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

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
28 February 2022

Overview

- While MJO activity remains apparent in multiple observational fields, the amplitude of the signal has diminished in RMM space.

- Destructive interference between a resurgent La Niña pattern and the leading edge of the MJO enhanced convective envelope (or Kelvin wave activity ahead of the enhanced envelope) may be contributing to a weakening of the RMM index.

- Dynamical model solutions are increasingly divergent, with the GEFS in particular showing a wide range of potential solutions. The ECMWF system has more ensemble members depicting MJO propagation over the West Pacific during Week-2.

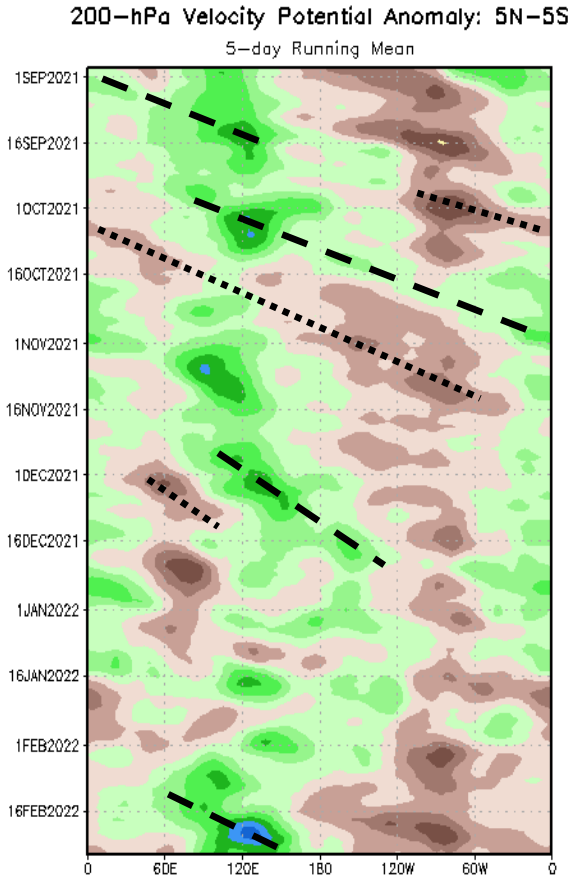
- Based on the weakening indices and model inconsistency, the future evolution of the MJO is highly uncertain as it begins destructively interfering with the low frequency base state.

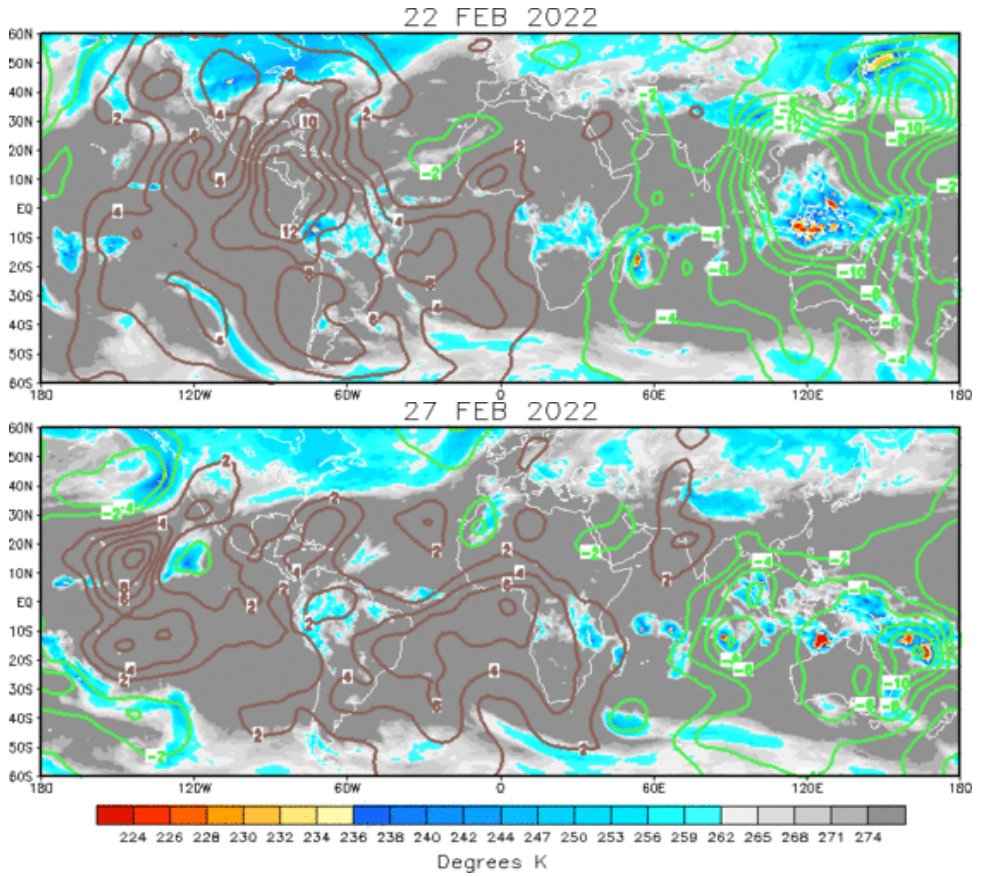
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)



