

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



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

Overview

- The MJO continues to present itself well in the upper-level velocity potential fields, however there has been little eastward propagation of the intraseasonal signal likely due to competing interference with Rossby wave activity over the Indian Ocean during the last week.
- Dynamical models continue to favor the MJO to resume propagating eastward across the Indian Ocean and over the Maritime Continent during the next two weeks.
 - There continues to be large ensemble spread contributing to uncertainty regarding the strength and evolution of the MJO later in July.
- While tropical cyclone (TC) development is favored in the eastern Pacific during week-1 associated with recent Kelvin wave activity, the large scale environment is anticipated to be unfavorable for TC activity over the Western Hemisphere during week-2.

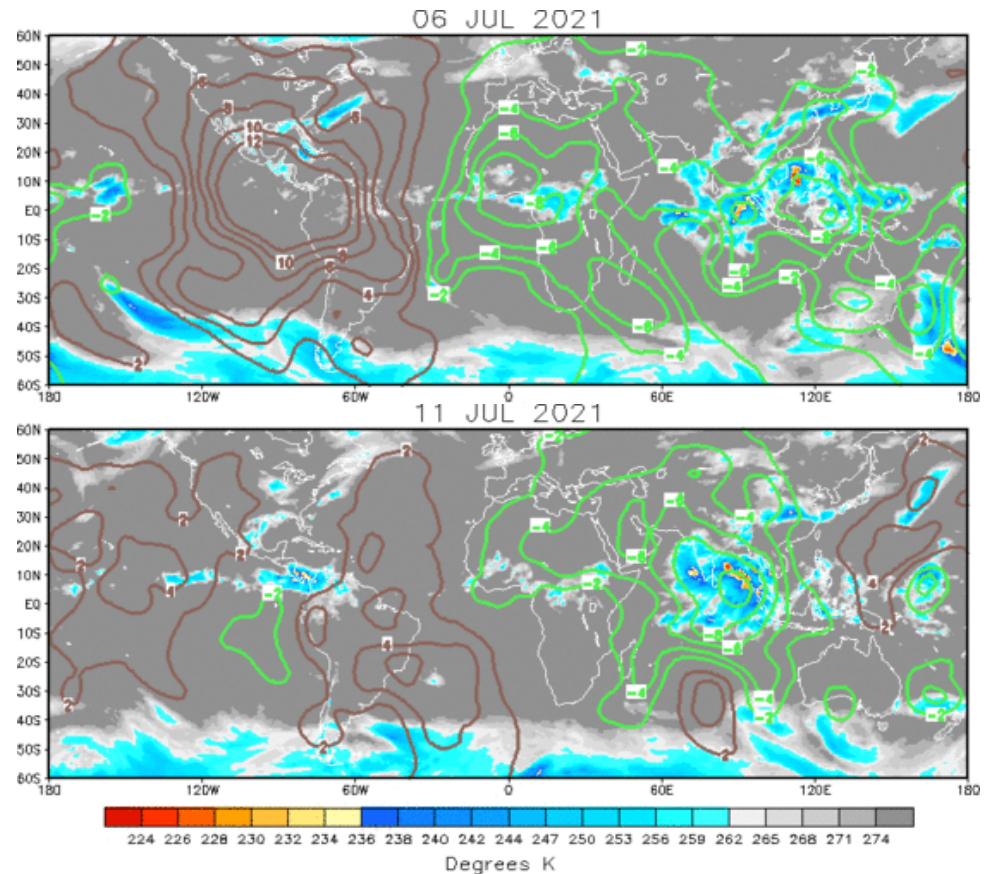
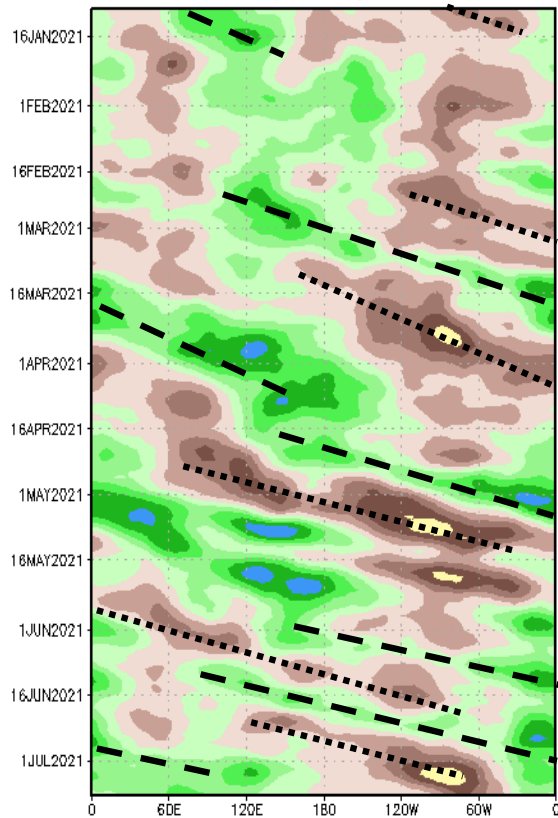
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

