

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
18 July 2022

Overview

- The enhanced phase of the MJO has stalled over the Maritime Continent where constructive interference with the ongoing La Niña led to an enhanced trade wind regime over the equatorial Pacific.
- Dynamical model RMM forecasts have come into good agreement favoring resumed eastward propagation of the intraseasonal signal at a low amplitude over the Western Pacific, with the potential for a more coherent MJO emerging over the Western Hemisphere during the next two weeks.
- Combined with forecast Kelvin wave activity, conditions are expected to be conducive for additional tropical cyclone formation in the eastern Pacific.

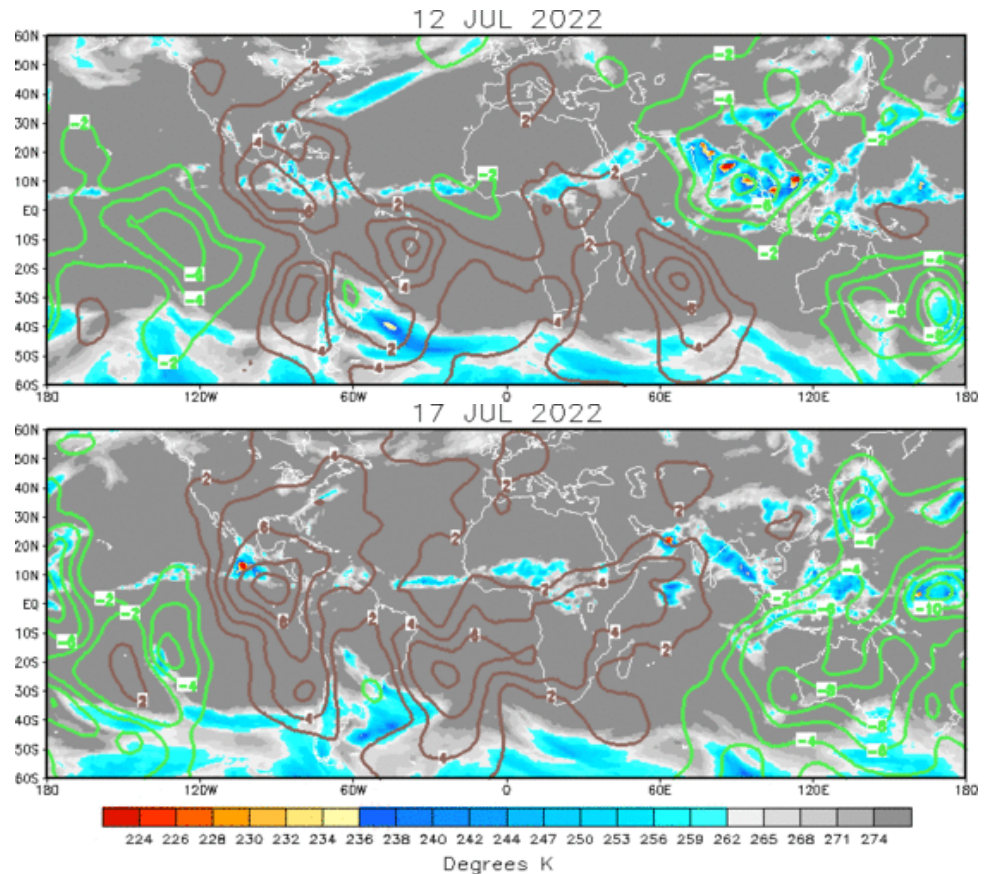
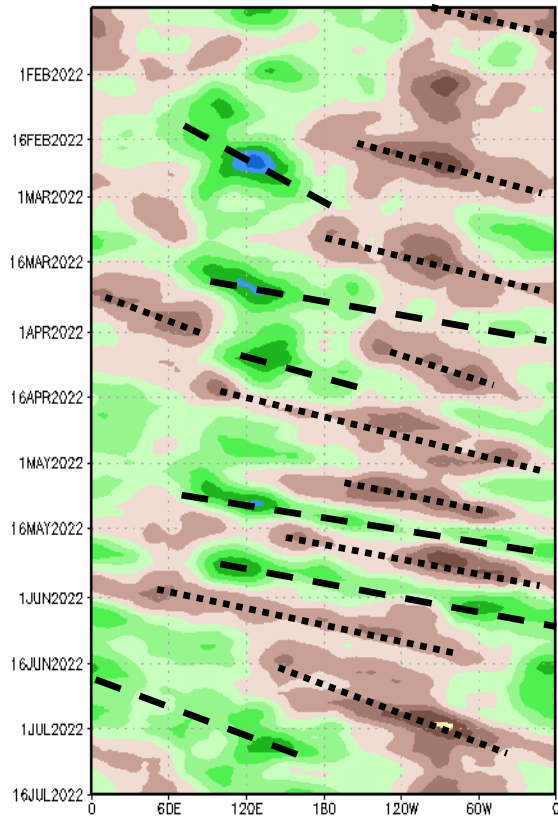
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

