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## Pissing in the wind:

How irrigation, falling snow, and dying leaves  
can change the weather

DESAI LAB, CPEP Seminar, 2 Oct 2018

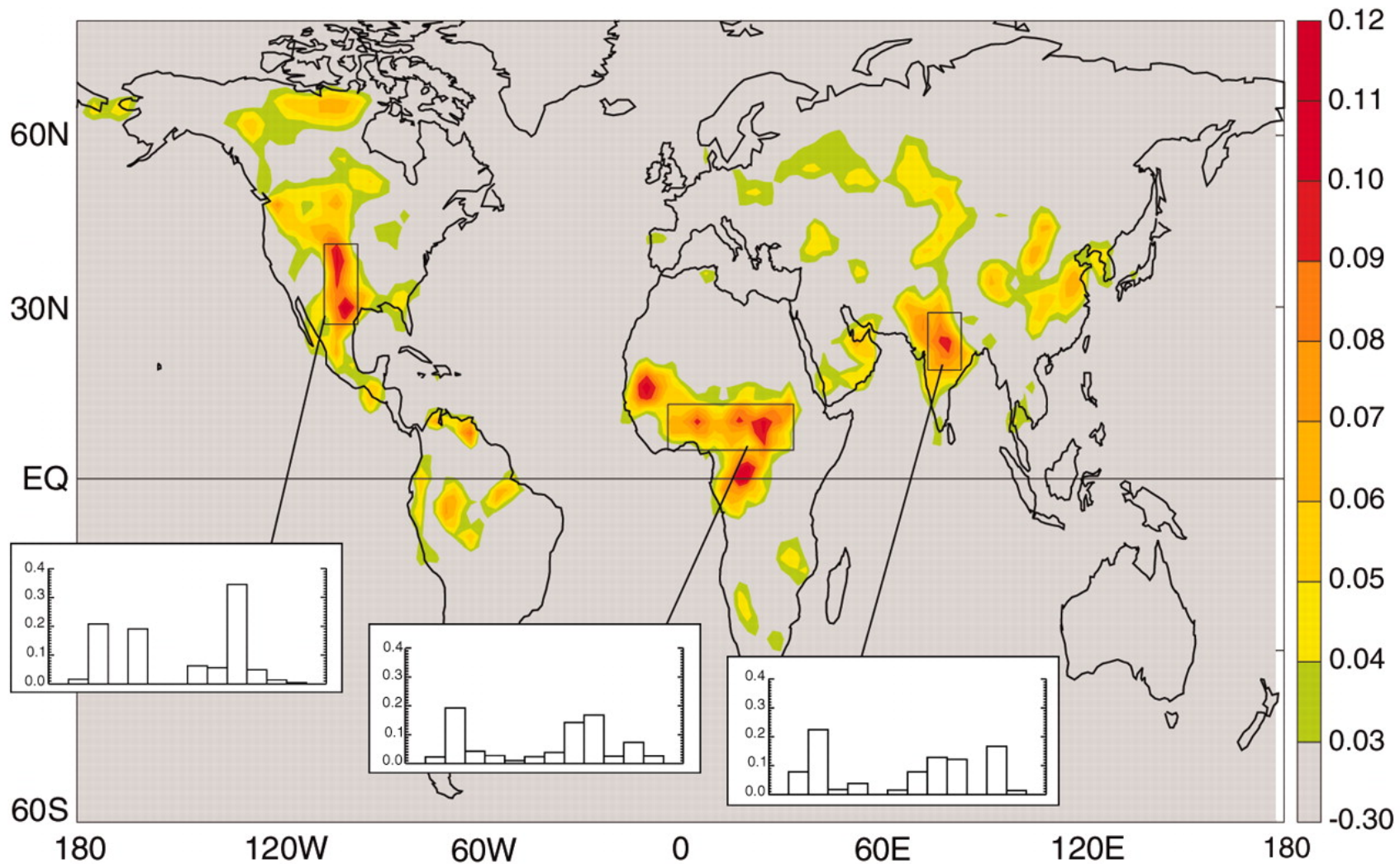
# Why you should apply for a Bryson/CPEP Seed Grant

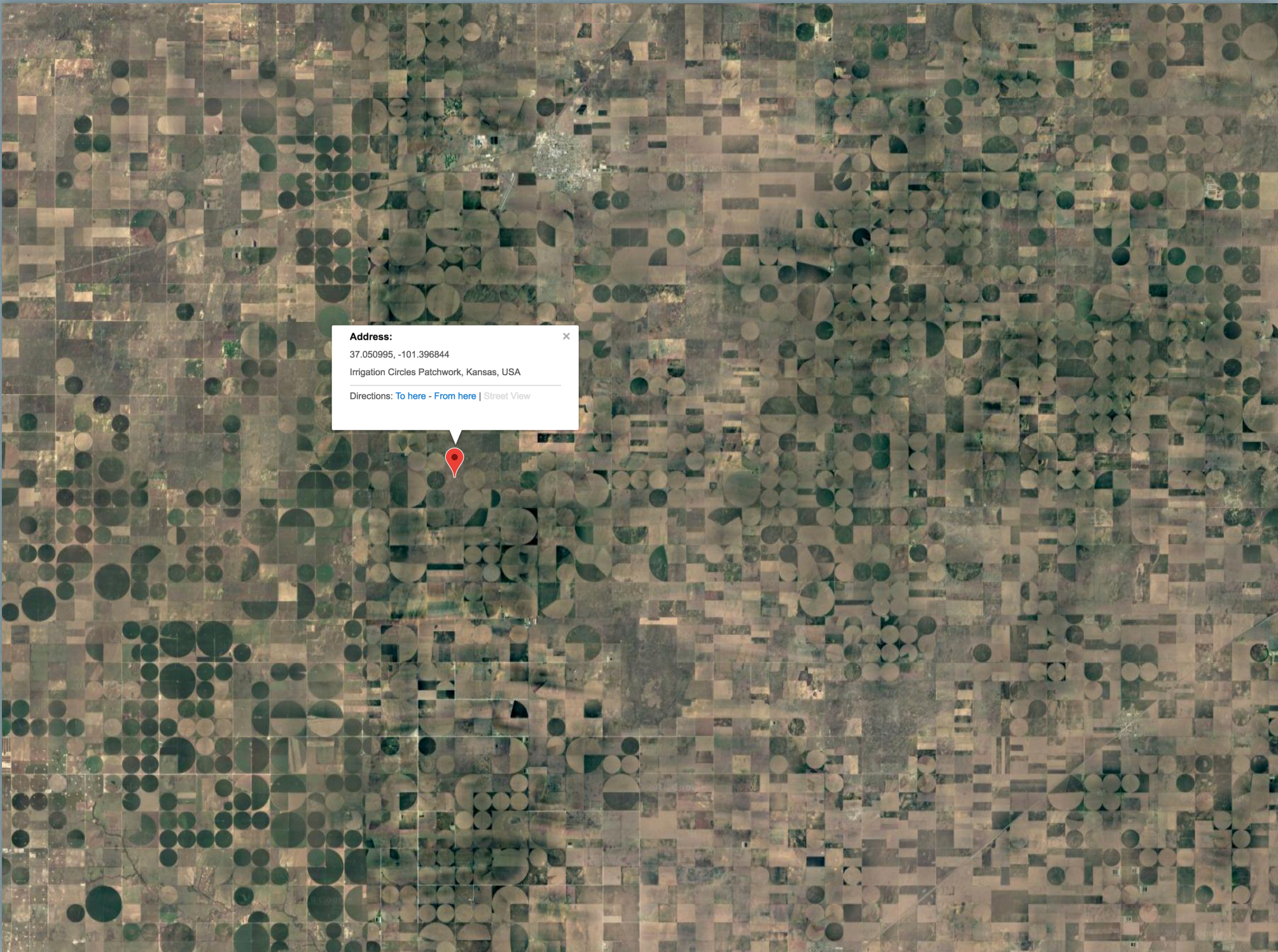
- Short proposals provided partial support for graduate students (4) and experiments that led to preliminary data and figures for full agency proposals
- Connect to CCR scientists and affiliates, try new ideas, encourages students to write proposals
- Turn \$25,000 (4 awards) into >\$4,500,000 from NSF, DOE, Wisconsin DNR, and non-profits



