Madden-Julian Oscillation:
Recent Evolution, Current Status and Predictions

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
1 November 2021

Overview

- The RMM-based MJO index rapidly weakened during mid-October, where it has since remained within the unit circle.

- Kelvin Wave propagation from the East Pacific and into the Atlantic Basins likely resulted in a temporary disruption of the Walker Circulation across the Pacific Ocean, with anomalous low-level (upper-level) westerlies (easterlies) apparent over the equatorial East Pacific.

- This Kelvin Wave is forecast to propagate eastward into the Indian Ocean where it may contribute to increased tropical activity over the next week, and may also help to rejuvenate the MJO signal.

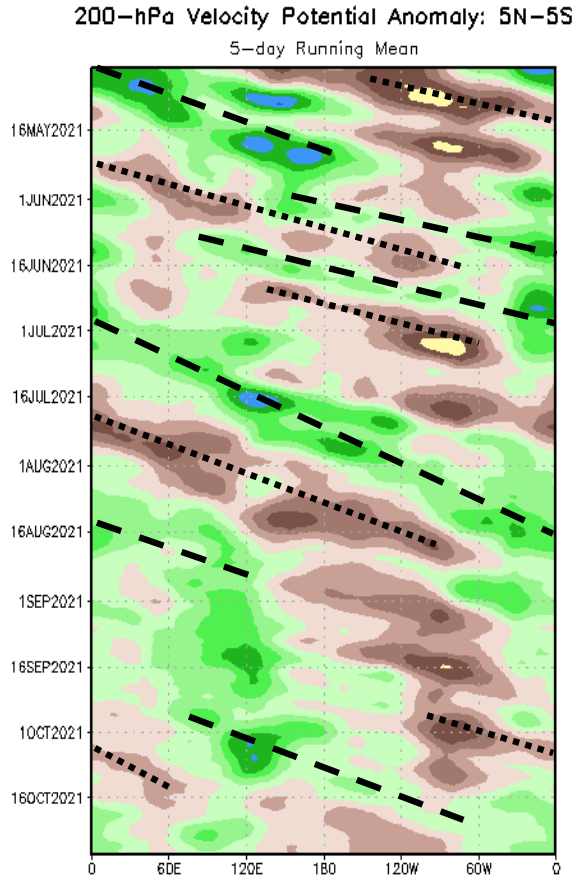
- Dynamical model forecasts favor a slight amplification of the intraseasonal signal across the Maritime Continent and Western Pacific during the next two weeks, but destructive interference with the La Niña base state is likely to hinder its eastward propagation.

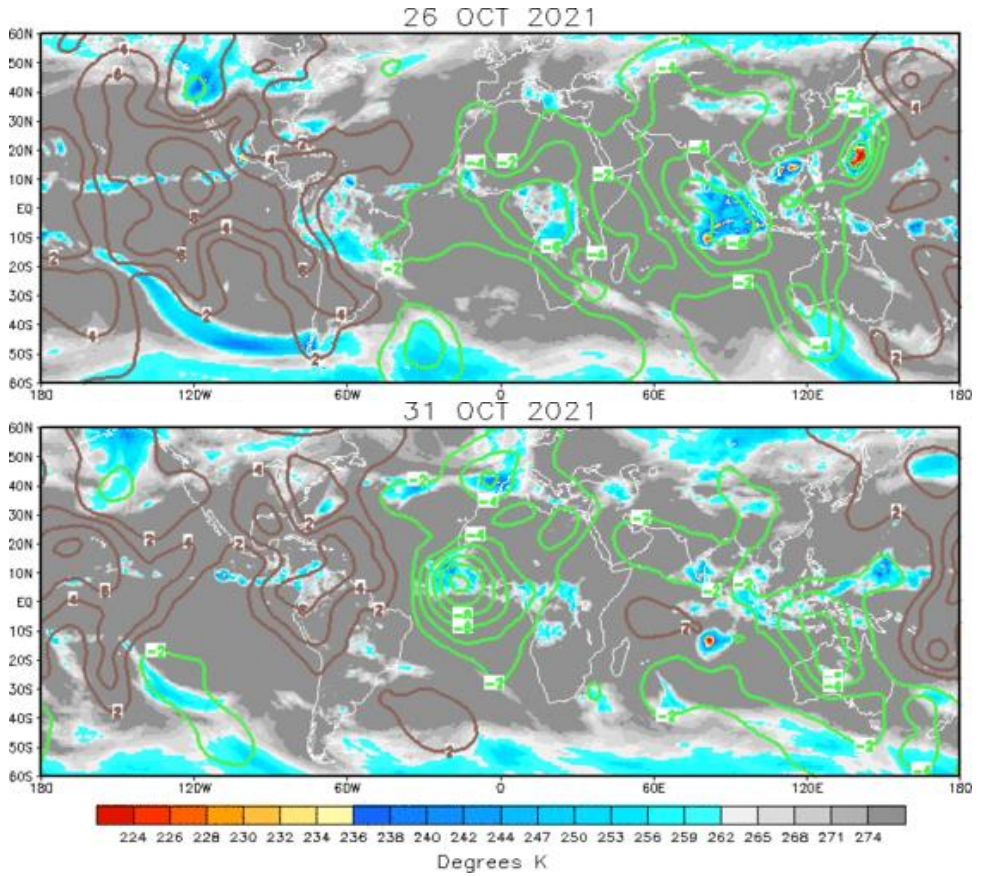
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).



