

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



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

Overview

- The MJO became more coherent at the beginning of July as anomalous upper-level divergence (convergence) developed over the Eastern (Western) Hemisphere.
- The GFS ensemble mean depicts a continued eastward propagation of the MJO from the Indian Ocean to the Maritime Continent which is likely to enhance the Asian Monsoon.
- The MJO is expected to decrease chances of tropical cyclone development across the Atlantic basin through mid-July.

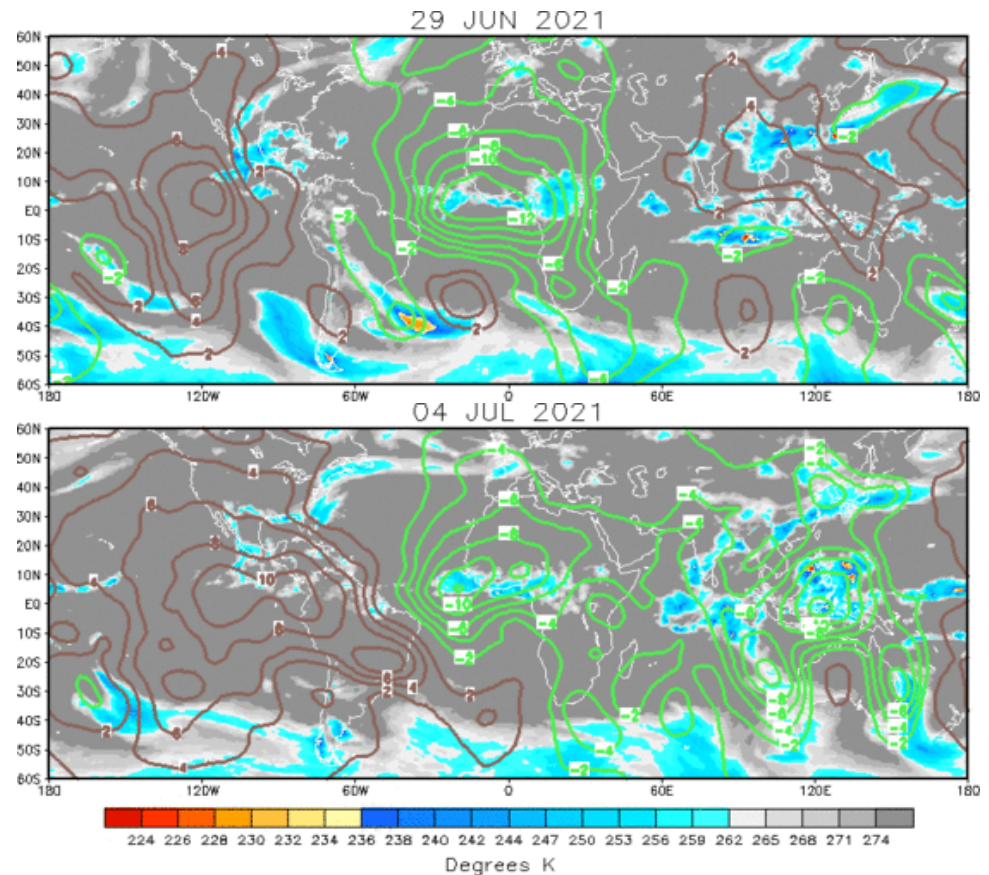
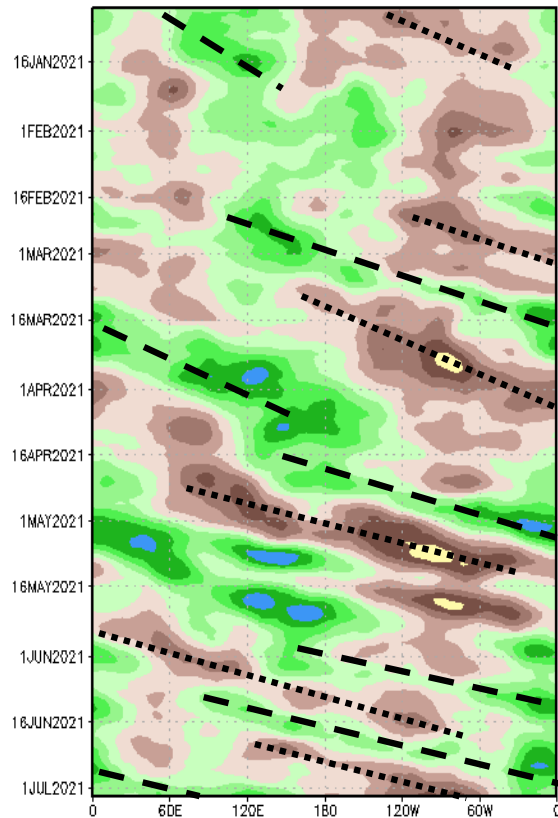
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