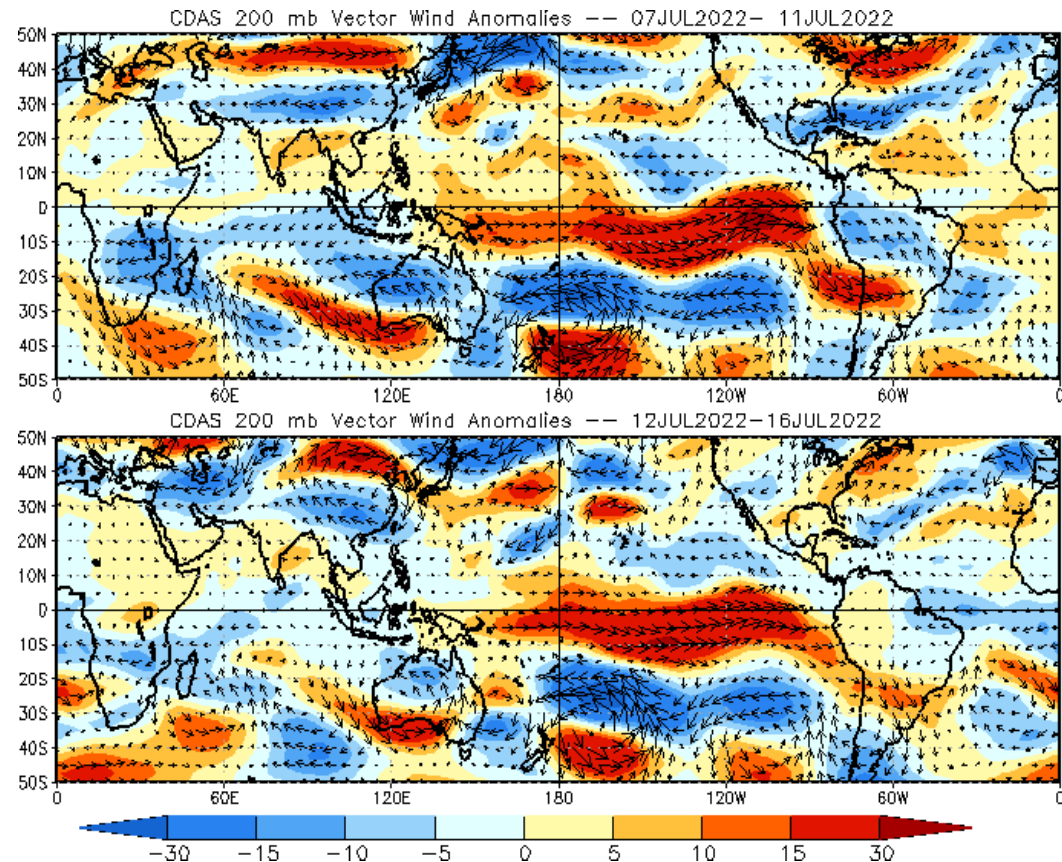
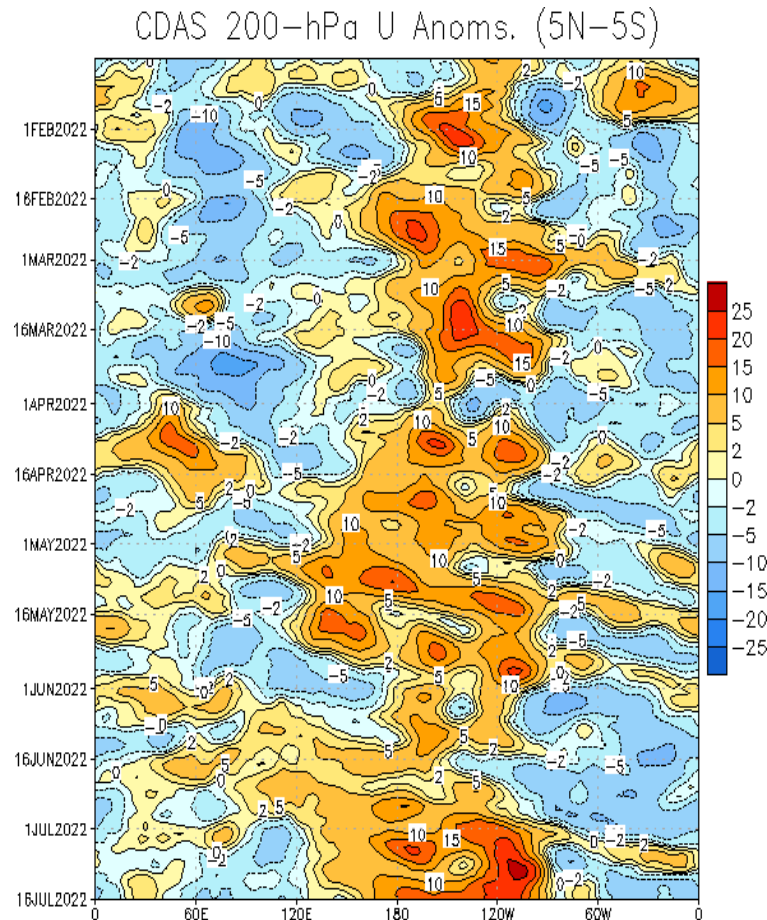
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- Following a period of coherent intraseasonal activity last month, the MJO has since stalled where it has constructively interfered with the low frequency base state over the Maritime Continent, with anomalous convergence aloft anchored over the Americas.
- Recently, the leading edge of the main convective envelope has shifted eastward beyond the Date Line, suggestive of renewed eastward propagation.

200-hPa Wind Anomalies

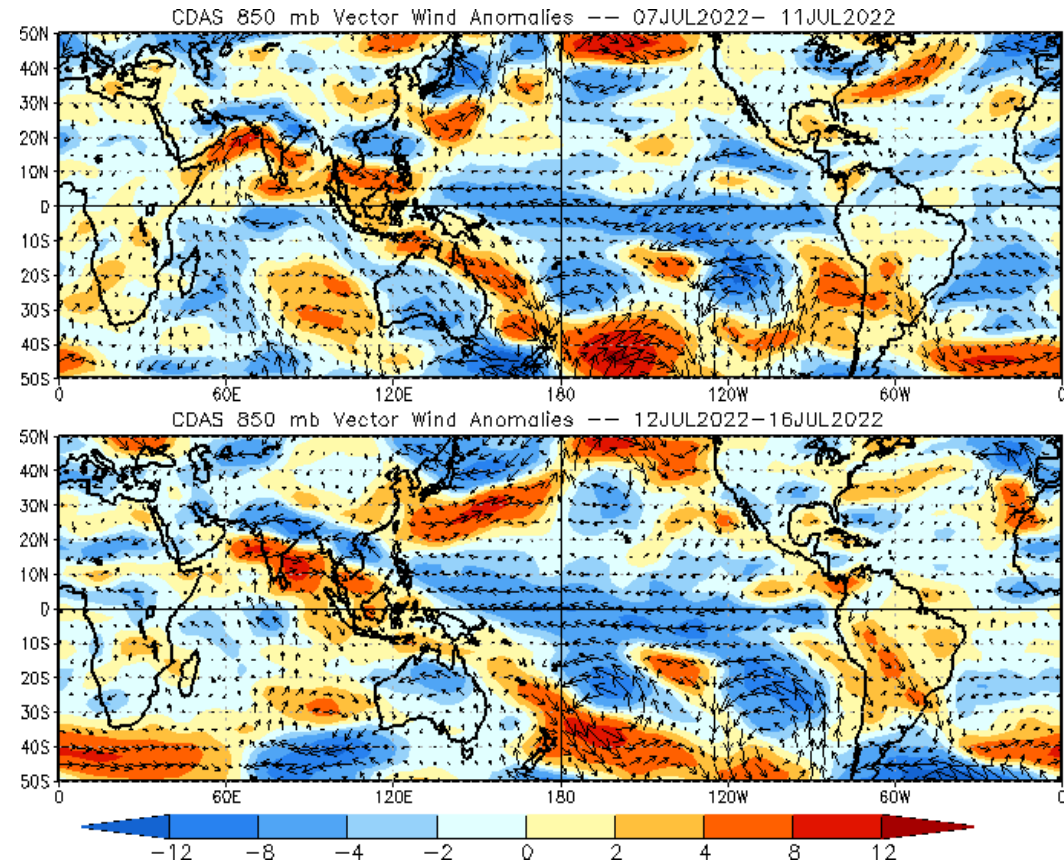
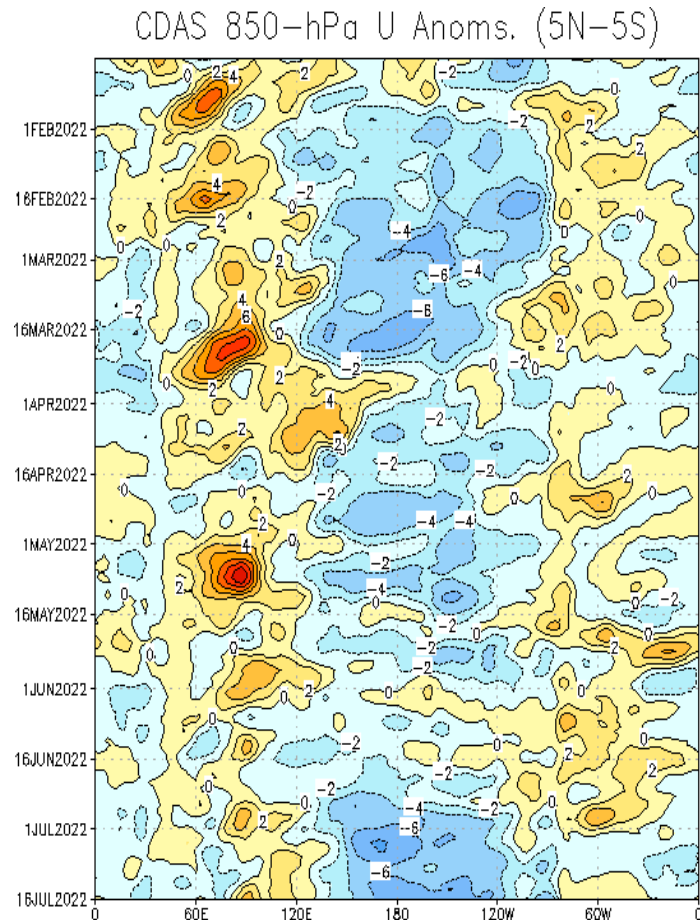
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Anomalous westerlies aloft have been firmly planted across the central and eastern Pacific since the start of July, consistent with the ongoing La Niña. Wave train activity remains evident in the extratropics.
- Anomalous westerlies have weakened between 120°E and 150°E during the past week, with more anomalous easterly flow in the region.

