

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



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

Overview

- The MJO continued its eastward propagation with the enhanced phase shifting east over the West and Central Pacific, with the suppressed phase becoming centered over the Indian Ocean.
- GEFS and ECMWF model forecasts diverge as early as Week-1 with many of the ECMWF members showing a rapid weakening of the MJO amplitude while the GEFS propagates the signal across the Western Hemisphere.
- Tropical cyclone development is expected to become more likely across the East Pacific later this week into next week.
- The subtropical jet across the Pacific has remained anomalously strong, which is expected to enhance precipitation associated with a relatively strong upper-level trough over the western U.S. for this time of year.

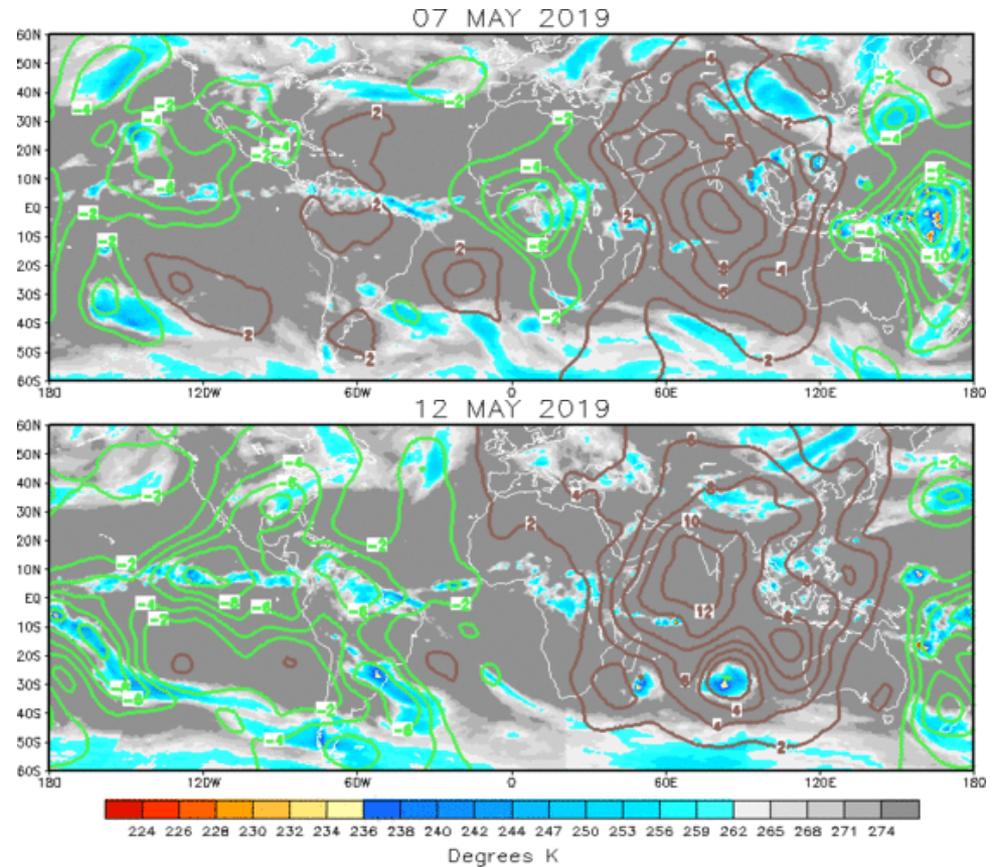
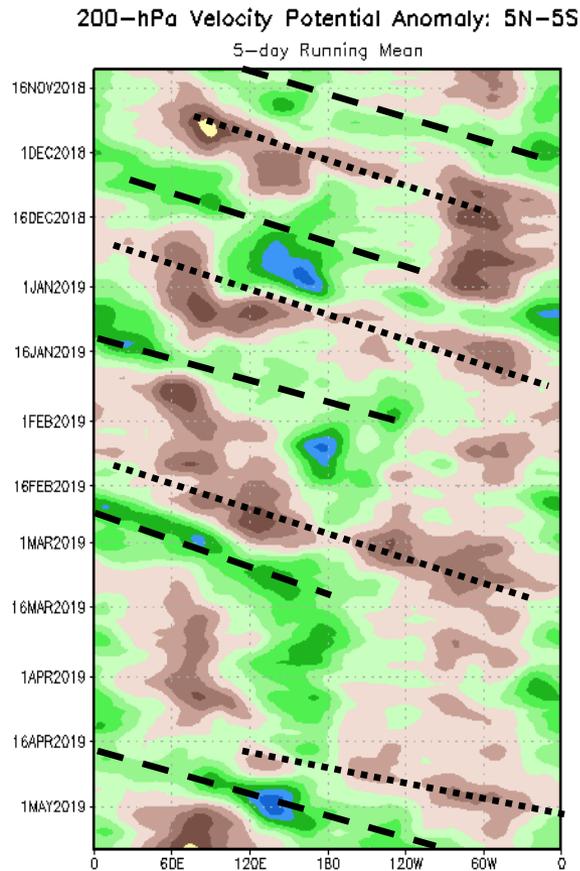
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:

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

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

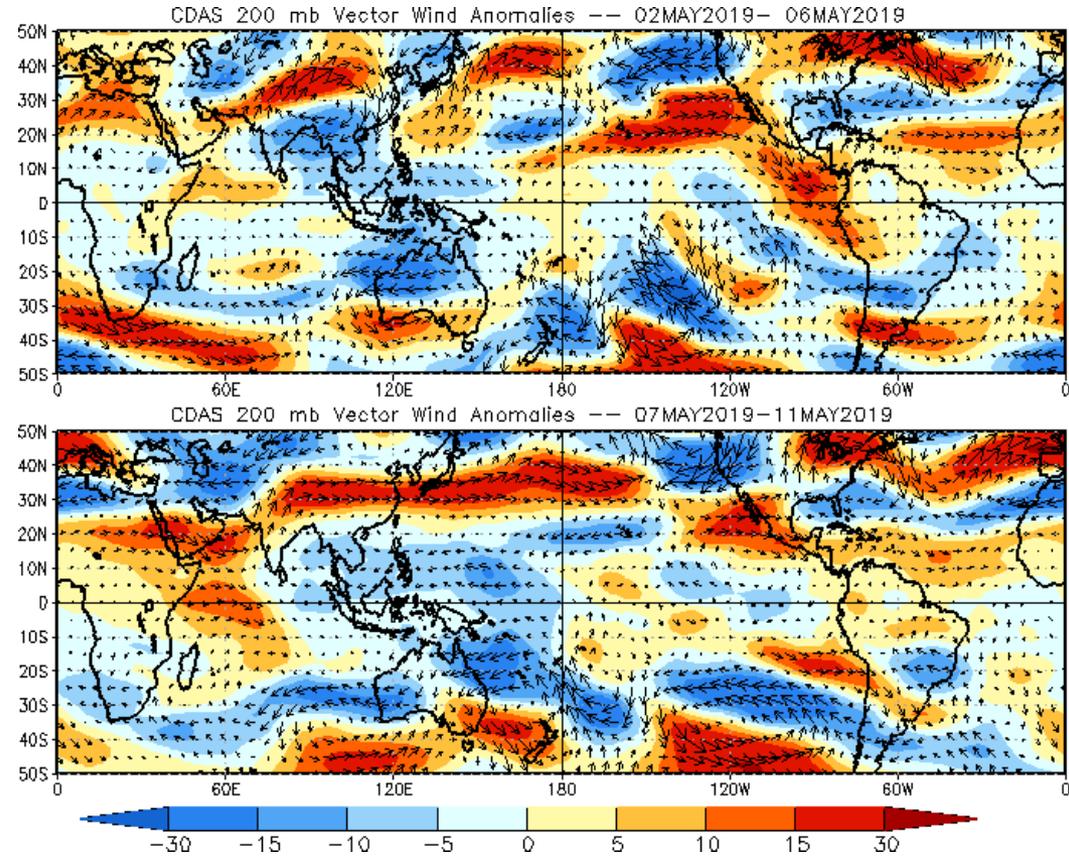
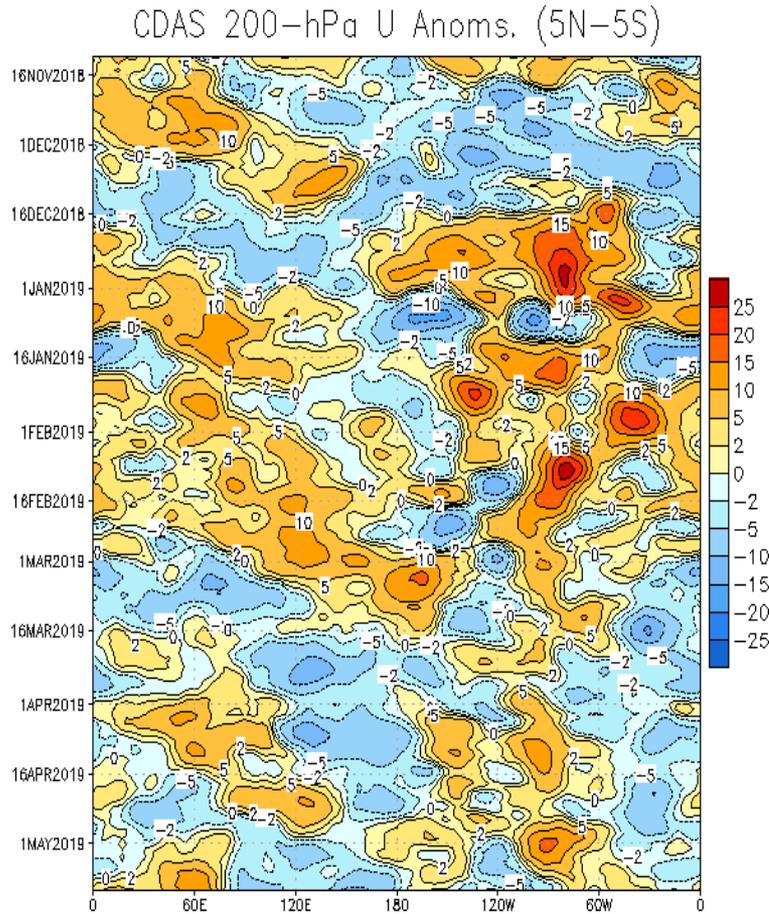
Brown shades: Anomalous convergence (unfavorable for precipitation).



- The MJO, which was consistently active throughout boreal fall and winter, weakened by early March.
- During March, the pattern has been dominated by low-frequency signals, with some modulation by Rossby and Kelvin wave activity.
- Mid-April shows the beginning of a more coherent MJO with renewed eastward propagation during late April. Recently, the enhanced phase of MJO shifted east of the Date Line while its suppressed phase overspread the Indian Ocean and western Maritime Continent.