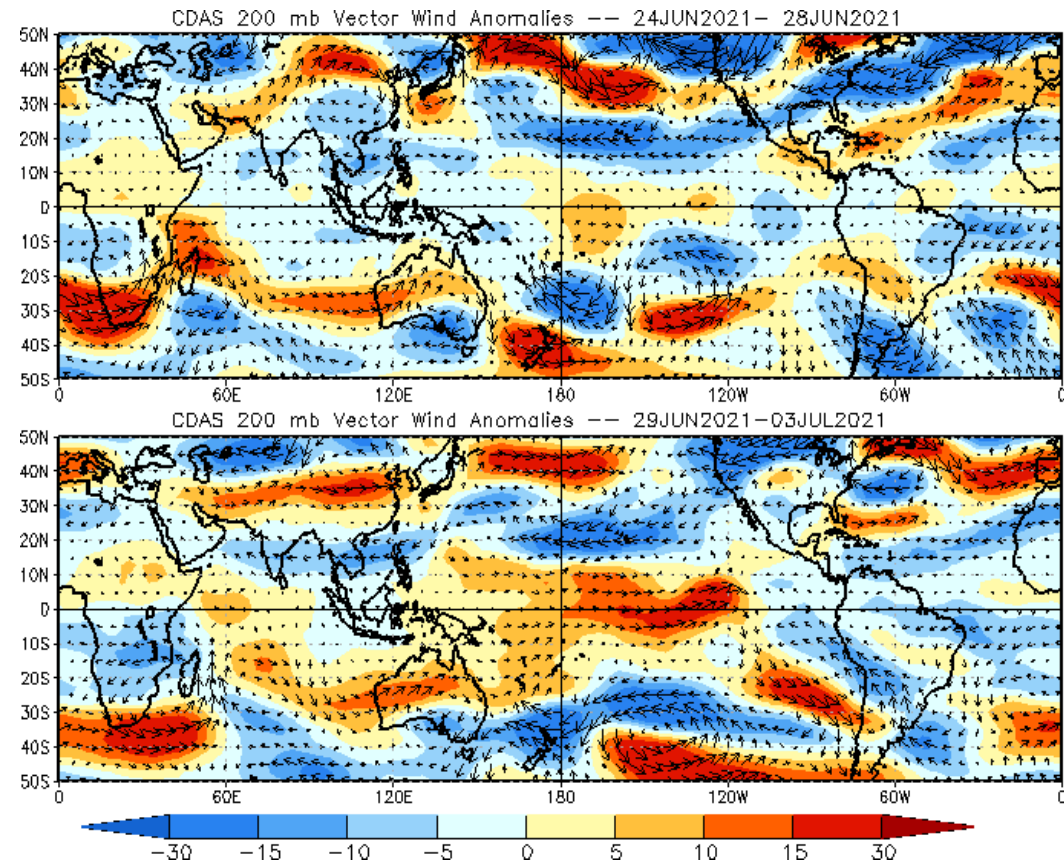
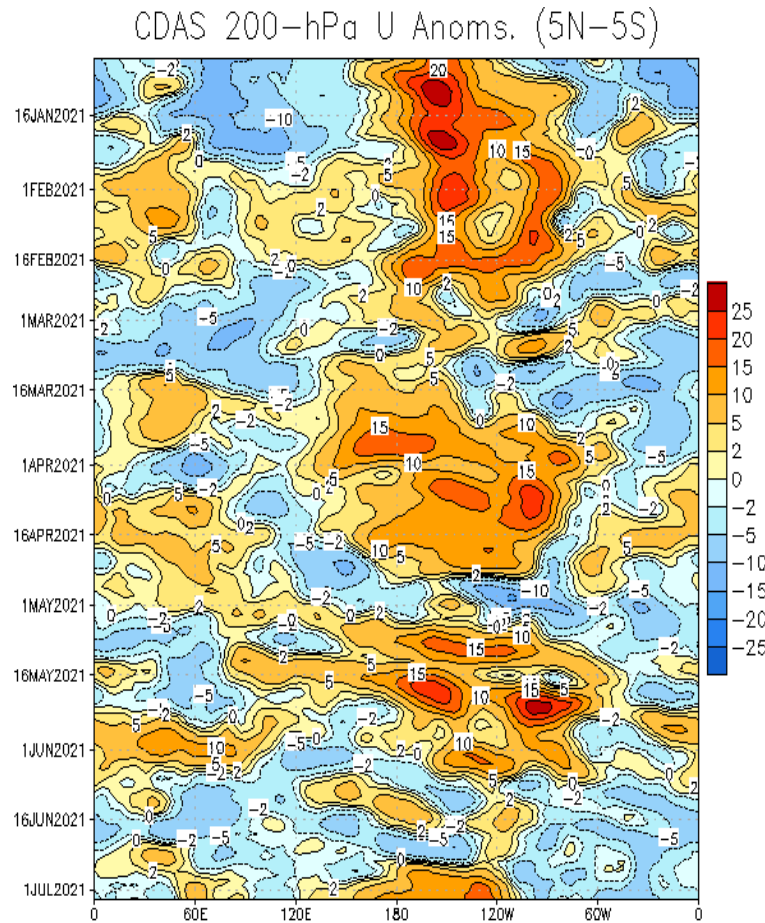
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- A more coherent wave-1 pattern of 200-hPa Velocity Potential anomalies recently developed with anomalous upper-level divergence (convergence) over the Eastern (Western) Hemisphere.
- The spatial pattern represents a strengthening MJO since the end of June.

200-hPa Wind Anomalies

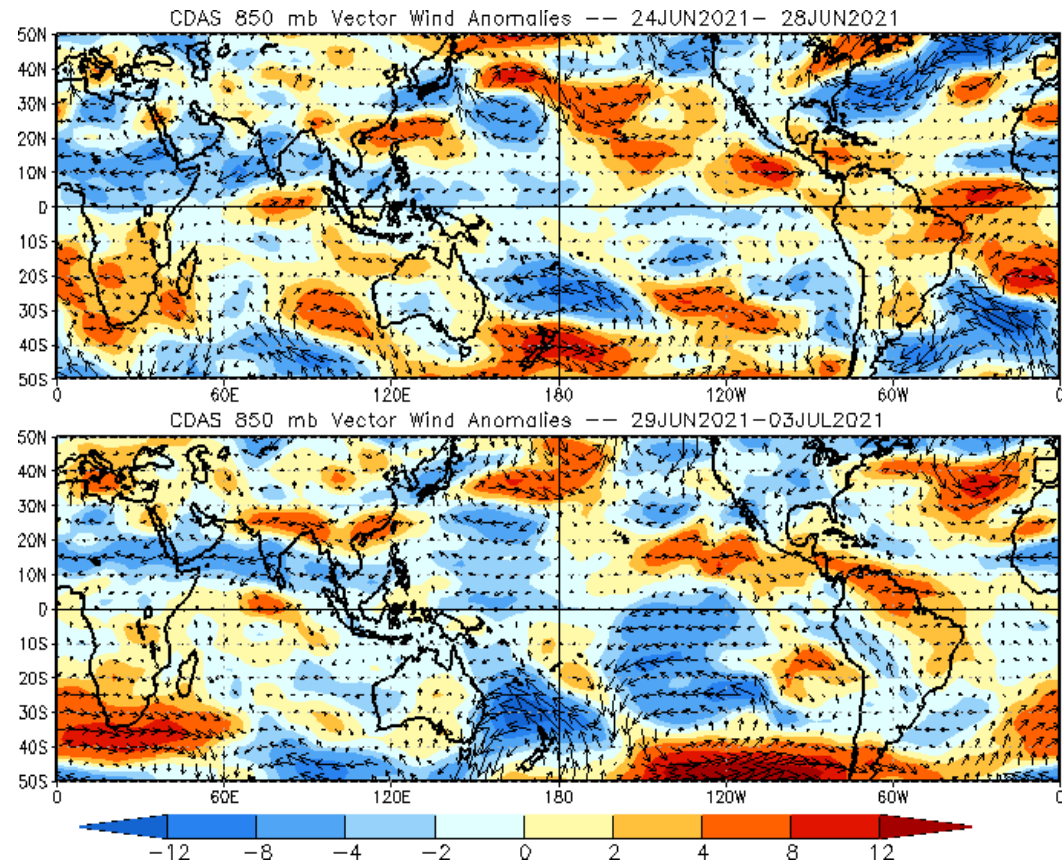
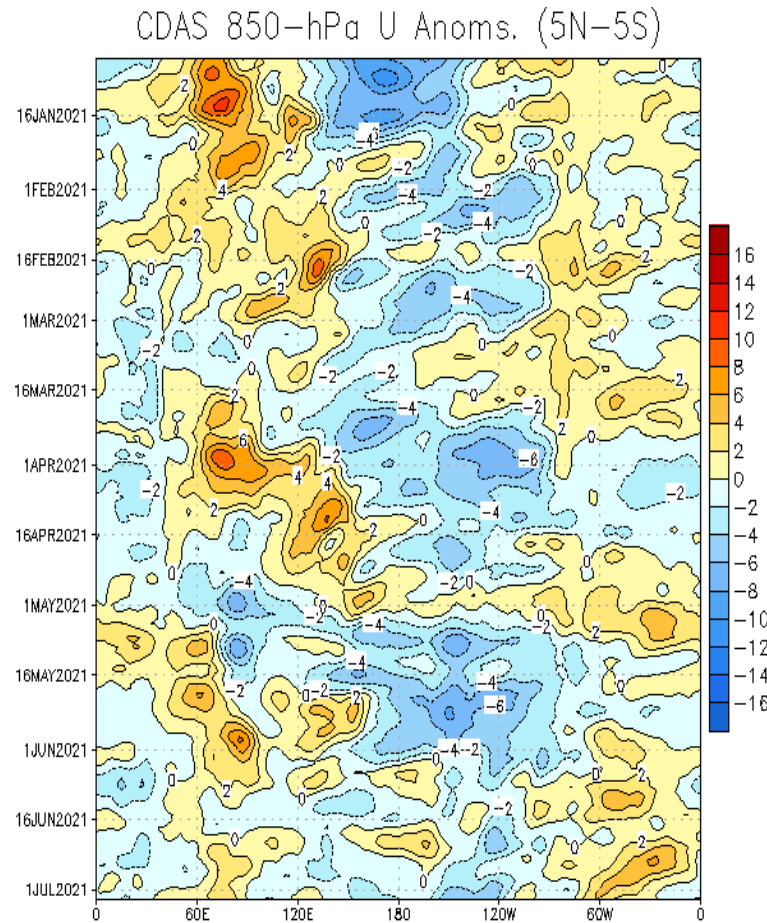
Shading denotes the zonal wind anomaly. Blue shades: Anomalous easterlies. Red shades: Anomalous westerlies.



