

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



Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
11 May 2020

Overview

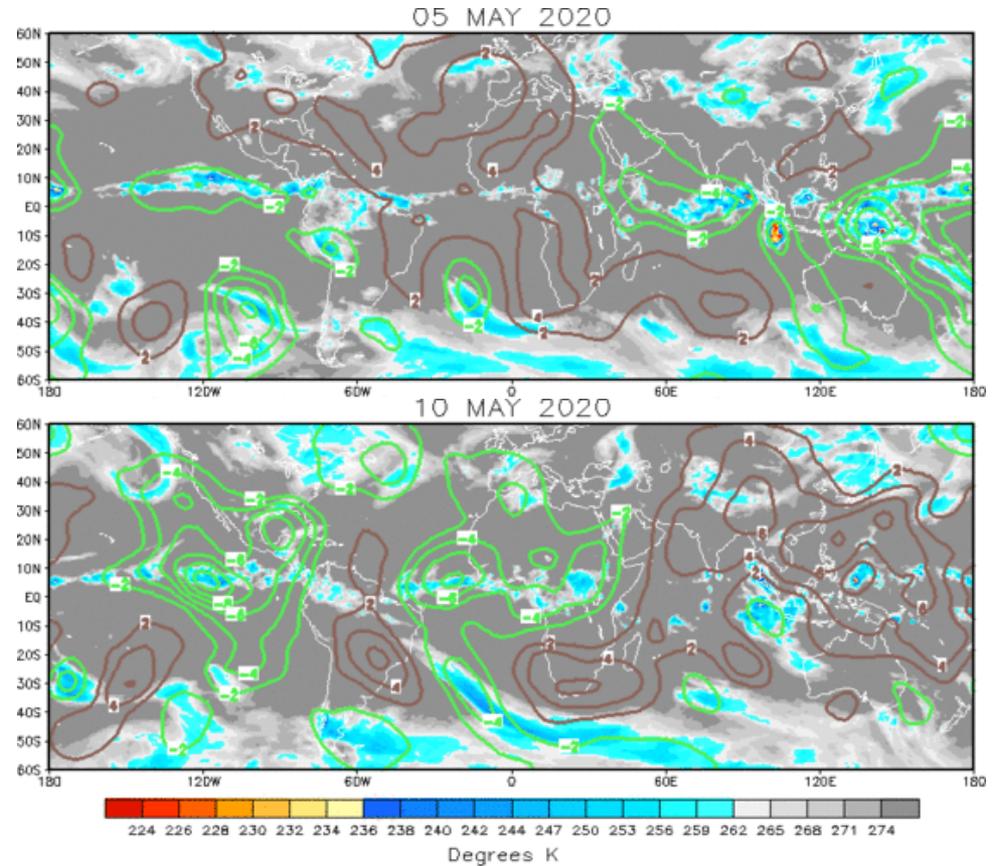
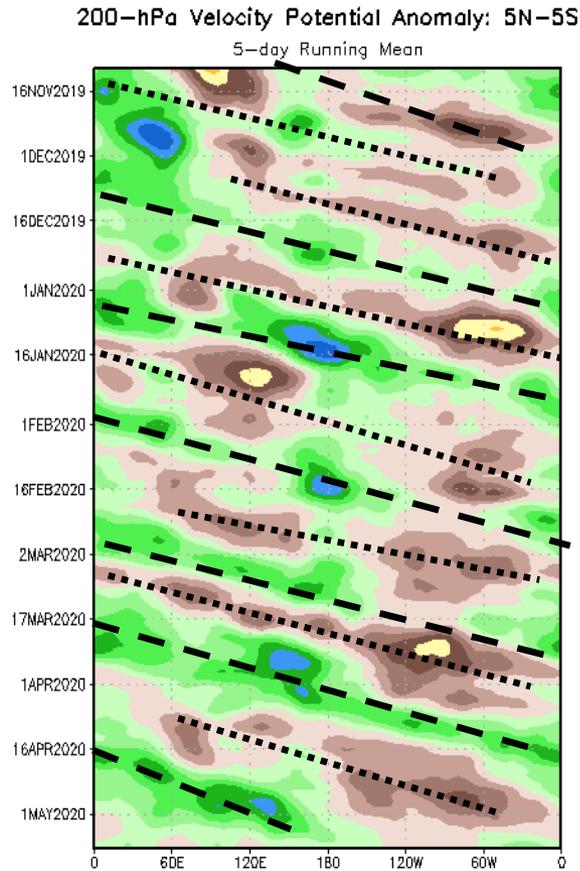
- The MJO is currently weak. There is some model support suggesting that it will strengthen over the Indian Ocean during the next couple of weeks; the ECMWF supports a stronger MJO than the GEFS.
- Partially as a result of a weak MJO, the upper-level velocity potential field has shifted from Wave-1 to Wave-2 during the past week.
- Extratropical wavebreaking over the North Pacific has led to consistent upper-level anomalous westerlies over the North Pacific during the past month.

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).

