The Great Salt Lake Ozone Study

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$GSLSO_3S$ Team

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Utah Division of Air Quality – Seth Arens, Munkh Baasandorj

Background

- High ozone at two sites close to the Great Salt Lake (GSL) 2010-2014
- GSL a closed basin
  - Accumulation, distribution of pollutants
- Increased albedo, increased rate of ozone formation
- Chlorine chemistry

Project Goals

- Influence of GSL on ozone formation on Wasatch Front
- Spatial and temporal distribution of ozone
- Meteorology of high ozone events
- Increase accuracy of pollution forecasting

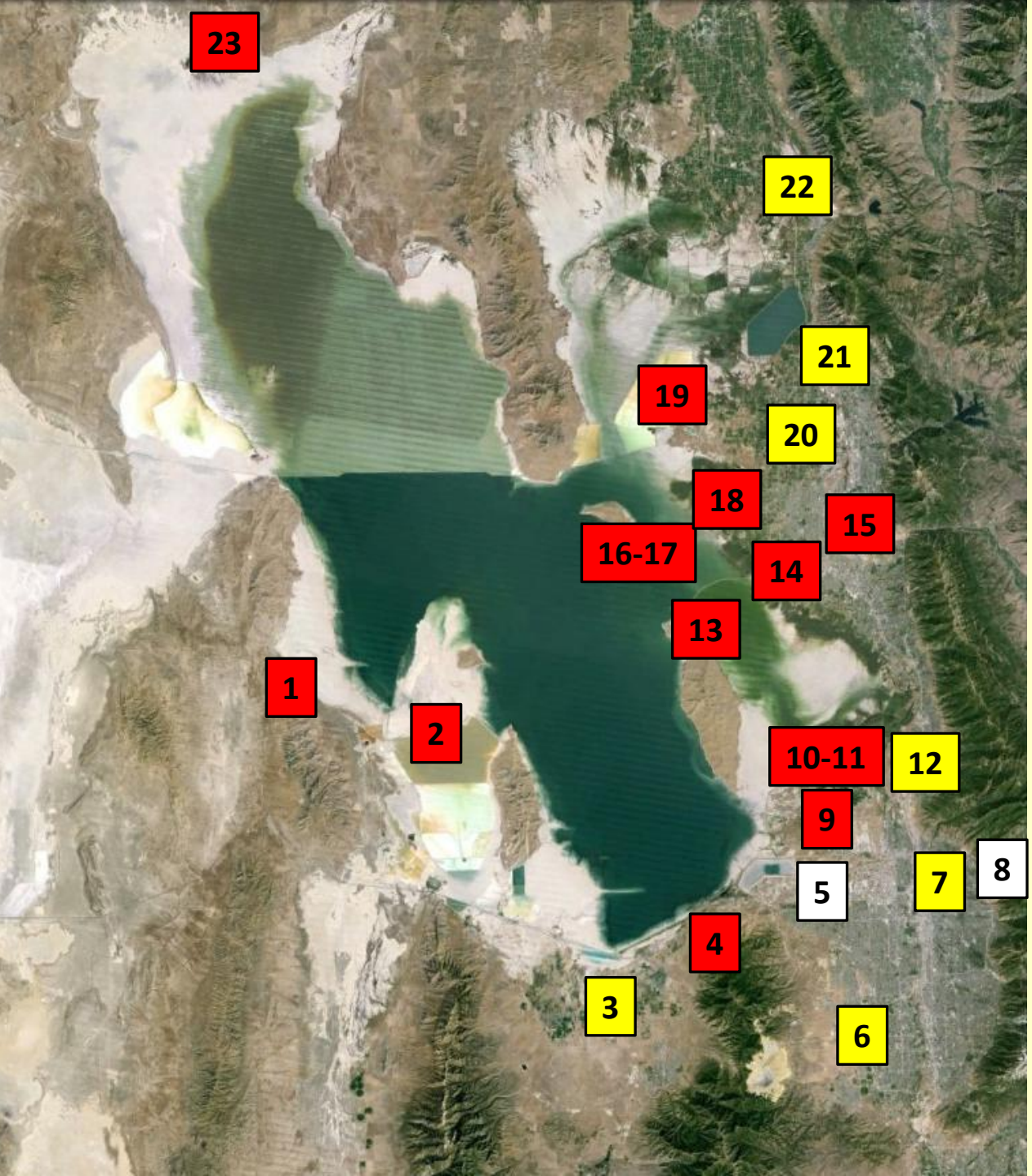
Measurements Summer 2015

- **In situ ozone and met**
- 7 permanent sites
- 16 temporary sites
  - 5/15 – 9/15
- Sodar (3)
- Lidar (1)

- **Mobile ozone**
- 2-3 vehicles
- TRAX red line
- KSL new chopper
- Conway Shipping trucks
- UAV
- Tethersonde

Intensive Operating Periods

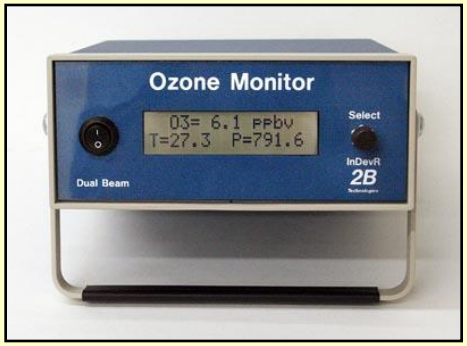
- IOP #1
  - 6/17 - 6/18/15
  - High ozone
- IOP #2
  - 7/15 – 7/16/15
  - Low to moderate ozone
- IOP#3
  - 8/3 – 8/7/15
- In situ through 9/15



1. Lakeside
2. Badger Island
3. Erda
4. Farnsworth Peak
5. Neil Armstrong Acad. (U of U)
6. Herriman (DAQ)
7. Hawthorne (DAQ)
8. Mountain Met. (U of U)
9. Saltaire
10. Farmington Bay – Goose I.
11. Farmington Bay – Miller Flat
12. Bountiful (DAQ)
13. Antelope Island
14. Syracuse
15. Hill Air Force Base
16. Fremont Island Summit
17. Fremont Island Kate's point
18. Ogden Bay WMA
19. Great Salt Lake Minerals
20. Ogden (DAQ)
21. Harrisville (DAQ)
22. Brigham City (DAQ)
23. Locomotive Springs

