

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
6 July 2020

Overview

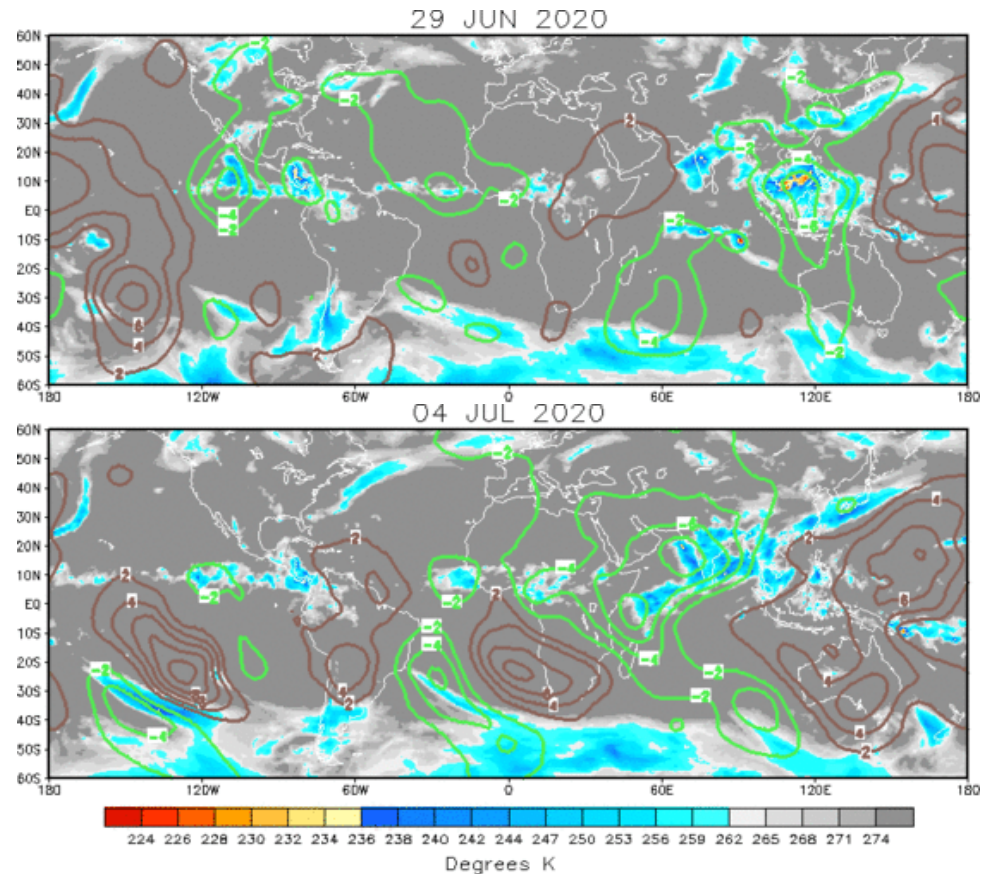
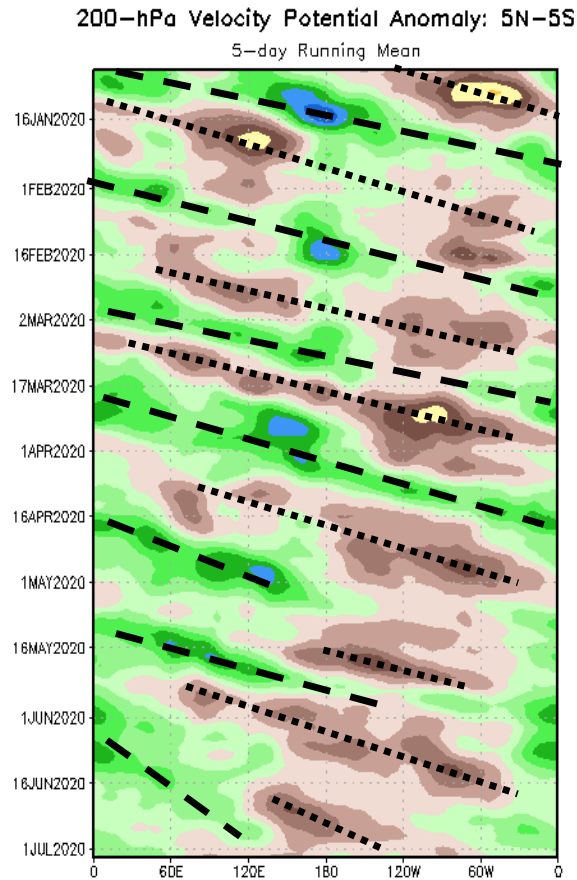
- A broad convective envelope persists over the Indian Ocean, associated with the convergence of an equatorial Rossby wave and a Kelvin wave. Suppressed convection over the Western Pacific is associated with a low frequency signal.
- Most dynamical models forecast the intraseasonal signal to remain over the Indian Ocean during the next two weeks.
- The best chances for tropical cyclone (TC) development are over the Eastern Pacific (associated with a Kelvin wave) and possibly the Indian Ocean (due to the constructive interference of an equatorial Rossby wave and a Kelvin wave).
- Extratropical impacts from the MJO, should it develop, appear unlikely at this time.

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).