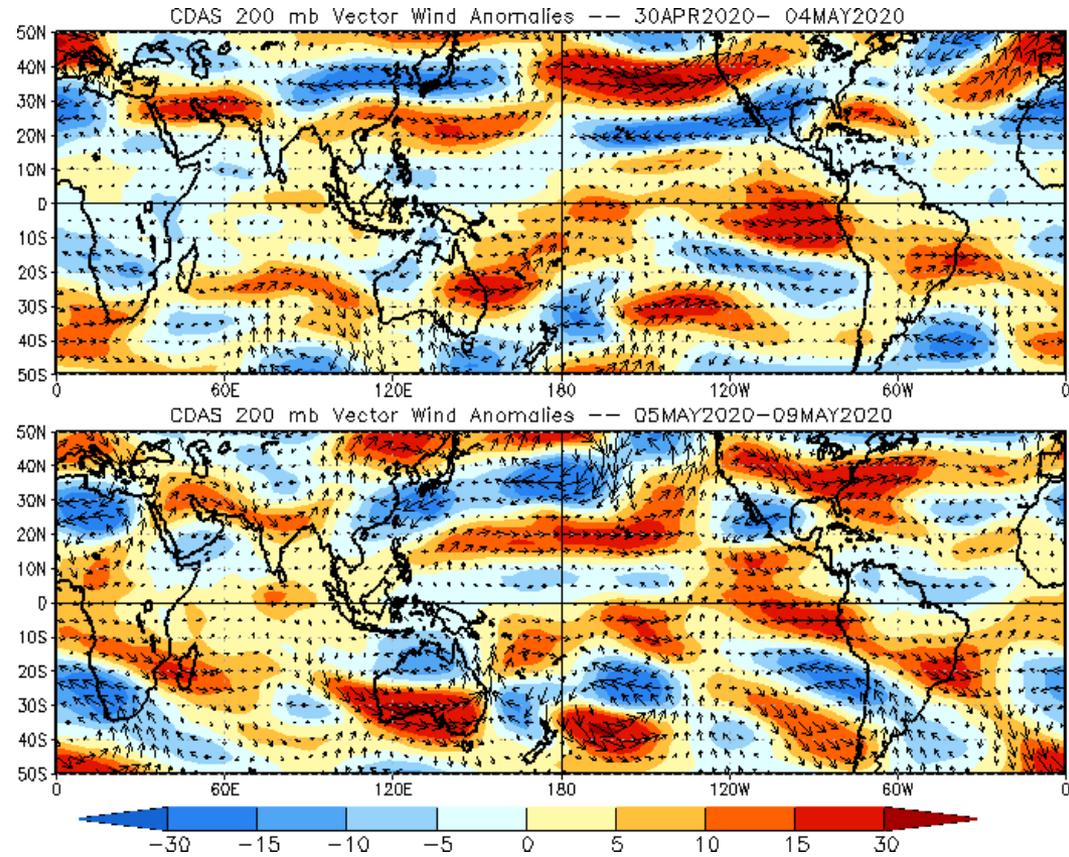
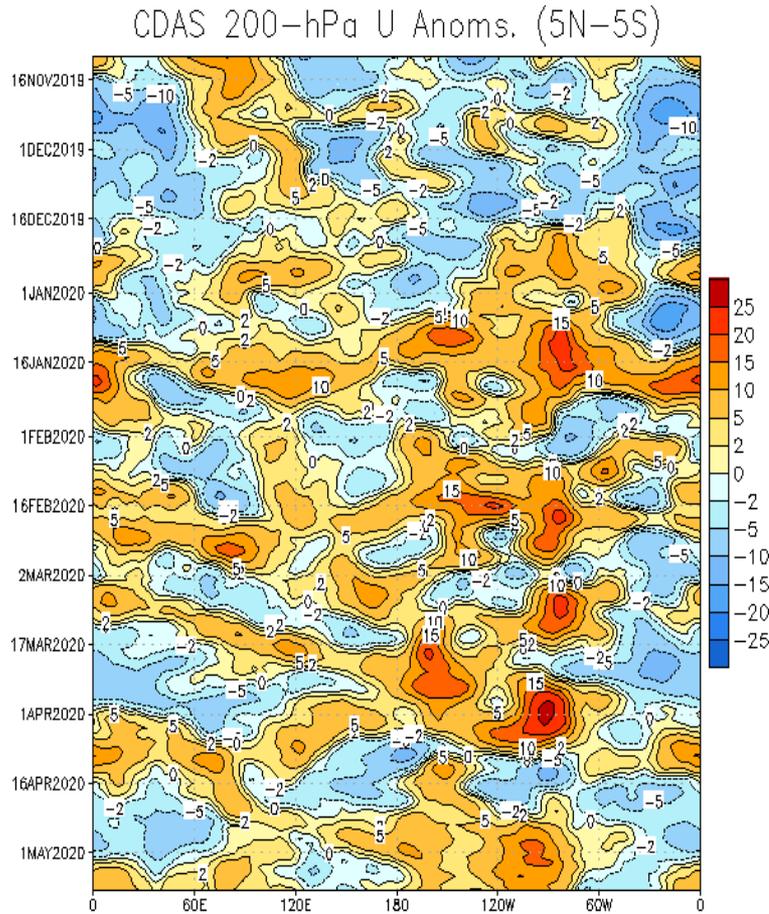
Brown shades: Anomalous convergence (unfavorable for precipitation).



- Last week's Wave-1 pattern has evolved into a noisy Wave-2 pattern over the globe as the MJO has weakened.
- Higher frequency modes such as Kelvin and Rossby waves appear to anchor most of the convection throughout the tropics.

