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

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

Overview

- A rapidly propagating eastward moving envelope has crossed the Maritime Continent during the past week, with its phase speed highly suggesting of being a convectively-coupled Kelvin wave.

- Dynamical models support the continued progression of this envelope across the West Pacific during Week-1 and Western Hemisphere during Week-2. The resultant signal is likely to be located over the Western Indian Ocean by the end of Week-2 (~April 20th).

- Extratropical influences from the MJO are not anticipated during the next two weeks, given the rapid progression of this feature.

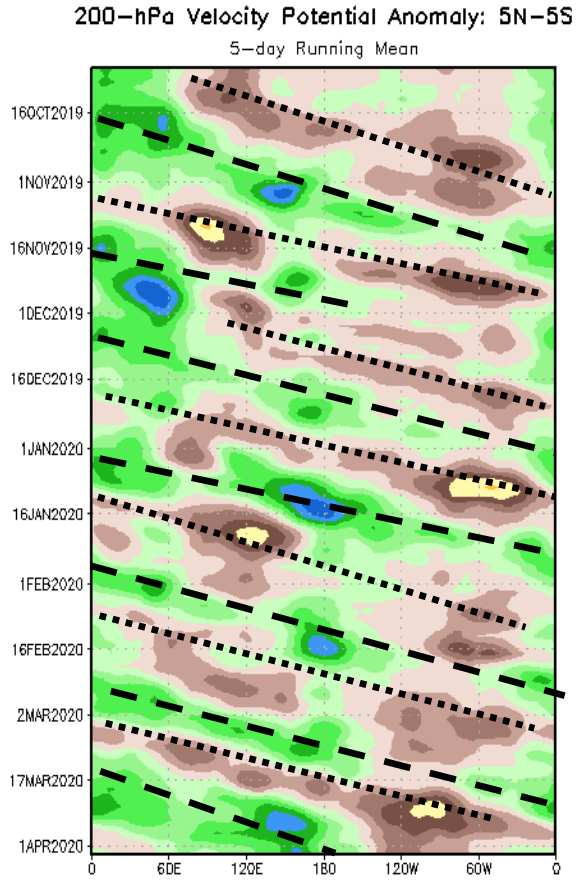
- One key area worth monitoring the next two weeks is the East Pacific, which could be ripe for an early season tropical cyclone forming south-southwest of Panama. Sea surface temperatures in the vicinity of the area are at least +1 degree C, while the aforementioned intraseasonal envelope crossing the Western Hemisphere would support TC formation during the typical East Pacific Hurricane Season (15 May – 30 November).

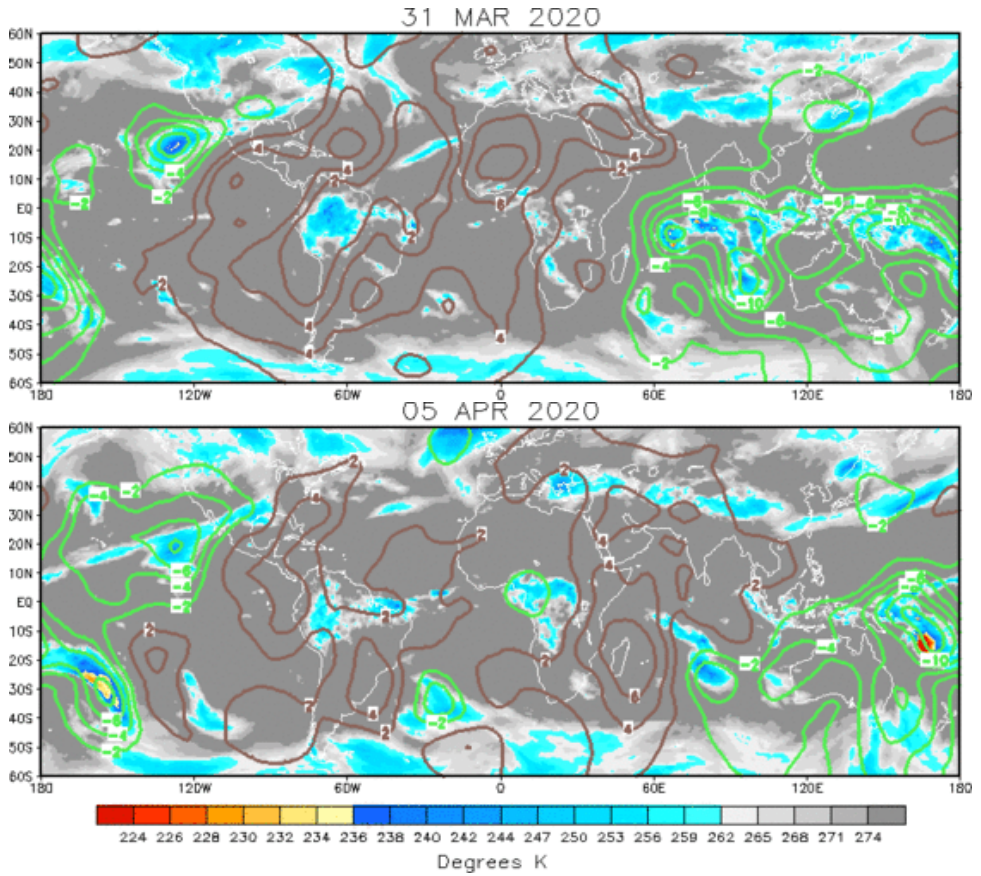
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).



