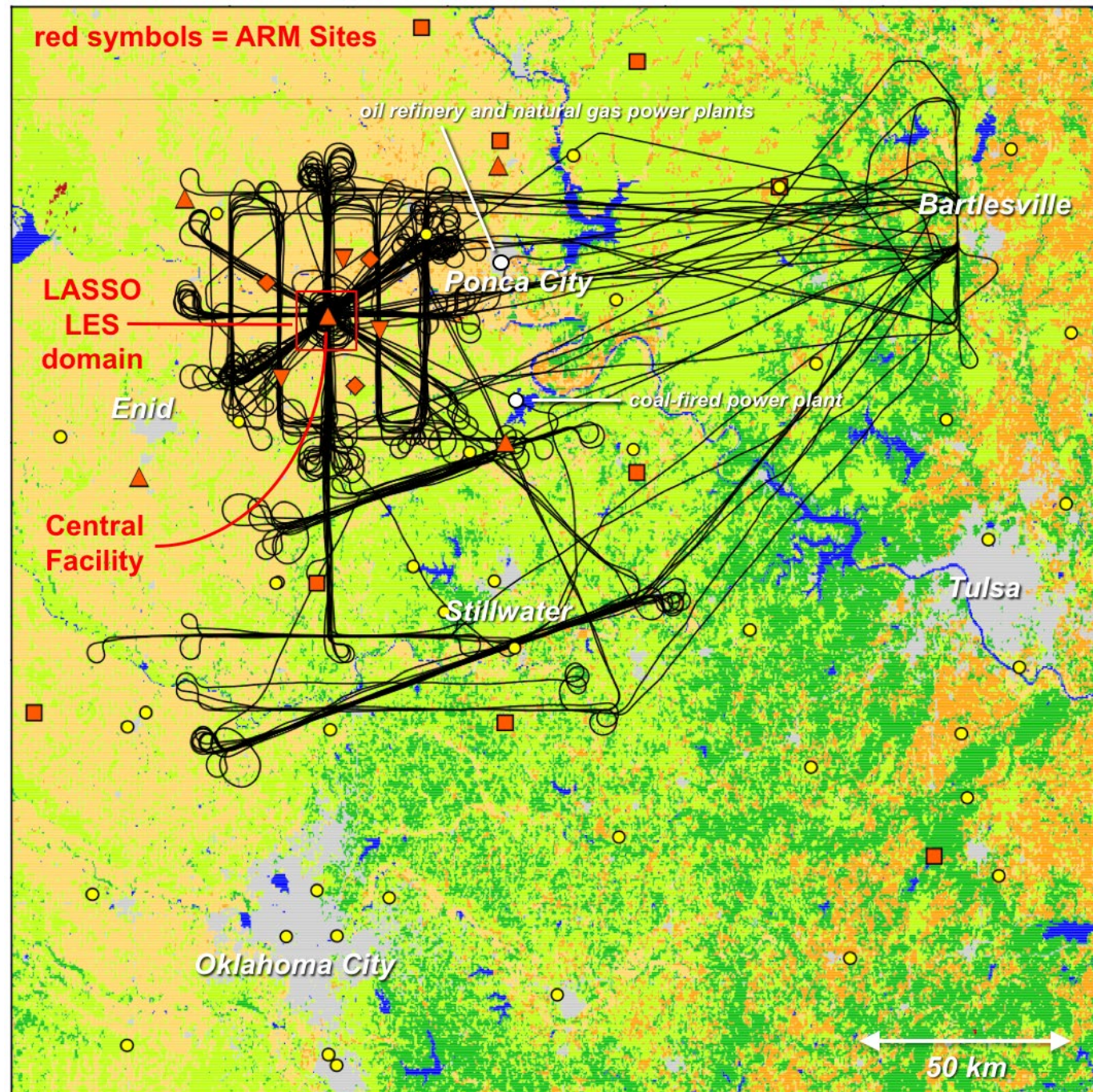


# Using UAS to Study Land- Atmosphere-Cloud Interactions

Jerome Fast



# Perform Sampling Similar to HI-SCALE



- ▶ G-1 flight periods were typically between 2 – 3 hours, so only a snapshot of conditions during the day
- ▶ UAS could fly over longer time periods to continually obtain data as BL evolves during the day

