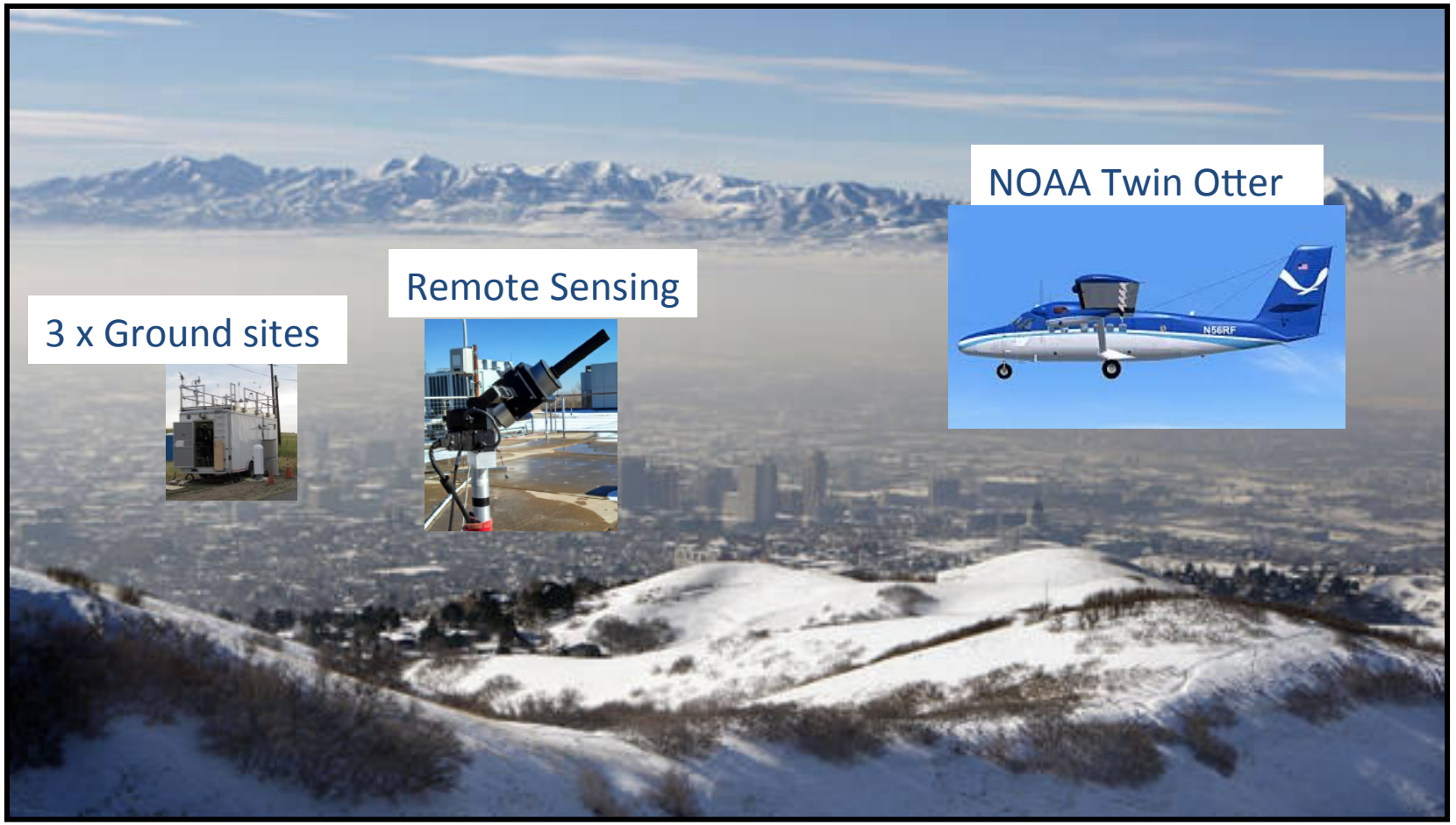
Utah Winter Fine Particulate Study (UWFPS)
January 15 – February 15, 2017
Salt Lake City and Adjacent Basins

