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

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

Overview

- The RMM index depicts a weakening MJO during mid to late August as other modes of tropical variability become more dominant.

- Dynamical model forecasts are in good agreement and consistent that the MJO remains weak during the next two weeks.

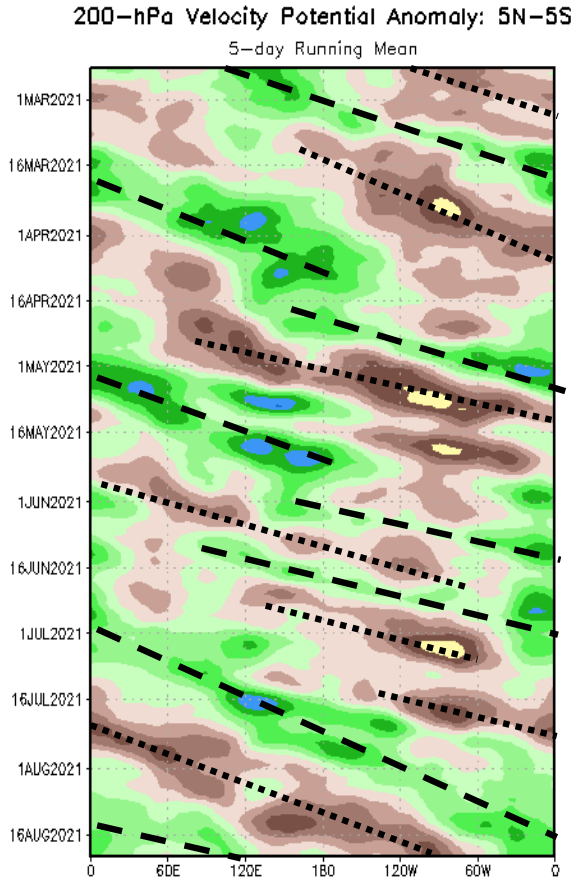
- A Kelvin wave, crossing the Western Hemisphere, elevates chances of tropical cyclone (TC) development over the East Pacific and Atlantic basins during the remainder of August. Climatology favors an increased chance of TC genesis across the Main Development Region of the Atlantic basin heading into September.

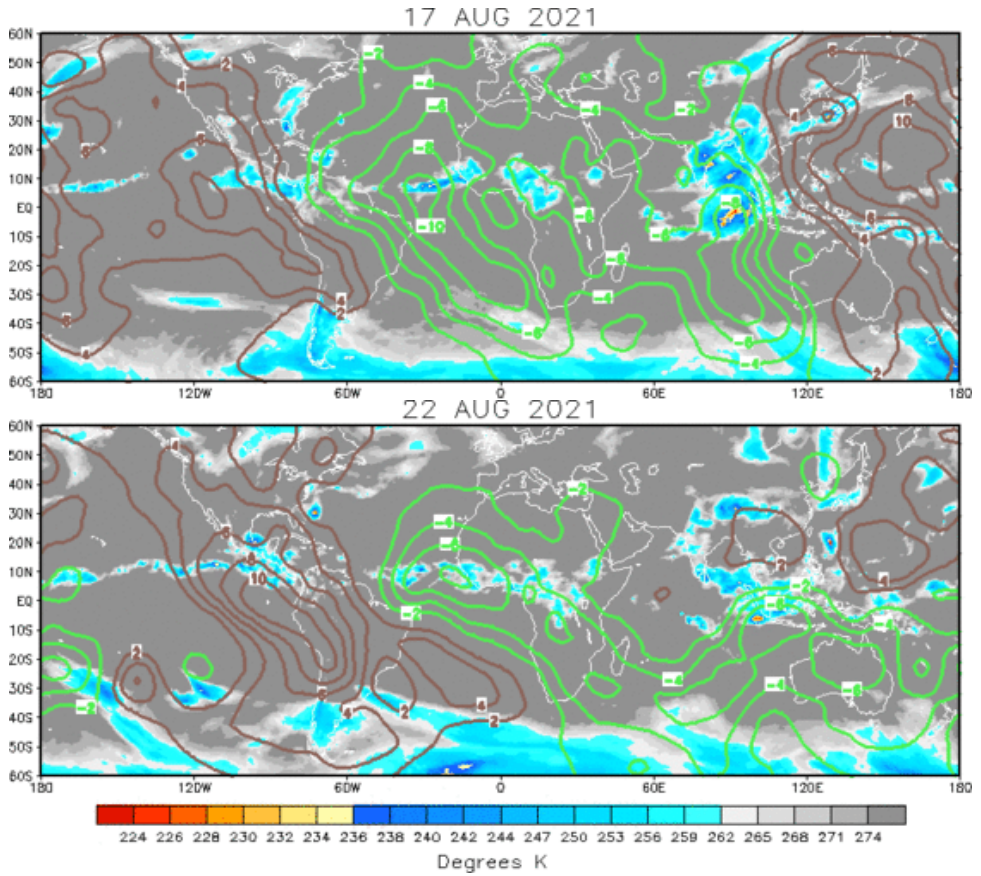
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).



