

Madden-Julian Oscillation:

Recent Evolution, Current Status and Predictions



Update prepared by the Climate Prediction Center
Climate Prediction Center / NCEP
28 December 2020

Overview

- La Niña conditions dominate the convective variability over the equatorial Indian and Pacific oceans, while mid-latitude wave breaking from the Northern and Southern hemispheres adds significant noise and variability to the lower and upper level wind fields over the Pacific.
- The MJO remains weak but models are in good agreement that an event will form over the Indian Ocean during Week-2.
- There is potential for tropical cyclone development in the Indian Ocean during the next two weeks.

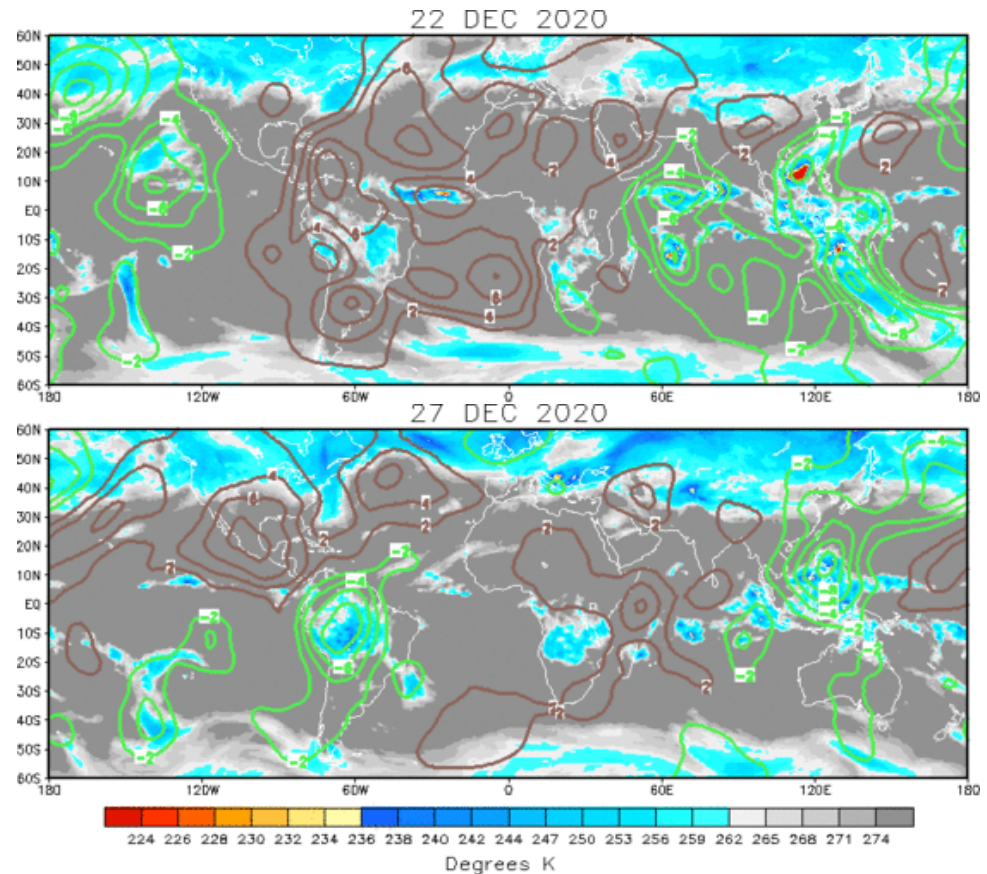
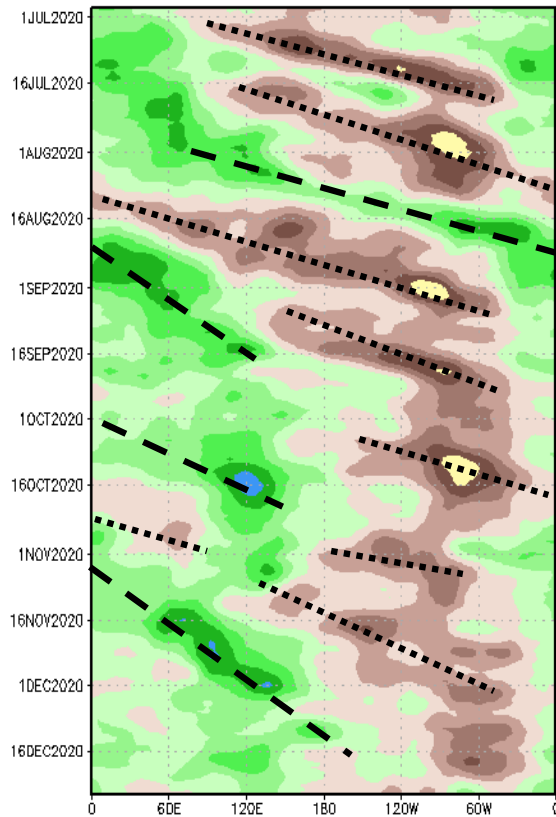
A discussion of potential impacts for the global tropics and those related to the U.S. are updated on Tuesday at:
<http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/index.php>

200-hPa Velocity Potential Anomalies

Green shades: Anomalous divergence (favorable for precipitation).

Brown shades: Anomalous convergence (unfavorable for precipitation).

