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

Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
16 January 2023

Overview

- As previously forecast, the MJO weakened and became more quasi-stationary over the Western Hemisphere during the past week.

- There is continued good agreement in the dynamical models favoring the development of a well organized and potentially robust Indian Ocean MJO event during the next two weeks.
    - In the extended range, ensemble mean RMM solutions depict a much weakened MJO signal while continuing to propagate it eastward across the Maritime Continent during early February. However, this loss of amplitude may be the product of the 120-day mean removal in RMM computation, obscuring the true amplitude of the intraseasonal signal as it constructively interferes with the low frequency base state. This realization is supported by alternate RMMs and upper-level velocity potential anomaly forecasts.

- A potentially robust Indian Ocean MJO event favors increased chances for TC formation over the southwestern portion of the basin, with decreasing chances of development over the South Pacific during the next several weeks.

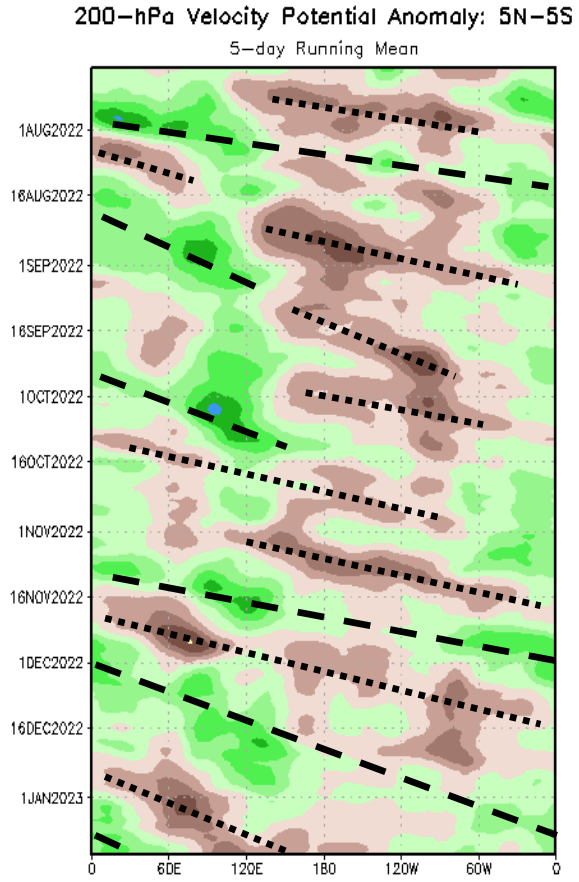
- A constructively interfering MJO may reinforce the low frequency La Nina circulation and its typical extratropical response over North America, where models do favor more of a negative Pacific North America (-PNA) pattern taking shape by the end of January and early February.

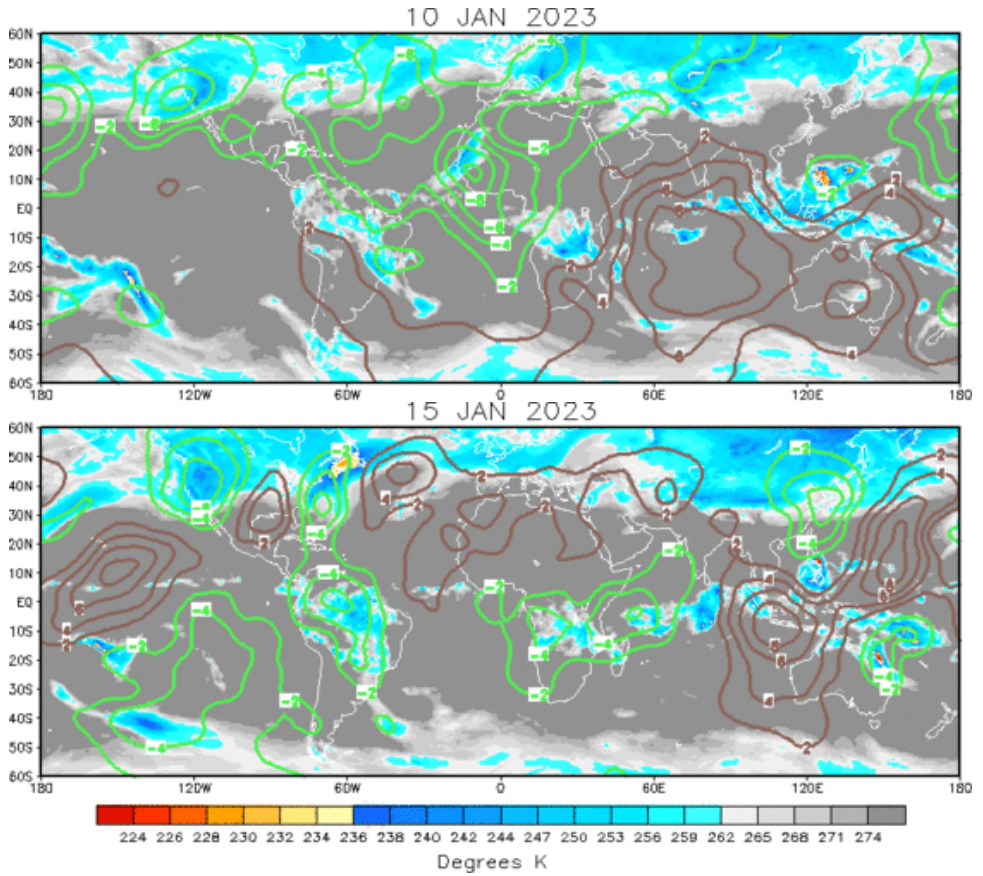
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)



