

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
26 July 2021

Overview

- During the last week, the MJO propagated across the Maritime Continent to the West Pacific.
- Other modes, including a Kelvin wave that moved ahead of the main MJO convective envelope and is now over the East Pacific and the low frequency state over the Pacific are increasingly interfering with the MJO signal.
- Dynamical model MJO index forecasts indicate a potential for additional eastward propagation of the MJO, but depict a weakening signal due to the interference.
- The Kelvin wave and MJO activity may contribute to increased tropical cyclone activity over the Central and East Pacific during the next two weeks.

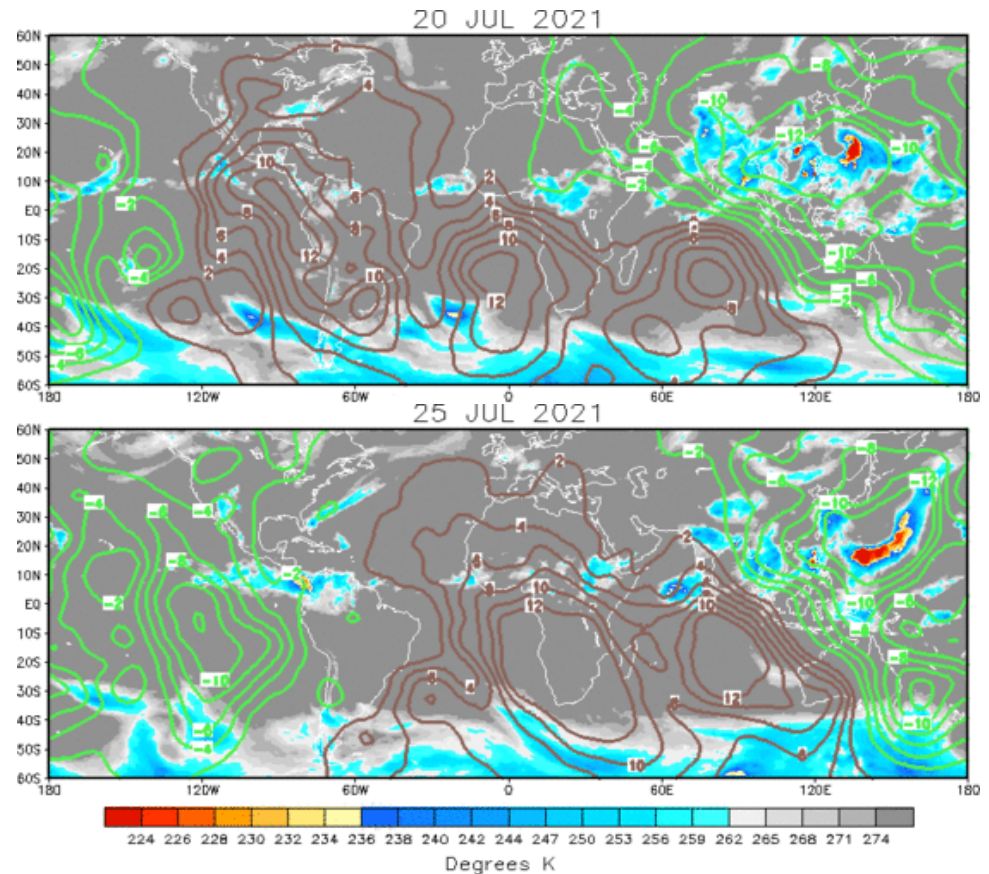
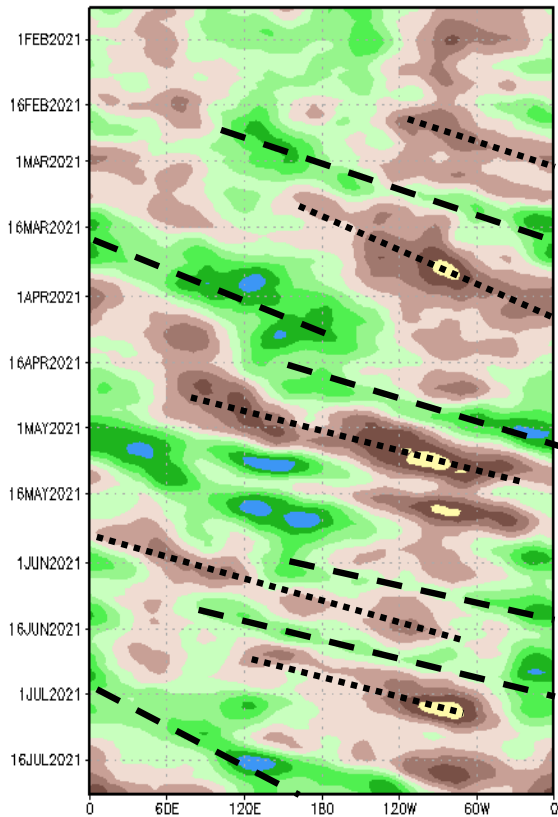
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