Variety of flight patterns (grids, stacked legs, profiles) could be used to address land-atmosphere-cloud coupling issues

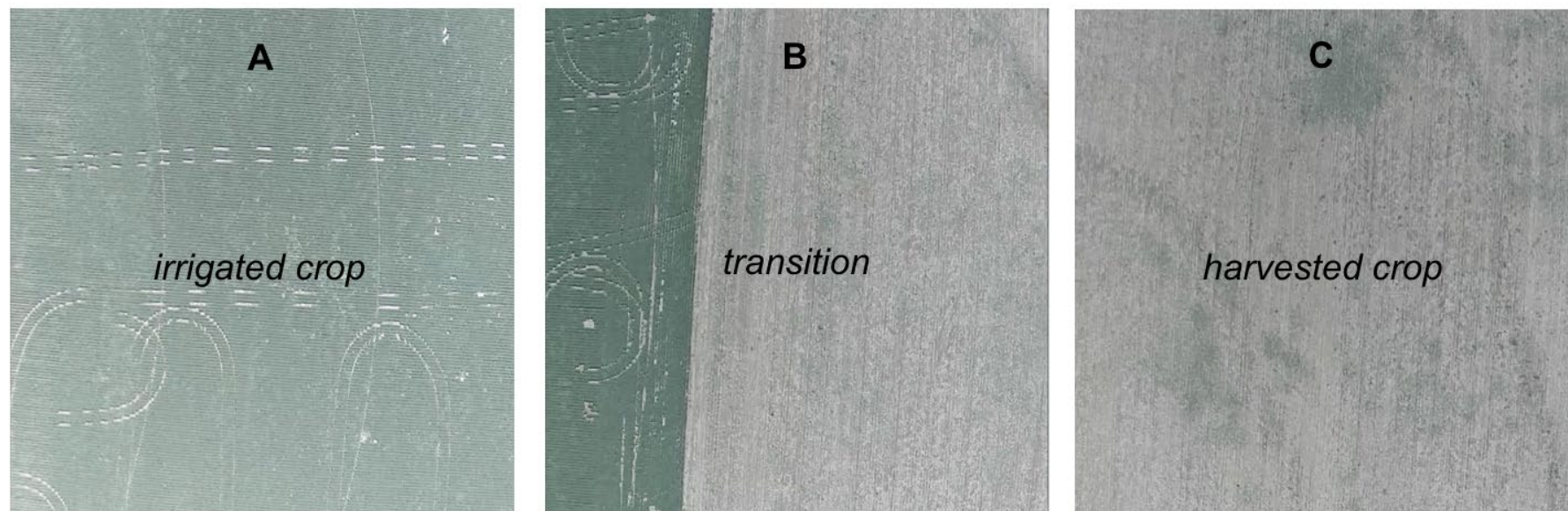
from Fast et al. BAMS (2019)



