

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
27 May 2019

Overview

- The enhanced convective phase of the MJO remains over the Western Hemisphere this week, as eastward propagation has slowed of late. The suppressed convective phase is now centered over the Maritime Continent and far western Pacific.
- The ECMWF model predicts eastward propagation of the MJO signal across Africa and the western Indian Ocean over the next two weeks, with gradual de-amplification of the signal during Week-2. The GEFS model predicts less coherent MJO evolution with enhanced convection remaining anchored over the Western Hemisphere and Africa.
- There is a slight chance of tropical cyclone development over the far East Pacific or western Atlantic basins over the next week or two, consistent with MJO evolution. The latest dynamical model guidance indicates only a very slight risk (~10%).

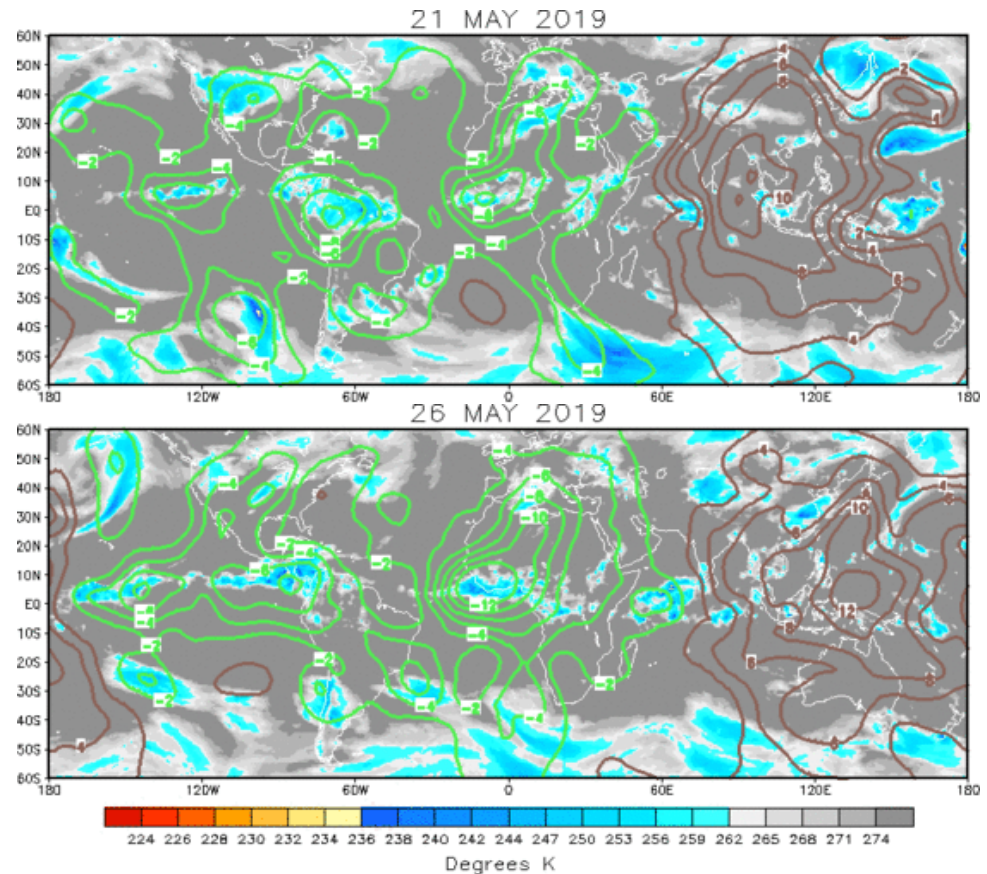
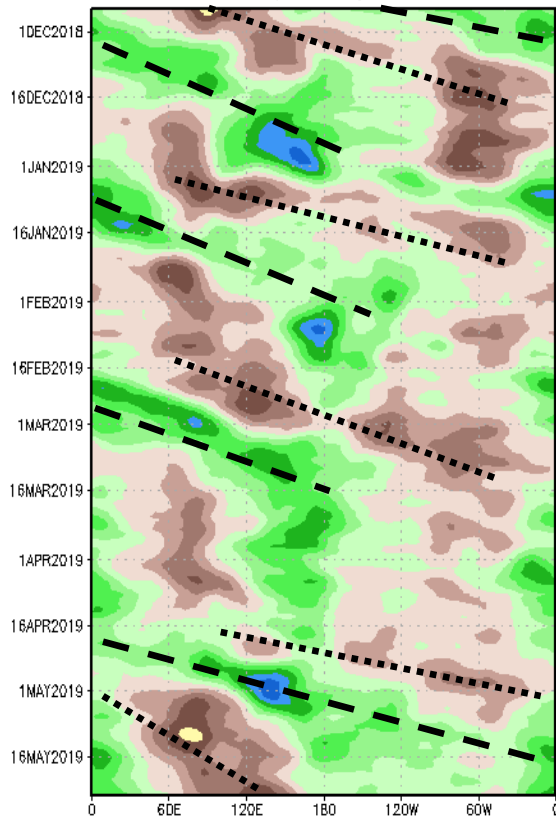
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

