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

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
13 April 2020

Overview

- A rapidly propagating eastward moving envelope of convection has crossed the Western Pacific and into the Western Hemisphere during the past week, with a phase speed continuing to suggest a convectively-coupled Kelvin wave.

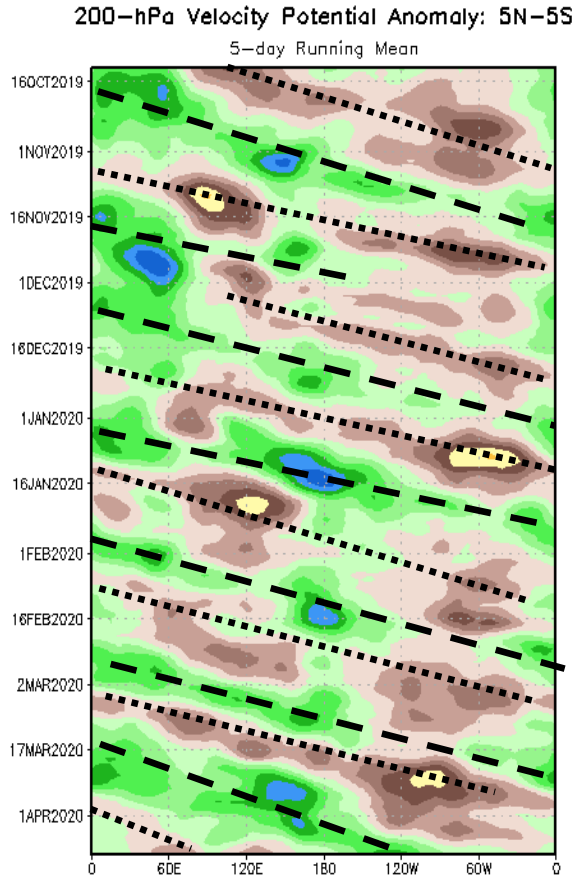
- Dynamical models support the continued progression of this envelope across the Africa during Week-1 and into the Indian Ocean during Week-2.

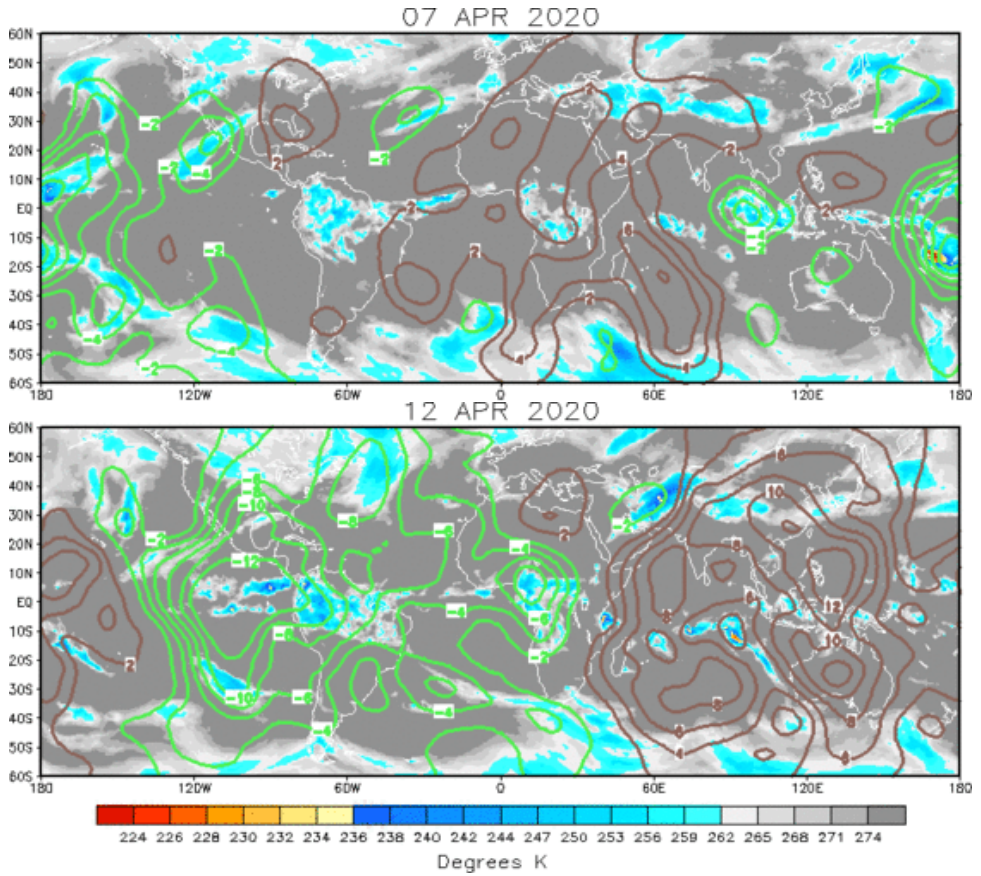
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).