850-hPa Wind Anomalies

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

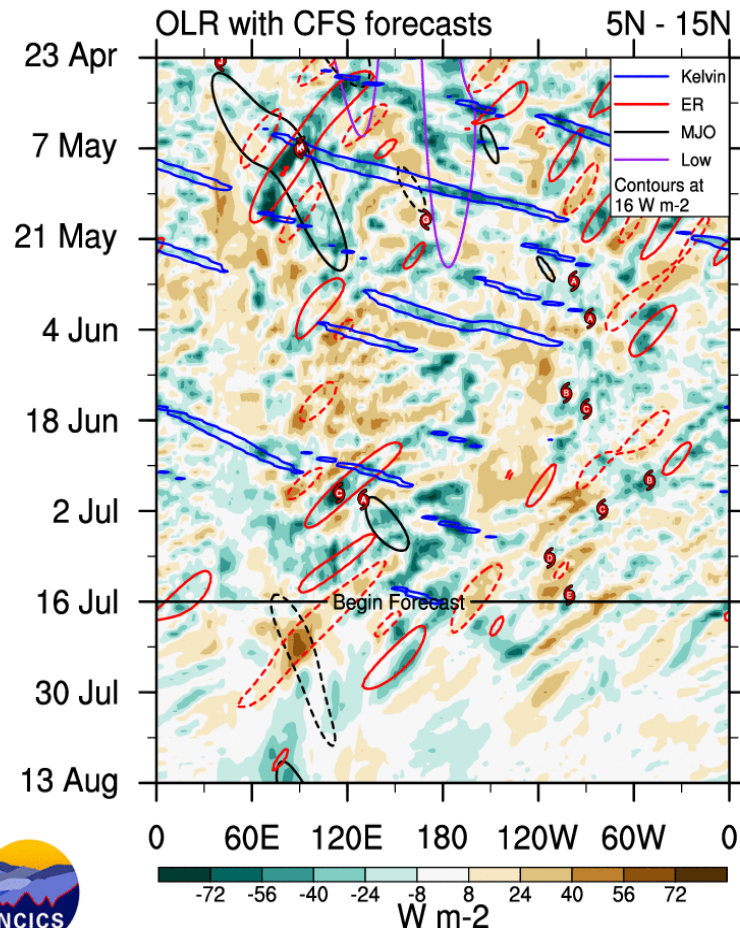


- Enhanced trades continue to prevail across the entire Pacific basin (10S-10N), as well parts of the tropical Atlantic, with little evidence of eastward propagating features during the past few weeks.
- Strong cross-equatorial flow over the Indian Ocean and monsoonal troughing are evident throughout Indian and southeastern Asia.

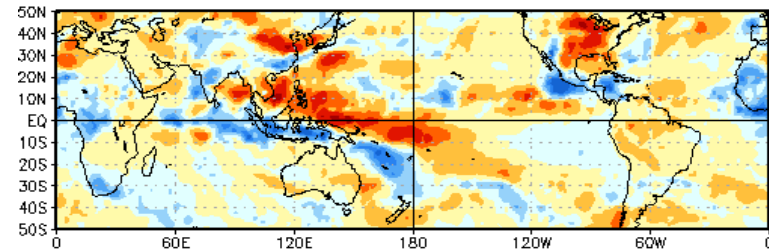
Outgoing Longwave Radiation (OLR) Anomalies

Green shades: Anomalous convection (wetness)

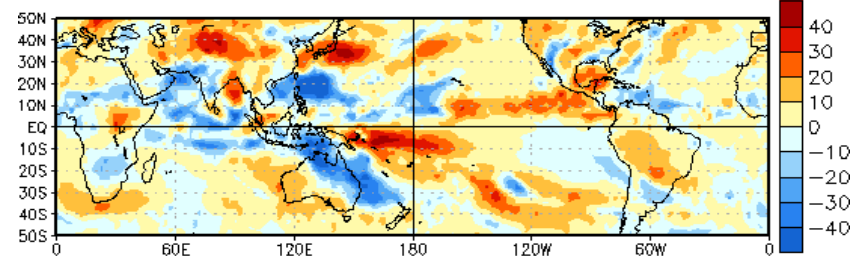
Brown shades: Anomalous subsidence (dryness)



