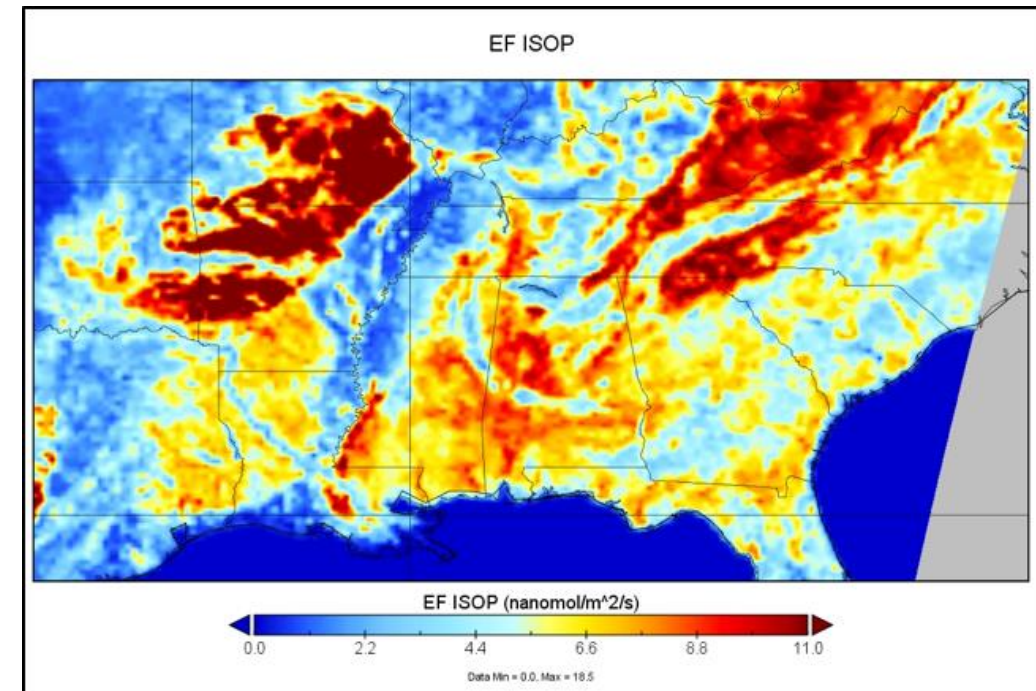
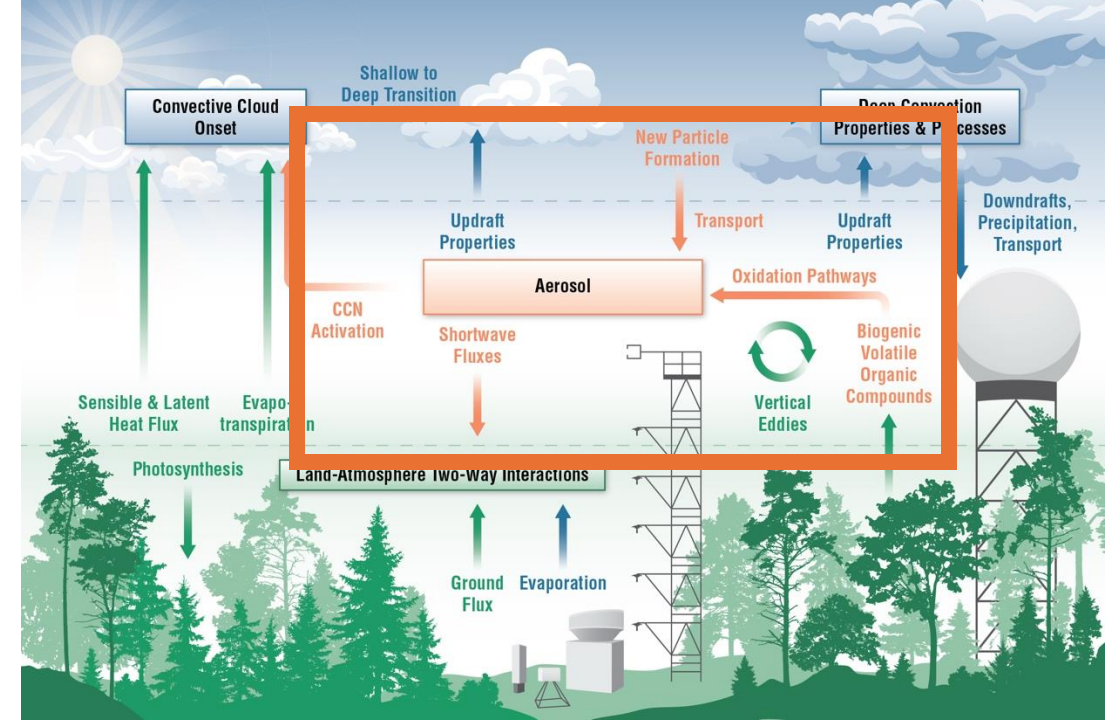