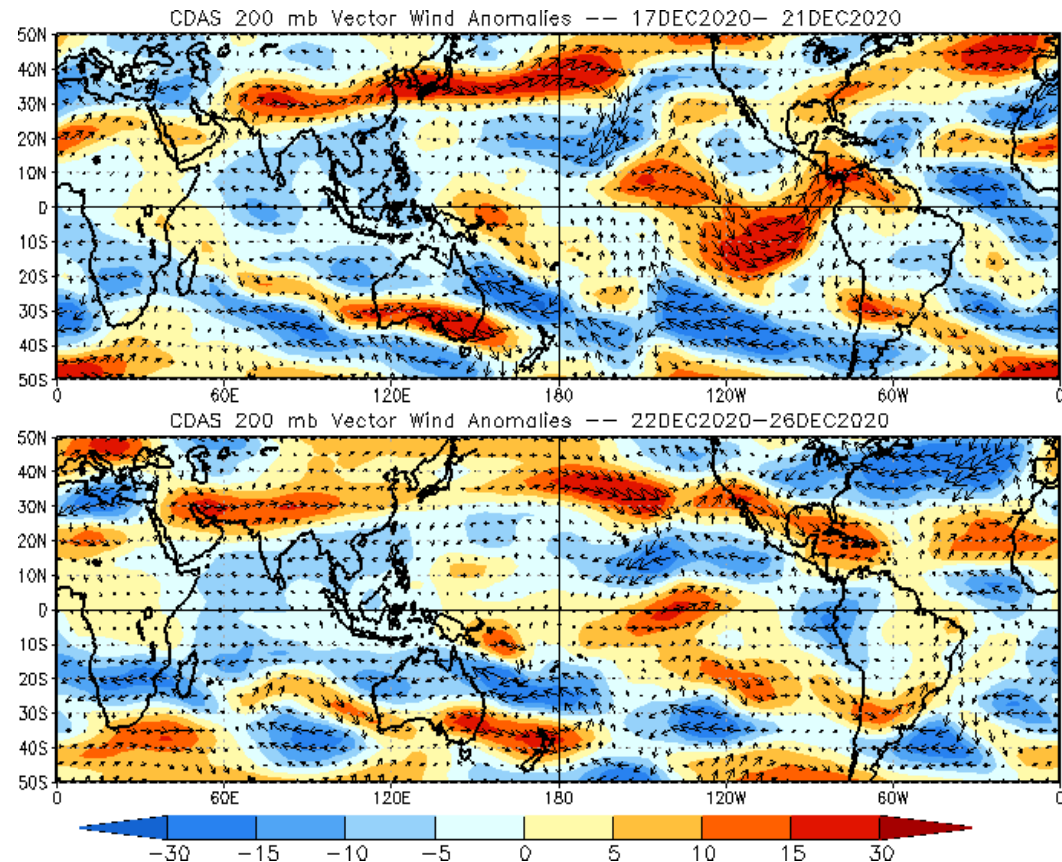
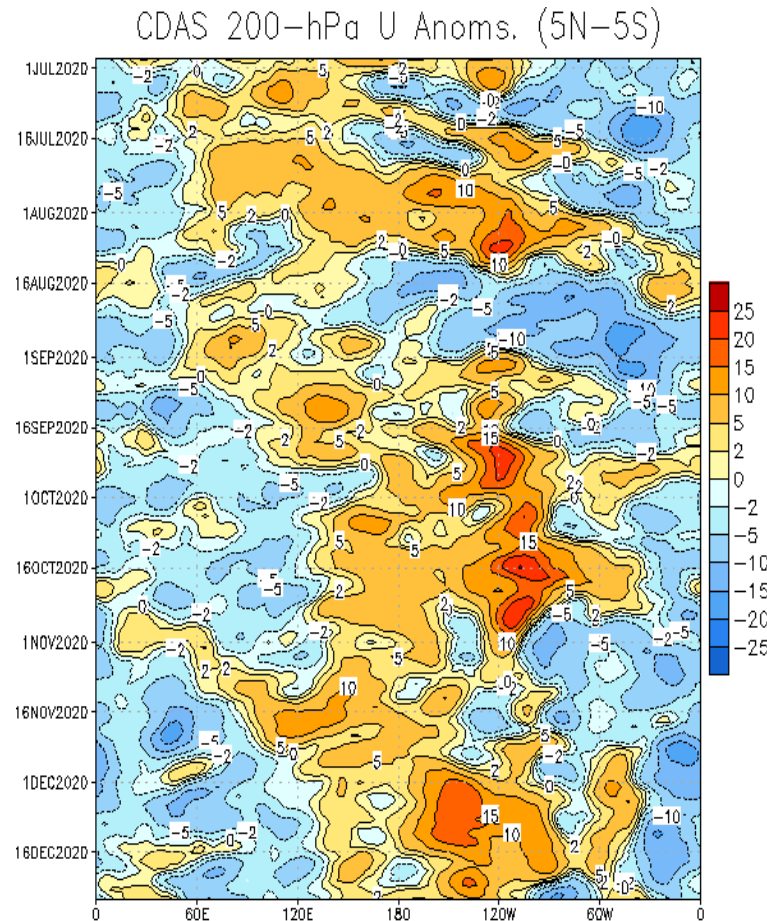
200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean



- The MJO was active during much of November and early December, with slow eastward propagation from the Indian Ocean to the far West Pacific.
- The upper-level pattern has become increasingly disorganized as the intraseasonal MJO signal moves away from the constructive interference offered by La Niña.

