

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



Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
30 March 2020

Overview

- An enhanced convective intraseasonal signal is located over the Maritime Continent region. Part of this signal appears to be due to Kelvin wave activity.
- The latest dynamical model guidance is less bullish (compared to last week) in predicting a robust MJO event during the next two weeks. Most models rapidly weaken the MJO signal to within the unit circle during week-1. In week-2, some models maintain a weak signal within the unit circle, while others show some emergence of the signal out over the Western Hemisphere.
- During week-1, tropical cyclone activity is favored over the Coral Sea in the southwestern Pacific, and possibly the central South Indian Ocean.
- The low-frequency enhanced convective signal near the Date Line appears to have broken down during March.

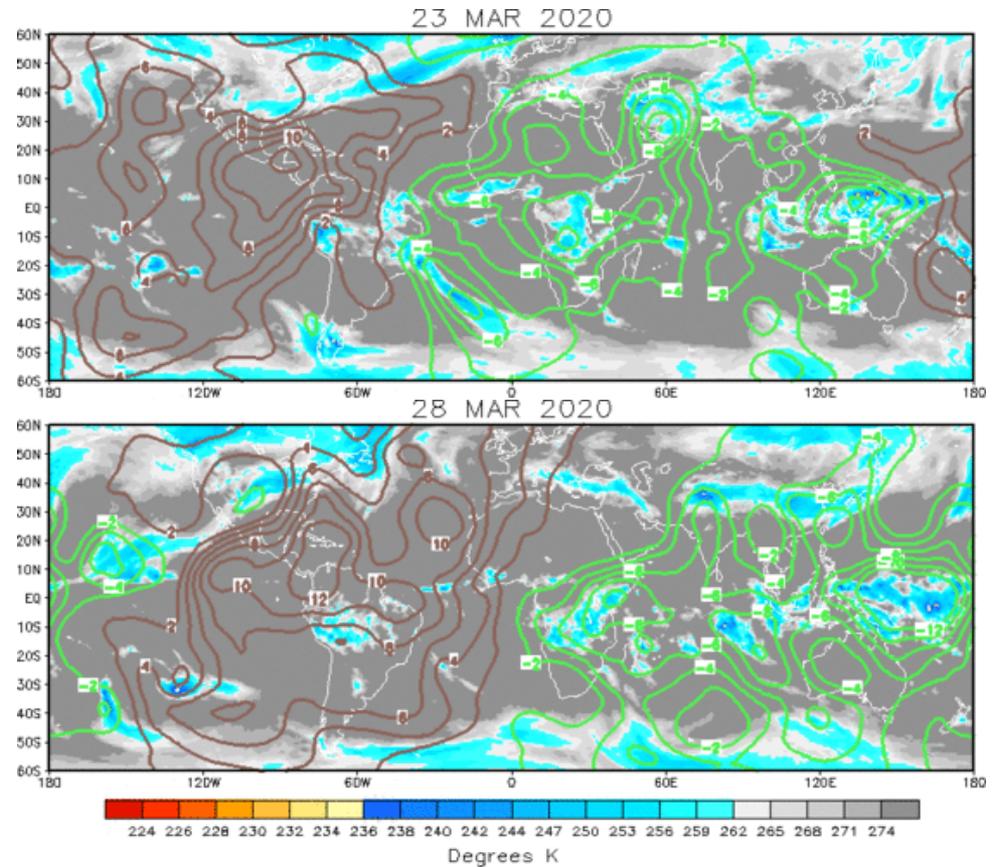
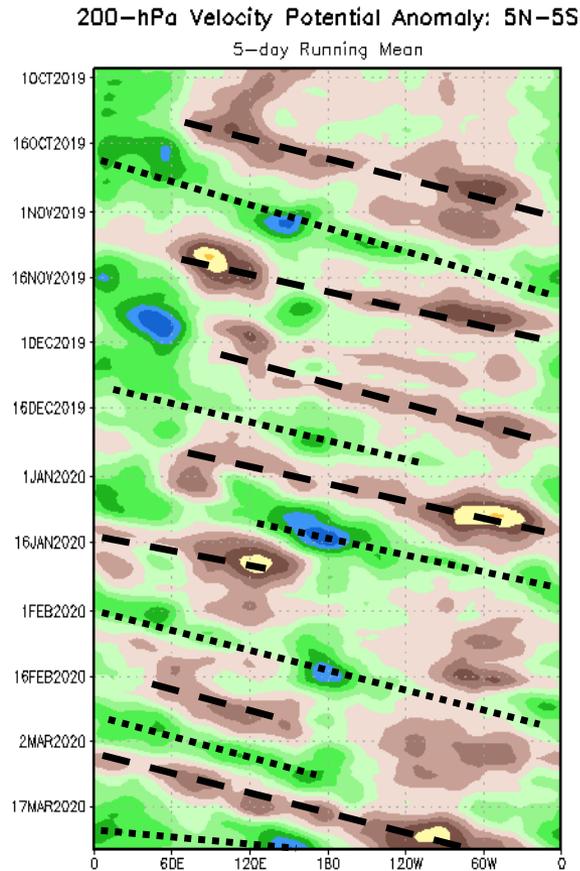
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:

