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

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
9 September 2019

Overview

- The MJO remains weak with a Kelvin wave propagating east from Africa to the vicinity of India during the past week. During week 2, the MJO may strengthen as it traverses the Pacific and moves into the Western Hemisphere.

- Dynamical models generally agree on a continued weak MJO signal during the next two weeks. There are differences however in their predictions of how far east this subseasonal signal may get. The GEFS forecasts the signal will remain in the Maritime Continent/Western Pacific area where it has been recently, while the ECMWF ensemble predicts the signal could propagate across the Western Pacific and toward the Western Hemisphere. Kelvin wave activity over the Pacific is likely to interact with MJO signal, leading to a jump in the signal outside the unit circle in Week-1.

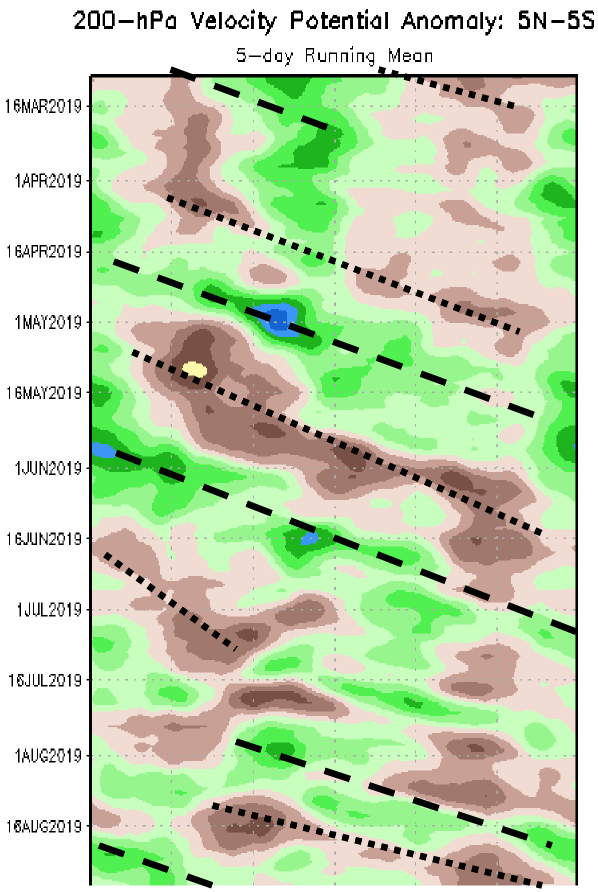
- Tropical Cyclone (TC) development picked up in the Atlantic in late August, with a Kelvin wave causing a period of suppressed wind shear over the tropical Atlantic. Both the Atlantic and the East Pacific appear favorable for TC development during the next two weeks.

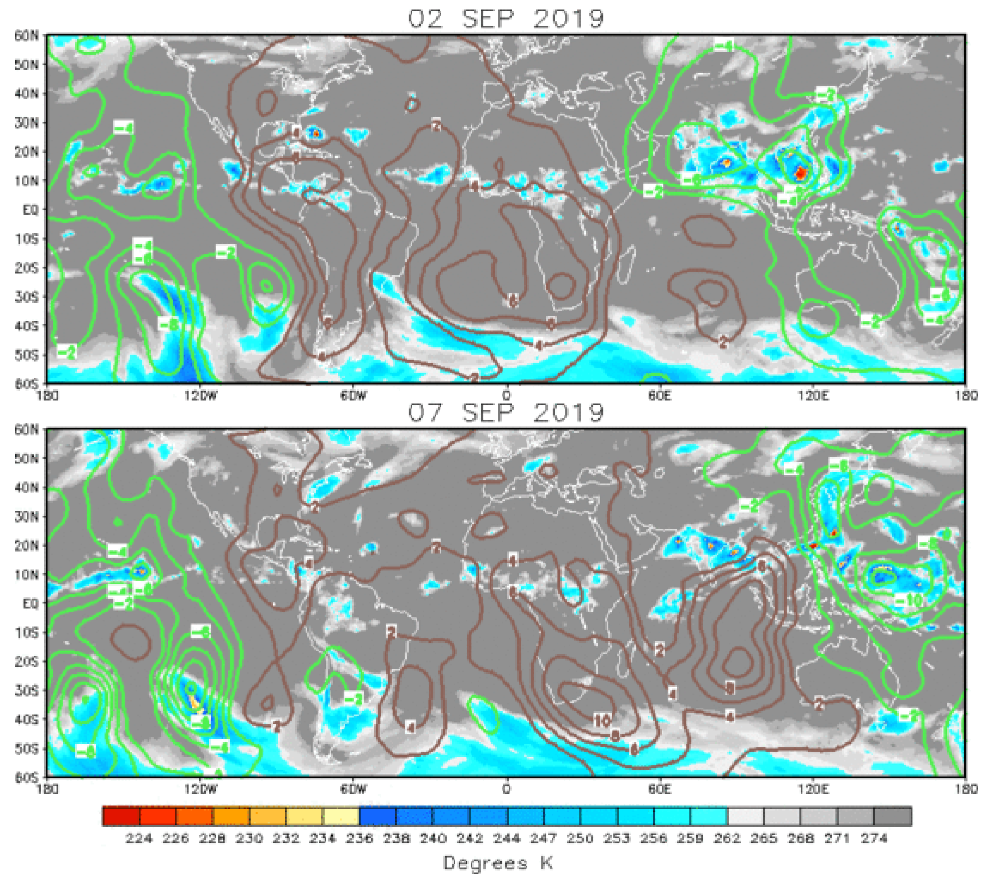
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

