

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



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

Overview

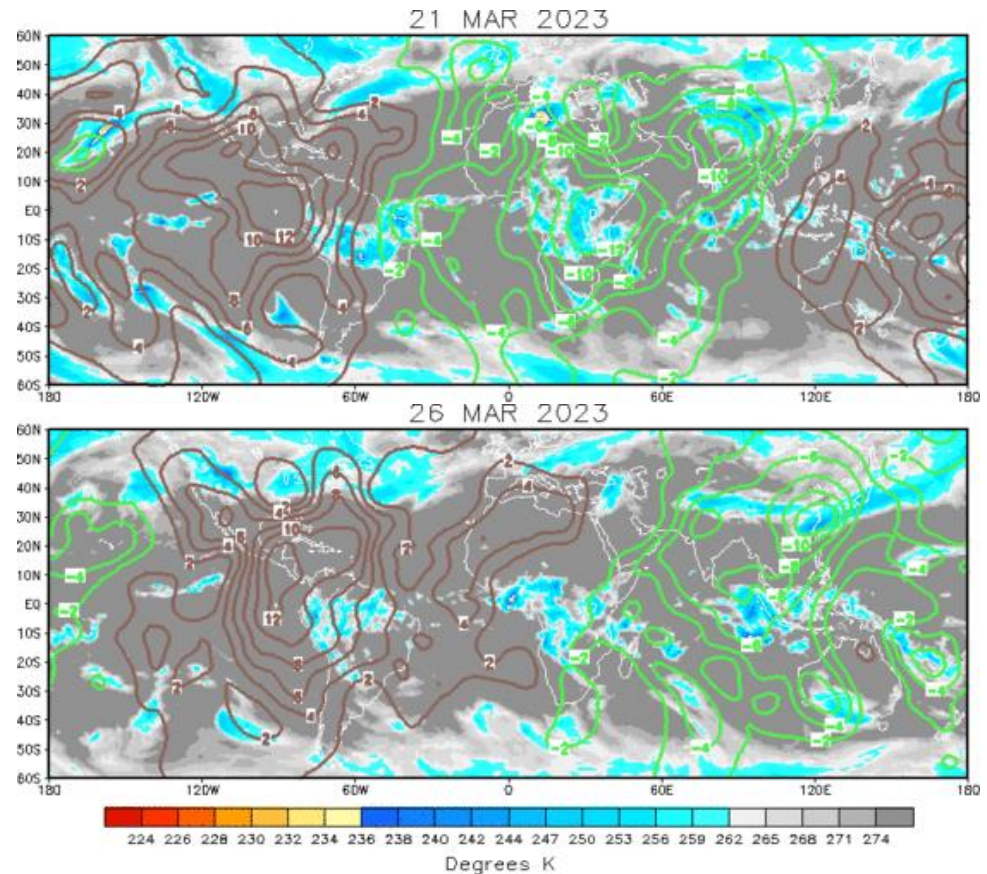
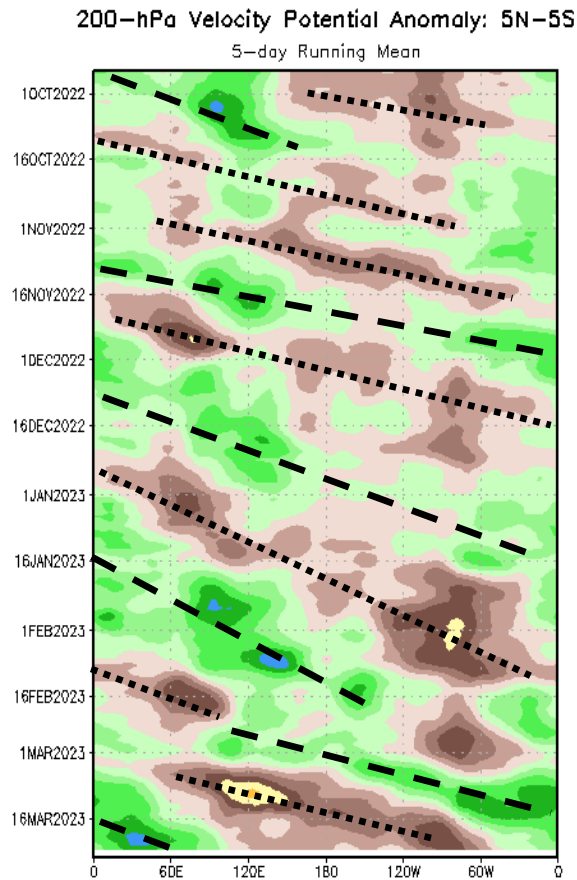
- Following a very strong MJO signal across the Western Hemisphere earlier in March, the intraseasonal signal has since weakened as it moved into the Indian Ocean.
- Dynamical models are in good agreement regarding continued MJO propagation across the Maritime Continent and Western Pacific during the next 2 weeks.
- The global tropics are expected to remain generally quiet with suppressed convection forecast to expand across the Indian Ocean during the next 2 weeks. Chances for tropical cyclone formation may begin to increase across the Western Pacific by mid-April, consistent with the MJO and climatology.
- A strengthening MJO over the Maritime Continent/Western Pacific could lead to an extratropical response typical of La Nina, possibly leading to above normal temperatures over the eastern U.S. later in April.

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)

