

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



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

Overview

- The enhanced convective phase of the MJO remains over the Indian Ocean. It has moved very little during the past week.
- Both the GFS and ECMWF models predict eastward propagation of the MJO signal from the Indian Ocean to the Maritime Continent over the next two weeks.
- Anomalous easterlies remain around India, which suggests that the monsoon will continue to be delayed.

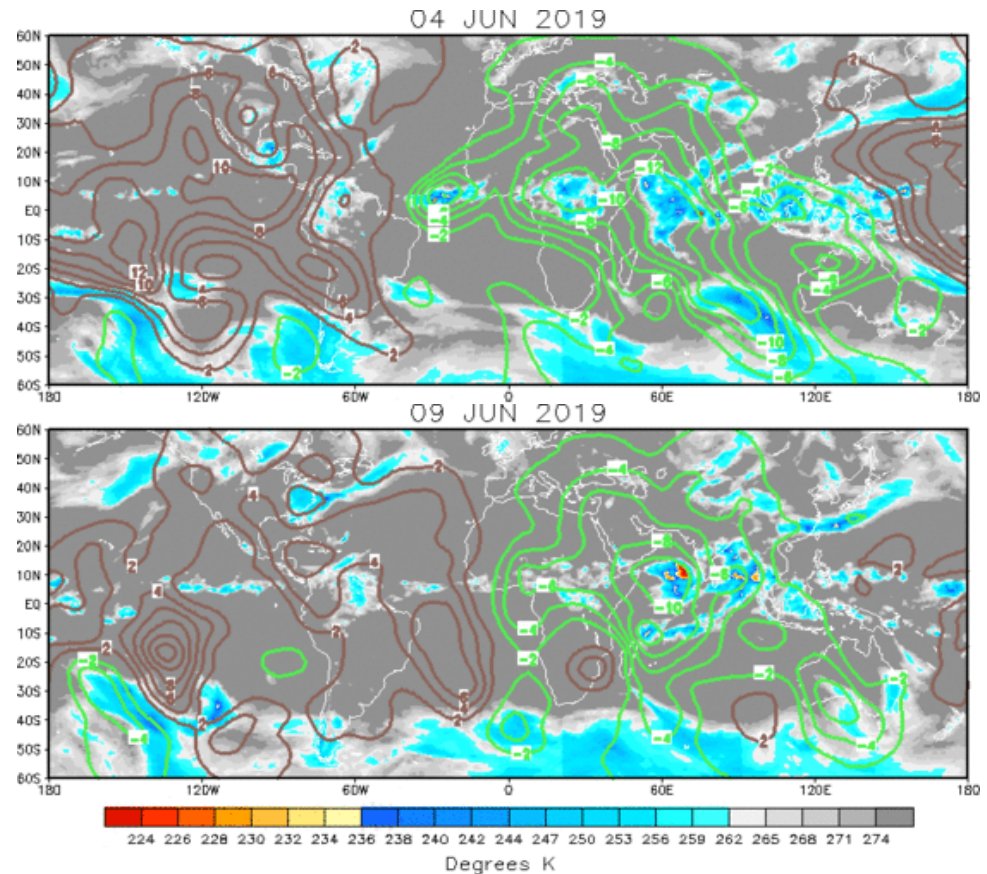
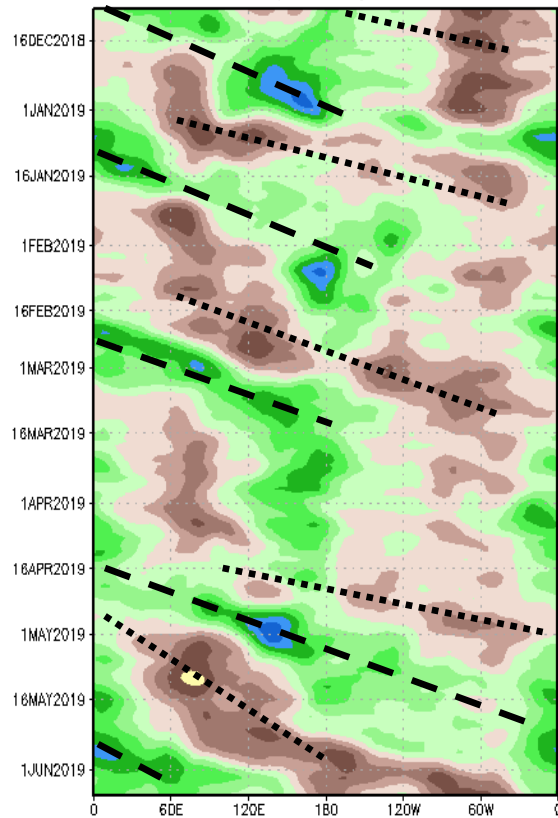
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

