



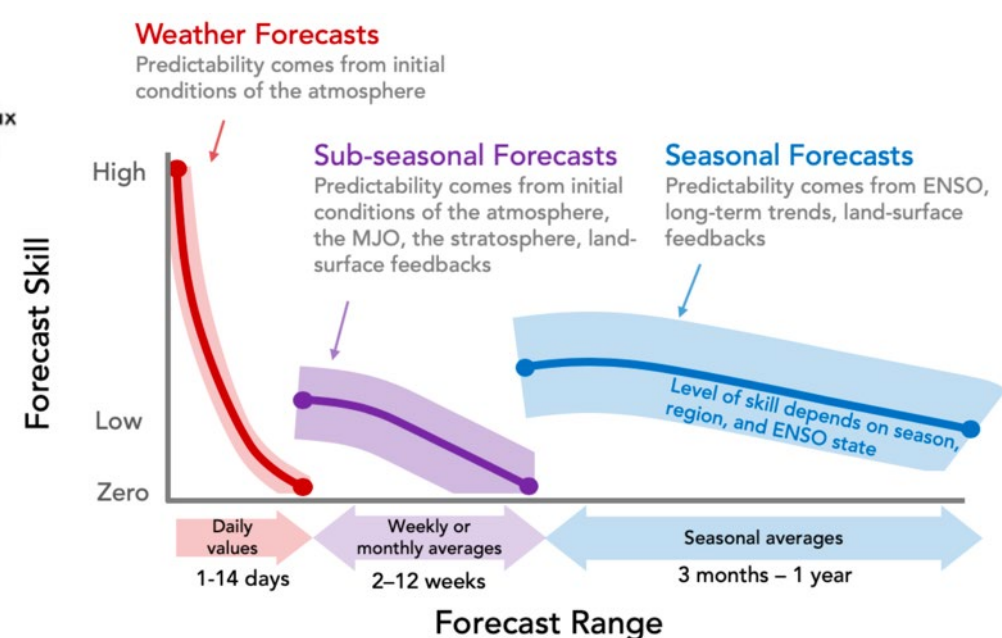
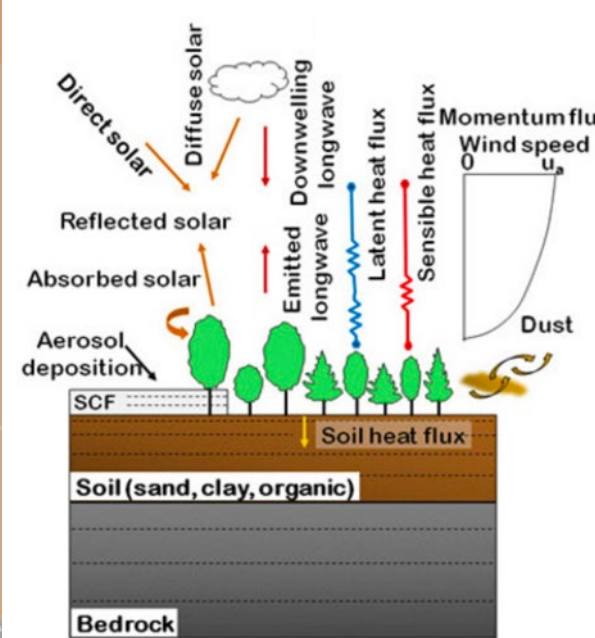
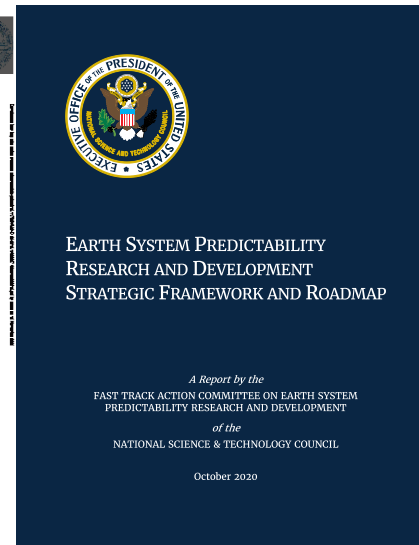
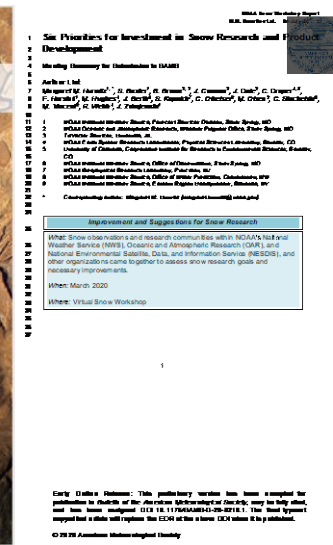
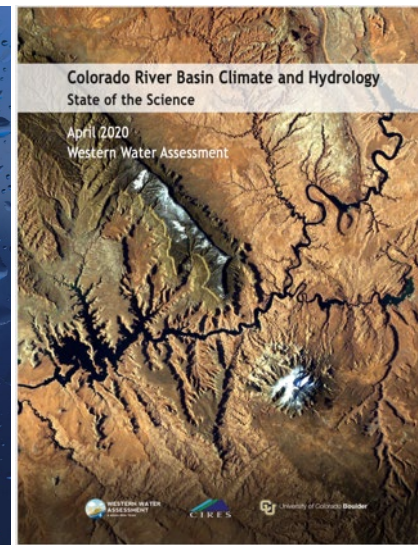
The **S**tudy of **P**recipitation, the **L**ower-**A**tmosphere, and **S**urface for **H**ydrometeorology

