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

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
3 January 2022

Overview

- MJO propagation has stalled near the Date Line, likely due to the destructive interference with La Niña.

- Dynamical models exhibit large spread regarding the evolution of the MJO over the next 2 weeks, with a meandering intraseasonal signal depicted in the GEFS and ECMWF ensembles.

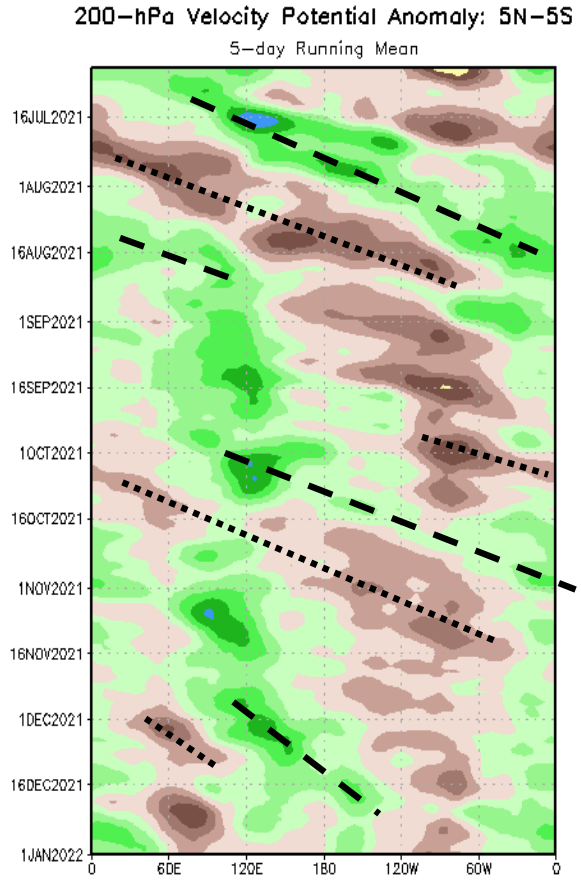
- Tropical cyclone formation remains possible across the South Pacific during the next week, consistent with the current MJO signal.

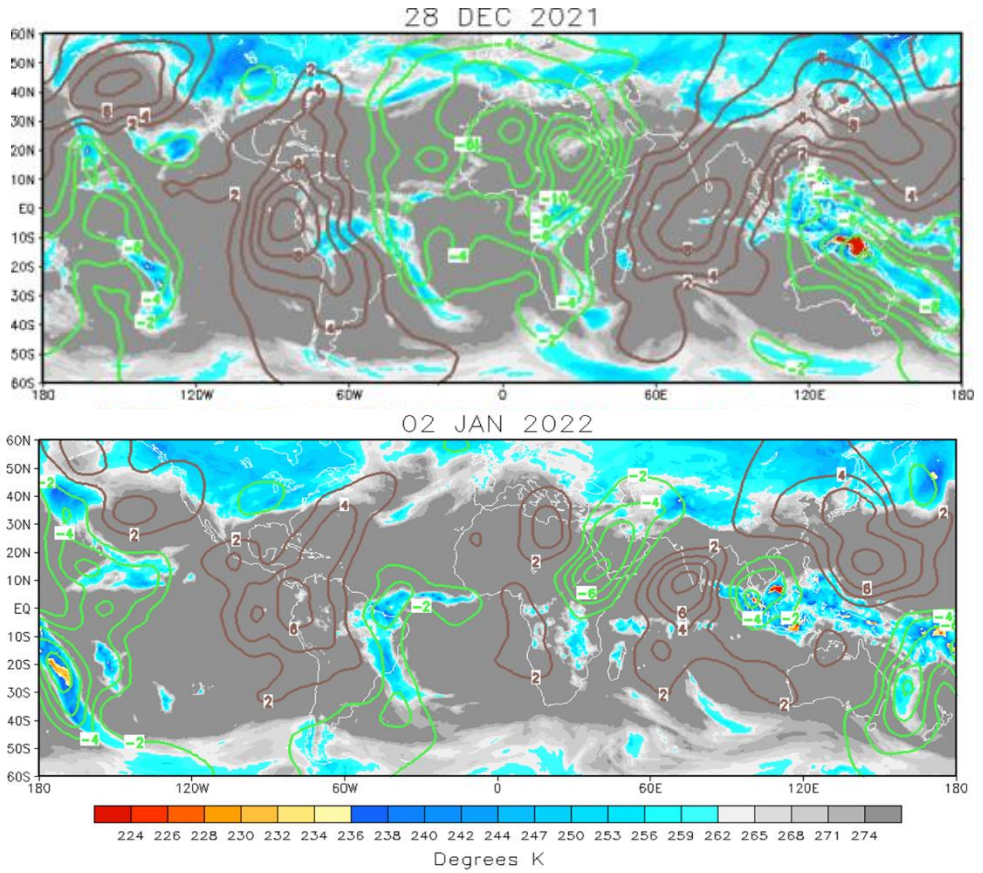
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