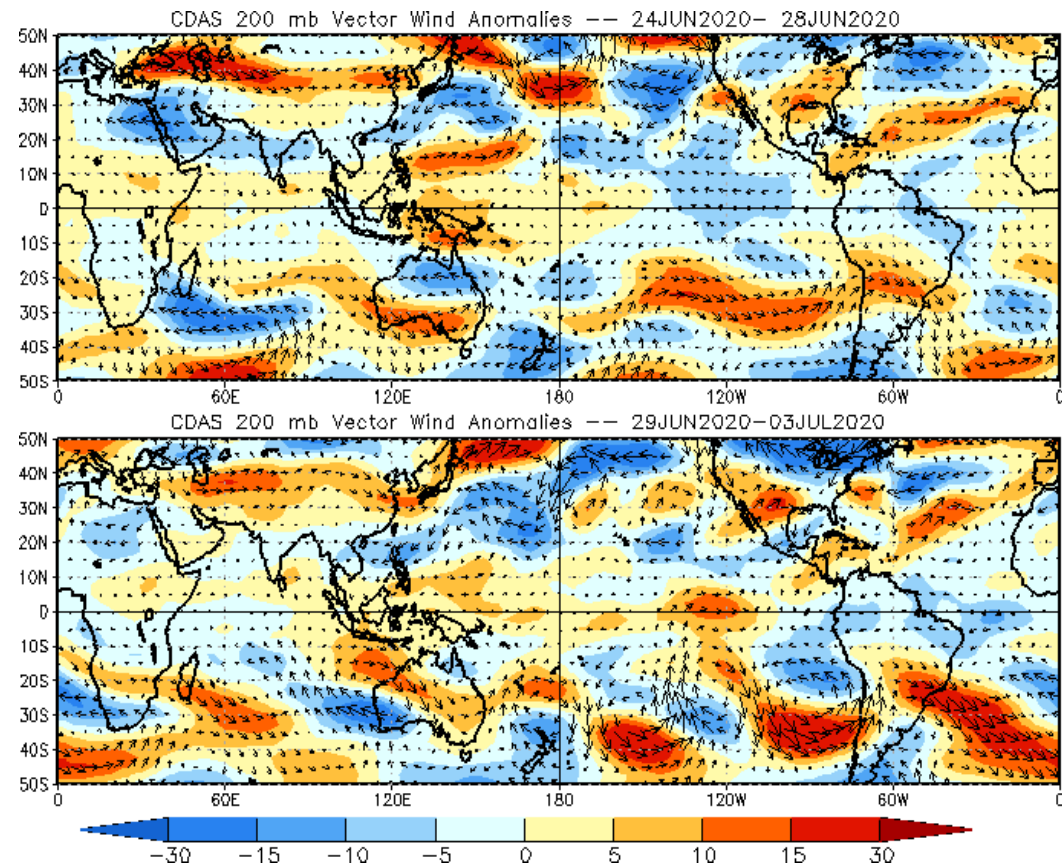
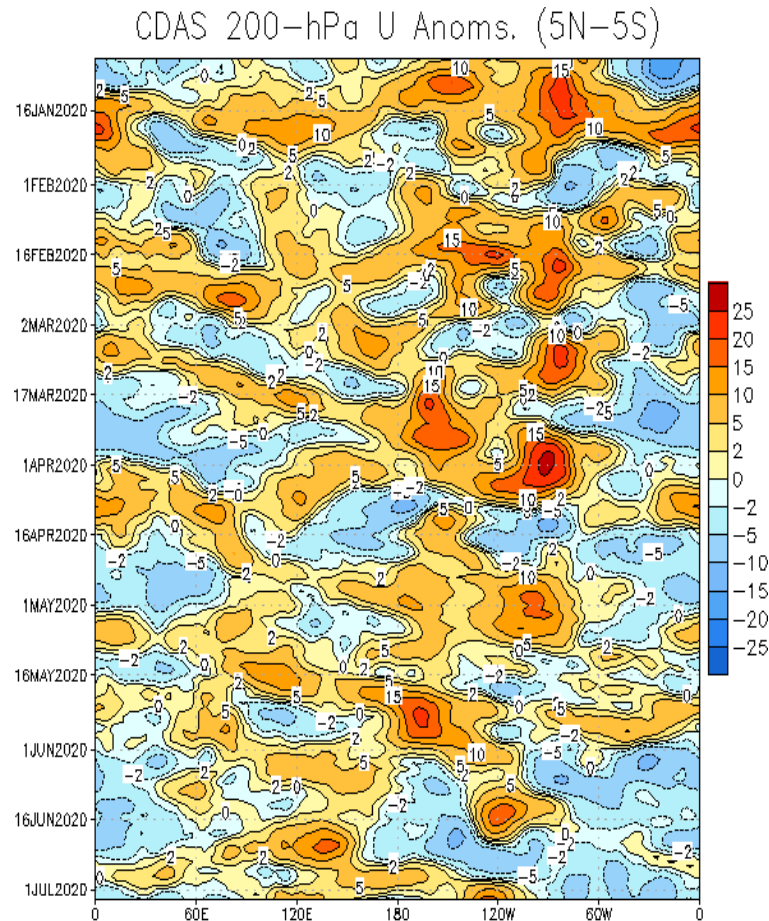
Brown shades: Anomalous convergence (unfavorable for precipitation).



- The remains of a wavenumber-2 pattern from June 29th have consolidated (especially across the Eastern Hemisphere), with enhanced (suppressed) convection over Africa and the Indian Ocean (Maritime Continent and Western Pacific).
- Over the Western Hemisphere, an alternating VP anomaly pattern is primarily concentrated across the Southern Hemisphere.

200-hPa Wind Anomalies

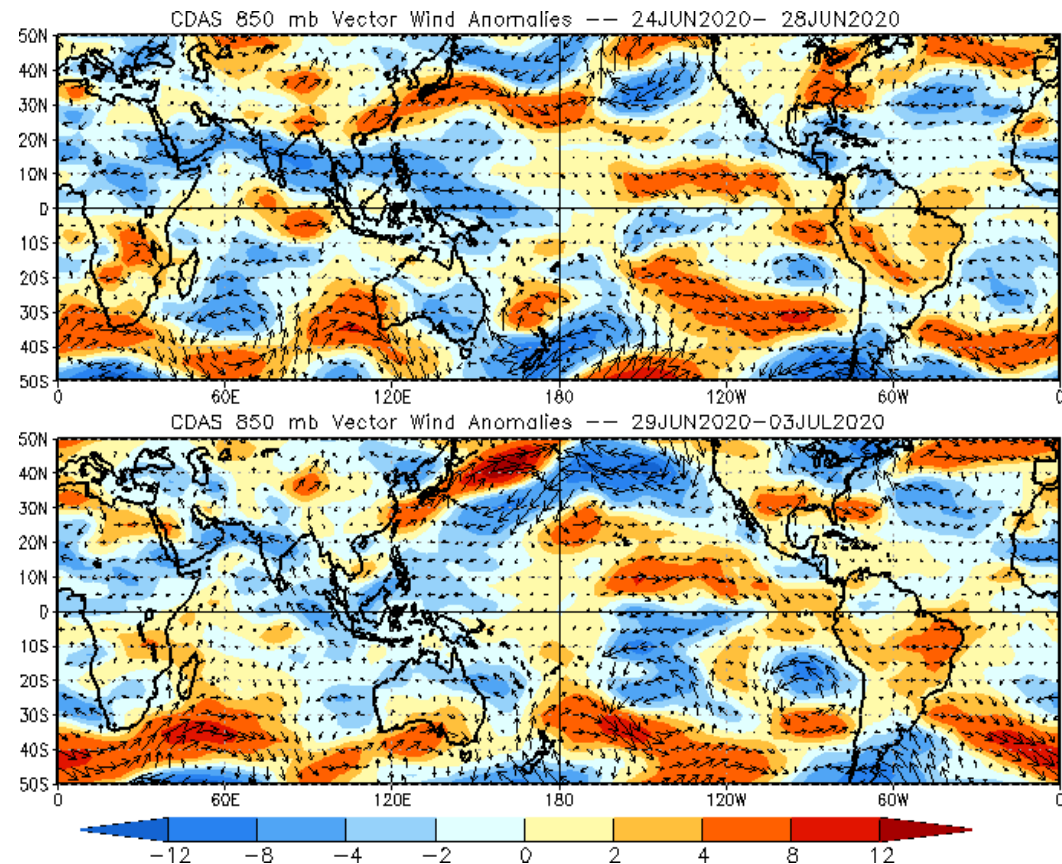
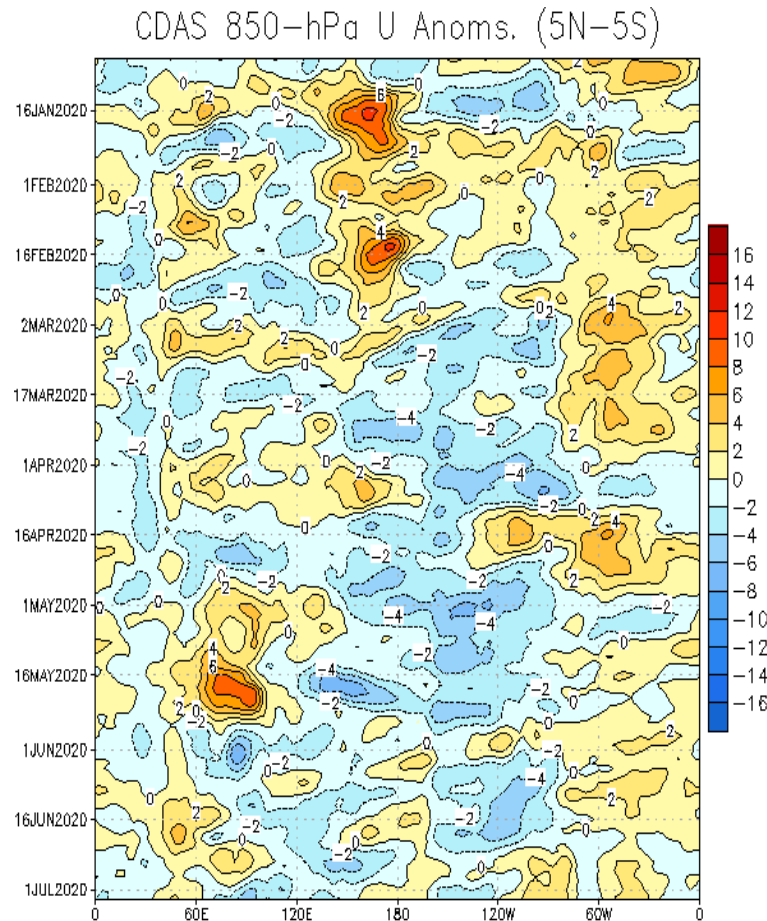
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Anomalous westerlies drifted westward from near the Date Line to over the Maritime Continent during the past 2-3 months, where they stalled. During the past week, the anomalous westerlies rapidly surged eastward over the entire near-equatorial Pacific. Anomalous easterlies are prevalent across the Atlantic.
- An amplified circulation pattern is evident over the Northern Hemisphere extratropics, with substantial wavebreaking across the North Pacific exhibiting some linkage to the lower latitudes in the top panel.

