

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



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

Overview

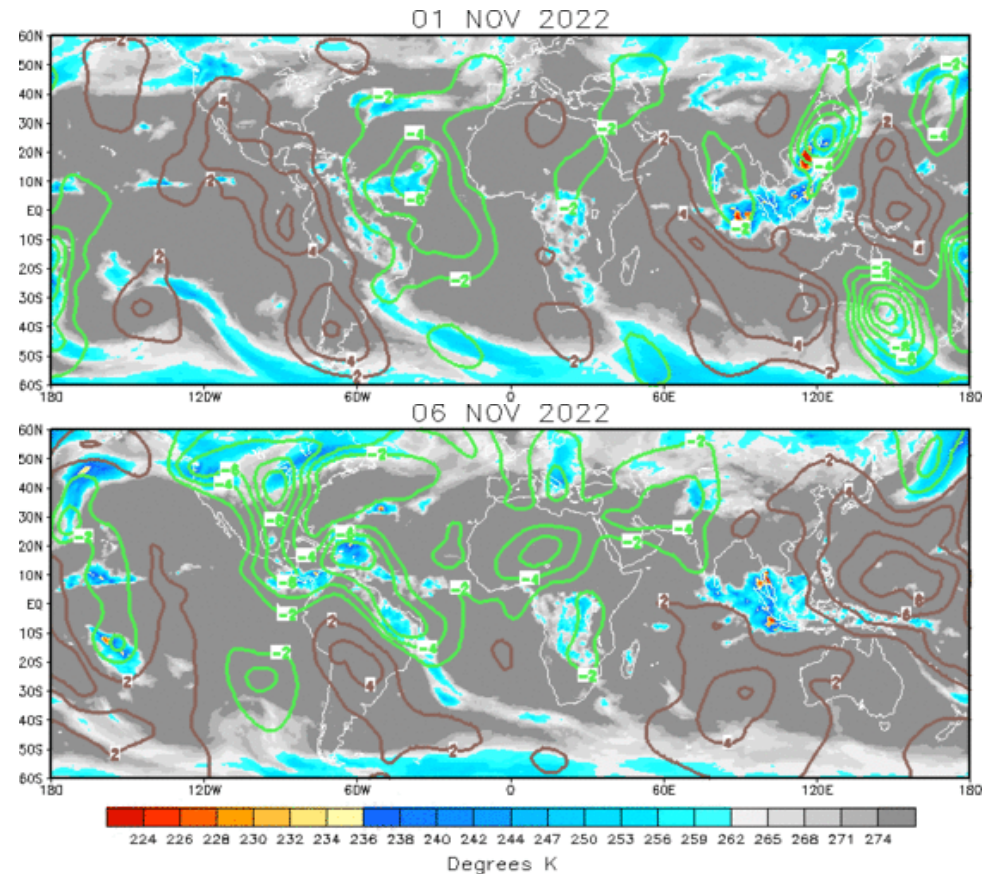
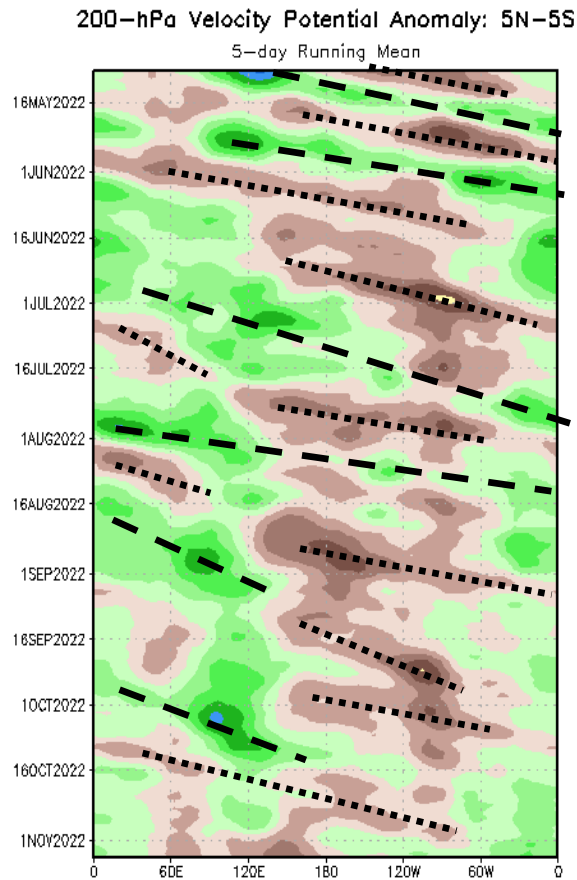
- There has been coherent propagation of the RMM-based MJO index through phase 7 during the past week, although the phase speed is more indicative of a Kelvin Wave.
- This has resulted in an increase in convection across the Atlantic during the past week, and the development of Subtropical Storm Nicole. Additional tropical cyclone development is possible across the Caribbean during week-2.
- Dynamical models weaken the RMM-based signal during the next few days, but reemerge the signal across the Maritime Continent and West Pacific during week-2.
- The renewed MJO across the Maritime Continent and West Pacific may favor late-season tropical cyclone development over the West Pacific following a period of decreased activity, along with an enhancement of the South Pacific Convergence Zone.

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)

