

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



**Update prepared by the Climate Prediction Center**  
Climate Prediction Center / NCEP  
24 June 2019

# Overview

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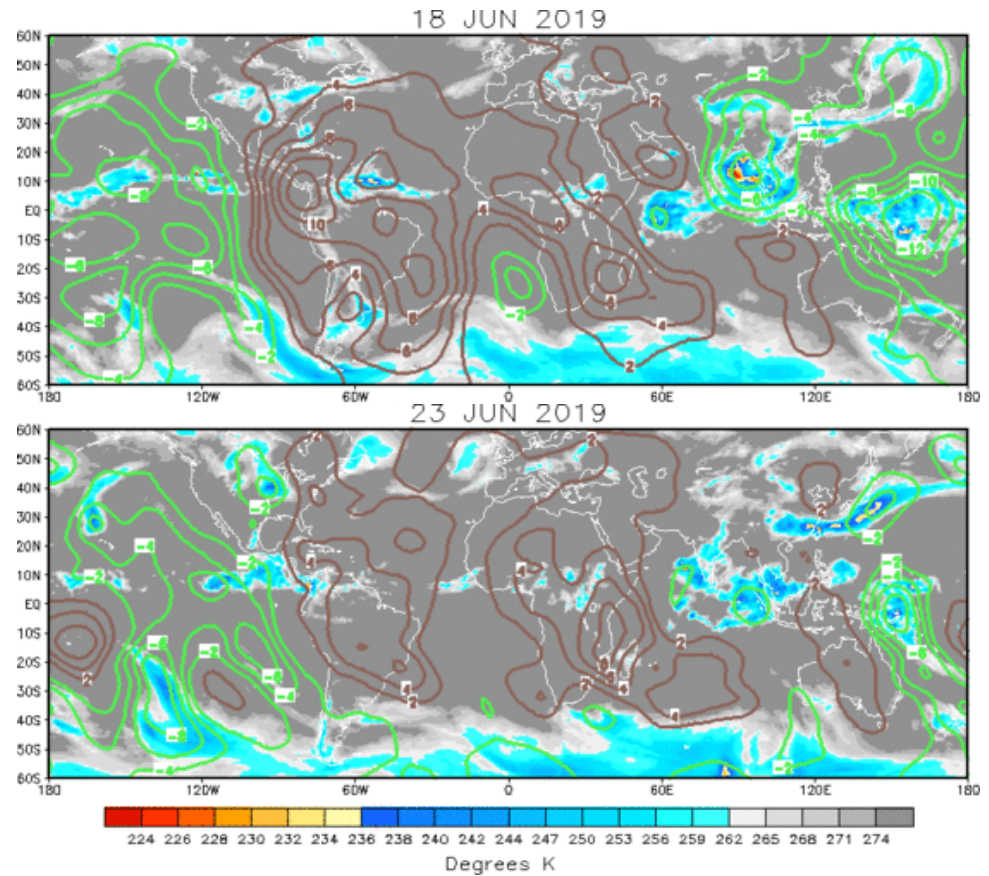
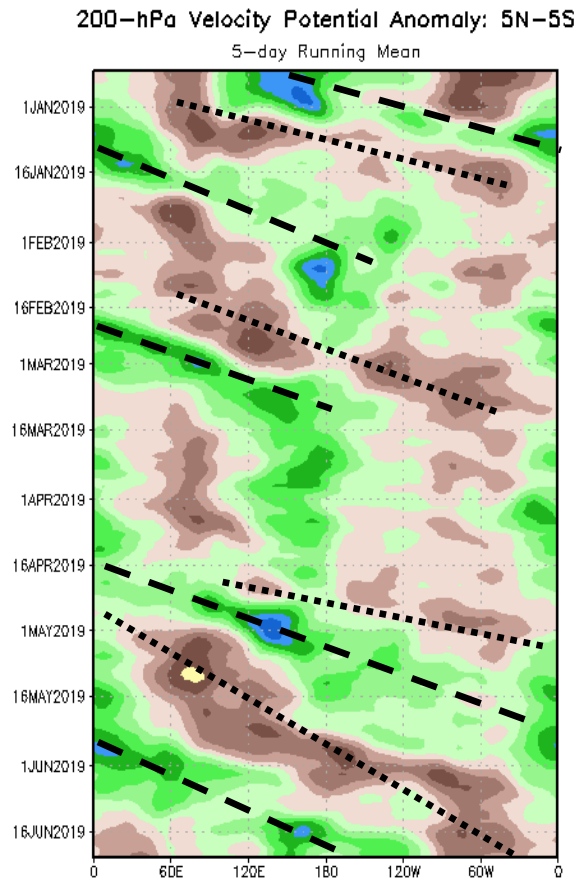
- The MJO weakened over the past week due to destructive interference with an equatorial Rossby wave over the West Pacific. However, the upper-level signal remains fairly coherent.
- Both the GFS and ECMWF models predict weak MJO activity during the next two weeks. The GEFS supports amplification over the Western Hemisphere towards the end of Week-2, which is out of phase with the current MJO event and may be due to extratropical influences. The ECMWF solutions suggest considerable uncertainty.
- Due to the destructive interference, the MJO has not produced significant low-level westerly anomalies over the west-central Pacific. Still, Kelvin wave activity ahead of the remnant MJO convective envelope as well as anomalously warm SSTs should enhance the Pacific ITCZ and may contribute to tropical cyclone formations over the central and eastern Pacific basins during the next two weeks.

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).

