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

Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
6 March 2023

Overview

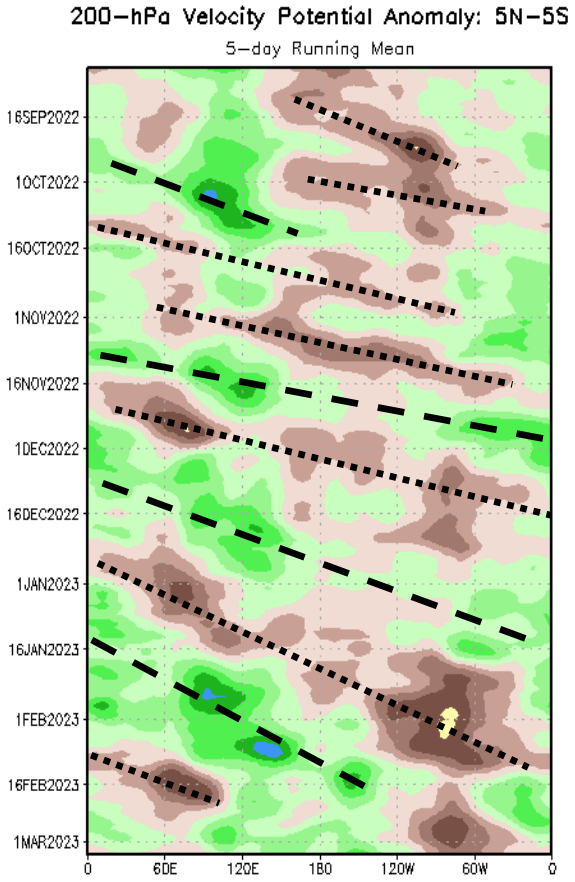
- The MJO strengthened over the West Pacific during early March.
- Dynamical model MJO index forecasts depict a strong MJO signal propagating eastward from the Americas to Africa through mid-March.
- This MJO evolution typically results in a more (less) favorable environment for tropical cyclone development across the Coral Sea and South Pacific (South Indian Ocean).

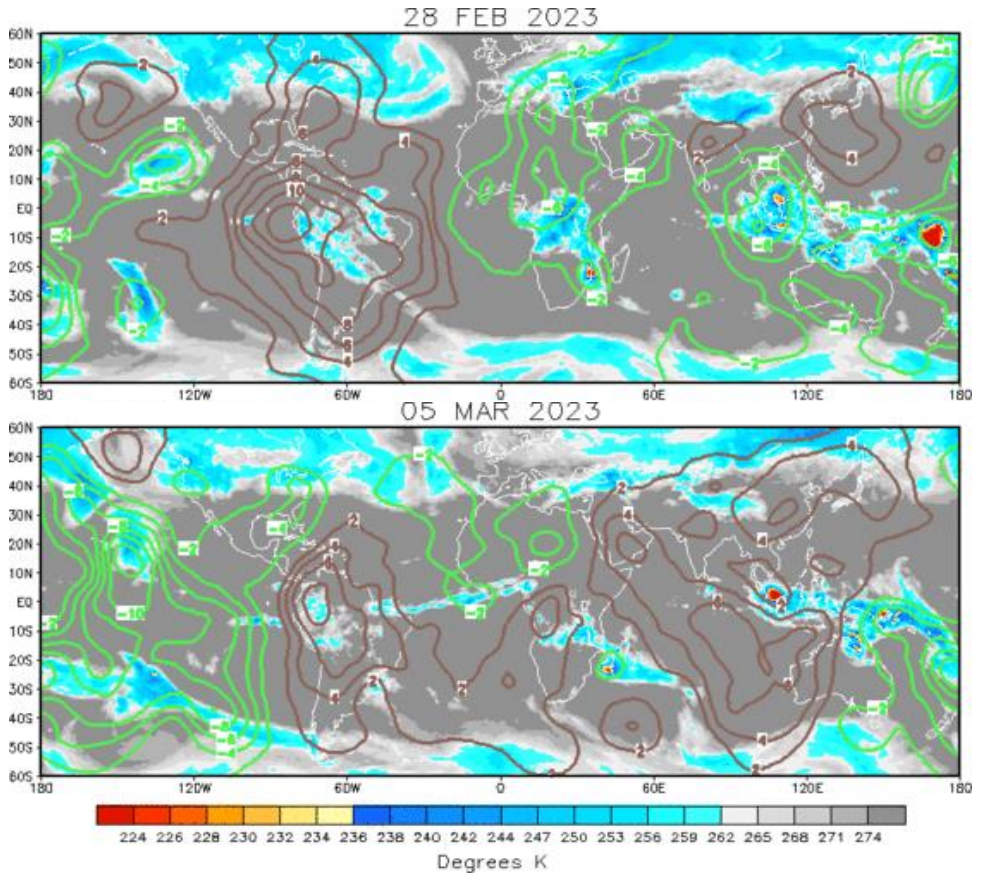
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)