Visit http://www.esrl.noaa.gov/csd/groups/csd7/measurements/2017uwfps/

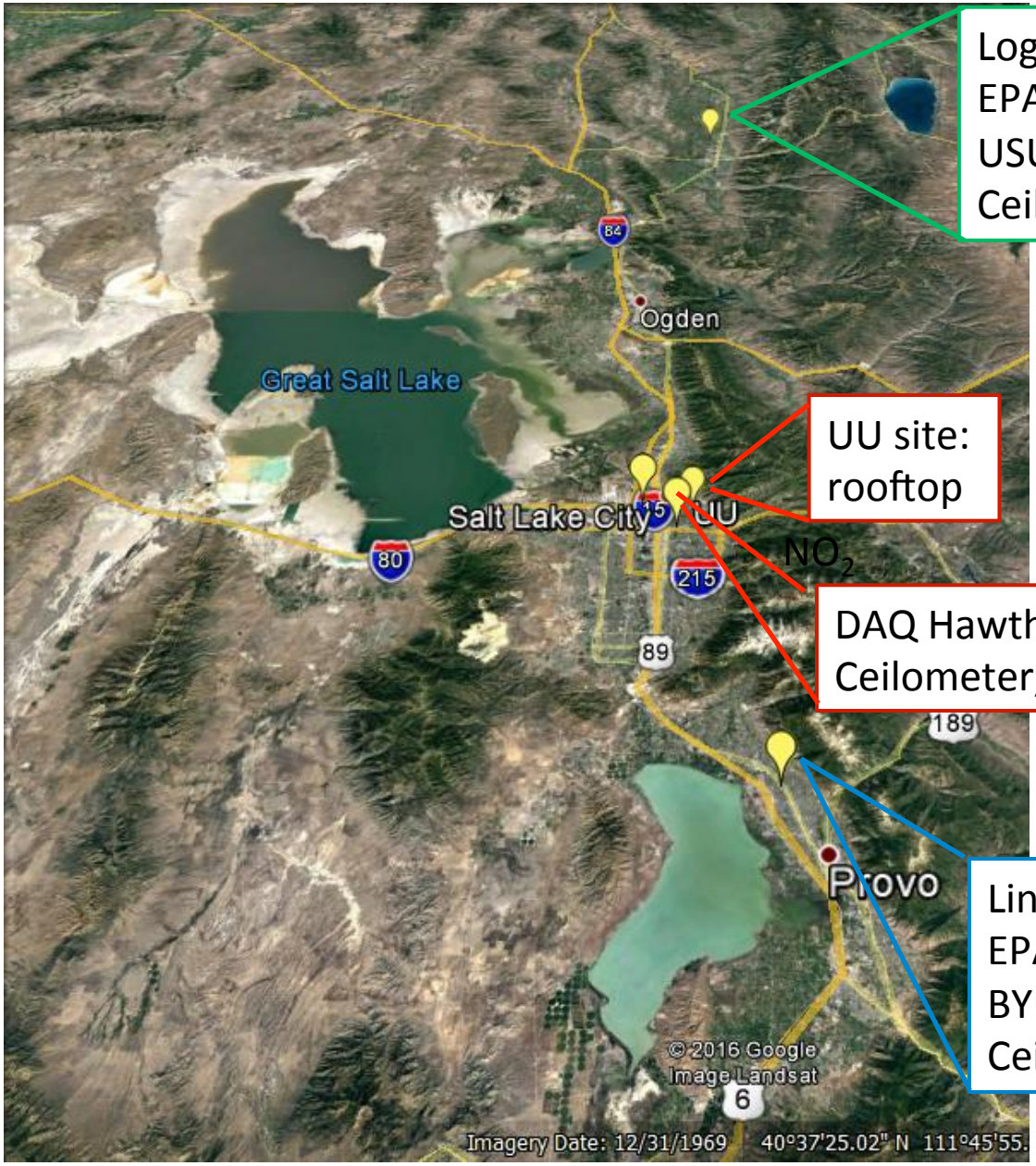
Components of UWFPS

A twin otter aircraft and ground based observations
to investigate the factors governing high $PM_{2.5}$ events in mountain basins of northern Utah



Ground-based Observations

Sites for Ground-based Observations



Logan site:
EPA trailer
USU
Ceilometer, PANDORA

UU site:
rooftop
NO_2

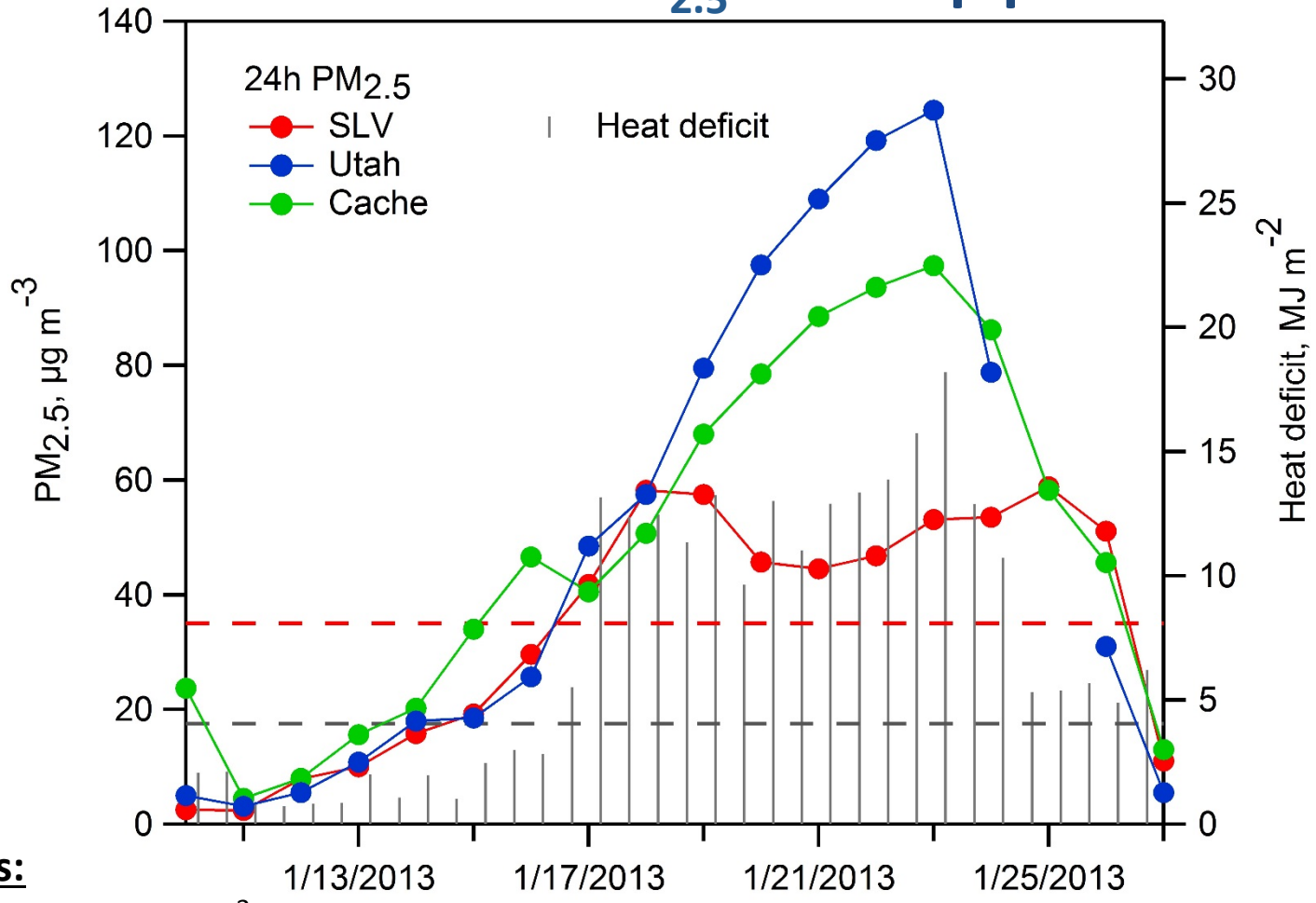
DAQ Hawthorne site:
Ceilometer, PANDORA

Lindon site:
EPA
BYU
Ceilometer, PANDORA

Salt Lake, Cache and Utah Valleys: Different chemical and met conditions lead to different $PM_{2.5}$ build-up patterns

<u>Salt Lake Valley:</u>

- $PM_{2.5}$ levels rarely exceed 60 µg m^{-3}.