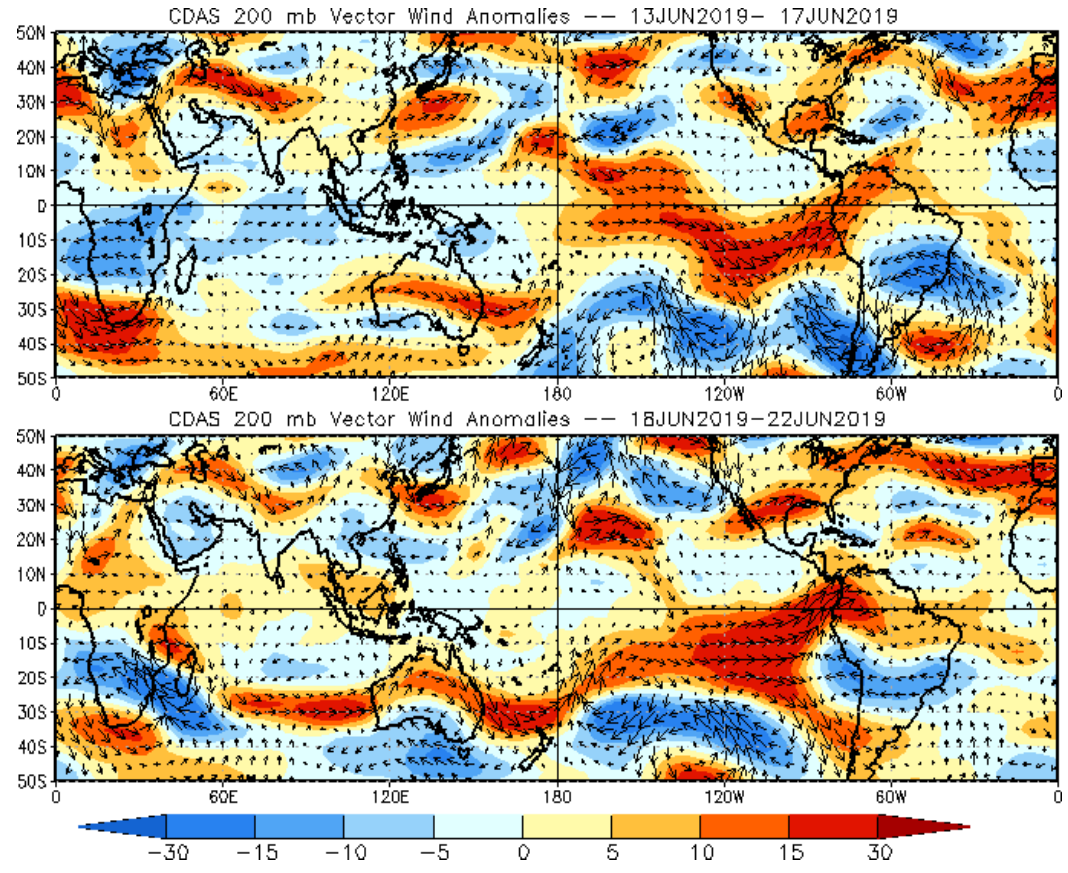
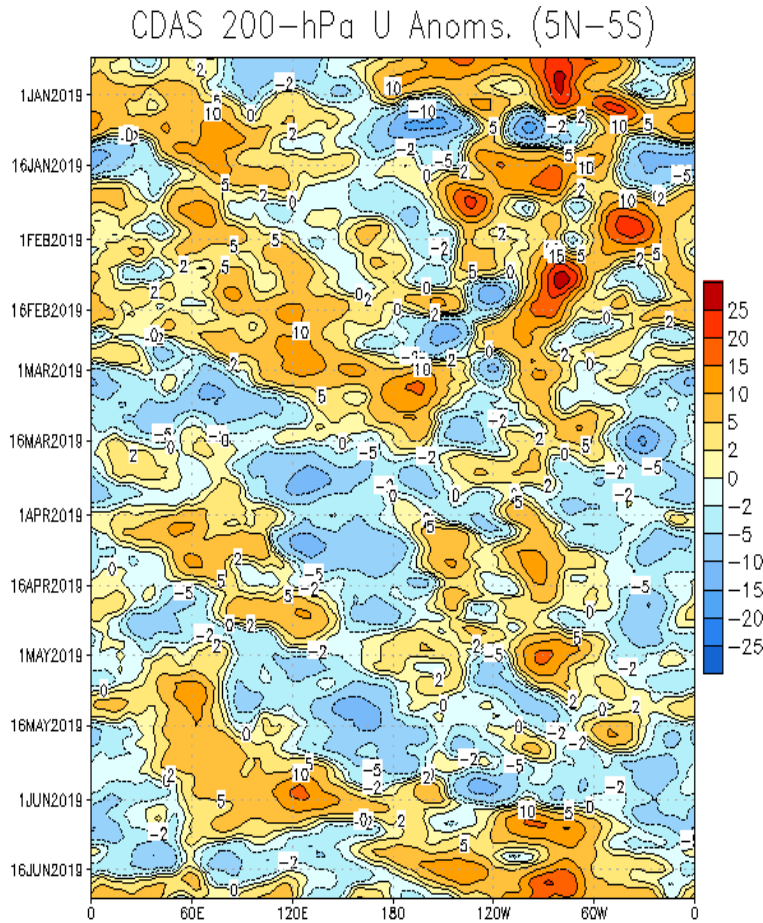
**Brown shades:** Anomalous convergence (unfavorable for precipitation).



- The MJO has been active since December except for a 1.5 month pause during March and early April.
- The latest MJO event began in mid-April and was influenced by westward moving features over the Indian Ocean in early June before returning to the Maritime Continent and West Pacific.
- The velocity potential pattern shows recent splitting of the eastward propagating signal and low-frequency features persisting over the West Pacific and Western Hemisphere.