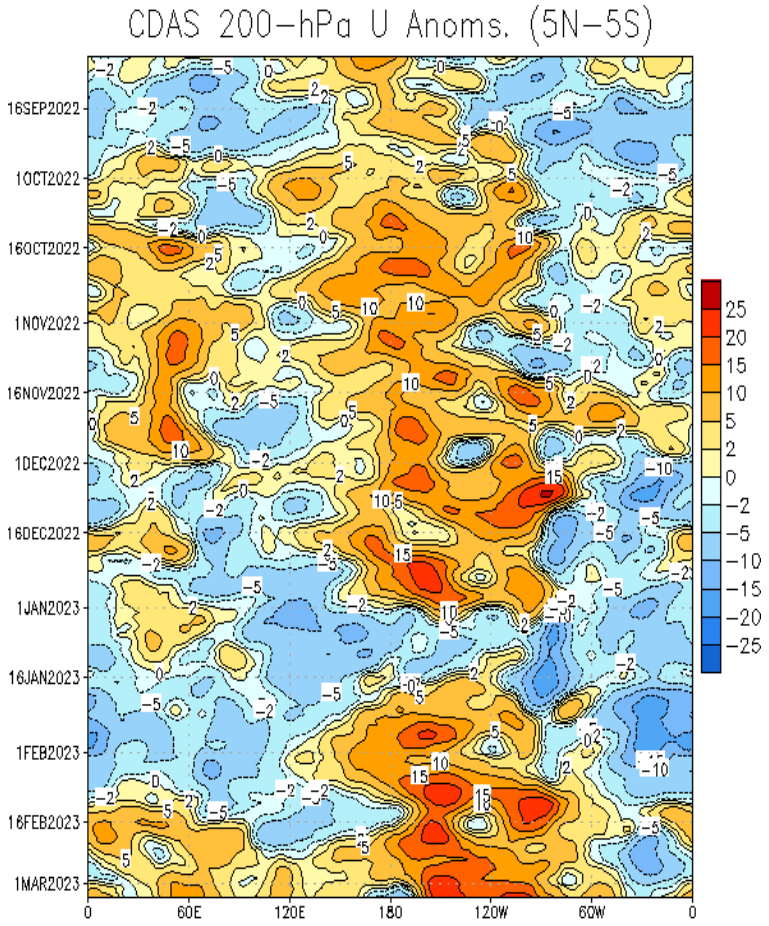


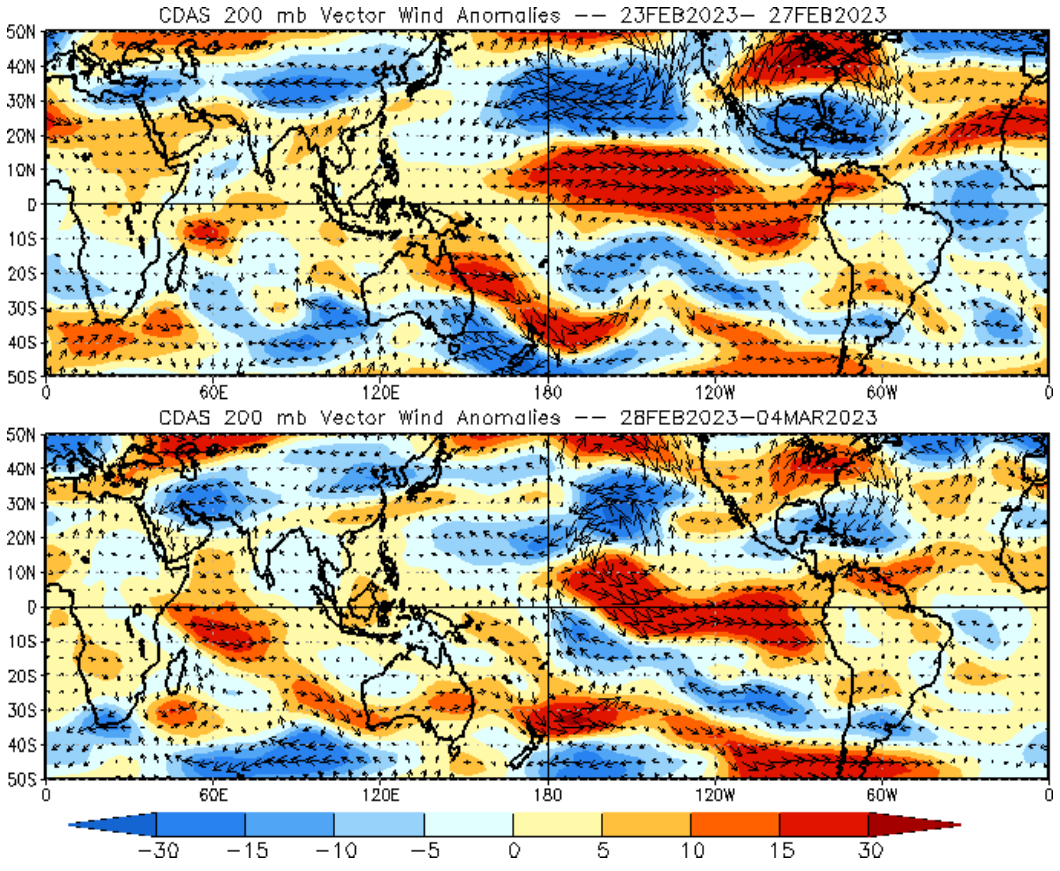
- After a period of robust MJO activity which is clearly evident in the Hovmoller plot, the signal weakened during late February.

- A more coherent wave-1 pattern developed during early March with anomalous divergence (convergence) over the Maritime Continent and west-central Pacific (South America).

200-hPa Wind Anomalies

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



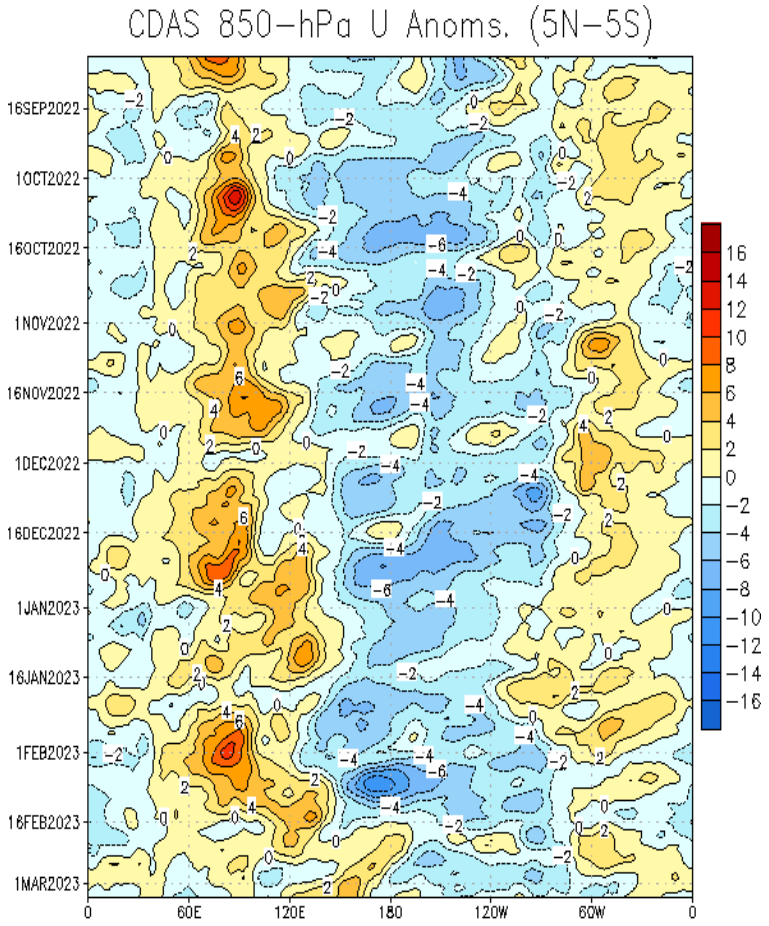


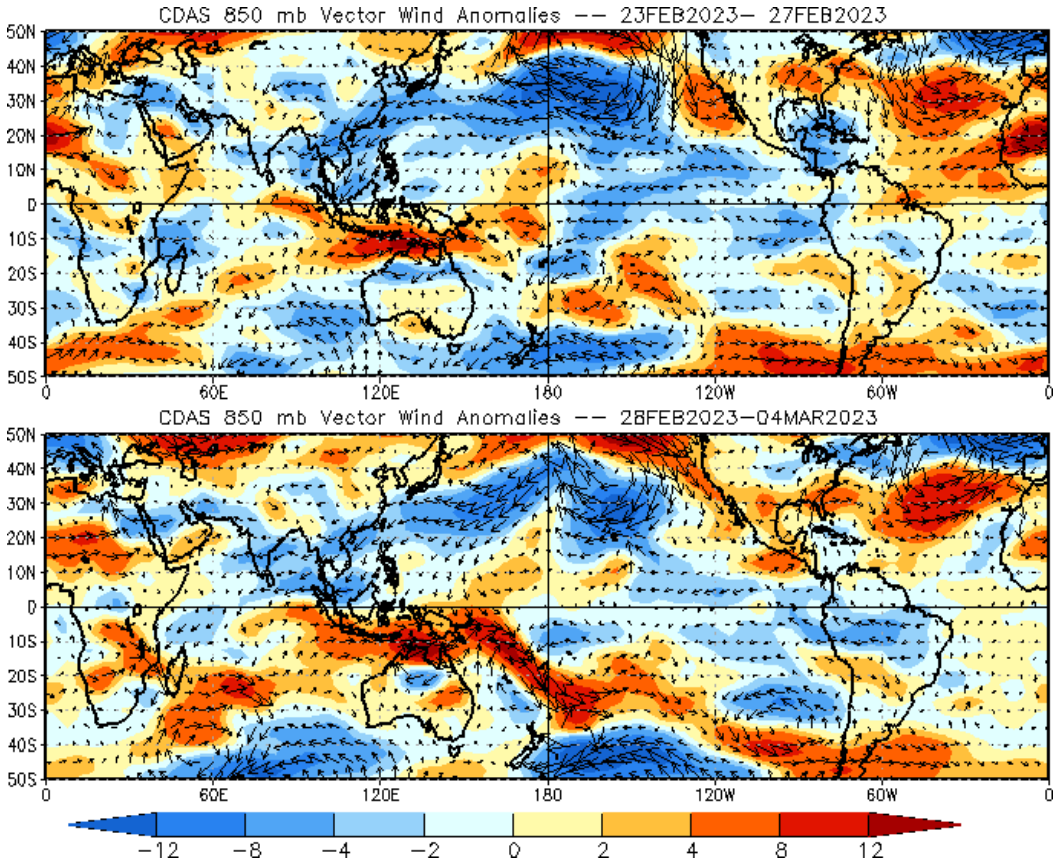
- Anomalous westerlies near and east of the Date Line have increased in strength after a brief lull in mid-February.

