

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
19 July 2021

Overview

- During the last week, the MJO became better organized as the enhanced phase propagated eastward from the Indian Ocean to the Maritime Continent.
- There is consensus in the dynamical models favoring continued eastward propagation of the intraseasonal signal at a higher amplitude through the Maritime Continent and to the West Pacific, with increasing uncertainty as to the strength and position of the MJO by early August.
- The enhanced phase of the MJO is likely to contribute to additional tropical cyclone (TC) development across the West Pacific, with increasing chances for TC formation in the eastern Pacific as the large scale environment is expected to become more favorable.
- Suppressed TC activity remains anticipated for the tropical Atlantic, particularly throughout the Main Development Region, where climatologically, TC formation becomes increasingly favored by this time of the year.

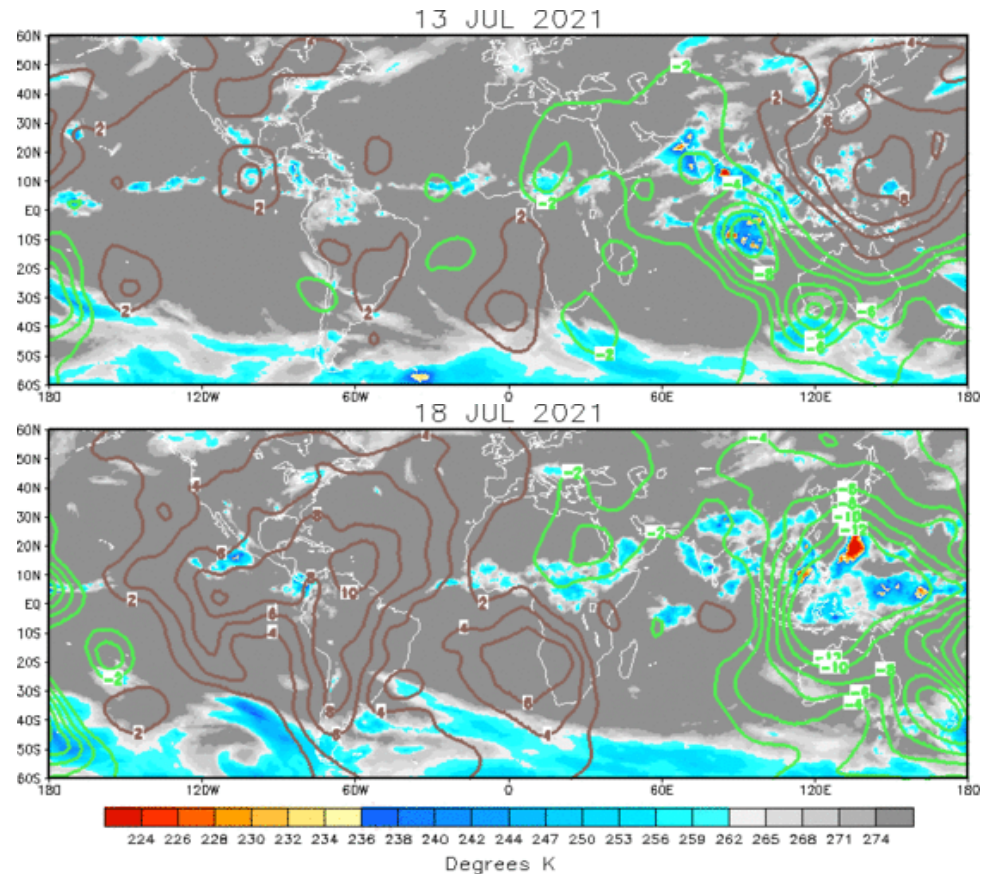
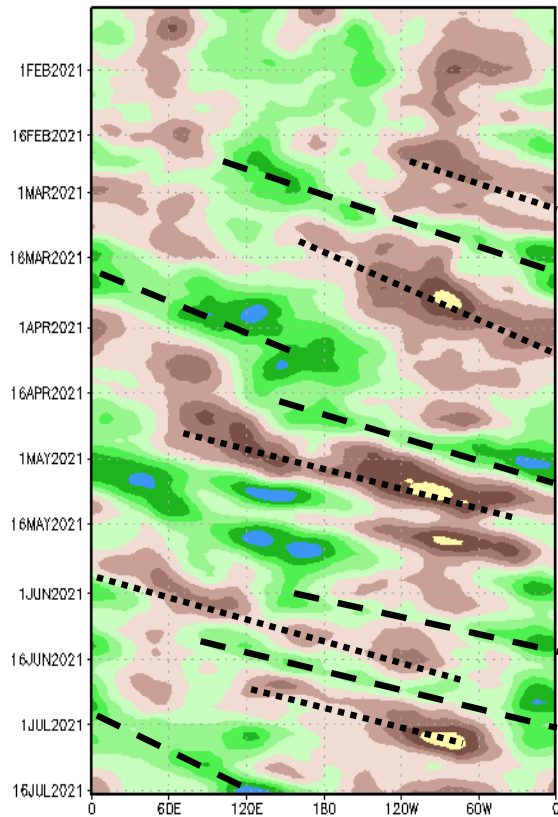
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