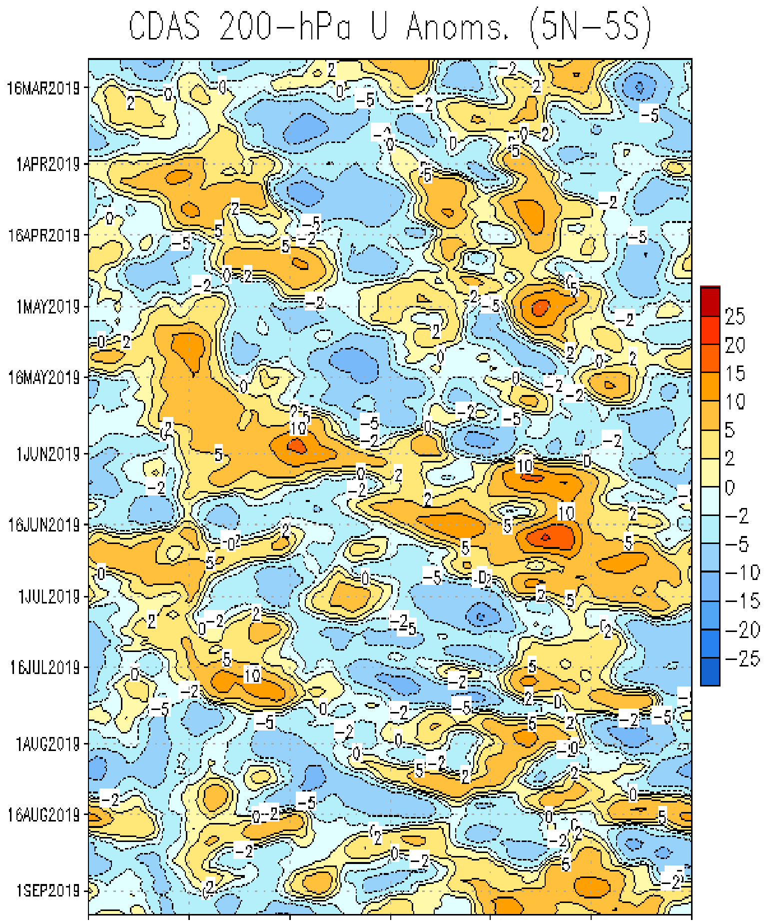


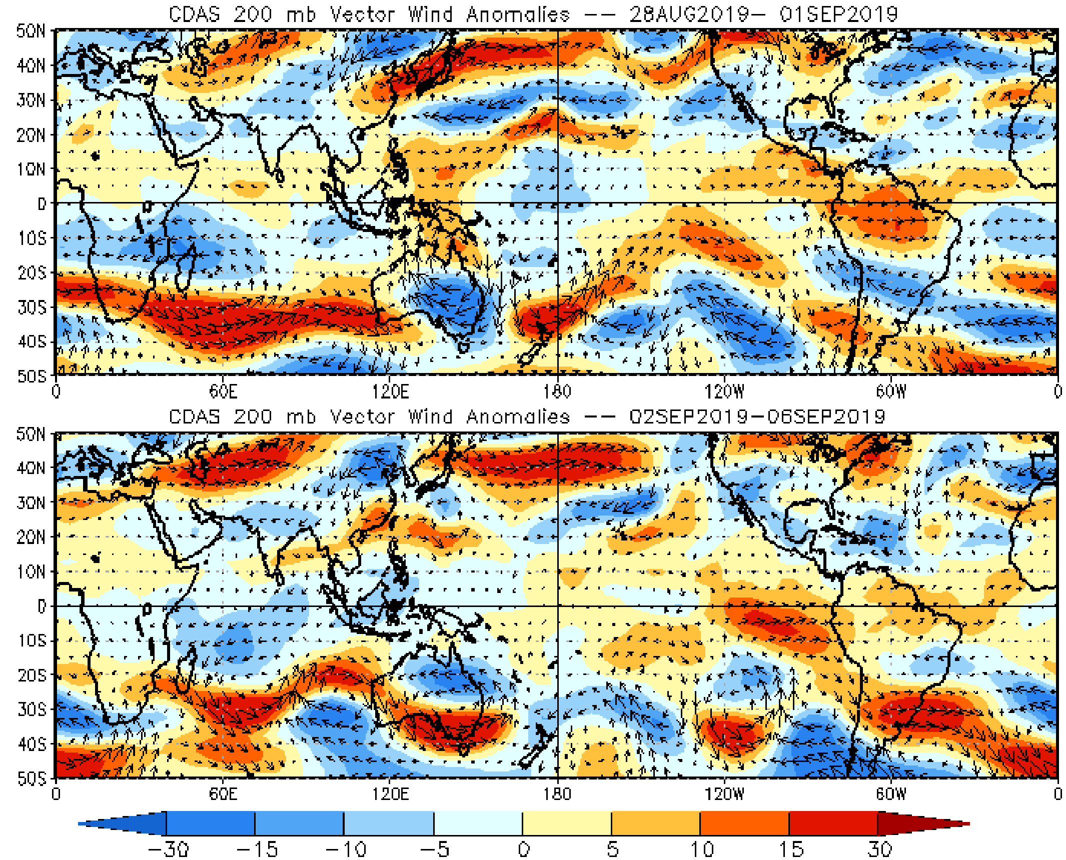


- A Kelvin wave crossed the Western Hemisphere during mid-August and propagated east of the Prime Meridian to Africa. This signal appears to have now reached the Northern Indian Ocean.
- Rossby and Kelvin wave activity have left the upper-level VP anomaly field noisy over the past few weeks, with a somewhat coherent wave-1 pattern in the background.
- Upper-level convergence remains over North America, the Atlantic and Africa, and has spread farther east across much of the Indian Ocean during the past week.

