

Development, Operation, and Modification of UUNET for Local Stakeholder Needs



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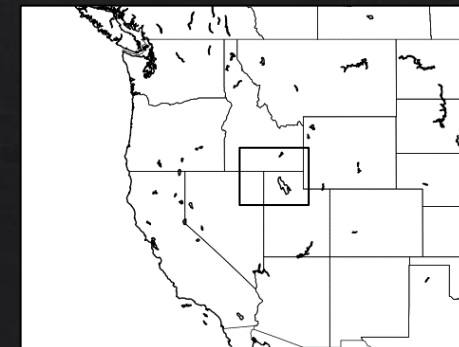
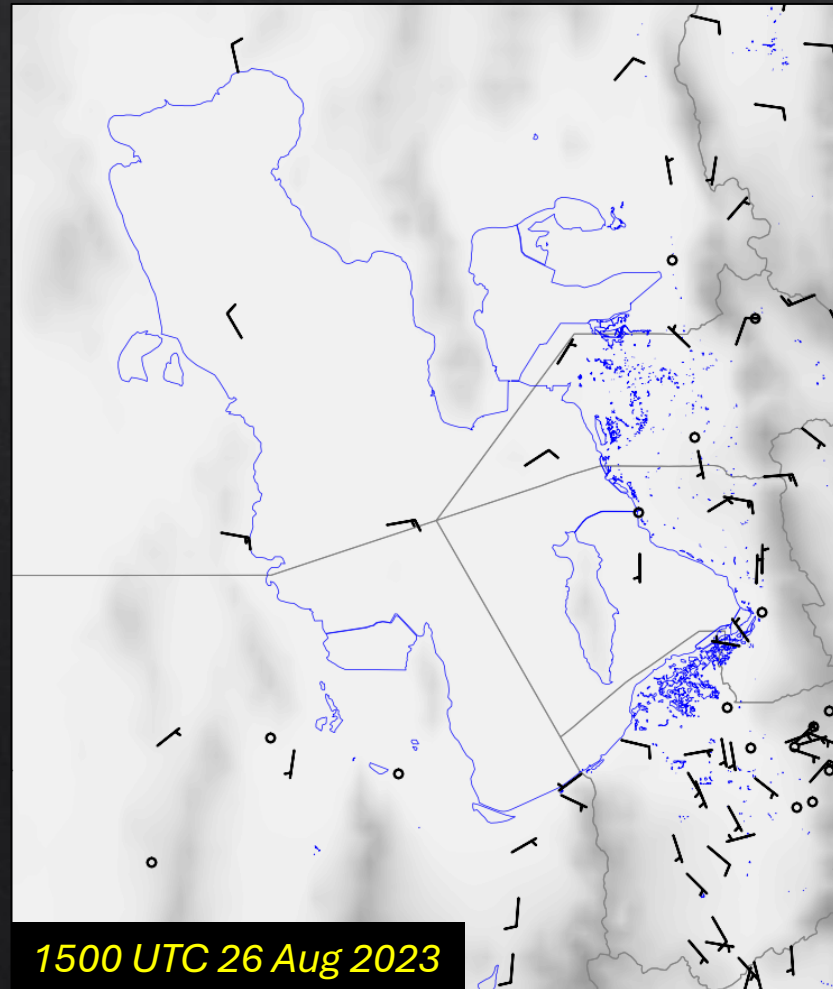
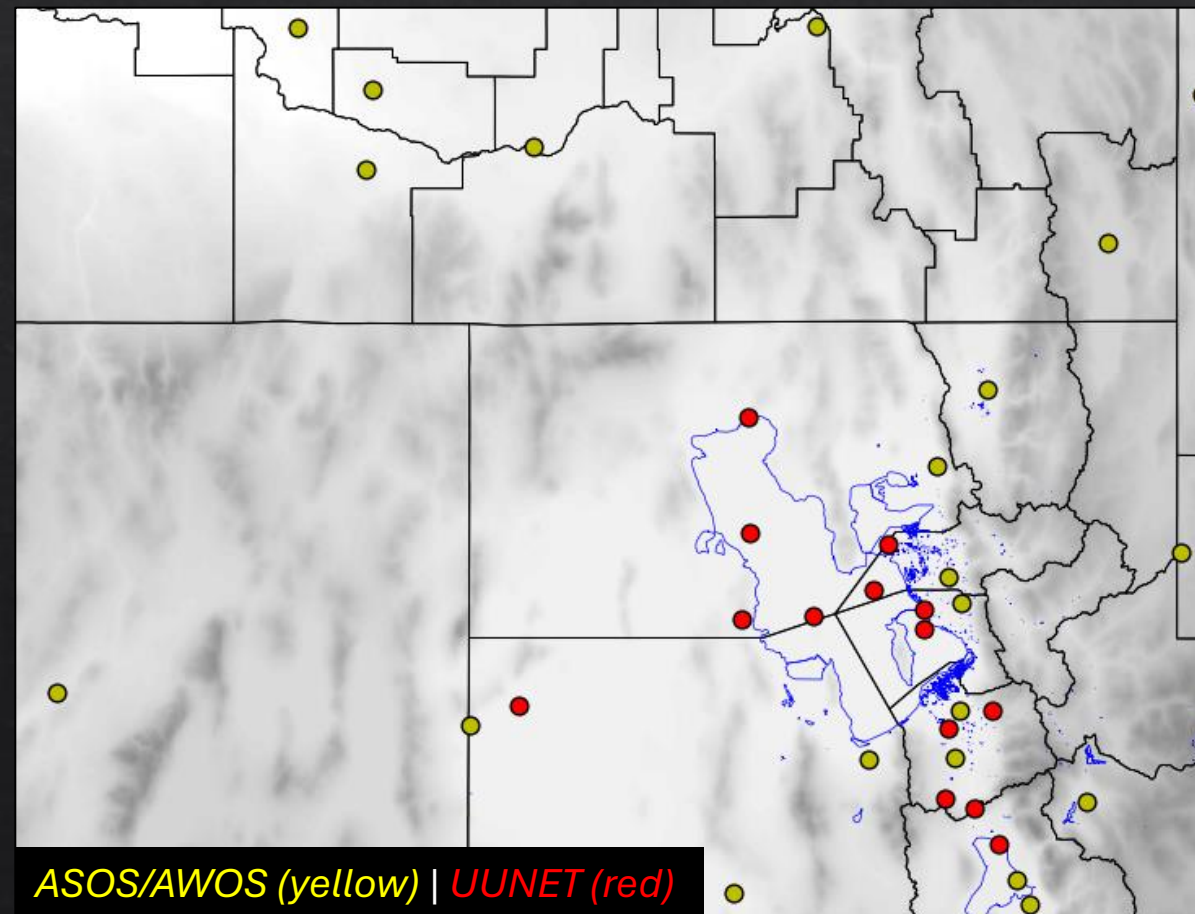
Introduction – What is UUNET?