- A persistent anticyclone remains over the northeast Pacific, with a second large anticyclone over the eastern CONUS.

850-hPa Wind Anomalies

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



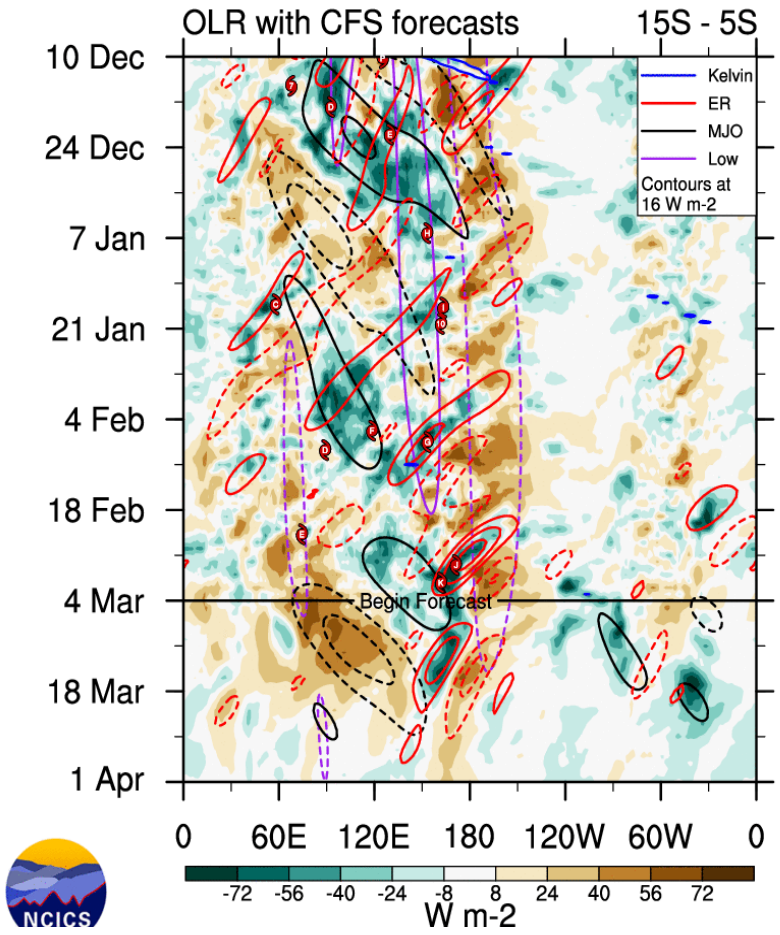


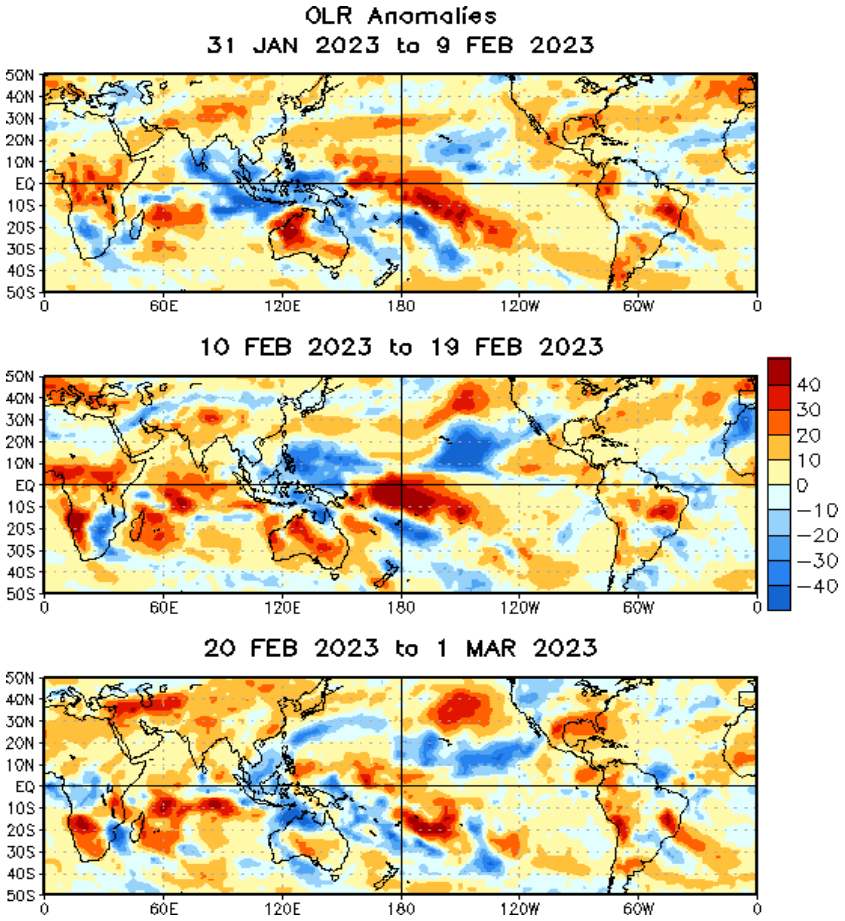
- To the south of the equator, anomalous westerlies strengthened and expanded east across northern Australia and the South Pacific.

- Enhanced trade wind regime over the central Pacific, associated with La Niña, has weakened near the Date Line.