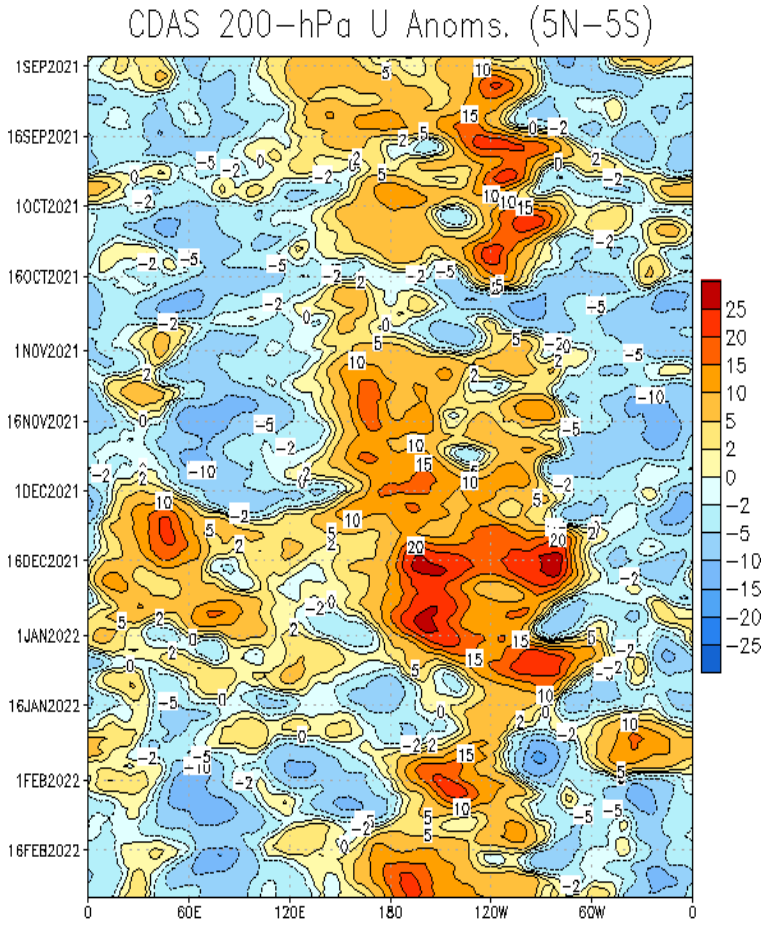


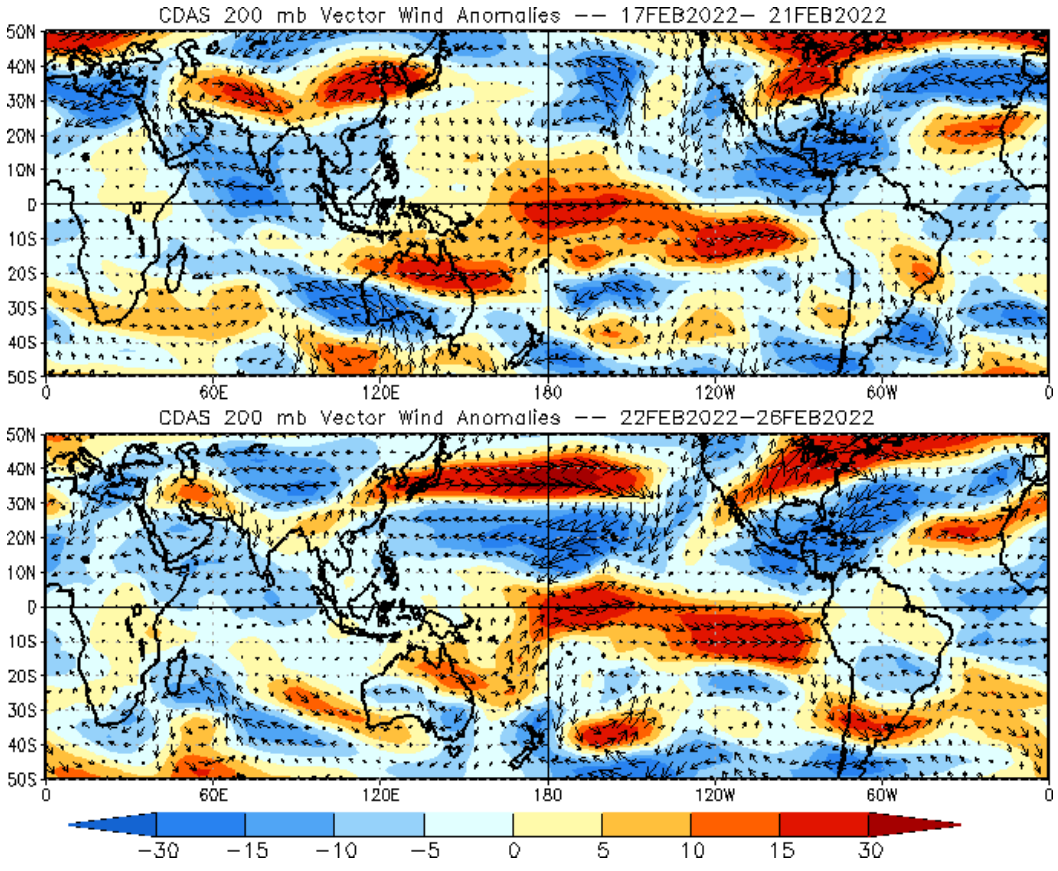
- Following a period of strong equatorial Rossby wave activity in late January and early February, an active MJO pattern emerged, with the enhanced phase propagating from the Indian Ocean to the Maritime Continent.

- The intraseasonal signal constructively interfered with the La Niña background state in late February. More recently, destructive interference between the leading edge of the MJO enhanced envelope and ENSO is apparent near the Date Line.

