

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



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

Overview

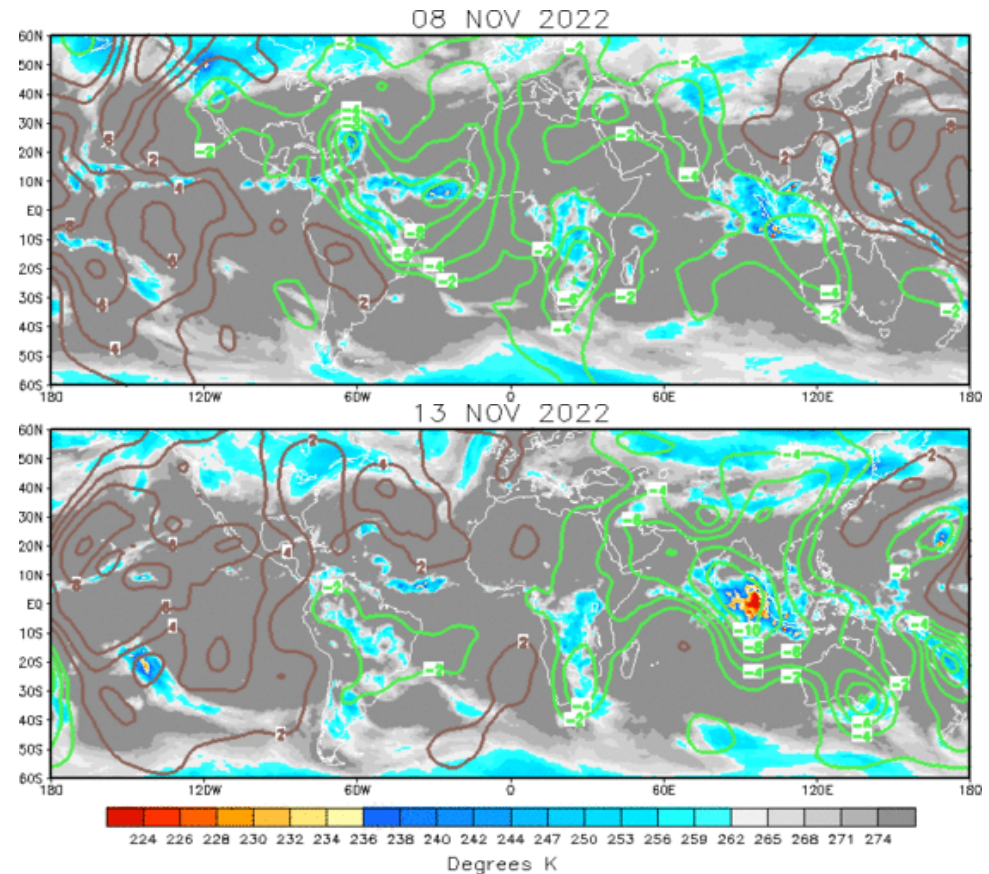
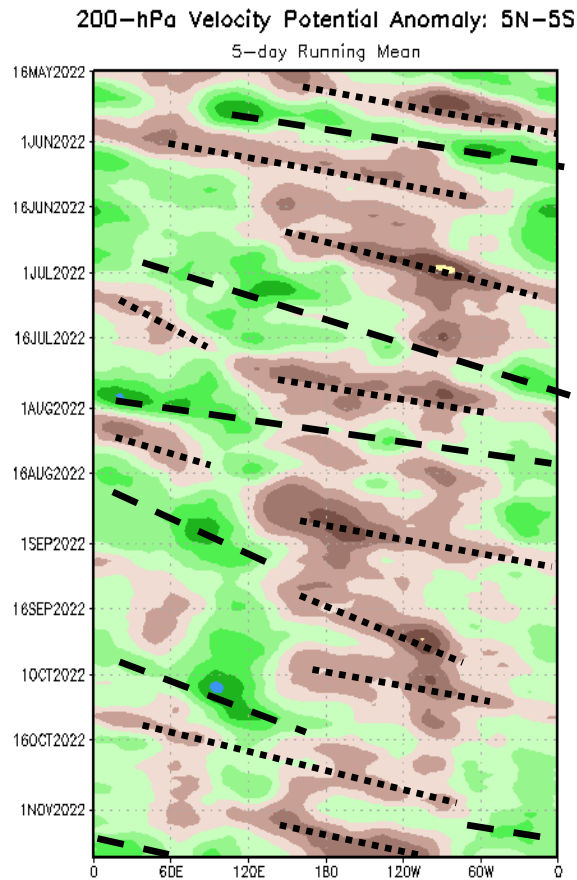
- The RMM index indicates the MJO has greatly weakened in amplitude (approaching the origin in RMM space), but the signal has continued to steadily propagate eastward over the western Hemisphere and Indian Ocean during the past week.
- There is good agreement among the dynamical models favoring a more coherent MJO signal remerging over the Maritime Continent during week-1, and continuing to propagate eastward to the western Pacific during week-2. Additionally, there is increased support in the extended range ensemble solutions depicting a strong MJO event that returns over the Western Hemisphere by early December following destructive interference with the La Niña footprint.
- The renewed MJO forecast is expected to provide a large scale environment conducive for tropical cyclone formation mainly across the eastern Hemisphere during the next two weeks, with decreasing chances for development over the Indian Ocean during the week-3 period.
- The extratropical response associated with West Pacific MJO events during late boreal autumn historically favors the development of anomalously warm conditions over many portions of the CONUS.

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)

