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

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
26 April 2021

Overview

- During mid to late April, the MJO became less coherent likely due to destructive interference with the lingering effects of La Niña and other modes of tropical variability.

- Dynamical models favor a renewed eastward propagation of the MJO over the Western Hemisphere during week-1, but uncertainty on its evolution increases later in May.

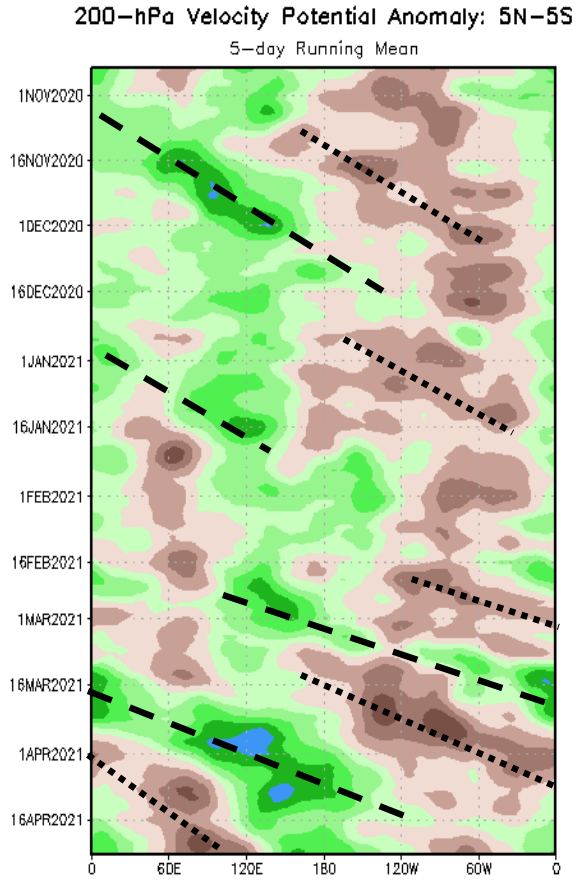
- Later in week-2, chances for tropical cyclone development are forecast to increases over the southern Arabian Sea.

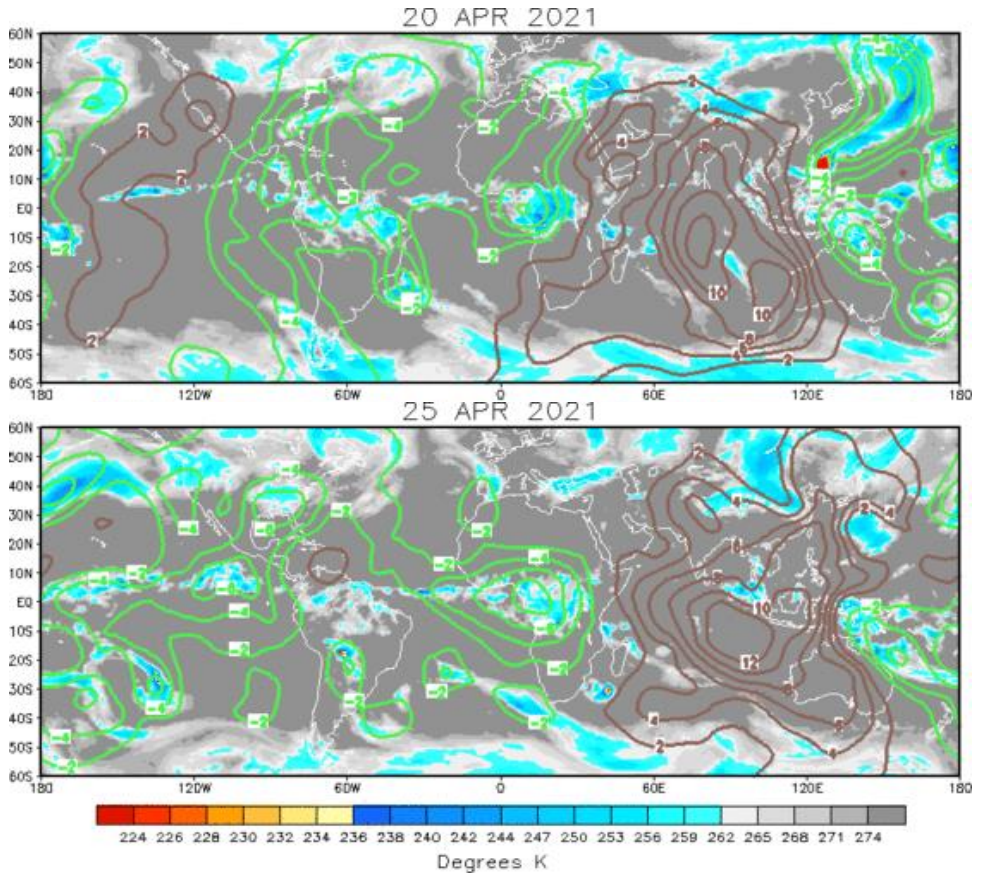
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