200-hPa Wind Anomalies

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



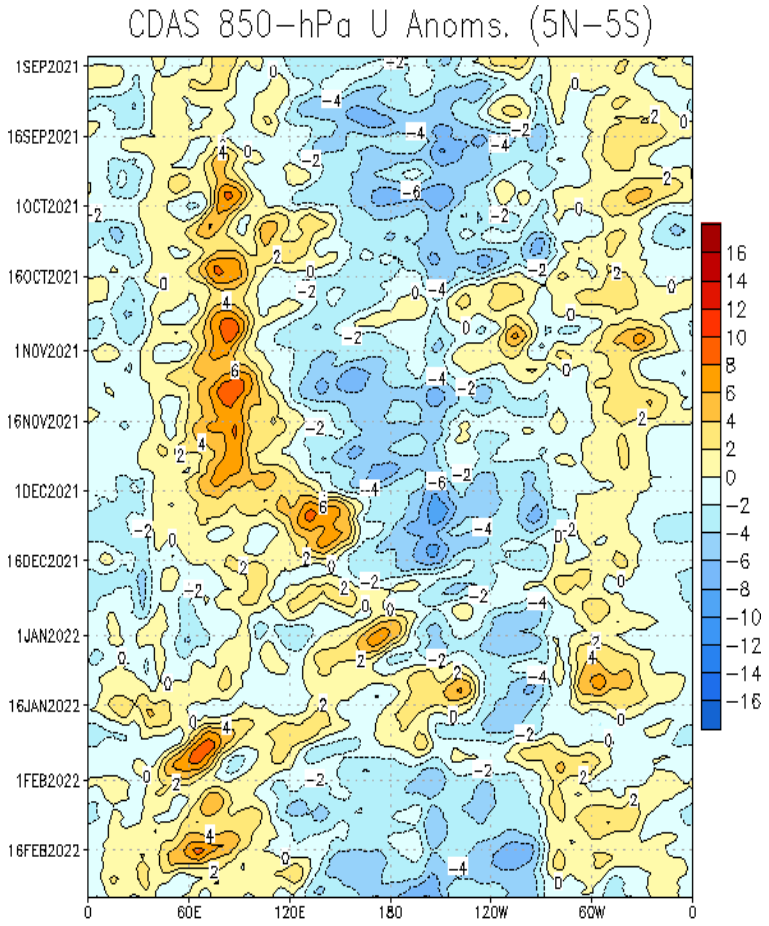


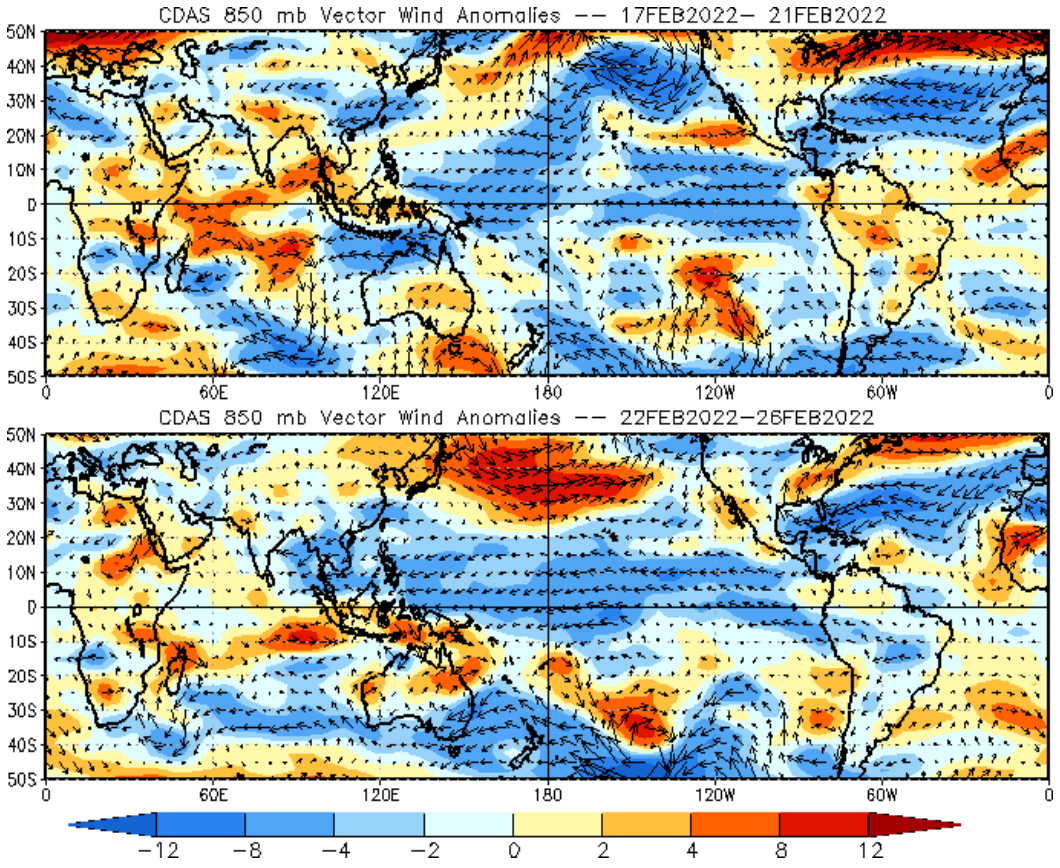
- Large envelopes of upper-level westerly (easterly) anomalies near and east of the Date Line (over the Indian Ocean and Maritime Continent) is consistent with both MJO and ENSO activity. There is some evidence of eastward propagation of these features.

- A robust anticyclonic circulation remains evident over eastern North America.

850-hPa Wind Anomalies

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



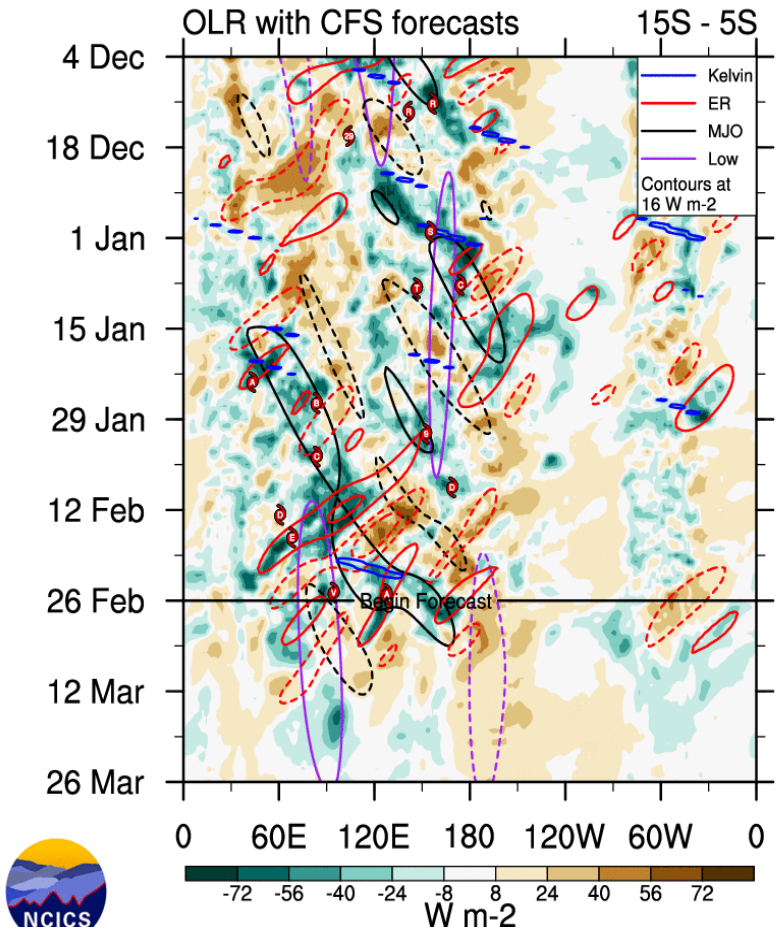


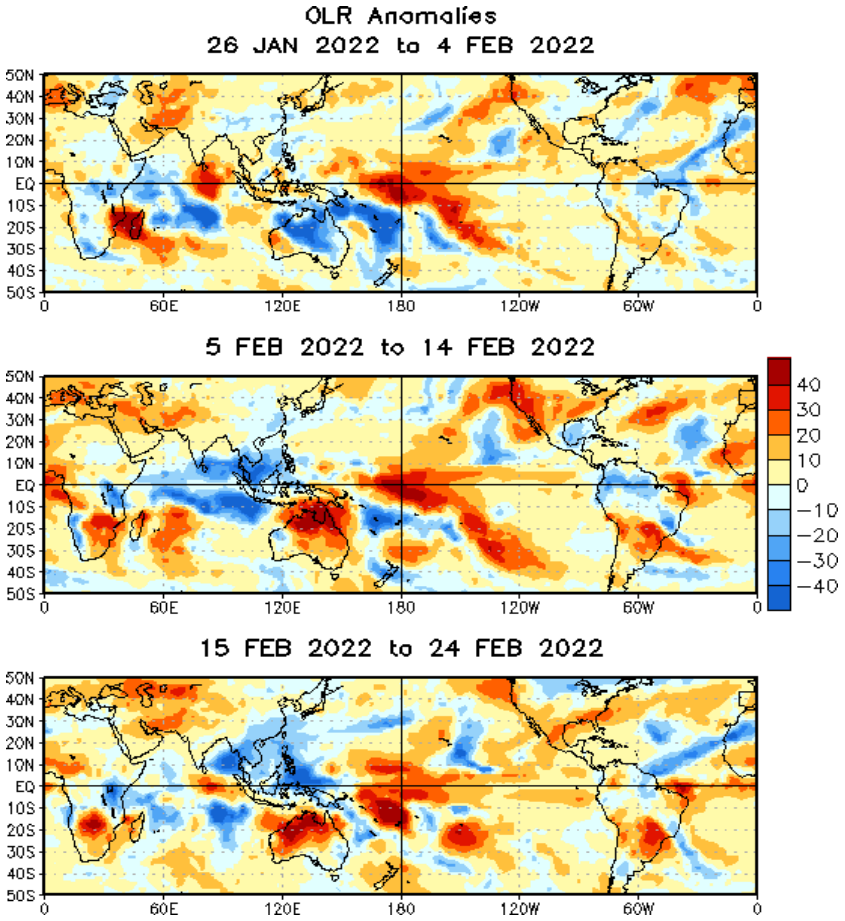
- Westerly anomalies have propagated eastward across the Maritime Continent south of the Equator, but robustly enhanced trades remain prevalent across the entire Pacific basin, and have even spread eastward across Southeast Asia.

- From a MJO perspective, the low-level wind field appears displaced further west than some of the other observational fields.

