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

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

Overview

- Since the beginning of February, there are signs of a developing MJO over the Indian Ocean as the spatial pattern of 200-hPa velocity potential anomalies becomes more coherent throughout the global tropics.

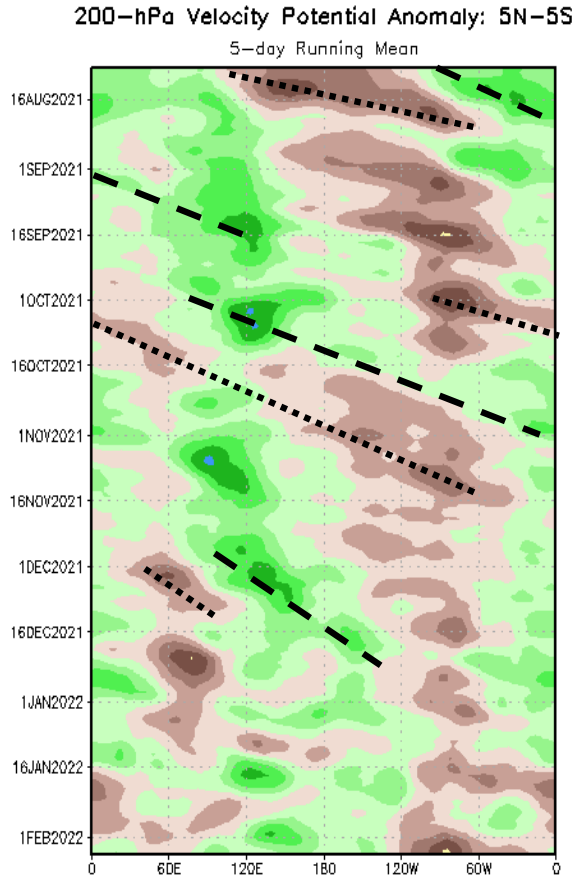
- Dynamical model MJO index forecasts depict the MJO slowly propagating east to the Maritime Continent during the next two weeks.

- Based on this predicted MJO and model guidance, the South Indian Ocean is likely to remain active with multiple tropical cyclones forecast to develop through mid-February.

- Given the increasing likelihood that the MJO constructively interferes with La Niña, an atmospheric response typical of La Niña is expected across the mid-latitudes of the North Pacific and North America during the latter half of February.

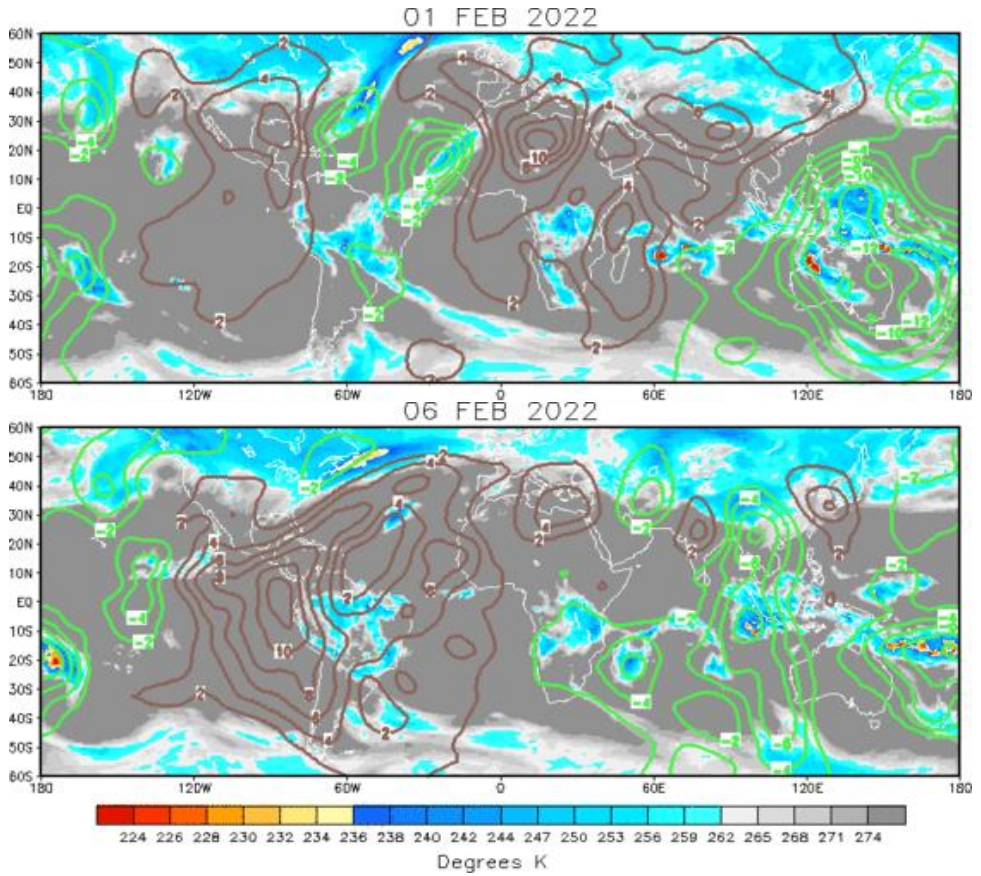
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies



Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)

