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

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
1 July 2019

Overview

- The MJO has remained fairly weak over the past several days, with the weak enhanced phase centered over the Pacific; robust equatorial Rossby wave activity continues to interfere with the MJO.

- Both the GFS and ECMWF models predict weak MJO activity early, followed by reemergence over Africa and the western Indian Ocean as the upper-level signal continues its eastward propagation.

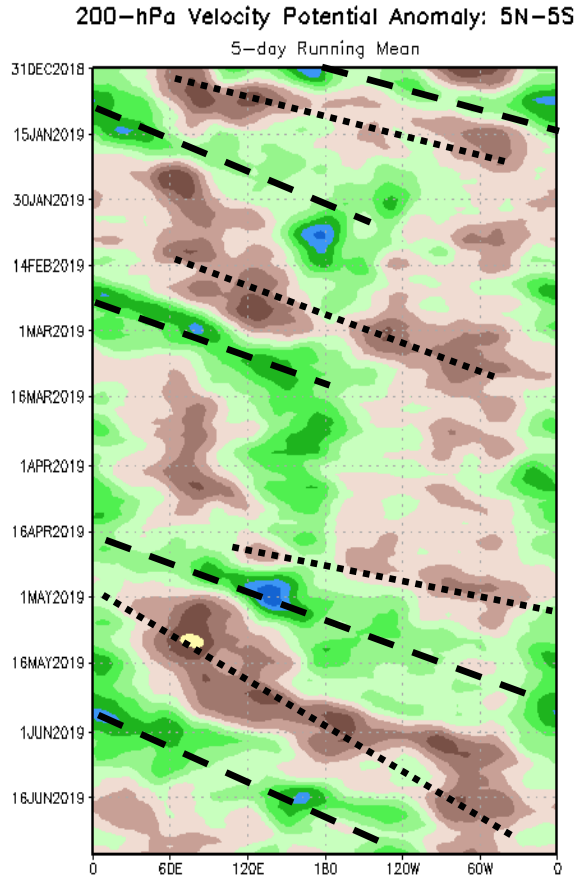
- The MJO supports enhanced odds of tropical cyclone formation over the East Pacific during Week-2 as the weak active phase shifts eastward across the Americas during the next two weeks.

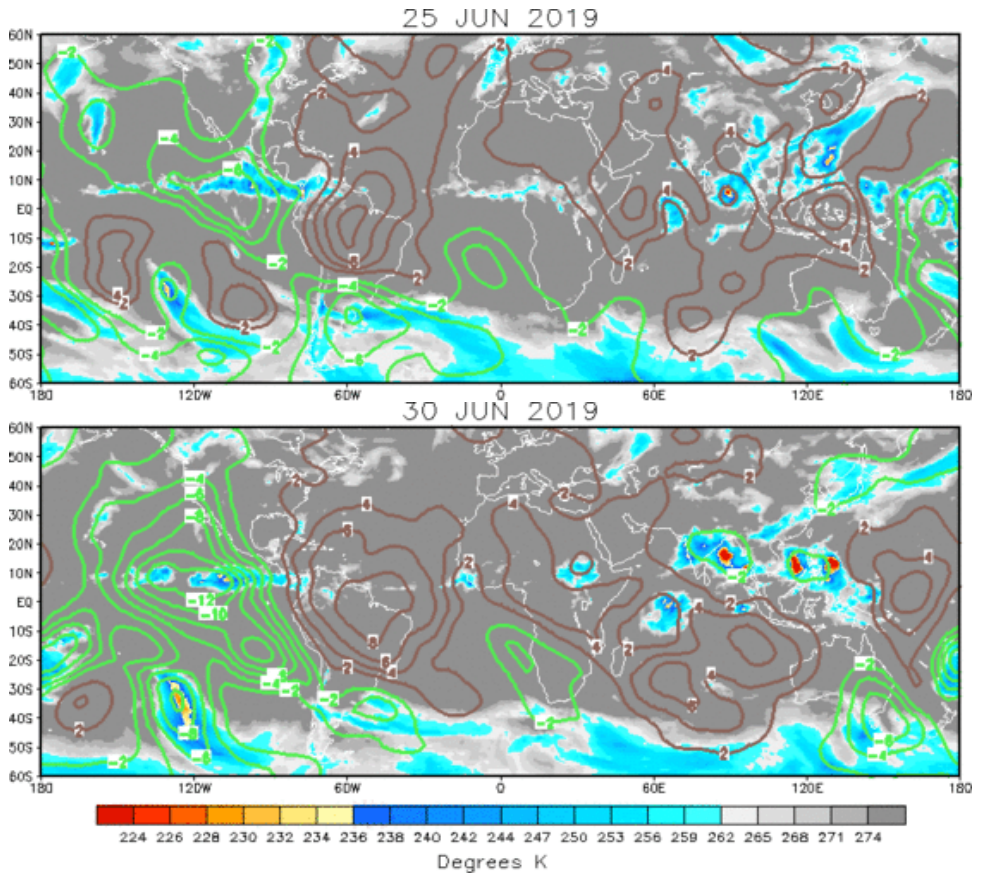
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

