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

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
11 January 2021

Overview

- Recent observations depict the stationary La Niña signal continuing to dominate the overall global tropical convective field.

- Similar to what occurred in November, enhanced convection has developed over the Indian Ocean in response to midlatitude wavebreaking onto the tropics.

- Dynamical model MJO index forecasts do not generally favor a robust eastward propagation of this emerging signal in a way that would compete with the low frequency base state.

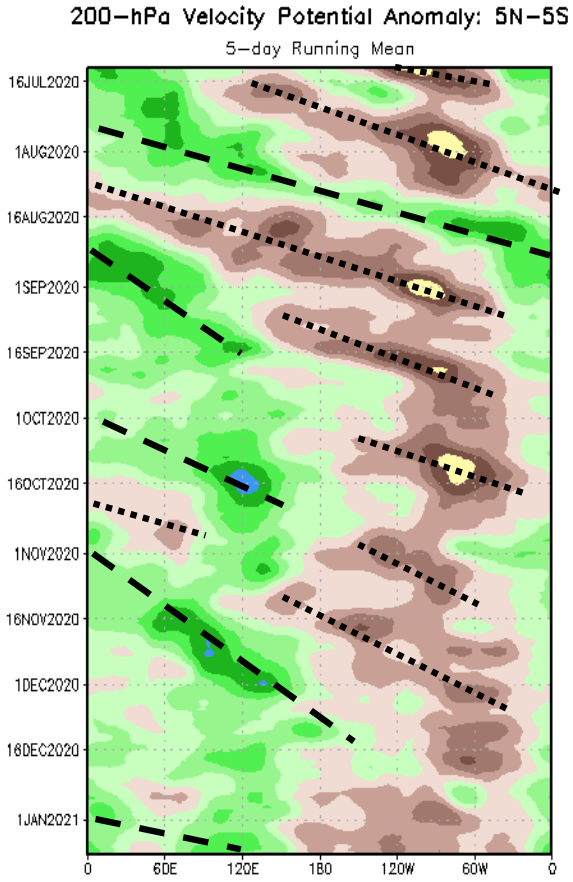
- Climate anomalies associated with the ongoing La Niña appear to be the most likely outcome from the observed and forecasted tropical state.

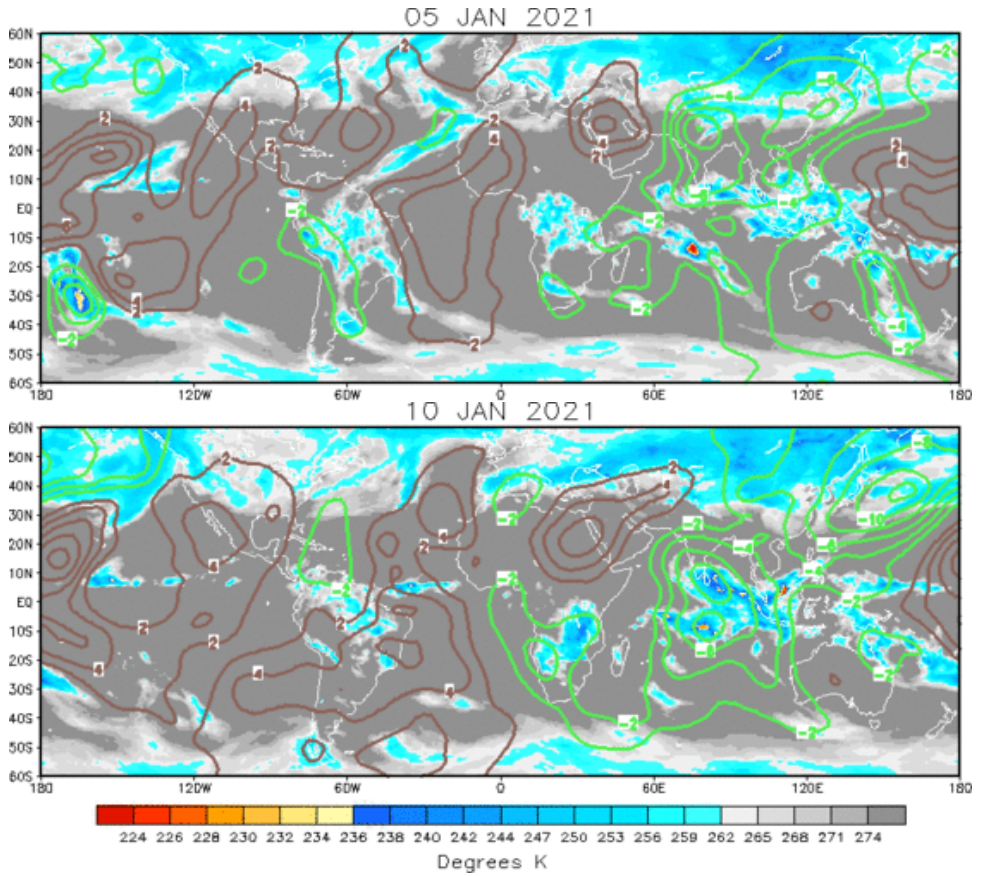
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).