- Anomalous westerlies that developed across the Pacific were tied to mid-latitude wave breaking in both hemispheres.
- These westerly anomalies strengthened east of the Date Line during the past five days.

850-hPa Wind Anomalies

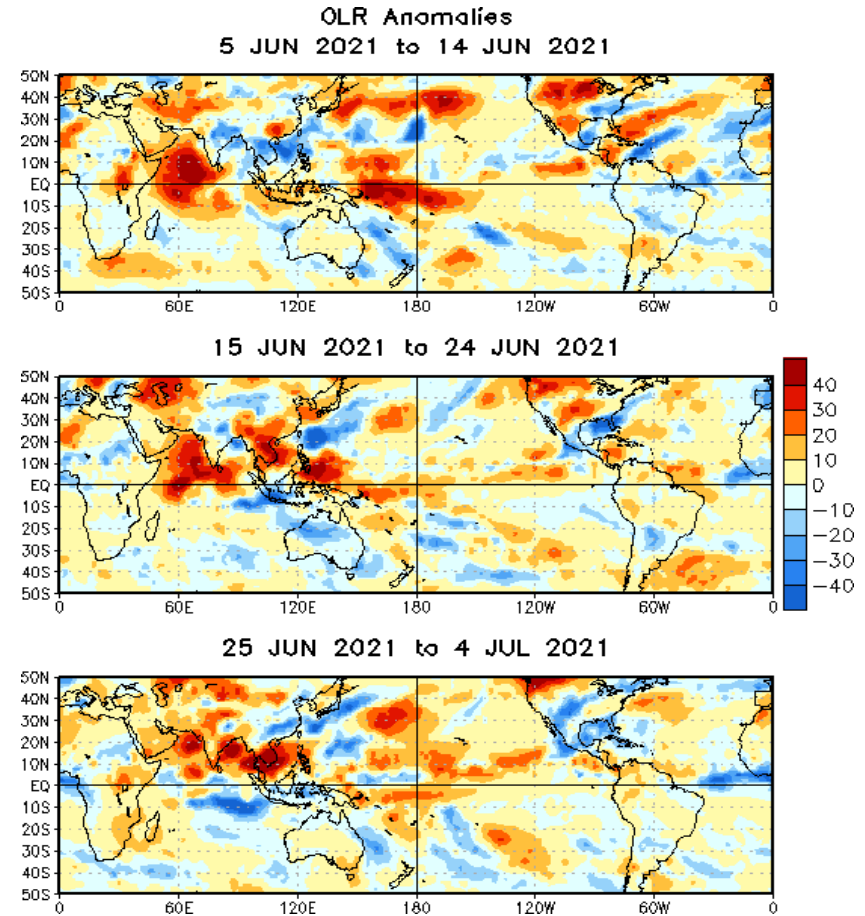
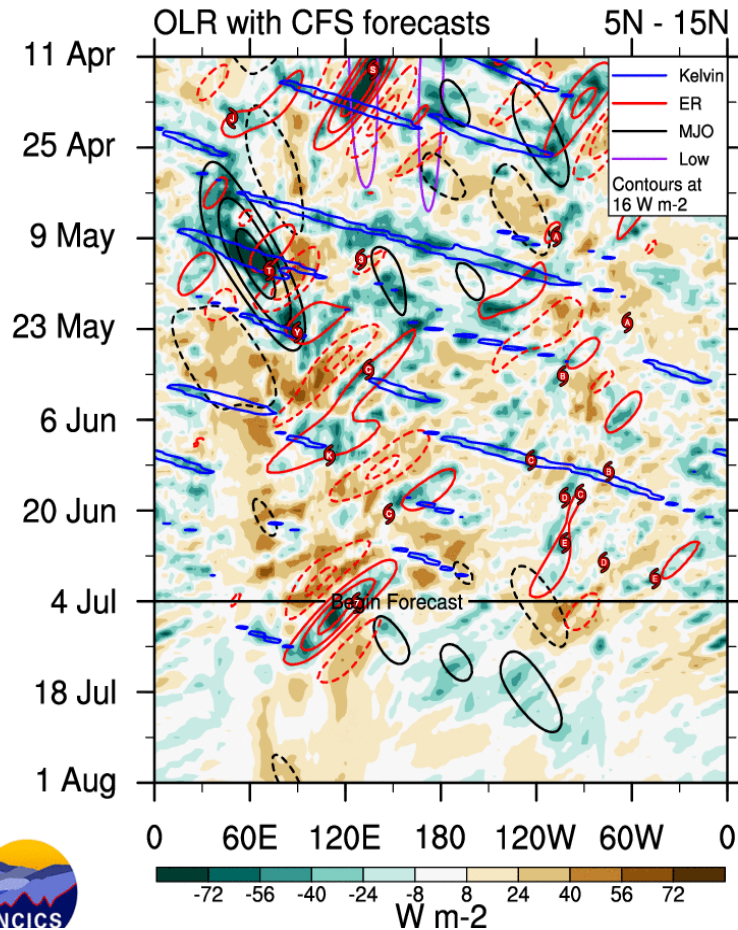
Shading denotes the zonal wind anomaly. Blue shades: Anomalous easterlies. Red shades: Anomalous westerlies.