Gijs de Boer^{1,2,3}

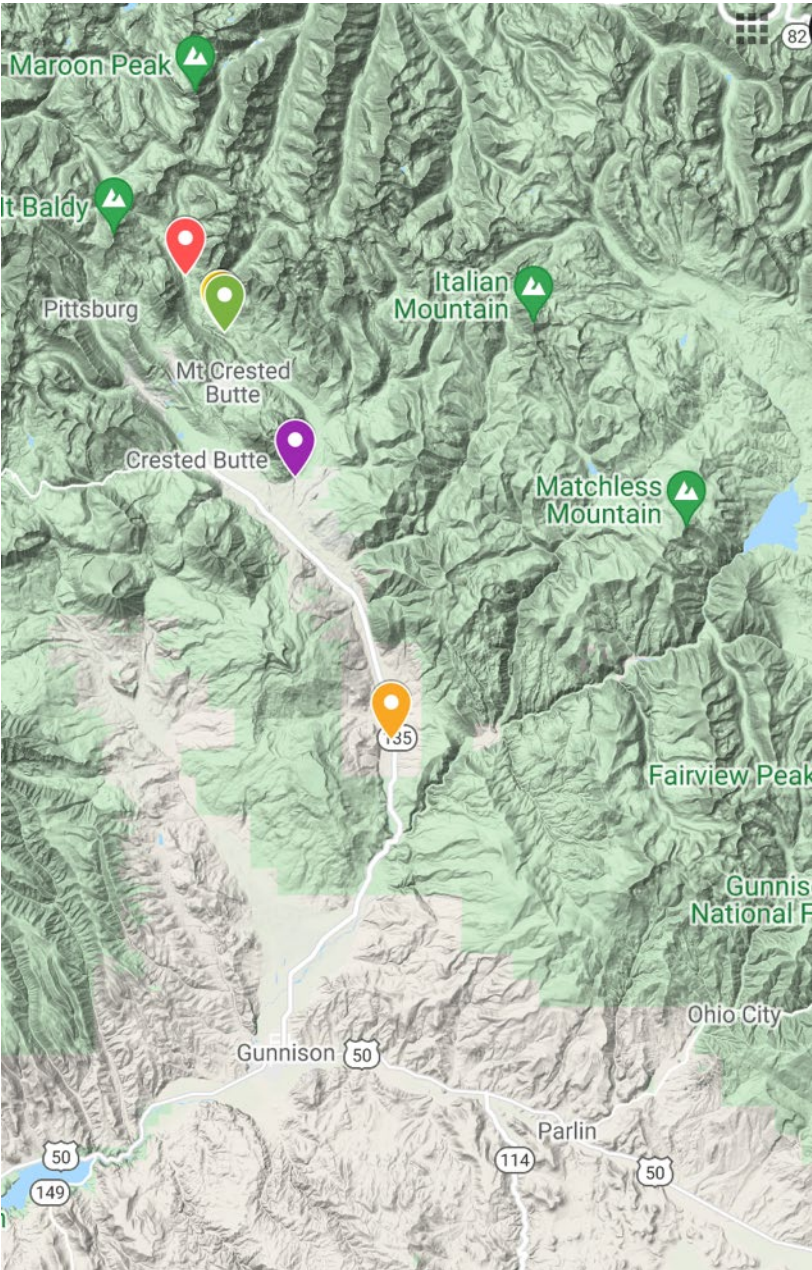
A. White¹, R. Cifelli¹, T.P. Meyers¹, K.O. Lantz¹, J. Intrieri¹, E.N. Smith¹, E. Hulm⁴, M.R. Hughes¹,
K.M. Mahoney¹, A. Morales^{1,2}, B. Adler^{1,2}, W.R. Carrier¹, L. Bianco^{1,2}, J. Wilczak¹, C.J. Cox¹,
J.O. Pinto⁵, A.A. Jensen⁵, V. Chandrasekar⁴, S. Morris¹, J. Elston⁶, M. Stachura⁶, J. Hamilton^{1,2},
J. Reithel⁴, J. Sedlar^{1,2}, L. Riihimaki^{1,2}, M. Gallagher^{1,2}, D. L. Jackson^{1,2}, B. DeLuisi², and K. Schloesser^{1,2}



