S3O2 - Large spatial and temporal science studies

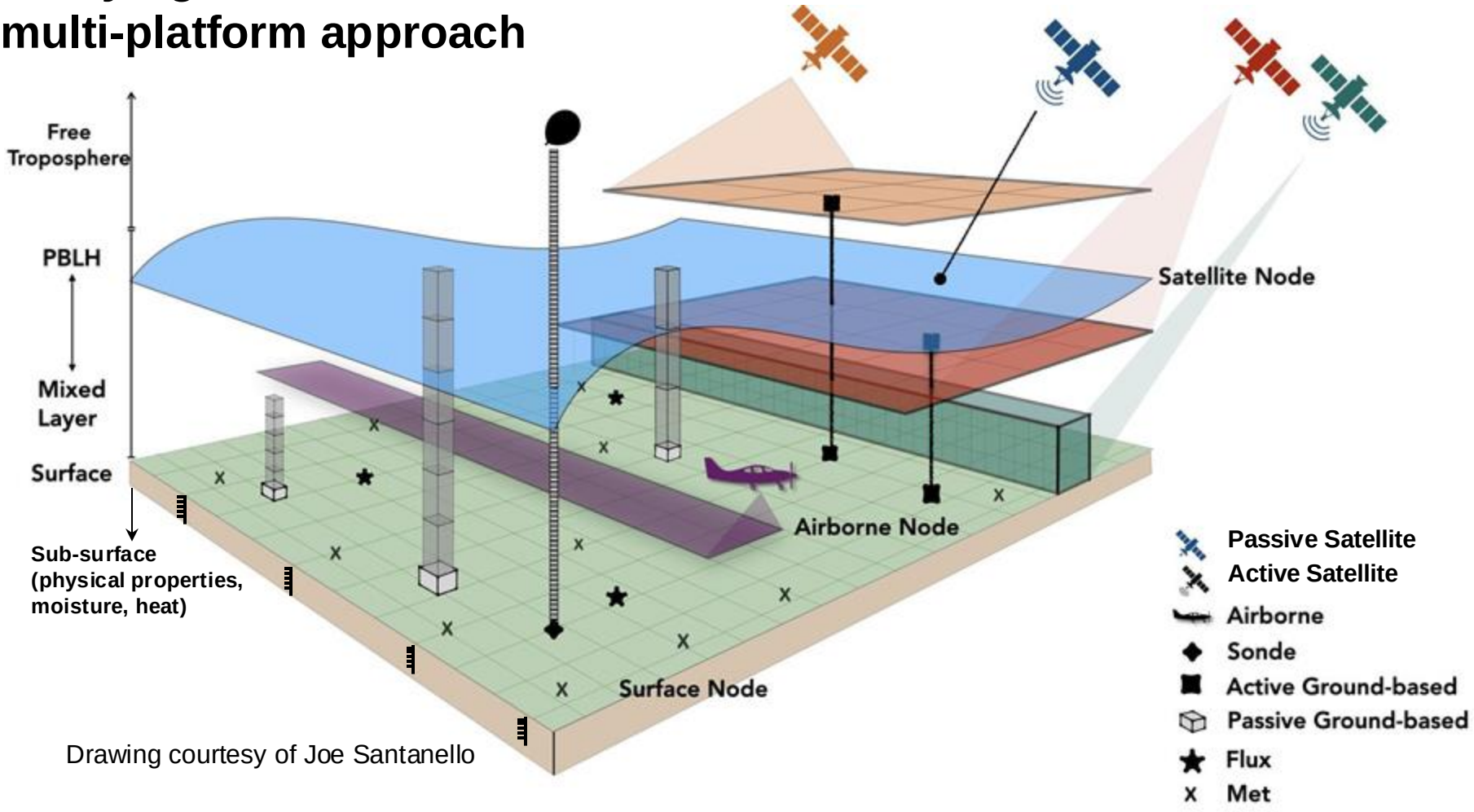
Block 1: 15:00 - 15:55, “Setting the Table”

- 15:00 - 15:10 ARM Large-Scale Science (Chongai Kuang)
- 15:10 - 15:15 Multi-scale Temporal Analysis (Jim Smith)
- 15:15 - 15:25 Surface-through-Vertical Observational Analysis (Maria Zawadowicz)
- 15:25 - 15:35 Multi-scale Spatio-Temporal Modeling Analysis (Allison Steiner, virtual)
- 15:35 - 15:45 Aerosol Vertical Profile Data Products (Peng Wu, virtual)
- 15:45 - 15:55 UAS-enabled Aerosol Science (Beat Schmid, virtual)

