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

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

Overview

- The RMM index depicts a weak MJO that has stalled over the Indian Ocean (phase 2) since mid-August.

- There are indications in some of the dynamical models favoring renewed eastward propagation of the intraseasonal signal. However, overall model disparities in the predicted evolution and strength of the MJO, as well as competing influences from Rossby wave activity forecast in the Indian Ocean, lead to increased uncertainty in the MJO outlook during the next two weeks.

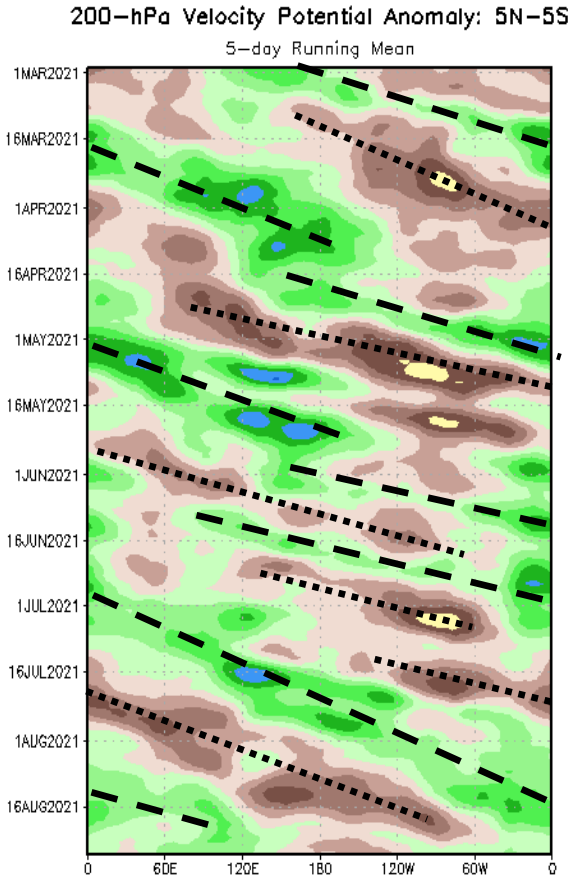
- There is continued support in model guidance favoring tropical cyclone (TC) development over the tropical eastern Pacific and Atlantic basins into mid-September.

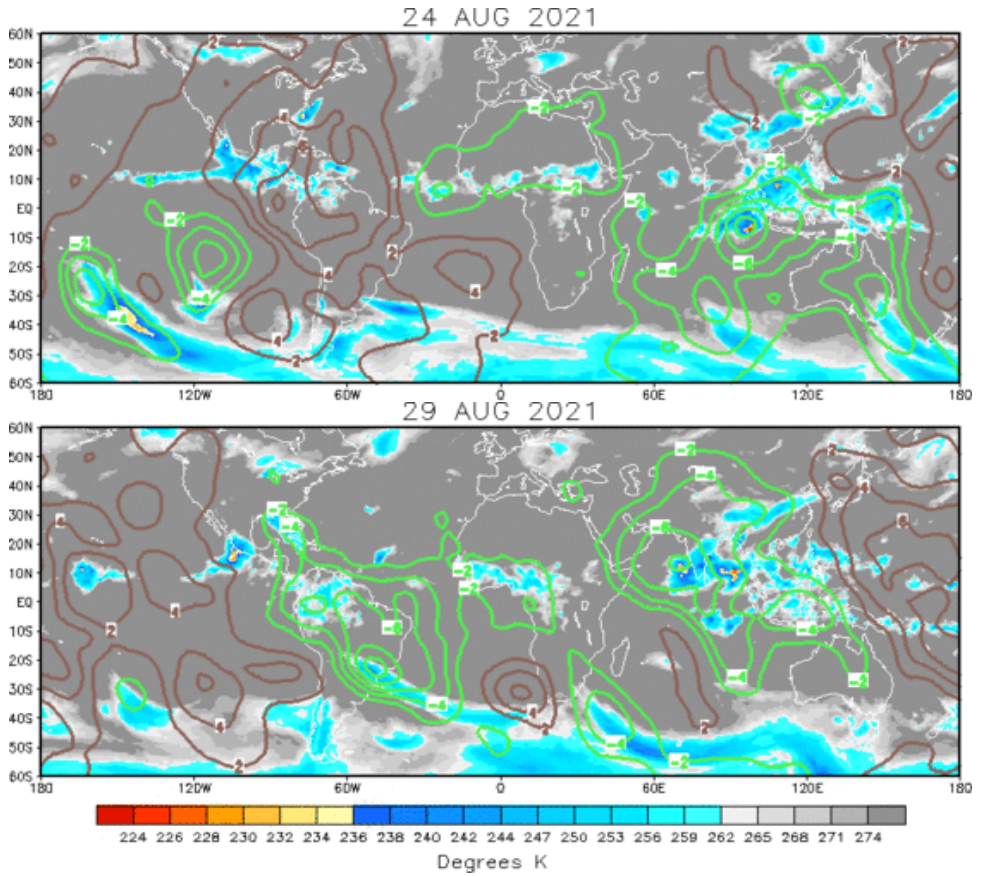
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).



