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

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

Overview

- The enhanced convective phase of the MJO is noted over the Western Hemisphere this week, with the primary convective envelope centered over the Central Pacific. The suppressed convective phase has expanded from the Indian Ocean eastward across the Maritime Continent.

- The ECMWF model predicts eastward propagation of the MJO signal across the Western Hemisphere, 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 slower eastward propagation across the Western Hemisphere and Africa during the ensuing two weeks, with considerable spread apparent among ensemble members during Week-2.

- Tropical cyclone development is possible over the East Pacific, Atlantic, and South Pacific basins during the two-week period.

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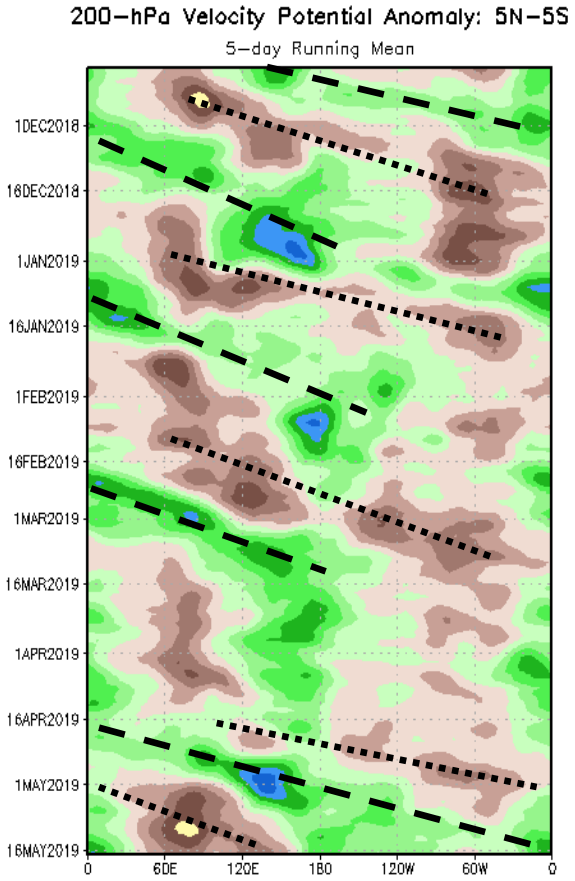
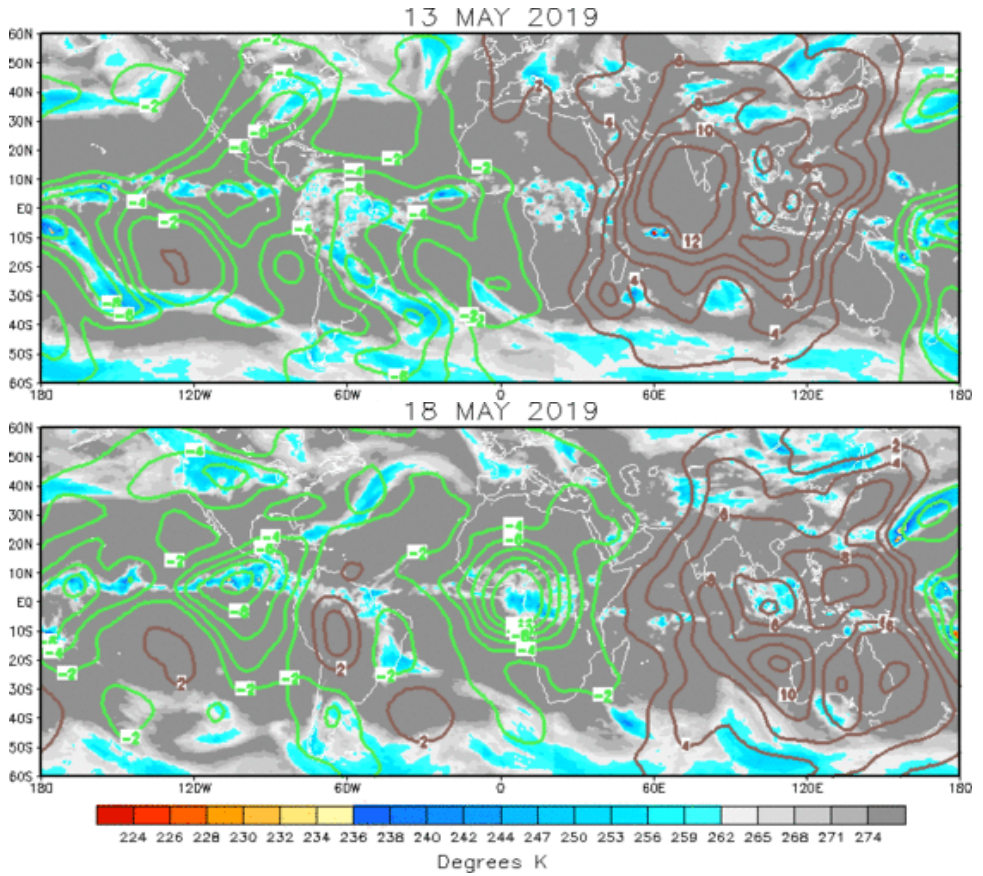
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

