



Soil Moisture – Precipitation Interactions in the Central U.S. using Thunderstorm Observation by Radar (ThOR)

TRENT FORD

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Soil Moisture – Precipitation Coupling

Coupling and feedbacks important processes for regional hydroclimate



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- 1. Difficulty of establishing causality
 - a) Accounting for precipitation persistence and large-scale forcing



Persistence Potential Feedback Synoptic



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2. Dataset dependency

a) Multiple soil moisture datasets – SMERGE, ESA-CCI, National Soil Moisture Network, etc.



Ford *et al.* (2018), J. Hydrometeorol.



- 3. Precipitation vs. convection initiation
 - a) Thunderstorm Observation by Radar (ThOR, Houston *et al.* 2015) roughly 200,000 initiation points between 2005 and 2017





2007 Ford *et al.* (2018), *J. Hydrometeorol.*



4. Spatial Scale

- a) Dry soil preference diminishes as soil moisture and initiation is aggregated to courser scales
- b) Slight wet (root zone) soil preference at 250 km scale
- c) Test sensitivity of results to scale



Yuan et al. (2020), Clim. Dyn.

Project Objectives

- Evaluate climatological preferences for soil moisture conditions underlying convection initiation in the central U.S.
- Confront statistics with process-based coupling and feedback metrics and land surface, boundary layer observations
- Evaluate response of convection initiation to land surface conditions using WRF with LES mode



Results – Statistical Preferences

Top Maps:

- Climatological preference for initiation over drier than normal soils across MO River Basin
- Preference for initiation over wetter soils in southern Rockies, south-central Texas

Bottom Maps:

• No climatological difference in soil moisture between point of initiation and surrounding areas





Results – Statistical Preferences

SMERGE

Soil Moisture Heterogeneity

- Surface layer (ESA-CCI) more • heterogeneous than 0 - 40 cm layer (SMERGE)
- Areas of highest heterogeneity co-• located with dry and wet preferences





Summary

Past

- Complexities when detecting soil moisture precipitation feedbacks (using obs)
 Present
- Using multiple (*in situ*, satellite, model) soil moisture datasets
- Using hundreds of thousands of convection initiation points from ThOR
- Climatological preferences for soil moisture conditions, anomalies + heterogeneity

Future

- Process-based understanding of boundary layer conditions, modification associated with soil moisture and land surface feedback
- Confronting statistical analysis with numerical modeling

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