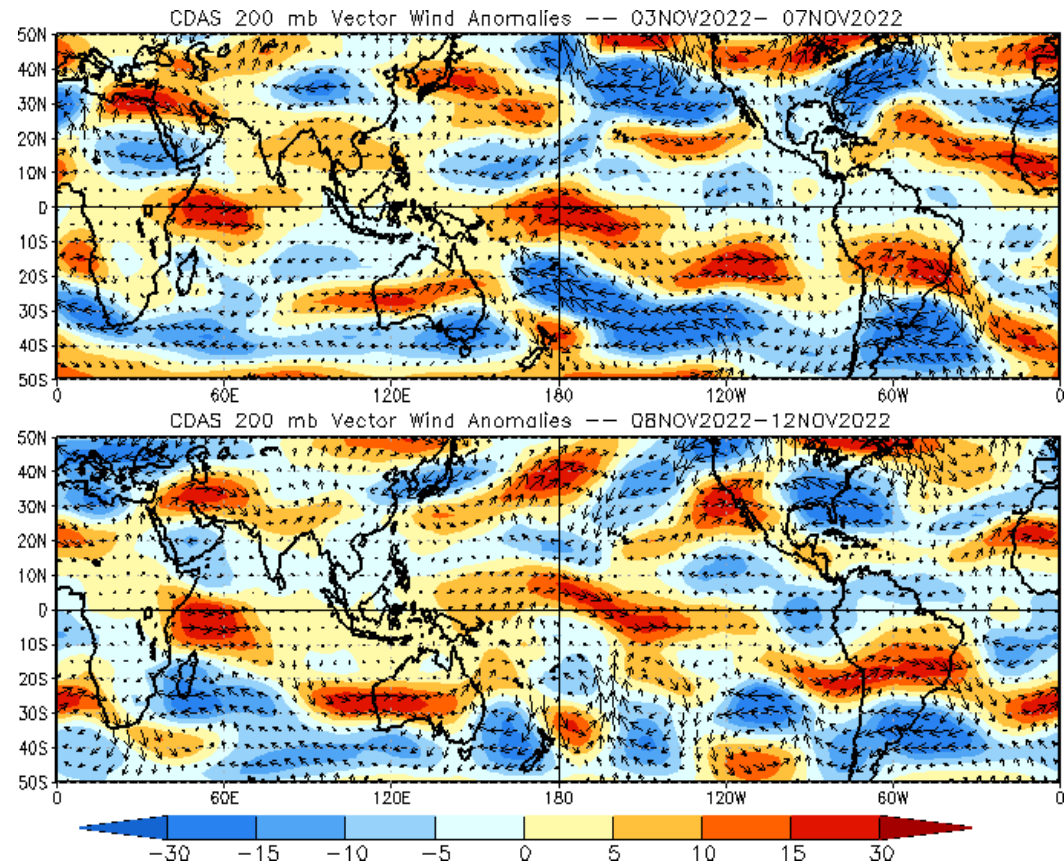
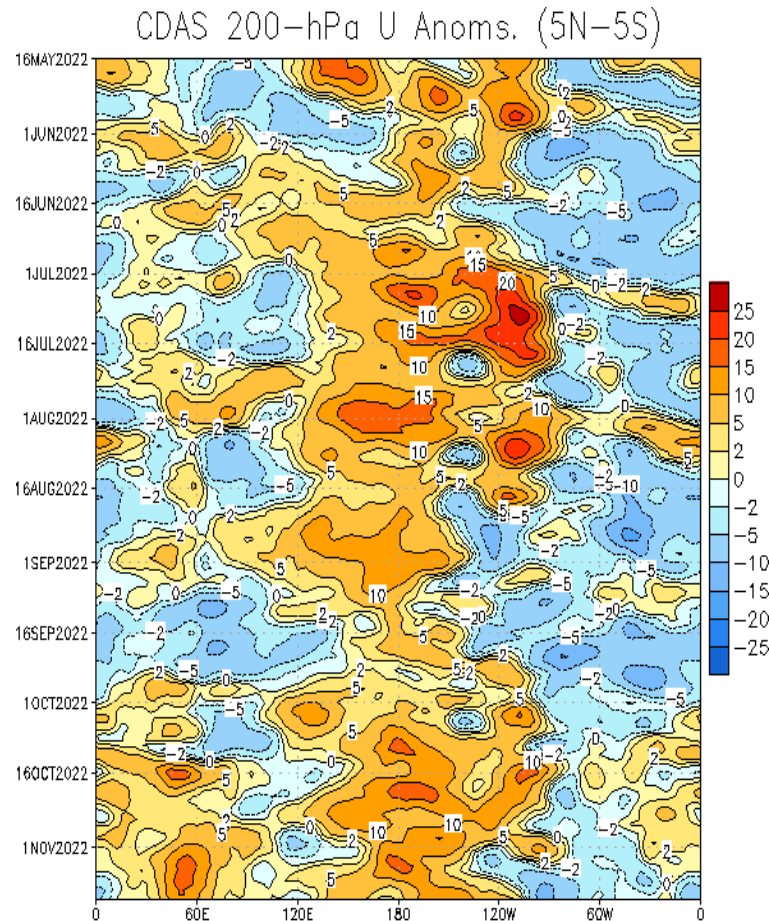
Brown shades: Anomalous convergence (unfavorable for precipitation)



- A more coherent velocity potential anomaly pattern is reemerging across the global tropics.
- While not quite a classic wave-1 symmetry, suppressed upper-level conditions have shifted eastward over the equatorial Pacific, with the enhanced convective envelope also having moved over the Indian Ocean where it is nearly rejoined with the low frequency base state.

