

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



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

Overview

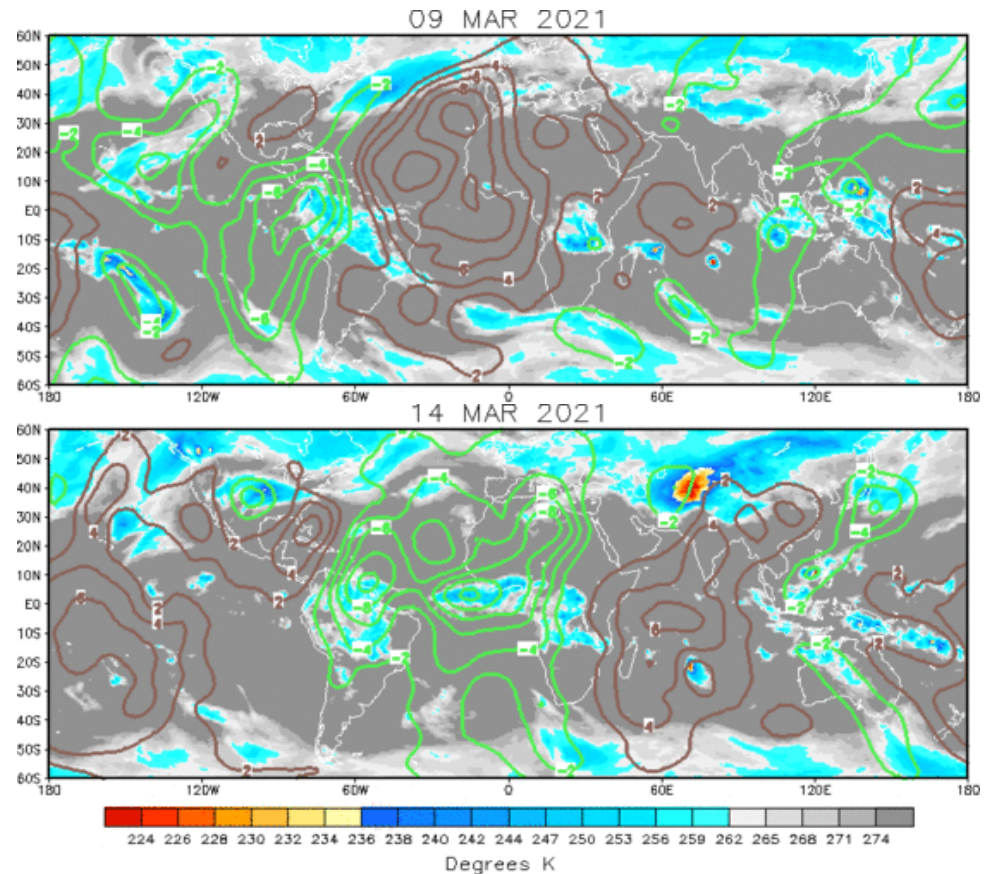
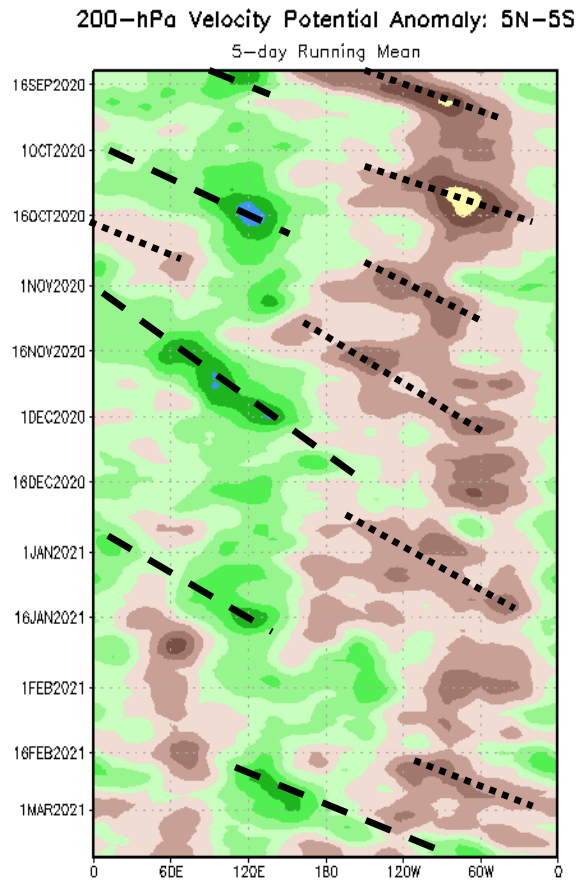
- The MJO remains active, and the RMM index indicates the intraseasonal signal has gained amplitude while propagating eastward over the Western Hemisphere (phases 8/1) since early March.
- Fair agreement among the dynamical models exists which forecast the continued eastward propagation of MJO in phase 1 during week-1, but favor an overall decrease in amplitude by week-2.
- The current phase of the MJO would favor enhanced precipitation over portions of the Americas and Africa during week-1, though there is still much uncertainty in regards to downstream impacts given large ensemble spread of the intraseasonal signal in late March.
- Tropical cyclone activity is anticipated to be quiet over the southern Indian Ocean, and over the West and South Pacific 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).