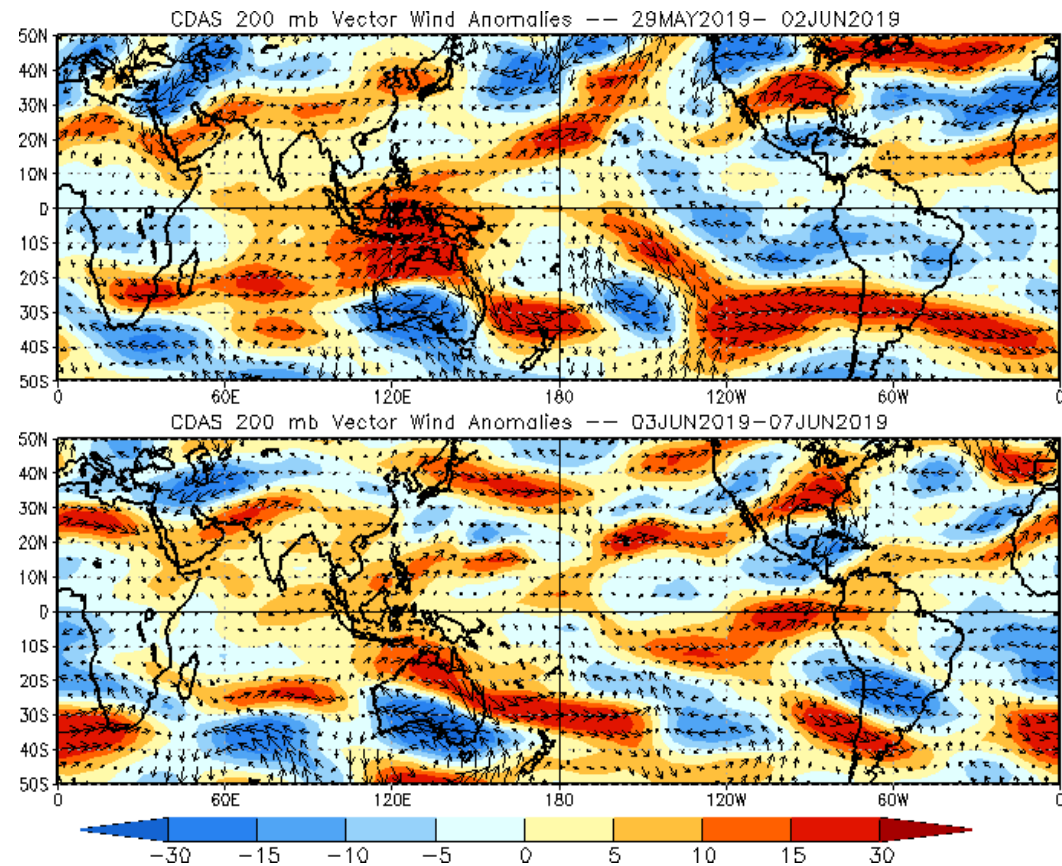
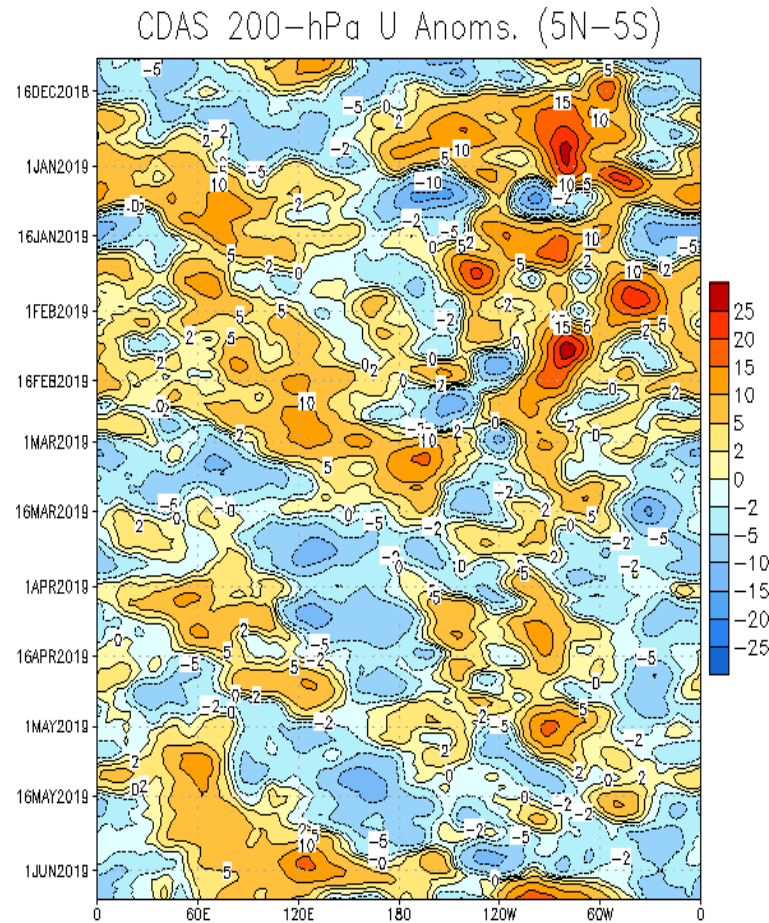
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- The MJO has been active since December except for a 1.5 month pause during March and early April.
- The latest MJO event began in May and is currently stalled and showing signs of weakening over the eastern Indian Ocean.
- The velocity potential pattern shows a Wave-1 signal with large-scale descent from the Maritime Continent to the Atlantic Ocean and large-scale ascent from the Atlantic Ocean to the Indian Ocean.

200-hPa Wind Anomalies

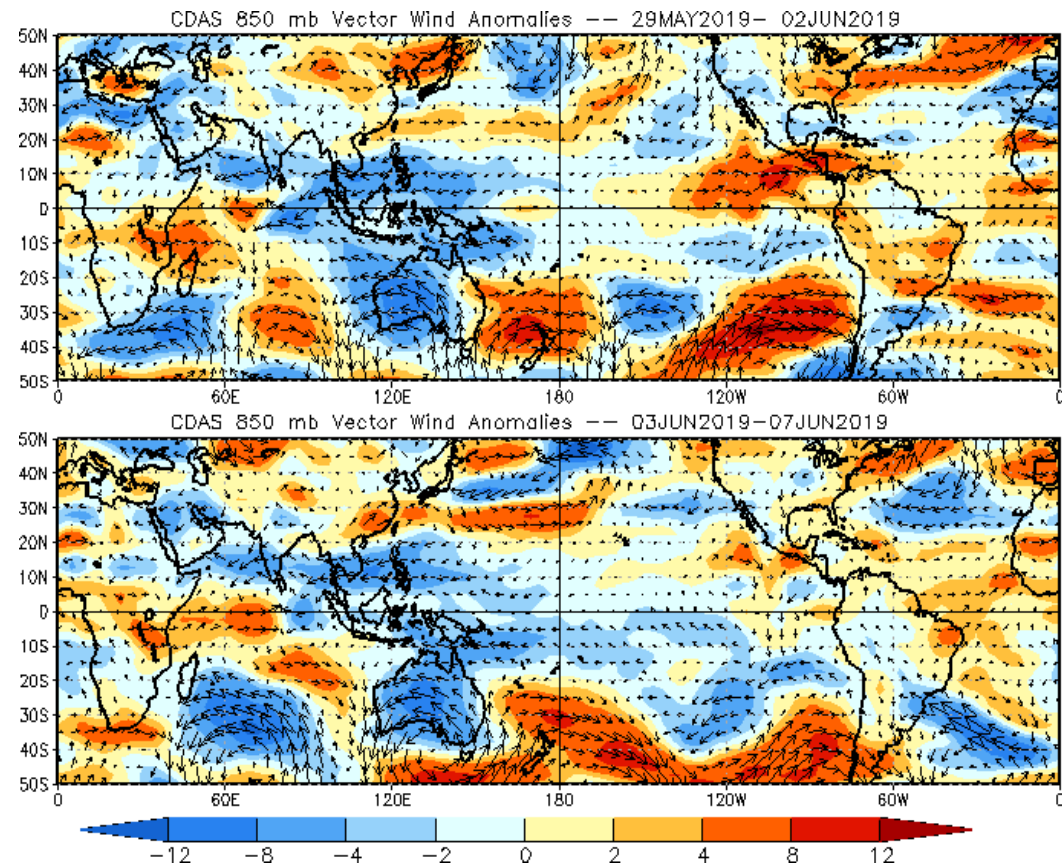
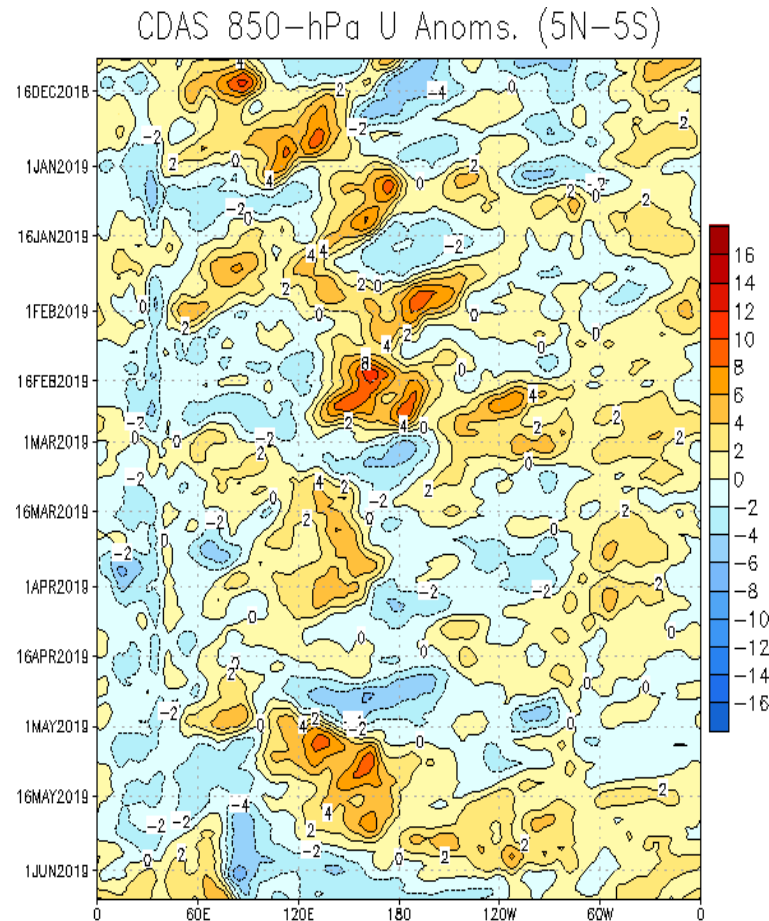
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Anomalous westerlies were located over the Maritime Continent last week but have since weakened as the MJO continued to propagate.
- The upper-level flow has been less amplified over the past 5 days than it was at the end of May, which is consistent with the transition to boreal summer setting in.