850-hPa Wind Anomalies

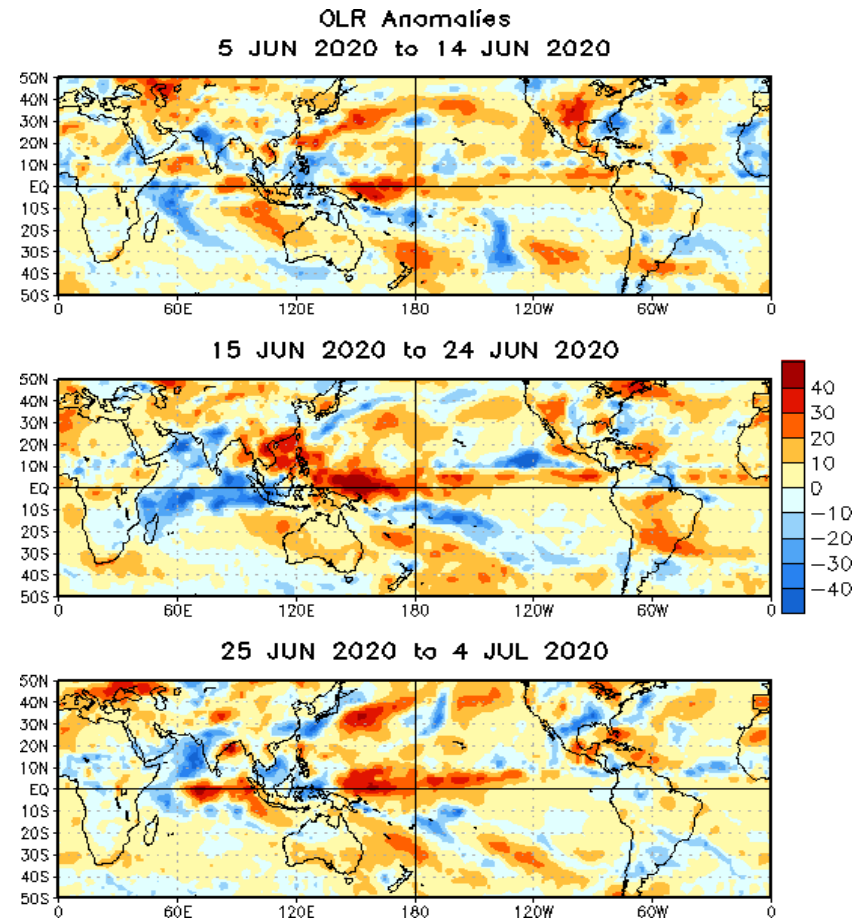
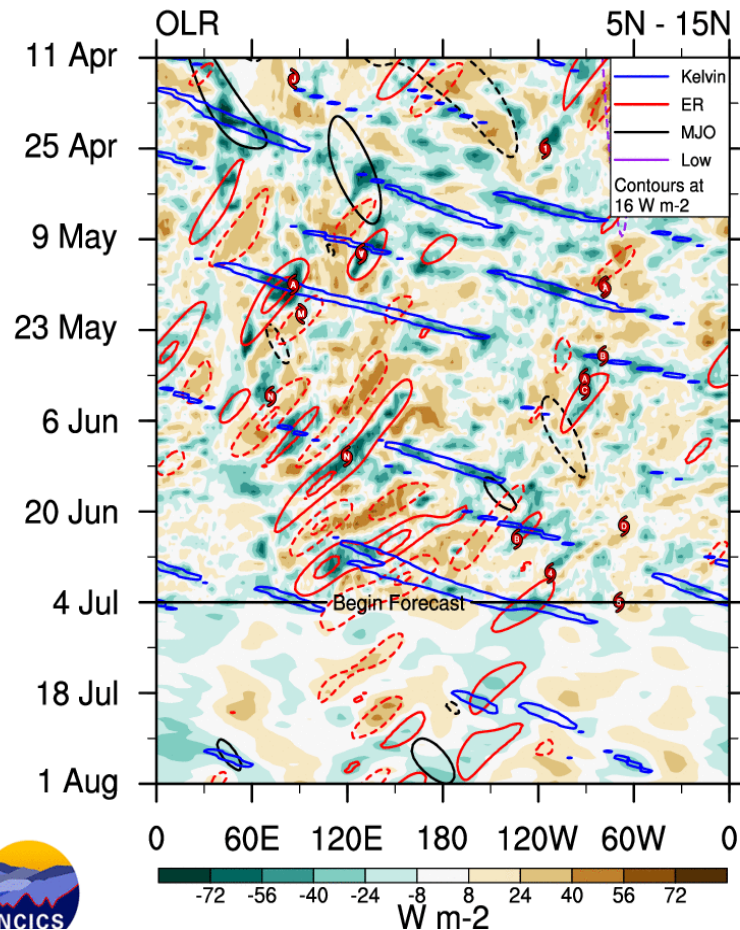
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- Low-level anomalous westerlies pushed eastward across the Indian Ocean in late June, but have since drifted westward to about 60E.
- Anomalous divergence is apparent near the Date Line, further reinforcing the anomalous subsidence within the Walker Circulation.
- Recent anomalous low-level cyclonic flow is apparent over much of the East Pacific, representing a favorable state for tropical cyclone development (while also a feature of the circulation of these systems themselves).