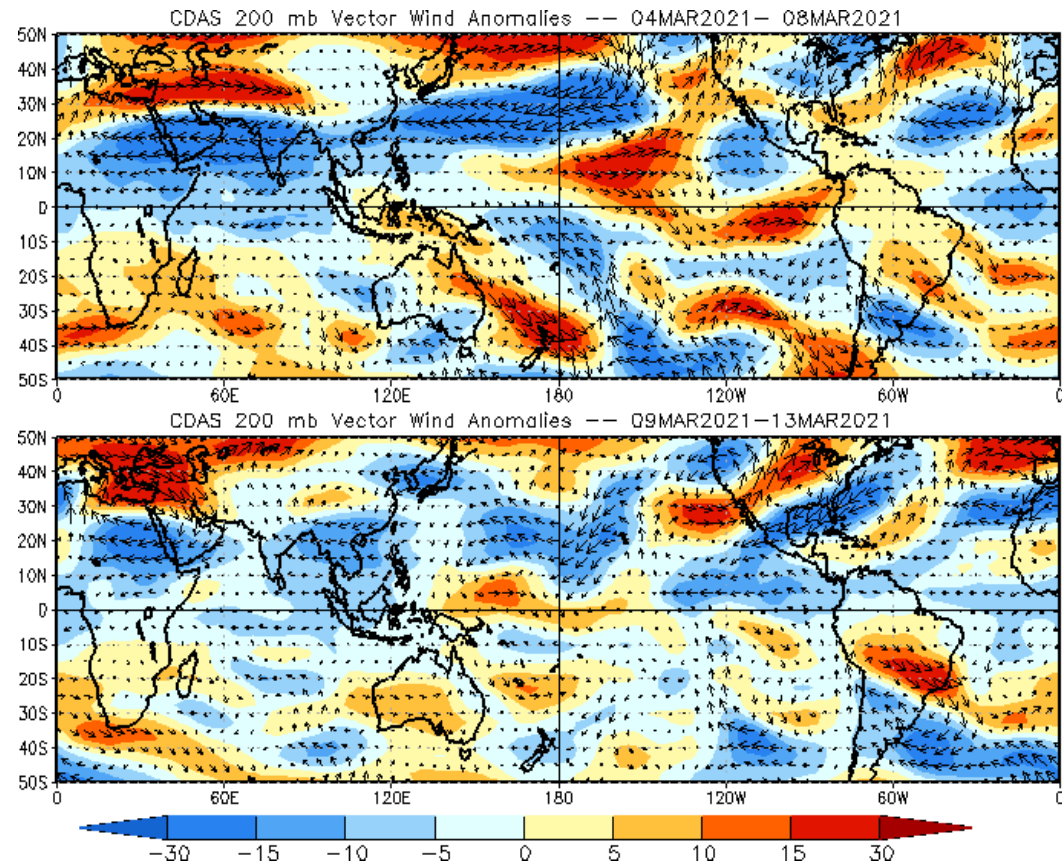
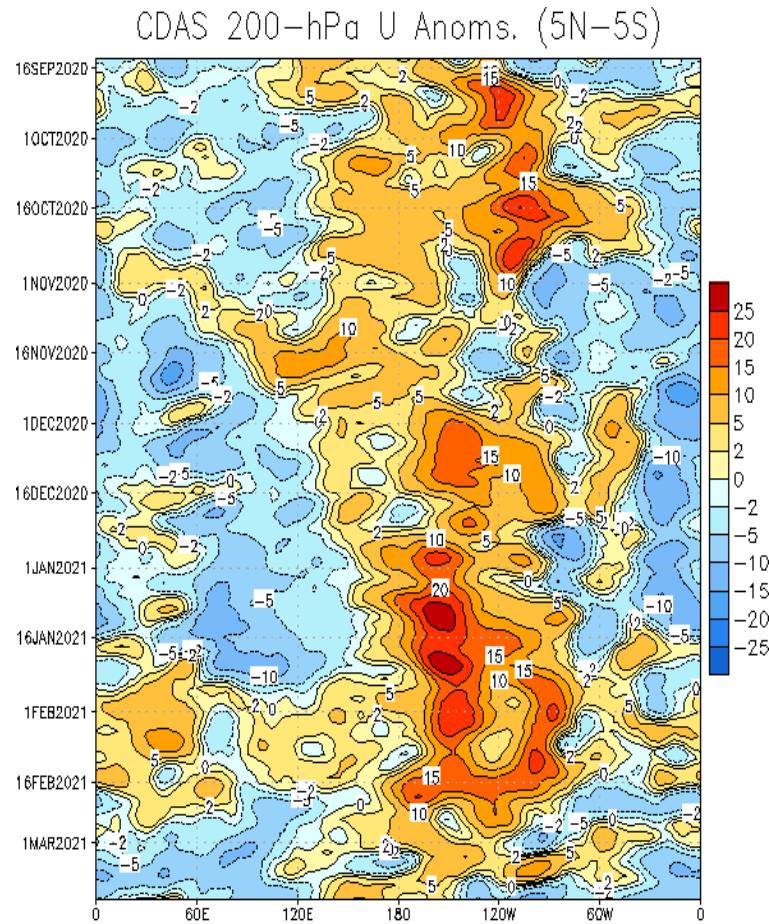
Brown shades: Anomalous convergence (unfavorable for precipitation).



- Since mid-February, eastward propagation of the MJO has been evident, with the enhanced phase recently propagating across the Western Hemisphere and western Africa.
- Anomalous convergence aloft has increased over the Indian Ocean and the Pacific.

200-hPa Wind Anomalies

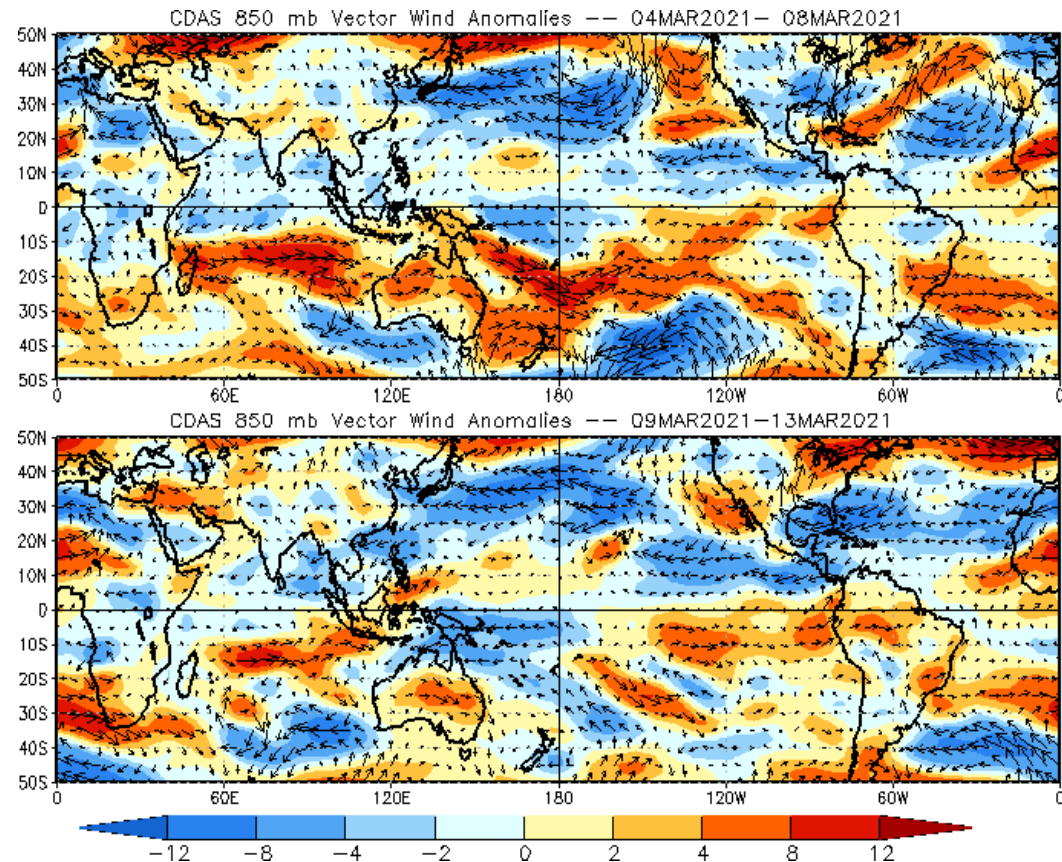
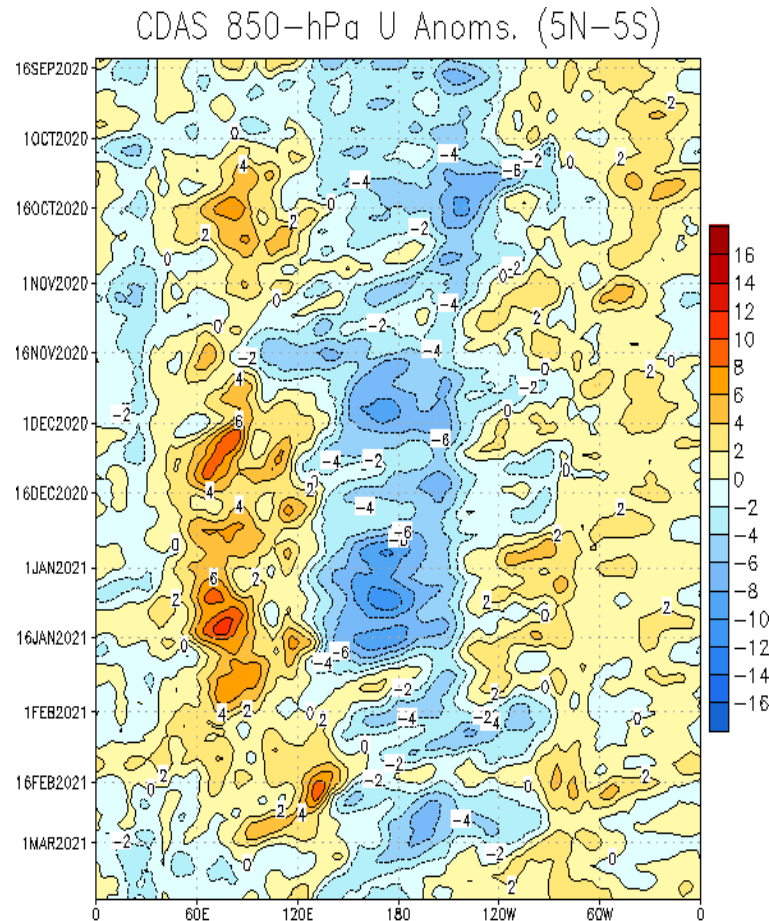
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Wave breaking over the North Pacific is helping to reinforce anomalous westerlies aloft to the west of the Date Line.
- The increase in anomalous easterlies for the East Pacific suggests destructive interference with the low frequency La Niña base state.