# Koster et al., 2004

Land-atmosphere coupling strength (JJA), averaged across AGCMs





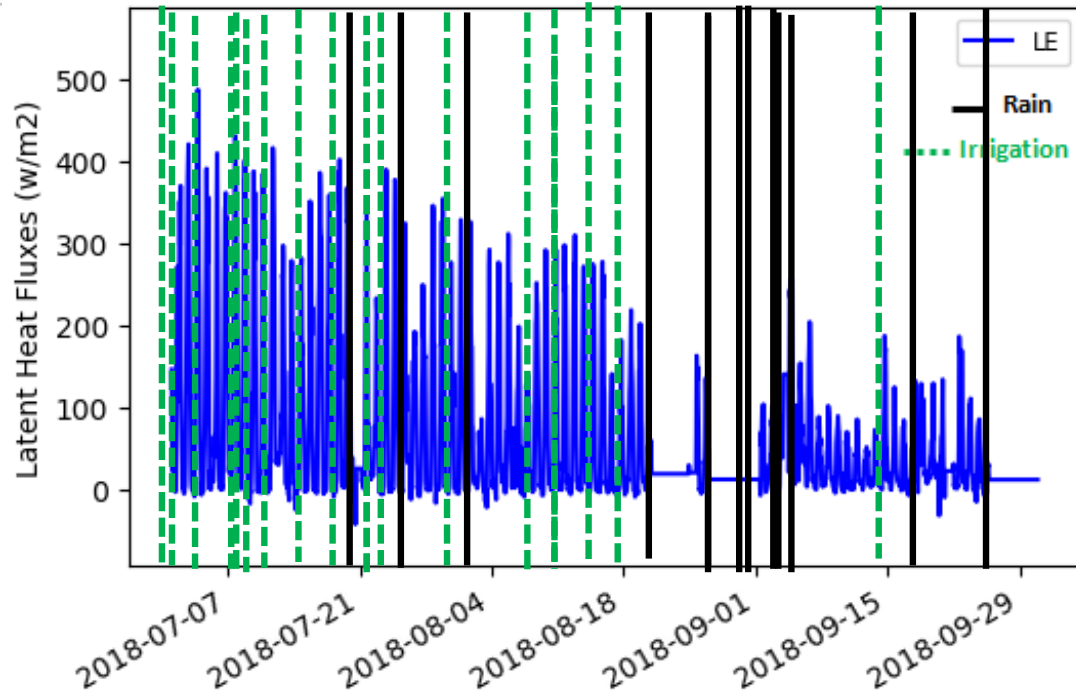
Address: ×  
37.050995, -101.396844  
Irrigation Circles Patchwork, Kansas, USA  
Directions: [To here](#) - [From here](#) | [Street View](#)

