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

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
17 August 2020

Overview

- Envelopes of active convection associated with the MJO and an atmospheric Kelvin wave were collocated over the East Pacific during the past week. This superposition of wave modes likely contributed to enhanced tropical cyclone activity throughout the basin.

- Dynamical models suggest that an active MJO is likely during the next two weeks. If these forecasts hold true, it's reasonable to expect the MJO to continue throughout the East Pacific and Atlantic over the next month, which could have meaningful impacts on prospective La Niña development and tropical cyclone activity.

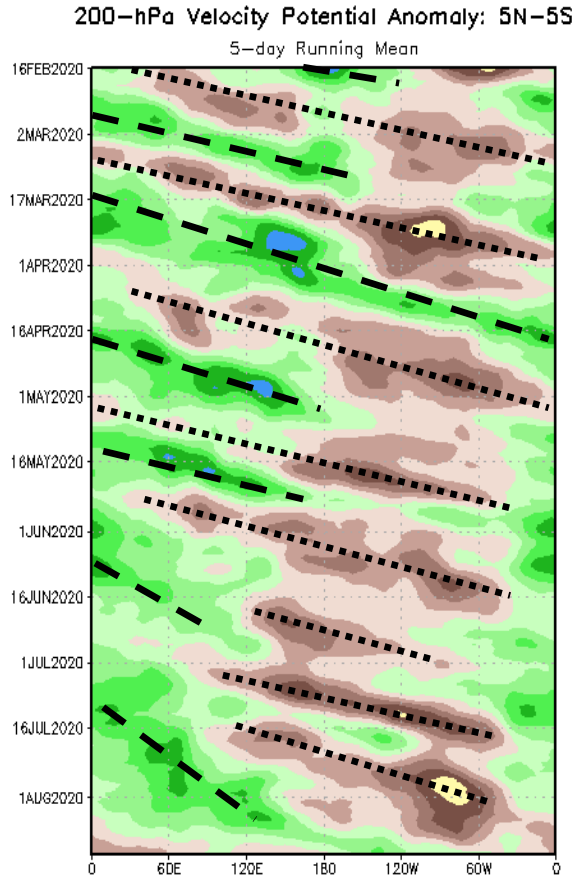
- Dynamical models also forecast Kelvin wave activity to continue during the next two weeks, which could serve to amplify convection associated with the MJO.

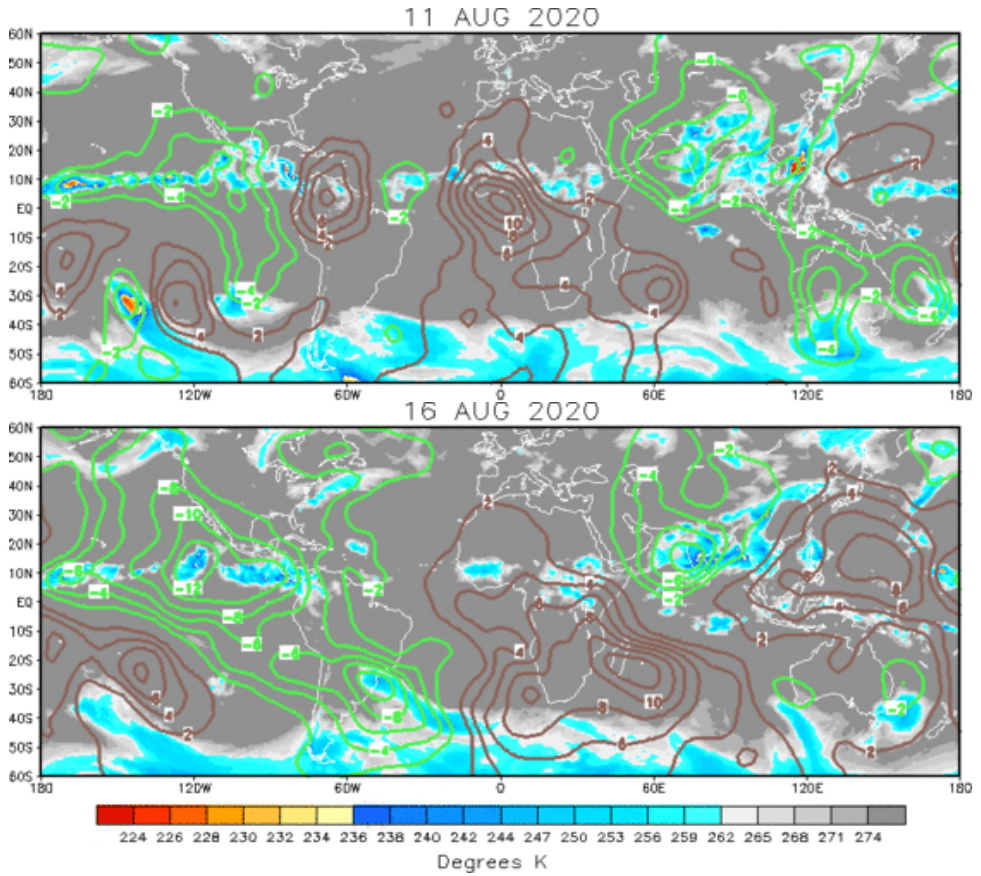
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).