850-hPa Wind Anomalies

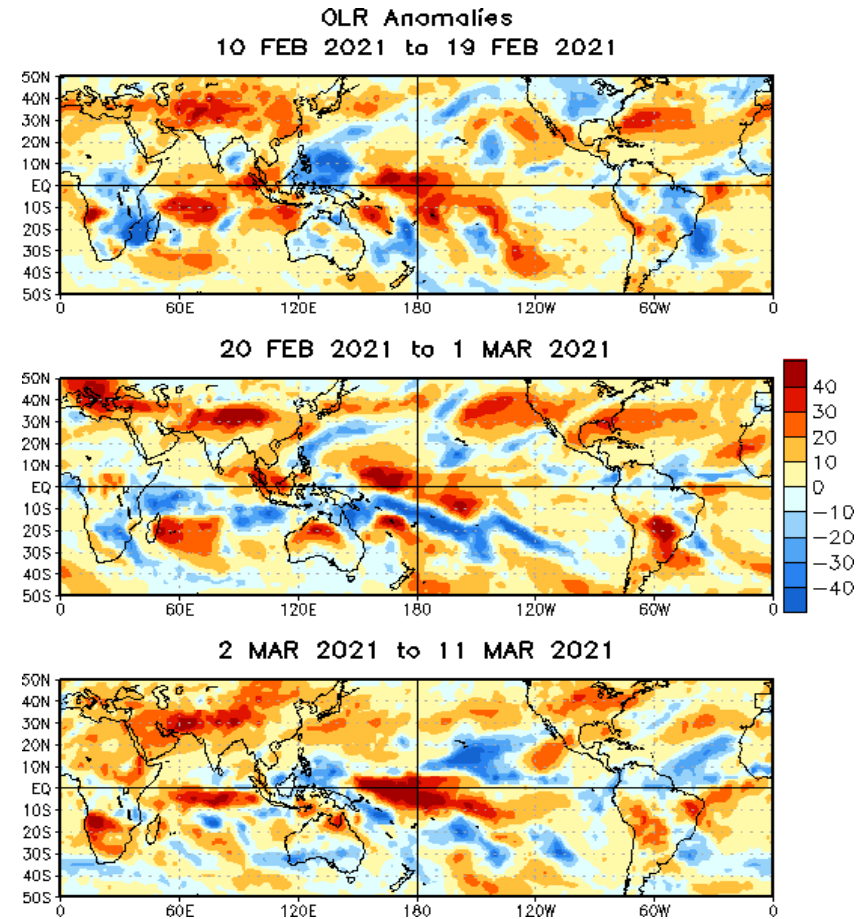
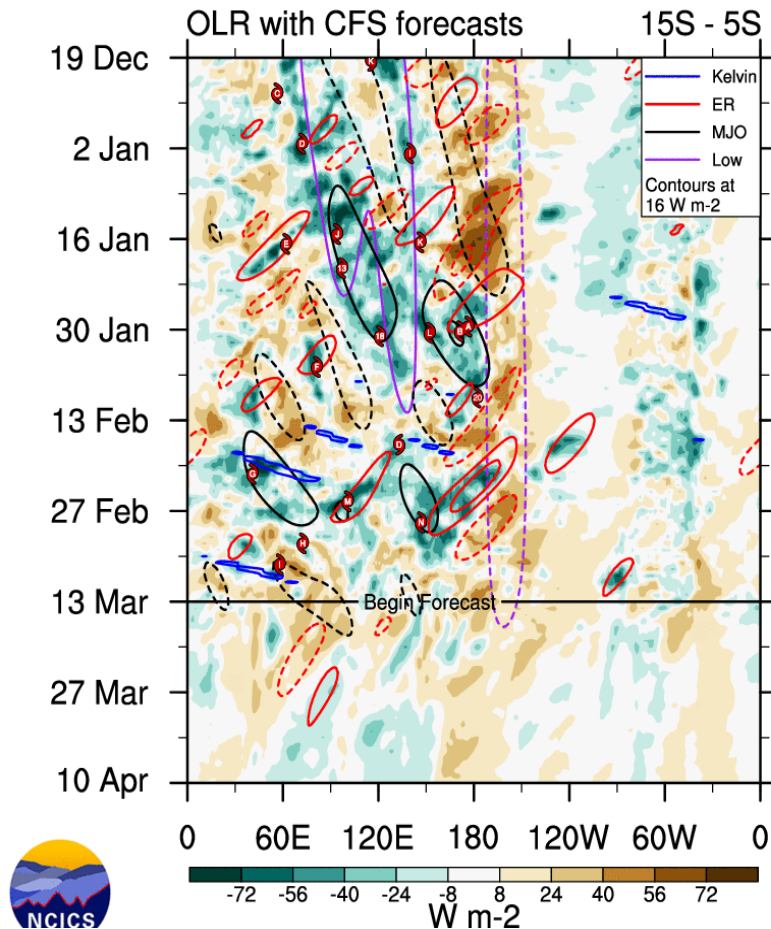
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- There has been a westward shift in the anomalous westerlies to the east of the Date Line. The weakened trades may be associated with the gradual decline of La Niña or intraseasonal variability.
- Anomalous easterlies persist across parts of equatorial Africa and the western Indian Ocean.