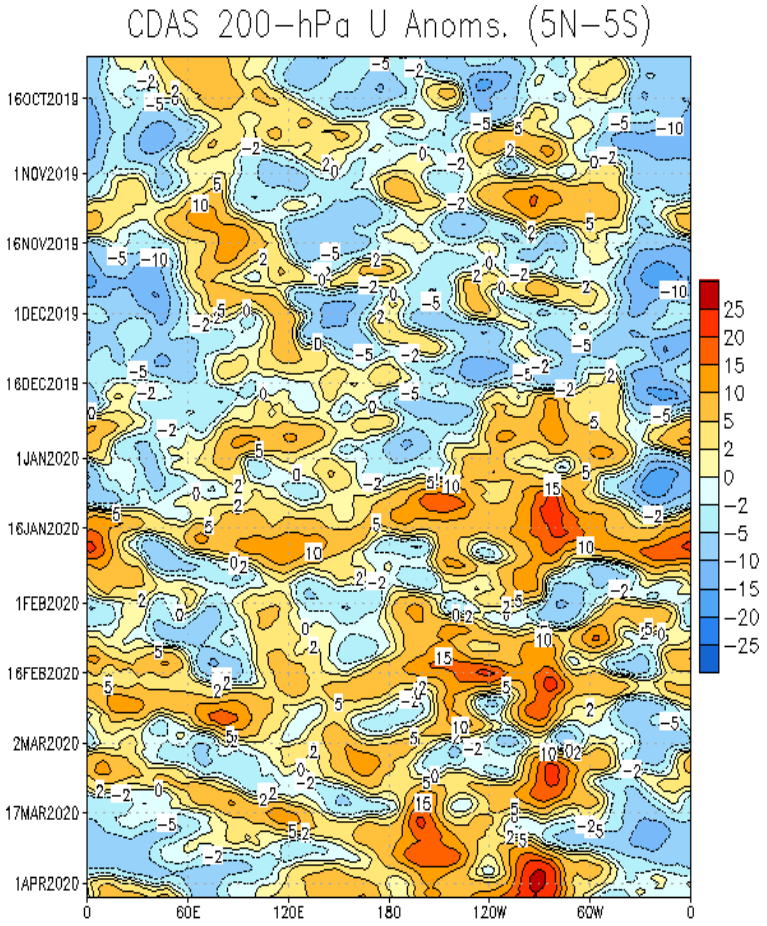


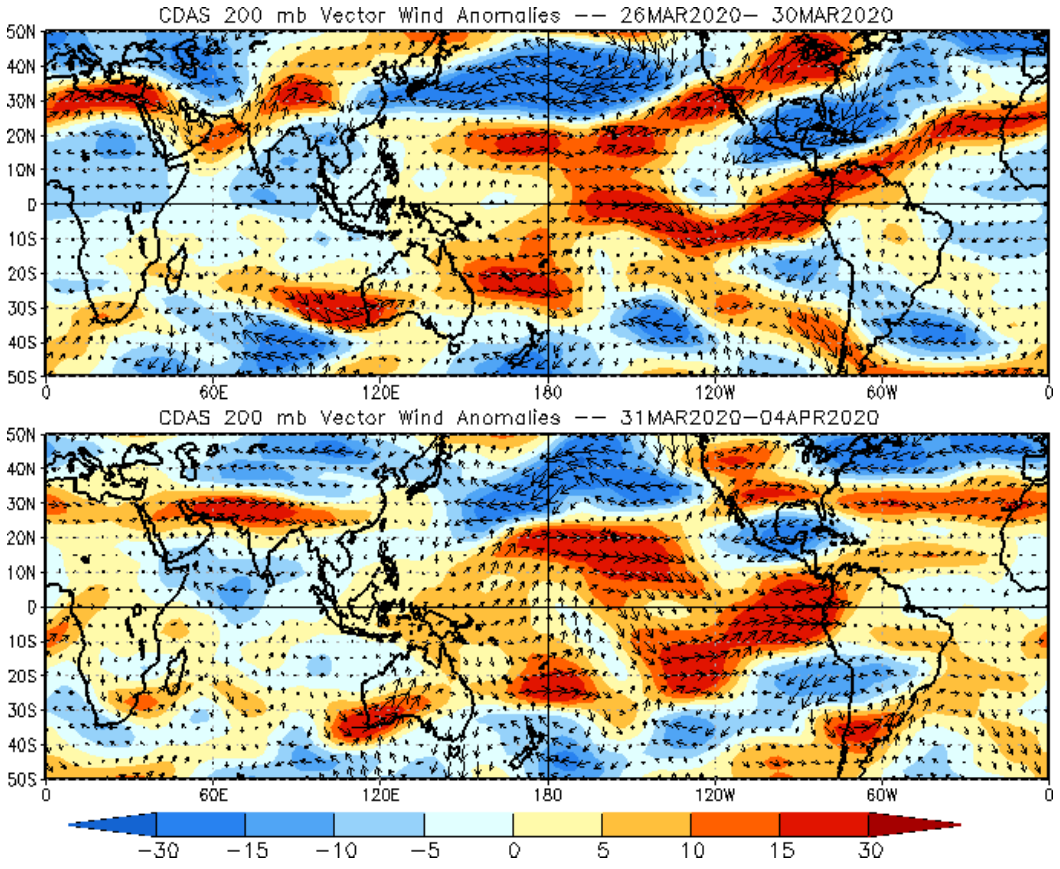
- A wave-1 pattern has persisted over the past week, showing signs of rapid eastward propagation (approximately 60E-160W shifting to 80E-140W).

- This rapid progression is indicative of likely convectively-coupled Kelvin wave activity.

200-hPa Wind Anomalies

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



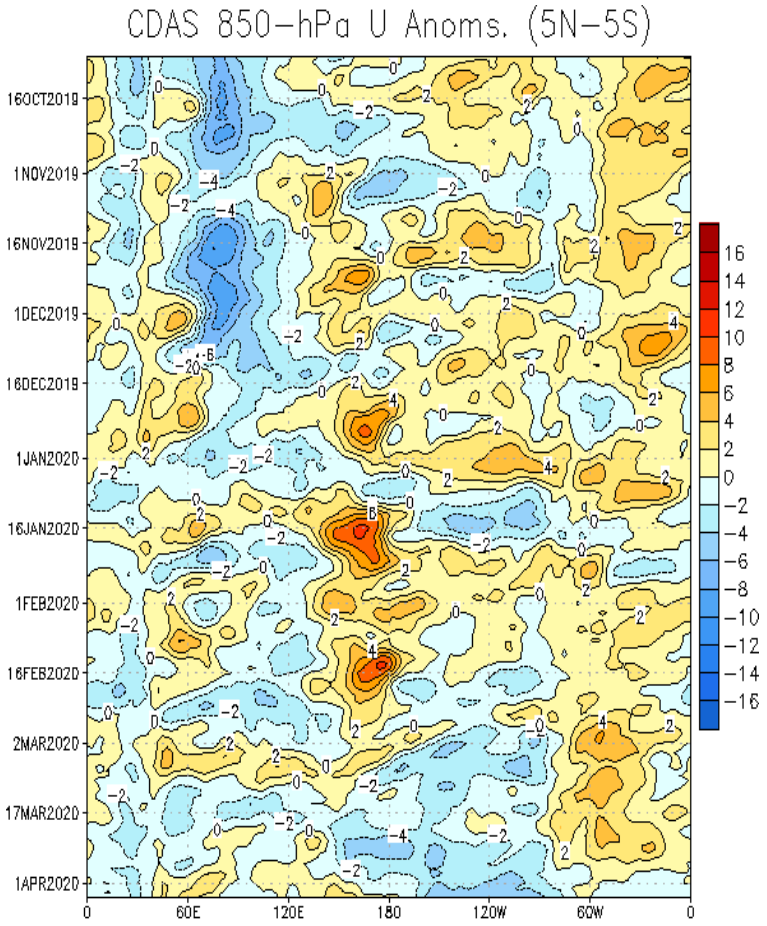


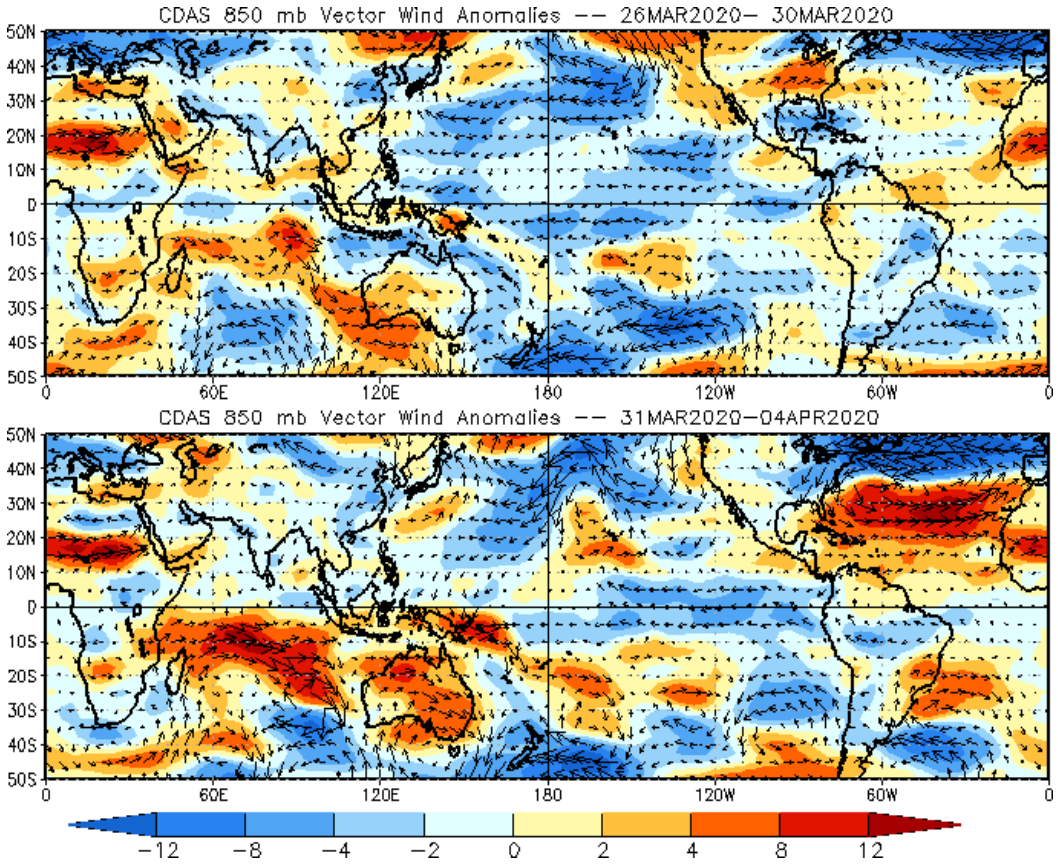
- Anomalous westerlies have persisted across much of the tropical Pacific during the past two weeks.

