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

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
4 May 2020

Overview

- A fast moving intraseasonal signal is centered over the Maritime Continent at present. This envelope appears to be tied to a pair of Kelvin waves, one over the Indian Ocean and another approaching the Date Line.

- Dynamical models continue the rapid propagation of this feature during the next week, but show it decaying in amplitude in the RMM index framework. By late in Week-2 a new intraseasonal mode over the Indian Ocean appears and may become the primary focus. This is likely associated with the easternmost Kelvin wave coming to dominate with time, while the westernmost feature is the primary focus initially.

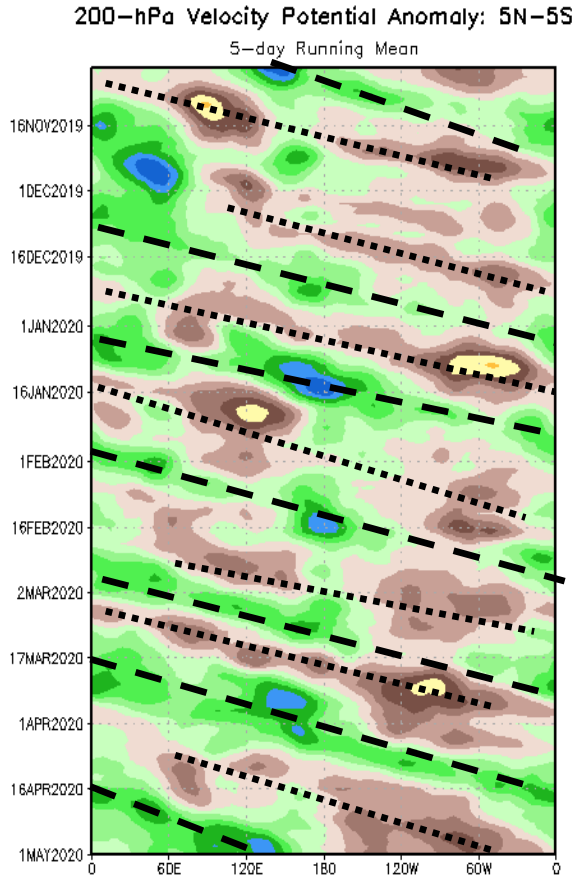
- Extratropical impacts from the MJO appear unlikely at this time. The best chances for extratropical influence appears to be over the East Pacific, where very late in Week-2 or early in Week-3 tropical cyclone formation potential could build as the westernmost Kelvin wave shifts east of the basin.

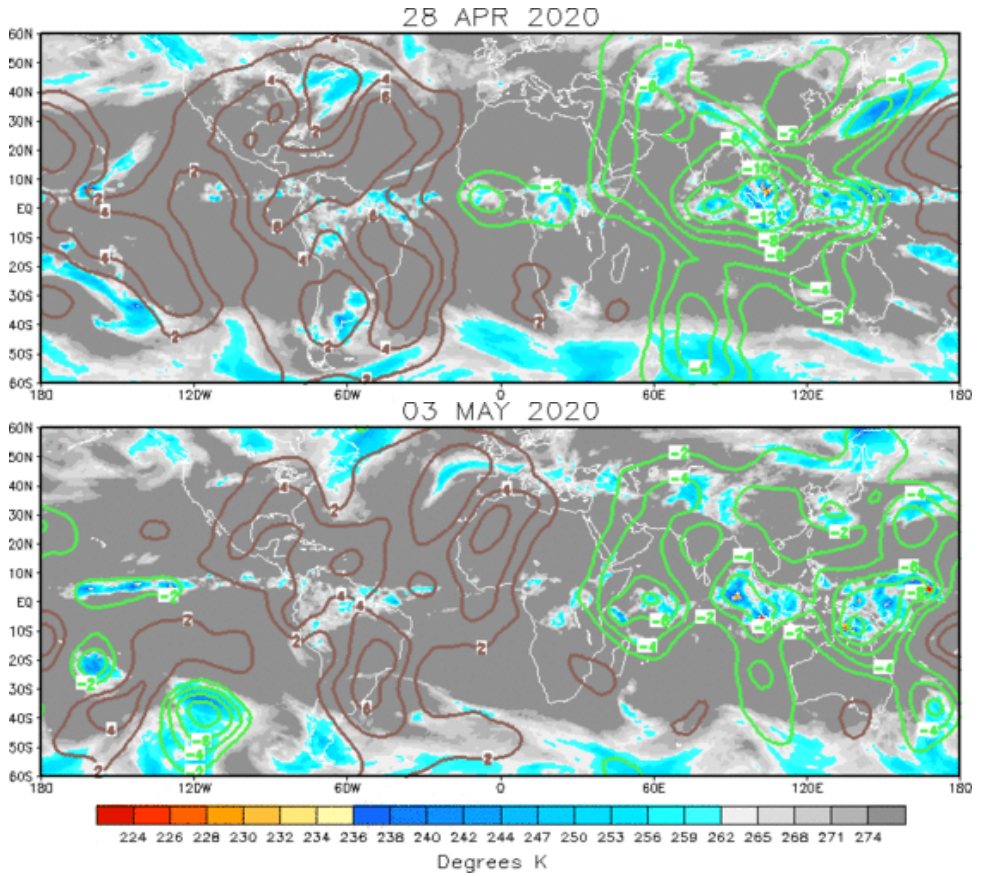
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