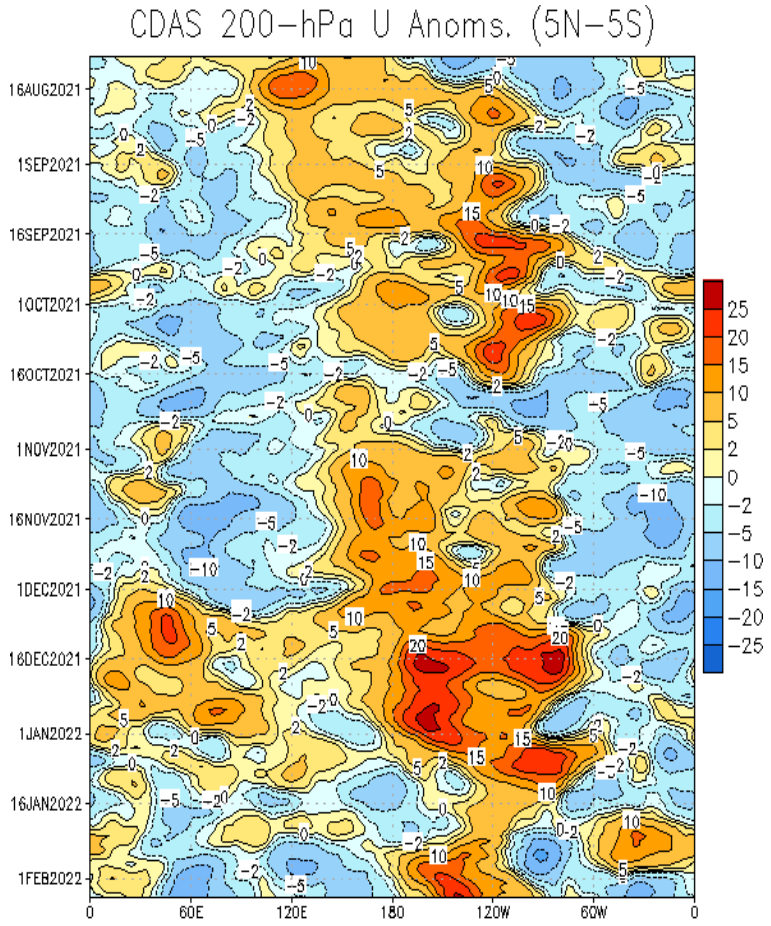


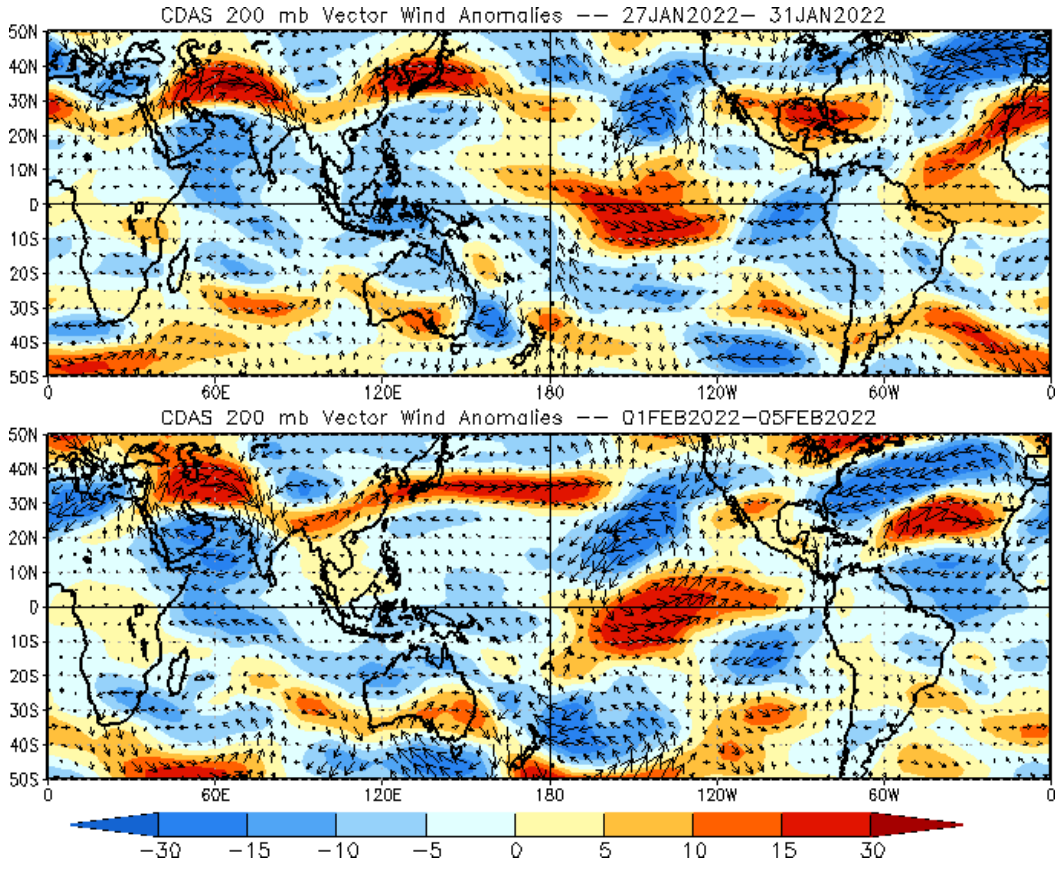
- During the past two weeks, other tropical modes such as Kelvin wave activity over the Western Hemisphere and a Rossby wave over the Indian Ocean were influencing the pattern.

- The upper-level velocity potential pattern is becoming more coherent with broad-scale divergence (convergence) over the Eastern (Western) Hemisphere.