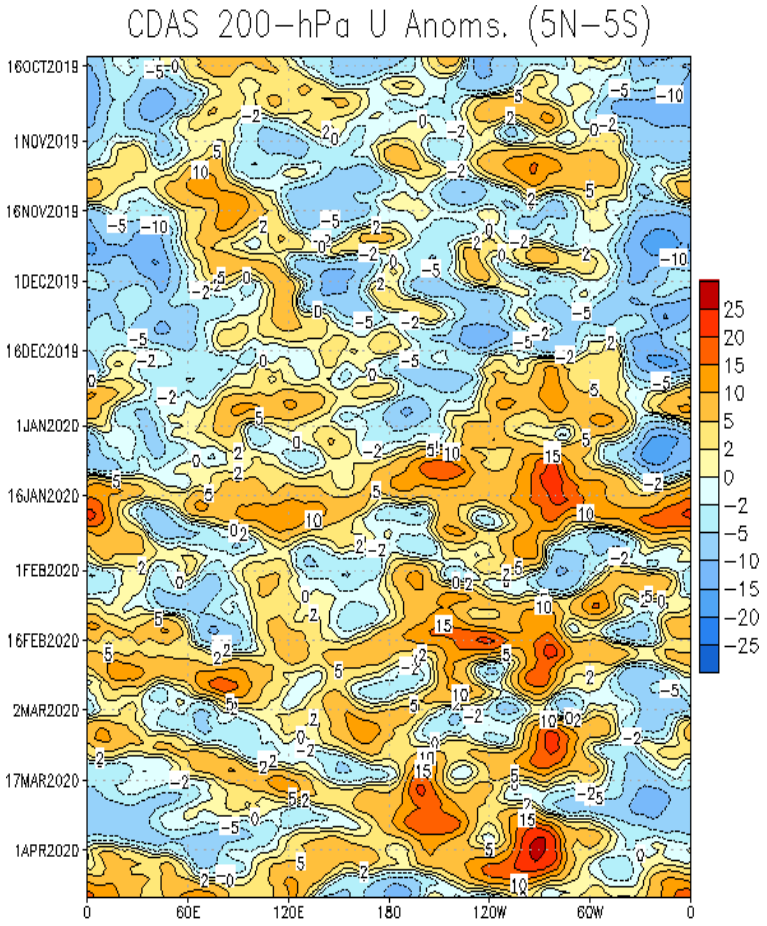


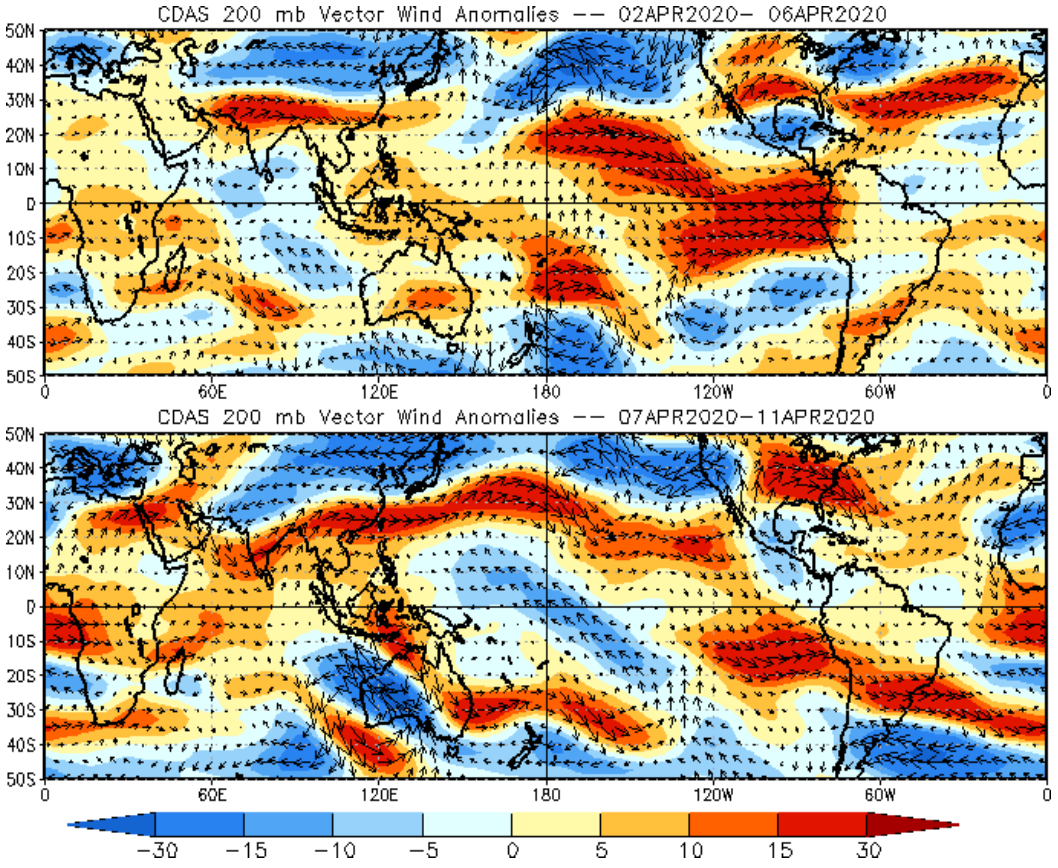
- A well-defined wave-1 pattern has been recently observed, as enhanced convection has propagated eastward from the Western Pacific to Western Hemisphere/Africa during the past week

- The rapid progression of the enhanced signal is suggestive of a convectively-coupled Kelvin wave.

200-hPa Wind Anomalies

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



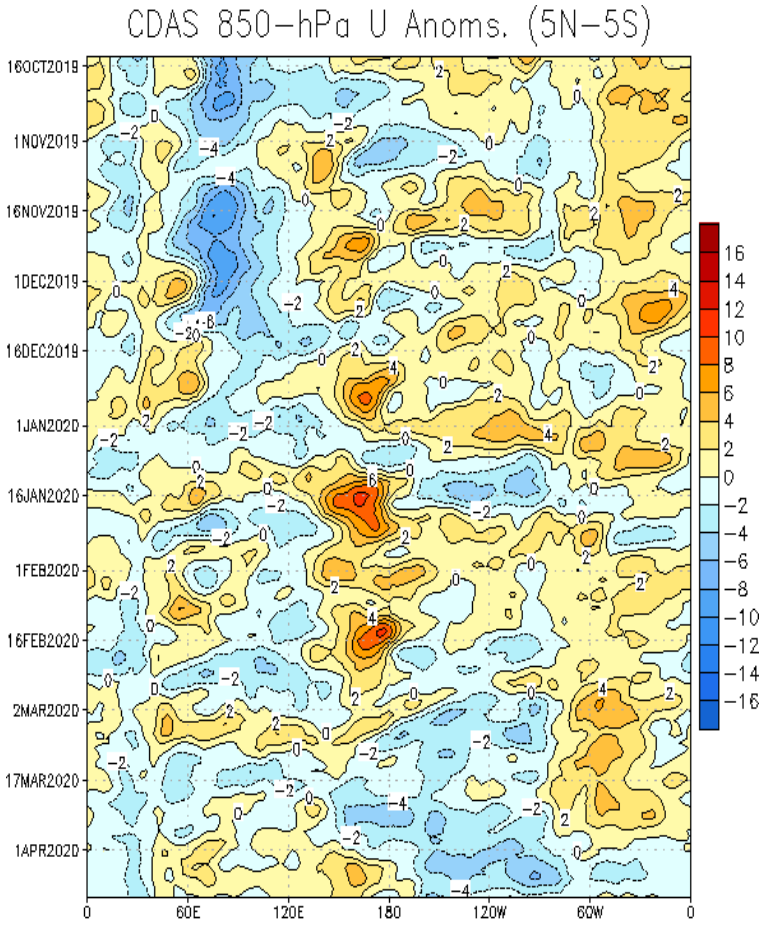


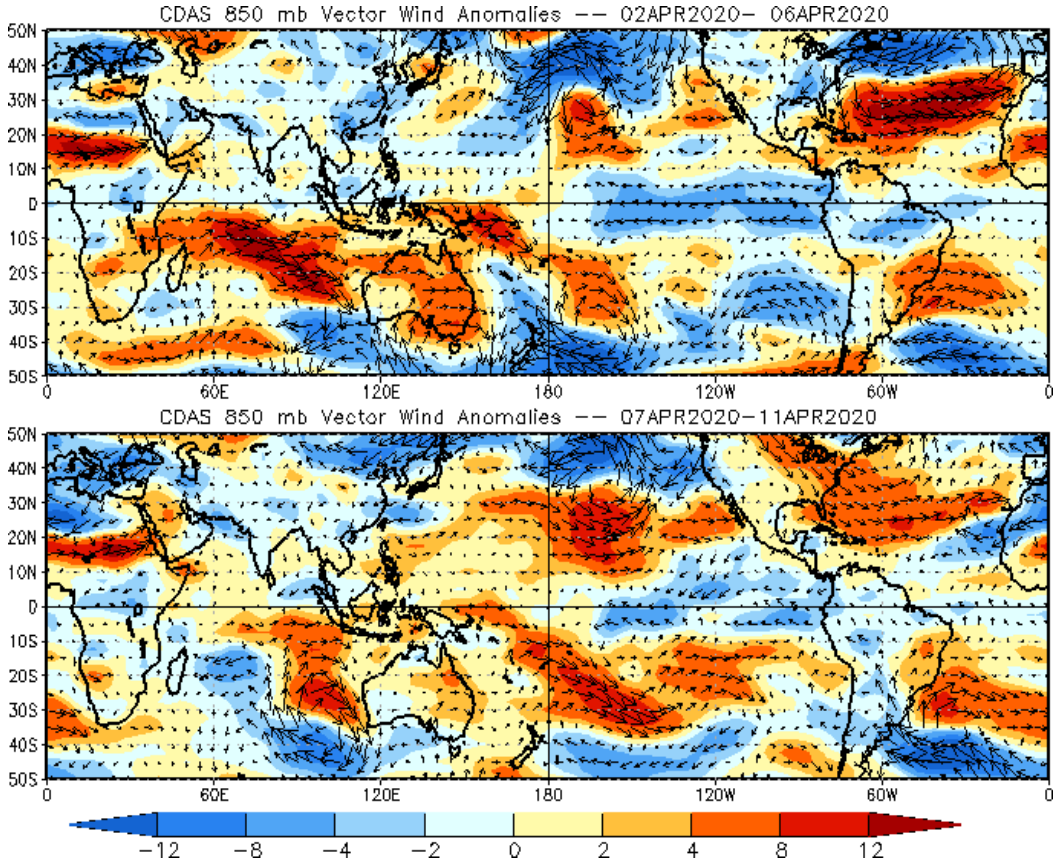
- Following the persistence of anomalous westerlies over the tropical Pacific since late March, anomalous easterlies have recently developed around the date line supporting divergence aloft over the eastern Pacific.