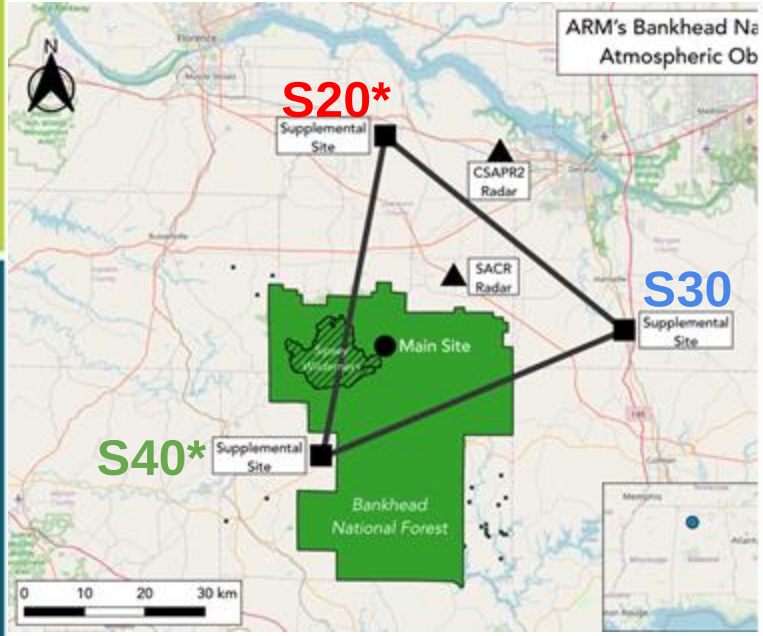
Block 2: 15:55 - 16:30, Discussion Highlights

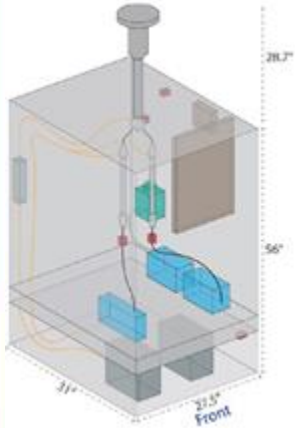
- develop/deploy sampling “nodes/pods” for “path-finding”/pre-deployment activities
- AI/ML-accelerated modeling for pre-deployment (siting/sampling), and during-deployment (forecast) activities
- coordinate NEON/AOP, NOAA, NASA for targeted PBL studies
- spatial AND temporal variability can/must help drive/organize IOPs

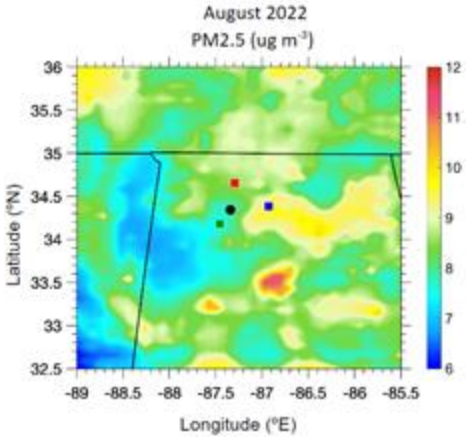
Studying the PBL via a multi-scale, multi-platform approach

