

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



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

Overview

- The upper-level pattern and recent observations of the OLR field suggest renewed MJO activity over the western Indian Ocean.
- A low-frequency signal favoring enhanced convection near the Date Line persists, with a weaker amplitude due to destructive interference with the intraseasonal suppressed envelope.
- Dynamical models favor eastward propagation of this signal to the Maritime Continent, followed by rapid weakening during Week-2 due to interference from Rossby wave activity.

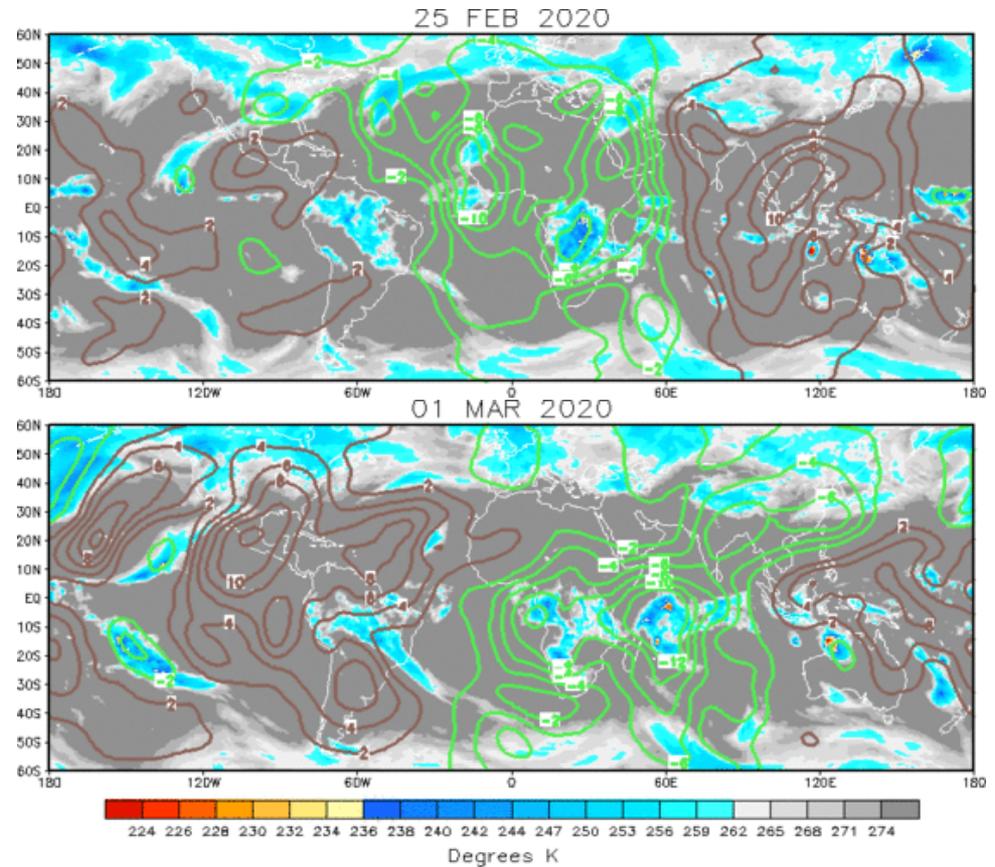
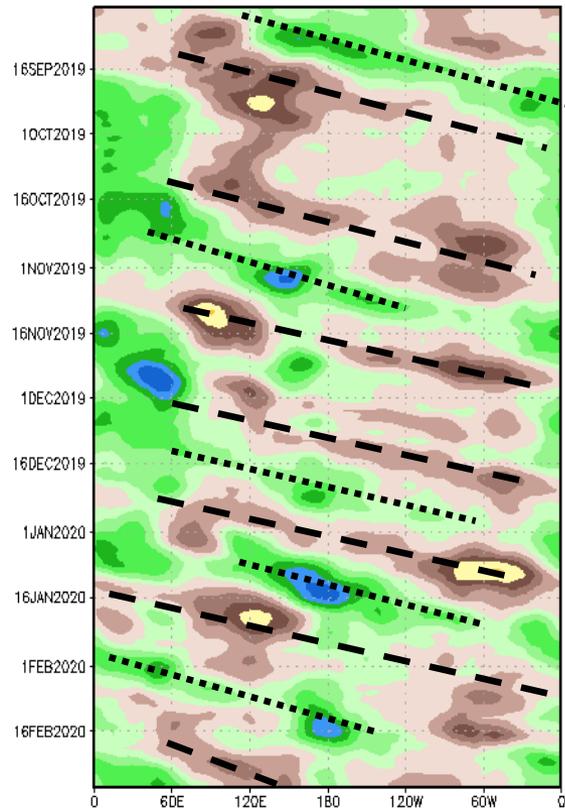
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

