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

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
10 February 2020

Overview

- A pair of slow-moving envelopes of enhanced convection exist in the global tropics. The first is presently over the Western Indian Ocean, while the second is over the Maritime Continent.

- Model guidance disagrees on which of these will come to dominate, with the GEFS emphasizing the latter center of action, while the ECMWF splits the difference and maintains both features.

- Given this complicated perspective, extratropical circulation responses to the MJO are difficult to anticipate at this time.

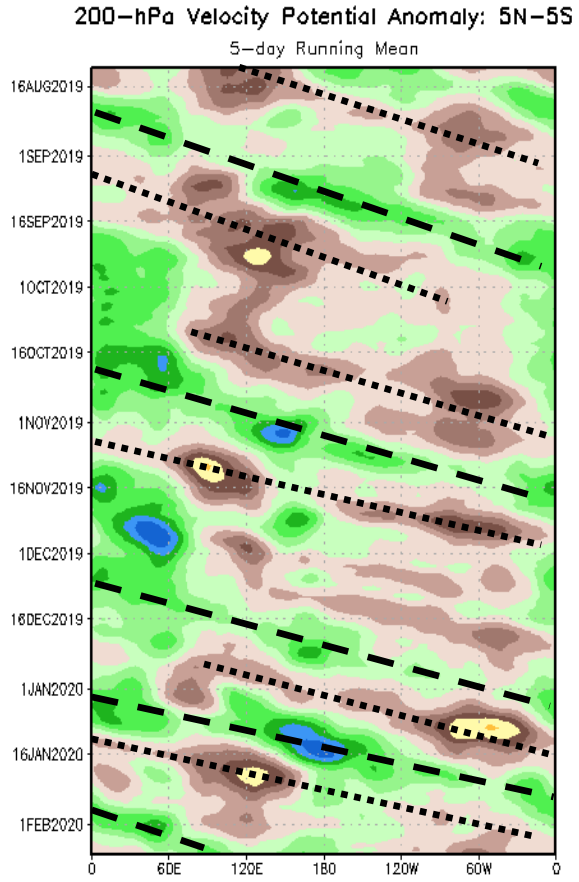
- A noteworthy possibility exists for anomalous low-level westerly winds east of New Guinea associated with the easternmost envelope of enhanced convection to potentially trigger a downwelling oceanic Kelvin wave. This would help to reinforce the volume of warm water available below the surface in the Pacific and possibly fuel an El Niño event.

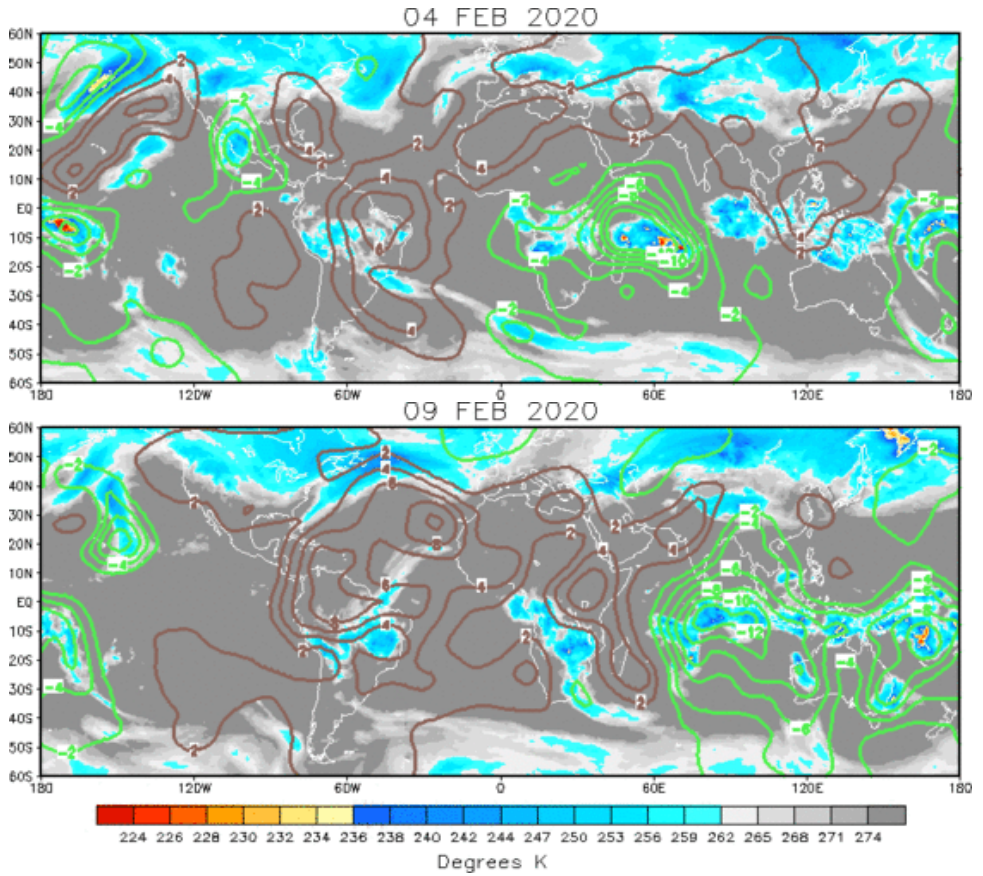
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

