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

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
16 March 2020

Overview

- Following a more coherent MJO signal during early March, the upper-level velocity potential pattern and RMM index indicate that the MJO weakened during the last week.

- A low-frequency signal favoring enhanced convection near the Date Line persists.

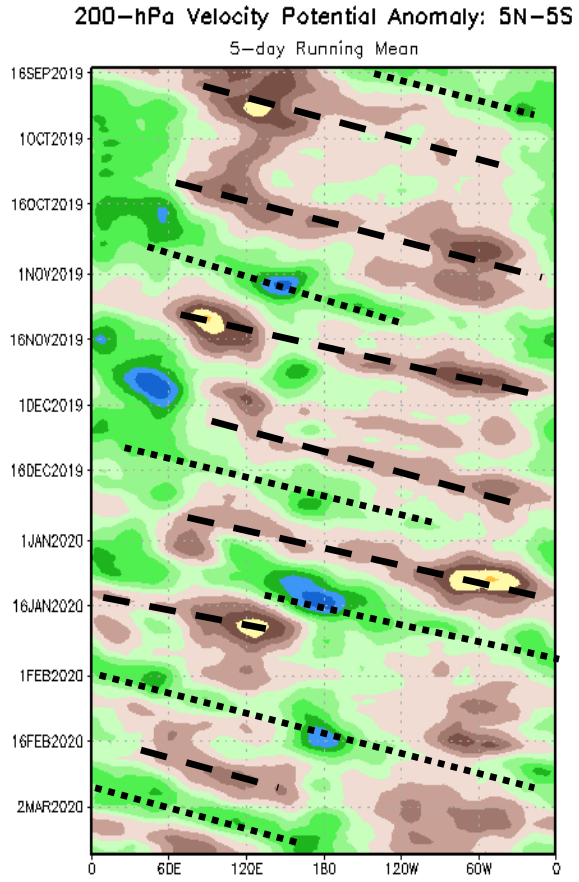
- Dynamical models favor the reemergence of the MJO over the Western Hemisphere/Africa during Week-1, with uncertainty relative to its continued propagation and amplitude during Week-2.

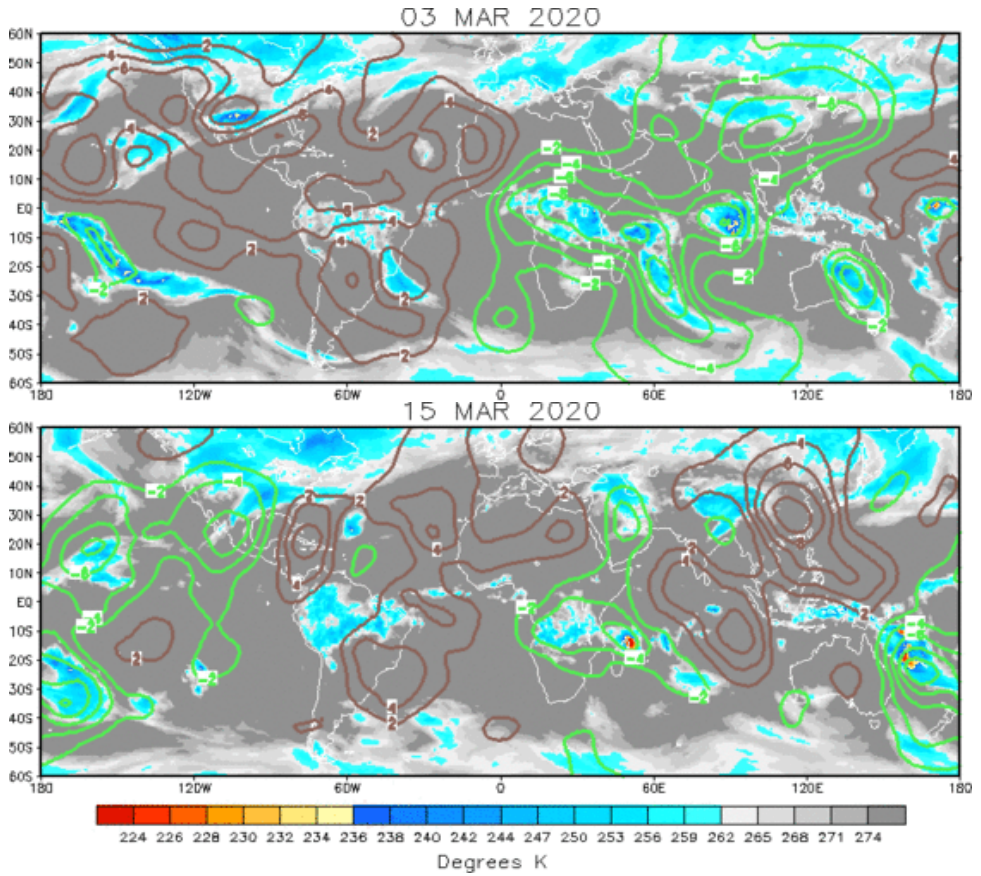
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).