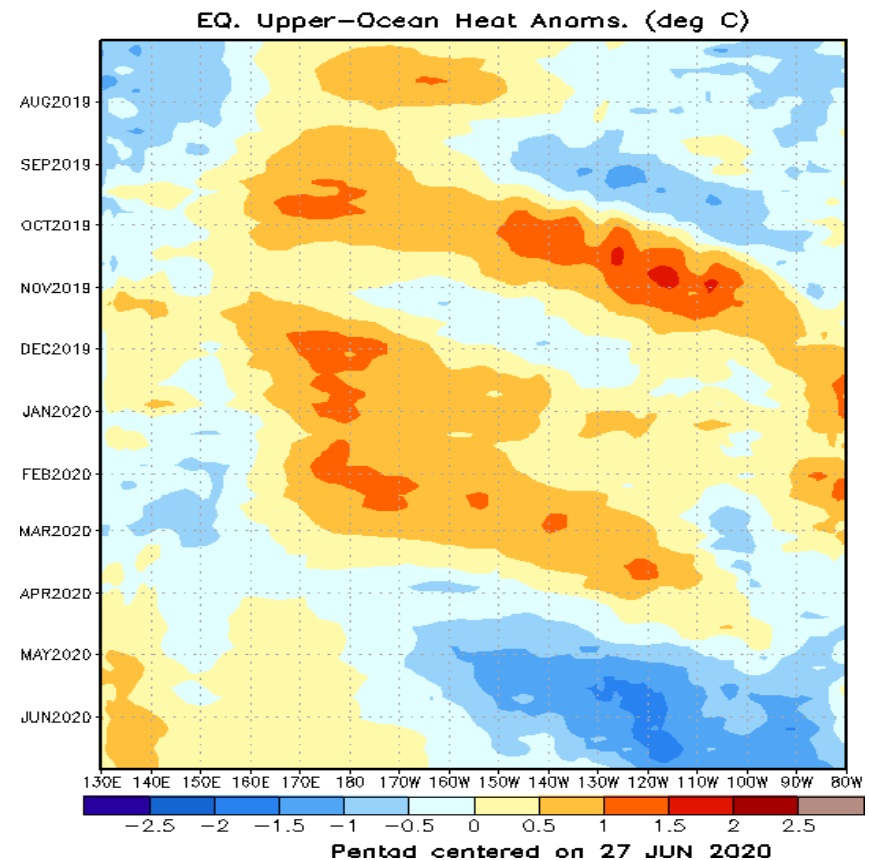
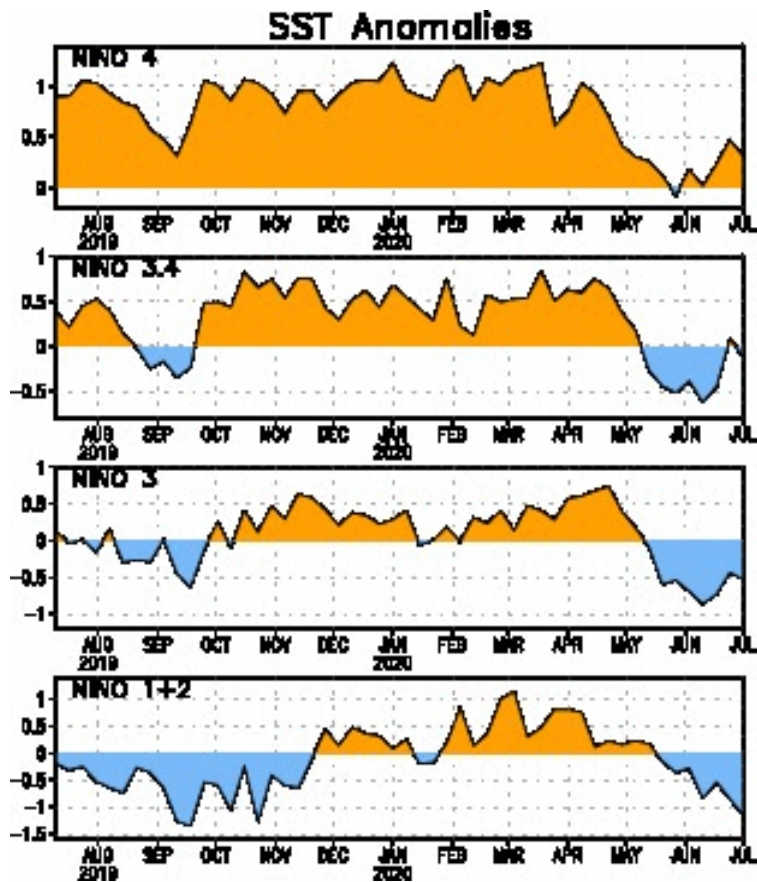
Outgoing Longwave Radiation (OLR) Anomalies

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



- Objective OLR filtering highlights several Kelvin waves over the global tropics; one near the Prime Meridian, a second over the Indian Ocean, and a third over the far East Pacific.
- Periodic Rossby wave activity over the West Pacific has been ongoing since mid-June. The possible interaction between a Kelvin wave and an equatorial Rossby wave over the Indian Ocean during week-1 may lead to TC development.