Outgoing Longwave Radiation (OLR) Anomalies

Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

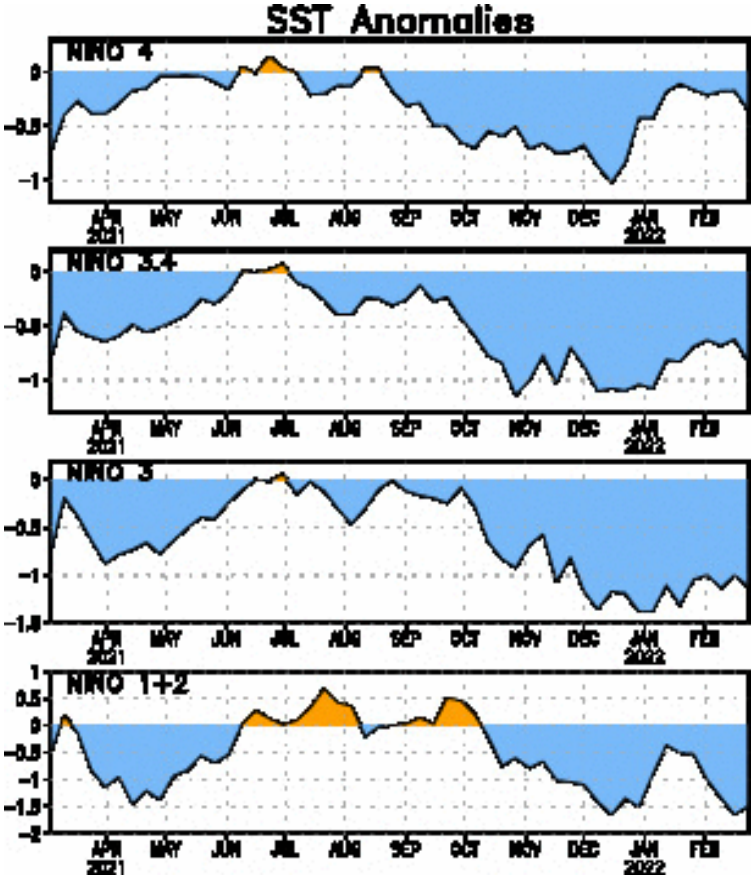


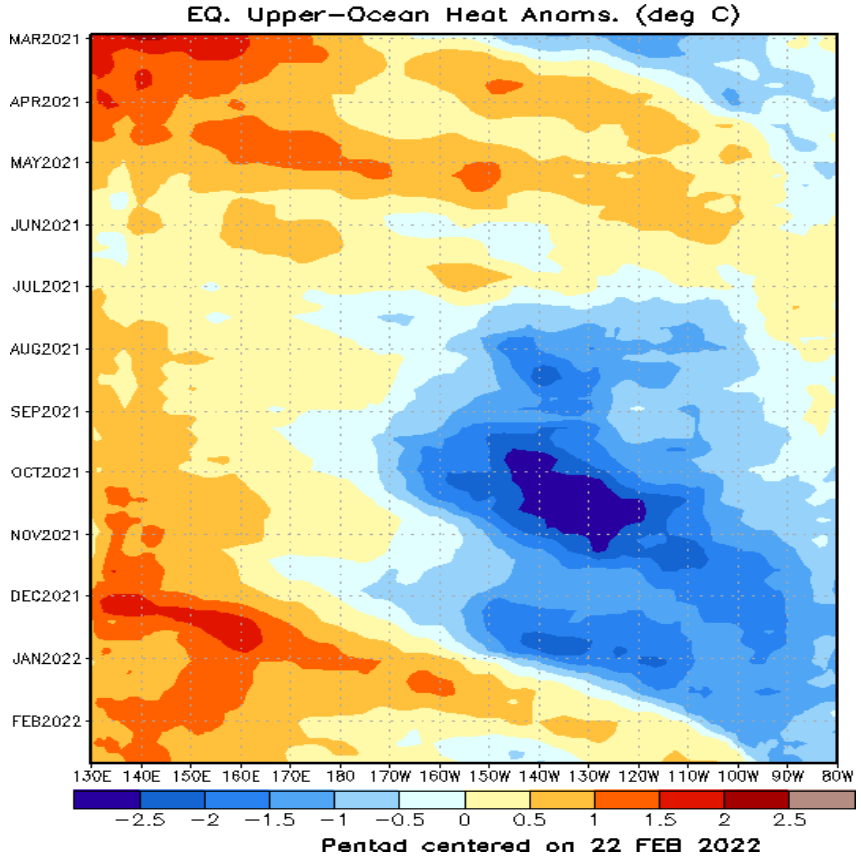


- During February, enhanced convection propagated from the Indian Ocean to the Maritime Continent, consistent with MJO activity.

- Suppressed convection continues near and to the west of the Date Line indicative of the low frequency La Niña footprint.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



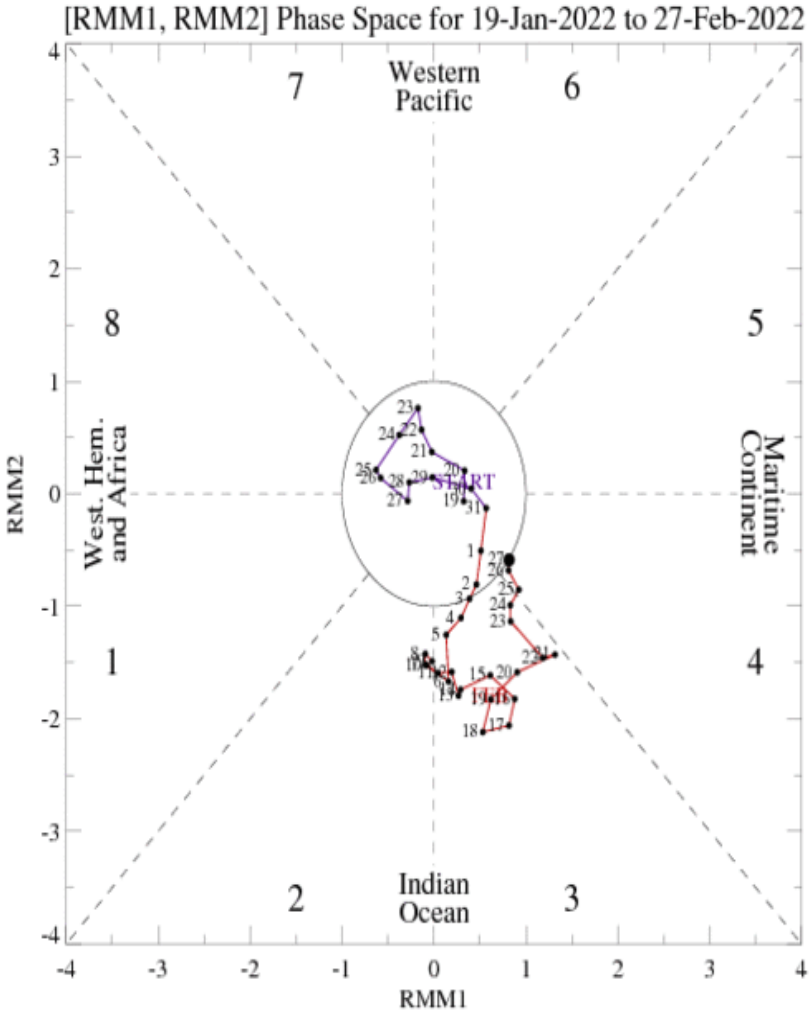


- Following the passage of a robust downwelling oceanic Kelvin wave that was generated in response to a significant westerly wind burst in December, negative upper-oceanic heat content anomalies returned between 160W and 130W.

- Negative sea-surface temperature anomalies in the Niño 3, 4, and 3.4 regions all increased during late February, influenced by a return of enhanced trade winds.