200-hPa Wind Anomalies

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

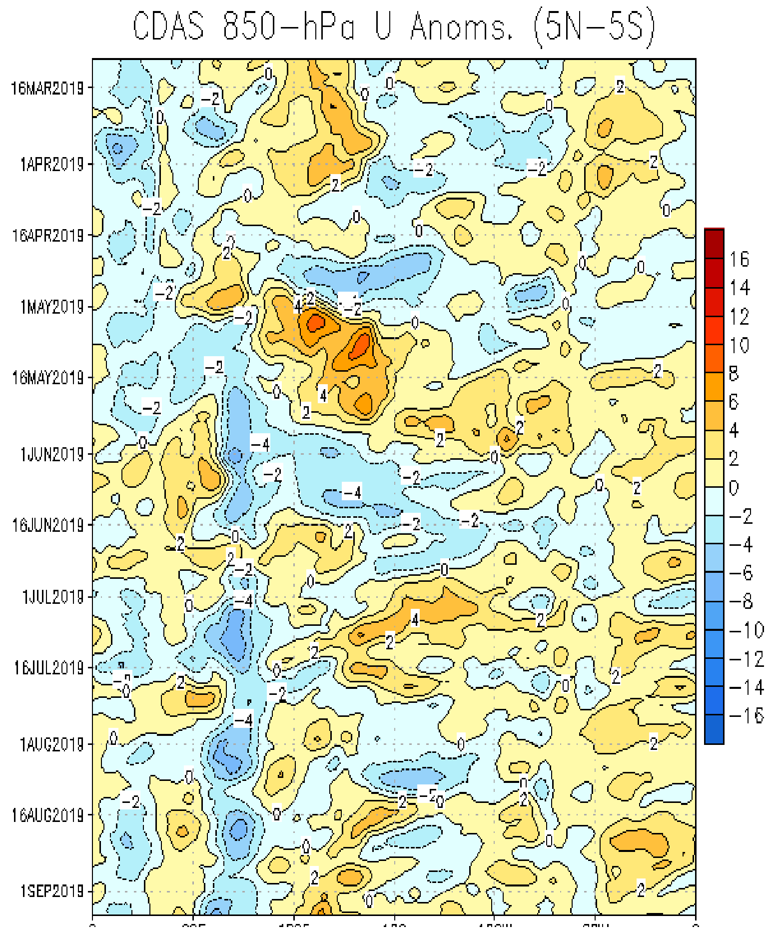


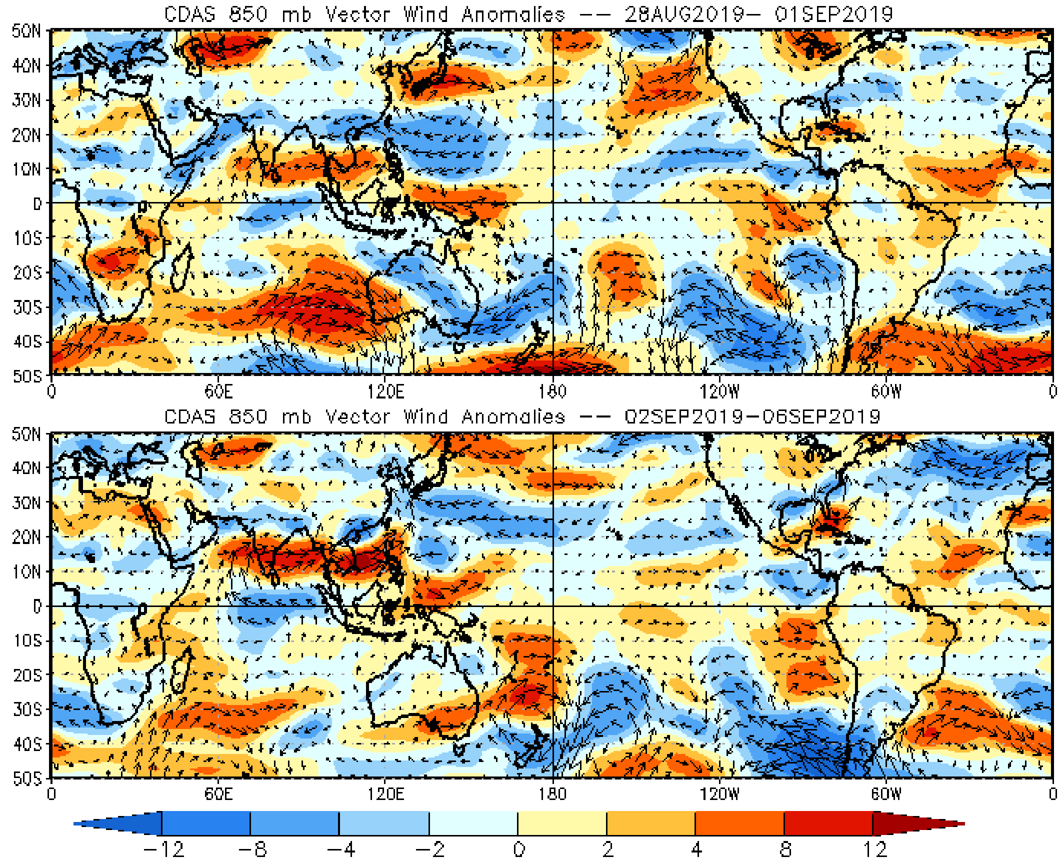


- Anomalous upper-level westerlies moving along the Equator from the Pacific and over North America have broken up the anomalous easterlies over the tropical Atlantic. Anomalous flow over the western and central tropical Pacific has weakened during the past week. The large anticyclone centered near the U.S. West Coast in the final days of August appears to have shifted inland since then.
- During the past week, the influence of Hurricane Dorian can be seen in west of Puerto Rico highlighted by a region of amplified anomalous easterlies.

850-hPa Wind Anomalies

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

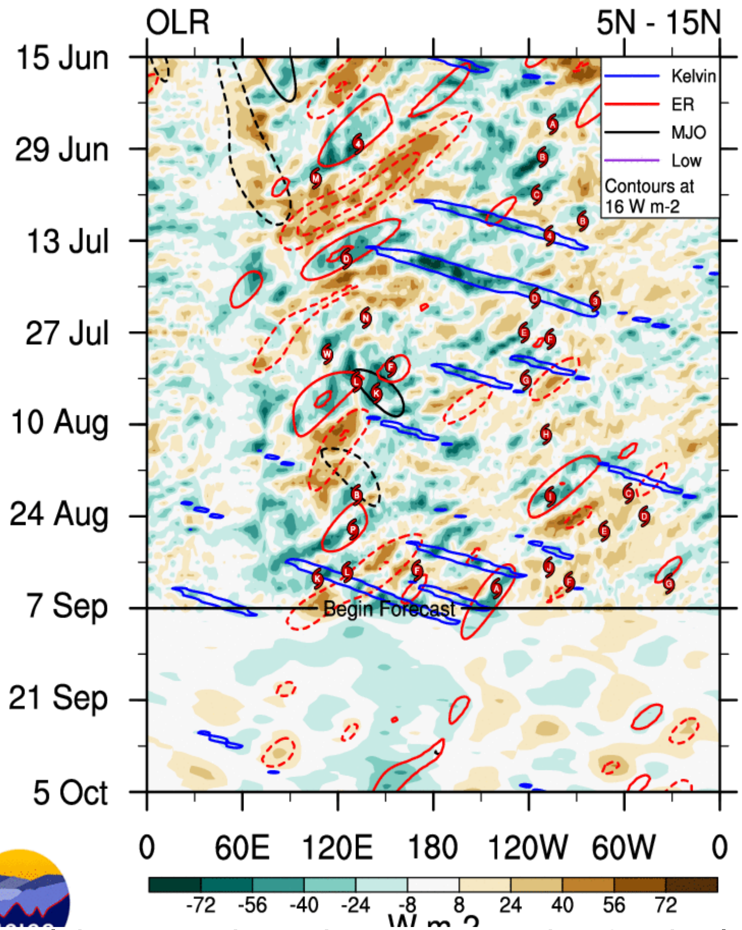


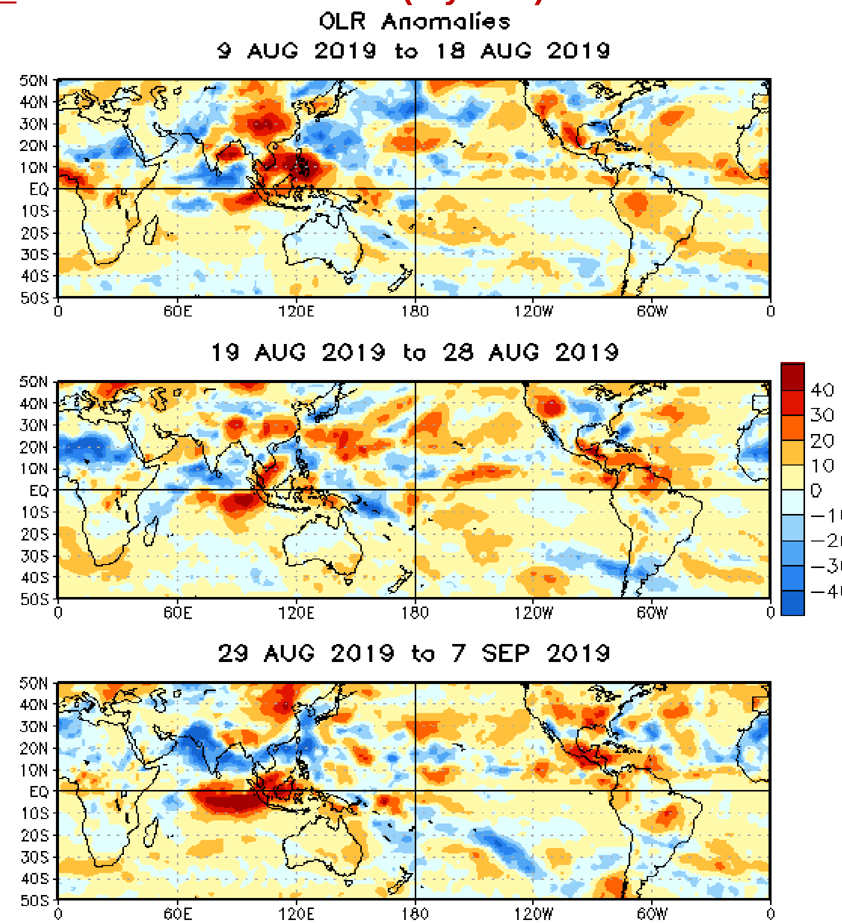


- Low-level westerlies have weakened across the tropical Atlantic and the eastern Pacific during the past week.
- Anomalous easterlies continue from southern China to northern India, likely enhanced by the recent tropical cyclone activity, while a belt of anomalous westerlies continue just to the south of this area.