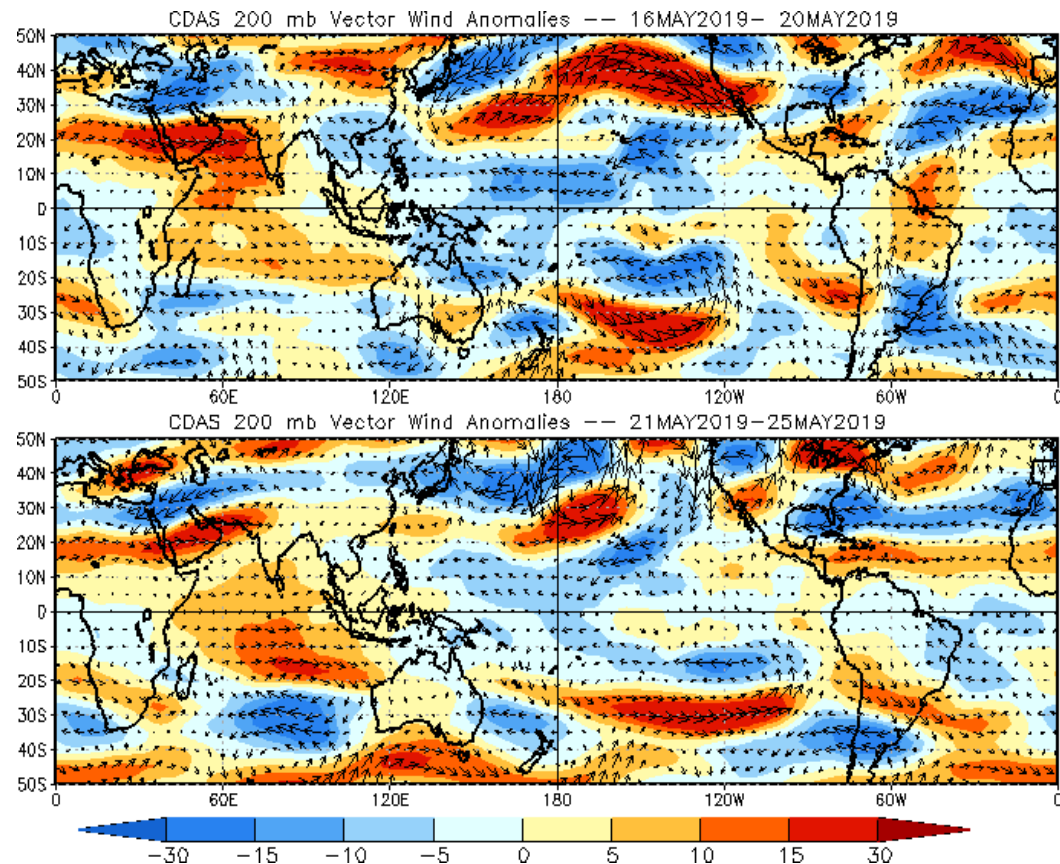
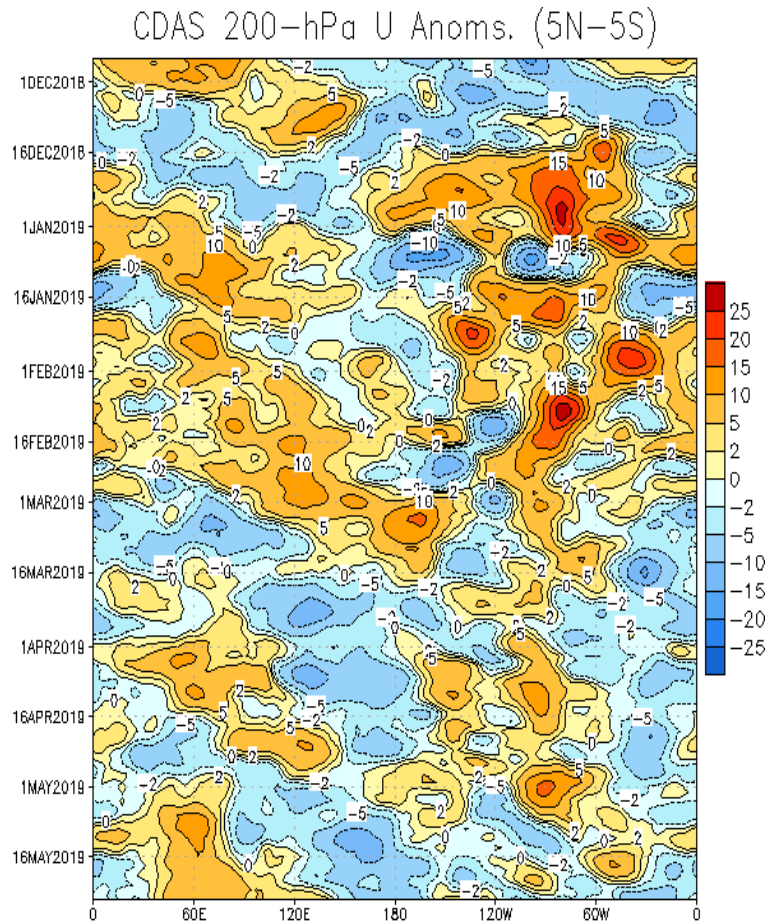
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- 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.
- Mid-April shows the beginning of a robust MJO event with renewed eastward propagation during late April and continuing through May. Recently the enhanced convective signal has become more stationary over the Western Hemisphere and Africa.

200-hPa Wind Anomalies

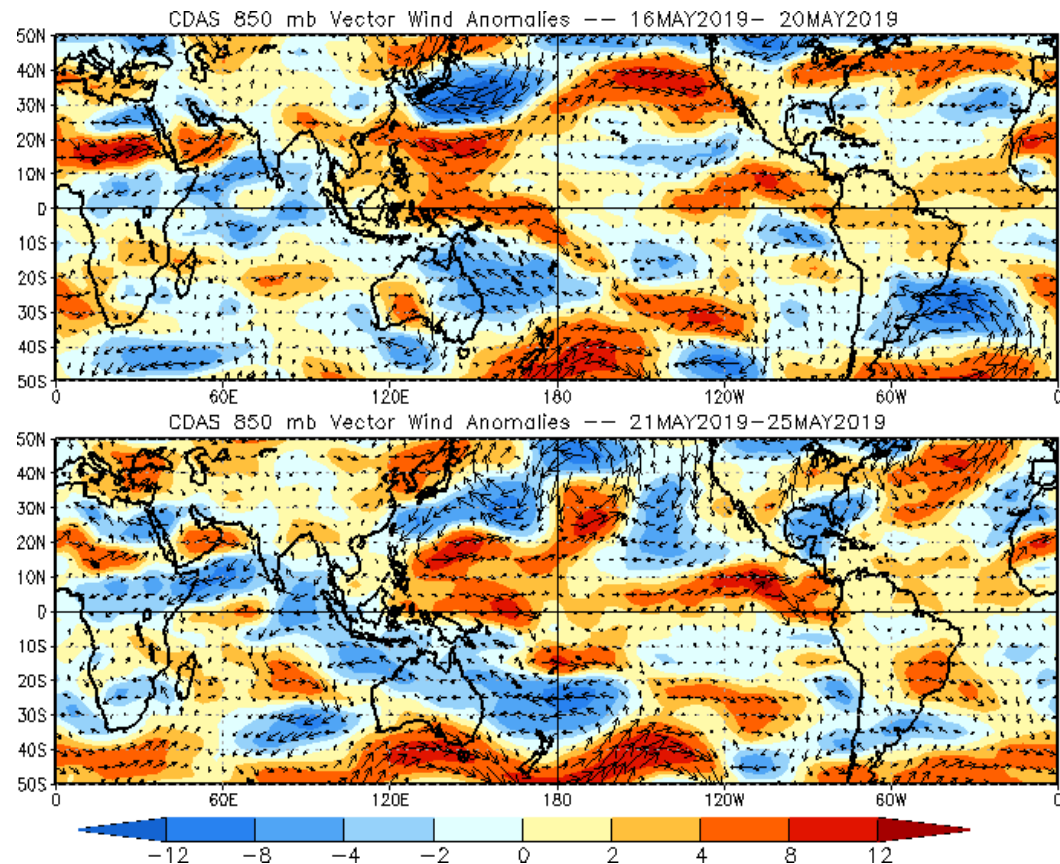
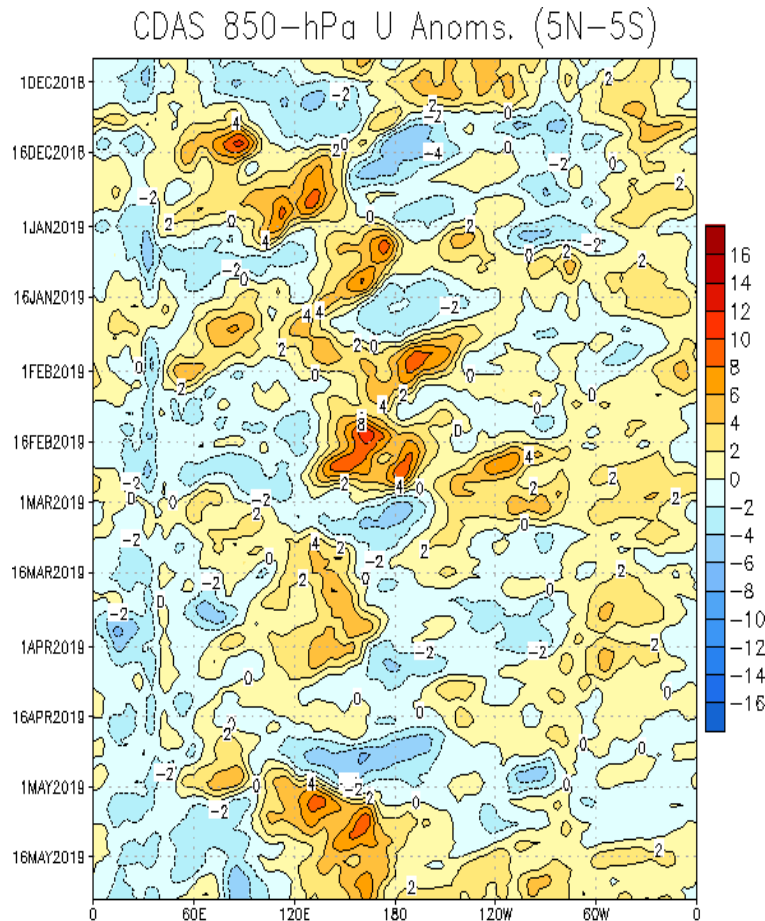
Shading denotes the zonal wind anomaly. **Blue shades: Anomalous easterlies.** **Red shades: Anomalous westerlies.**



