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

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
13 January 2020

Overview

- The MJO had an anomalous surge in signal during the past week over the Maritime Continent (Phase 4) and has shifted into Phase 5 over the past day.

- Dynamical model guidance shows consensus with the week-1 forecast, keeping the signal very strong as it moves toward the western and central Pacific (phases 5/6/7). Moving into week-2, the models show varying degrees of possible decay to the MJO footprint as it shifts toward the eastern Pacific and western hemisphere (phases 7/8).

- The Indian Ocean Dipole has seen a small rebound in signal after weeks of rapid decline from the incredibly strong event that lasted through late boreal fall into early winter. It appears as though the signal has settled as slightly positive/close to normal, which will likely mean the influence of this low frequency signal will be limited for the rest of boreal winter and into spring.

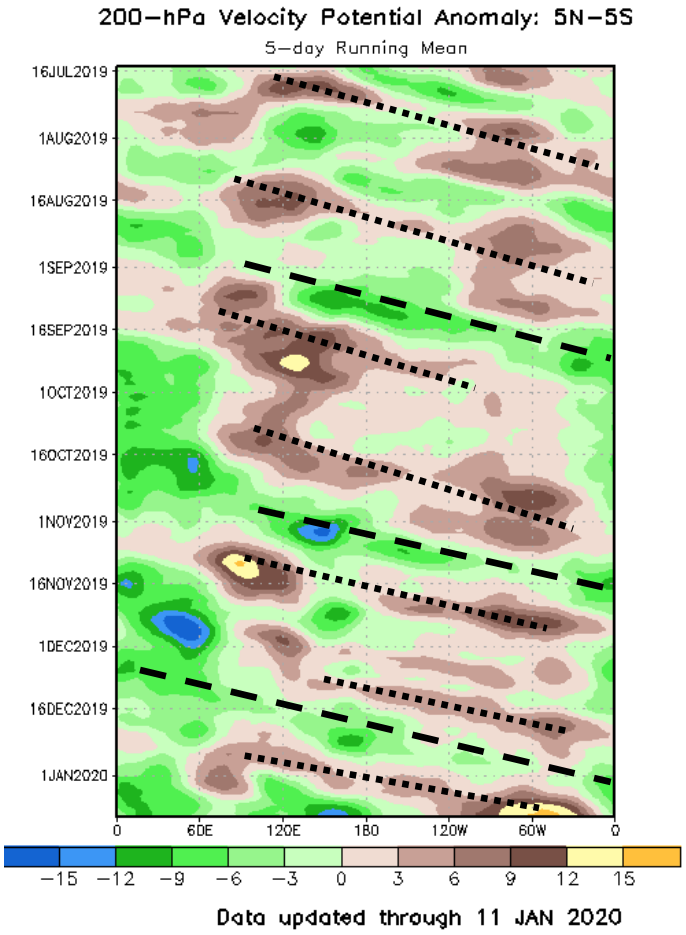
- The MJO's emergence across the Maritime Continent and forecast propagation to the Pacific over the next two weeks would typically support an initial continuation of the relatively cold (warm) pattern for the western (eastern) U.S. Over time the cold in the West would be expected to slowly abate with time while warmer conditions overspread North America, before some potential colder weather would emerge over the Northeast by early February. Currently, week-2 (Jan 21-27) forecasts for the CONUS show a cold signal over the eastern U.S., which would favor the faster phase speed of the GEFS.

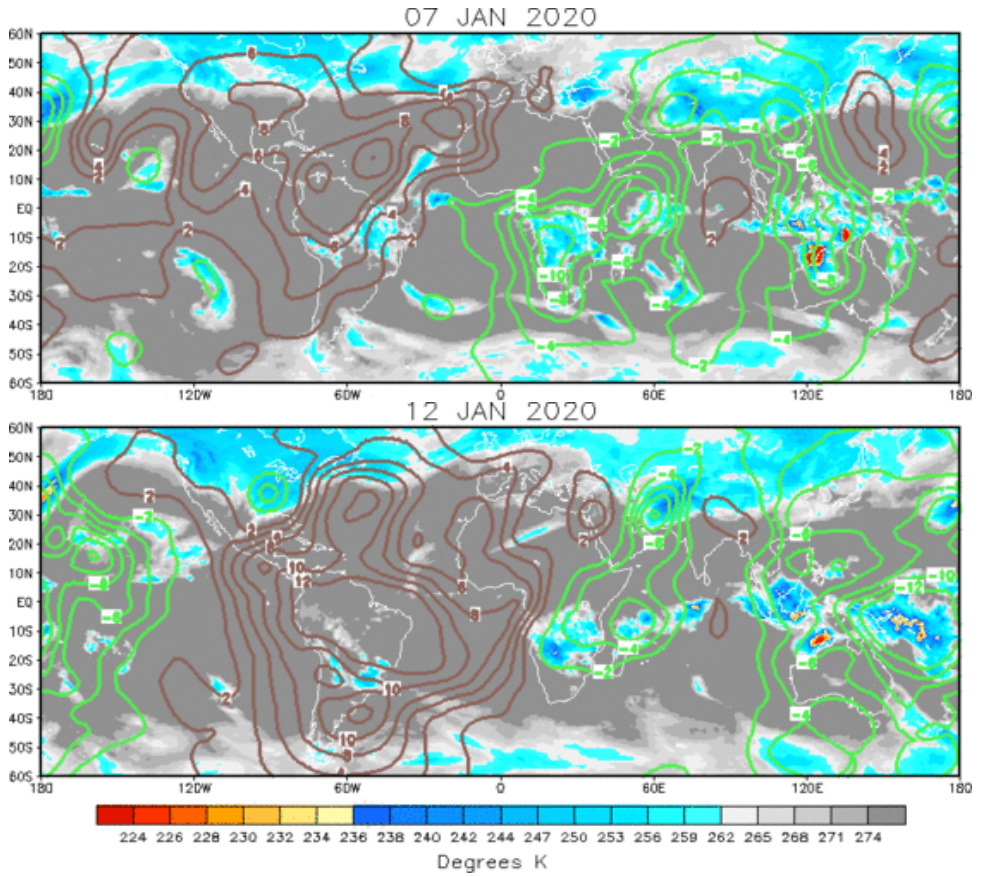
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

