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

Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
30 May 2022

Overview

- Strong Kelvin wave (KW) activity continues to circumnavigate the globe, with a KW progressing from Africa back to the West Pacific over the last week. KW activity is projecting prominently onto the CPC upper-level velocity potential based index, reflecting the strength of these higher frequency features.

- As the Kelvin wave progressed back to the Pacific, the RMM index re-amplified, and is currently between Phases 6 and 7.

- Dynamical model MJO index forecasts depict a slower evolution over the East Pacific and Western Hemisphere during Week-2. This may be reflective of a more canonical MJO progression, but it could also reflect constructive interference among the Kelvin wave, tropical cyclone activity, and an enhanced Central American Gyre.

- Enhanced rainfall and MCS activity along the Meiyu Front is dominating West Pacific activity, while a delayed monsoon onset across South Asia is resulting in widespread excessive heat concerns.

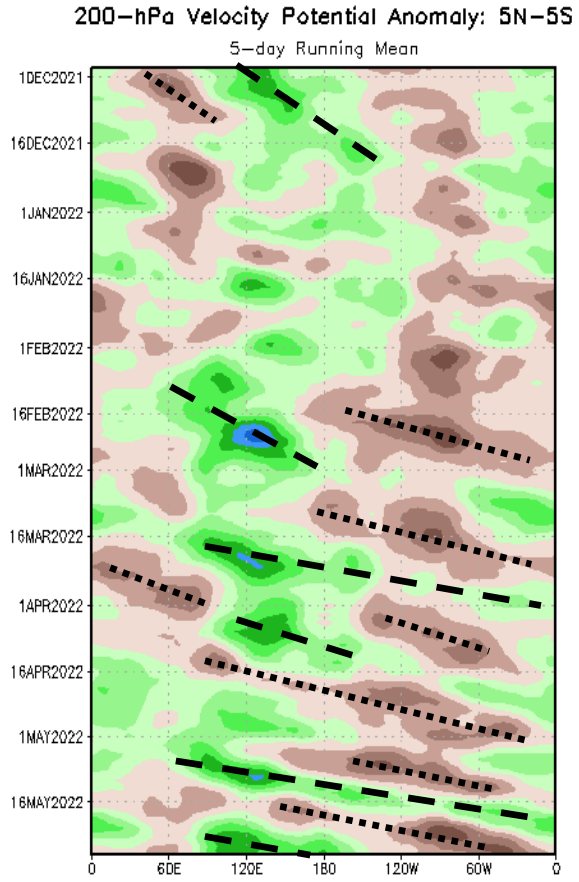
- Tropical cyclogenesis over the Gulf of Mexico or western Caribbean is possible over the next week or so, due to a favorable environment and the remnants of Hurricane Agatha emerging back over open water.

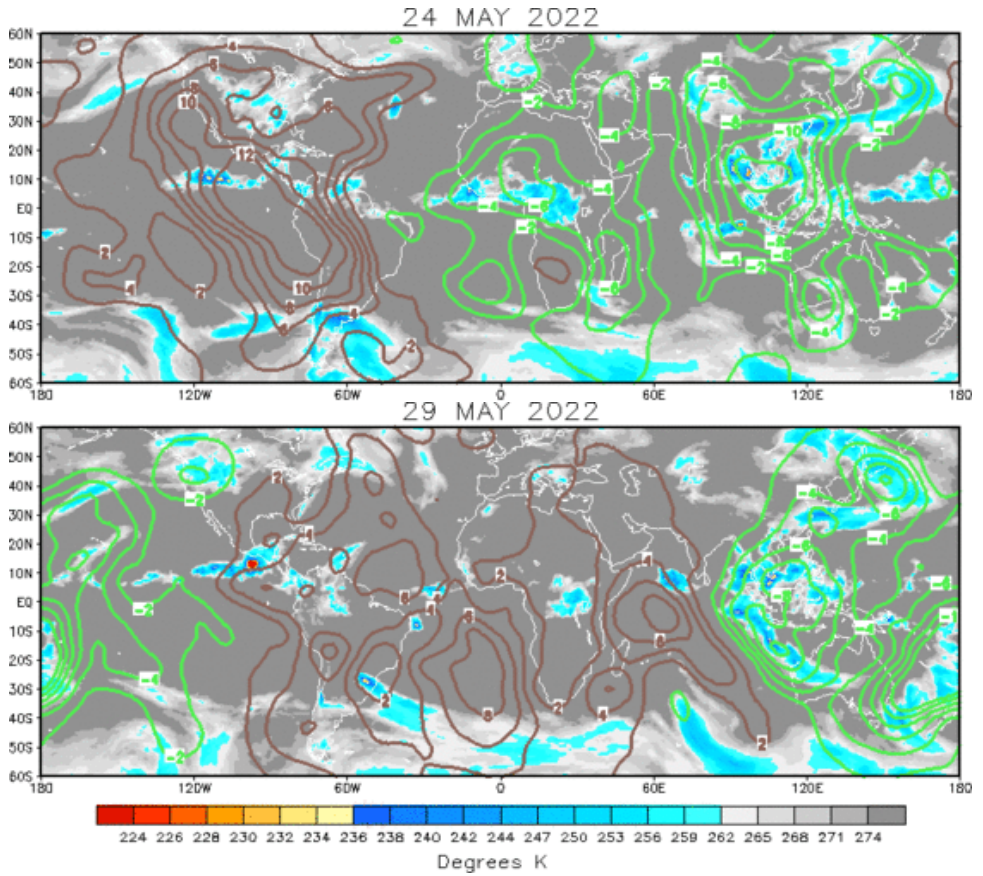
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation)

Brown shades: Anomalous convergence (unfavorable for precipitation)



