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

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

Overview

- There is evidence of a robust MJO event over the Indian Ocean. There is also strong Kelvin wave activity in the same region, which results in especially strong convection within the MJO envelope.

- The superposition of these two wave modes could result in enhanced tropical cyclone activity over the Indian Ocean during the next two weeks.

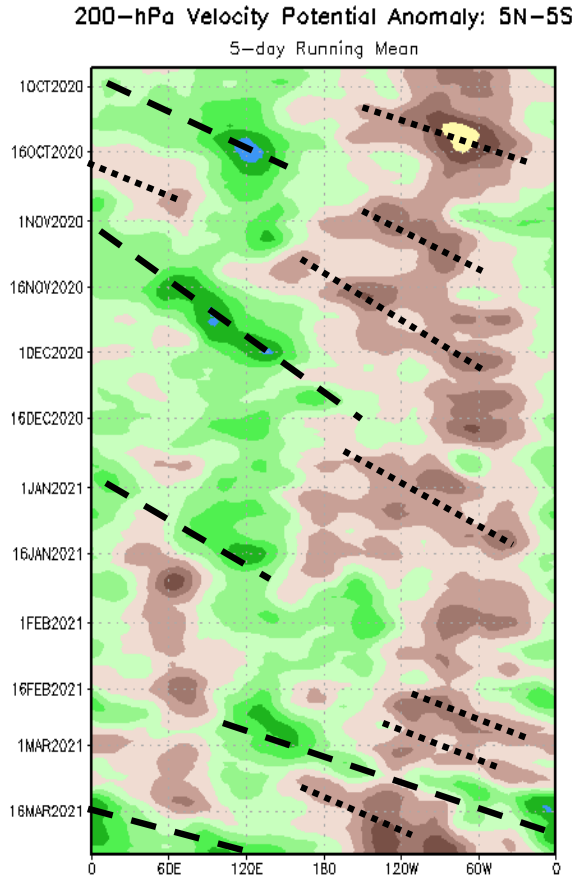
- Model forecasts of the MJO suggest that its active convection will reach the central Pacific during Week-2. Such a situation could result in a temporary disruption of the La Niña signal.

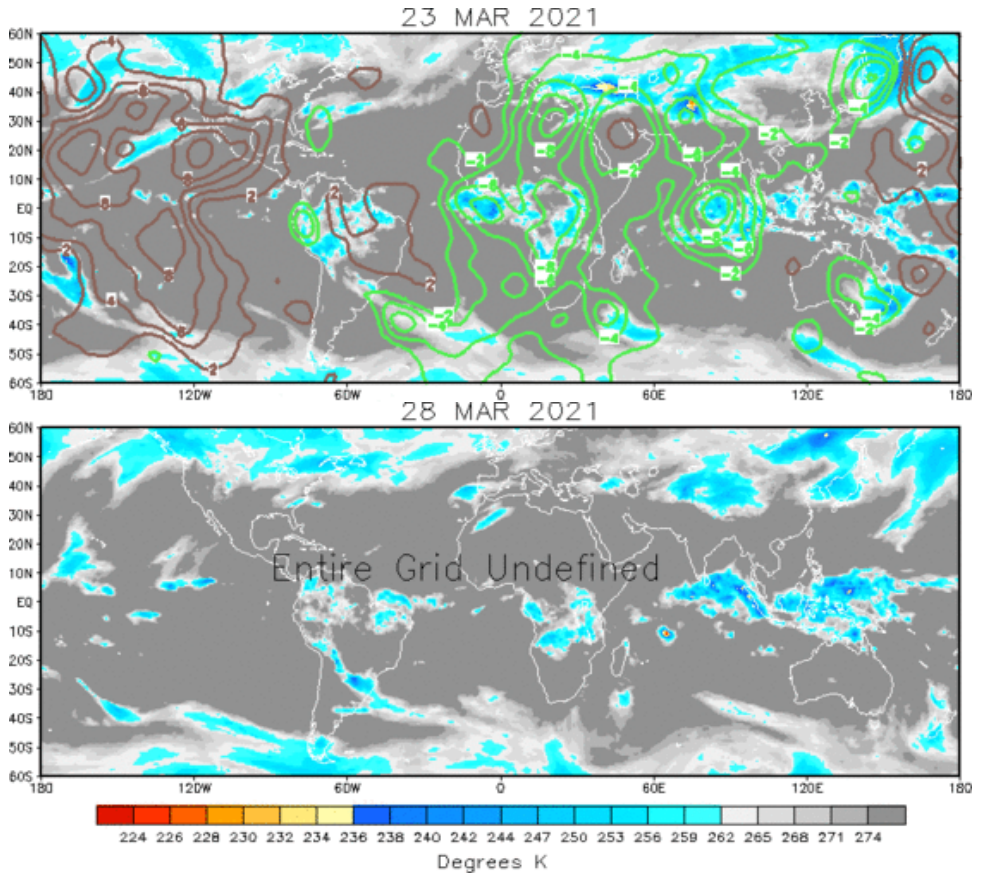
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