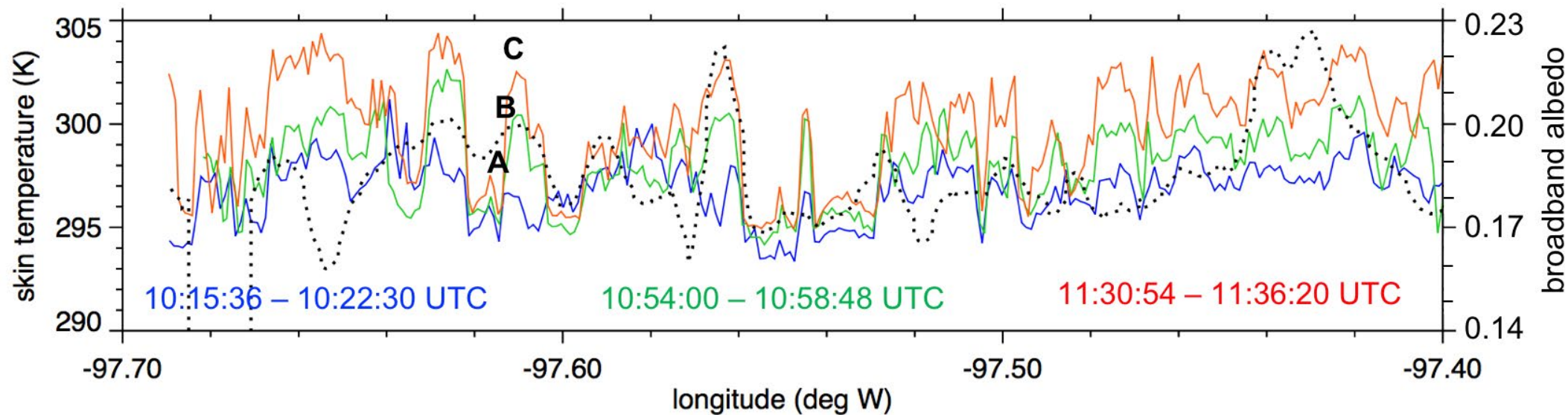
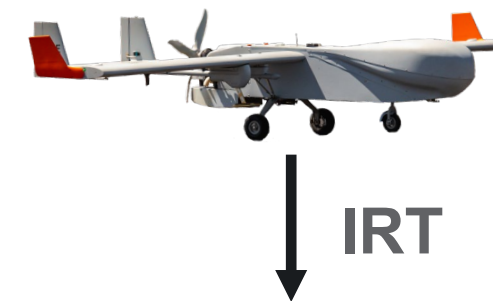


# Linking Variable Surface Properties and Meteorology

## G-1 HI-SCALE Repeated Passes Along the Same Flight Track



UAS can provide similar information, but over longer time periods and slower speeds (higher spatial resolution)

