Selected Highlights from the Surface Atmosphere Integrated Field Laboratory (SAIL) Field Campaign

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With Major Contributions from the SAIL, SPLASH and SOS Science Teams

Poster 822

Abstract

With SAIL, the ARM Program successfully deployed the AMF-2 across the East River Watershed near Crested Butte, Colorado. SAIL collected data from Sept. 1, 2021 to June 15, 2023. With over 150 data-streams and strong federal, state, and local partnerships, SAIL has advanced understanding of the precipitation, snowpack, aerosol, and radiative processes that impact surface water and energy budgets in the Upper Colorado River. A small sample of ongoing research highlights are shown.

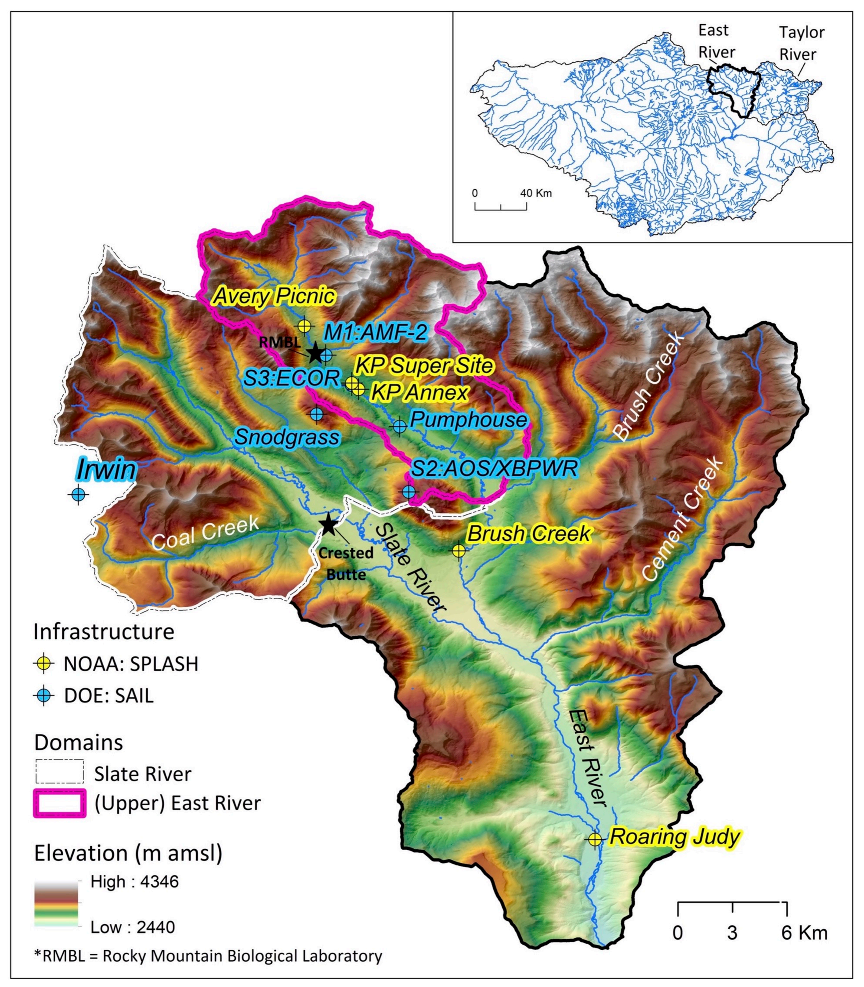


Fig 1: Location of SAIL in Upper Colorado River Basin and SAIL specific locations (in blue) and partner SPLASH locations (in yellow) from [1]

SAIL Observational Overview

SAIL measured across the 300 km^2 East River Watershed and included 3 valley sites, and one mountain site.

