

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
5 December 2022

Overview

- The RMM index indicates the MJO has decreased in amplitude during the past week, but a remnant MJO signal continues as depicted by the 200-hPa velocity potential anomaly field.
- Although large ensemble spread exists, many GFS and ECMWF ensemble members feature a continued eastward propagation from the Indian Ocean to the Maritime Continent and West Pacific during the next two weeks.
- Based on the expectation that a remnant MJO signal shifts eastward, elevated chance of tropical cyclone development are forecast across the Indian Ocean basin for week-2.

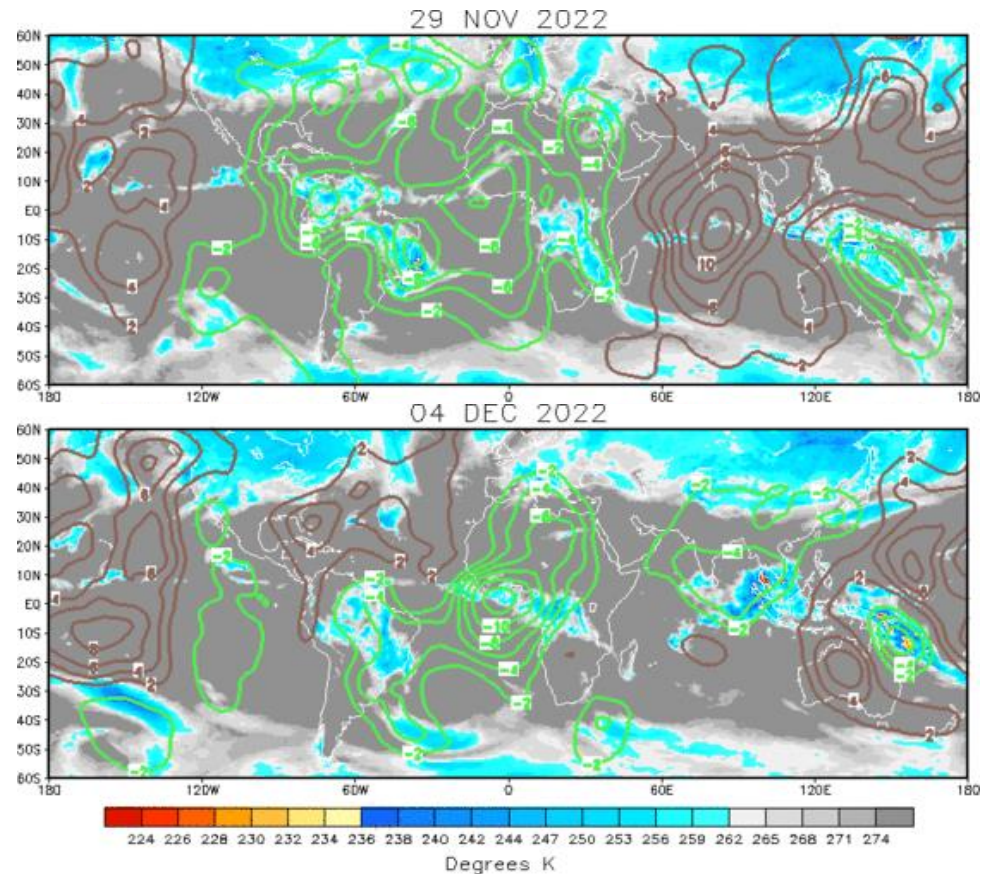
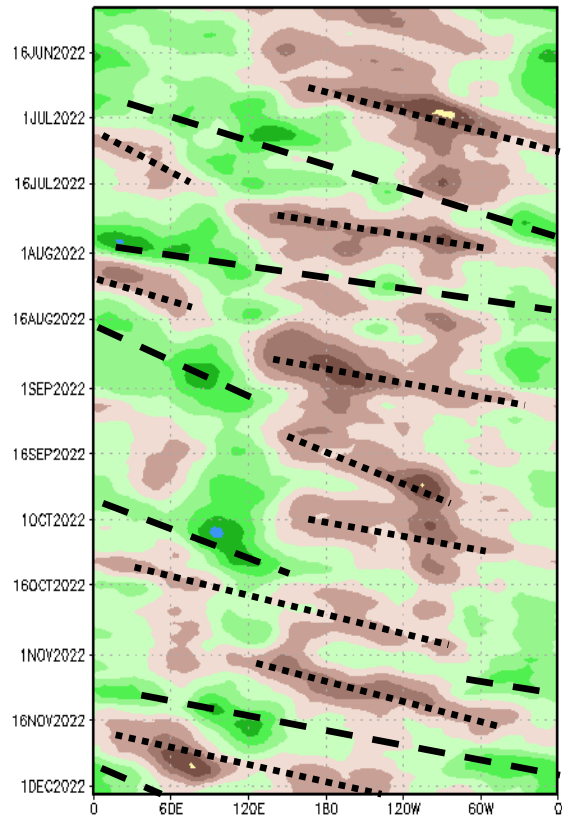
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

