

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



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

Overview

- The RMM-based MJO index has been meandering across the Indian Ocean during the past week due to interference with enhanced Rossby Wave activity.
- The MJO has been constructively interfering with La Niña, leading to a reemergence of a pattern typical of La Niña across the extratropics, most notably warmer weather across the eastern United States.
- Dynamical models indicate a quick resumption of an eastward propagating MJO into the Western Pacific later this week.
- Based on this MJO evolution, tropical cyclone development is most favored near the Kimberley Coast of western Australia during week-2.

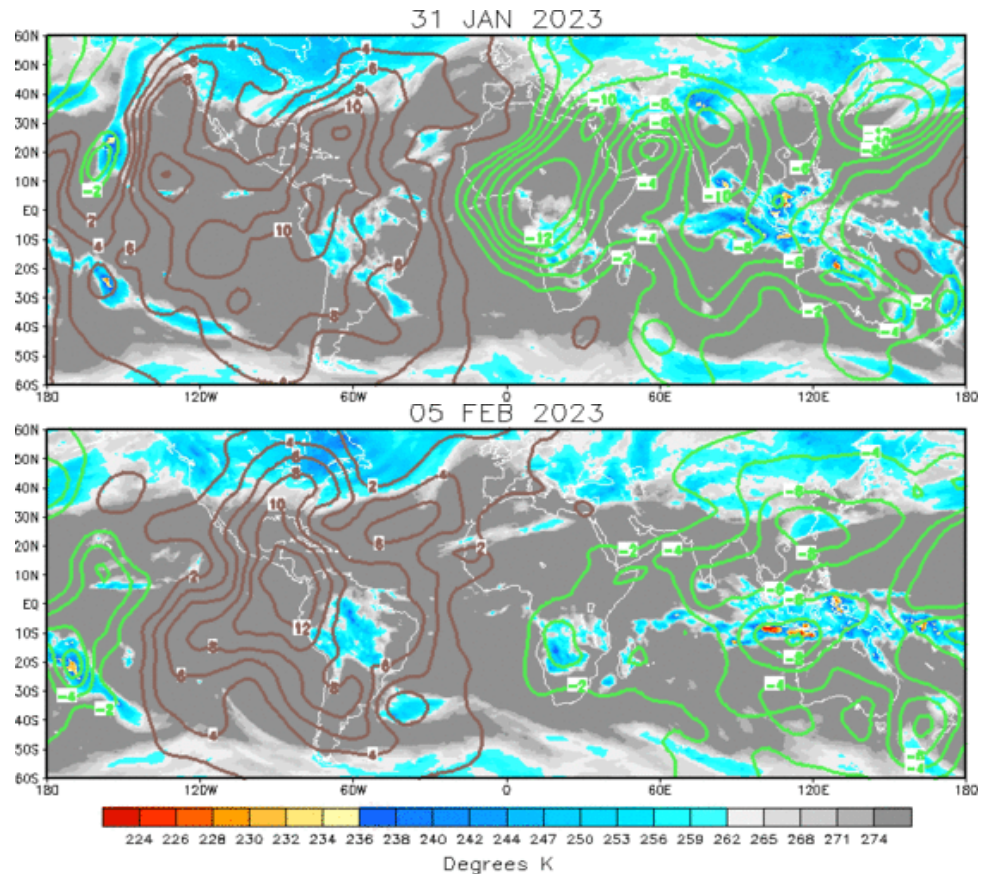
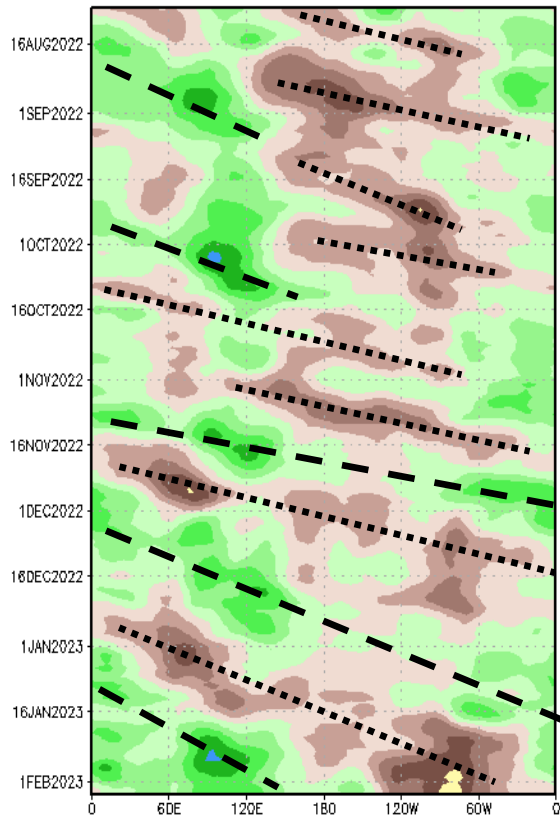
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