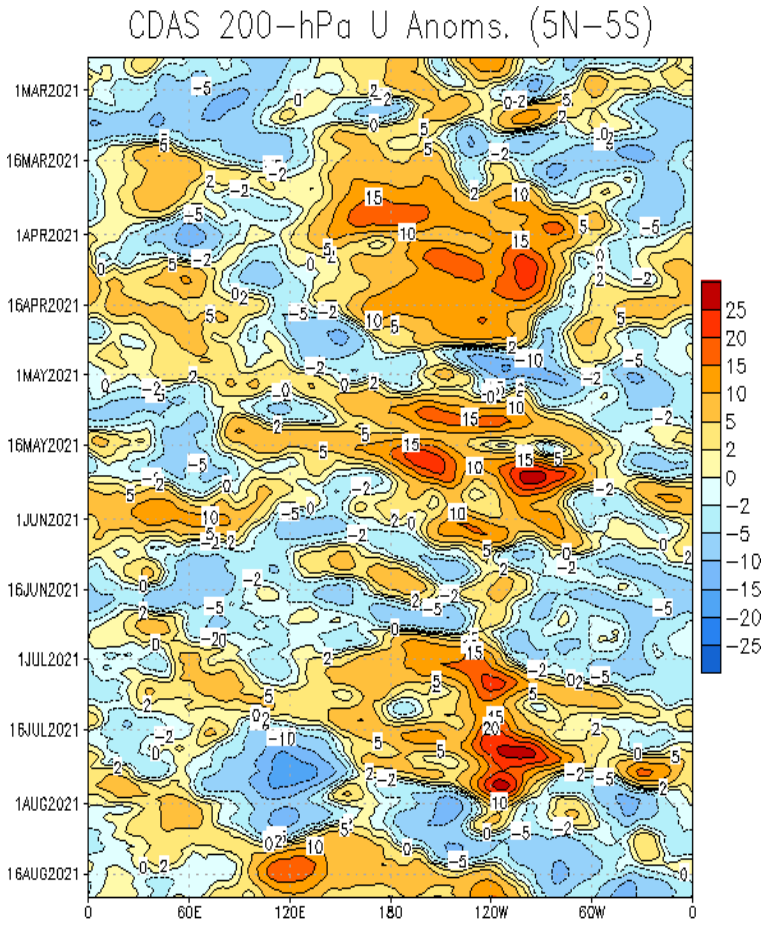


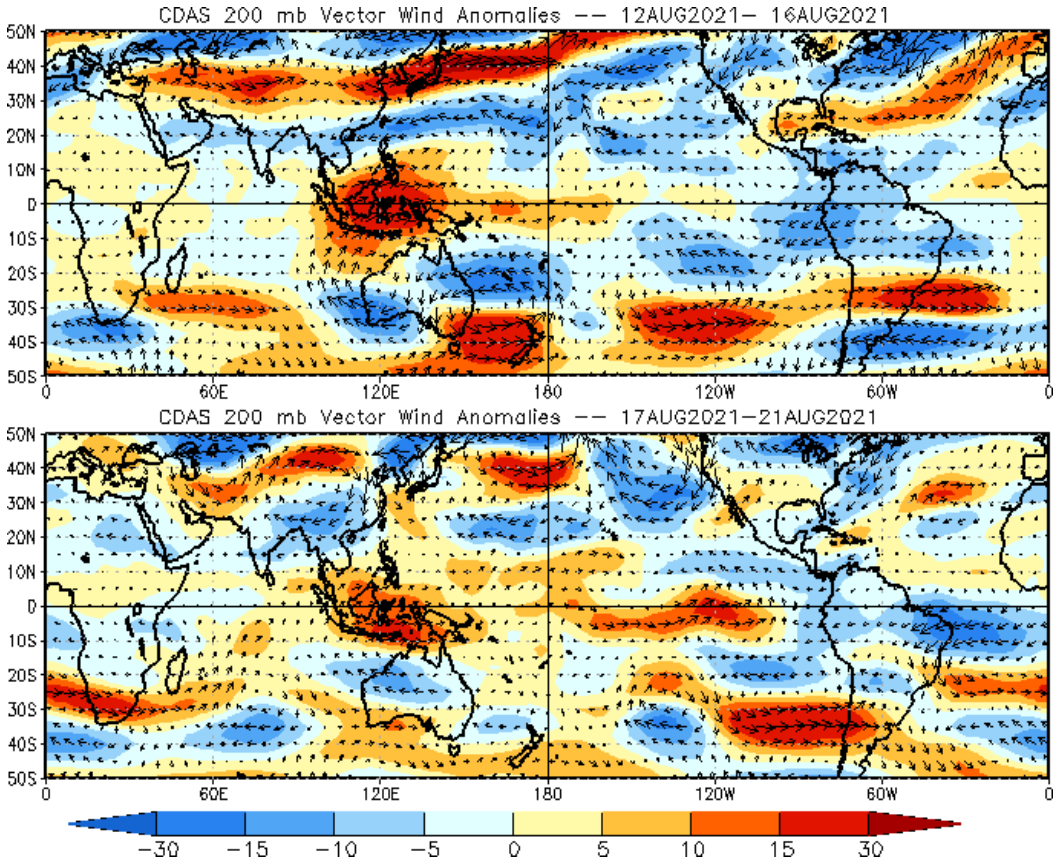
- A robust intraseasonal signal was apparent in the upper-level velocity potential field during July and early August.

- As other modes of tropical variability (equatorial Rossby and Kelvin wave activity) interfered, the MJO recently began to weaken.