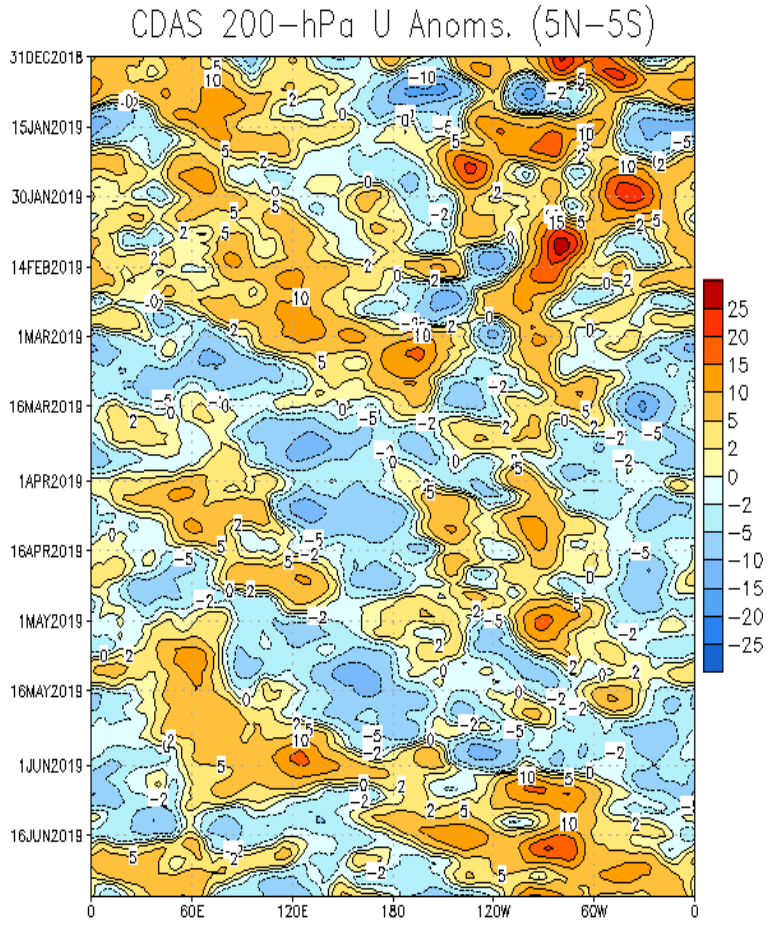


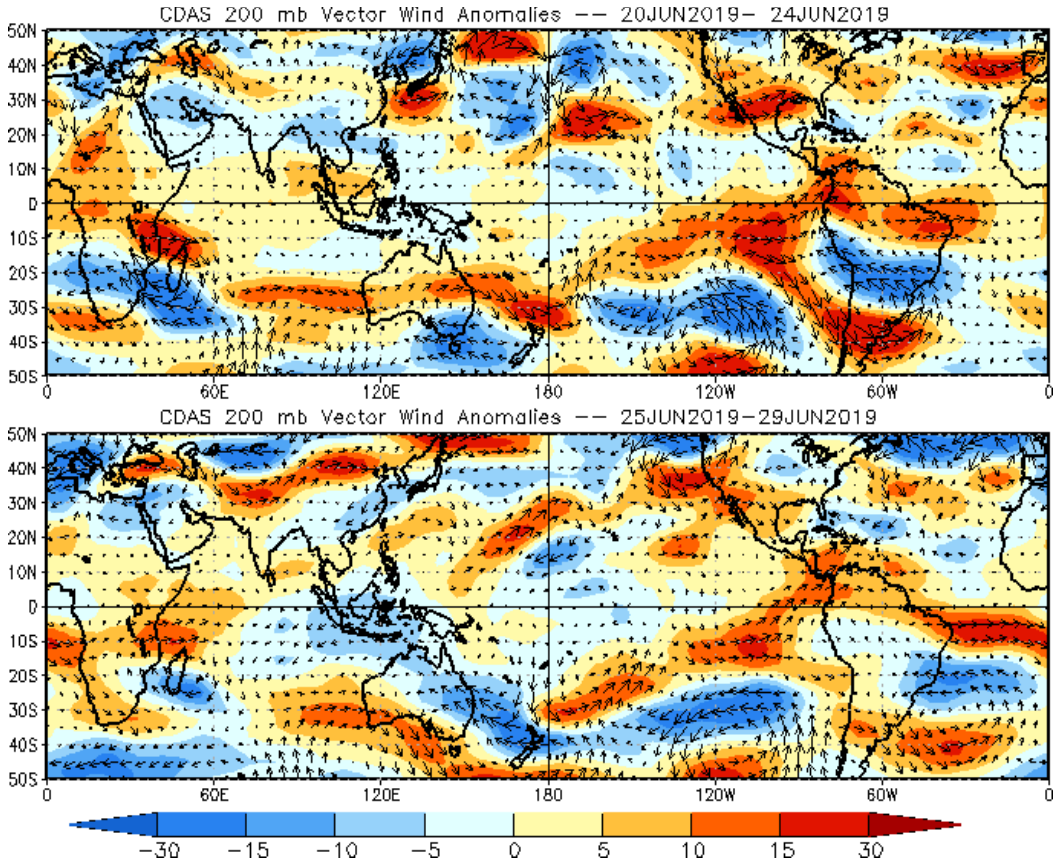


- The MJO has been active since December except for a 1.5 month pause during March and early April.
- The latest MJO event began in mid-April and was influenced by westward moving features over the Indian Ocean in early June before returning to the Maritime Continent and West Pacific.
- The velocity potential pattern shows recent a breakdown of the wave-1 structure due to interference by equatorial Rossby waves and atmospheric Kelvin waves.