- Flow along the equator has been fairly incoherent over the past ten days, mostly highlighted by equatorial Rossby wave activity over the Pacific.
- Trade winds from 10-20N over the eastern Pacific remain weaker than average..

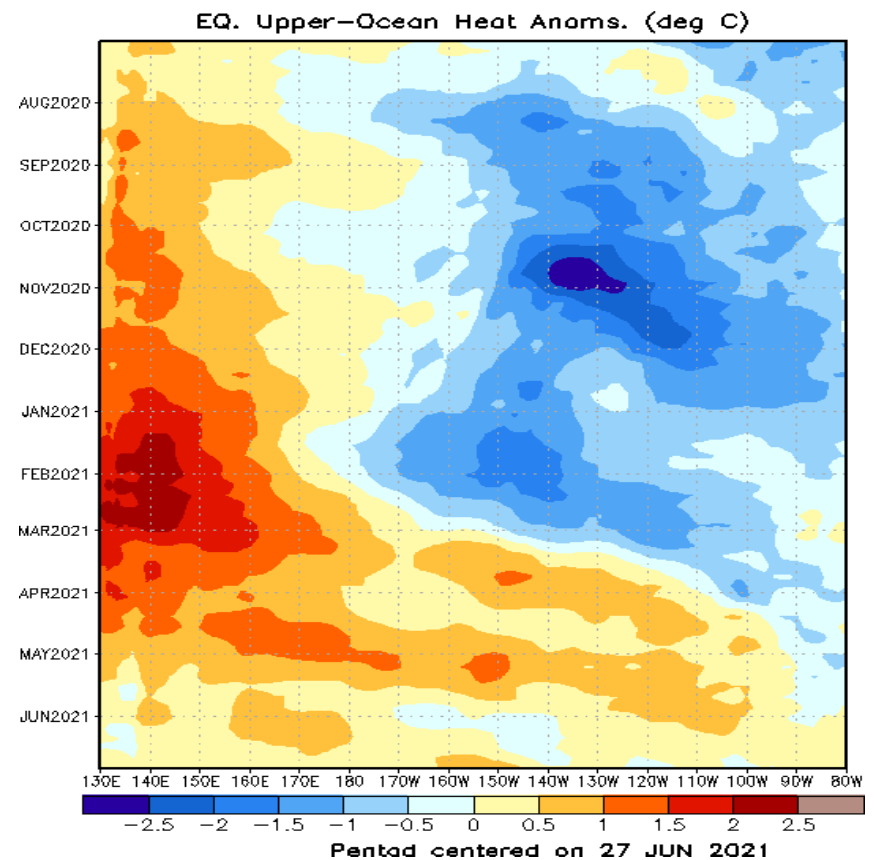
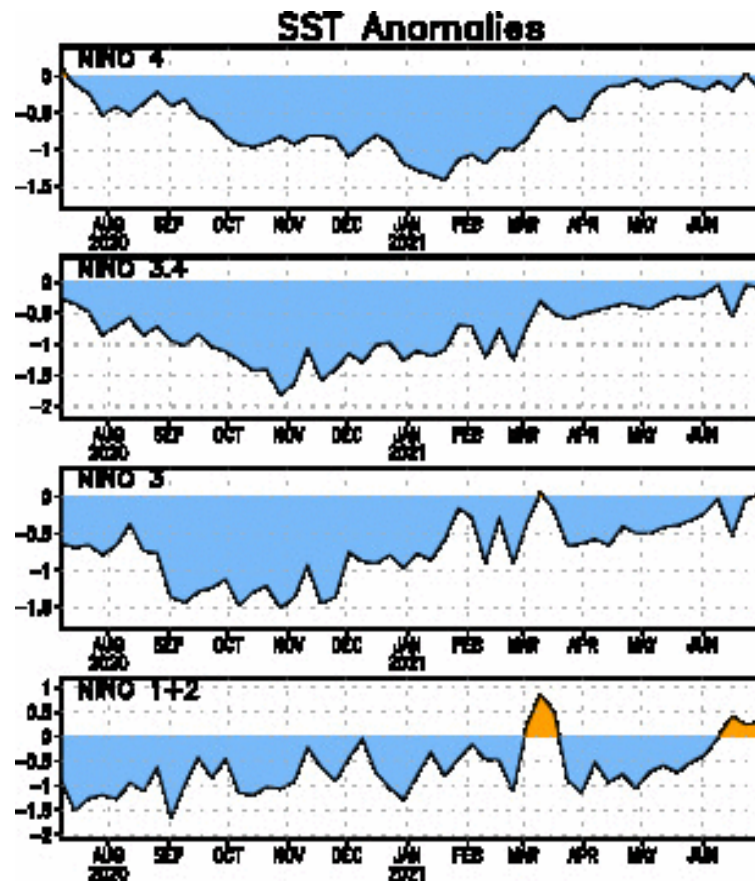
Outgoing Longwave Radiation (OLR) Anomalies

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



- Suppressed convection built in across Southeast Asia during late June, indicating a weaker monsoon.
- The North American Monsoon became more enhanced by the end of June.
- Convection increased across the equatorial Indian Ocean during the past ten days, associated with the developing MJO.