200-hPa Wind Anomalies

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



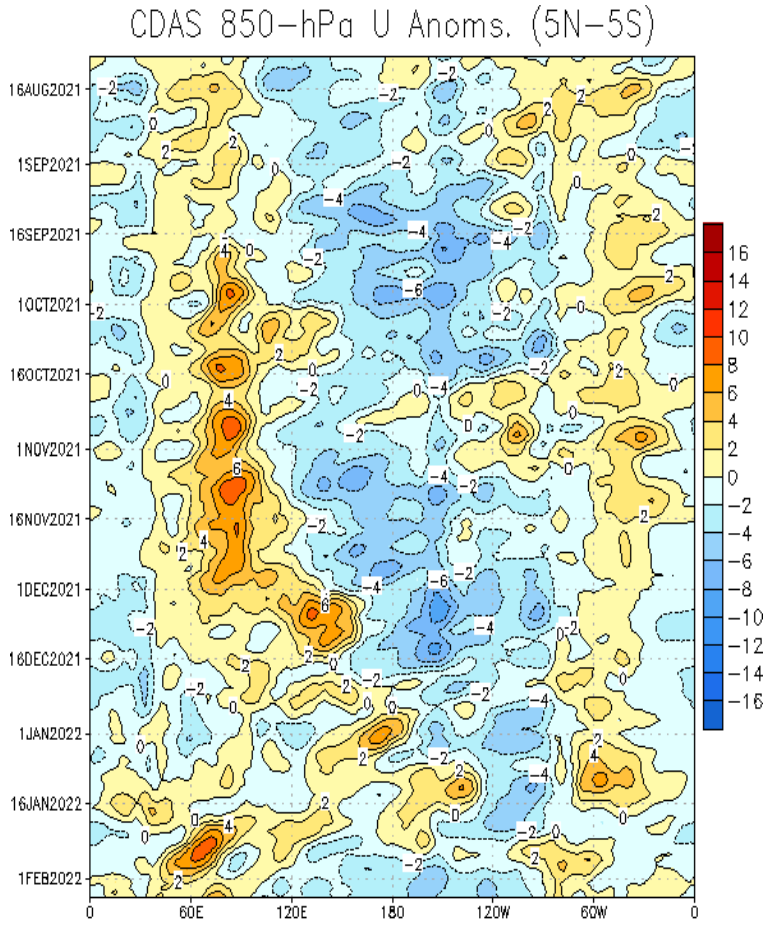


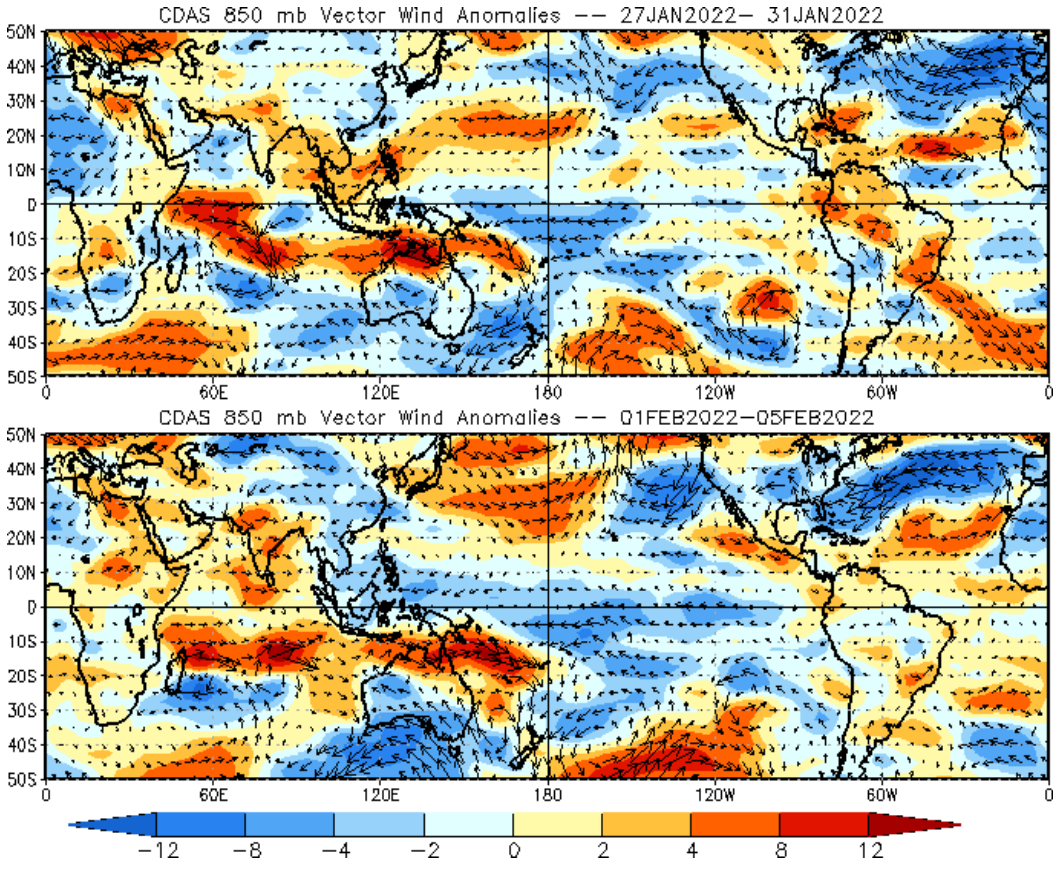
- Westerly anomalies persist over the east-central Pacific due in part to interactions with the mid-latitudes.

- Easterly anomalies continue over the Maritime Continent, promoting anomalous divergence aloft over the West Pacific.

850-hPa Wind Anomalies

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



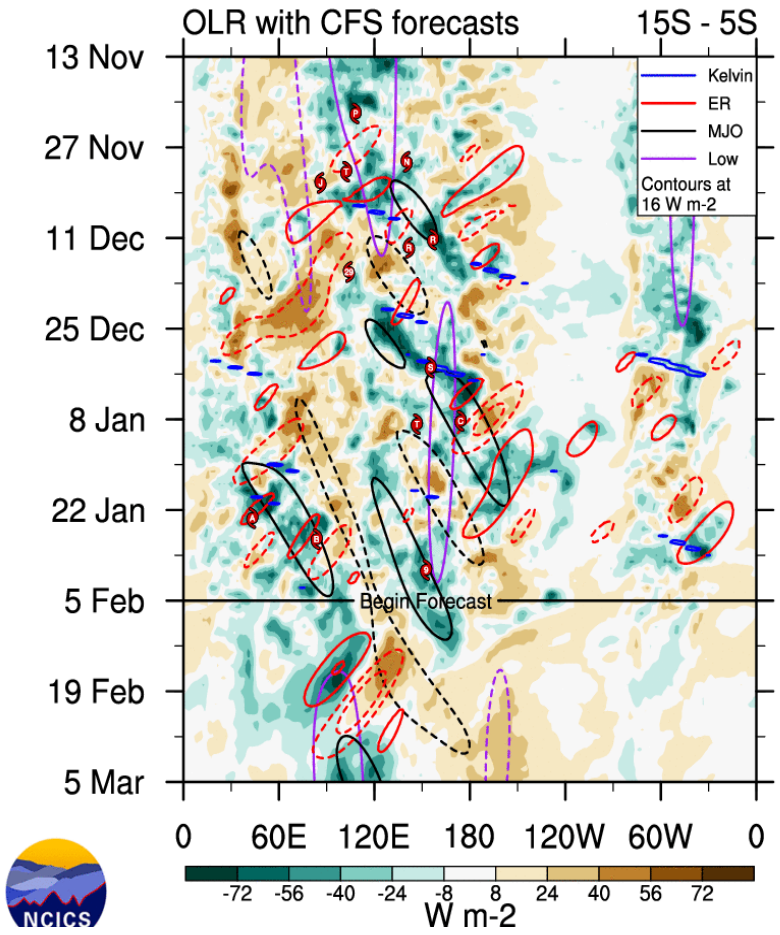


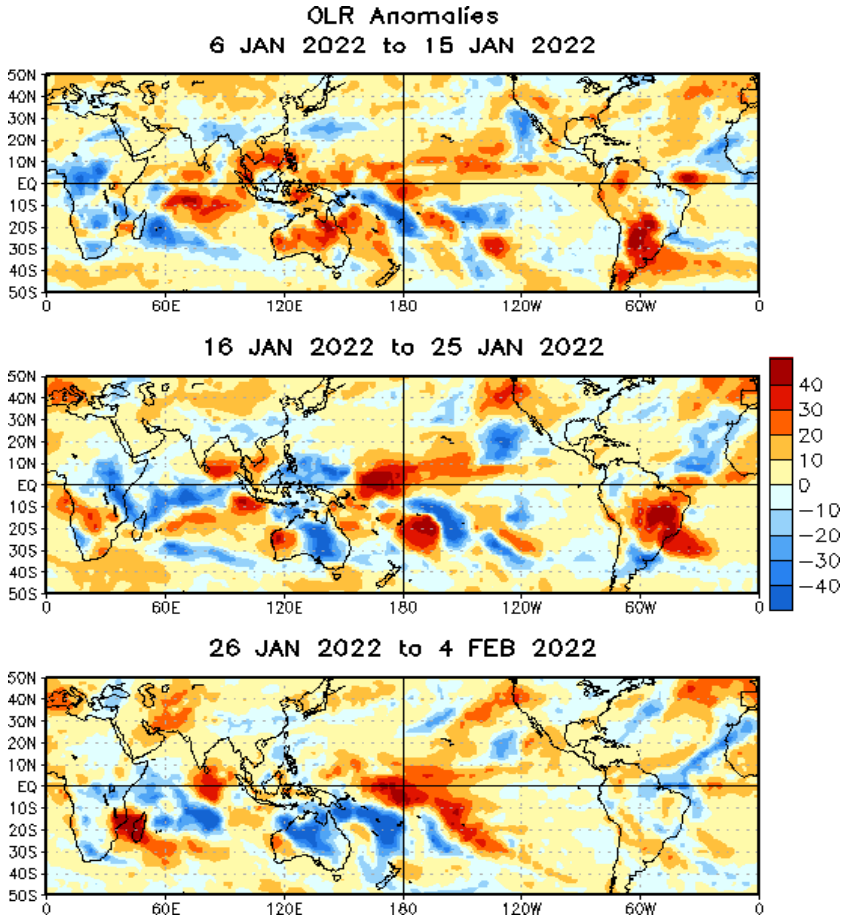
- Rossby wave activity over the Indian Ocean is reflected by a westward propagating envelope of strong westerly anomalies during late January.

- Easterly anomalies recently returned to the east-central Pacific which is consistent with the canonical La Niña atmospheric response.

