

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



Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
3 June 2019

Overview

- The enhanced convective phase of the MJO remains over Africa and the Indian Ocean this week. The suppressed convective phase is now centered over parts of the Maritime Continent and the western Pacific.
- Both GFS and ECMWF models predict eastward propagation of the MJO signal from the Indian Ocean to the Maritime Continent over the next two weeks. The ECMWF propagates the signal a bit faster than the GEFS.
- There is an increased chance of tropical cyclone development over the Gulf of Mexico, and the current state of the MJO favors development over the Arabian Sea/Gulf of Aden during Week-1. The latest dynamical model guidance suggests little to no risk for TC activity during Week-2.

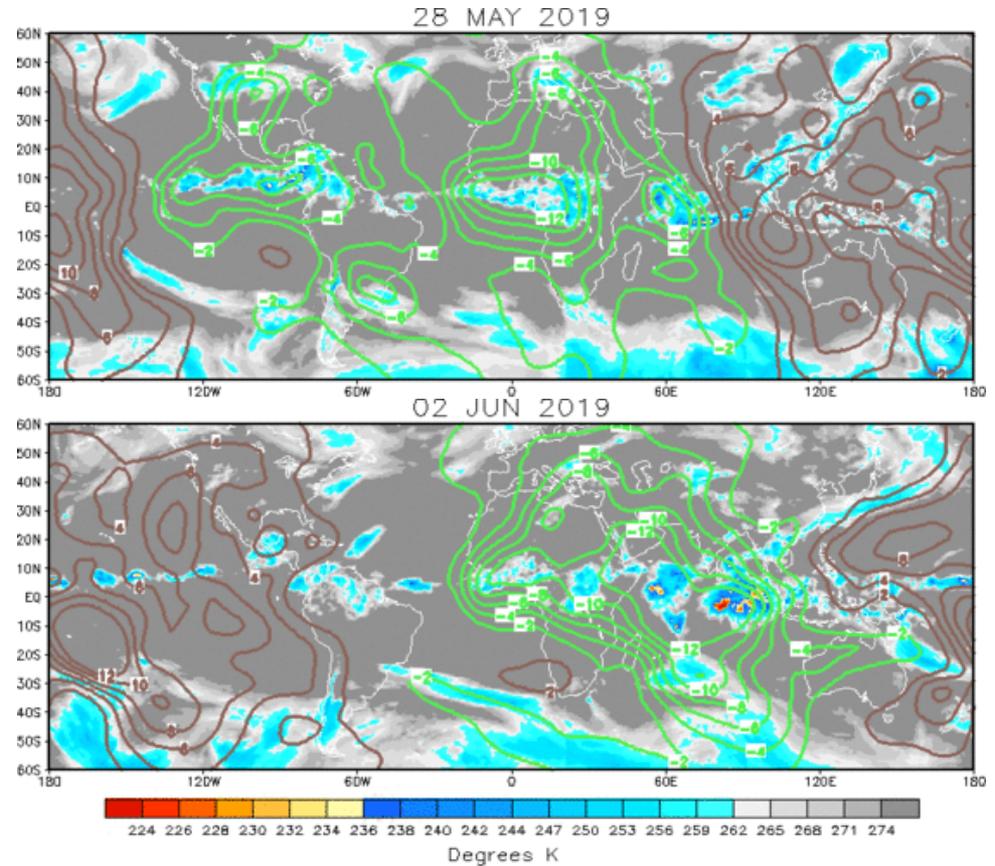
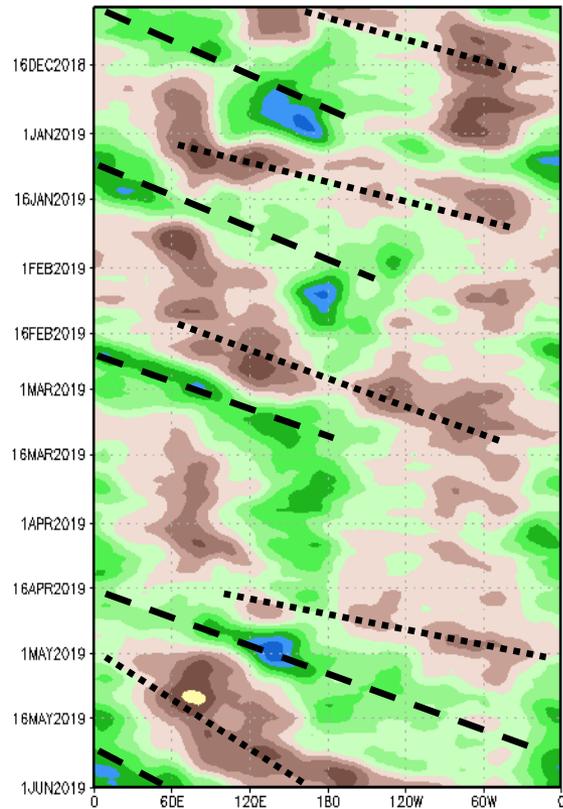
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