200-hPa Wind Anomalies

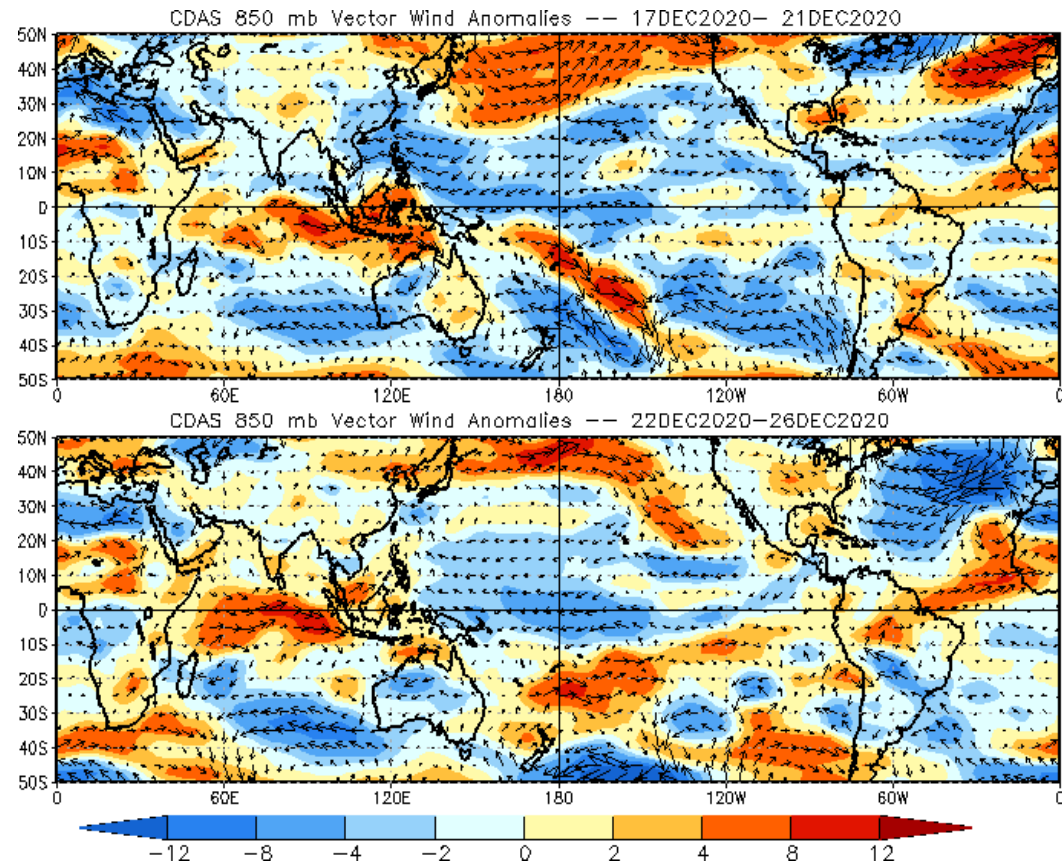
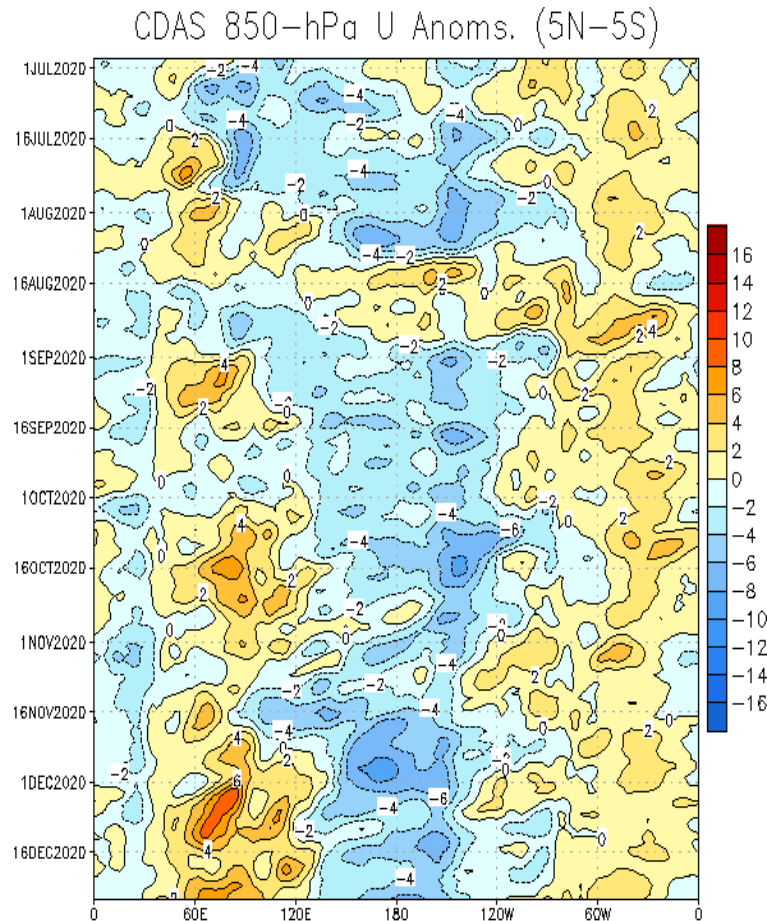
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



- There is evidence of wave breaking over the central and eastern Pacific in the Northern and Southern Hemispheres.
- The upper-level westerlies along the equator just east of the Date Line are consistent with La Niña conditions.

850-hPa Wind Anomalies

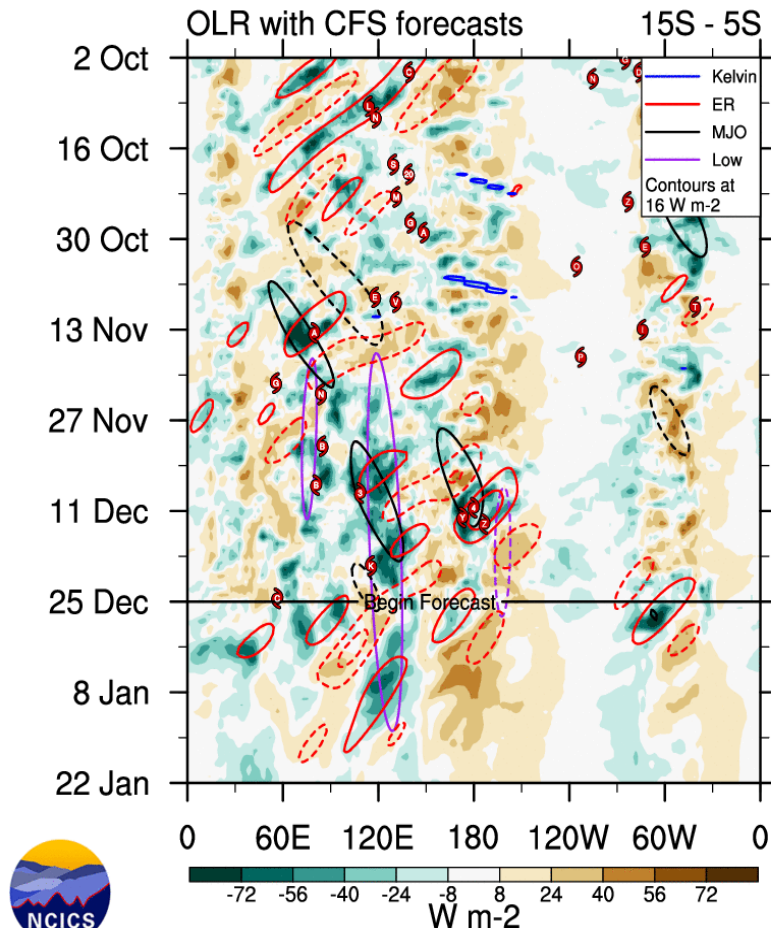
Shading denotes the zonal wind anomaly. **Blue shades:** Anomalous easterlies. **Red shades:** Anomalous westerlies.



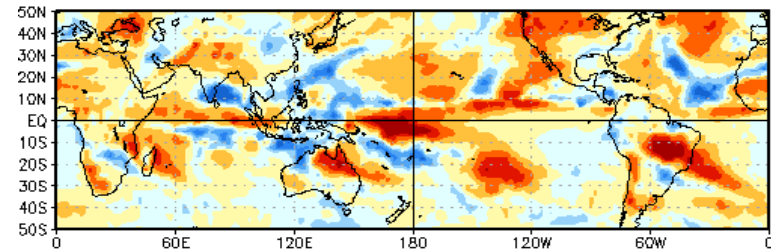
- Anomalous low-level easterlies along the Equator in the Pacific are consistent with La Niña conditions.
- These easterlies were also enhanced by higher frequency Rossby and Kelvin wave activity during December.
- There hasn't been much tropical wave activity in the Indian Ocean lately; the anomalous westerlies project strongly onto low-frequency modes, likely dominated by La Niña since there isn't evidence to support a negative IOD event.