Outgoing Longwave Radiation (OLR) Anomalies

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

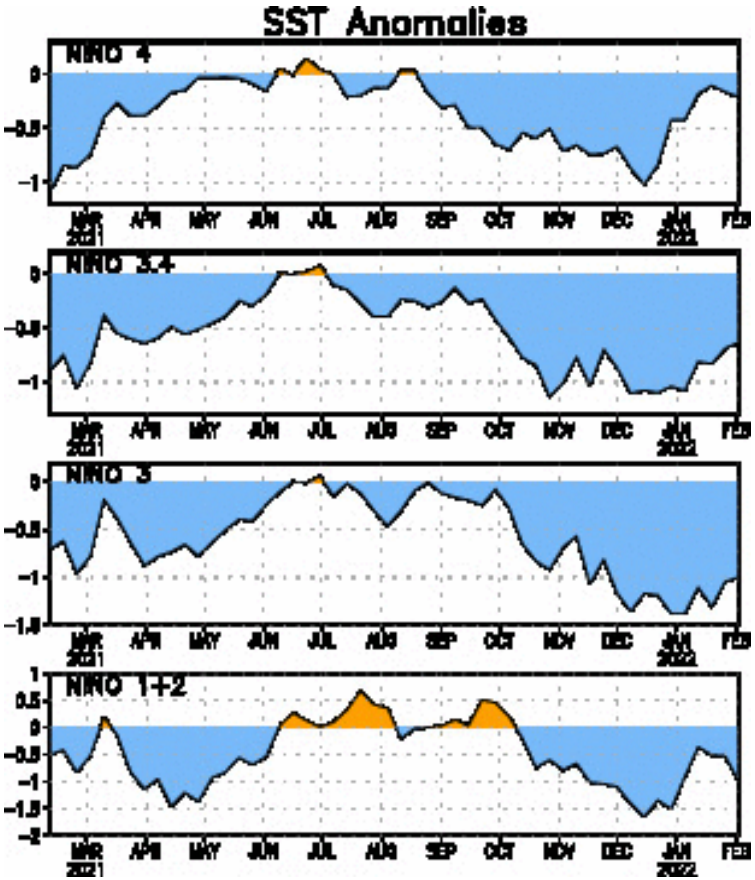


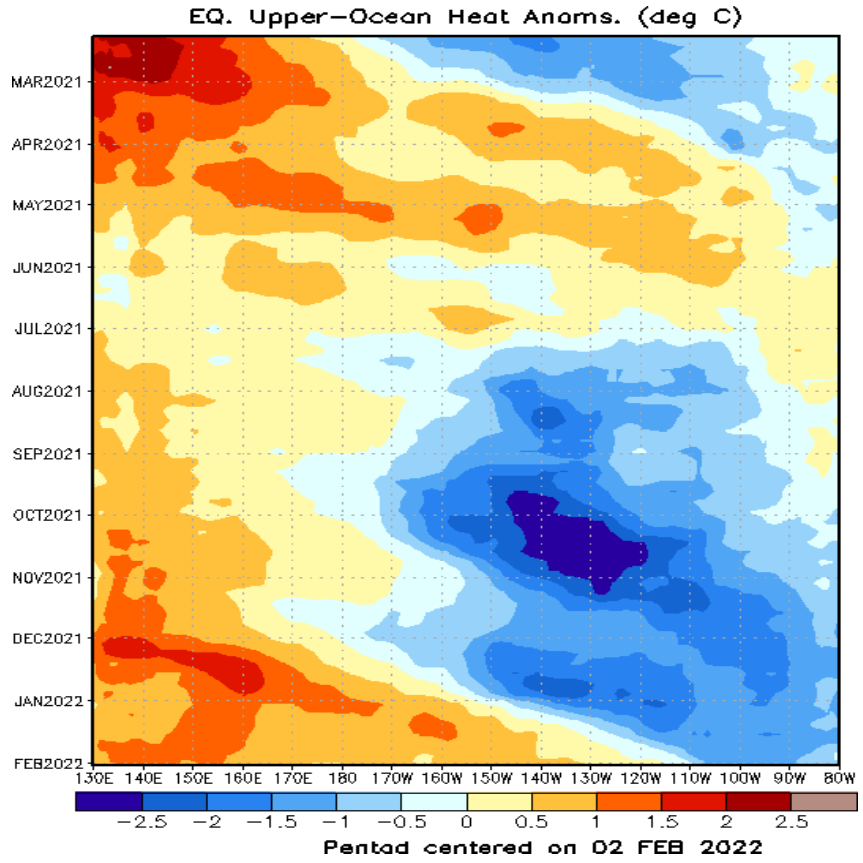


- Following a slight weakening of suppressed convection across the equatorial Central Pacific, suppressed convection strengthened over this region due to La Niña.

- Enhanced convection over the Maritime Continent continues to be disrupted by other modes of tropical variability.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



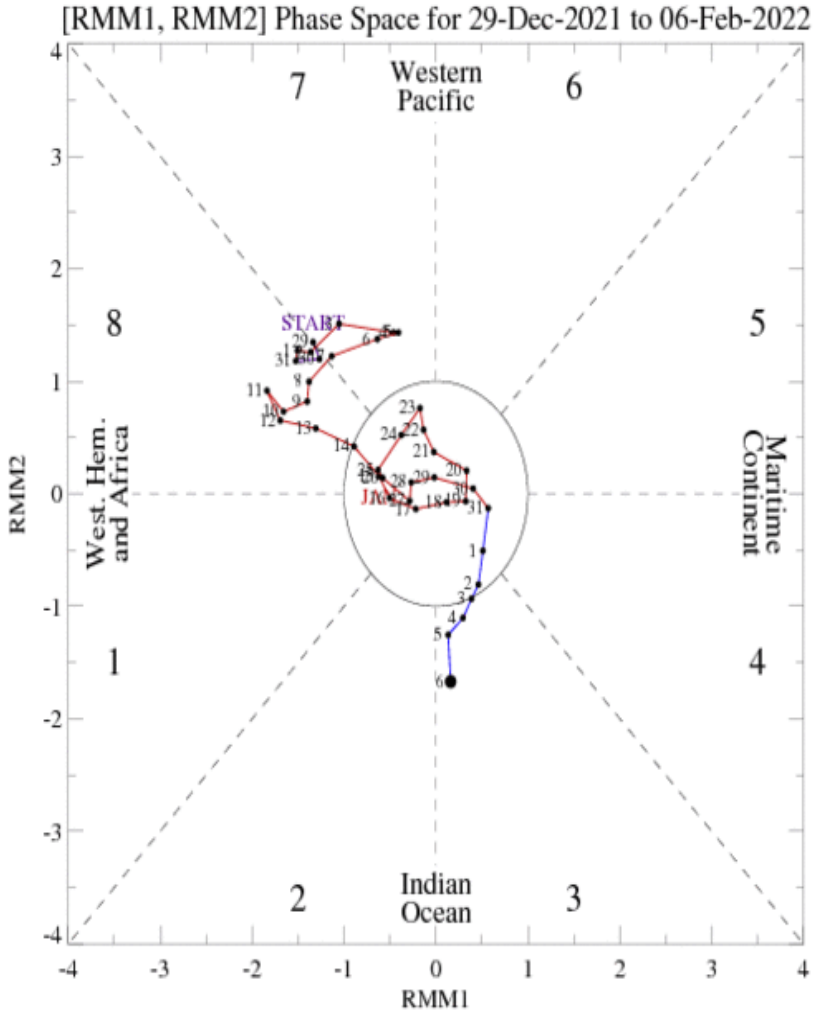


- A low level westerly wind burst (linked to the eastward propagation of the MJO) during December/January led to a robust downwelling Kelvin Wave, resulting in above average OHC progressing to the Central Pacific (135°W).
- While SST anomalies remain negative in all regions, a large warming was observed over the Niño 4 region during January tied to the downwelling Kelvin Wave.
- Significant warming was also observed closer to the West Coast of South America (Niño 1+2 region) due to enhanced rainfall over the area, but has since cooled again in recent weeks.