# Pervez and Brown. 2010





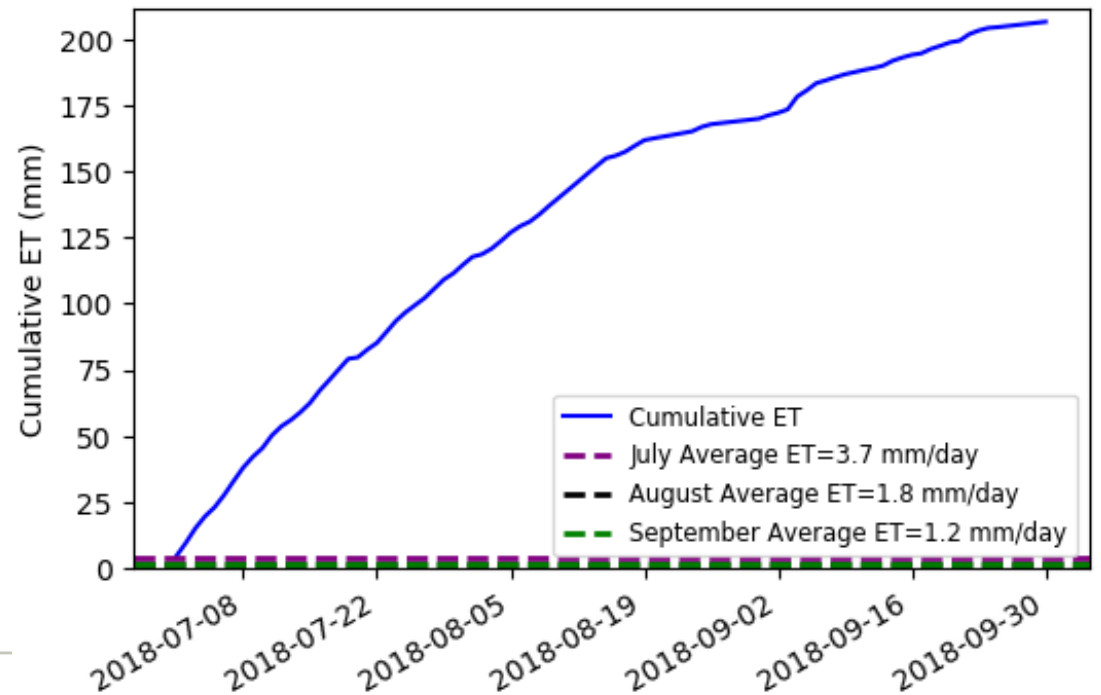
Diurnal Cycle of Hourly Mean LE fluxes



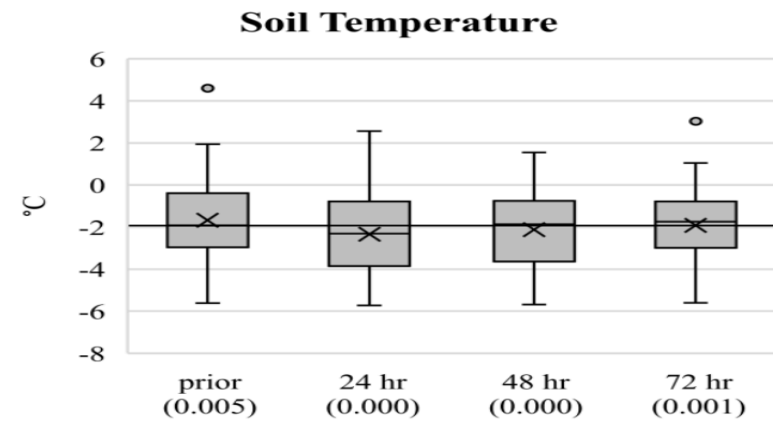
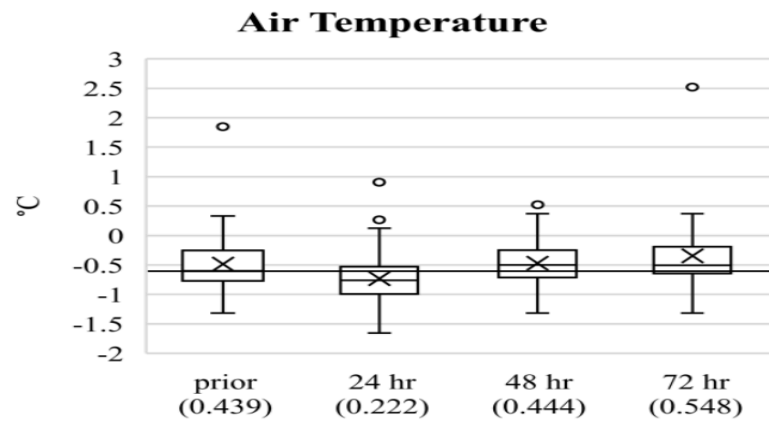
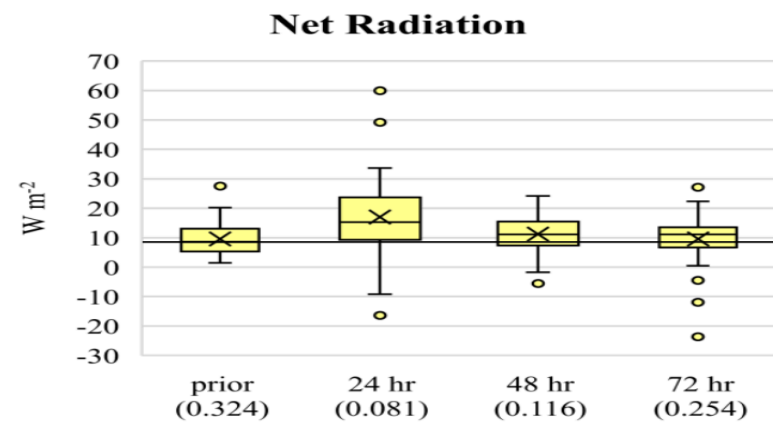
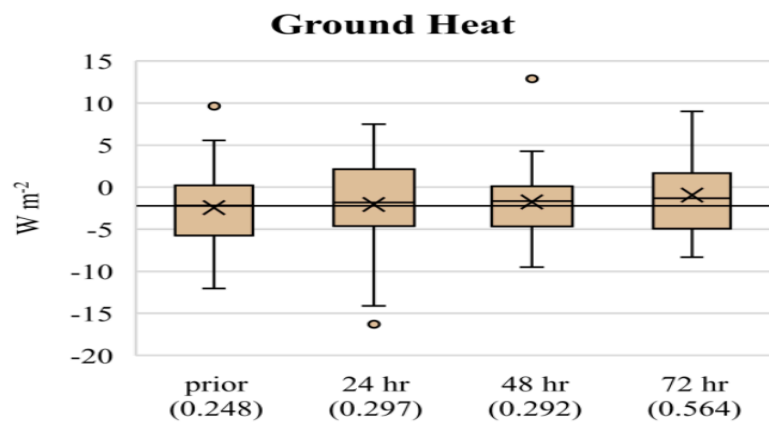
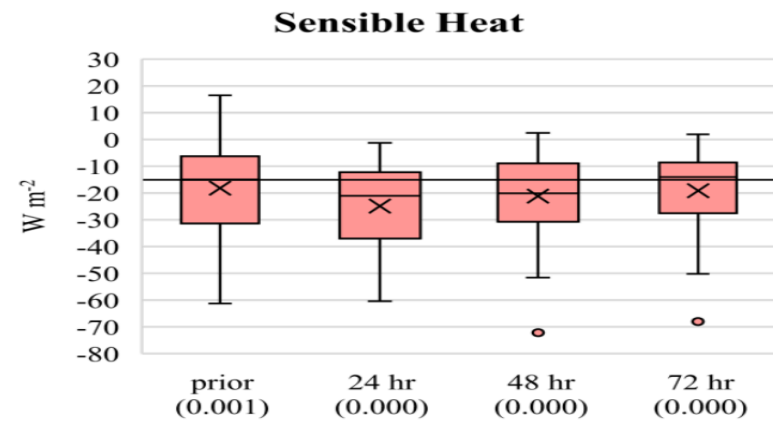
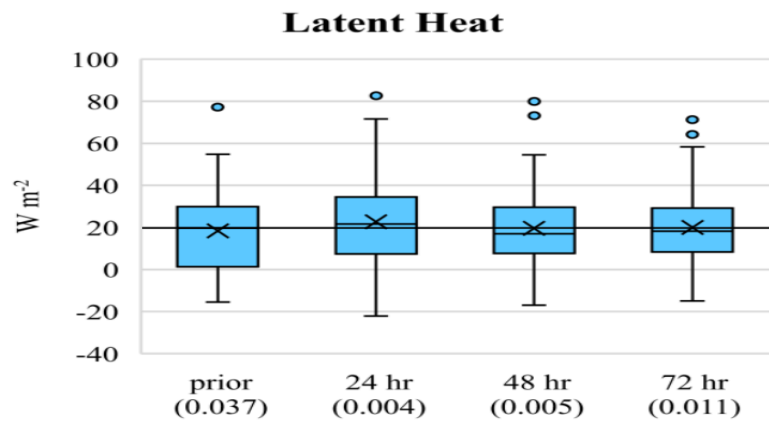
**Total Rainfall (inches):**  
**July: 3.1**  
**August: 7.3**  
**September: 5.2**