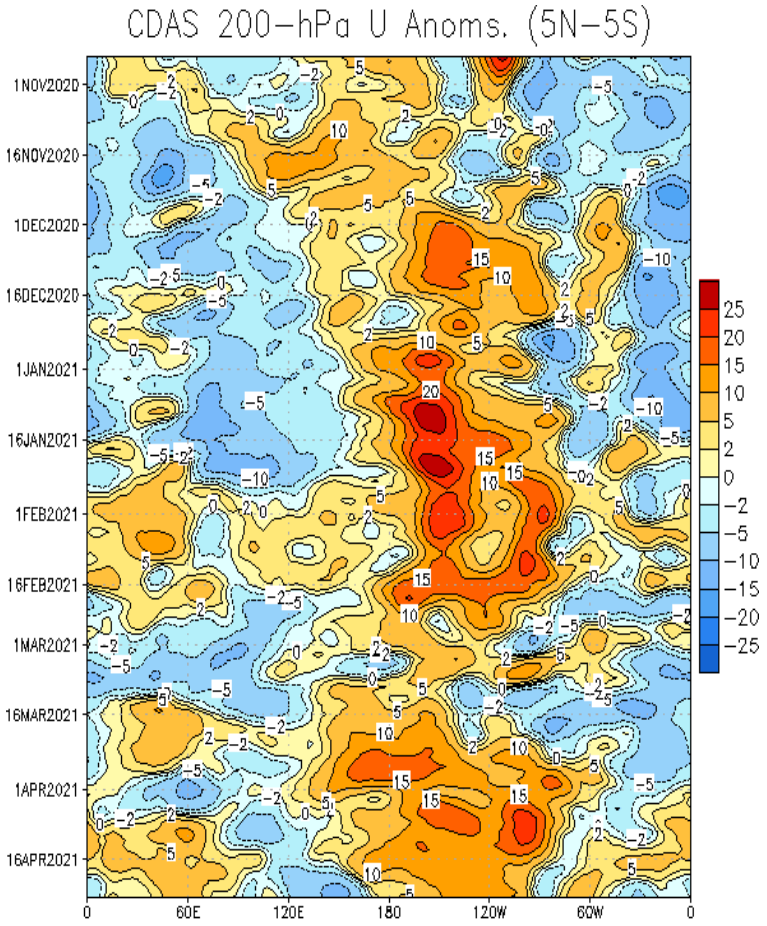


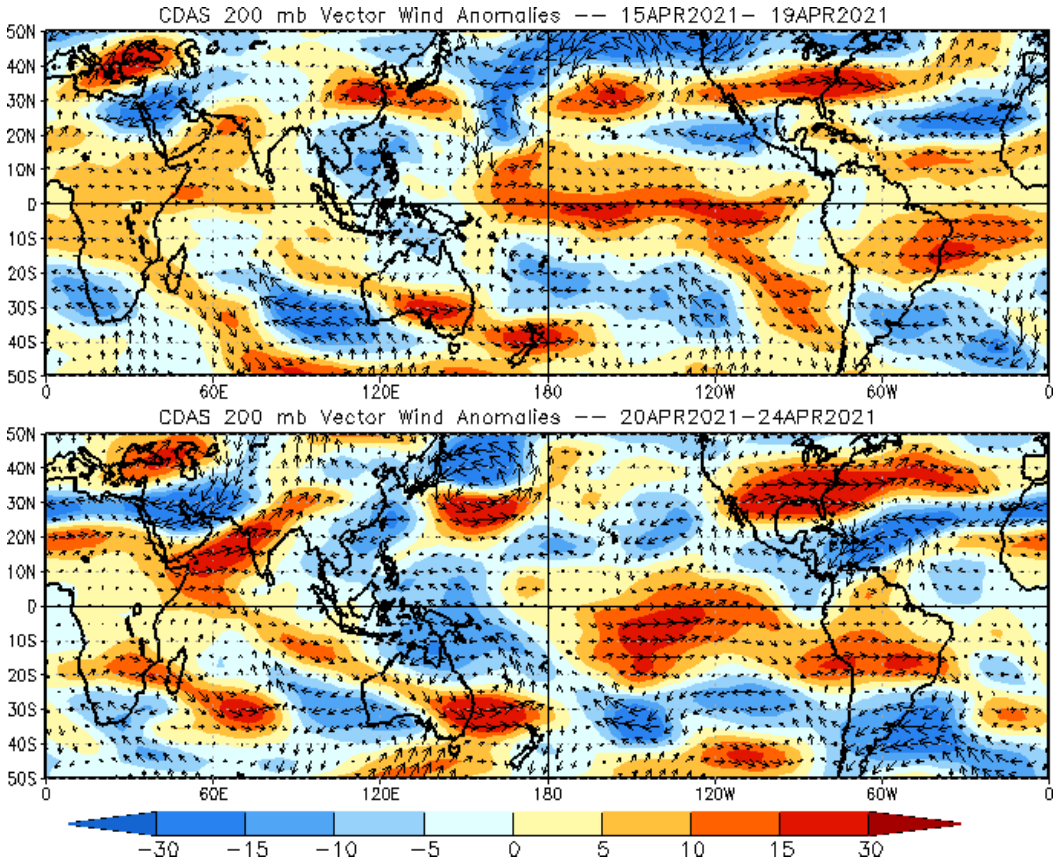


- A robust MJO completed a circumnavigation of the global tropics by the beginning of April.
- The velocity potential spatial pattern features anomalous upper-level divergence (convergence) over the East Pacific and Americas (Indian Ocean and western Maritime Continent).