Temporary Ozone/Met sites

Lakeside



Portable ozone monitor – 2B Technologies, model 205

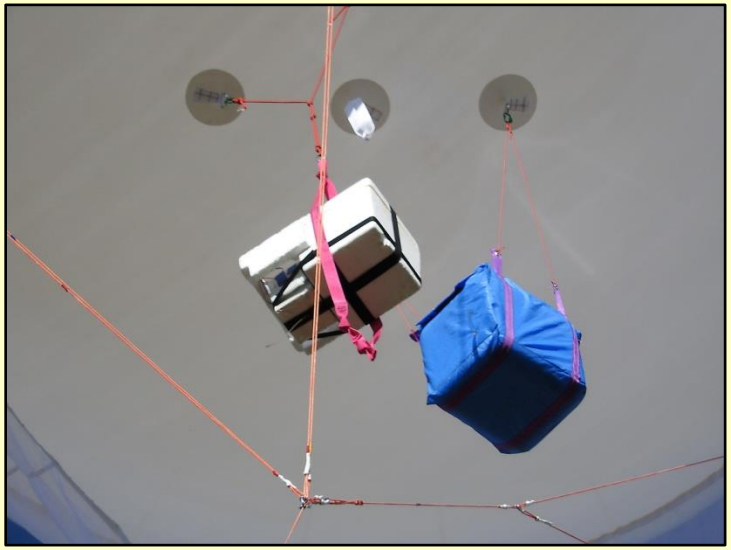
Ogden Bay WMA

Mobile ozone

- "Nerdmobile"
  - Ozone, CO_2, CO, CH_4, Nox, met
- U of U truck
  - ozone
- TRAX
  - Red and Green line
- KSL News Helicopter
  - During IOP
  - Random times when pilot flies

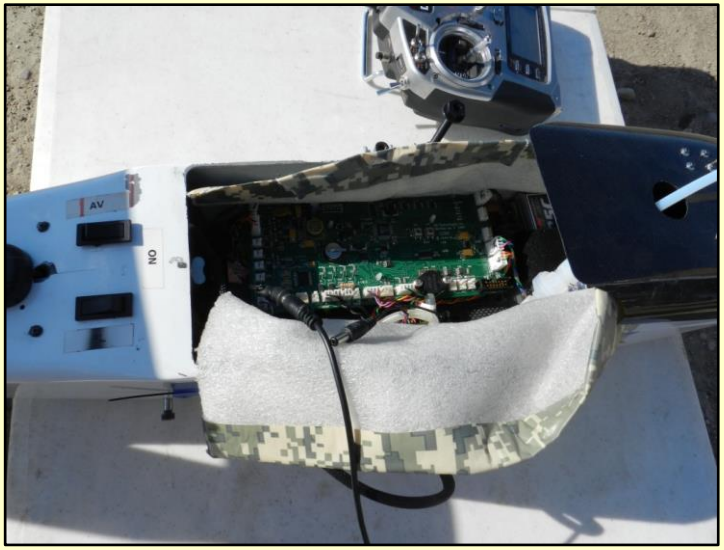
Tethersonde

- Tethered balloon
- 500 ft A.G.L. flights
- Ozonesonde
- Radiosonde
  - GPS, temp, pressure
- AtmoSniffer
  - O3, NO2, SO2, CO, NH3, PM2.5



Unmanned Aerial Vehicle (UAV)

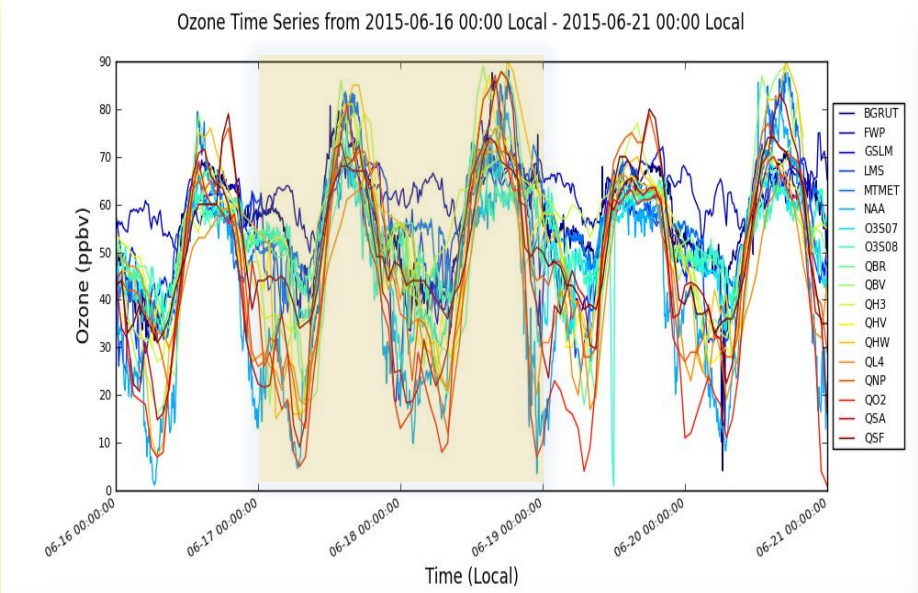
- Vertical ozone transects
- Temp, WS, WD, pressure
- Promontory Point in IOP 2-3
- 1 mile radius at 600 m A.G.L.



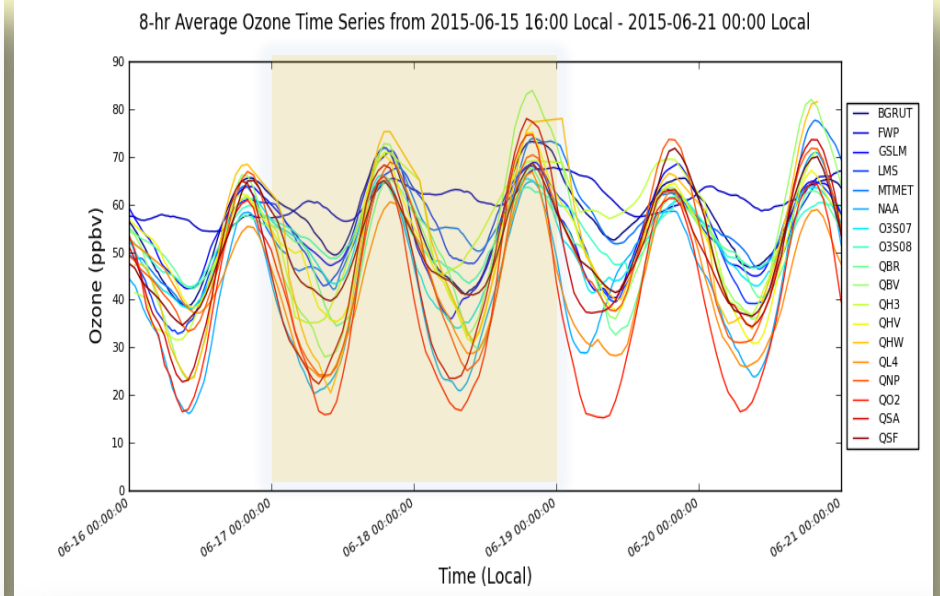
IOP 1
June 17-18, 2015

Fremont Island summit 6/1/15

In-situ Ozone Summary



Station ID	Average	Range	Maximum ▲	Max Local Time
Hawthorne (QHW)	53.27	83.00	90.00	2015-06-18 18:00
Bountiful - Viewmont (QBV)	52.08	73.00	89.00	2015-06-18 14:00
U of U Mountain Met Lab (MTMET)	57.02	61.20	88.20	2015-06-18 18:15
Saltaire (QSA)	46.88	78.74	87.80	2015-06-18 17:00
Badger Island (BGRUT)	56.86	83.50	87.60	2015-06-18 15:30