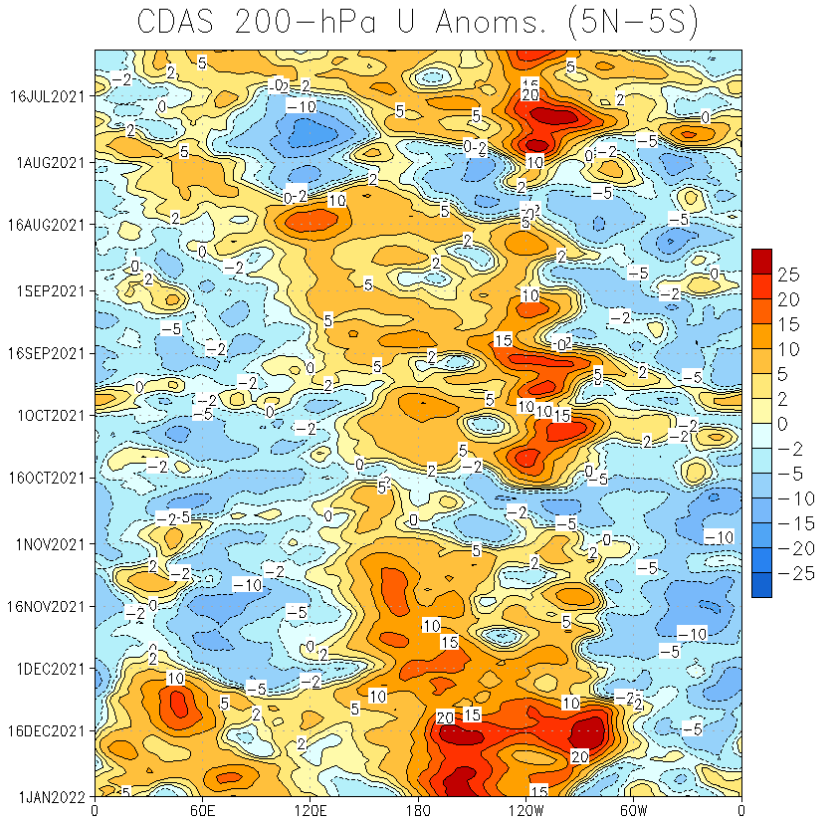


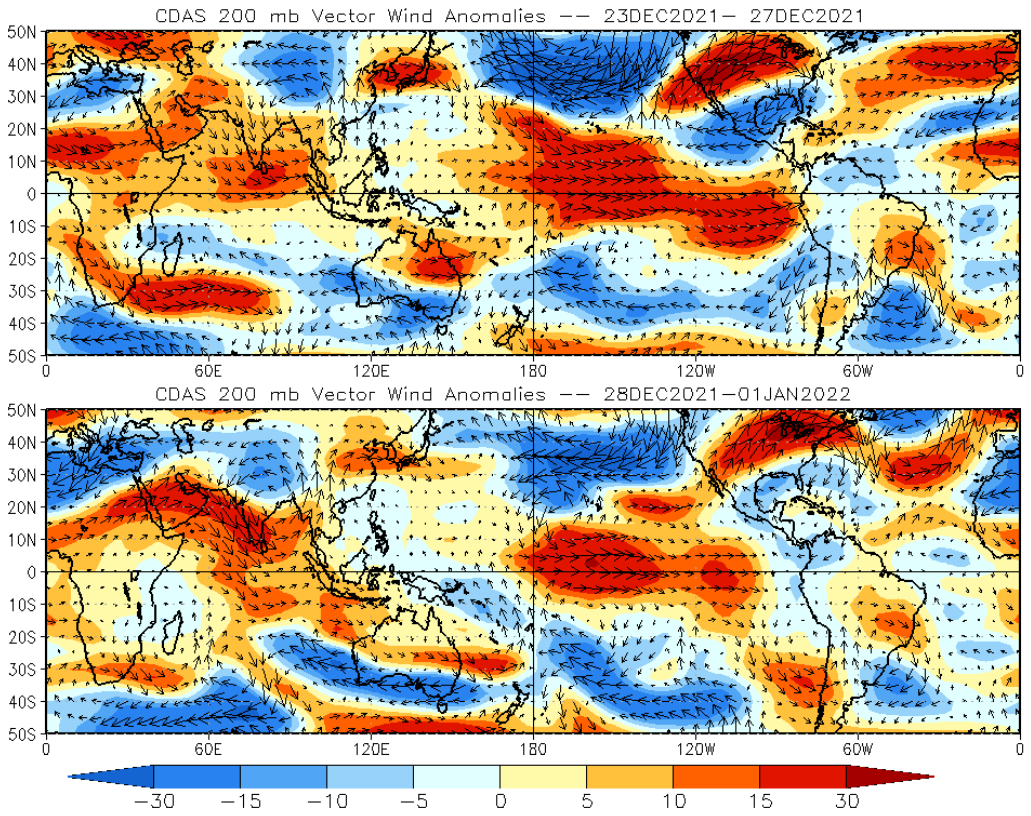


- Eastward propagation of the intraseasonal signal appears to have stalled as of late December.
- The spatial pattern of the upper level velocity potential remains incoherent, with an enhanced convective signal persisting over the southwestern Pacific.
- The enhanced convective signal across Africa and the Middle East has weakened, with continued suppressed convection observed over much of the Americas and the Indian Ocean.

200-hPa Wind Anomalies

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

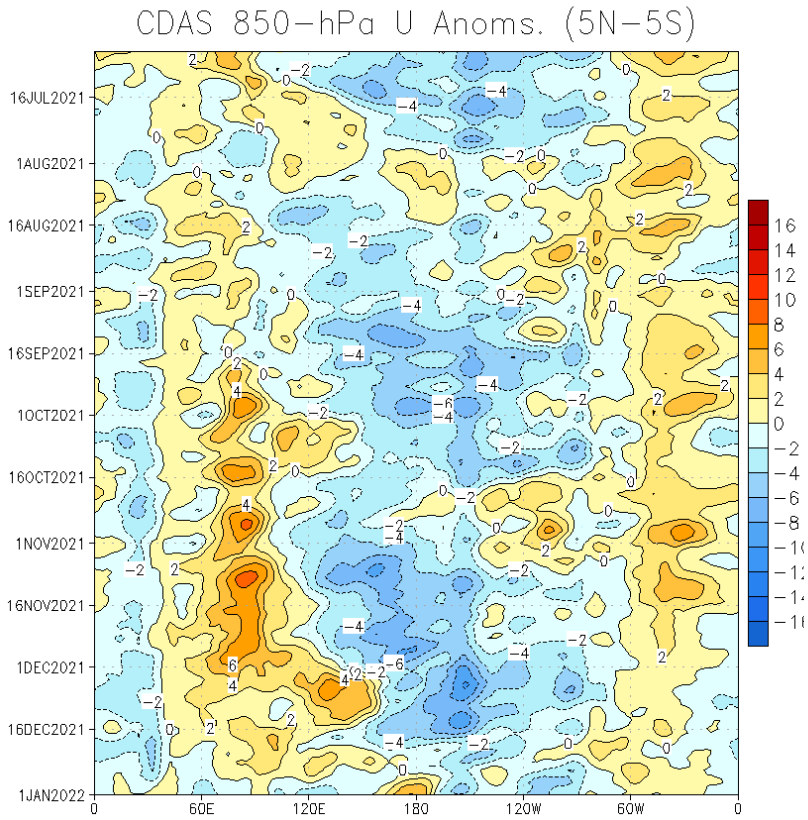


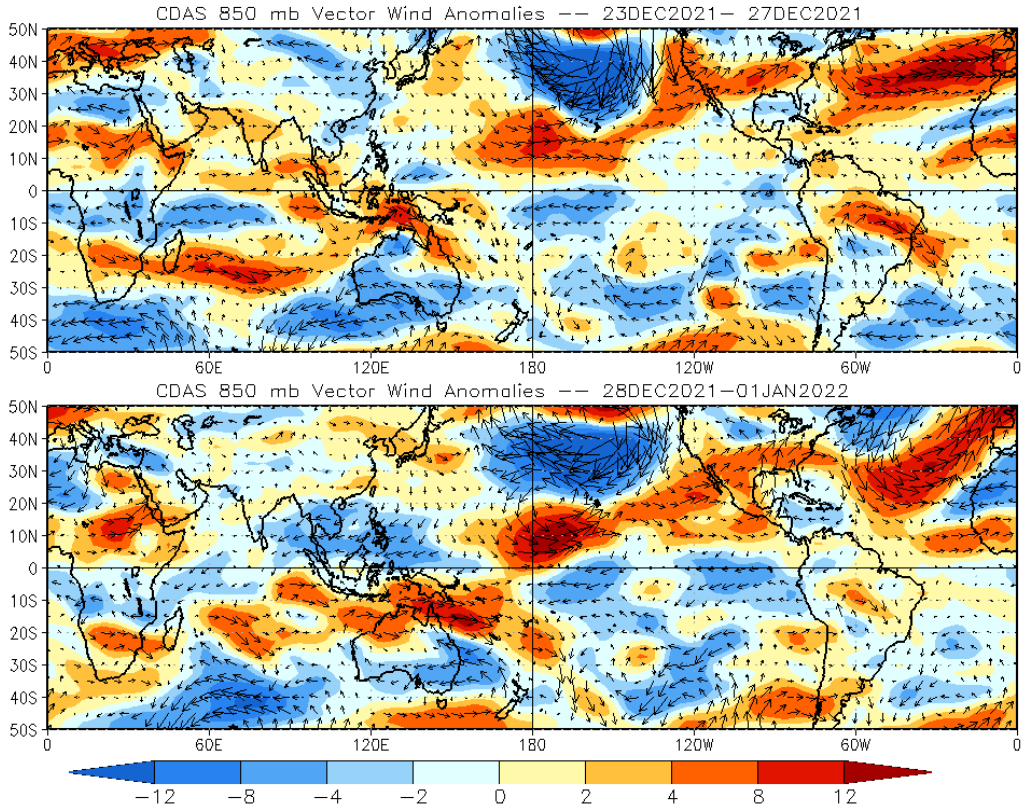


- Anomalous upper-level westerlies remain quite robust throughout the equatorial Pacific, consistent with the low frequency base state.
- Anomalous westerlies have expanded across the Indian Ocean and Maritime Continent in the wake of the departing MJO.
- An active wave train remains in place across the mid-latitudes, with a strong upper level jet observed over western North America.