Outgoing Longwave Radiation (OLR) Anomalies

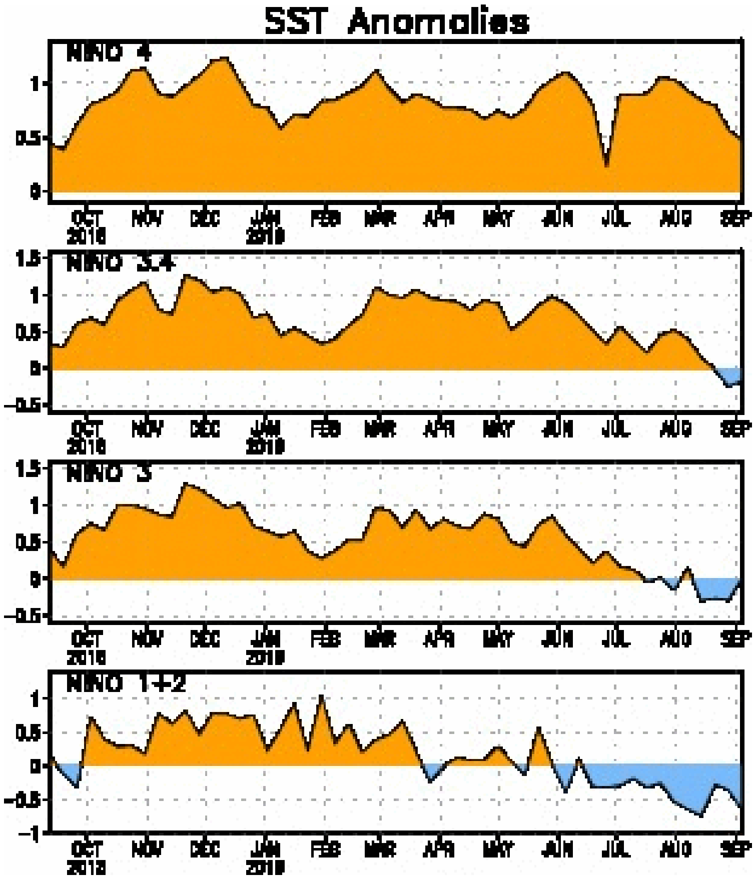
Blue shades: Anomalous convection (wetness). Red shades: Anomalous subsidence (dryness).

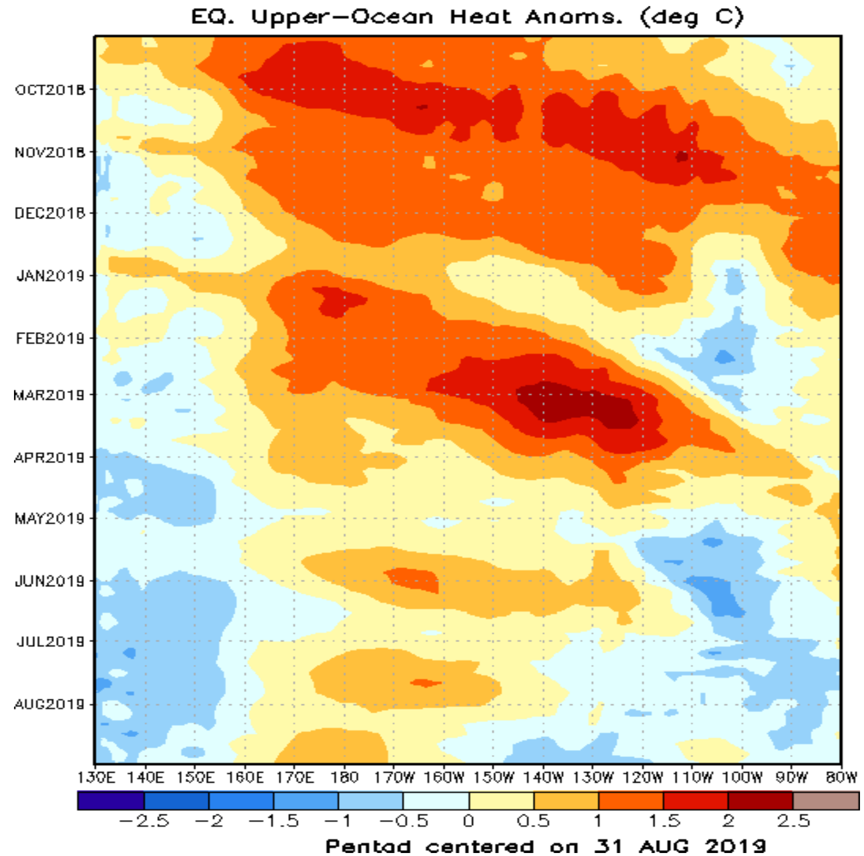




- Kelvin waves have been very active for the latter half of August and early September throughout the tropics, causing an uptick in tropical cyclone activity through most of the tropics.
- Suppressed convection has remained over the Maritime Continent during the past 30-days, spreading westward to the central and eastern equatorial Indian Ocean.
- Anomalous enhanced convection (likely associated with a Kelvin wave) overspread northern Africa in mid-late August. The enhanced convection over India in early September may be associated (at least in part) with the continued eastward propagation of this Kelvin wave.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

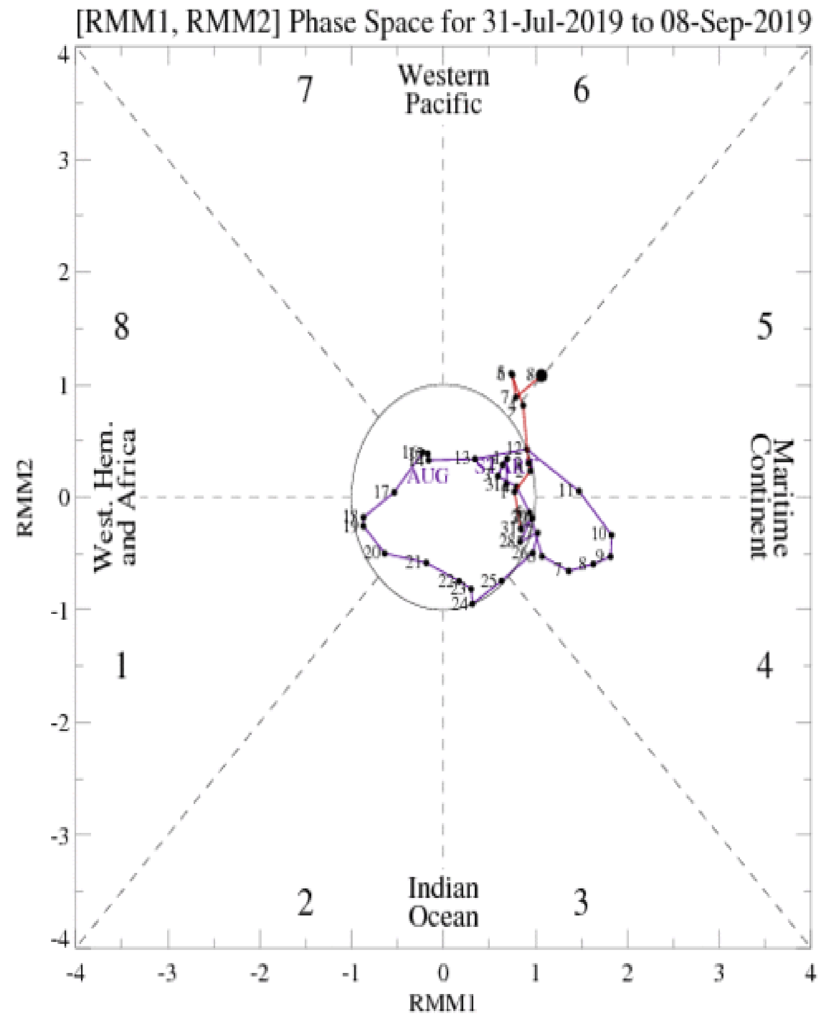




- Equatorial SST anomalies are near to slightly negative across much of the Pacific, particularly the eastern Pacific.
- A downwelling Kelvin wave event was evident over the central and eastern Pacific during mid-May through mid-June, but its amplitude was weaker than what was observed in previous events. Overall, upper-ocean heat content has continued to steadily decline over the past several months.
- Another weak downwelling wave developed in response to a recent period of anomalous westerlies over the central Pacific.