Outgoing Longwave Radiation (OLR) Anomalies

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

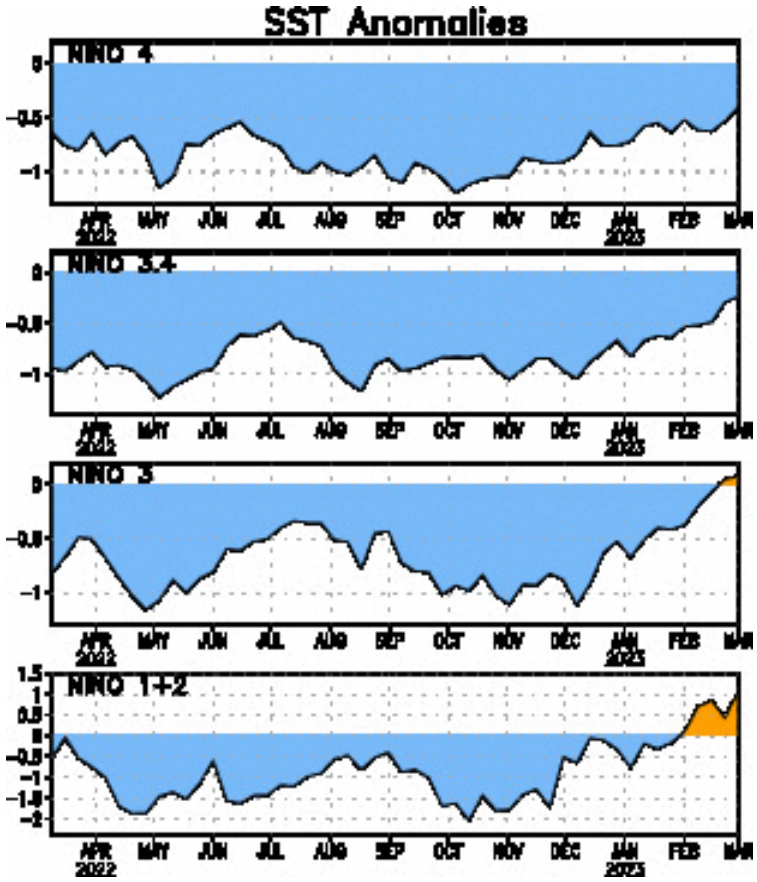


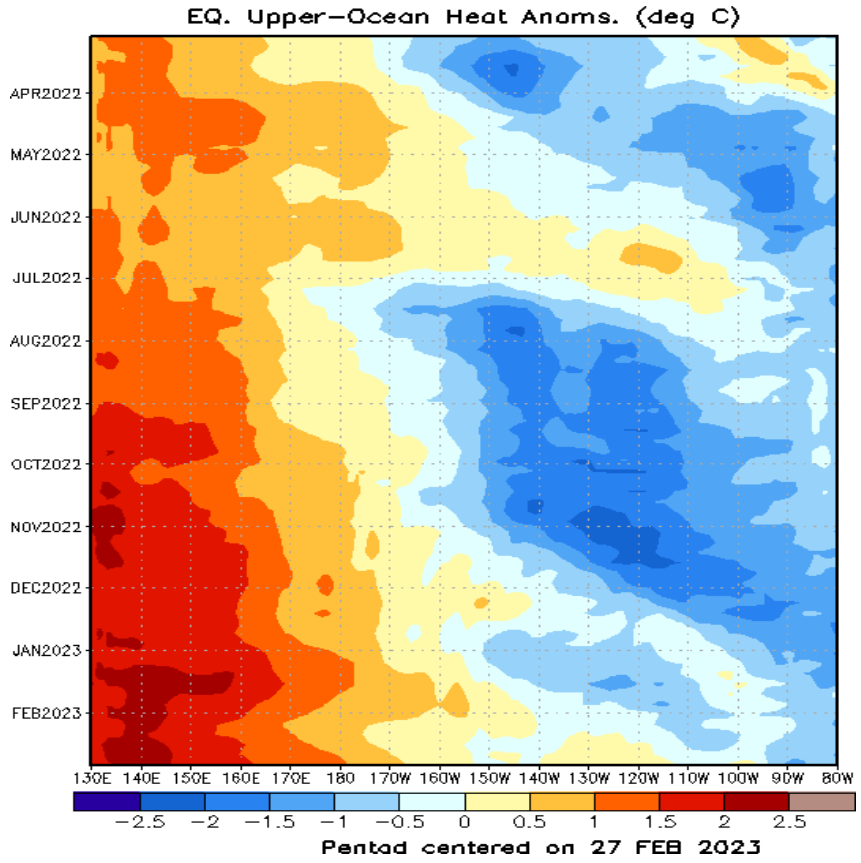


- During late February, Rossby waves along with the La Niña base state interfered with the MJO signal.

- However, the magnitude of the suppressed convection at the Date Line recently decreased which is consistent with a strengthening MJO.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

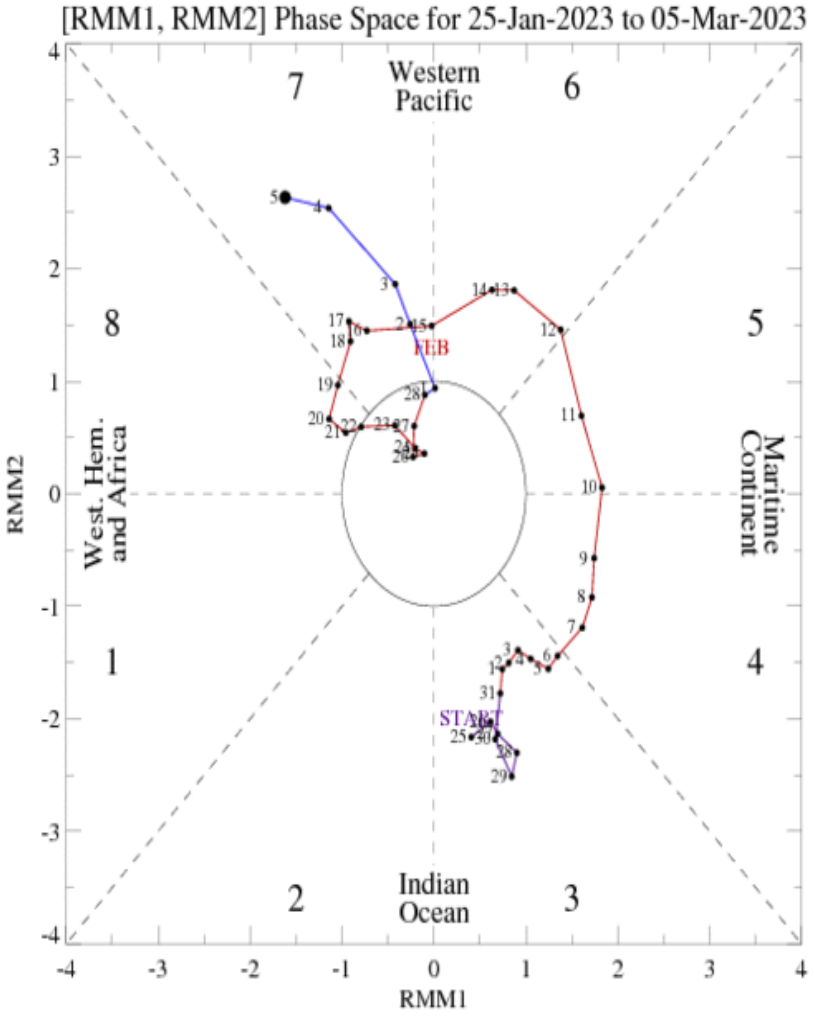




- Oceanic downwelling Kelvin wave activity has led to a gradual erosion of the anomalously cold subsurface waters in the central and eastern equatorial Pacific.
- A warming trend is noted in all of the Niño indices since December, with the eastern Pacific (Niño 1+2) now indicating above-normal conditions and Niño 3 just above zero as well.
- Dynamical models indicate a potential for enhanced low-level westerly anomalies across the Equatorial Pacific, which may initiate a reinforcing downwelling Kelvin wave.