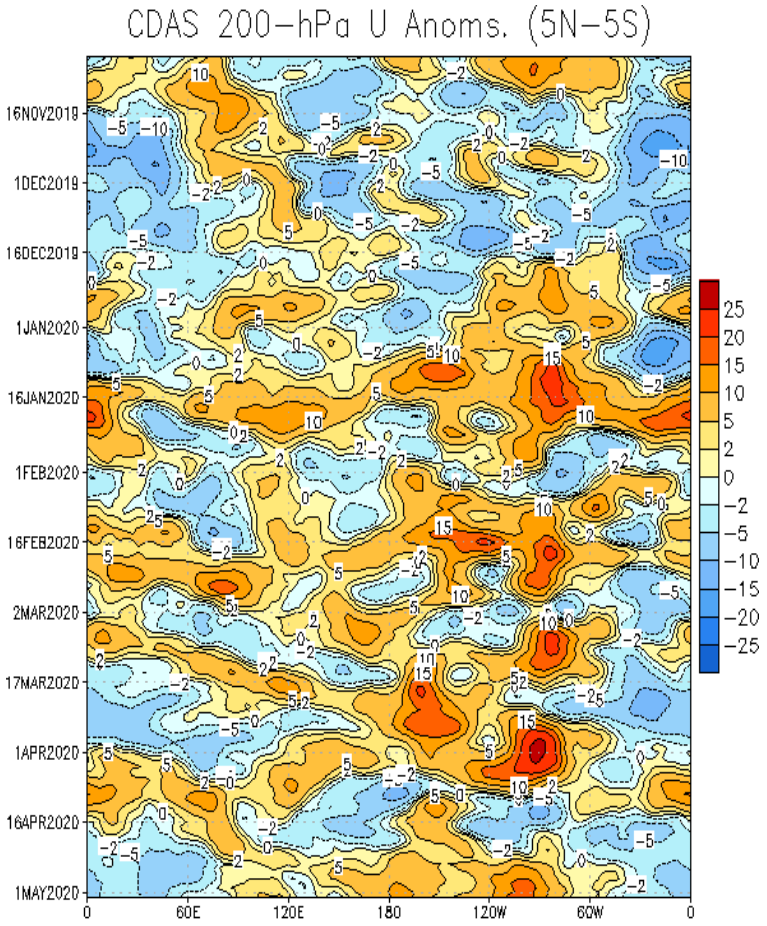


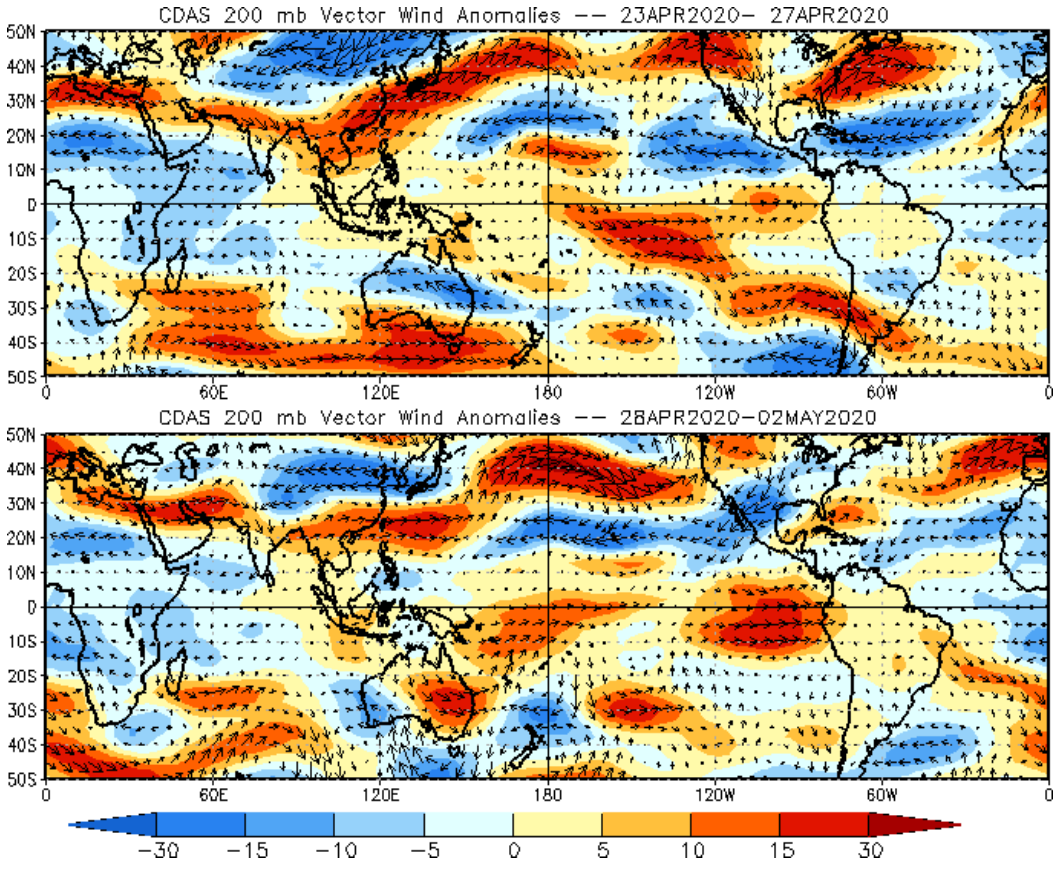


- A robust wave-1 pattern remains apparent in the upper-level velocity field, with enhanced (suppressed) convection generally over the Eastern (Western) Hemisphere.
- This envelope did not progress as rapidly eastward as other fields would suggest for an intraseasonal feature near the wavenumber/frequency boundary of Kelvin wave and MJO activity.

