

Mobile Air Quality Measurements on Light Rail and Helicopter

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Overview and Motivation

- “Internet of Things” technologies growing source for observations
 - Smaller/cheaper meteorological and air quality sensors
 - Mobile real-time connectivity via cell/internet
- Air Quality Concerns within Salt Lake Valley
 - Winter: secondary PM_{2.5} formation over several days when persistent surface stable layers present
 - Summer: diurnal formation of boundary layer ozone
- NAAQS standard for ozone lowered from 75 to 70 ppbv
- Real-time data collection, monitoring, and analysis of spatial distribution of pollutants across Salt Lake Valley

Mobile Instrument Platforms

KSL-TV News “Chopper 5” Helicopter

- Typical flight operation during evening commute (4-6pm local)
- Additional operation during high-profile news events
- Compact sensor package deployed inside helicopter:
 - 2B Technologies 205 Ozone Monitor
 - Pressure Sensor
- Real-time data collection with email alerting of ongoing flight
- Observations available: <http://meso2.chpc.utah.edu/gslso3s>



Utah Transit Authority (UTA) Light Rail Car (TRAX)

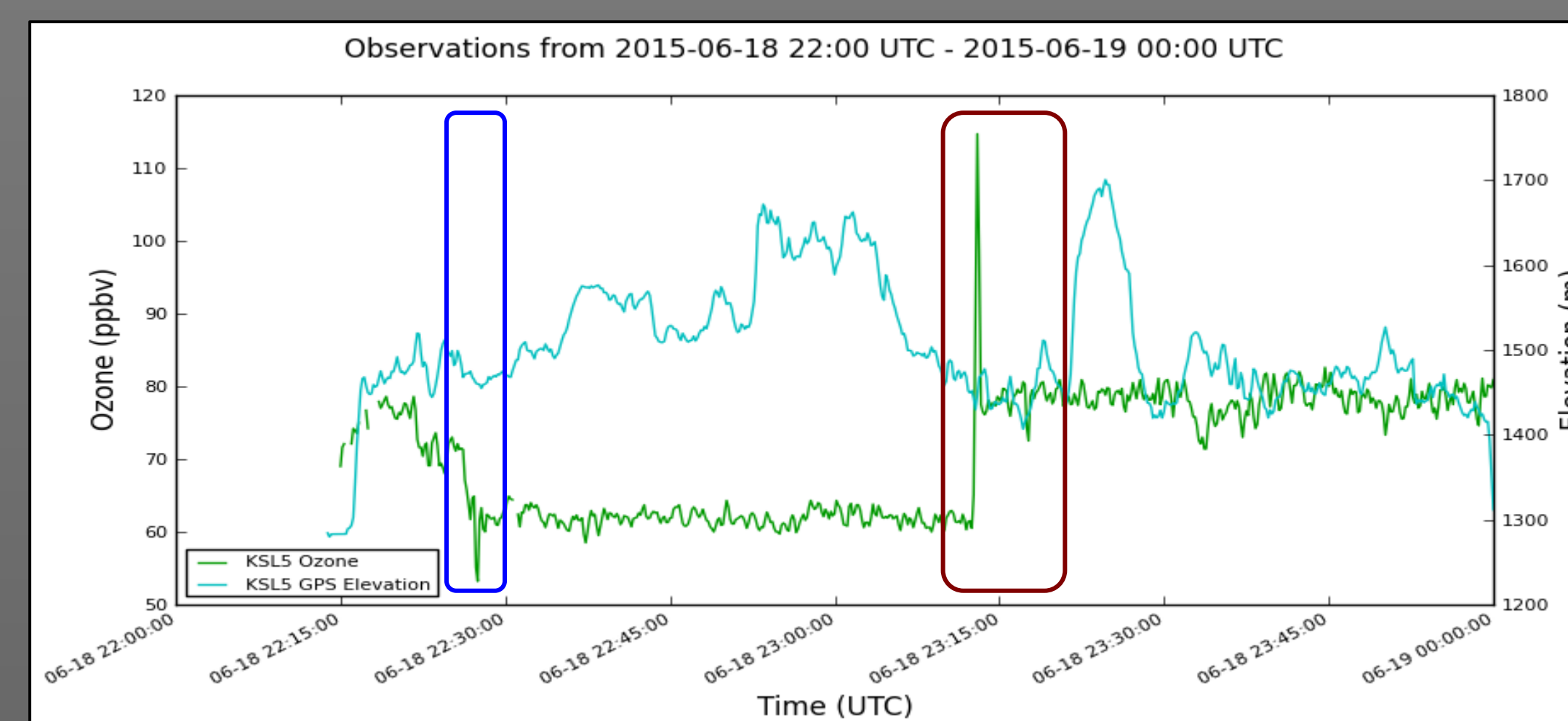
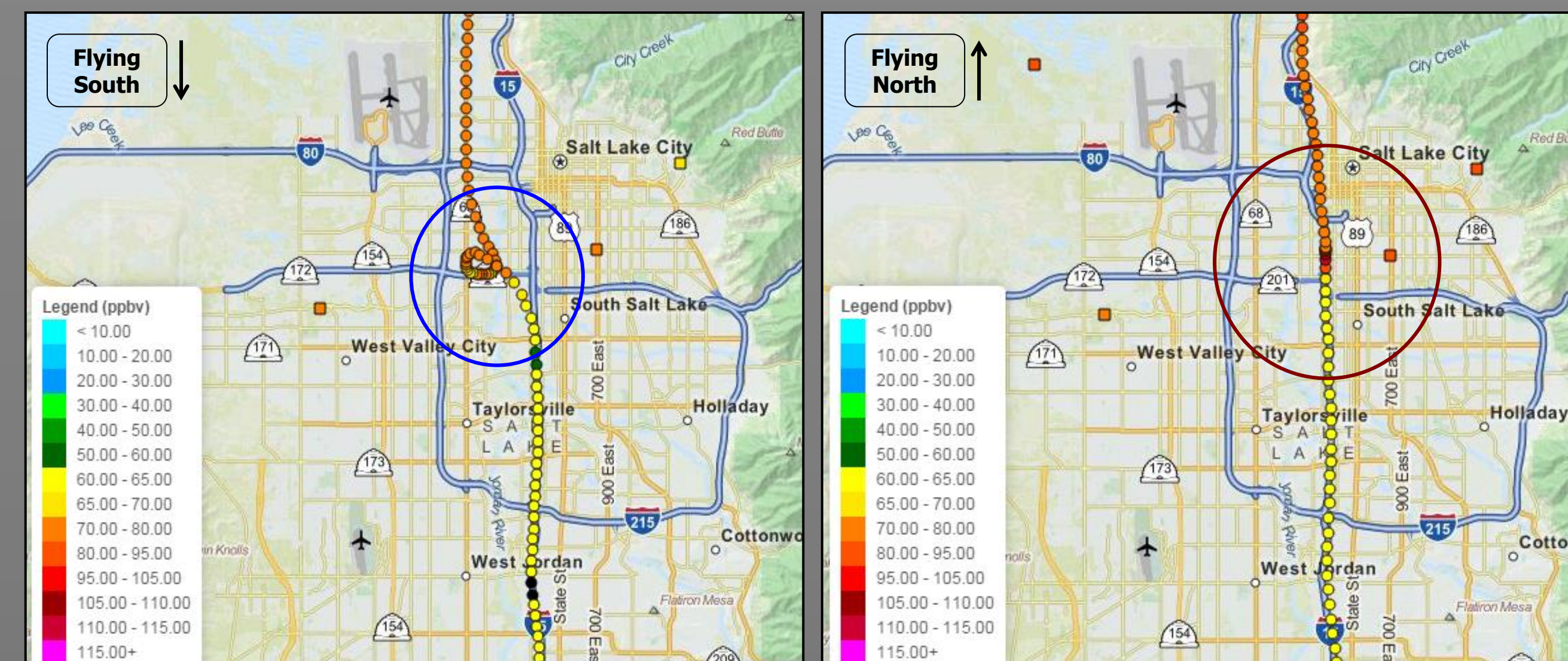
- Operates on daily basis on one of three selected lines
- Research-grade met and air quality equipment:
 - MetOne E-Sampler Particulate Monitor
 - 2B Technologies 205 Ozone Monitor
 - Los Gatos Research (LGR) Trace Gas (CO₂ and CH₄) Monitor
 - Air temperature and pressure meteorological sensors
- Data storage locally via data loggers and Raspberry Pi computer
- Real-time data collection via cellular devices and available: <http://meso1.chpc.utah.edu/mesotrax> and <http://air.utah.edu>