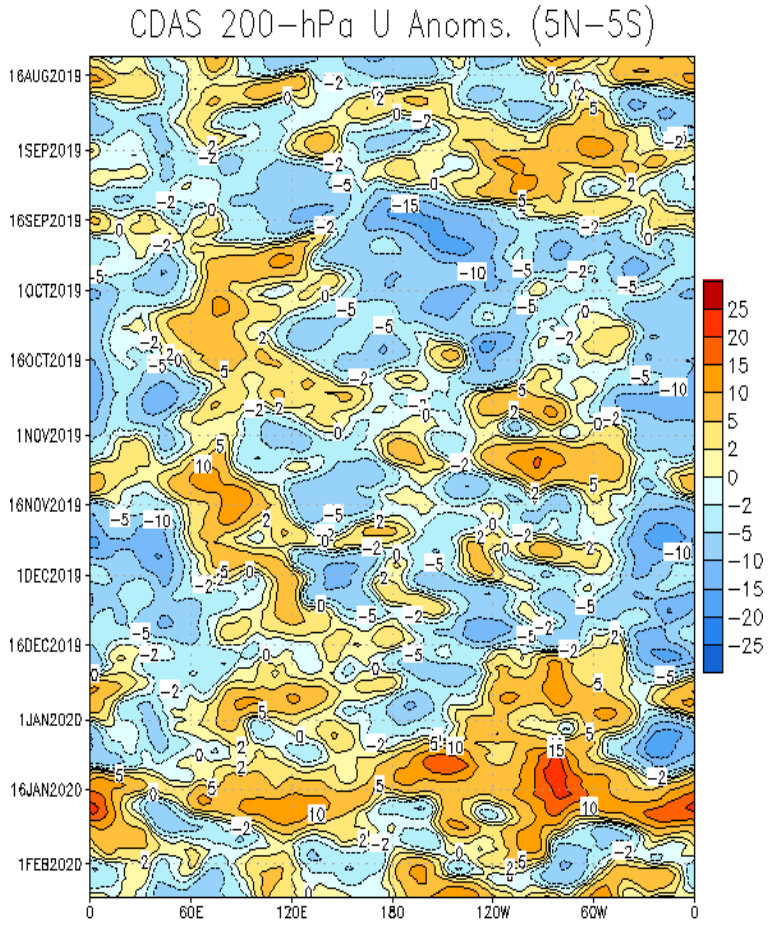


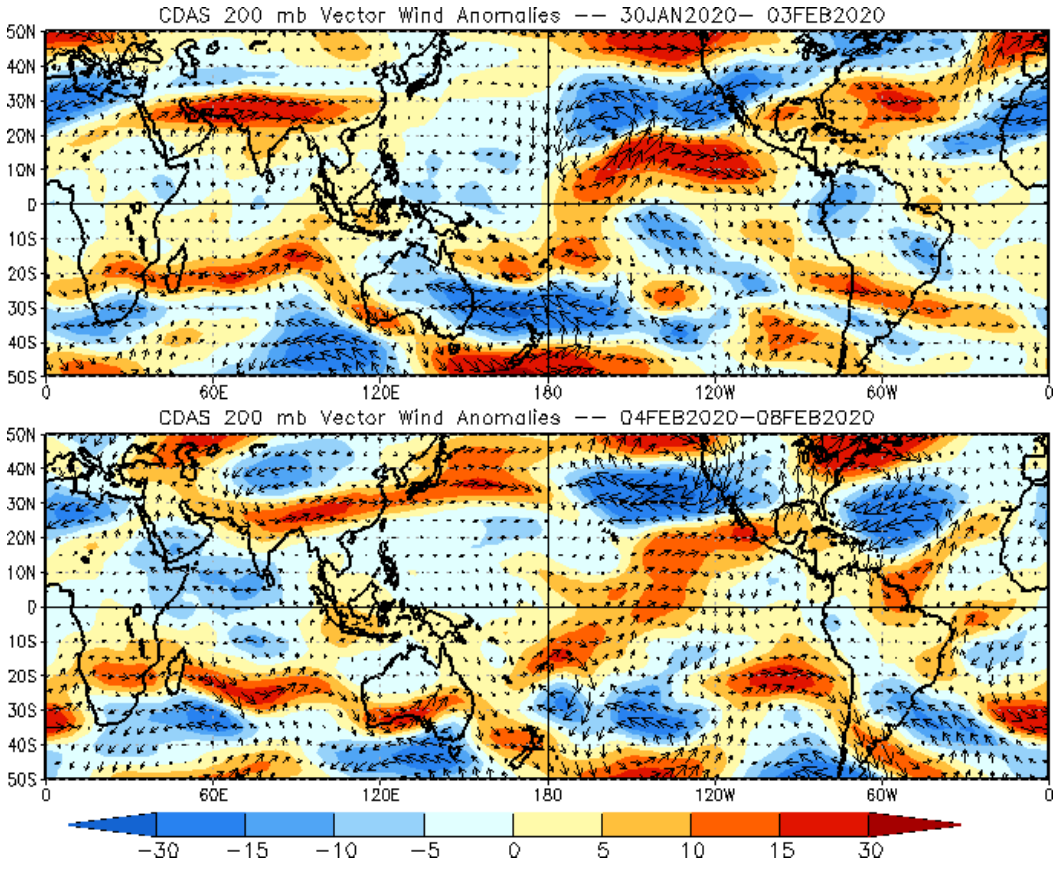


- The upper-level velocity field exhibits eastward propagation of an envelope favorable for enhanced convection shifting east from over Africa and the western Indian Ocean to between 60E-150W during early February.
- The Hovmoller diagram (left) shows this envelope to have its origins traced back until at least last December, with a period of ~30 days. This is on the fast end of the MJO phase speed envelope.