# 200-hPa Wind Anomalies

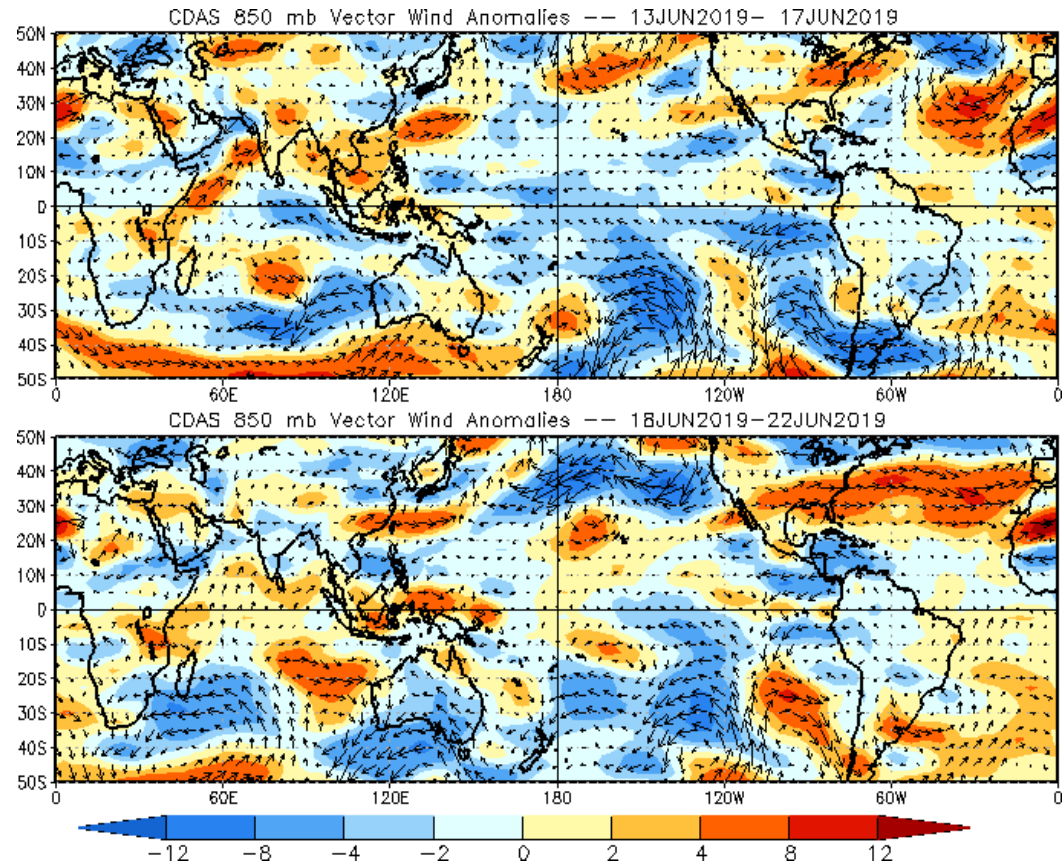
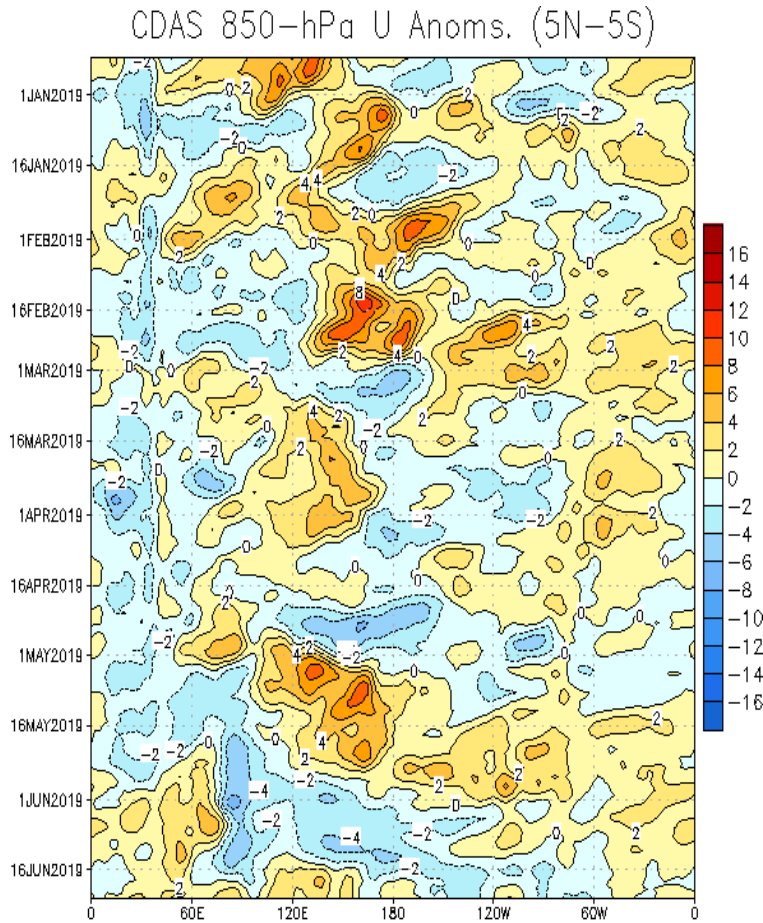
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- An envelope of westerly anomalies associated with the MJO continued propagating eastward to the East Pacific during mid-June.
- Easterly anomalies weakened or reversed sign over the Indian Ocean, possibly due to Monsoon activity.

# 850-hPa Wind Anomalies

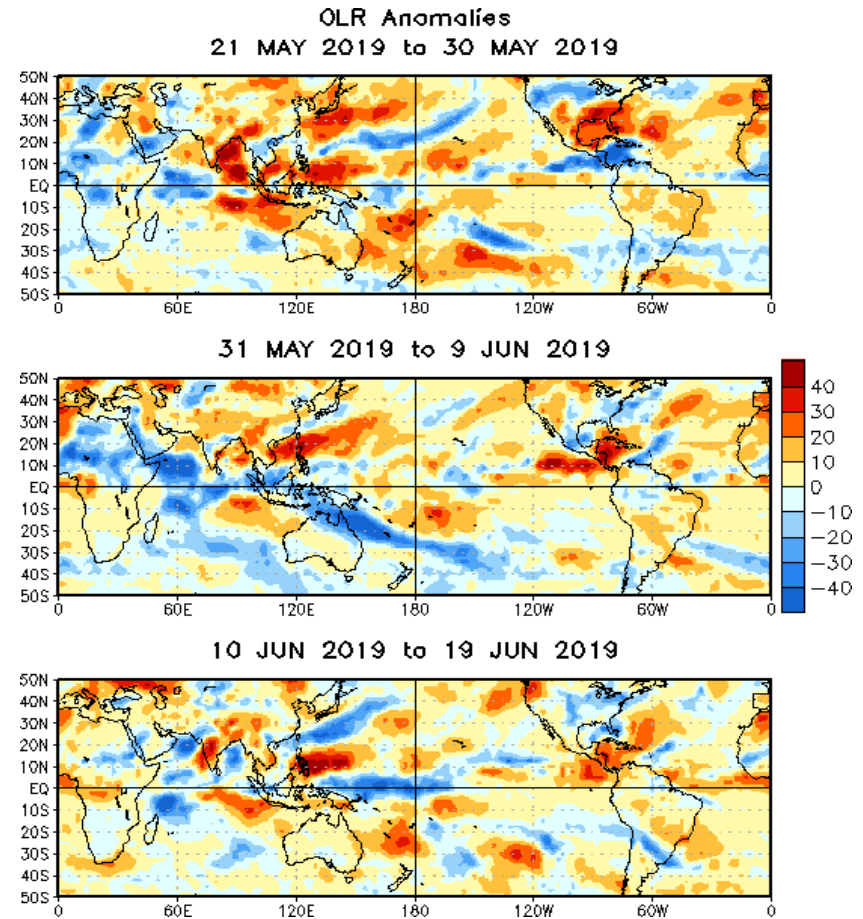
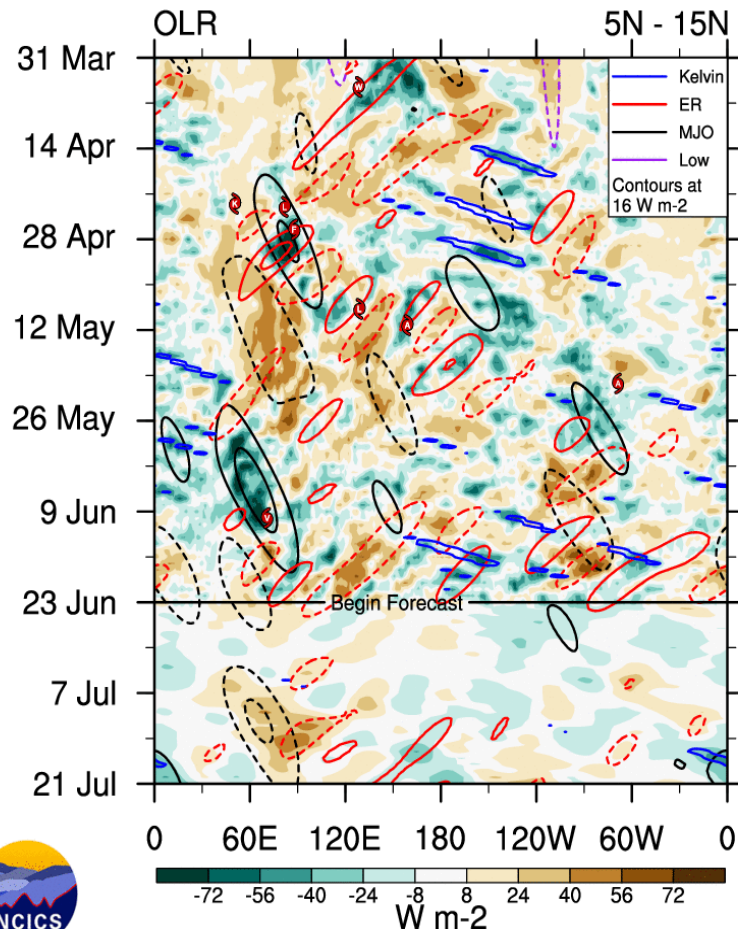
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Unlike the previous time when the MJO enhanced phase moved across the Pacific and generated a substantial westerly wind burst, the current event is not yet producing a substantial low-level wind response.
- Robust south-north cross-equatorial flow is evident over the western Indian Ocean, which may aid advancement of the South Asian Monsoon.

