

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



Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
15 February 2021

Overview

- The RMM index continues to portray a weak MJO signal over the Western Pacific, which is likely influenced by other tropical waves and the La Niña state.
- Model guidance varies on the evolution of this intraseasonal signal during the next two weeks, but is consistent in showing some westward progression that would be uncharacteristic of the MJO but more in line with equatorial Rossby wave activity. The ECMWF ensemble mean and some GEFS members also portray the MJO as weakening over the next two weeks.
- Given the lack of a strong MJO signal, the most significant extratropical teleconnection will likely be driven by the low frequency La Niña state during the next two weeks.

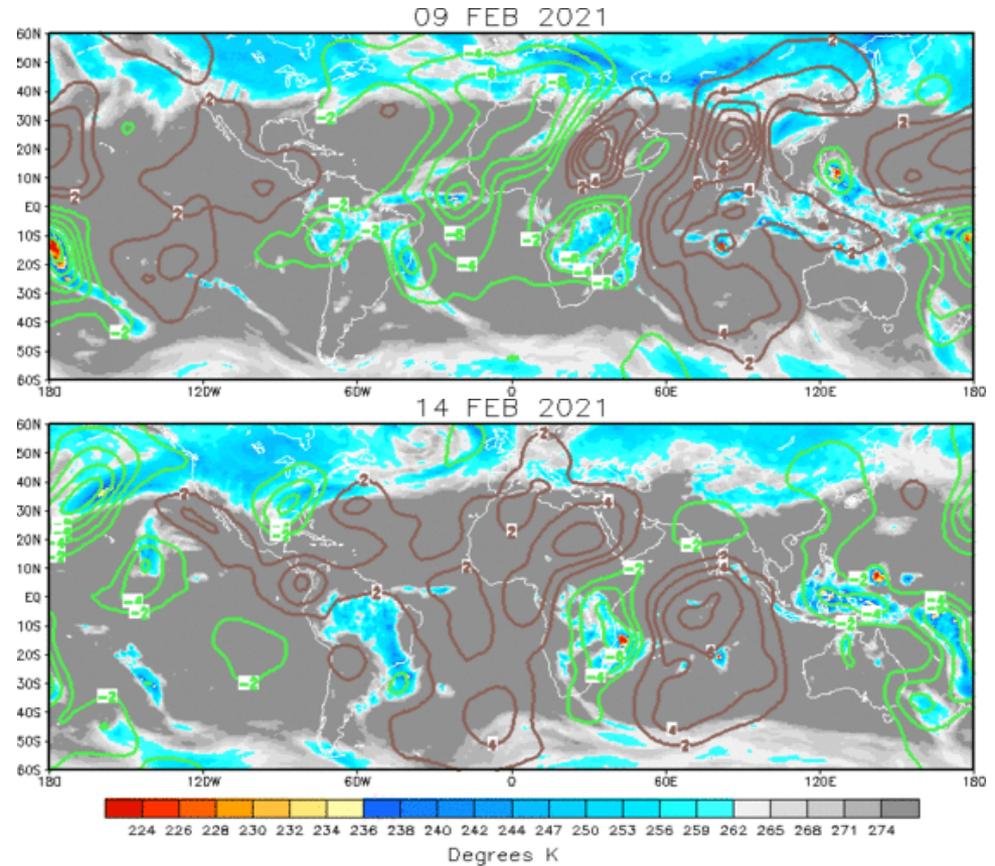
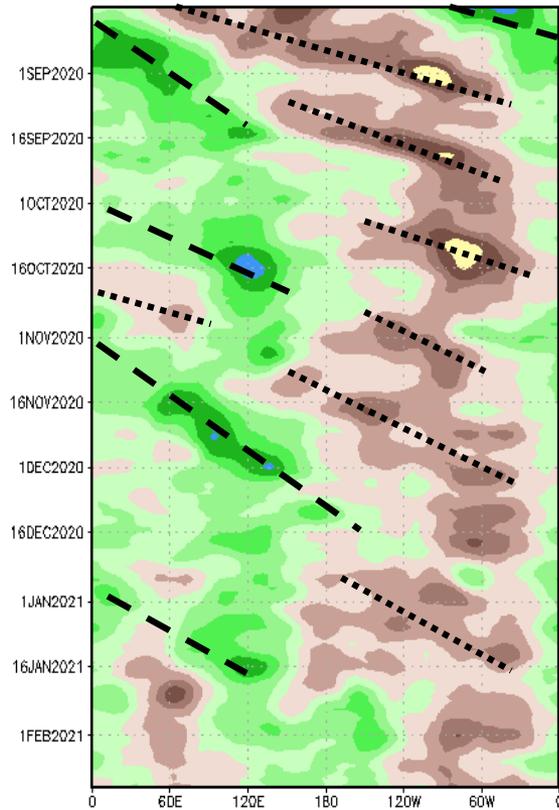
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

