



Evaluation of Low-Cost Scalable Road Weather Information Systems (RWIS)

Presentation on the findings from testing eight low-cost scalable RWIS in Alaska

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Presentation Overview

- The Challenge
- Why mini-RWIS?
- Project Overview
 - Site selection
 - Equipment used
- A look at the stations
- Summary of Data
 - Atmospheric and Road Surface
 - Cellular
 - Power
- Atigun Pass Station



The Challenge

- ▶ Alaska is a huge state!
- ▶ 70 RWIS sites throughout AK
 - Limited road weather info for such a large geographic area. Gaps in data!
 - M&O personnel and public unsure of conditions in many areas
- ▶ Non-trivial power requirements for full RWIS sites
 - Development of infrastructure for power and fiber/comms is costly
- ▶ Challenging environment
 - Extreme cold, months of no light, wildlife



Why Mini-RWIS (or RWIS-Scalable)?

- ▶ “Full” RWIS systems require AC power. This is not always available, especially in remote areas.
- ▶ Mini-RWIS stations are self-sufficient, running exclusively on solar power & batteries, with cellular communications (3G/4G). This makes it possible to install them in areas without existing power or fiber/landline communications.
- ▶ Mini-RWIS feature a select set of sensors, typically camera, wind, air temp/RH and IR road temp.



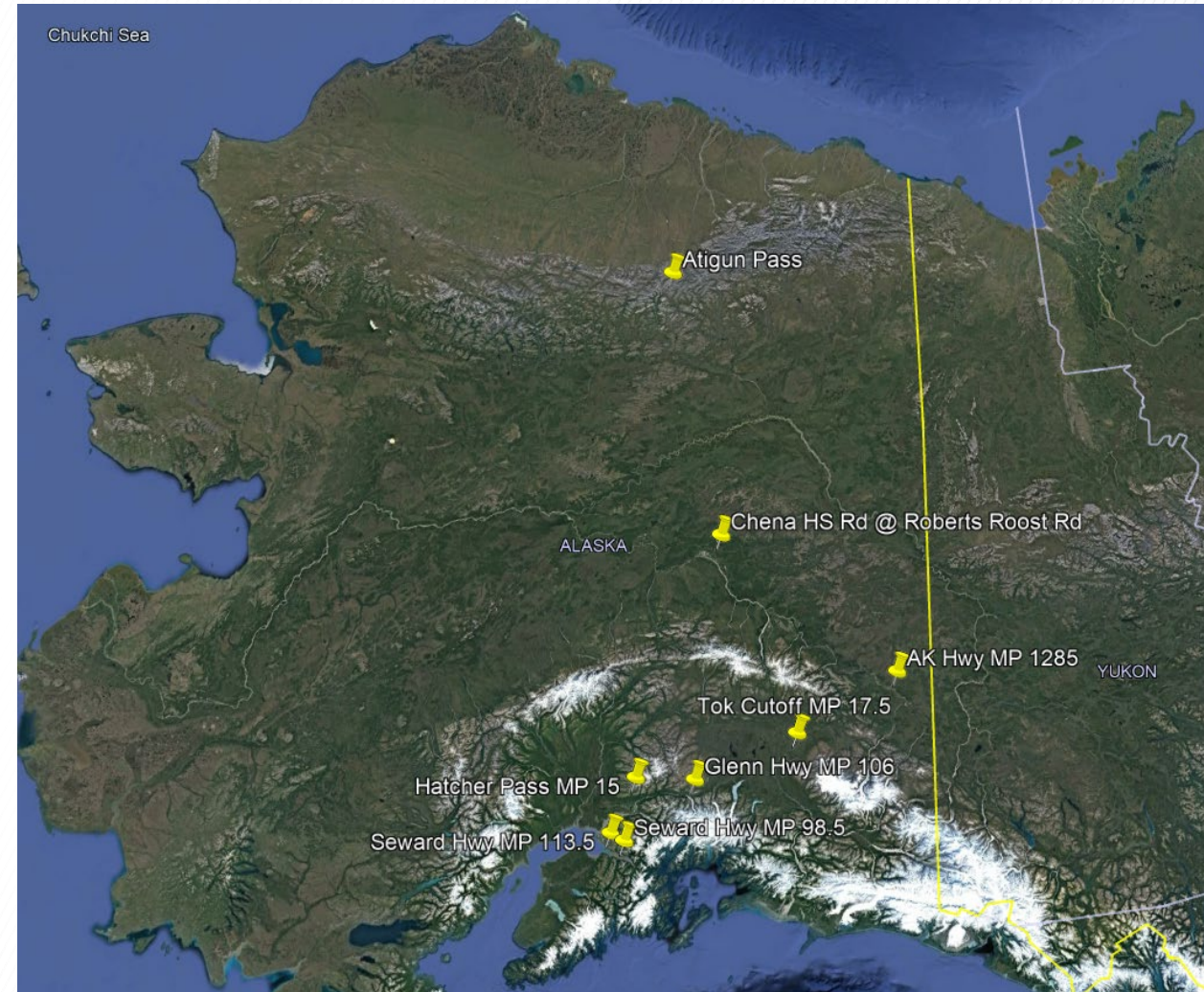
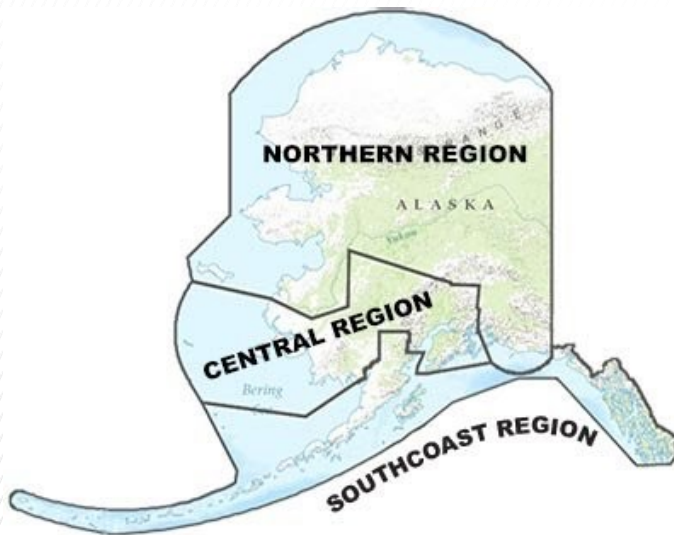
Project Overview

