Observing Spatial and Temporal Variations in Air Quality in the Salt Lake Valley Using Mobile Platforms

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Motivation for Study

Improved understanding of the spatial complexity and temporal variability of air pollutants during both summer and winter are needed along Utah's Wasatch Front.

Methodology:

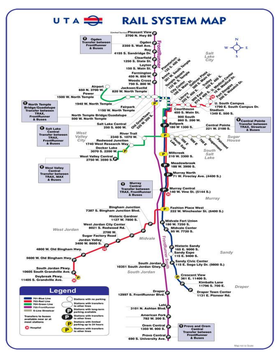
- Continuously measure greenhouse gases & criteria pollutants across the Salt Lake Valley along a fixed spatial route using a light rail car as a measurement platform.
- Targeted mobile observations in a news helicopter and several vehicles during summer 2015 during the Great Salt Lake Summer Ozone Study ($GSLSO_3S$).

Goals:

- Test the feasibility of using a light rail platform to measure across rural and urban typologies.
- Supplement surface data from light rail platform with helicopter data aloft and additional mobile vehicles
- Improve understanding of the spatial and temporal patterns of greenhouse gases & criteria air pollutants.

Utah Transit Authority (UTA) TRAX light rail system:

- Red Line: traverses the entire Salt Lake Valley (northeast to southwest)
- Green Line: runs from the SLC airport to West Valley.



KSL Chopper 5

Often traverses Salt Lake Valley along major traffic corridors at elevation between 200-800 m AGL.

Sometime travels outside of the SLV for breaking news

Great Salt Lake research flight on June 17th 2015.

Mobile Units

Several vehicles were instrumented .

Instrumentation

TRAX

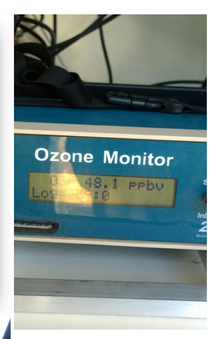
- Dec 8, 2014 to present.
- Sensors and sampling on roof.
- Measures $PM_{2.5}$, PM_{10}, CO_2, CH_4 .and O_3.

KSL Chopper 5

- 17June-present.
- 2B Technology O_3 sensor

Department of Atmospheric Sciences Truck and Nerdmobile

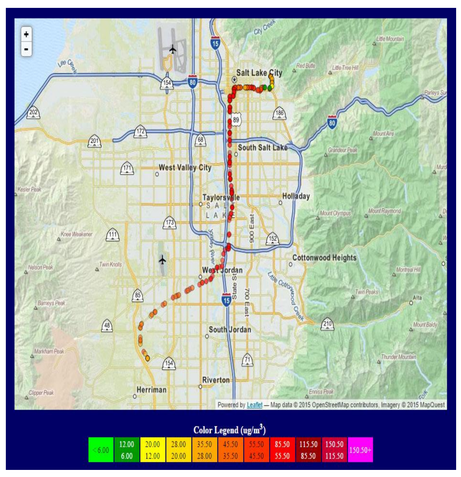
- 17June-present only during intensive observational periods.
- 2B Technology O_3 sensor.



Upcoming TRAX Possibilities

- Expand TRAX setup to additional rail cars to increase spatial & temporal coverage.
- Low-cost sensors on additional trains.
- Additional trace gas species that could be added include: (a) NOx (NO_2 and N_2O) would assist in closing the ozone budget, (b) ethane (C_2H_6) would provide a distinction between biogenic & fossil CH_4 sources, and (c) radon (^{222}Rn) would constrain local atmospheric mixing.

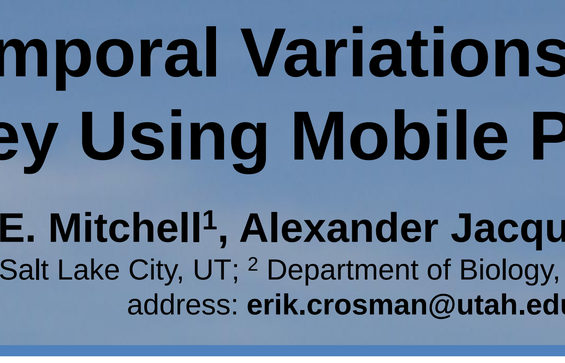
Particulate Matter (PM)



Two optical particle counter instruments: measure PM

(1) Met One E-Sampler, heated inlet, $PM_{2.5}$ cyclone, 1-minute averages.