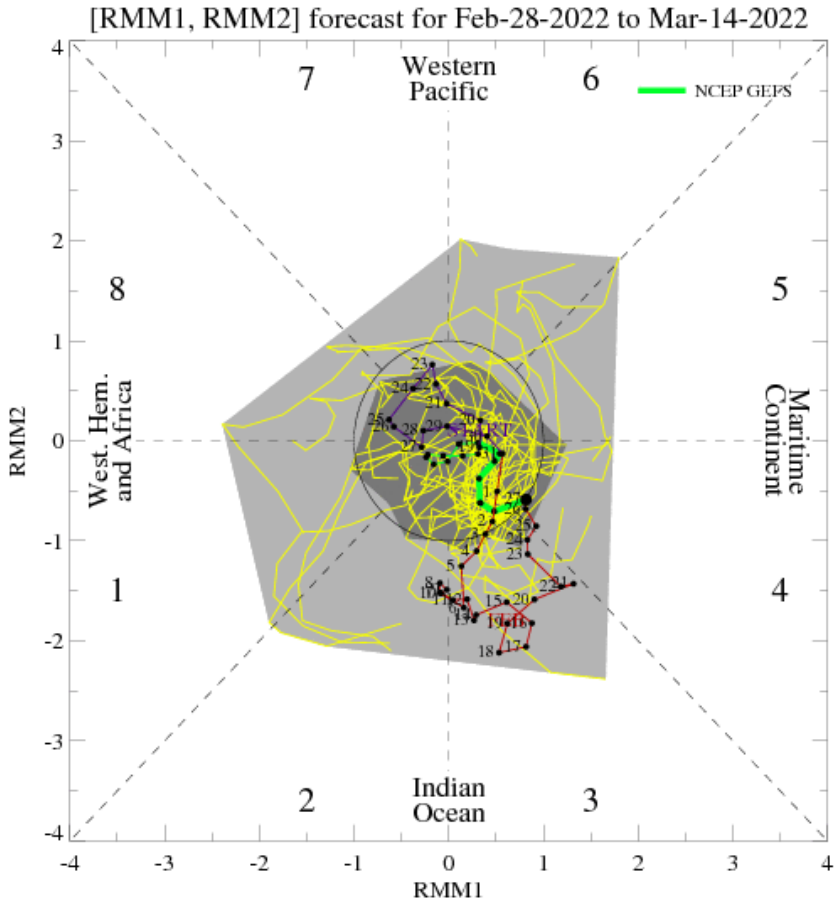
MJO Index: Recent Evolution

- Weak eastward propagation has been established in RMM space over the past few days, but the amplitude of the intraseasonal signal has decreased.