**ET (mm/day):**  
**July: 3.7**  
**August: 1.8**  
**September: 1.2**

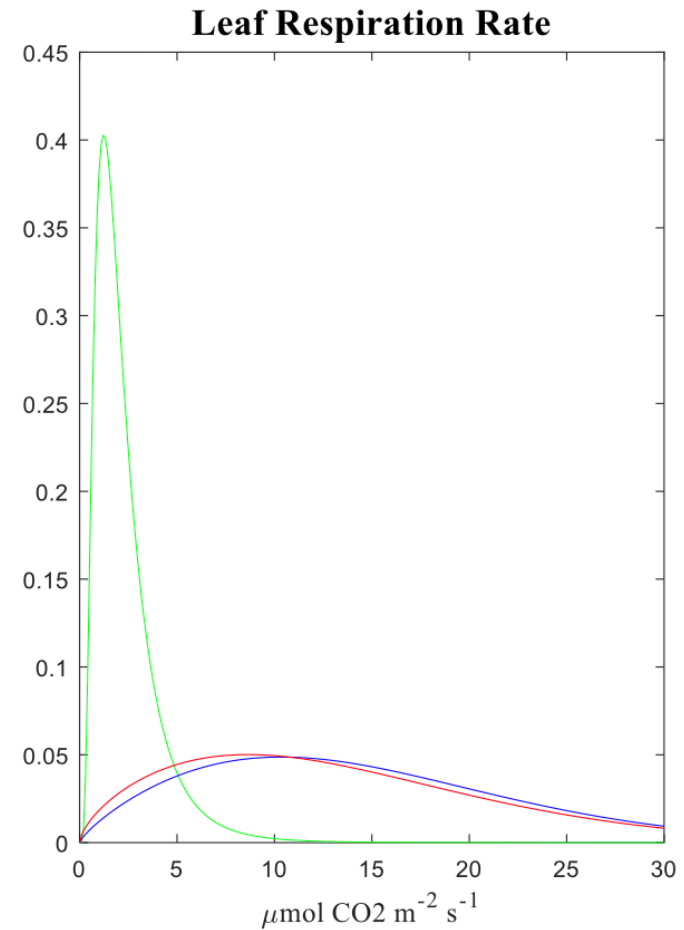
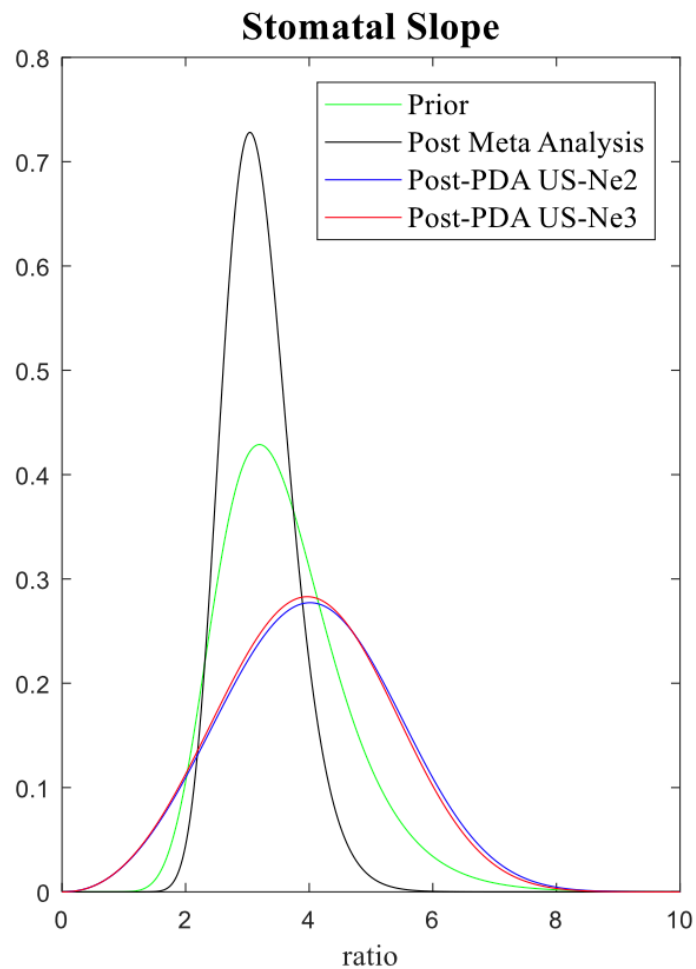
ET in Hearland WI Potato Farm