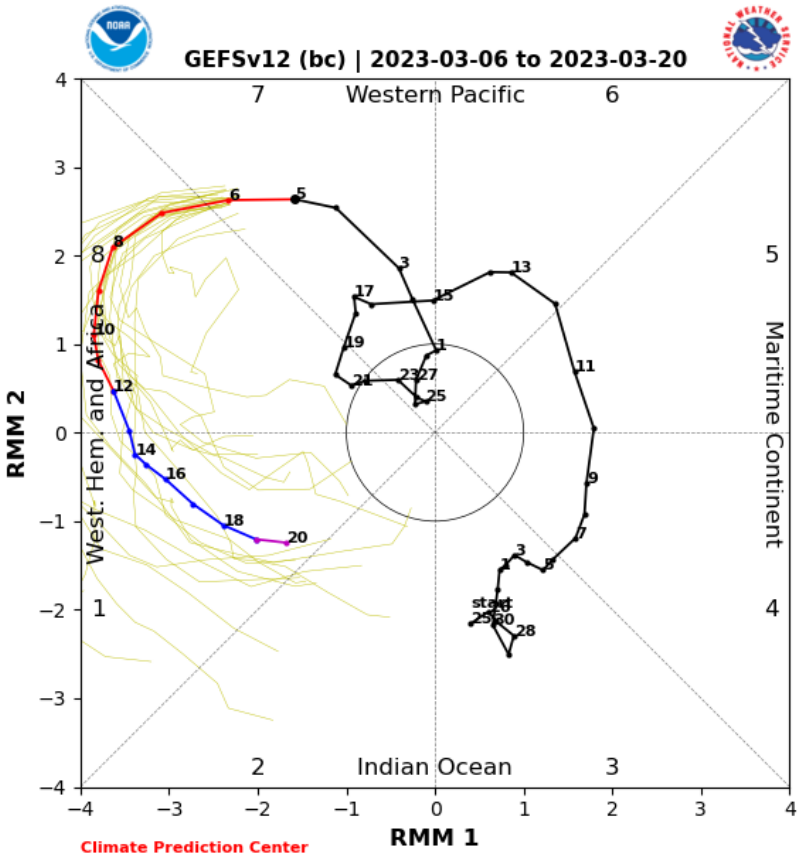
MJO Index: Recent Evolution

- Following eastward propagation of the MJO during early to mid-February, the signal weakened due to interference with Rossby waves.
- At the beginning of March, the RMM-index depicts a strengthening MJO over the West Pacific.