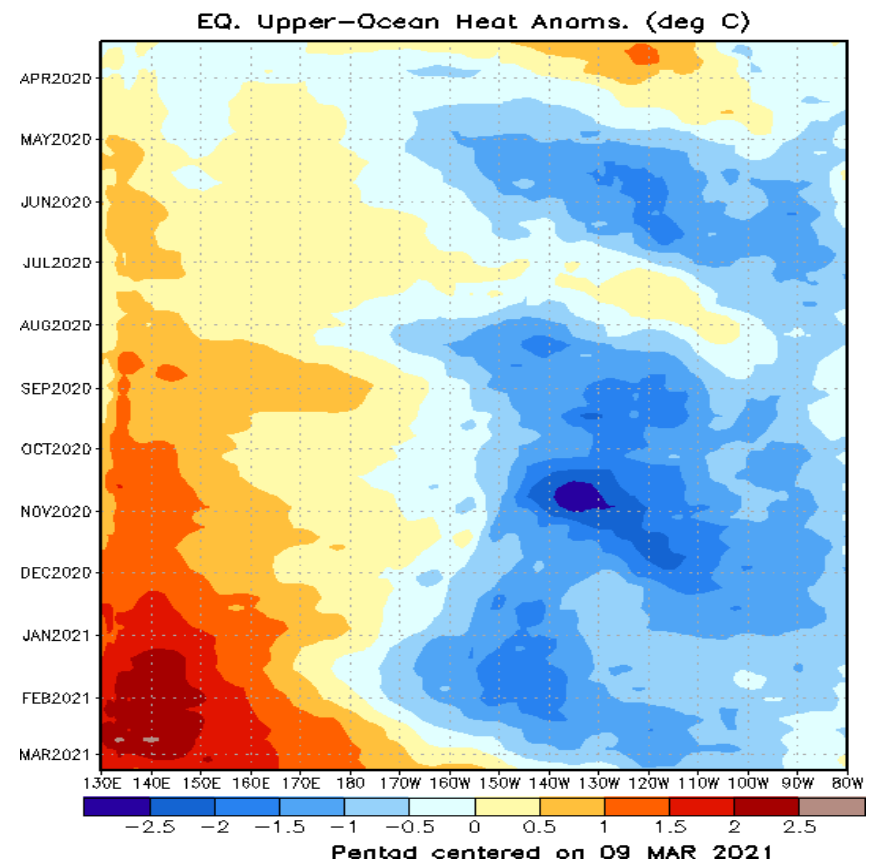
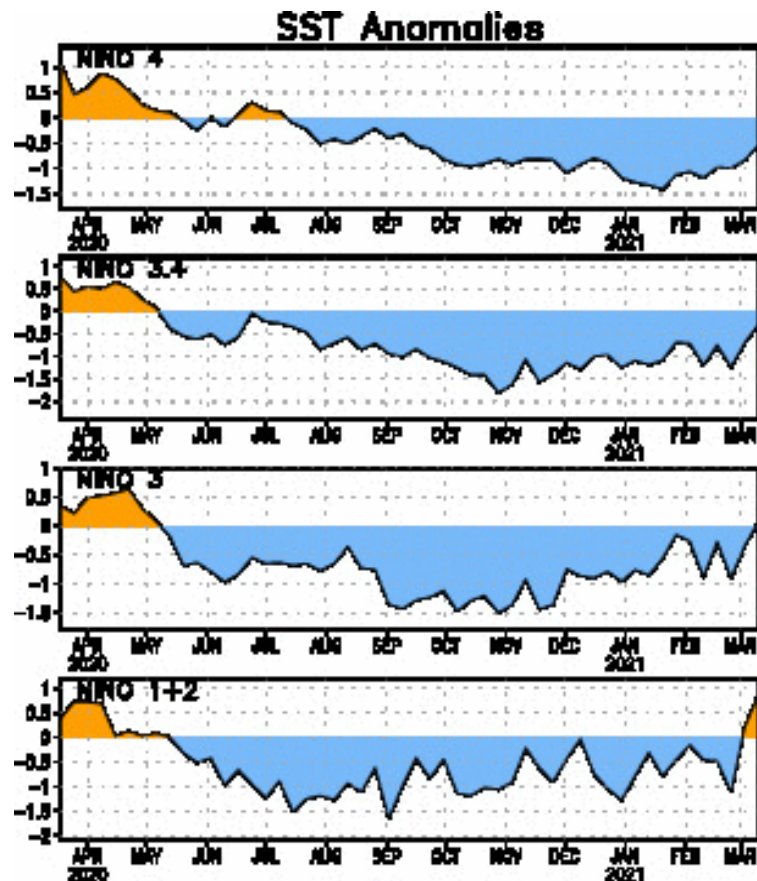
Outgoing Longwave Radiation (OLR) Anomalies

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



- As the active phase of the MJO crossed the western Hemisphere, enhanced convection became more widespread over parts of the central and eastern Pacific, South America, and the Atlantic during early March.
- Since late February, enhanced convection entrenched within the SPCZ has relaxed.