- UUNET: **U**niversity of **U**tah **NET**work
- Fixed-site in-situ, mobile in-situ, and surface-based remote sensors deployed across primarily northern Utah to measure atmospheric and air quality parameters



Initial Motivations for UUNET

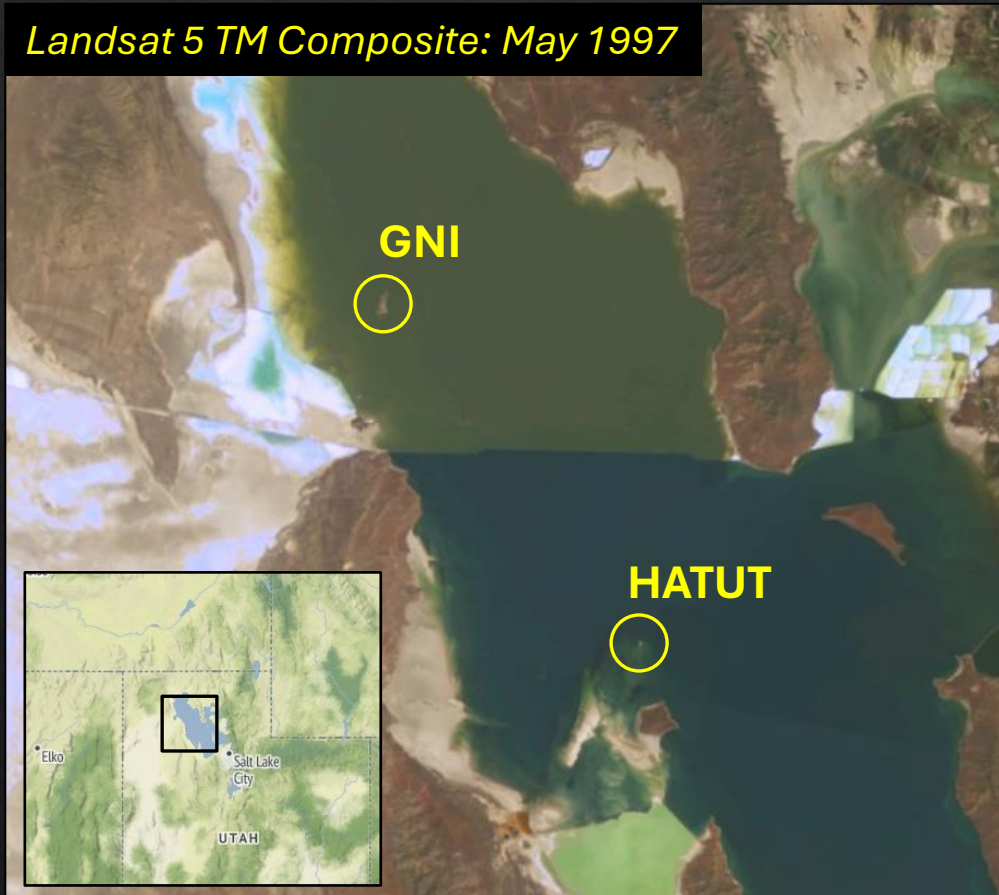
- Gap in real-time surface weather stations over NW UT and Great Salt Lake (GSL)
 - ASOS/AWOS in south-central ID and along urban/highways in UT
 - Great Salt Lake immediately upstream of sensible weather along Wasatch Front including metro Salt Lake City



Installation and Deployment Challenges

- First remote stations deployed 1997-98 (data available back to 1997)
- Gunnison (GNI) and Hat Island (HATUT) sites fully surrounded by water
 - Local stakeholder Utah Division of Natural Resources (DNR): boat transport
 - Stations at critical pelican and gull nesting locations - one visit per year

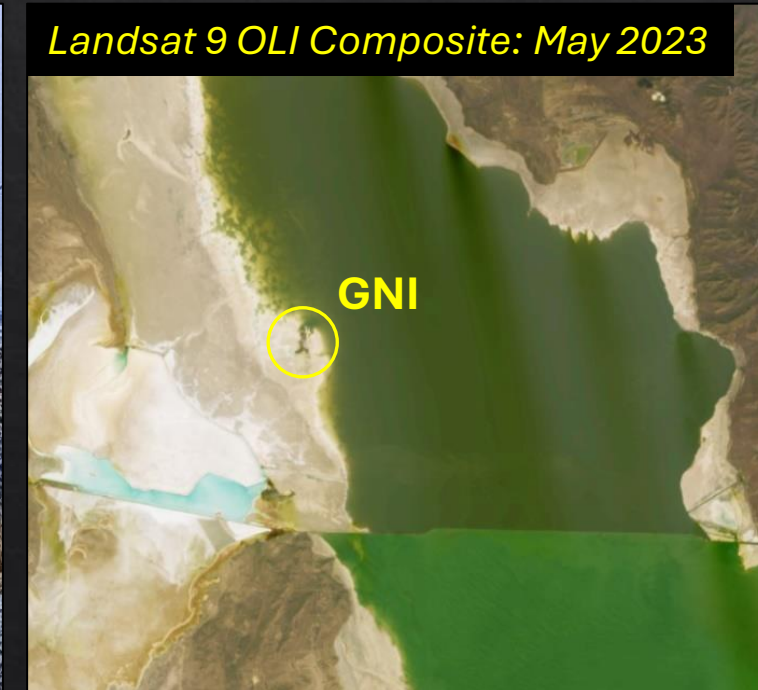
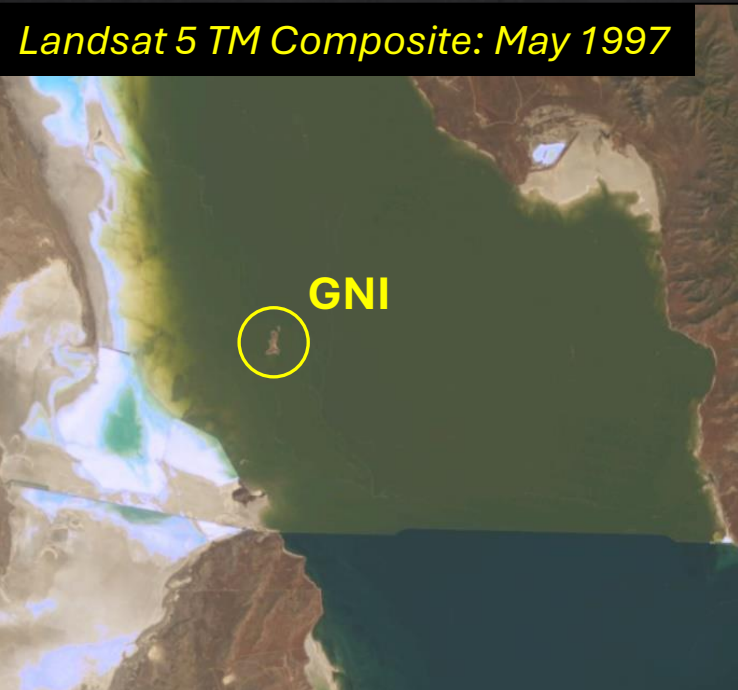
Landsat 5 TM Composite: May 1997



