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

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

Overview

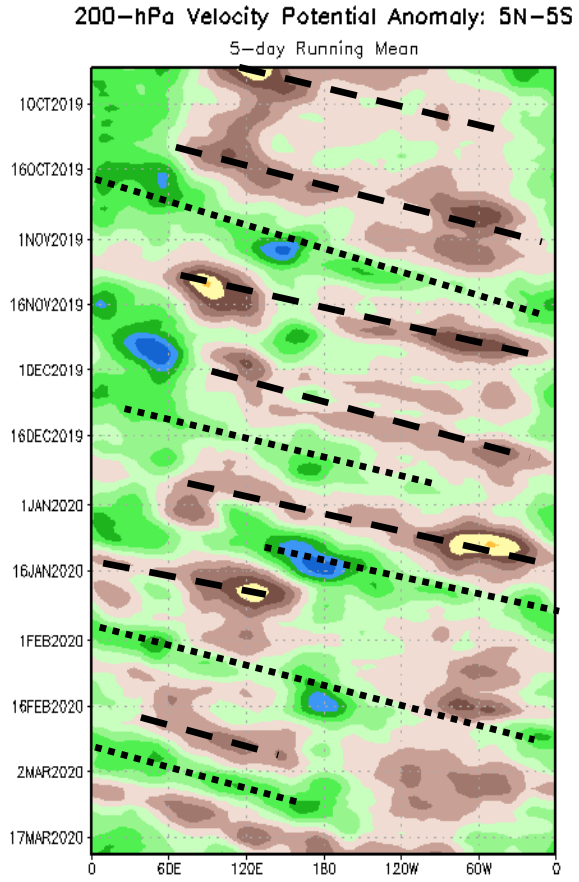
- The global tropical wind field has recently become more coherent, suggesting an enhanced signal over the Indian Ocean.
- The rapid return of the signal to the Indian Ocean suggests the influence of Kelvin wave activity.
- Dynamical and statistical model forecasts support a more MJO-like evolution over the Indian Ocean and Maritime Continent.
- Future evolution of this potential emerging MJO as it emerges over the West Pacific is uncertain.
- The low-frequency enhanced convective signal near the Date Line appears to have broken down during March.

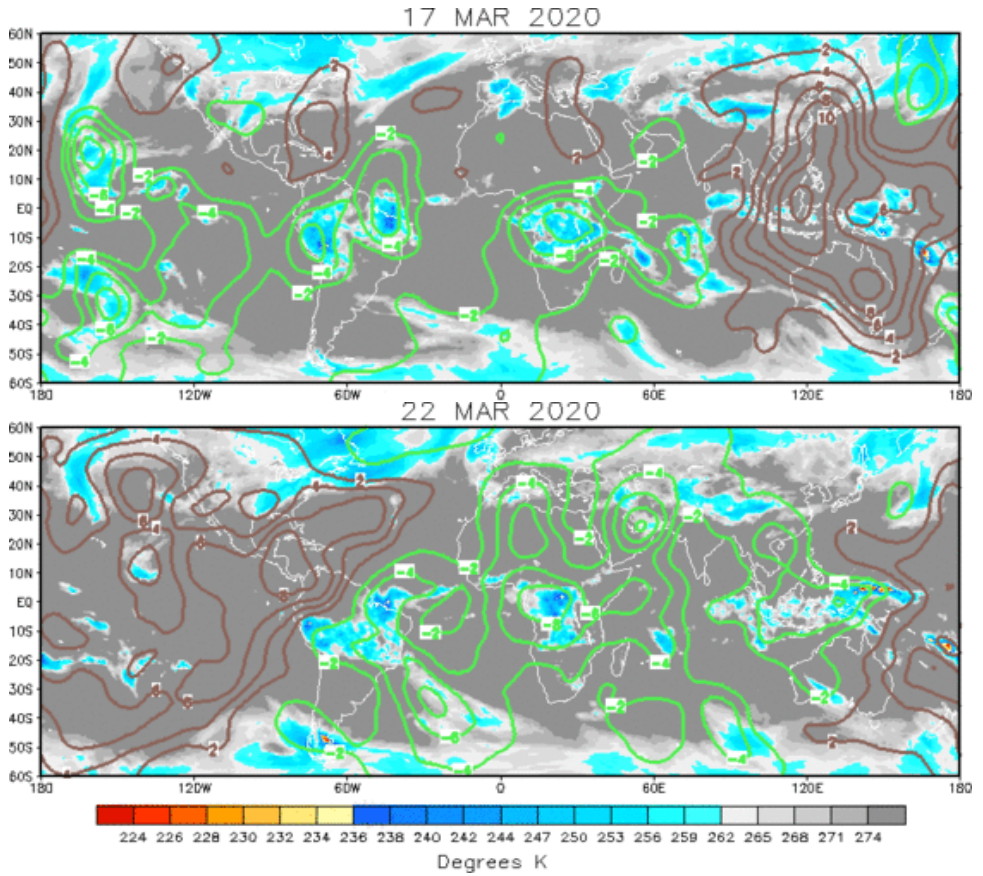
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).



