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

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
14 September 2020

Overview

- Although the intraseasonal signal remains evident in the upper-level pattern, recent observations show a weaker MJO due to interference from the base state, Kelvin wave activity, and ongoing tropical cyclone activity over the Atlantic.

- Dynamical model forecasts show eventual eastward propagation of the MJO's enhanced envelope signal across the Maritime Continent over the next two weeks.

- Considerable uncertainty remains regarding the future evolution of the tropics due to continued tropical cyclone activity over the Atlantic and La Niña conditions for the Pacific.

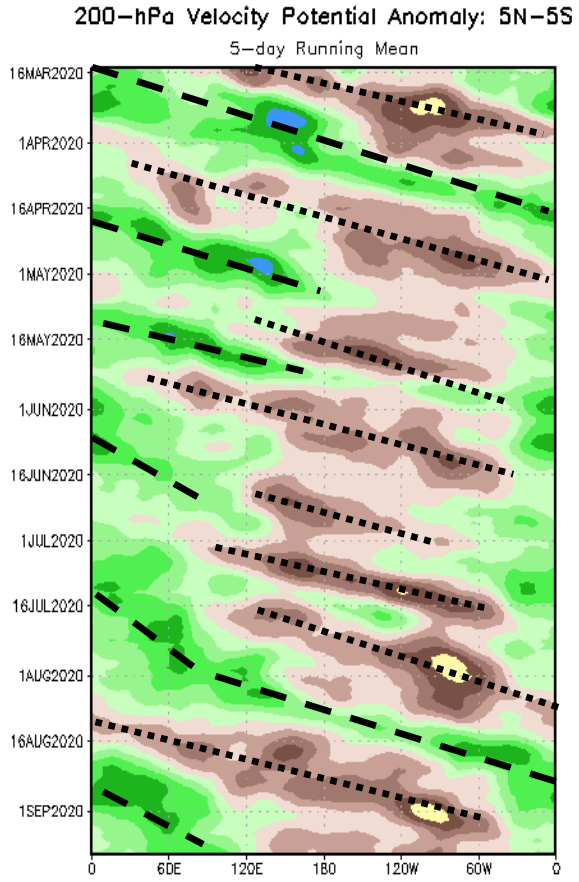
- While MJO activity emerging over the Pacific is associated with reduced tropical cyclone activity over the Atlantic, La Niña conditions may help to disrupt the intraseasonal signal.

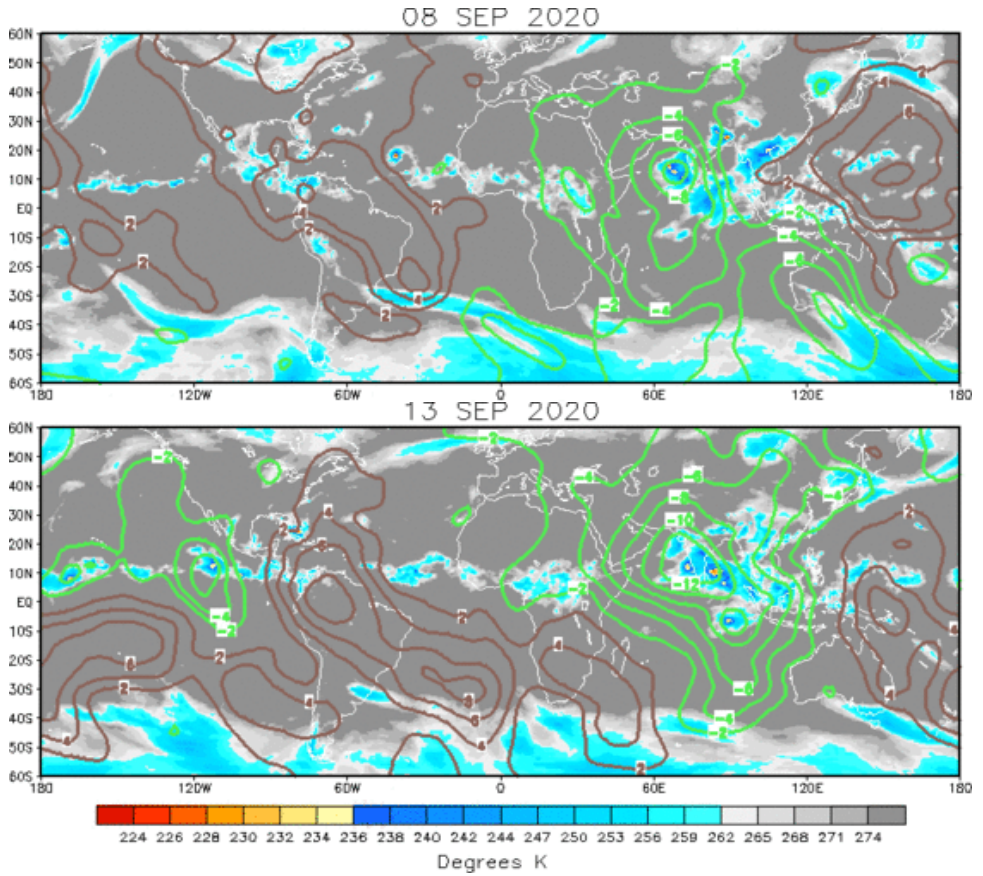
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