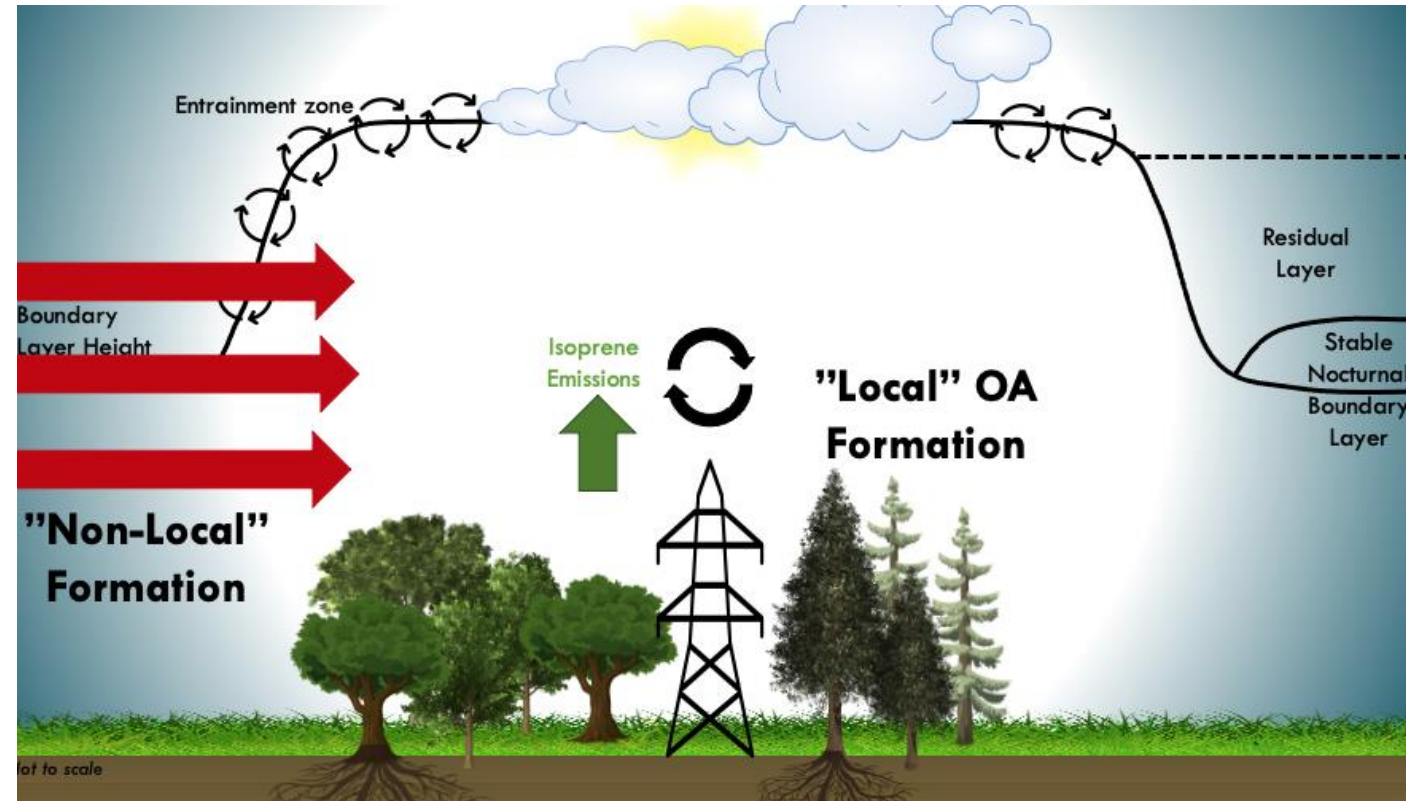
Local versus advective controls on aerosol concentrations

