

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



Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
6 September 2021

Overview

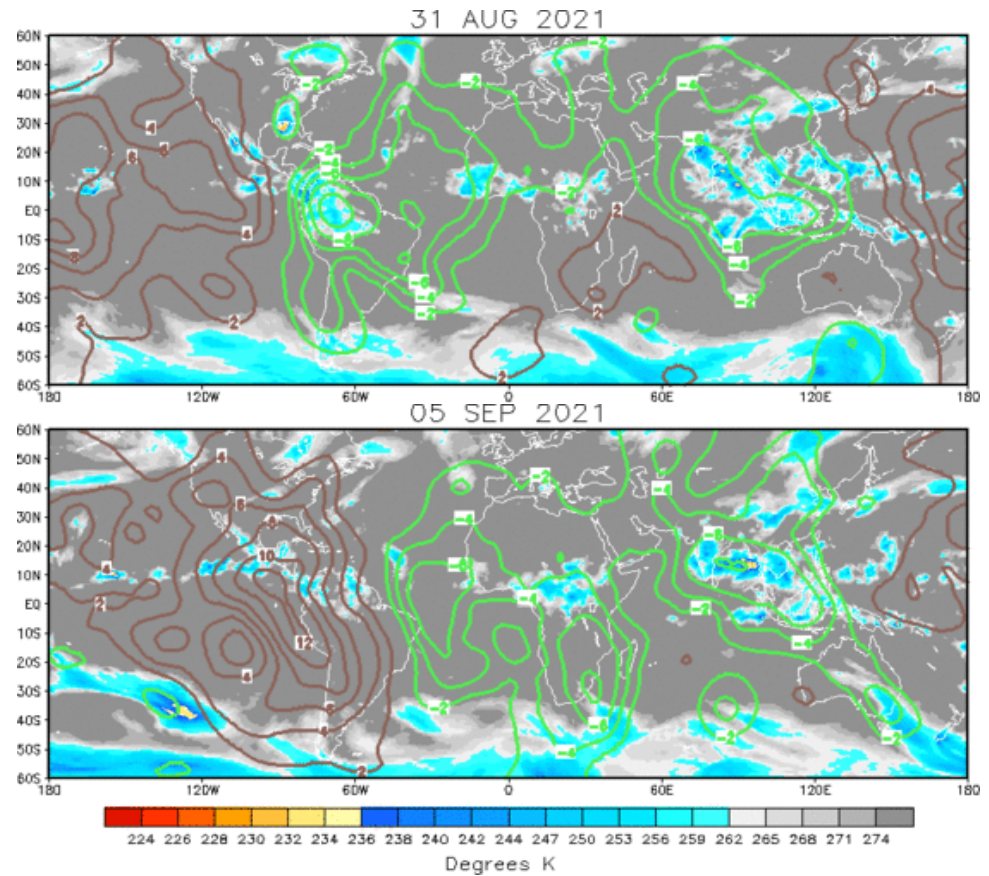
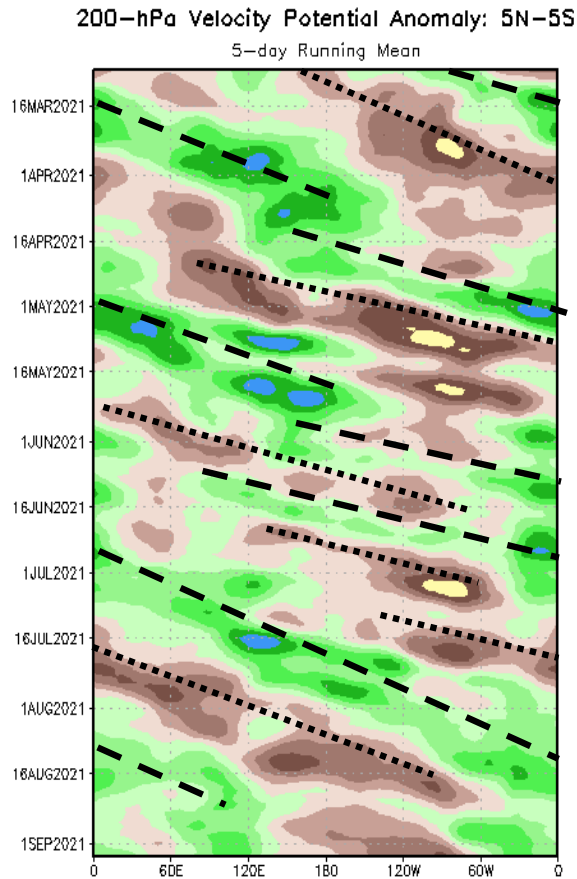
- The RMM index depicts a weak MJO over the Maritime Continent. The spatial fields of associated anomalies are showing more coherence and less interference into the MJO space.
- There are indications in some of the dynamical models favoring renewed eastward propagation of the intraseasonal signal. However, overall model disparities in the predicted strength of the MJO, lead to increased uncertainty in the MJO outlook during the next two weeks. The potential emergence of a more stationary, seasonal type pattern is evident in some fields as well.
- With respect to tropical cyclones, there are some signals for an active period in the West Pacific and a relatively quiet period for the Atlantic 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).