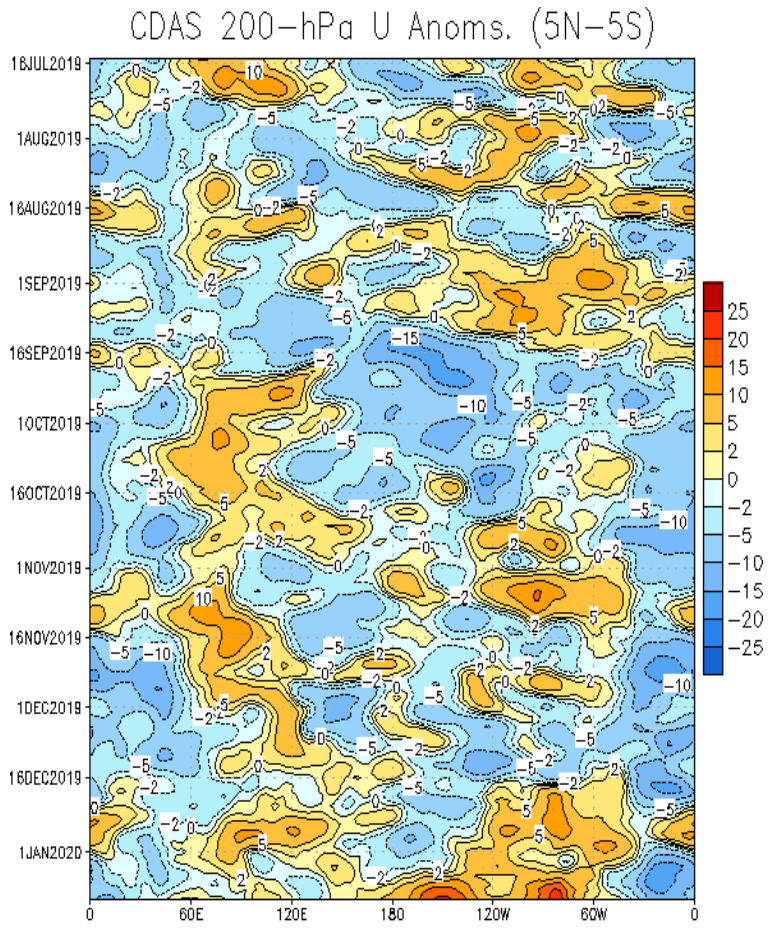


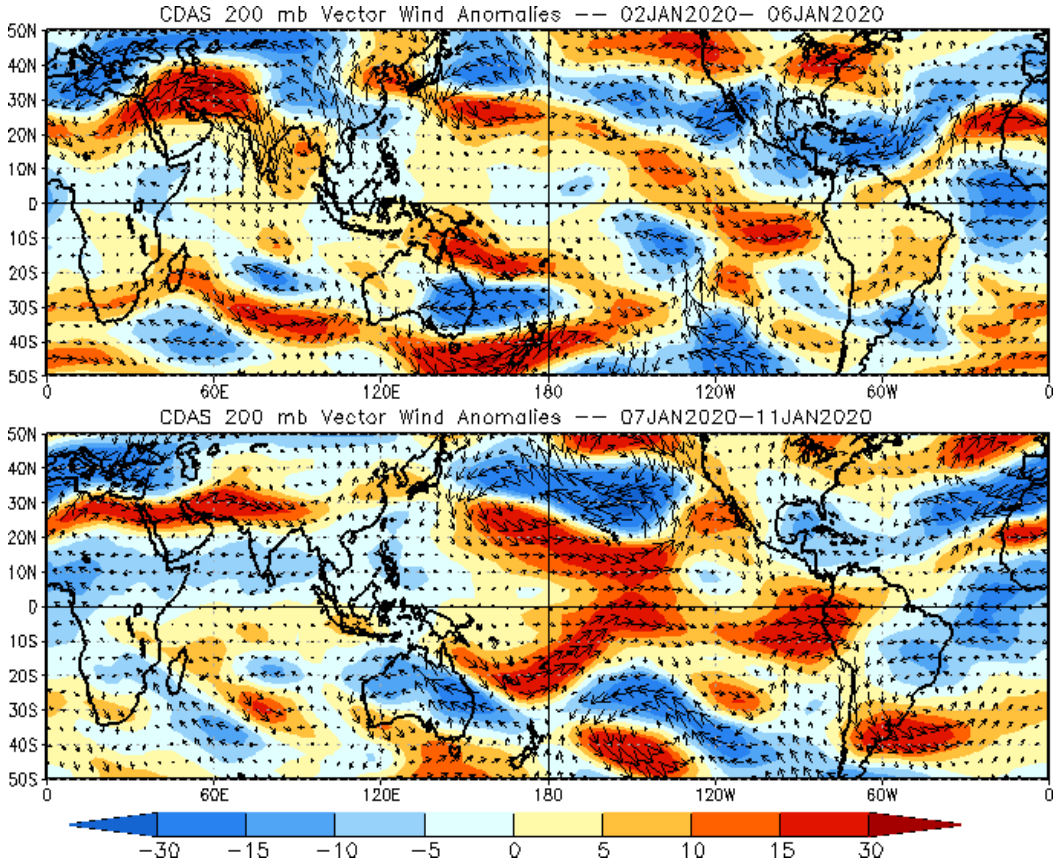


- Over the past week, the anomalous divergence and convergence at the upper-levels has become more organized and strengthened. Convection remains focused over the Maritime Continent, aided by Tropical Cyclone Claudia off the Kimberley Coast, and the signal has pushed further into the central and eastern Pacific. Upper-level convergence remains mostly in the western hemisphere, but has amplified and shifted slightly eastward toward West Africa.