Allison Steiner
University of Michigan



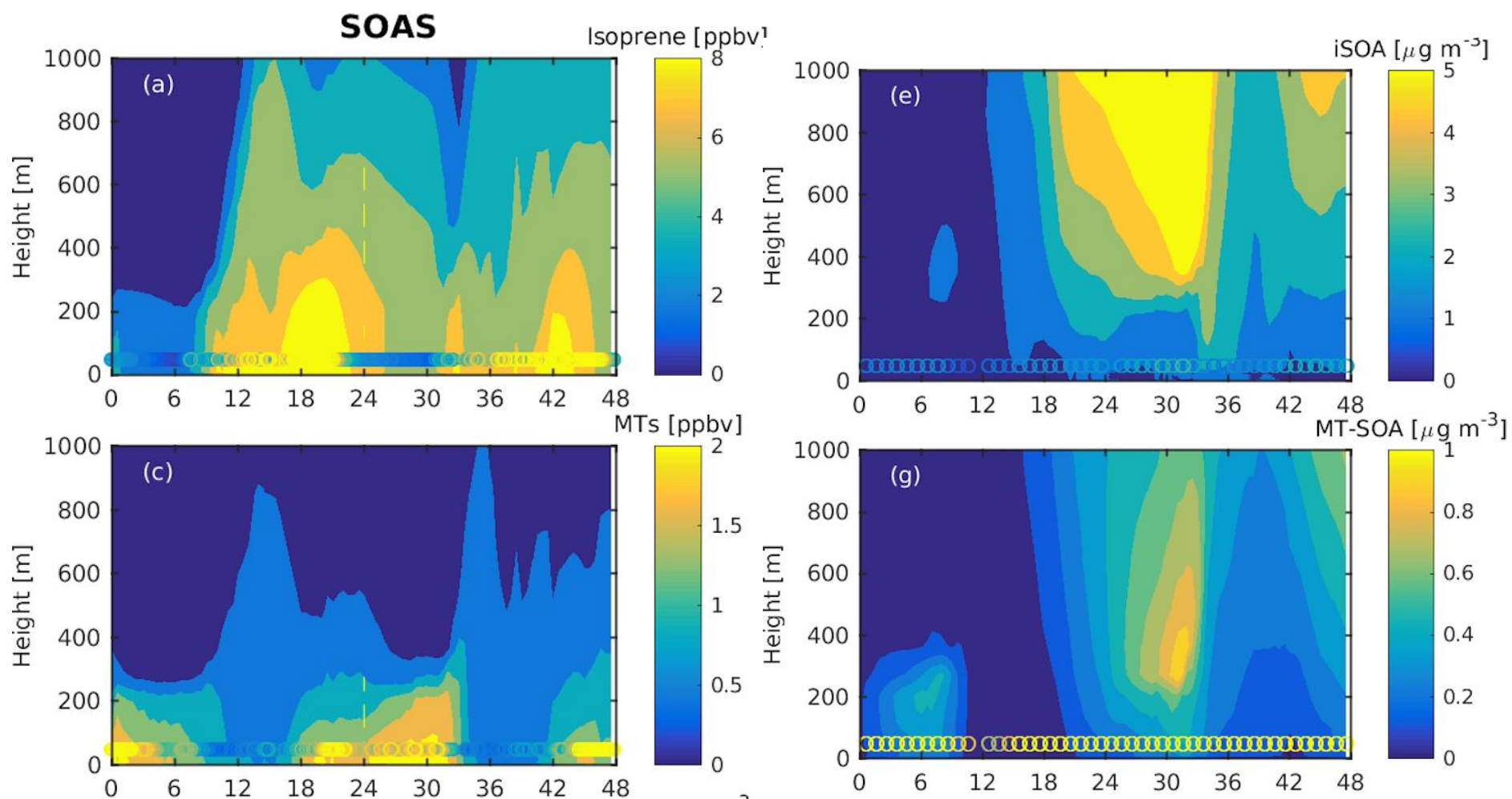
Temporal and spatial controls on aerosol

- How to compare the local versus non-local contributions to aerosol formation?
- Advective contribution: Use WRF-Chem 3D model simulations (12 km)
- Local contribution: Use 1D modeling
- AMF opportunity: Continuous aerosol observations over long term