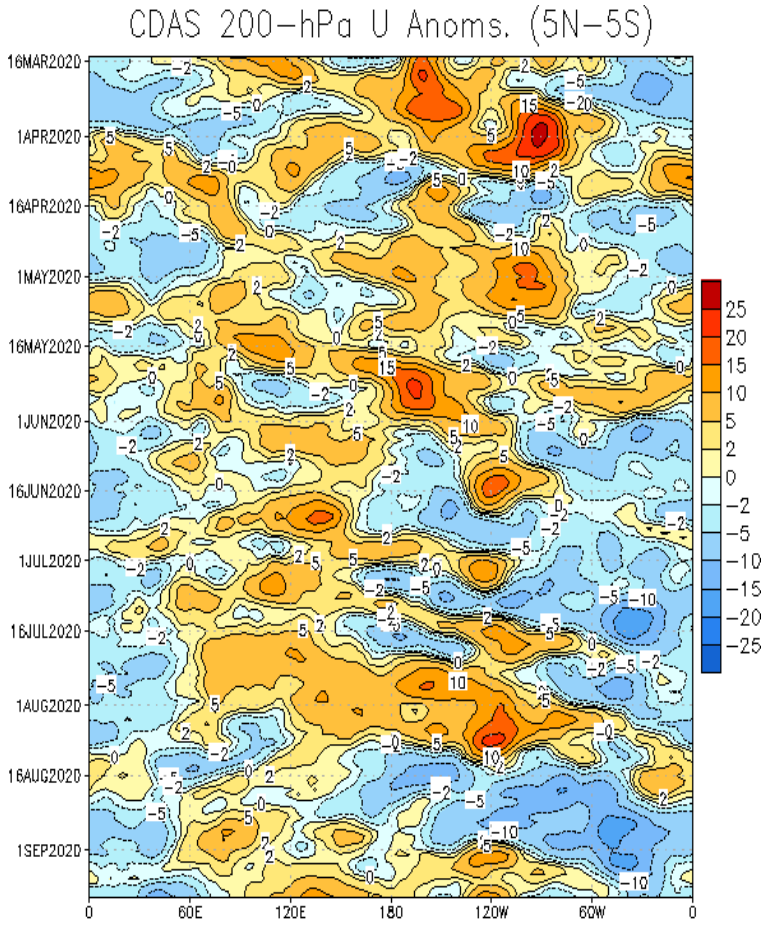


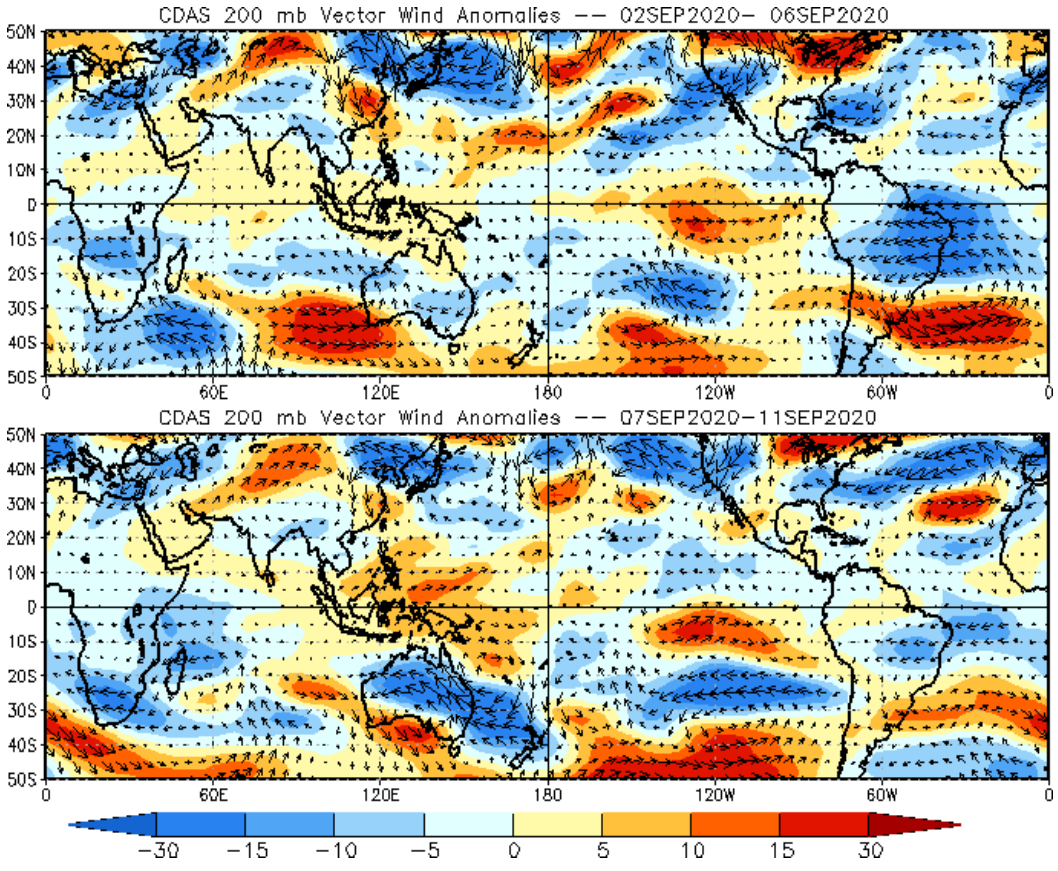


- Since earlier this year, a slow westward shift of suppressed convection across the Pacific was apparent.
- Since July, more robust and slower evolving MJO activity was evident, especially across the Indian Ocean. The signal progressed rapidly across the Pacific, influenced by the low-frequency state.
- Recently, the signal weakened somewhat as enhanced Asian monsoon activity persisted. Kelvin wave activity is evident over the East Pacific despite the low frequency suppression.