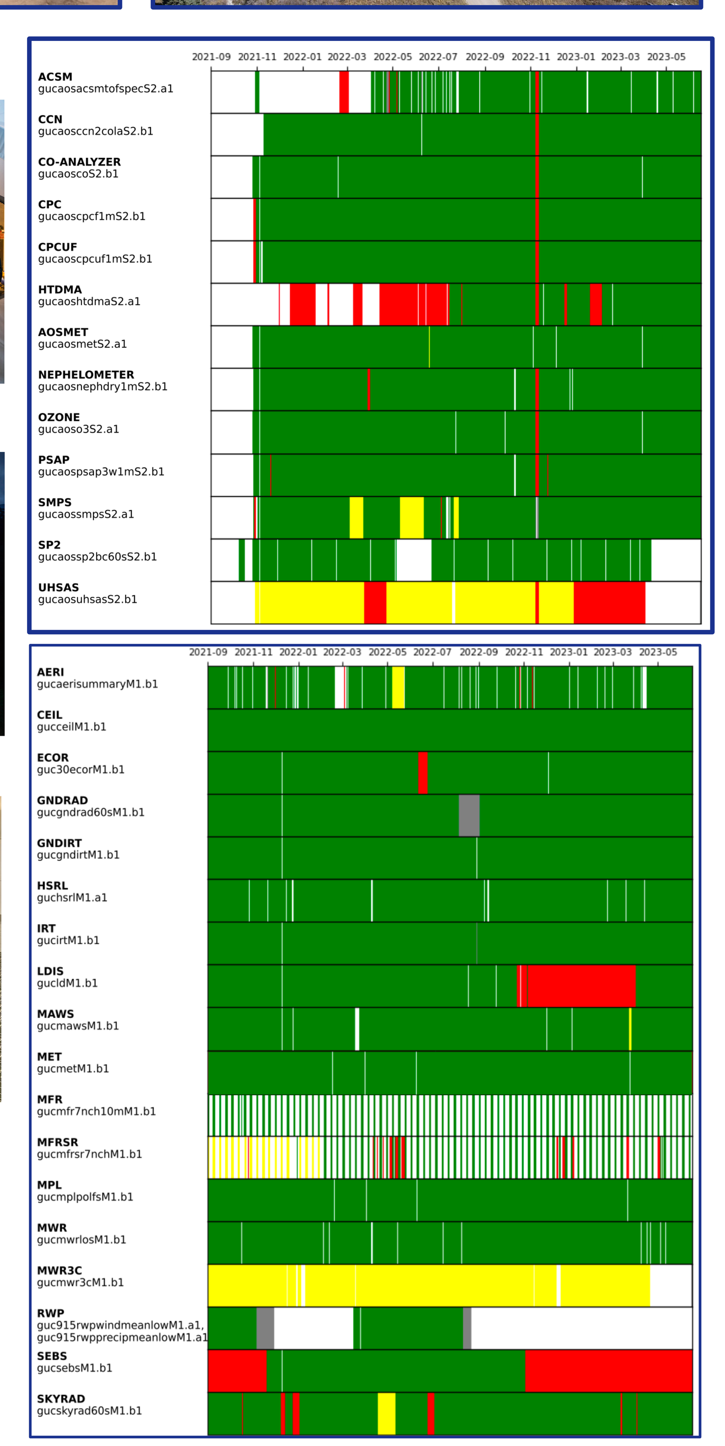


Fig 2: SAIL's data-streams are publicly-available and capture multiple atmospheric and surface processes

Highlight: Campaign Overview

The scientific goals, numerous data-streams, instrumental configurations, guest instruments, partnerships, and surprising findings of the SAIL are all summarized in an overview paper that serves as the reference for the SAIL campaign [1].

