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

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
10 May 2021

Overview

- The MJO remains active over the Indian Ocean and has completed nearly two full global circumnavigations since late February.

- There is continued confidence that the MJO will remain active and continue propagating eastward over the Indian Ocean and the Maritime Continent during the next two weeks. Reduced support of this realization exists in the RMM forecasts, which may be attributed by the following caveats.
    - An artificially dampened amplitude of the intraseasonal signal resulting from the removal of 120-day mean in the RMM index, which is not an ideal application during the current transition to ENSO neutral conditions.
    - A westward shifting signal in RMM space stemming from the detachment of a convectively coupled Kelvin Wave that is forecast to weaken over the Pacific during week-1.
    - Models generally have difficulty propagating the MJO over the Maritime Continent Islands.

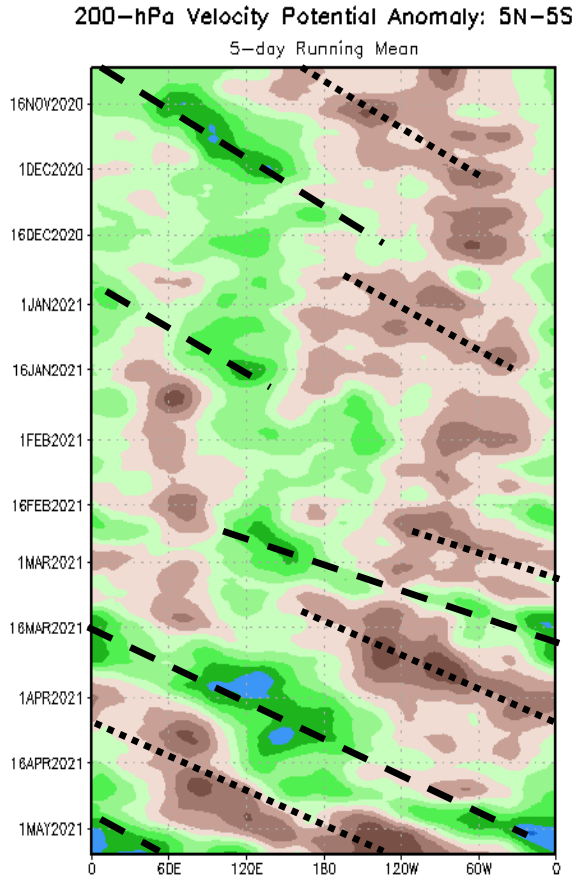
- The enhanced phase of the MJO and predicted Rossby Wave activity are anticipated to contribute to an uptick in tropical cyclone activity over the eastern Hemisphere during the next two weeks.

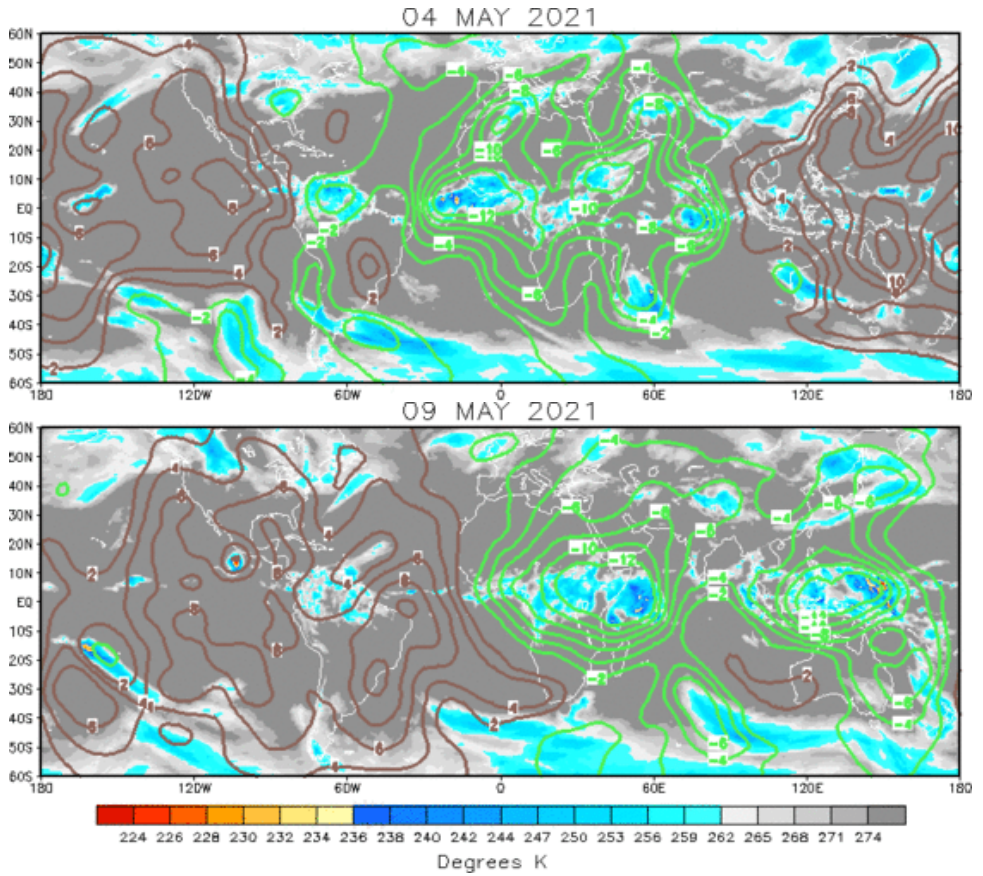
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).



