

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
21 November 2022

Overview

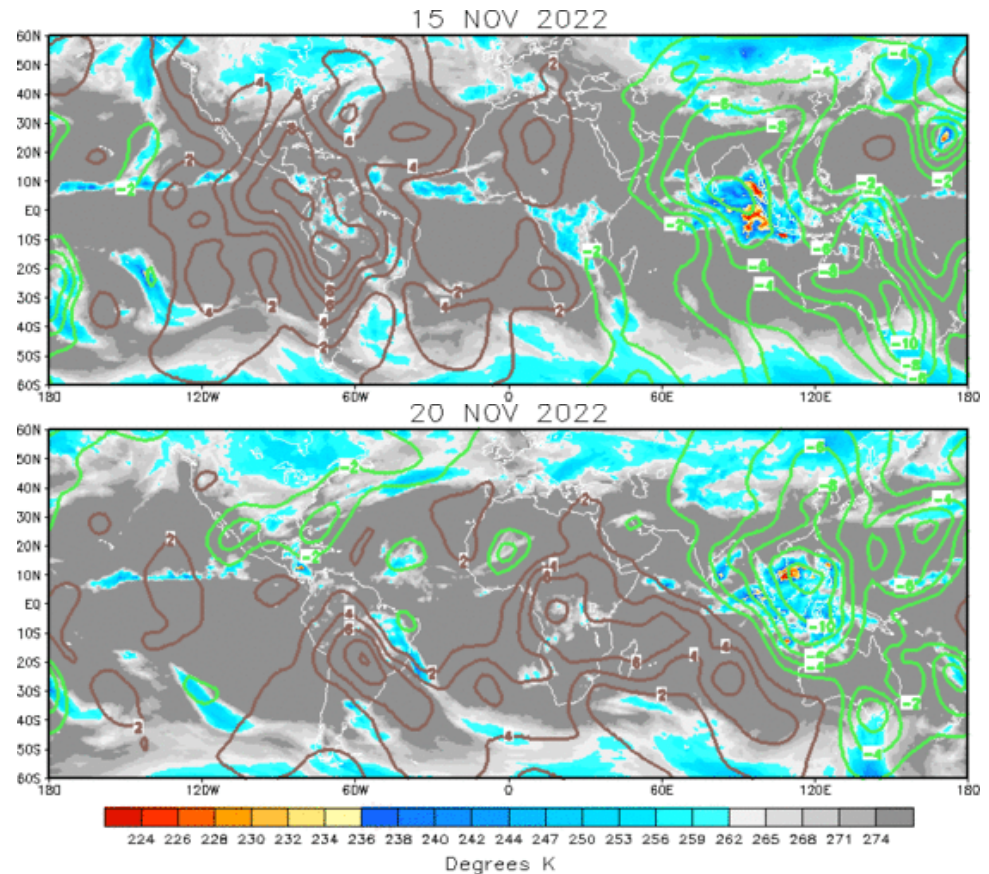
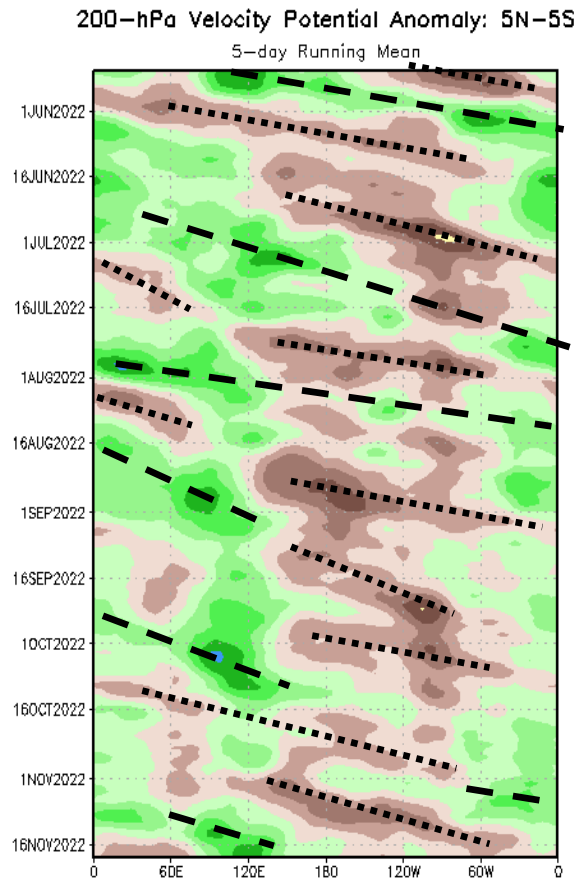
- The RMM index indicates the MJO has increased in amplitude over the last week and the signal has continued to steadily propagate eastward into the Western Pacific.
- There is generally good agreement among the dynamical models favoring rapid eastward propagation of the convective envelope during week-1, followed by a weakening of the MJO signal with destructive interference from La Nina base state. In the extended range there is some indication of the MJO signal reemerging over the Indian Ocean and Maritime Continent later in week-3.
- Strong La Nina base state will provide a favorable environment for tropical cyclone (TC) genesis around the Maritime Continent for both weeks 2 and 3.

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)