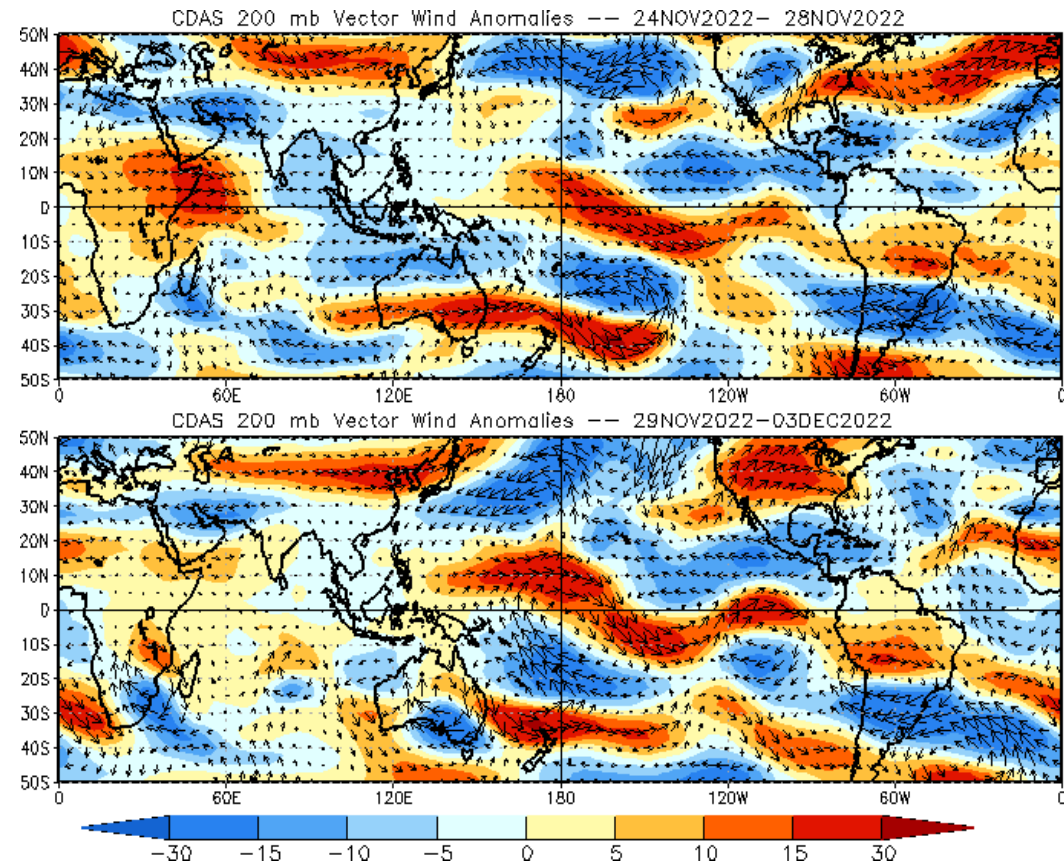
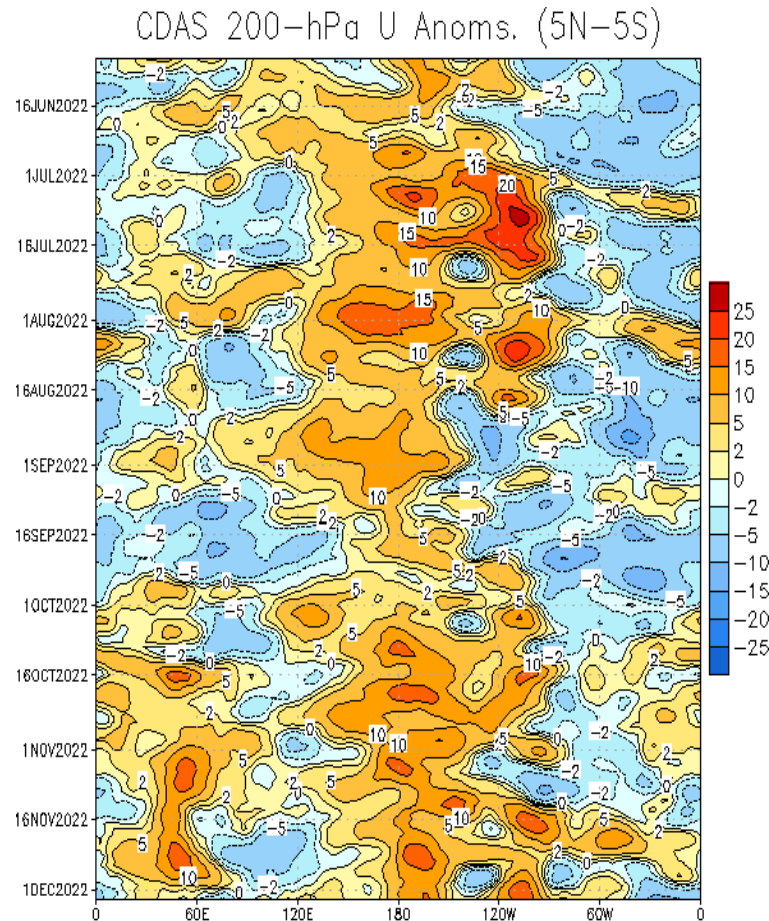
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- Velocity potential pattern continues to depict a wave-1 symmetry since late November.
- Anomalous upper-level divergence propagated eastward over the Indian Ocean during the past week, while anomalous upper-level convergence expanded east of the Date Line.