- Wavebreaking is apparent across North and Central America. In association with this, a pair of anomalous cyclones aloft near 90W in both hemispheres have given rise to robust westerly anomalies along the equator.

850-hPa Wind Anomalies

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

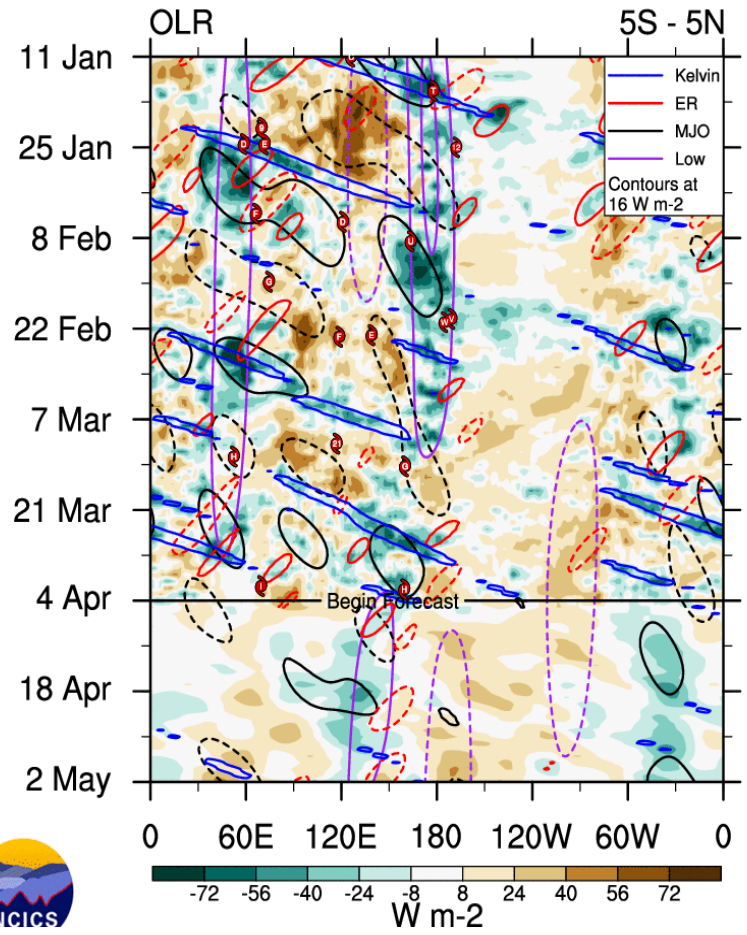


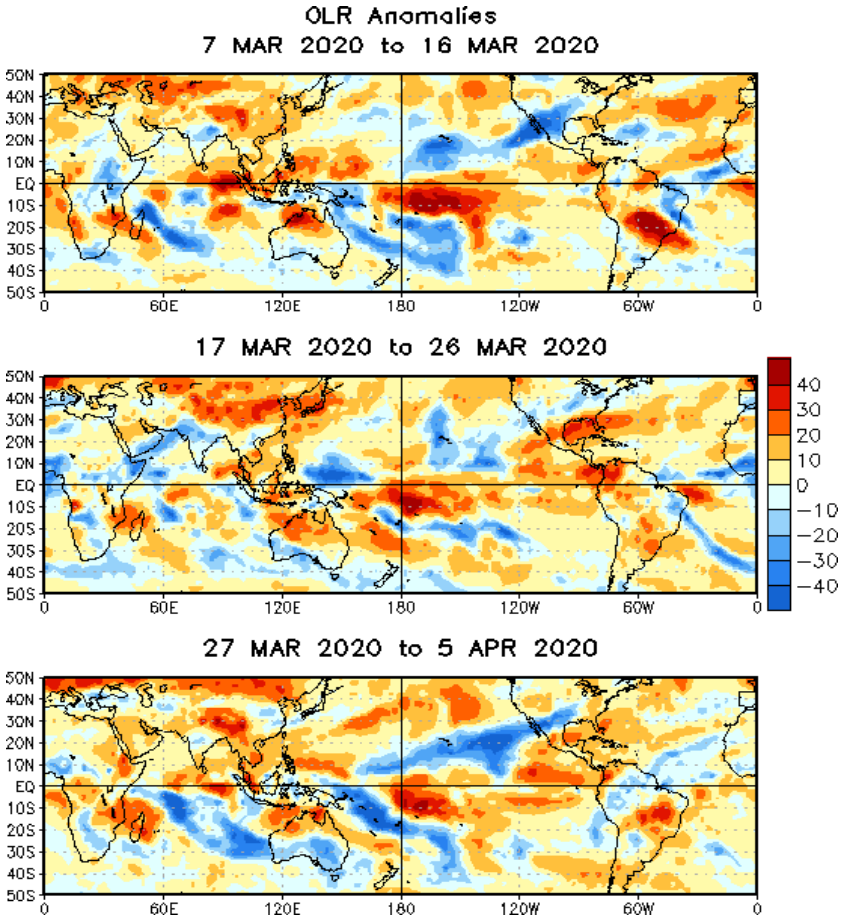


- Anomalously strong trades are observed across much of the equatorial Pacific.
- Anomalous westerlies across the southern Indian Ocean have intensified since late March, likely in association with the development of TC Irondro which is apparent in the circulation west of Australia.