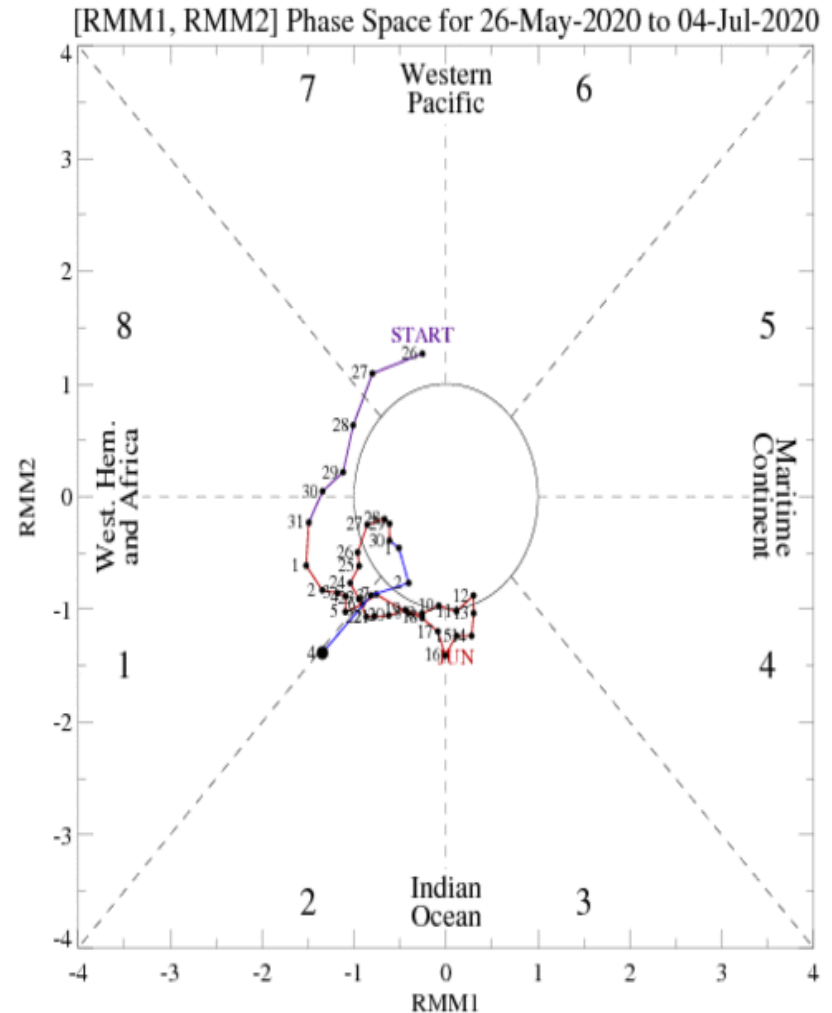
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- SST anomalies in the three easternmost Niño regions have been negative since mid-May.
- An upwelling oceanic Kelvin wave is at least partially responsible for this SST reduction, as evident in the time evolution of upper ocean heat content.

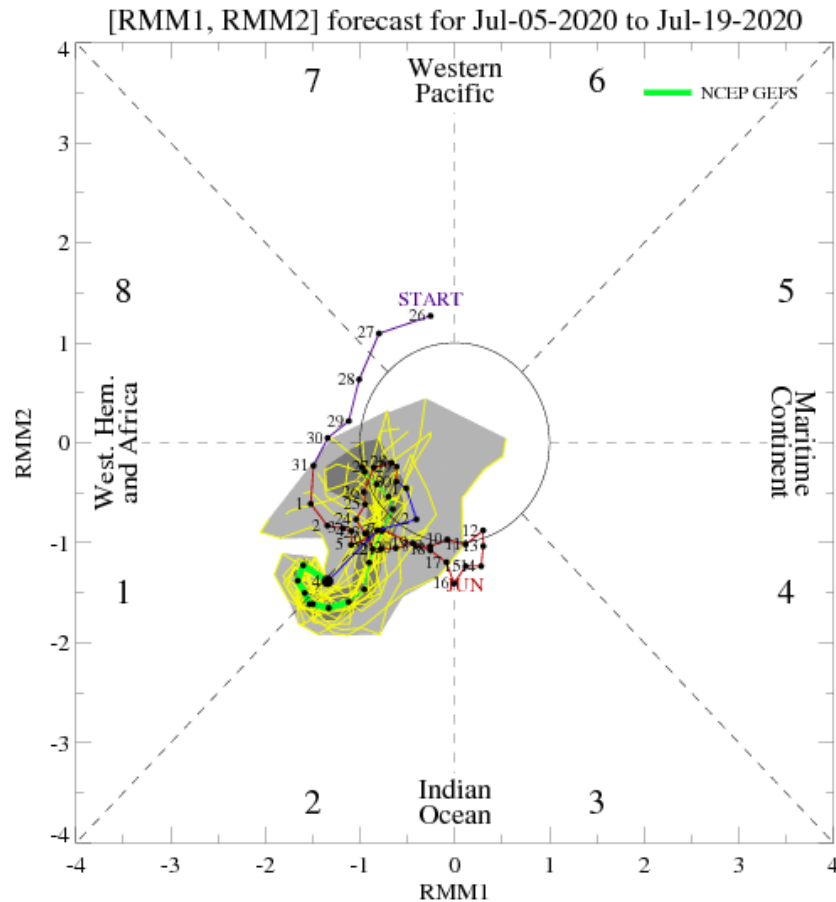
MJO Index: Recent Evolution

- The RMM index has drifted about the interface between Phases 1 and 2 during the past week, and has remained of low amplitude. This is not characteristic of a singular, robust MJO event.