200-hPa Wind Anomalies

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

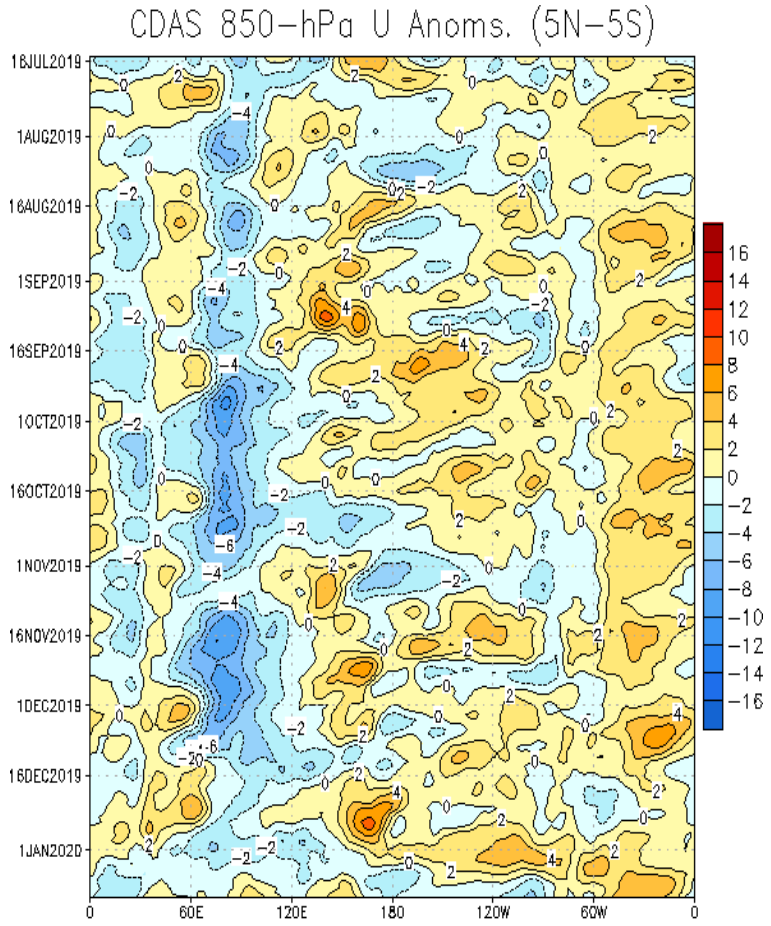


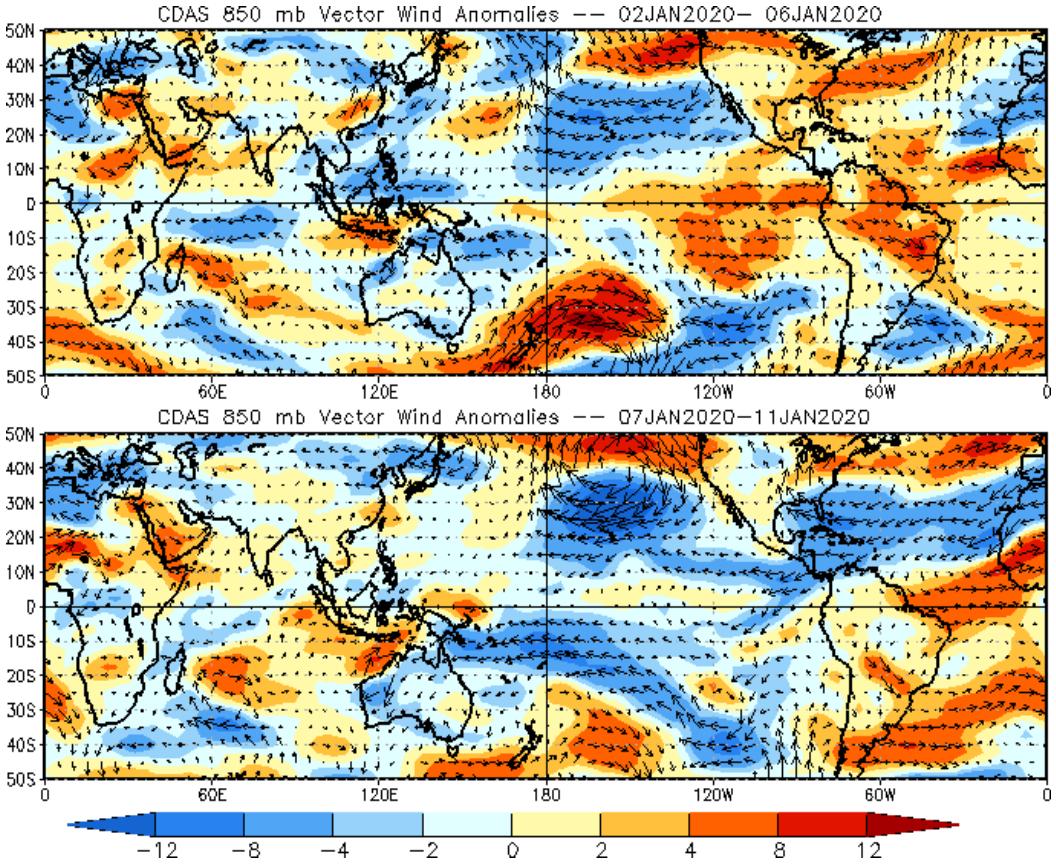


- Strong anomalous westerlies appeared over the central and eastern Pacific over the past week, extending north and south of the equator with flow into western North and South America. An extratropical cyclone is apparent in the North Pacific.
- This strong signal over the tropical Pacific seems to be the dominant feature, impacting the anomalous flow for both hemispheres.

850-hPa Wind Anomalies

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

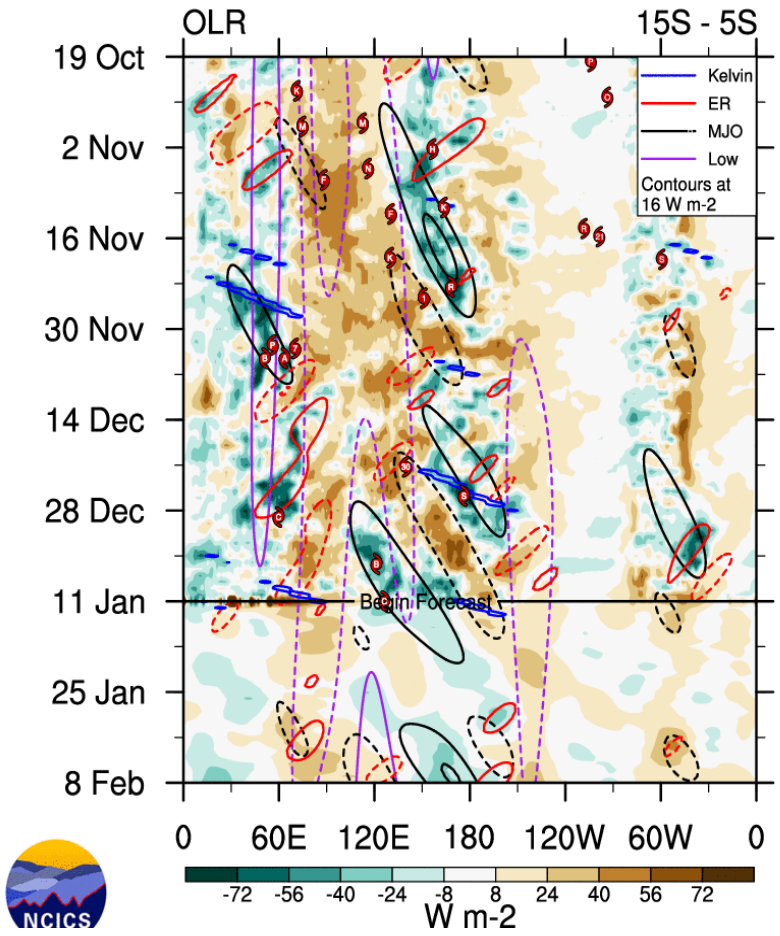


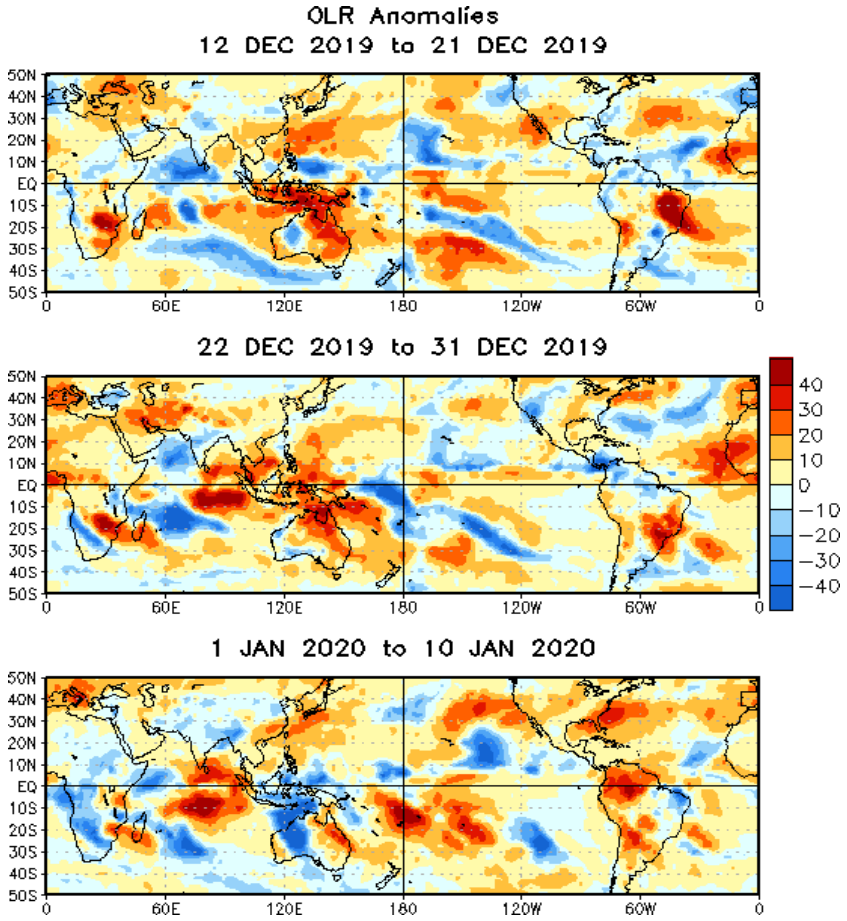


- Corresponding anticylonic flow can be seen over the North Pacific in the lower-level wind field. Strong anomalous easterly flow is seen over much of the Northern/Western Hemisphere and north and south of the equator in the Pacific.
- The anomalous easterlies in the Atlantic aided in delivering Caribbean moisture into the Mississippi Valley.
- Anomalies over the Indian Ocean have further weakened and become less organized with the decay of the +IOD.