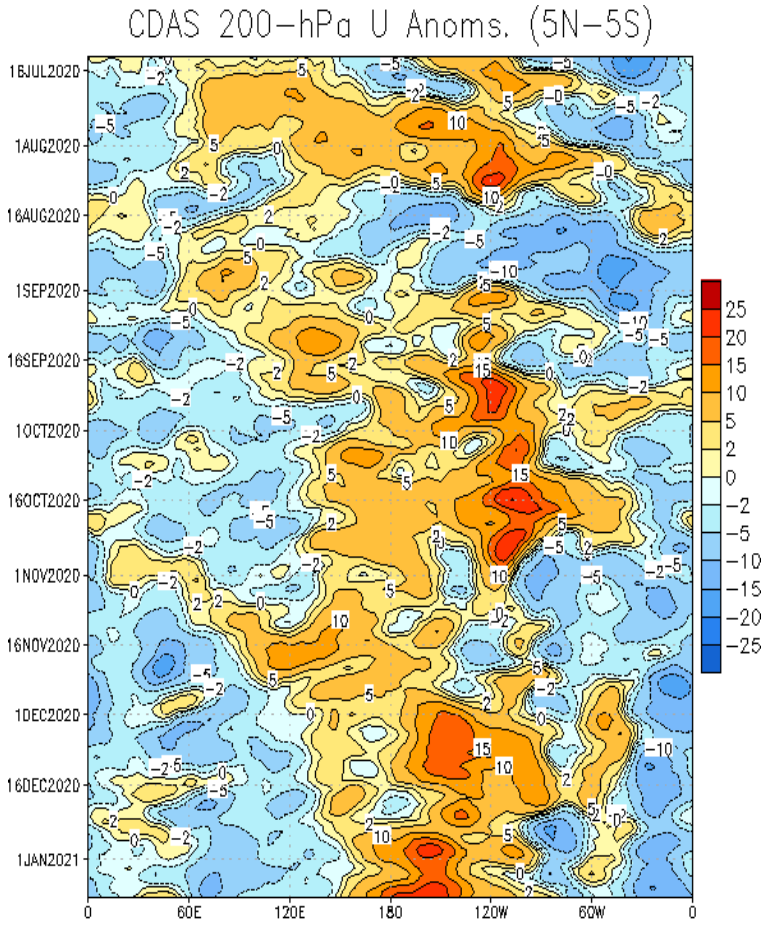


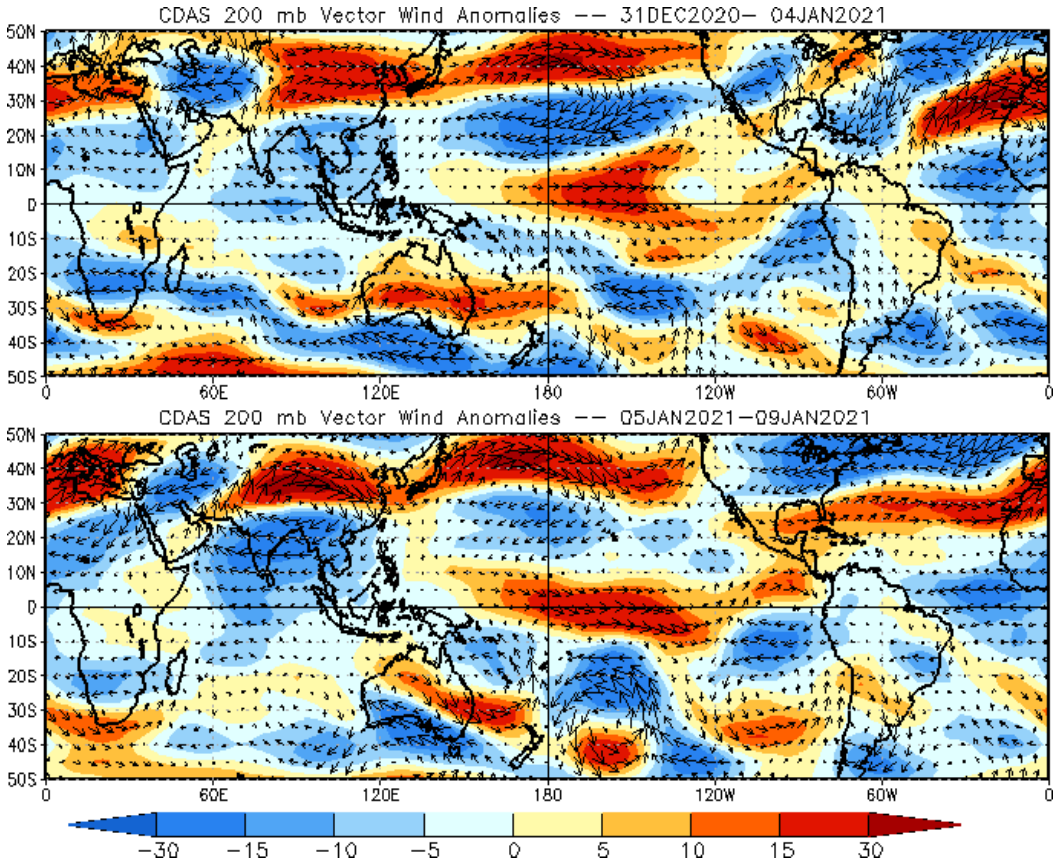
- The MJO had periods of activity during November and December, as midlatitude wavebreaking events onto the tropical Indian Ocean generated eastward moving convective envelopes.

- Since mid-December, the low-frequency La Niña base state has been the dominant feature, but there is still some evidence of fast moving, eastward propagating features in the tropical convective pattern.

200-hPa Wind Anomalies

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



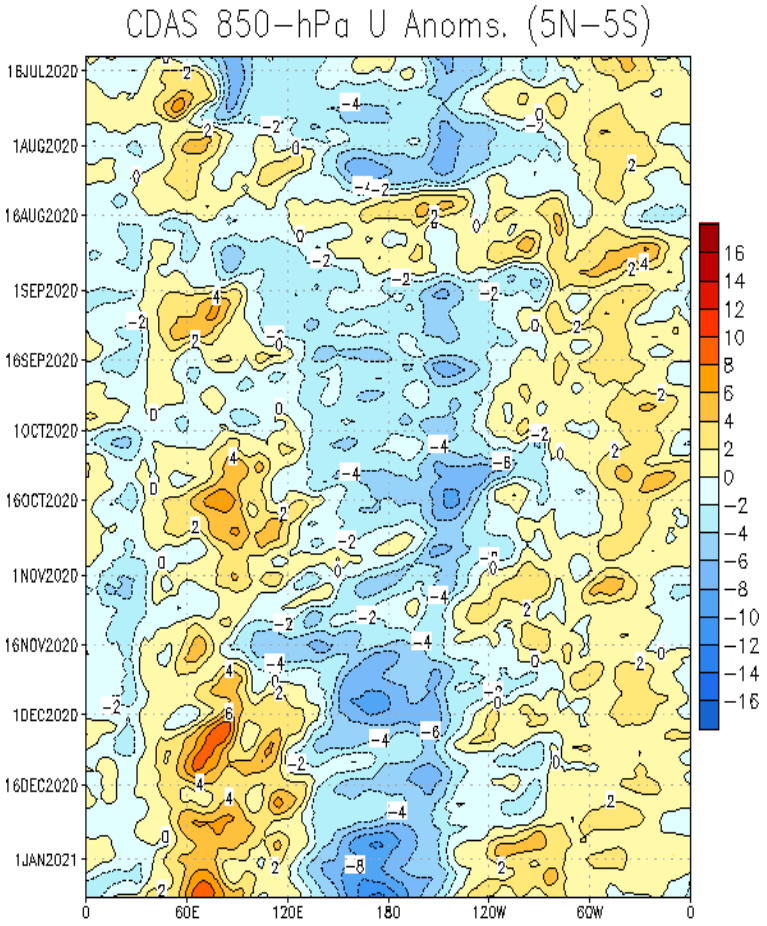


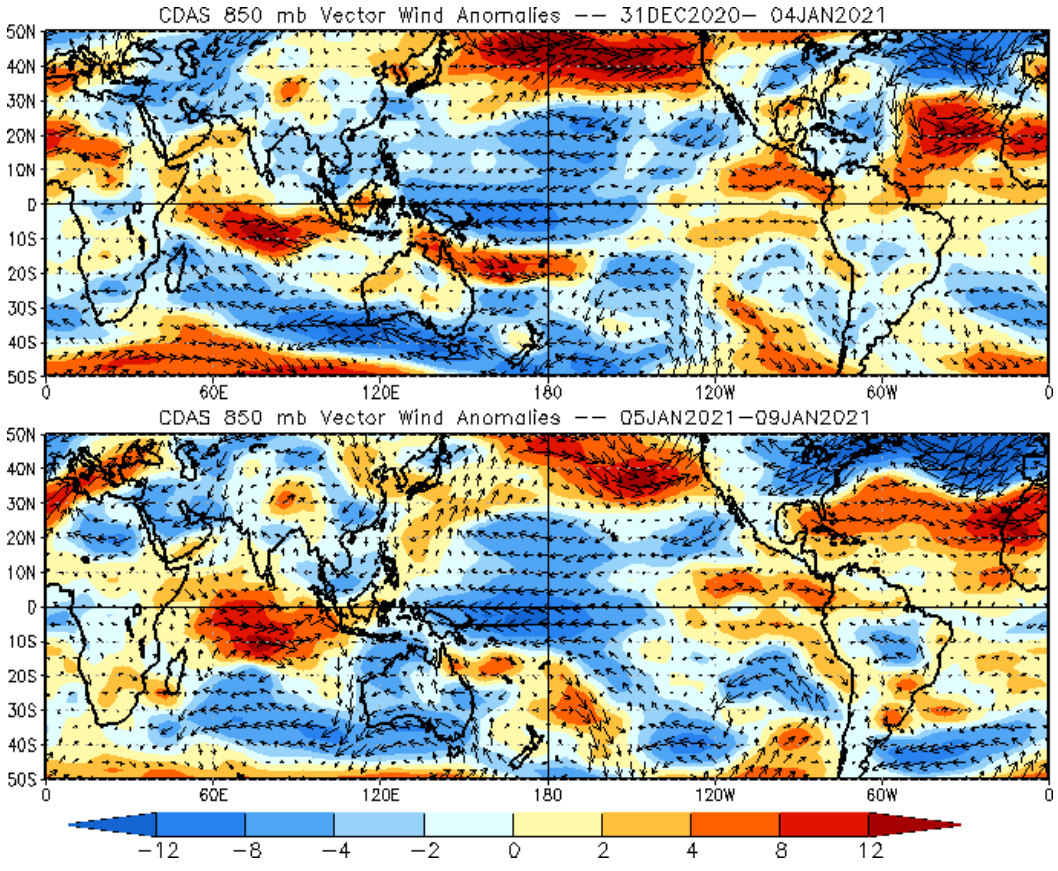
- Anomalous westerlies have strengthened over the Central and Eastern Pacific since late December, which can be traced to mass being transported onto the equator near the Date Line from the extratropics.