- Anomalous westerlies aloft have expanded over the Indian Ocean and into the Maritime Continent.

850-hPa Wind Anomalies

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



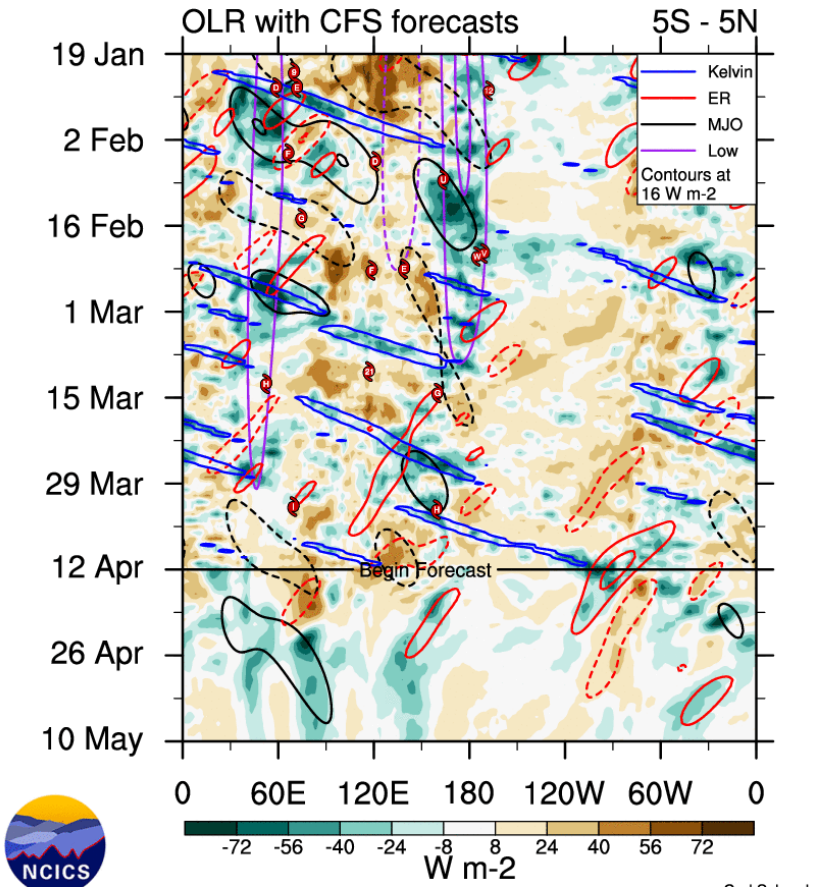


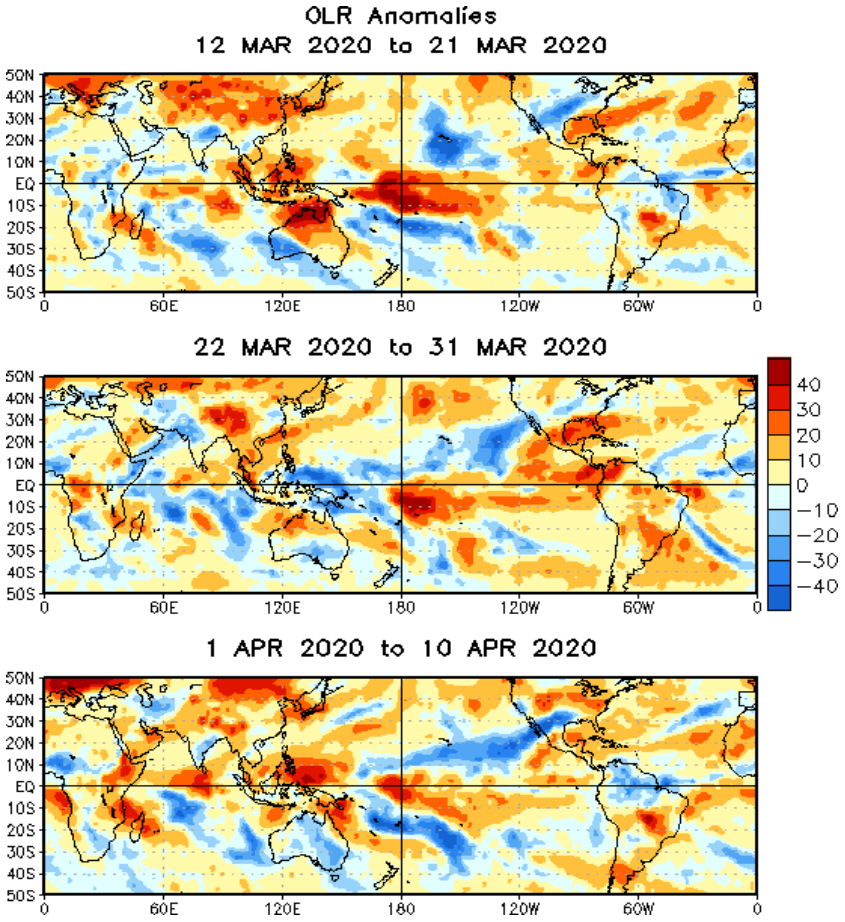
- Anomalous westerlies remain west of the Date Line with strong trades persisting over the equatorial East Pacific.

- Two cyclonic circulation centers are apparent in the South Indian Ocean (one associated with TC Irondro).