200-hPa Wind Anomalies

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

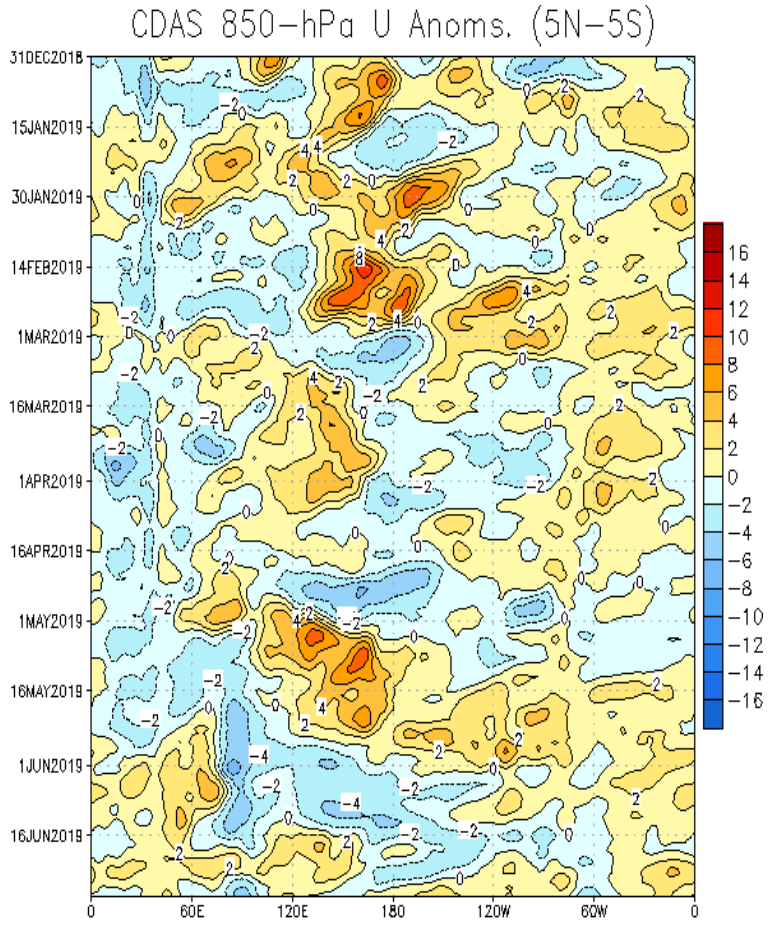


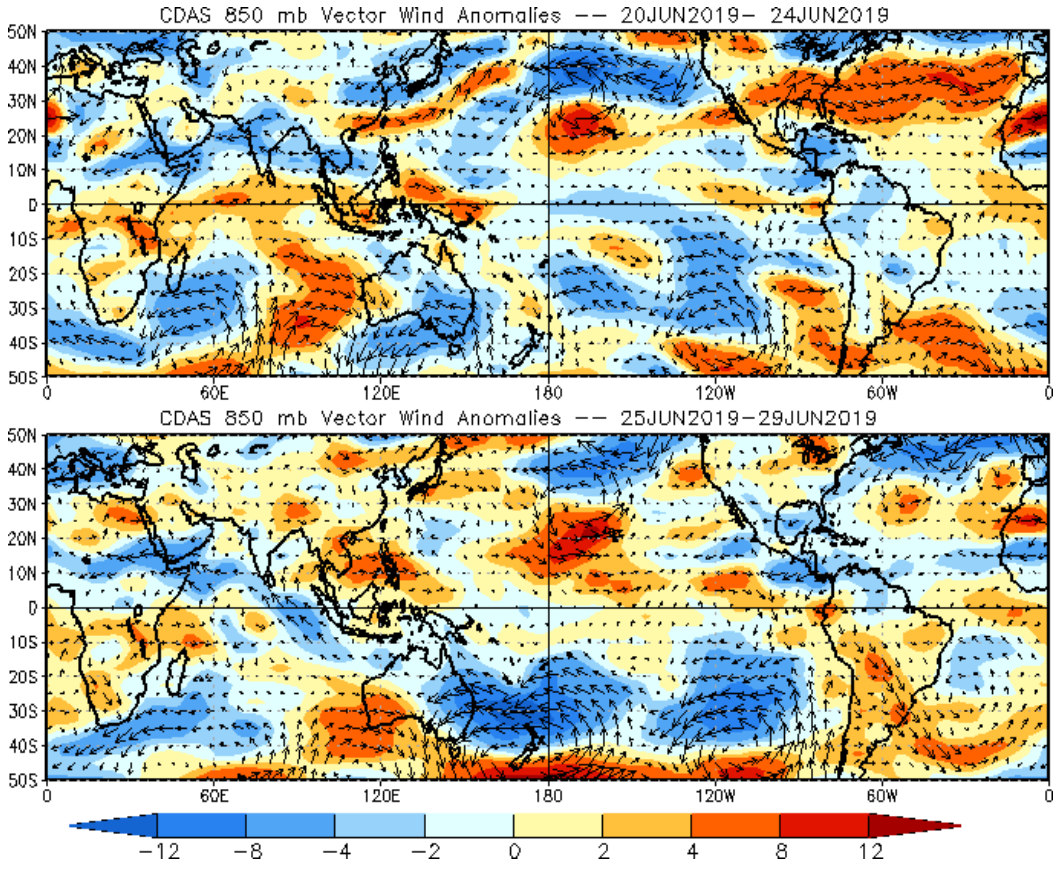


- An envelope of westerly anomalies associated with the MJO continued propagating eastward across the Pacific to the Atlantic during late June.
- Easterly anomalies have generally propagated eastward across the Date Line of late, as the upper-level zonal wind signal remains consistent with ongoing MJO activity.

850-hPa Wind Anomalies

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

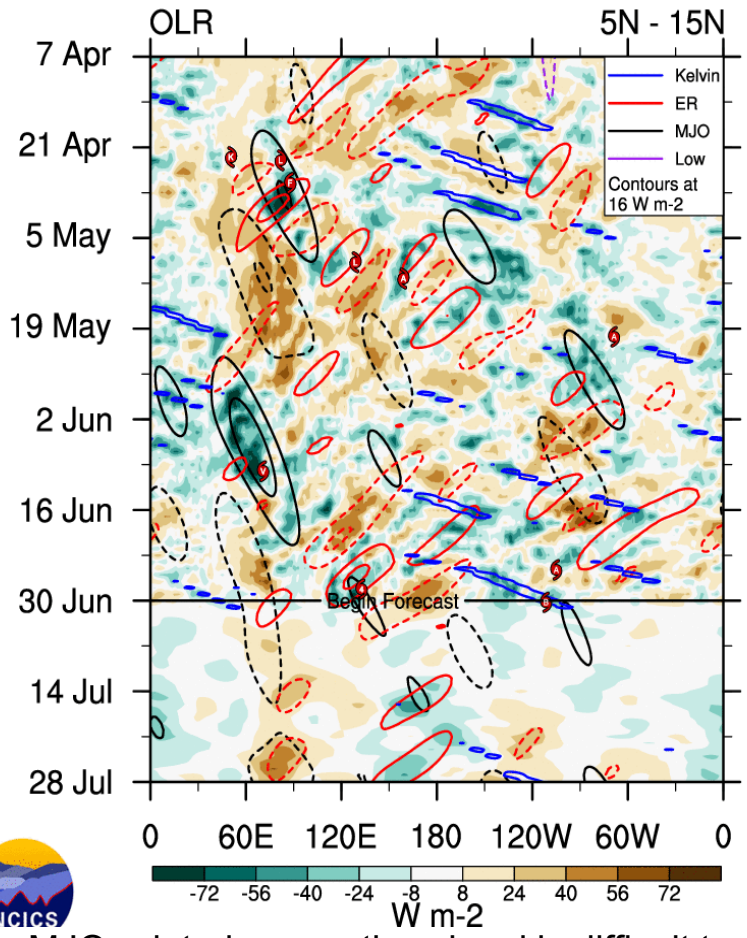


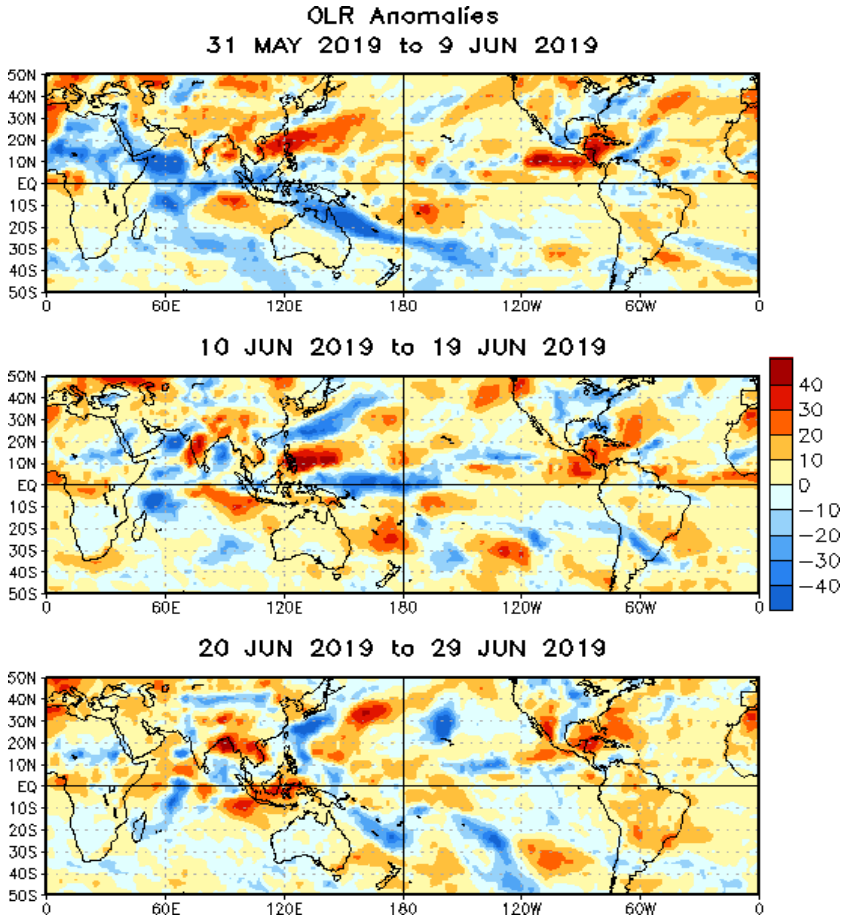


- Unlike the previous time when the MJO enhanced phase moved across the Pacific and generated a substantial westerly wind burst, the current event is not yet producing a robust low-level wind response.
- The eastward propagation of a weak MJO signal remains evident, with notable interference by westward-moving variability.