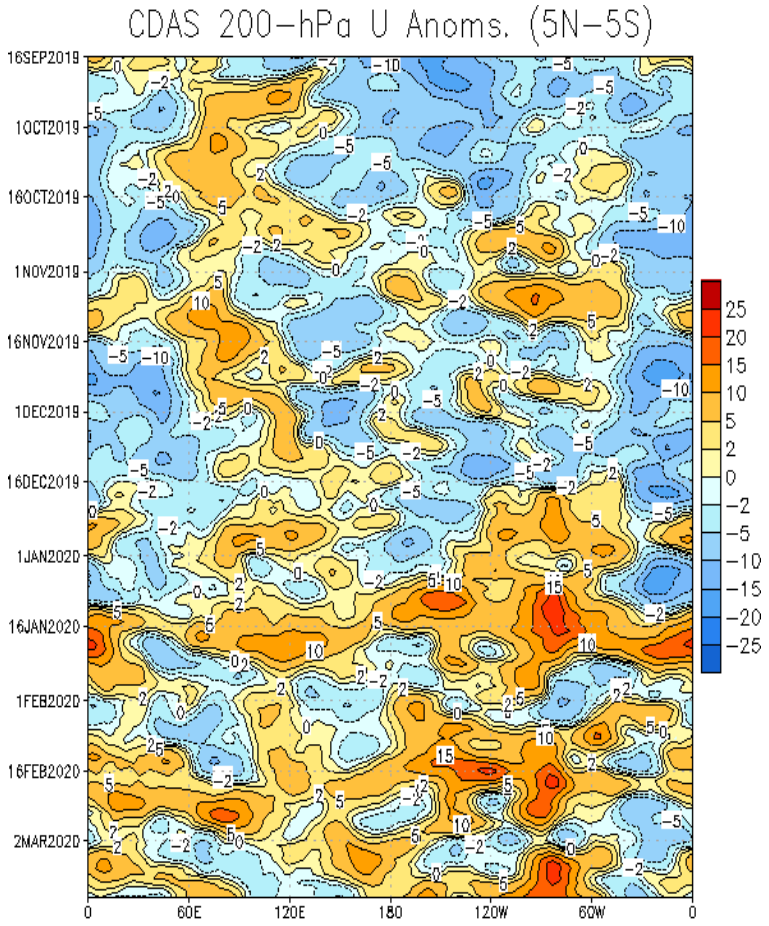


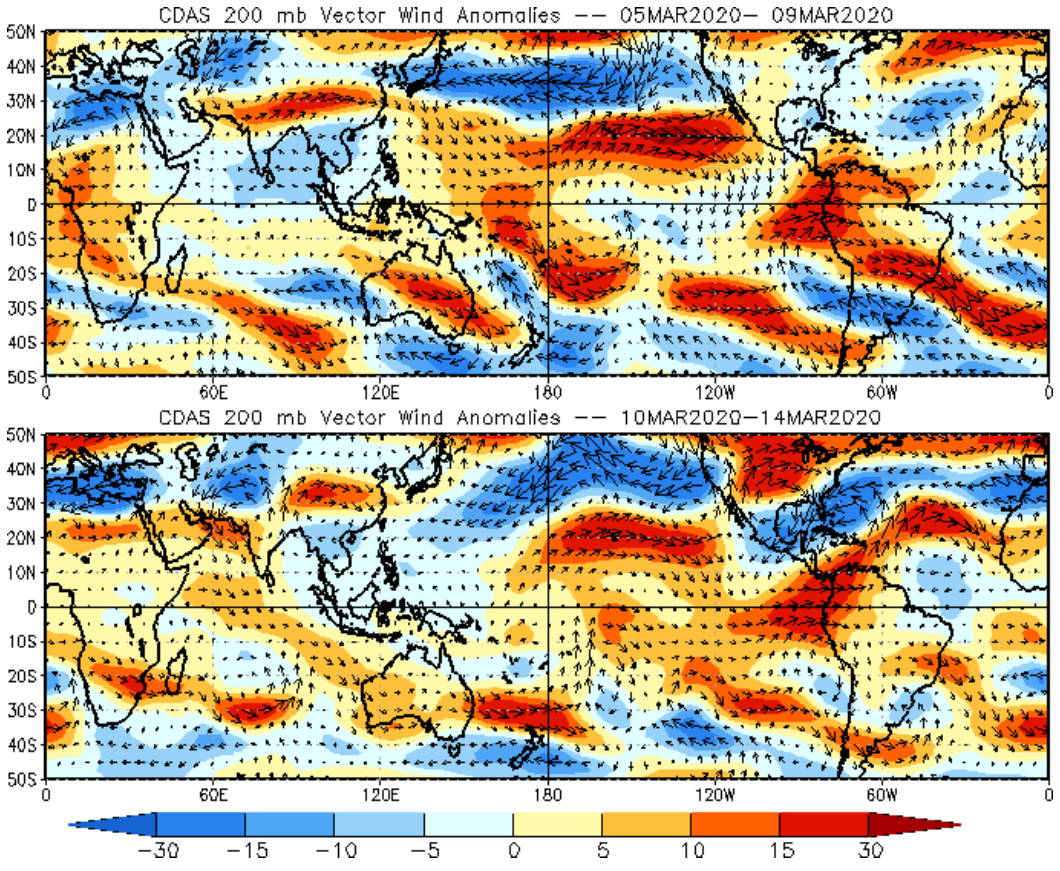
- The global convective pattern was coherent at the beginning of March with upper-level divergence (convergence) over Africa and the Indian Ocean (East Pacific and the Americas).

- During mid-March, however, the subseasonal signal has become less organized, and a low-frequency signal supporting enhanced convection continues near the Date Line.

200-hPa Wind Anomalies

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



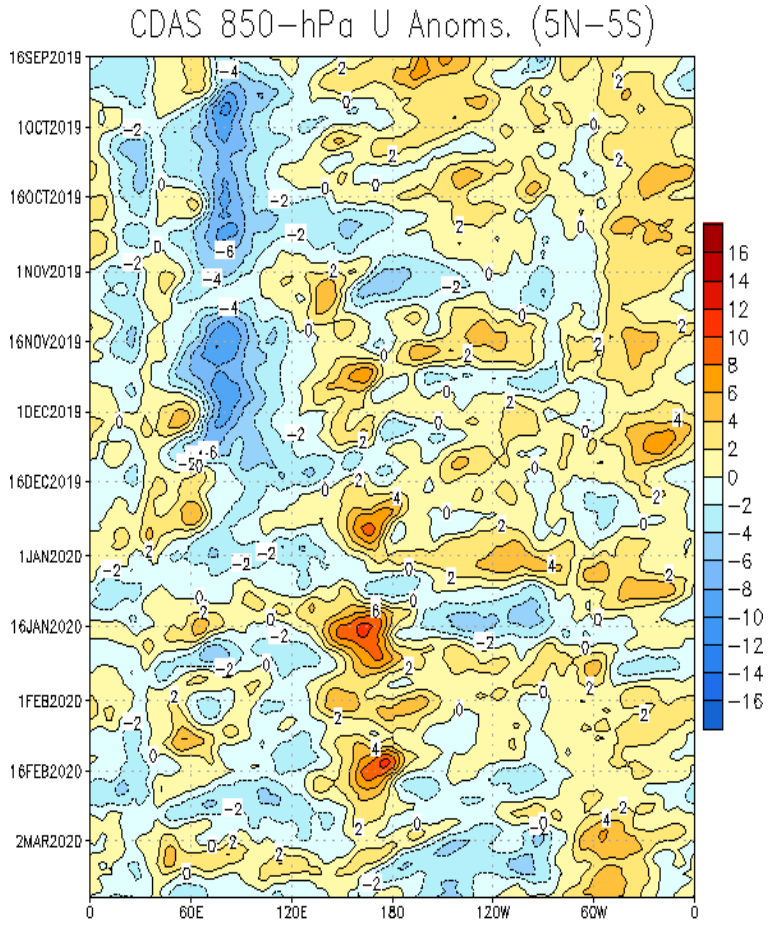


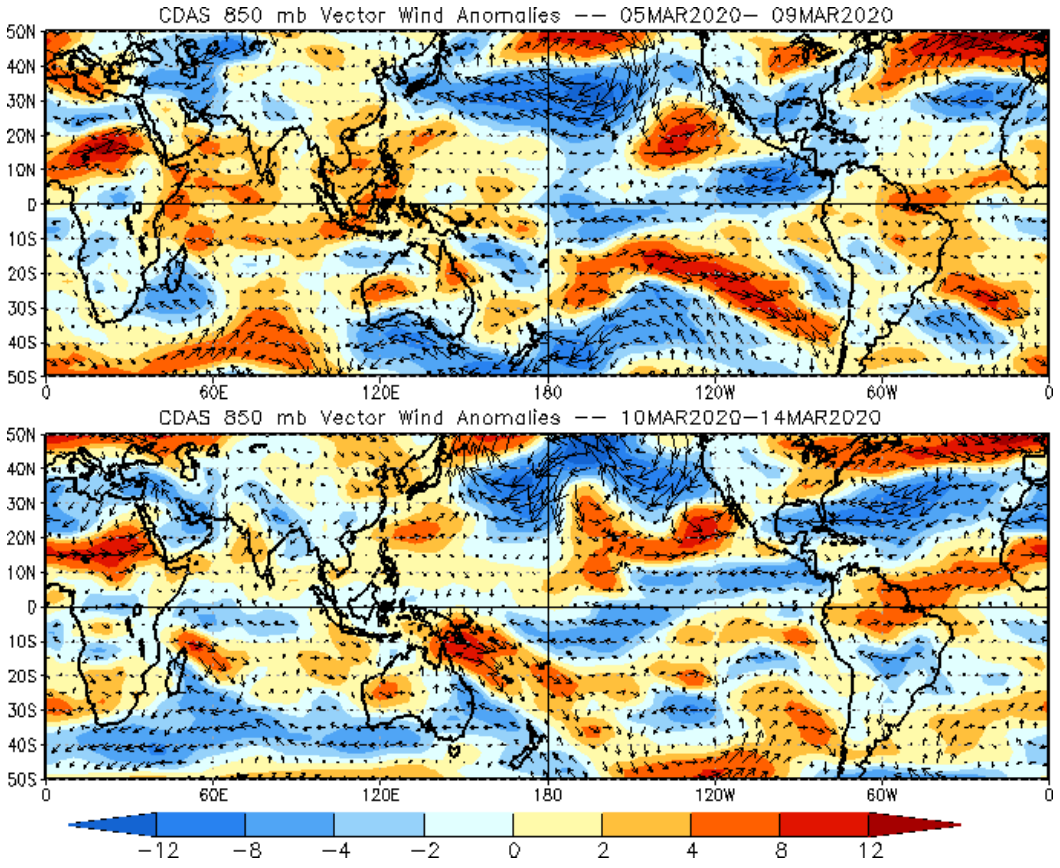
- Easterly (westerly) anomalies over the Maritime Continent (Western Hemisphere) contributed to enhanced convection across the Western Pacific and Melanesia.