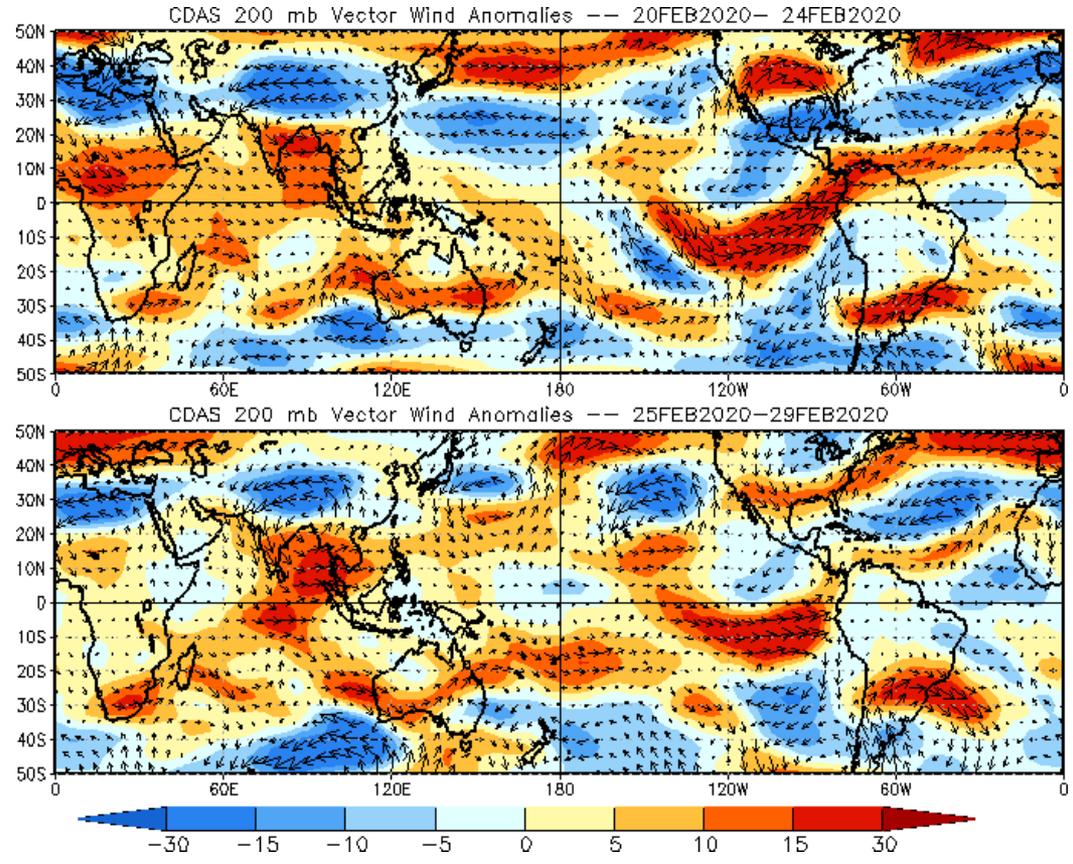
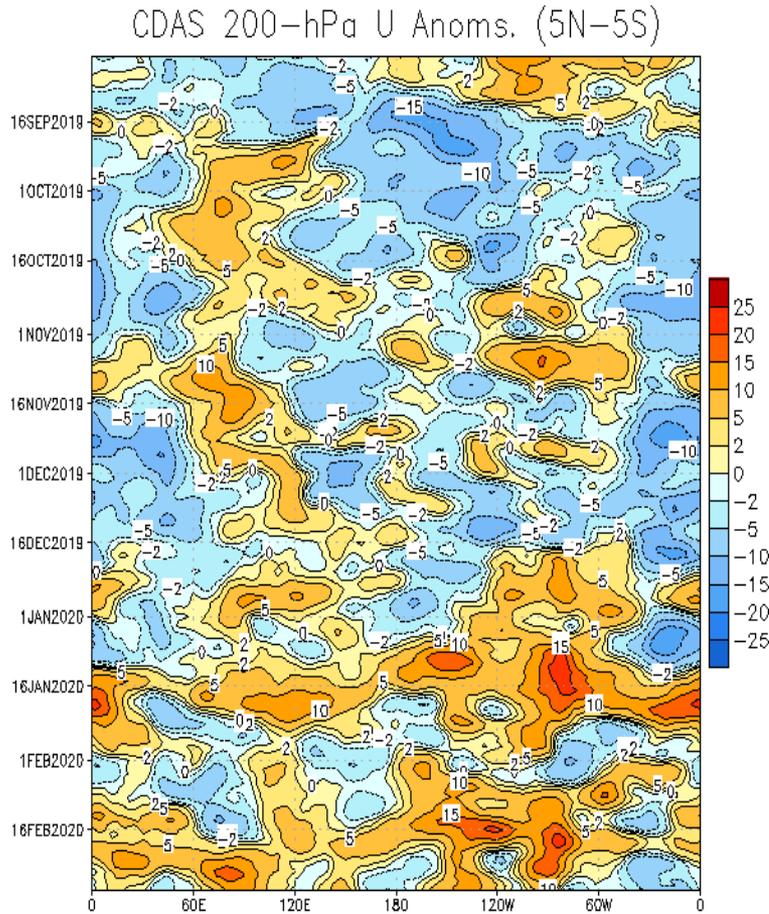
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- The global-scale upper-level convective pattern became increasingly coherent in late February and the beginning of March, with a robust enhanced convective signal propagating from the Western Hemisphere to the western Indian Ocean.
- Other modes continue to influence the pattern, including a low-frequency signal supporting enhanced convection near the Date Line and remnant tropical cyclone activity over northern Australia.

200-hPa Wind Anomalies

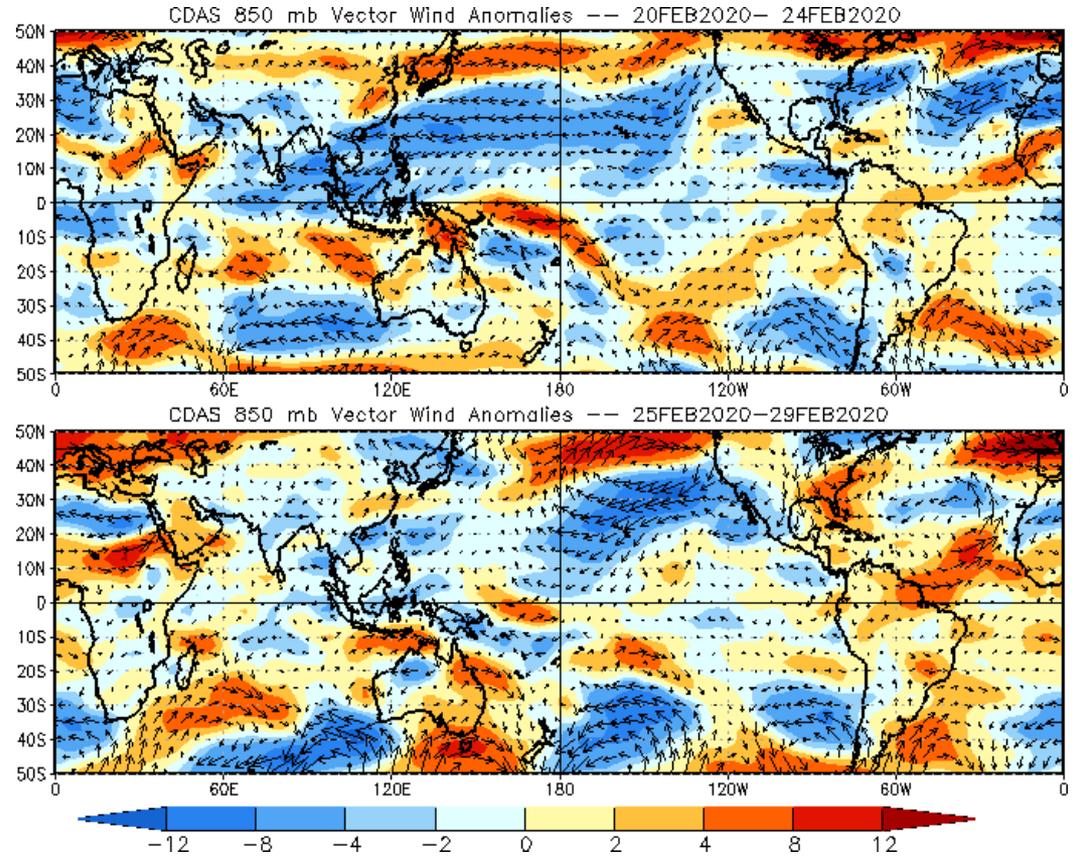
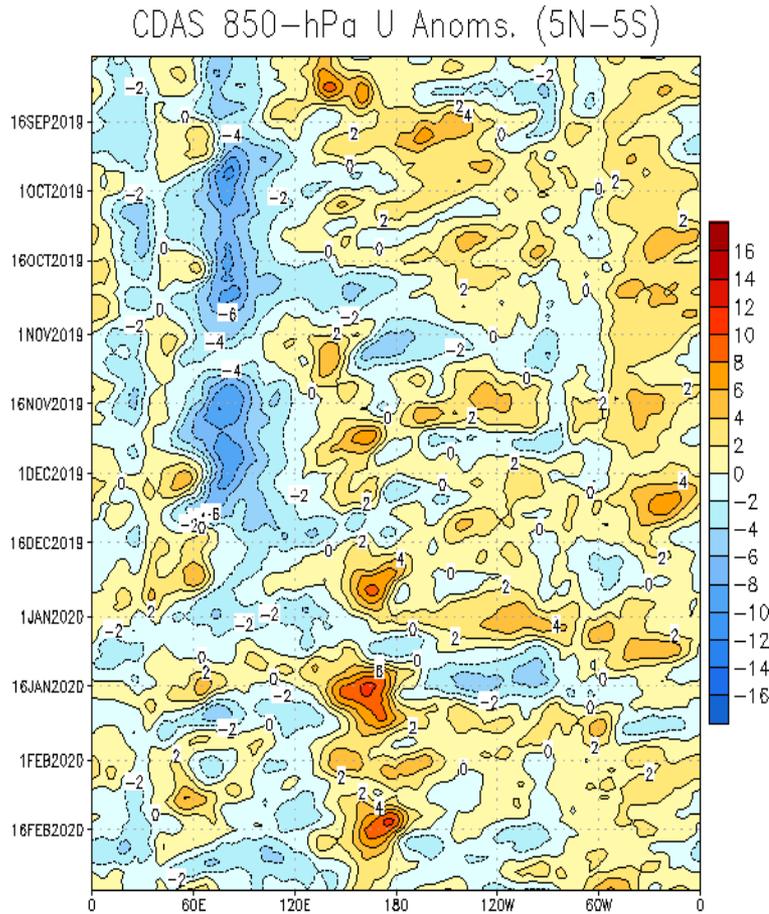
Shading denotes the zonal wind anomaly. **Blue shades: Anomalous easterlies.** **Red shades: Anomalous westerlies.**



