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

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
24 January 2022

Overview

- The RMM-based MJO index remains within the unit circle, indicating a weakened intraseasonal signal relative to previous weeks.

- Continued disruption of the La Niña signal is apparent in the low-level wind anomaly fields over the Pacific, as well as in the sea surface temperate anomalies, which have trended upward over the Central Pacific.

- Dynamical models generally show the MJO remaining weak and incoherent, with extratropical variability likely playing a more dominant role in influencing weather conditions across the globe.

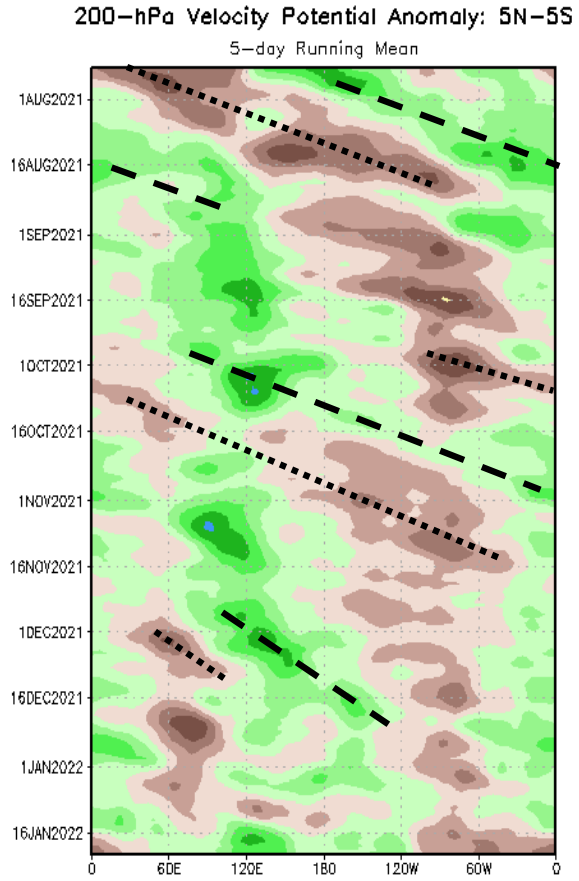
- Tropical cyclone formation remains most likely over the Southern Indian Ocean and along the South Pacific Convergence Zone (SPCZ) during the next week.

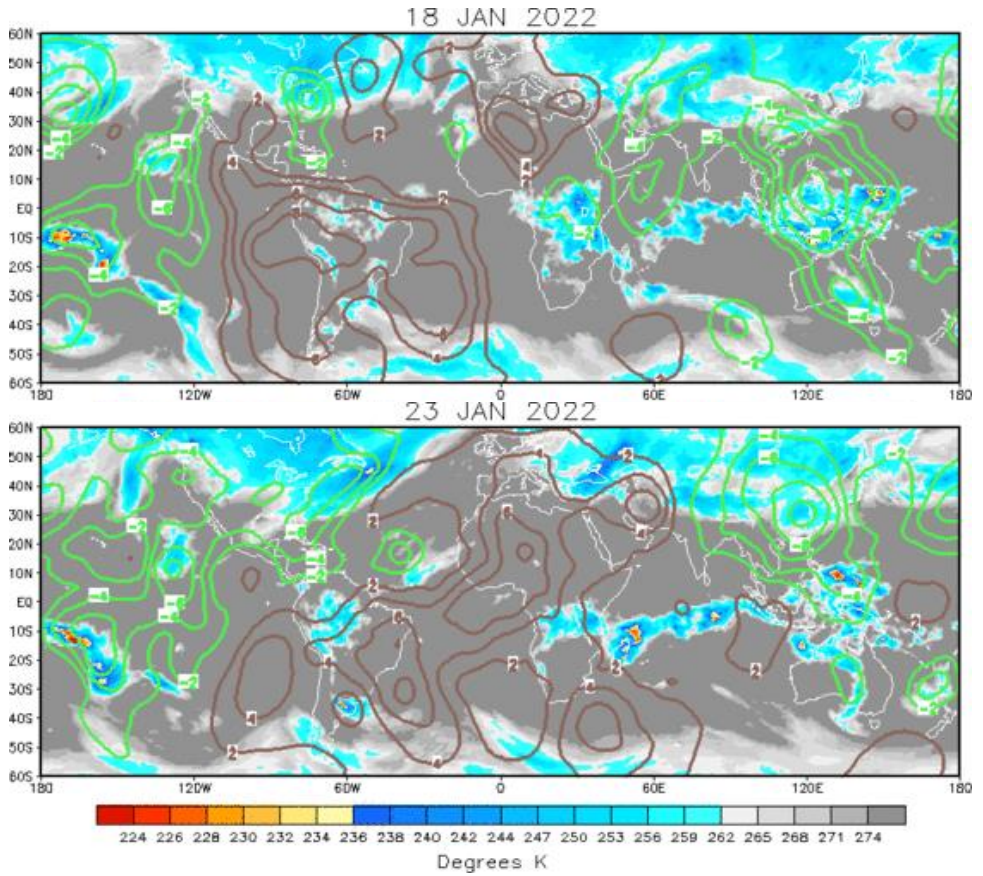
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)