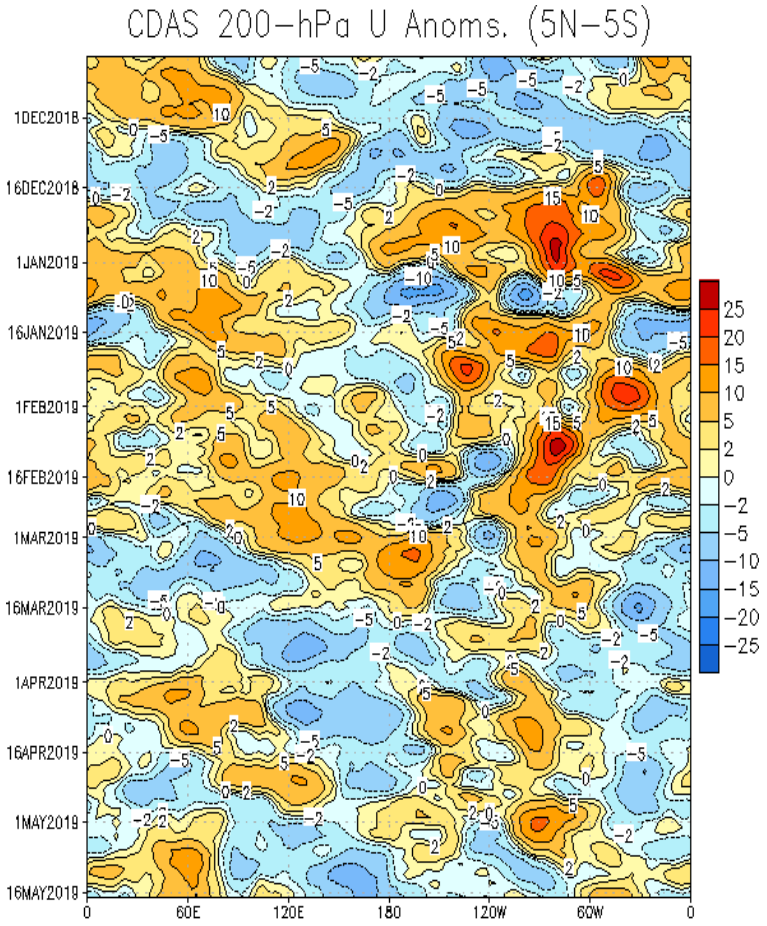


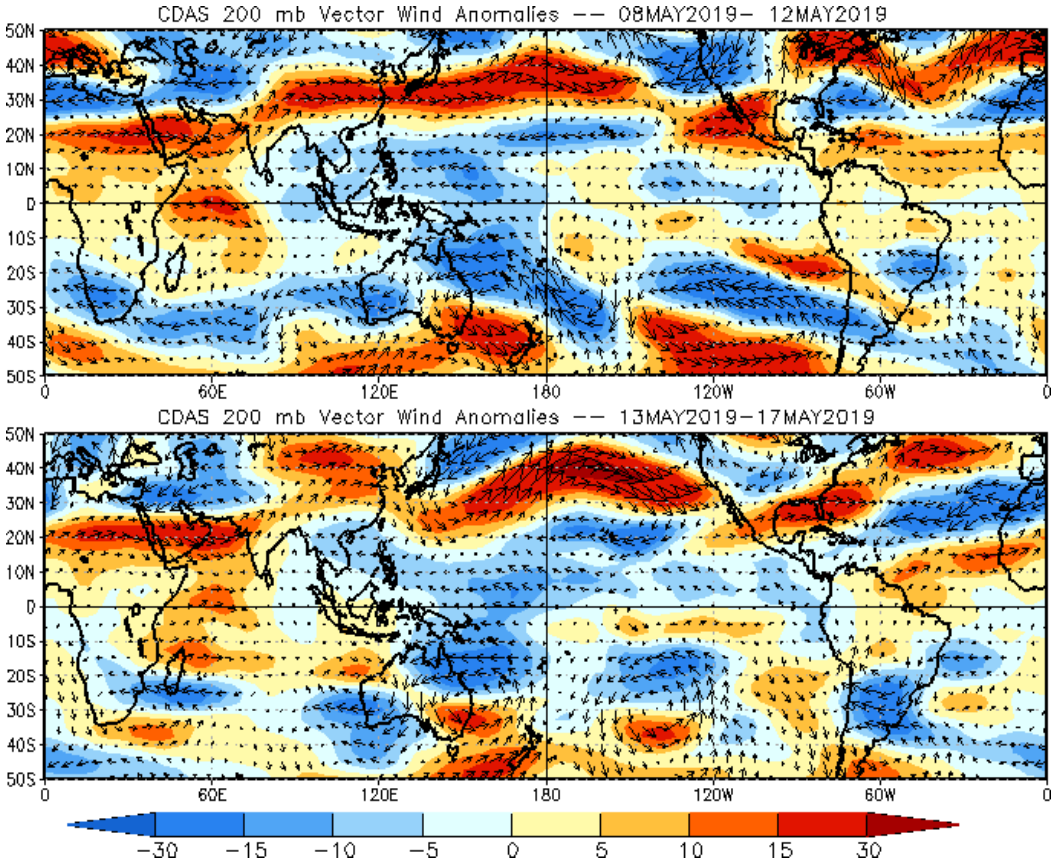


- The MJO, which was consistently active throughout boreal fall and winter, weakened by early March.
- During March, the pattern has been dominated by low-frequency signals, with some modulation by Rossby and Kelvin wave activity.
- Mid-April shows the beginning of a more coherent MJO with renewed eastward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