200-hPa Wind Anomalies

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

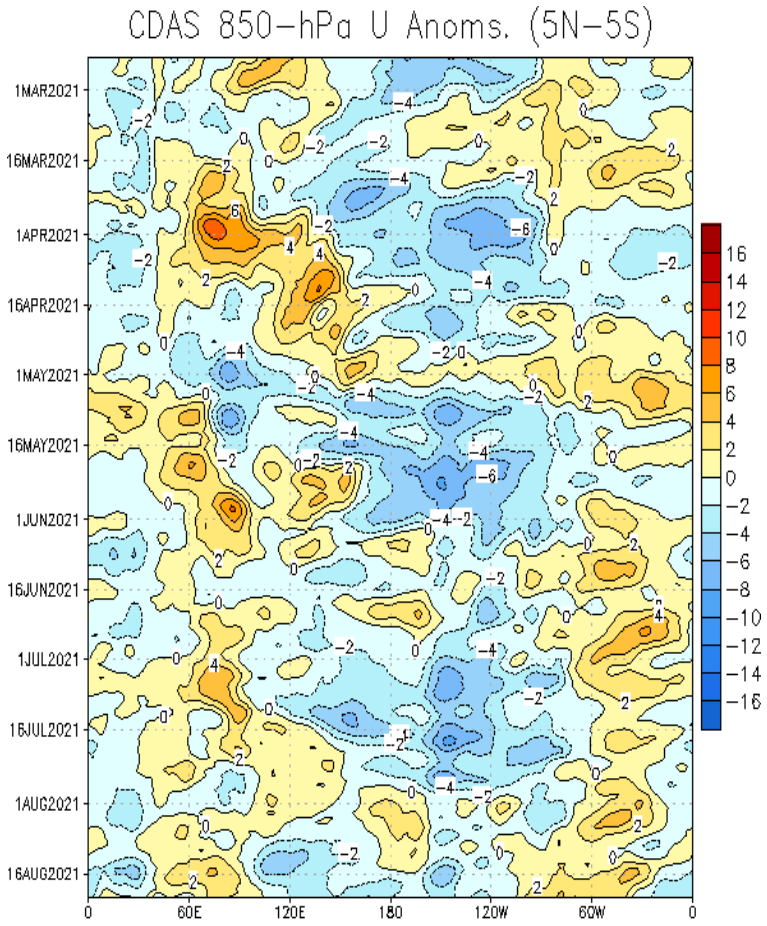


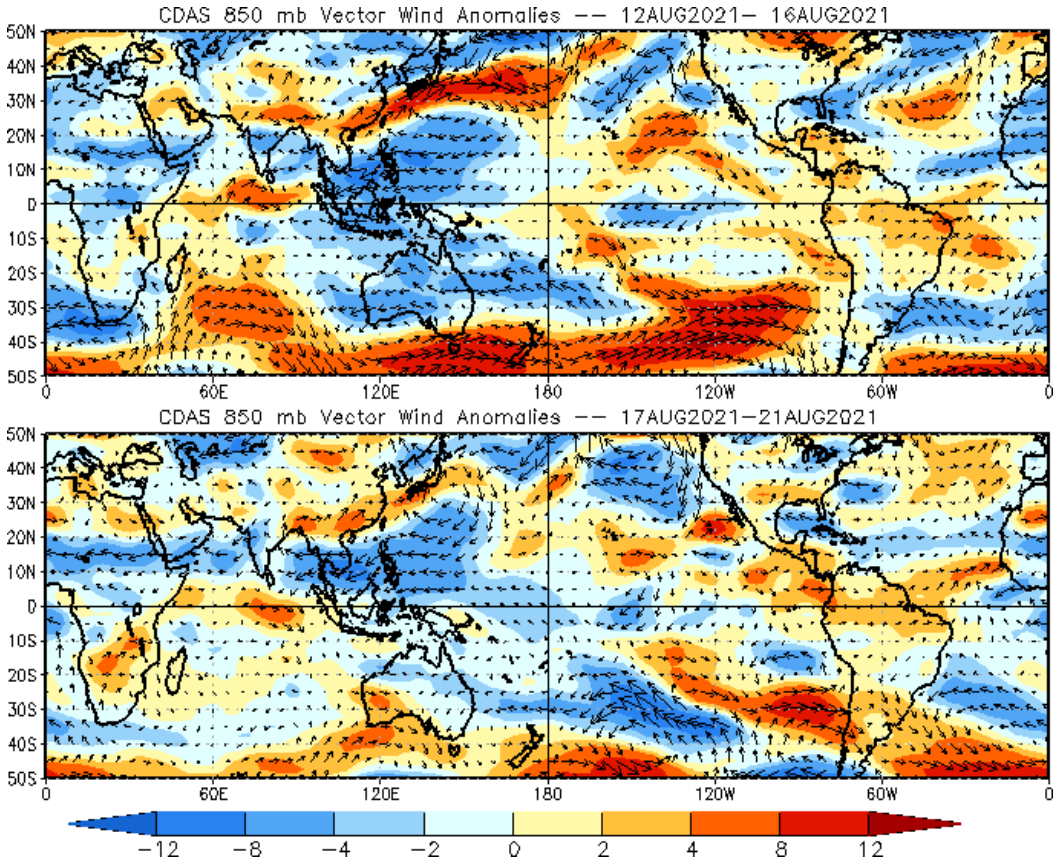


- Upper-level westerly anomalies shifted eastward to the Maritime Continent and Pacific during mid-August.
- A more stationary pattern of upper-level easterly anomalies developed over the Western Hemisphere, reducing vertical wind shear and providing a favorable large-scale environment for tropical cyclone development across the East Pacific and Atlantic basins.
- Anticyclone over the South Atlantic contributed to increasing easterly anomalies along the equator in the Atlantic.

850-hPa Wind Anomalies

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

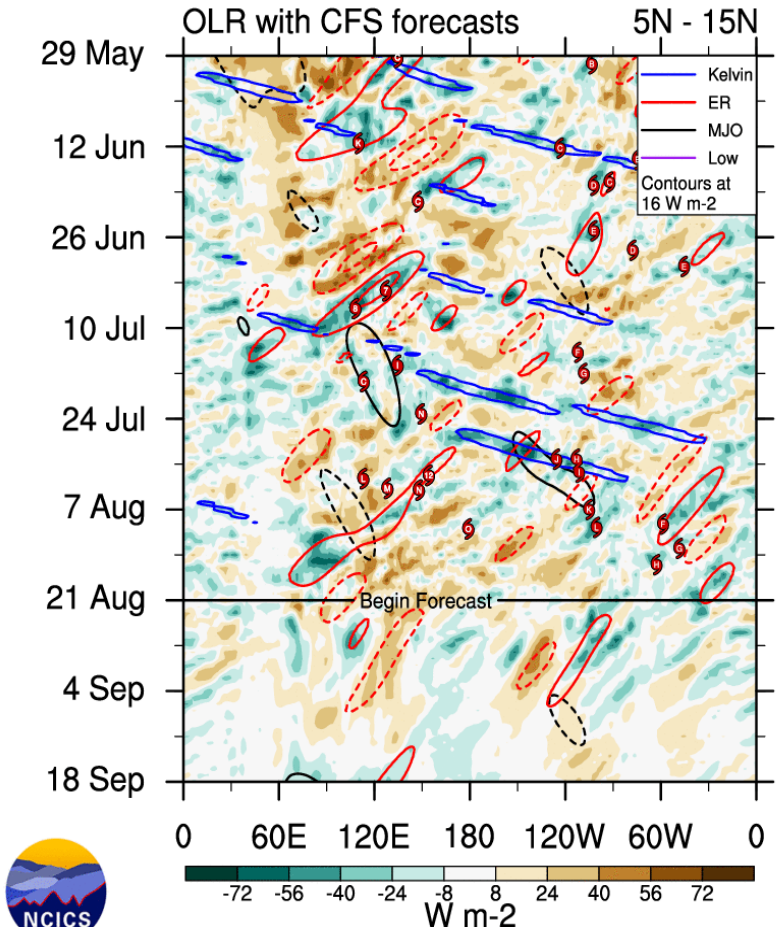


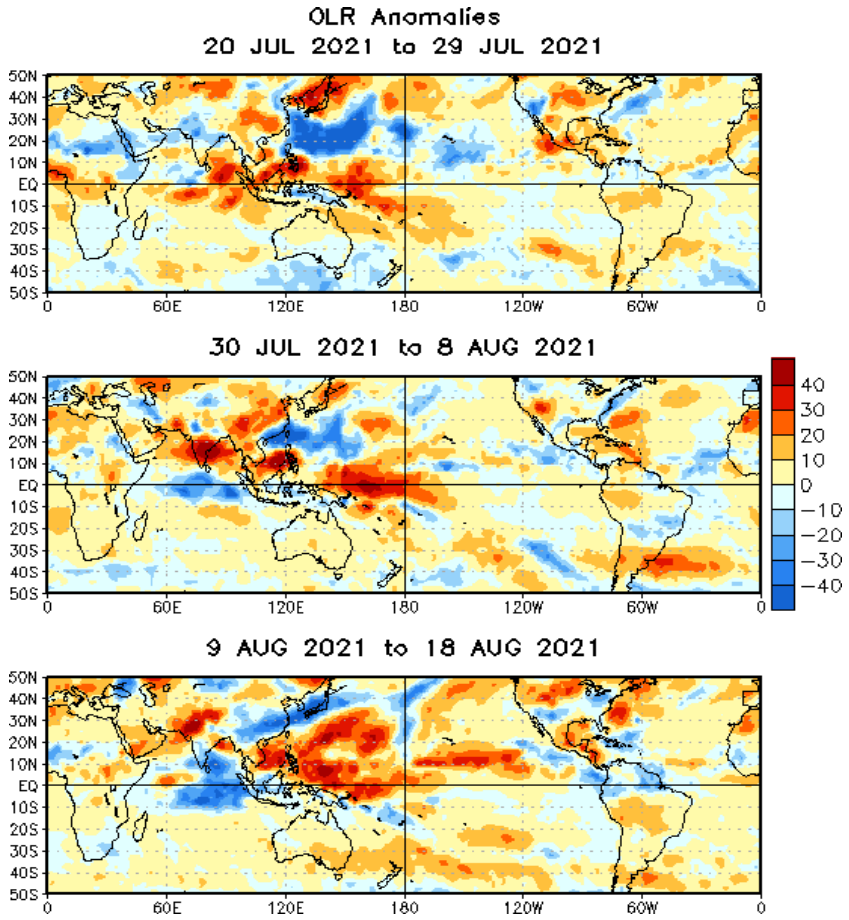


- A low-frequency base state of low-level westerly anomalies continues to persist around 60 degrees W.
- Trade winds increased over the West Pacific during mid-August as enhanced easterlies overspread that region.