<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

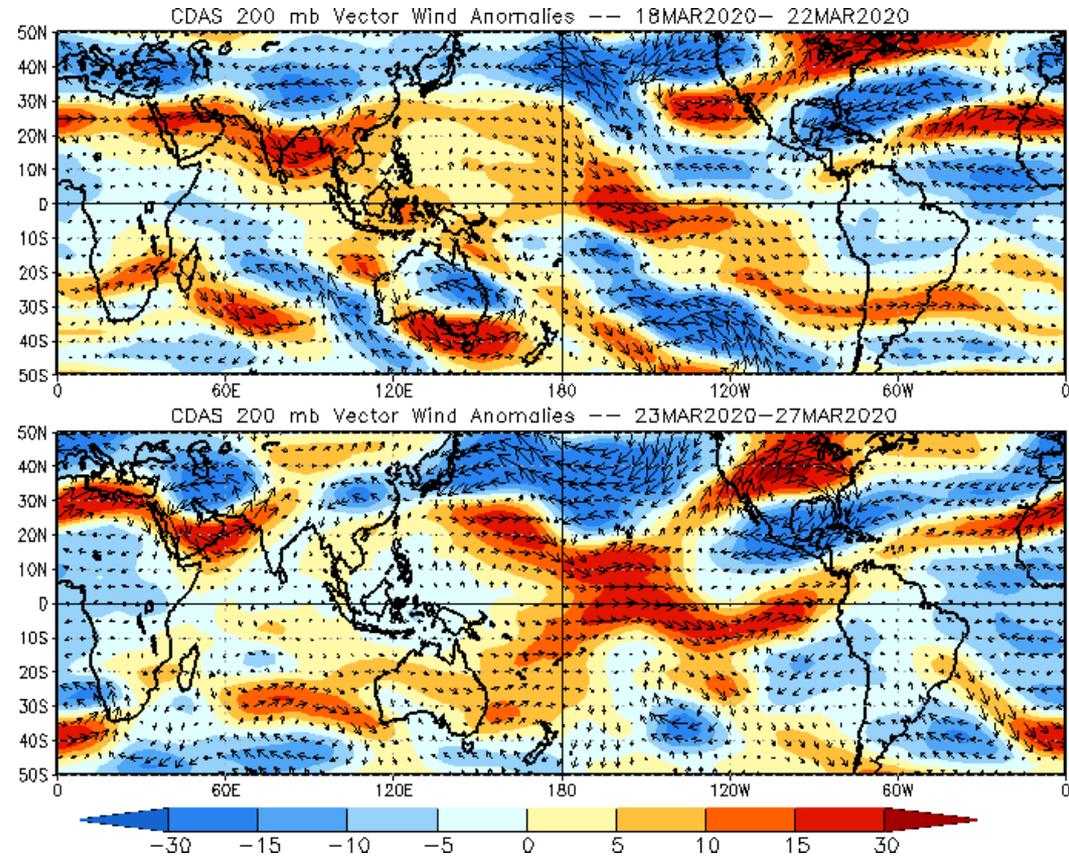
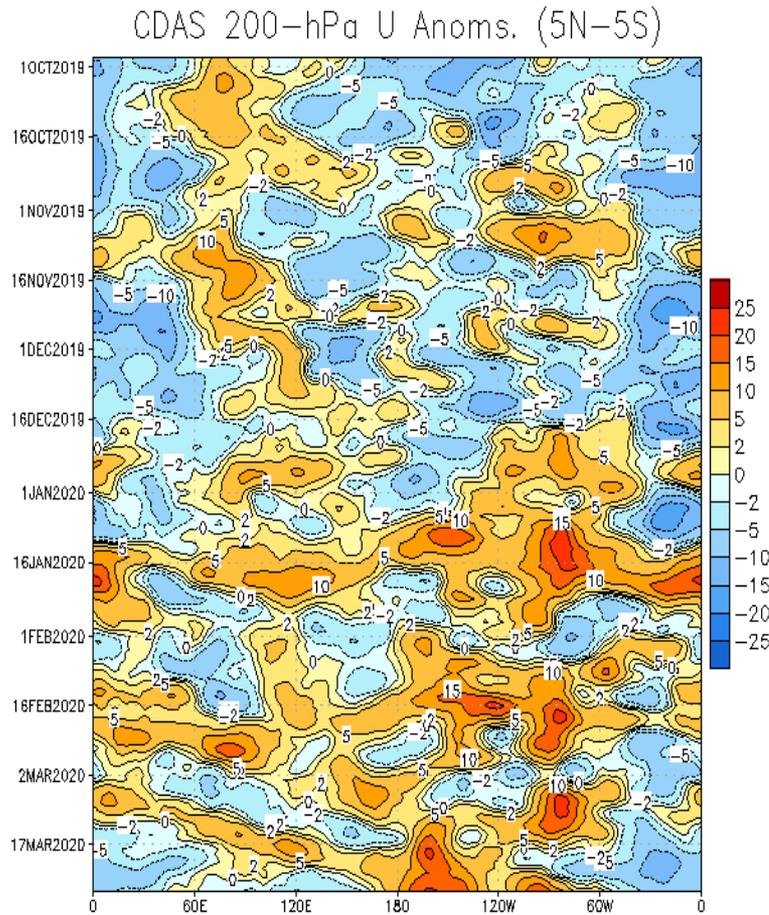
Brown shades: Anomalous convergence (unfavorable for precipitation).



- The global convective pattern continues to exhibit a Wave-1 pattern (enhanced over the Eastern Hemisphere and suppressed over the Western Hemisphere).
- This periodicity is considerably faster than the MJO envelope, and suggests convectively coupled Kelvin wave activity is helping to drive the upper-level circulation.