850-hPa Wind Anomalies

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



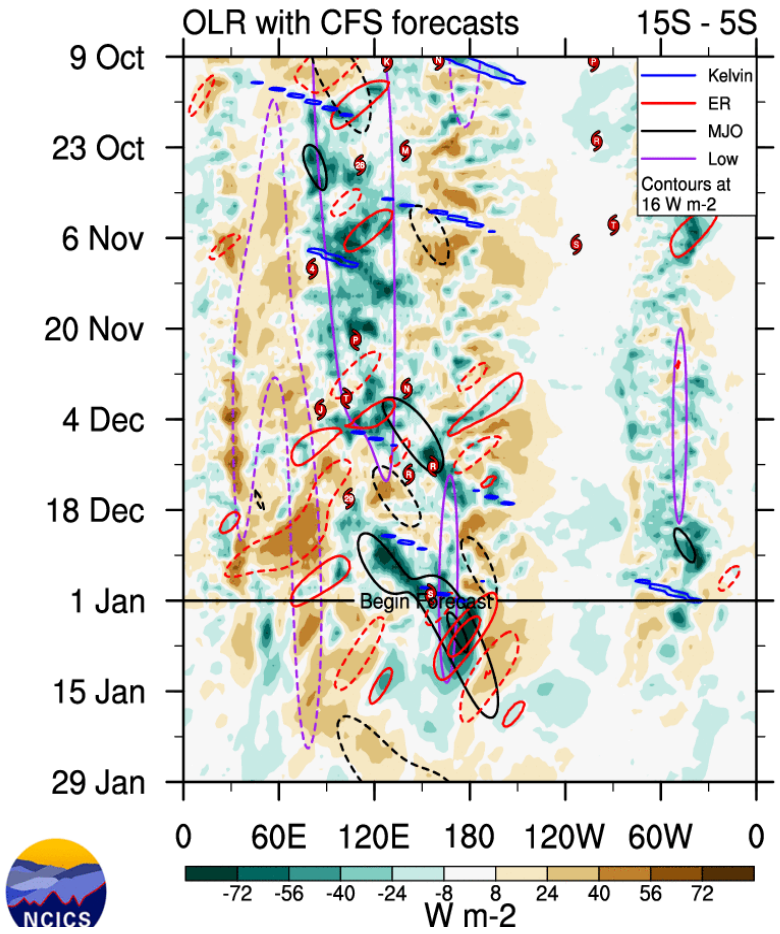


- Persistent cyclonic circulation continues across the North Pacific, leading to weaker trades along the equatorial Pacific.

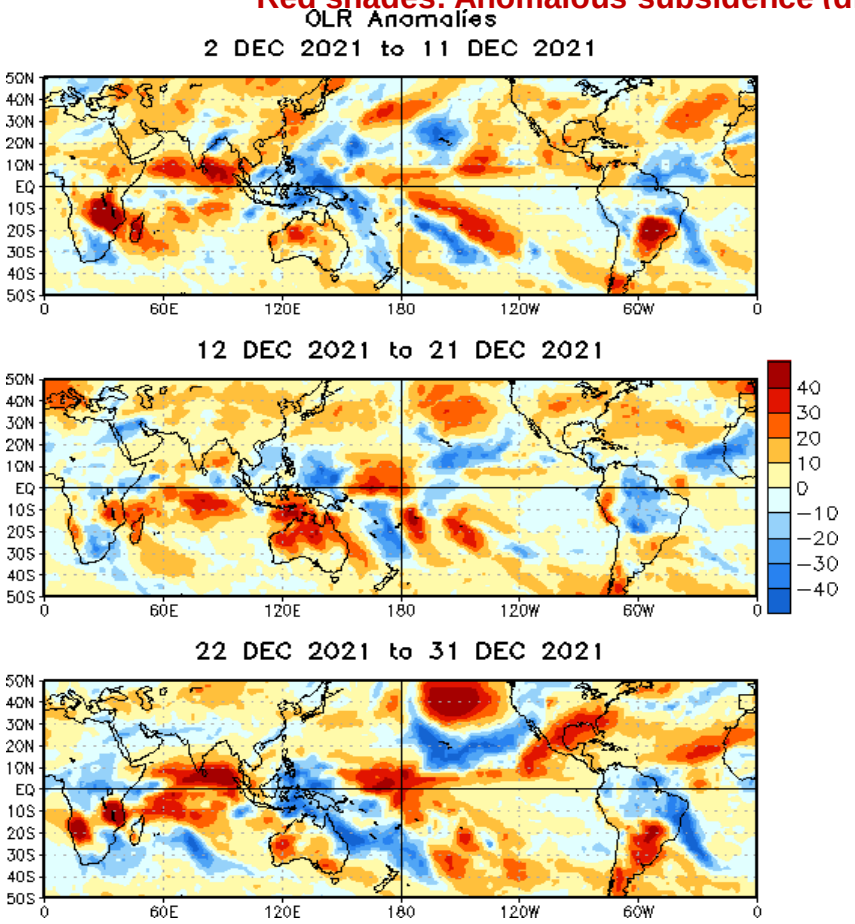
- Anomalous easterlies have developed over the Western Pacific and Maritime Continent, mainly north of the equator.

Outgoing Longwave Radiation (OLR) Anomalies

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



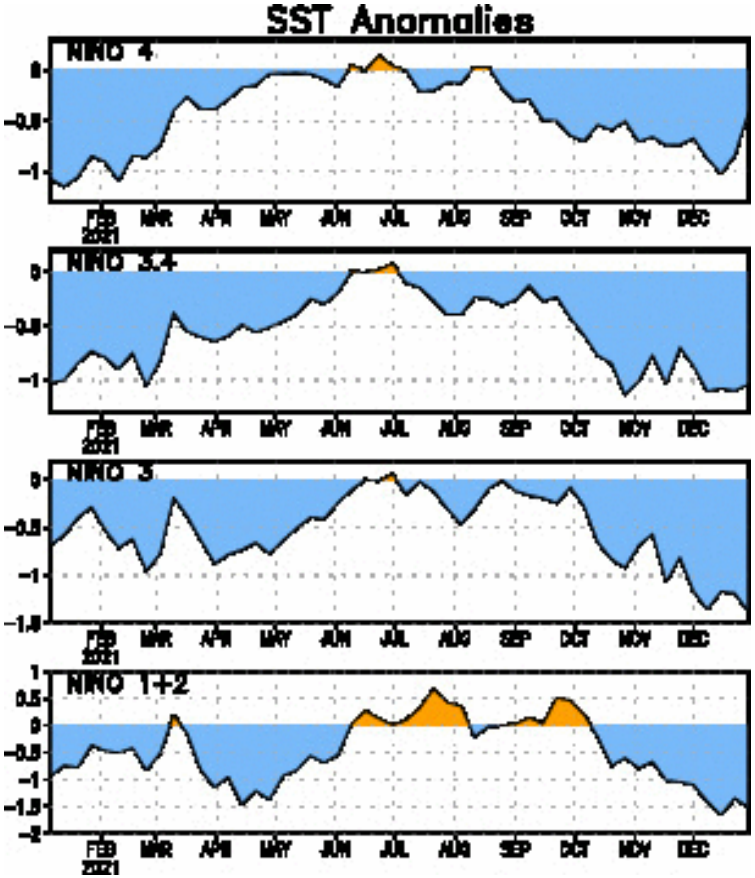
Blue shades: Anomalous convection (wetness)
Red shades: Anomalous subsidence (dryness)