MJO Index: Recent Evolution

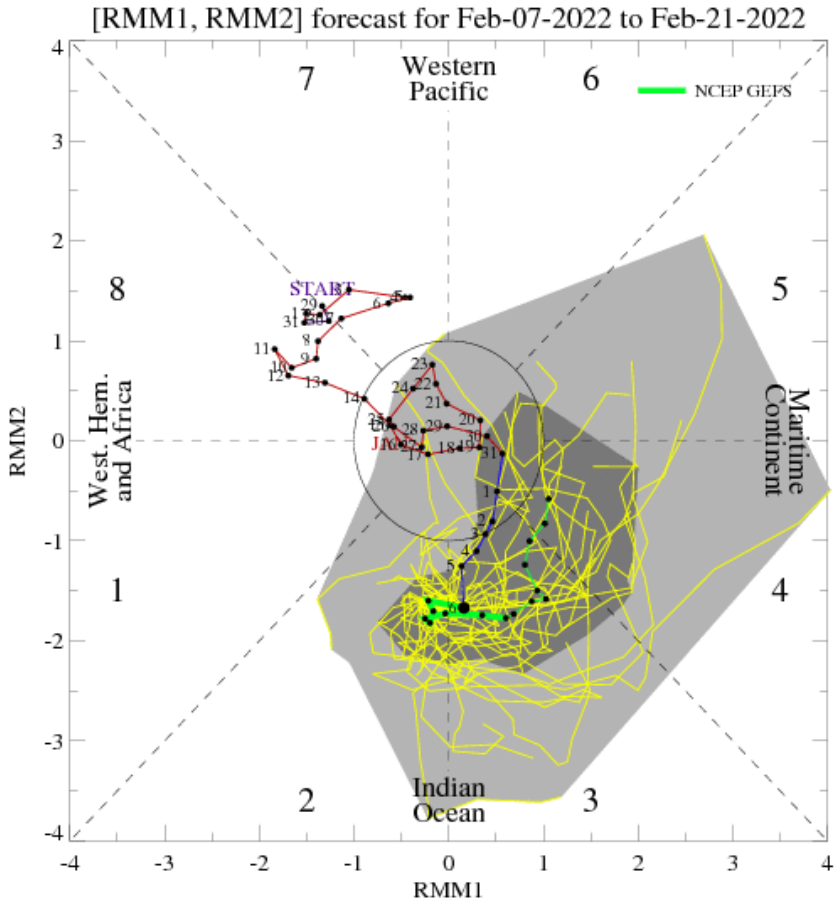
- After progressing eastward across the Pacific, the amplitude of the RMM index diminished in mid-January.

- During early February, the amplitude of the RMM index increased which may be partly due to tropical cyclones over the South Indian Ocean.