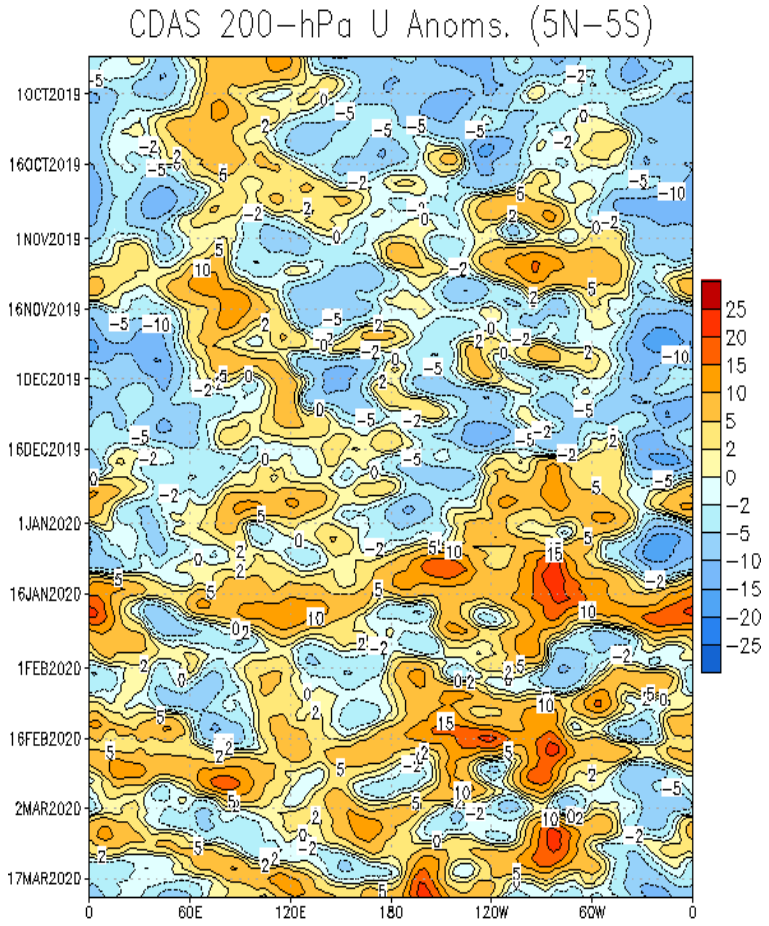


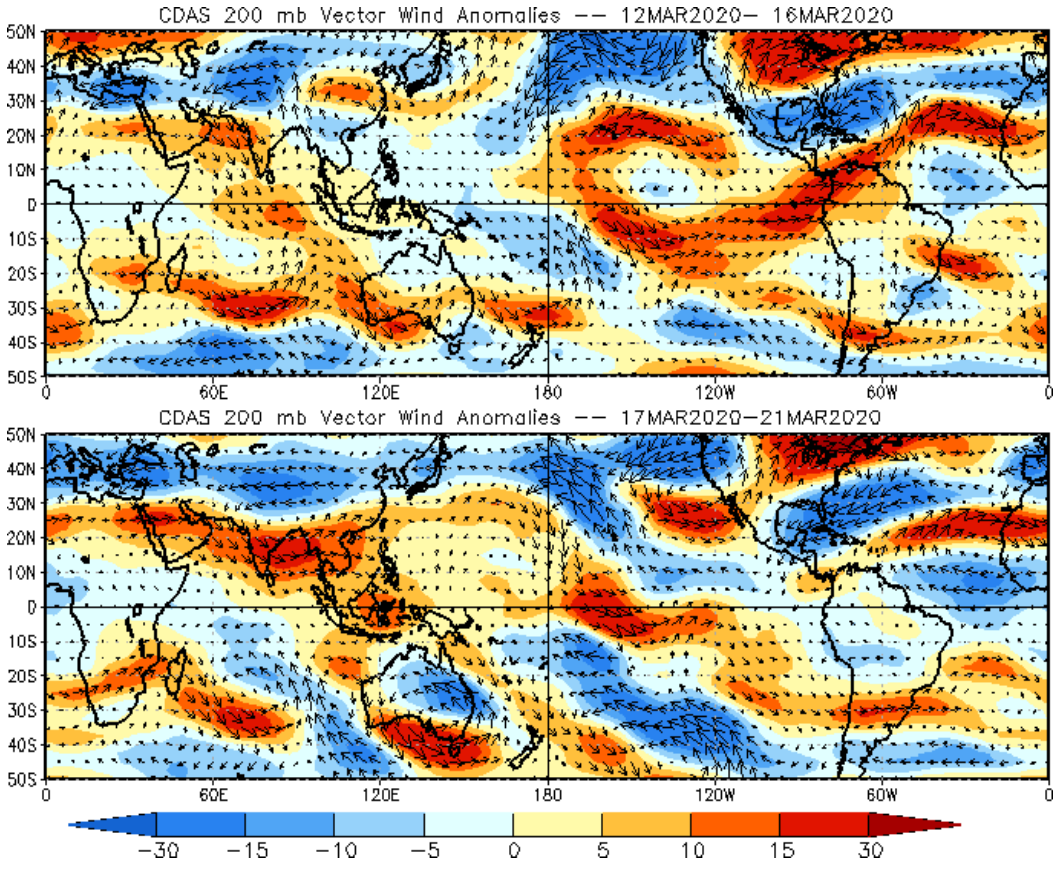
- The global convective pattern has returned to the coherent Wave-1 pattern (enhanced over Africa and the Indian Ocean, suppressed over the Pacific) that was observed at the beginning of March.

- This periodicity is considerably faster than the MJO envelope, and suggests convectively coupled Kelvin wave activity is helping to drive the upper-level circulation.

200-hPa Wind Anomalies

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



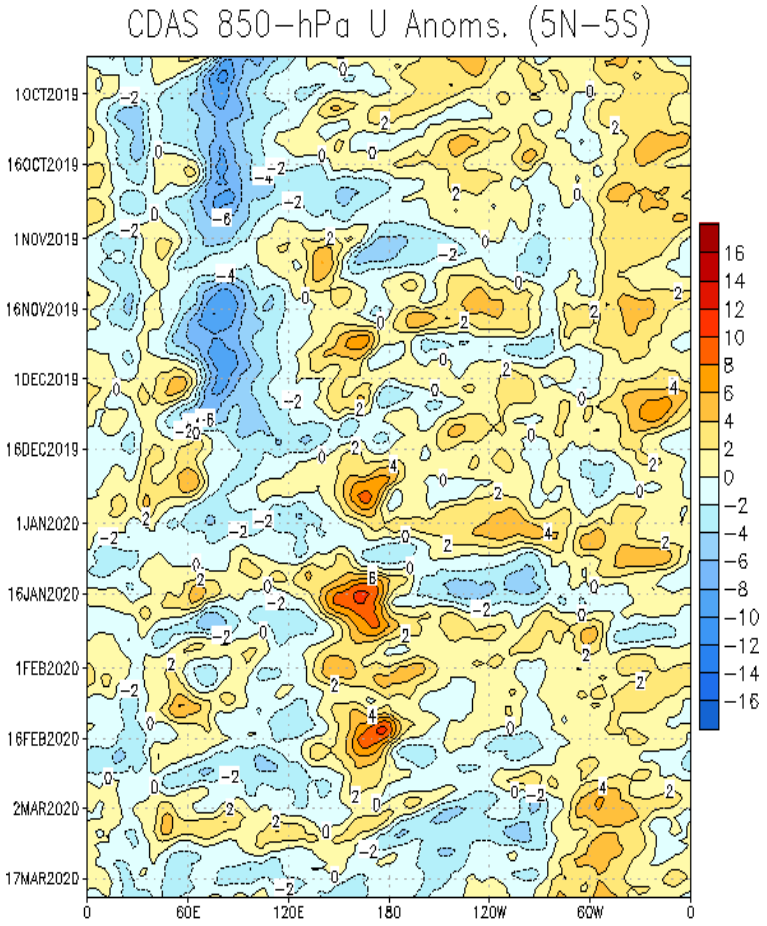


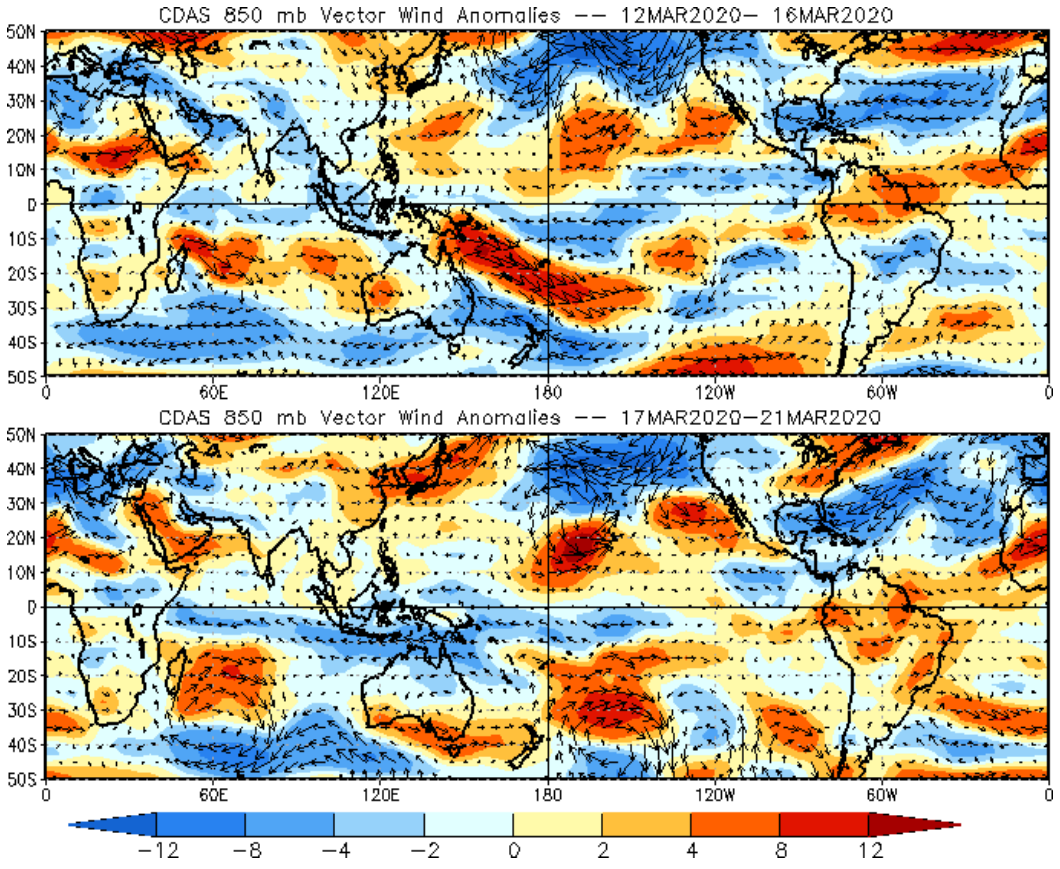
- An eastward propagating band of anomalous westerlies has recently returned to the Maritime Continent, with a phase speed consistent with Kelvin wave activity.