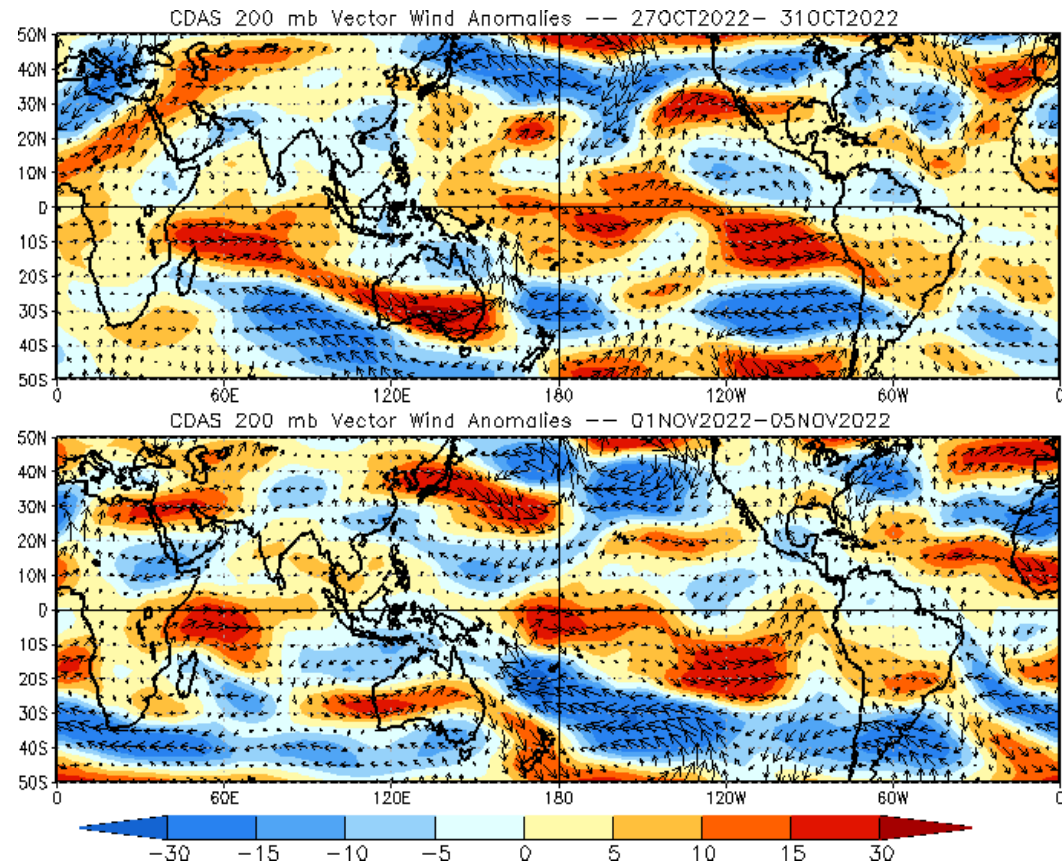
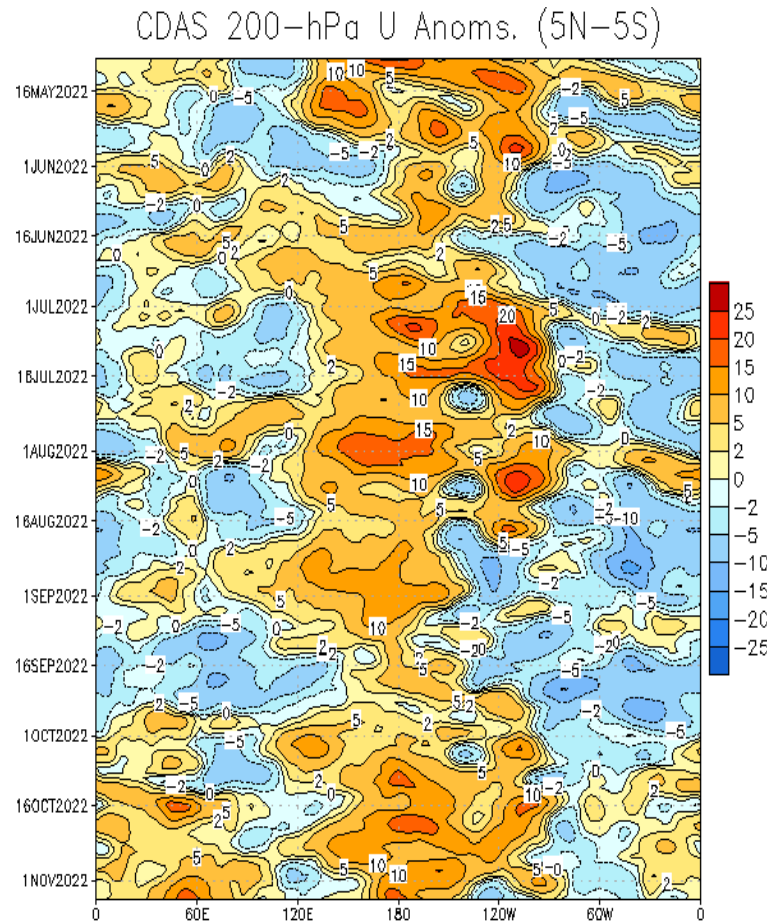
Brown shades: Anomalous convergence (unfavorable for precipitation)



- Some reorganization of the spatial upper-level velocity potential field has been noted during the past week.
- Enhanced convection has consolidated across North America, Atlantic, and Africa, with suppressed convection becoming more dominant across the western Pacific.

200-hPa Wind Anomalies

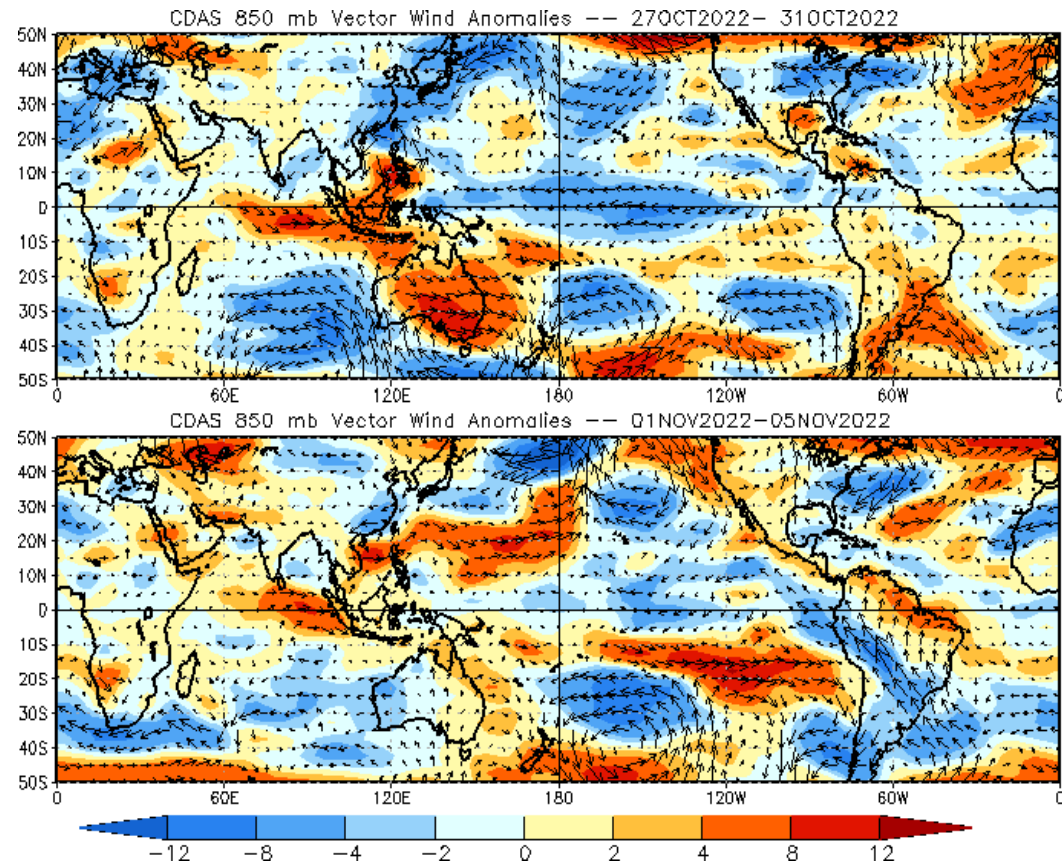
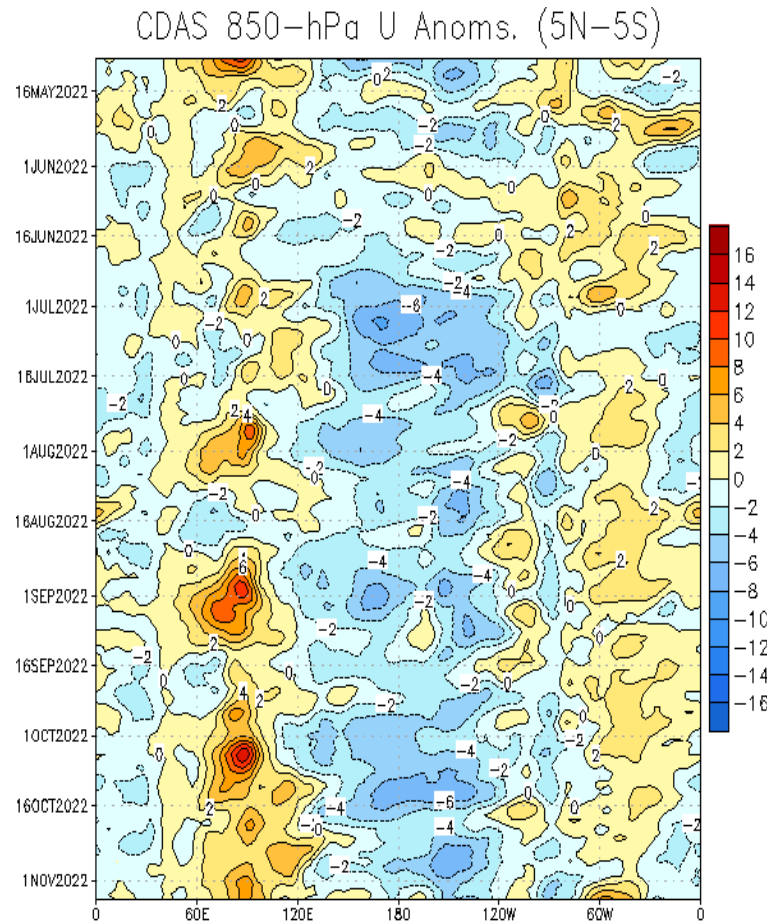
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Anomalous upper-level westerlies continued across much of the equatorial Pacific, tied to the low frequency La Niña state, and over the Indian Ocean.
- Anomalous upper-level westerlies have also increased across parts of the eastern Atlantic and western Africa.

