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

Update prepared by the Climate Prediction Center
NWS / NCEP / CPC
28 August 2023

Overview

- An active MJO signal is apparent in the upper-level velocity potential field, but its impacts on other fields such as zonal winds and OLR anomalies appears less coherent.

- Any intraseasonal signal over the Western Hemisphere or Indian Ocean would destructively interfere with the El Niño base state, which may explain some of the incoherence.

- Dynamical model MJO index forecasts depict a fast translation and emergence of the intraseasonal signal over the Maritime Continent, with some ensemble members bringing the signal to the West Pacific by the end of Week-2. Longer range model forecasts from the GEFS and ECWMF show a potential West Pacific event during Week-3.

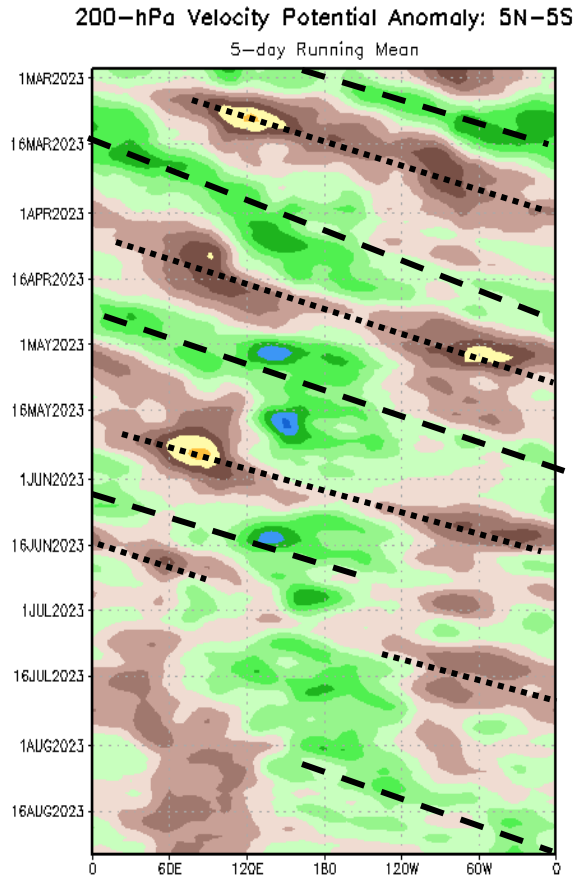
- MJO activity across the Maritime Continent and West Pacific would potentially increase favorability for TC development over the West Pacific, while suppressing activity over the East Pacific and Atlantic basins. Given abnormally warm SSTs and the peak season climatology, however, TC development is still possible in these basins.

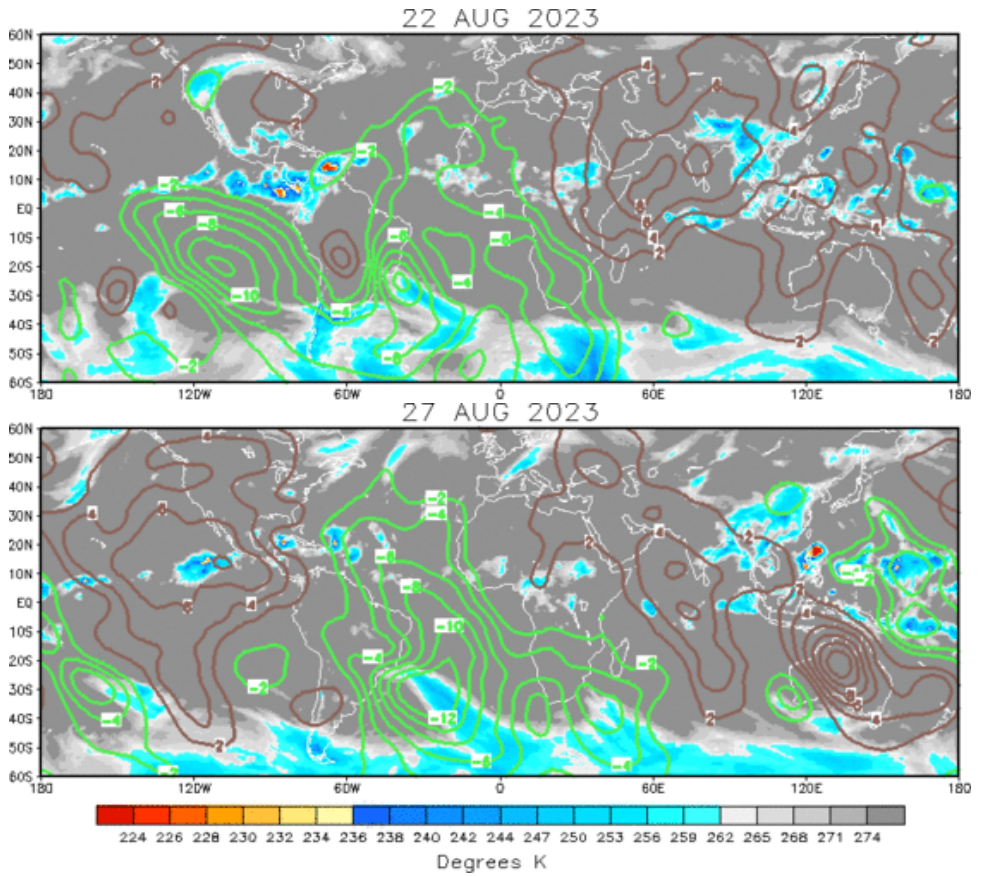
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