- While westerly anomalies are present over the eastern Indian Ocean, which may provide some upper-level ventilation for convection over the Indian Ocean, a robust upper-level low centered over Bangladesh is not consistent with MJO activity.

850-hPa Wind Anomalies

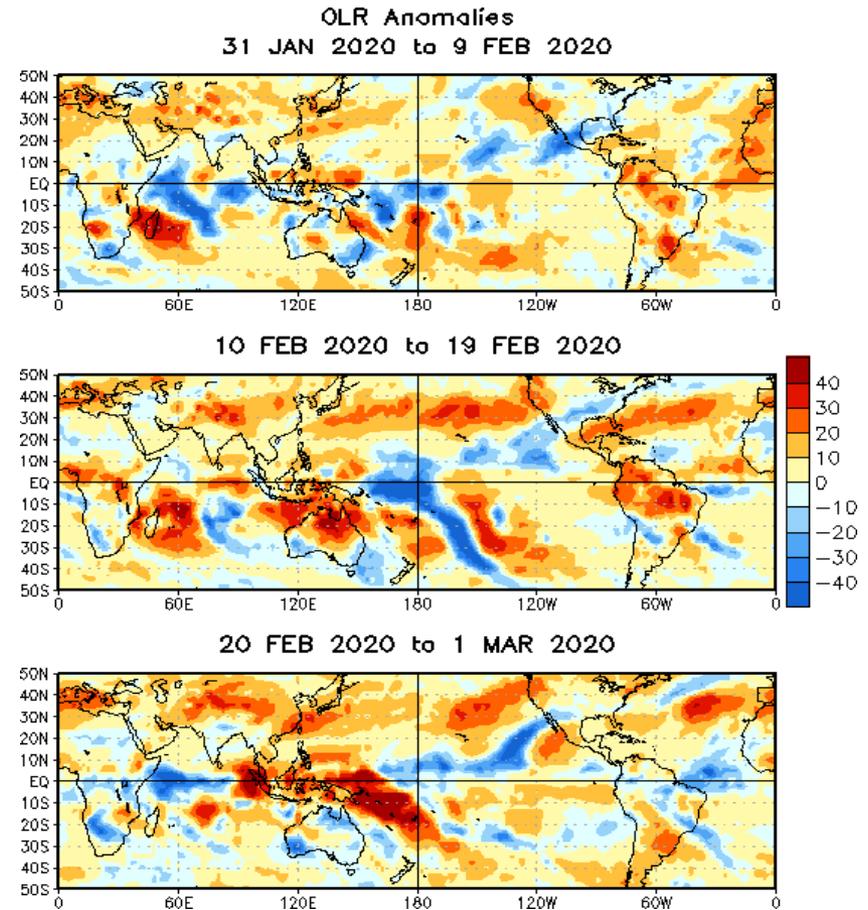
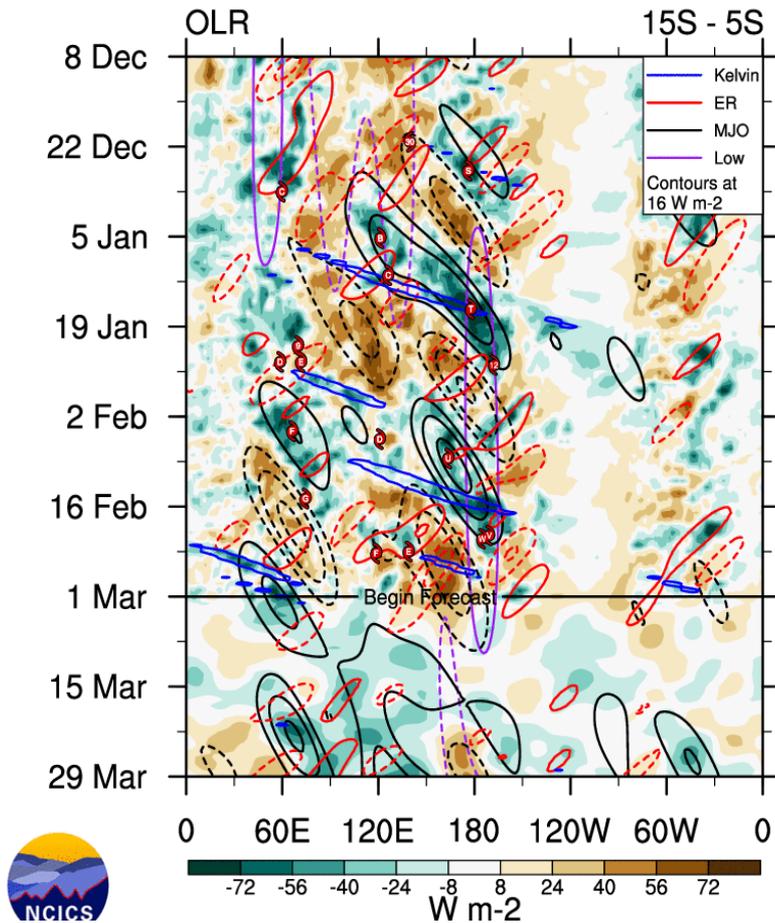
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- The low-level wind field is weak and disorganized.
- A low-frequency signal near the Date Line that was recently associated with an enhanced SPCZ persists, albeit weaker than in mid-February.