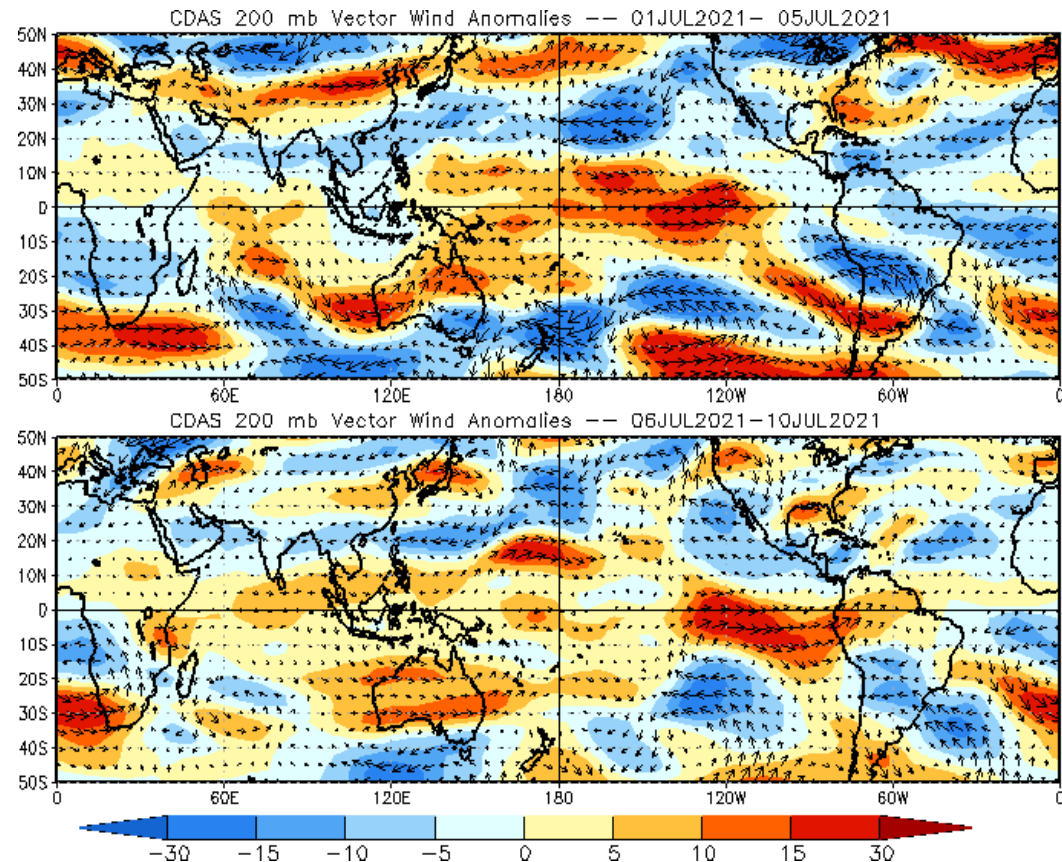
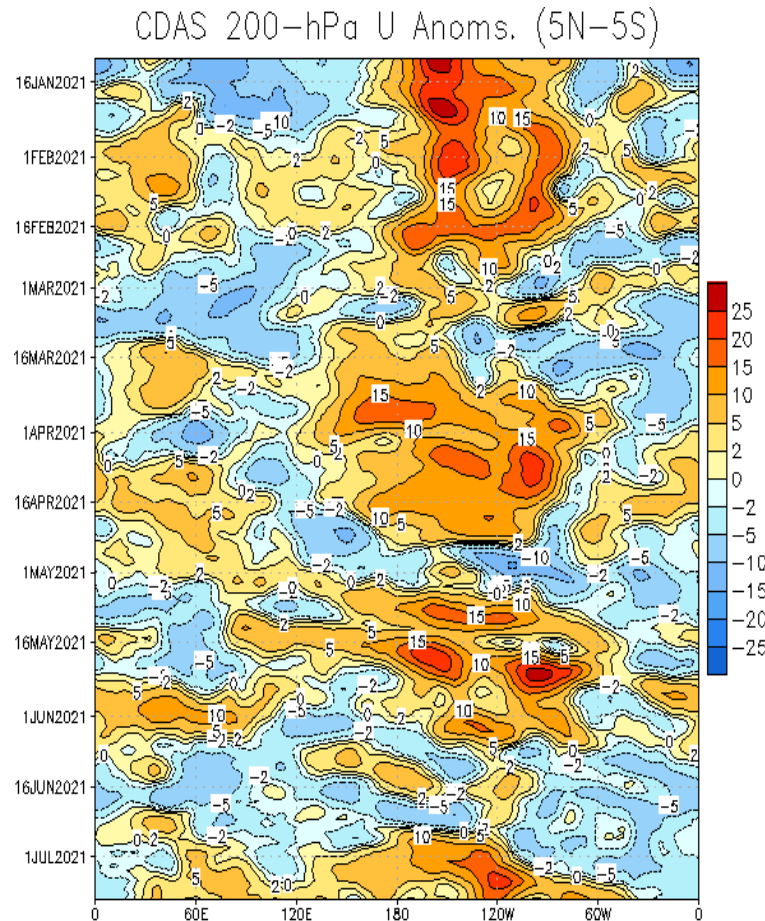
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- After a wave-1 pattern developed in early July, there has been little eastward propagation of the convective envelope as enhanced upper-level conditions have persisted over the Indian Ocean during the last week.
- Weakness in the suppressed convective envelope observed over the eastern Pacific is likely tied to the passage of a Kelvin wave.

200-hPa Wind Anomalies

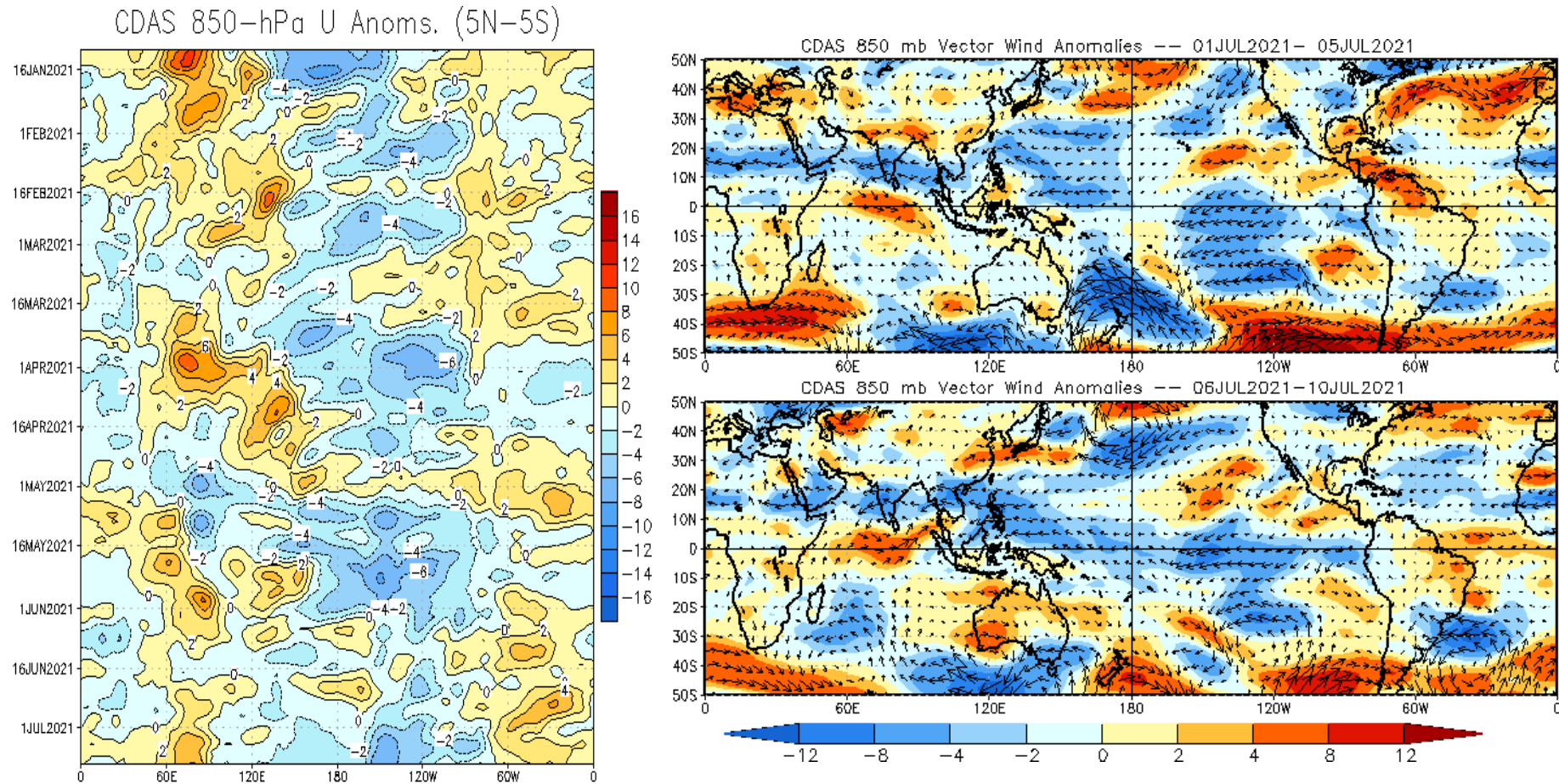
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Anomalous upper-level westerlies have become more uniform across much of the global tropics, with the strongest anomalies focused near 120W consistent with the low frequency footprint observed earlier this year.
- Anomalous easterlies aloft are observed to the south of the equator near the Prime Meridian associated with an enhanced South Atlantic anticyclonic circulation.