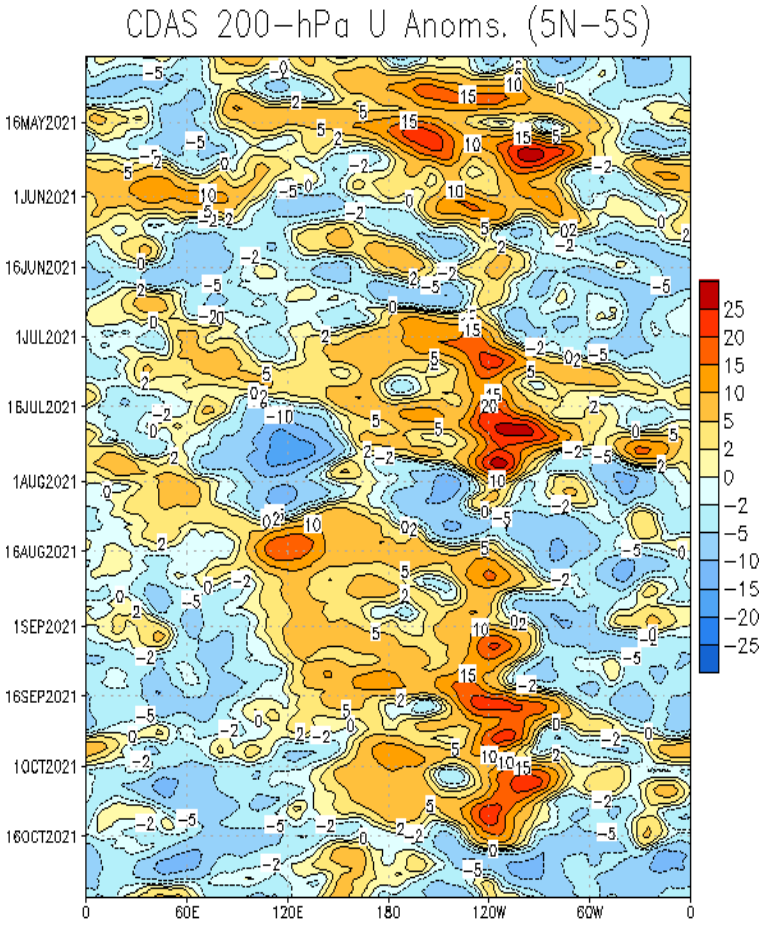


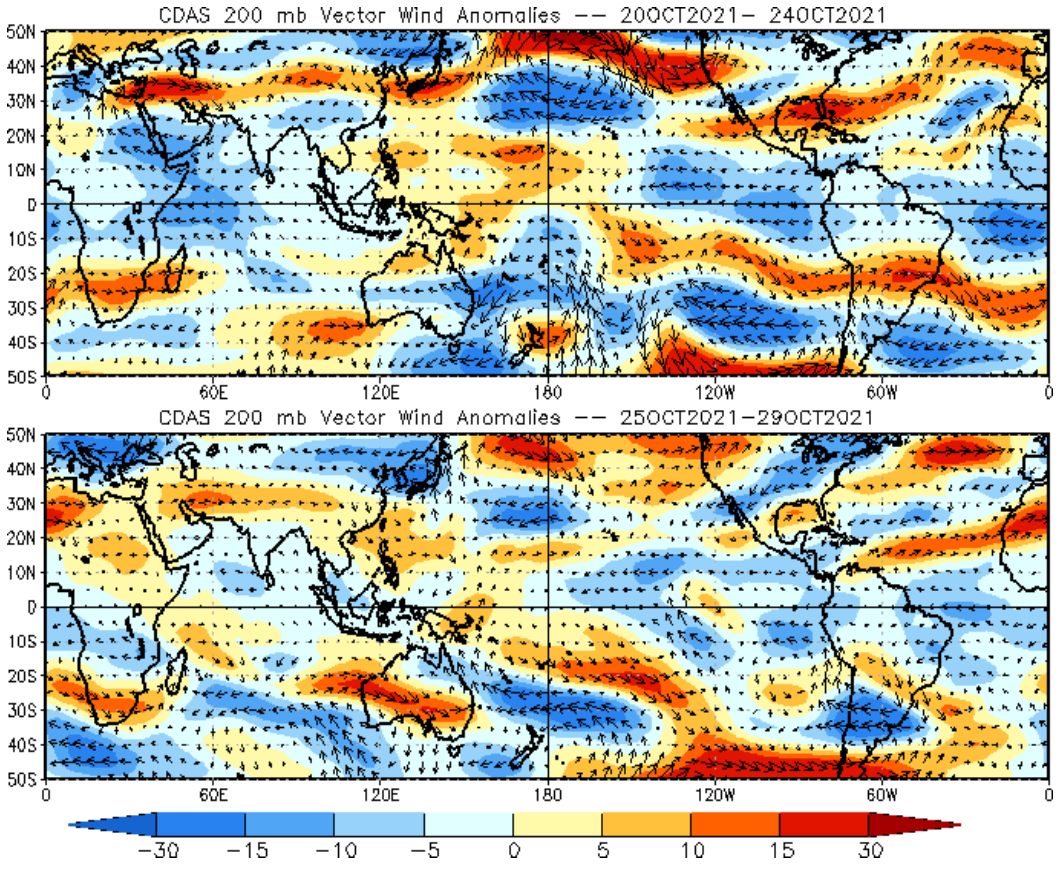
- MJO has remained in a stationary state since mid to late October corresponding with an increase in the low frequency signal.

- A convectively coupled Kelvin wave is indicated over the eastern Atlantic and Africa. Convection is suppressed across the western Atlantic and eastern Pacific.