200-hPa Wind Anomalies

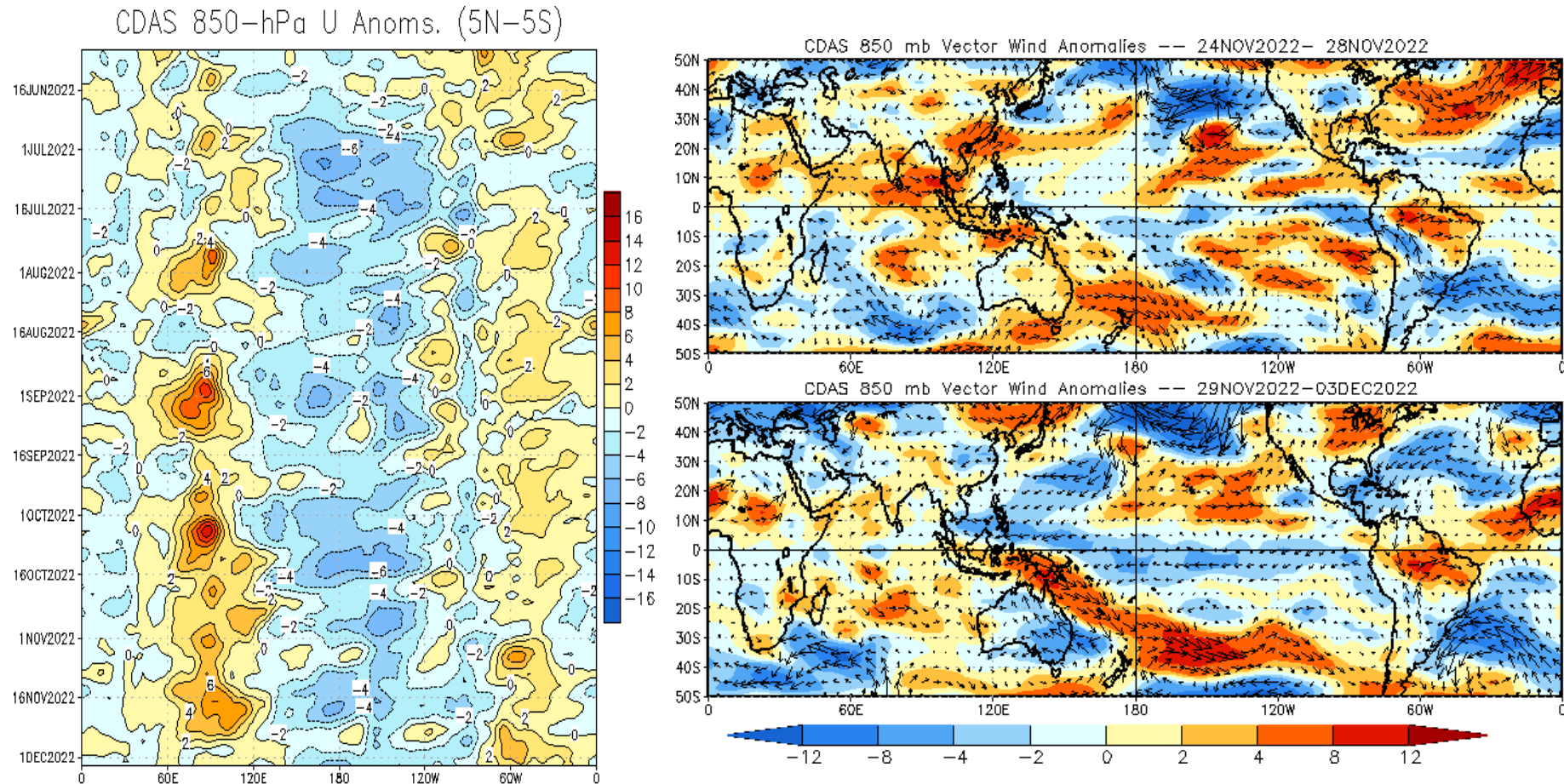
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Consistent with La Niña, anomalous upper-level westerlies continued across equatorial Pacific but have decreased in areal coverage after a recent emergence of anomalous easterlies over the Maritime Continent and South Pacific.
- Anomalous westerlies recently expanded east from Africa to the Indian Ocean.

850-hPa Wind Anomalies

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

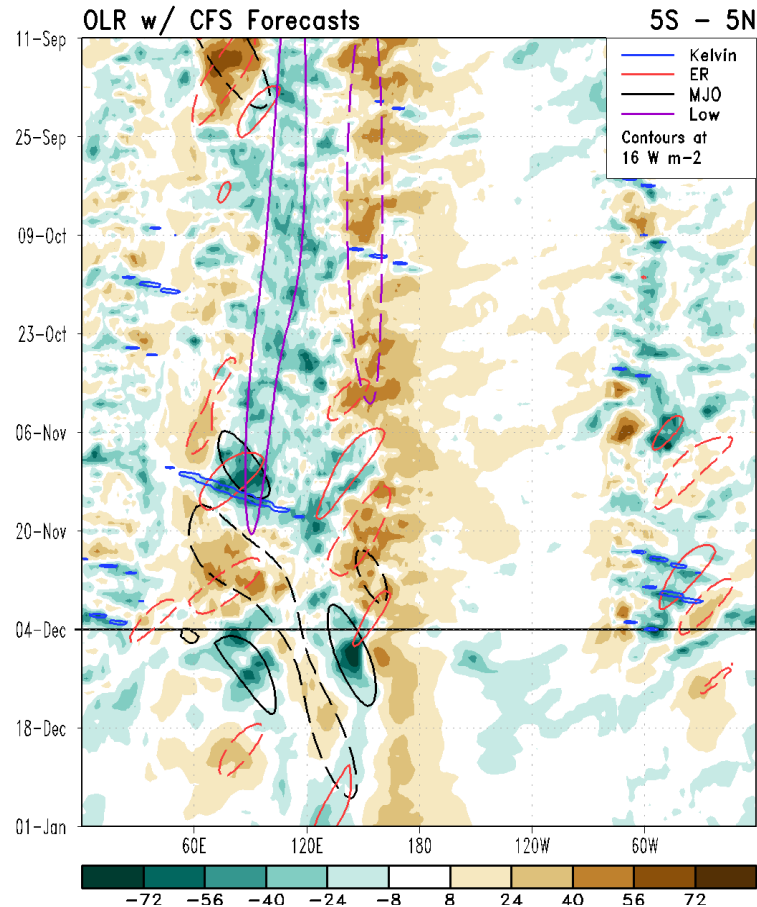


- After a brief weakening of the enhanced trade winds during late November, anomalous low-level easterlies expanded in coverage across the equatorial Pacific.
- Anomalous westerlies strengthened over northern Australia and the Coral Sea.

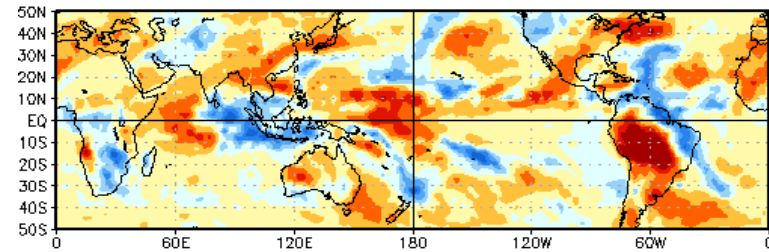
Outgoing Longwave Radiation (OLR) Anomalies

Green shades: Anomalous convection (wetness)

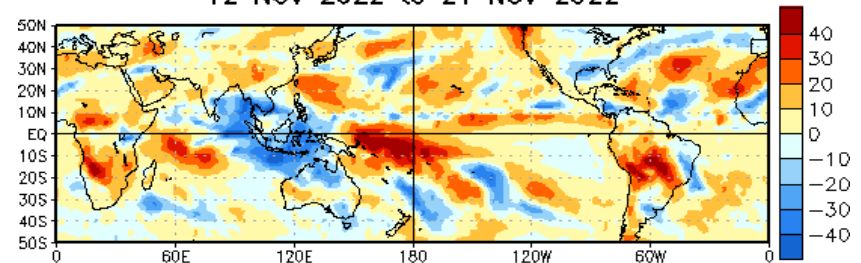
Brown shades: Anomalous subsidence (dryness)