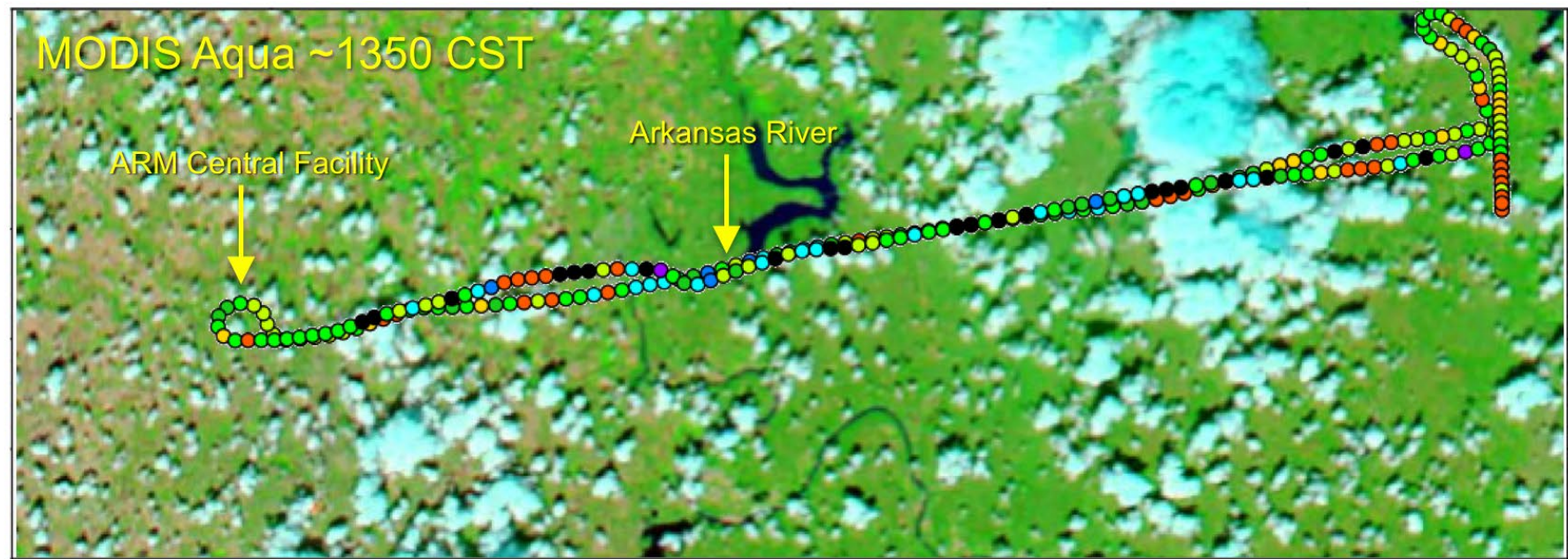


Characterize evolving CBL properties associated with local variations in surface properties (vegetation, land-use, soil type, soil moisture)



# Linking Variable Surface Properties, Meteorology, and Radiation

## G-1 HI-SCALE Skin Temperature and SW Radiation

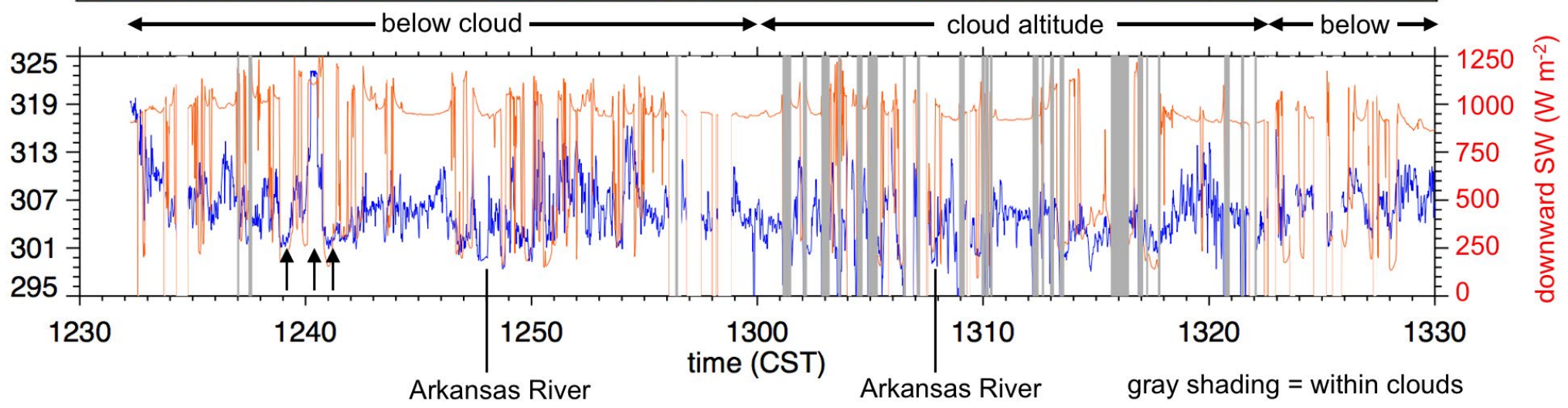
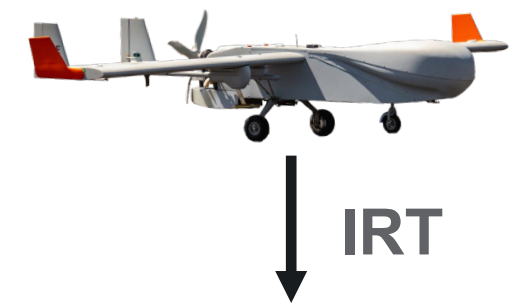


skin temperature

- > 310 K
- 308-310
- 306-308
- 304-306
- 302-304
- 300-302
- 298-300
- < 298 K

within clouds

UAS can provide similar information, but over longer time periods and slower speeds (higher spatial resolution)