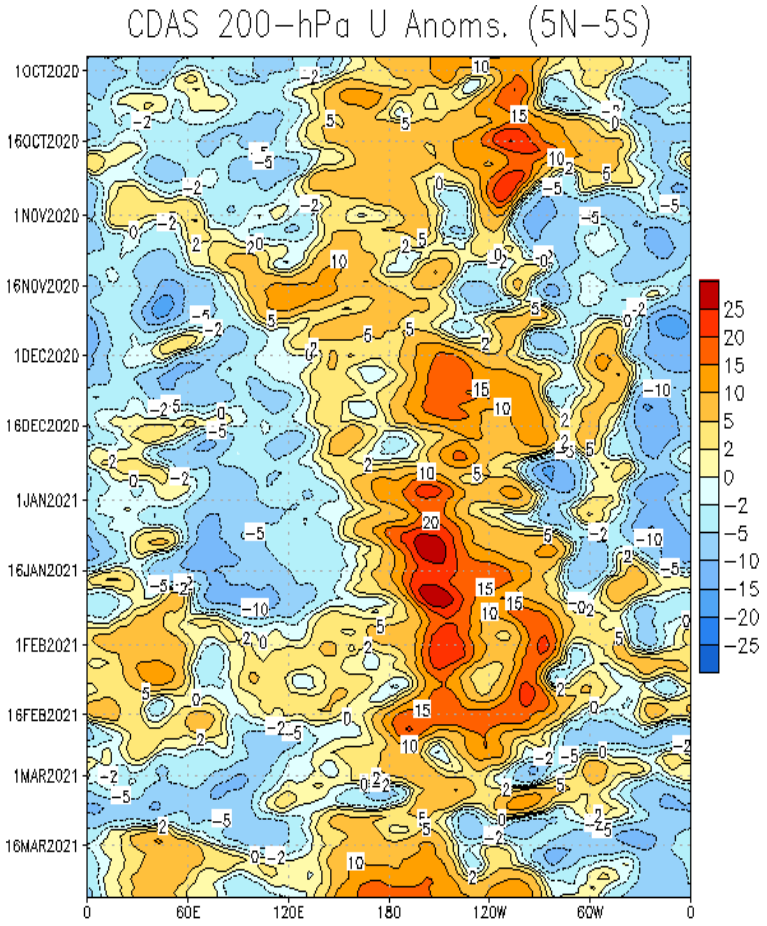


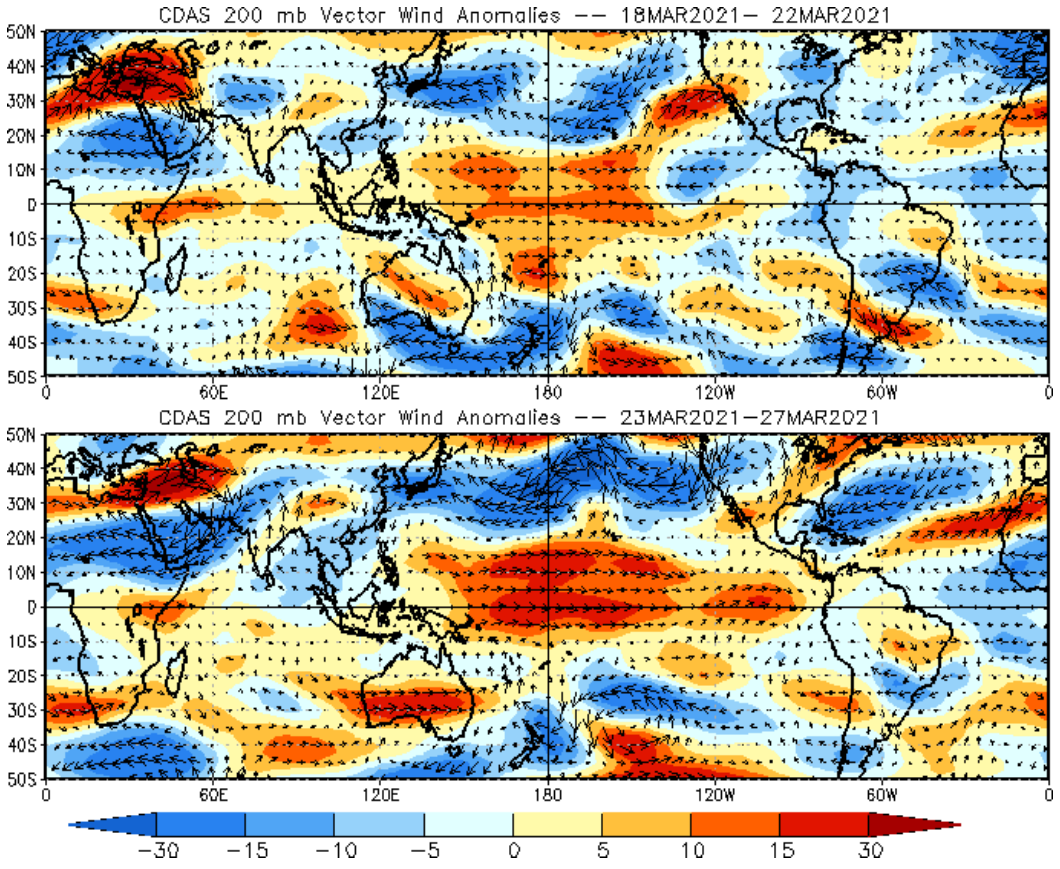


- MJO activity has picked up since mid-March and there is currently a well-defined Wave-1 pattern in the velocity potential field with enhanced ascent over the Eastern Hemisphere and enhanced descent over the Western Hemisphere.