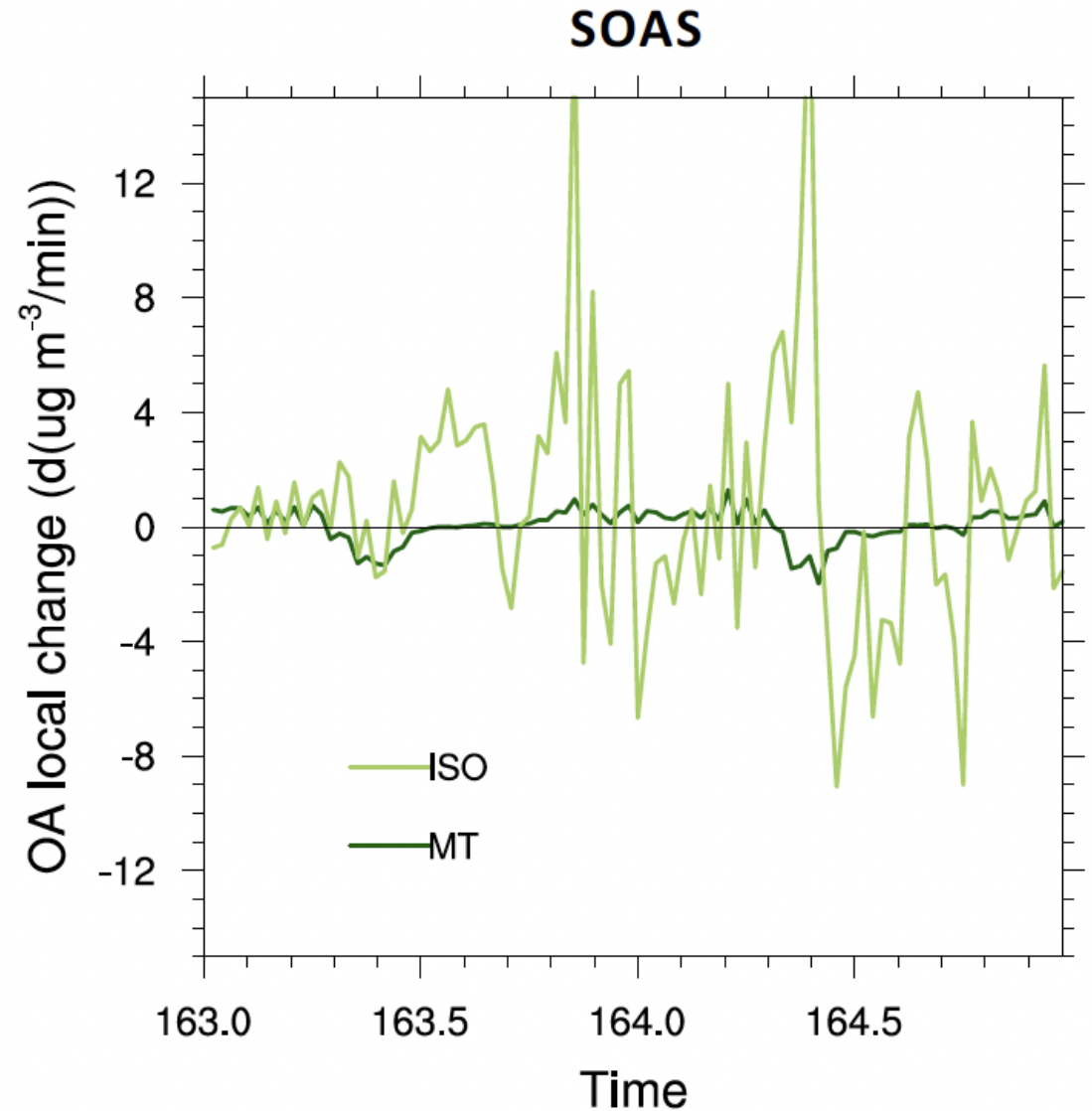
Local SOA simulations (1D model)