850-hPa Wind Anomalies

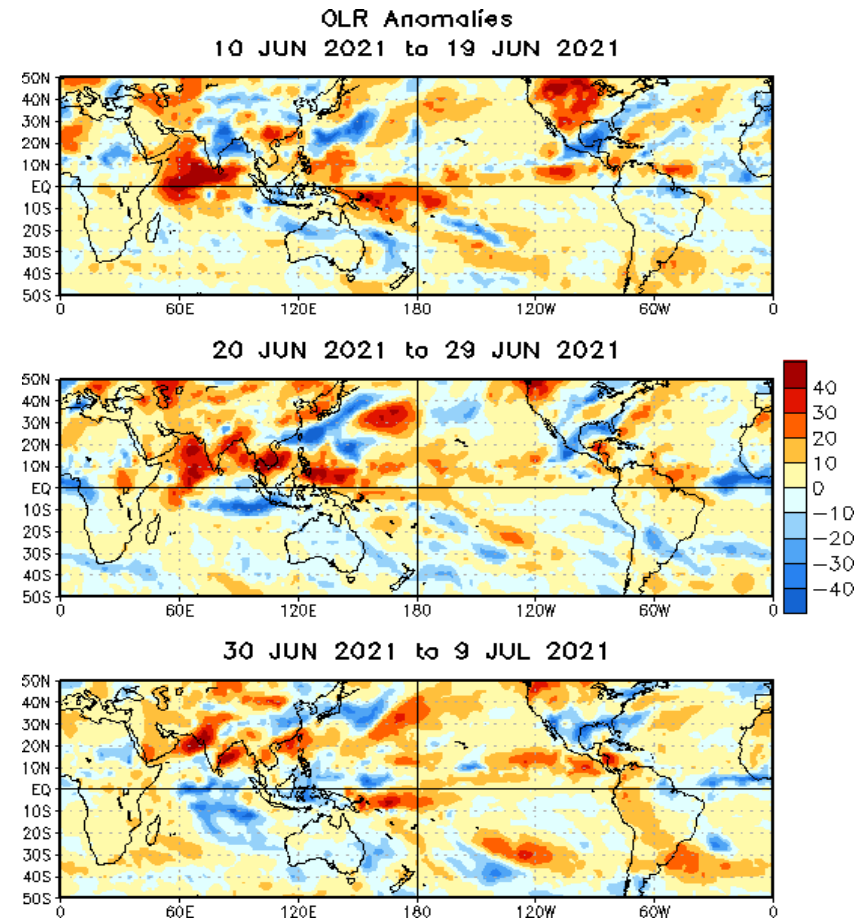
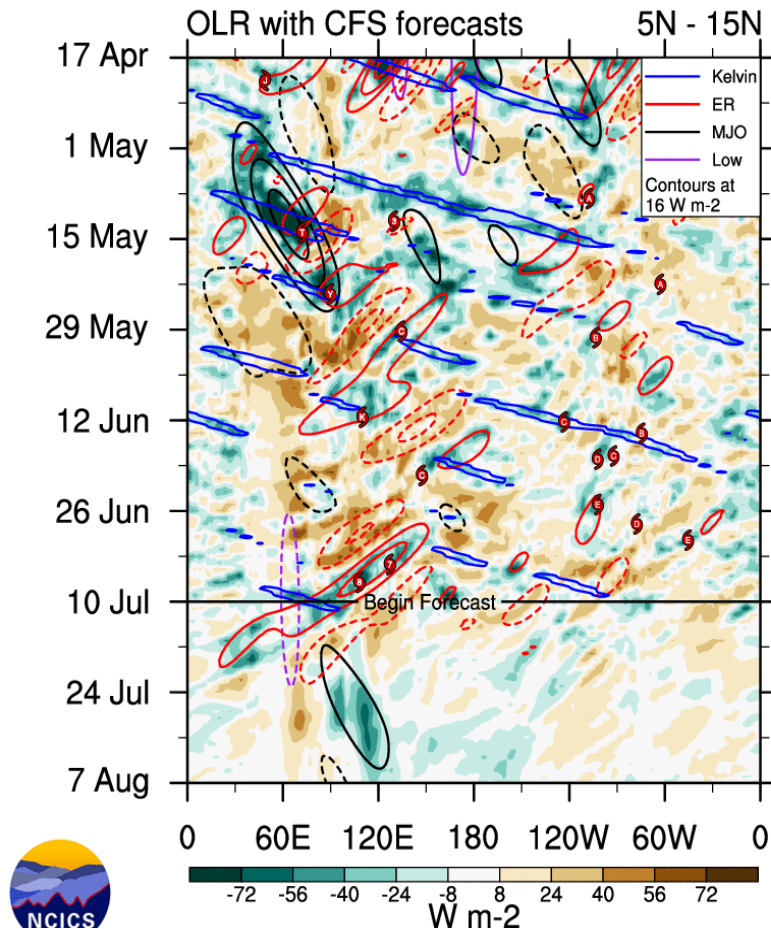
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- There has been little change to the lower-level wind field over the northern Indian Ocean since early July.
- Trades have become more pronounced across much of the equatorial Pacific, while trades have relaxed over the tropical Atlantic.