200-hPa Wind Anomalies

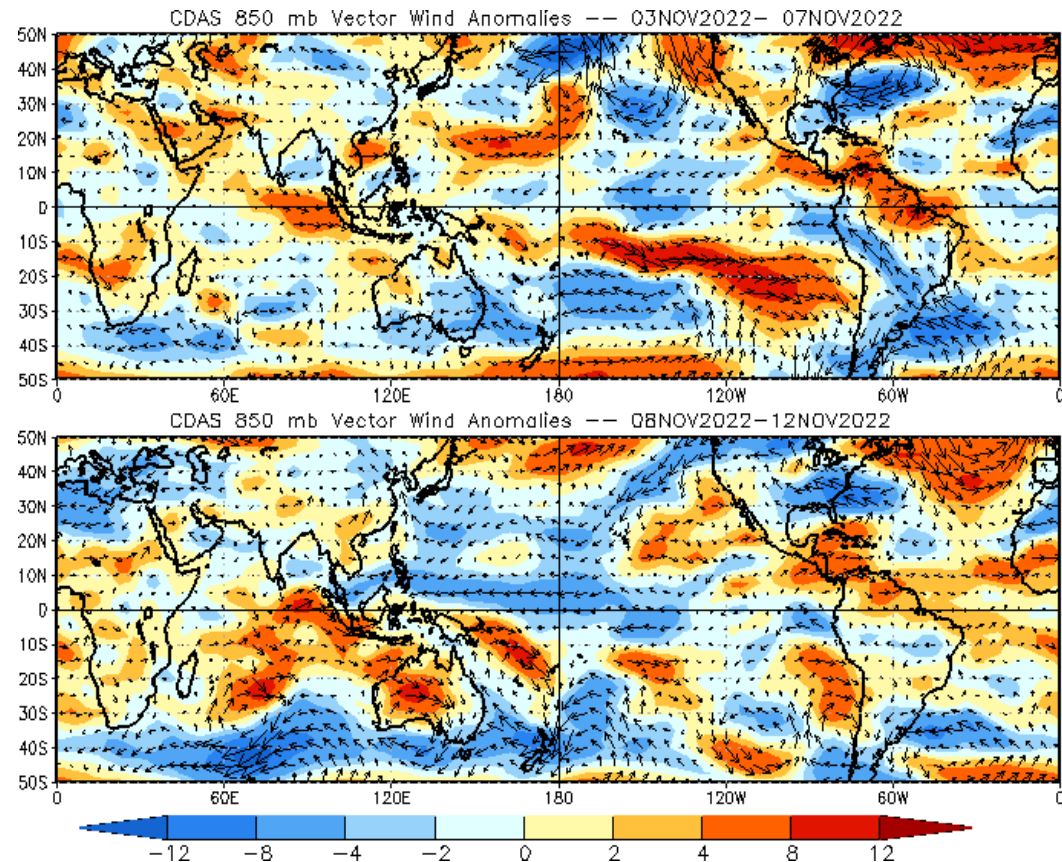
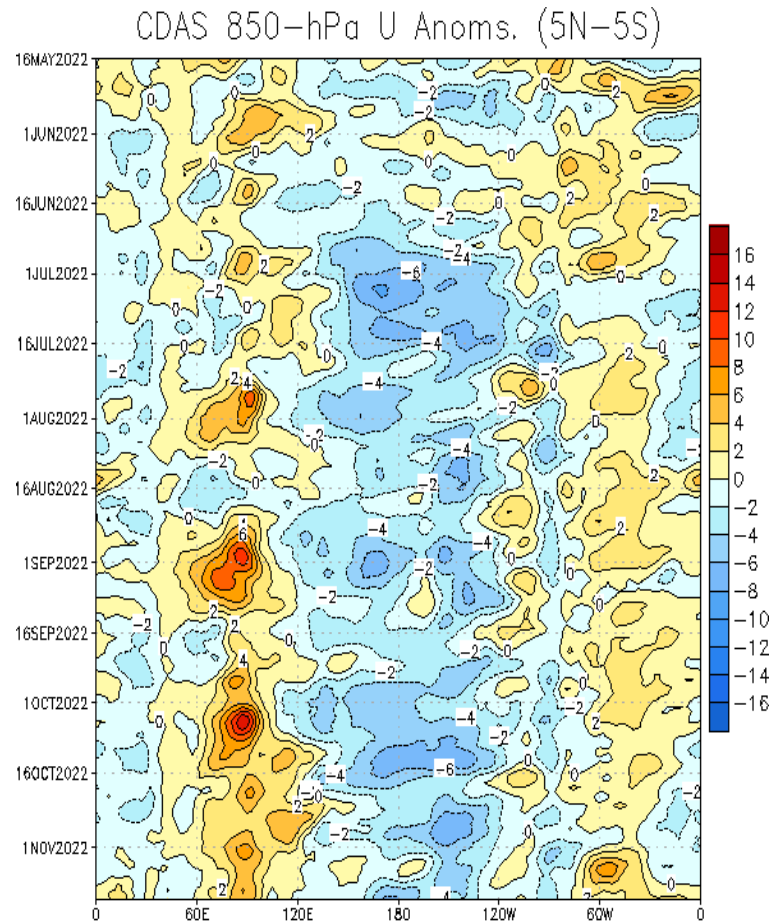
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Consistent with La Niña, anomalous upper-level westerlies continued across equatorial Pacific, however anomalous easterlies have strengthened over many parts of the eastern Pacific.
- Strongly 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.

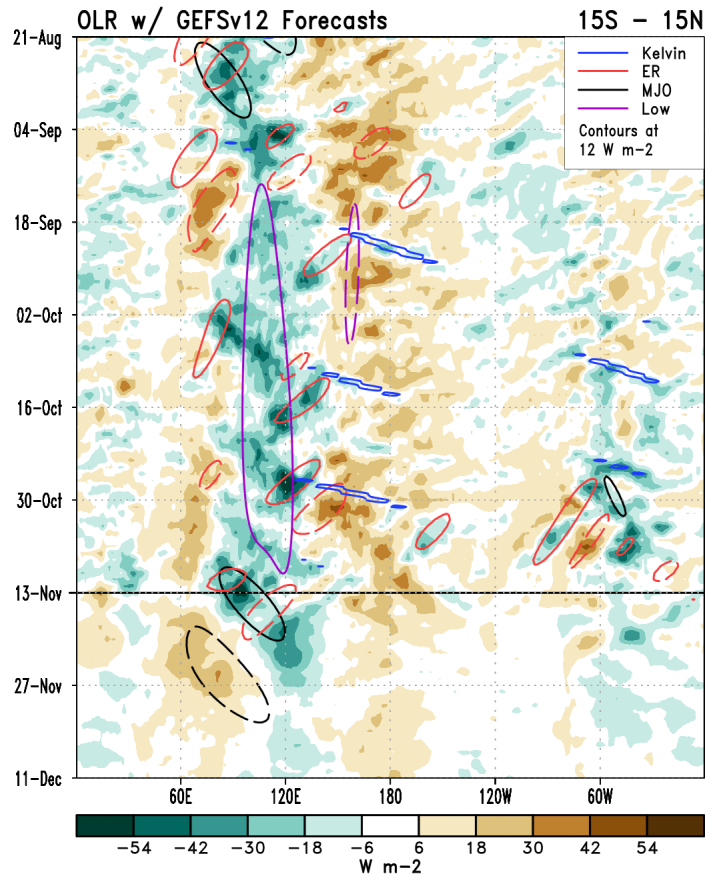


- Enhanced trades returned over the western and central Pacific mainly north of the equator.
- Anomalous westerlies persist across the eastern Indian Ocean and Maritime Continent, with a strengthening westerly band observed to the east of Papua New Guinea.
- A fairly broad area of lower level cyclonic flow developed over the southwestern Atlantic, which helped spawn Hurricane Nicole earlier in November.

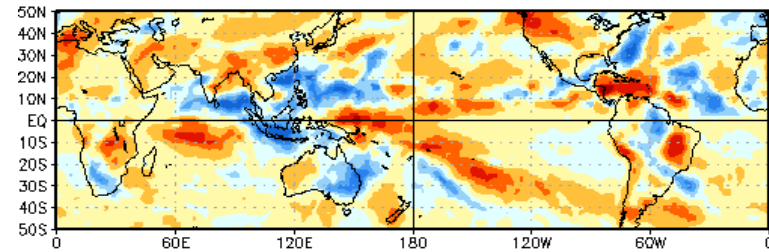
Outgoing Longwave Radiation (OLR) Anomalies

Green shades: Anomalous convection (wetness)

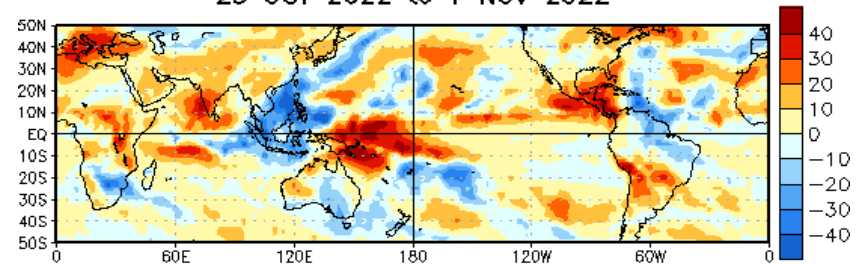
Brown shades: Anomalous subsidence (dryness)