Outgoing Longwave Radiation (OLR) Anomalies

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

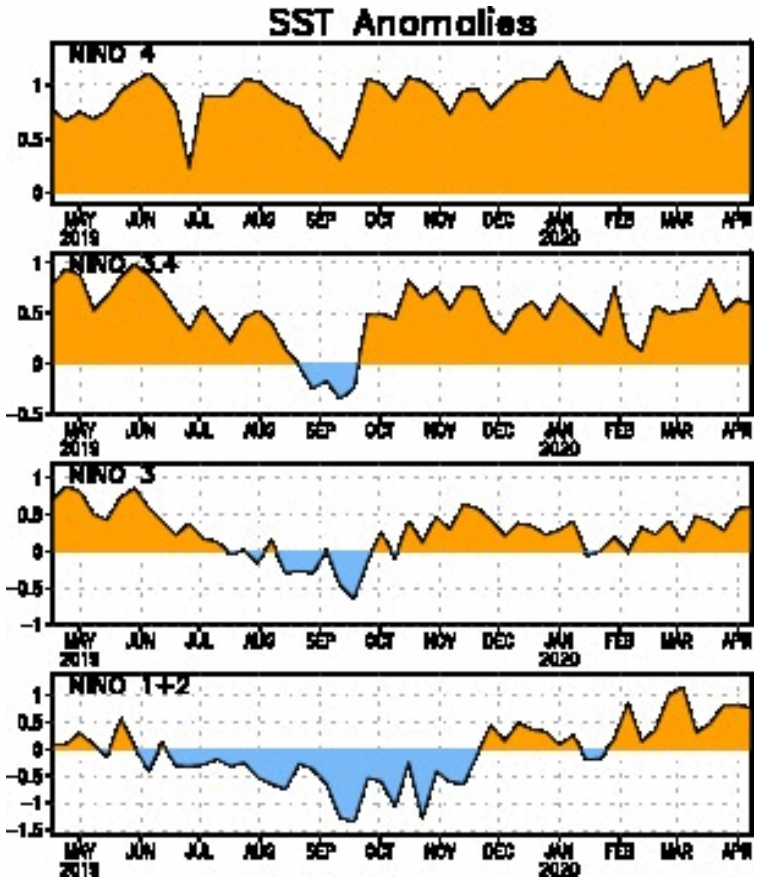


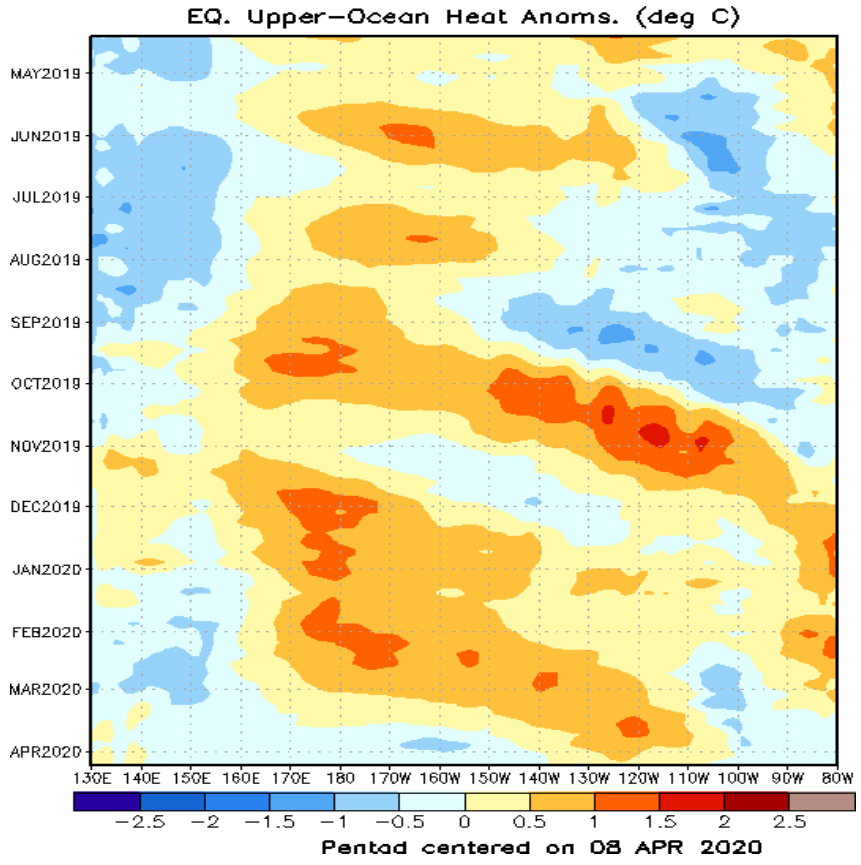


- Frequency filtering of OLR field suggests high frequency modes have prevailed across the global tropics during early April.

- Forecasts suggest enhanced (suppressed) convection to become anchored over the Maritime Continent (along the Date Line).

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific





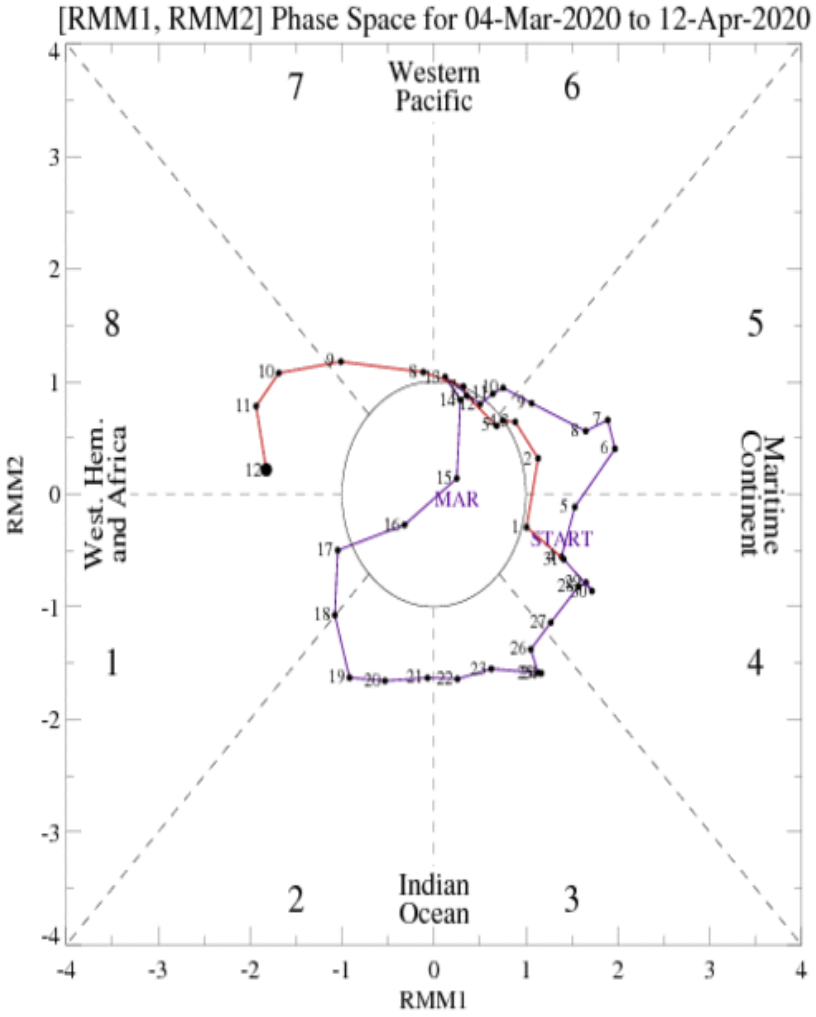
- Upper-ocean heat content anomalies remain marginally below-average over much of the equatorial Pacific, with the exception of between 135-110W where a reservoir of heat remains.

- With above-average SST anomalies in all four ENSO domains, this suggests a shallow layer of warm surface water, possibly tied to increased incoming shortwave radiation from suppressed convection across the equatorial Pacific since early March (see OLR graphics on prior slide). No evidence of downwelling associated with anomalous lower-level westerlies west of the Date Line.