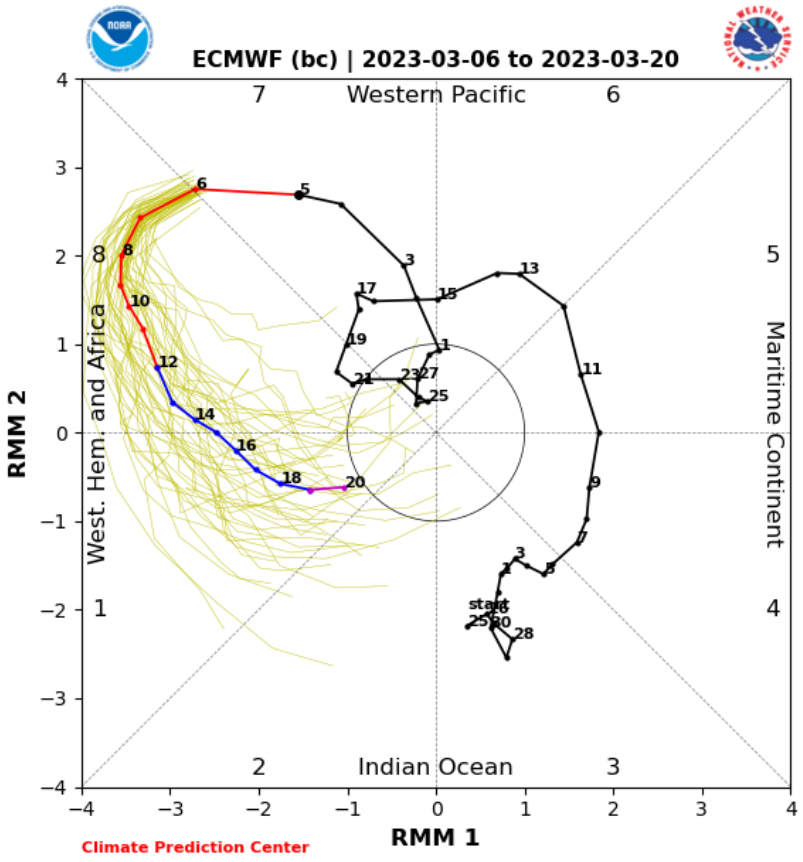


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

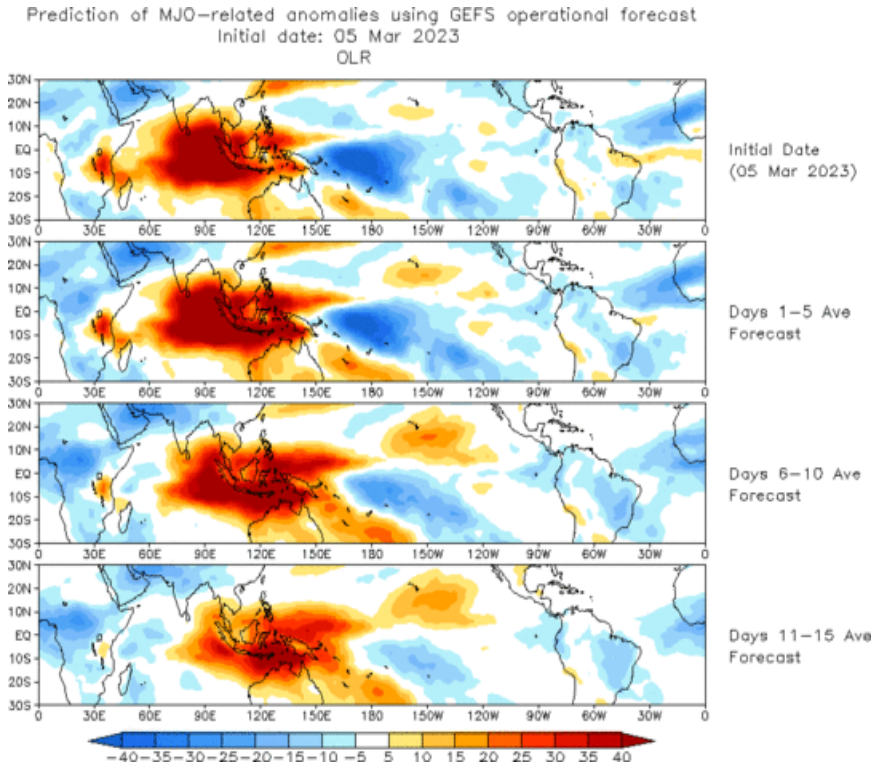


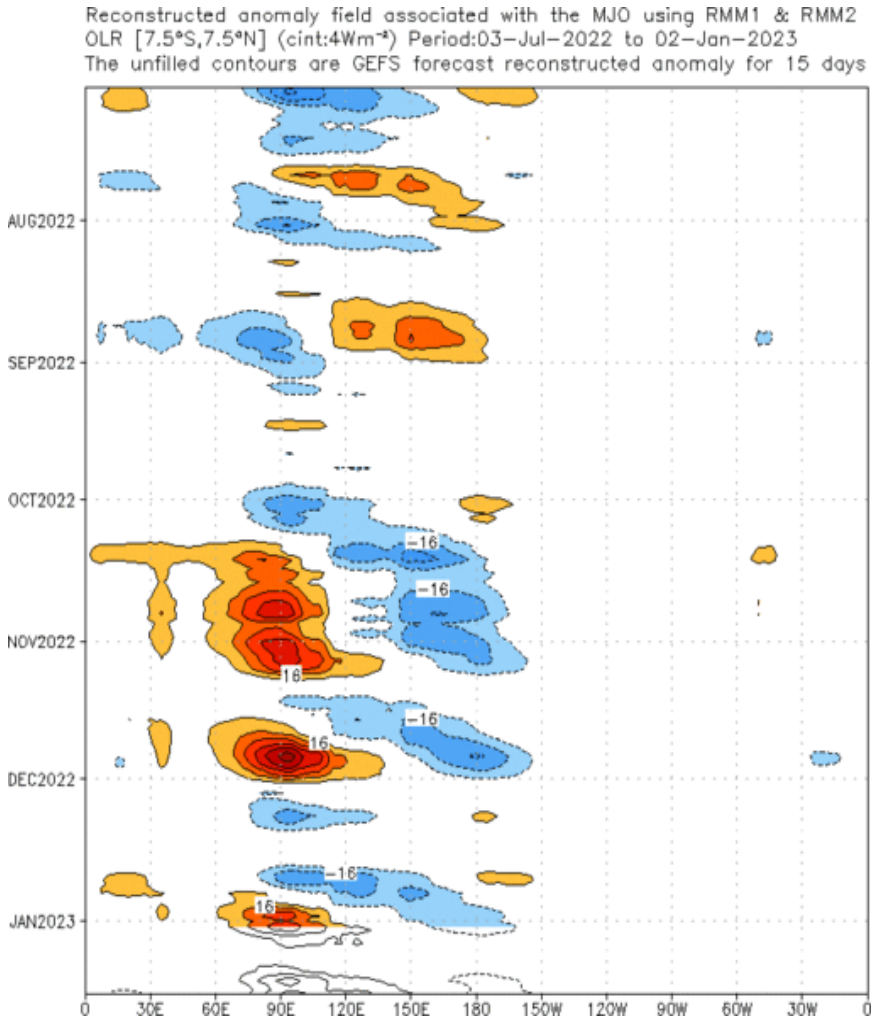
ECMWF Forecast

- Dynamical model MJO index forecasts are in good agreement that the MJO propagates eastward during week-1 but many ECMWF ensemble members depict a weakening signal by week-2.

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.)

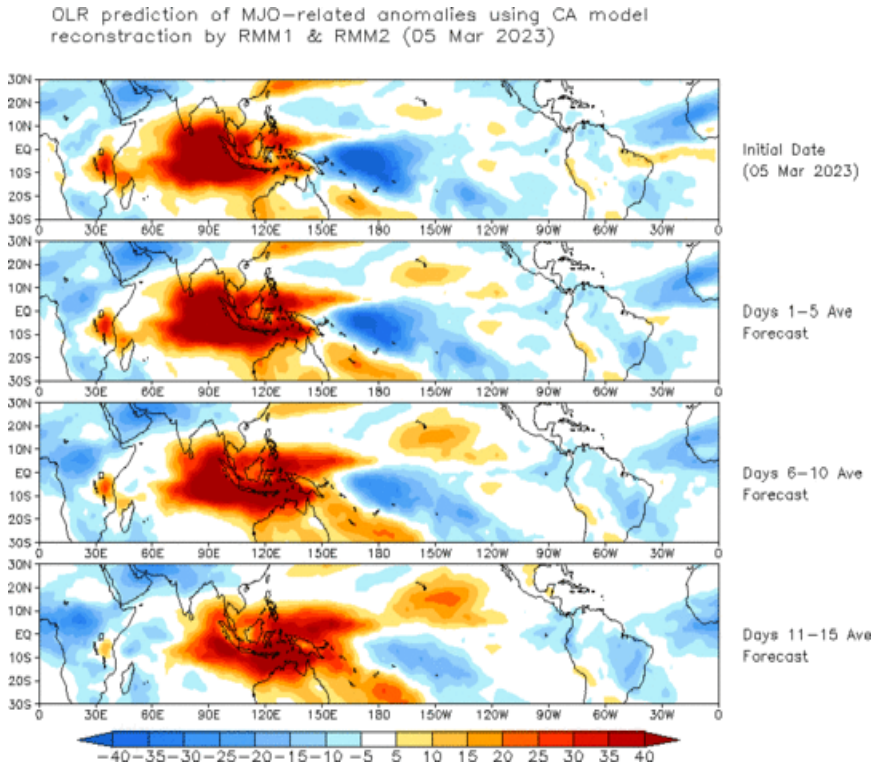


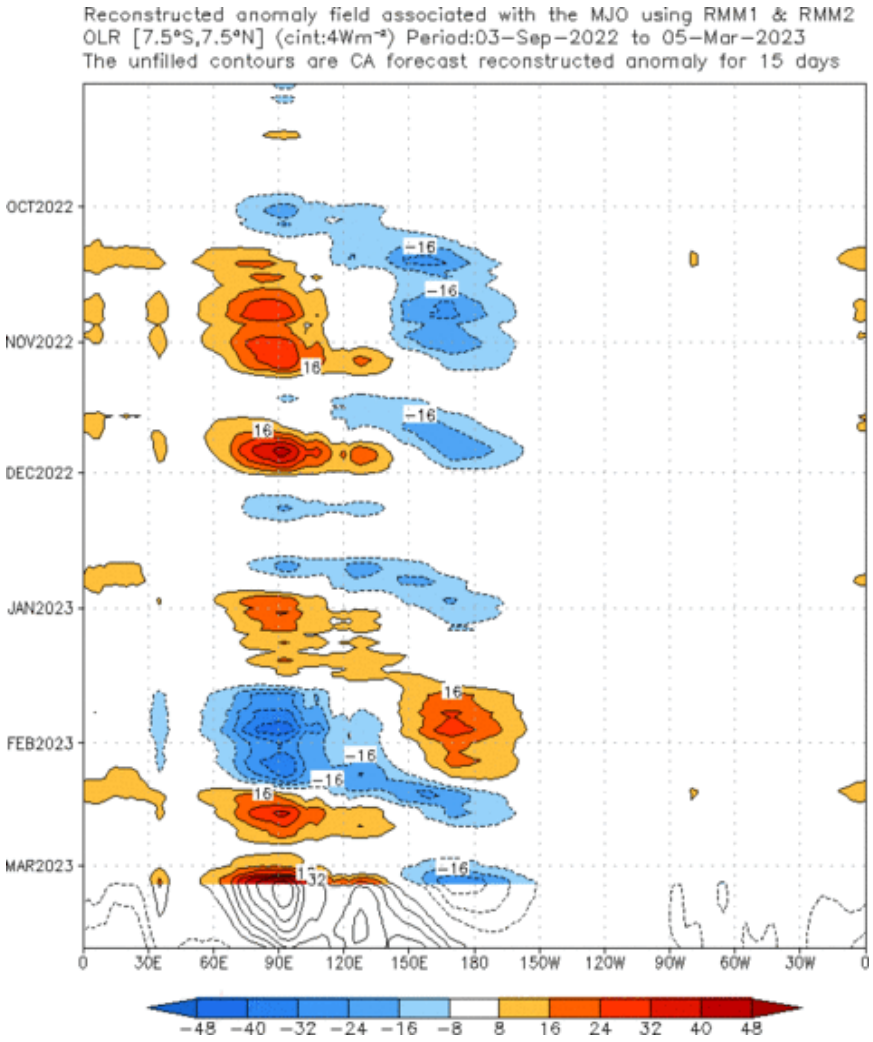


- The GEFS RMM forecast based OLR anomaly outlook features enhanced convection over the Western Hemisphere during the next two weeks, with suppressed convection shifting eastward from the Indian Ocean to the West Pacific.