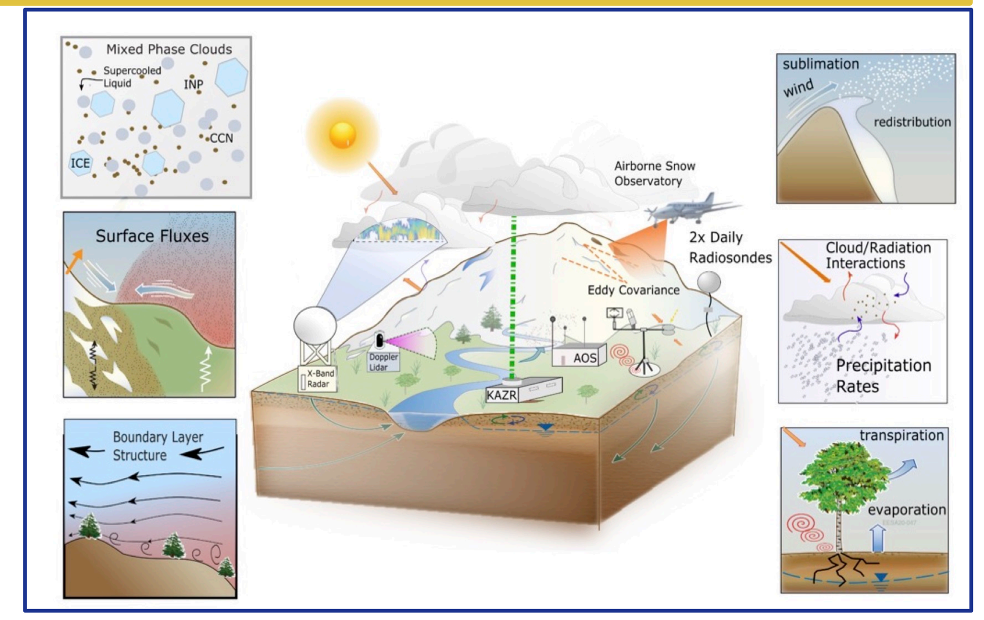


Fig 3: SAIL's density and process constraints.

Highlight: Insights into T2m Biases

Dozens of publications have all found that the two-meter surface air temperature (T2M) field that Earth System Models and atmospheric process models report is too cold in mountains in the winter. There are many potential causes for these biases. SAIL data provide unique insights into when, where, and possibly why these biases arise: They show that models need to couple the surface and atmosphere more tightly in winter. [2]

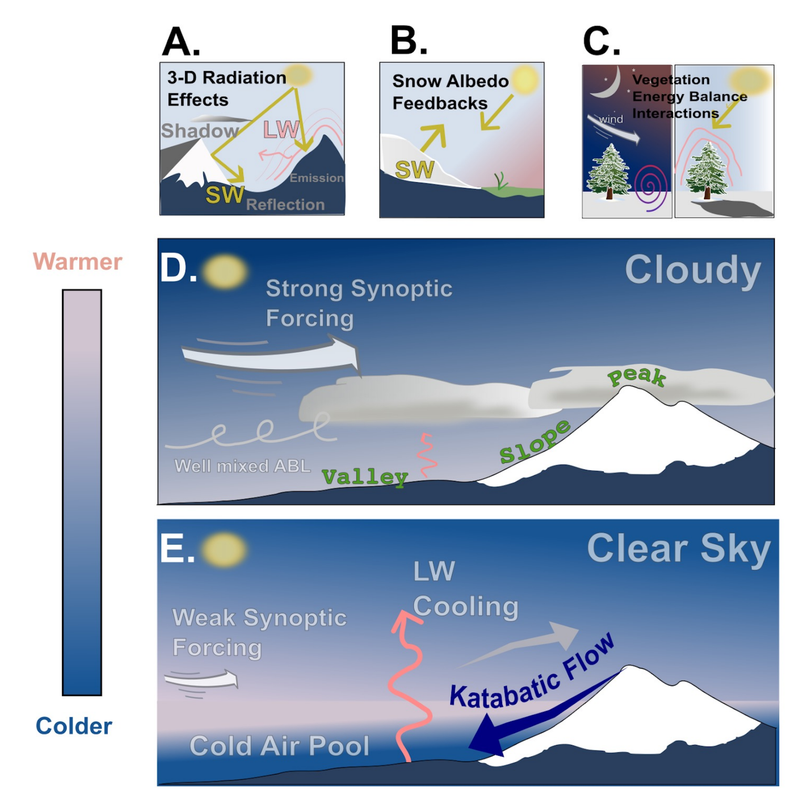


Fig 4: Cartoon of the processes that materially impact the surface air temperature in complex terrain. From [2].