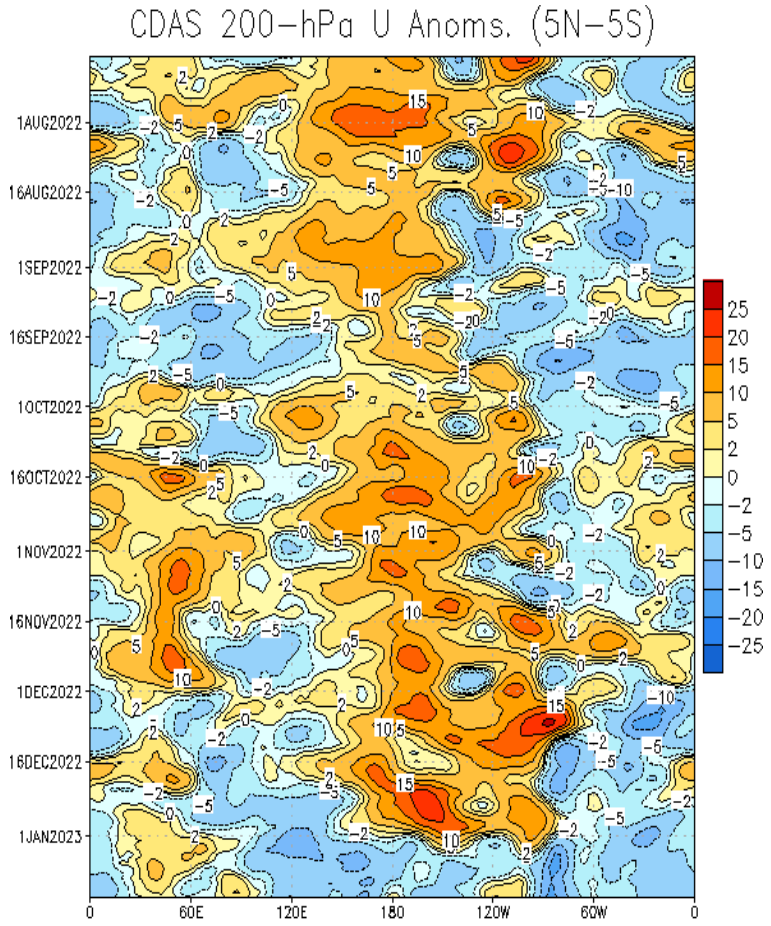


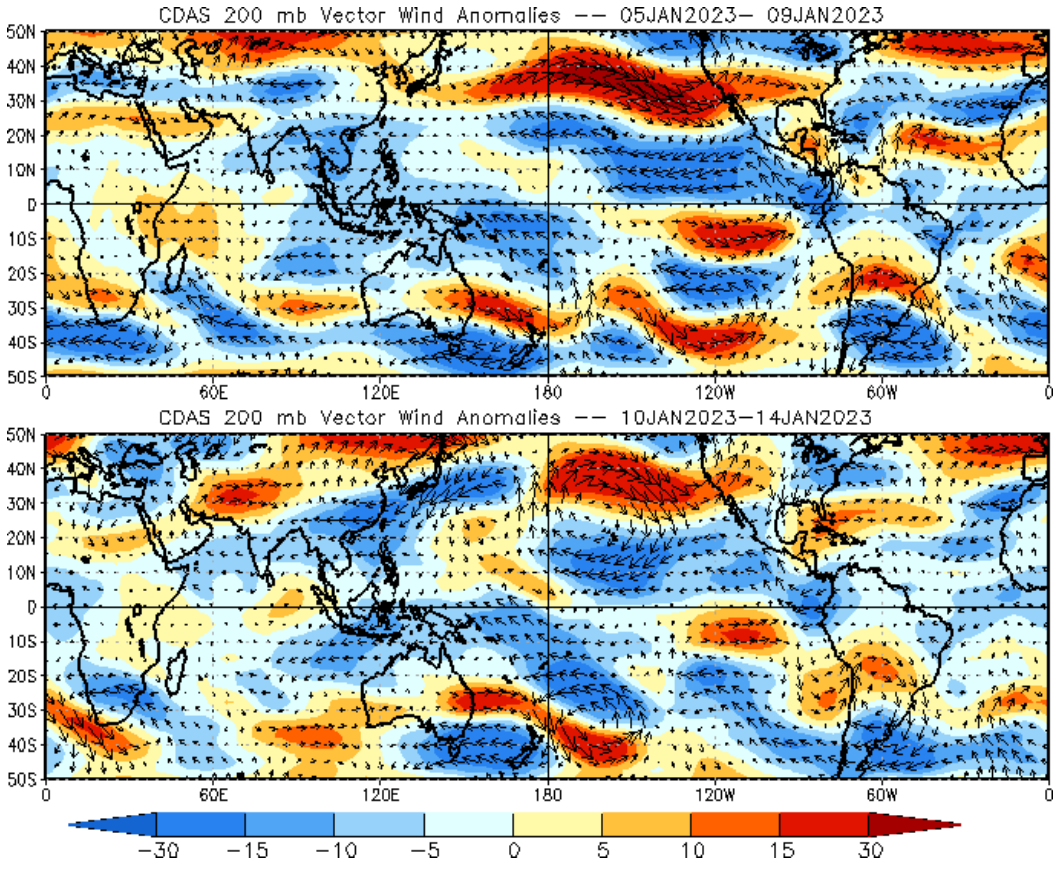
- Despite some weakening, continued MJO activity is featured in the latest upper-level velocity potential analyses, where there appears to be a slower phase speed of intreaseasonal activity this winter compared to last year in the time-longitude observations.

- The leading edge of the enhanced MJO phase crossed the Prime Meridian and entered the eastern Indian Ocean with more suppressed conditions developing over the equatorial Pacific in the past week.