Outgoing Longwave Radiation (OLR) Anomalies

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

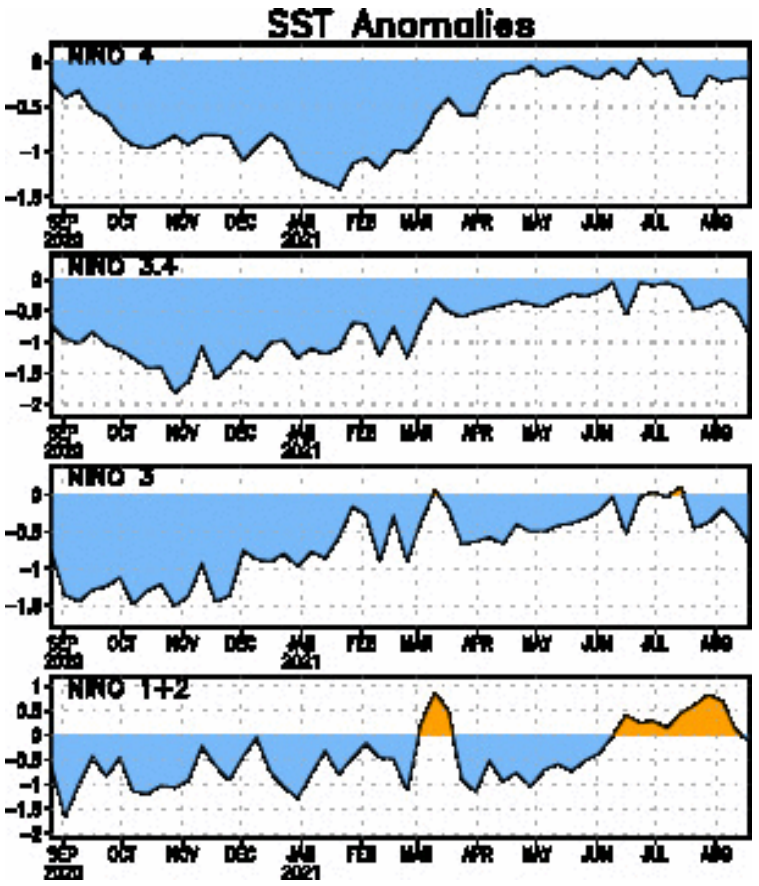


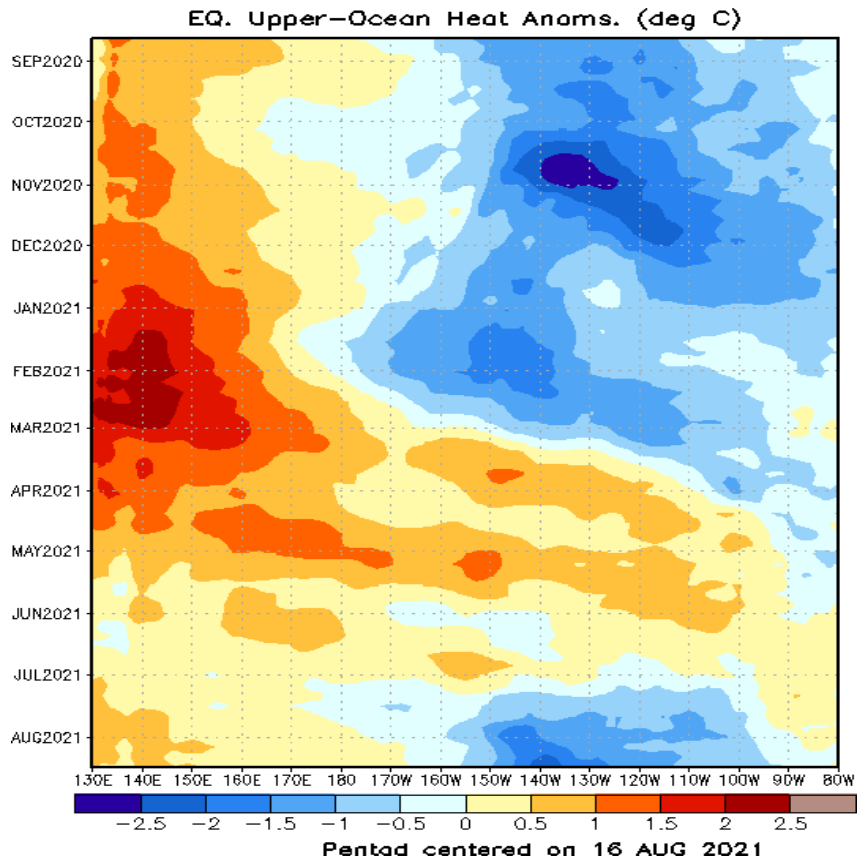


- As the MJO propagated eastward, convection increased across the Indian Ocean and shifted eastward to the western Maritime Continent.

- Rossby wave activity became more apparent in the filtering since early August, which contributed to the recent weakening of the MJO.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



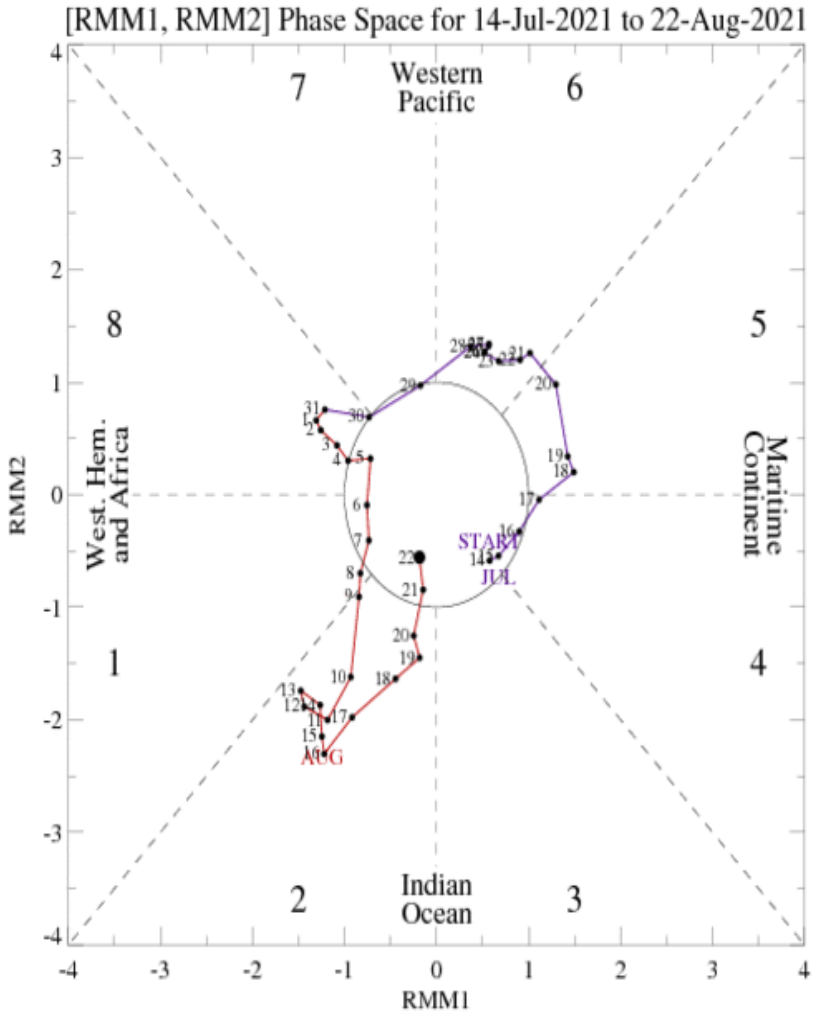


- Multiple episodes of oceanic Kelvin wave activity led to a strengthening of upper-ocean heat content during this past spring. However, these positive anomalies weakened during June, and negative anomalies have been strengthening across much of the Pacific during August.

- An increase of negative anomalies were observed in the Nino 3.4 and Nino 3 regions of the equatorial Pacific.