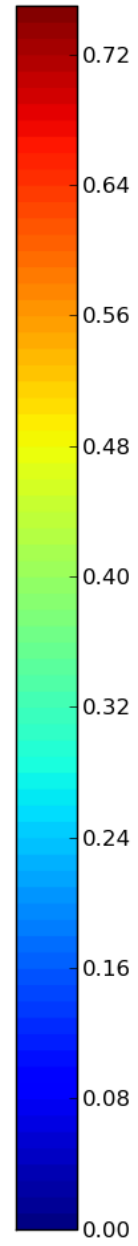
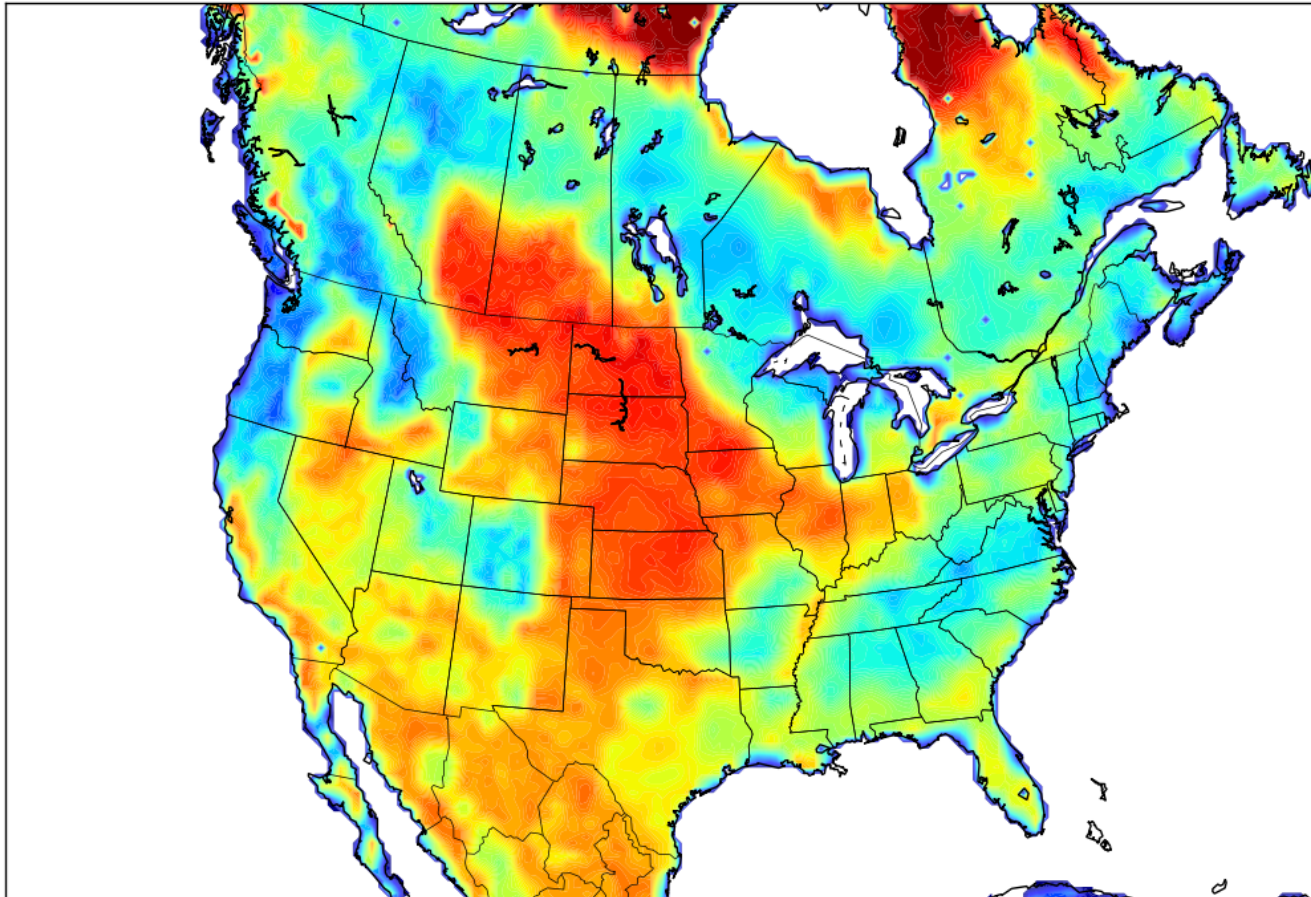