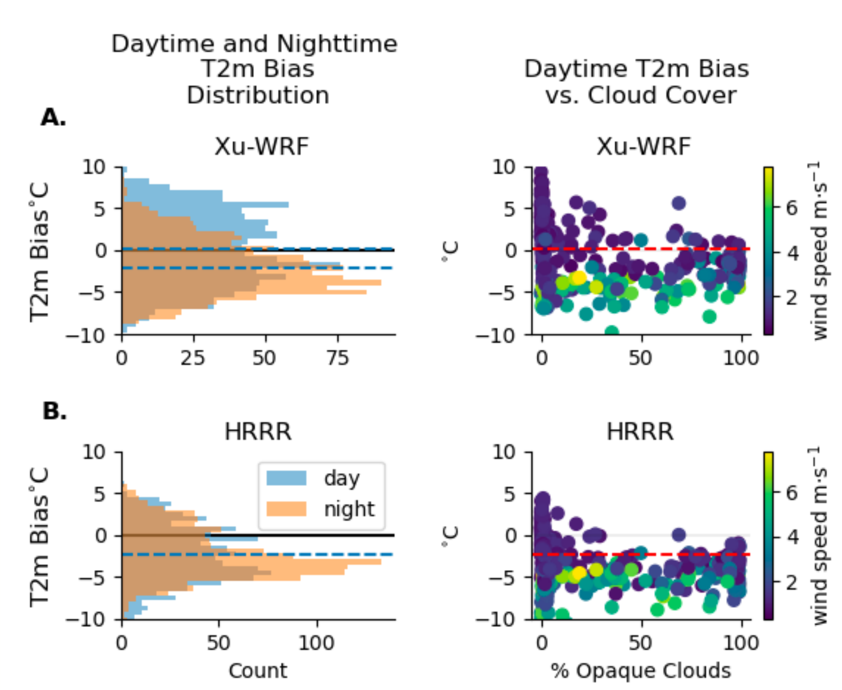


Fig 5: Comparison of T2m vs skin temperature at SAIL vs modeled values from WRF and HRRR. From [2].

Highlight: Climate-Resilient Snowpack Data

SAIL show how radar data can address a known problem with snowpack estimation: snow patterns are expected to change in the future, but the network of snow monitoring stations cannot move, so precipitation observations and artificial intelligence methods can fill this growing gap. From [3].