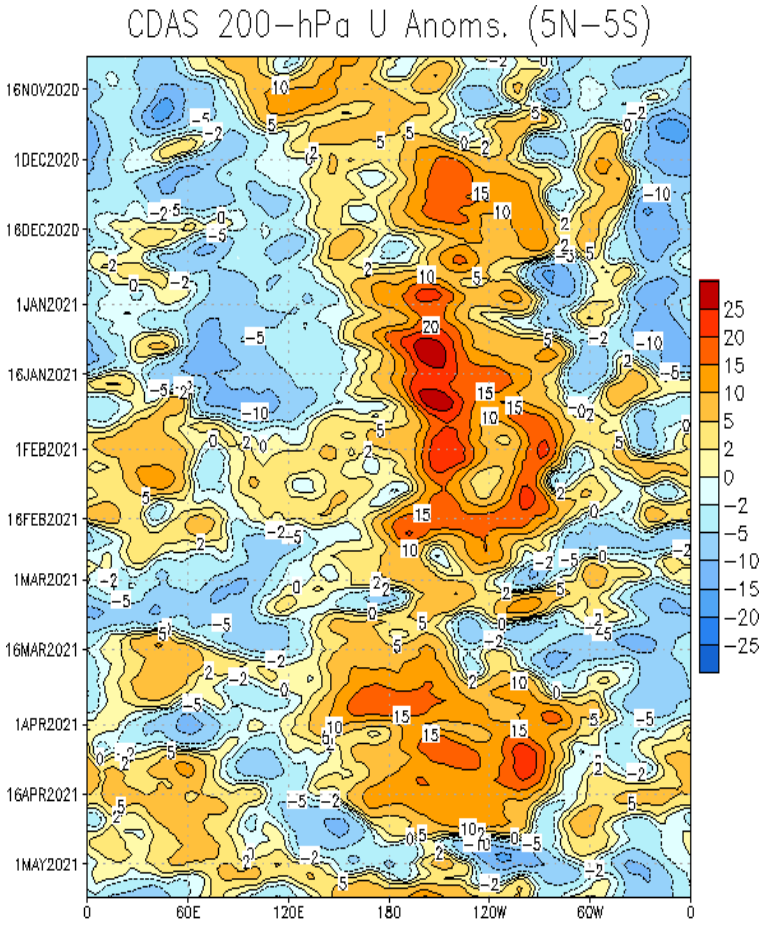


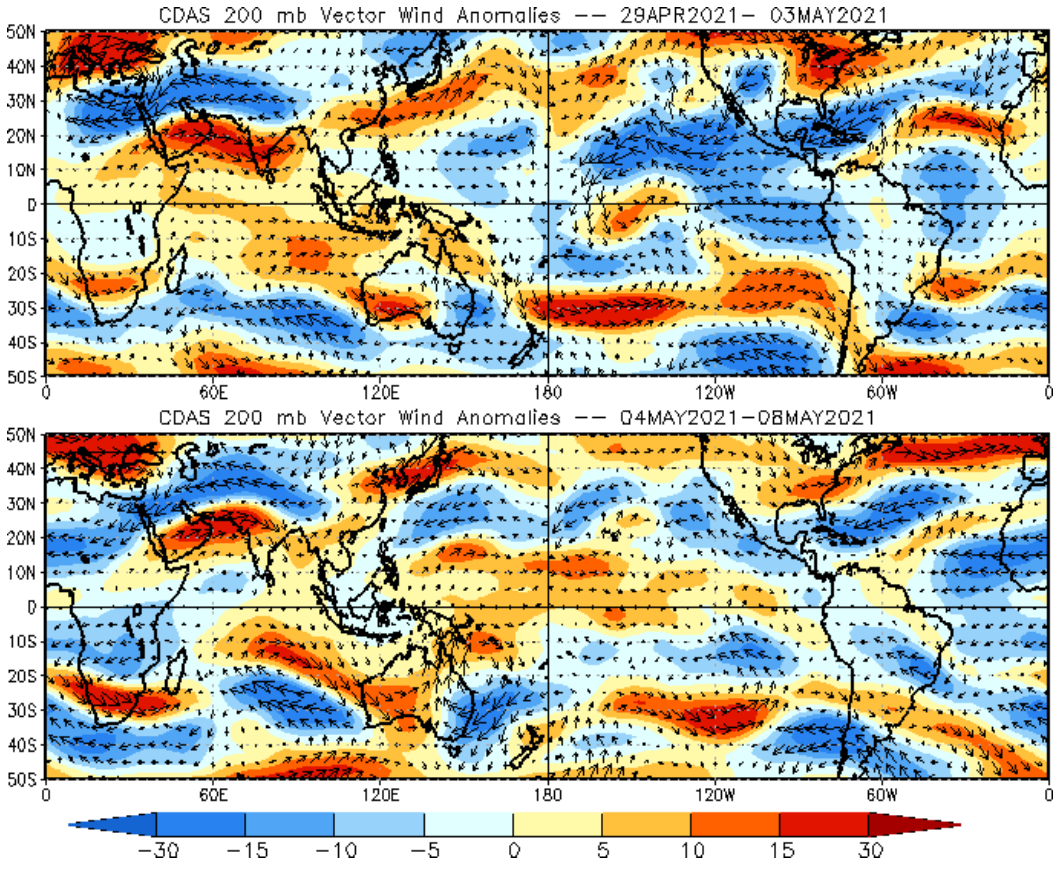
- Velocity potential anomalies indicate a clear intraseasonal event that has been ongoing since late February, while nearly completing two full global circumnavigations since this time.

- Latest spatial maps continue to show a well-defined wave-1 pattern, with anomalous upper-level divergence (convergence) shifting east and overspreading the Indian Ocean (western Hemisphere) during the past week.

