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The University of Utah MesoWest Mesonet

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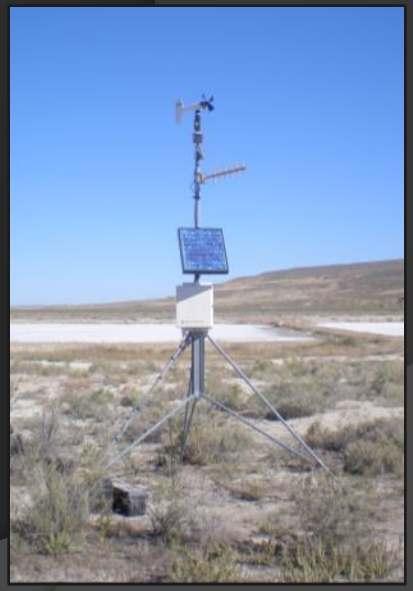
Network Design and Accuracy
19th Symposium on Meteorological Observation and Instrumentation
9 January 2018

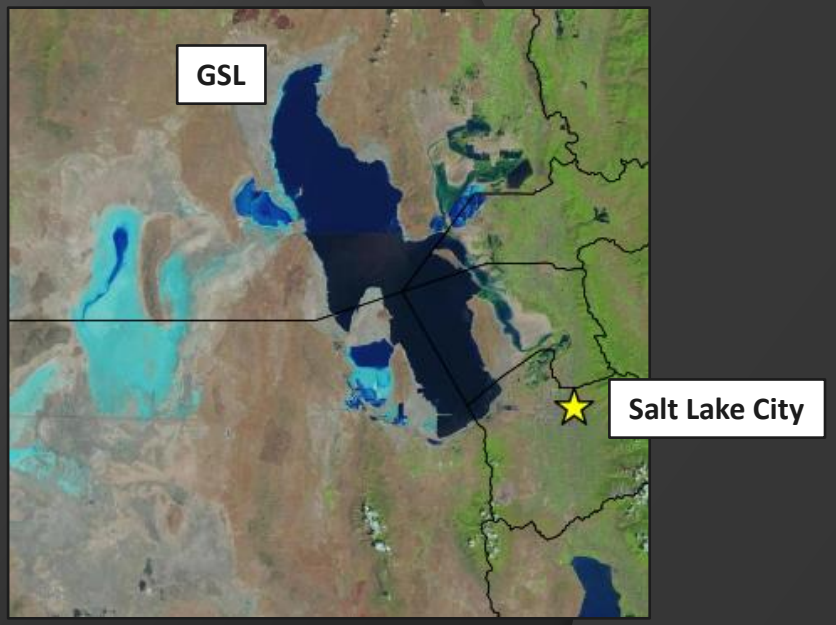
Outline

- Motivation
- History
- Active Deployments
    - Platforms maintained by University of Utah
    - Platforms owned by other entities
- Communications Protocols
- Data Access, Storage, and Dissemination
- Impact Weather Examples
- Research Initiatives



Motivation and Challenges

- Great Salt Lake (GSL) and surrounding region sit immediately upstream of heavily populated Utah Wasatch Front, which includes the Salt Lake City metro area



- Operational Weather/AQ Impacts
  - Strong frontal passages
  - Summertime convection
  - Lake enhanced/effect snow
  - Persistent cold-air pools
  - Dust events
- GSL projected to continue decreasing in areal size and depth due to changing climate and water use
- Area sparsely populated, so few agency-based or citizen-owned surface weather deployments

Motivation and Challenges

- Site Access: multiple areas in/around GSL are restricted to specific times of year and require escorts by additional personnel
  - Island Bird Wildlife Refuges
  - Mineral Collection Companies
  - Active Military Areas

- Usually restricted to one annual visit per year and coordination to move supplies by either boat or ATV depending on the site
- Need to keep equipment, power consumption, data communications, and repair equipment relatively simplistic
- Allows siting of equipment in protected areas to deter vandalism

Utah Mesonet History

- First GSL mesonet weather stations were installed in late 1990s

Photos at lake stations from early 2000s

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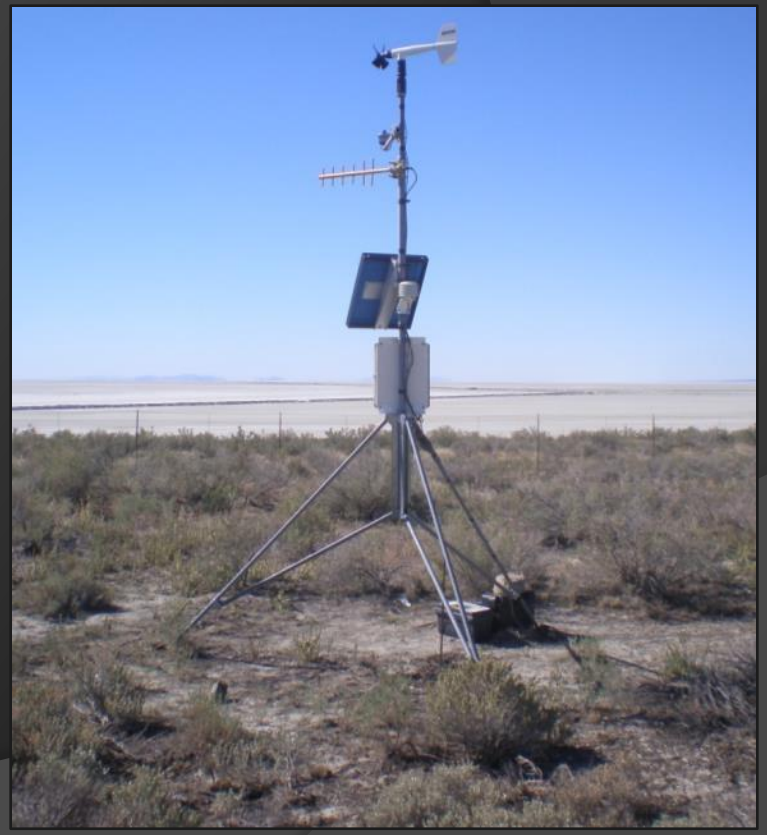
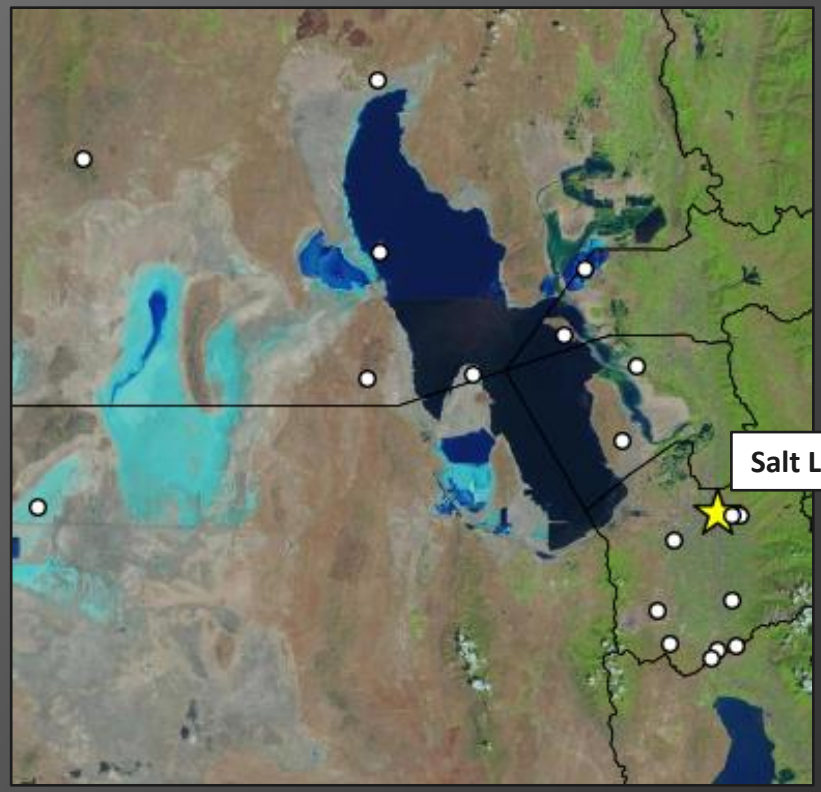