200-hPa Wind Anomalies

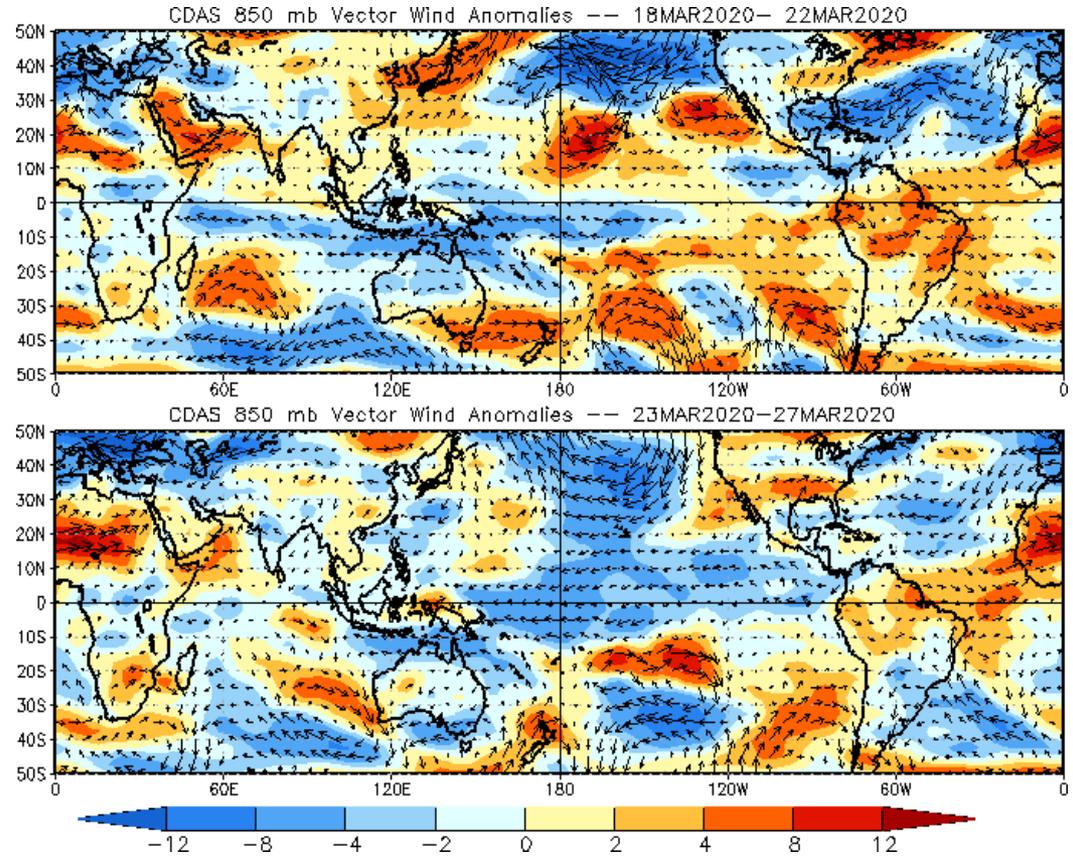
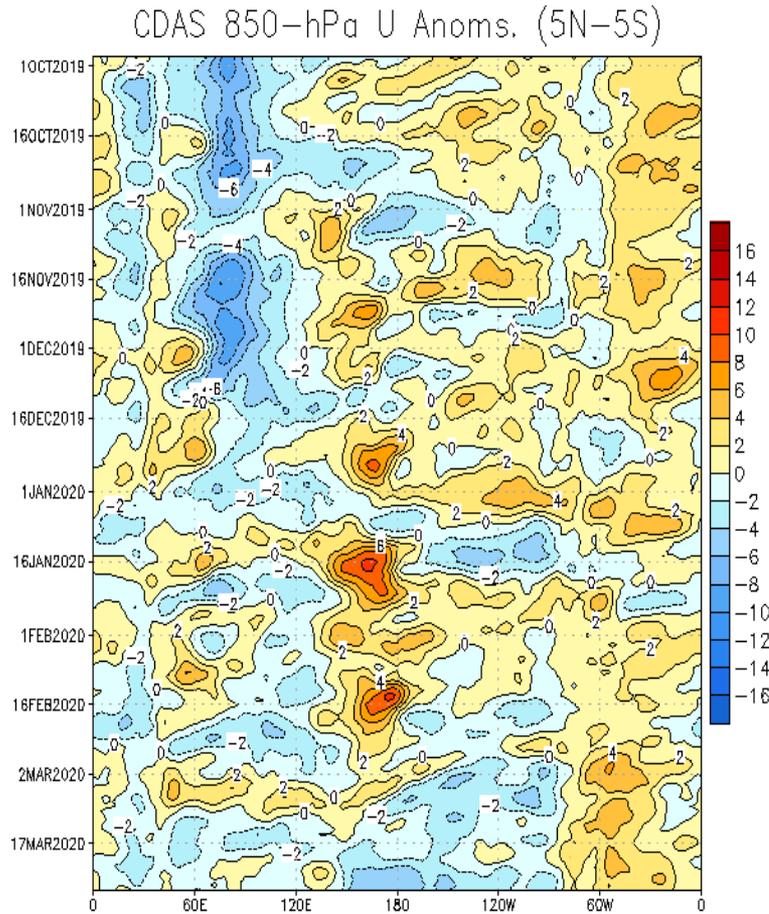
Shading denotes the zonal wind anomaly. **Blue shades: Anomalous easterlies.** **Red shades: Anomalous westerlies.**



- An eastward propagating band of anomalous westerlies has reached the Western Hemisphere. Anomalous easterlies dominate the near-equatorial Eastern Hemisphere.
- Low-latitude westerly anomalies in both hemispheres appear to converge briefly over the central Pacific. During the previous 5-day period in this same region, cross-equatorial flow is indicated from the mid-latitudes of the Northern Hemisphere to the tropical Southern Hemisphere.

850-hPa Wind Anomalies

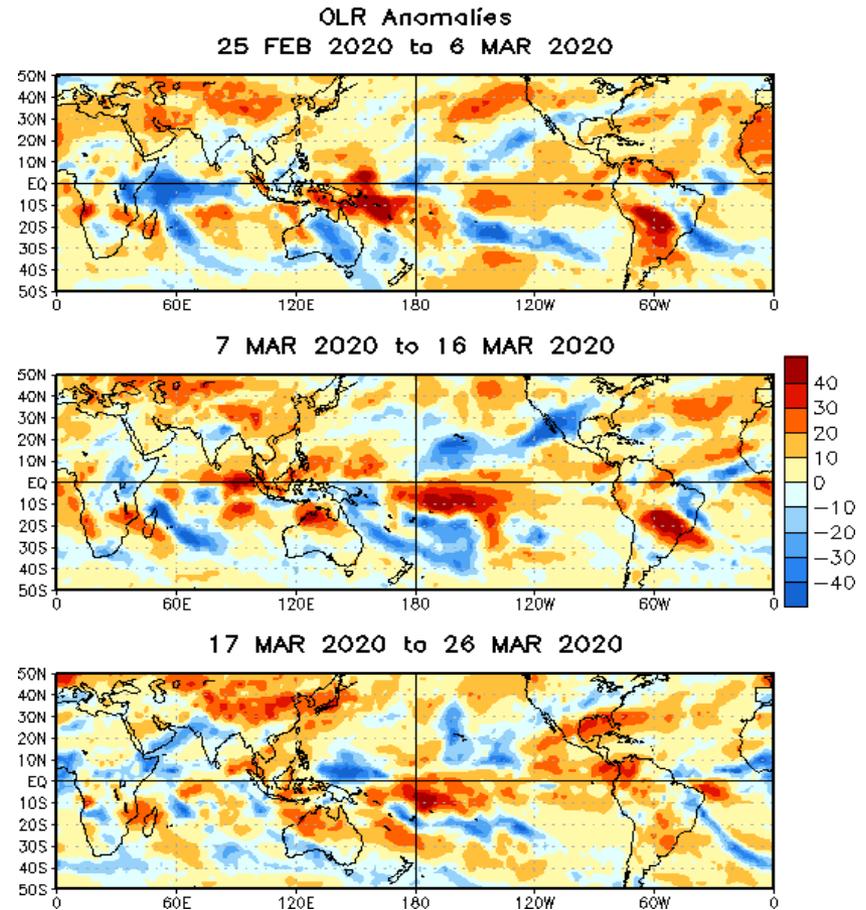
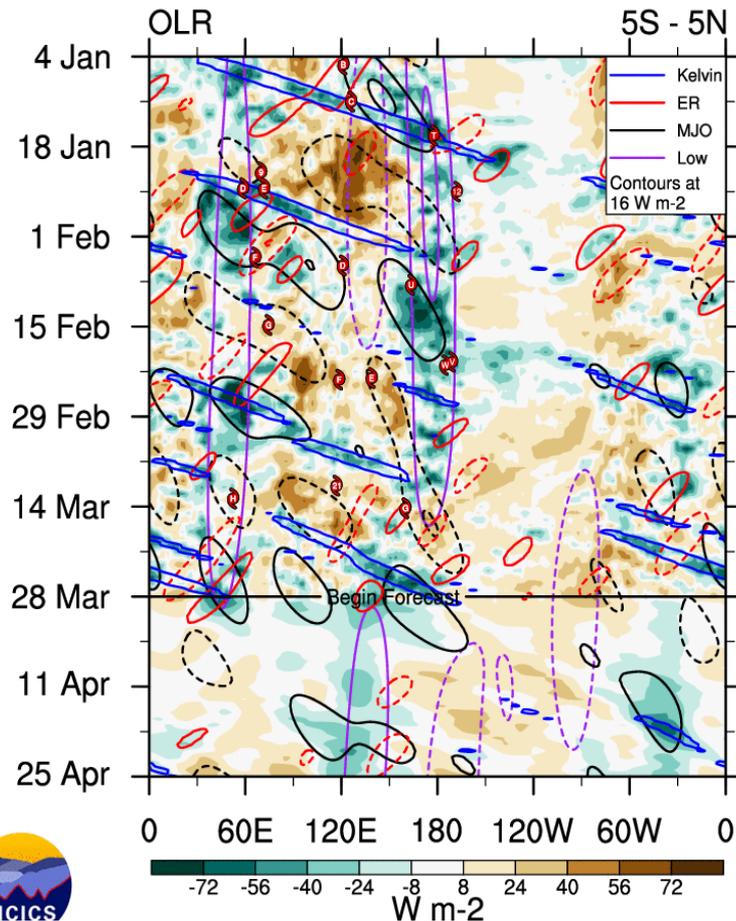
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- The near-equatorial low-level wind field is fairly coherent from about 140E to the Prime Meridian, featuring low-level easterly anomalies between about 140E to 80W, and westerly anomalies from 80W to the Prime Meridian.
- The low-frequency westerly signal just west of the Date Line has reversed sign/direction. It is not clear at this time whether or not this is just a temporary reversal or a long-lasting change.