200-hPa Wind Anomalies

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

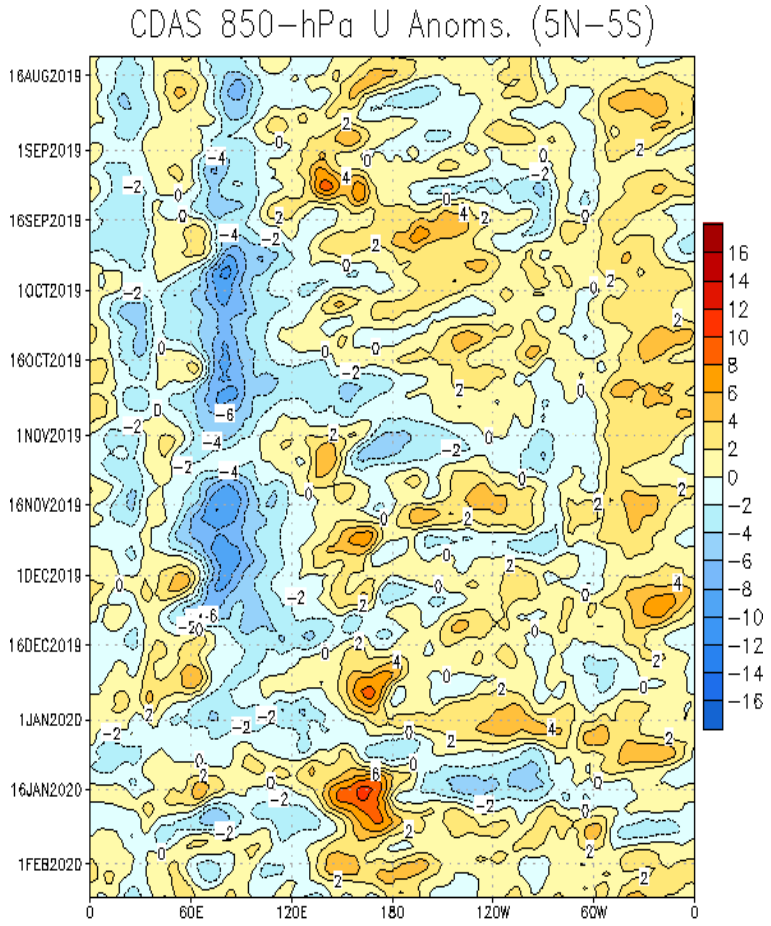


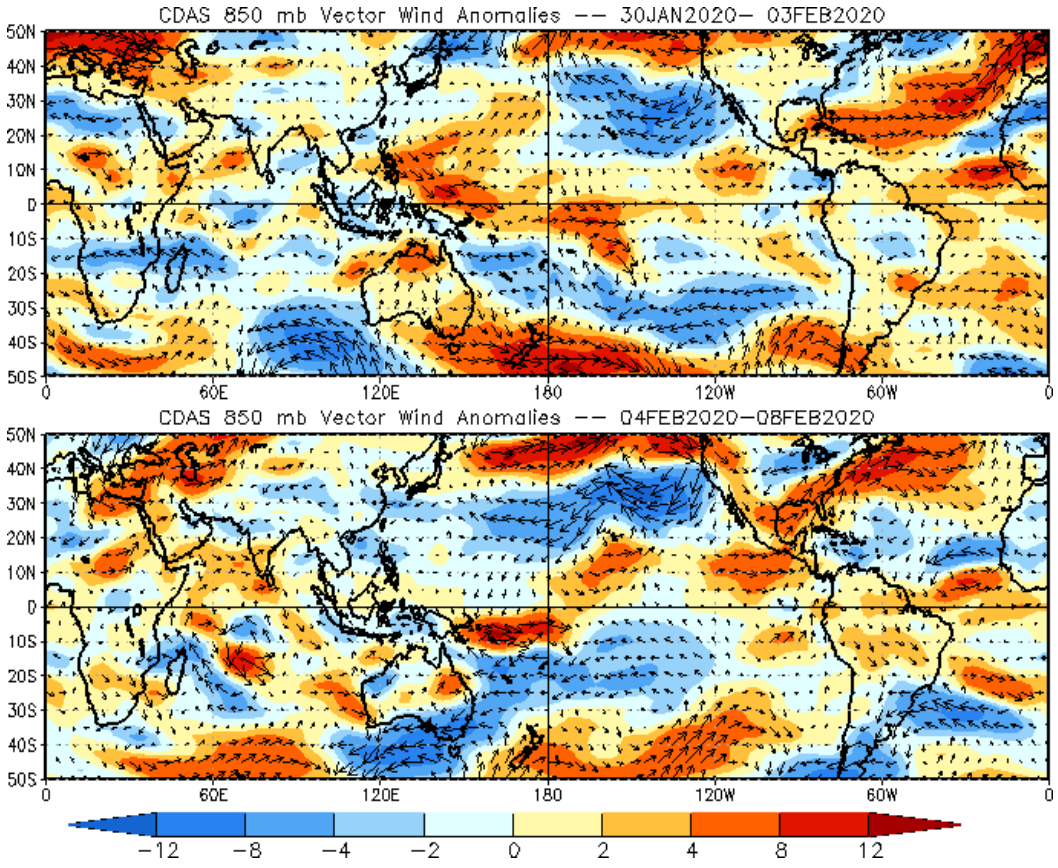


- Wavebreaking near the Date Line in both the Northern and Southern Hemispheres is contributing to anomalous westerlies across the East Pacific.
- Outside of this signal, equatorial anomalies are generally weak, with the exception over the Arabian Sea and western Indian Ocean where robust easterlies are apparent.

850-hPa Wind Anomalies

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

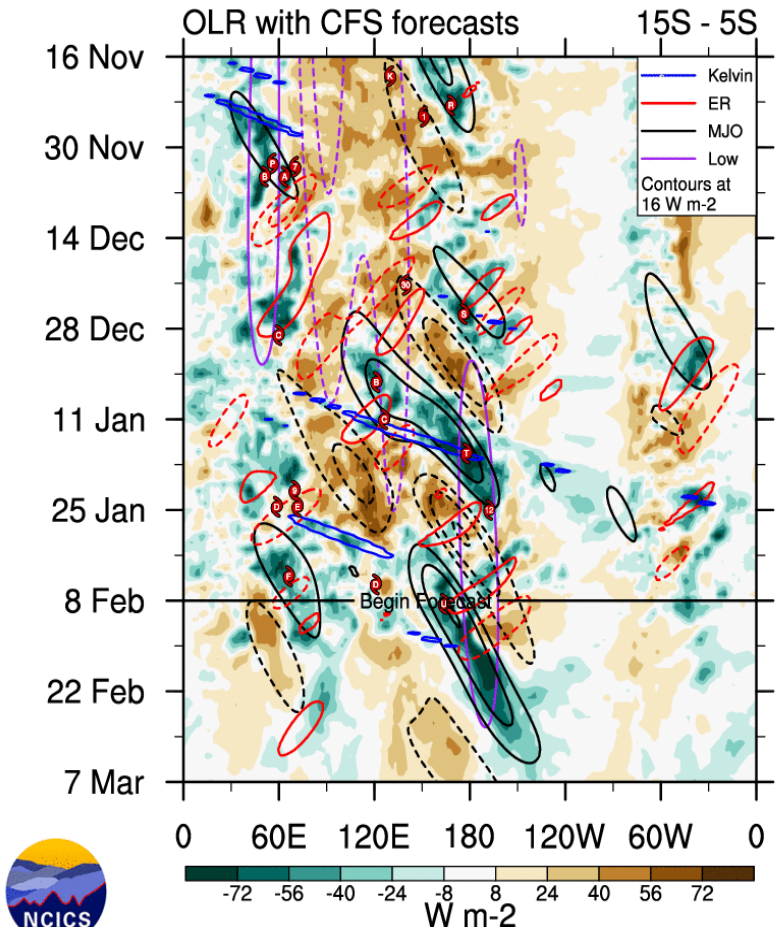


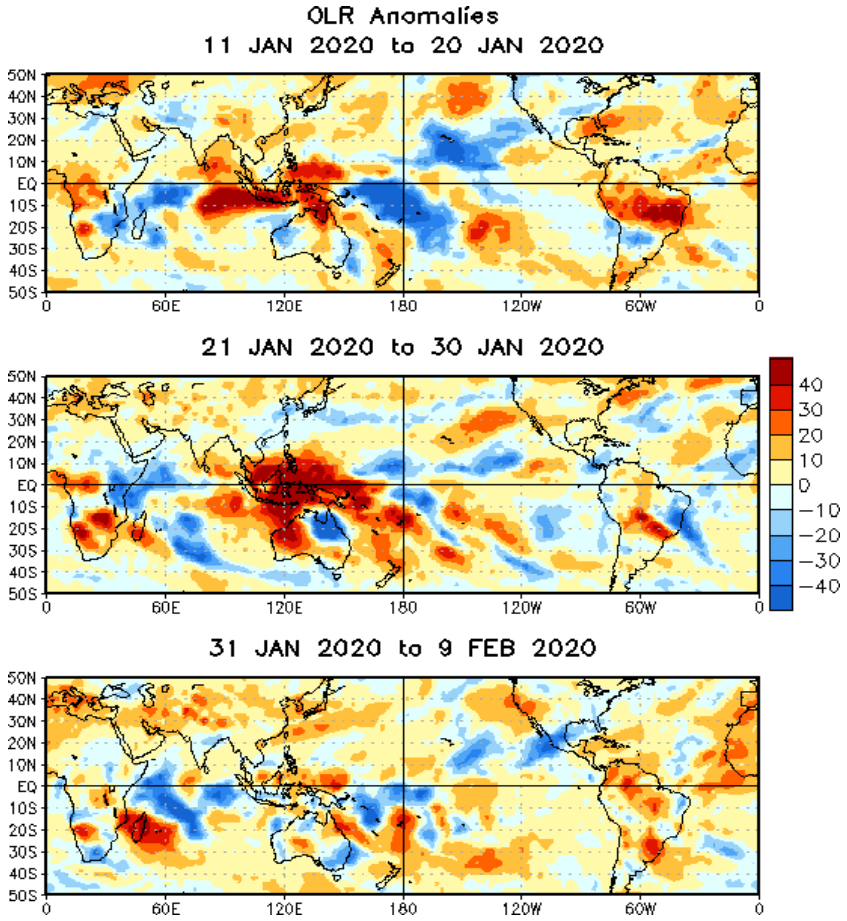


- Anomalous low-level westerlies persist east of New Guinea, which could have repurcussions on the state of the ocean on the seasonal timescale should a downwelling Kelvin wave be triggered.
- Recent heavy rains over the southeastern U.S. appear tied to low-level moisture transport from both the East Pacific and Gulf of Mexico.