200-hPa Wind Anomalies

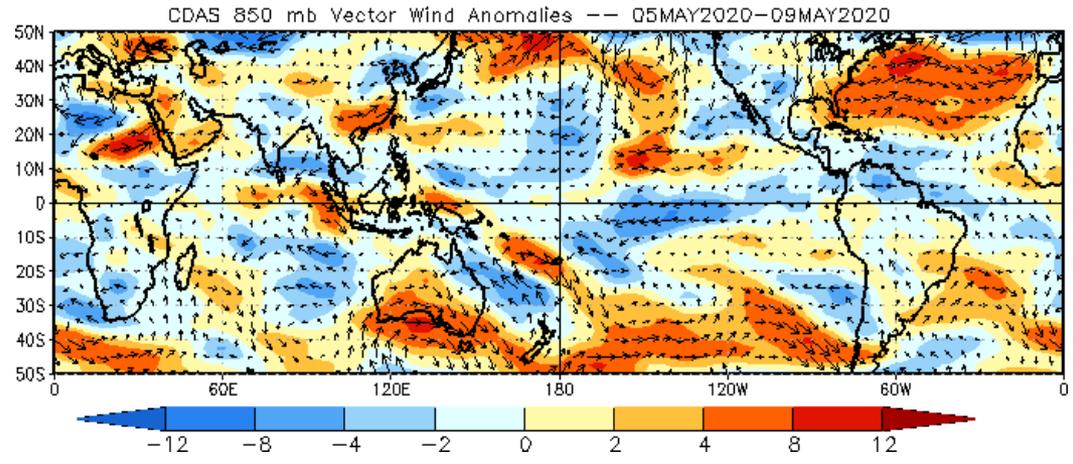
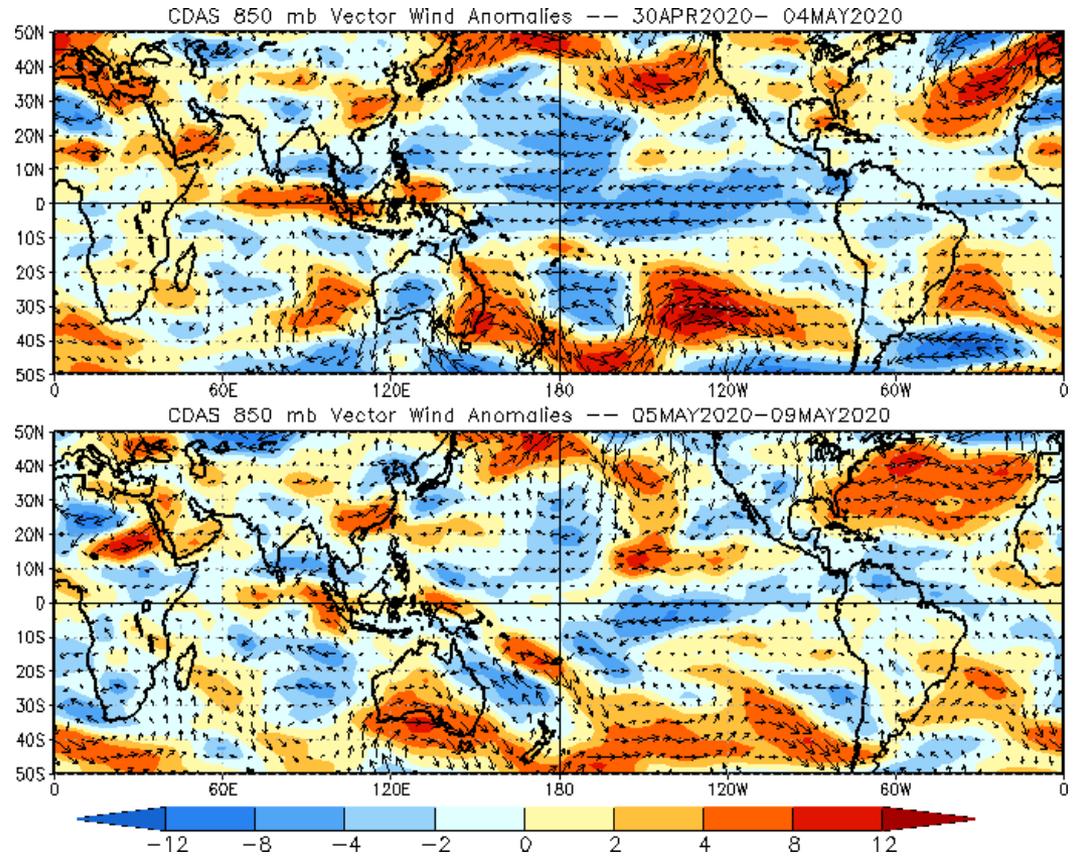
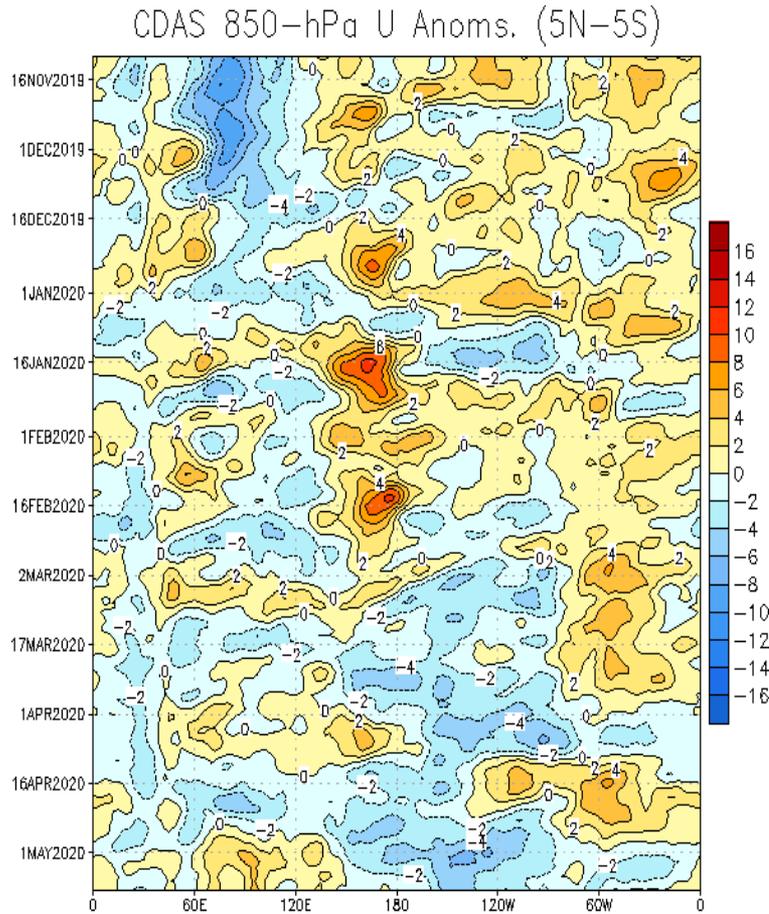
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- The Northern Hemisphere continues to exhibit a highly amplified pattern that appears extratropically driven.
- Anomalous westerlies near the antimeridian appear to be associated with wavebreaking over the North Pacific, which is common in the Spring as the jet stream weakens.