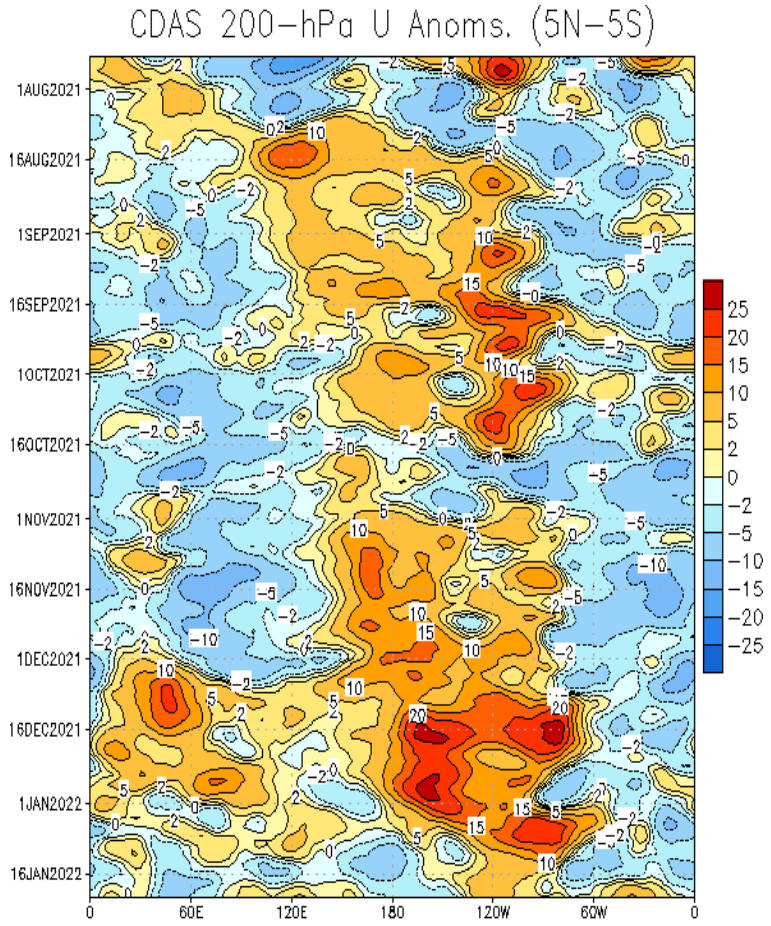


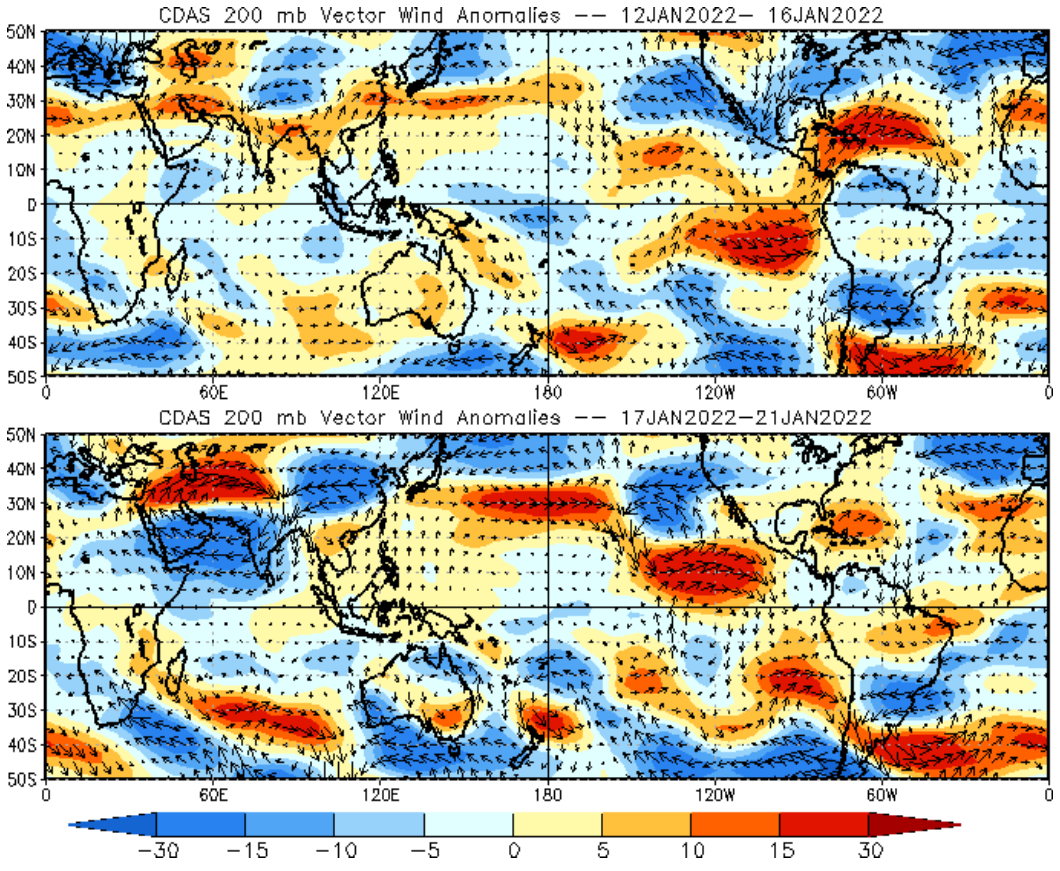
- Some evolution toward a wave-1 asymmetry is depicted in the spatial velocity potential field, although there are considerable noise and localized extrema that is more likely associated with extratropical variability.

- Enhanced convection is noted over much of the Pacific and North America, with suppressed convection across South America, Africa, and Eurasia.