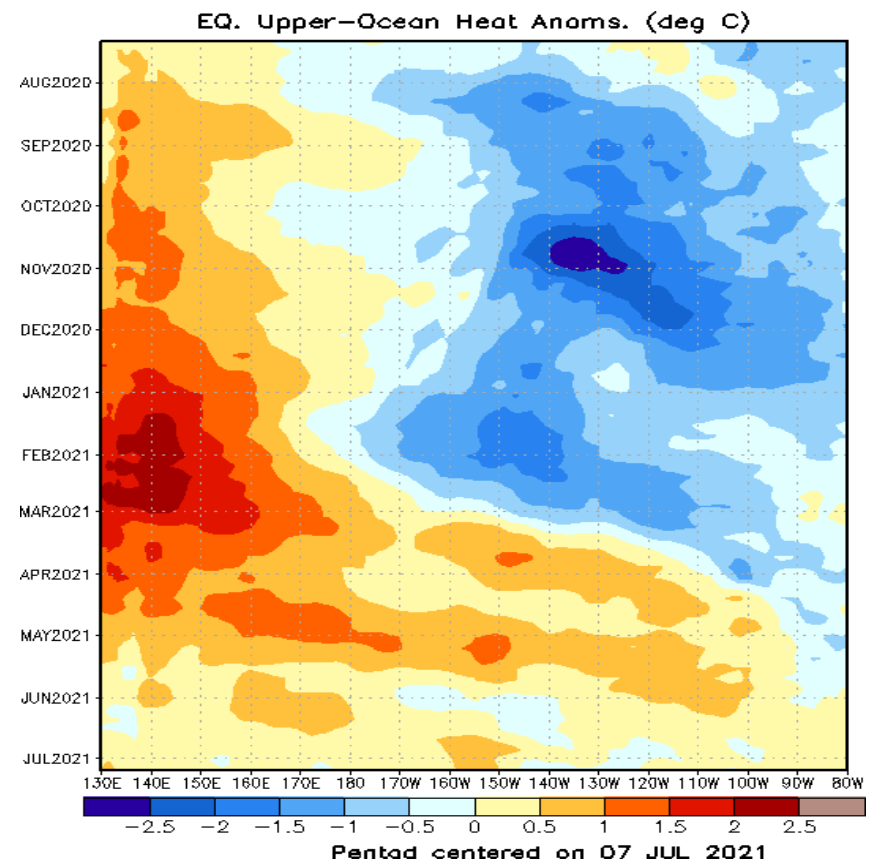
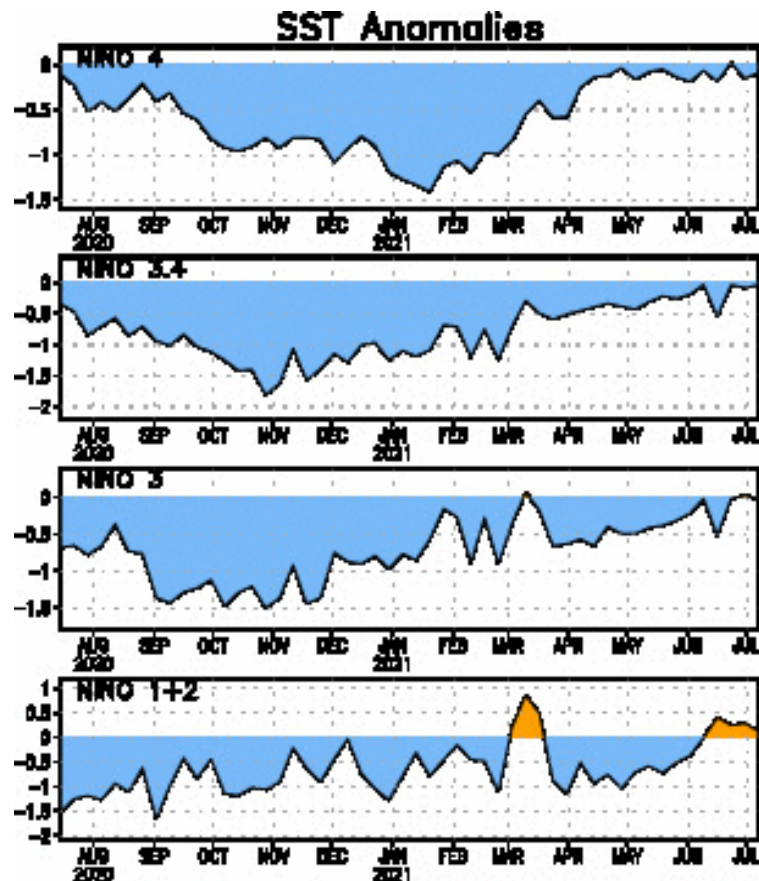
Outgoing Longwave Radiation (OLR) Anomalies

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



- Since late June, convection continues to be generally suppressed across Southeast Asia and India, indicative of a weak monsoon regime. Conversely, enhanced convection continues across Mexico and the southwestern CONUS.
- Convection increased across the equatorial Indian Ocean during the past ten days associated with Rossby wave activity.

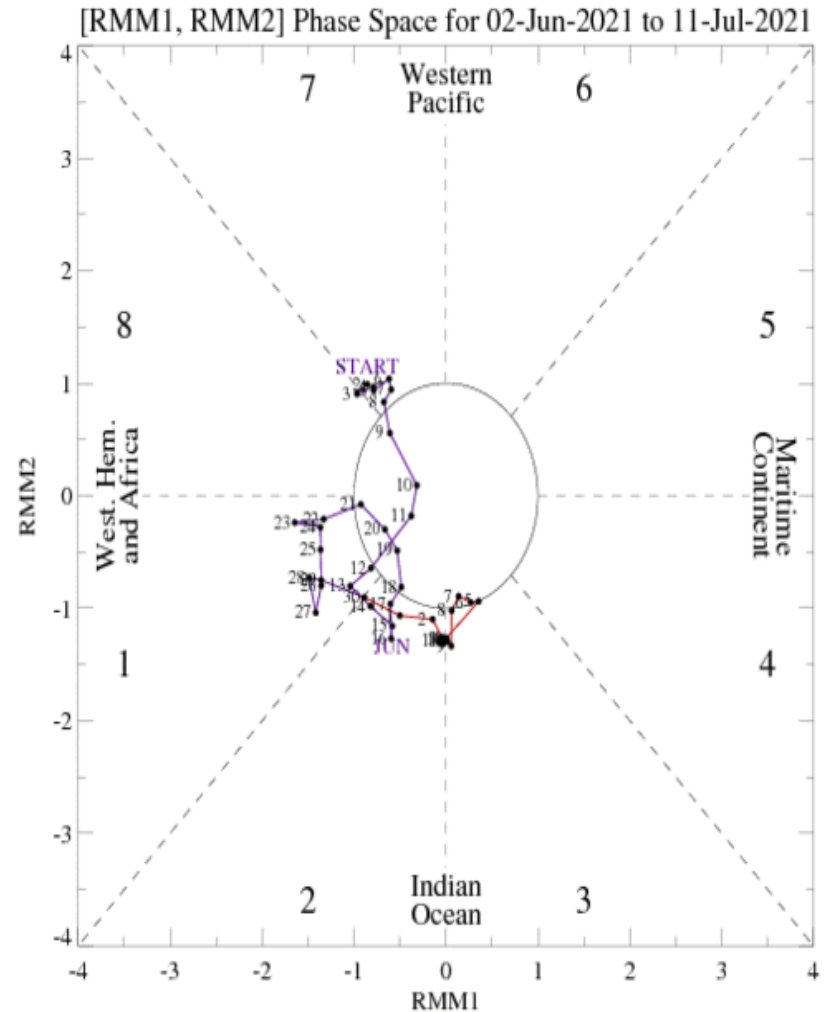
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- During spring, multiple episodes of oceanic Kelvin wave activity strengthened upper-ocean heat content, however these positive anomalies have been weakening over the central and eastern Pacific since June.
- Niño indices continue to remain marginally below average with the exception of Niño 1+2.