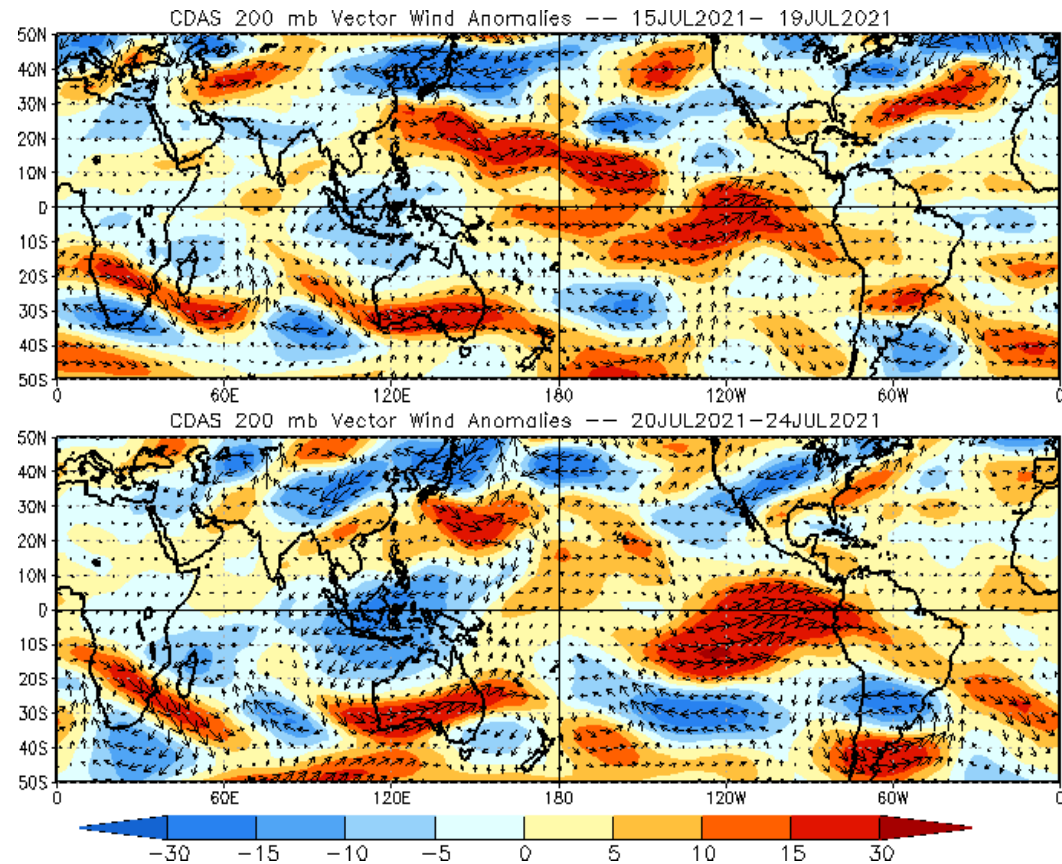
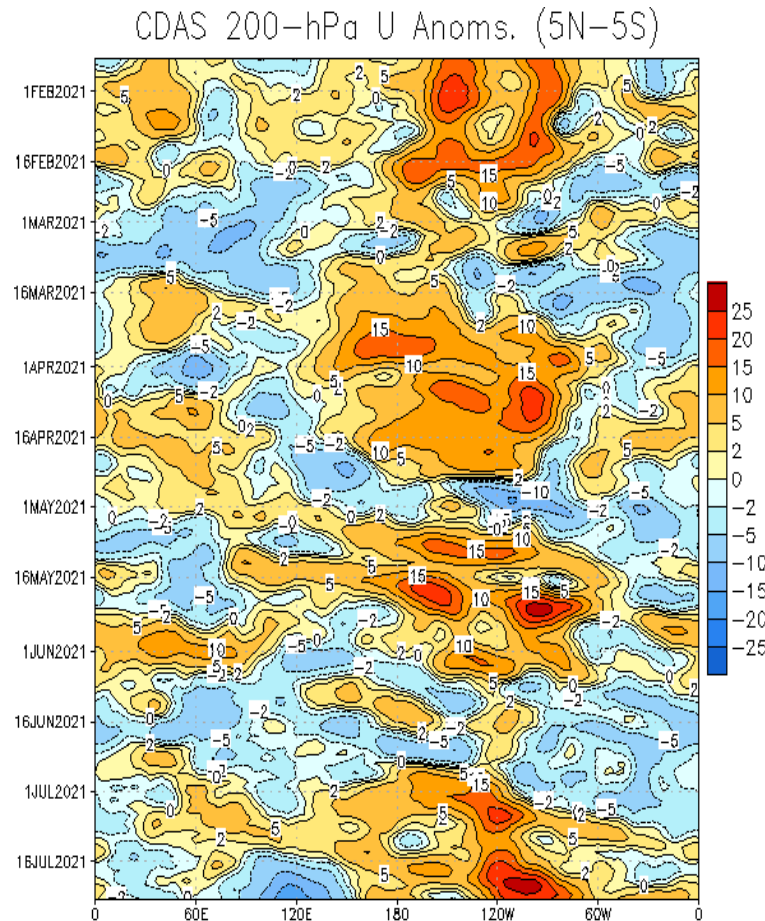
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- A coherent Wave-1 asymmetry reflective of an active MJO pattern continued during the last week, with the enhanced phase now over the Pacific.
- There is a clear split in the enhanced envelope as a fast propagating Kelvin wave crosses the Pacific while a slower evolving envelope remains over the West Pacific.

200-hPa Wind Anomalies

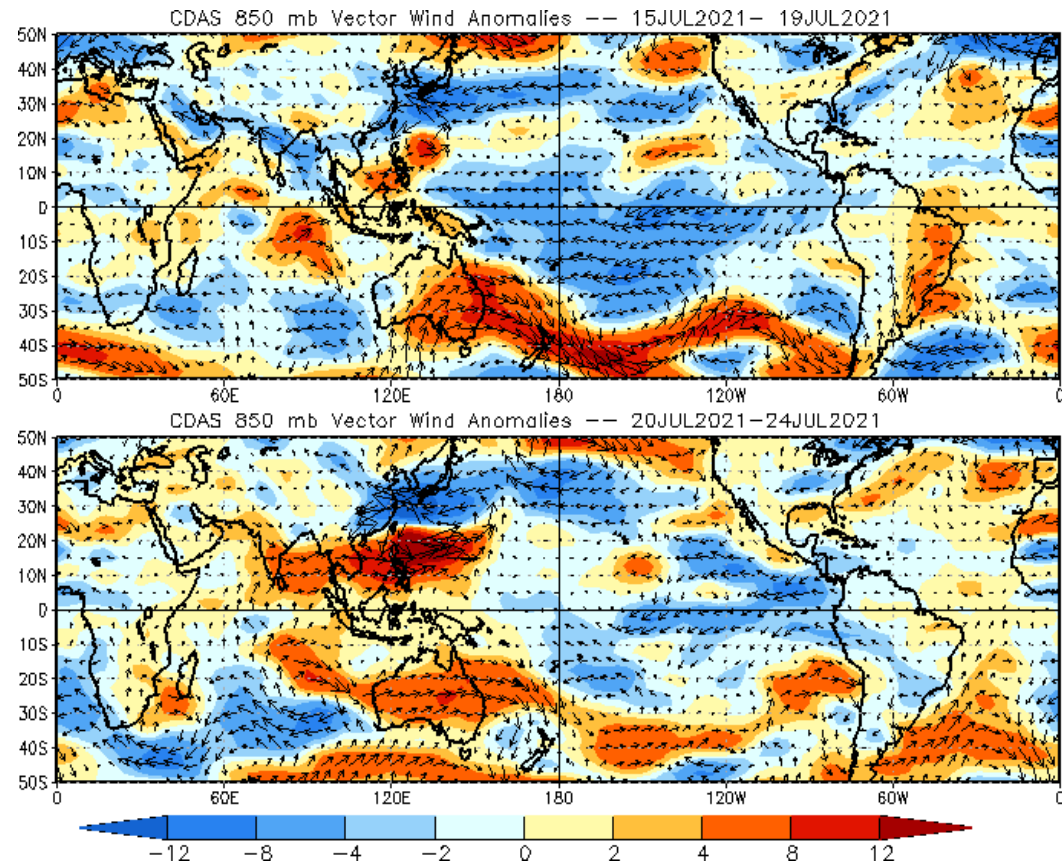
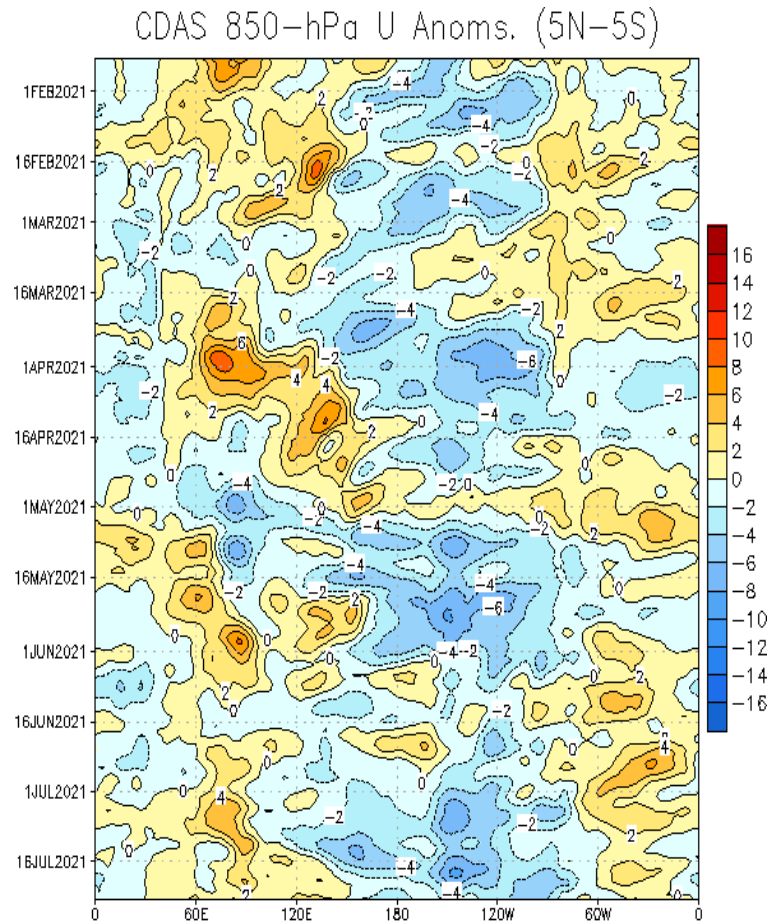
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- The upper-level zonal wind anomalies are also reflective of an organized MJO, with robust easterlies (westerlies) over the Maritime Continent (East Pacific) propagating eastward.
- Strong westerly anomalies over the East Pacific are also consistent with the low frequency state observed through the boreal Summer months.