200-hPa Wind Anomalies

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

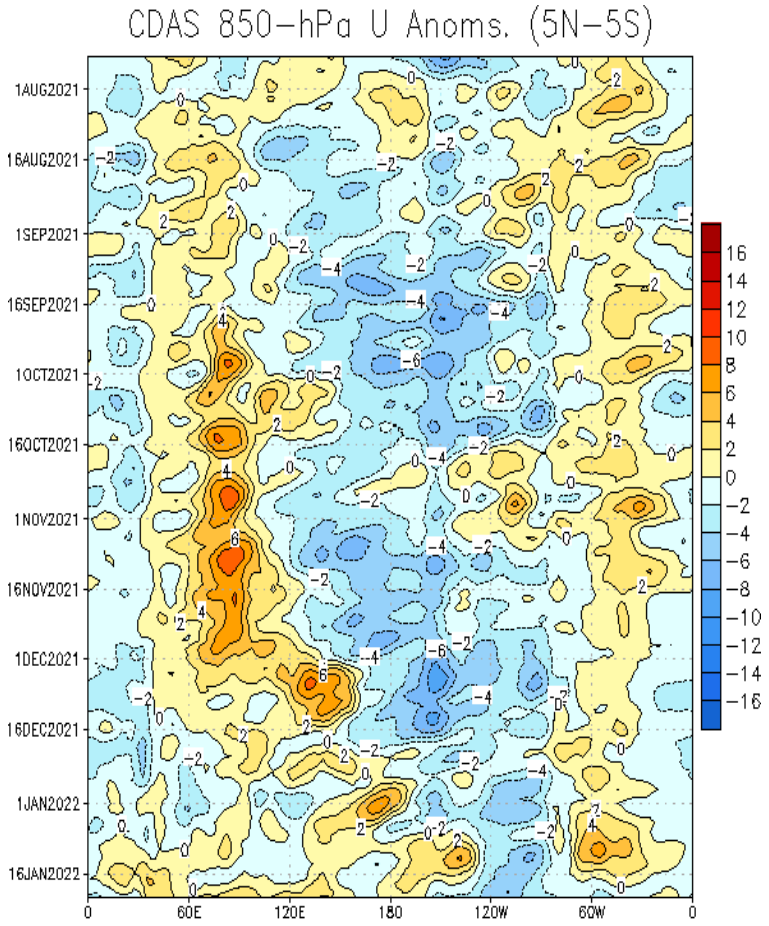


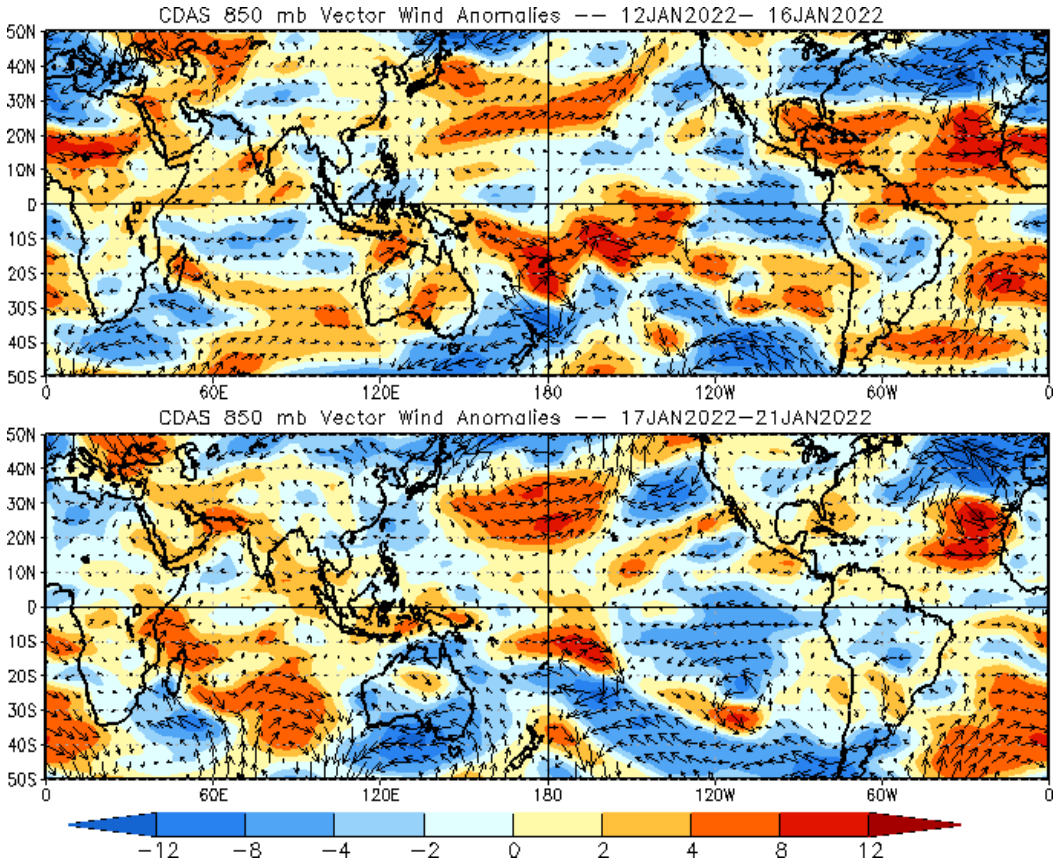


- Upper-level wind anomalies have generally weakened along the Equator, with extra-tropical variability contributing to the largest upper-level wind anomalies at the mid and high latitudes.
- Anti-cyclonic (cyclonic) anomalous circulation over the Northeast Pacific resulted in anomalous upper-level easterlies (westerlies) off the West Coast of the contiguous U.S (equatorial East Pacific).
- Strengthening upper-level anti-cyclonic circulation observed over the Middle East and western Asia.

850-hPa Wind Anomalies

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



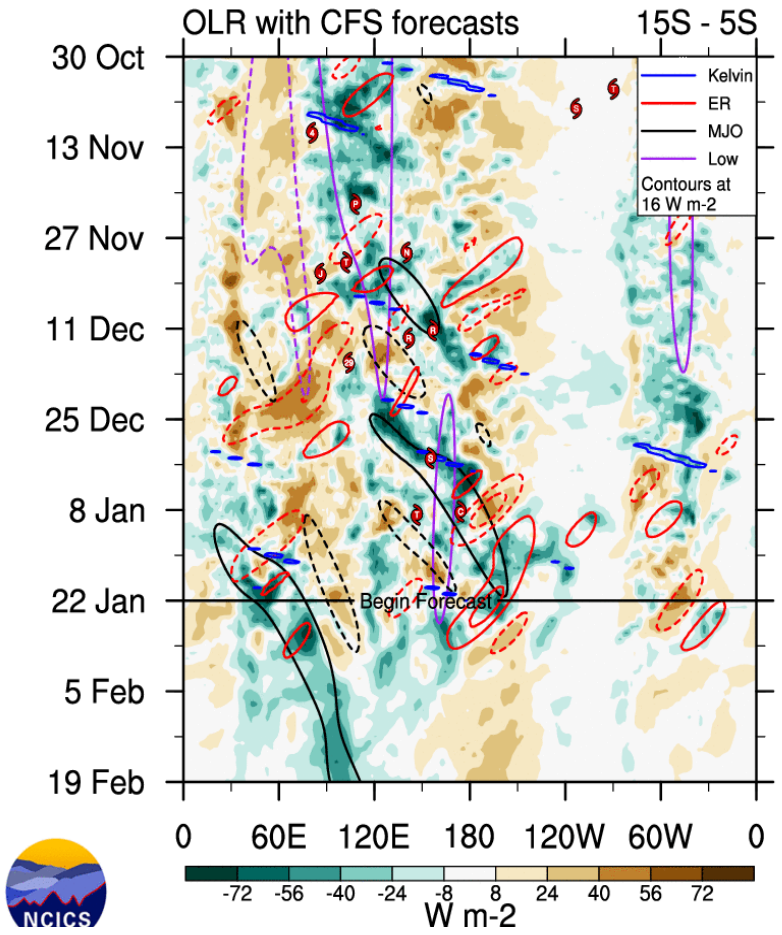


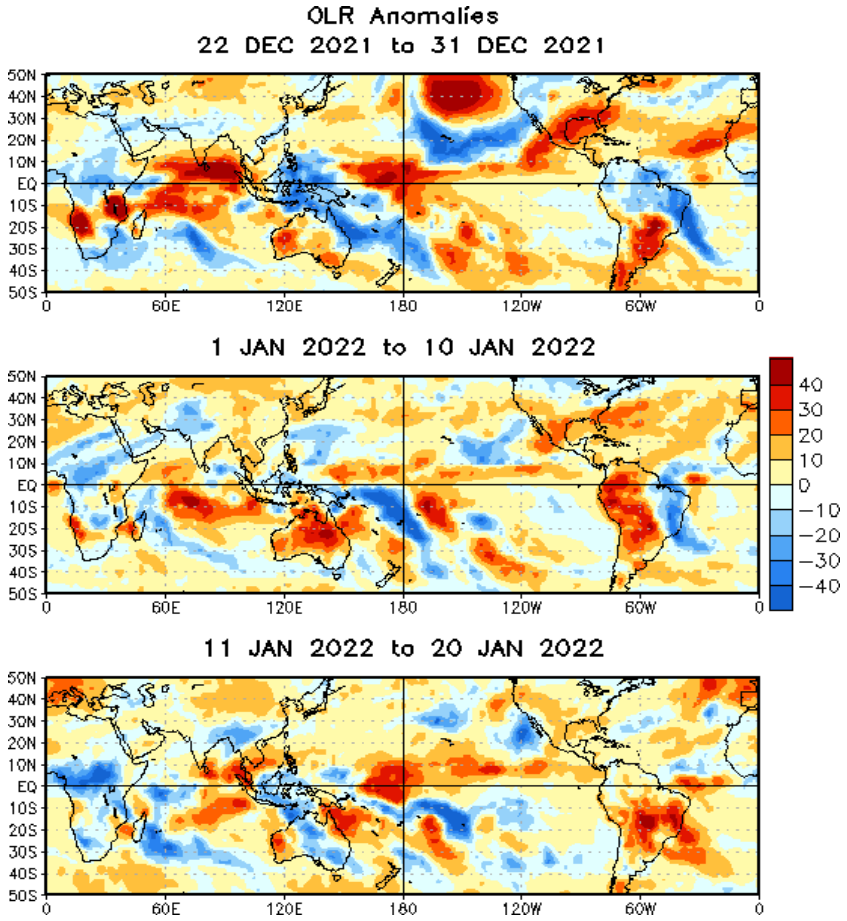
- A weakening of the trades is observed across the equatorial Pacific, with a gradual eastward progression of the westerly wind anomalies. This will continue to disrupt the low frequency La Niña signal.

- Anomalous low-level westerlies have strengthened over the southern Indian Ocean.