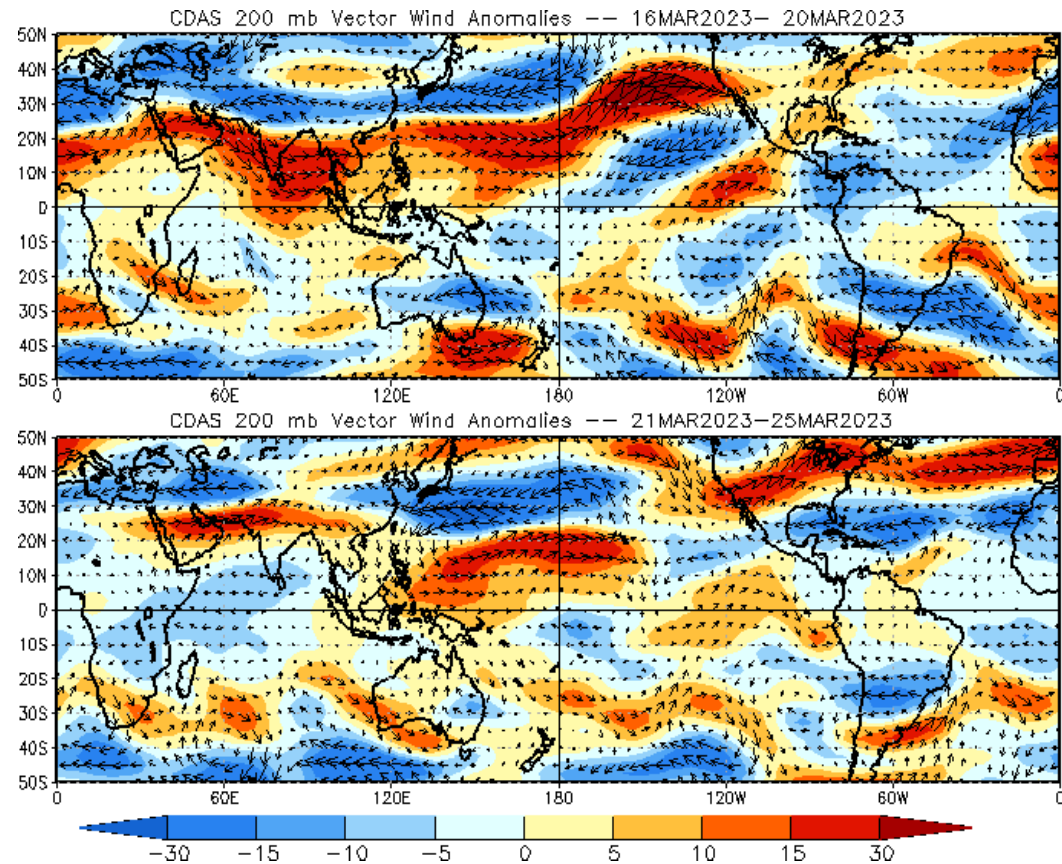
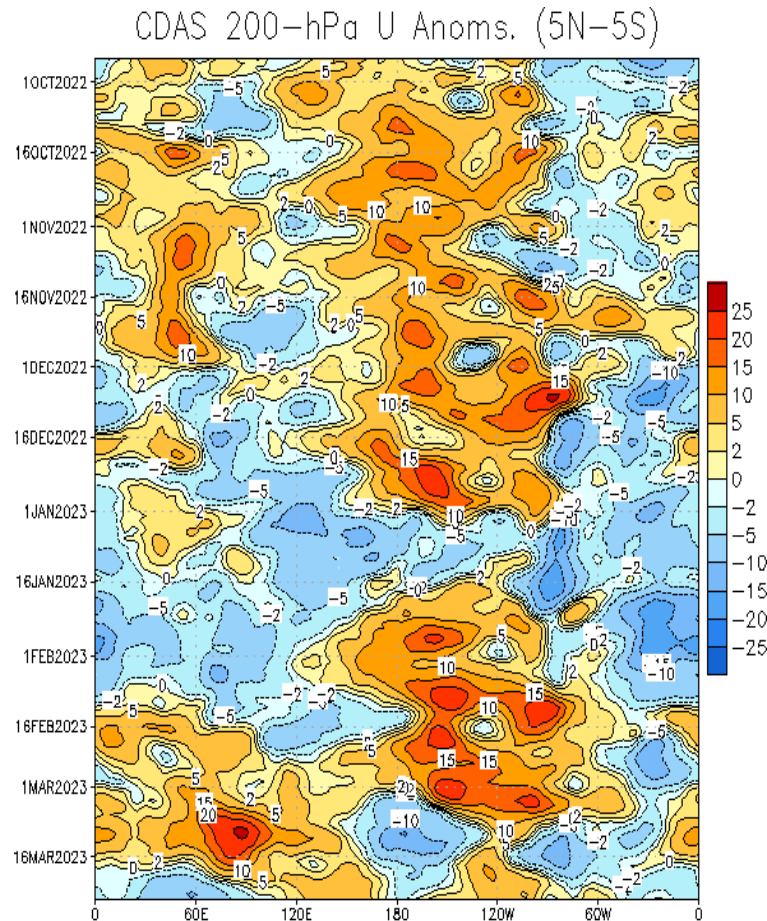
Brown shades: Anomalous convergence (unfavorable for precipitation)



- The MJO signal remains evident across the Indian Ocean, completing a full circumnavigation of the globe beginning in late February.
- A strong suppressed phase of the MJO with associated anomalous upper-level convergence has expanded across the East Pacific, Americas, and the Atlantic during the past week.

200-hPa Wind Anomalies

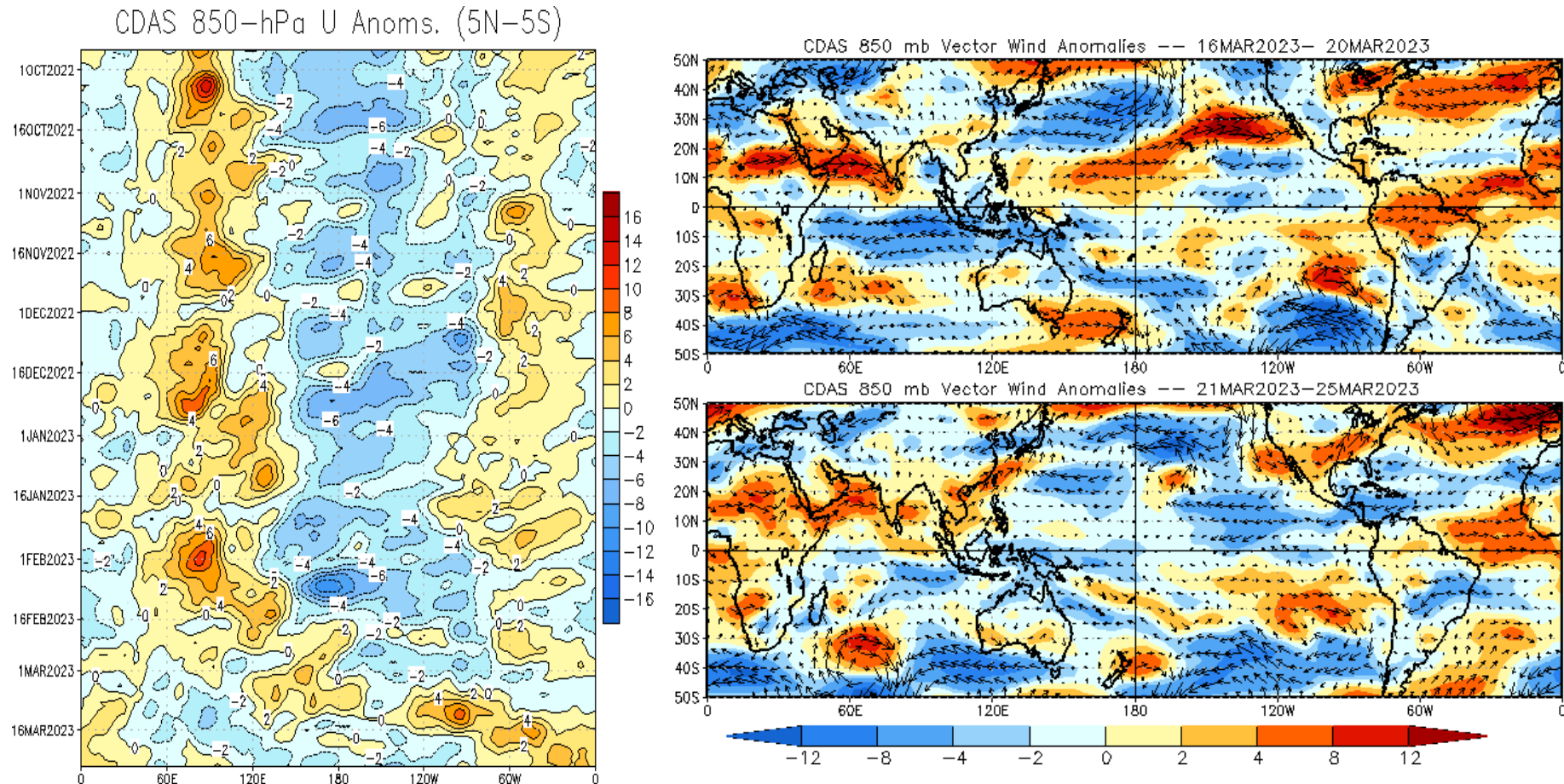
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Upper-level westerly wind anomalies rapidly weakened across the equatorial Pacific, consistent with the active MJO and the return to ENSO-neutral conditions.
- Anomalous upper level easterlies increased over the Indian Ocean, with the region of anomalous upper-level westerlies shifting east to the Maritime Continent and Western Pacific.
- The subtropical jet across the Pacific has weakened compared to last week.