200-hPa Wind Anomalies

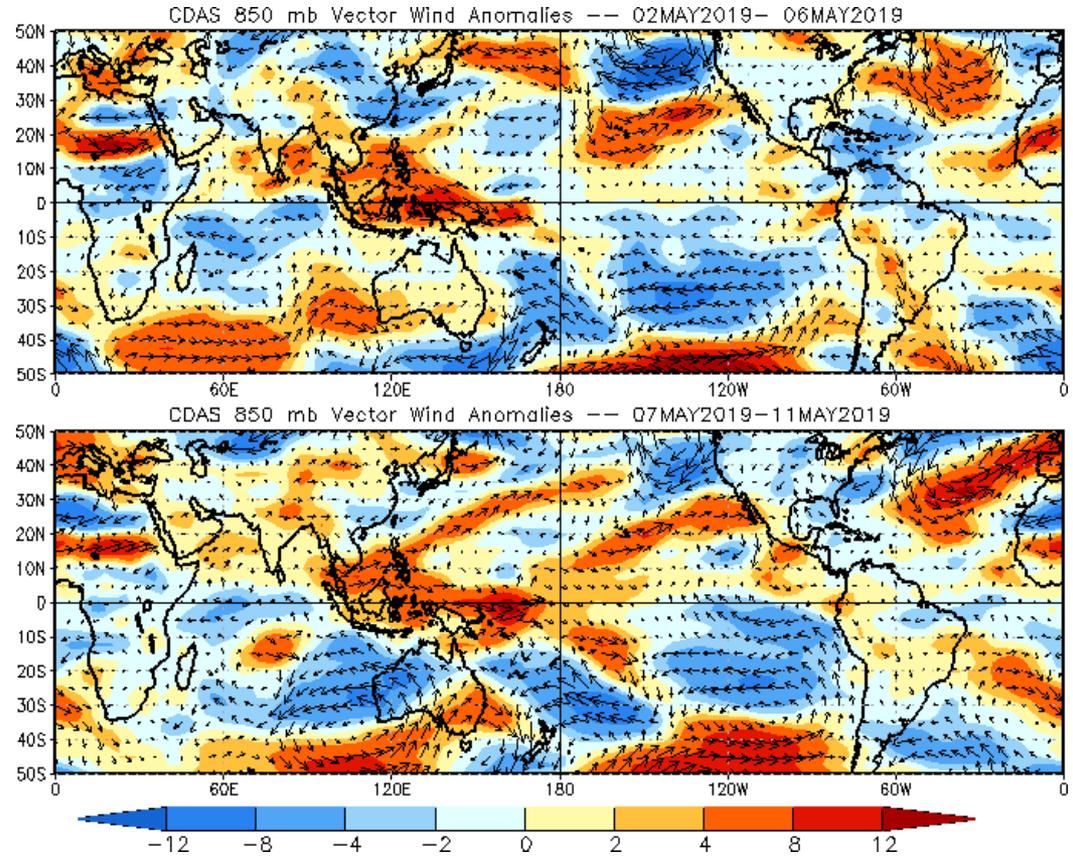
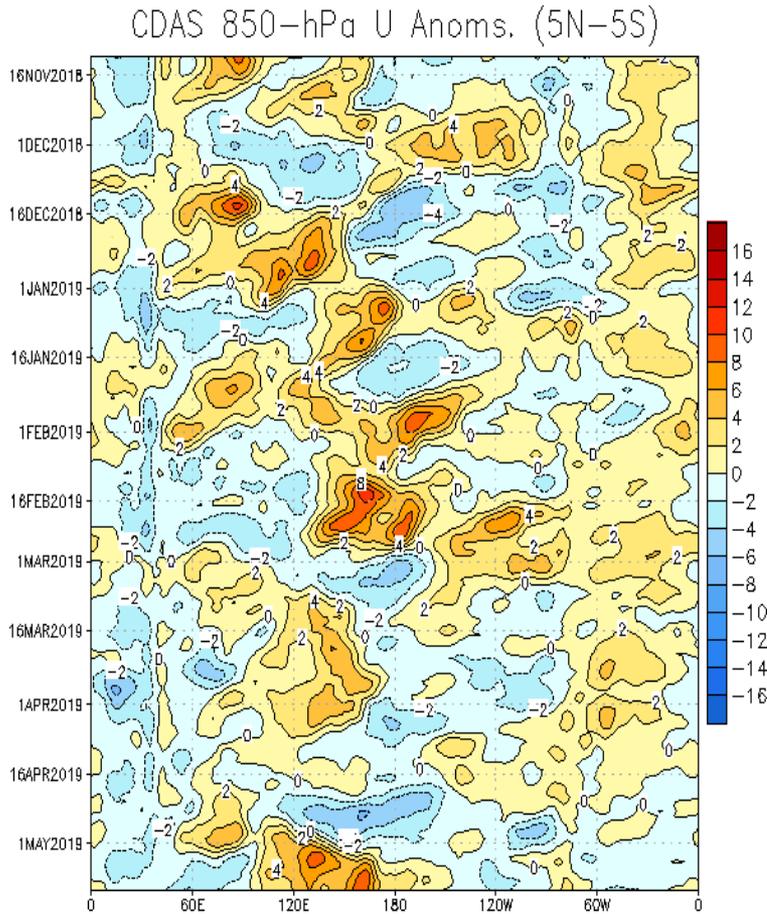
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- As seen in the upper-level VP field on the previous slide, the MJO became inactive during mid-March, but showed signs of re-emerging by April.
- Upper-level wind anomalies reversed across the Maritime Continent since late April, becoming easterly.
- The subtropical jet remained enhanced over the northeast Pacific since the beginning of May.

850-hPa Wind Anomalies

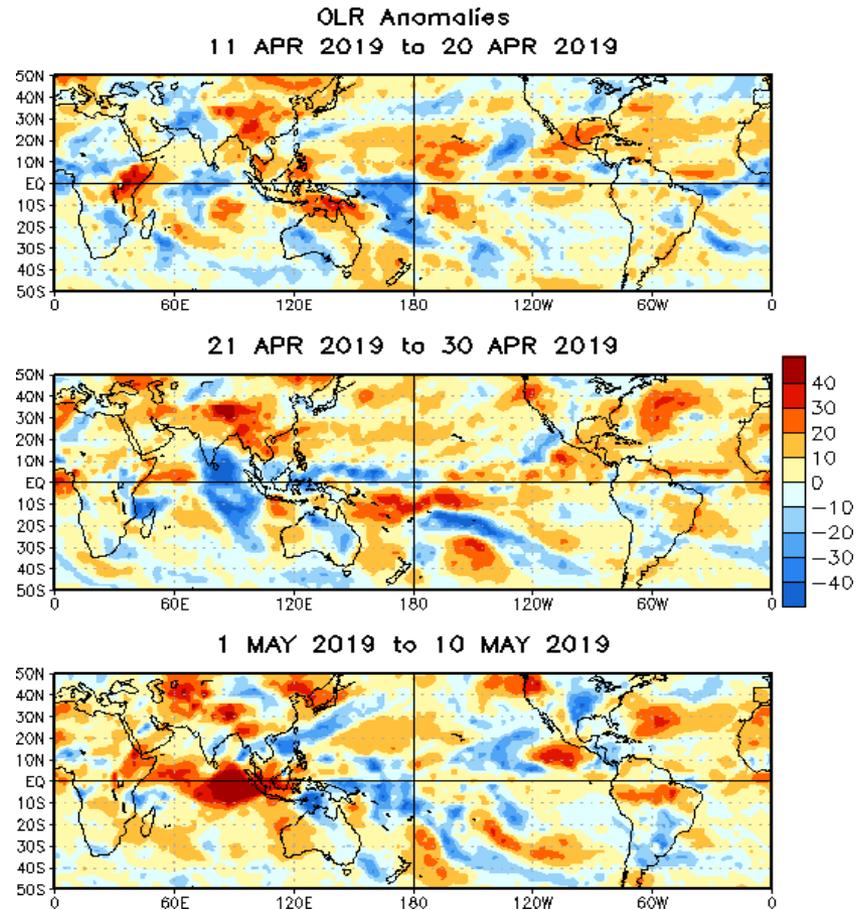
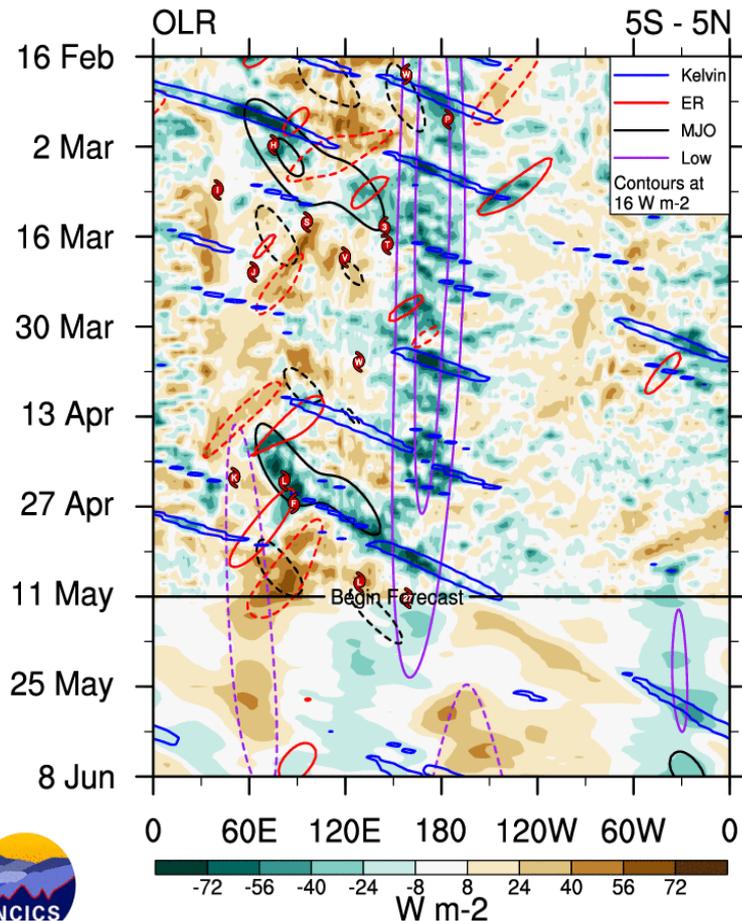
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Anomalous westerlies tied to the MJO shifted from the Indian Ocean to over the Maritime Continent from late April into early May.
- During the past five days, anomalous westerlies shifted east to the Central Pacific with a strong westerly wind burst observed along the equator to the east of Papua New Guinea.

