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Observational evidence of the land cover effect on shallow cumulus clouds over the Southern Great Plains

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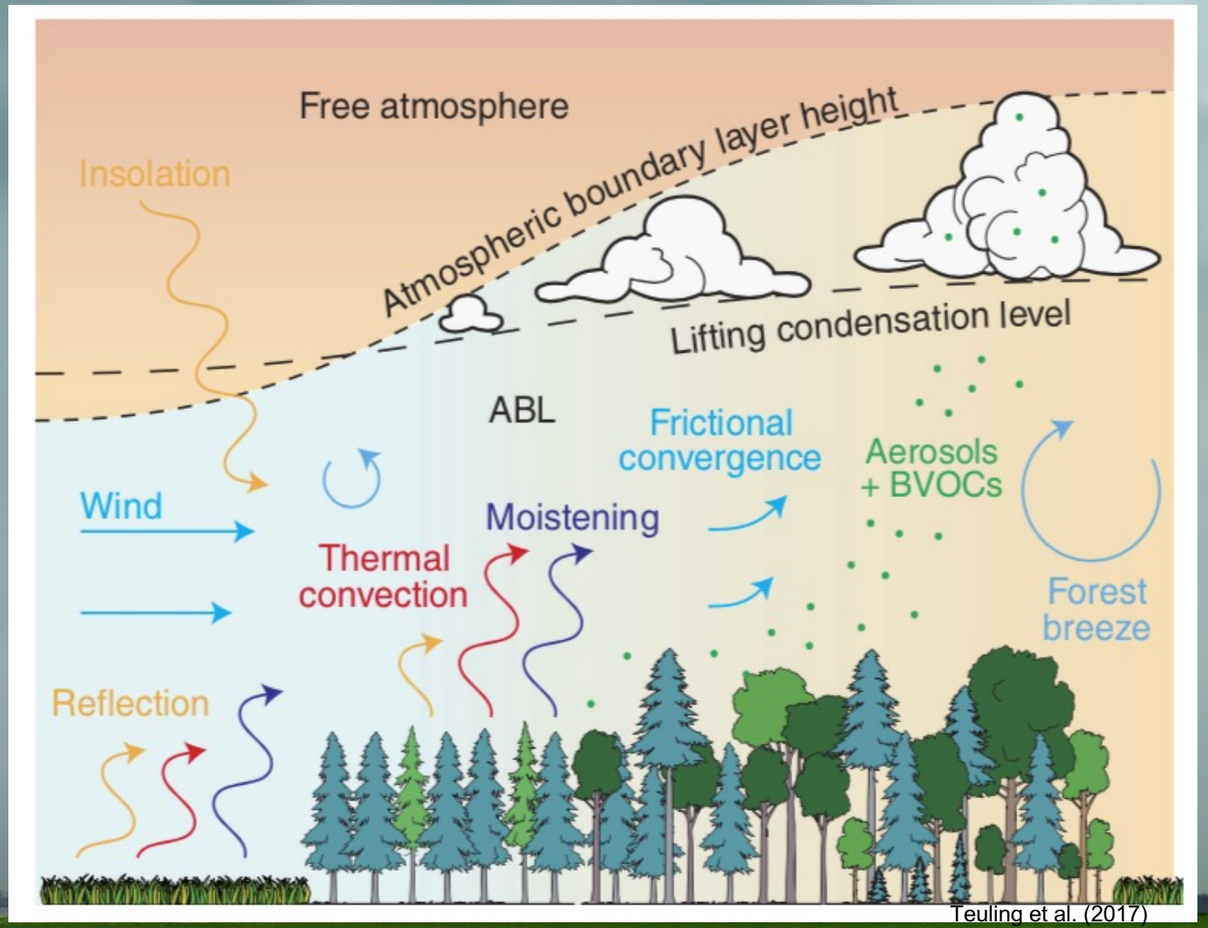
ECRP
DOE Early Career Research Program

ARM
CLIMATE RESEARCH FACILITY



Teuling et al. (2017)

U.S. DEPARTMENT OF ENERGY

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A. Is there any diurnal variability of the preference of ShCu occurrence over different land covers at SGP?

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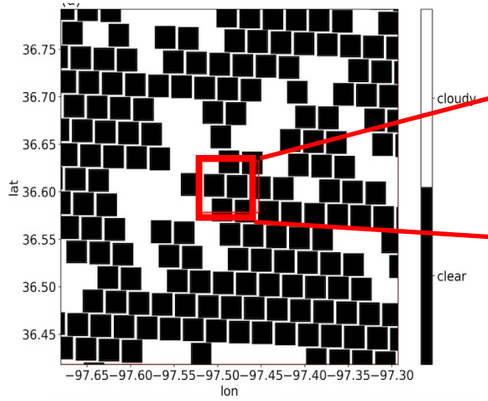
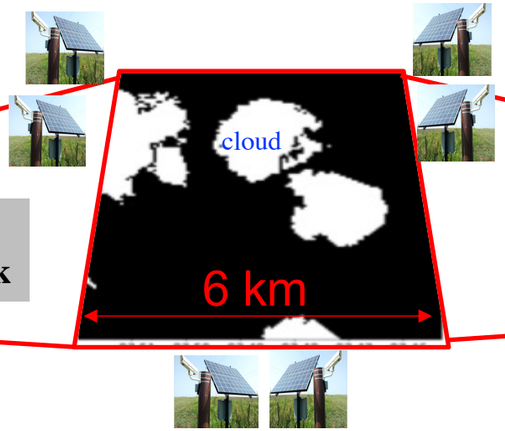
Data and Method