200-hPa Wind Anomalies

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



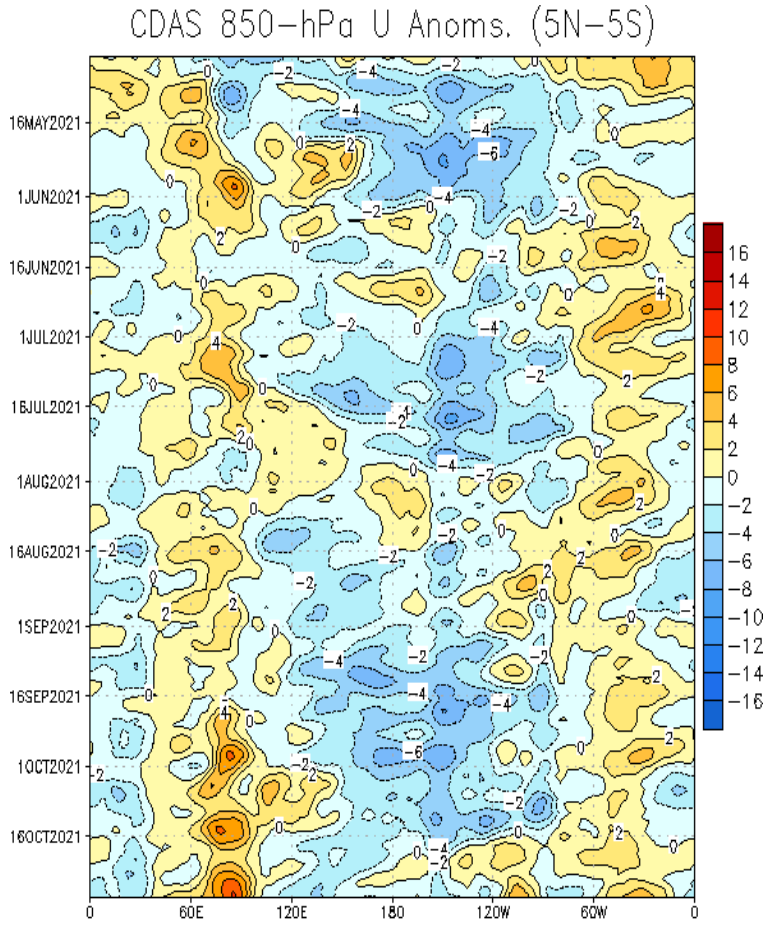


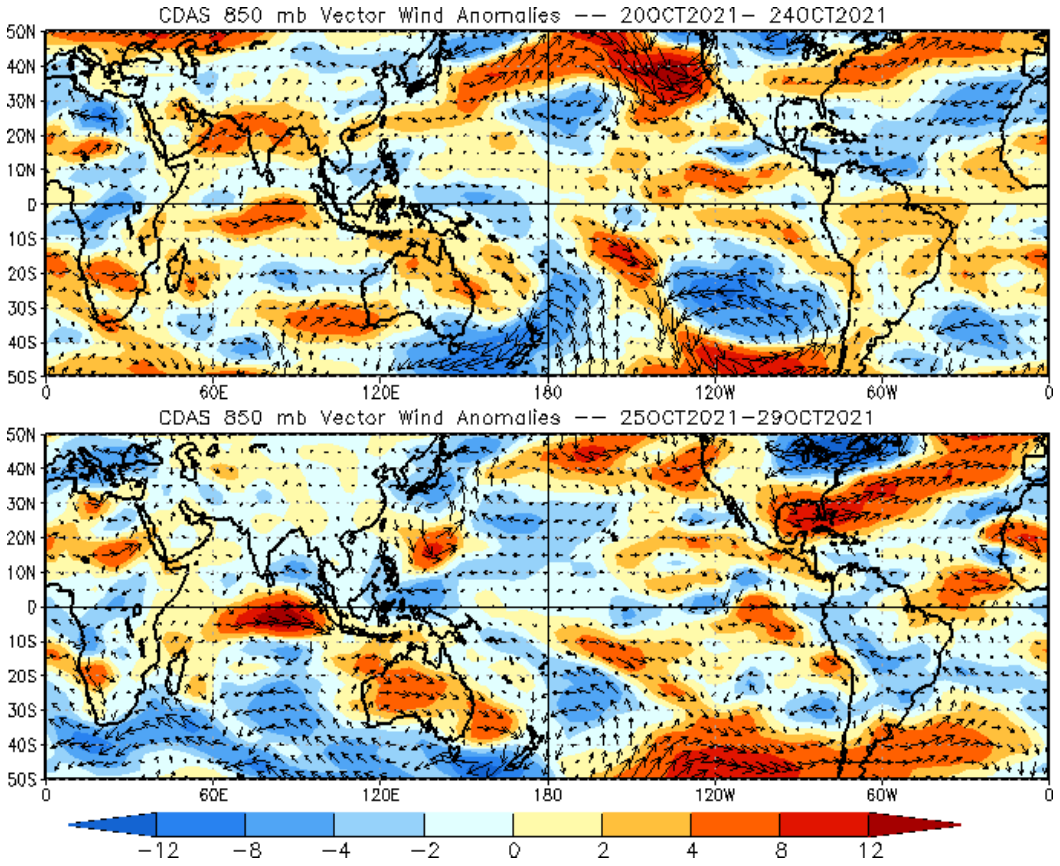
- Following a disruption in the low frequency state with upper-level easterly anomalies developing over the equatorial East Pacific, the magnitude of these anomalous easterlies now appear to be weakening.

- Anomalous westerlies continue across the western Pacific.

850-hPa Wind Anomalies

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





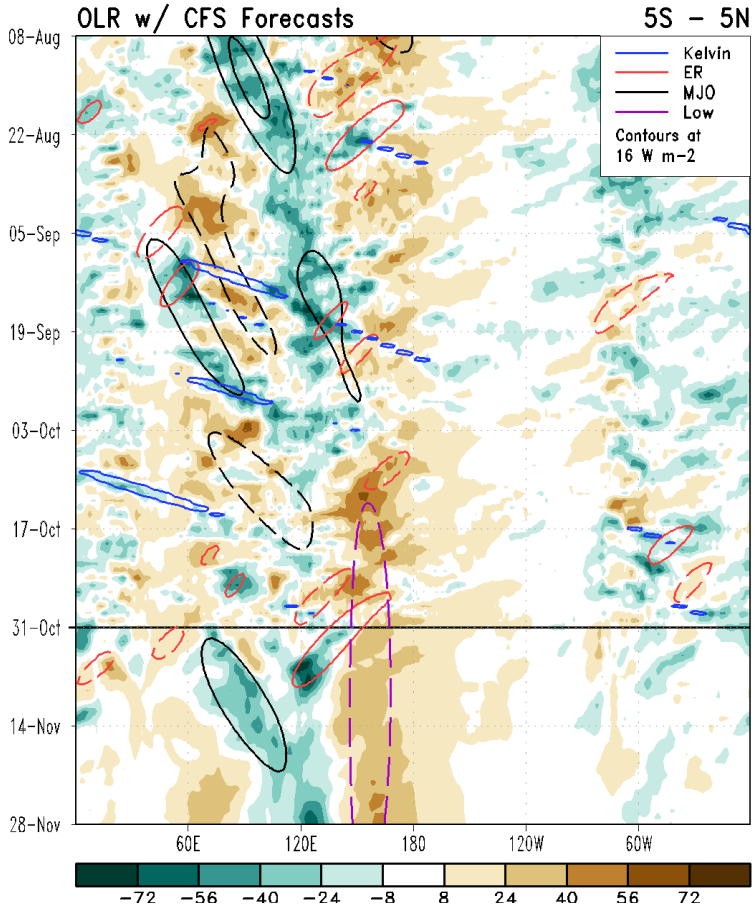
- Low-level westerly anomalies developed across much of the equatorial Pacific east of the Date Line in the past two weeks, opposite of what would be expected during a La Niña, and likely the result of enhanced Kelvin Wave activity.

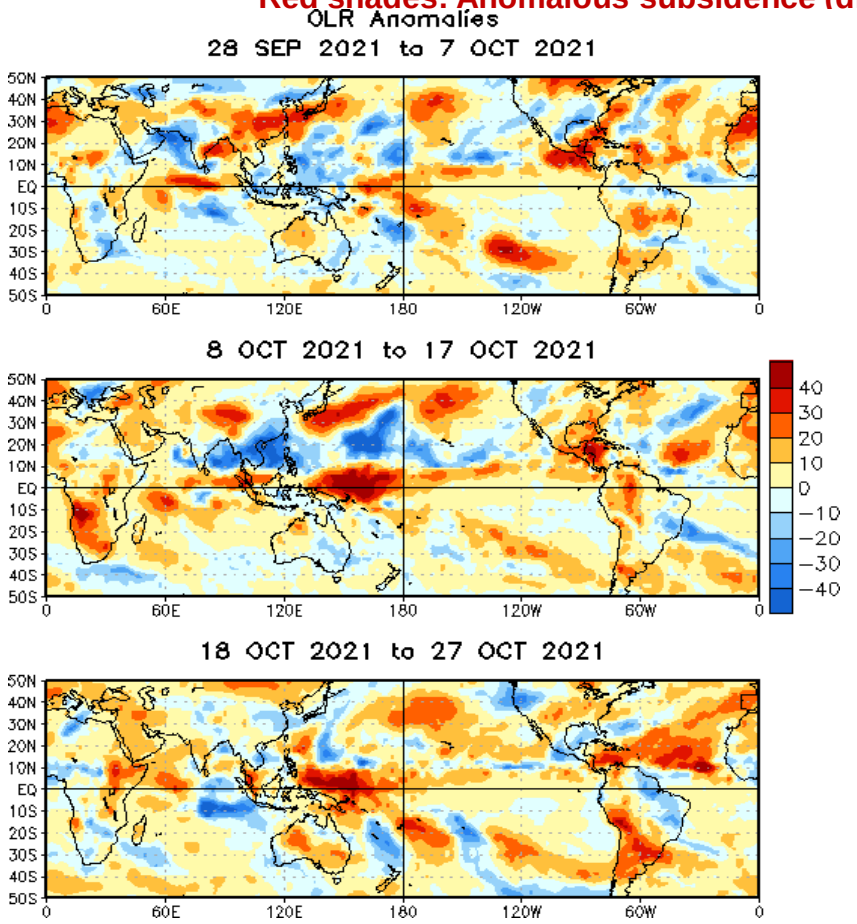
- Anomalous westerlies have strengthened over the equatorial Indian Ocean, and have expanded over parts of the Atlantic Basin.