850-hPa Wind Anomalies

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

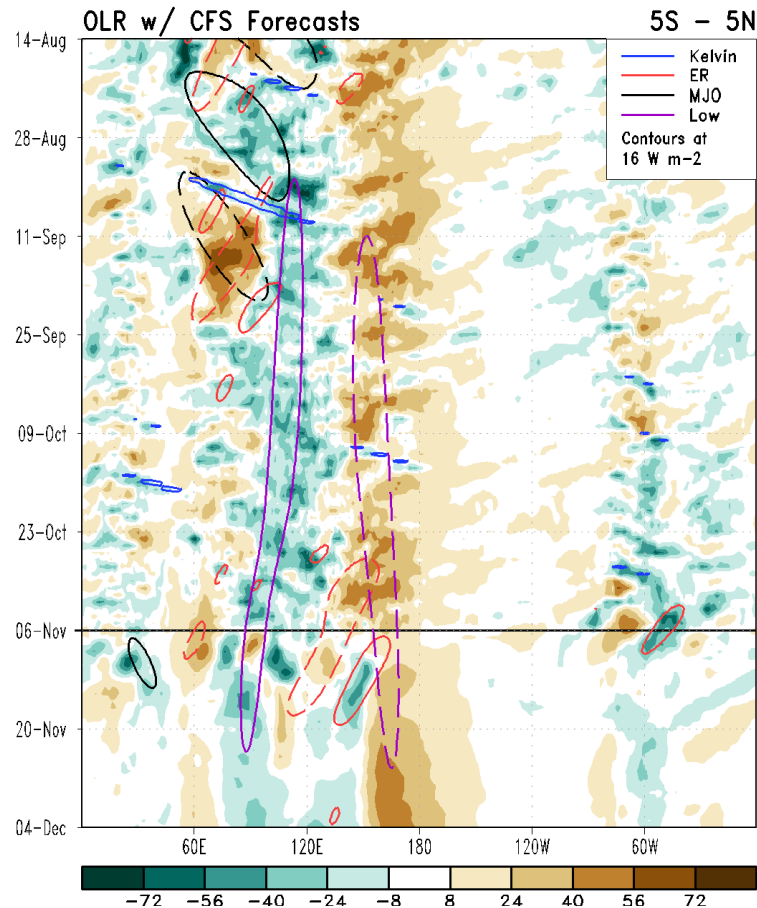


- Anomalous low-level westerlies continue across the equatorial Indian Ocean, but have weakened considerably over the Maritime Continent and Australia.
- Some weakening of the trades noted across the equatorial Pacific in the past week.

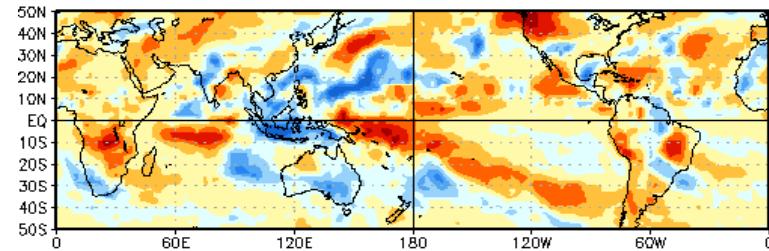
Outgoing Longwave Radiation (OLR) Anomalies

Green shades: Anomalous convection (wetness)

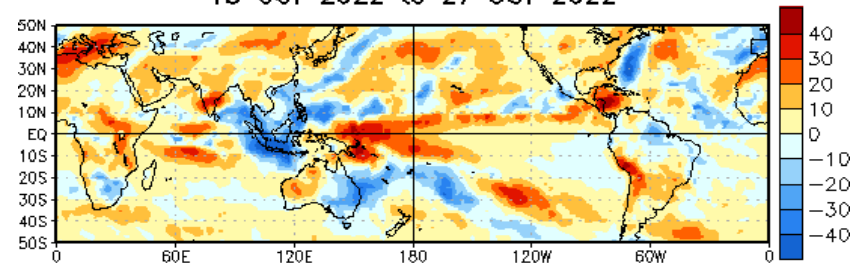
Brown shades: Anomalous subsidence (dryness)