Outgoing Longwave Radiation (OLR) Anomalies

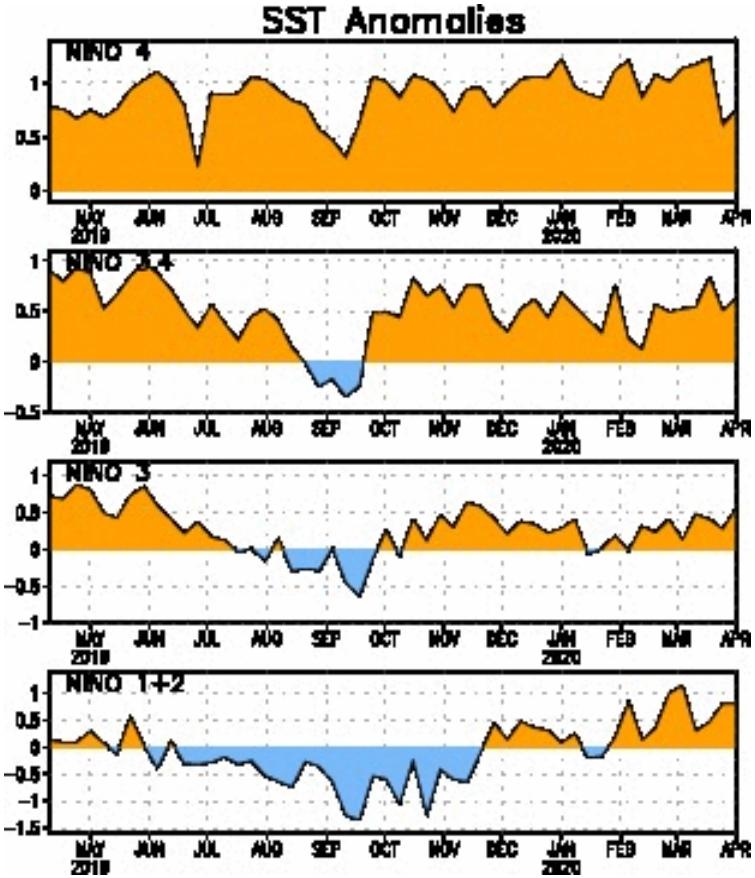
Blue shades: Anomalous convection (wetness). Red shades: Anomalous subsidence (dryness).

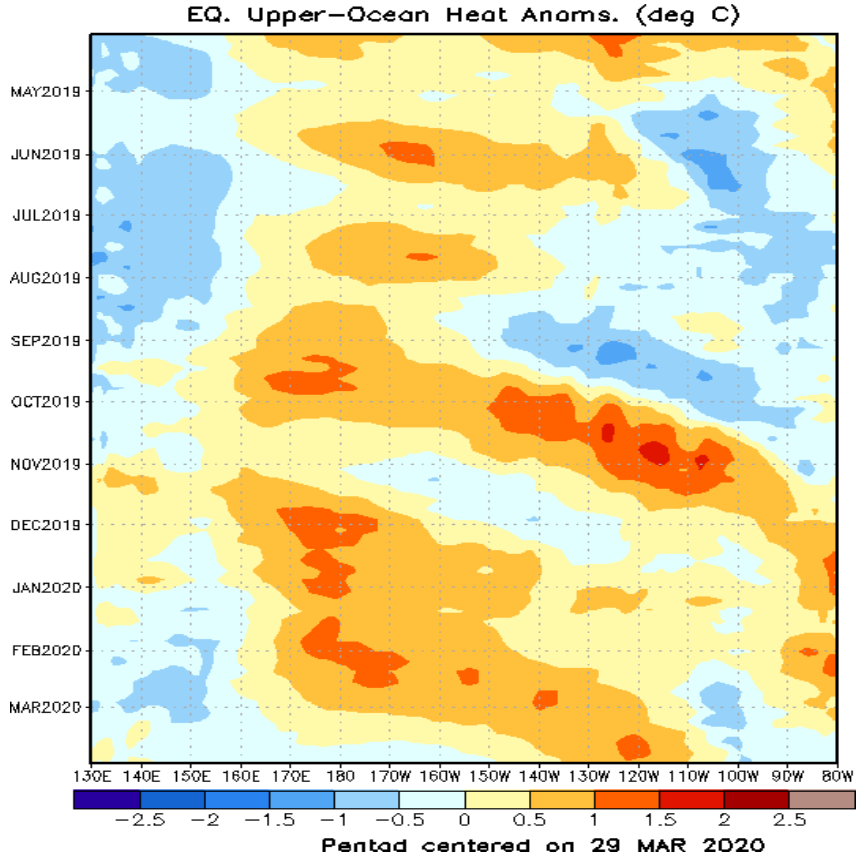




- High frequency modes dominate the most recent observations of anomalous convection in the deep tropics.
- Convection that has been anchored near and just west of the Date Line shows signs of shifting westward toward New Guinea over the last few weeks.
- TCs in the southern Indian Ocean (Irondro) and South Pacific (Harold) are prominent in the latest OLR field.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific





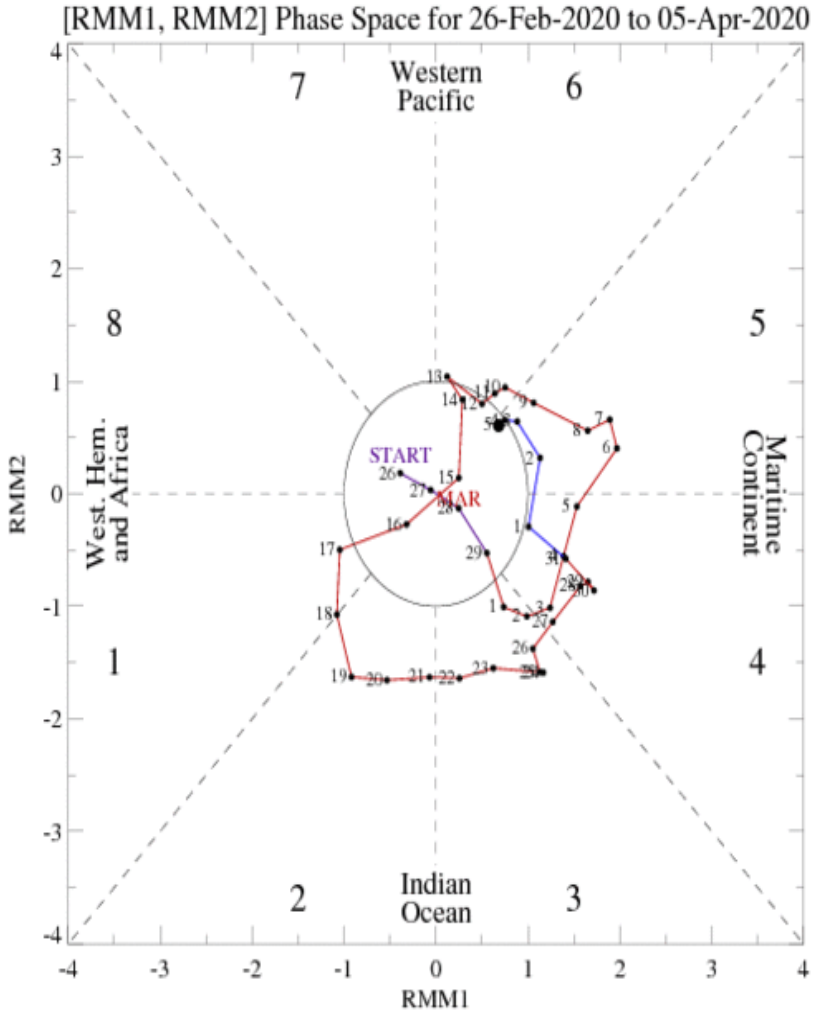
- Upper-ocean heat content anomalies are minimal across much of the equatorial Pacific, with the exception of between 135-110W where a reservoir of heat remains.

- Despite this, SST anomalies are all near or above 0.5 degrees C in each of the four ENSO analysis domains highlighted here. This suggests an extremely 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) in the absence of any circulation features to increase warmth at depth.