850-hPa Wind Anomalies

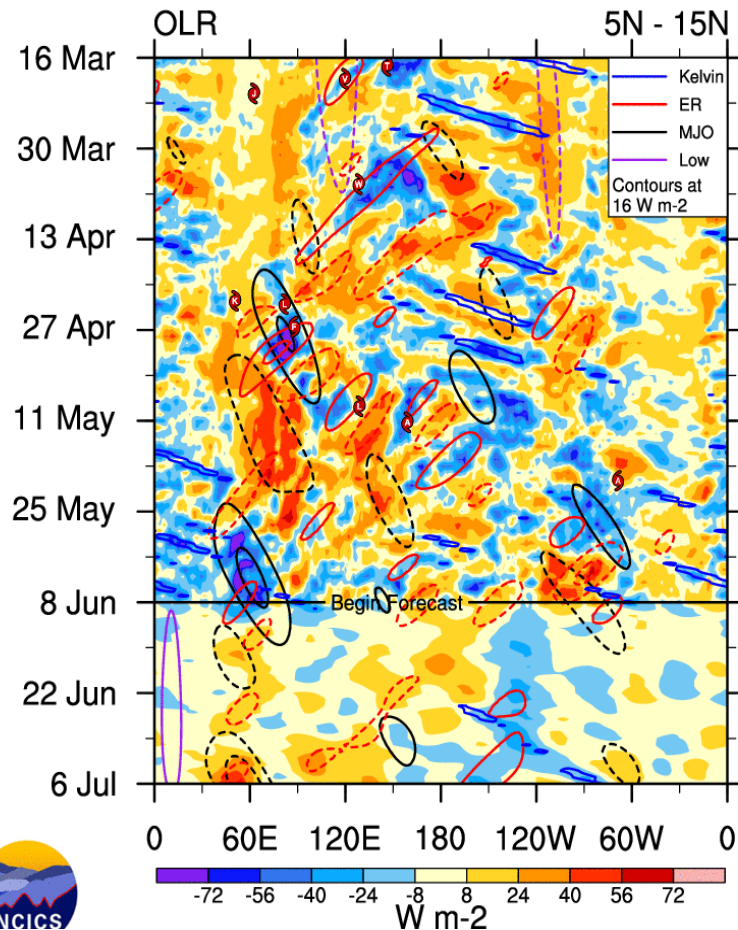
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



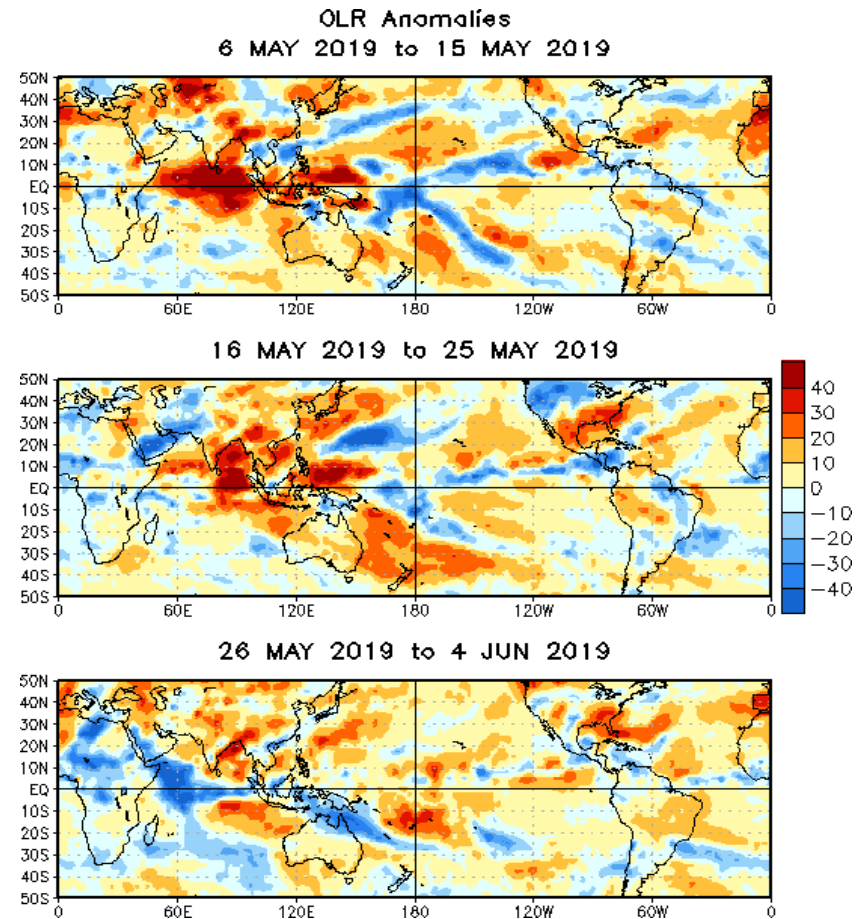
- Similarly to the upper-level wind field, the low-level wind field is fairly low amplitude over the Northern Hemisphere.
- Low-level anomalous easterlies are still present around India, contributing to a delayed monsoon onset.

