SAIL: The Surface Atmosphere Integrated Field Laboratory

ARM

Aerosol-Cloud-Precipitation

Jiwen Fan

Paul DeMott, Allison Aiken, Jim Smith, McKenzie Skiles

Overall: How strongly do aerosols affect the surface energy and water balance by altering clouds, precipitation, and surface albedo, and how do these impacts vary seasonally?

- Do new particle formation events control the variability of aerosol hygroscopicity and **CCN concentrations, and their subsequent impacts** on precipitation?

- What are the contributions of **biological particles, wildfires, and long-range transported dust** to INP concentrations, do they vary seasonally, and are they linked strongly to precipitation efficiency of clouds?

- How does the aerosol-precipitation relationship vary with **different aerosol regimes, and atmospheric dynamic and thermodynamic conditions**?

CCN and INP impacts on Snow

Warm mixed-phase clouds
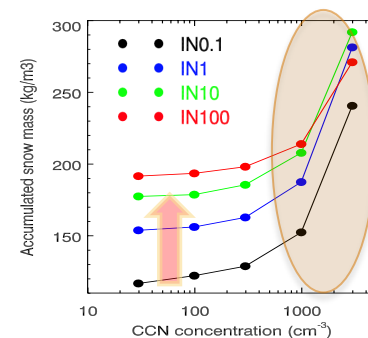
Cold mixed-phase clouds

Fan et al., 2017, ACP

Proposed studies
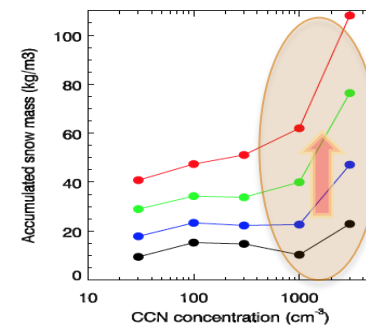
Observational analysis

- Quantify relationships of aerosol characteristics (e.g., size distribution, composition, and hygroscopicity) with CCN and INP under different aerosol scenarios

- Quantify relationships of CCN with precipitation, cloud microphysical properties (e.g., LWC, IWC, cloud phase, hydrometeor type), and updrafts under each typical meteorological conditions

- Quantify relationships of INP with snow precipitation, cloud microphysical properties under each typical meteorological conditions

Modeling study

- **LES/CRM study:** In combination with observational analysis, conduct model simulations for process-level mechanistic investigation with **selected cases** for the summer and winter seasons

- **E3SM evaluation** (1-deg, RRM-25 km, and RRM-3km) particularly on the performances of the E3SM new cloud microphysics scheme (P3) and aerosol effects (e.g., relationships of aerosols with precipitation at different seasons).
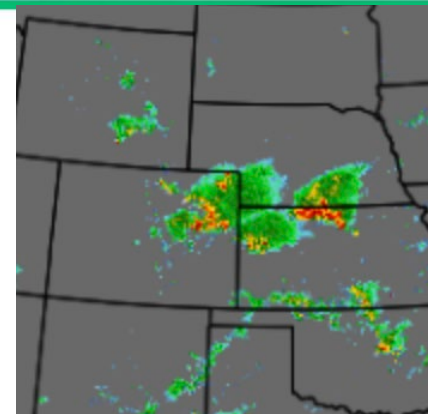
Case selection for modeling work

Case selection criteria

- Initiate or pass over SAIL domain (better to be isolated storms for summer cases.

- Comprehensive measurements in aerosols, meteorology, cloud, and precipitation

- Better to have aerosol, CCN, and INP measurements right before the events

- Better associated with an aerosol events, such as biomass burning, dust, etc.

July 29 UTC

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SAIL – SPLASH 29 JUL 2022