

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
1 August 2022

Overview

- The MJO signal weakened through mid-July due to destructive interference with the La Niña base state.
- Dynamical model RMM forecasts a continued weak MJO signal in the coming two weeks, and there is a lot of uncertainty regarding whether convective activity will continue to propagate eastward in the coming weeks.
- The Atlantic basin continues to be quiet with regard to tropical cyclone (TC) development, while the East Pacific continues to be active, possibly due to Rossby wave activity enhancing convection.

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>

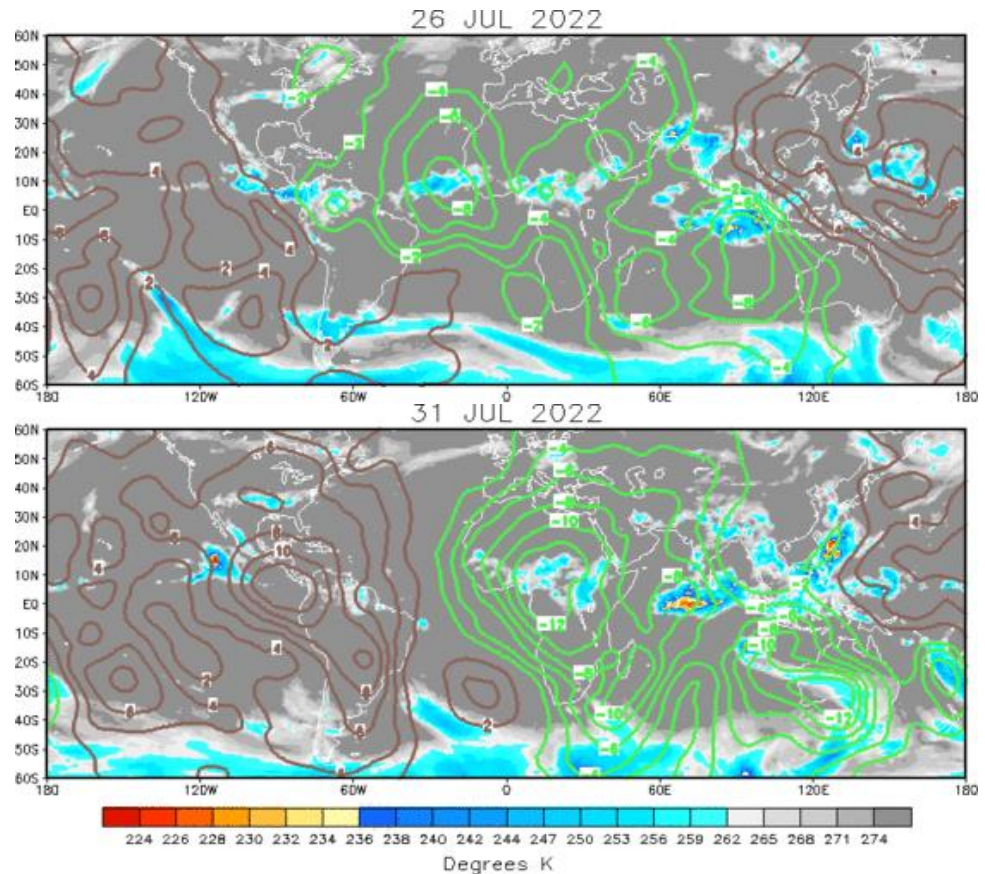
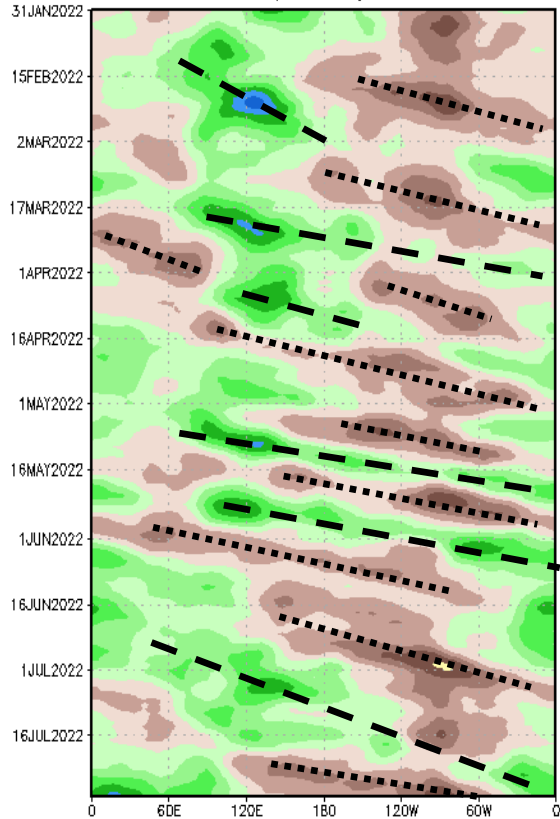
200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