Photos at lake stations from summer 2017

UUNET Today

- Through additional collaborations, the mesonet has expanded and was renamed the University of Utah MesoWest Mesonet (UUNET)



- 20 active platforms are operated and/or maintained by the University of Utah MesoWest Group

UUNET Today

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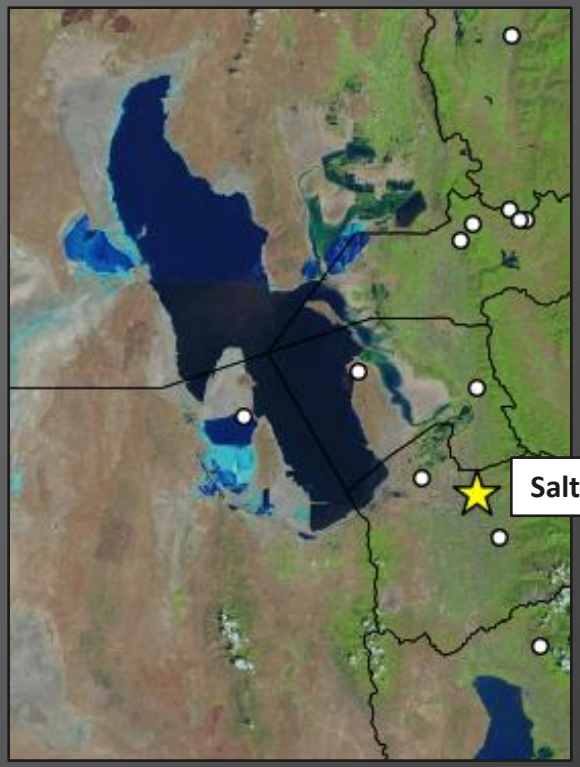
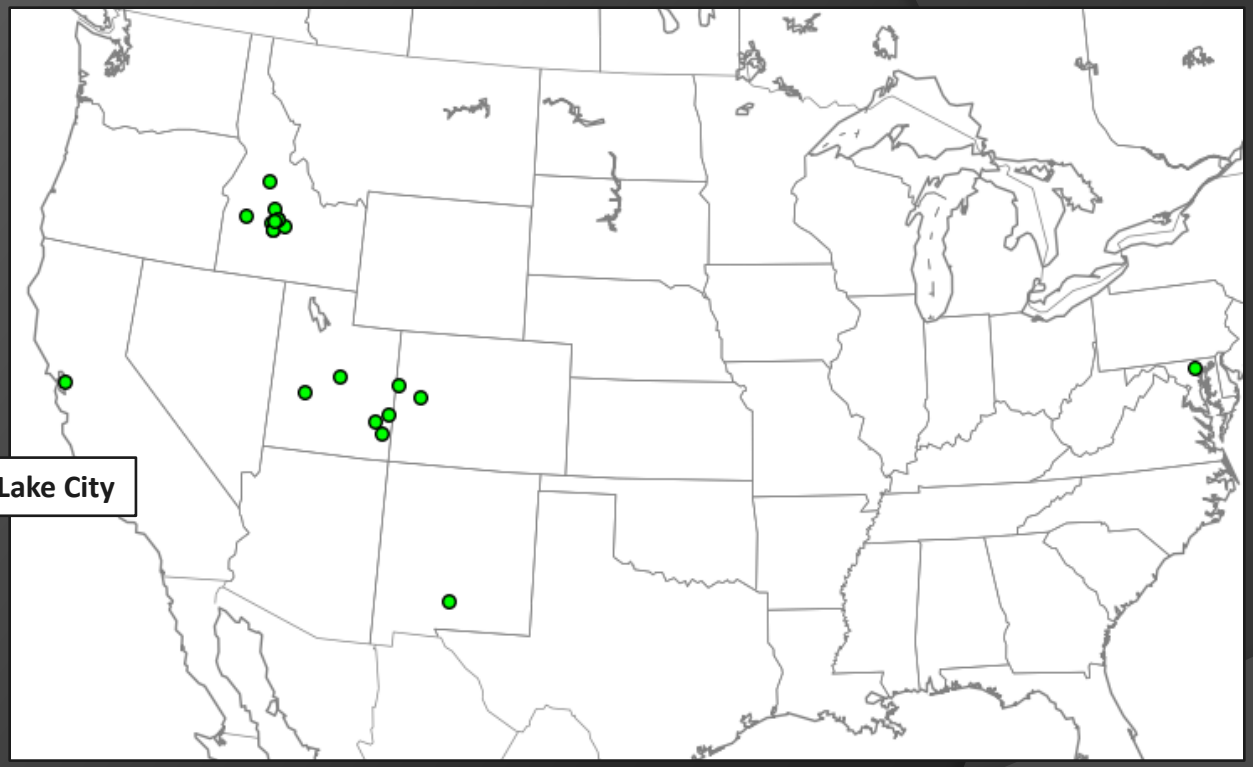




- 33 active platforms are operated and maintained by other entities, but MesoWest given permission to directly access the data loggers, collect, and distribute data in real-time