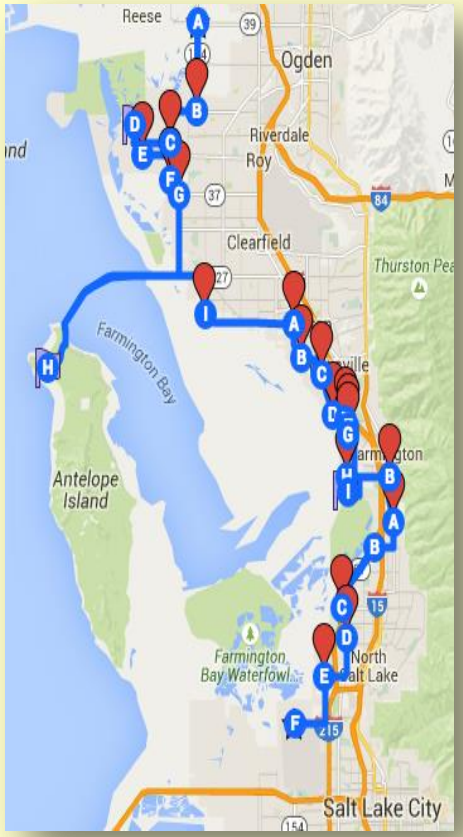


Station ID	Average	Range	Maximum ▲	Max Local Time
Bountiful - Viewmont (QBV)	52.00	60.88	83.88	2015-06-18 20:00
Hawthorne (QHW)	48.97	61.07	81.50	2015-06-20 20:00
Saltaire (QSA)	47.18	55.64	77.98	2015-06-18 19:00
U of U Mountain Met Lab (MTMET)	56.51	39.53	77.61	2015-06-20 19:35
Harrisville (QHV)	51.35	44.25	75.12	2015-06-18 20:00

“Nerdmobile”

– Transects between North Ogden, Antelope Island, and SLC Airport

- 6/17 – 3 transects
- 6/18 – 4 transects



U of U Truck #1 and#2

- 6/17/15
  - Promontory Point
    - Start 7:45 AM
    - End 6:00 PM
  - I-80 to Badger Island
    - Start 9:00 AM
    - End 1:30 PM
- 6/18/15
  - Promontory Point