850-hPa Wind Anomalies

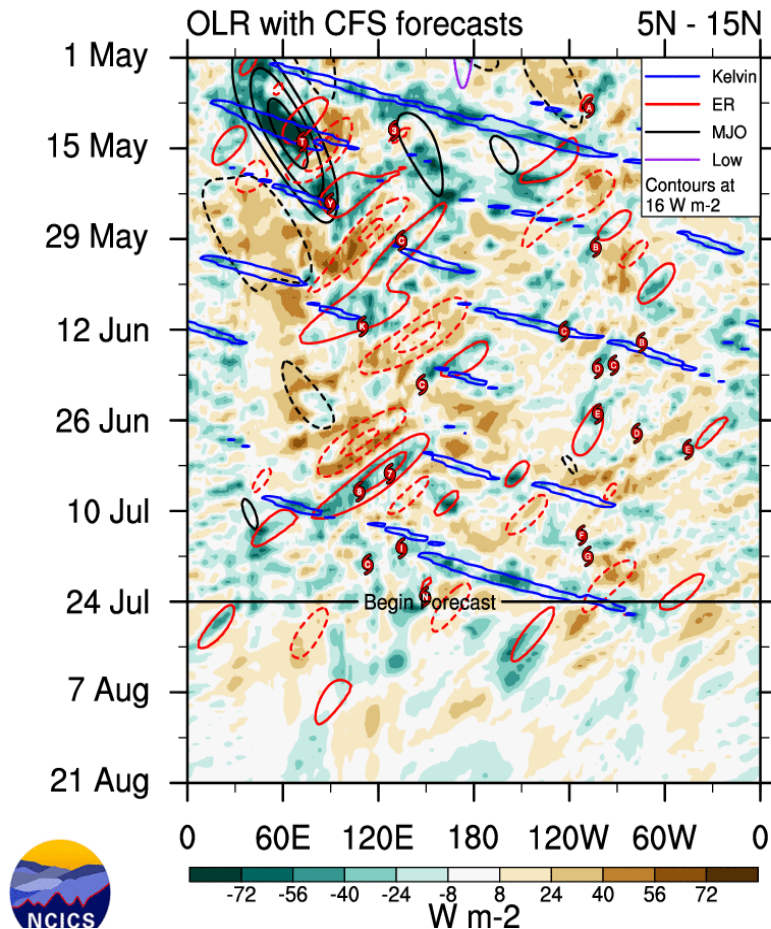
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



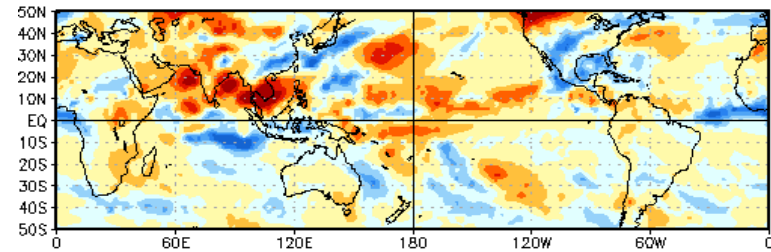
- Enhanced trades weakened across the West Pacific as the intraseasonal signal began to interfere with the low frequency state.
- While the leading edge of the MJO enhanced convective envelope destructively interfered with the base state, strongly enhanced monsoon activity developed over South and Southeast Asia in response to the subseasonal signal.

Outgoing Longwave Radiation (OLR) Anomalies

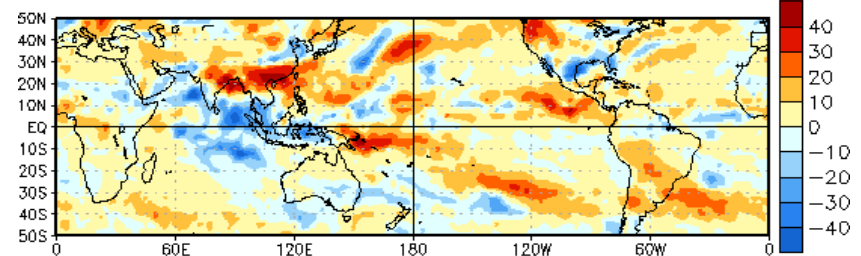
Blue shades: Anomalous convection (wetness). **Red shades:** Anomalous subsidence (dryness).