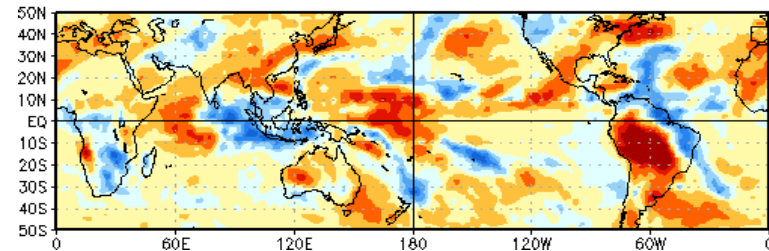
OLR Anomalies
13 OCT 2022 to 22 OCT 2022



23 OCT 2022 to 1 NOV 2022

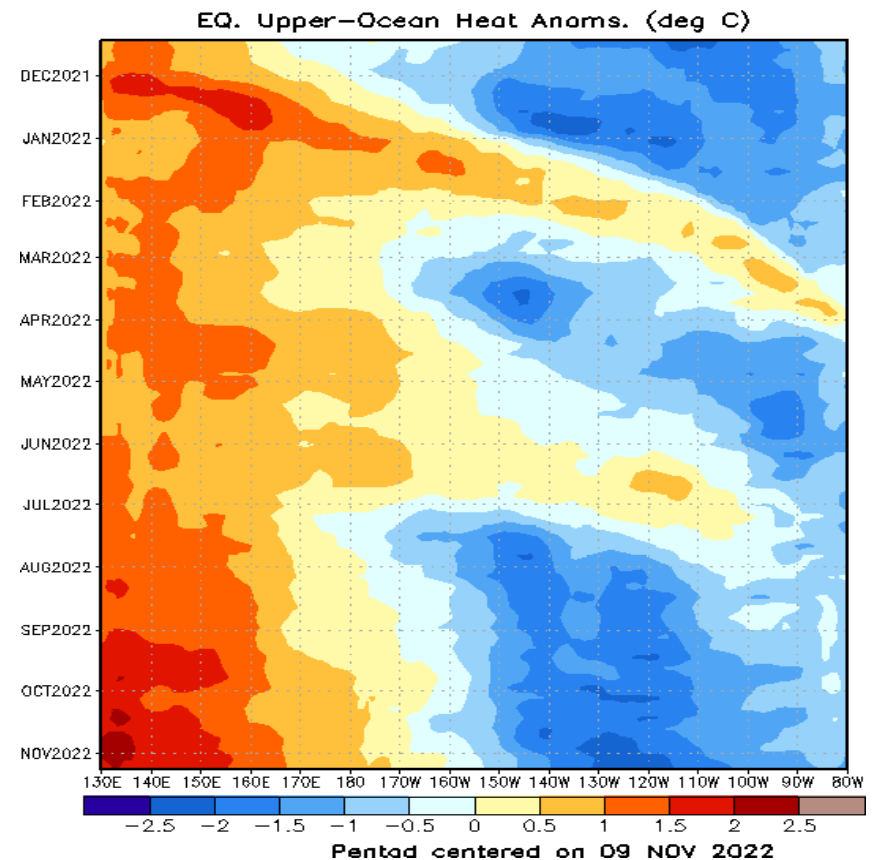
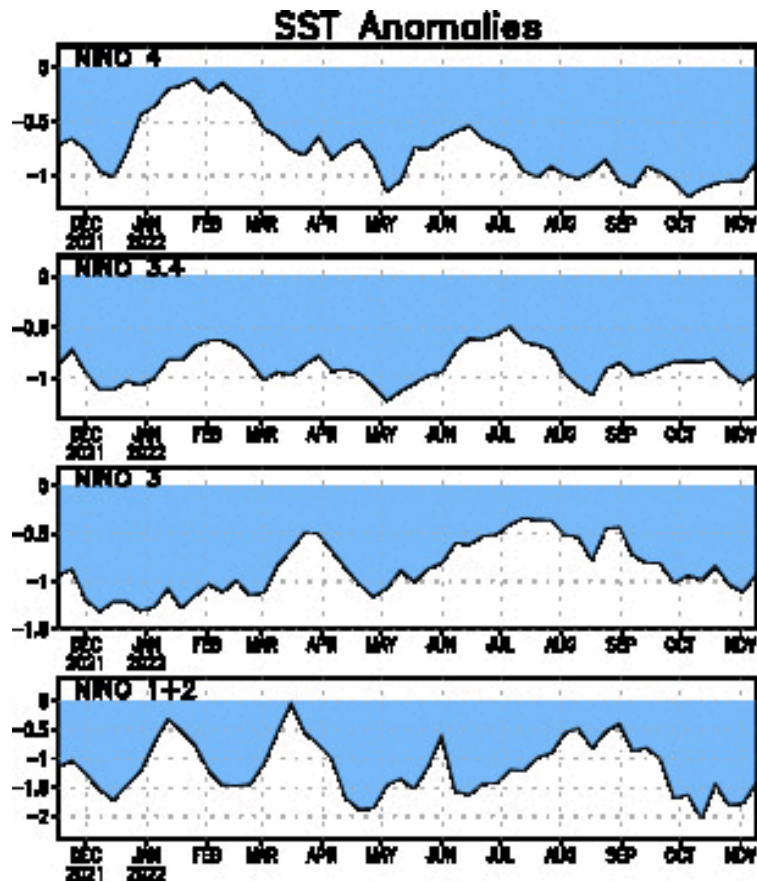


2 NOV 2022 to 11 NOV 2022



- Relative to late October, suppressed convection subsided somewhat to the west of the Date Line, suggestive of a briefly weakened La Nina state.
- The GEFS forecast shows a sharp uptick in enhanced convection near 90E on the near-term, with MJO activity coming through the filtering.