200-hPa Wind Anomalies

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

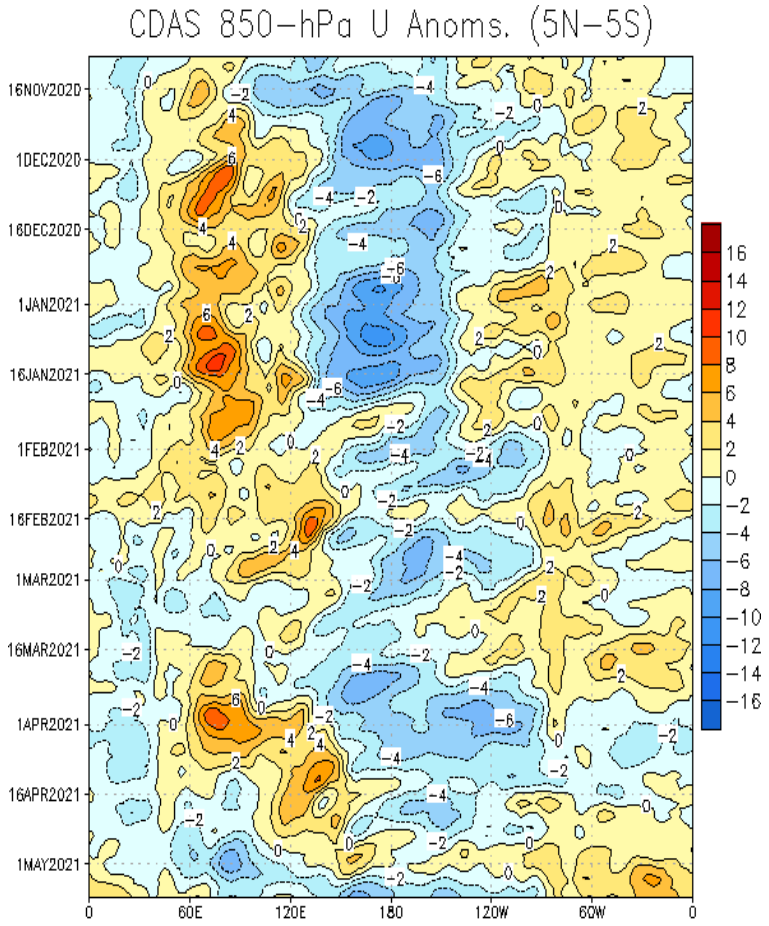


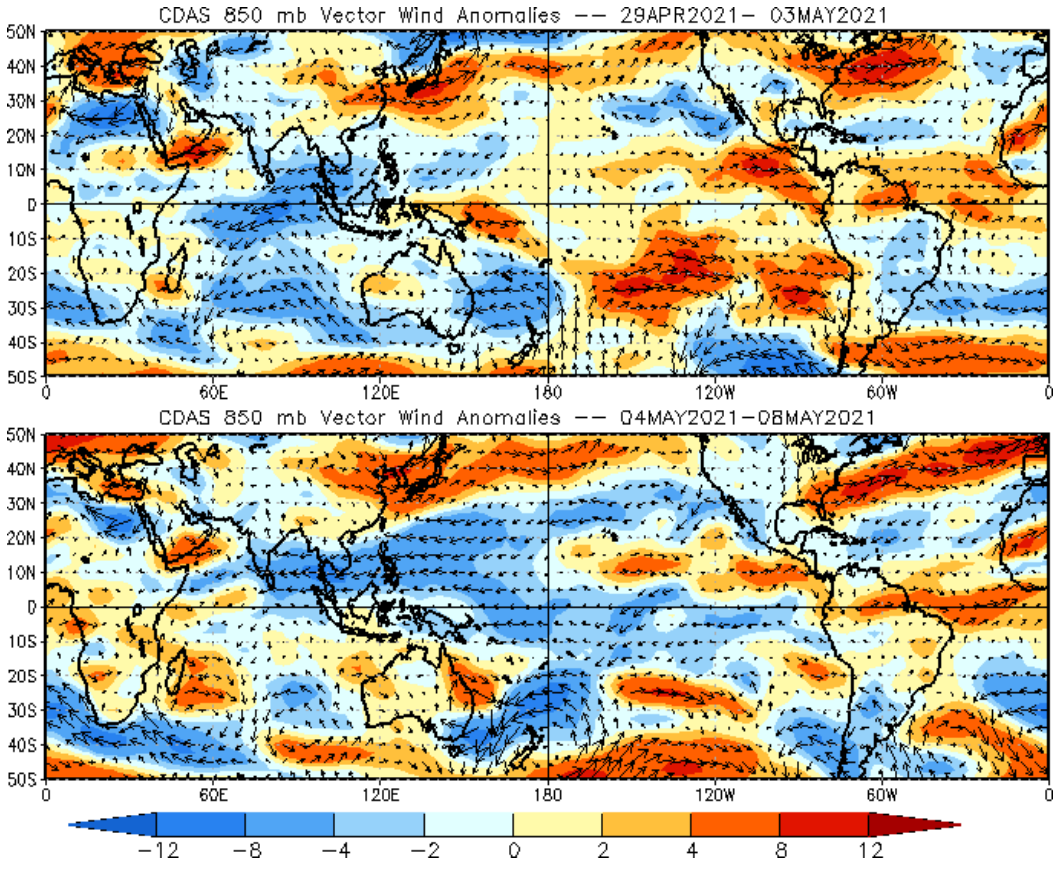


- Westerly anomalies have returned over the Pacific to the north of the equator. The strongest anomalous westerlies lie near the Date Line and appear to be reinforced by an anomalous anticyclonic circulation to the east of Australia.
- Enhanced divergence aloft has been observed over the western Indian Ocean during early May.

850-hPa Wind Anomalies

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

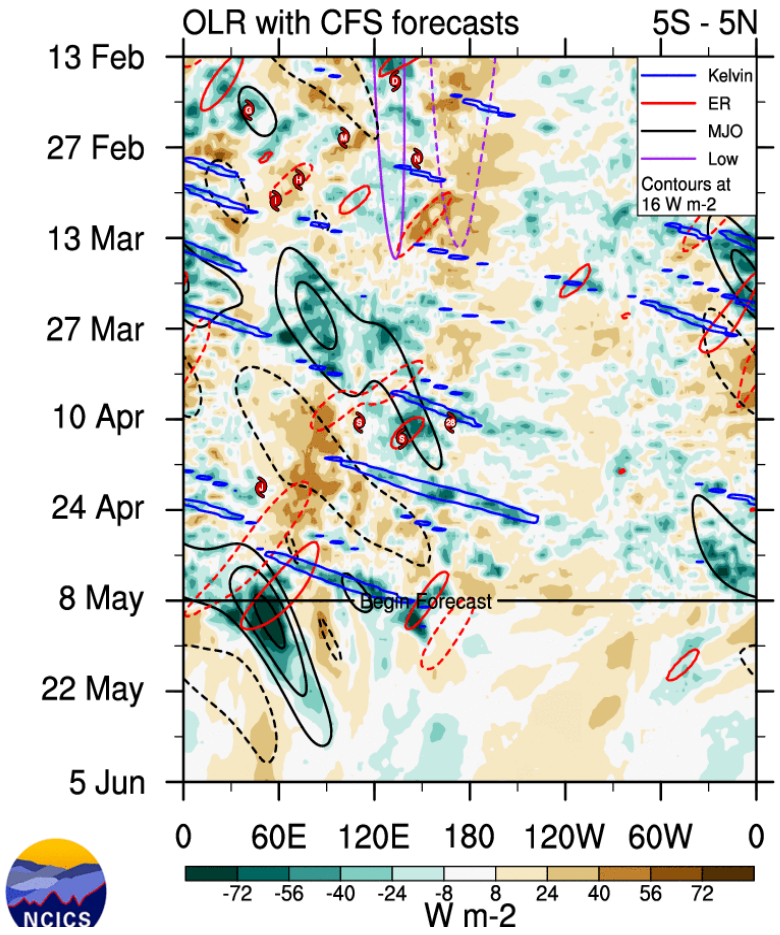


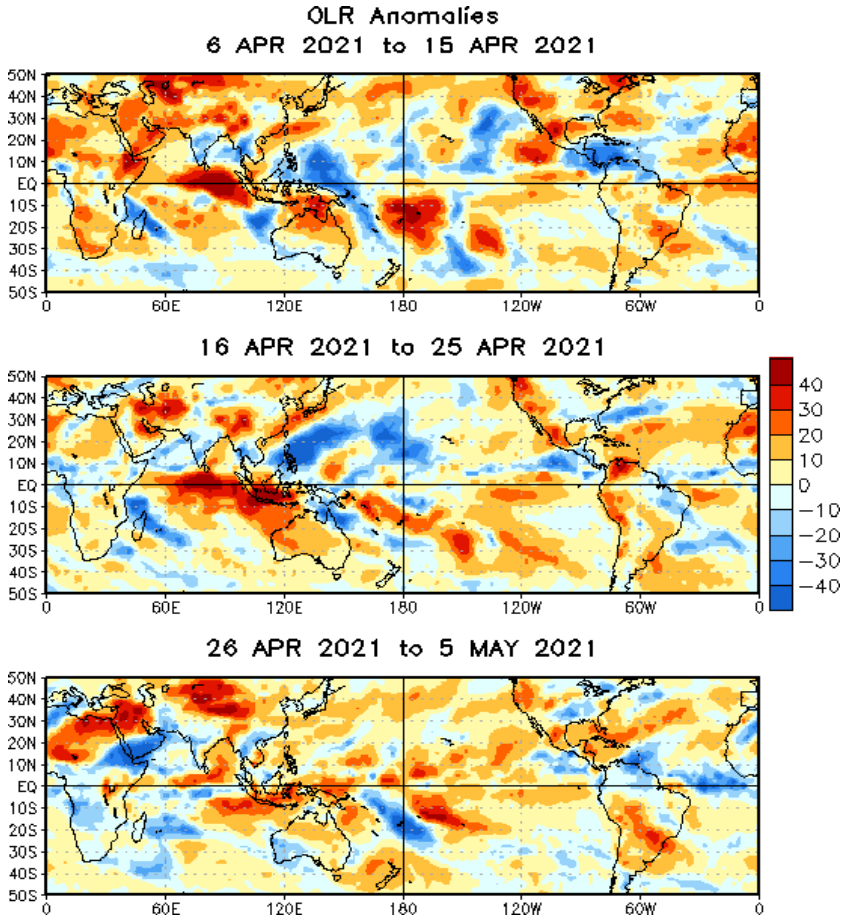


- Anomalous westerlies have persisted over the eastern Pacific to the north of the equator and likely contributed to the development of tropical cyclone Andres (earliest TC on record in Eastern Pacific).
- Enhanced trades have returned over the equatorial central and eastern Pacific as the low frequency footprint may be resurfacing.