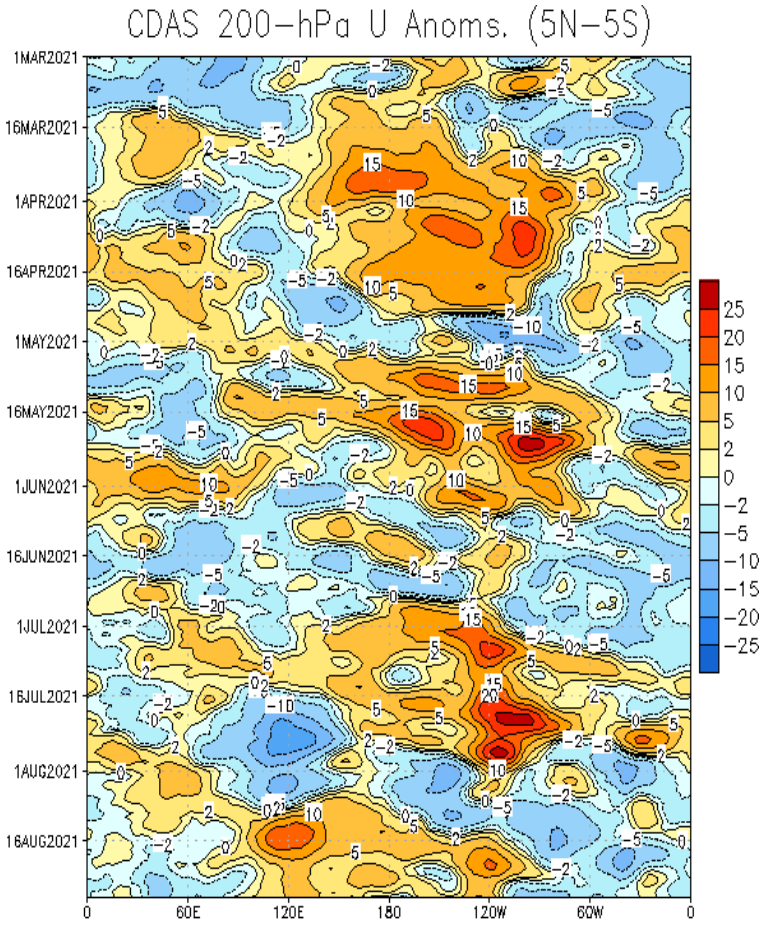


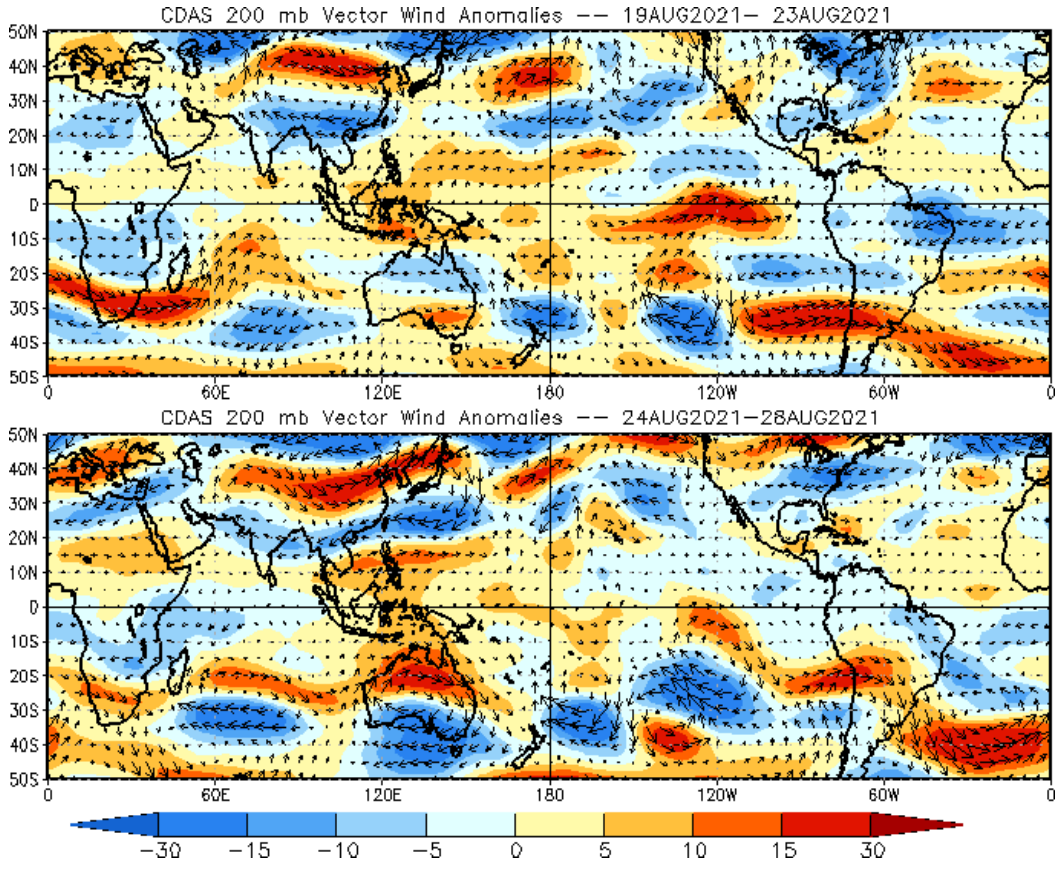
- Since mid-August, the intraseasonal signal weakened and became more disorganized in the upper level velocity potential field.

- Kelvin Wave activity is featured over the Americas and Atlantic basin as the main convective envelope remains over the Indian Ocean.