Outgoing Longwave Radiation (OLR) Anomalies

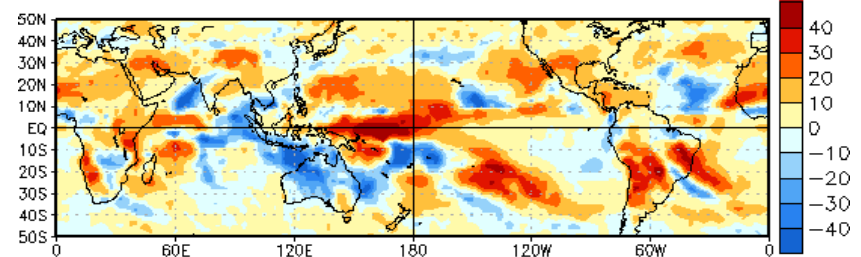
Blue shades: Anomalous convection (wetness). **Red shades:** Anomalous subsidence (dryness).



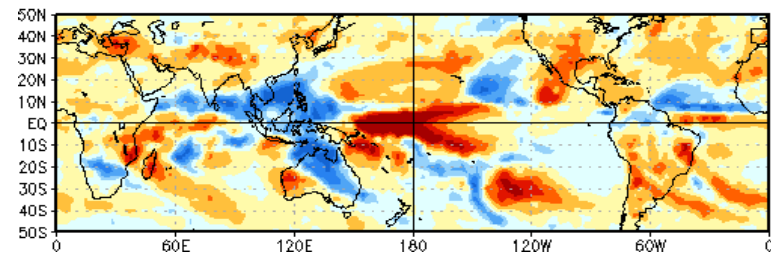
OLR Anomalies
27 NOV 2020 to 6 DEC 2020



7 DEC 2020 to 16 DEC 2020

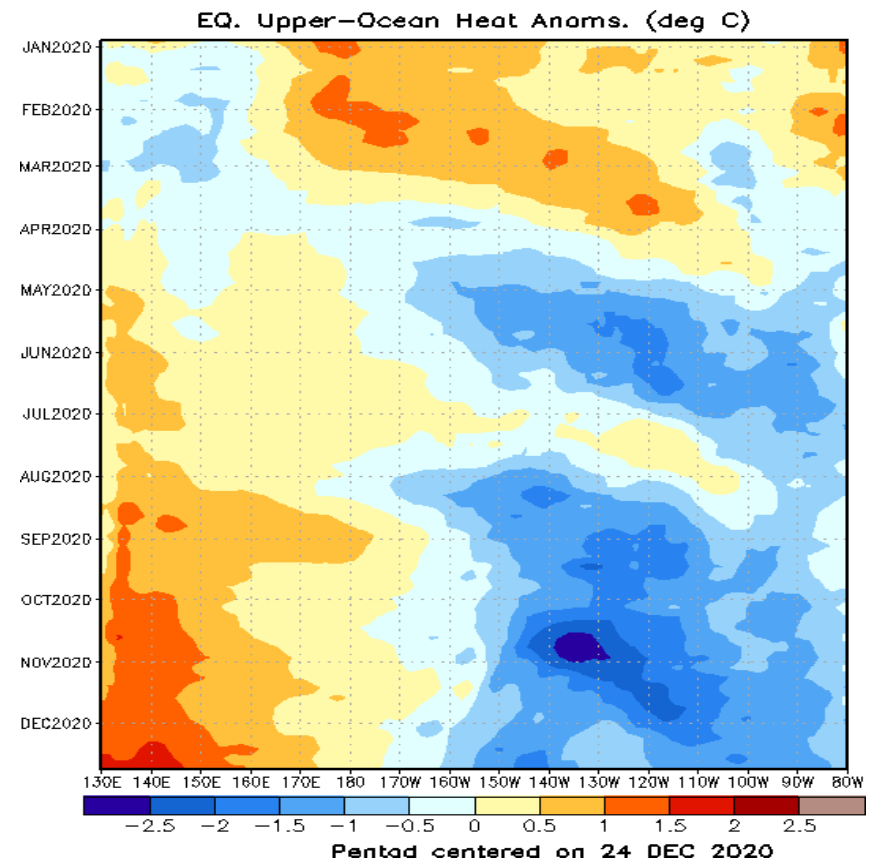
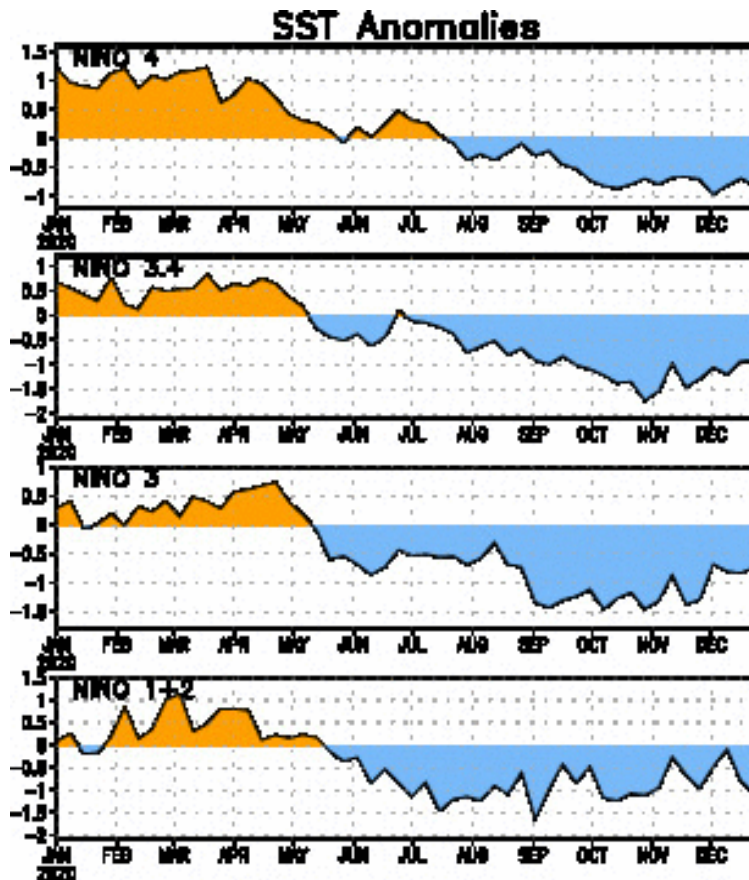


17 DEC 2020 to 26 DEC 2020



- There has been a large region of anomalous convection over the Maritime Continent since early December, which is consistent with an atmospheric response to anomalously warm SSTs related to La Niña.