Outgoing Longwave Radiation (OLR) Anomalies

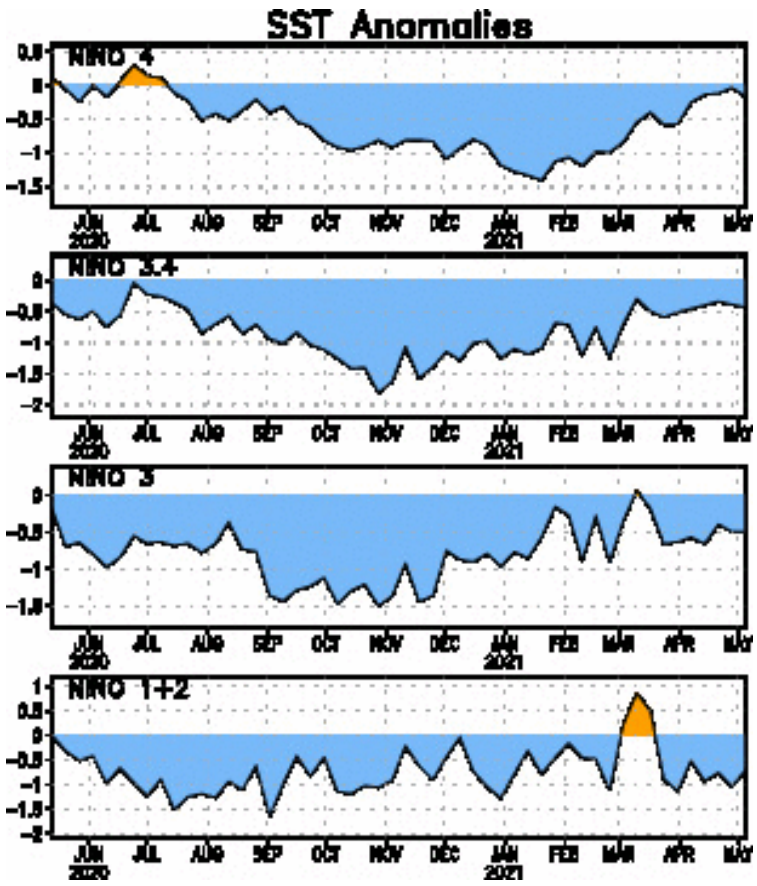
Blue shades: Anomalous convection (wetness). Red shades: Anomalous subsidence (dryness).

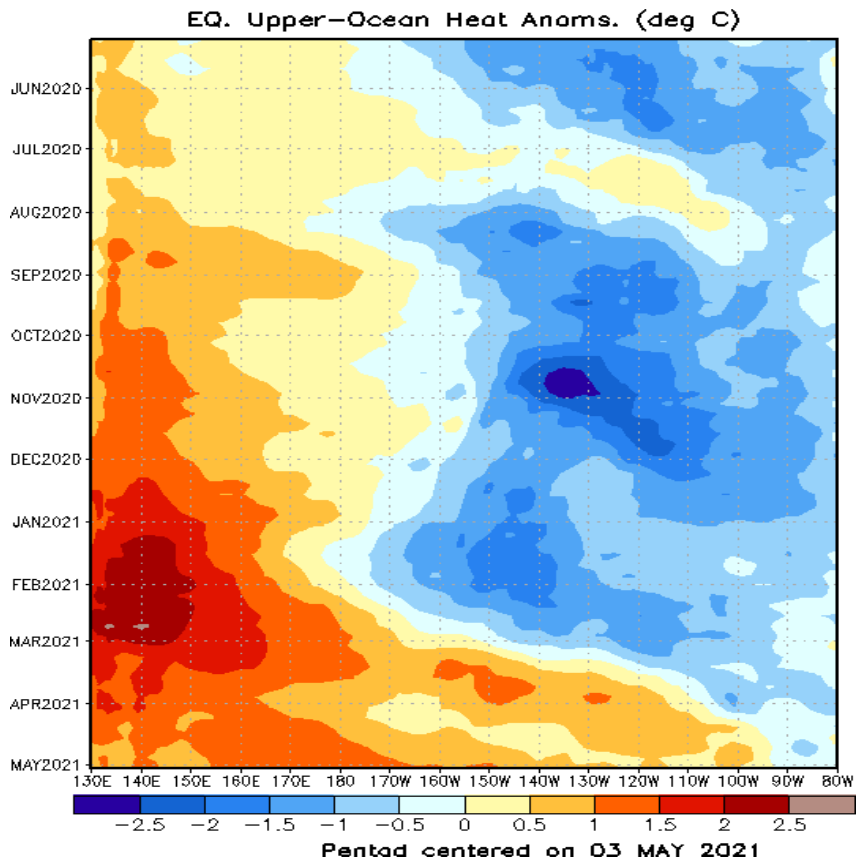




- Enhanced convection has been observed extending from the equatorial Atlantic, through Africa, and into the western Indian Ocean, consistent with the MJO propagating through RMM phases 8 and 1 since late April.
- The CFS forecasts enhanced convection tied to MJO, Kelvin, and equatorial Rossby wave activity across the Eastern Hemisphere during the next week.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

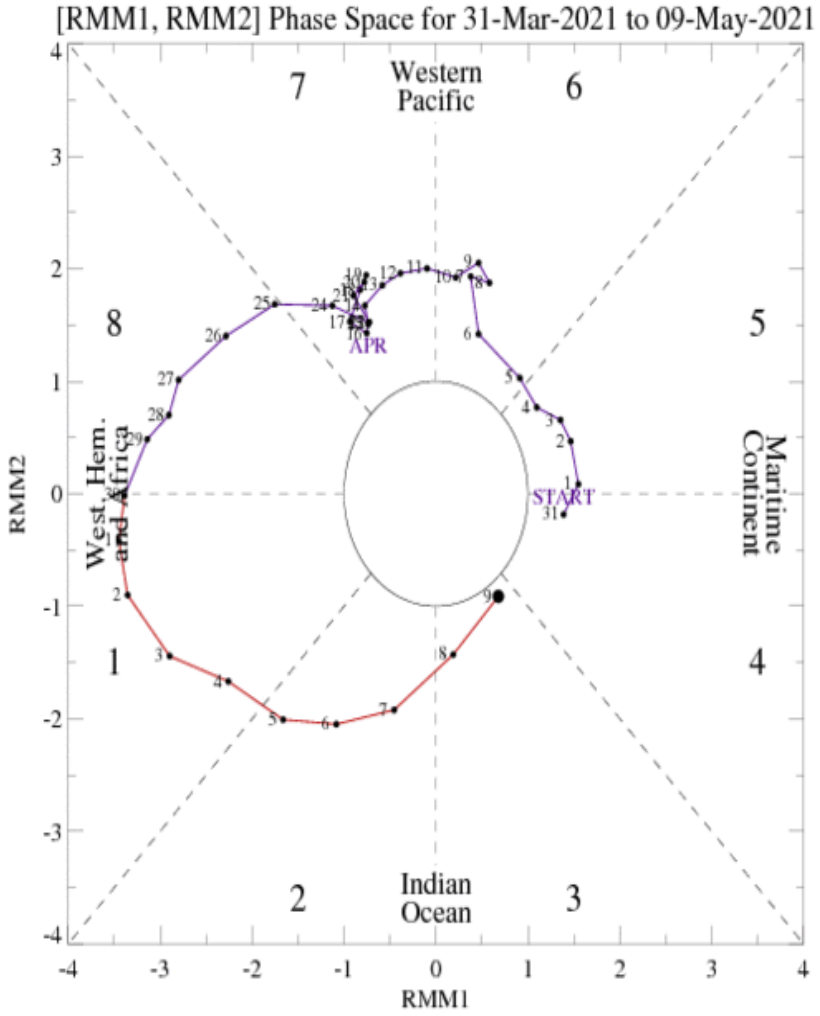




- La Niña conditions have been present since August 2020. Negative SST anomalies in the Niño 4 region have steadily weakened since January and are currently registering near zero.
- Strong Rossby wave activity over the West Pacific in February generated a westerly wind burst (WWB) that initiated a downwelling oceanic Kelvin wave to push warmer water within the upper-ocean across the Central and East Pacific. Similarly, another wave may be ongoing tied to another WWB event that occurred in mid-April.