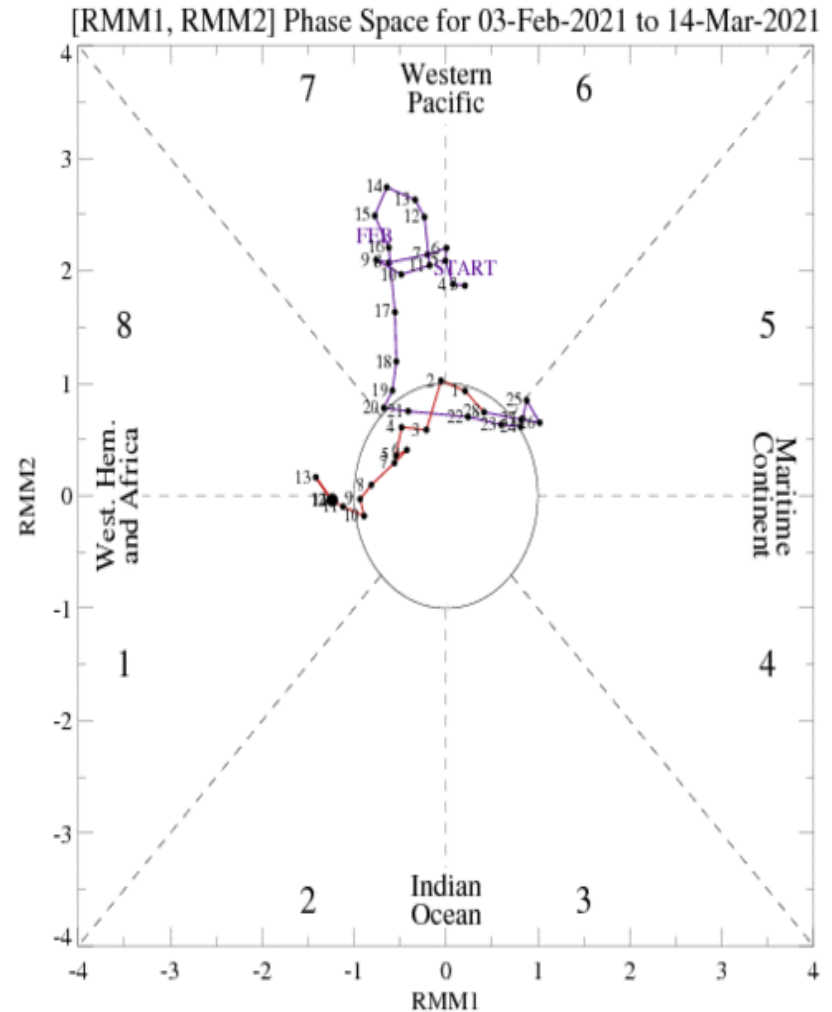
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- La Niña conditions have been present since August 2020.
- Strong Rossby wave activity over the West Pacific in February generated a westerly wind burst that initiated a downwelling oceanic Kelvin wave. This Kelvin wave continues to push warmer water further east of the Date Line.

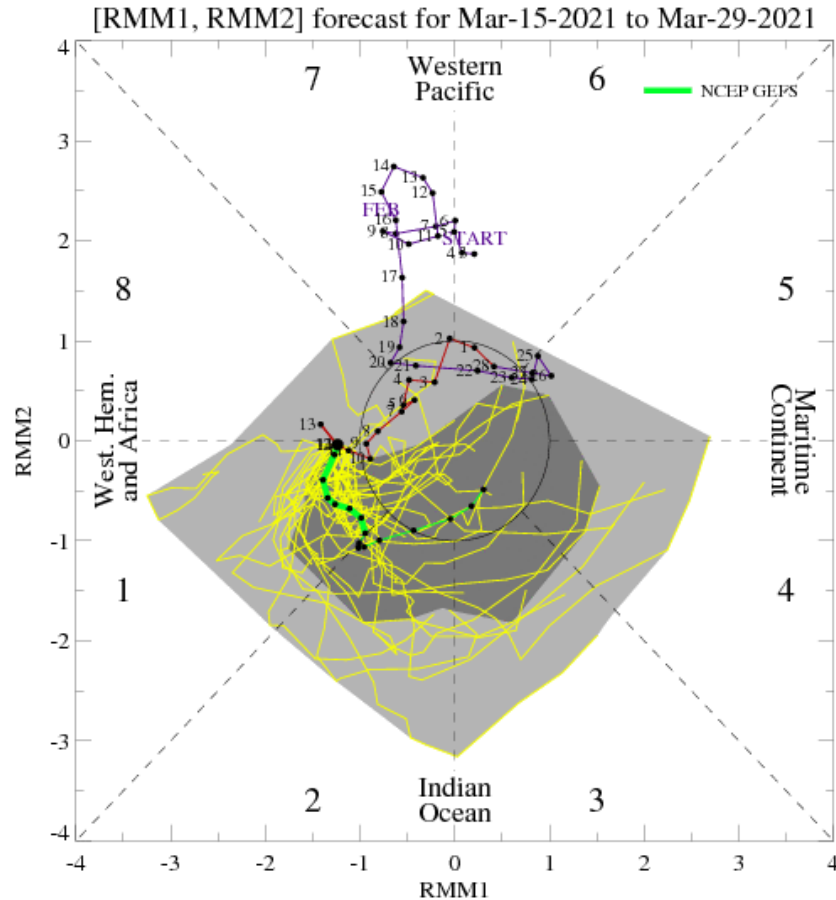
MJO Index: Recent Evolution

- The RMM index indicates an increase in amplitude of the intraseasonal signal over phases 8 and 1 during the last week.
- Decreasing RMM1 values are likely tied to development of anomalous equatorial easterlies aloft across the eastern Pacific.