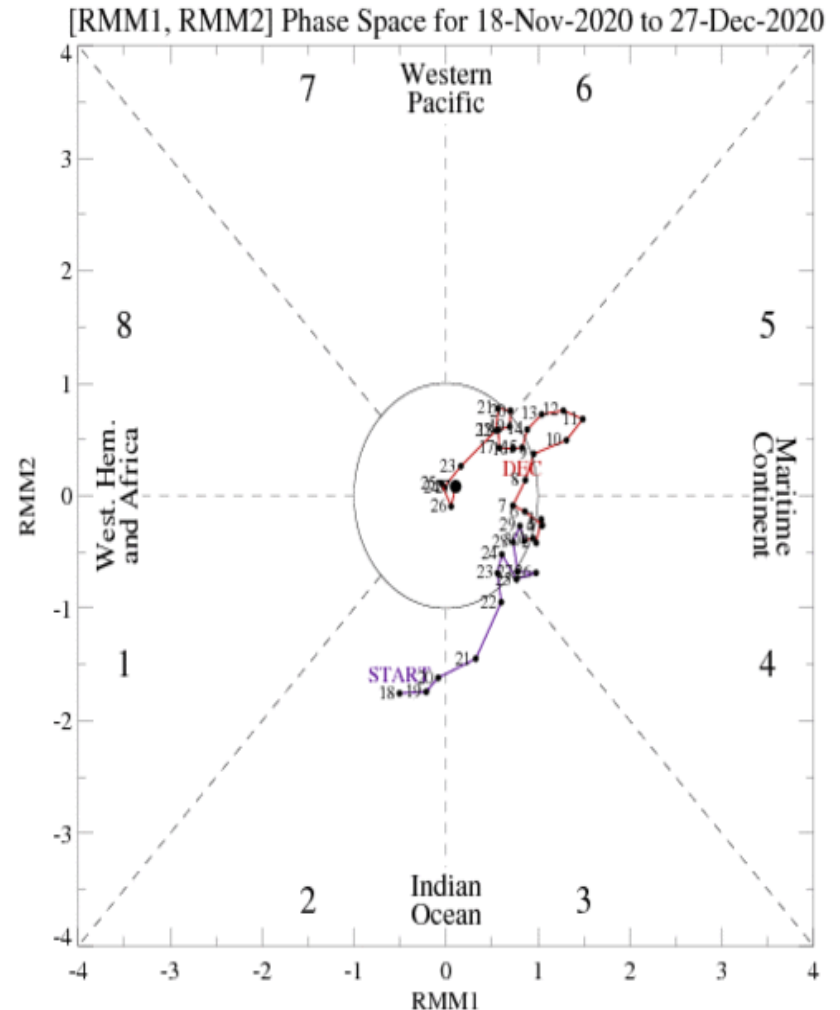
SSTs and Weekly Heat Content Evolution in the Equatorial Pacific



- Following destructive interference with the base state by a downwelling Kelvin wave during July, the subsequent upwelling phase has pushed the Pacific into La Niña conditions.
- Cold anomalies shifted slightly westward across the central Pacific during November and early December.

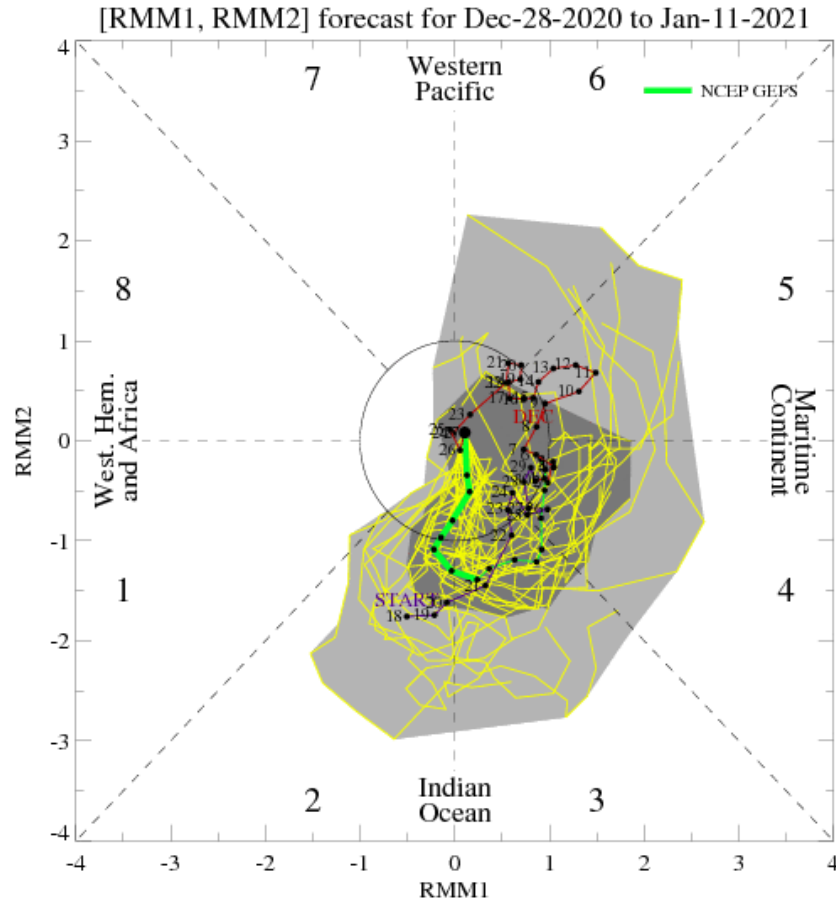
MJO Index: Recent Evolution

- The RMM index has been weak since late November. There has not been much organized MJO activity since then.
- The short term amplitude spike in Phase 5 was due more to an equatorial Rossby wave projecting onto the RMM index than an actual MJO event.