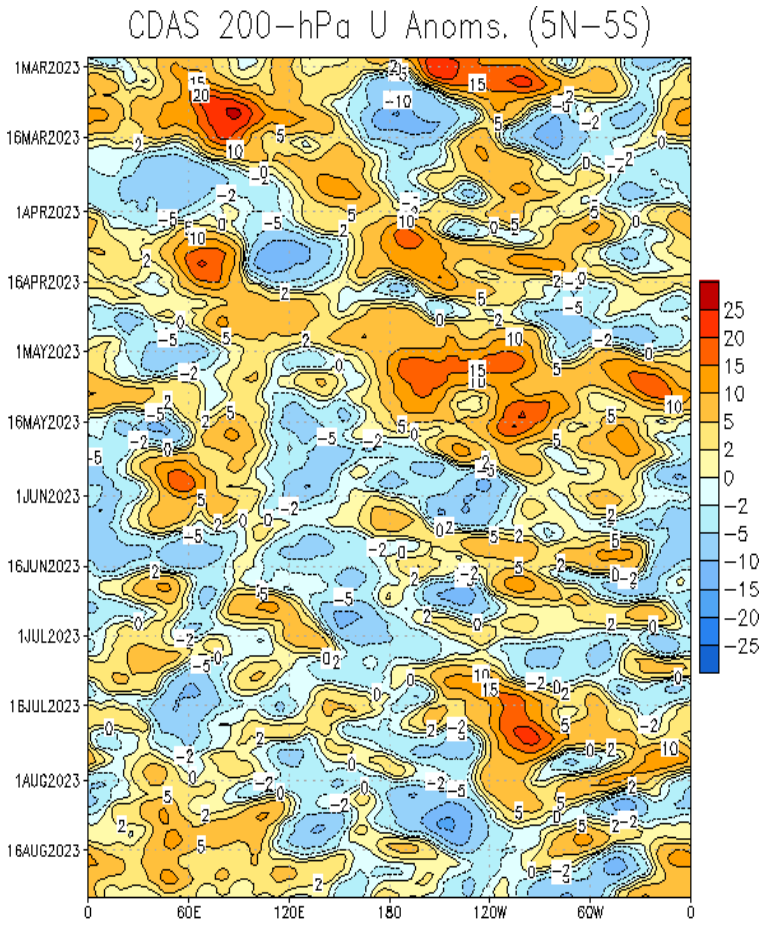


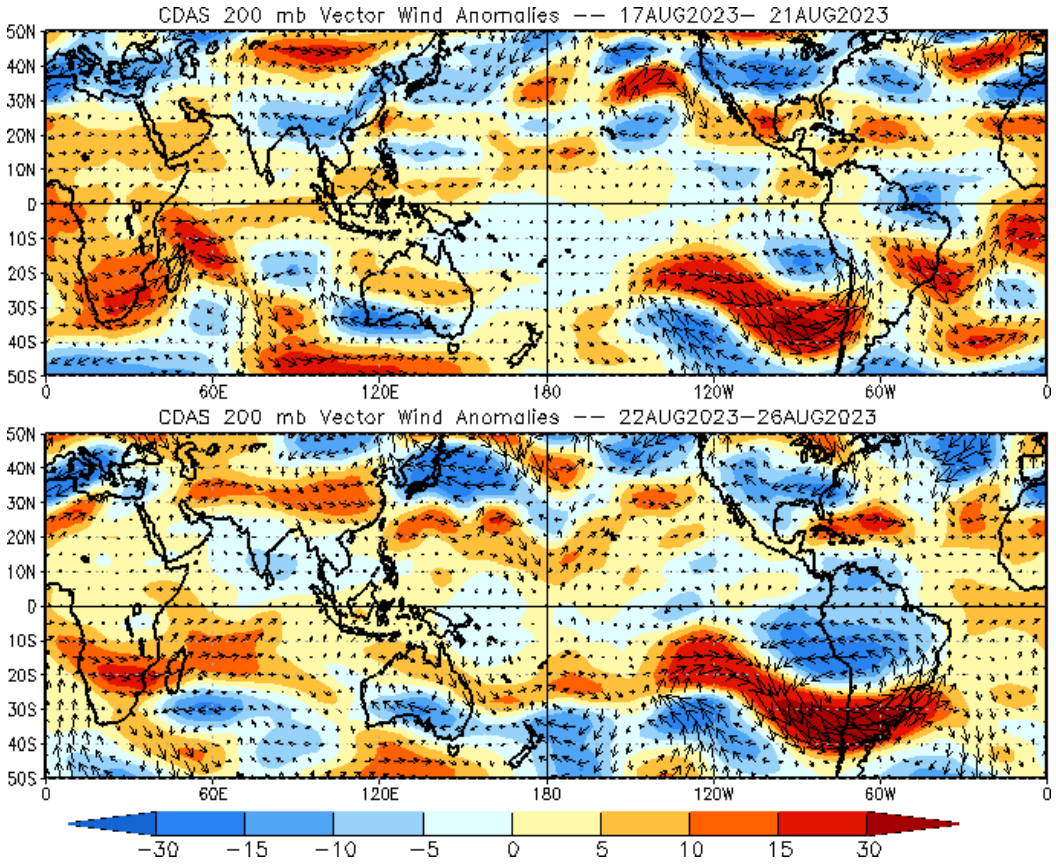


- Intraseasonal MJO activity was prominent during the Boreal spring and early summer.
- Since mid-July, as El Niño conditions provided more influence, a more stationary pattern developed, favoring enhanced (suppressed) convection over the central Pacific (Indian Ocean and Maritime Continent).
- More recently, eastward propagation associated with MJO activity was renewed, with an enhanced convective envelope crossing the Western Hemisphere, and the suppressed phase interfering with the ENSO base state.