- Upper-level convergence and suppressed convection are observed in the northern Indian Ocean, and strong westerly anomalies aloft have persisted across the eastern equatorial Pacific since early March.

850-hPa Wind Anomalies

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

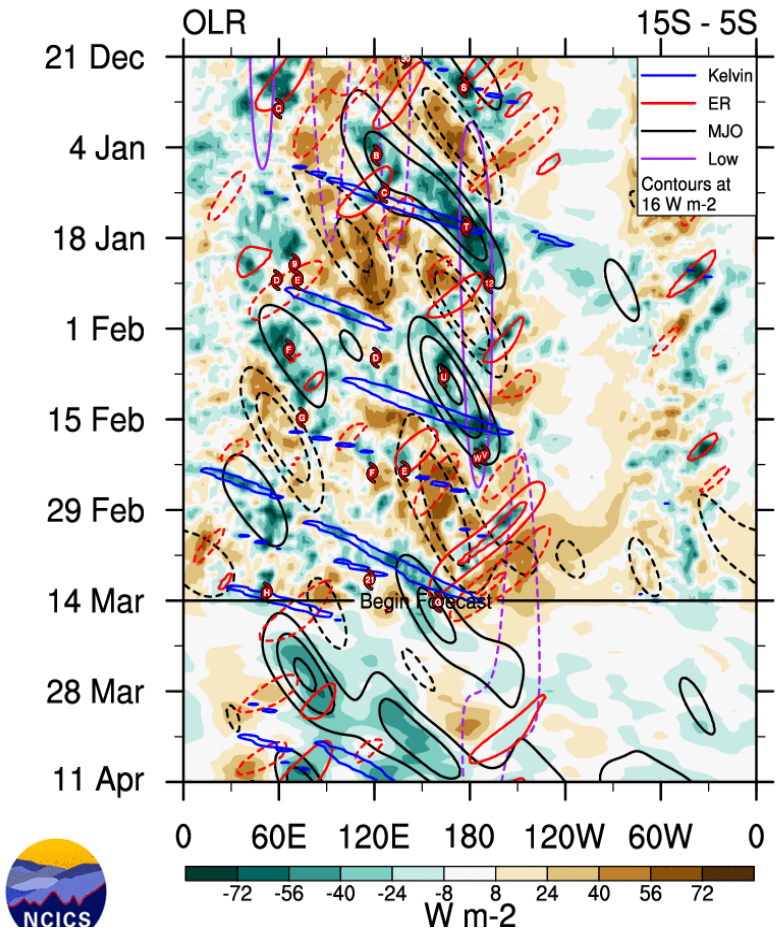


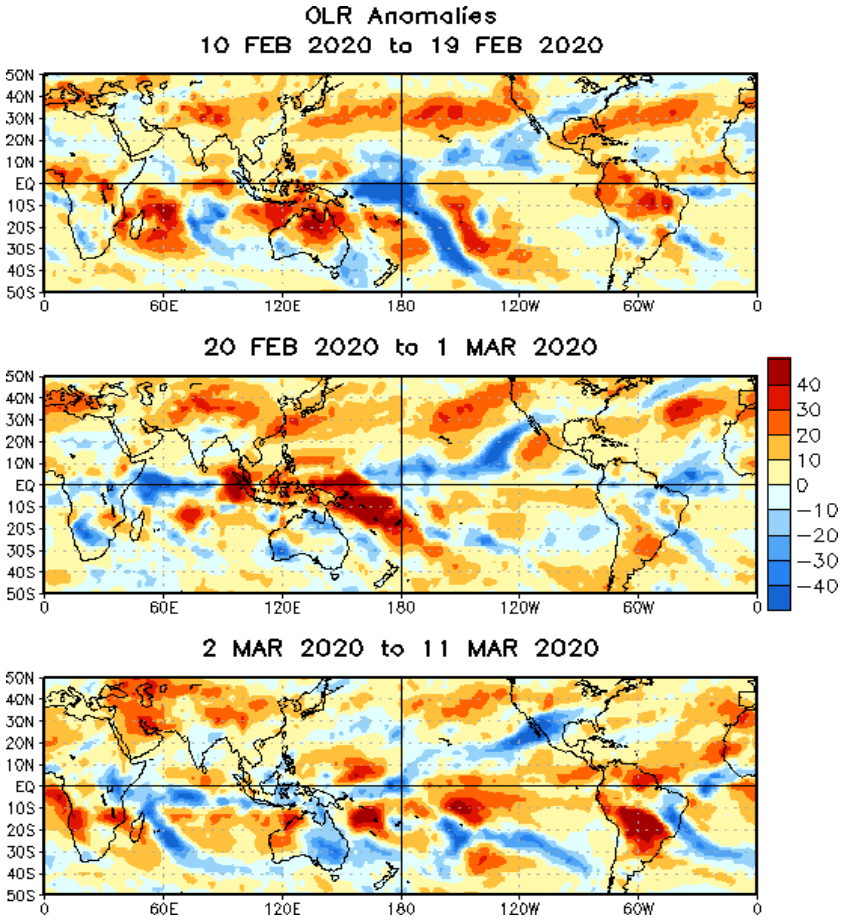


- Lower-level easterly anomalies returned to the equatorial Indian Ocean, and to the west of the Date Line.
- Easterly anomalies over the eastern equatorial Pacific coupled with westerly anomalies over the Atlantic has promoted lower-level divergence and suppressed convection over northern South America since early March.