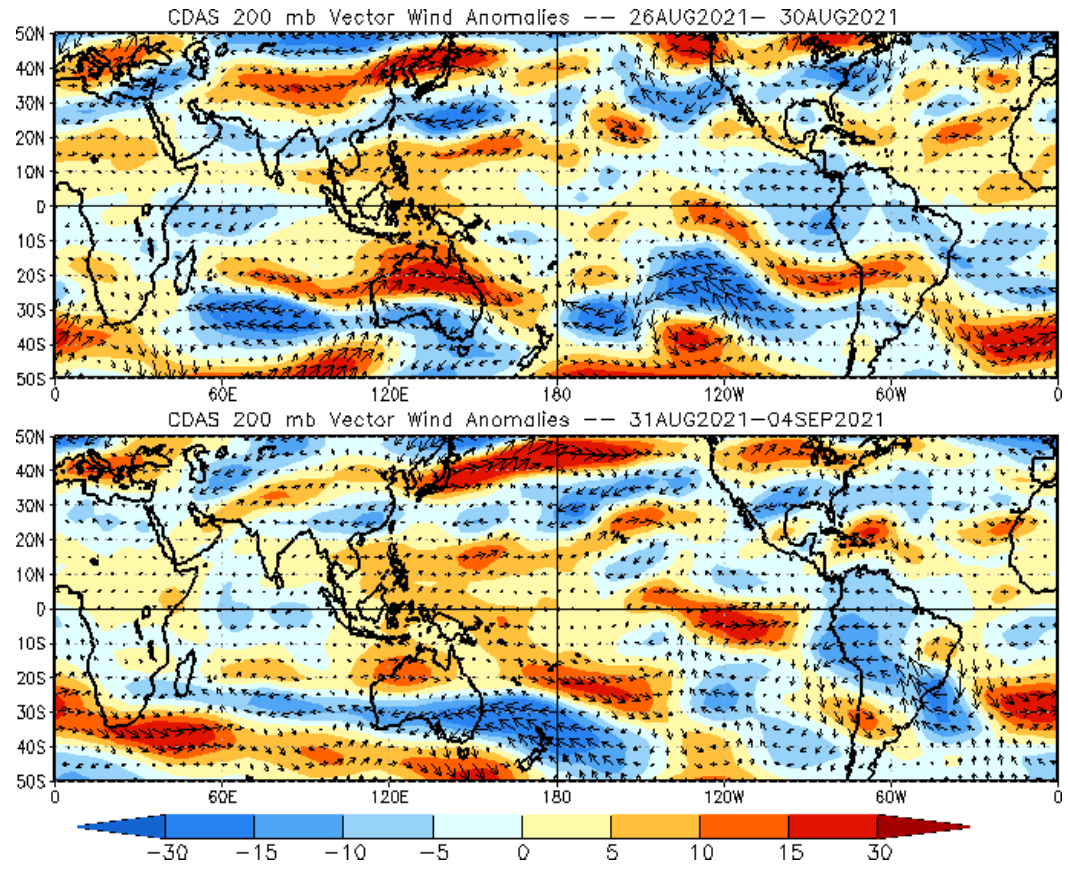
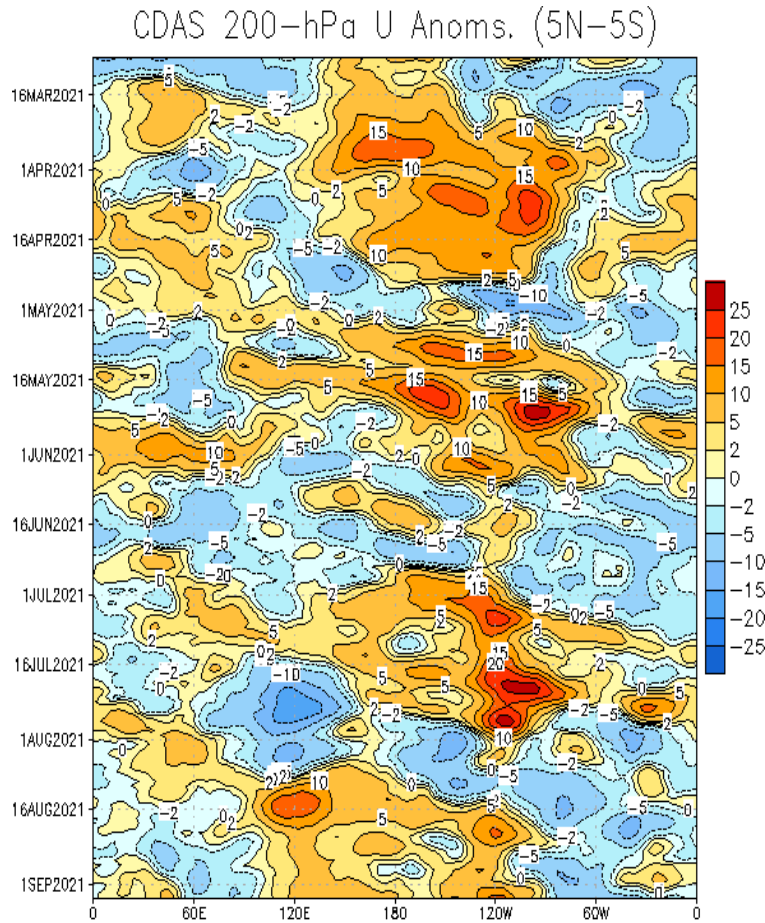
Brown shades: Anomalous convergence (unfavorable for precipitation).



- From mid-August to early September, the MJO signal and a strong Kelvin Wave (KW) are evident. Monsoonal structures also become more evident in the 5N-5S band during the transition seasons.
- The active phase of the MJO is over the Maritime Continent, with a KW and the West African Monsoon aligning over the Atlantic/Africa.
- There is a bit of persistence in the pattern over the central Pacific as well.