UUNET Communications Protocols

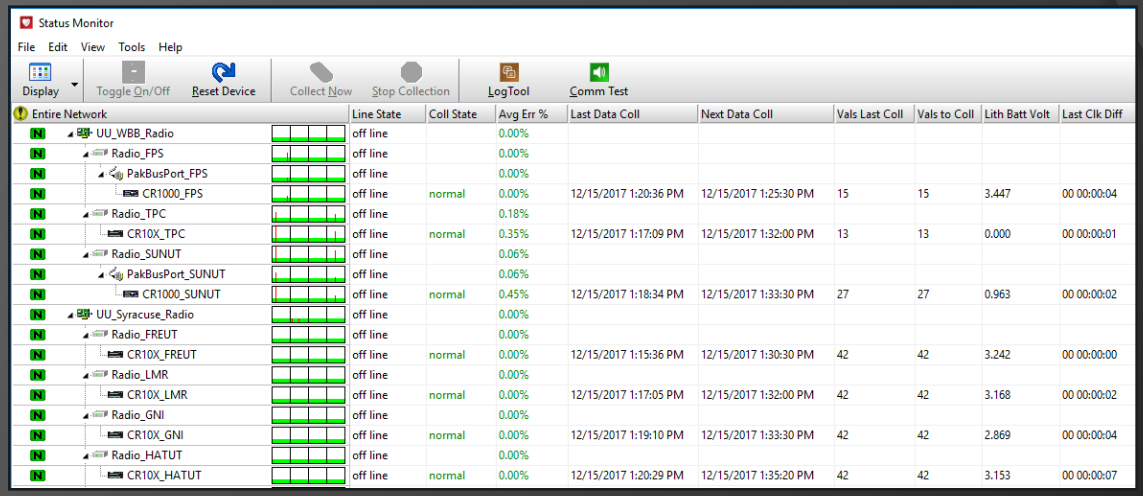
- Urban-based deployments primarily utilize available Ethernet

- Remote deployments within line-of-sight of the Wasatch Front rely on freewave radio communications to reduce power consumption

- Very remote and temporary deployments rely on low-power cellular modems for real-time data collection

UUNET Data Access and Collection

- 24/7 CS LoggerNet Operating in AWS Cloud Environment



Entire Network	Line State	Coll State	Avg Err %	Last Data Coll	Next Data Coll	Vals Last Coll	Vals to Coll	Lith Batt Volt	Last Clk Diff
UU_WBB_Radio	off line		0.00%						
Radio_FPS	off line		0.00%						
PakBusPort_FPS	off line		0.00%						
CR1000_FPS	off line	normal	0.00%	12/15/2017 1:20:36 PM	12/15/2017 1:25:30 PM	15	15	3.447	00 00:00:04
Radio_TPC	off line		0.18%						
CR10X_TPC	off line	normal	0.35%	12/15/2017 1:17:09 PM	12/15/2017 1:32:00 PM	13	13	0.000	00 00:00:01
Radio_SUNUT	off line		0.06%						
PakBusPort_SUNUT	off line		0.06%						
CR1000_SUNUT	off line	normal	0.45%	12/15/2017 1:18:34 PM	12/15/2017 1:33:30 PM	27	27	0.963	00 00:00:02
UU_Syracuse_Radio	off line		0.00%						
Radio_FREUT	off line		0.00%						
CR10X_FREUT	off line	normal	0.00%	12/15/2017 1:15:36 PM	12/15/2017 1:30:30 PM	42	42	3.242	00 00:00:00
Radio_LMR	off line		0.00%						
CR10X_LMR	off line	normal	0.00%	12/15/2017 1:17:05 PM	12/15/2017 1:32:00 PM	42	42	3.168	00 00:00:02
Radio_GNI	off line		0.00%						
CR10X_GNI	off line	normal	0.00%	12/15/2017 1:19:10 PM	12/15/2017 1:33:30 PM	42	42	2.869	00 00:00:04
Radio_HATUT	off line		0.00%						
CR10X_HATUT	off line	normal	0.00%	12/15/2017 1:20:29 PM	12/15/2017 1:35:20 PM	42	42	3.153	00 00:00:07

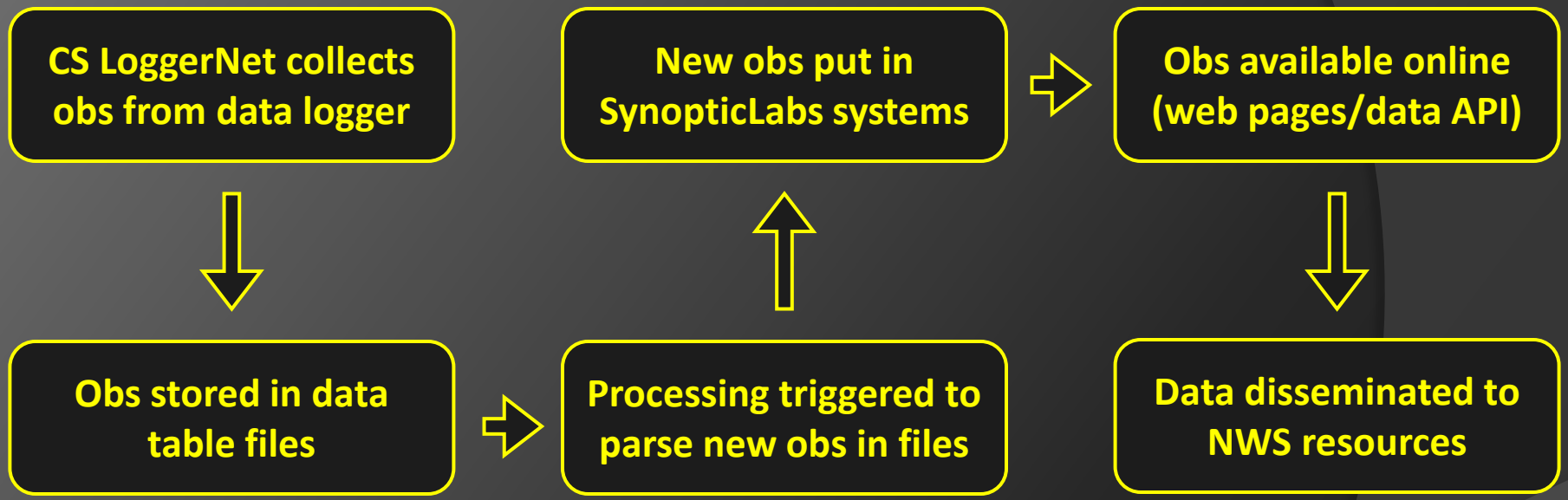
- Observations collected on set schedules based on station reporting intervals, current power status, etc.