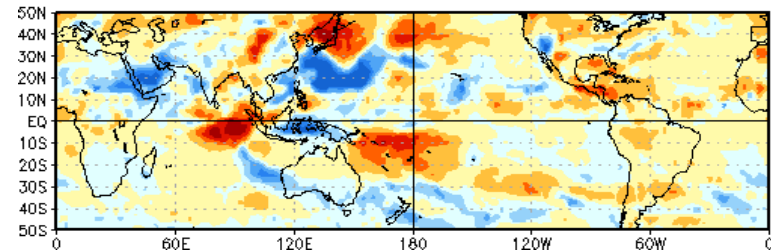
OLR Anomalies
25 JUN 2021 to 4 JUL 2021



5 JUL 2021 to 14 JUL 2021

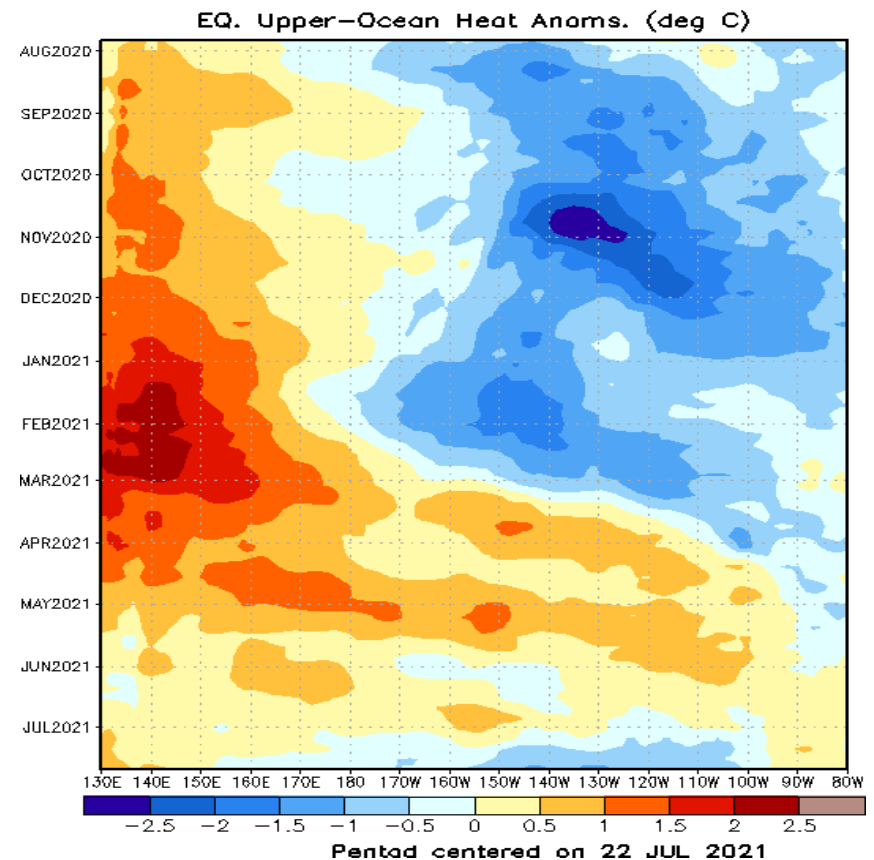
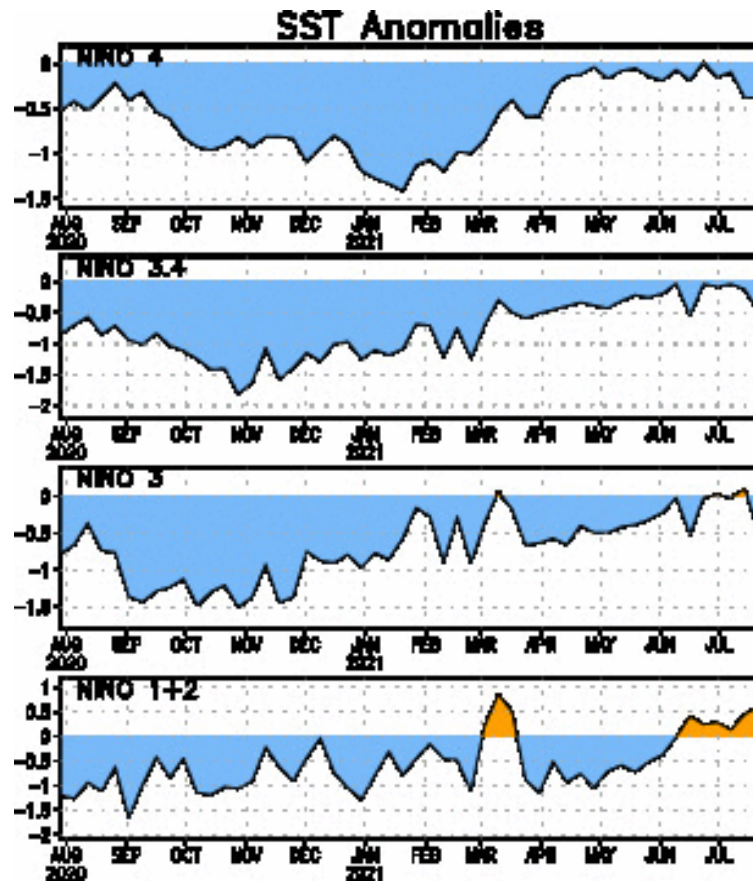


15 JUL 2021 to 24 JUL 2021



- The OLR field is a bit less organized than the zonal wind fields with respect to the intraseasonal signal. Enhanced convection was observed over parts of the Maritime Continent and Northwest Pacific.
- The Kelvin wave crossing the East Pacific was the most prominent feature on the OLR-based time-longitude plot over the past week.