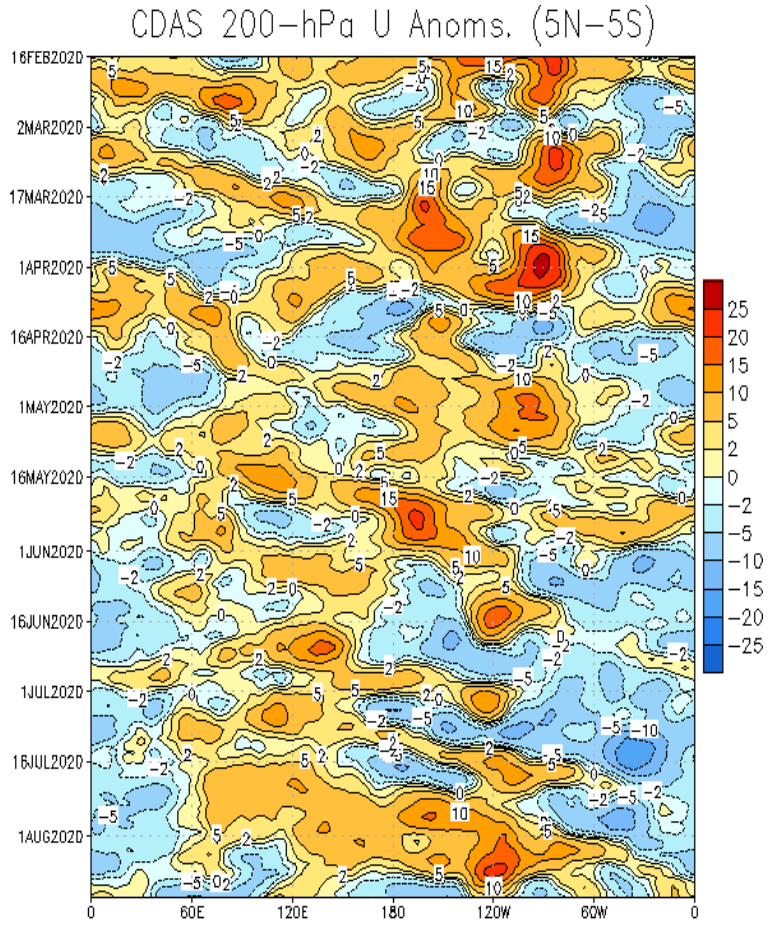


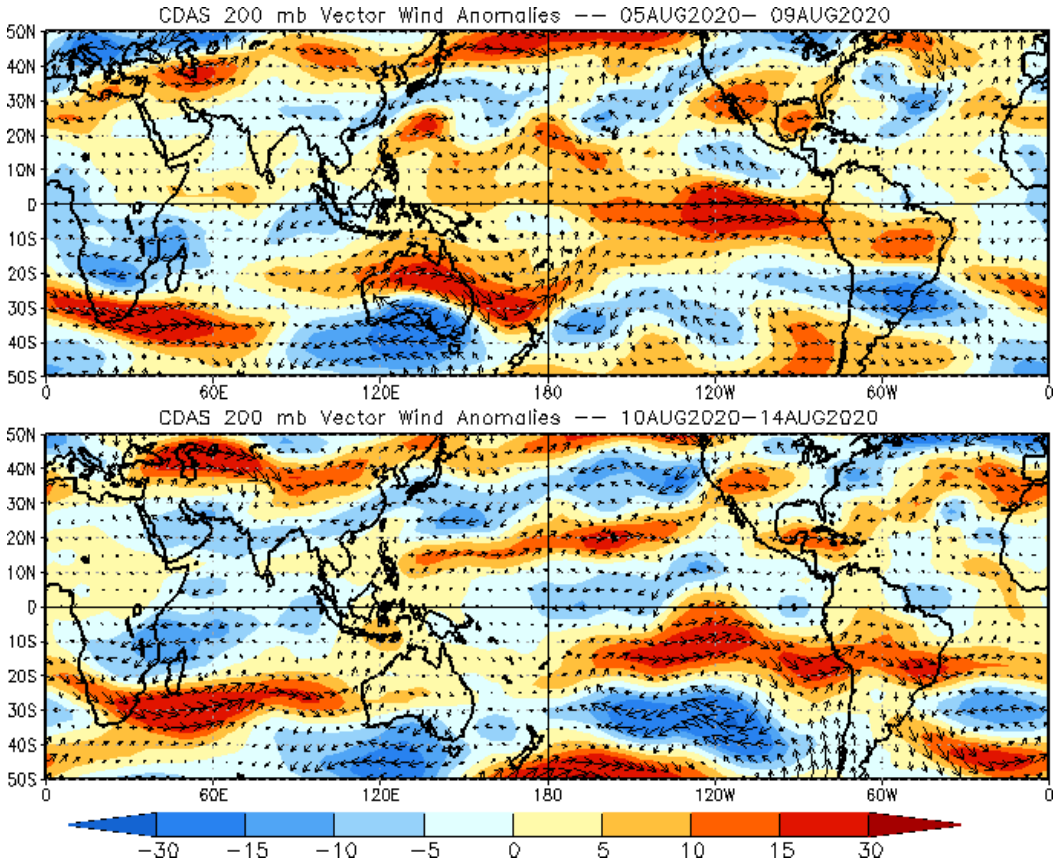
- Throughout 2020 the base state has seen a westward shift of conditions favorable for enhanced (suppressed) convection from near the Date Line (Americas) to the Indian Ocean (Central Pacific). This has been interspersed with periodic intraseasonal activity.

- Most recently, a large intraseasonal envelope has propagated from Africa to near the Maritime Continent. This envelope has a phase speed consistent with the MJO but is also amplified by Kelvin wave activity within it.