200-hPa Wind Anomalies

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

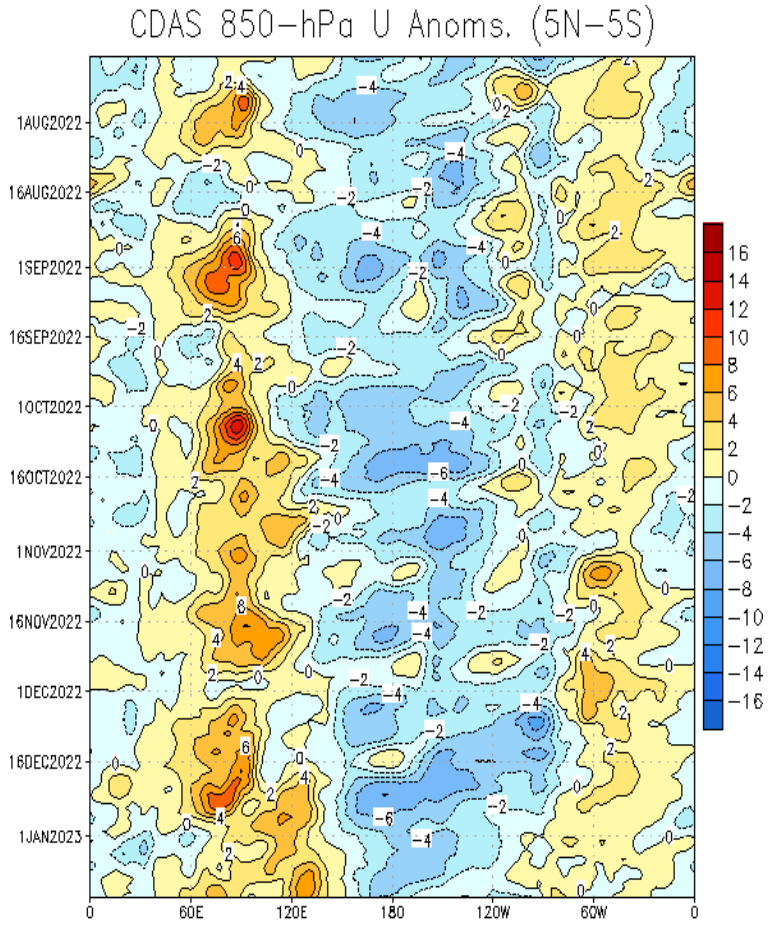


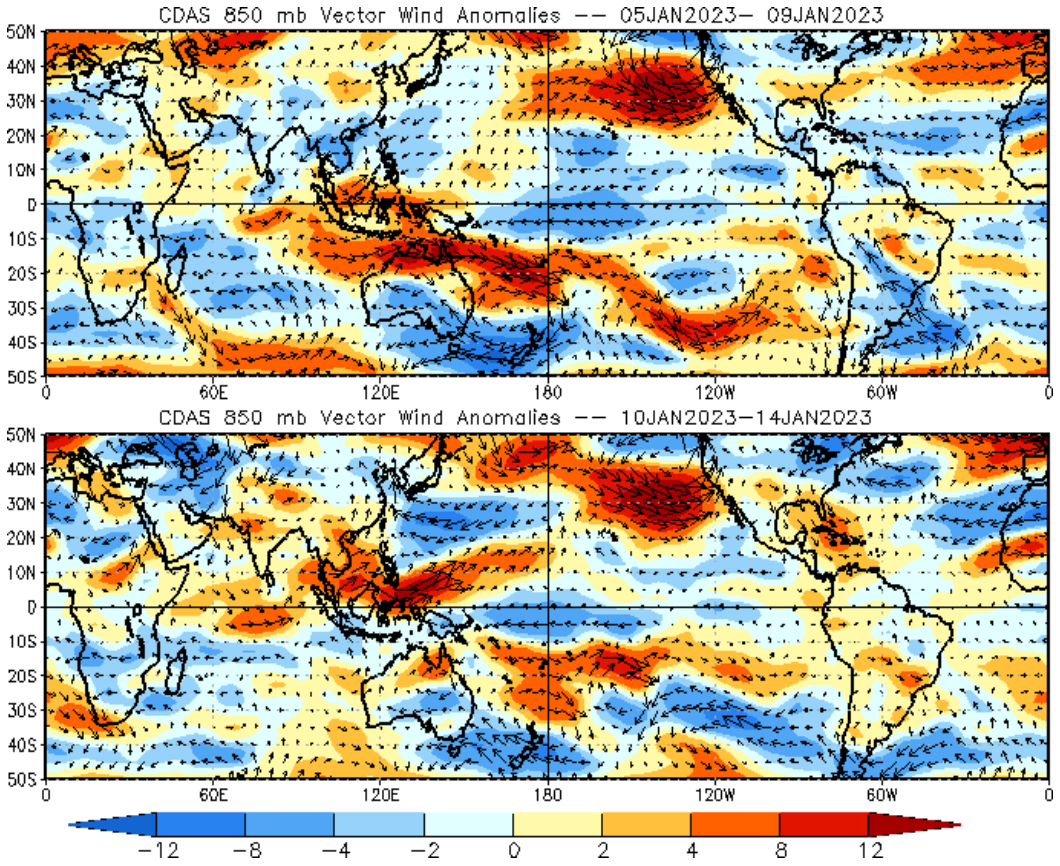


- The ongoing MJO event appeared to have caused a major disruption of the anomalous westerlies aloft over the equatorial Pacific tied to the ongoing La Nina, where enhanced easterlies remain through mid-January.
- Although relatively less coherent, anomalous westerlies aloft have shifted eastward across the equatorial Indian Ocean since the beginning of the year.

850-hPa Wind Anomalies

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

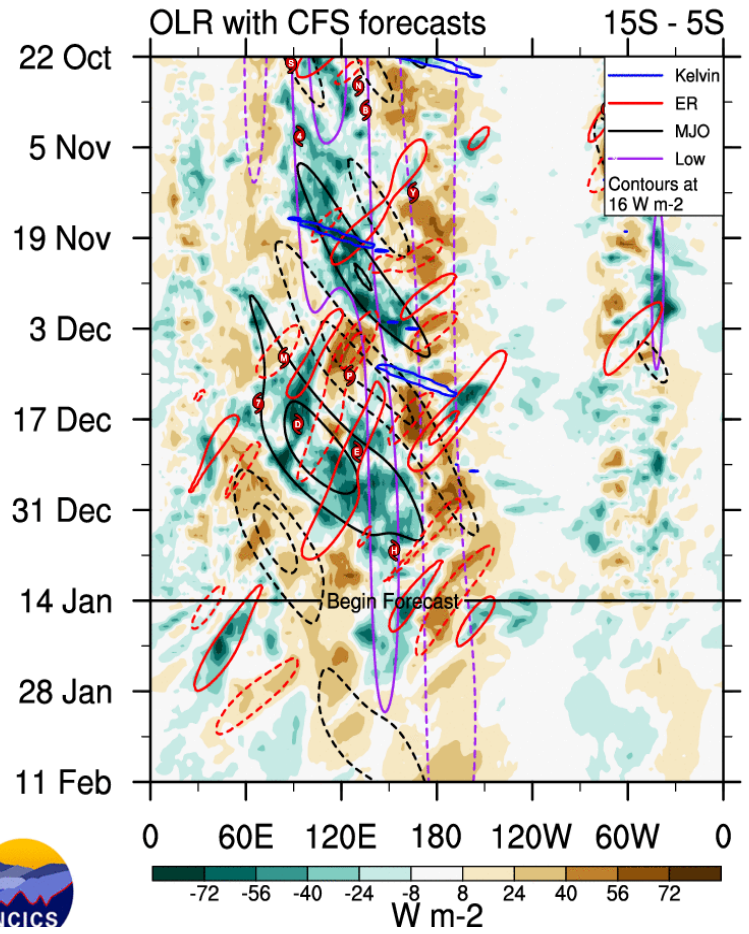


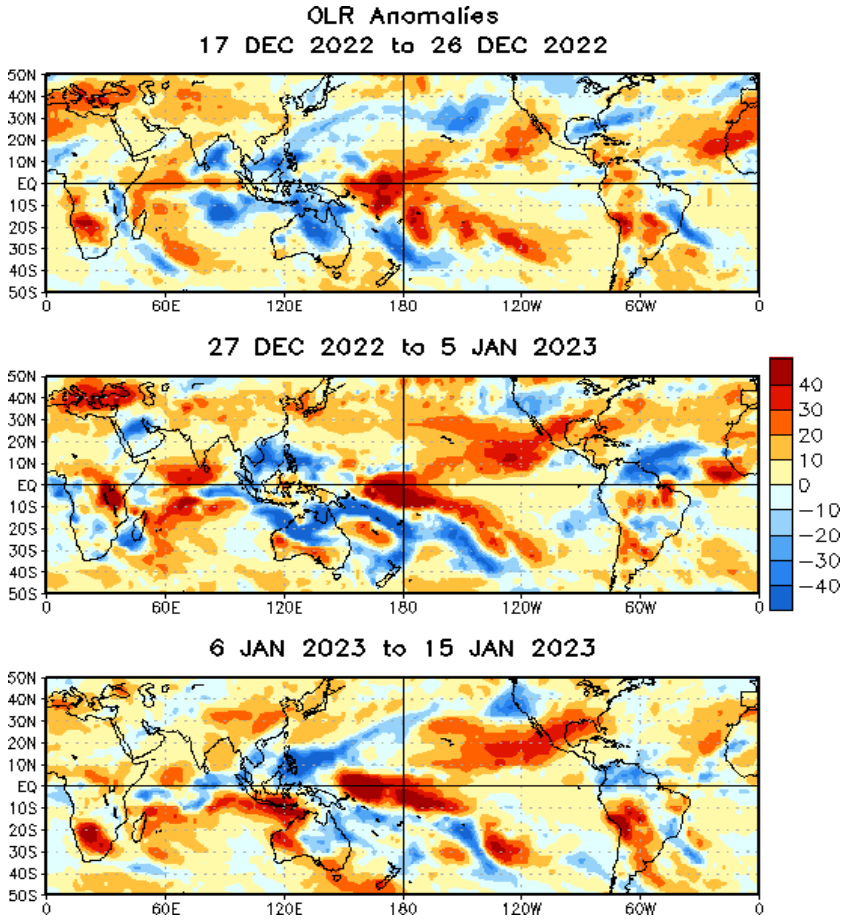


- Contrast to the circulation aloft, enhanced trades persist across the equatorial Pacific, though the spatial extent and magnitude have been reduced.
- Weakly anomalous westerlies persist over the eastern equatorial Pacific.
- Since early January, some of the strongest lower-level wind signals reside well off the equator in the South Pacific Convergence Zone and over the eastern North Pacific tied to persistent troughing and atmospheric river activity impacting the west coast of the contiguous U.S.