Outgoing Longwave Radiation (OLR) Anomalies

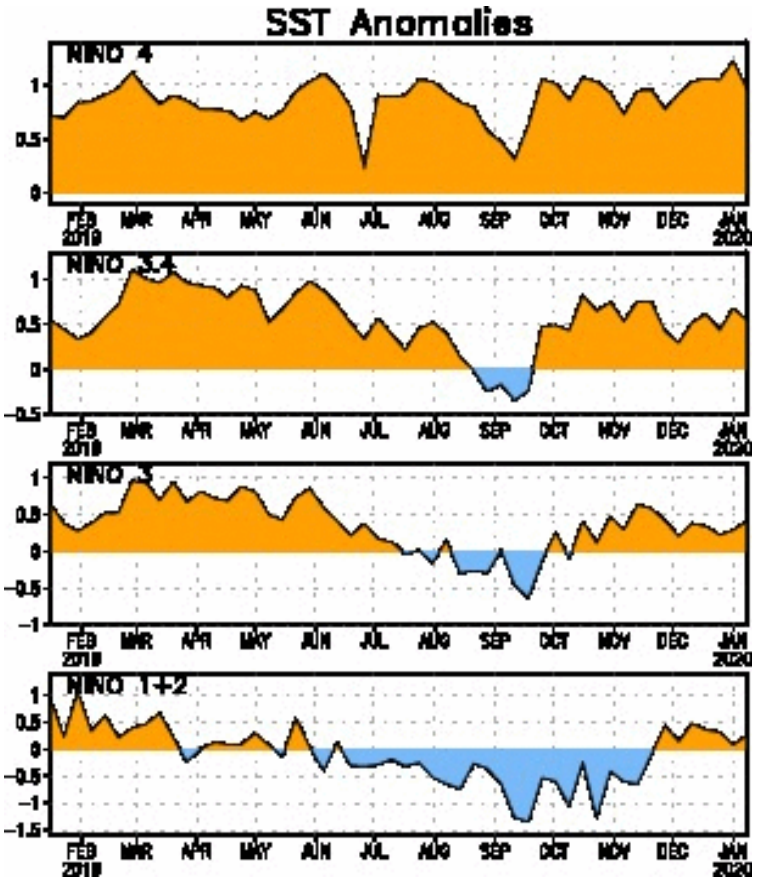
Blue shades: Anomalous convection (wetness). Red shades: Anomalous subsidence (dryness).

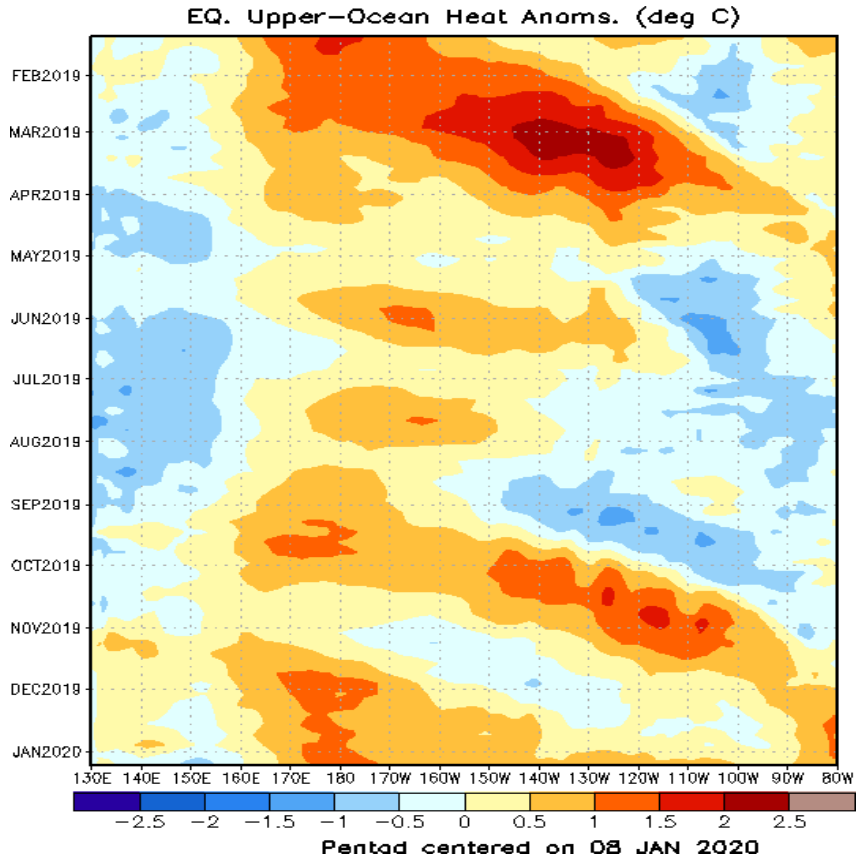




- The influence of the convective envelope of the MJO can be seen near 120E since the beginning of the New Year, constructively interfering with other modes of variability. Over the past few days, convection has been extending eastward toward the Date Line, aided by a Kelvin wave.
- Conversely, enhanced convection across the Arabian sea and western Indian Ocean has turned suppressed, linked to the weakening IOD and MJO's emergence east of the region.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



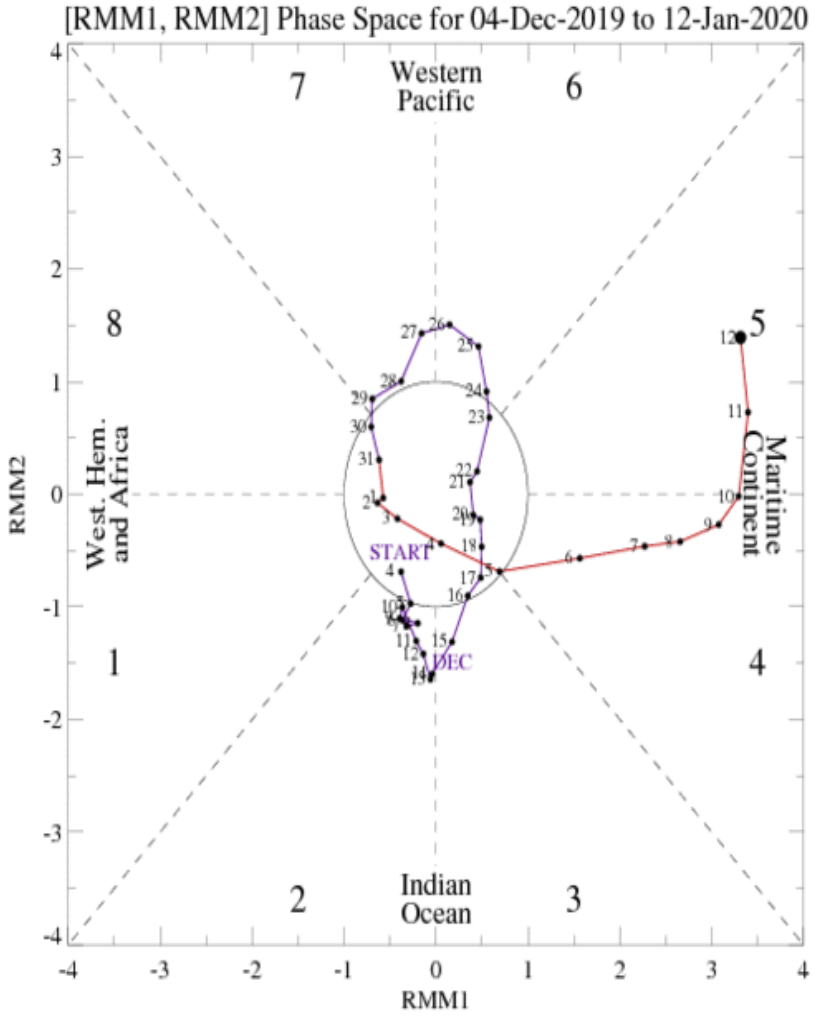


- Upper-oceanic heat content anomalies remain slightly above-normal across most of the basin, with anomalies in the eastern Pacific showing an increase at the start of the month. This is likely due to anomalous westerlies east of the Date Line late in December.
- Several westerly wind bursts over the West Pacific resulted in new downwelling Kelvin wave activity near the Date Line since November.