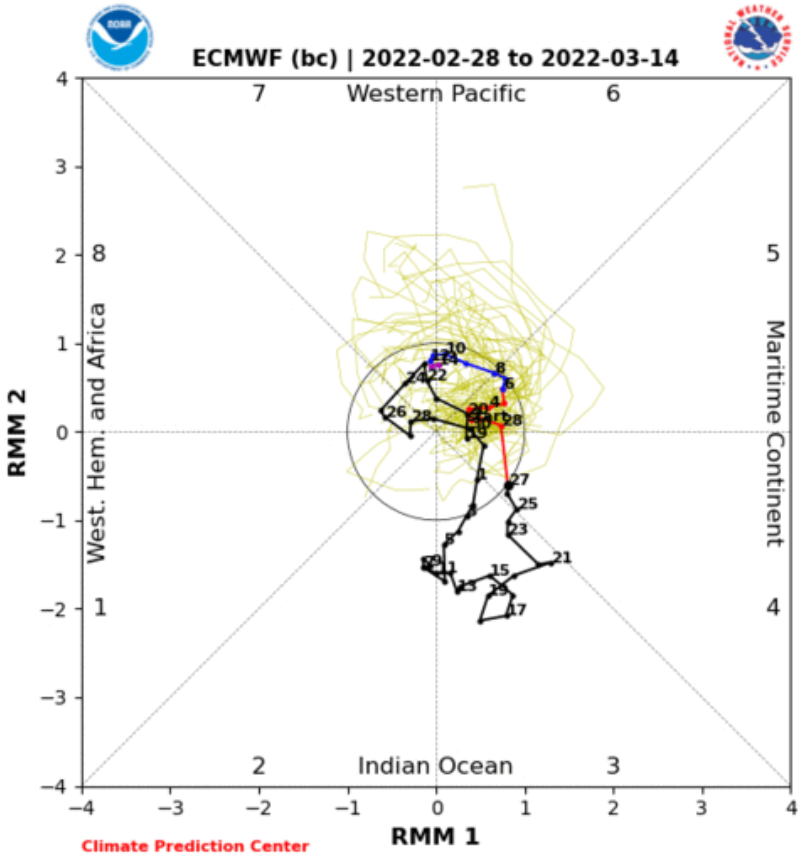


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

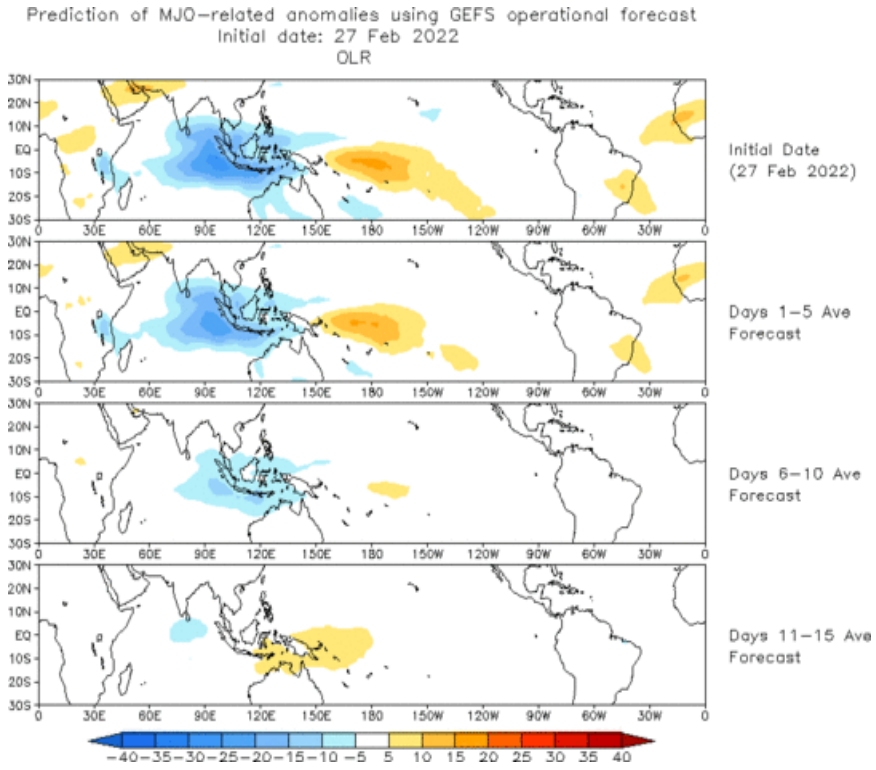


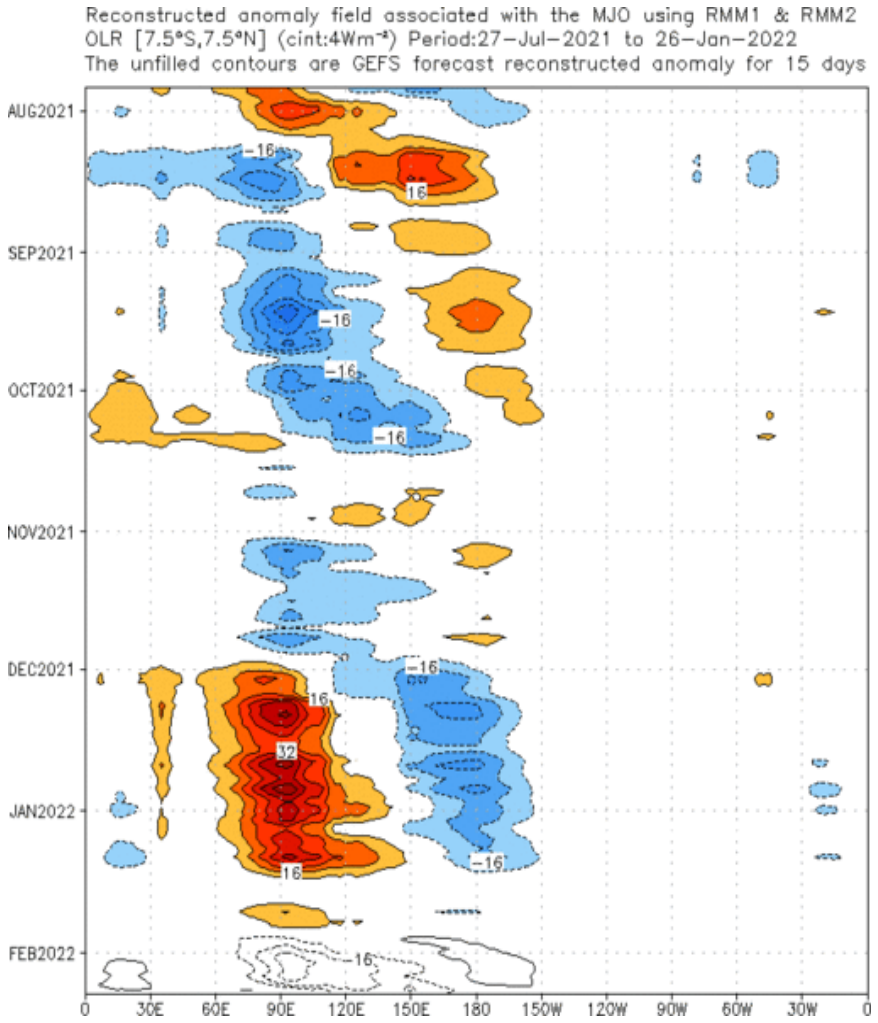
ECMWF Forecast

- The GEFS and ECMWF forecasts have begun to diverge considerably, with the GEFS depicting a wide range of possible solutions suggesting Kelvin wave influences.
- The ECMWF forecast depicts fast, weak propagation across the Maritime Continent during Week-1, with many ensemble members showing an enhanced Pacific signal emerging during Week-2.

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.)

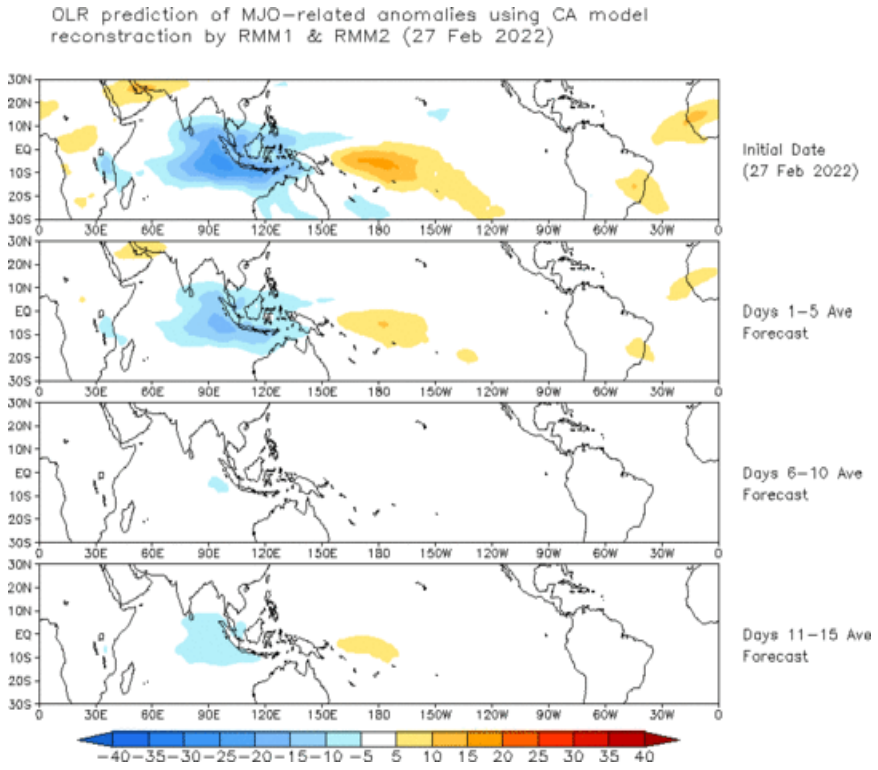


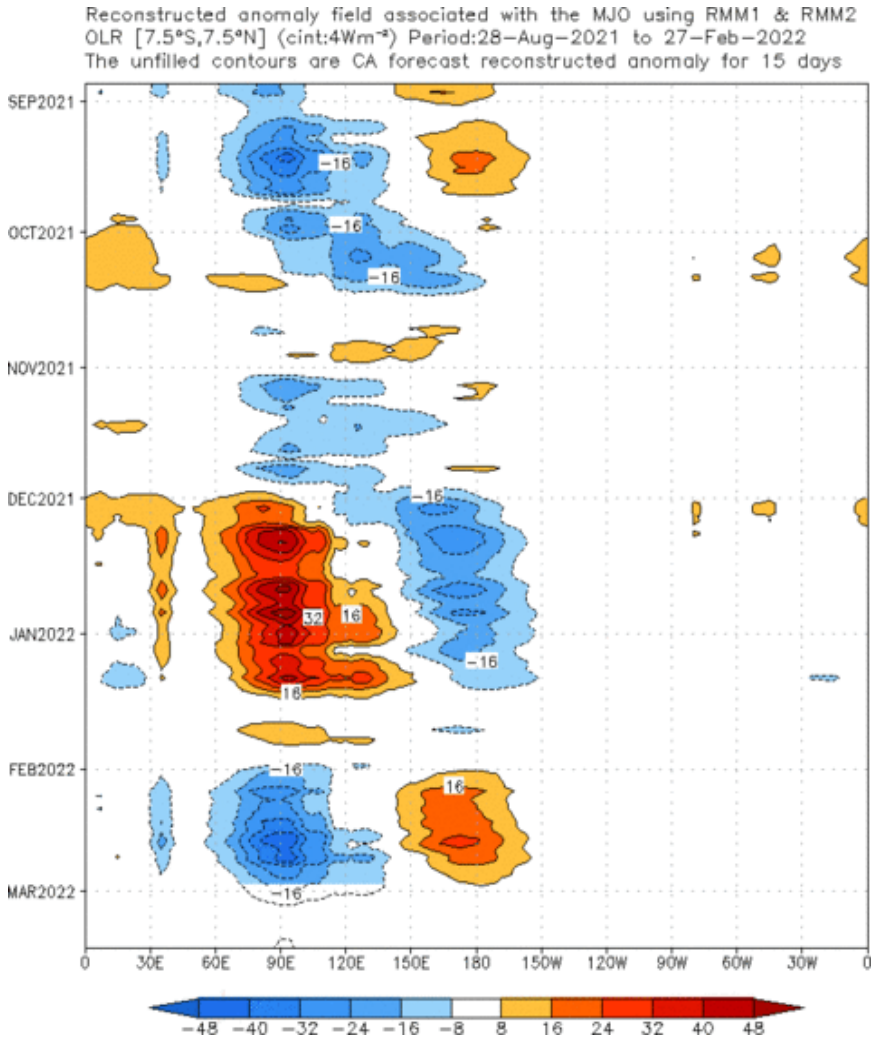


- The GEFS RMM-based OLR field depicts a strong eastern Indian Ocean/Maritime signal that weakens considerably over the next two weeks. This weakening is reflective of the wide and conflicting range of solutions yielded by the individual ensemble members.