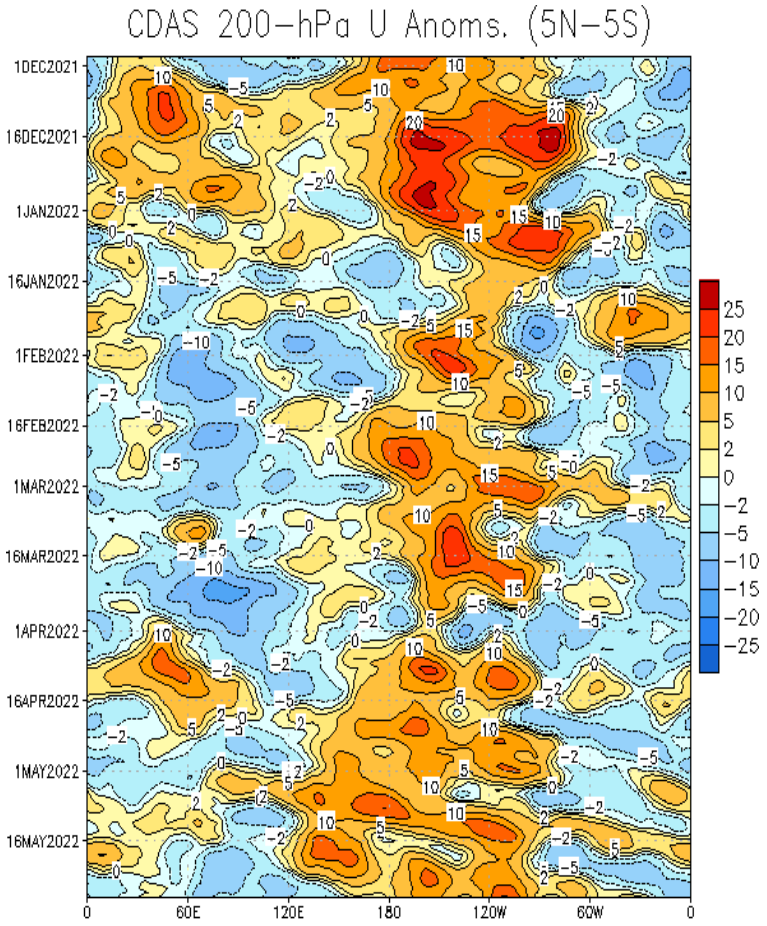


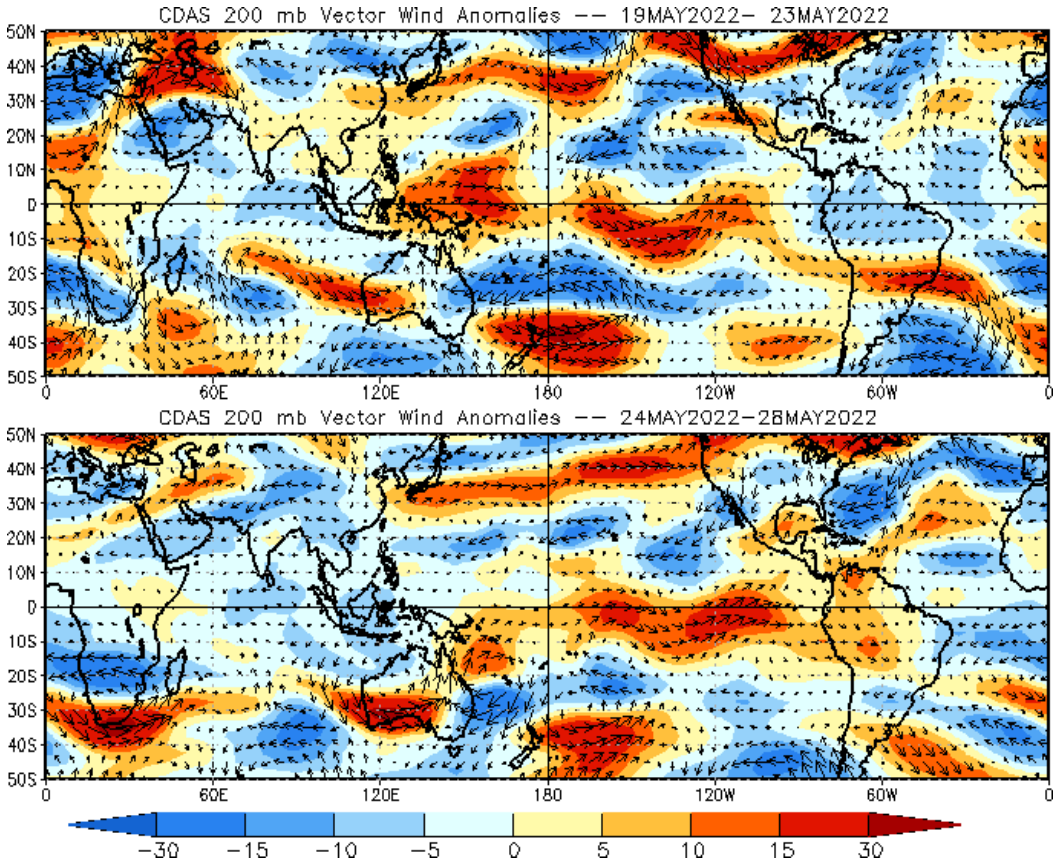
- The spatial pattern of upper-level velocity potential anomalies is strongly suggestive of MJO activity, with an eastward propagating Wave-1 pattern resembling a strong West Pacific MJO event.

- Time-Longitude (Hovmoller) plots of recent activity show that this signal is largely due to aliasing of robust Kelvin wave activity moving from Africa back to the Pacific and the low-frequency base state favoring enhancement over the Maritime Continent.