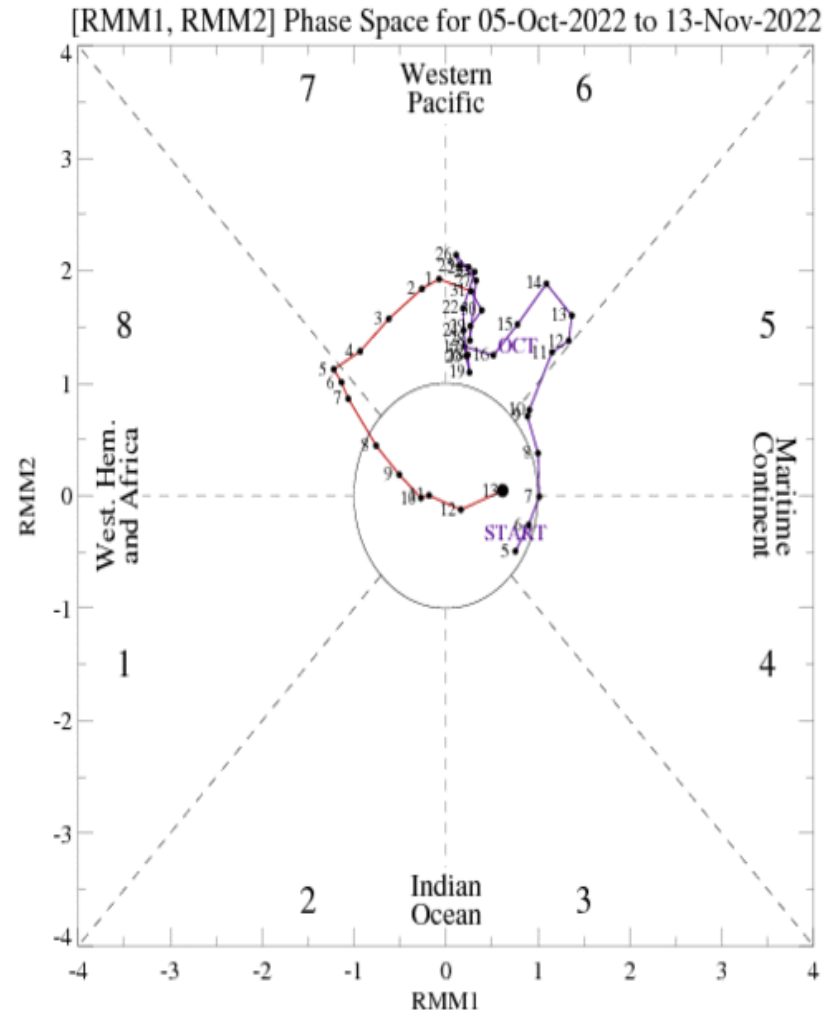
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- There is some indication of the positive subsurface temperature anomalies shifting further eastward, as the subsurface cold pool has become more zonally narrow during the past month.
- SSTs remain well below average across all Niño basins, reflecting robust and persistent cold ENSO conditions.

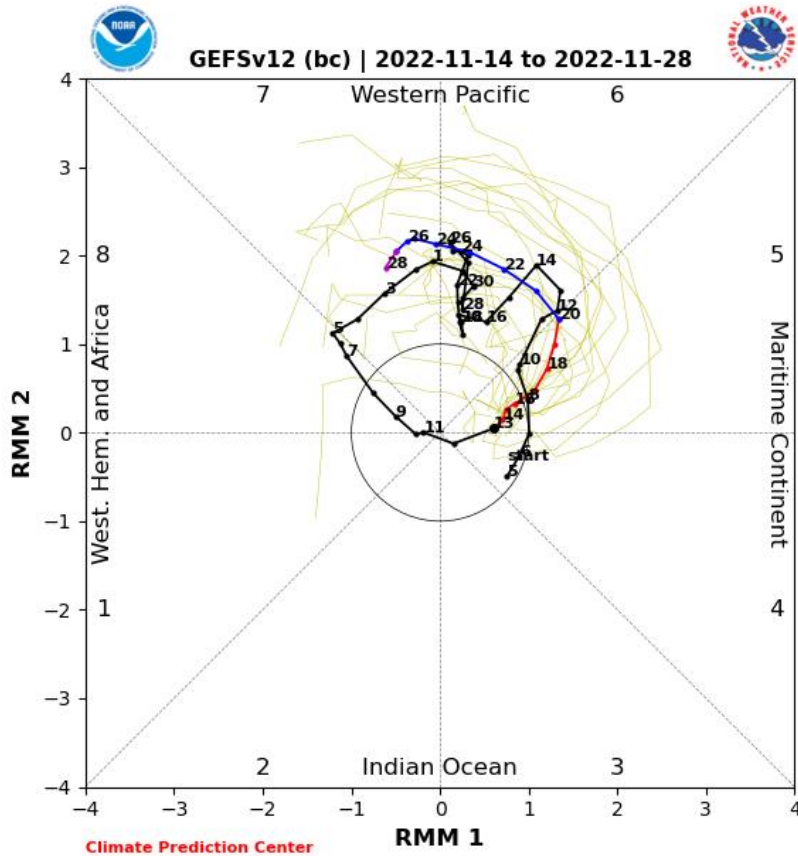
MJO Index: Recent Evolution

- Despite a period of quasi-stationary intraseasonal activity over the western Pacific, RMM observations show a full circumnavigation of the signal since early October.
- Although the latest observations depict a more weakened signal, the MJO has continued to propagate eastward across the western Hemisphere and Indian Ocean, which is well reflected in the observed velocity potential anomaly fields.