TRAX

6/17/15

Red Line

6/18/15

Green Line

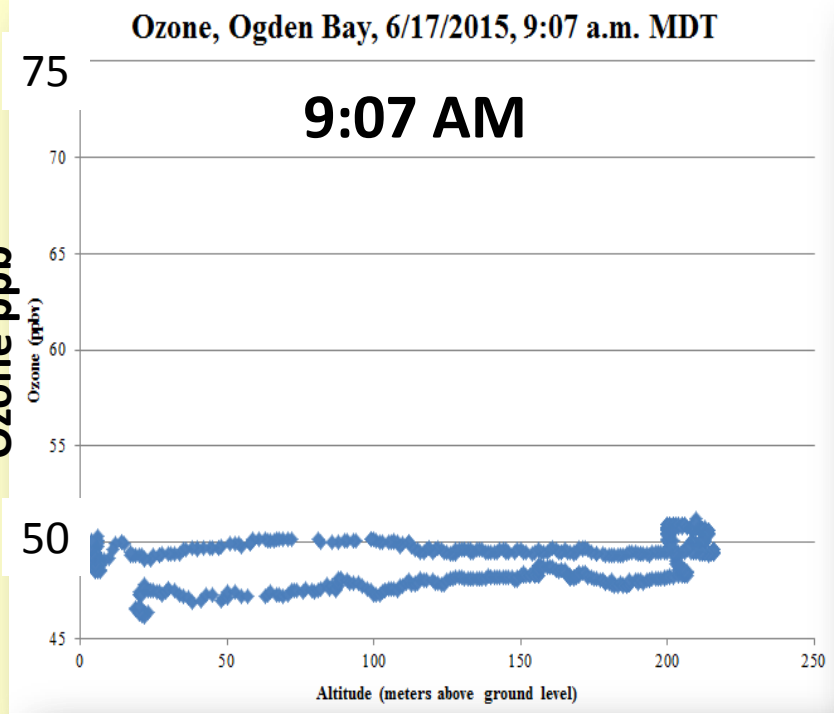
KSL Chopper 5

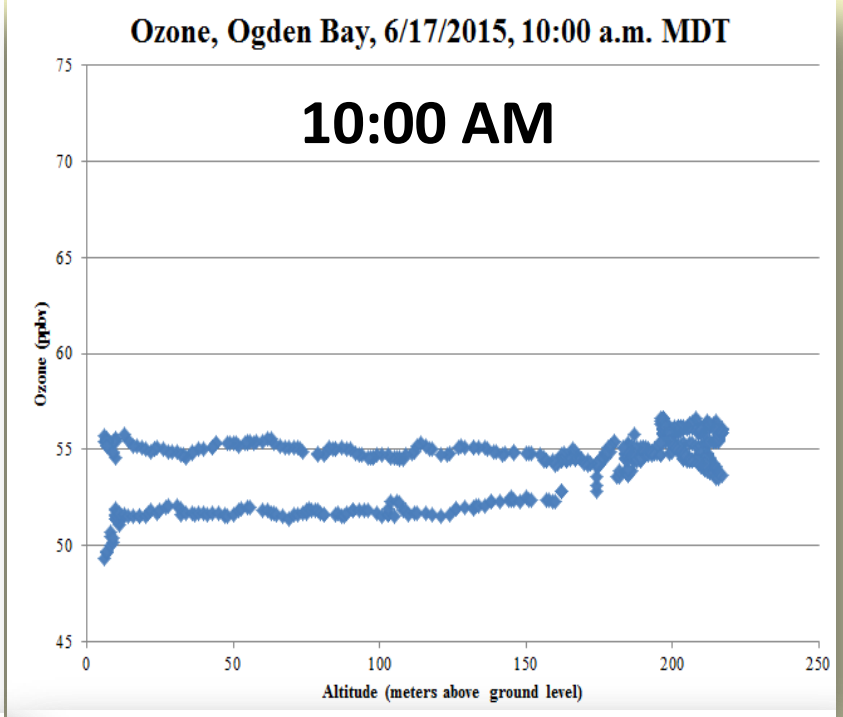
6/17/15
Afternoon

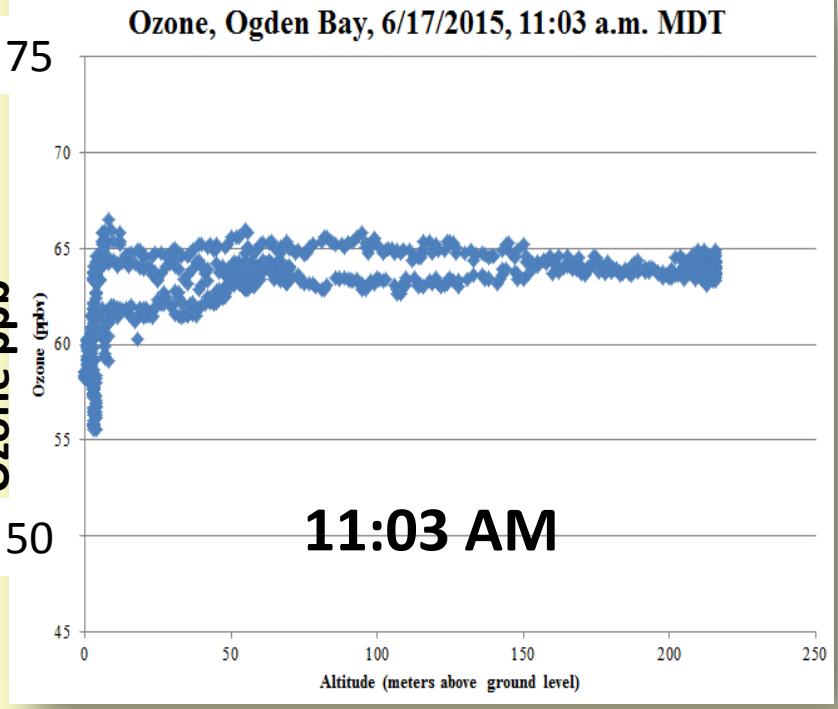
6/18/15
Afternoon

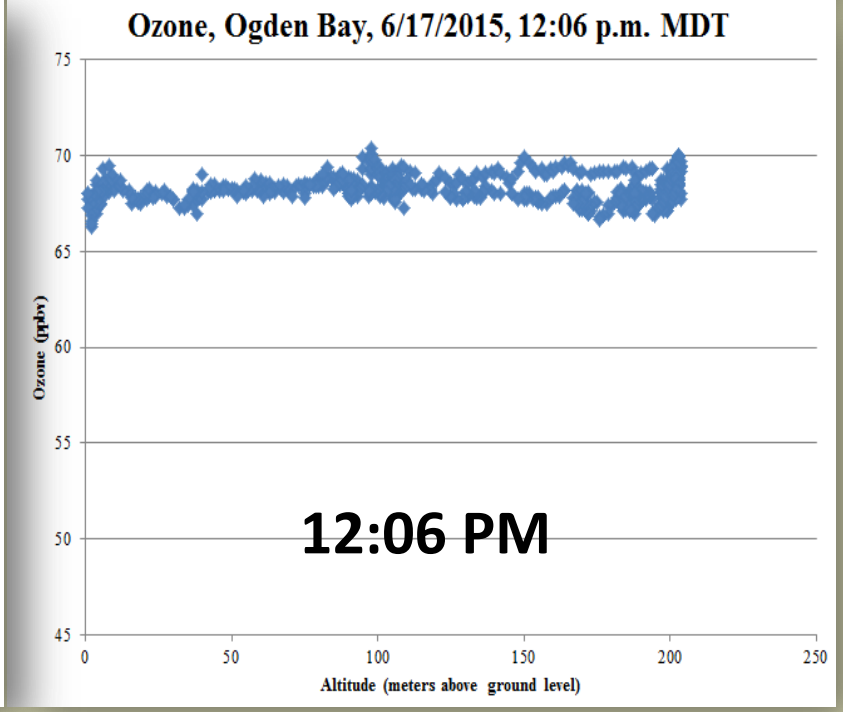
6/18/15
Evening

Tethersonde ozone 6/17/15
Ogden Bay WMA

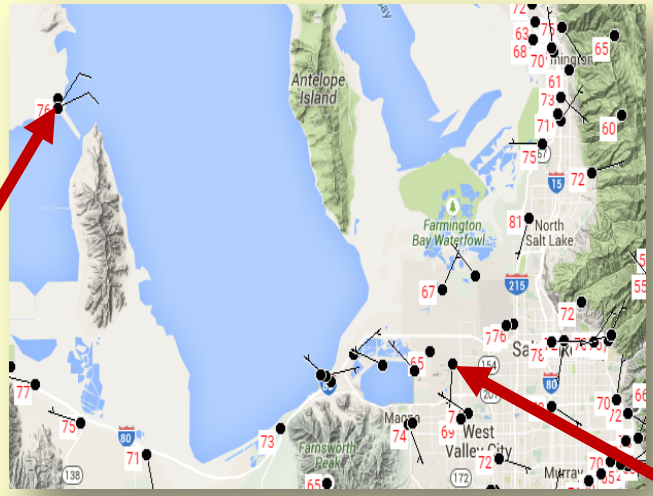

Ozone, Ogden Bay, 6/17/2015, 9:07 a.m. MDT
9:07 AM
Ozone ppb
Ozone (ppbv)
Altitude (meters above ground level)


Ozone, Ogden Bay, 6/17/2015, 10:00 a.m. MDT
10:00 AM
Ozone (ppbv)
Altitude (meters above ground level)


Ozone, Ogden Bay, 6/17/2015, 11:03 a.m. MDT
11:03 AM
Ozone ppb
Ozone (ppbv)
Altitude (meters above ground level)

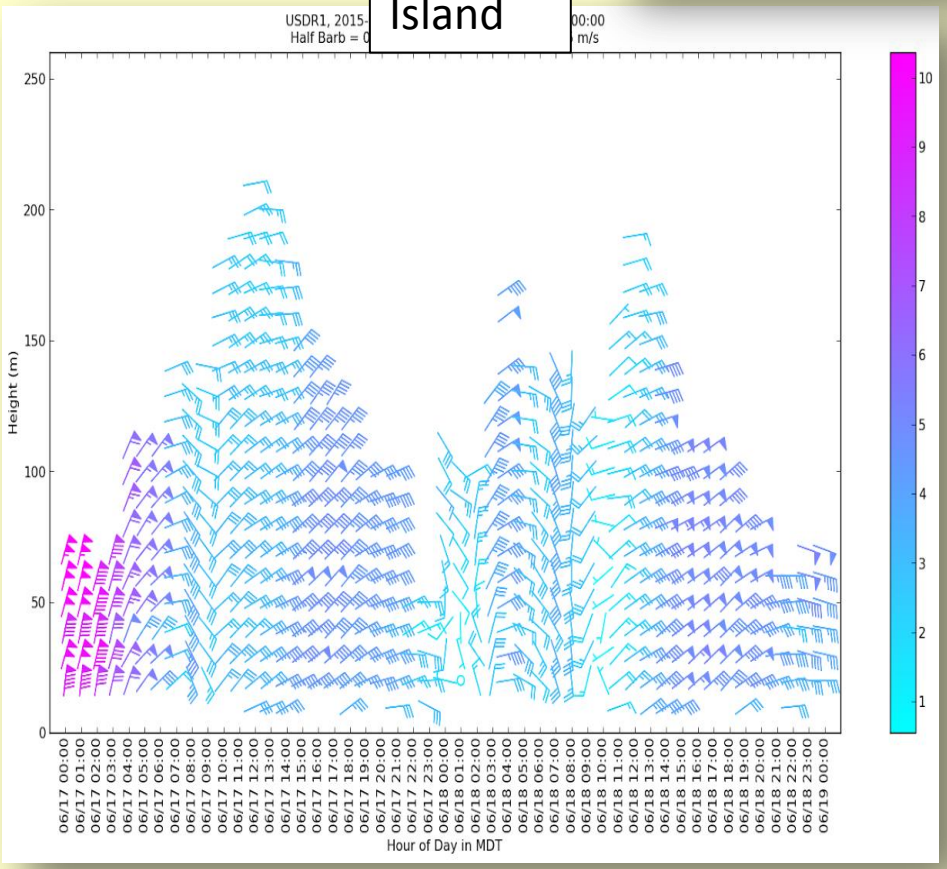

Ozone, Ogden Bay, 6/17/2015, 12:06 p.m. MDT
12:06 PM
Ozone (ppbv)
Altitude (meters above ground level)