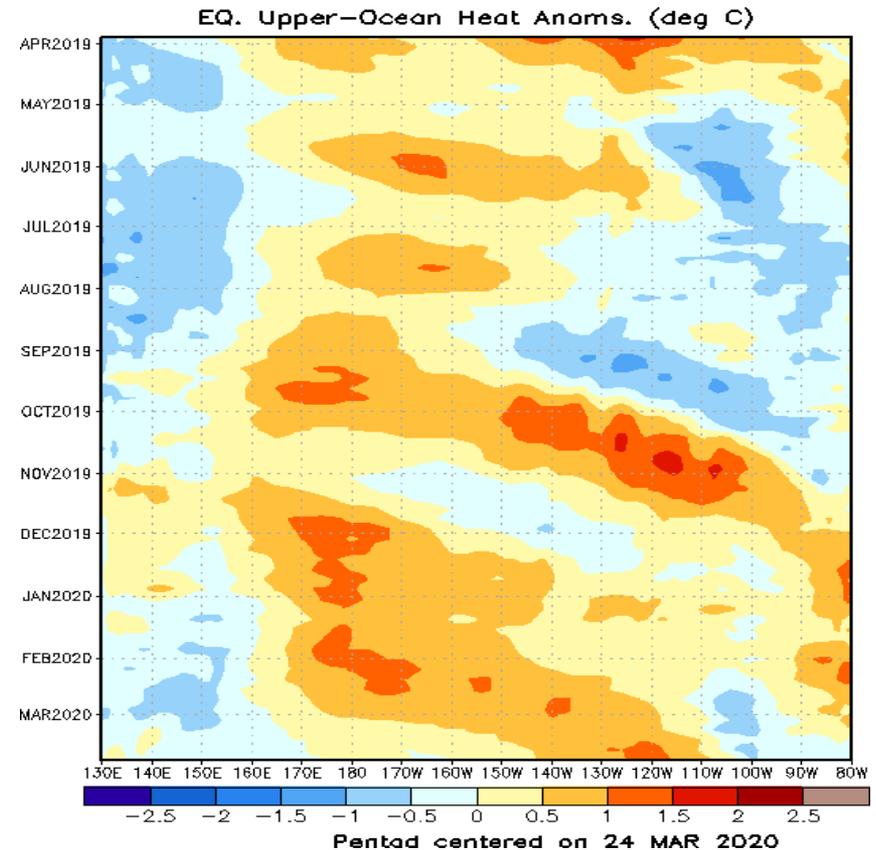
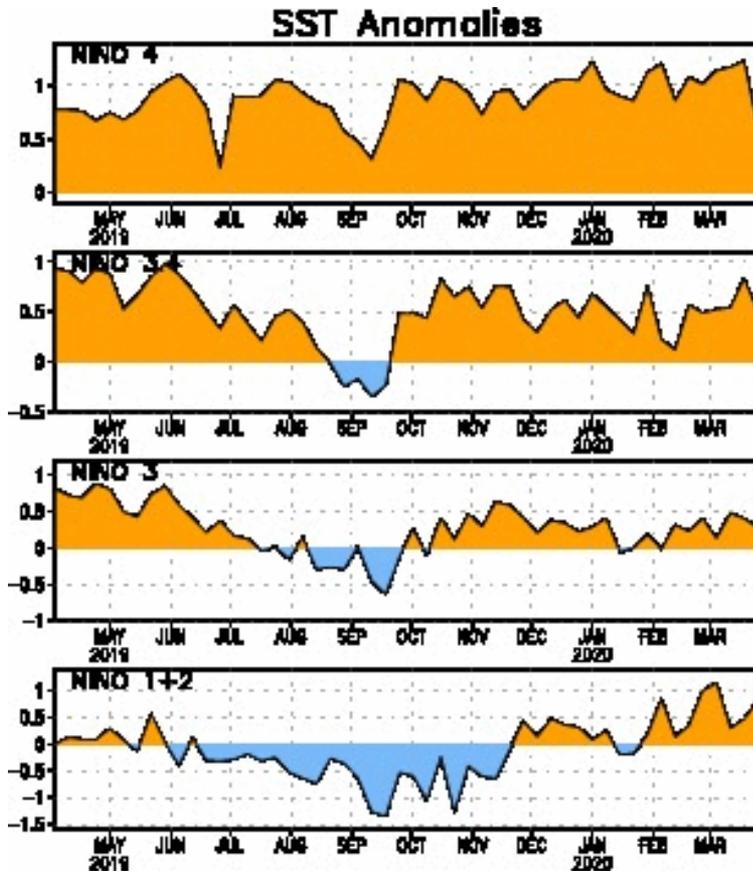
Outgoing Longwave Radiation (OLR) Anomalies