200-hPa Wind Anomalies

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

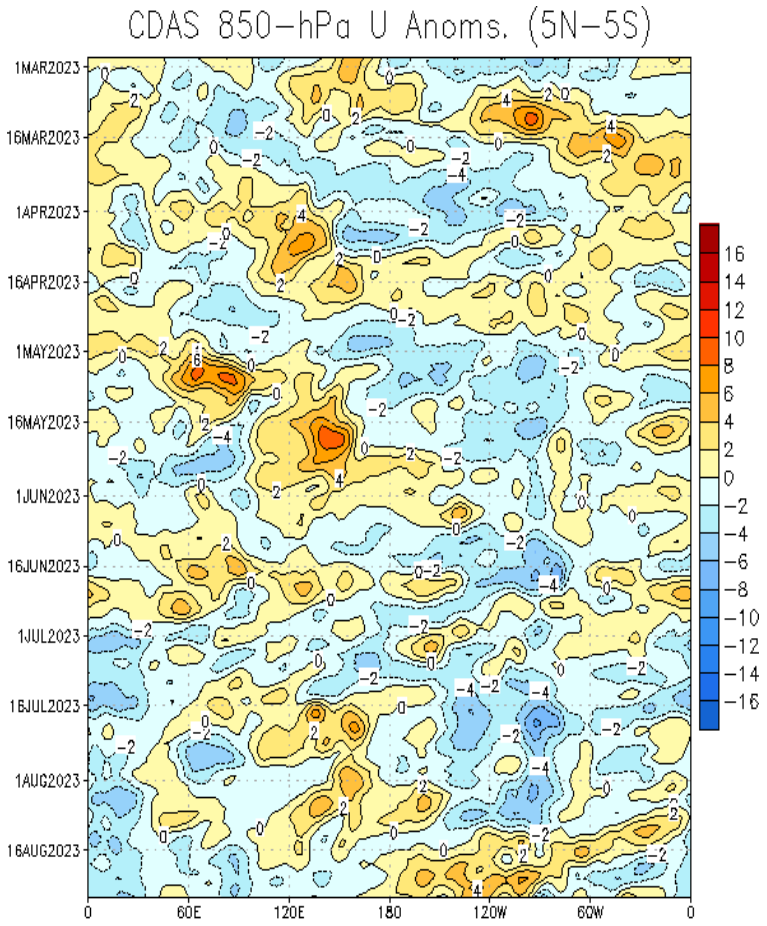


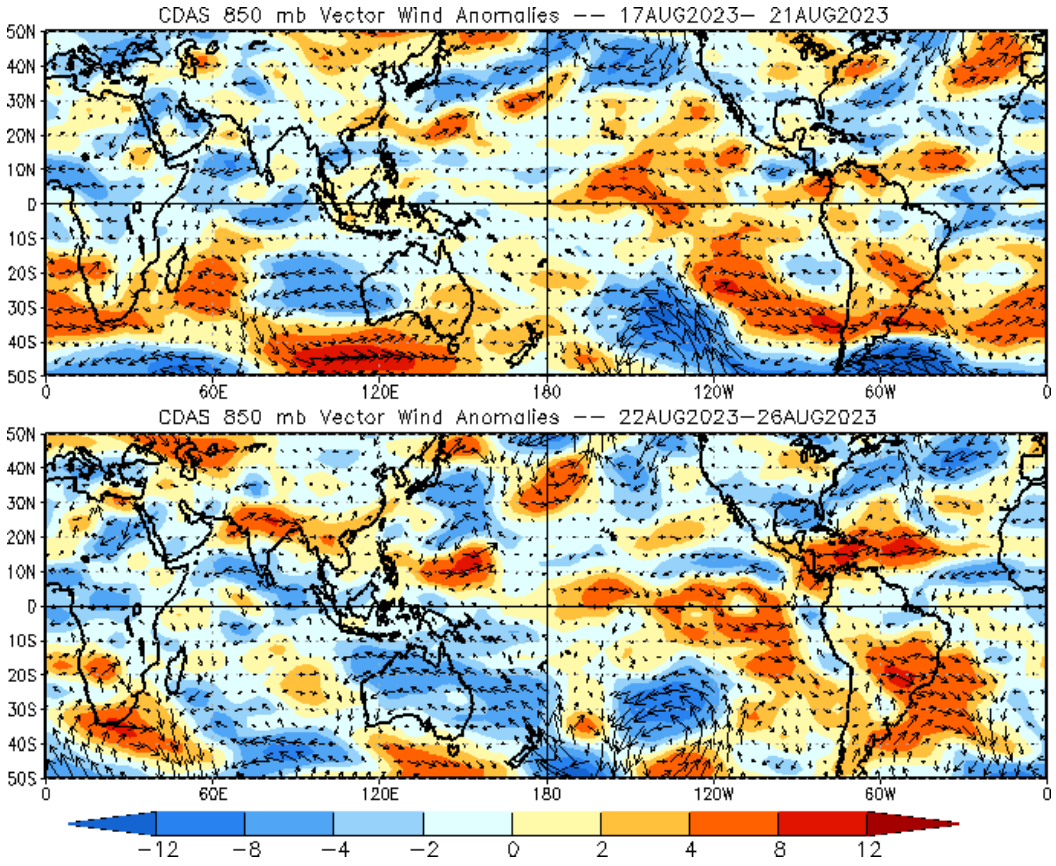


- Easterly anomalies weakened over much of the Pacific basin, possibly due to interference from MJO activity.
- Strong ridging is present over both North and western South America.

850-hPa Wind Anomalies

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

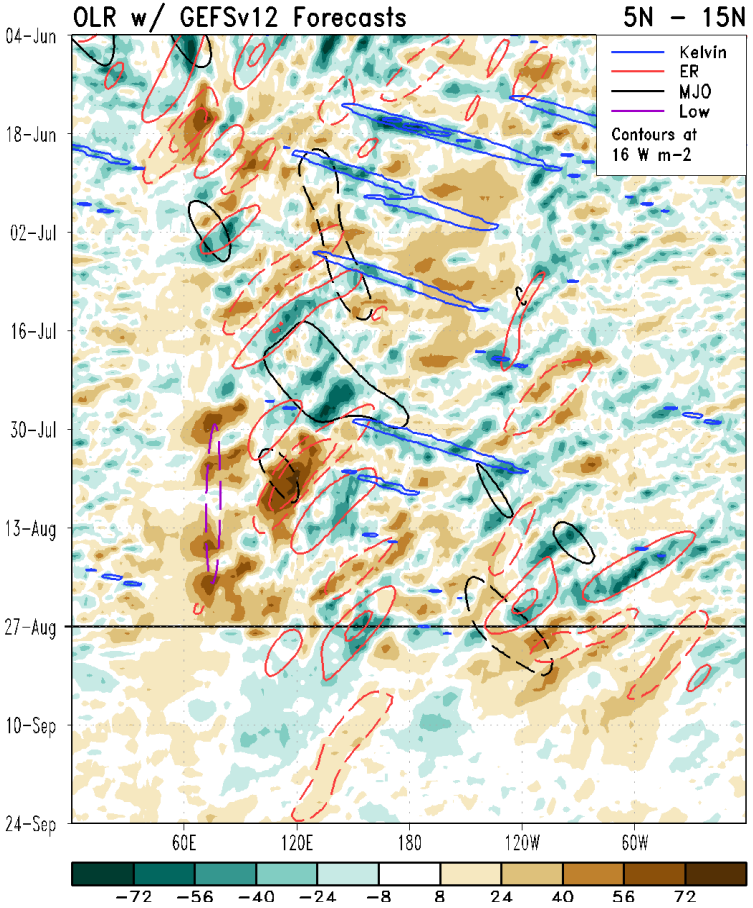


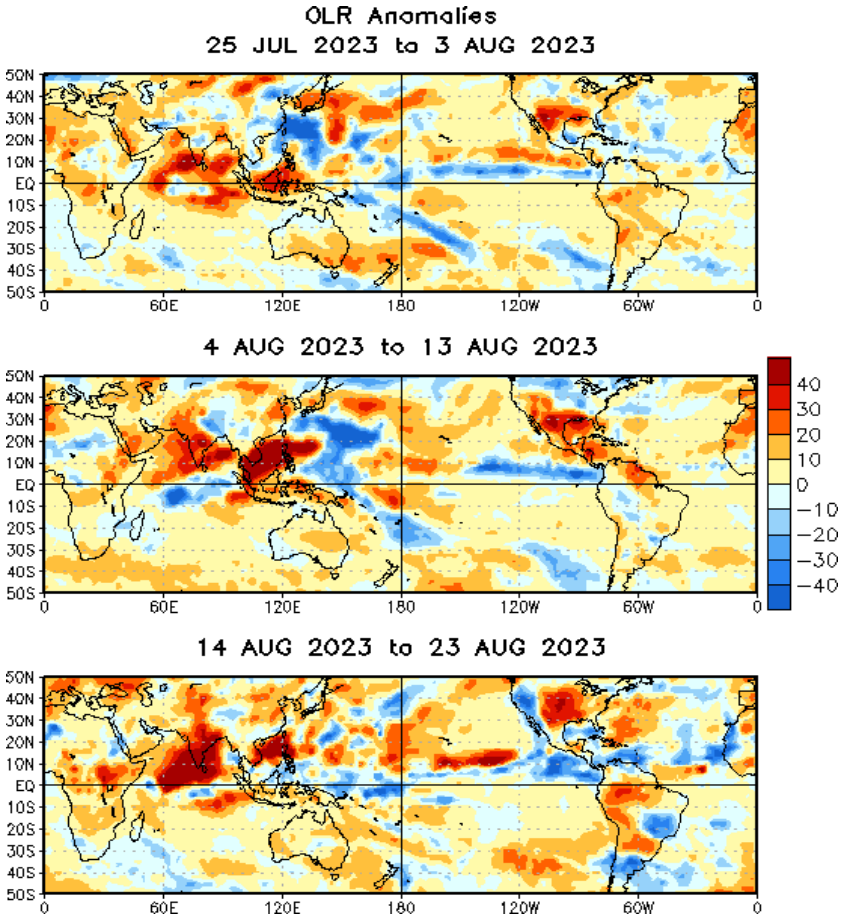


- The low-level wind field remains fairly chaotic, with some hints of eastward propagation during late July through August.
- Low-level westerly anomalies reflect a response to El Niño conditions across the central and eastern Pacific, though easterly anomalies strengthened in the vicinity of New Guinea.
- Westerly anomalies strengthened across the Caribbean and tropical Atlantic.