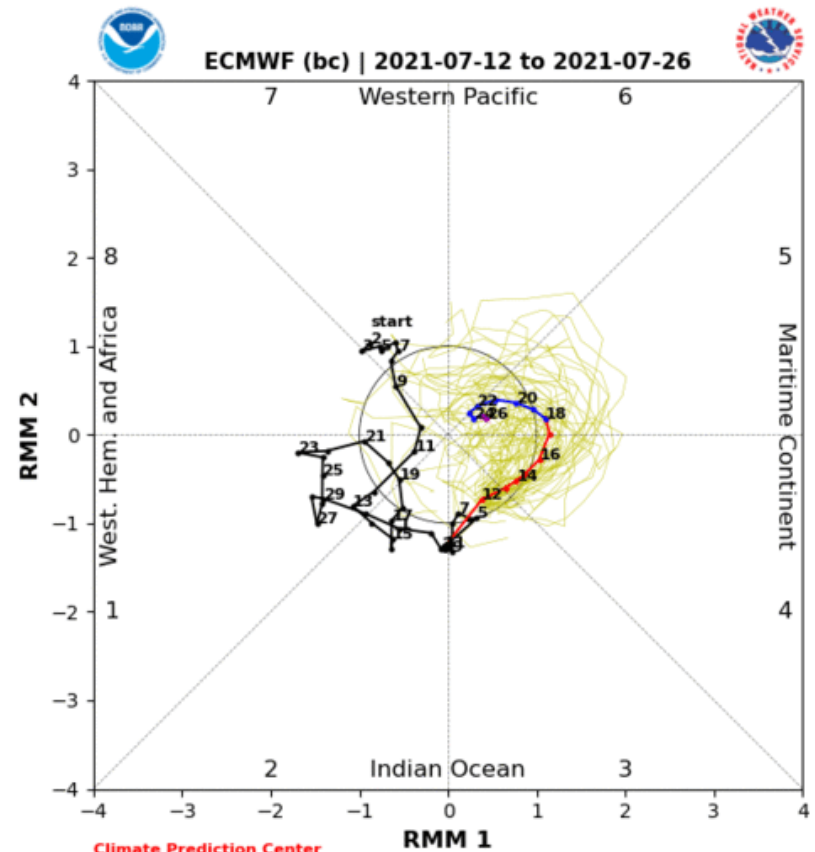
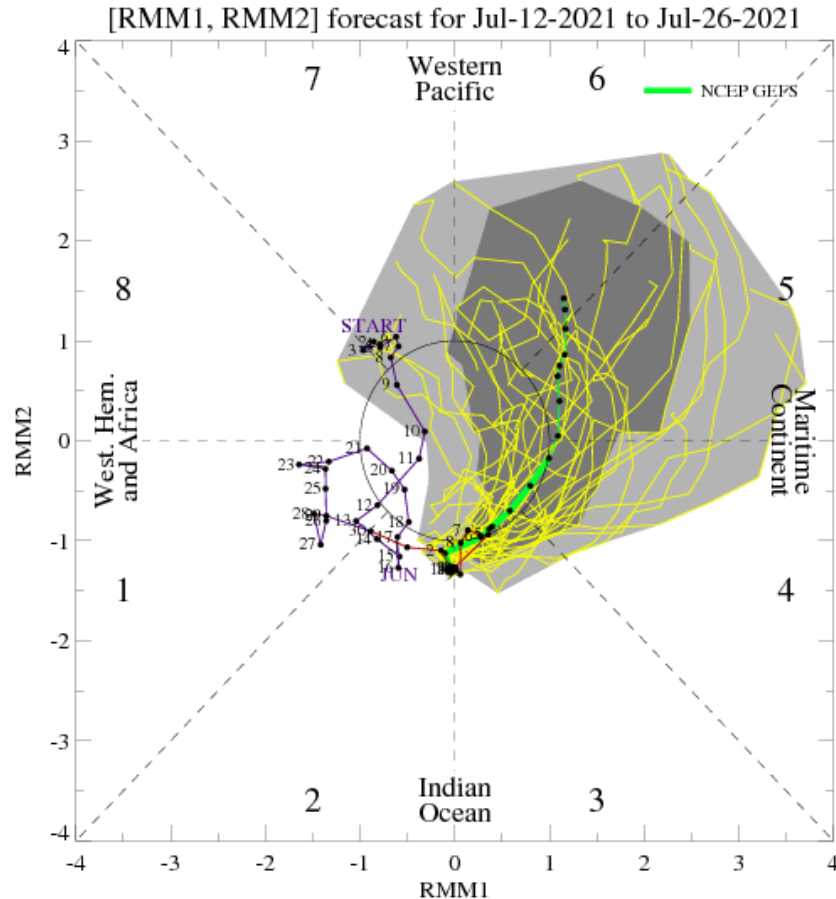
MJO Index: Recent Evolution

- The RMM index indicates the intraseasonal signal remains over the Indian Ocean (straddling phases 2 and 3) with westward shifting variability likely tied to Rossby wave activity in the region during the last week.