200-hPa Wind Anomalies

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

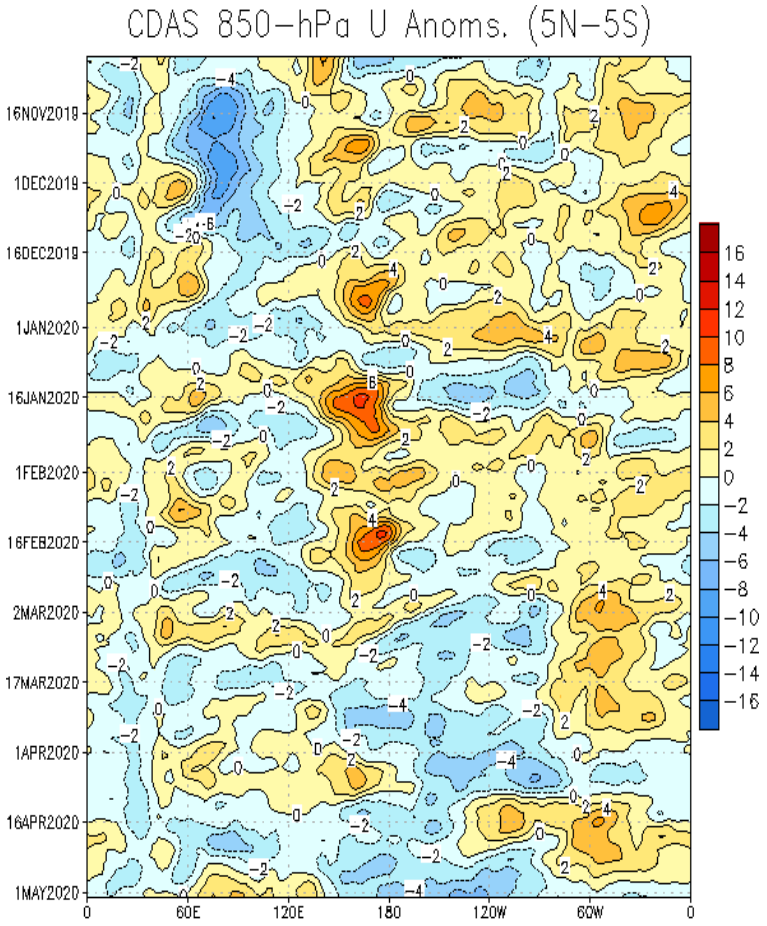


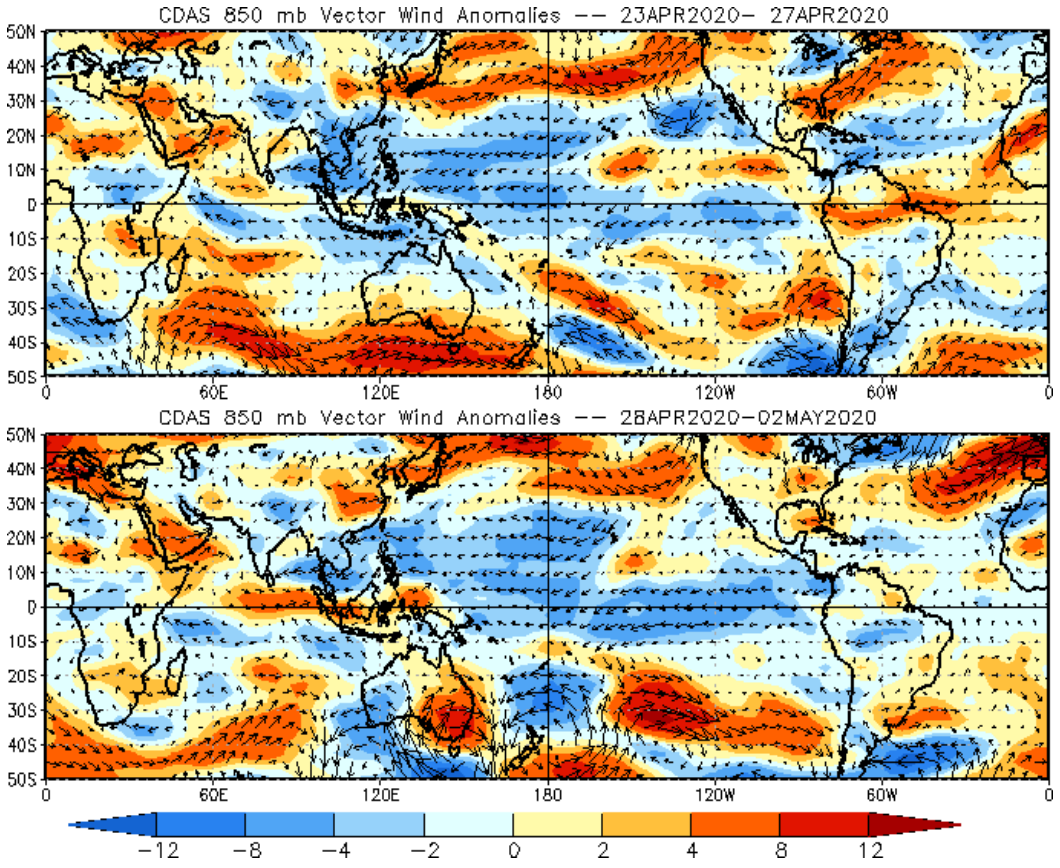


- The Northern Hemisphere continues to exhibit a highly amplified pattern that appears extratropically driven.
- Anomalous westerlies are along the equator outside of the Atlantic basin, Africa, and the western Indian Ocean. This reflects the enhanced upper-level divergence (convergence) in the wave-1 pattern shown on the prior slide.
- Recent anomalous westerlies along the equator near the Antimeridan appear to be associated with wavebreaking downstream of the anomalous ridge over the Coral Sea.

850-hPa Wind Anomalies

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

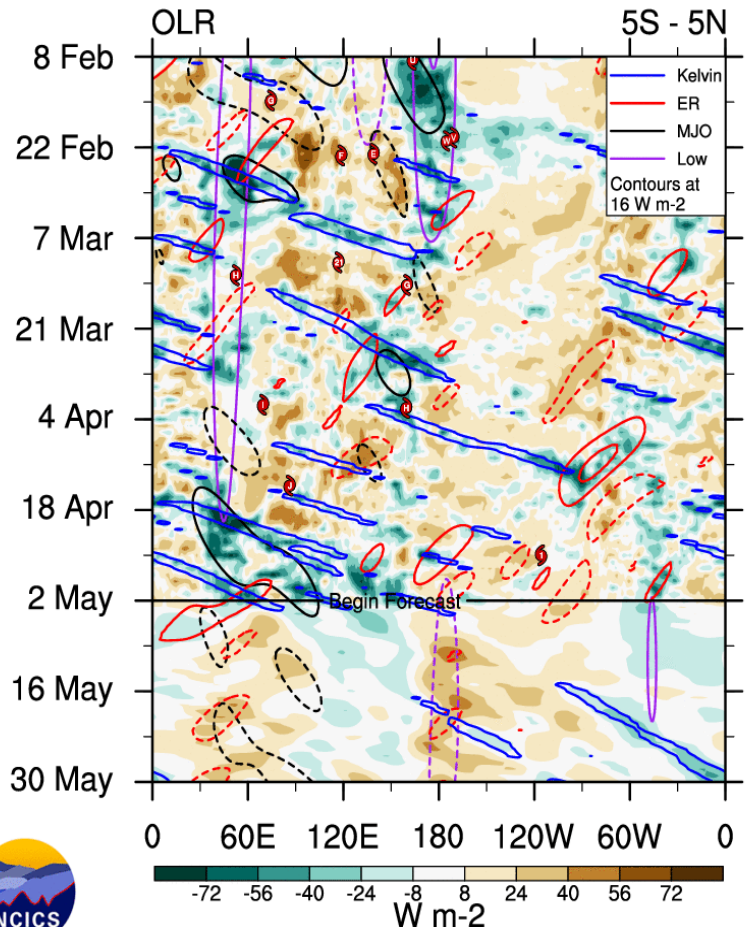


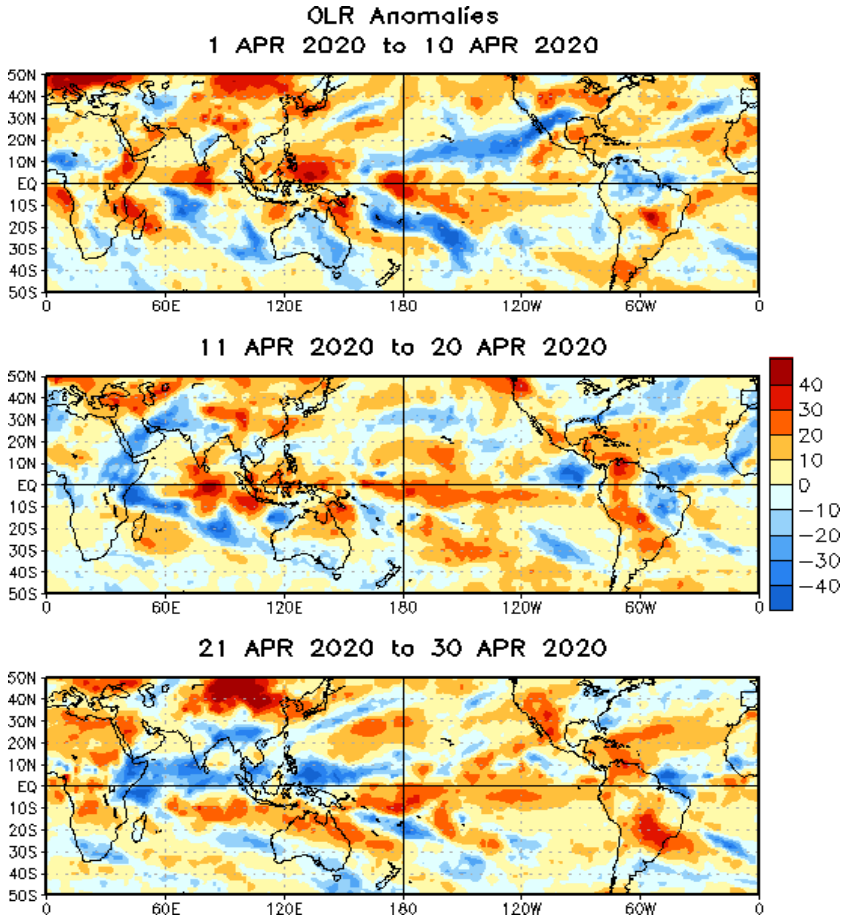


- Enhanced trades continue to persist across the Pacific, supporting erosion of the heat content in the upper layers of the ocean.
- Anomalous westerlies developed across the eastern Indian Ocean near the beginning of May, tied to the advancing intraseasonal envelope.