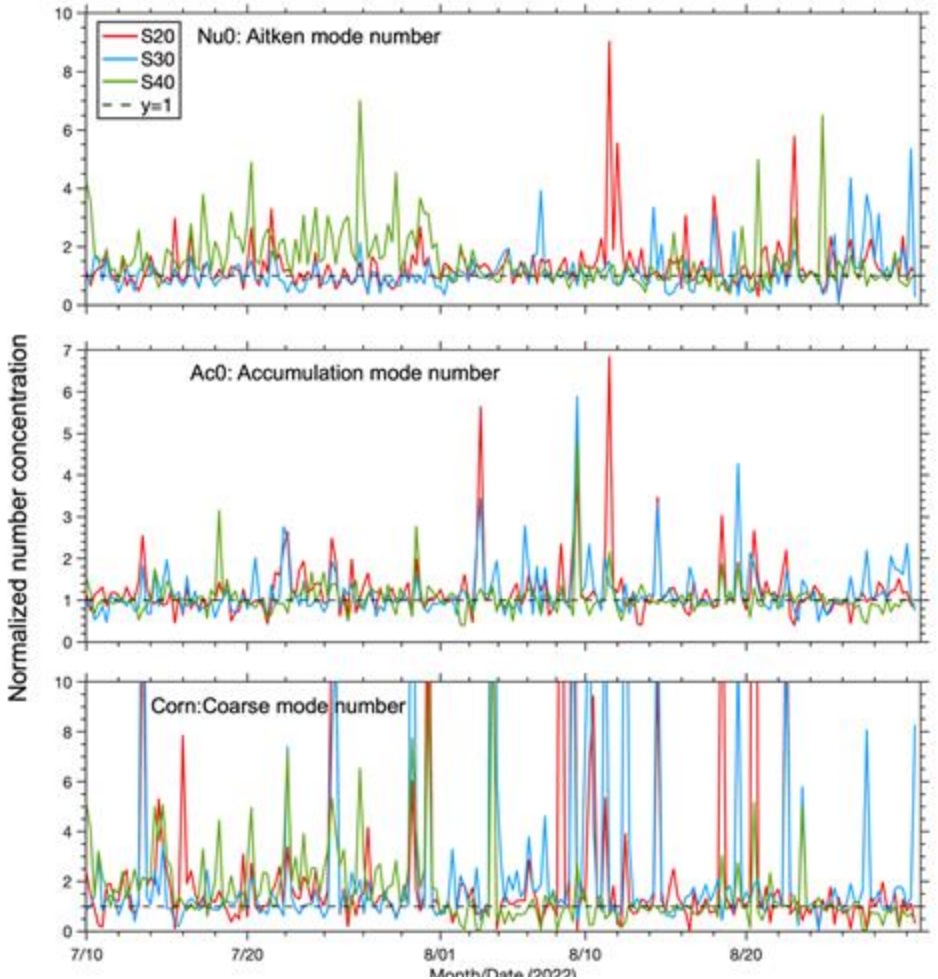


Drawing courtesy of Joe Santanello





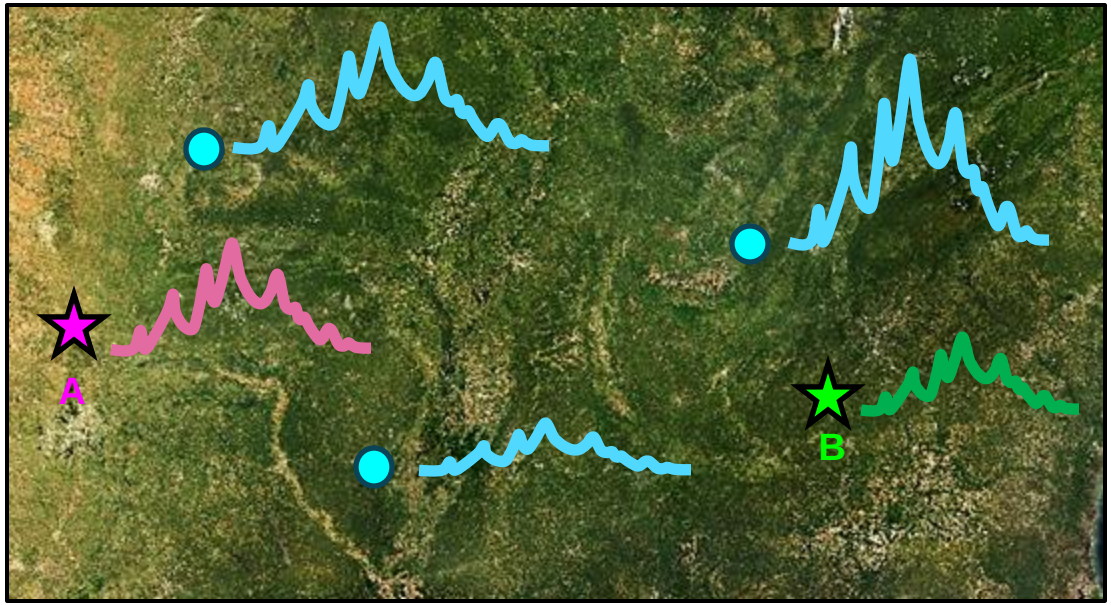




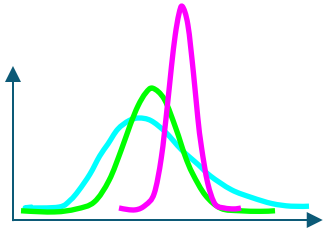
courtesy of Tamanna Subba

ModEx 2.0: Optimal experimental design (site selection)

- Of two proposed new site locations (**A** and **B**), which should we choose?
  - Select the location whose data, *if measured*, reduces model uncertainty the most