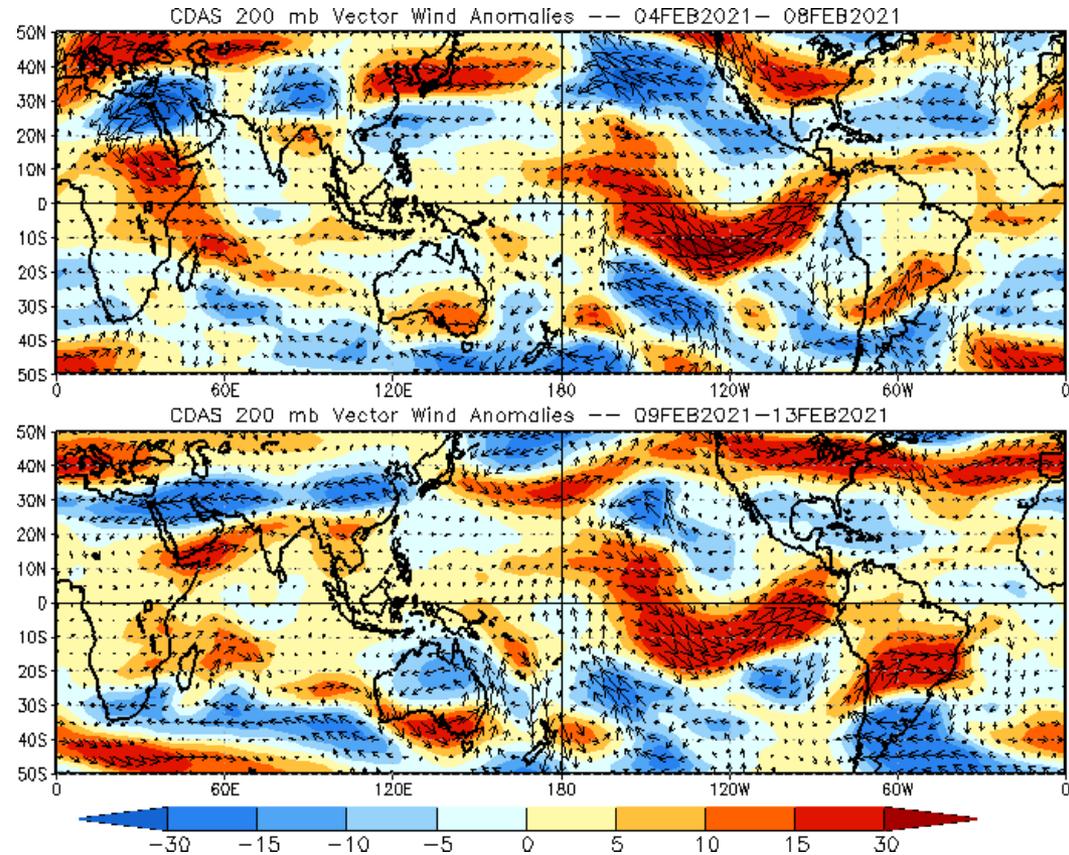
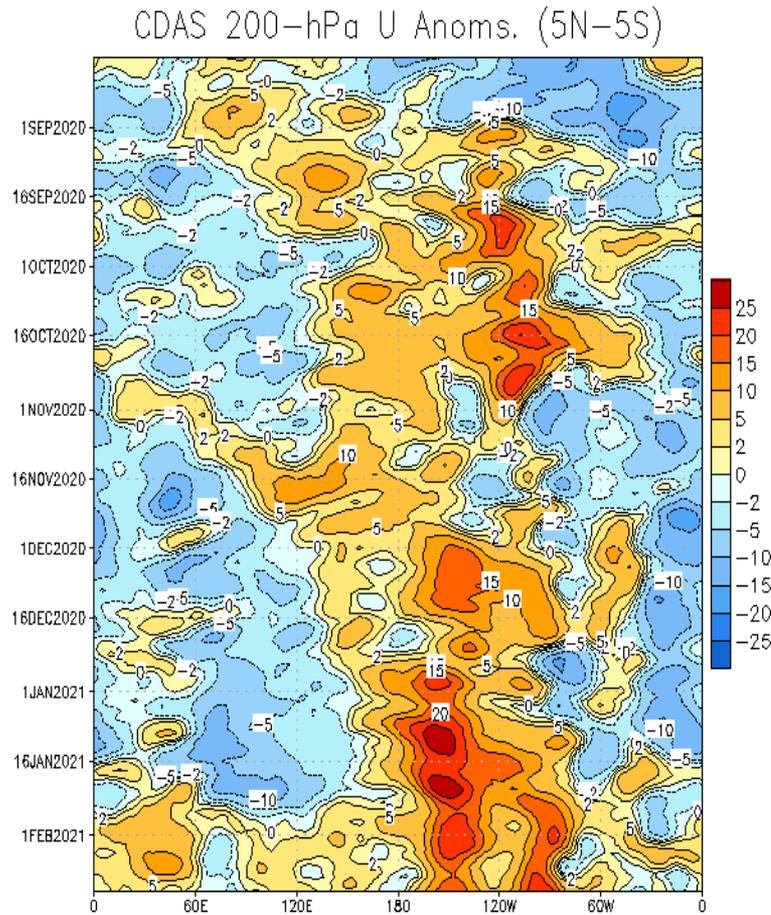
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- Upper-level velocity potential anomalies have remained fairly stationary following an eastward shift of the pattern during late January.
- There is enhanced convection along the South Pacific Convergence Zone (SPCZ) and western Indian Ocean due to Tropical Cyclone Faraji.

200-hPa Wind Anomalies

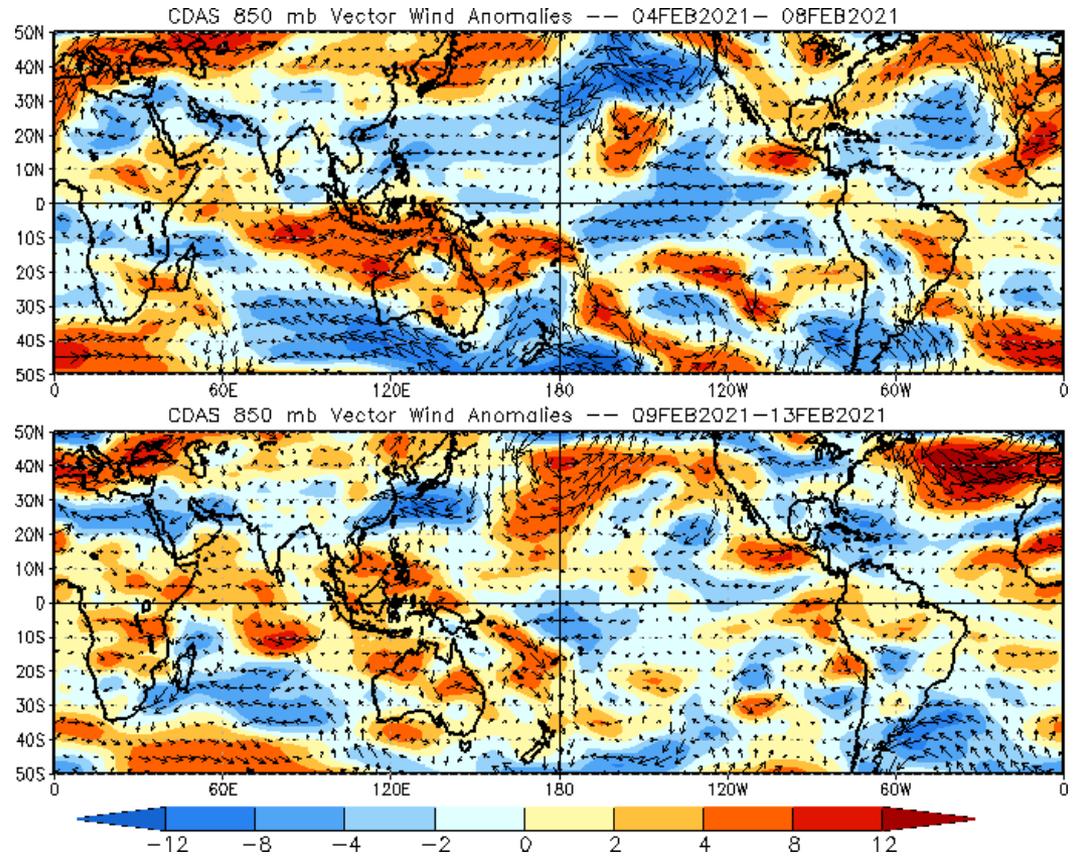
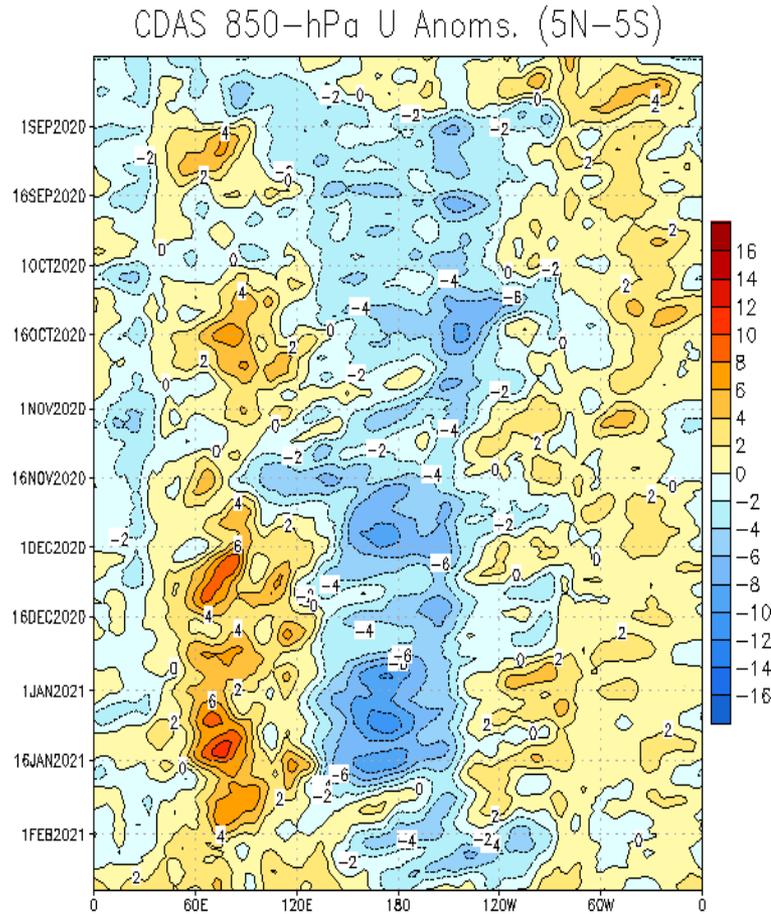
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Wave breaking continues to inject mass from the higher latitudes of both hemispheres of the Pacific into the tropics to help reinforce robust anomalous westerlies to the east of the Date Line.
- Positive 200-hPa zonal wind anomalies remain active east of the Date Line, which is typical of La Niña conditions.