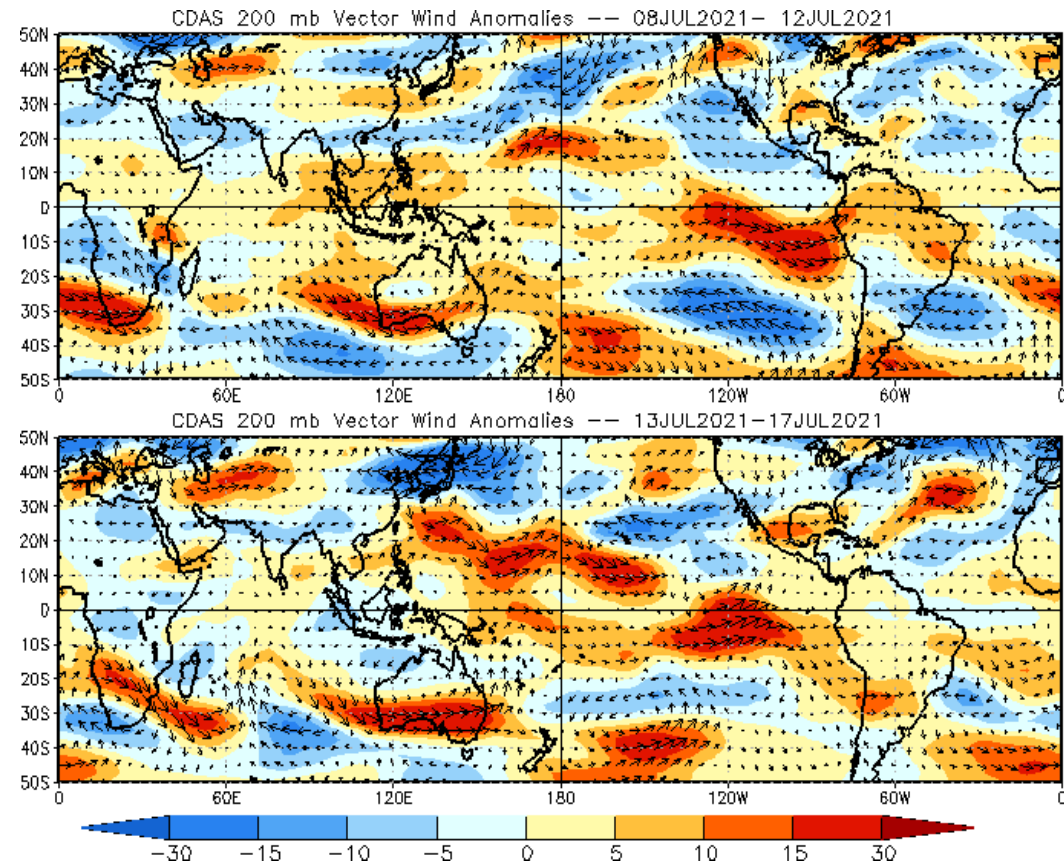
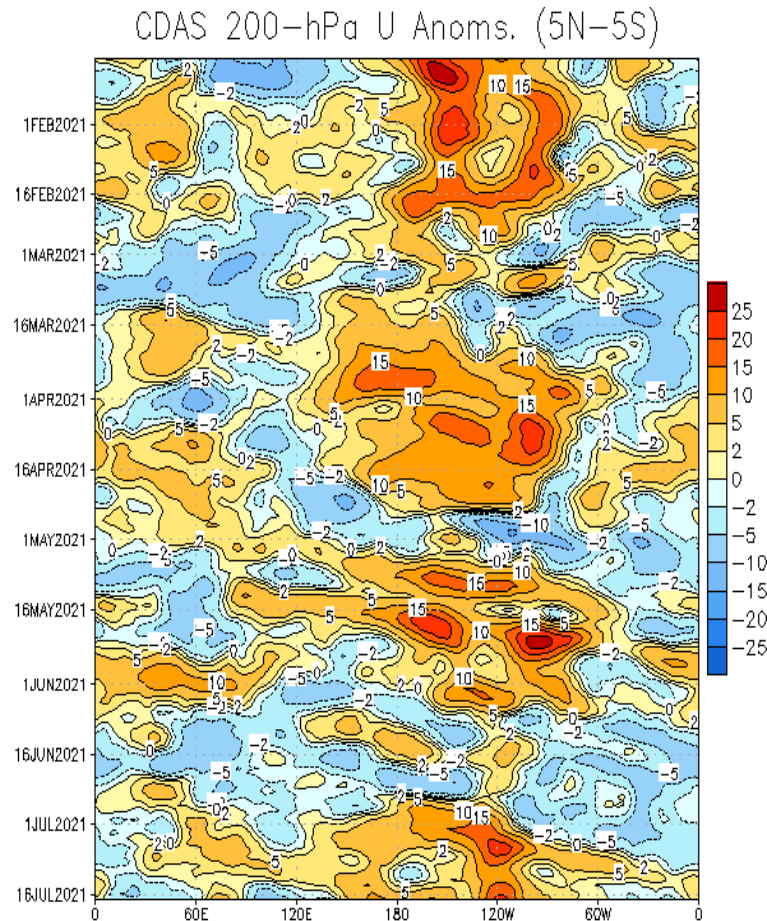
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- The enhanced convective envelope has resumed propagating eastward from the Indian Ocean to the Maritime Continent following interference with Rossby wave activity during early July.
- There is a better defined Wave-1 pattern, with suppressed conditions strengthening over the Western Hemisphere since last week.

200-hPa Wind Anomalies

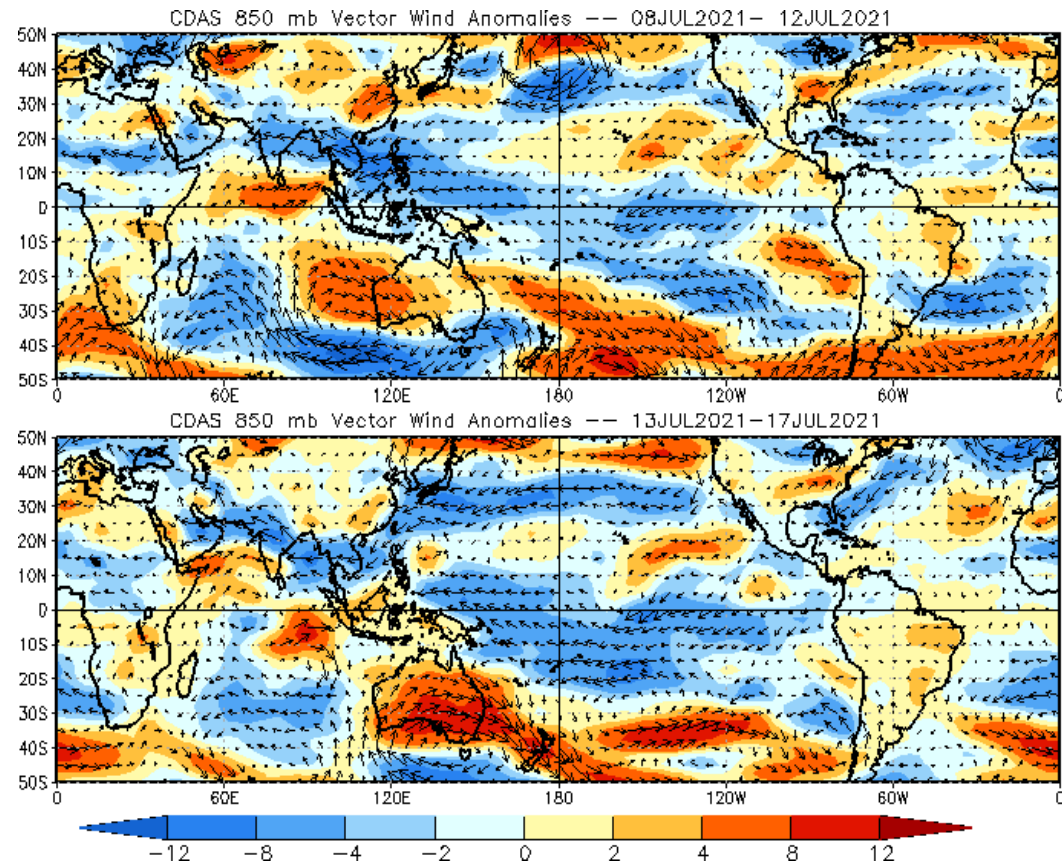
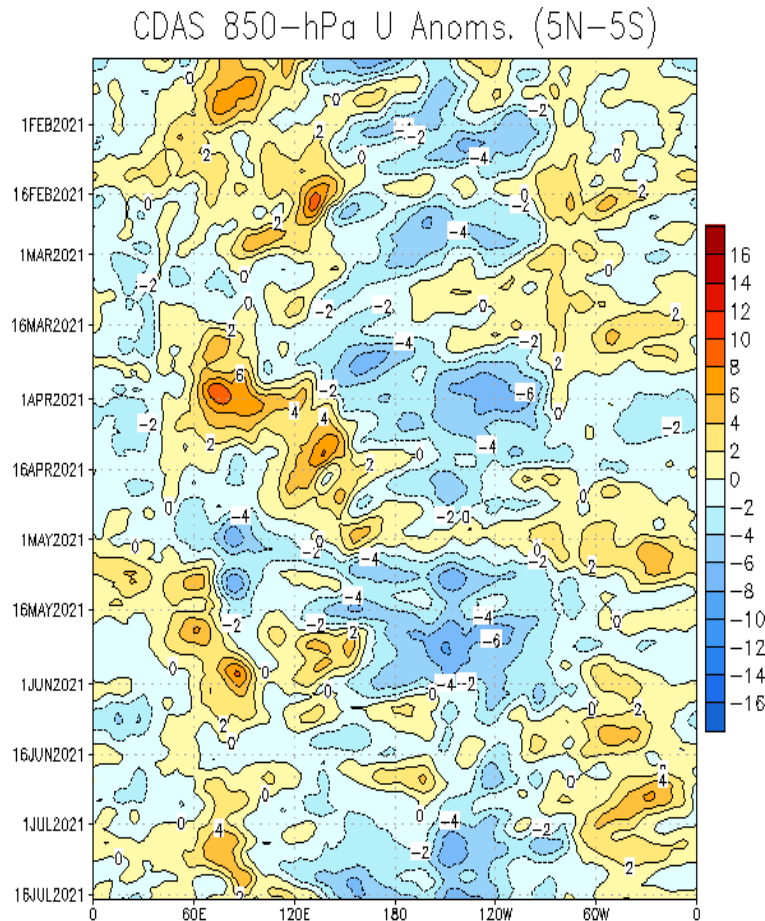
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- The upper-level wind pattern appears more coherent with recent emergence of easterlies aloft to the west of 120°E, and strengthening westerlies aloft across the West Pacific.
- East of the Date Line, anomalous westerlies persist along the equator near 120°W, consistent with the low frequency footprint observed since earlier this year.