200-hPa Wind Anomalies

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



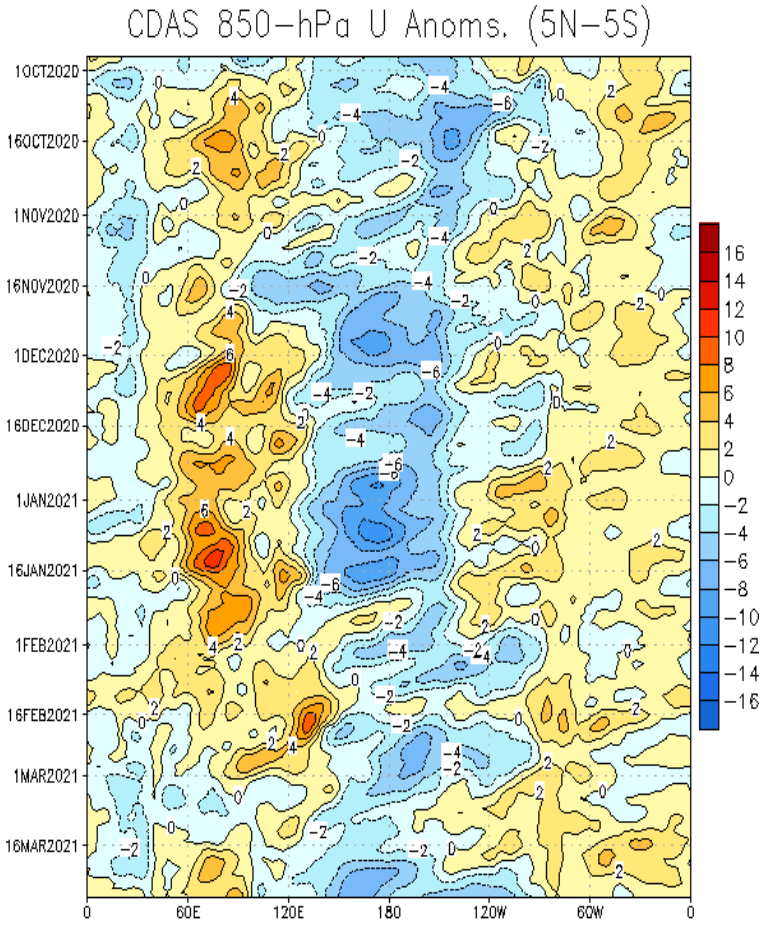


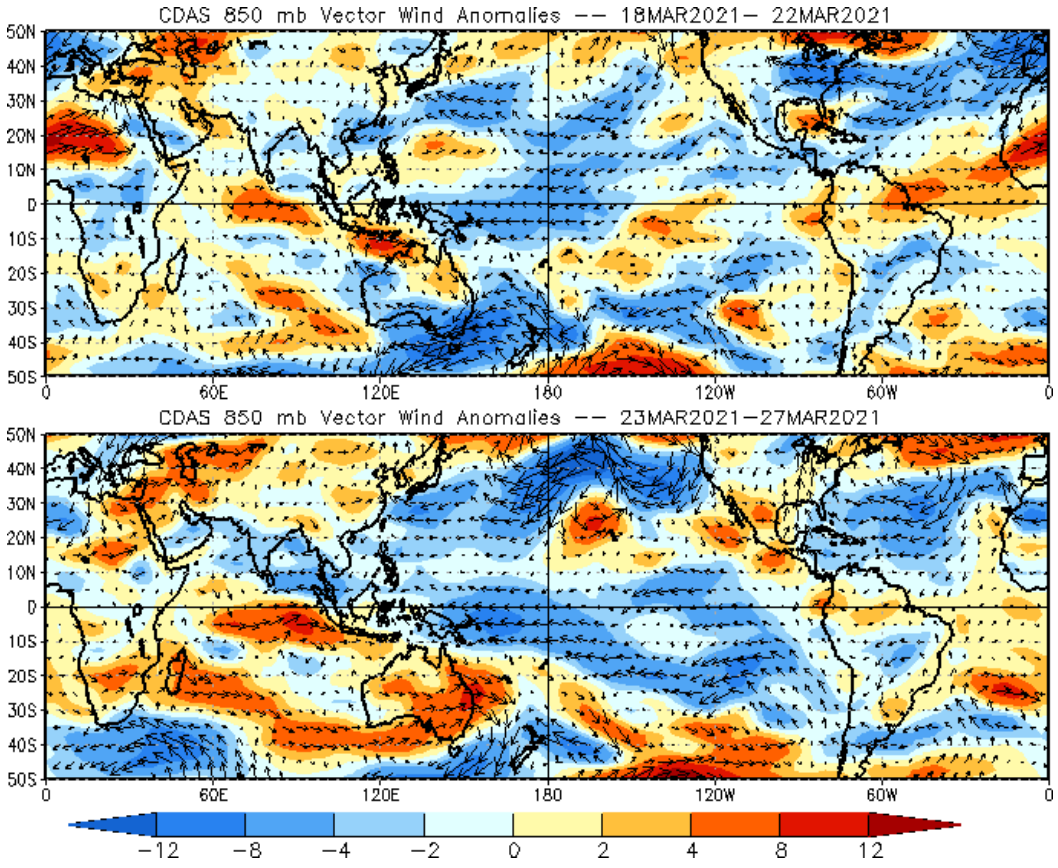
- There is evidence of Rossby wave breaking off of the North Pacific Jet during mid-March. This likely contributed to the current strengthening MJO signal.

- Anomalous westerlies over the central Pacific are consistent with a La Niña signal.