850-hPa Wind Anomalies

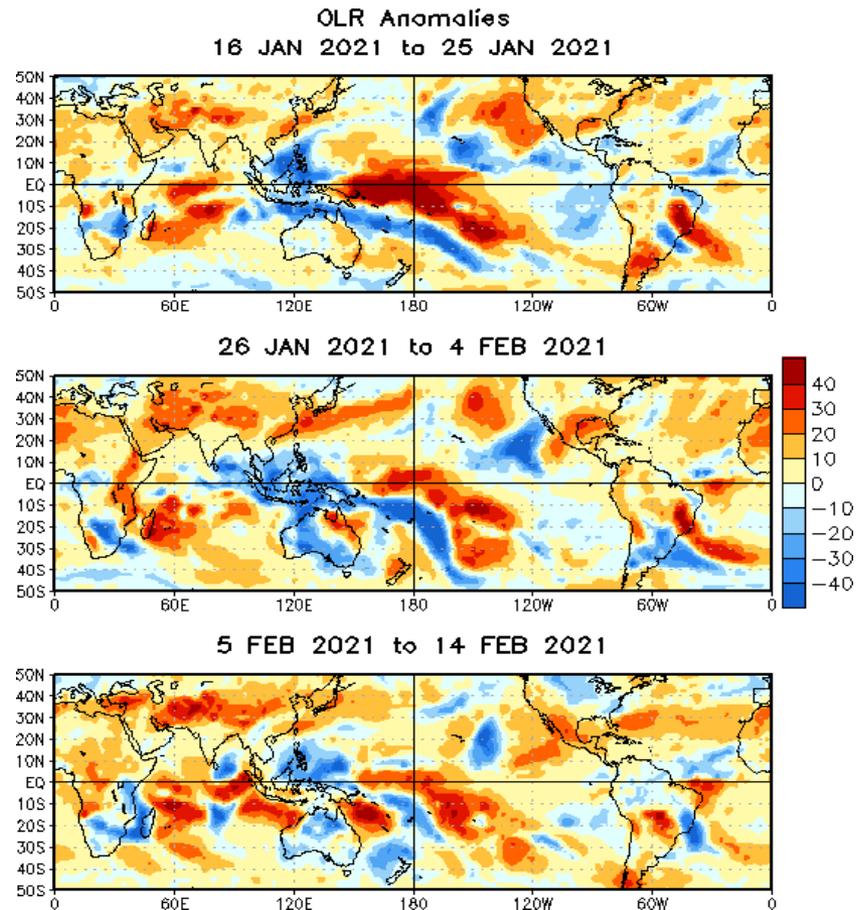
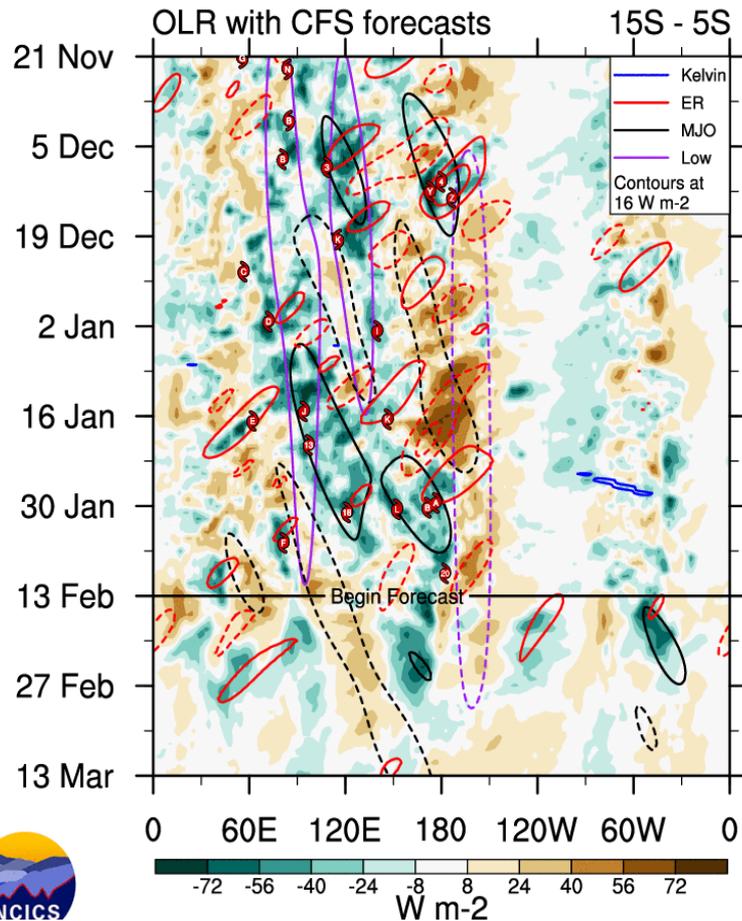
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- The negative 850-hPa wind anomalies east of the Date Line have shifted eastward relative to their low-frequency position, due to weak MJO and equatorial Rossby wave activity lately.