- Strong westerly anomalies just east of the Date Line appear to be driven by mid-latitude intrusions into the tropics.

850-hPa Wind Anomalies

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

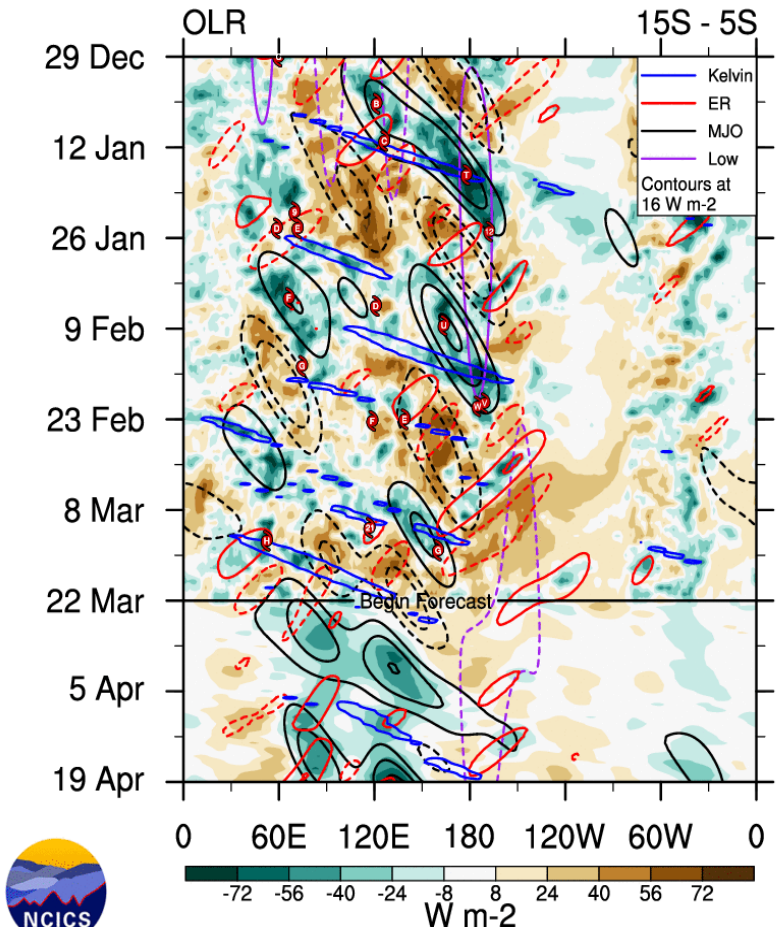


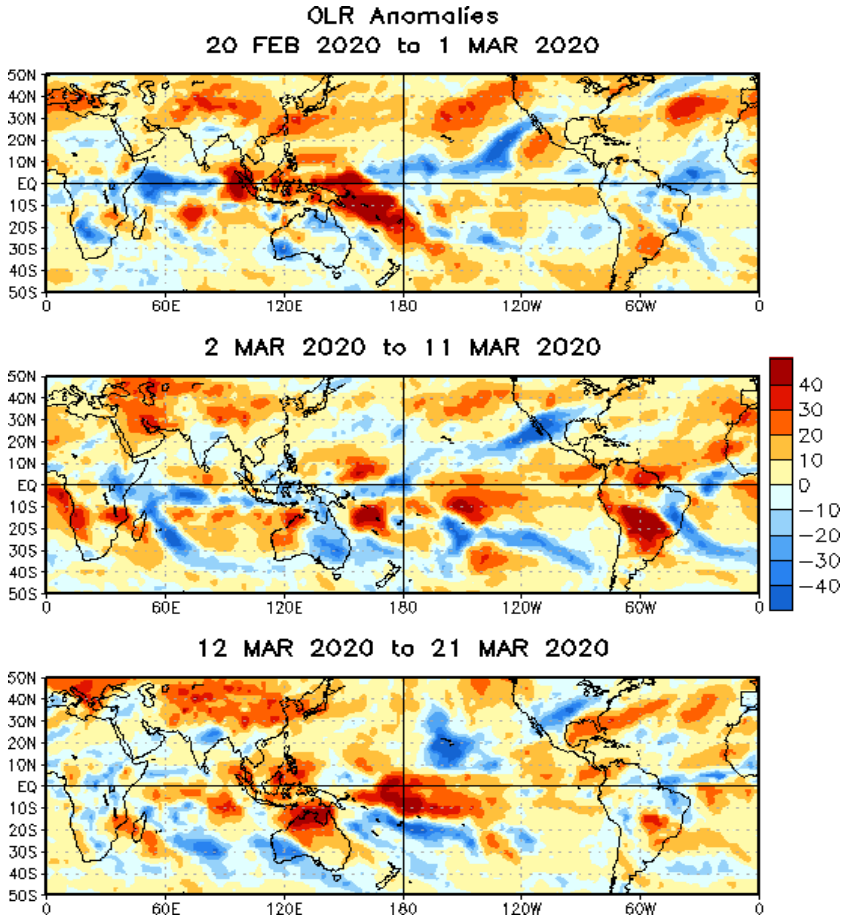


- The near-equator low-level wind field is fairly coherent though meridionally narrow, with easterly (westerly) anomalies extending from the Indian Ocean to just past the Date Line (East Pacific to the tropical Atlantic).
- The low-frequency westerly signal just west of the Date Line has weakened during March.