Outgoing Longwave Radiation (OLR) Anomalies

Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

Blue shades: Anomalous convection (wetness)
Red shades: Anomalous subsidence (dryness)

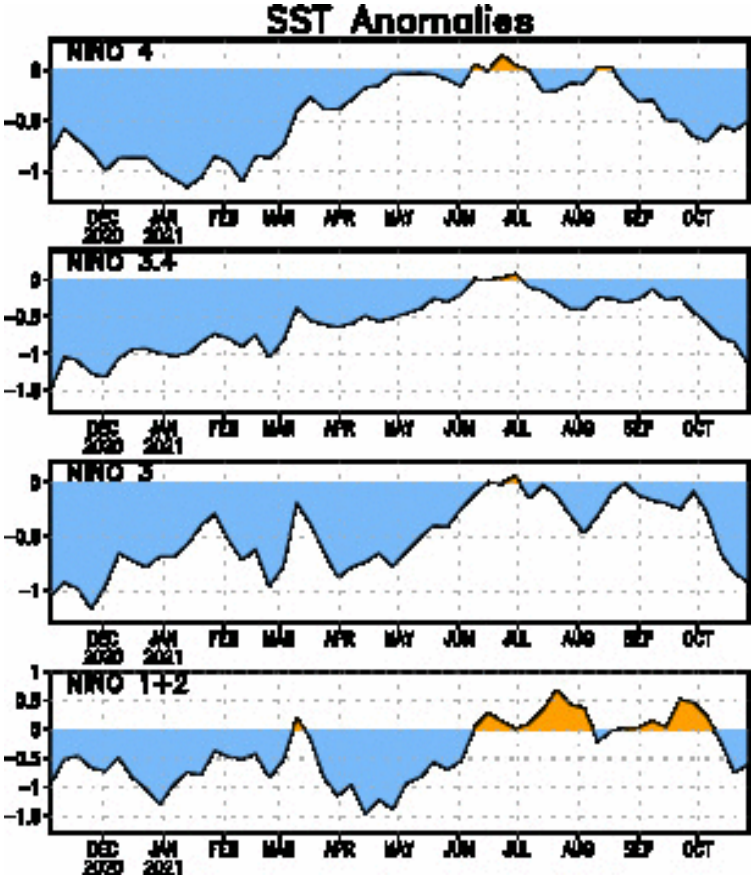


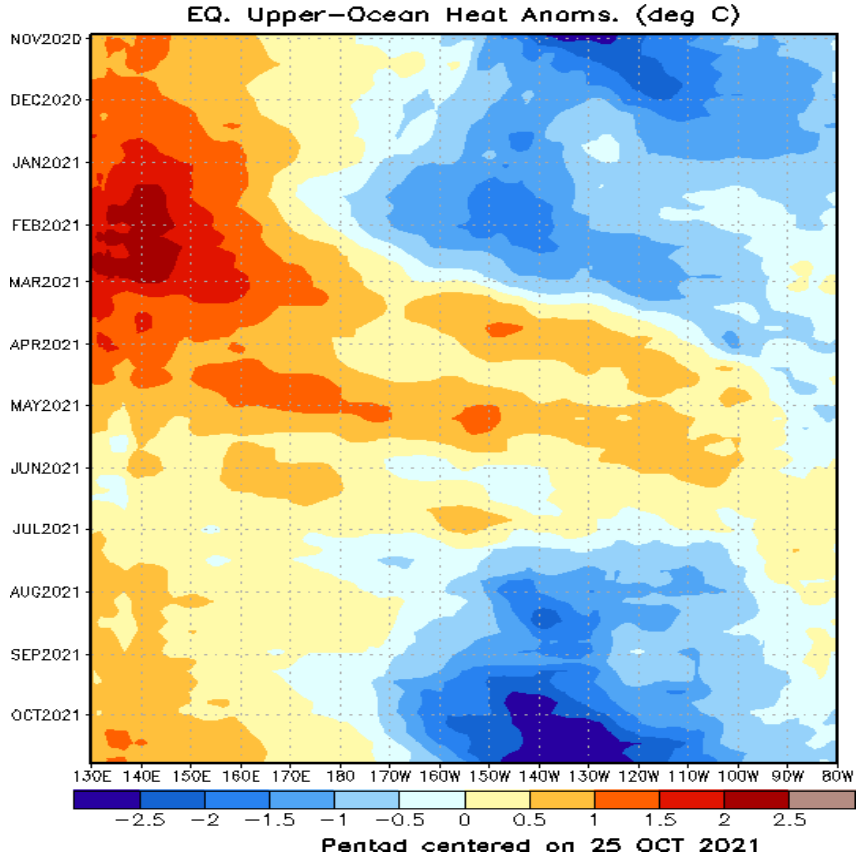


- The MJO signal weakened rapidly during mid-October, with enhanced/suppressed convection mainly tied to enhanced Kelvin and Rossby Wave activity embedded within the La Niña base state.

- The CFS favors some strengthening of the MJO signal over the Maritime Continent and Western Pacific during the next 2 weeks, although it's eastward propagation is likely to be hampered by the low frequency signal.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



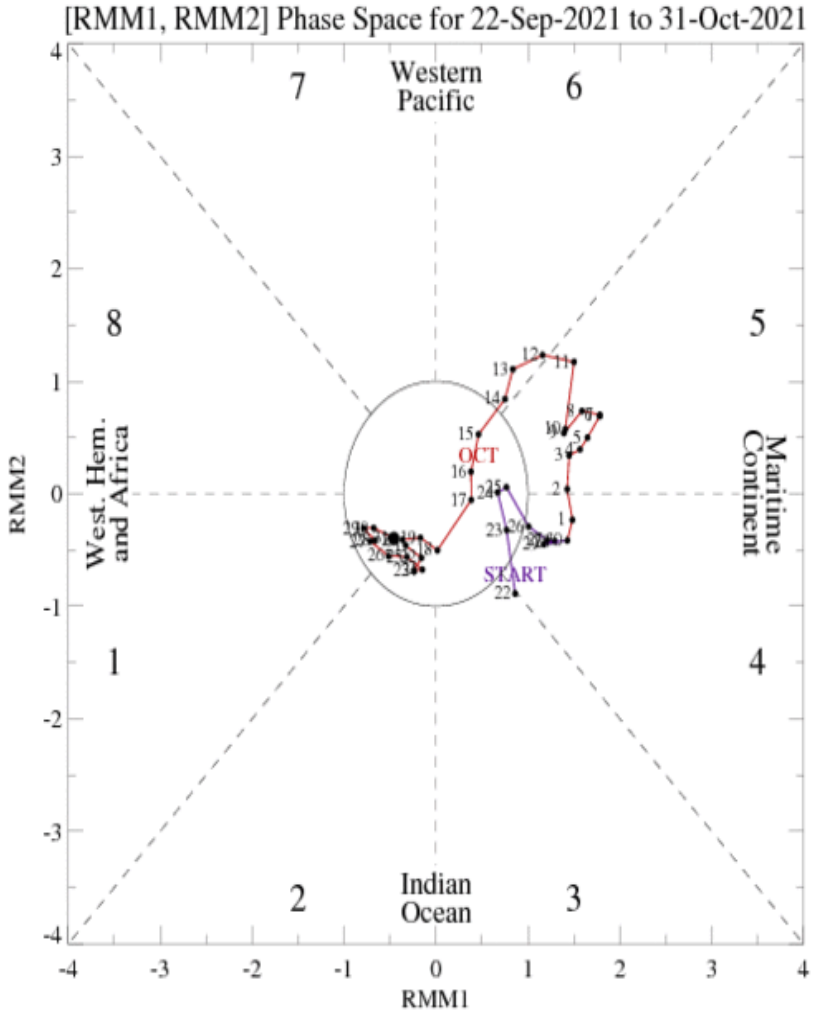


- Negative upper-ocean heat anomalies continue to intensify across much of the central and eastern equatorial Pacific. A substantial sub-surface cooling is evident near 140W since late September.

- Below-normal sea surface temperatures are now observed within all Niño regions, consistent with the development of La Niña conditions.