850-hPa Wind Anomalies

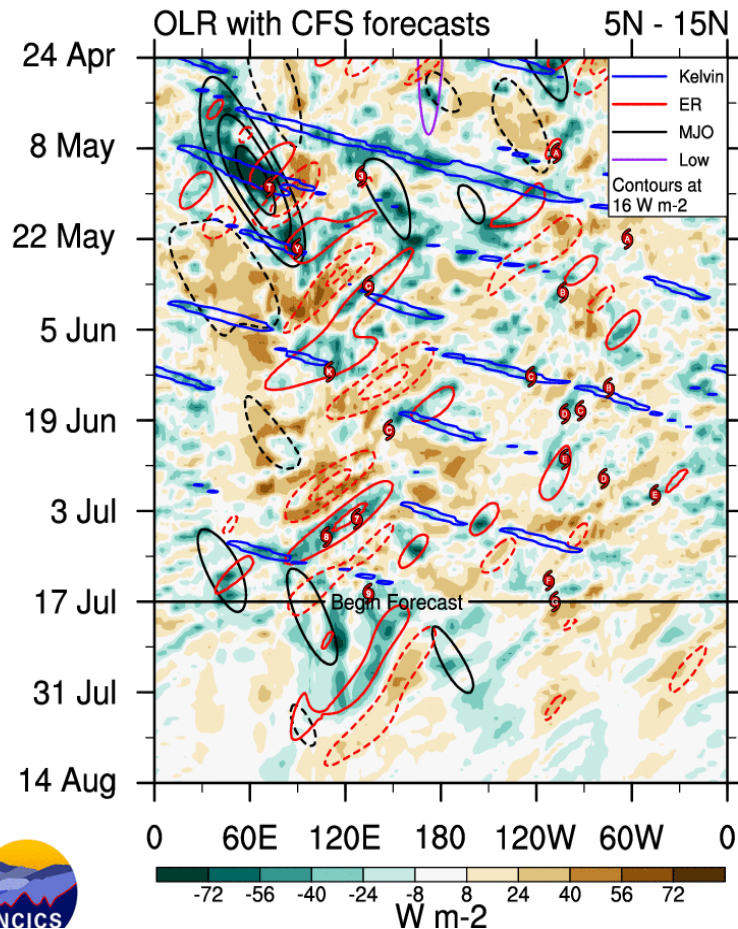
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



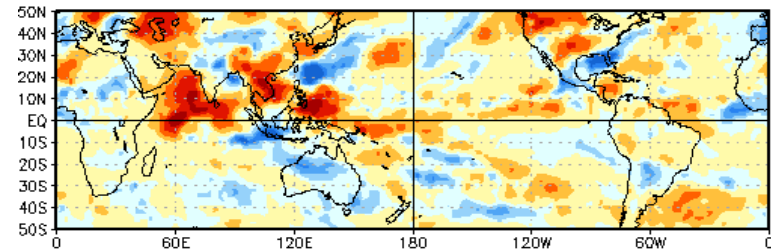
- Consistent with the upper-level velocity potential pattern, anomalous westerlies have shifted eastward from the Indian Ocean to the Maritime Continent during the last week.
- Enhanced trades persist across much of the equatorial Pacific with some strengthening near the Date Line.

Outgoing Longwave Radiation (OLR) Anomalies

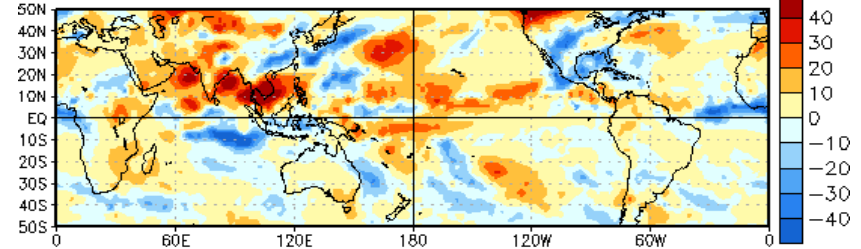
Blue shades: Anomalous convection (wetness). **Red shades:** Anomalous subsidence (dryness).