2015 Great Salt Lake Summer Ozone Study Helicopter and TRAX Case Studies

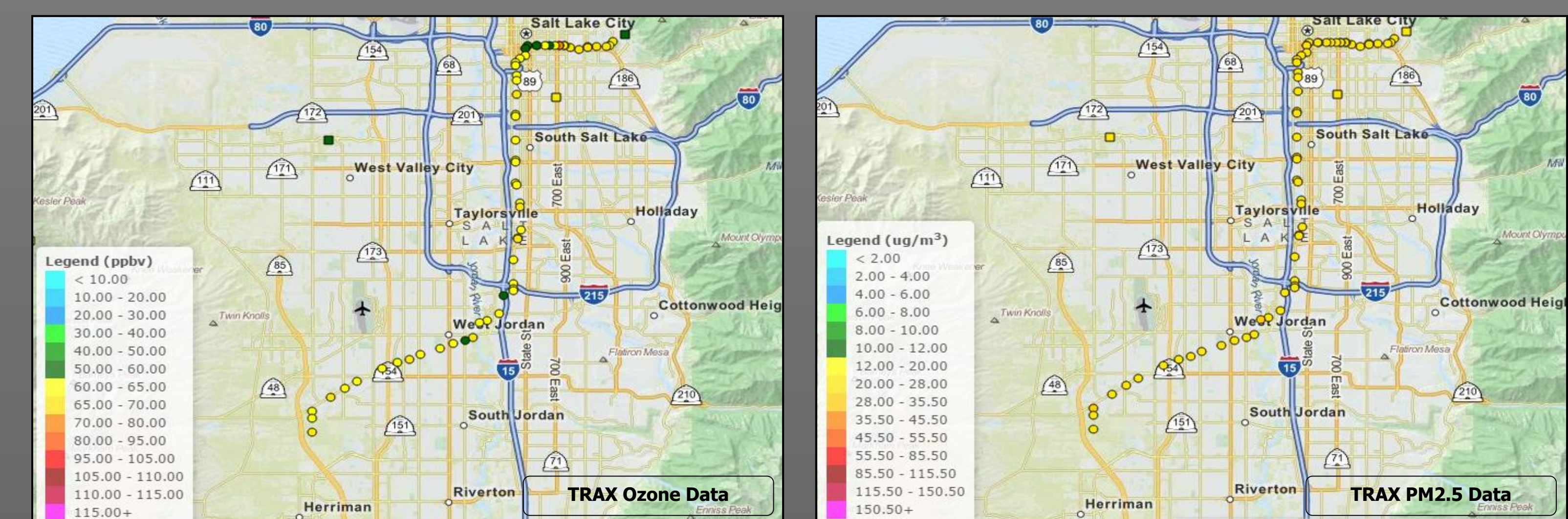
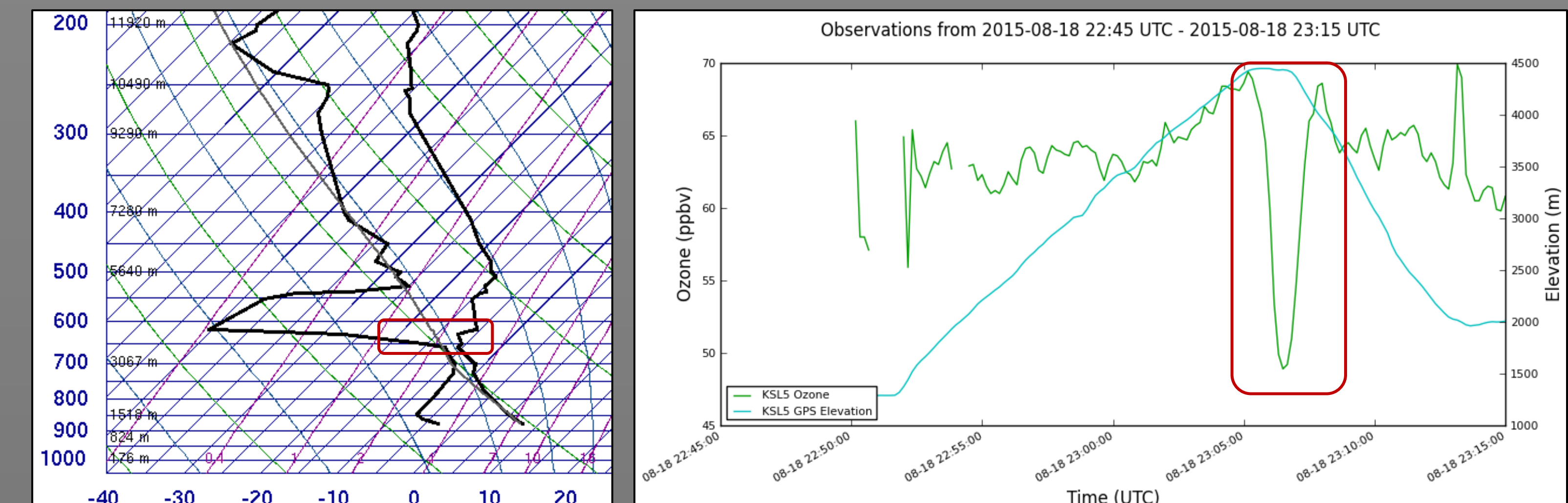
18 Jun 2015 Lake Breeze Convergence Zone