200-hPa Velocity Potential Anomaly: 5N-5S

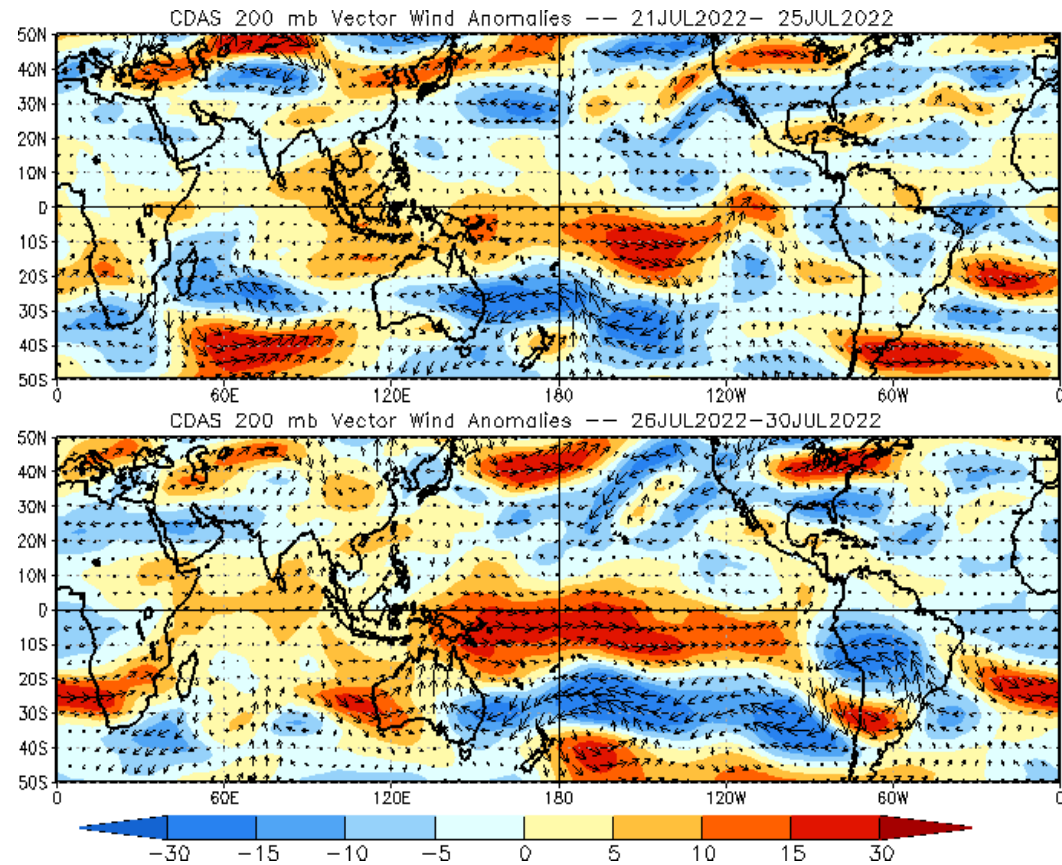
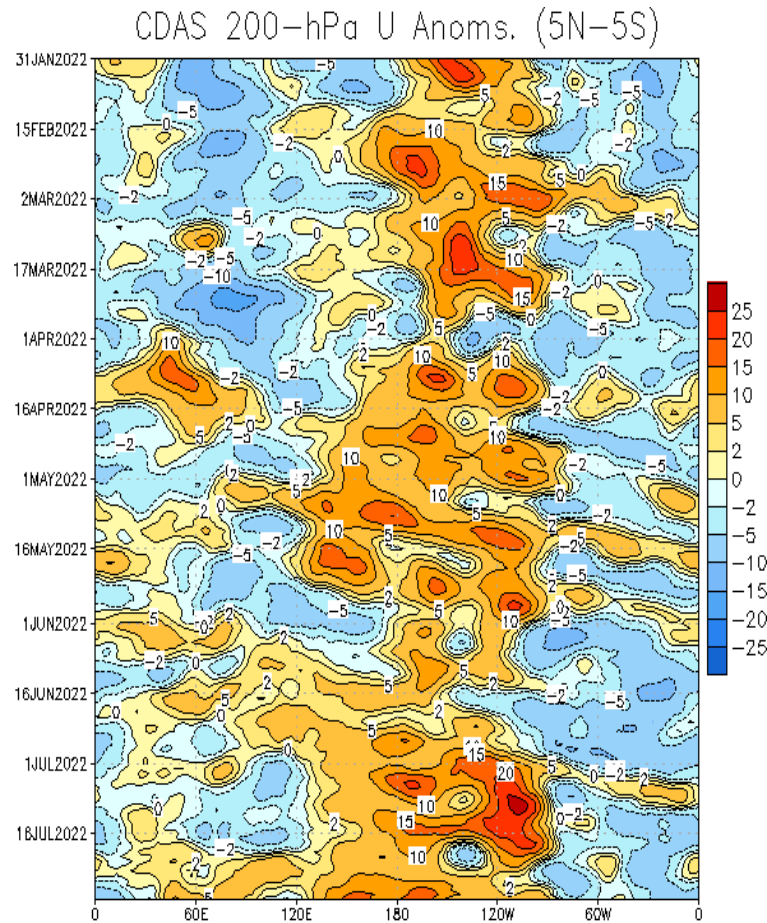
5-day Running Mean



- Despite increased MJO activity in late June and early July, interaction with La Nina base state continues to interfere with MJO eastward propagation when convective envelop reaches Maritime Continent.
- Recently there has been a clear wave-1 pattern that has been slowly propagating eastward, with main convective envelope currently situated from Africa eastward across Indian Ocean.

200-hPa Wind Anomalies

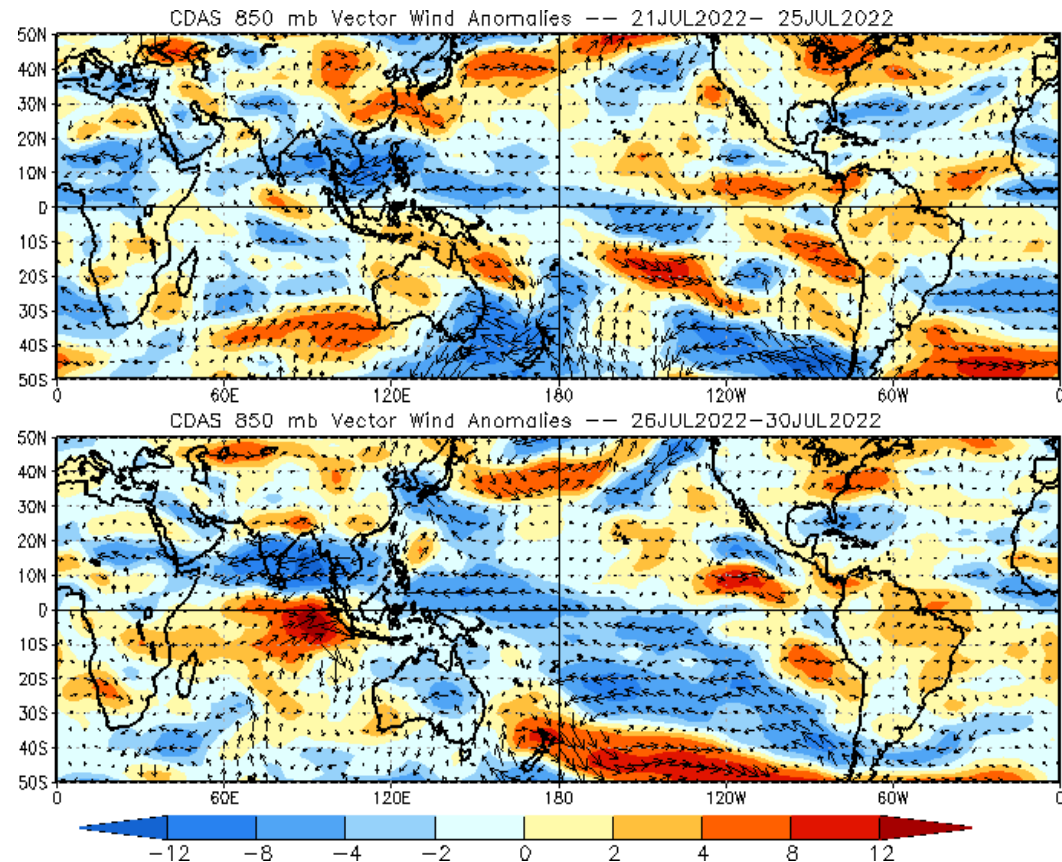
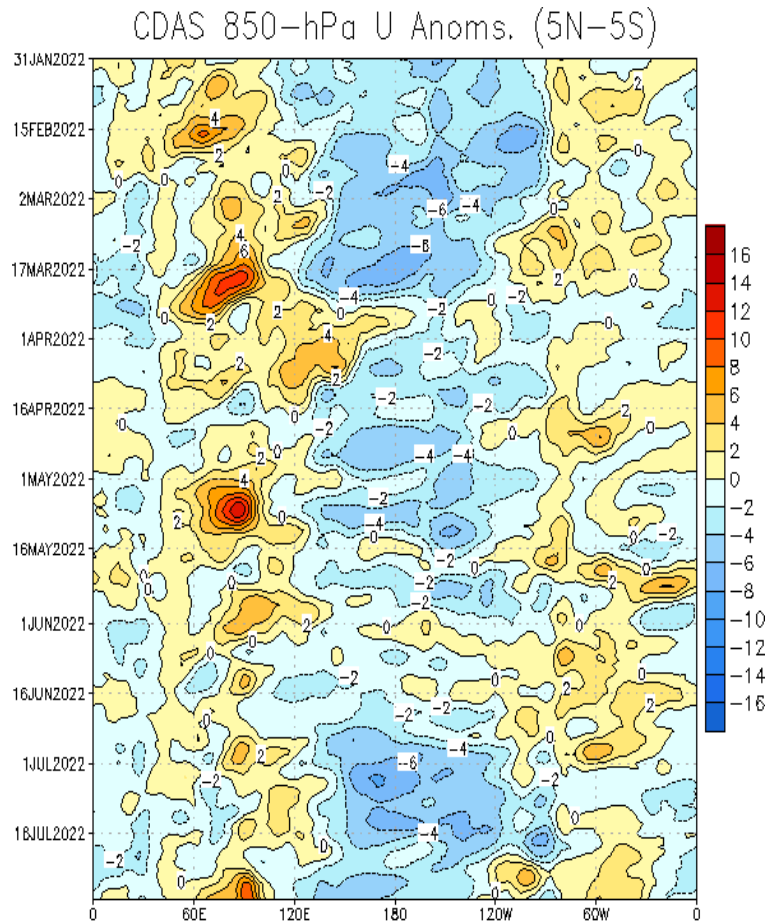
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Strong westerly anomalies continue across much of the equatorial Pacific.
- This broad area of westerly anomalies has spread westward and strengthened in the last week.