850-hPa Wind Anomalies

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

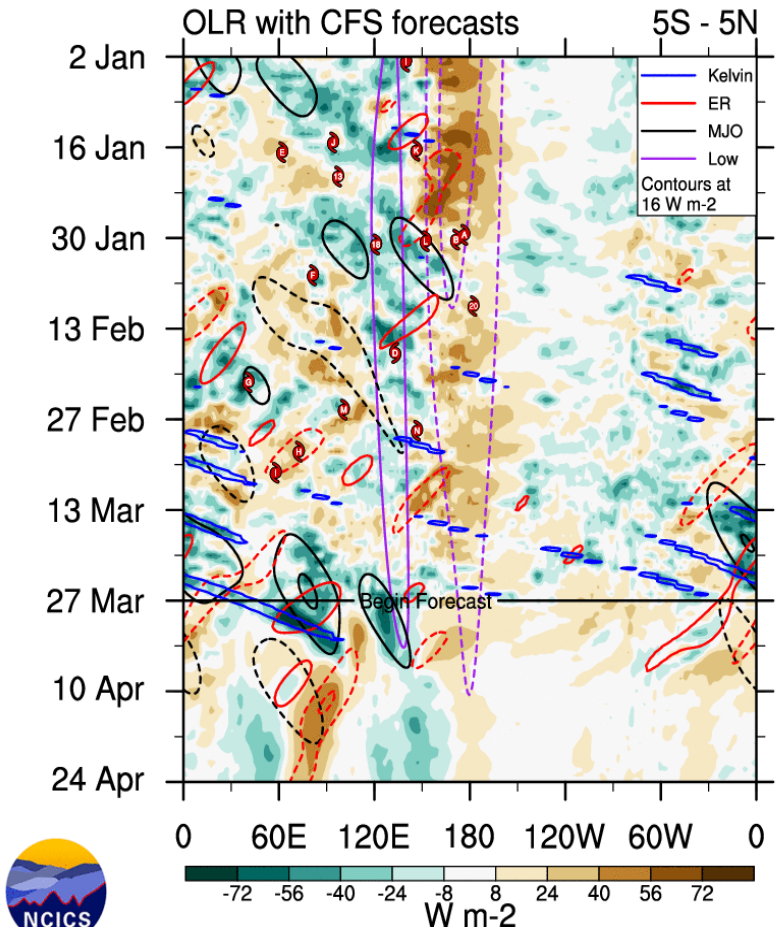


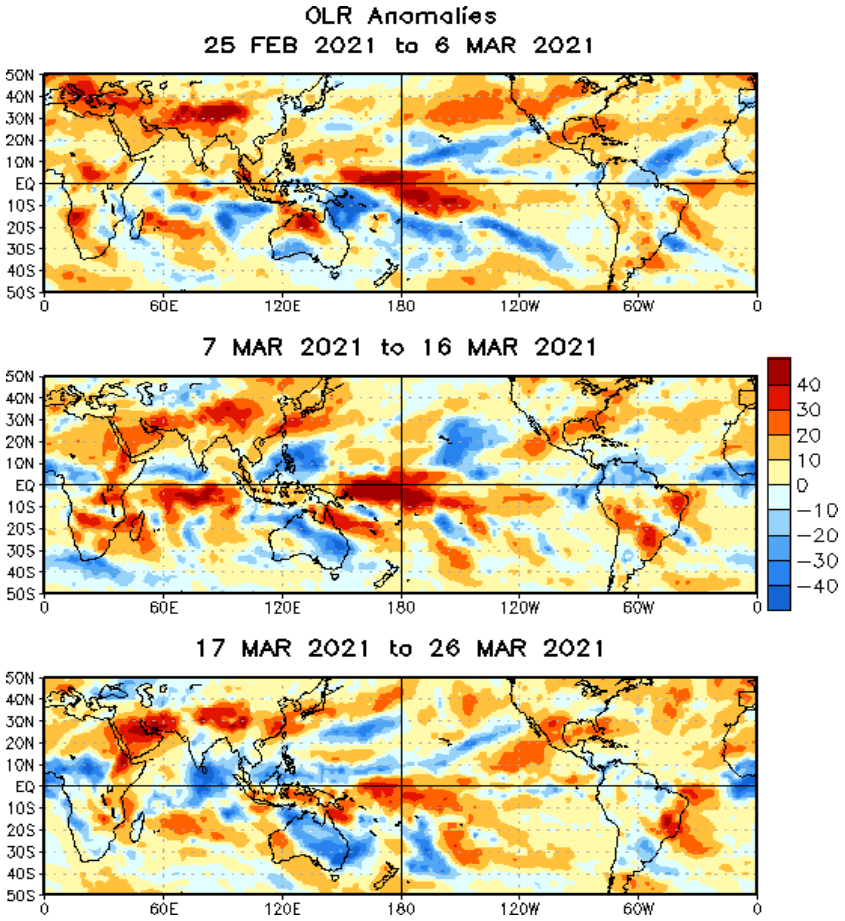


- The aforementioned wave breaking is also apparent in the low-level wind field.
- The trade winds are enhanced throughout the equatorial Pacific, consistent with the current La Niña.

Outgoing Longwave Radiation (OLR) Anomalies

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

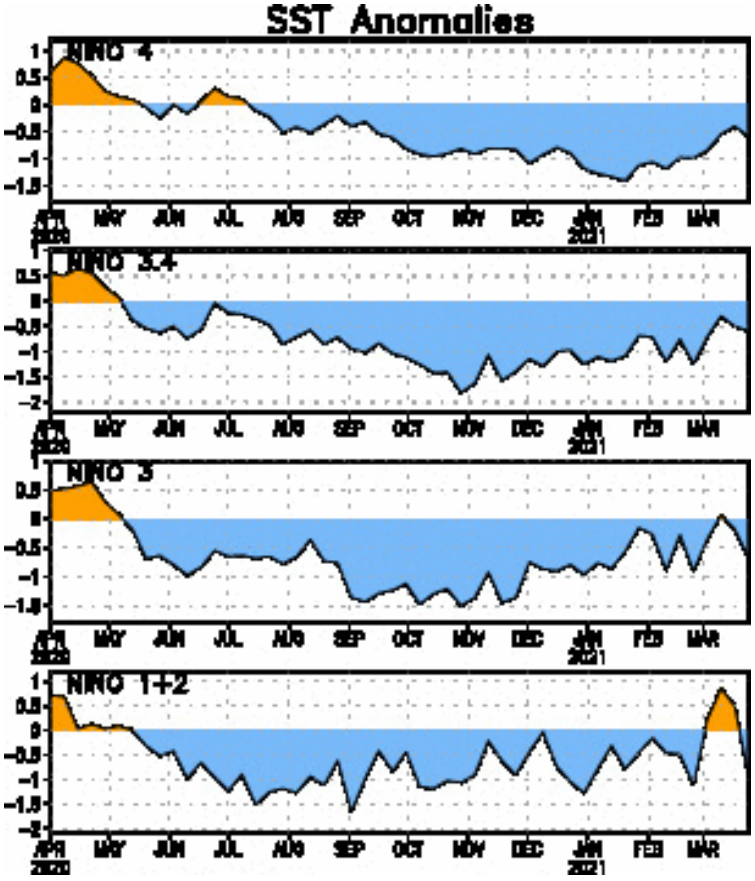


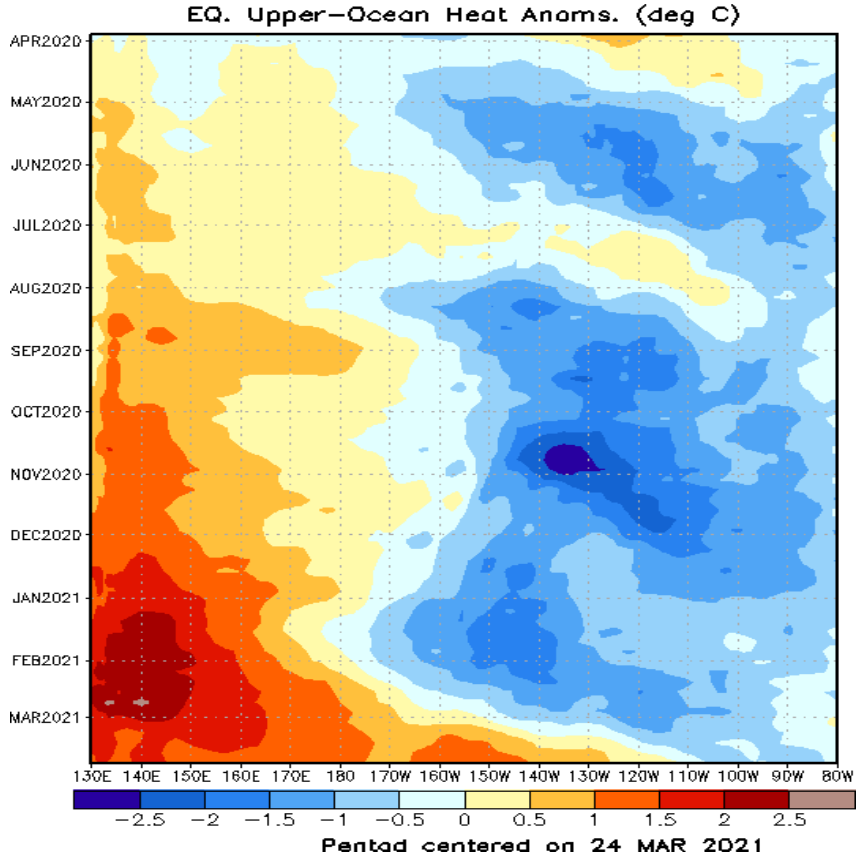


- There is a strong Kelvin wave over the Indian Ocean contained within MJO related active convection. This superposition of wave modes results in enhanced convection around 60 deg east, and could provide fuel for tropical cyclone activity during Week-1.