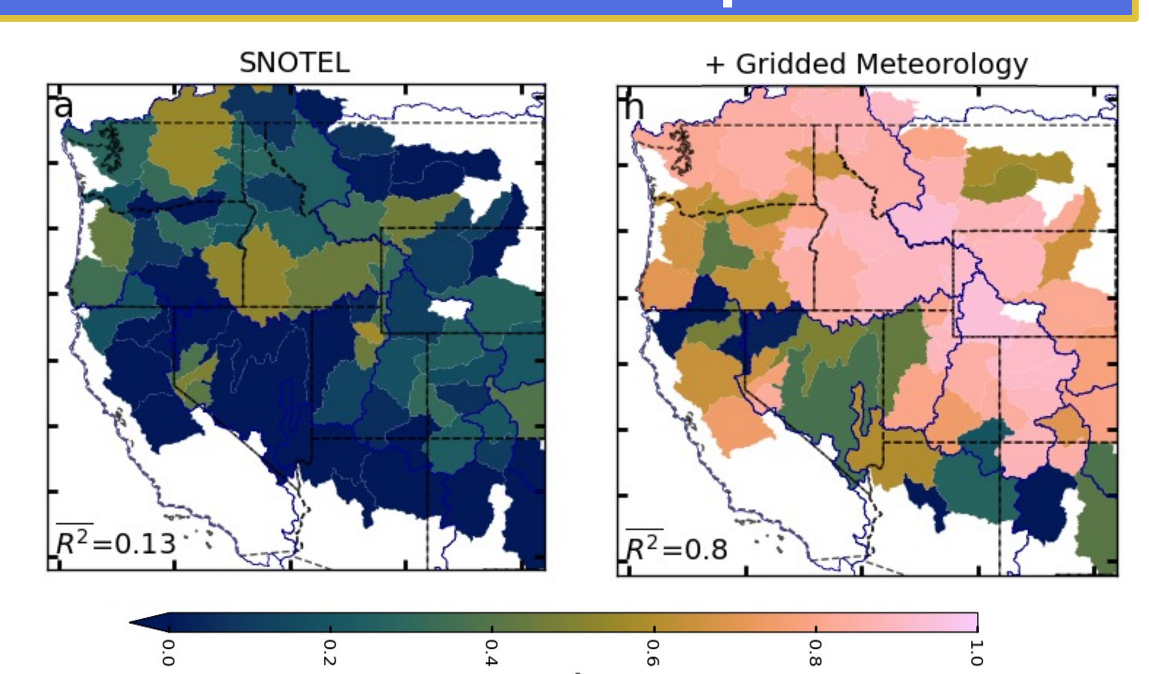


Fig 5: Estimated 21st Century snowpack estimation skill using (left) SNOTEL stations or when they are enhanced with precip. obs and a U-Net. From [3]

Highlight: The End of Hoar Frost?

Surface hoar-frost formation is the result of thermodynamic deposition of water. Warmer temperatures can create unfavorable conditions for hoar-frost formation. SAIL observations probe the climate-sensitivity of this process. From [4].

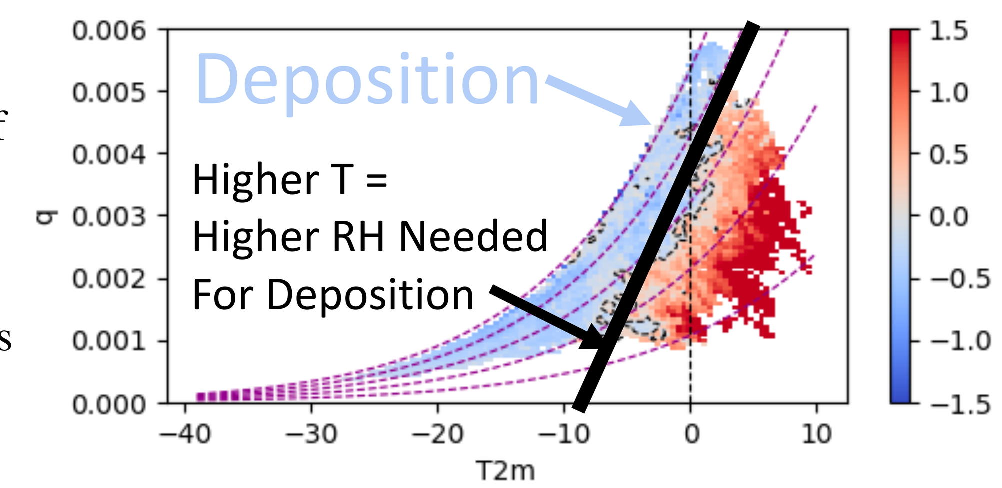


Fig 6: SAIL data show higher RH required for deposition to occur in the future.

Highlight: Santa Slammer Case Study

SAIL + SPLASH data capture the atmospheric dynamics, thermodynamics, and microphysics that produced ~1/3 of total annual snowfall in 2021/2022 from 23-Dec-2021 to 1-Jan-2022, enabling connections between precipitation, thermodynamics, and microphysics [5].