- ▶ Public/Private partnership between ADOT&PF and Campbell Scientific, Inc.
 - In collaboration with University of Alaska Fairbanks (UAF-INE) and Geo-Watersheds Scientific (GWS)
- ▶ Demonstration and testing of scalable (mini) RWIS concept
 - Low power
 - Low cost
 - Easy installation
 - Cellular comms (or satellite), RF/Spread-Spectrum radio
- ▶ Eight scalable (mini) RWIS deployed over two winters
 - Seven mini-RWIS deployed
 - One station repurposed for Atigun Pass project (Advanced RWIS – Winter Hazards Station UAF/GWS project)



2020 and 2021 Installations

- ▶ Northern Region
 - 3 mini-RWIS
 - Atigun Pass (Advanced RWIS - Winter Hazards Station)
- ▶ Central Region – 4 stations
- ▶ Installations outside the clear zone (i.e. rest stops, outside guard rails)

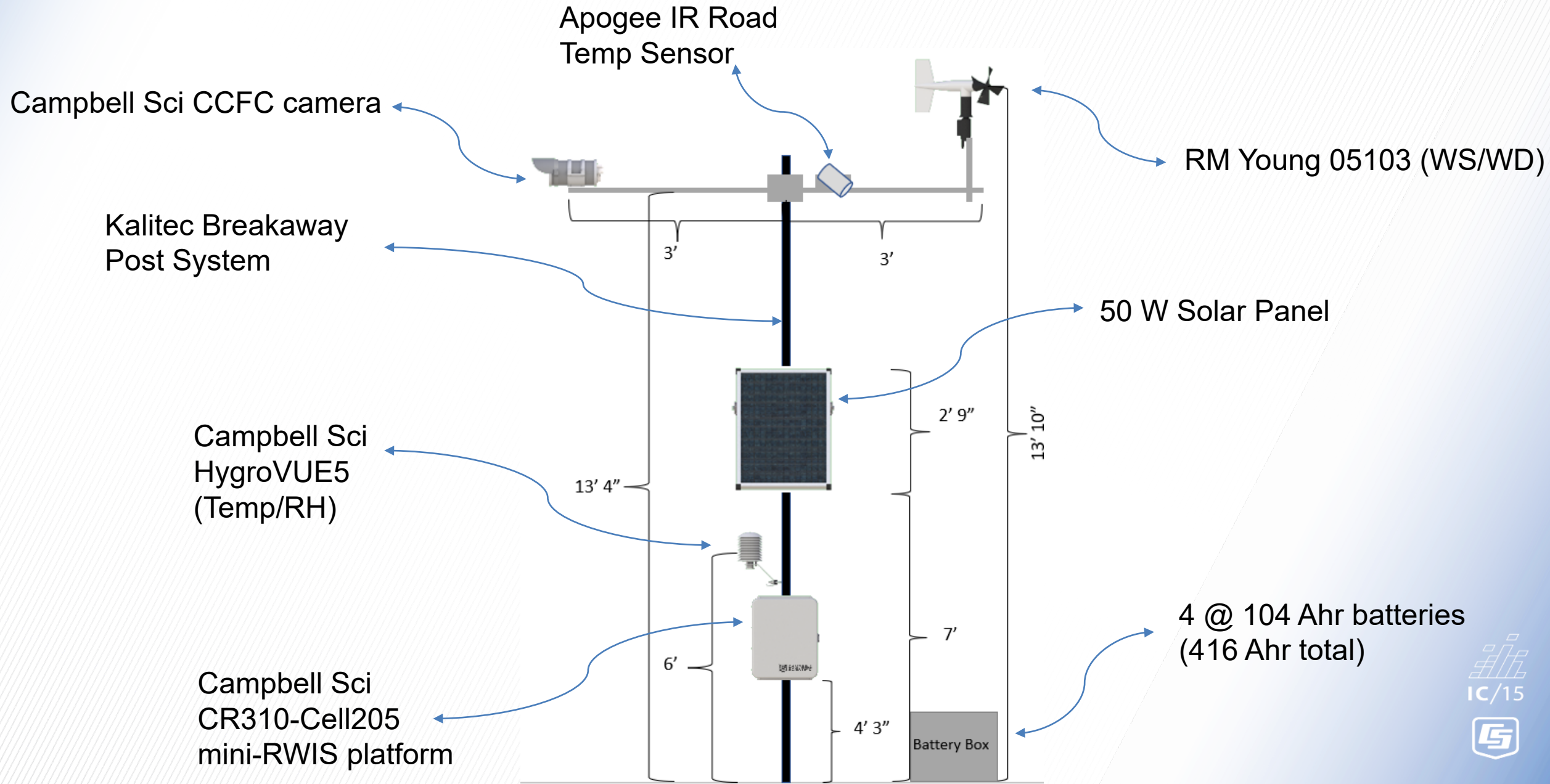


Project Overview and History

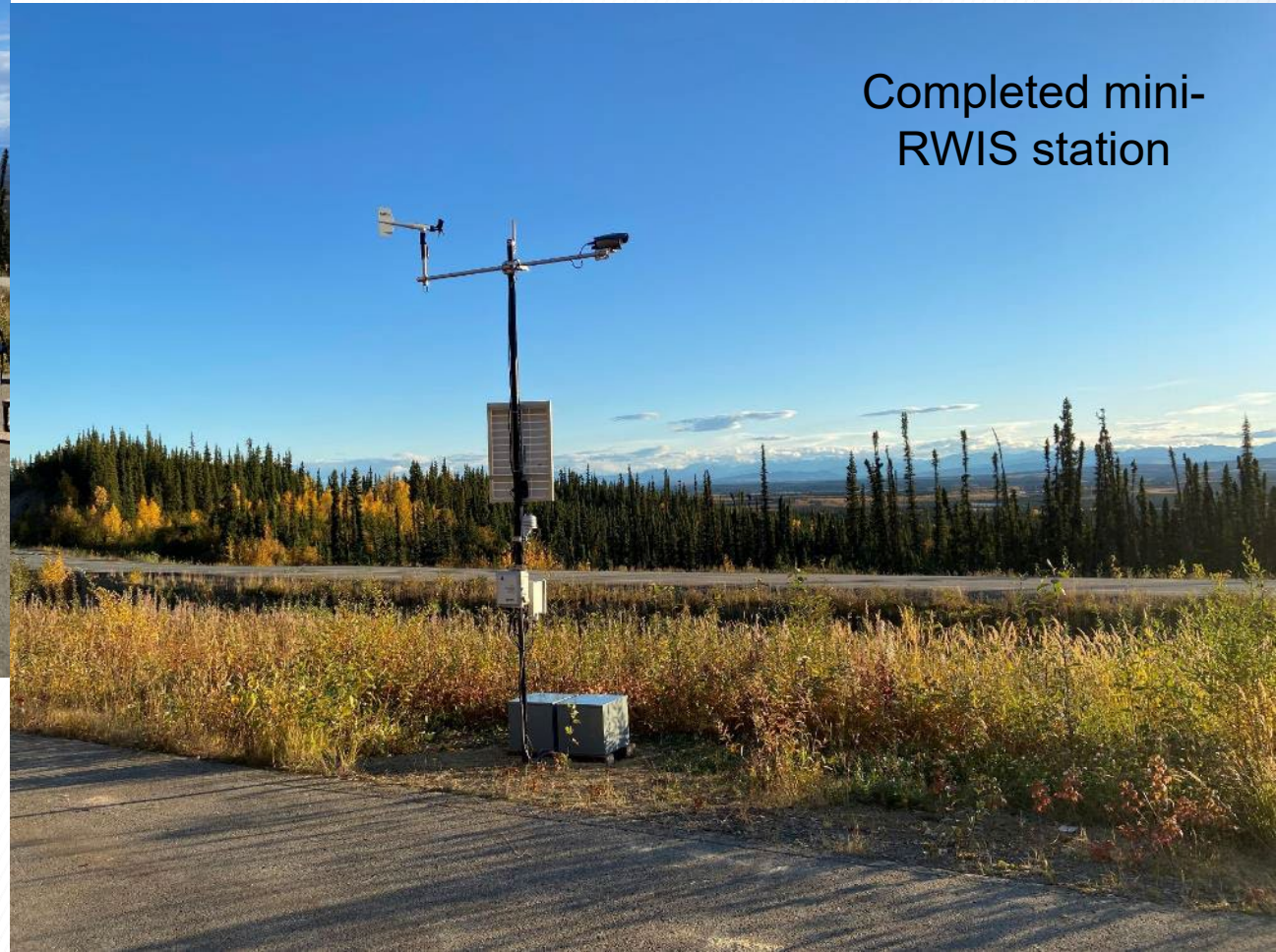
- ▶ Two stations installed in January 2021 by GW Scientific
 - Chena Hot Springs Rd at Roberts Roost Rd (Northern Region; Fairbanks area)
 - Seward Hwy @ MP 98.5 (Central Region; between Anchorage and Girdwood)
- ▶ One station installed on March 8, 2021 by ADOT staff
 - Seward Hwy @ MP 113.5
 - One-day installation with pole mounted to sign post
- ▶ Four stations installed in September 2021 by Campbell Scientific
 - Alaska Hwy MP 1285, Tok Cutoff MP 17.5, Glenn Hwy MP 106, Hatcher Pass MP 15
- ▶ One station repurposed for Atigun Pass Project (Dalton Highway)



Equipment Used



Northern Region – AK Hwy MP 1285



Northern Region – Tok Cutoff MP 17.5



Station design modified to two poles:

- Pole #1 – Enclosures, Temp/RH, Camera, IR sensor
- Pole #2 – WS/WD, Solar Panel

Central Region – Glenn Hwy MP 106



Standard installation

- Maintain required distance from guardrail



Central Region – Glenn Hwy MP 106



Battery box located
behind bushes to
decrease visibility



Central Region – Hatcher Pass MP 15

Mini-RWIS located behind guardrail, view looking north toward avalanche area.