200-hPa Wind Anomalies

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

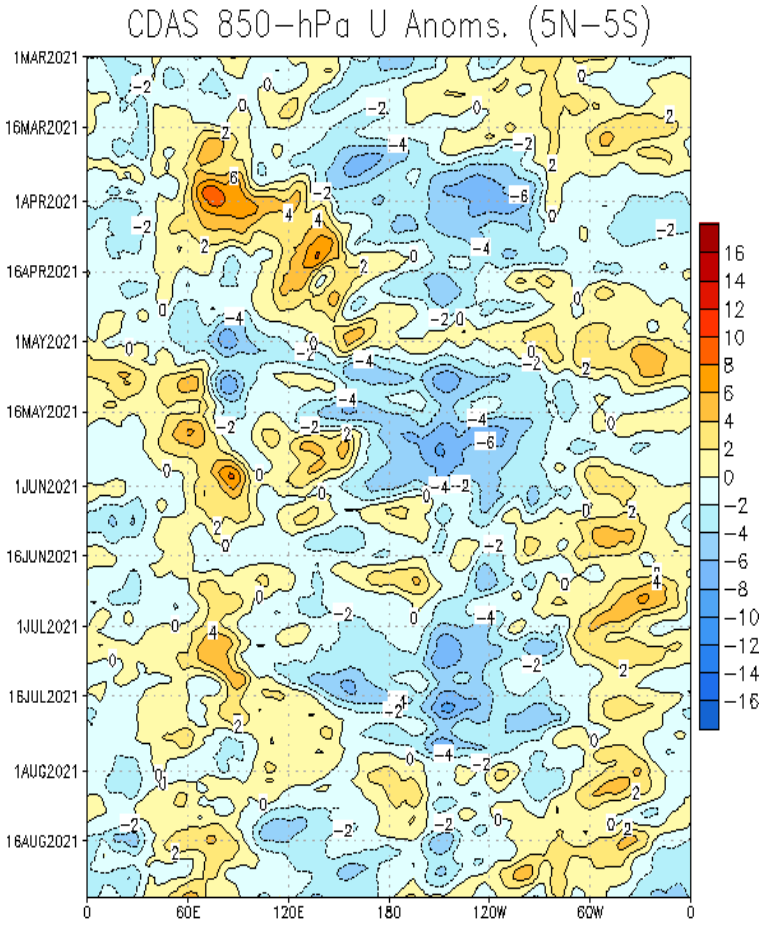


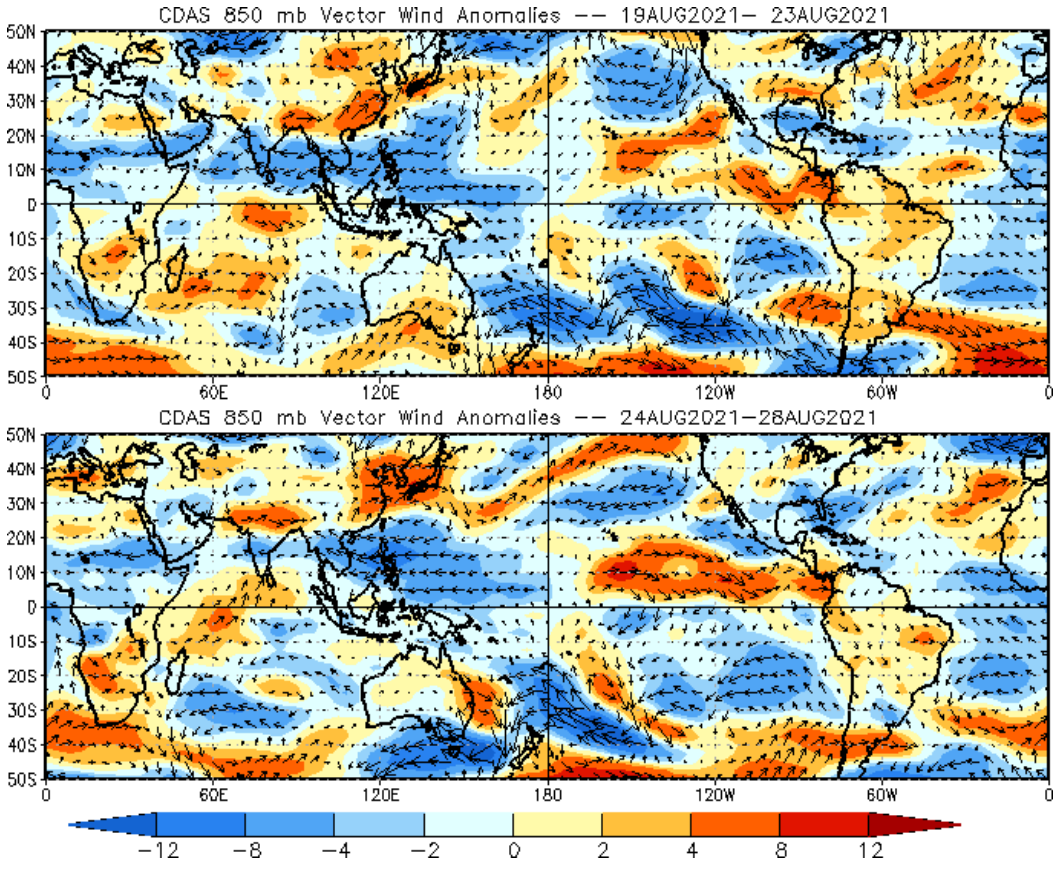


- Anomalous upper-level easterlies strengthened over equatorial Africa and the western Indian Ocean, with anomalous westerlies persisting over the Maritime Continent and West Pacific.
- The spatial extent of strong anomalous westerlies has diminished over the equatorial central and eastern Pacific, however, these winds remain near 120W tied to an anomalous cyclonic circulation in the southern Hemisphere.

850-hPa Wind Anomalies

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

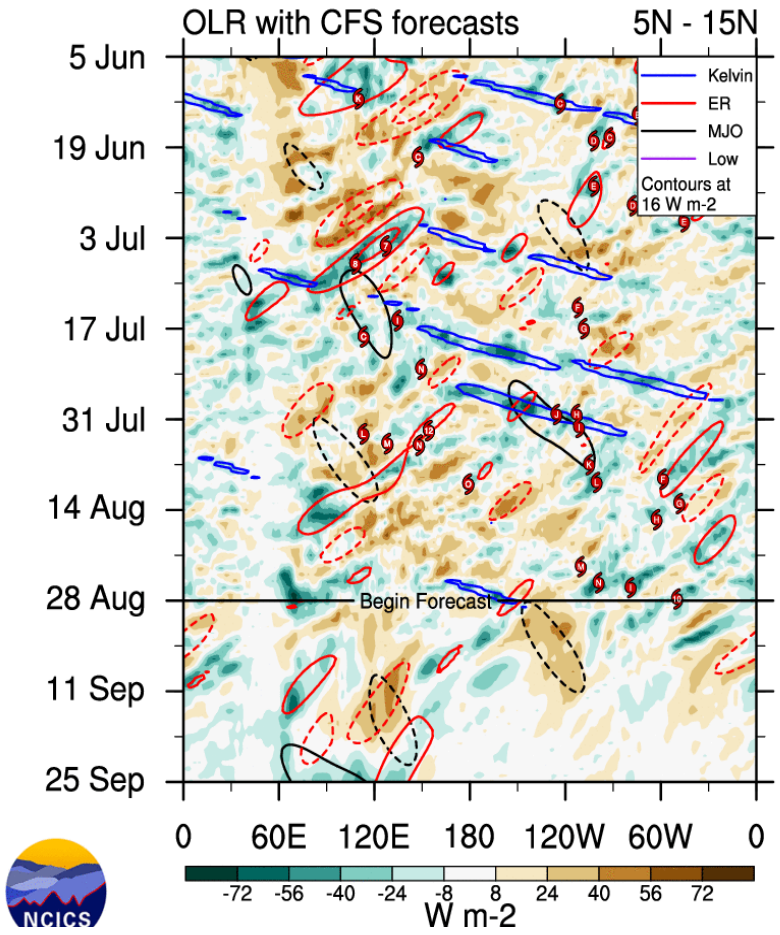


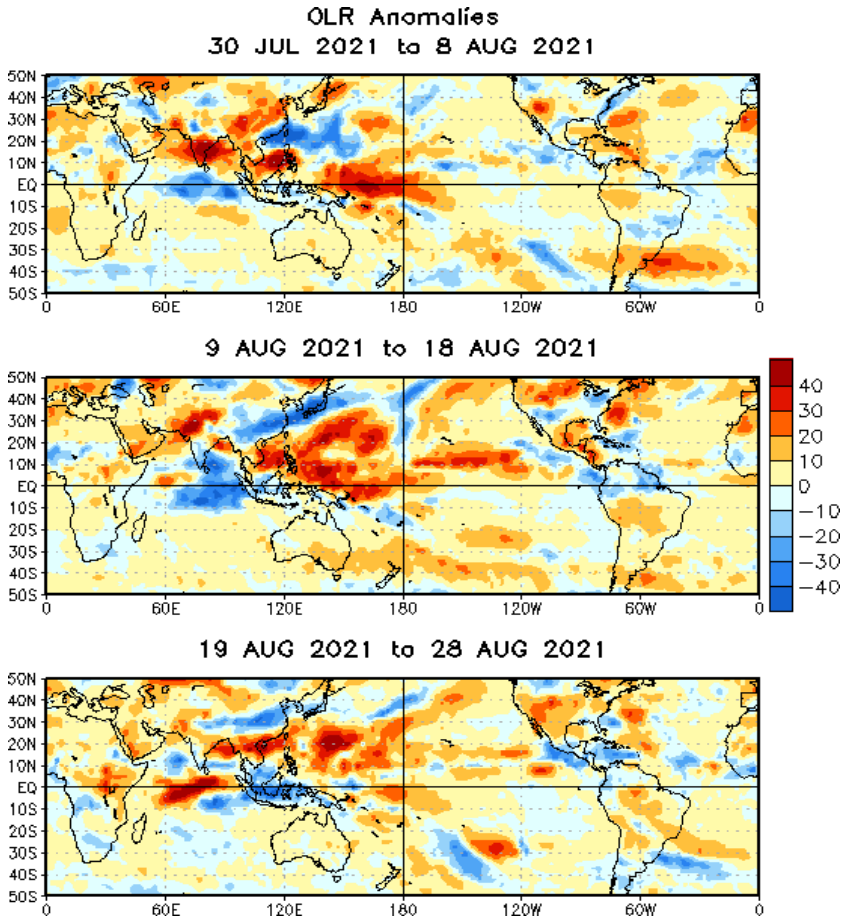


- A low-frequency base state of low-level westerly anomalies is seen near 60W and 60E.
- Enhanced trades remain over the West Pacific while a broad area of anomalous westerlies developed over the eastern Pacific to the north of the equator.

