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

**Update prepared by the Climate Prediction Center**
**Climate Prediction Center / NCEP**
**31 January 2022**

# Overview

- The MJO remains weak, with both the RMM-based and CPC velocity potential based indices reflecting low amplitude and no eastward progression.

- There are indications of an eastward propagating enhanced convective envelope now over the Indian Ocean, but a remarkably strong Rossby wave is destructively interfering with this signal.

- Anomalous lower-level westerlies over the east-central Pacific reflect a continued disruption of the La Niña background state.

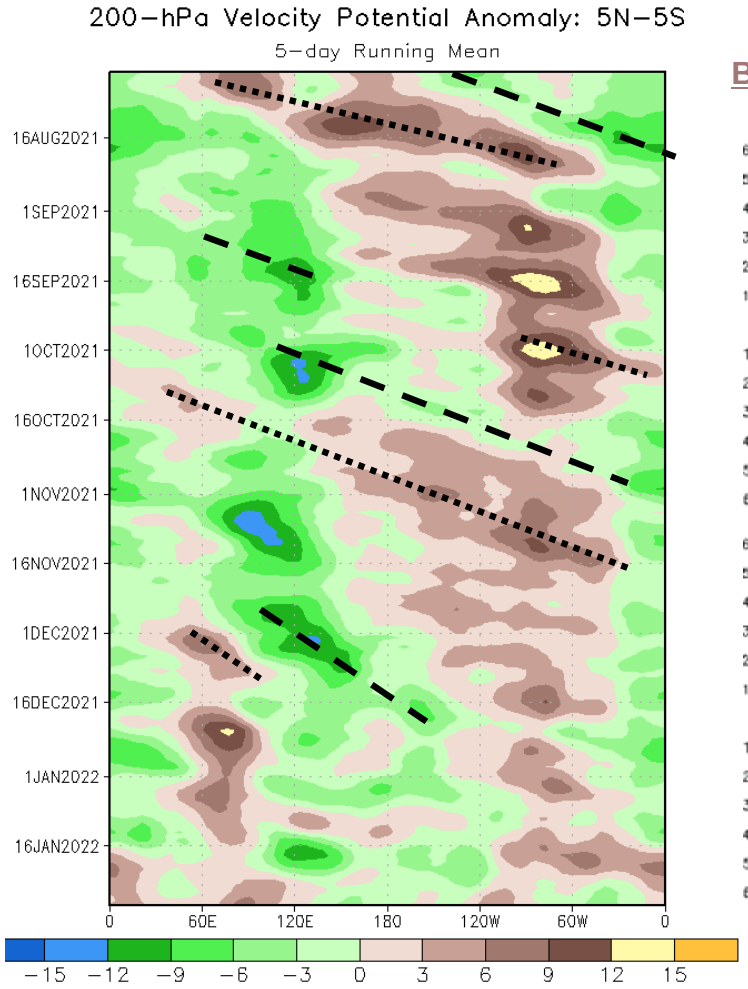
- Dynamical model MJO index forecasts depict a rapid strengthening MJO signal over the Indian Ocean during Week-1, as destructive interference with the Indian Ocean Rossby wave relaxes.

- Following this Indian Ocean amplification, many dynamical model ensemble members depict eastward propagation to the Maritime Continent, with some forecasts bringing the signal to the West Pacific.

- The MJO and Rossby wave activity may contribute to an uptick in tropical cyclone activity over the southern Indian Ocean and South Pacific.

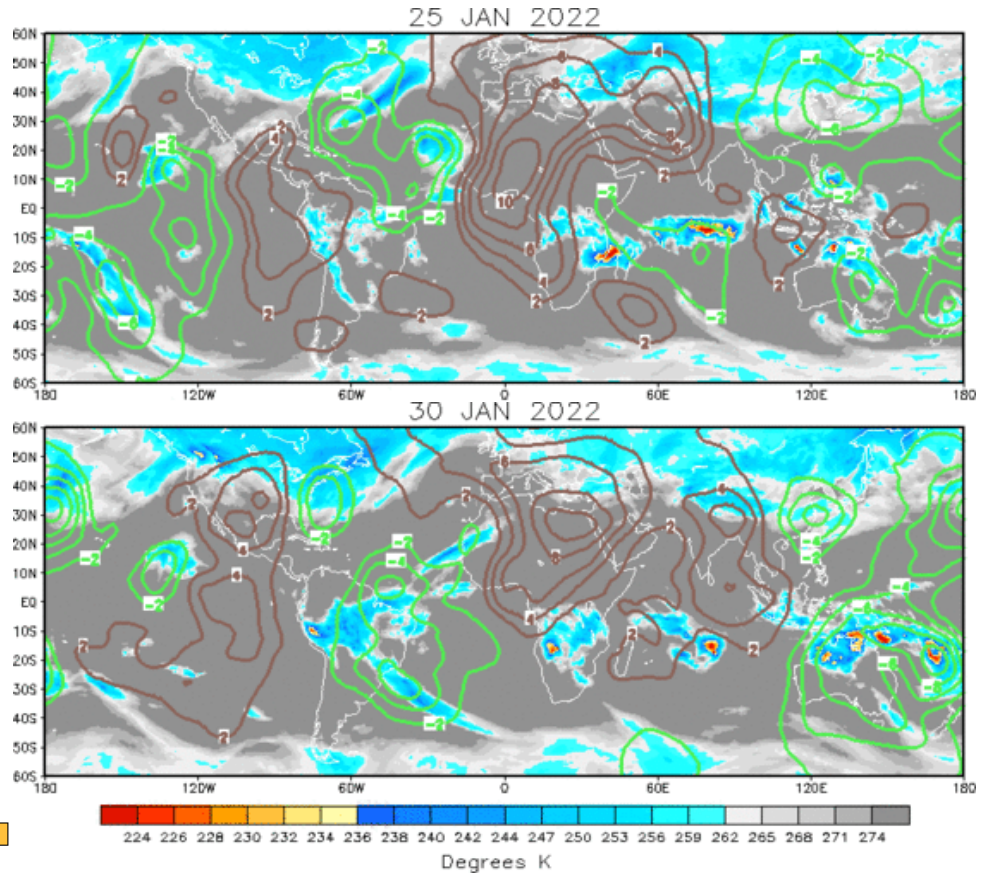
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

# 200-hPa Velocity Potential Anomalies




**Green shades: Anomalous divergence (favorable for precipitation)**

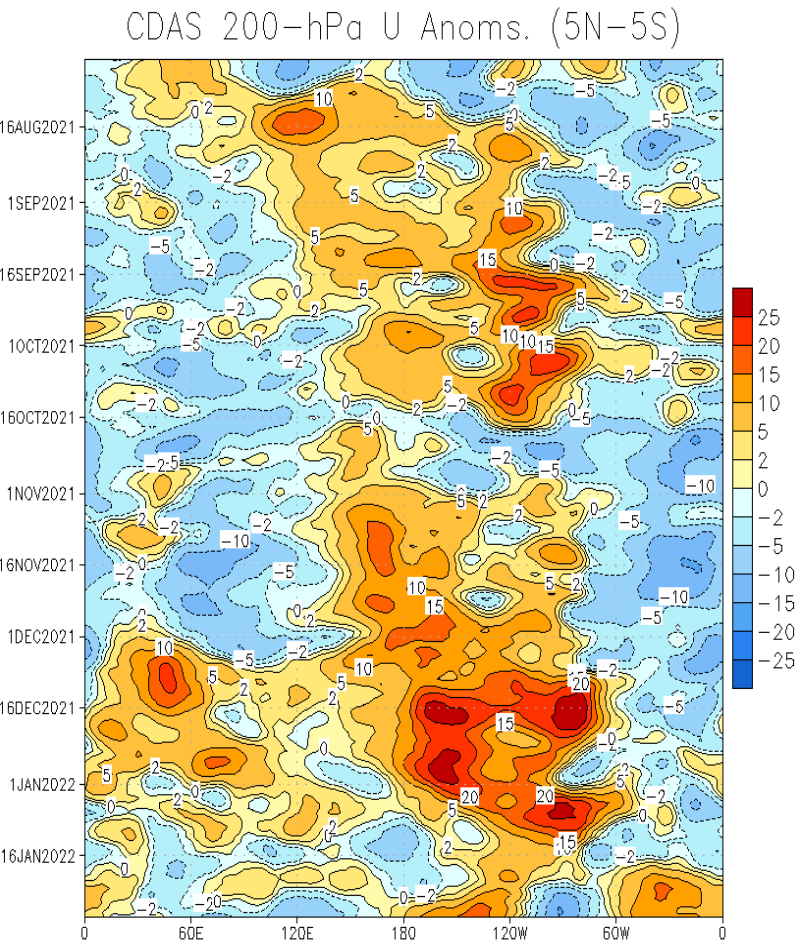
**Brown shades: Anomalous convergence (unfavorable for precipitation)**