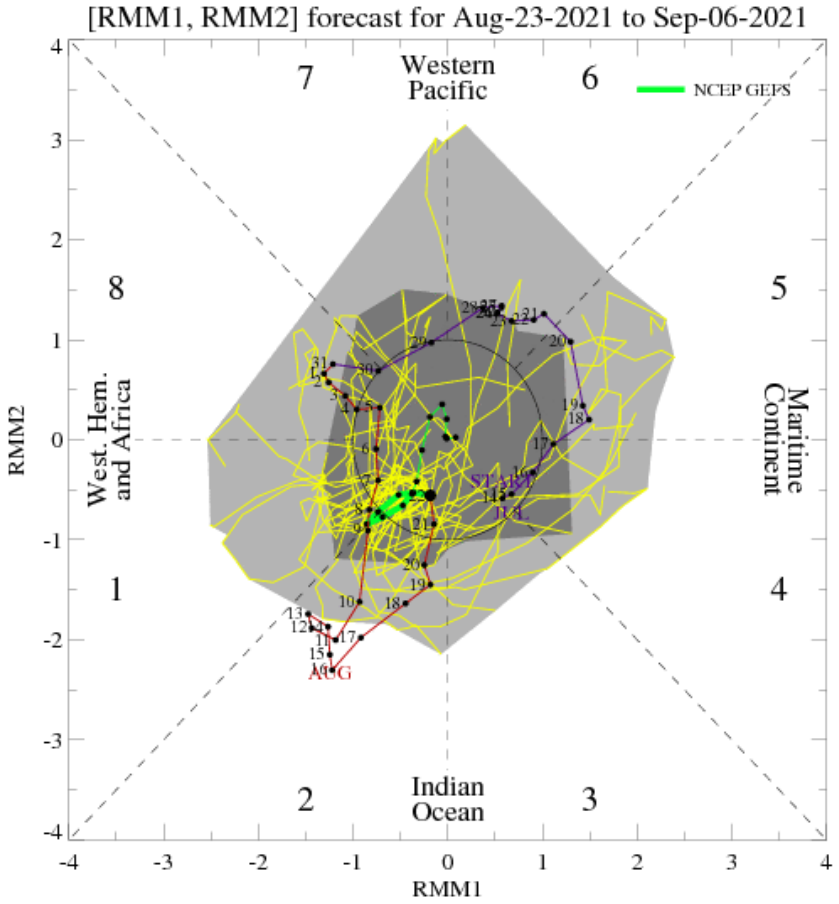
MJO Index: Recent Evolution

- The RMM index depicted eastward propagation across the Western Hemisphere during late July and early August, consistent with a well-established MJO.
- An equatorial Rossby wave slowed its eastward propagation by mid-August and the amplitude of the RMM index rapidly decreased, signaling a weakening MJO.