Outgoing Longwave Radiation (OLR) Anomalies

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

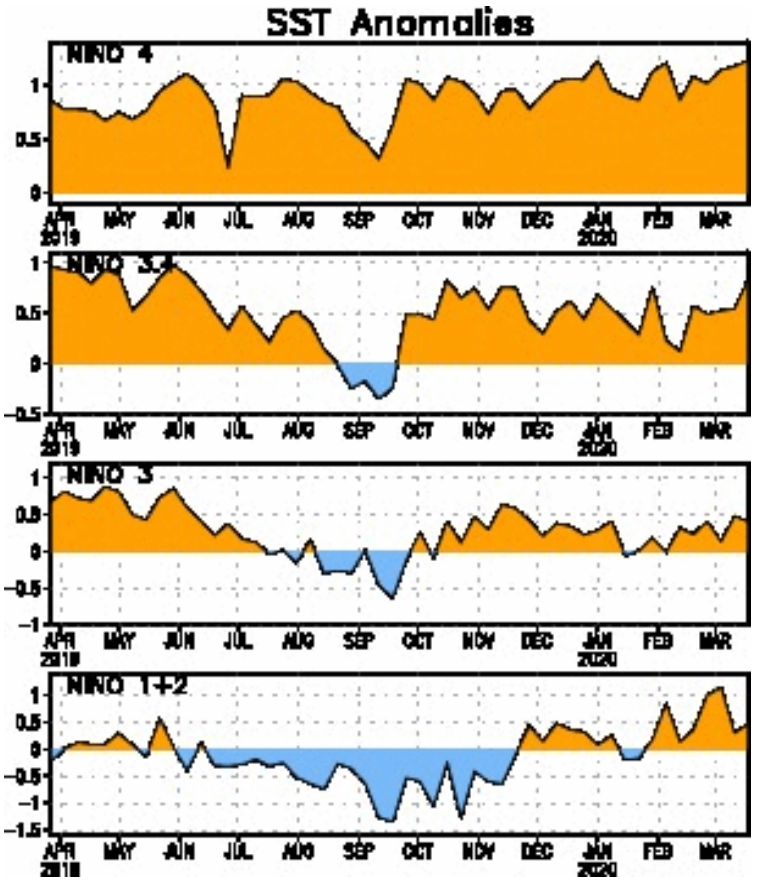


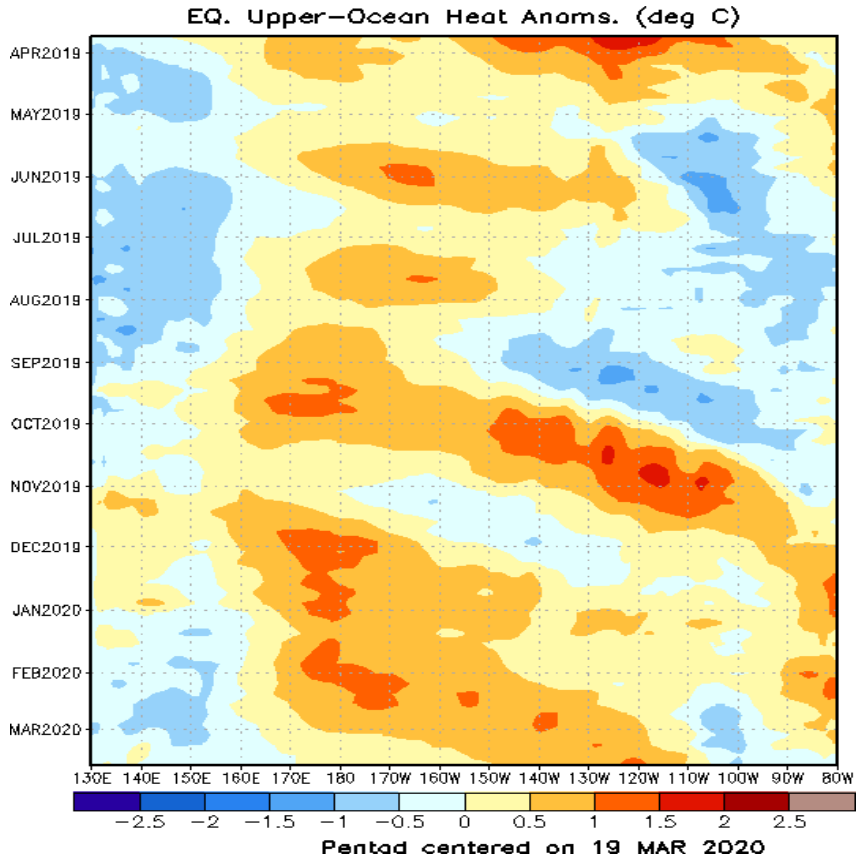


- Enhanced convective anomalies are weak across the global tropics, with suppressed convection over the Maritime Continent and near the Date Line providing the strongest signals.

- The forecast suggests the potential for Kelvin wave activity over the Indian Ocean to evolve into a more robust MJO signal during April.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific





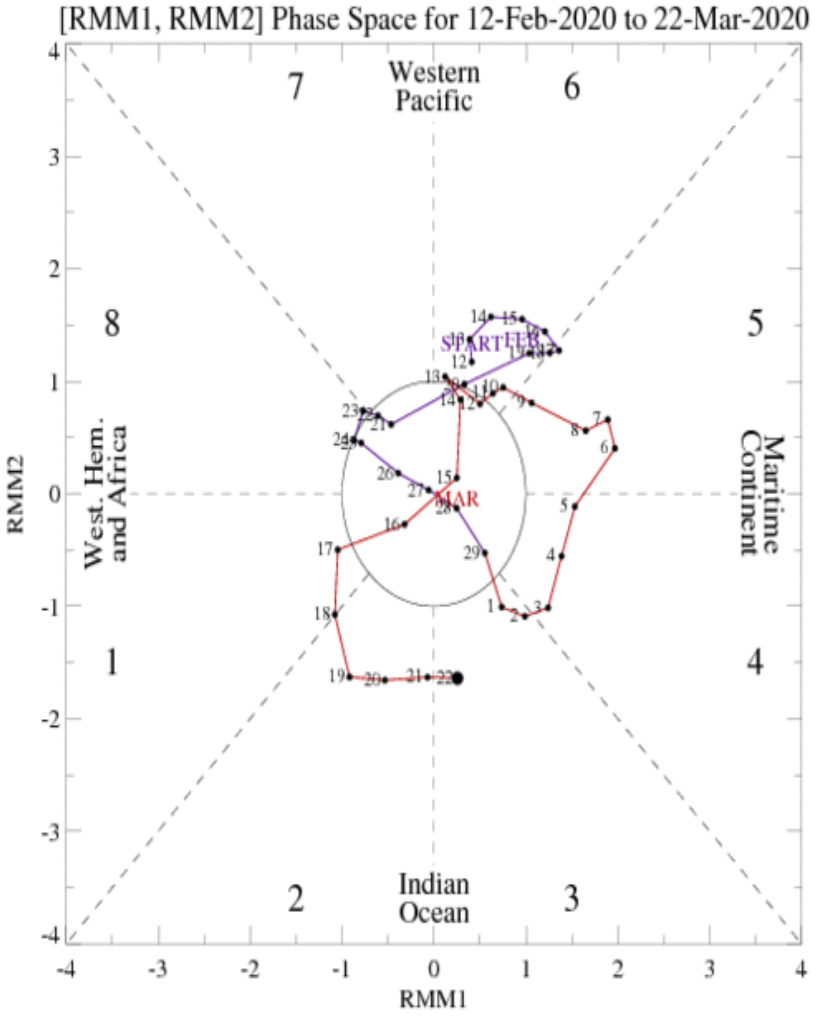
- Upper-oceanic heat content anomalies continue to remain above-normal across most of the basin.

- Since mid-December, episodes of westerly wind bursts west of the Date Line contributed toward a double-barrel downwelling Kelvin wave event that sustained anomalously warm temperatures across the Pacific.