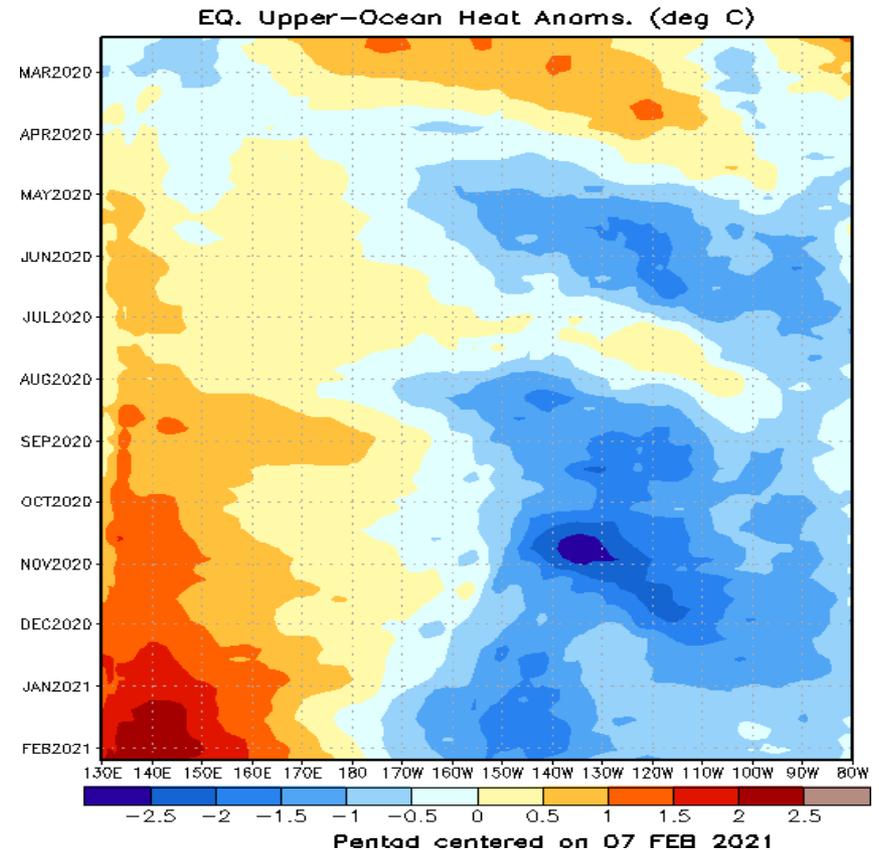
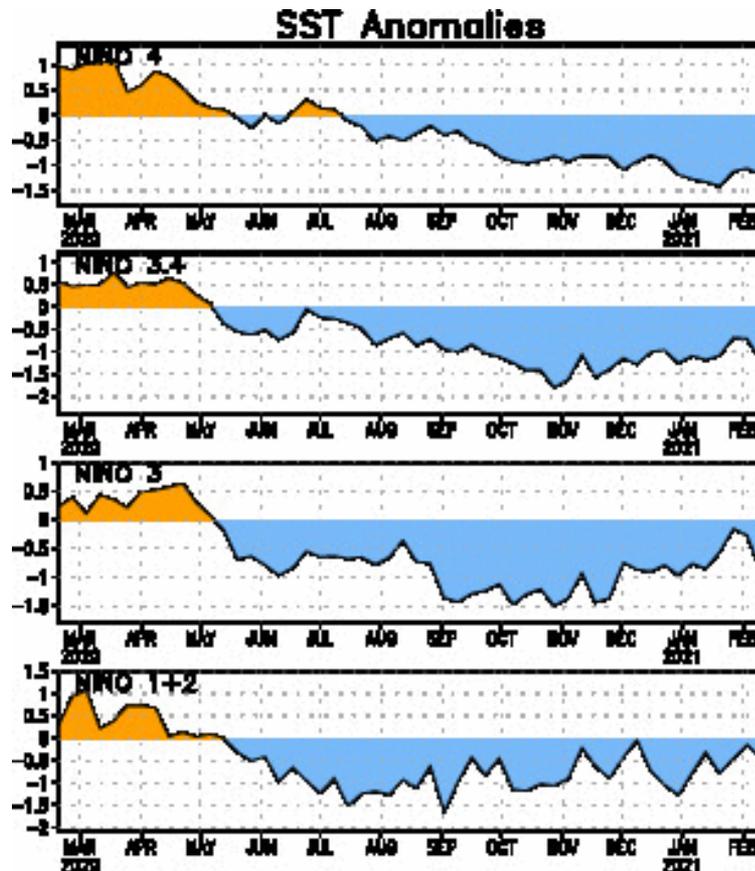
Outgoing Longwave Radiation (OLR) Anomalies

Blue shades: Anomalous convection (wetness). **Red shades: Anomalous subsidence (dryness).**



- Enhanced (suppressed) convection has been established over the Maritime Continent (Central Pacific) since mid-December in association with warm (cold) sea surface temperatures and the ongoing La Niña.
- The MJO and other tropical wave activity remain weak. The CFS forecasts this trend to continue through at least the next two weeks.