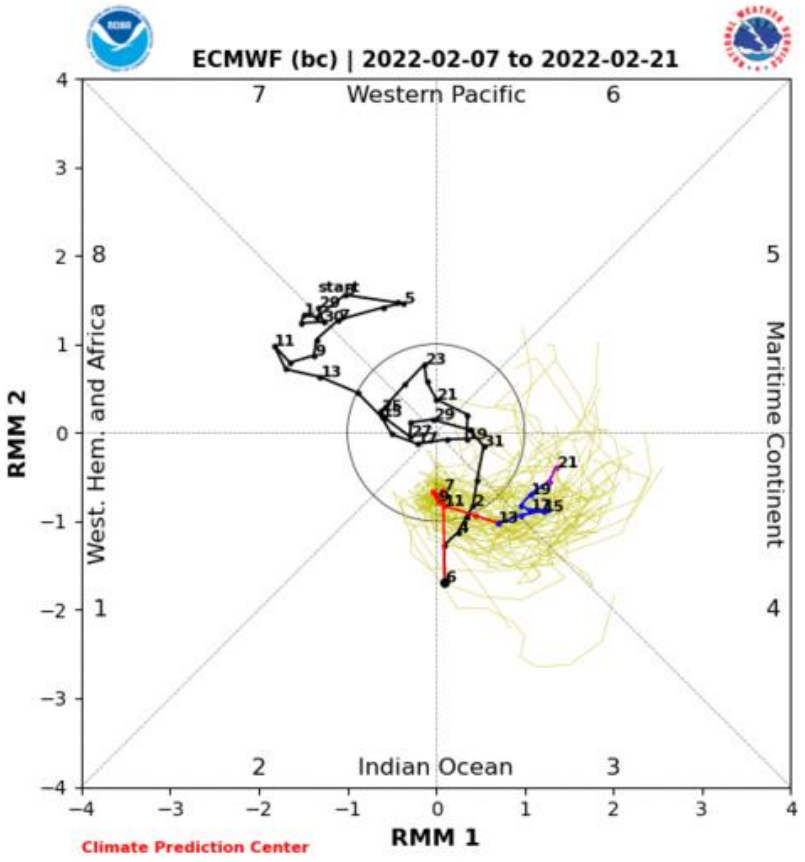


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



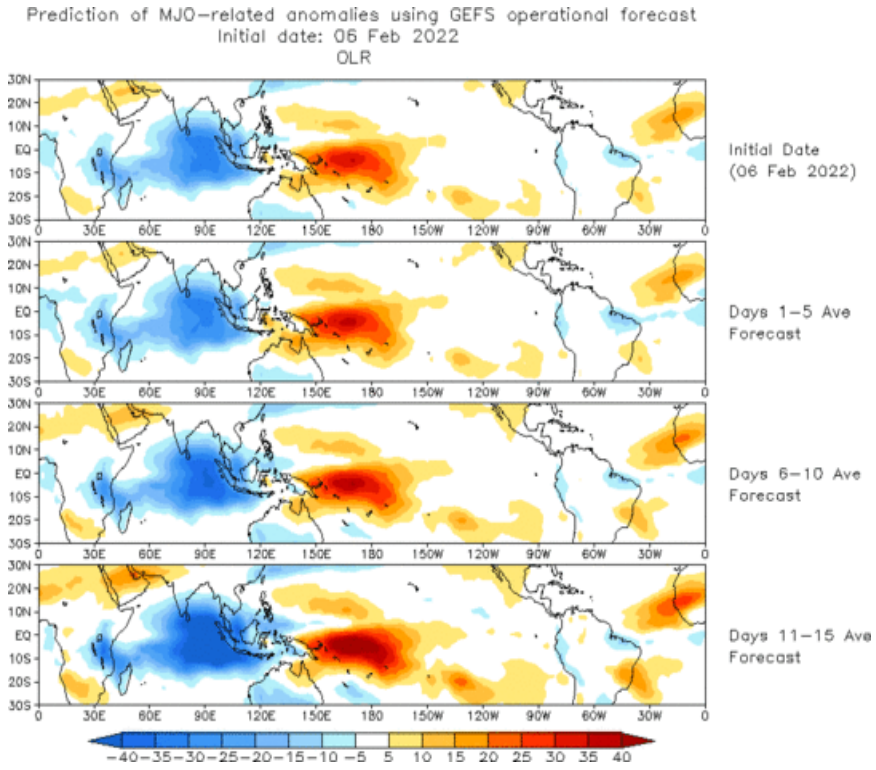
ECMWF Forecast

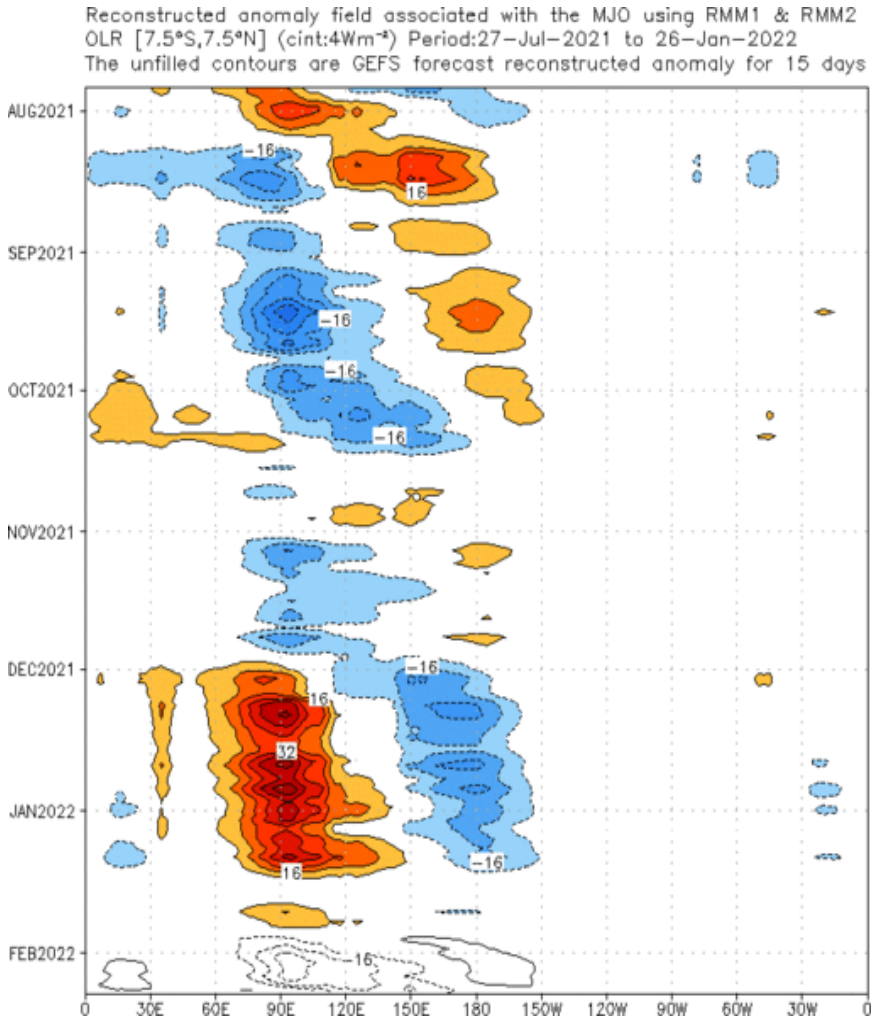
- The GEFS and ECMWF ensemble means depict a slow eastward propagation of a MJO from the Indian Ocean to the Maritime Continent during the next two weeks.

- This developing MJO would constructively interfere with the ongoing La Niña.

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.)

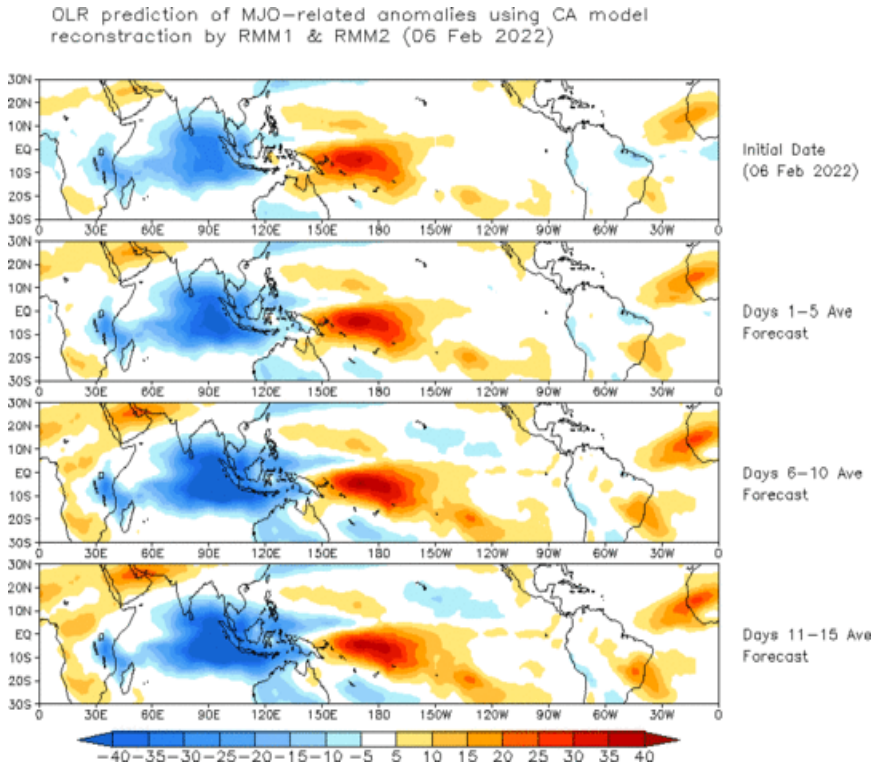


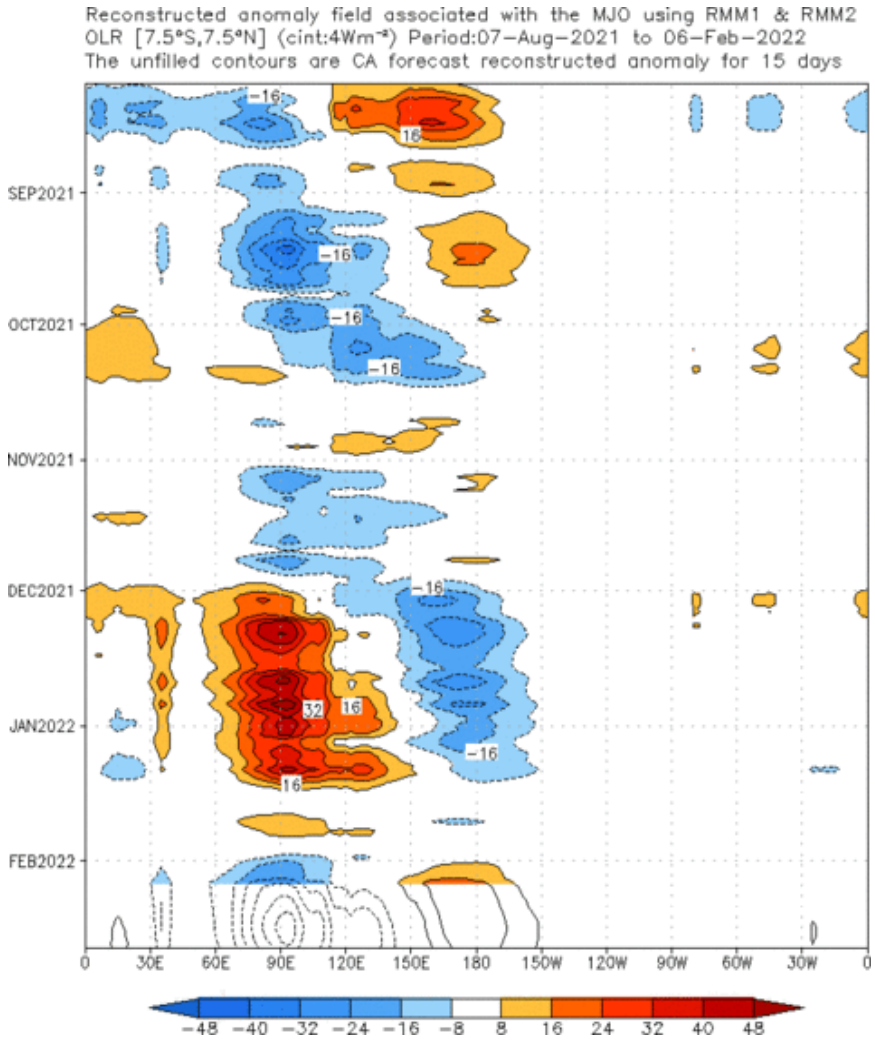


- The GEFS RMM-based OLR field features a nearly stationary pattern with enhanced convection over the Indian Ocean and Maritime Continent with suppressed convection across northern Australia and much of the tropical Pacific.