- In theory, any CS logger that is remotely accessible via an external IP address could be added to this system

- Advantageous for entities who install equipment and want to disseminate real-time data but do not want to manage software

UUNET Data Storage and Dissemination

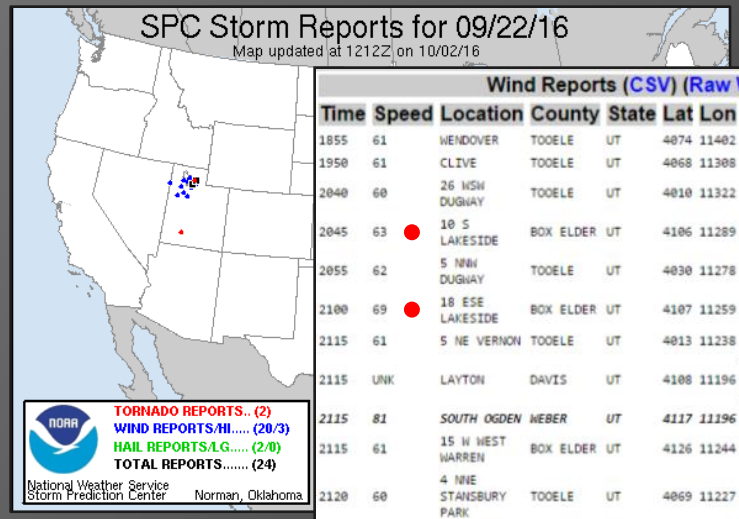
- Data parsing/processing developed to ingest collected data into MesoWest/SynopticLabs databases immediately at the time of data collection



- Data "latency" from when the observation is measure to online availability is less than a couple of minutes
- Automated alerts for stations with issues (e.g. power problems)

UUNET During Impact Weather

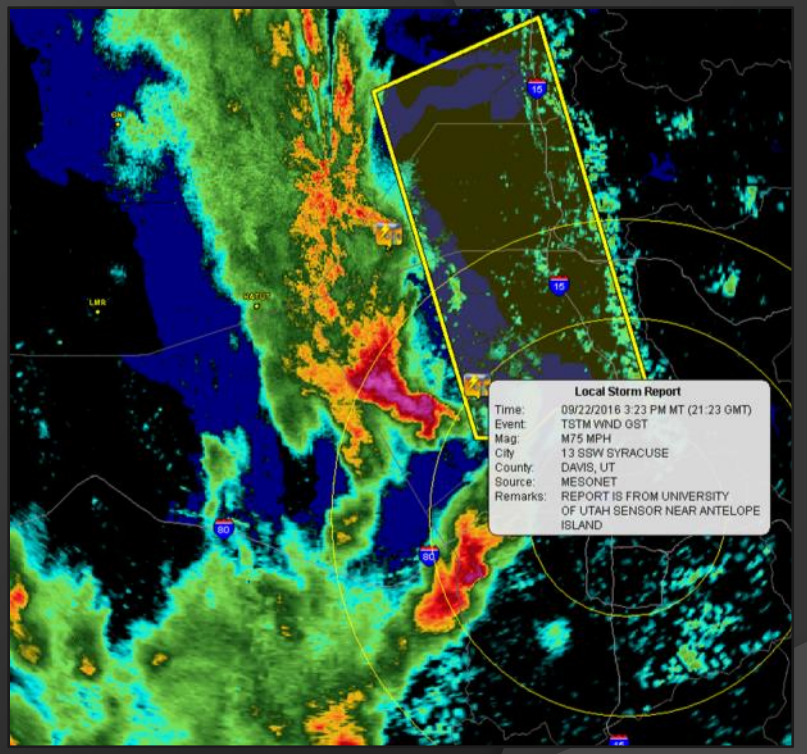
- 2016 Sep 22: Severe Convection Impacting Wasatch Front
  - 75 mph wind gust from 10 ft UUNET tripod off Antelope Island



Wind Reports (CSV) (Raw Wind CSV)(?)

Time	Speed		Location	County	State	Lat	Lon	Comments
1855	61		WENDOVER	TOOELE	UT	4074	11402	(SLC)
1950	61		CLIVE	TOOELE	UT	4068	11308	(SLC)
2040	60		26 NNW DUGWAY	TOOELE	UT	4010	11322	TARGET R MESONET STATION (SLC)
2045	63	●	10 S LAKESIDE	BOX ELDER	UT	4106	11289	LAKESIDE MOUNTAIN MESONET STATION (SLC)
2055	62		5 NNW DUGWAY	TOOELE	UT	4030	11278	CEDAR MOUNTAIN MESONET SITE (SLC)
2100	69	●	18 ESE LAKESIDE	BOX ELDER	UT	4107	11259	HAT ISLAND MESONET SITE (SLC)
2115	61		5 NE VERNON	TOOELE	UT	4013	11238	VERNON HILL MESONET SITE (SLC)
2115	UNK		LAYTON	DAVIS	UT	4108	11196	TWO LARGE TREES REPORTED DOWN IN LAYTON. ONE SNAPPED OFF AND ONE UPROOTED. (SLC)
2115	*81*		*SOUTH OGDEN*	*WEBER*	*UT*	*4117*	*11196*	*(SLC)*
2115	61		15 W WEST WARREN	BOX ELDER	UT	4126	11244	PROMONTORY POINT MESONET SITE (SLC)
2120	60		4 NNE STANSBURY PARK	TOOELE	UT	4069	11227	LAKE POINT I-80 MESONET SITE (SLC)
2123	*75*	●	*13 SSW SYRACUSE*	*DAVIS*	*UT*	*4093*	*11216*	*REPORT IS FROM UNIVERSITY OF UTAH SENSOR NEAR ANTELOPE ISLAND (SLC)*
2130	69	●	11 W HOOPER	WEBER	UT	4115	11233	REPORT FROM FREMONT ISLAND MESONET SITE (SLC)
2150	60		WNW FARMINGTON	DAVIS	UT	4099	11190	MESONET SITE AT US-89 AND PARK LANE (SLC)
2150	59		5 NE LAYTON	WEBER	UT	4114	11189	WEBER CANYON POWER PLANT MESONET SITE (SLC)
2200	59		4 NW MAGNA	SALT LAKE	UT	4075	11213	CENTER TAILINGS MESONET SITE (SLC)
2200	59		6 ESE OGDEN	MORGAN	UT	4119	11187	SNOWBASIN - STRAWTOP SENSOR - 8999 FEET (SLC)
2200	59		5 ENE SOUTH OGDEN	WEBER	UT	4120	11186	SNOWBASIN WILDCAT SENSOR - 77703 FEET (SLC)
2200	*101*		*5 ESE OGDEN*	*WEBER*	*UT*	*4120*	*11188*	*OGDEN PEAK SENSOR - 9570 FEET (SLC)*
2200	58		3 SSW HUNTSVILLE	WEBER	UT	4122	11180	TRAPPERS LOOP ROAD MESONET SITE (SLC)