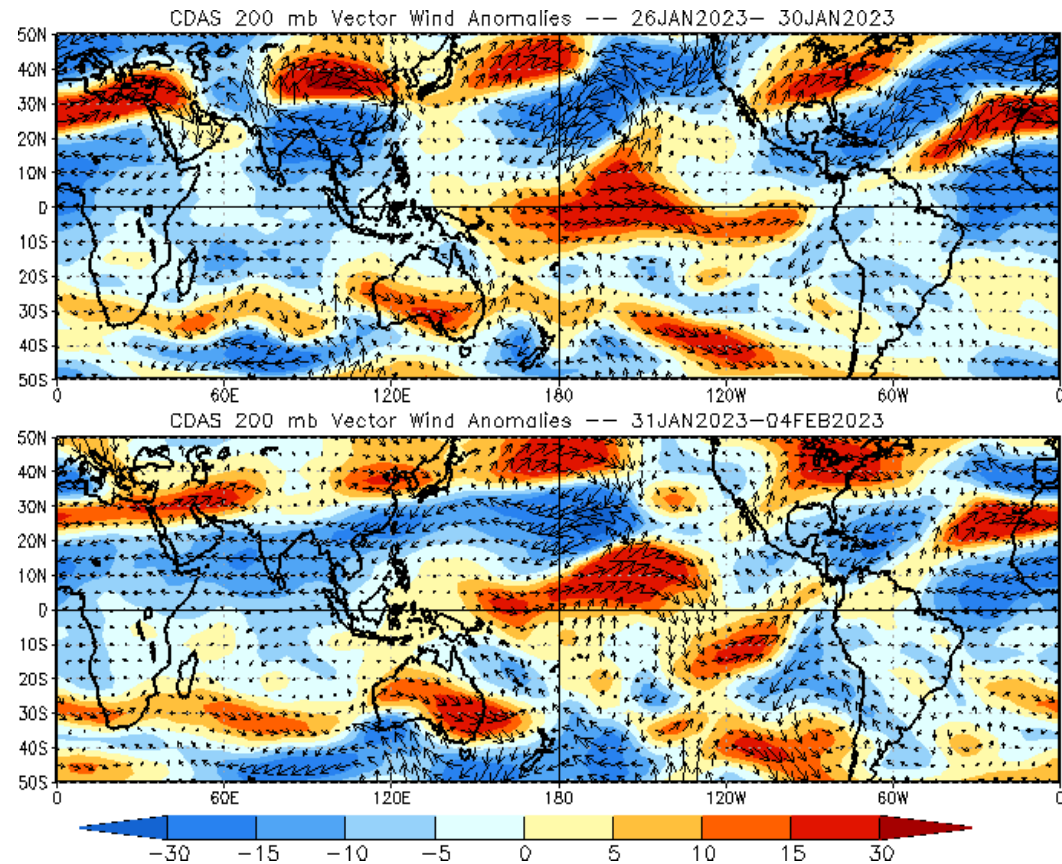
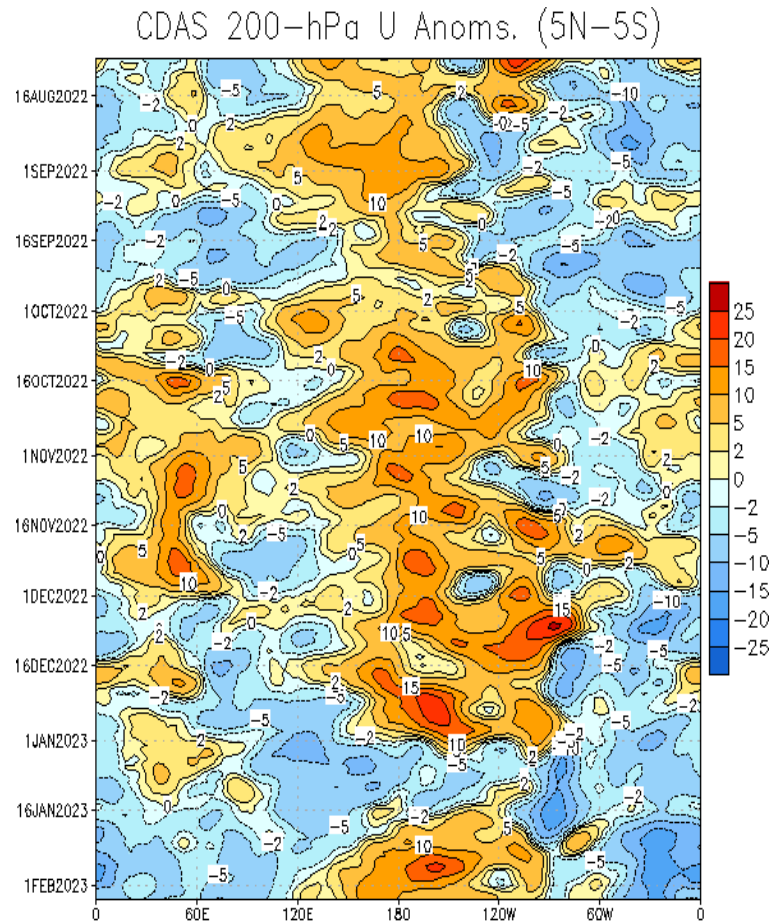
200-hPa Velocity Potential Anomaly: 5N–5S
5-day Running Mean



- Beginning last autumn, a clear MJO signal is seen propagating across the globe multiple times, suggesting the background La Niña state is becoming less dominant.
- A wave-1 asymmetry pattern is depicted in the spatial upper-level velocity potential field with enhanced (suppressed) convection across the Indian Ocean, Maritime Continent and Western Pacific (Eastern Pacific, Americas, and Atlantic).

200-hPa Wind Anomalies

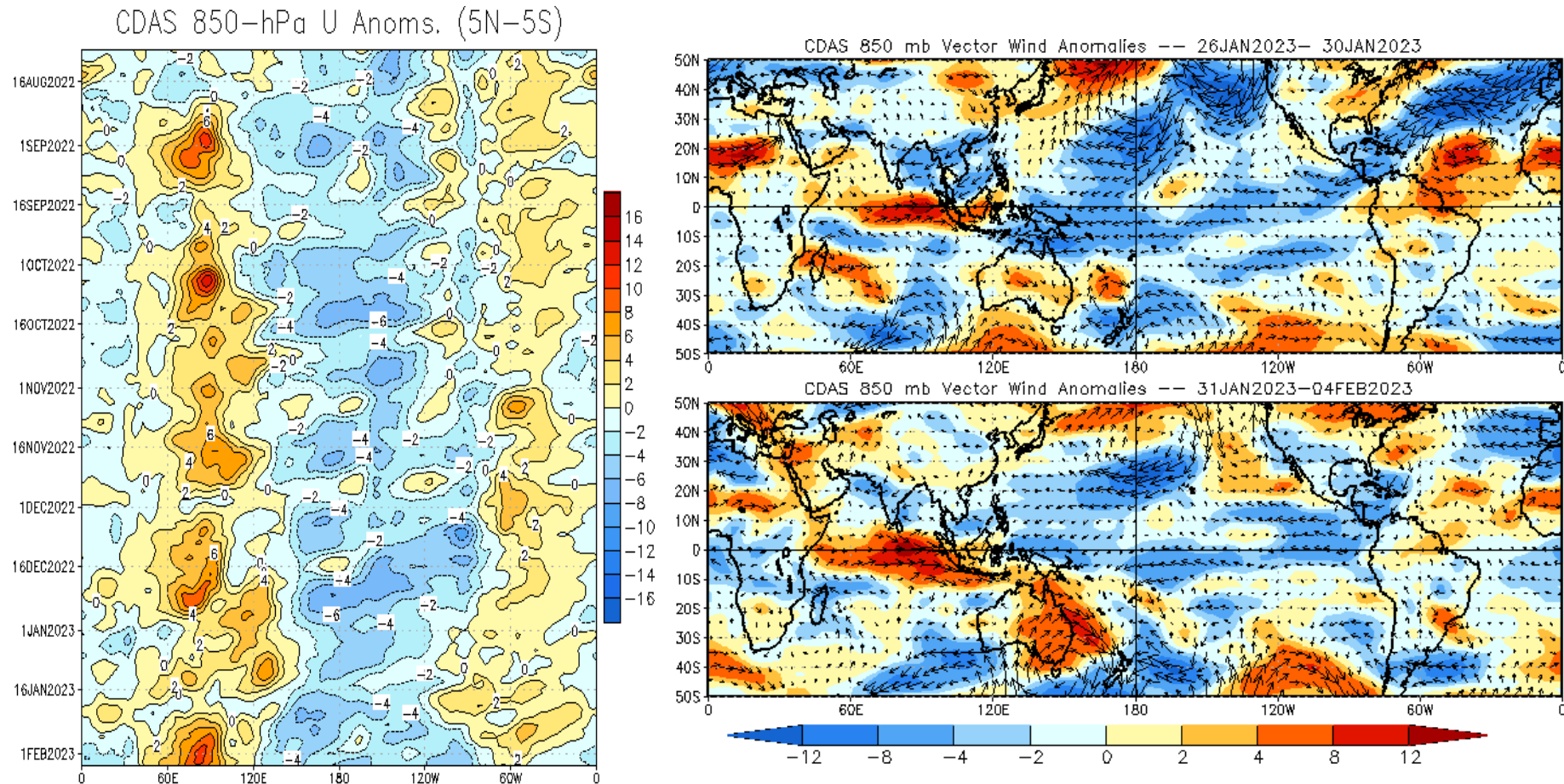
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- During late January, constructive interference between La Niña and the MJO resulted in an increase in upper-level westerlies across the equatorial Pacific, typical of La Niña.
- Upper-level easterlies decreased across the southern Indian Ocean during the past week.
- A large anti-cyclonic circulation is depicted across the eastern United States, which is predicted to persist and lead to warmer than average conditions during the month of February.