Outgoing Longwave Radiation (OLR) Anomalies

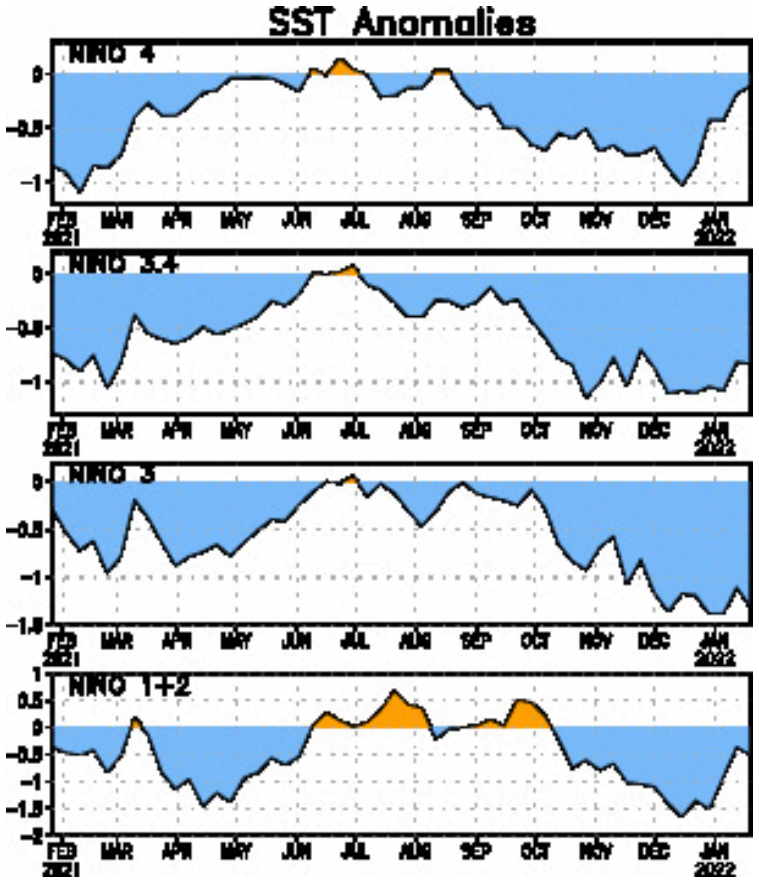
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

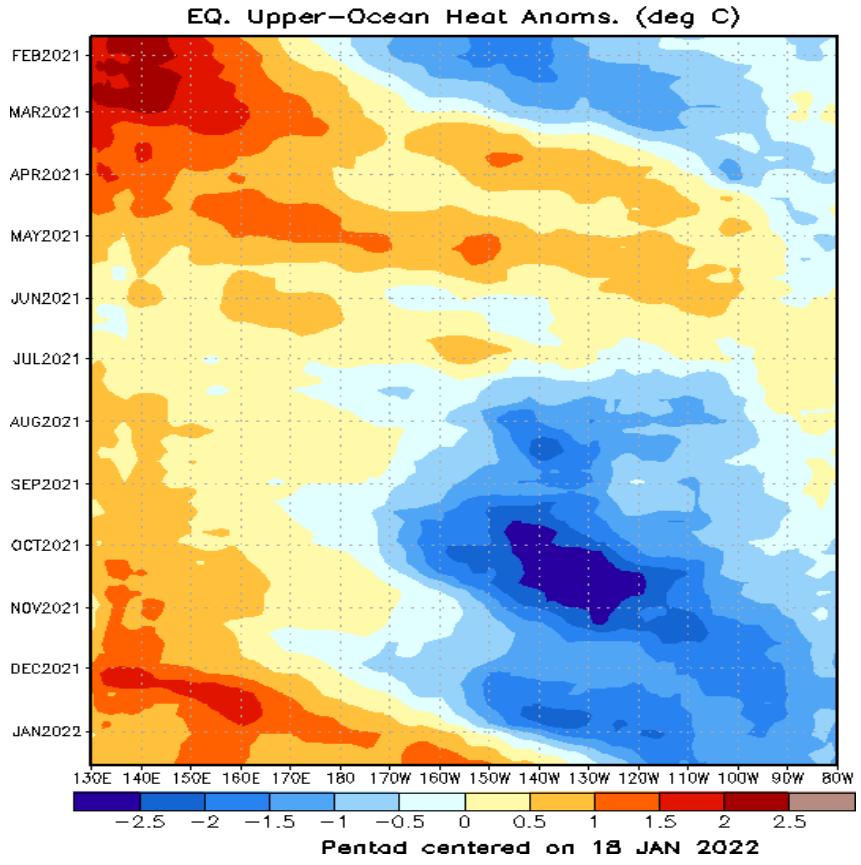




- A weak and incoherent signal is depicted in the OLR anomaly field, with Rossby Wave activity contributing to enhanced convection across portions of Africa and the southwestern Indian Ocean, as well as over the Maritime Continent and northwestern Australia.
- The CFS favors enhanced convection developing over the southern Indian Ocean and the Maritime Continent during the next two weeks.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

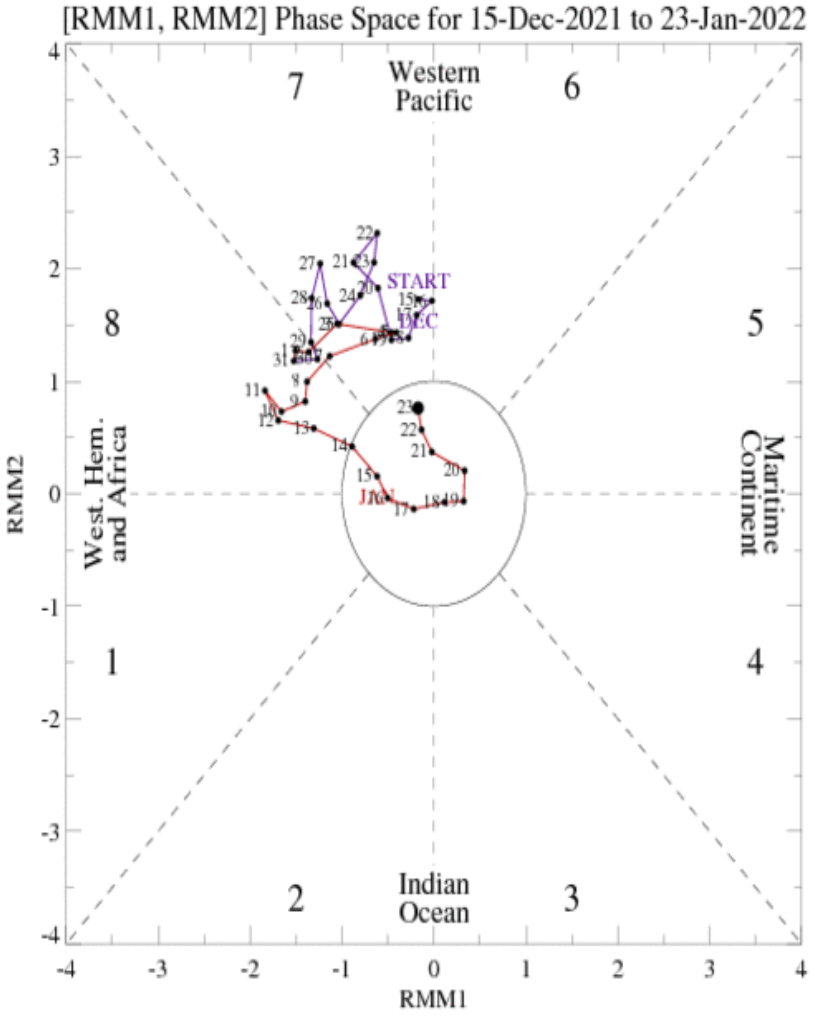




- A low level westerly wind burst (linked to the eastward propagation of the MJO) during December/January led to a robust downwelling Kelvin Wave, resulting in above average OHC progressing to the Central Pacific (135°W).
- While SST anomalies remain negative in all regions, a large warming was observed 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.