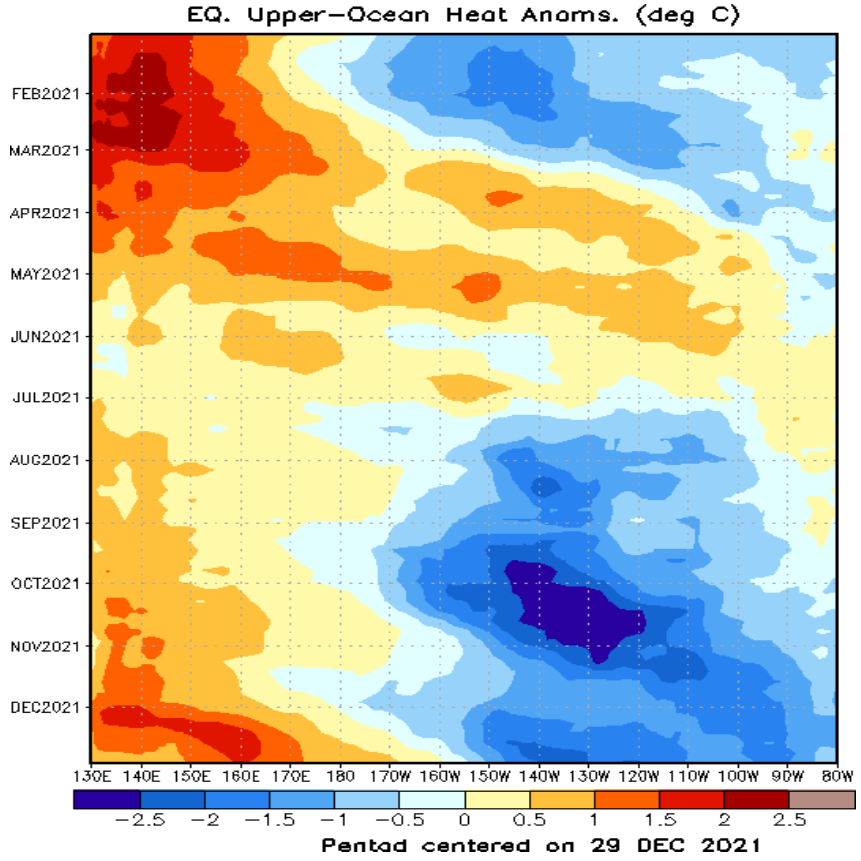


- Enhanced Rossby Wave activity and the low frequency La Niña base state continue to destructively interfere with the MJO near the Date Line.

- During late December, enhanced convection expanded across the southwest Pacific with suppressed convection observed over the Indian Ocean, consistent with MJO phase 7.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

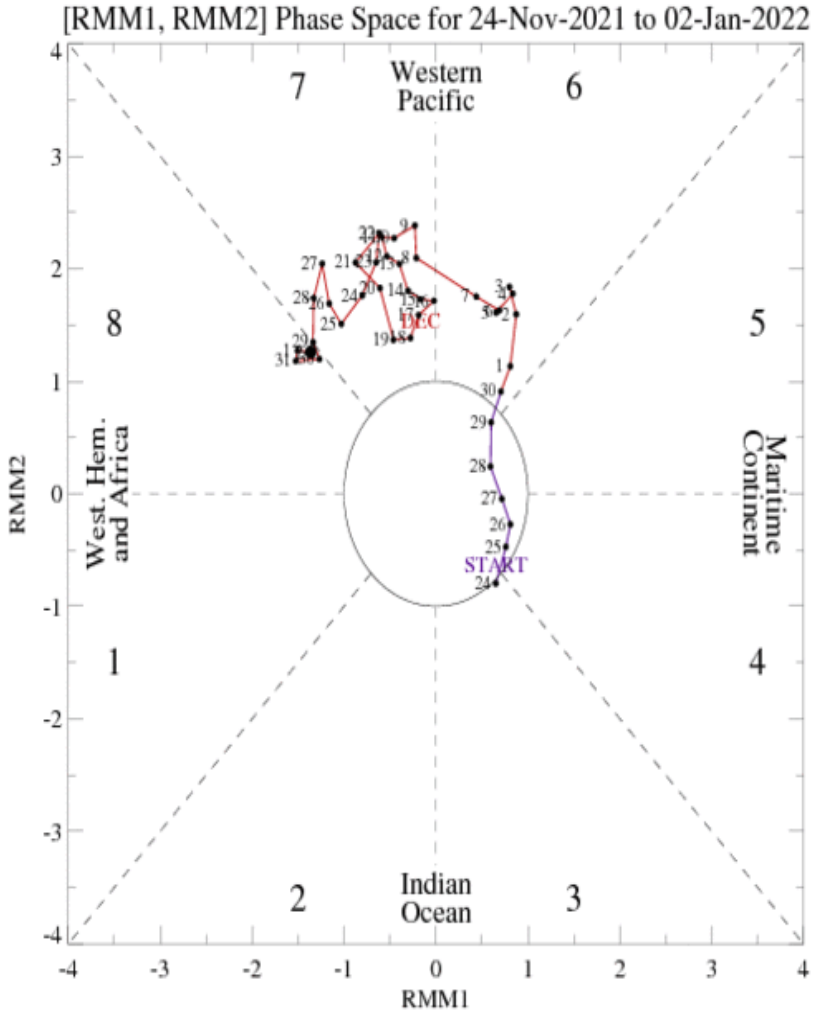




- Anomalously warm upper ocean heat content observed over the west-central Pacific during December due to a low level westerly wind burst and eastward propagating MJO.
- Although some of this anomalous warmth extended to the Date Line, subsurface temperature anomalies became more negative across the east-central Pacific in late-December.
- At the surface, below-normal temperatures continue to be observed within all Niño regions, though increasing temperatures have been observed in the Nino 4 region.