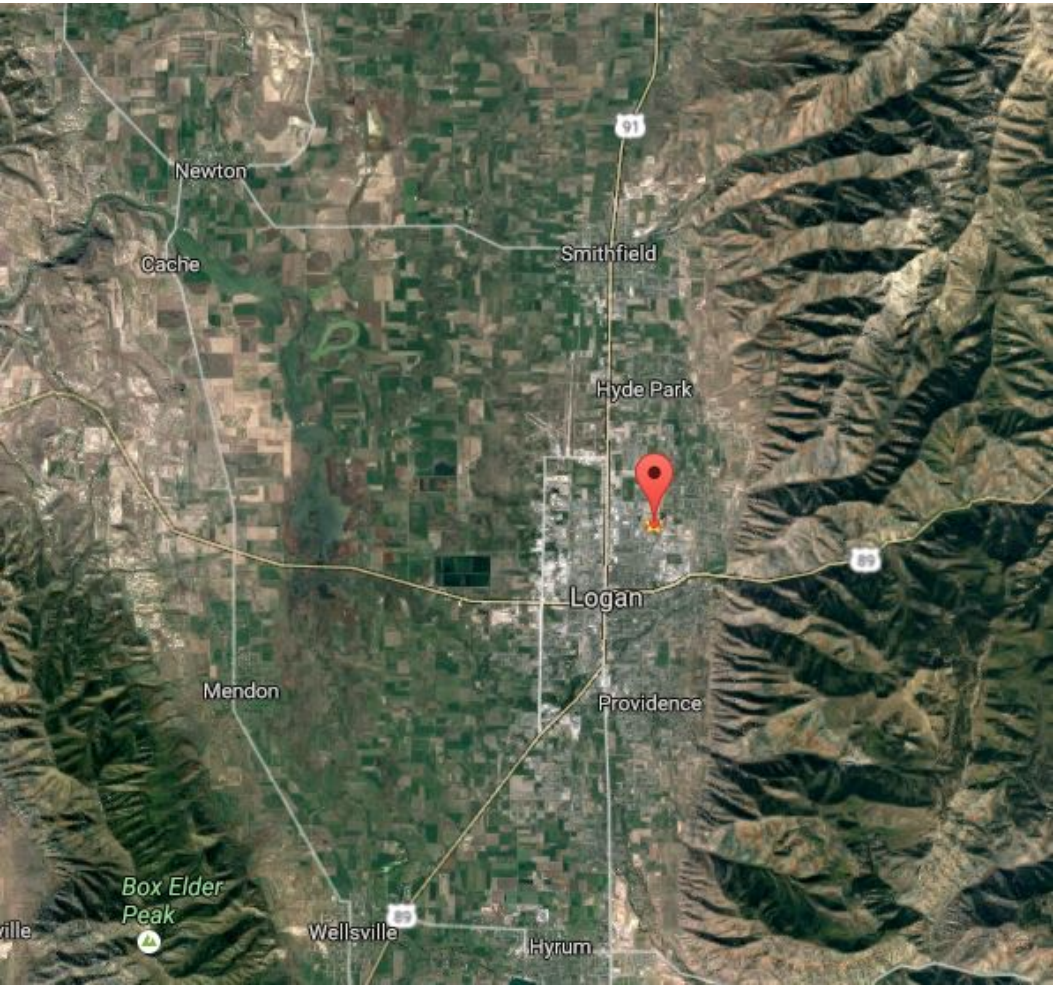


<u>Cache and Utah Valleys:</u>

- $PM_{2.5}$ can reach up to >120 µg m^{-3}.
- Experience often continuous build-up of $PM_{2.5}$ indicating more oxidant rich environment.

Ground-based observations provide continuous, detailed measurements of chemistry & met parameters

Cache Valley : USU Logan, Utah



- Population: ~ 125, 000
- Strong agricultural economy

Cache Valley : USU Logan, Utah

EPA trailer
USU

Instrument	Species Measured	PI
<u>Trace gas analyzers</u> T-API T200U T-API T500U CAPS 2B	 NOy, NO, NOy-NO, NO2 only O_3	Dr. Russell Long EPA ORD
~ 60 x canister sampling; 2 per day	VOC speciation	
Aerodyne Iodide CIMS	HNO3, N2O5, ClNO2, HONO	
TSI SMPS and UPC OPC	Size distribution from ultrafines through coarse	
2 x Tisch Hi-Vol samplers	PM composition: OA speciation, EC/OC, inorganic ions, C14, etc	
Aerodyne ToF AMS	Real-time PM_1 composition, size	
Ceilometer	time evolution of aerosol layer	
PANDORA	-Total column measurements of HCHO, NO_2, and O_3, -Altitude profiles	
Vaisala weather transmitter	Met parameters (T, RH, ws, wd etc.)	
??	NH_3	Dr. Randy Martin USU
R & P	OC/EC	