Outgoing Longwave Radiation (OLR) Anomalies

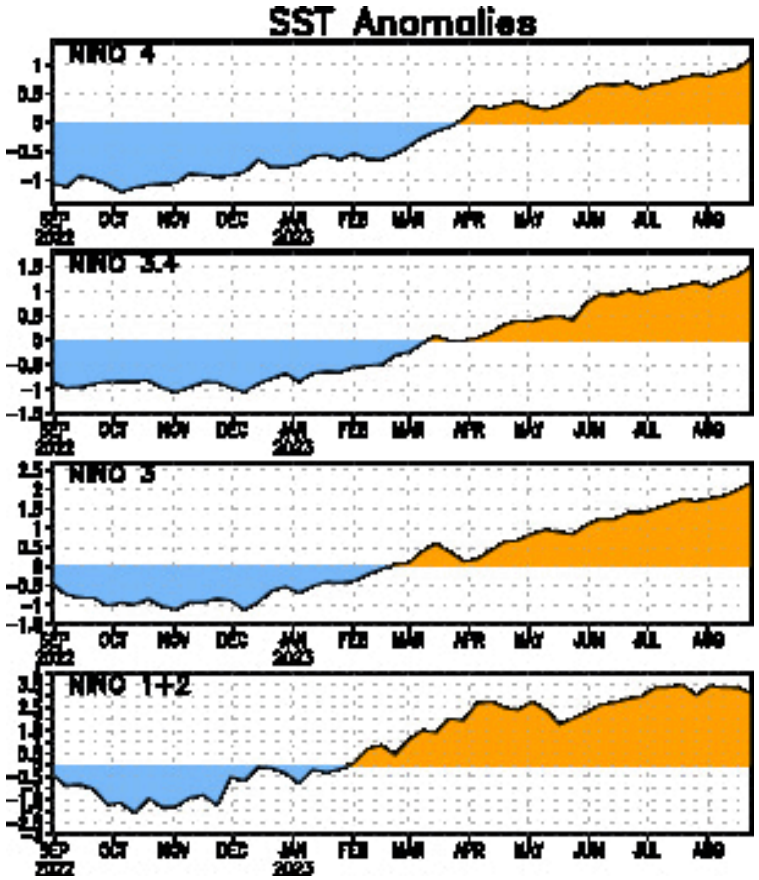
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

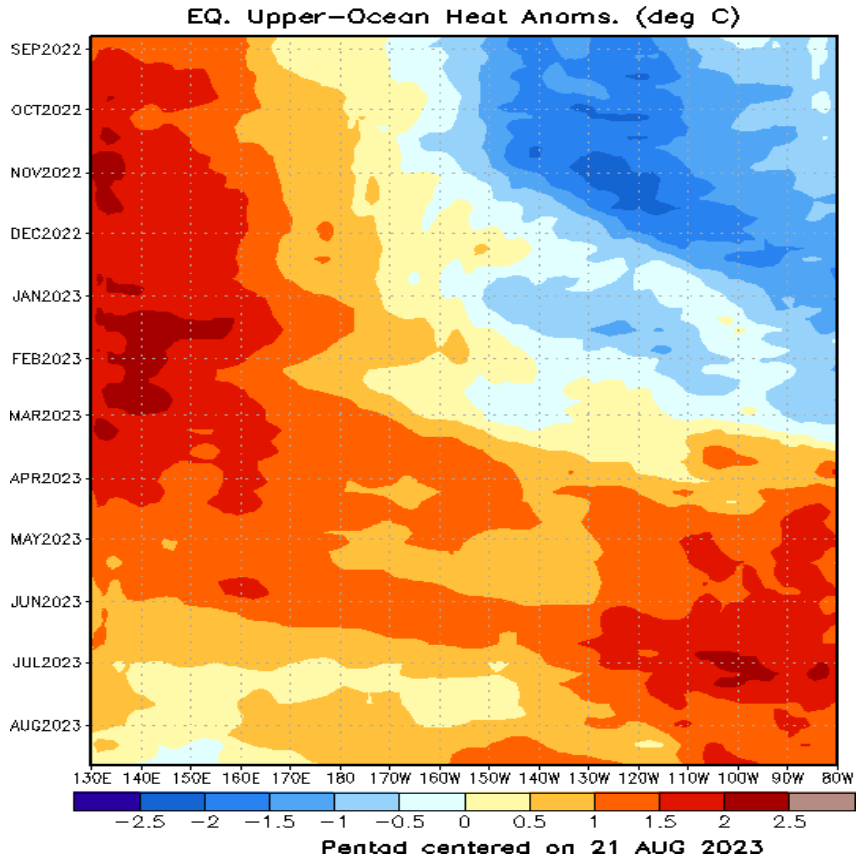




- The South and Southeast Asia Monsoon remained weak through late July and much of August, consistent with El Niño conditions.
- The North American Monsoon was also weak, other than a remarkable surge of moisture in late August associated with Hurricane Hilary.
- Enhanced precipitation eventually began across southern Brazil following a prolonged period of abnormal dryness.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

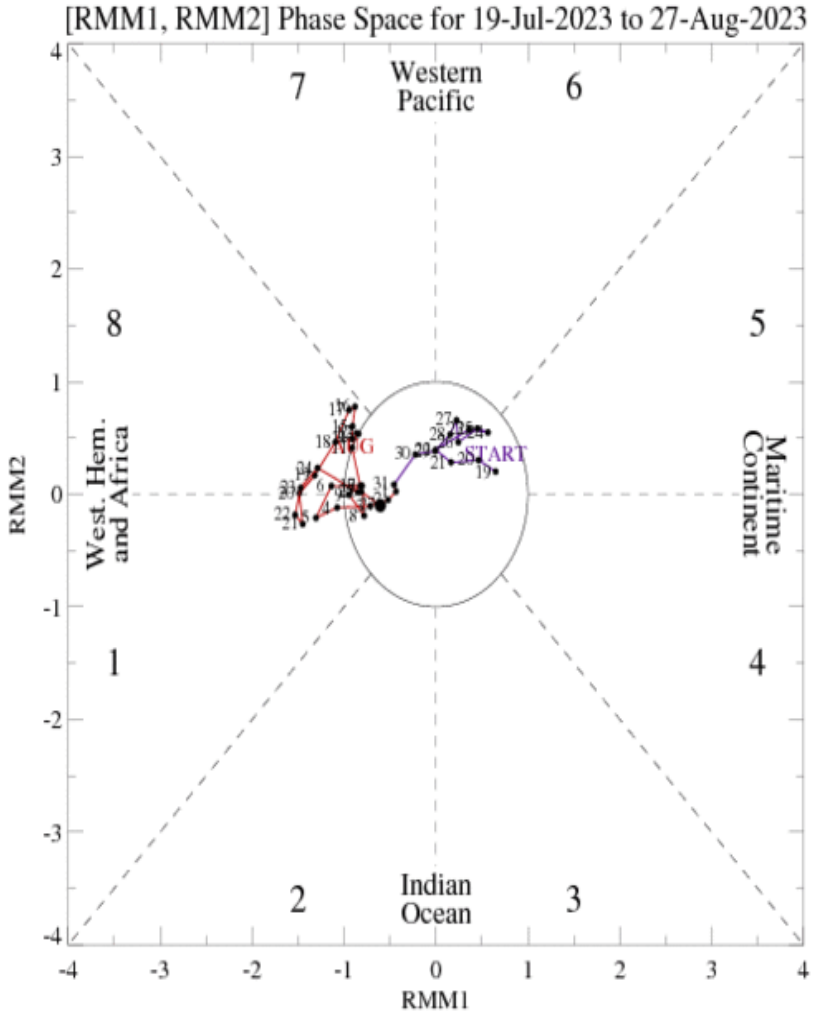




- El Niño conditions are present across the equatorial Pacific as SST anomalies continue to climb throughout the Nino regions other than the far East Pacific, which is already extremely warm.
- Following some attenuation during July, a new downwelling oceanic Kelvin wave appears to have been initiated, bringing warmer subsurface ocean water eastward across the central Pacific.

