

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
7 March 2022

Overview

- The MJO is weak in RMM space and a coherent, eastward propagation signal is mostly observed in upper-level fields.
- La Niña remains the major contributor to anomalous rainfall throughout the global tropics and this is forecast to continue into late March.
- Tropical cyclone (TC) development is likely near Madagascar during week-1 with an elevated chance of TC formation over the southeastern Indian Ocean during the next two weeks.

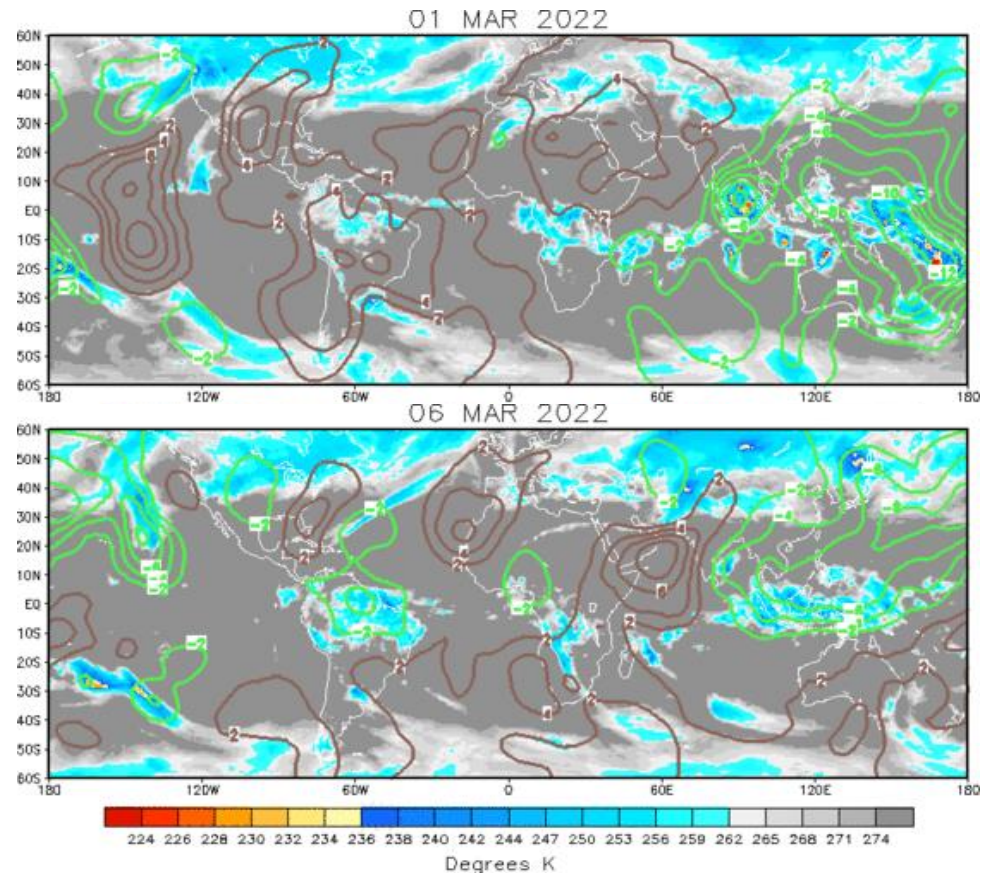
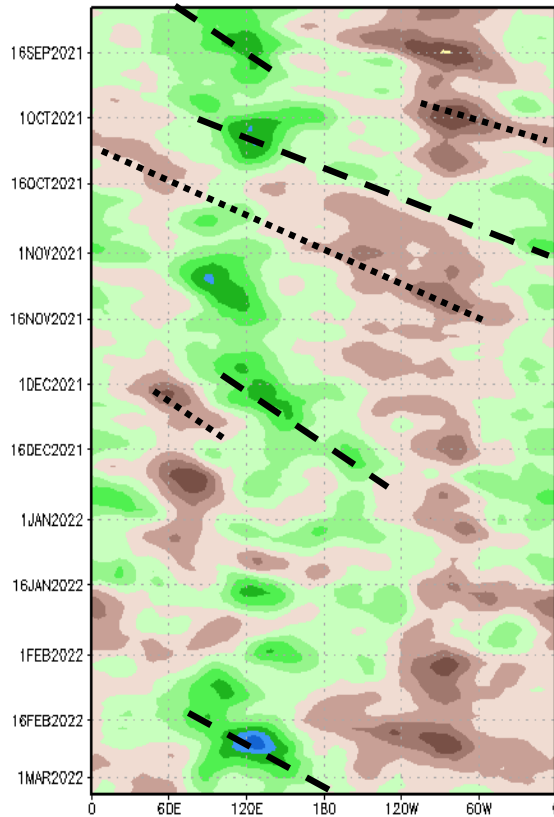
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