200-hPa Wind Anomalies

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

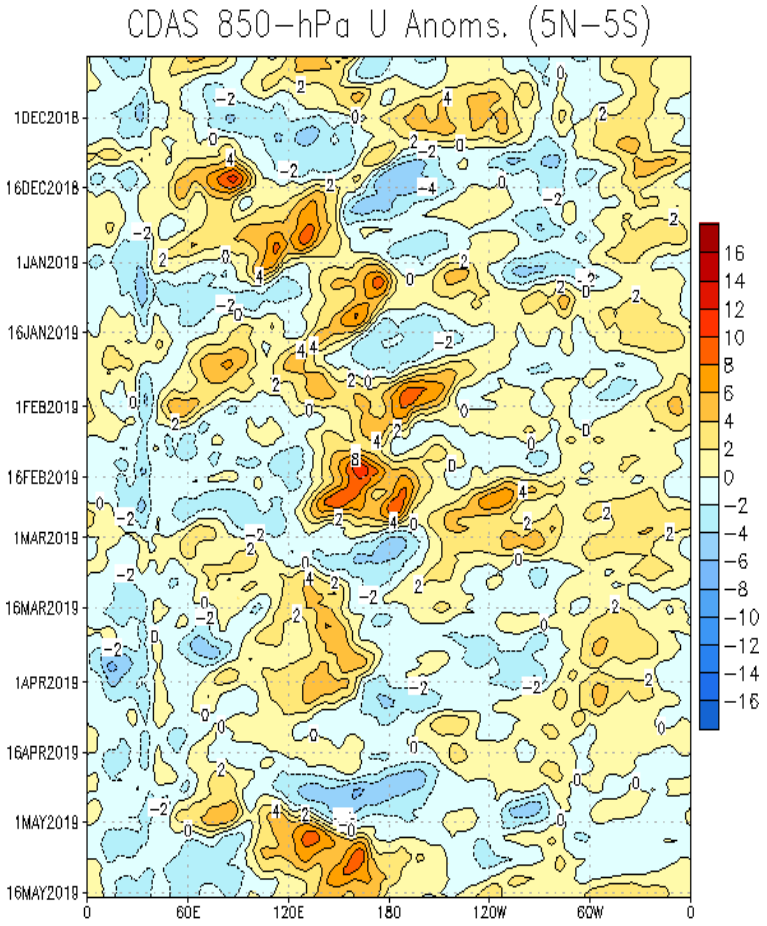


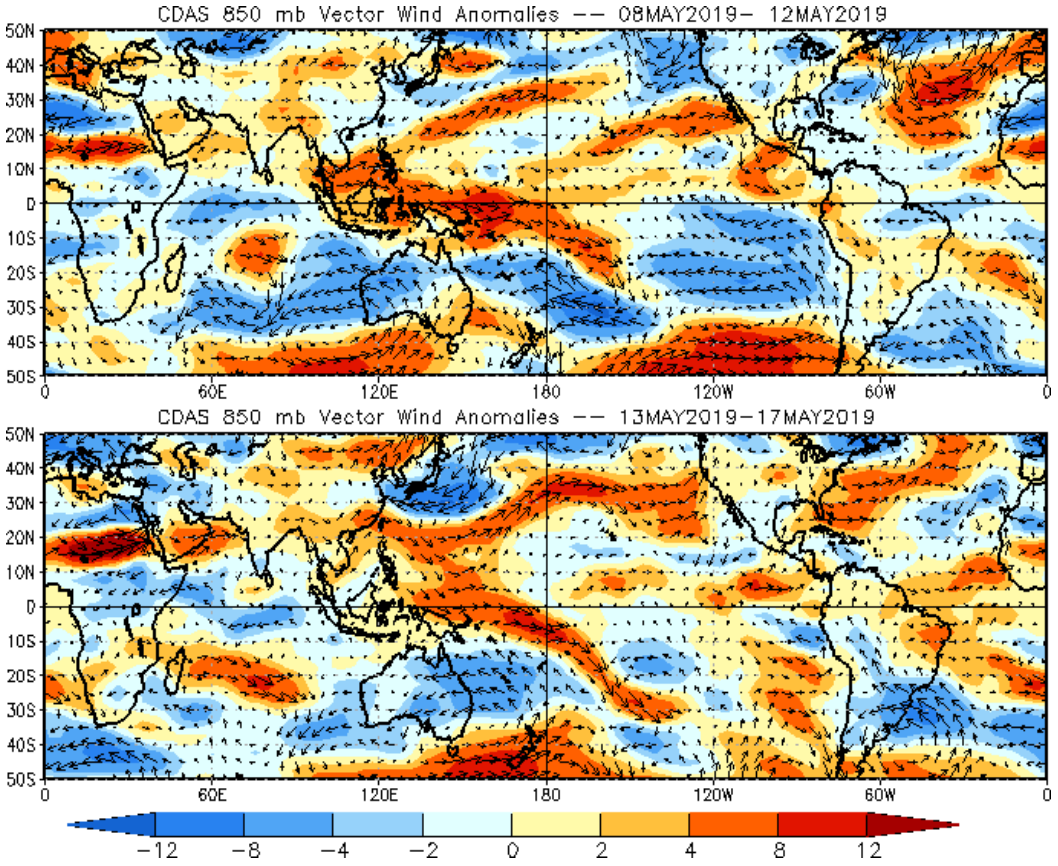


- As seen in the upper-level velocity potential field on the previous slide, the MJO became inactive during mid-March, but showed signs of re-emerging by April.
- Upper-level wind anomalies have reversed across the Maritime Continent since late April, becoming easterly. The latest observations show that westerly anomalies have re-emerged (at least temporarily) over the western Maritime Continent.
- 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.

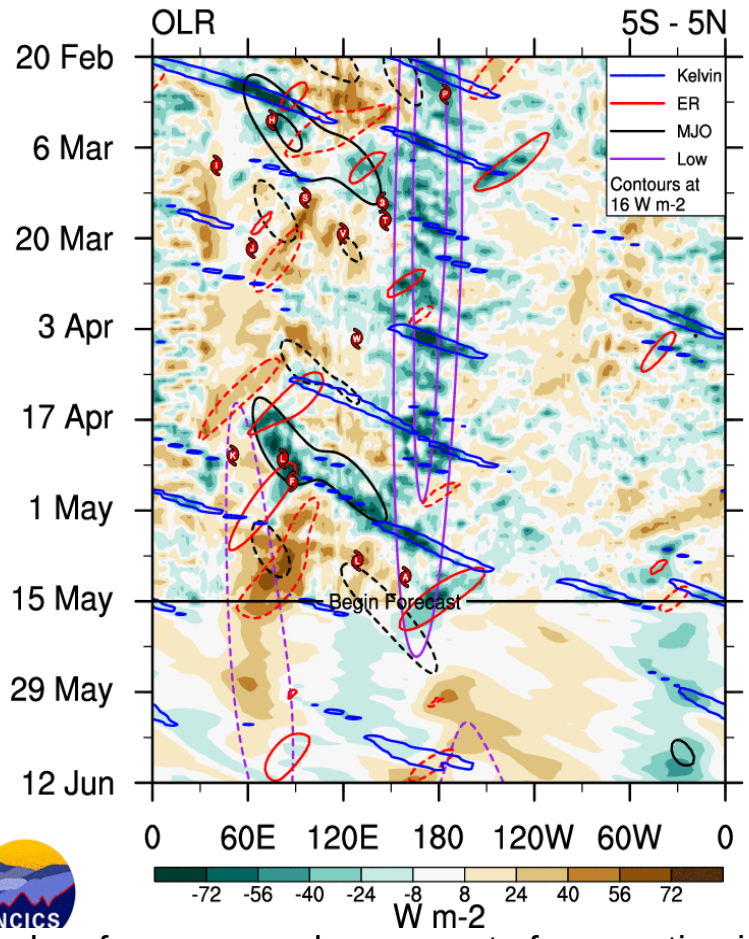


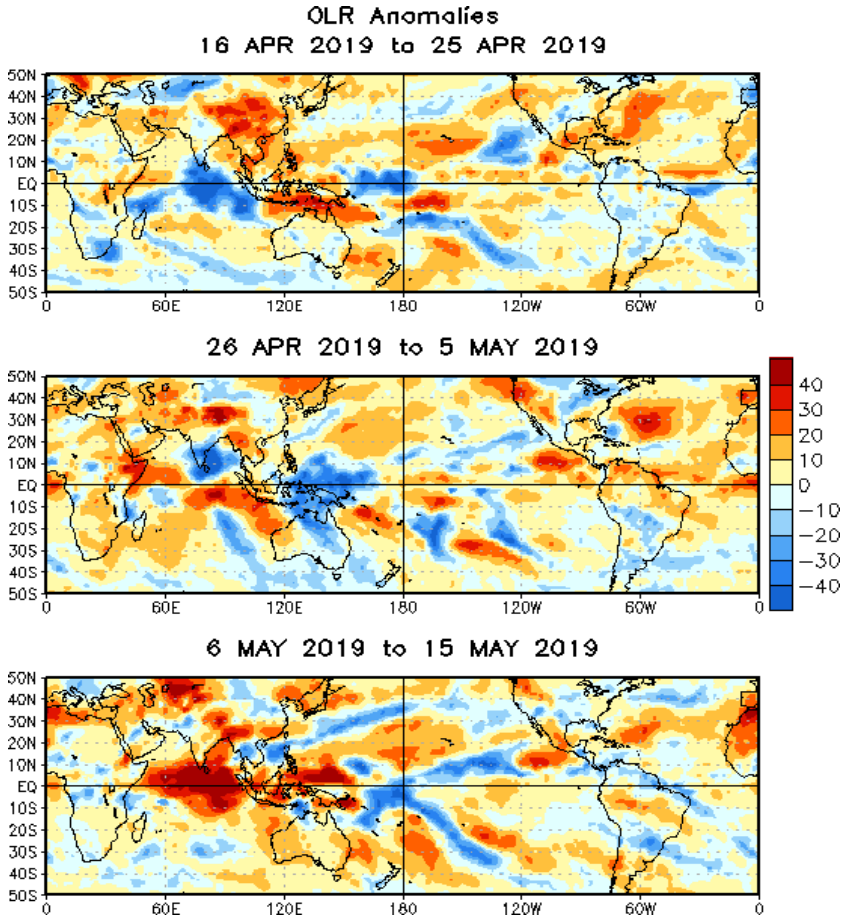


- Anomalous westerlies tied to the MJO shifted from the Indian Ocean to over the Maritime Continent and western Pacific from late April into mid-May.
- During the past five days, anomalous westerlies over the equatorial western Pacific have not shown much eastward displacement. Anomalous easterlies remained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