- Lake breeze convergence zone propagating southward across Salt Lake Valley
- Boundary separated higher (lower) ozone concentrations to the north (south)
- Helicopter captured transition zone on both southbound and northbound flights

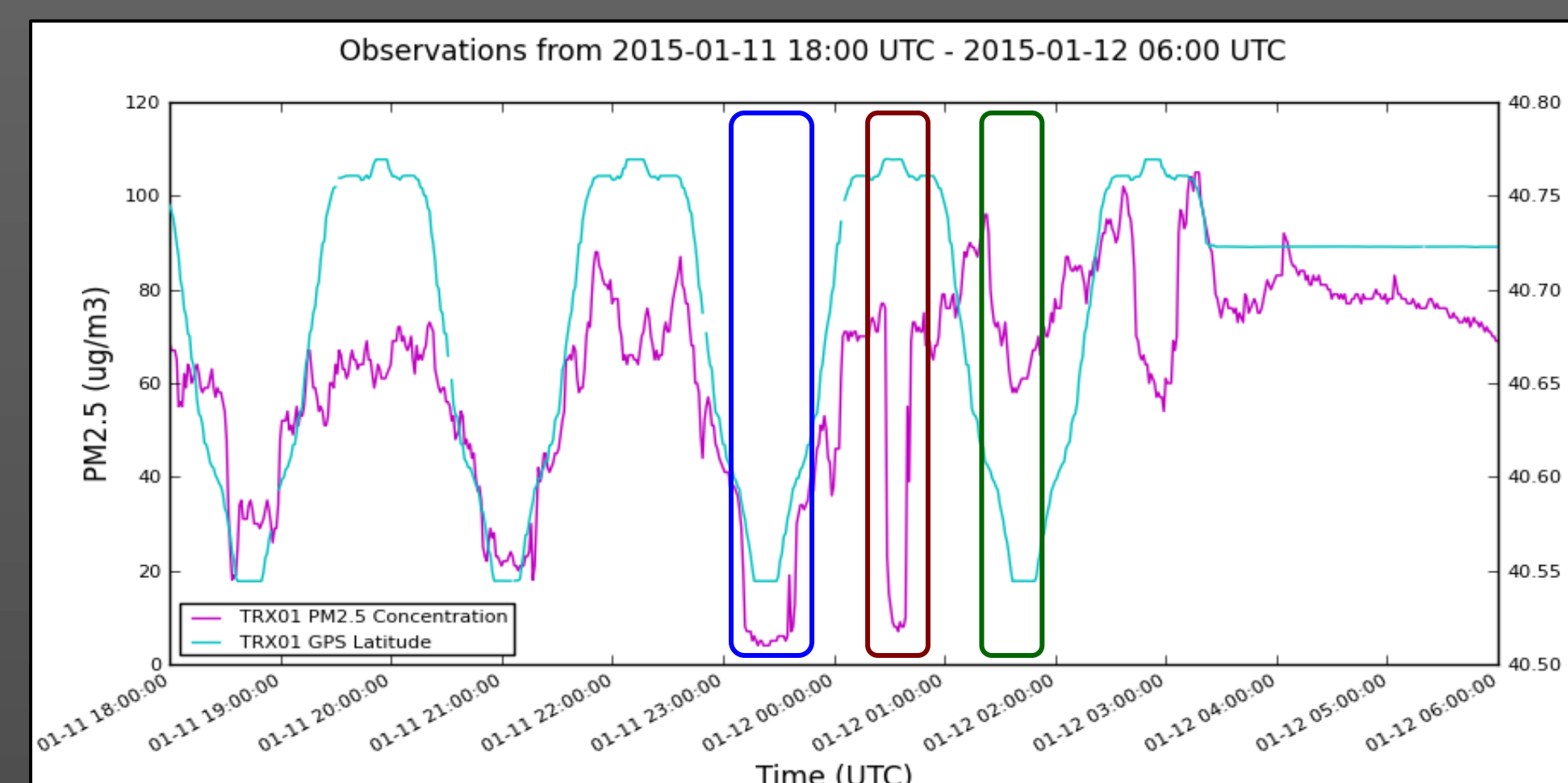


15-23 Aug 2015 Smoke Period