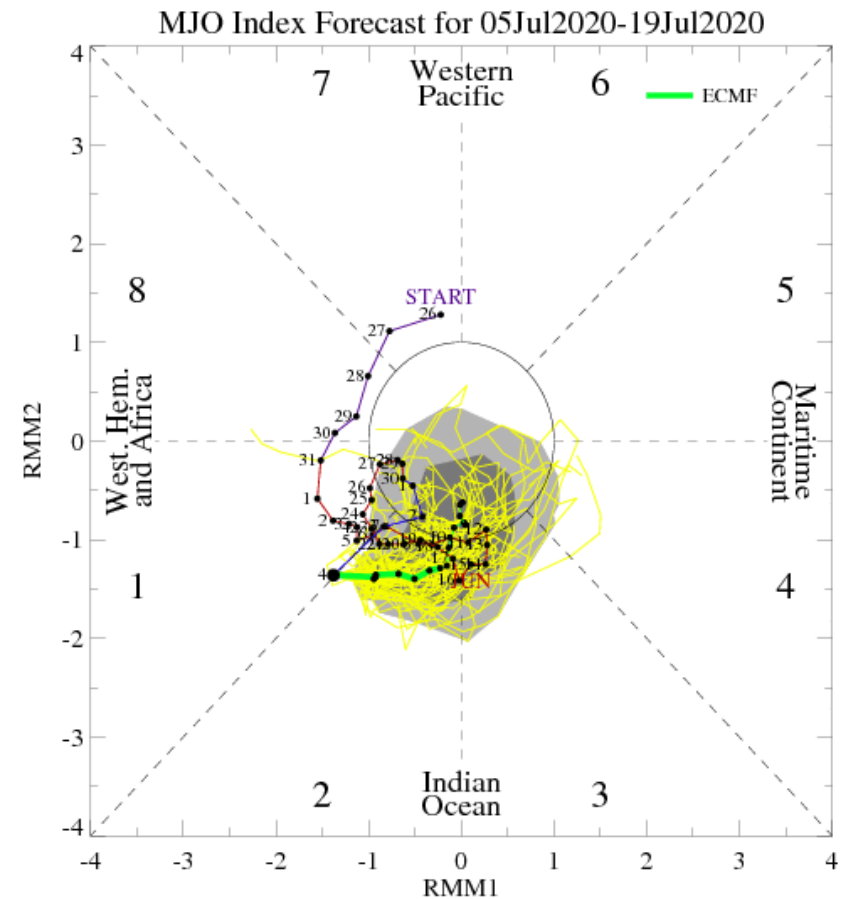


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



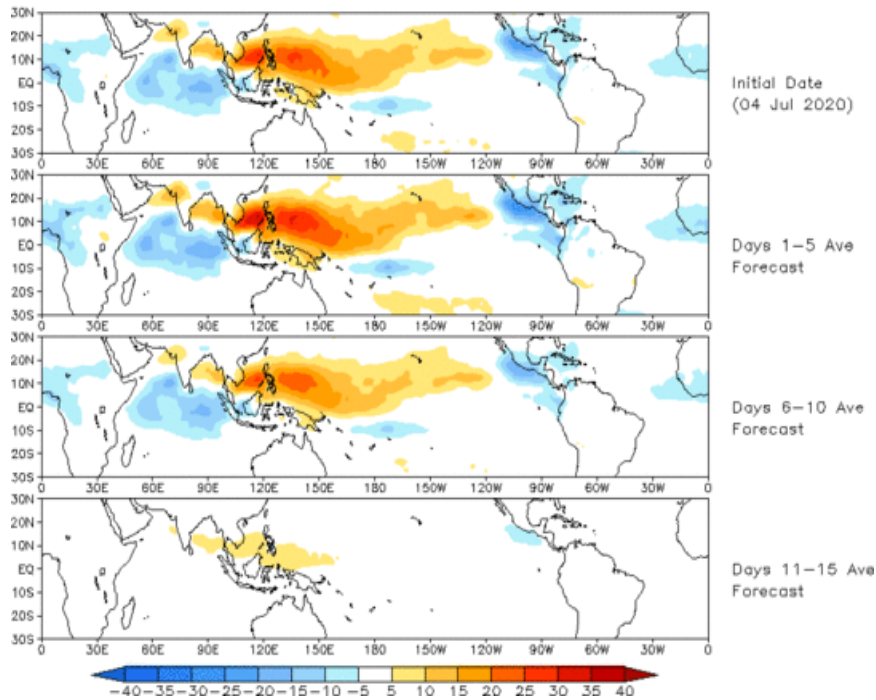
ECMWF Forecast

- The GEFS forecast of the MJO index shows little forward (eastward) propagation of the subseasonal signal during weeks 1 and 2, and a weakening of the signal to within the unit circle in week-2.
- The ECMWF forecast of the MJO index predicts significantly greater spread among ensemble members, with the subseasonal signal propagating eastward across the Indian Ocean and weakening over the next two weeks. A few members bring the signal as far east as the Maritime Continent region.

MJO: GEFS Forecast Evolution

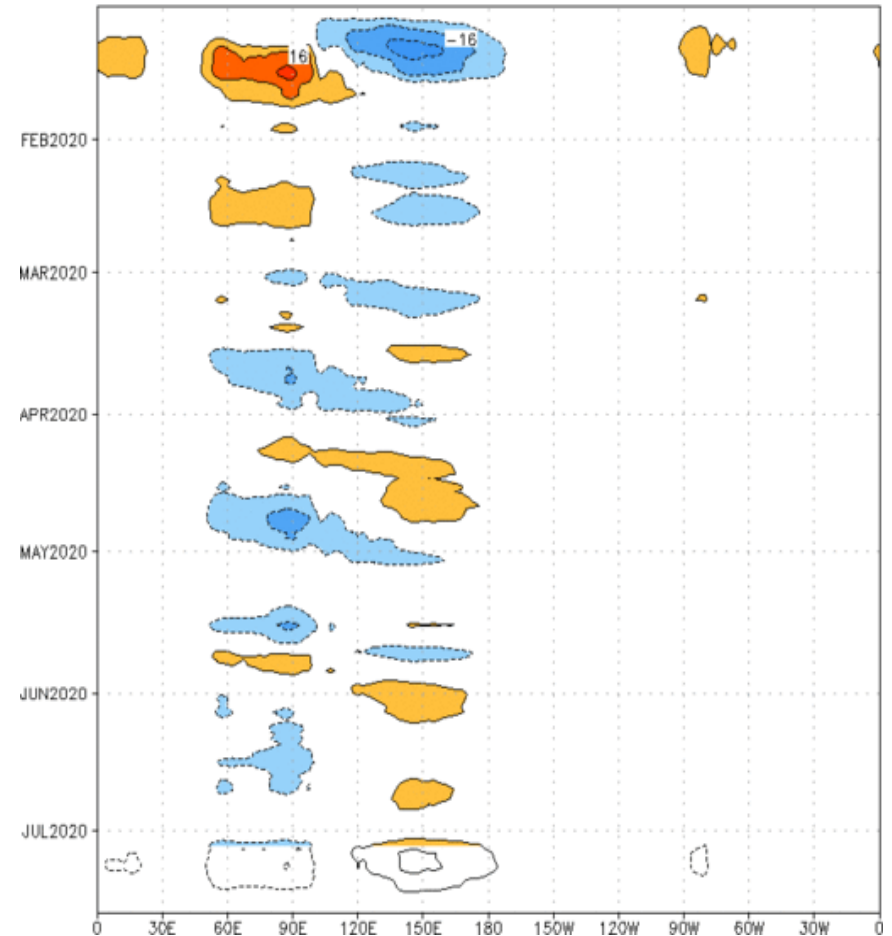
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 04 Jul 2020
OLR



- The GEFS spatial maps show a quasi-stationary tropical convective pattern that weakens only slightly during the next 10 days, but collapses rapidly thereafter.

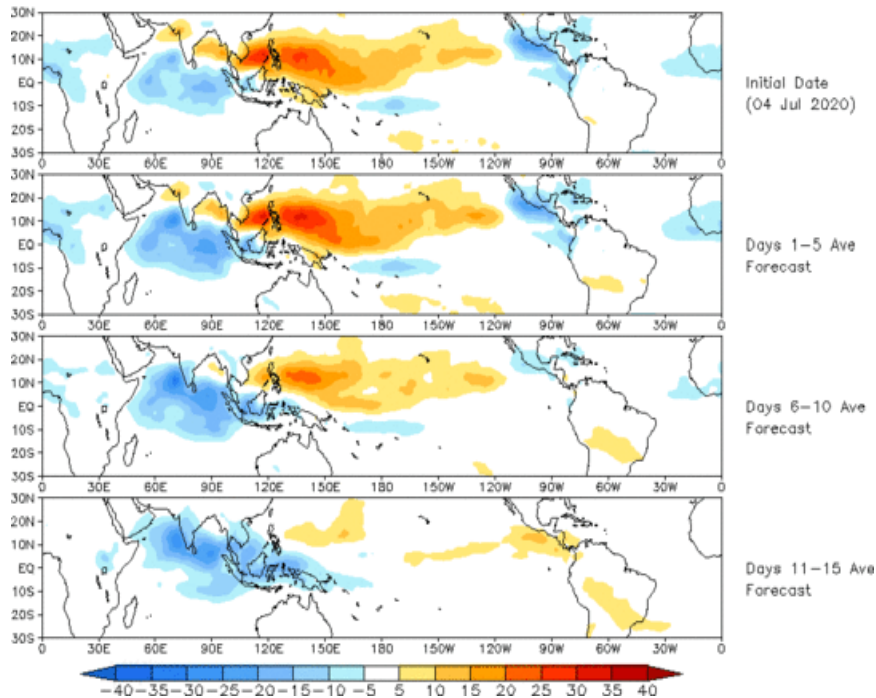
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S, 7.5°N] (cont: 4 Wm^{-2}) Period: 03-Jan-2020 to 04-Jul-2020
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