Hat Island (looking northwest): 2001

A Changing Landscape

- Great Salt Lake water level and spatial coverage continuing to drastically decline
- Hat Island: now fully exposed and accessible via land (humans and bird predators)
- Gunnison Island: access and logistics have varied from year to year
 - Early-mid 2010s: transit via ATV from western shore
 - Mid-late 2010s: transit via boat due to lake level rise after causeway breach
 - 2020s: back to ATV due to continual lake decline



Real-Time Data Dissemination Needs

- Cloud-based CSI Loggernet: data collection and initial ingest procedures
- Real-time weather observations sent to Synoptic Data PBC for access, display (via [MesoWest](#), [Synoptic Data PBC](#), [NWS WRH](#)), and dissemination to NWS internal resources via NOAA National Mesonet Program (NMP)
- Data archived for research usage by UUNET team

	UU_AMFKM		off line	
	PakBusPort_AMFKM		off line	
	CR1000_AMFKM		off line	normal
	UU_BFLAT		off line	
	PakBusPort_BFLAT		off line	
	CR1000X_BFLAT		off line	normal
	UU_LMS		off line	
	PakBusPort_LMS		off line	
	CR1000_LMS		off line	normal
	UU_PRCUT		off line	
	PakBusPort_PRCUT		off line	
	CR3000_PRCUT		off line	normal
	UU_UUSYR		off line	
	PakBusPort_UUSYR		off line	
	CR1000_UUSYR		off line	normal
	UU_GNI_PeliCam		off line	
	UU_WBB_Radio		off line	
	Radio_FPS		off line	
	PakBusPort_FPS		off line	
	CR1000_FPS		off line	normal
	Radio_SUNUT		off line	
	PakBusPort_SUNUT		off line	
	CR1000_SUNUT		off line	normal

Region: Alaska GCA
Product: Surface Weather Maps

STATION INFO

ID: SUNUT
NAME: SunCrest
LATITUDE: 40.48042
LONGITUDE: -111.83714
ELEVATION: 6100 ft
MNET: UUNET
LAND COVER: 2001 USGS
DATA COURTESY OF:
SunCrest Community
and
U of U MesoWest Group

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Weather Conditions for SUNUT

Current Time: 12/28/2023 13:05 MST
Most Recent Weather Conditions at: 12/28/2023 12:45 MST

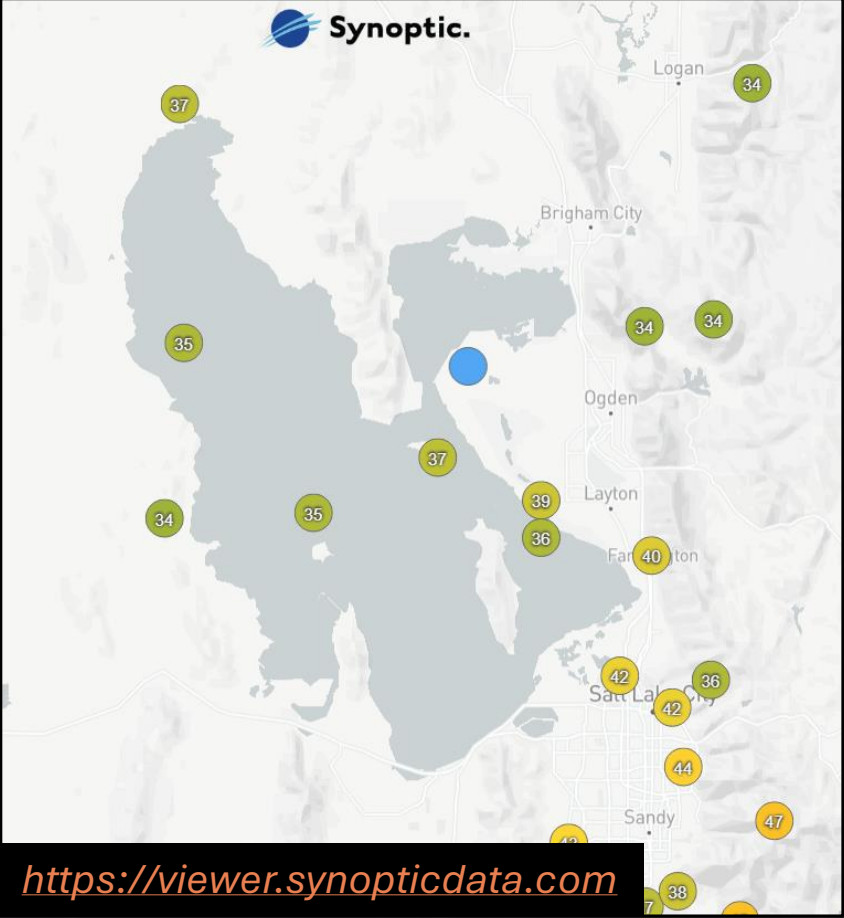
Graphical Links	12:45	Max Since 0:00 (MST)
3.0m Temperature	37.1° F	40.7 at 10:25
3.0m Dew Point	24.8° F	24.8 at 12:45
3.0m Wet bulb temperature	31.9° F	33.2 at 10:25
3.0m Relative Humidity	61%	82 at 1:15
4.0m Wind Speed	0.9 mph	5.7 at 8:20
4.0m Wind Gust	2.0 mph	7.5 at 8:20
4.0m Wind Direction	NNE	-
Pressure	24.22 in	24.24 at 11:20
Altimeter	30.34 in	30.36 at 11:35
Solar Radiation	297.3 W/m²	438.2 at 12:15
Battery voltage	14.23 volt	14.94 at 10:05