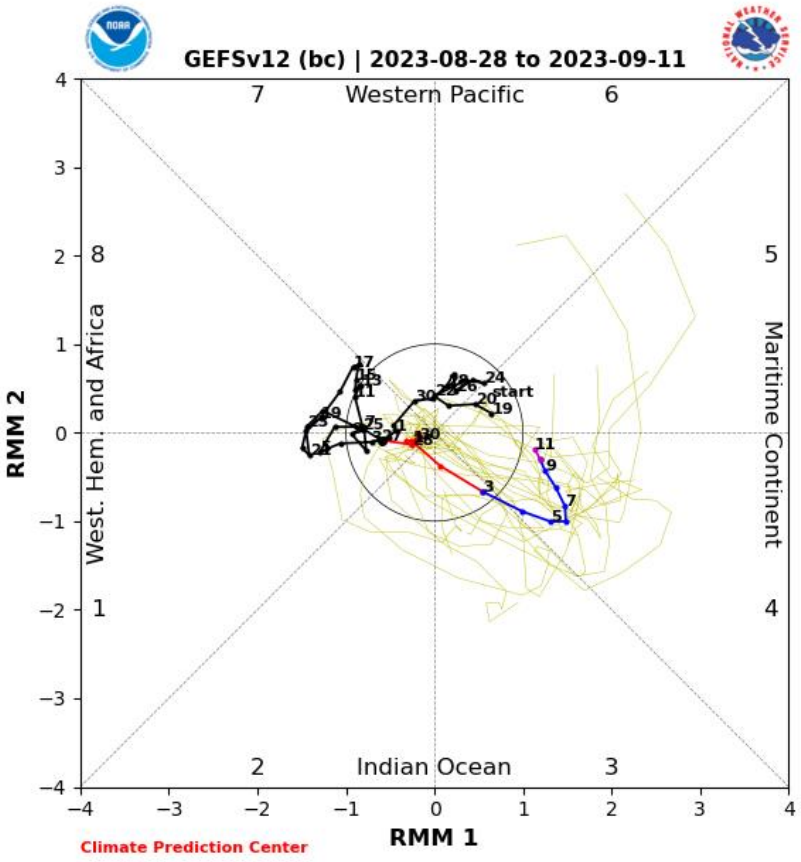
MJO Index: Recent Evolution

- The RMM index weakened following a period of enhancement over the Western Hemisphere.
- Little eastward propagation was evident in the RMM-based index, though a more robust propagation was observed in the upper-level velocity potential field (Slide-3).