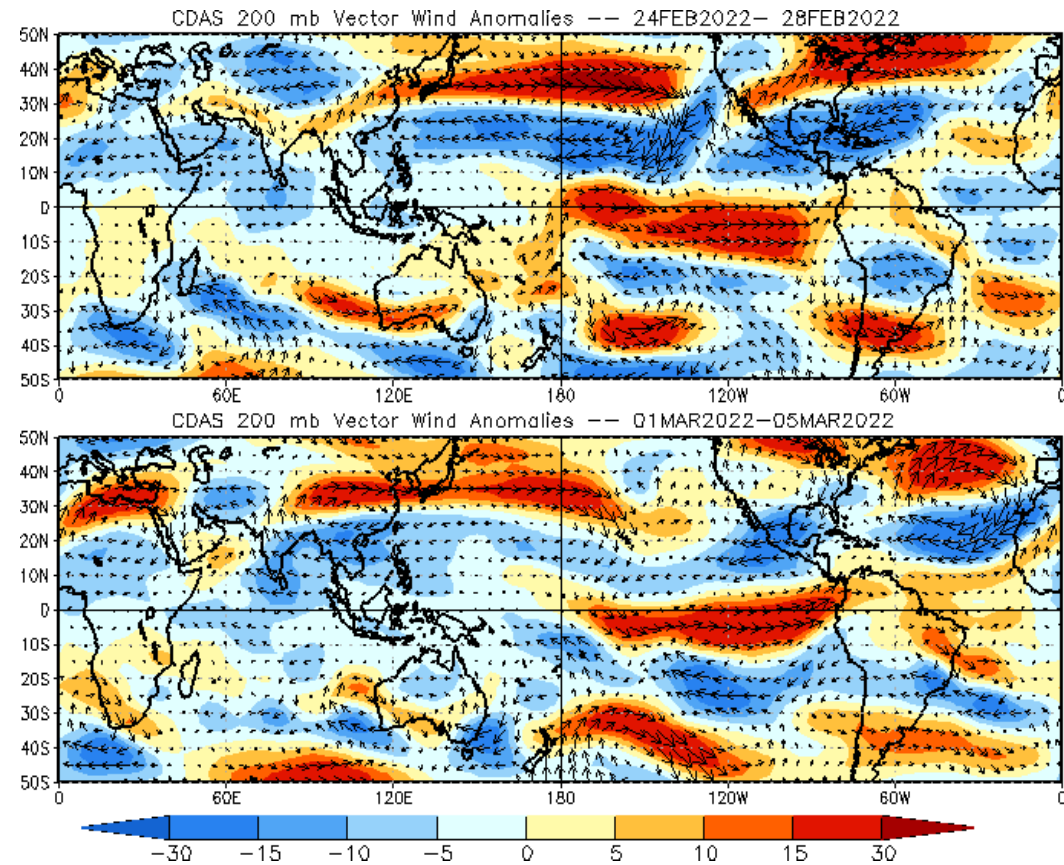
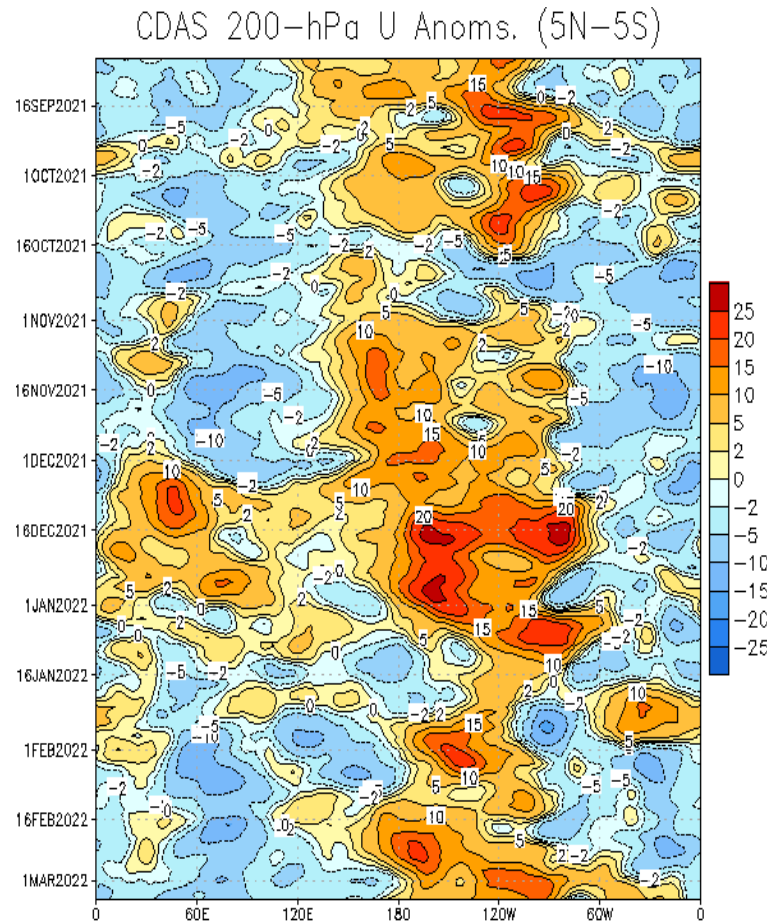
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- Following a period of strong equatorial Rossby wave activity in late January and early February, an active MJO pattern emerged, with the enhanced phase propagating from the Indian Ocean to the Maritime Continent.
- The intraseasonal signal constructively interfered with the La Niña background state in late February. However, by early March, destructive interference between the leading edge of the MJO enhanced envelope and ENSO is apparent near the Date Line.