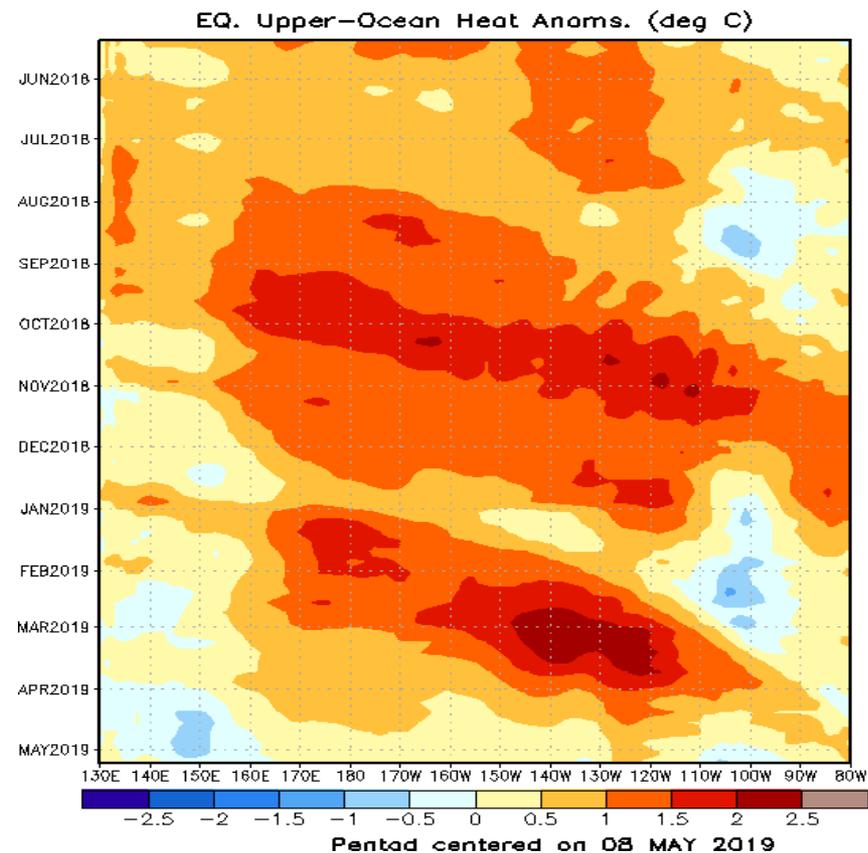
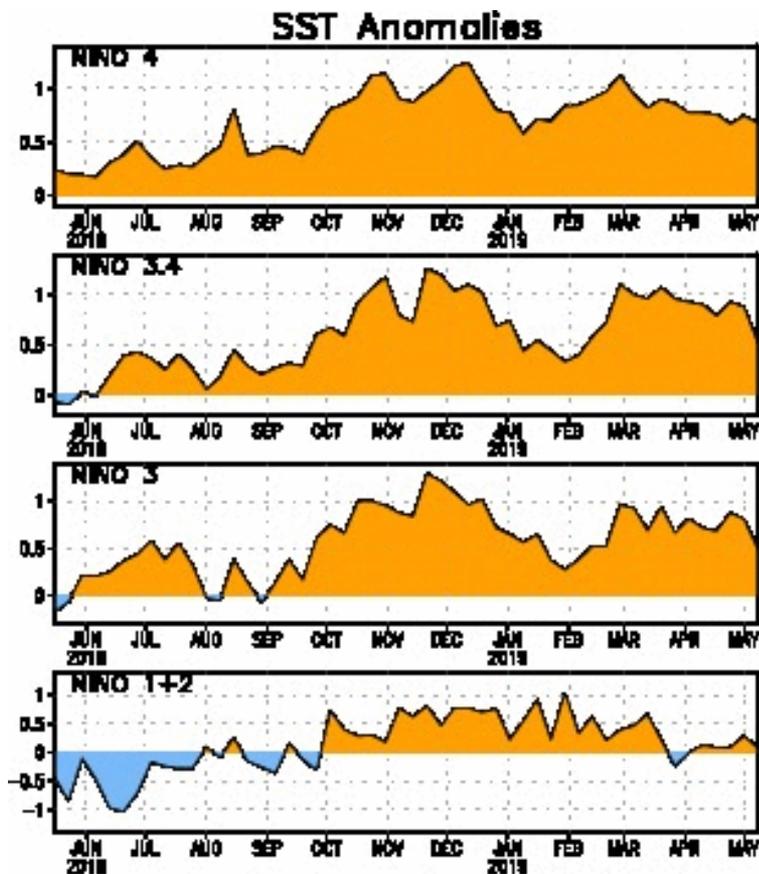
Outgoing Longwave Radiation (OLR) Anomalies

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 recent observations showing the enhanced envelope shifting rapidly from the Indian Ocean to the central Pacific.
- The enhanced phase of the MJO likely contributed to the development of tropical cyclones Lili and Ann in the Southern Hemisphere.