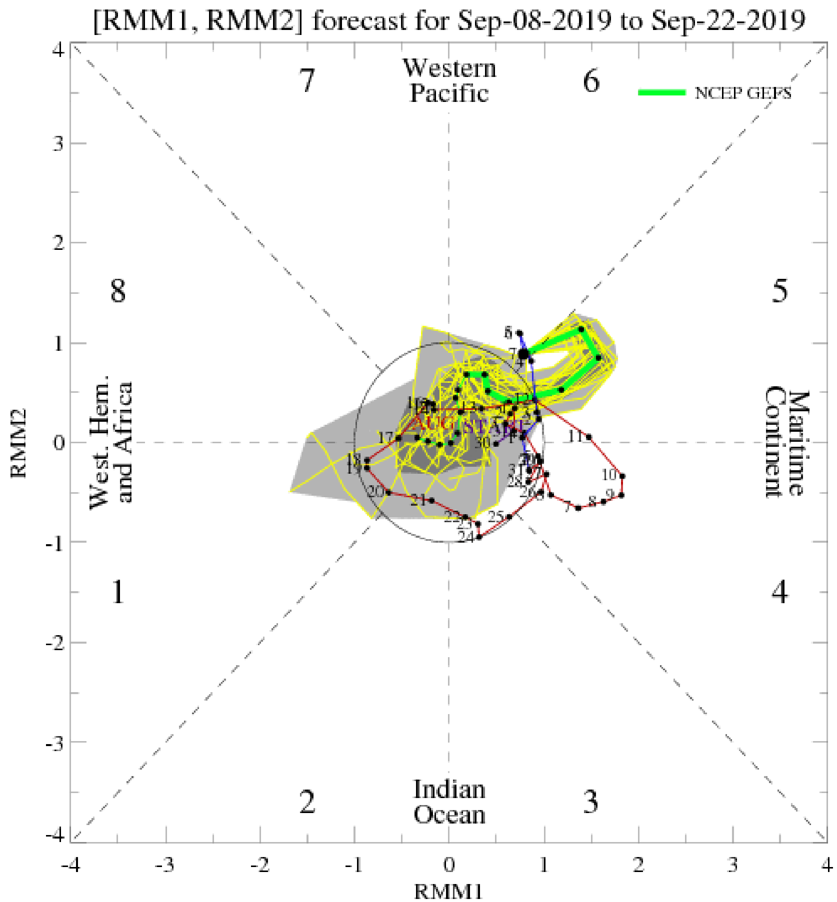
MJO Index: Recent Evolution

- The projection of the intraseasonal signal in RMM space remains weak and incoherent.
- A brief period of resurgence of the signal was seen in early to mid August, but since then, the signal has remained near or within the unit circle.
- Whatever weak signal exists has been meandering over the Maritime Continent.