SPLASH Motivation



SPLASH Observational Summary



Measured quantities	Avery Picnic	Kettle Ponds	Brush Creek	Roaring Judy
Surface Meteorology (2m T, p, q, winds)	X	X	X	X
Soil Moisture	X	X	X	
Snow depth	X	X	X	
Snow temperature and density		X		
Thermodynamic profiling			X*	X*
Wind profiling			X*	
Cloud base height		X	X	X*
Surface precipitation rate and droplet size distribution		X	X	
Snow/Rain level		X	X	
Precipitation profiling		X	X	X
Sky/Surface broadband surface radiation	X	X	X	
Surface Spectral radiation		X	X	
Surface turbulent fluxes	X	X	X	
Turbulence at 10 m		X		
Cloud optical depth			X	
Aerosol optical depth		X	X	
Cloud fraction		X	X	X
Surface albedo, snow cover and soil moisture surveys	X	X	X	
In-situ thermodynamic, wind and turbulence profiling	X	X		
Normalized Difference Vegetation Index	X	X	X	

Additional Assets: Spatial Information

NOAA Snow Survey Aircraft:

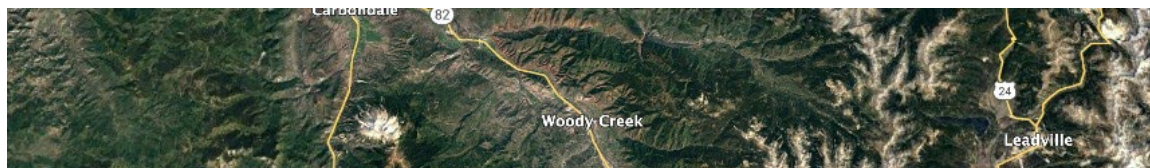
- Deployment 1: 10/21/21-10/25/21 – Fall soil moisture
- Deployment 2: 3/20/22-3/24/22 – Peak SWE
- Deployment 3: 4/30/22-5/4/22 -- Late spring SWE

Snow Stakes

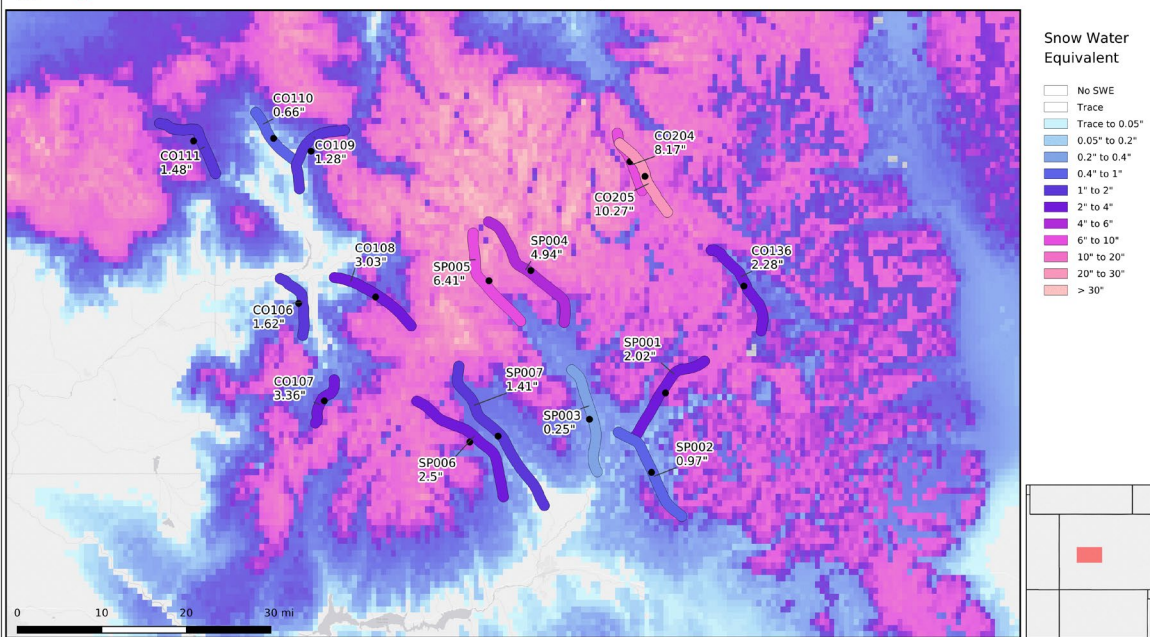
- 3 m tall stakes paired with time lapse cameras to provide evolution of snow depth in given areas
- Seven locations, including at the Kettle Ponds supersite