MJO Index: Recent Evolution

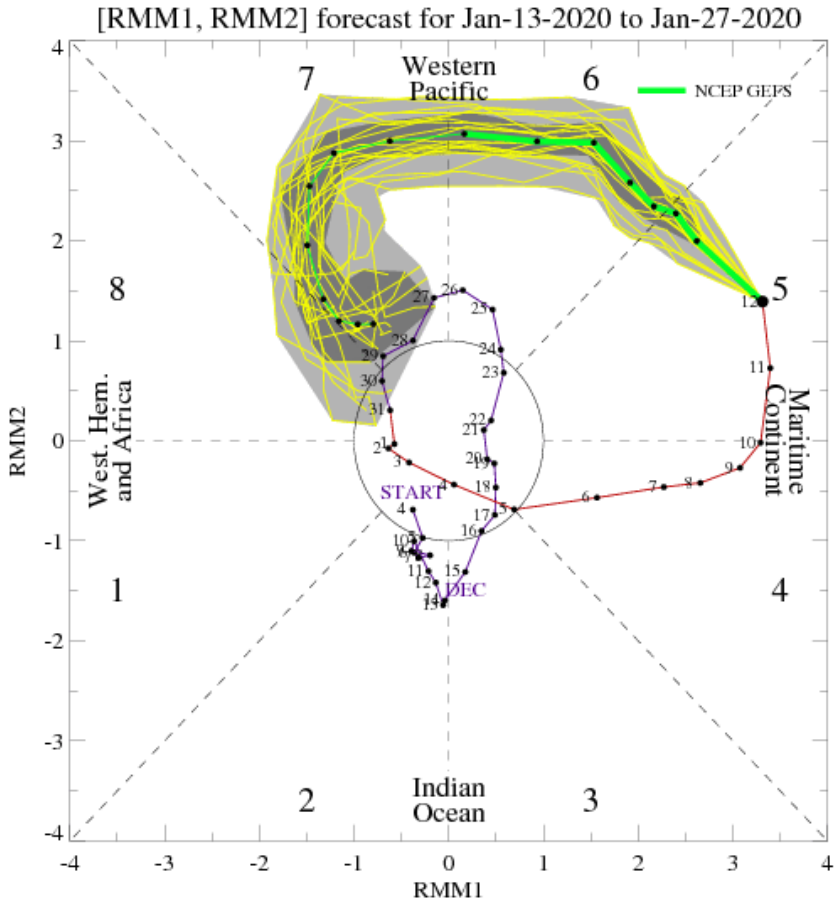
- The RMM index shows a surge in strength for the MJO over the past week, passing through Phase 4 and now into Phase 5.

- The decay of the IOD aided in the resurgence of the MJO signal over the Maritime Continent, as the suppressed signal had been dominant over the region for the past few months.