200-hPa Wind Anomalies

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



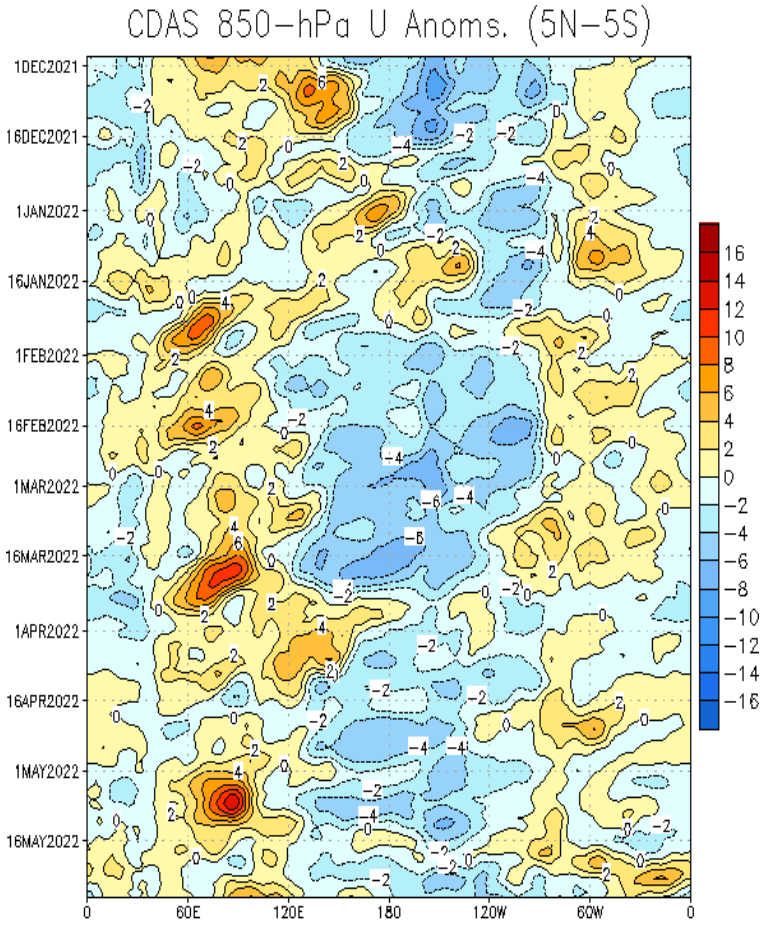


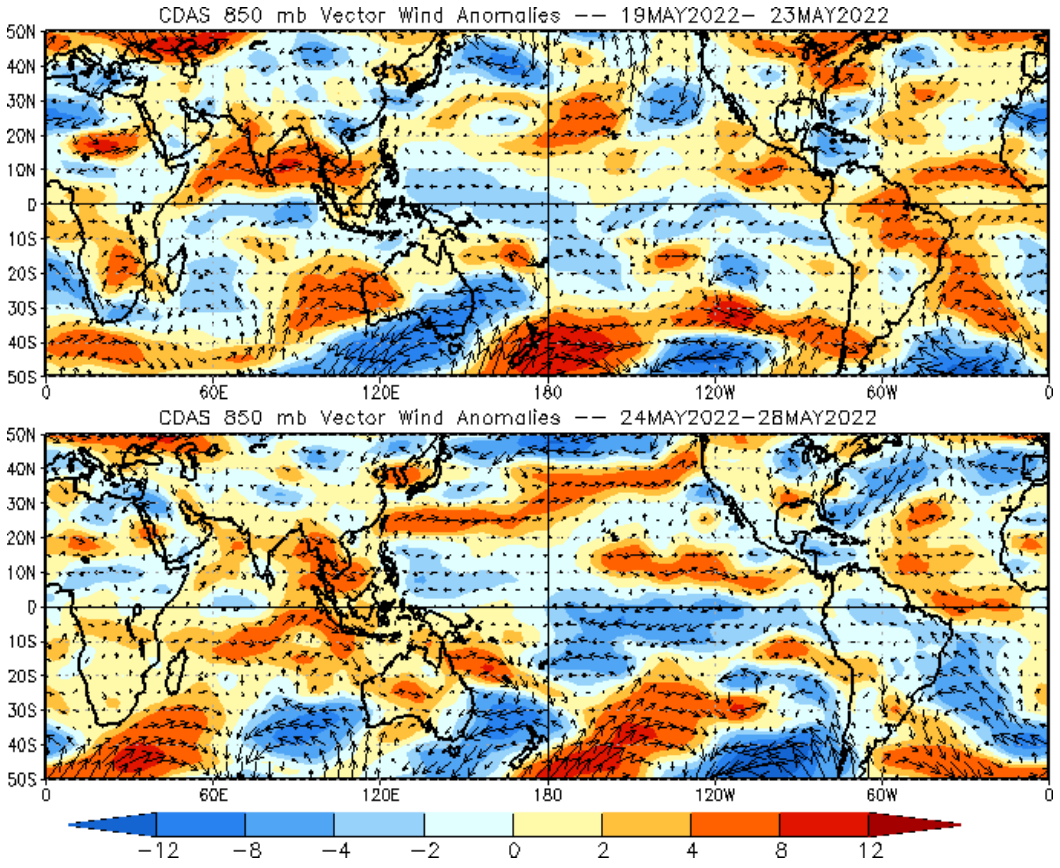
- Westerly anomalies aloft remain persistent over the East Pacific, reflective of the La Niña response.

- Eastward propagating features are evident in the field, with the phase speed more consistent with Kelvin wave activity.

850-hPa Wind Anomalies

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



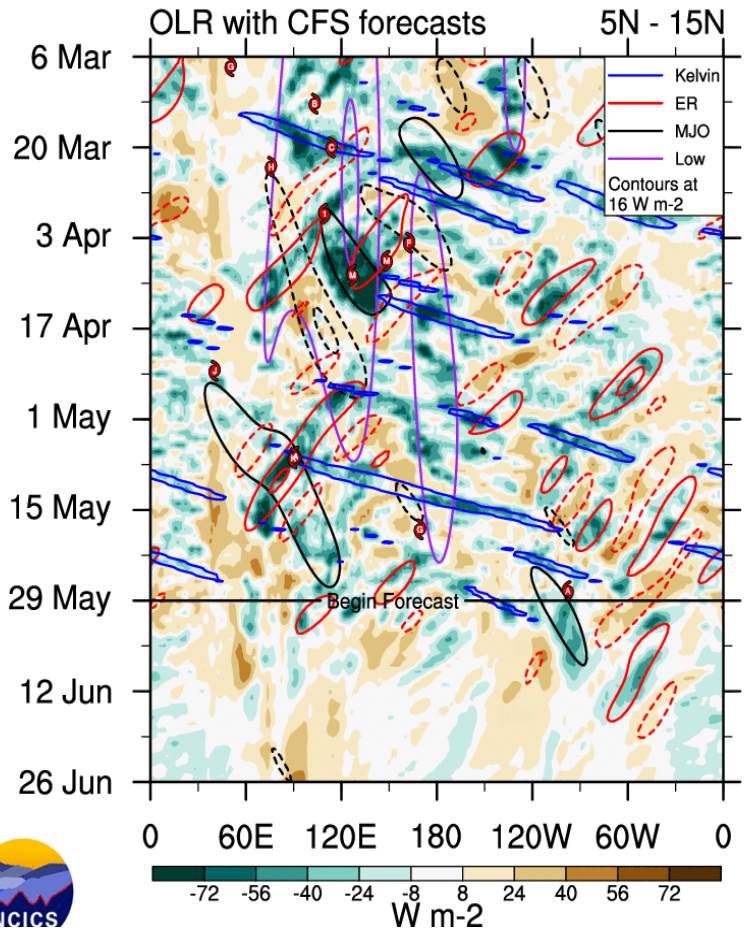


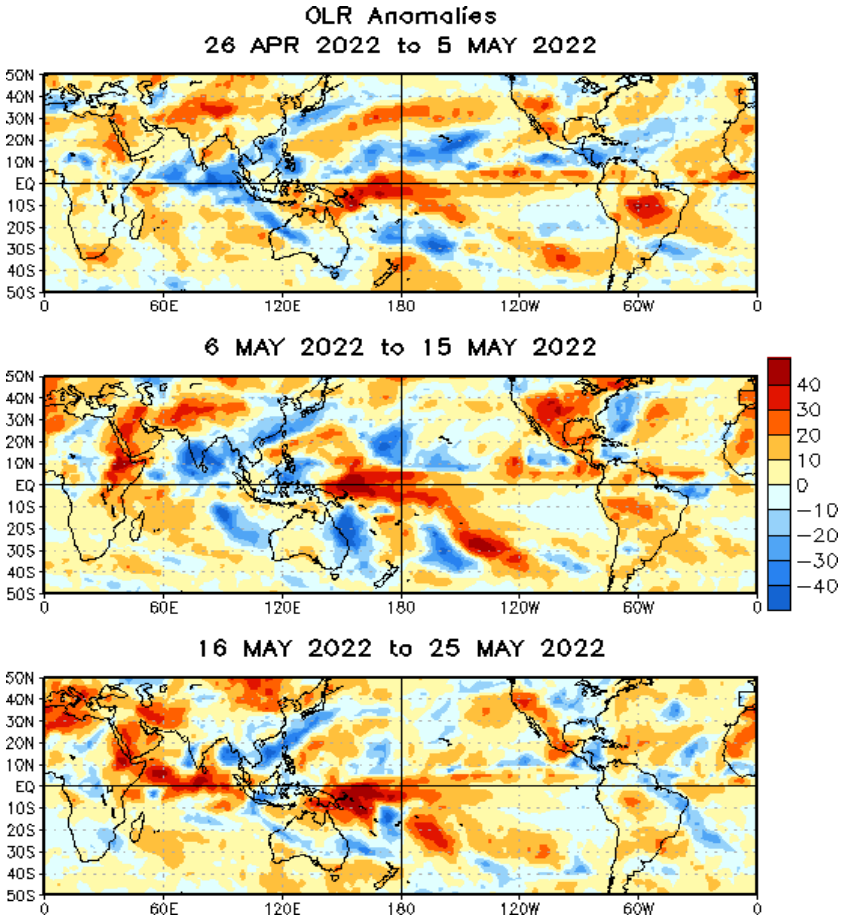
- Following a brief disruption of the La Niña enhanced trade wind regime in mid-May as a strong Kelvin wave moved across the Pacific, enhanced trades have resurged east of the Date Line.

- Westerly anomalies have increased in coverage and strength over the Maritime Continent as Kelvin activity returned to the West Pacific and constructively interfered with the base state.