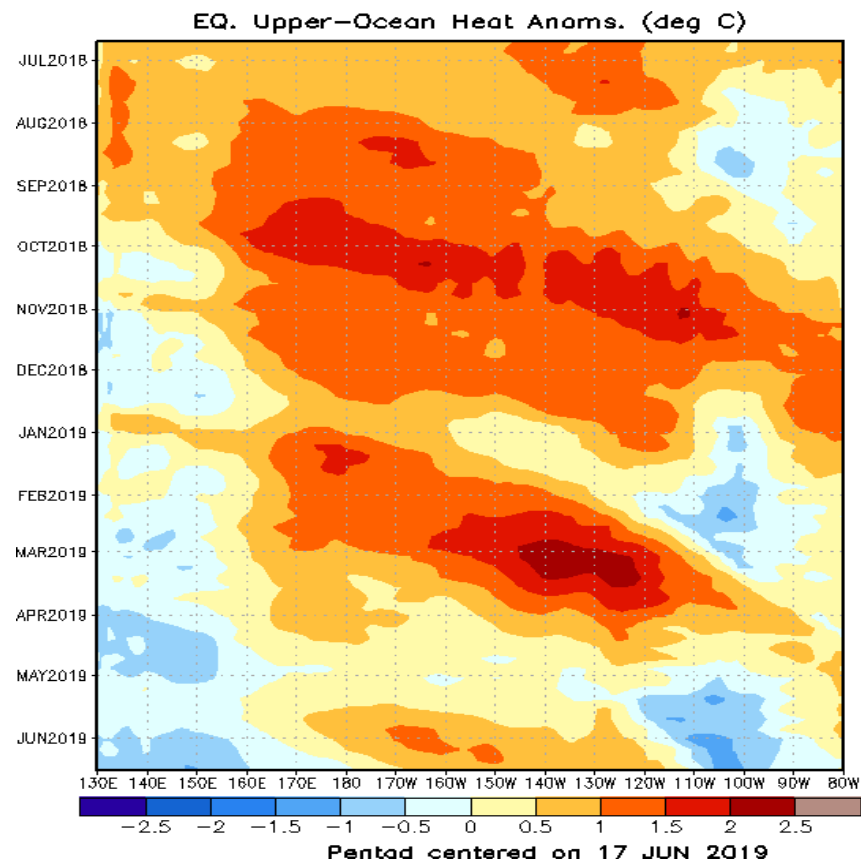
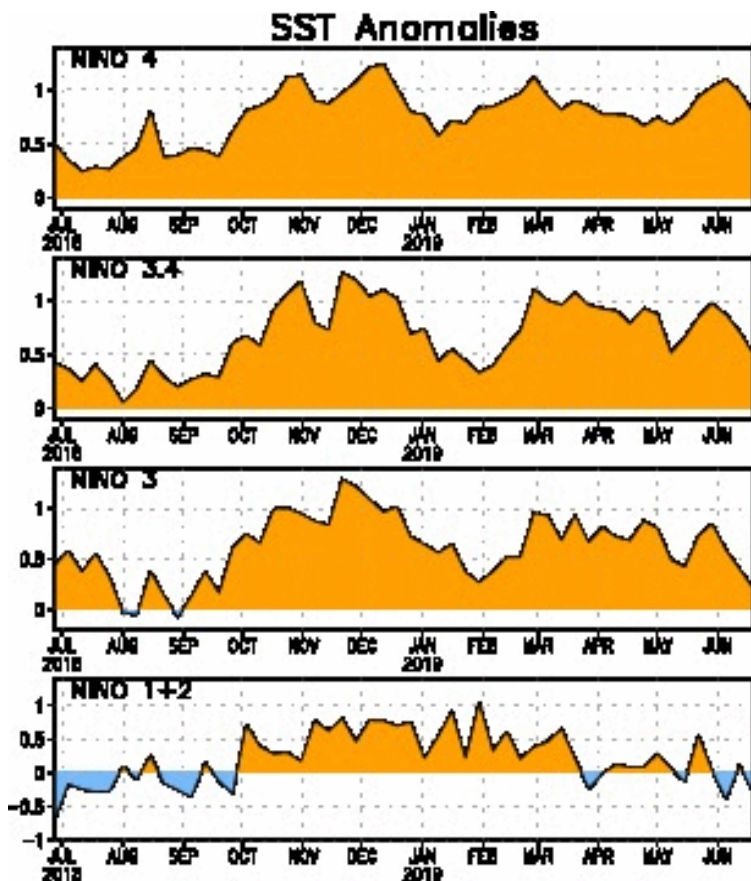
# Outgoing Longwave Radiation (OLR) Anomalies

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



- While MJO-related convection has emerged along the equator over the West Pacific, there is little footprint evident over the Northern Hemisphere tropics between 5N and 15N.
- An area of suppressed convection is evident between this equatorial convection and the Meiyu Front extending across Taiwan and south of Japan.
- Rossby wave activity is evident in the OLR field.

