



Surface Atmosphere Integrated Field Laboratory (SAIL) aerosol regimes and processes, including supermicron and bioaerosol events measured during the SAIL Supermicron Bioaerosol (SSB) campaign



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Aerosols Impact Mountain Hydrology SUBMICRON AND SUPERMICRON Aerosols play different roles during different Aerosol Observing System (AOS) and Guest Aerosol Measurements CRESTED BUTTE, CO

Aerosol Observing System data showed high supermicron scattering events in May, 2022.



54 rain events were sampled during the initial WIBS deployment from Jun 15 – Sept 13, 2022. Fig 6. shows the different fluorescent particle types during one example event.



seasons in high elevation mountain regions. Absorbing aerosols, e.g. black carbon, brown carbon, dust, can be deposited on surfaces with high albedos like snow, altering surface radiation, snowmelt and the watershed.



Caption: Aerosol processes scatter and absorb sunlight in the atmosphere, change the surface albedo, and impact precip.

Supermicron aerosols, including bioaerosols, are also important in high mountainous areas, including their ability to serve as nuclei for cloud droplets, ice crystals, and precipitation.





The ARM AMF2 Aerosol Observing System (AOS) was deployed on Mount Crested Butte in Colorado for SAIL. The AOS was moved to the S2 site with the CSU cloud radar to get out of valley-influenced airmasses and enable the ability to sample more regionally representative aerosol with less interferences from local sources.





Fig 3: Particulate scattering and absorption coefficients as detected by the Nephelometer (Neph) at 450 nm and Particle Soot Absorption Photometer (PSAP) at 470 nm in the AOS shown with the rain amount by the meteorology sensor (AOSMET).

SAIL Supermicron Bioaerosol (SSB) JUNE 15, 2022 – JUNE 15, 2023 The SAIL Supermicron Bioaerosol (SSB)

Campaign complements SAIL science goals to understand supermicron and bioaerosol processes and aerosol-cloud interactions in the East River Watershed. A bioaerosol



Fig 6: Time series of the different fluorescent particle types as measured by the WIBS along with meteorological data before, during and after a rain event on June 30, 2022.

SAIL Aerosol Vertical Profiles (SAILAVP) TETHERED BALLOON SONDE (TBS)



Caption: TBS at SAIL in 2022 as will be deployed in 2023 as a part of the Facilities Integrating Collaborations for User Science (FICUS) program..

Caption: Schematic of supermicron and bioaerosol cycles in mountainous terrain. After emission particles can be transported into the atmosphere where they interact with clouds and the water cycle. Bioaerosols can be recycled back to the surface where they can alter plant and microbial growth and/or be reemitted, thus forming a positive feedback loop within the Earth system known as bioprecipitation.



Two particulate monitors to measure Particulate Mass (PM_1 , PM_{10}) were deployed at the AMF2 in Gothic (M1) and the AOS (S2). PM_1 and PM_{10} mass at M1 are higher than S2. A diurnal trend was also observed in Gothic that was not measured on the mountain at S2 during the summer measurement period.



Fig 1: Time series of particulate mass for PM1 at M1/AMF2/Gothic and S2/AOS/Mount Crested Butte sites in the summer. sensor (Wideband Integrated Bioaerosol Sensor – WIBS) was deployed for high timeresolution data along with cascade impactors for offline bioaerosol analyses. The WIBS reports 7 types of fluorescent particles (Perring et al., 2015, Savage et al., 2017). Fluorescent particles indicate the presence of biological material (Tryptophan, NADH).



Fig 4: Time series of the different fluorescent particle types as measured by the Wideband Integrated Bioaerosol Sensor (WIBS). A biomass burning plume measured by the AOS was also captured by the TBS on May 16, 2022. TBS vertical profiles measured two concentrated plumes of $689 - 1018 \text{ cm}^{-3}$ at 2898 - 2963 m in addition to elevated particle concentrations between $200 - 400 \text{ cm}^{-3}$ that were well-mixed within the boundary layer up to 3150 m during the downward trajectory.

3400 -	ഗ ല്റ്റ – 6.6 x10 ⁴ റ്റ	Fig 7: Particle
3300 -	– 6.4 since 2	number concentrations
3200 -	- 6.0 - 5.8 - 5.8	versus altitude measured by the

"Atmospheric aerosol processes alter radiation and precipitation events that impact surface hydrology."



Fig 2: Scatter plots of PM₁ and PM₁₀ at M1 and S2.





TBS on May 16, 2022 between 15:01-18:46 UTC.

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