Outgoing Longwave Radiation (OLR) Anomalies

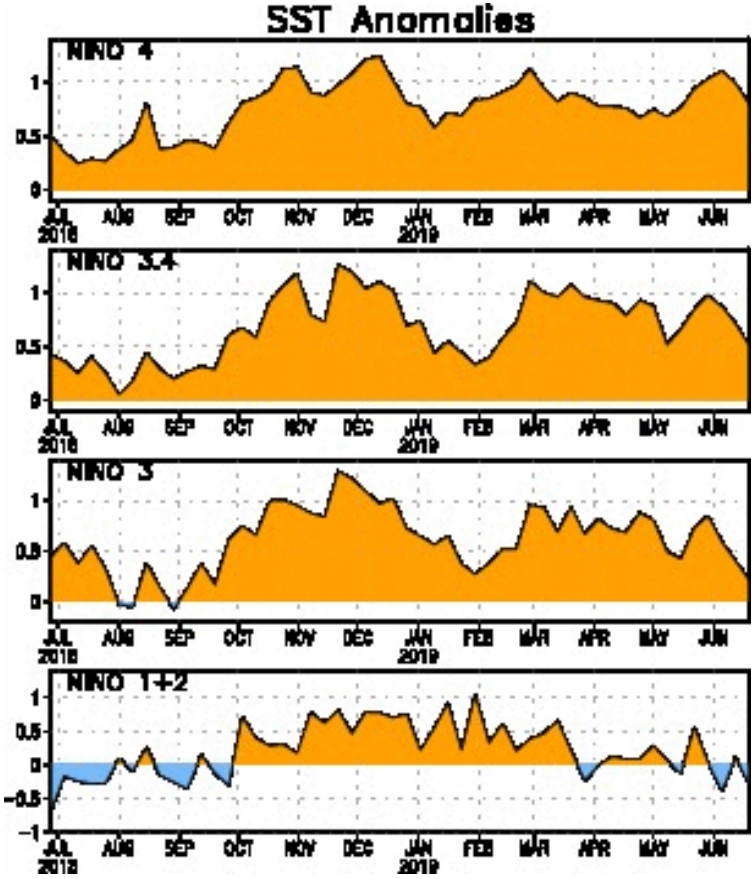
Blue shades: Anomalous convection (wetness). Red shades: Anomalous subsidence (dryness).

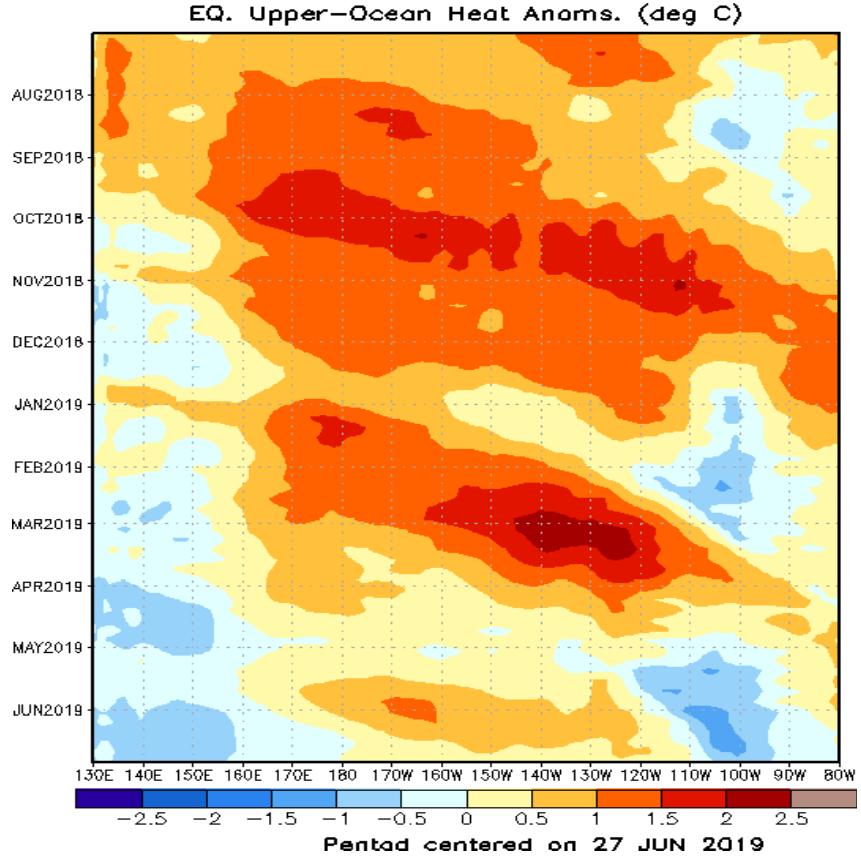




- Any MJO-related convective signal is difficult to detect, as areas of anomalous convection are dominated by Kelvin and Rossby wave activity.
- Enhanced convection near the Meiyu Front near and south of Japan persisted during much of June.
- Recent drying over the central Pacific appears most closely tied to the suppressed phase of an equatorial Rossby wave.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

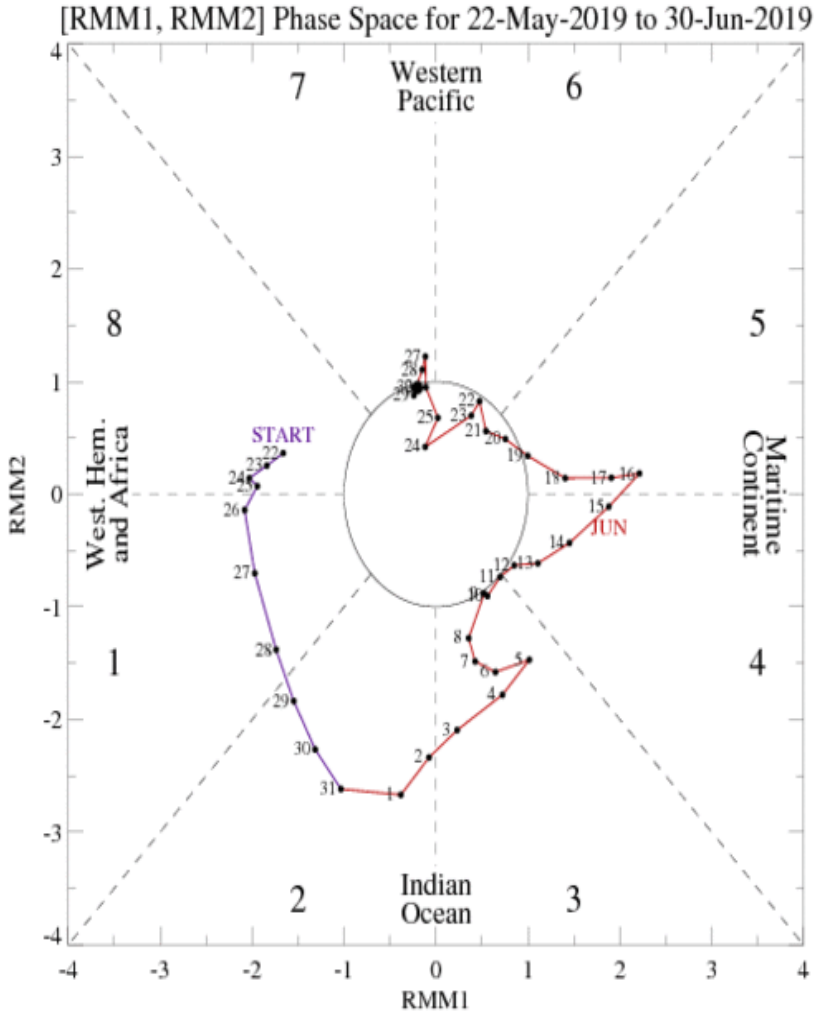




- SST anomalies remain above climatology across much of the equatorial Central and East Pacific, consistent with the ongoing El Niño event, though anomalies are decidedly low amplitude.
- A downwelling Kelvin wave event is evident over the central and eastern Pacific since mid-May, but its amplitude is weaker than what was observed in previous events. Overall, upper-ocean heat content has been on a steady decline over the past several months.