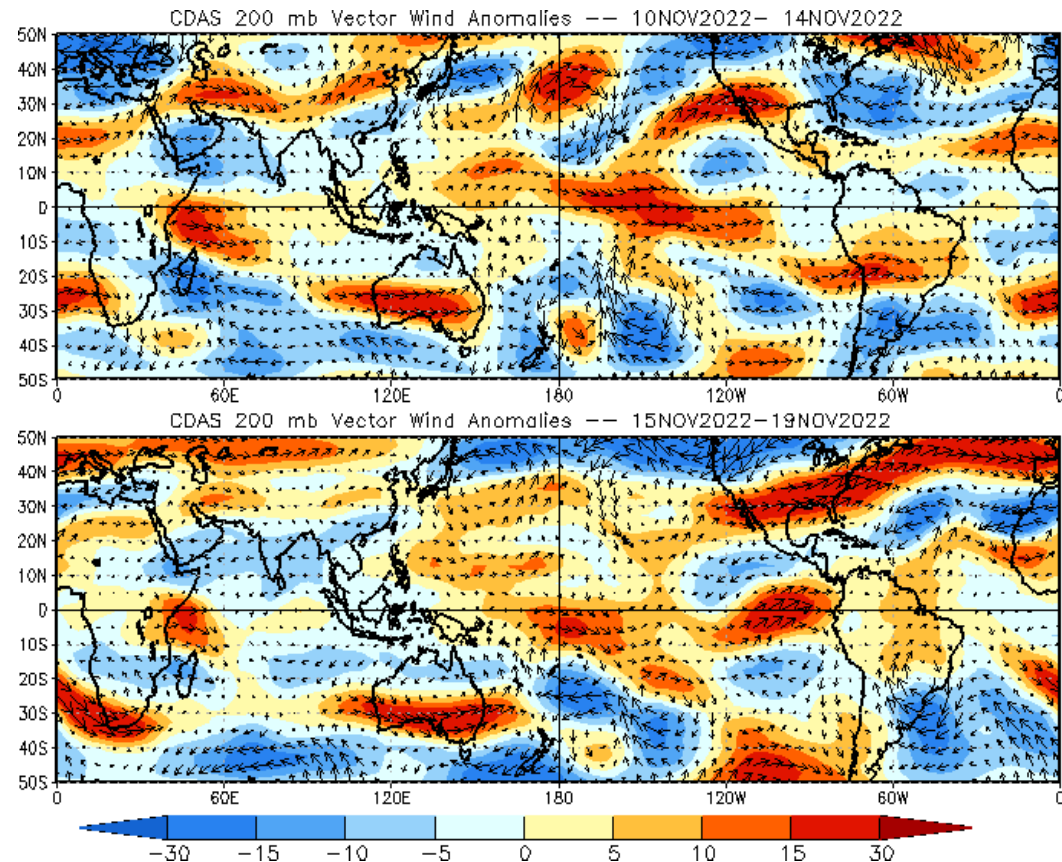
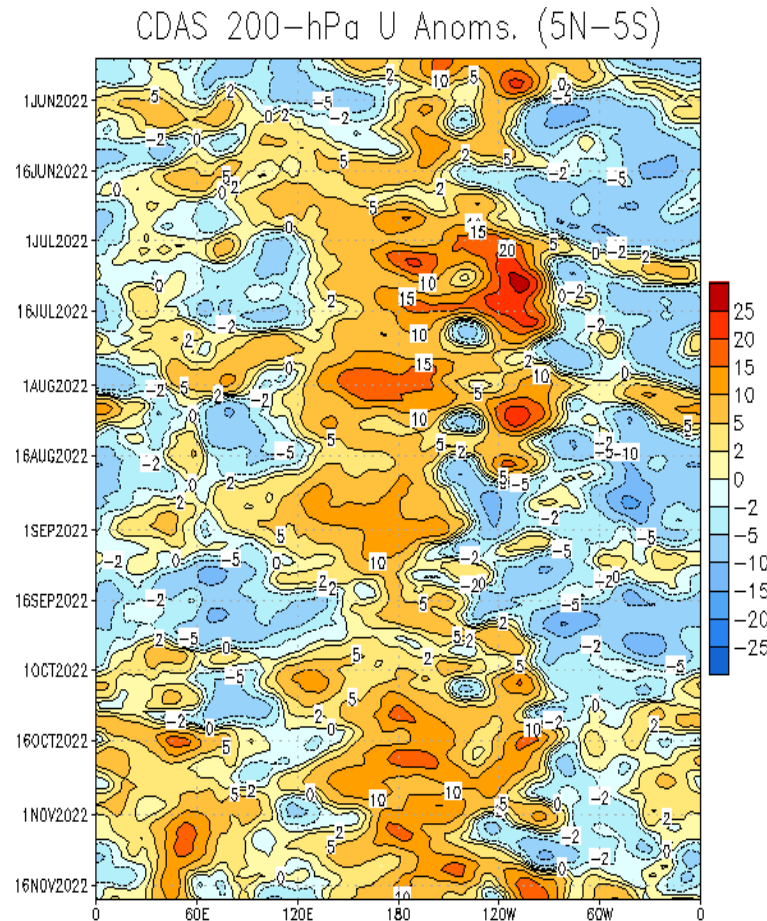
Brown shades: Anomalous convergence (unfavorable for precipitation)



- Velocity potential pattern is becoming less coherent after a period of well-defined wave-1 symmetry.
- There has been a slight eastward propagation of the enhanced convective envelope over the last week, which is currently centered over the Philippines. Suppressed convection spans a broad area from South America to the central Indian Ocean.