# Land surface models require proper parameterization

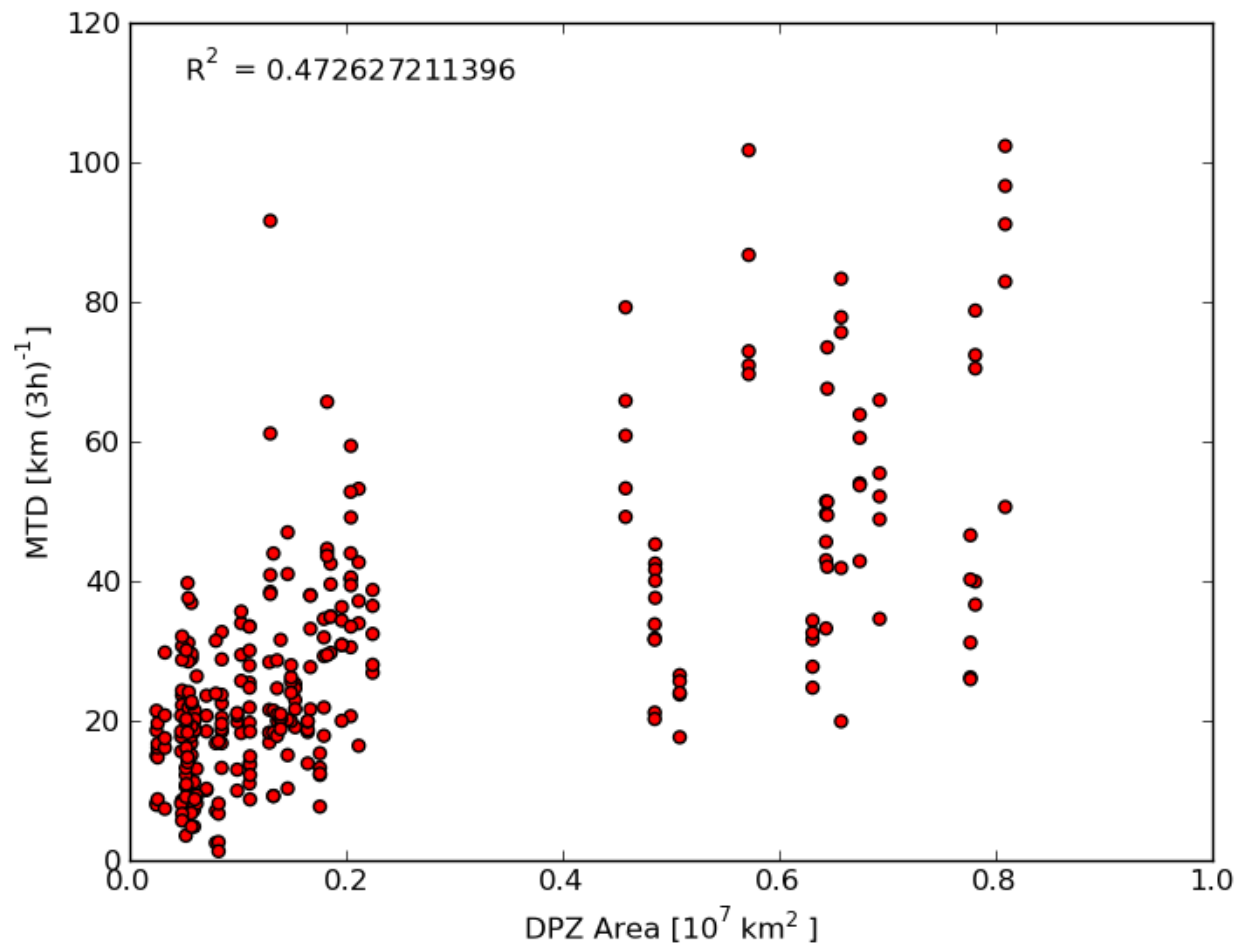






Maximum snow albedo – background surface albedo

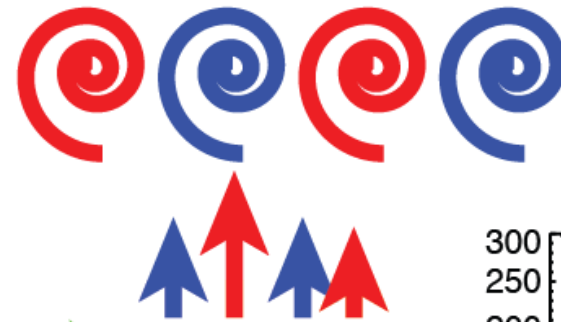
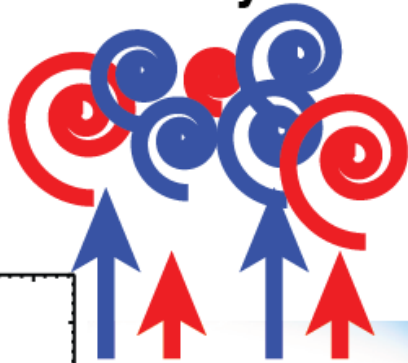
# Changing snow boundaries influences mid-latitude cyclone trajectories





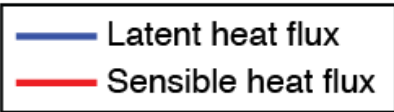
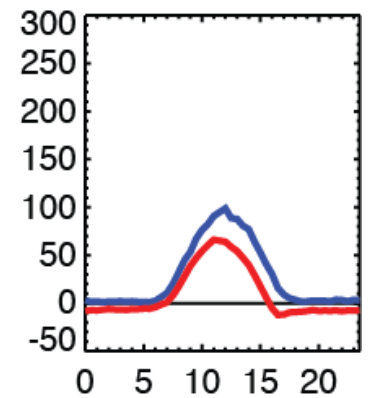
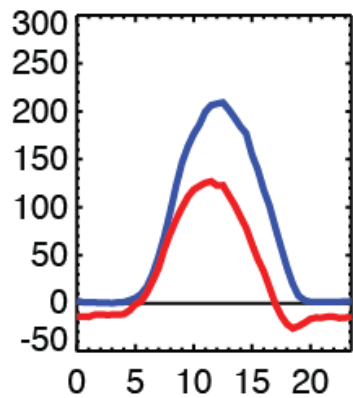
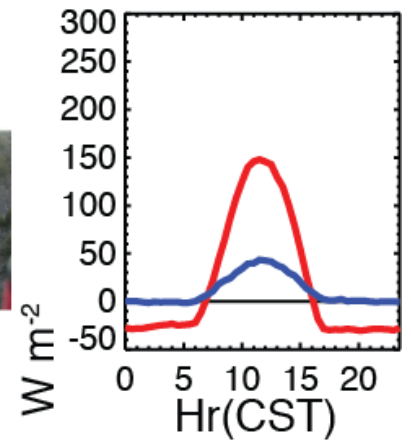
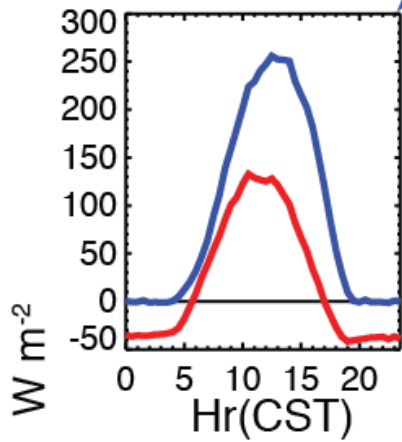
July