EPA Trailer

Utah Valley: DAQ's Lindon Station

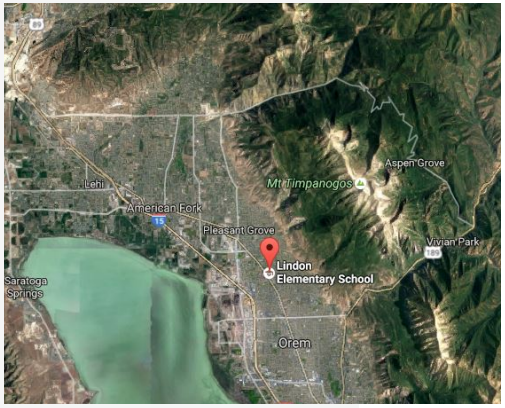
Trailer 1. UDAQ

Trailer 2. BYU

Trailer 1. UDAQ

- Population: ~575, 000

Instrument	Species Measured	PI
<u>Trace gas analyzers</u> Thermo 42iY Aerodyne CAPS 2B	 NOy, NO, NOy-NO, NO2 only O3	Dr. Russell Long EPA ORD
TSI APS	Size distribution from ultrafines through coarse	
2 x PM2.5 samplers	PM composition: OA speciation, EC/OC, inorganic ions, C14, etc	
Ceilometer	time evolution of aerosol layer	
PANDORA	-Total column measurements of HCHO, NO2, and O3, -Altitude profiles	
Organic Aerosol Monitor	Hourly speciated organic aerosol	Dr. Jaron Hansen/ Dr. Delbert Eatough BYU
Sunset	OC/EC	
AIM-IC	PM inorganic composition Visibility $PM_{2.5}$, PM_{10}, CO,, met parameters (T, RH, ws, wd etc.)	UDAQ



Salt Lake Valley: Rooftop Measurements at University of Utah

Atmospheric Sciences Building

Instrument	Species Measured	PI
AIM-IC	PM inorganics, HNO_3, NH3, HONO	Dr. Jen Murphy, University of Toronto
Passive sampler	PM OA speciation	Dr. Brent Williams, Washington University in St. Louis
SMPS; SMPS nano; APS	Size distribution from ultrafine through coarse	Dr. Gannet Hallar (University of Utah)
TEOM	$PM_{2.5}$ mass concentration	UDAQ
Trace gas analyzers	CO, NOx	
Trace gas analyzers	O_3,, CO_2, CH_4	Dr. John Lin group/ Munkh (University of Utah)
VOCs	PTR-MS	Dr. Munkh/ Dr. Dylan Millet (University of Minnesota)
Aerodyne QCL	HCHO	
Aerodyne CAPs	NO_2	Dr. Russell Long, EPA ORD
Pandora	Column HCHO, NO2, O3	
	Met observations, forecasting	Dr. Sebastian Hoch and E. Crossman (University of Utah)

Salt Lake Valley: DAQ's Hawthorn Site

Instrument	Species Measured	PI
SMPS; APS	Size distribution from ultrafine through coarse	Dr. Kerry Kelly (University of Utah)
Wind profile	LiDAR	Dr. Sebastian Hoch (University of Utah)
Ceilometer	Aerosol back scattering	Dr. Russell Long, EPA ORD
Pandora	Column HCHO, NO2, O3	
	$PM_{2.5}$, PM_{10}, PM2.5 speciation, CO,NOx, O3, met parameters (T, RH, ws, wd etc.)	UDAQ