UAS

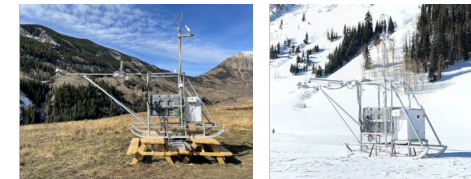
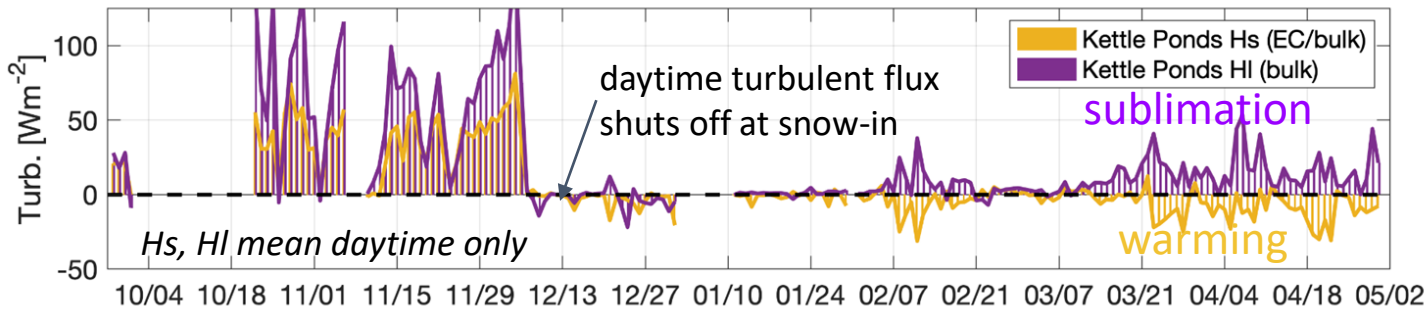
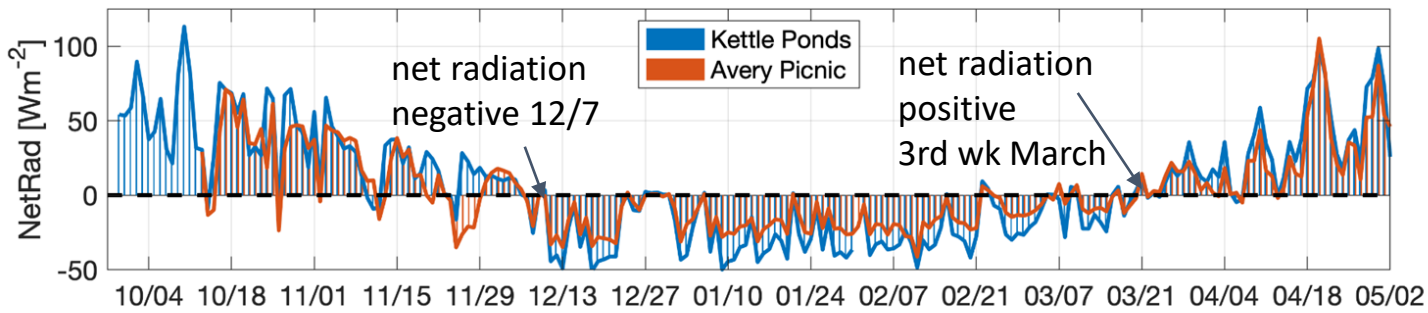
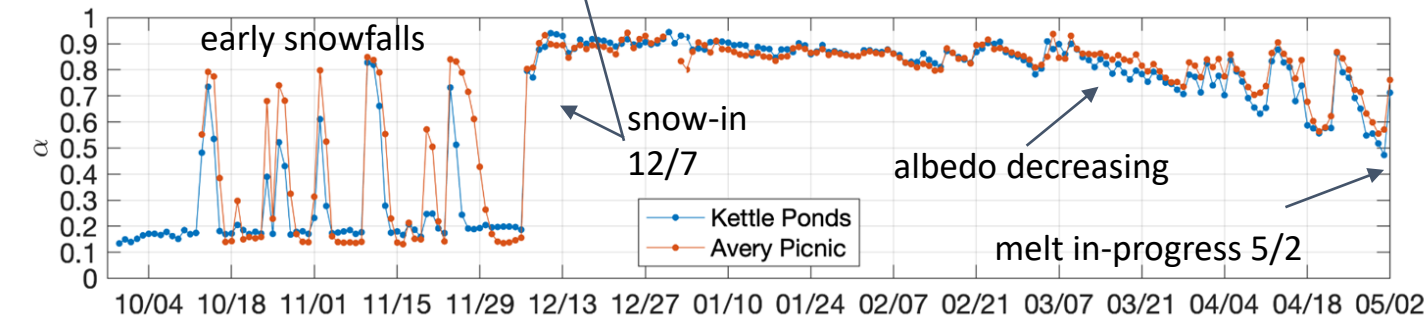
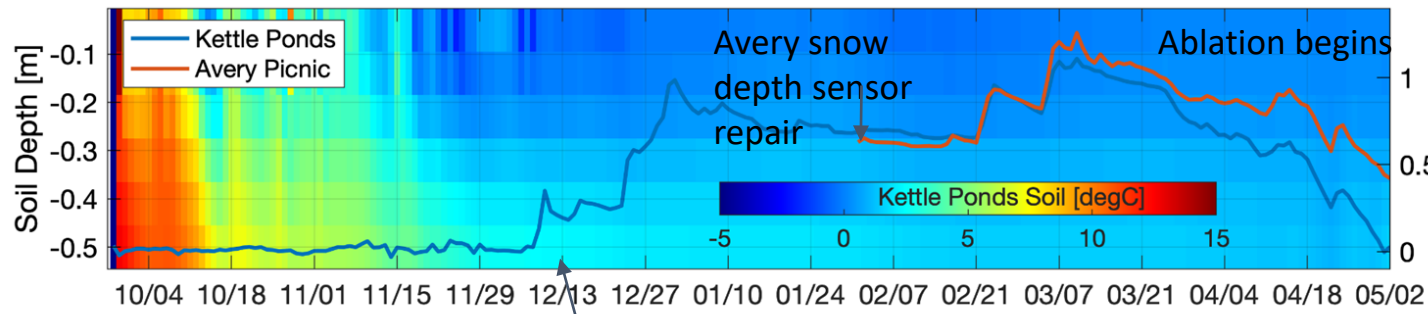
- Multiple UAS to map surface and atmospheric properties