MJO Index: Recent Evolution

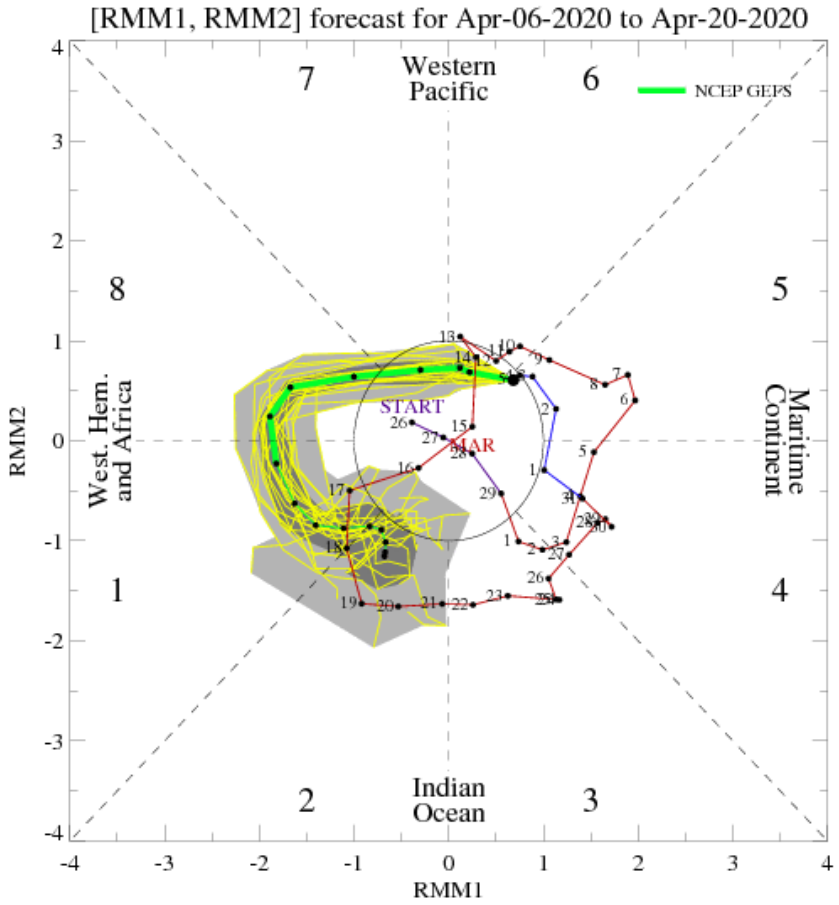
- The RMM index shows an eastward propagating feature that crossed the Maritime Continent during the past week, with its amplitude on the cusp of being considered a robust MJO.

- This rapid phase speed (~3 days per phase) puts it near the boundary of being considered a Kelvin wave or a MJO event on the fast end of the spectrum.