200-hPa Wind Anomalies

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

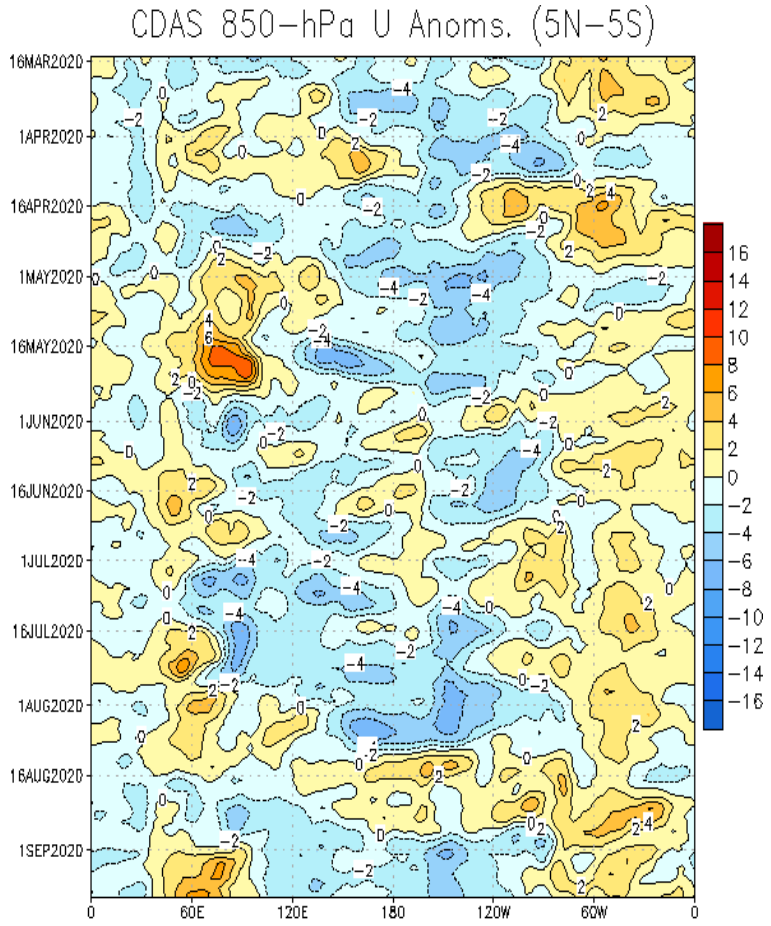


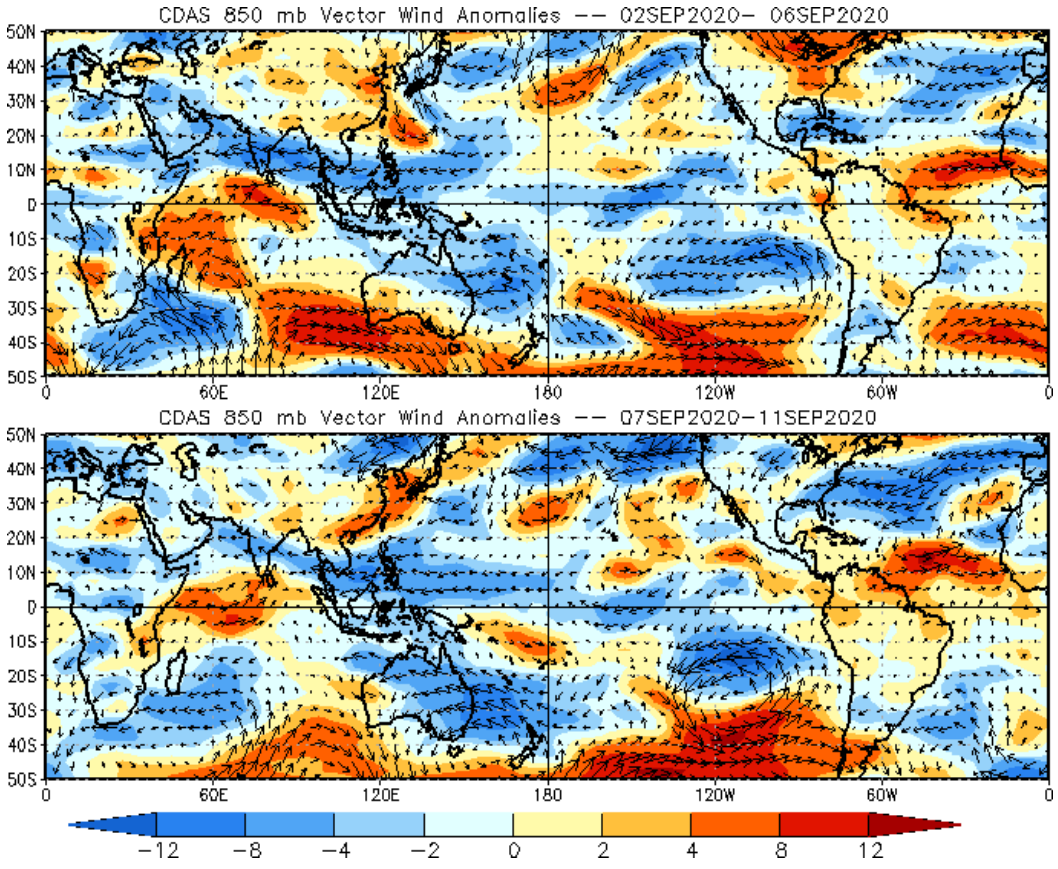


- Upper-level zonal wind anomalies are consistent with MJO activity, as a couplet of easterly/westerly anomalies propagated eastward across the Indian Ocean with a larger pattern suggestive of a wave-1 asymmetry.
- Easterly anomalies remain in place across much of the tropical Atlantic, helping to maintain a favorable environment for tropical cyclone development.

850-hPa Wind Anomalies

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



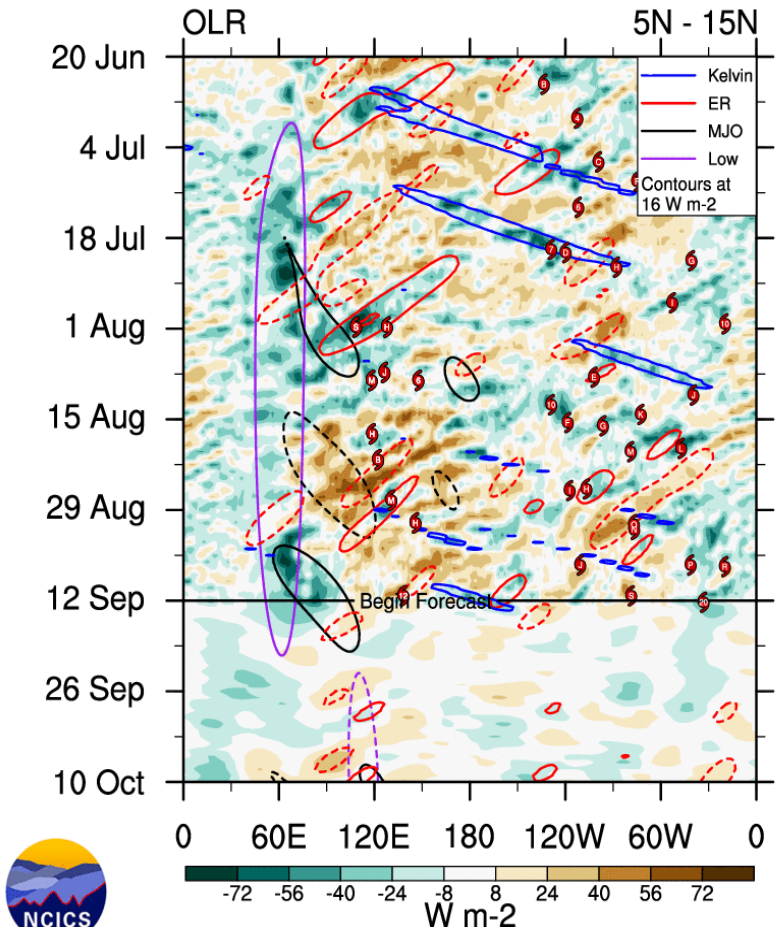


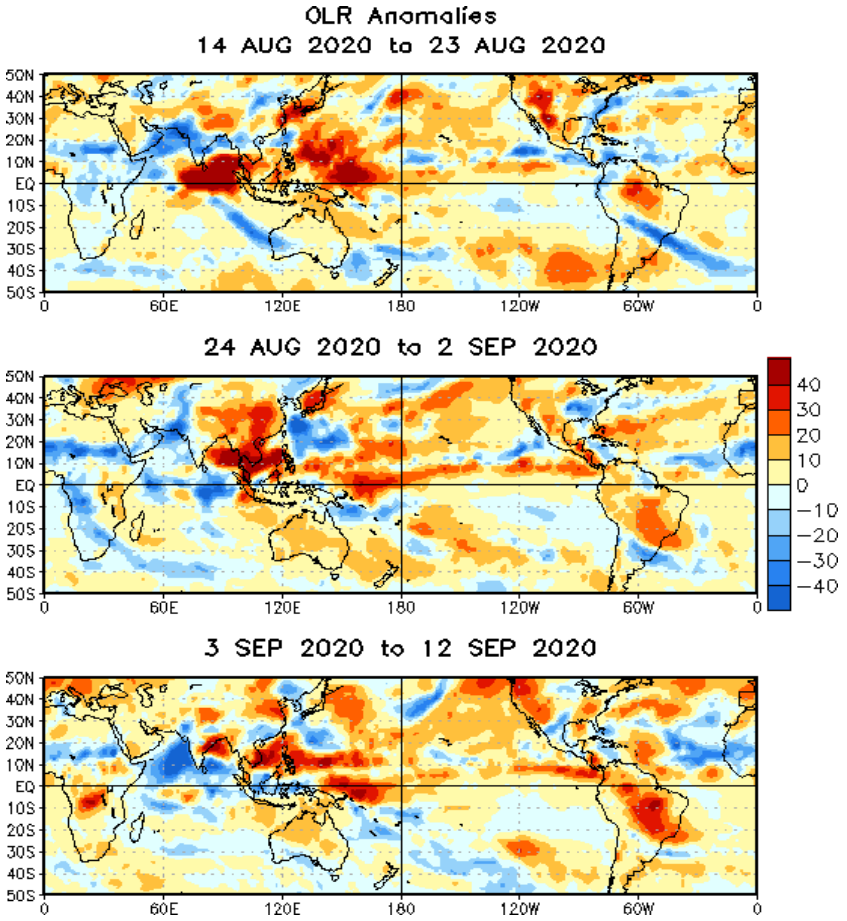
- The intraseasonal signal is less apparent in the low levels, where easterly anomalies over the Pacific associated with the developing La Niña dominate the pattern.

- Westerly anomalies remain in place over the tropical Atlantic main development region, tied to anomalous cyclonic flow between 10-20N.