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.)

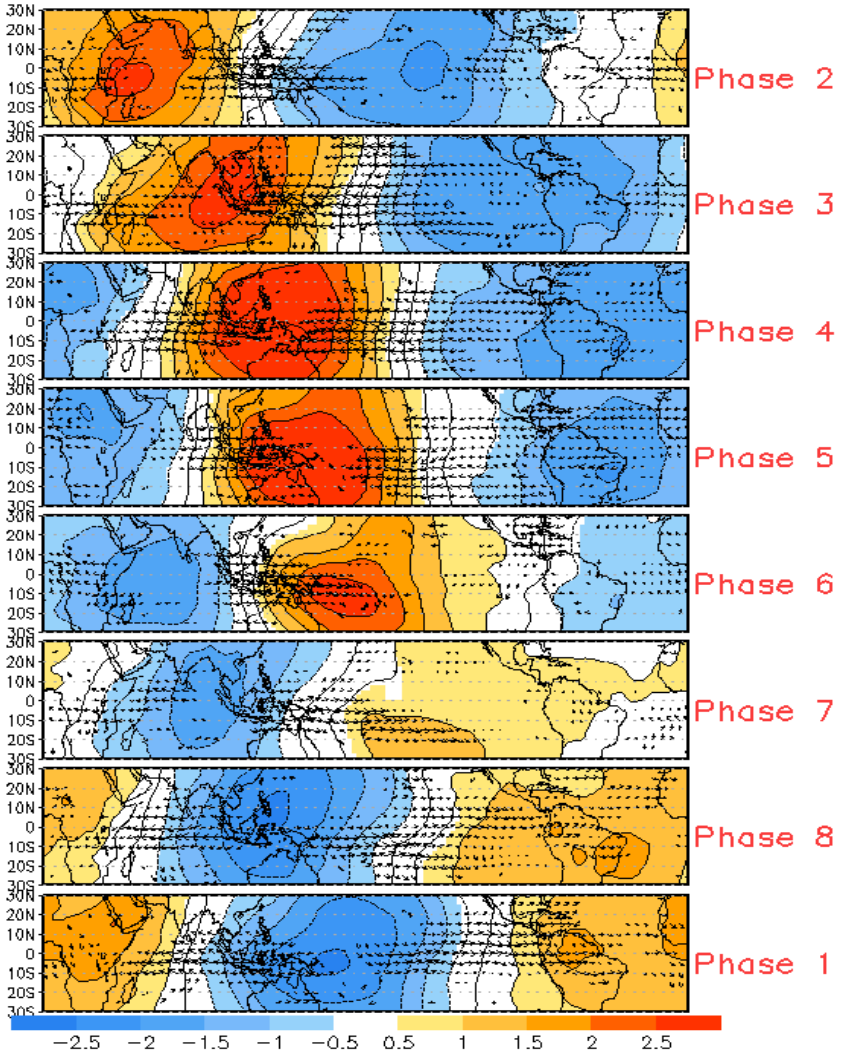




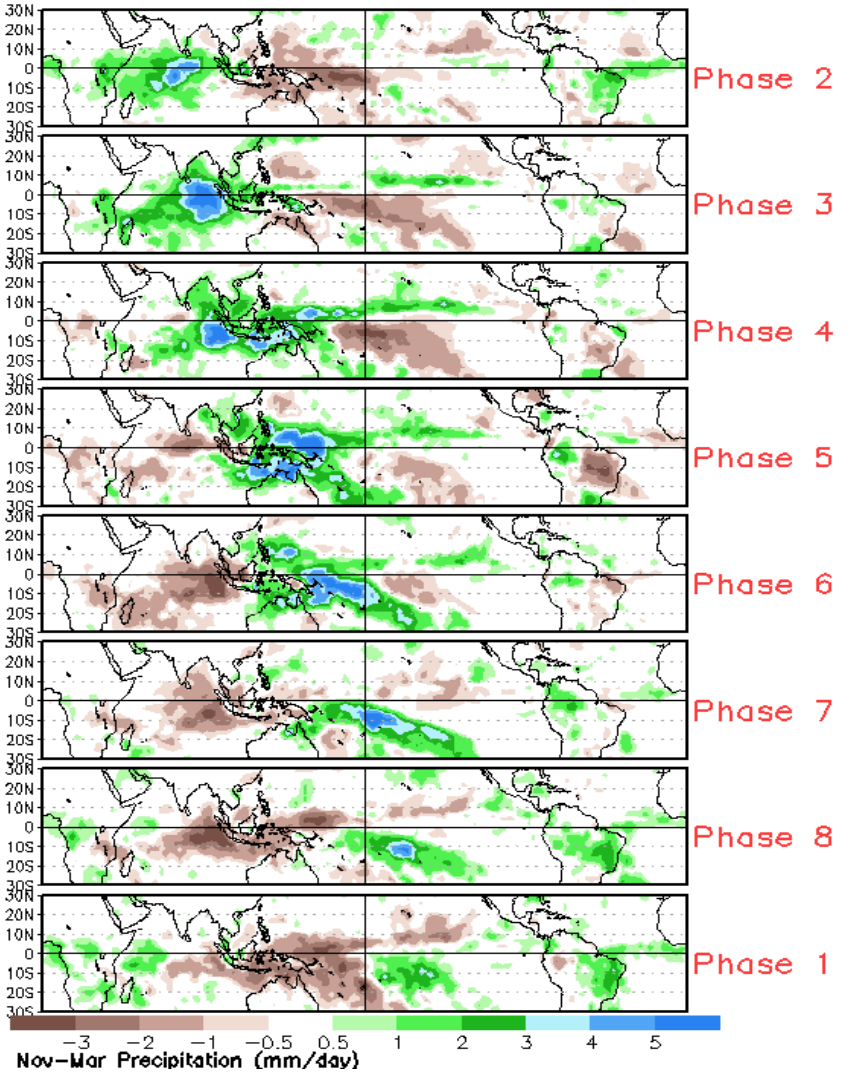
- The constructed analog forecast also favors a rapid weakening of the intraseasonal signal, with little evidence of eastward propagation.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