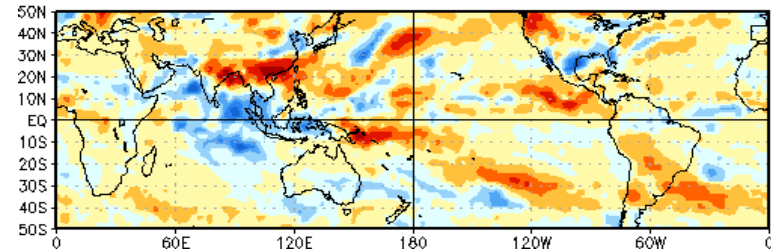
OLR Anomalies
15 JUN 2021 to 24 JUN 2021



25 JUN 2021 to 4 JUL 2021

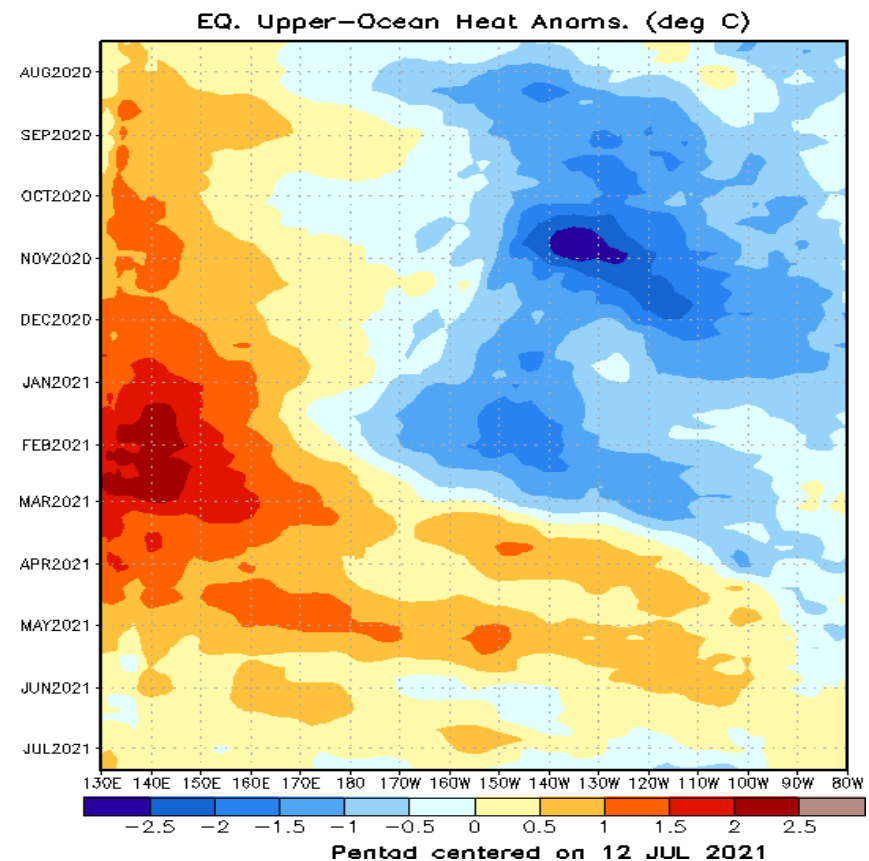
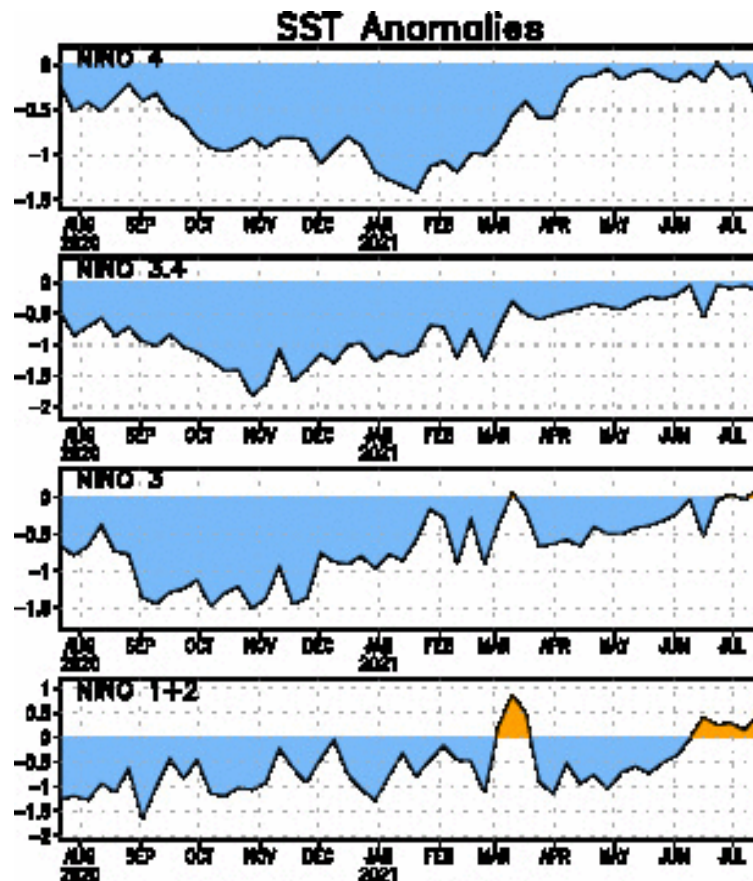


5 JUL 2021 to 14 JUL 2021



- During the last ten days, enhanced convection has returned throughout the northern Indian Ocean, while expanding eastward over the equatorial Maritime Continent.
- Suppressed convection is observed across the East Pacific, and to a lesser extent, throughout the Atlantic tied to the suppressed phase of the MJO. Conversely, enhanced convection continues across Mexico and the southwestern CONUS indicative of an active monsoon circulation.