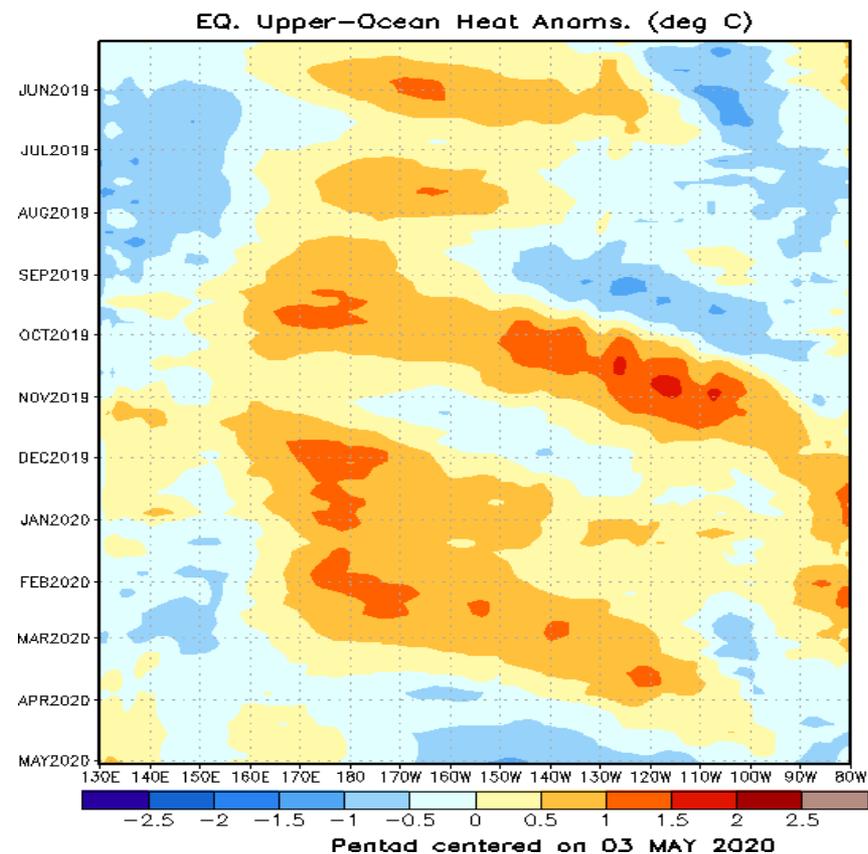
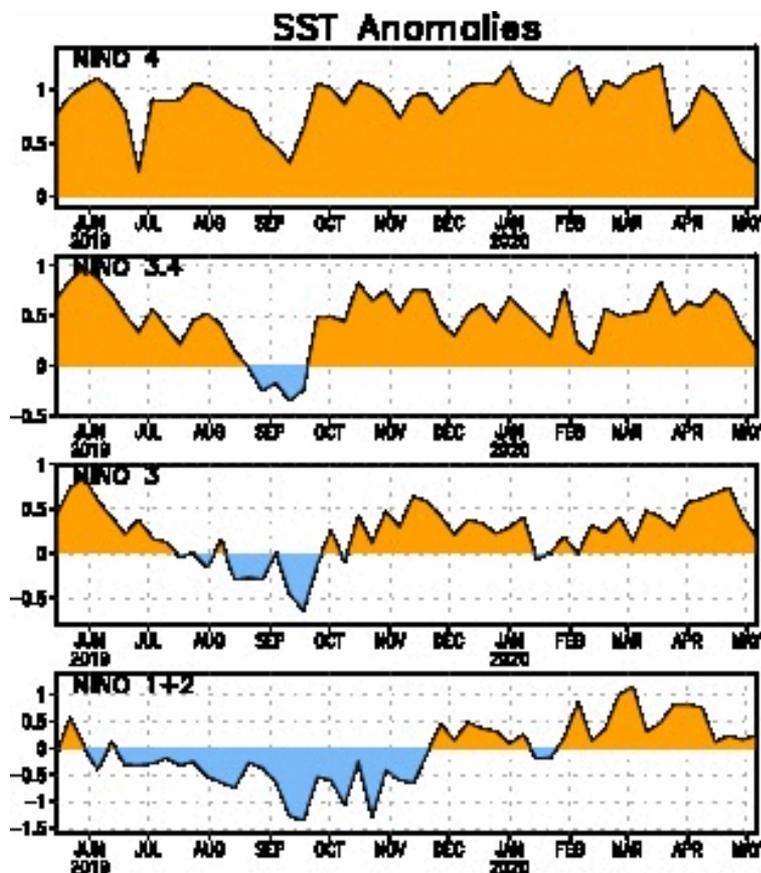
850-hPa Wind Anomalies

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



- Enhanced trades persist across the Pacific, although they do not extend as far west as last week.
 - These support erosion of the heat content in the upper layers of the ocean.
- There is no large scale MJO footprint anymore; the convective envelope has weakened substantially over the past couple of weeks.

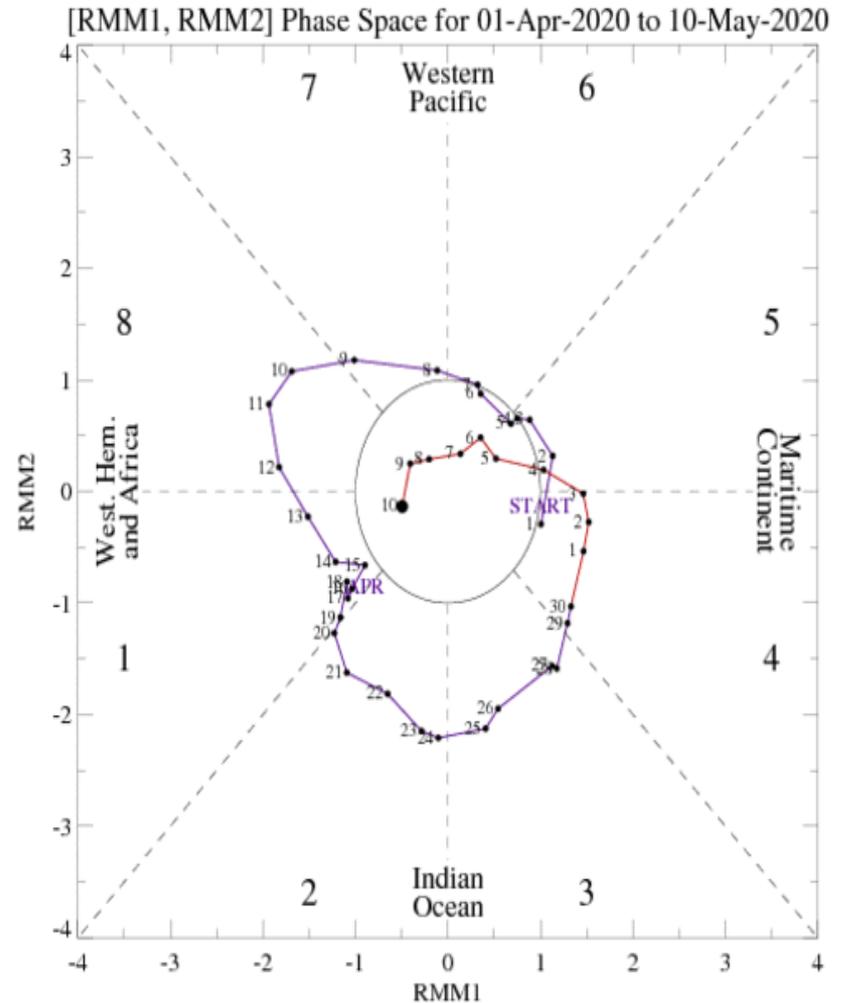
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Upper-ocean heat content anomalies remain below-average over much of the equatorial Pacific with the exception of between 160E-180.
- The cooling trend across the upper-ocean during April is tied to the persistence of the enhanced trades (see 850-hPa anomaly slide).
- Weakening above-average SSTs in the Niño 3, 3.4, and 4 regions are confined to the near surface and likely to be short-lived.