http://www.spc.noaa.gov/climo/reports/160922_rpts.html

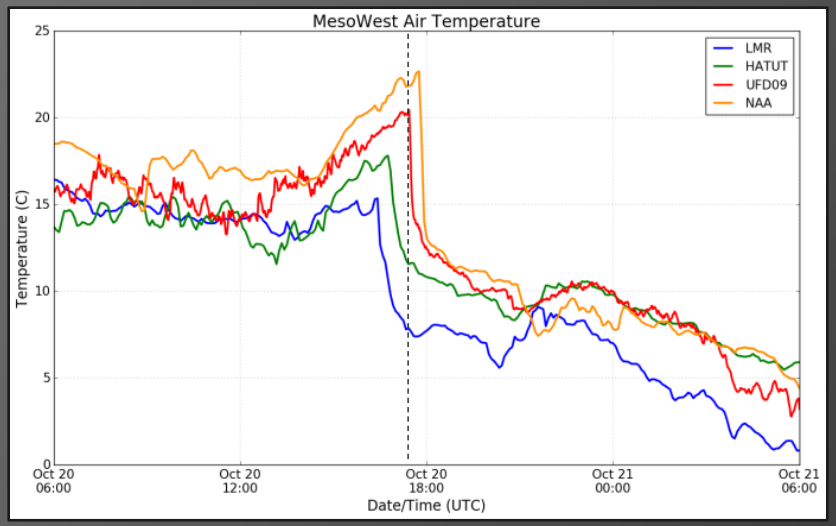


Courtesy: WeatherTAP RadarLab Application

- Storms turned tornadic across northern Wasatch Front with straight-line wind and tornado damage reported

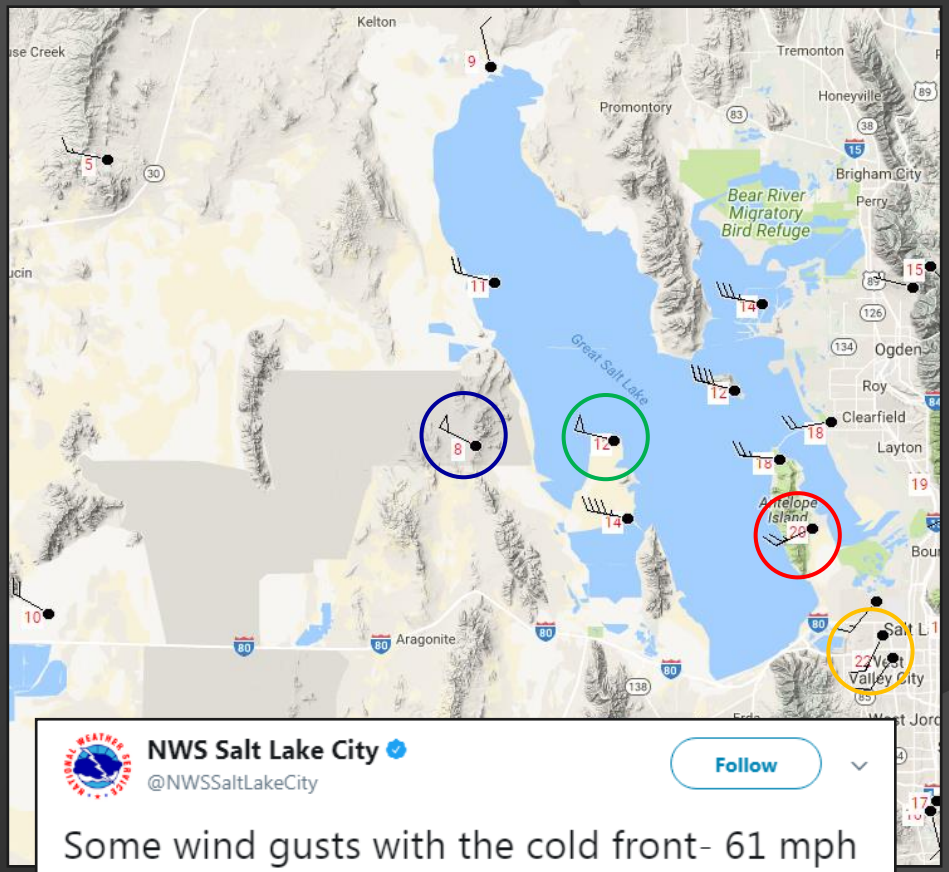
UUNET During Impact Weather

- 2017 Oct 20: Strong Cold Frontal Passage and Dust Event



http://home.chpc.utah.edu/~u0553130/Brian_Blaylock/cgi-bin/ts_multistations.cgi

http://mesowest.utah.edu/



NWS Salt Lake City
@NWSSaltLakeCity
Follow

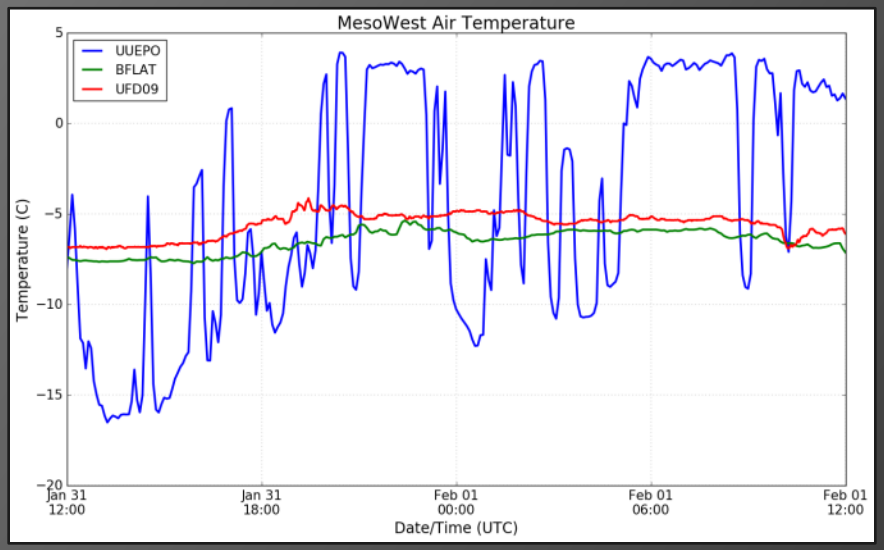
Some wind gusts with the cold front- 61 mph Lakeside Mountain, 61 mph Badger Island, 60 mph Hat Island, 50 mph Promontory Point. #uwtx

10:14 AM - 20 Oct 2017

Courtesy: U/Utah Ute Weather Center

UUNET During Impact Weather

- Persistent Cold Air Pools (usually with poor air quality)