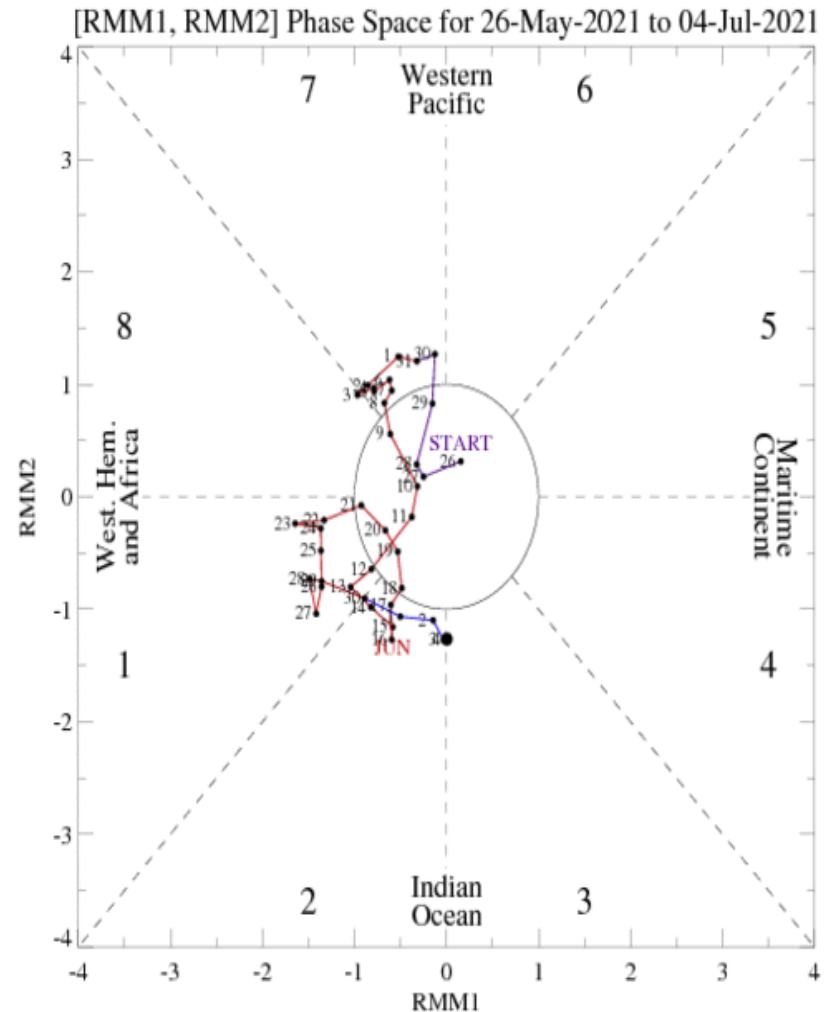
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Upper-ocean heat content is above-normal along the equator as a result of three downwelling oceanic Kelvin waves since March. The latest downwelling feature is currently near 150W.
- Niño indices continue to remain marginally below-normal with the exception of Niño 1+2, although the vertically-integrated heat content near the surface suggests any cold water volume is extremely shallow.

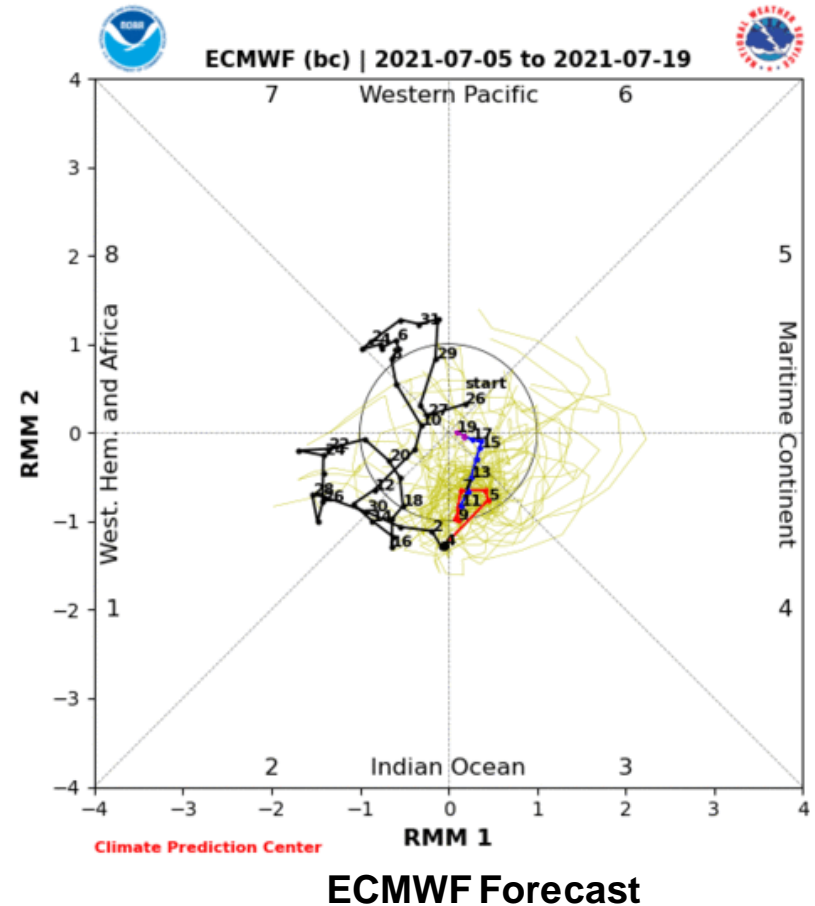
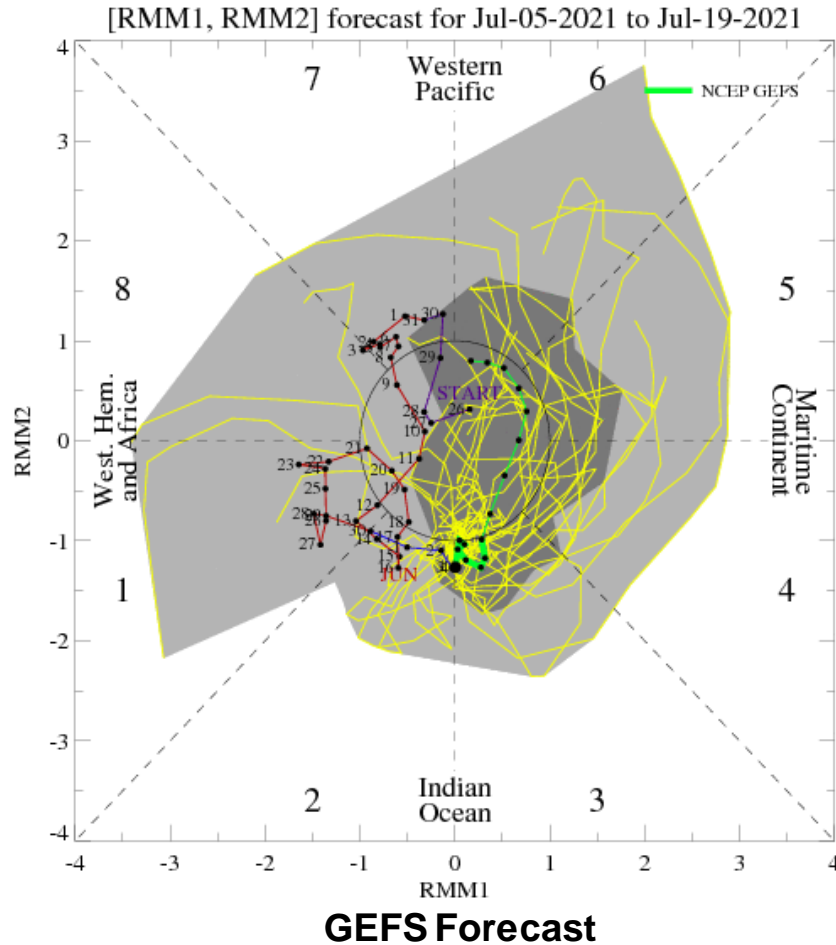
MJO Index: Recent Evolution

- The RMM index emerged from the unit circle during late June, with a signal over Africa which is evident in the velocity potential anomalies.
- This signal propagated eastward to the Indian Ocean at the beginning of July.