Gamma Airborne Snow Survey
Survey 16 - SPLASH Exercise (Colorado)
Valid Date: 25 April 2022
NWC National Water Center



First Look: Surface Energy Budget

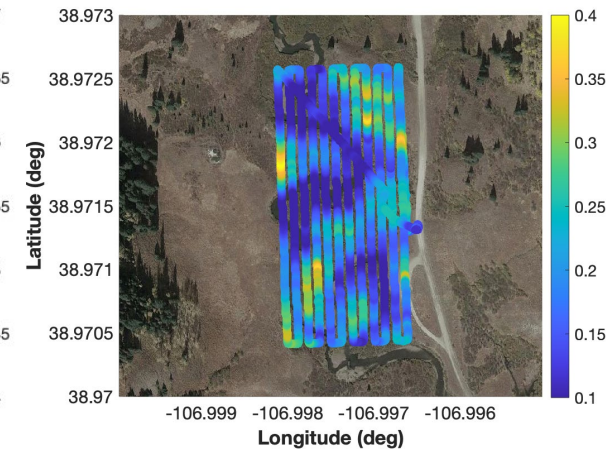
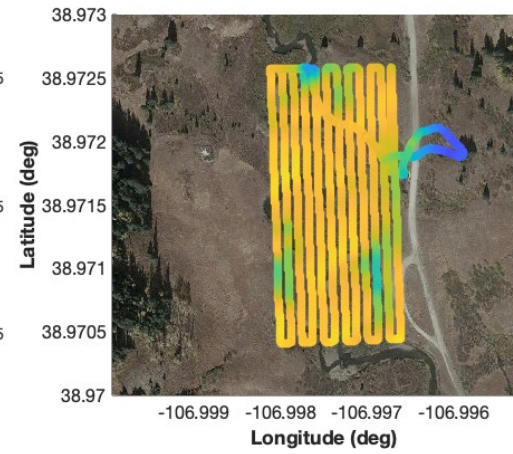