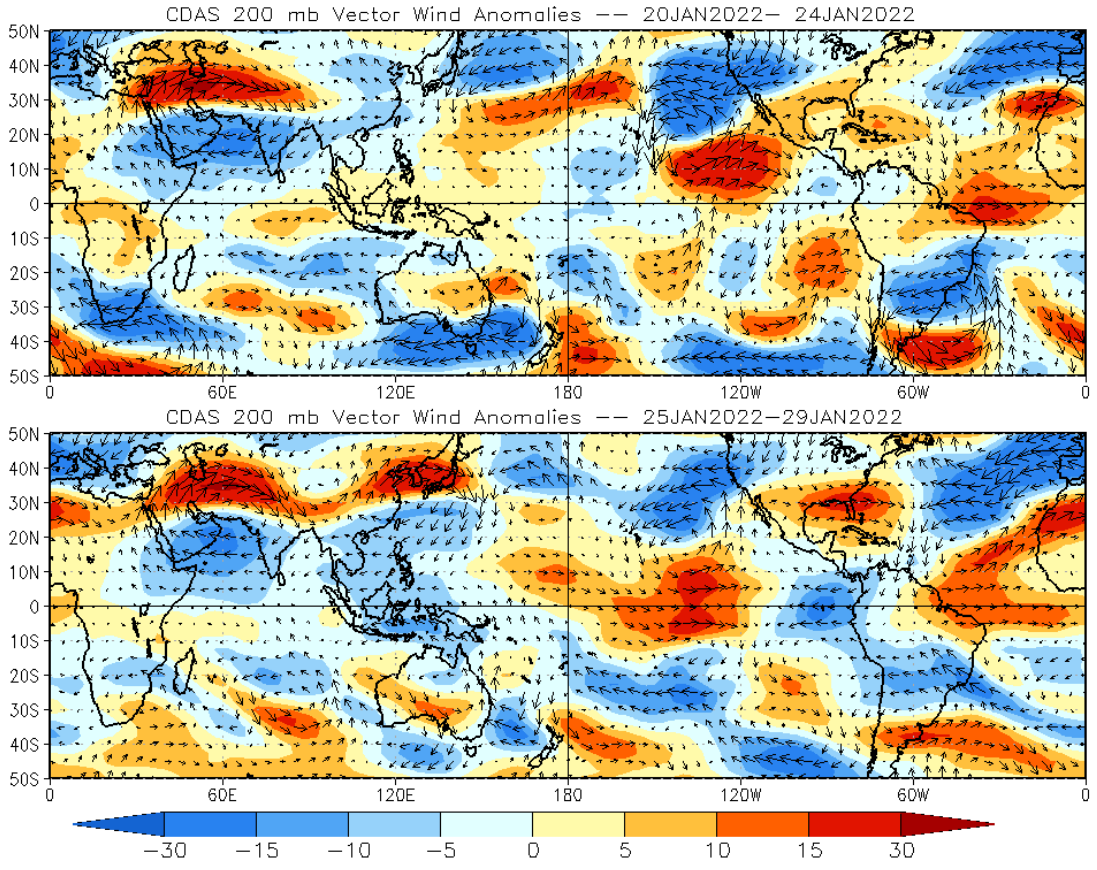



- The upper-level velocity potential pattern is disorganized and not reflective of robust MJO activity.
- Other modes such as Kelvin wave activity over the Western Hemisphere and a Rossby wave over the Indian Ocean are influencing the pattern.