*Note: Observations above in yellow indicate that they are older than 1 hour

Tabular Listing of 297 Observations from 12/27/2023 12:05 MST

Time (MST)	3.0m Temperature ° F	3.0m Dew Point ° F	3.0m Wet bulb temperature ° F	3.0m Relative Humidity %
12:45	37.1	24.8	31.9	61
			31.2	59
			31.0	62

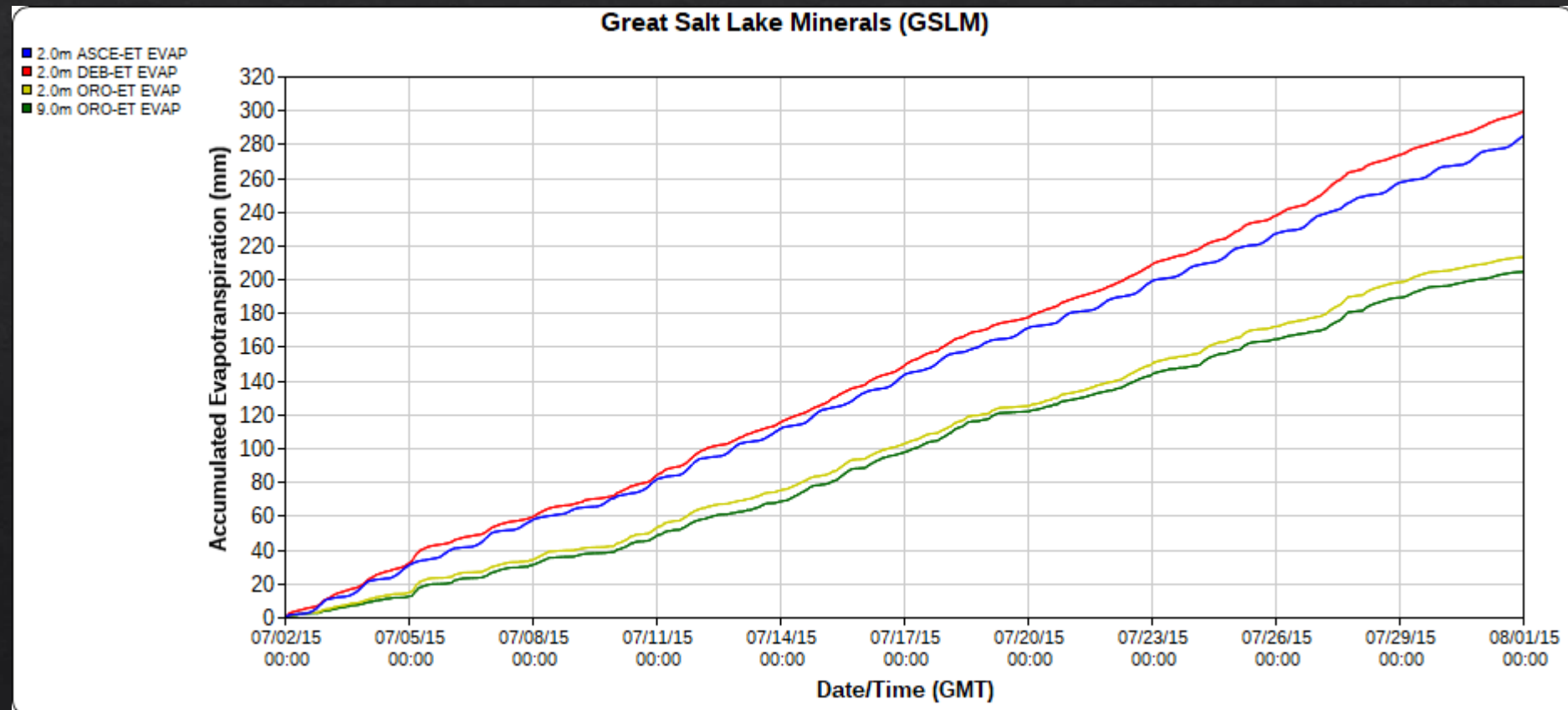
<https://mesowest.utah.edu>



<https://viewer.synopticdata.com>

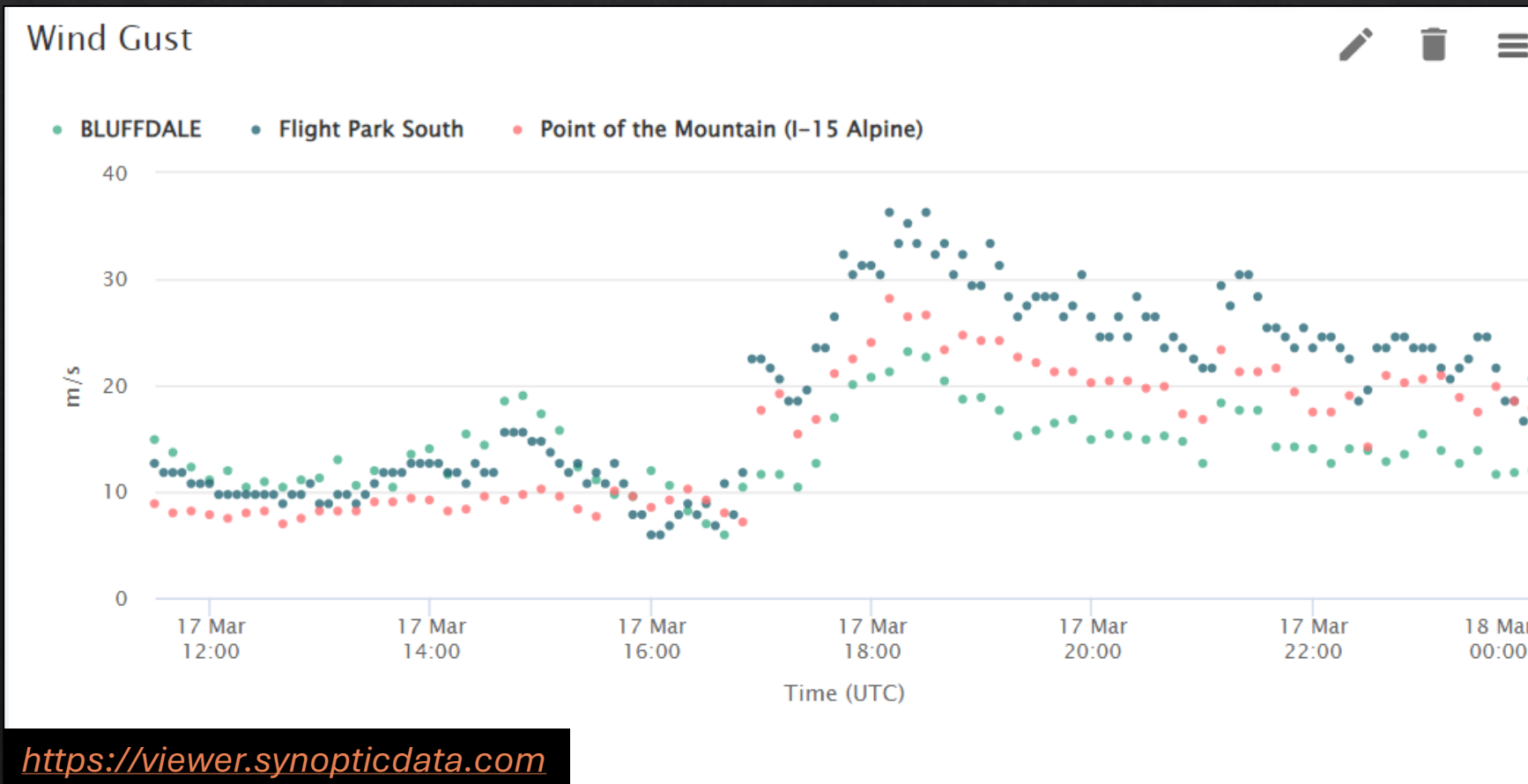
Stakeholder Collaboration - Private Industry

- Summer 2013: Acquired existing tower located at GSL mineral extraction company
- Site retrofitted with multiple temperature, humidity, and wind sensors to research various algorithms to best quantify evaporation of a high salinity lake
- Involved in 2024 pilot program testing EC evaporation methods to further assess lake



Stakeholder Collaboration - Recreation Industry

- Paragliding very popular activity at “Point of the Mountain” (southern Salt Lake County)
- 2010: Initial station deployed at primary paragliding location (Flight Park South - FPS)
- 2011: Station upgraded to full fenced 10m tower with CSAT3 Sonic Anemometer
- Elevated location can experience very strong winds (17 Mar 2014: 36.3 m s^{-1})



Stakeholder Collaboration - Education and Outreach

- Stations installed at several on and off-campus research and educational facilities
 - Utah Natural History Museum (NHMU - left)
 - Collaboration with Storm Peak Laboratory (CO - center)
 - Neil Armstrong Academy (West Valley, UT - right)