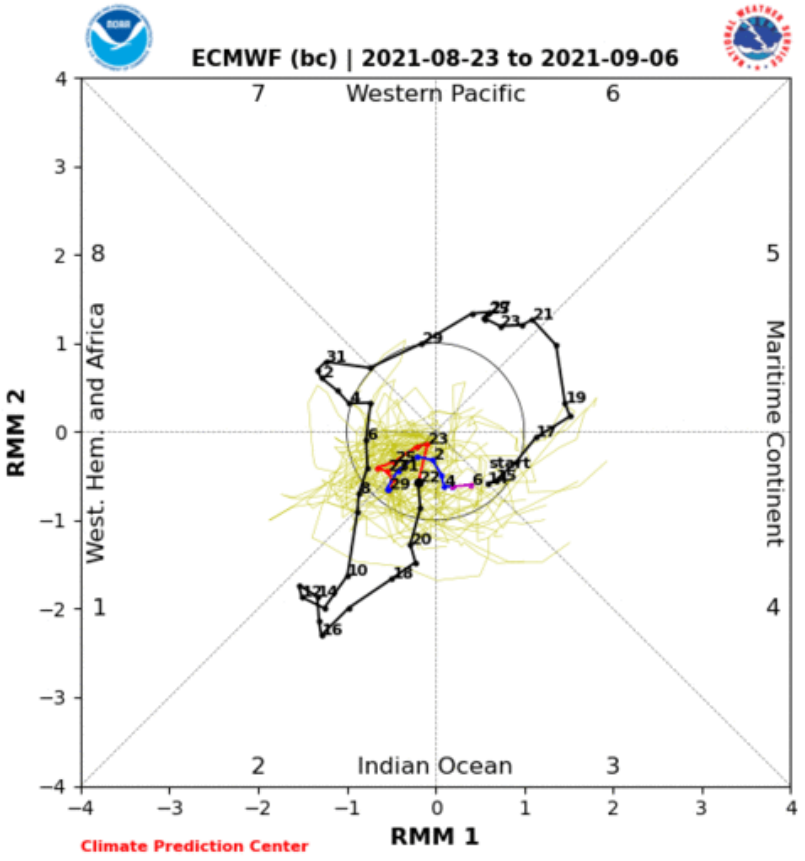


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

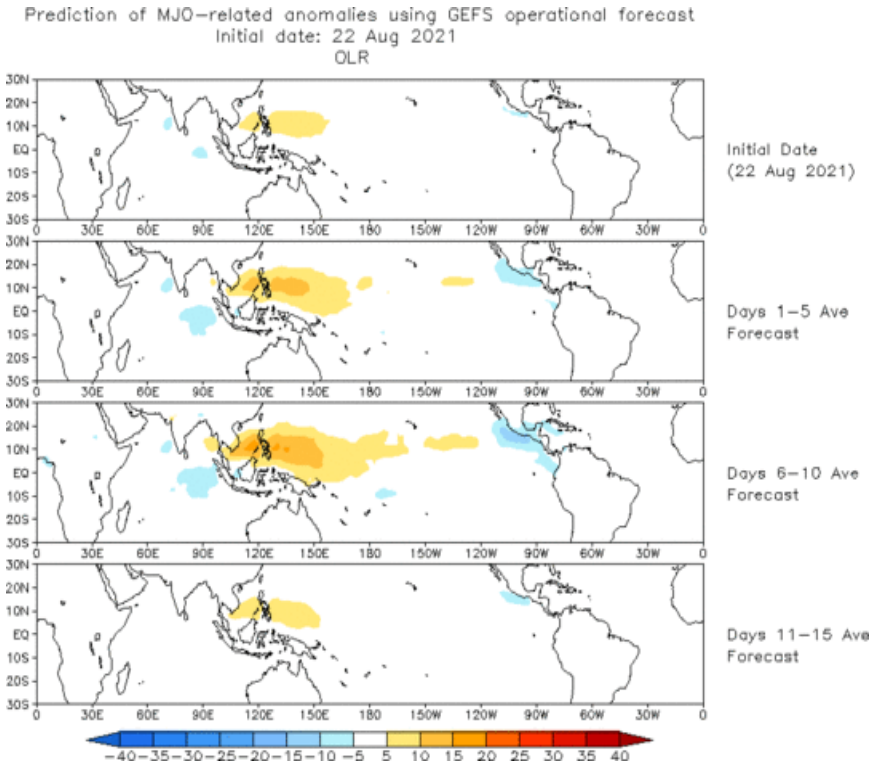


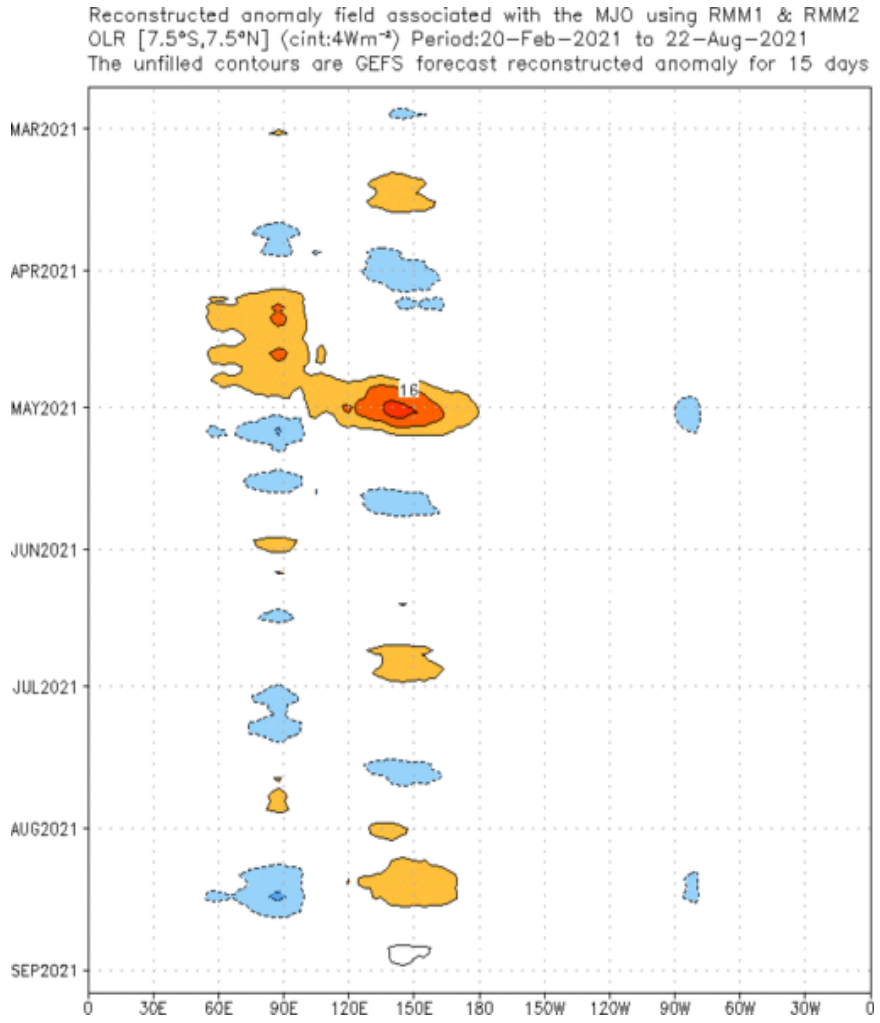
ECMWF Forecast

- Dynamical models are in good agreement that the MJO remains weak through early September.
- Large spread exists among the GEFS and ECMWF ensemble members due to influence from other modes of tropical variability.

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.)

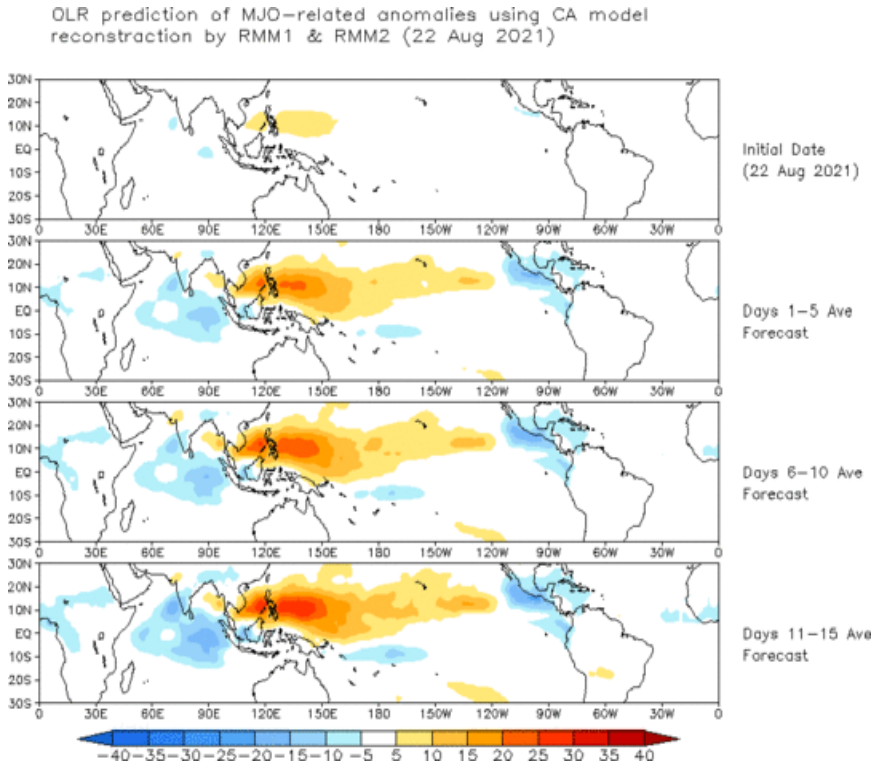


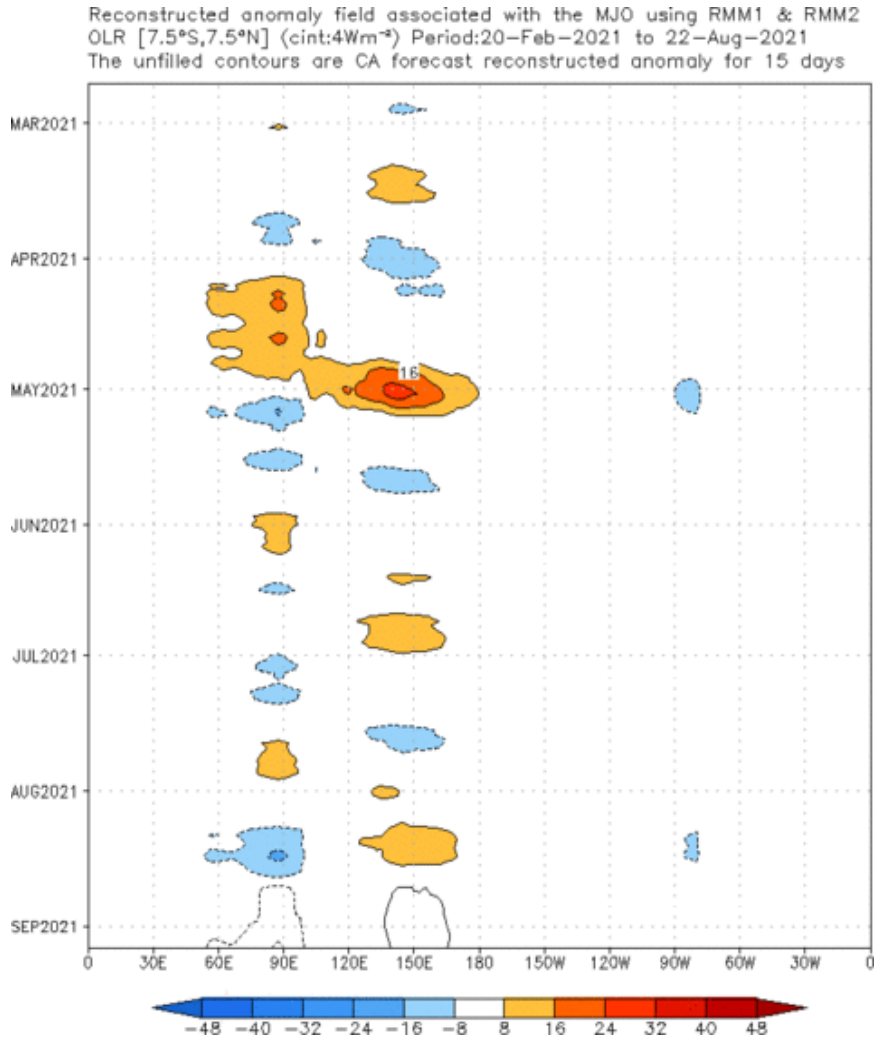


- The GEFS RMM-based OLR anomaly forecast features diminishing anomalies during the next two weeks which is consistent with a weak MJO.