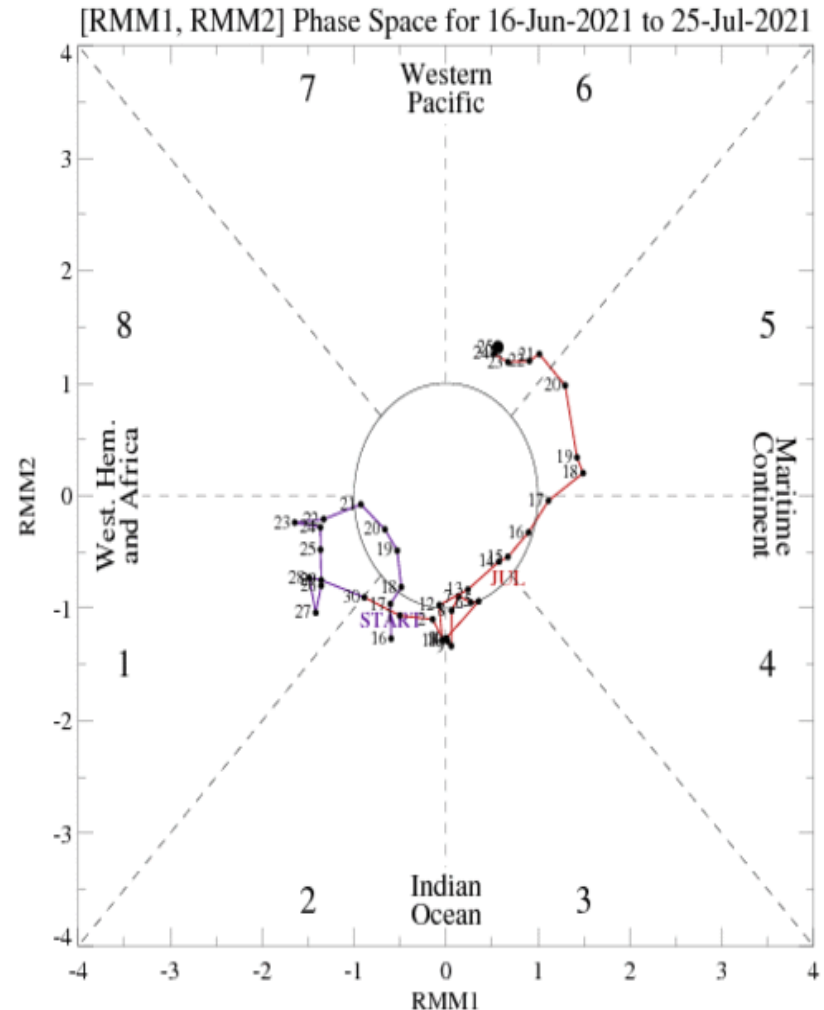
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Multiple episodes of oceanic Kelvin wave activity strengthened upper-ocean heat content during this past spring; however, these positive anomalies have been weakening over the central and eastern Pacific, with negative anomalies re-emerging over most of the basin more recently.
- Niño indices continue to remain slightly above-average in the Niño 1+2 region of the far East Pacific.

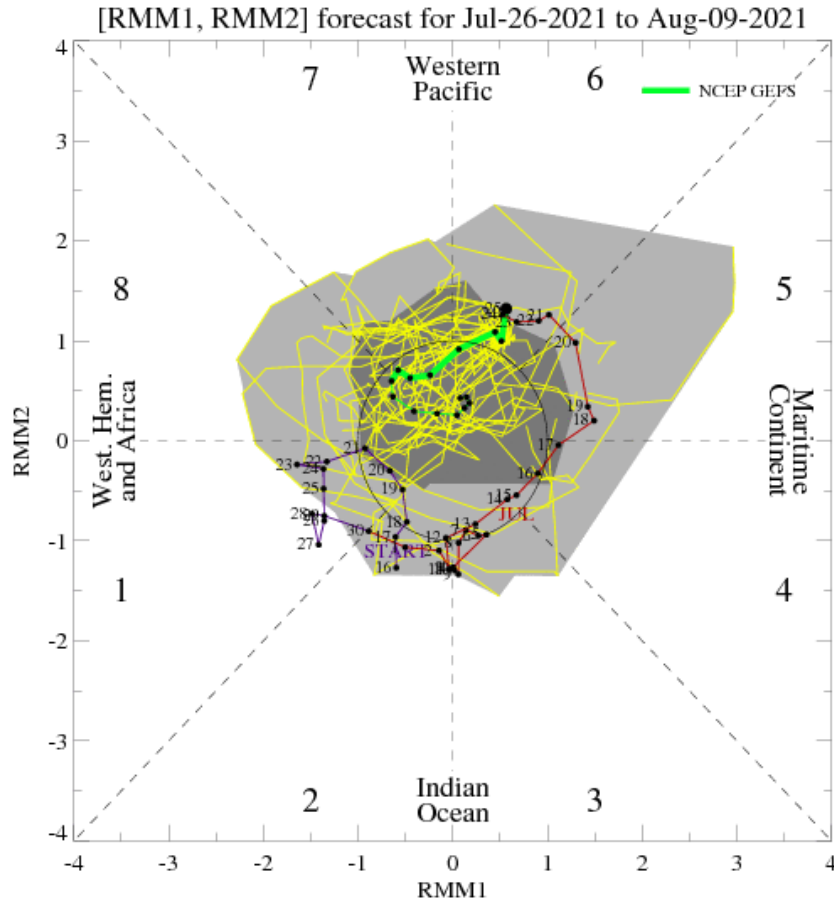
MJO Index: Recent Evolution

- The RMM index progressed rapidly across the Maritime Continent with a phase speed more consistent with Kelvin wave activity than a canonical MJO signal.
- More recently, the MJO index slowed over the West Pacific as the Kelvin wave crossed the East Pacific.