Outgoing Longwave Radiation (OLR) Anomalies

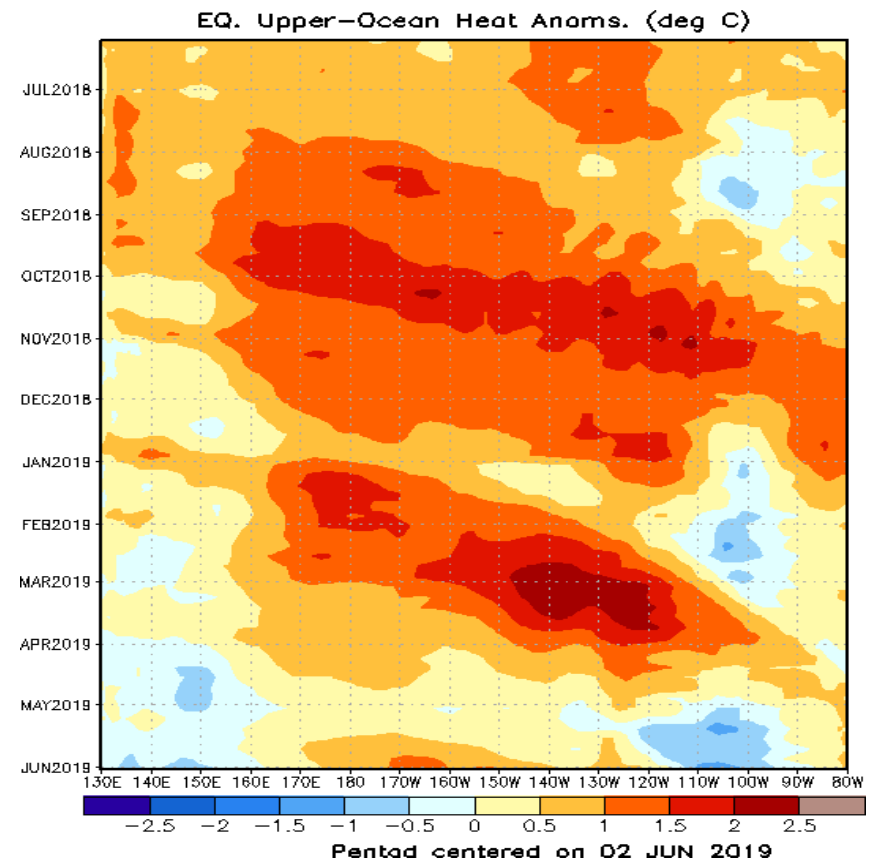
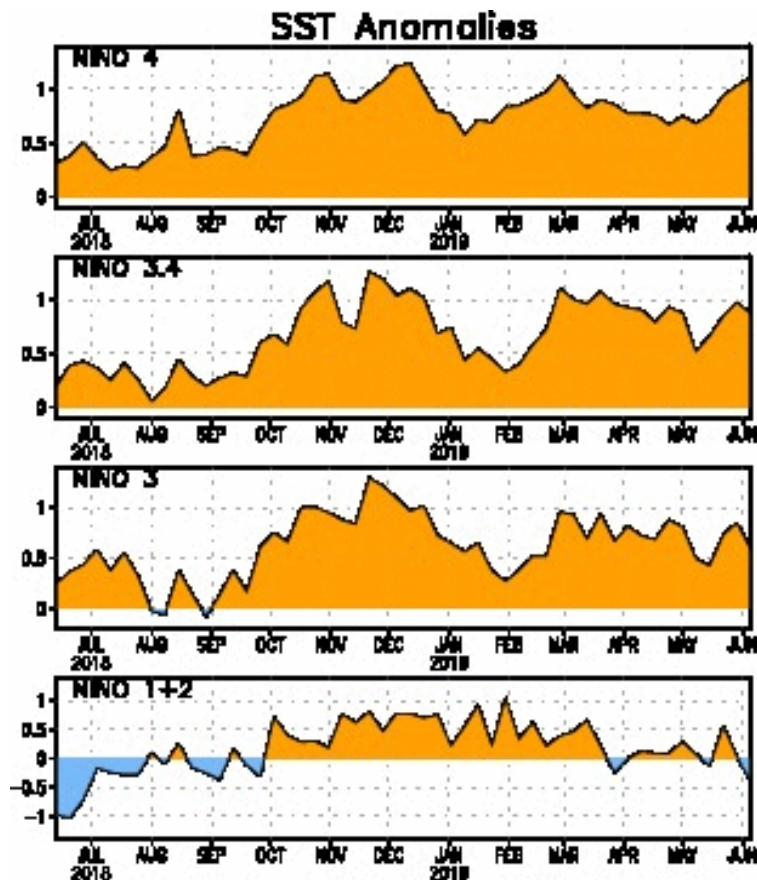
Blue shades: Anomalous convection (wetness). **Red shades:** Anomalous subsidence (dryness).



- The MJO's active convective signal is still located over the Indian Ocean.
- The convection within this region is further amplified by constructive interference of Kelvin and equatorial Rossby wave signals.