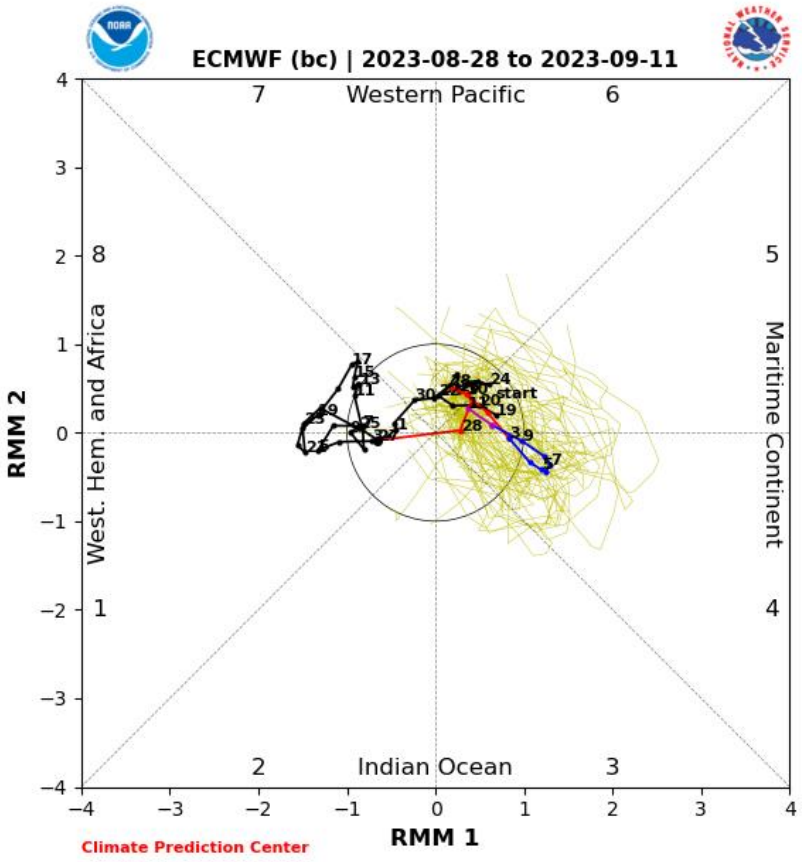


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

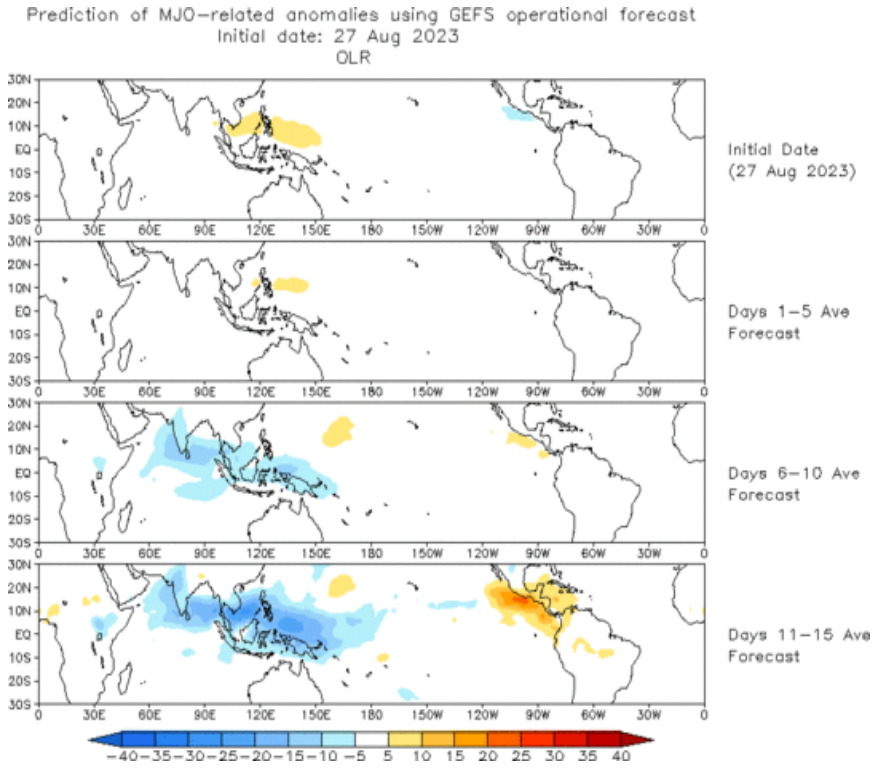


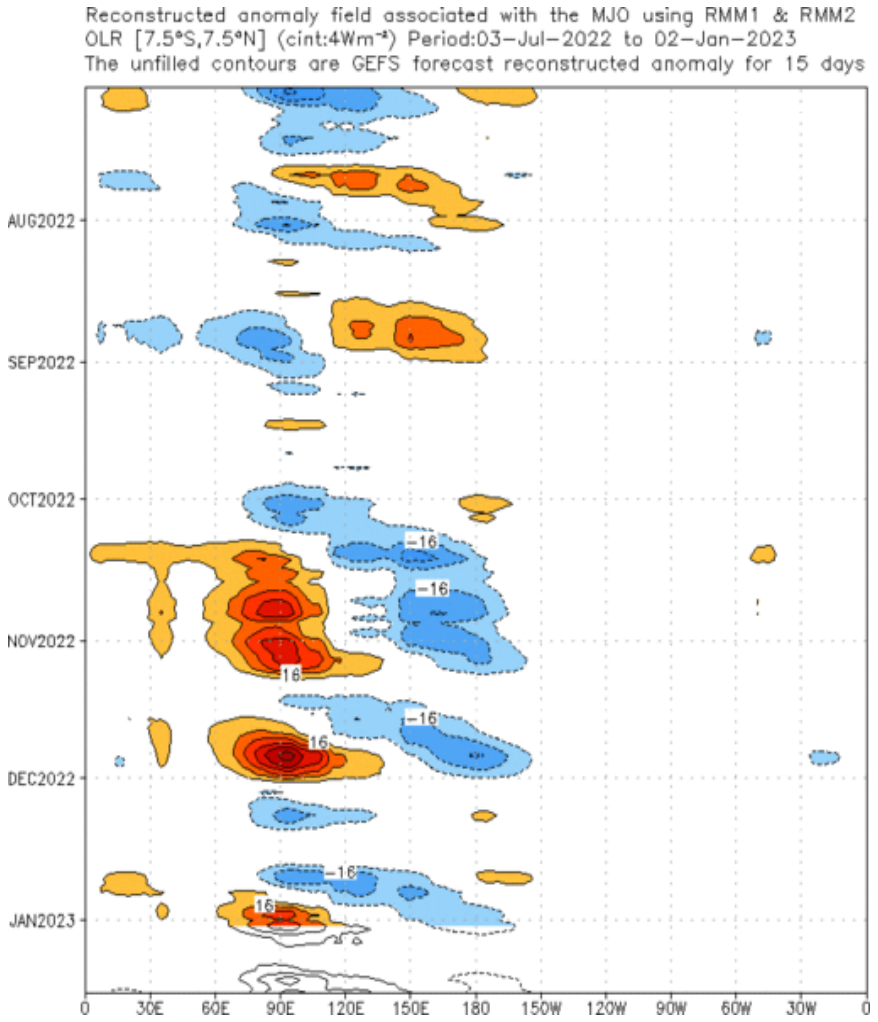
ECMWF Forecast

- Both the GEFS and ECMWF depict a fast moving signal returning to the Maritime Continent by Week-2.
- There is considerable spread in the amplitude and position of the signal, but several ensemble members of the GEFS and ECMWF show the signal returning to the West Pacific by the end of 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.)

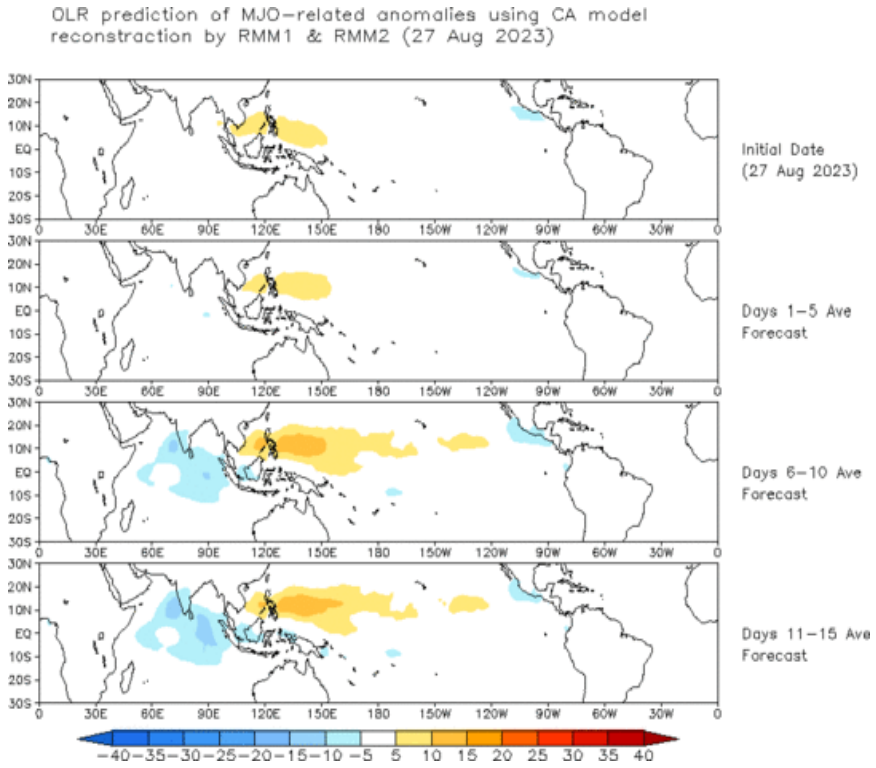


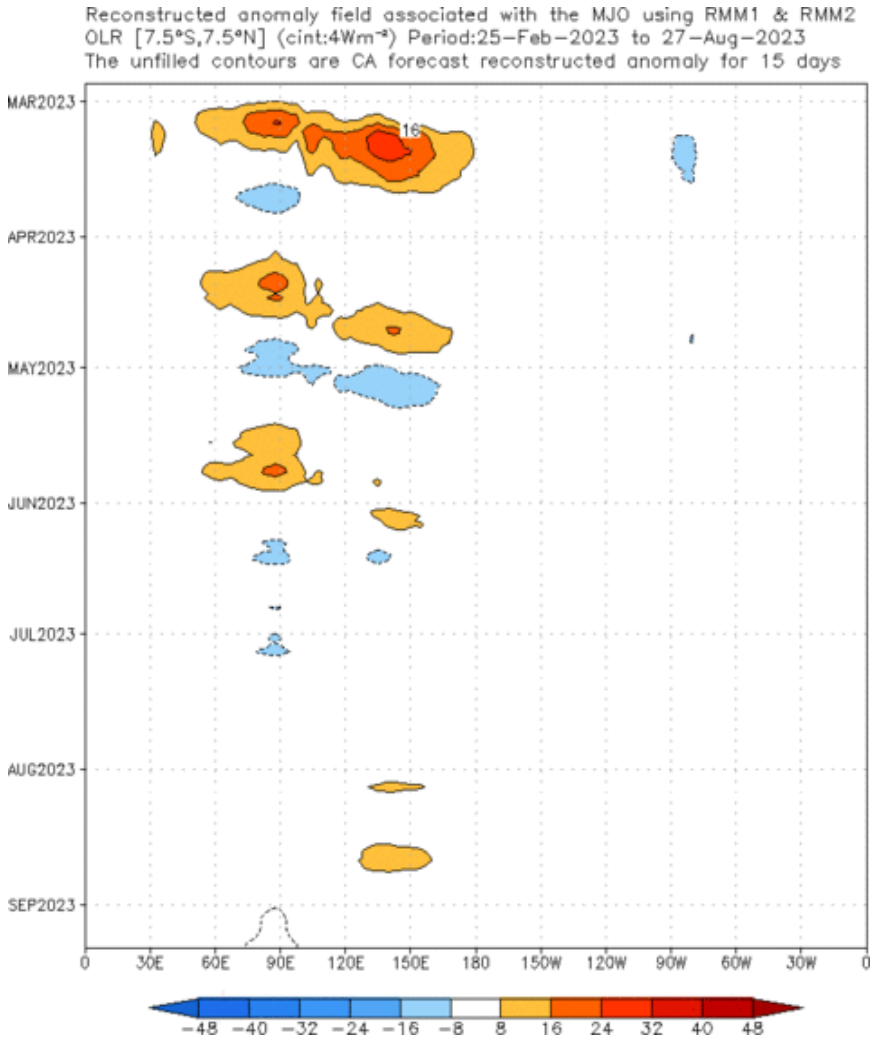


- The GEFS RMM-based OLR forecast shows an amplifying response over the Maritime Continent during Week-2.