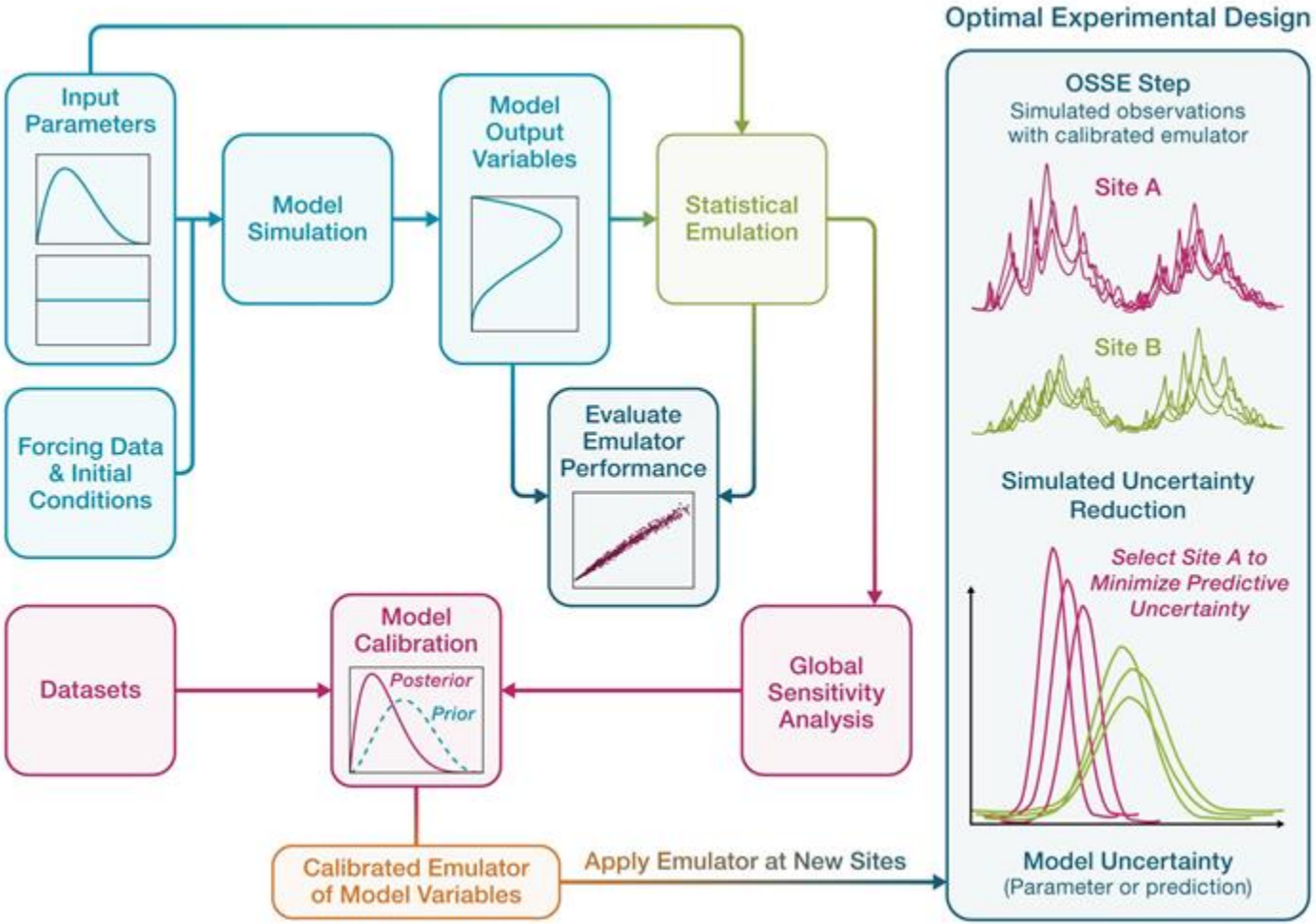
Data-model calibration (ModEx 1.0)

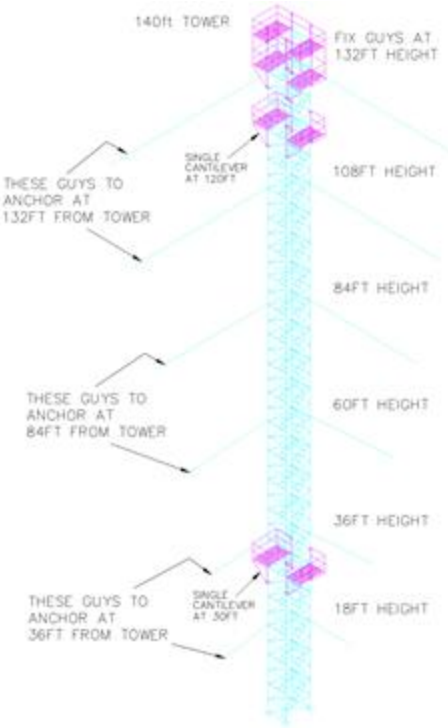


Model uncertainty
(parameter or prediction)