200-hPa Wind Anomalies

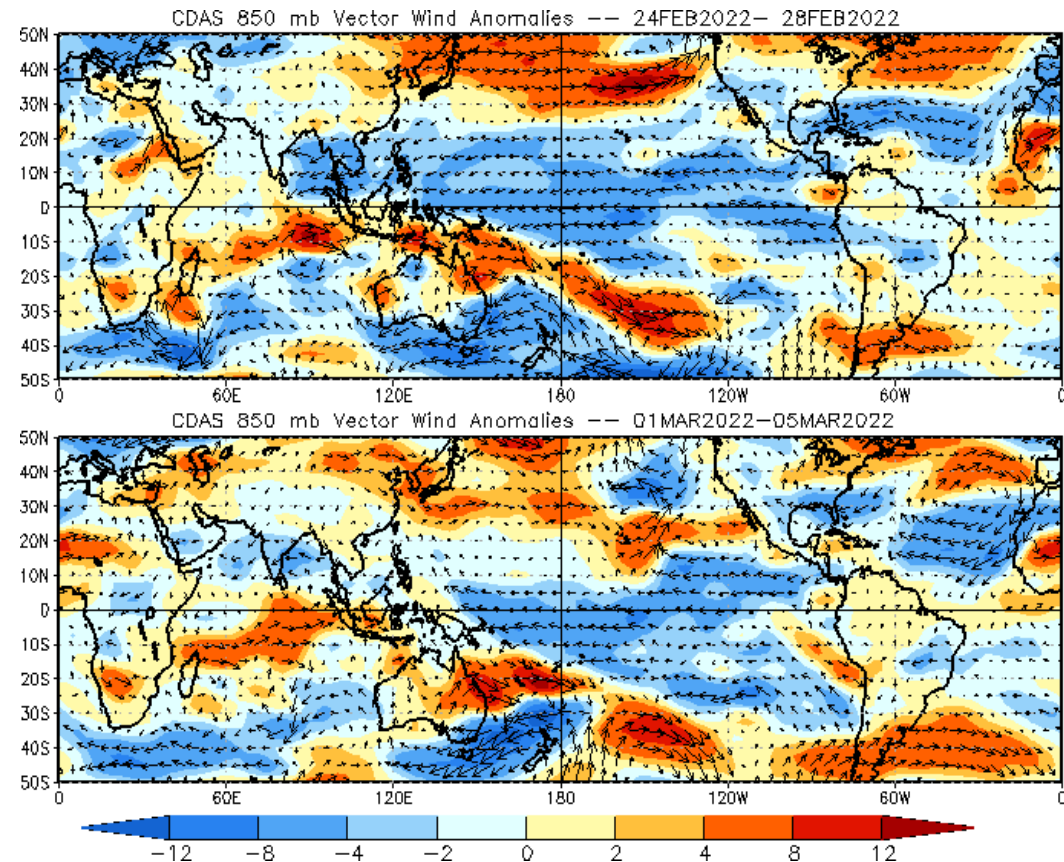
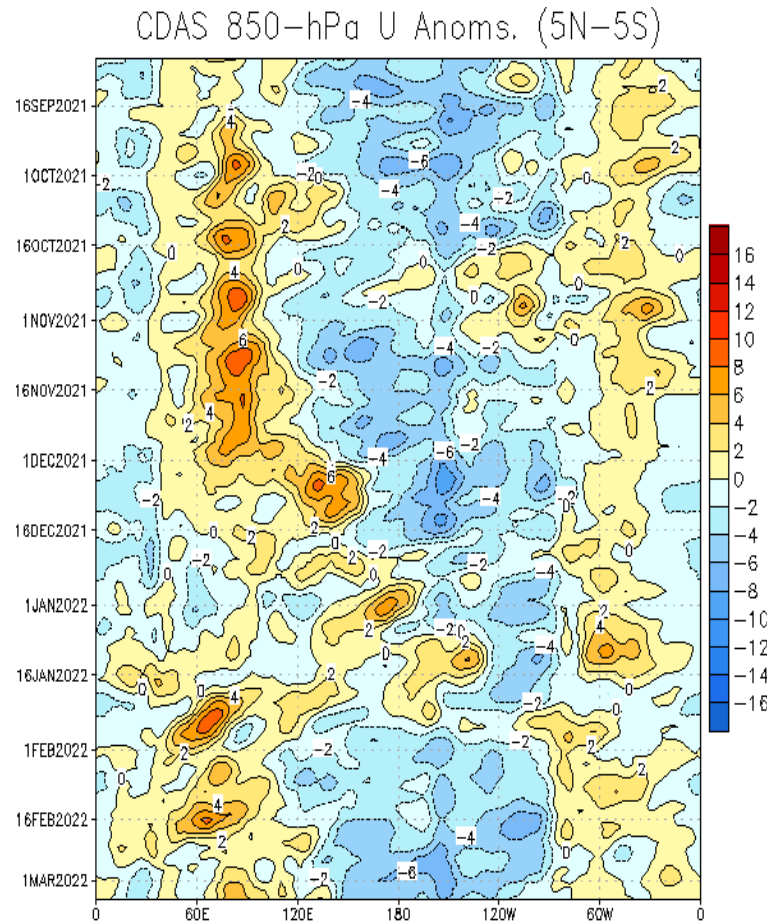
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Large envelopes of upper-level westerly (easterly) anomalies near and east of the Date Line (over the Indian Ocean and Maritime Continent) is consistent with both MJO and ENSO activity.
- During late February and the beginning of March, these upper-level anomalies propagated eastward with easterly anomalies nearing the Date Line.

850-hPa Wind Anomalies

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

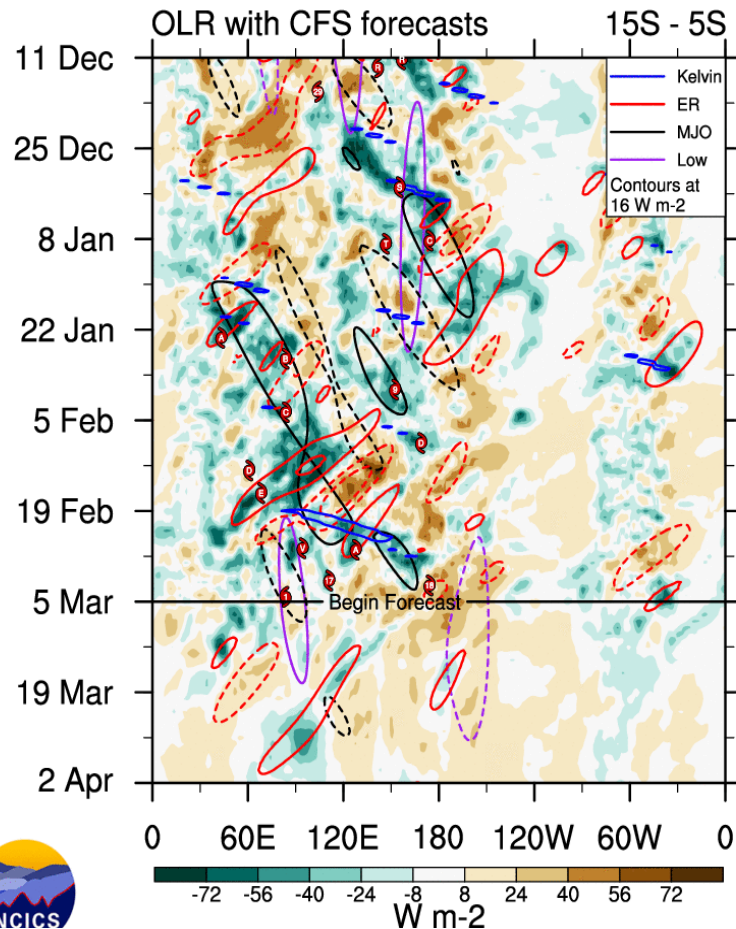


- Enhanced trade winds persist across equatorial central Pacific, consistent with the ongoing La Niña.
- Unlike the 200-hPa velocity potential and wind anomalies, there is a lack of well-defined eastward propagation of the low-level wind anomalies.