Outgoing Longwave Radiation (OLR) Anomalies

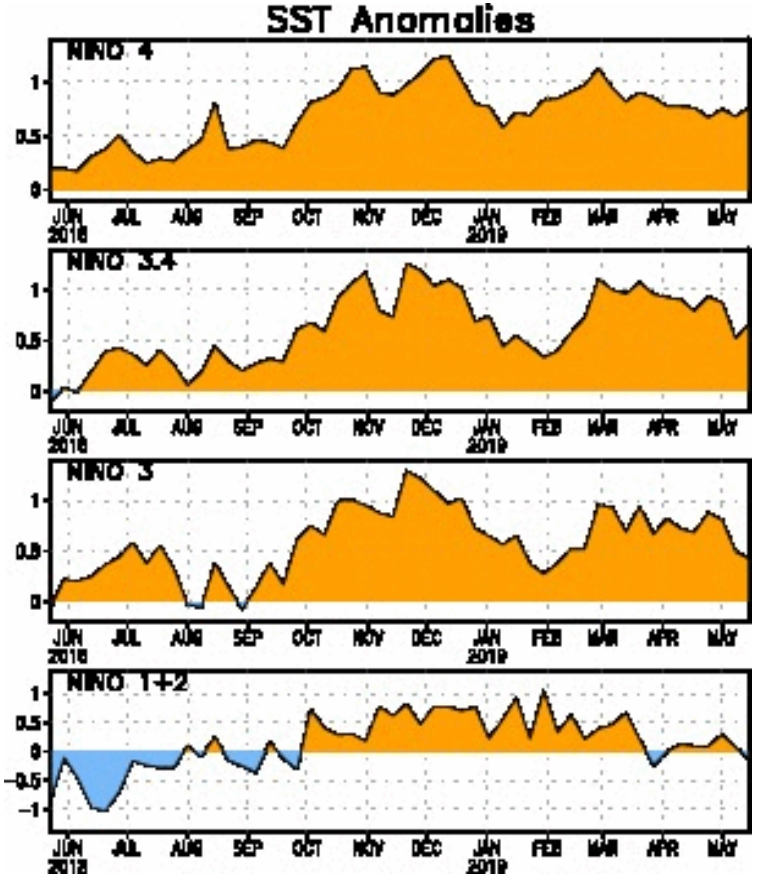
Blue shades: Anomalous convection (wetness). Red shades: Anomalous subsidence (dryness).

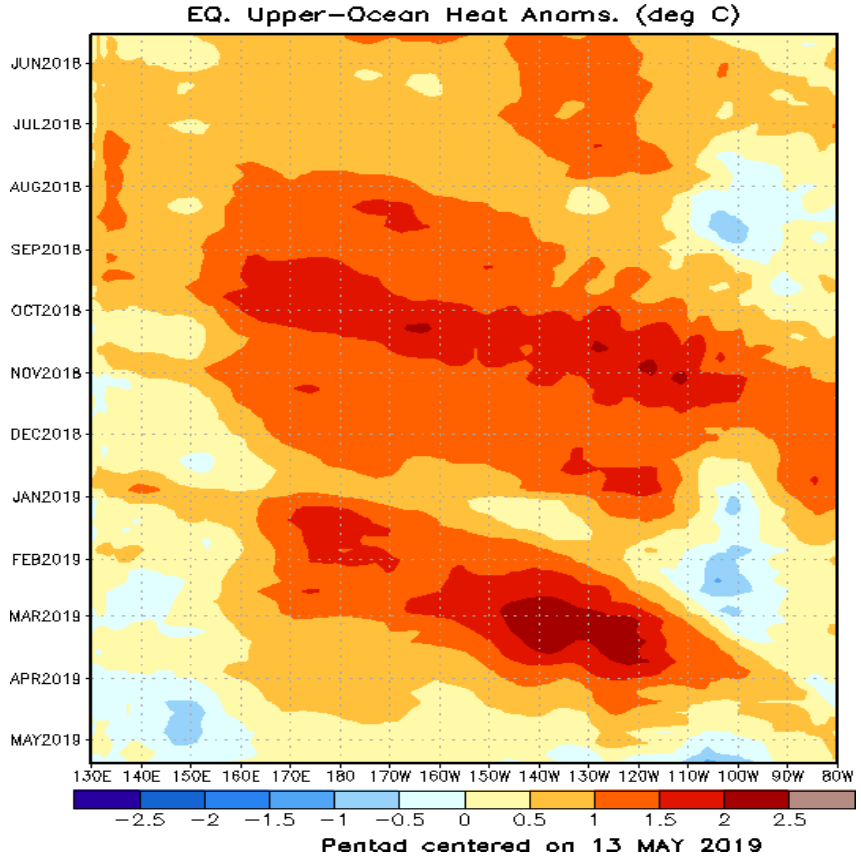




- The low-frequency enhancement of convection just west of the Date Line has been the most consistent signal during 2019.
- The MJO has been apparent since at least mid-April, with noted equatorial Rossby wave (ERW) activity near the Date Line and Indian Ocean.
- The enhanced phase of the MJO likely 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

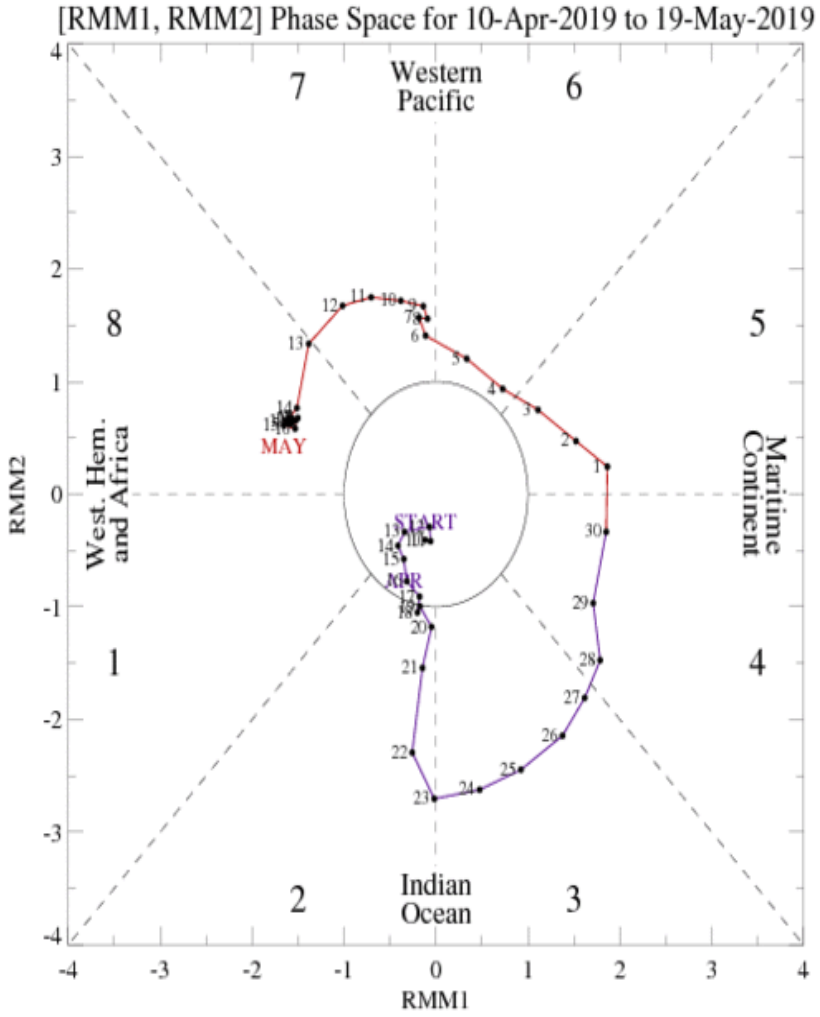




- SST anomalies remain above climatology across much of the equatorial Central and East Pacific, consistent with the ongoing El Niño event.
- Some erosion of upper ocean heat content is apparent east of the Maritime Continent, but most noteworthy is a westerly wind burst that recently developed near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