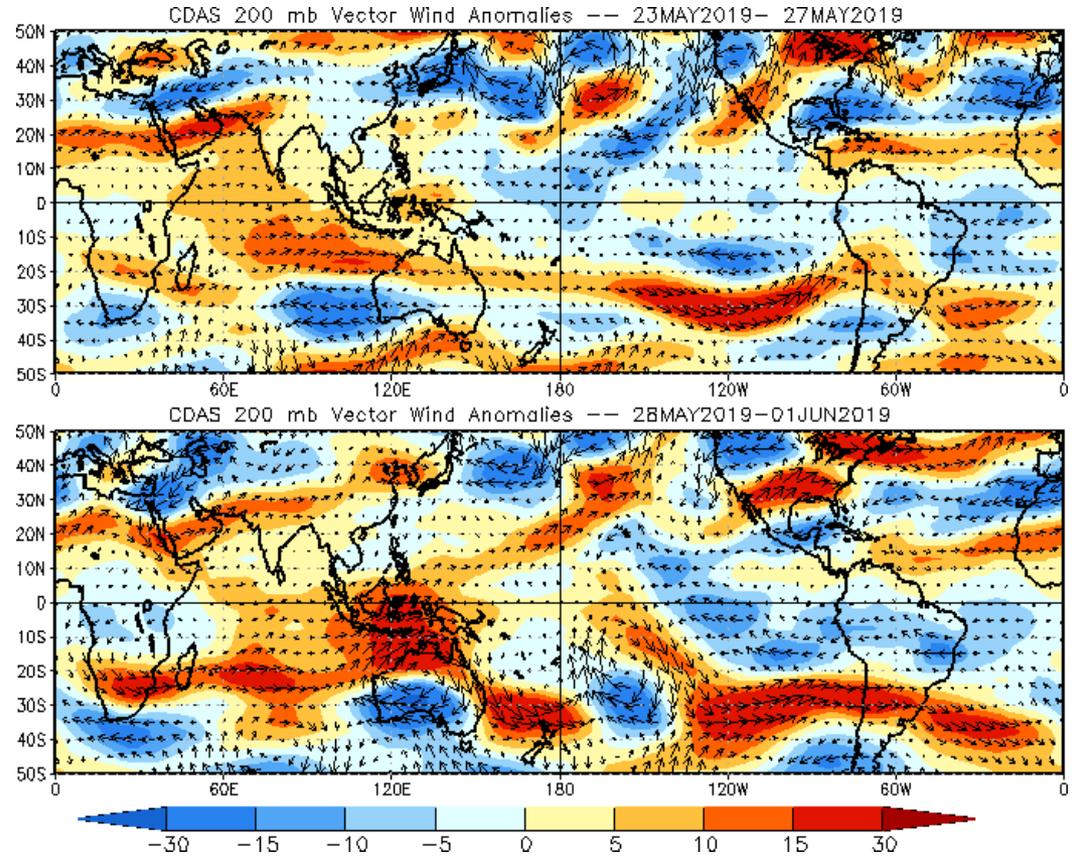
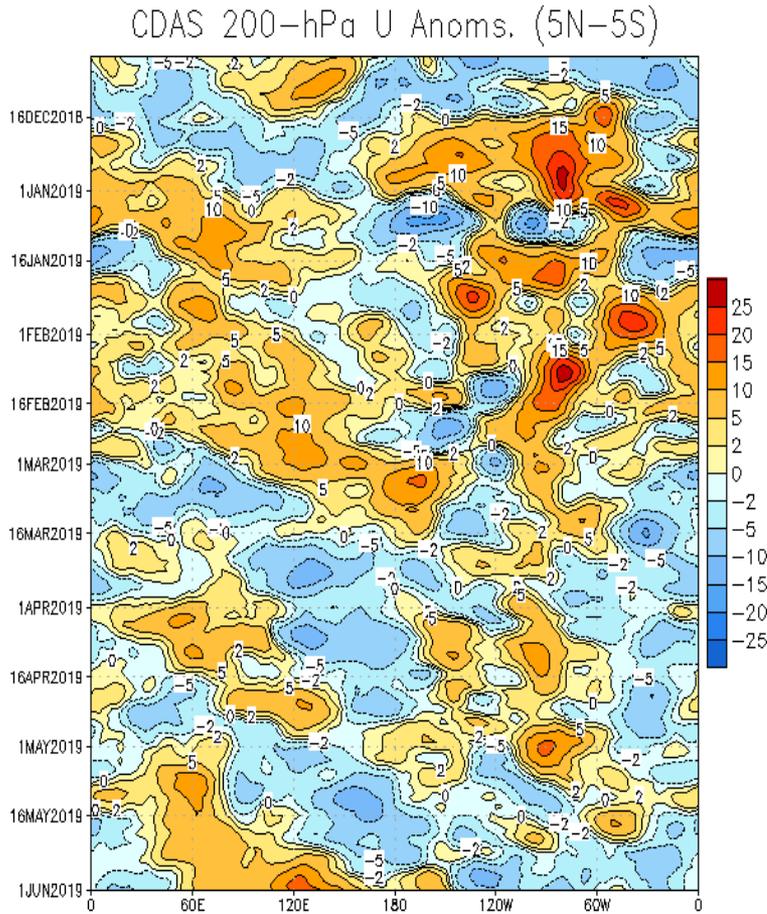
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- The MJO, which was consistently active throughout boreal fall and winter, weakened during March.
- During March, the pattern was dominated by low-frequency signals, with some modulation by Rossby and Kelvin wave activity.
- Since mid-April, robust MJO activity began and propagated eastward, continuing through early June. Recently, the enhanced convective signal has shifted over Africa and the Indian Ocean.

200-hPa Wind Anomalies

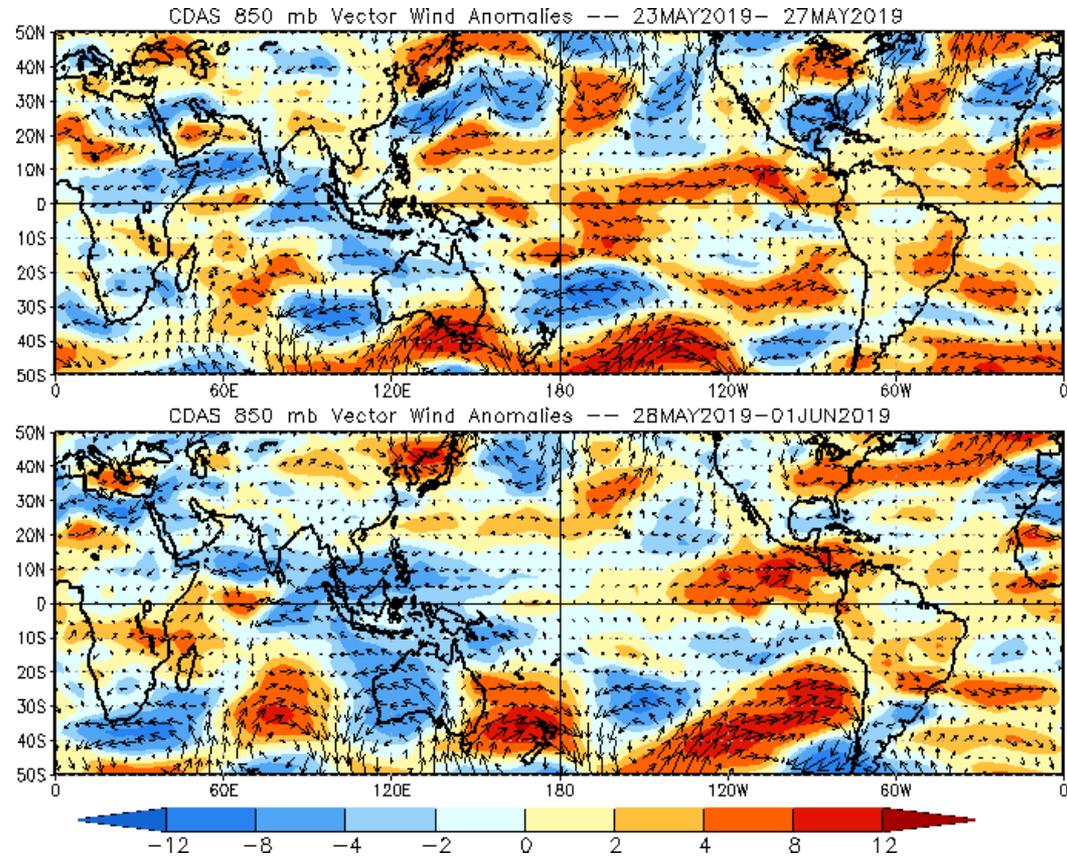
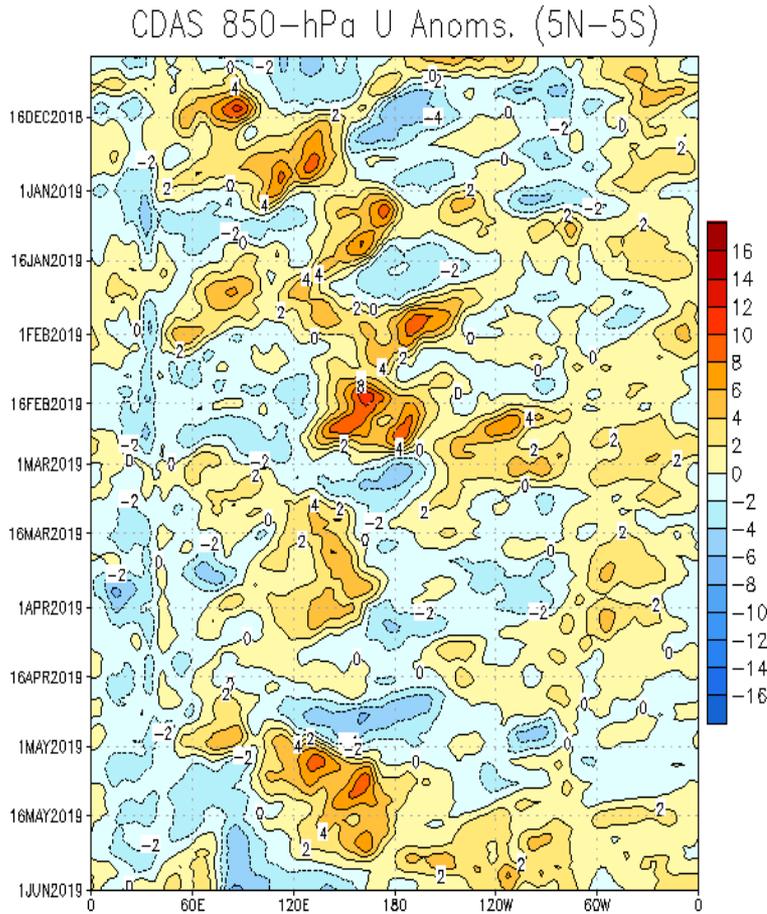
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- As seen in the upper-level velocity potential field on the previous slide, the MJO became inactive during mid-March, but re-emerged in April.
- Upper-level easterly anomalies show coherent eastward propagation over the past few weeks associated with ongoing MJO activity.
- The subtropical jet remained enhanced over the North Pacific and the North America during late May.