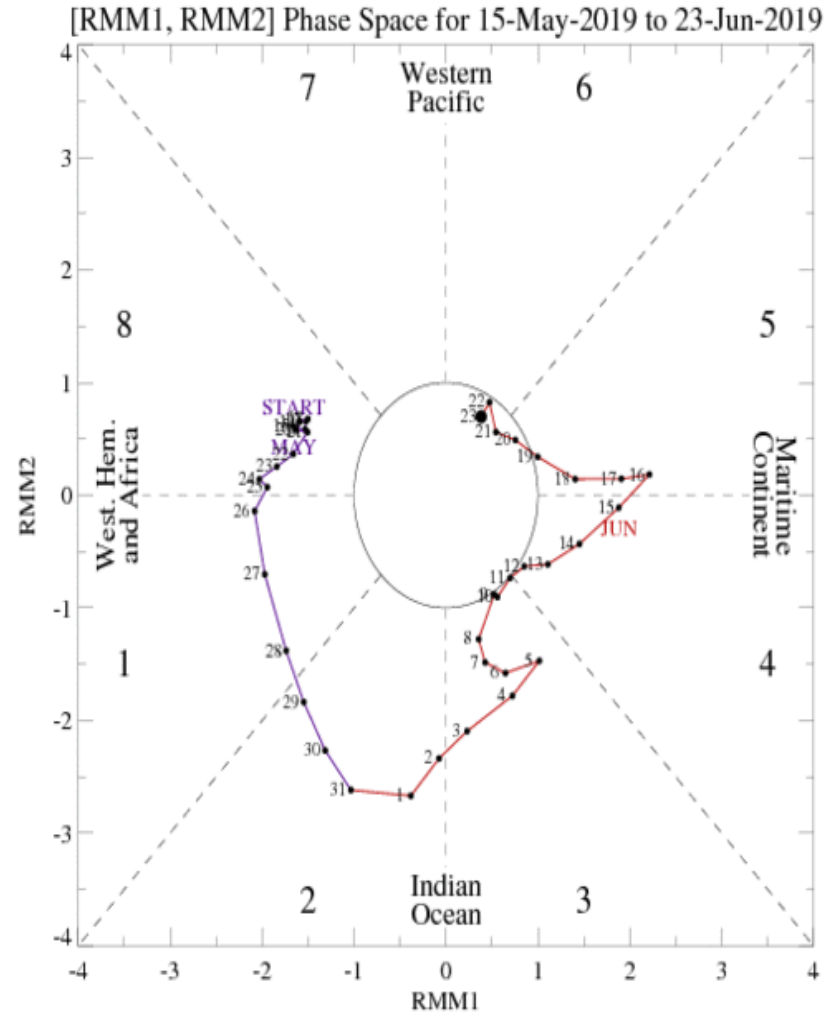
# SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- SST anomalies remain above climatology across much of the equatorial Central and East Pacific, consistent with the ongoing El Niño event.
- Another downwelling Kelvin wave event is evident over the central and eastern Pacific, but its amplitude is weaker than what was observed in previous events.

# MJO Index: Recent Evolution

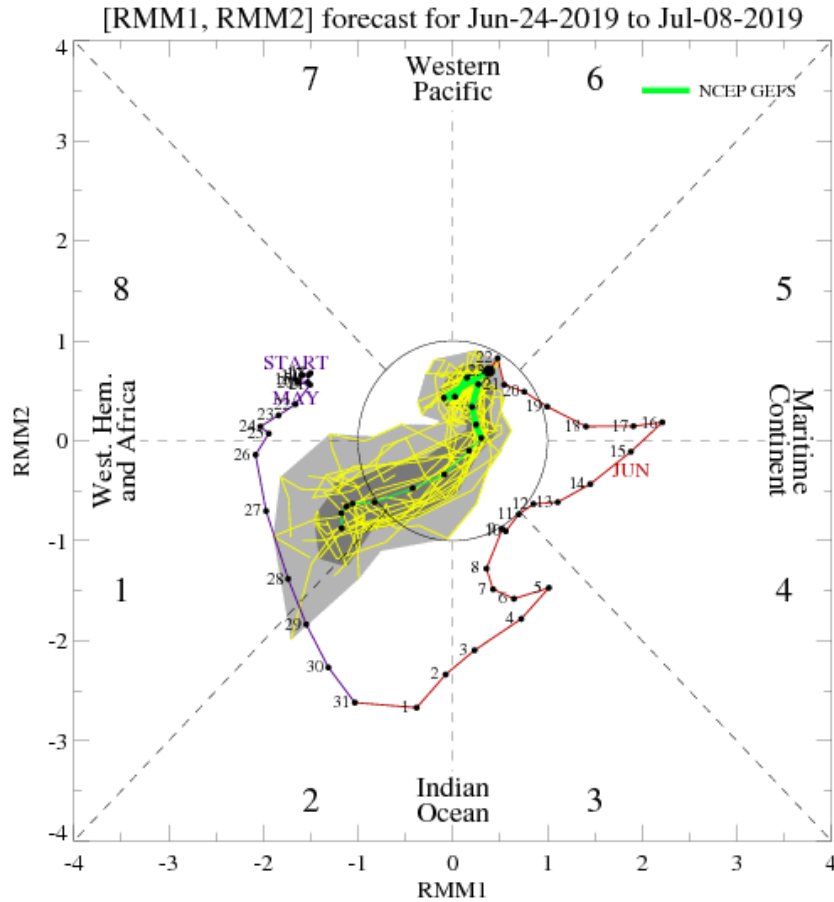
- The RMM index shows continued eastward propagation of the MJO, but with a weakened amplitude as the signal emerged over the West Pacific.



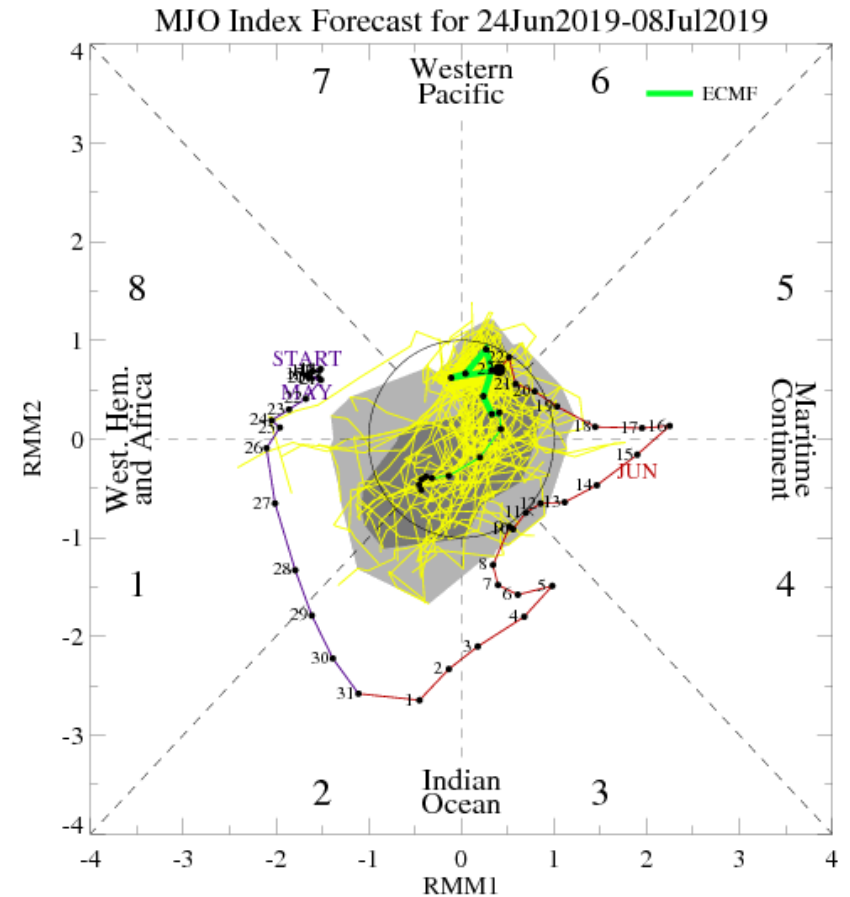
For more information on the RMM index and how to interpret its forecast please see:  
[https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC\\_MJOinformation.pdf](https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf)