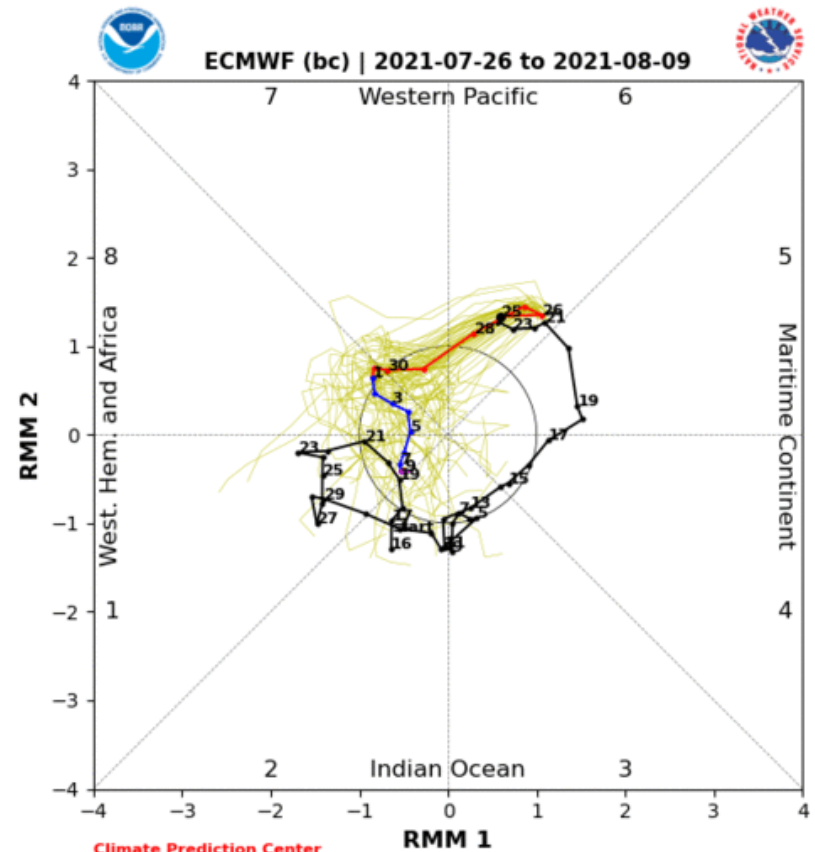


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



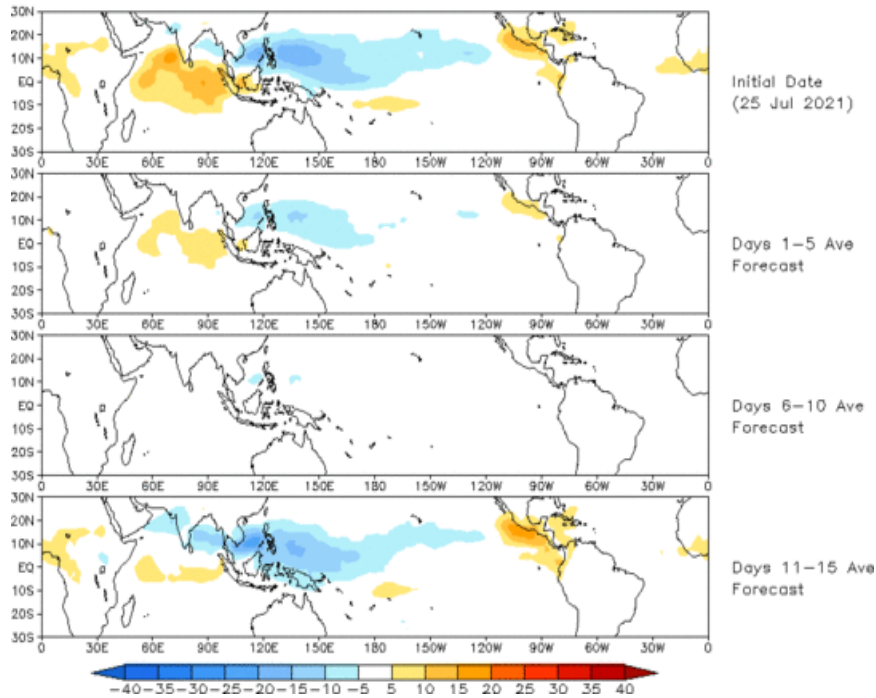
ECMWF Forecast

- Due to potential interference from the Kelvin wave and destructive interference with the base state, the RMM-index forecast shows a fairly weak signal over the next two weeks.
- Some ensemble members depict a more robust MJO event, while others bring the index back within the unit circle.
- The ECMWF is more progressive with the intraseasonal signal, and indicates that the MJO may help to bring increased tropical cyclone activity to the East Pacific during the next few weeks.

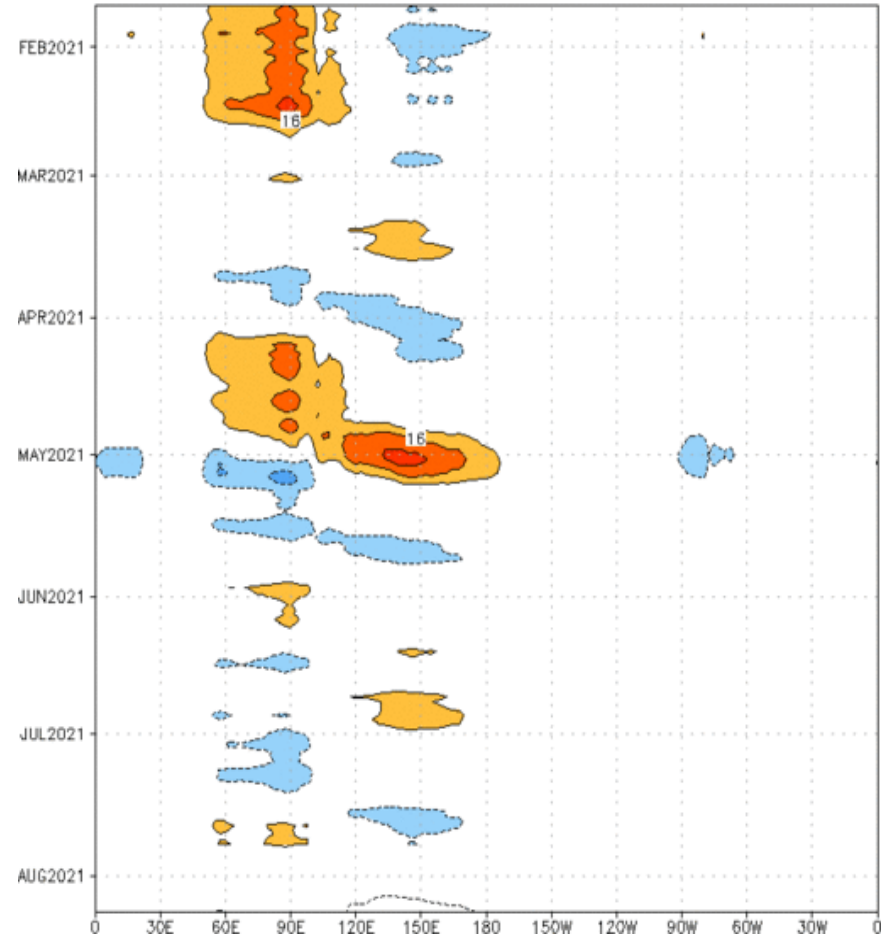
MJO: GEFS Forecast Evolution

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.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 25 Jul 2021
OLR



Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S, 7.5°N] ($\text{cont: } 4\text{Wm}^{-2}$) Period: 23-Jan-2021 to 25-Jul-2021
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days

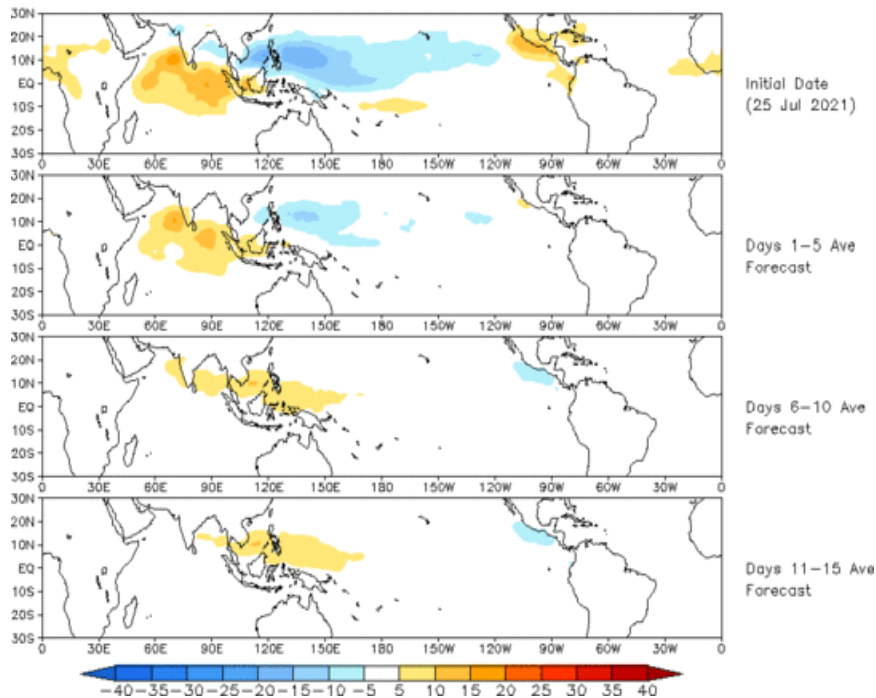


- The GEFS RMM-based OLR anomaly forecast features a weakening signal during most of the period, with a return of enhanced West Pacific convection at the end of Week-2.