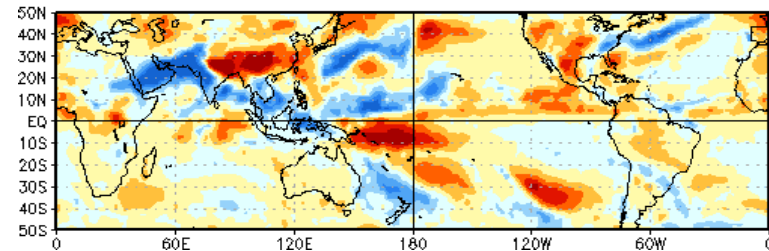
OLR Anomalies
15 JUN 2022 to 24 JUN 2022



25 JUN 2022 to 4 JUL 2022

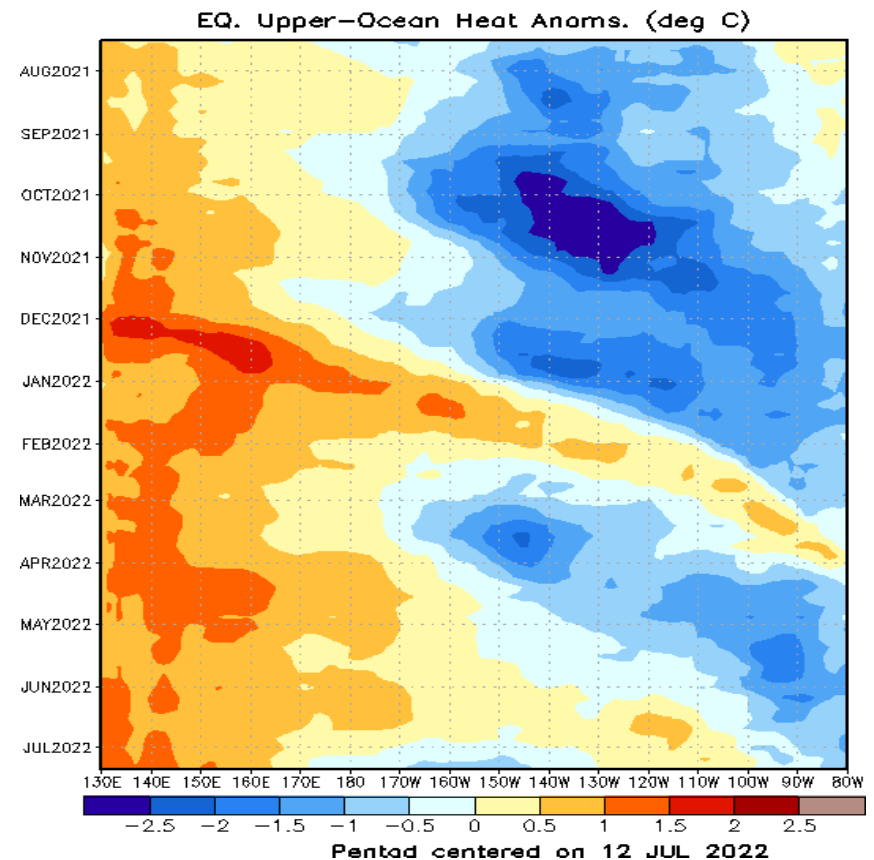
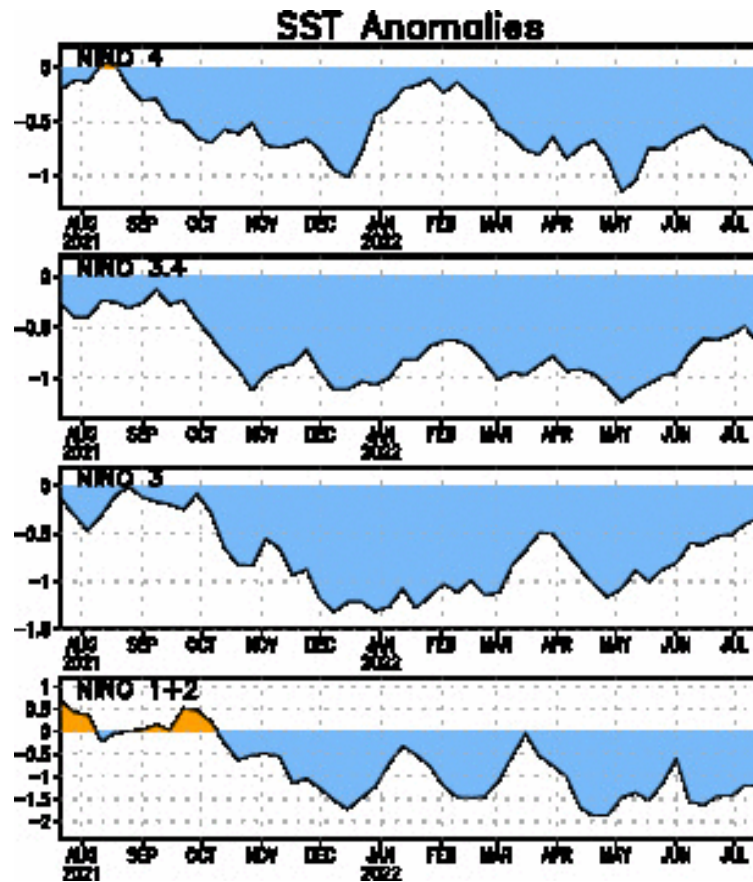


5 JUL 2022 to 14 JUL 2022



- Enhanced convection has become more pronounced north of equator to the west of the Date Line tied to Kelvin wave activity. Suppressed conditions are evident across the eastern Pacific, despite an active tropical cyclone season thus far in the eastern Pacific (TCs Bonnie and Darby contributed ~27% to the mean total ACE).
- CFS forecasts indicate Rossby wave associated enhanced convection in the Western Pacific later in July.