850-hPa Wind Anomalies

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

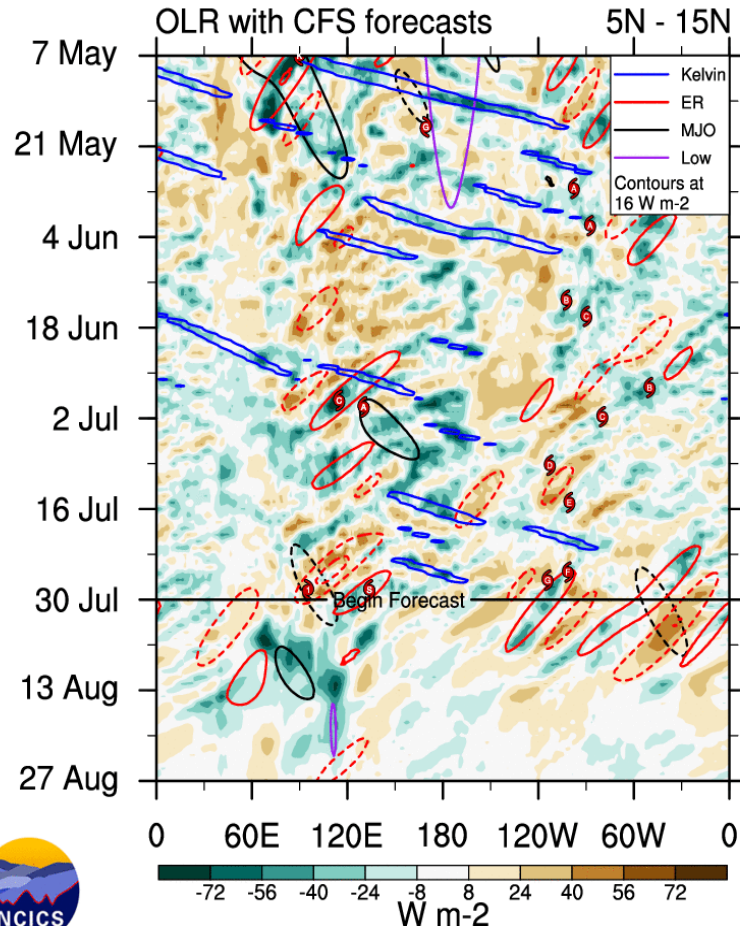


- Anomalous strong trade winds seen in the first half of July have weakened somewhat and have reduced in their eastward extent but remain enhanced west of the Date Line.
- Anomalous easterlies over the Asian Monsoon region have increased in intensity recently after a lull in mid- to late-July.
- An area of anomalous westerlies has emerged over the eastern Indian Ocean in the last week.

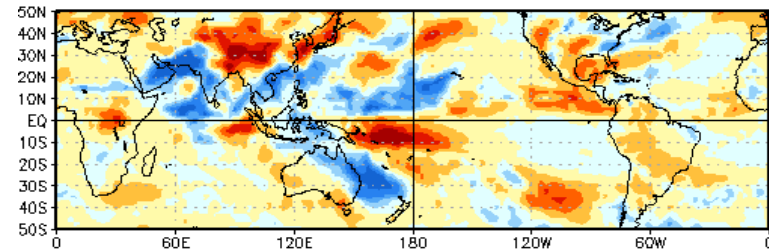
Outgoing Longwave Radiation (OLR) Anomalies

Green shades: Anomalous convection (wetness)

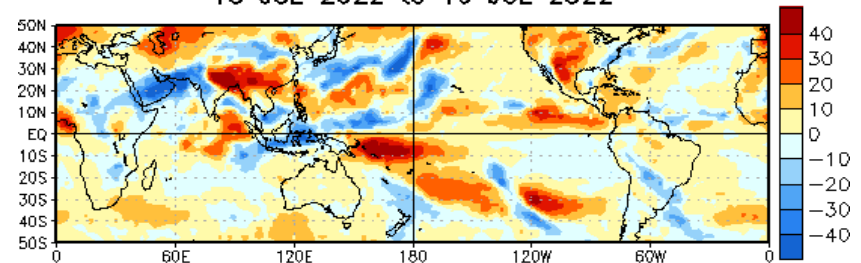
Brown shades: Anomalous subsidence (dryness)