ASFS at Avery Picnic and Kettle Ponds

- Early snows Oct/Nov: little accumulation but influential on albedo: longer-lasting at Avery compared to KP.
- No zero-curtain effect observed in subsurface temperatures at either site: SPLASH slightly below minimum elevation for alpine permafrost.
- Snow-in at both sites 12/7: corresponds to transition to negative daily mean net radiation and shuts off daytime turbulent fluxes (convection in BL).
- Persistent positive daily net radiation late March corresponds in time to decreases in albedo and snow depth + re-activation of turbulent fluxes that warm (sensible) and sublimate (latent) snowpack, possibly with net neutral effect on heat budget.
- Some persistent differences in radiative cooling rate and albedo between sites.
- Spring albedo decrease shows alternating periods of rapid ablation and new (possibly redistributed) snowfall.

Note: Fluxes are really preliminary!

First Look: UAS for Surface Properties



First Look: Precipitation

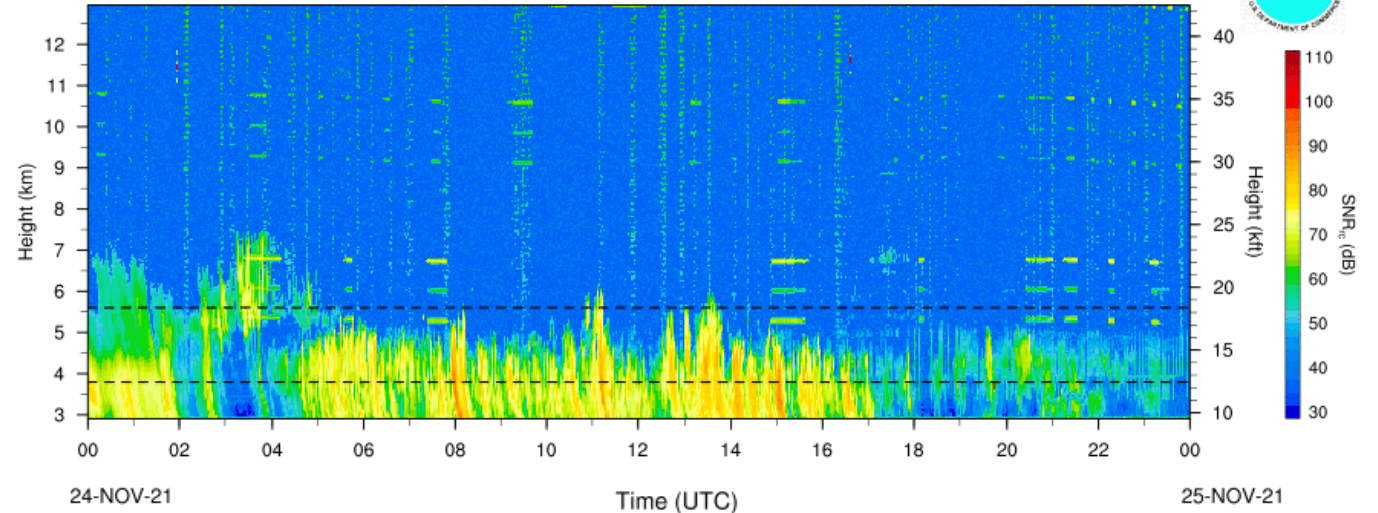
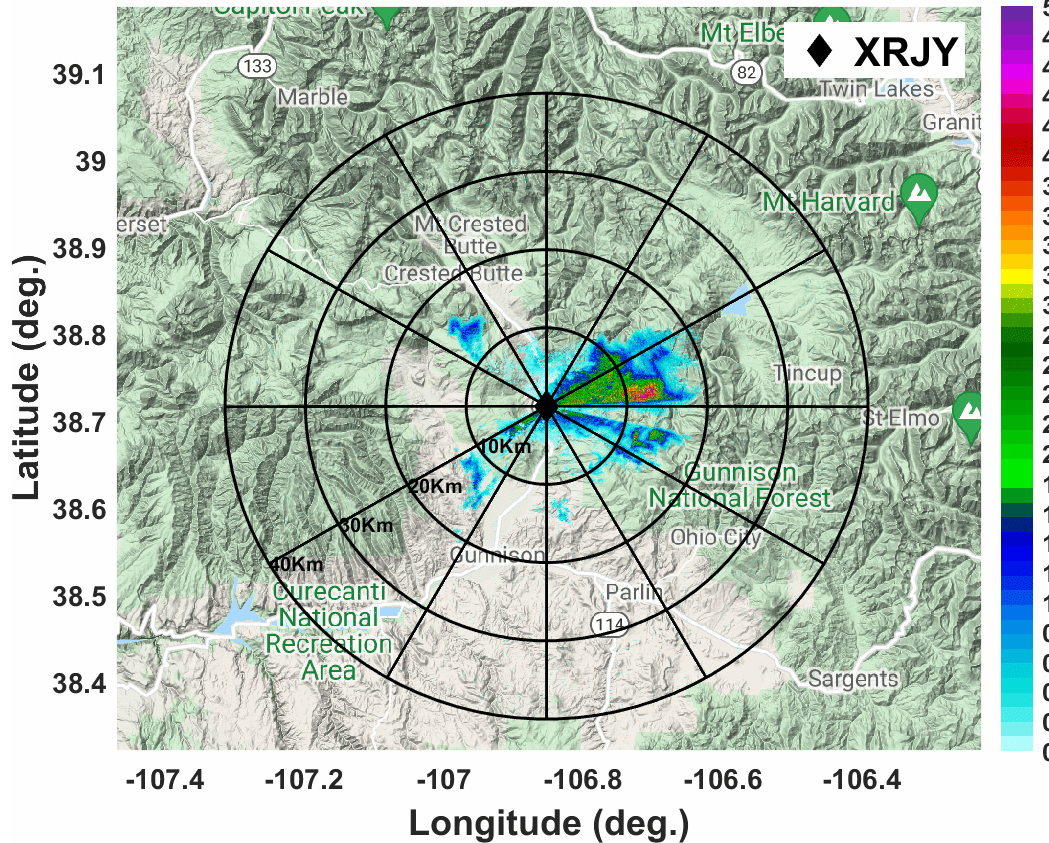
NOAA Physical Sciences Laboratory
FMCW Profiling Radar and Disdrometer Precipitation Analysis