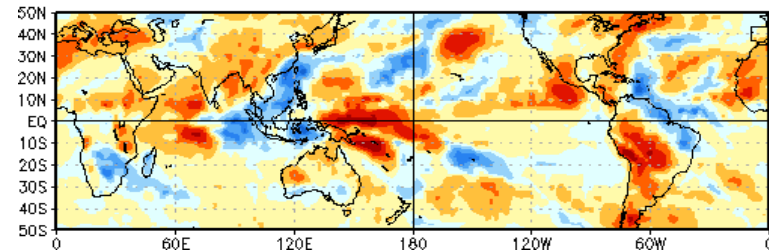
OLR Anomalies
8 OCT 2022 to 17 OCT 2022



18 OCT 2022 to 27 OCT 2022

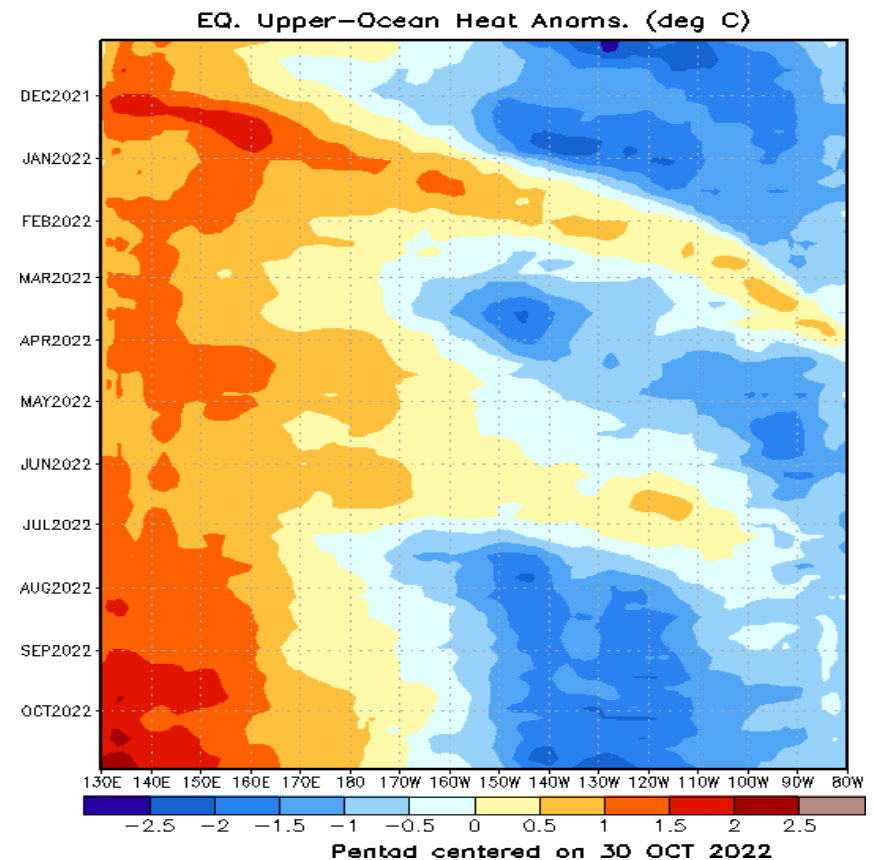
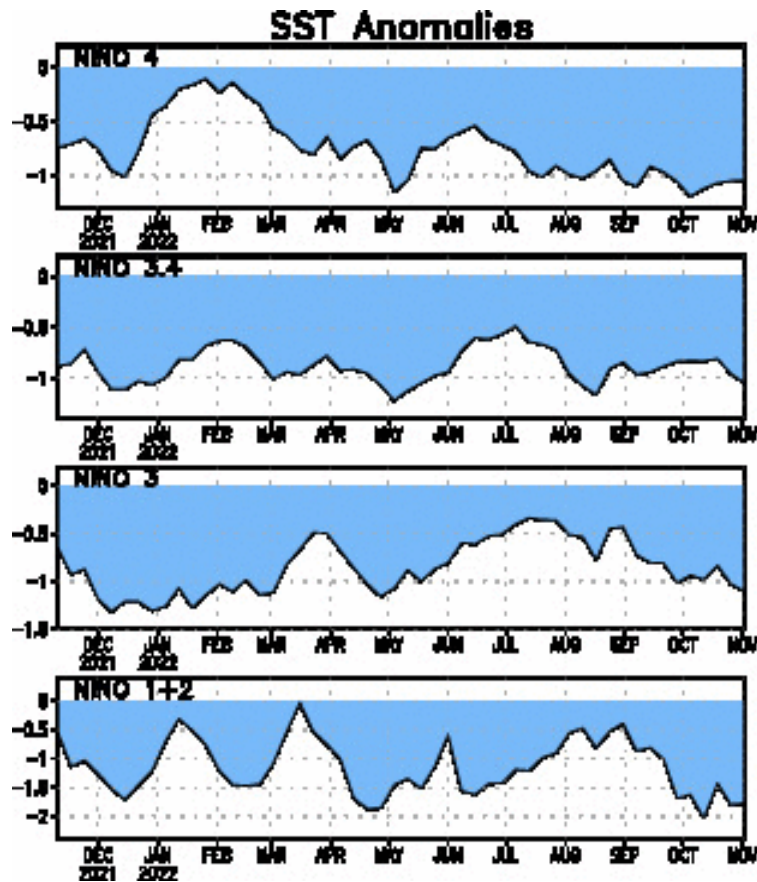


28 OCT 2022 to 6 NOV 2022



- The dipole of suppressed (enhanced) convection over the central Pacific (Maritime Continent) associated with La Niña remains the most robust feature across the global tropics.
- Enhanced convection has developed across northern South America and the southern Atlantic Ocean, leading to the development of Subtropical Storm Nicole.