850-hPa Wind Anomalies

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

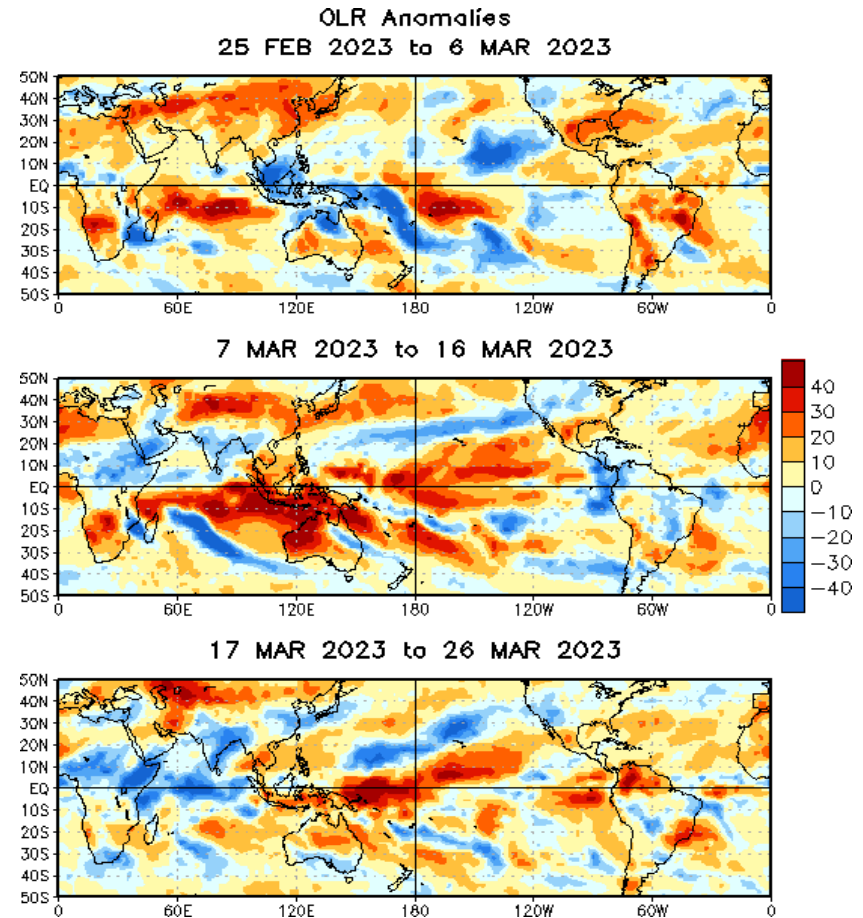
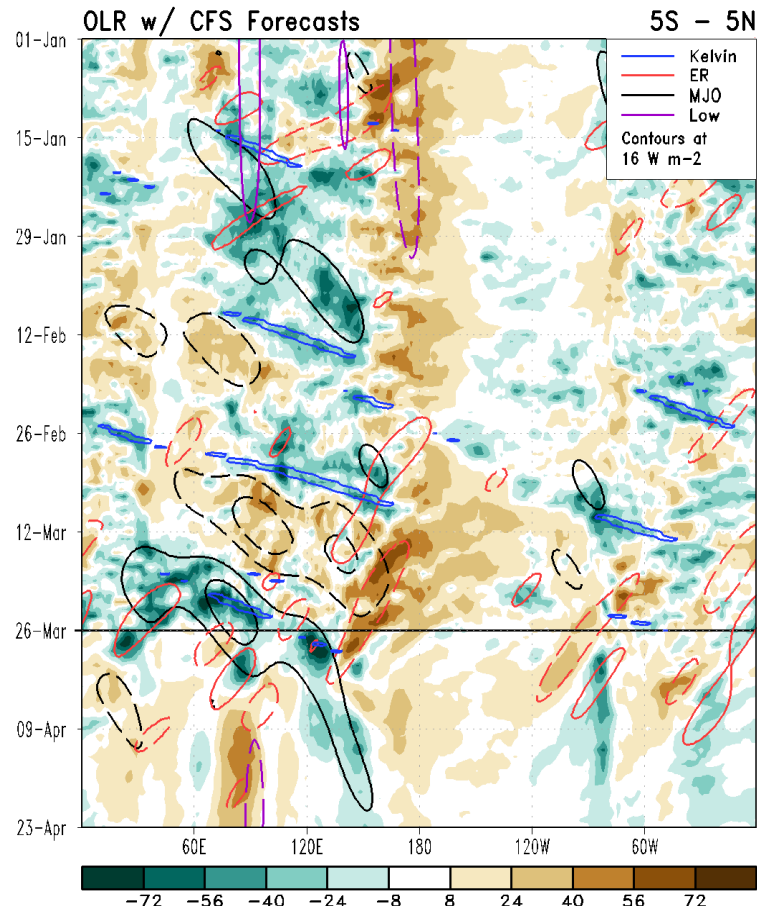


- A clear eastward progression of westerly low-level wind anomalies is apparent in association with the MJO propagation across the globe.
- Anomalous low-level easterlies have returned to much of the equatorial Pacific during the past week.