October



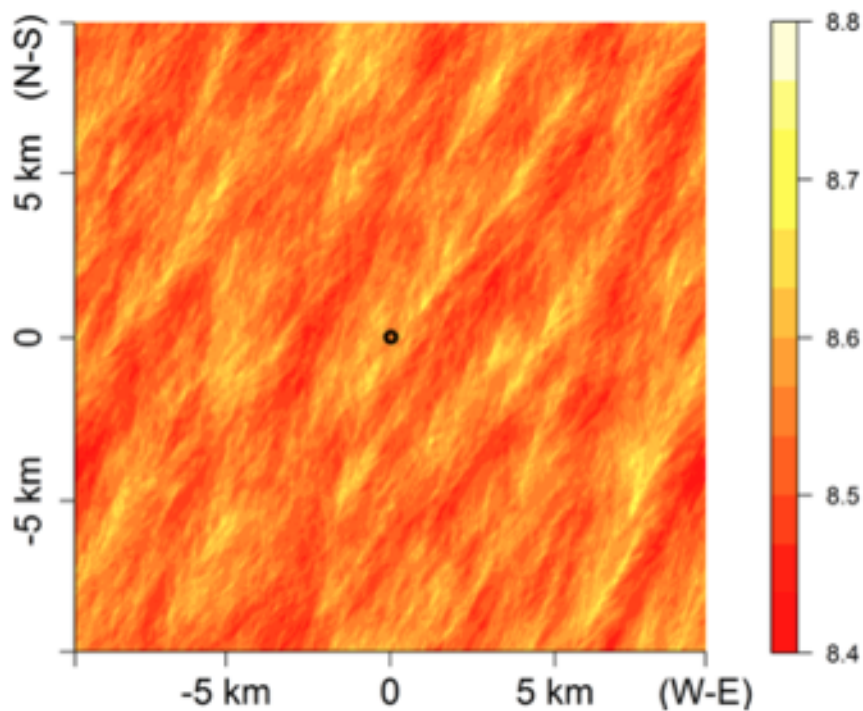
Forests

Wetlands

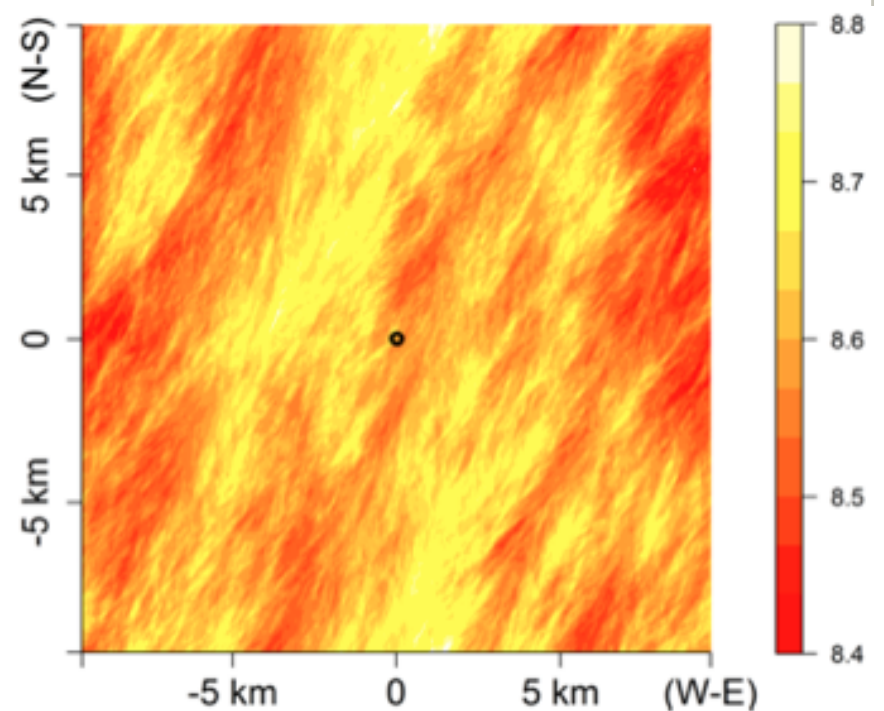


# Large Eddy Simulations demonstrate the influence of land surface heterogeneity on atmosphere

- Compared to homogenous surface energy balance forcing (left), a realistic pattern of surface heating leads to a non-random structure in the water vapor field (right). This LES was conducted over study domain. Dot = tall tower



Homogeneous  $\bar{q}(xy)$  at 122 m [g/kg]

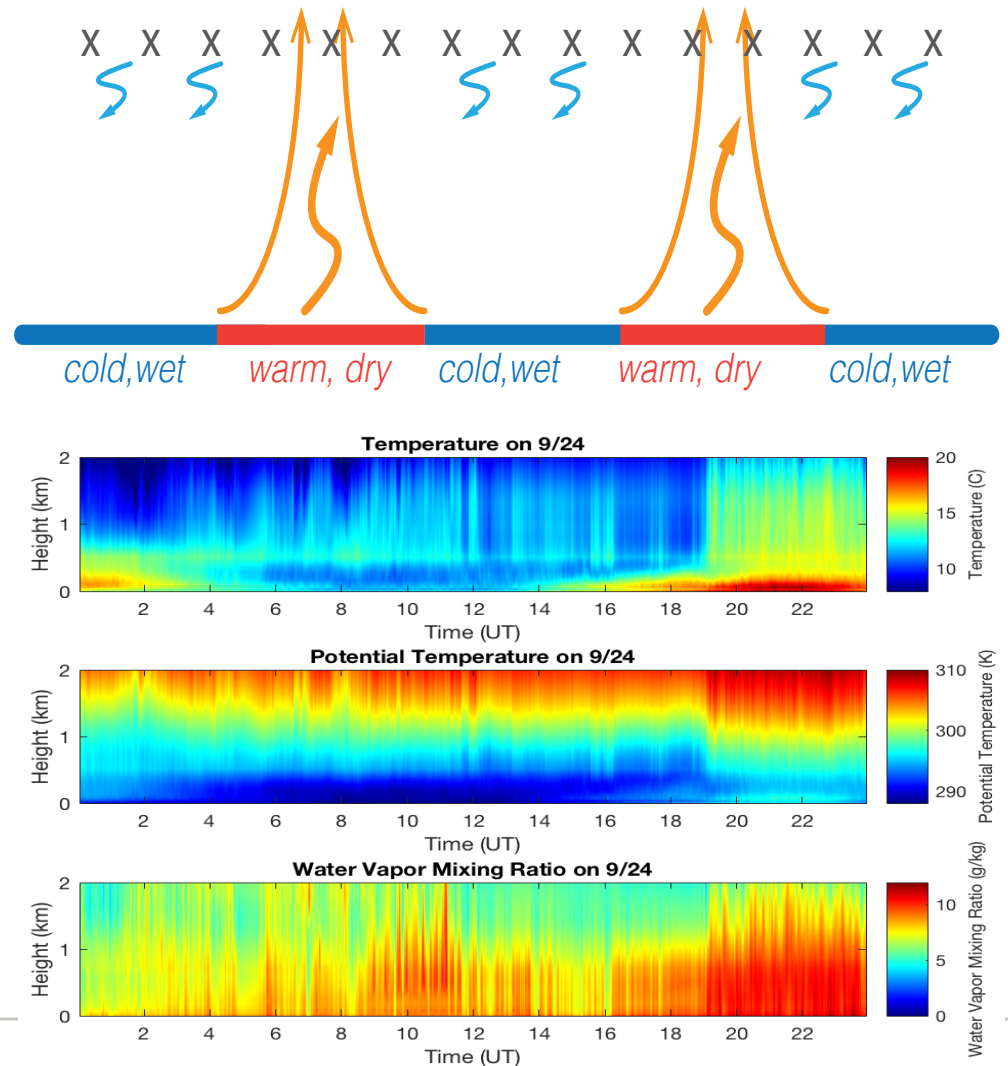
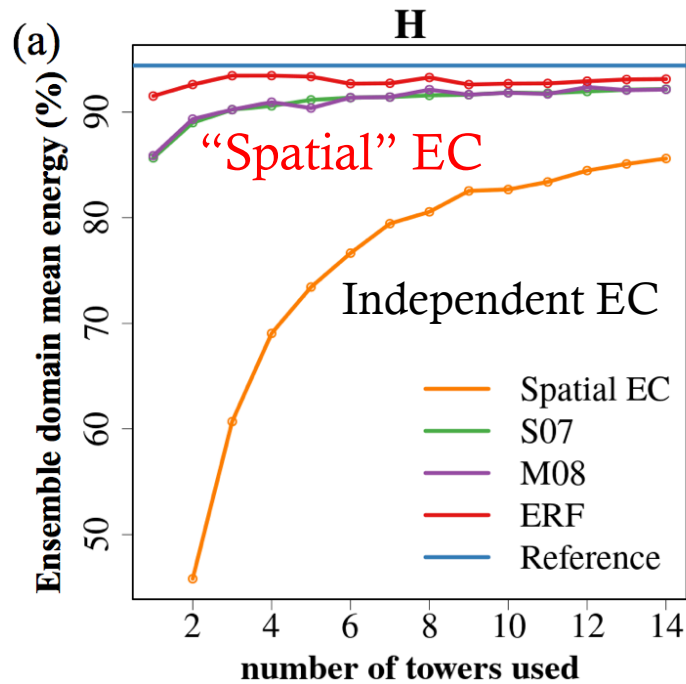