MJO Index: Recent Evolution

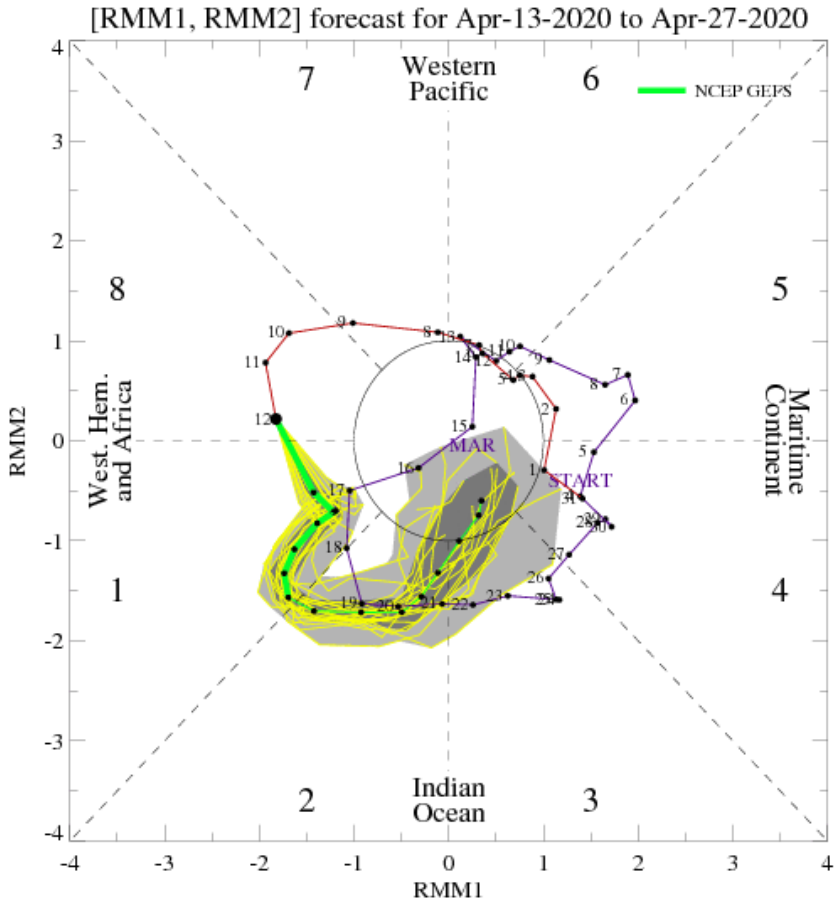
- The RMM index shows an rapidly eastward propagating feature that crossed the Western Pacific into the Western Hemisphere while gaining amplitude during the past week.

- This rapid phase speed (~2-3 days per phase) suggests this signal is operating more on the Kelvin wave side of the frequency spectrum.