850-hPa Wind Anomalies

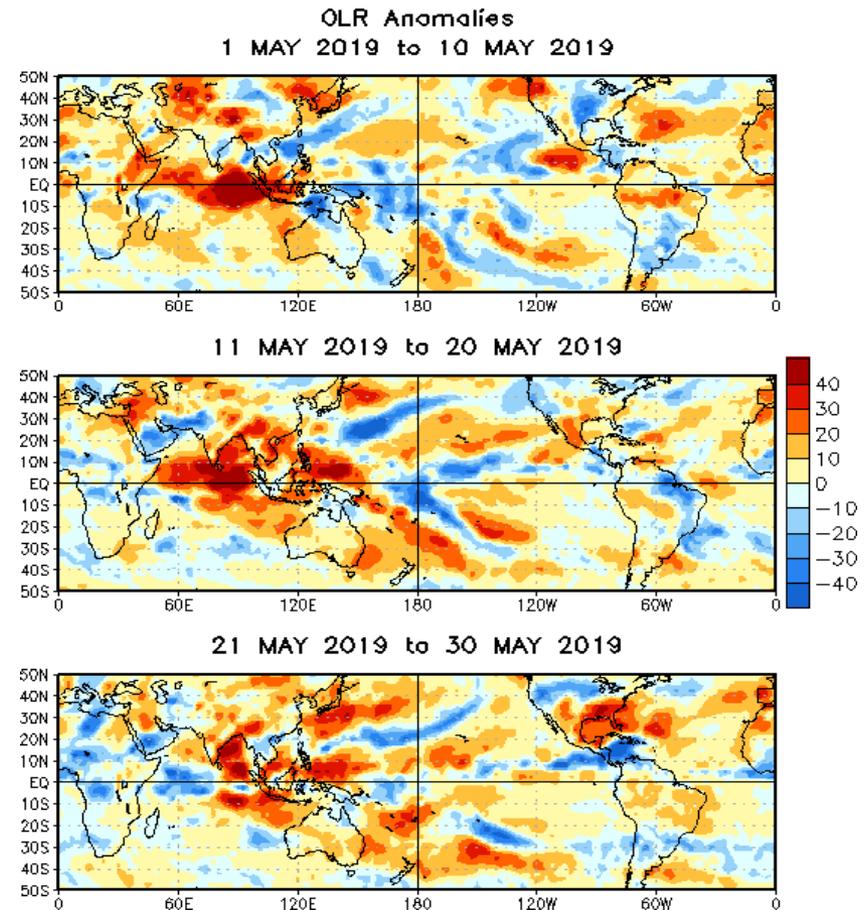
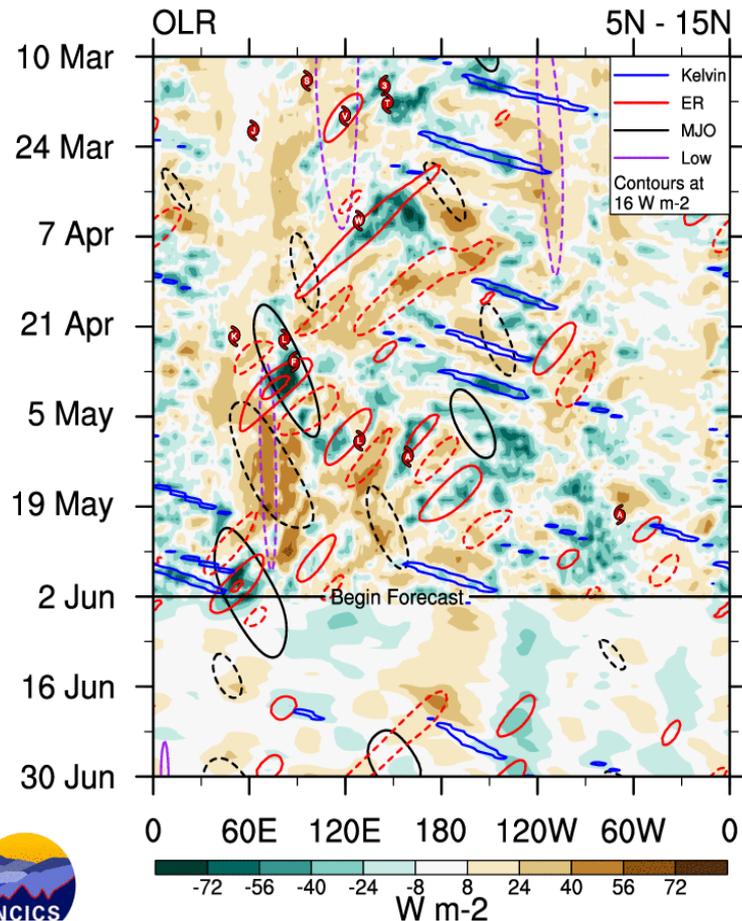
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Anomalous westerlies associated with the MJO shifted from the western Pacific into the eastern Pacific during late-May.
- Anomalous easterlies have strengthened and expanded over the past ten days, and now extend from eastern Africa towards the Maritime continent.