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.)

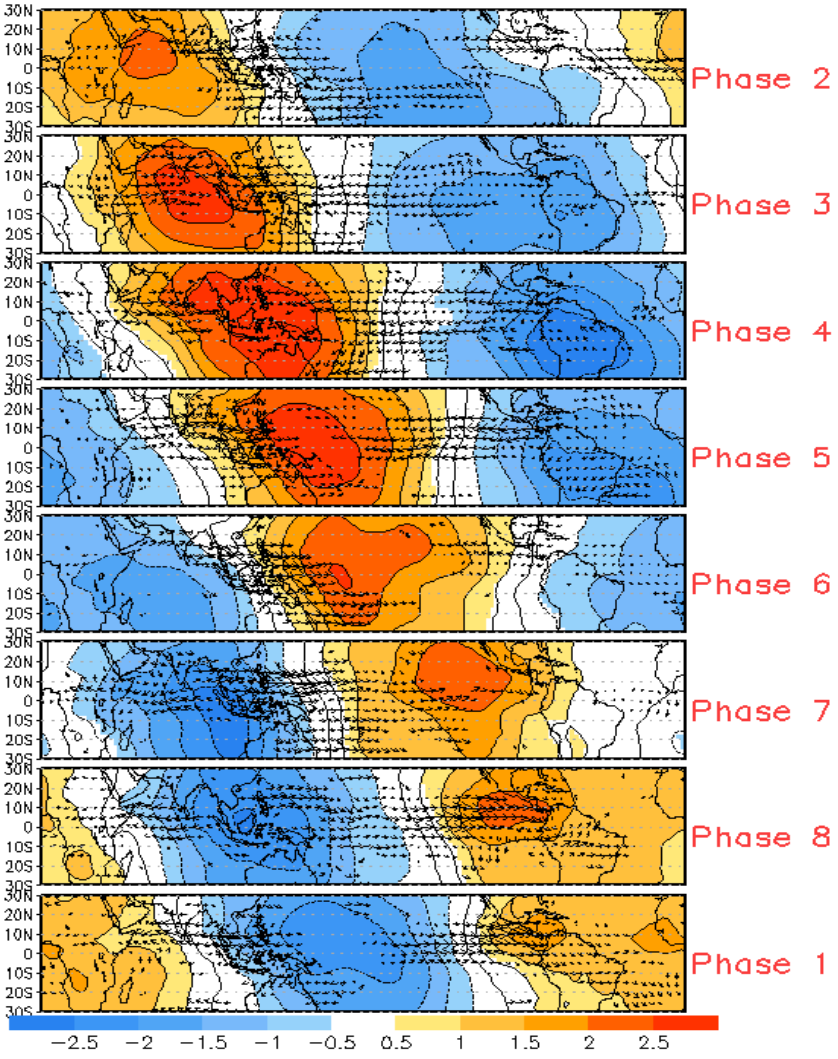




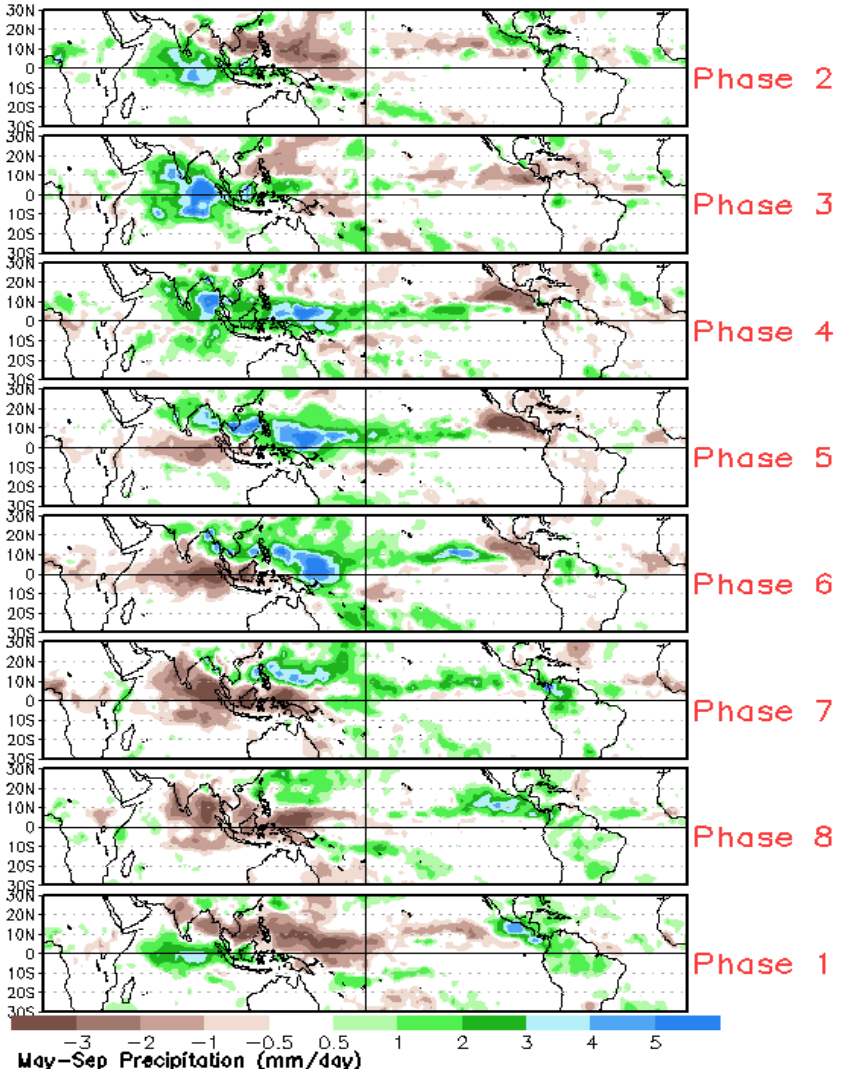
- The constructed analog forecast has a more stationary pattern of anomalous tropical convection with a continuation of enhanced convection across the East Pacific and Atlantic basins.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