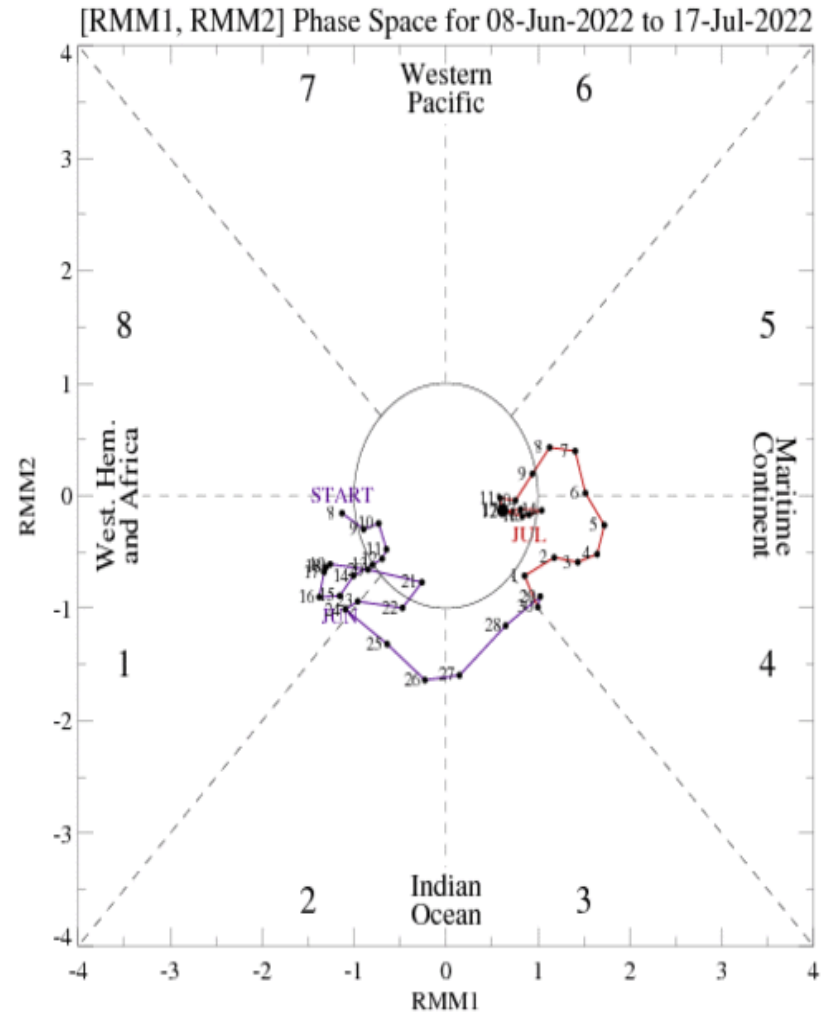
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Subsurface cooling has emerged mainly to the east of the Date Line in response to the strong lower-level easterlies observed over the equatorial central Pacific since June.
- While modulated by oceanic downwelling Kelvin wave activity which led to periods of warming, all Niño regions have remained below-normal since boreal autumn of last year.

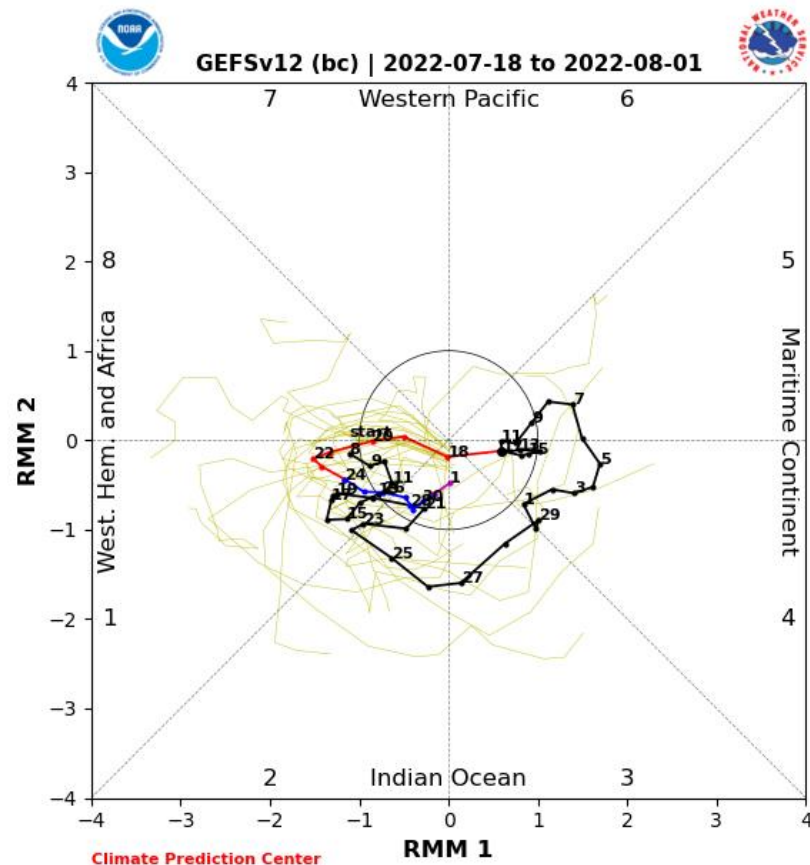
MJO Index: Recent Evolution

- Consistent with upper-level velocity potential anomalous fields, the intraseasonal signal has stalled over the Maritime Continent since early July, where it currently resides within the RMM unit circle.