200-hPa Wind Anomalies

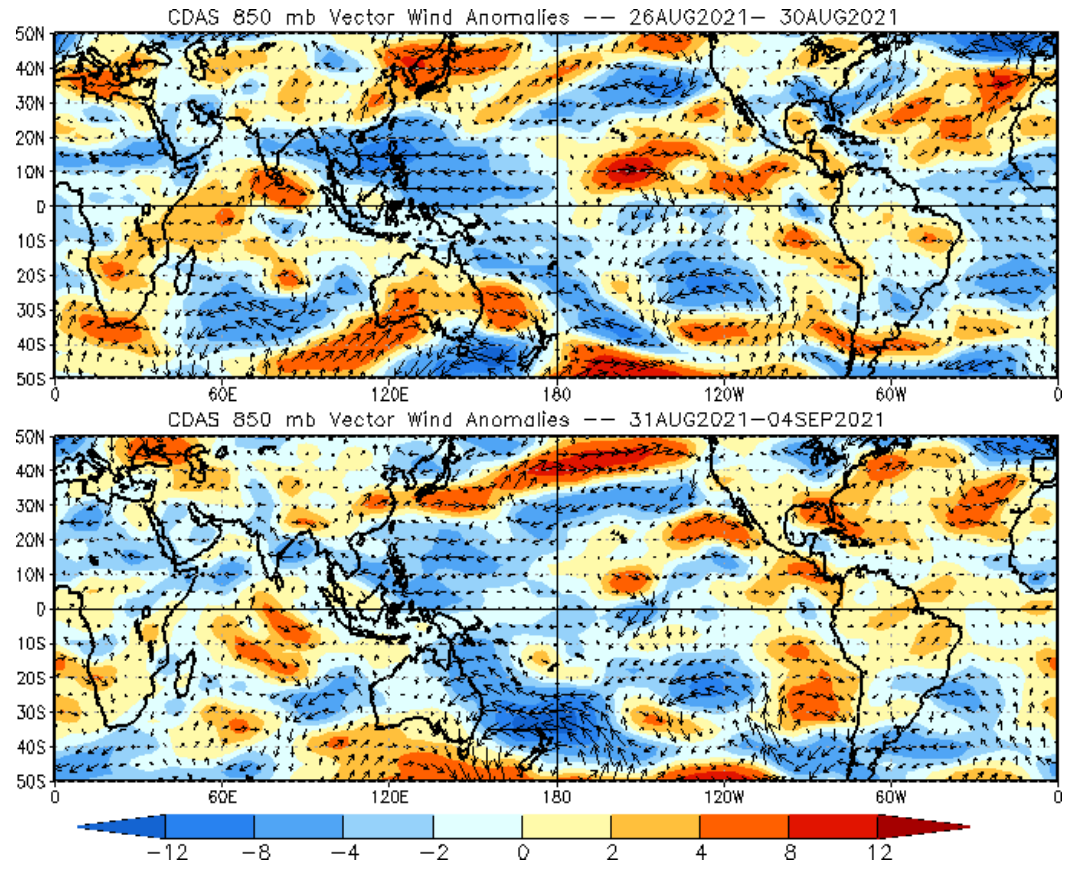
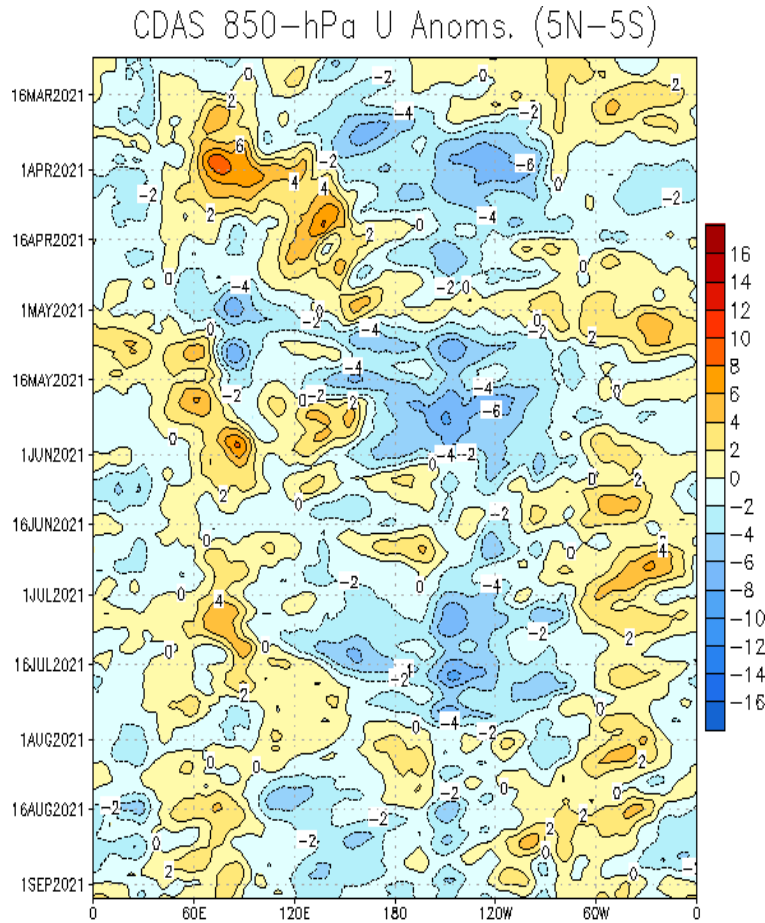
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Anomalous easterlies are almost wrapped eastward from the Americas to the Indian Ocean, but disrupted by the West African Monsoon, with anomalies westerlies from the Maritime Continent to the East Pacific.
- The anomalous easterlies have moved eastward over the Indian Ocean a bit, while the westerly anomalies expanded over the central Pacific.

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 and spread into the Central Pacific, while westerly anomalies developed over the Atlantic and Indian Ocean.

Outgoing Longwave Radiation (OLR) Anomalies

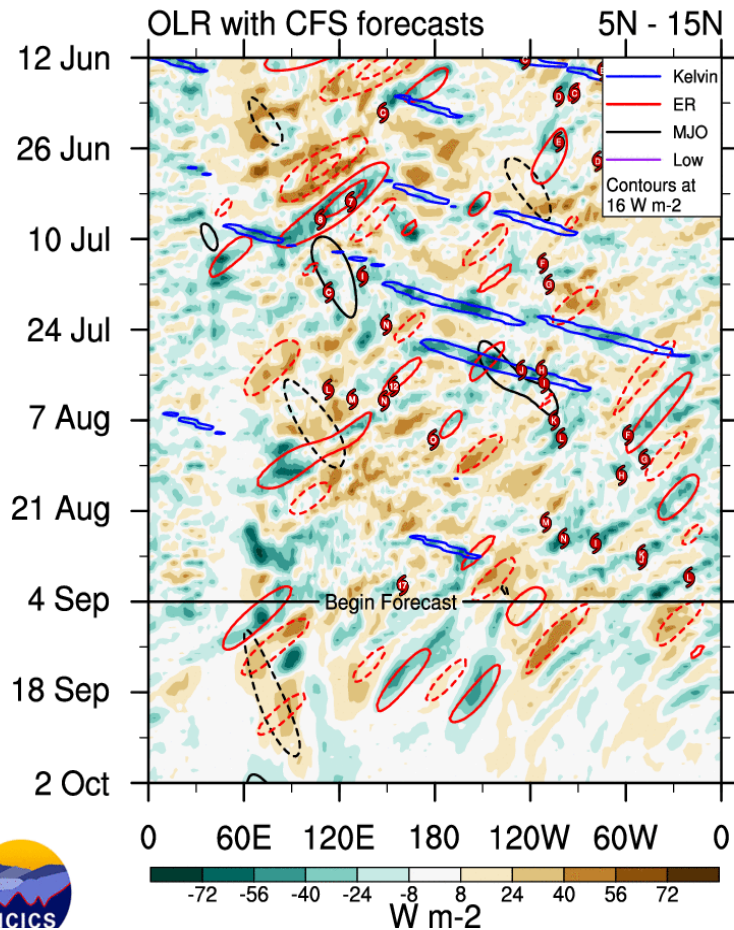
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)

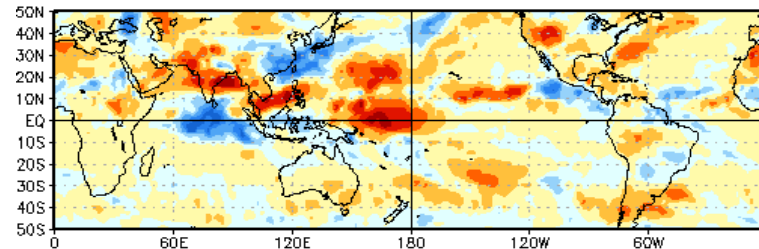
Blue shades: Anomalous convection (wetness)

Red shades: Anomalous subsidence (dryness)