Outgoing Longwave Radiation (OLR) Anomalies

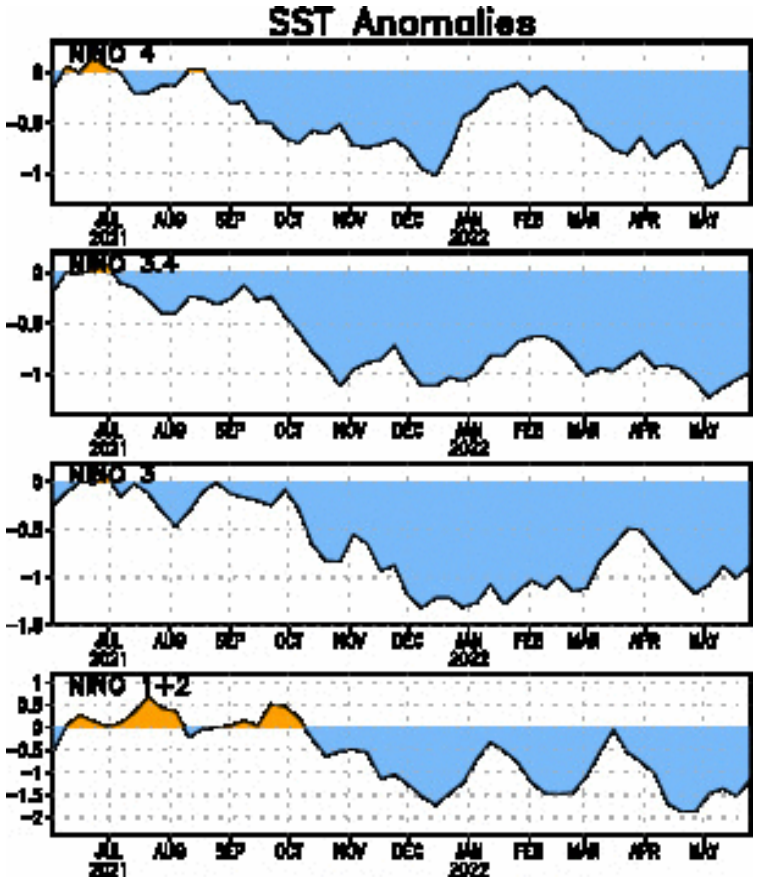
Green shades: Anomalous convection (wetness)
Brown shades: Anomalous subsidence (dryness)

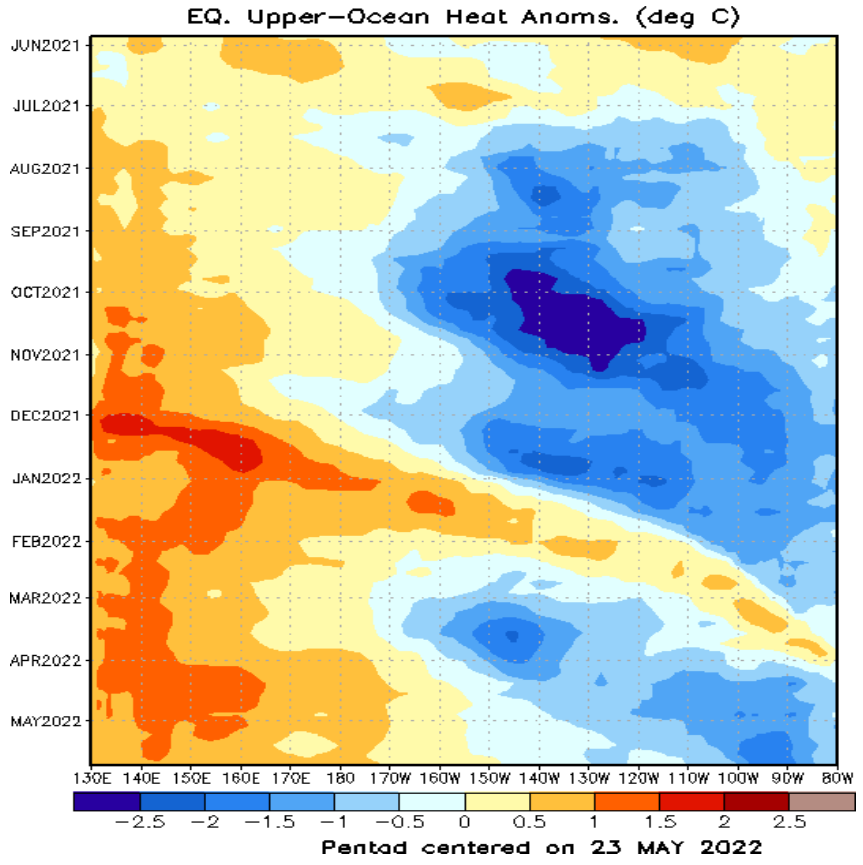




- Convectively-coupled Kelvin wave activity has disrupted the low-frequency signal during most of May.
- Kelvin and Rossby wave activity over the Maritime Continent has contributed to the appearance of a slower evolving eastward moving feature over the Maritime Continent.
- Convection remains strongly suppressed across the equatorial Pacific.

SSTs and Weekly Heat Content Evolution in the Equatorial Pacific

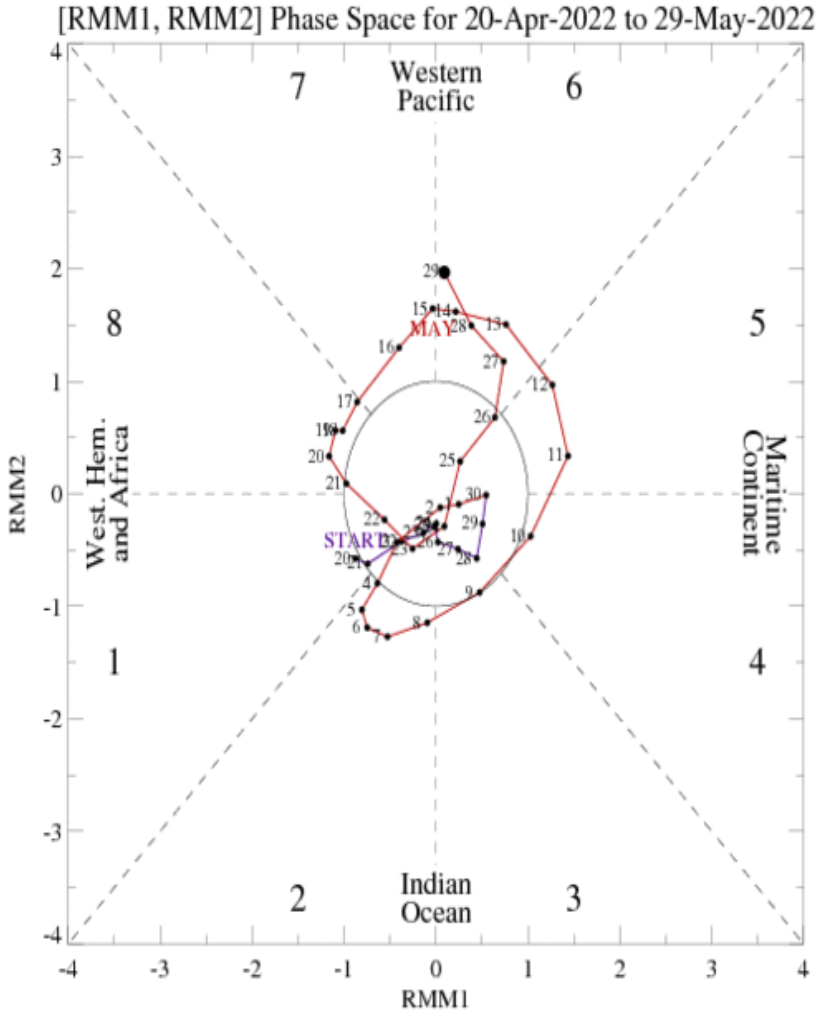




- Following a downwelling Kelvin wave intrusion during the first months of the year, strong upwelling returned to the east-central Pacific, shoring up the La Niña event through the Spring.
- Above-average heat content anomalies have built across the West Pacific, and there is some evidence of a weak downwelling wave, though anomalies remain negative east of 150W.