- A pattern change towards increased blocking is evident over eastern North America and the North Atlantic.

850-hPa Wind Anomalies

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

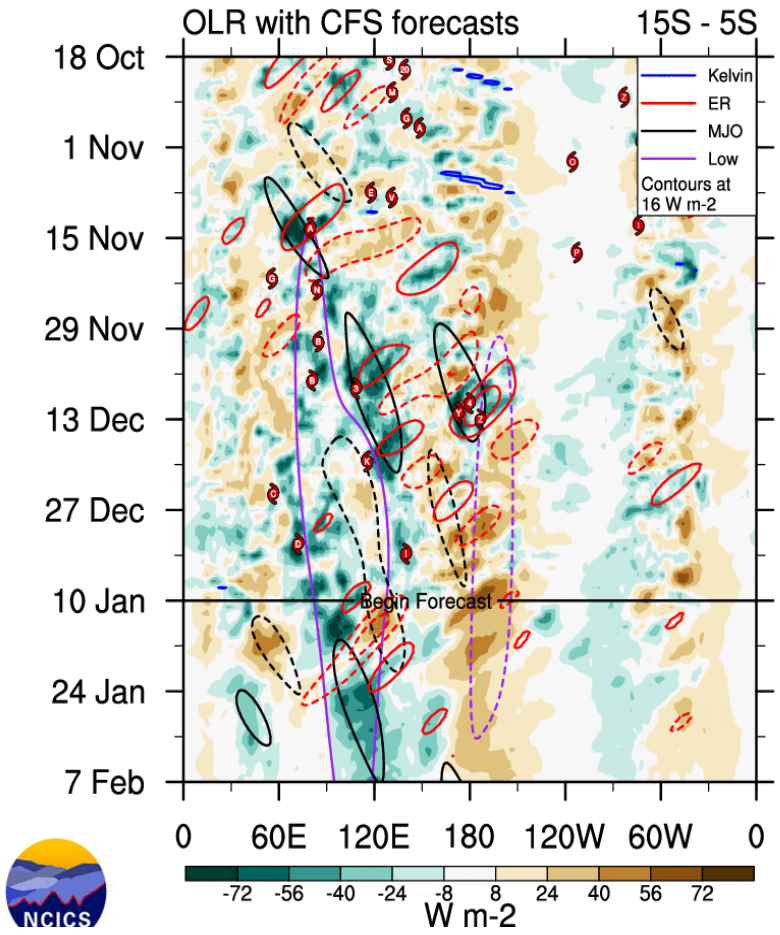


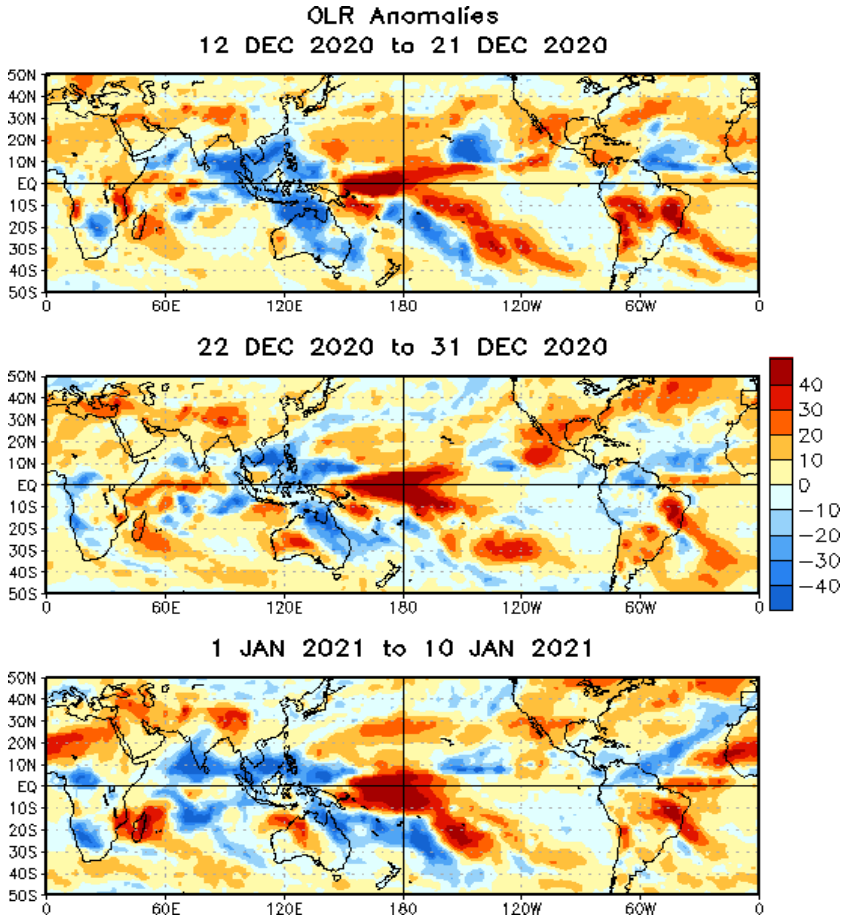


- Enhanced convergence along the equator near 120E is tied to the low-frequency state.
- Westerly winds increased over the equatorial Indian Ocean in recent days.