200-hPa Wind Anomalies

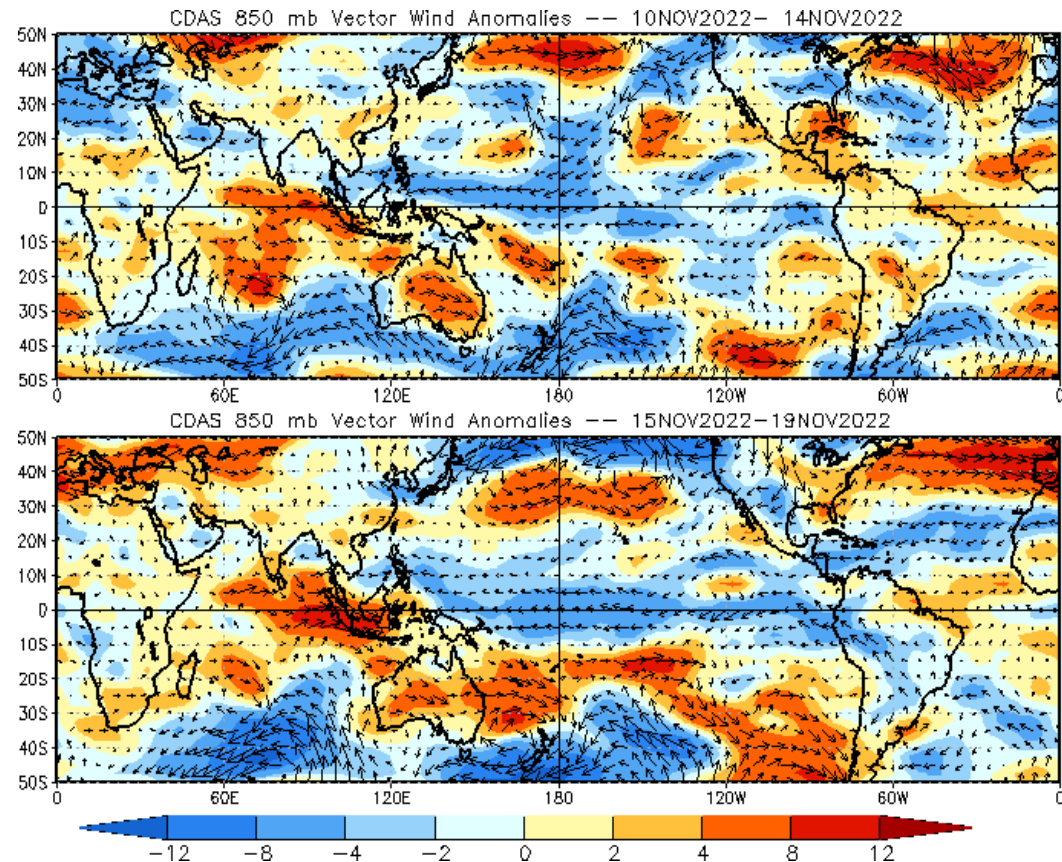
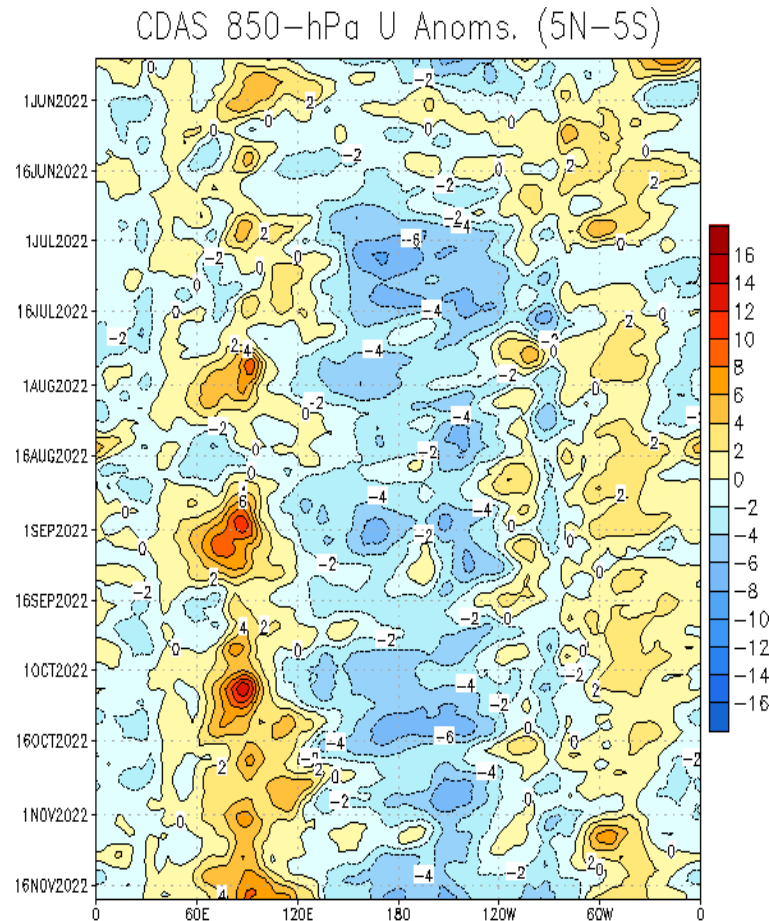
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Consistent with La Niña, anomalous upper-level westerlies continued across equatorial Pacific and have increased in areal coverage after a recent emergence of anomalous easterlies over the Eastern Pacific.
- Anomalous upper-level westerlies persist offshore of equatorial East Africa tied to an anomalous cyclonic circulation aloft over the southwestern Indian Ocean.

850-hPa Wind Anomalies

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

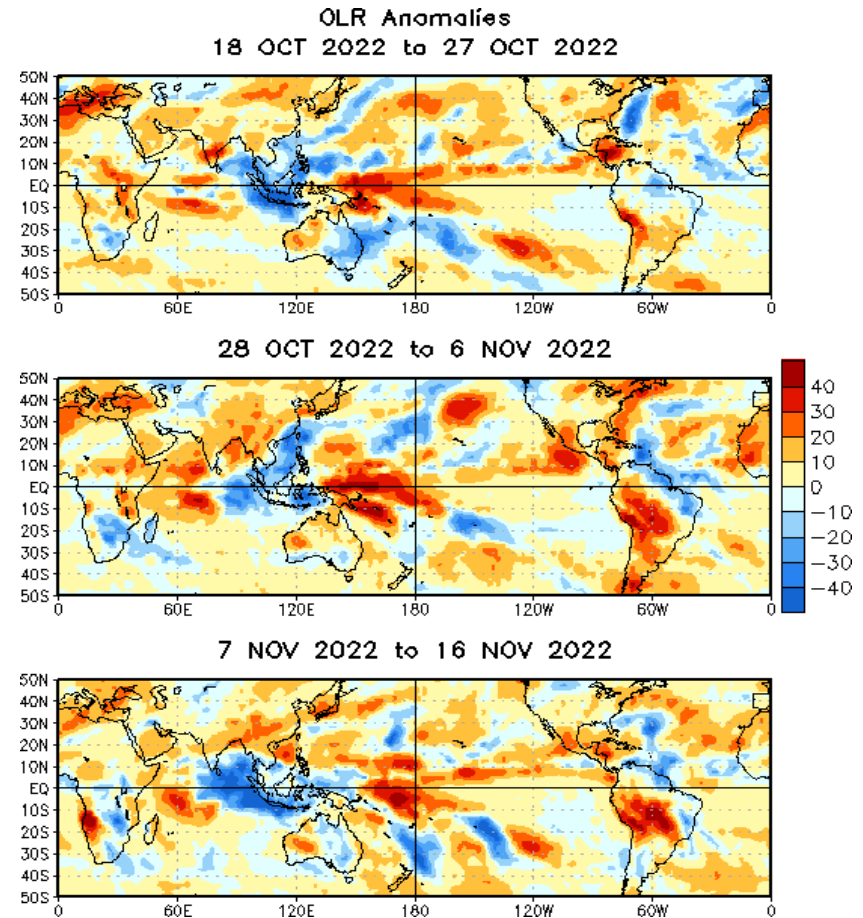
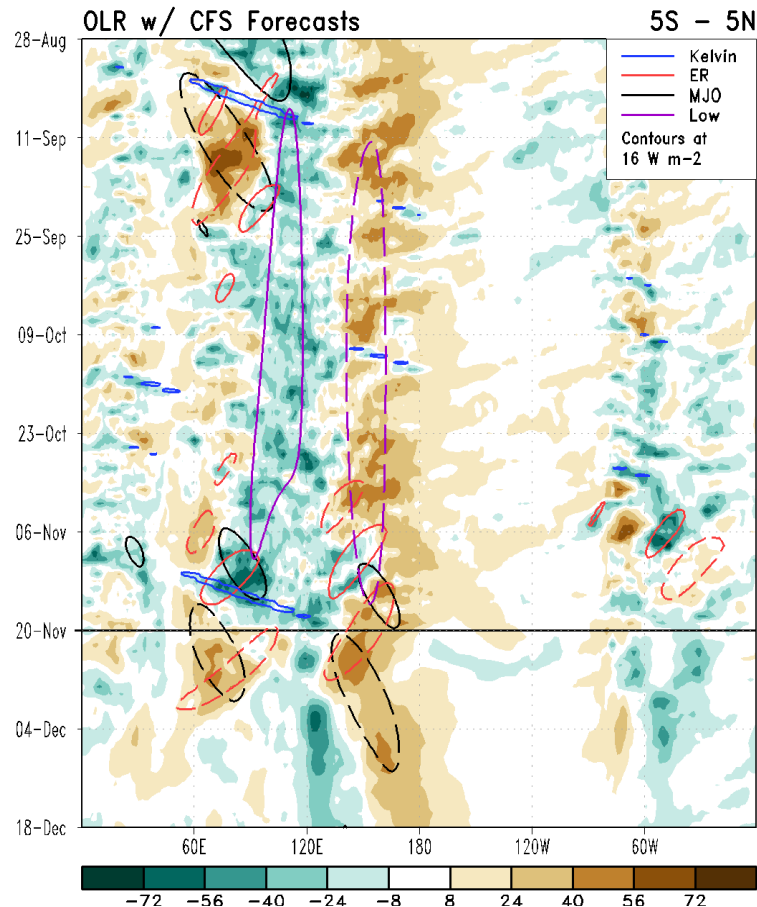