200-hPa Wind Anomalies

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

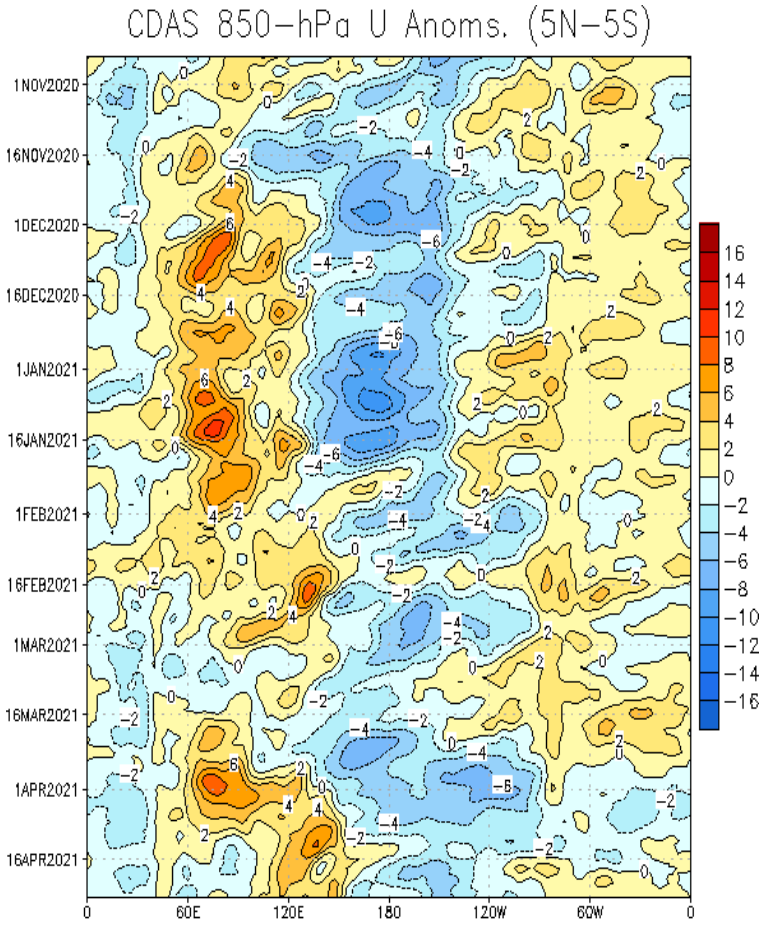


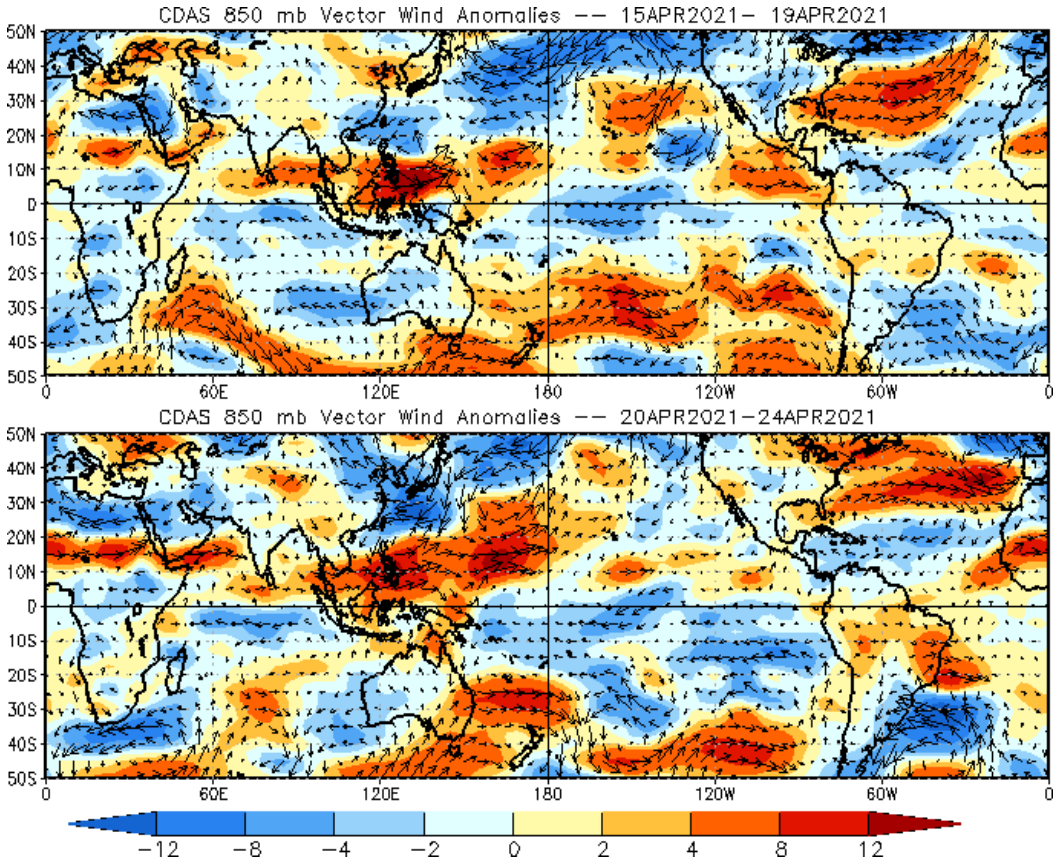


- Anomalous upper-level westerlies are present throughout the central and eastern equatorial Pacific, which is consistent with the weak La Niña as well as the current state of the MJO, which is located over the central to eastern Pacific.

850-hPa Wind Anomalies

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

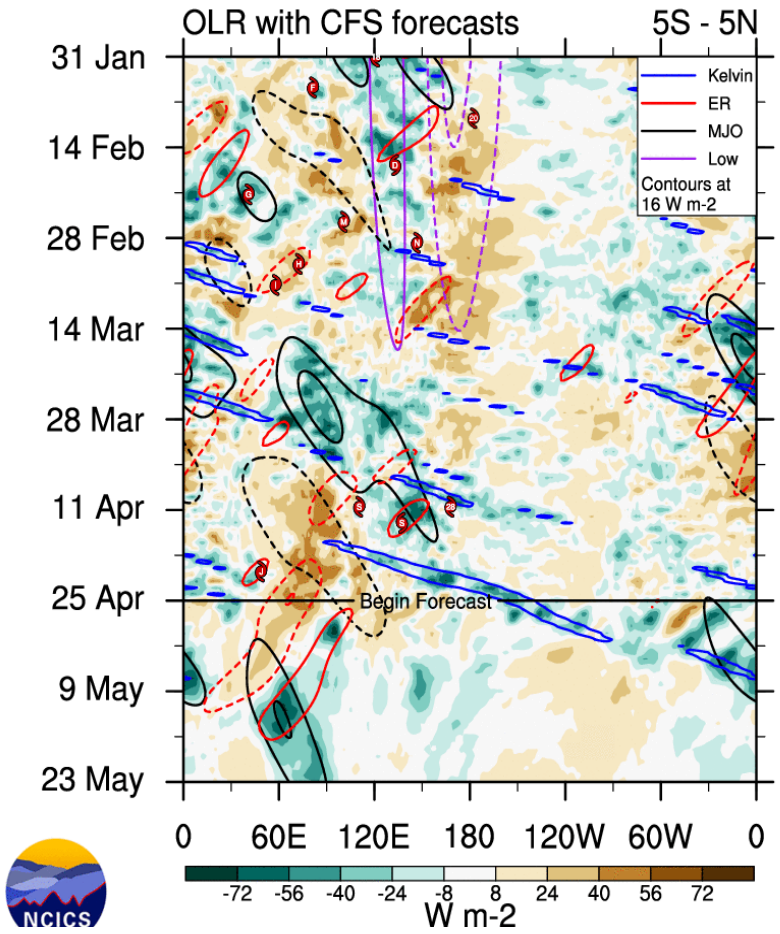


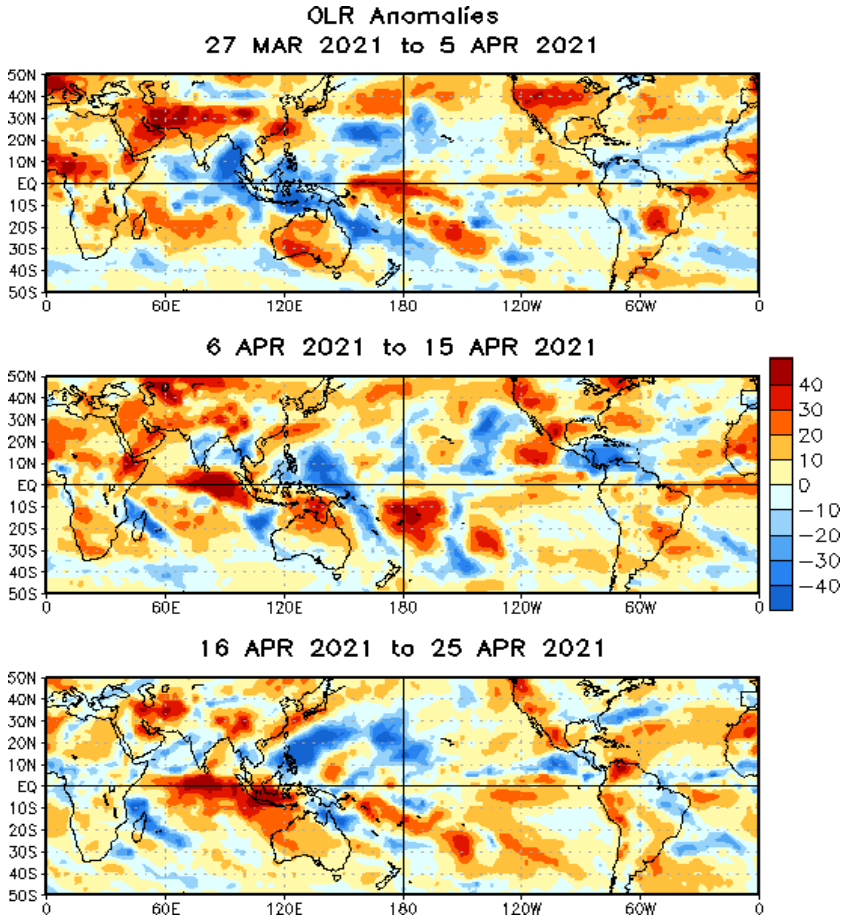


- Although trade winds were closer to average during mid-April due to a weakening La Niña and the passage of the MJO, westerly low-level anomalies were unable to shift east of the Date Line along the equator.