Outgoing Longwave Radiation (OLR) Anomalies

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

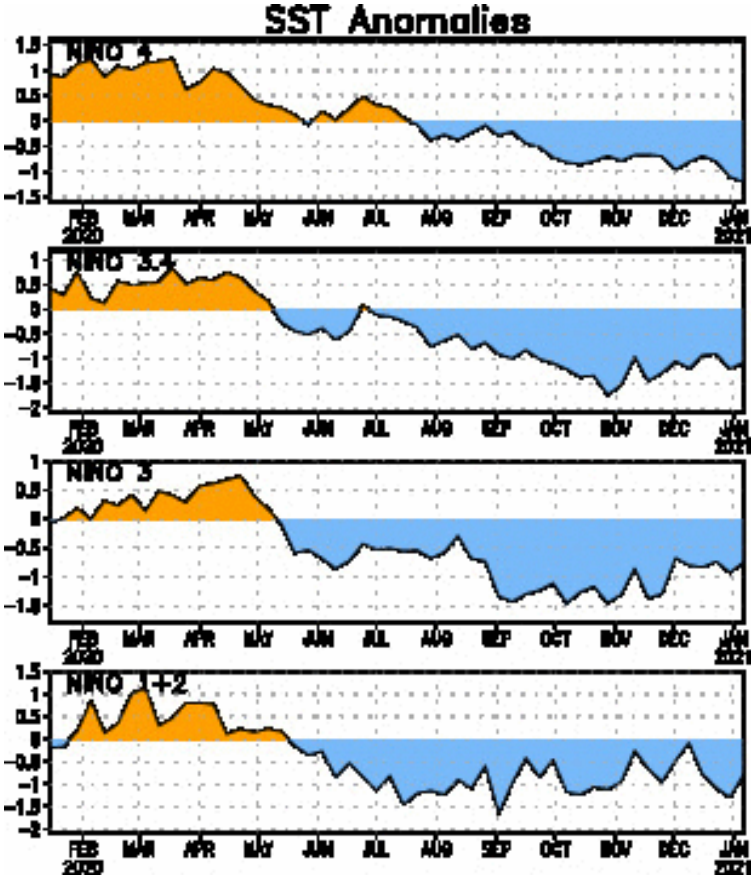


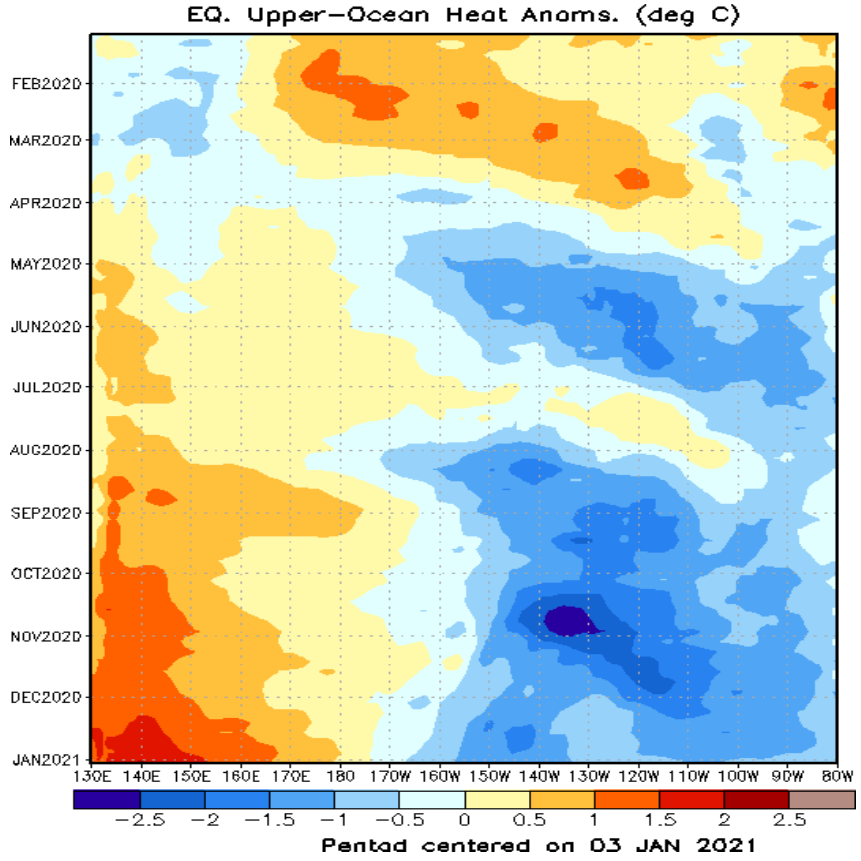


- Convection has been established over the Maritime Continent since mid-December in association with warm sea surface temperatures and the ongoing La Niña.

- Convection has increased over the Indian Ocean, with the CFS depicting a slow eastward propagation of this envelope, similar to what was observed during November and December.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



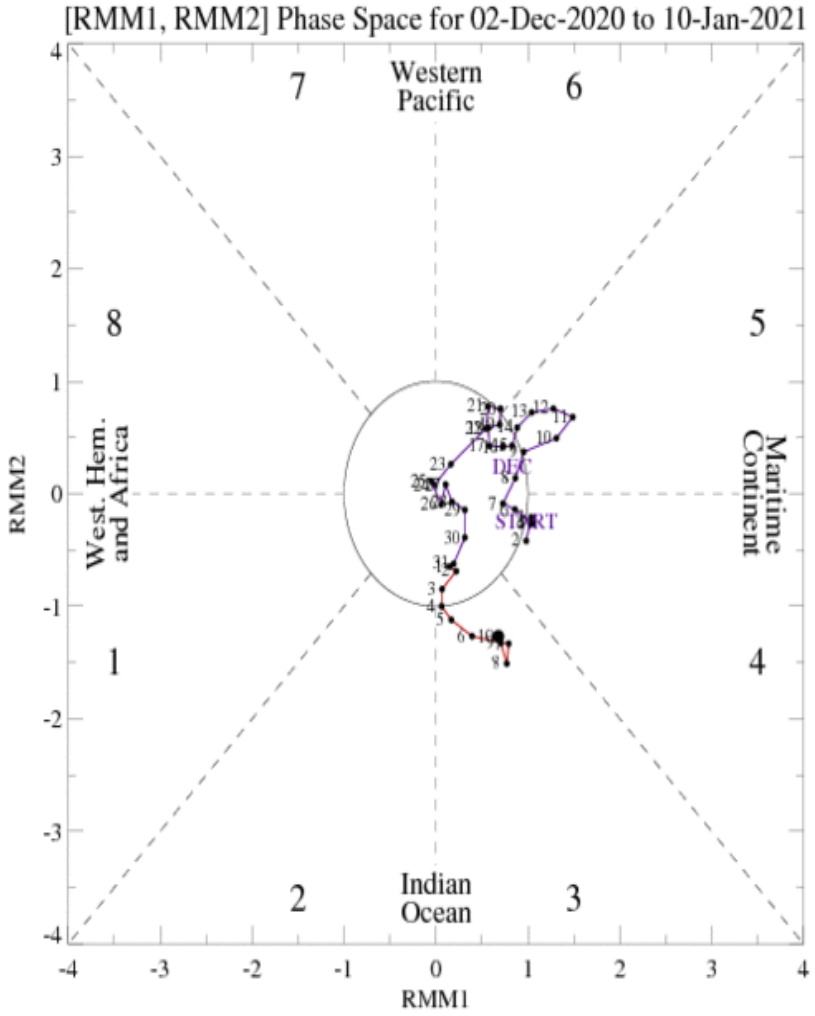


- Following destructive interference with the base state by a downwelling Kelvin wave during July, the subsequent upwelling phase pushed the Pacific into La Niña conditions.

- Cold anomalies have shifted slightly westward across the central Pacific since November.