Outgoing Longwave Radiation (OLR) Anomalies

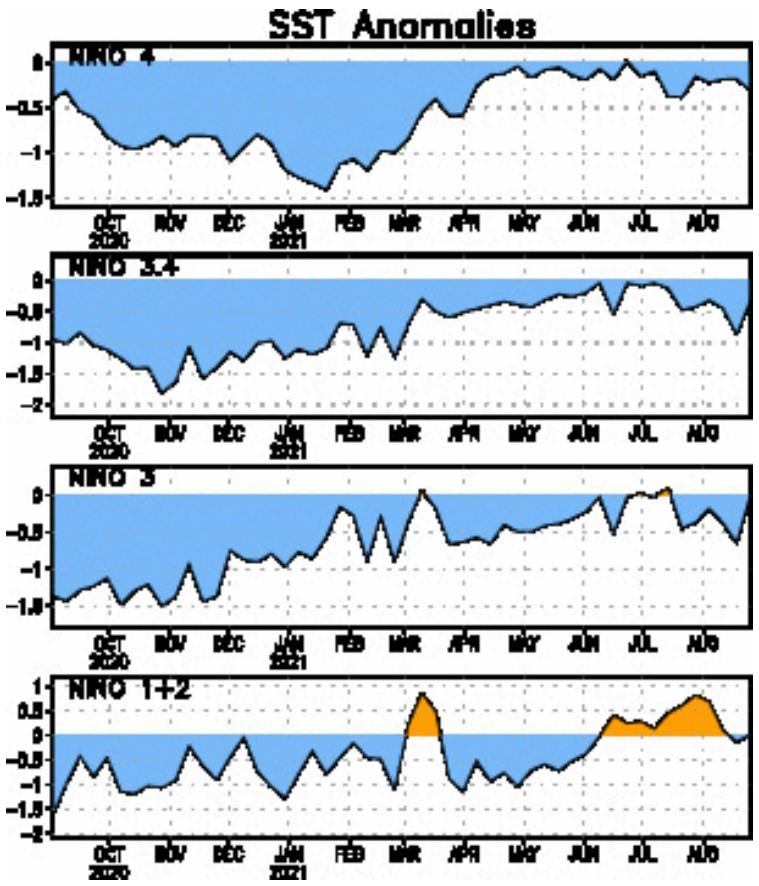
Blue shades: Anomalous convection (wetness). Red shades: Anomalous subsidence (dryness).

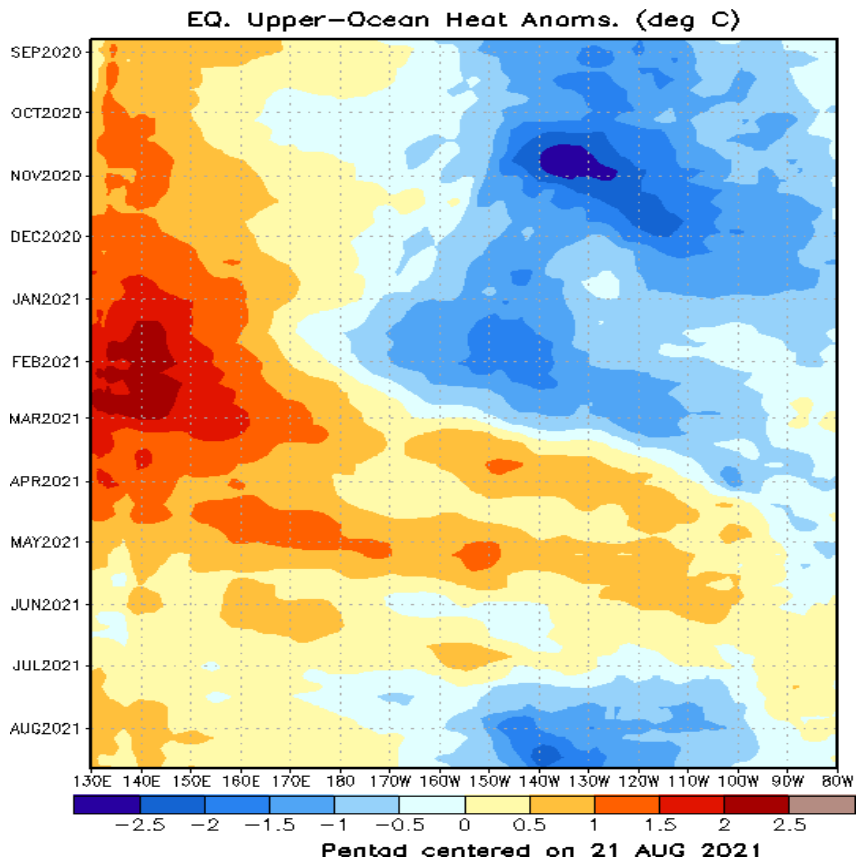




- Enhanced convection continued over the eastern Pacific and Atlantic tied to tropical cyclone activity during August.
- As the MJO propagated eastward into the Indian Ocean, convection increased throughout the Basin and spread into the Maritime Continent.
- Rossby Wave activity remains apparent in the forecast over the Indian Ocean.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



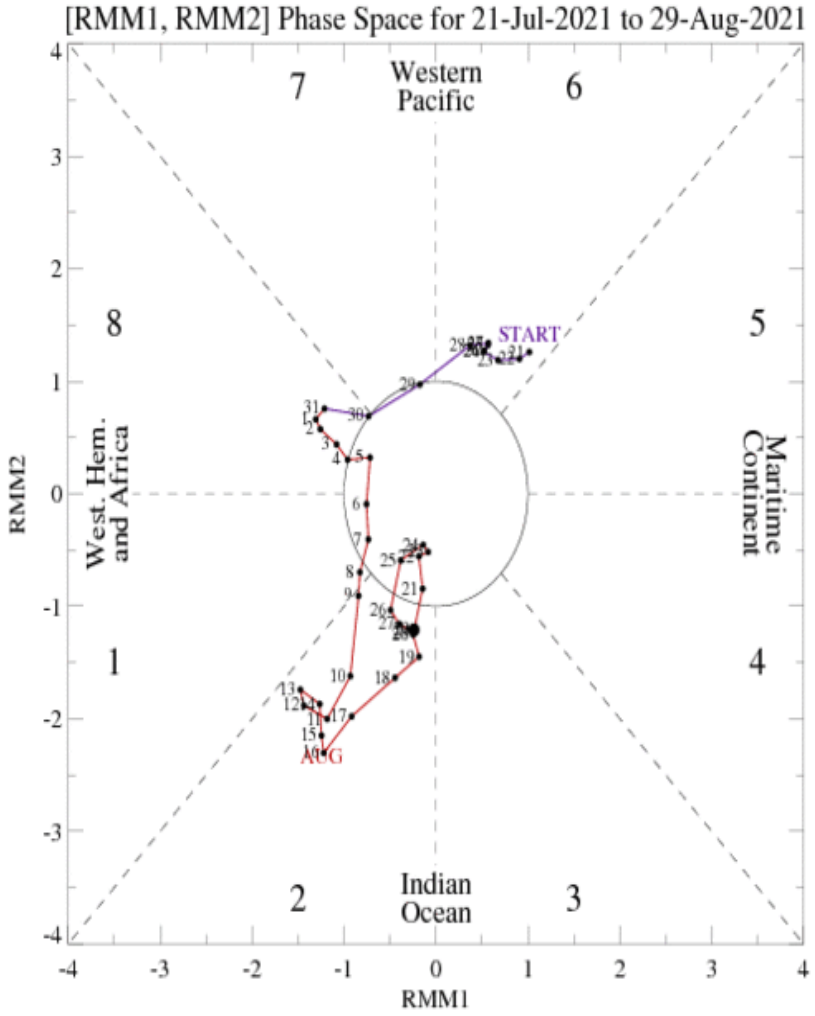


- Multiple episodes of oceanic Kelvin wave activity led to a increase of upper-ocean heat content during this past spring. However, these positive anomalies have since weakened, as negative anomalies have been strengthening across much of the Pacific since July.

- Below normal sea surface temperatures are observed over all Nino regions.