- Enhanced trades continue for most of the Equatorial Pacific and has become more north/south symmetrical.
- Anomalous westerlies persist across the eastern Indian Ocean and Maritime Continent, resulting in strong lower-level convergence near New Guinea.

Outgoing Longwave Radiation (OLR) Anomalies

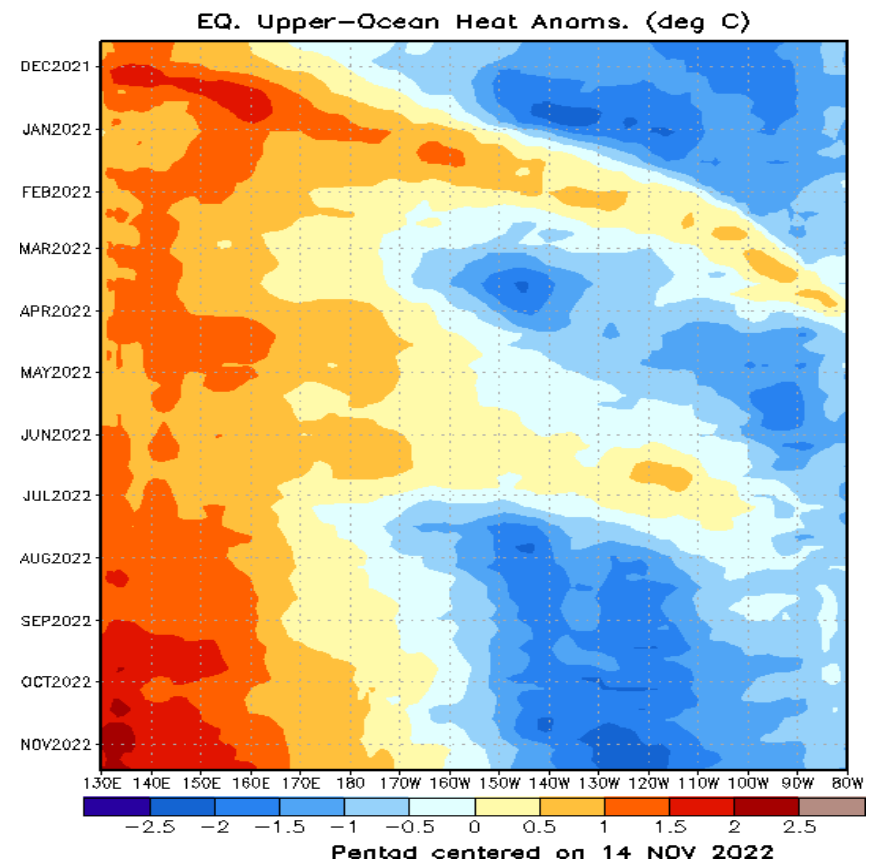
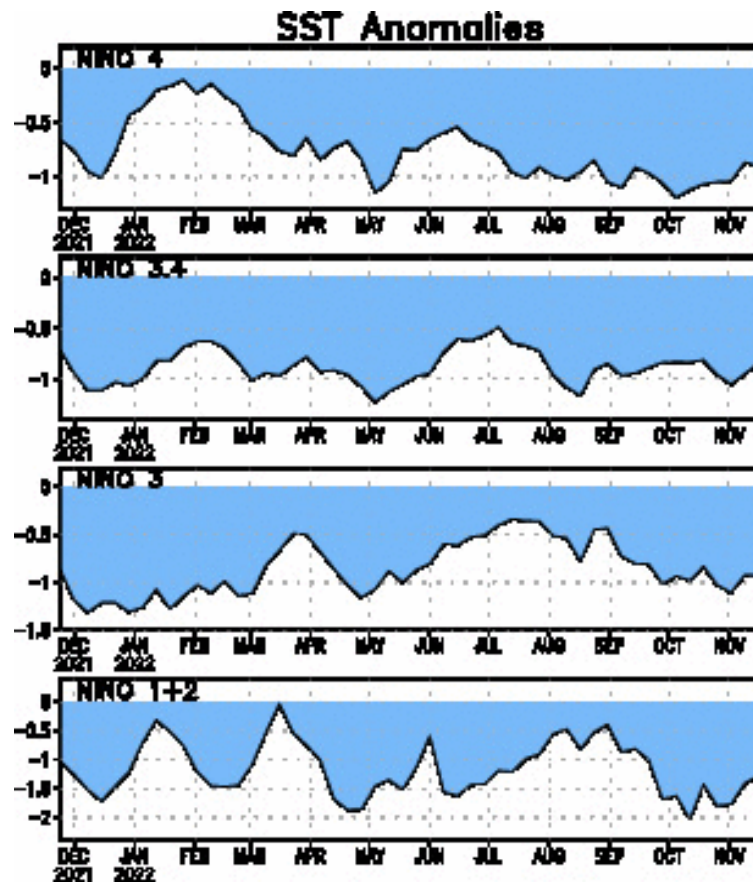
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- After a brief weakening of the La Nina base state, strong suppressed convection near the Date Line is reemerging.
- A mixture of Rossby wave and MJO activity is picked up in the OLR filtering for the coming two weeks, along with a potential Kelvin wave moving through the Eastern Pacific later in week-1.