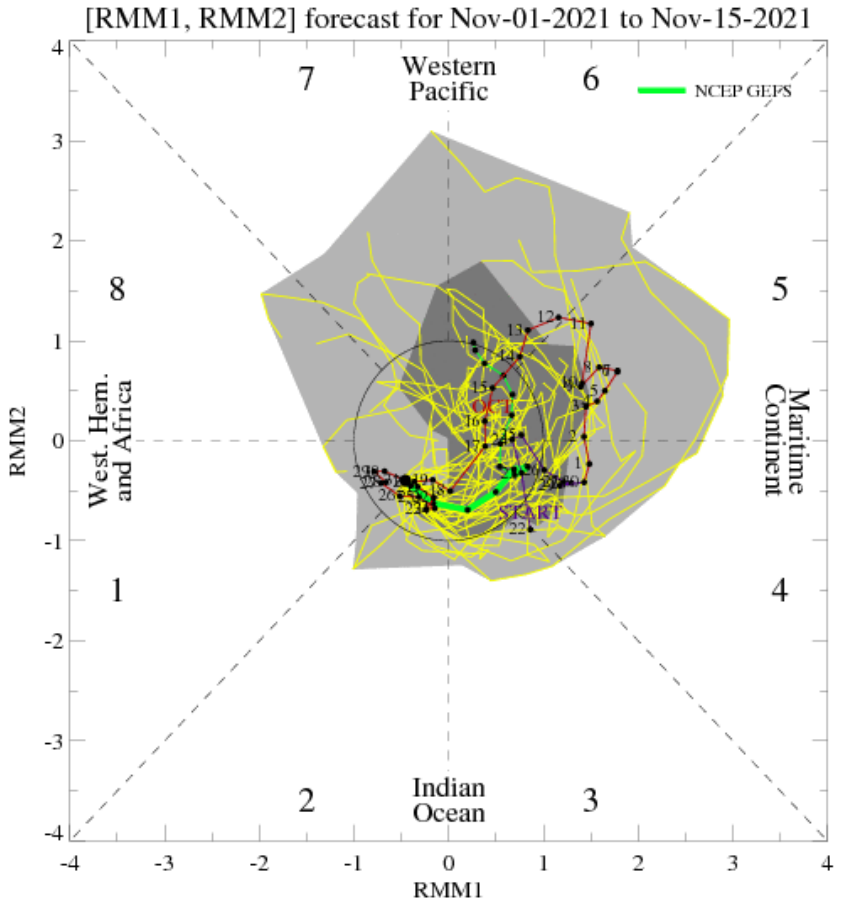
MJO Index: Recent Evolution

- From late September to early October, the RMM-based MJO index was amplified across the Maritime Continent, consistent with emerging La Niña conditions.
- The intraseasonal signal rapidly collapsed into the unit circle in mid-October with little eastward propagation thereafter.