Outgoing Longwave Radiation (OLR) Anomalies

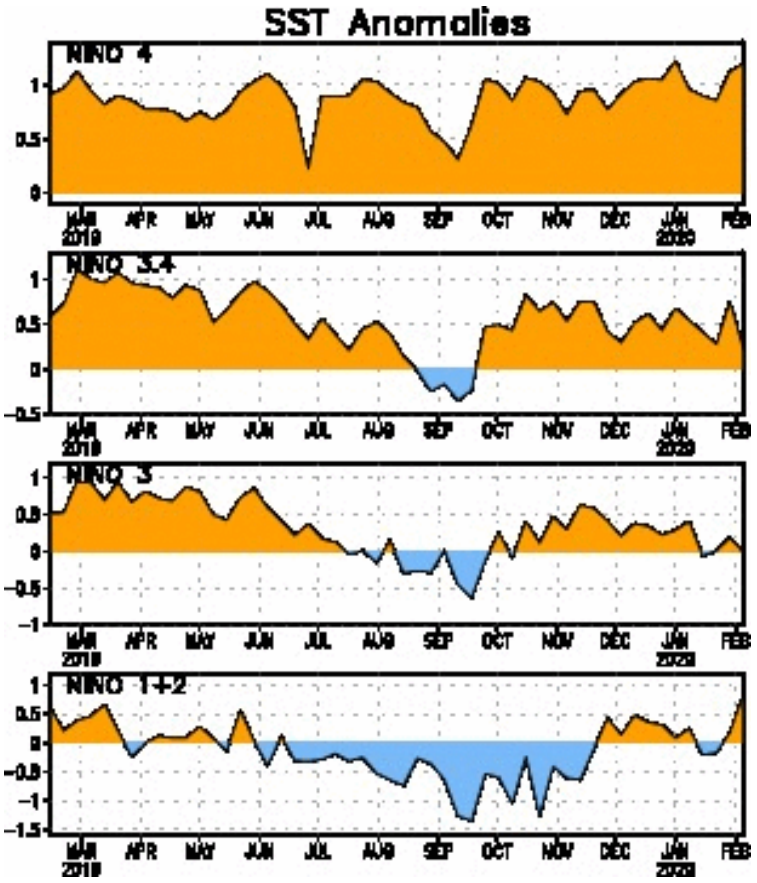
Blue shades: Anomalous convection (wetness). Red shades: Anomalous subsidence (dryness).

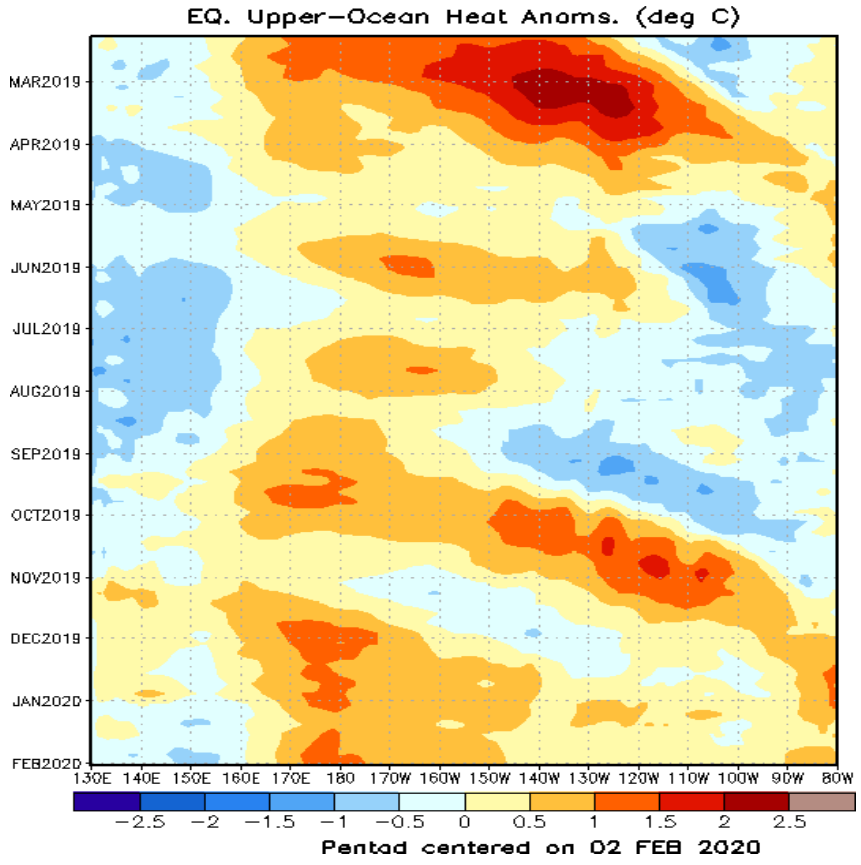




- Recent OLR variability features a number of modes, anchored by a pair of slowly-propagating easterly envelopes of enhanced convection over the Western Indian Ocean and near the Date Line. In addition, Equatorial Rossby wave (tropical cyclone) activity in the South Pacific near the Antimeridian and the low frequency state favoring enhanced convection just east of the Date Line muddy the perspective.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

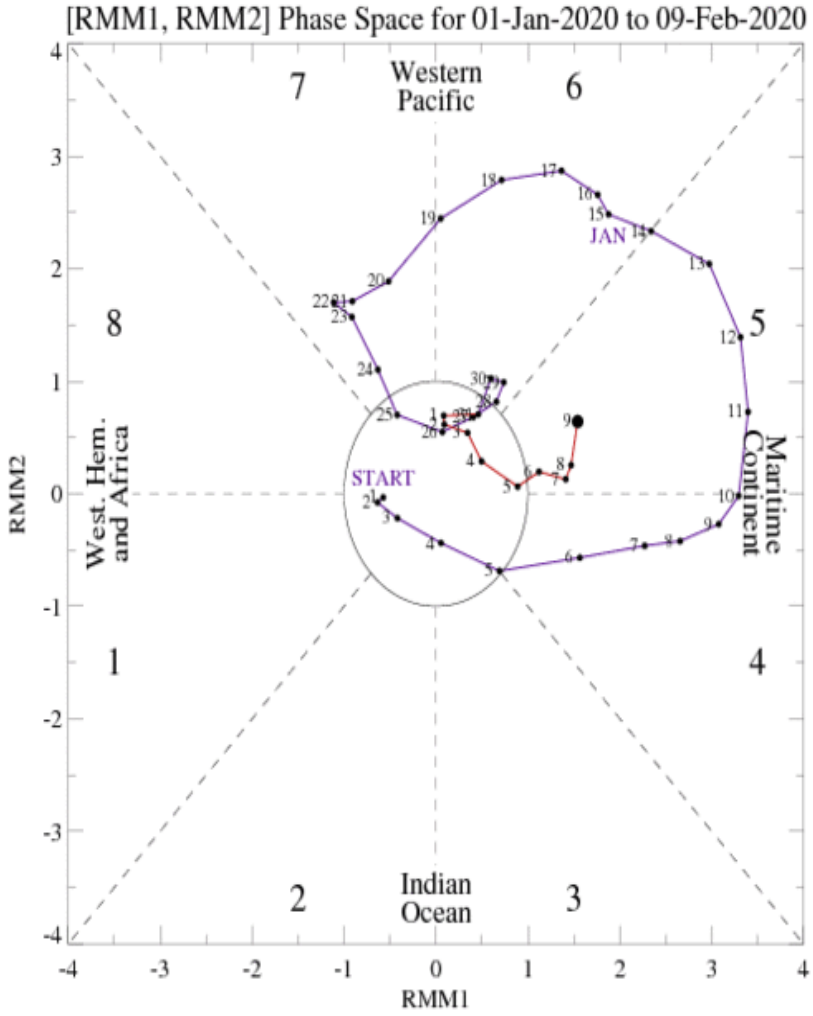




- Upper-ocean heat anomalies are positive across the equatorial Pacific in the Western Hemisphere.
- The warmest upper-ocean water is focused near, and just west of, the Date Line since late November.