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.)

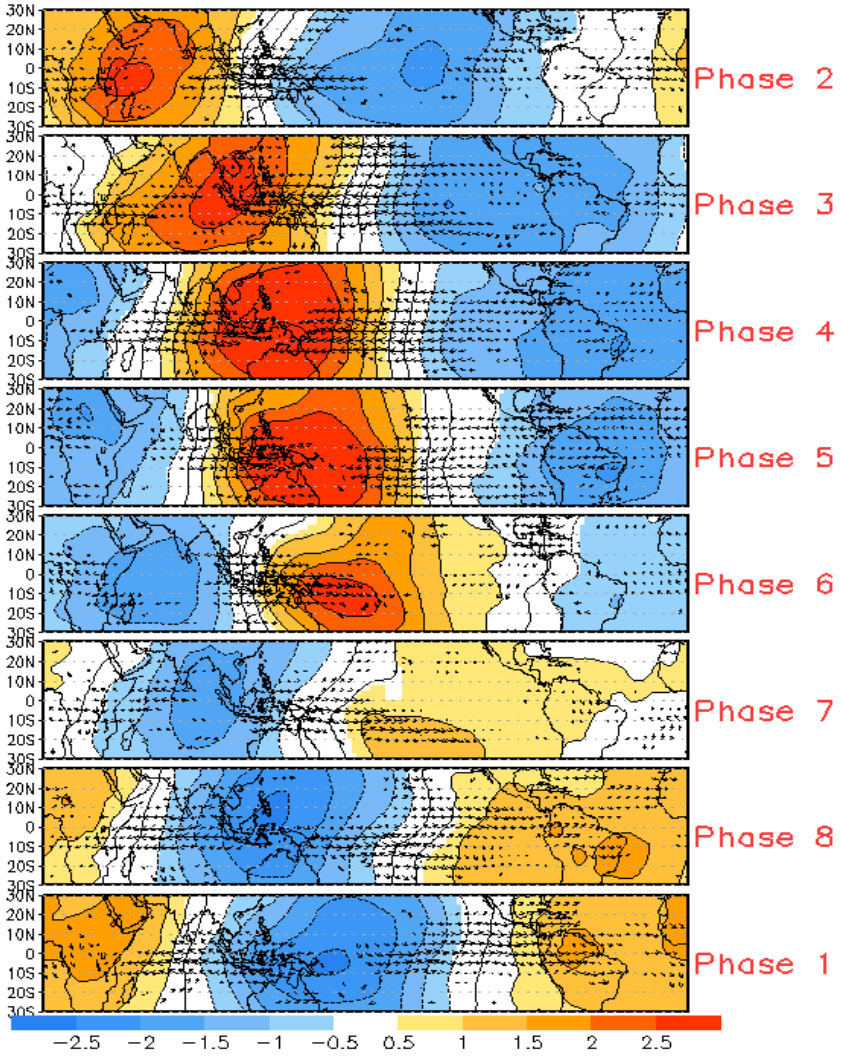




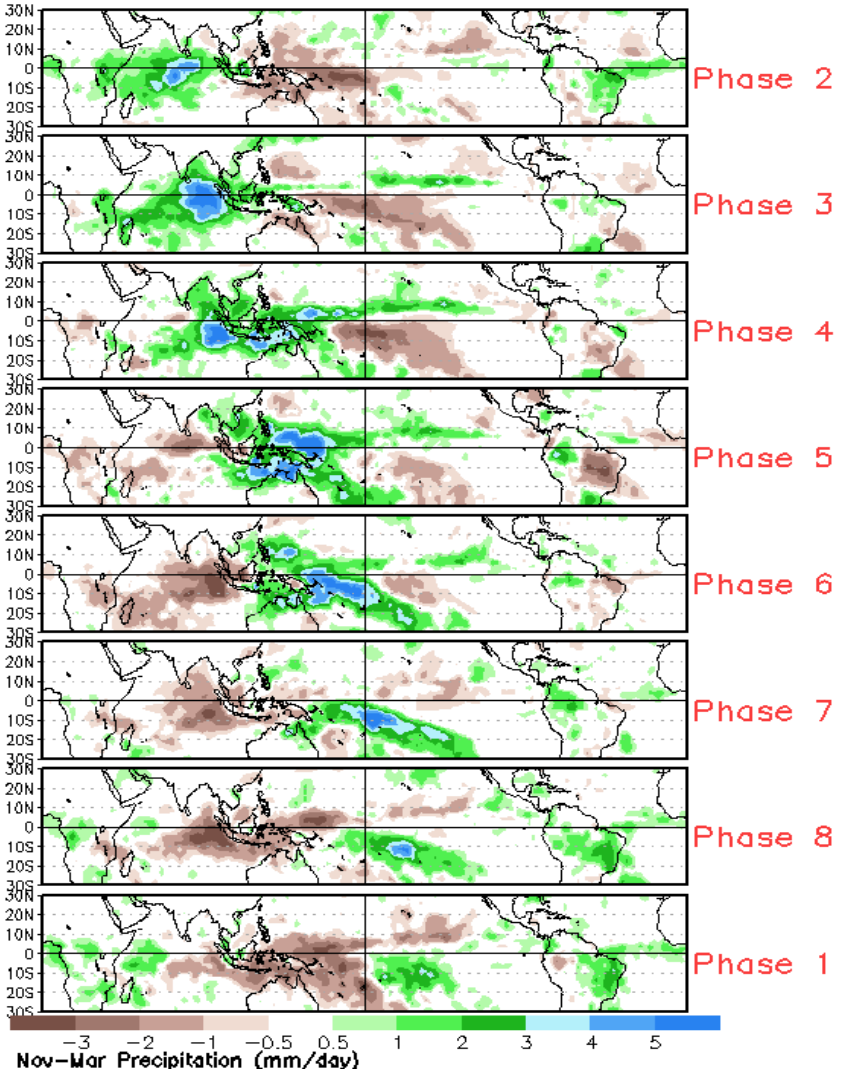
- The constructed analog forecast depicts a similar evolution which would be a major change in anomalous tropical rainfall.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