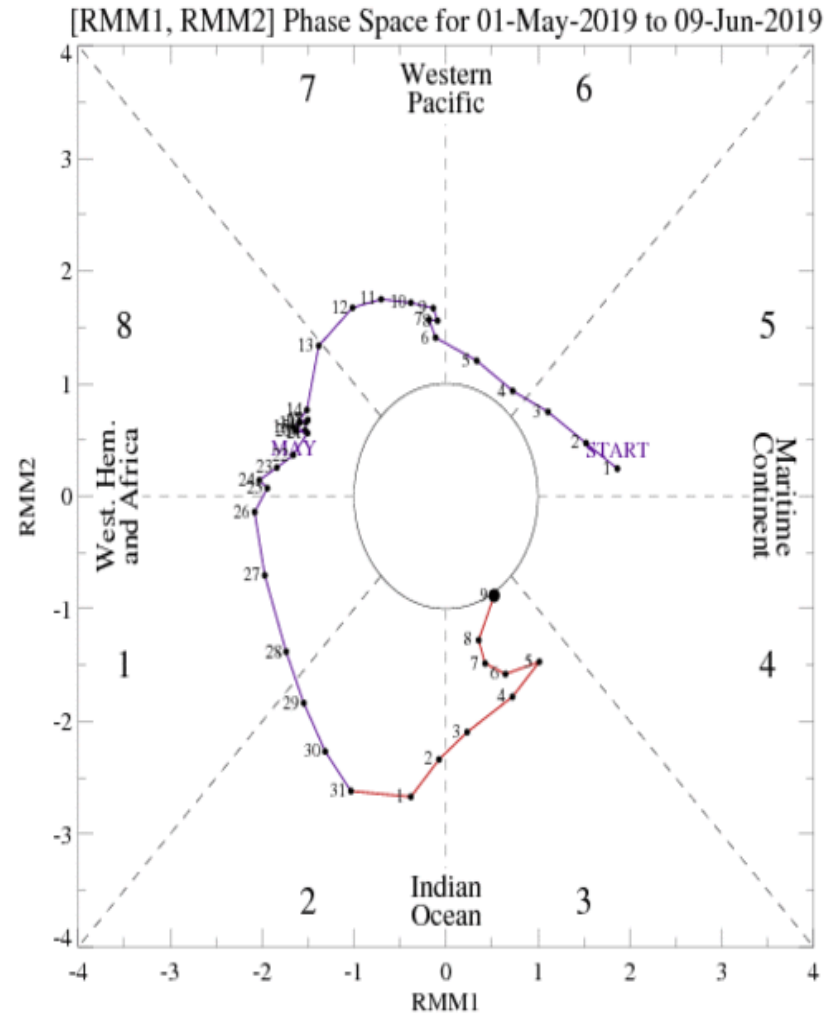
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- 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. Thus far there has been a modest oceanic response to a westerly wind burst that occurred during May.

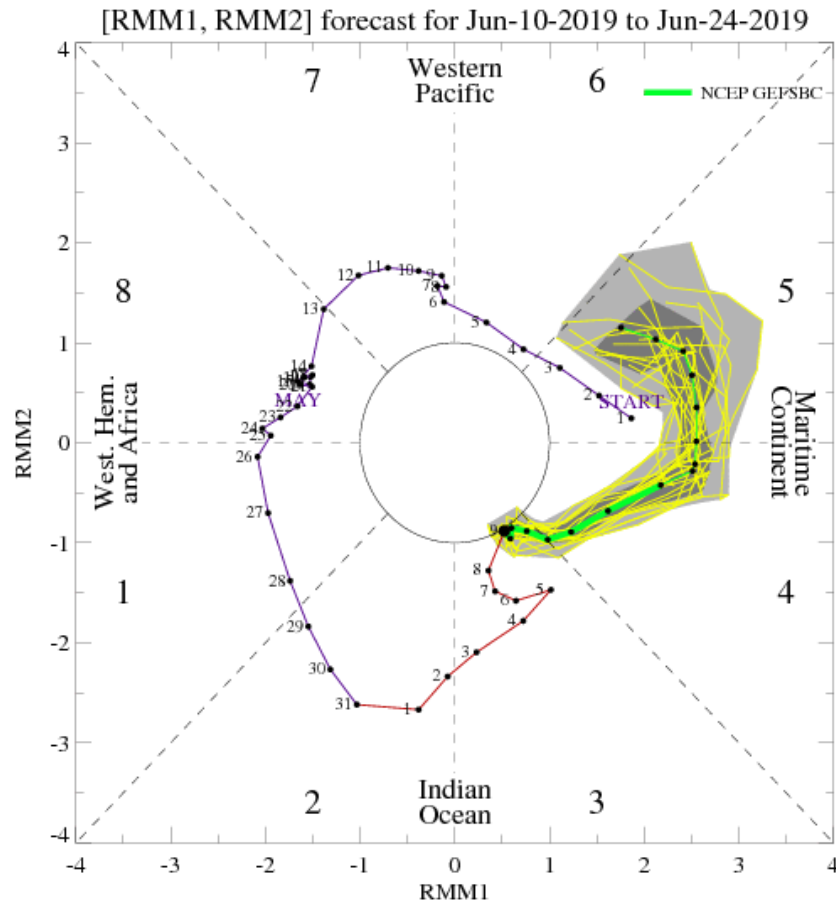
MJO Index: Recent Evolution

- The RMM index shows that the MJO has stalled over the eastern Indian Ocean during the past week.