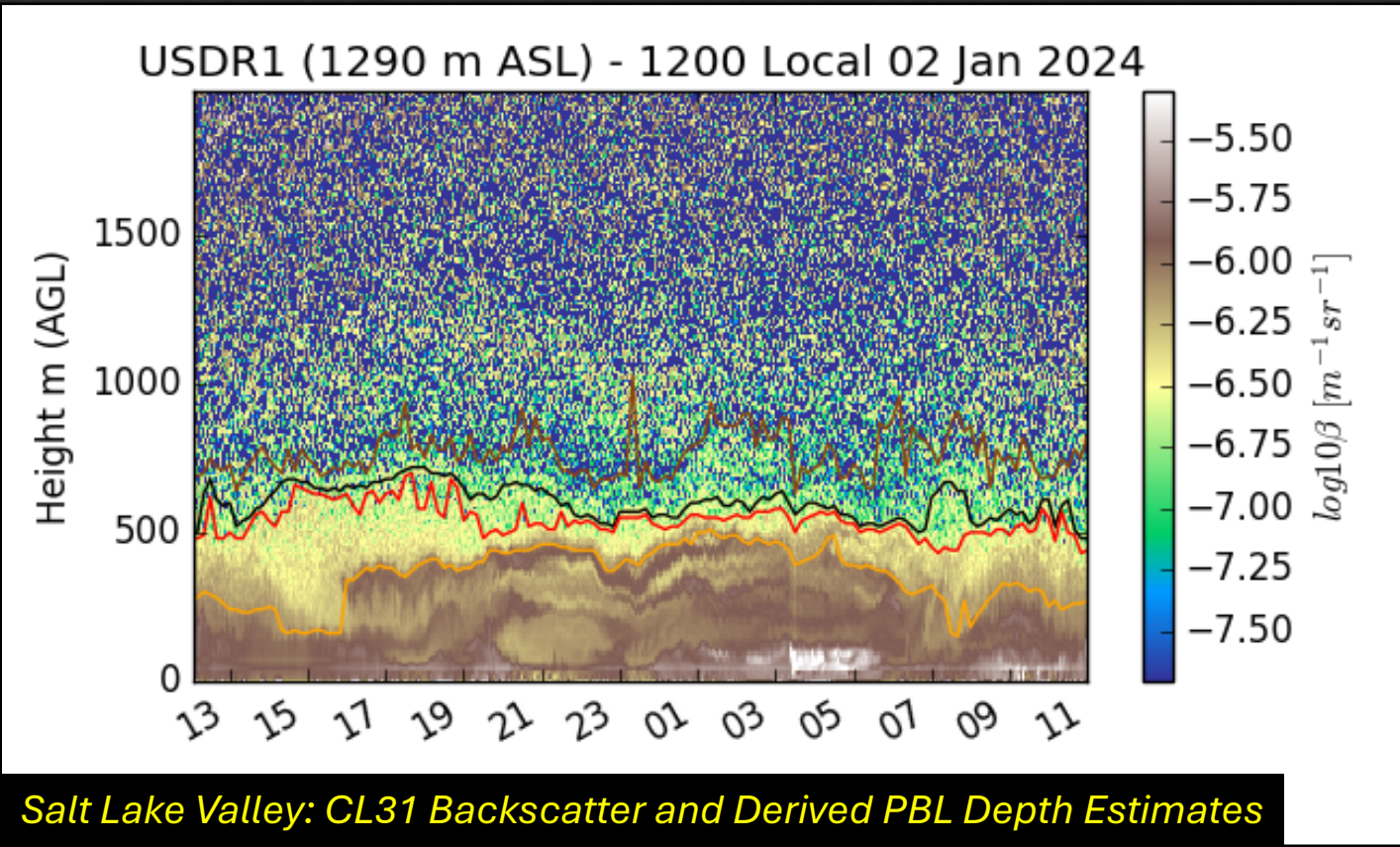
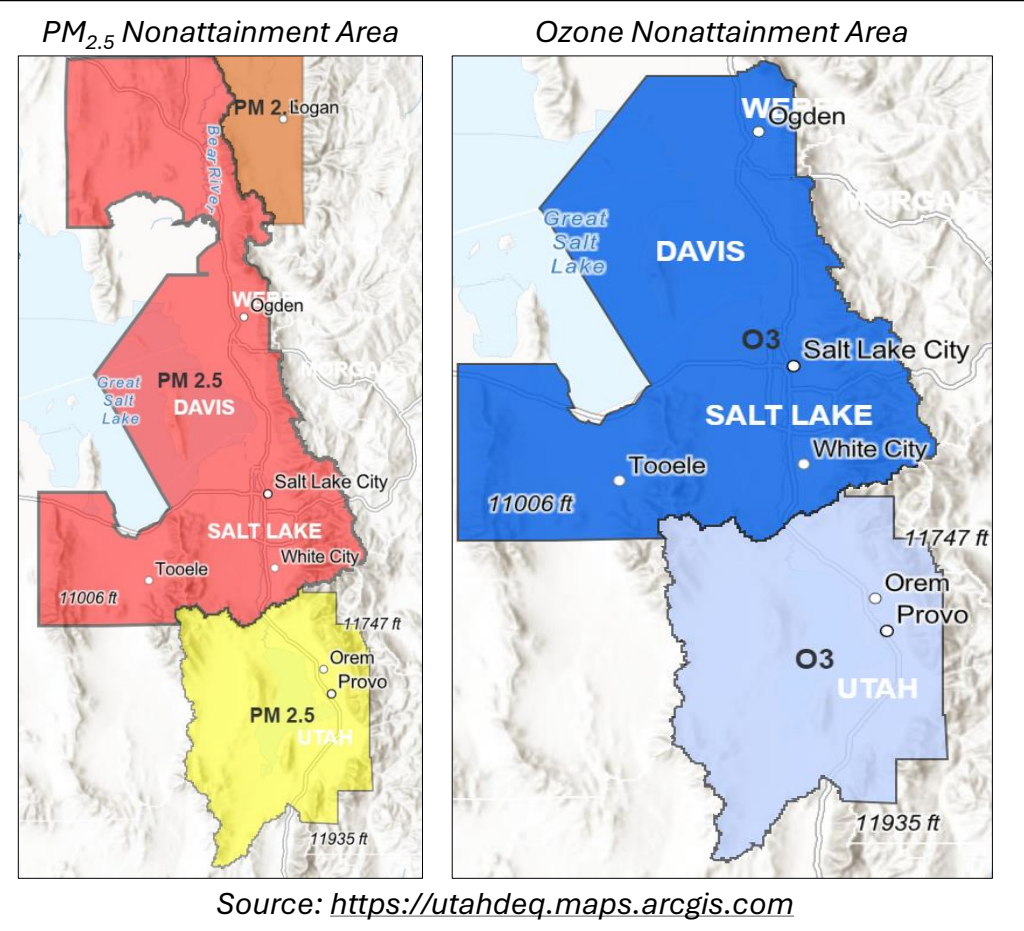
Stakeholder Collaboration - Research Field Work

- Non-NMP funding drives significant portion of other field work deployments
 - Bonneville Salt Flats (BFLAT): research with U/Utah Geology & Geophysics
 - Great Salt Lake Playa (UUPYA): research involving dust sources from lakebed
 - Sodars and ceilometers deployed for specific field research initiatives
 - When practical: communications and dissemination of data to NWS occurs



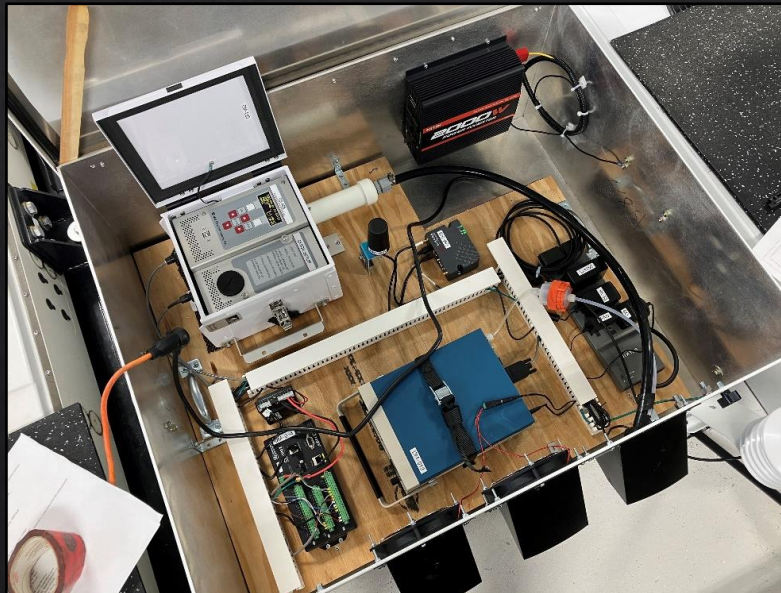
Pivoting to Stakeholder Needs - Local Air Quality Concerns

- Northern Utah in non-attainment for both $PM_{2.5}$ (winter) and ozone (summer)
- Continuing local momentum to tackle health problems with pollution and heat stress
- Increases in smoke and dust exposure due to regional wildfires and evaporating lake



Utah Mobile Air Quality Program

- Late 2018: Operational phase began with installs on 3 Utah Transit Authority (UTA) Light Rail Cars (TRAX): continuous monitoring on 3 rail lines traversing Salt Lake Valley
- 2021: Pilot design and deployment on top of a UTA electric-only bus
- 2022-Present: Additional installations on board expanding UTA electric bus fleet
 - 8 currently operating in the Salt Lake Valley (1 in Ogden metro area)
 - 6 more expected in 2024 for total of 18 mobile units (15 bus, 3 light rail)
- Funded by numerous local stakeholders (UTA, UDAQ, SLC, SLC_o, HEAL Utah)