Outgoing Longwave Radiation (OLR) Anomalies

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

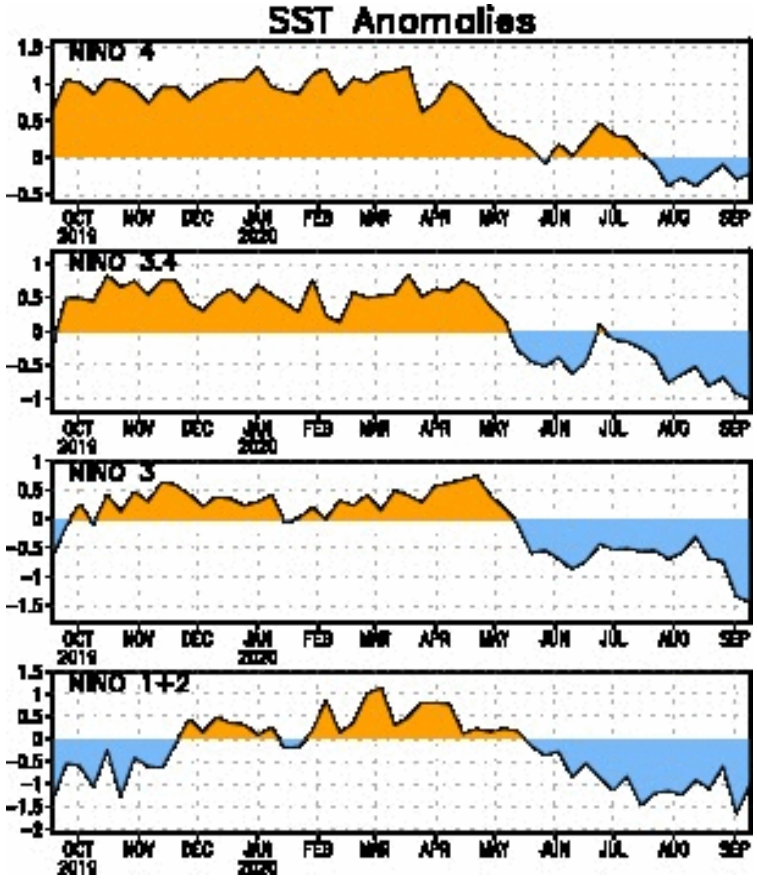


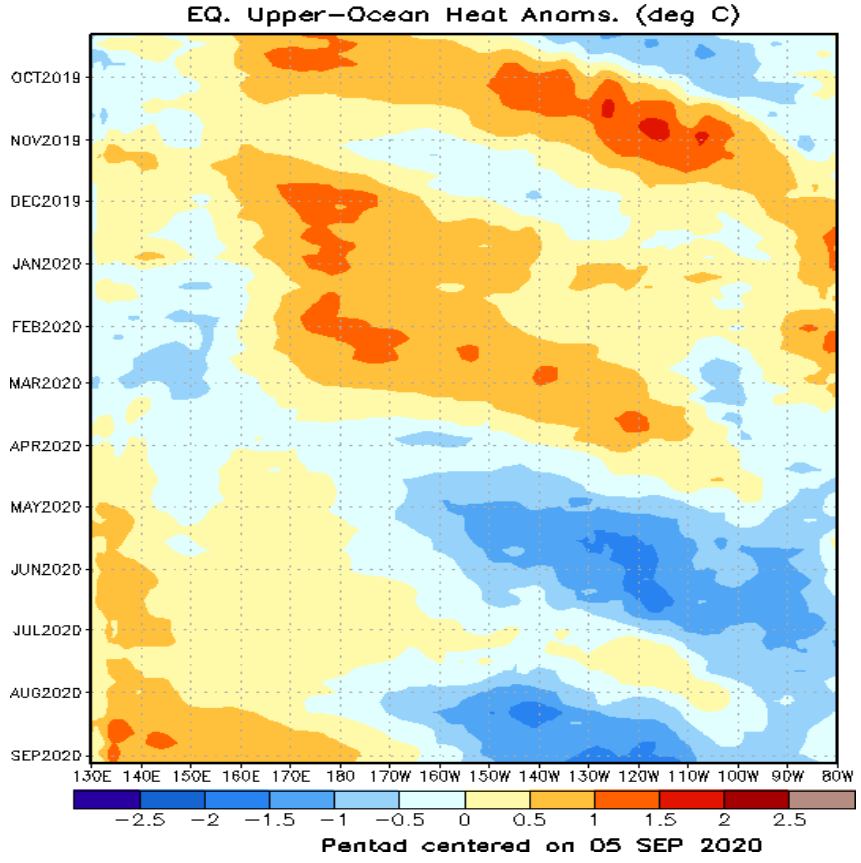


- Some eastward propagation of the MJO over the Indian Ocean is evident in the OLR field, but Rossby wave activity and the low-frequency state are causing interference.

- A Kelvin wave is propagating across the eastern Pacific.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

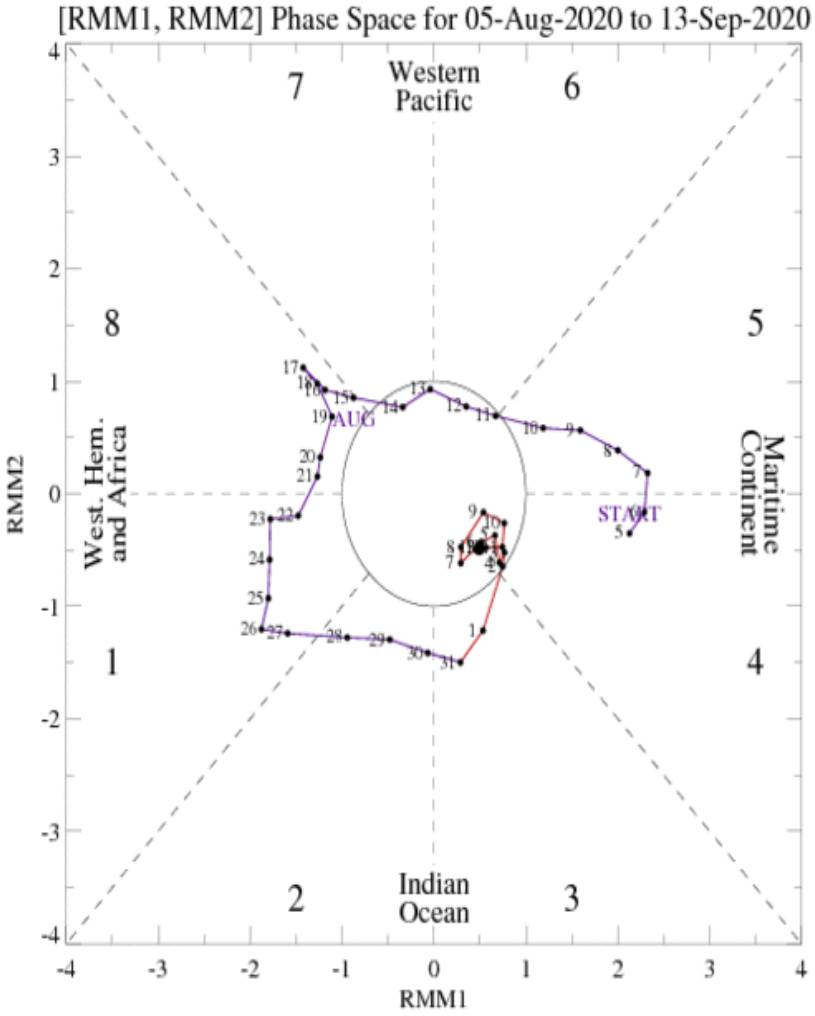




- Following destructive interference with the base state by a downwelling Kelvin wave, the subsequent upwelling phase has pushed the Pacific into La Niña conditions.
- Heat content anomalies in the Niño 3.4 region have become strongly negative since July.
- A second downwelling Kelvin wave is evident over the central Pacific.