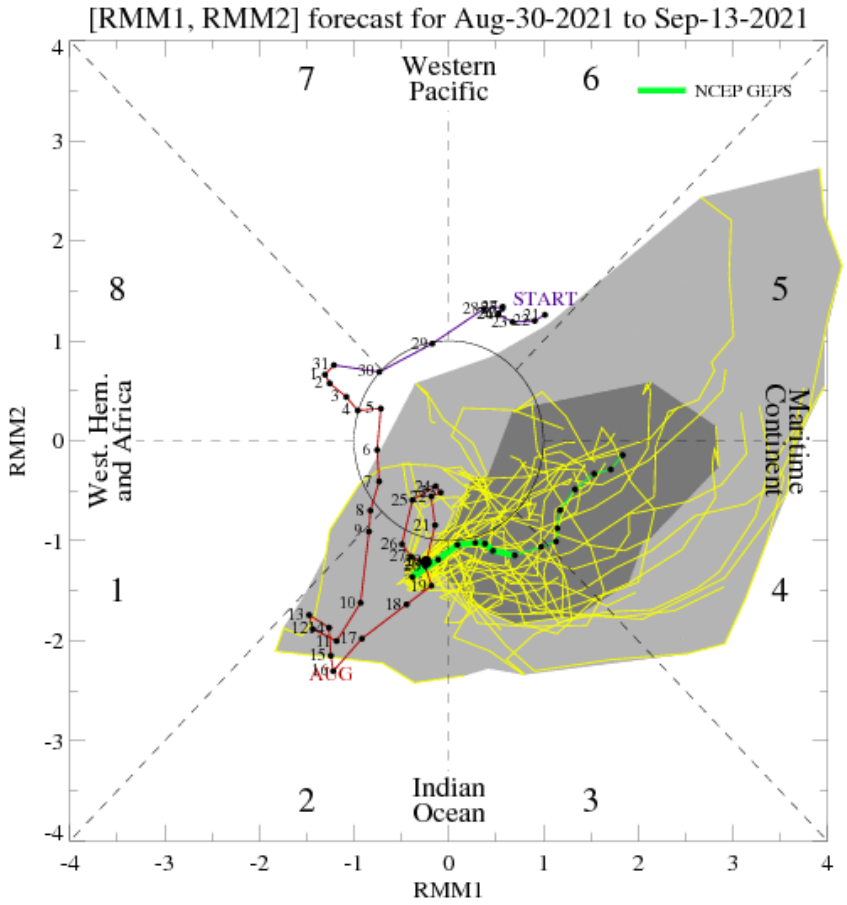
MJO Index: Recent Evolution

- The RMM index indicates the MJO has remained over the Indian Ocean (phase 2) since mid-August.
- The intraseasonal signal recently experienced an increase in amplitude which may be tied to strengthening easterlies aloft over Africa and the western Indian Ocean.