GOES-16 ABI Cloud Mask
ShCu are often falsely reported as clear-sky



Cloud in white
clear-sky in black

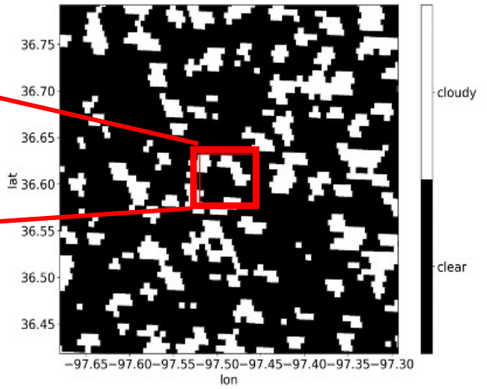


High-resolution Geostationary satellite
(GOES-16, 5 mins, 650 m)

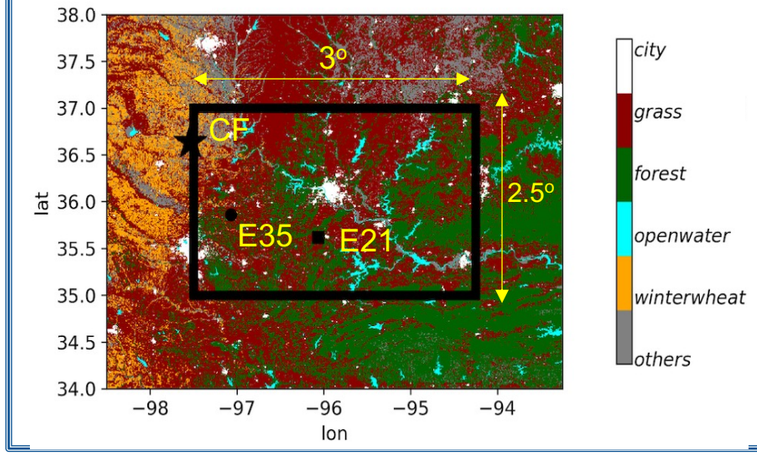
DOE ARM ground-based stereo-cameras
[Romps and Öktem, 2018]

Tian et al. (2021) *Remote Sensing*

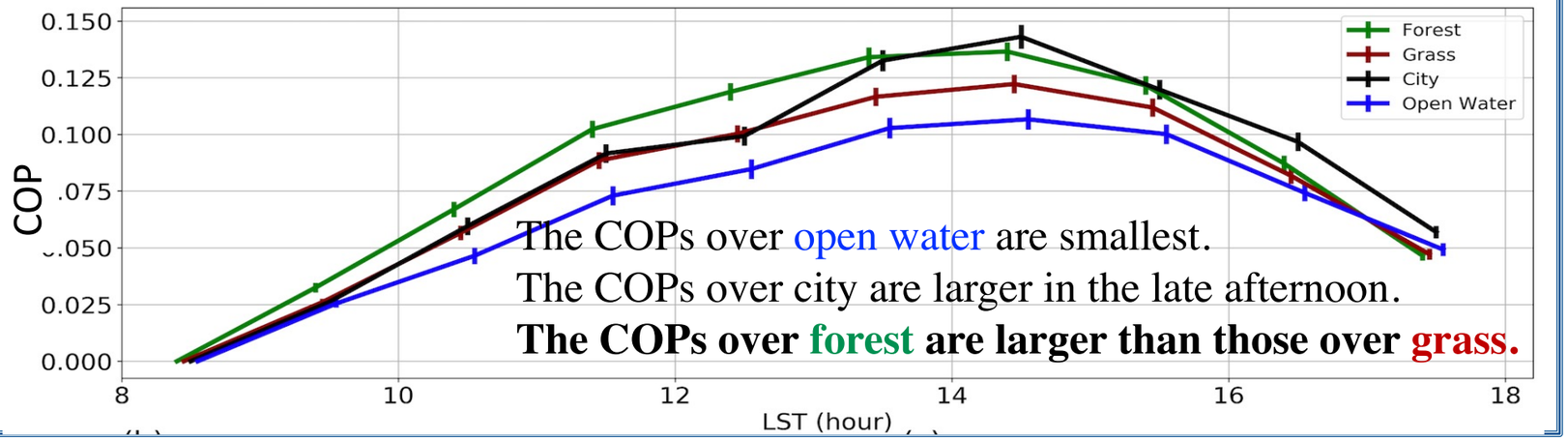
Our Newly Detected Shallow Cumulus Clouds using GOES-16 reflectance



Area of focus (Black Rectangle)



A. Cloud Occurrence Probability (COP) diurnal cycles over different land covers



The COPs over open water are smallest.
The COPs over city are larger in the late afternoon.
The COPs over forest are larger than those over grass.