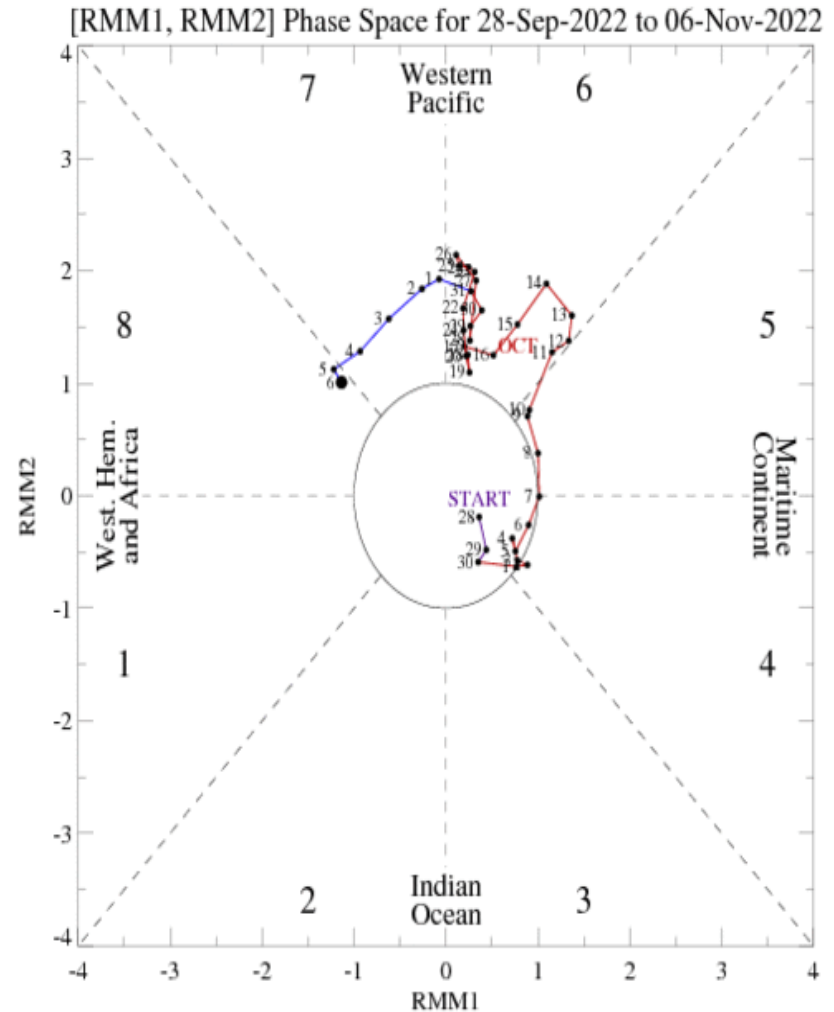
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Enhanced trades tied to the ongoing La Niña have resulted in subsurface below-normal heat content.
- There has been little to no eastward progression of the positive subsurface temperature anomalies across the western Pacific in the past month.
- SSTs remain well below average across all Niño basins, reflecting robust and persistent cold ENSO conditions.

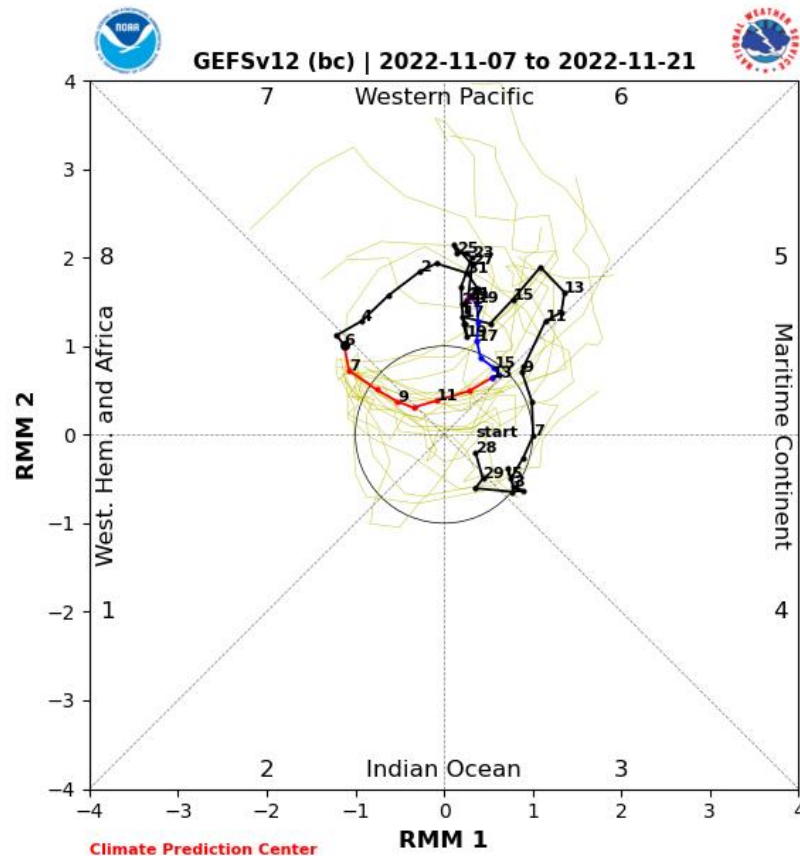
MJO Index: Recent Evolution

- There has been a coherent propagation of the RMM-based MJO index through phase 7 in the past week.
- The phase speed appears to be more related to a Kelvin Wave than a true MJO.