RJY to Kettle Ponds Distance: 27.08 Km
Azimuth: 337.4°
RJY Height: 2.5 Km MSL
Kettle Ponds Height: 2.86 Km MSL

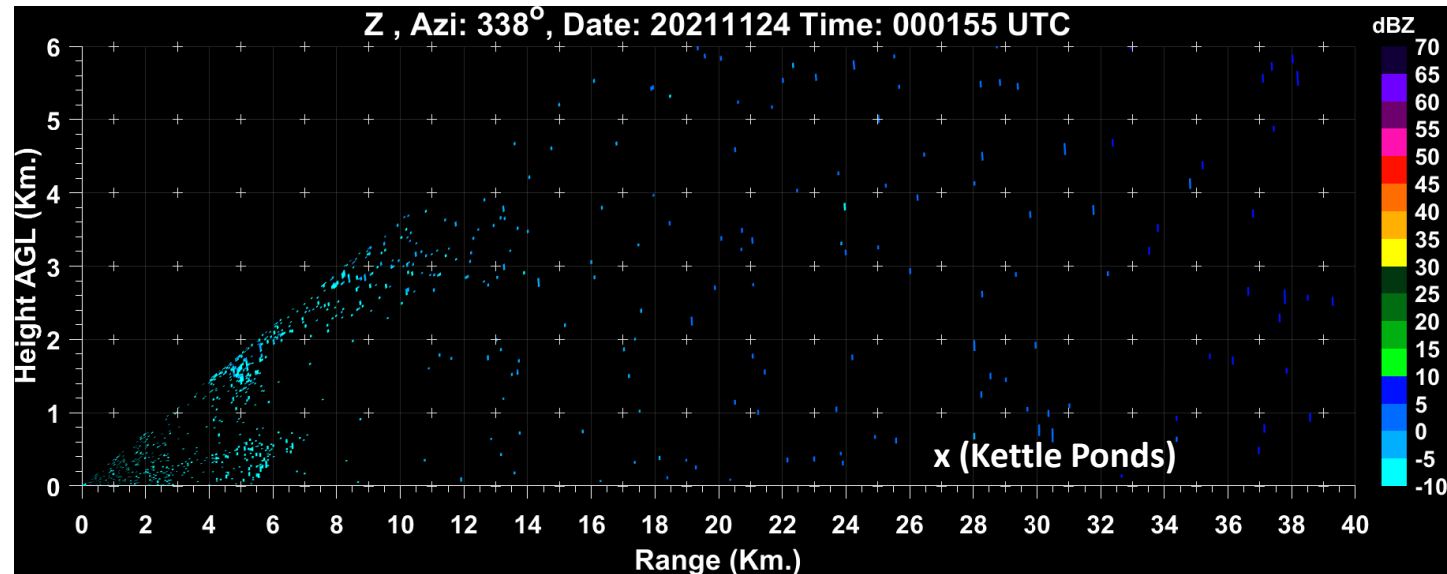
Snowfall Rate (Z-S)