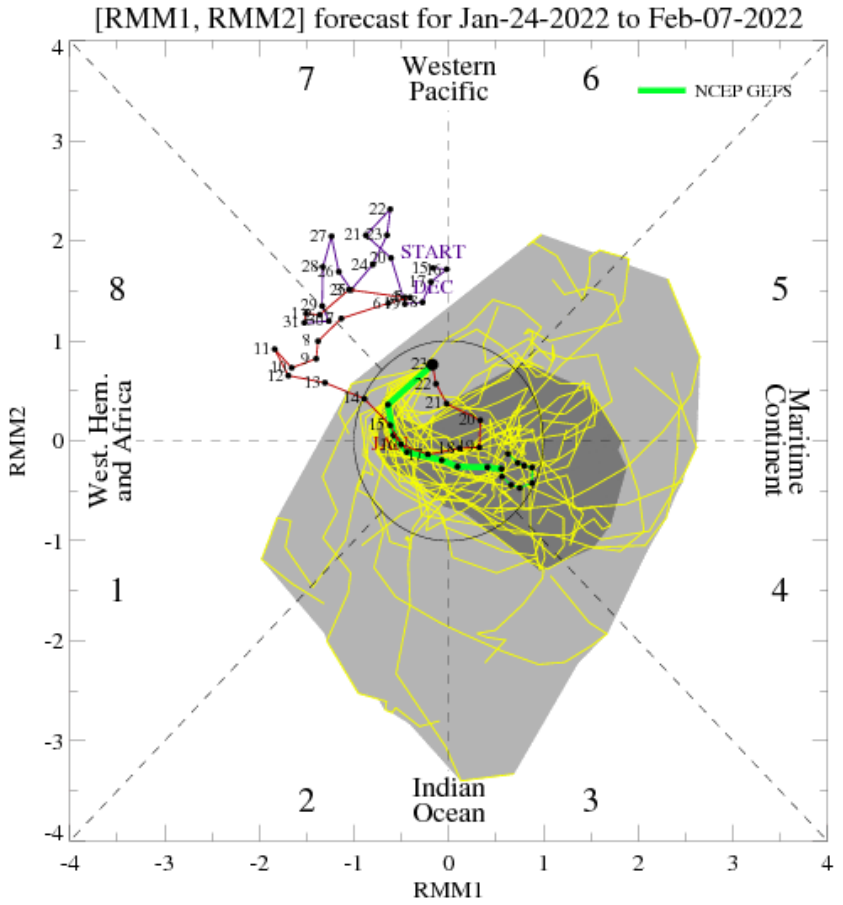
MJO Index: Recent Evolution

- An active MJO was observed across the Western and Central Pacific during late December and early January.
- During the past two weeks, the RMM-based MJO index decayed into the unit circle, indicating a weakened intraseasonal signal.