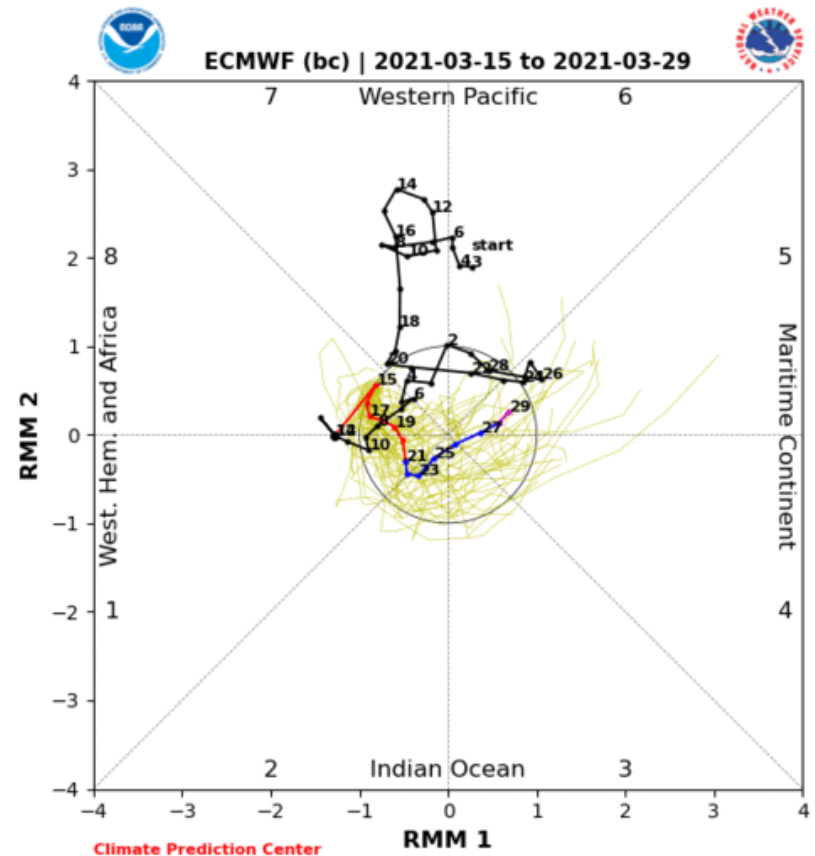


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



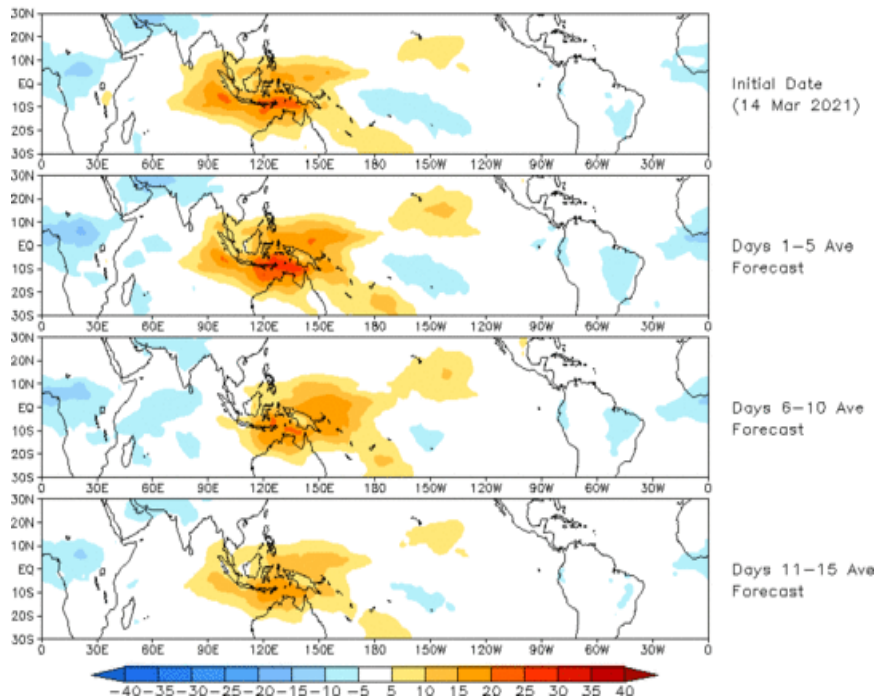
ECMWF Forecast

- The GEFS forecast depicts a gradual increase in MJO amplitude while propagating eastward in phase 1 during week-1, before decreasing in amplitude during week-2. Several ensemble members continue to depict a strong event crossing the Indian Ocean and reaching the Maritime Continent by the end of March.
- The bias corrected ECMWF favors a weaker amplitude event with a faster phase speed.

MJO: GEFS Forecast Evolution

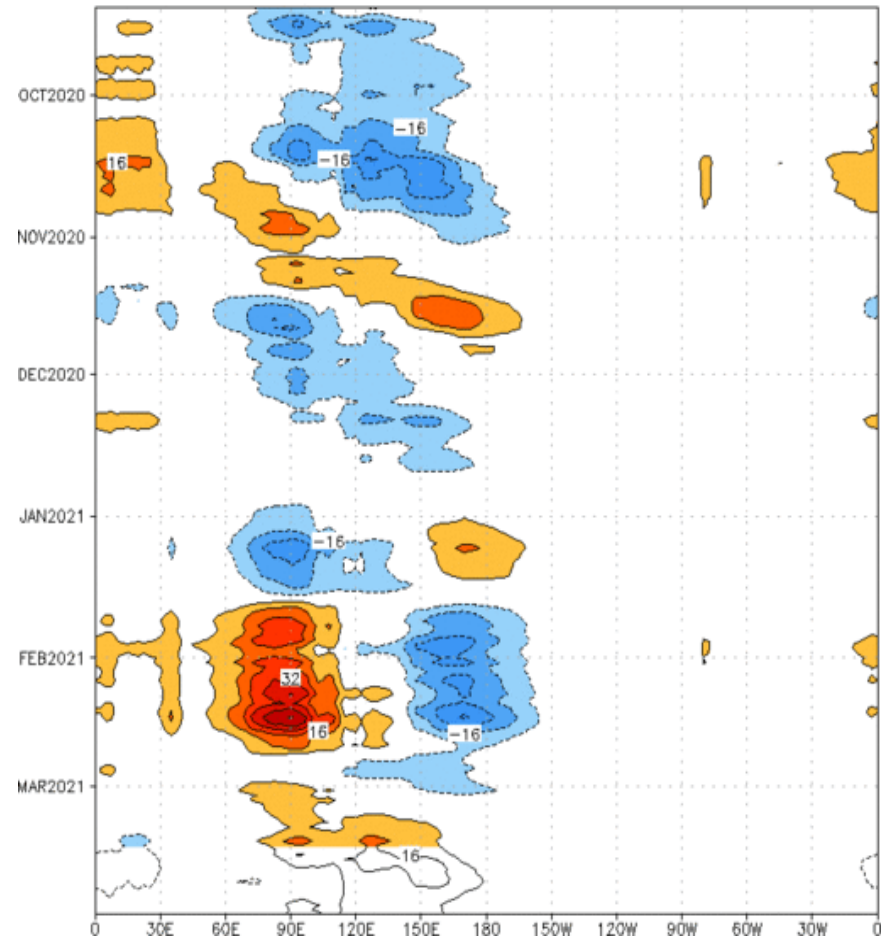
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 14 Mar 2021
OLR



- The GEFS RMM forecast based OLR anomalies depict a quasi-stationary pattern that gradually deamplifies by week-2.

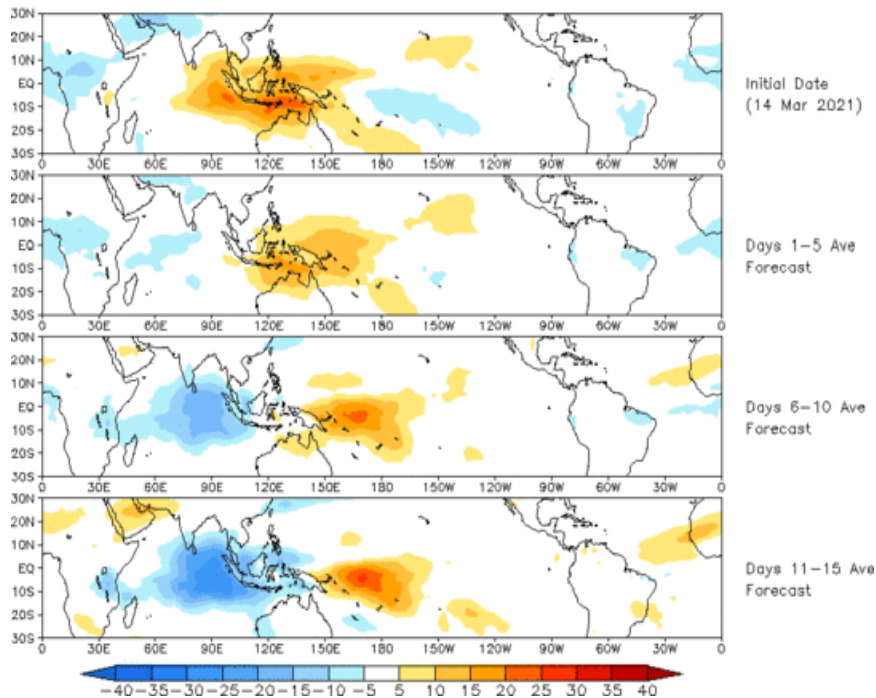
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:12-Sep-2020 to 14-Mar-2021
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