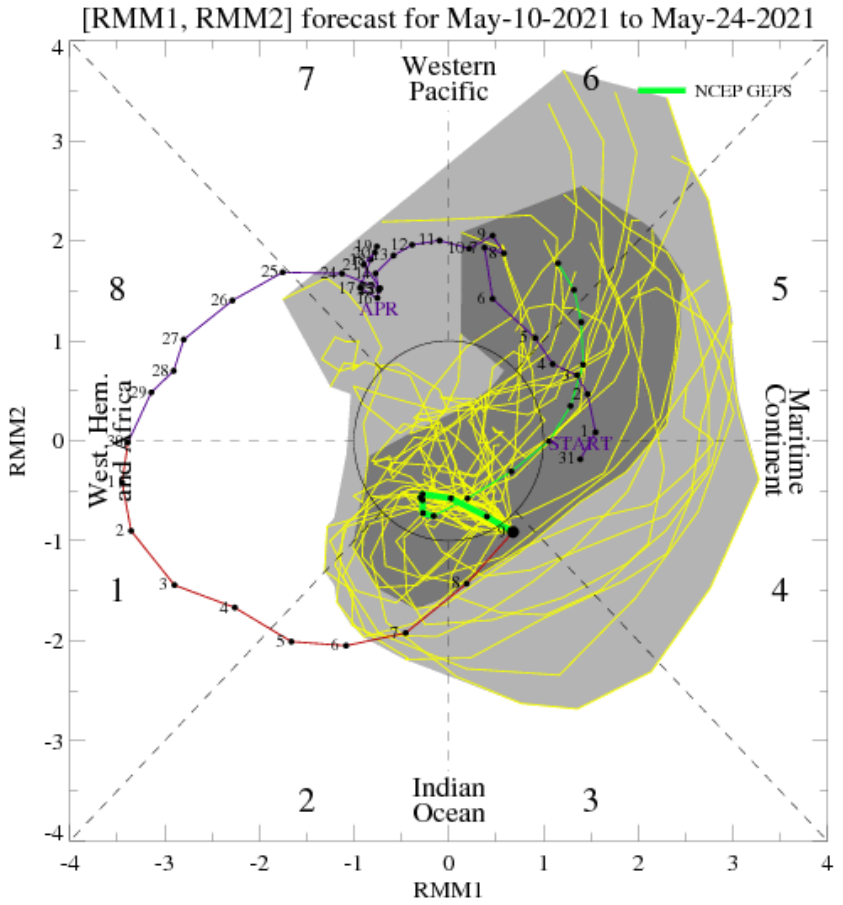
MJO Index: Recent Evolution

- The MJO is in RMM Phase 3, shifting from Africa to the Indian Ocean. The RMM index indicates a faster phase speed during May compared to what was observed in April.