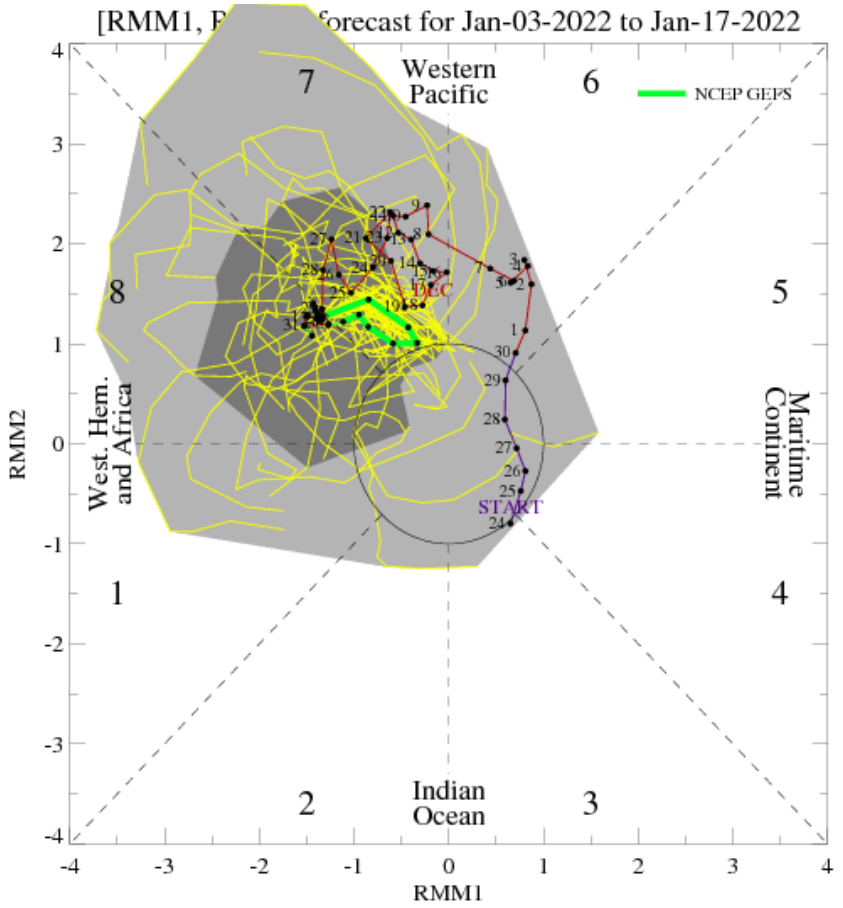
MJO Index: Recent Evolution

- The RMM based MJO index depicts a robust MJO event during the month of December across the Western Pacific.
- The intraseasonal signal has been meandering for the last few weeks, in part due to destructive interference with La Nina.