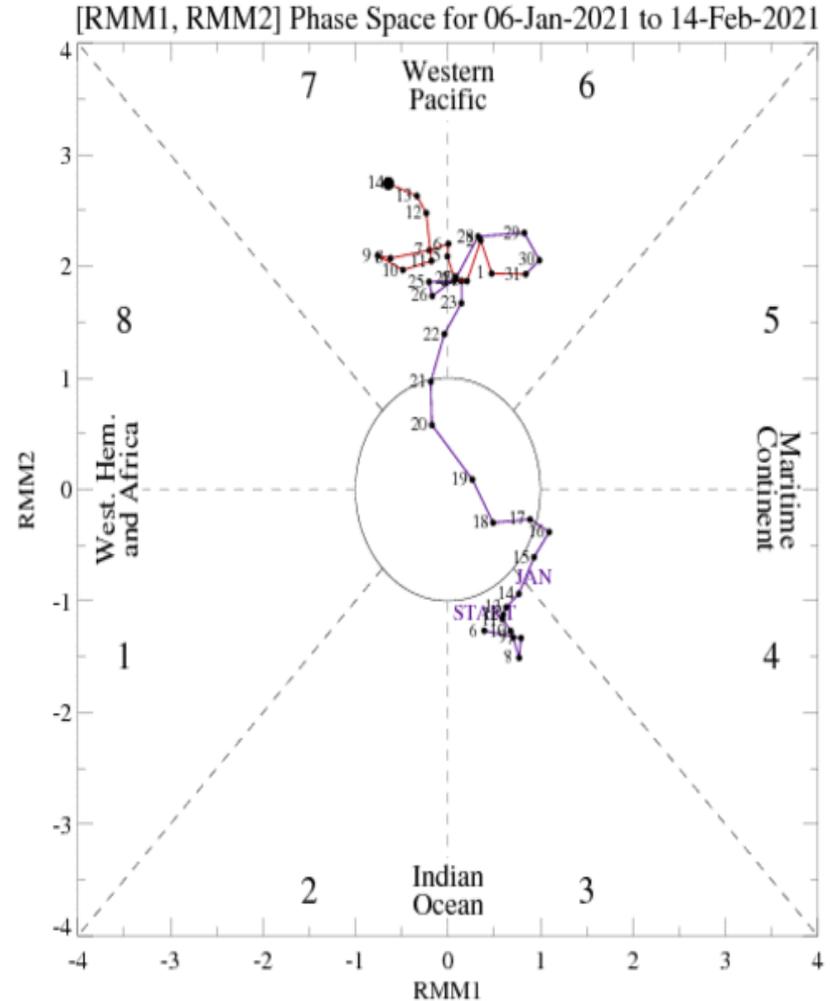
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Following destructive interference with the base state by a downwelling Kelvin wave during July, the subsequent upwelling phase pushed the Pacific into La Niña conditions.
- Anomalous cold conditions have shifted westward across the central Pacific. However, most Niño regions have warmed slightly since January.

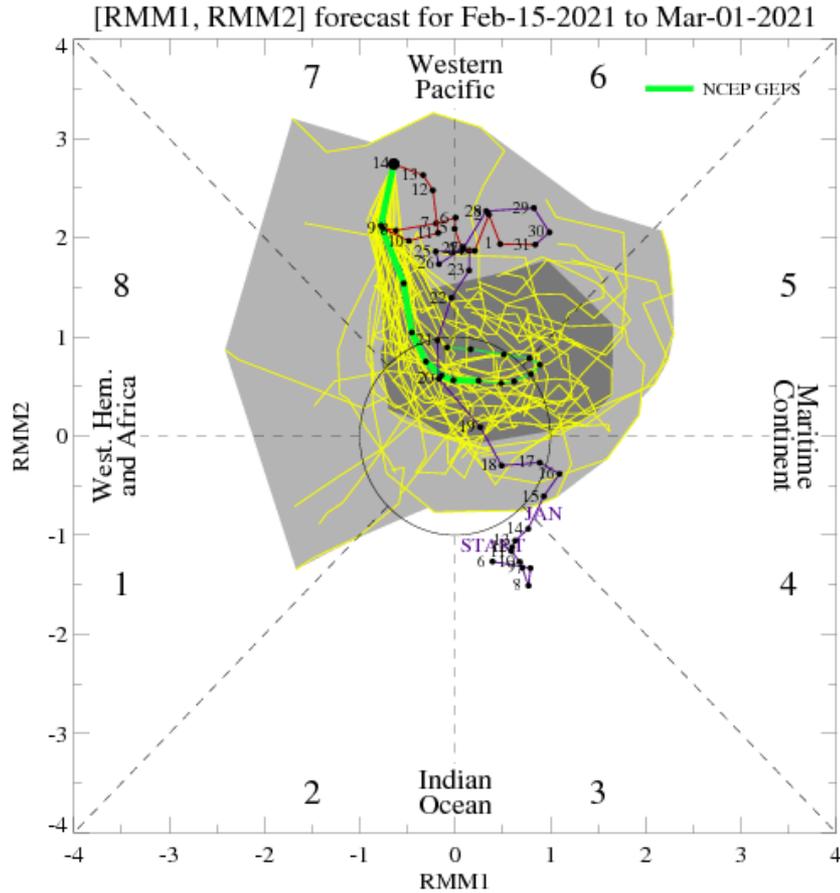
MJO Index: Recent Evolution

- The tropical state has projected onto the Western Pacific phases of the RMM index since mid-January. This is more due to interference from higher frequency tropical waves and the lower-frequency La Niña signal than from the MJO itself.