Outgoing Longwave Radiation (OLR) Anomalies

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

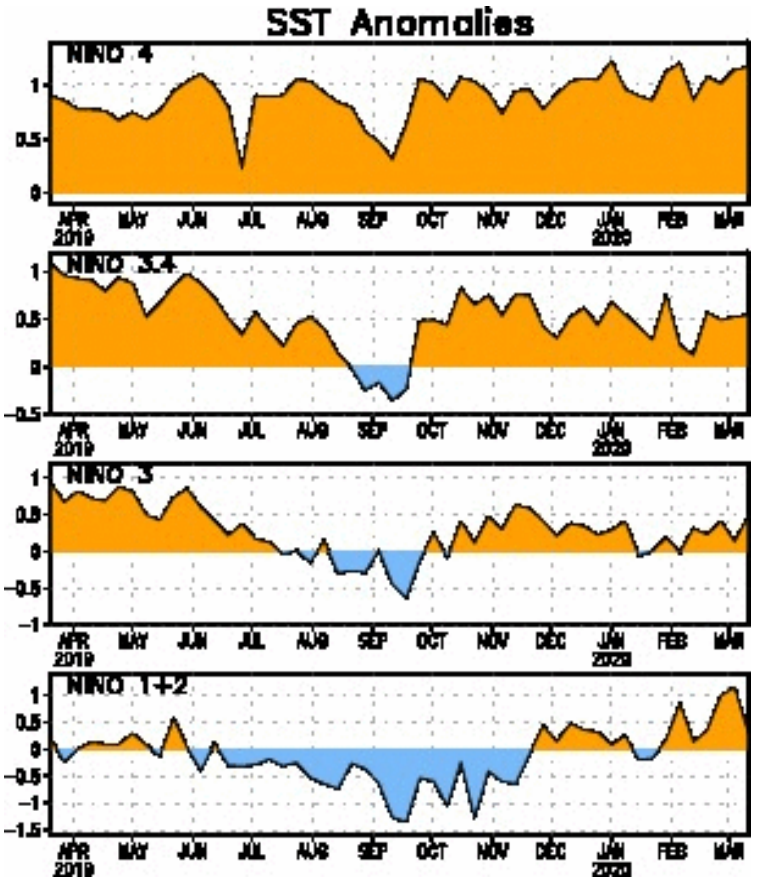


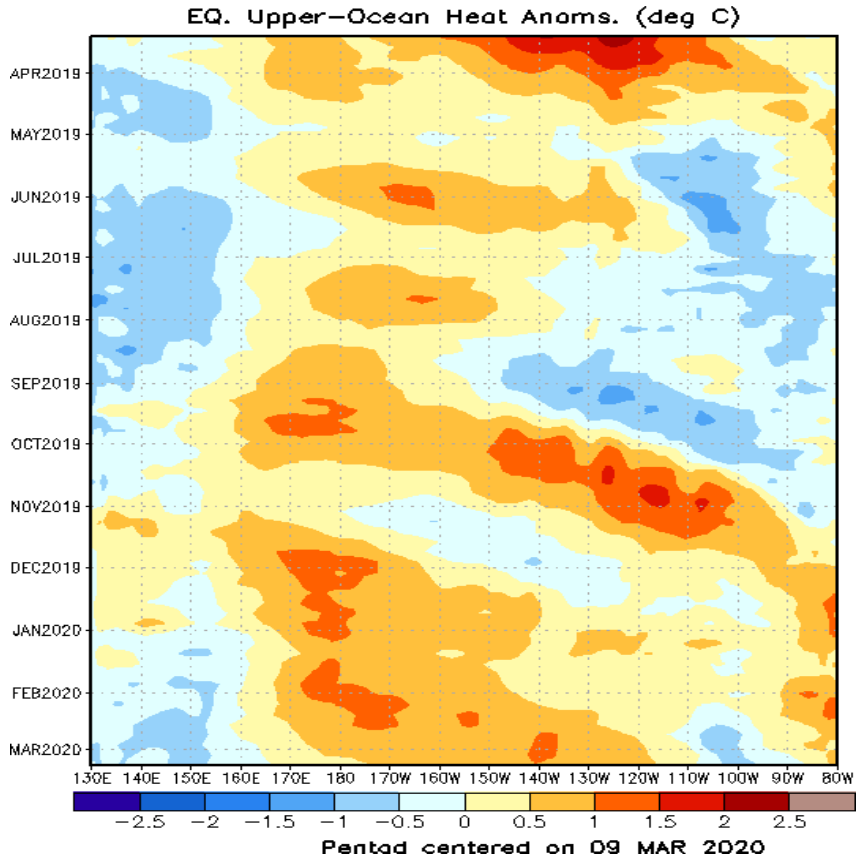


- Enhanced convection associated with a weak MJO and an embedded Kelvin wave has shifted across the western Pacific. A Kelvin wave triggered Tropical Cyclone Herold during the last week.

- Forecast suggests the MJO to emerge over the western Indian Ocean during the next week.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



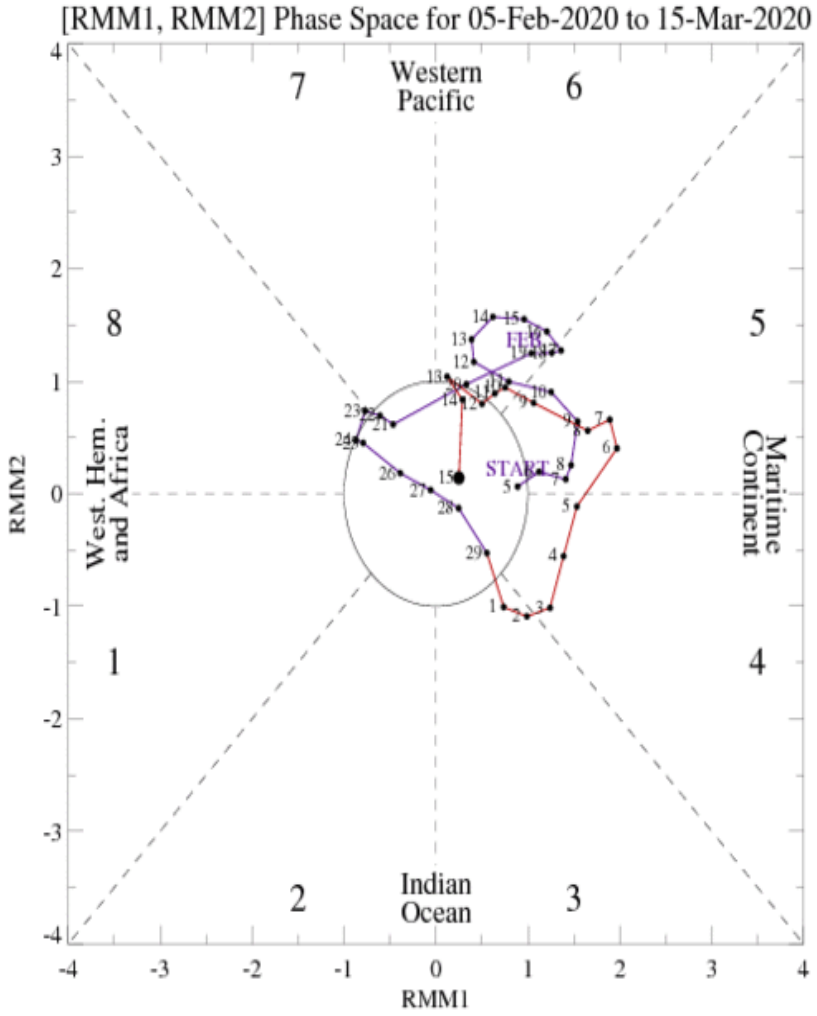


- Upper-oceanic heat content anomalies continue to remain above-normal across most of the basin.

- Since mid-December, several episodes of westerly wind bursts west of the Date Line have contributed toward a downwelling event to sustain anomalously warm temperatures across the Pacific.