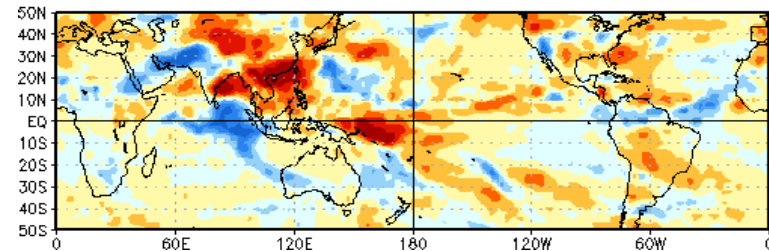
OLR Anomalies
30 JUN 2022 to 9 JUL 2022



10 JUL 2022 to 19 JUL 2022

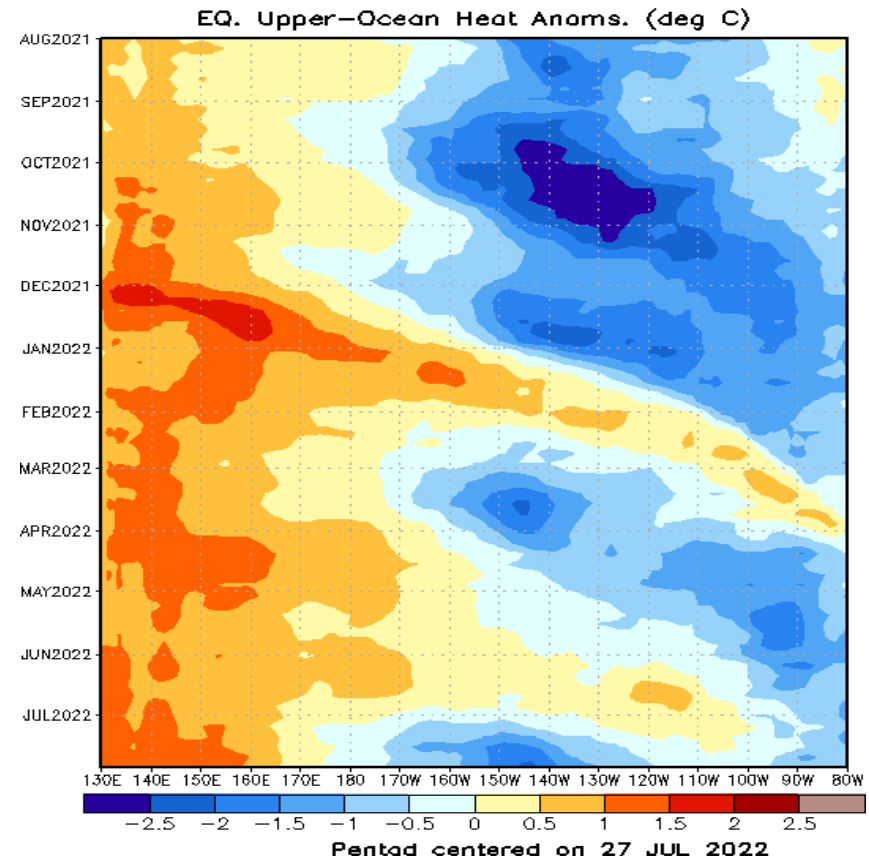
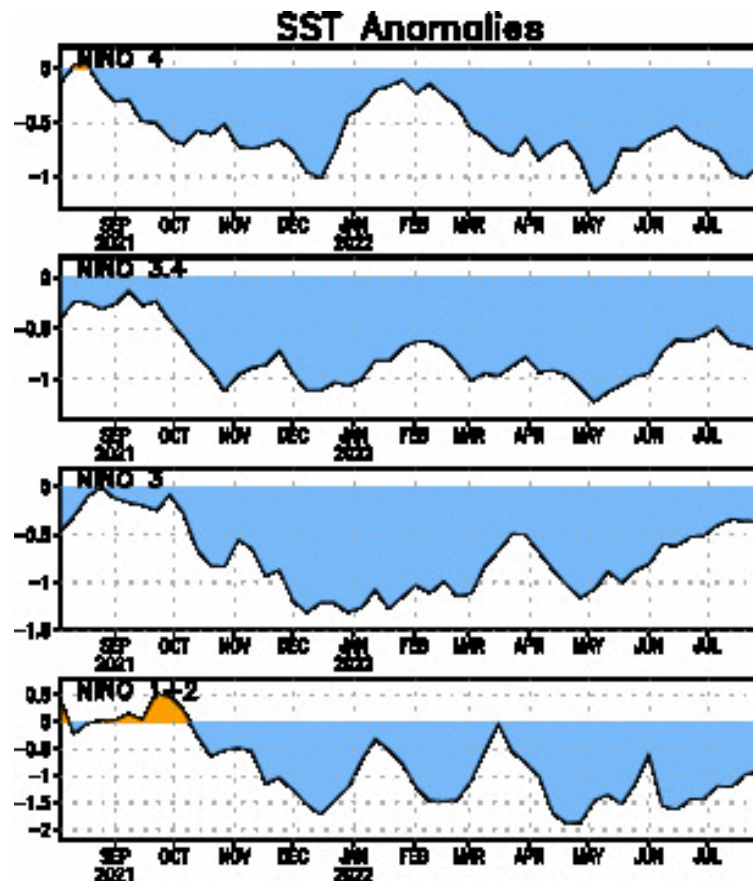


20 JUL 2022 to 29 JUL 2022



- La Nina-induced suppressed convection west of the Date Line remains a predominant feature in OLR anomalies.
- Abundant Rossby wave activity appears to be an important feature in increased East Pacific TC activity.
- The CFS forecast with wave filtering indicates a potential for renewed MJO activity in early August across the Indian Ocean.