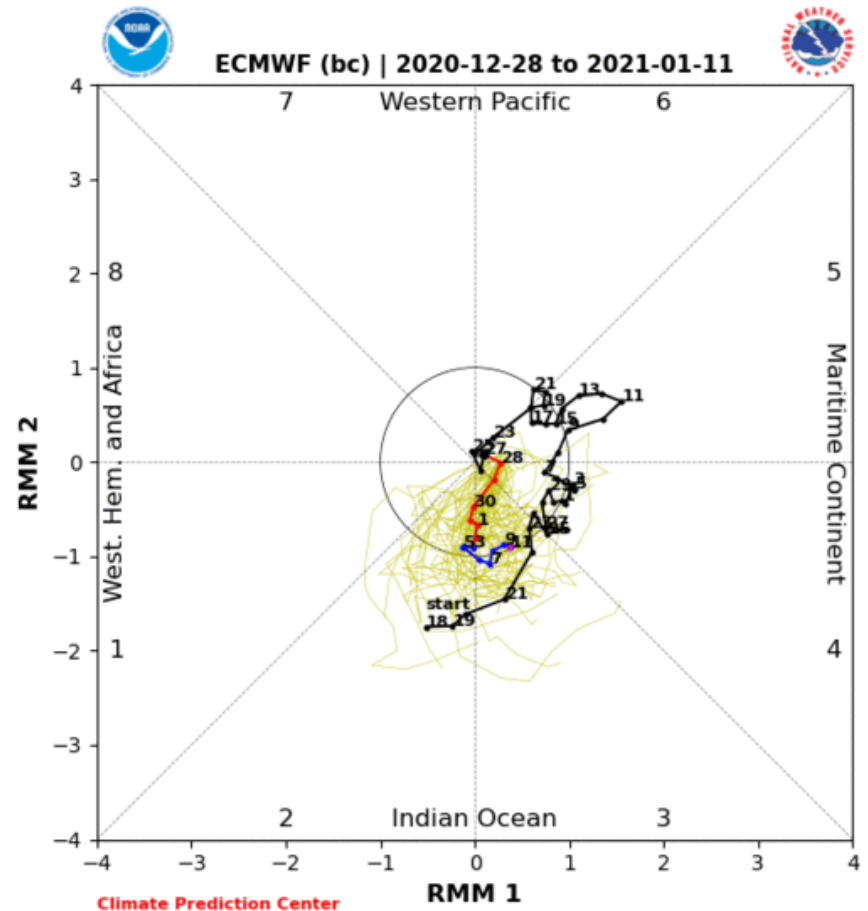


For more information on the RMM index and how to interpret its forecast please see:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CPC_MJOinformation.pdf

MJO Index: Forecast Evolution



GEFS Forecast



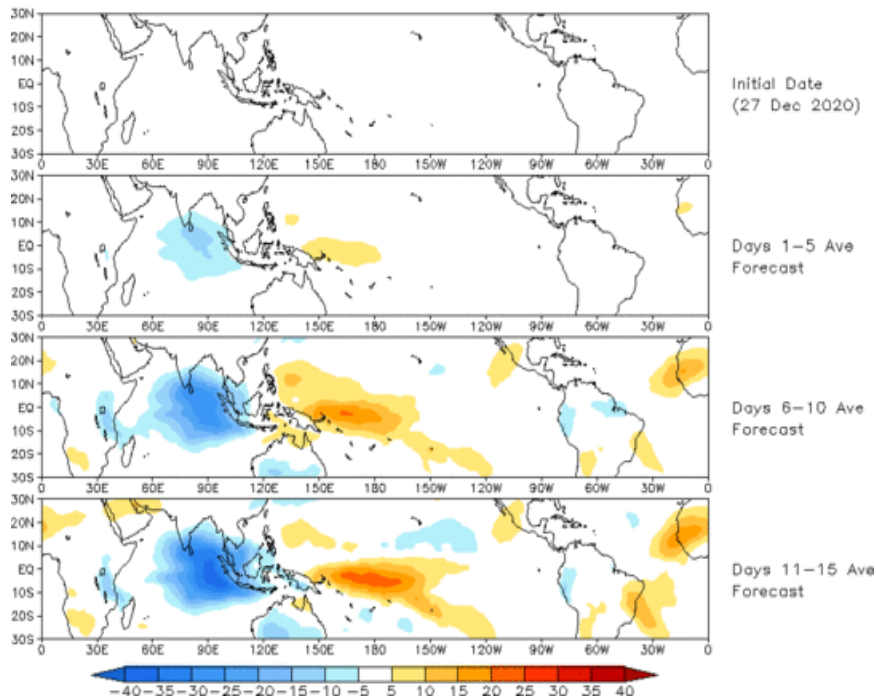
ECMWF Forecast

- The GEFS and ECMWF predict an MJO signal evolving over the Indian Ocean during Week-2.
- This is the strongest MJO forecast in some time and there is especially high confidence since so many ensemble members appear to be in agreement.

MJO: GEFS Forecast Evolution

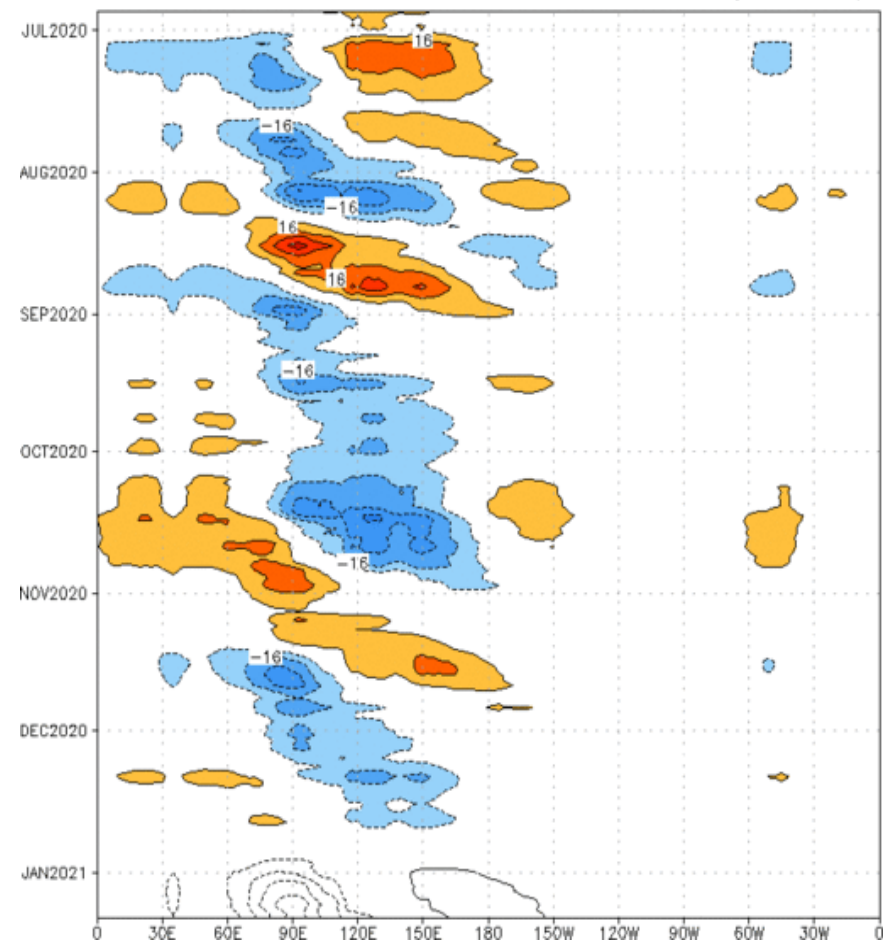
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

Prediction of MJO-related anomalies using GEFS operational forecast
Initial date: 27 Dec 2020
OLR



- This GEFS forecast matches the previous slide's RMM forecast – a strong MJO signal is forecast to develop during Week-2.

