The Association Between the Madden Julian Oscillation and Violent Tornado Outbreaks in the Spring

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RMM Index

Multivariate EOF analysis of 15N-15S averaged OLR, U850, and U200

First 2 EOFs describe propagating structure

Wind structure is primarily k=1, m=1



Courtesy of Kathy Straub

RMM plot

X-axis = PC1 Y-axis = PC2

Green dot = start Red dot = end

Color = month

Dates labeled every 5 days

Counterclockwise = eastward motion



Courtesy of Kathy Straub

Data

 Violent Tornado Outbreak Day: 24 hour period 6UTC to 6 UTC in which 6 or more tornadoes of at least (E)F2 anywhere in the continental United States (Cook and Schaefer 2008), Storm Prediction Center's Severe Weather Reports Database (Schaefer and Edwards 1999) Results dominated by the region east of the Rocky Mountains









Identifying MJO-Patterns Conducive to VTDs

- Composite circulation patterns during phase 2 and compare with the patterns during phase 2 VTDs
- Identify the mean low frequency background state that precedes phase 2 VTDs
 - Index that state
- Compare the relative frequency of occurrence of VTDs during phase 2 states that occur coincident with conducive low frequency states



a. OLR, 300 hPa Ht. and Wind Anom., lag -15 days





b. OLR, 300 hPa Ht. and Wind Anom., lag -12 days





c. OLR, 300 hPa Ht. and Wind Anom., lag -9 days



d. OLR, 300 hPa Ht. and Wind Anom., lag -6 days



e. OLR, 300 hPa Ht. and Wind Anom., lag -3 days



f. OLR, 300 hPa Ht. and Wind Anom., lag 0 days

a. OLR and 300 hPa Height and Wind Anom., lag 0 days



Low Frequency Background







a. OLR and 300 hPa Ht. and Wind Anom., Phase 2 Only





b. OLR and 300 hPa Ht. and Wind Anom., Phase 2 + Low Frequency





c. OLR and 300 hPa Ht. and Wind Anom., Phase 2 VTD

Discussion

- The MJO modulates Violent Tornado Outbreaks
- VTDs occur 4% of the time March through May
- VTDs occur 9% of the time March through May RMM 2
- VTDs occur 50% of the time March through May RMM 2 when low frequency patterns also project positively onto the above pattern