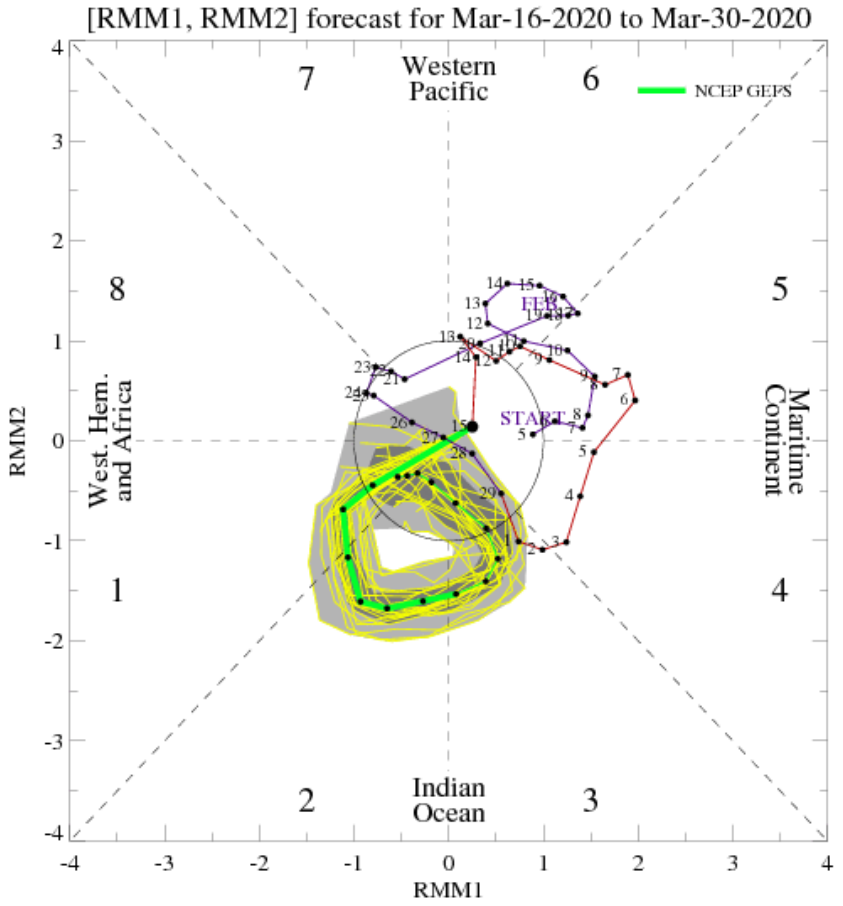
MJO Index: Recent Evolution

- A RMM-based MJO signal that emerged over the eastern Indian Ocean and propagating through Maritime Continent has become weaker during the first half of March.