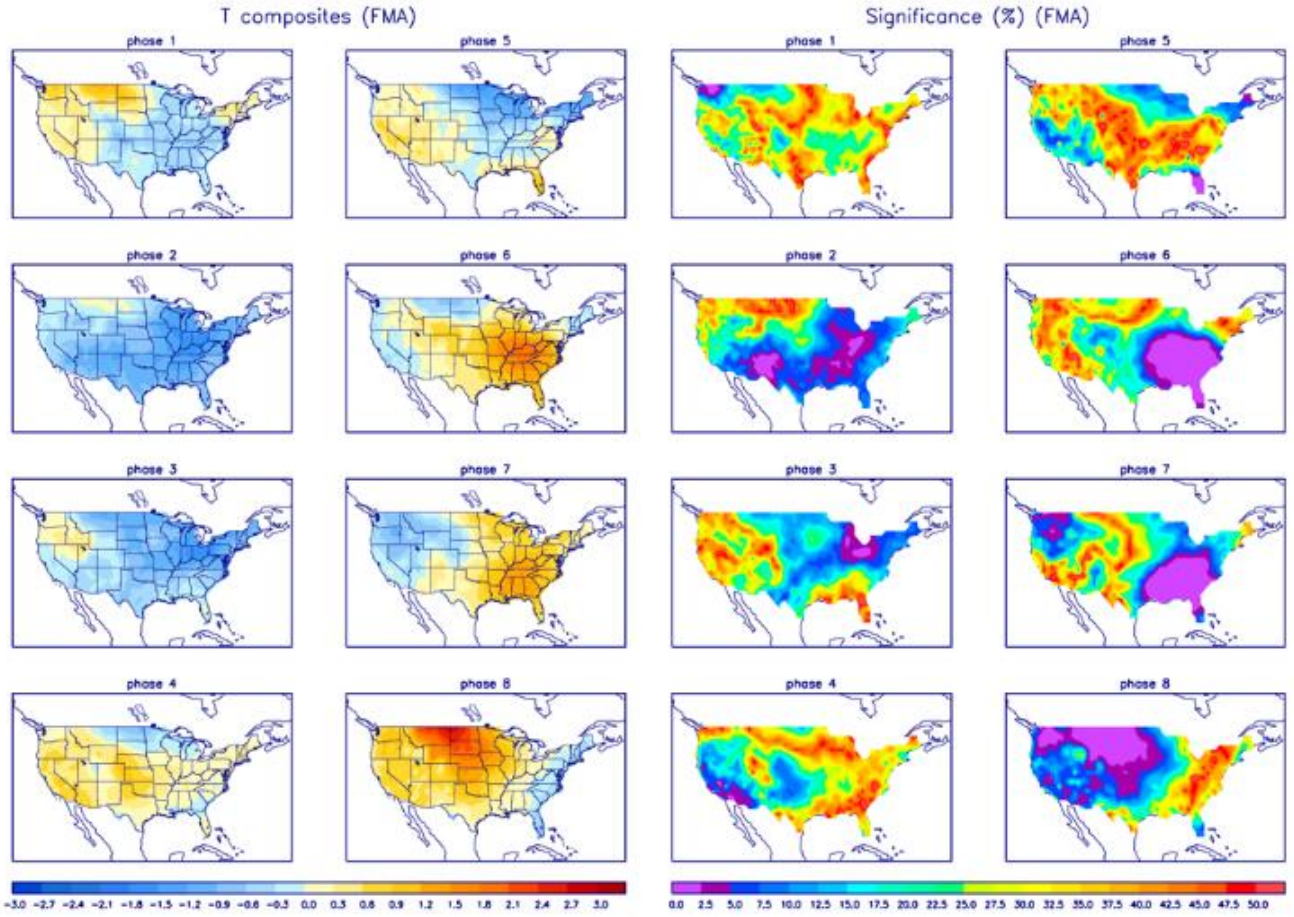
Precipitation Anomalies



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.

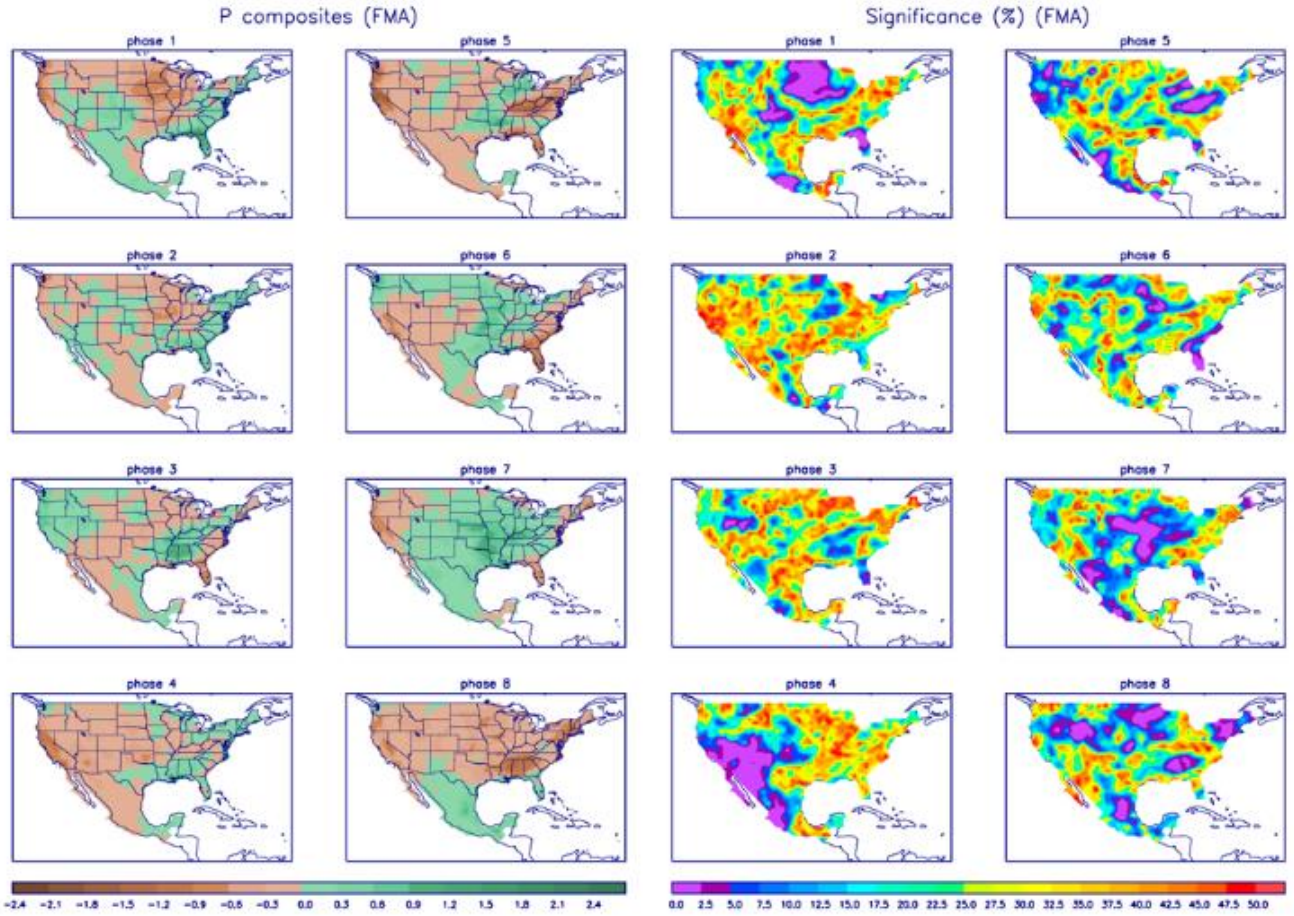


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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