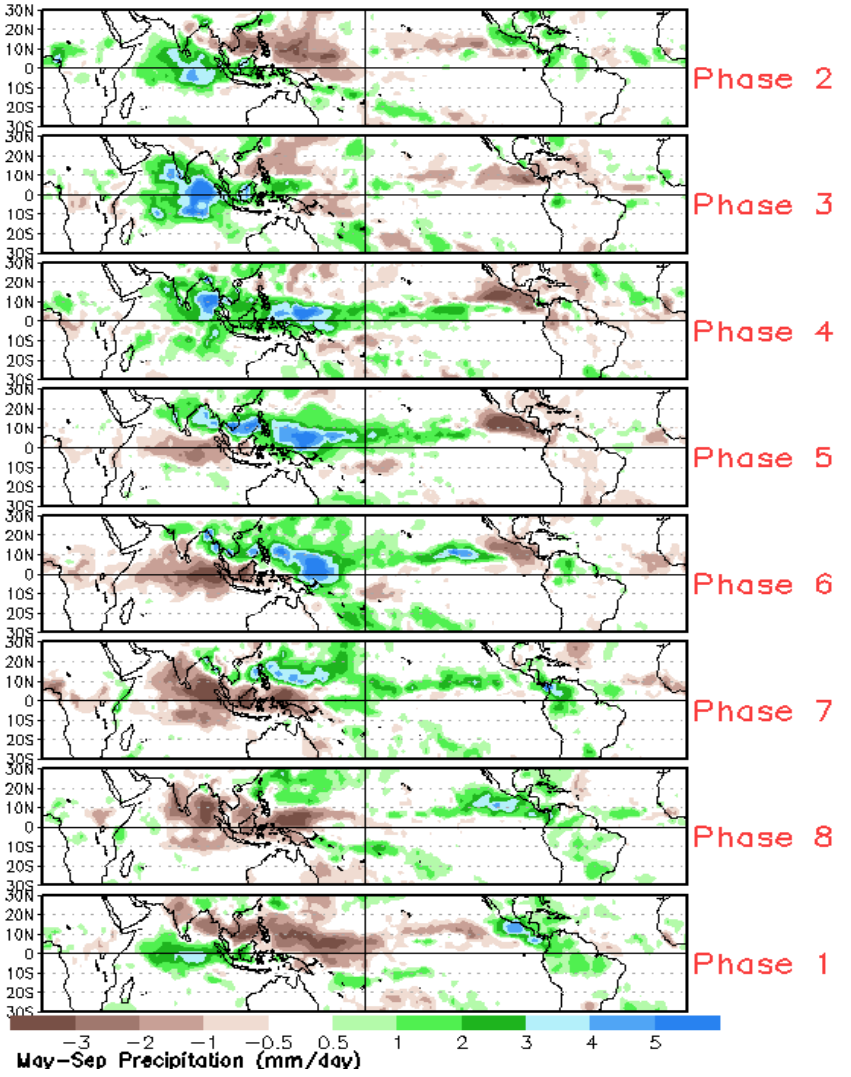
- The constructed analog forecast is similar to that of the GEFS, but features a convective pattern that is of higher magnitude.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