MJO: Constructed Analog Forecast Evolution

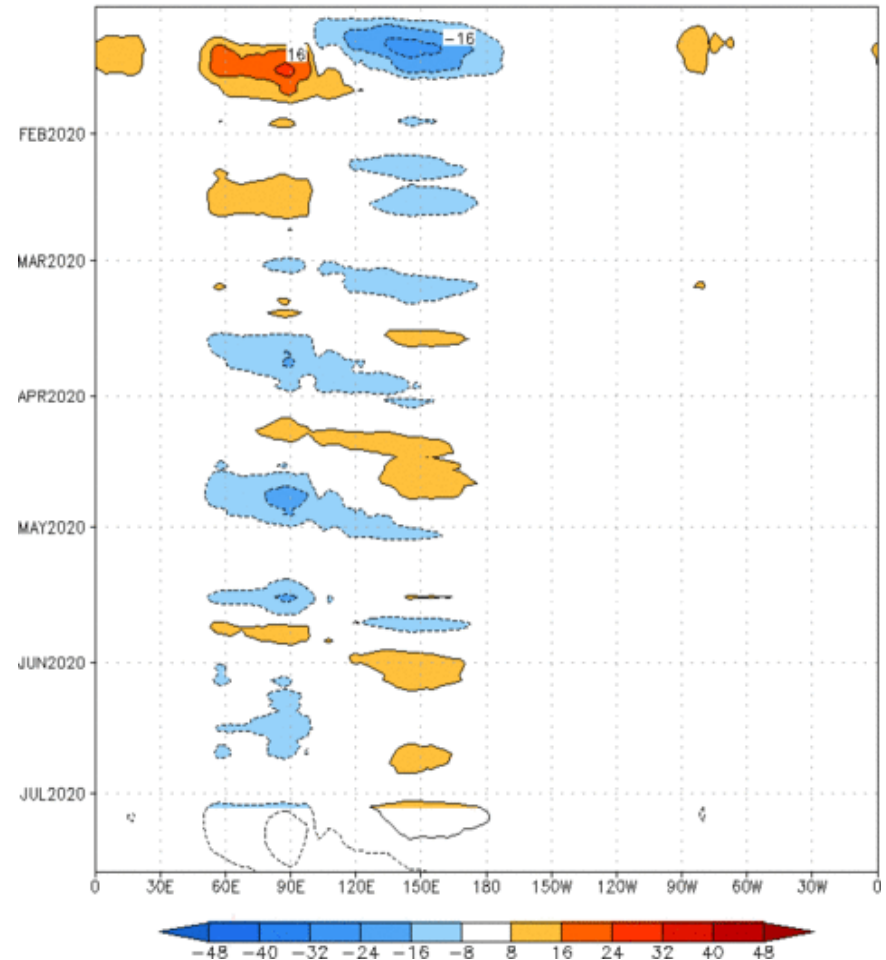
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (04 Jul 2020)



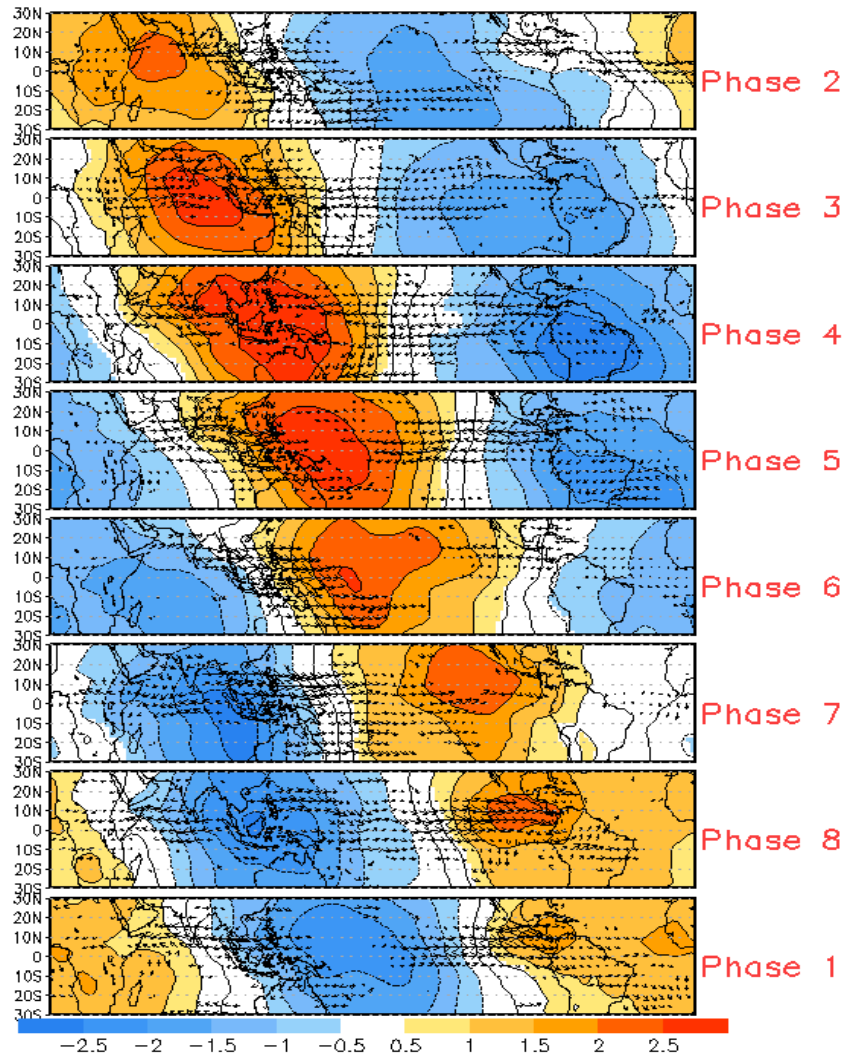
- The constructed analog model depicts a very similar scenario to that of the GEFS, featuring enhanced convection over the Indian Ocean spreading across the Maritime Continent region during week-2; and suppressed convection from the South China Sea and Philippines eastward to the east-central Pacific.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:03-Jan-2020 to 04-Jul-2020
The unfilled contours are CA forecast reconstructed anomaly for 15 days