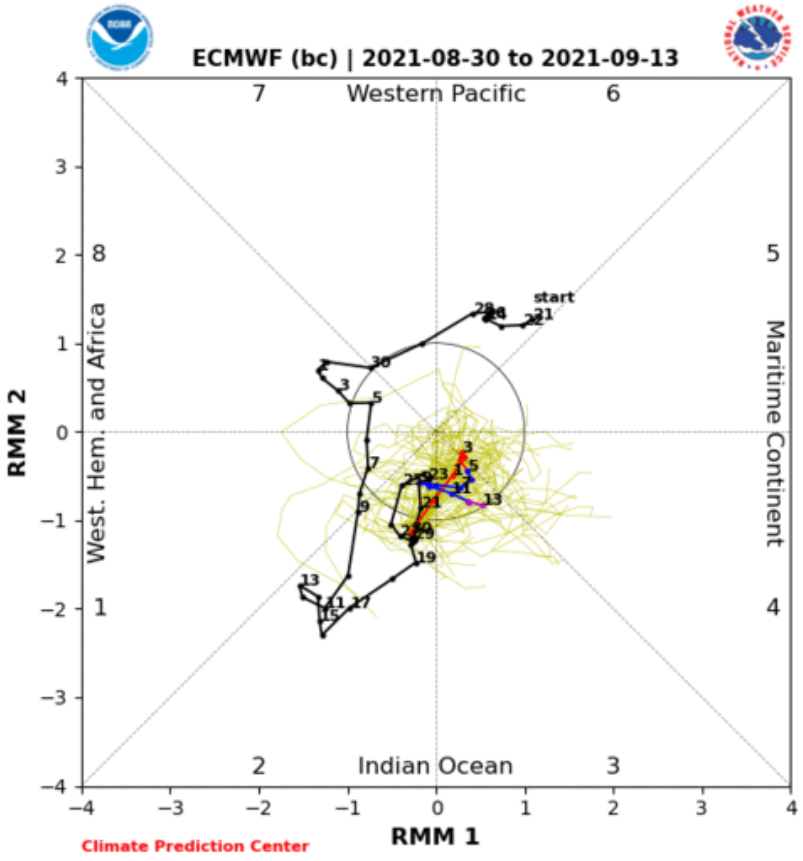


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

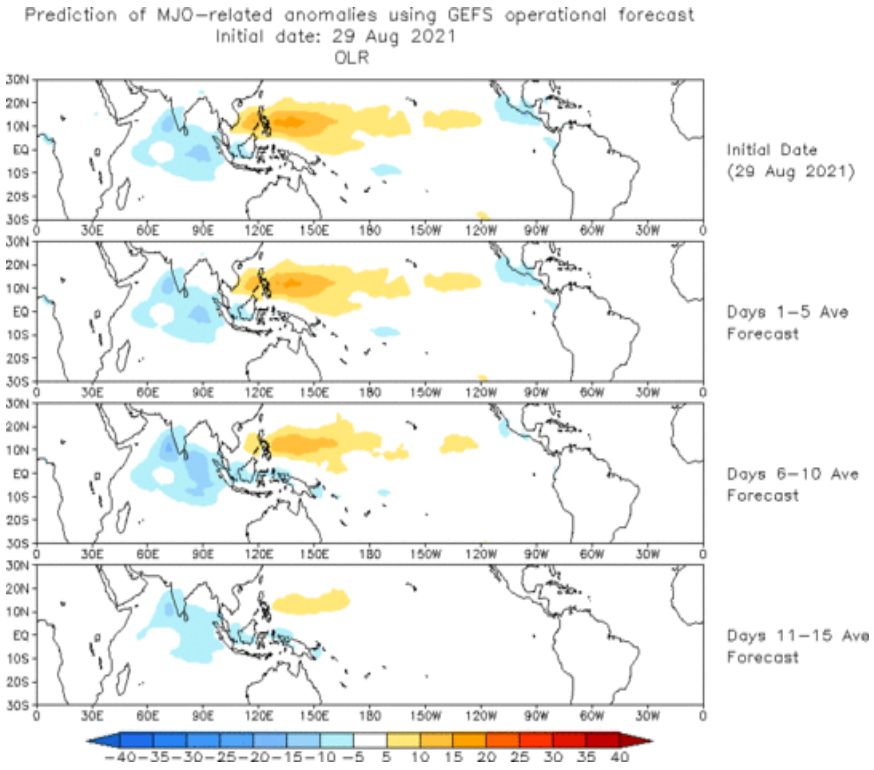


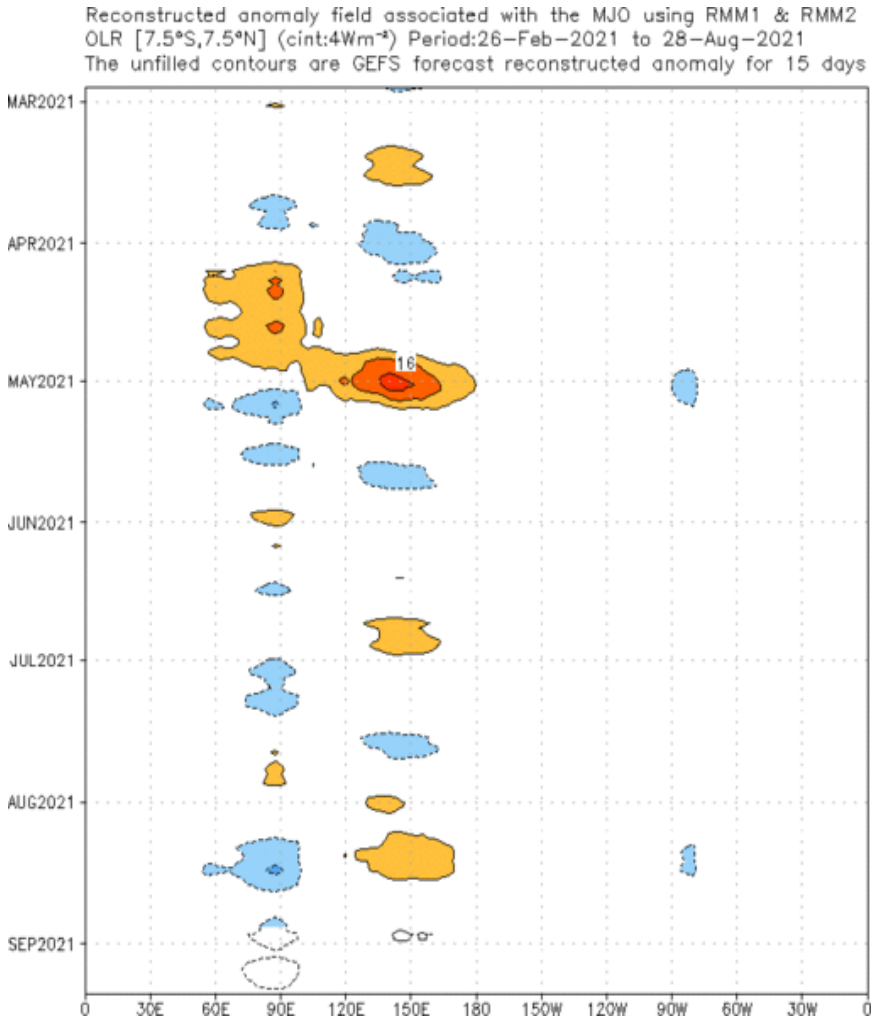
ECMWF Forecast

- The GEFS, Canadian and CFS point to the resumption of an eastward propagating signal across the across the Indian Ocean and into the Maritime Continent of varying degrees of amplitude during the next two weeks.
- The ECMWF is less supportive of this realization, depicting a mean signal that stays within the RMM unit circle with large ensemble spread contributing to uncertainty in the MJO outlook.

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.)

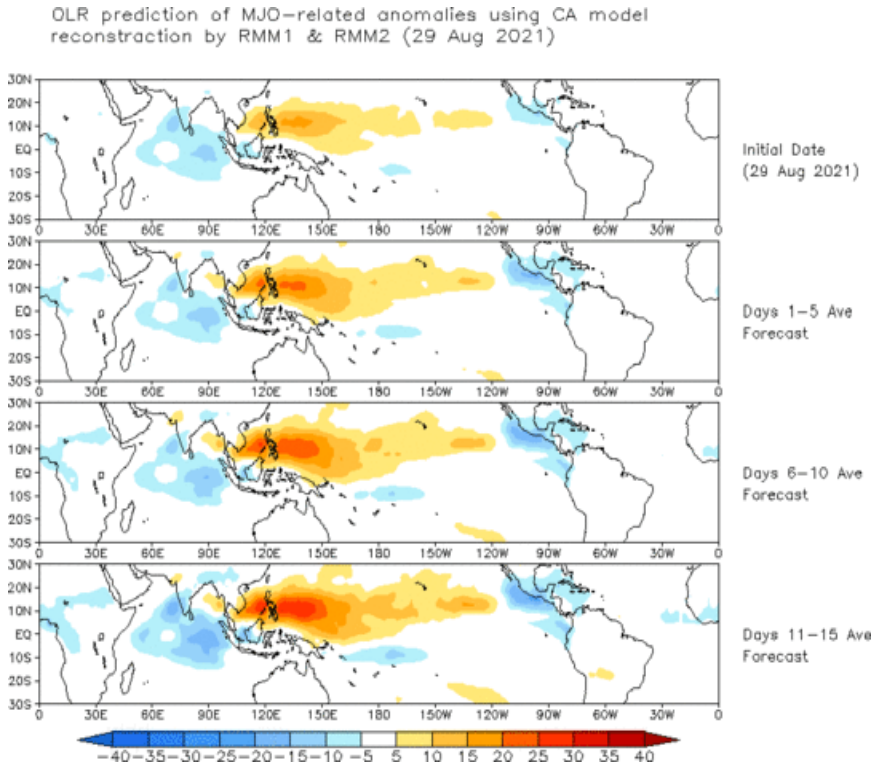


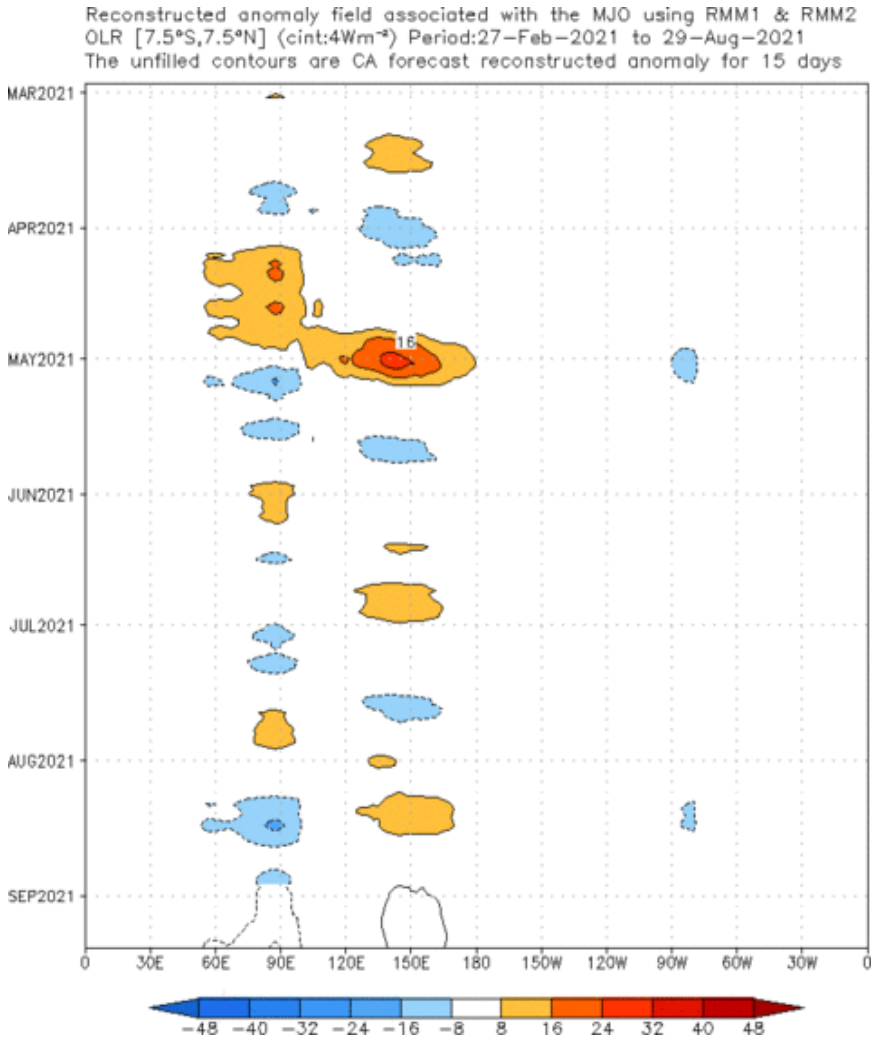


- The GEFS RMM-based OLR anomaly forecast features a stationary convective pattern that gradually weakens during the next two weeks.