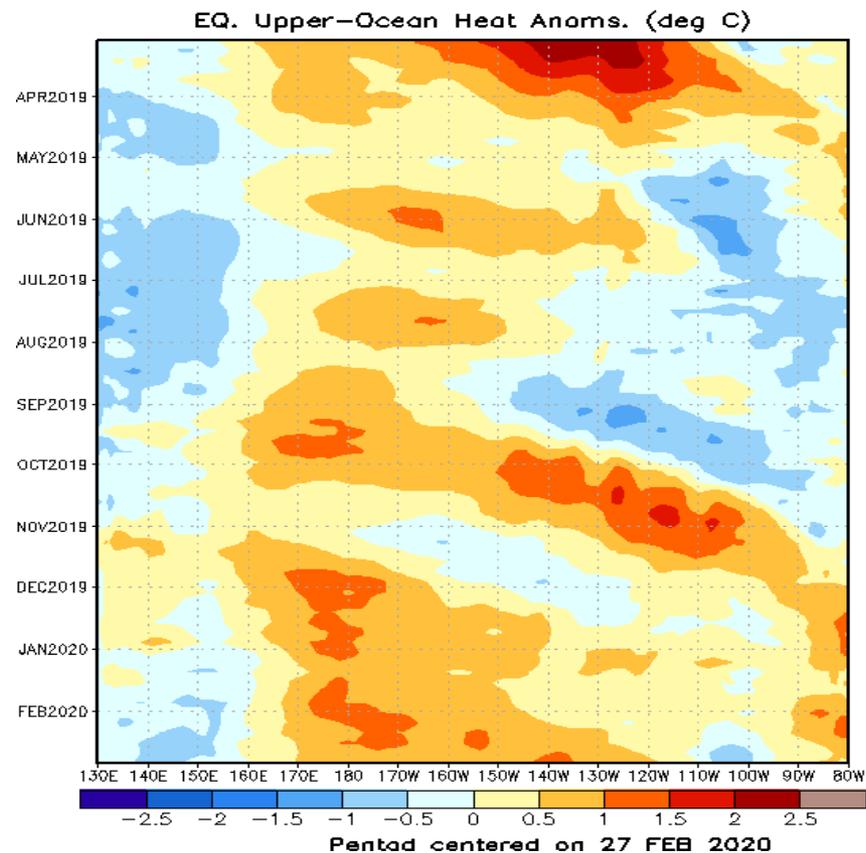
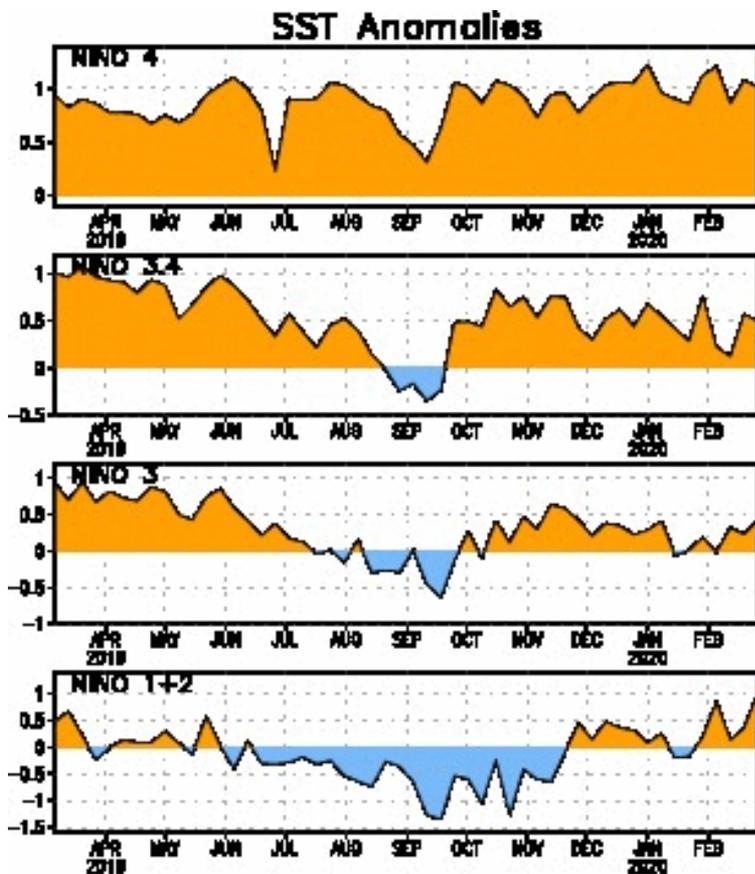
Outgoing Longwave Radiation (OLR) Anomalies

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



- There is some evidence of an MJO signal emerging over the western Indian Ocean.
- Enhanced convection persists over the North Pacific ITCZ, but suppressed convection has recently overspread the equatorial West Pacific.
- Remnant tropical cyclone activity is evident over northern Australia.