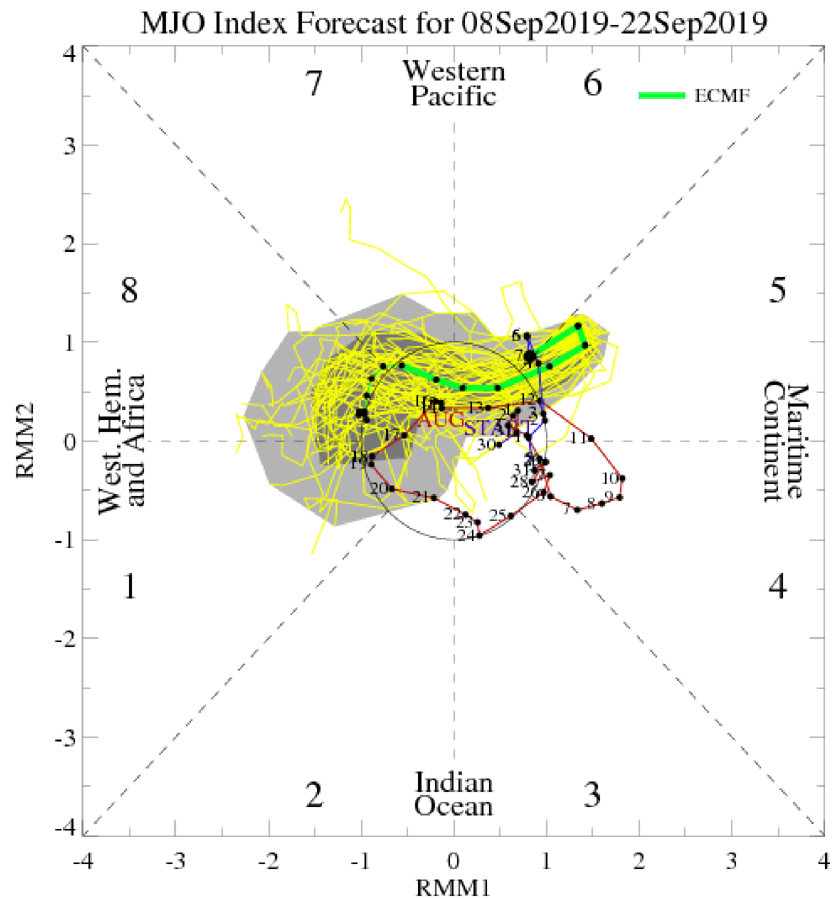


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

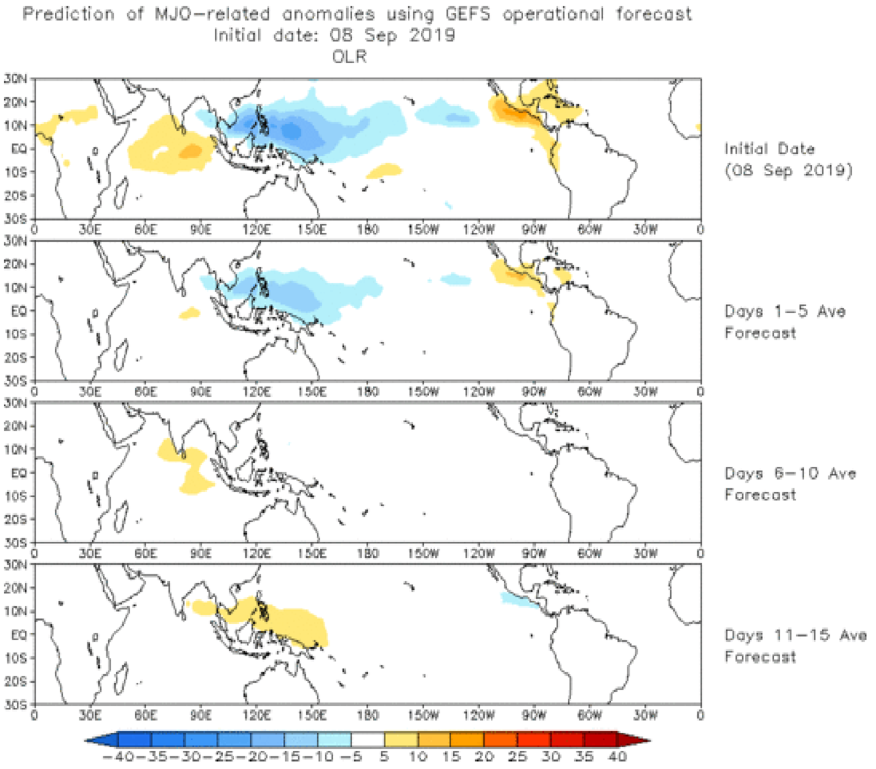


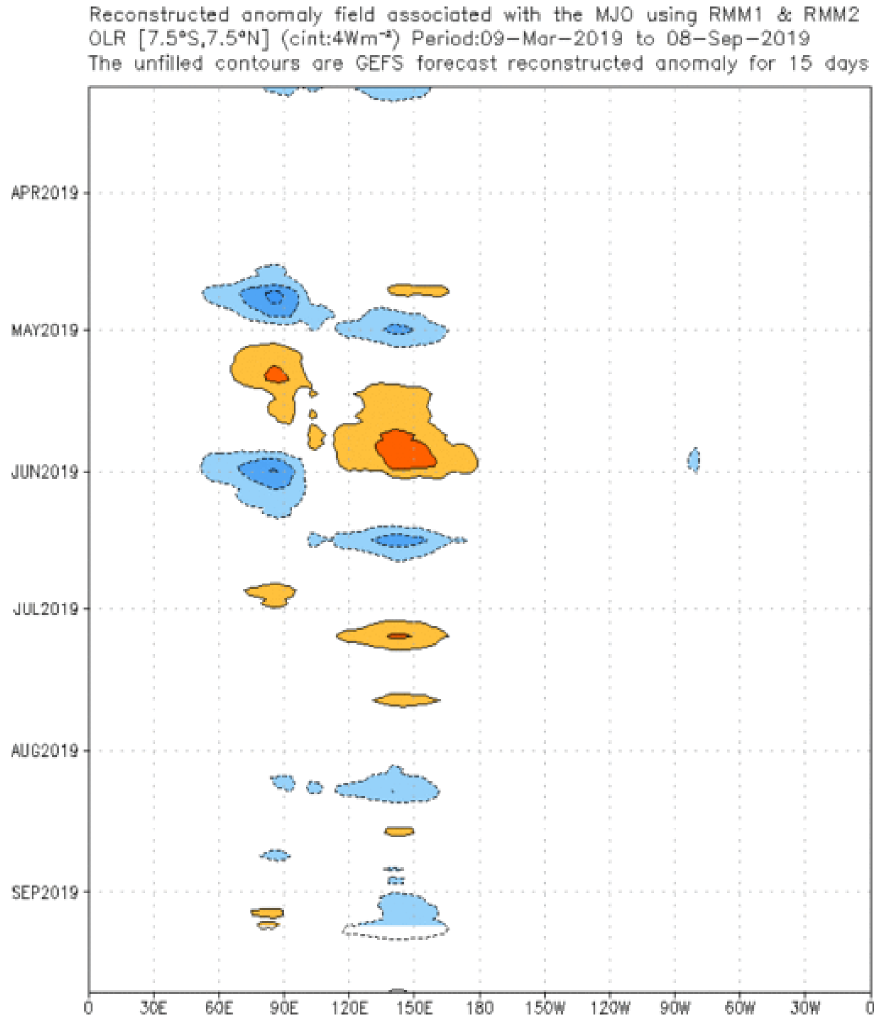
ECMWF Forecast

- The GEFS indicates a continued weak MJO signal during the next two weeks, remaining over the Maritime Continent/Western Pacific region.
- The ECMWF ensemble predicts the continuation of a weak MJO signal during week-1 over the Maritime Continent/Western Pacific region, with many ensemble members depicting continued eastward propagation across Phases 7/8 (Western Pacific and Western Hemisphere) and possible strengthening during week-2.
- Kelvin wave is also likely to interact with the MJO signal, leading to a forecast uptick in activity on the RMM index in Week-1.

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.)