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

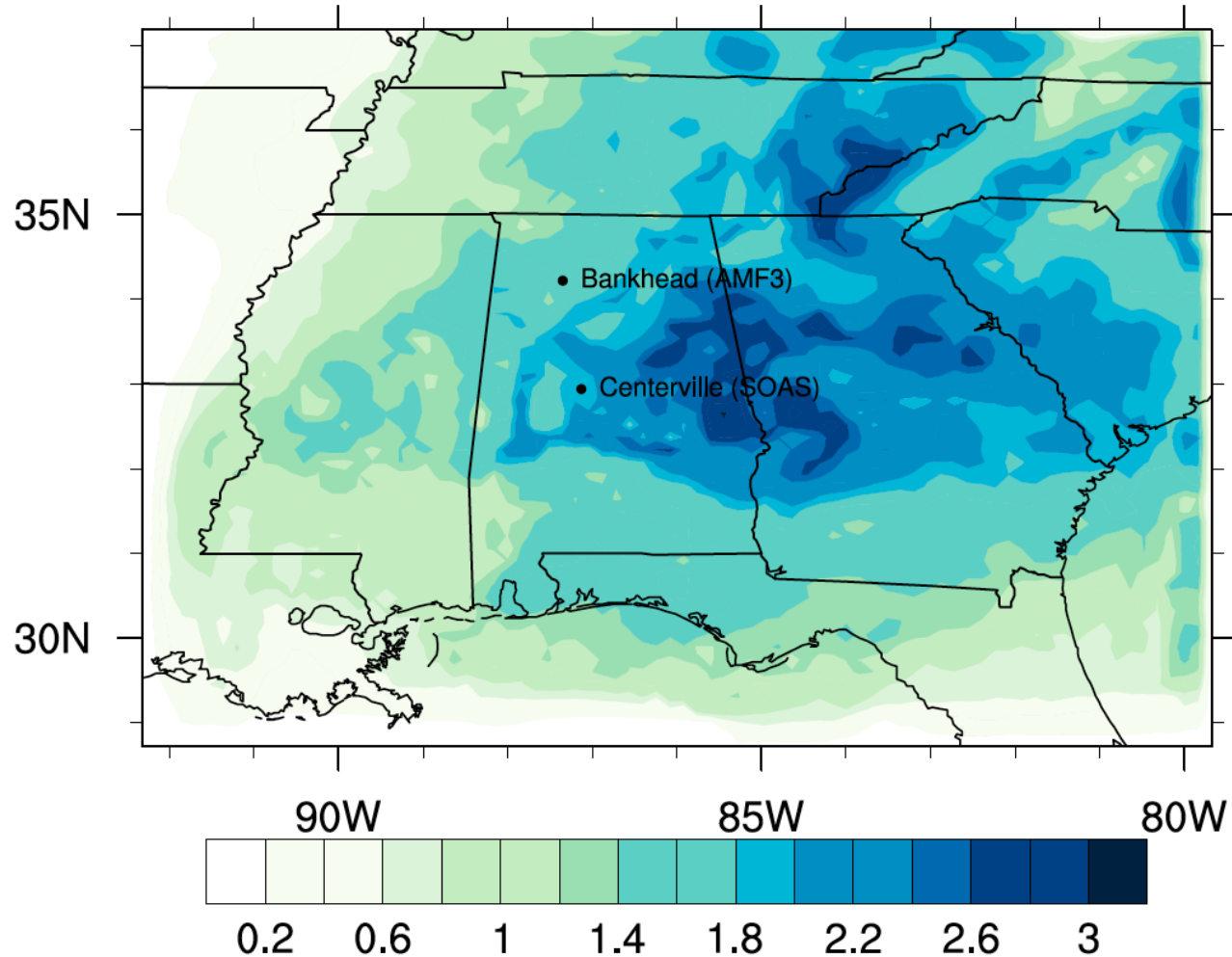


Local contributions to SOA

- Calculate local OA formation rates using 1D modeling approach (Wei et al., 2021)
- Local isoprene SOA production rates dominate over MT-SOA production rates in the model
- Local production generally peaks in the early morning and evening