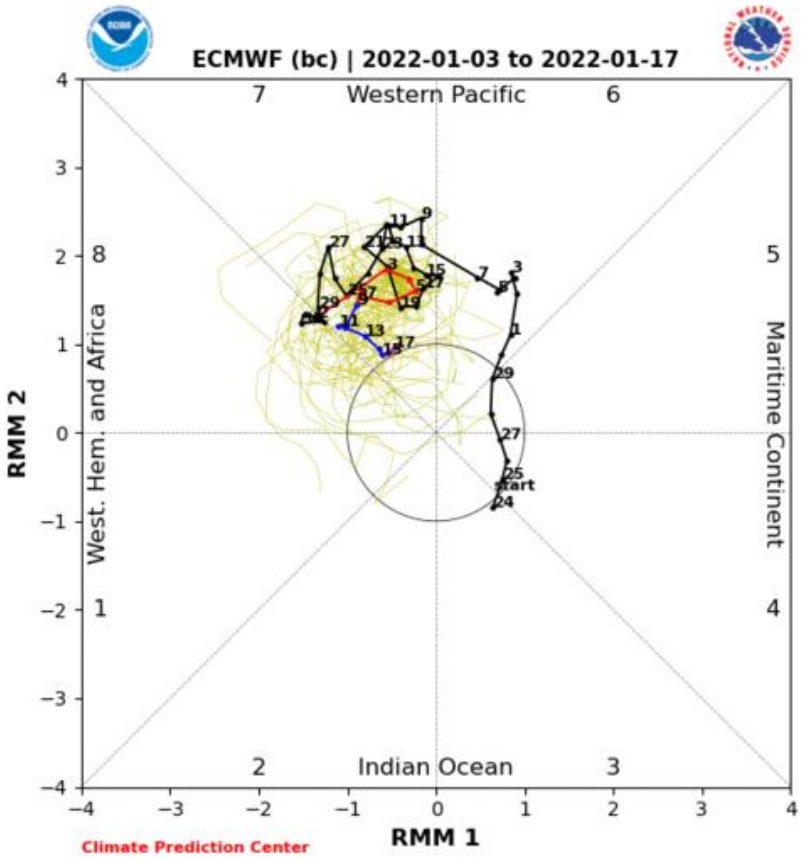


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

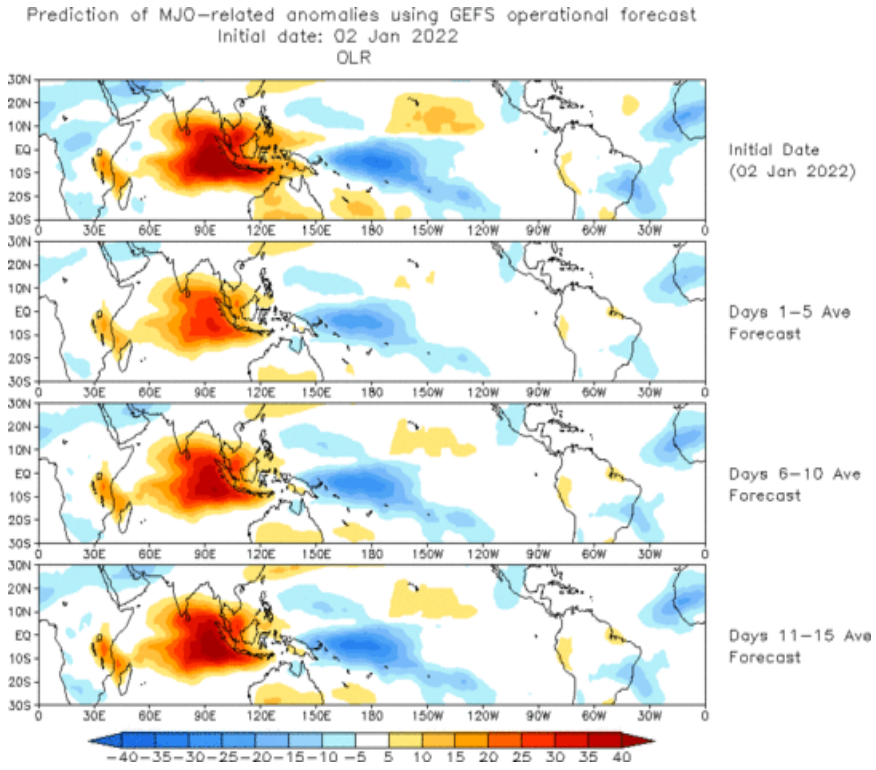


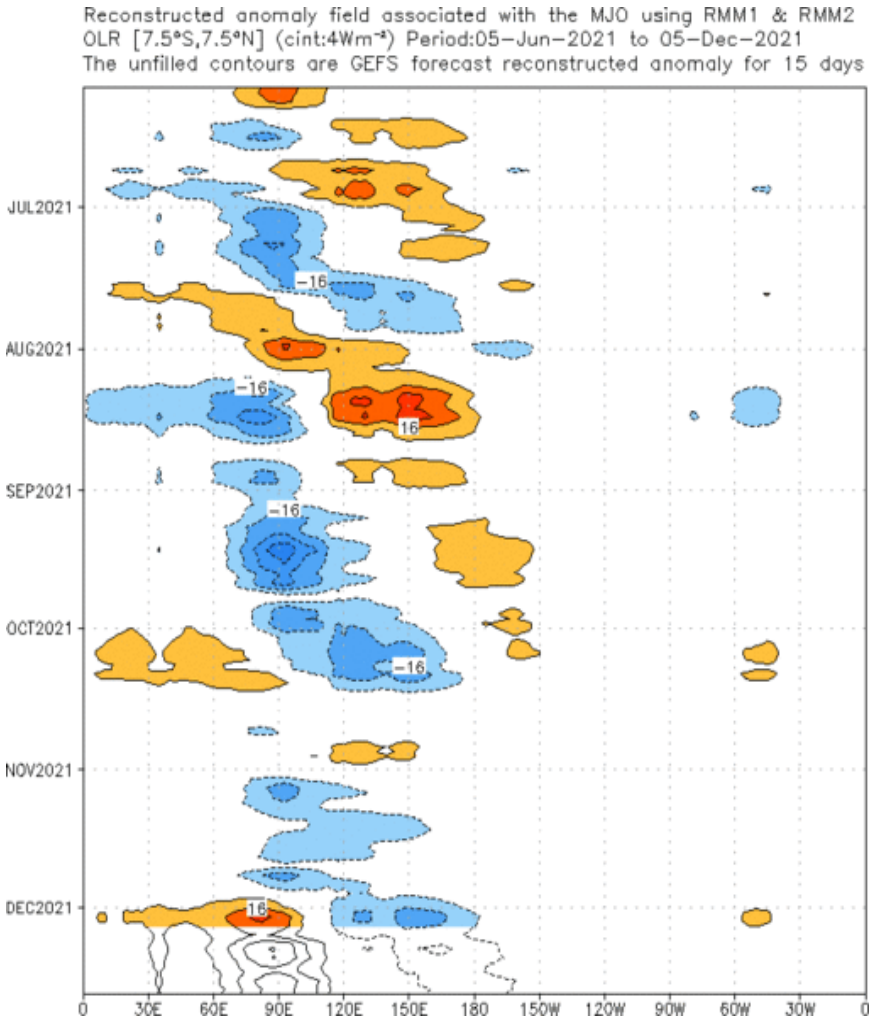
ECMWF Forecast

- Dynamical model guidance continues to suggest a variable MJO amplitude, with the signal continuing to meander within phases 7 and 8, with more weakening apparent in the ECMWF ensembles compared to the GEFS.
- As has been the case for the last several weeks, there is very large ensemble spread, particularly in the GEFS.

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.)

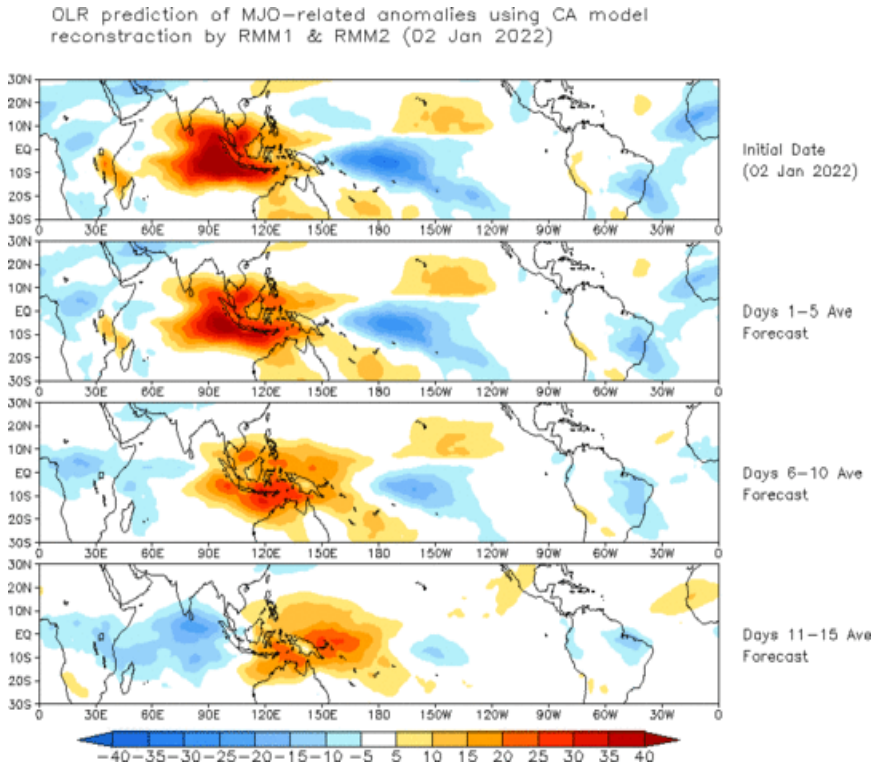


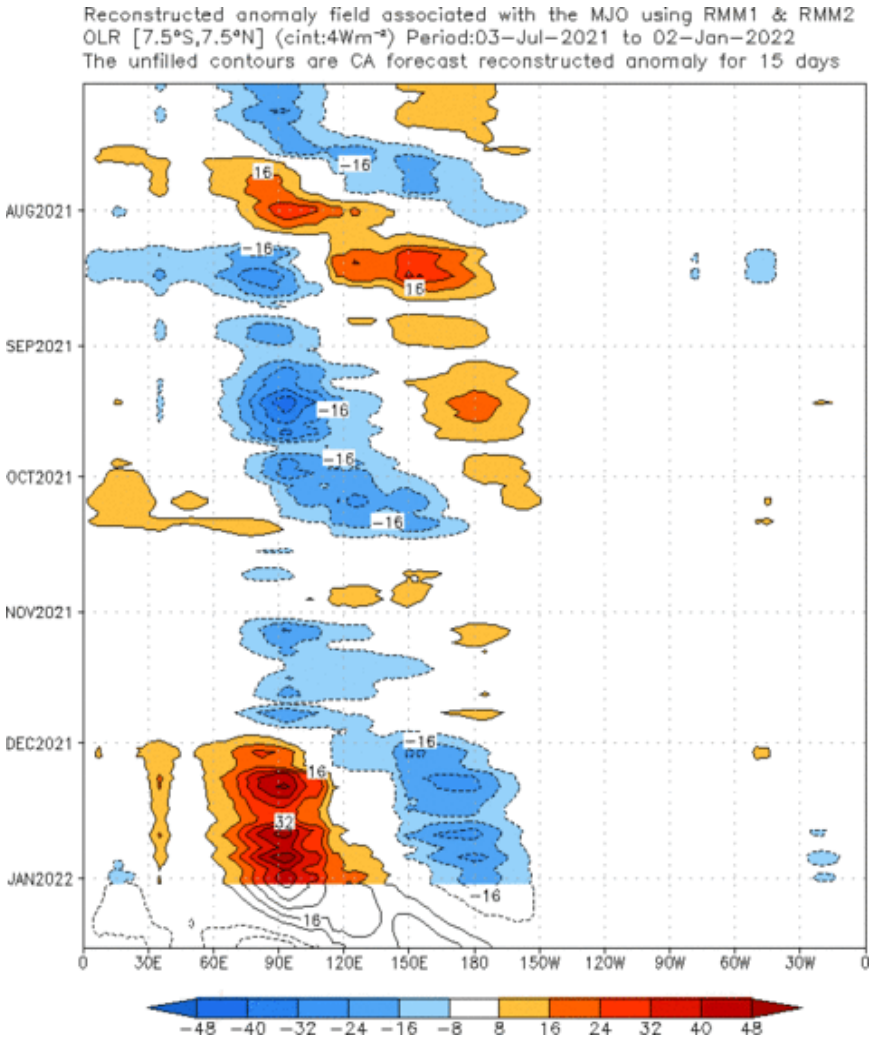


- The GEFS RMM-based OLR anomaly forecast depicts suppressed convection over the much of the Indian Ocean, and a slight retrogression of the enhanced convection over the Pacific during the next week.
- The enhanced convection increases in amplitude during week-2.