Outgoing Longwave Radiation (OLR) Anomalies

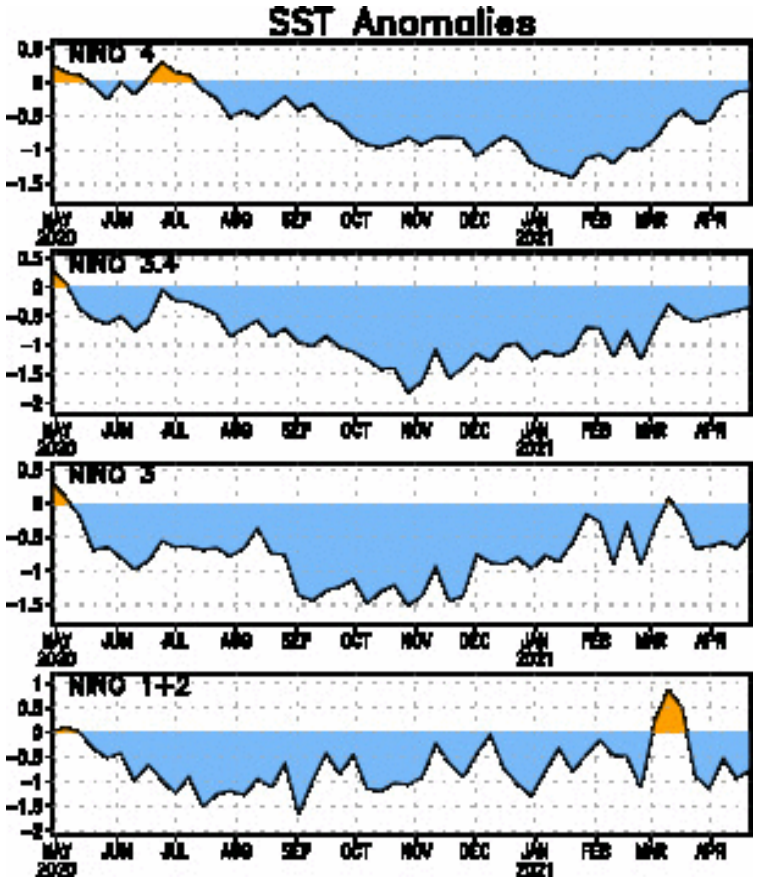
Blue shades: Anomalous convection (wetness). Red shades: Anomalous subsidence (dryness).

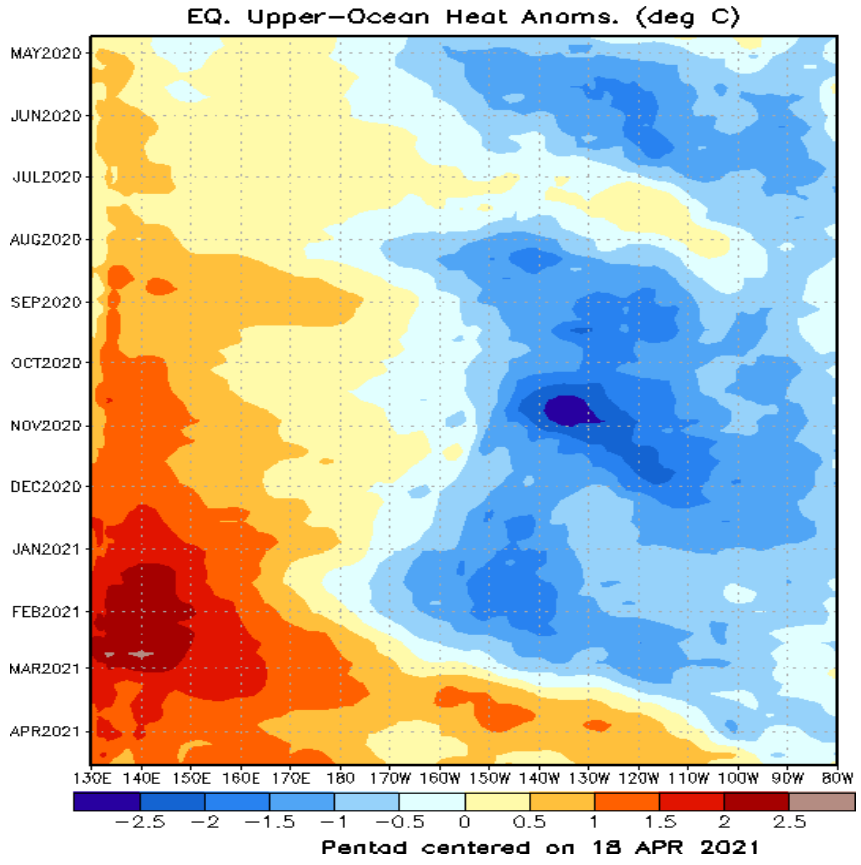




- The majority of the anomalous convection related to the current MJO event has been located north of the Equator, well outside of the 5S-5N band shown in the above hovmöller diagram associated with TC Surigae in the Western Pacific.
- The MJO resulted in strong suppressed convection across the equatorial Indian Ocean and much drier conditions over the western Maritime Continent from Apr 16-25.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



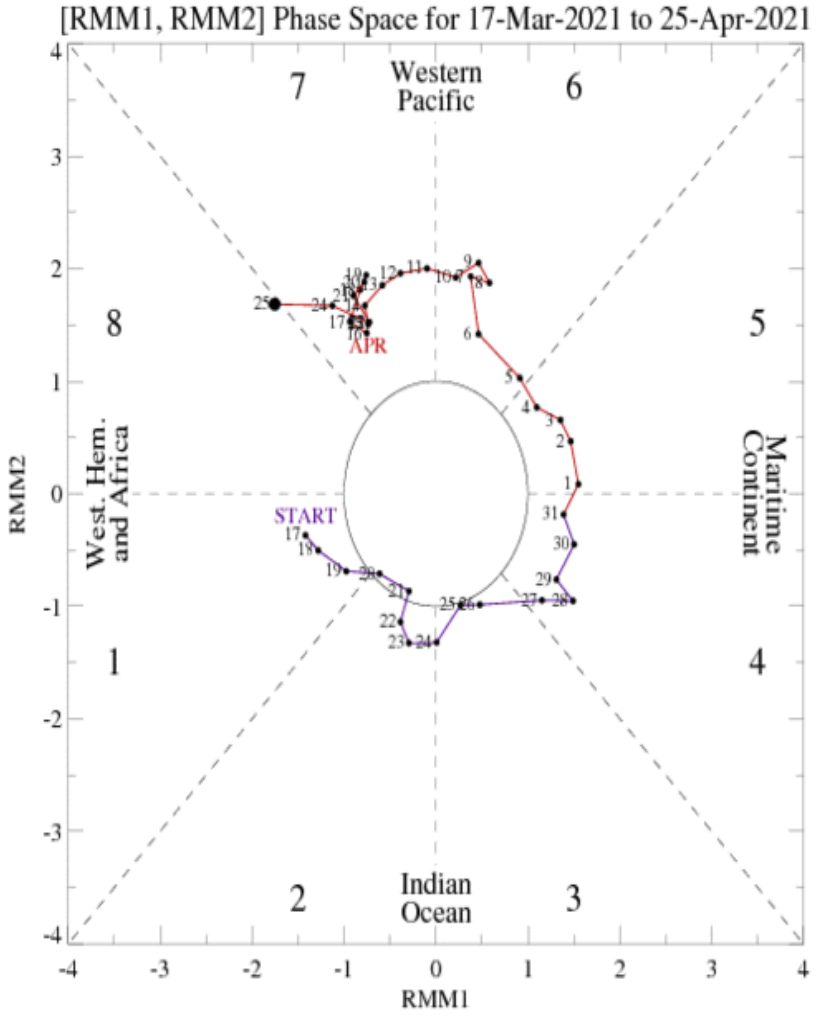


- La Niña conditions have been present since August 2020. Negative SST anomalies in the Niño 4 region have steadily weakened since January.

- Strong Rossby wave activity over the West Pacific in February generated a westerly wind burst that initiated a downwelling oceanic Kelvin wave. This Kelvin wave pushed warmer water within the upper-ocean across the Central and East Pacific. Similarly, another wave may be ongoing near the Date Line.