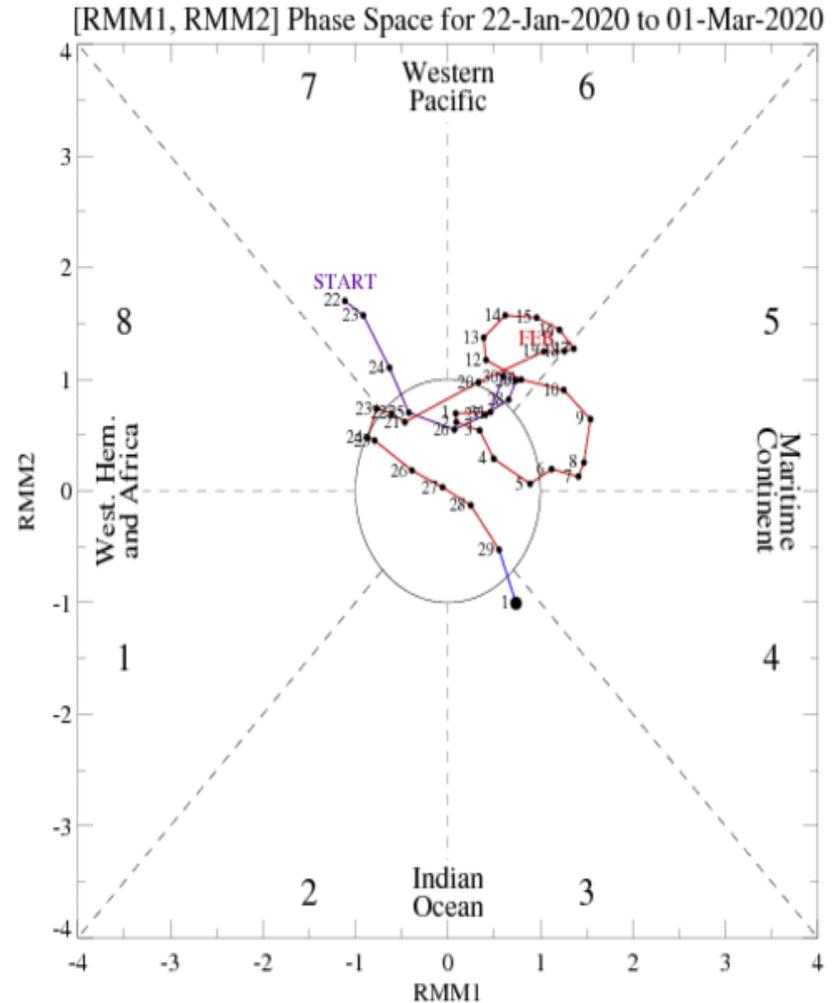
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Upper-oceanic heat content anomalies remain slightly above-normal across most of the basin.
- Several episodes of westerly wind bursts west of the Date Line have contributed toward a downwelling event that has been ongoing since mid-December. The ongoing event seems to be contributing to a push of the highest temperature anomalies further east across the basin.

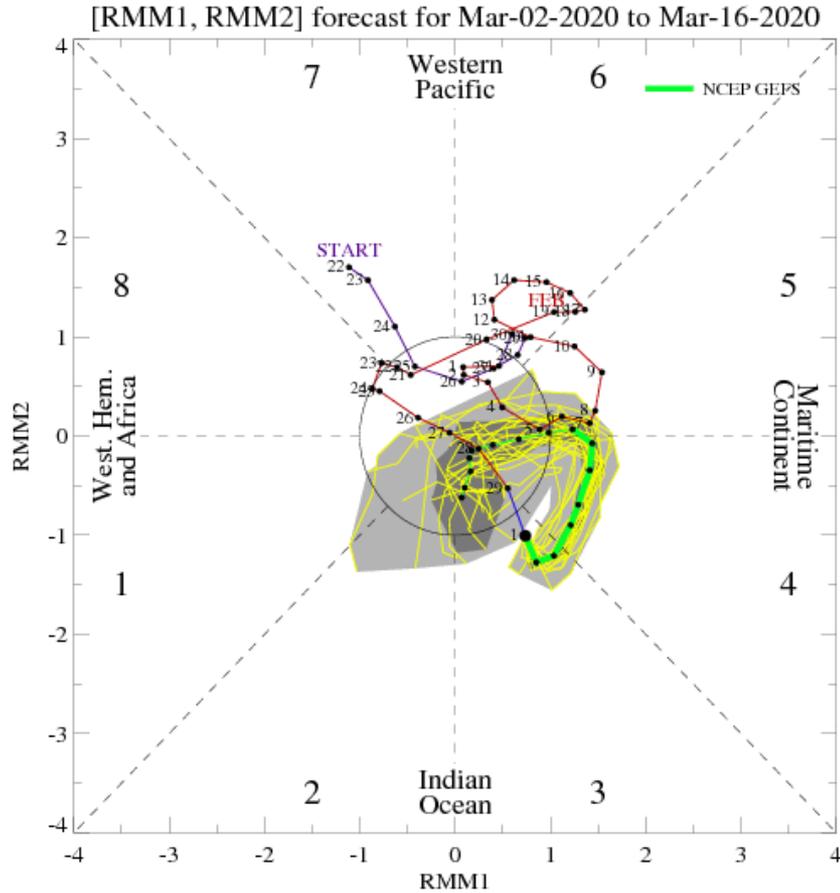
MJO Index: Recent Evolution

- A RMM-based MJO signal has emerged over the Indian Ocean.
- The upper-level wind and OLR patterns appear to be the biggest drivers of the signal. The low-level wind field is a bit less consistent with MJO activity.