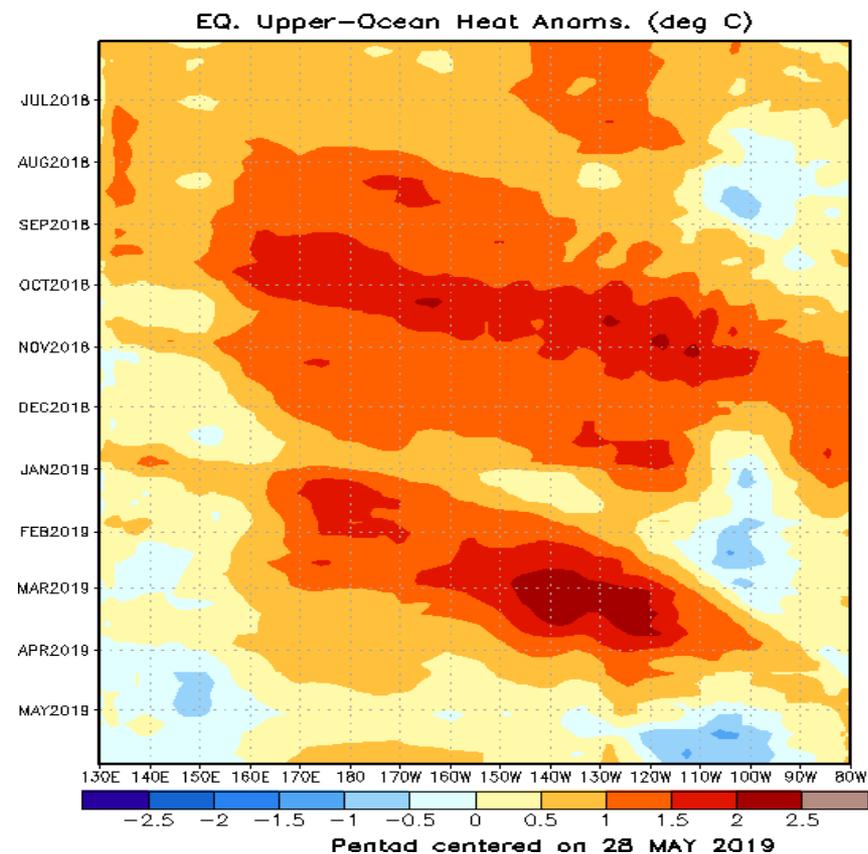
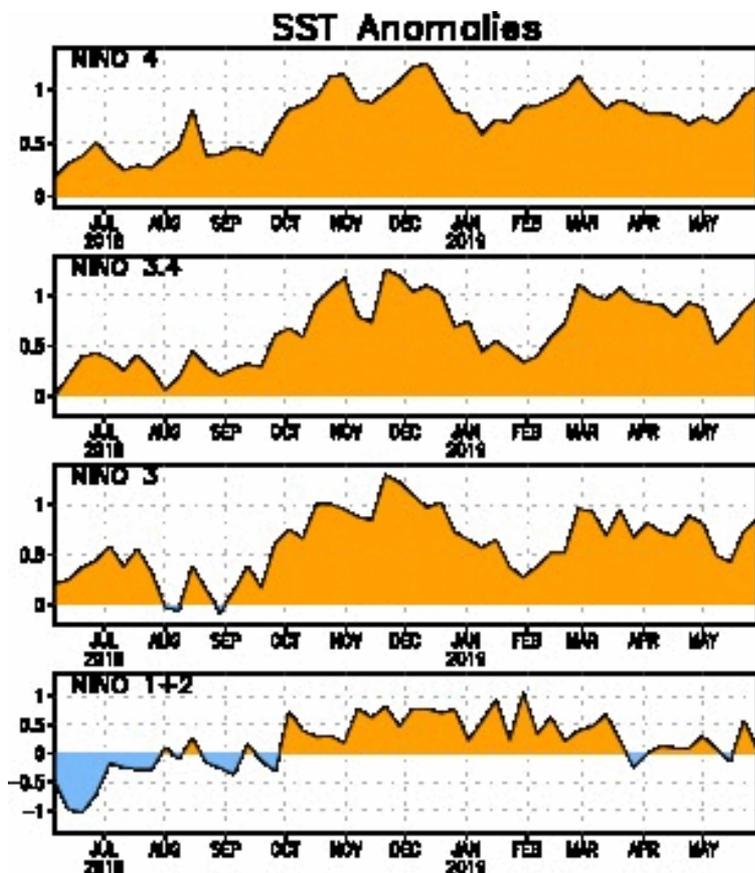
Outgoing Longwave Radiation (OLR) Anomalies

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



- The low-frequency enhancement of convection just west of the Date Line has been the most consistent signal during 2019.
- The MJO has been apparent since at least mid-April, with noted equatorial Rossby wave activity embedded in the eastward propagating MJO signal.
- Throughout much of May, suppressed convection has been observed across the Indian Ocean, with some enhancement over the western Indian Ocean recently during the last 10 days.