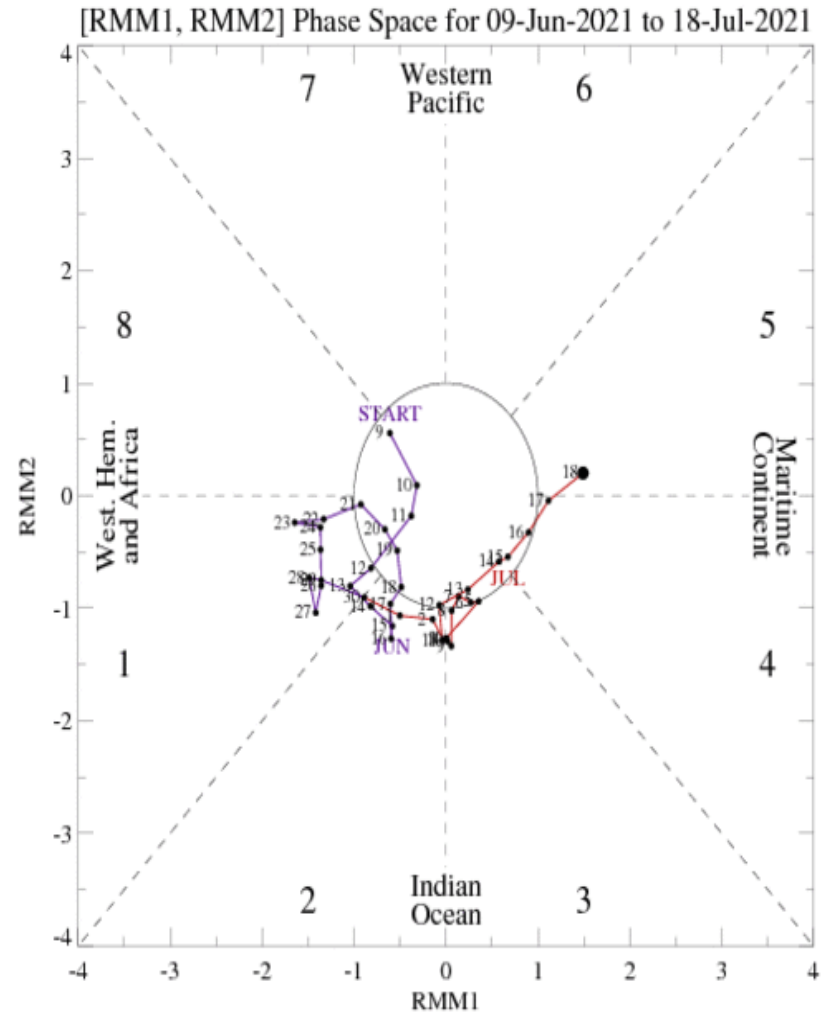
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Multiple episodes of oceanic Kelvin wave activity strengthened upper-ocean heat content during this past spring, however these positive anomalies have been weakening over the central and eastern Pacific, with negative anomalies emerging near 110W more recently.
- Niño indices continue to remain near average with the exception of Niño 1+2.

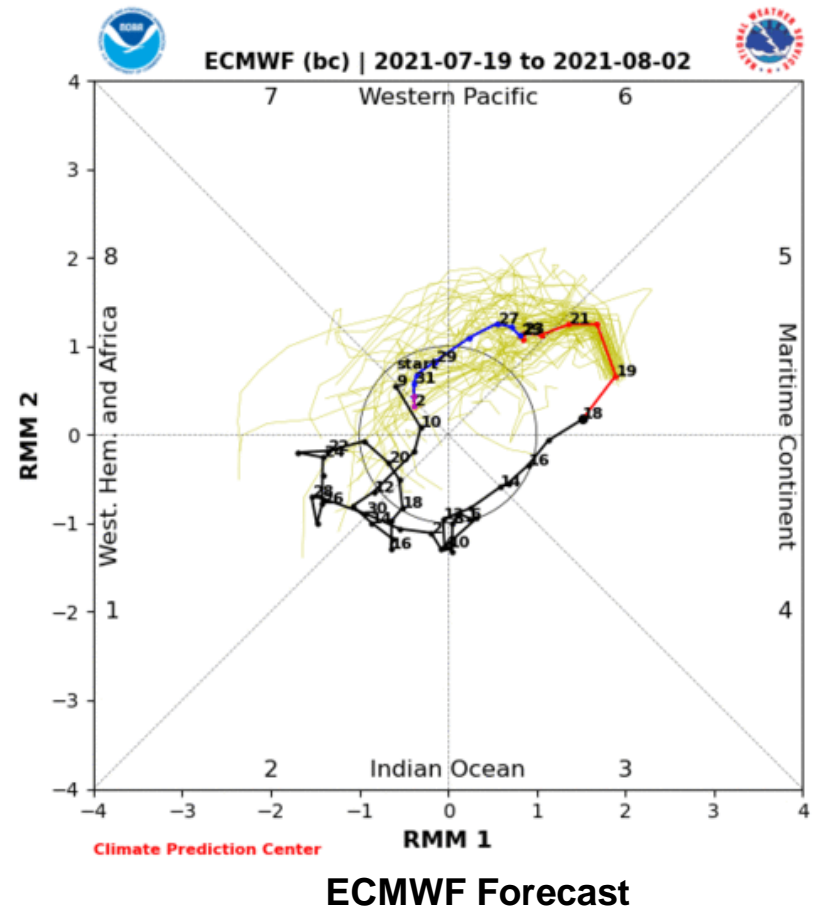
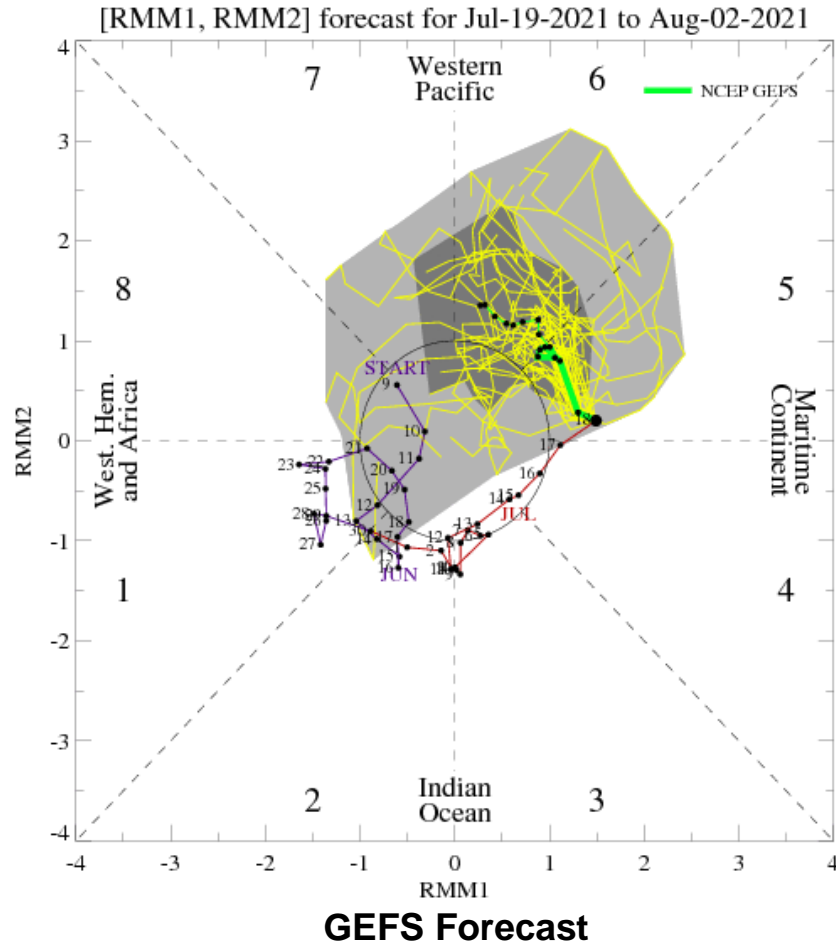
MJO Index: Recent Evolution

- The RMM index indicates the intraseasonal signal has shifted eastward over the Maritime Continent during the last week (phase 5).