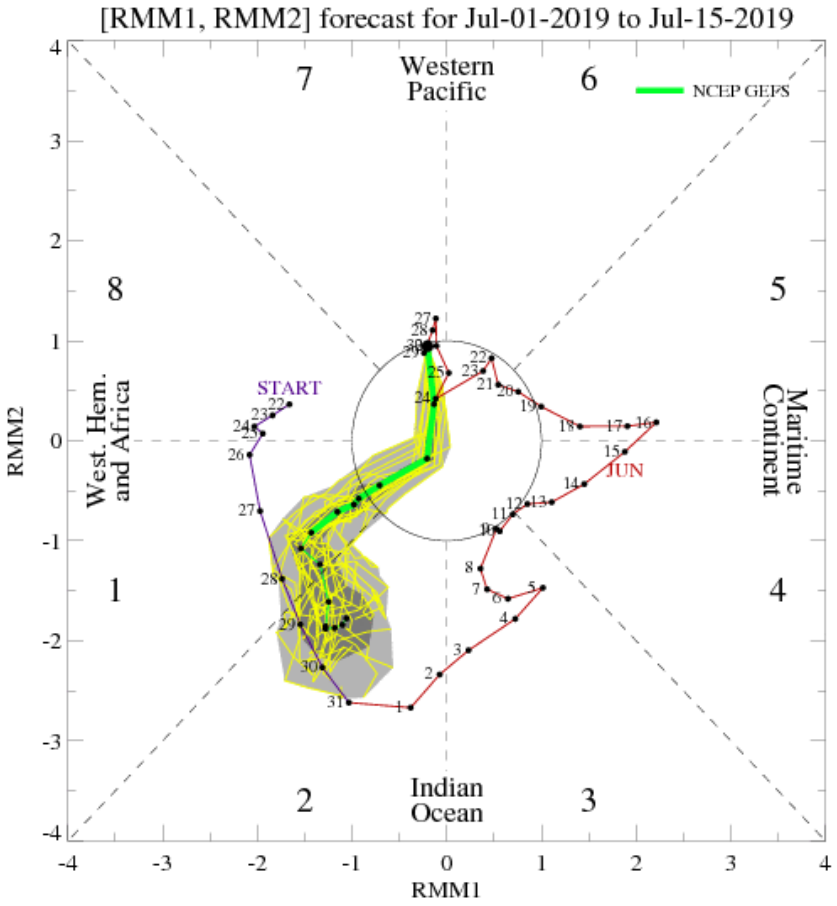
MJO Index: Recent Evolution

- The RMM index shows a nearly stalled signal over the western and central Pacific, driven by the upper- and lower-level zonal wind fields.