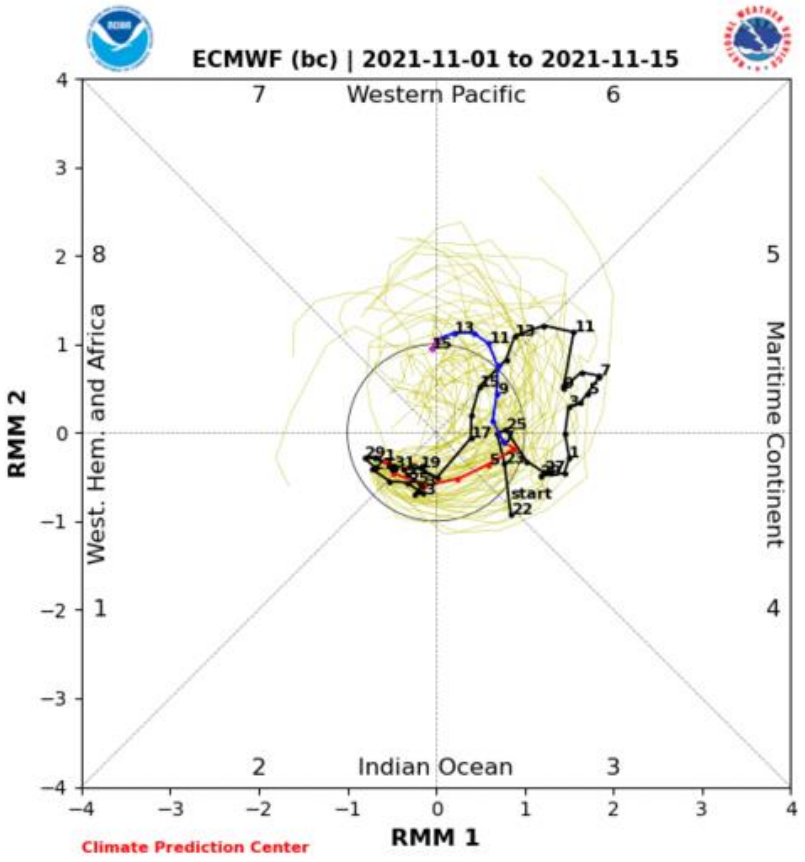


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



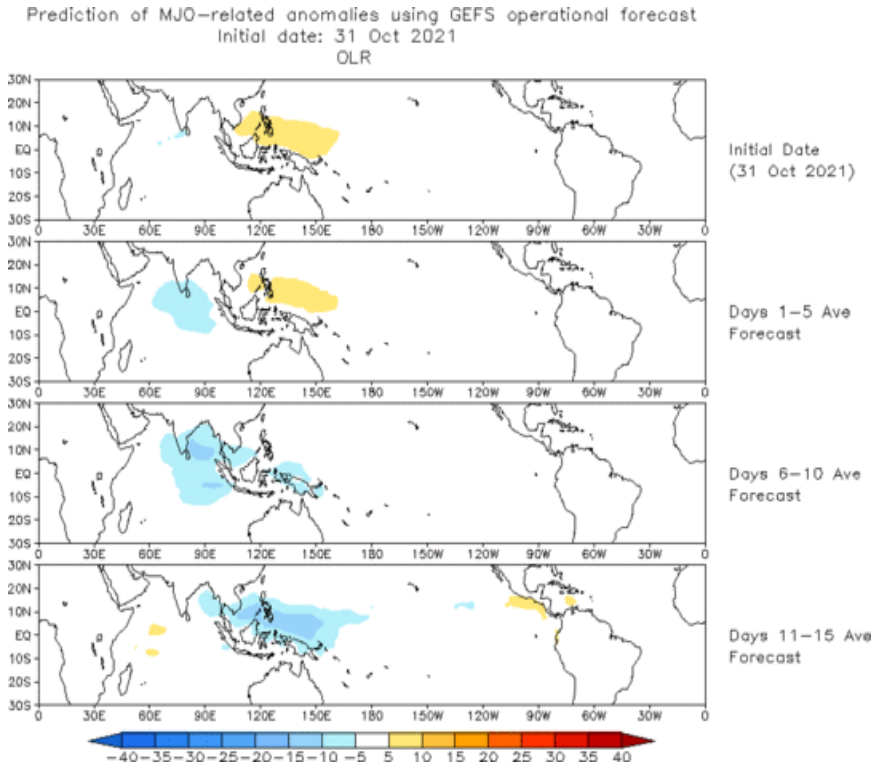
ECMWF Forecast

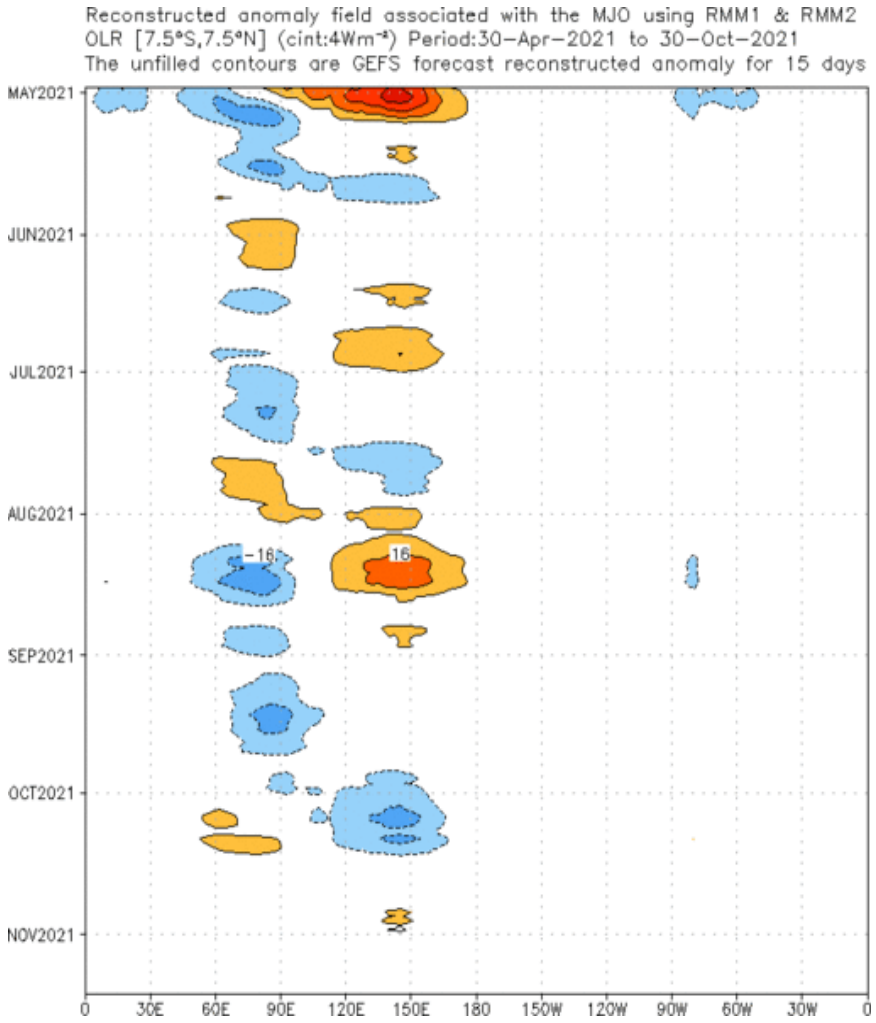
- Some propagation of the RMM-based MJO index within the unit circle is forecast during early November over the Indian Ocean, with potential for some amplification of the intraseasonal signal across the Maritime Continent and Western Pacific by week-2.

- The spread of the model ensemble members remains very high, leading to increased uncertainty.

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.)

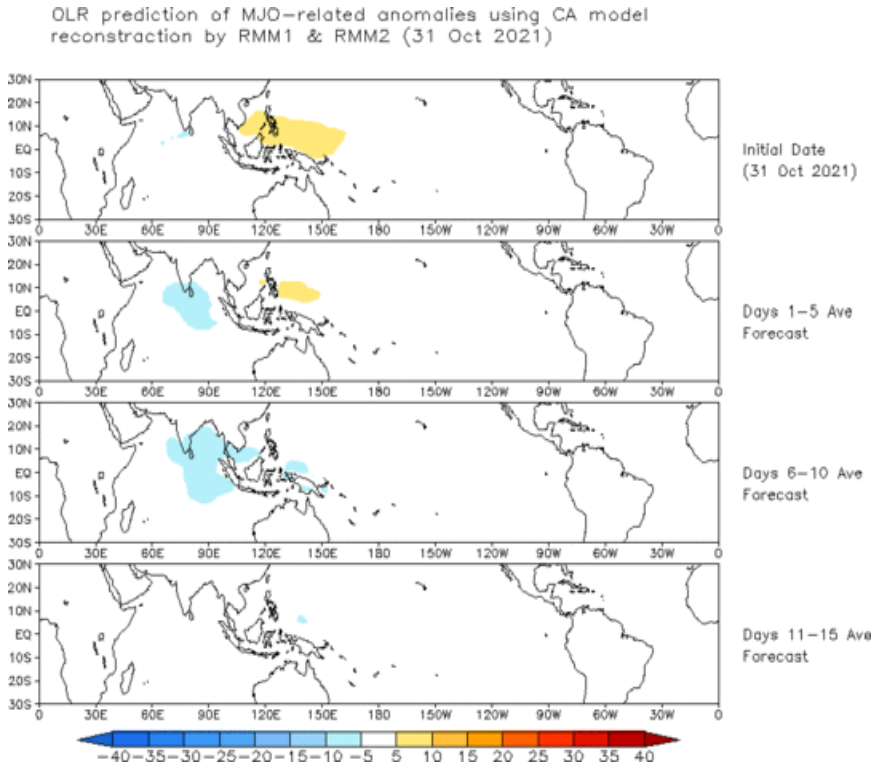


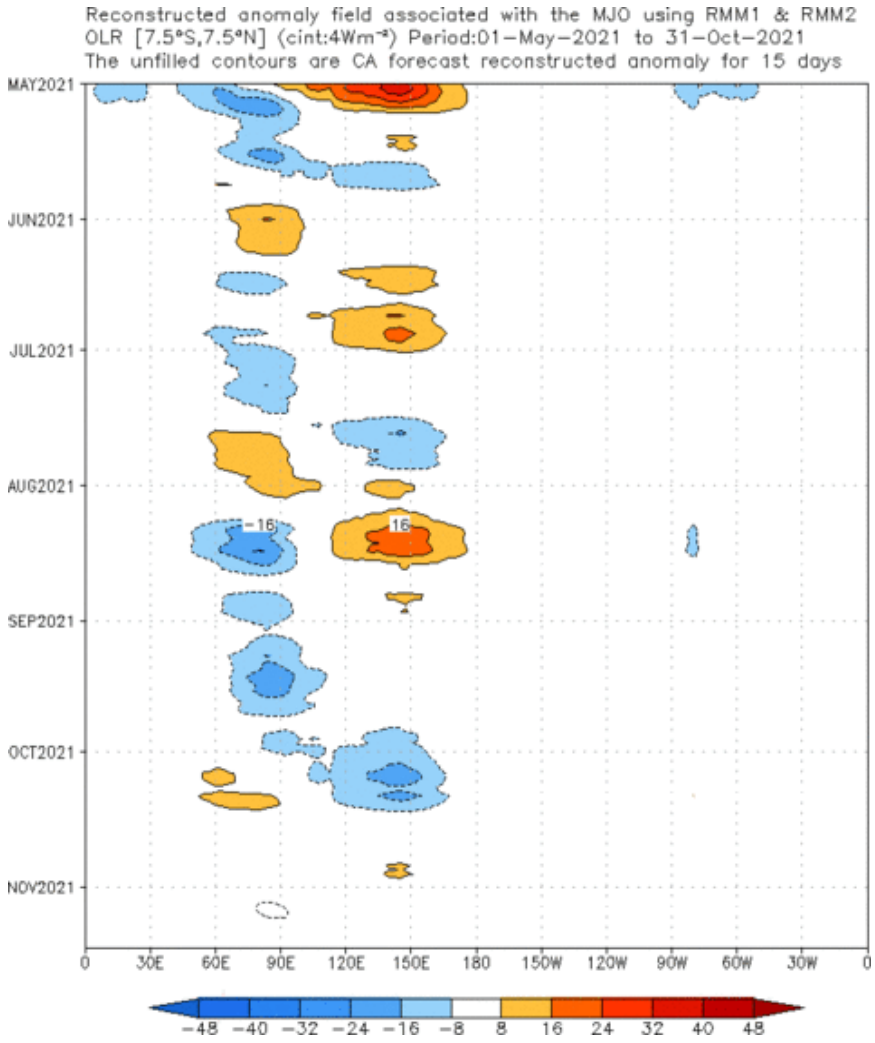


- The GEFS RMM-based OLR anomaly forecast features increasing negative OLR anomalies expanding across the eastern Indian Ocean, and then over the Maritime continent and western Pacific by the end of week-2.