200-hPa Wind Anomalies

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



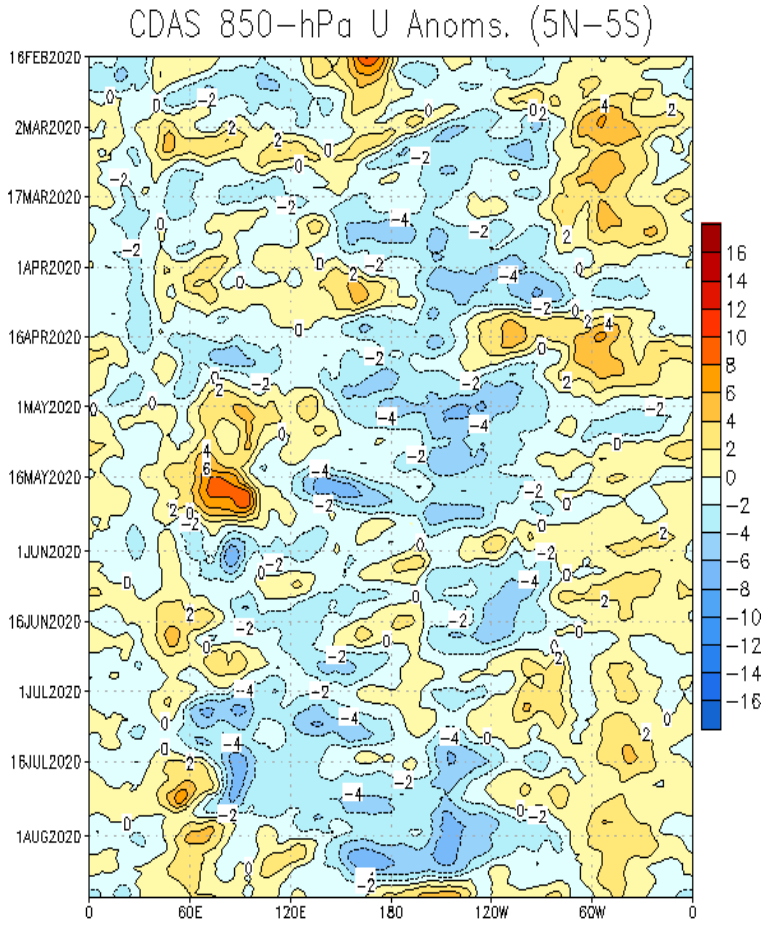


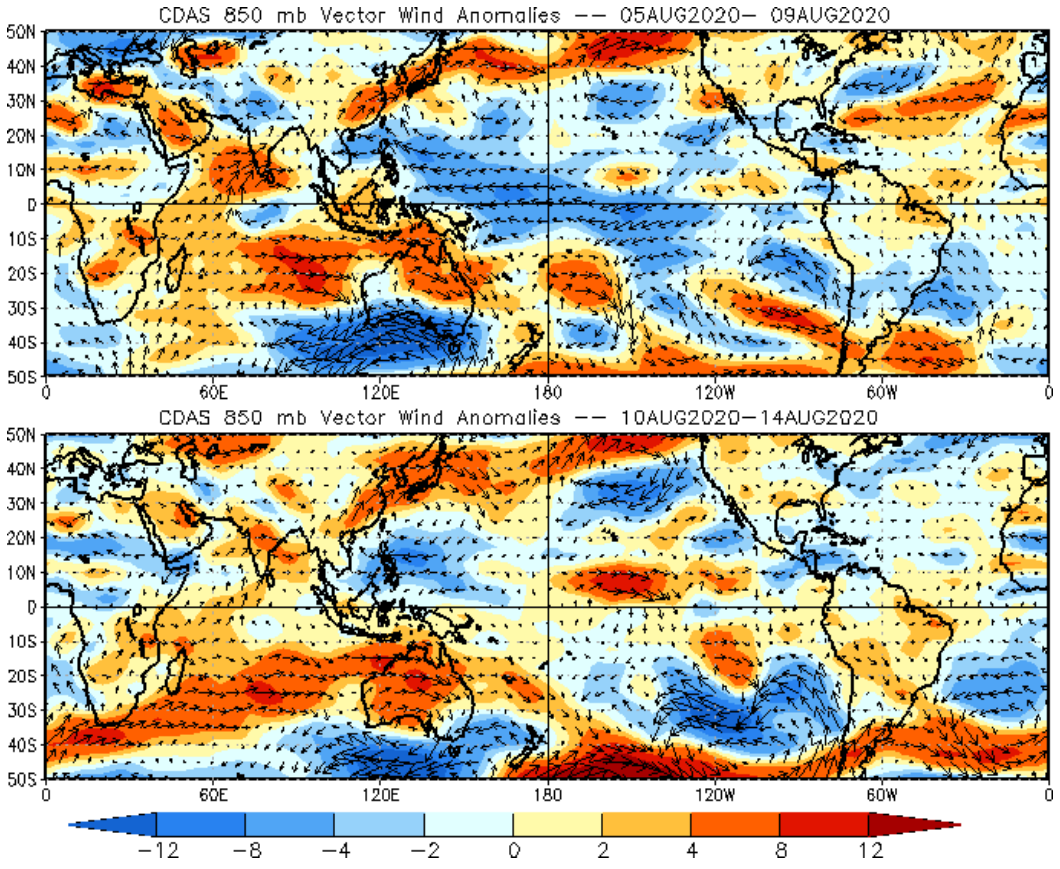
- The upper-level flow over the North and South Pacific shows evidence of continued Rossby wave breaking throughout the month.

- The wave breaking drives mass onto the equator east of the Date Line in both hemispheres, giving rise to prominent anomalous westerlies along the equator over the East Pacific.

850-hPa Wind Anomalies

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



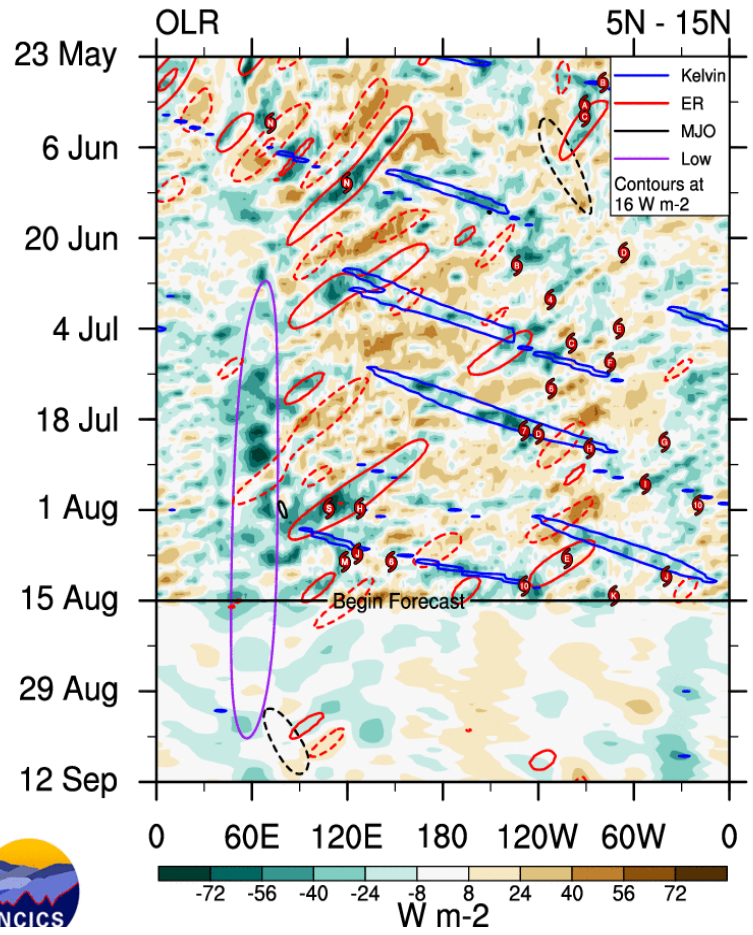


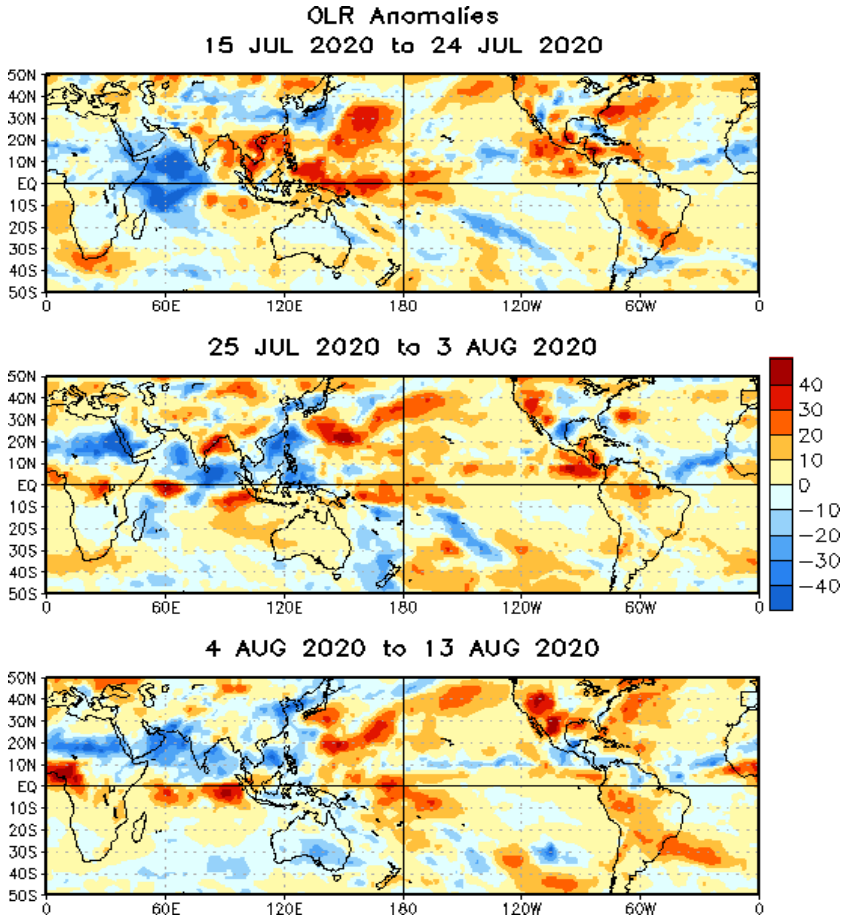
- Anomalous easterlies throughout the equatorial Pacific have weakened during the past week as some SST anomalies have warmed along with the passage of an active MJO and Kelvin wave convective envelope.