Outgoing Longwave Radiation (OLR) Anomalies

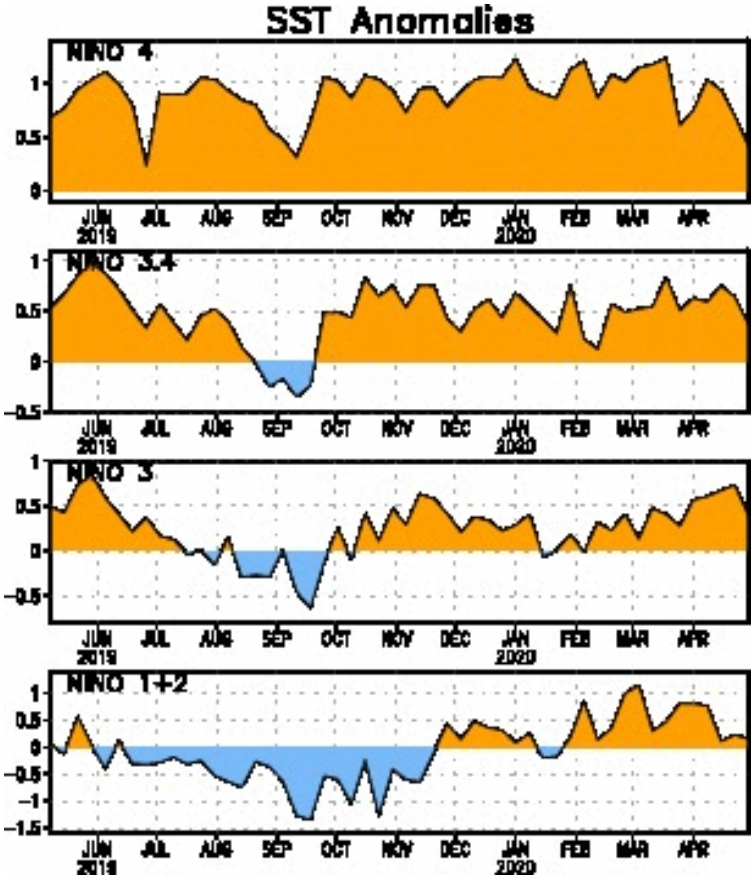
Blue shades: Anomalous convection (wetness). Red shades: Anomalous subsidence (dryness).

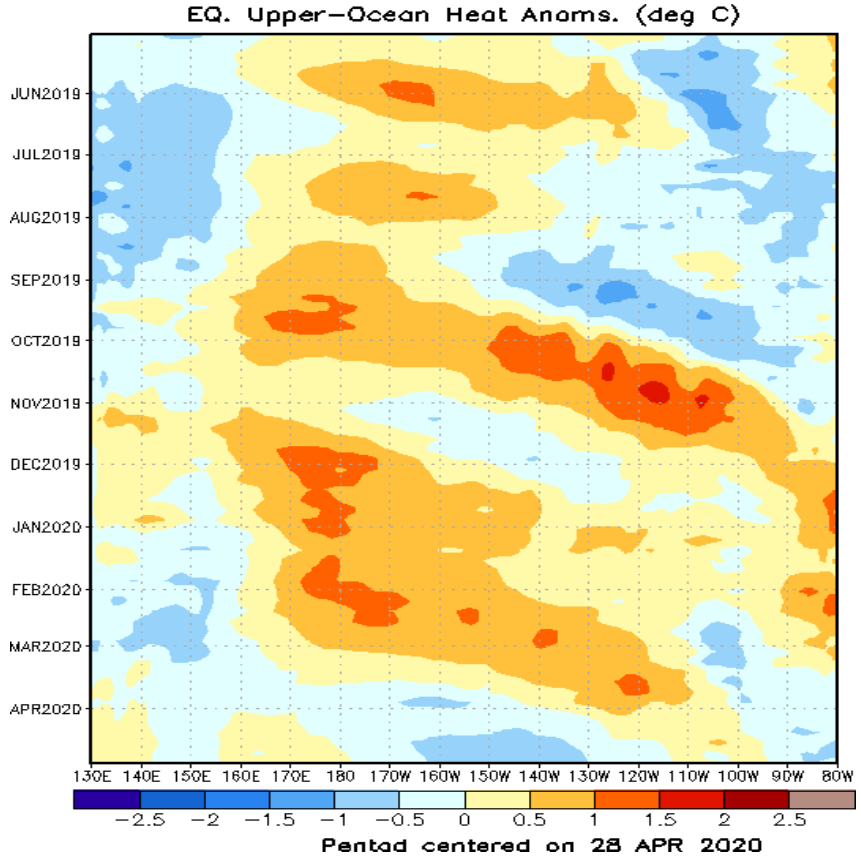




- Enhanced convection over the Indian Ocean during late April is tied to the superposition of multiple tropical convective modes (MJO, Kelvin waves, equatorial Rossby wave).
- The MJO is beginning to take on a “double barrel Kelvin wave” appearance, with one Kelvin wave currently near 75E and another out ahead closer to the Date Line. These features may compete with one another for dominance and cause difficulty in the RMM index tracking eastward propagating intraseasonal modes.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

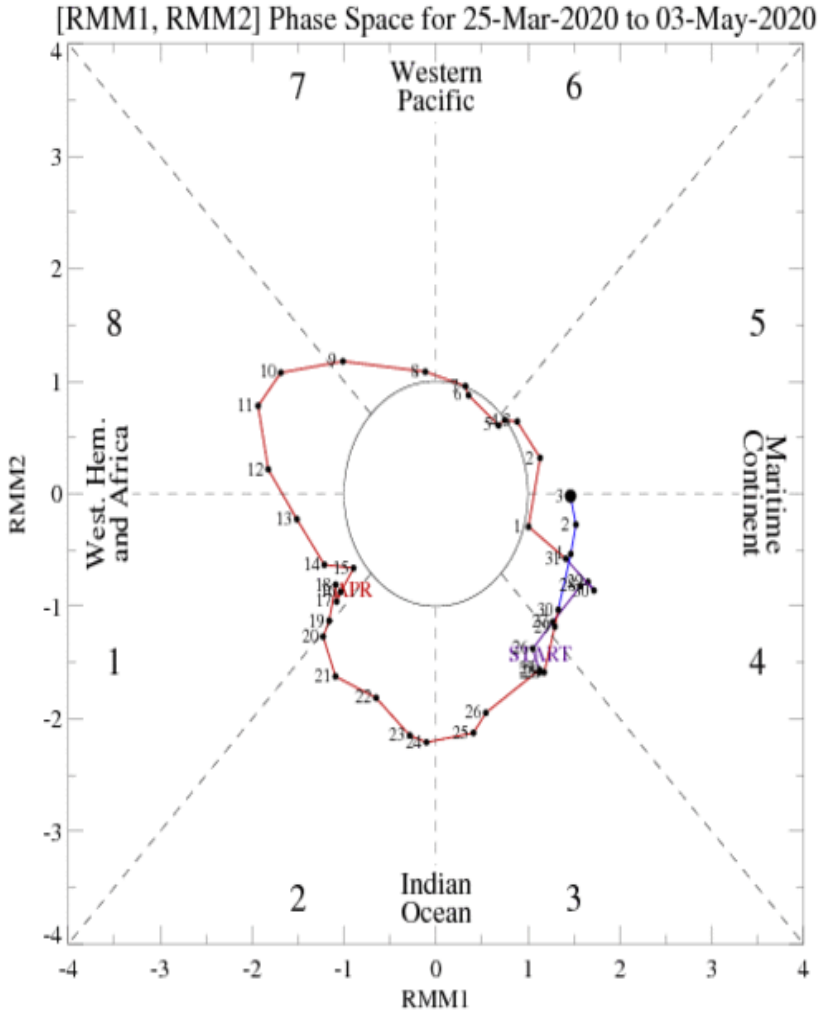




- Upper-ocean heat content anomalies remain below-average over much of the equatorial Pacific with the exception of between 160E-180.
- The cooling trend across the upper-ocean during April is tied to the persistence of the enhanced trades (see 850-hPa anomaly slide).
- Above-average SSTs in the Niño 3, 3.4, and 4 regions are confined to the near surface and likely to be short-lived.