# 200-hPa Wind Anomalies

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

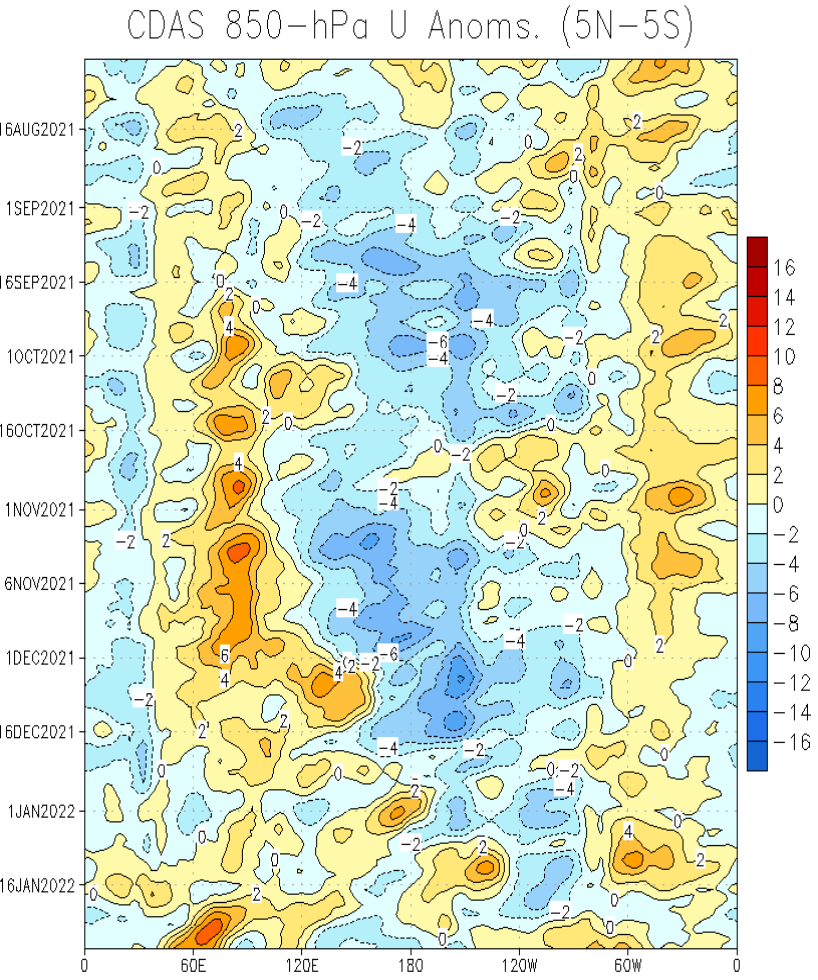


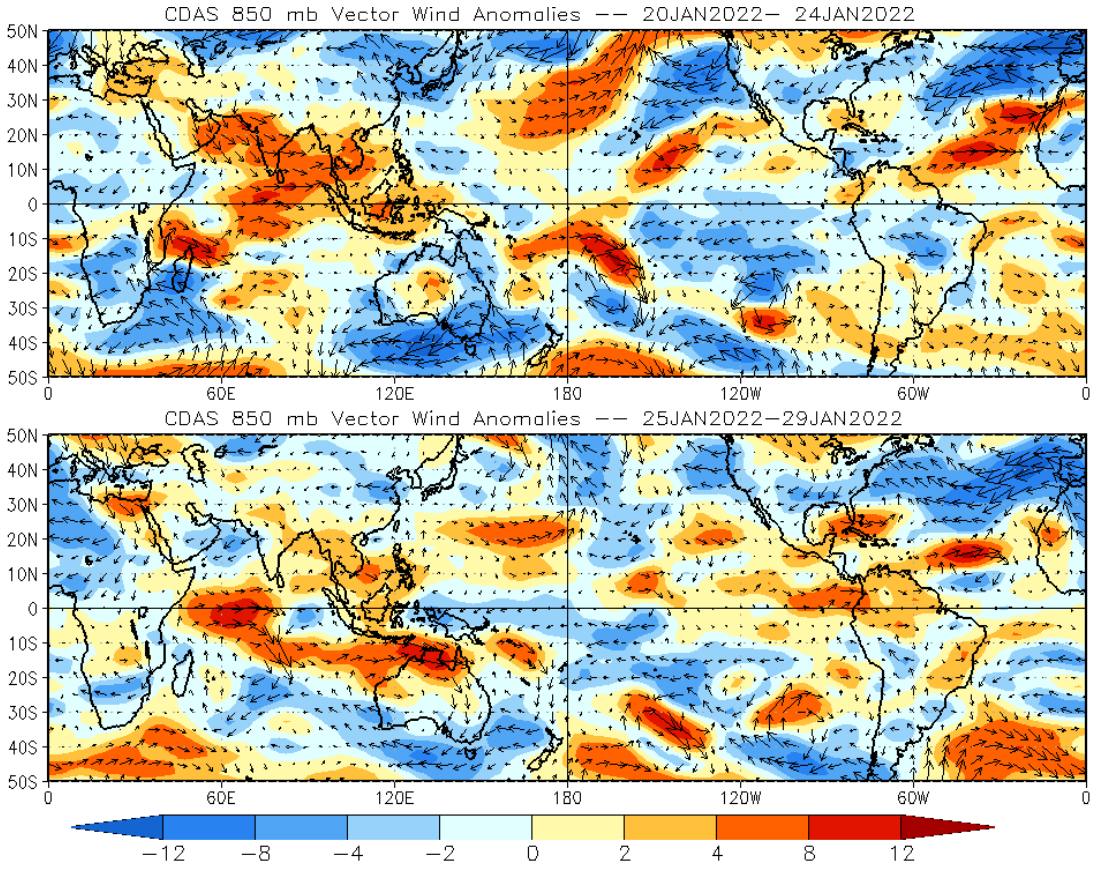




- Westerly anomalies have strengthened over the east-central Pacific.
- Persistent anomalous anti-cyclonic (cyclonic) circulation over the Northeast Pacific resulted in anomalous upper-level easterlies (westerlies) off the West Coast of the contiguous U.S (equatorial East Pacific).
- Easterly anomalies strengthened over the Maritime Continent, promoting anomalous divergence aloft over the West Pacific.

# 850-hPa Wind Anomalies

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

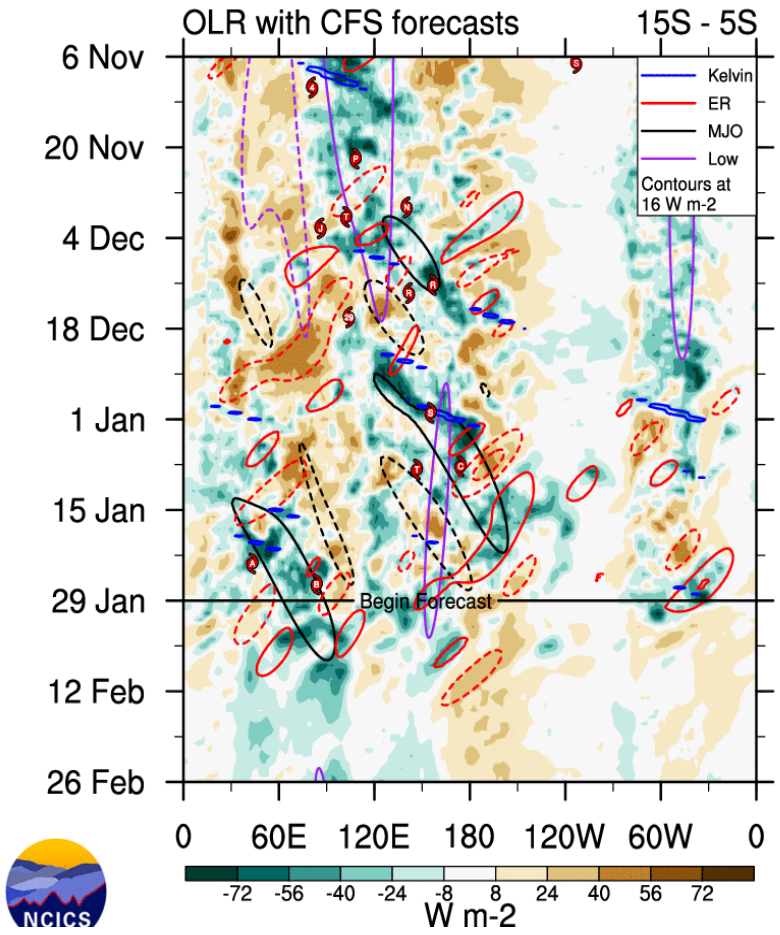


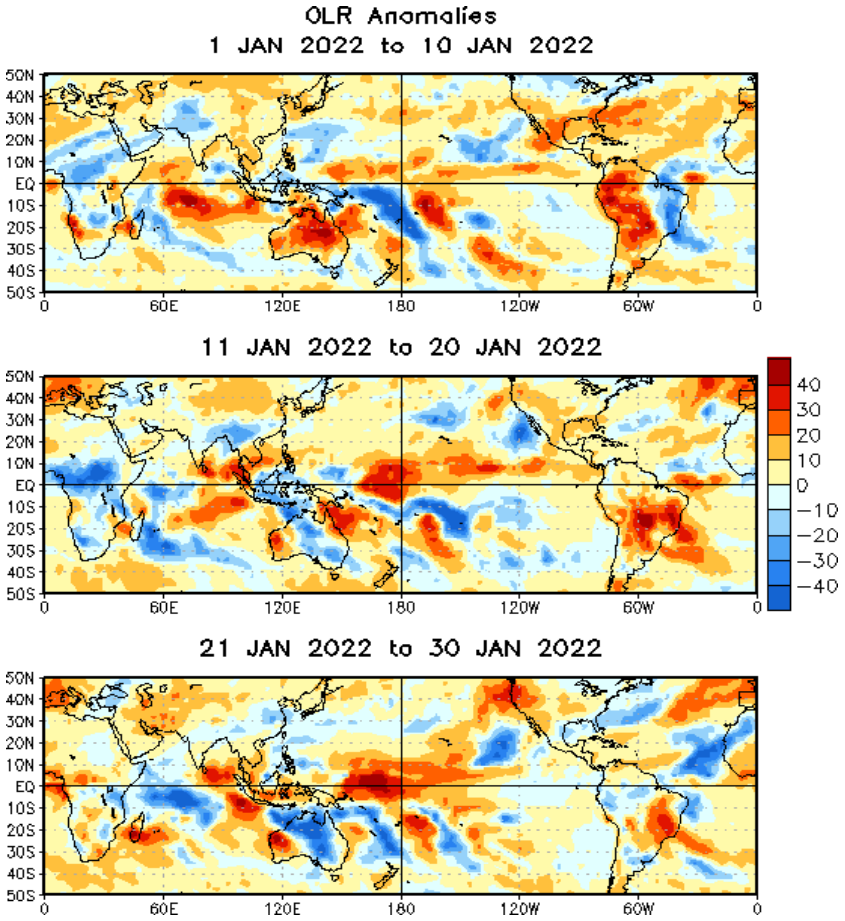




- Westerly anomalies over much of the equatorial east-central Pacific reflect a disruption of the canonical La Niña atmospheric response, though trade winds have strengthened near and west of the Date Line.
- Rossby wave activity over the Indian Ocean is reflected by a westward propagating envelope of strong westerly anomalies.