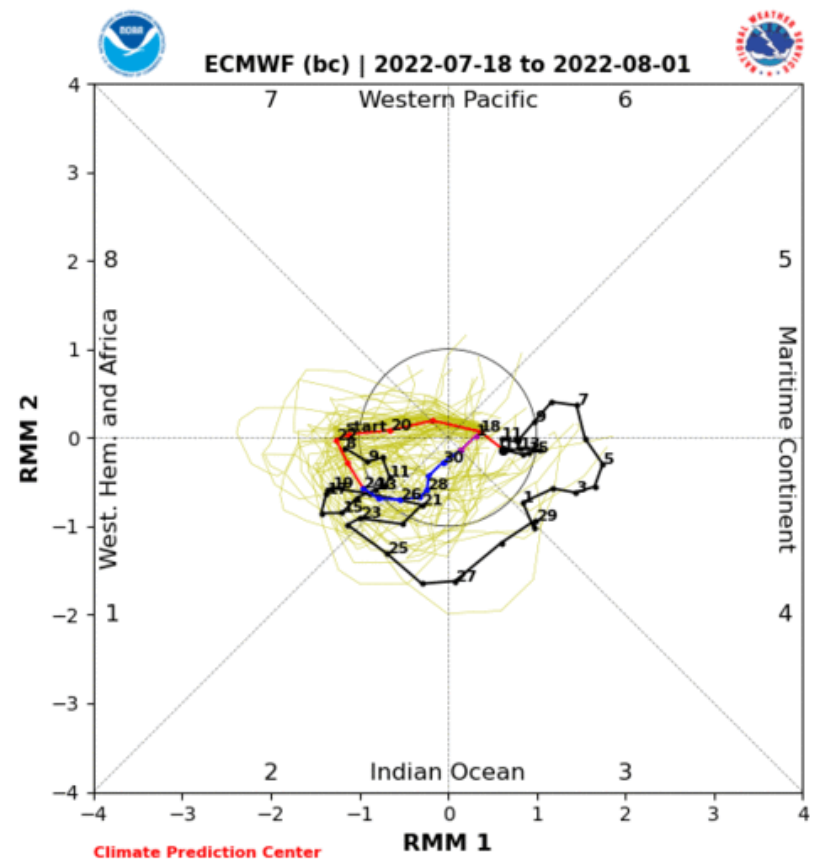


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



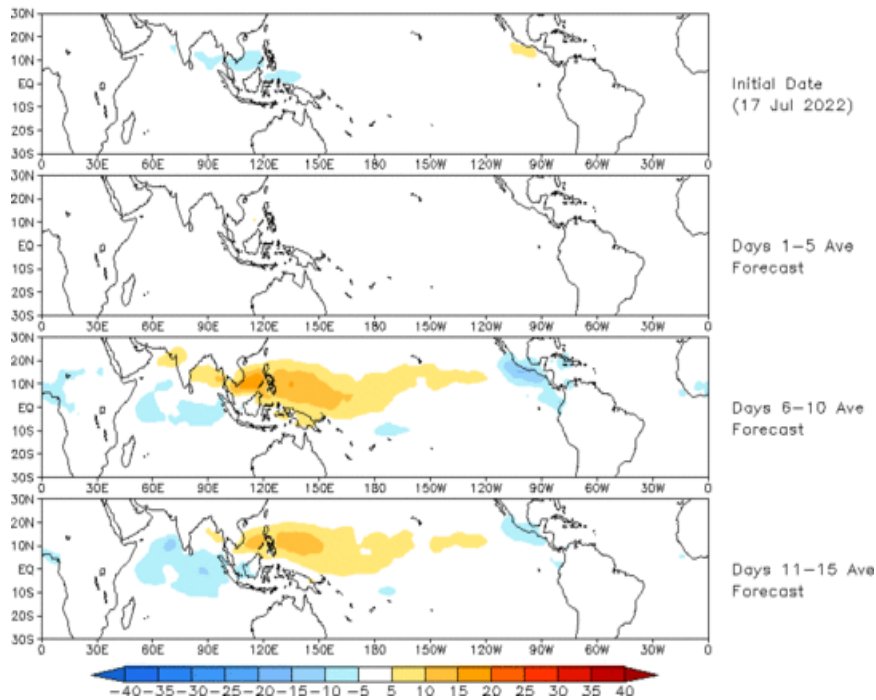
ECMWF Forecast

- Good agreement exists in the dynamical models favoring a “bee-line” of the signal into the western Hemisphere by the end of week-1, with the potential for more coherent MJO activity during week-2.
- Since last week, the ECWMF and BOMM (not pictured) have been bullish with this outlook, with the CFS and GEFS becoming more aligned with this realization more recently.

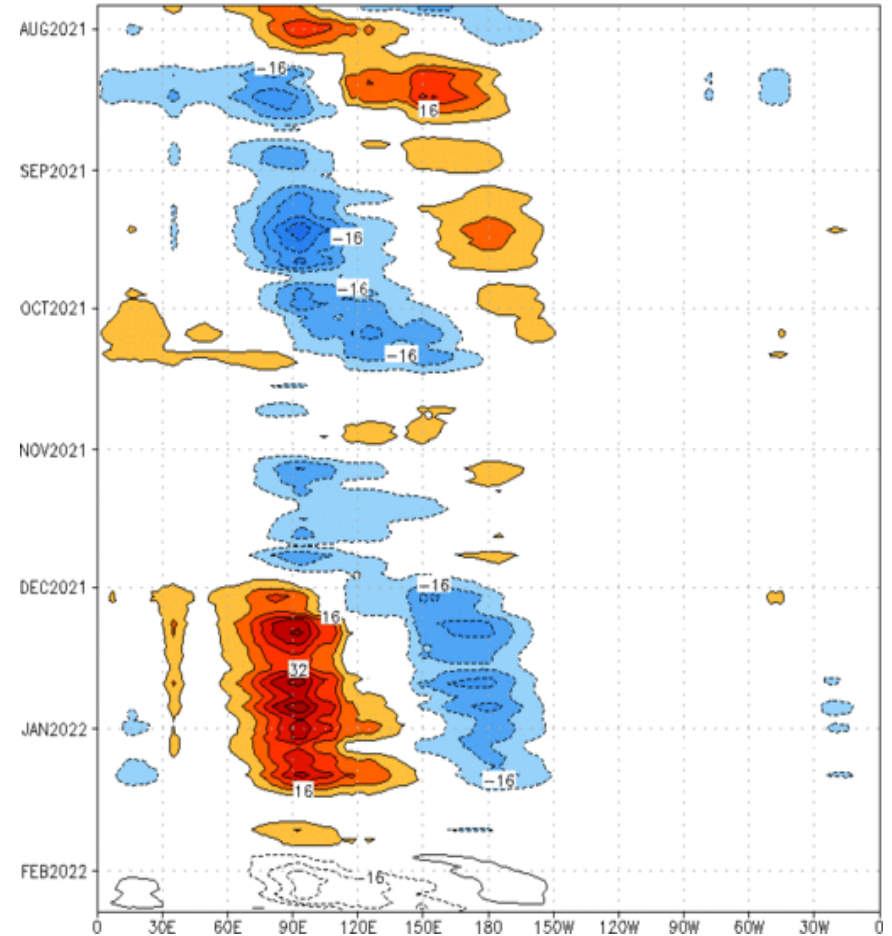
MJO: GEFS Forecast Evolution

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: 17 Jul 2022
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [$7.5^{\circ}\text{S}, 7.5^{\circ}\text{N}$] ($\text{cont: } 4\text{Wm}^{-2}$) Period: 27-Jul-2021 to 26-Jan-2022
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

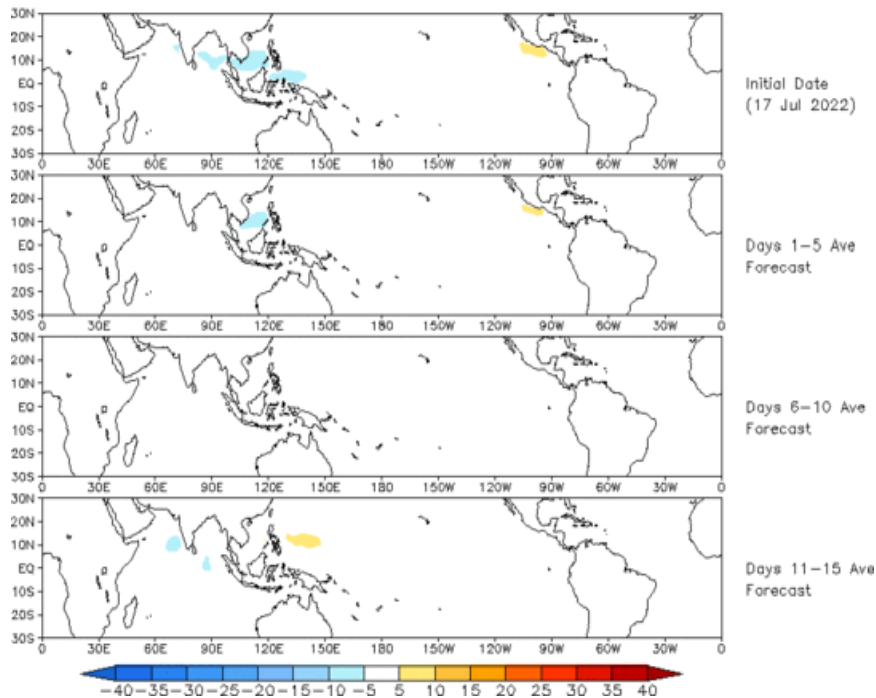


- The GEFS RMM-index based OLR anomaly field depicts enhanced (suppressed) convection developing over the Indian Ocean (Maritime Continent/West Pacific) by week-2, consistent with phase 1 MJO precipitation composites during boreal summer.