# MJO Index: Forecast Evolution



**GEFS Forecast**



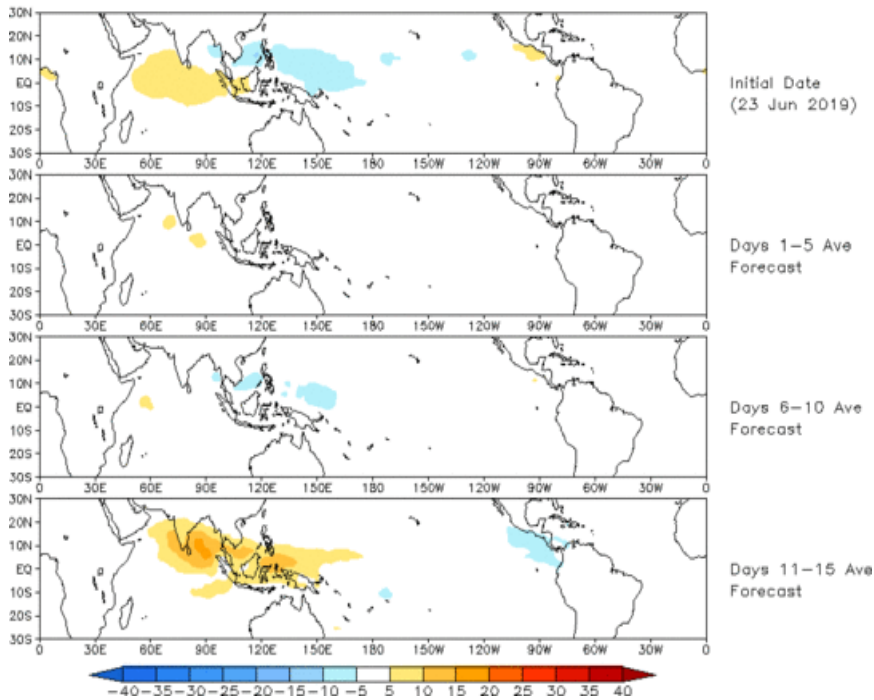
**ECMWF Forecast**

- The GEFS shows little additional MJO activity during Week-1, with amplification of a new signal over Africa during late Week-2.
- The ECMWF is broadly consistent with the GEFS, showing weak MJO activity. There is a greater spread among the ensemble members, with individual forecast members emerging outside the unit circle in every single phase during the next two weeks.

# MJO: GEFS Forecast Evolution

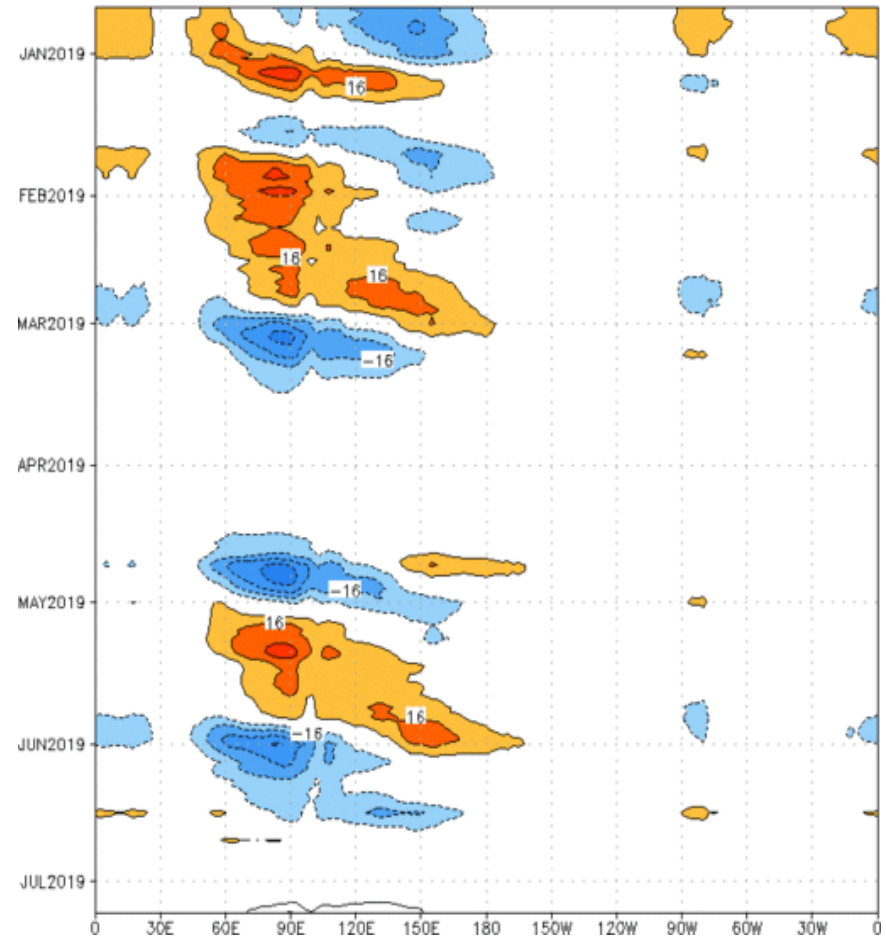
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast  
Initial date: 23 Jun 2019  
OLR



- The spatial depiction of the RMM-based OLR anomalies shows little signal for much of the period.
- Suppressed convection returns to the North Indian Ocean and West Pacific at the end of Week-2.

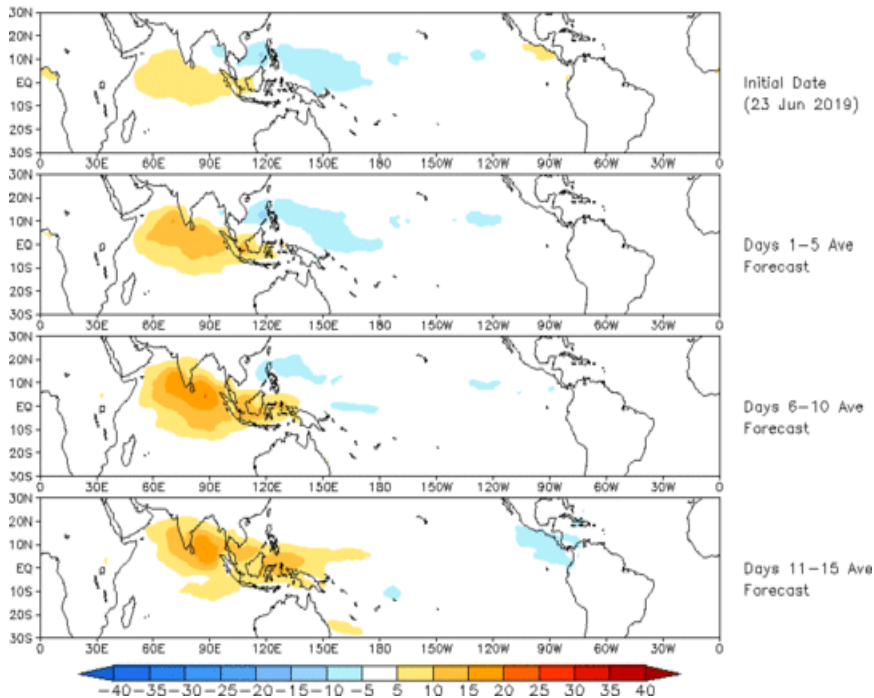
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2  
OLR [7.5°S,7.5°N] (cont:4Wm<sup>-2</sup>) Period:22-Dec-2018 to 23-Jun-2019  
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