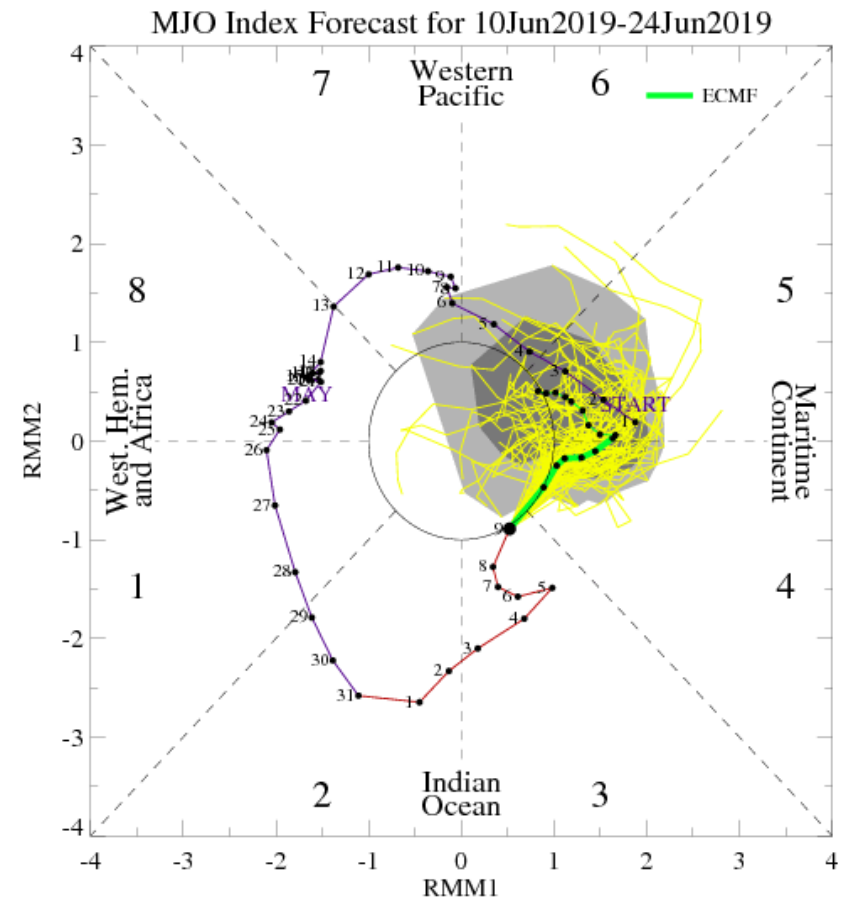


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



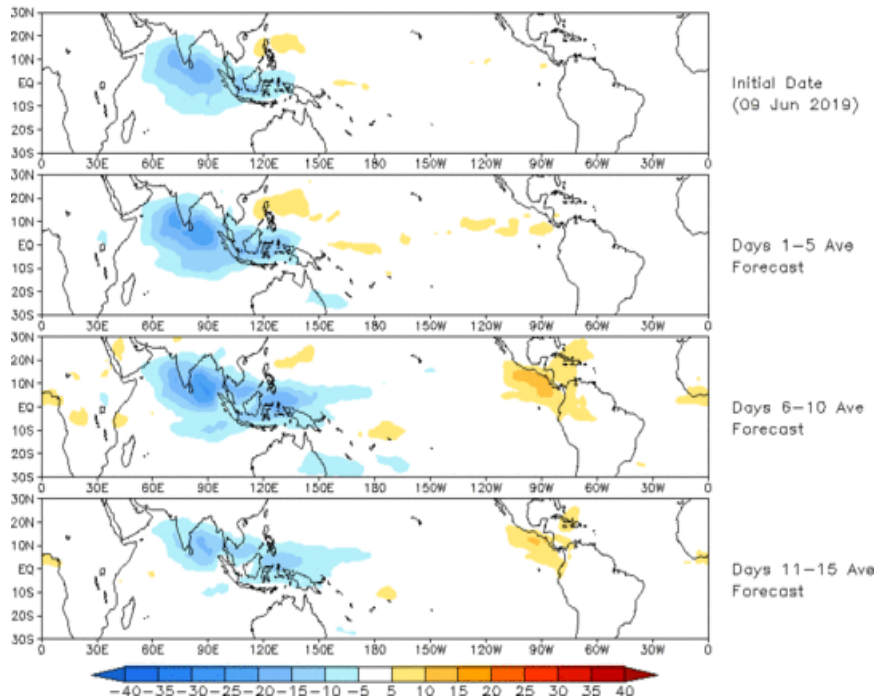
ECMWF Forecast

- The GEFS and ECMWF both forecast the MJO to continue propagating eastward during the next two weeks, with some possible weakening indicated late in Week-2. This may simply be the dynamical models having typical difficulty of propagating the MJO across the topography of the Maritime Continent, thus this may not be physical.

MJO: GEFS Forecast Evolution

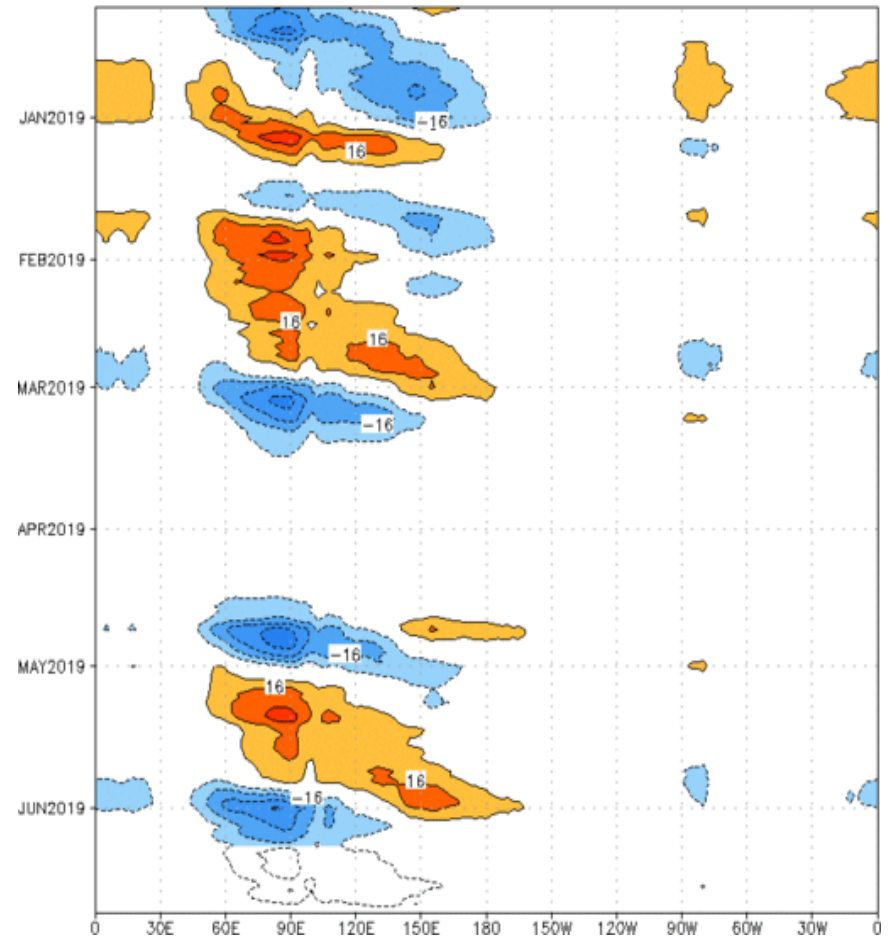
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 09 Jun 2019
OLR



- The spatial depiction of the MJO shows the area of convection is forecast to propagate eastward over the Maritime Continent.
- The RMM index forecast looks stronger than this figure implies, which suggests that the MJO will project more strongly onto its wind field than its OLR field.

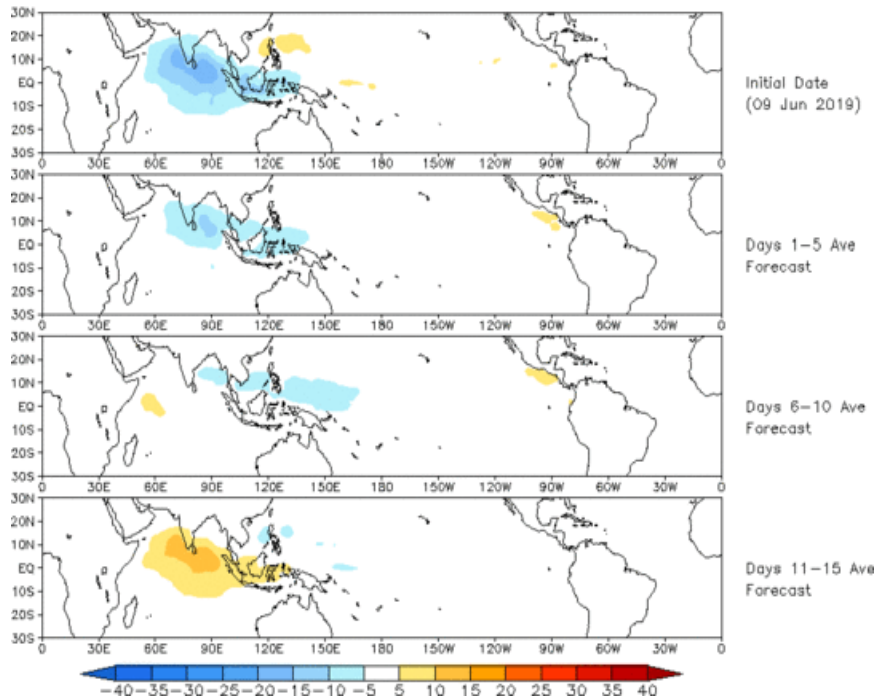
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [$7.5^{\circ}\text{S}, 7.5^{\circ}\text{N}$] ($\text{cint:}4\text{Wm}^{-2}$) Period: 08-Dec-2018 to 09-Jun-2019
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