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



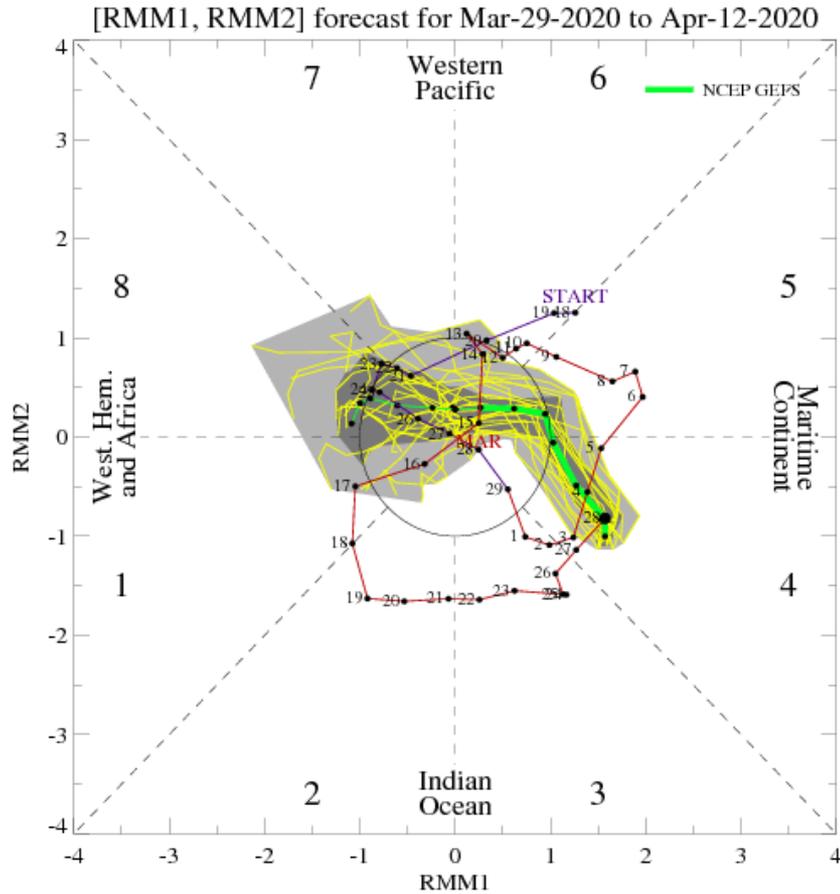
- Enhanced convective anomalies are indicated just north of the equator near the Prime Meridian and the Western Pacific. Suppressed convective anomalies are located just south of the equator in the vicinity of the Date Line, and near South America.
- The forecast suggests a more stationary pattern of anomalous convection, with last week's prospects of a more robust MJO event appearing less likely now.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

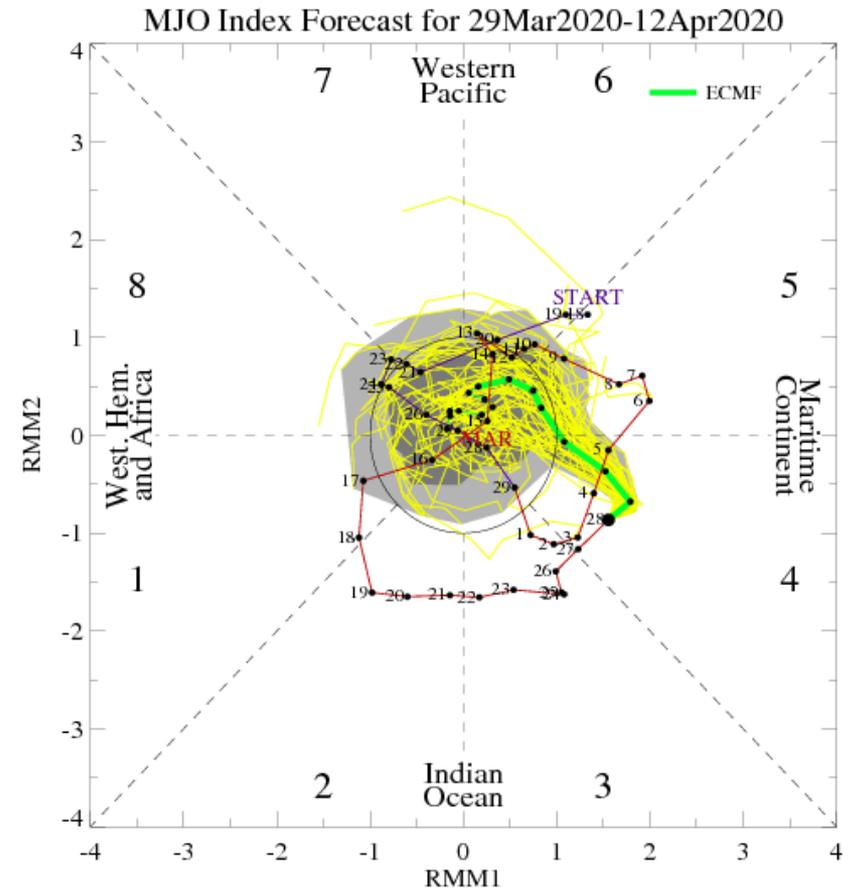


- Upper-ocean heat content anomalies continue to remain above-normal across most of the Pacific basin.
- From mid-December to the beginning of March, episodes of westerly wind bursts west of the Date Line contributed toward a double-barrel downwelling Kelvin wave event that sustained anomalously warm temperatures across the Pacific.