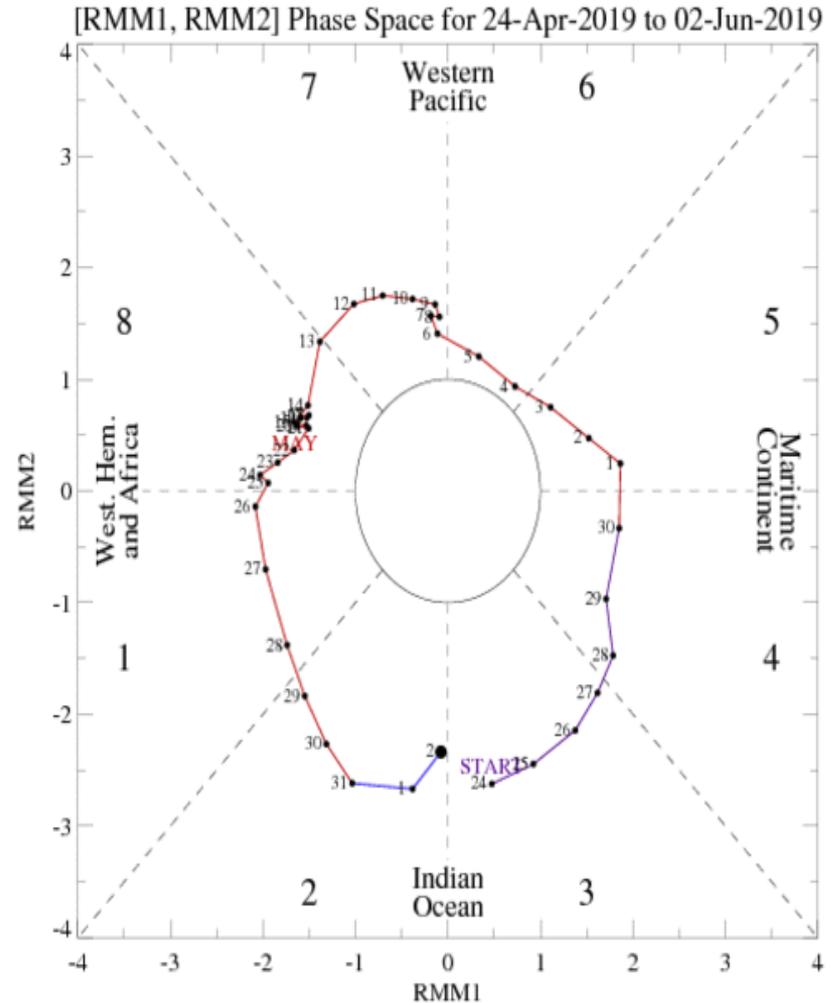
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- SST anomalies remain above climatology across much of the equatorial Central and East Pacific, consistent with the ongoing El Niño event.
- Since March, upper-ocean heat content decreased significantly east of the Maritime Continent, but has increased more recently near the Date Line. There has been a weak oceanic response to a westerly wind burst that occurred during May.

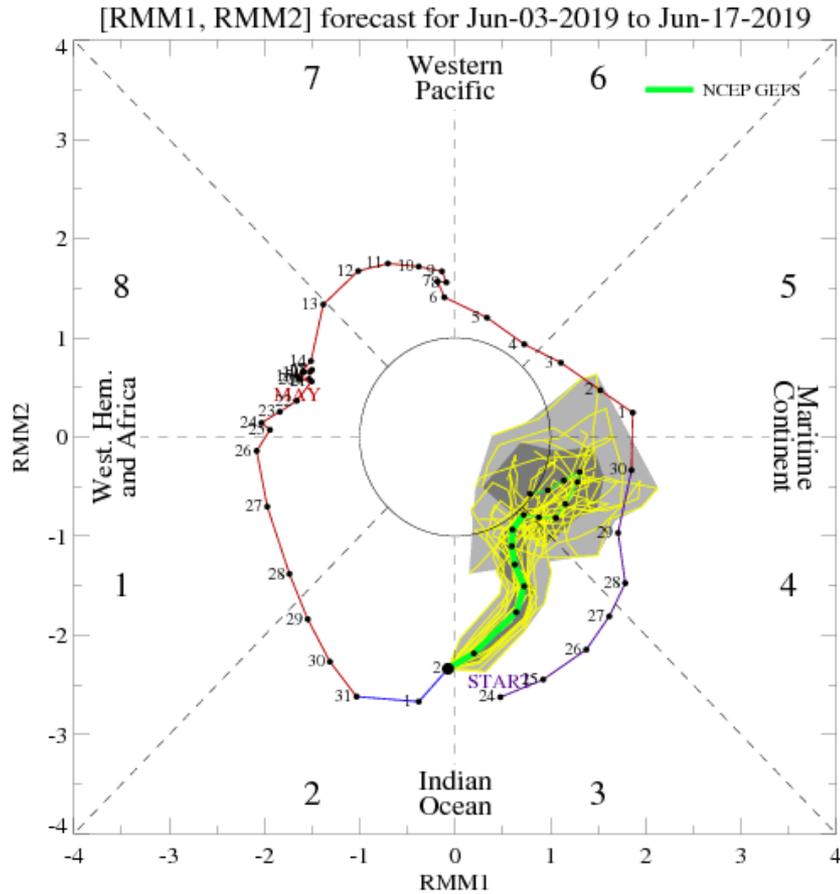
MJO Index: Recent Evolution

- The RMM index shows the MJO propagating eastward across the West Pacific during early to mid-May, emerging over Africa and the Indian Ocean during late May and early June.