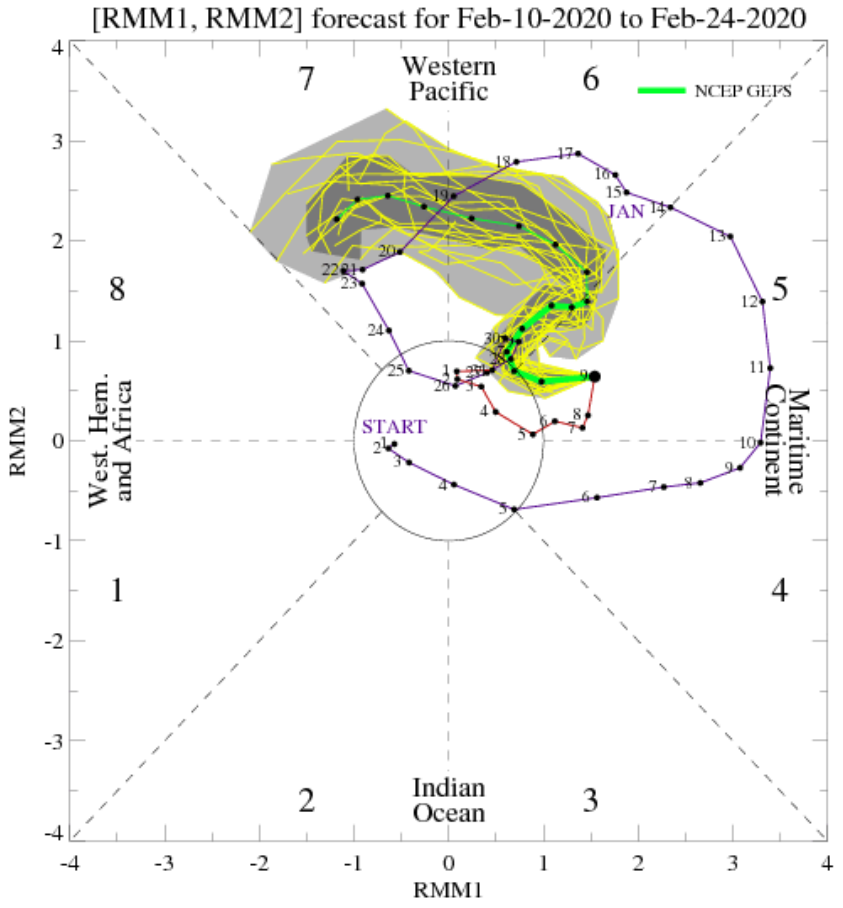
MJO Index: Recent Evolution

- The RMM index shows the MJO emerging over the western Maritime Continent in early February after a period of incoherence to begin the month.