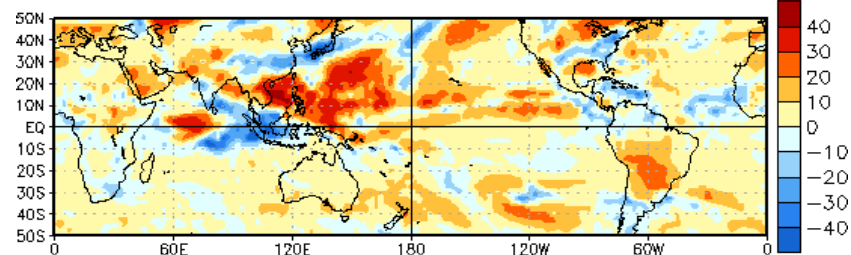
OLR Anomalies



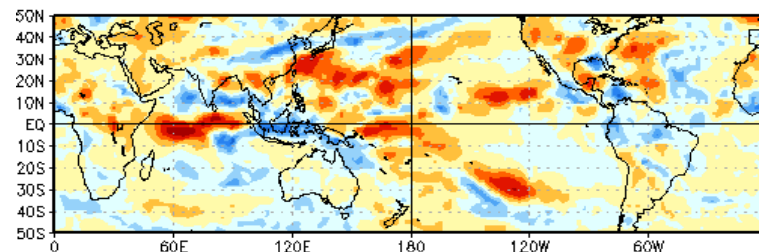
4 AUG 2021 to 13 AUG 2021



14 AUG 2021 to 23 AUG 2021

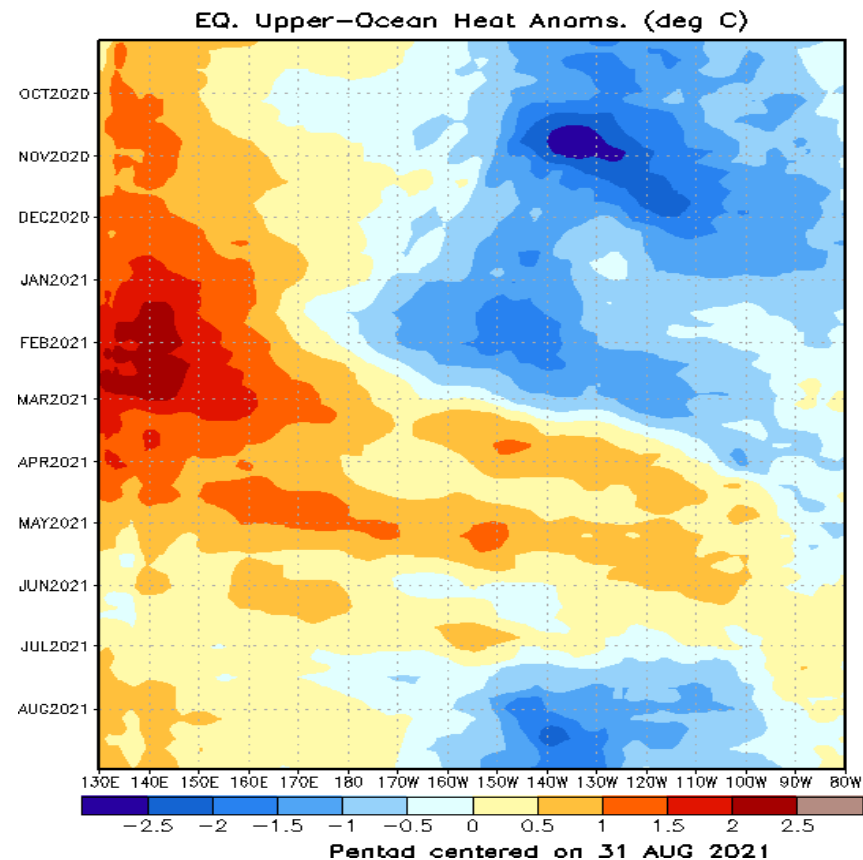
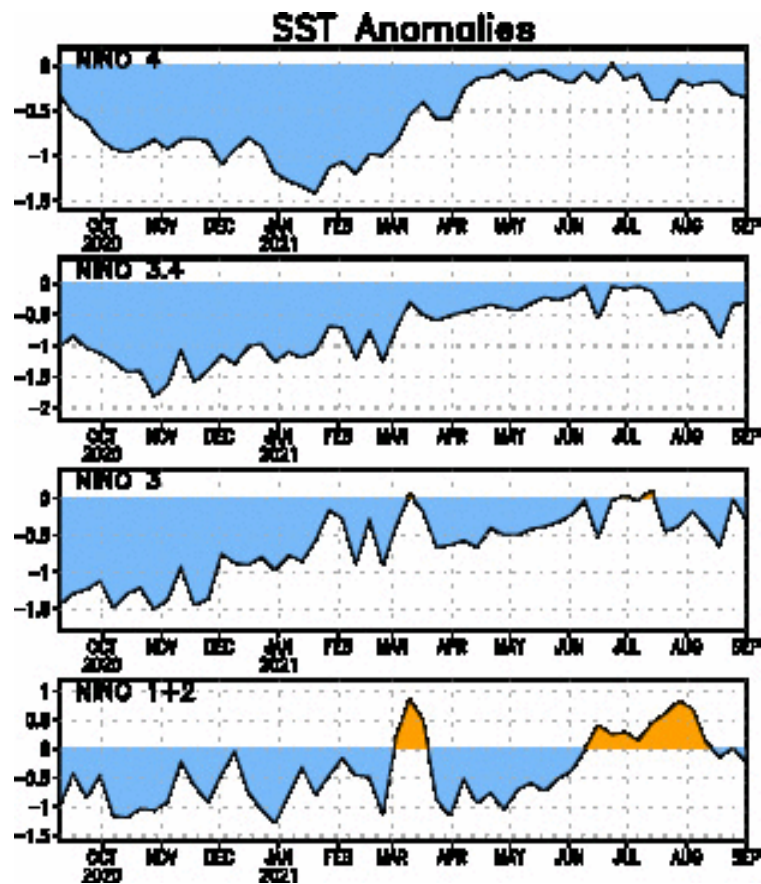


24 AUG 2021 to 2 SEP 2021



- Enhanced convection spread over more of the Maritime Continent, with suppressed convection strengthening near the Date Line. Evidence of the Asian Monsoon and intraseasonal oscillation are evident.
- Over the East Pacific and Western Atlantic, convection associated with tropical cyclone activity is evident.