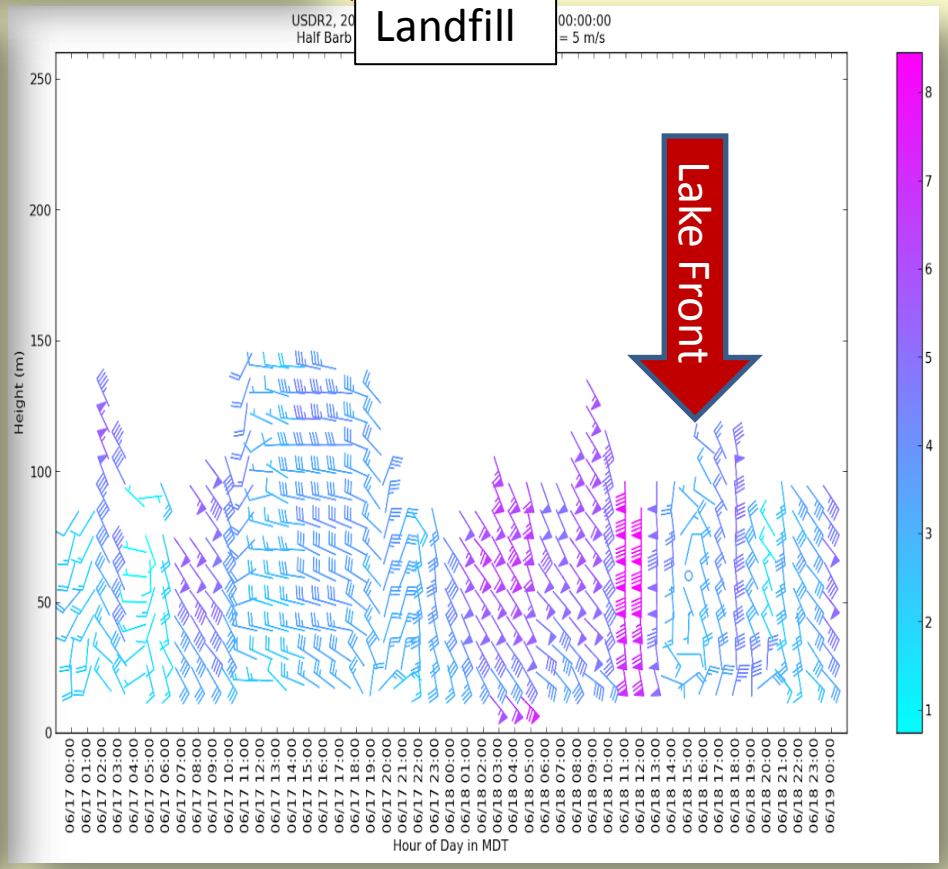
Sodar
Vertical wind profiles
6/17 – 6/18/15