- 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 since the beginning of May.

850-hPa Wind Anomalies

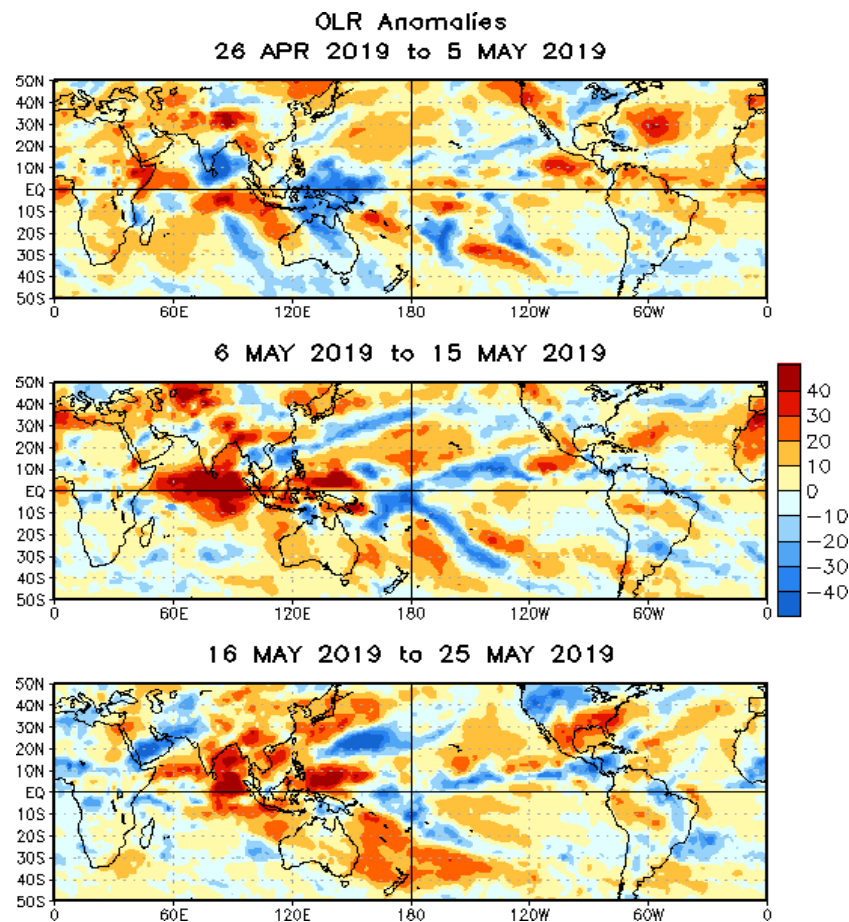
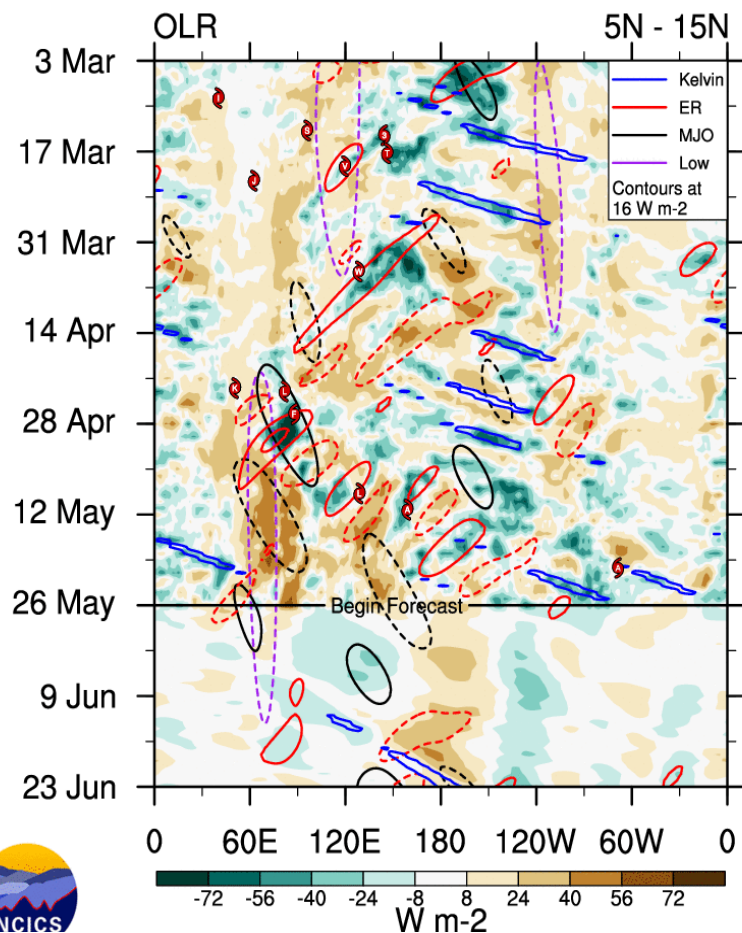
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Anomalous westerlies tied to the MJO shifted from the Indian Ocean to over the Maritime Continent and western Pacific from late April into mid-May.
- During the past five days, anomalous westerlies over the equatorial western Pacific have not shown much eastward displacement. Anomalous easterlies remained over the equatorial Indian Ocean, which is favorable for enhanced rainfall over eastern Africa.