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.)

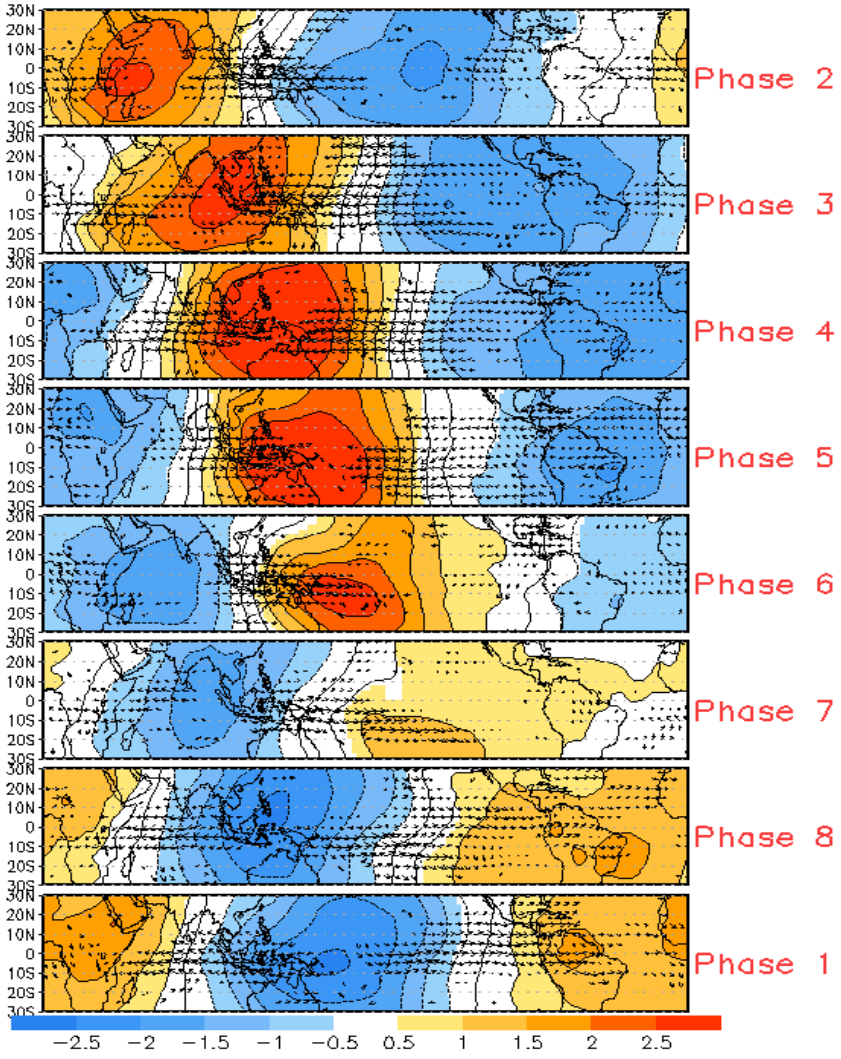




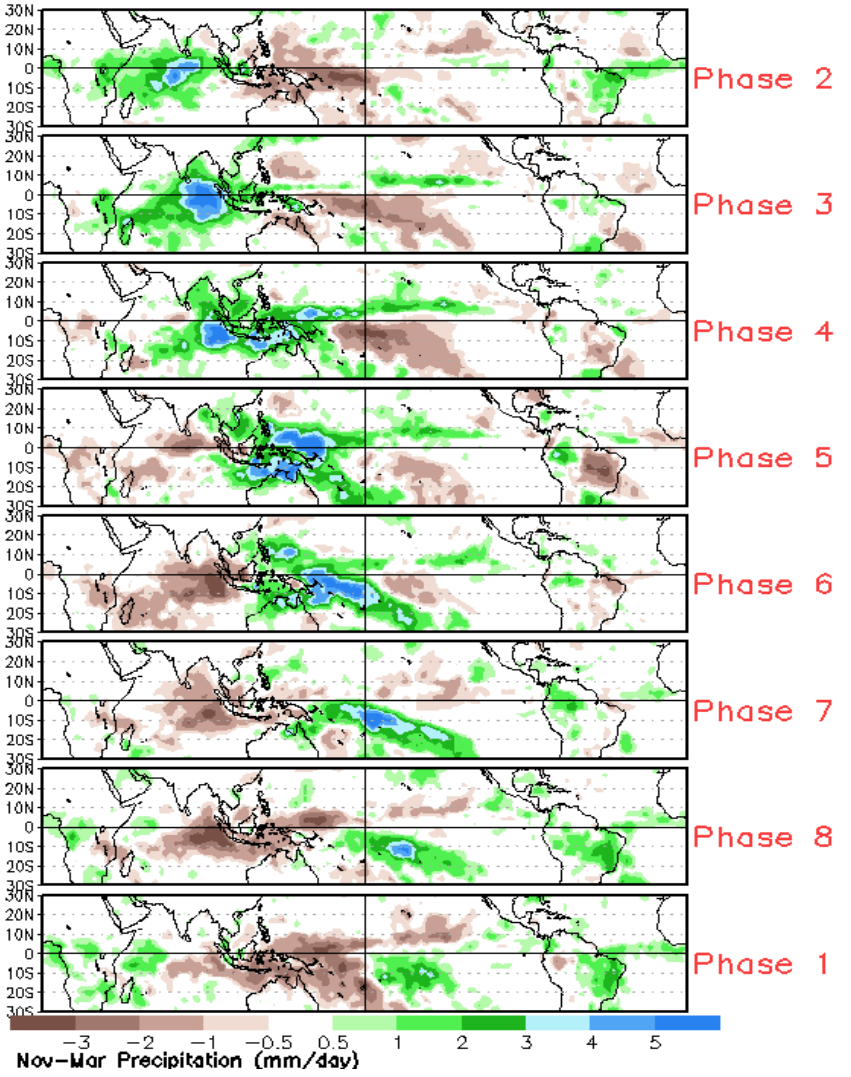
- The constructed analog depicts a similar evolution as the GEFS, although it is considerably weaker in its emergence of enhanced convection across the Maritime Continent and Western Pacific.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