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

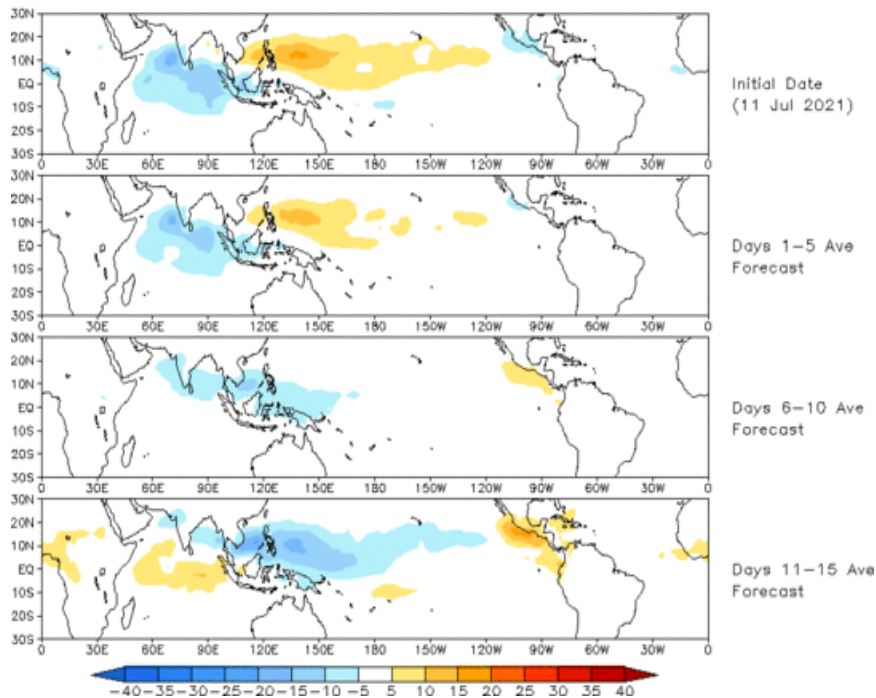


- Similar to last week, both the GEFS and ECMWF favor eastward propagation of the MJO at a low amplitude across the Indian Ocean and the Maritime Continent during week-1.
- By week-2, RMM mean solutions diverge among the models, where the GEFS features a more progressive, stronger signal approaching the West Pacific while the ECMWF favors a weakening event over the Maritime Continent.

MJO: GEFS Forecast Evolution

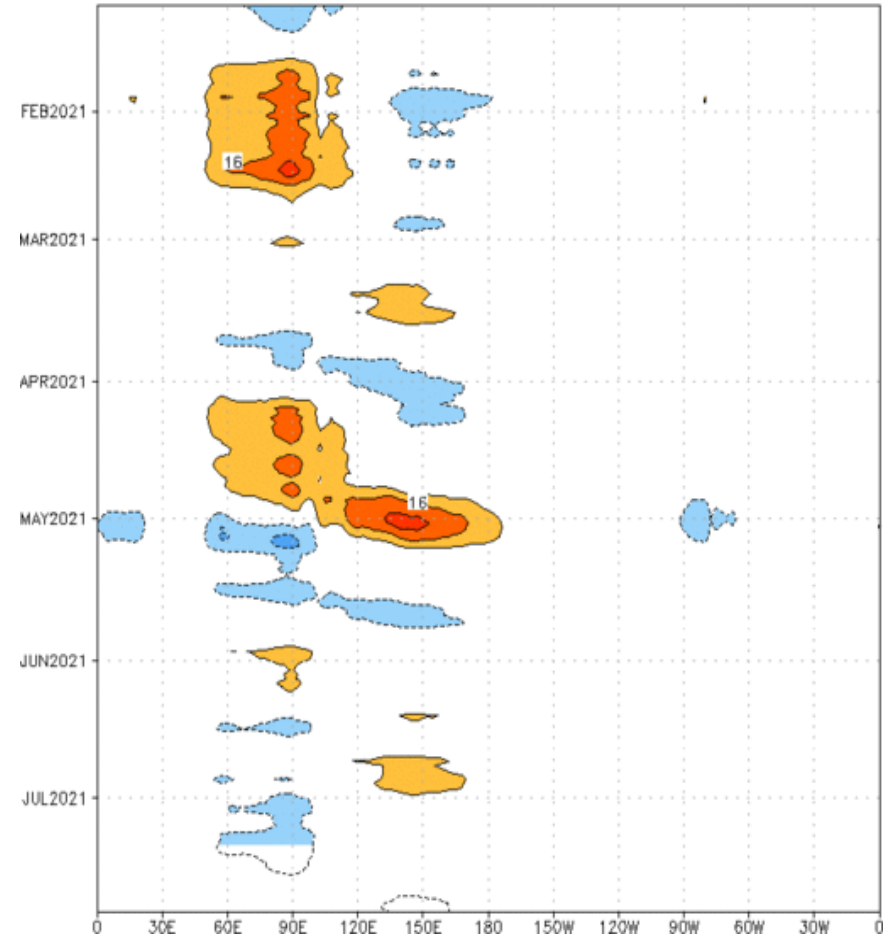
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 11 Jul 2021
OLR



- The GEFS RMM-based OLR anomaly forecast features enhanced convection shifting eastward across the Maritime Continent and West Pacific, with suppressed convection developing over the western Indian Ocean and East Pacific during week-2.

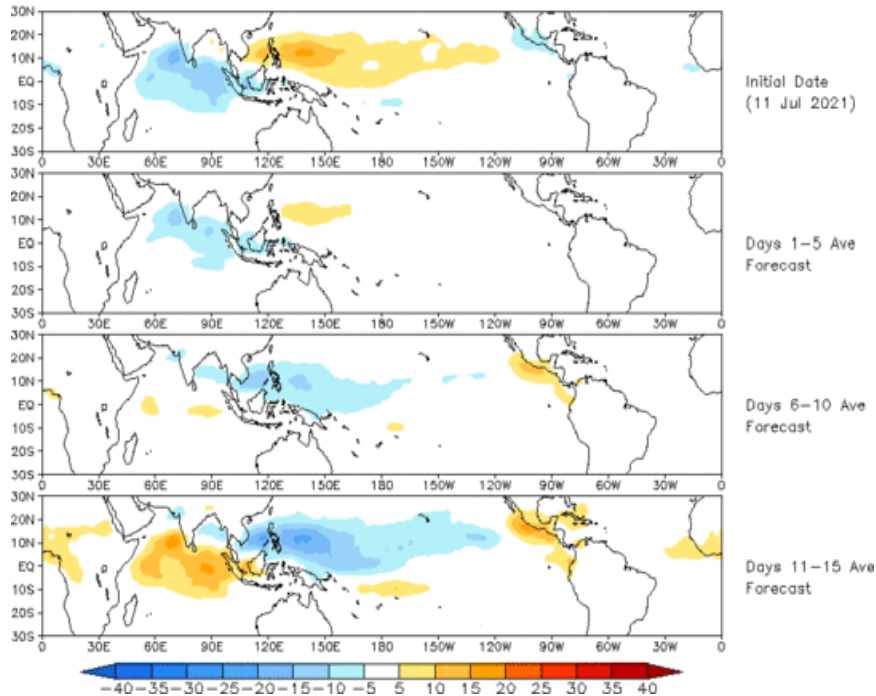
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cint:4Wm^{-2}) Period:09-Jan-2021 to 11-Jul-2021
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