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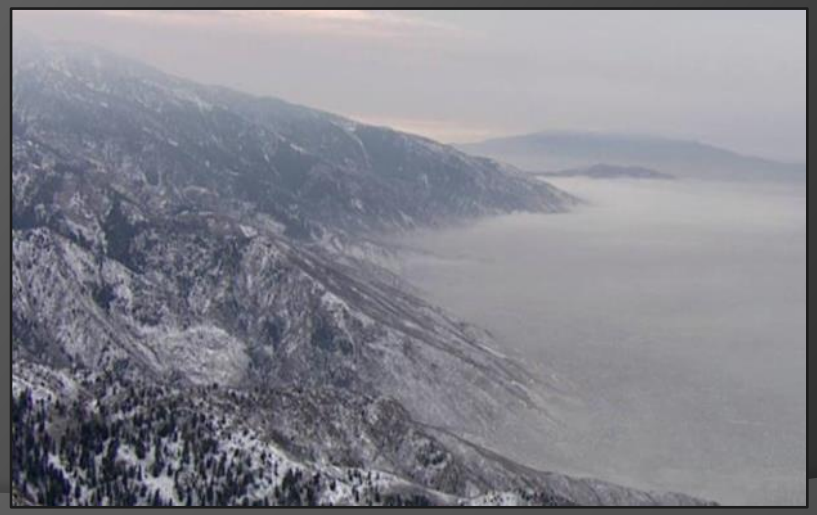
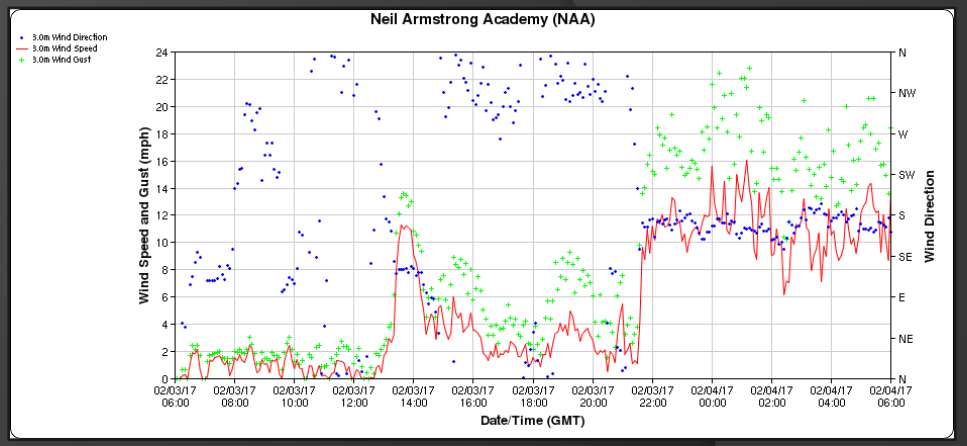
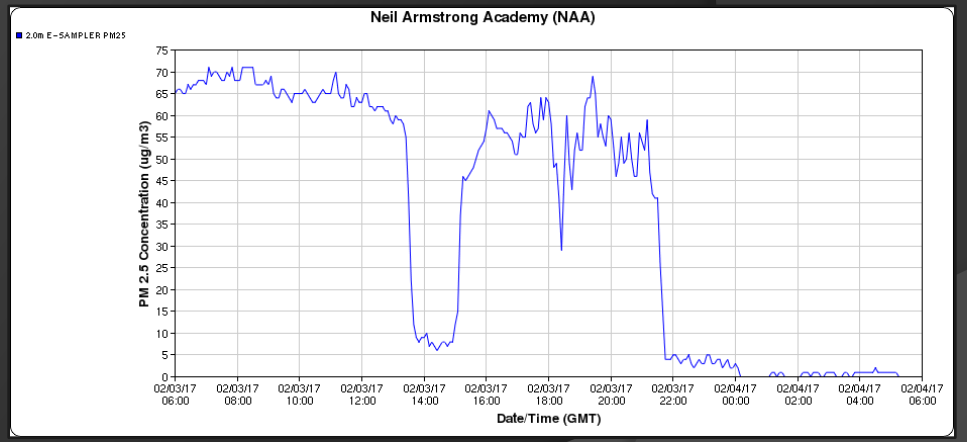


Courtesy: KSL-TV Chopper 5 News Helicopter





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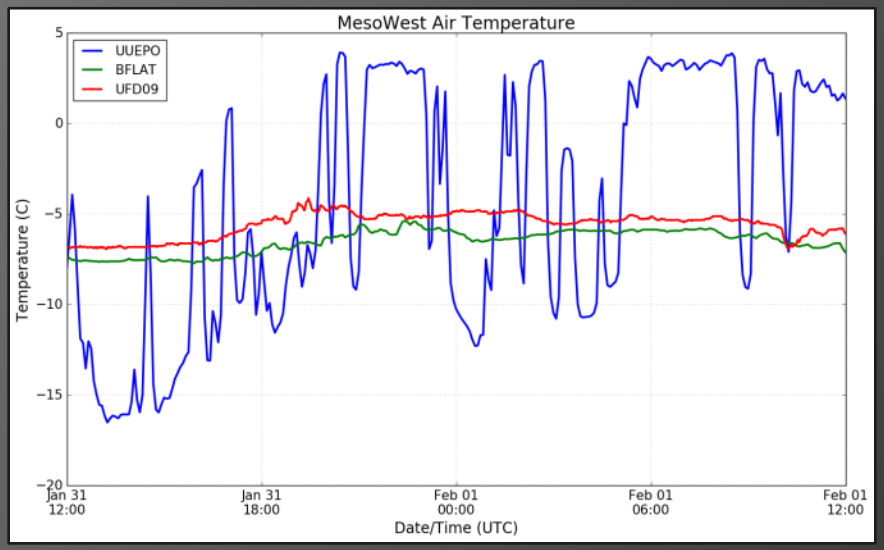