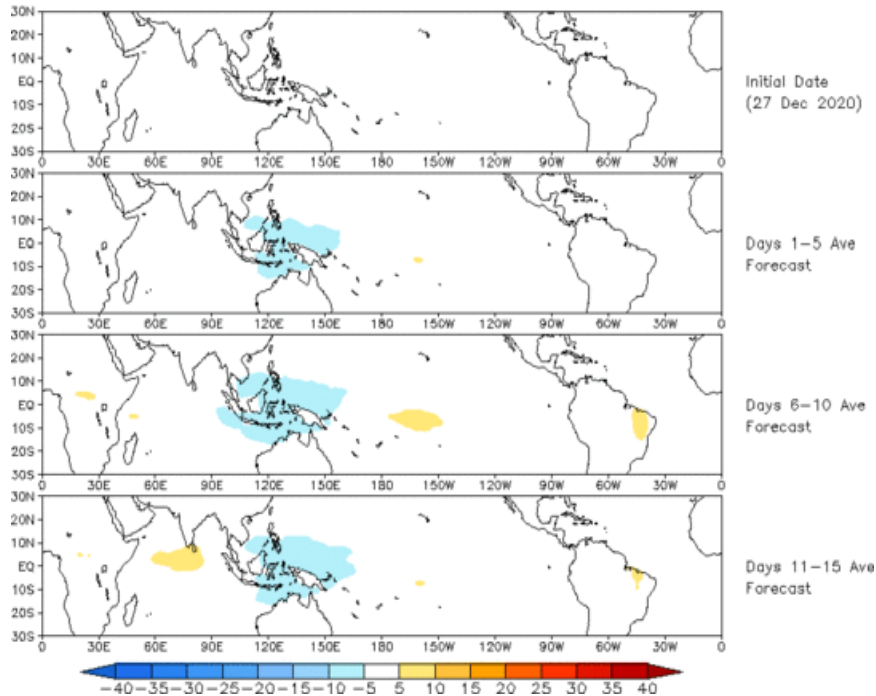
Reconstructed anomaly field associated with the MJO using RMM1 & RMM2
OLR [7.5°S,7.5°N] ($\text{cint:}4\text{Wm}^{-2}$) Period:27-Jun-2020 to 27-Dec-2020
The unfilled contours are GEFS forecast reconstructed anomaly for 15 days



MJO: Constructed Analog Forecast Evolution

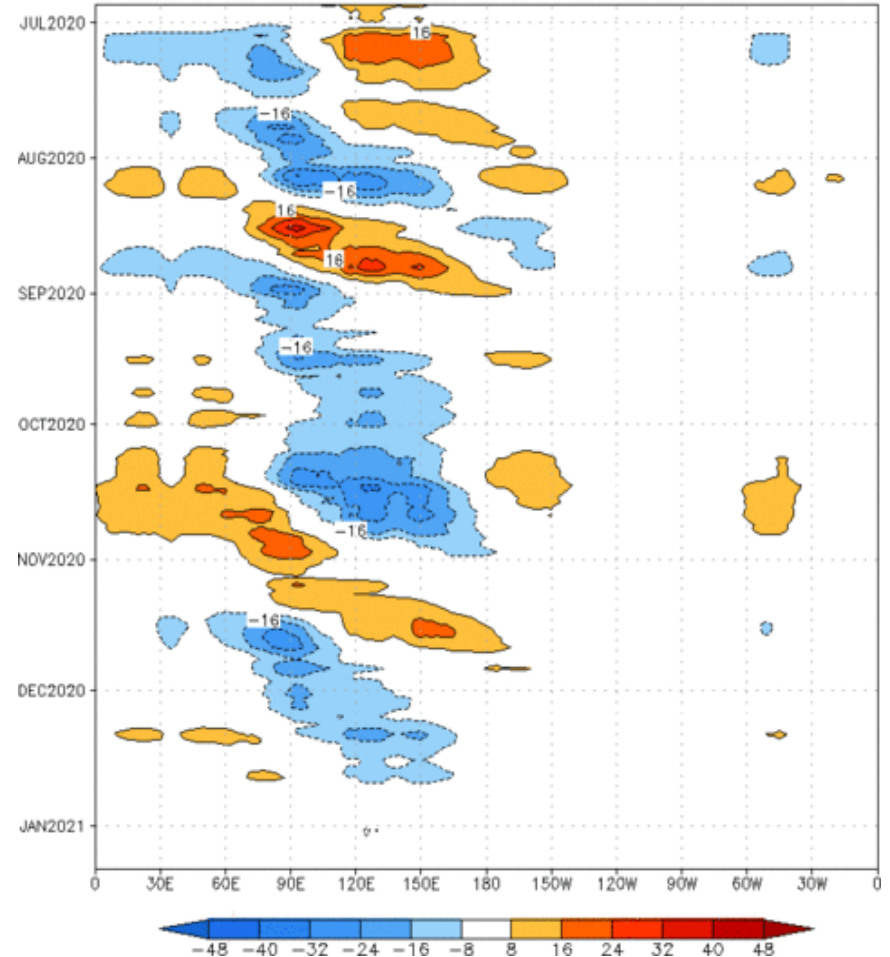
Figures below show MJO associated OLR anomalies only (reconstructed from RMM1 and RMM2) and do not include contributions from other modes (*i.e.*, ENSO, monsoons, etc.)