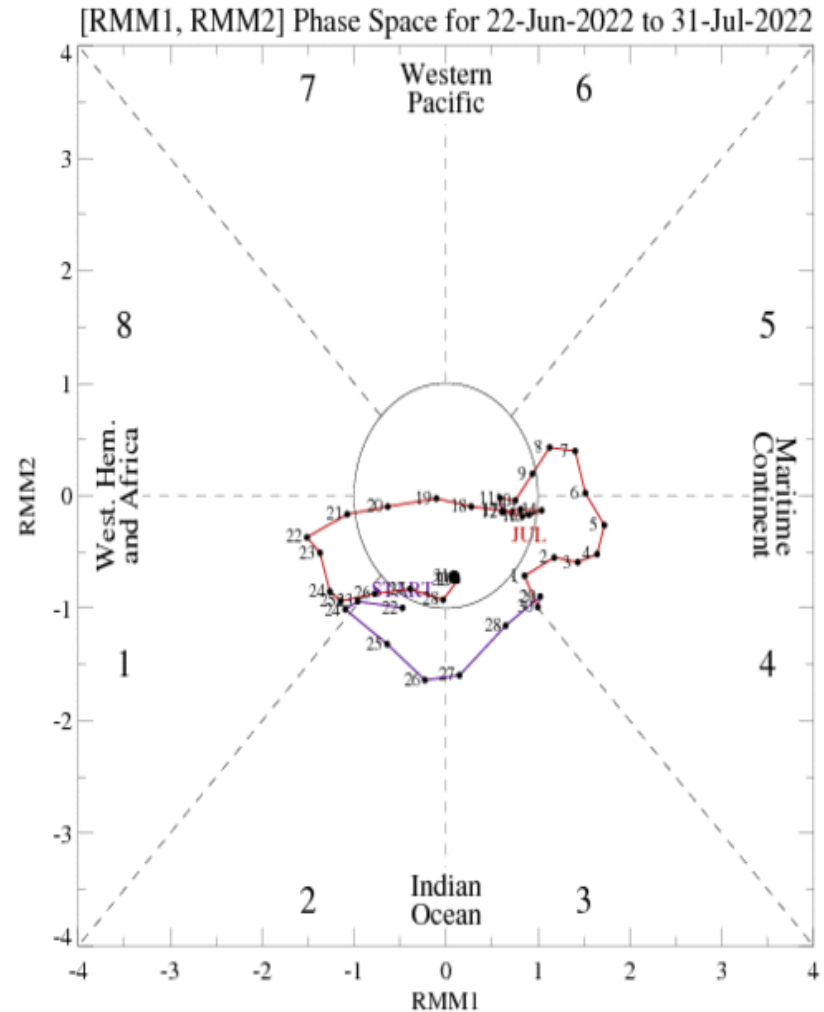
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Strongly enhanced trade winds through much of July have resulted in an upwelling oceanic Kelvin wave following the passage of the downwelling phase in June. Warm anomalies east of the Date Line have been replaced with cold anomalies in the last few weeks.
- SSTs remained below average across all Niño basins, allowing for a continuation of the atmospheric response.

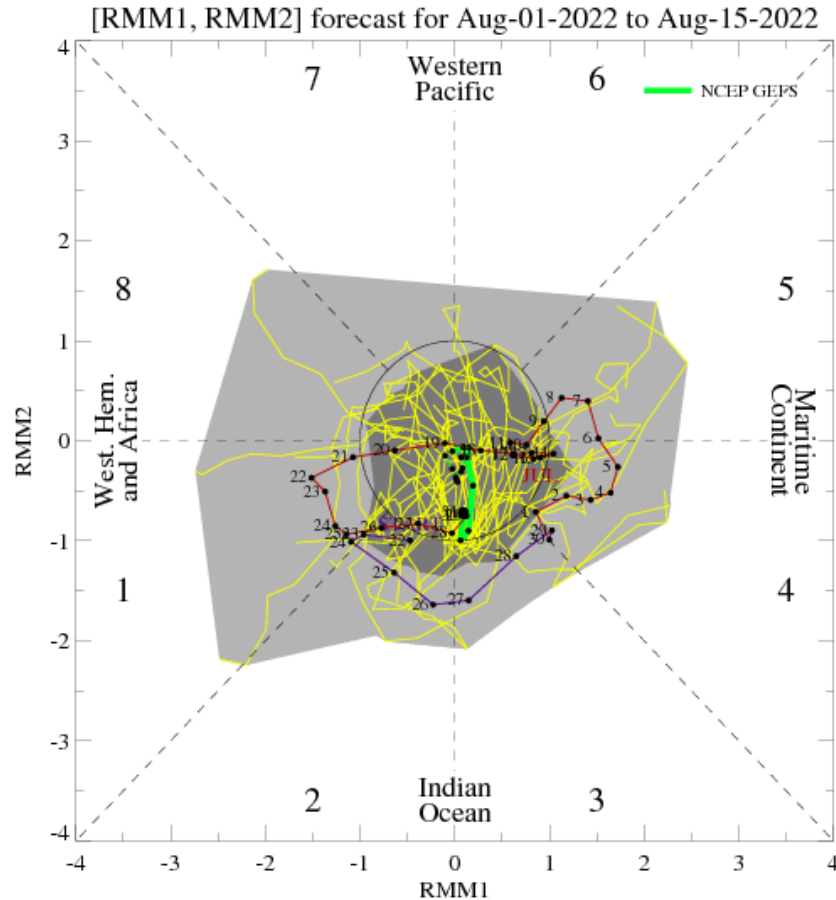
MJO Index: Recent Evolution

- After a round of enhanced MJO activity in late July the RMM index has fallen back into the unit circle.
- Despite this reduction in strength of RMM signal, eastward propagation has continued in recent past.