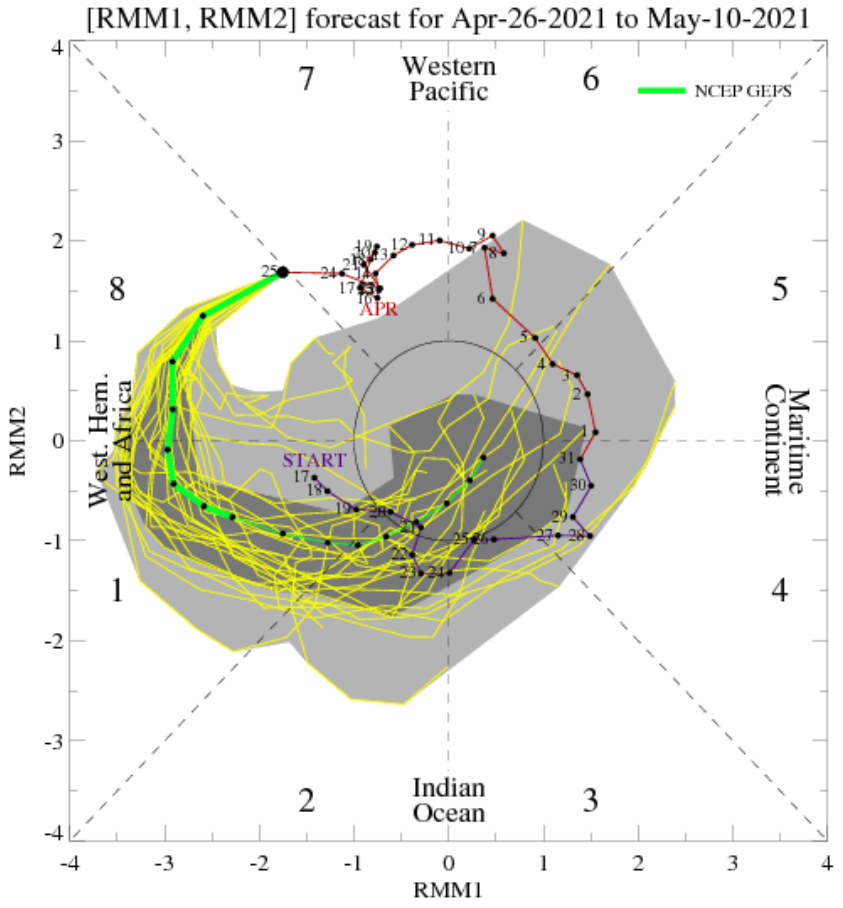
MJO Index: Recent Evolution

- The RMM index depicts the well-defined MJO and its eastward propagation from mid-March through early April. The recent slowing of the MJO is related in part to Super Typhoon Surigae.