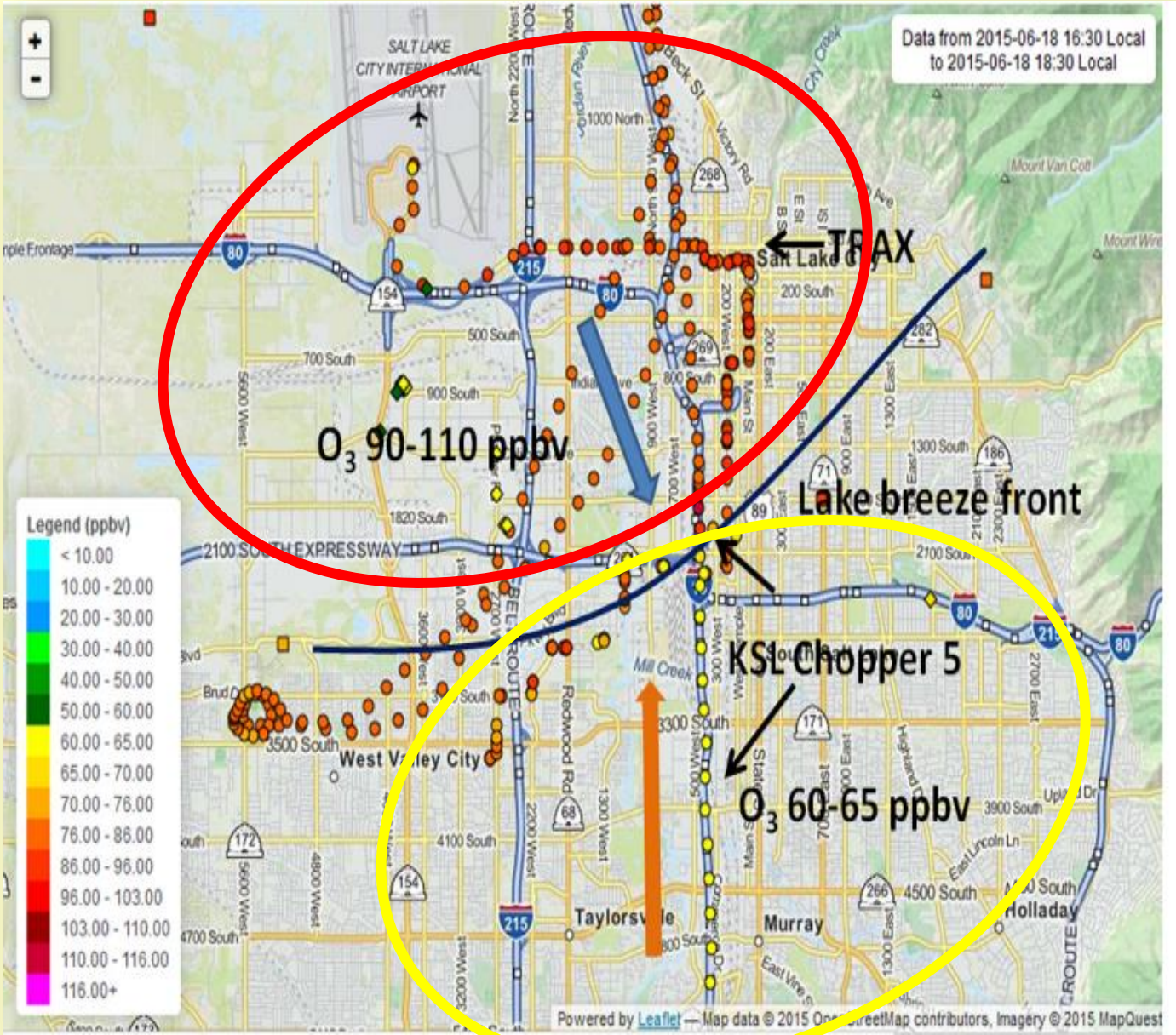
Badger Island

SLC Landfill



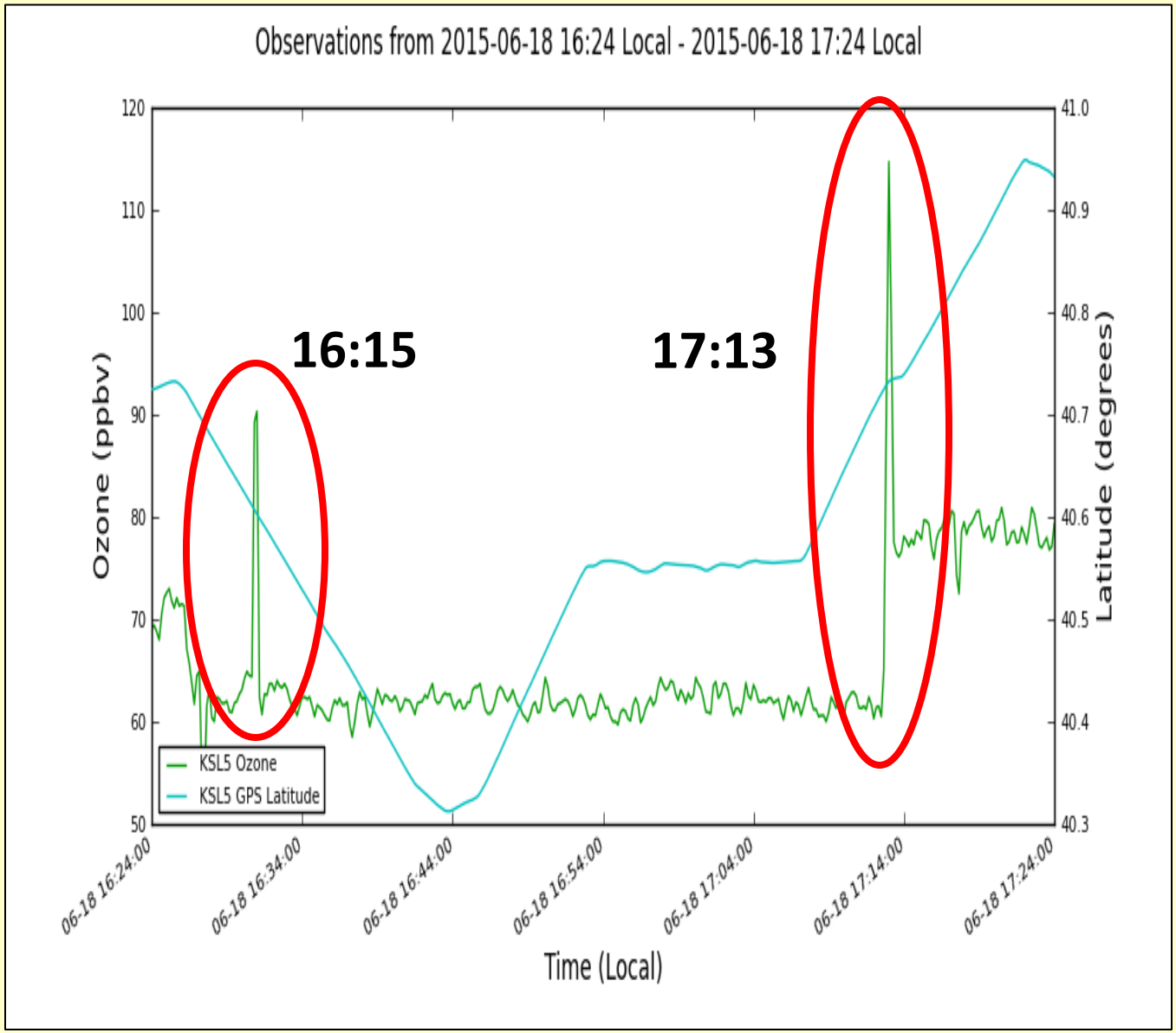


High Ozone Crossing a Lake Breeze Front



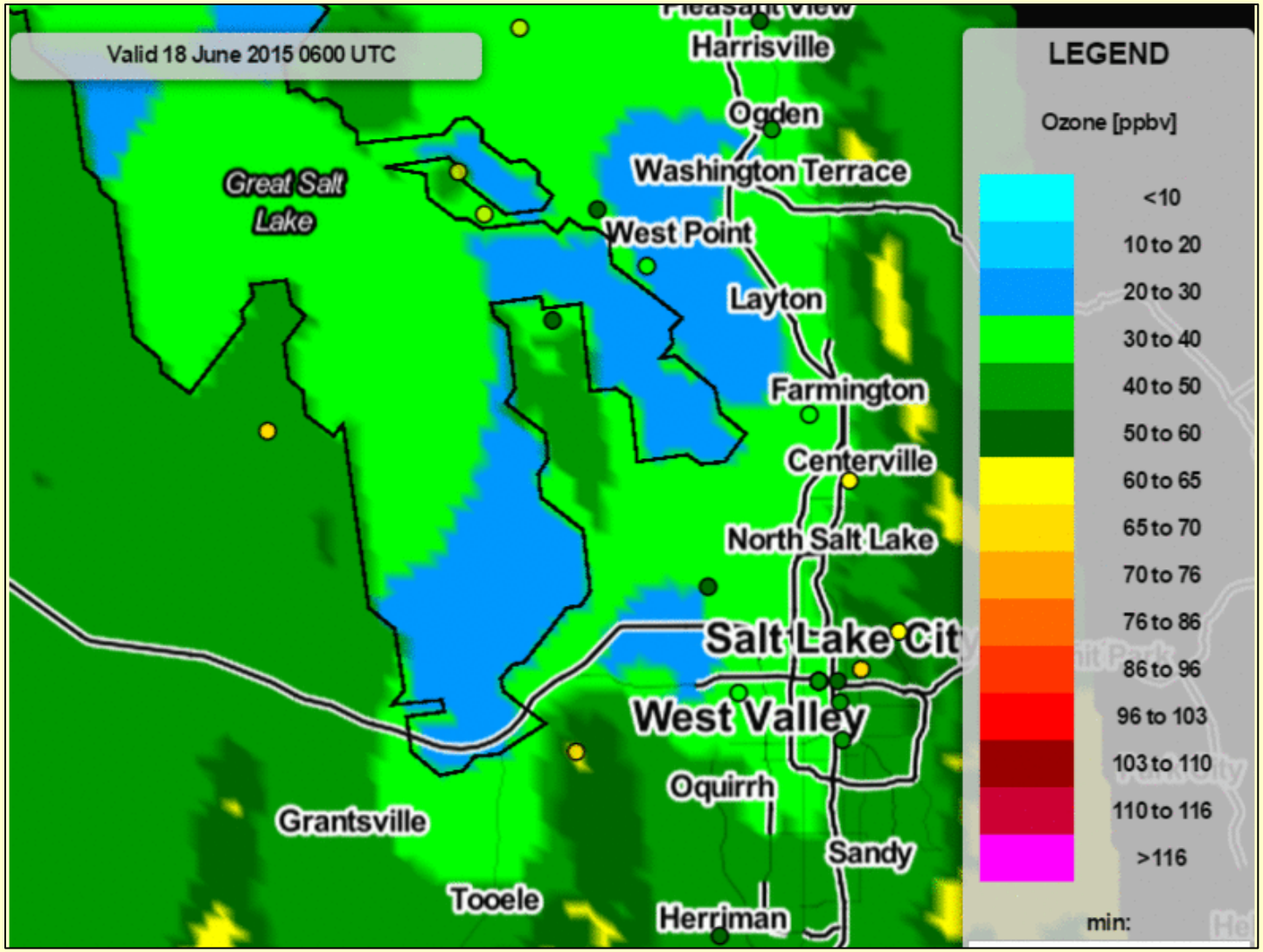
- 6/18/15
- TRAX, KSL 5 detected a lake breeze front