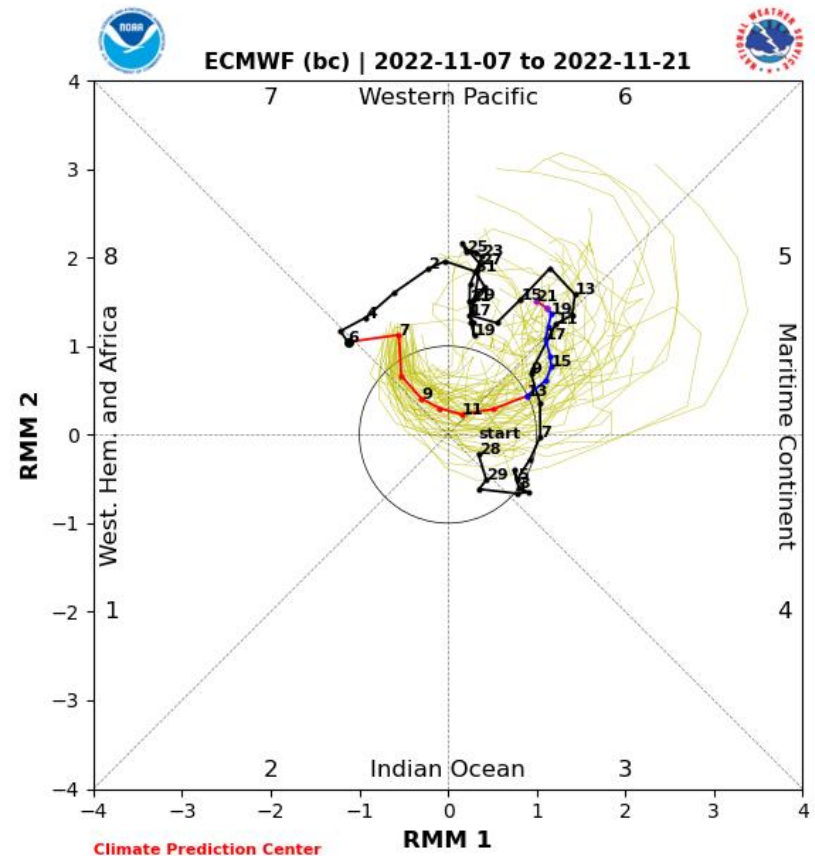


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



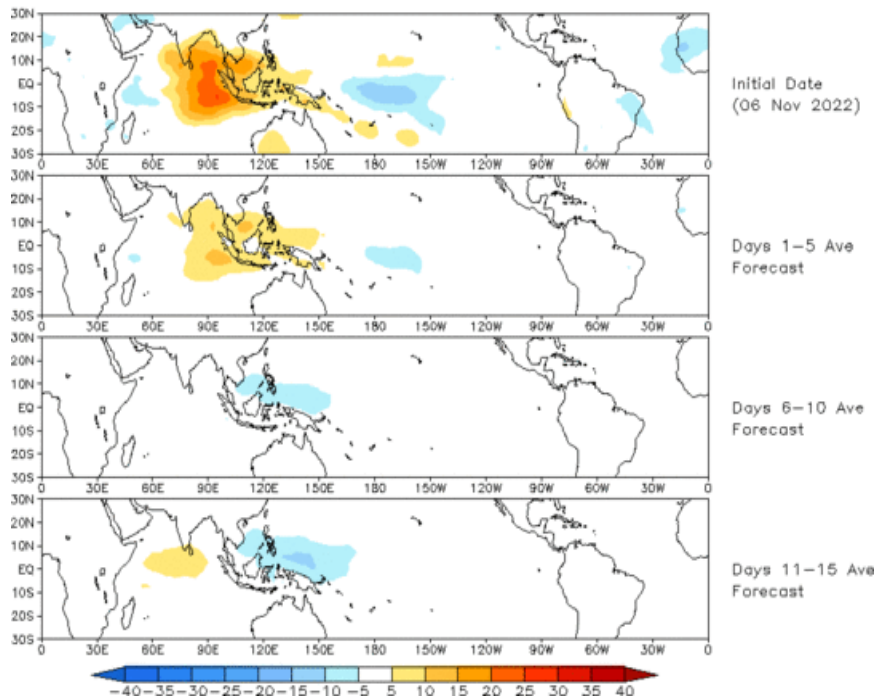
ECMWF Forecast

- Both the GEFS and ECMWF RMM-index forecasts decay the signal back into the unit circle during the next few days.
- The RMM-based signal is forecast to reemerge across the Maritime Continent by week-2, with possible renewed eastward propagation into the western Pacific.

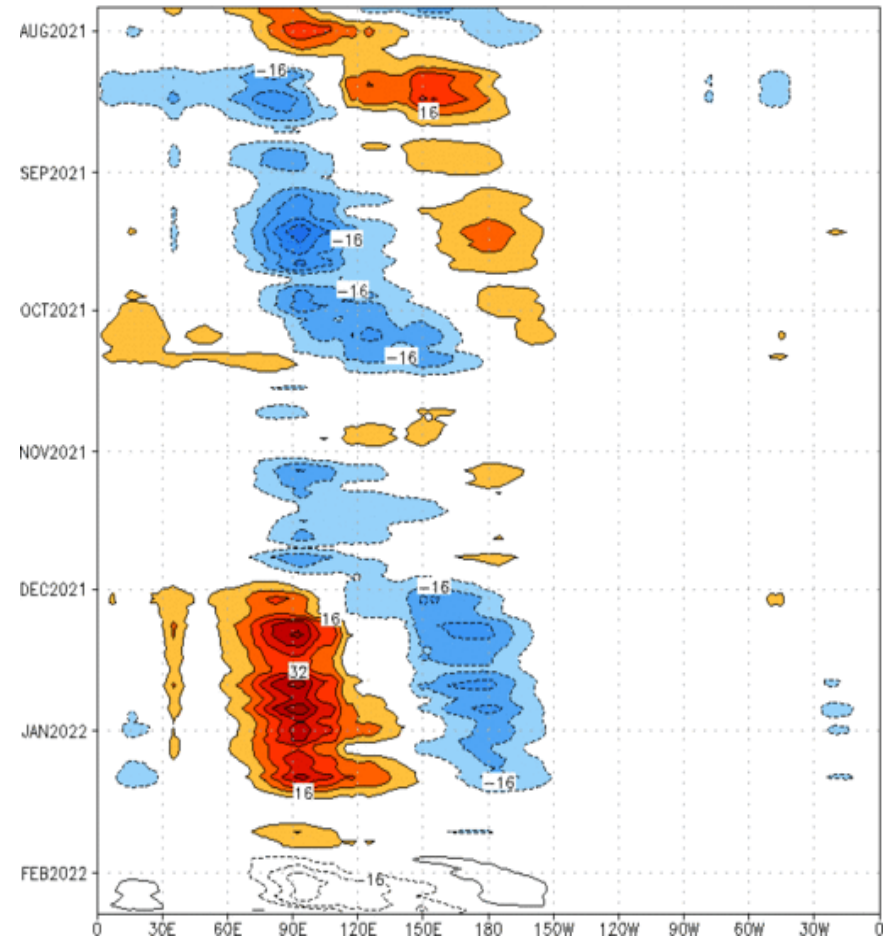
MJO: GEFS Forecast Evolution

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: 06 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

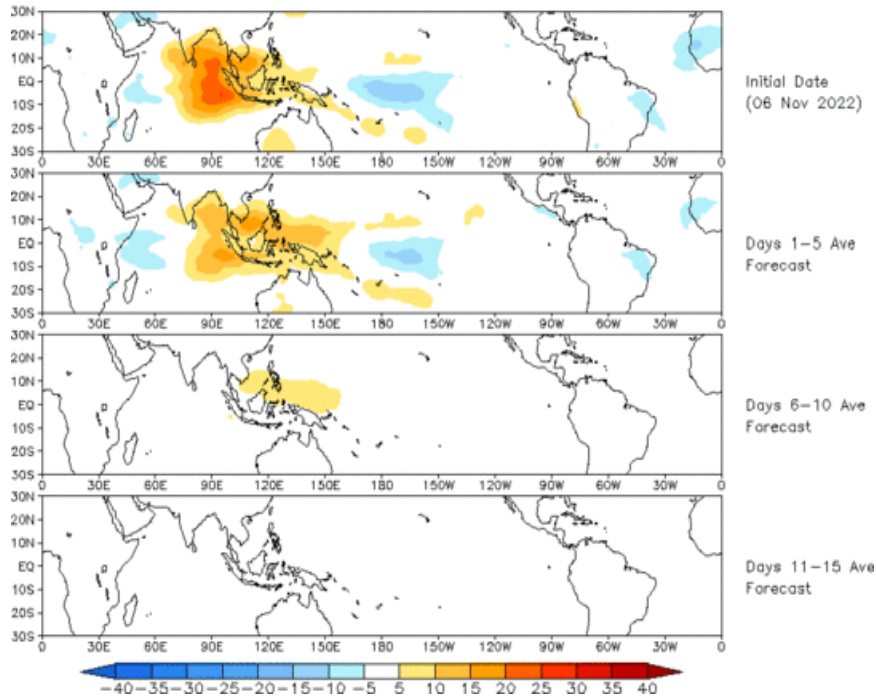


- The GEFS-based OLR anomaly fields depict positive OLR anomalies (suppressed convection) across the Indian Ocean and Maritime Continent during week-1.
- By week-2, these positive anomalies weaken, with negative OLR anomalies developing across the western Pacific.