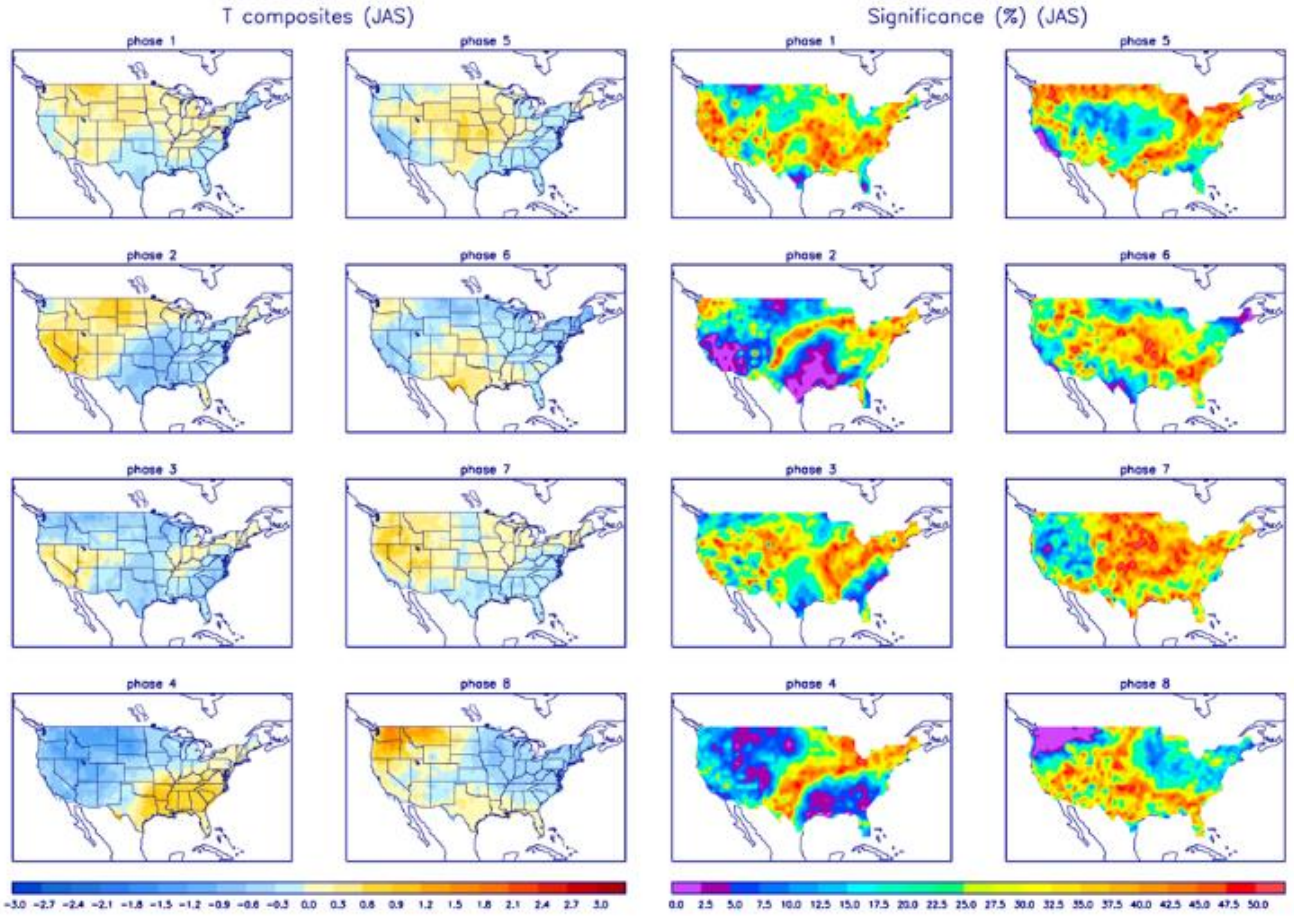
Precipitation Anomalies



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.

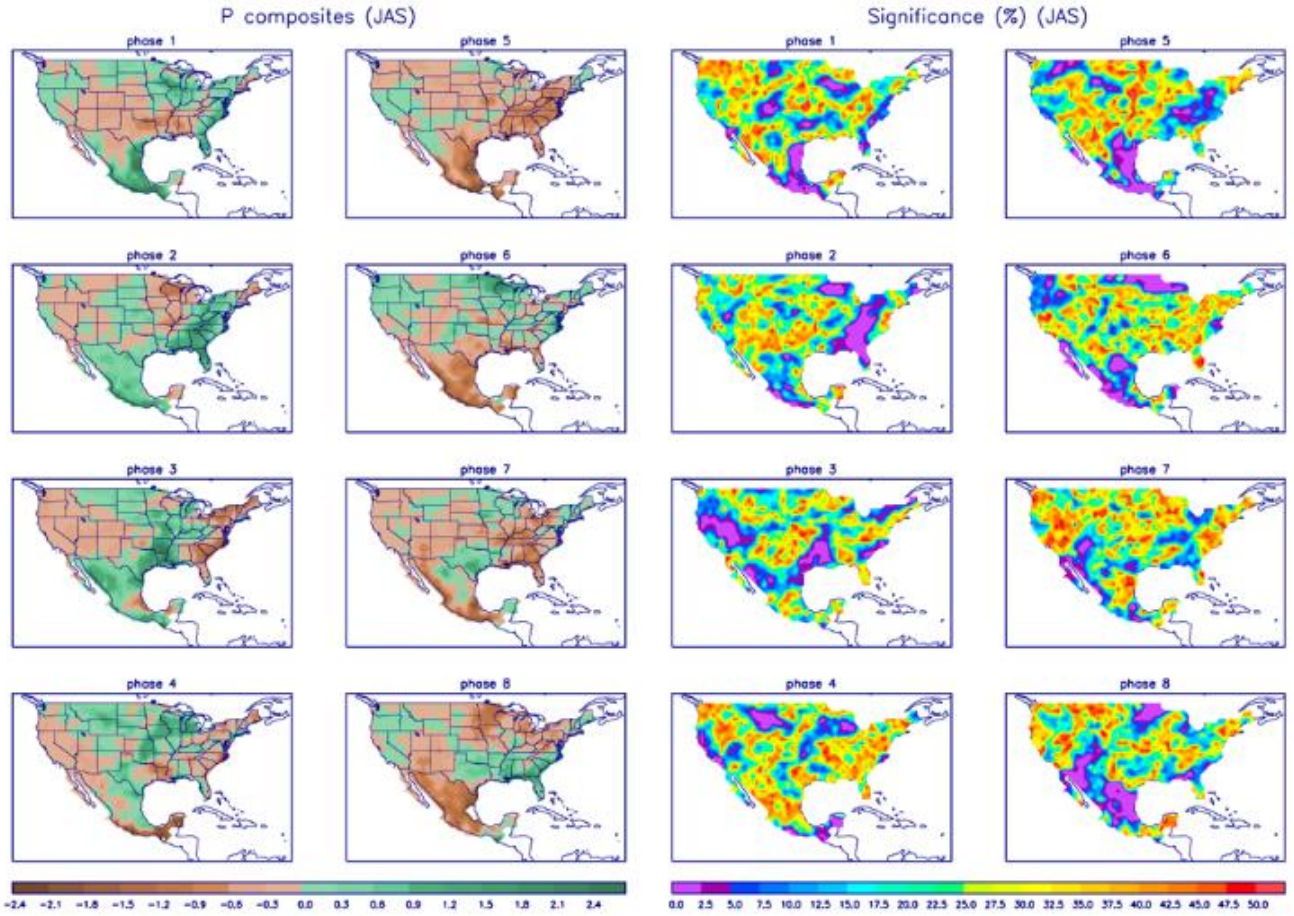


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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