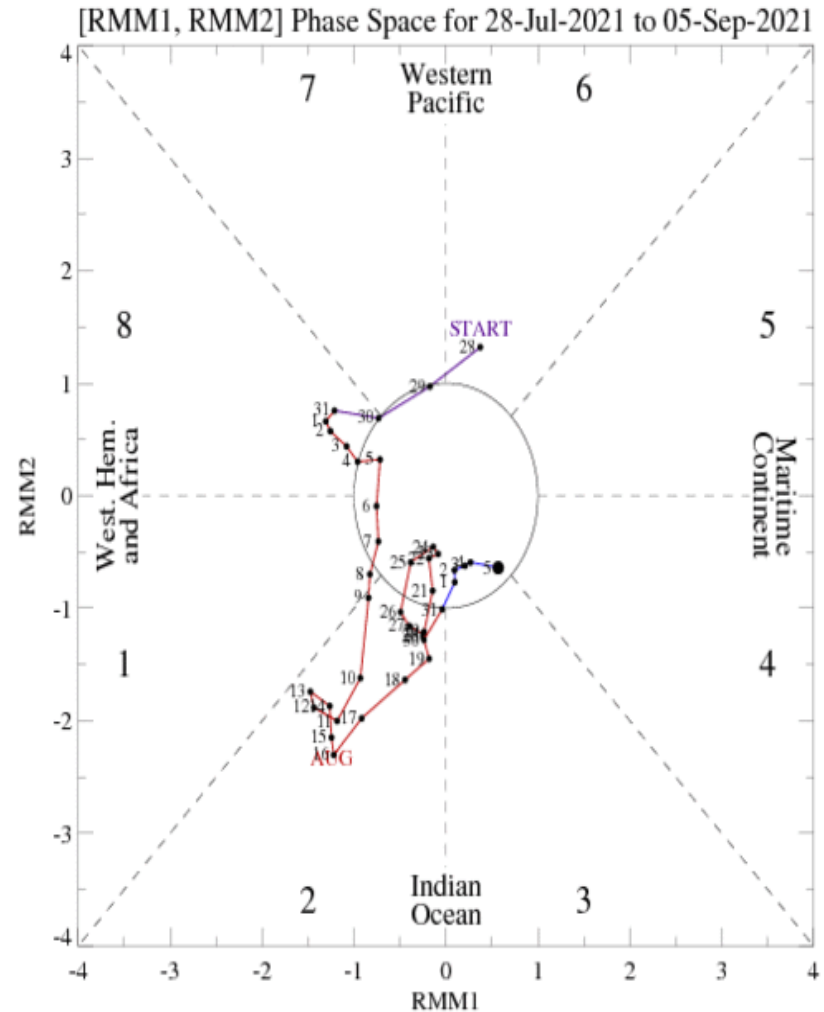
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- 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 Niño regions.

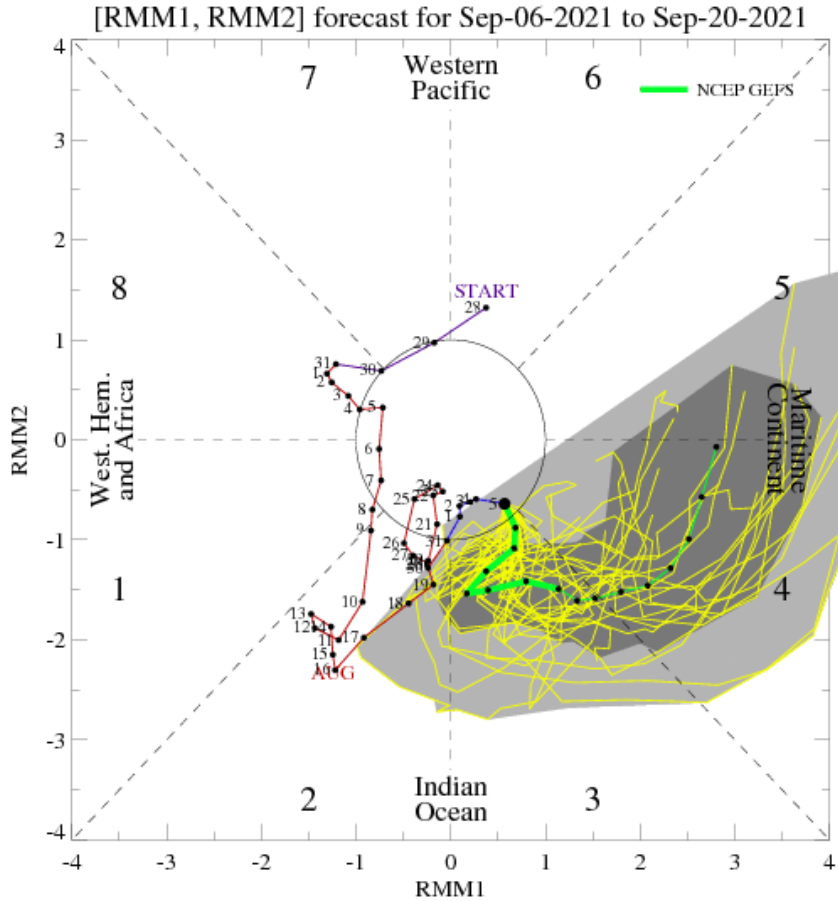
MJO Index: Recent Evolution

- The RMM index indicates the MJO has moved to the Maritime Continent (phase 3) during early September.
- The intraseasonal signal remains weak but could strengthen as KW and MJO interactions become less destructive.