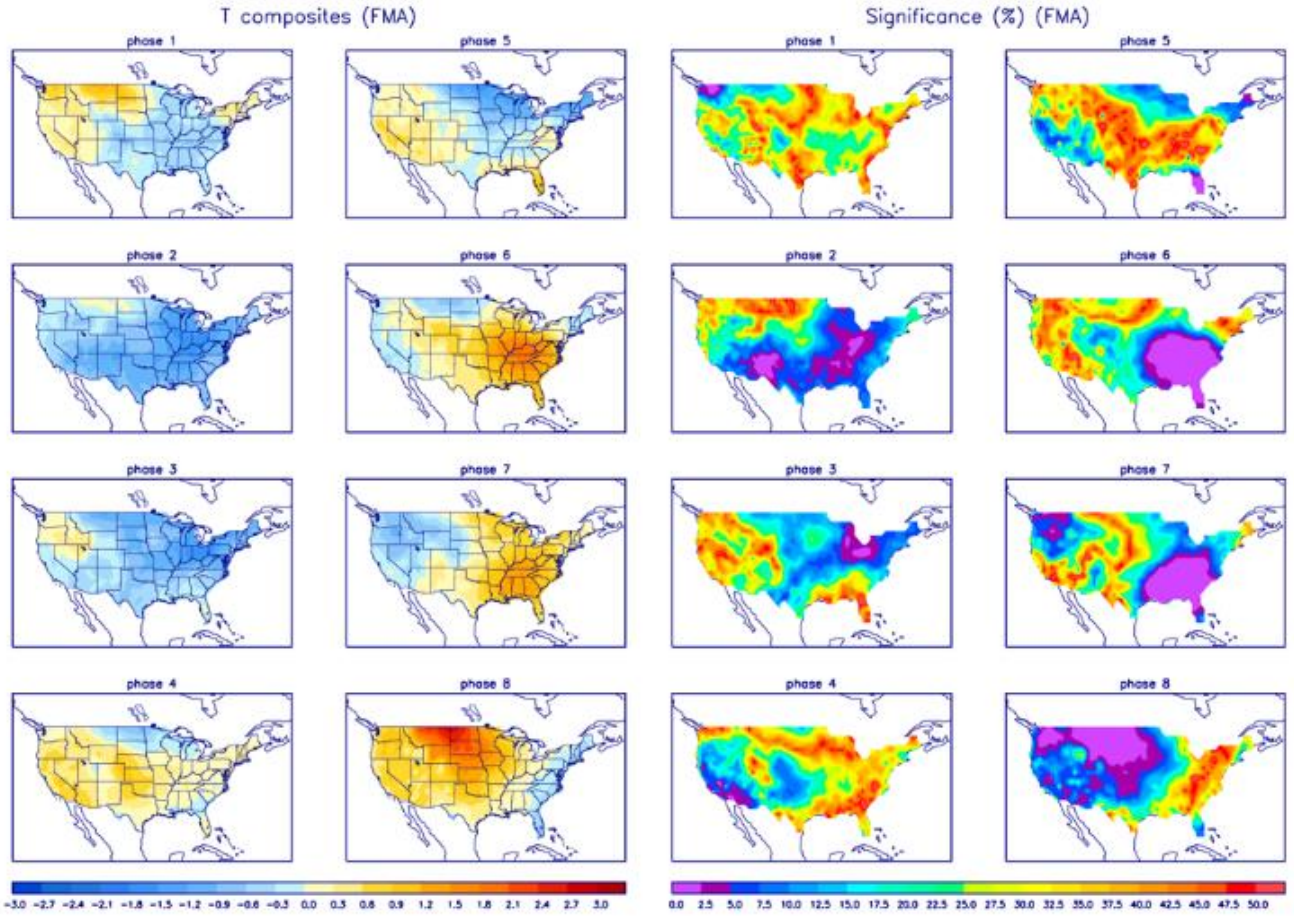
Precipitation Anomalies



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.

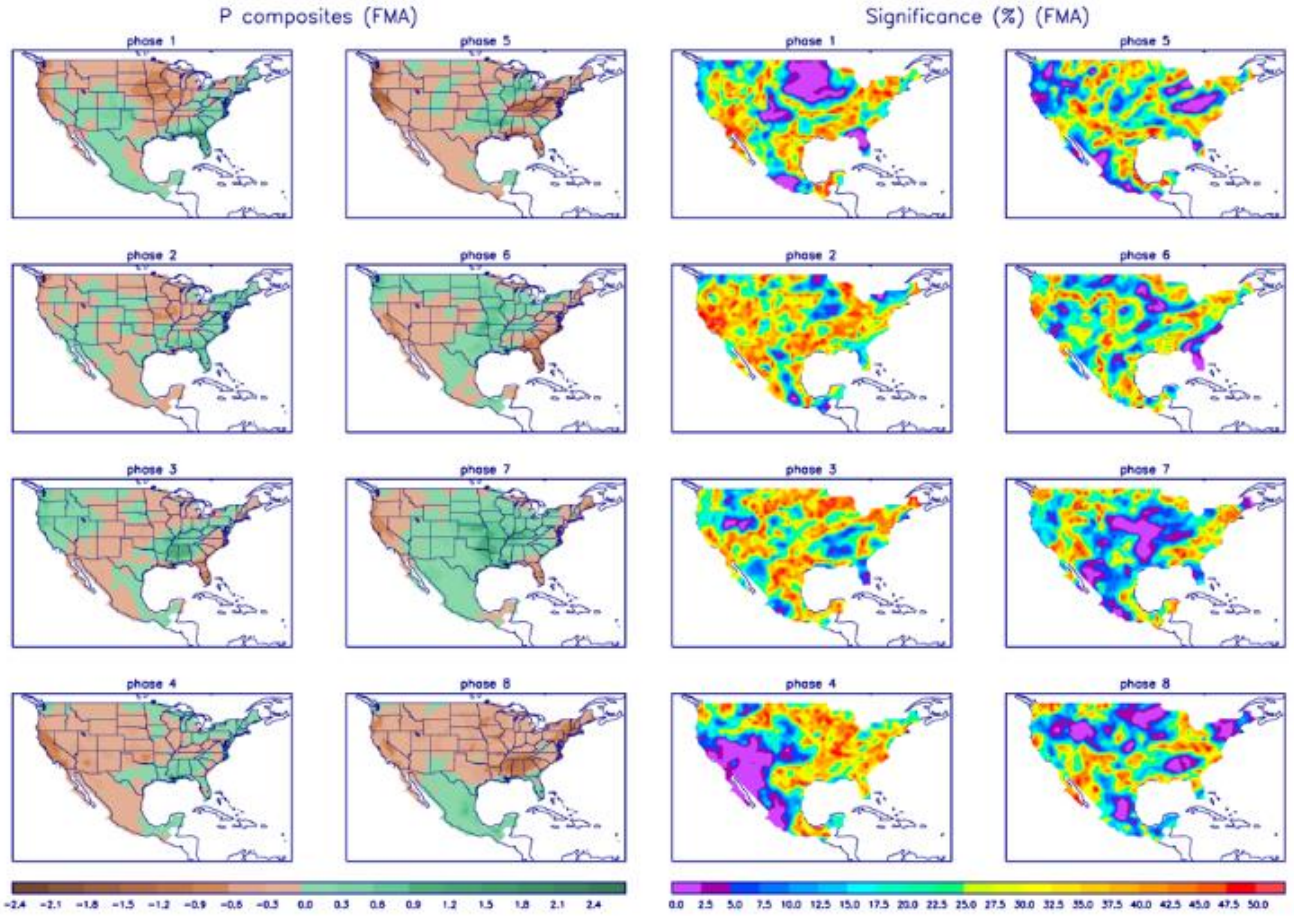


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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