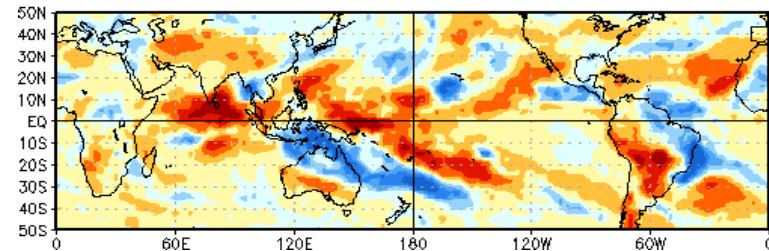
OLR Anomalies
2 NOV 2022 to 11 NOV 2022



12 NOV 2022 to 21 NOV 2022

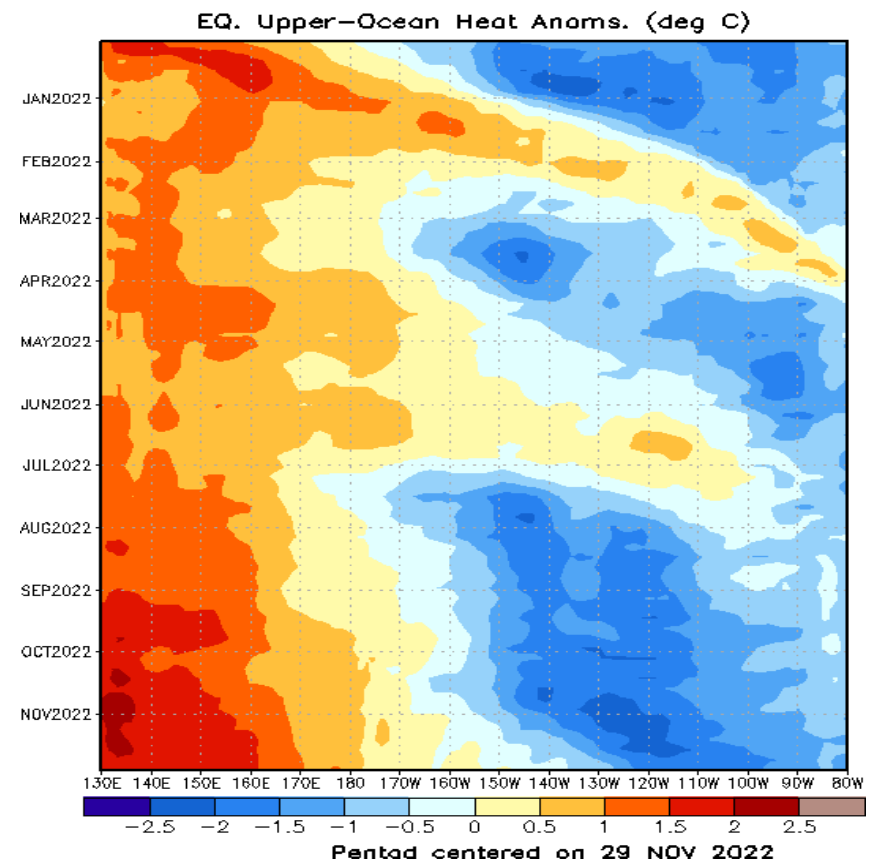
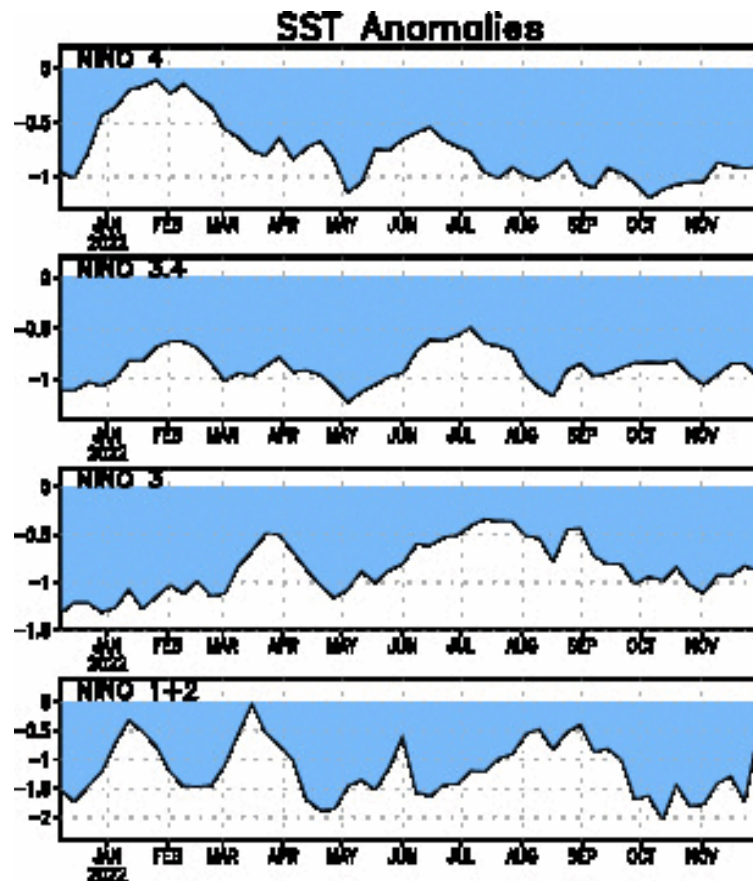


22 NOV 2022 to 1 DEC 2022



- Suppressed convection over the western Indian Ocean has intensified and shifted eastward, briefly overcoming the long-standing enhanced convection over the Maritime Continent.
- By the end of November, enhanced convection overspread northern Australia and the South Pacific Convergence Zone.