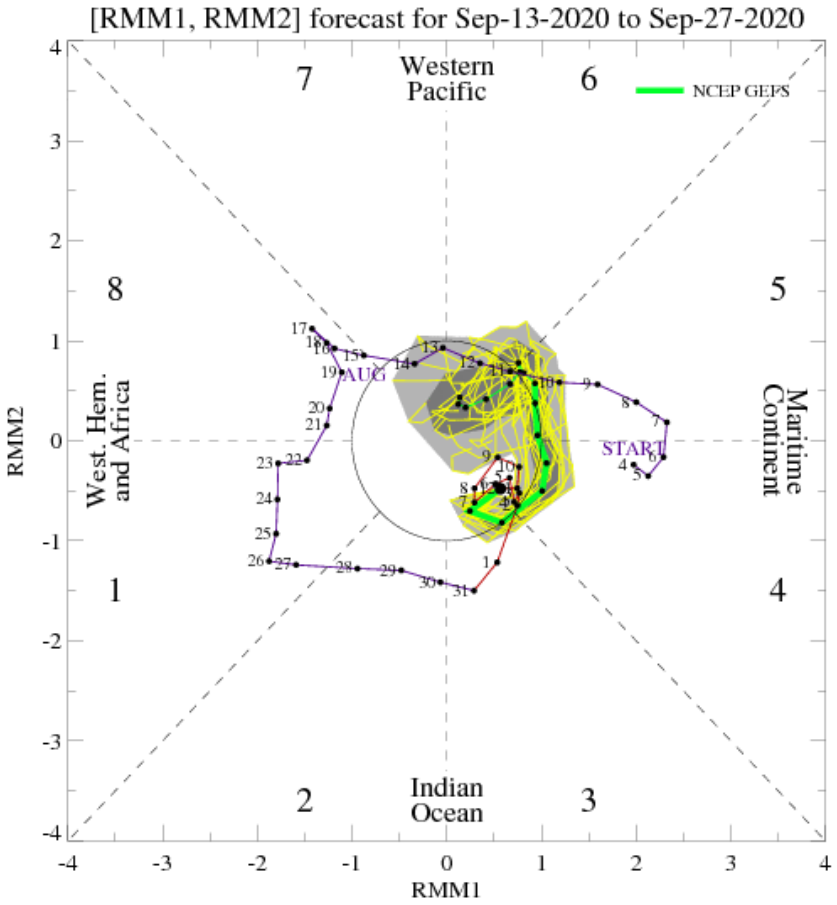
MJO Index: Recent Evolution

- The RMM index weakened as other modes (e.g., Kelvin wave over the Pacific, Atlantic tropical cyclone activity) interfered with the pattern.