- Despite this relatively high frequency fluctuation, the low frequency signal still supports La Niña-like conditions continuing into the future.

Outgoing Longwave Radiation (OLR) Anomalies

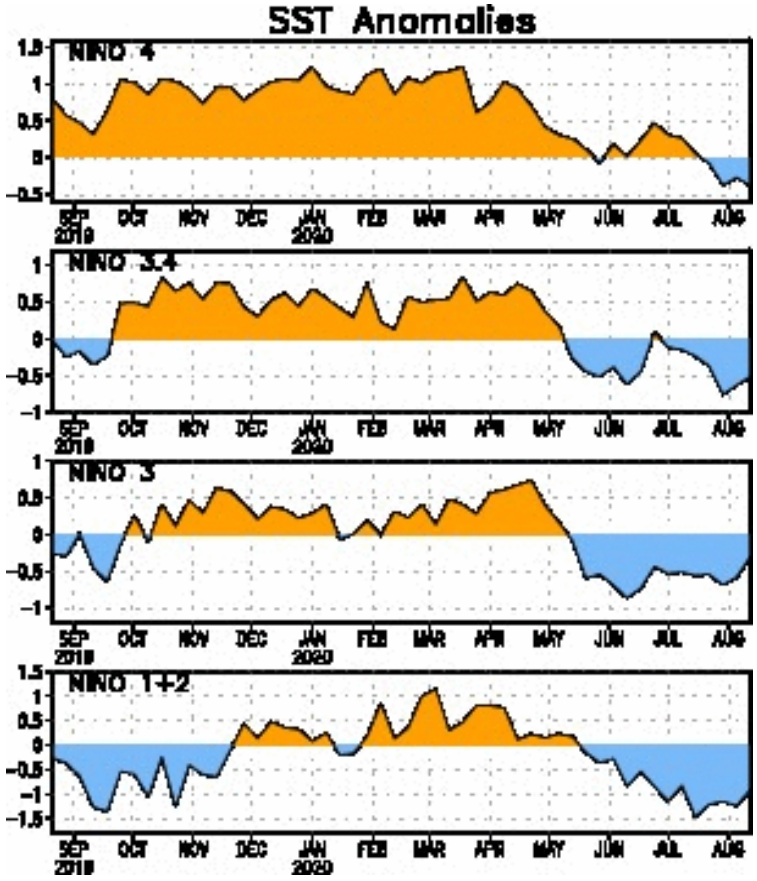
Blue shades: Anomalous convection (wetness). Red shades: Anomalous subsidence (dryness).

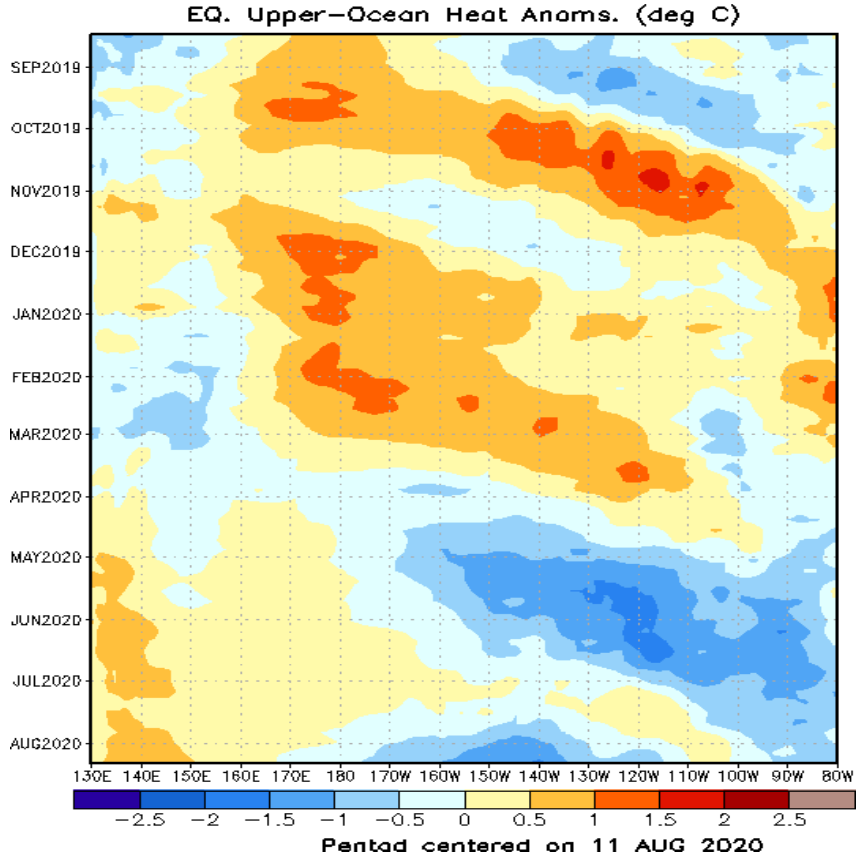




- The OLR fields associated with the passage of an MJO and Kelvin wave over the East Pacific are unusually weak.
- Stronger signals are present in the upper-level velocity potential field, which suggests that the superposition of these waves aided in the development of Tropical Storms Fausto and Genevieve this week.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