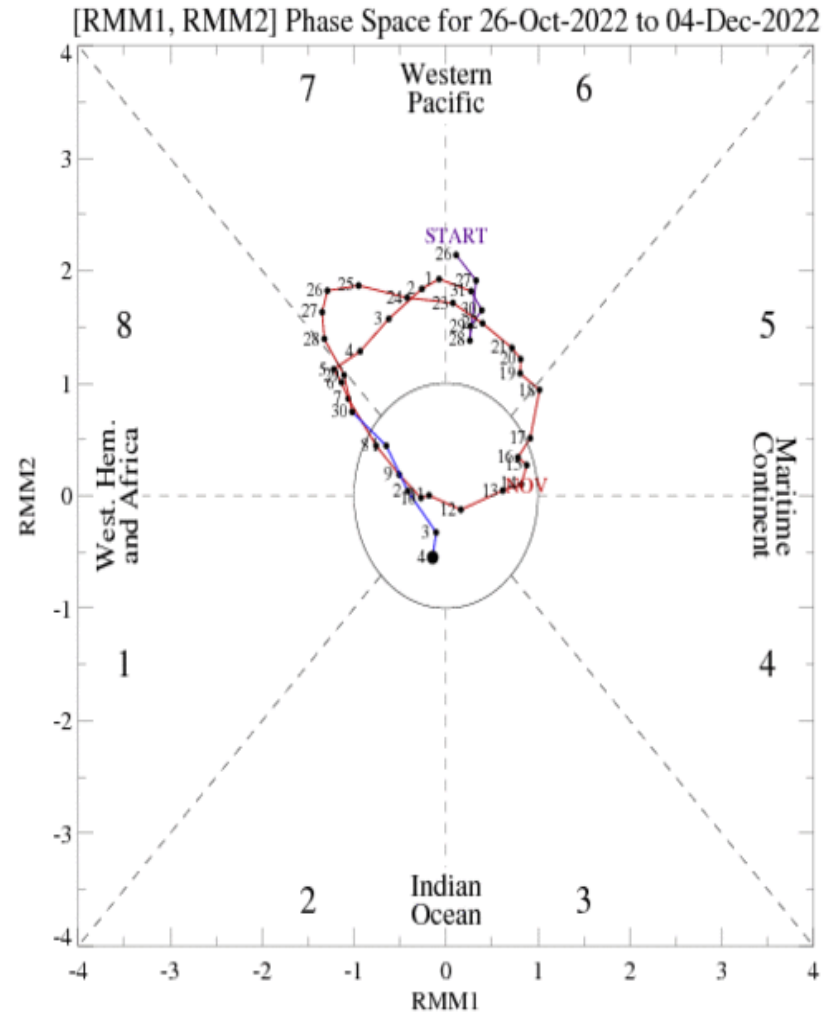
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- The zonal gradient of upper-ocean heat anomalies has been increasing over the last month and the westward extent of anomalous cold is beginning to shift eastward.
- SSTs remain well below average across all Niño basins, reflecting robust and persistent cold ENSO conditions.

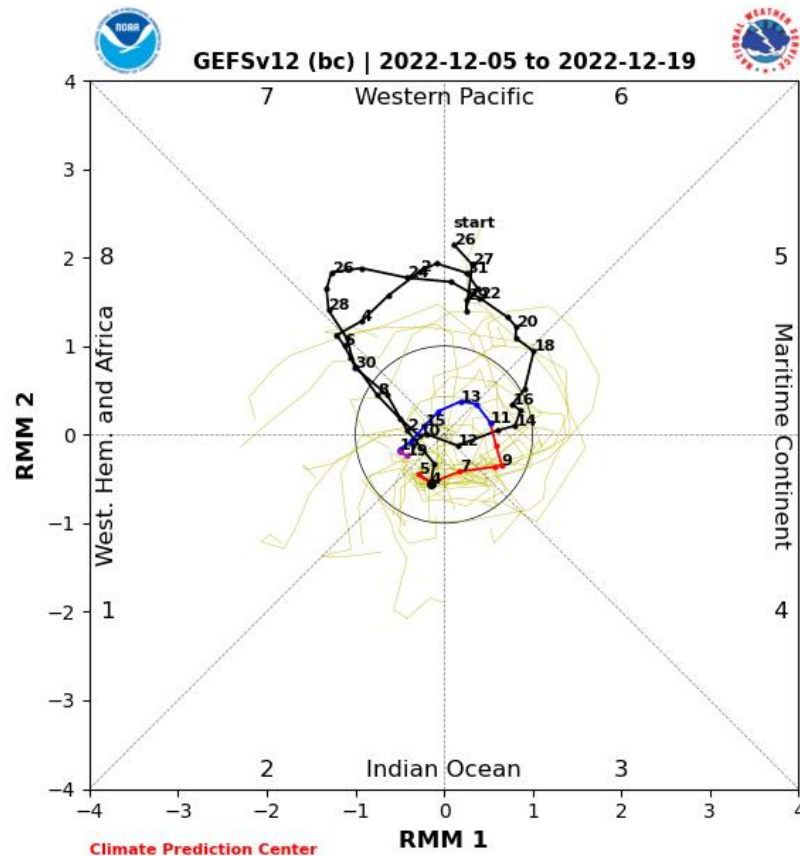
MJO Index: Recent Evolution

- RMM observations feature steady eastward propagation and a full circumnavigation of the globe since the beginning of November.
- Latest observations depict a decrease in the amplitude of the RMM index within the unit circle, signifying a weakened MJO.