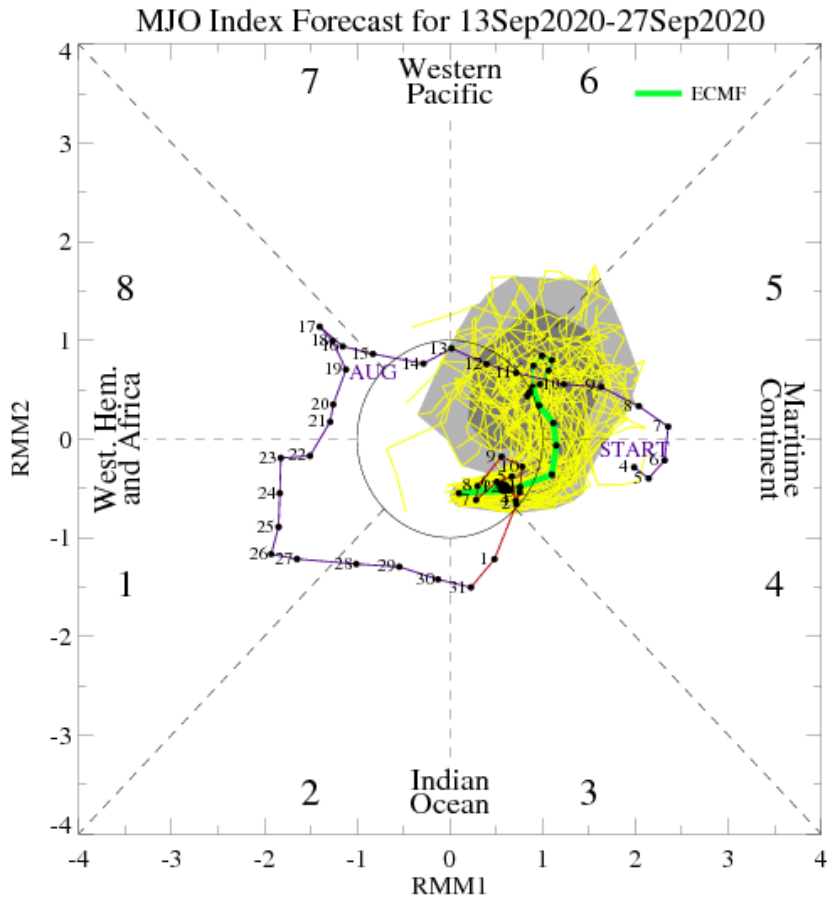


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



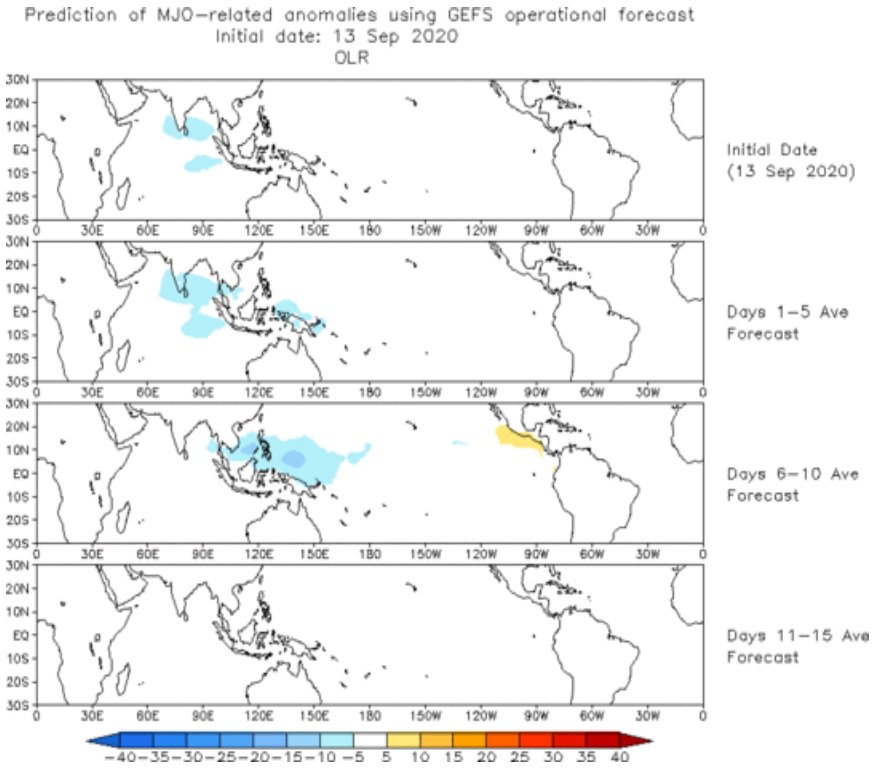
ECMWF Forecast

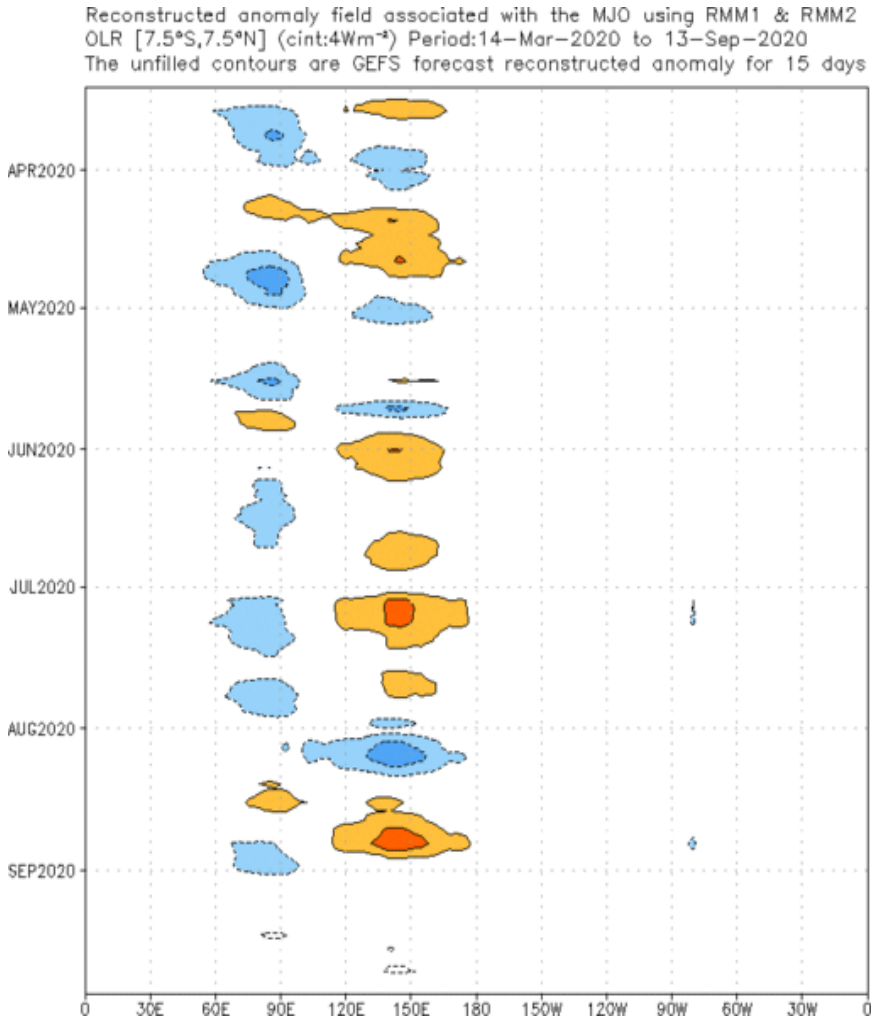
- The GEFS and ECMWF RMM-index forecasts are in fairly good agreement, suggesting renewed eastward propagation of the MJO across the Maritime Continent over the next two weeks.

- Ongoing tropical cyclone activity over the Atlantic basin may continue to interfere with the overall MJO signal.

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.)