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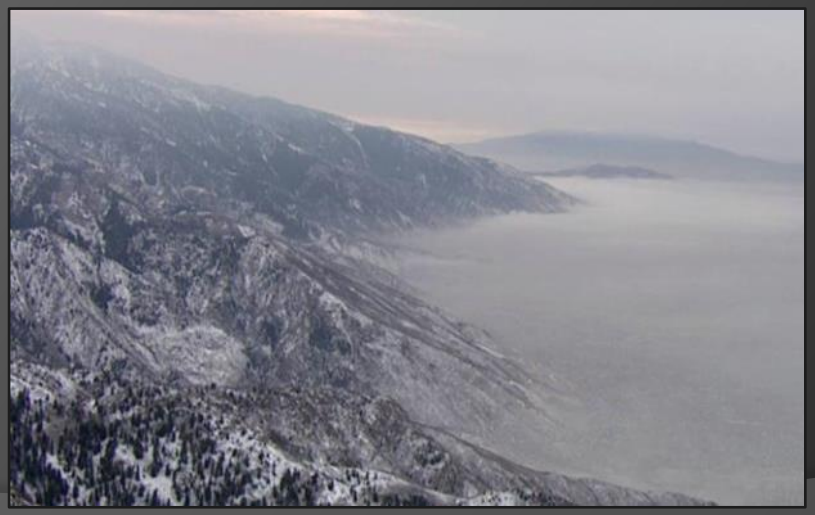
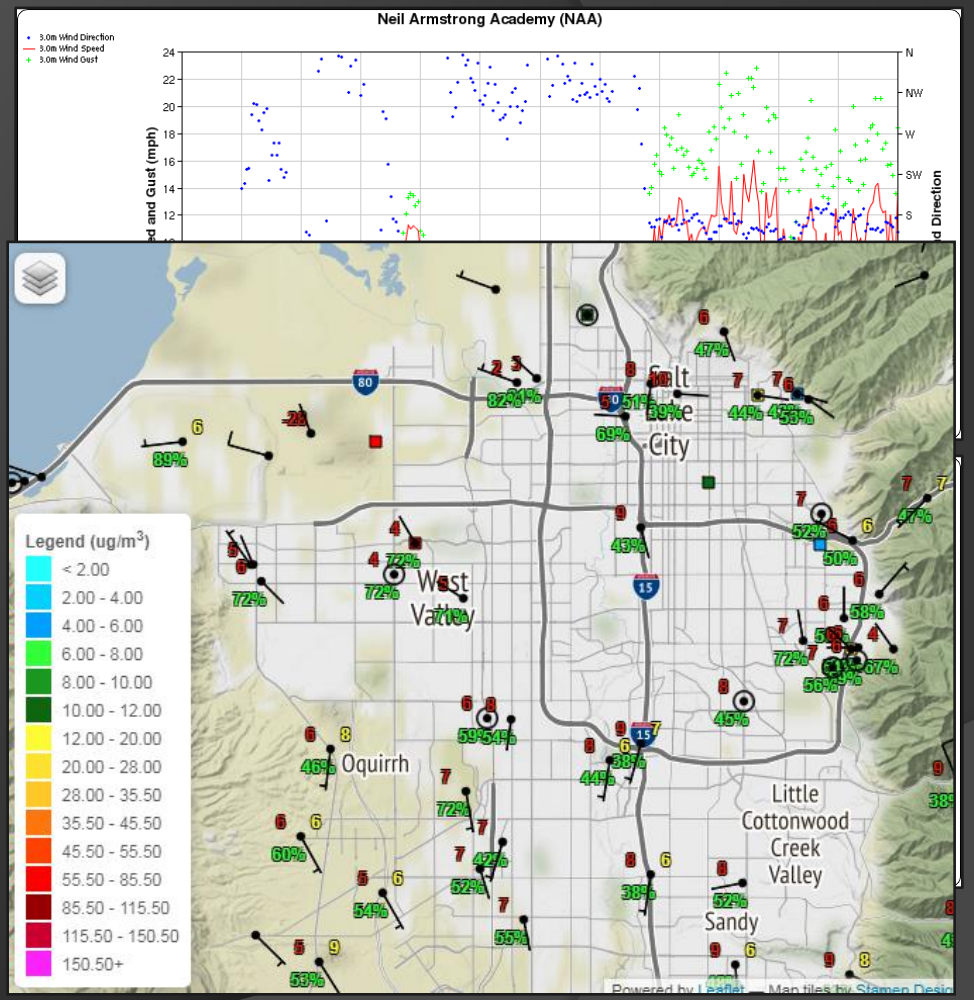


Courtesy: KSL-TV Chopper 5 News Helicopter



http://utahaq.chpc.utah.edu/

UUNET During Impact Weather

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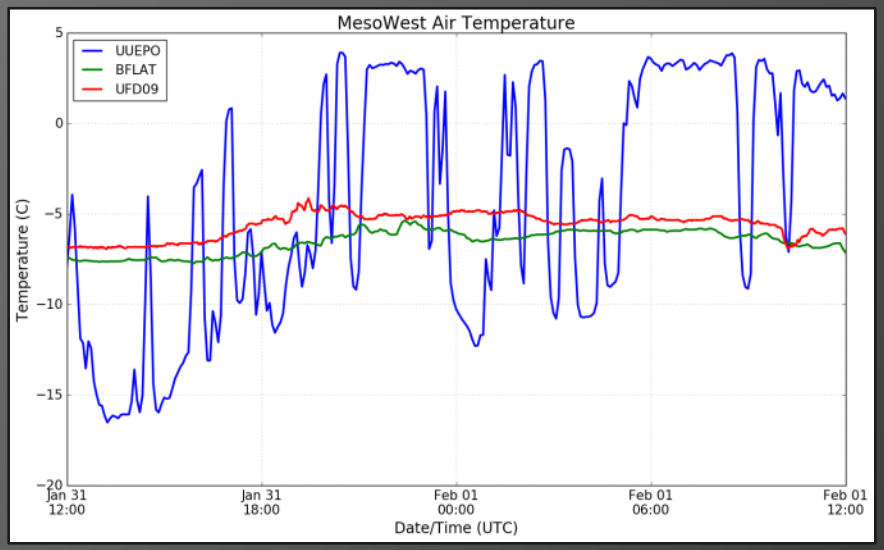

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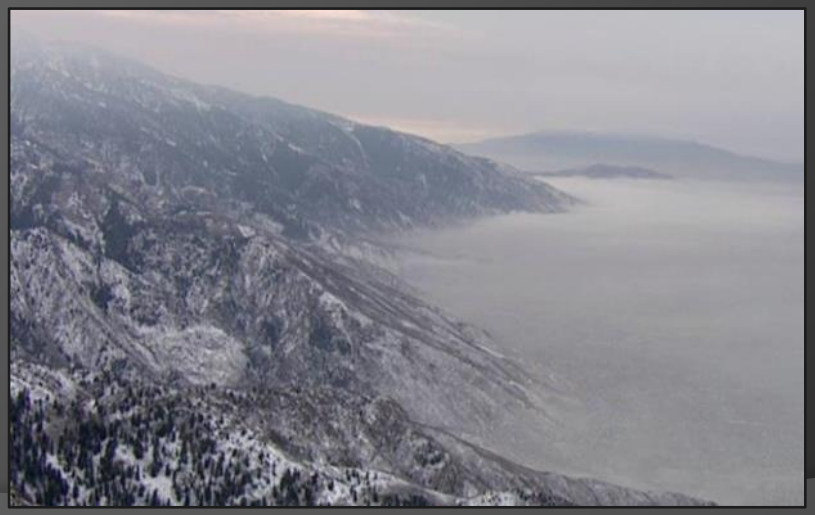