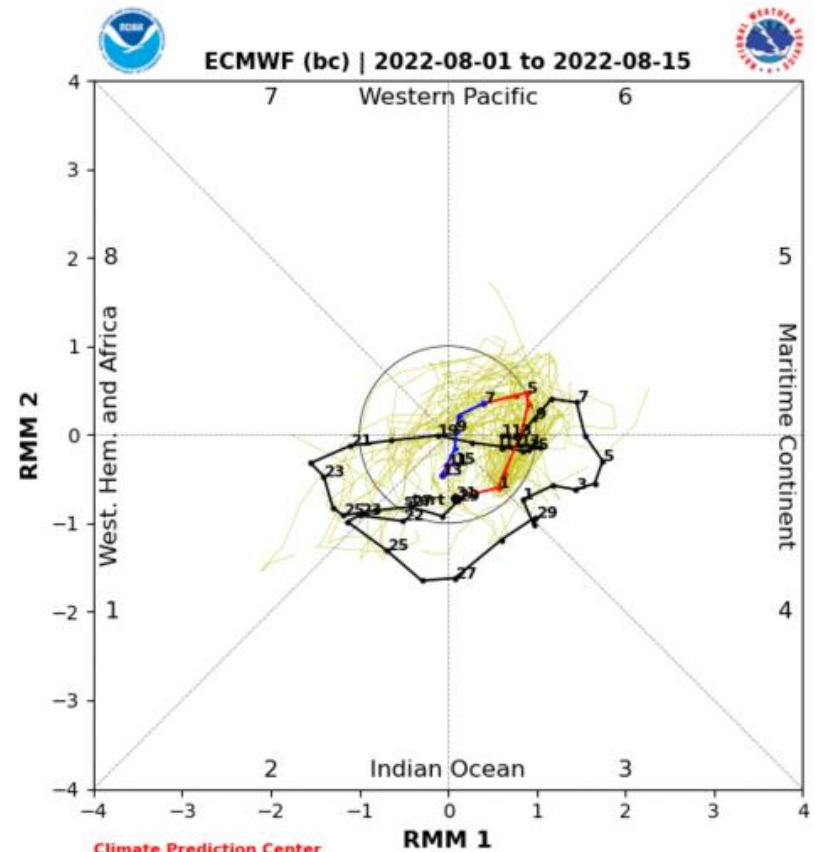


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



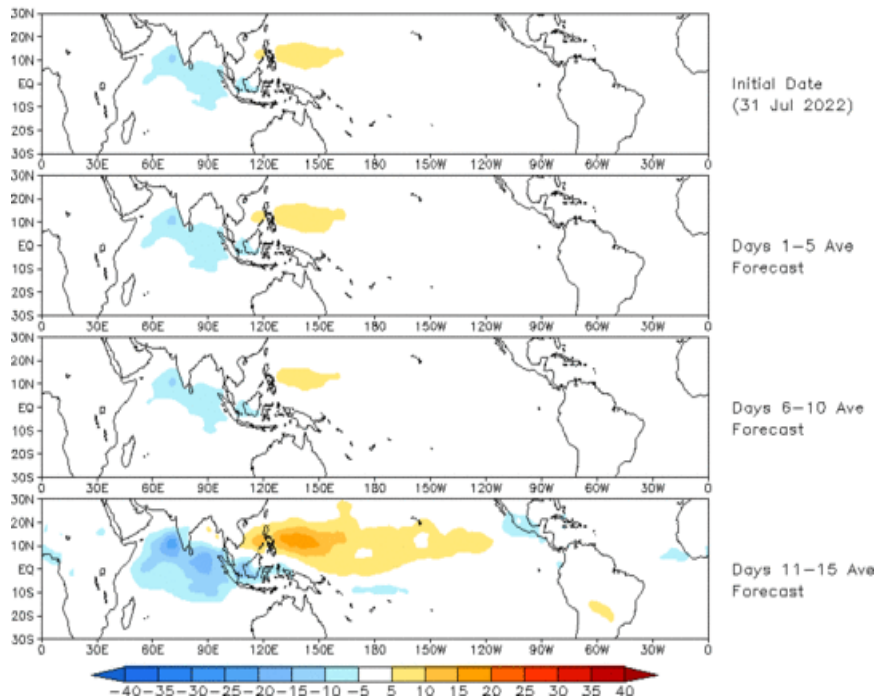
ECMWF Forecast

- GEFS RMM forecast favors further weakening of signal and a halt of eastward propagation.
- ECMWF forecast indicates continued eastward propagation of a weak MJO signal through the Maritime Continent over the two weeks.
- The GEFS solutions exhibit a wider range of possibilities than the ECMWF ensemble, with individual ensemble members appearing in every phase of the diagram over the next two weeks.

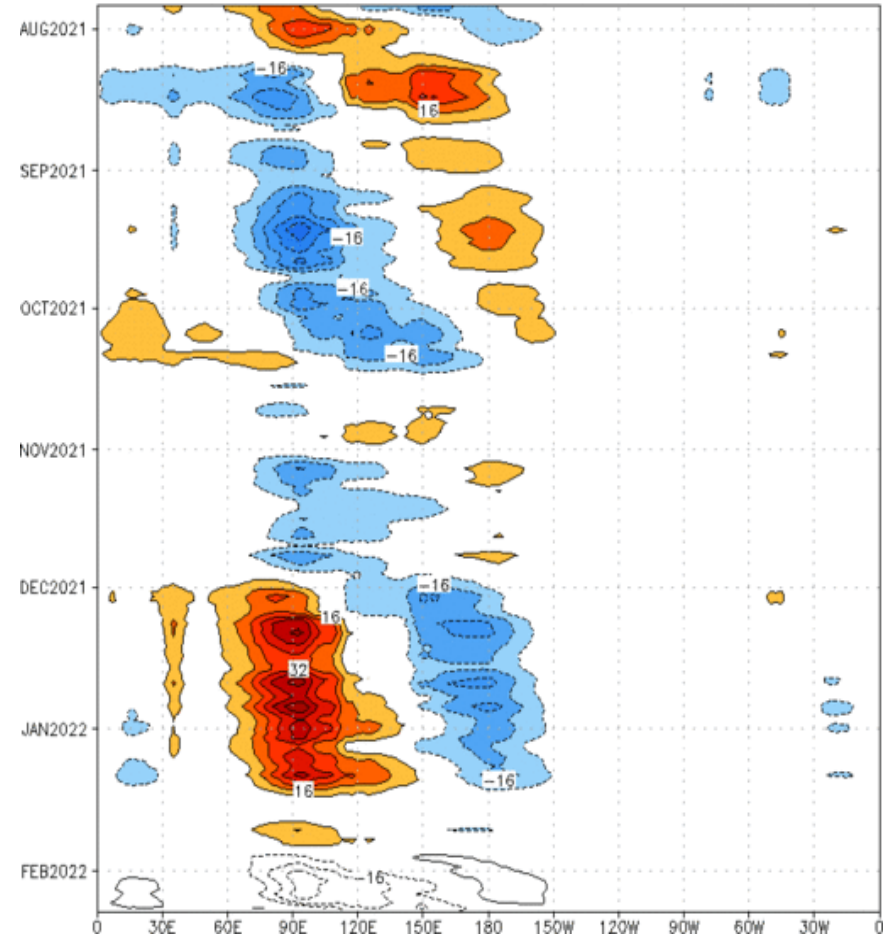
MJO: GEFS Forecast Evolution

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: 31 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

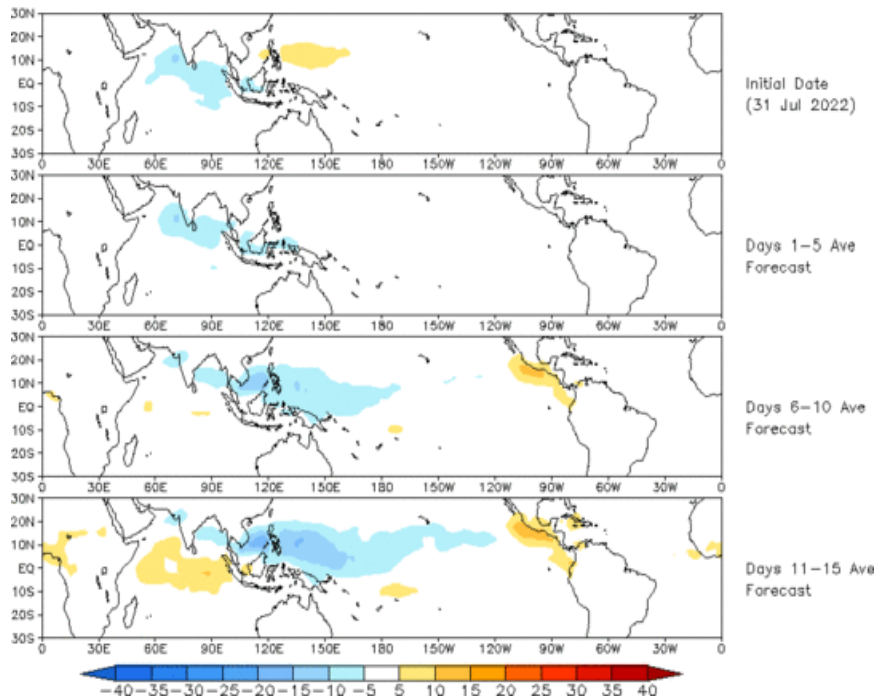


- The GEFS RMM-index based OLR anomaly field depicts a nearly stationary area of enhanced (suppressed) convection over the Indian Ocean (Western Pacific) that strengthens late in the forecast period.