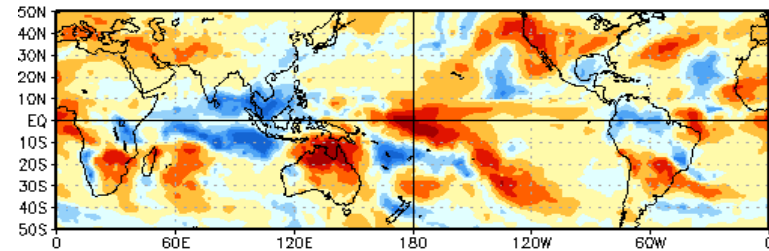
Outgoing Longwave Radiation (OLR) Anomalies

Green shades: Anomalous convection (wetness)

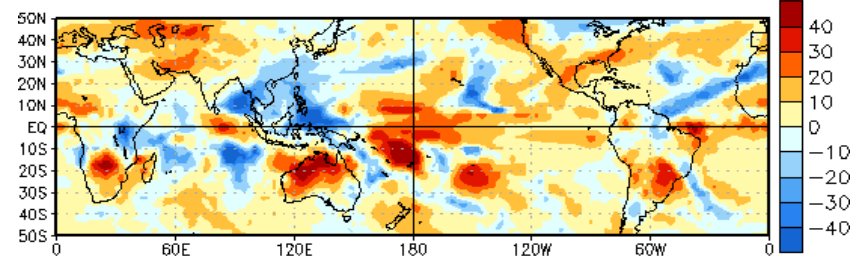
Brown shades: Anomalous subsidence (dryness)



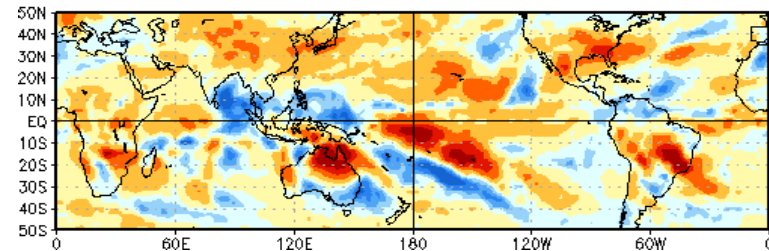
OLR Anomalies
5 FEB 2022 to 14 FEB 2022



15 FEB 2022 to 24 FEB 2022

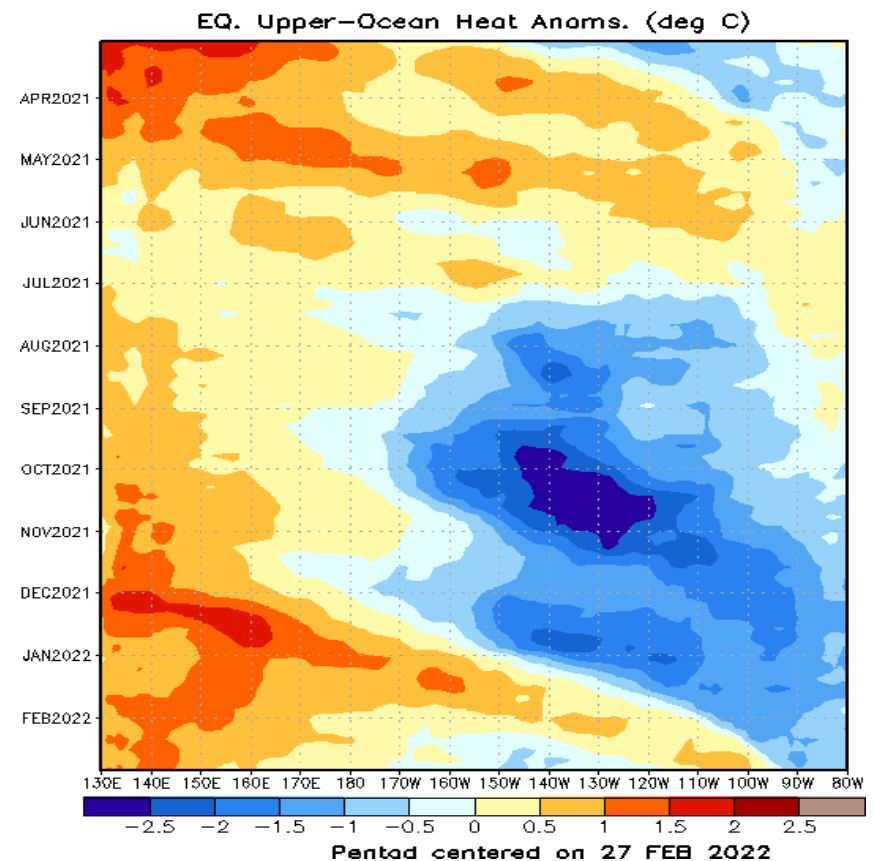
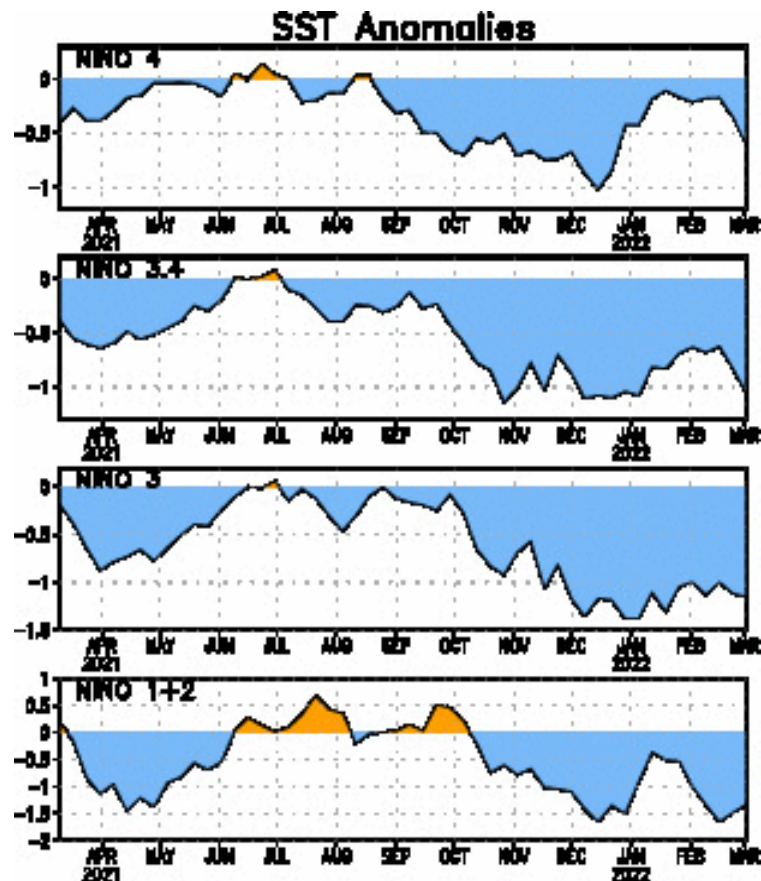


25 FEB 2022 to 6 MAR 2022



- During February, enhanced convection shifted from the Indian Ocean to the Maritime Continent, consistent with MJO activity.
- Suppressed convection continues near and to the west of the Date Line indicative of the low frequency La Niña footprint.