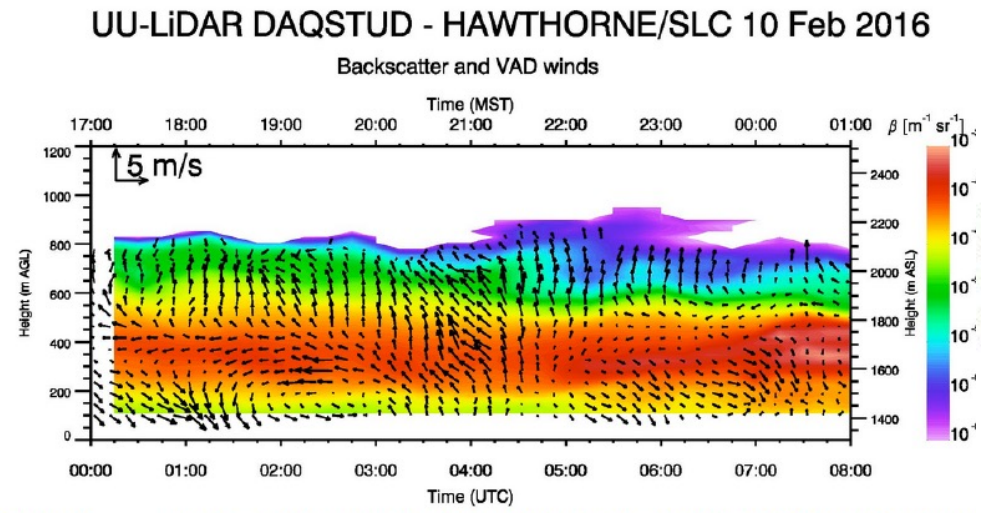
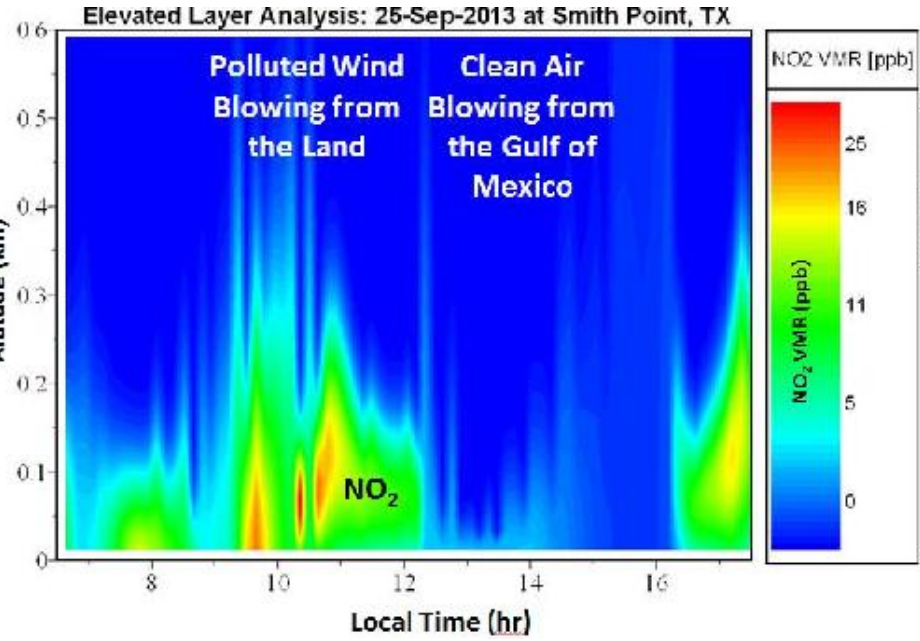
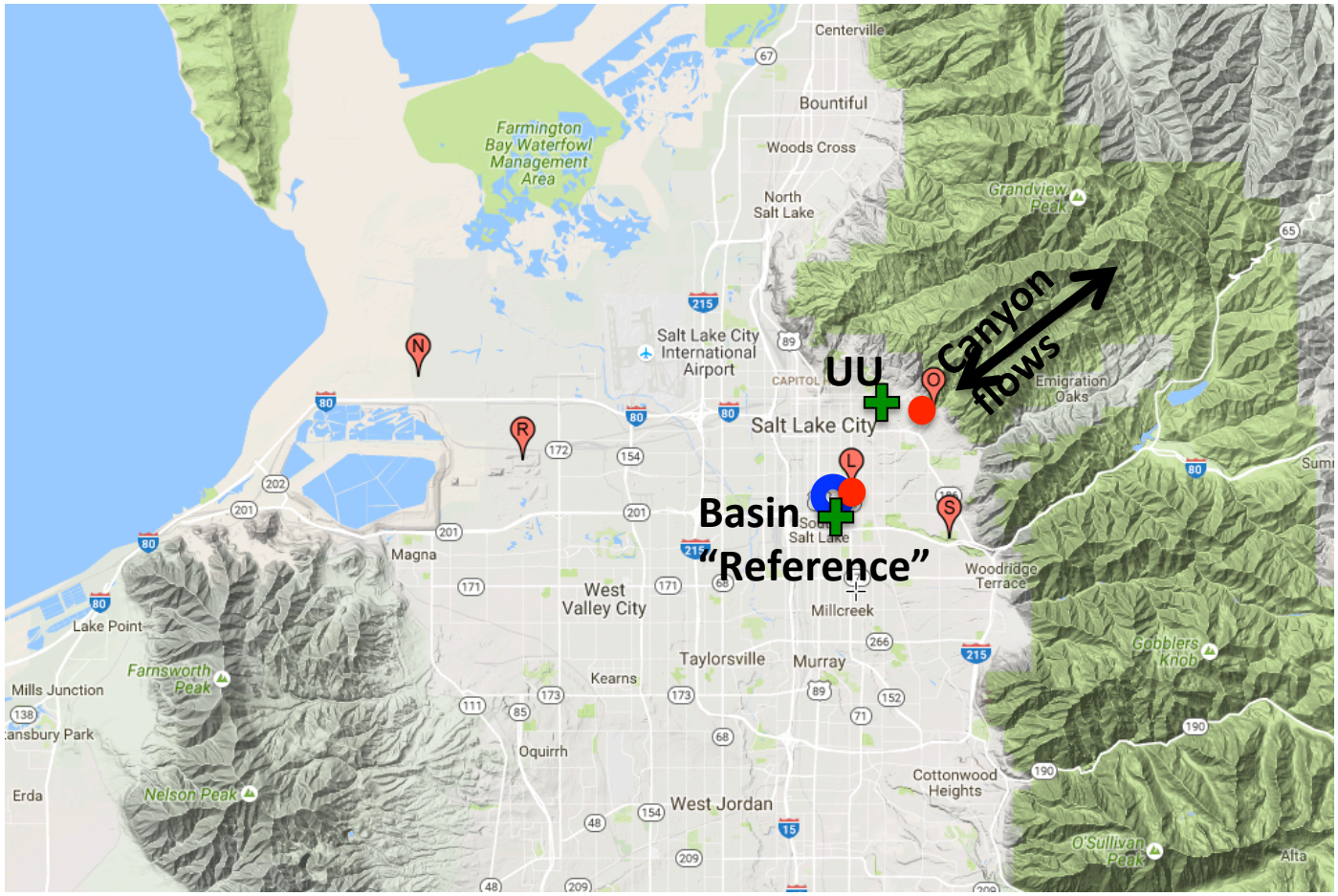


Figure 4: Example quicklook product (subset) showing the Doppler wind lidar retrieved vert profile of the wind field above the Hawthorne (HW) site.



Salt Lake City Basin

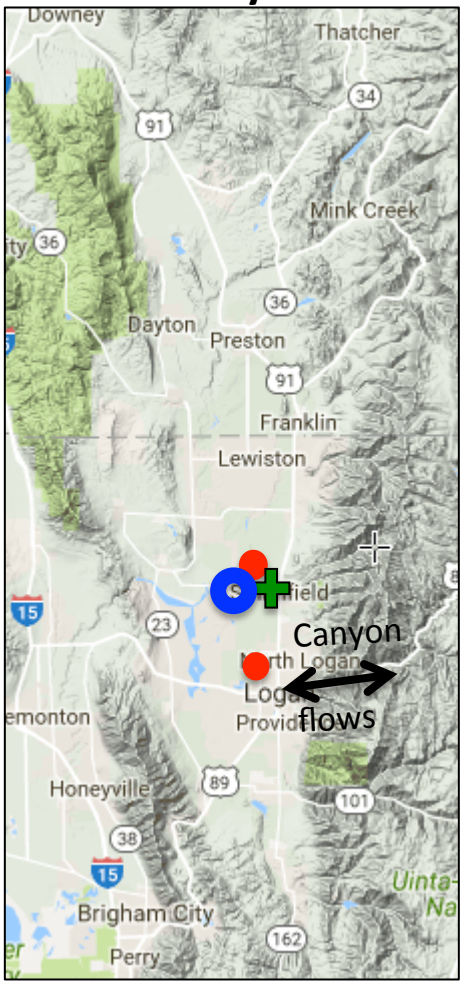


- Ceilometer
- LiDAR / SoDAR
- Pandora

Nighttime thermally driven flows will be the focus.