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.)

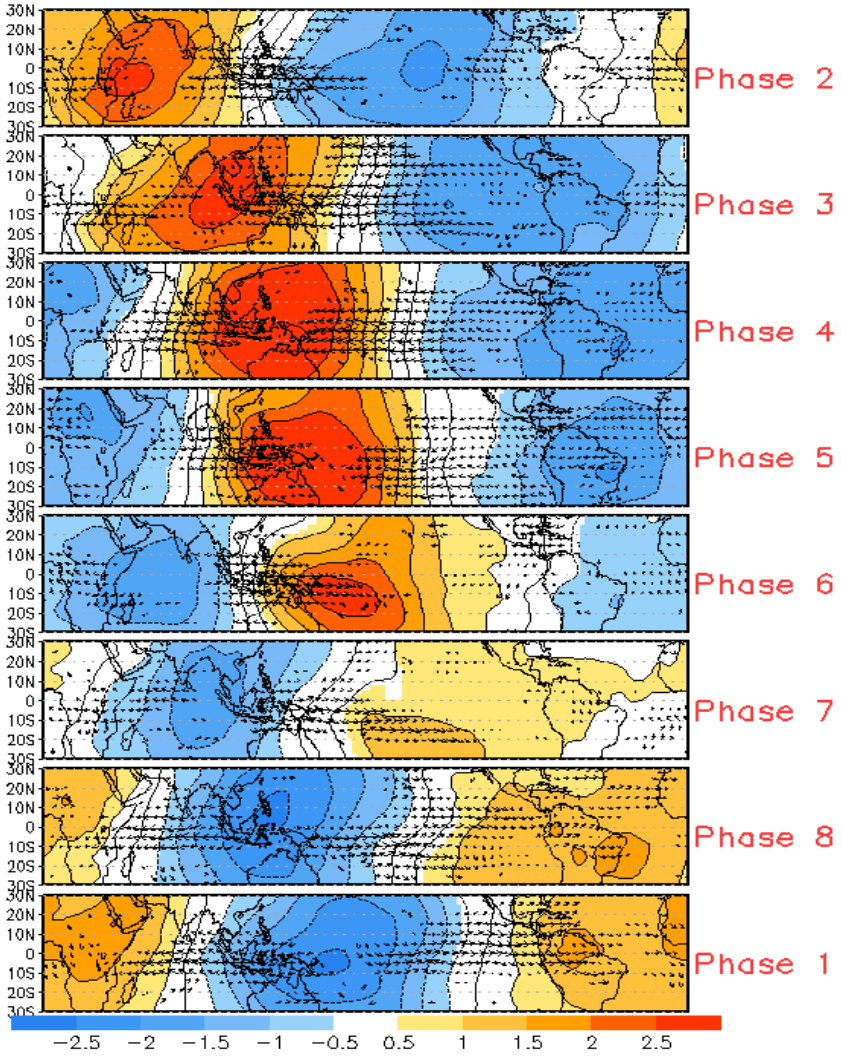




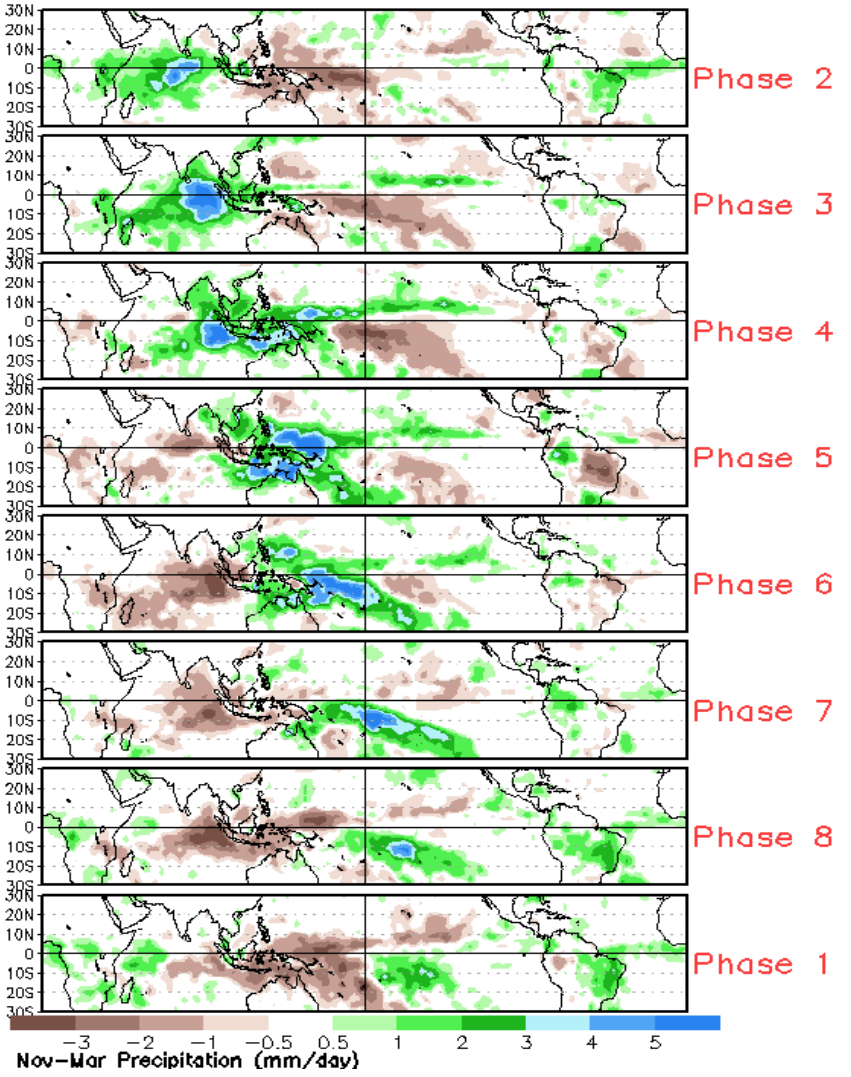
- The constructed analog depicts a pattern more consistent with a developing MJO propagating eastward from the Indian Ocean along with La Niña.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