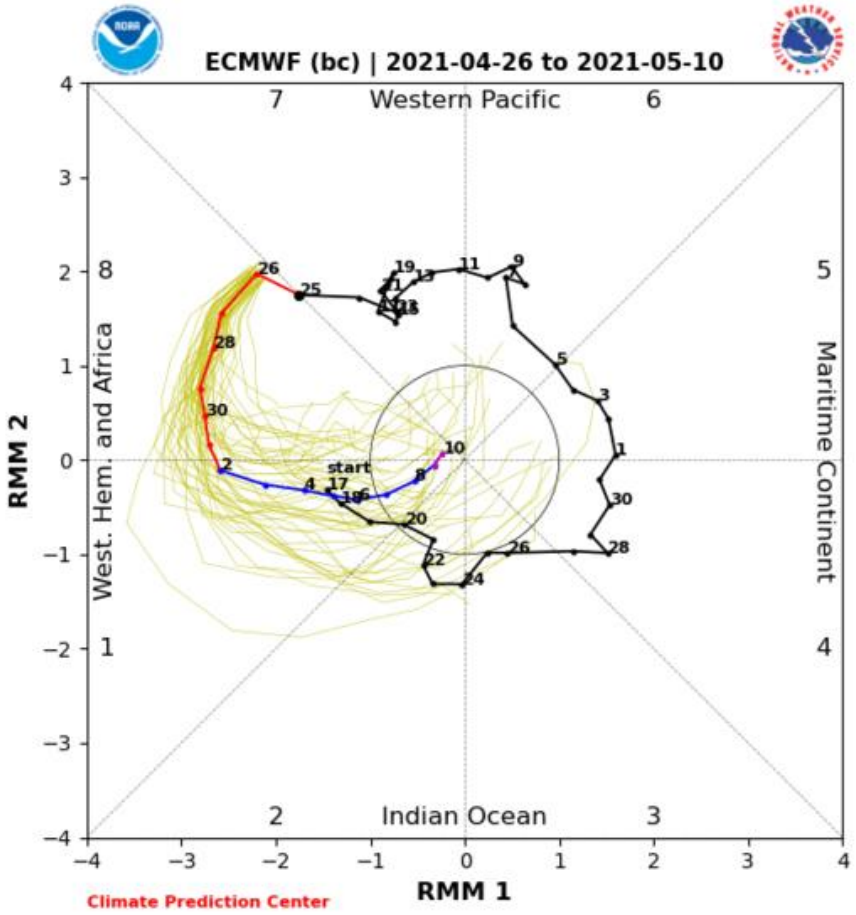


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

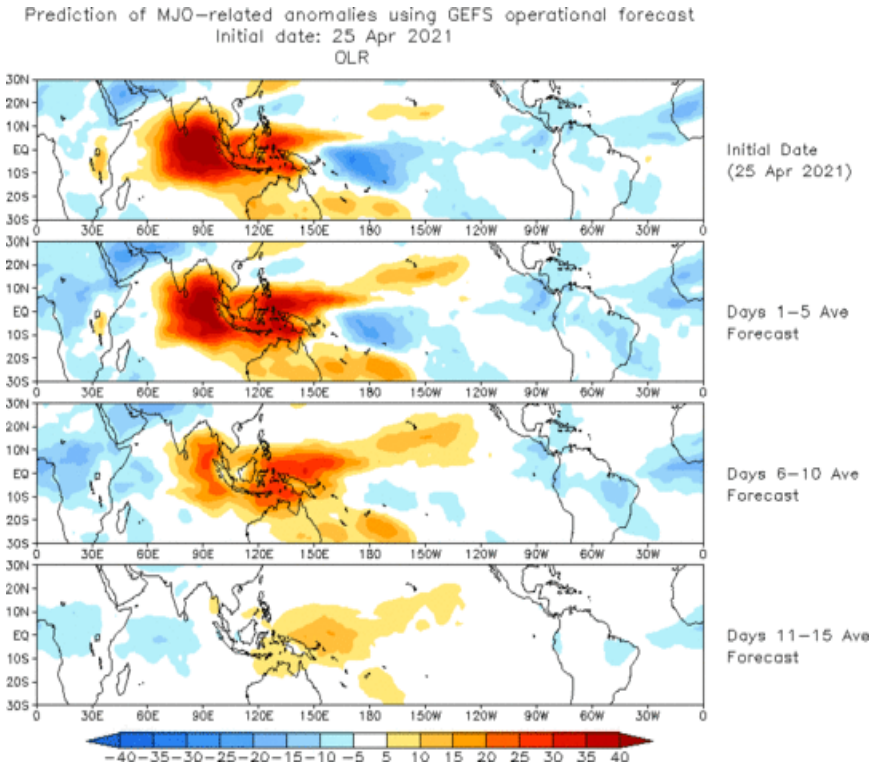


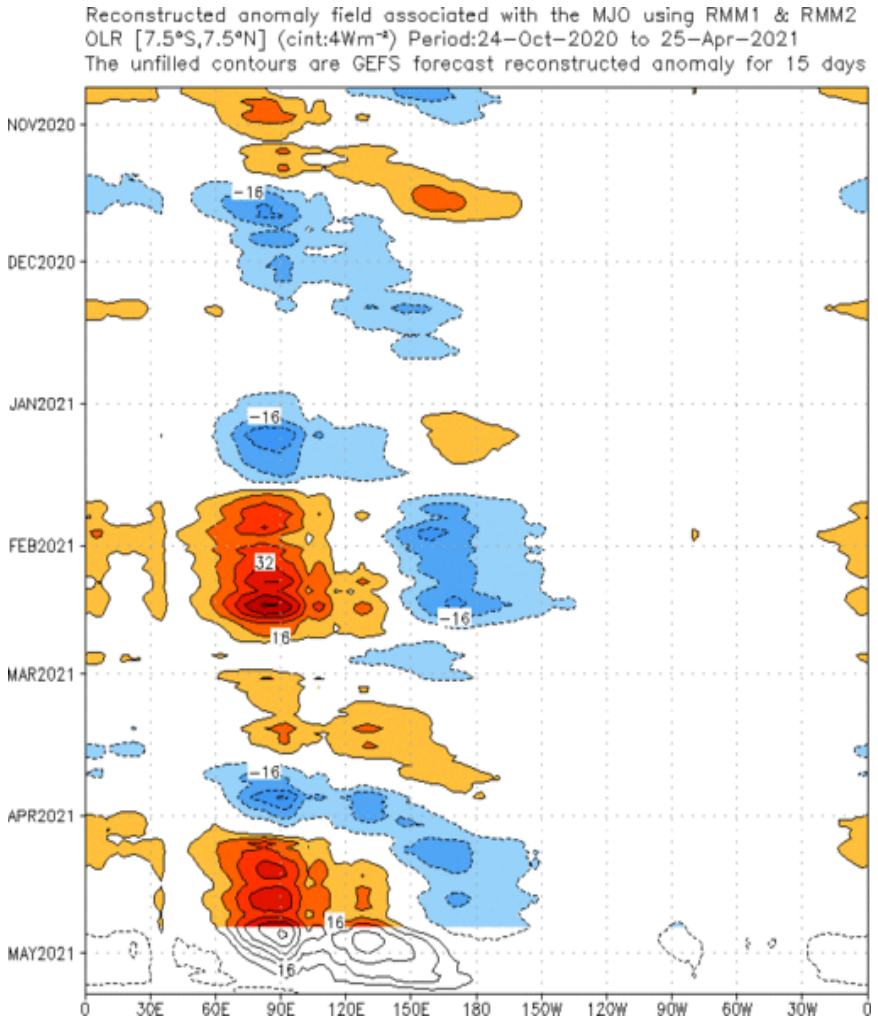
ECMWF Forecast

- The GEFS and ECMWF are in good agreement that the MJO resumes its eastward propagation over the Western Hemisphere during week-1. Compared to previous weeks, ensemble spread is much larger 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.)



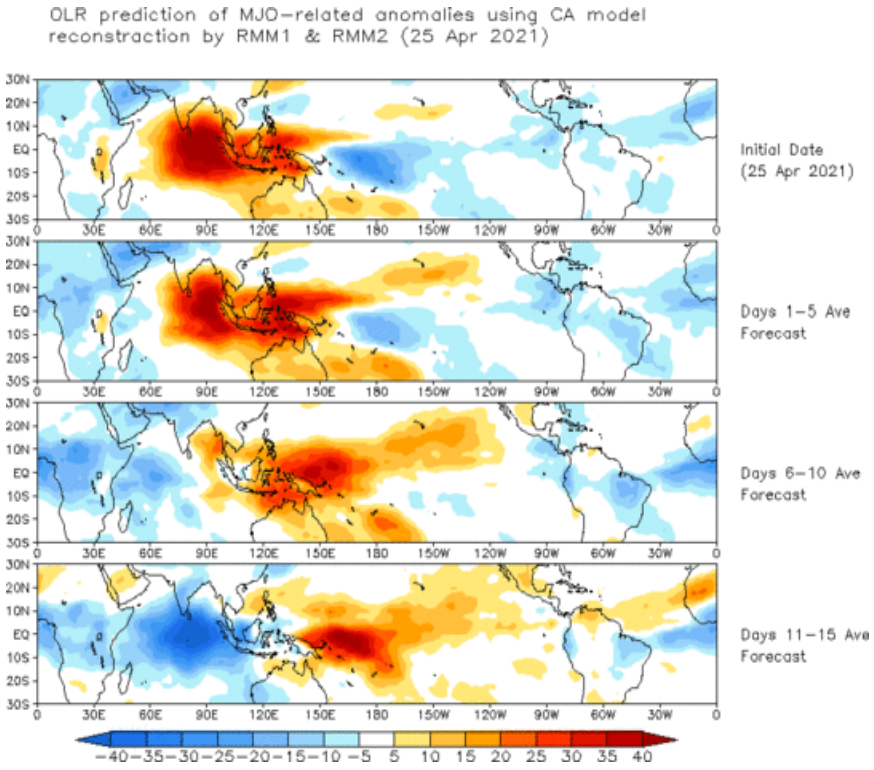


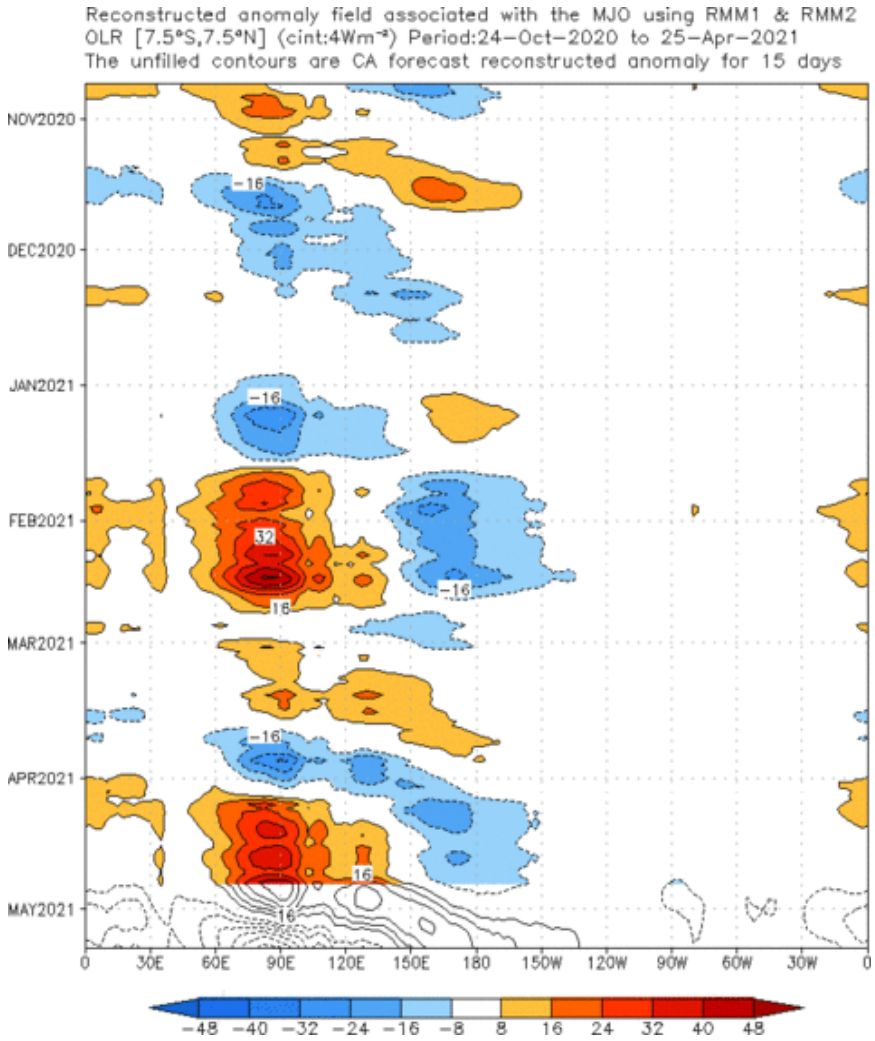
- The GEFS spatial OLR plots feature an increase in convection across the Americas and Africa during the next ten days, while suppressed convection expands to Australia and the West Pacific.