850-hPa Wind Anomalies

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

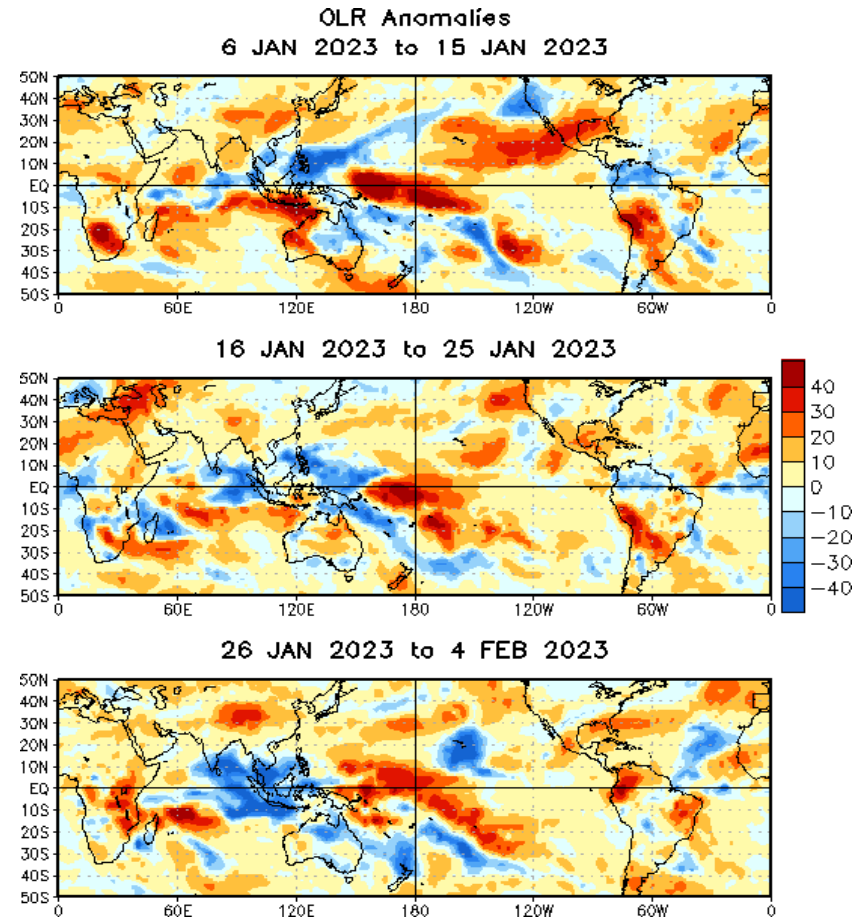
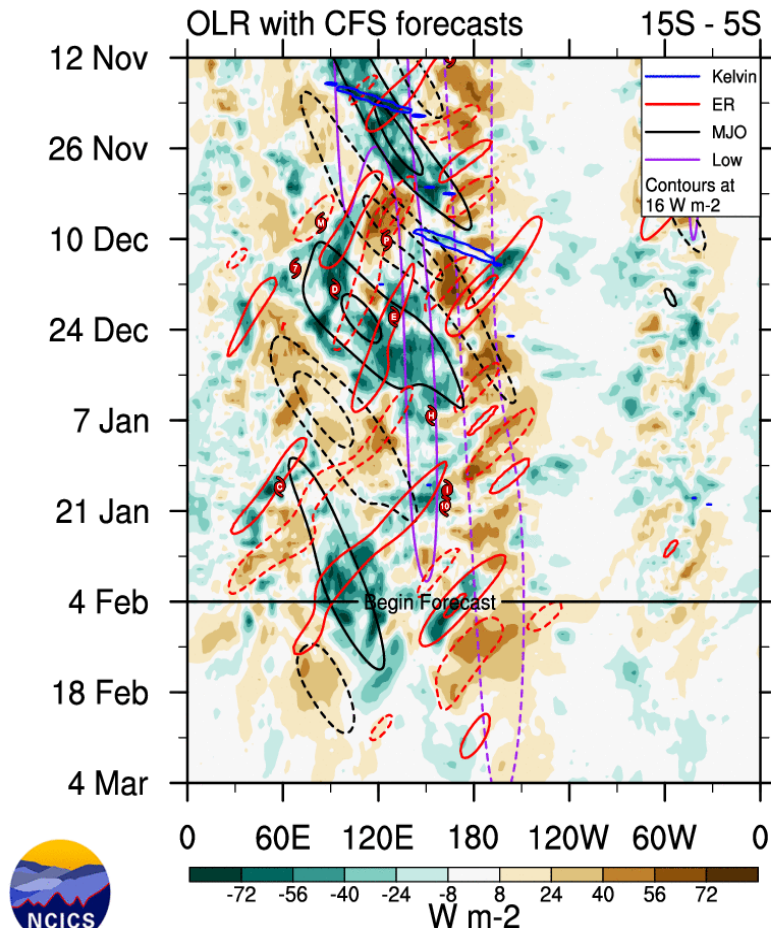


- Low-level westerlies have increased across the Indian Ocean associated with the MJO.
- Enhanced trade winds associated with the La Niña persist throughout the equatorial Central Pacific, but are less expansive compared to last week.