# Outgoing Longwave Radiation (OLR) Anomalies

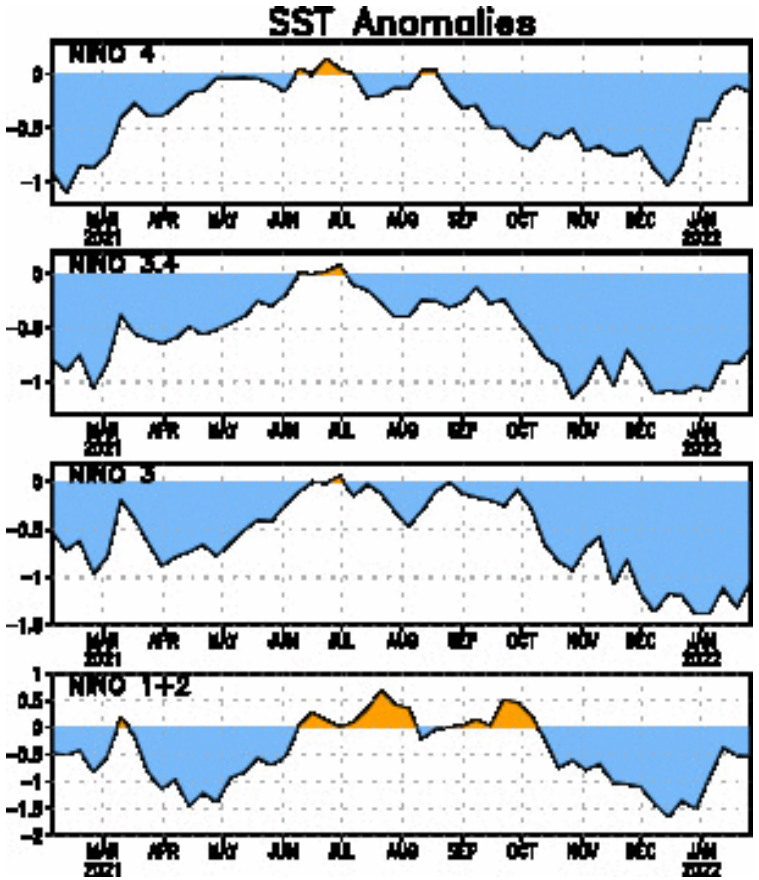
**Green shades: Anomalous convection (wetness)**
**Brown shades: Anomalous subsidence (dryness)**

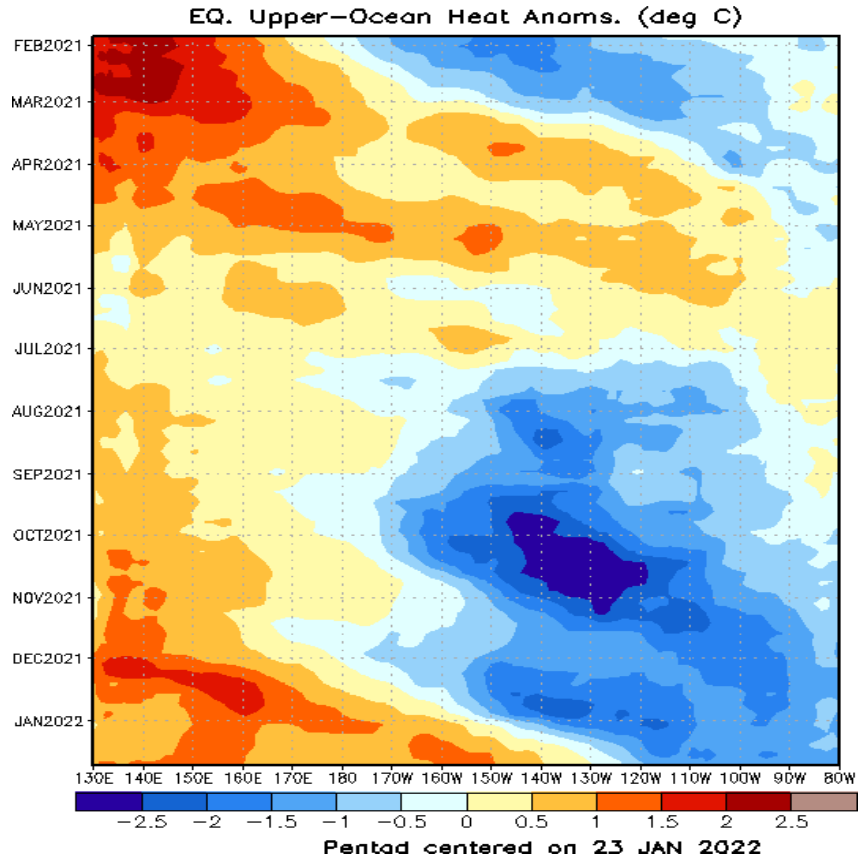



- The OLR pattern remains fairly incoherent overall, but suppressed (enhanced) convective anomalies strengthened near and west of the Date Line (over the Indian Ocean).
- Enhanced convection over the Maritime Continent is largely confined to the Southern Hemisphere, particularly across Australia.

# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

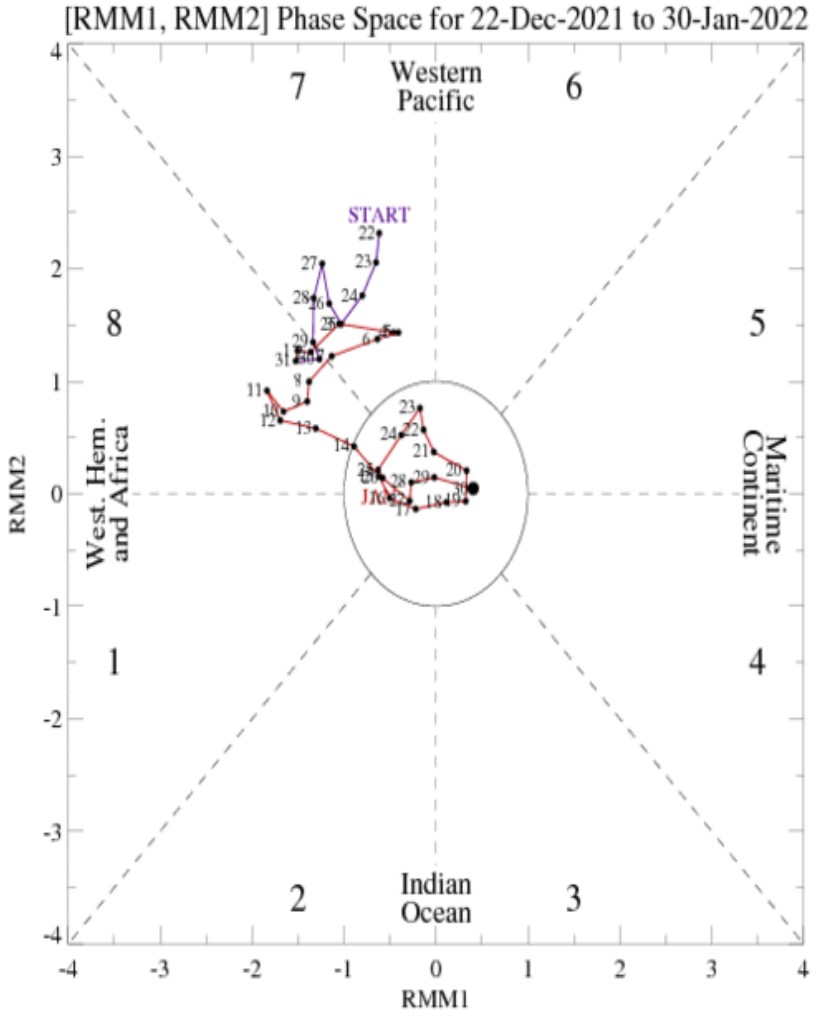



- A low level westerly wind burst (linked to the eastward propagation of the MJO) during December/January led to a robust downwelling Kelvin Wave, resulting in above average OHC progressing to the Central Pacific (135°W).
- While SST anomalies remain negative in all regions, a large warming was observed over the Niño 4 region during the past month tied to the downwelling Kelvin Wave.
- Significant warming also observed closer to the West Coast of South America (Niño 1+2 region) due to enhanced rainfall over the area.