MJO Index: Forecast Evolution



GEFS Forecast



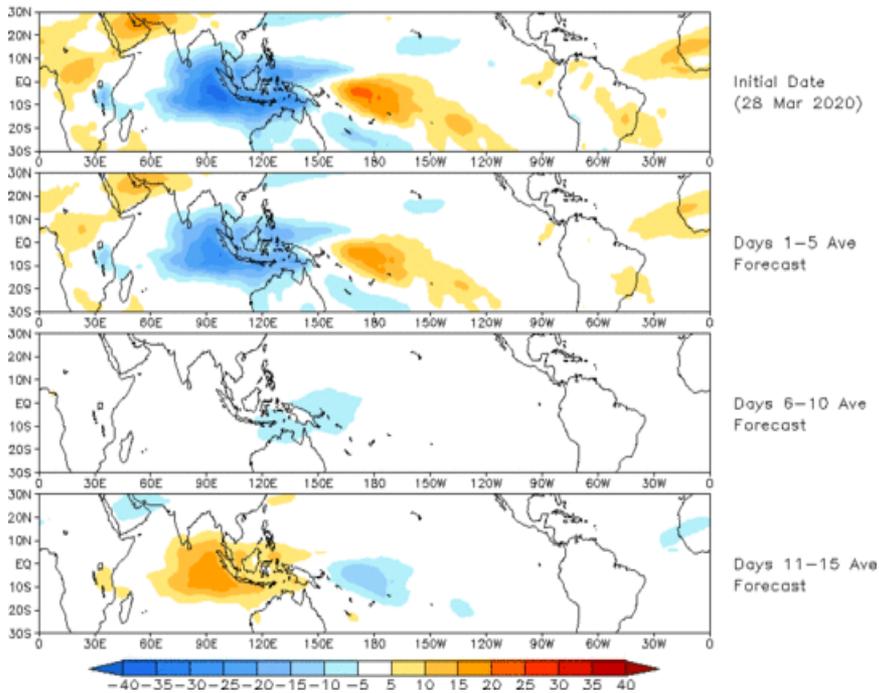
ECMWF Forecast

- Dynamical models forecast a rapid weakening of the intraseasonal signal over the Maritime Continent during week-1. During week-2, the GEFS keeps the signal almost entirely within the unit circle, possibly emerging late in the period in Phase 8. The ECMWF also keeps the signal within the unit circle, but with a tendency towards the center (origin).

MJO: GEFS Forecast Evolution

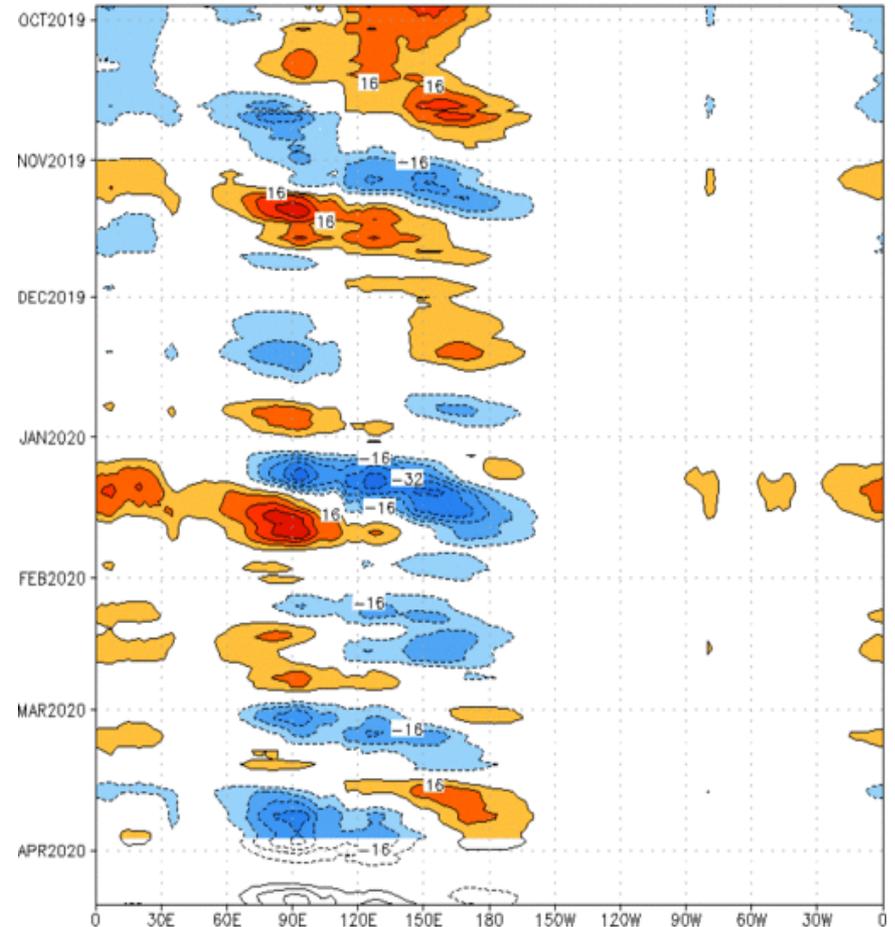
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 28 Mar 2020
OLR



- The GEFS RMM-index based spatial forecast depicts robust MJO activity progressing across the Indian Ocean/Maritime Continent in week-1, with suppressed convection prevailing across this same region in week-2.

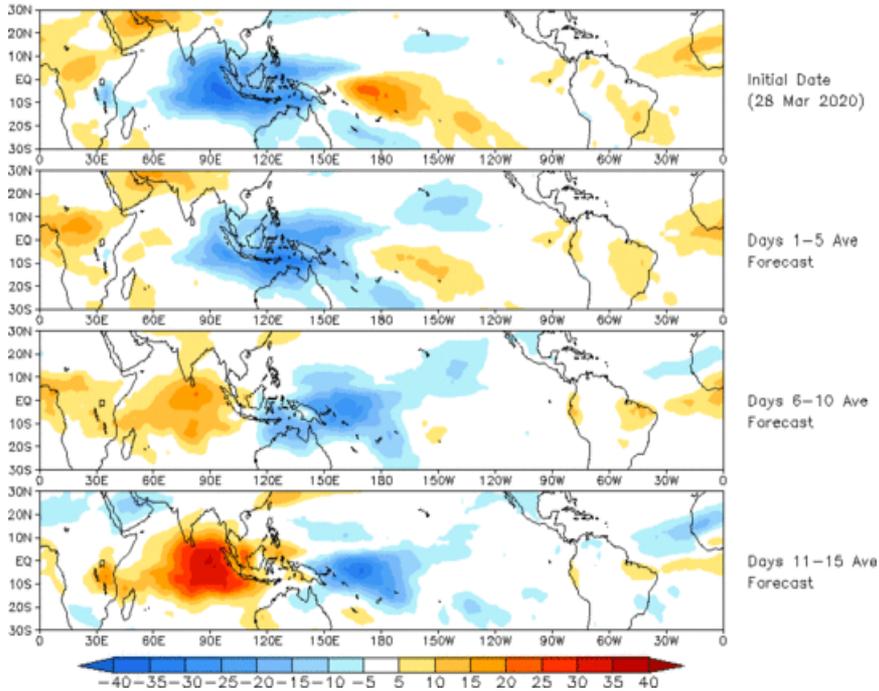
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [$7.5^{\circ}S, 7.5^{\circ}N$] (cont: $4Wm^{-2}$) Period: 28-Sep-2019 to 29-Mar-2020
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