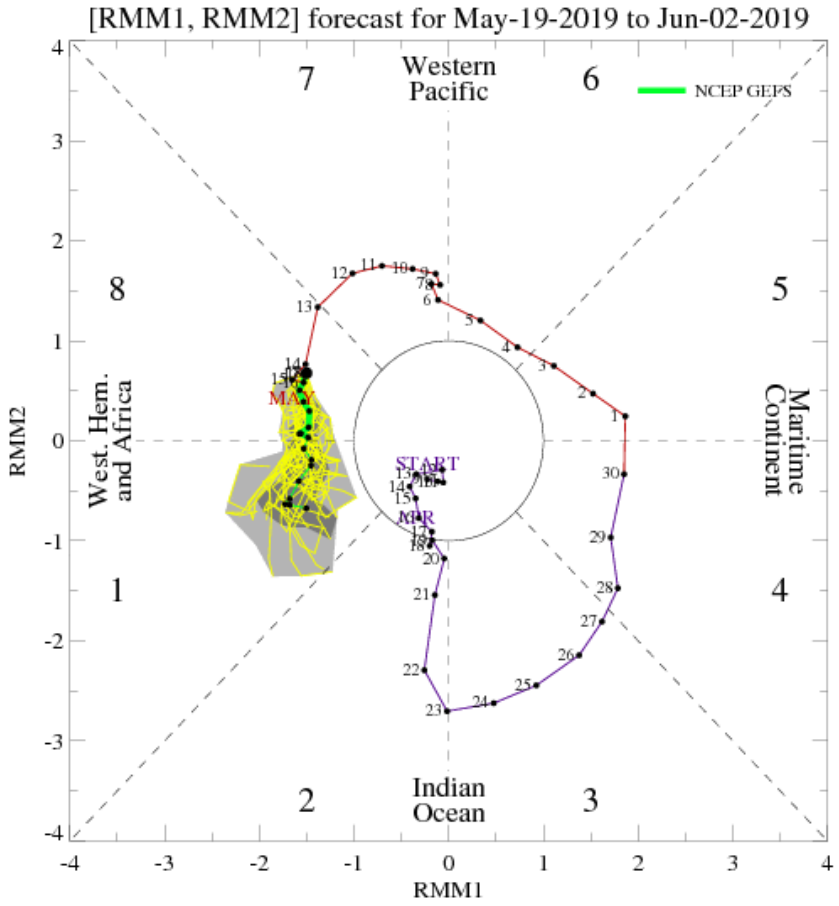
MJO Index: Recent Evolution

- The RMM index shows the MJO propagating eastward across the West Pacific during early to mid-May, though now the signal has become quasi-stationary during the past 7-days. This may be related to ERW activity near the Date Line.