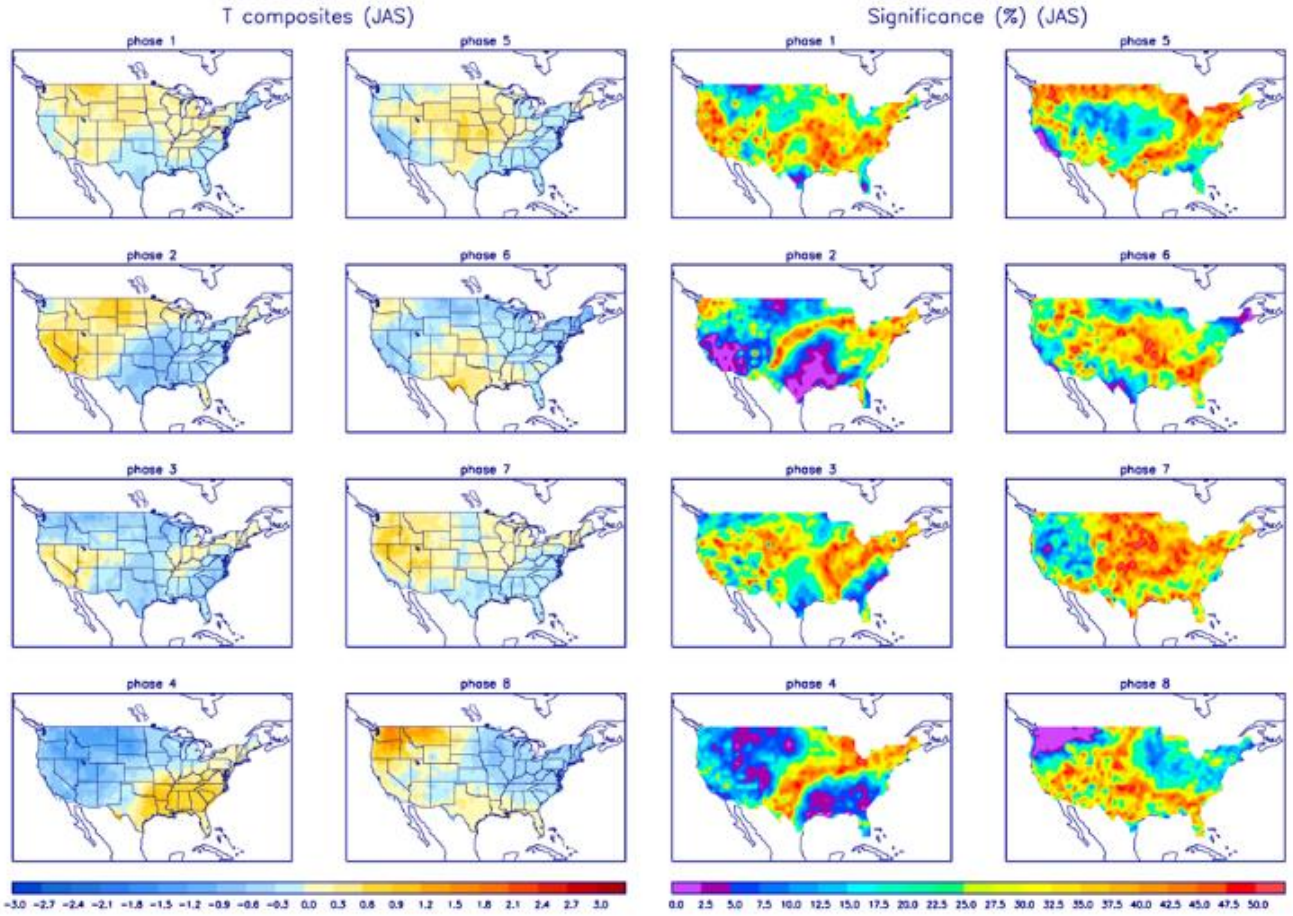
Precipitation Anomalies



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.

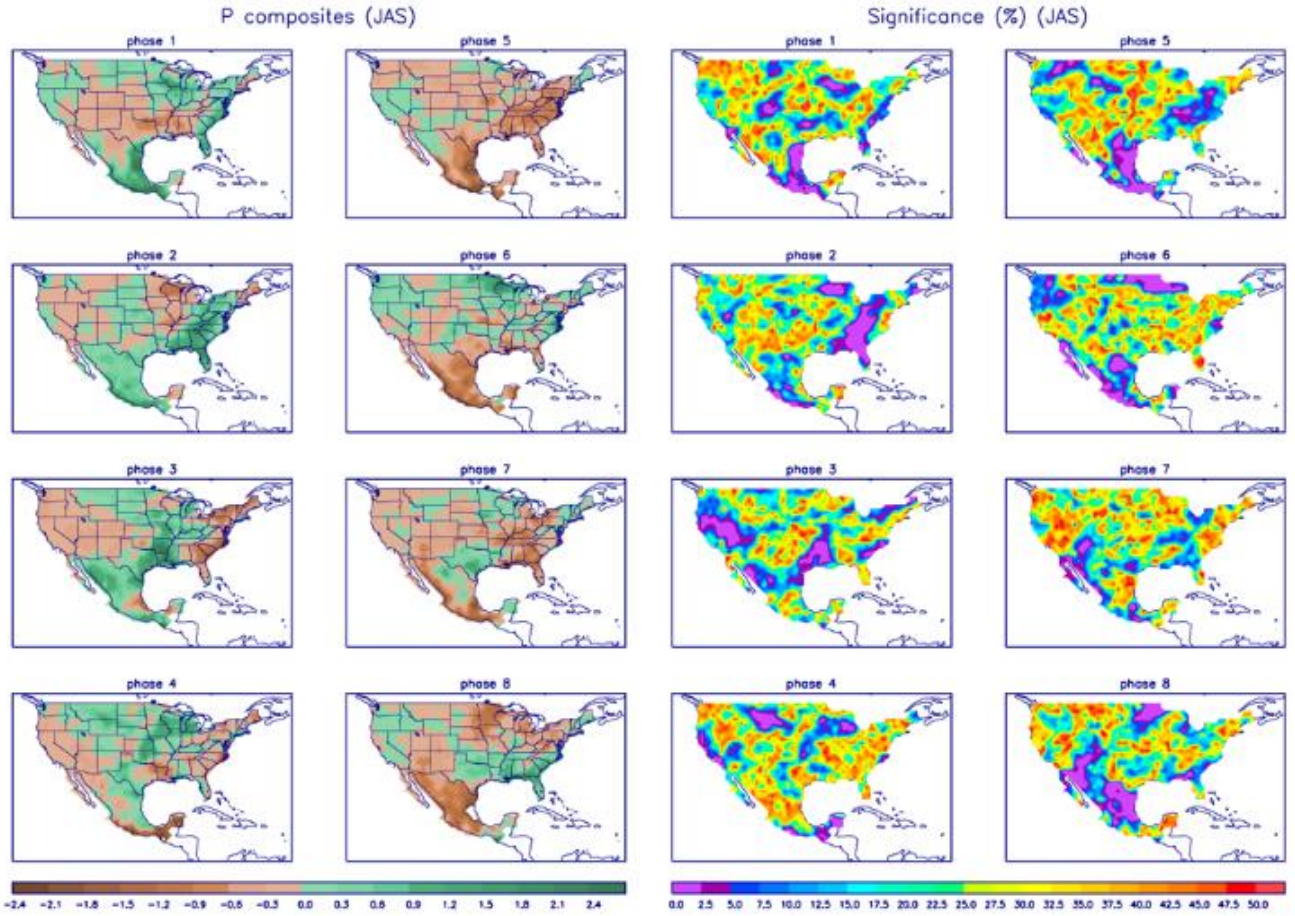


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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