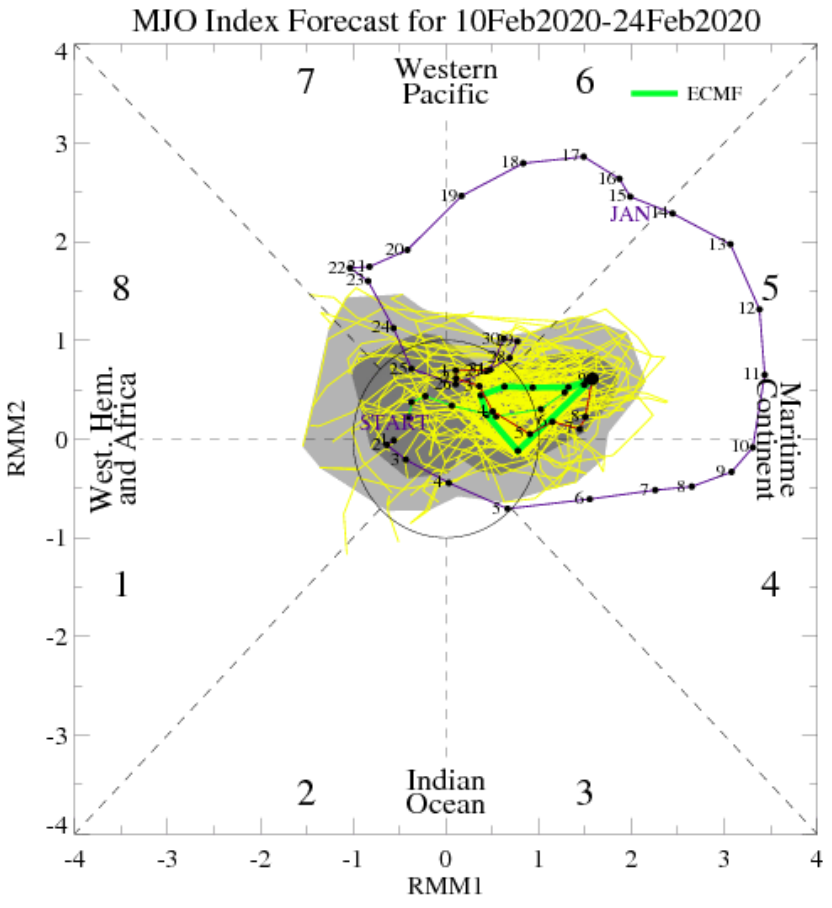


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

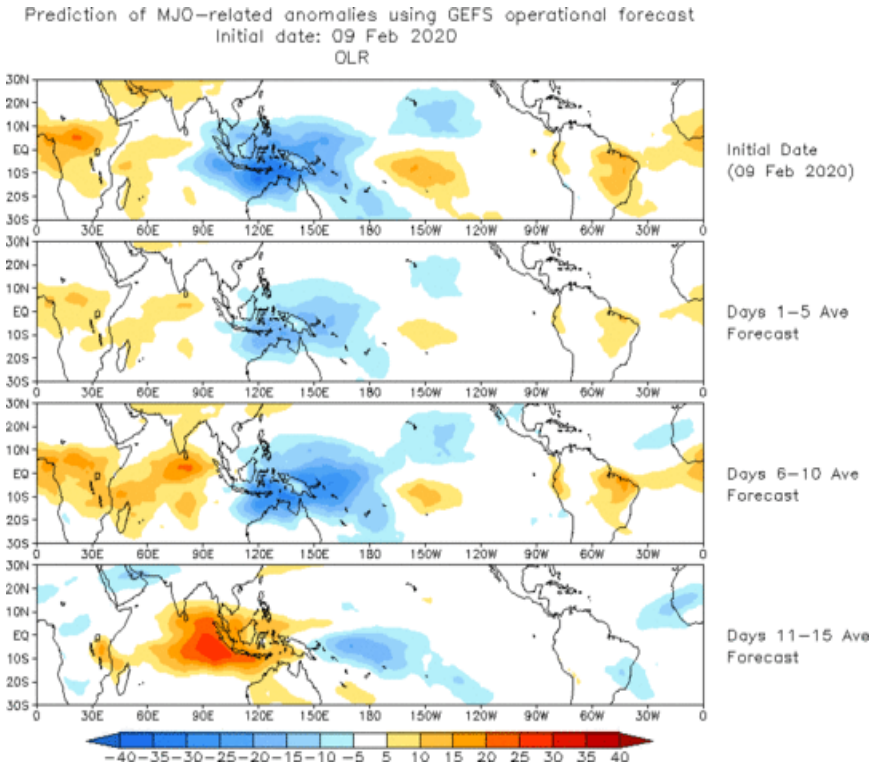


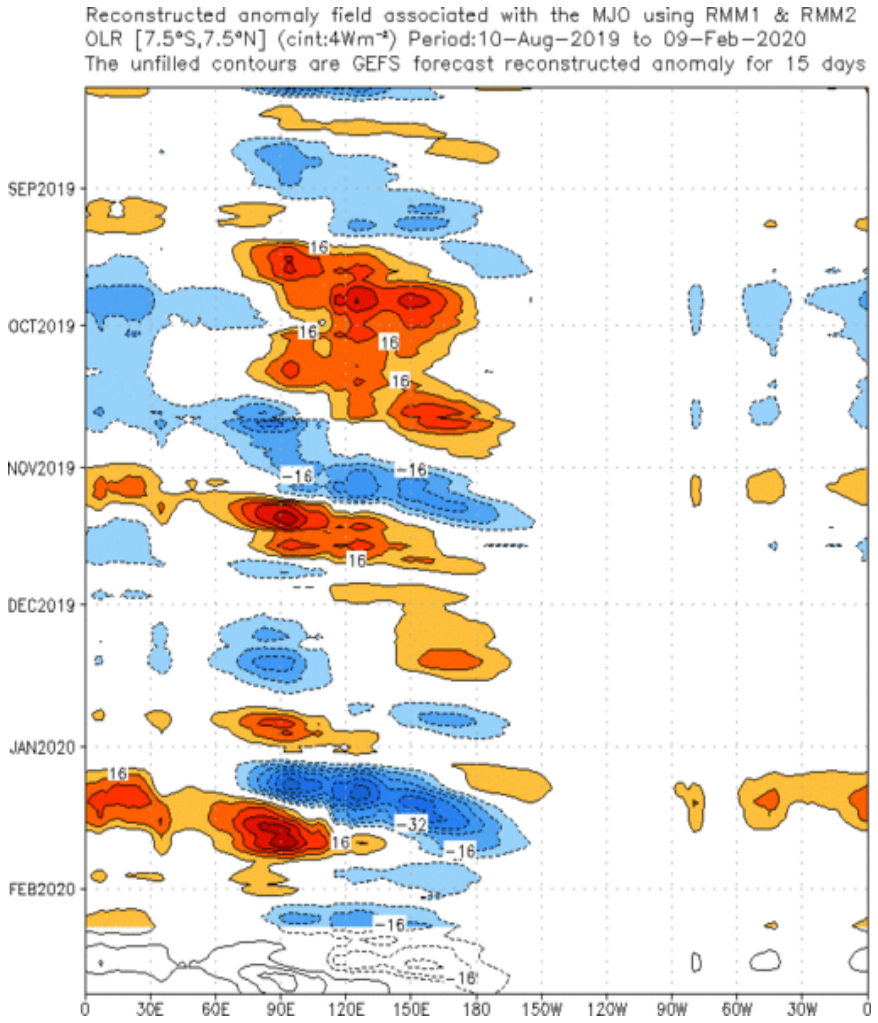
ECMWF Forecast

- The GEFS forecasts a strengthening and rapidly-propagating MJO during Week-2 after some initial mixed signals.
- Conversely, the ECMWF forecast appears to have difficulty with emphasizing the two envelopes of enhanced convection, leading to a fairly weak and incoherent MJO response when using an RMM perspective.

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.)

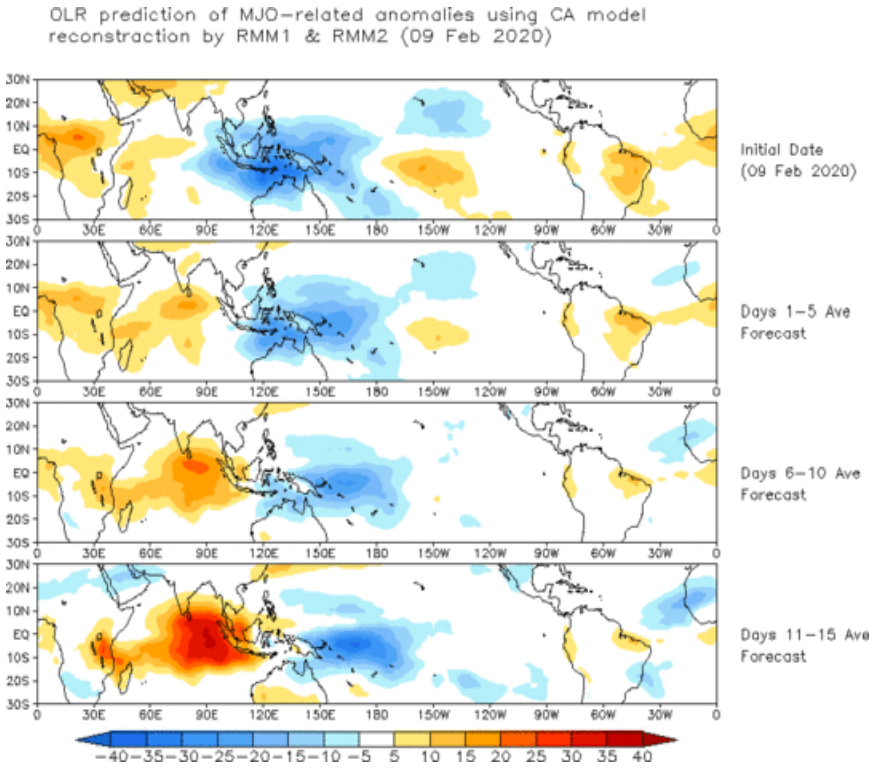


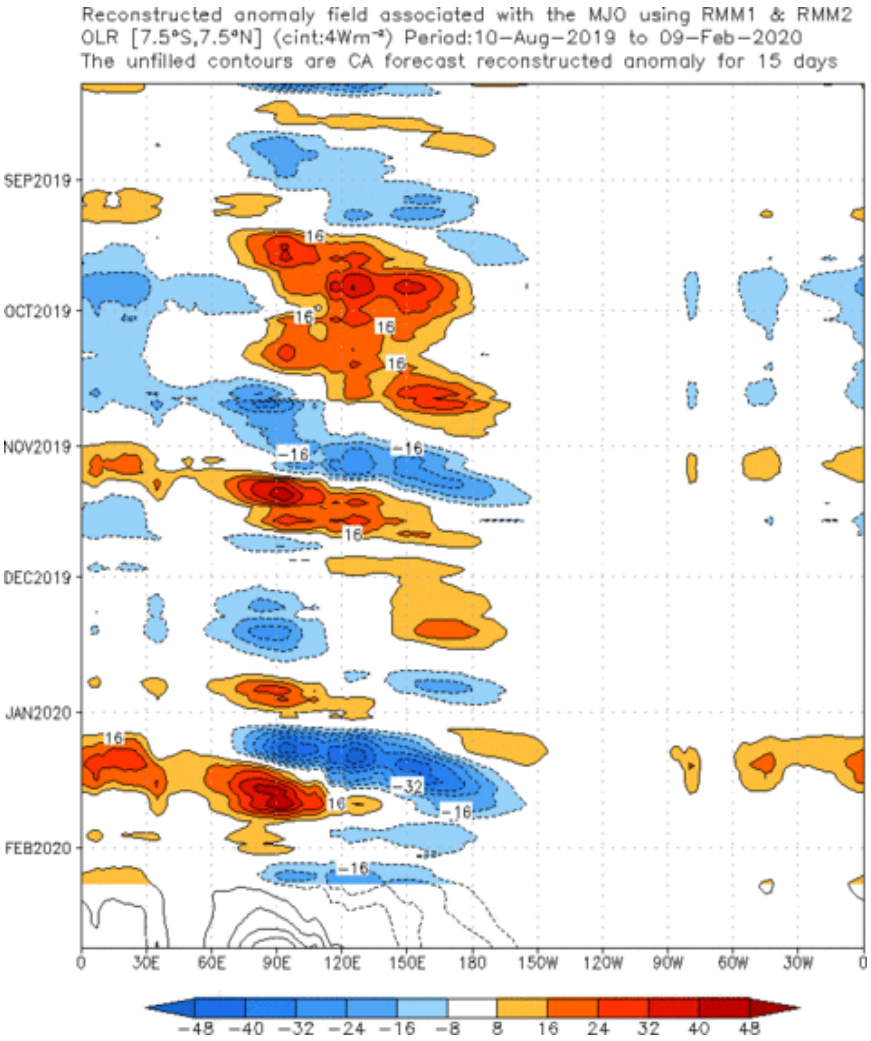


- The GEFS spatial MJO forecast shows the MJO propagating eastward to near the Date Line by late February, while suppressed convection pushes east over the Indian Ocean.