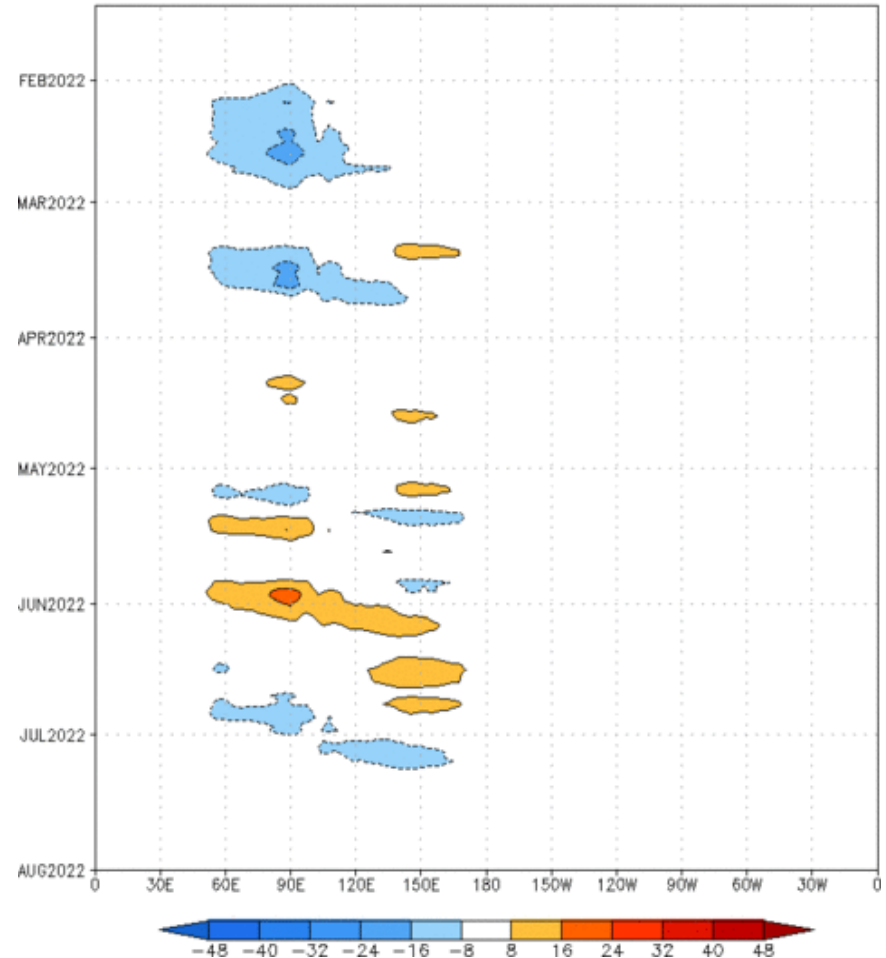
MJO: Constructed Analog Forecast Evolution

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 (17 Jul 2022)



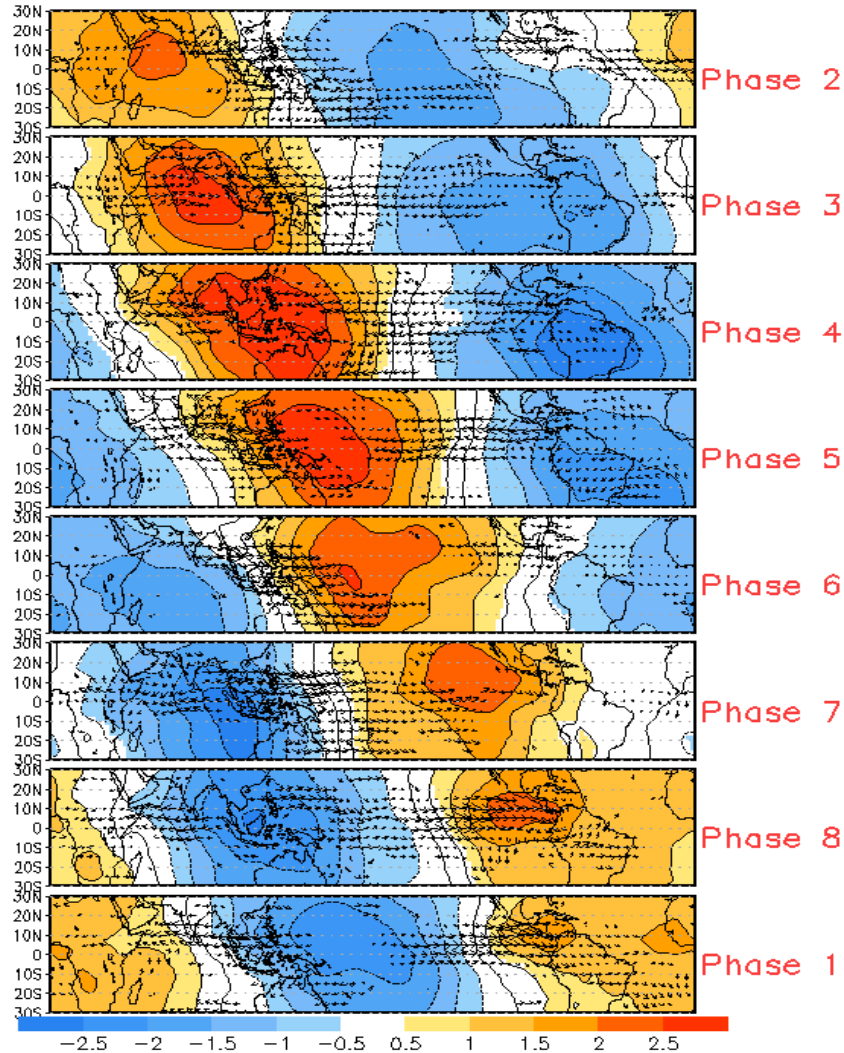
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:15-Jan-2022 to 17-Jul-2022
The unfilled contours are CA forecast reconstructed anomaly for 15 days