OLR prediction of MJO-related anomalies using CA model reconstruction by RMM1 & RMM2 (27 Dec 2020)



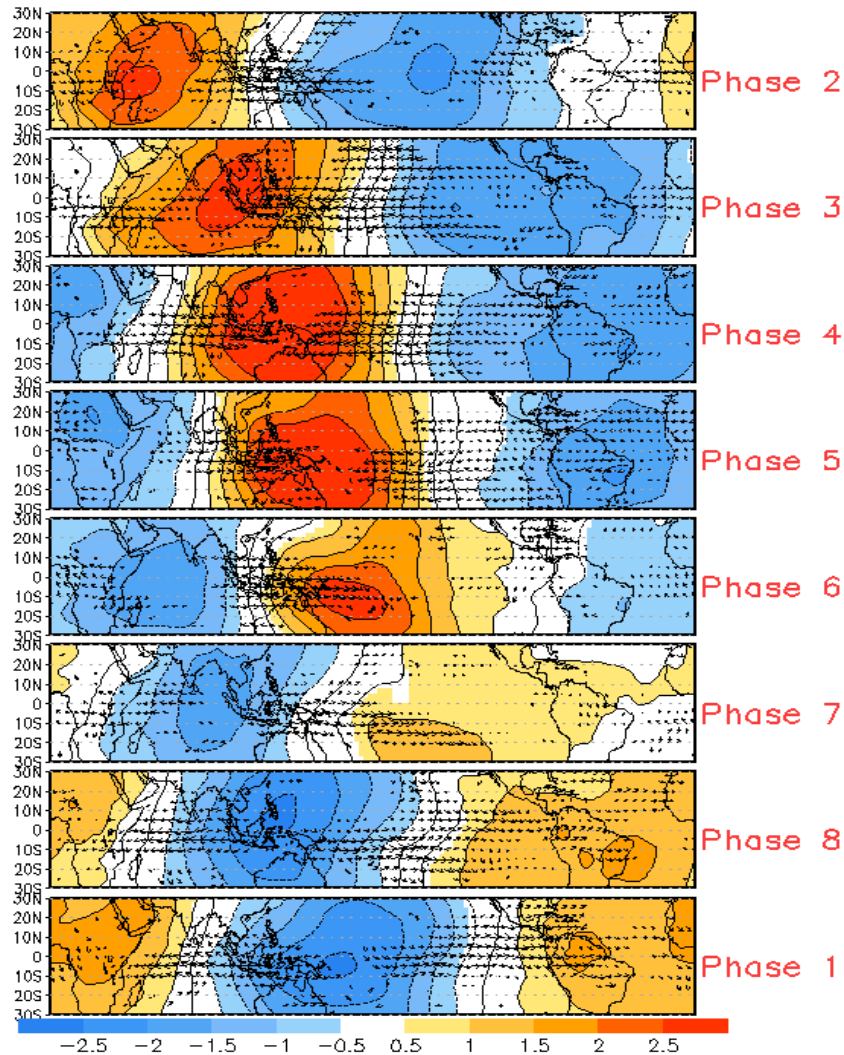
- The constructed analog tool does not forecast MJO development during the next two weeks.

Reconstructed anomaly field associated with the MJO using RMM1 & RMM2 OLR [7.5°S,7.5°N] (cint:4Wm⁻²) Period:27-Jun-2020 to 27-Dec-2020
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



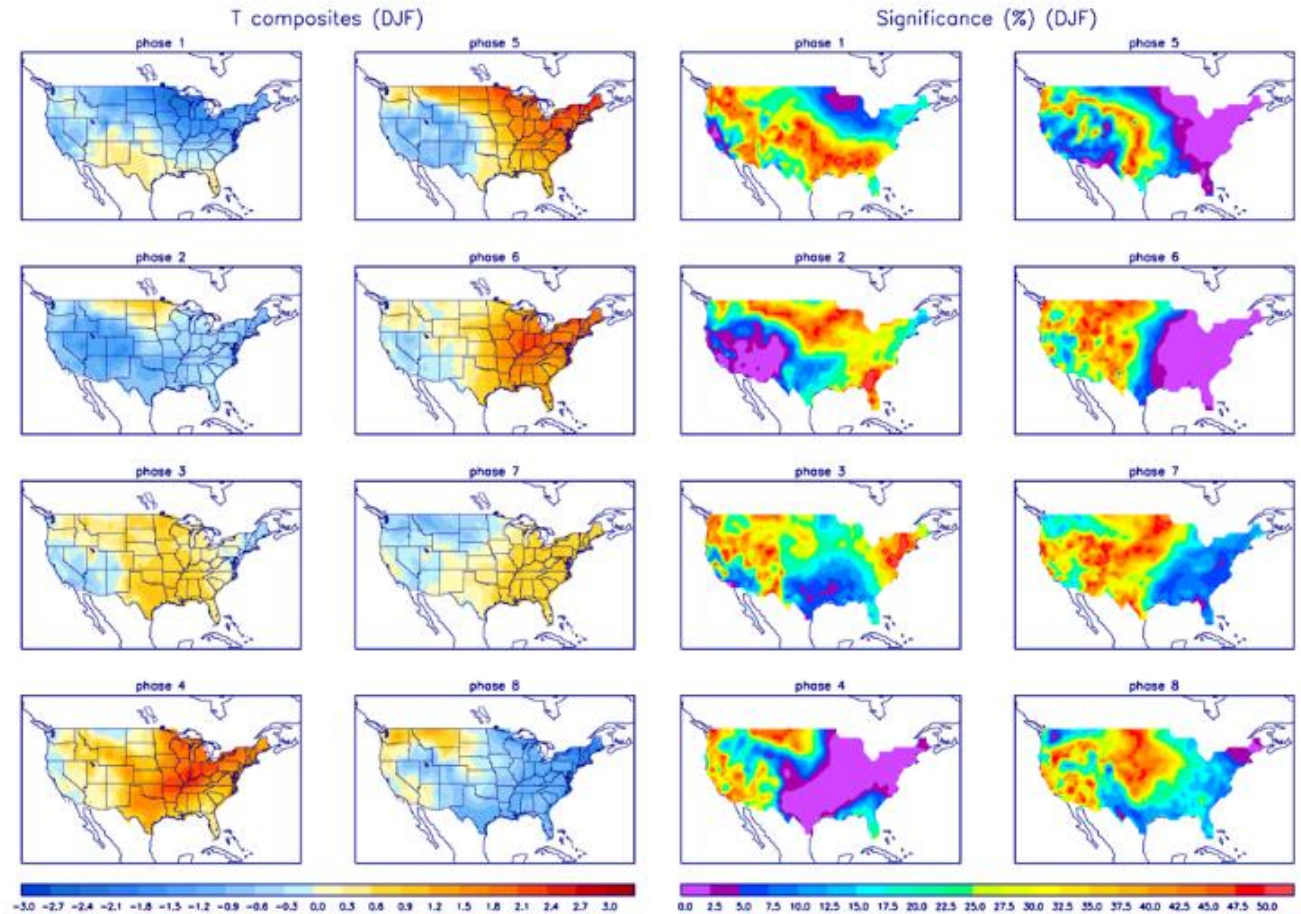
Precipitation Anomalies



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.