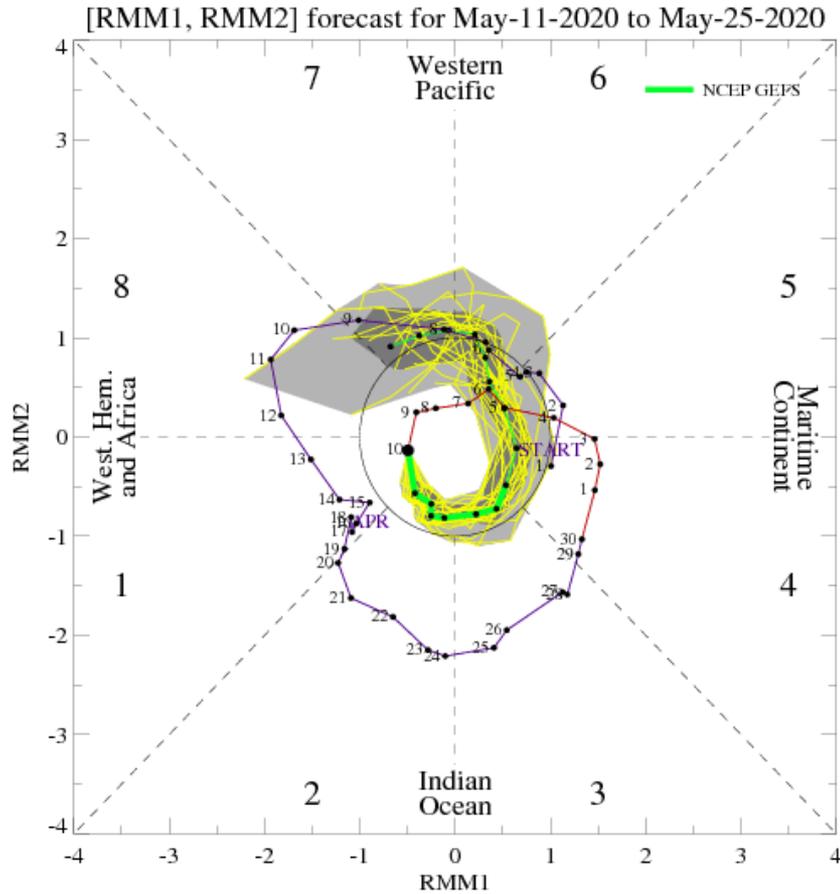
MJO Index: Recent Evolution

- The RMM index is within the unit circle, which suggests an inactive MJO signal.