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.)

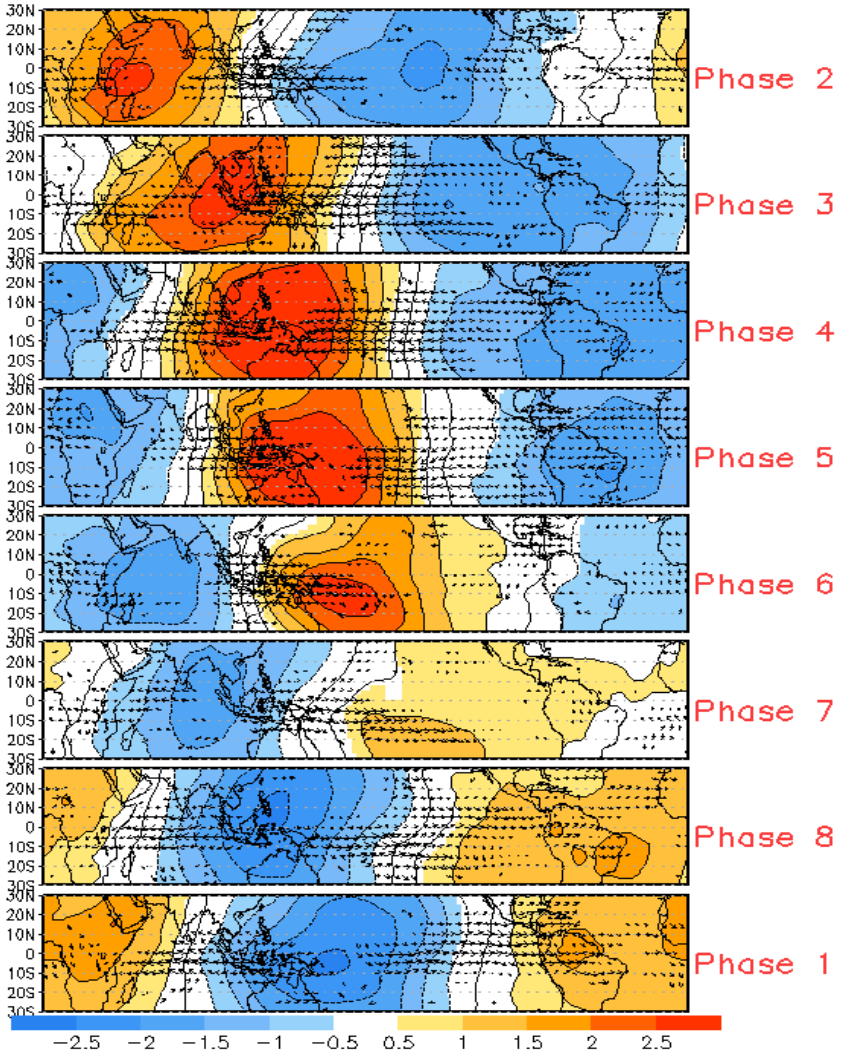




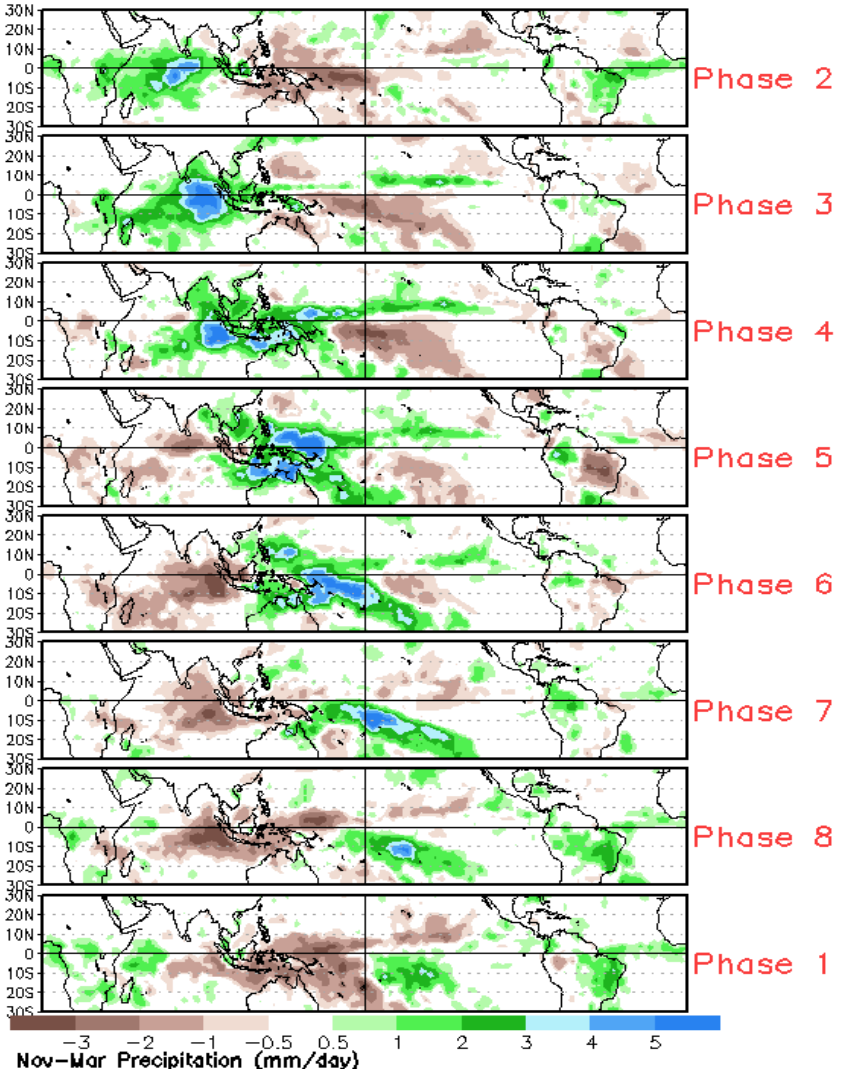
- The constructed analog model forecasts a slightly slower MJO propagation, with a more robust area of suppressed convection over the eastern Indian Ocean by late February.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