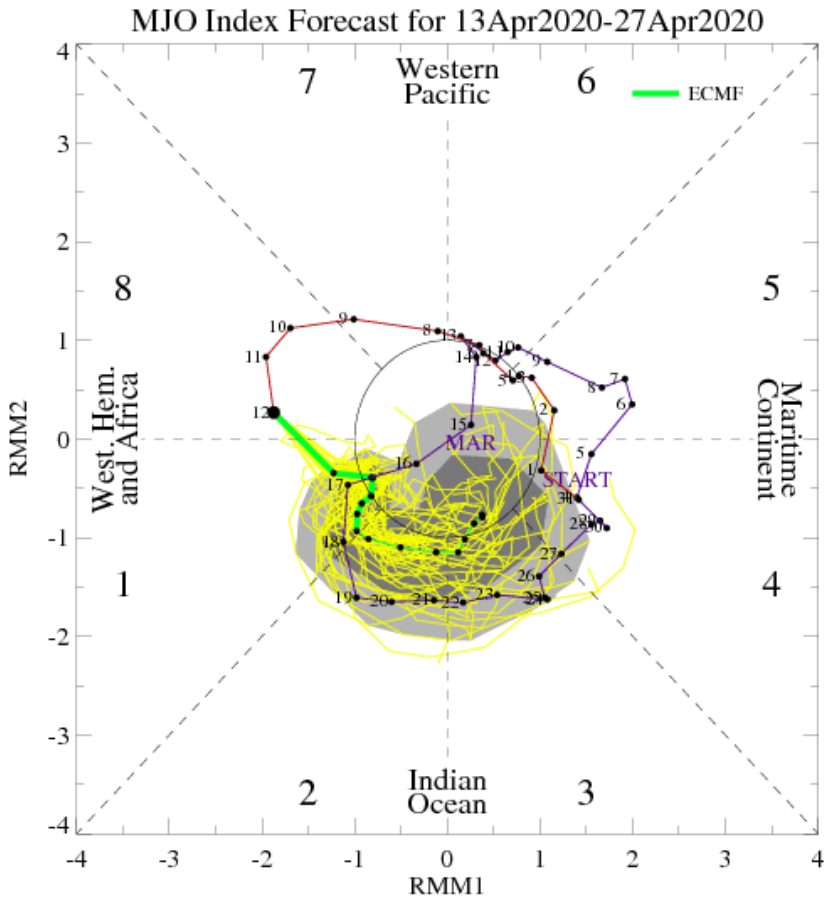


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



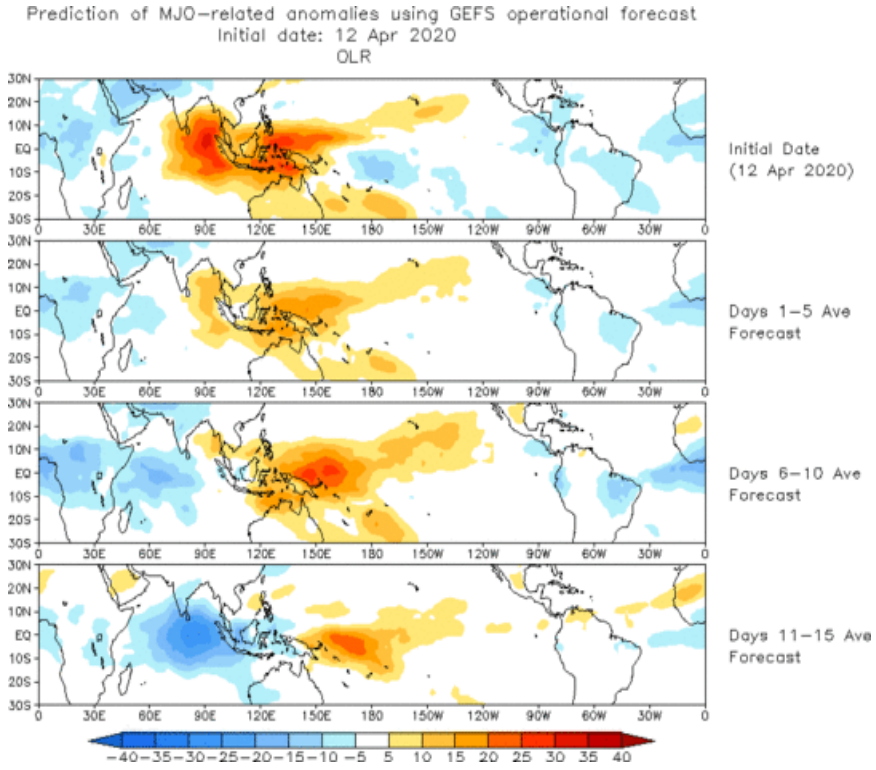
ECMWF Forecast

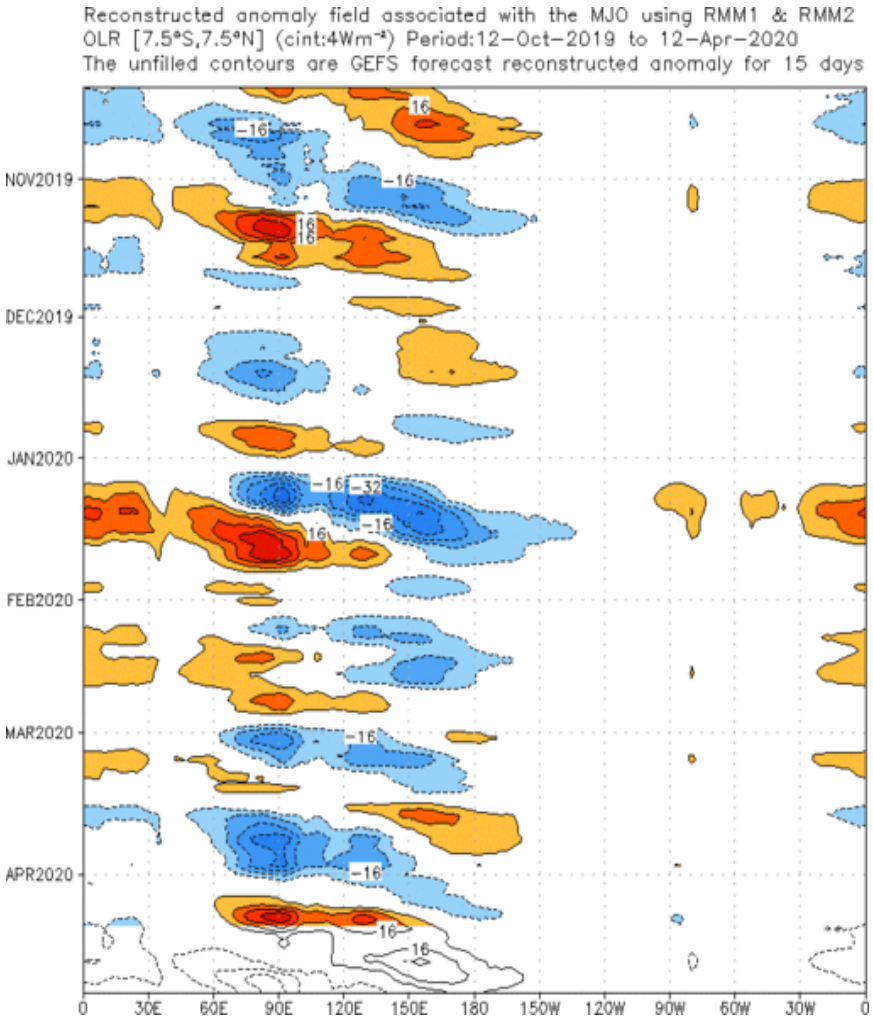
- Dynamical models favor a continued eastward propagating signal across the Western Hemisphere/Africa during Week-1 and into the Indian Ocean by Week-2.

- Some deceleration of the signal is apparent in both models, however, the ECMWF favors a generally weaker signal with many ensemble members falling into the unit circle.

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.)

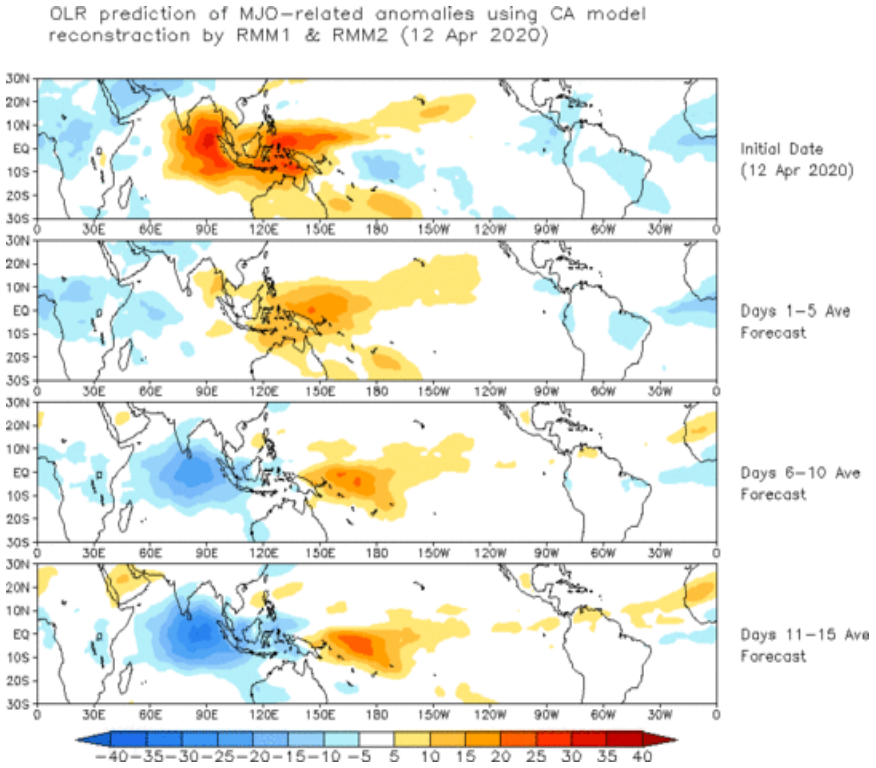


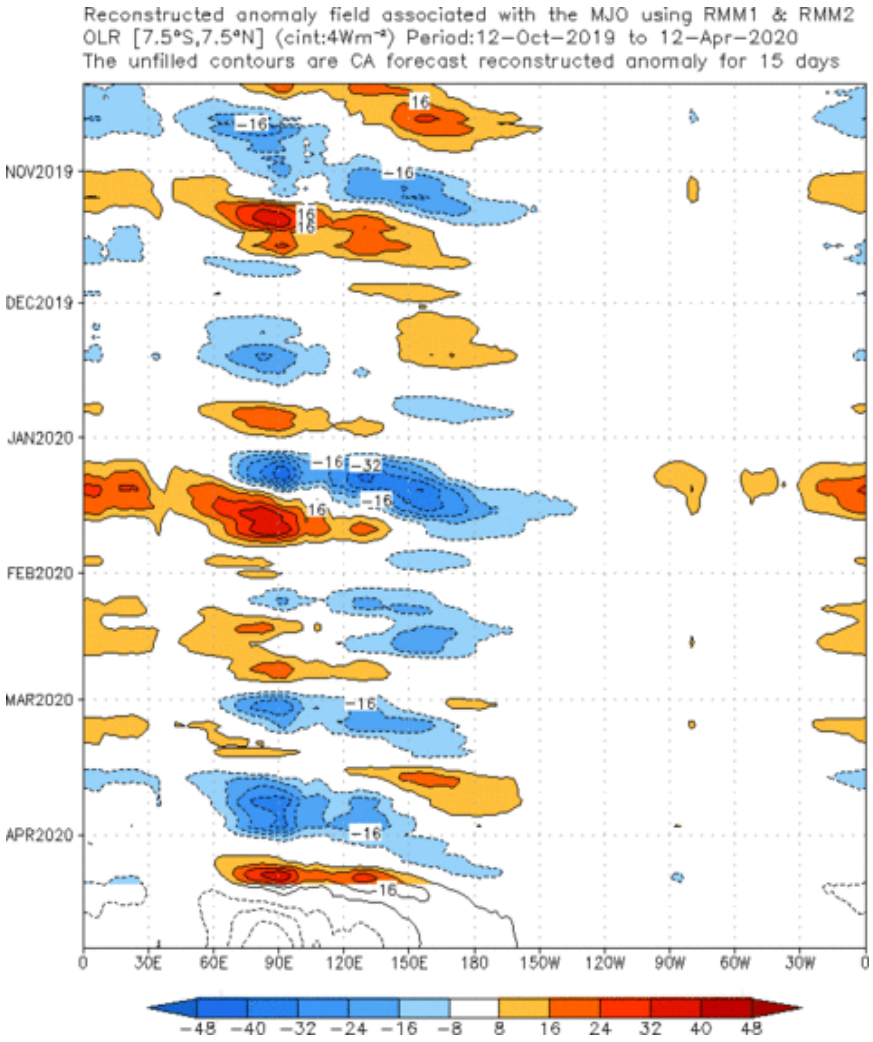


- The GEFS OLR forecast based on the RMM shows eastward propagation of the suppressed and enhanced convective envelopes over the next two weeks. Suppressed convection shifts from the Indian Ocean to West Pacific, while enhanced convection shifts from Africa into the Indian Ocean during this period.