Outgoing Longwave Radiation (OLR) Anomalies

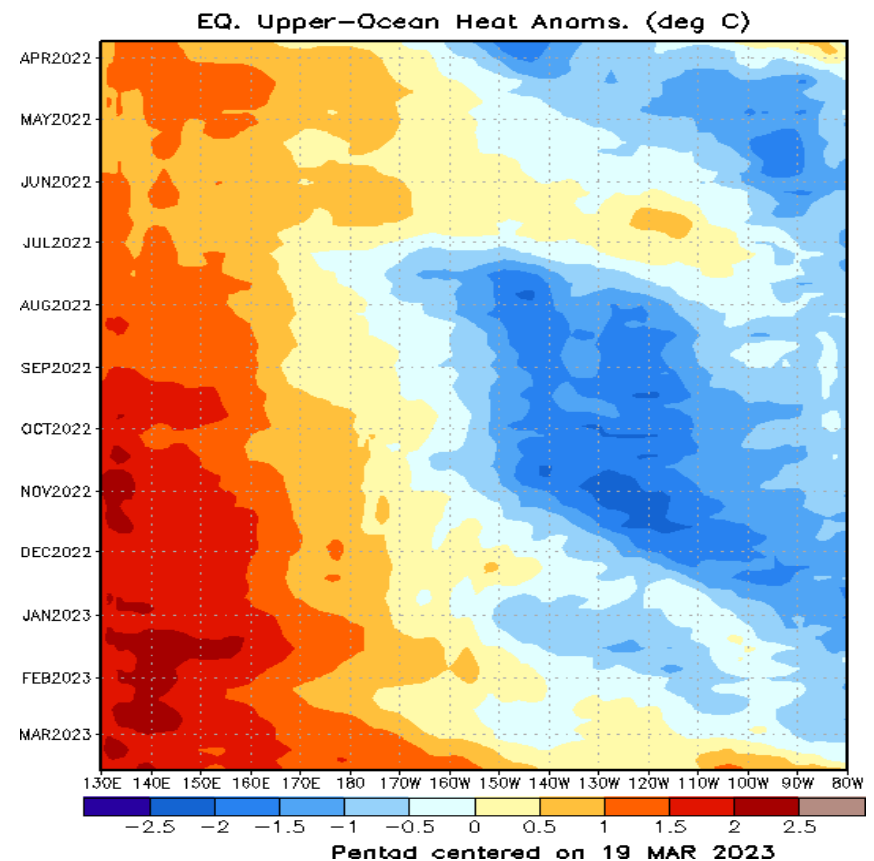
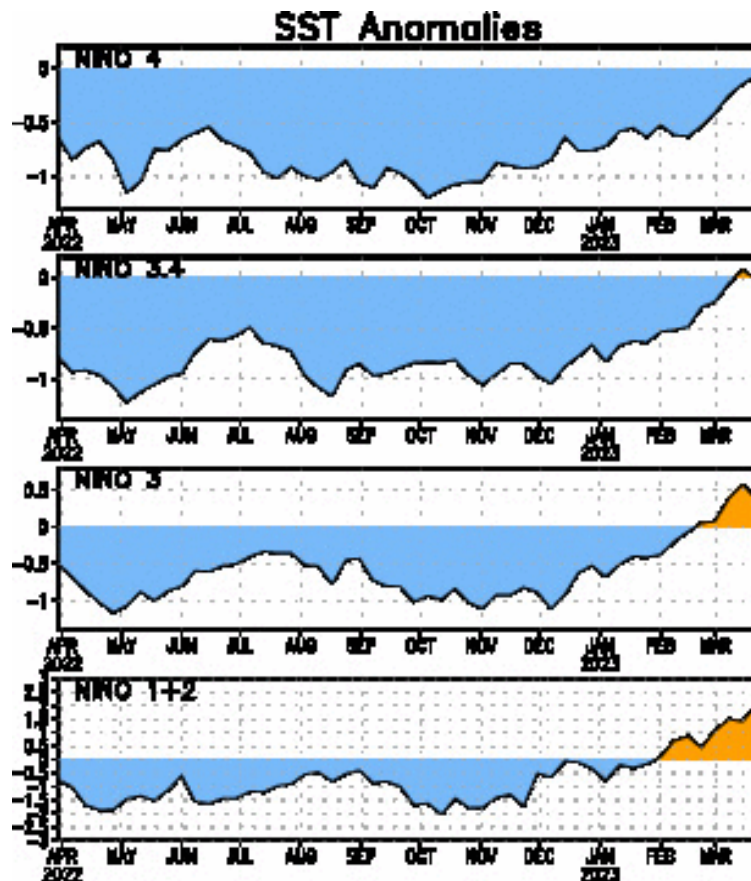
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- Along the equator, negative OLR anomalies were noted across Africa and the Indian Ocean during the past week, with positive OLR anomalies across much of the Pacific, Americas, and Atlantic.
- The CFS forecast depicts a slowing of the enhanced convective envelope as it moves into the Maritime Continent and Western Pacific and constructive interference with Rossby Wave activity.

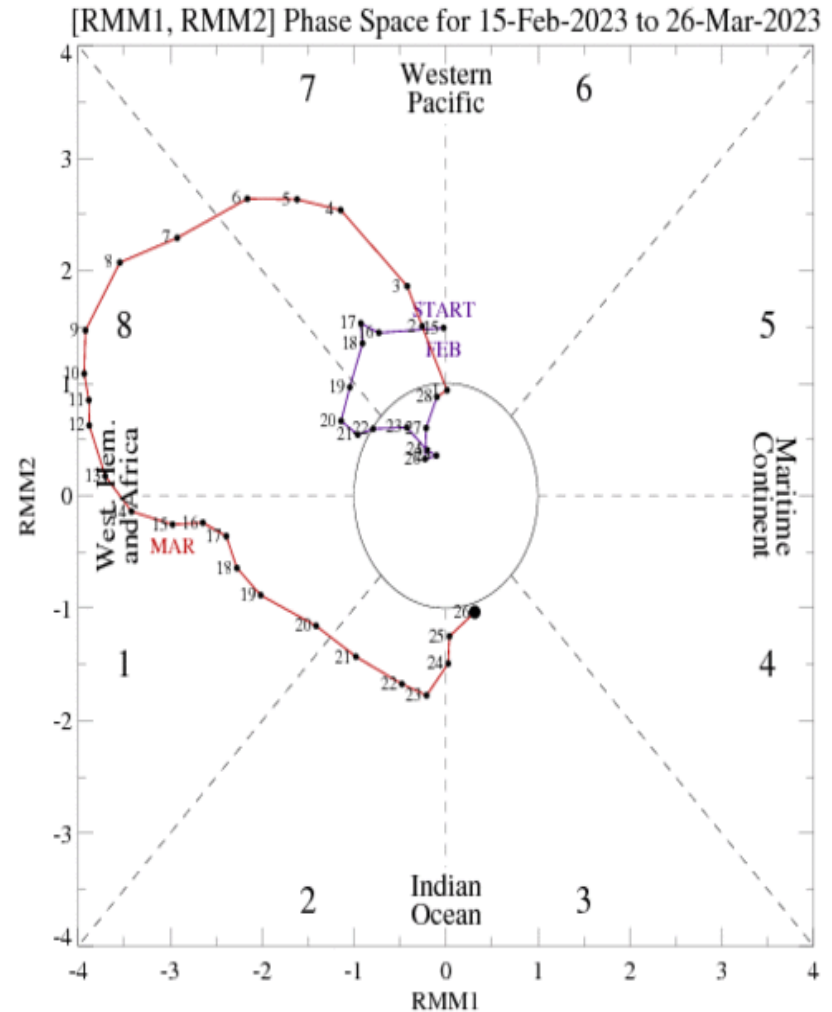
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Upper-ocean heat content is now above normal across the entire Pacific as a downwelling oceanic Kelvin Wave led to warming east of the Date Line.
- SSTs in all of the Niño regions have trended upwards during the past month and are now close to or above normal. The largest positive SST anomalies are over the eastern Niño regions (1+2 and 3).