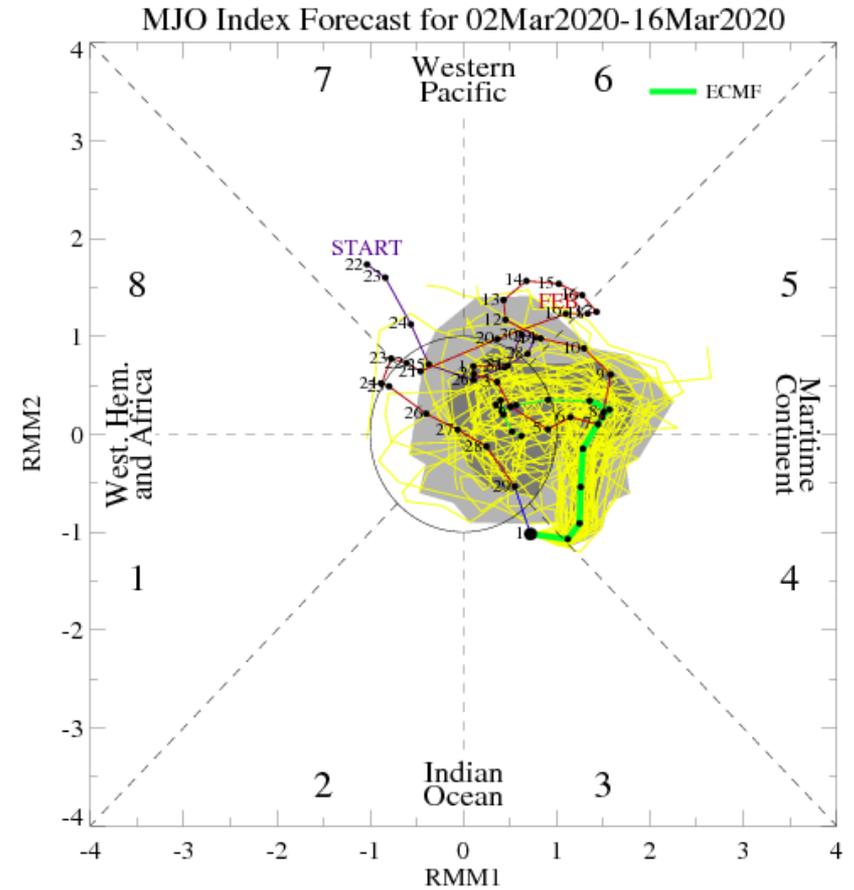


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



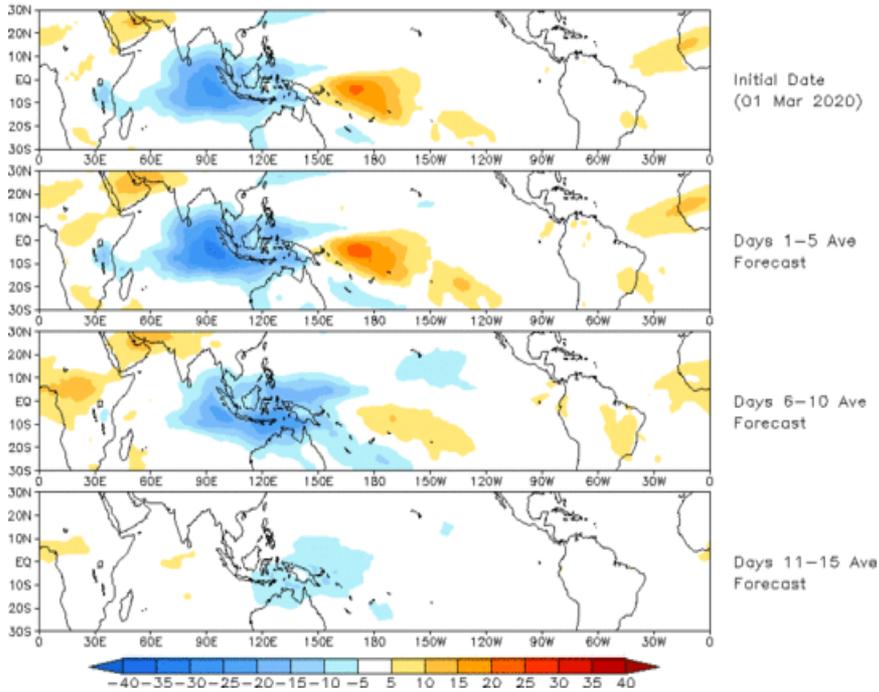
ECMWF Forecast

- Dynamical models are forecasting some eastward propagation of the signal to the Maritime Continent during Week-1.
- Both models depict a pronounced leftward turn of the index during Week-2, which suggests Rossby wave interference with the intraseasonal signal.

MJO: GEFS Forecast Evolution

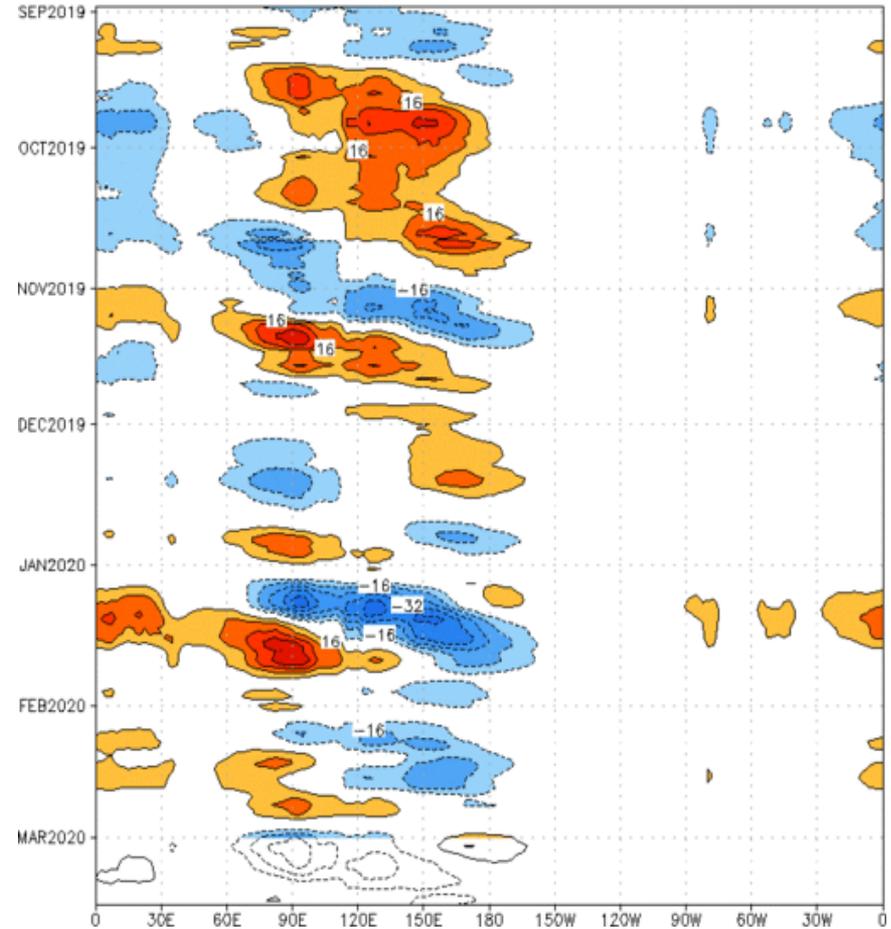
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 01 Mar 2020
OLR



- The GEFS RMM-index based spatial forecast depicts enhanced convection propagating over the Maritime Continent, followed by a weakening of the anomaly field.

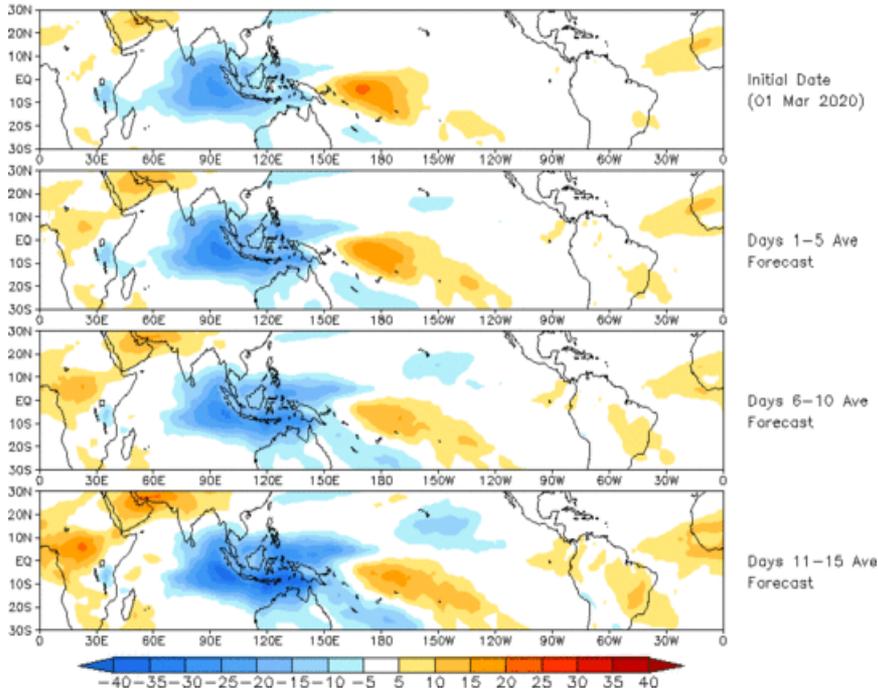
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:31-Aug-2019 to 01-Mar-2020
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