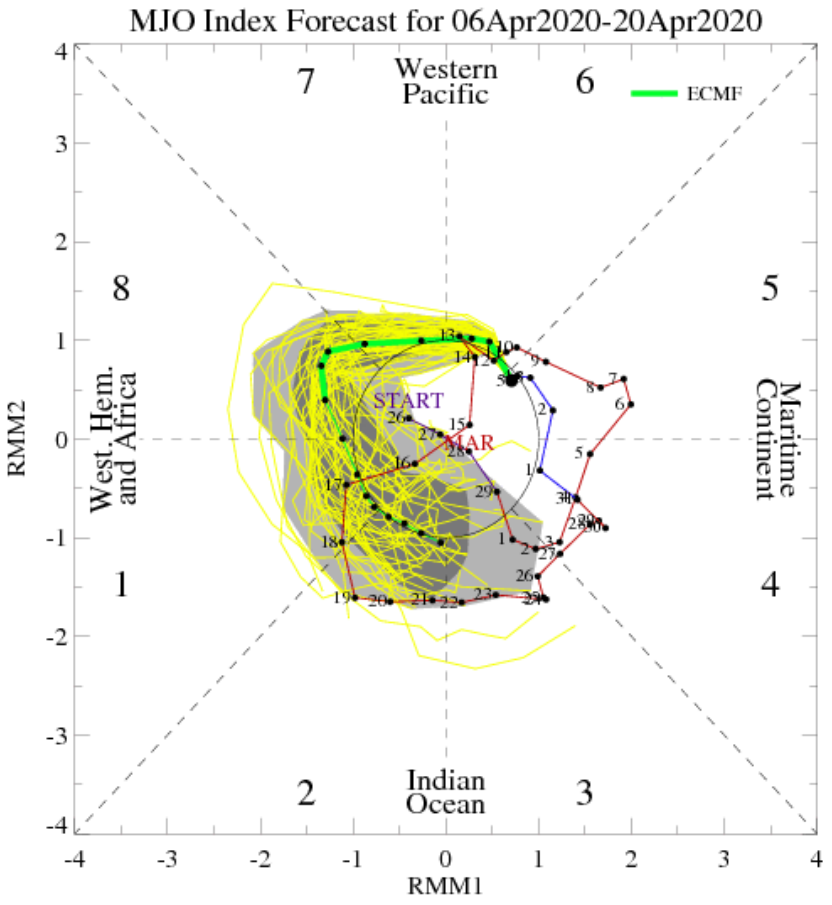


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

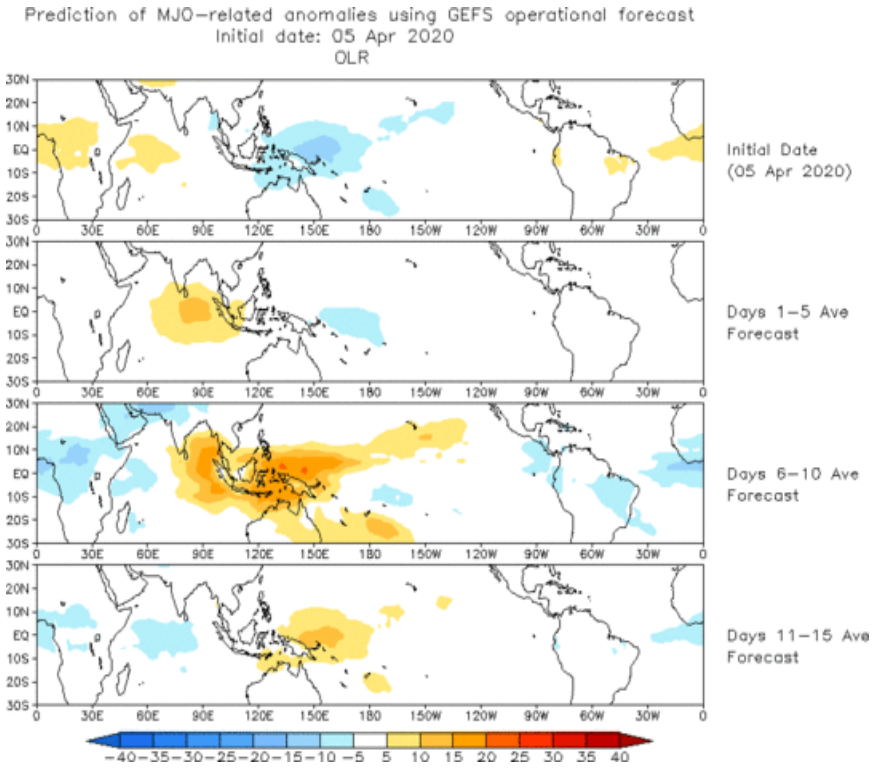


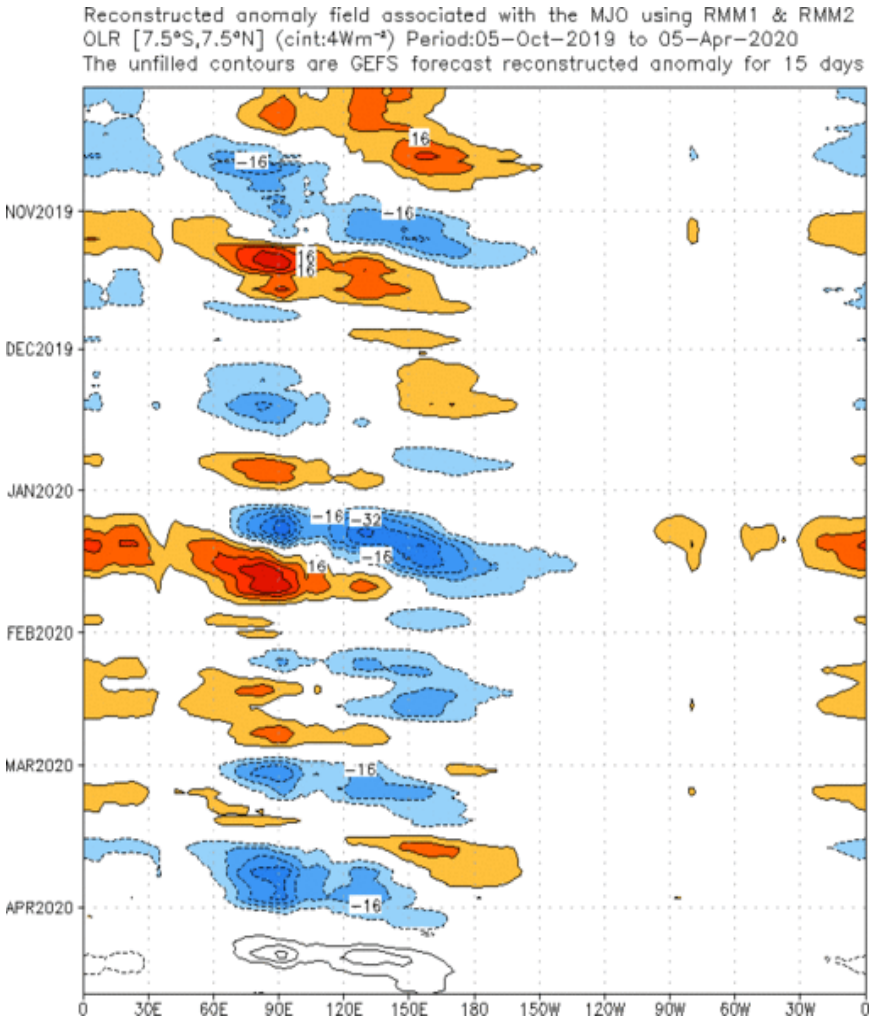
ECMWF Forecast

- Dynamical models show continued rapid eastward propagation of the intraseasonal signal across the Pacific during Week-1 and the Western Hemisphere through western Indian Ocean during Week-2. The GEFS does this at a more rapid pace than the ECMWF, while both models are clustered fairly close together in time and space.

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.)