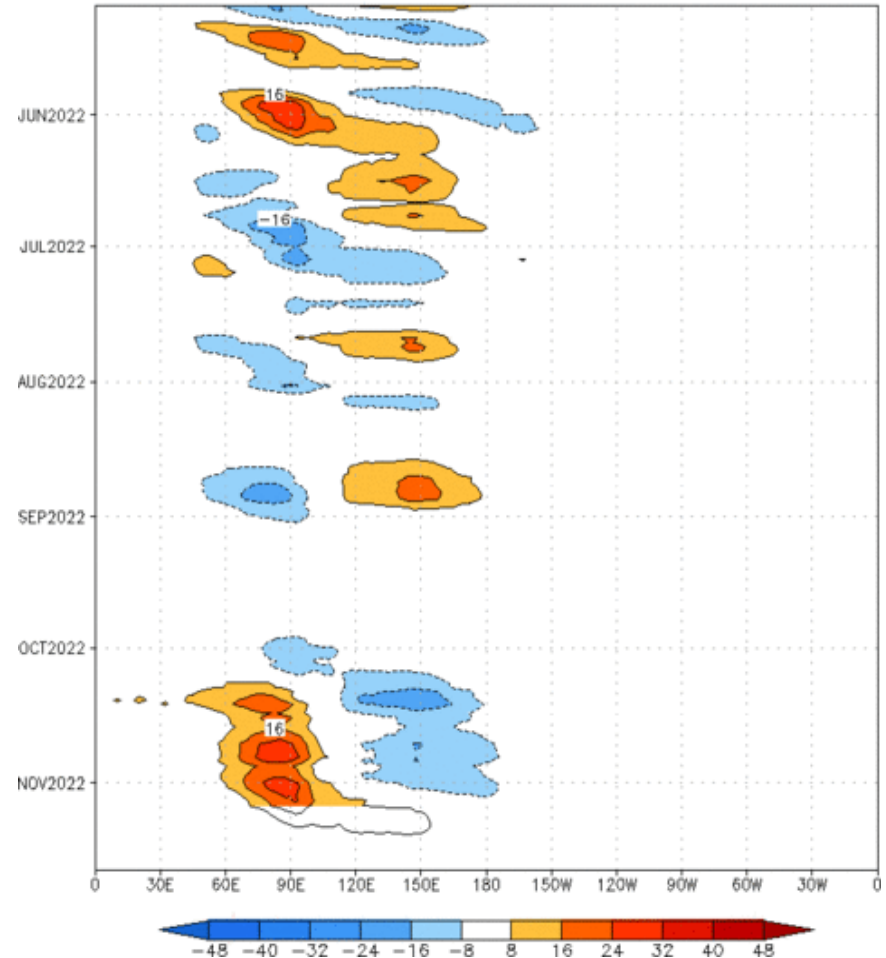
MJO: Constructed Analog Forecast Evolution

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 (06 Nov 2022)



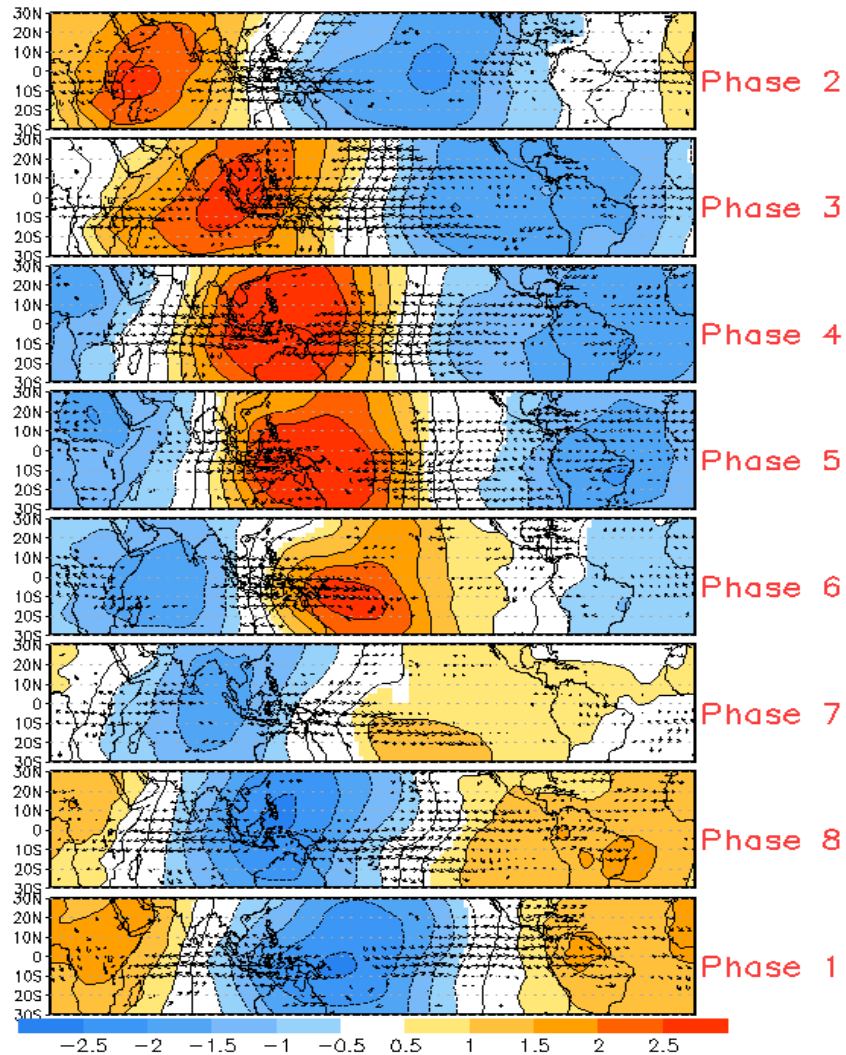
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:07-May-2022 to 06-Nov-2022
The unfilled contours are CA forecast reconstructed anomaly for 15 days