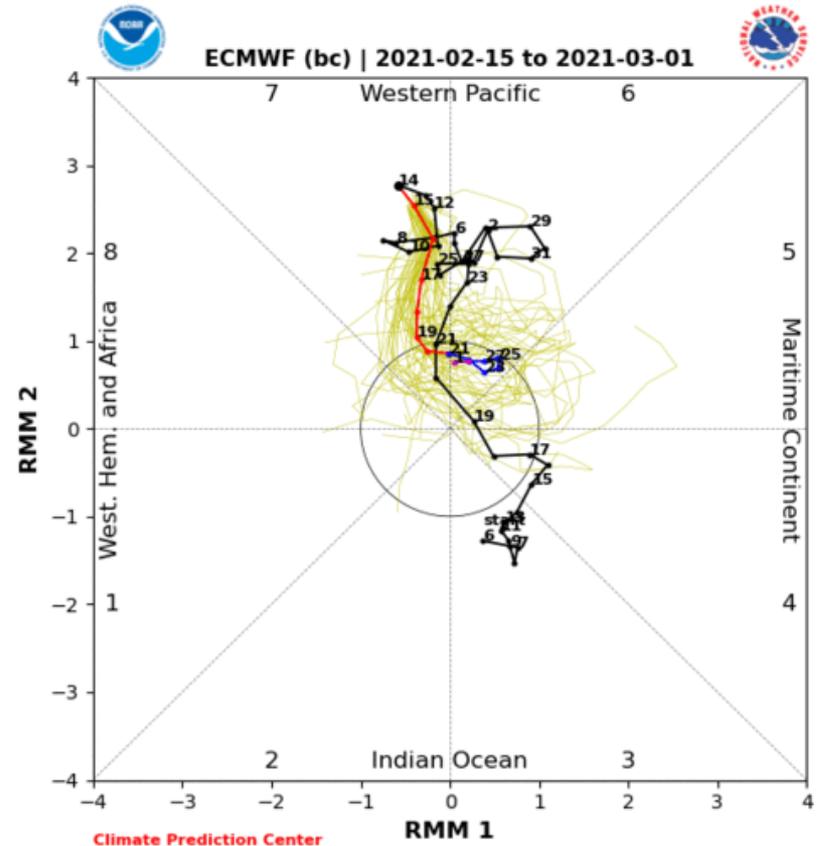


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



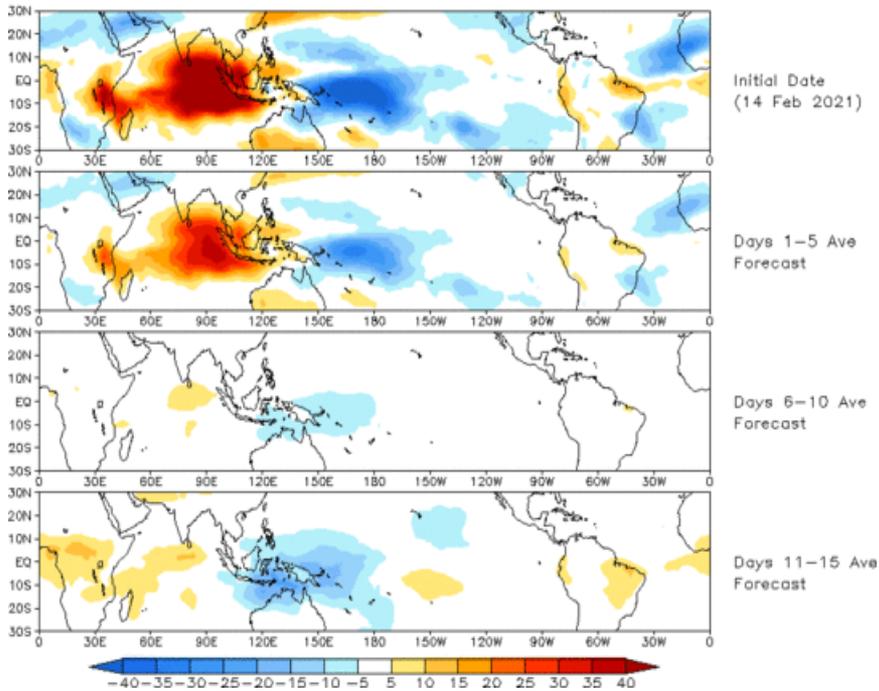
ECMWF Forecast

- Ensemble guidance continues to forecast a weak MJO signal during the next two weeks. There is unlikely to be any coherent tropical wave activity during this period.

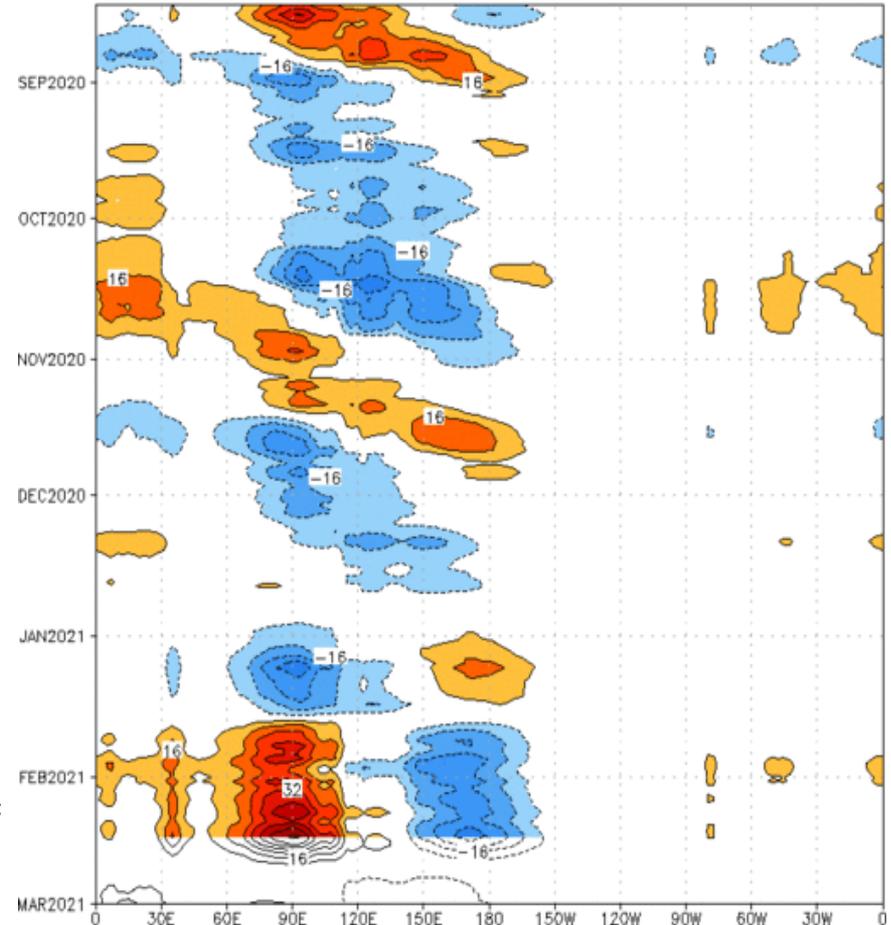
MJO: GEFS Forecast Evolution

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: 14 Feb 2021
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [$7.5^{\circ}\text{S}, 7.5^{\circ}\text{N}$] (cont: 4Wm^{-2}) Period: 15-Aug-2020 to 14-Feb-2021
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

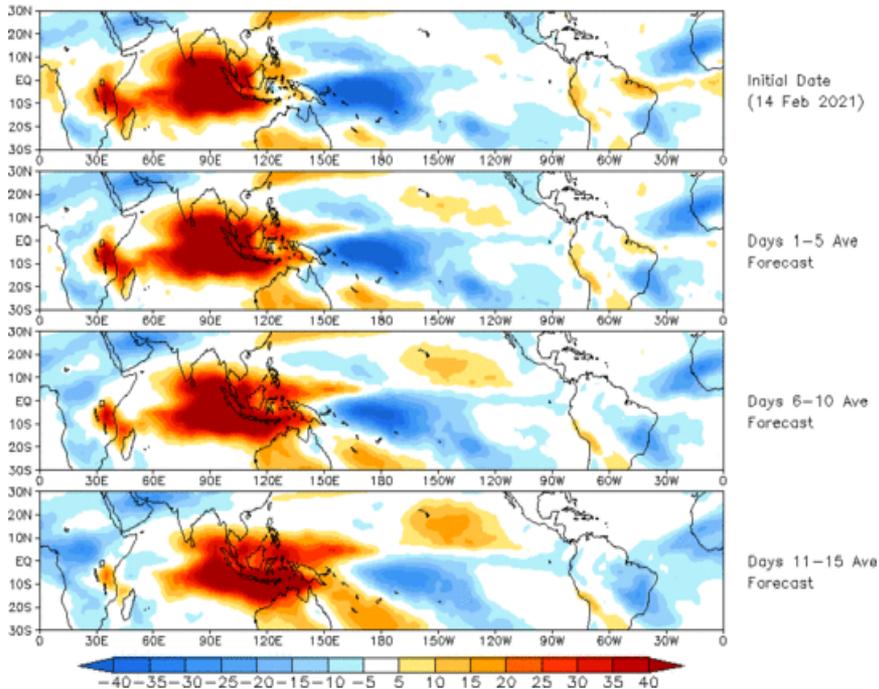


- The GEFS predicts a retrograding pattern of enhanced (suppressed) convection over the Pacific (Indian Ocean) that weakens late in Week-1 and early Week-2.