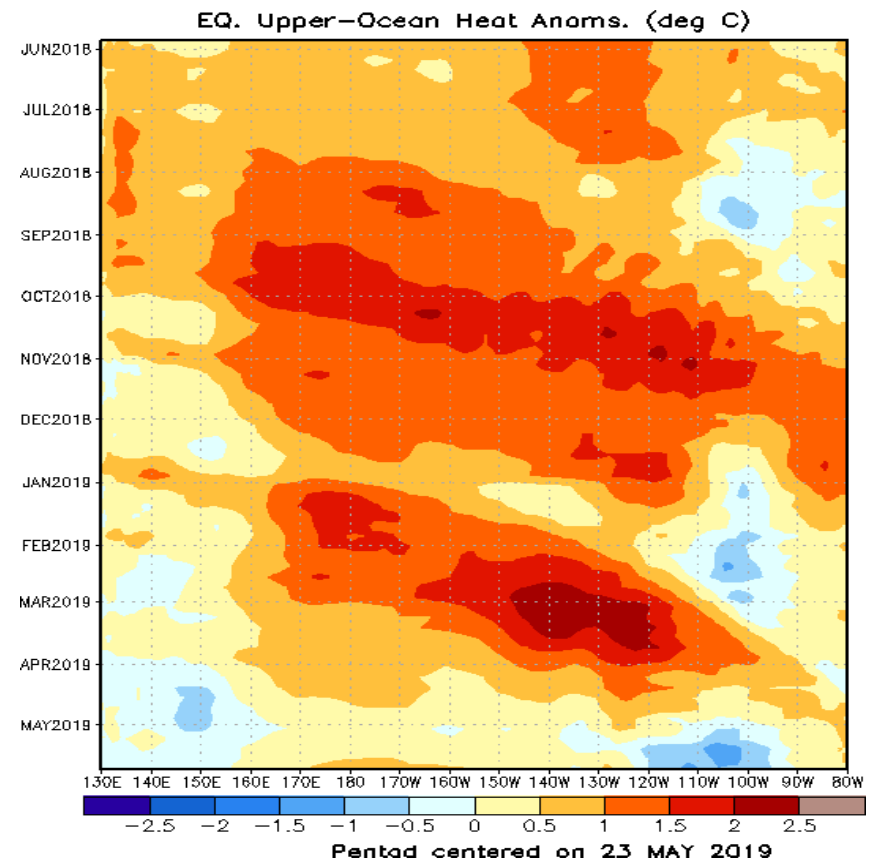
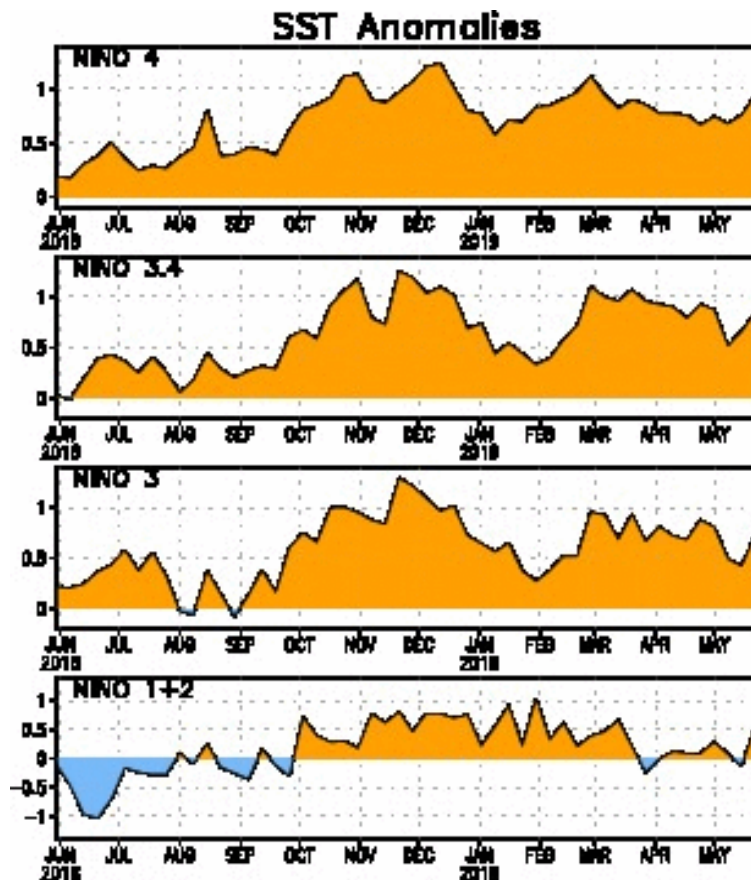
Outgoing Longwave Radiation (OLR) Anomalies

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.
- The enhanced phase of the MJO likely contributed to the development of tropical cyclones Lili and Ann in the Southern Hemisphere during the first half of May.