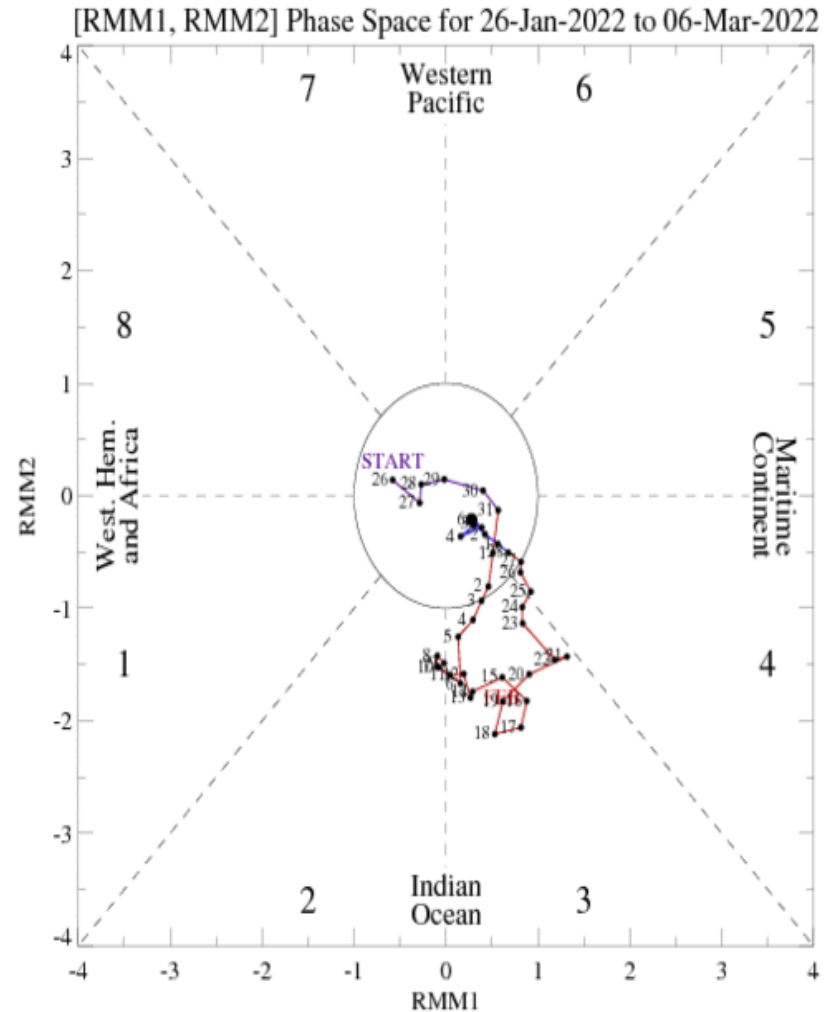
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Following the passage of a robust downwelling oceanic Kelvin wave that was generated in response to a significant westerly wind burst in December, negative upper-oceanic heat content anomalies returned between 160W and 130W.
- Negative sea-surface temperature anomalies in the Niño 4, and 3.4 regions all increased during late February, influenced by enhanced trade winds.

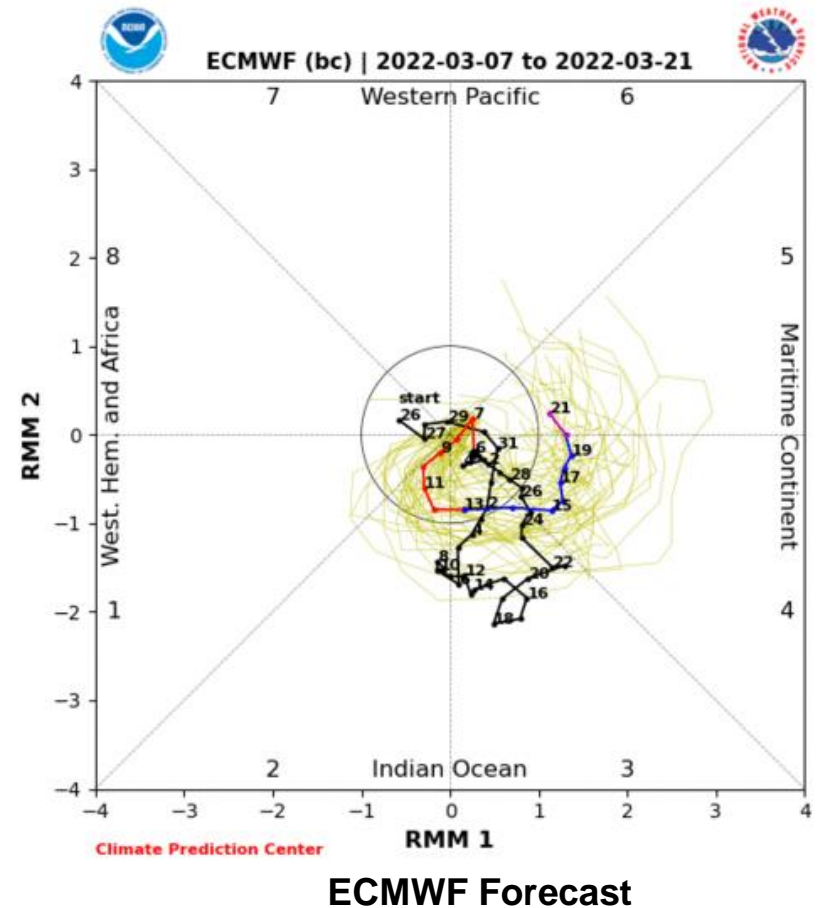
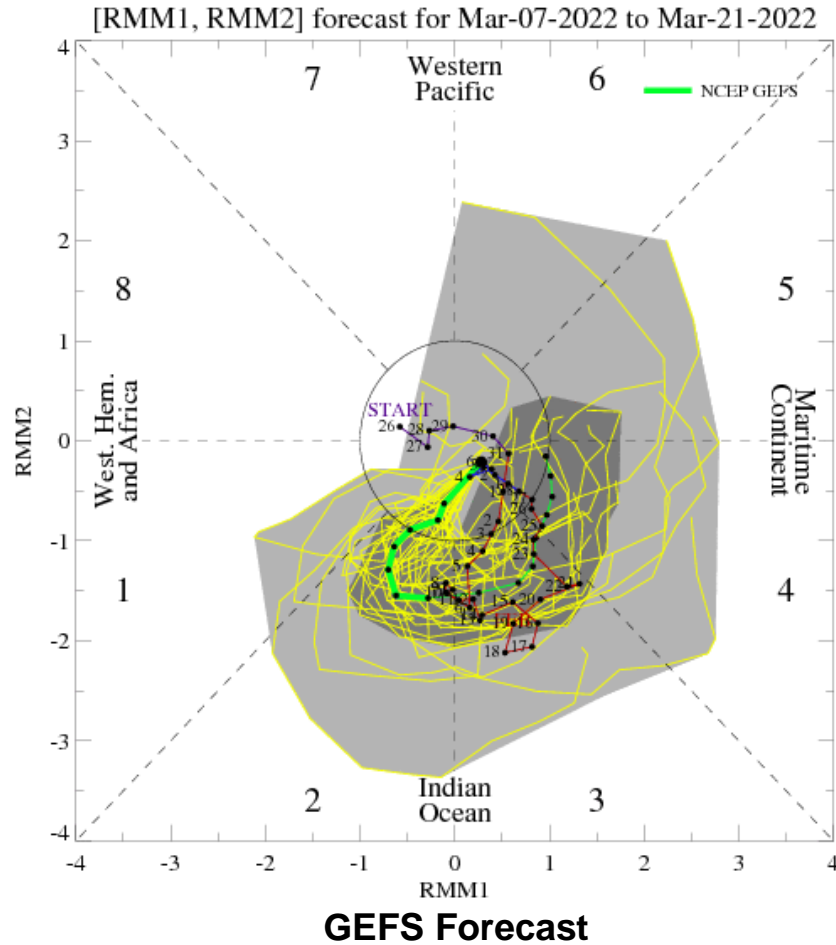
MJO Index: Recent Evolution