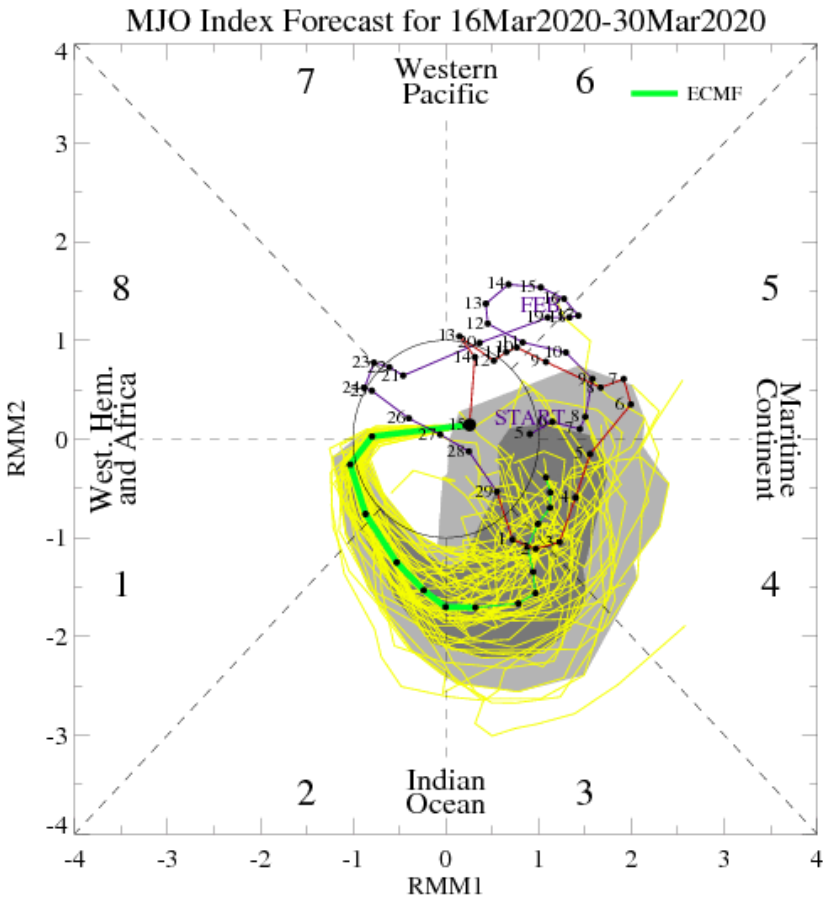


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

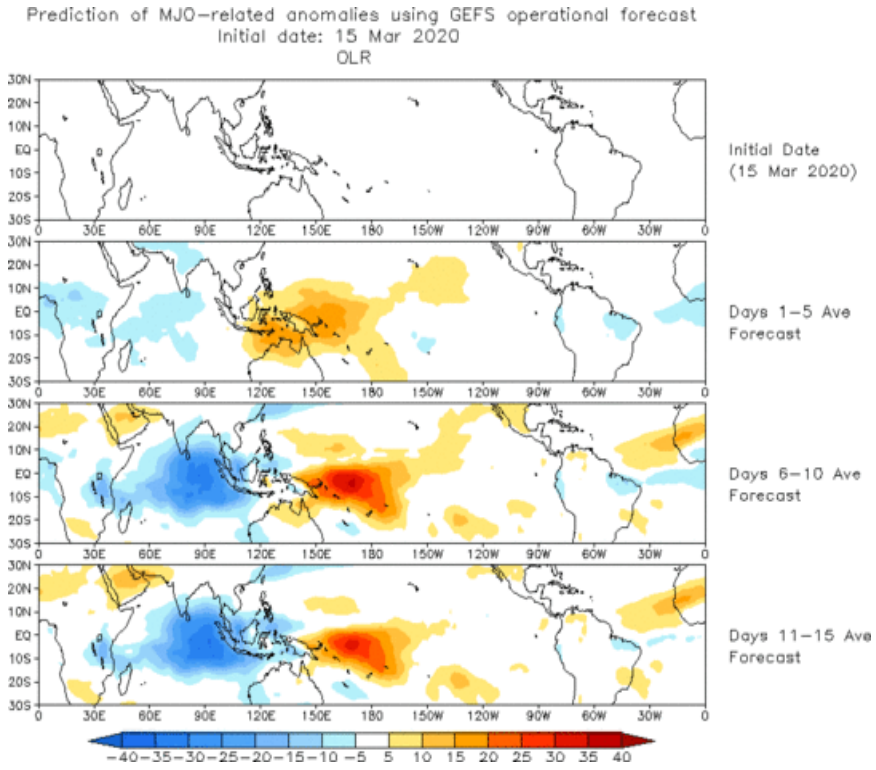


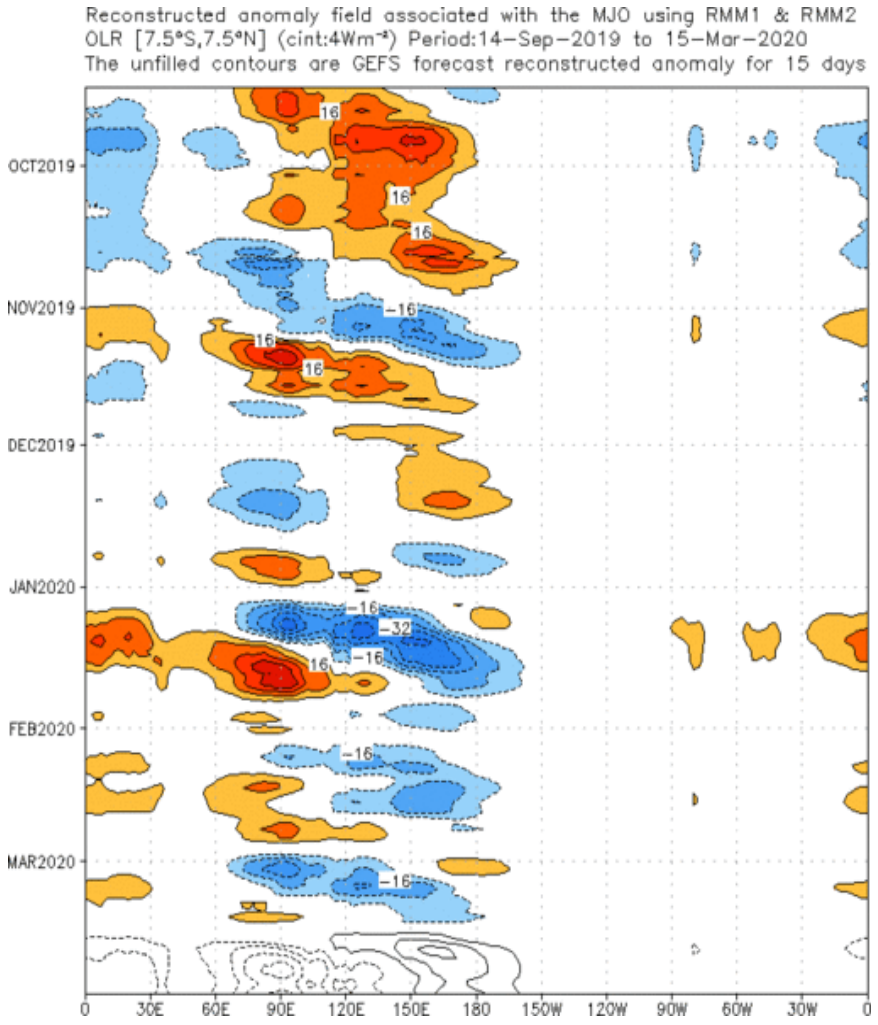
ECMWF Forecast

- Dynamical models exhibit good agreement with a MJO re-emerging over the Western Hemisphere and Africa, with eastward propagation into the Indian Ocean during the next week.
- However, models diverge with Week-2 solutions, with the ECMWF maintaining eastward propagation of the MJO into the Maritime Continent.

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.)

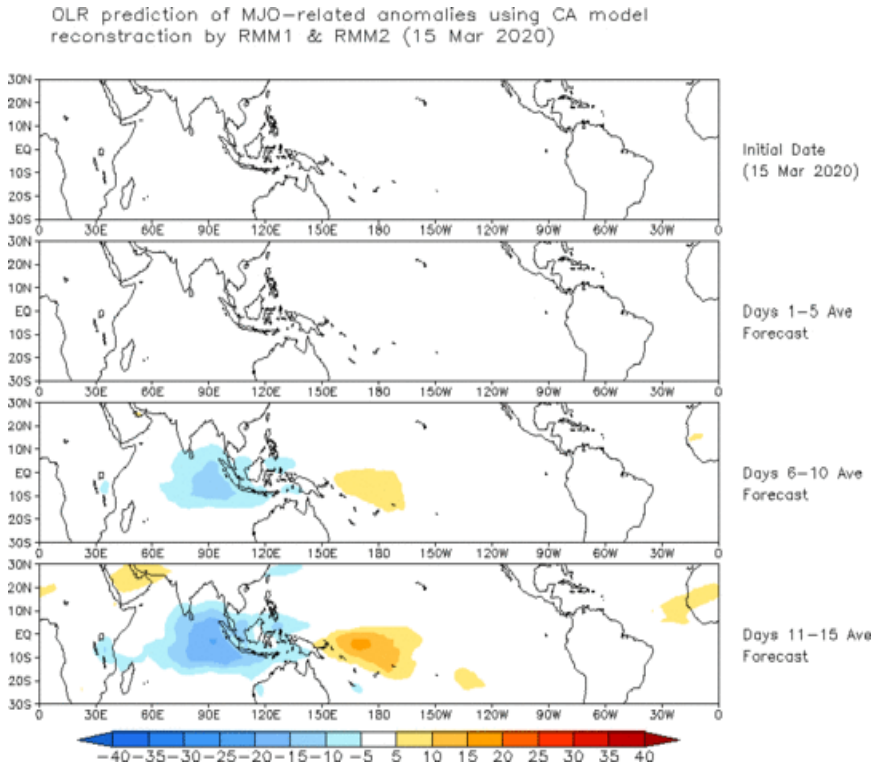


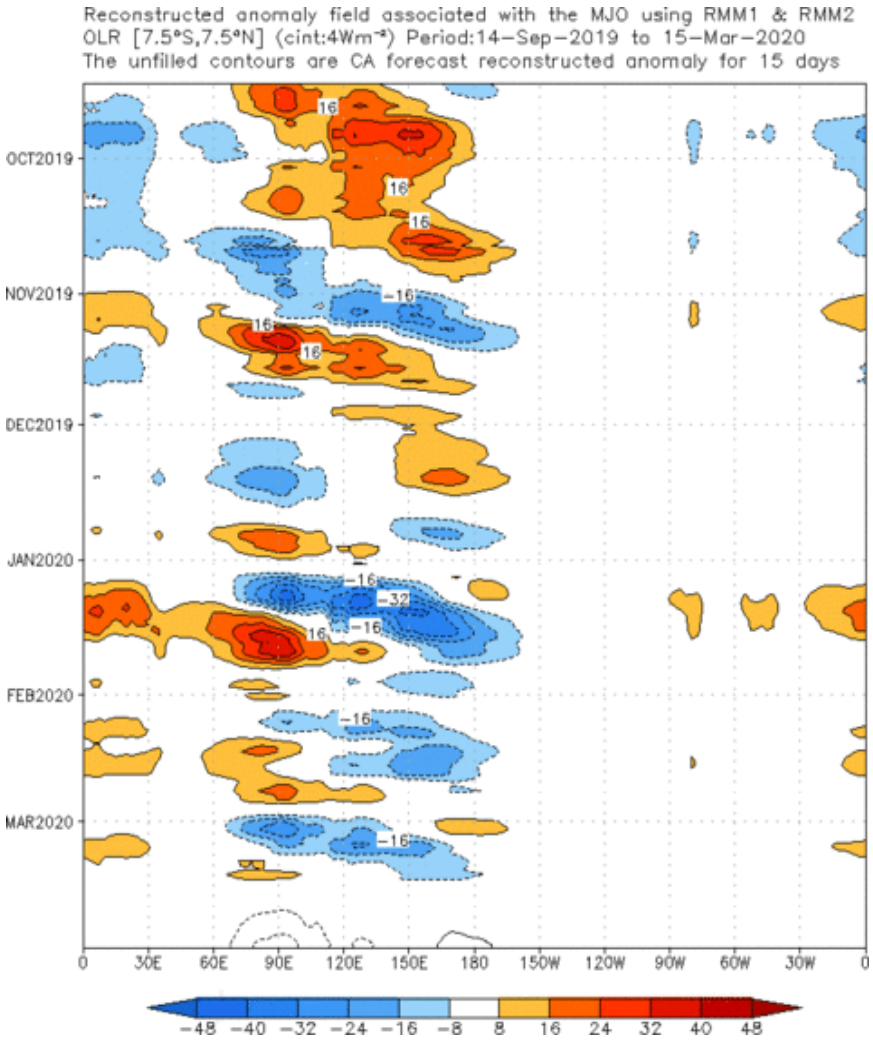


- The GEFS RMM-index based spatial forecast depicts enhanced convection returning to the Indian Ocean and spreading eastward over the Maritime Continent in Week-2.