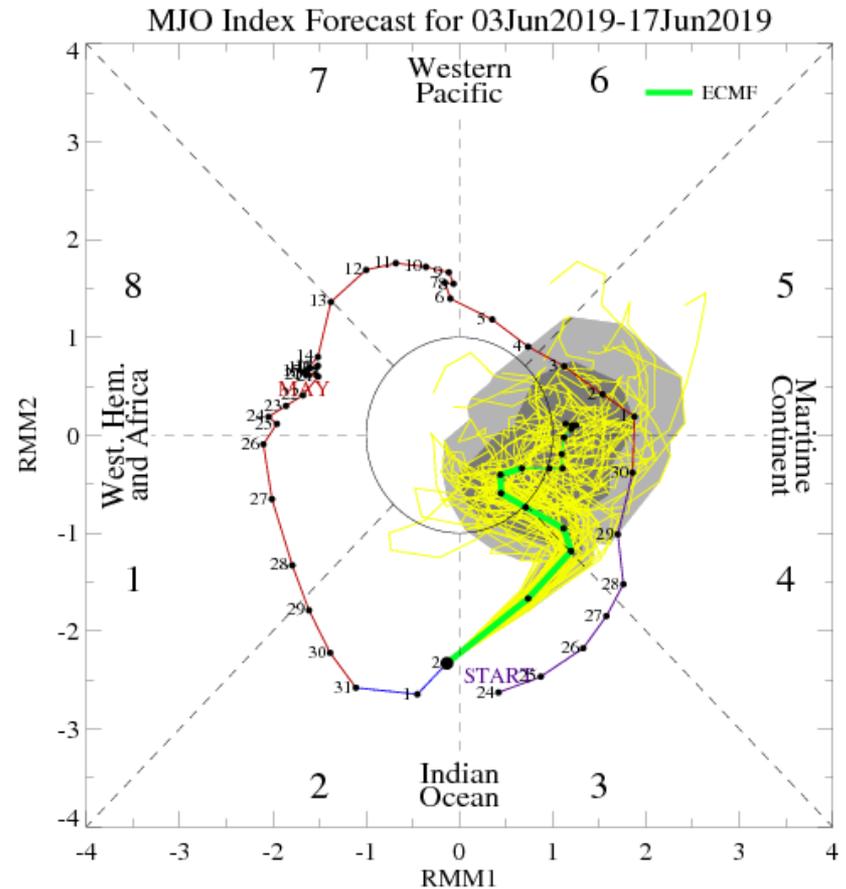


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



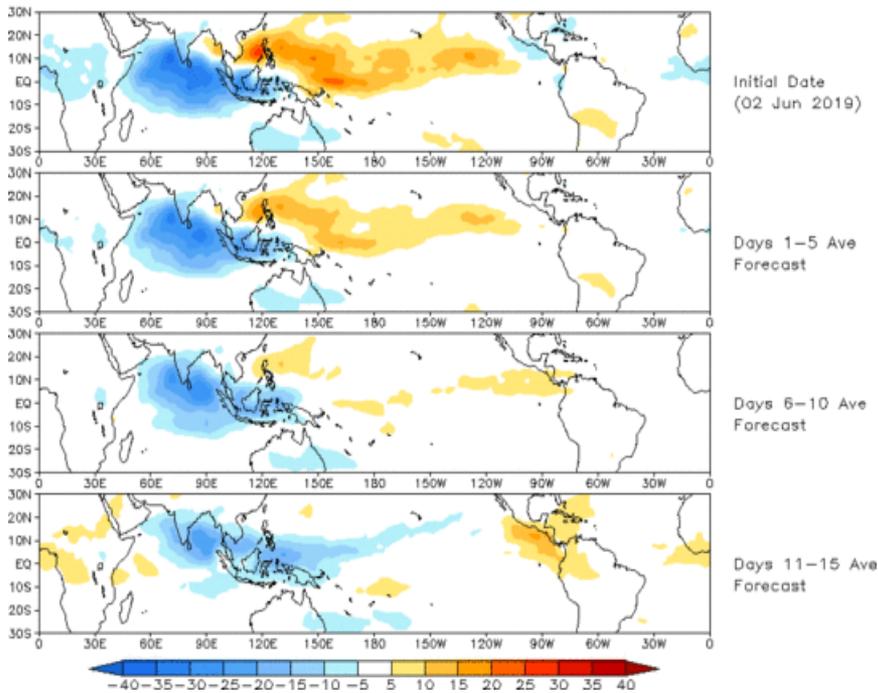
ECMWF Forecast

- Model guidance is fairly consistent with the MJO evolution during the next two weeks. Both GEFS and ECMWF models maintain eastward propagation of the MJO with some de-amplification over the Indian Ocean during Week-1 and over the Maritime Continent during Week-2. The ECMWF propagates the MJO signal a bit faster than the GEFS.

MJO: GEFS Forecast Evolution

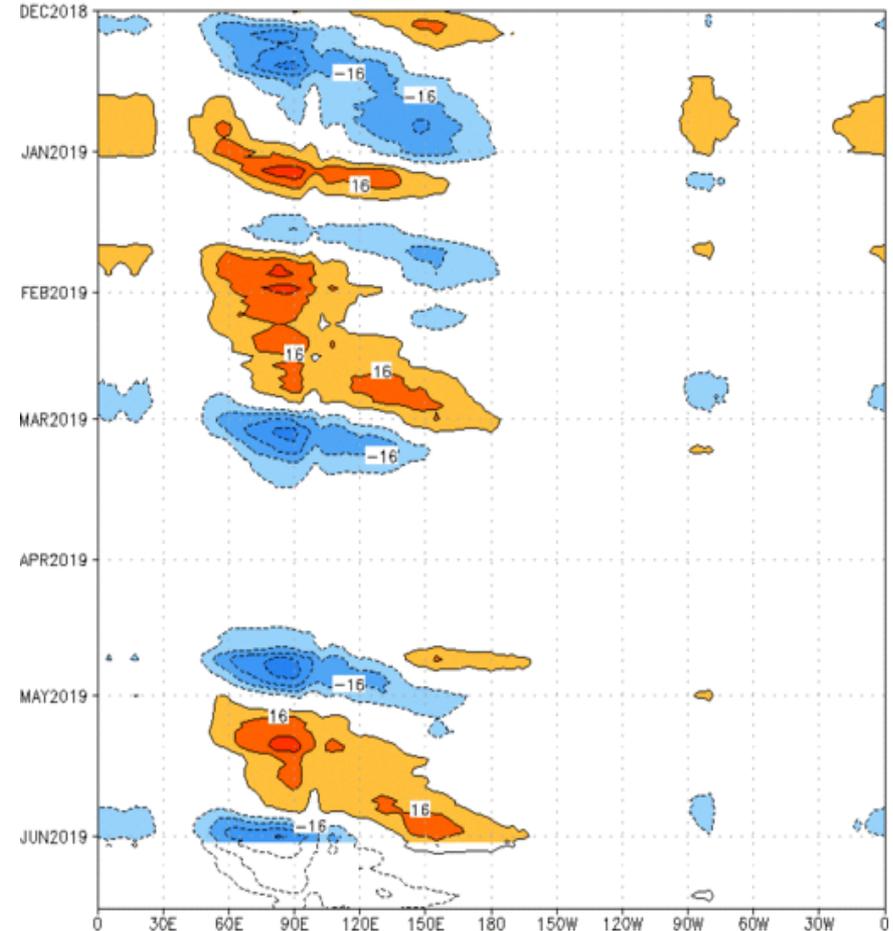
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 02 Jun 2019
OLR



- The GEFS RMM-based anomalies depicts enhanced convection over the Indian Ocean and Maritime Continent, with suppressed convection over western and central Pacific. By Week-2, the enhanced phase persists with decreasing amplitude over the Indian Ocean, Maritime Continent and western Pacific, with suppressed convection emerging over the eastern Pacific.

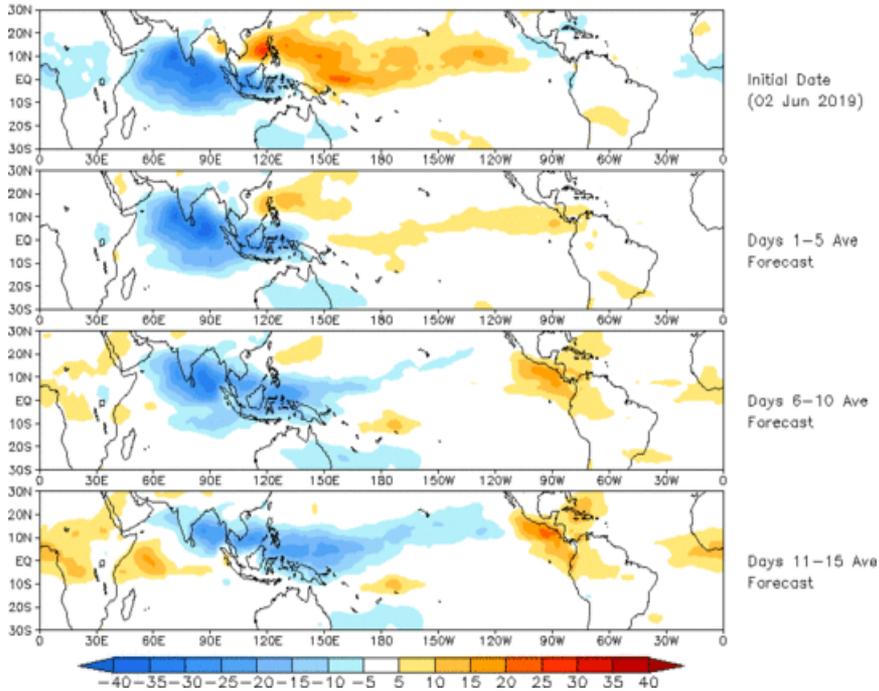
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:01-Dec-2018 to 02-Jun-2019
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