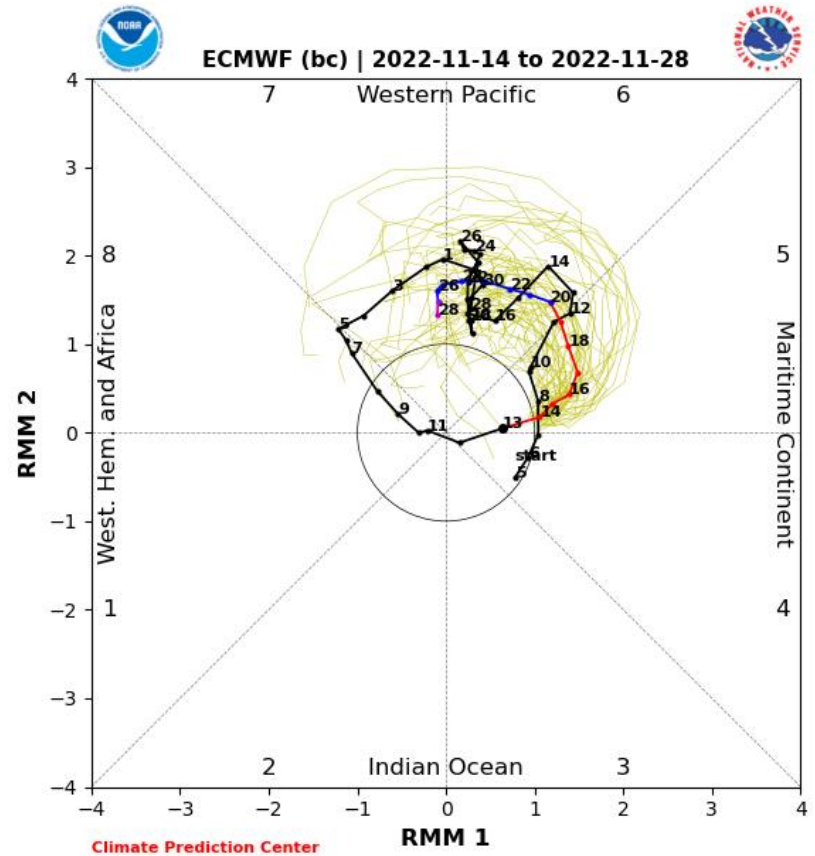


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



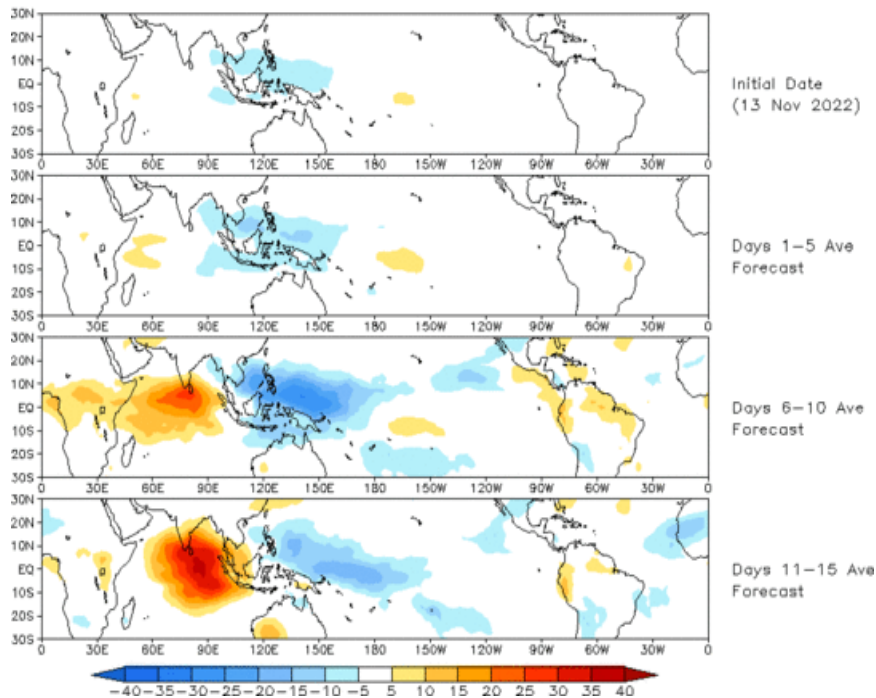
ECMWF Forecast

- Good agreement exists among the dynamical models favoring a renewed MJO activity over the Maritime Continent during week-1 and propagating eastward to the Western Pacific during week-2, with several ensemble members indicating a potential high amplitude event.
- Although the ECWMF is less supportive of coherent MJO activity persisting into week-3, other extended range model solutions maintain a well organized signal over the Western Pacific and Western Hemisphere heading into December.

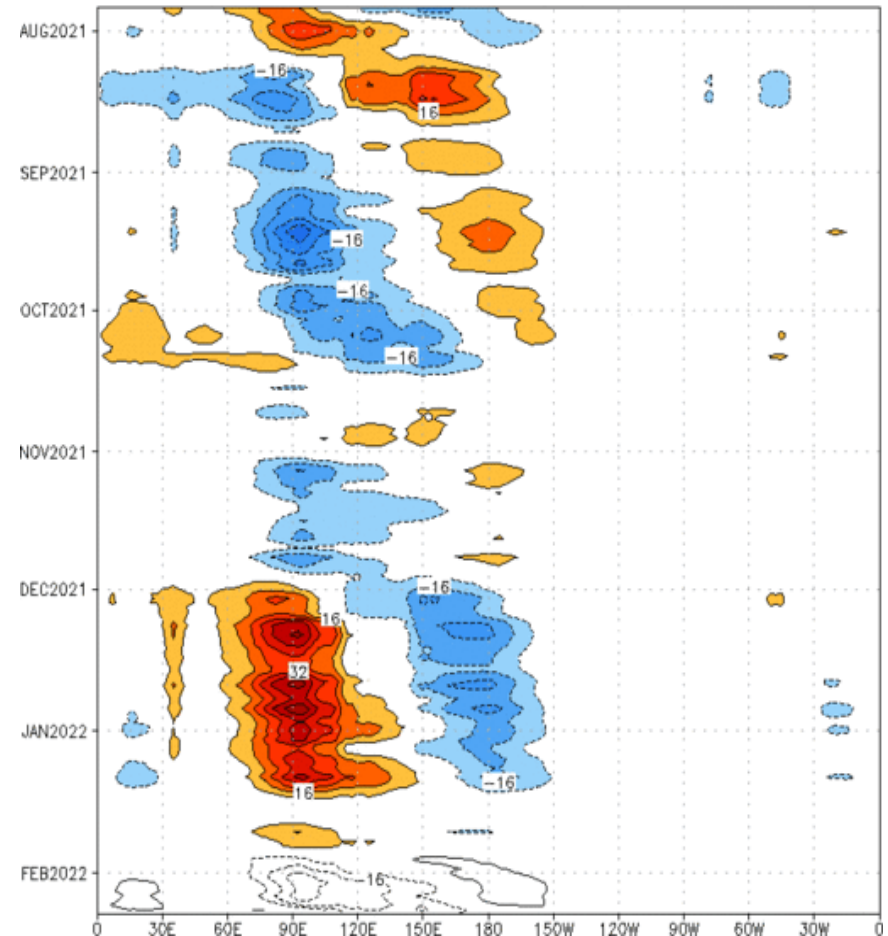
MJO: GEFS Forecast Evolution

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: 13 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

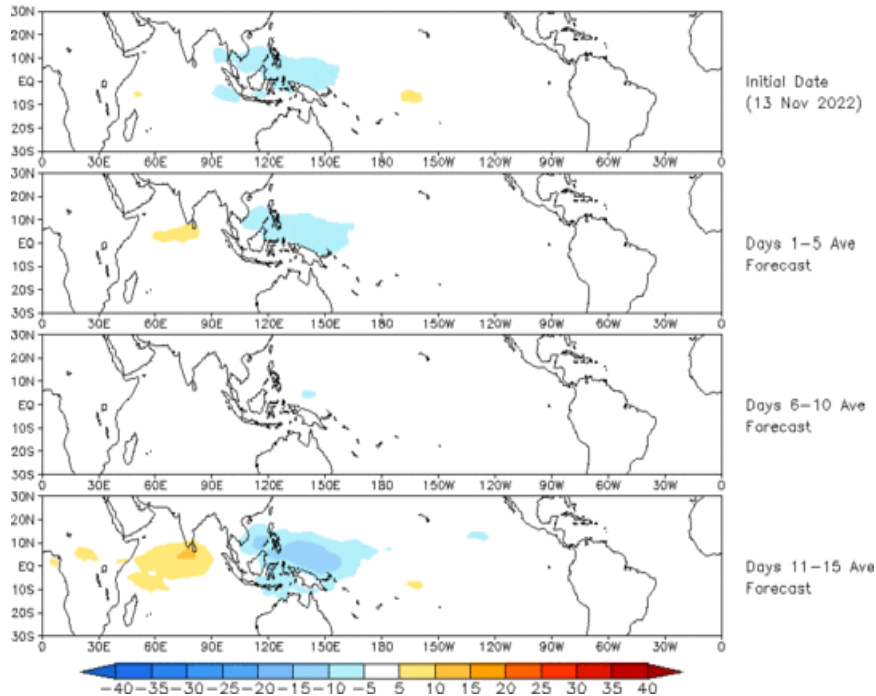


- The GEFS-based OLR anomaly fields depict a strengthening convective dipole shifting eastward with time, consistent with a canonical MJO event.