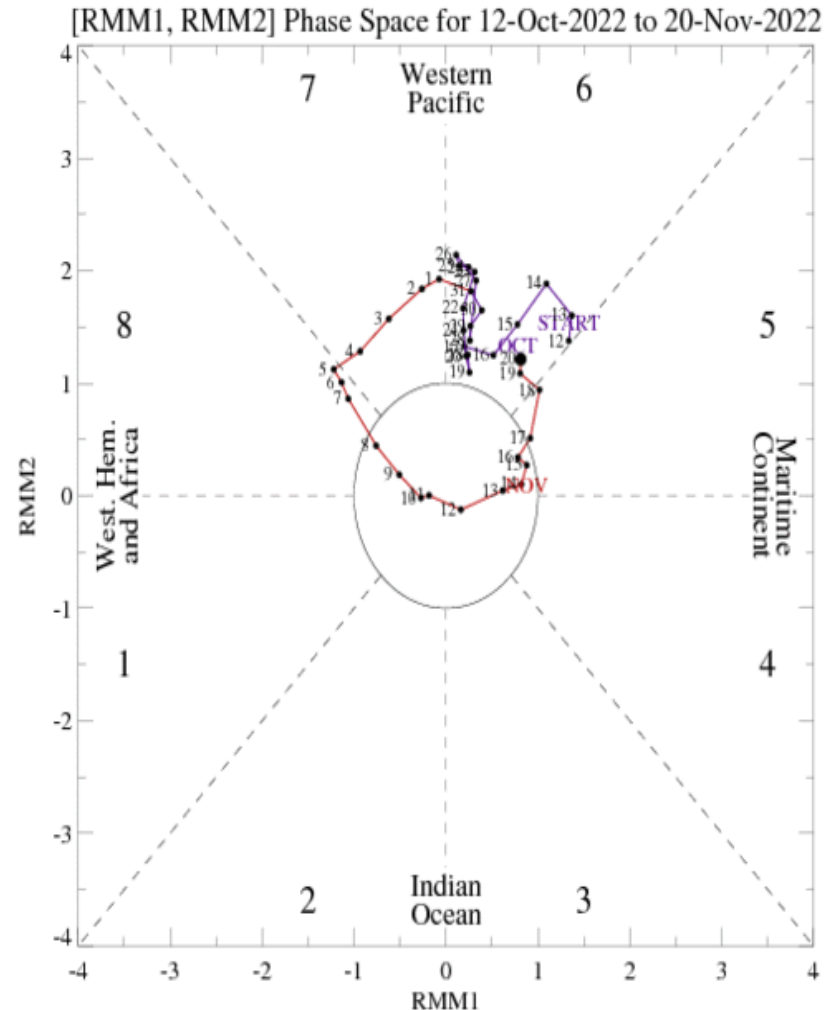
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Zonal gradient of upper-ocean heat anomalies has been increasing over the last month.
- SSTs remain well below average across all Niño basins, reflecting robust and persistent cold ENSO conditions.

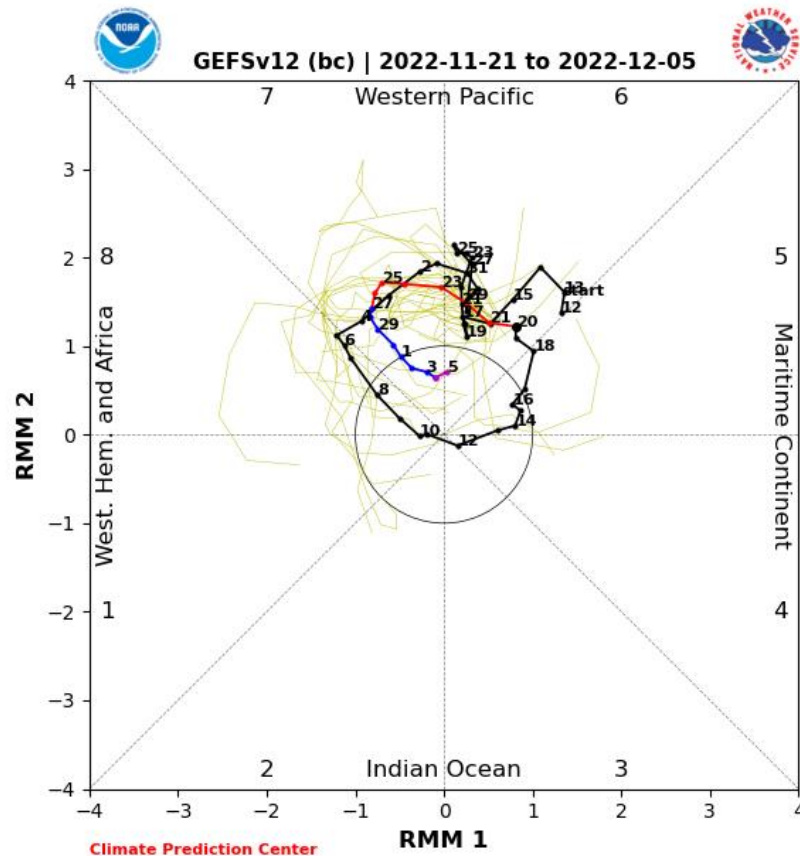
MJO Index: Recent Evolution

- After a period of quasi-stationary intraseasonal activity over the western Pacific, RMM observations show nearly a full circumnavigation of the signal since the beginning of November.
- Latest observations depict a strengthening signal, and the MJO has continued to propagate eastward across the Maritime Continent, which is well reflected in the observed velocity potential anomaly fields.