Outgoing Longwave Radiation (OLR) Anomalies

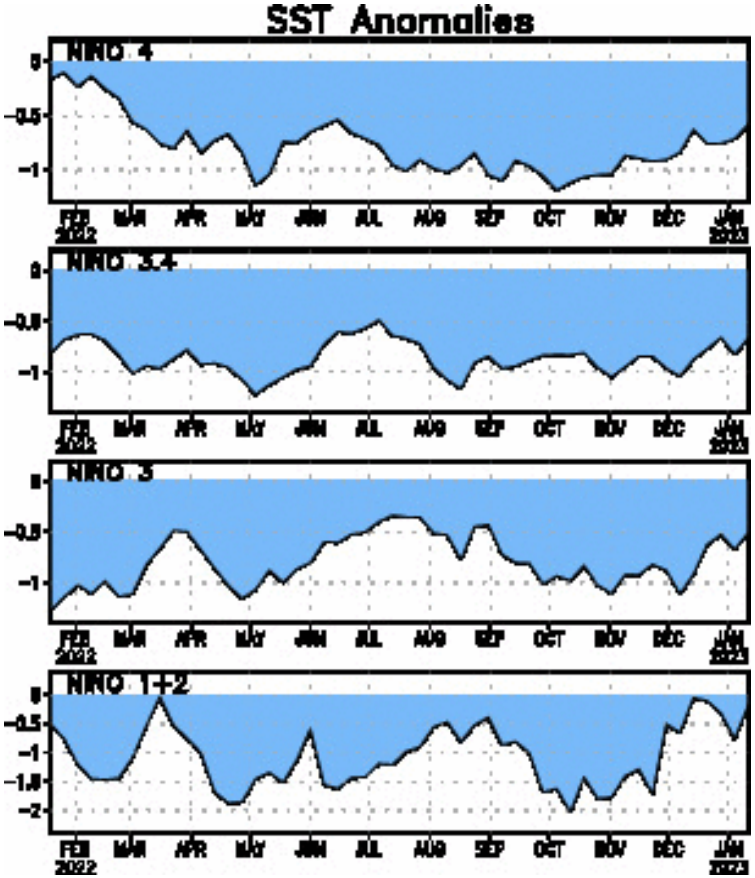
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

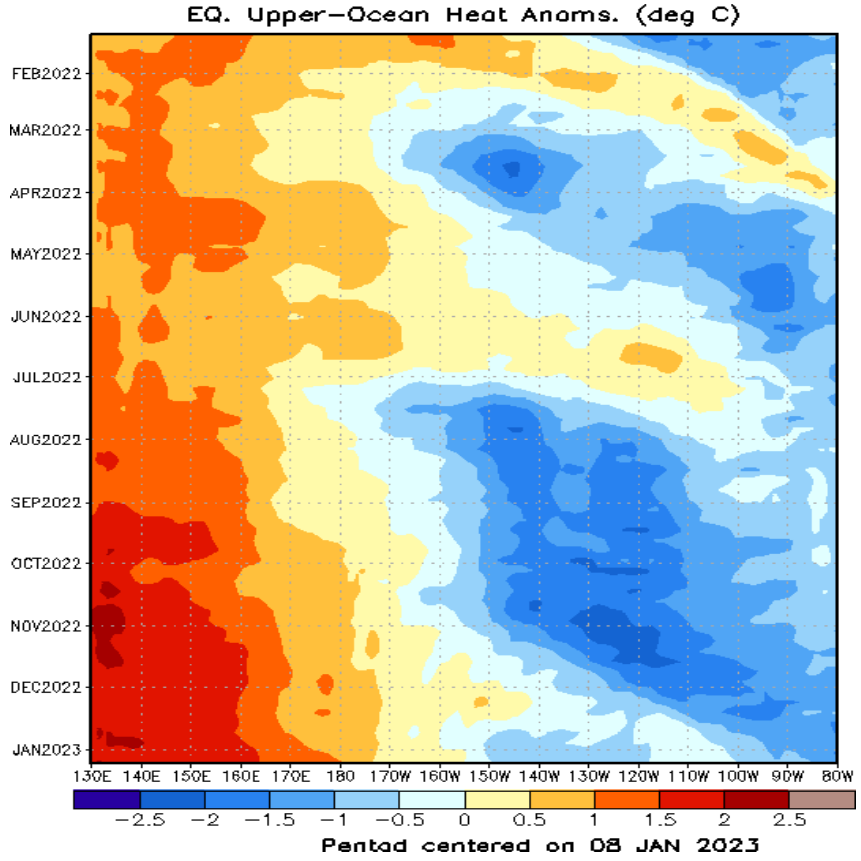




- Both the enhanced and suppressed phase of the MJO is evident in the OLR filtering since late last year.
- Following an uptick in convection tied to Rossby Wave activity over the western Pacific, more suppressed convection is favored along and to the west of the Date Line, suggestive of La Nina conditions becoming reestablished later in January.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

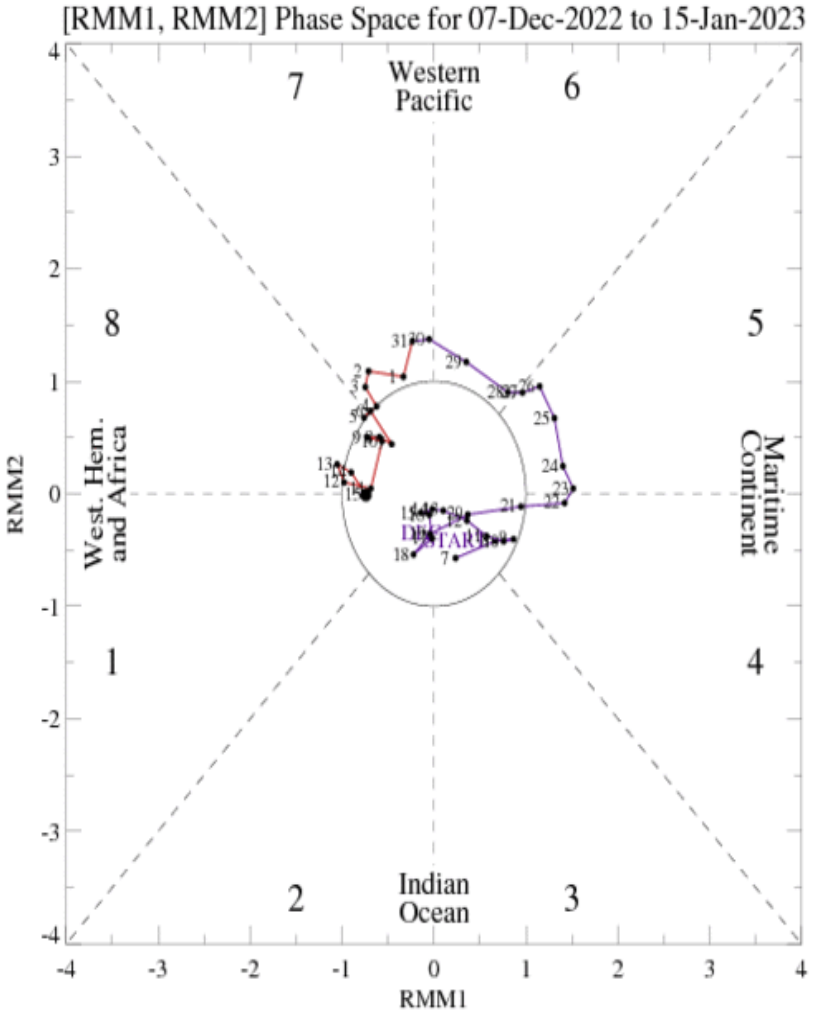




- Similar to a couple episodes last year, an oceanic downwelling Kelvin wave aided in the reduction of negative subsurface anomalies over the equatorial Pacific, though colder waters appear to be reforming from 150W to 120W more recently.
- Much of this warming is reflected at the surface in the Nino indices since December.