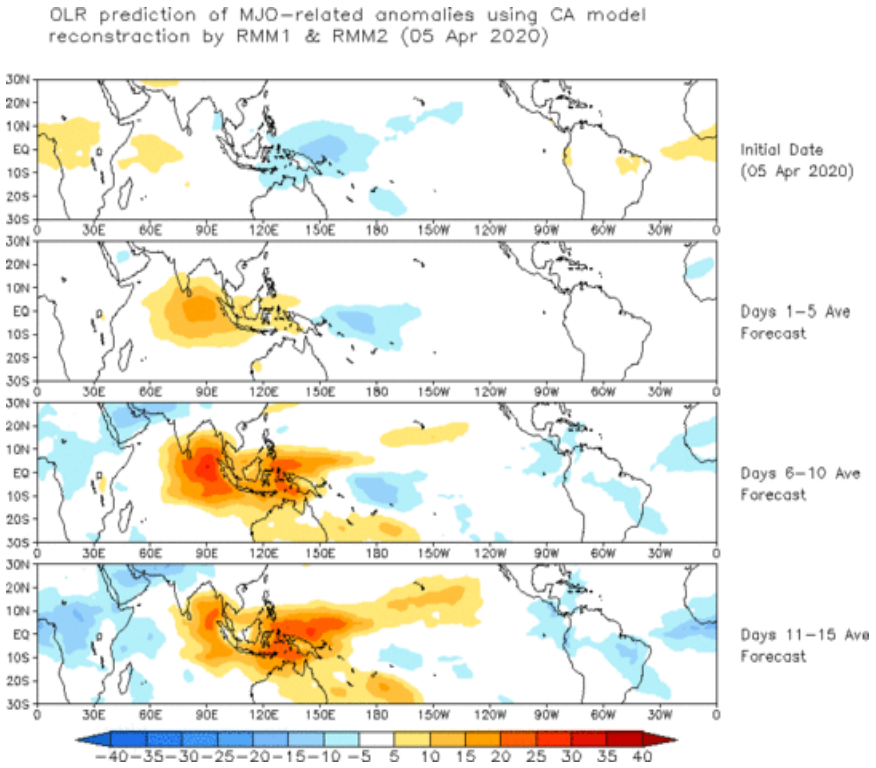


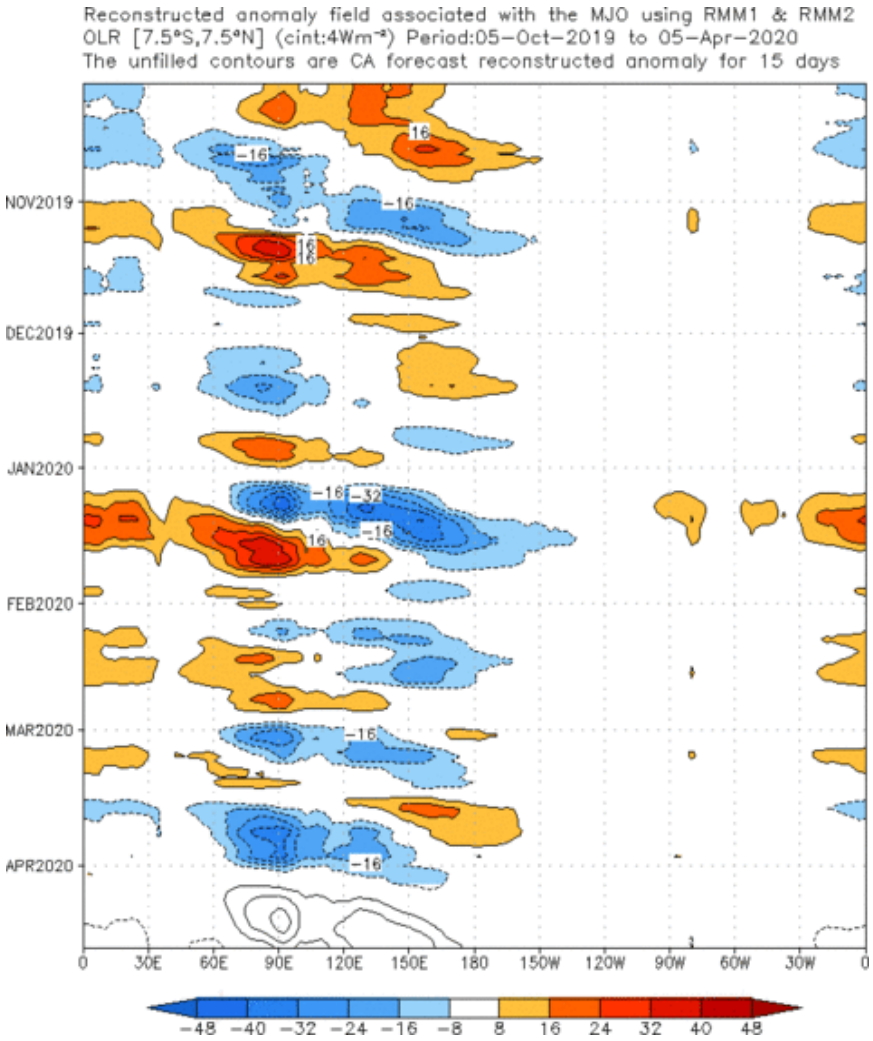


- The GEFS OLR forecast based on the RMM reveals rapid eastward propagation of the suppressed and enhanced convective envelopes over the next two weeks. Suppressed convection shifts from the Indian Ocean to West Pacific, while enhanced convection transitions from the West Pacific to western Indian Ocean 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.)

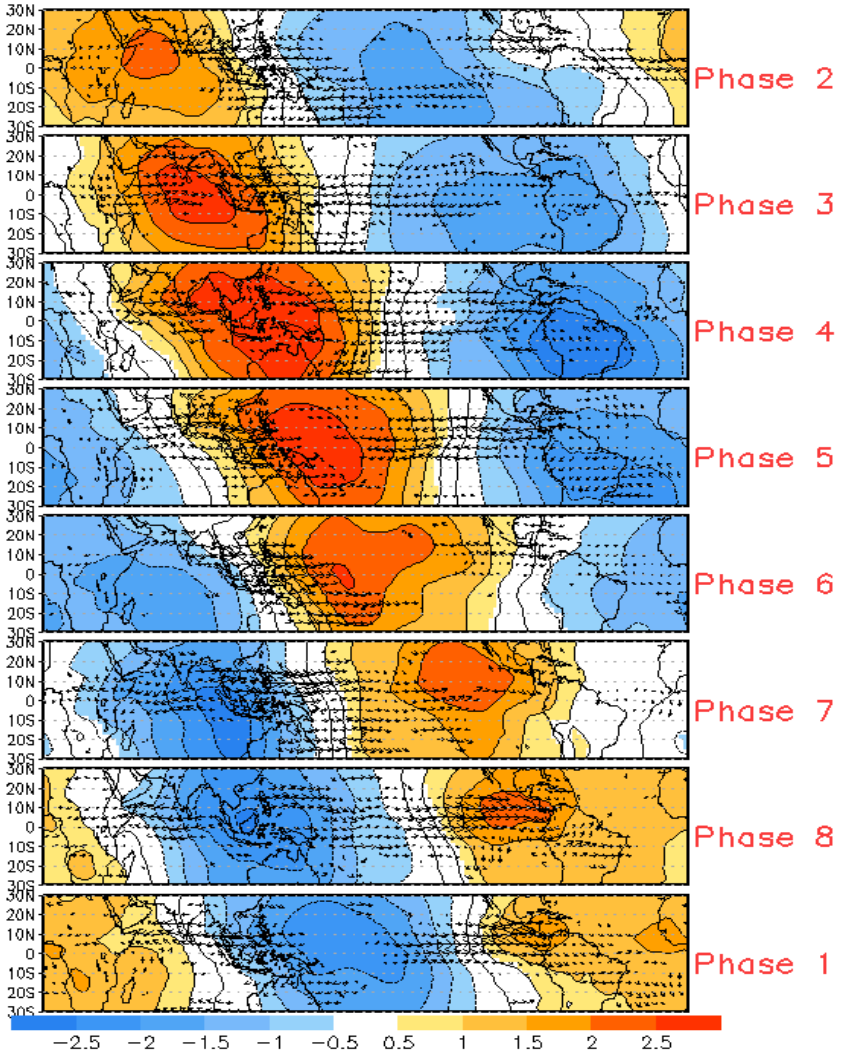




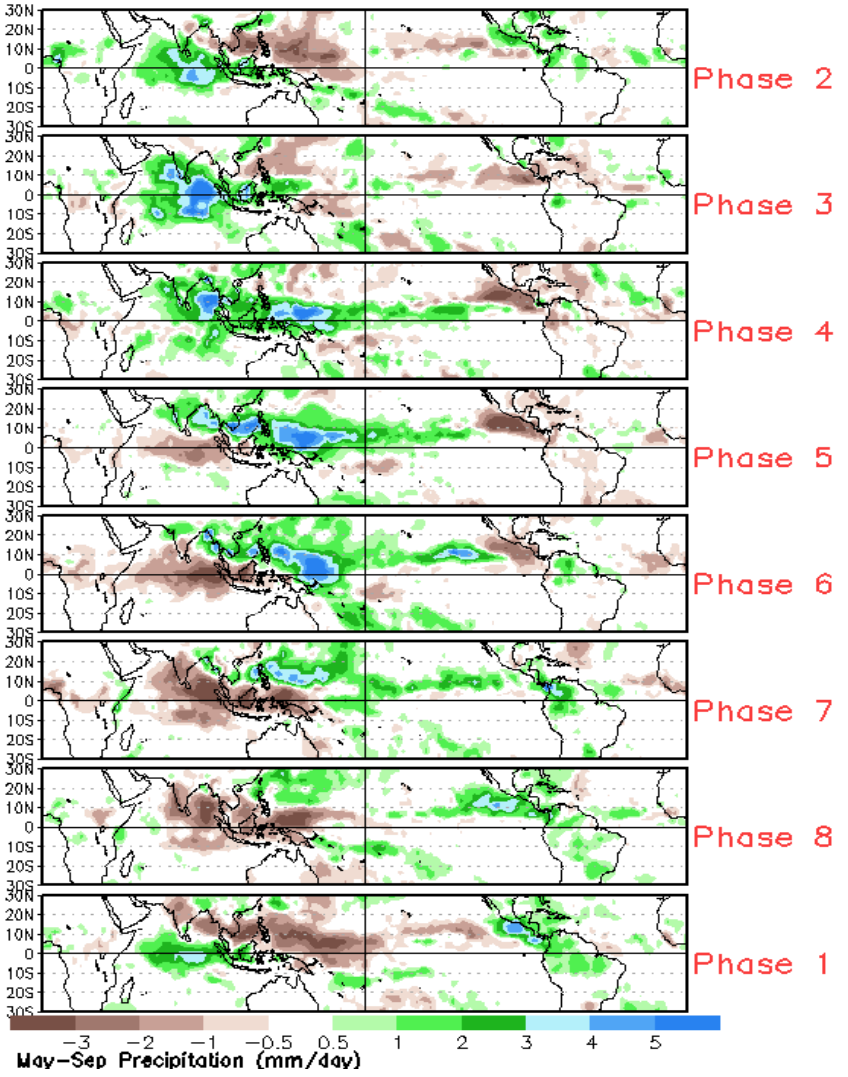
- The constructed analog forecast is similar to that of the GFS, although at a higher amplitude that is most apparent within its suppressed convective envelope.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