Advective contributions to SOA

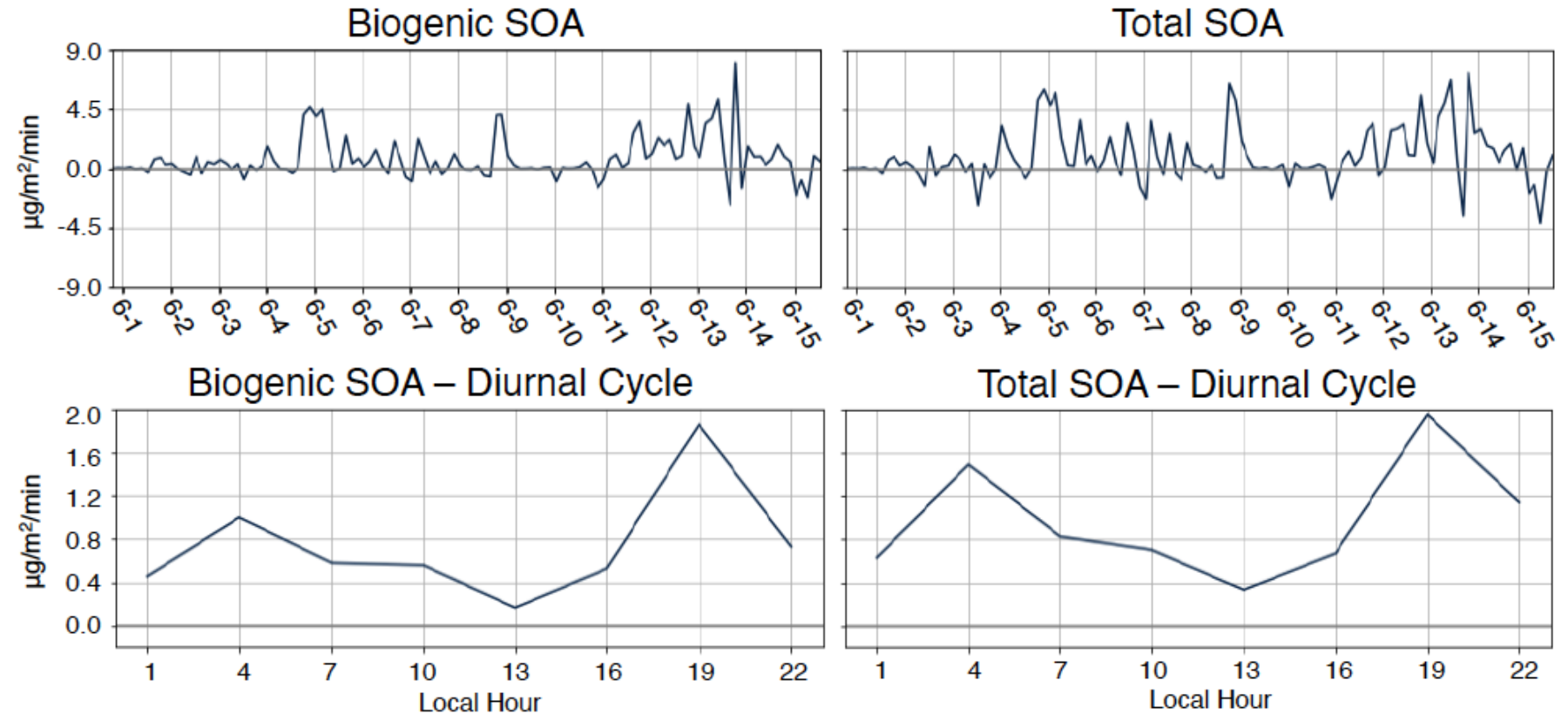


Calculate regional OA contribution using WRF-Chem model simulations and divergence calculation of advective contribution of aerosol

$$\iint_A \left[\nabla \cdot \int_{p_l}^{p_s} (\mathbf{c}\mathbf{u}) dp \right] dA = \int_l \left[\int_{p_t}^{p_s} (\mathbf{c}\mathbf{u}) dp \cdot \hat{\mathbf{n}} \right] dl$$