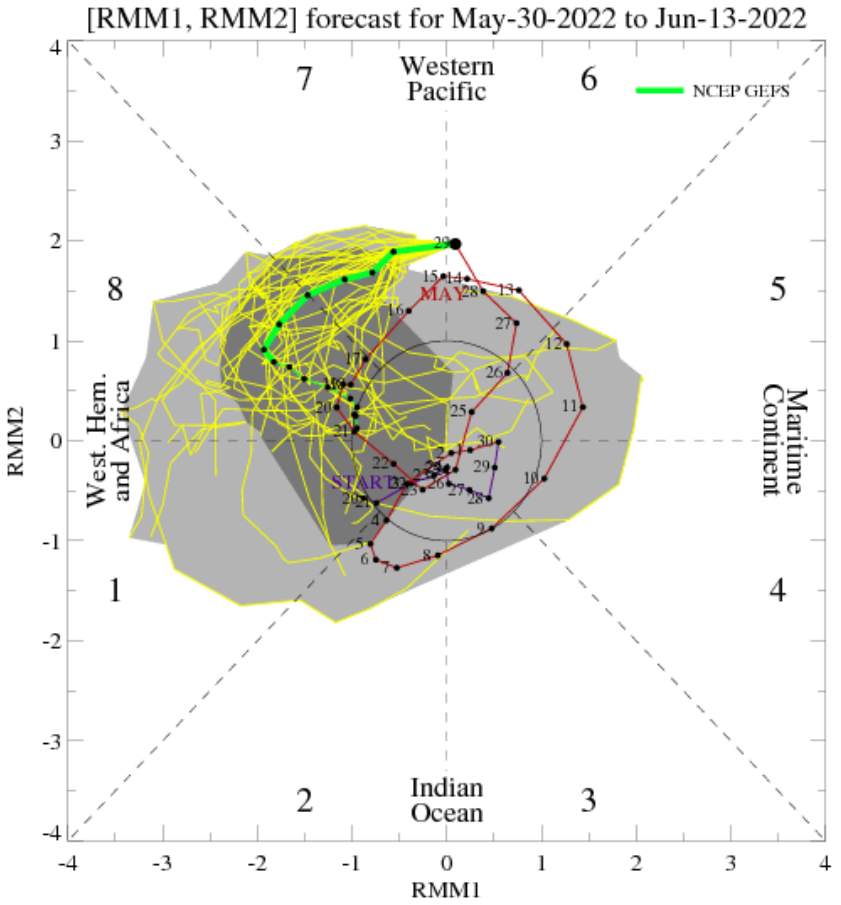
MJO Index: Recent Evolution

- Kelvin wave activity projected strongly onto the RMM index during the first half of May.
- The RMM index weakened as the Kelvin wave crossed the Western Hemisphere; however, there has been a recent resurgence over the West Pacific as the Kelvin wave completed its circumnavigation of the world.