MJO: Constructed Analog Forecast Evolution

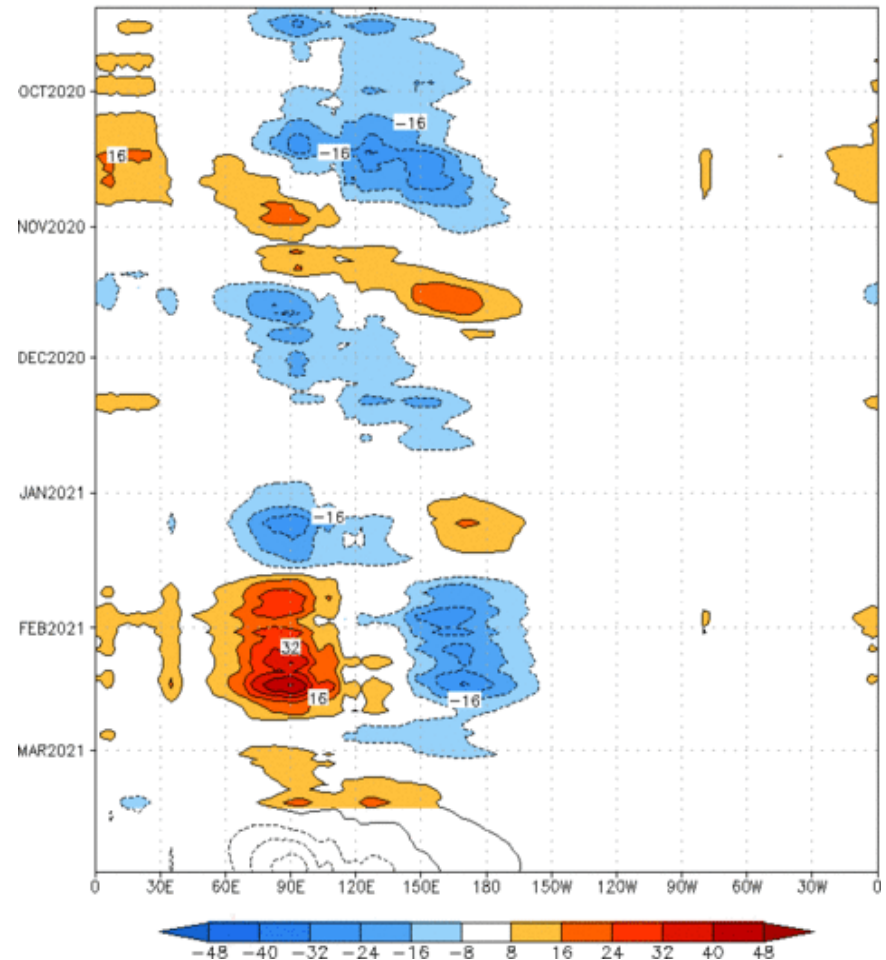
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (14 Mar 2021)



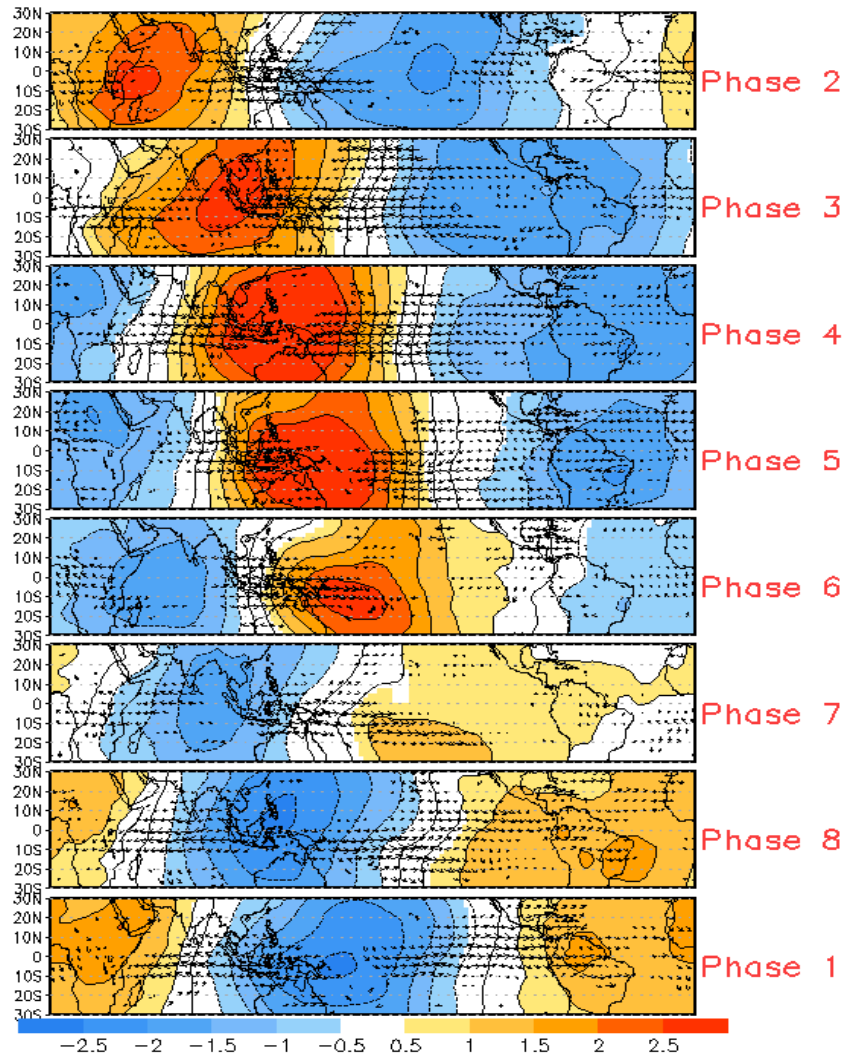
- The constructed analog, compared to the GEFS, predicts a more progressive pattern with stronger convective anomalies, particularly over the Indian Ocean with time.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:12-Sep-2020 to 14-Mar-2021
The unfilled contours are CA forecast reconstructed anomaly for 15 days