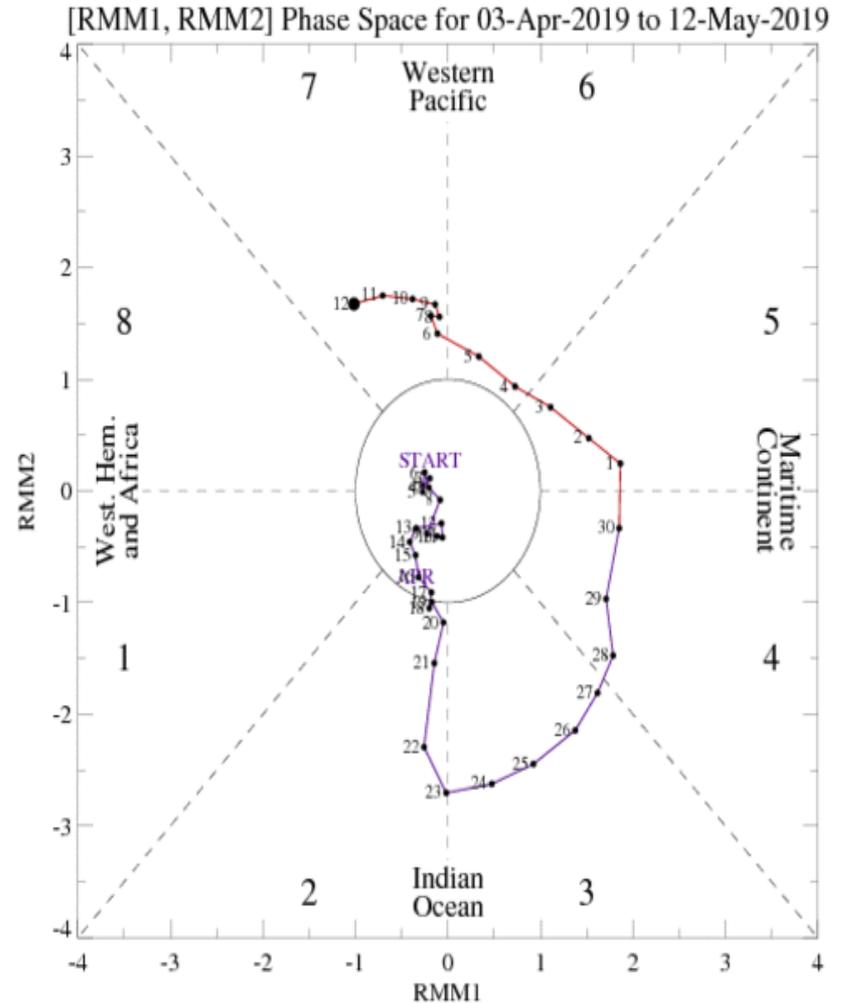
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- SST anomalies remain above climatology across much of the equatorial Central and East Pacific, consistent with the ongoing El Niño event.
- Some erosion of upper ocean heat content is apparent east of the Maritime Continent, but most noteworthy is a westerly wind burst recently developed at 160°E. This is likely to trigger a downwelling oceanic Kelvin wave to help reinforce the warm water availability for the low frequency state in the Pacific.

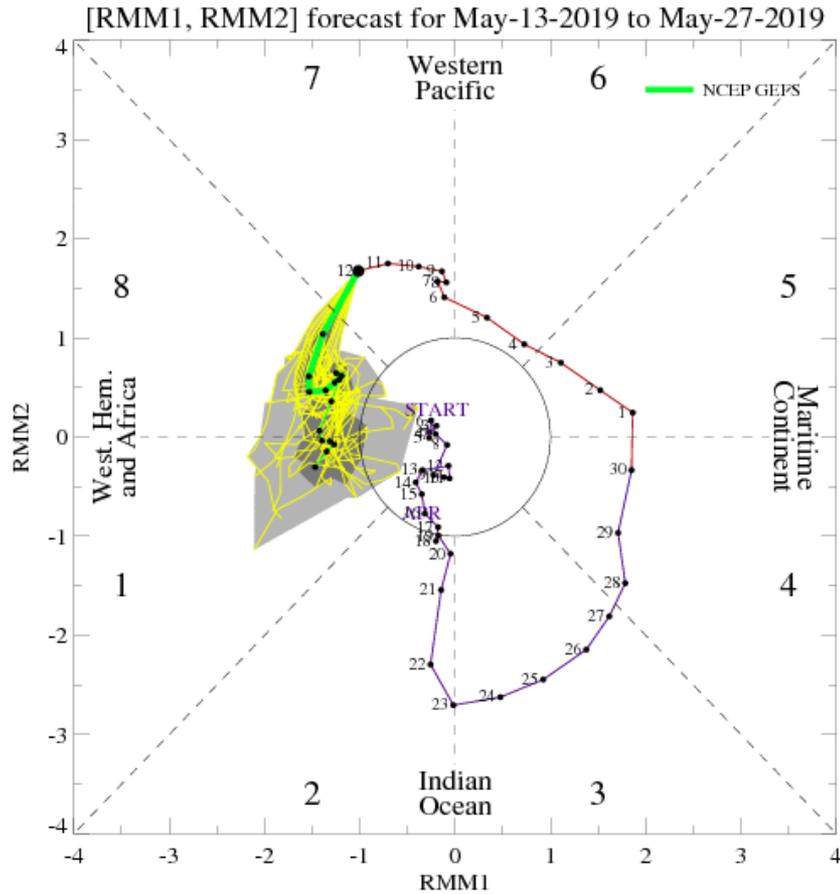
MJO Index: Recent Evolution

- The RMM index shows the MJO propagating eastward across the West Pacific with a slightly slower speed over the past seven days.