MJO Index: Recent Evolution

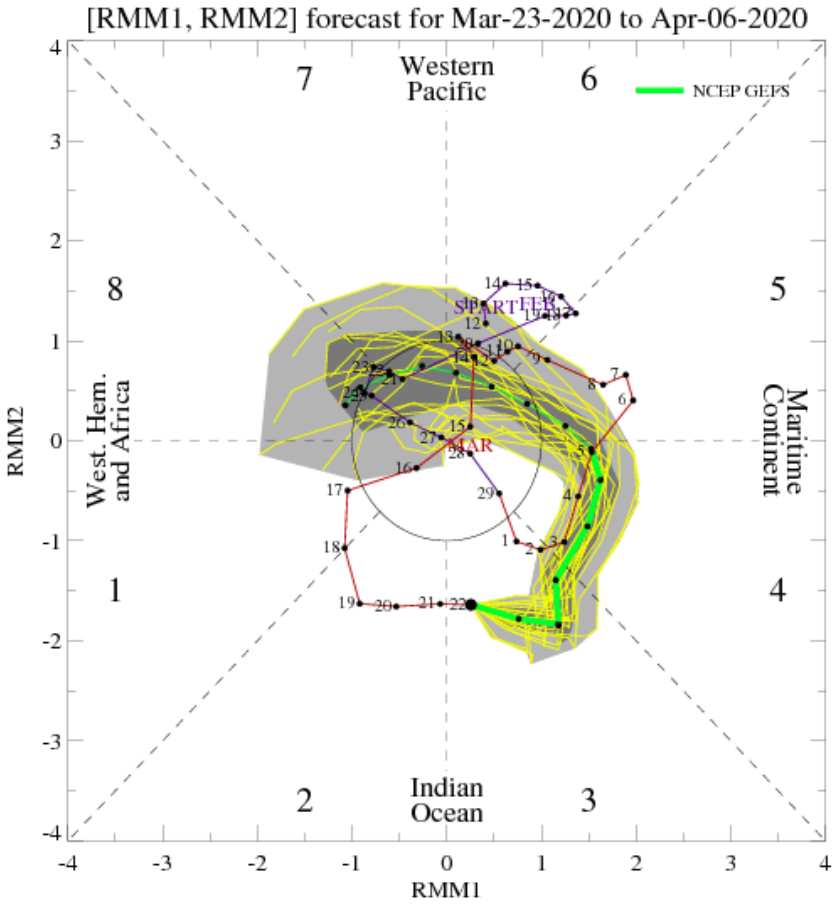
- The RMM index quickly progressed from the West Pacific back to the Indian Ocean within the span of a week, suggestive of Kelvin wave activity.

- Over the past few days, the index has propagated eastward at a slower phase speed.