MJO: Constructed Analog Forecast Evolution

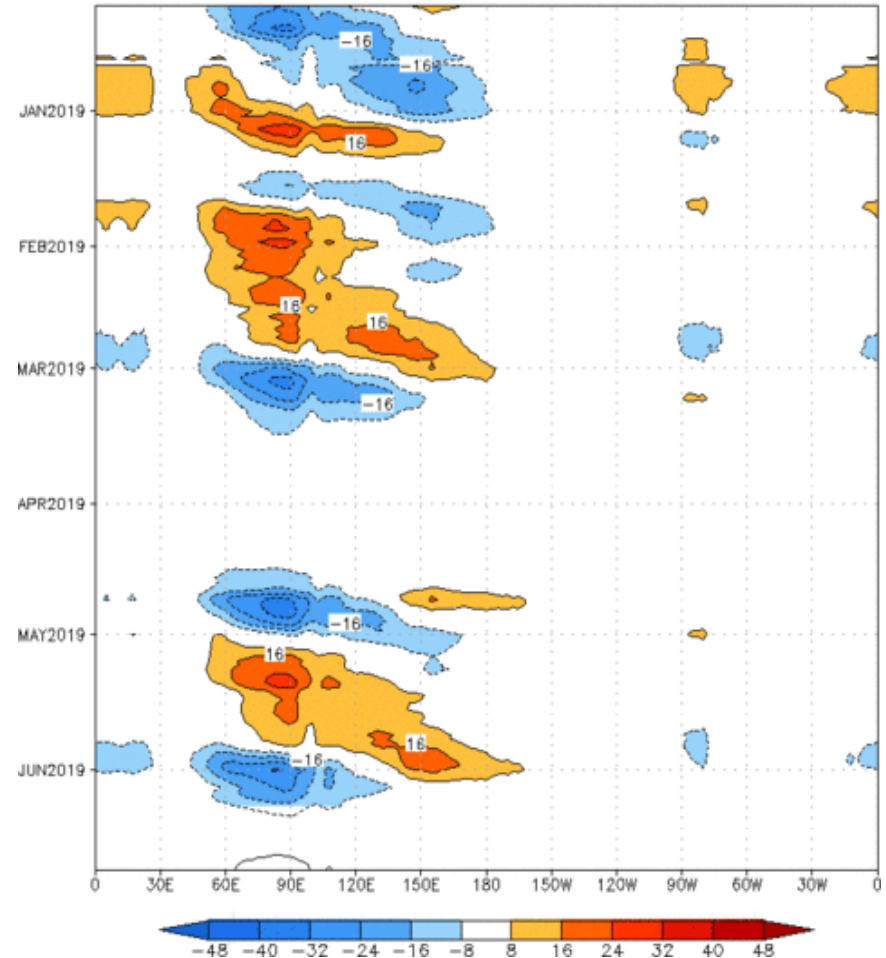
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (09 Jun 2019)



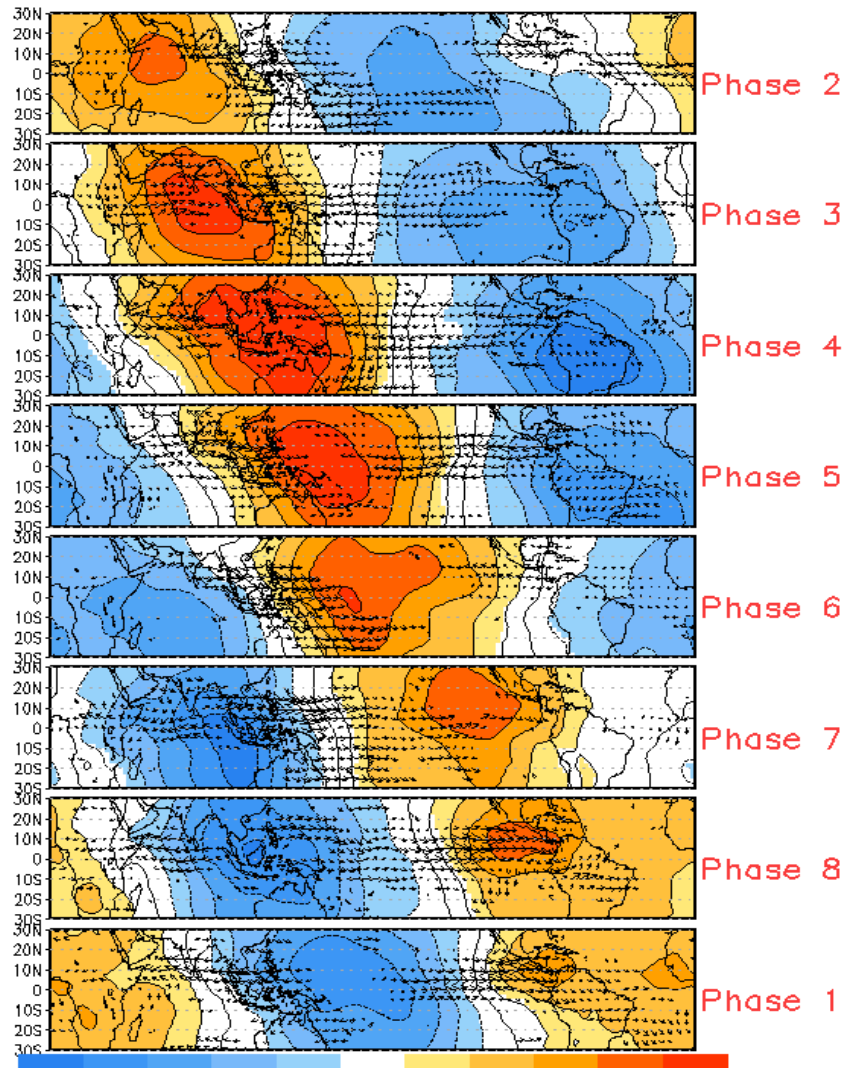
- The constructed analog forecast propagates the MJO eastward much more quickly than the GEFS, and with a much more muted signal for enhanced convection.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:08-Dec-2018 to 09-Jun-2019
The unfilled contours are CA forecast reconstructed anomaly for 15 days