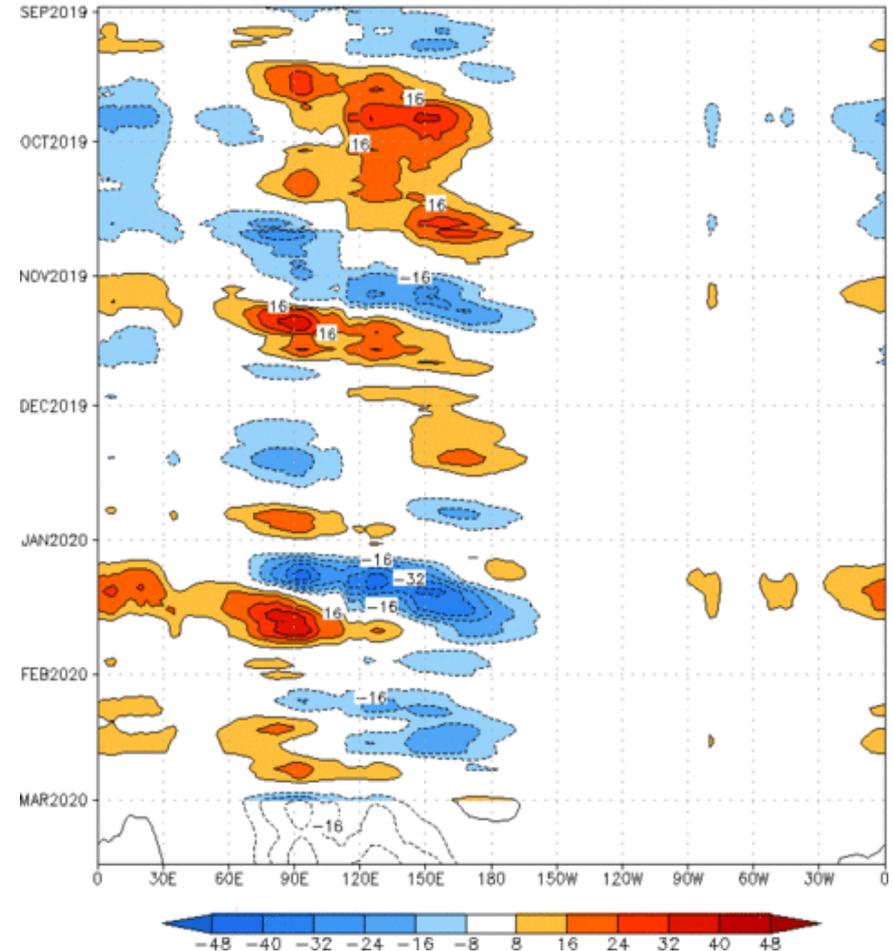
MJO: Constructed Analog Forecast Evolution

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.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (01 Mar 2020)



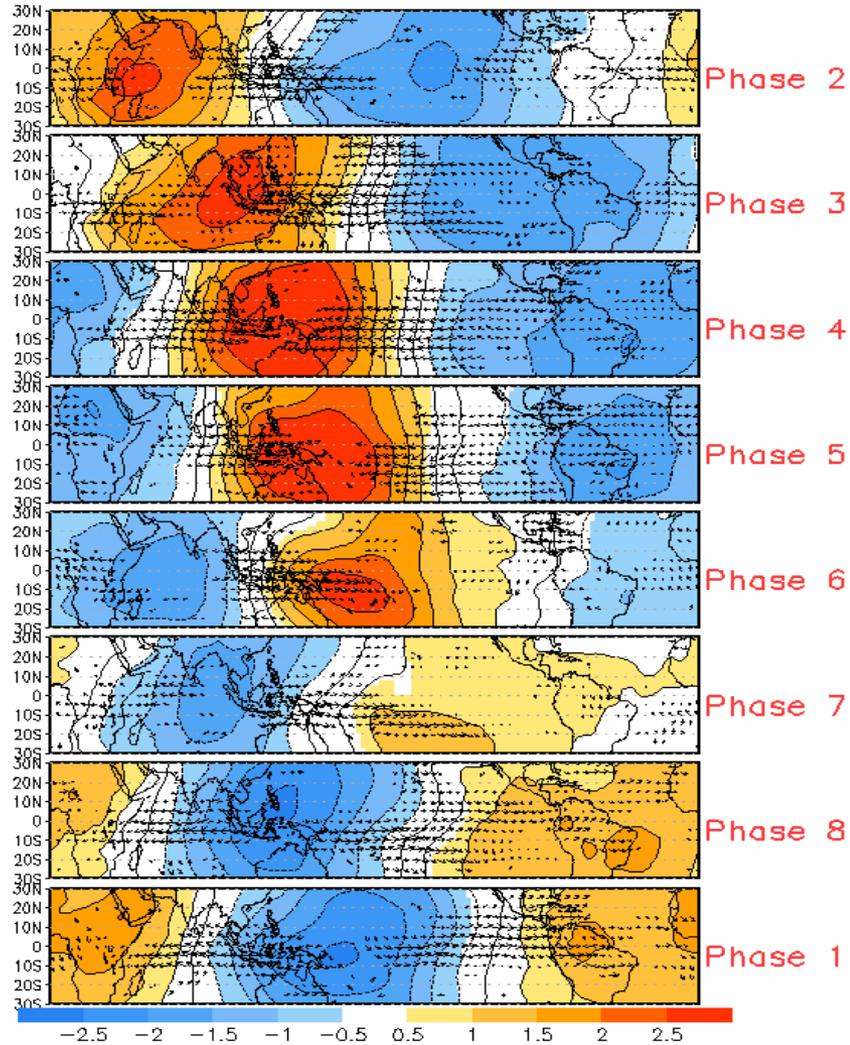
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cont:4Wm⁻²) Period:31-Aug-2019 to 01-Mar-2020
The unfilled contours are CA forecast reconstructed anomaly for 15 days