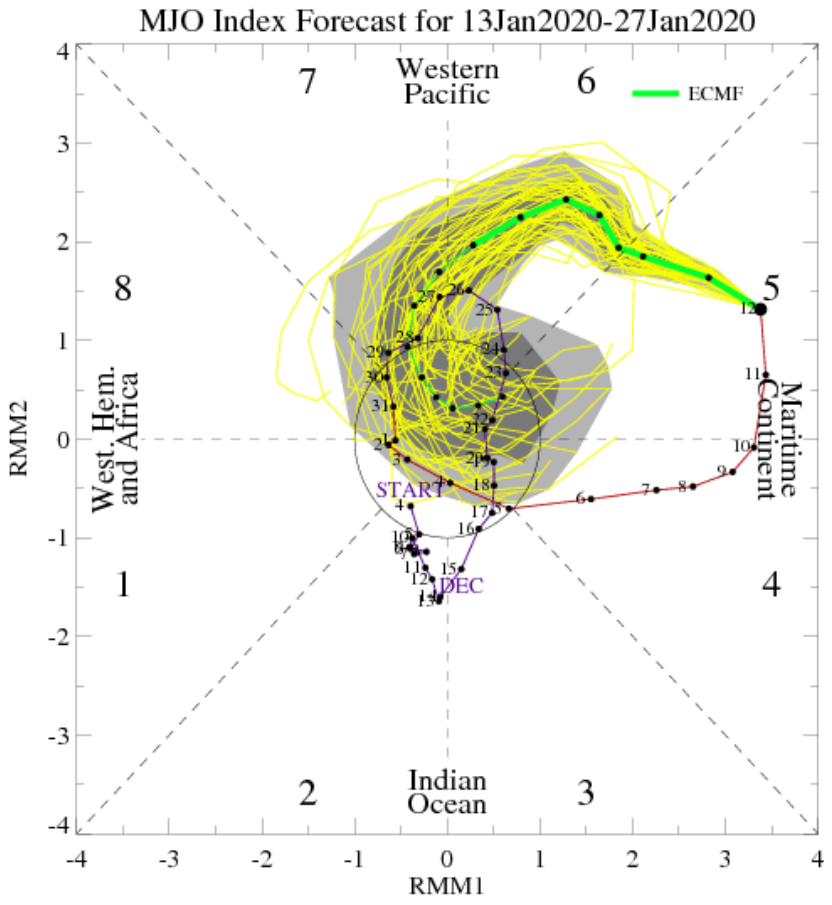


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

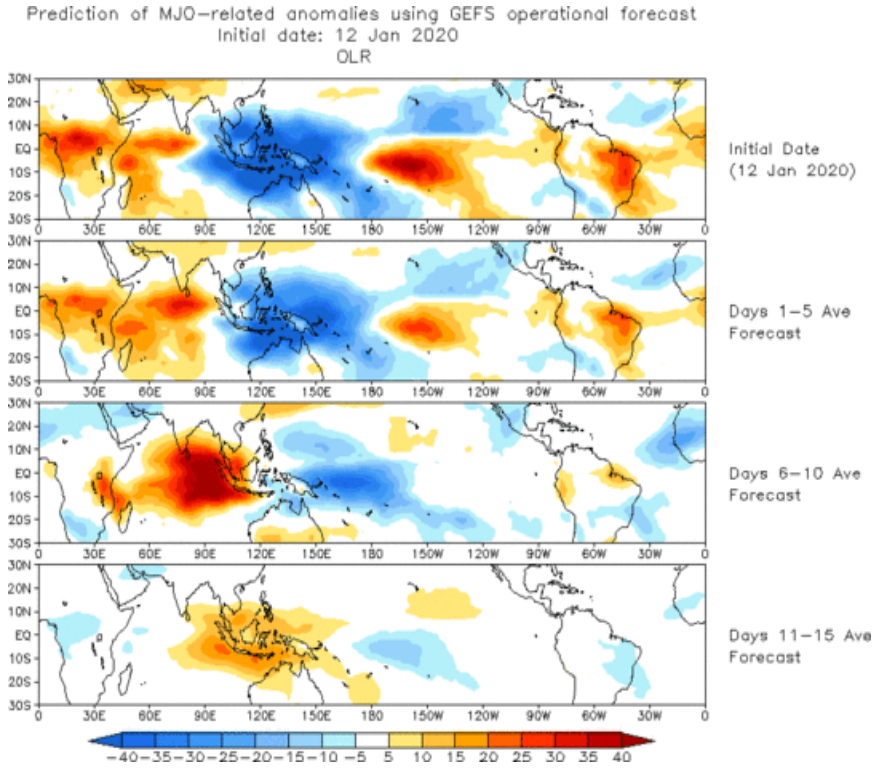


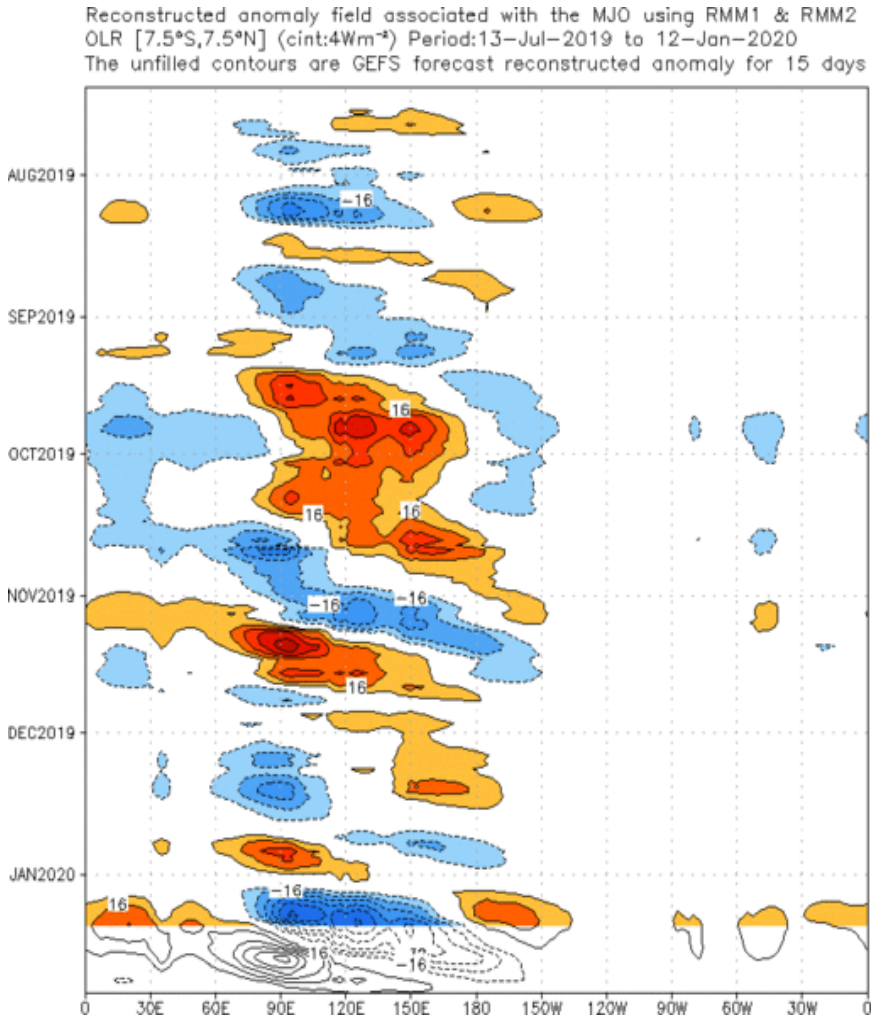
ECMWF Forecast

- The GEFS and ECMWF both forecast the signal maintaining strength through week-1 before some decay seen during week-2.
- The GEFS exhibits a faster and stronger solution for the MJO over the next two weeks, with the signal decaying mid week-2 as it approaches the western hemisphere. The ECMWF shows a slower phase speed with a faster decay to the signal in week-2 as it shifts toward the central and eastern Pacific (Phase 7).

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.)