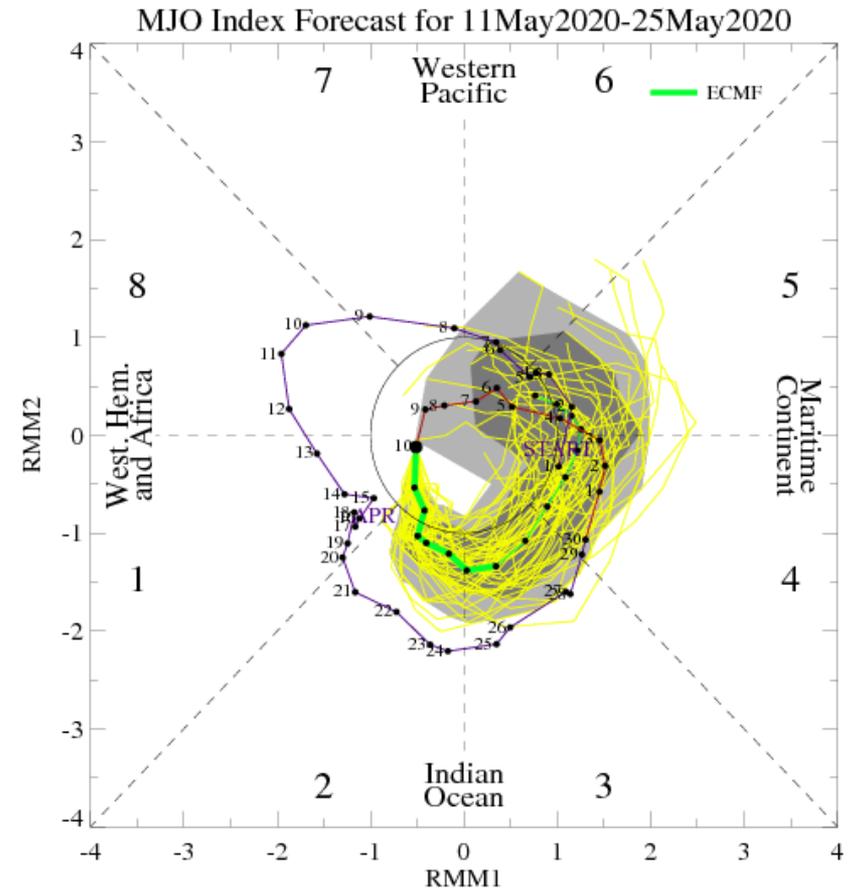


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



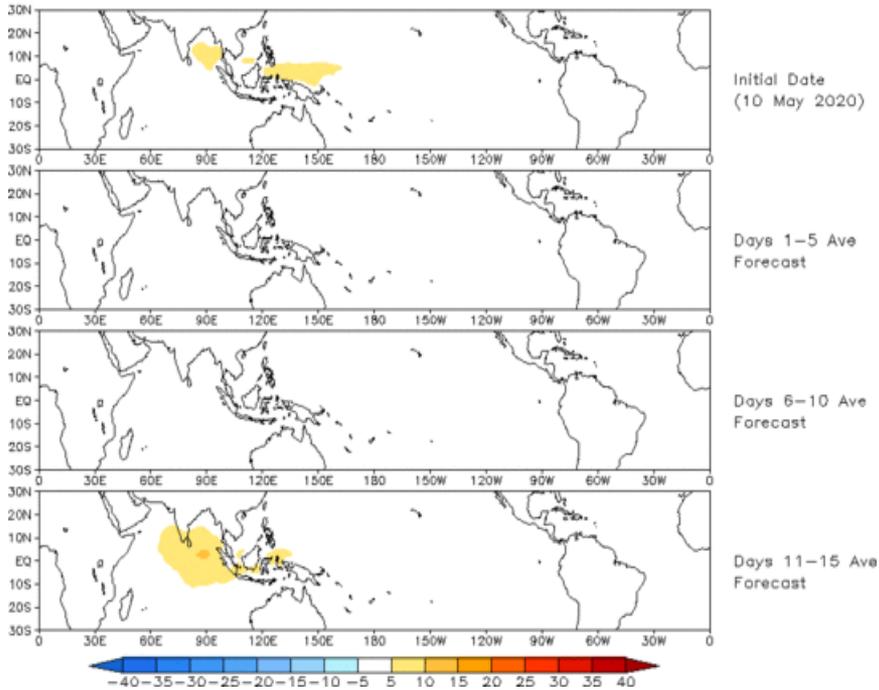
ECMWF Forecast

- There is good model agreement that the MJO will re-form over the Indian Ocean and propagates eastward throughout the next two weeks.
- The GEFS suggests the MJO will remain weak, and implies that any MJO development won't be strong enough to anchor the upper-level pattern. However, most of the ECMWF ensemble members support a stronger event.

MJO: GEFS Forecast Evolution

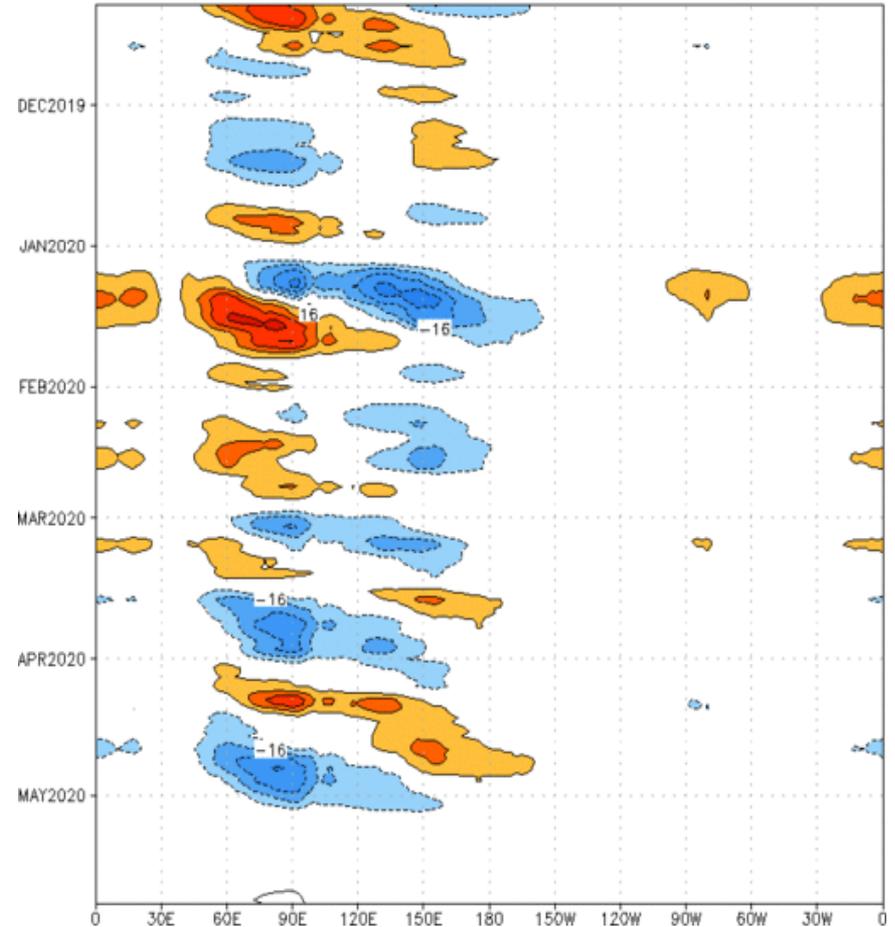
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 10 May 2020
OLR



- The GEFS spatial forecast is weak, which is consistent with its RMM forecast.

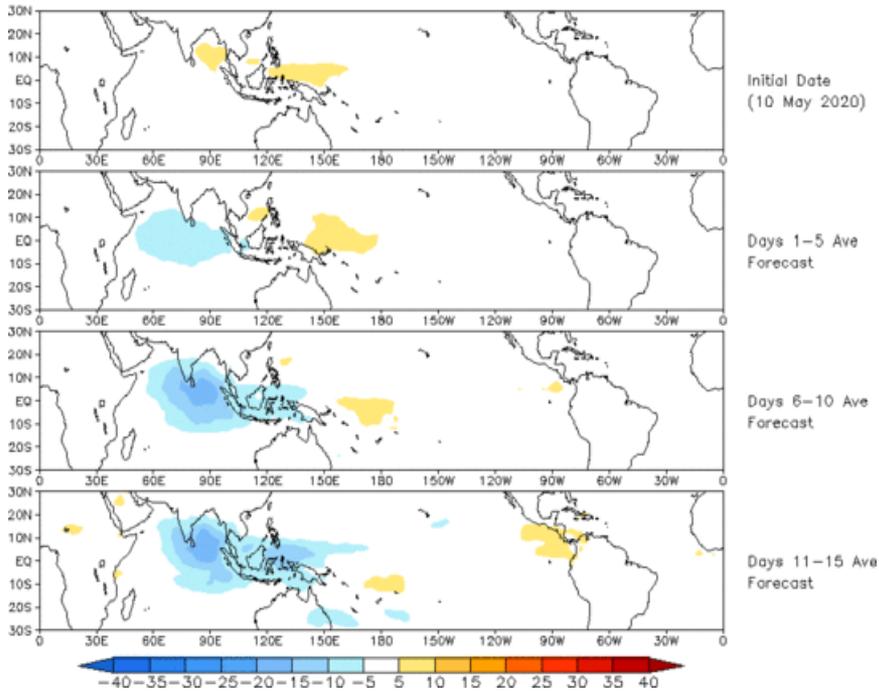
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:09–Nov–2019 to 10–May–2020
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