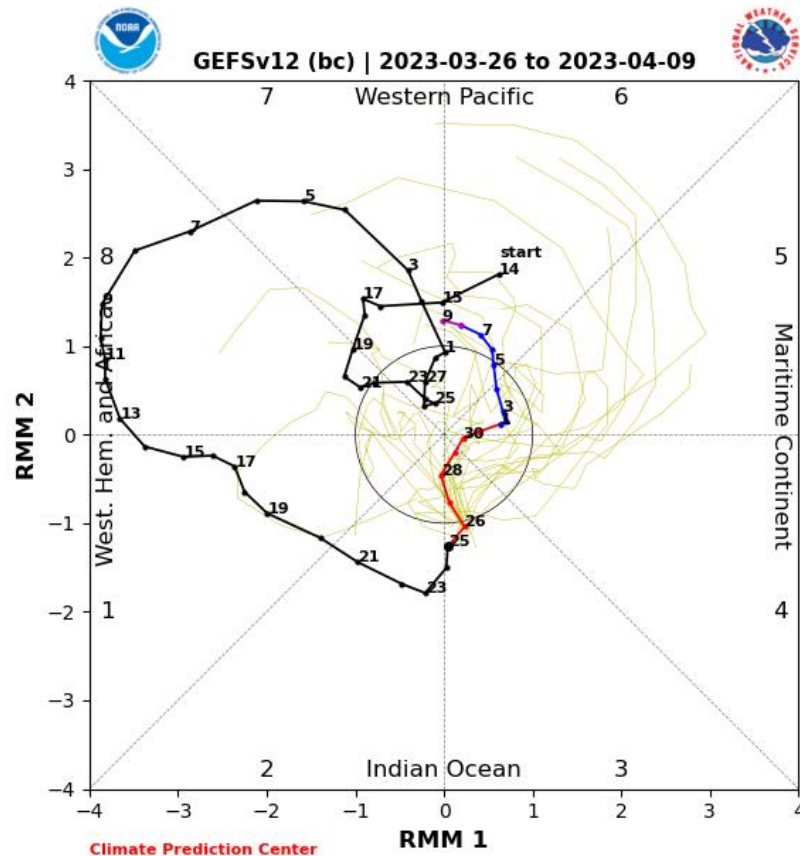
MJO Index: Recent Evolution

- A strong RMM-based MJO was apparent across the Western Hemisphere earlier in March.
- The signal has since weakened as it moved into the Indian Ocean.