- The amplitude of the RMM index decreased since late February.



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

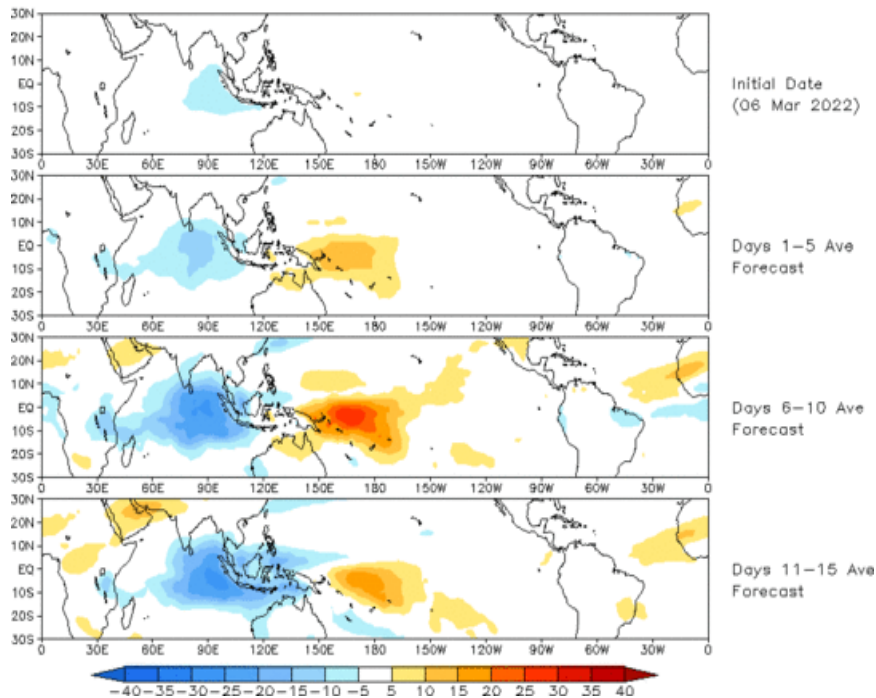


- The GEFS and ECMWF ensemble means depict an increase in the amplitude RMM index over the Indian Ocean with fast eastward propagation to the Maritime Continent during the next two weeks.
- These dynamical model forecasts appear to be more related to the ongoing La Niña and Kelvin wave activity.

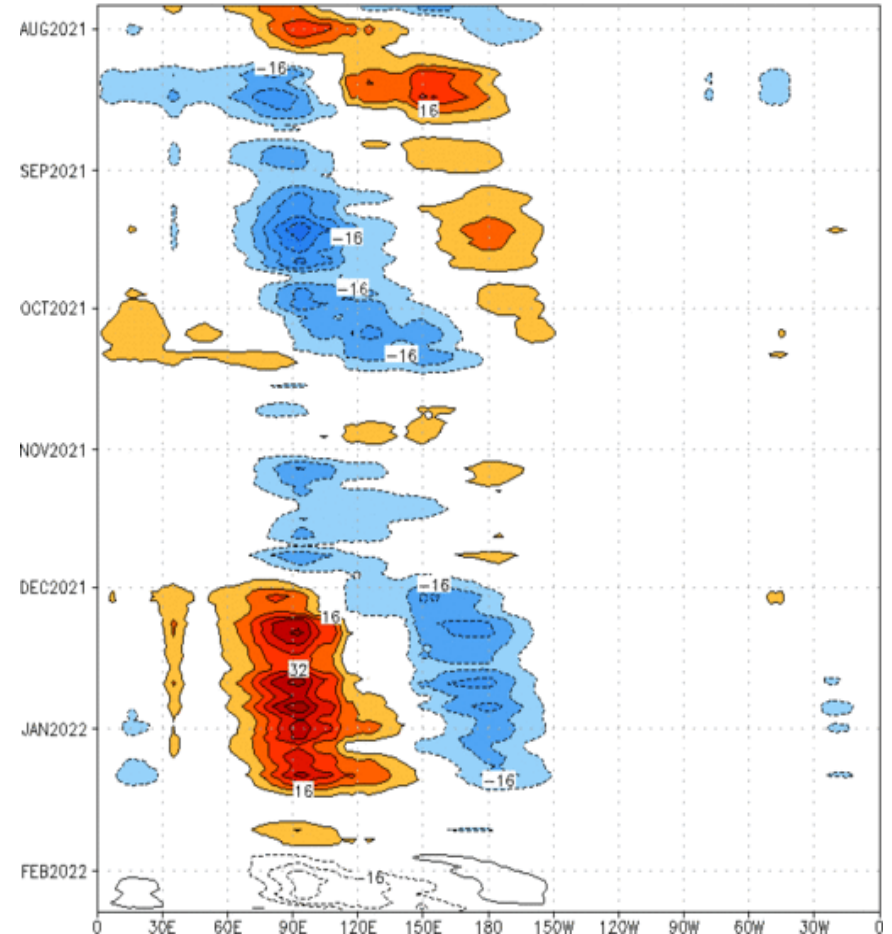
MJO: GEFS Forecast Evolution

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: 06 Mar 2022
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: 27-Jul-2021 to 26-Jan-2022
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