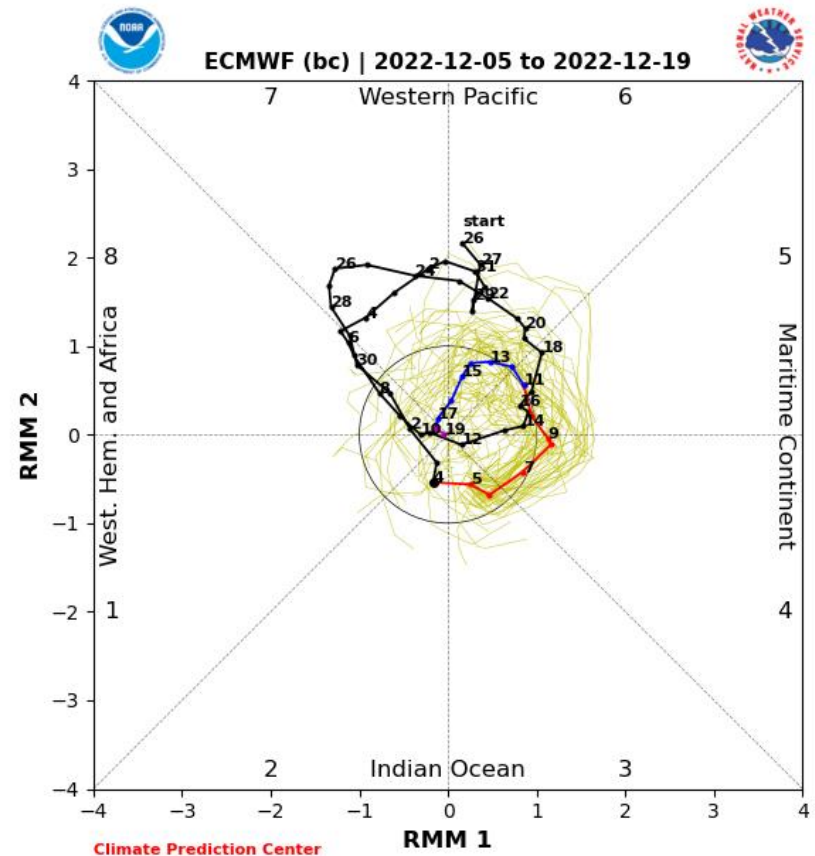


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



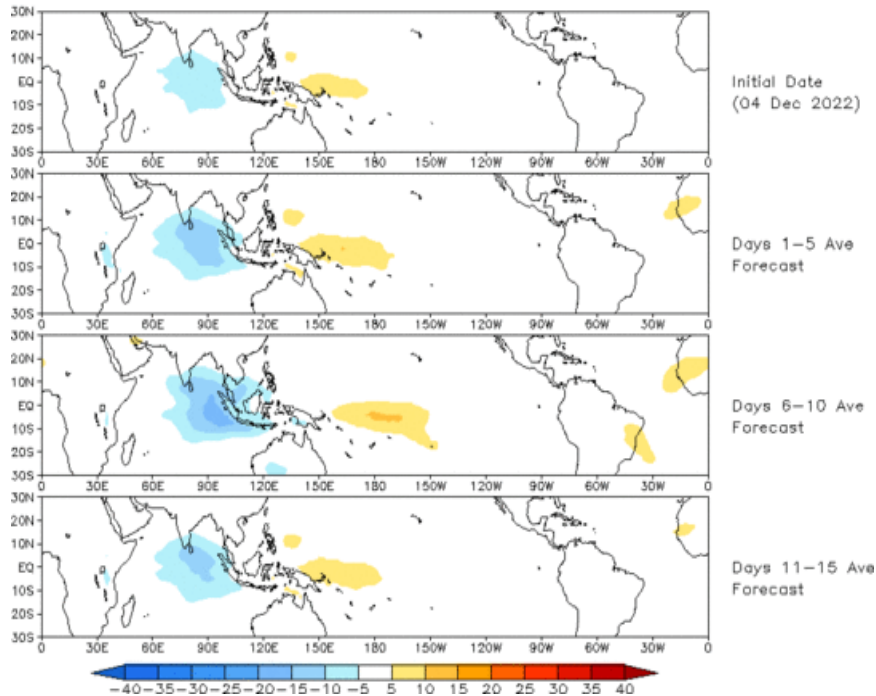
ECMWF Forecast

- Good agreement exists among the ensemble means that the MJO remains weaker than the previous month, according to the RMM index.
- However, ensemble spread is large with a number of ensemble members depicting a continued eastward propagation from the Indian Ocean to the Maritime Continent.