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.)

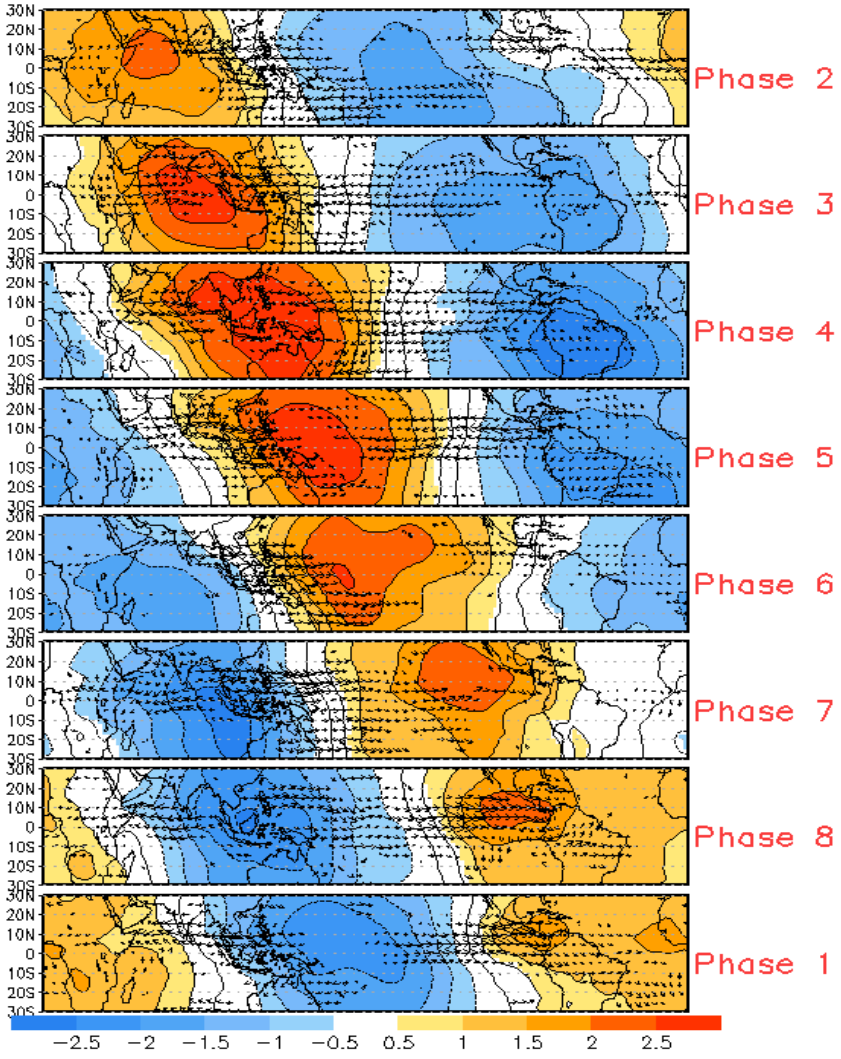




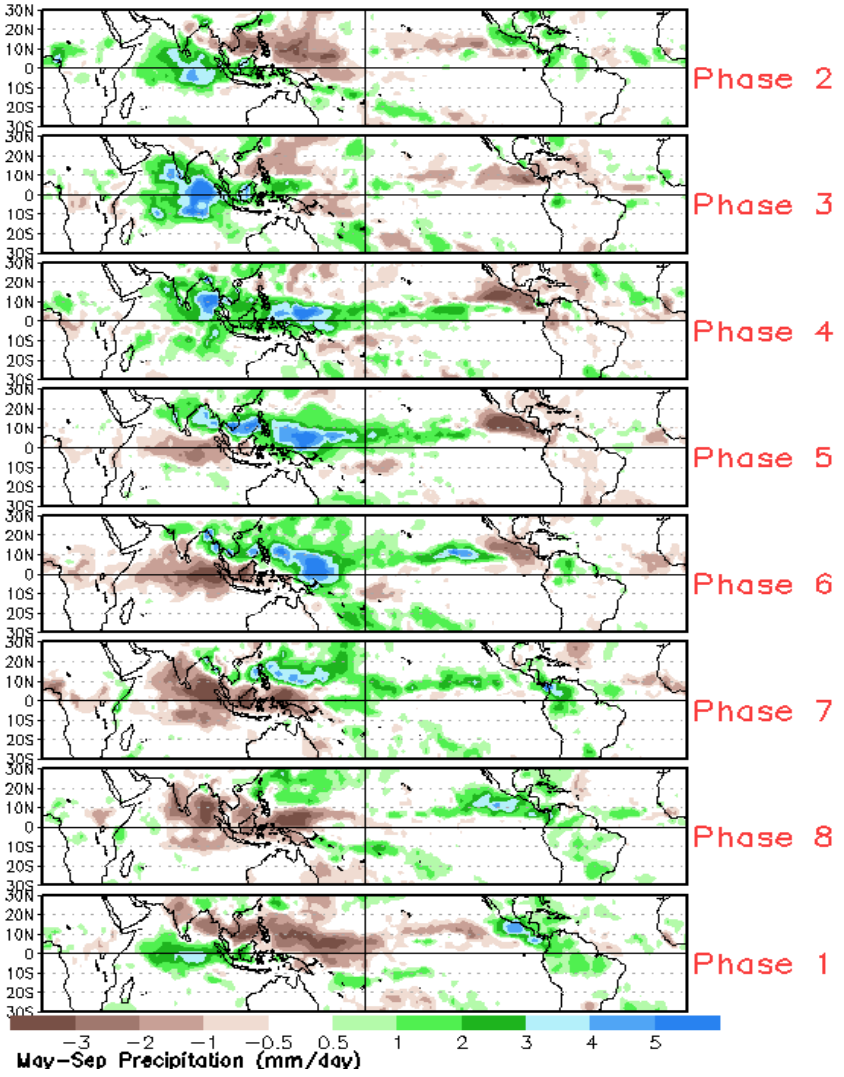
- The constructed analog forecast is similar to that of the GEFS, although the suppressed convective envelope weakens over the Western Pacific during Week-2.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