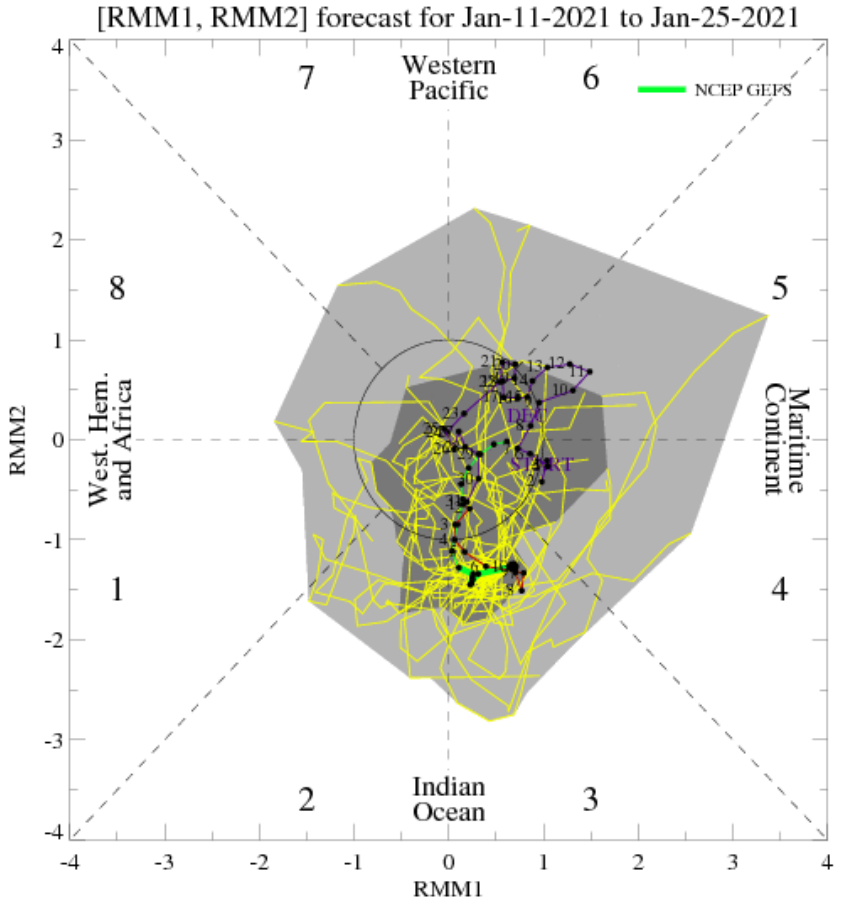
MJO Index: Recent Evolution

- The RMM index amplified over the past few days, depicting an enhanced convective envelope over the Indian Ocean.
- Robust eastward propagation of this enhanced envelope has not yet been established.