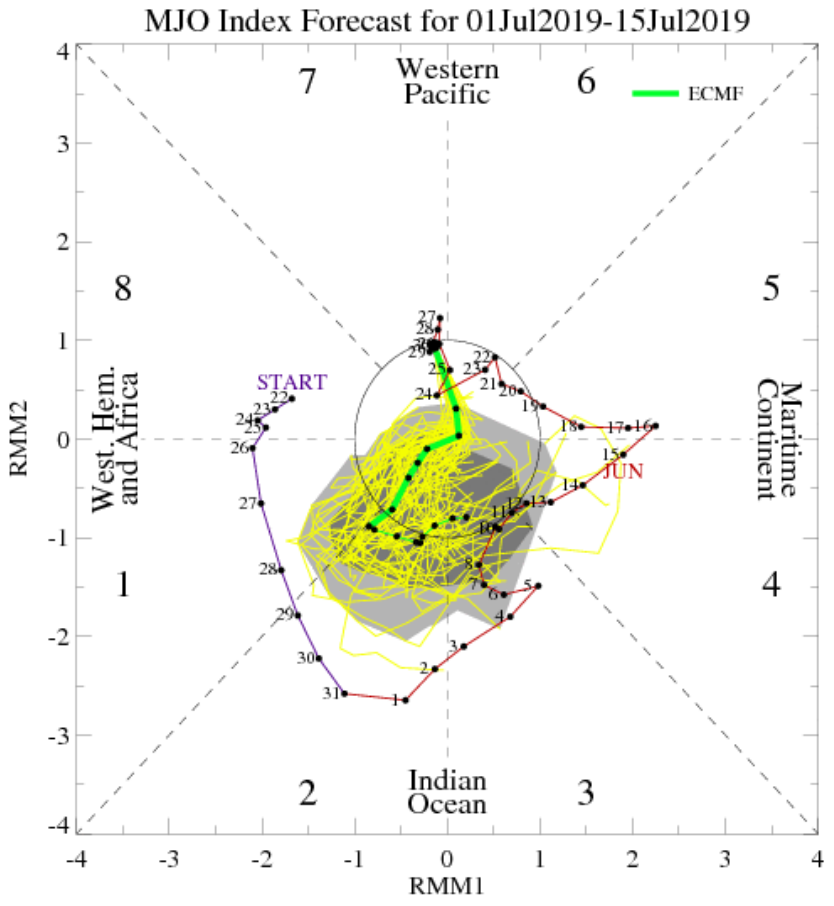


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

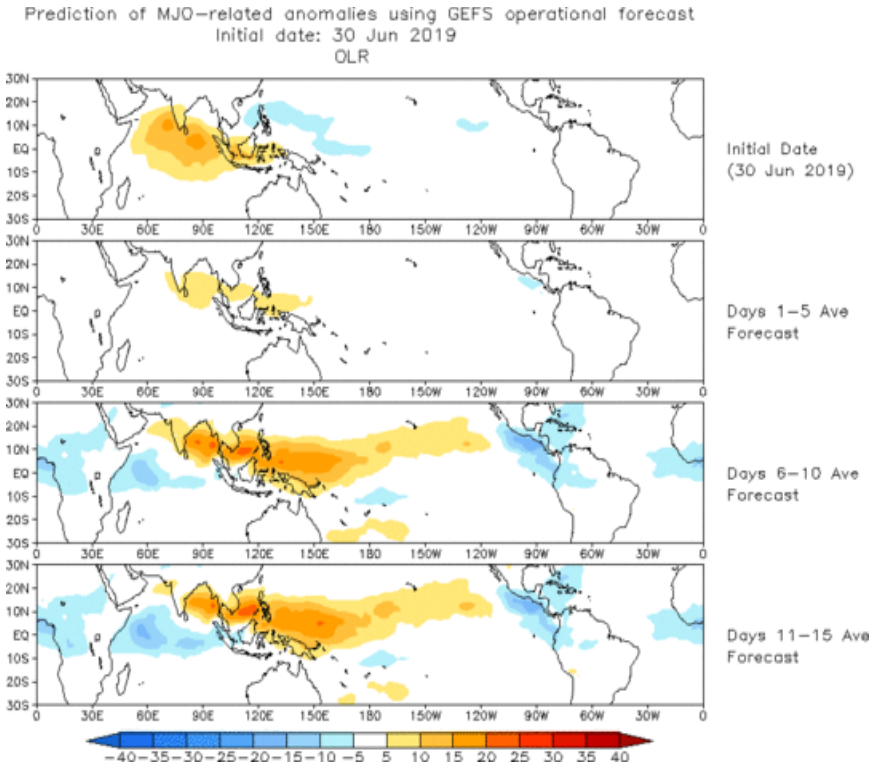


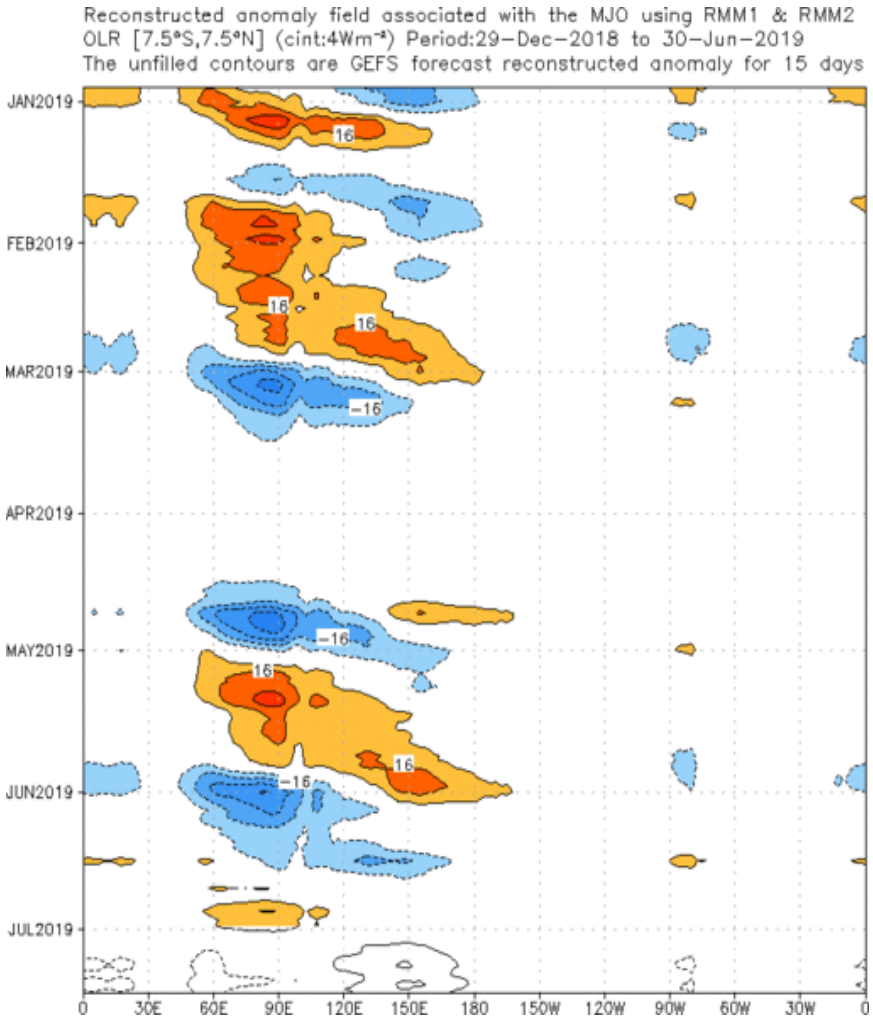
ECMWF Forecast

- The GEFS and ECMWF are in reasonably good agreement in depicting more coherent MJO activity emerging over Africa and the far western Indian Ocean during Week-2.

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.)