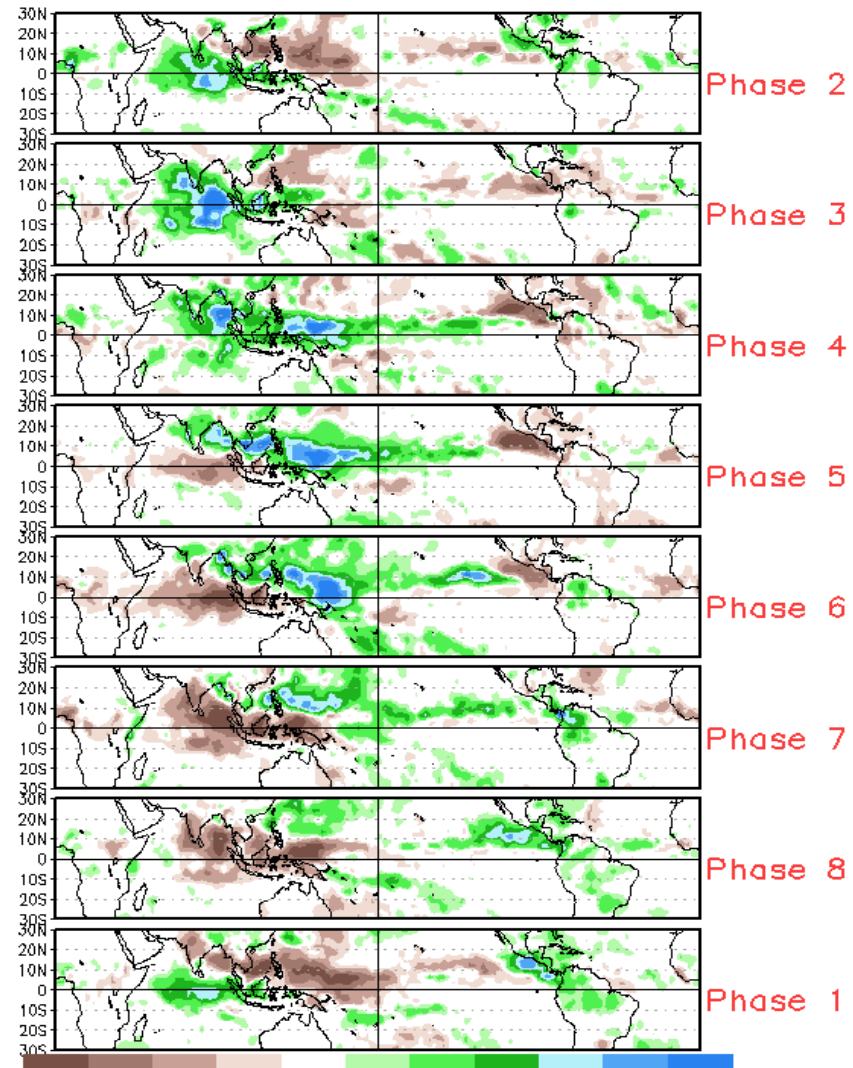


MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



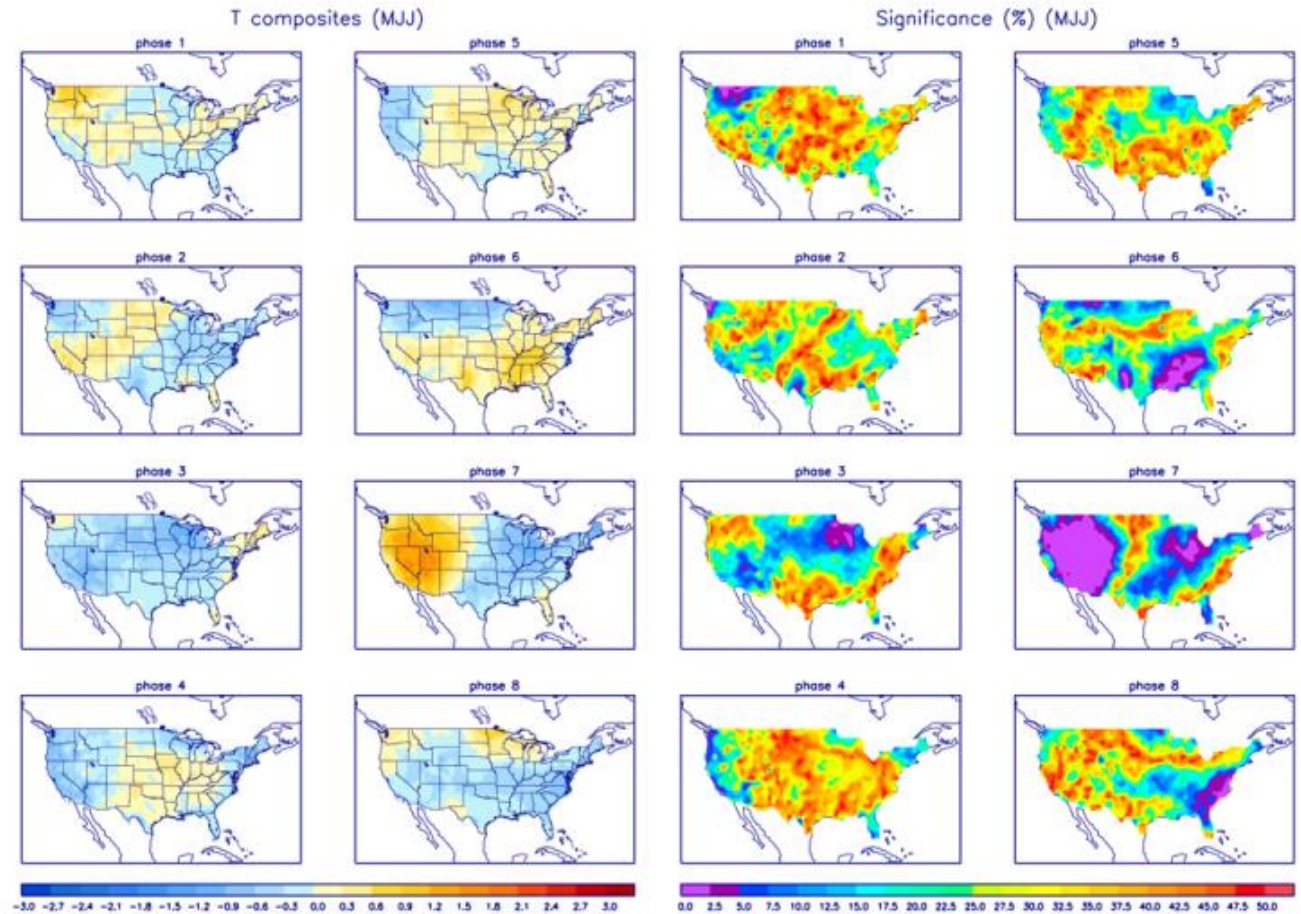
Precipitation Anomalies



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.