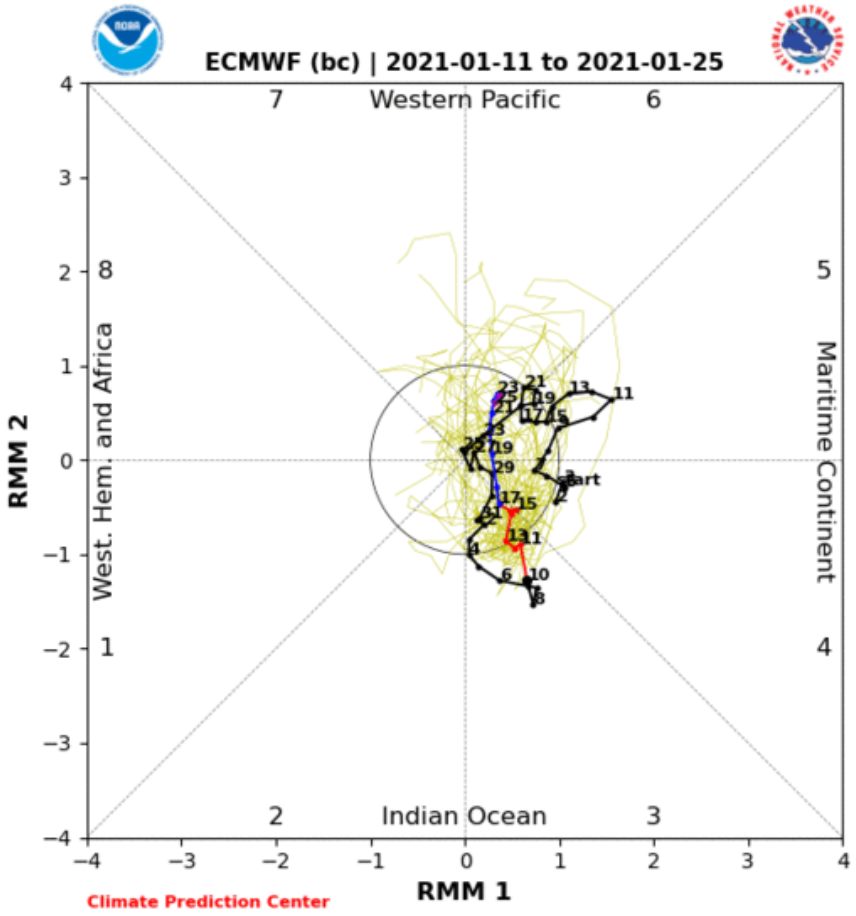


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



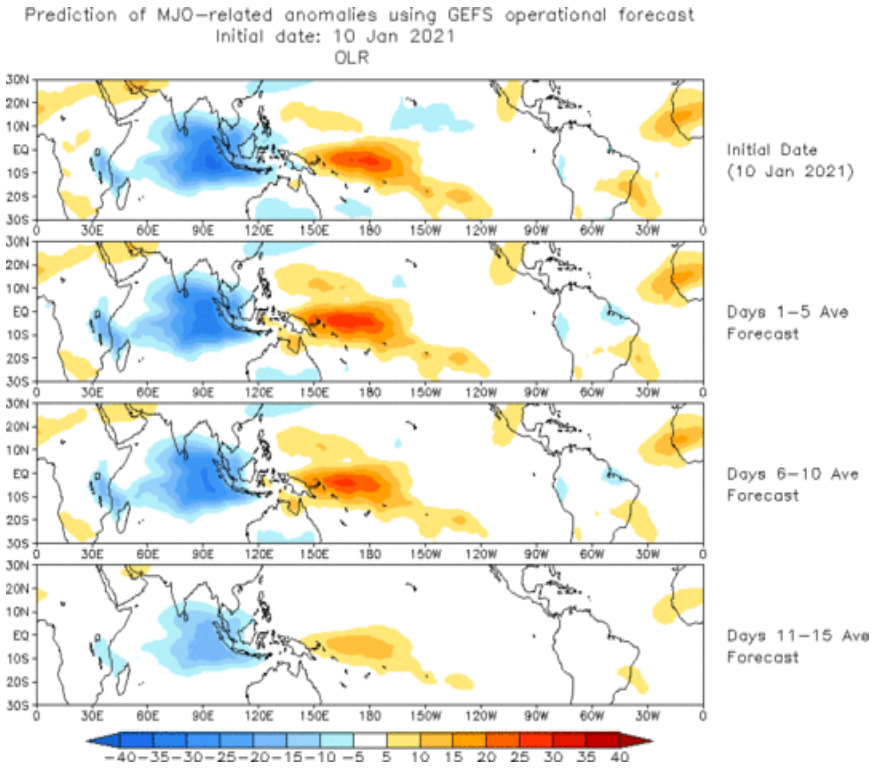
ECMWF Forecast

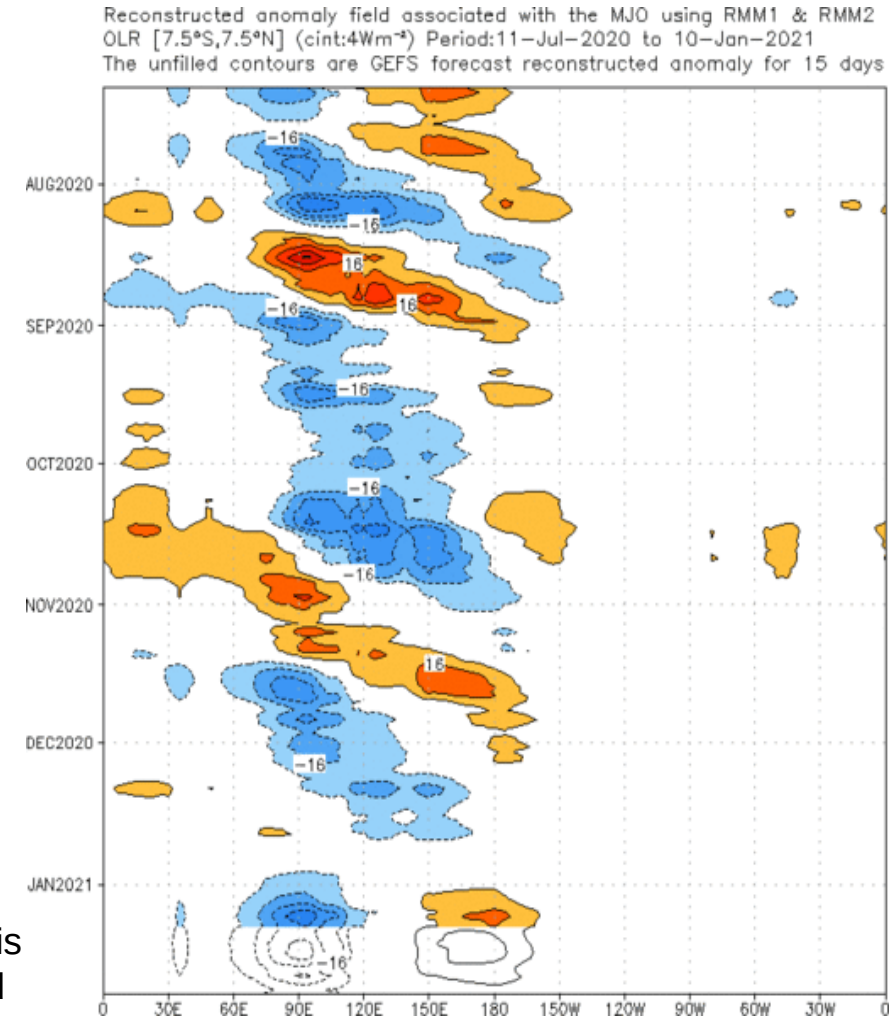
- The GEFS ensemble members show considerable spread, with members in all eight of the RMM-based MJO phases over the next two weeks. The overall signal appears to favor a weakening MJO signal, suggesting the recent Indian Ocean enhancement will not overcome the La Niña base state.

- The ECMWF forecasts show a bit more robust eastward propagation of the emerging signal over the next two weeks, but most ensemble members substantially weaken the signal's amplitude.

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.)

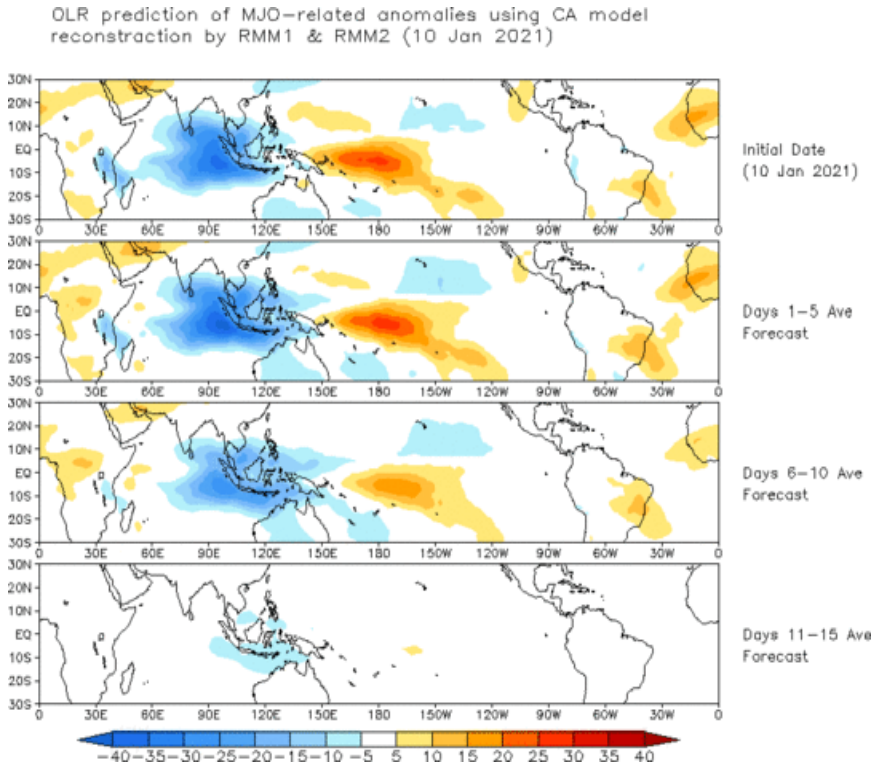


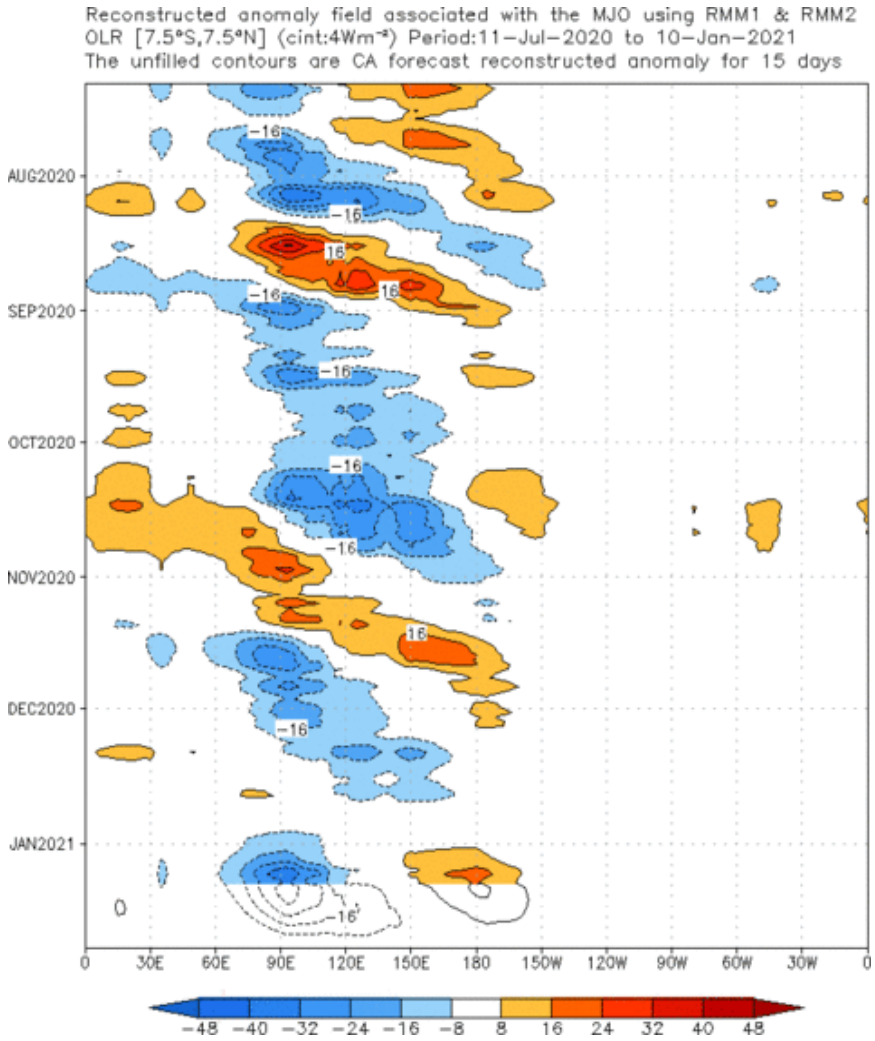


- This GEFS forecast shows convective anomalies displaced to the west of the canonical La Niña Maritime Continent enhancement. However, there is little eastward propagation of these anomalies, and they gradually weaken over the two-week period.