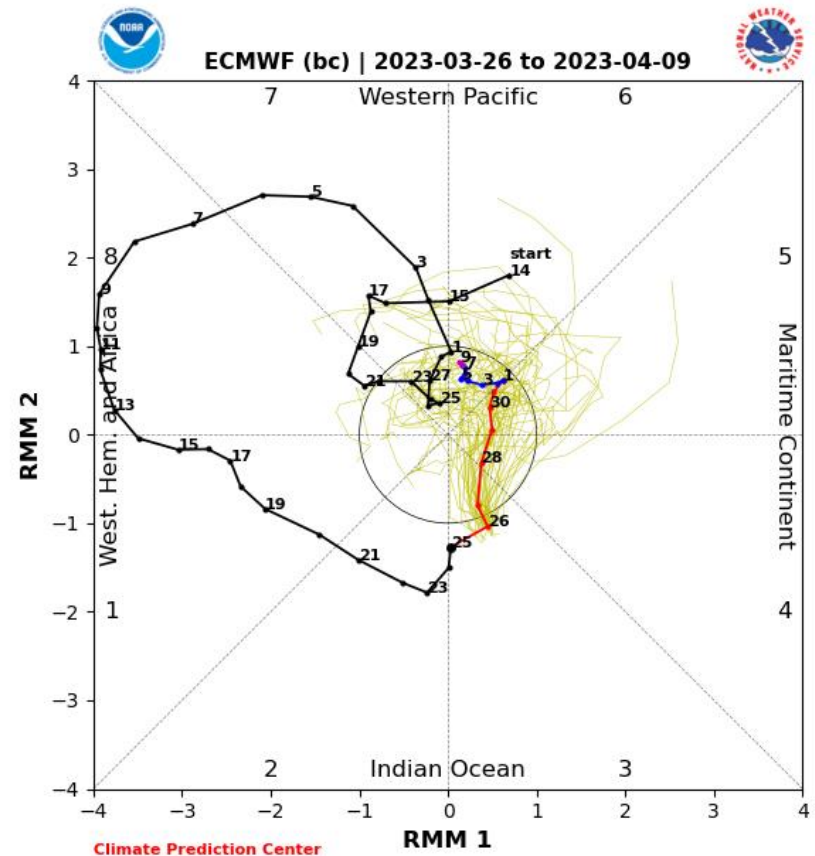


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



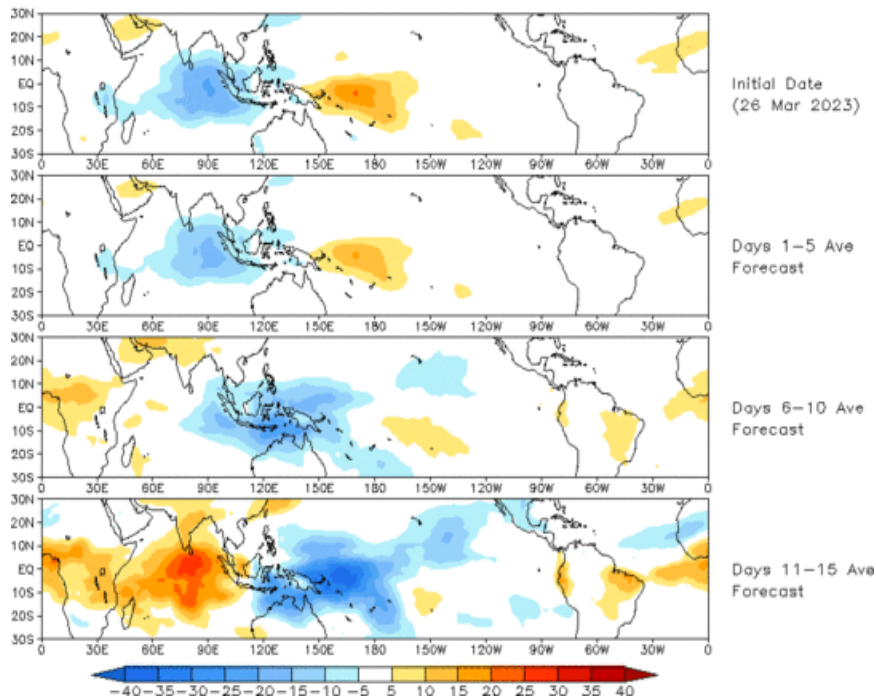
ECMWF Forecast

- The GEFS and ECMWF dynamical model ensembles are in good agreement regarding a short-term weakening of the RMM-based MJO signal back into the unit circle followed by renewed strengthening of the signal across the Maritime Continent and Western Pacific in early April.

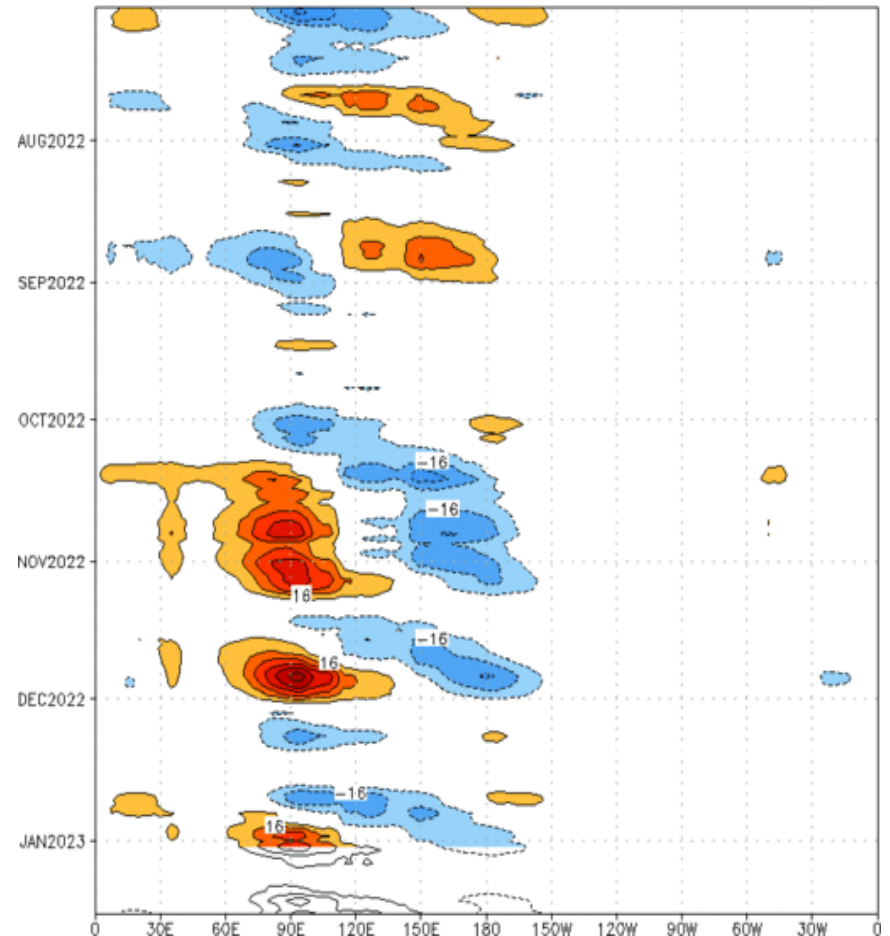
MJO: GEFS Forecast Evolution

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.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 26 Mar 2023
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [$7.5^{\circ}\text{S}, 7.5^{\circ}\text{N}$] ($\text{cont: } 4\text{Wm}^{-2}$) Period: 03-Jul-2022 to 02-Jan-2023
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

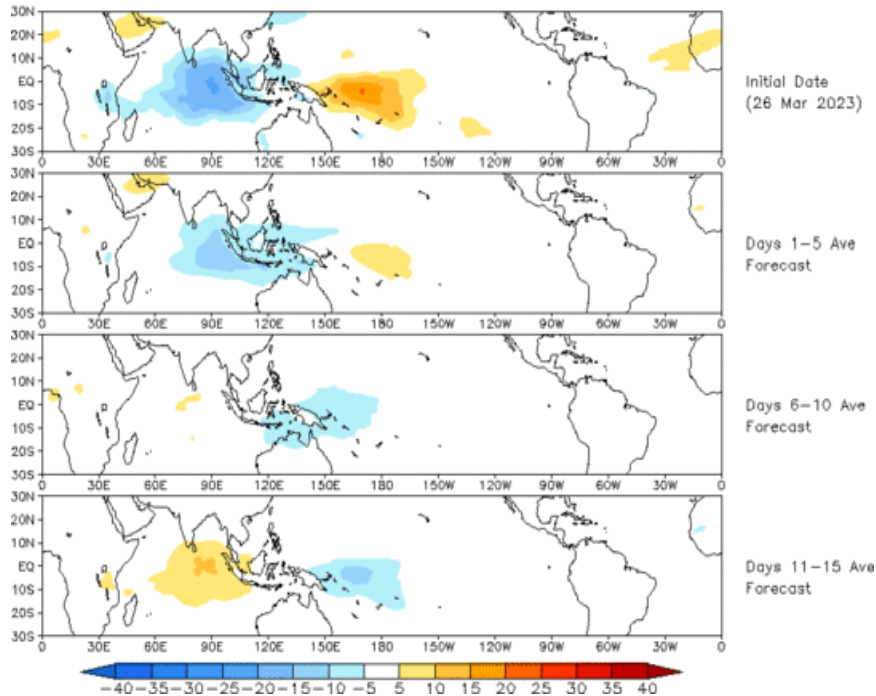


- The GEFS RMM-based forecast depicts negative OLR anomalies (enhanced convection) shifting from the Indian Ocean to the Western Pacific during the next 2 weeks.
- Conversely, positive OLR anomalies (suppressed convection) are forecast to increase across the Indian Ocean during week-2.