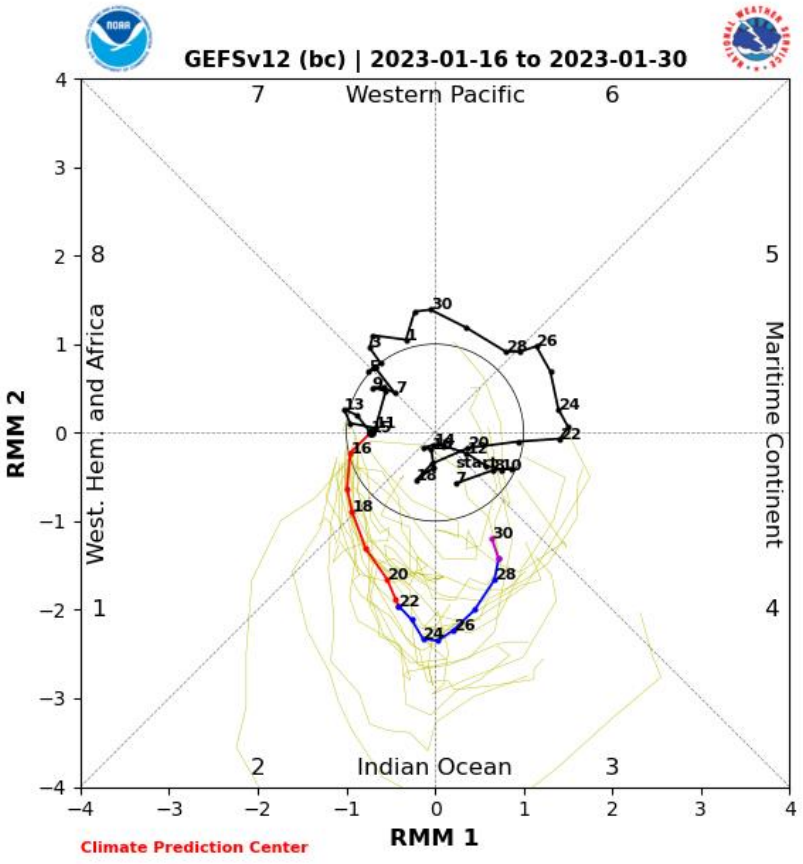
MJO Index: Recent Evolution

- During the past week, the RMM-based MJO index depicts a weak MJO, having remained nearly stationary in the Western Hemisphere during the past week.