- Suppressed convection tied to the low frequency state remains anchored over the equatorial West Pacific.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



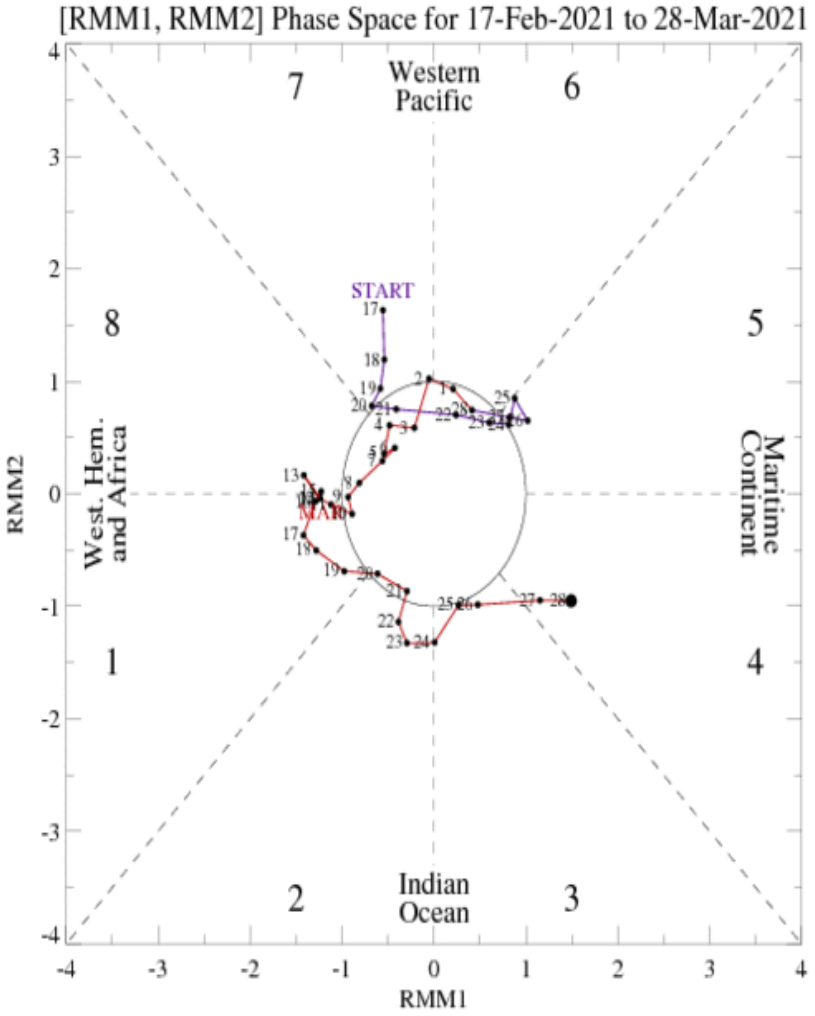


- La Niña conditions have been present since August 2020.

- 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 within the upper-ocean across the Central and East Pacific.

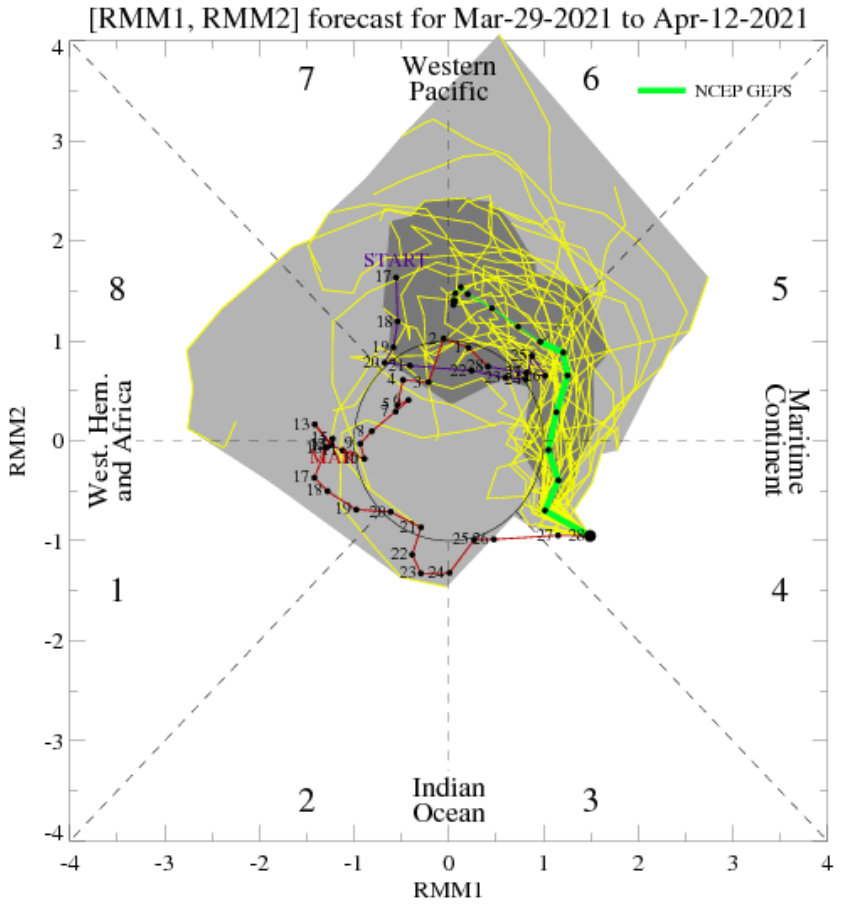
MJO Index: Recent Evolution

- The RMM index suggests that active MJO convection is present over the Maritime Continent.