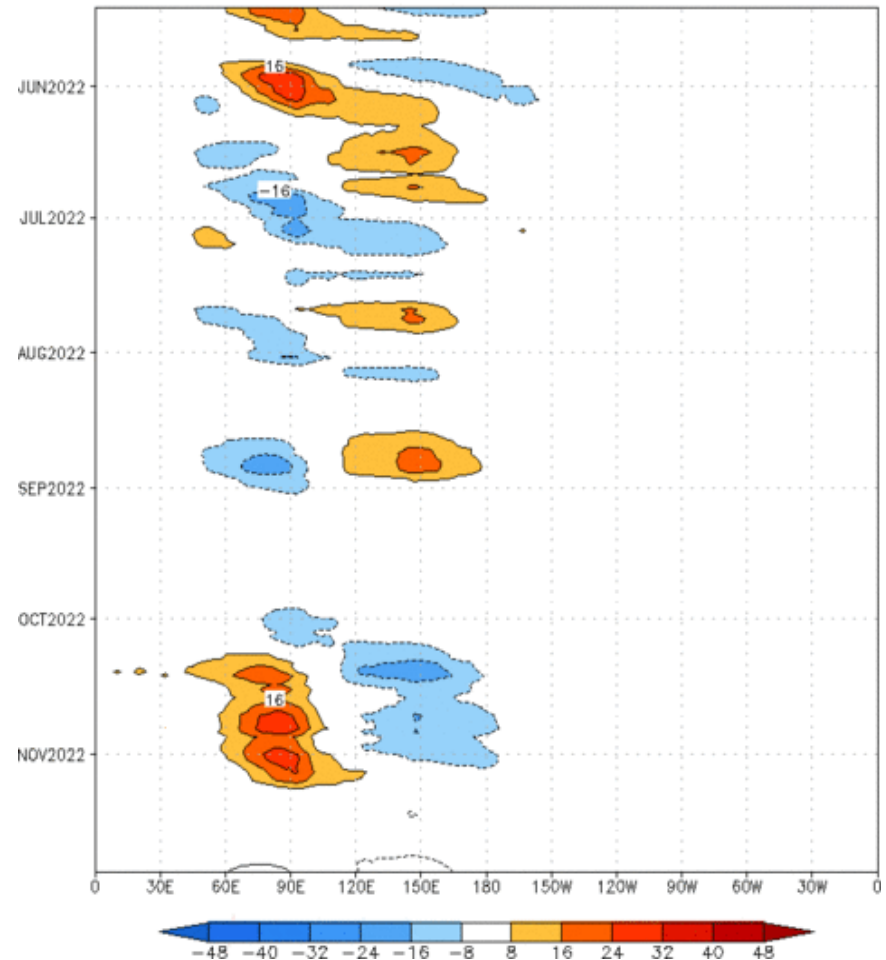
MJO: Constructed Analog Forecast Evolution

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 (13 Nov 2022)



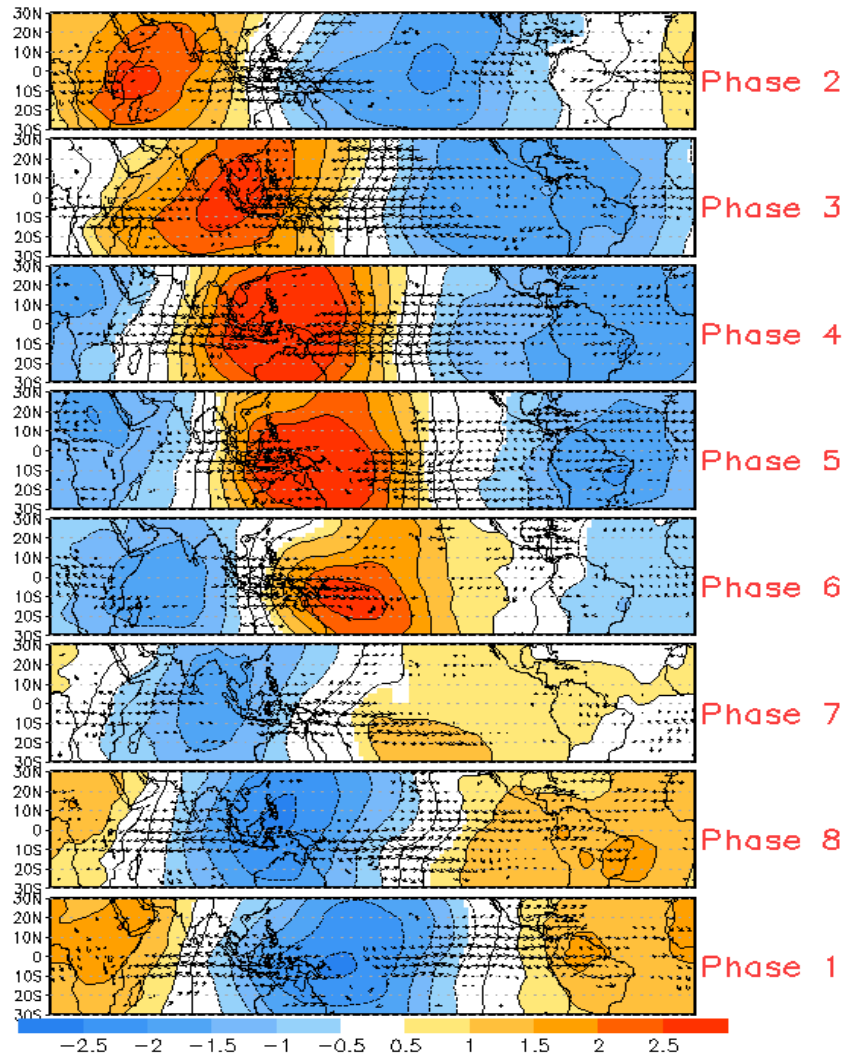
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:14-May-2022 to 13-Nov-2022
The unfilled contours are CA forecast reconstructed anomaly for 15 days