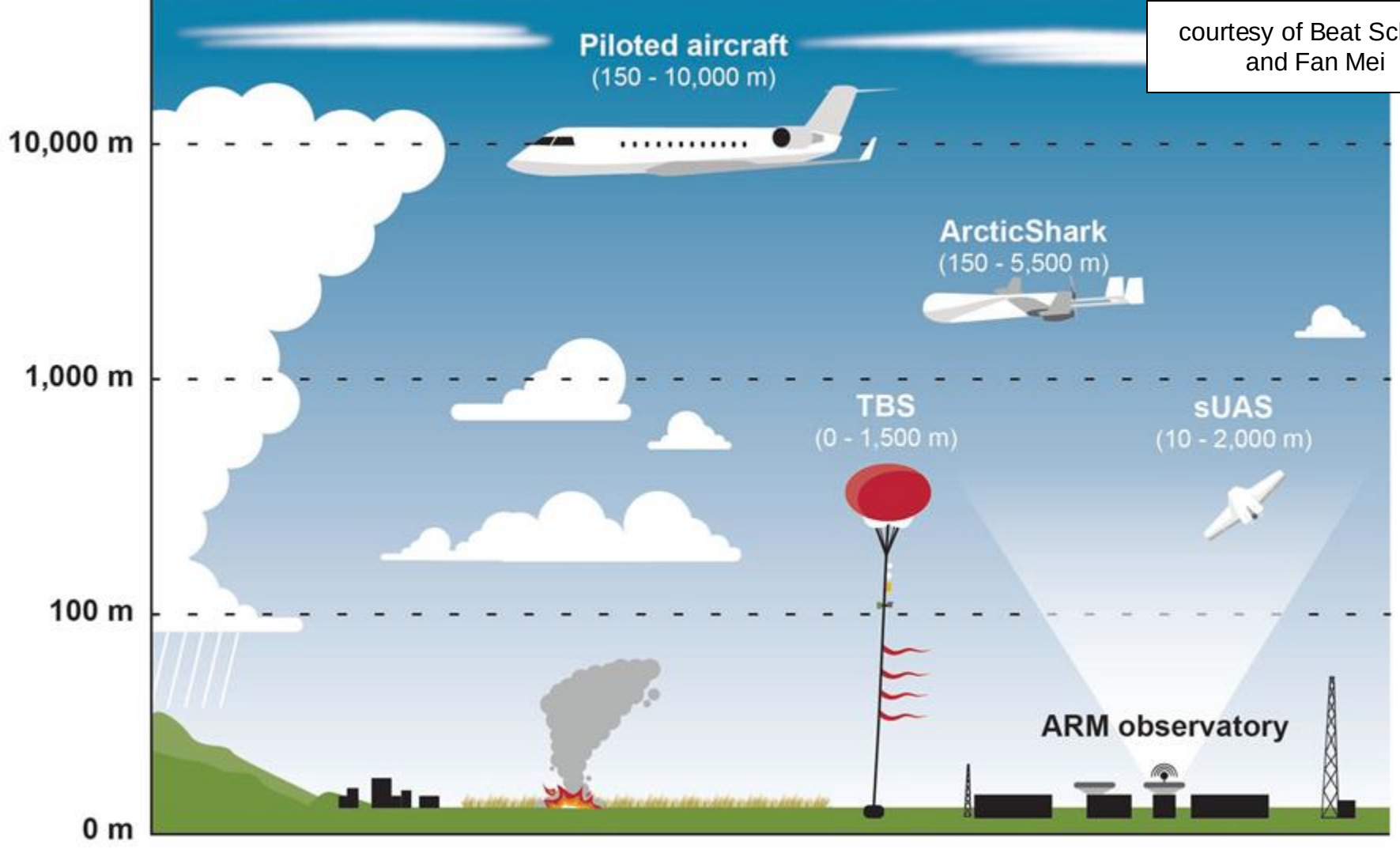
FASSt - Simulation

A Novel Computational Framework for Model-Measurement Integration for Climate Prediction”