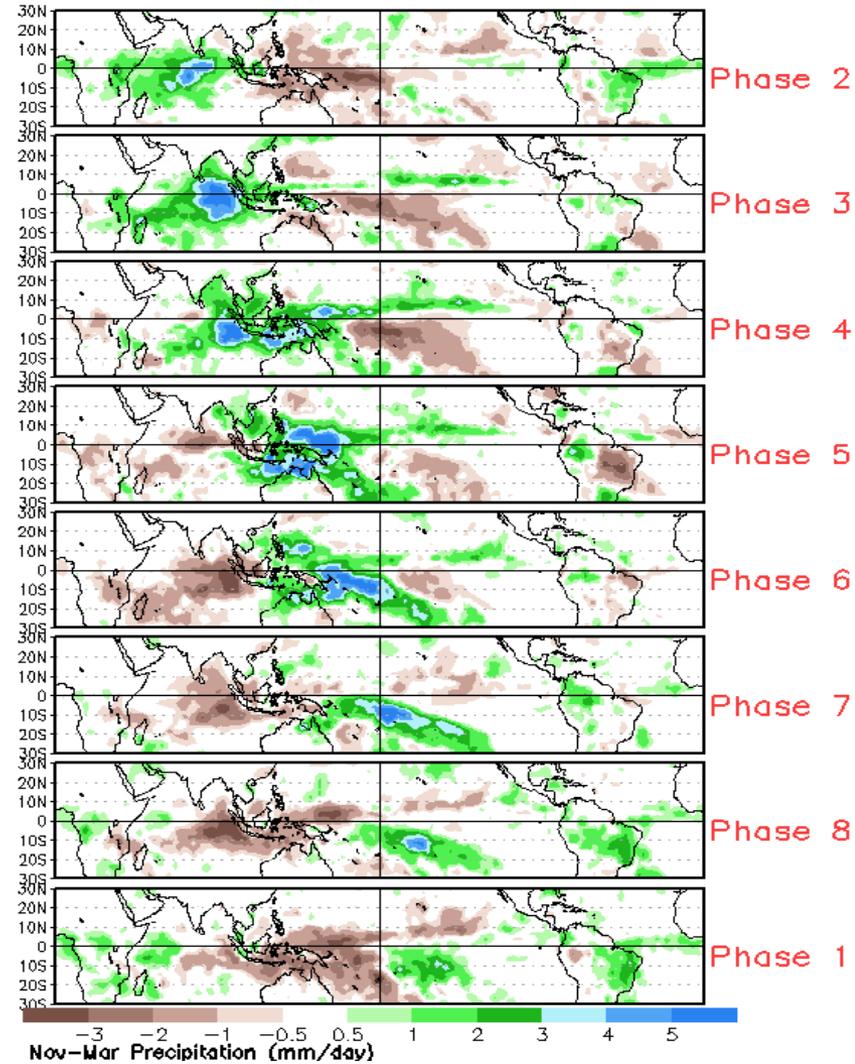
- The constructed analog forecast depicts a stronger anomaly field than the GFS, with a slower eastward propagation.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



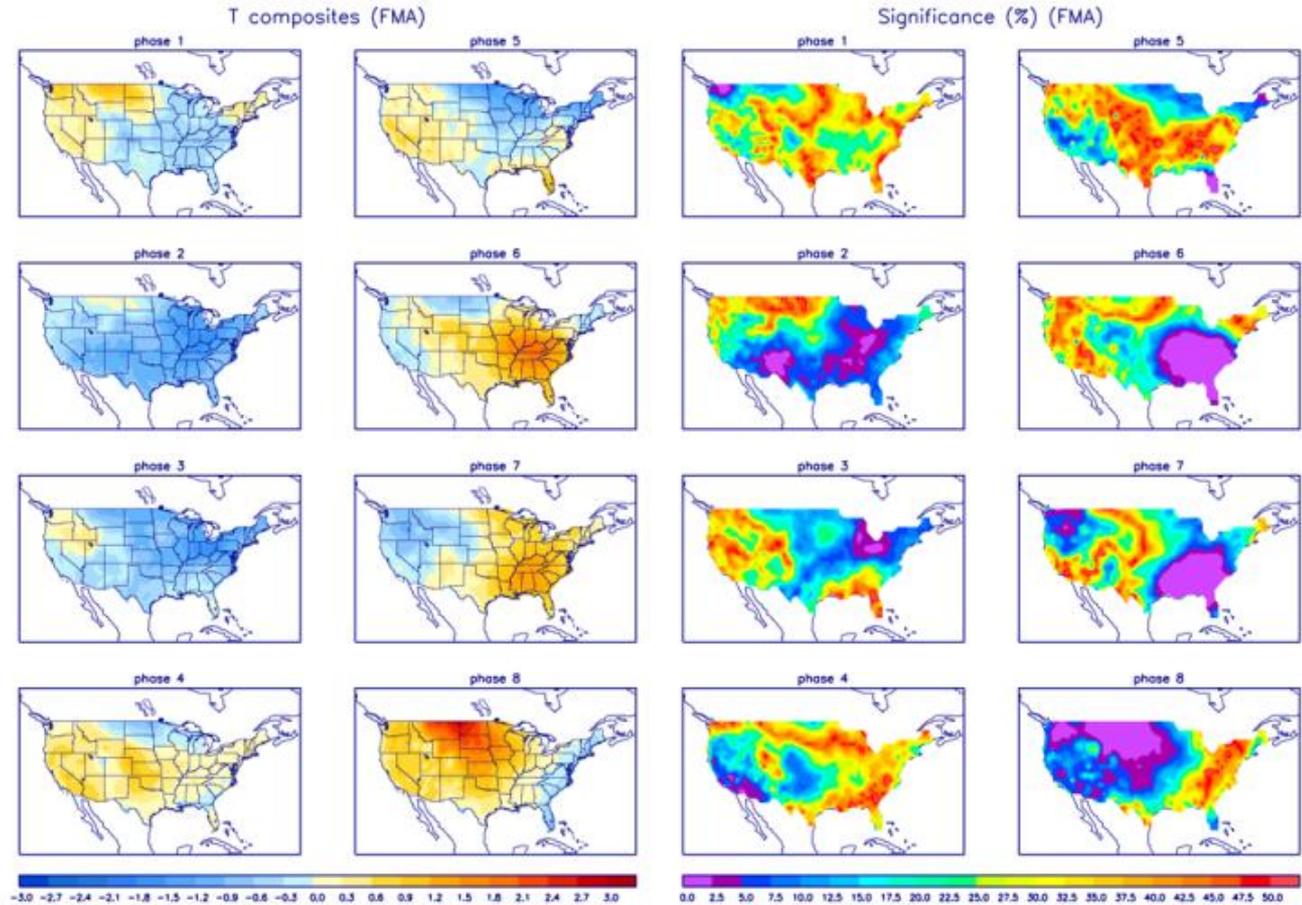
Precipitation Anomalies



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.



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.