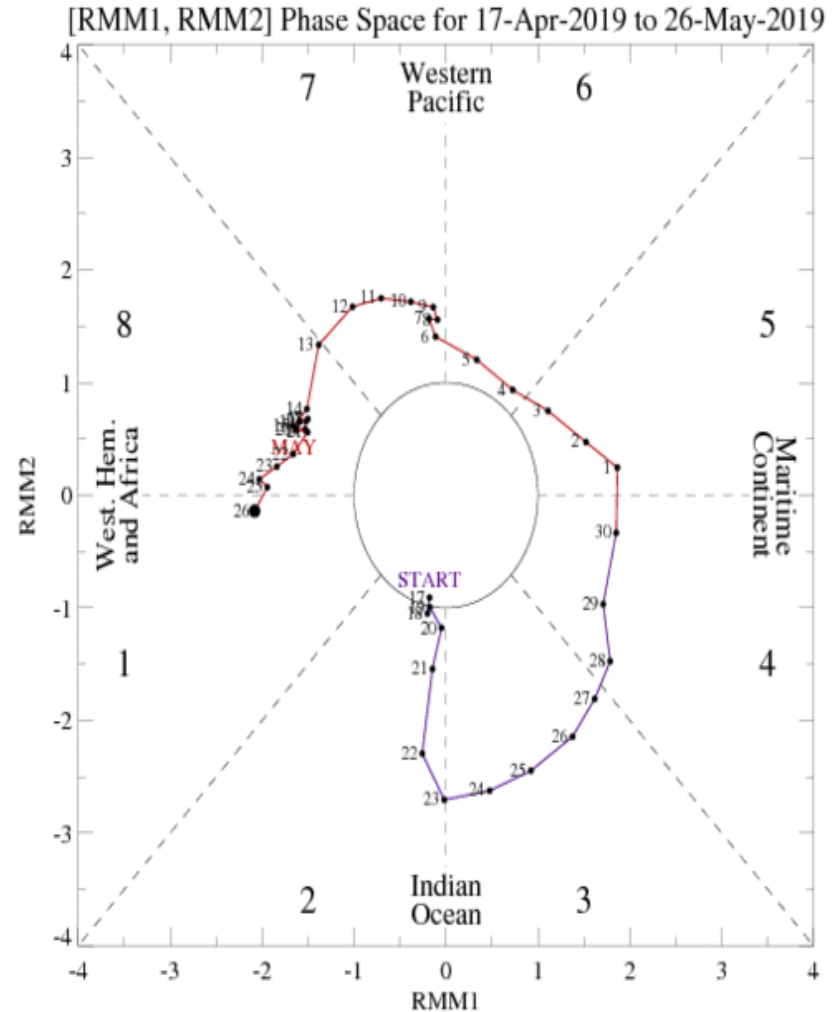
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- SST anomalies remain above climatology across much of the equatorial Central and East Pacific, consistent with the ongoing El Niño event.
- Upper-ocean heat content has decreased significantly since March east of the Maritime Continent, but most noteworthy is a westerly wind burst that recently developed near 160°E. There is some question as to how much influence a resultant downwelling oceanic Kelvin wave would have to help reinforce the warm water availability for the low frequency state in the Pacific.

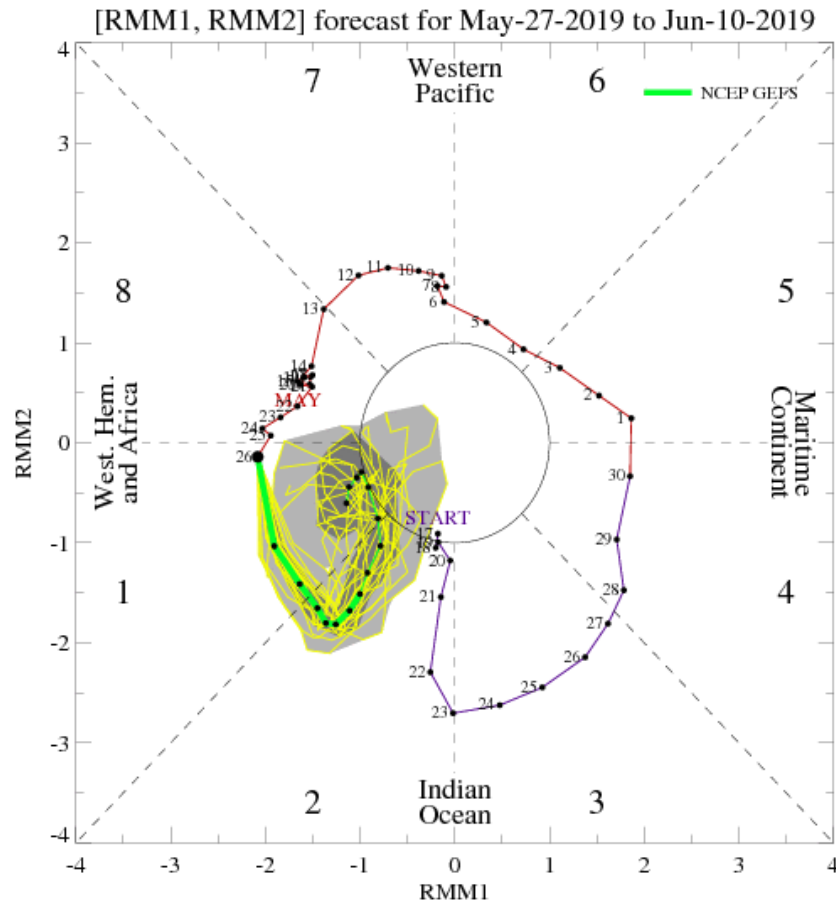
MJO Index: Recent Evolution

- The RMM index shows the MJO propagating eastward across the West Pacific during early to mid-May, slowing significantly over the past two weeks. This may be related to ERW activity near the Date Line.