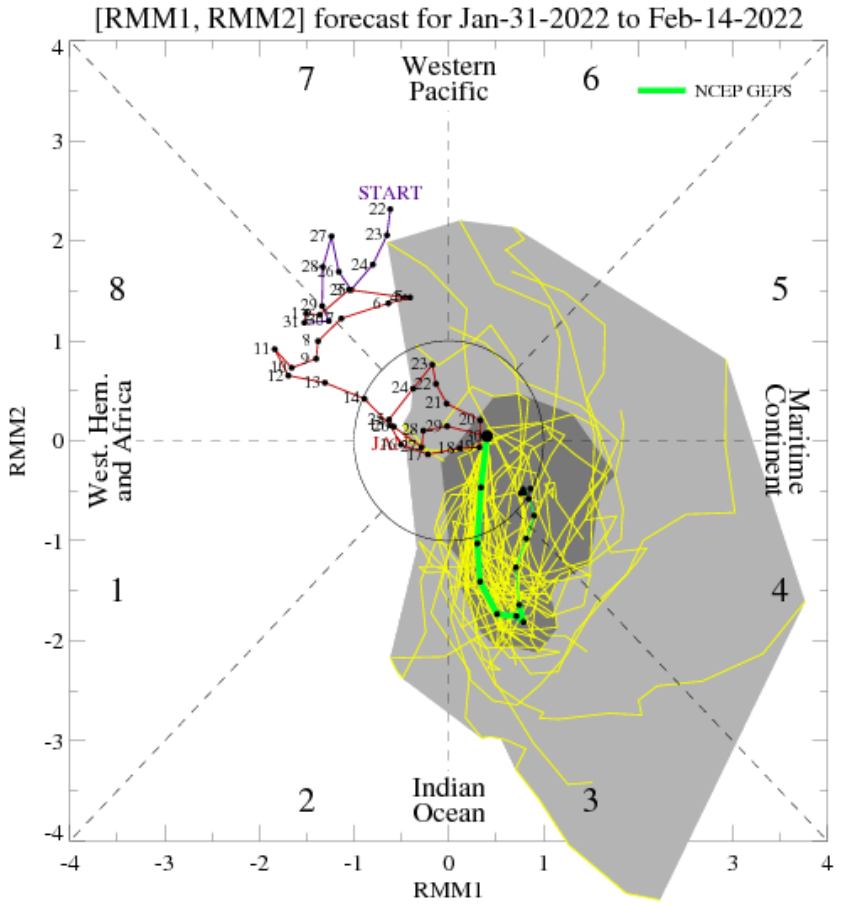
# MJO Index: Recent Evolution

- After progressing eastward across the Pacific, the amplitude of the RMM index diminished in mid-January and has remained weak ever since.
- Enhanced divergence over the far West Pacific and strong Rossby wave activity over the Indian Ocean are likely disrupting the intraseasonal signal.