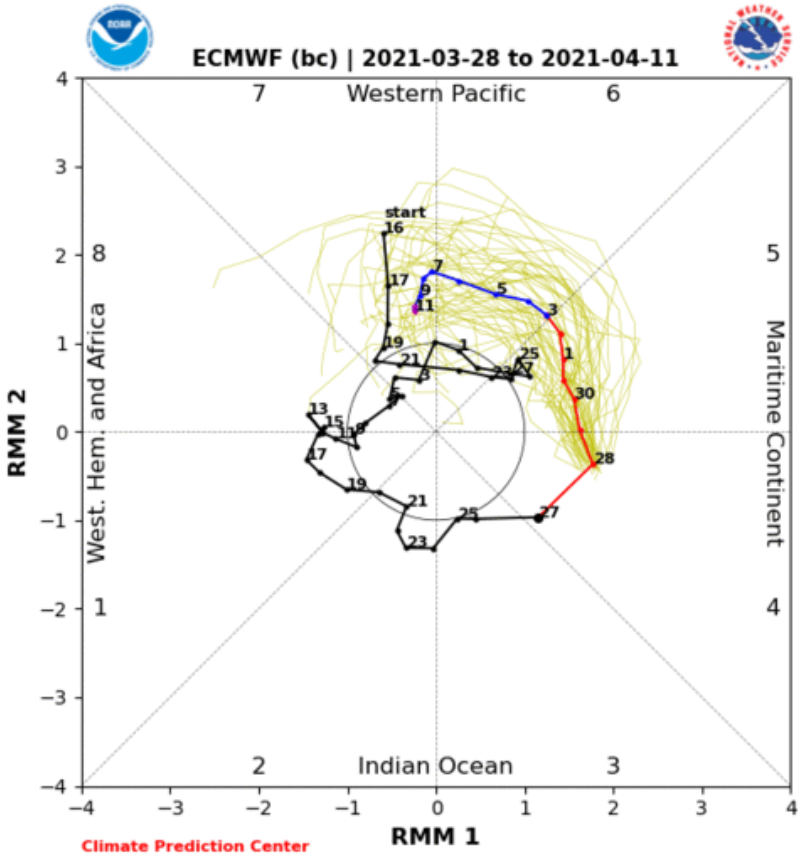


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



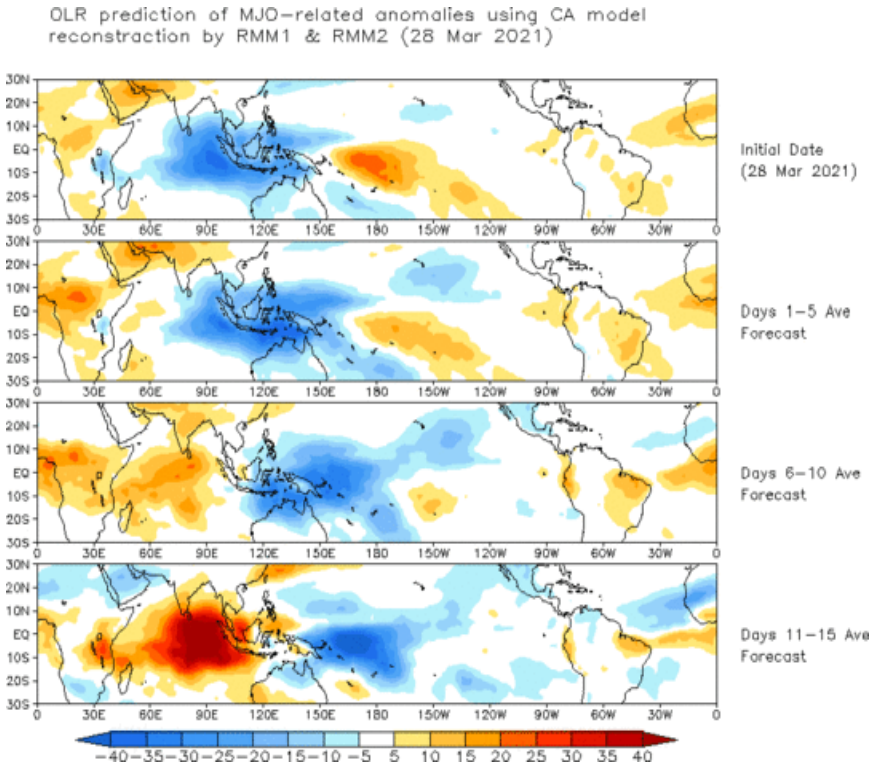
ECMWF Forecast

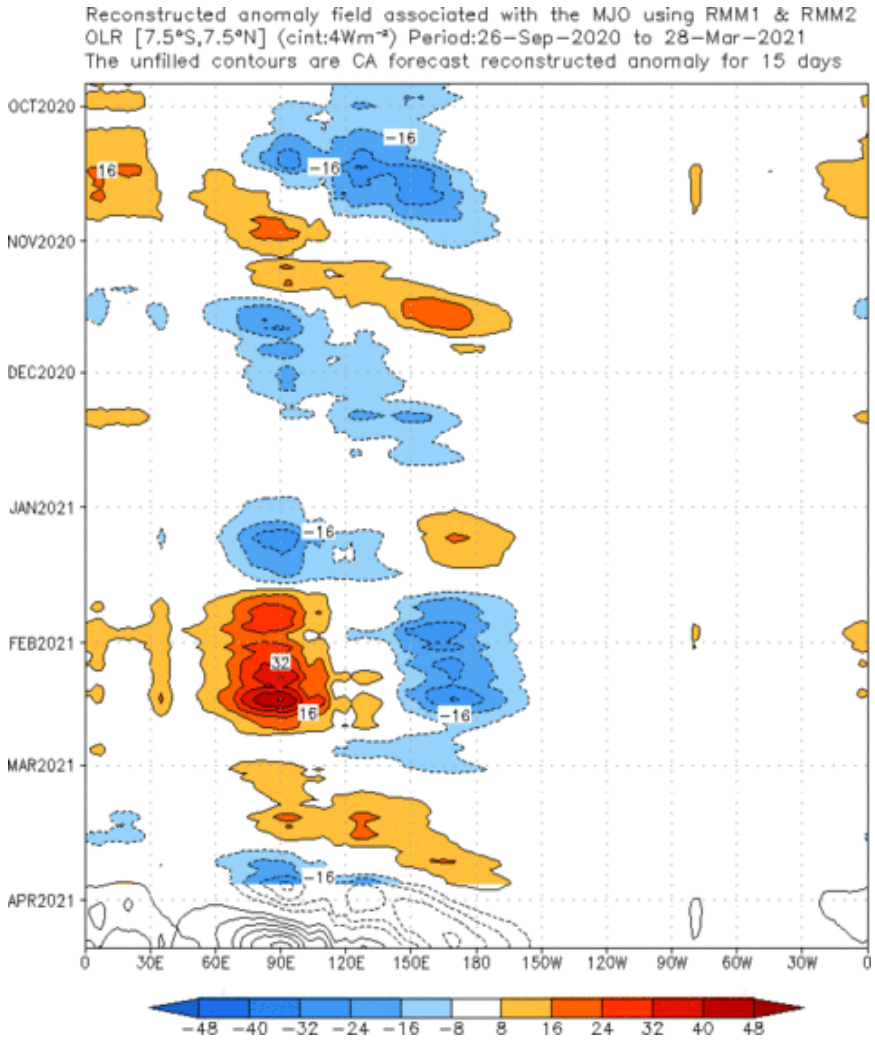
- Both the GEFS and ECMWF models predict the MJO to remain active and propagate over the Maritime Continent and Western Pacific during Weeks 1 and 2.

- The consistency between these two models, as well as relatively small ensemble spread and recent run-to-run continuity, results in increased confidence in this forecast.

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.)