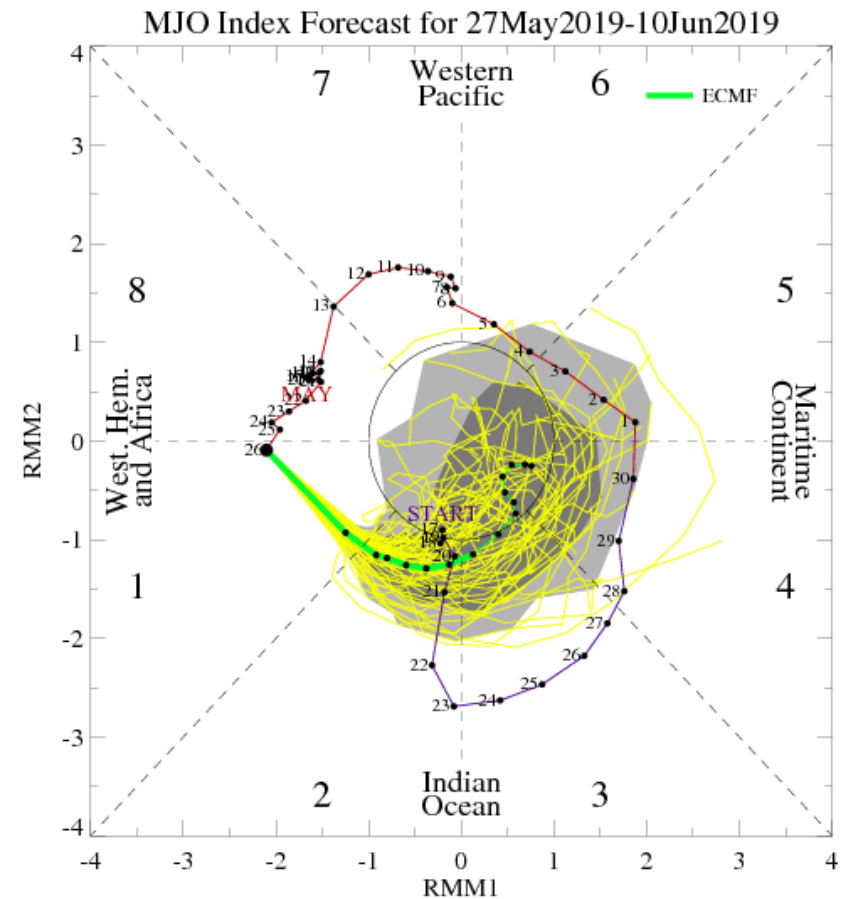


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



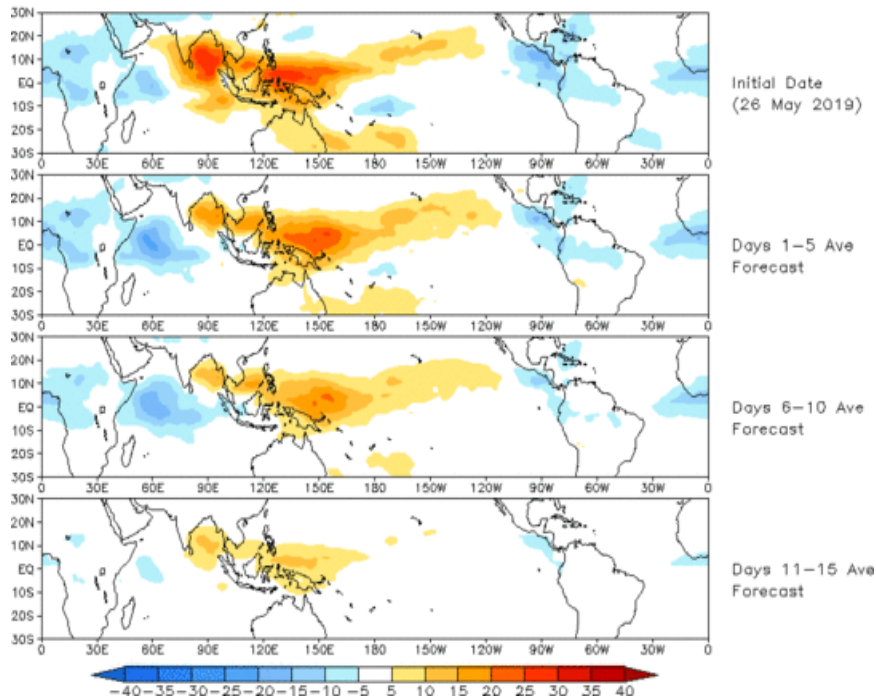
ECMWF Forecast

- Model guidance diverges on the MJO evolution during the next two weeks. The GEFS model maintains a and enhanced signal over the Western Hemisphere and Africa whereas the ECMWF model shows renewed propagation of the MJO signal, decreasing in amplitude during Week-2. This diverging model solutions lowers MJO forecast confident heading into June.

MJO: GEFS Forecast Evolution

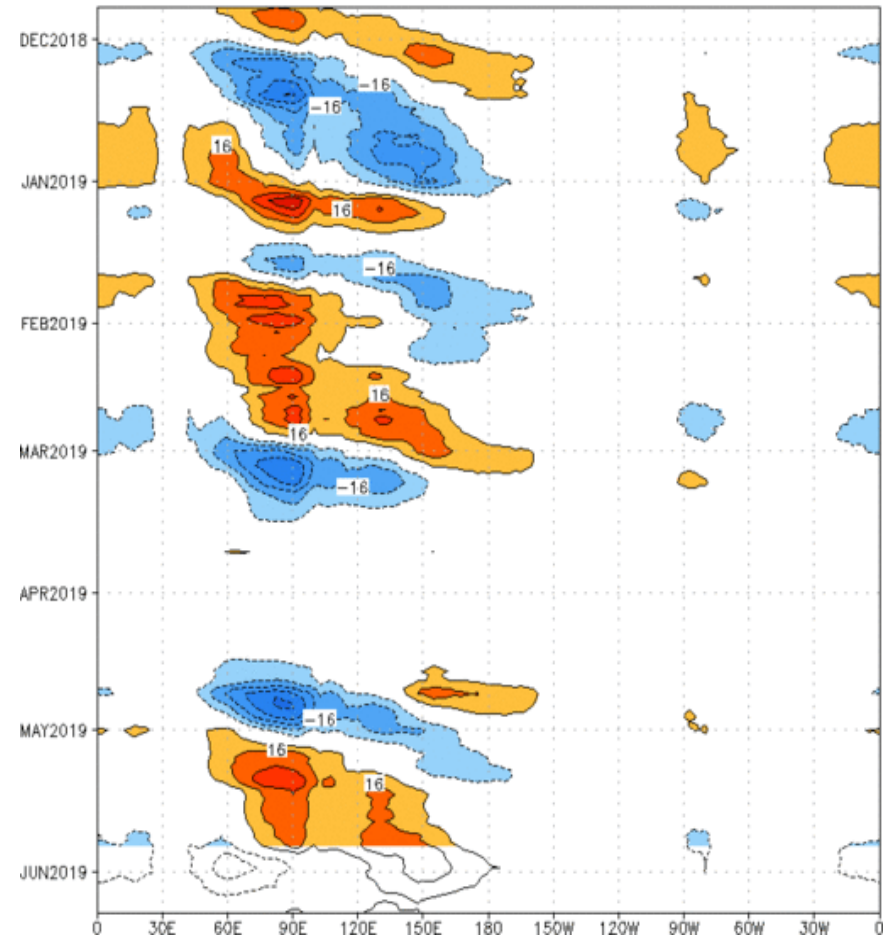
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 26 May 2019
OLR



- The GEFS indicates suppressed convection remaining anchored over the Maritime Continent. The enhanced phase persists, with decreasing amplitude, over the East Pacific, Central America, Africa, and northern parts of South America, and the western Indian Ocean through Week-2.

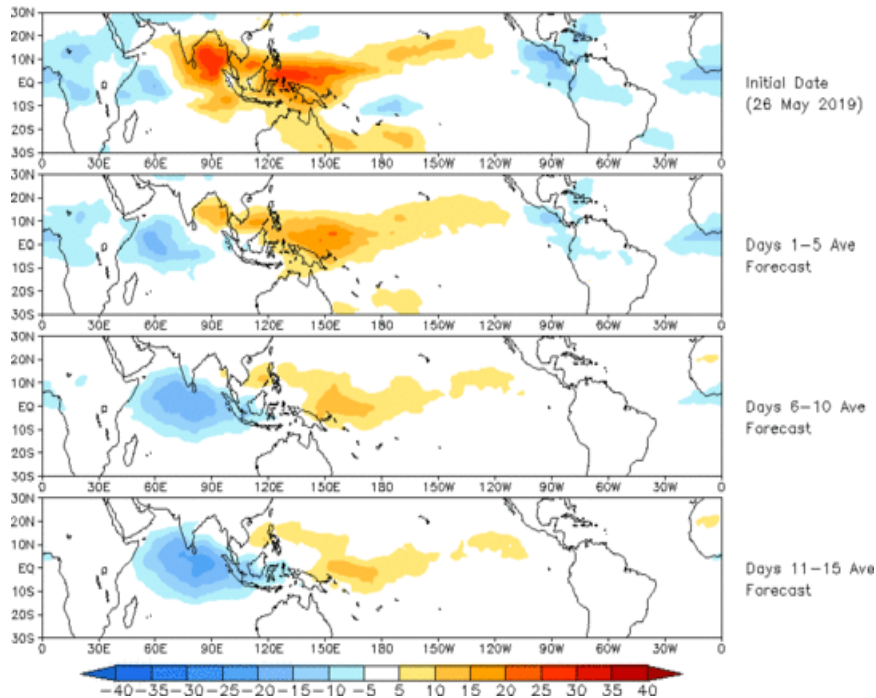
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [$7.5^{\circ}\text{S}, 7.5^{\circ}\text{N}$] ($\text{cont: } 4\text{Wm}^{-2}$) Period: 24-Nov-2018 to 26-May-2019
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