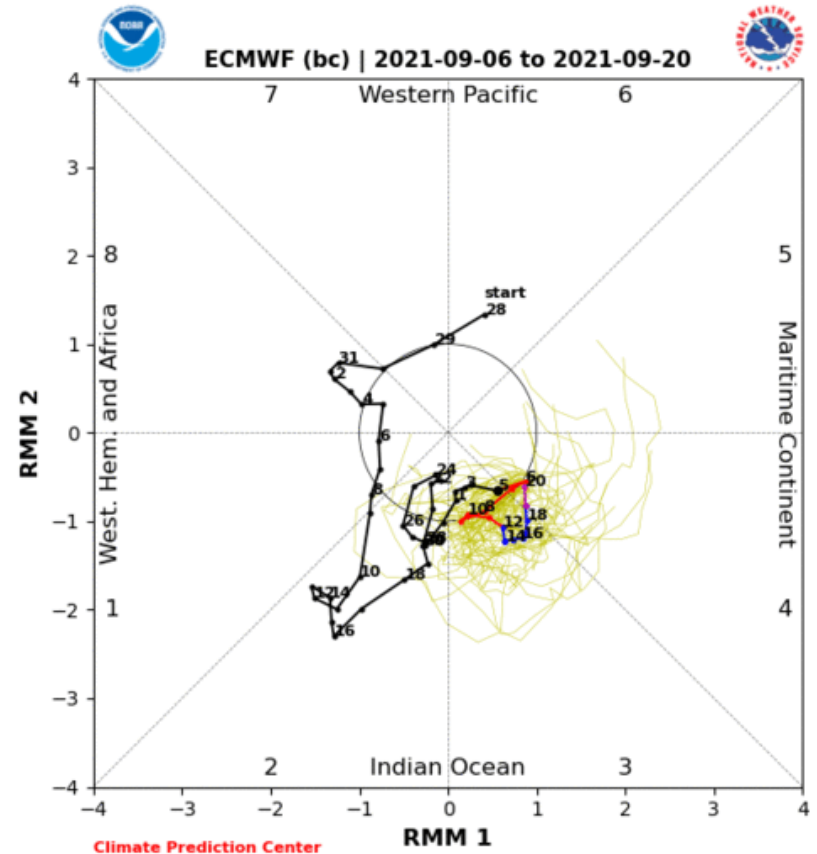


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



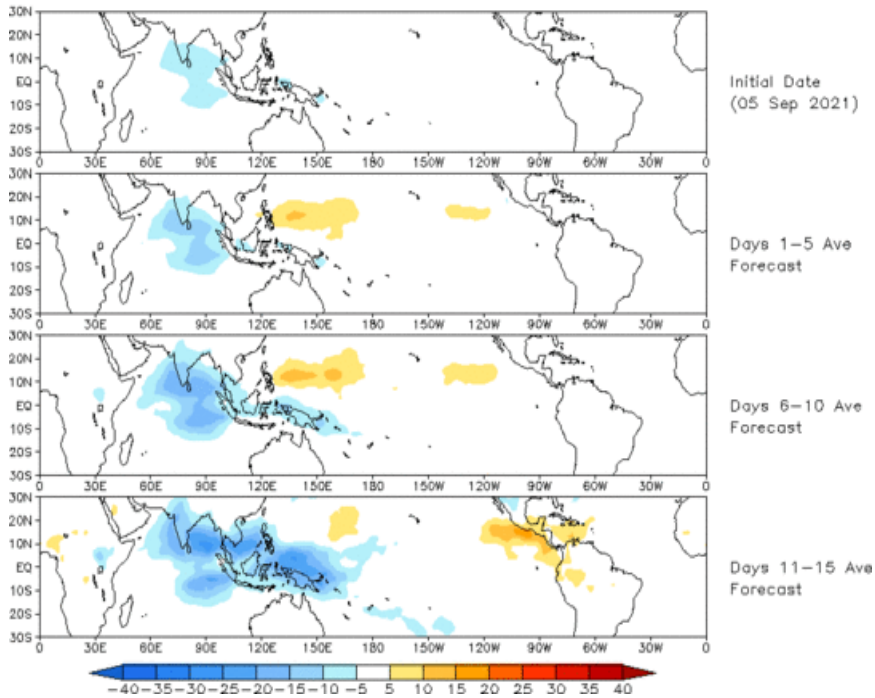
ECMWF Forecast

- The GEFS is the most bullish in a signal strengthening over the Maritime Continent.
- The ECMWF, ECCO, and JMA models are supportive of the spatial pattern but show weaker signals. The GEFS is a bit of an outlier at this time.

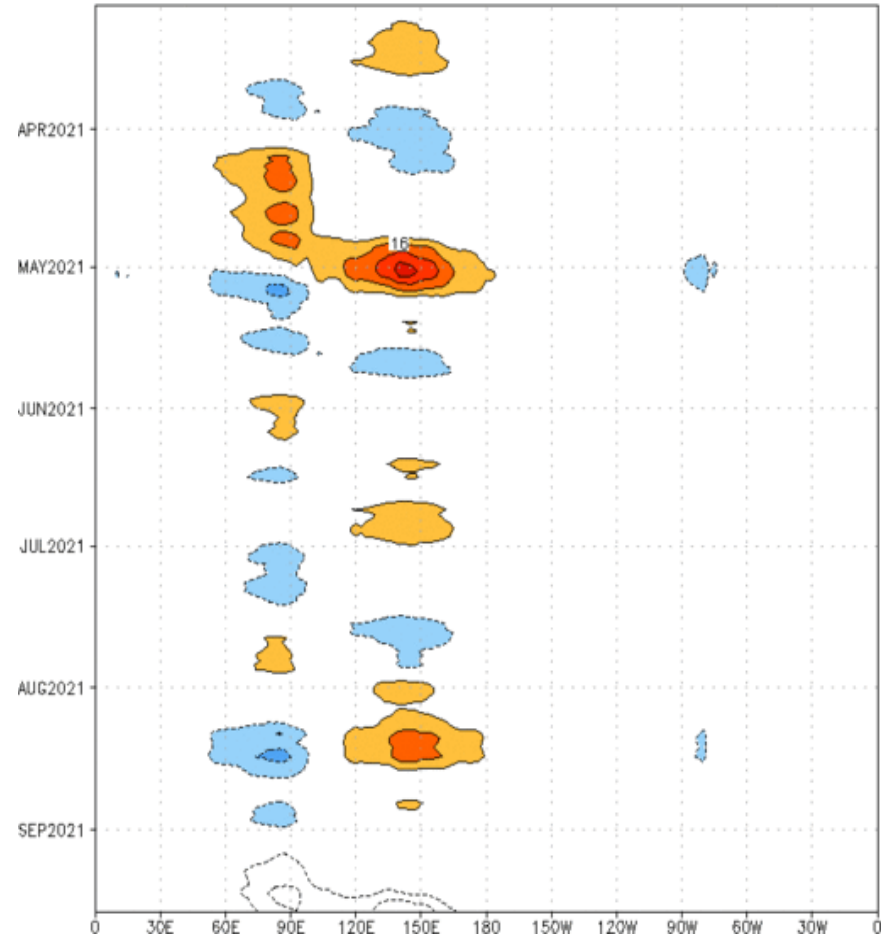
MJO: GEFS Forecast Evolution

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.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 05 Sep 2021
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:05-Mar-2021 to 04-Sep-2021
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

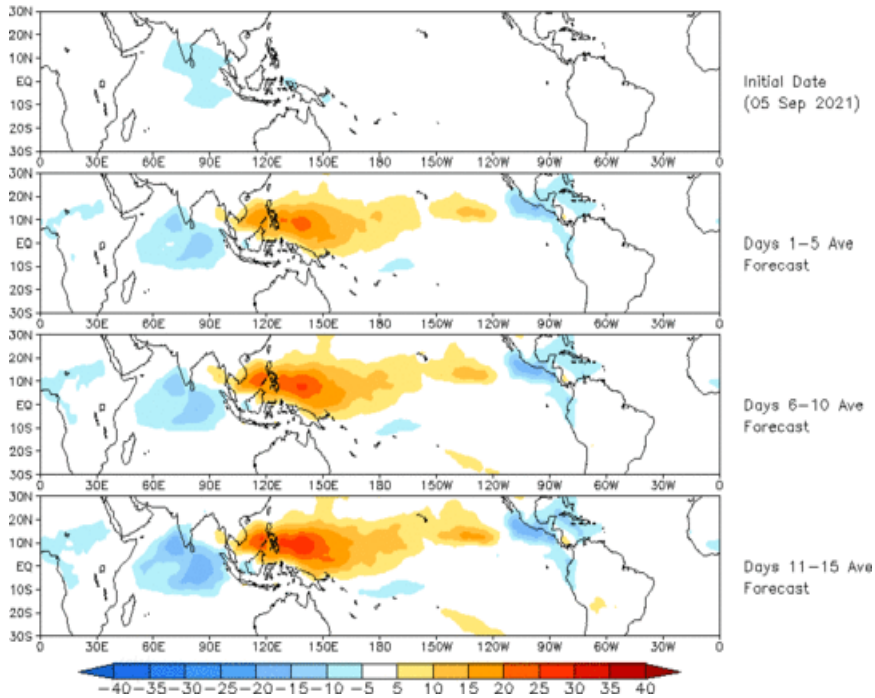


- The GEFS RMM-based OLR anomaly forecast features a strengthening signal and a progressive pattern. The strongest positive anomalies are slightly off equator, over Central America and the East Pacific, so the time-longitude plot doesn't show them.