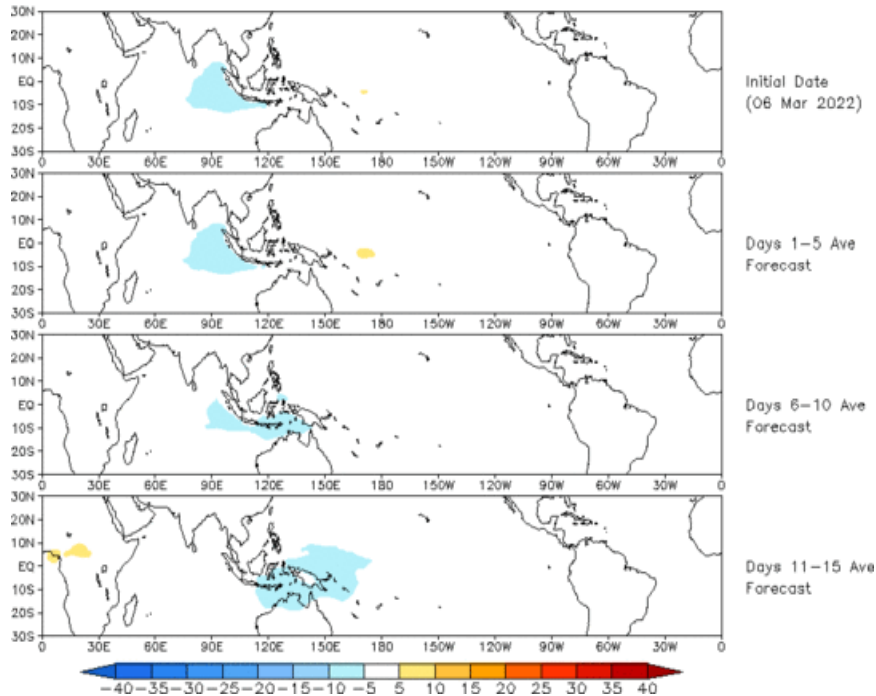


- The GEFS RMM-based OLR field depicts enhanced convection strengthening over the Indian Ocean and expanding east to the Maritime Continent. Suppressed convection is forecast to persist across the equatorial central Pacific.

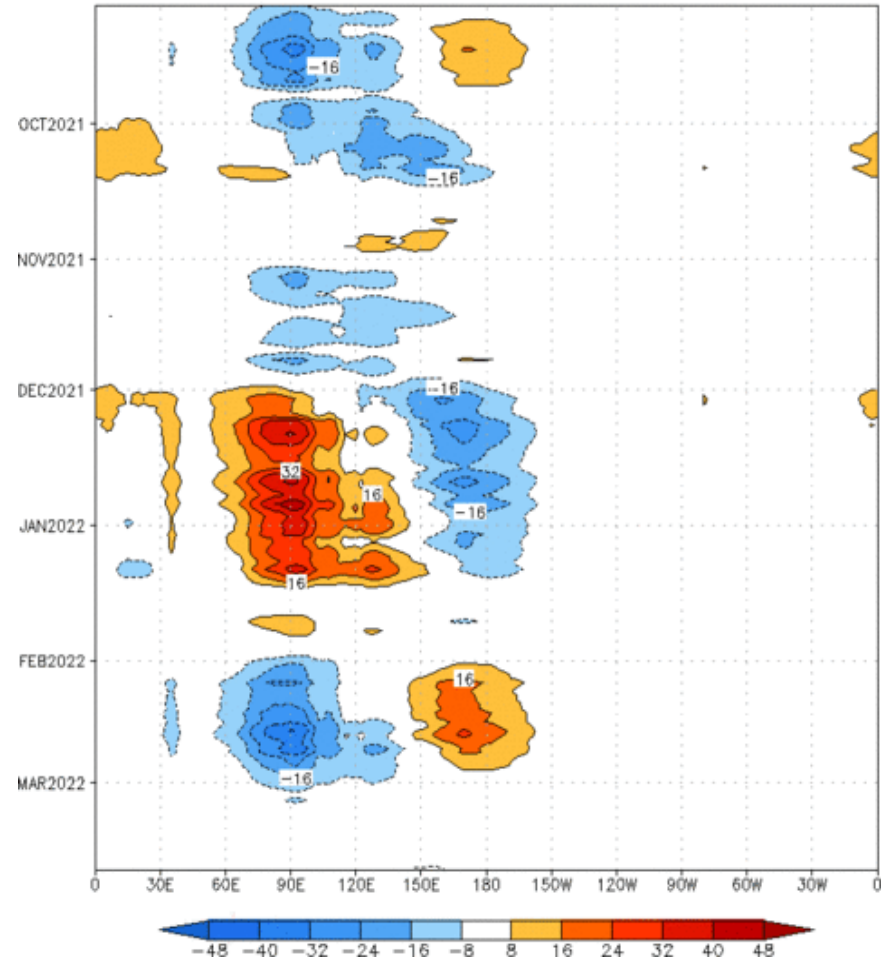
MJO: Constructed Analog Forecast Evolution

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.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (06 Mar 2022)