- Later in week-2, anomalies become smaller as spread among ensemble members increases.

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.)

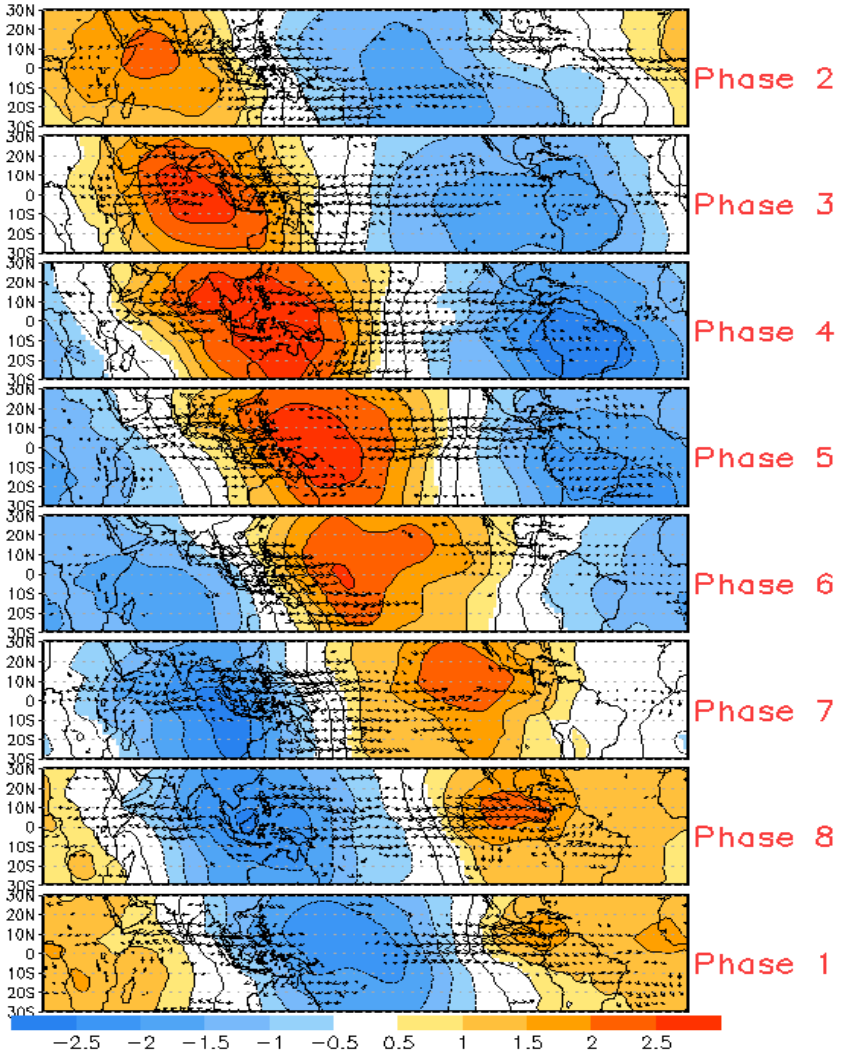




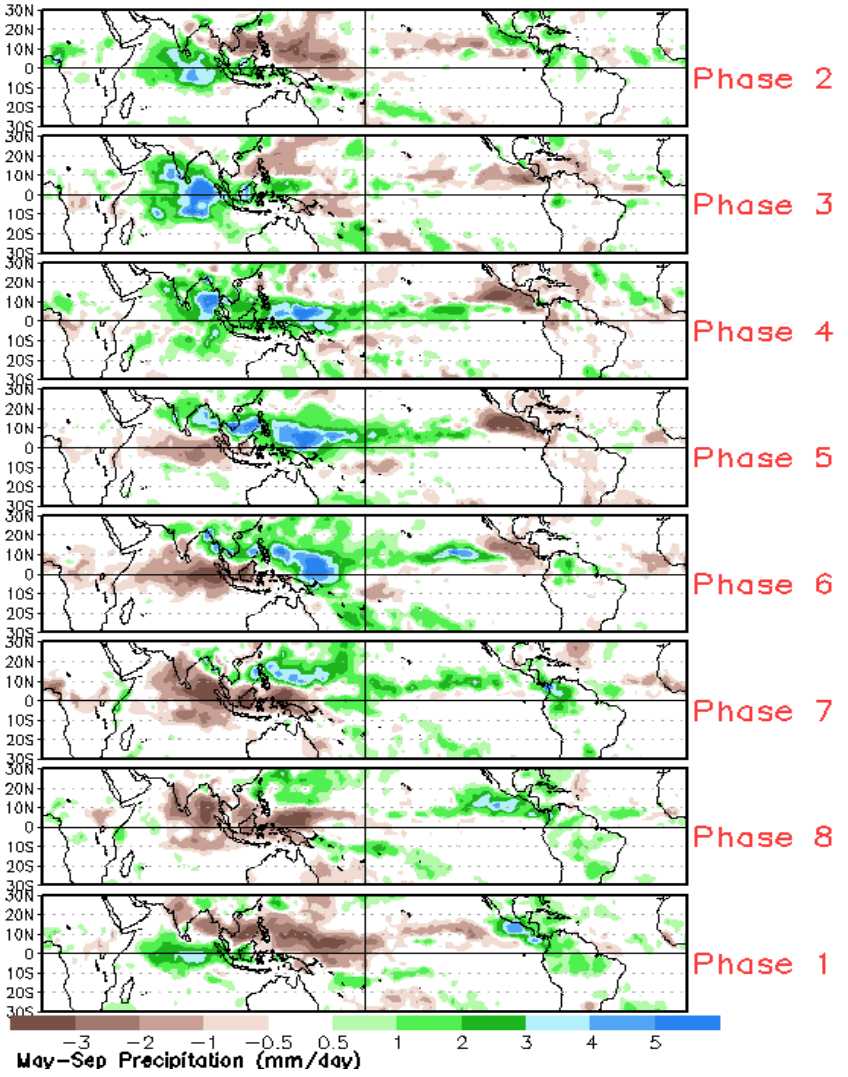
- The constructed analog forecast produces a more canonical MJO response which continues through week-2.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