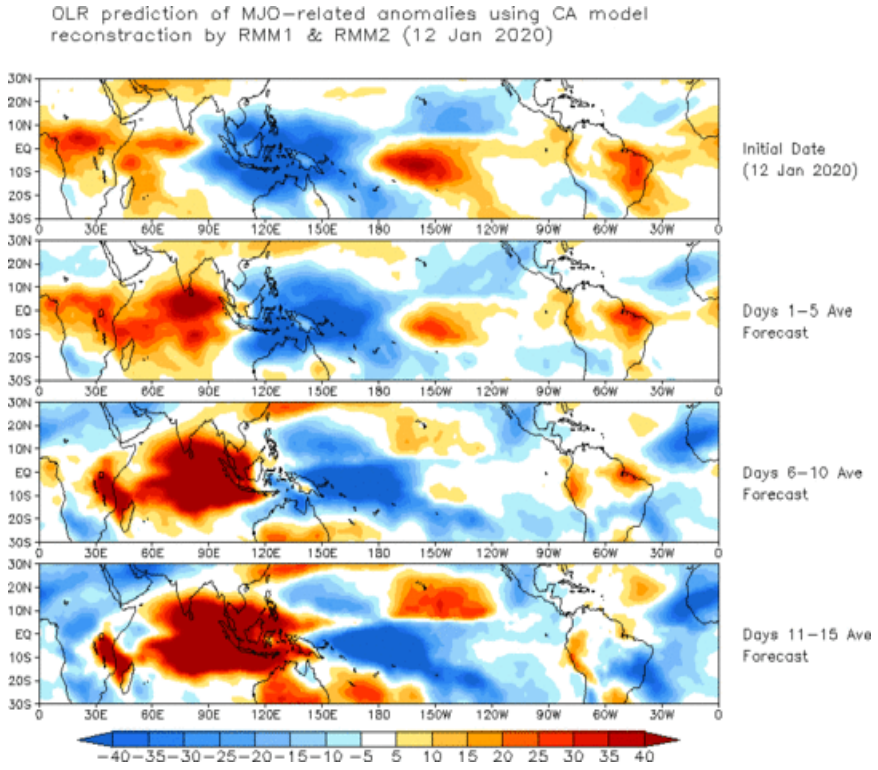


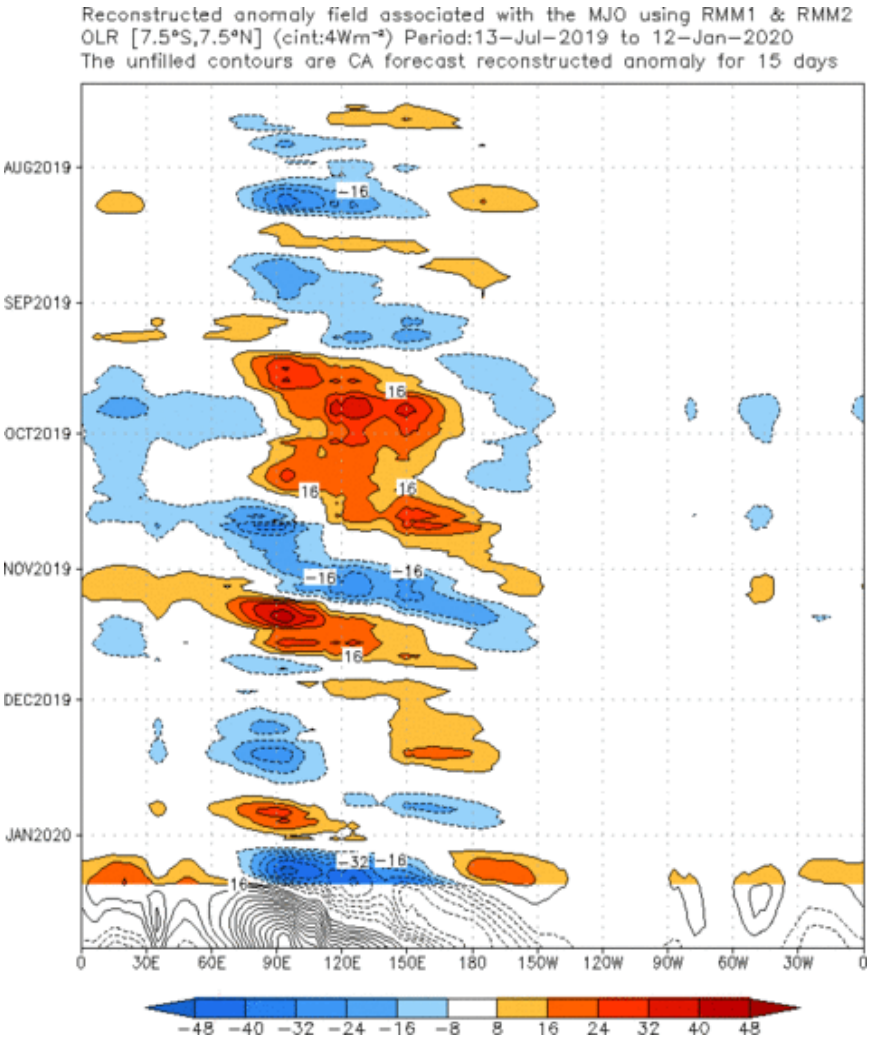


- The GEFS spatial forecast of the MJO exhibits a convective tripole spanning from Africa toward the central Pacific for week-1. In week-2, the eastern suppressed signal decays as the western signal over the Indian Ocean amplifies while the entire pattern propagates eastward.

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.)

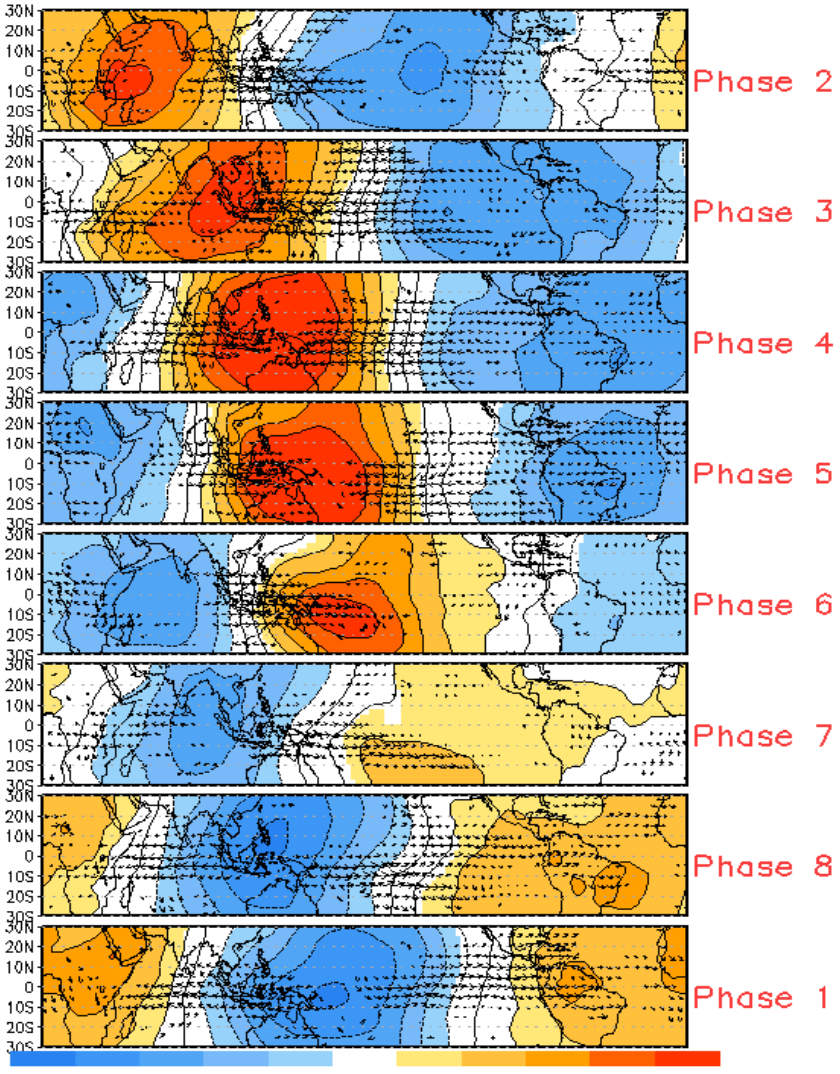




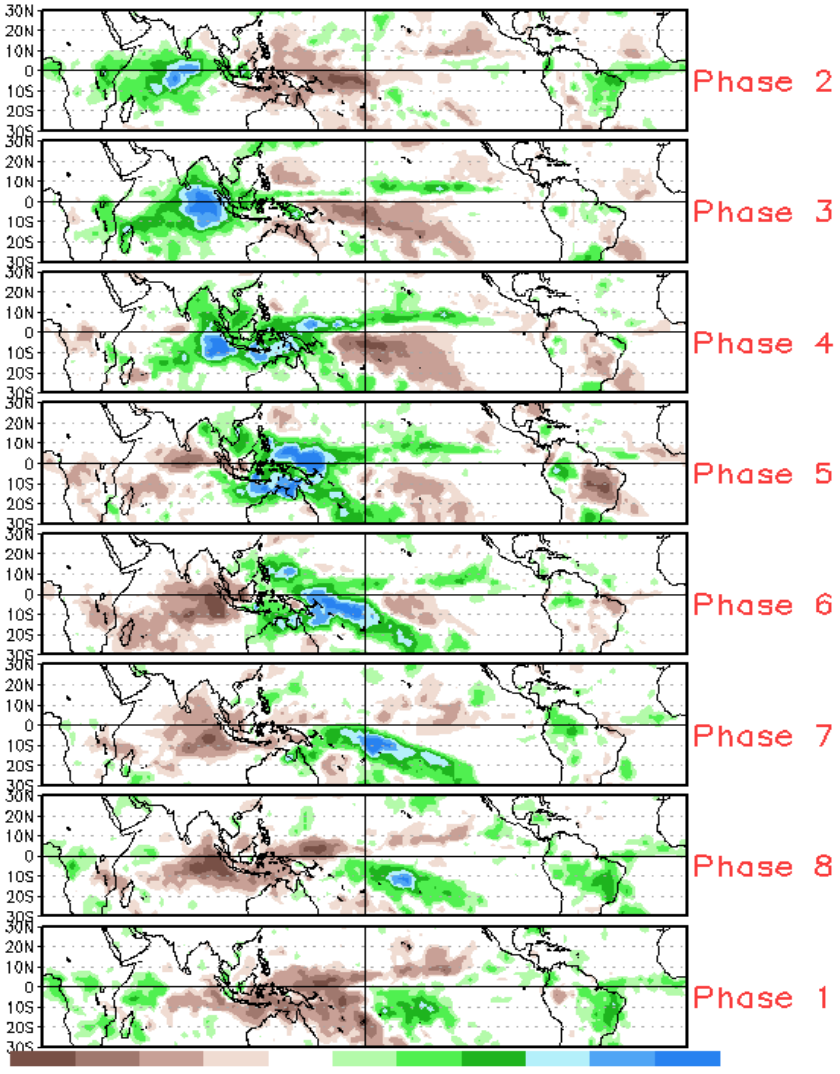
- The constructed analog MJO forecast shows a similar tripole as the GEFS forecast for week-1. As it moves into late week-1/early week-2, the constructed analog shows a strong amplification of the signal, which is likely overdone.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