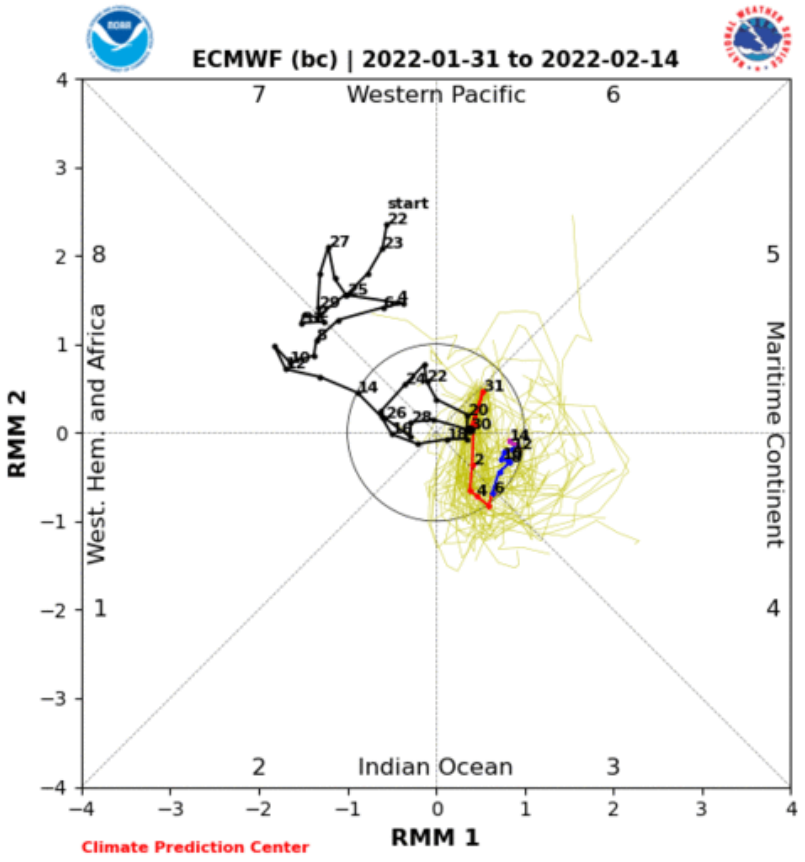



For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

# MJO Index: Forecast Evolution




GEFS Forecast

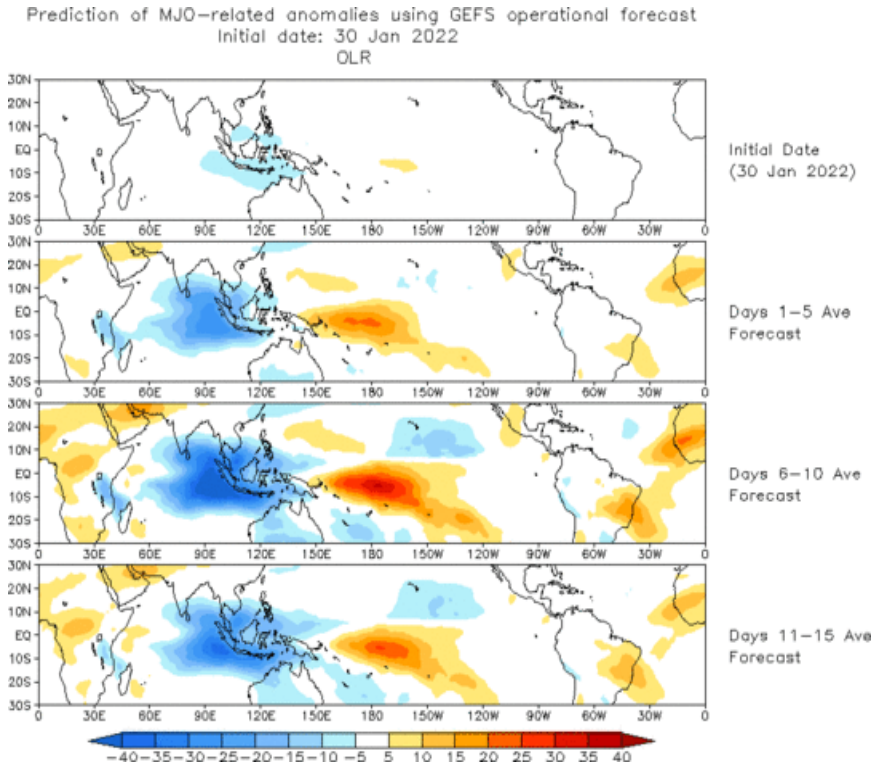


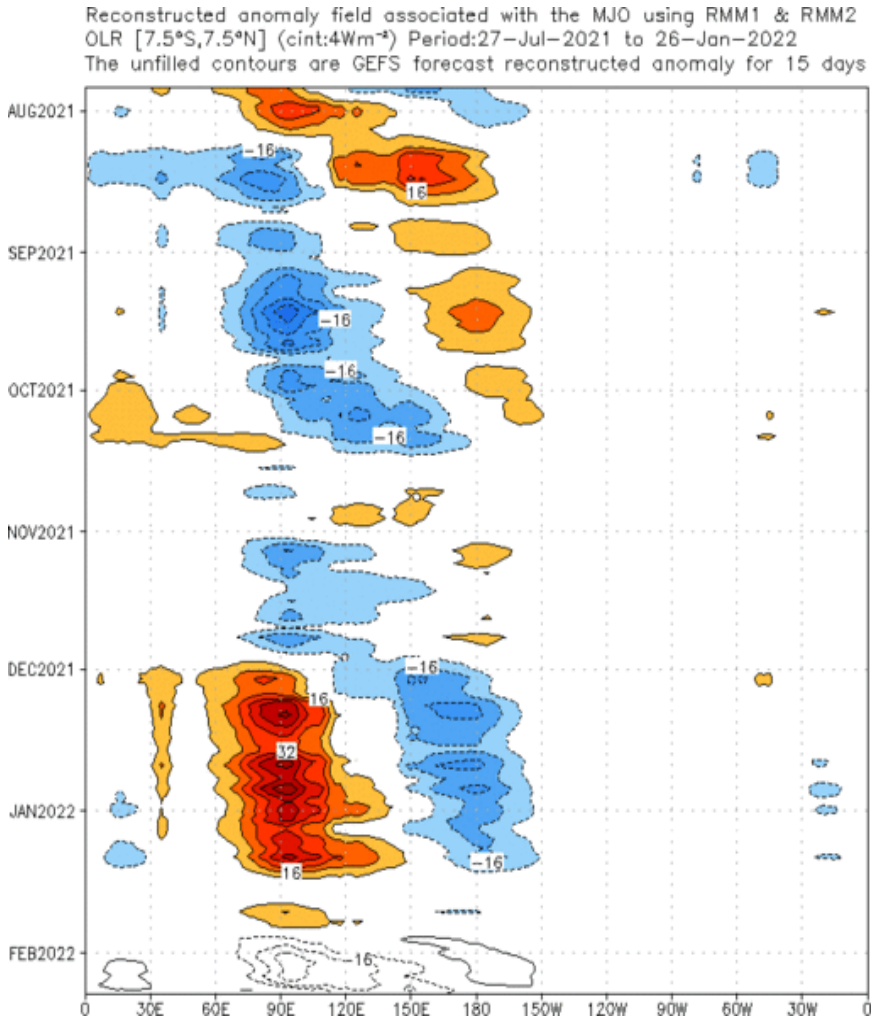

ECMWF Forecast

- Both the GEFS and ECMWF depict an amplifying signal over the Indian Ocean, possibly tied to constructive interference between a Kelvin wave now over the Western Hemisphere and a relaxation of destructive interference from strong Indian Ocean Rossby wave activity.
- Many GEFS and ECMWF ensemble members depict a more MJO-like evolution during Week-2, with eastward propagation of the Indian Ocean signal to the Maritime Continent or even the West 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.)