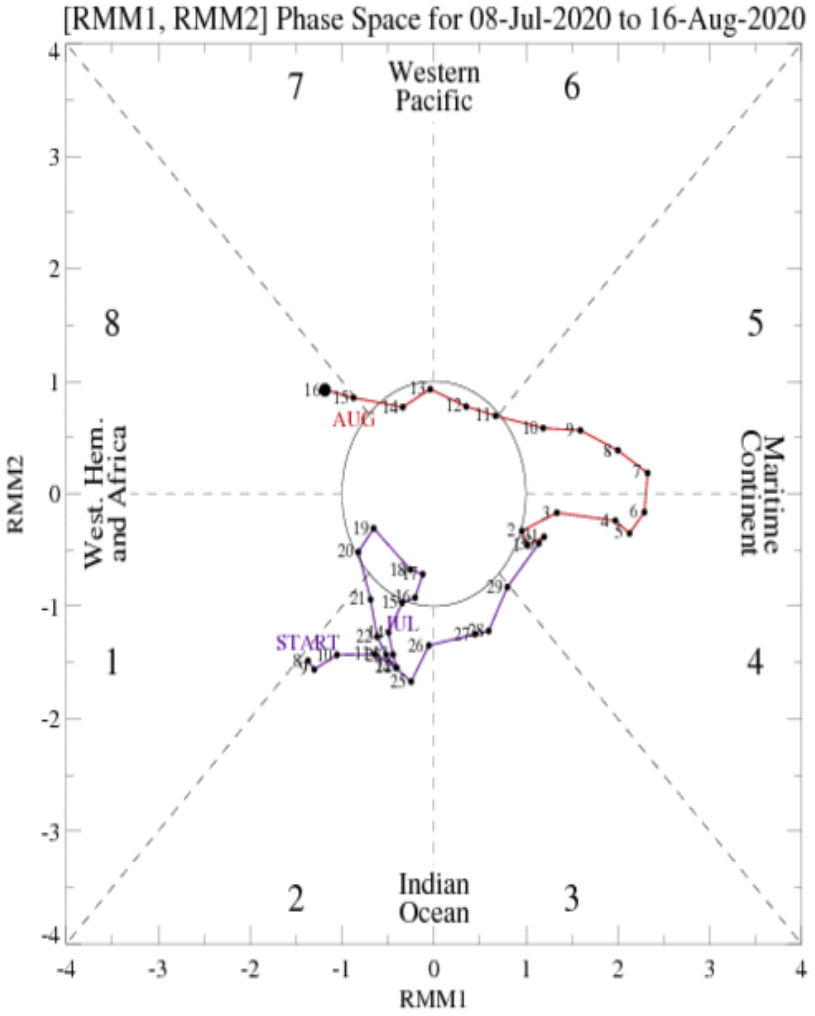




- A La Niña Watch is in effect from CPC.
- SST anomalies in the three easternmost Niño regions have been mostly negative since mid-May, with the Niño 4 SST anomalies turning negative in mid-July.
- High frequency variations in the SST time series are mostly attributed to MJO, Kelvin wave, and TC activity.

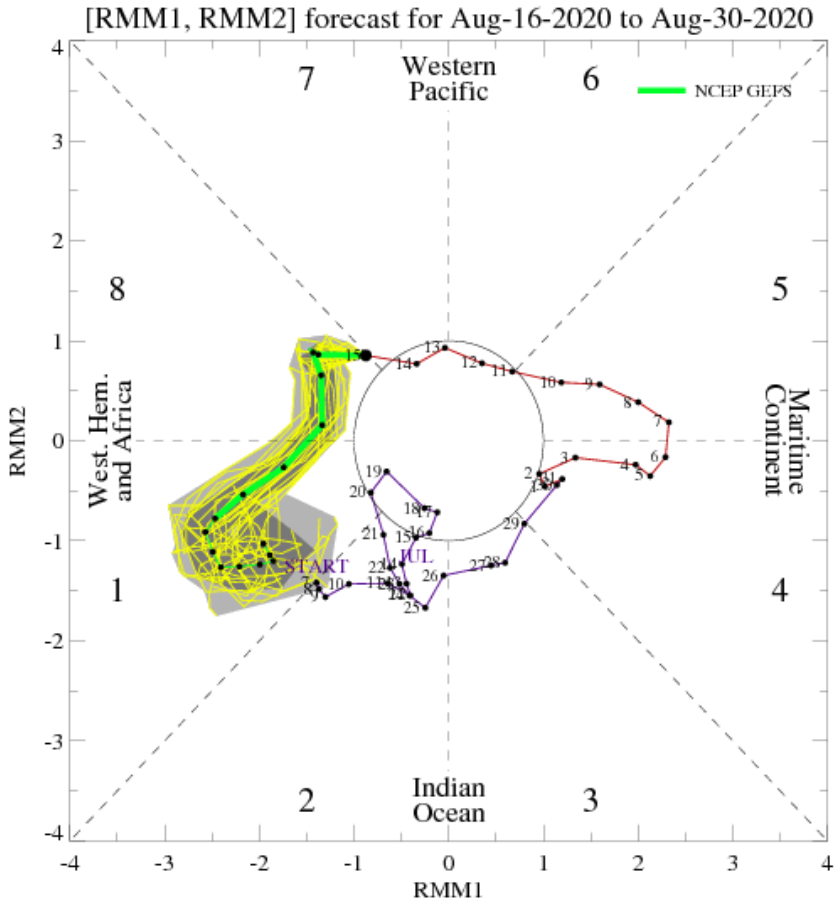
MJO Index: Recent Evolution

- The RMM index shows the MJO moving over the Western Hemisphere.