Completed station, looking east



Summary of Data

› Atmospheric Parameters and Road Temp

- Measurements every 10 seconds
 - NTCIP compliant values
- Data processed and stored in hourly & one min data tables
- Data transmitted hourly
 - Wind Speed and Direction
 - Air Temp/Relative Humidity, Dew Point
 - Road Surface Temperature

› Camera Images

- On demand as required
- Automated once per hour

› Detailed Diagnostics

- Power (measured every 10 seconds, transmitted hourly)
 - Battery: Voltage, Current, Capacity, Qloss, Ahr Remaining
 - Solar Panel: Voltage and Current
- Cellular
 - Cell State, Signal Quality, Daily Usage, Monthly Usage,

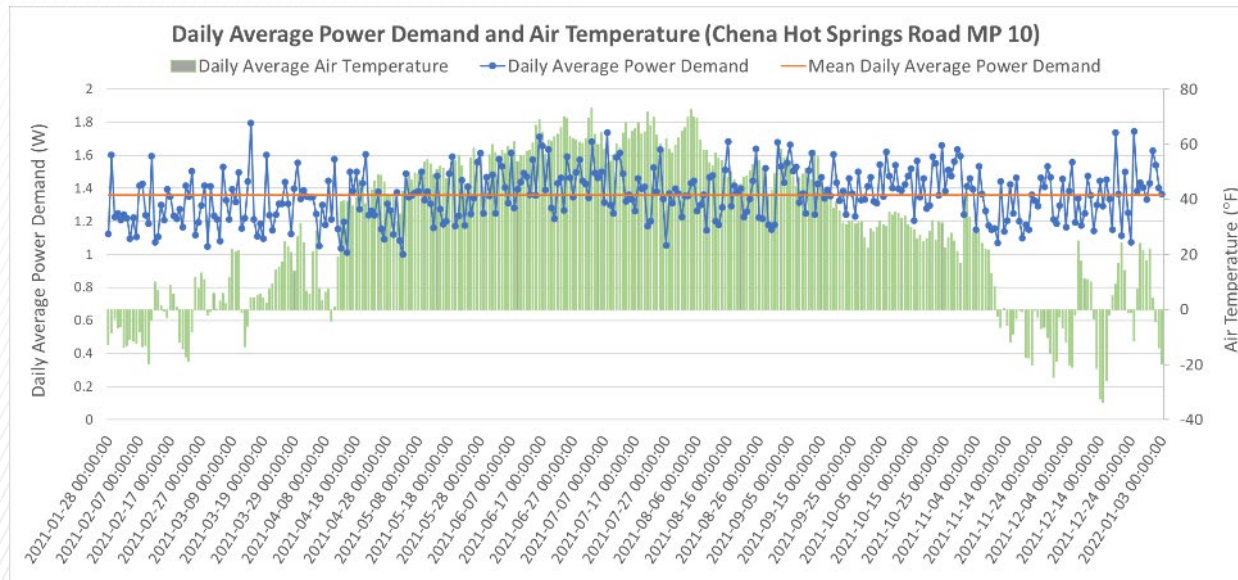
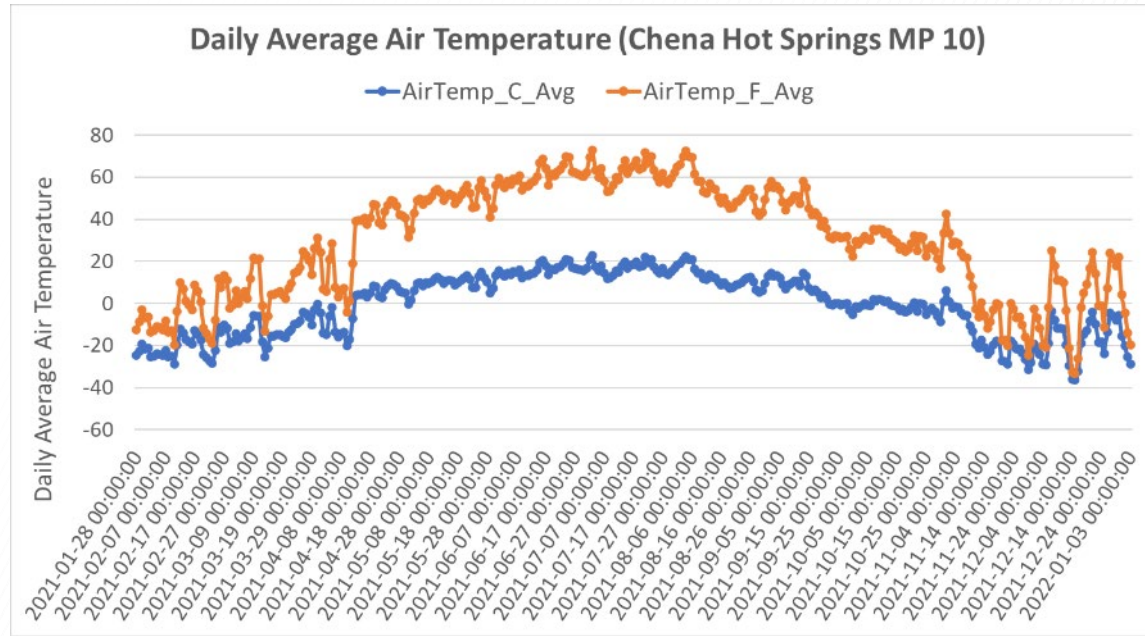