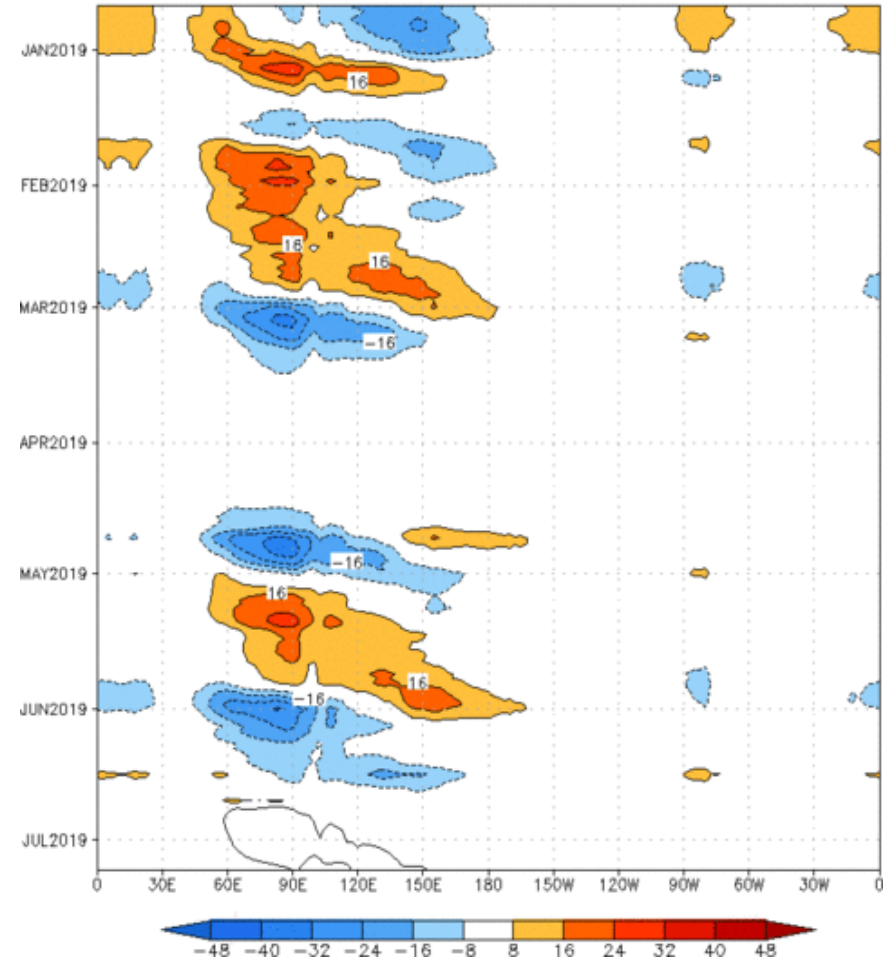
# MJO: Constructed Analog Forecast Evolution

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 (23 Jun 2019)



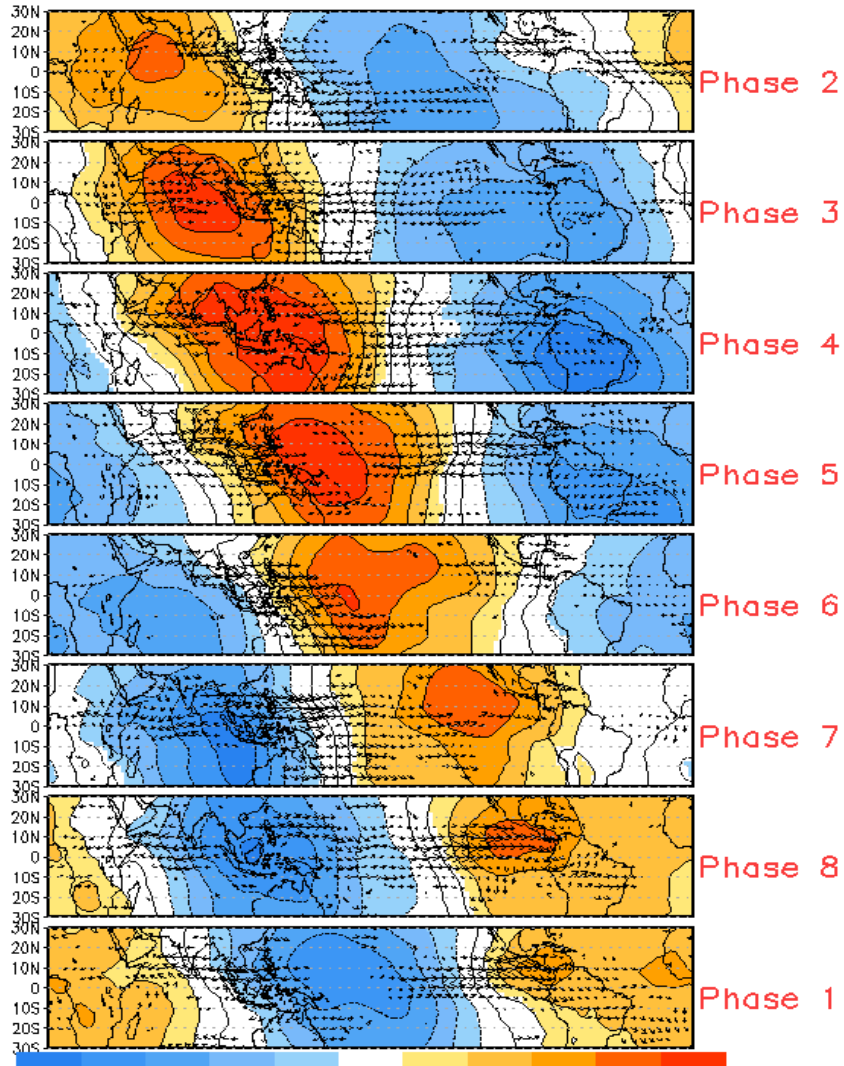
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm<sup>-2</sup>) Period:22-Dec-2018 to 23-Jun-2019  
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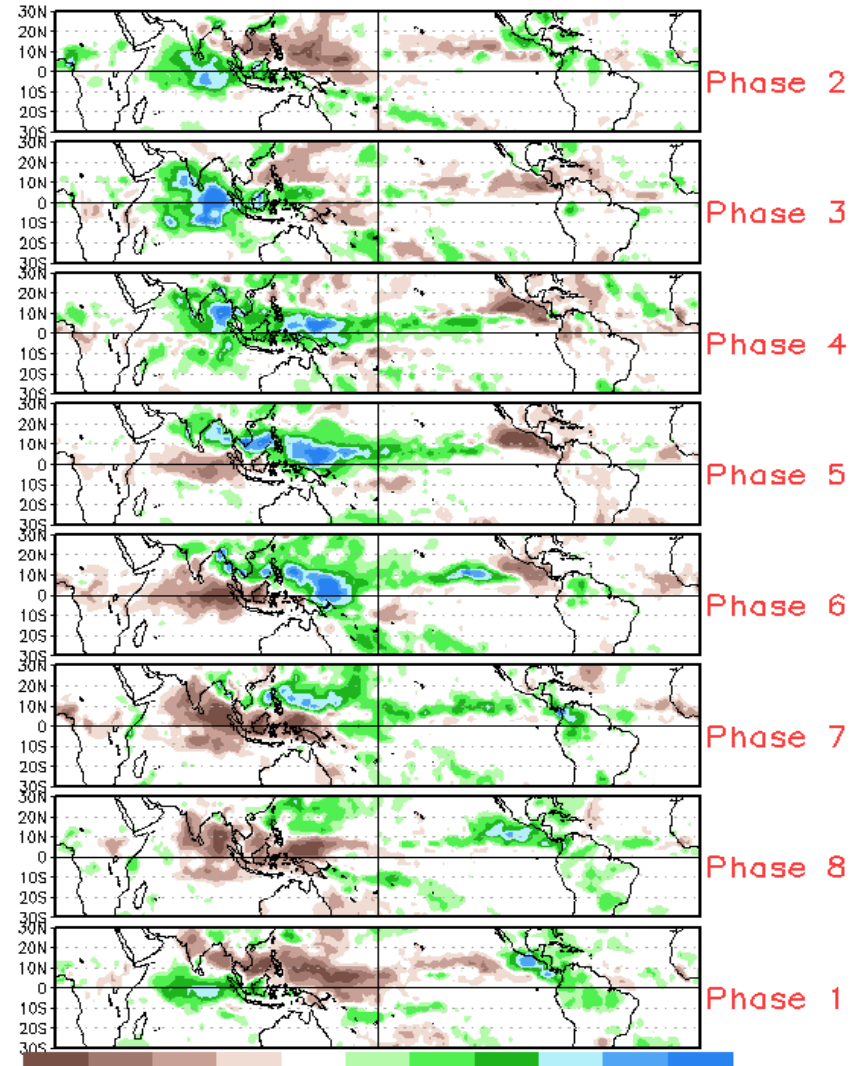
- The constructed analog depicts continued canonical MJO eastward propagation during the period.