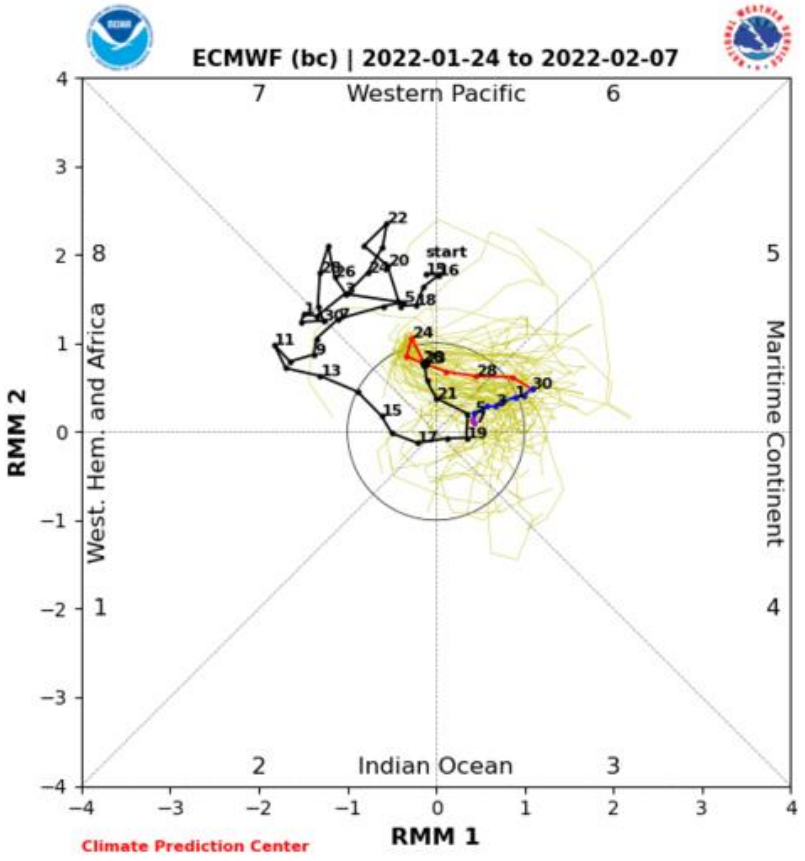


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

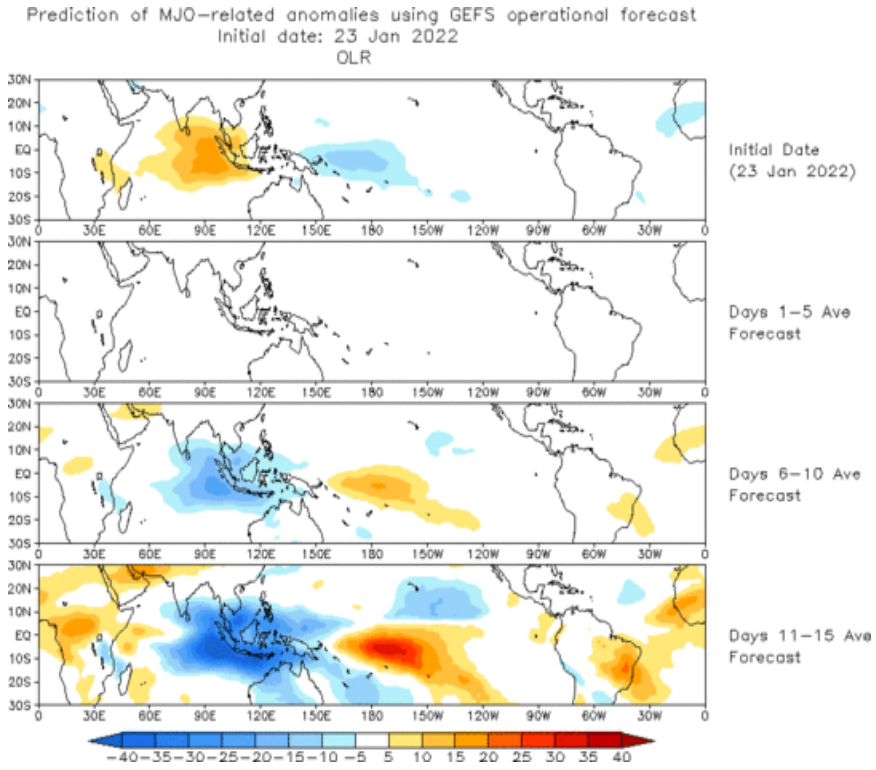


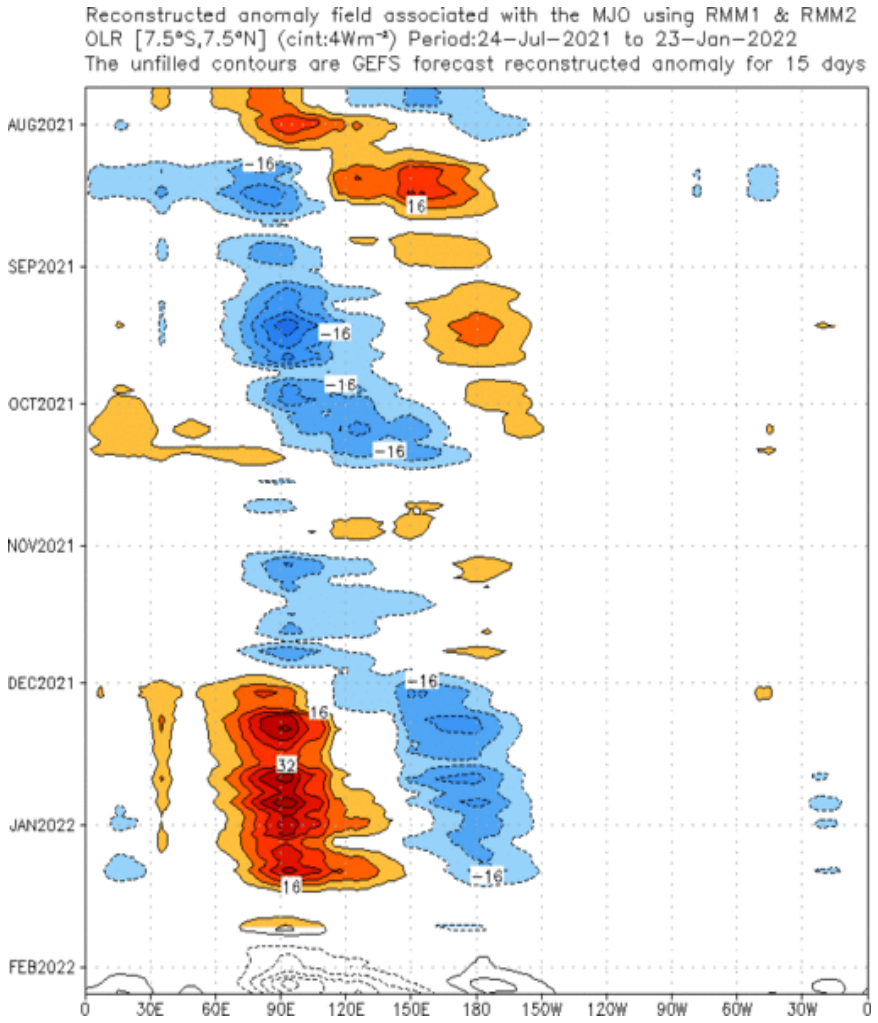
ECMWF Forecast

- The GEFS exhibits a large amount of ensemble variability in regards to the MJO evolution, with the ensemble mean remaining inside the RMM-unit circle.
- The ECMWF MJO forecast is generally similar to the GEFS, but with a bit more amplification of the intraseasonal signal toward the Maritime Continent by the end of January.

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.)

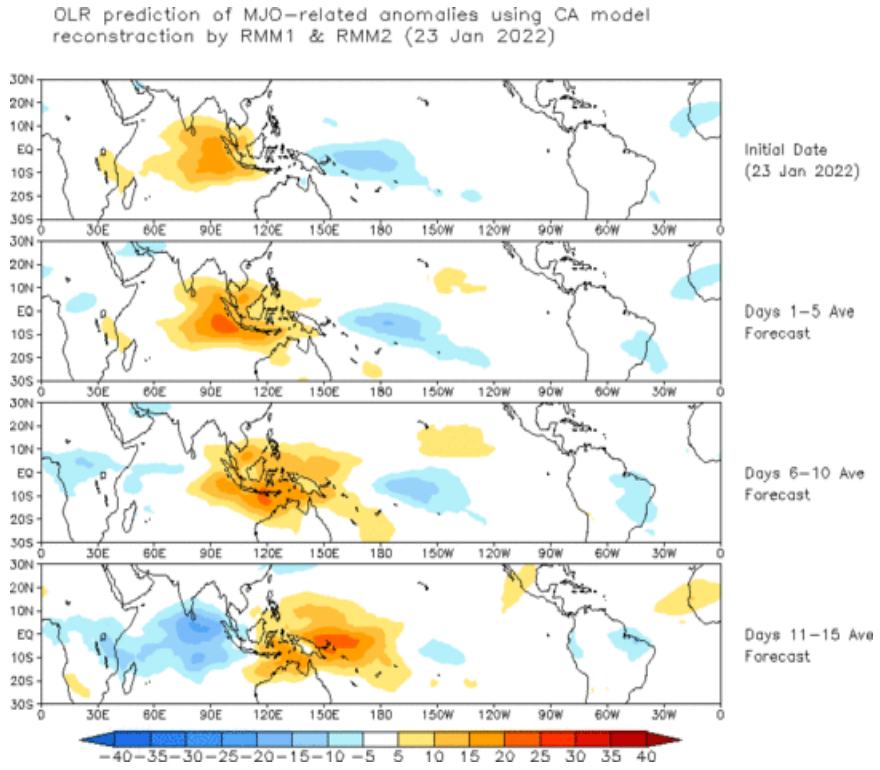


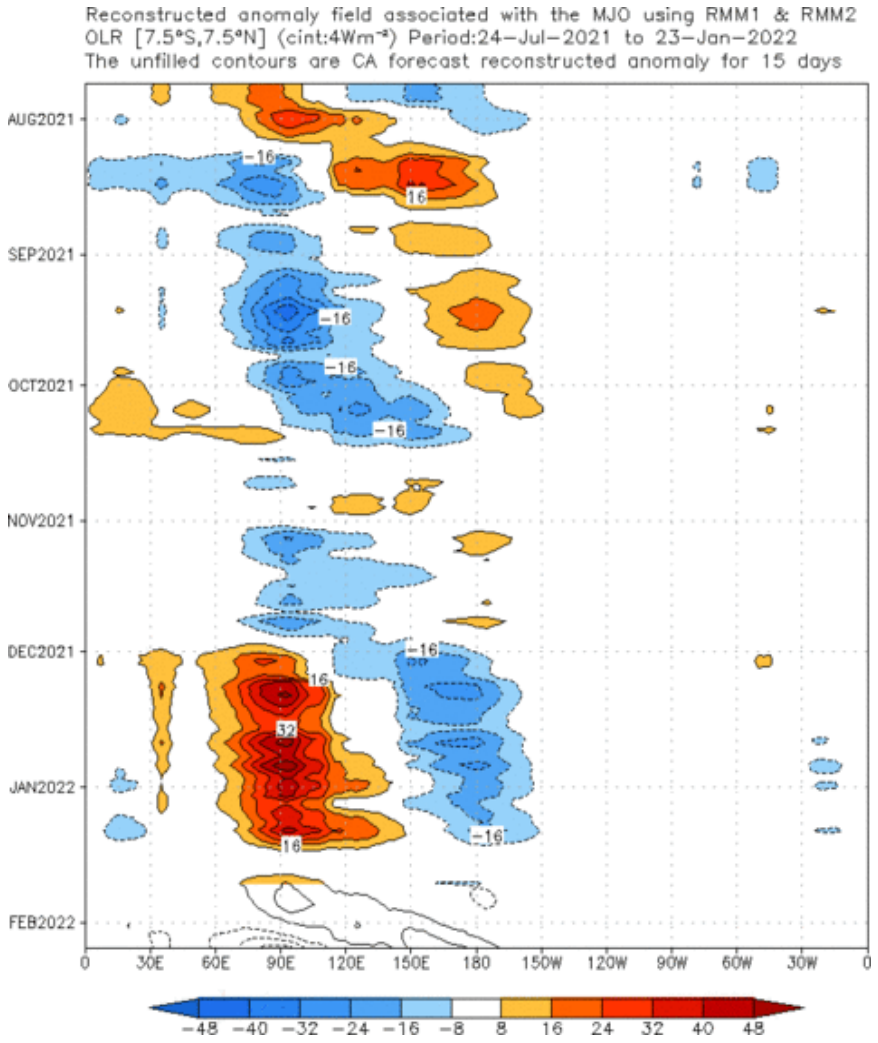


- The GEFS depicts a transition from positive to negative OLR anomalies across the eastern Indian Ocean and Maritime Continent over the next two weeks, with positive OLR anomalies developing over the south-central Pacific.