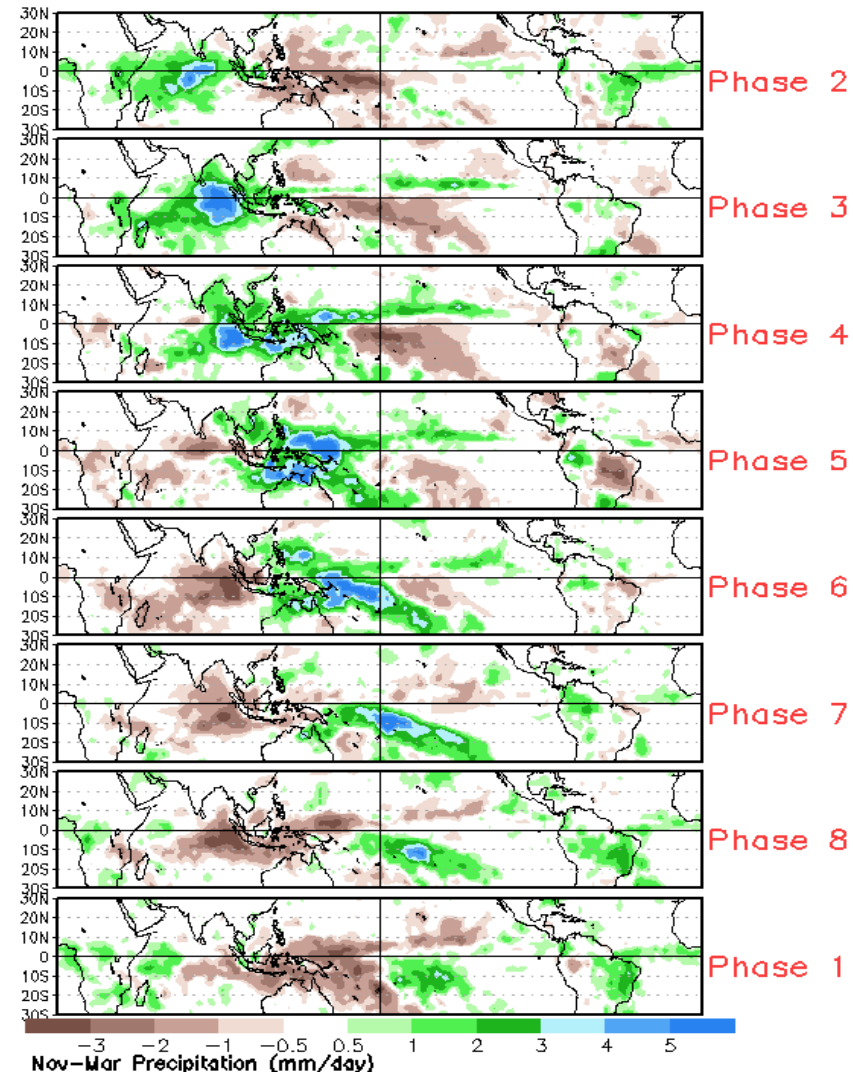
- The constructed analog forecast of RMM-based OLR is similar to the GEFS during week-1, although does not depict the increasing negative OLR anomalies over the western Pacific in week-2 as the GEFS does.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



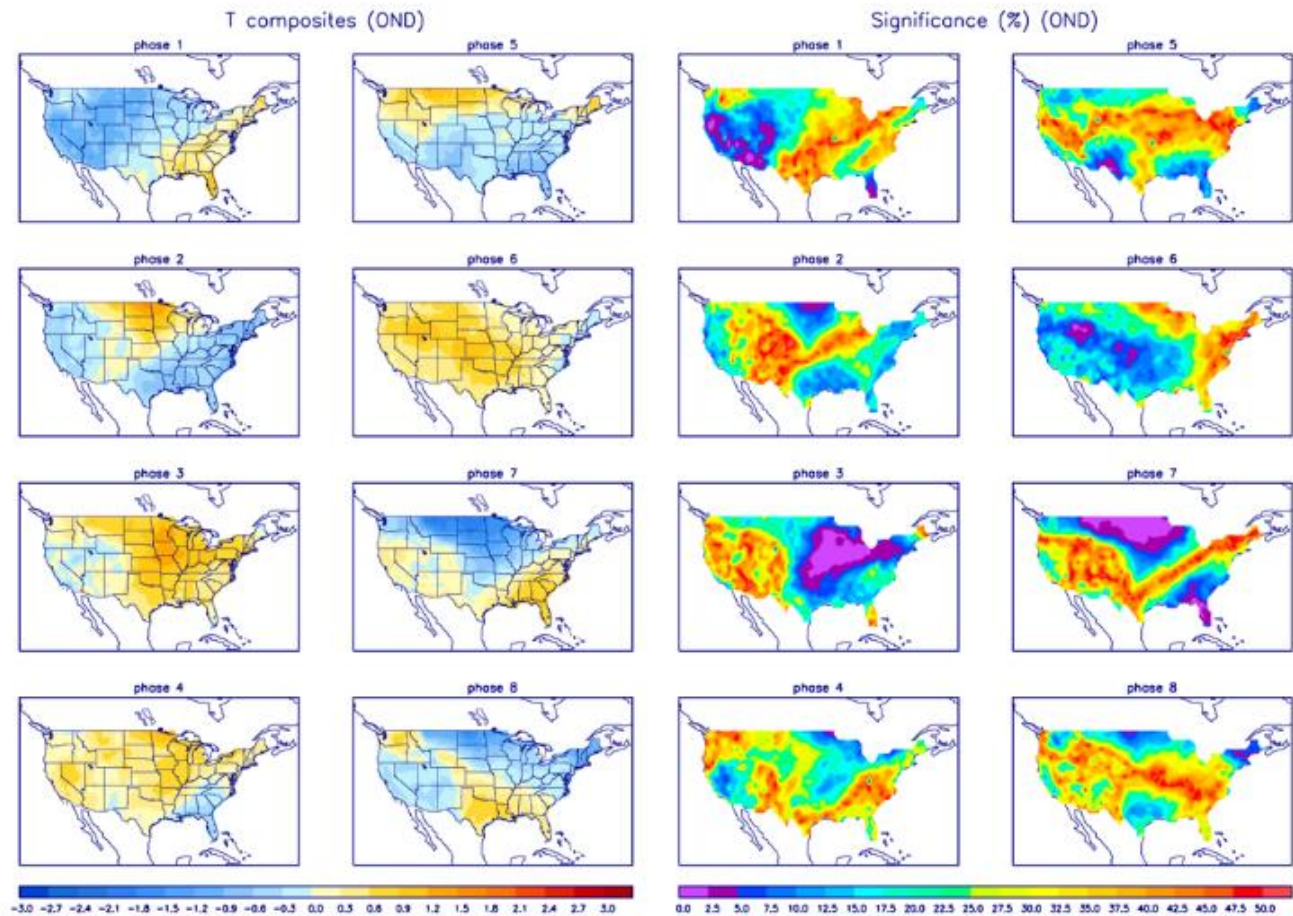
Precipitation Anomalies



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.