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

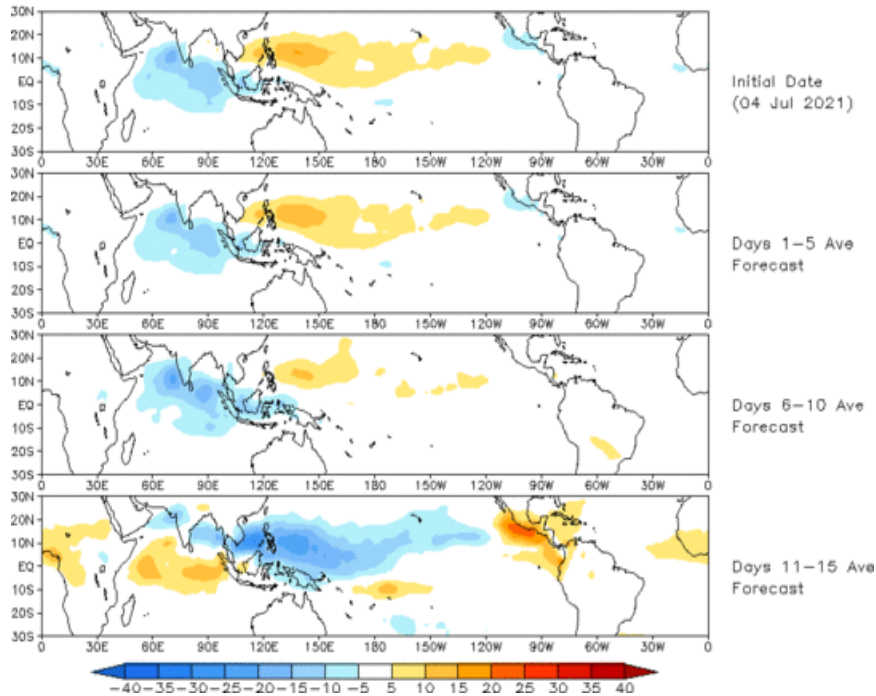


- The GEFS depicts a continued eastward propagation of the MJO from the Indian Ocean to the Maritime Continent during the next two weeks.
- However, spread is large among the GFS and ECMWF ensemble members and they also imply Kelvin wave activity.

MJO: GEFS Forecast Evolution

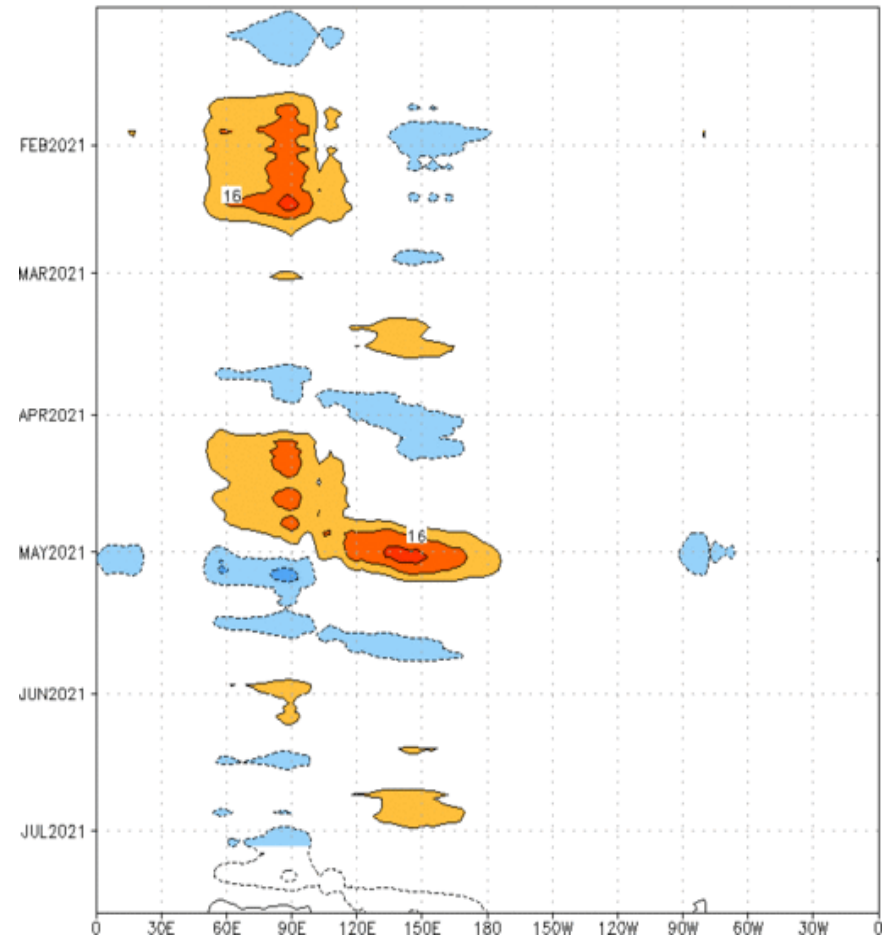
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 04 Jul 2021
OLR



- The GEFS RMM-based OLR anomaly forecast features an enhanced Asian Monsoon while convection becomes suppressed over the East Pacific and Caribbean Sea.

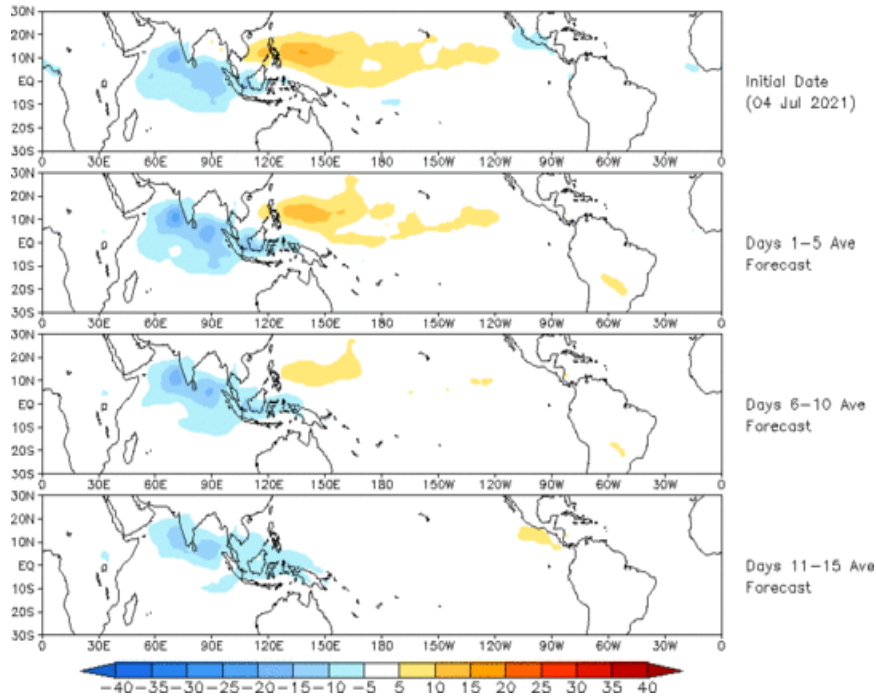
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [$7.5^{\circ}\text{S}, 7.5^{\circ}\text{N}$] ($\text{cint: } 4\text{Wm}^{-2}$) Period: 02-Jan-2021 to 04-Jul-2021
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