B. What is the impact of land cover heterogeneity length scale on cloud occurrence?

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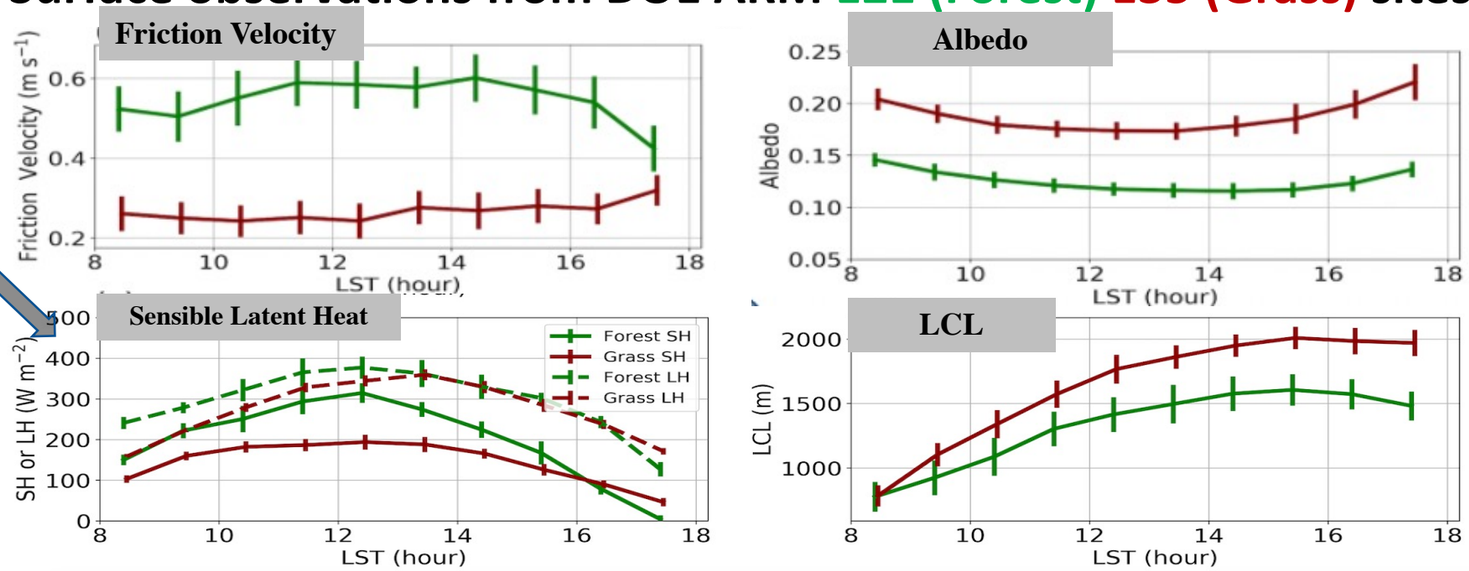
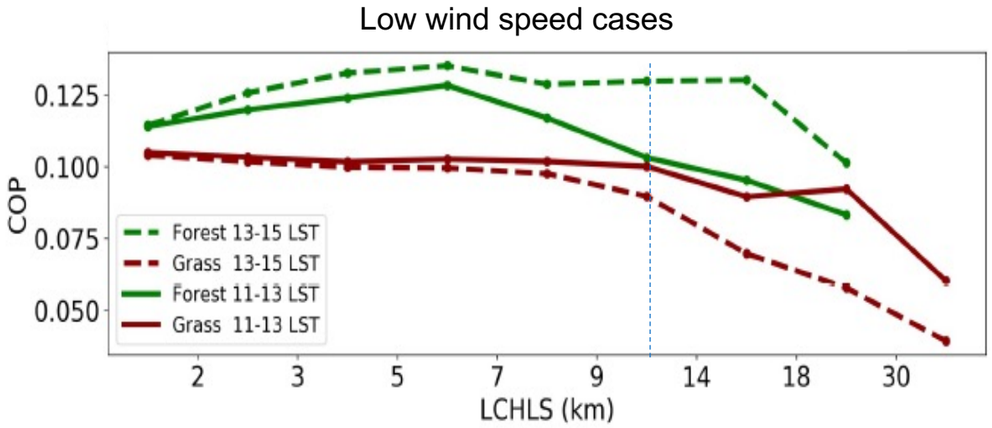
- Heterogeneous heating over forest and grass may generate a secondary circulation.
- LES: An optimal heterogeneity length scale can trigger the strongest mesoscale circulation.

Limited observational support

Surface observations from DOE ARM E21 (Forest) E35 (Grass) sites



B. Different impacts of land cover heterogeneity length scale on ShCu from forest and grass



Onset (11 -13 LST) (solid lines)	At smaller length scale (< 9 km), clear ShCu occurrence preference over forest. Similar COPs at larger scale.
Mature (13-15 LST) (dash lines)	PBL is already high enough, the length scale preference is less significant over forest.