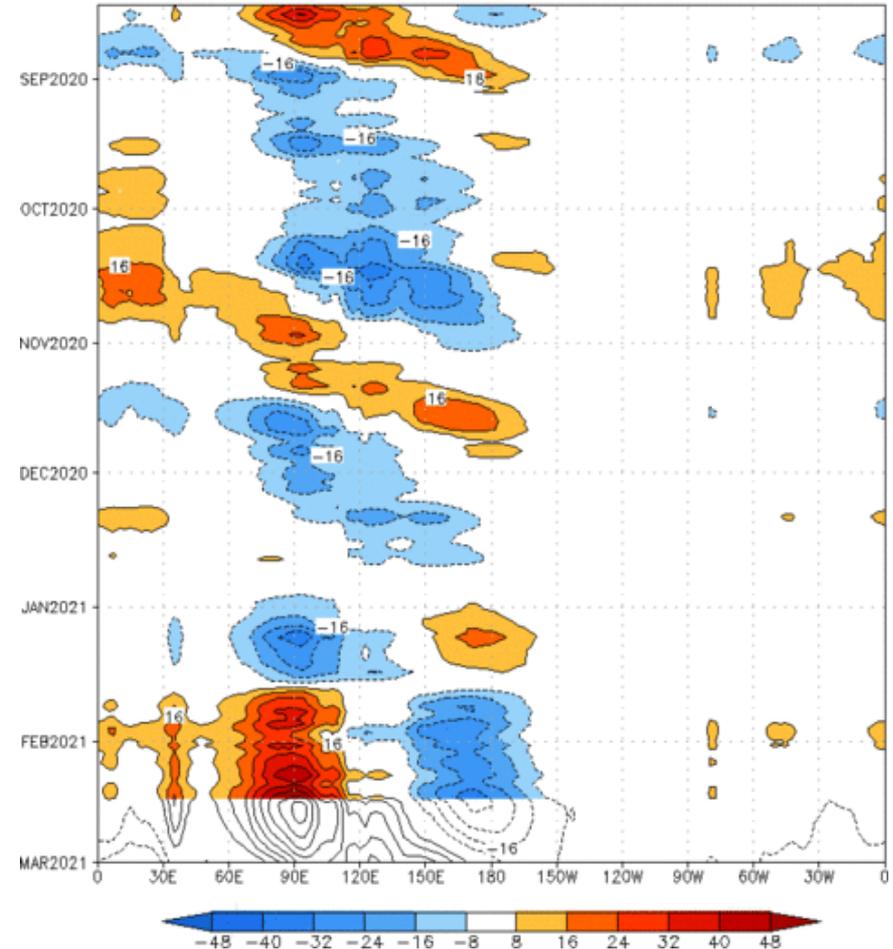
MJO: Constructed Analog Forecast Evolution

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 (14 Feb 2021)



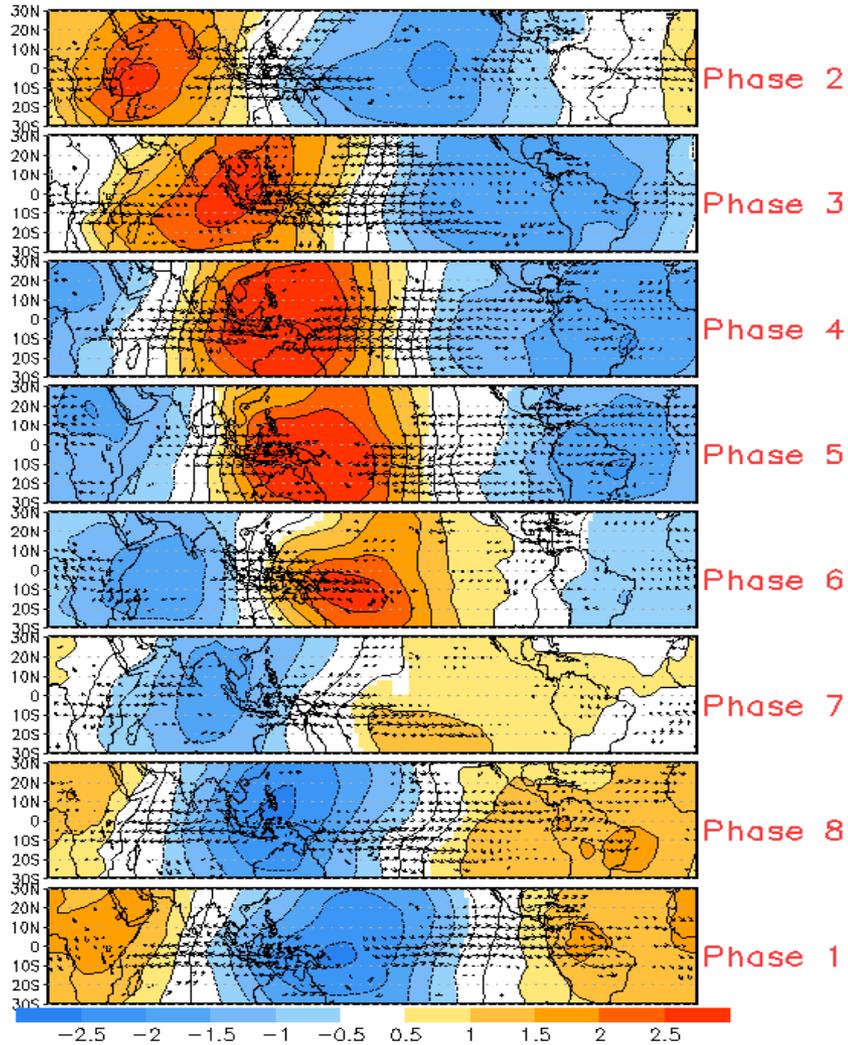
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:15-Aug-2020 to 14-Feb-2021
The unfilled contours are CA forecast reconstructed anomaly for 15 days