# MJO: Tropical Composite Maps by RMM Phase

## 850-hPa Velocity Potential and Wind Anomalies



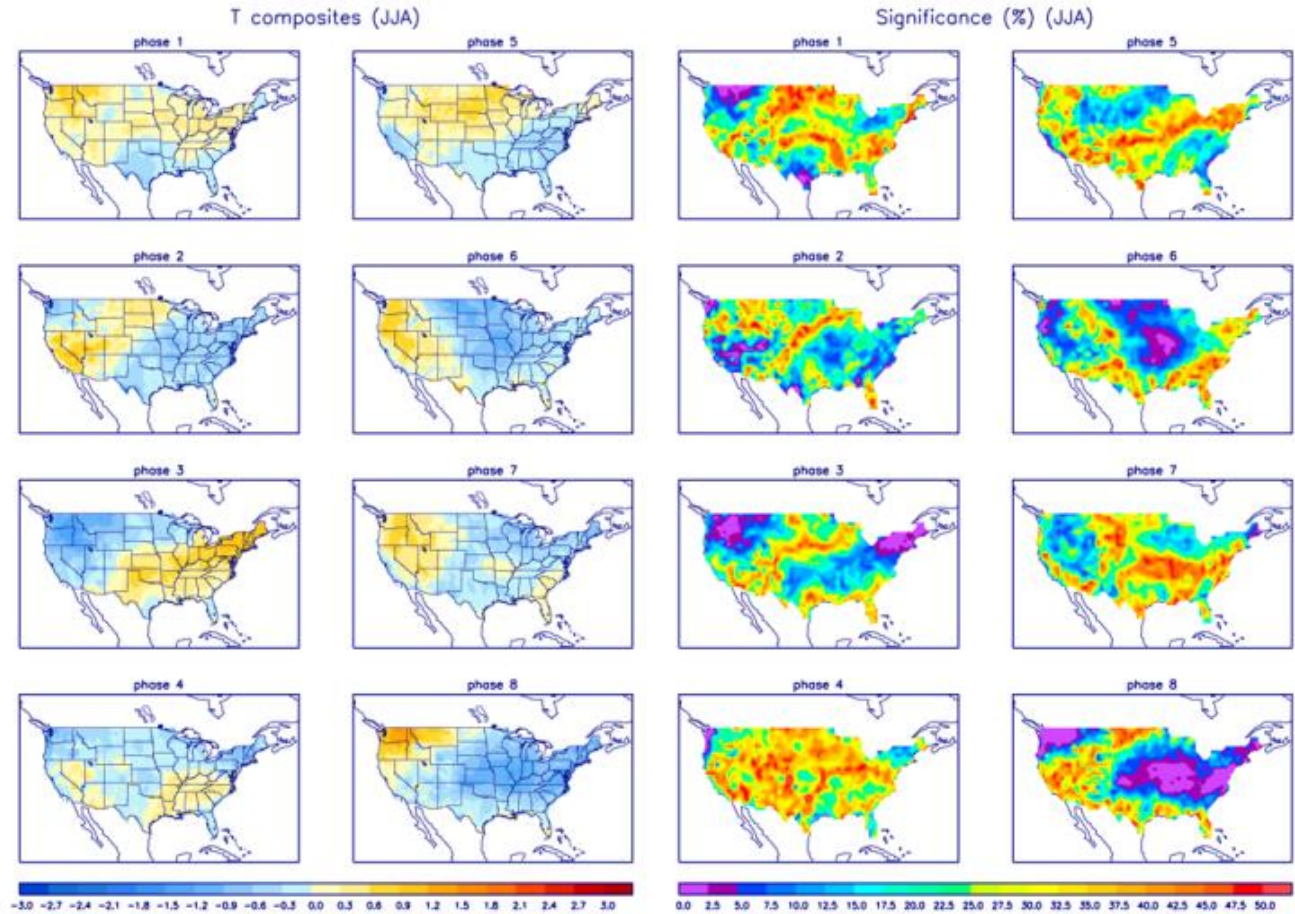
## Precipitation Anomalies



# 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.