MJO: Constructed Analog Forecast Evolution

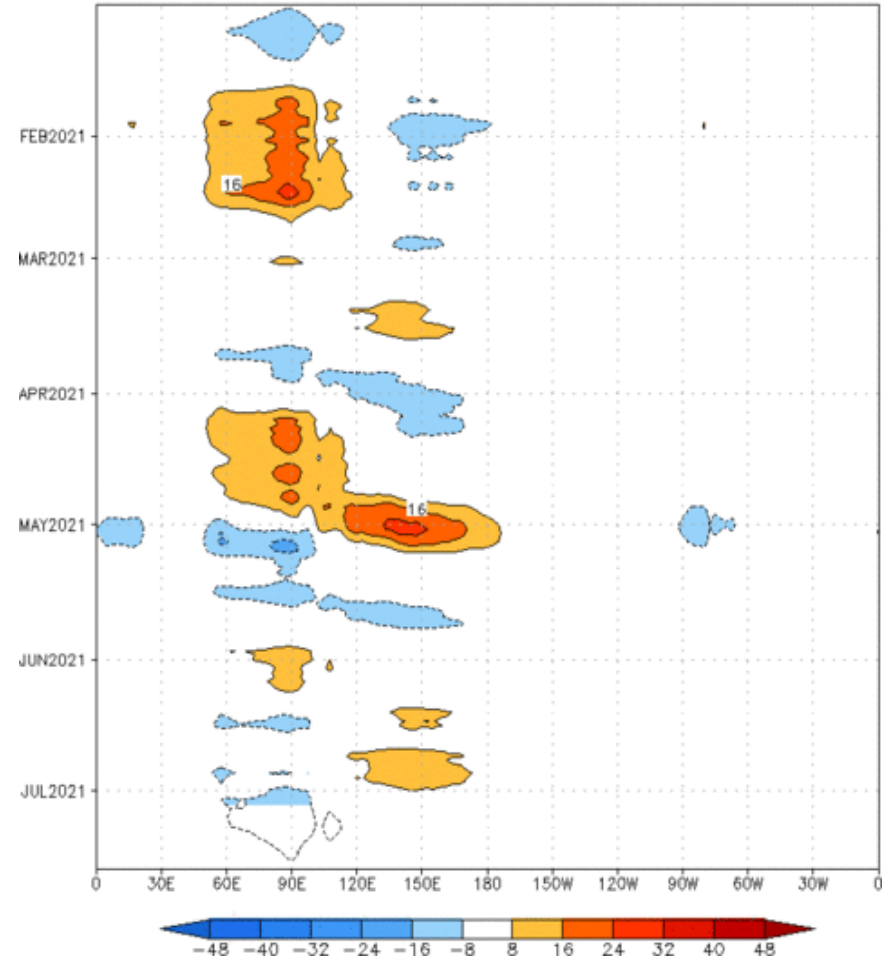
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (04 Jul 2021)



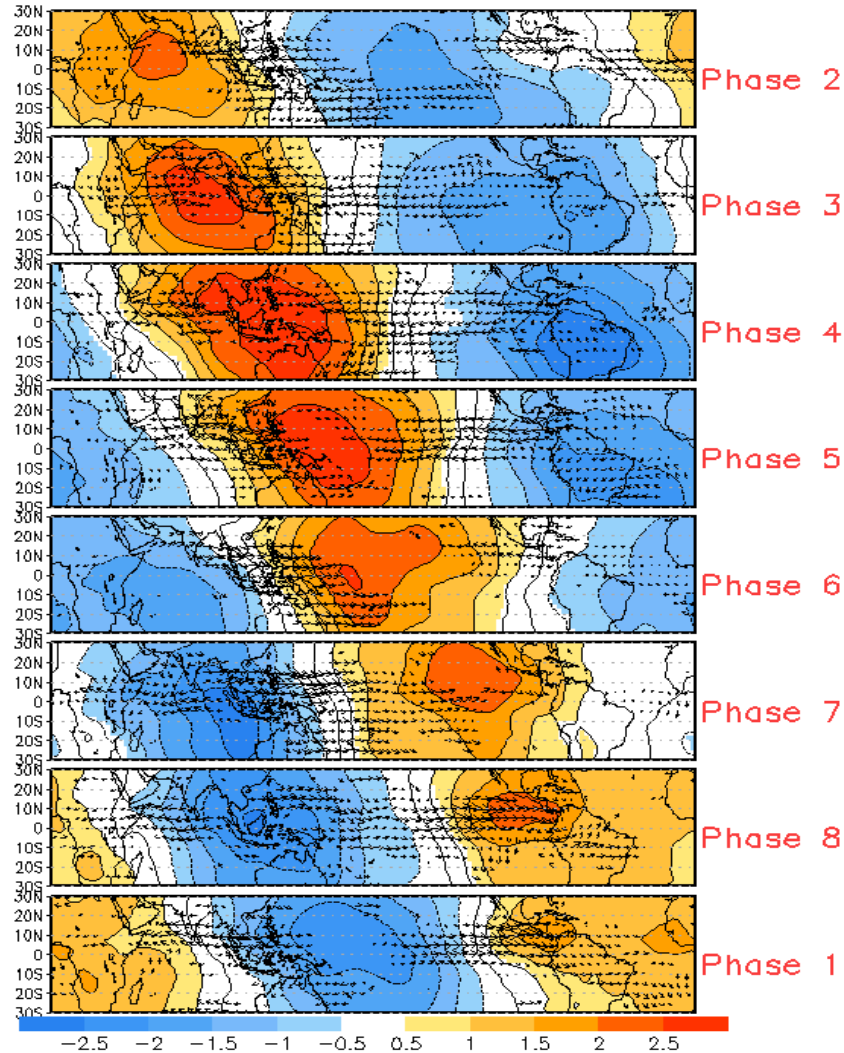
- The constructed analog forecast is similar to that of the GEFS but with less drying across the Western Hemisphere.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:02-Jan-2021 to 04-Jul-2021
The unfilled contours are CA forecast reconstructed anomaly for 15 days