Utah Mobile Air Quality Program - Sensor Packages

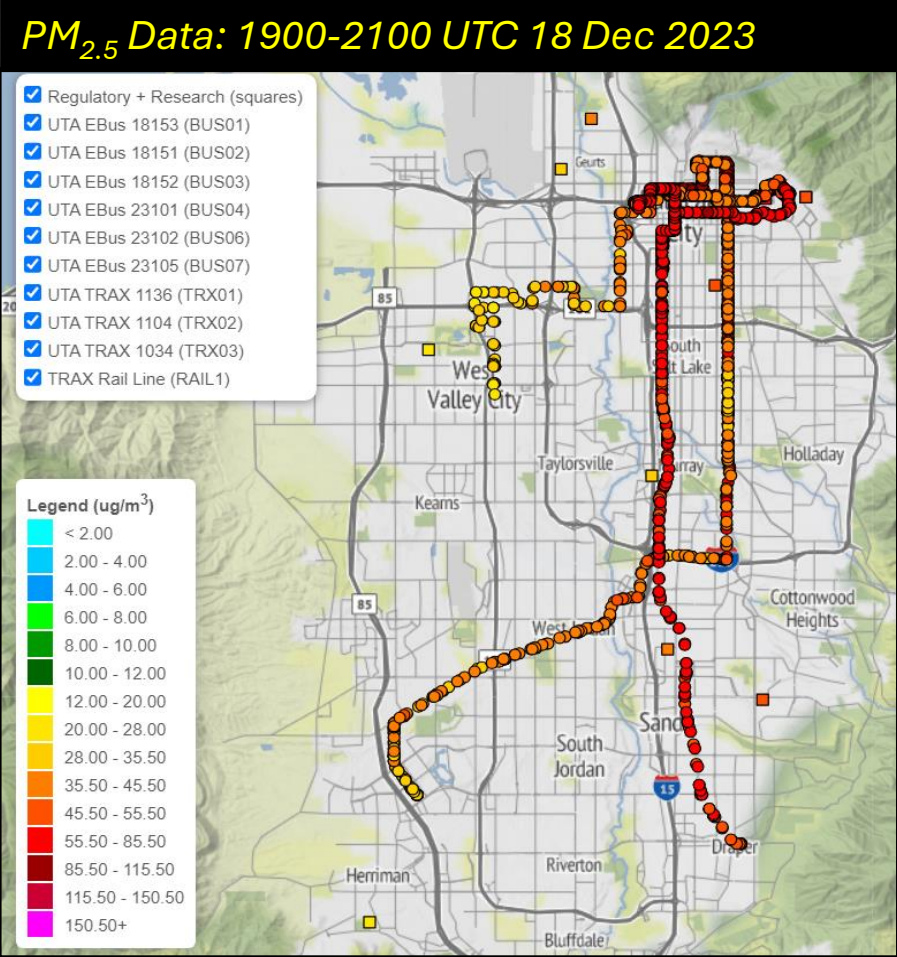
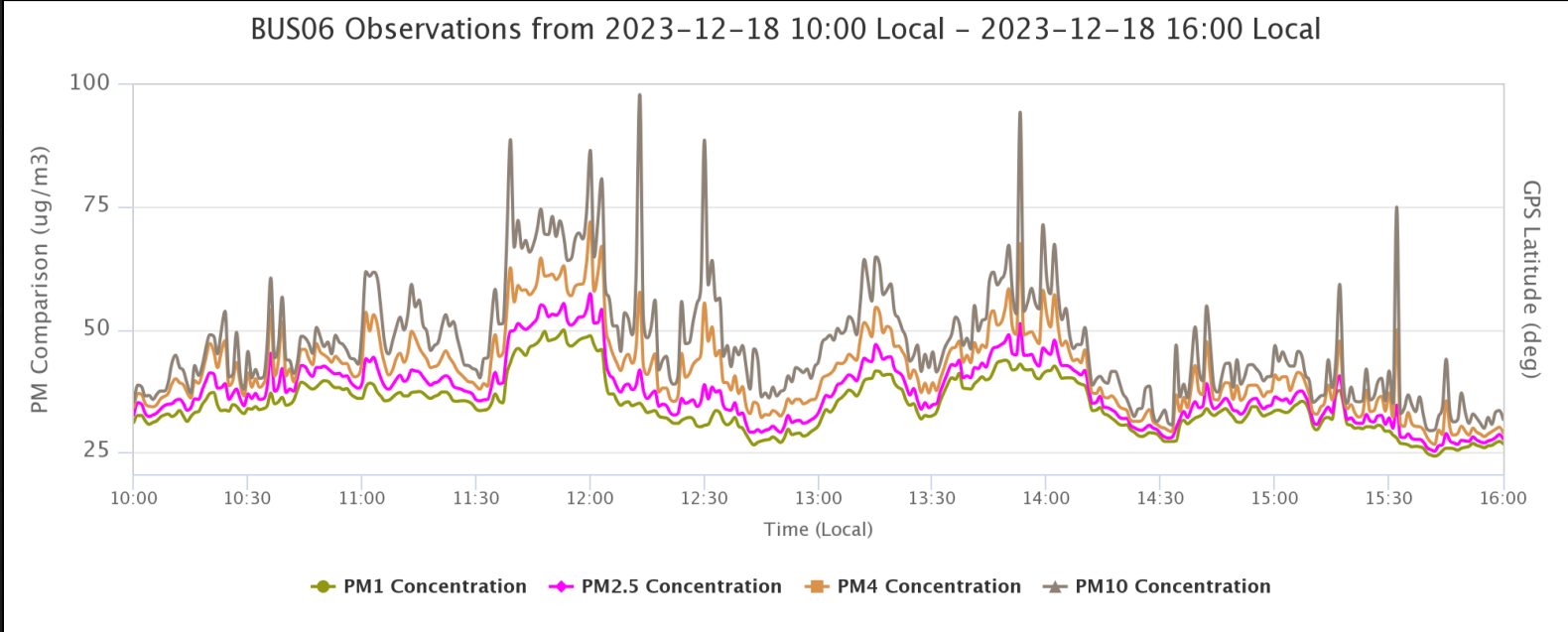
- Measurements collected every 2-5 seconds and transmitted to a central storage system located at the University of Utah every 5 minutes ([Mendoza et al. - submitted](#))