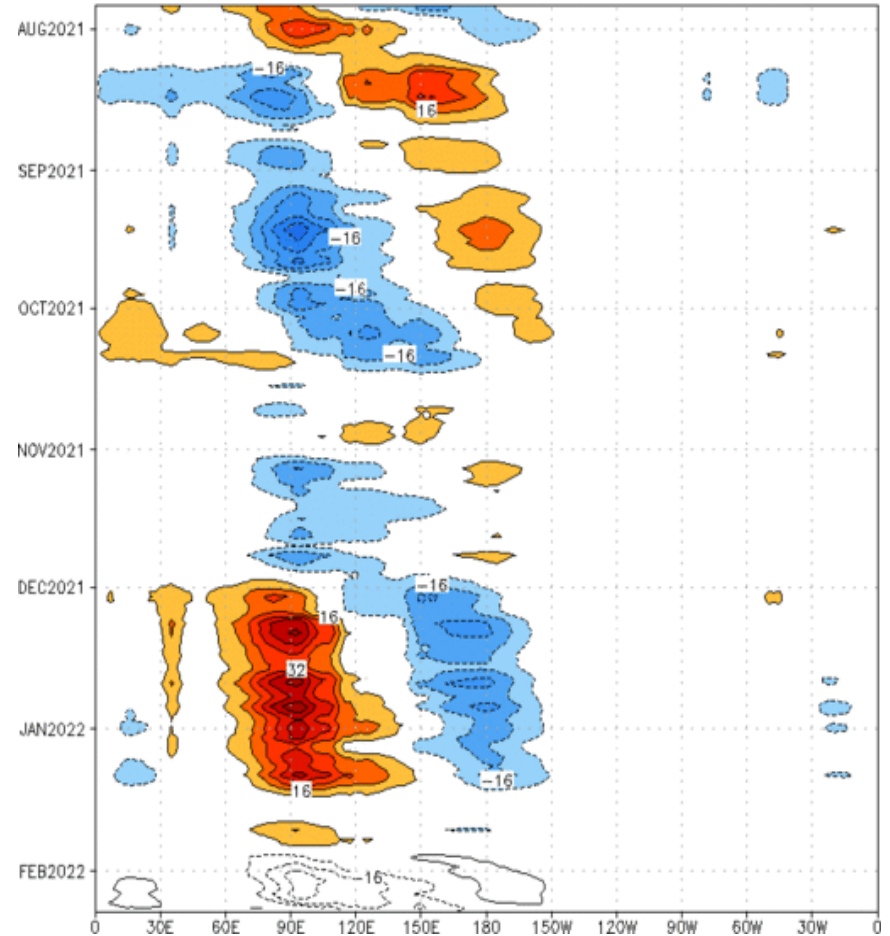
MJO: GEFS Forecast Evolution

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: 04 Dec 2022
OLR



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

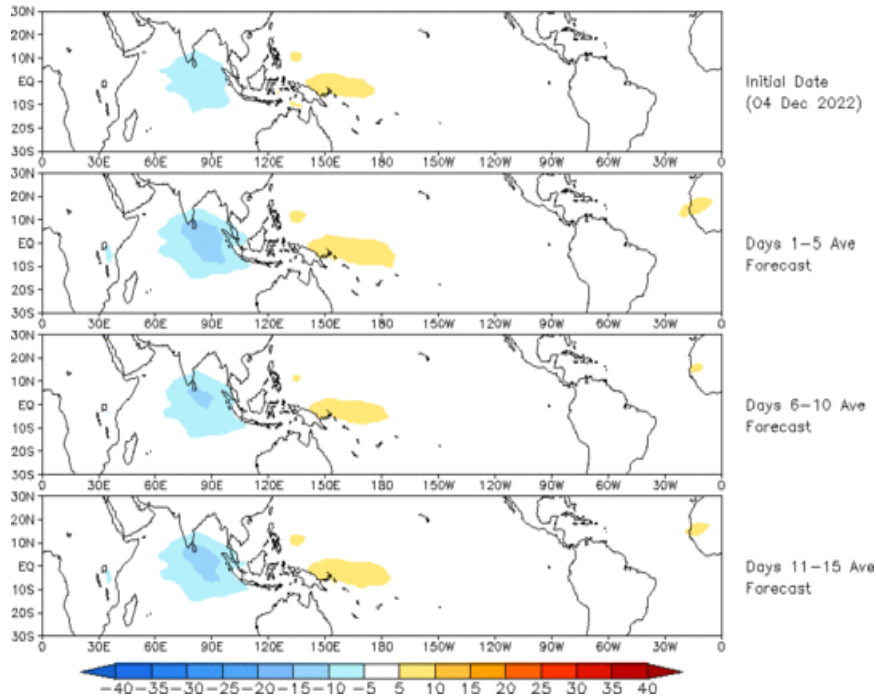


- The GEFS-based OLR anomaly fields depict enhanced convection expanding eastward over the Indian Ocean and western Maritime Continent with suppressed convection across the equatorial Pacific.

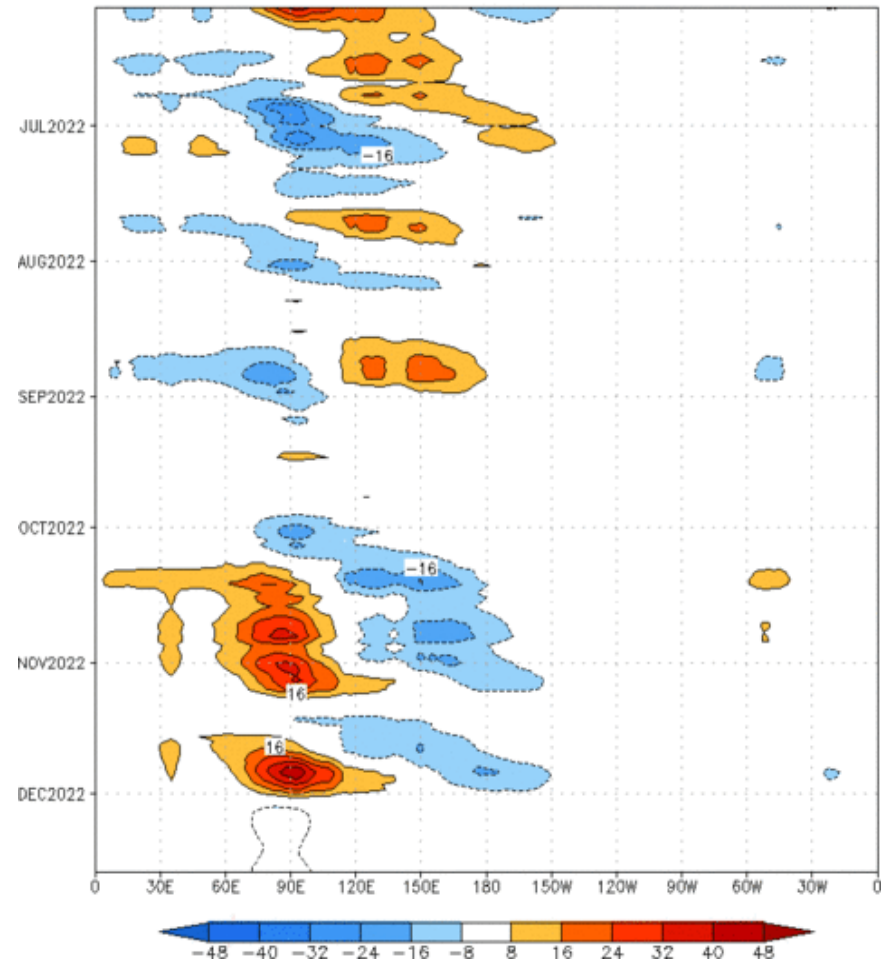
MJO: Constructed Analog Forecast Evolution

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 Dec 2022)