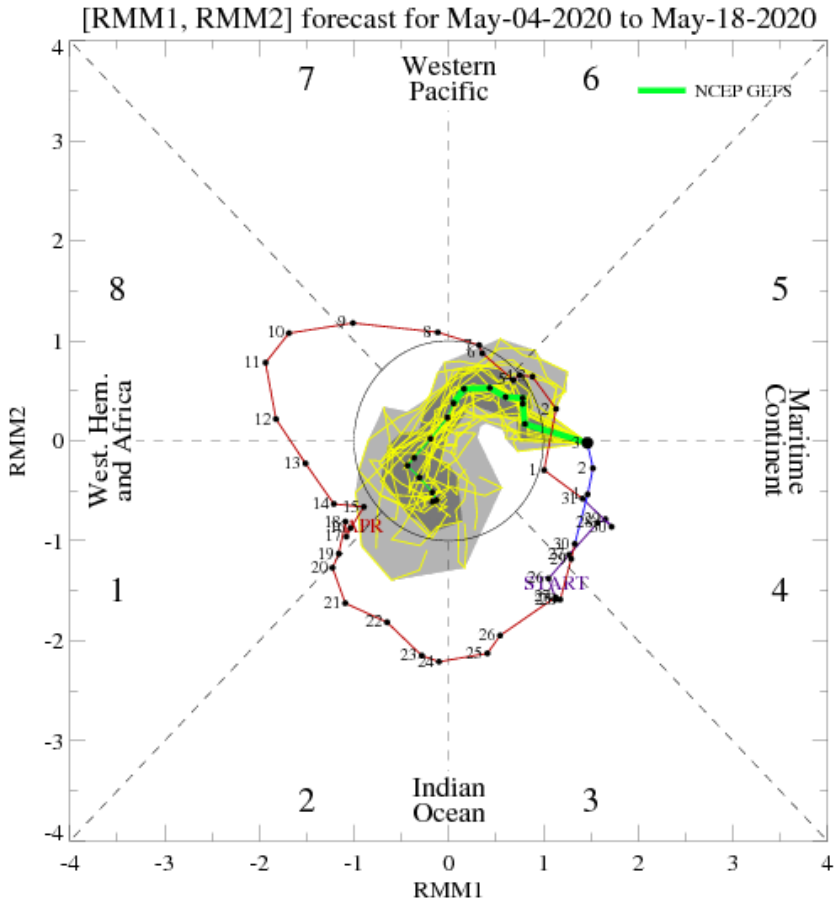
MJO Index: Recent Evolution

- The RMM index is located on the boundary of Phases 4 and 5 over the Maritime Continent.
- The recent MJO event has continued to exist on the fast side of its typical phase speed spectrum, close to a 30 day period.