- Chemistry and dynamics are closely coupled during the pollution episodes.
- Transport of clean air is important in SLV. Need to quantify contributions of photochemistry and transport to oxidant budget.

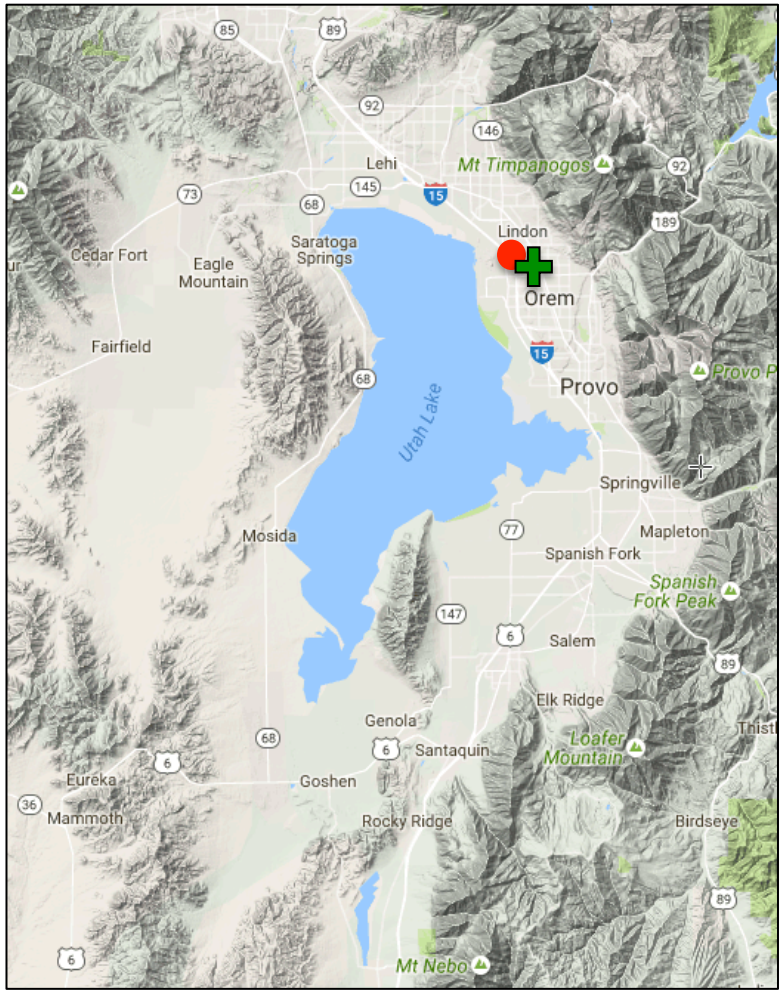
Cache Valley



- Ceilometer
- LiDAR / SoDAR
- Pandora

Co-location of instrumentation is planned to evaluate meteorological processes affecting the surface observations.

Utah Basin



Deployment University of Utah and EPA ORD resources for the UWFPS Project to study transport patterns

Aerosol Backscatter
Wind Profile
Pandora / Chemistry Profile

Salt Lake Basin

Hawthorne: UU LiDAR, ORD ceilometer-1, Pandora-1
Red Butte: UU ceilometer-fixed
UU: UU basic met observations, ORD Pandora-1

Cache Valley

Smithfield: ORD ceilometer-2, Pandora-2
Campbell: CS ceilometer-fixed

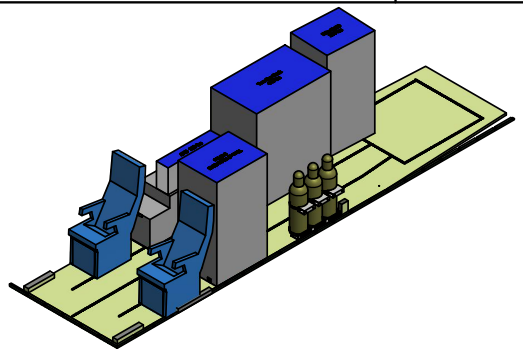
Utah Valley

Lindon: ORD ceilometer-3, Pandora-3

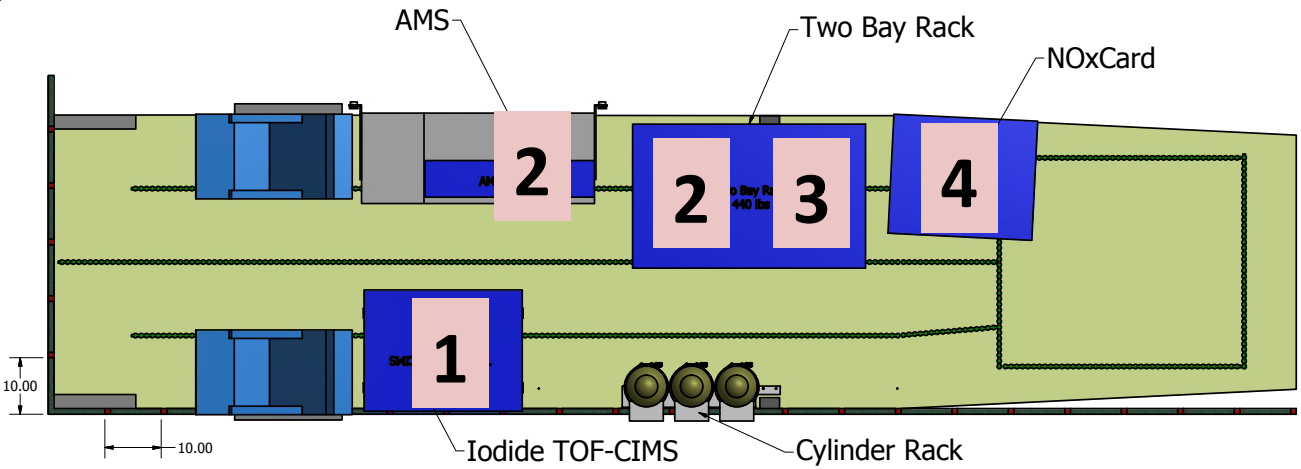
Tentative Schedule for Arrival & Installation