MJO: Constructed Analog Forecast Evolution

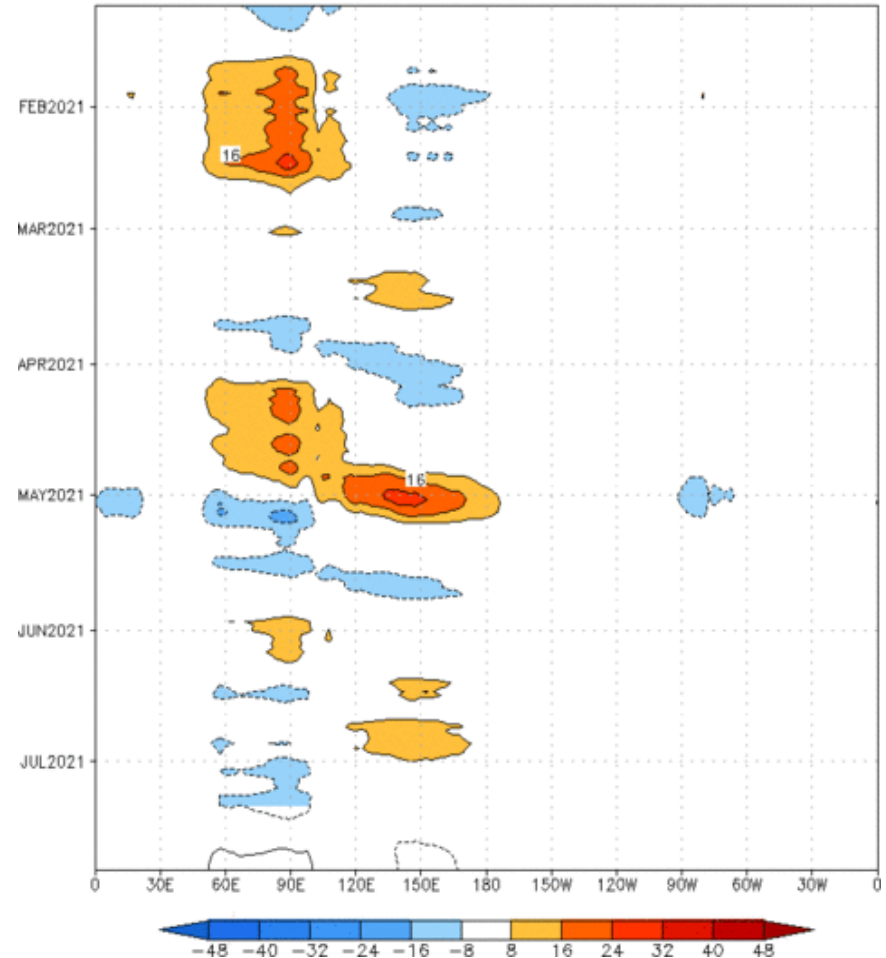
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (11 Jul 2021)



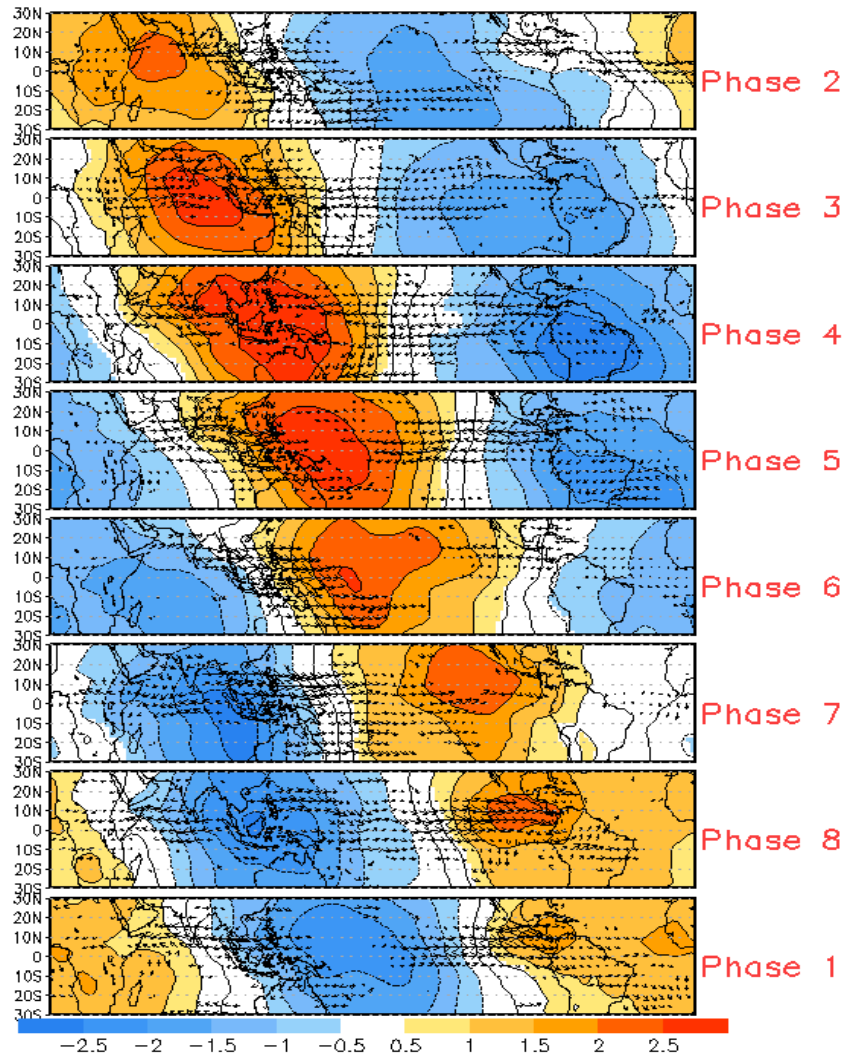
- The constructed analog forecast is similar to that of the GEFS but shows a stronger convective pattern by late July.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:09-Jan-2021 to 11-Jul-2021
The unfilled contours are CA forecast reconstructed anomaly for 15 days