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.)

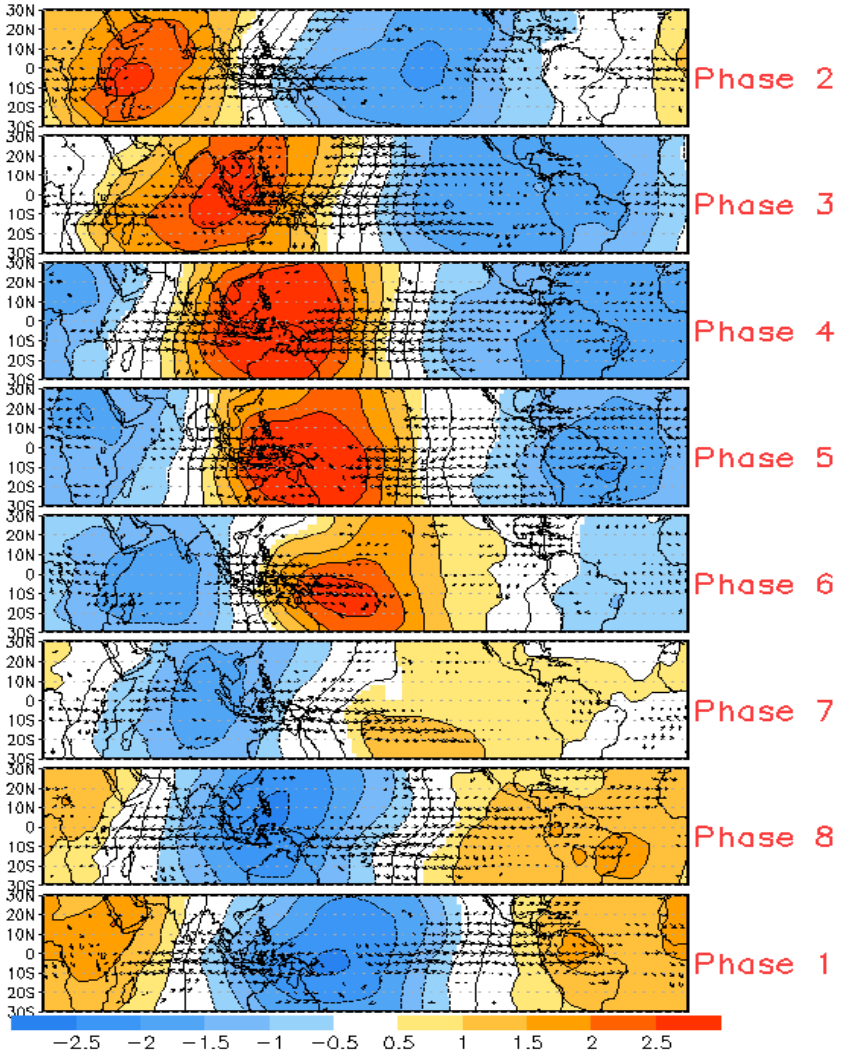




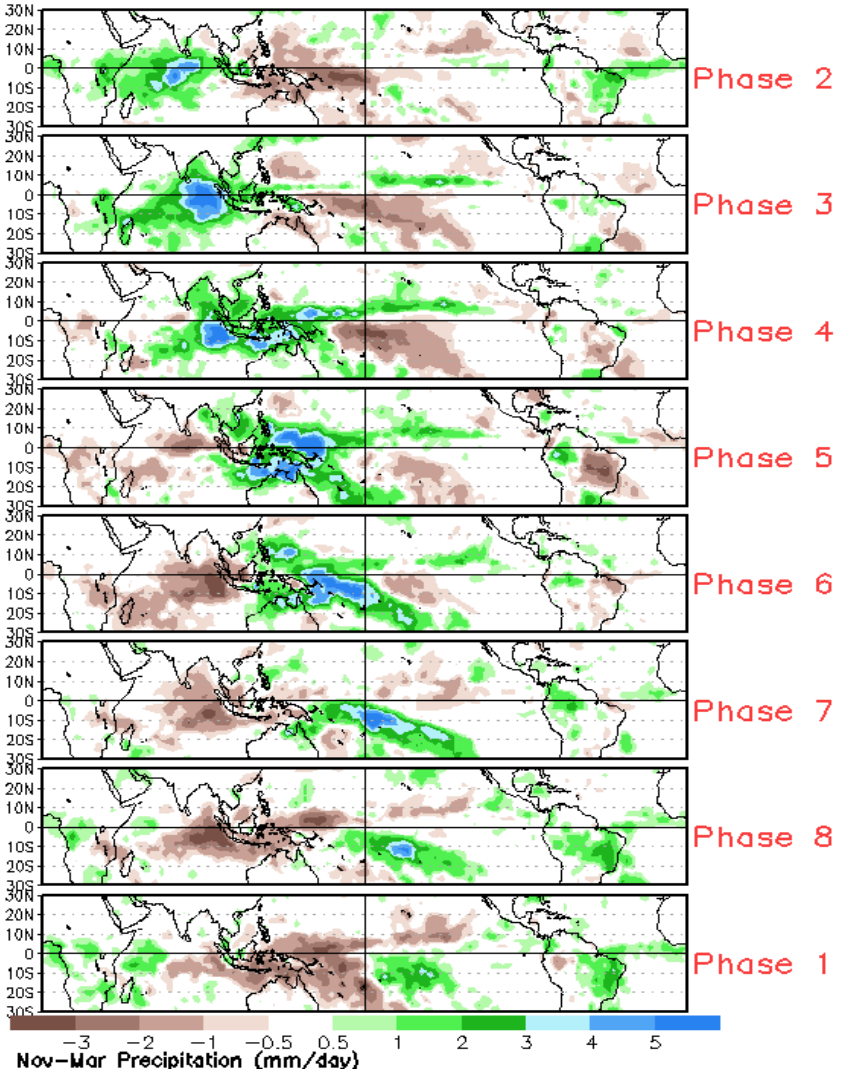
- The constructed analog tool depicts a more progressive MJO signal than the GEFS, with enhanced convection reemerging over Africa and the Indian Ocean and suppressed convection shifting east into the West Pacific.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