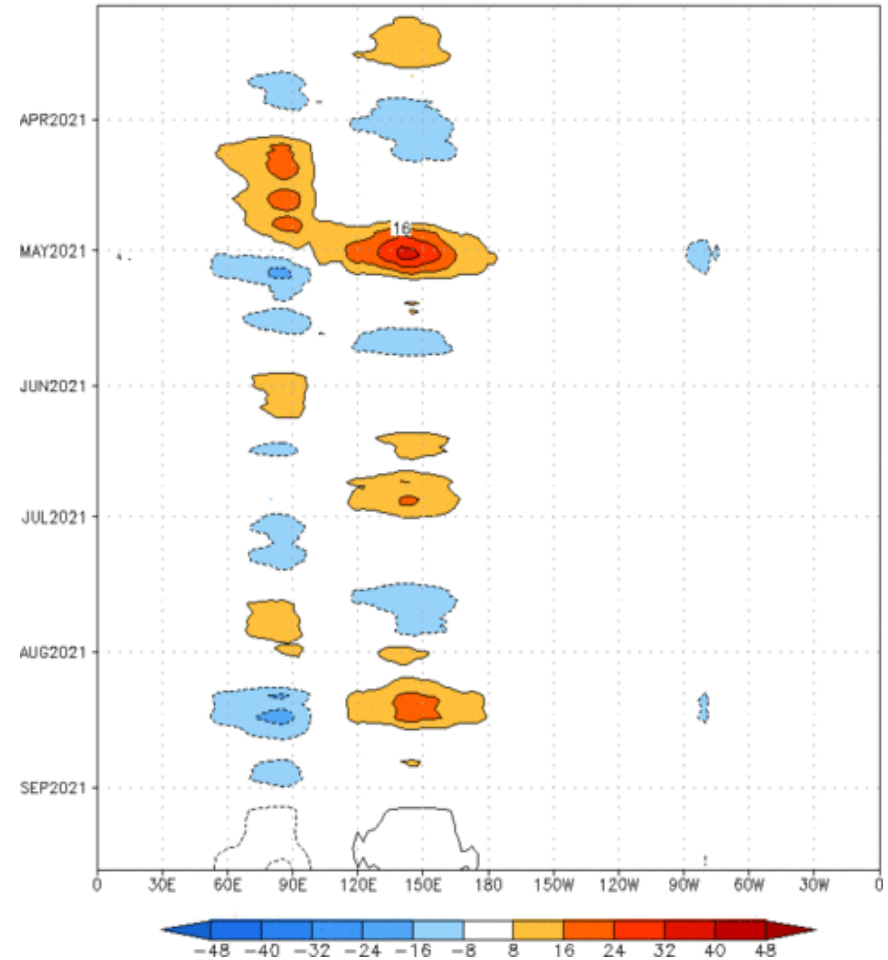
MJO: Constructed Analog Forecast Evolution

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.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (05 Sep 2021)



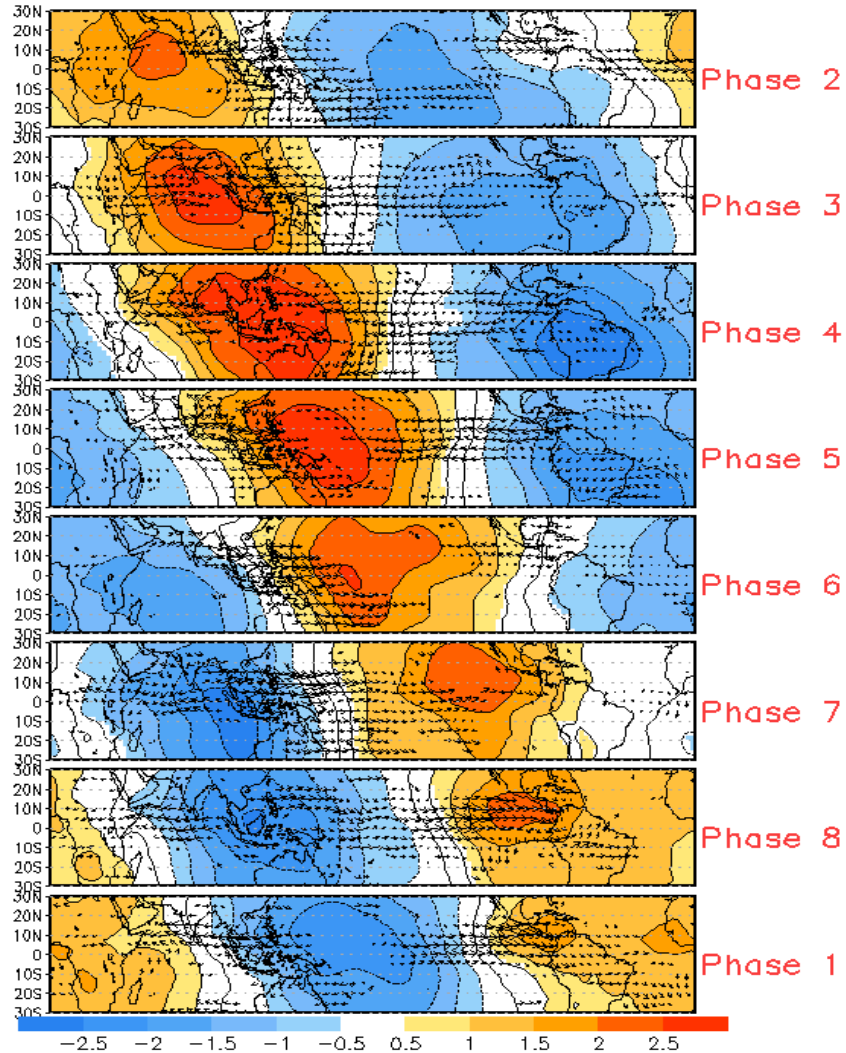
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:06-Mar-2021 to 05-Sep-2021
The unfilled contours are CA forecast reconstructed anomaly for 15 days