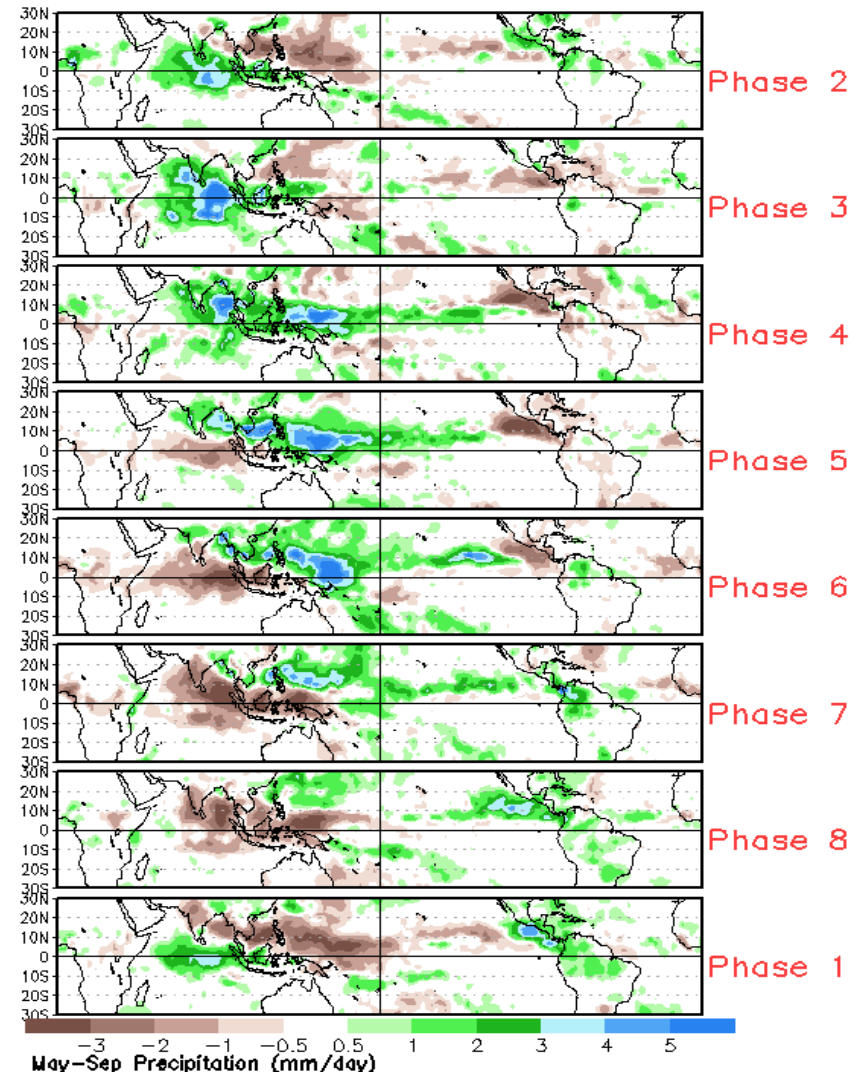


MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



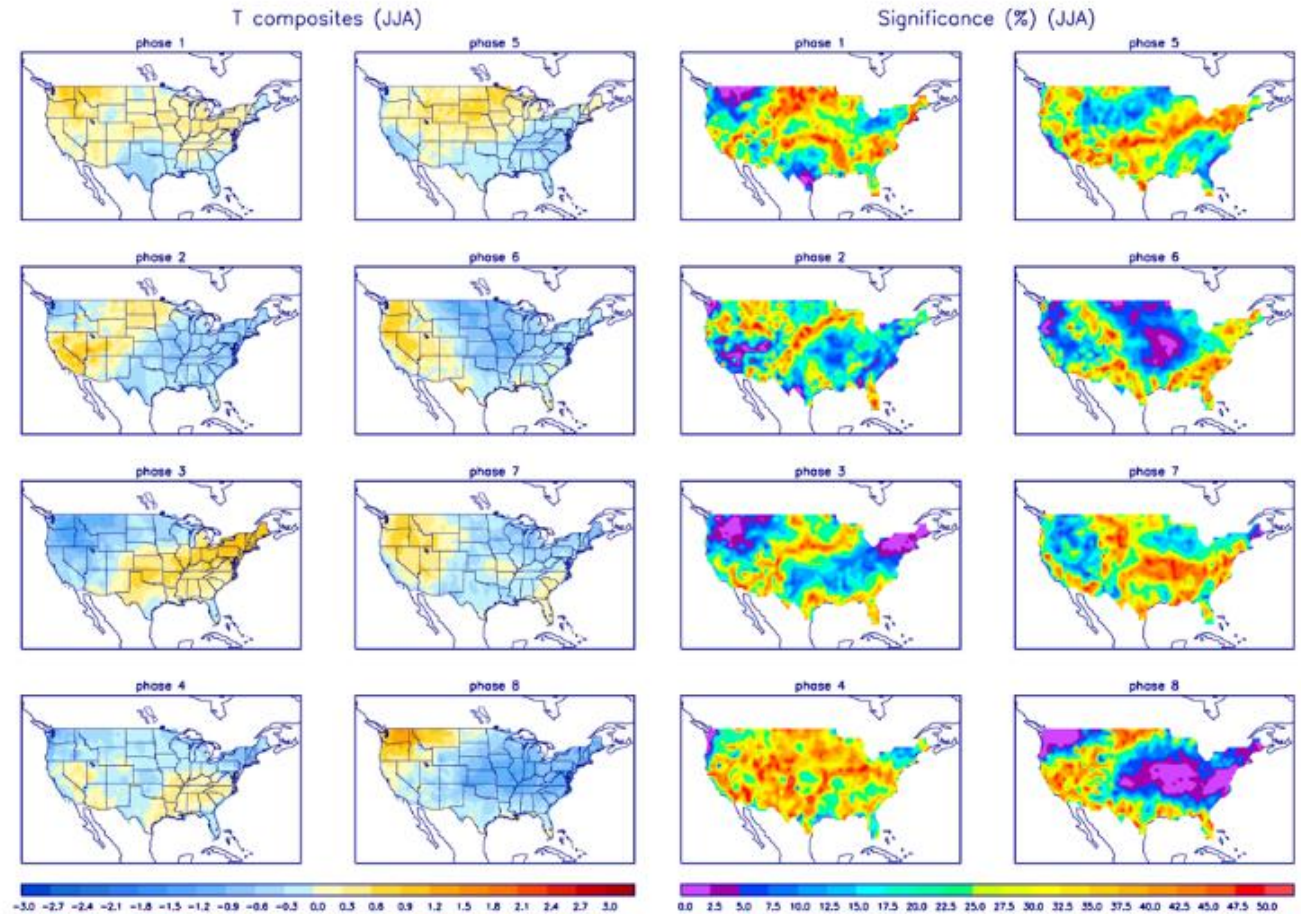
Precipitation Anomalies



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.