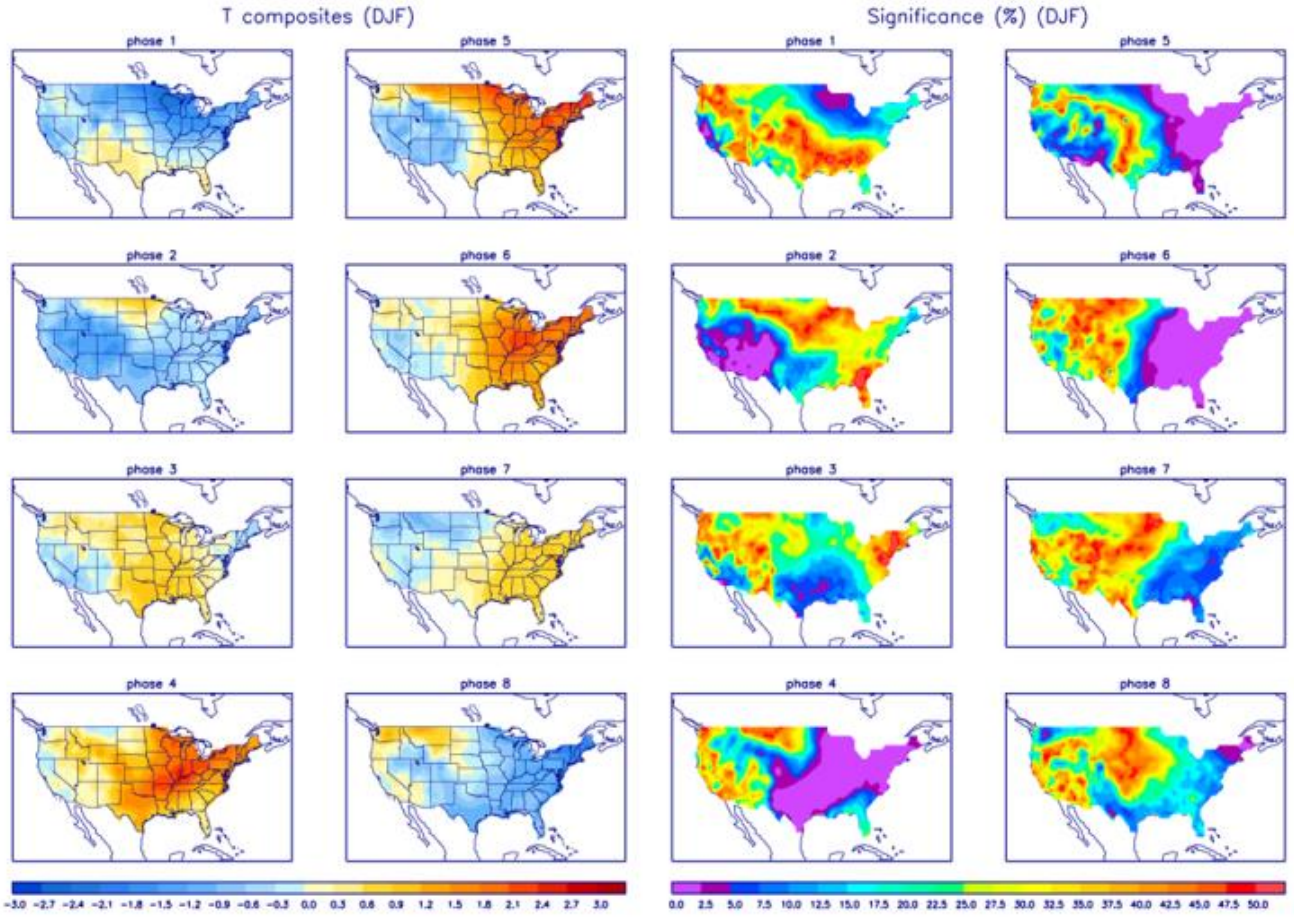
Precipitation Anomalies



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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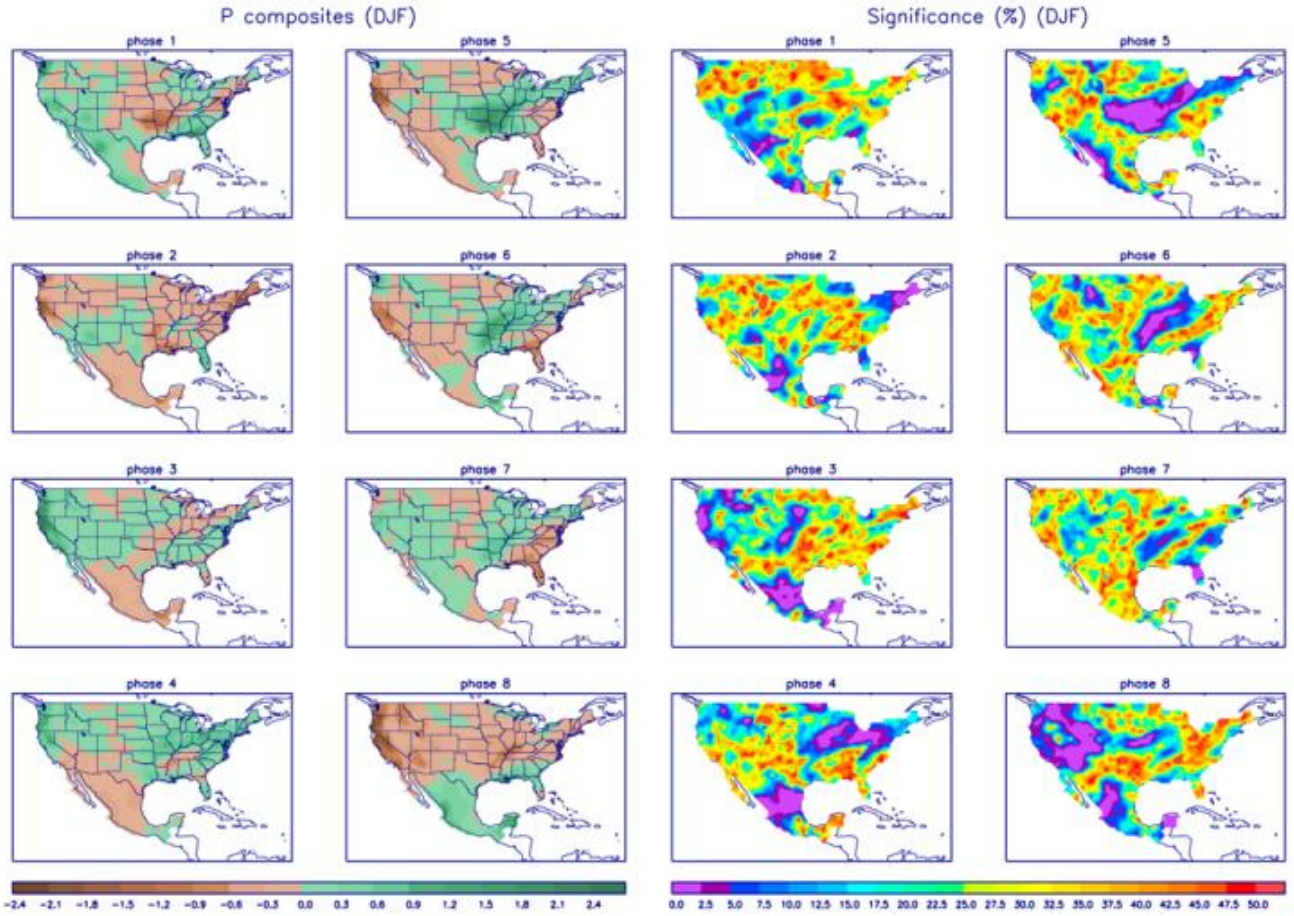

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