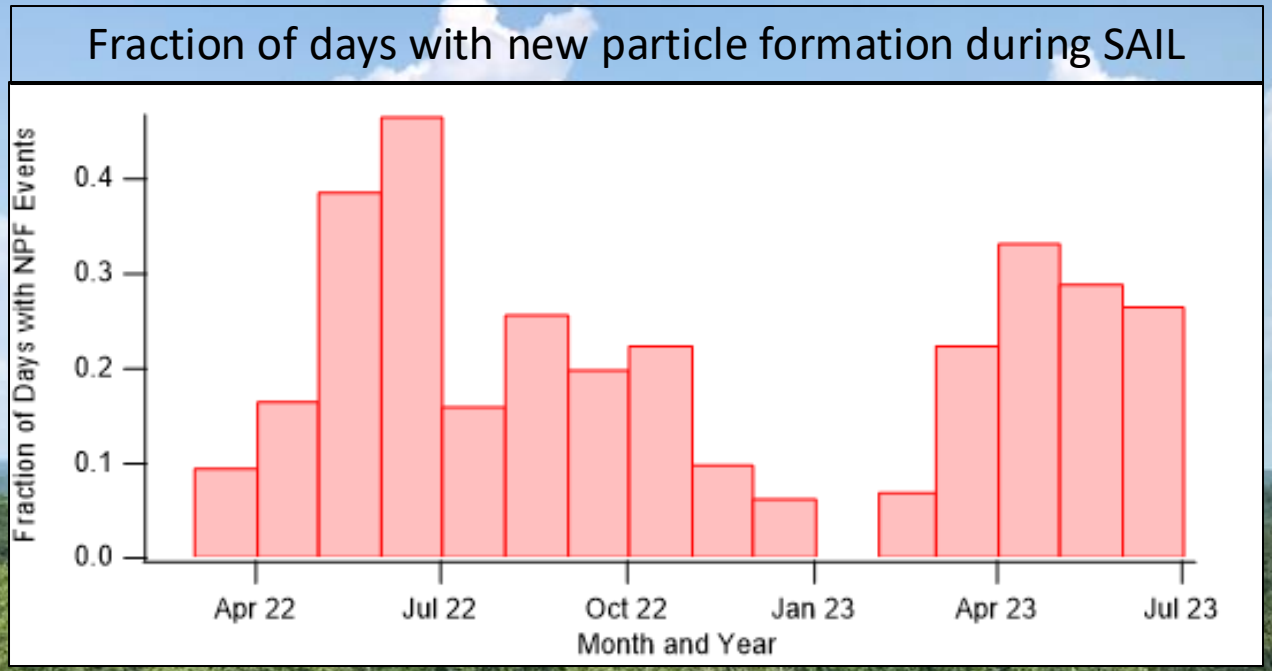


courtesy of Zhongjing Jiang



courtesy of Beat Schmid and Fan Mei

Seasonal measurements are essential for understanding biosphere-atmosphere interactions!