Outgoing Longwave Radiation (OLR) Anomalies

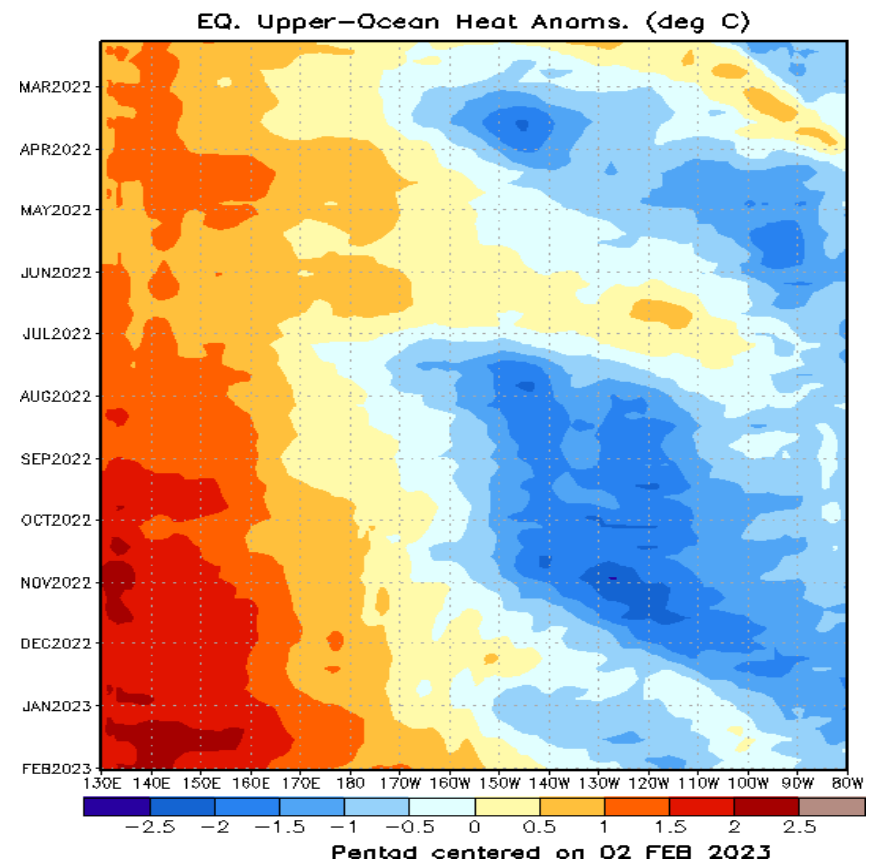
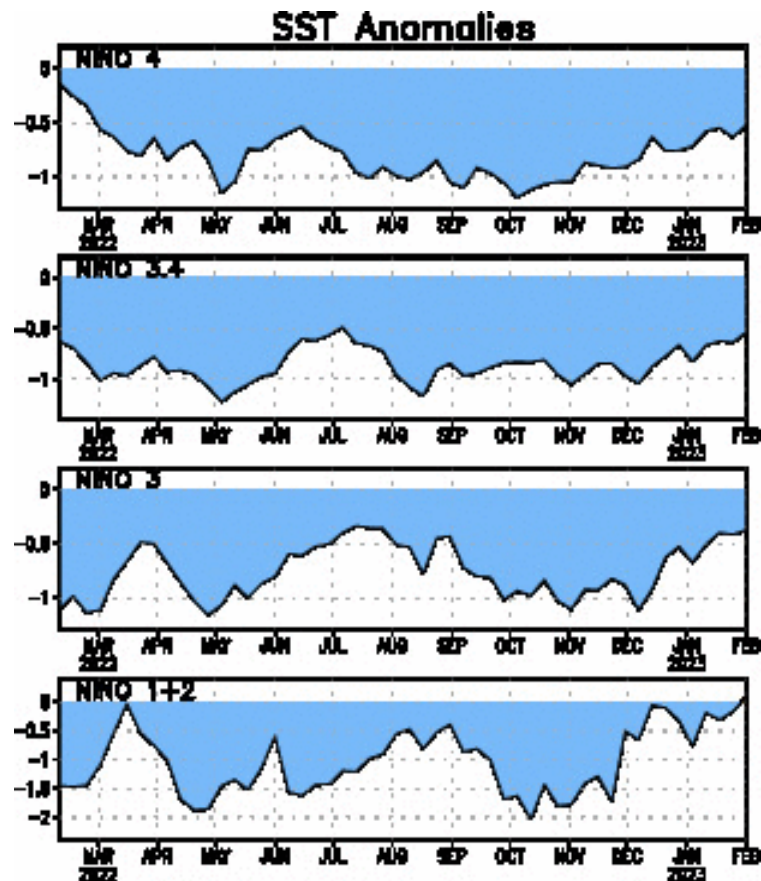
Green shades: Anomalous convection (wetness)

Brown shades: Anomalous subsidence (dryness)



- Enhanced Rossby Wave activity along with the MJO has led to enhanced convection across the eastern Indian Ocean and Maritime Continent.
- Currently, a La-Nina-like signal is established across the equatorial central Pacific with positive OLR anomalies strengthening relative to the previous week.

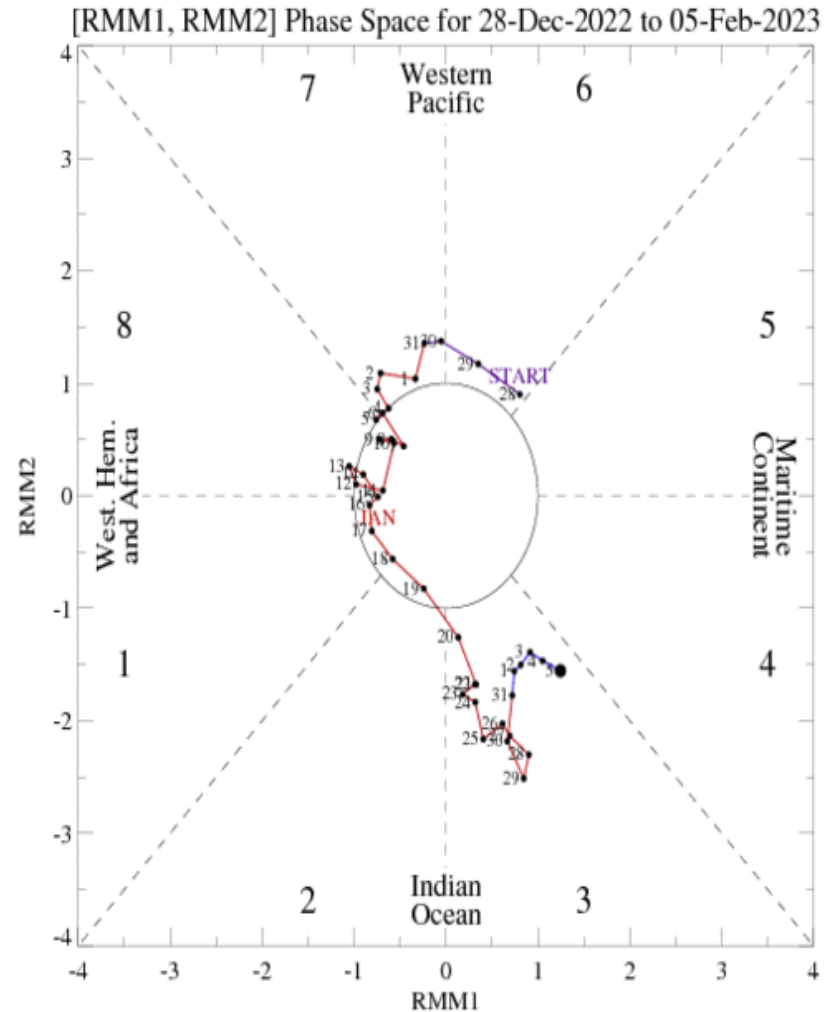
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Following a period of subsurface cooling across the central and eastern equatorial Pacific tied to La Niña during January, increased low-level westerlies upstream are leading to another downwelling Kelvin Wave and renewed subsurface warming extending through $\sim 130^{\circ}\text{W}$.
- A warming trend is noted in all of the Niño indices since December.