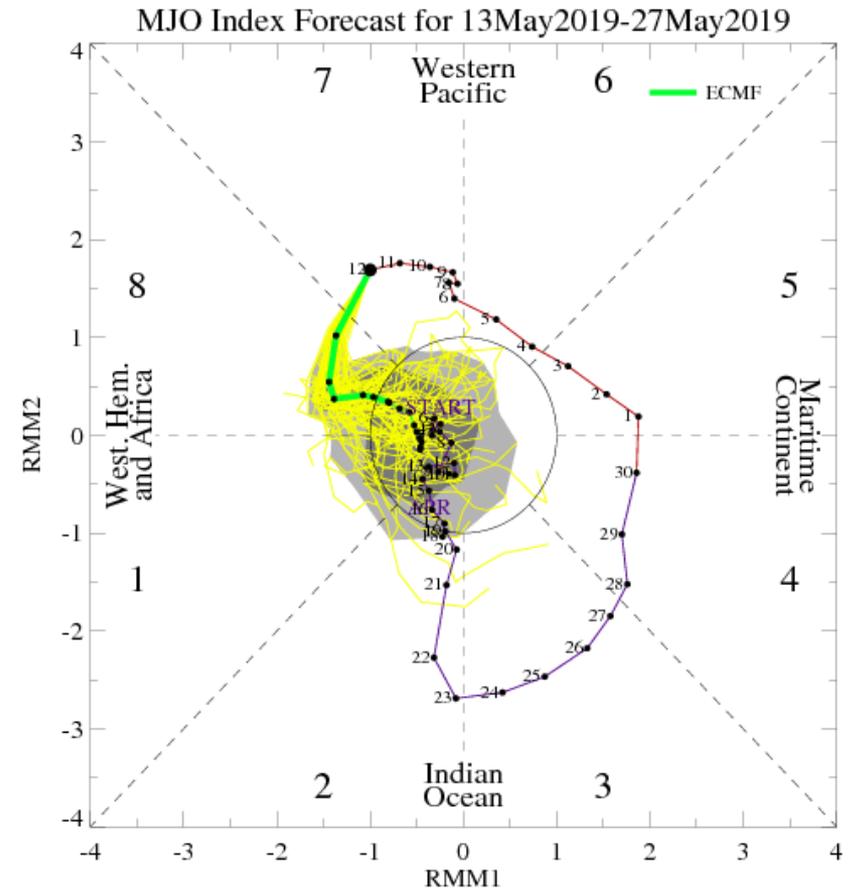


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



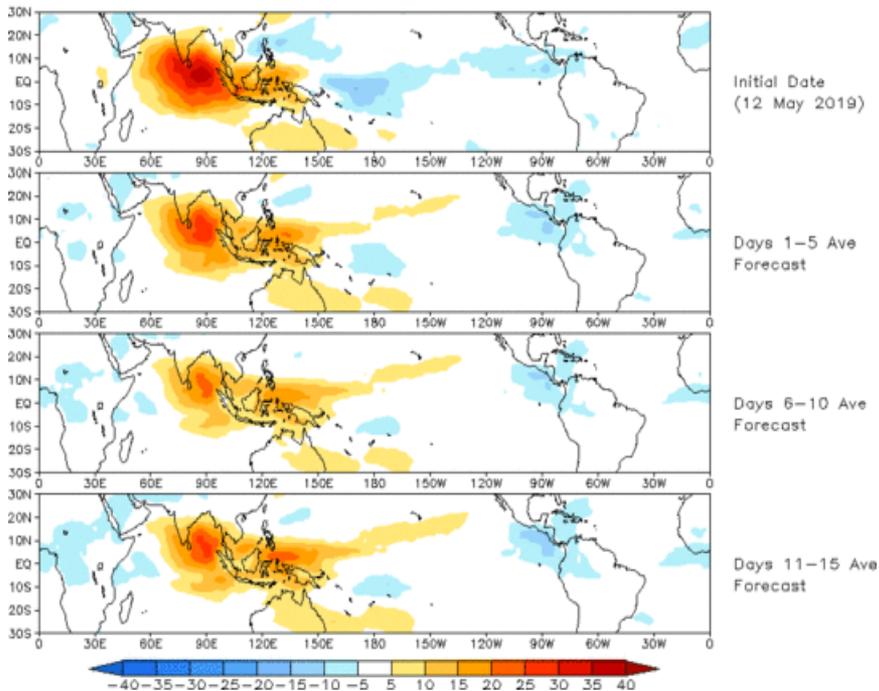
ECMWF Forecast

- Model guidance diverges on the MJO evolution during the middle of Week-1. The GFS model maintains eastward propagation over the Western Hemisphere, while the ECMWF model begins to weaken the signal abruptly as early as Week-1. This diverging model solutions lowers forecast confidence on the longevity of the MJO later in May.

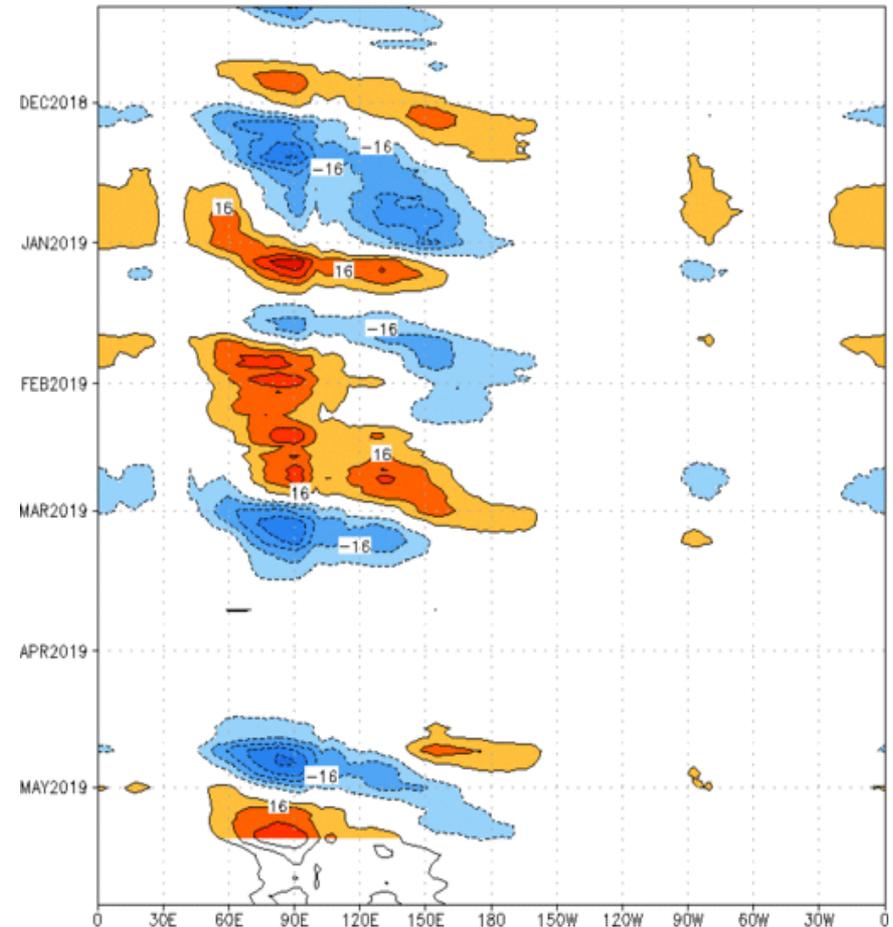
MJO: GEFS Forecast Evolution

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: 12 May 2019
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:10-Nov-2018 to 12-May-2019
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

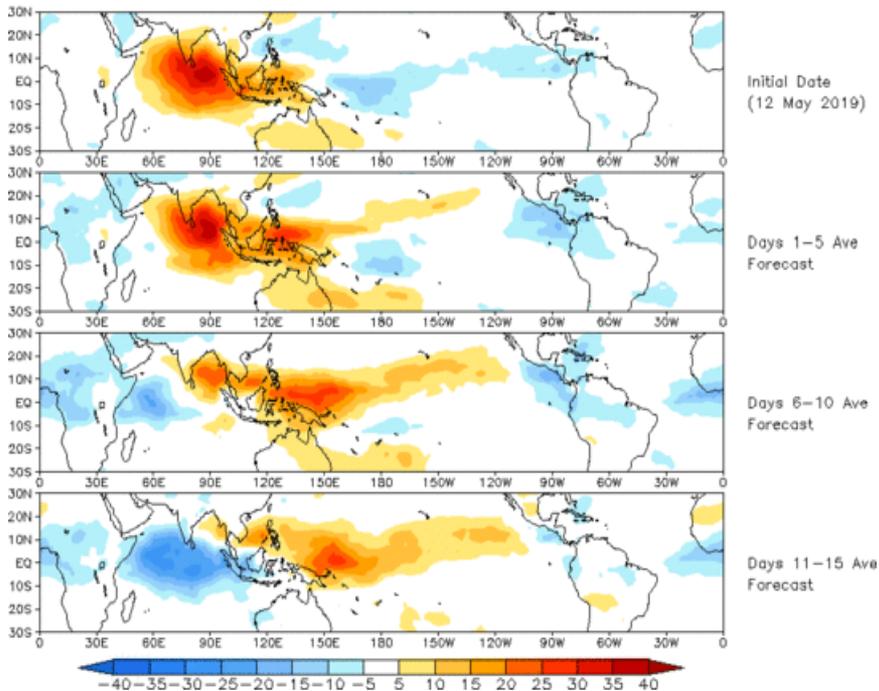


- The GEFS indicates suppressed convection expanding east from the Indian Ocean to the Maritime Continent. The enhanced phase continues over the East Pacific, Central America, and northern parts of South America through Week-2.