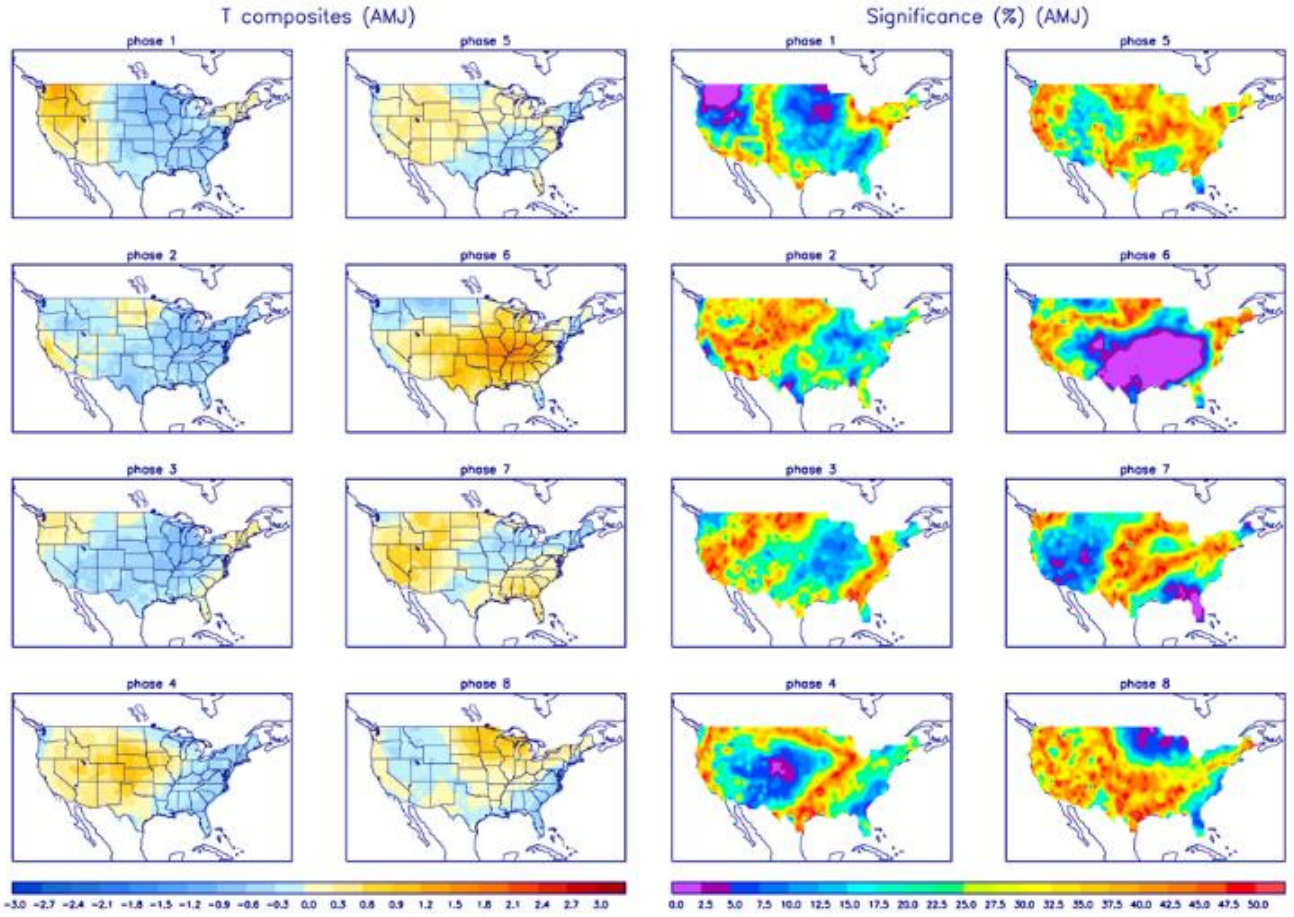
Precipitation Anomalies



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.

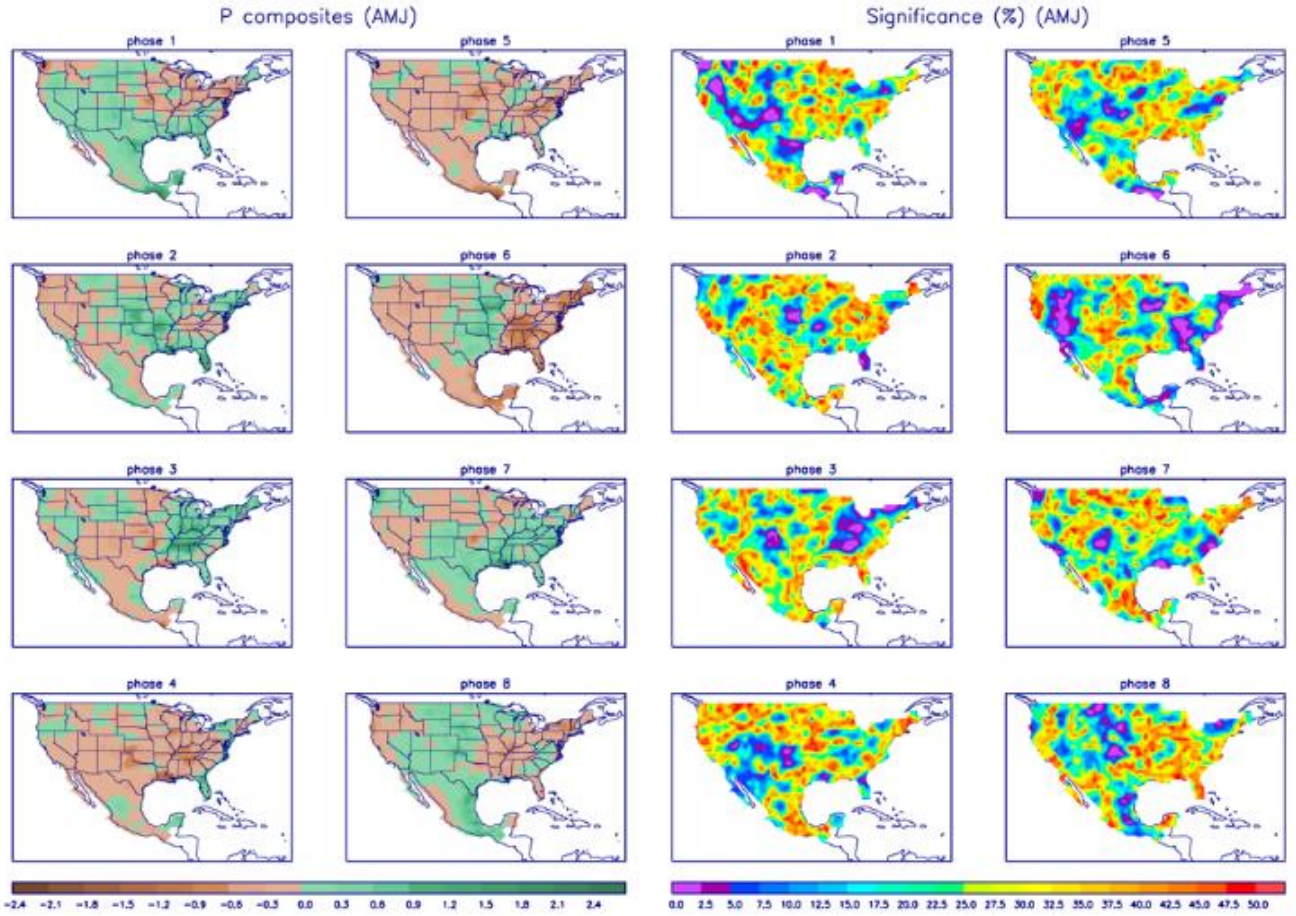


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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