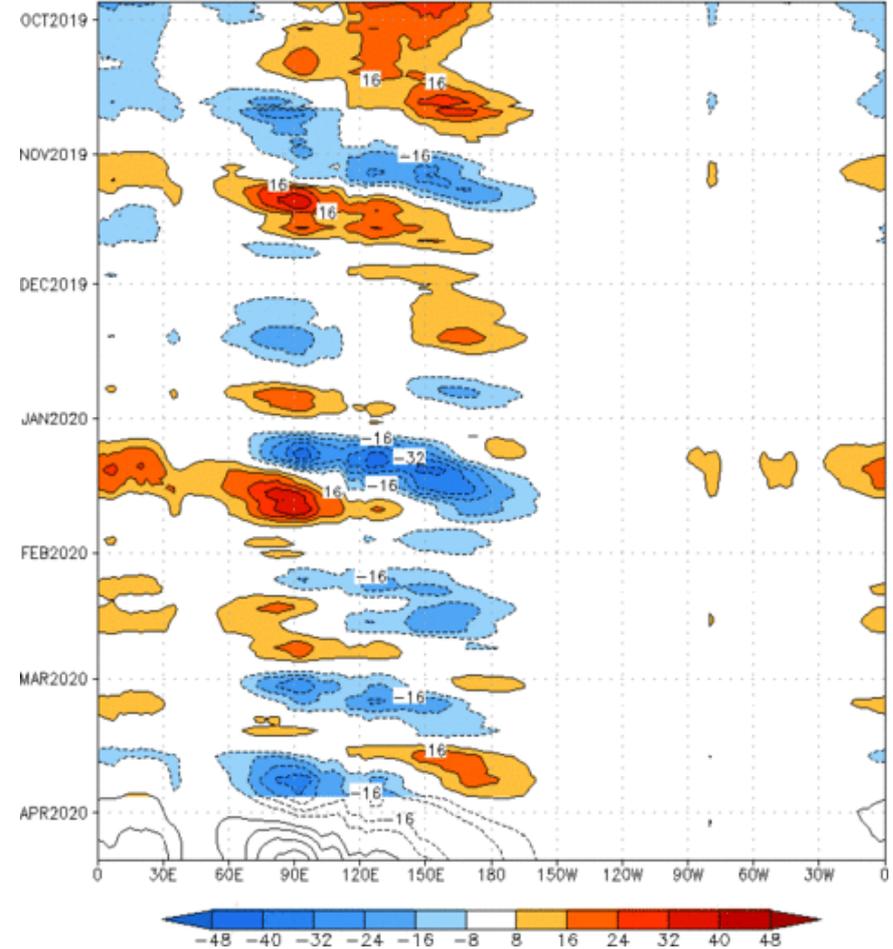
MJO: Constructed Analog Forecast Evolution

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 (28 Mar 2020)



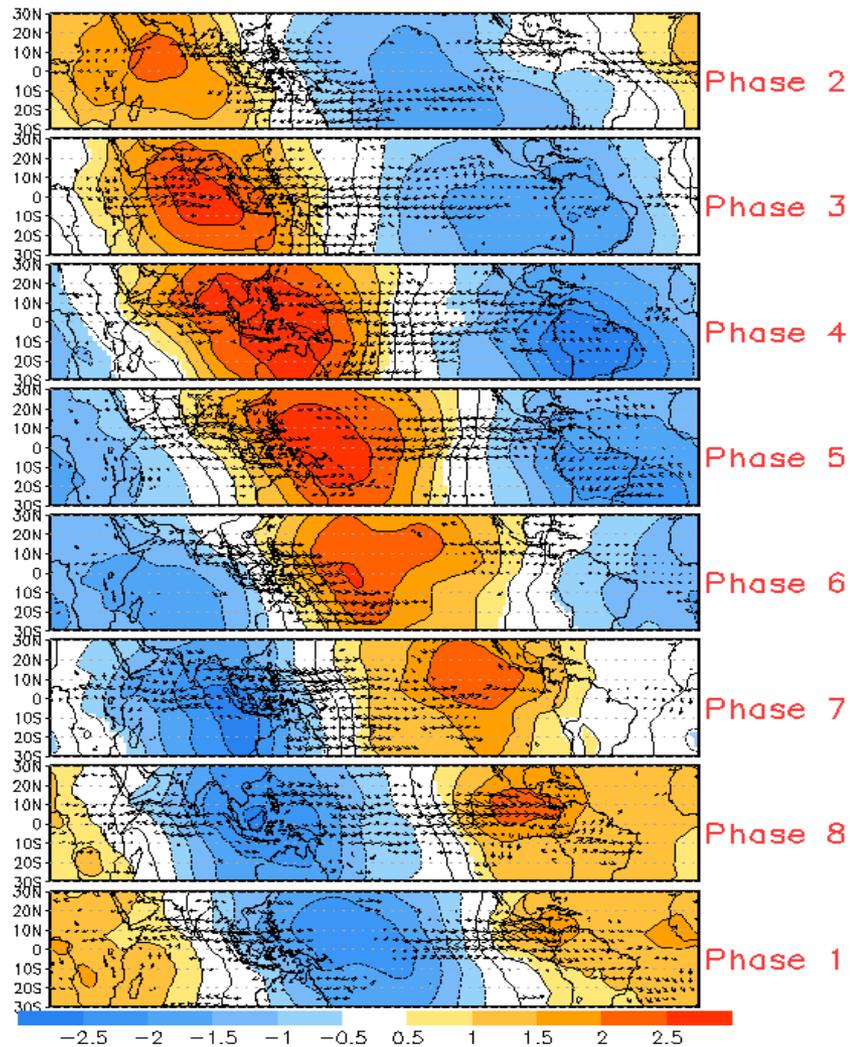
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:27-Sep-2019 to 28-Mar-2020
The unfilled contours are CA forecast reconstructed anomaly for 15 days