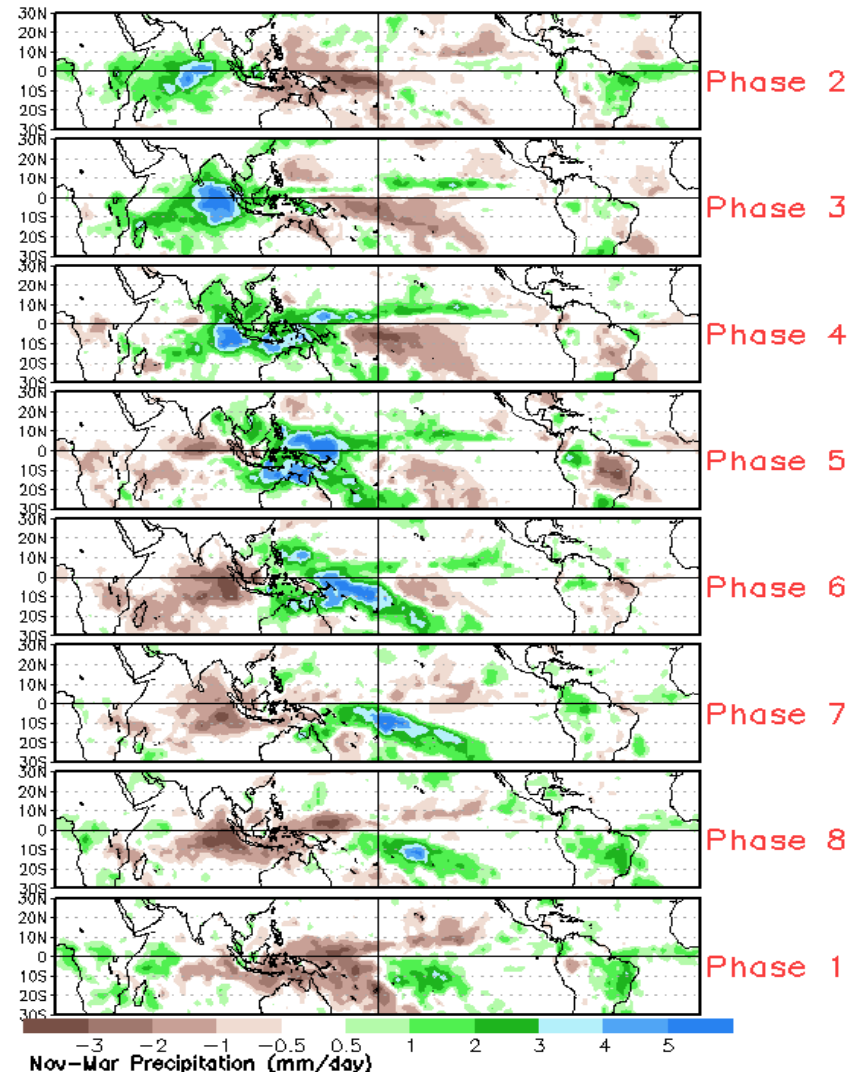
- The constructed analog forecast of RMM-based OLR also favors the development of a convective dipole, but is much less progressive than the GEFS, keeping the enhanced convection over the Maritime Continent and western Pacific.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



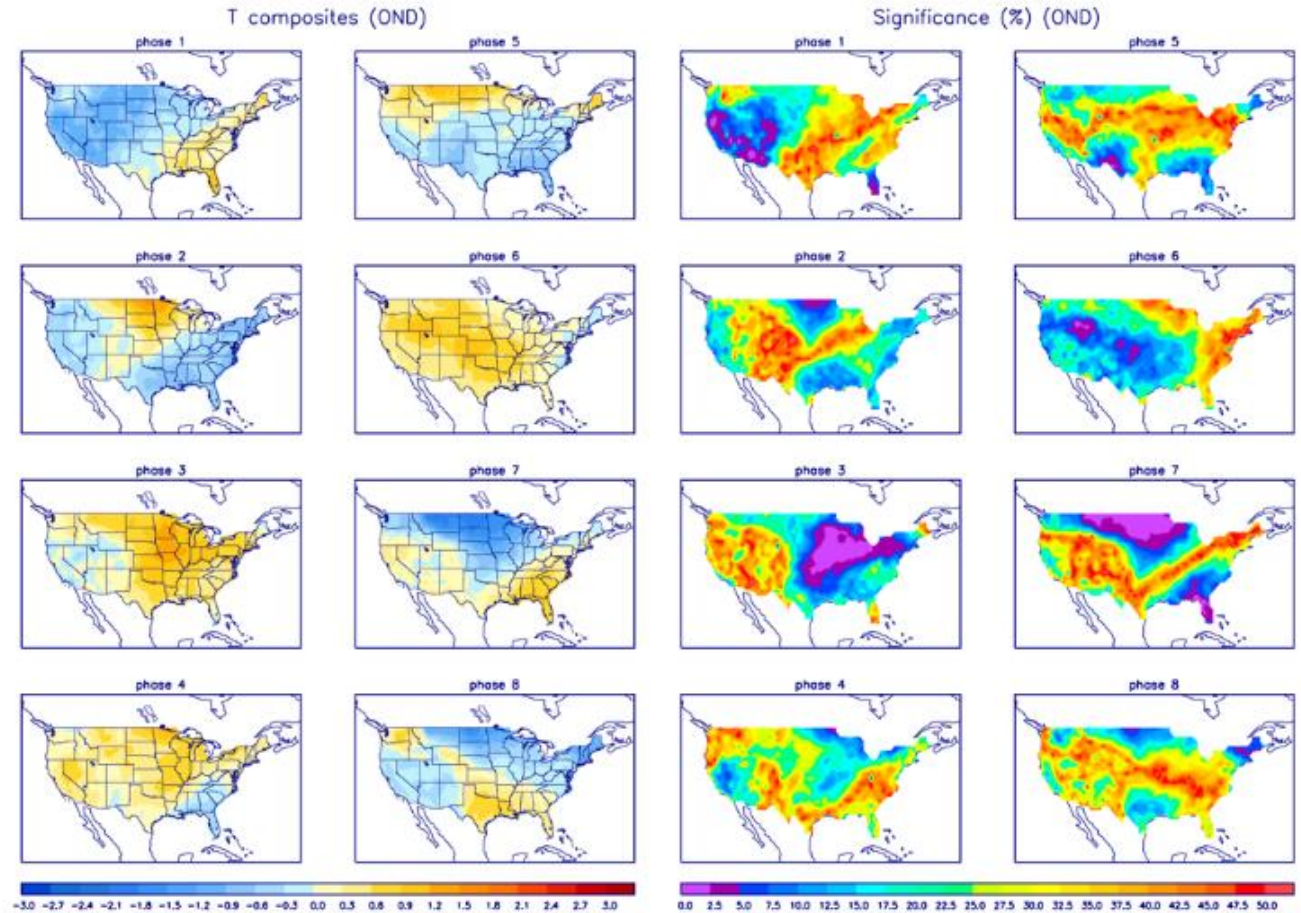
Precipitation Anomalies



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.