High Ozone Crossing a Lake Breeze Front

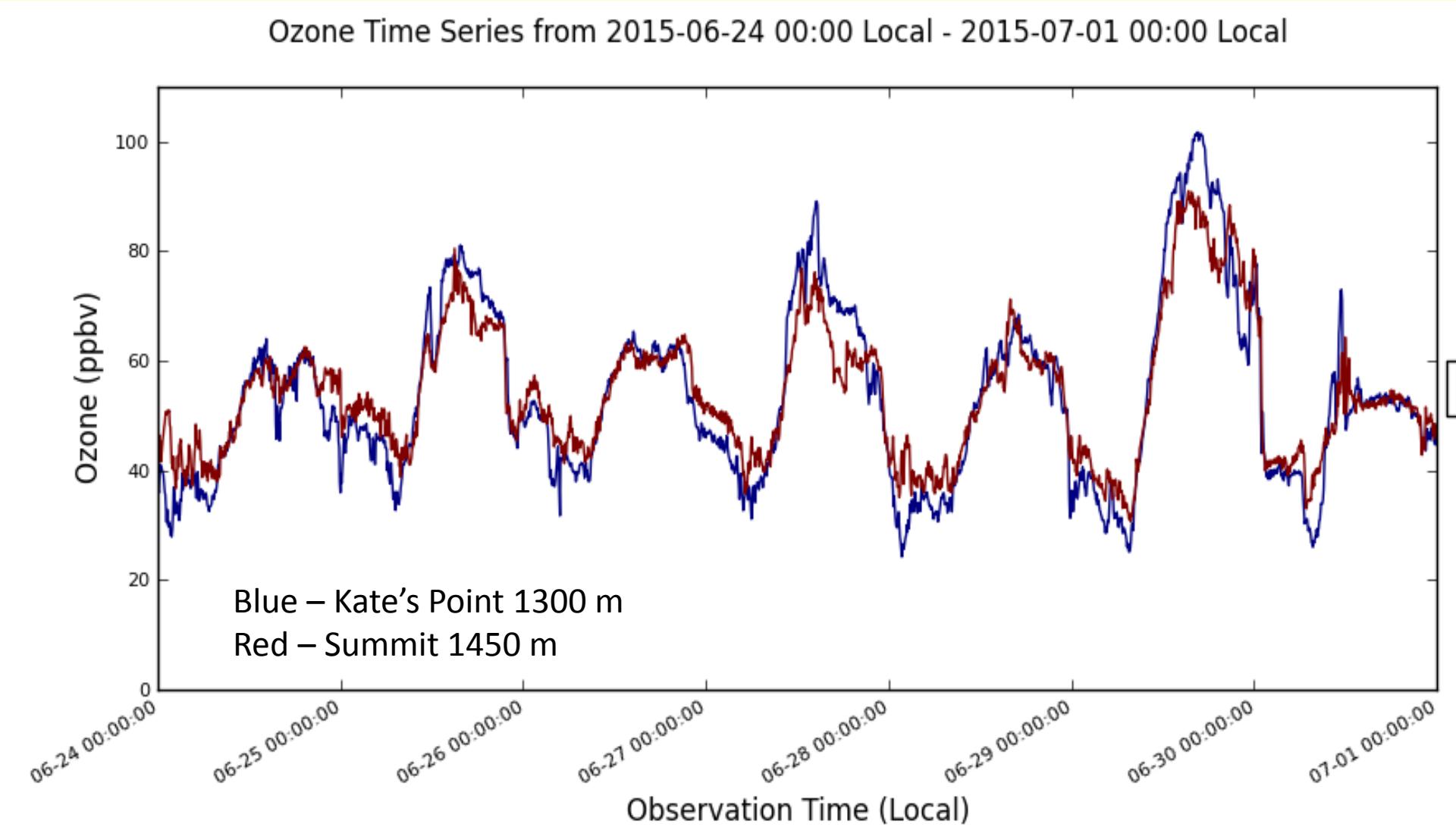


- Spike in O3 at breeze front
- Spiked to 115 ppb
- 20 ppb increase across breeze front

Afternoon push of high ozone over Lake into Salt Lake Valley behind Lake breeze front



Fremont Island – in situ vertical profile



IOP 2
July 15-16, 2015

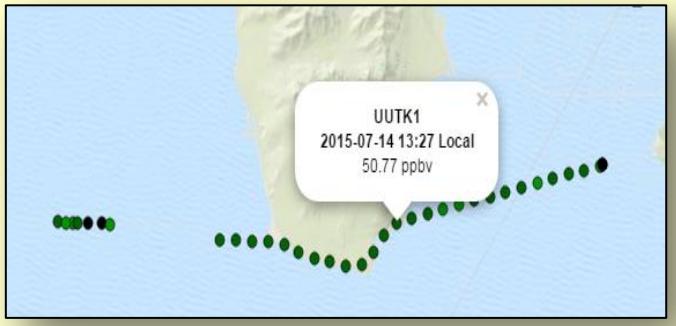
Fremont Island summit 6/1/15

Operations IOP #2

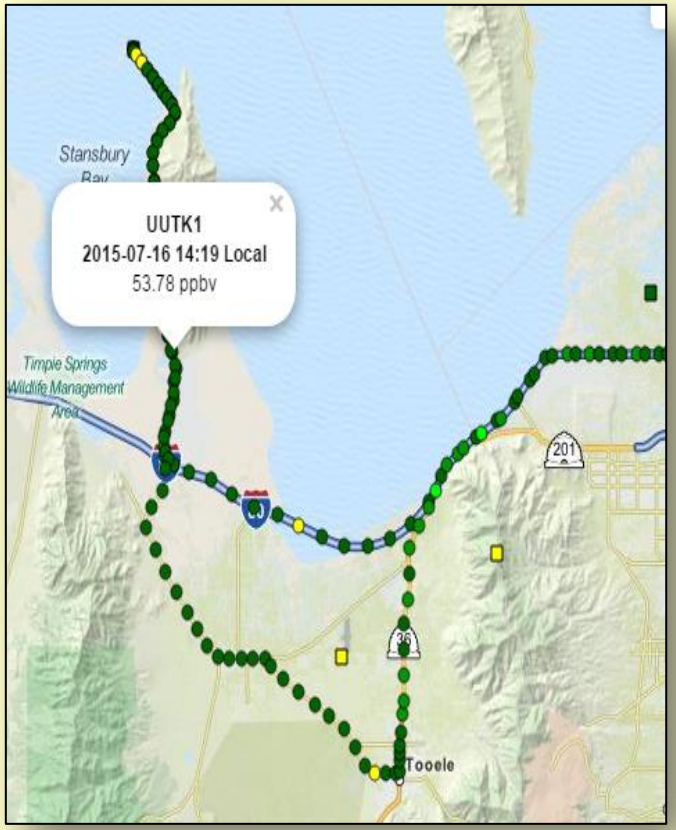
- Nerdmobile
- Tethersonde
- UAV
- Trucks
- TRAX
- KSL Chopper 5