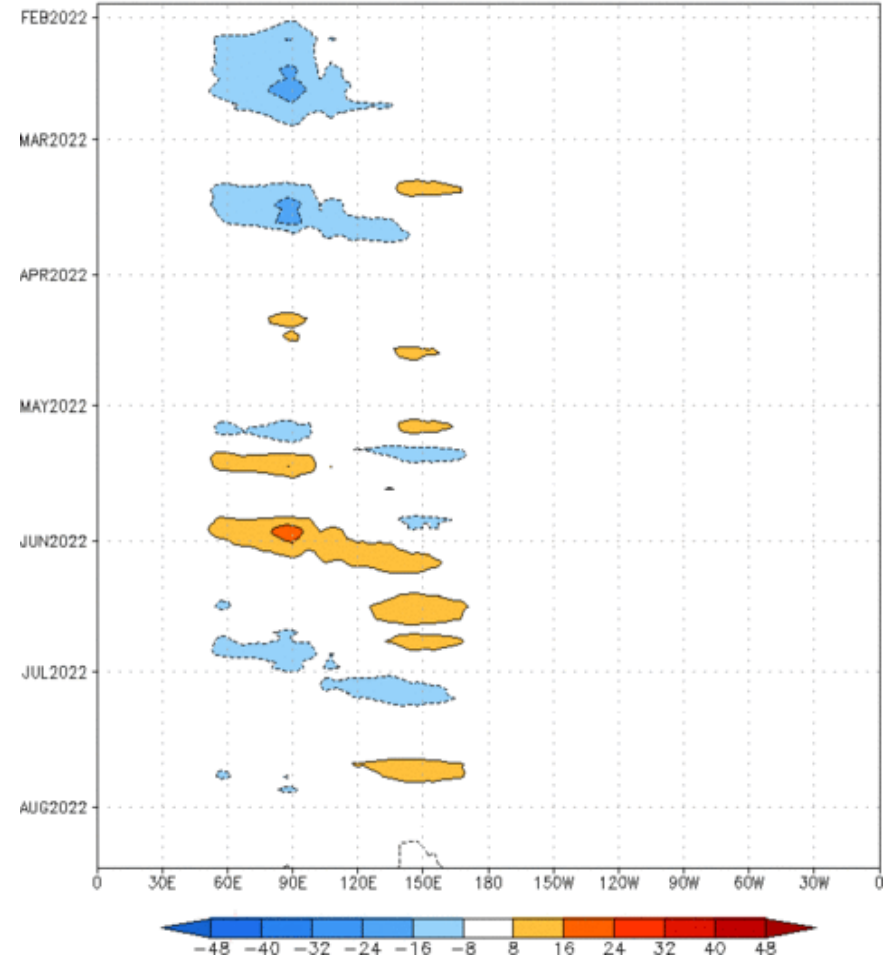
MJO: Constructed Analog Forecast Evolution

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 (31 Jul 2022)



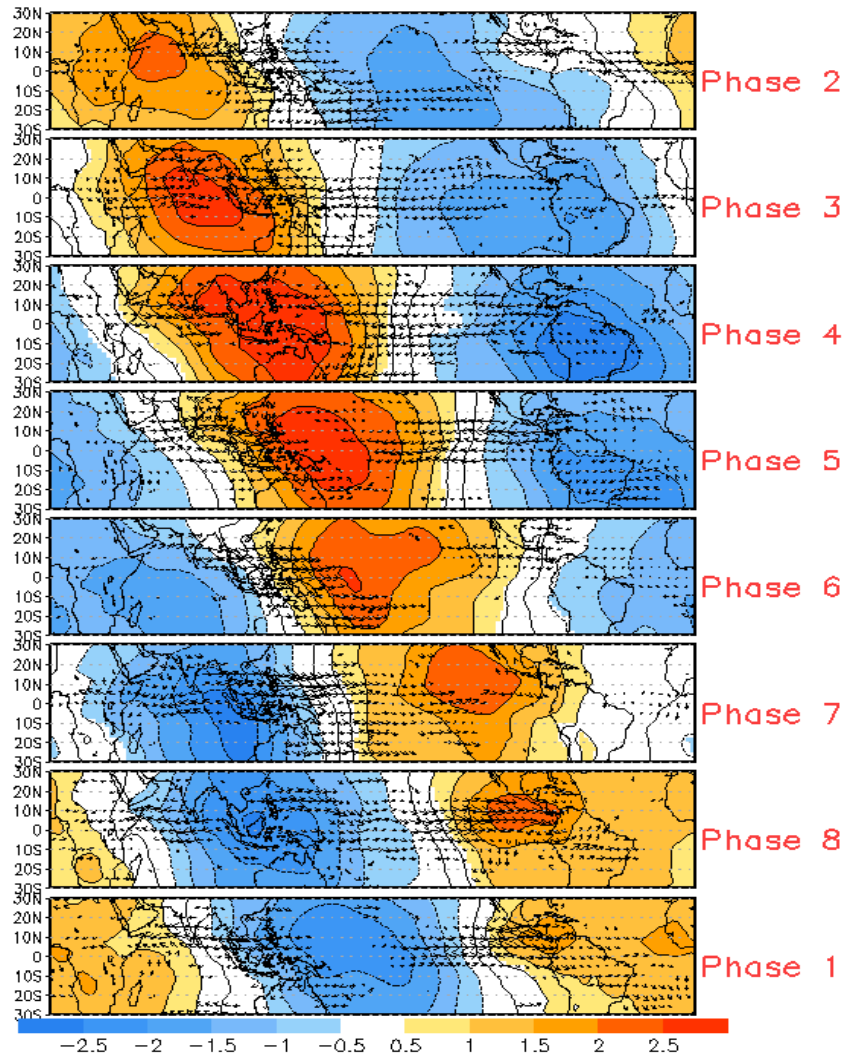
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:29-Jan-2022 to 31-Jul-2022
The unfilled contours are CA forecast reconstructed anomaly for 15 days