Chena Hot Springs Rd Station

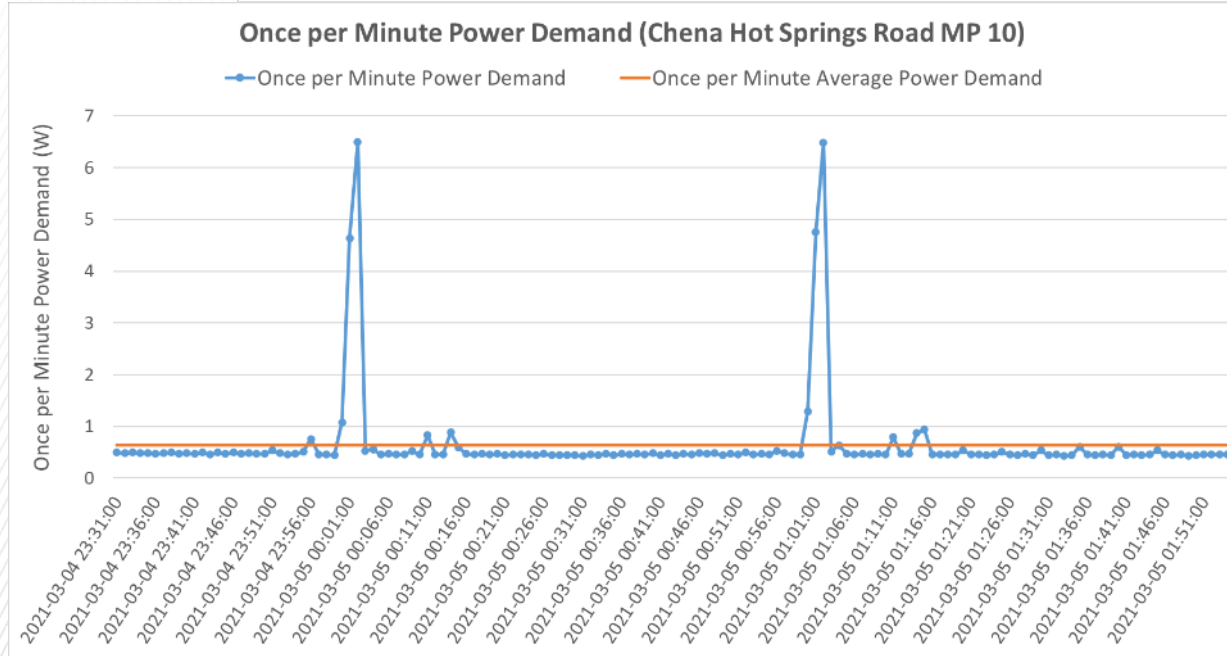
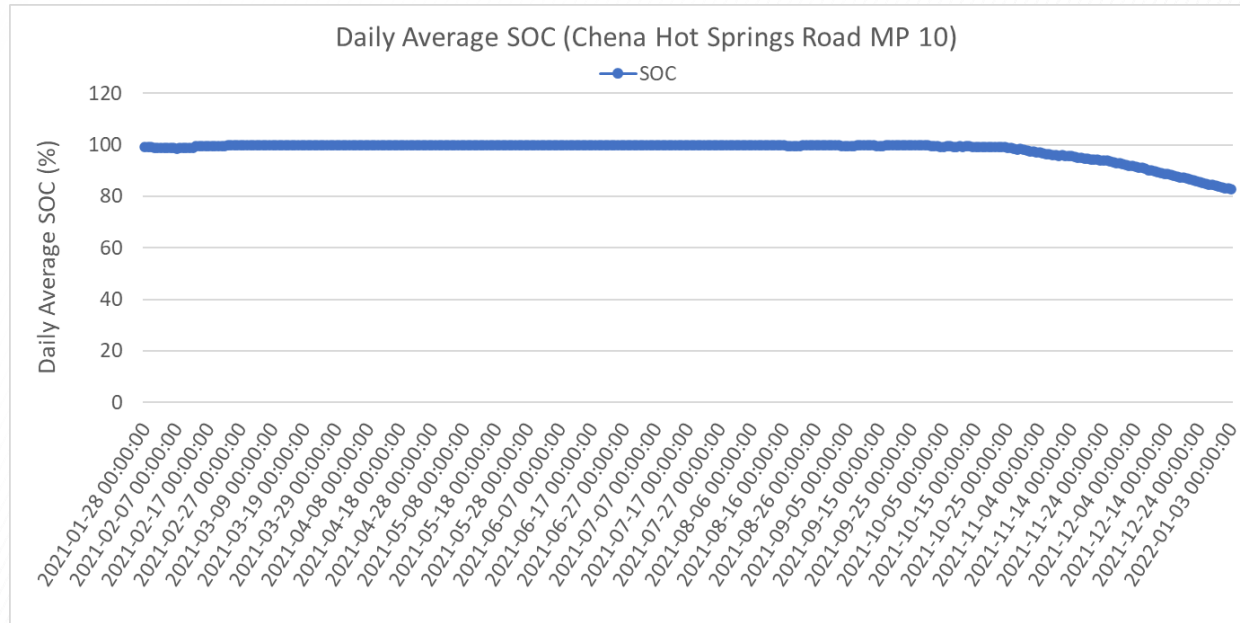
- ▶ Northernmost of the seven Mini-RWIS stations
- ▶ Station was able to measure, record and transmit data and images (hourly) while consuming on average 1.36 Watts of power.
- ▶ Battery State of Charge (SoC) maintained at or near 100% until late October (2021). Reached a low (SoC) on January 3, 2022 at 83%



Chena Hot Springs Rd Station – Air Temperature



Chena Hot Springs Rd Station – Power



Collaboration with Atigun Pass Project

- › One of the most formidable highway passes in North America
- › First Advanced RWIS – Winter Hazards Station on Dalton Highway
- › Monitoring diverse winter hazards
 - Two blowing snow flux sensors
 - Snow Depth and Snowpack temperature profile
 - Redundant WS/WD sensors (Standard and Alpine)
 - Extended Temperature Air Temperature sensor
- › Conditions leading to multiple avalanche zones
 - Avalanche images captured on 2 CCFC camera's
 - Cameras taking images to the east and west directions
 - Capturing images of the top avalanche chutes in the area
- › Spread-Spectrum Radio Telemetry, 90 W Solar, 624 Amp-Hr Battery Bank Power System
- › Providing more extreme power analysis data
- › Wind and temperature sensor comparisons



Eyal Saitet, UAF, 12/9/21

Gordon Scott, ADOT, 12/14/21

Thank you!