MJO: Constructed Analog Forecast Evolution

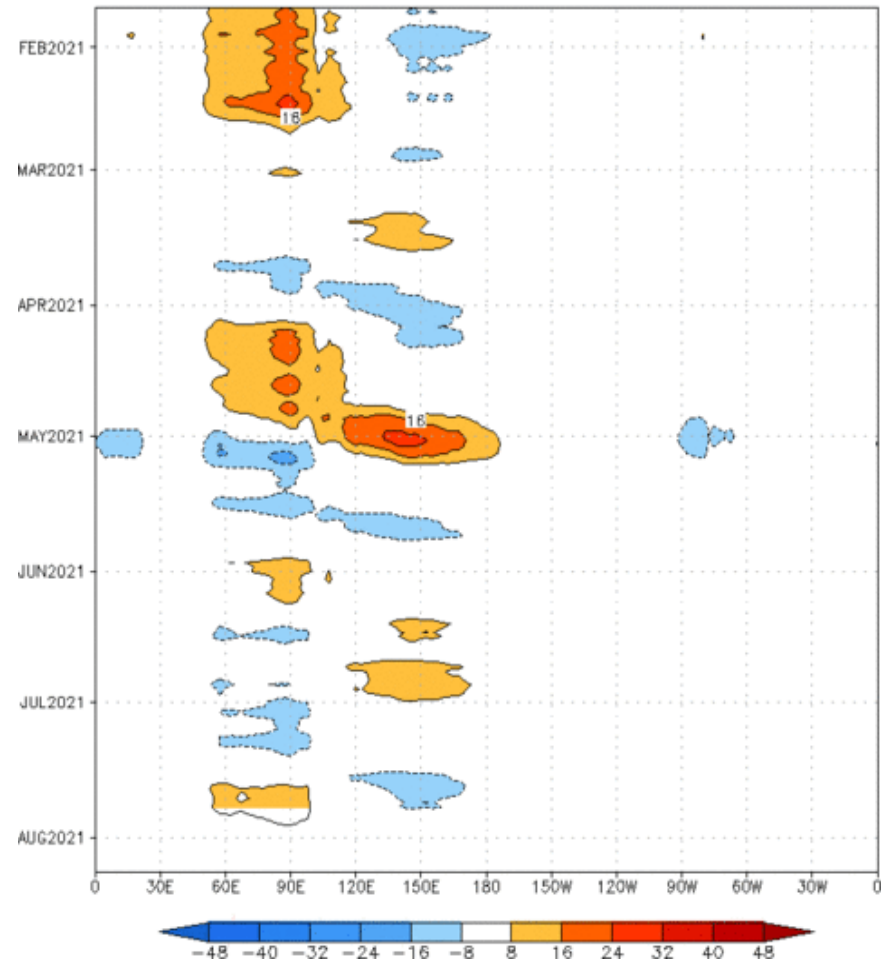
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (25 Jul 2021)



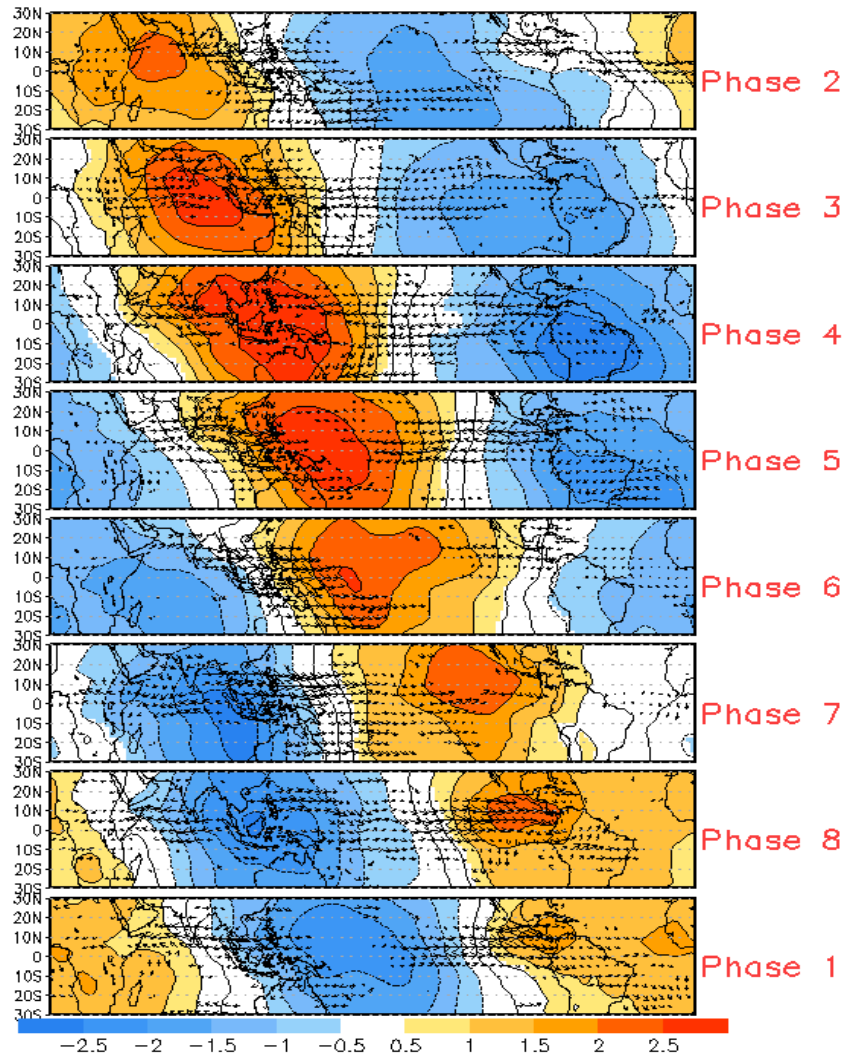
- The constructed analog forecast shows an eastward propagating but weakening signal over the next two weeks. Contrast to the GEFS, enhanced convection is favored over the East Pacific.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:23-Jan-2021 to 25-Jul-2021
The unfilled contours are CA forecast reconstructed anomaly for 15 days