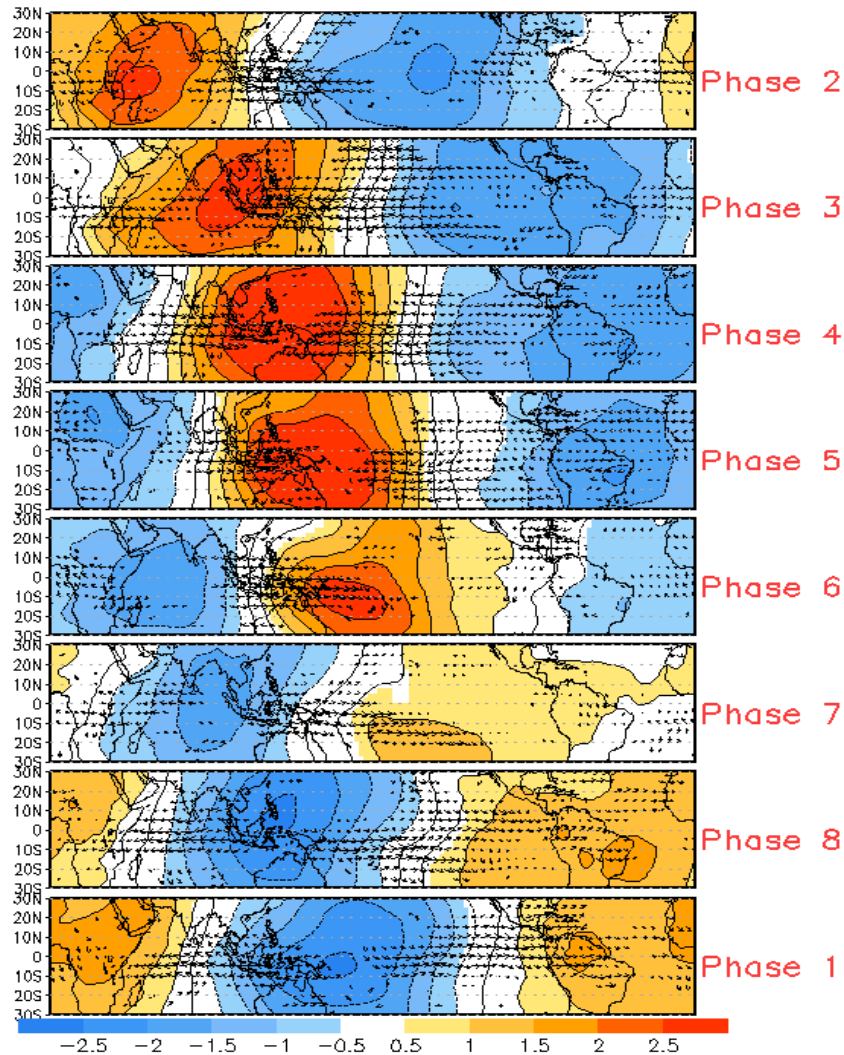
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:04-Jun-2022 to 04-Dec-2022
The unfilled contours are CA forecast reconstructed anomaly for 15 days



- The constructed analog forecast of RMM-based OLR depicts a more stationary pattern.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



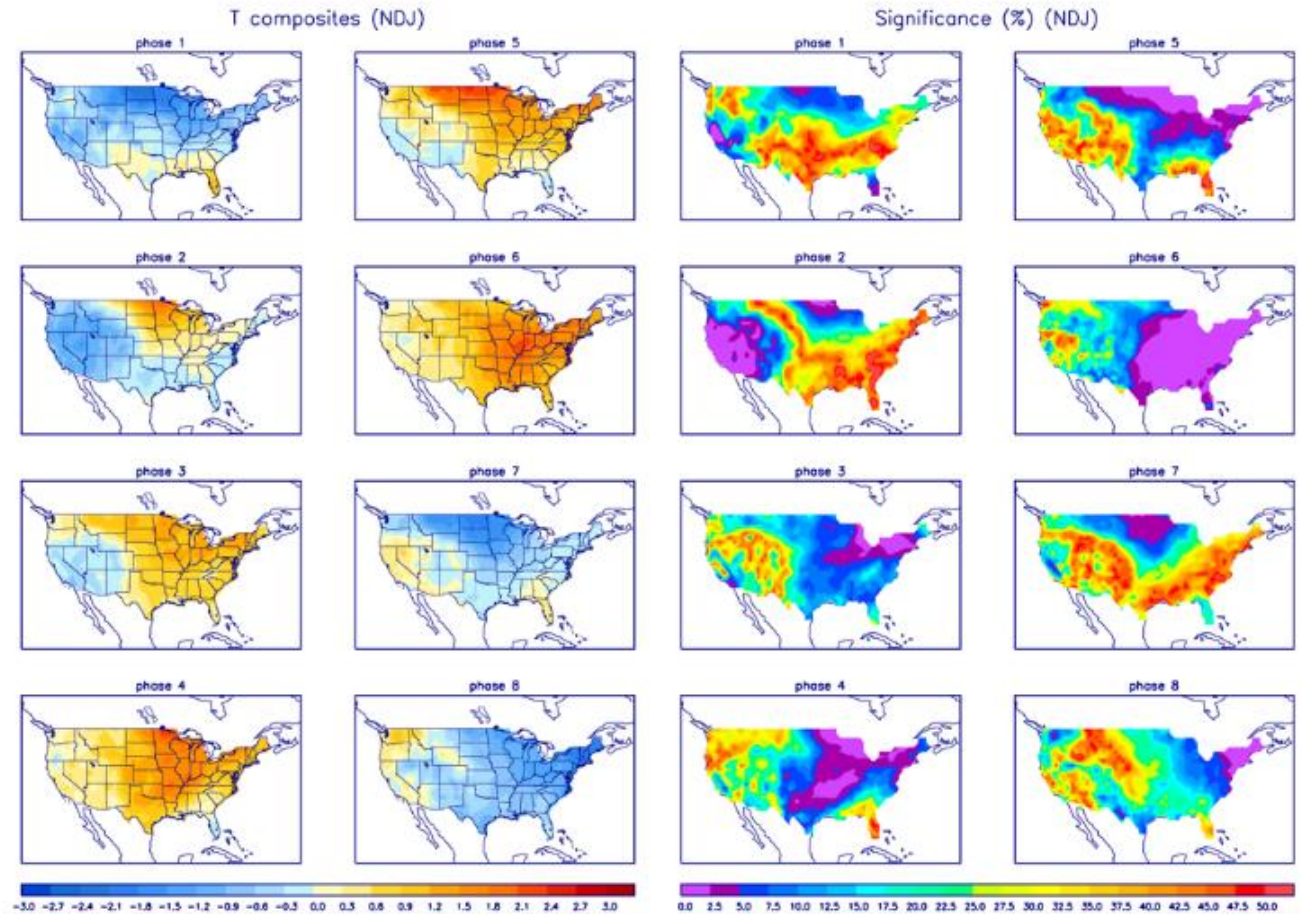
Precipitation Anomalies



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 - Precipitation

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.