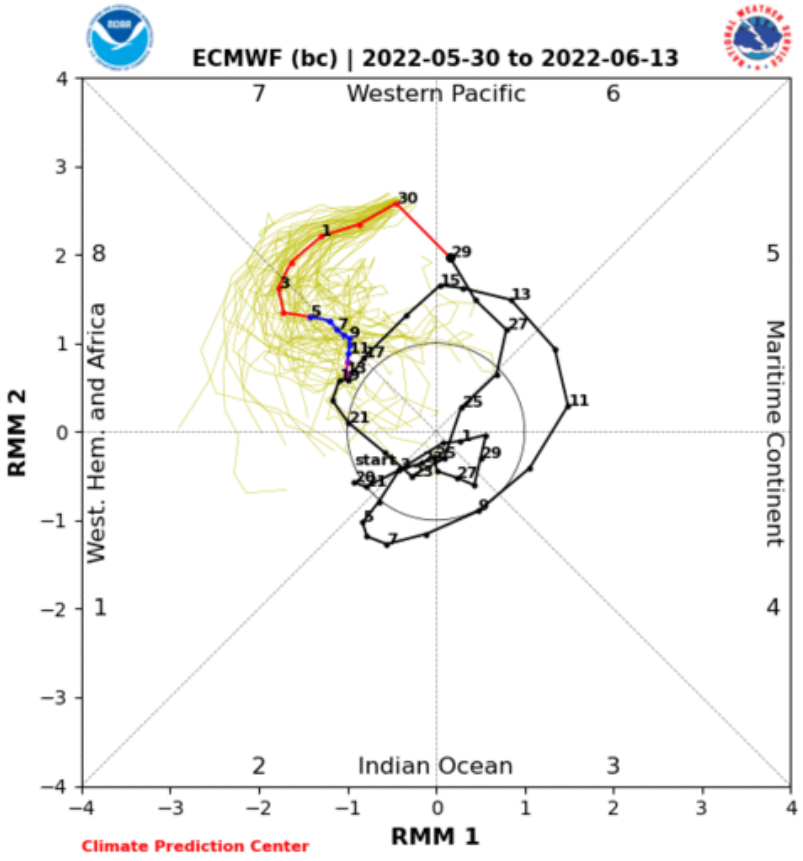


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast

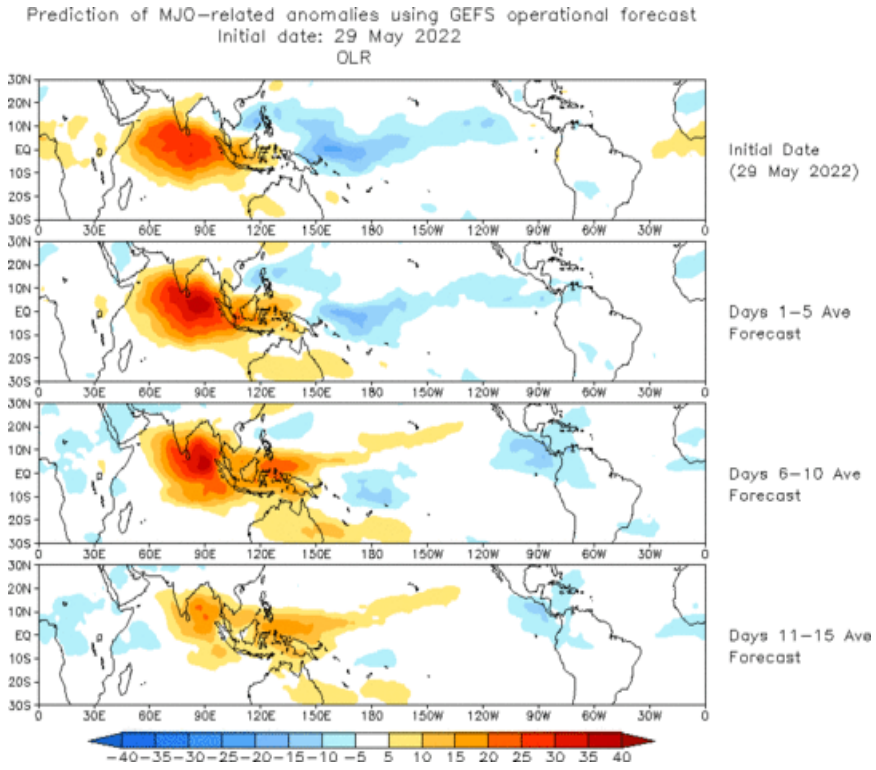


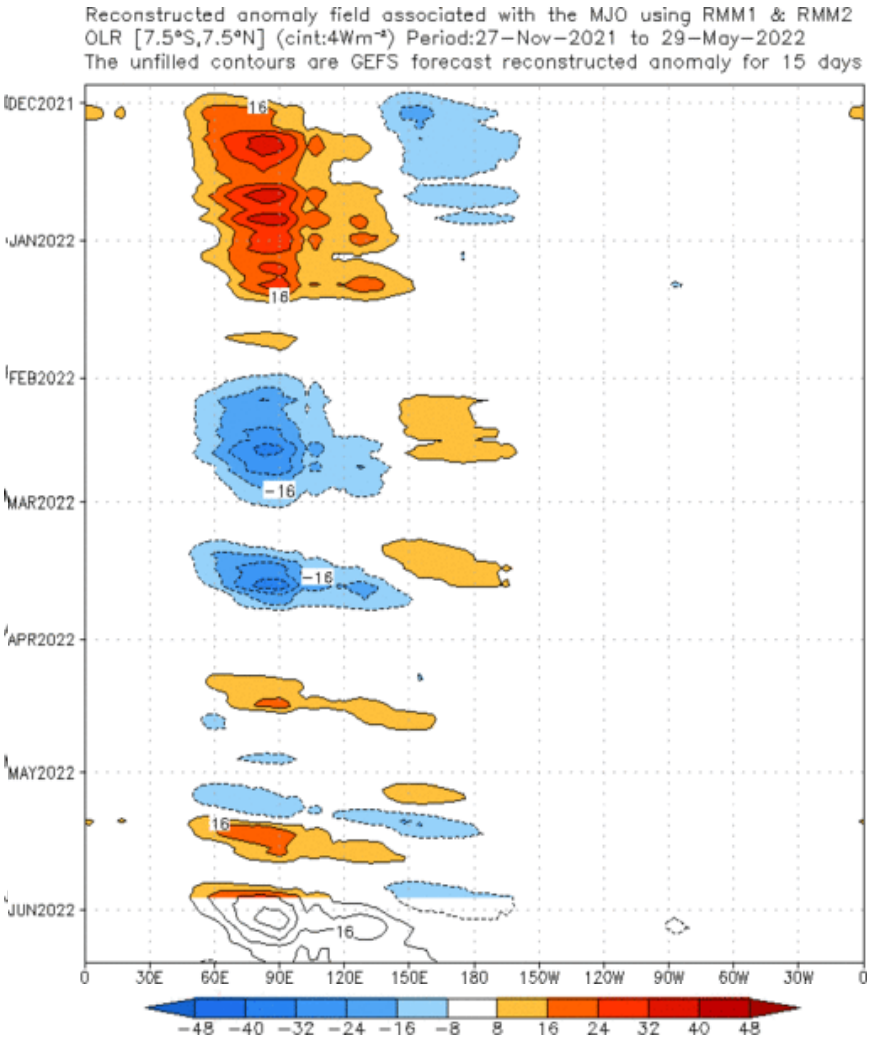
ECMWF Forecast

- The GEFS and ECMWF both depict a fairly fast progression of the signal across the Pacific, with a slower evolution over the East Pacific or North America.
- Slower evolution in Week-2 may reflect a developing MJO signal, but it may also be due to model forecasted tropical cyclone activity over the East Pacific or western Atlantic basin.

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.)