(2) GRIMM 1109, no heated inlet, PM in 31-size channels (0.25-32 µm), 6-sec resolution.



- Higher $PM_{2.5}$ observed frequently along the central urban corridor with lower $PM_{2.5}$ on the valley benches.
- Red Line allows for quasi-vertical profiles of $PM_{2.5}$ & GHGs during inversions.

Comparative $PM_{2.5}$ analyses underway:

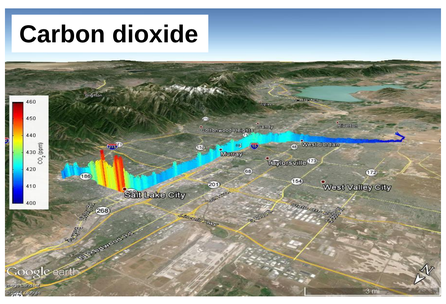
(1) E-Sampler vs. GRIMM as $PM_{2.5}$ instruments.

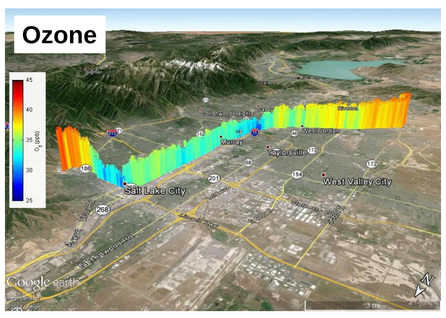
(2) Mobile versus fixed-site observations maintained by Utah DAQ (Hawthorne).

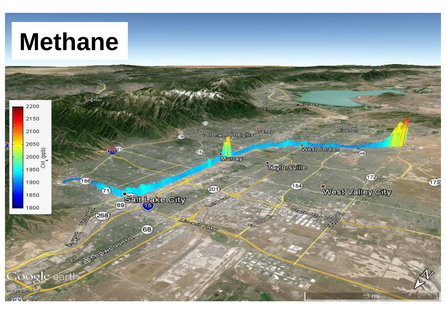
(3) CO_2 as a surrogate proxy for $PM_{2.5}$.

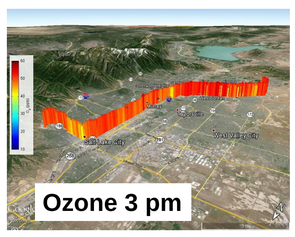
Summer 2014 TRAX Averages

Computed over the course of month Aug-Sept 2014









The Salt Lake Valley measurement programs:

(a) TRAX light rail network (http://meso1.chpc.utah.edu/mesotrax/)

(b) Great Salt Lake Summer Ozone Study (http://meso2.chpc.utah.edu/gslso3s/)

(c) 5-station, urban CO_2 network (http://co2.utah.edu)

(d) MesoWest (http://mesowest.utah.edu/)

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Mountain Meteorology Group

THE UNIVERSITY OF UTAH

GSLSO3S 2015

Real Time TRAX Data:

UTA TRAX

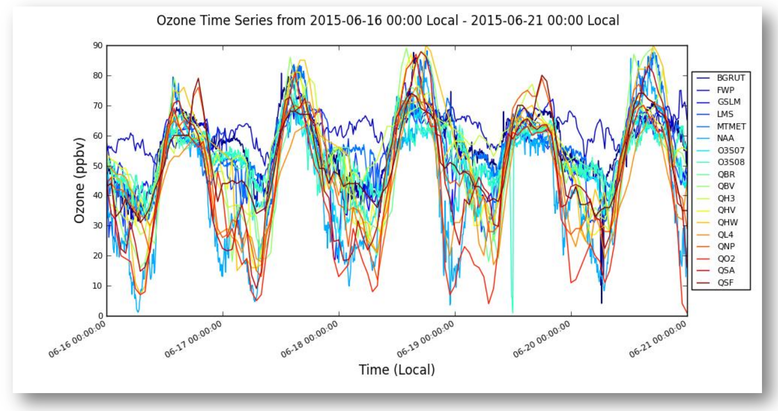
Mobile Ozone Observations during the Great Salt Lake Summer Ozone Study ($GSLSO_3S$) June-August 2015