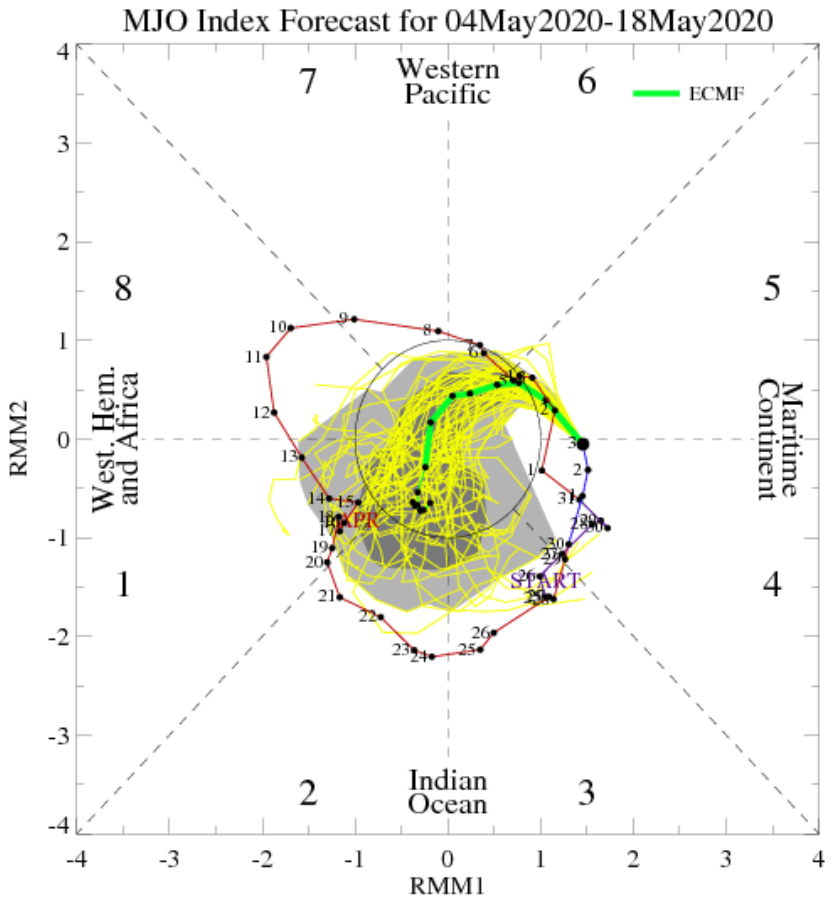


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

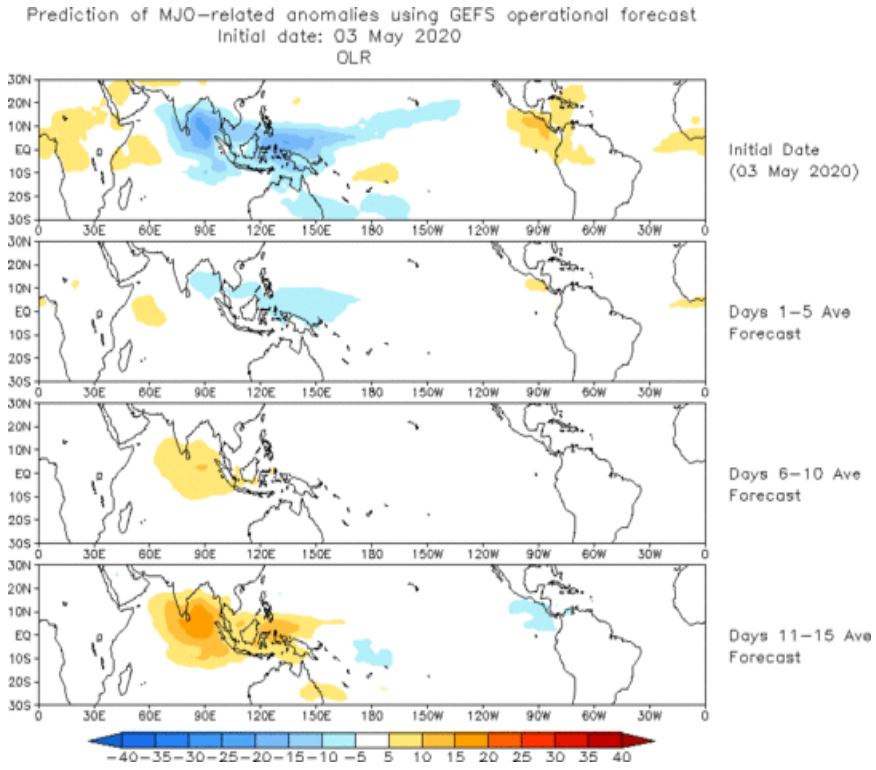


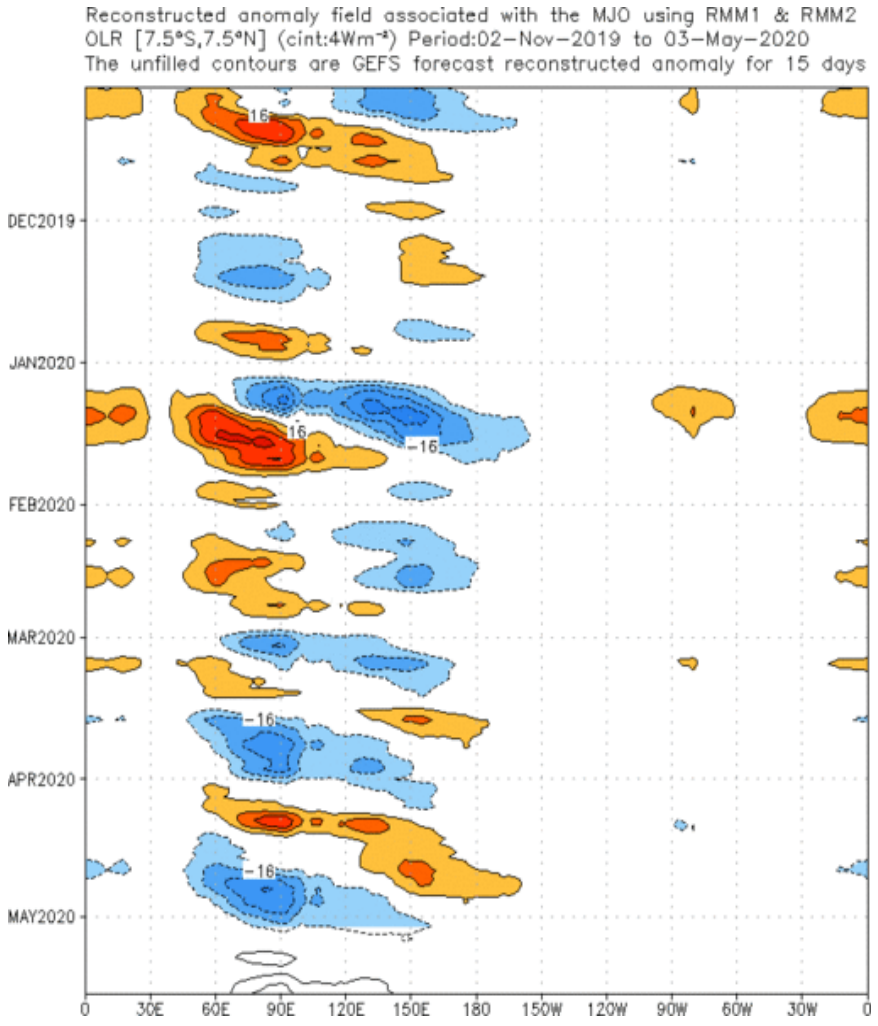
ECMWF Forecast

- Both the GEFS and ECMWF show the MJO continuing eastward during Week-1 and reaching the Pacific.
- Both models anticipate a weakening of the RMM index, with the GEFS being immediate and the ECMWF taking 3-4 days to show signs of decay.
- Both models push the signal toward the Indian Ocean by late in Week-2, likely shifting their attention from the westernmost to the easternmost Kelvin wave (see OLR slide).

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.)