Heterogeneous  $\bar{q}(xy)$  at 122 m [g/kg]



>15 “virtual” flux towers per 100 km<sup>2</sup> appear to be needed in a model to close energy balance in domain around tower using “naïve” approaches, but not so with advanced scaling methods

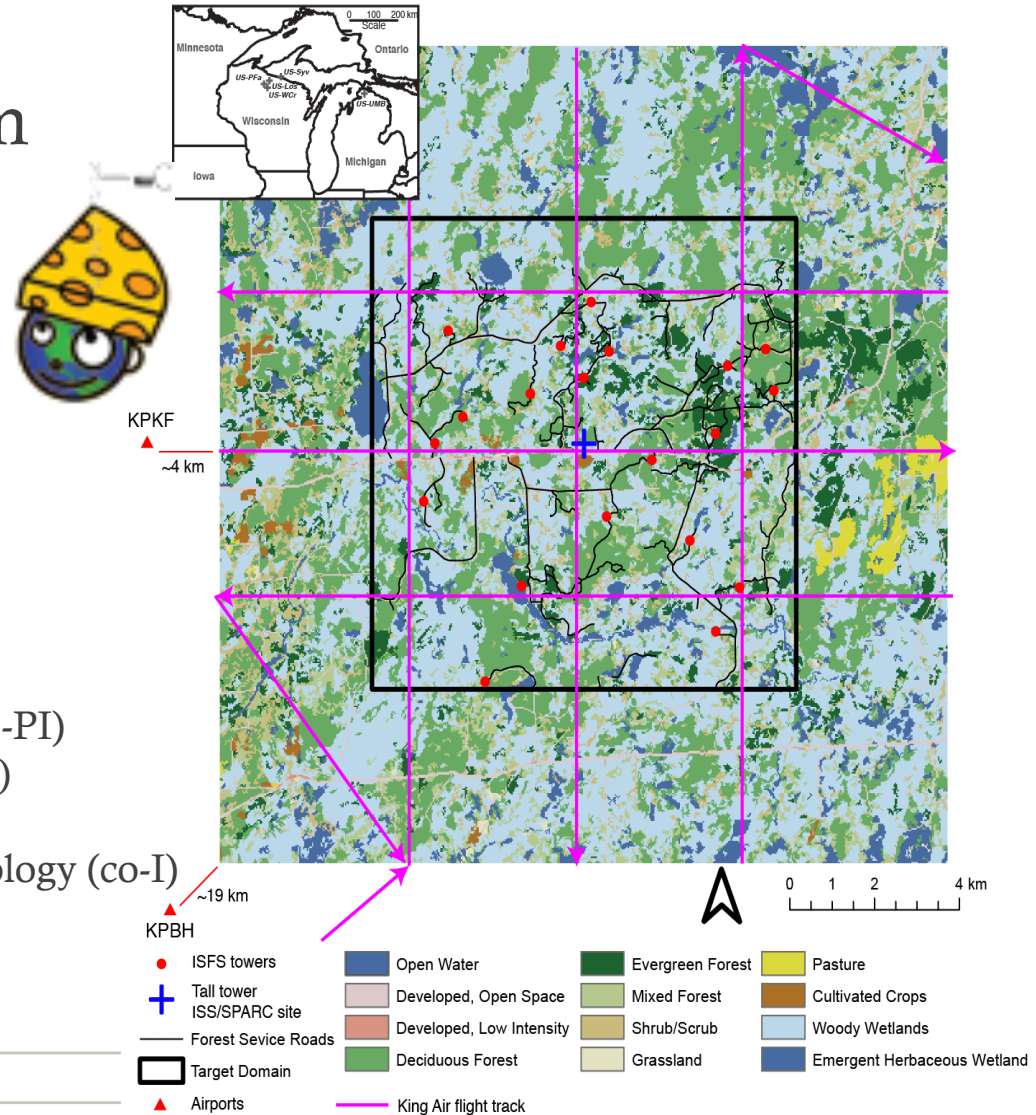
LES study (Xu et al., in review BLM)



AERI retrievals at tall tower in Sept 2016 (**lower right**) demonstrates mesoscale PBL structures to be compared to diagram (**top right**)

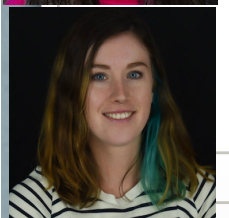
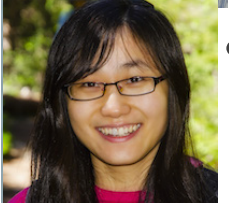
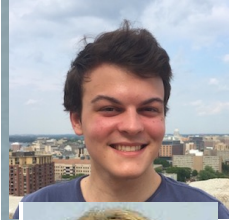
July-October allows us to sample landscape as it evolves from homogenous LE (transpiration) driven, to patchier H and LE patterns depending on ecosystem

**C**hequamegon  
**H**eterogeneous **E**cosystem  
**E**nergy-balance **S**tudy  
**E**nabled by a  
**H**igh-density **E**xtensive  
**A**rray of **D**etectors  
**(CHEESEHEAD19)**



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- Grant Petty, U. Wisconsin-Madison (co-PI)
- Phil Townsend, U. Wisconsin-Madison (co-PI)
- Mark D Schwartz, U. Wisconsin-Milwaukee (co-PI)
- Stefan Metzger, Battelle Ecology/NEON (co-PI)
- Rose Pertzborn, SSEC (co-I)
- Matthias Mauder, Karlsruhe Institute of Technology (co-I)
- Paul Stoy, Montana State University (co-I)
- NCAR, U Wyoming, NASA, NEON, DOE

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