MJO: Constructed Analog Forecast Evolution

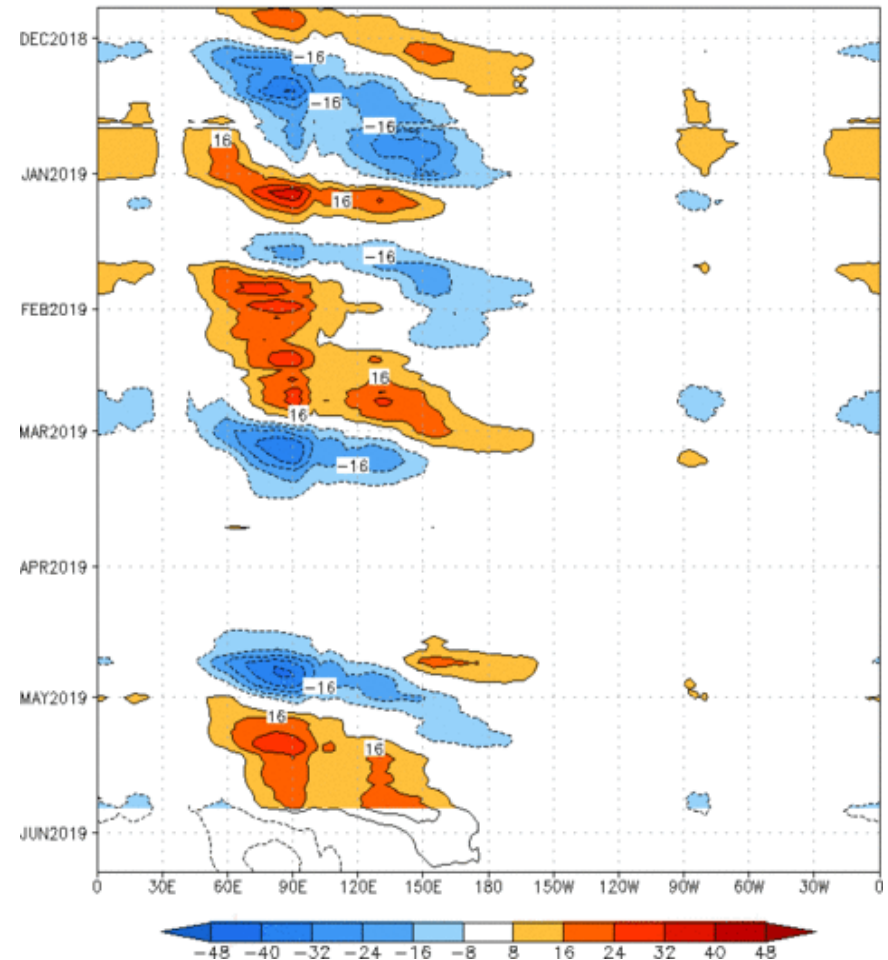
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (26 May 2019)



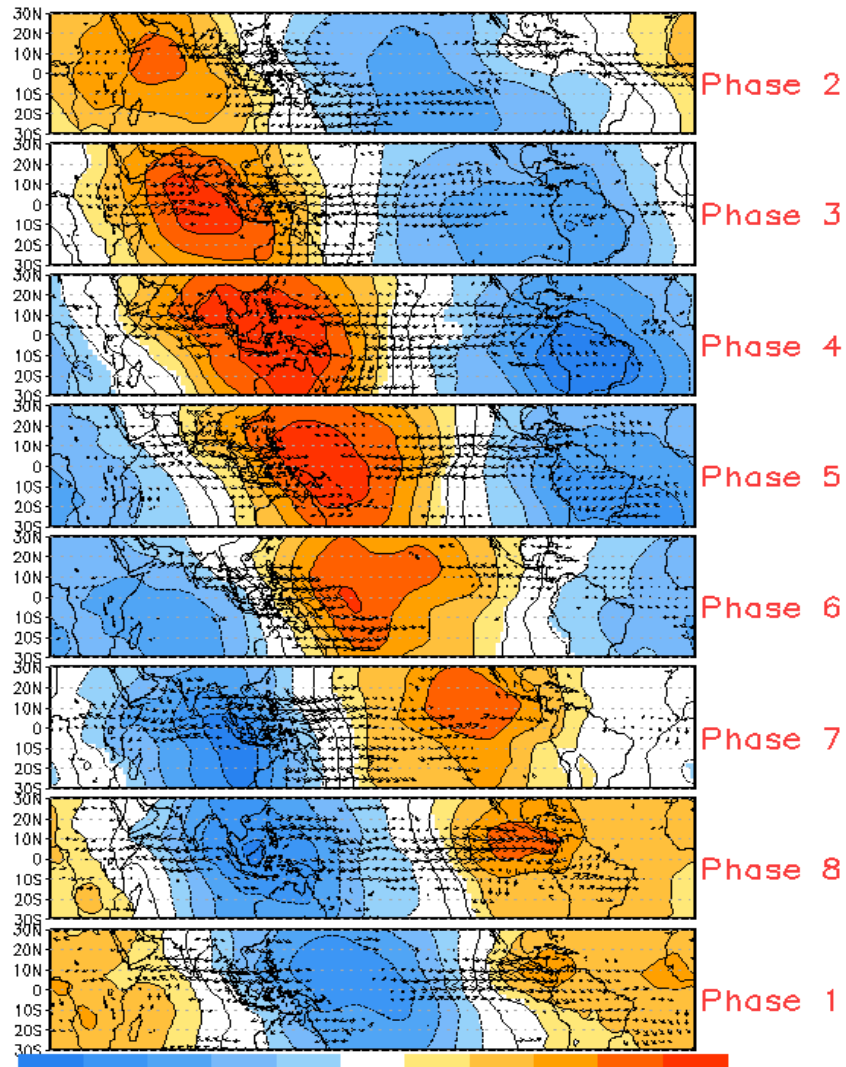
- The constructed analog forecast favors a canonical eastward propagation of the MJO compared to the GEFS; with enhanced convection propagating across the Indian Ocean during the next two weeks.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:24-Nov-2018 to 26-May-2019
The unfilled contours are CA forecast reconstructed anomaly for 15 days