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.)

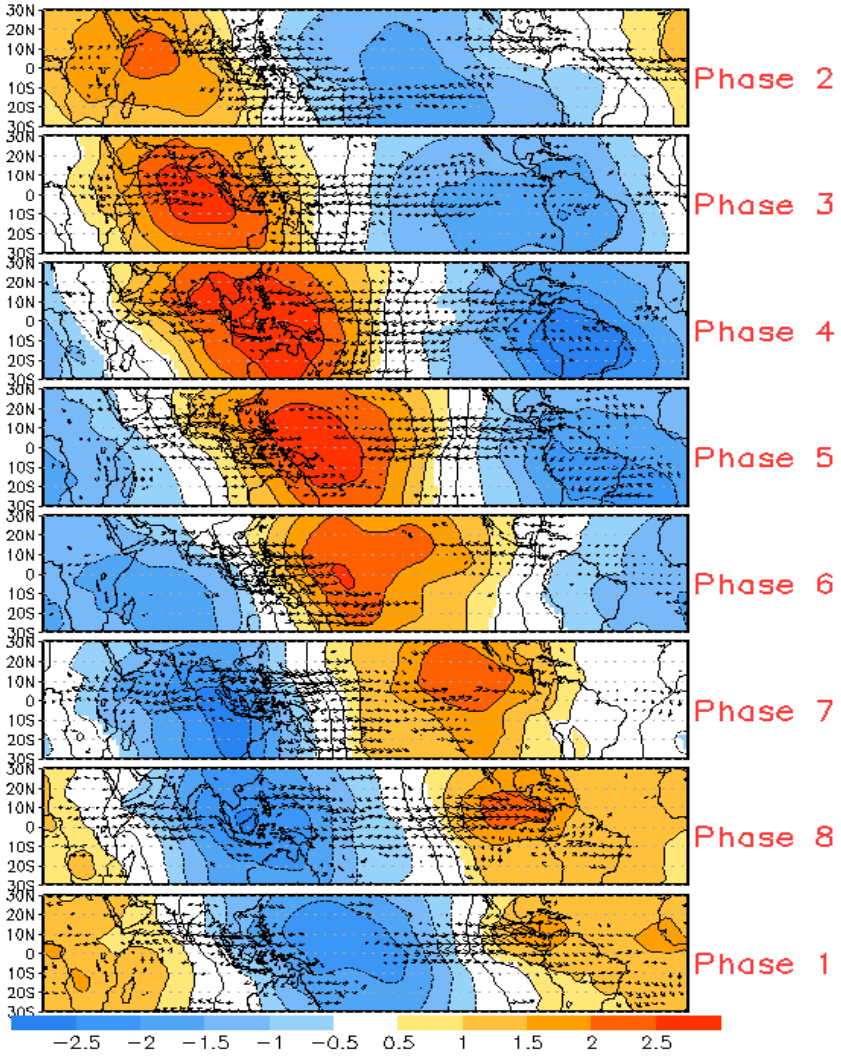




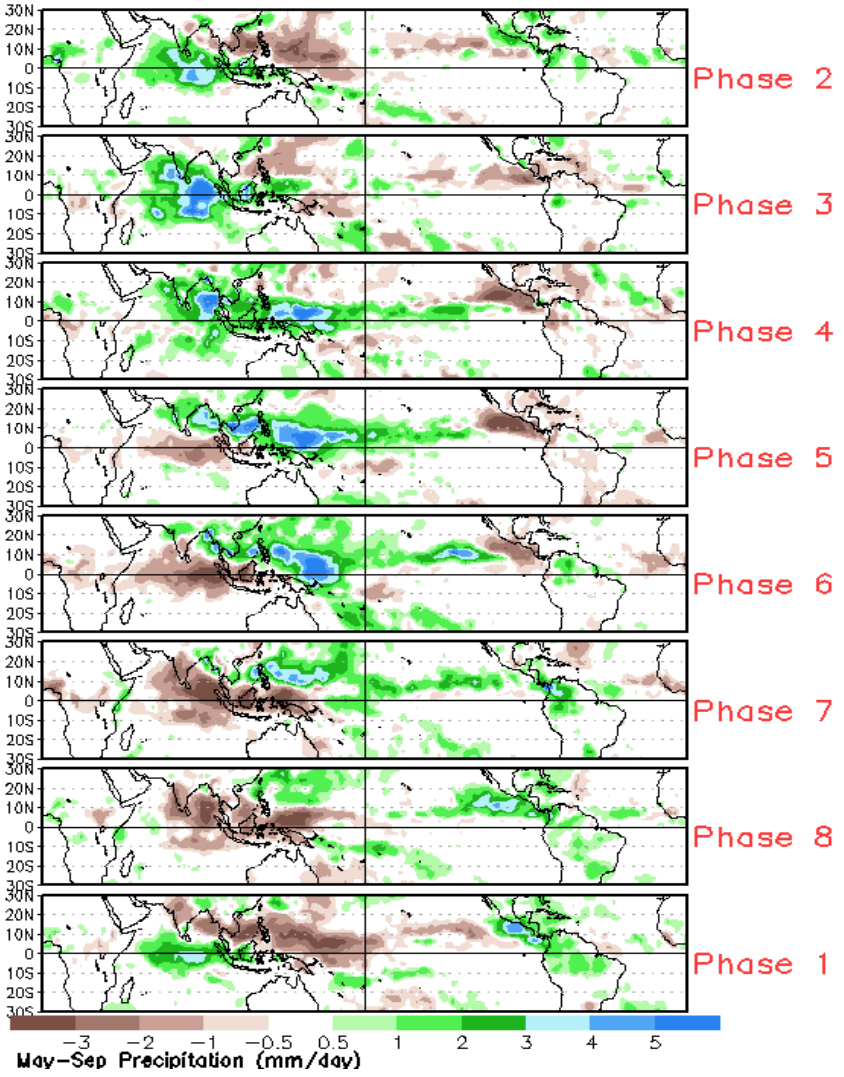
- The constructed analog forecast also depicts a more stationary convective pattern similar to the GEFS, but strengthens with time.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