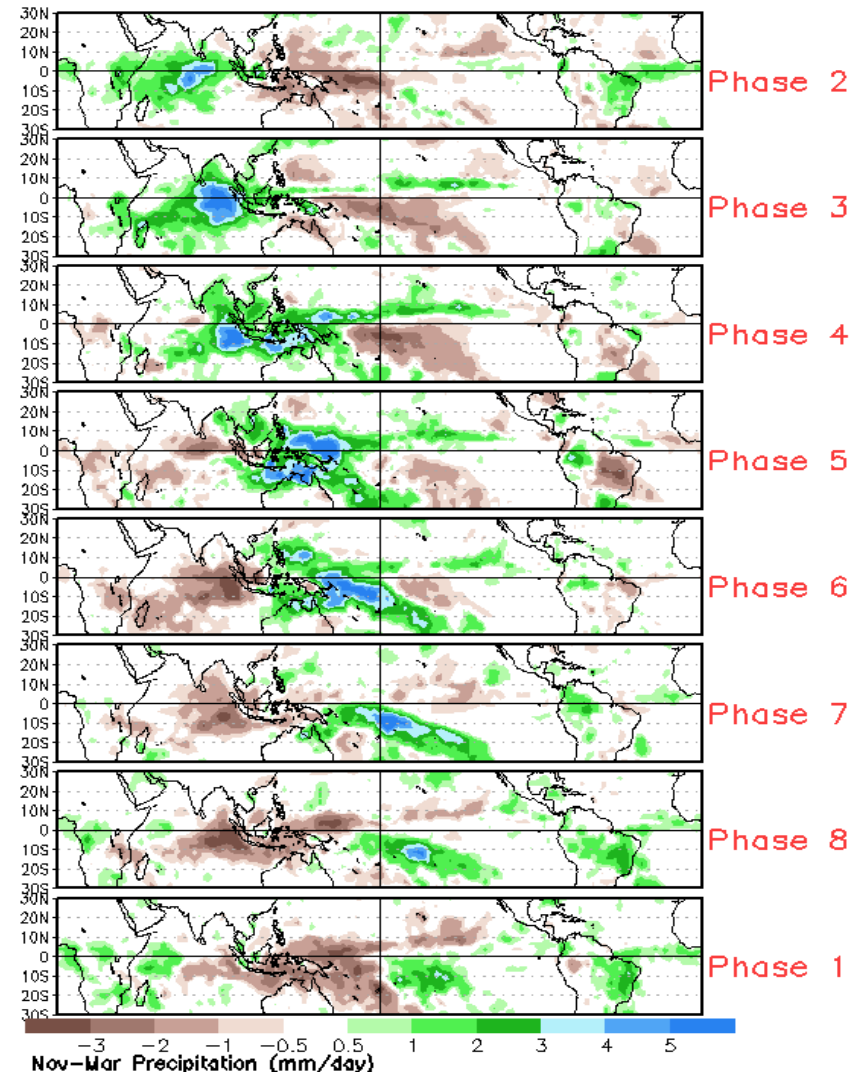


MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



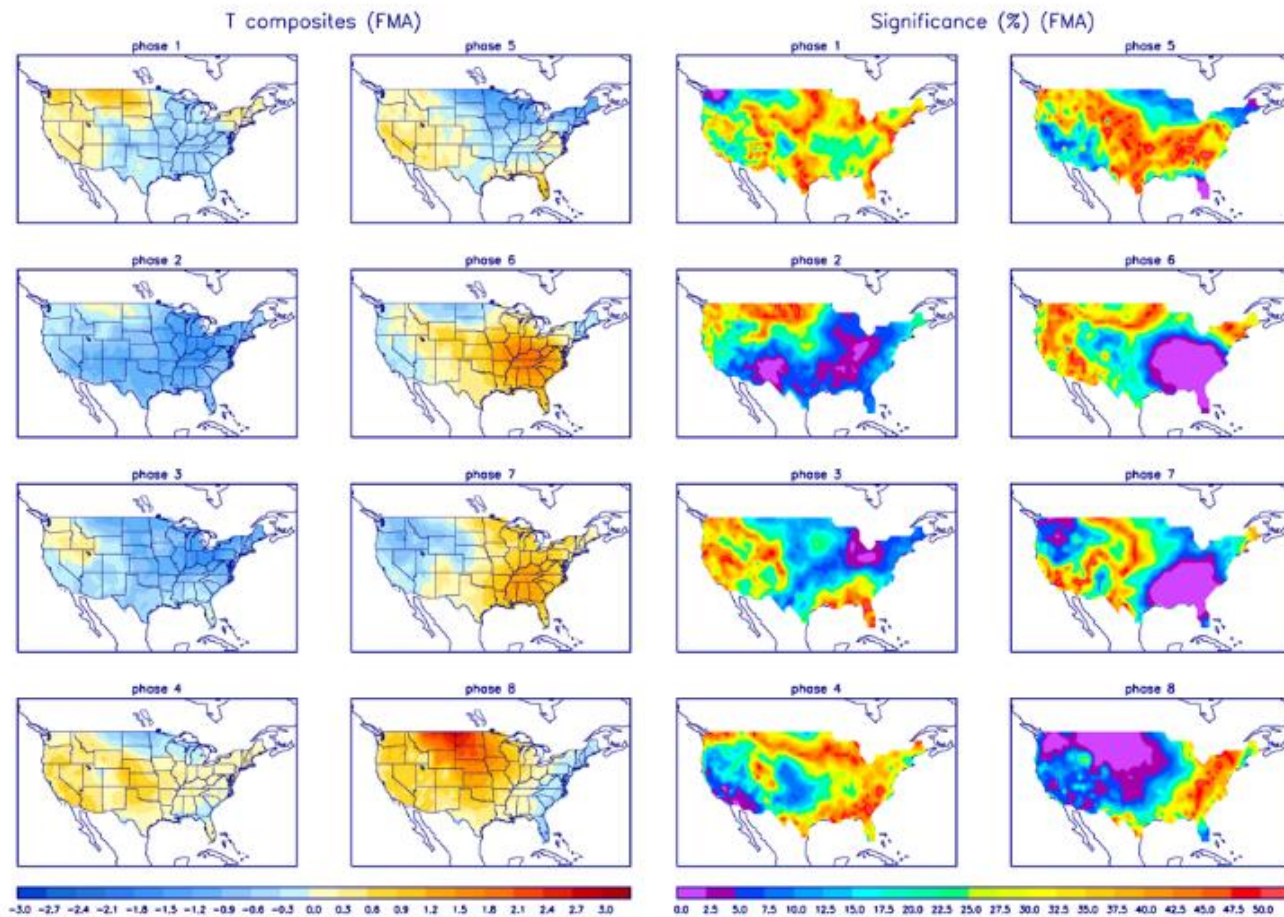
Precipitation Anomalies



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.