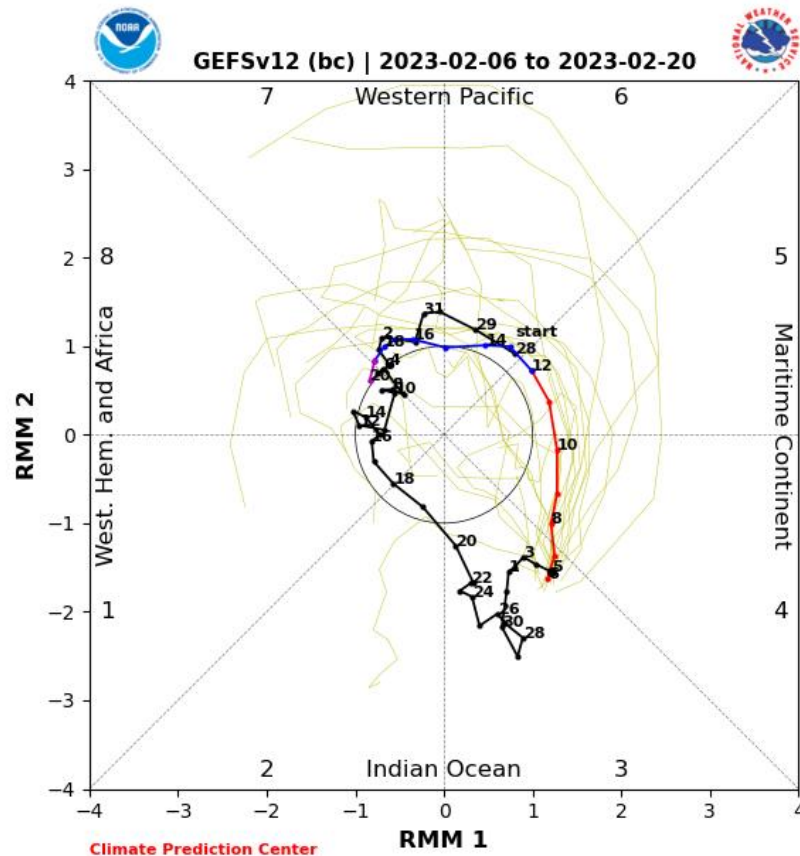
MJO Index: Recent Evolution

- During the past week the RMM-based MJO index has meandered over the Indian Ocean, likely driven by interference with enhanced Rossby Wave activity.