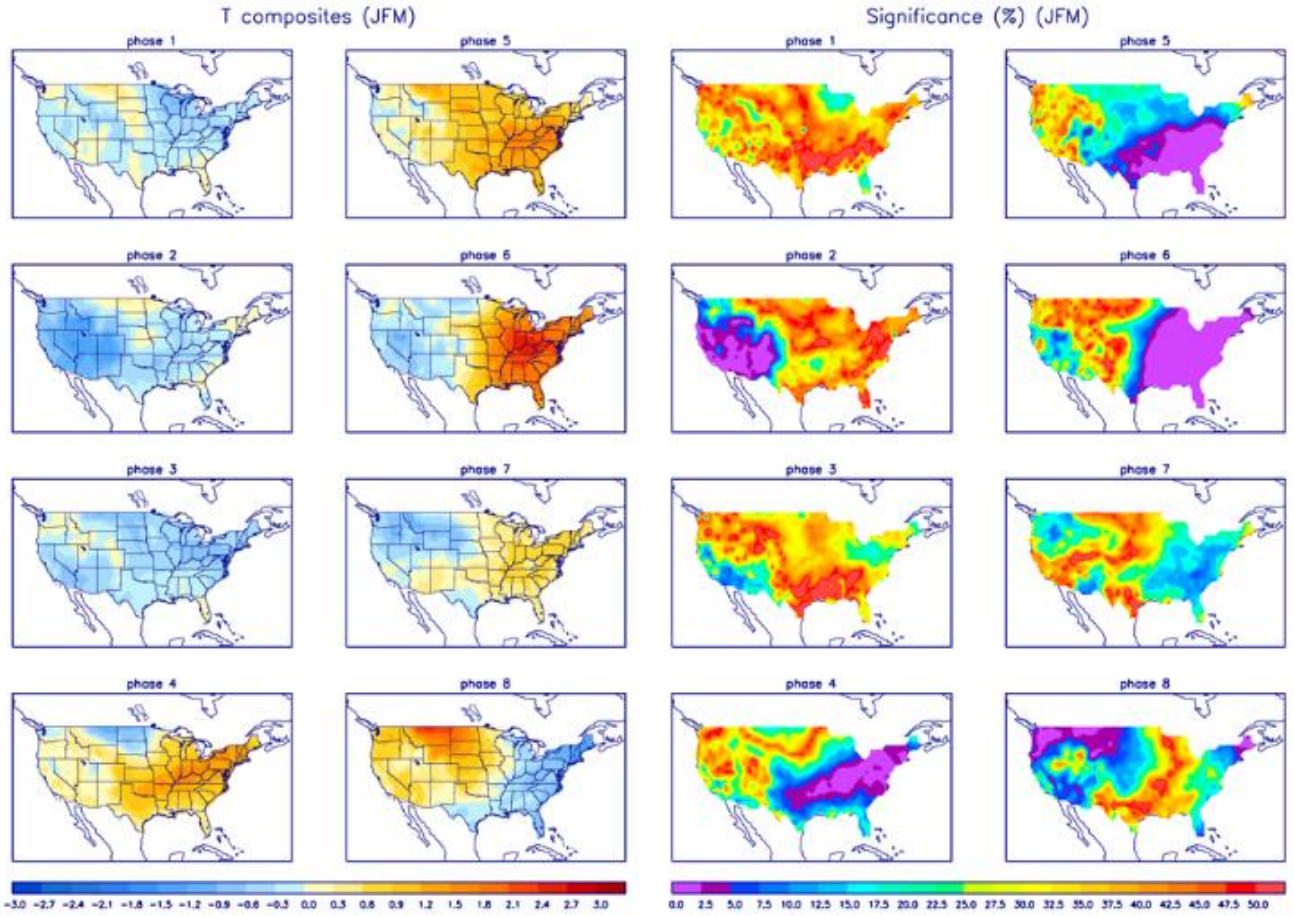
Precipitation Anomalies



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.

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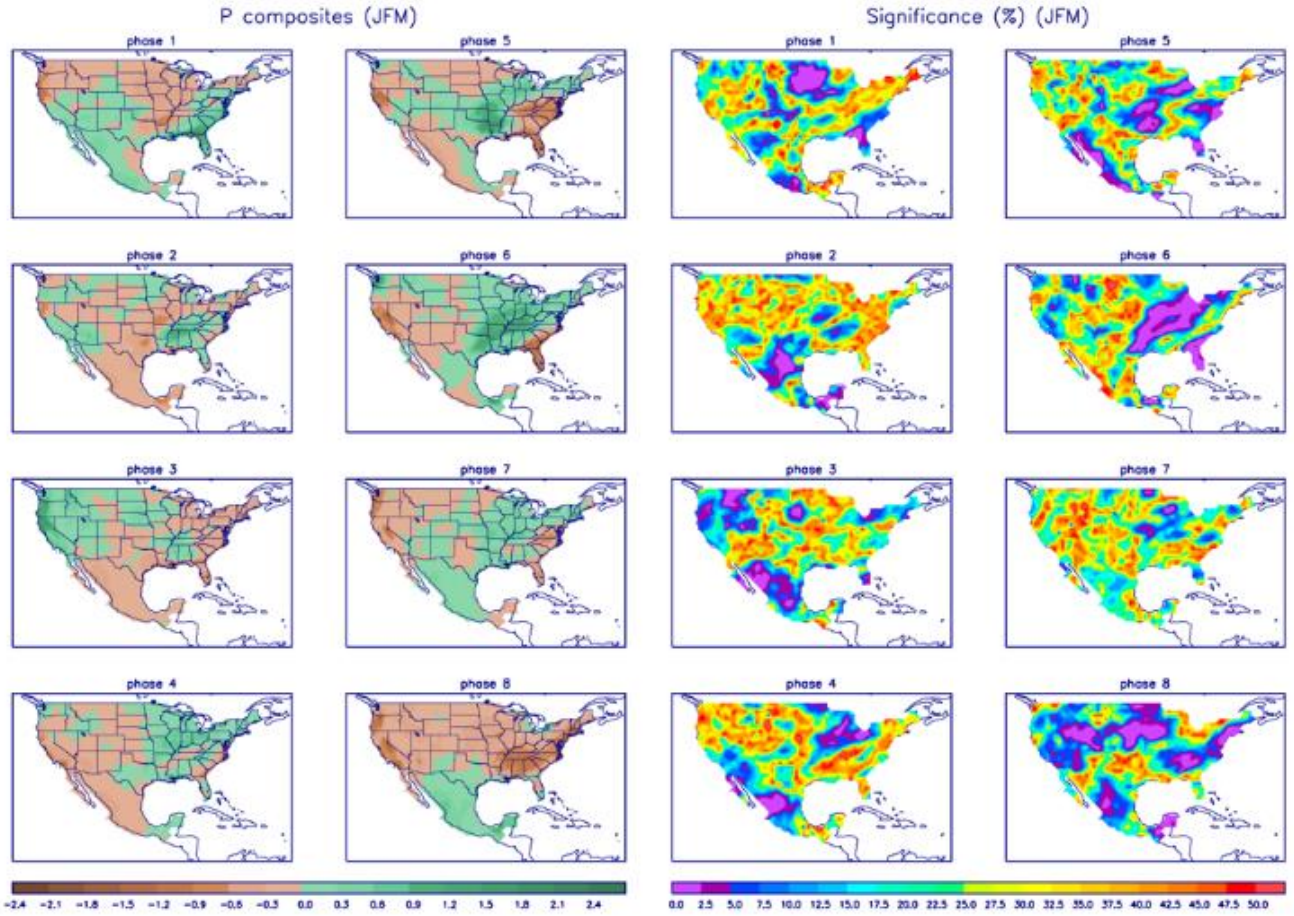

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