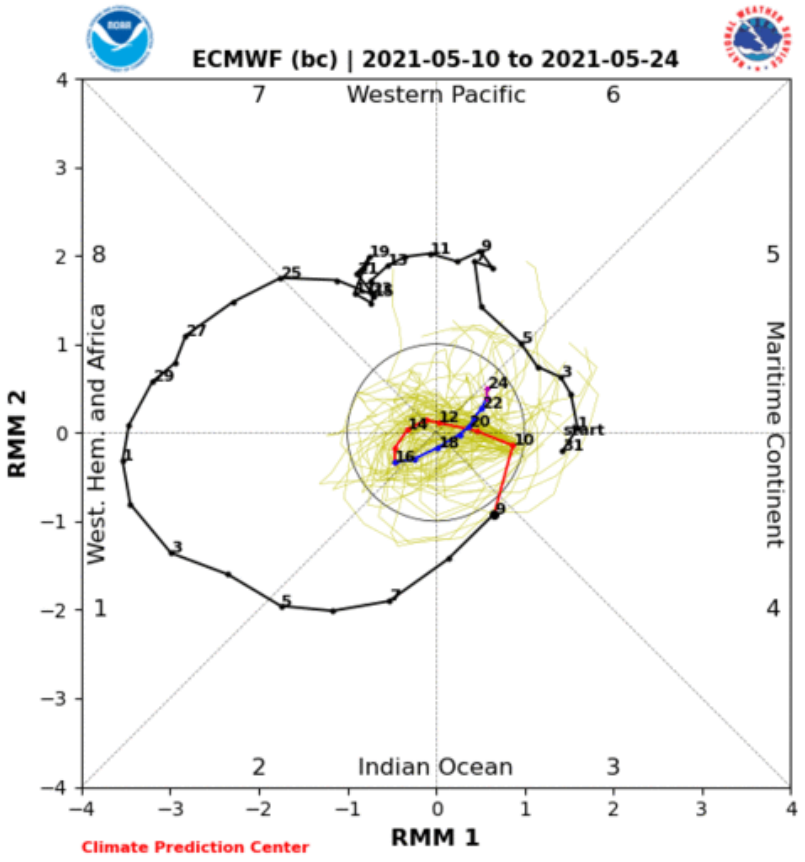


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

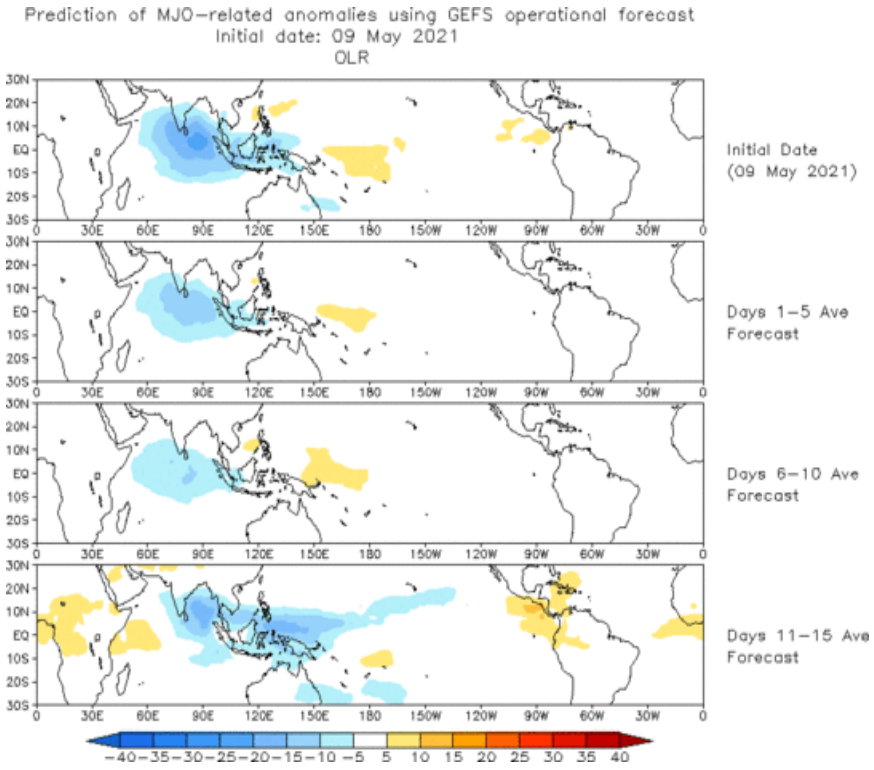


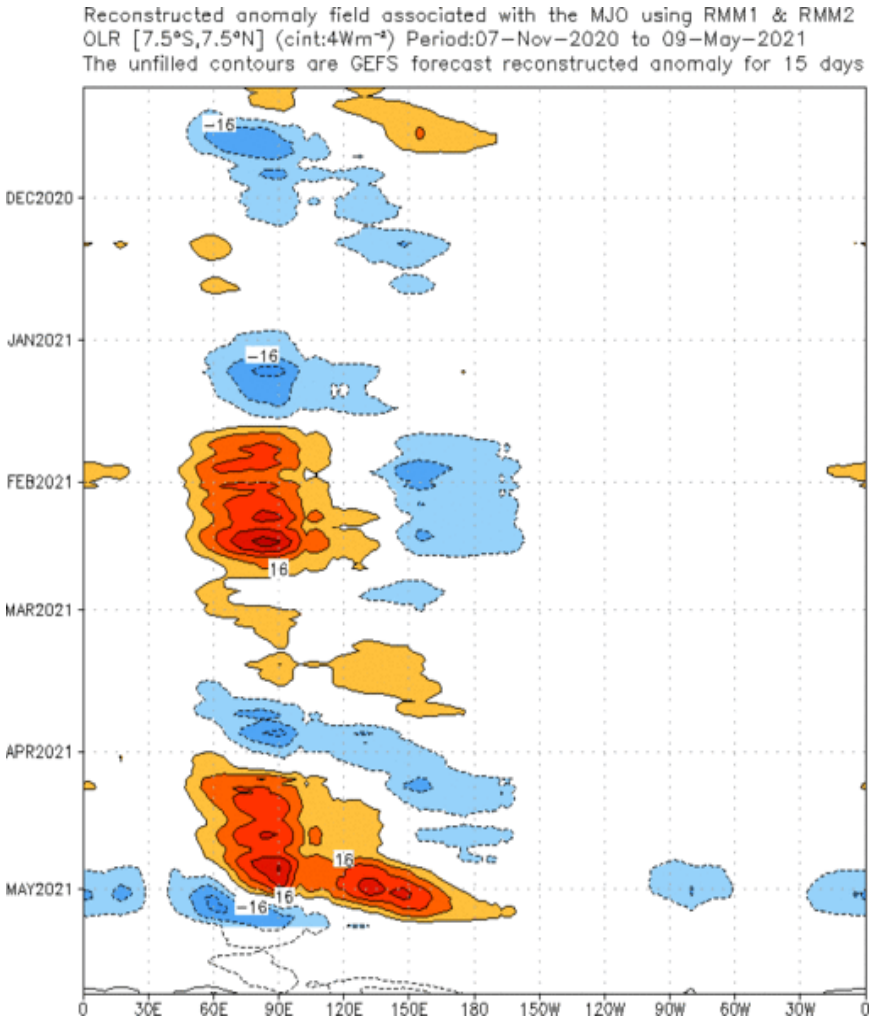
ECMWF Forecast

- The GEFS and ECMWF forecast the MJO to continue weakening over the Indian Ocean and the Maritime Continent. This weakening may not be an accurate representation of the MJO forecast during the transition to ENSO neutral conditions.
- Dynamical models also favor a westward shift in RMM space which may be reflective of a detachment from a convectively coupled Kelvin wave that is forecast to weaken over the Pacific during week-1.

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.)