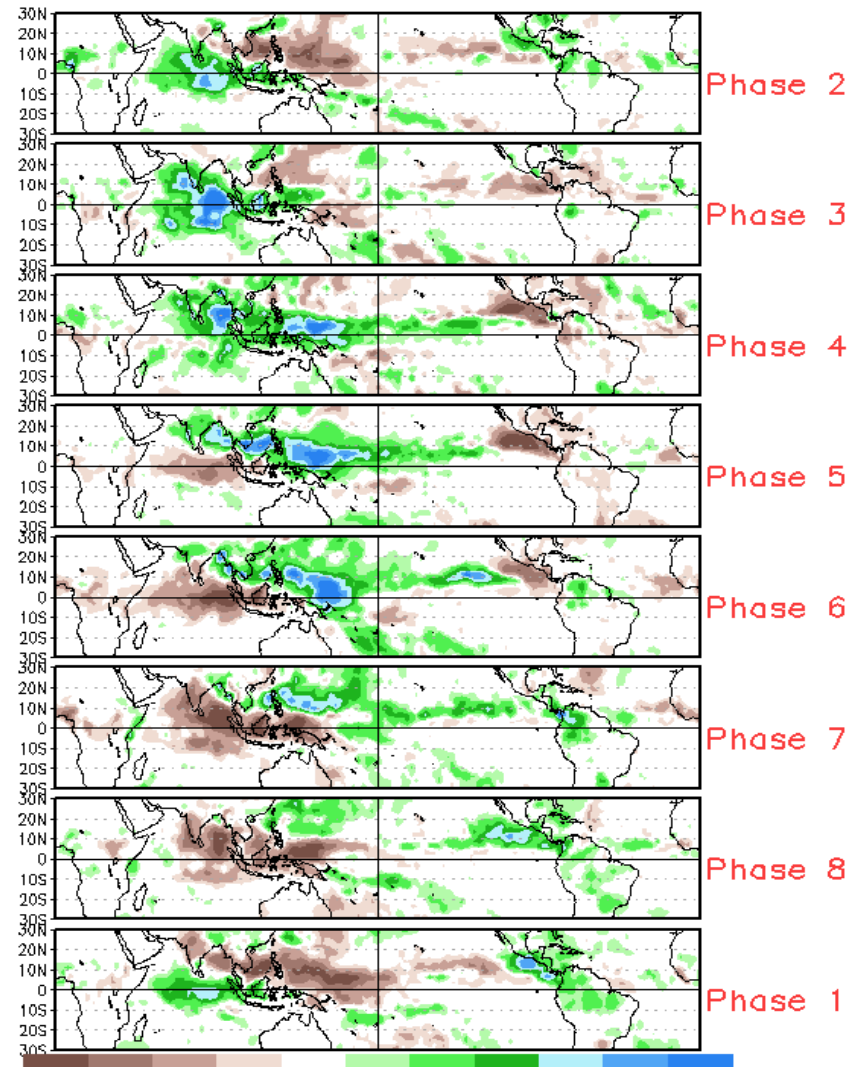


MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



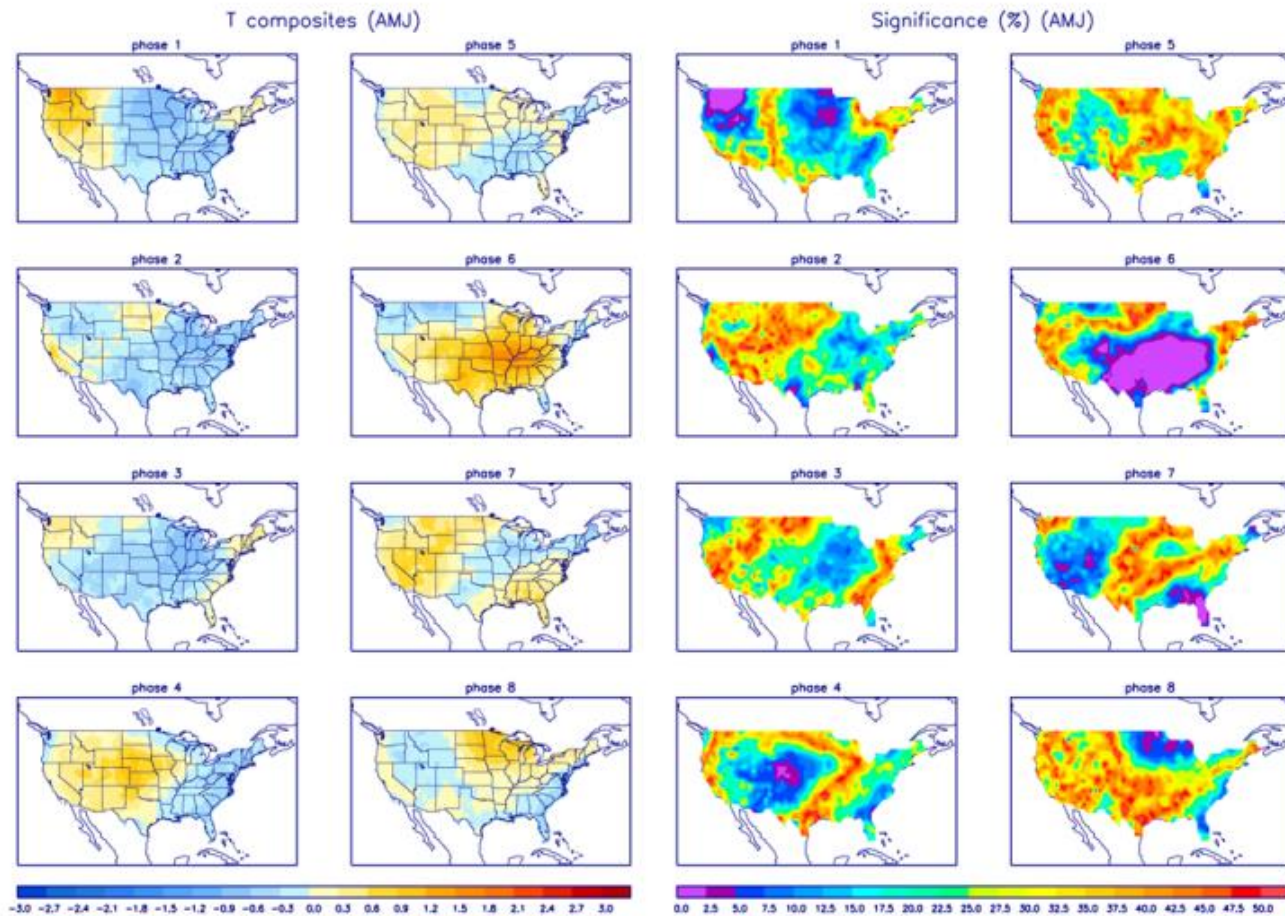
Precipitation Anomalies



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.