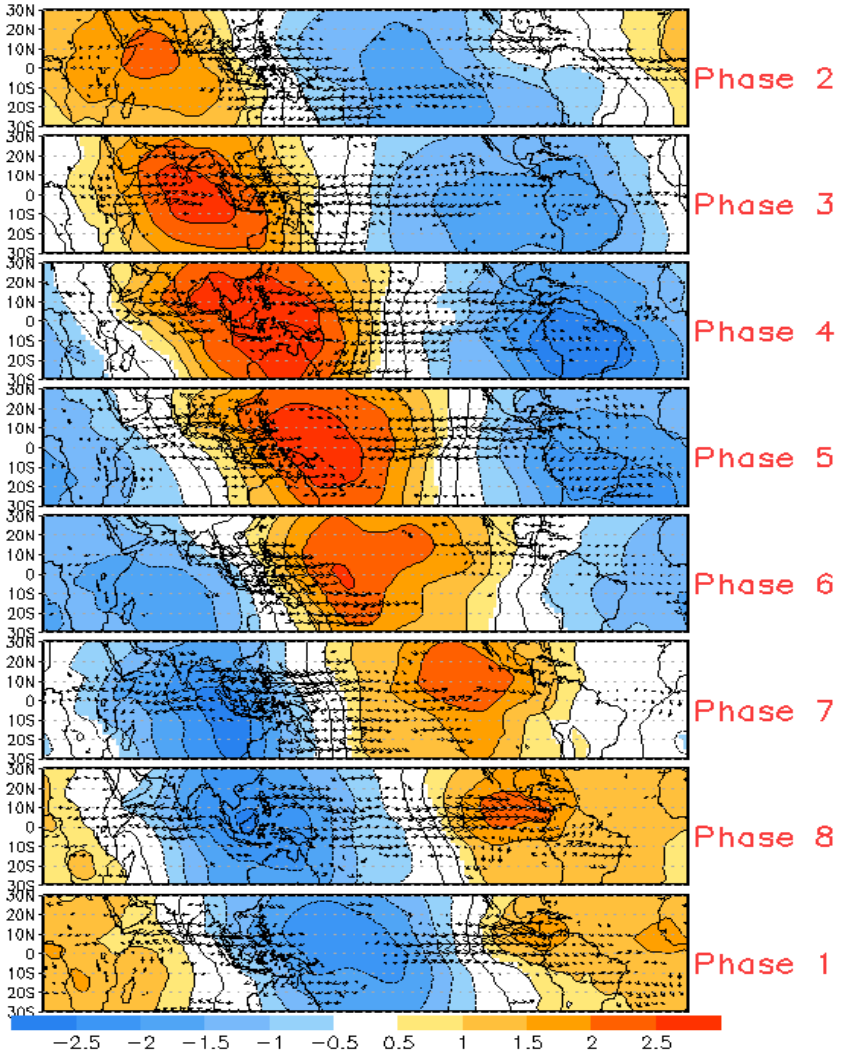




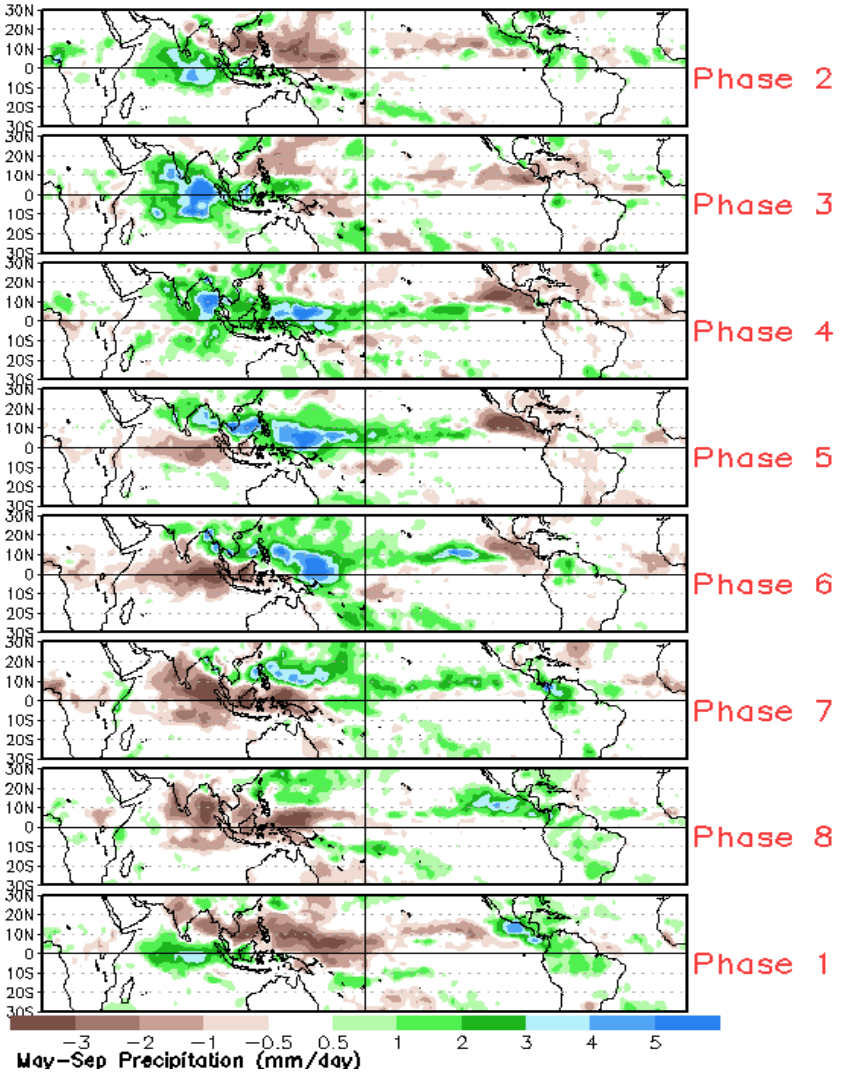
- The constructed analog forecasts an MJO evolution consistent with the GEFS and ECMWF RMM forecasts.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