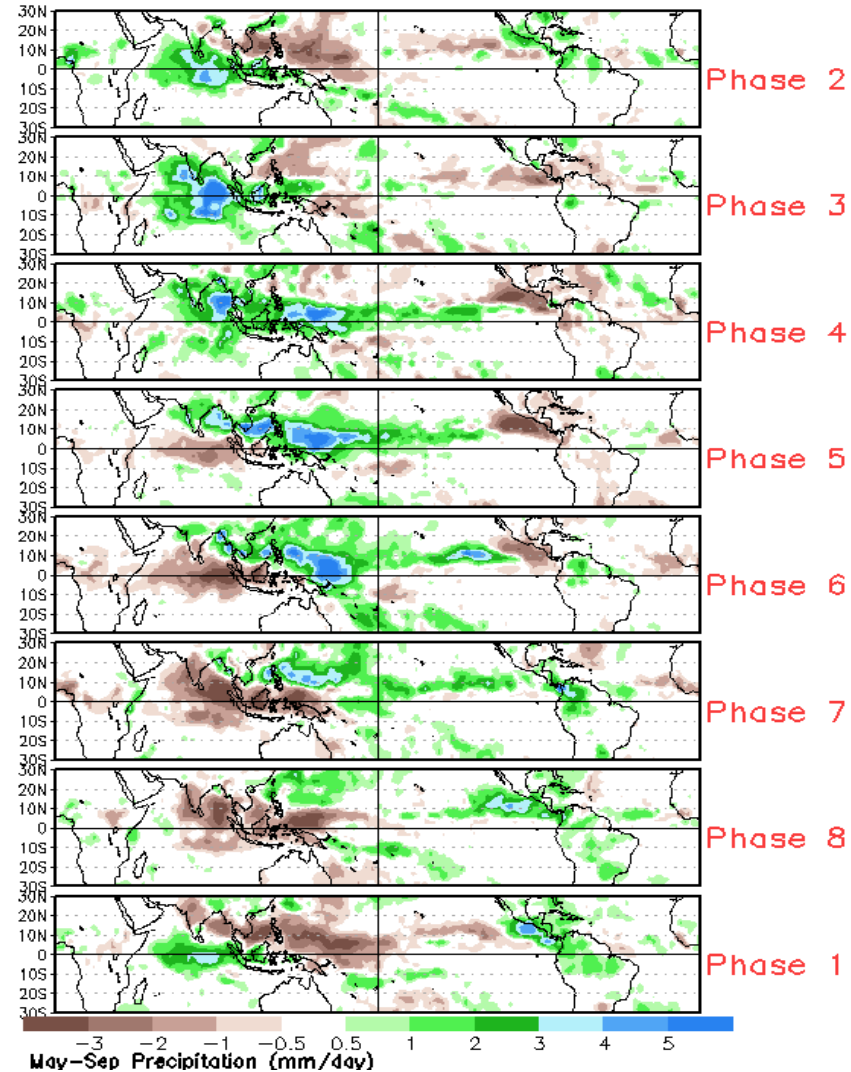
- The constructed analog forecast of RMM-based OLR anomalies is comparatively more muted, lacking any developing convective dipole structure.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



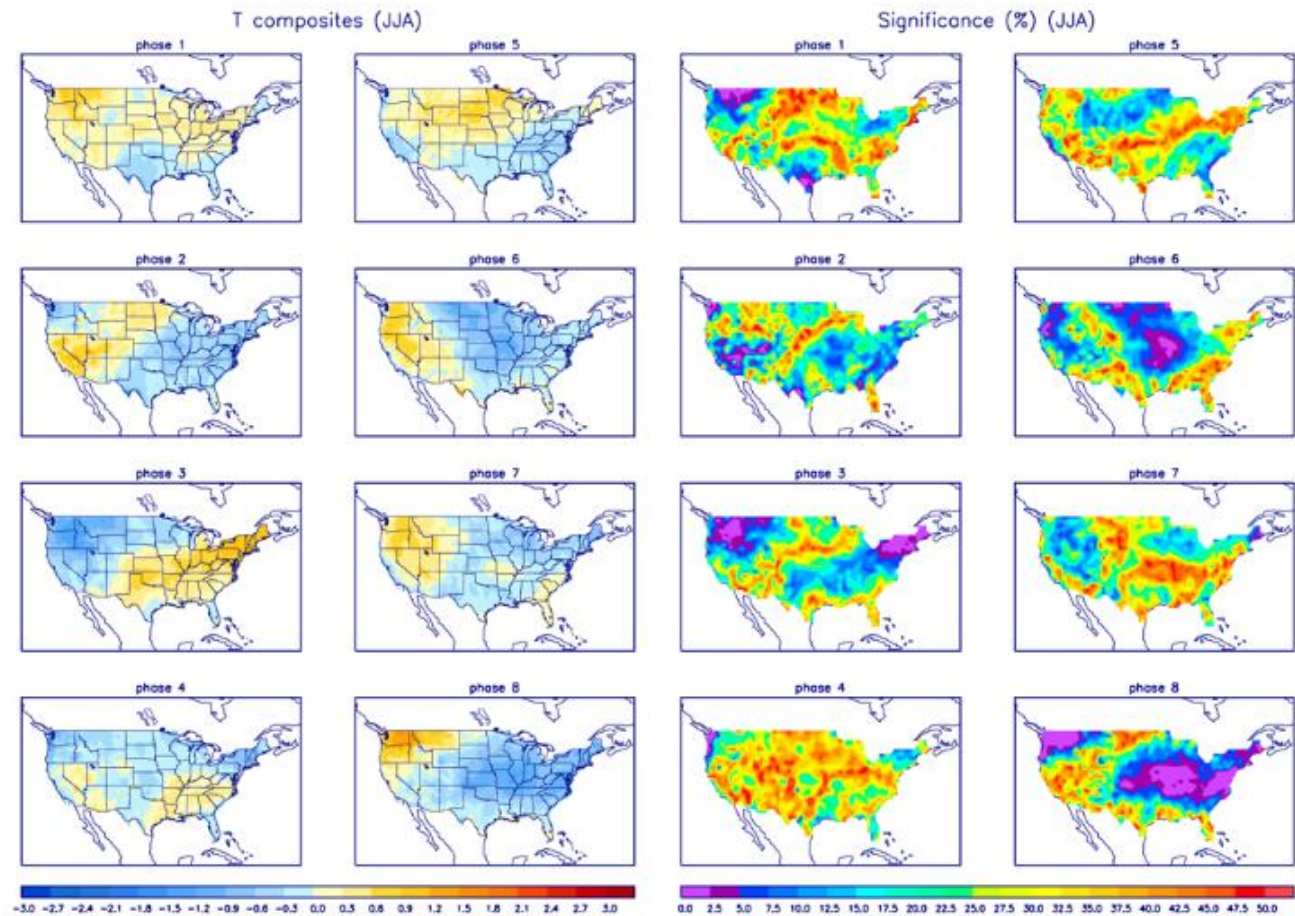
Precipitation Anomalies



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.