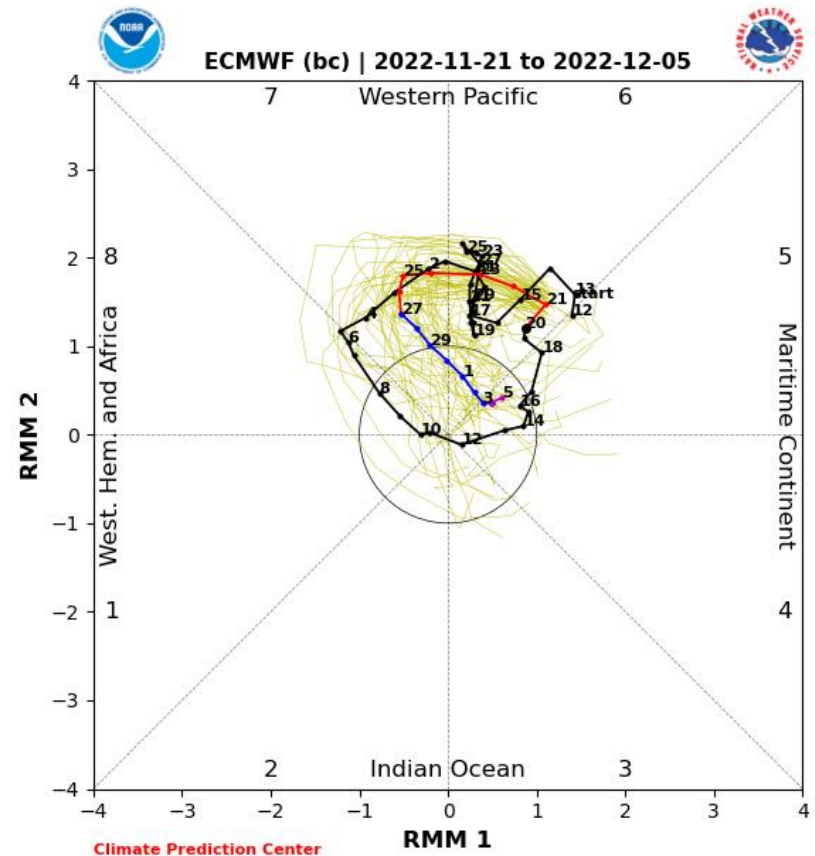


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



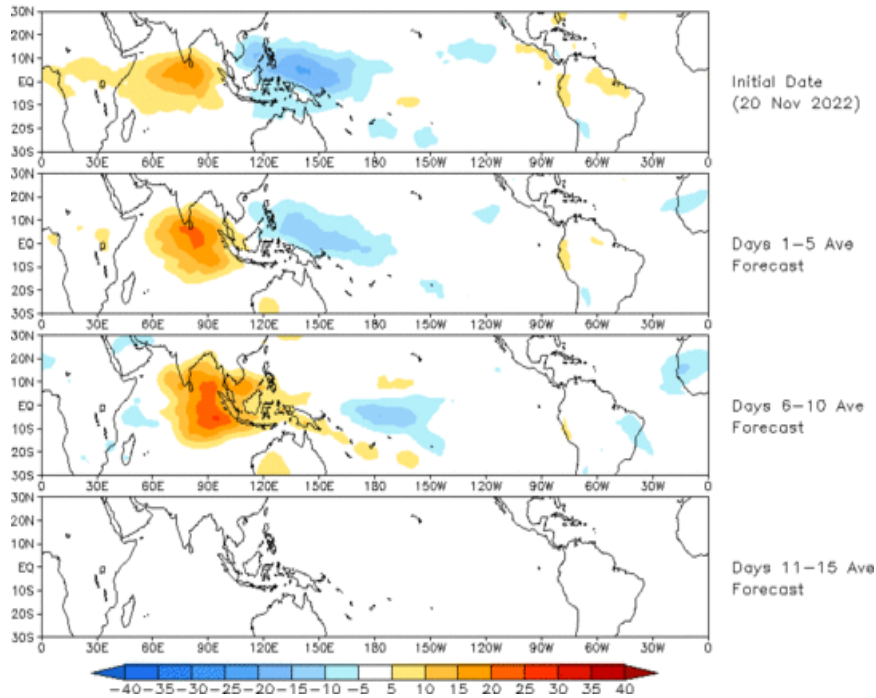
ECMWF Forecast

- Good agreement exists among the dynamical models favoring rapid Kelvin wave-like activity over the Western Pacific during week-1 before the signal weakens and moves back towards the right half of the RMM diagram within the unit circle during week 2. Model solutions diverge significantly for week 3.
- GEFS and BOMM both favor a more coherent RMM signal in phases 8-3, while other models push signal near the center of the unit circle.

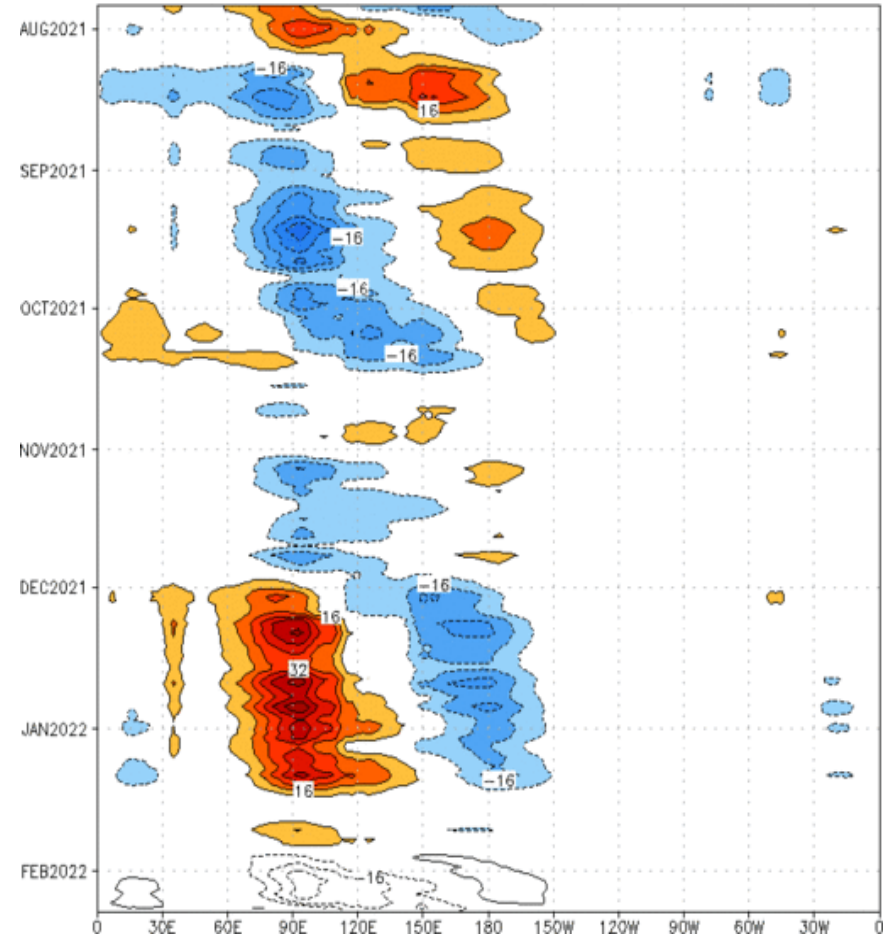
MJO: GEFS Forecast Evolution

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: 20 Nov 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