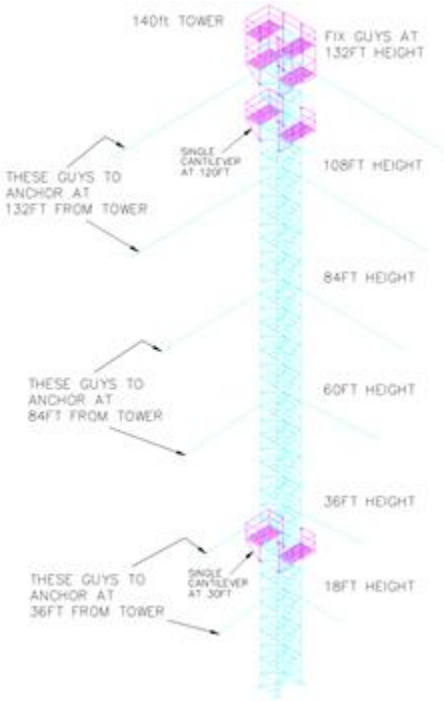


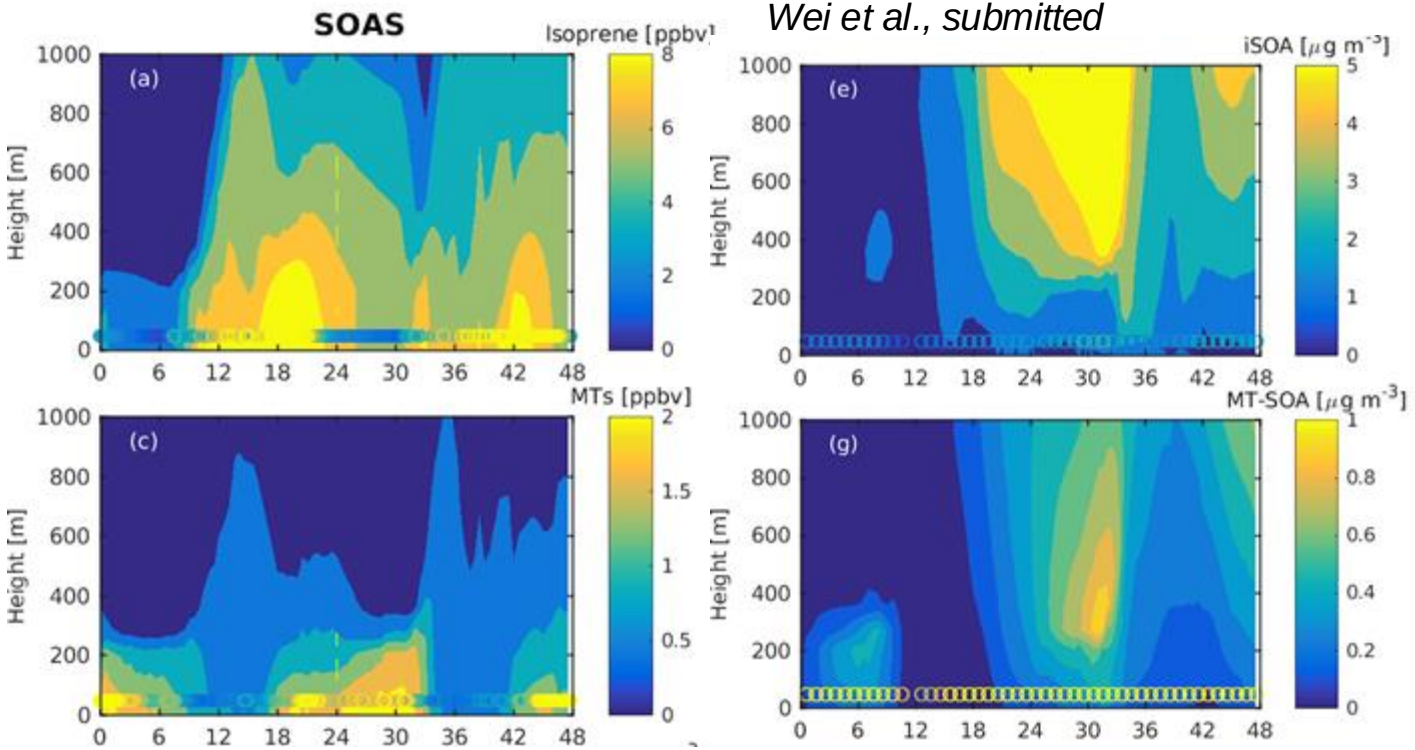
courtesy of Jim Smith

Local SOA simulations (1D model) to constrain regional contributions

courtesy of Allison Steiner

- 2013 simulations of gas-phase biogenic VOC (left panel) and secondary organic aerosol (right panel) at SOAS site

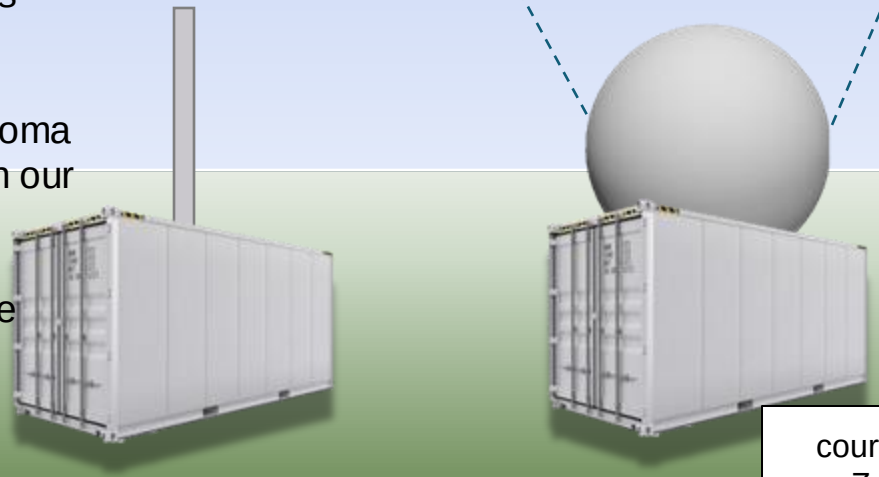




Wei et al., submitted

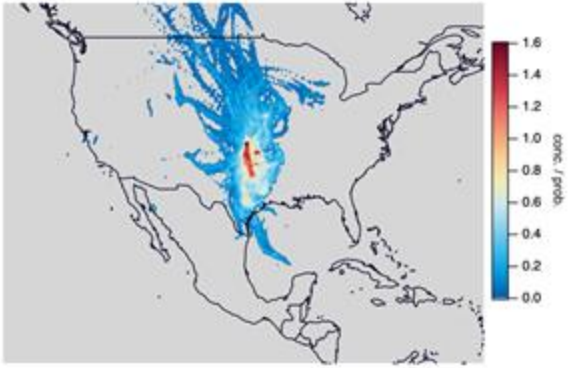
Linking AOS-measured aerosol properties to boundary layer clouds

- Goal is to identify conditions in which AOS-measured aerosol is representative of the boundary layer CCN.
- For now, we analyze SGP data collected in 2019.
- This will enable comparisons between cloud-processed and not cloud-processed particle populations. *Chemical signatures of aqueous processing*
- A lot of this was done by University of Oklahoma students, under a new collaboration between our group and ARM DQO.
  - Reese Mischler (2023)
  - Tristen Anderson, Lucas Bush and Dane Moak (2024)
  - Huge thanks to Ken Kehoe and Alyssa Sockol!