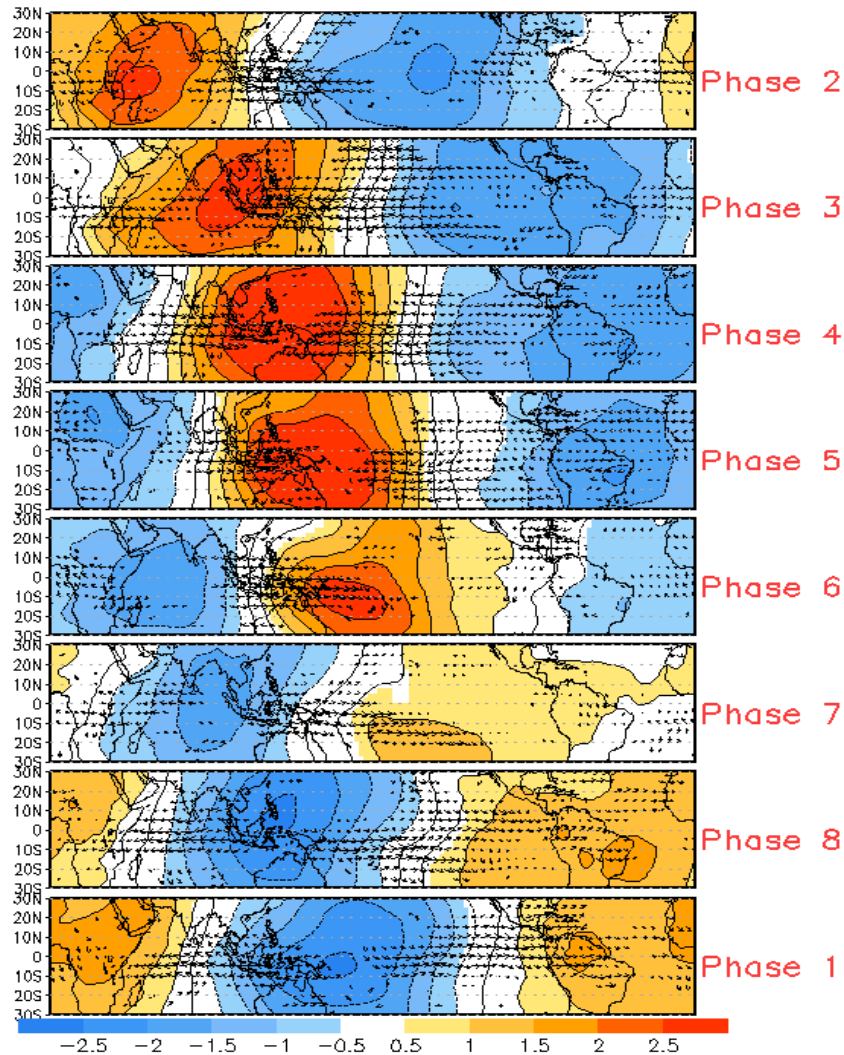
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:04-Sep-2021 to 06-Mar-2022
The unfilled contours are CA forecast reconstructed anomaly for 15 days



- The constructed analog features weak anomalies with enhanced convection shifting east from the Maritime Continent to the West Pacific.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



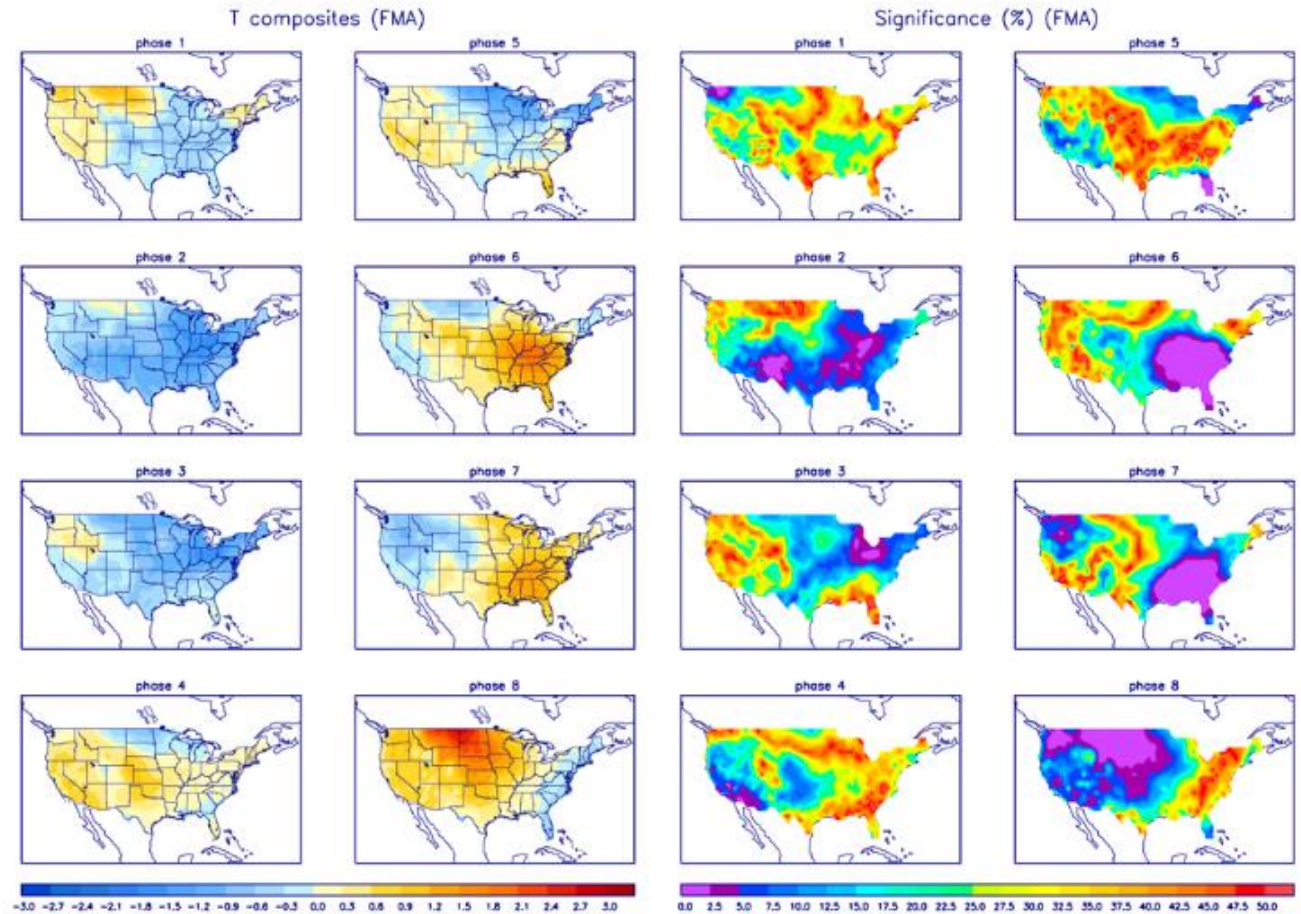
Precipitation Anomalies



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.



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.