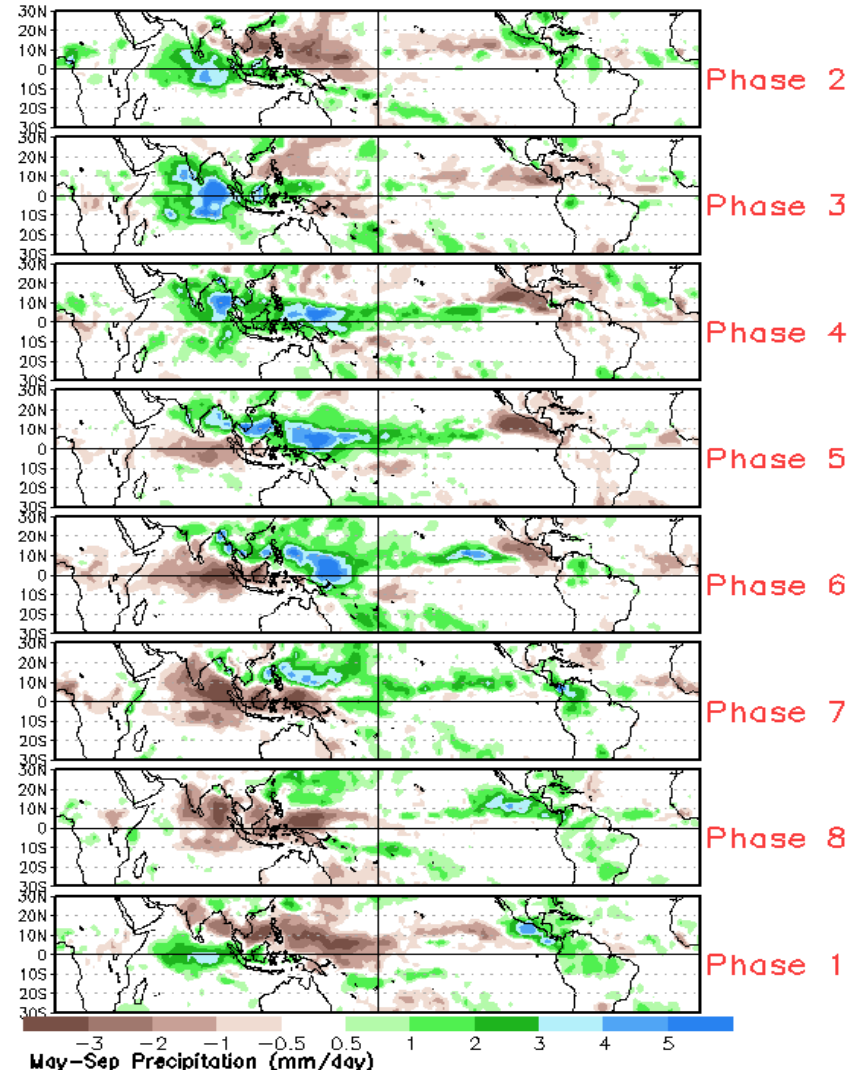
- The constructed analog forecast depicts a more stationary signal convective pattern, similar to the ECMWF and CFS, but strengthens with time.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



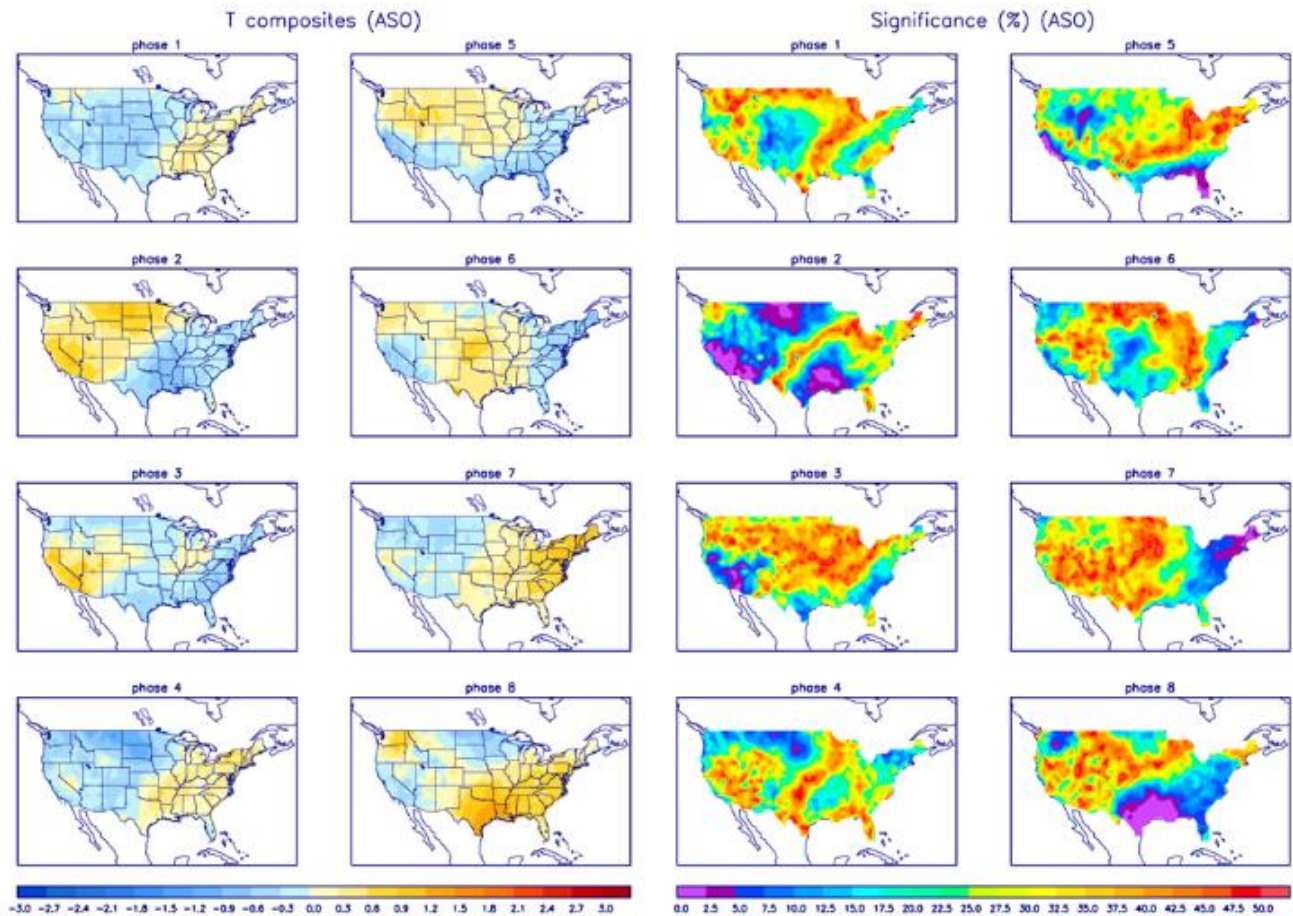
Precipitation Anomalies



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.



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.