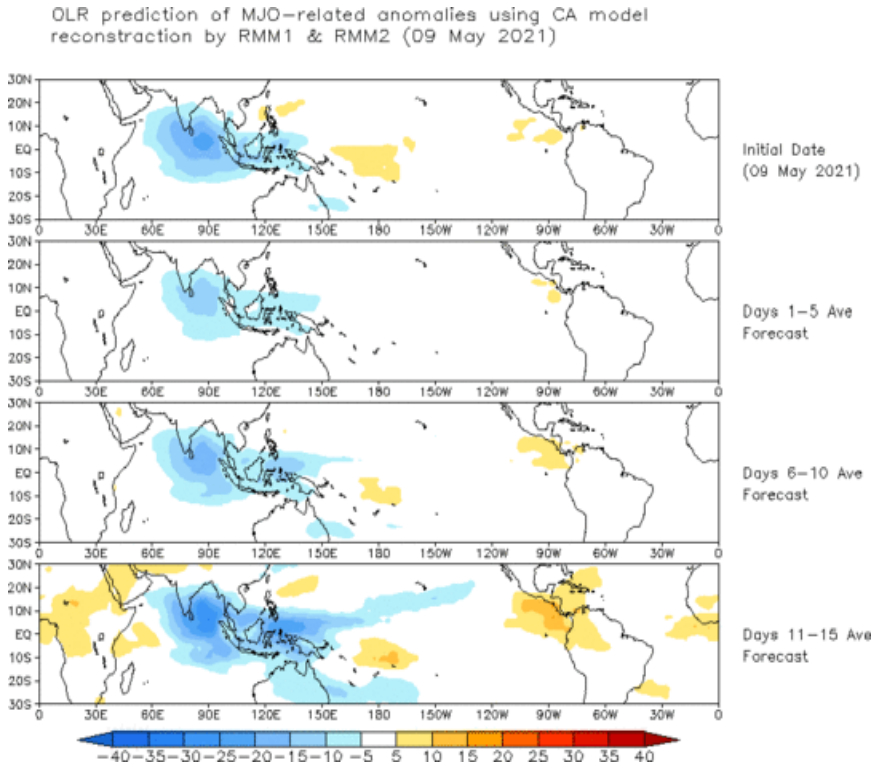


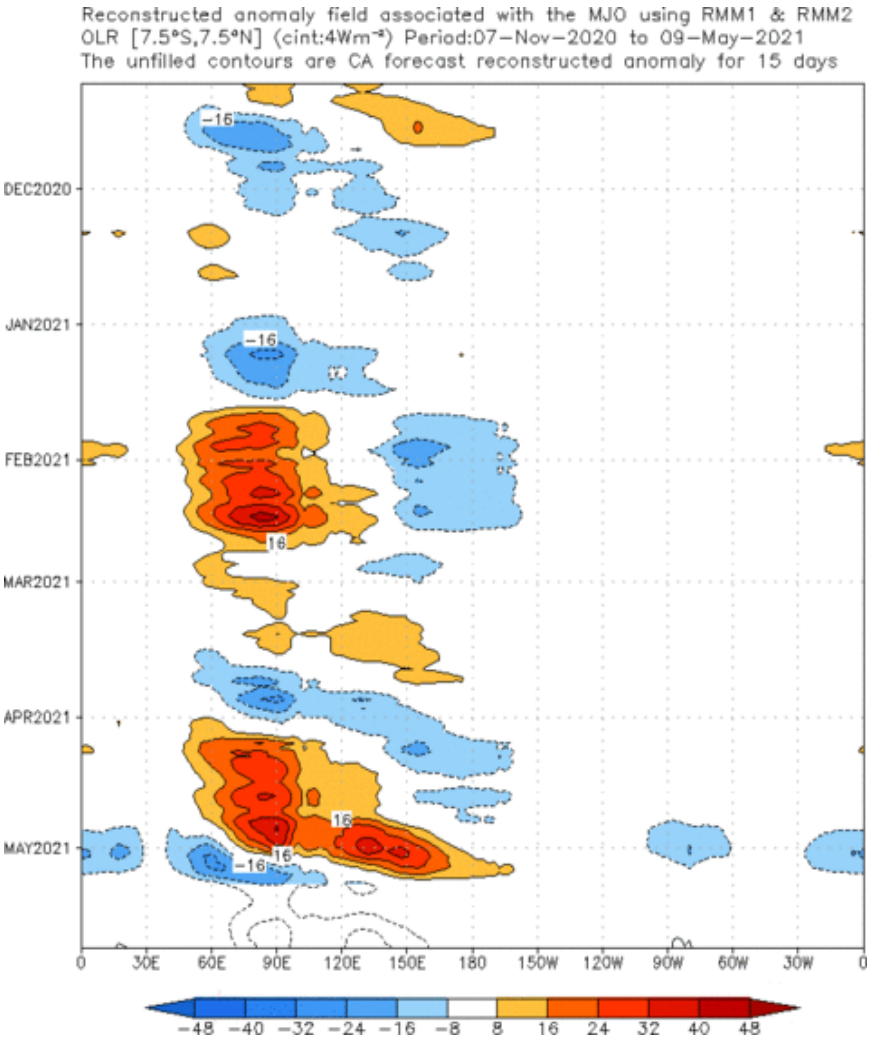


- As with the RMM index, the GEFS spatial maps depict a weakening intraseasonal signal with enhanced convection beginning to reemerge over the Maritime Continent and West Pacific later in May.

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.)

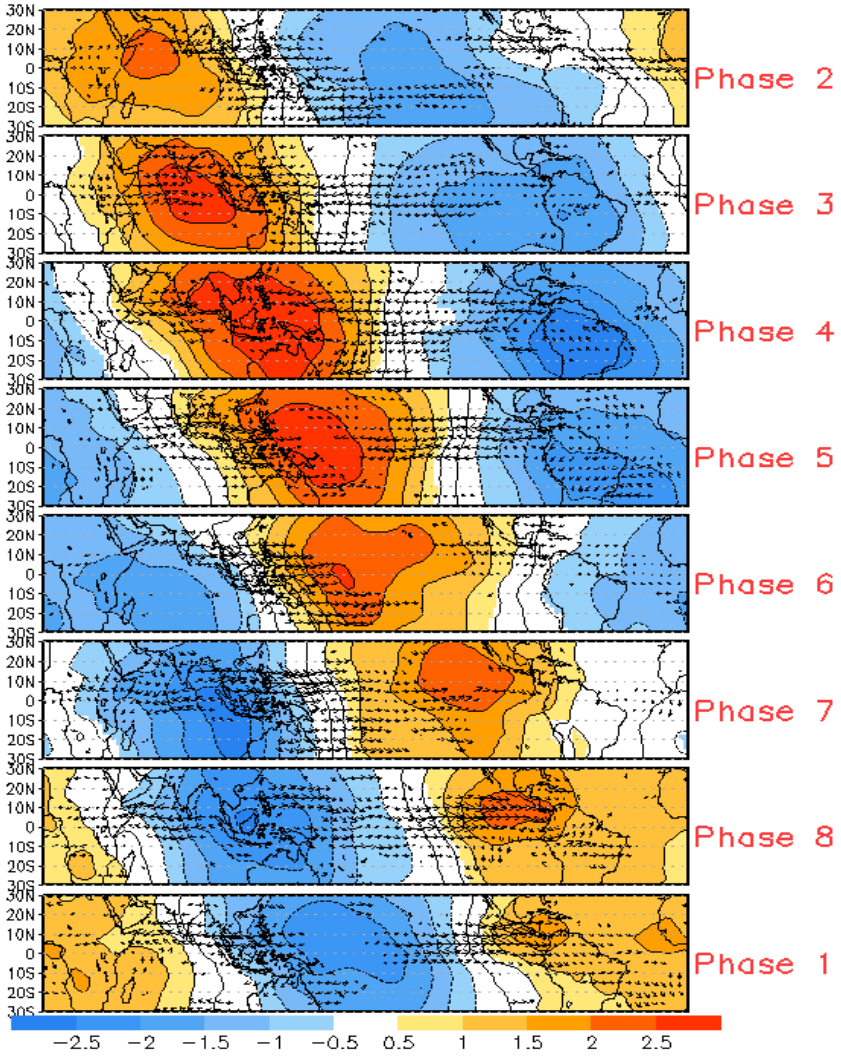




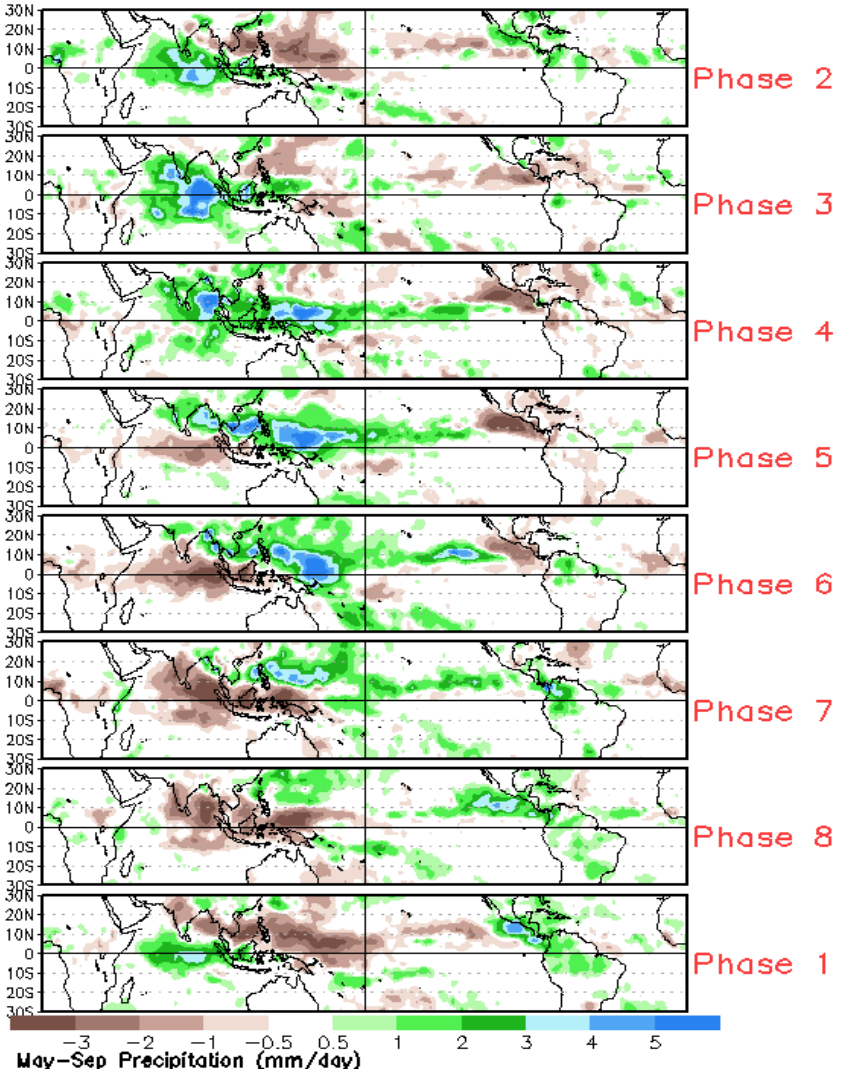
- The constructed analog favors more of a stationary convective pattern, as enhanced (suppressed) convection restrengthens over the eastern Indian Ocean and Maritime Continent (Americas and Africa) later in week-2.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