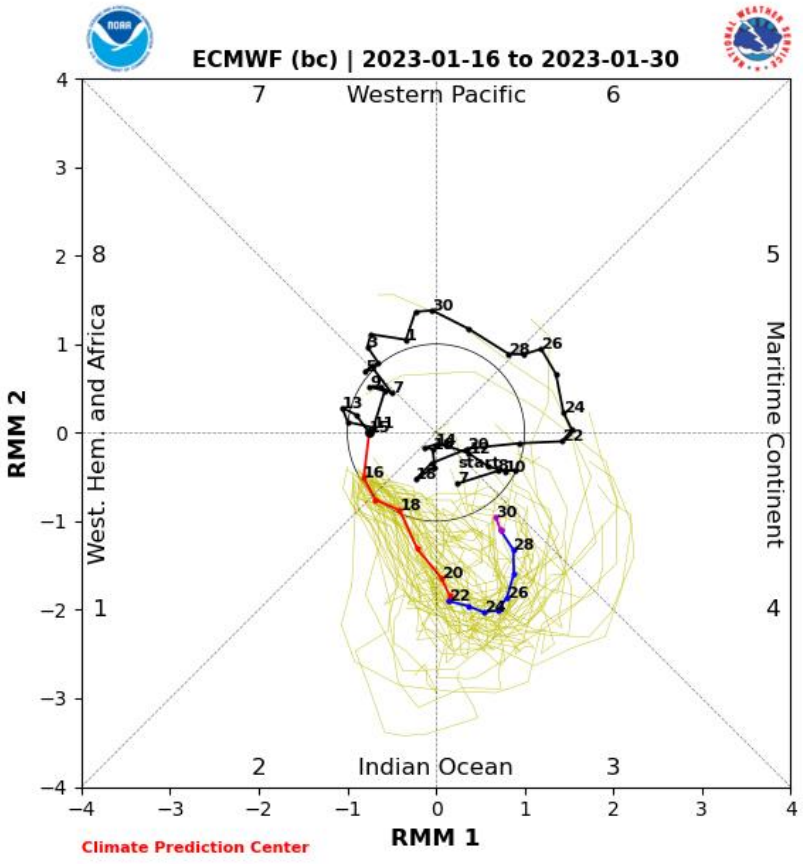


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

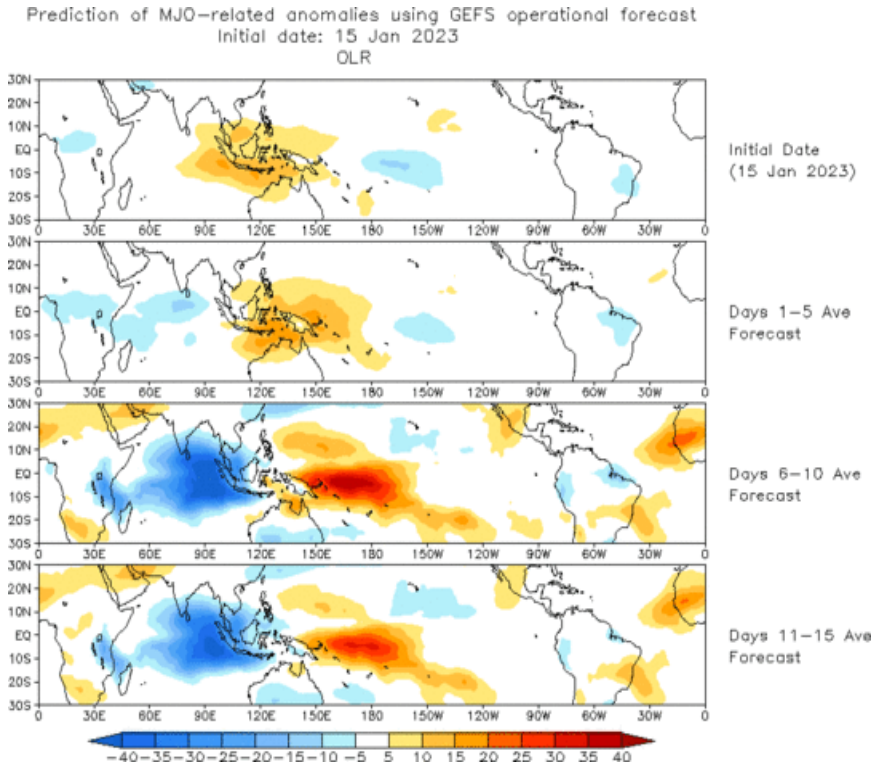


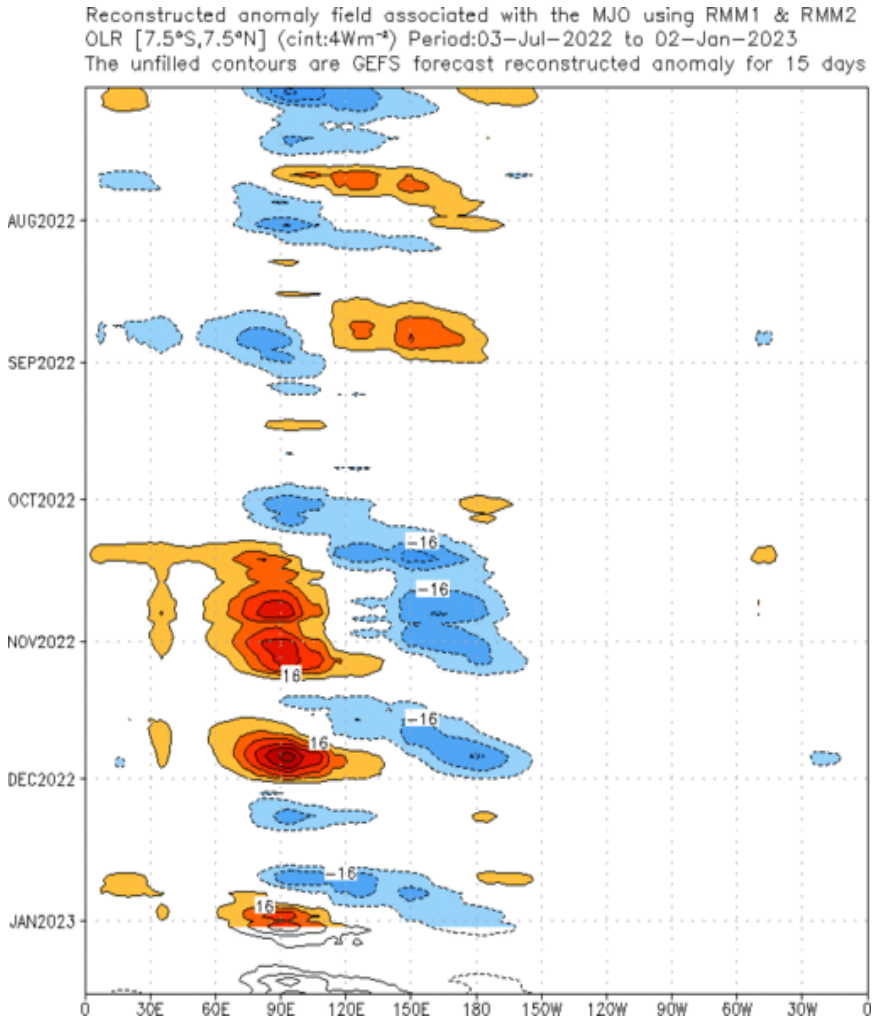
ECMWF Forecast

- There is good agreement between various model solutions depicting a sharp increase in the amplitude of the MJO while propagating it eastward into the Indian Ocean during the next two weeks.
- At the beginning of week-3, ensemble means feature a more weakened signal as the MJO approaches the Maritime Continent. However, RMM solutions retaining the 120-day mean reveal a more coherent signal later in February.

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.)

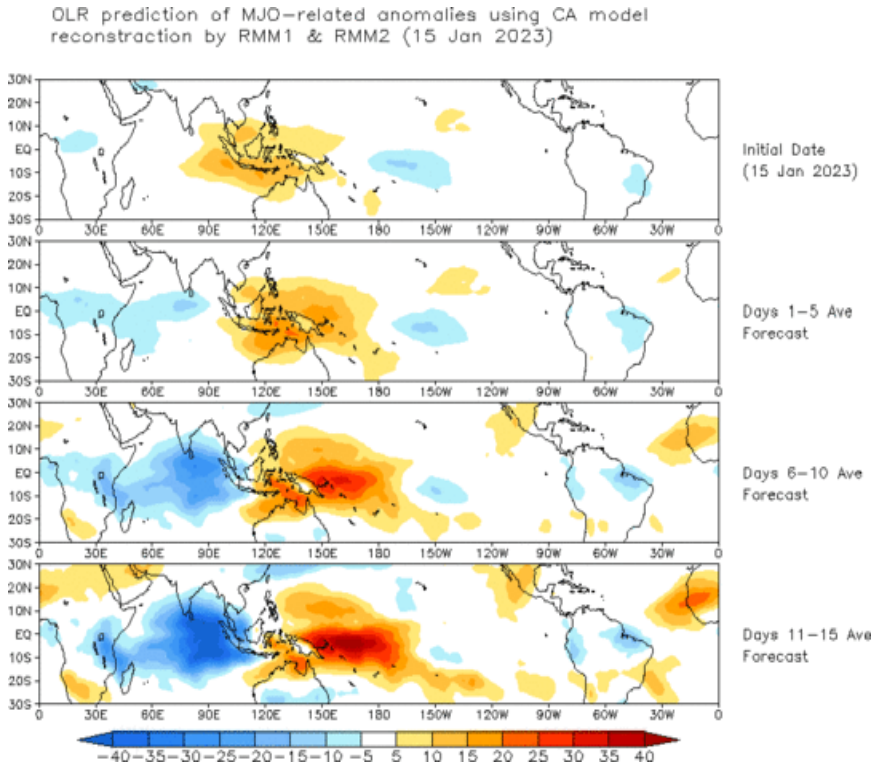


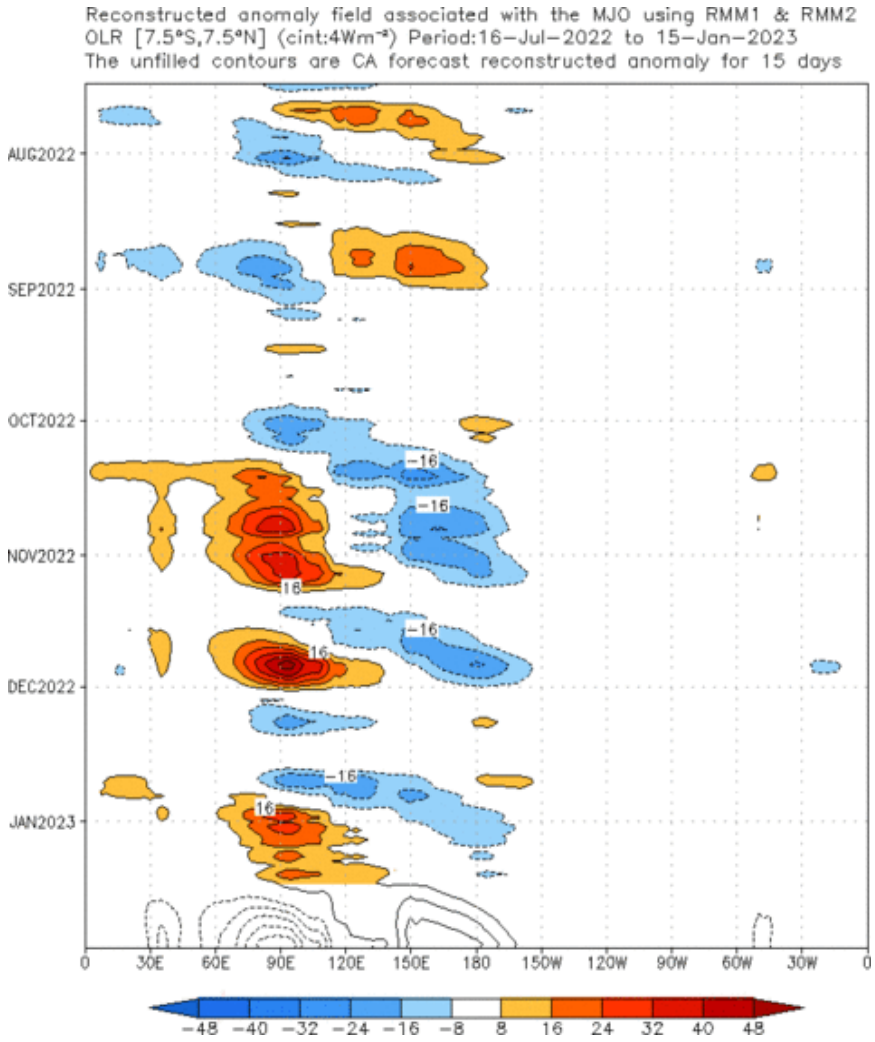


- The GEFS-based OLR anomaly fields depict the development of a robust dipole pattern, with enhanced (suppressed) convection emerging over the Indian Ocean (western Pacific) by week-2.