Elv: 8°, Date: 20211124 Time: 144655 UTC



Kettle Ponds (KPS)
38.9420 N, 106.9730 W, 2863 m

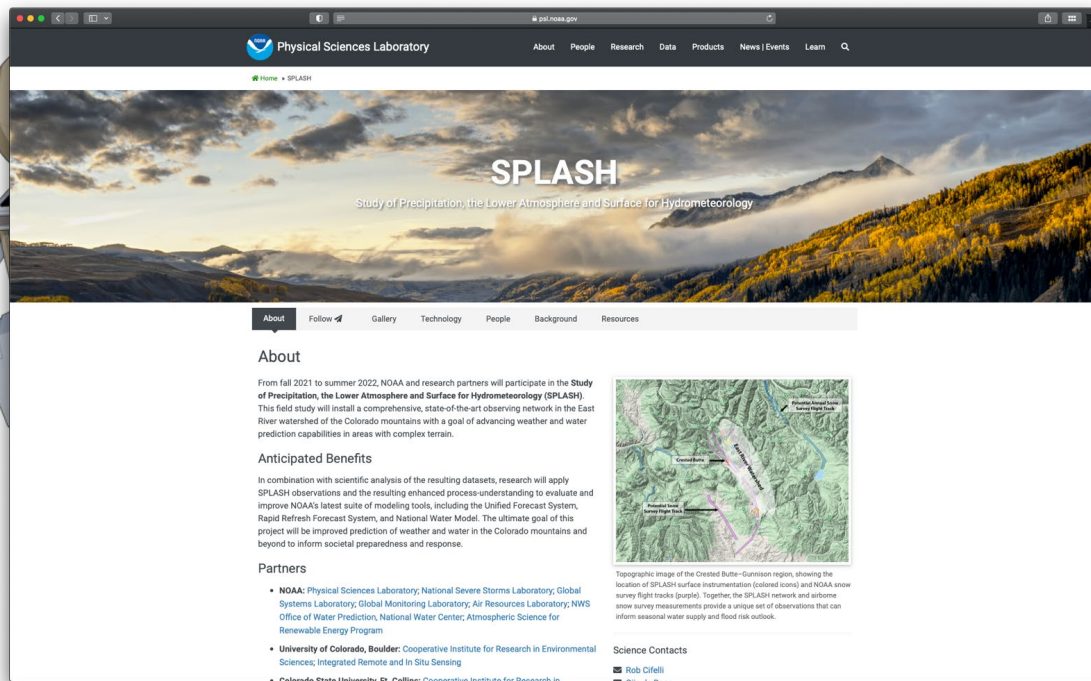
--- KGJX WSR-88D 0.5 degree elevation
• Snow Level



Outreach

Education, Training and Outreach Efforts

- Community Day
- Student mentorship through multiple avenues (currently 5 interns!)
- Superheroes
- Gunnison Watershed RE-1J School District Summer Experience
- Signage at deployment sites
- Teacher and Western Colorado University tours
- 2-day Western Colorado University Summer Teacher Institute for K-12 teachers from Western Colorado
- Website with information and real-time data



Summary



- SPLASH has been extended through summer 2023, matching the timeframe of DOE's SAIL project
- Work is ongoing to process and start to analyze data
- Additional instrumentation coming to Kettle Ponds in the coming year as part of NSF-funded sublimation study (SOS)
- We are working to develop and implement model evaluation tools to assess the performance of NOAA models, including HRRR, RRFS, and NWM forcings
- Working to develop a BAMS article providing campaign overview and initial science results
- Collaborations are welcomed – we want to share data with you and help to support your analyses! Please reach out (gijs.deboer@noaa.gov) for more details. More information on SPLASH is available at: <https://psl.noaa.gov/splash>

Support for SPLASH comes from NOAA (Physical Sciences Laboratory and the Weather Program Office)