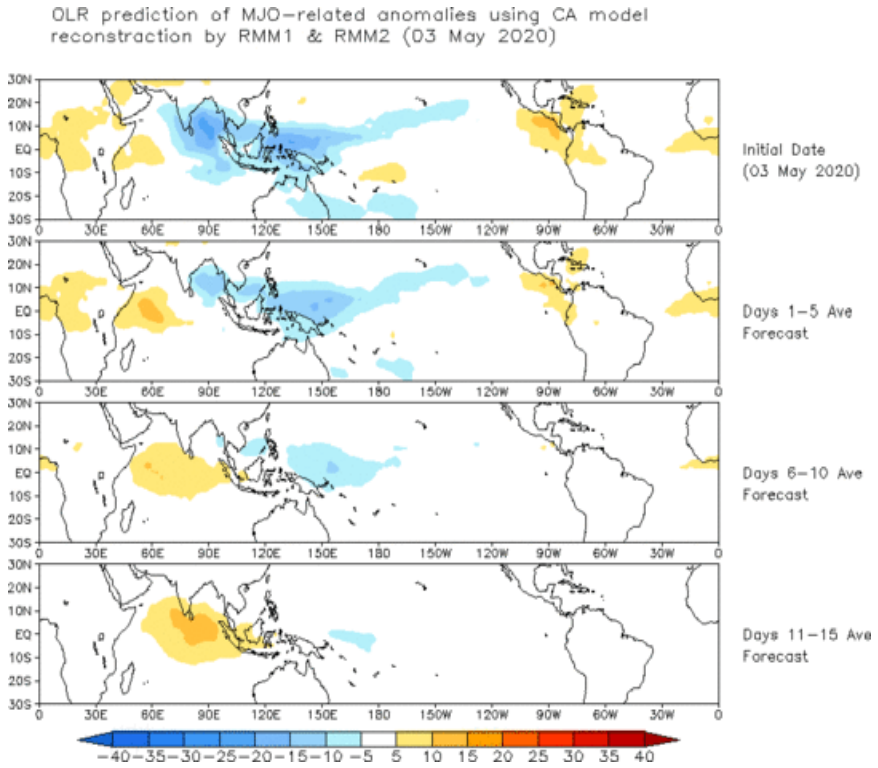


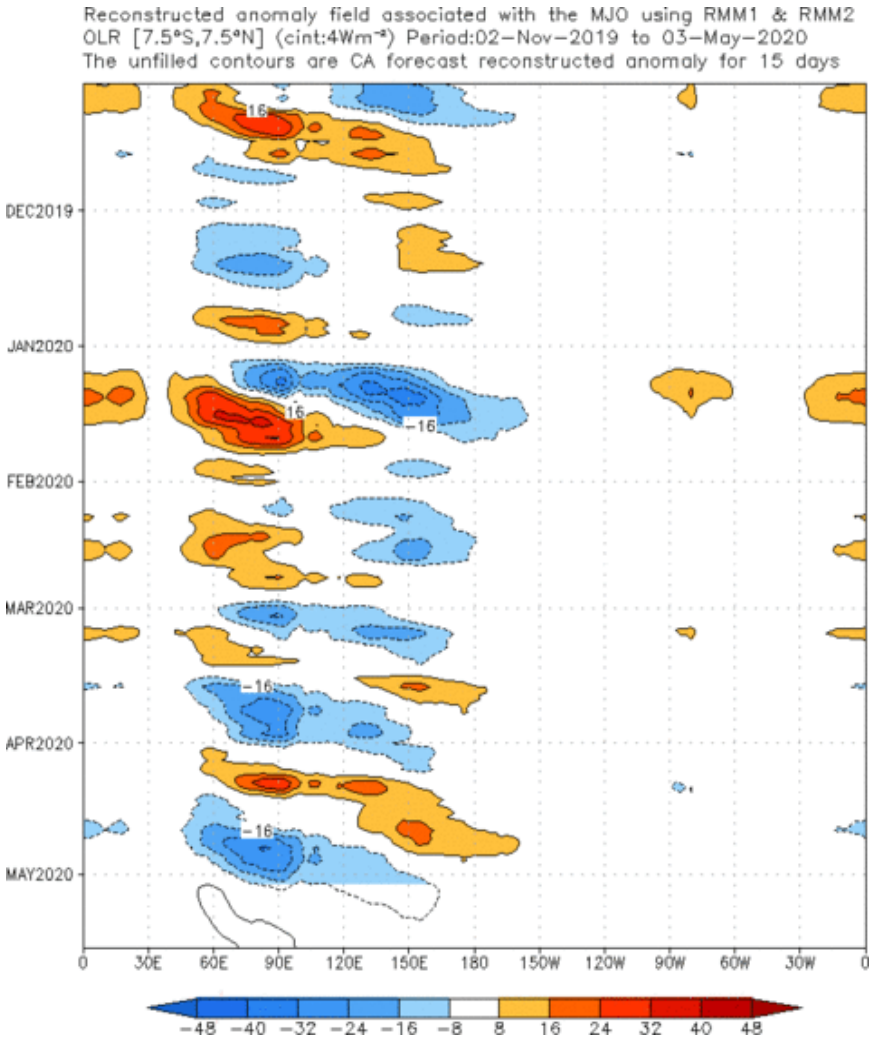


- The GEFS shows an eastward propagating signal that largely decouples from convection over the Western Hemisphere by mid-May, while suppressed convection builds across the Indian Ocean and Maritime Continent.

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.)

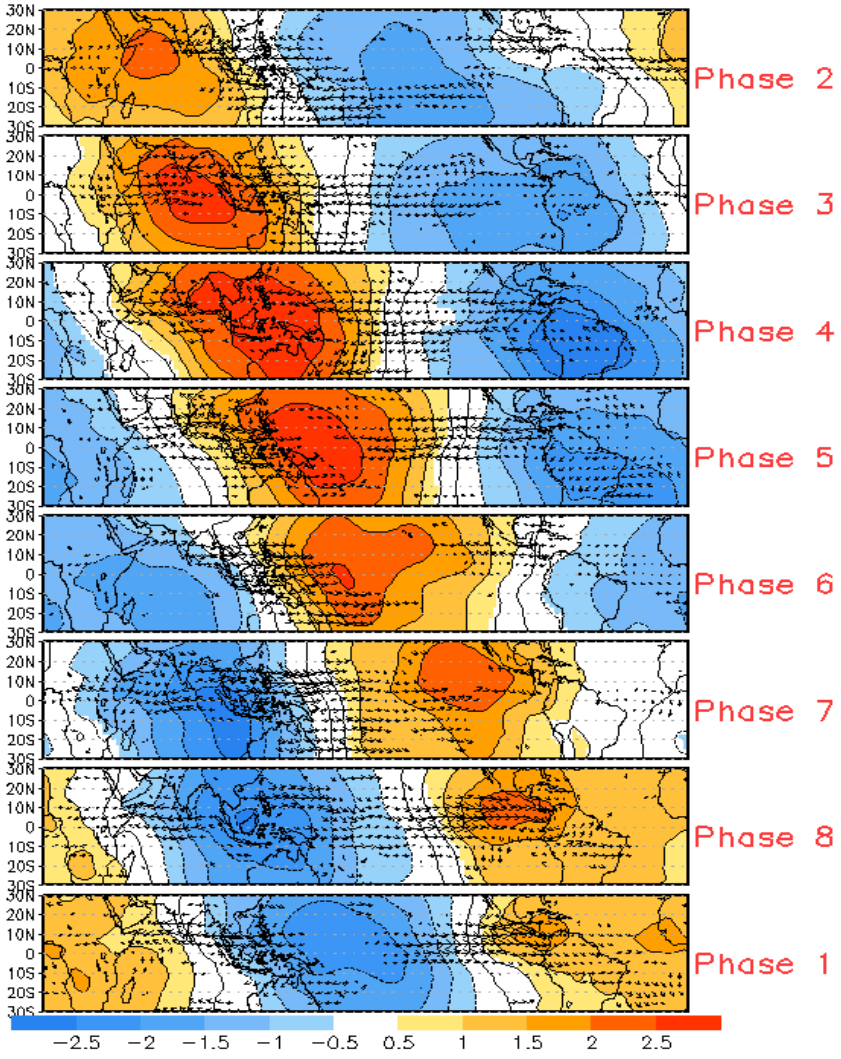




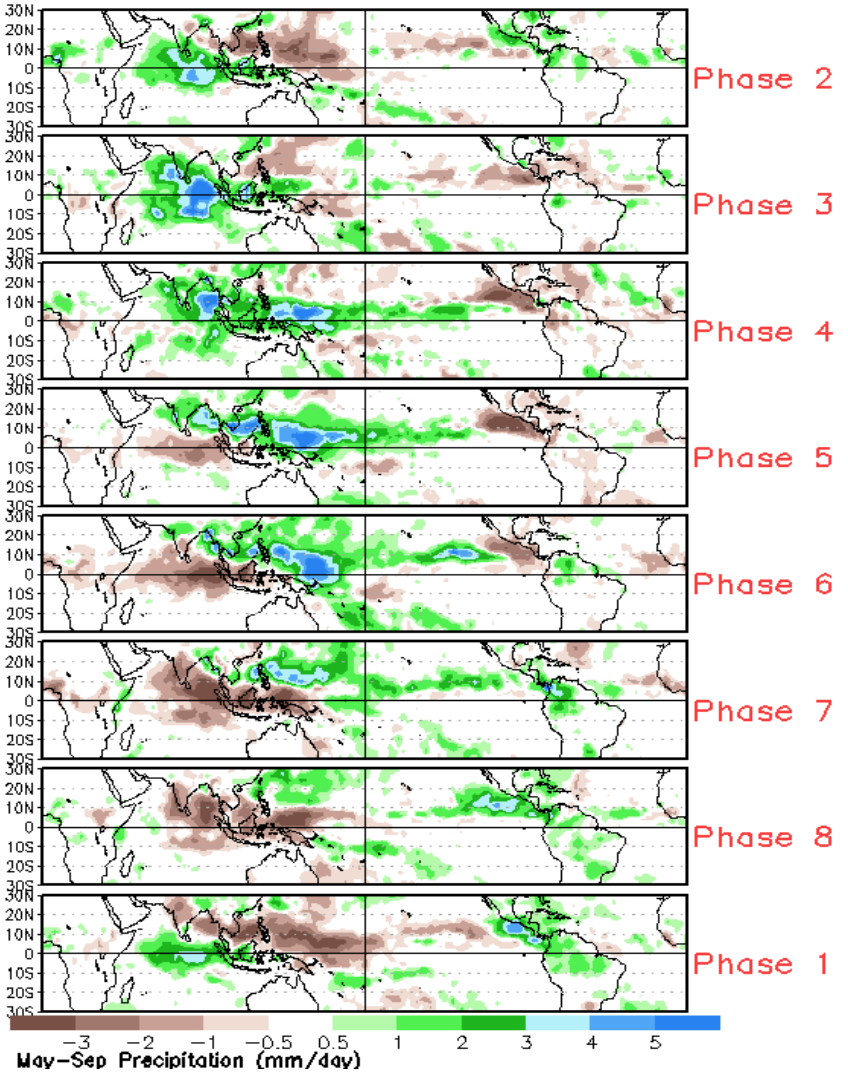
- The contstructed analog forecast is slower in its propagation of the intraseasonal envelope, but also emphasizes the suppression over convection over the Eastern Hemisphere more than the convection building over the Pacific with time.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