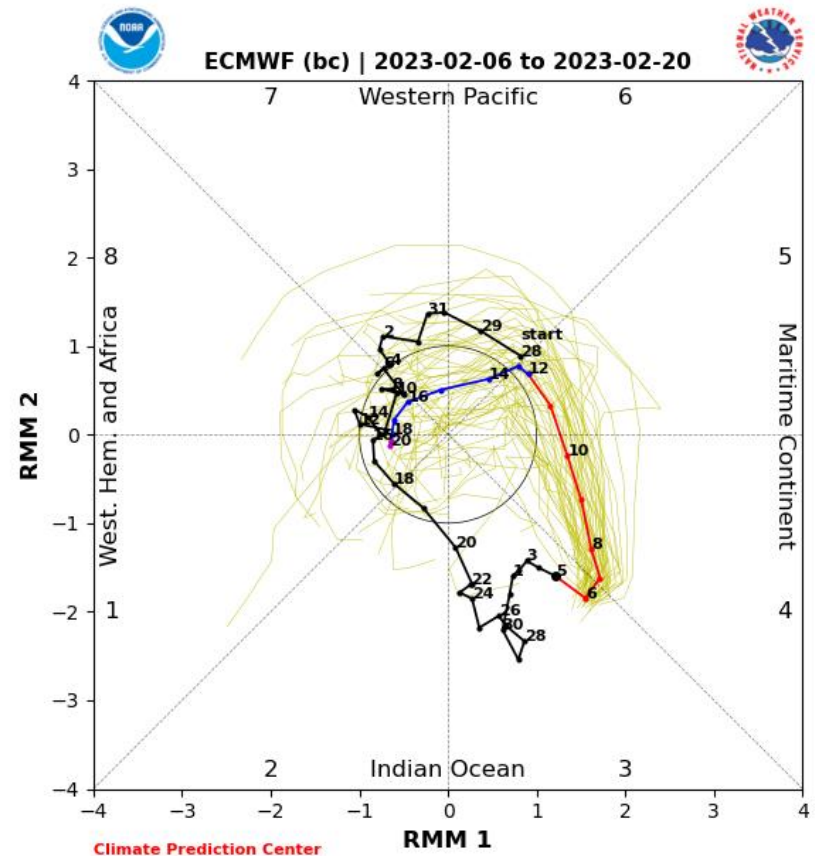


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



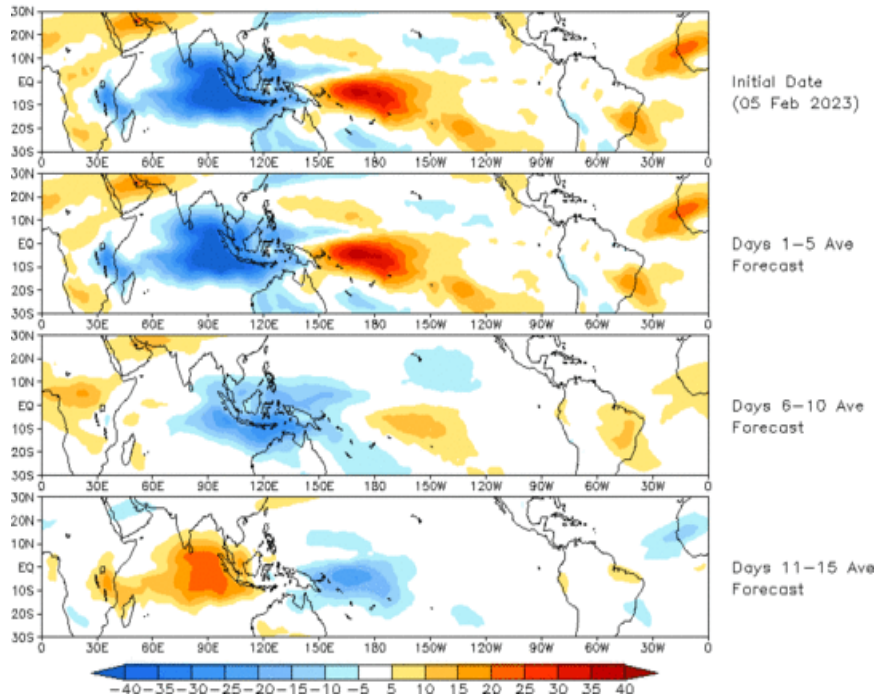
ECMWF Forecast

- The GEFS and ECMWF ensemble means are in good agreement that the MJO quickly propagates eastward into the Maritime Continent by the end of this week.
- Continued propagation of the MJO into the Western Pacific is indicated during week 2, with the signal possibly returning to the Western Hemisphere by mid- to late-February.

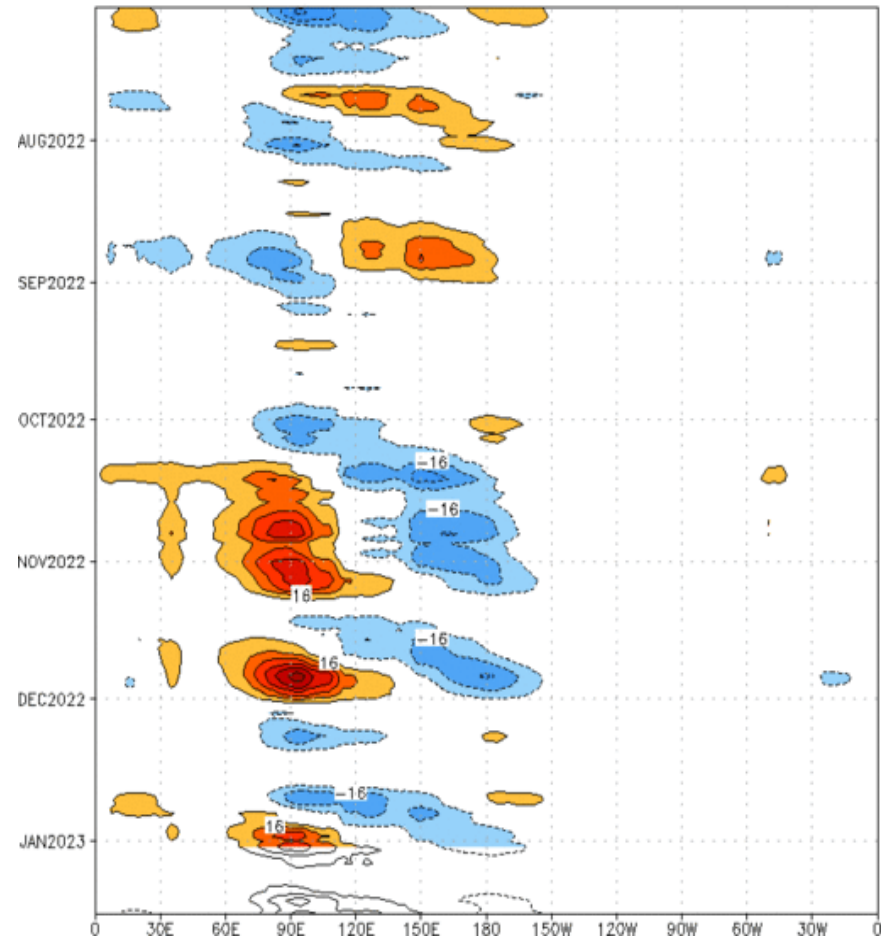
MJO: GEFS Forecast Evolution

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.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 05 Feb 2023
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S, 7.5°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

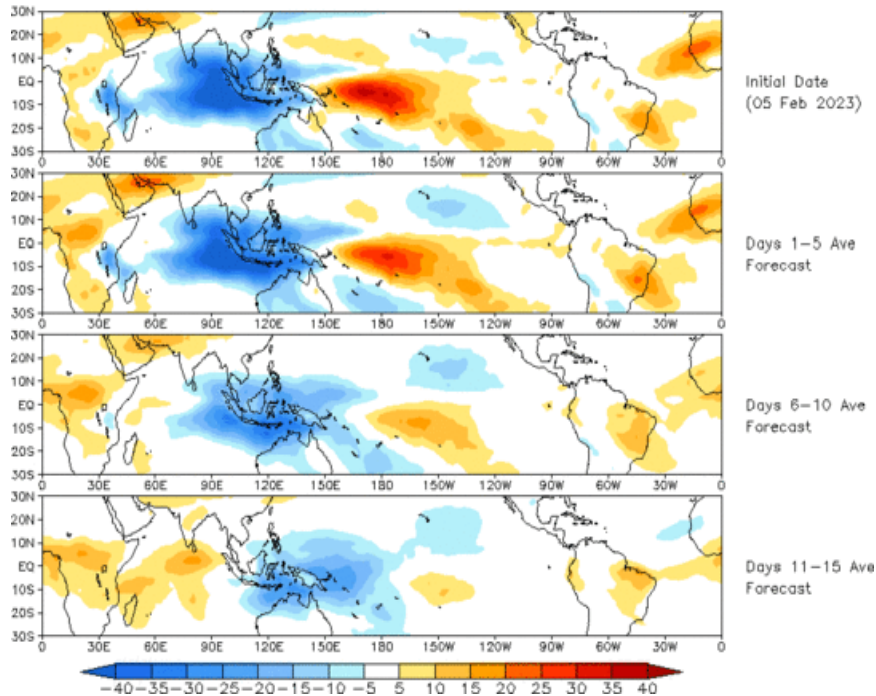


- The GEFS indicates negative OLR anomalies (enhanced convection) shifting from the Indian Ocean to the Maritime Continent and Western Pacific during week-2.
- Positive OLR anomalies (suppressed convection) are forecast to weaken with time across the Central Pacific, but increase across the Indian Ocean by the end of week-2.