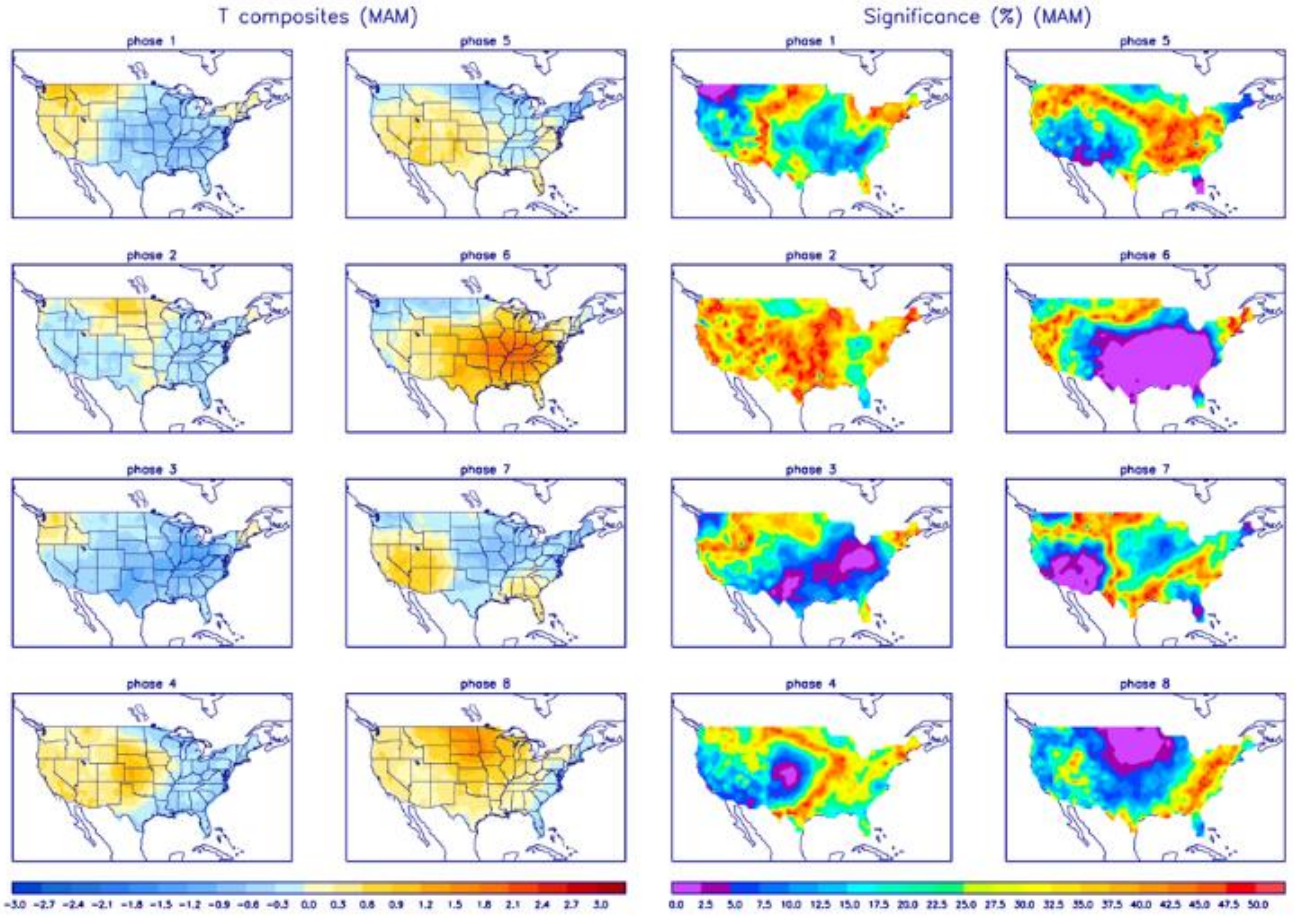
Precipitation Anomalies



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.

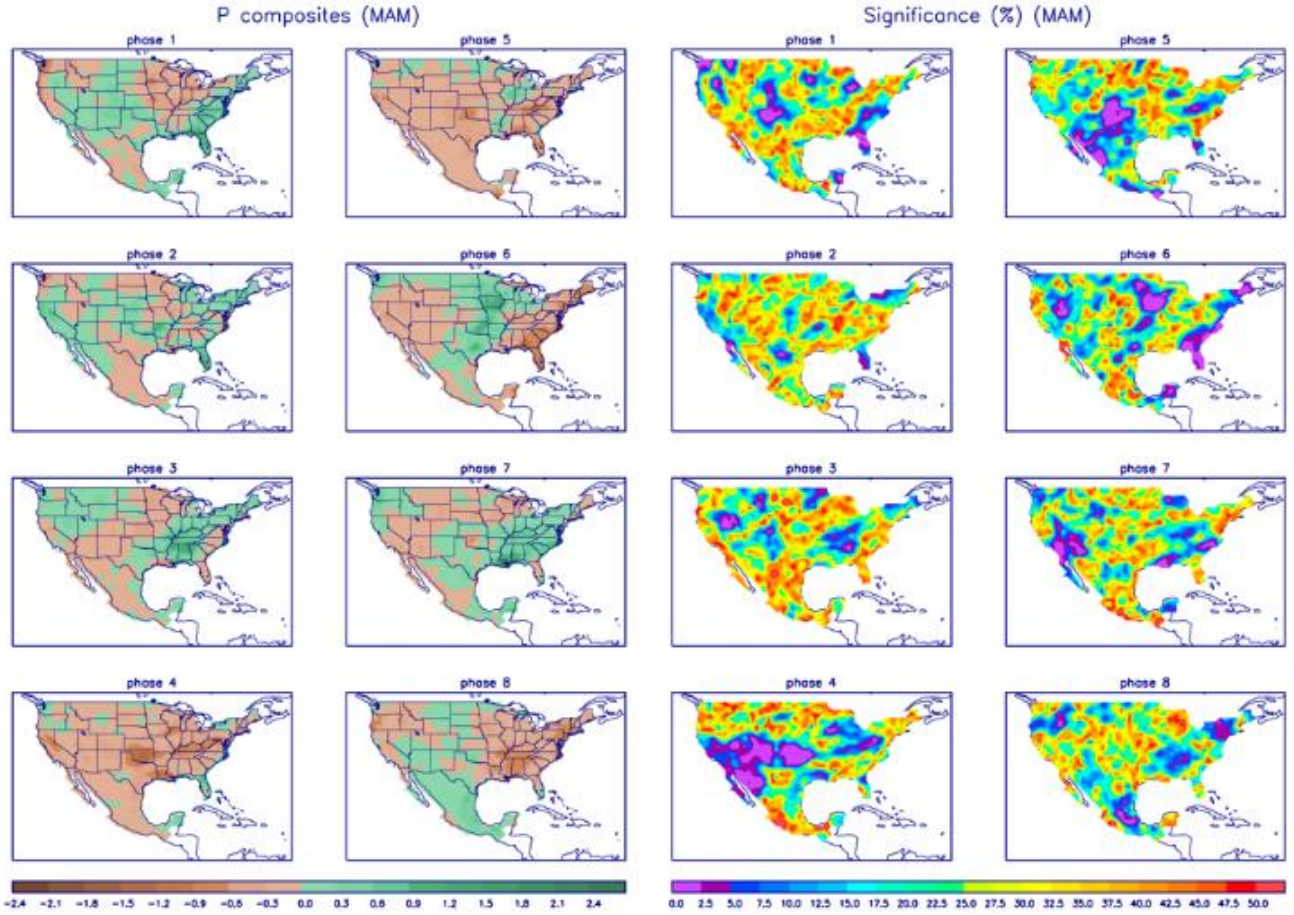


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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