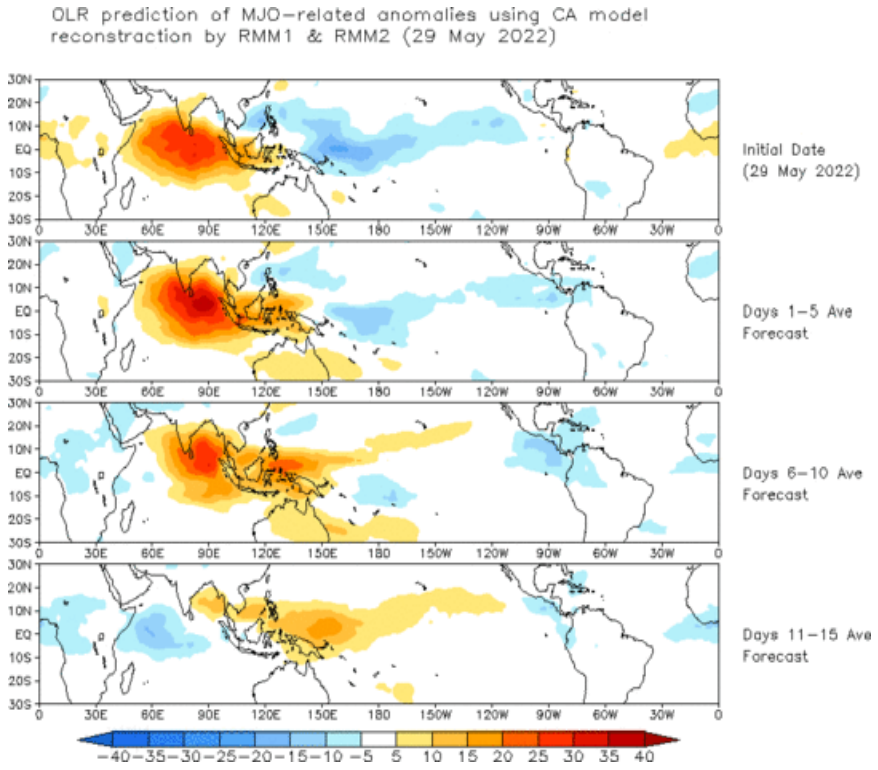


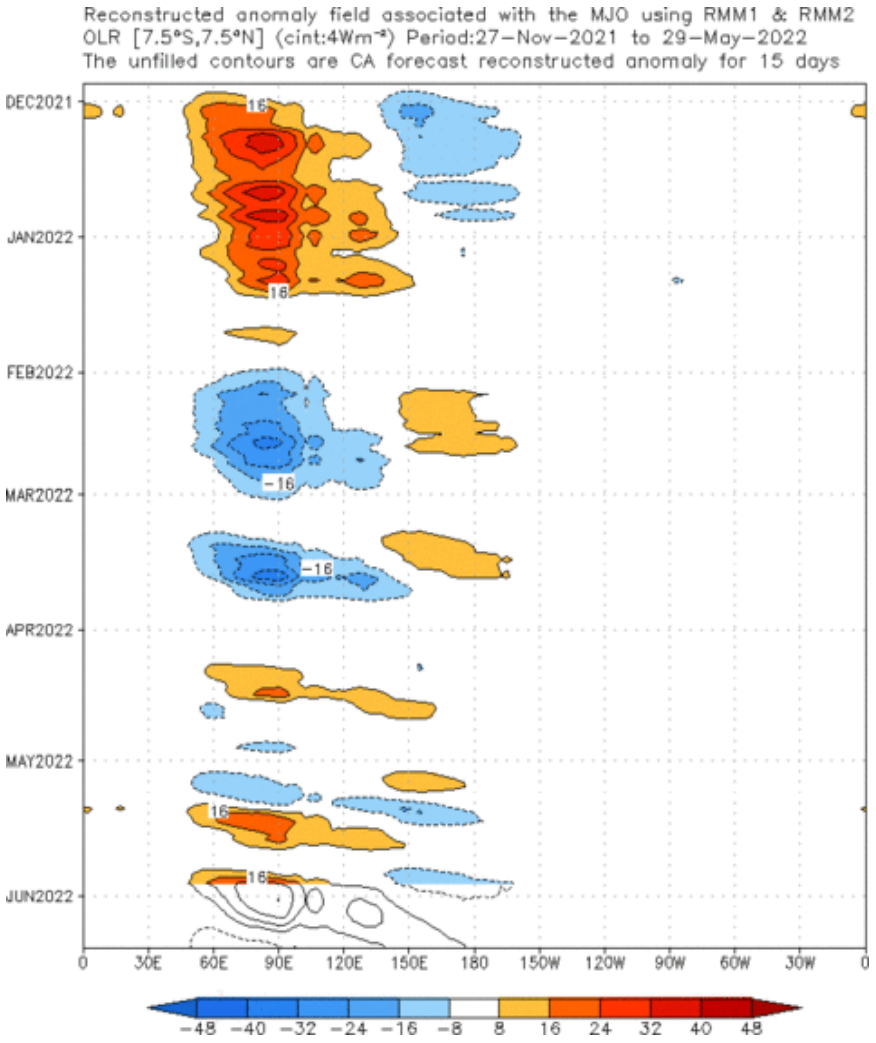


- The GEFS RMM-based OLR field depicts a fairly robust and canonical progression of MJO-like anomalies crossing from the West Pacific to North America over the next two weeks.

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.)

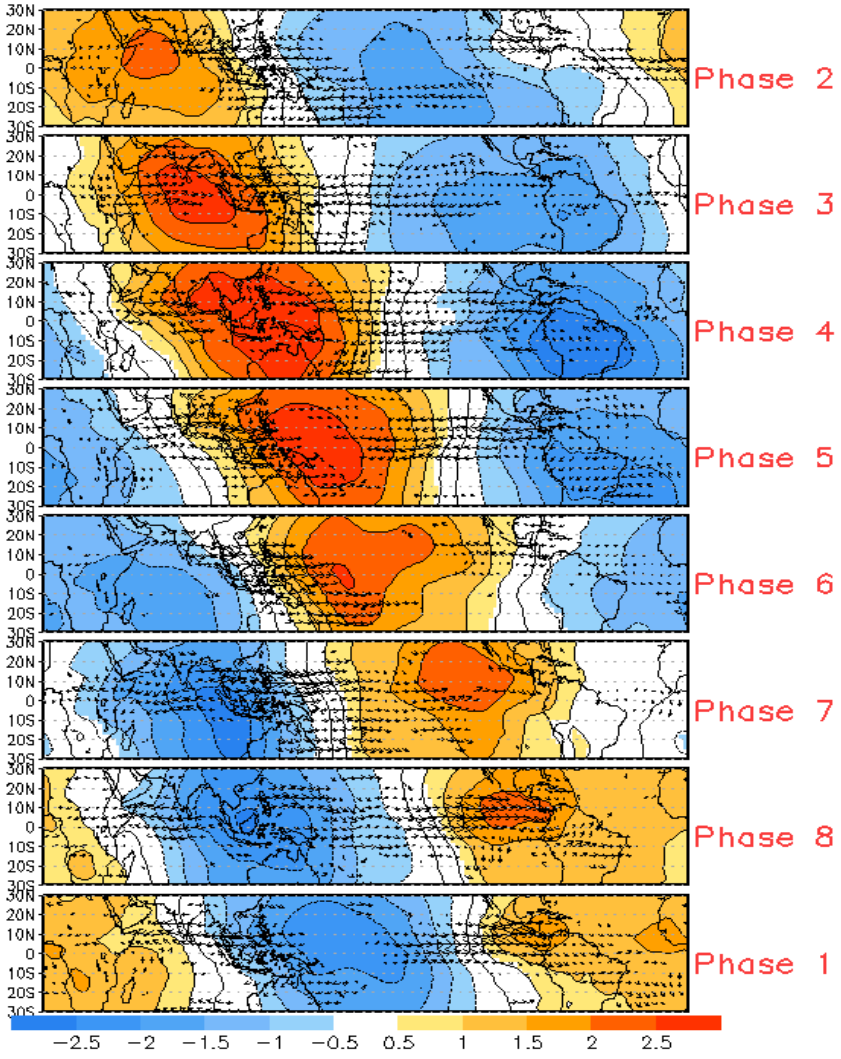




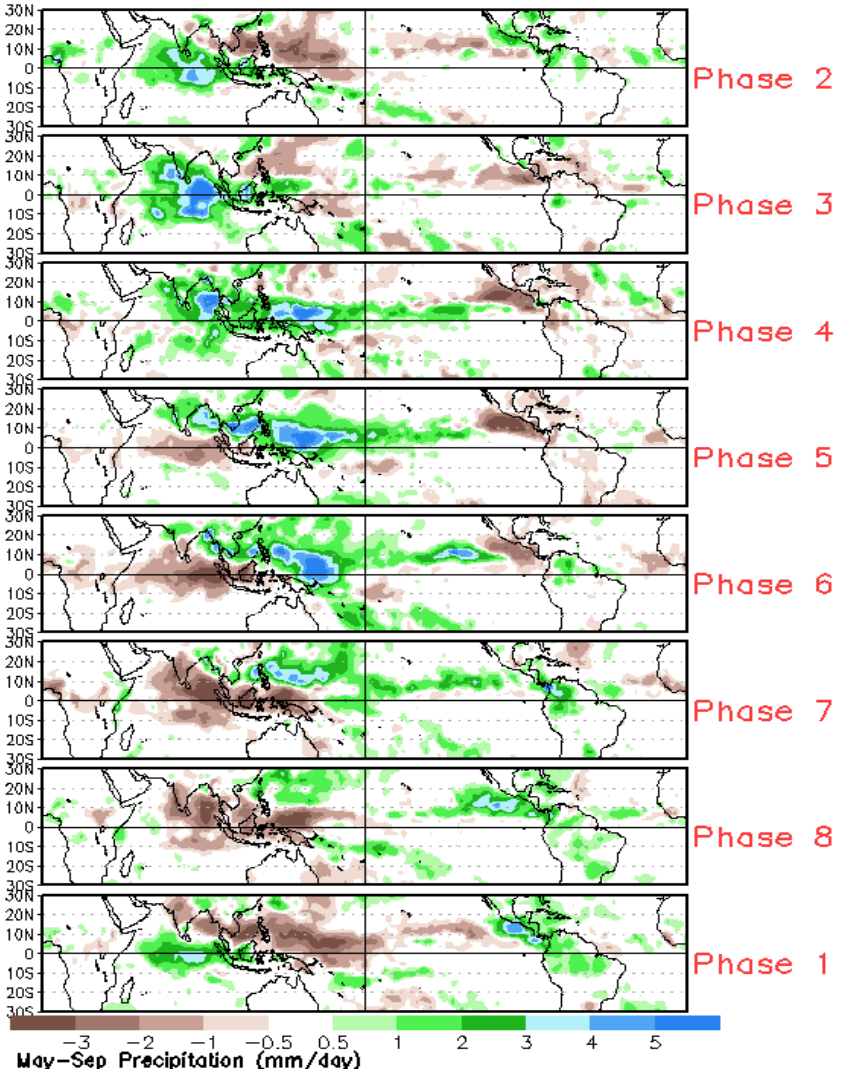
- The constructed analog forecast of RMM-based OLR anomalies is very similar to the GEFS forecast, with a slightly faster progression of the signal.

MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and Wind Anomalies



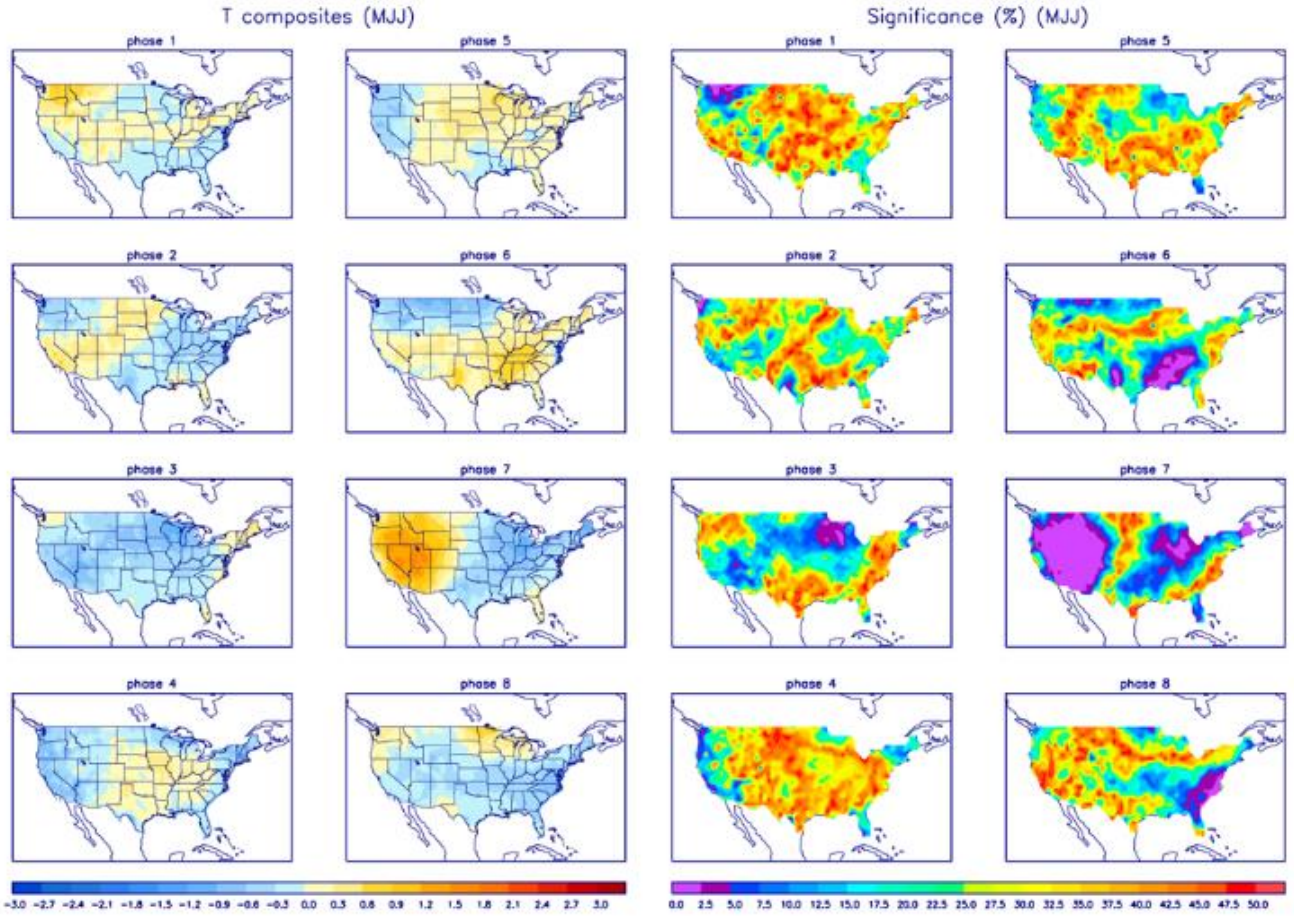
Precipitation Anomalies



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.

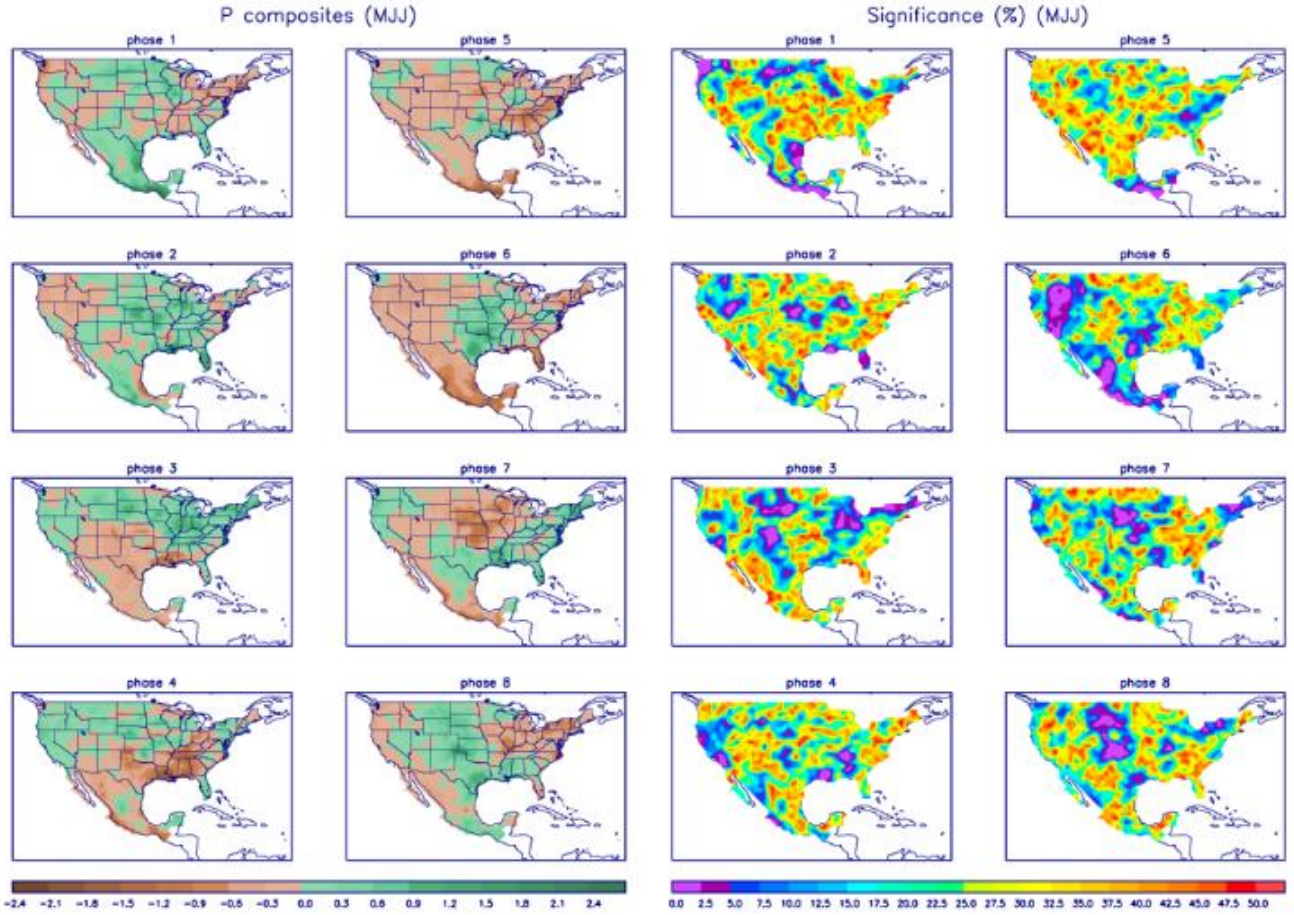


More information: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

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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