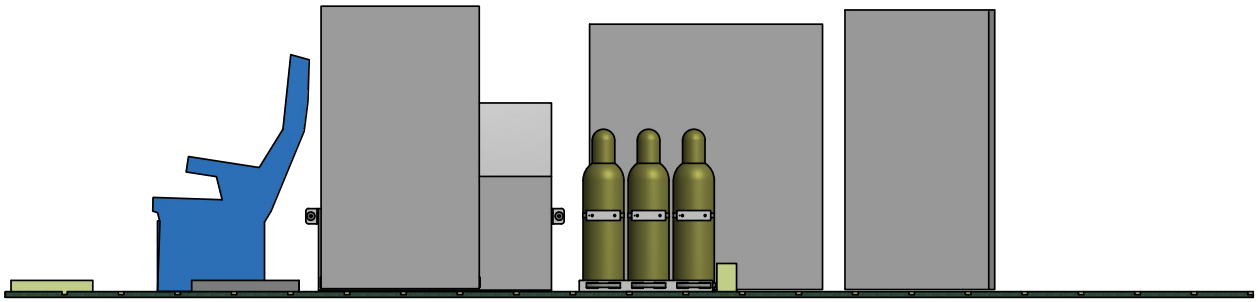
Start Date	Instrument	Who
December 15, 2016	Filter based samplers, AIM, CO analyzers, NOx, TEOM	UDAQ; locals
January 2, 2017	AIM-IC PTR-MS others	U. Toronto UMN
January 8-9	EPA trailer, remote sensing devices, analyzers	EPA ORD
	Ground sites : UU, Lindon, Cache	Ground team, BYU, UU met
January 15, 2017	Twin Otter Arrives	Twin Otter Team
February 15, 2017	End of Study	

Aircraft Planning Update



For the _instruments and cylinders alone_ (No passenegers, seats, table, computer, etc.)
The C.G. is 90 inches aft of the bulkhead.
Instrument C.G. is at station (90 + 112) = **Station 202**
The combined weight ~ 1500 lbs





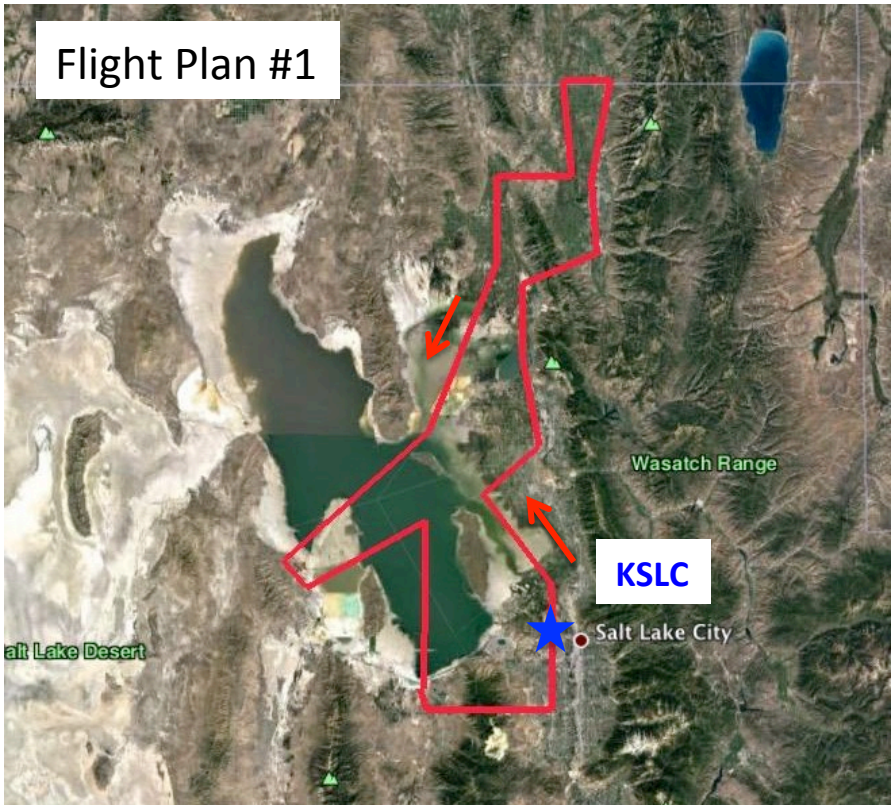
1. Iodide CIMS
2. AMS
3. NH3 QCL
4. NOxCaRD

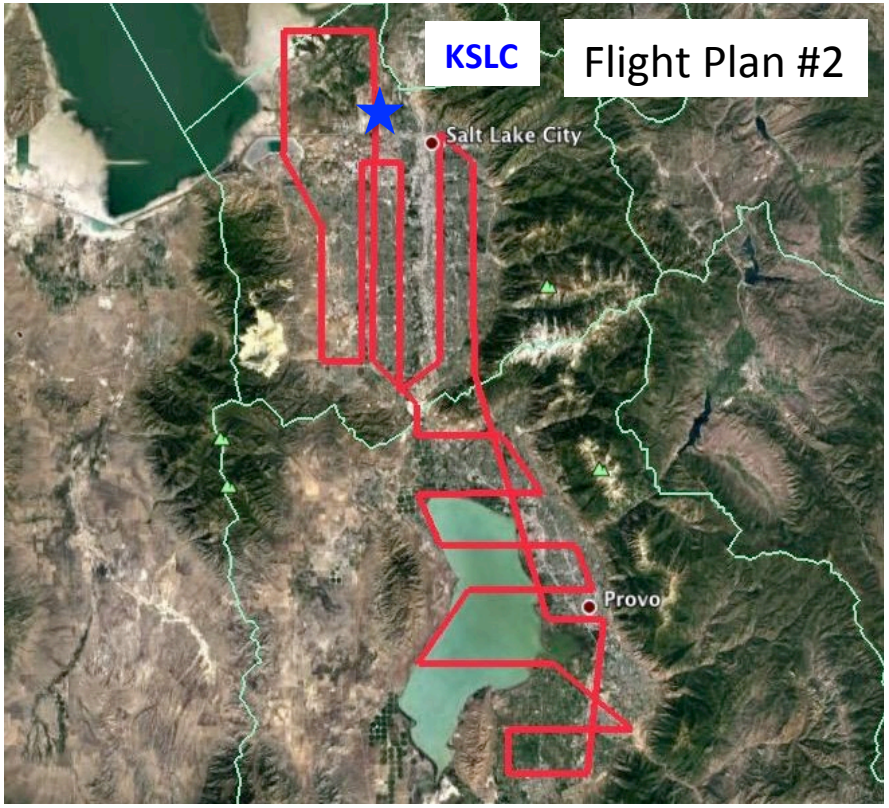
DRAWN bdube	11/16/2016		
CHECKED		TITLE	
QA			
MFG			
APPROVED		SIZE C	DWG NO Simple_N48_FloorPlanInstruments REV
		SCALE	SHEET 1 OF 1