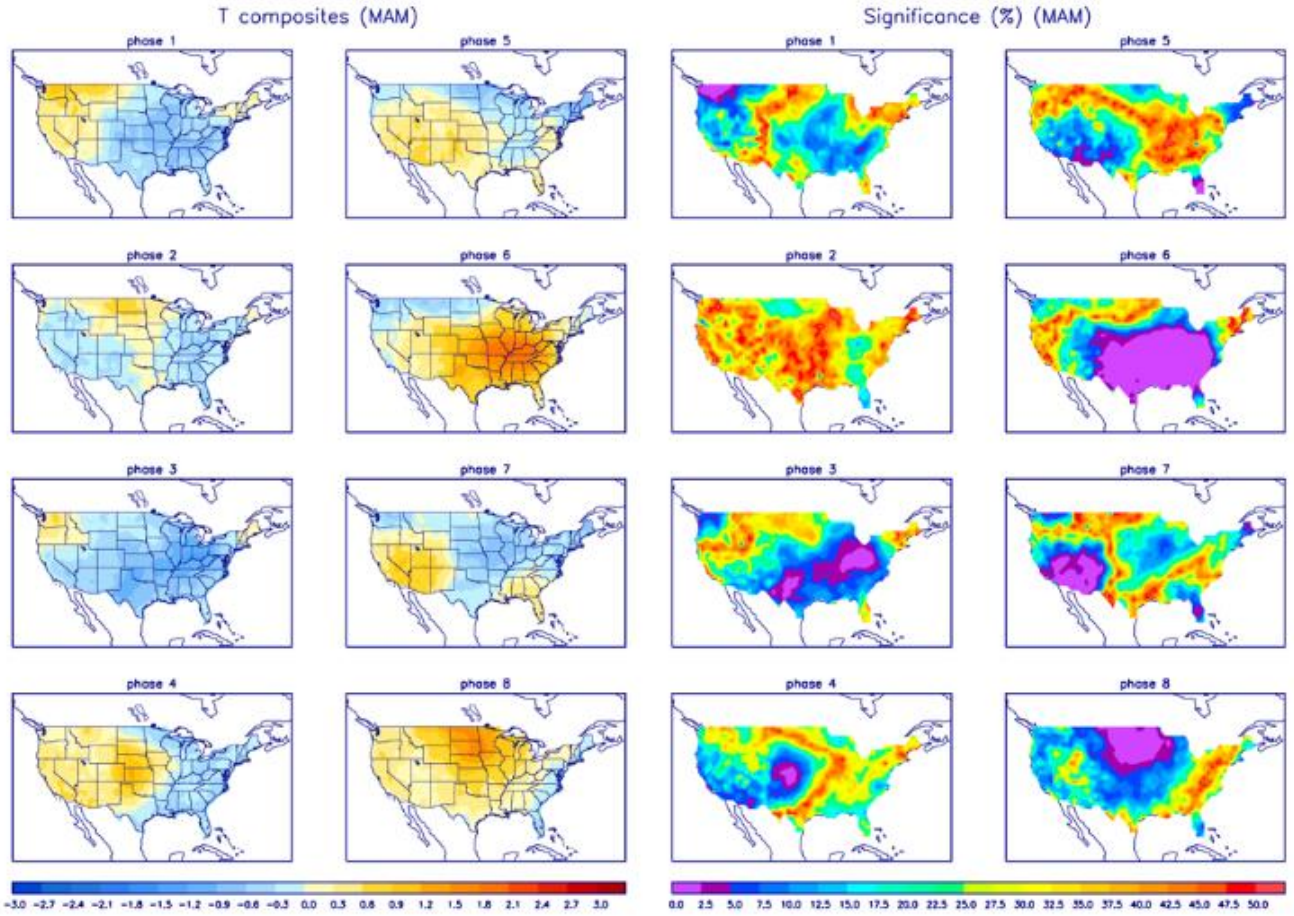
Precipitation Anomalies



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.

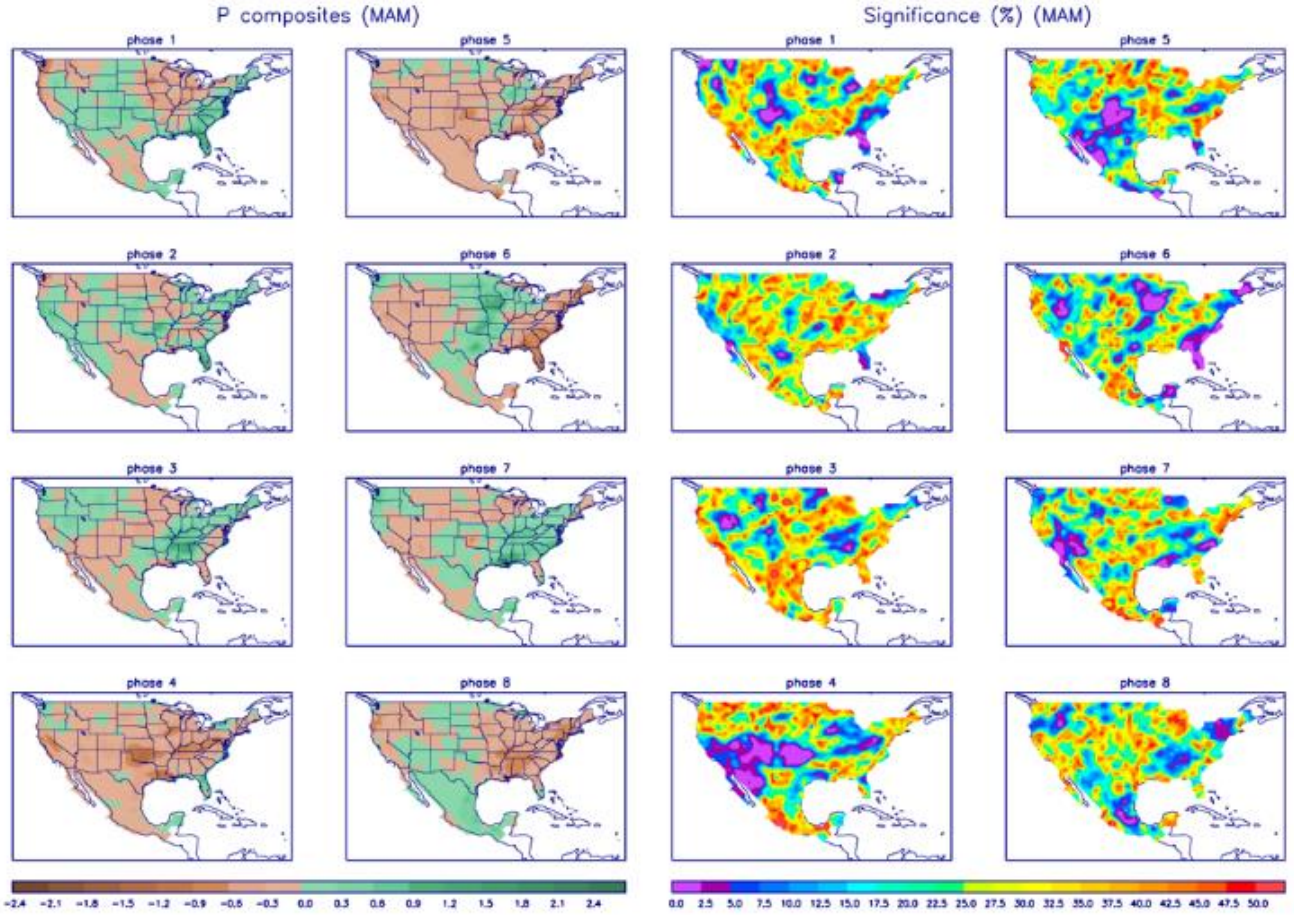


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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