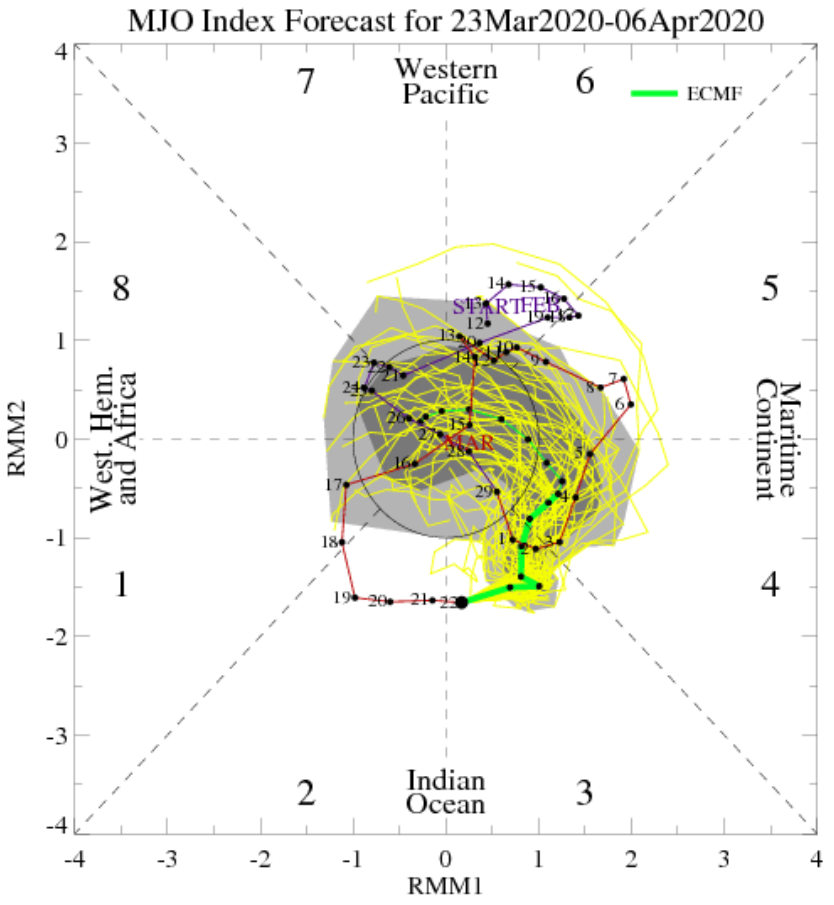


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



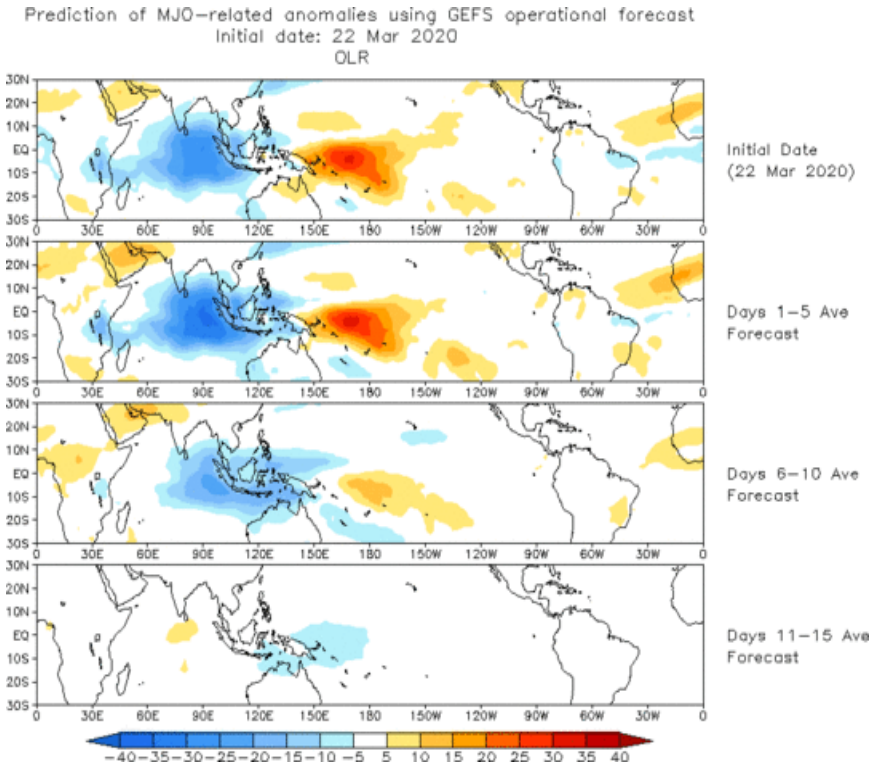
ECMWF Forecast

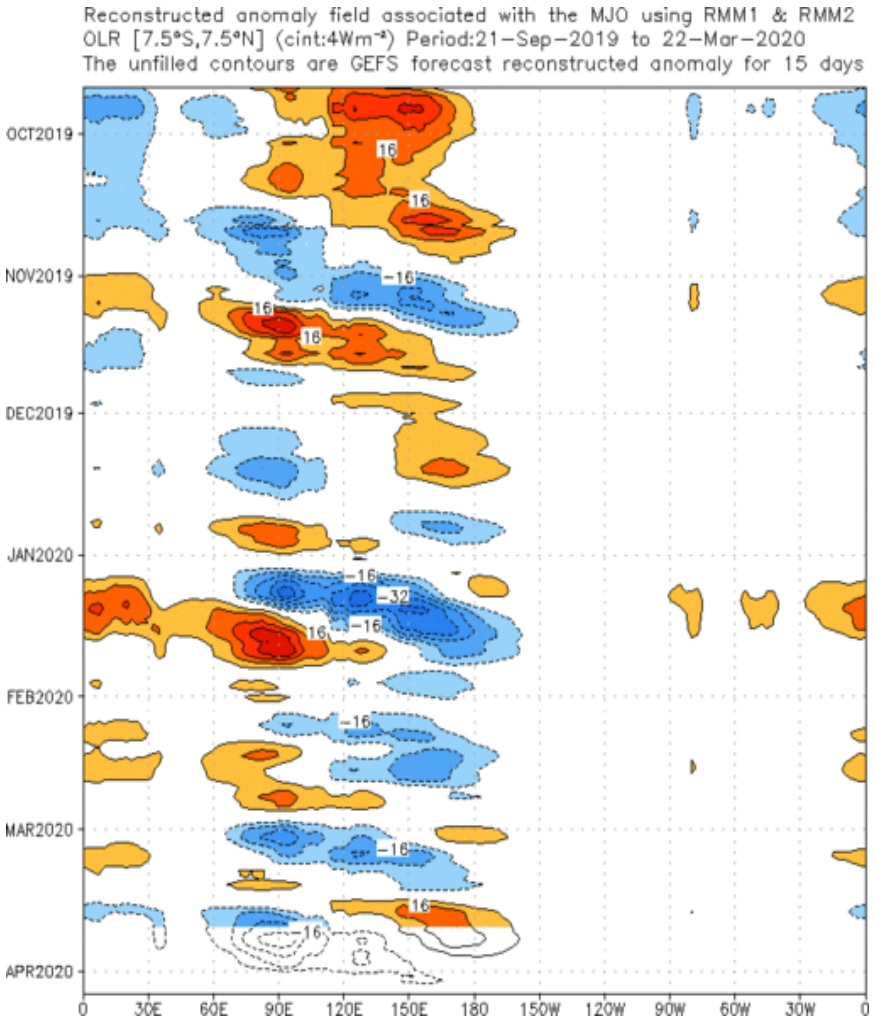
- Dynamical models depict robust eastward propagation of the enhanced convective signal to the Maritime Continent during Week-1, which is consistent with an evolving MJO.

- During Week-2, the GEFS and ECMWF differ on the strength of the signal over the Pacific, with the ECMWF ensemble mean weakening the signal considerably. This may be due to the low-frequency Pacific signal breaking down.

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.)

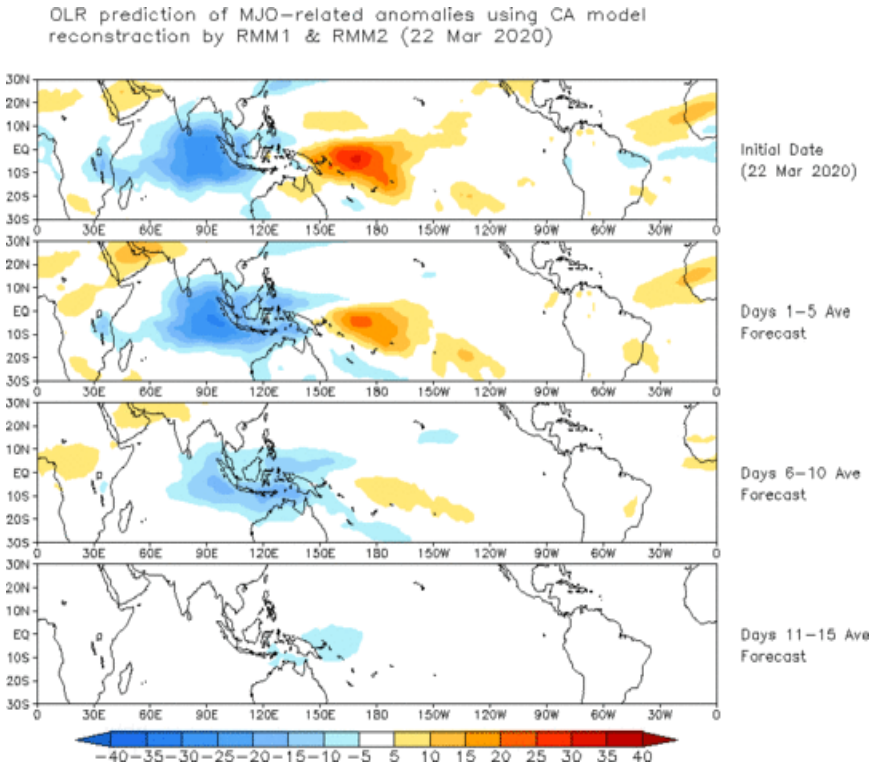


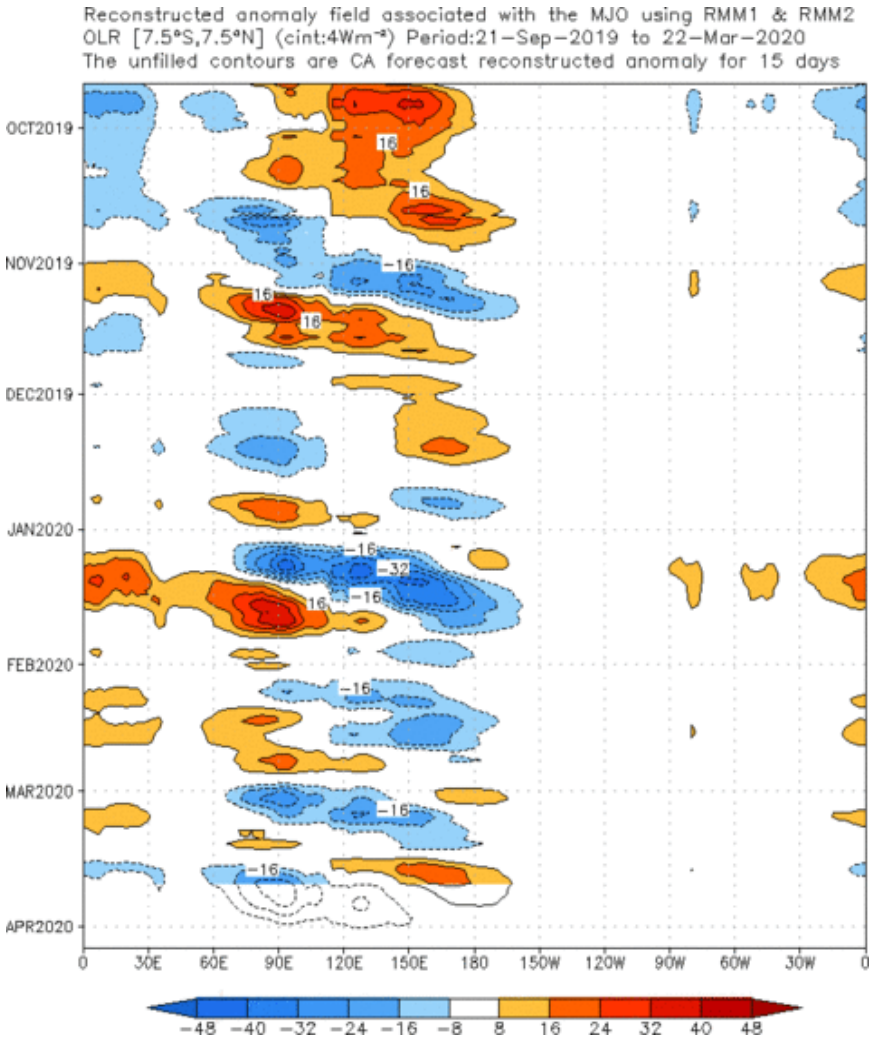


- The GEFS RMM-index based spatial forecast depicts robust MJO activity progressing from the Indian Ocean to the Maritime Continent, and then weakening over the West Pacific.