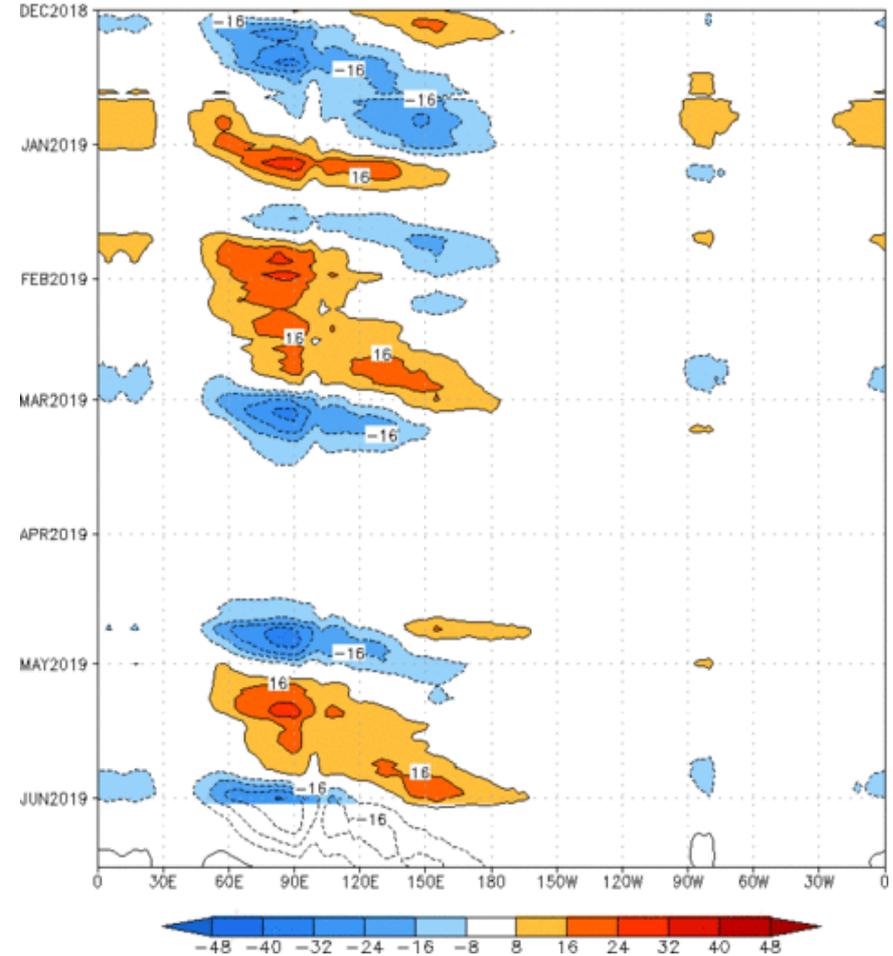
MJO: Constructed Analog Forecast Evolution

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 (02 Jun 2019)



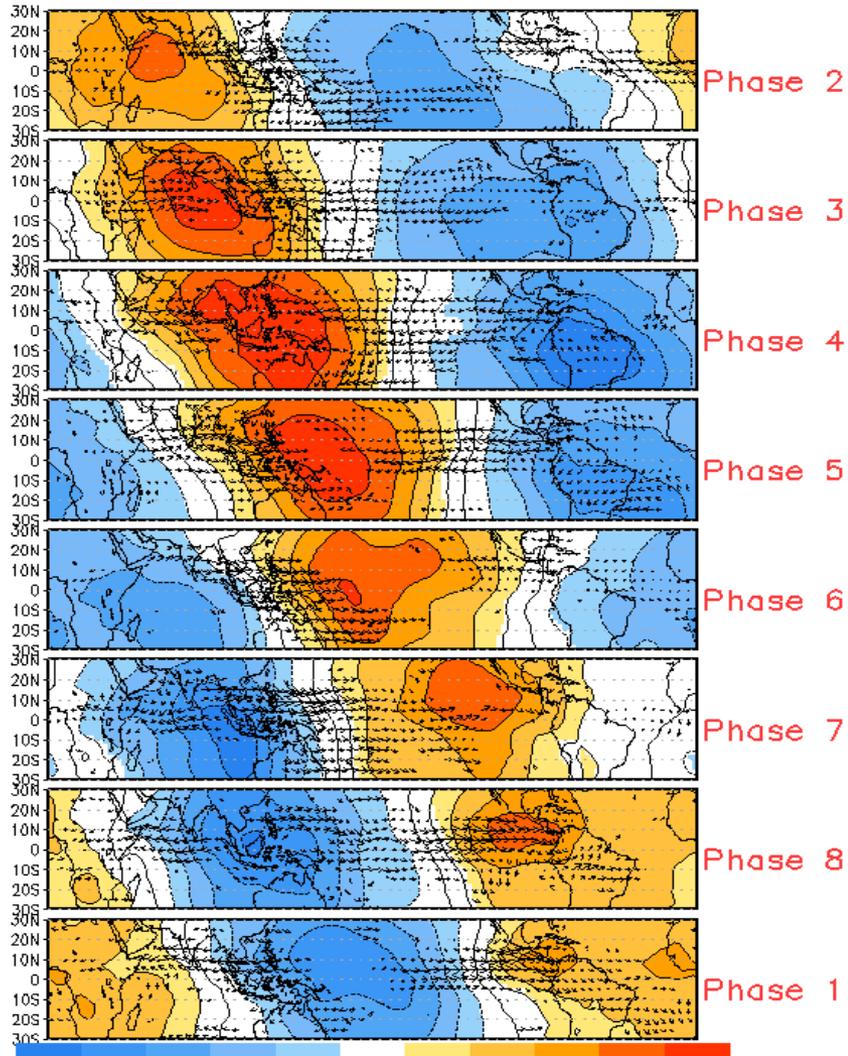
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:01-Dec-2018 to 02-Jun-2019
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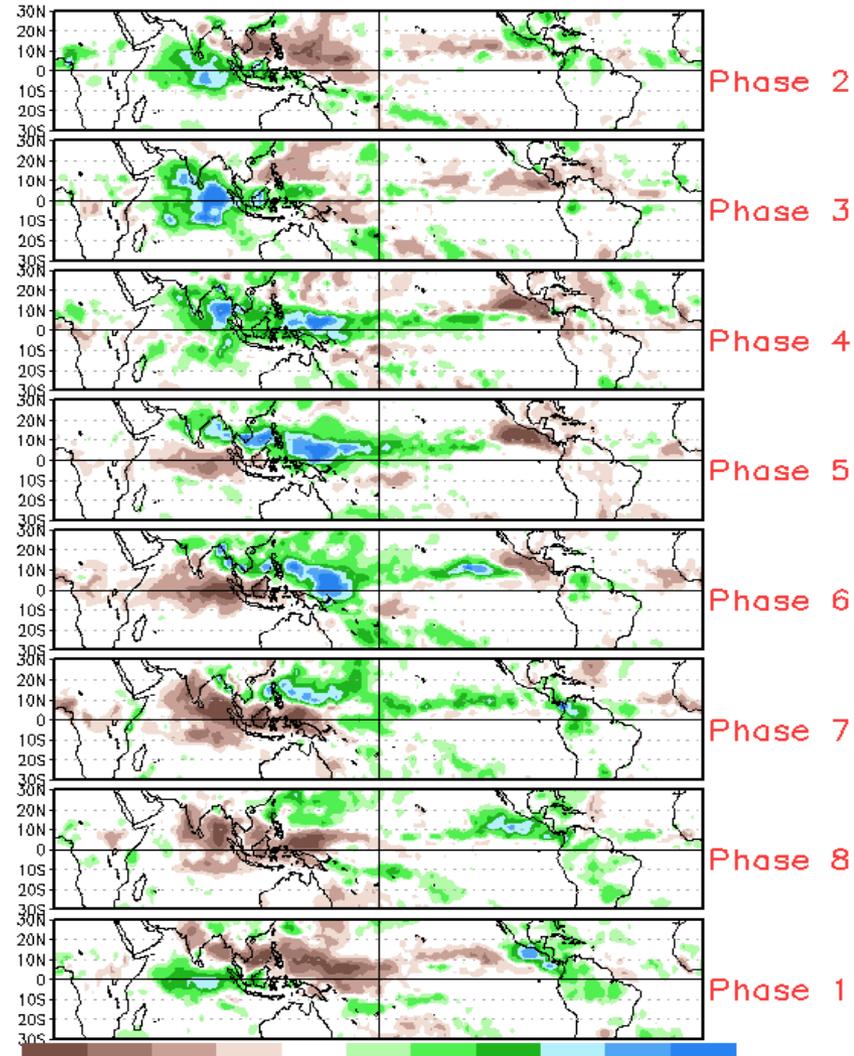
- The constructed analog forecast favors a canonical eastward propagation of the MJO, with a higher amplitude anomaly field during Week-2 than the GEFS.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