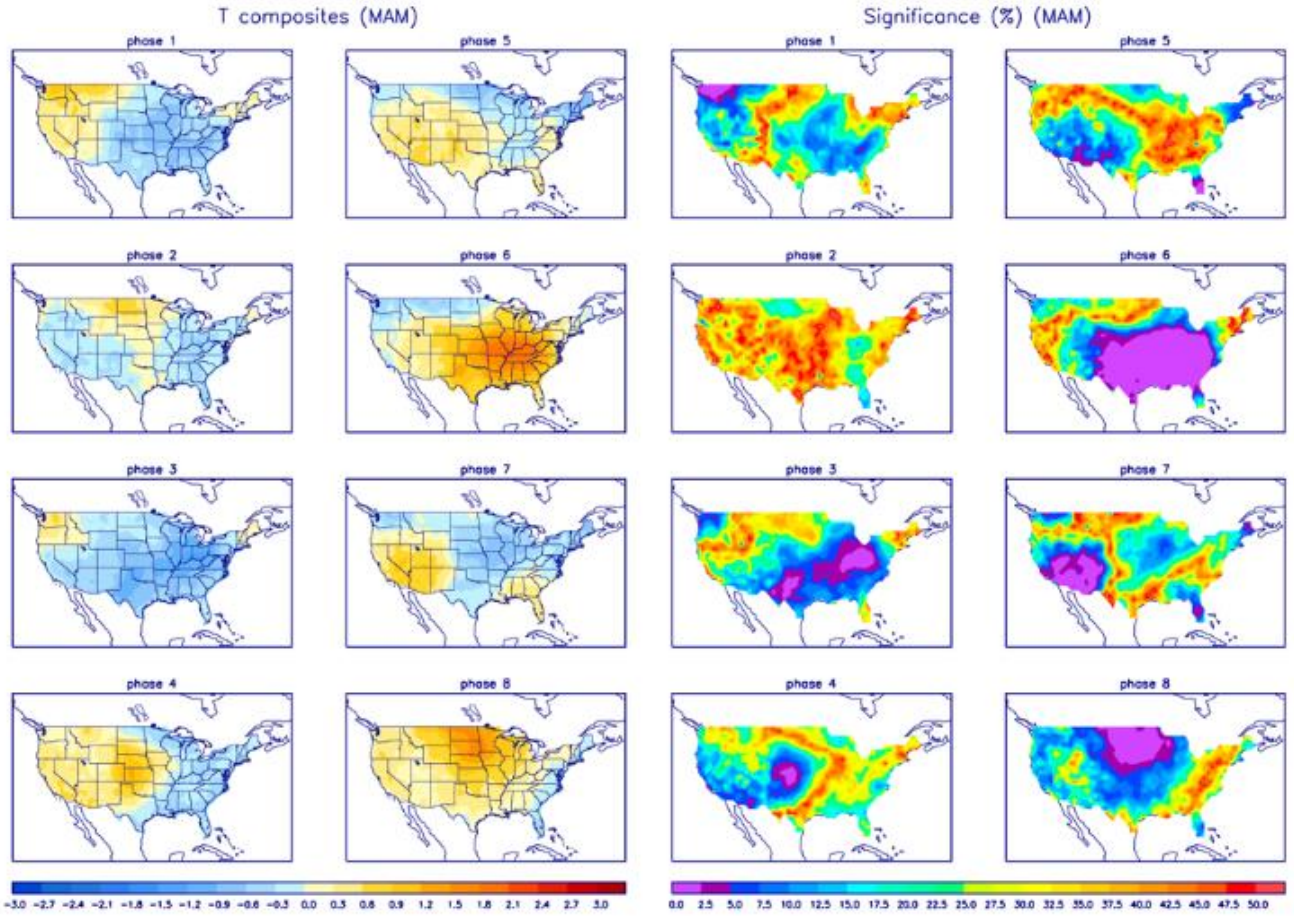
Precipitation Anomalies



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.



More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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.

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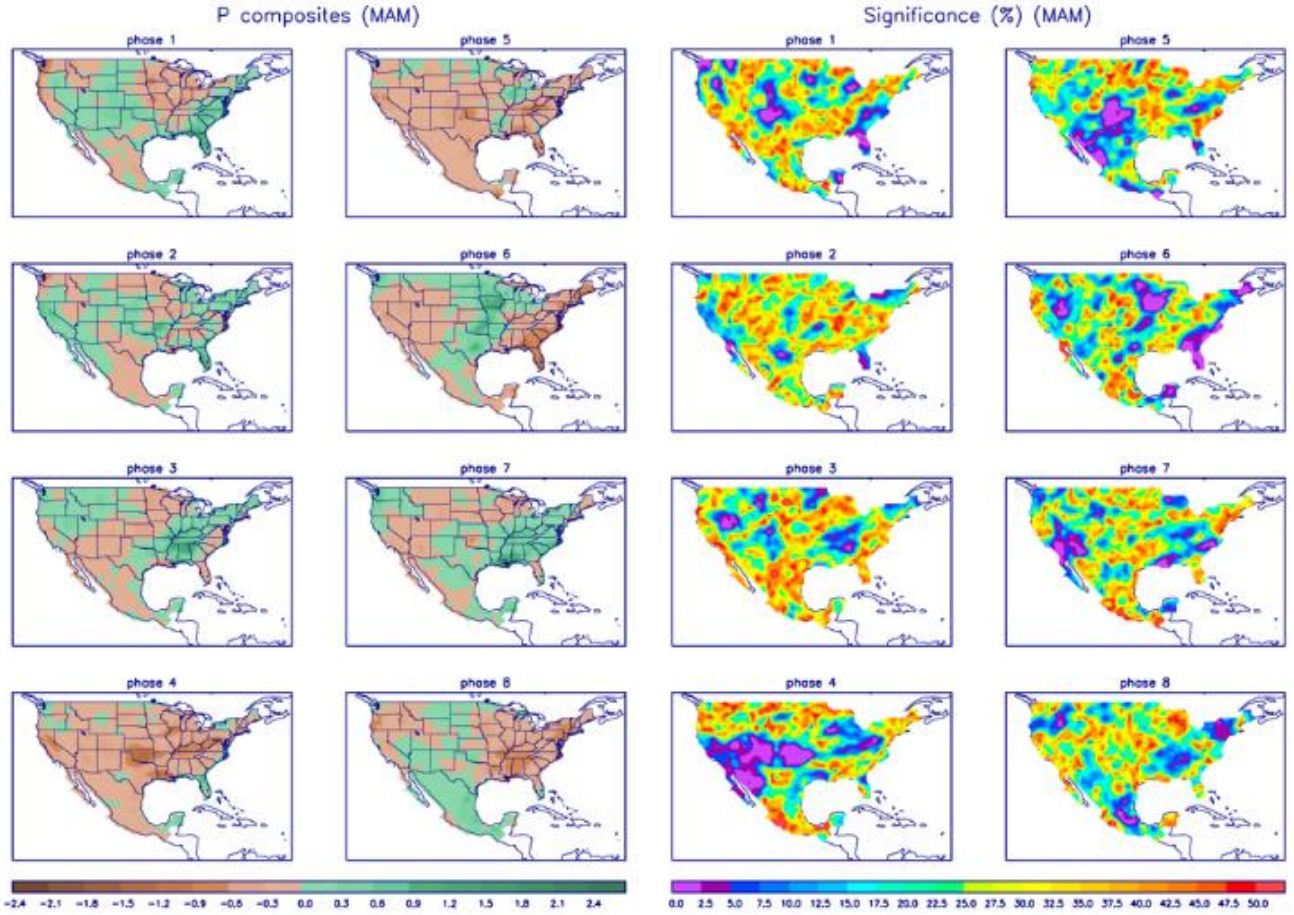

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