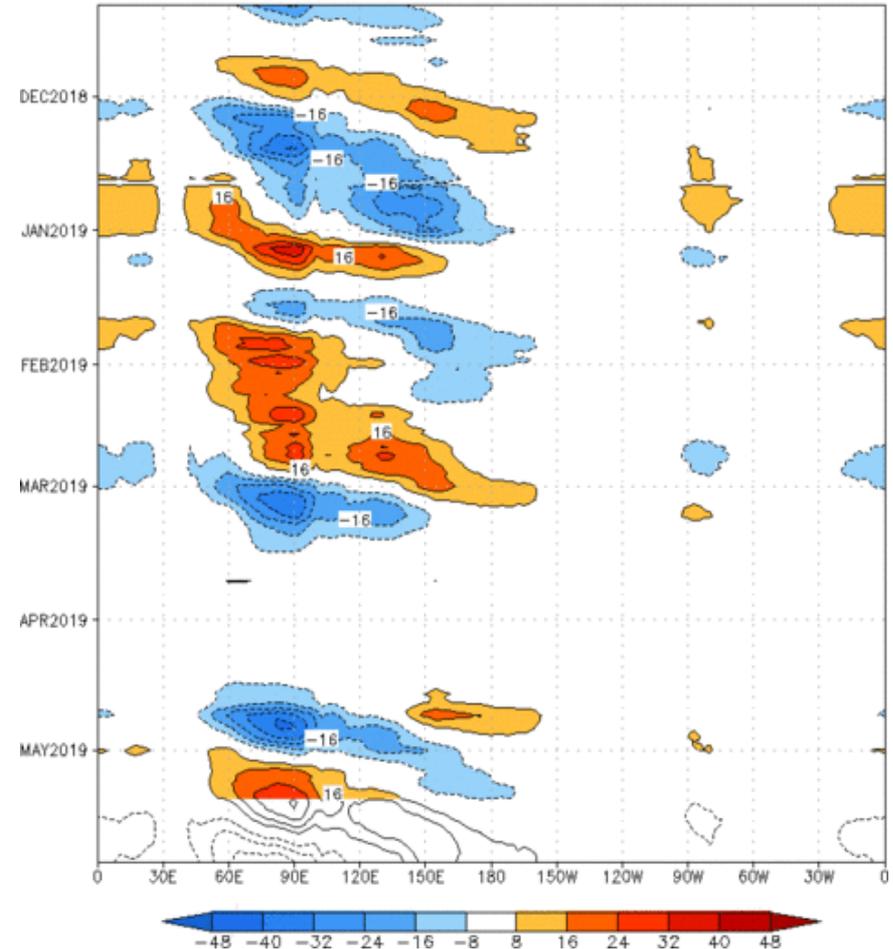
MJO: Constructed Analog Forecast Evolution

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 (12 May 2019)



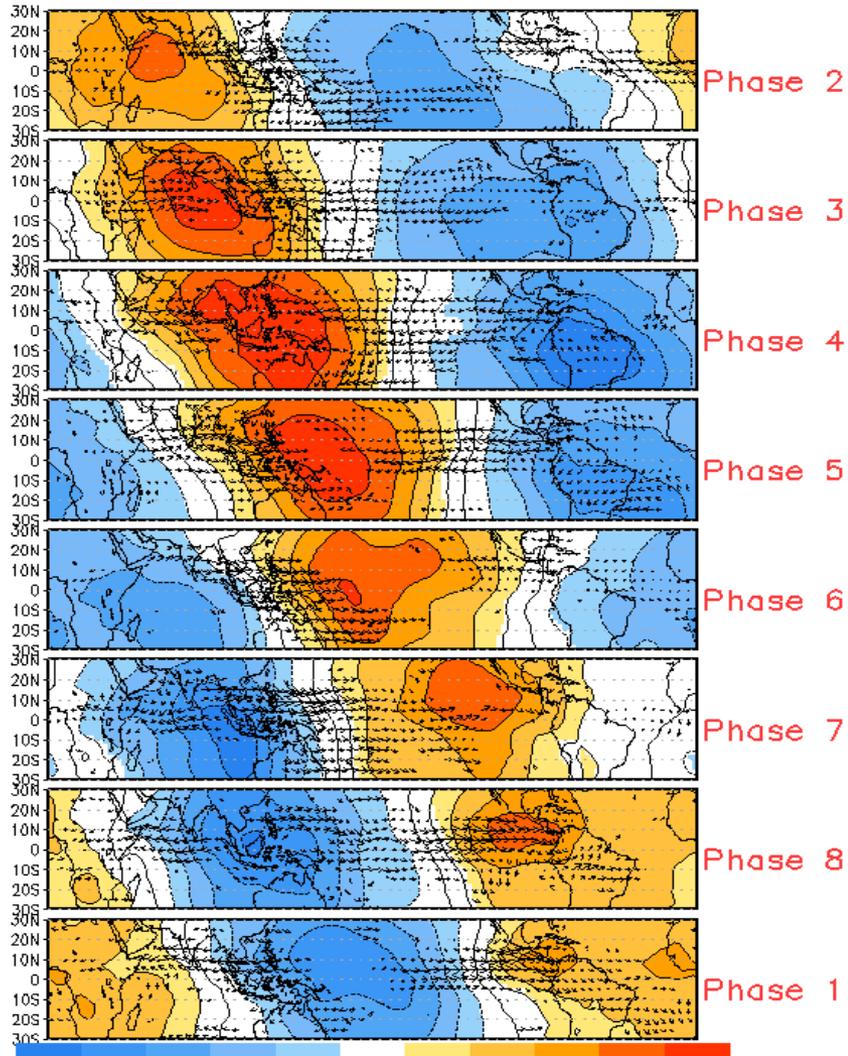
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:10–Nov–2018 to 12–May–2019
The unfilled contours are CA forecast reconstructed anomaly for 15 days