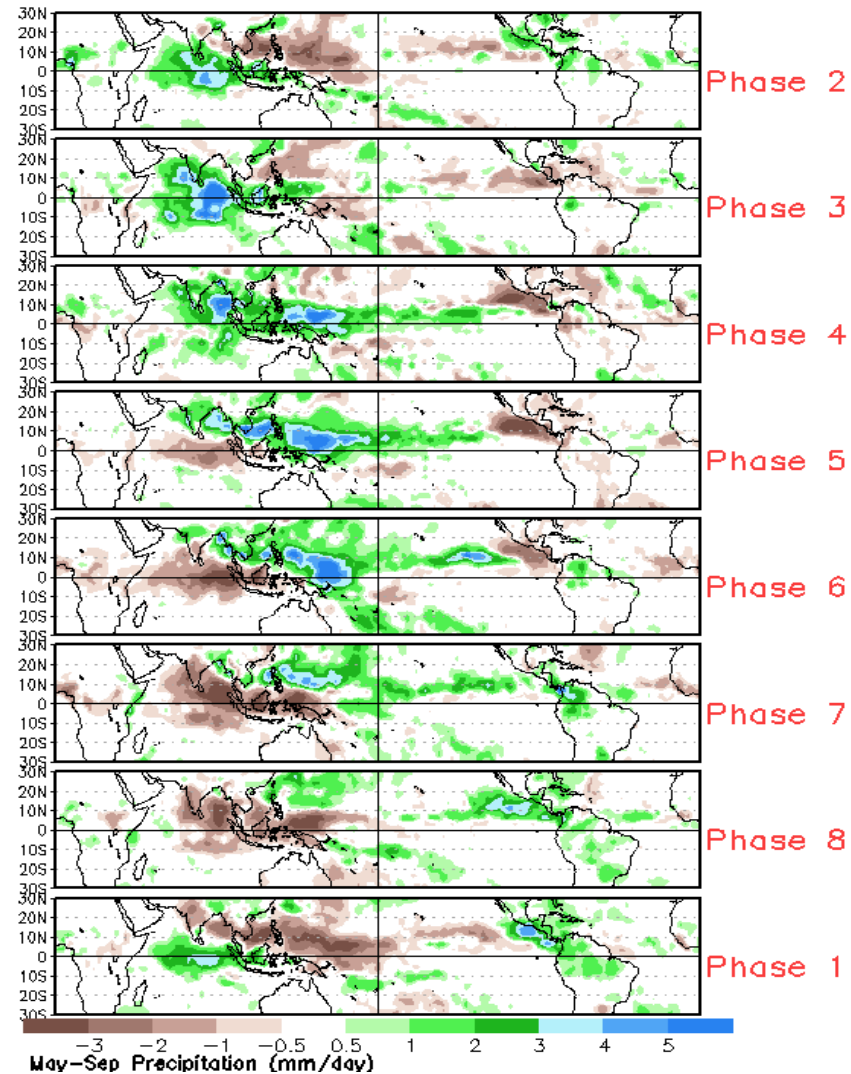
- The constructed analog forecast of RMM-based OLR favors a continuation of eastward propagation of convective envelope over the coming two week period, along with suppressed convection emerging over the Eastern Pacific and Indian Ocean late in the forecast period.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



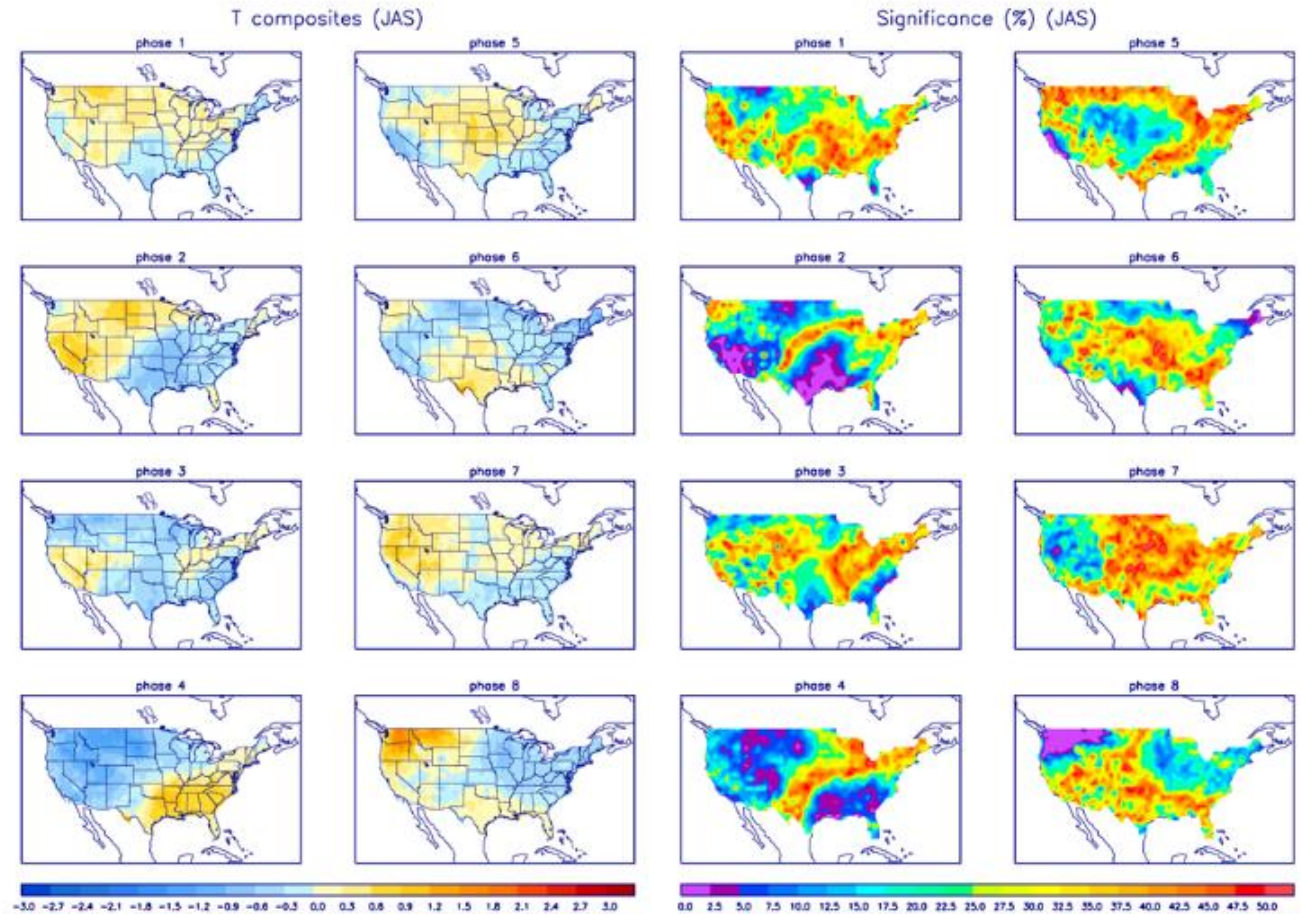
Precipitation Anomalies



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.