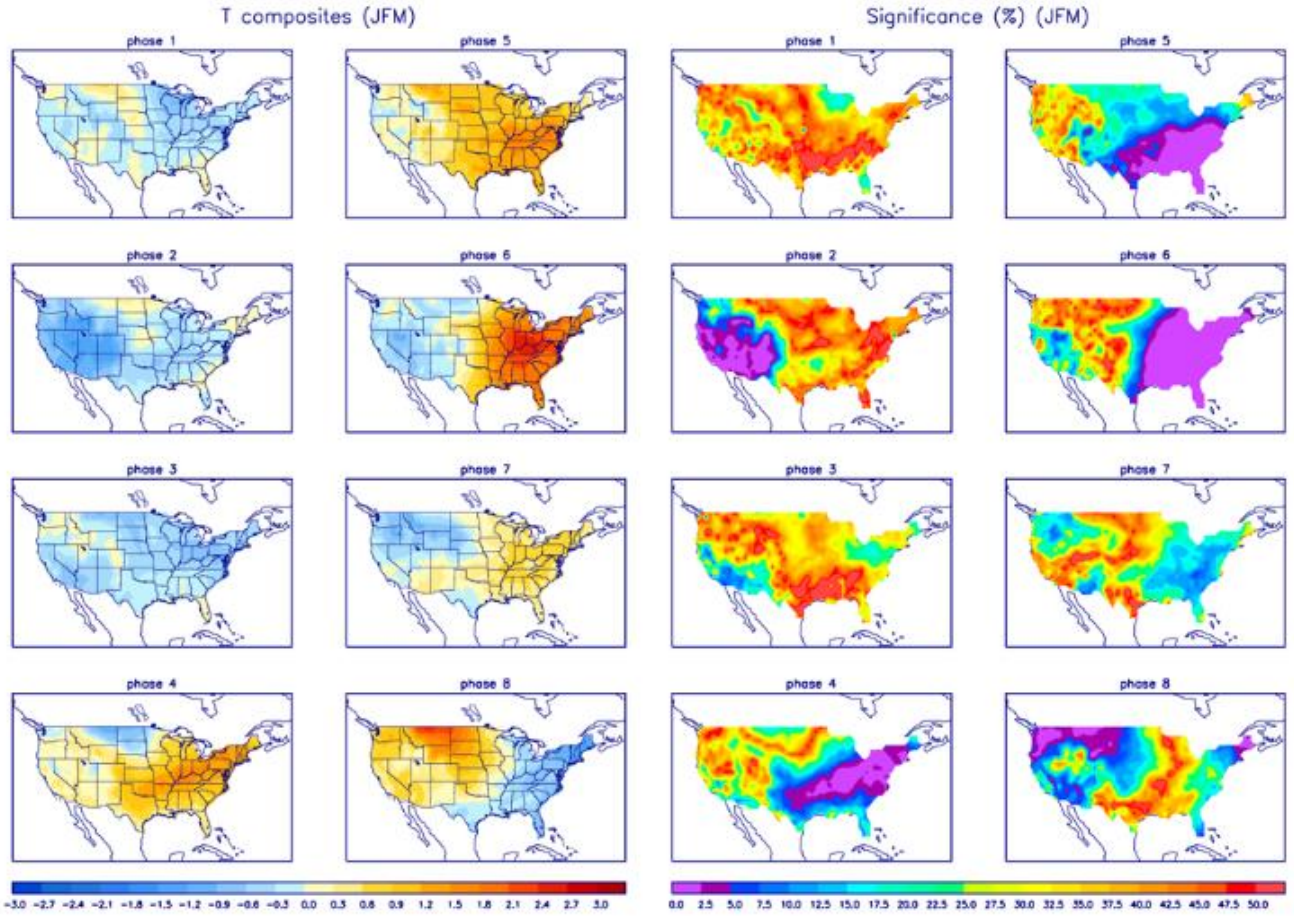
Precipitation Anomalies



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.

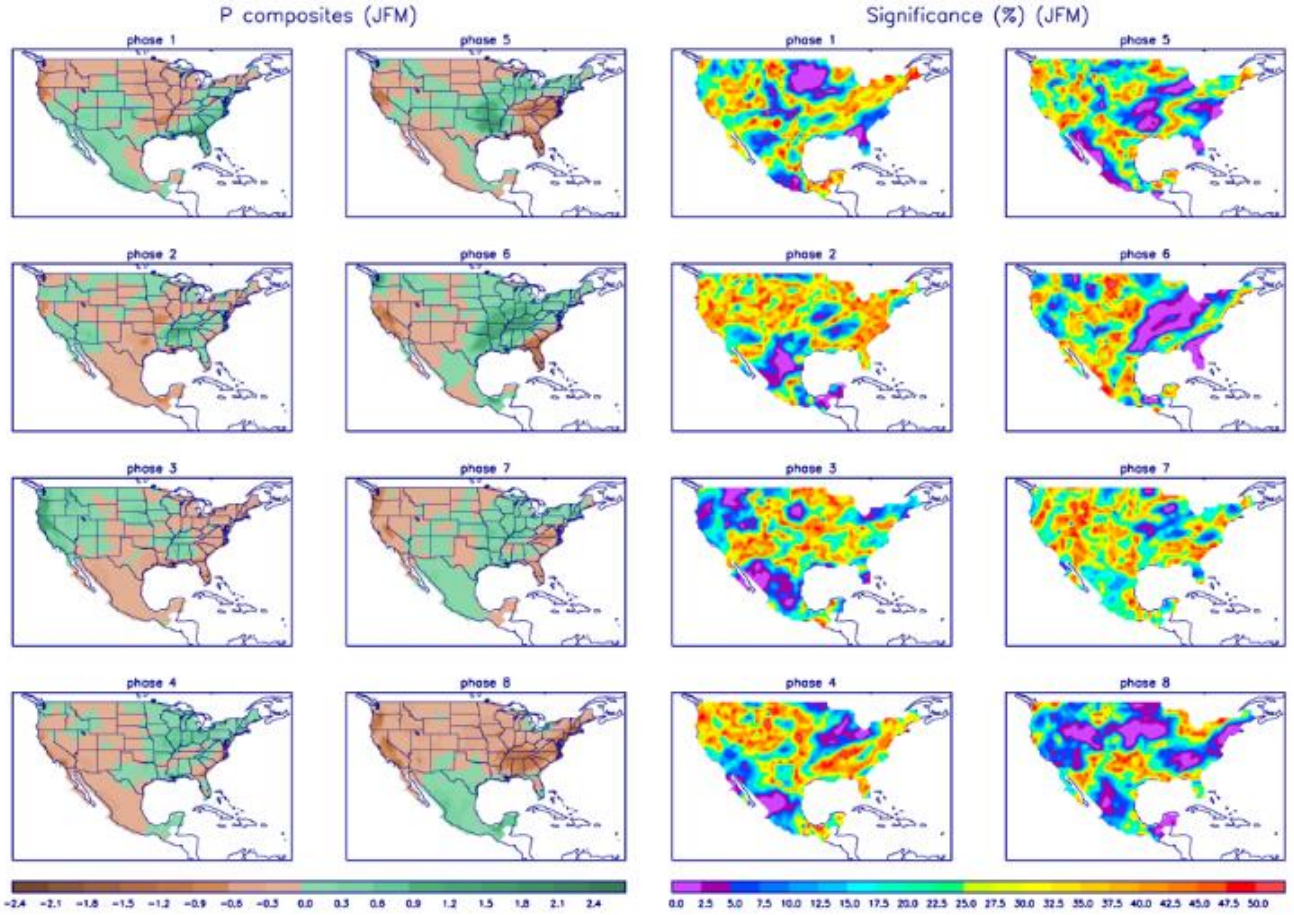


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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