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.)

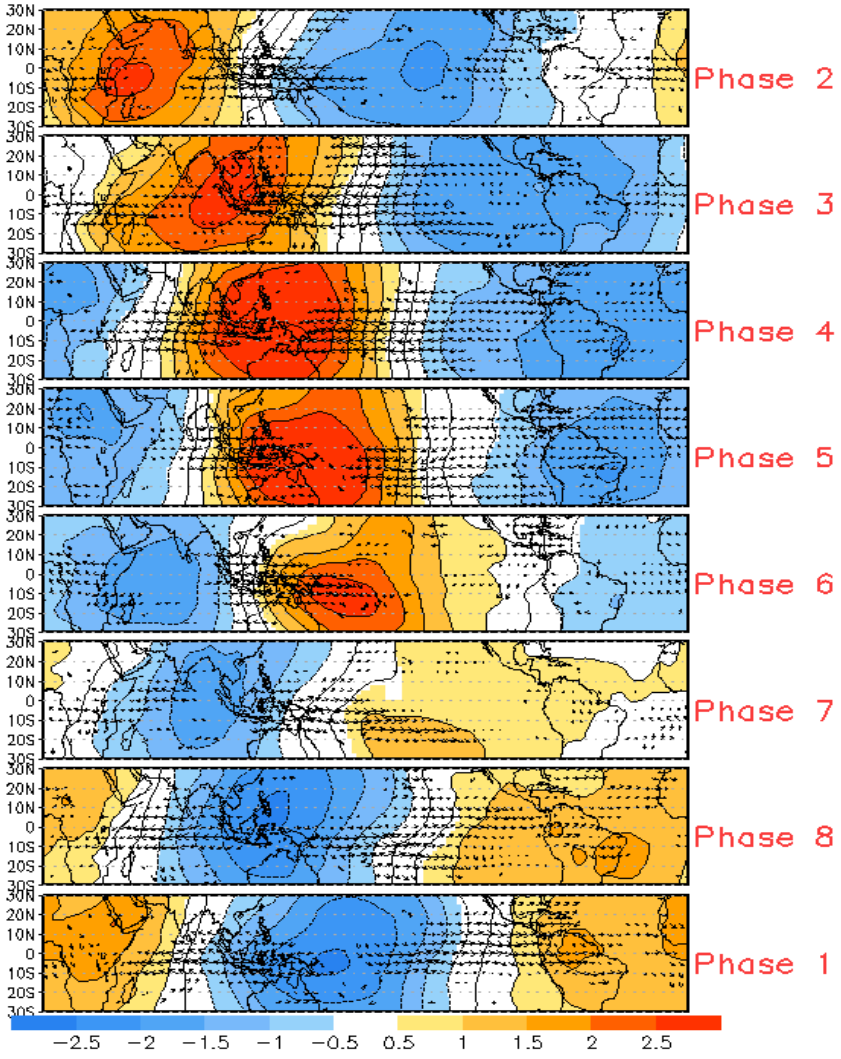




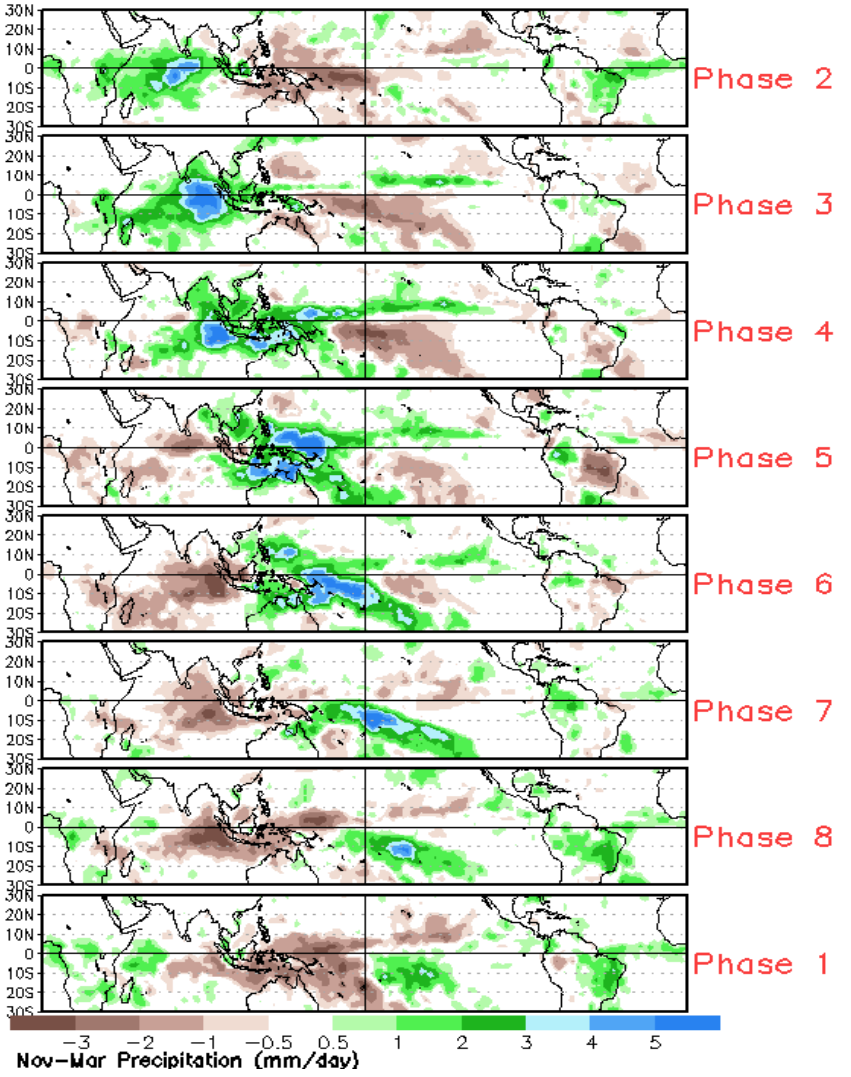
- Contrary to the GEFS, the constructed analog tool indicates positive OLR anomalies persisting longer across the Indian Ocean and Maritime Continent.
- By week-2, negative OLR anomalies begin to expand over the Indian Ocean, with positive OLR anomalies shifting to the West Pacific.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