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.)

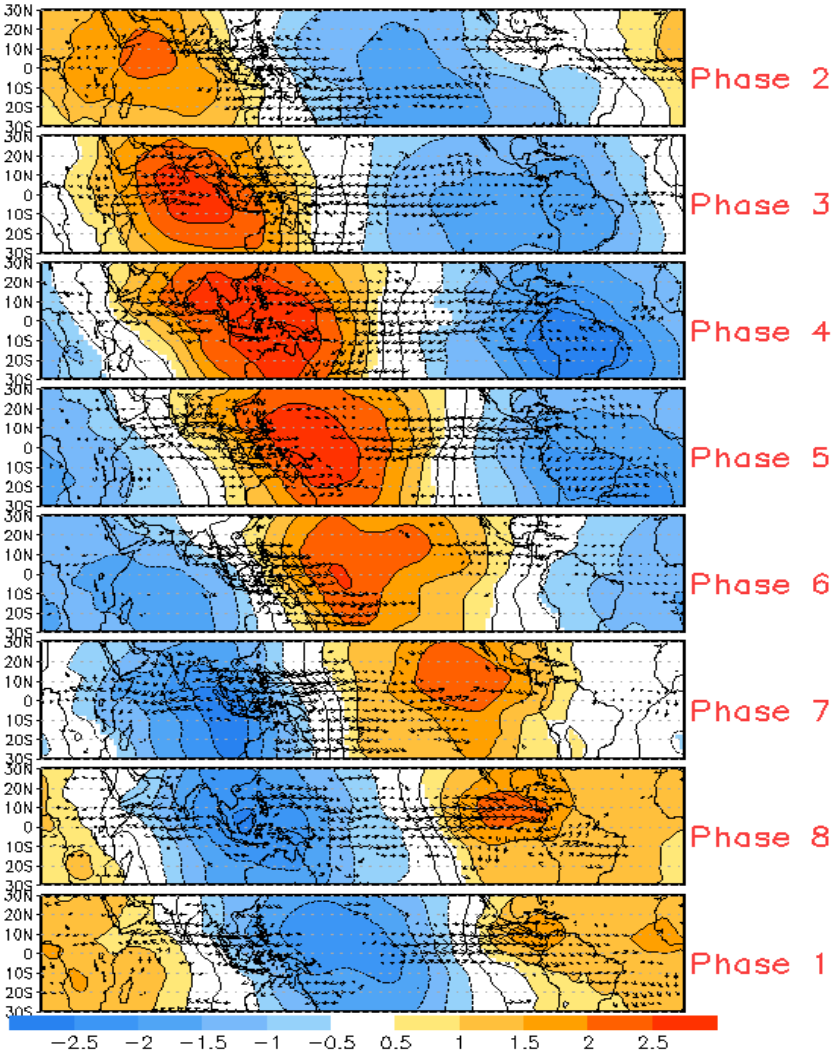




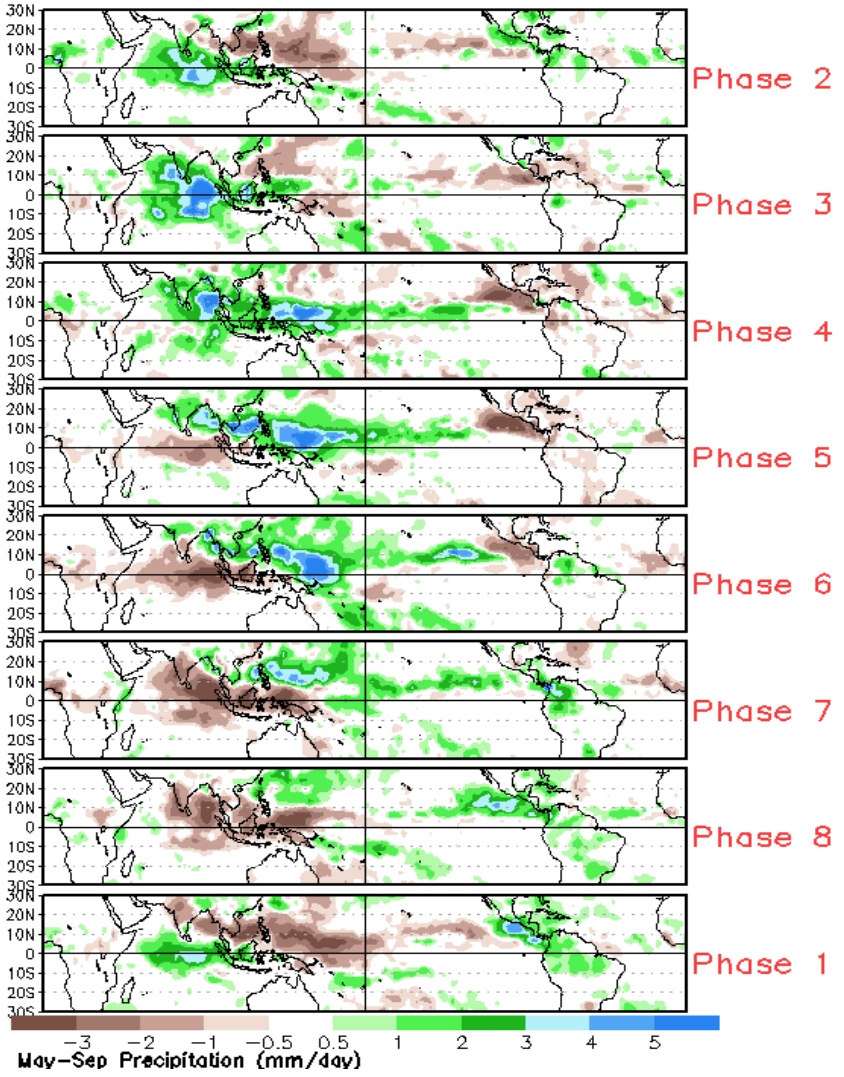
- The constructed analog RMM-based forecast depicts a slower evolution over the Indian Ocean, with some amplification of the signal as well.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