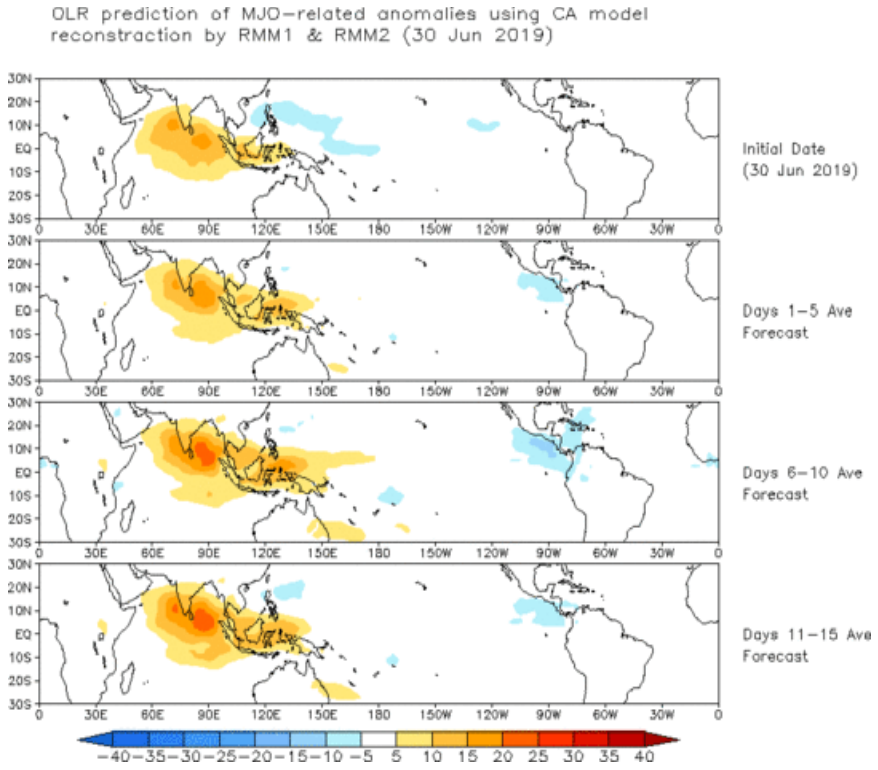


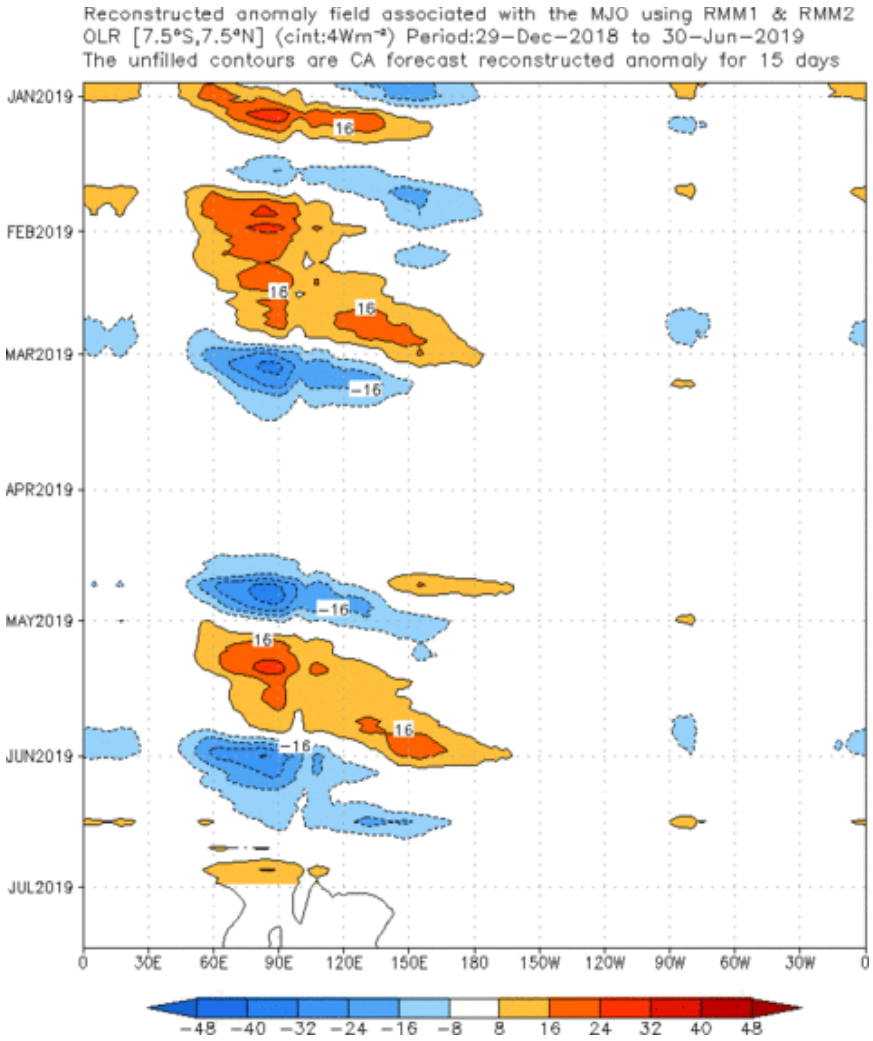


- The spatial depiction of the RMM-based OLR anomalies shows development of the canonical warm-season MJO dipole over the Eastern Hemisphere.

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.)

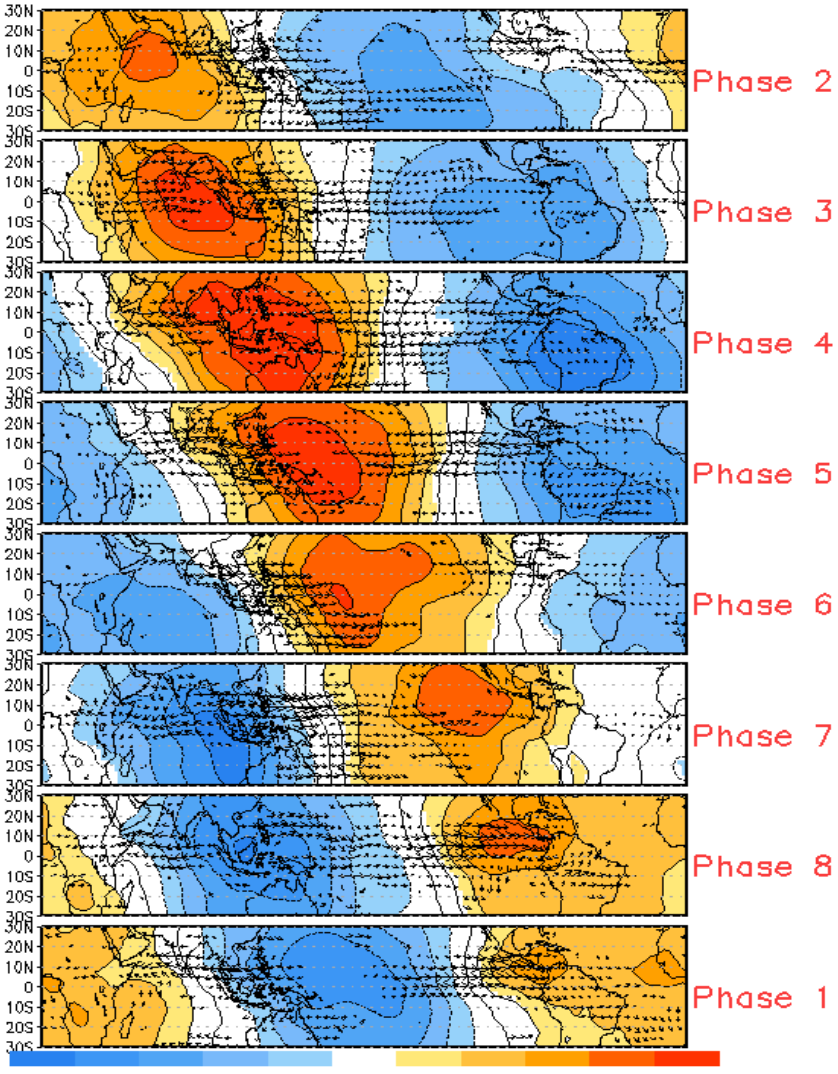




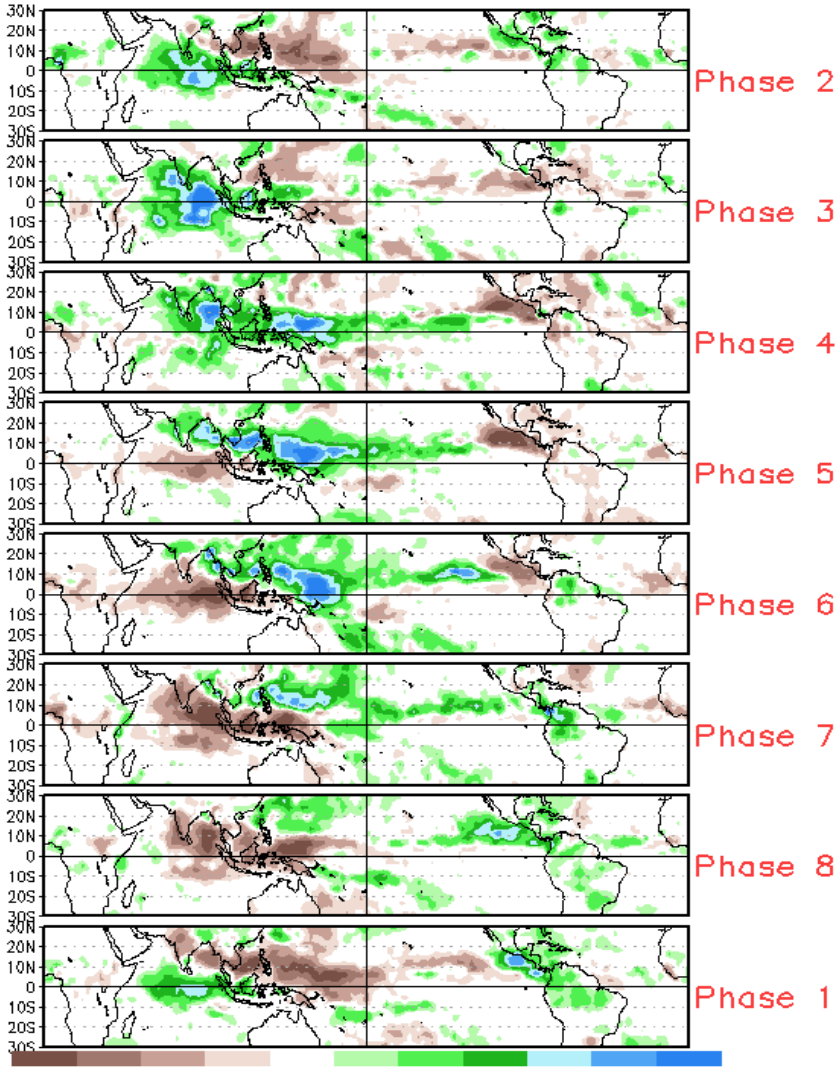
- The constructed analog depicts a stationary signal over the next two weeks.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