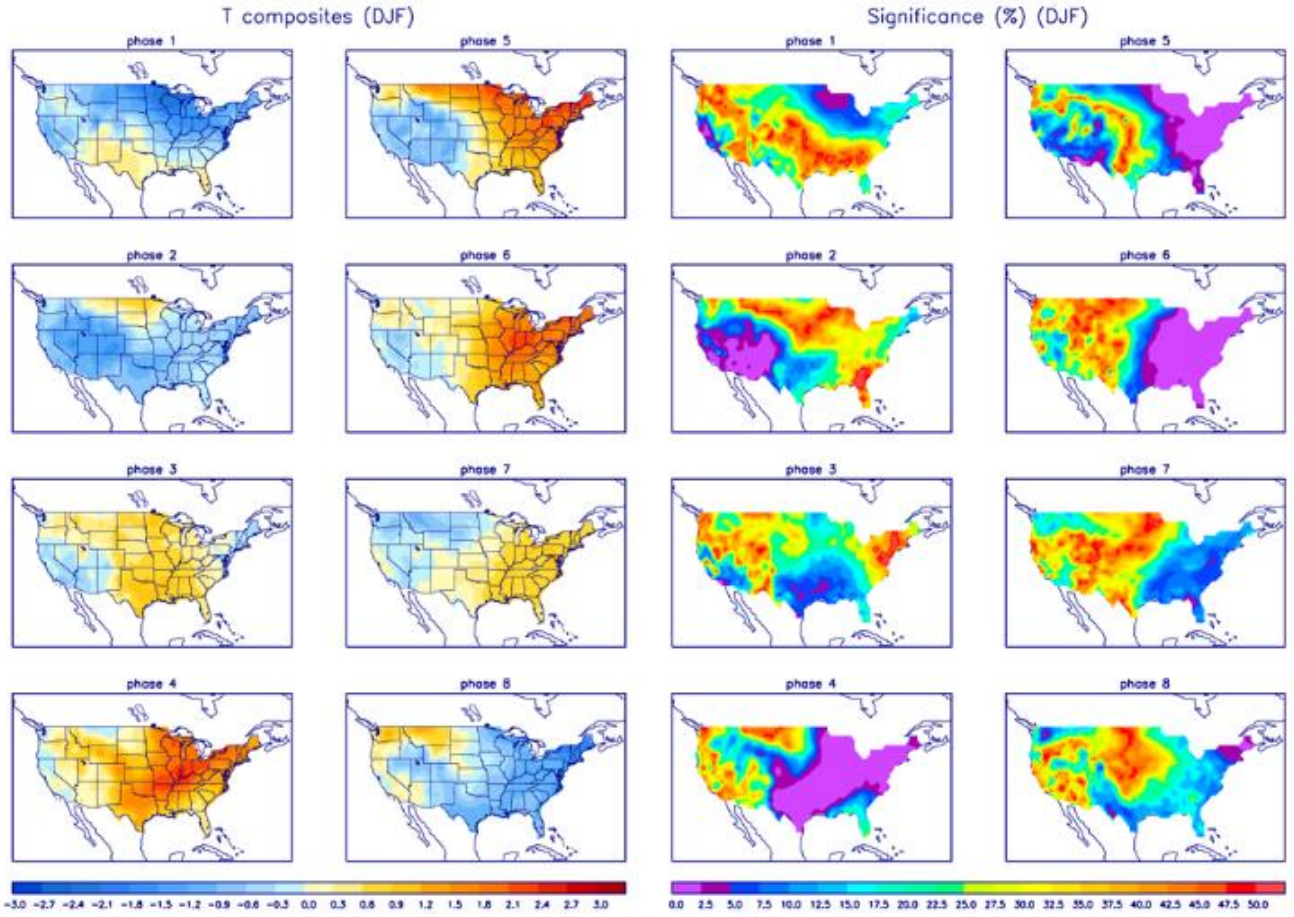
Precipitation Anomalies



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.

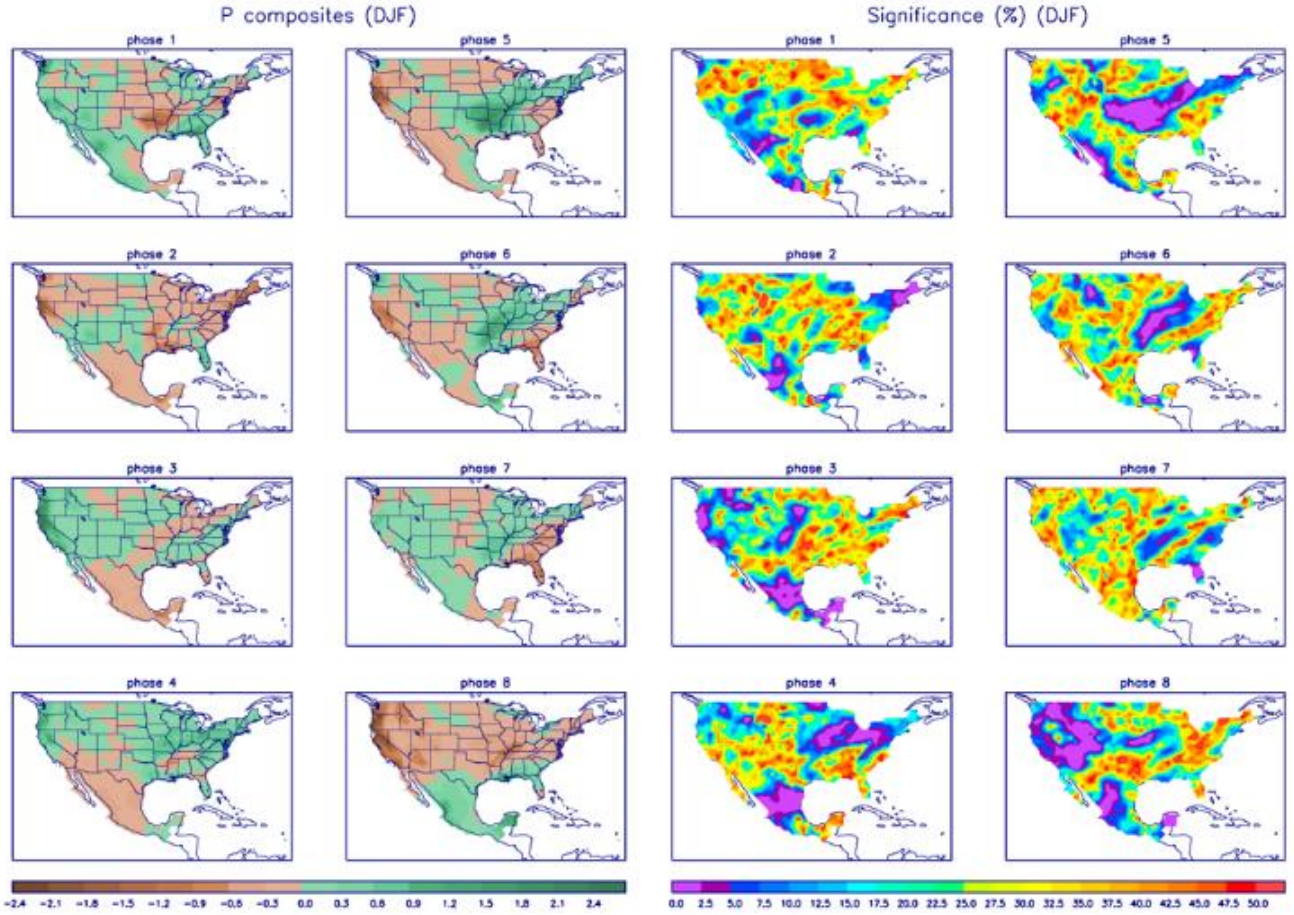


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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