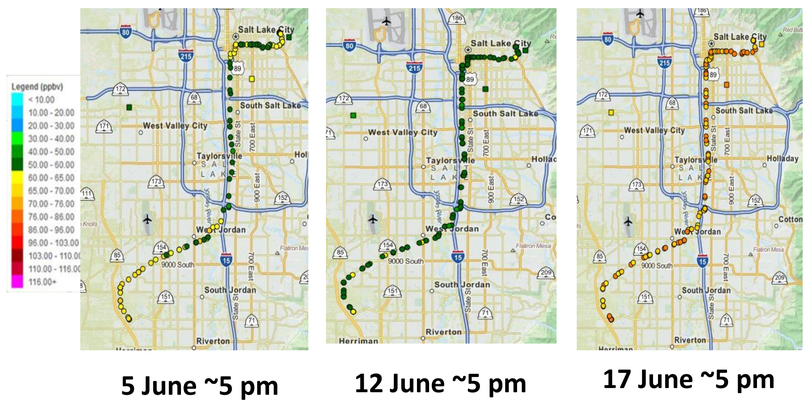
Goals of study:

- What is the influence of GSL on ozone formation on Wasatch Front?
- What is the spatial and temporal distribution of ozone?
- Document the meteorology of high ozone events
- Increase accuracy of pollution forecasting

- More details on the study can be found at the study website:

https://gslso3s.wordpress.com/





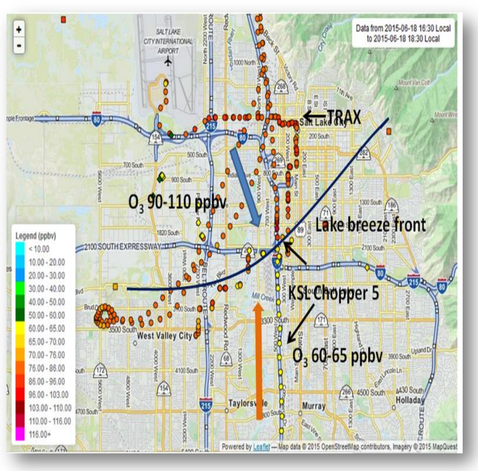
5 June ~5 pm | 12 June ~5 pm | 17 June ~5 pm

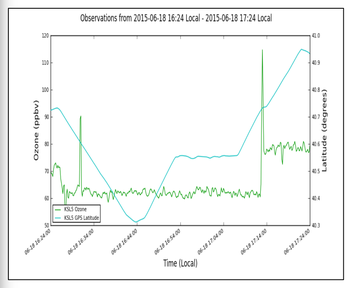
Initial $GSLSO_3S$ Study Findings

- High spatial and temporal variations in O_3 over and surrounding the Great Salt Lake.
- Complex terrain meteorology and lake breezes are important factors in precursor transport and afternoon ozone transport.
- KSL chopper has given insight into background ozone and elevated layering of ozone above the urban core.
- Great Salt Lake temperature may play a role in modulating shallow boundary-layer depth and ozone concentrations.
- Biogenics, playa albedo enhancements, wildfire smoke, and chlorine chemisty over Great Salt Lake brine may all be important .

Chopper on June 17th

Truck transects on 17 June 2015





18 June Lake Breeze Front

- Mobile truck, TRAX, and KSL Chopper sensors provided unprecedented view of spatial ozone distribution with Great Salt Lake breeze front.
- Much higher O_3 at and behind lake breeze front.
- Spike in O3 at breeze front (up to 115 ppb).
- 20 ppb increase across front.