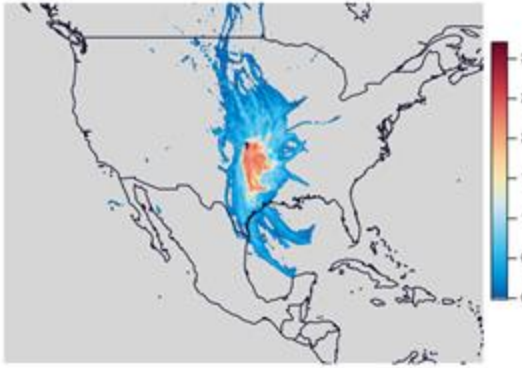


courtesy of Maria Zawadowicz

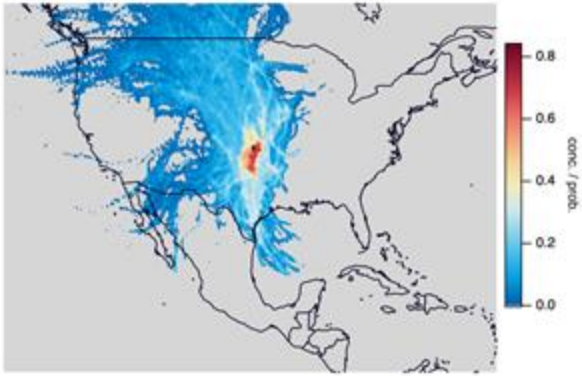
Regional - large



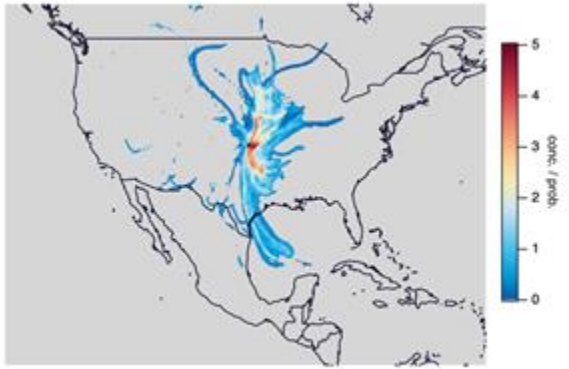
Biogenic



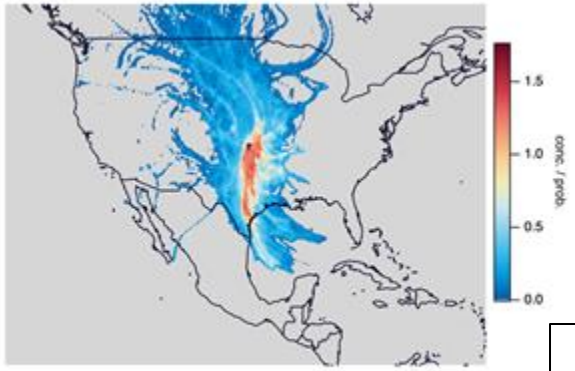
Clean



Biomass burning



Regional - small



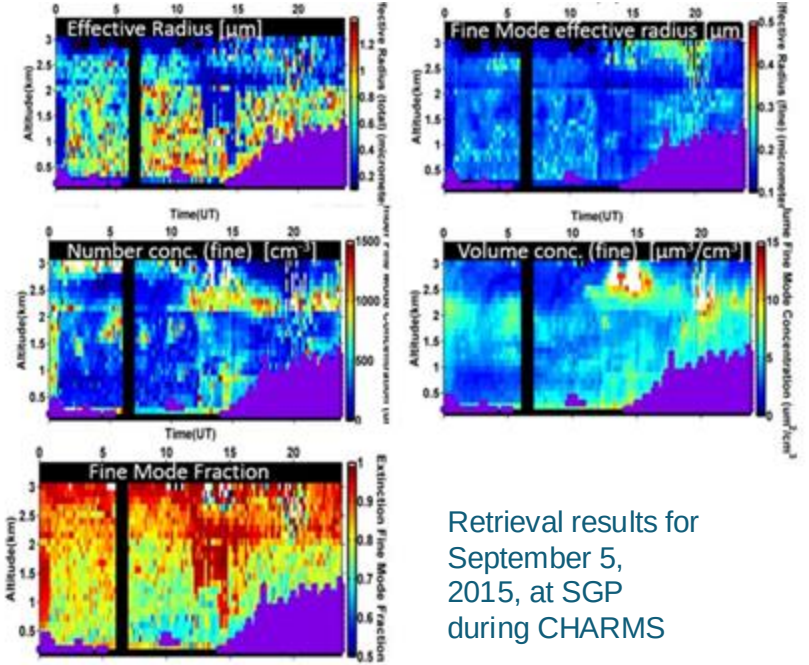
Brookhaven National Laboratory

courtesy of Maria Zawadowicz

Planned work – aerosol microphysics profiles

courtesy of Peng Wu

- Aerosol properties near the surface, such as aerosol number concentration and size can be significantly different from those aloft. This is especially true when there are new particle formation events
- We are working with Rich Ferrare and team at NASA LaRC on the retrieval algorithm
- Required inputs are in β_{355}, β_{532}, β_{1064}, α_{355}, and α_{532} profiles from RL and HSRL ("$3\beta + 2\alpha$" method)
- Test the code at the SGP site and plan to apply to BNF



Retrieval results for September 5, 2015, at SGP during CHARMS

Ferrare et al. (2017)

Thank you!

Questions and comments are welcome:

Peng Wu (peng.wu@pnnl.gov)

Damao Zhang (damao.zhang@pnnl.gov)