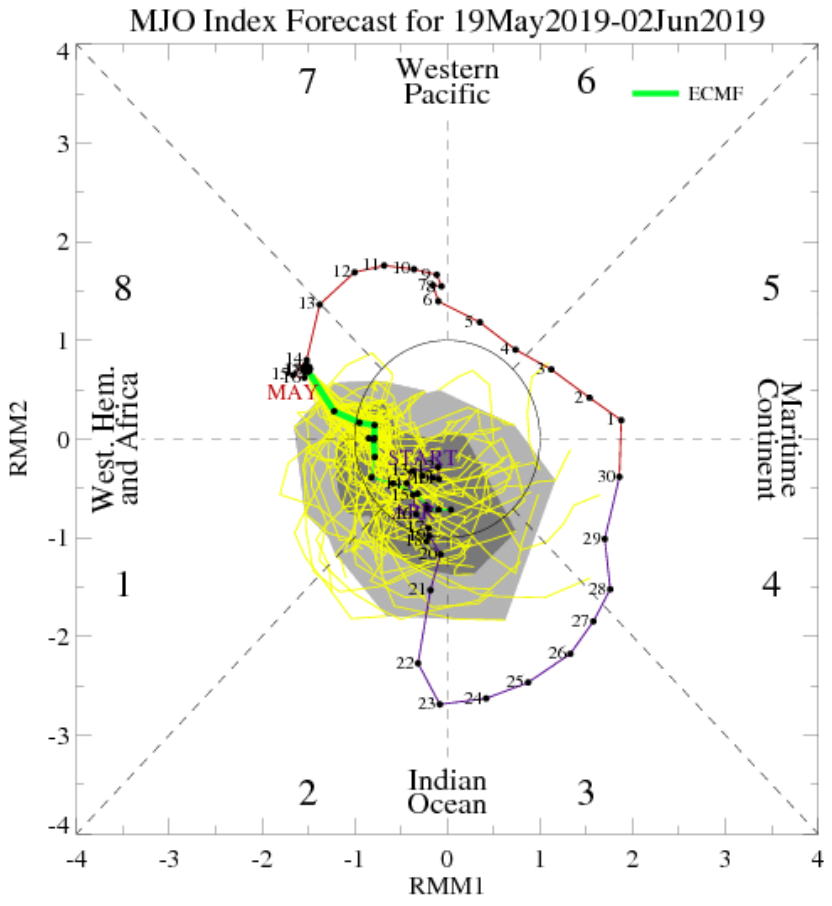


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

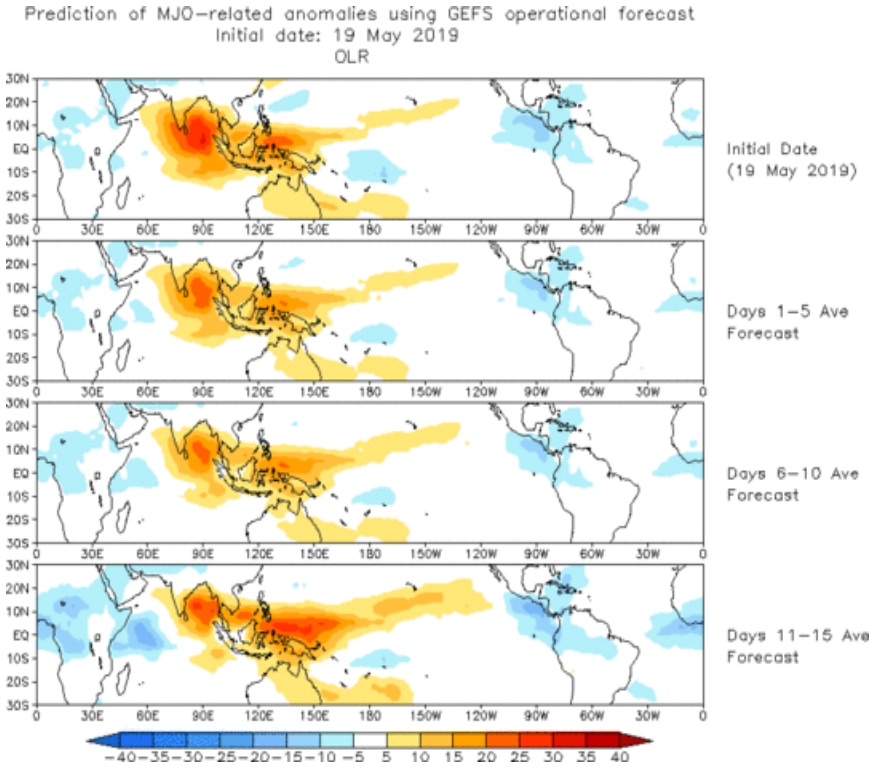


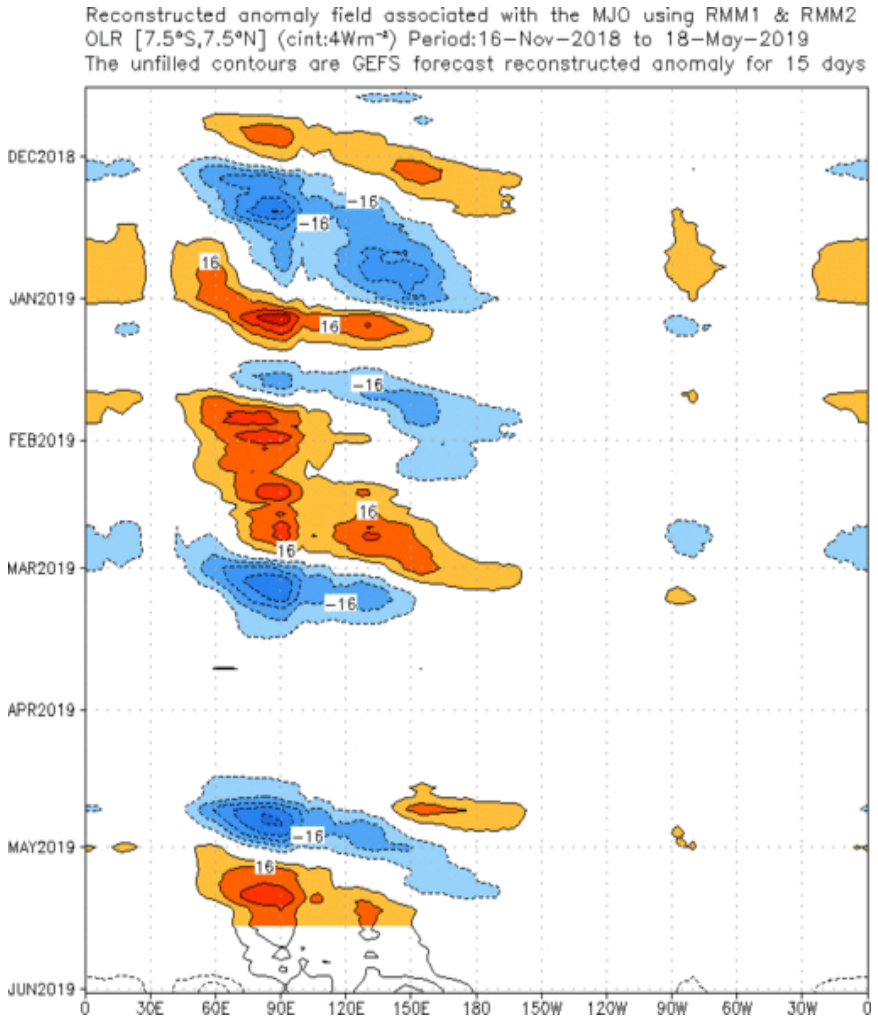
ECMWF Forecast

- Model guidance diverges on the MJO evolution during Week-1. The GFS model maintains a very slow eastward propagation over the Western Hemisphere while maintaining amplitude, whereas 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 in late 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.)

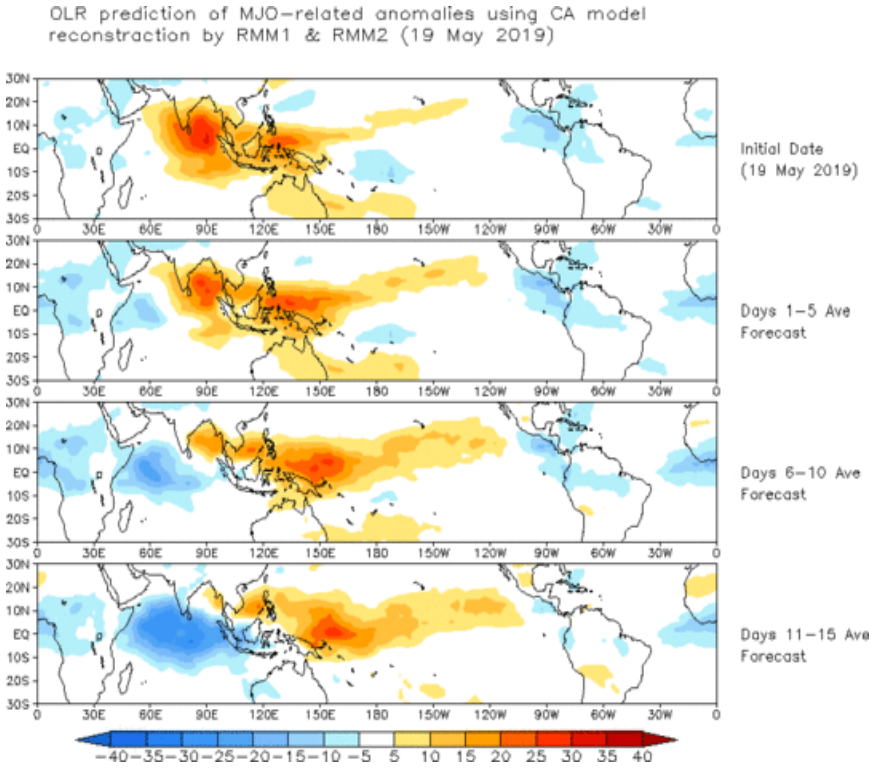


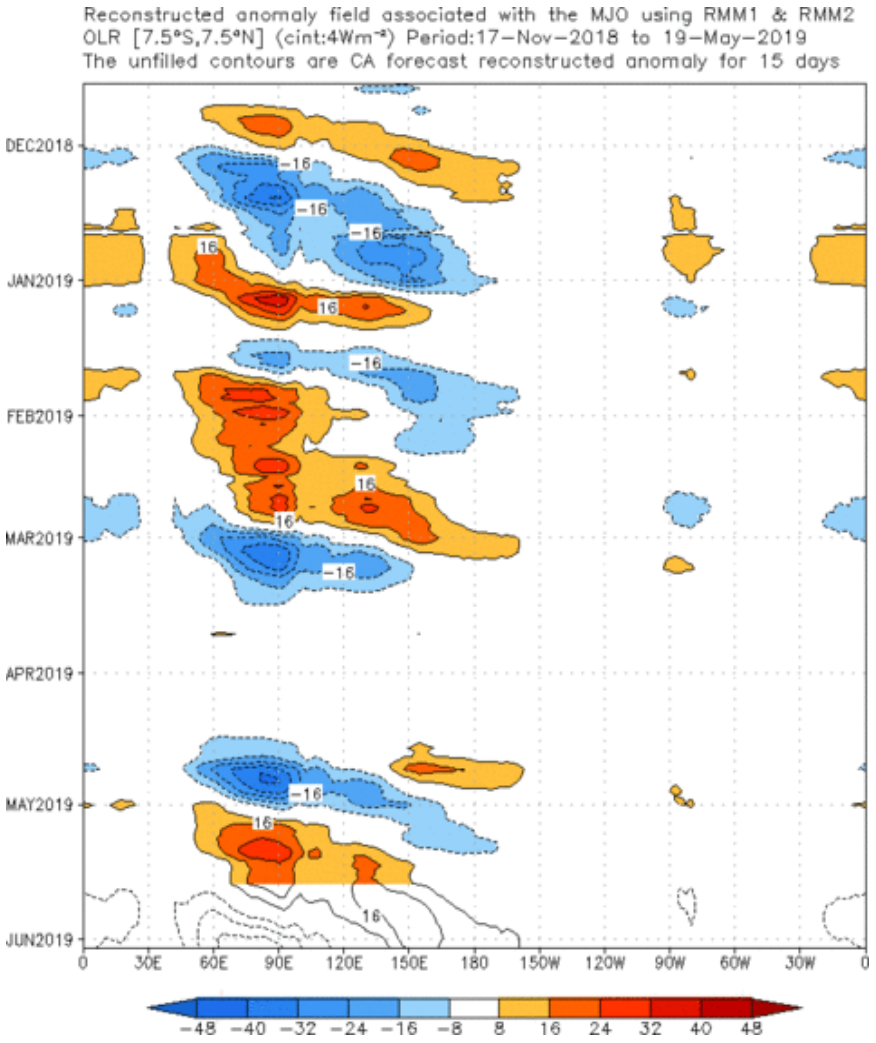


- The GEFS indicates suppressed convection expanding east from the Indian Ocean to the western Pacific. The enhanced phase continues over the East Pacific, Central America, Africa, and northern parts of South America, through Week-2. Enhanced convective anomalies also begin to show up over the Western Indian Ocean by late May.