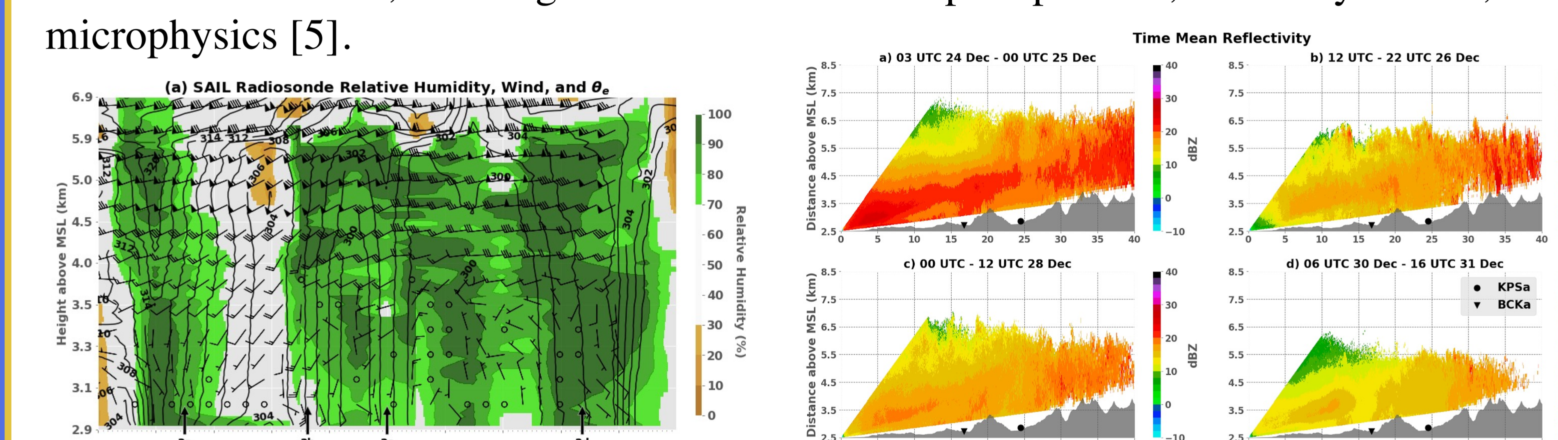
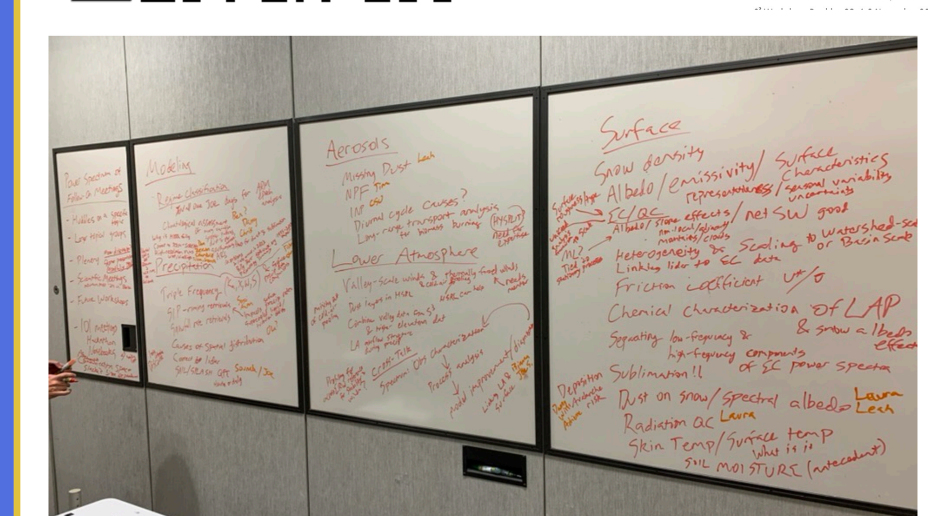


Fig 7: SAIL radiosondes and SPLASH radar time-mean reflectivity fields from RHI scans. From [5]

SAIL, SPLASH, and SOS Science Summit

The first Summit of SAIL, SPLASH, and SOS occurred November 1-3, 2023 with 30+ participants and the development of an ambitious set of science collaborations. Please consider joining!

Fig 8: Analysis-phase science activities and initial gathering of SAIL, SPLASH, and SOS scientists



References

1. Feldman et al (2023), doi: 10.1175/BAMS-D-22-0049.1. 2. Rudisill et al (2023), BAMS (In Revision). 3. Cowherd et al (2023), (In Prep). 4. Rudisill et al (2023), In Prep. 5. Hefflin et al, (2023), JAS, (Submitted).

Acknowledgements

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