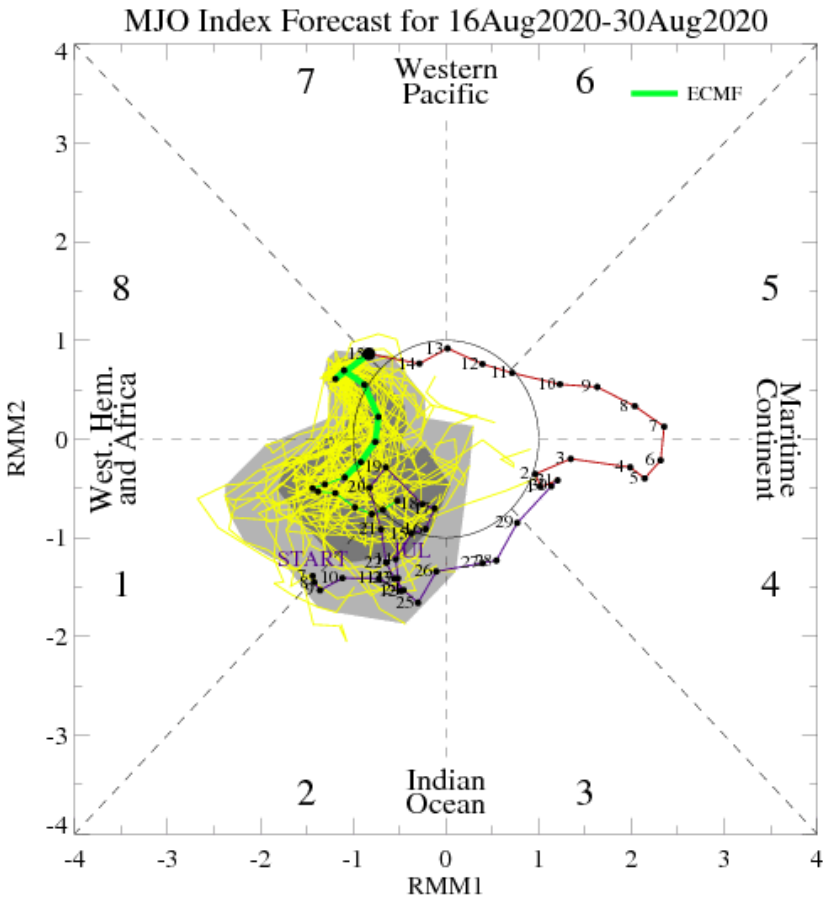


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

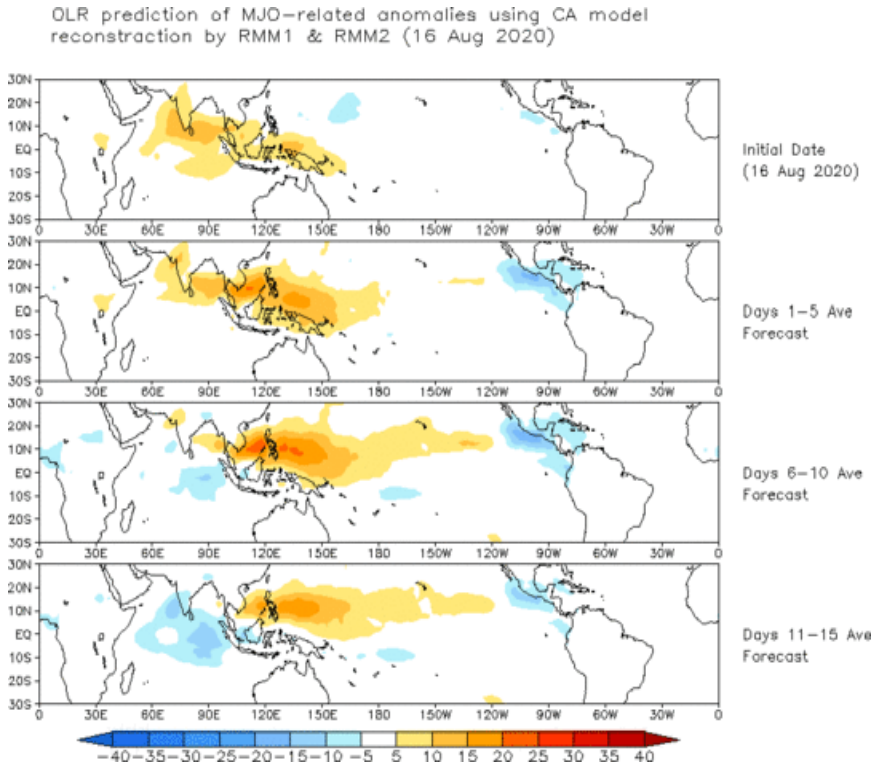


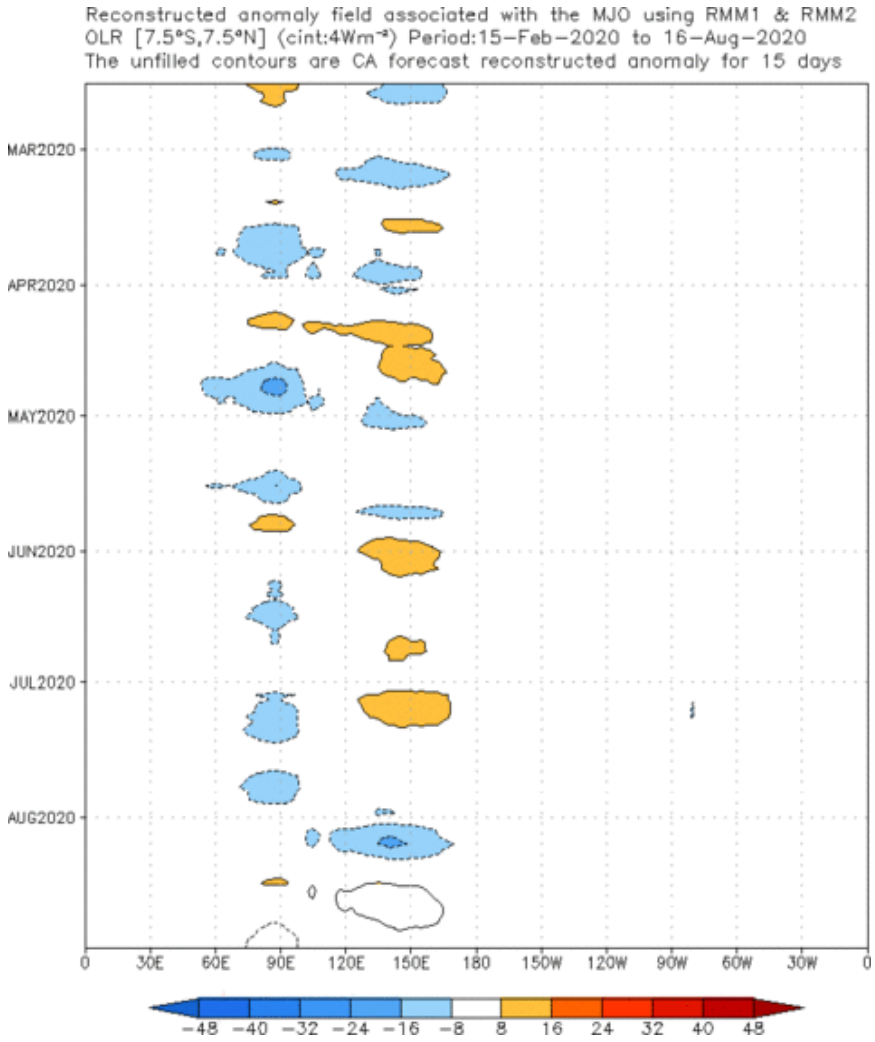
ECMWF Forecast

- Both the GEFS and ECMWF forecast an active MJO during the next two weeks. The GEFS forecast has a higher amplitude than the ECMWF, but both suggest similar outcomes.
- A moderate amplitude MJO event could have meaningful impacts on the prospective development of La Niña and on tropical cyclone activity over the Pacific and Atlantic basins during the next month.

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.)

