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DOE/SC-ARM-23-024

# Vertical Aerosol Profiling during SAIL (VAPS) Field Campaign Report

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ARM

## DISCLAIMER

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# Acronyms and Abbreviations

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|---|---|
| ARM | Atmospheric Radiation Measurement |
| ASR | Atmospheric System Research |
| CCN | cloud condensation nuclei |
| DOE | U.S. Department of Energy |
| INP | ice nucleating particle |
| SAIL | Surface Atmosphere Integrated Field Laboratory |
| TBS | tethered balloon system |

# Contents

# 1.0 Summary

To more fully address the science goals of the U.S. Department of Energy (DOE) Atmospheric Radiation Measurement (ARM) user facility's Surface Atmosphere Integrated Field Laboratory (SAIL) campaign, particularly the key science question of "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?", our campaign added instrumentation to planned tethered balloon system (TBS) flights in May and July of 2022. A key aspect of aerosol-cloud interactions is understanding cloud condensation nuclei (CCN) and ice nucleating particle (INP) populations, and how they vary seasonally and spatially. Because the interactions between aerosols and clouds is the target of this work, vertical distributions are particularly important to evaluate. Measurements of aerosol at ground level, below-cloud, and in-cloud will allow a better understanding of the airmasses that are feeding cloud-active particles into low- and mid-level clouds. Measurements of INP and aerosol populations often differ between the ground and aloft, with relationships that likely depend on regional and seasonal factors (Creamean et al. 2018, 2021). Because of this, collocated measurements of aerosol, CCN, and INP, across different seasons, are crucial to reducing uncertainties in relationships between ground-level and cloud-base aerosol populations.

Our campaign added online measurements of CCN using a compact CCN counter and offline filter collections for measurement of INP populations to the SAIL campaign TBS flights in May and July of 2022. The CCN instrument, the CloudPuck, flew and successfully collected data for a total of eight flights across both campaign periods. The IcePuck flew for most flights during the same period. Both instruments have continued to be used for other campaign requests in the SAIL domain.

Analysis of this data was proposed through a concurrent DOE Atmospheric System Research (ASR) project submission, which was not funded in 2022. A similar proposal, which would involve analysis of the samples and data collected from this campaign, has been resubmitted in 2023 but a funding decision has not yet been made. If the proposal is again declined, we will seek other resources to ensure that this data can be analyzed.

# 2.0 Results

CloudPuck data were successfully collected for eight flights, and IcePuck samples for several additional flights. Data and samples have not yet been analyzed, but our submitted ASR proposal titled "Comprehensive Characterization of the Seasonal Cycles of Ice Nucleating Particles for Studies of Precipitation Drivers in SAIL" would involve analysis of these samples and data if funded.

# 3.0 References

Creamean, J, D Dexheimer, and F Mei. 2018. Aerosol Vertical Profiling at Oliktok Point (AVPOP) Field Campaign Report. U.S. Department of Energy, Atmospheric Radiation Measurement user facility, Richland, Washington. DOE/SC-ARM-18-032.

Creamean, J, G de Boer, H Telg, F Mei, D Dexheimer, MD Shupe, A Solomon, and A McComiskey. 2021. “Assessing the vertical structure of Arctic aerosols using balloon-borne measurements.” *Atmospheric Chemistry and Physics* 21: 1737−1757, https://doi.org/10.5194/acp-21-1737-2021


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