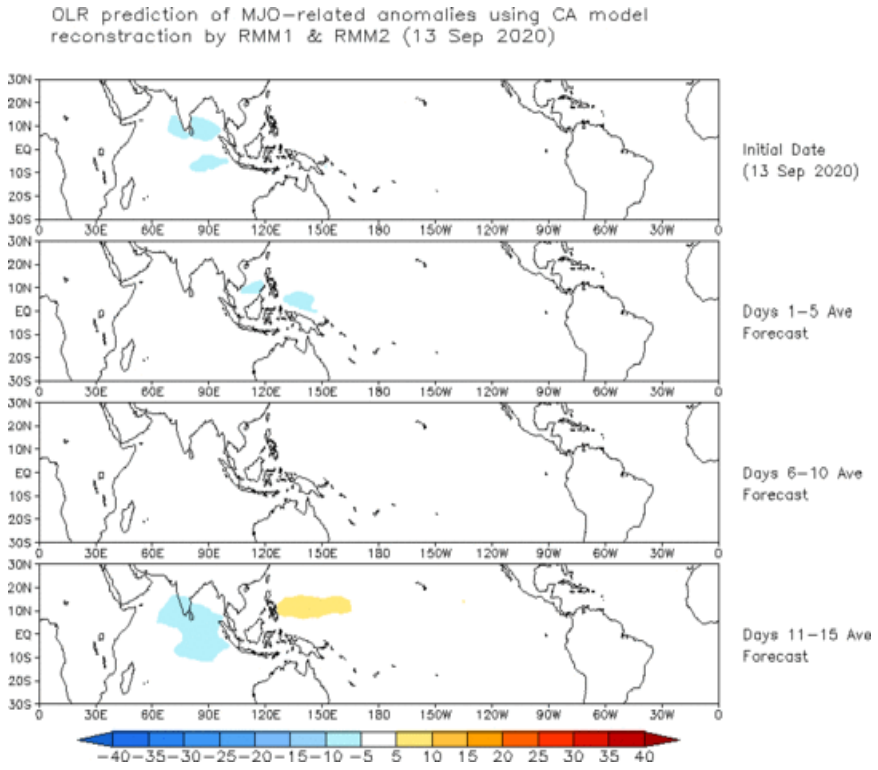


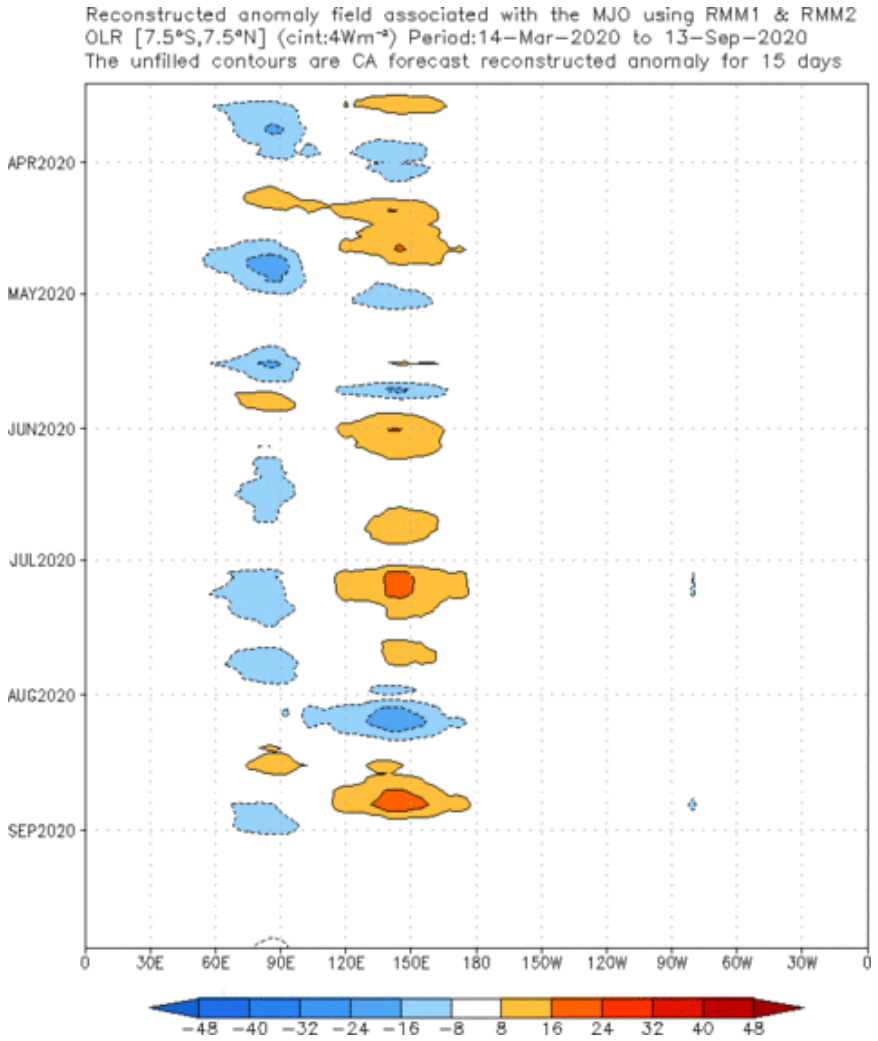


- The OLR anomaly evolution based on the GEFS RMM index forecast shows eastward propagation of a weak signal to the Maritime Continent.

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.)

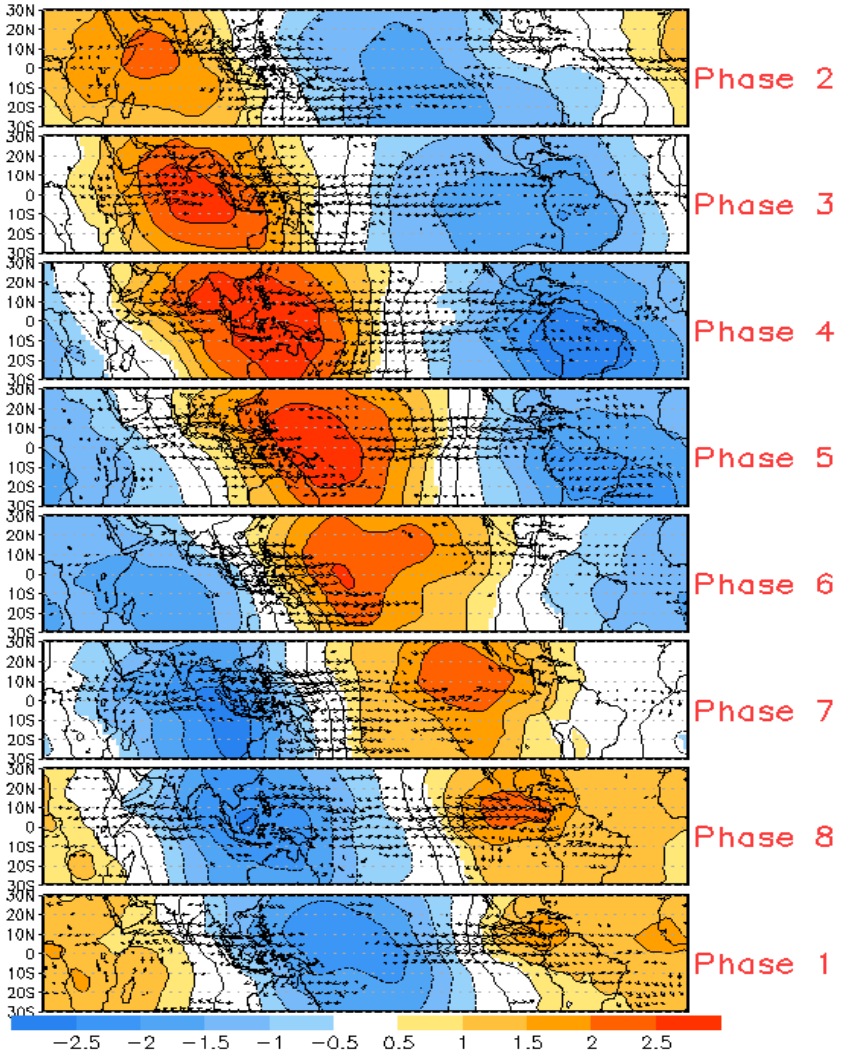




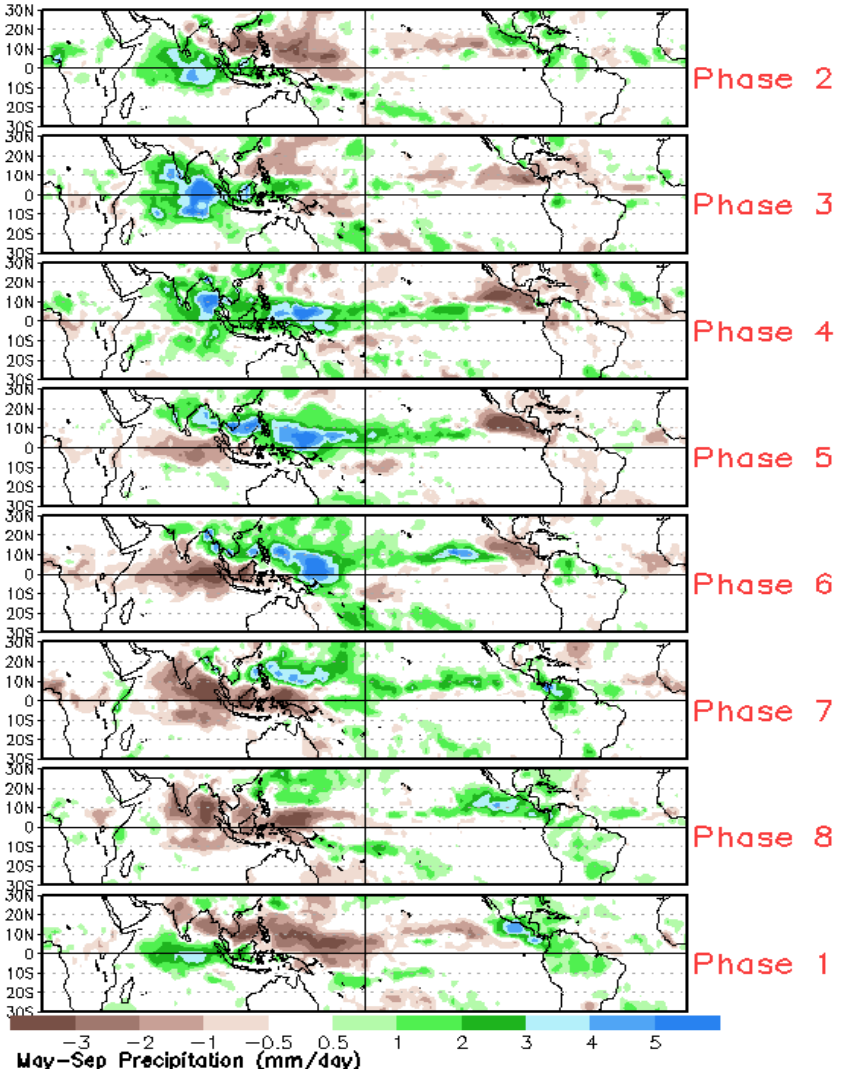
- The constructed analog forecast depicts a weak pattern not suggestive of active MJO activity.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