UU Truck 1

- 7/14/15 UPR Causeway



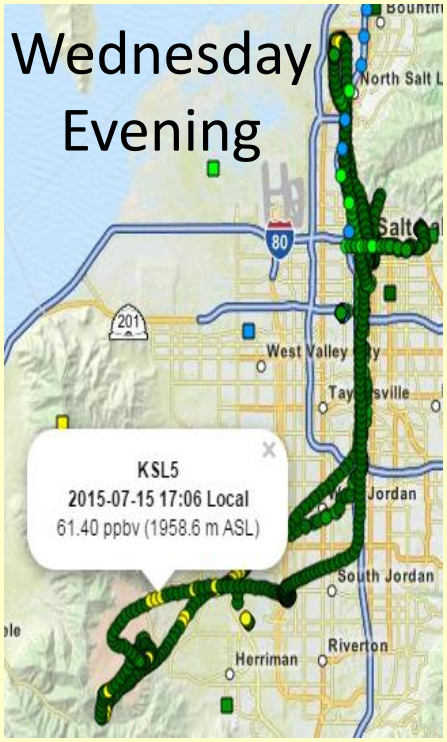
- 7/16/15
  - Tooele to Badger Is.
  - ~12:30 PM – 3:30 PM



KSL Chopper 5

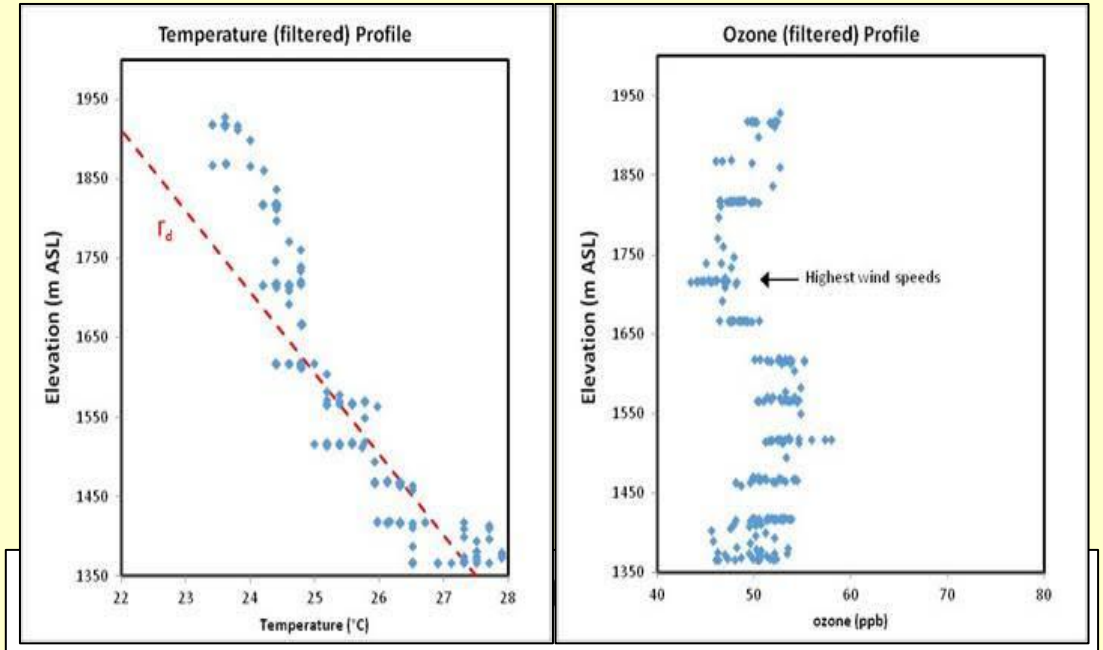
Tuesday Evening

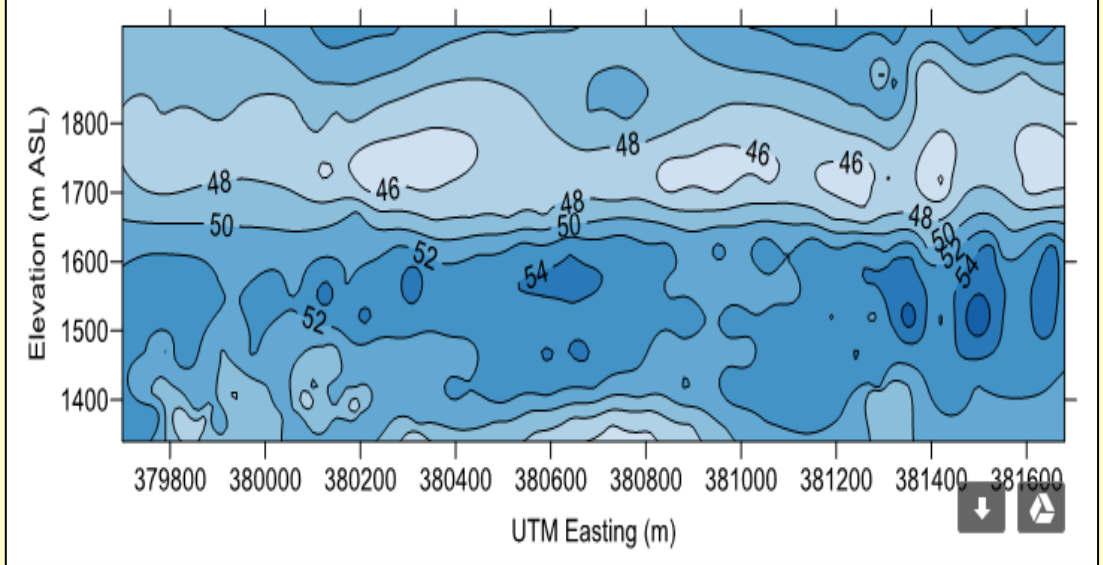
Wednesday Evening



Thursday Evening

Utah State UAV





Timeline

- IOP #3 8/3 – 8/7/15
- In situ ozone through 9/15
- HCl passive measurements
  - 3 measurement periods 8/15 – 9/15
- Fall 2015 - data analysis
- 12/15 - Final report

Project partners

- John Horel, University of Utah
- Randy Martin, Utah State University
- John Sohl, Weber State University
- Susan Bush, Erik Crosman, Alex Jacques, Brian Blaylock, Luke Leclair-Marzolf, Nola Lucke, Fahad Alotaibi. Ally Dugan, Tom Gowan, Will Howard, Jeff Jenkins, Ansley Long, Taylor McCorkle
- Apologies to those not acknowledged

Great Salt Lake Ozone Study Website
http://meso2.chpc.utah.edu/gslso3s/