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.)

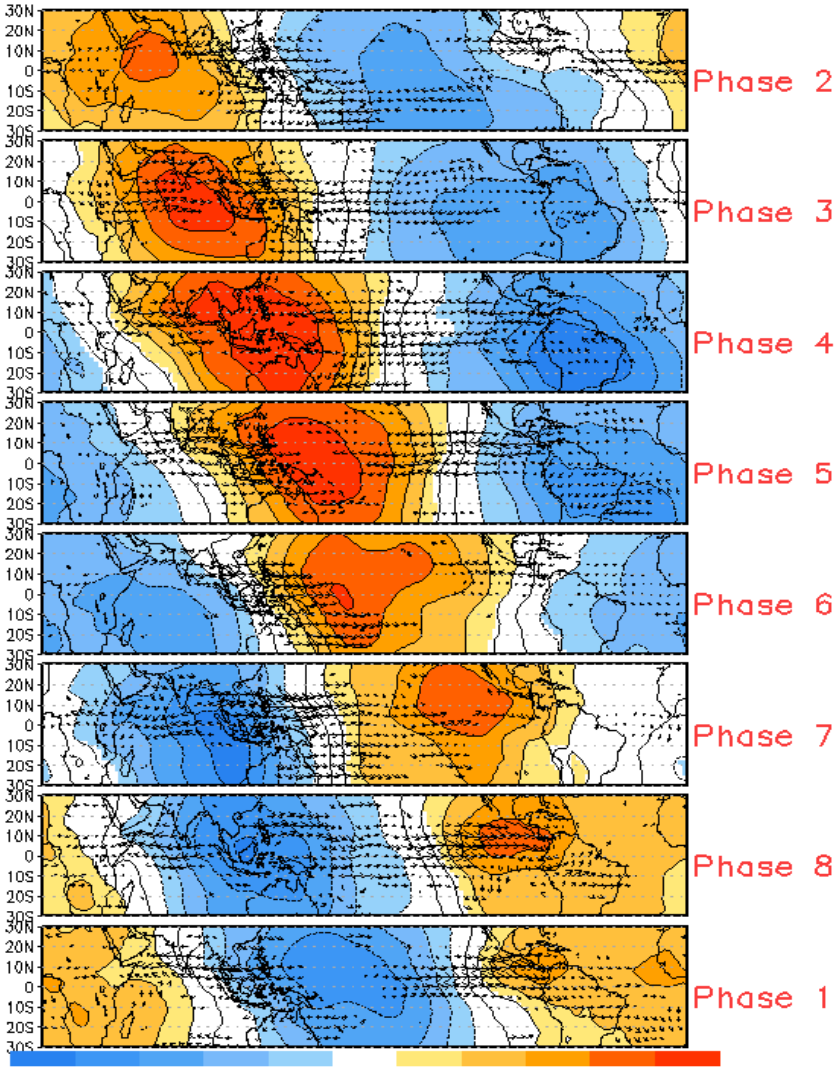




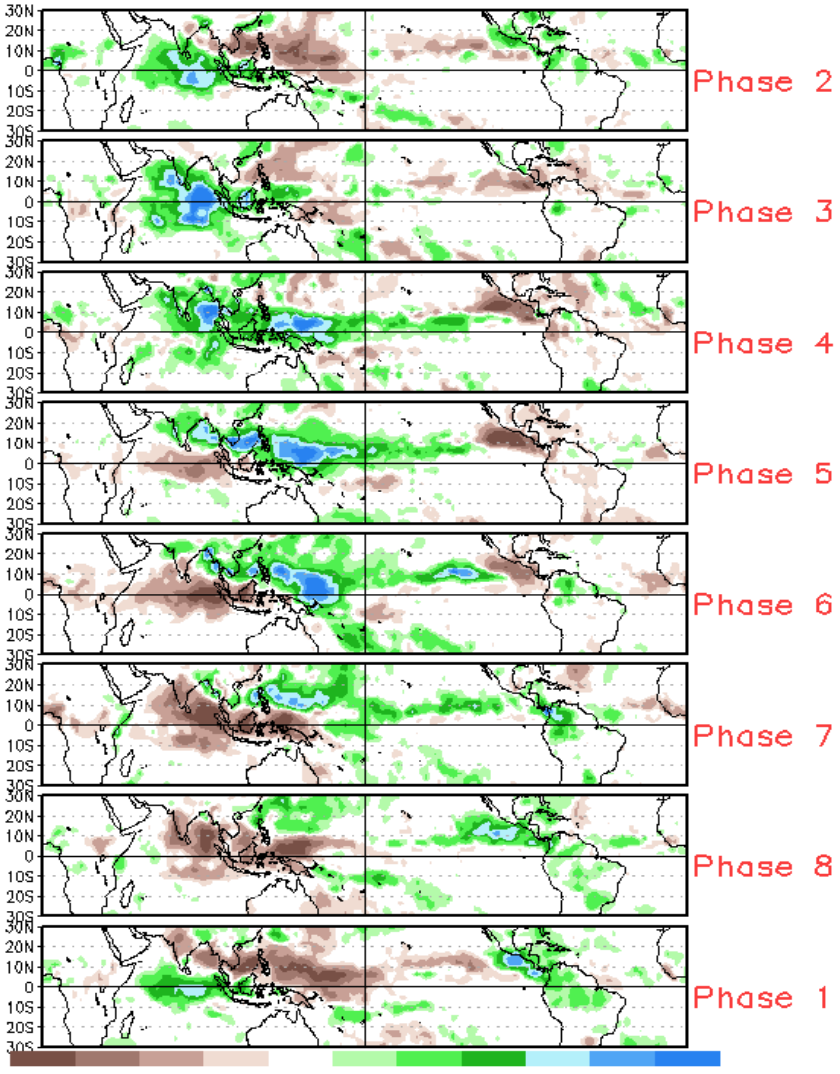
- The constructed analog forecast favors a relatively faster eastward propagation of the MJO compared to the dynamical models; with enhanced convection re-emerging over the Indian Ocean in the next few days.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