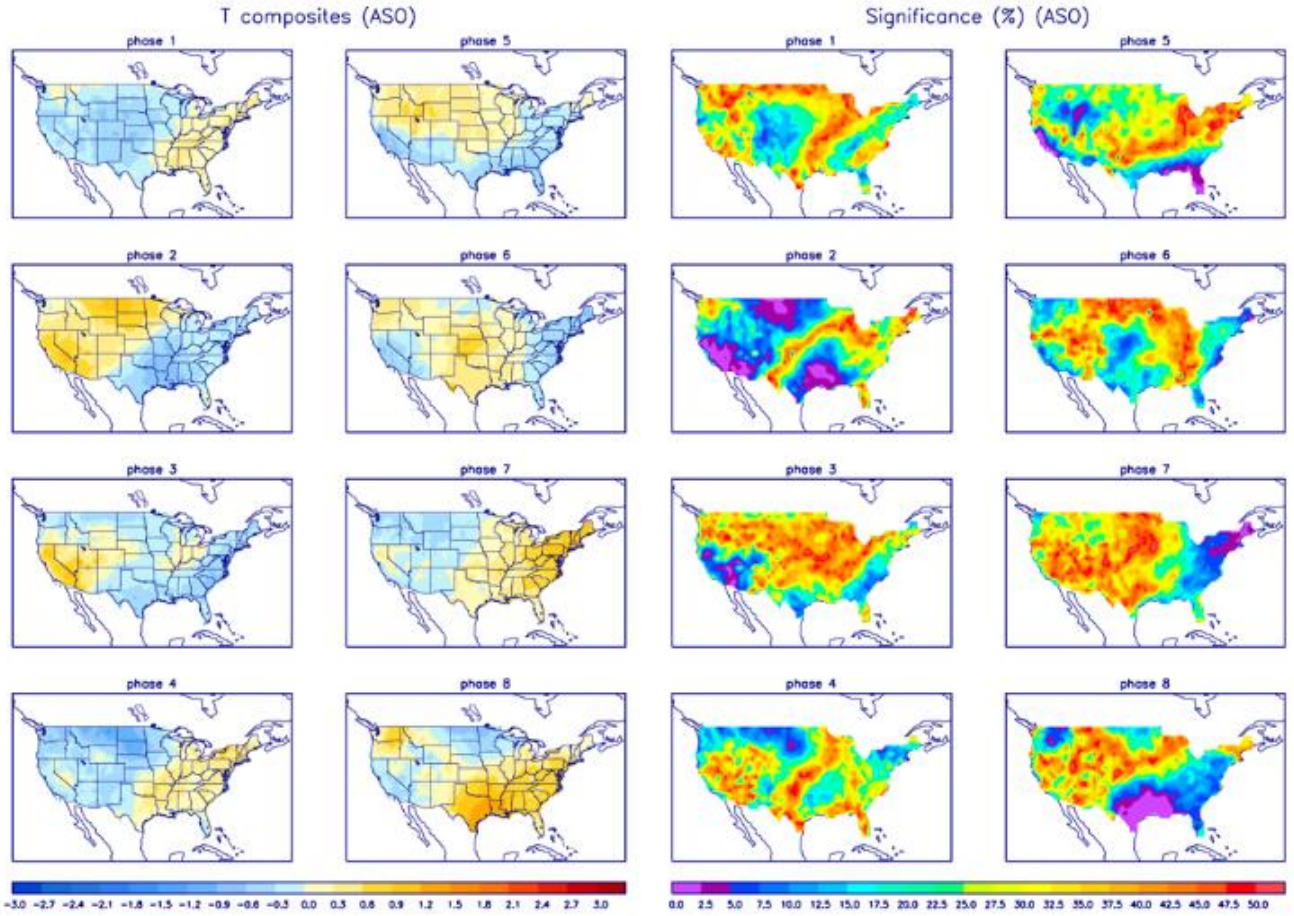
Precipitation Anomalies



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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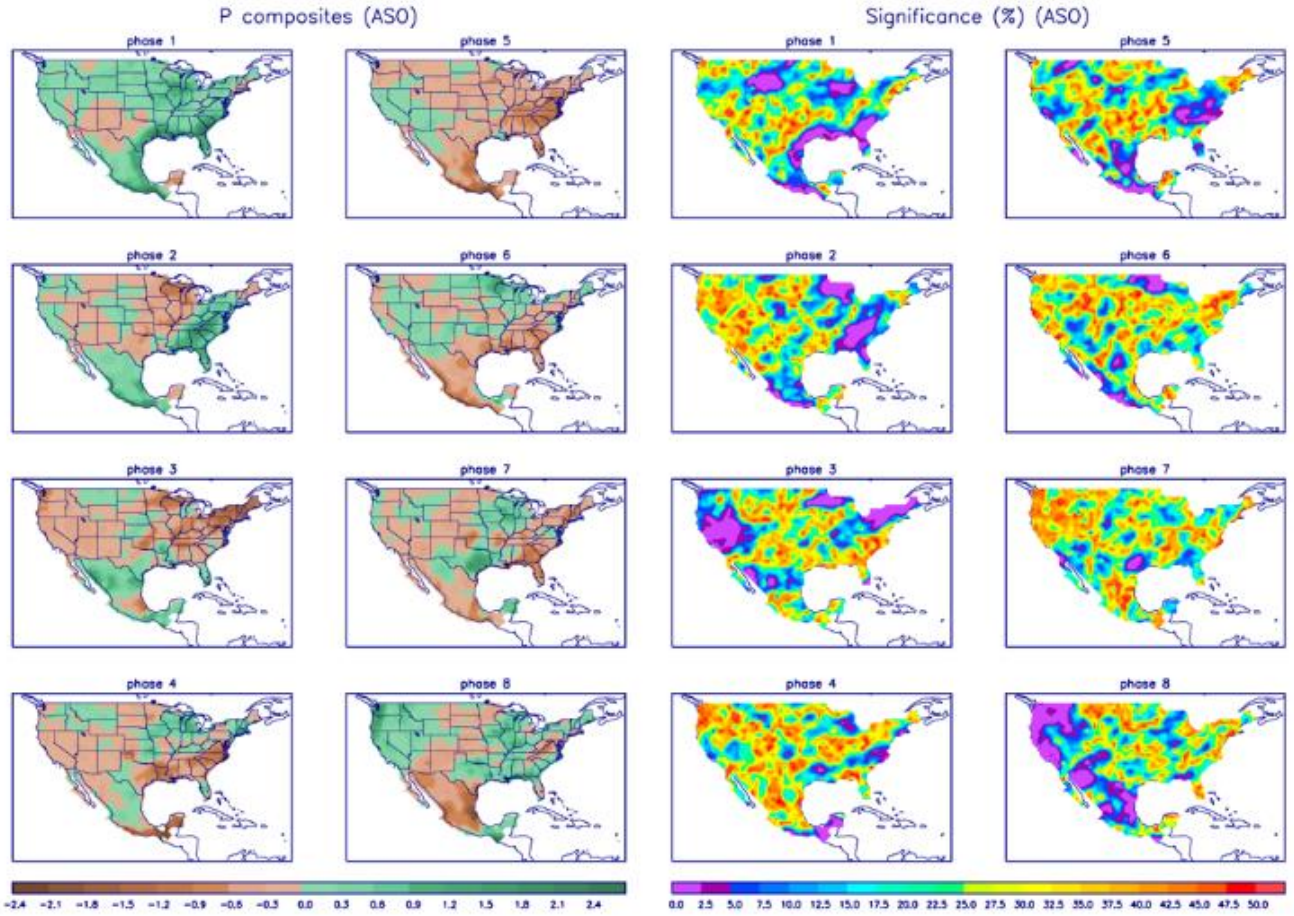

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