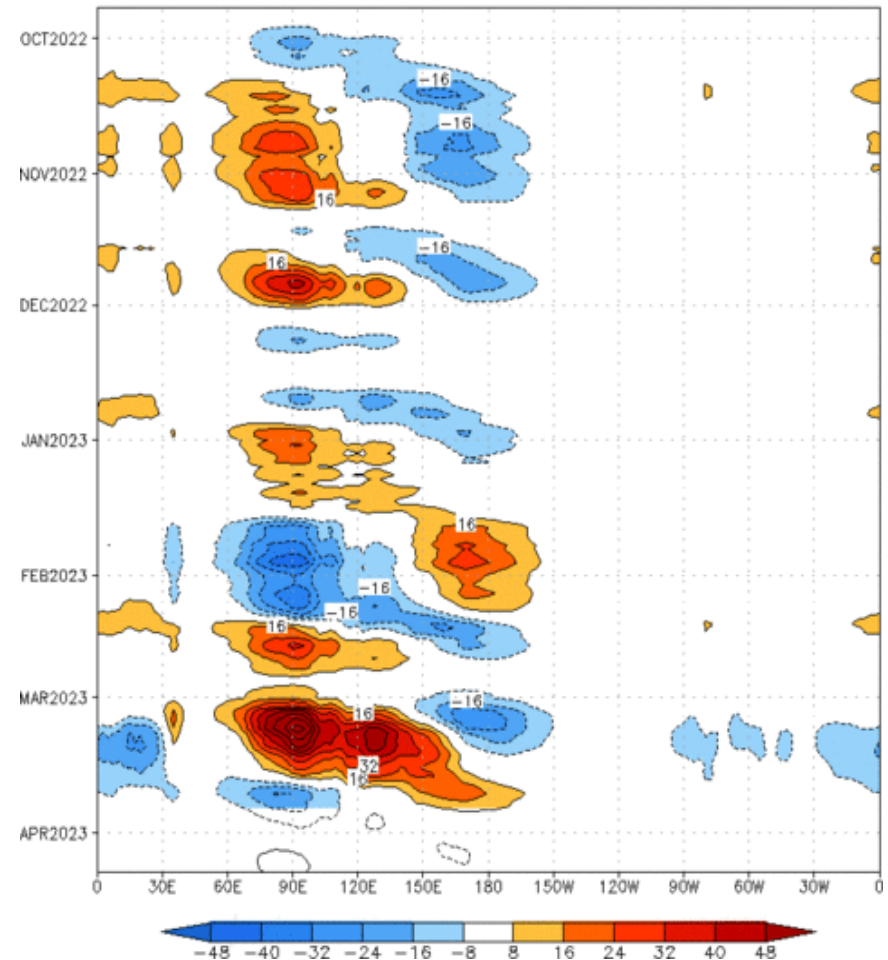
MJO: Constructed Analog Forecast Evolution

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.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (26 Mar 2023)



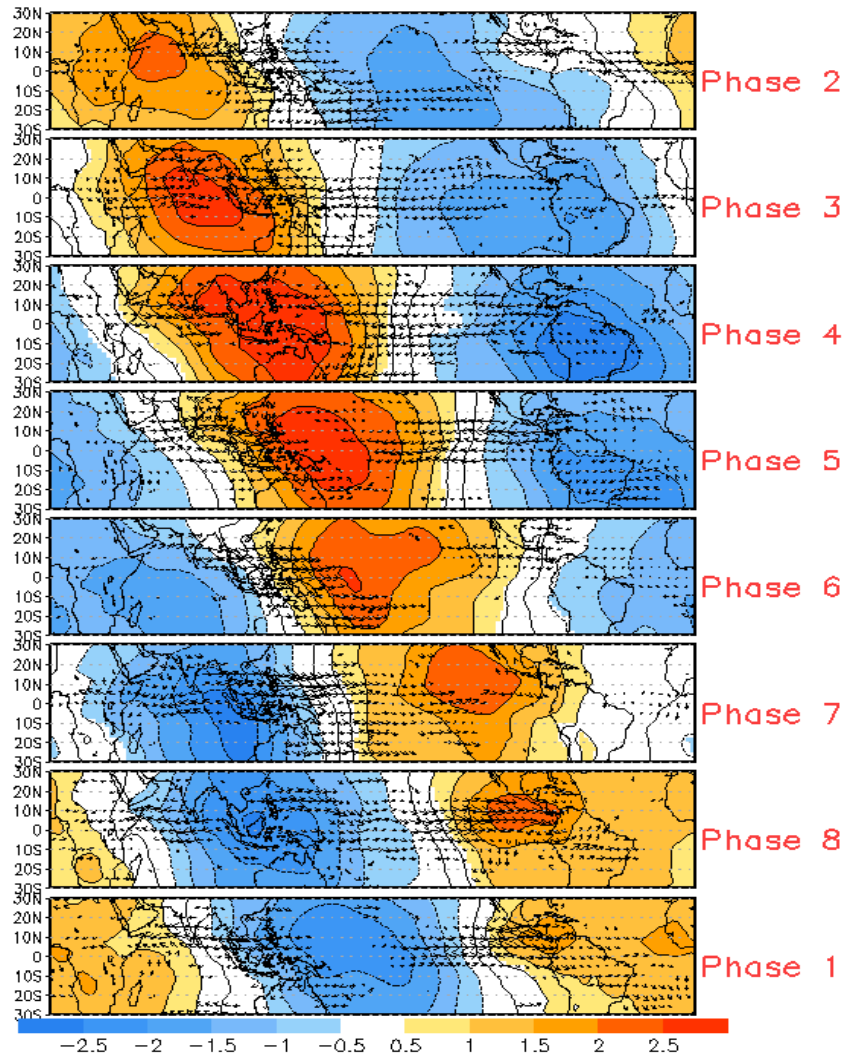
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S, 7.5°N] (cint:4Wm⁻²) Period:24-Sep-2022 to 26-Mar-2023
The unfilled contours are CA forecast reconstructed anomaly for 15 days