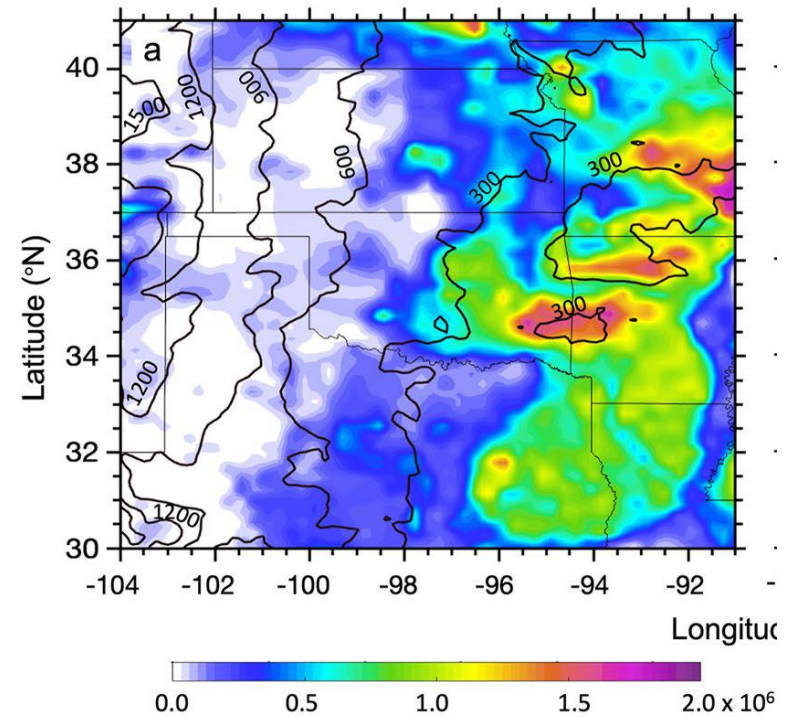
Advective contributions to SOA

- Despite SOA model biases, model suggest divergence dominates the region (e.g., flux of BSOA out of the region)
- Synoptic conditions alter the overall divergence pattern, with some time periods of convergence (eg., net flux in)



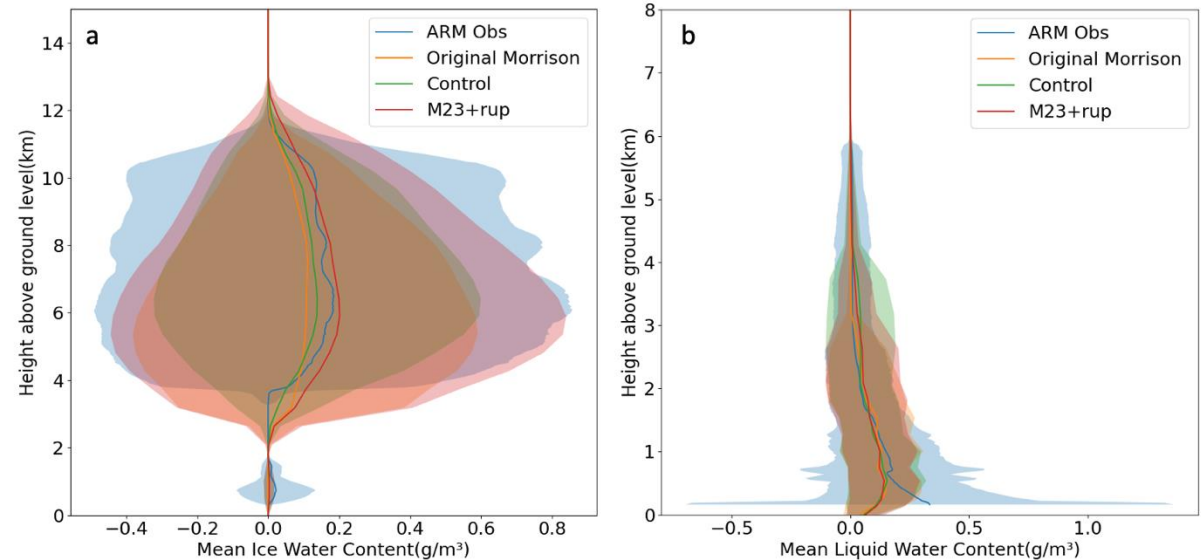
Aerosol-Climate Impacts

- Modeling frameworks can assess aerosol-cloud feedbacks
- Example from ARM SGP: simulations of pollen bioaerosol effects on vertical liquid and ice water content, evaluated with the SGP MICROBASEKAPLUS



Subba et al., 2023

Pollen grains ($\# \text{m}^{-2} \text{day}^{-1}$)



Zhang et al., 2024

Looking forward

- Getting at local versus regional contributions is tricky: requires use of models (or atmospheric reanalysis) – but observational constraints will help!
- Vertical and horizontal heterogeneities are important, and formation processes aloft appear to be important from modeling