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.)

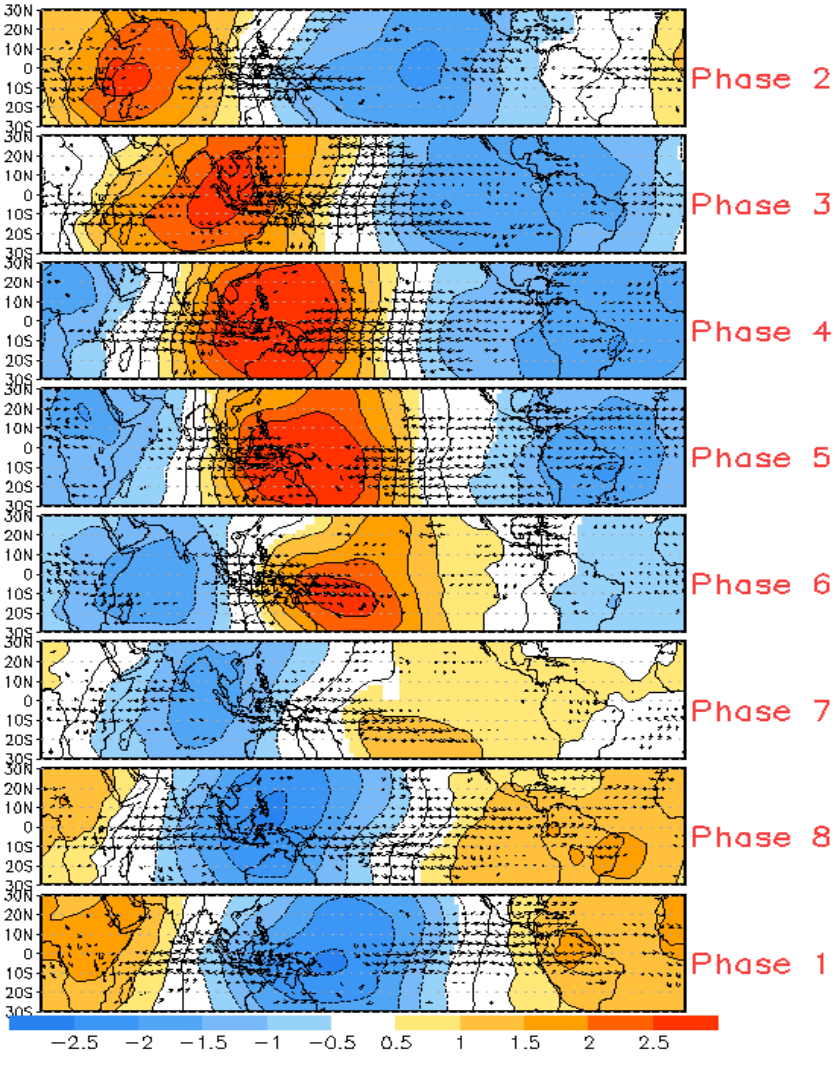




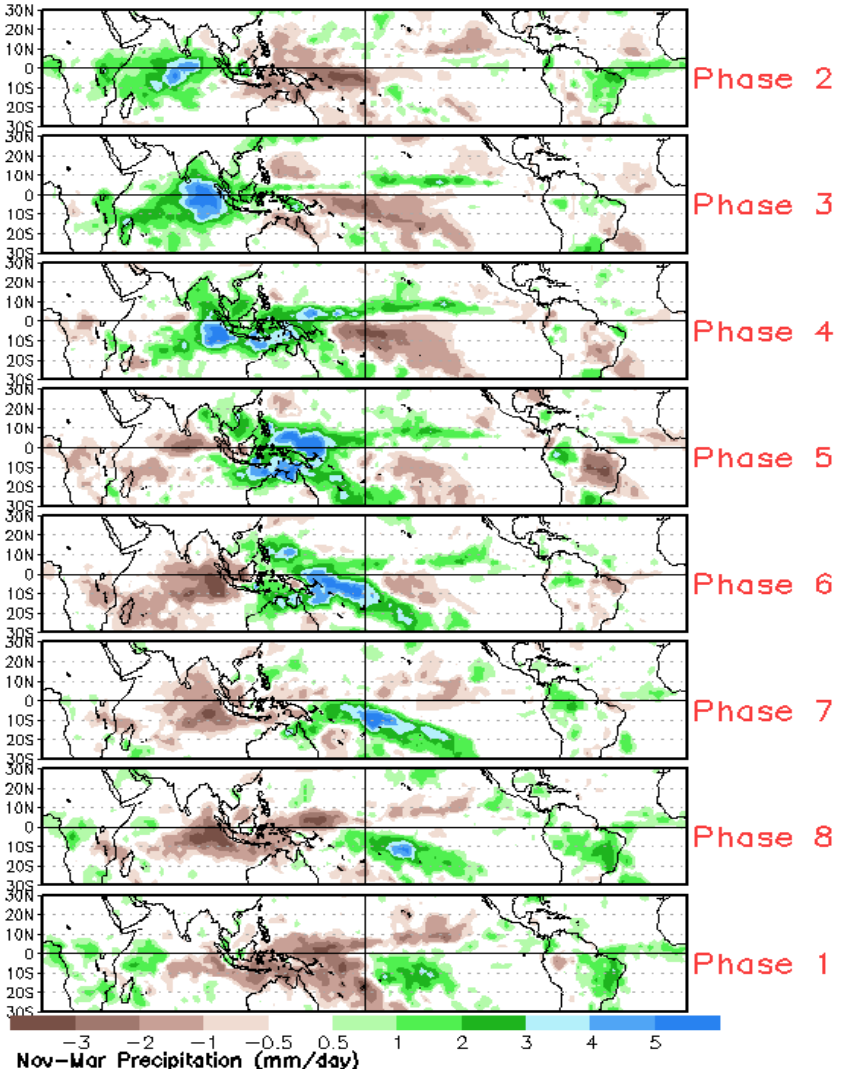
- The constructed analog MJO forecast is more progressive than the GEFS, but weakens the signal significantly once it reaches the Pacific.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