Atmospheric Chemistry Instrument Payload

Measurement	Instrument	Investigator(s)
Aerosol Composition	Aerosol Mass Spectrometer	Ann Middlebrook, Ale Franchin, NOAA
Acid Gases (N_2O_5, $ClNO_2$, HNO_3, HONO)	Time of Flight Iodide Chemical Ionization Mass Spectrometer	Lexie Goldberger, Joel Thornton, University of Washington
NOx, NOy, O3	NOxCaRD, Custom Cavity Ring Down Spectrometer	Dorothy Fibiger, Erin McDuffie, Carrie Womack, Steve Brown, NOAA
NH_3	Infrared absorption (QCL)	Alex Moravek, Jennifer Murphy, University of Toronto
PM size distributions	Ultra high sensitivity aerosol spectrometer	Loaned from Jon Abbatt, University of Toronto
CO, CH_4	Picarro, CRDS	Loaned from Colm Sweeney, NOAA (tentative, no space in current payload layout)

Flight Plans





Flights are 2:45 in duration, will be carried out back to back on flight days

Plans will be updated to include the following:

- One plan with intensive sampling over the east bench area of the salt lake valley
- Less emphasis on Utah valley and more on southern Great Salt Lake on flight plan #2

Aircraft Schedule

January 3: Twin Otter arrives at NCAR Research Aviation Facility (RAF), Broomfield CO

January 3 – 14: Integration and test flights

January 15: Transit to Salt Lake City. Twin Otter based at TAC Air, Salt Lake City International Airport

January 17 – February 12: Research flights in Great Salt Lake basin

27 Flight days, approximately 78-80 flight hours

February 13: Transit back to Colorado

February 14: De-installation at RAF

February 15: Twin Otter departs for next mission

Scientific Coordination During the Campaign

Aircraft measurements: Steve Brown (NOAA)
Ground based measurements: Munkh Baasandorj (UDAQ, U of U)

• Meeting(s) that include ground-based and aircraft investigators to discuss operations and preliminary scientific results will serve to coordinate the multiple ground site and aircraft operations and data

(Note that aircraft investigators will have daily meetings at UDAQ, to be announced separately to that group)

• Campaign schedule is very tight (one month intensive operating period), so such meetings will be optional and may be dependent on the aircraft schedule

• Suggested dates and location:

Monday, January 16, 9 AM WBB building at University of Utah, Room TBD

Day after twin otter transit: very tentative for aircraft investigators!

January 30, 9 AM WBB building

February 10 WBB building

Data Submission and Archiving

• Data from the NOAA twin otter aircraft will be archived at the campaign web site

http://esrl.noaa.gov/csd/groups/csd7/measurements/2017uwfps/TwinOtter/DataDownload/index.php?page=/csd/groups/csd7/measurements/2017uwfps/TwinOtter/DataDownload/

Site will be password protected during and immediately after the campaign. NOAA data policy required removal of password protection to make data publicly available after quality controlled, final data have been submitted.

Username: UWFPS
Password: S@ltLake!

• Archiving the data from multiple ground sites in a manner accessible to all investigators will help in coordinating scientific analyses.

Ken Aikin (NOAA/CSD data manager) will organize a tab on the data web site for each of the four ground sites and the twin otter

Steve Brown will circulate instructions for posting data to this site. ICARTT data format will be strictly adhered to. Data submitted in other formats will be rejected.

Schedule for Data Submission and Reporting NOAA Twin Otter Project

Task	Date
Field intensive measurement dates	January 15 – February 13
Webinar / discussion for preliminary findings	May 2017 (Day TBD)
Preliminary data submission to DAQ and NOAA Archive	August 1, 2017
Technical progress report	August 1, 2017
Draft report submitted to Utah DAQ	September 15, 2017
Final data submission to DAQ and NOAA Archive	October 1, 2017
Final report submitted to Utah DAQ	March 1, 2018

- No current schedule or requirement for archiving of data or reporting for ground-based intensive operations

- Coordination of data from ground based and aircraft data will strengthen conclusions from the entire study

- Are ground based investigators willing to adhere to the schedule above and contribute to the planned reporting from the twin otter investigation?

Scientific Meetings to Follow Field Intensives

• Meetings of aircraft and ground based investigators after the field intensive will be helpful in completion of the reporting requirements and coordinating publication of results

• No specific budget set aside currently to support travel to one or more meetings, but we (Munkh and Steve) will look into options for such support. Suggestions welcome.

• A science team meeting in the time frame around January 2018 would fall between the October 1 target for final data and the March 1 target for a final report

• Options for special sessions at national meetings:

AGU	December 2017 or 2018
AAAR	October 2017 or 2018
AMS	January 2018 or 2019

Special sessions at national meetings could bring together researchers from the Utah study (or studies) with those from other regions with similar air quality issues (e.g., California, recent DISCOVER AQ campaign)

Communications and Publicity

• Meeting on November 1 between UDAQ, NOAA and EPA communications groups to discuss publicity and outreach during the study

• Desire to hold a media event or publicity day during the study, but exact date and coordination with local media have not been set. Ongoing discussion likely to follow this meeting.