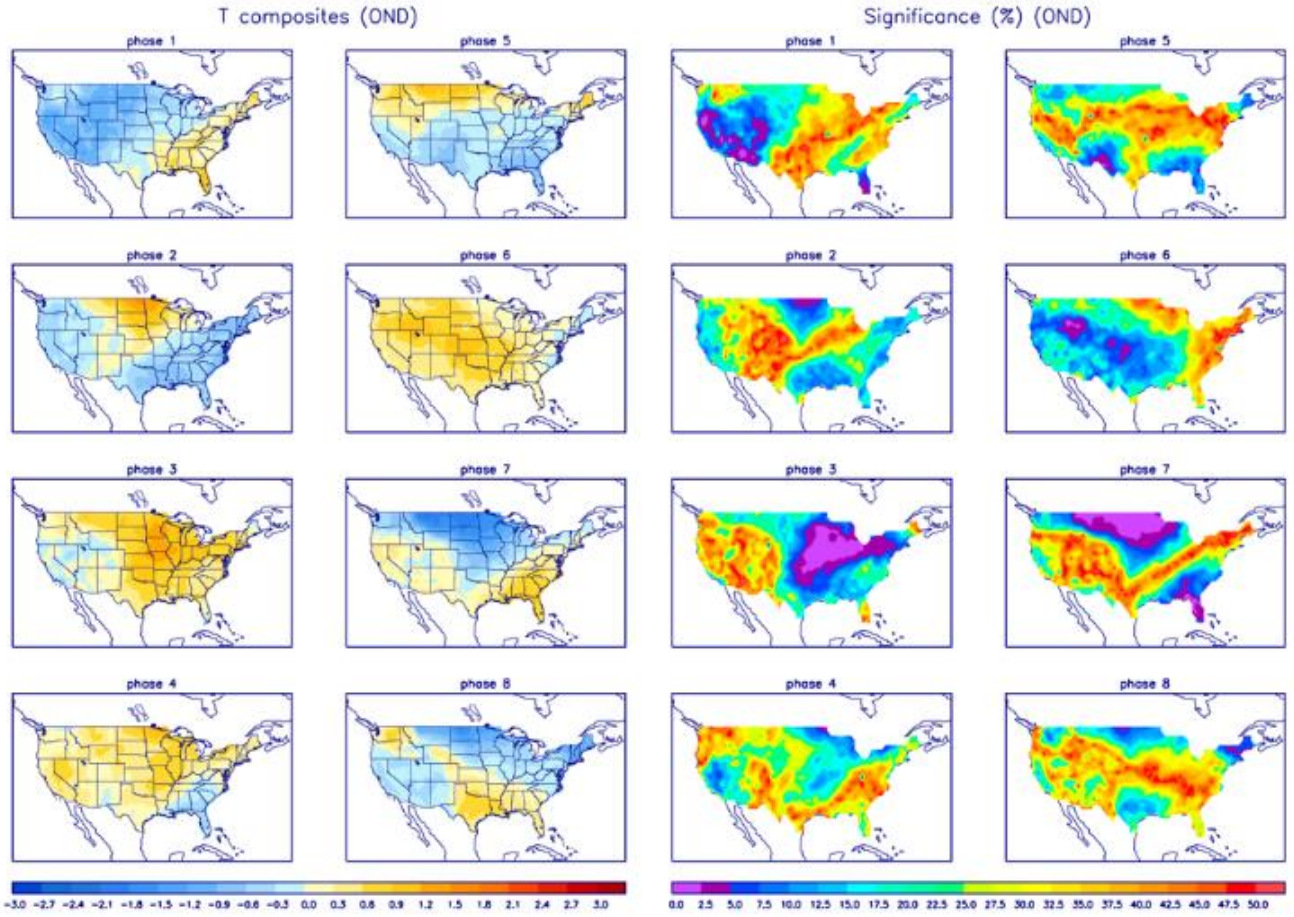
Precipitation Anomalies



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.

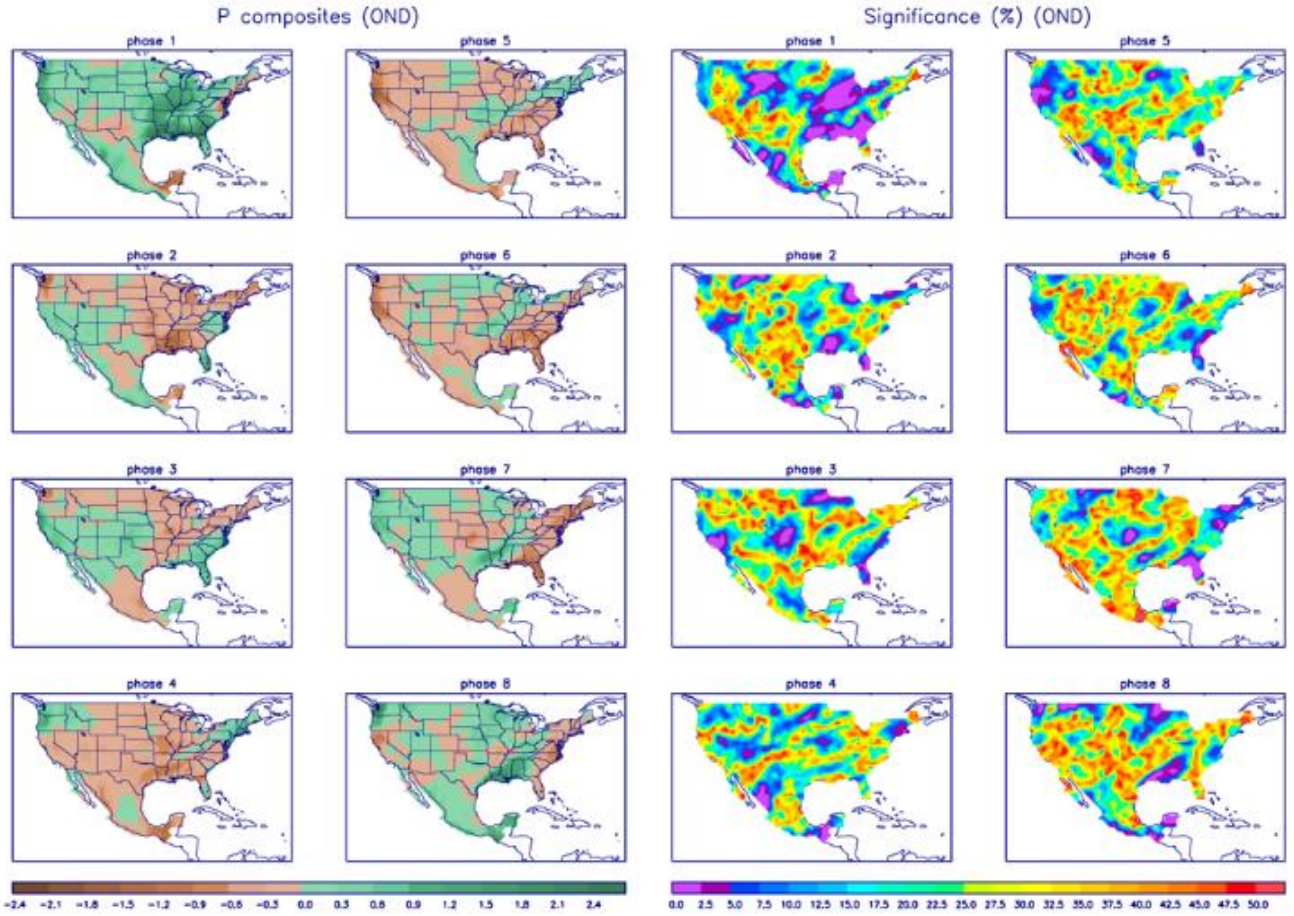


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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.



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