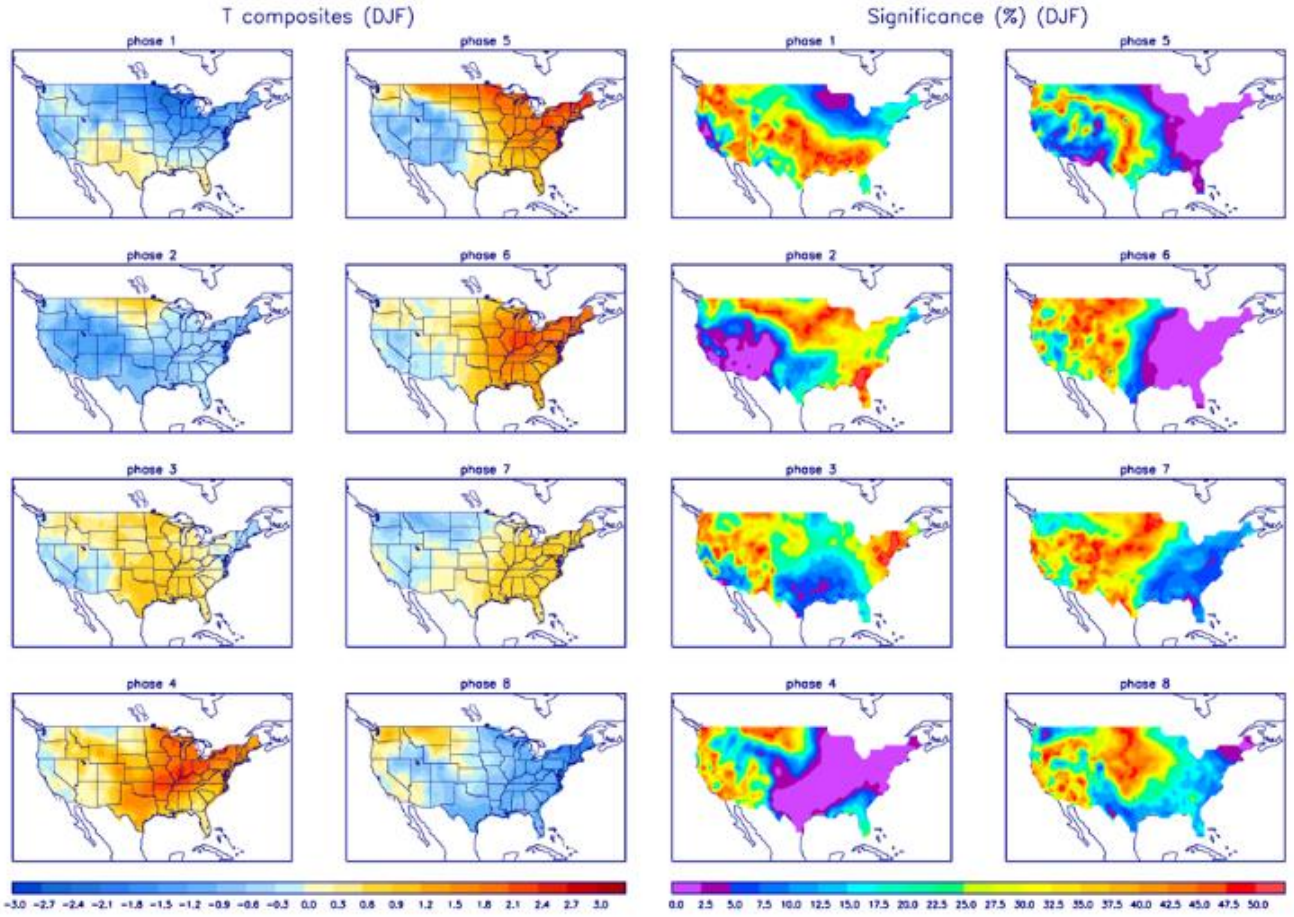
Precipitation Anomalies



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.

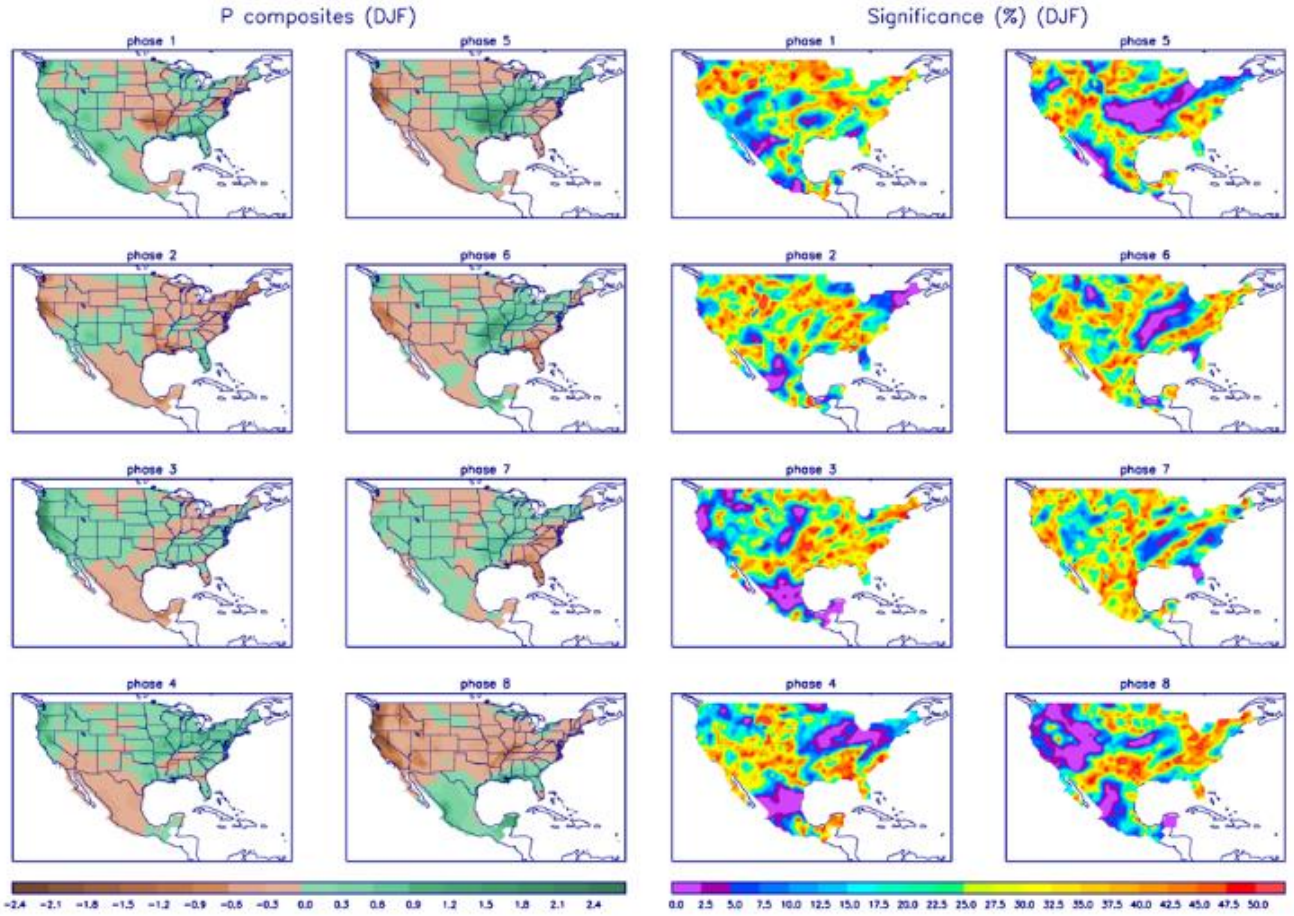


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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