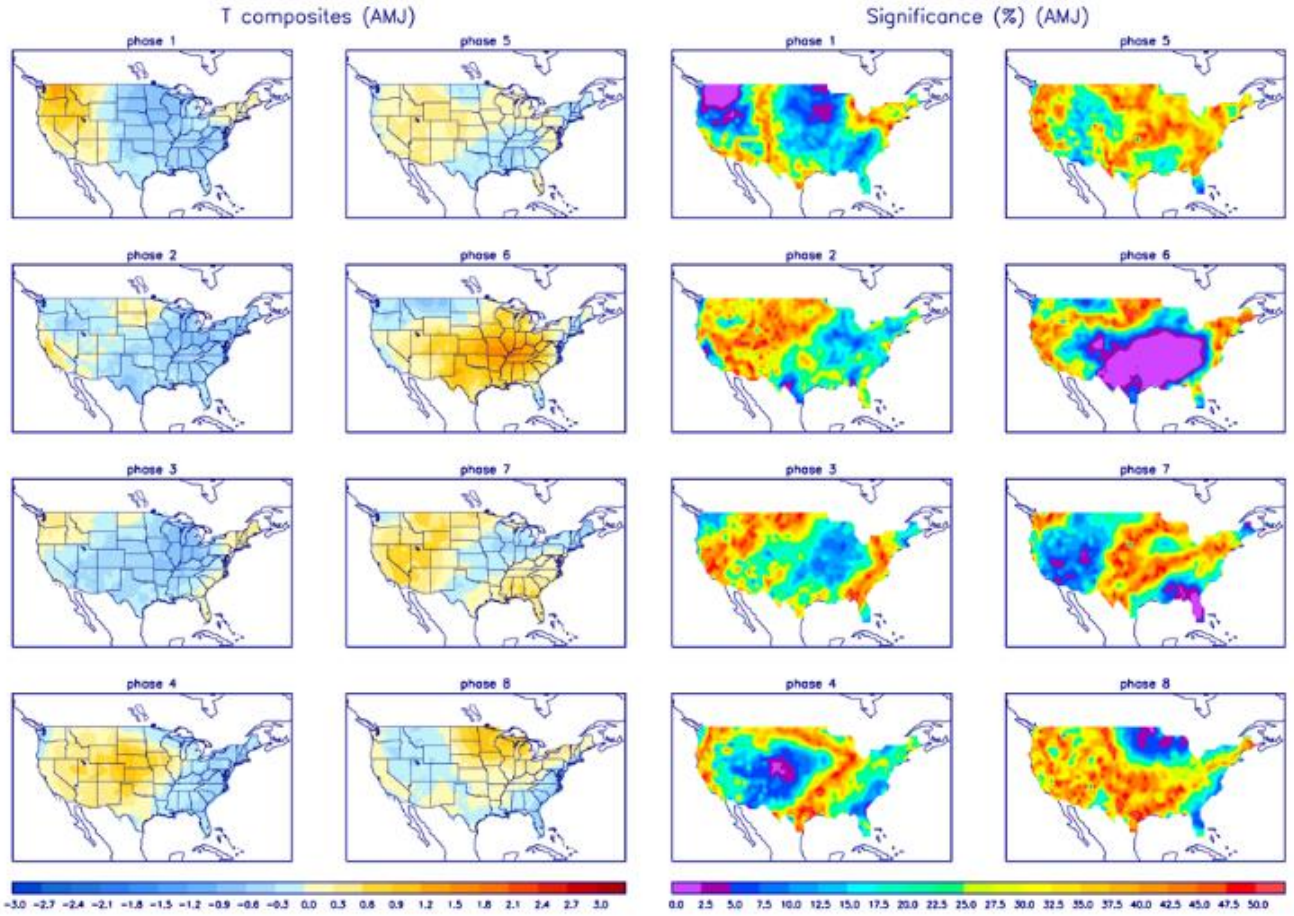
Precipitation Anomalies



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.

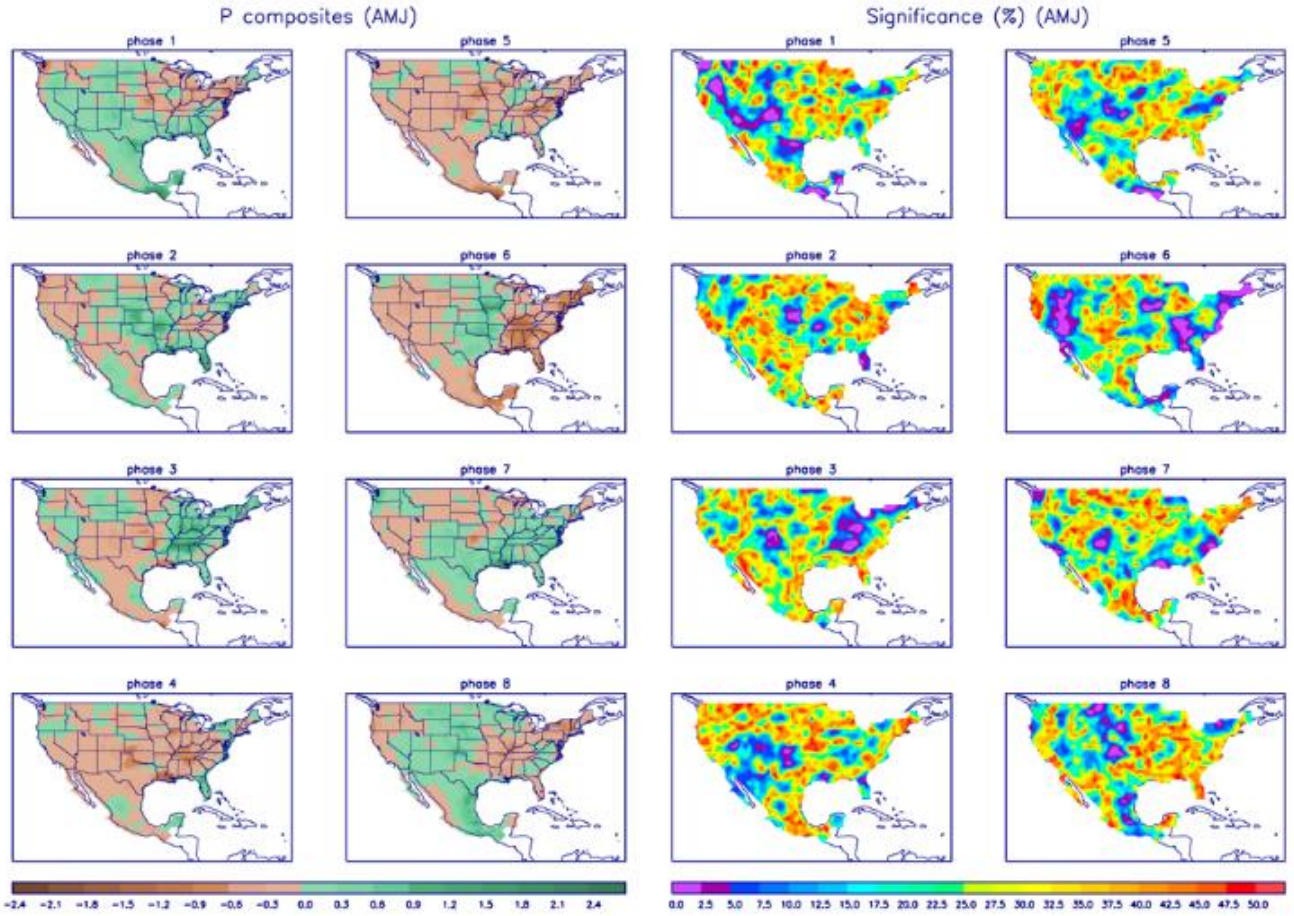


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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