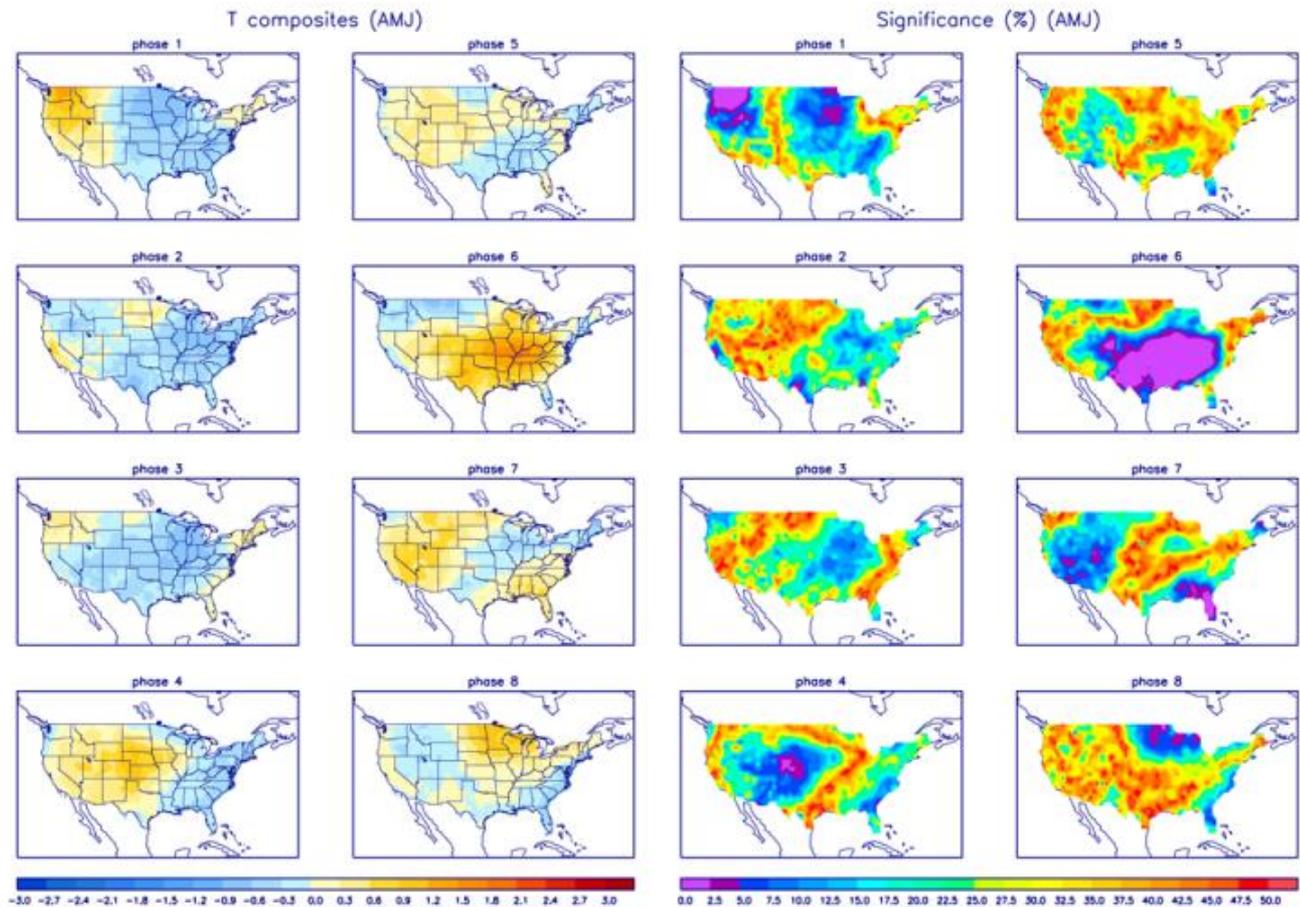
Precipitation Anomalies



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.