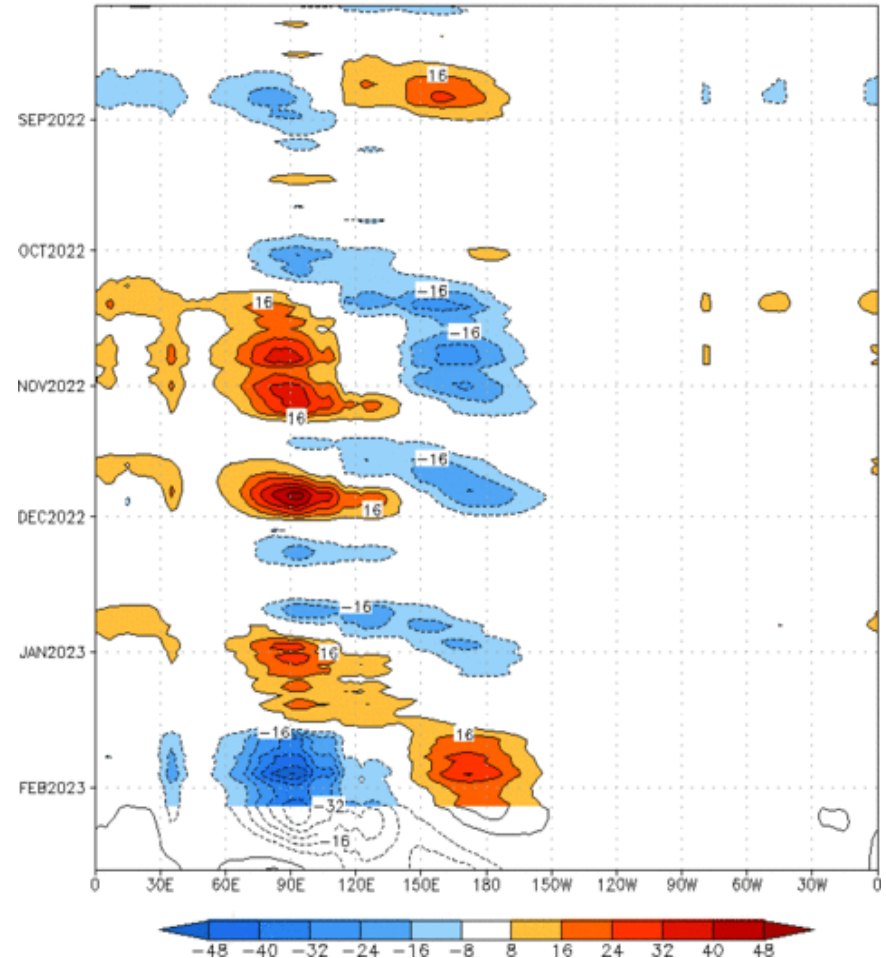
MJO: Constructed Analog Forecast Evolution

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 (05 Feb 2023)



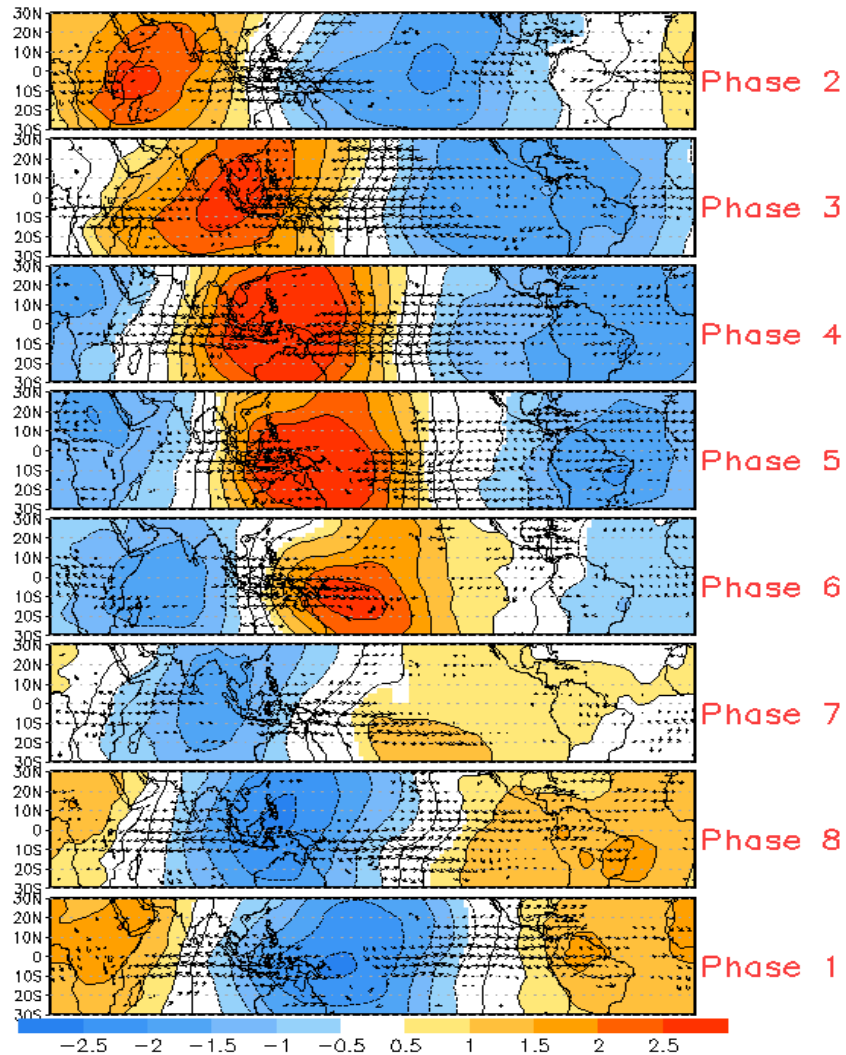
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:06–Aug–2022 to 05–Feb–2023
The unfilled contours are CA forecast reconstructed anomaly for 15 days