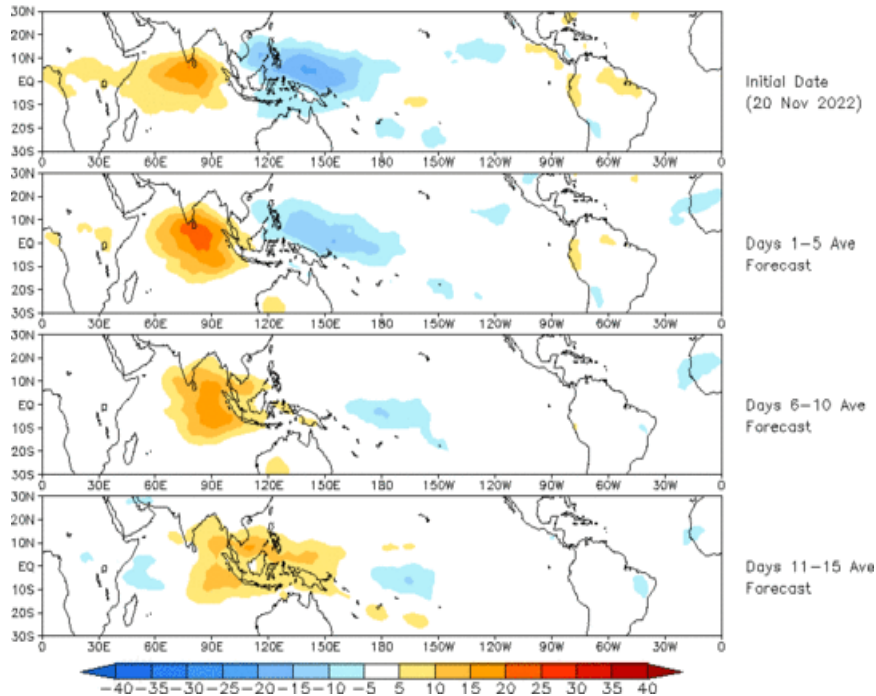


- The GEFS-based OLR anomaly fields depict a strong convective dipole shifting slightly eastward with time, consistent with a MJO event in the short term before flattening out later in week 2.

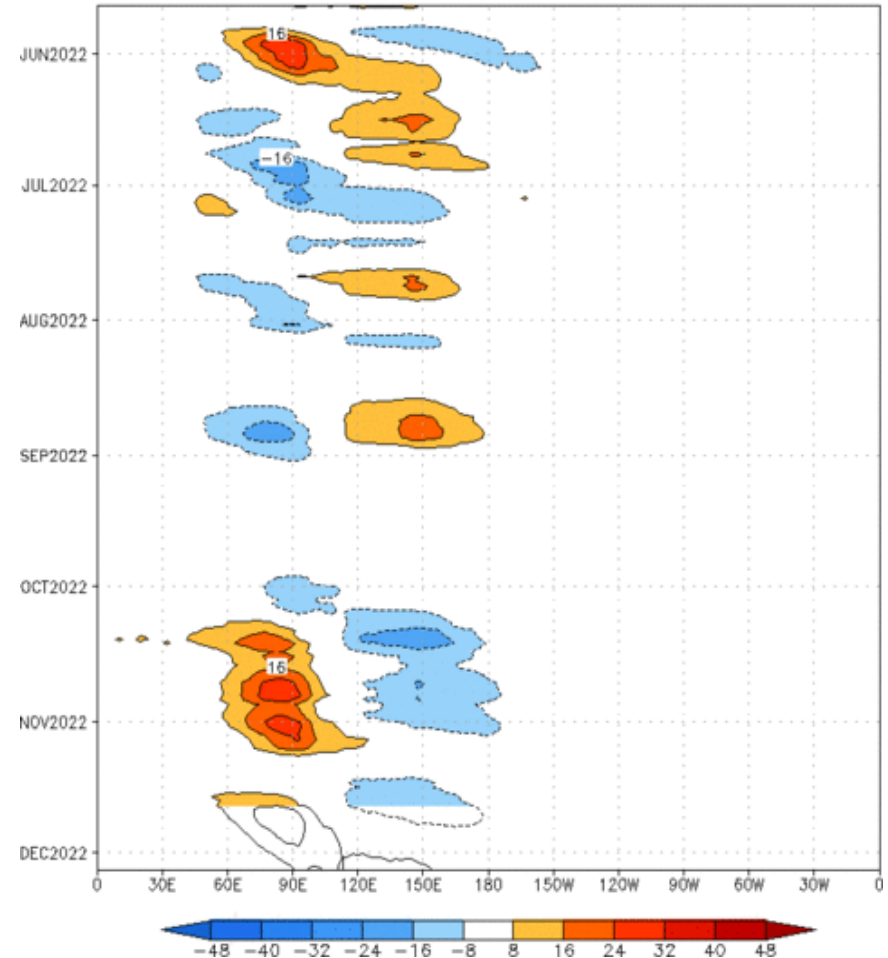
MJO: Constructed Analog Forecast Evolution

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 (20 Nov 2022)