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.)

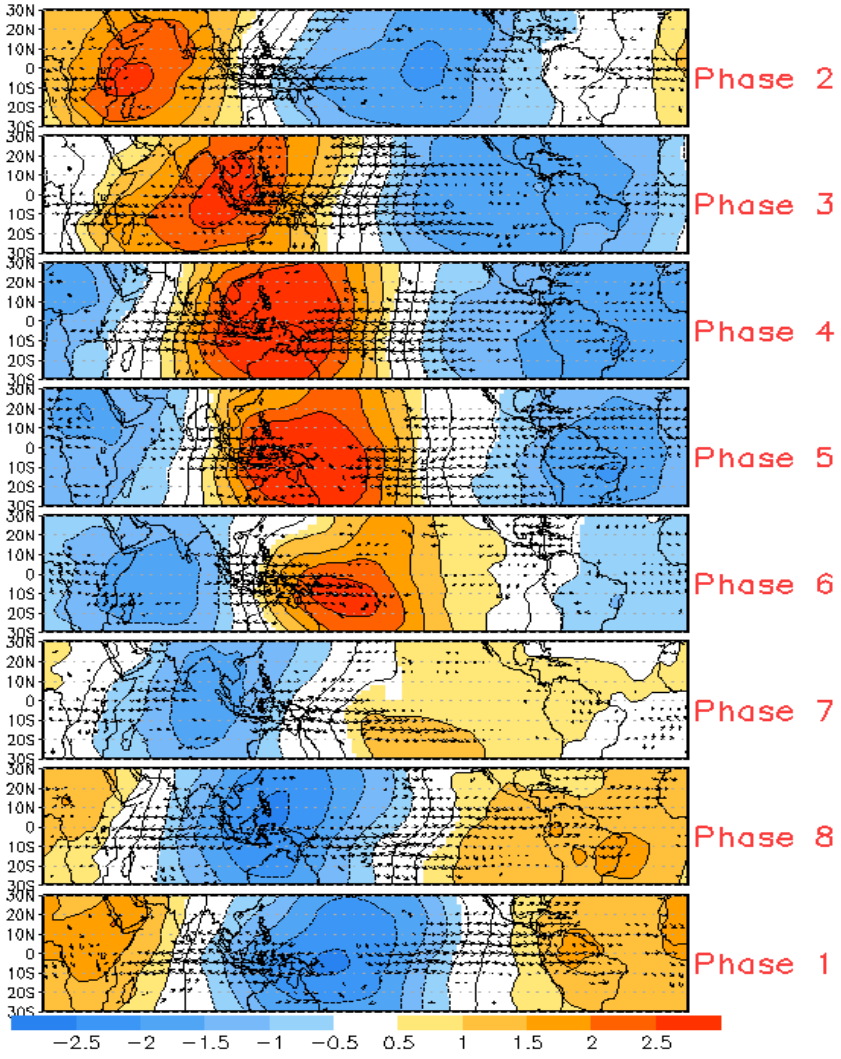




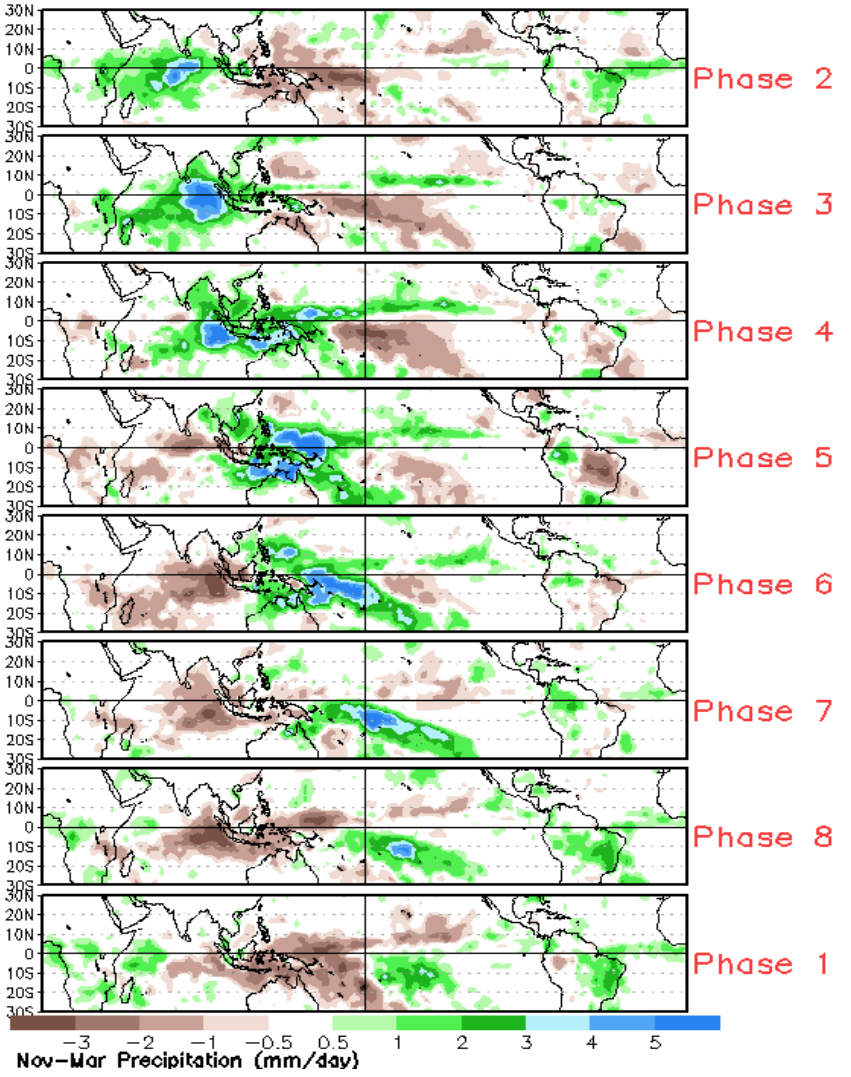
- The constructed analog forecast depicts little to no signal during Week-1, with enhanced convection over the Indian Ocean and into Week-2.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