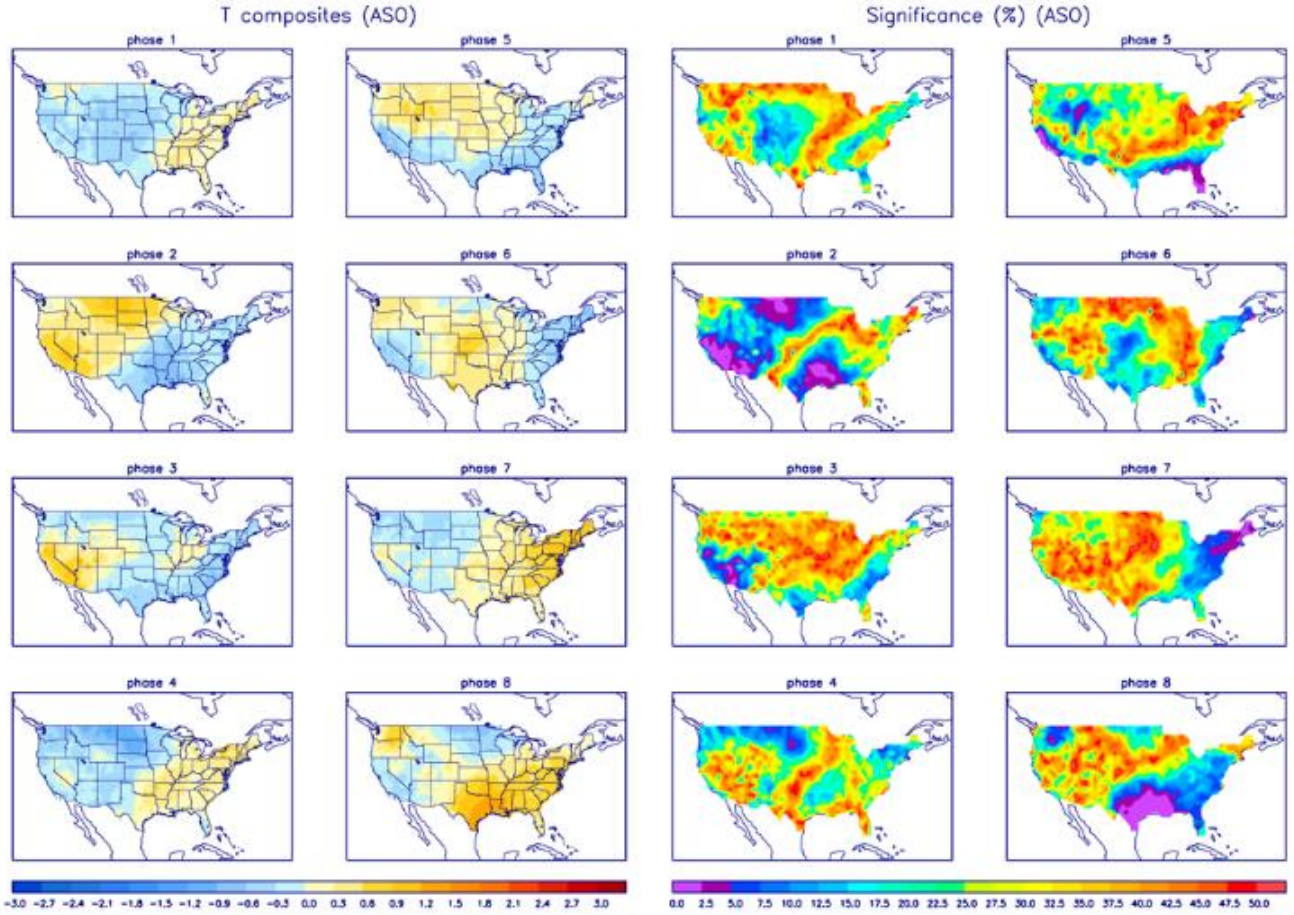
Precipitation Anomalies



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.

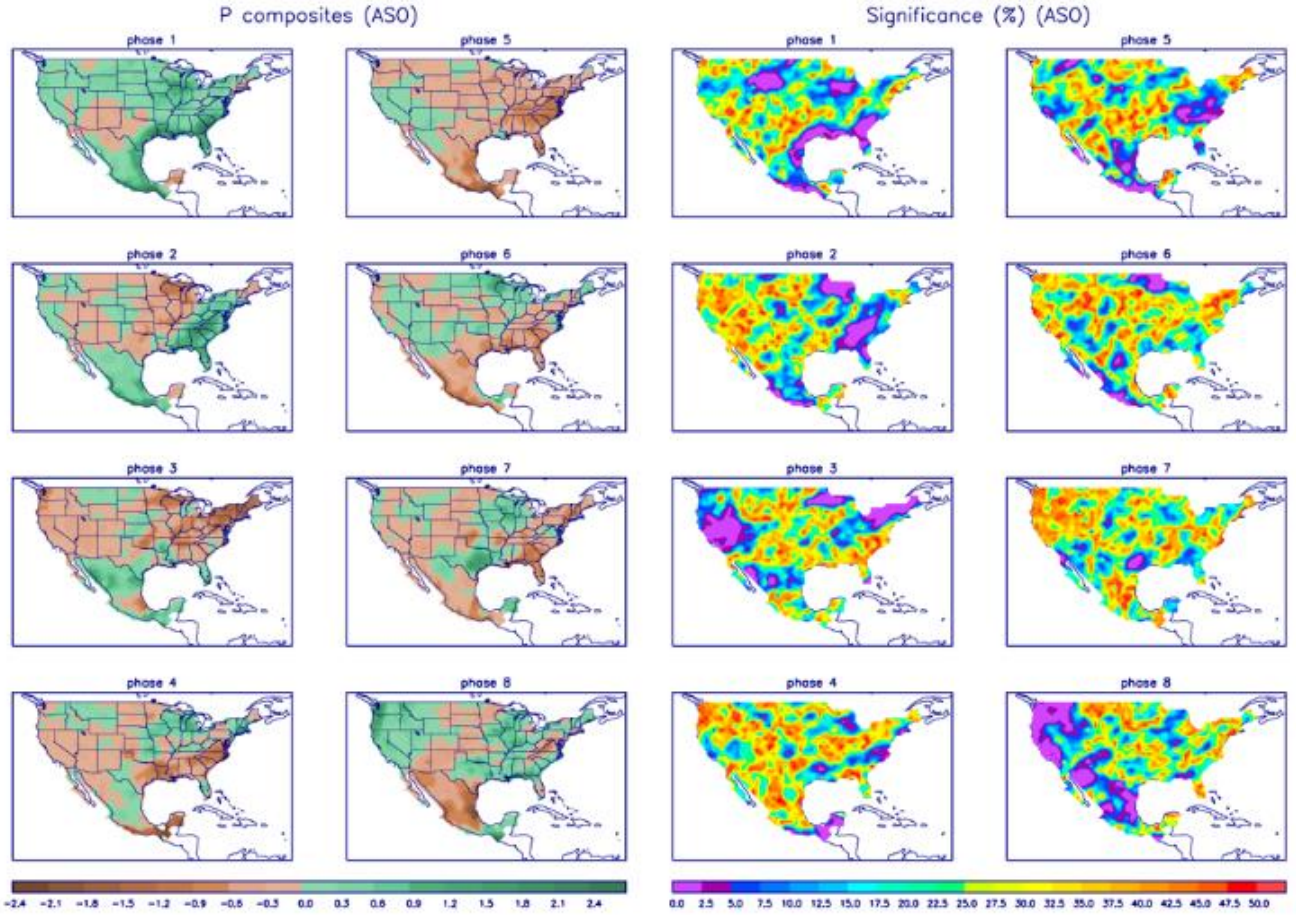


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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