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.)

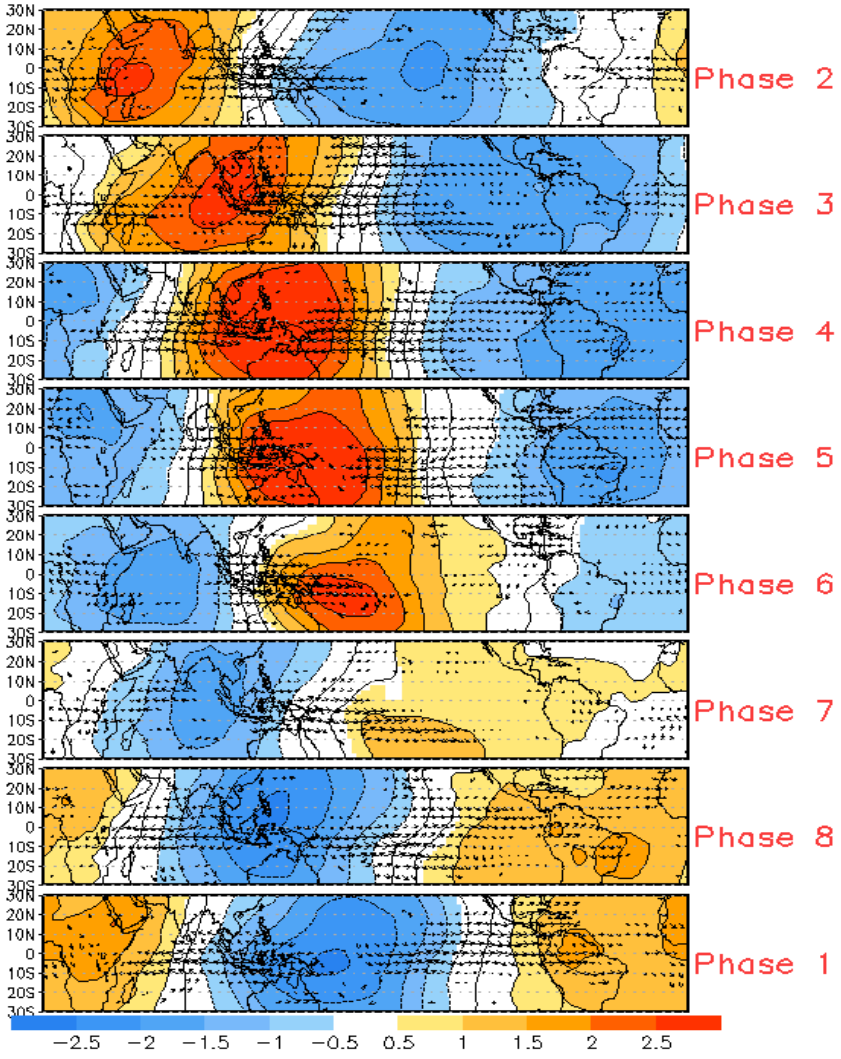




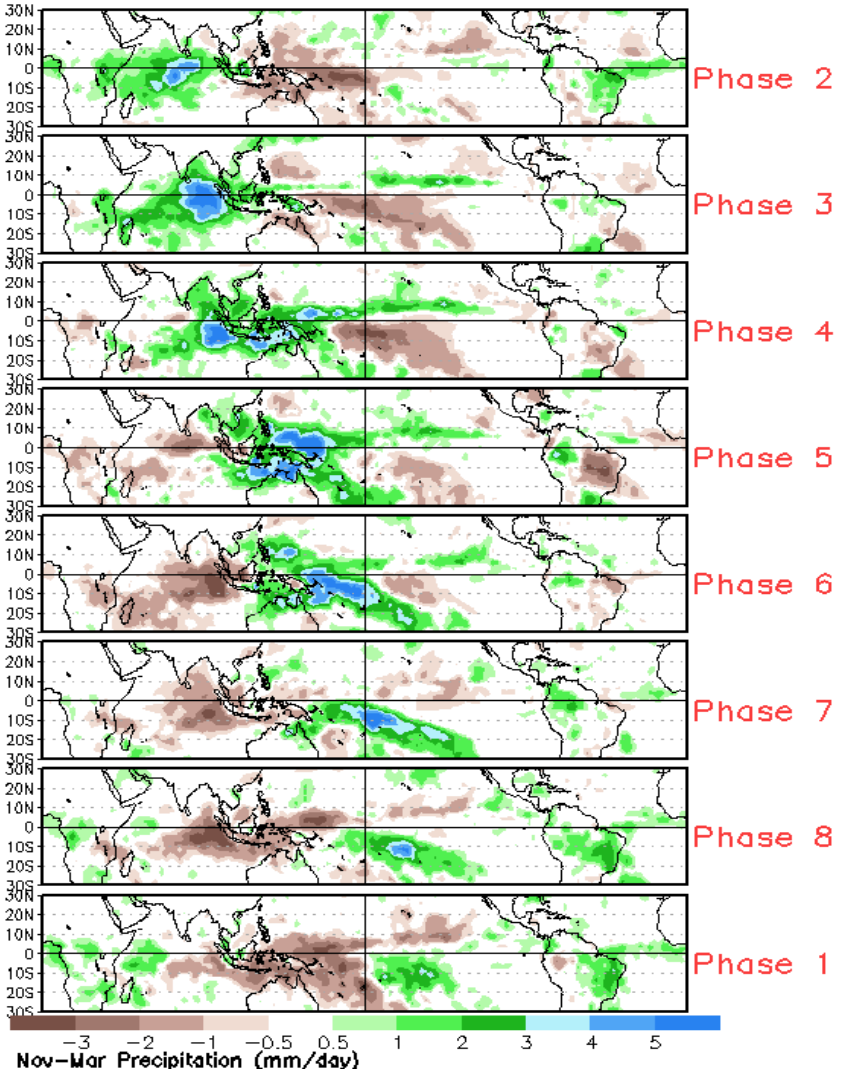
- The constructed analog RMM-based forecast is remarkably similar to the GEFS solution.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