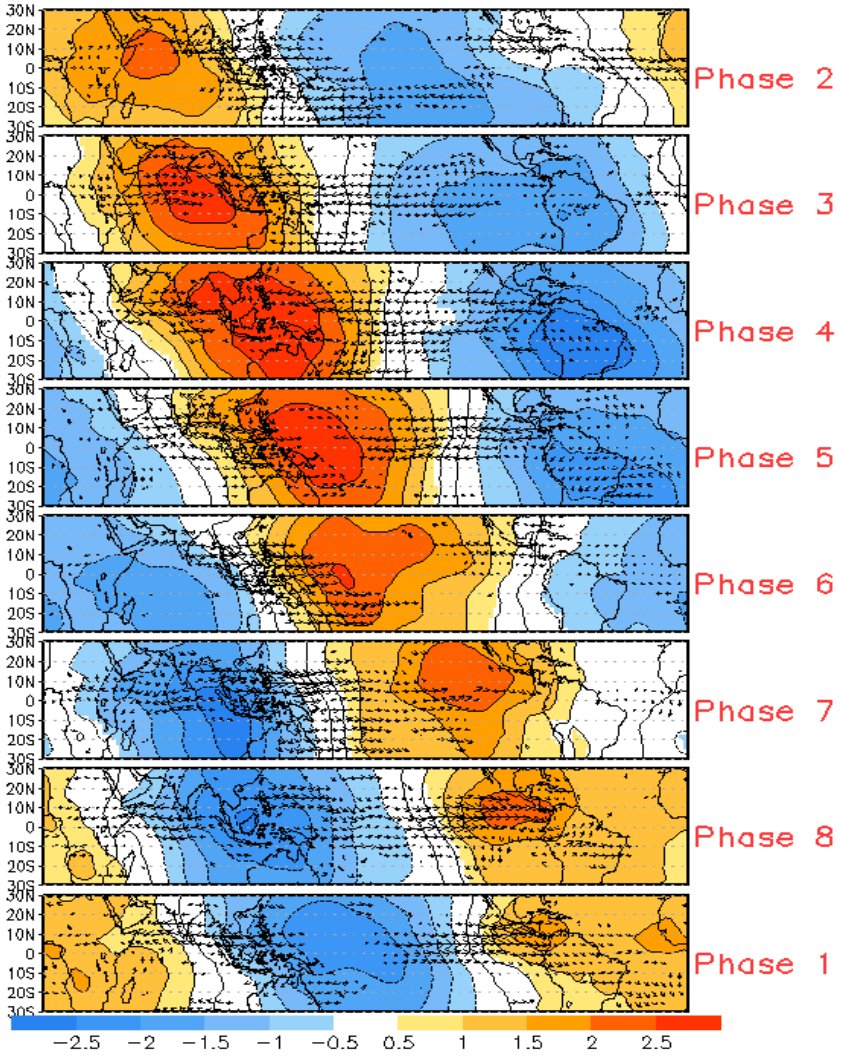




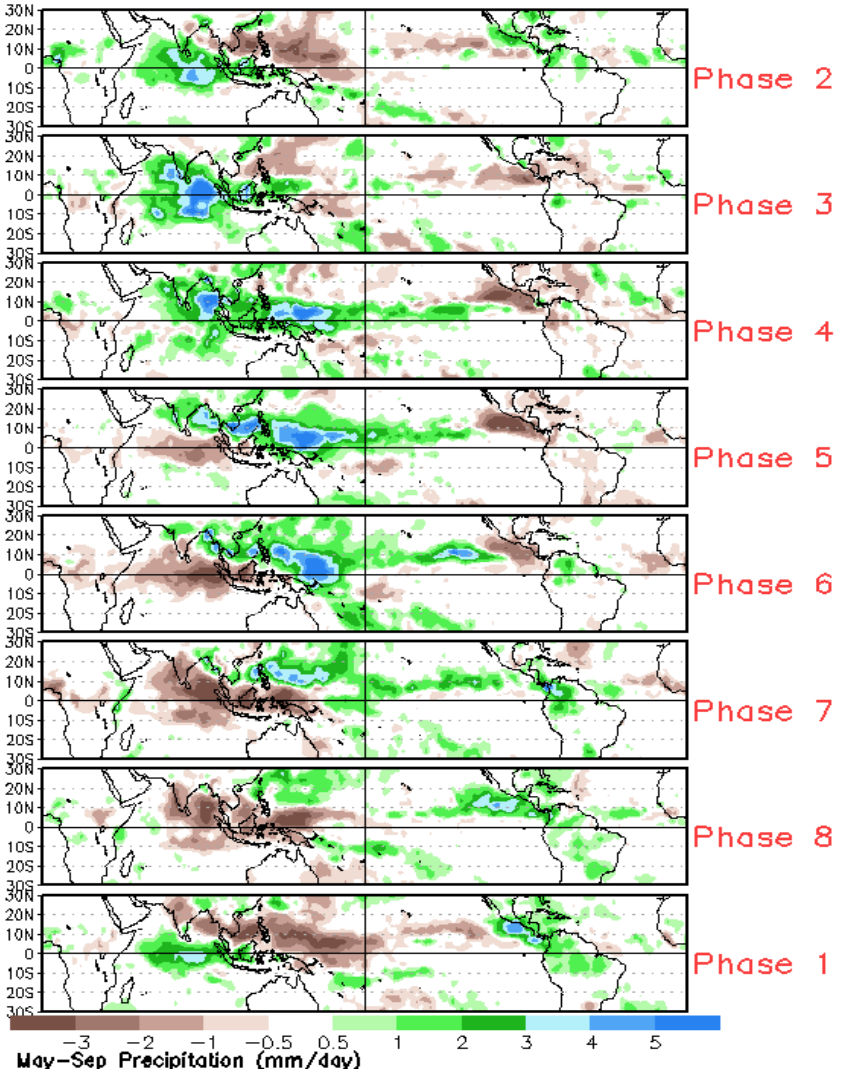
- The constructed analog model depicts a slowly moving MJO-like pattern.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