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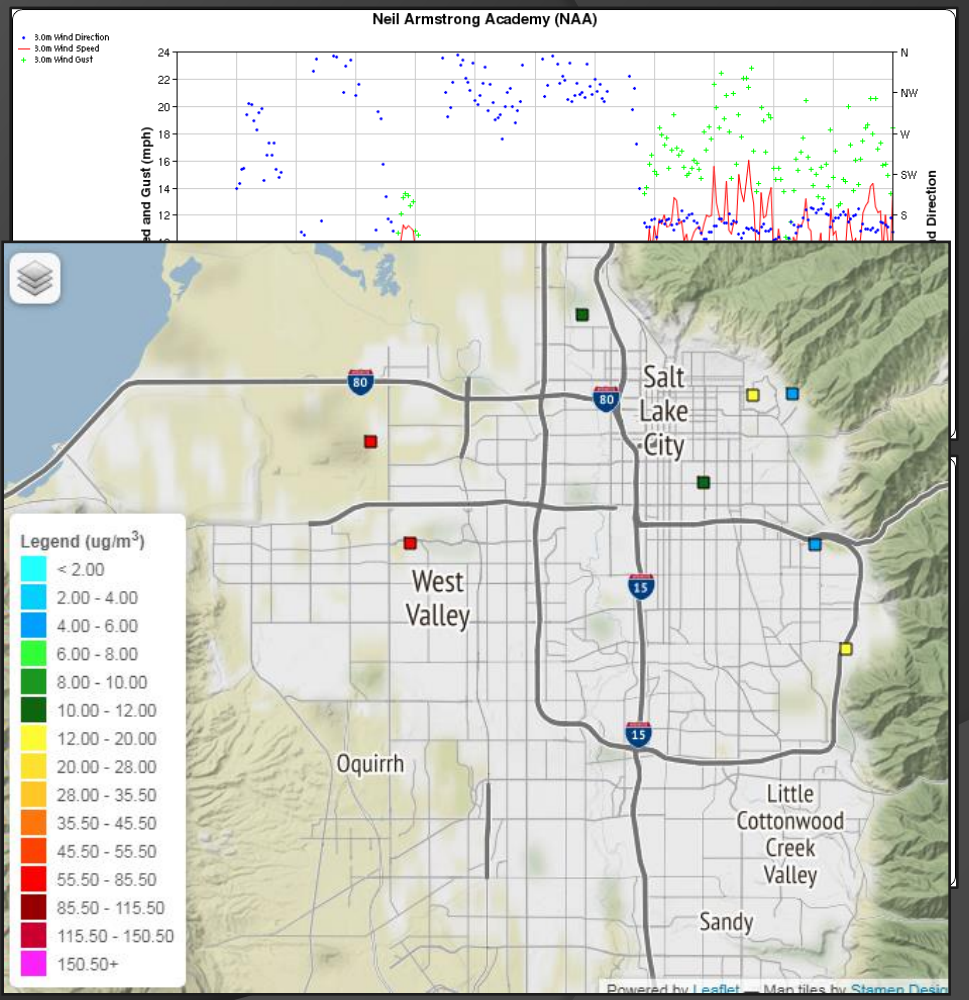
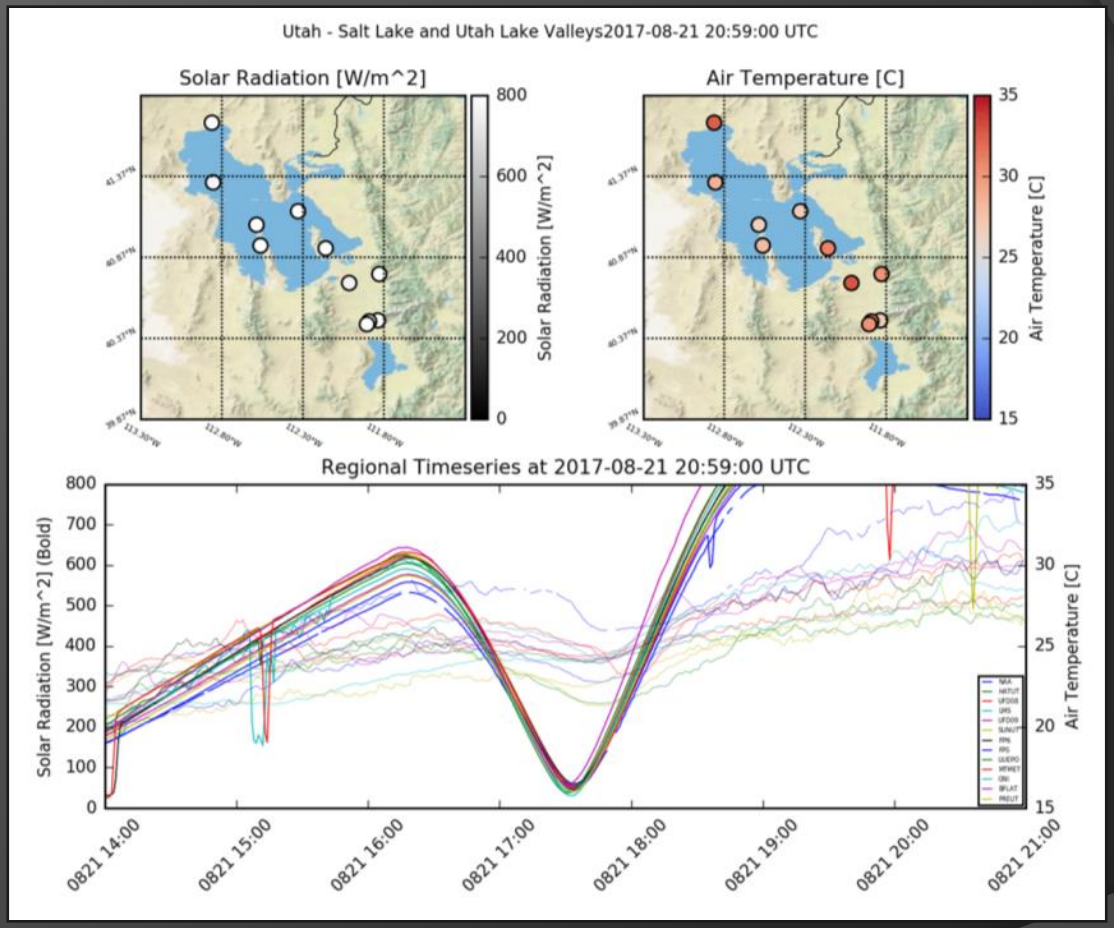


http://utahaq.chpc.utah.edu/

UUNET During Impact Weather

- 2017 Solar Eclipse (90% totality within Salt Lake Valley)



Courtesy: Mike Wessler (U/Utah Graduate Student)

- Updated remote station programs to record data at 1-minute frequency (usually 5-minute) for days surrounding the eclipse

UUNET Research Initiatives

- Collaboration with biology and geophysics researchers led to installation of remote camera systems at Gunnison Island and Bonneville Salt Flats weather stations

- Deployment of temporary sites around GSL with up/down shortwave radiation sensors to research lake surface albedo

- Deployment of long-term and temporary surface-based remote sensors (ceilometers, sodars, etc.) for boundary layer research

Summary

- UUNET stations deployed across/near the GSL help to fill a void in real-time surface-based observations immediately upstream of the urbanized Wasatch Front

- Ability to remotely access stations using real-time communications assists in diagnosing issues before annual visits due to land-access restrictions and logistics

- Data ingest/processing systems designed so that any CS logger with remote access via an IP/hostname could be added to the system
    - Lessens development of additional code by data providers
    - Reduces latency of data dissemination to NWS resources

- If you have a remotely-accessible CS station and wish to send data to MesoWest, contact us at atmos-mesowest@lists.utah.edu