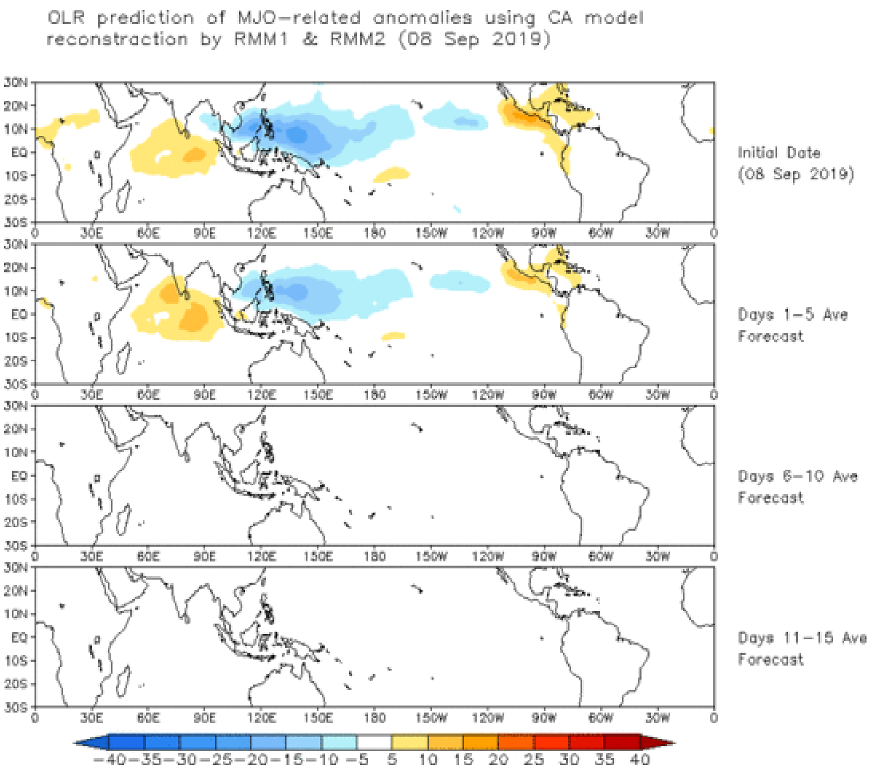


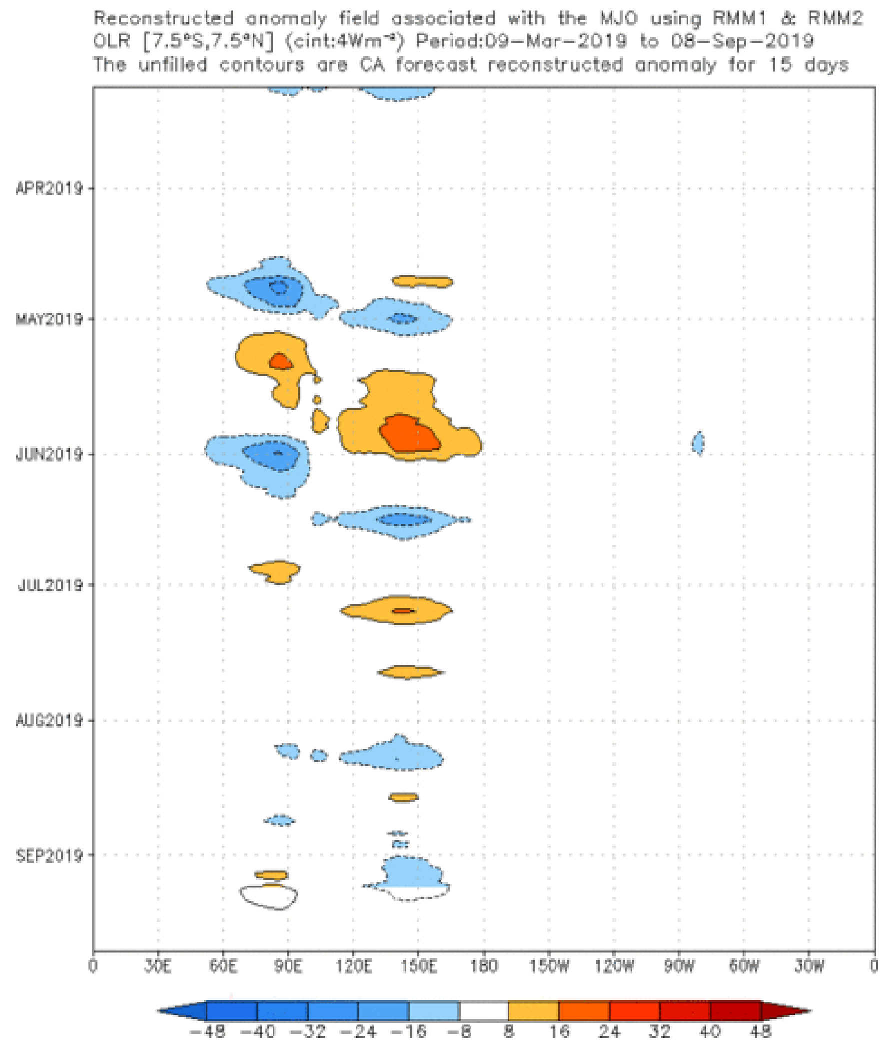


- The spatial depiction of OLR anomalies based on the GEFS RMM index shows enhanced convection across the Maritime Continent & Western Pacific during the first 5-days, and some tendency for suppressed convection to shift from the Indian Ocean to the Maritime Continent during the two-week period.

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.)

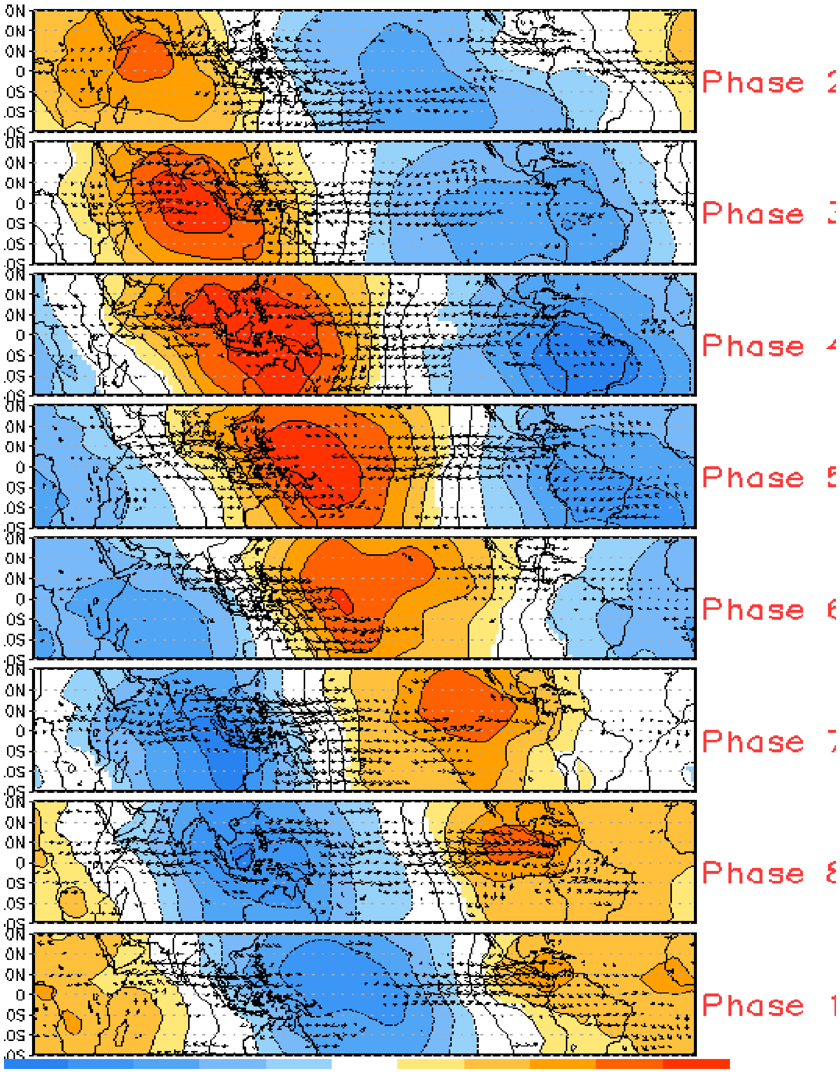




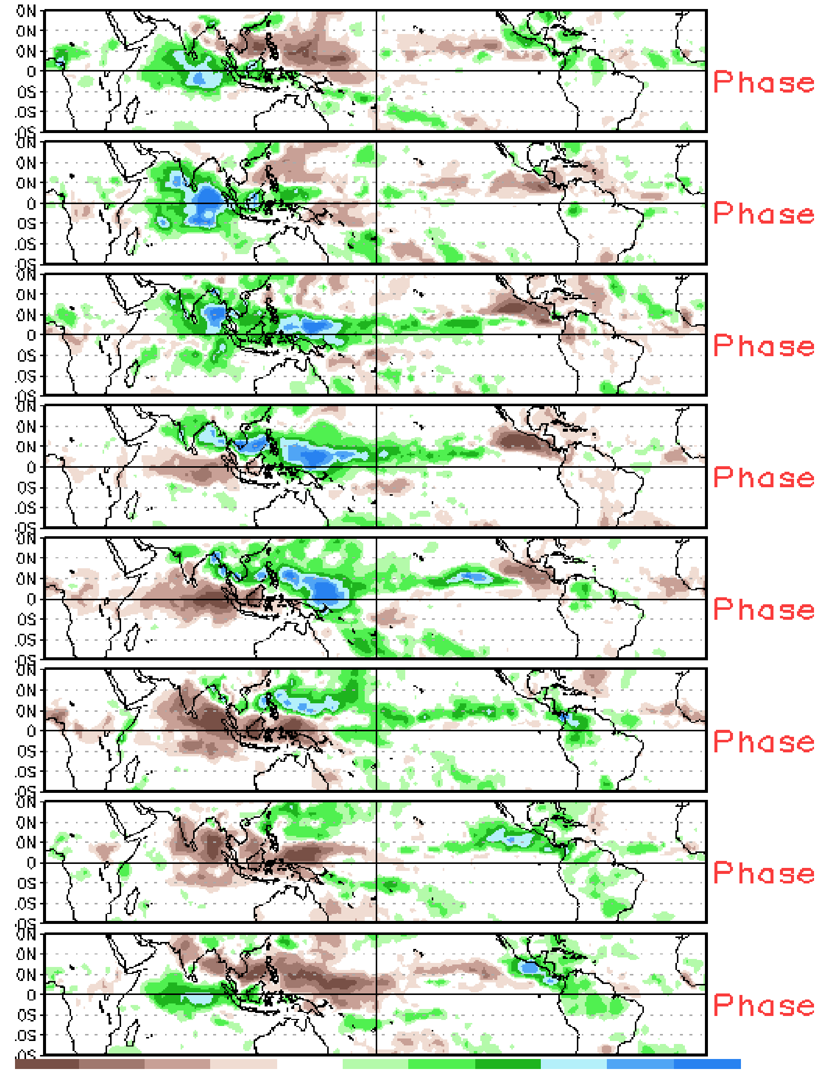
- The constructed analog MJO forecast indicates enhanced convection will extend over the Maritime Continent and West Pacific during the next 5-days. No discernible signal is apparent during the 6-10 day and 11-15 day periods.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