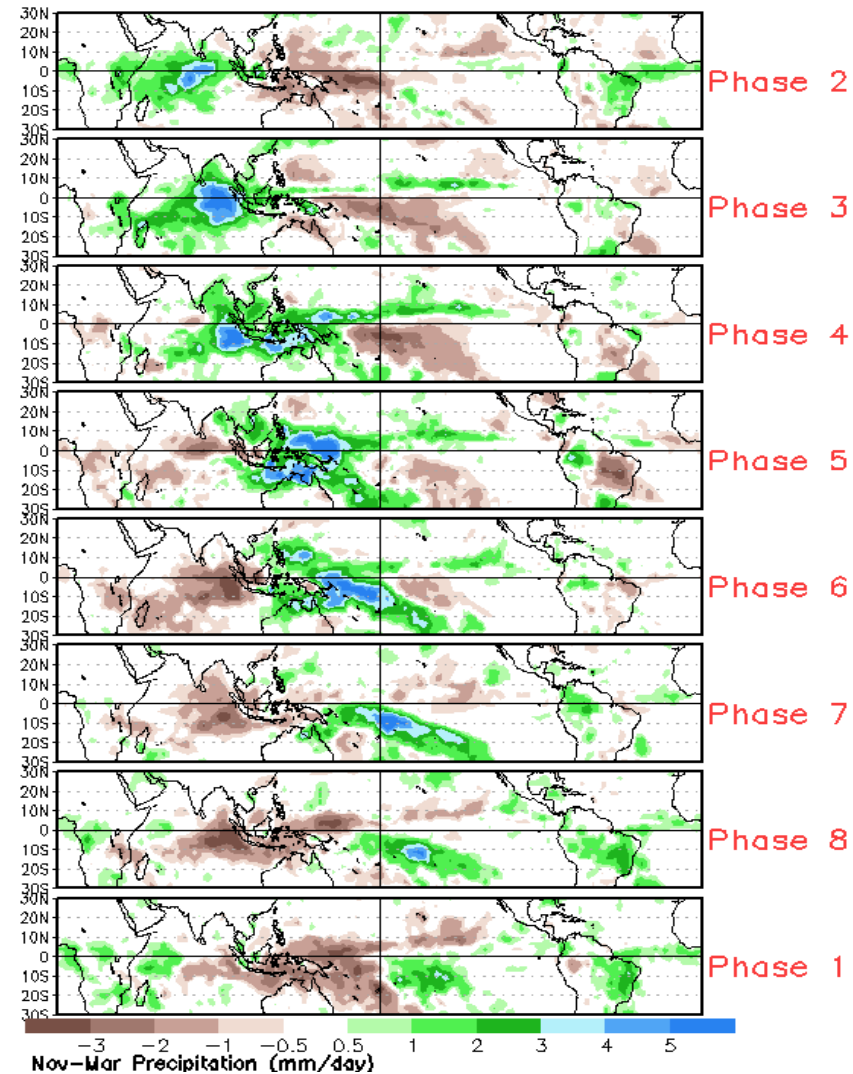
- The constructed analog forecast is very similar to the GEFS with a gradual eastward shift of negative OLR anomalies into the Maritime Continent and Western Pacific, and increasing positive OLR anomalies across the Indian Ocean.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



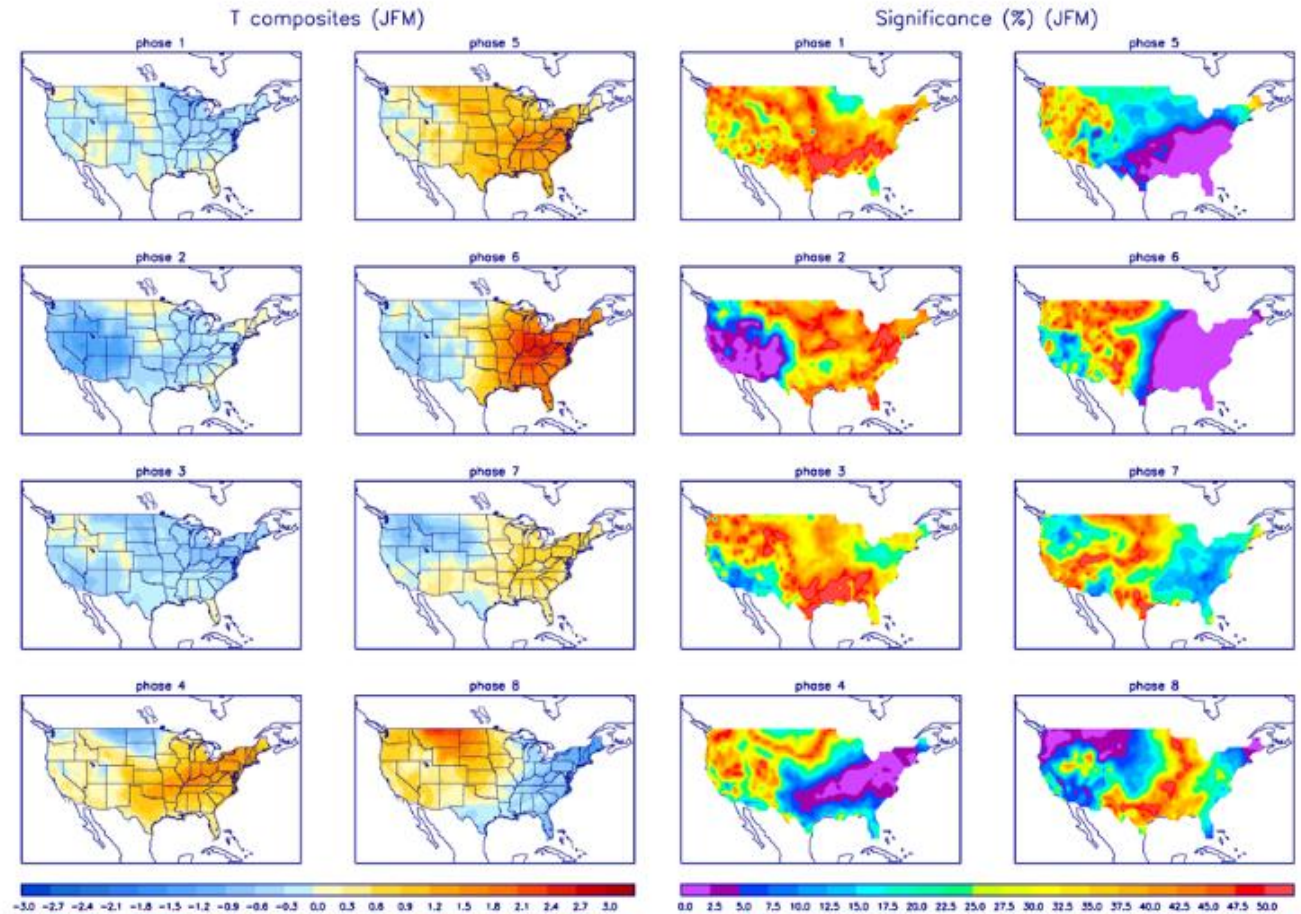
Precipitation Anomalies



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.