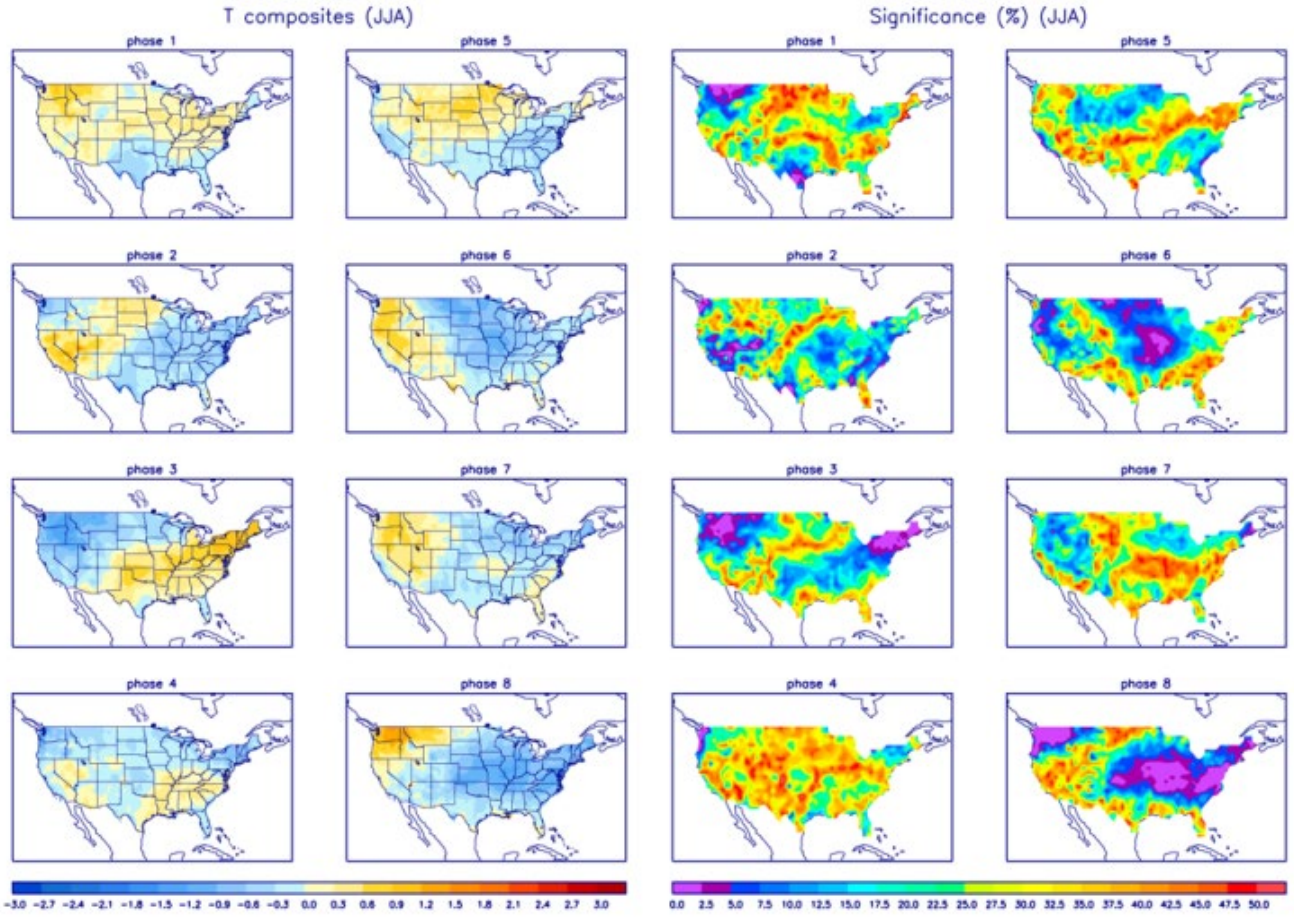
Precipitation Anomalies



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.

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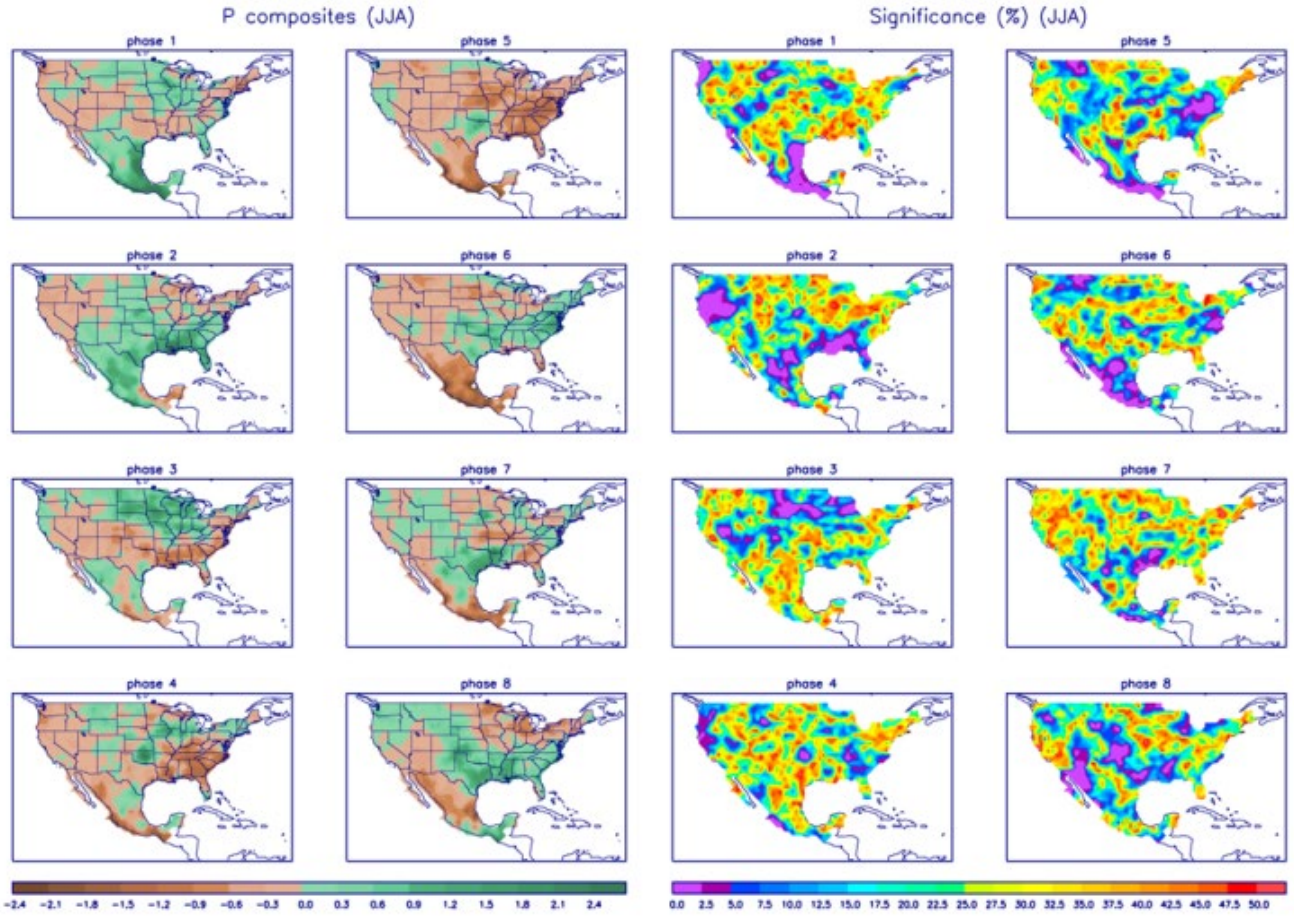

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