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.)

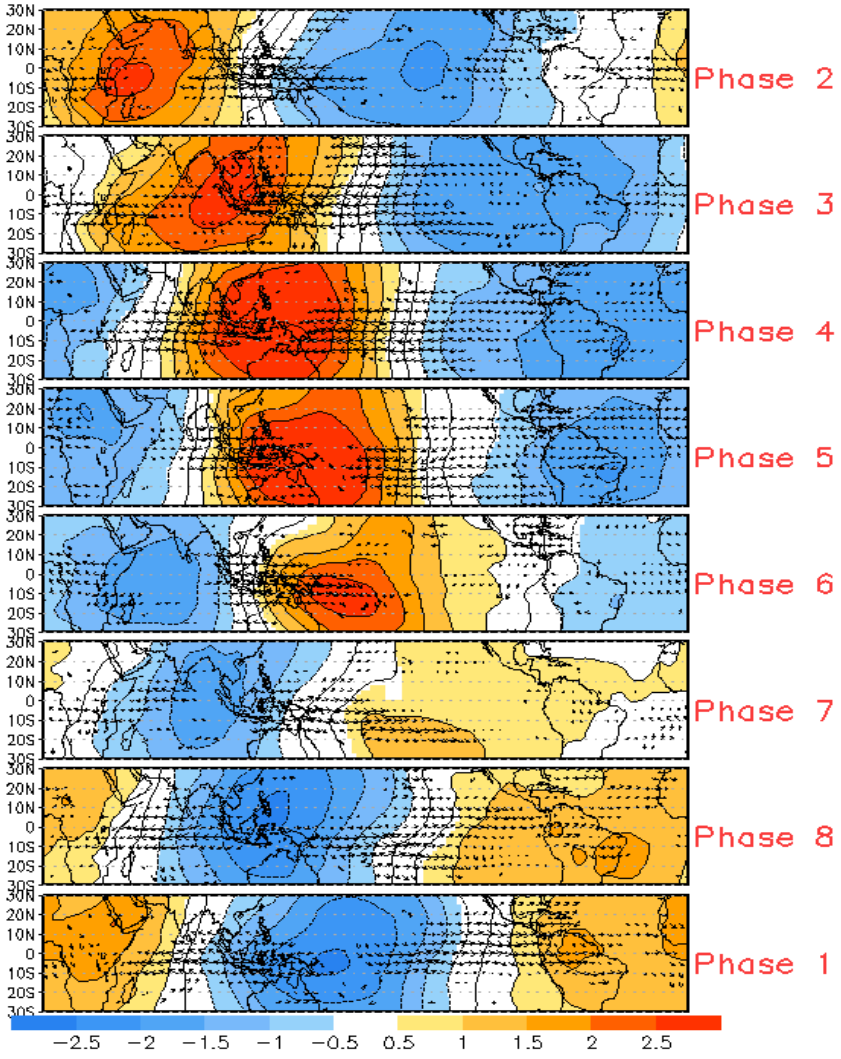




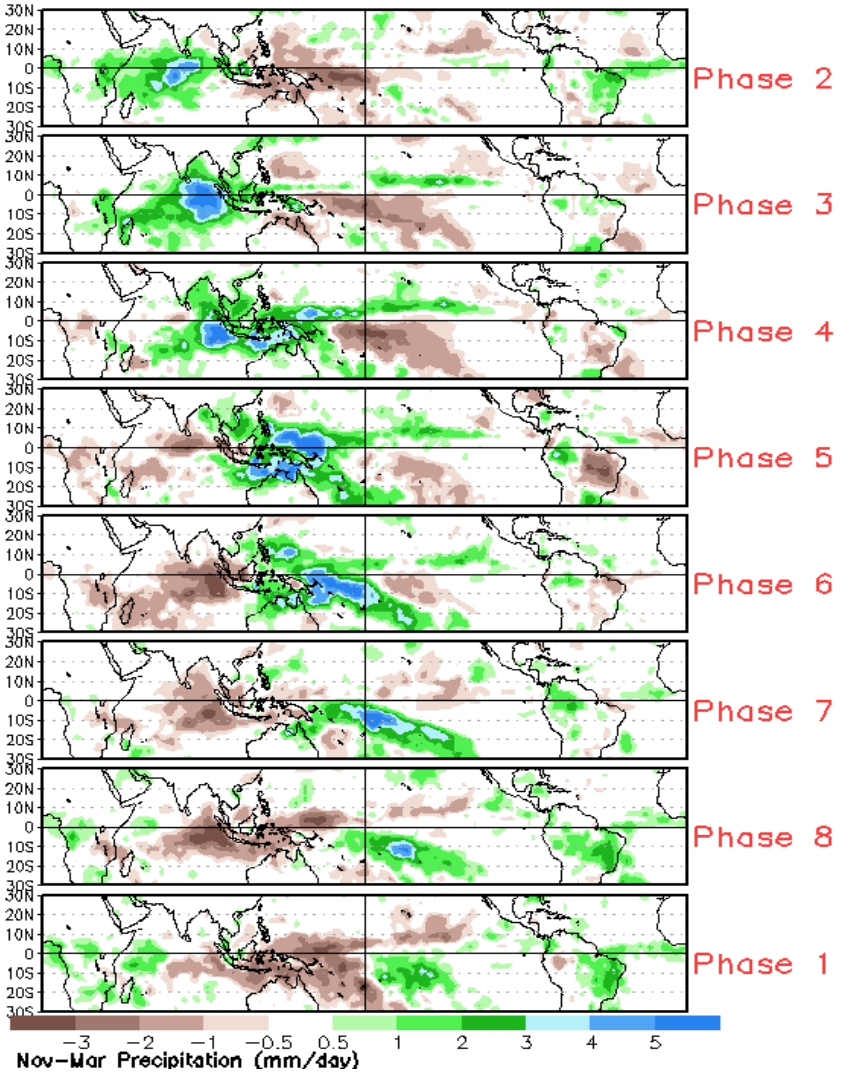
- The constructed analog forecast of RMM-based OLR is consistent with GEFS-based OLR anomaly featuring the development of this convective pattern by the end of January.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