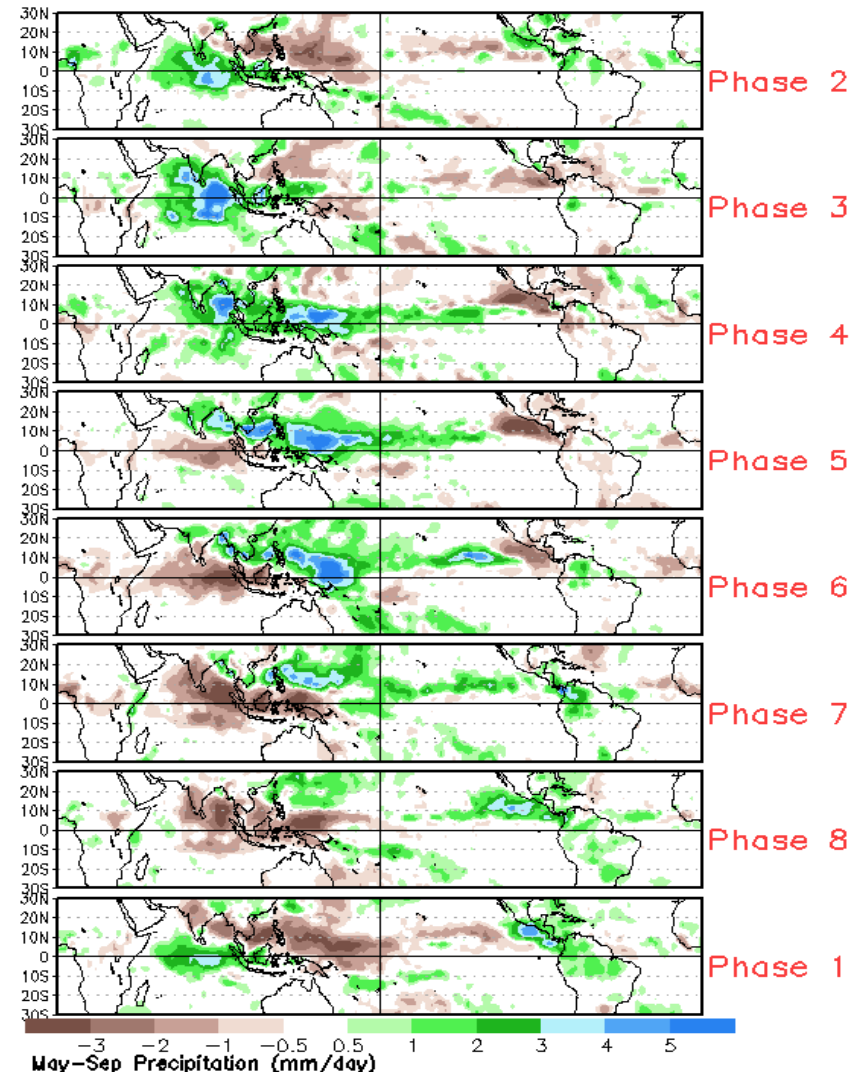


MJO: Tropical Composite Maps by RMM Phase

850-hPa Velocity Potential and
Wind Anomalies



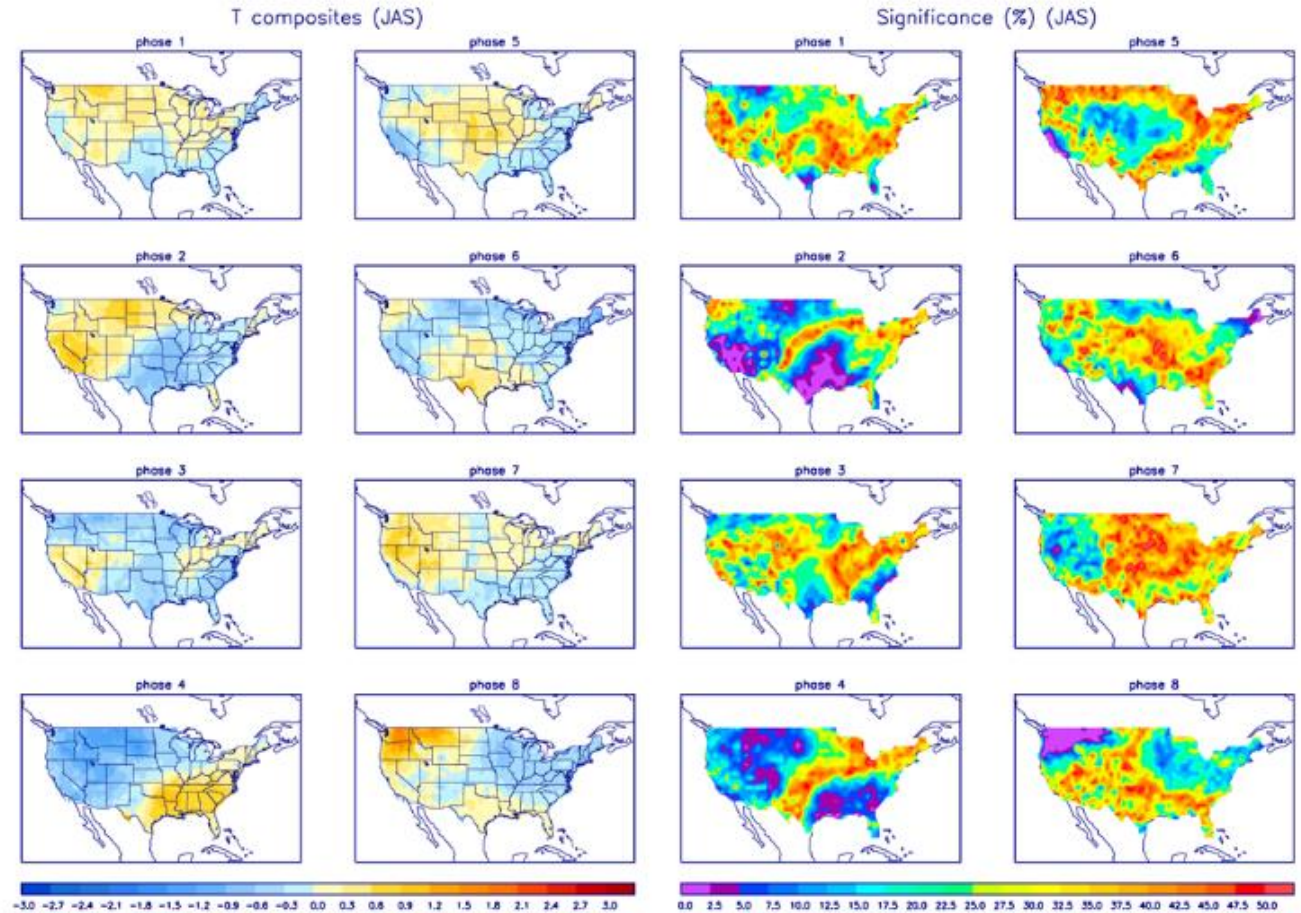
Precipitation Anomalies



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.



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.