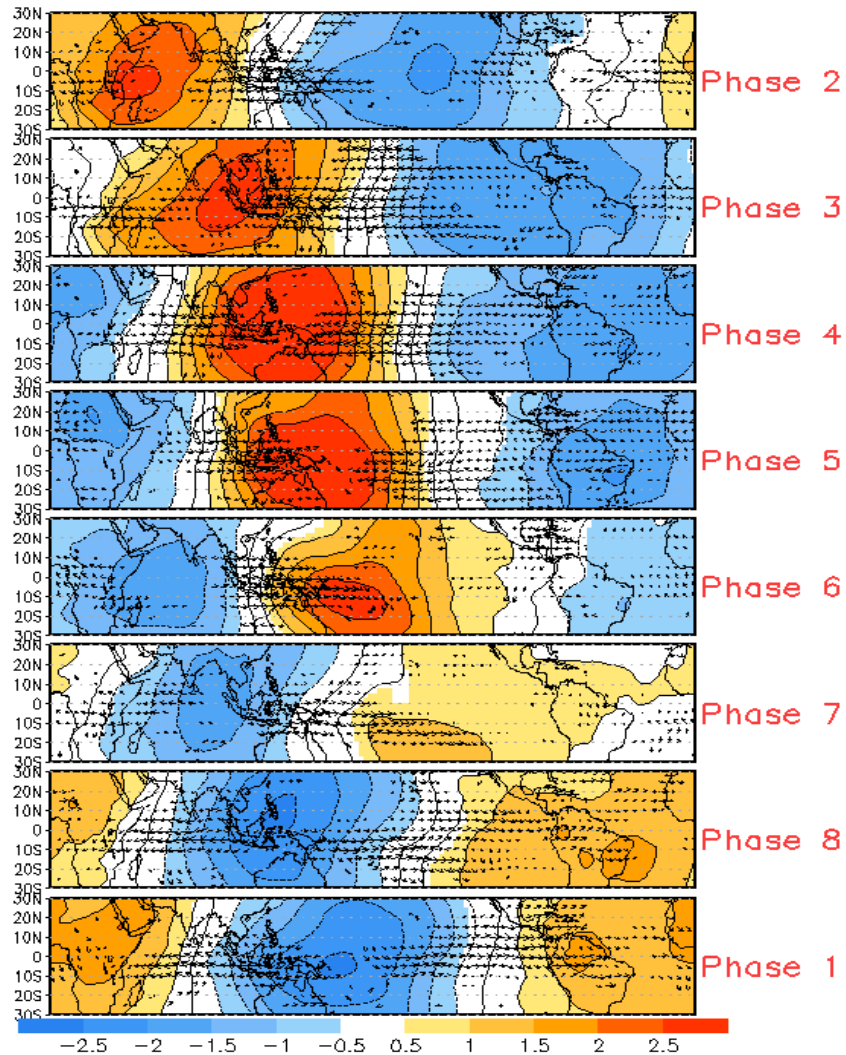
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S, 7.5°N] (cont: 4Wm⁻²) Period: 21-May-2022 to 20-Nov-2022
The unfilled contours are CA forecast reconstructed anomaly for 15 days



- The constructed analog forecast of RMM-based OLR also favors the development of a propagating convective dipole and maintains it throughout the week-2 period.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



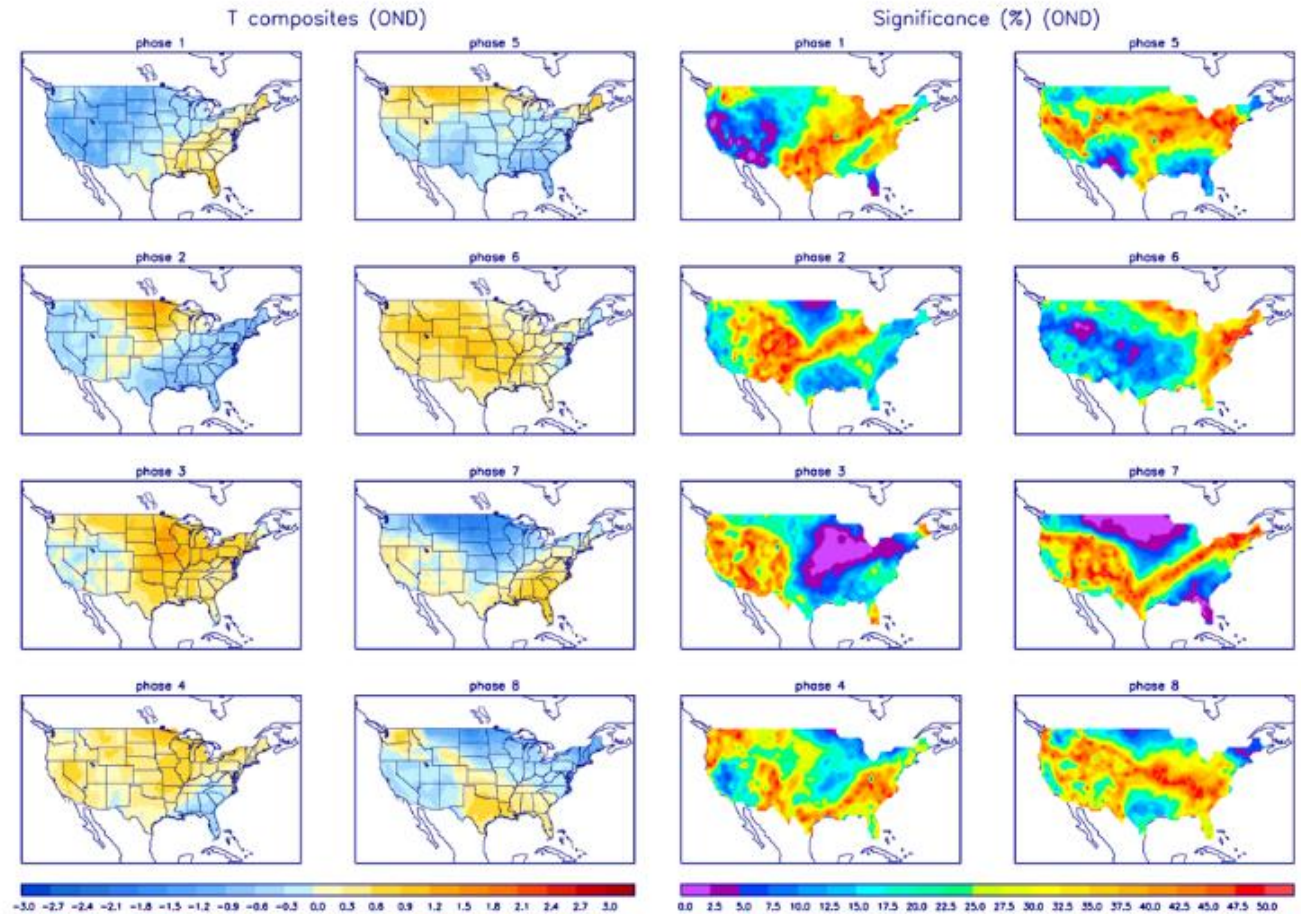
Precipitation Anomalies



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 - 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.