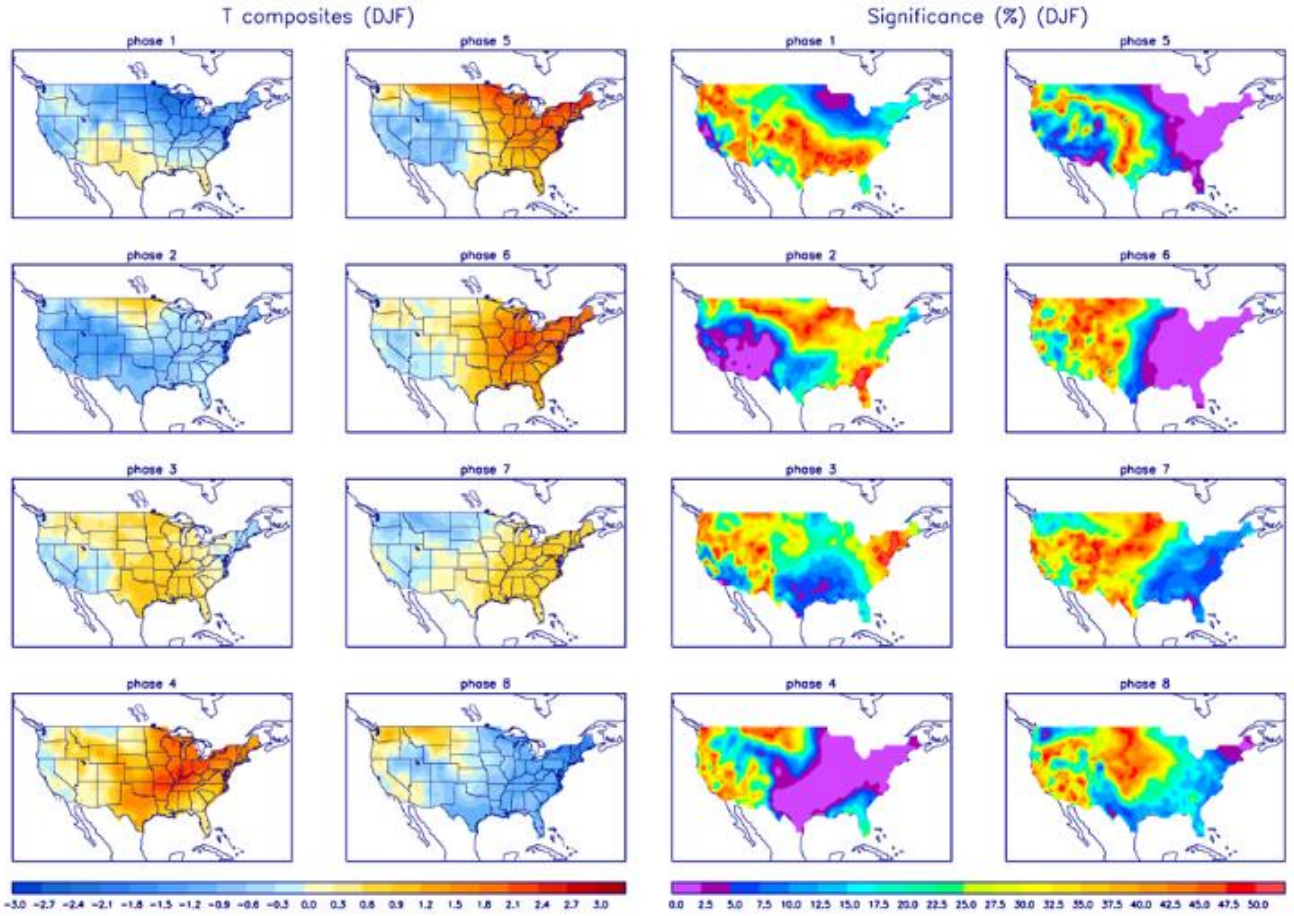
Precipitation Anomalies



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.

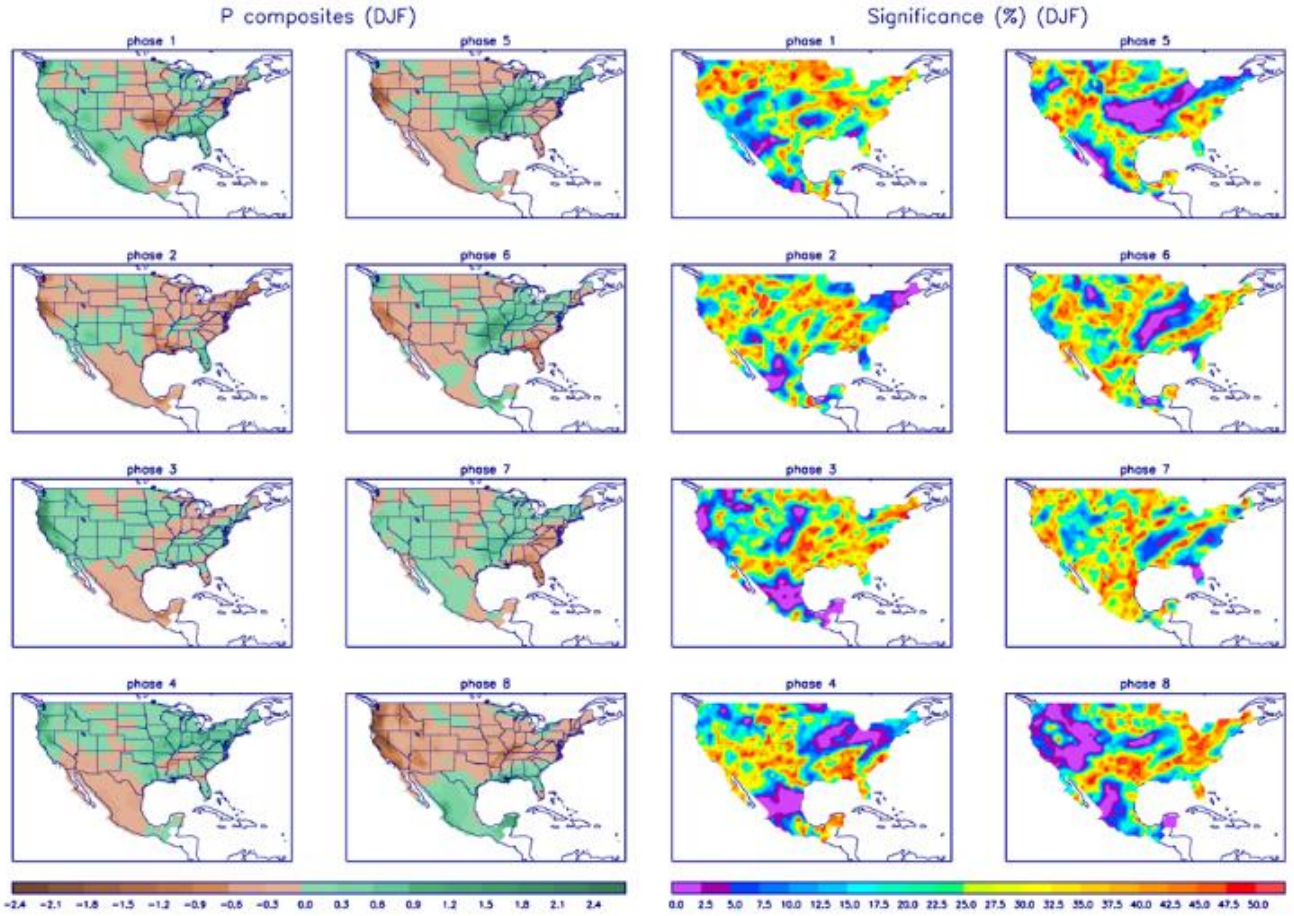


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

MJO: CONUS Composite Maps by RMM Phase - 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.



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