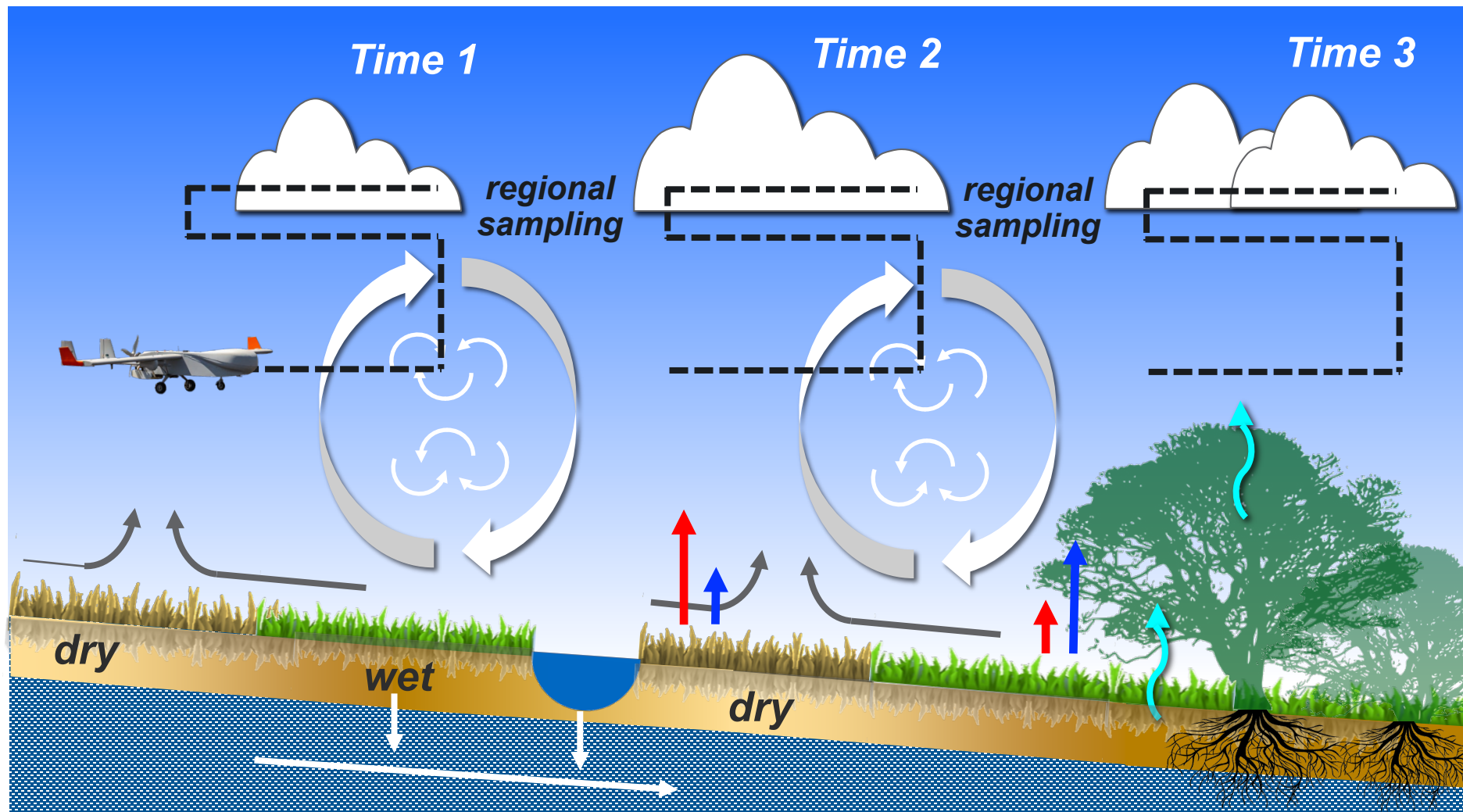


Able to sample over a smaller area at a higher frequency to see how surface meteorology responds to cloud shading