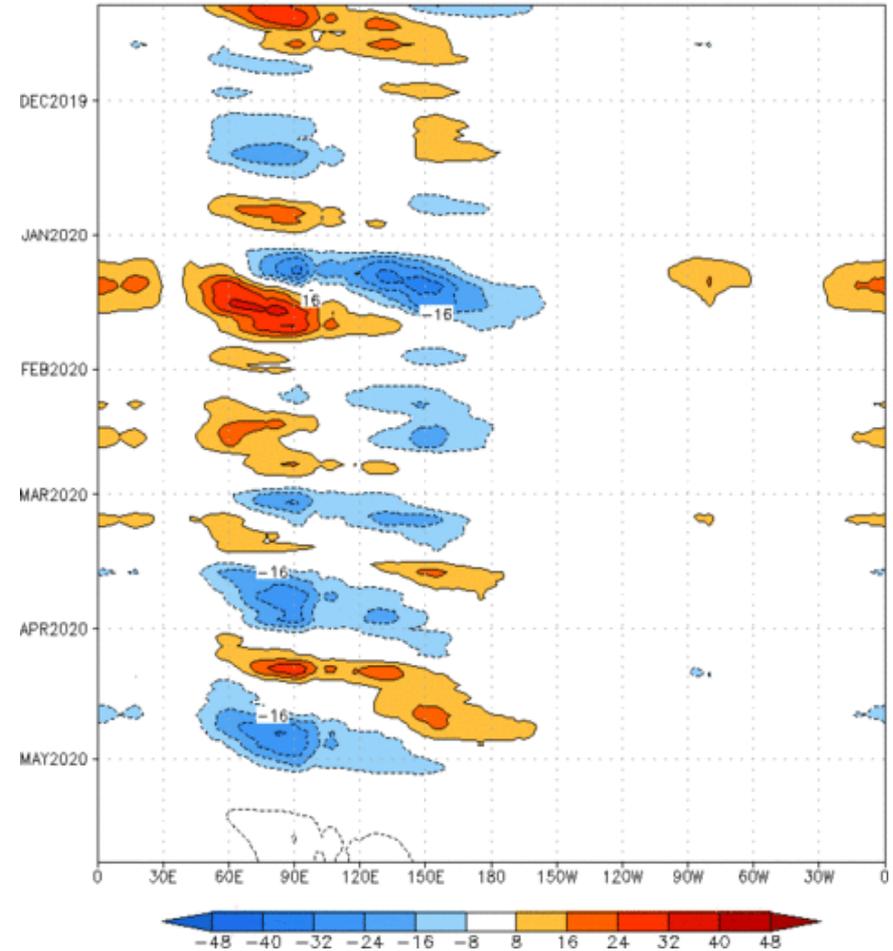
MJO: Constructed Analog Forecast Evolution

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 (10 May 2020)



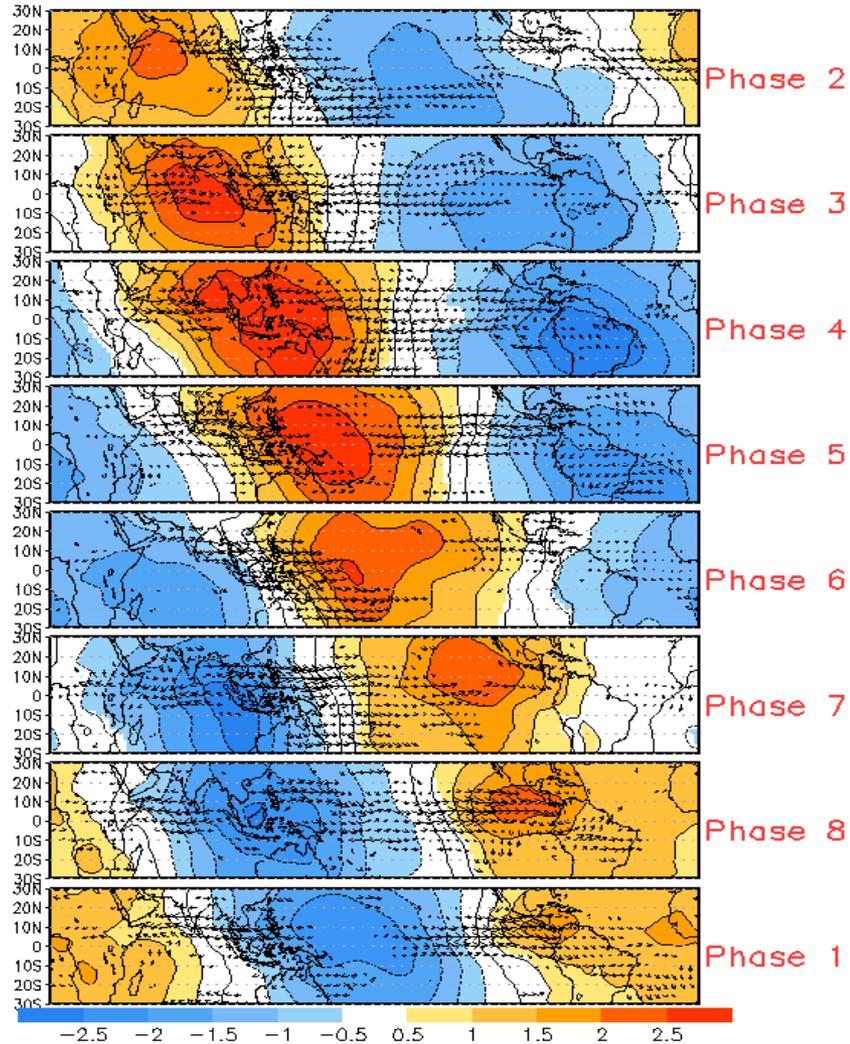
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:09-Nov-2019 to 10-May-2020
The unfilled contours are CA forecast reconstructed anomaly for 15 days