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

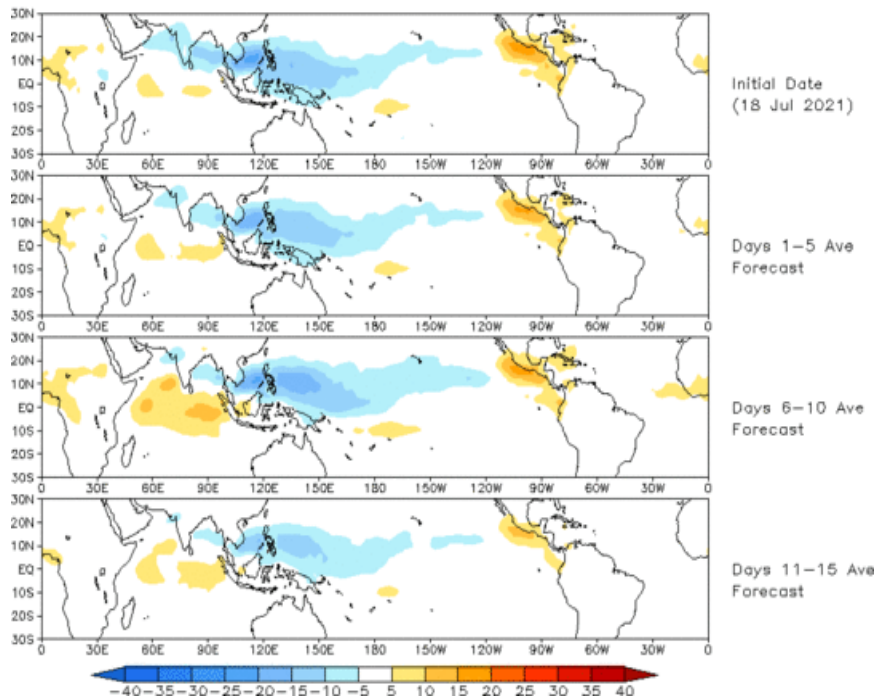


- Both the GEFS and ECMWF favor eastward propagation of the MJO at a higher amplitude across the Maritime Continent and West Pacific during week-1.
- By week-2, RMM mean solutions diverge among the models, where the GEFS features stronger and slower signal over the West Pacific while the ECMWF favors a faster weakening event.

MJO: GEFS Forecast Evolution

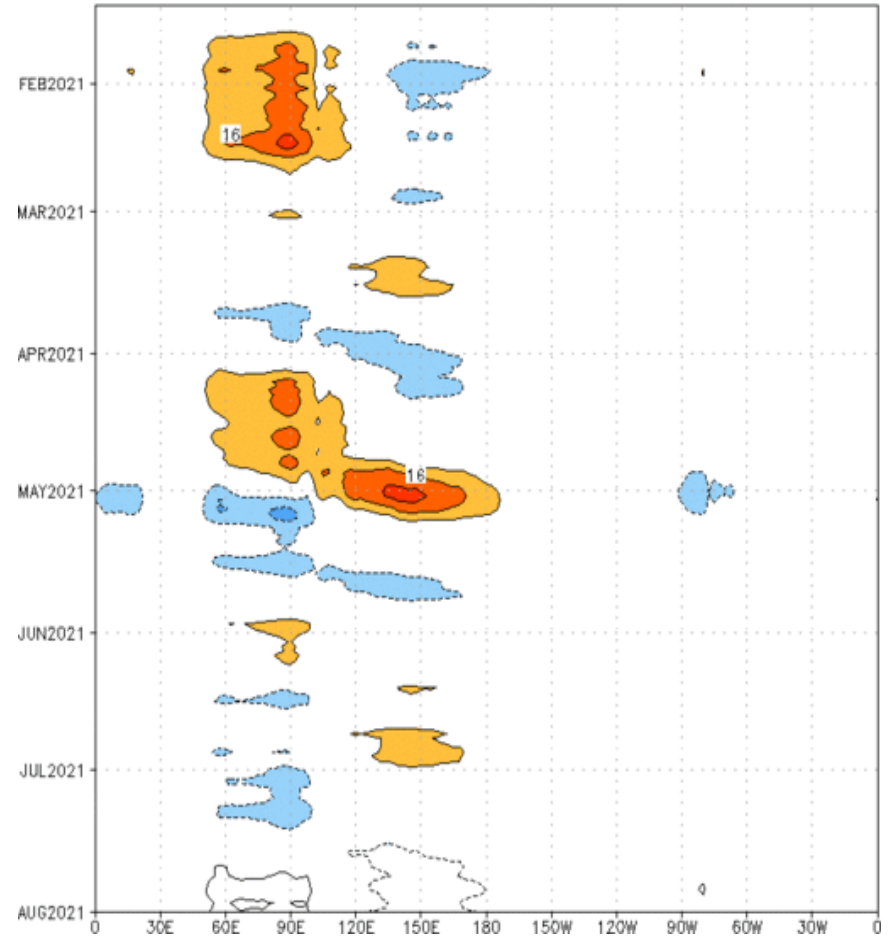
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 18 Jul 2021
OLR



- The GEFS RMM-based OLR anomaly forecast features a quasi-stationary convective pattern, with enhanced (suppressed) convection over the West Pacific (East Pacific and western Indian Ocean), through the next two weeks.

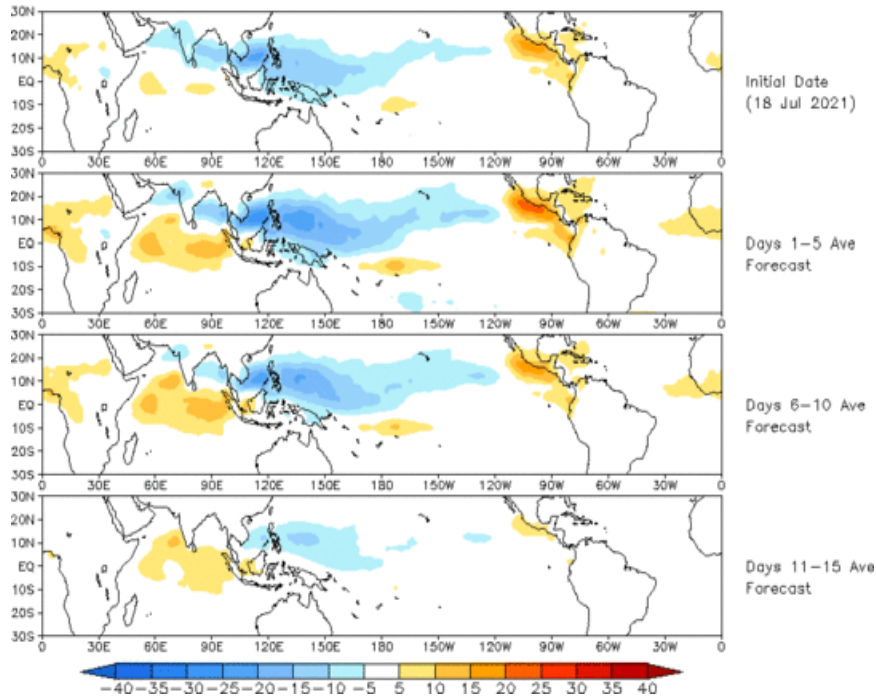
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cint:4Wm^{-2}) Period:15-Jan-2021 to 17-Jul-2021
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