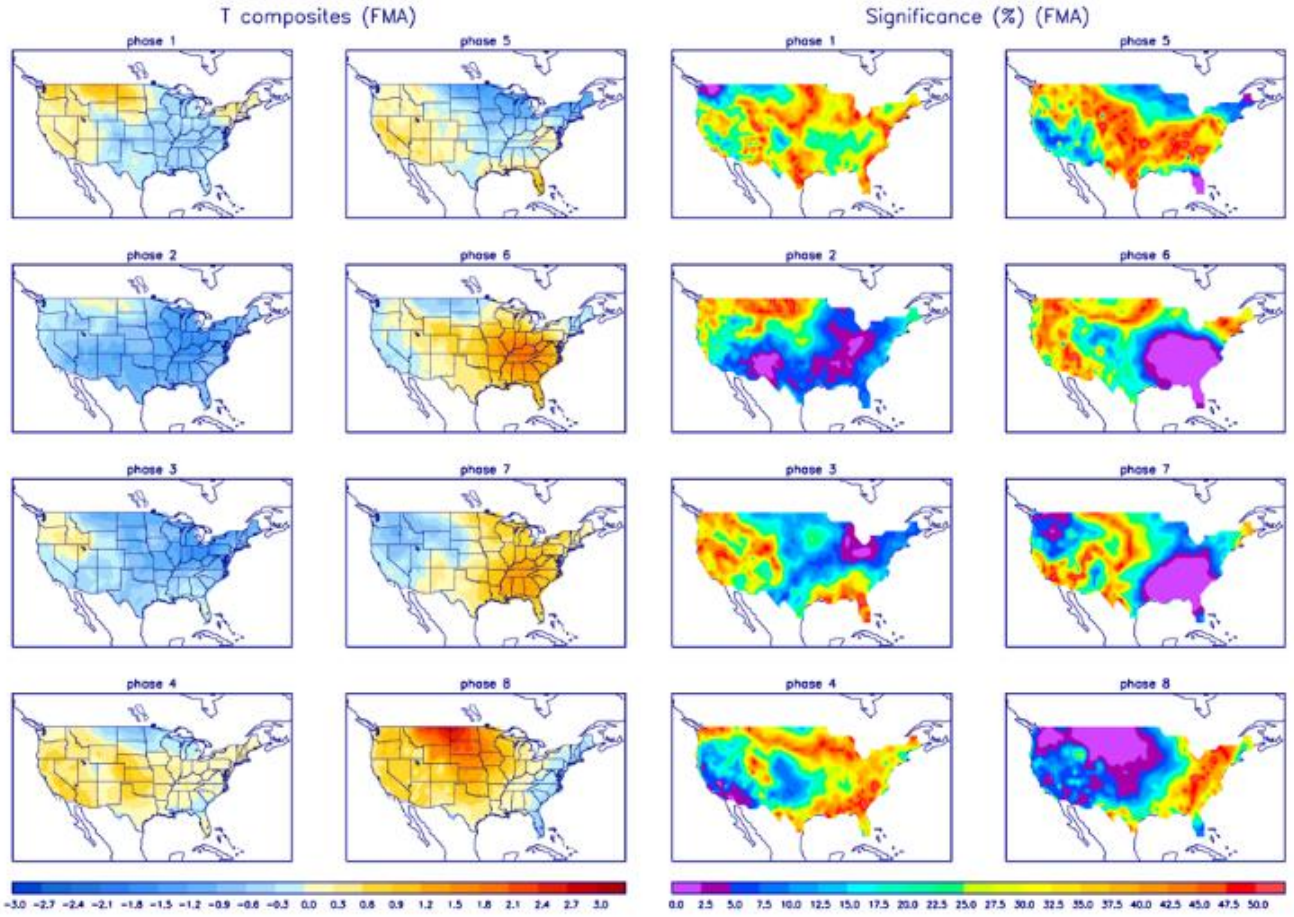
Precipitation Anomalies



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.

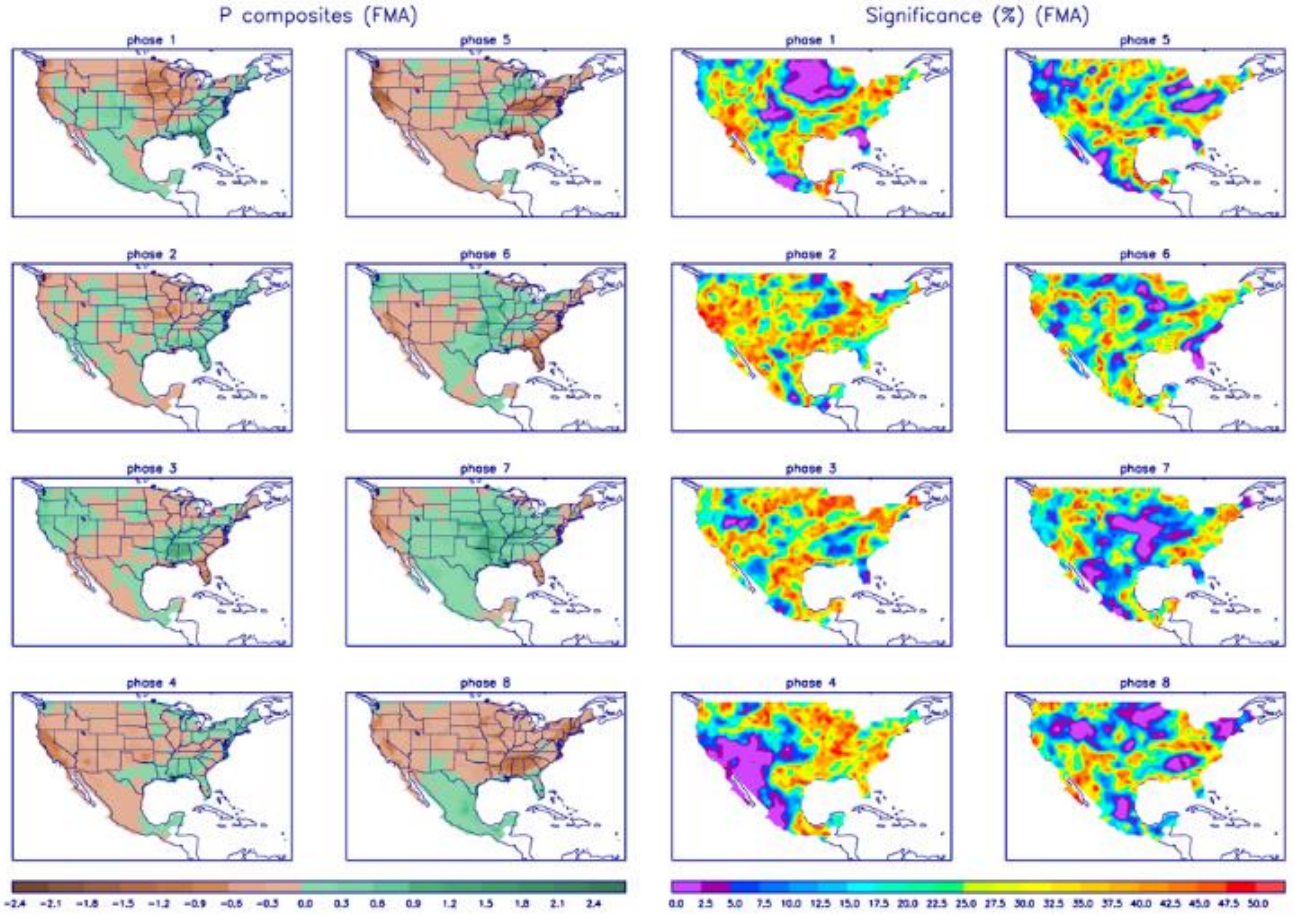


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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.



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