# Follow Clouds and/or Convective Eddies

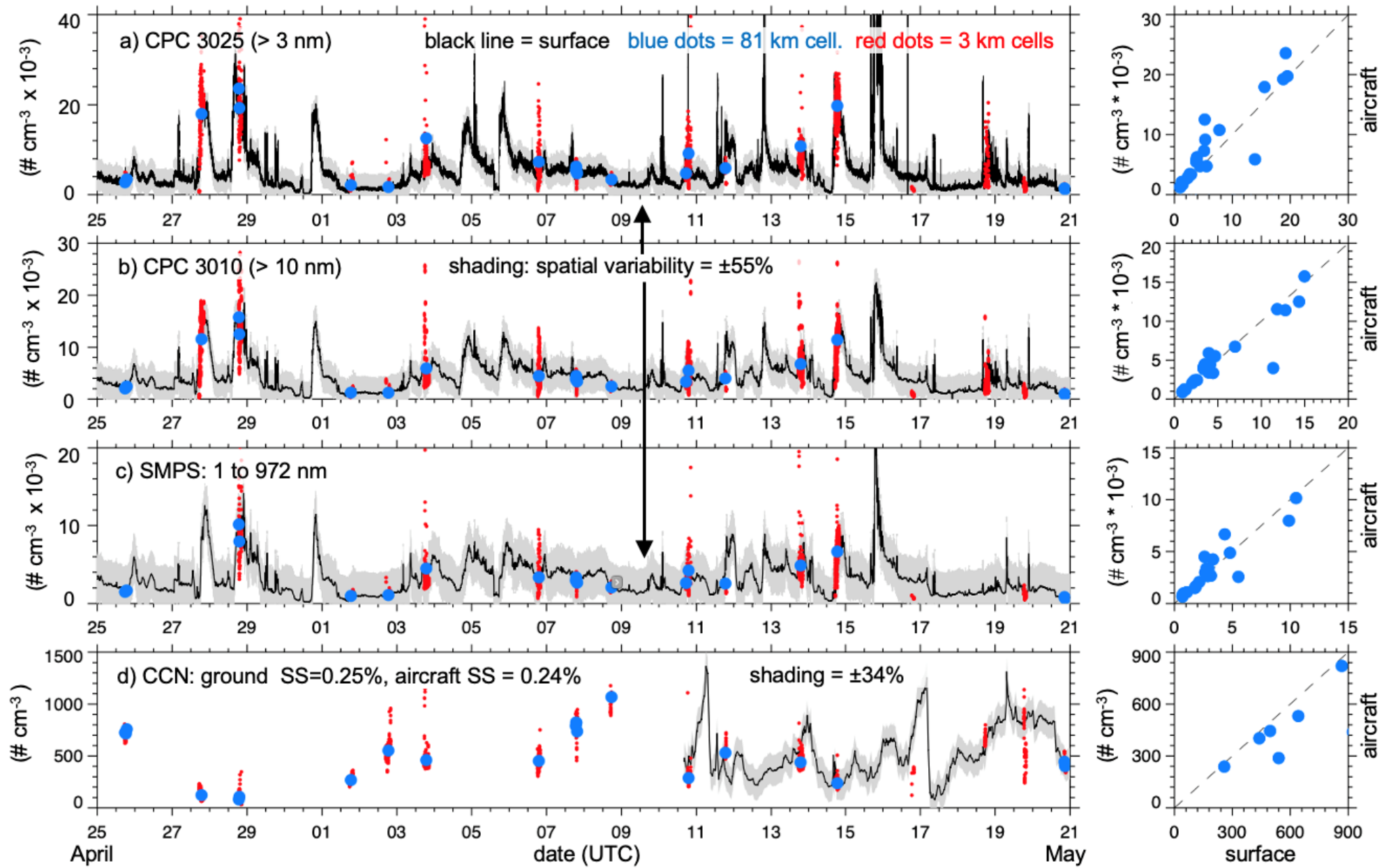
- ▶ G-1 sampling provided a snap-shots of of cloud properties and convective eddies
- ▶ Arctic Shark could sample the environment around a single cloud, group of clouds, and/or group of convective eddies, knowing the ambient wind speed and direction



- ▶ How does turbulence evolve as the air mass passes over variable surface fluxes?
- ▶ How do cloud properties evolve in response to BL forcing and the larger-scale environment?
- ▶ ARM fixed surface sites sample what passes over them, which may be different than BL air parcel evolution

# Representativeness of ARM Surface Sampling

► Routine UAS flights with POPS could provide a similar analysis to provide seasonal analysis of spatial variability of aerosol # and size.



from Fast et al. ACP (2022)