MJO: Constructed Analog Forecast Evolution

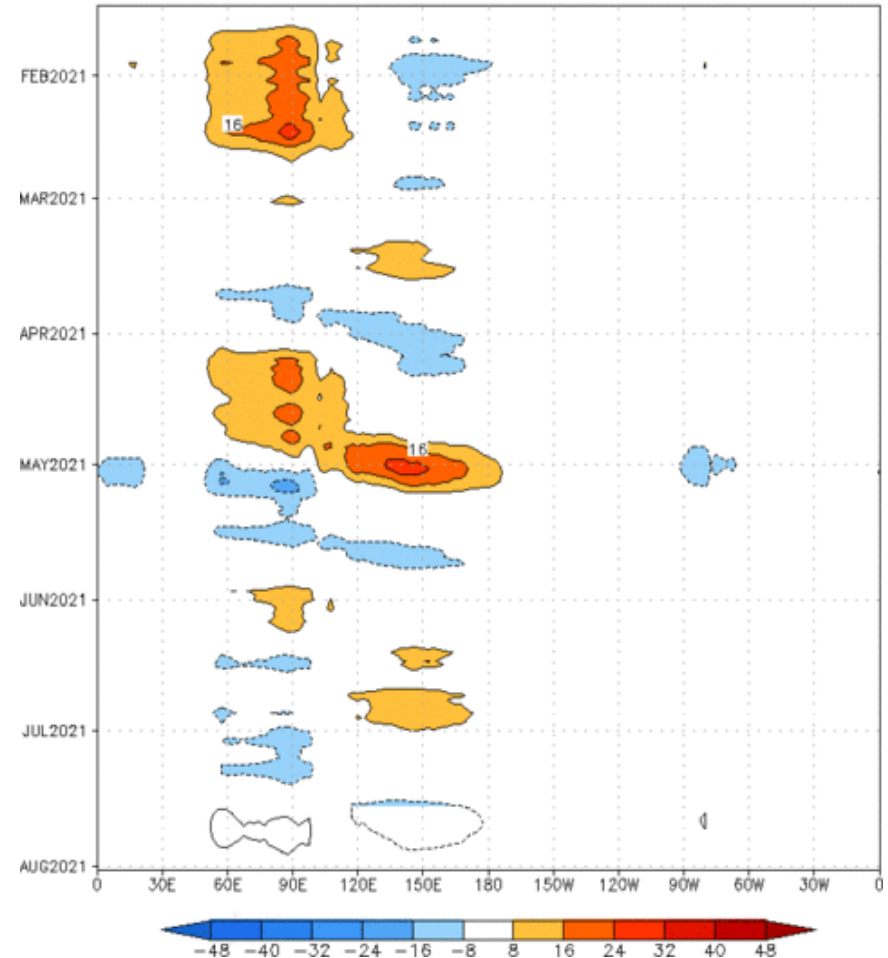
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (18 Jul 2021)



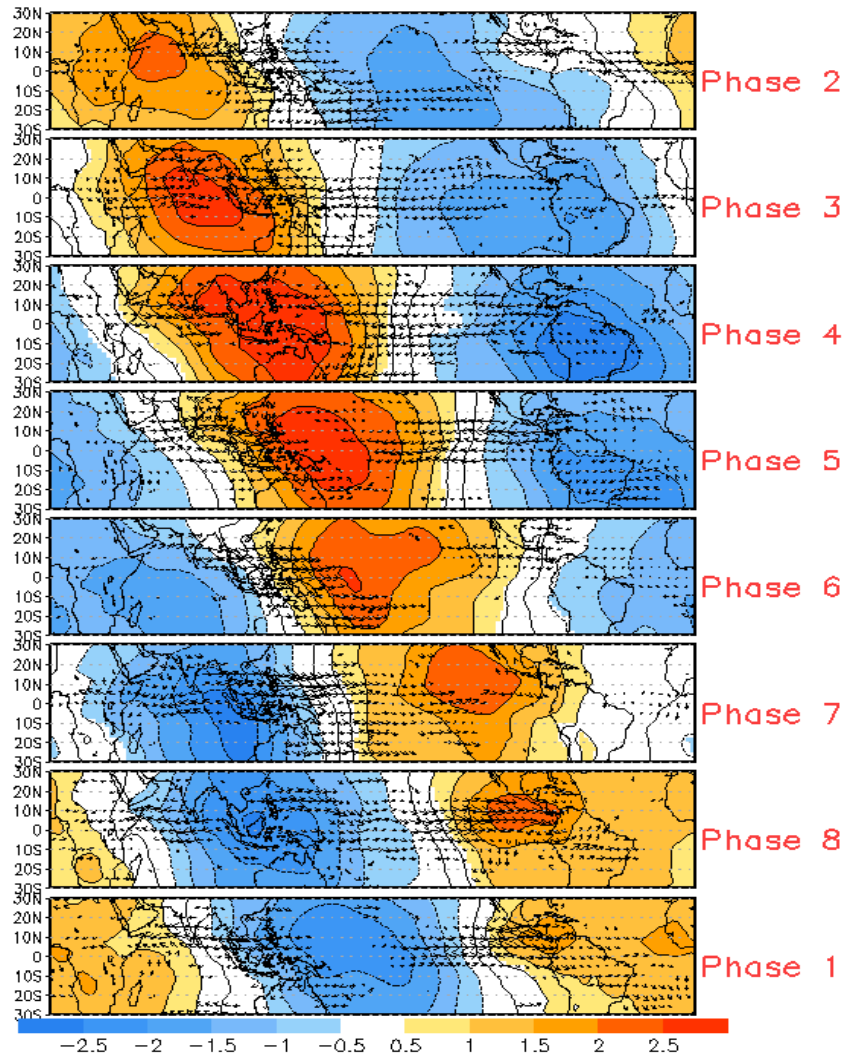
- The constructed analog forecast is similar to that of the GEFS but a weakening pattern with time.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:16-Jan-2021 to 18-Jul-2021
The unfilled contours are CA forecast reconstructed anomaly for 15 days