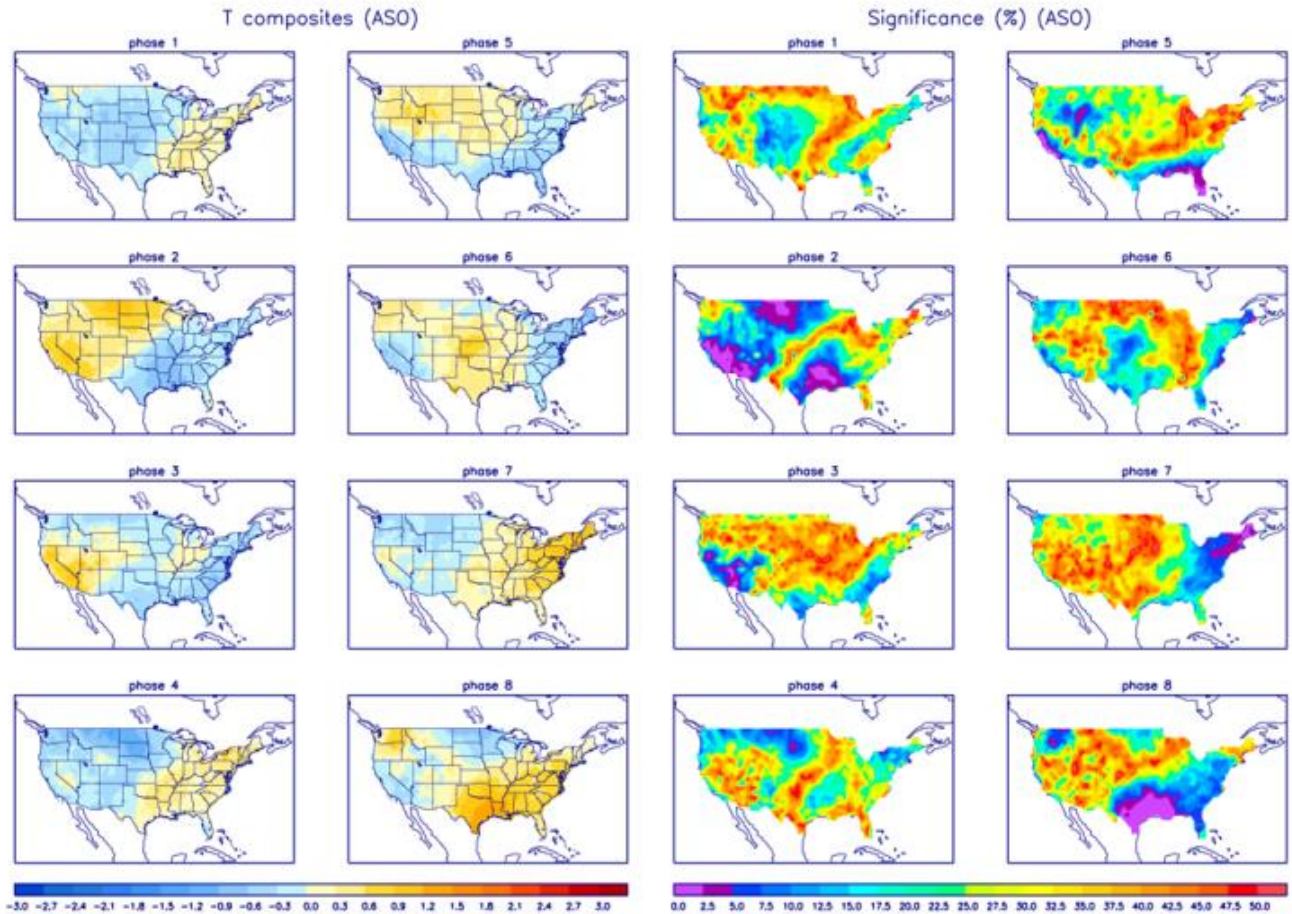
Precipitation Anomalies



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.

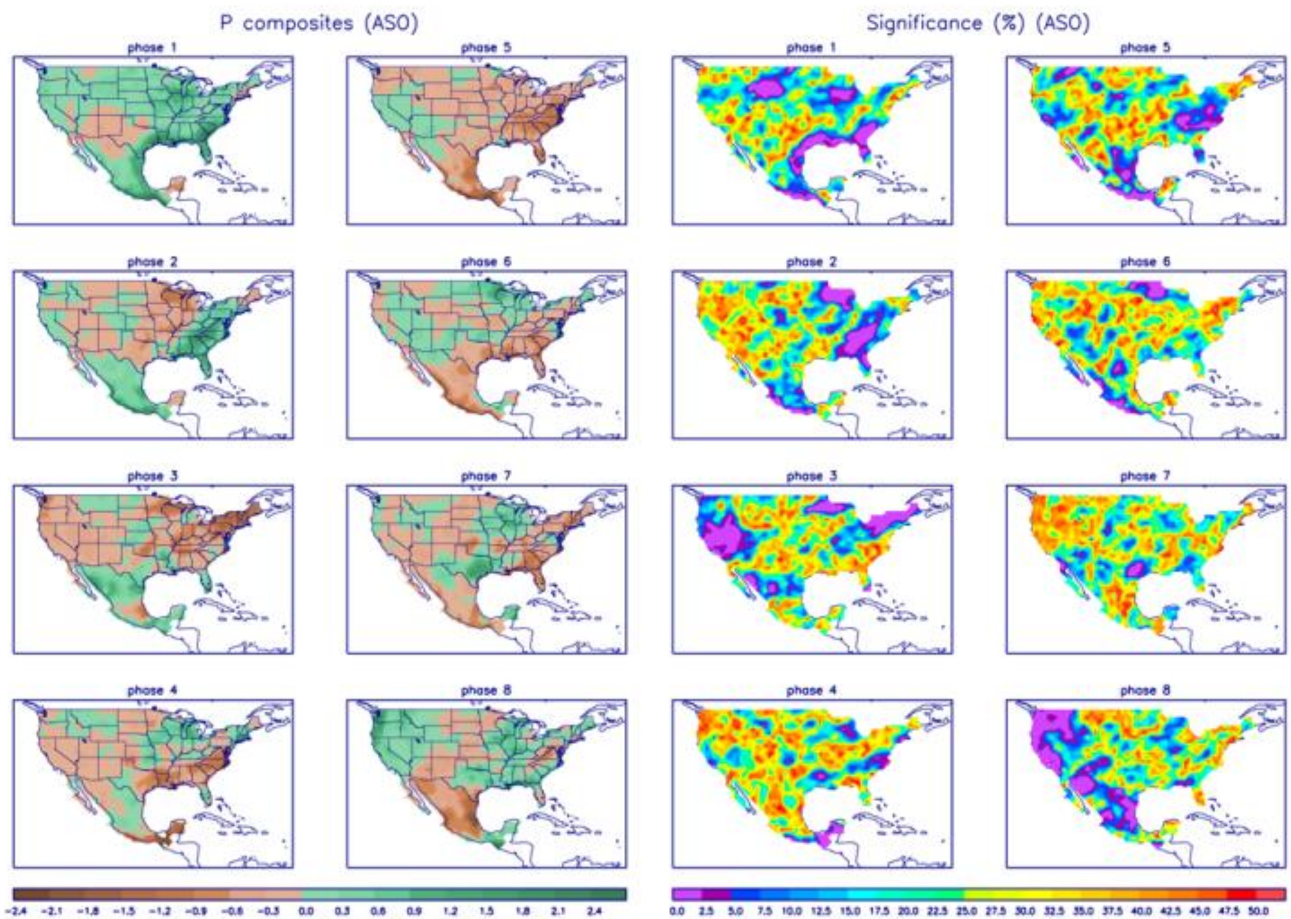


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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