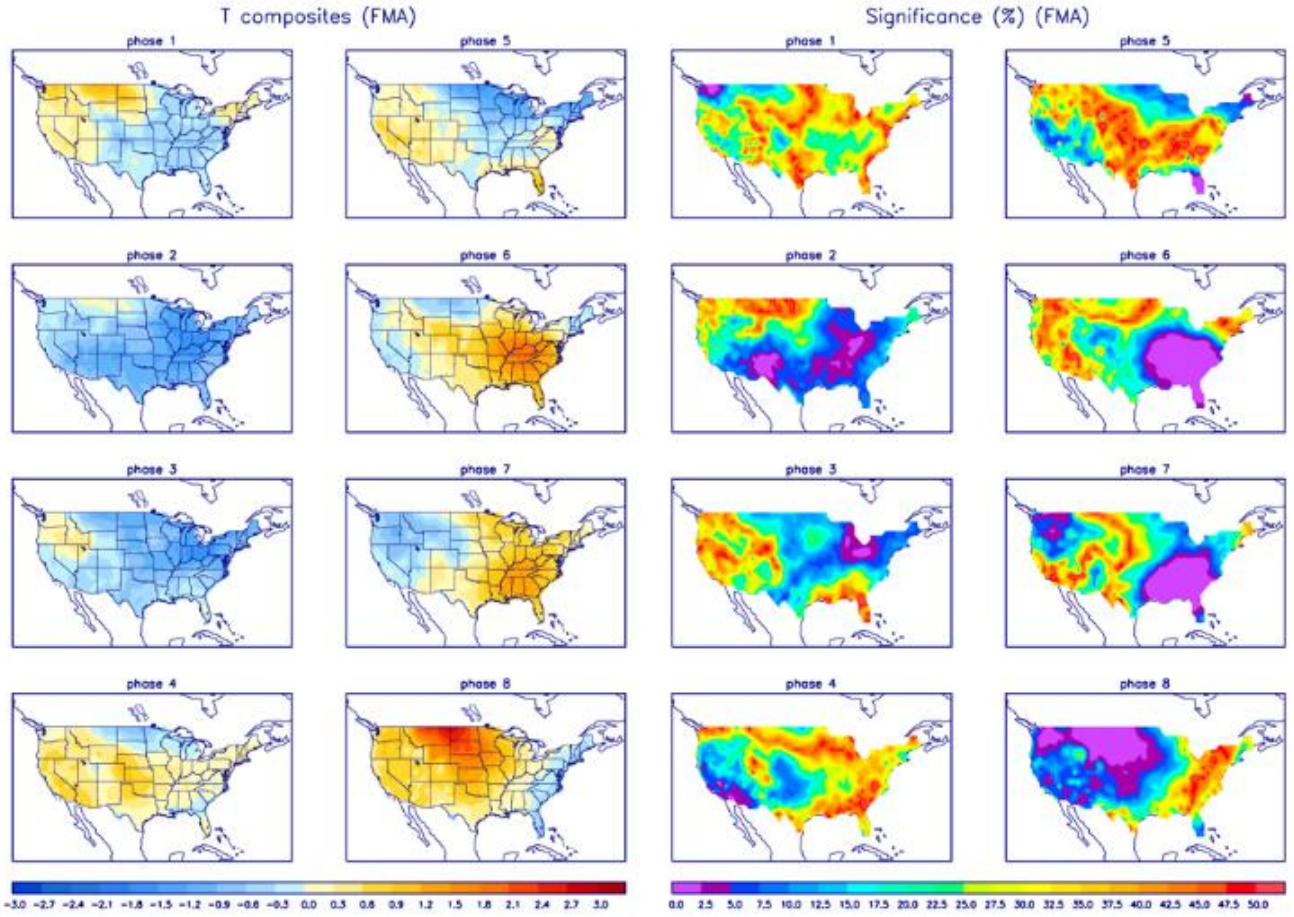
Precipitation Anomalies



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.

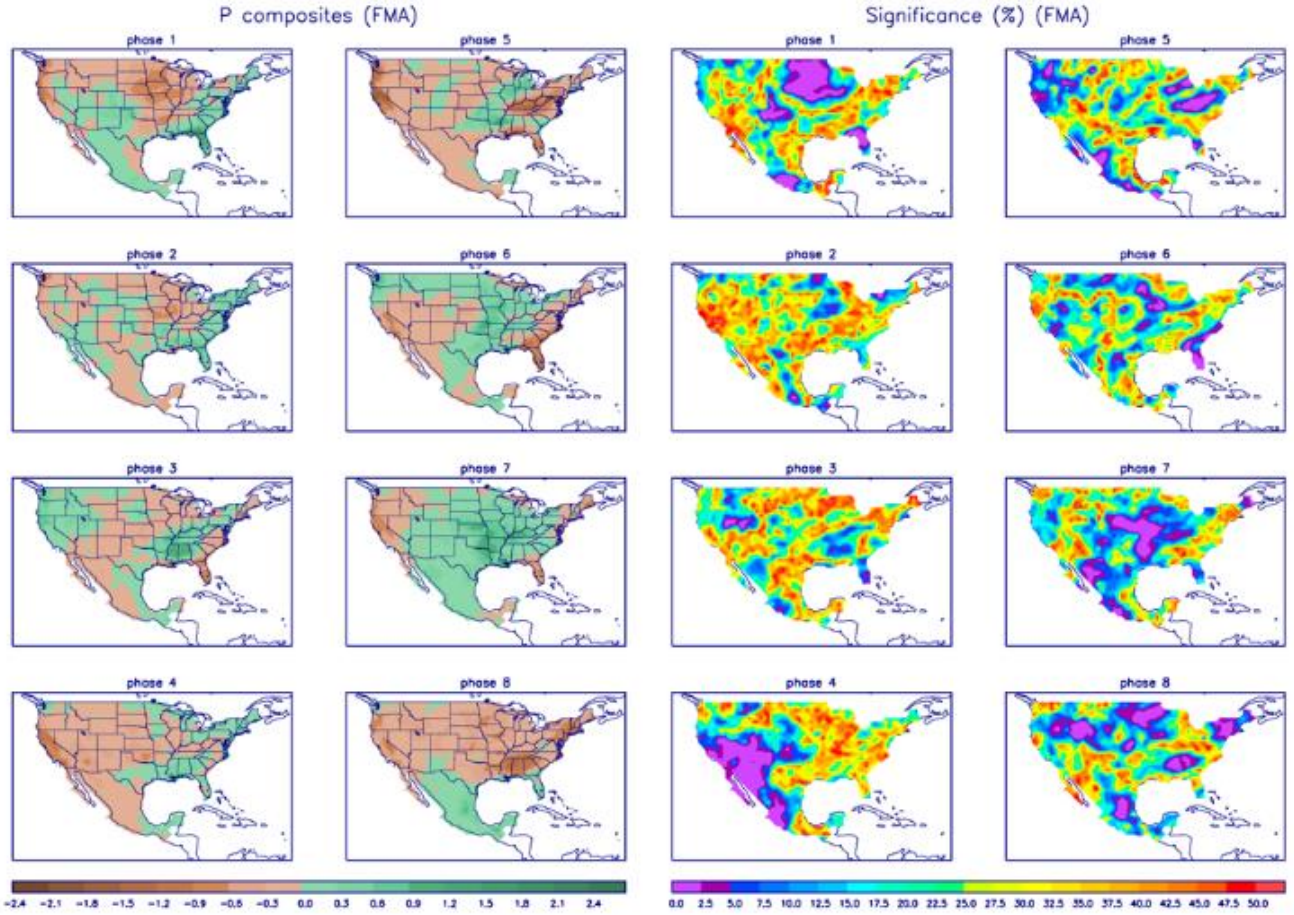


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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