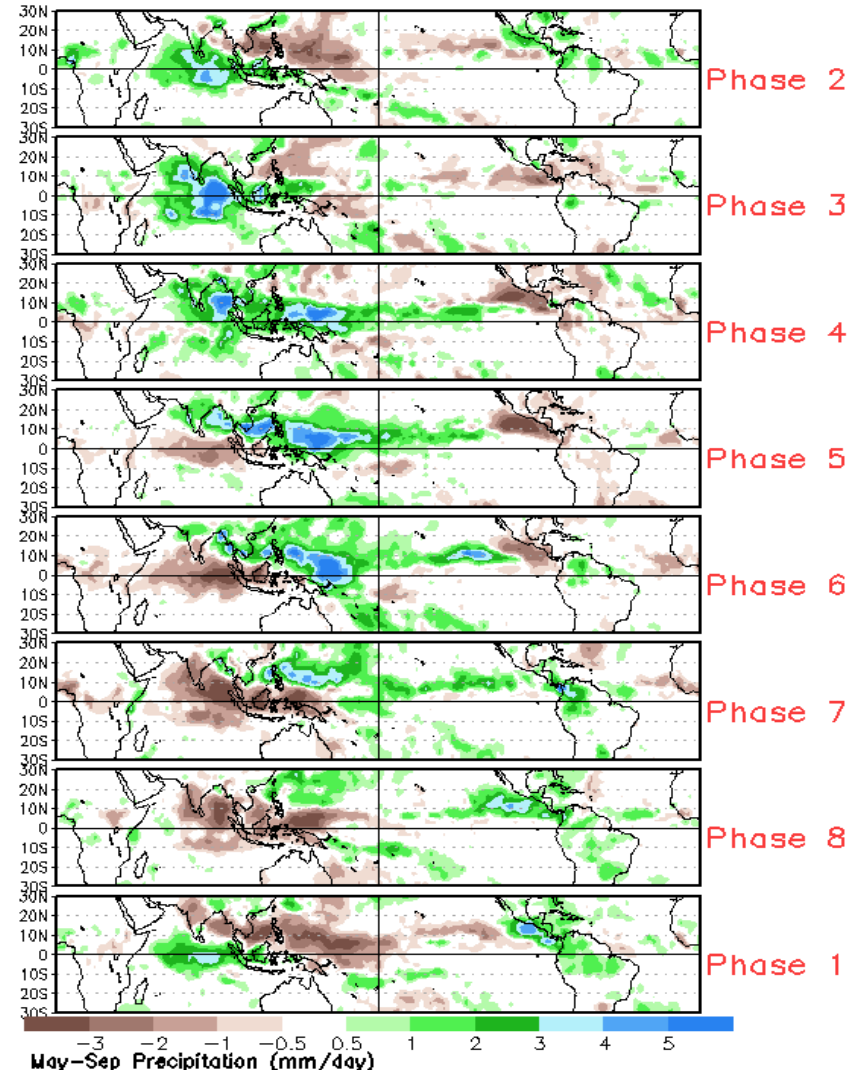


MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



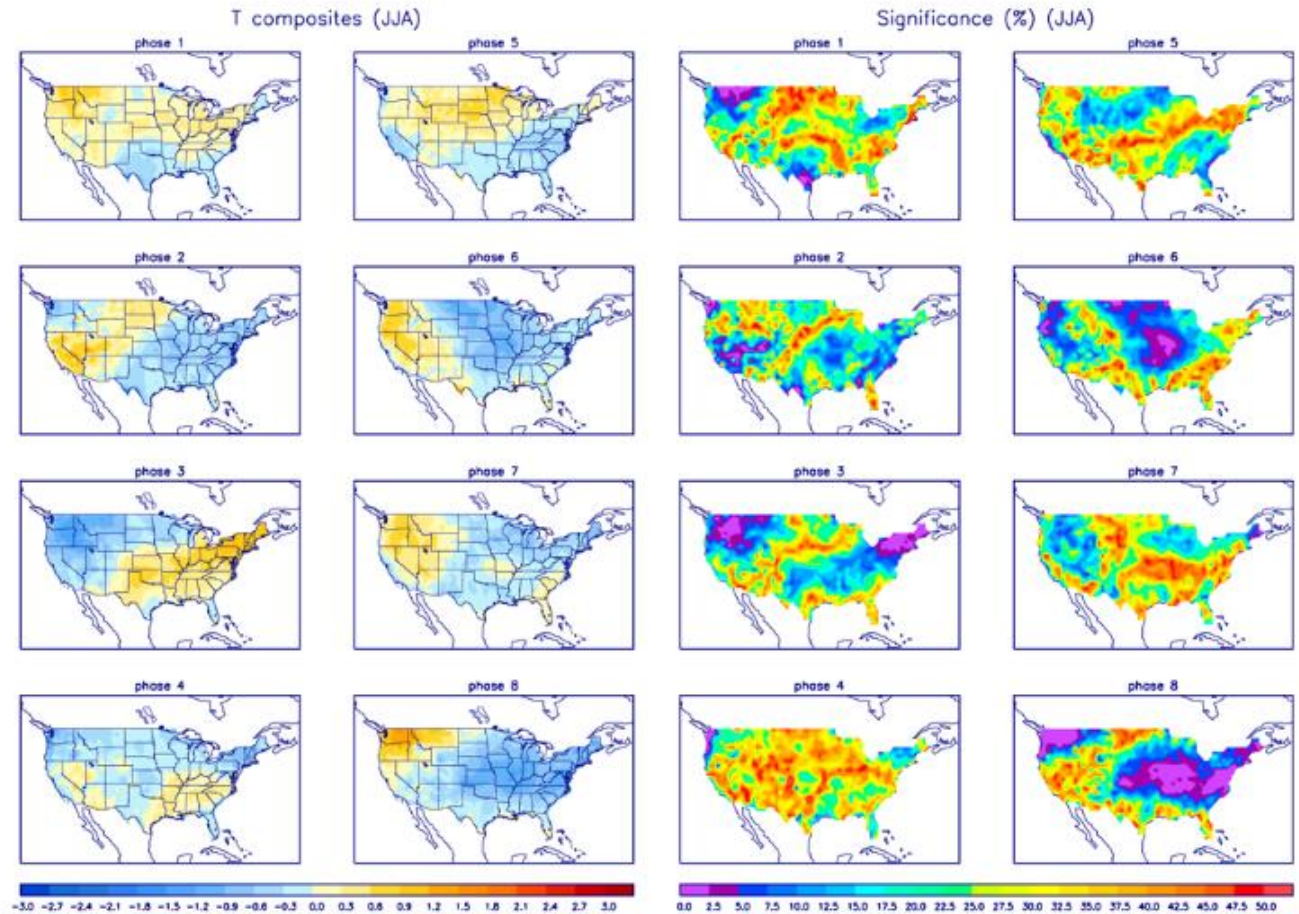
Precipitation Anomalies



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.