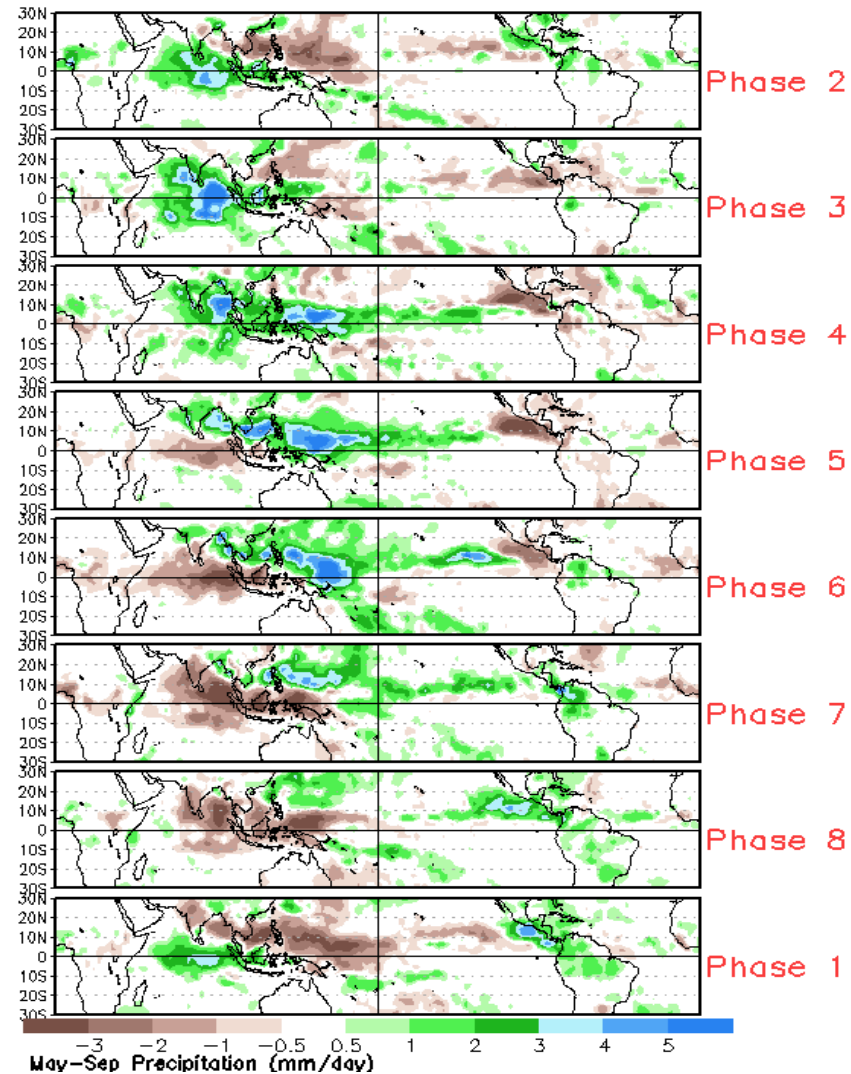


MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



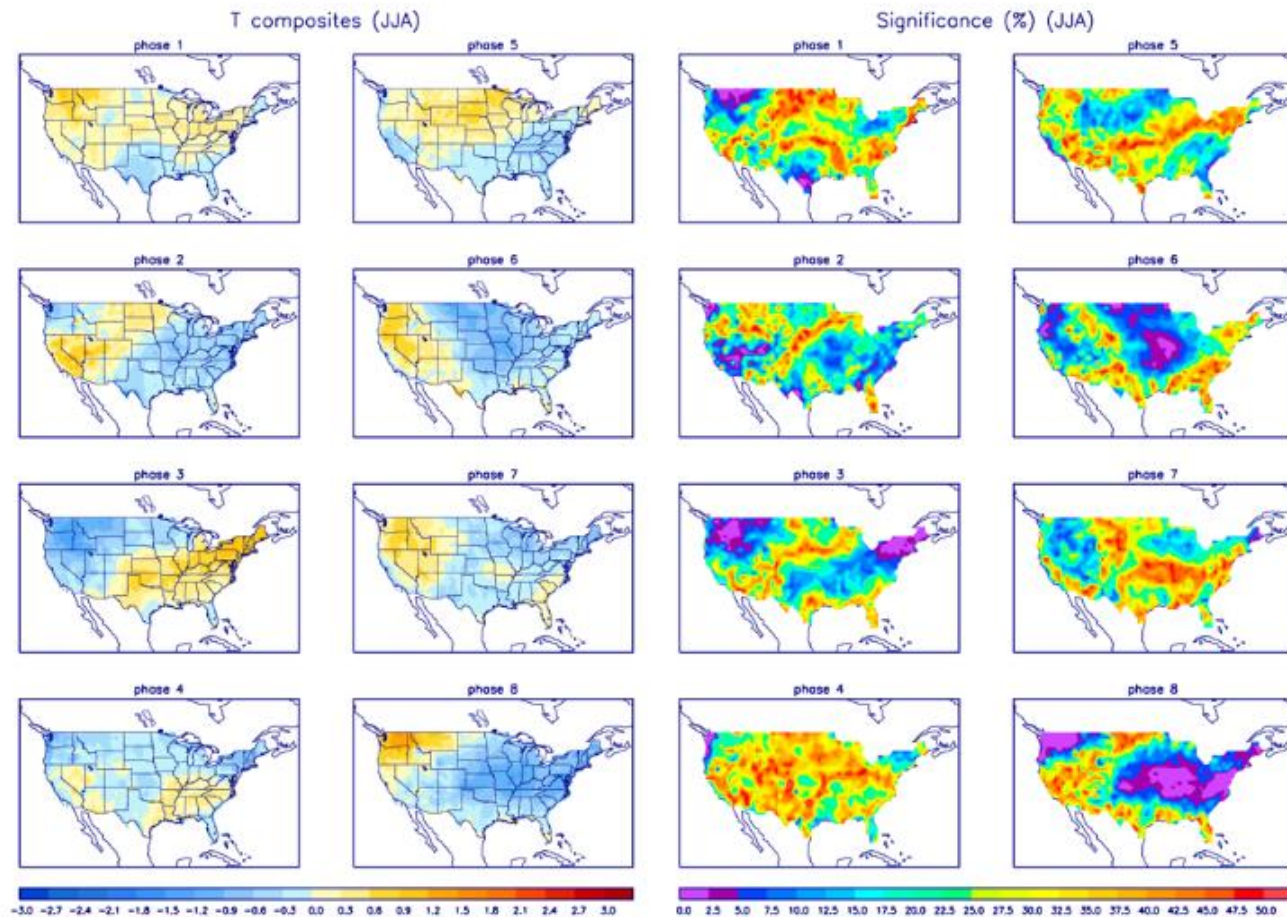
Precipitation Anomalies



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.