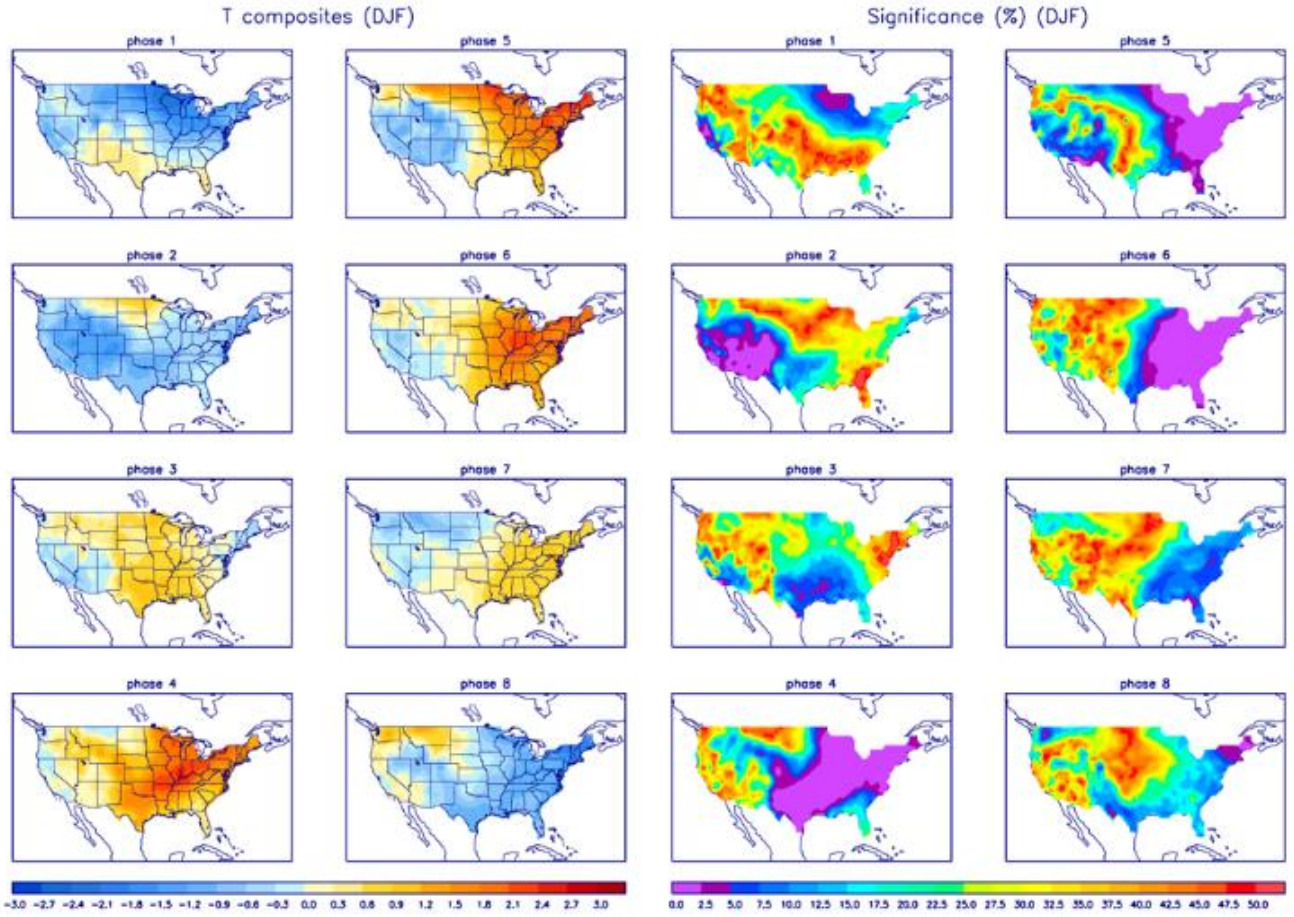
Precipitation Anomalies



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.

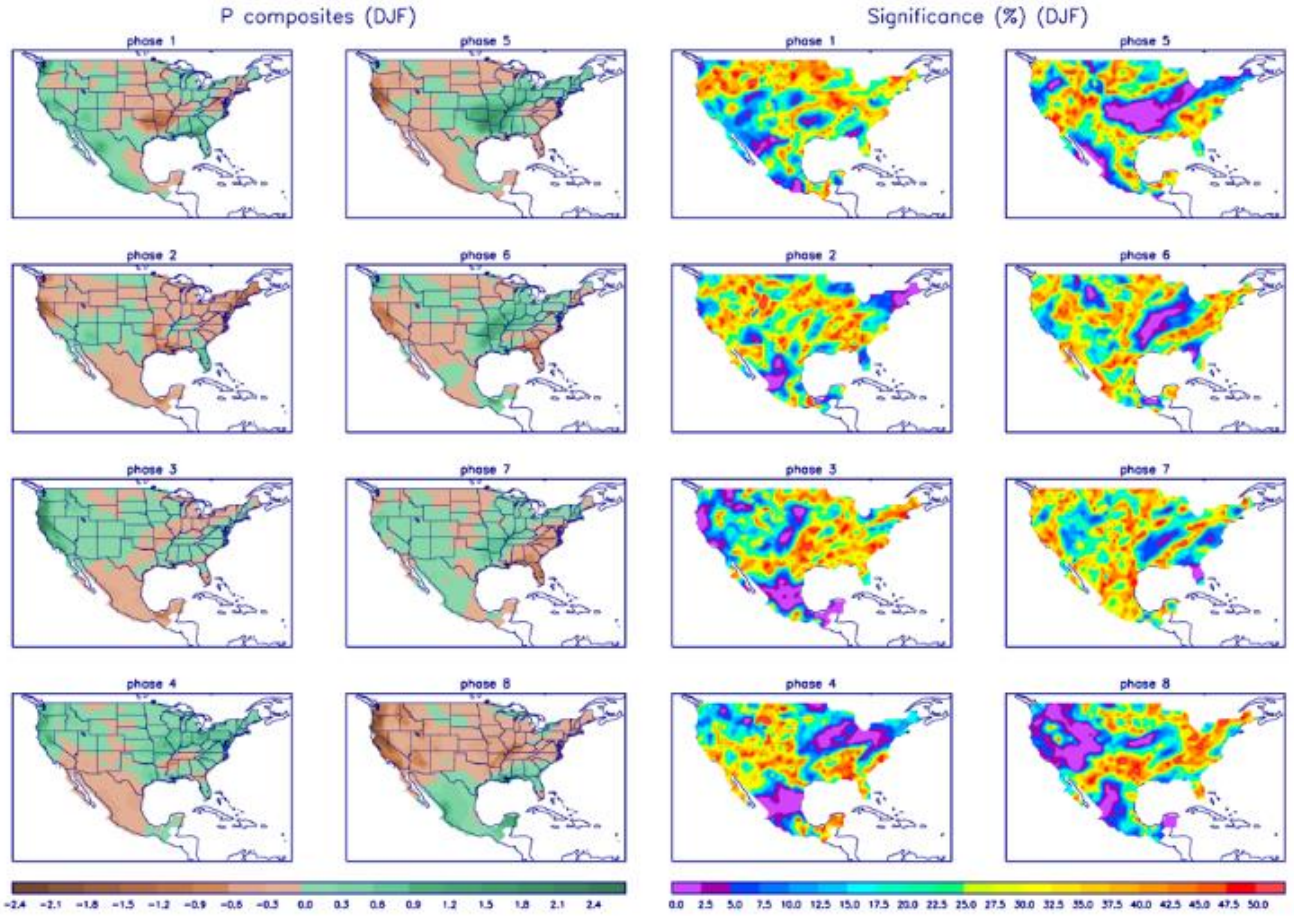


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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