Measurement	Instrument	Mobile Units Installed On
PM _{2.5}	Met One ES-642 Remote Dust Monitor	TRAX, Bus Units 1-3
PM ₁ , PM _{2.5} , PM ₄ , PM ₁₀	Met One ES-405 Simultaneous Particulate Profiler*	Bus Units 4-7+
Ozone	2B Technologies 205 Ozone Monitor	All TRAX and Bus Units
NO _x Species	2B Technologies 405 NO _x Monitor	Bus Units 1-3
External Air Temp and RH	Vaisala HMP60 + Shield	All TRAX and Bus Units
GPS	Garmin 18x	All TRAX and Bus Units
Data Logging	Campbell Scientific CR1000X (CR1000)	All TRAX and Bus Units

*Note: Met-One ES-405 has 1-minute average recording limitation

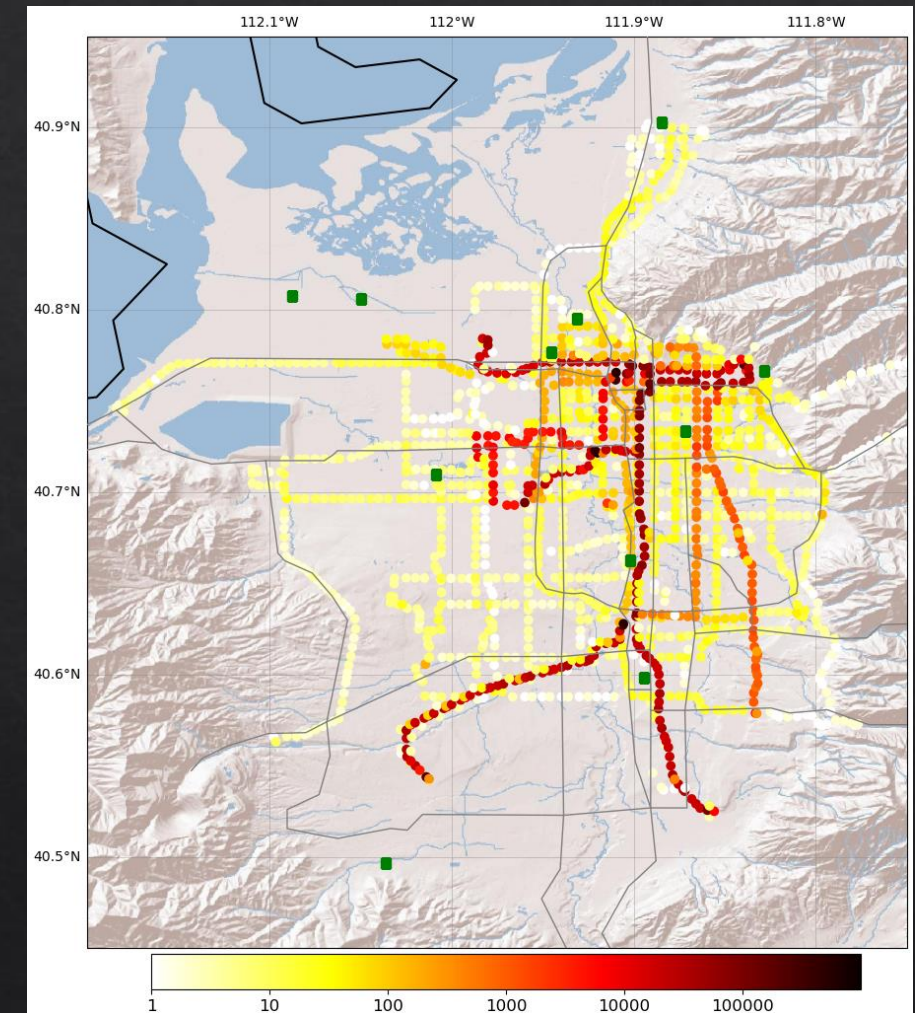
Utah Mobile Air Quality Program - Data Display and Access

- Provisional (Level 0) real-time and Level 1 QA/QC observations accessible through web interface tools (<https://utahaq.chpc.utah.edu>)
- Further QA/QC datasets (Levels 2-4) generated for research and stakeholder usage
- Recent Episode: Multi-Day PCAP (15-21 Dec 2023)
 - 3 TRAX platforms on UTA Red+Blue Lines
 - 6 UTA electric bus units on various routes



The Future of UUNET - Air Quality

- Continued expansion of the existing mobile fleet to 18 total units in 2024
- UTA also continuing expansion of routes covered by growing electric bus fleet
- Potential expansion of the program beyond Salt Lake County
- Collaboration with stakeholders involved in other upcoming research field campaigns
 - USOS (Ozone Study - Summer 2024)
 - SLC-SOS (Ozone - Summer 2024, 2025)
 - AQUARIUS (Winter 2025-2026)



Electric bus observation counts per 0.001° x 0.001° grid cell: Oct 2021 – Dec 2023

The Future of UUNET - Evaporation and Local Research

- Heavy emphasis by state and local governments on evaporation of Great Salt Lake
 - Ground measurements of ET desired to inform water use models
 - Pilot project (2024-25) to test EC evaporation estimates at multiple sites
 - Lead to installs/upgrades in equipment at multiple other locations around lake
- Continue investing into the needs of local research and educational communities with emphasis in our “own backyard” (e.g., Red Butte Canyon shown below)
- Opportunities should translate to:
 - Upgraded instrumentation
 - Upgraded data communications
 - Expansion of mobile systems
 - Student learning opportunities
 - Outreach



- The UUNET network of atmospheric and air quality instrumentation systems serves, and pivots, to the needs of numerous local stakeholder groups across several disciplines since its inception over 25 years ago
- Fixed-site weather stations, some located across remote areas upstream of Salt Lake City, provide extremely valuable real-time weather information for Great Salt Lake-invested entities and the local NWS office during high-impact events
- Surface-based remote sensors supplement the fixed-site weather observations and provide additional information regarding PBL structures in complex terrain
- Current stakeholder needs (and funding!) has migrated towards air quality and ET
 - Has led to the development of new mobile-based air quality monitoring initiatives for long-term spatial understanding of air quality impacts
 - UUNET positioned to contribute to ET efforts through upgrades to existing sites