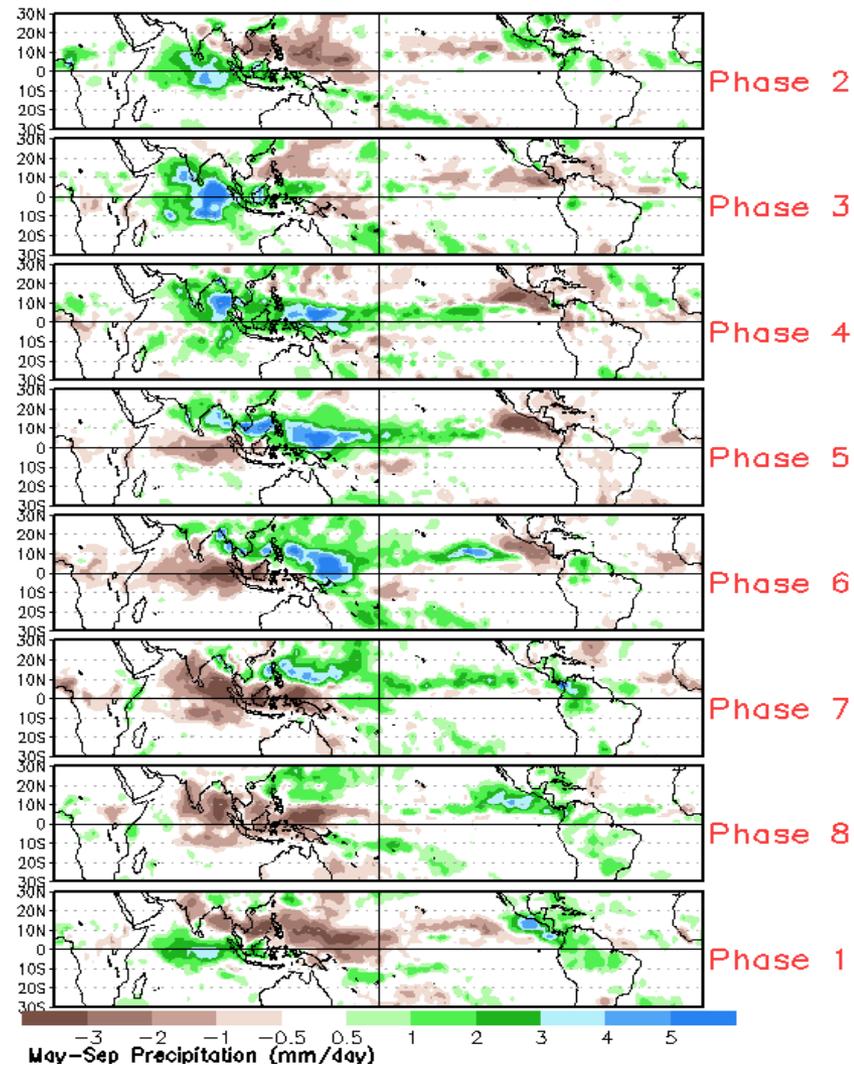
- The constructed analog RMM-based forecast is similar to the GEFS solution in week-1. During week-2, it retains a fairly strong enhanced convective signal over the western Pacific, and a strong suppressed convective signal over the Indian Ocean.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



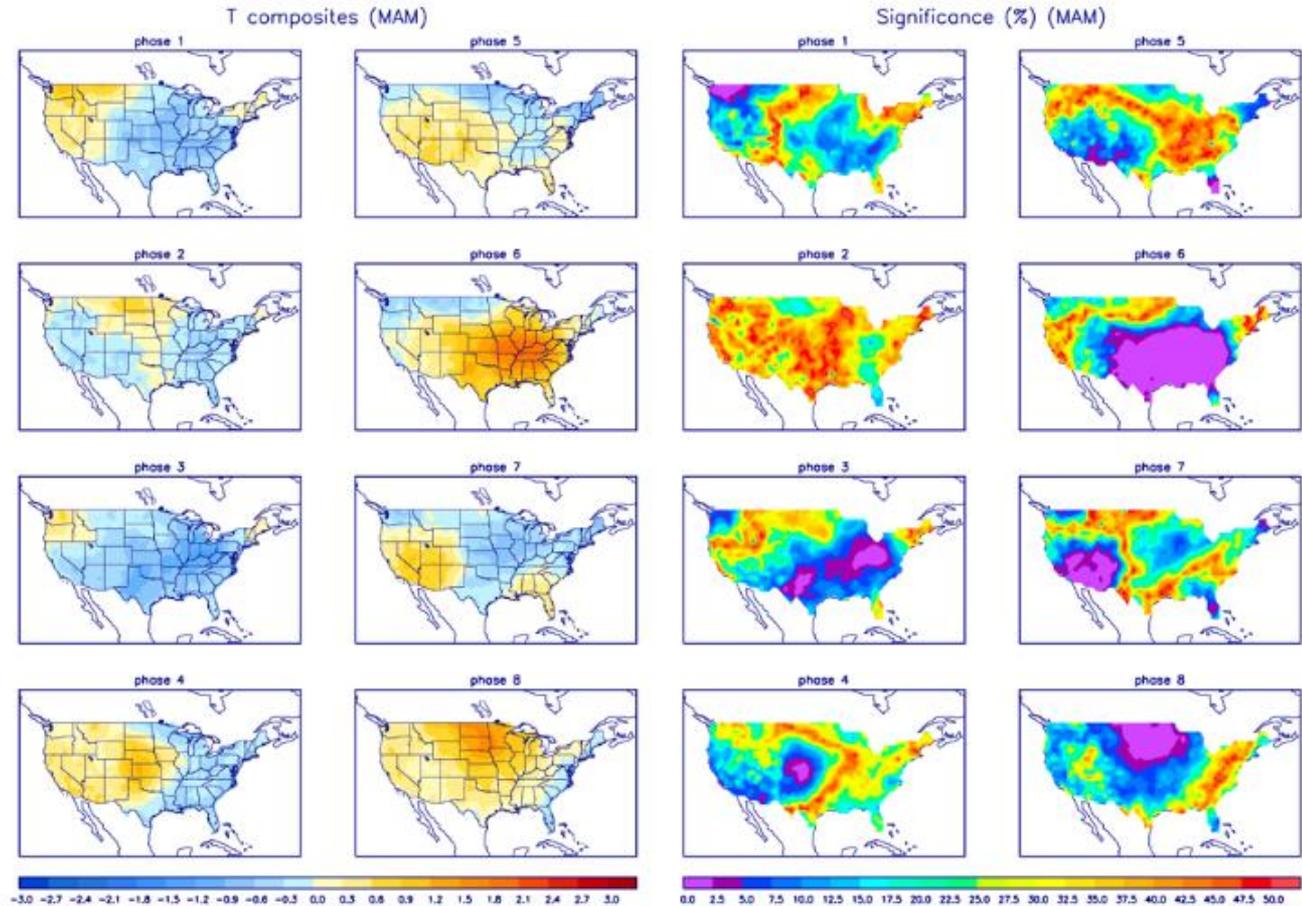
Precipitation Anomalies



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 - 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.