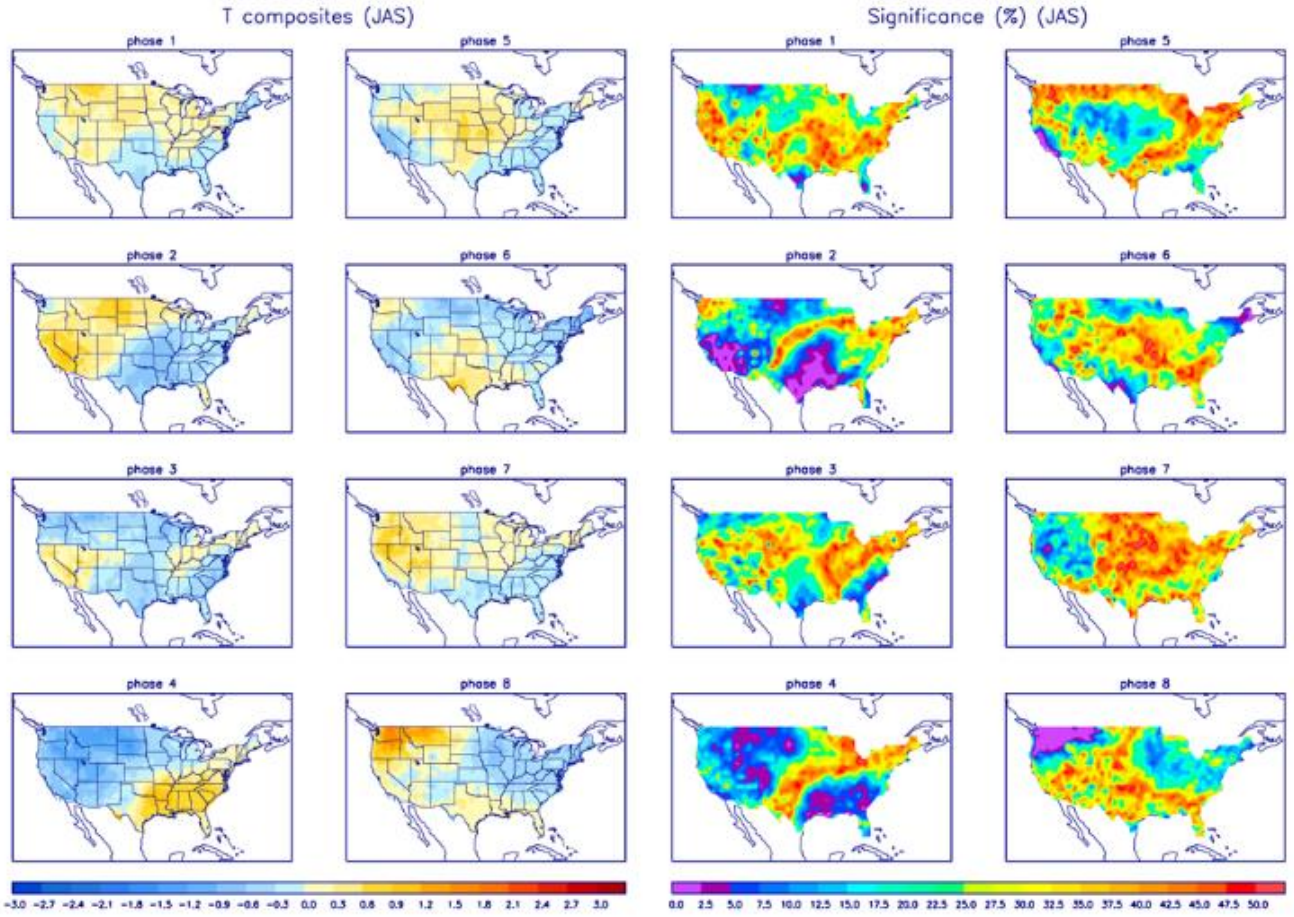
Precipitation Anomalies



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.

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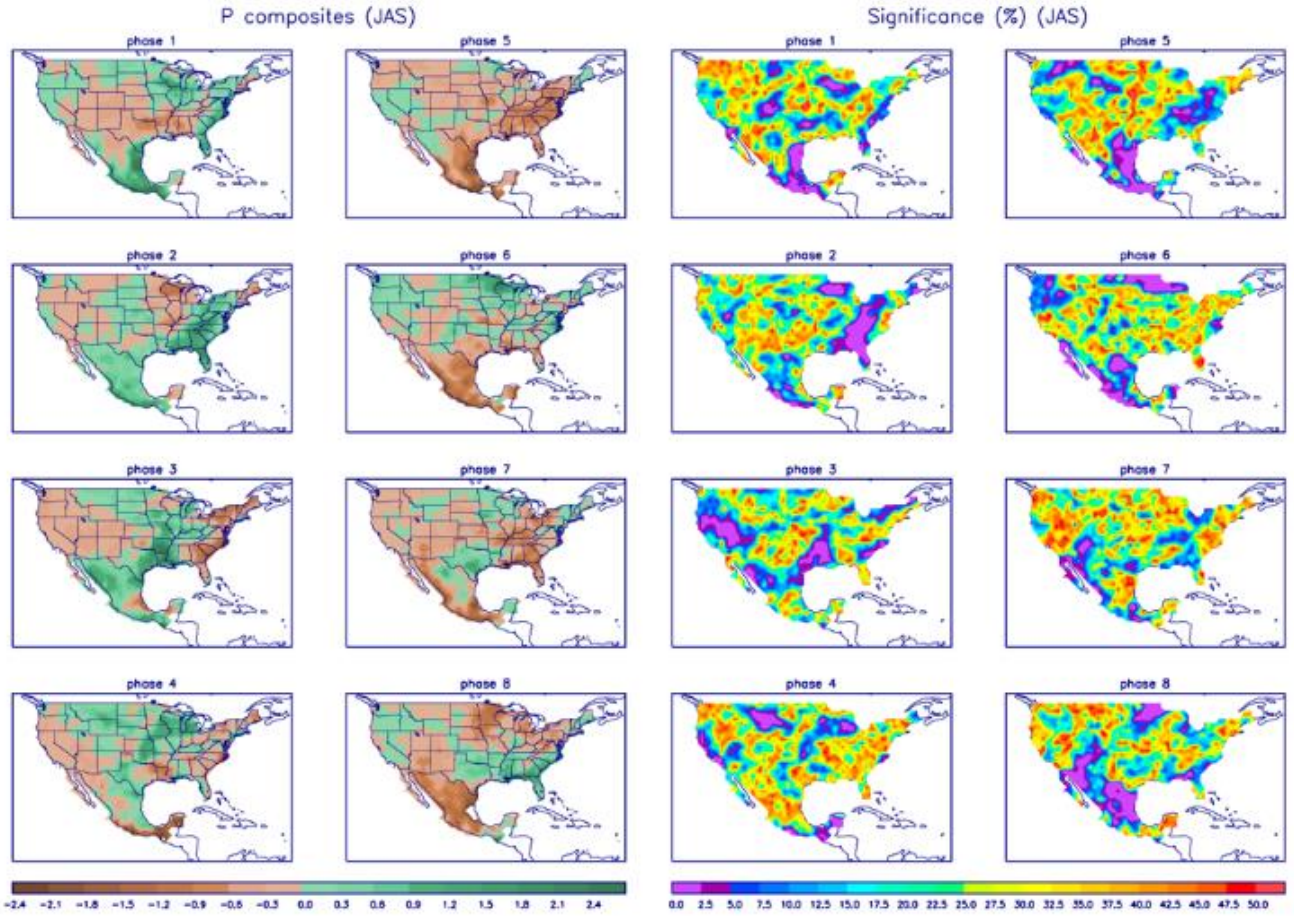

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