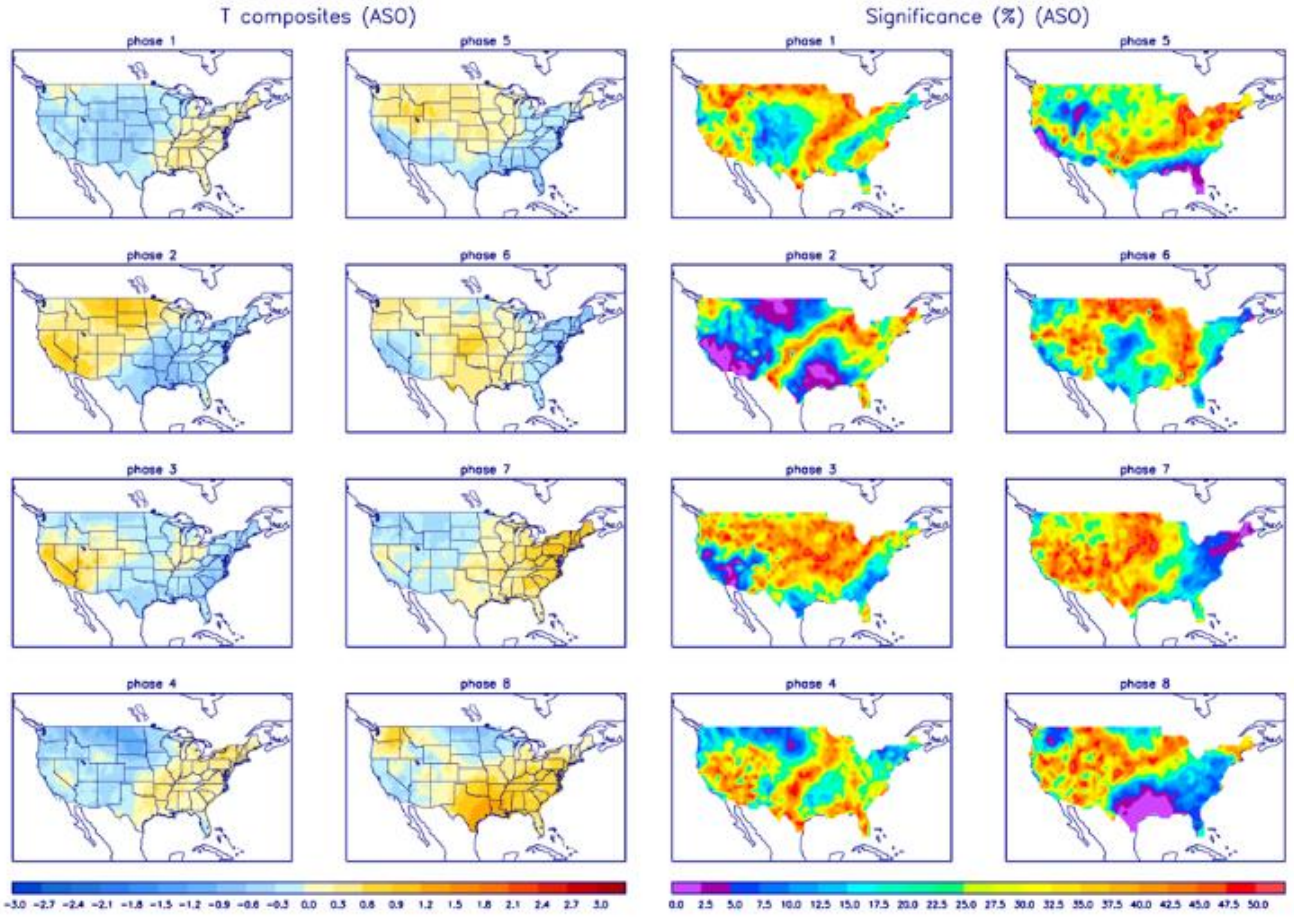
Precipitation Anomalies



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.

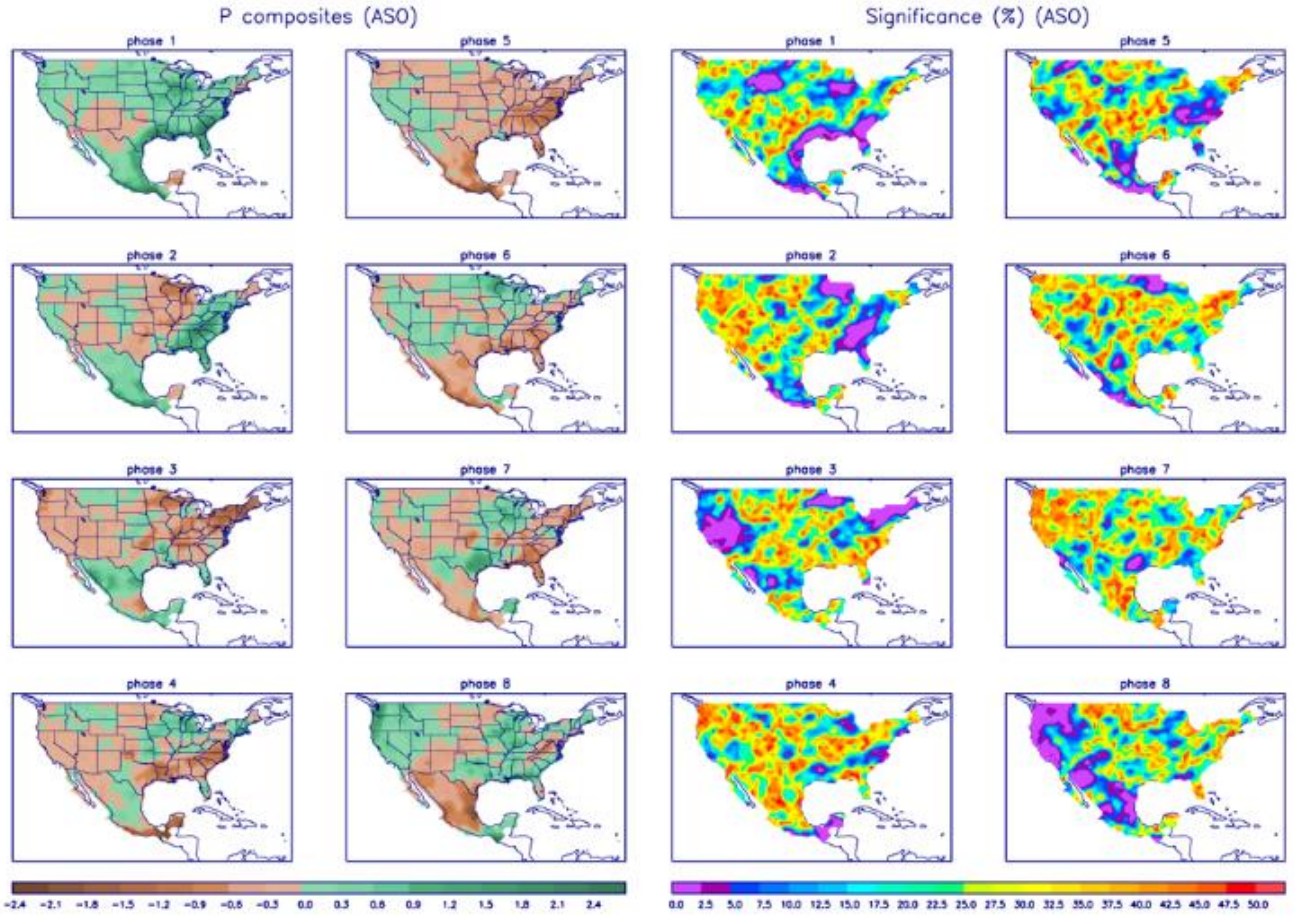


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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.



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