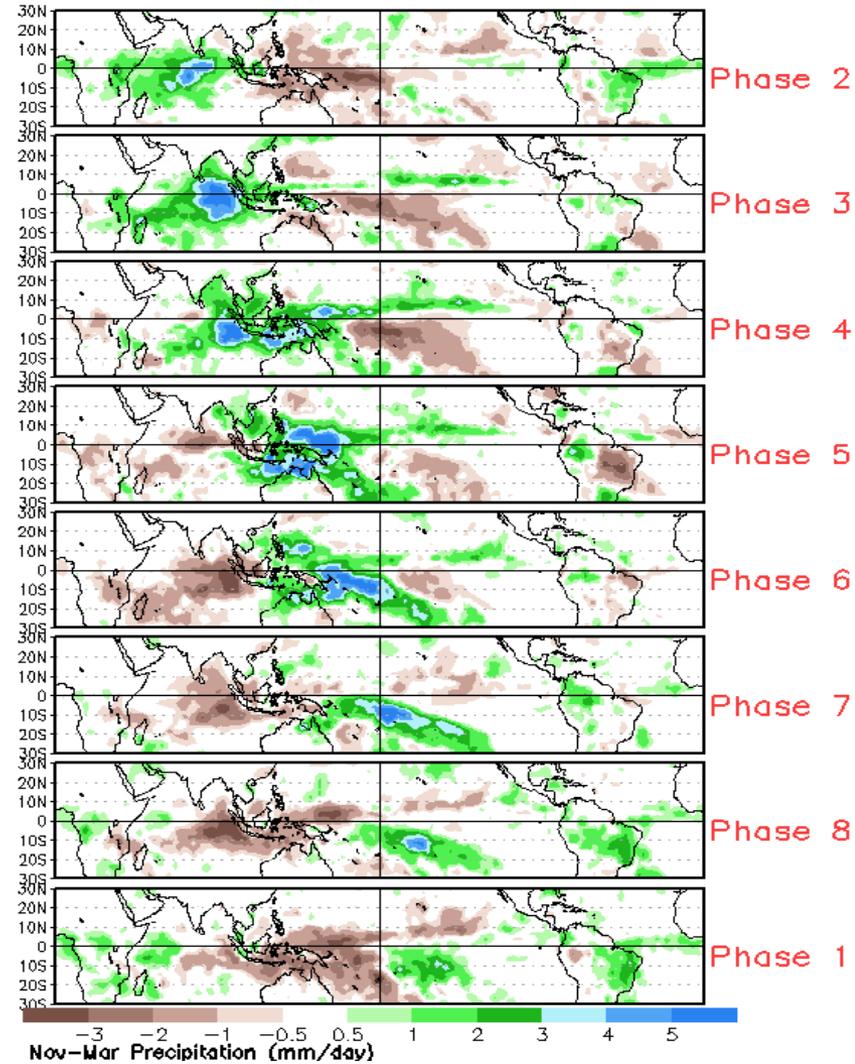
- The constructed analog predicts a slowly eastward propagating OLR pattern that maintains its amplitude through Week-2 unlike the GEFS.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



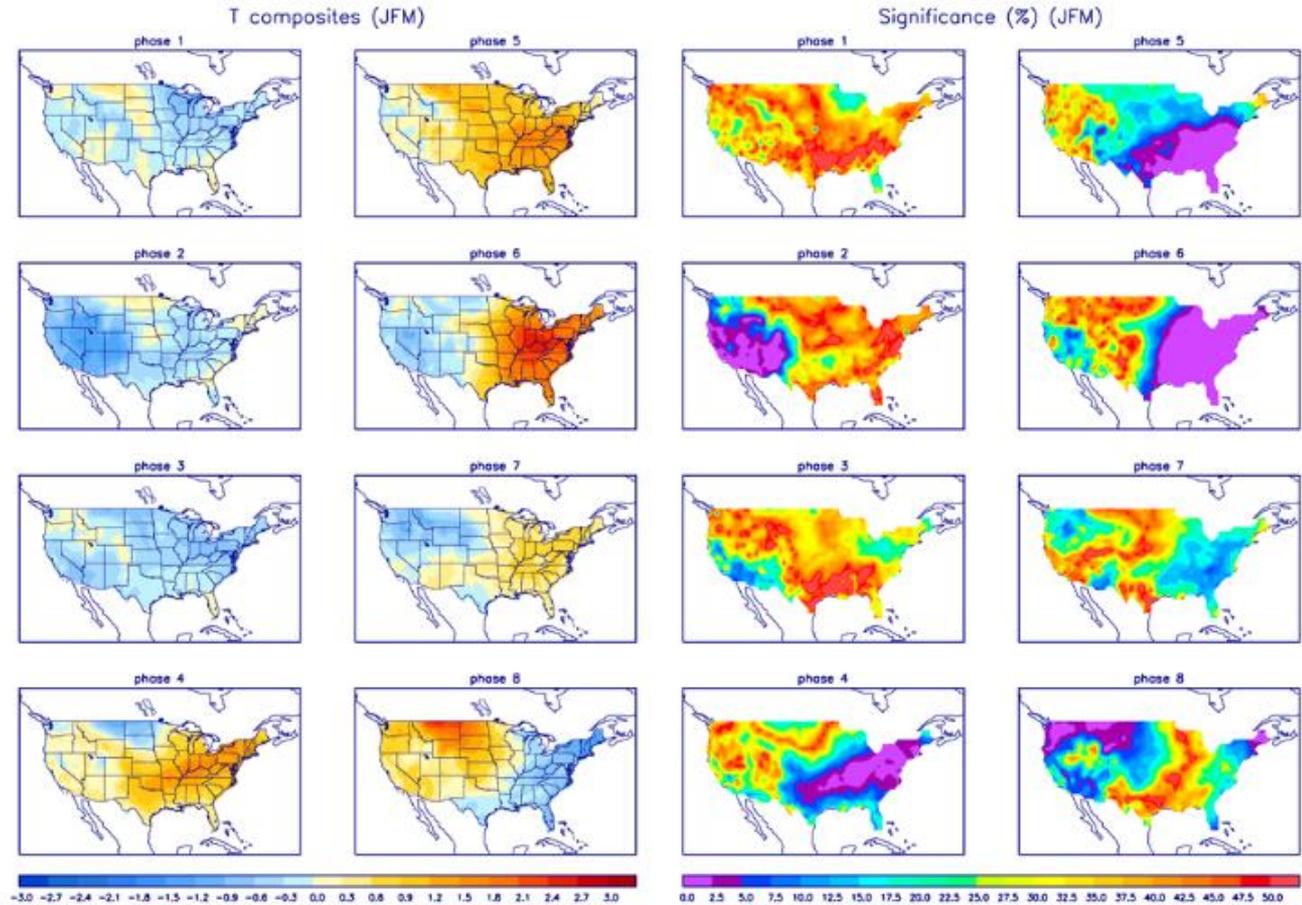
Precipitation Anomalies



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.