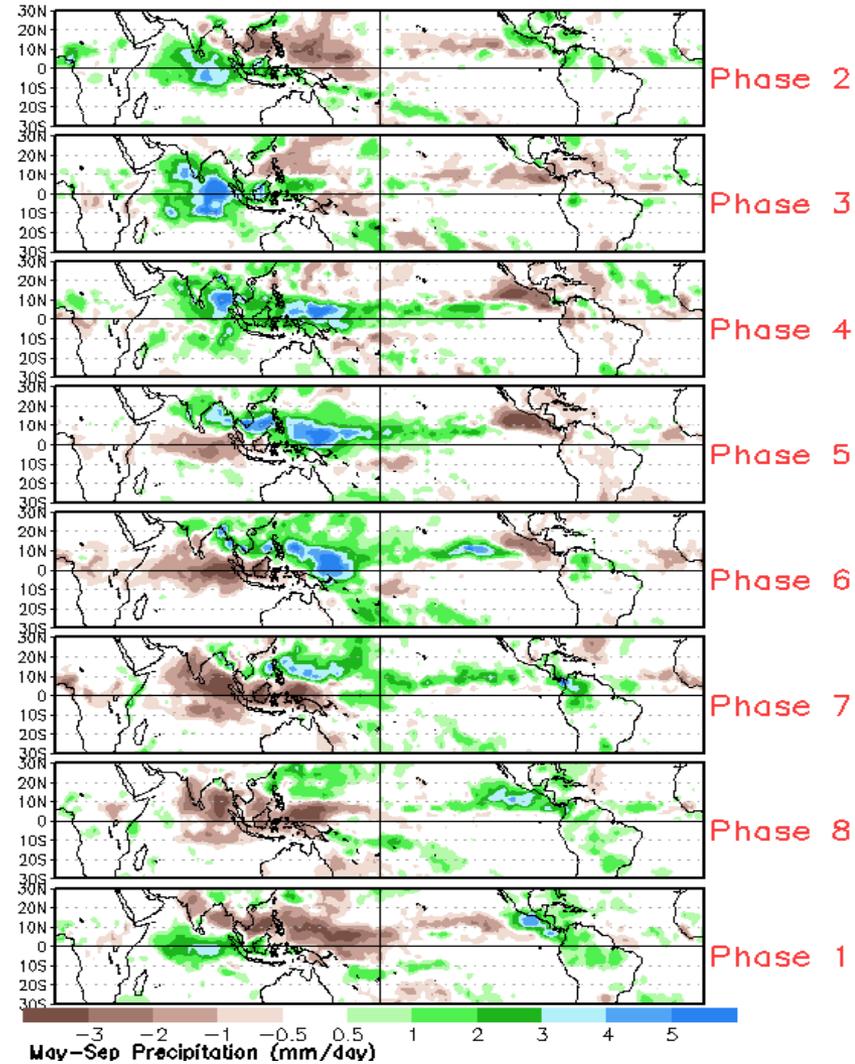
- The constructed analog forecast creates and propagates a weak MJO during the next two weeks.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



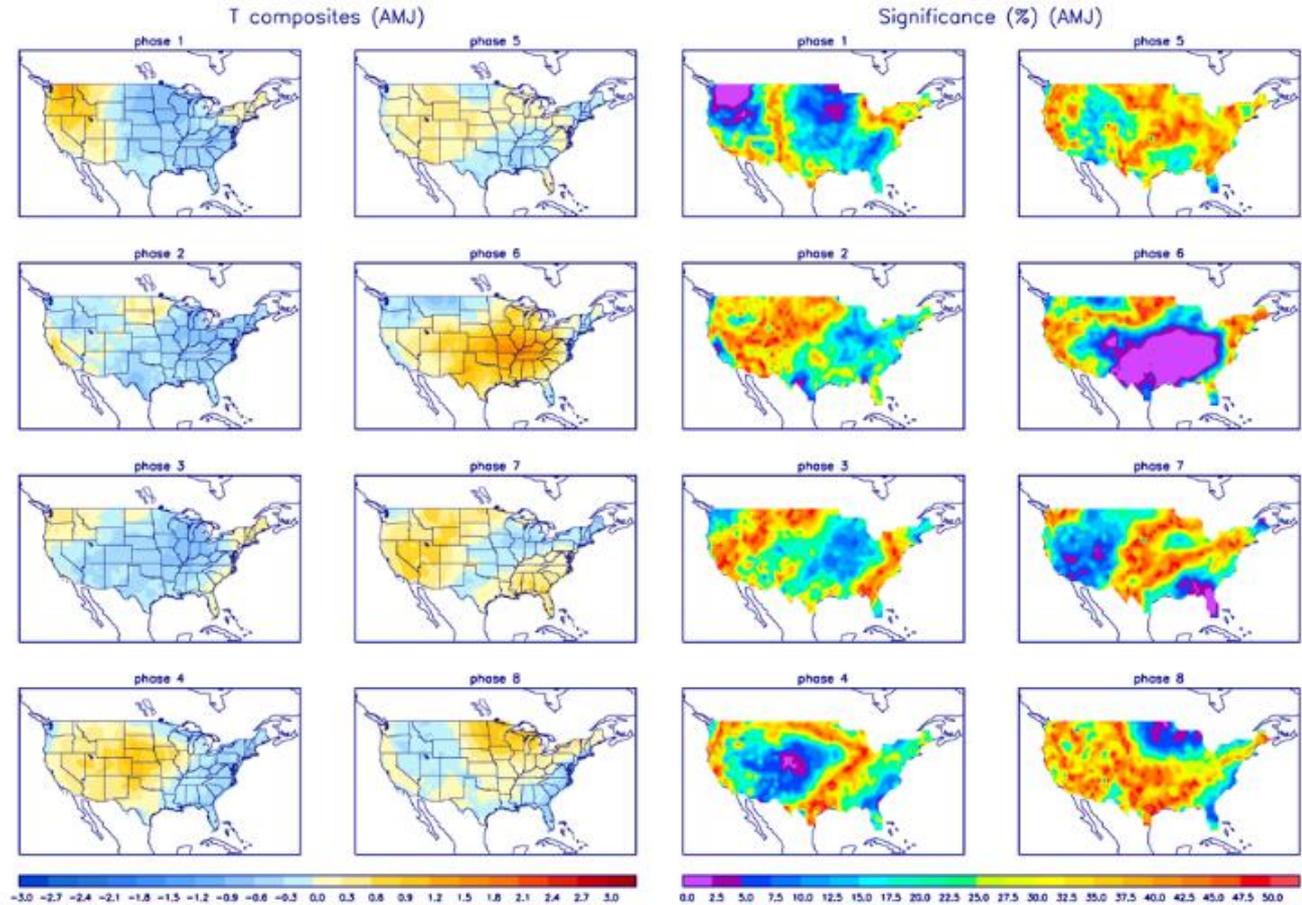
Precipitation Anomalies



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.