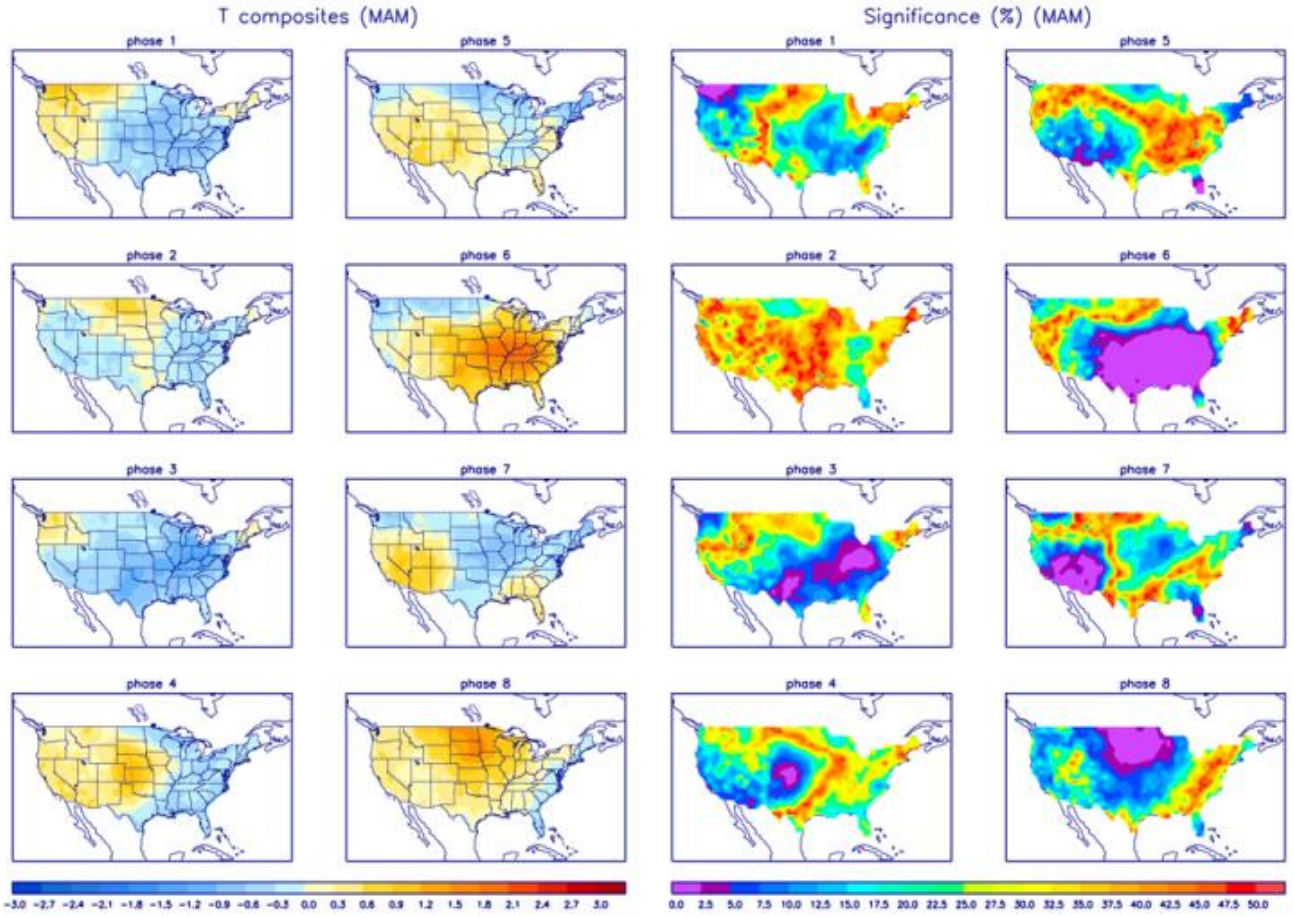
Precipitation Anomalies



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.

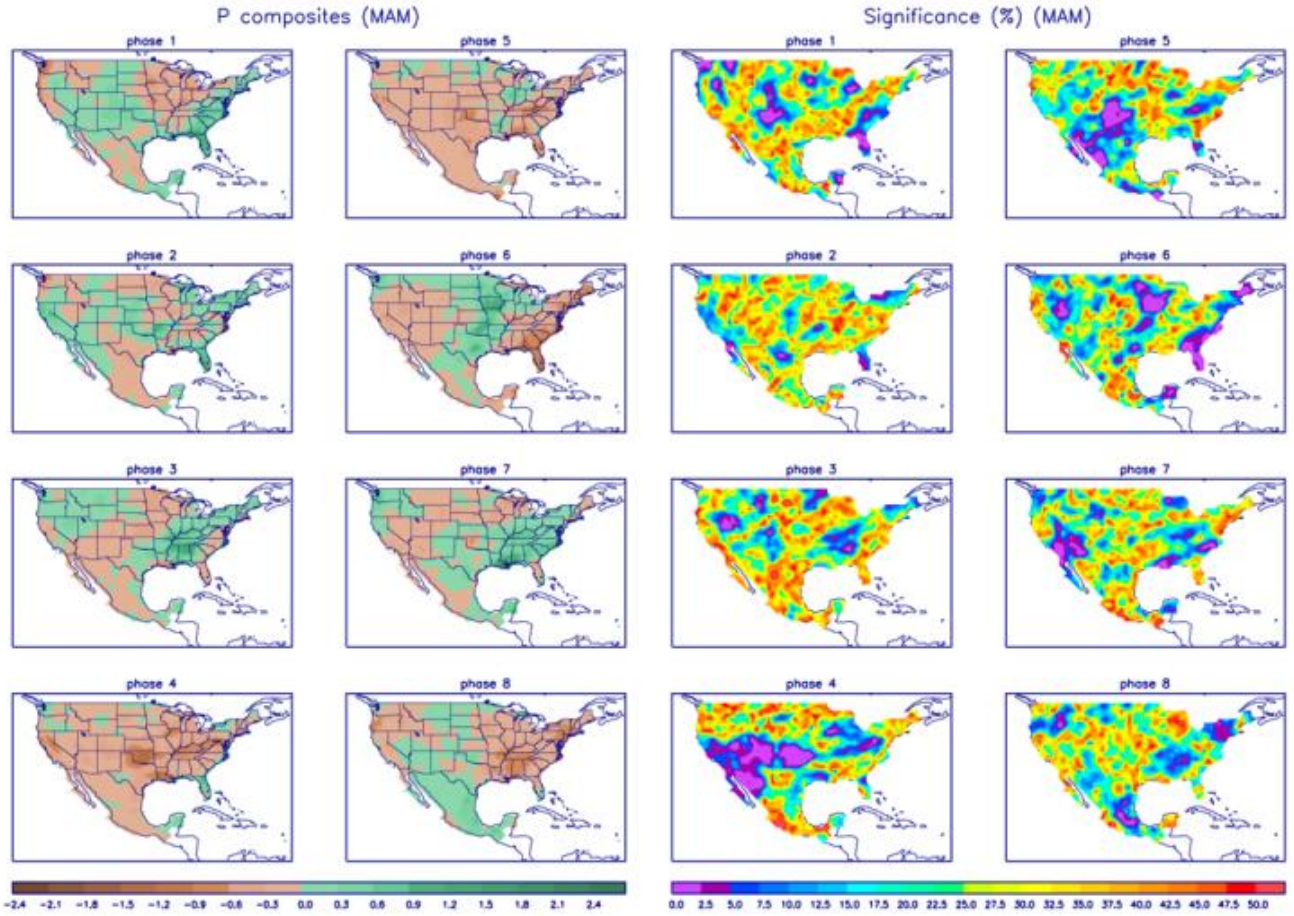


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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.



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