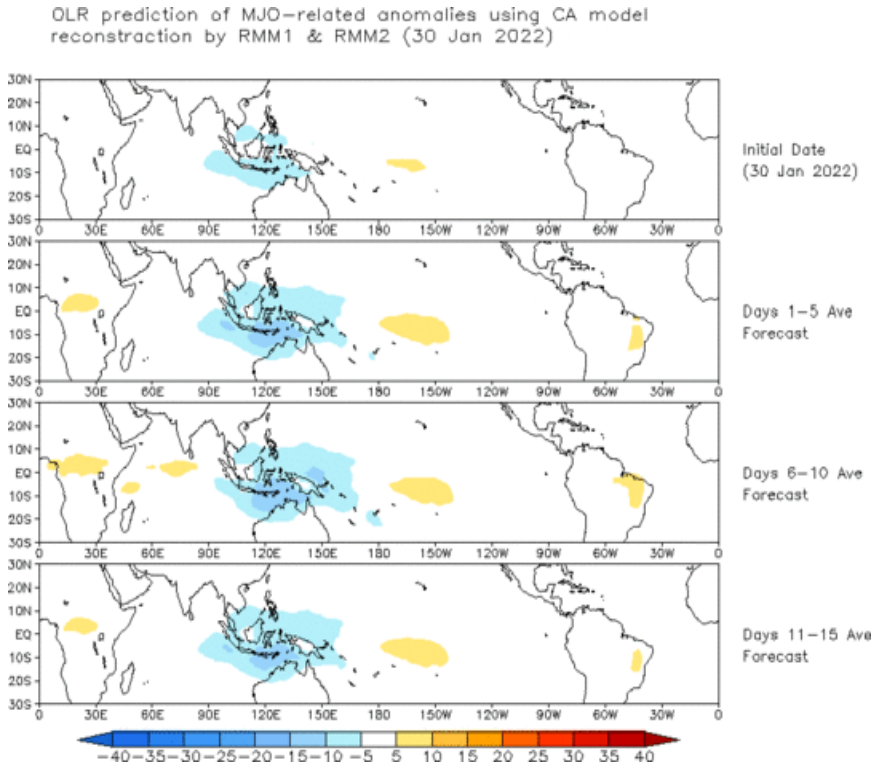


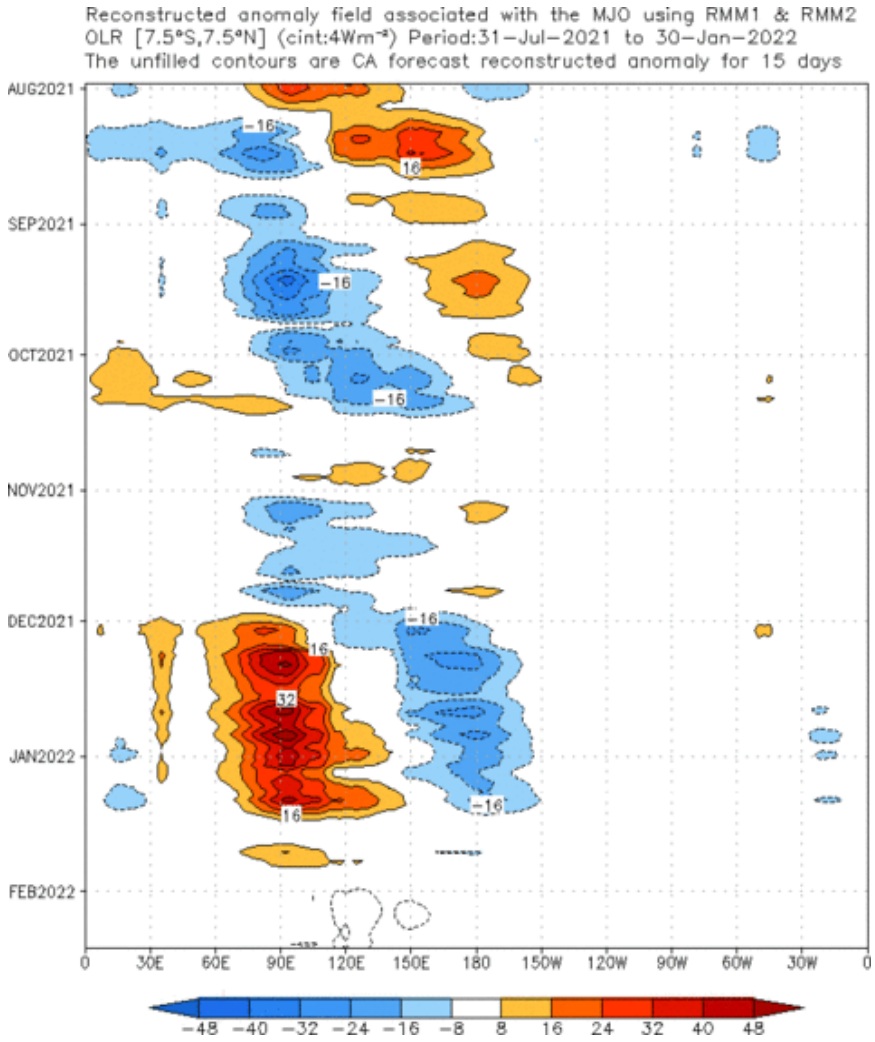




- The GEFS RMM-based OLR field shows a weak initial state followed by strong amplification of an enhanced convective envelope over the Indian Ocean. This enhanced convection then propagates eastward to the Maritime Continent during Week-2.

# 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.)

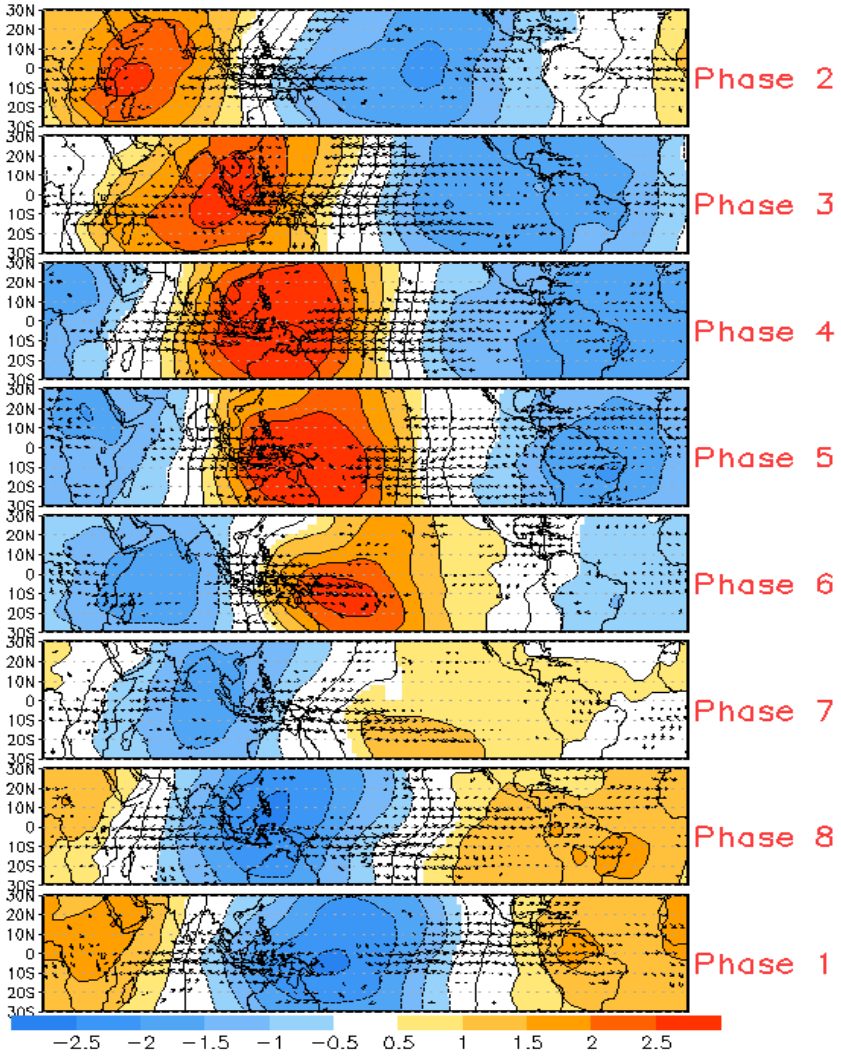


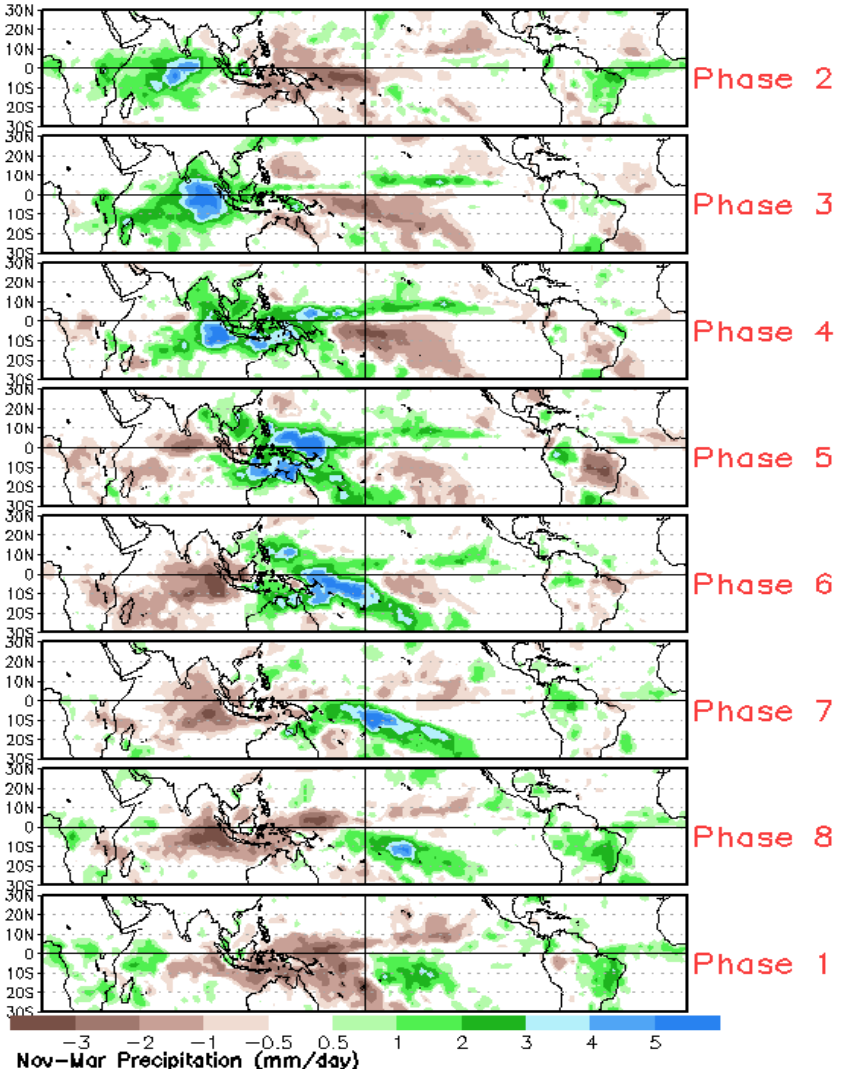

- The constructed analog depicts both weaker amplitude and less eastward propagation than the GEFS, with an enhanced convective signal slowly building over the Maritime Continent.

# MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



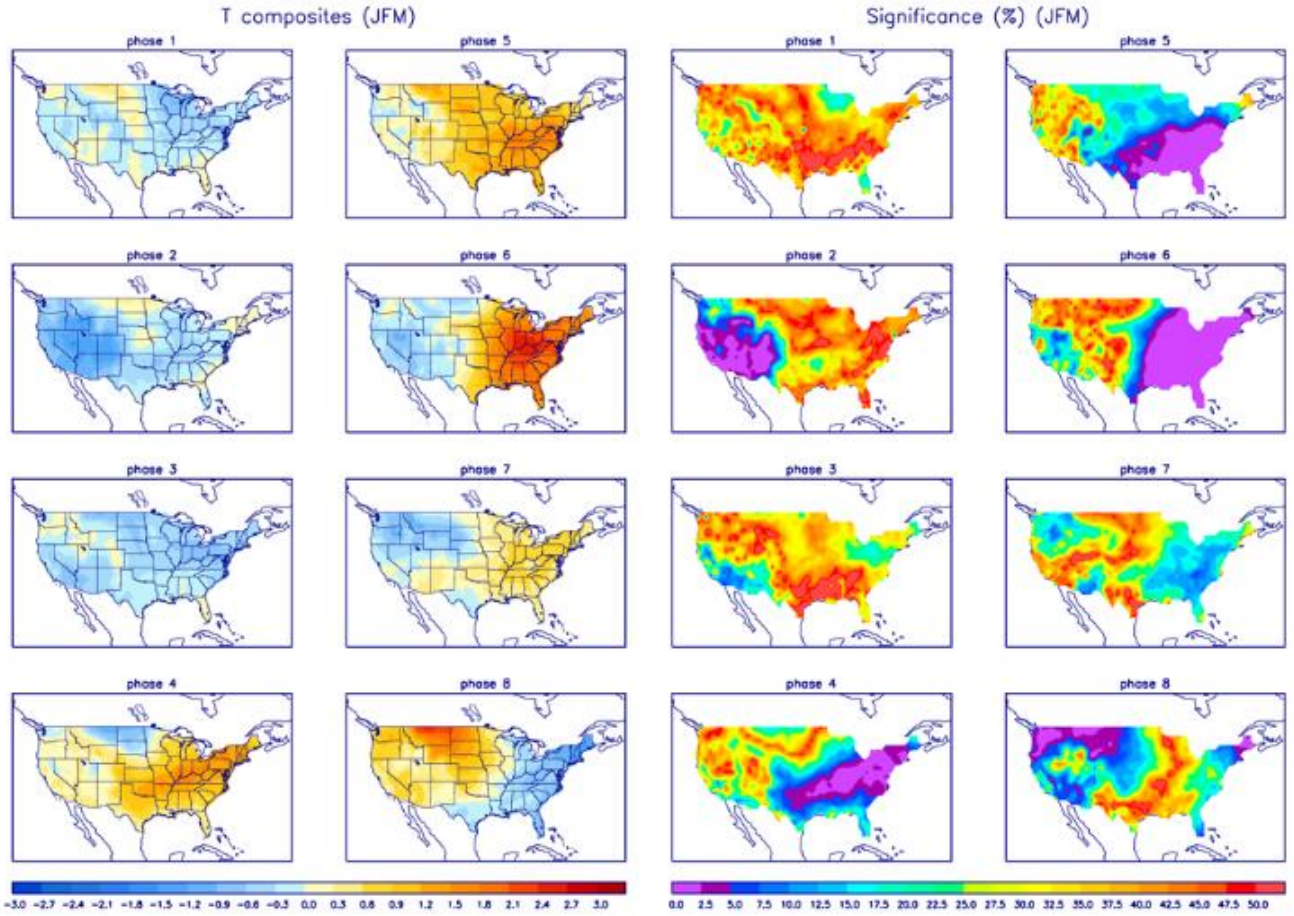

Precipitation Anomalies



# 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.

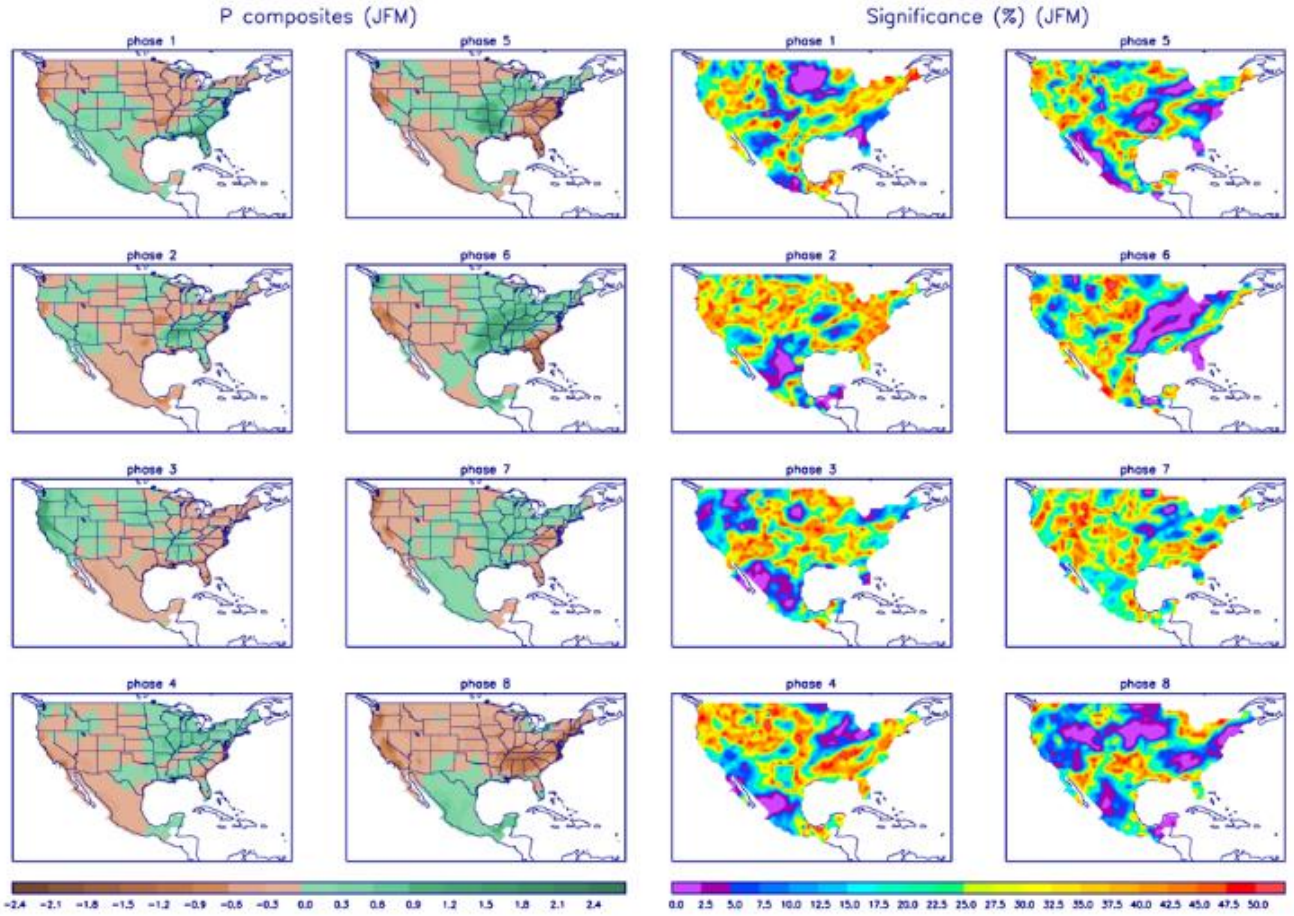



More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

# 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.




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