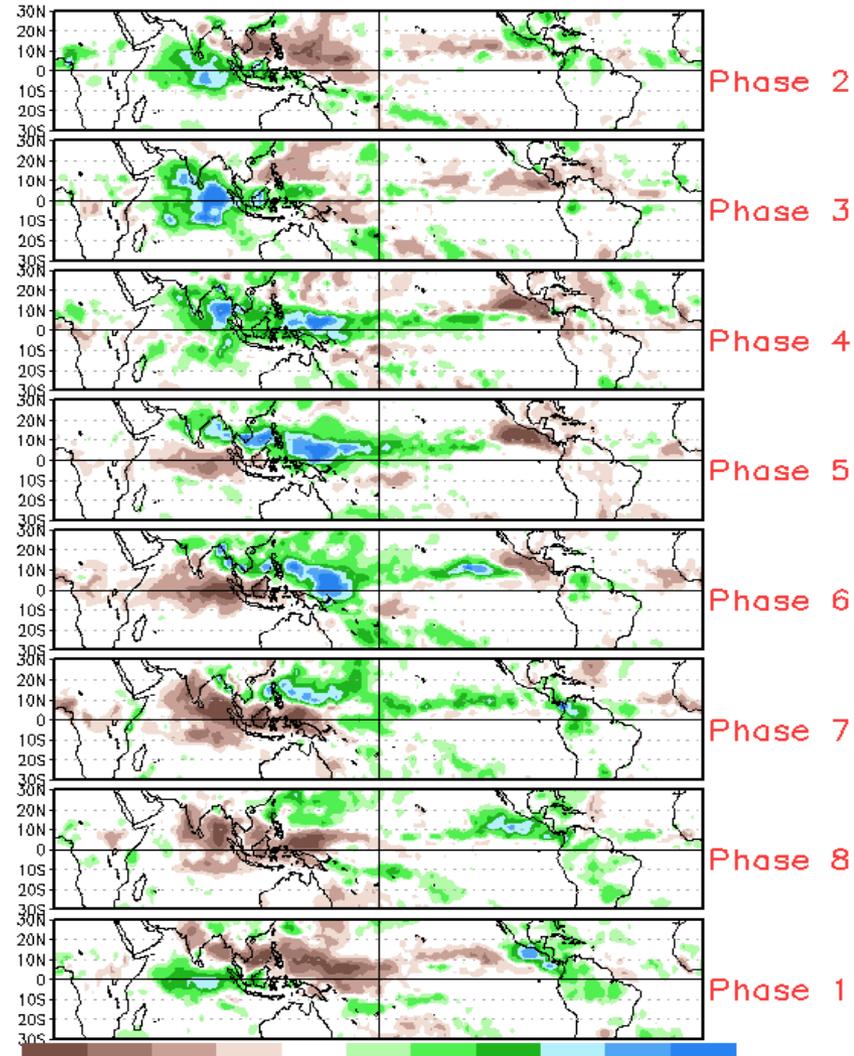
- The constructed analog forecast favors fast eastward propagation with enhanced convection re-emerging over the Indian Ocean later in Week-2.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



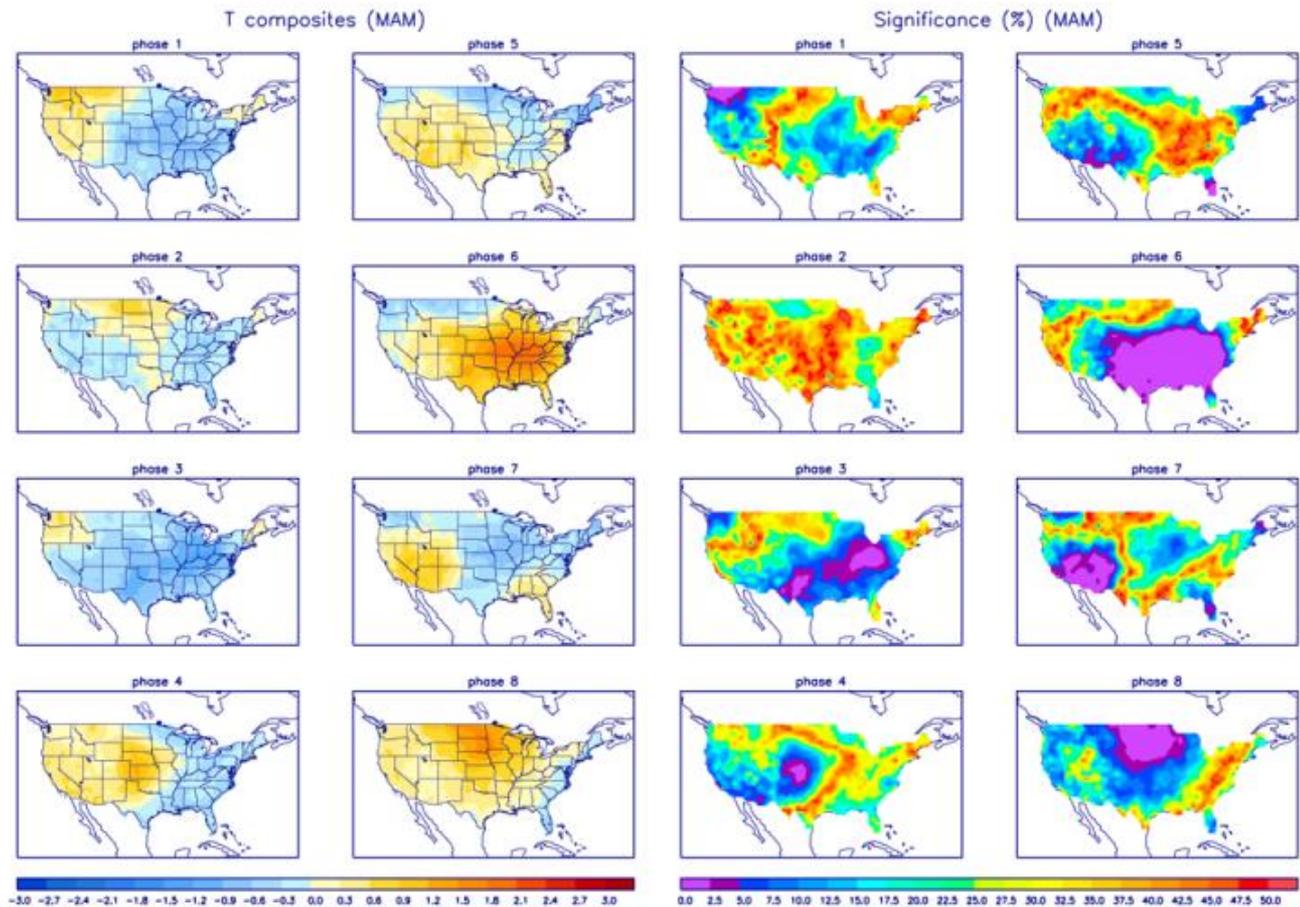
Precipitation Anomalies



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.