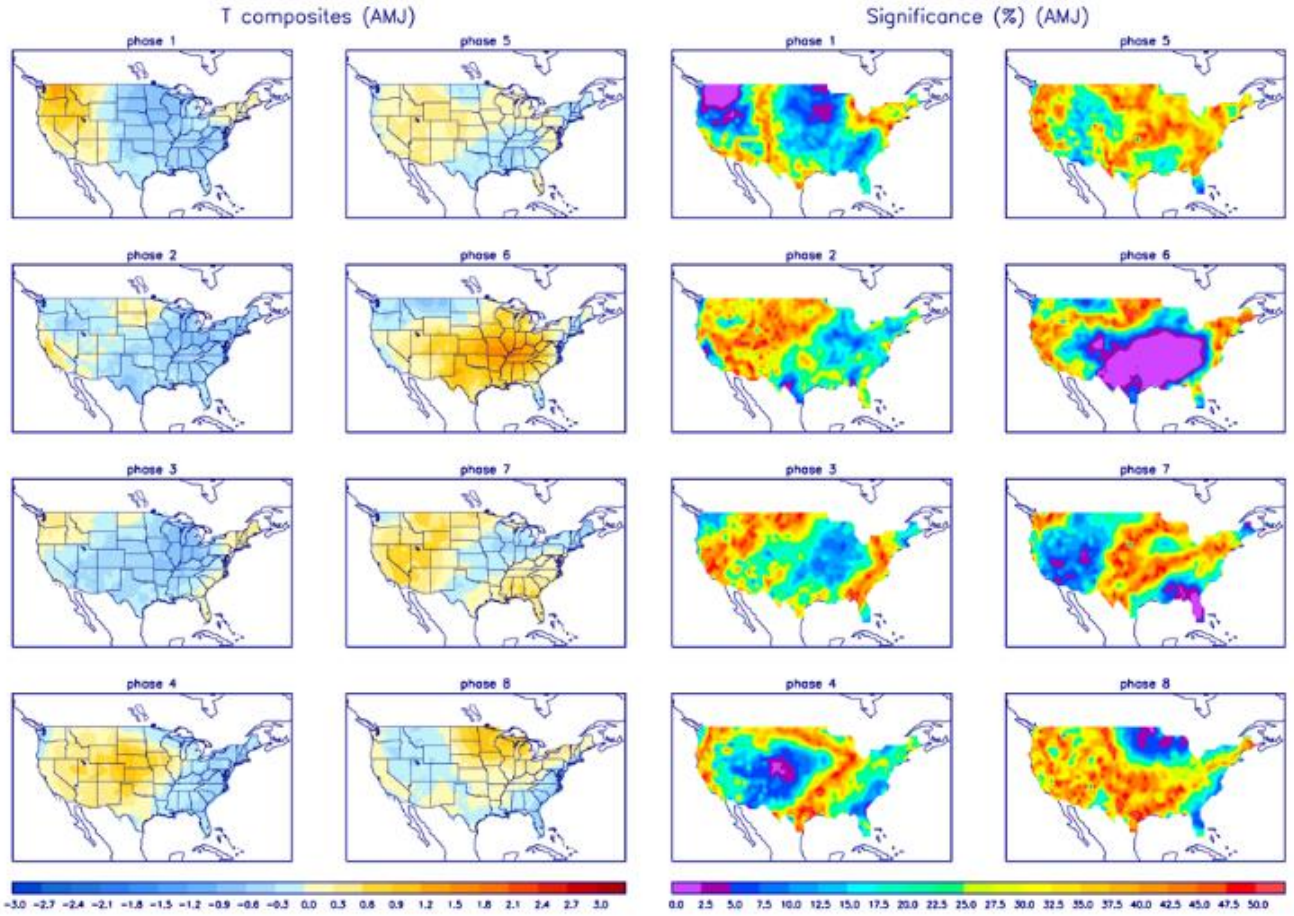
Precipitation Anomalies



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.

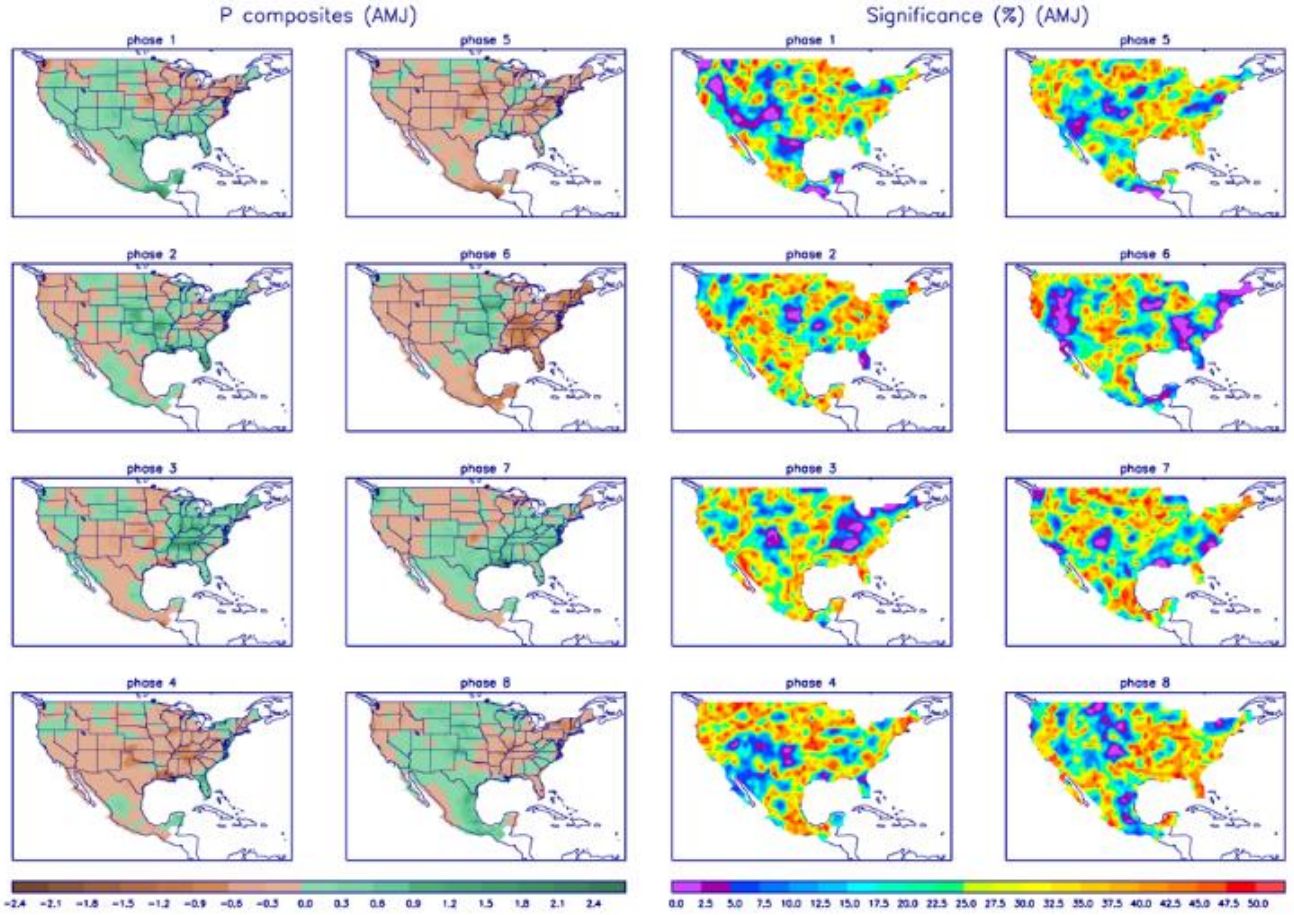


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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