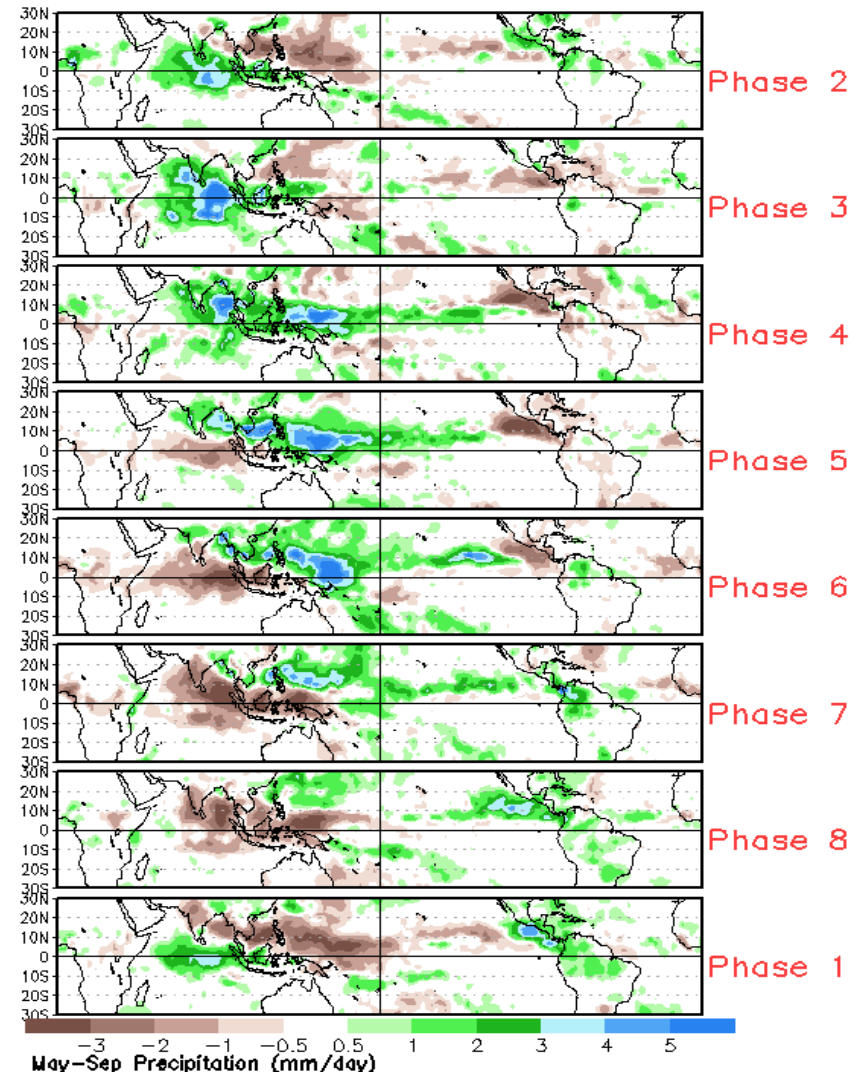
- The constructed analog RMM-based forecast is similar to the GEFS, but with weaker magnitudes of the positive and negative OLR anomalies over the Indian Ocean and Western Pacific respectively during week-2.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



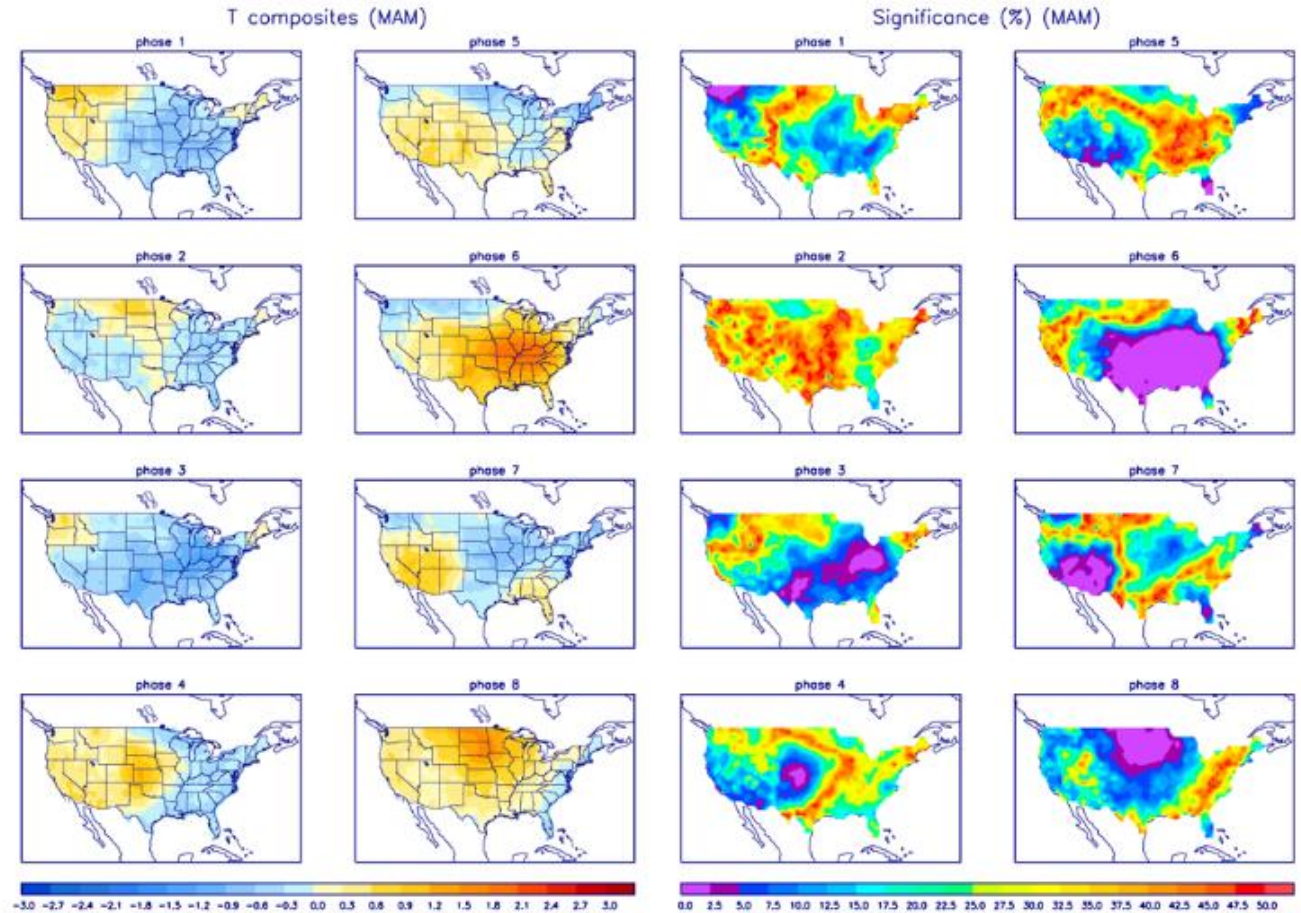
Precipitation Anomalies



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.



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.