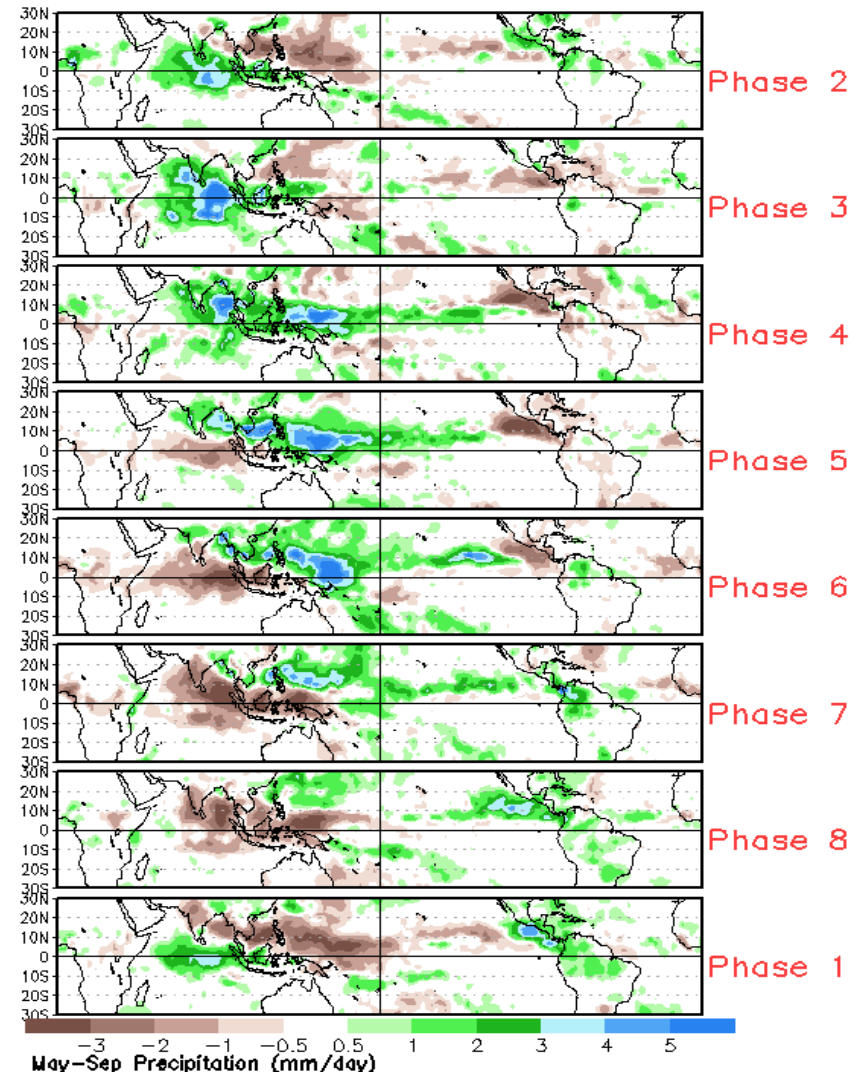


MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



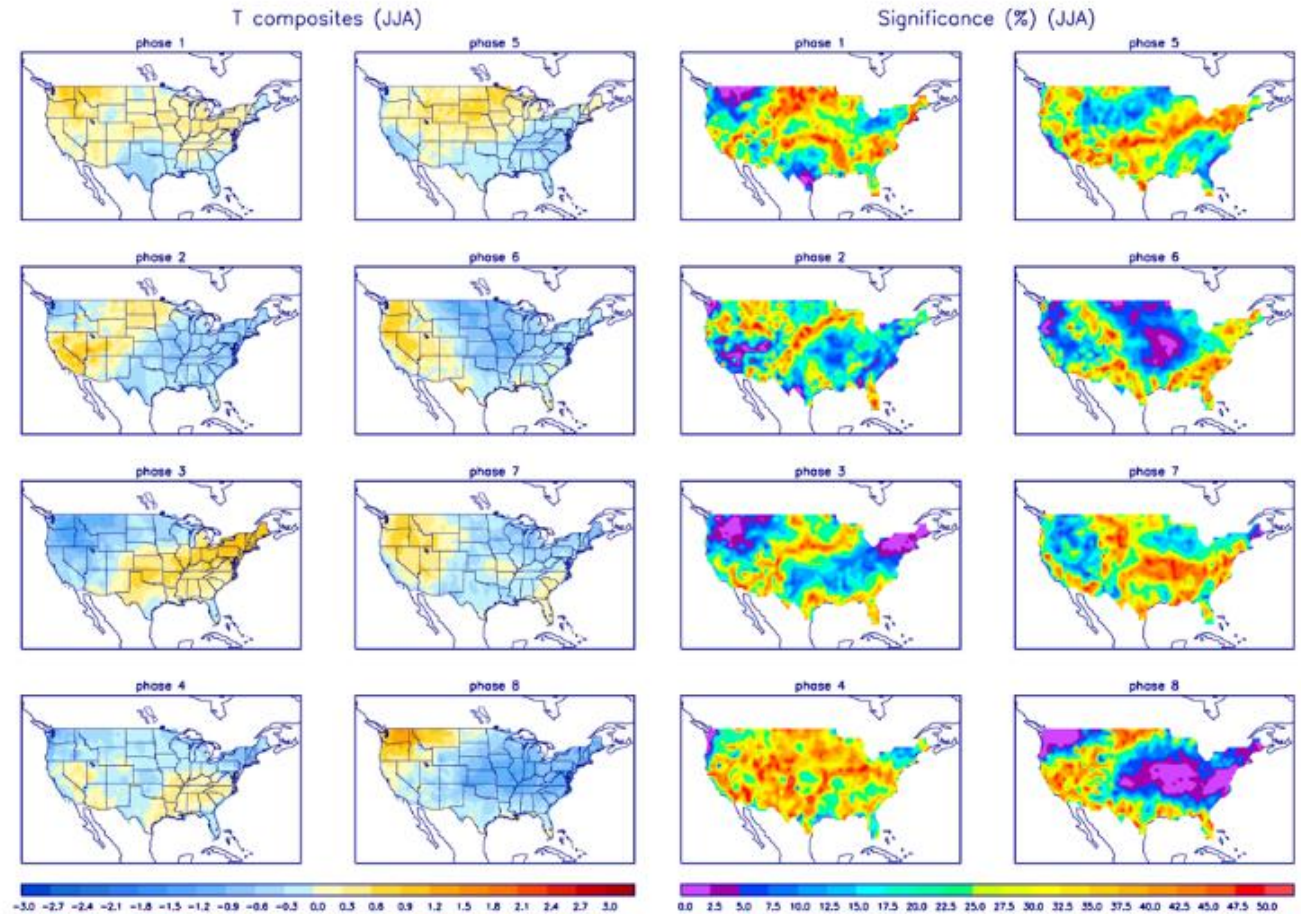
Precipitation Anomalies



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.