- Dry synoptic W-NW flow advected smoke into valley from large wildfires in Pacific NW
- Helicopter “vertical profile” depicts drop in ozone above subsidence inversion layer
- TRAX observations captured elevated ozone and PM_{2.5} during period

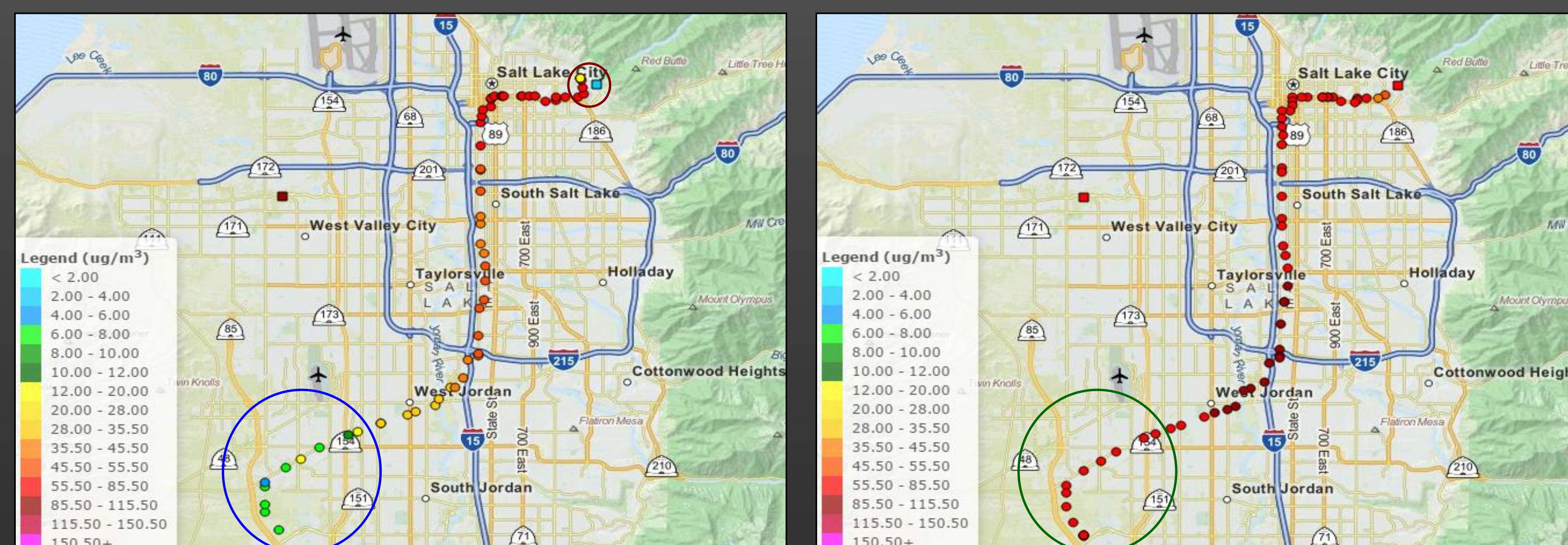


UTA TRAX Winter Case Studies and Trace Gas Analysis



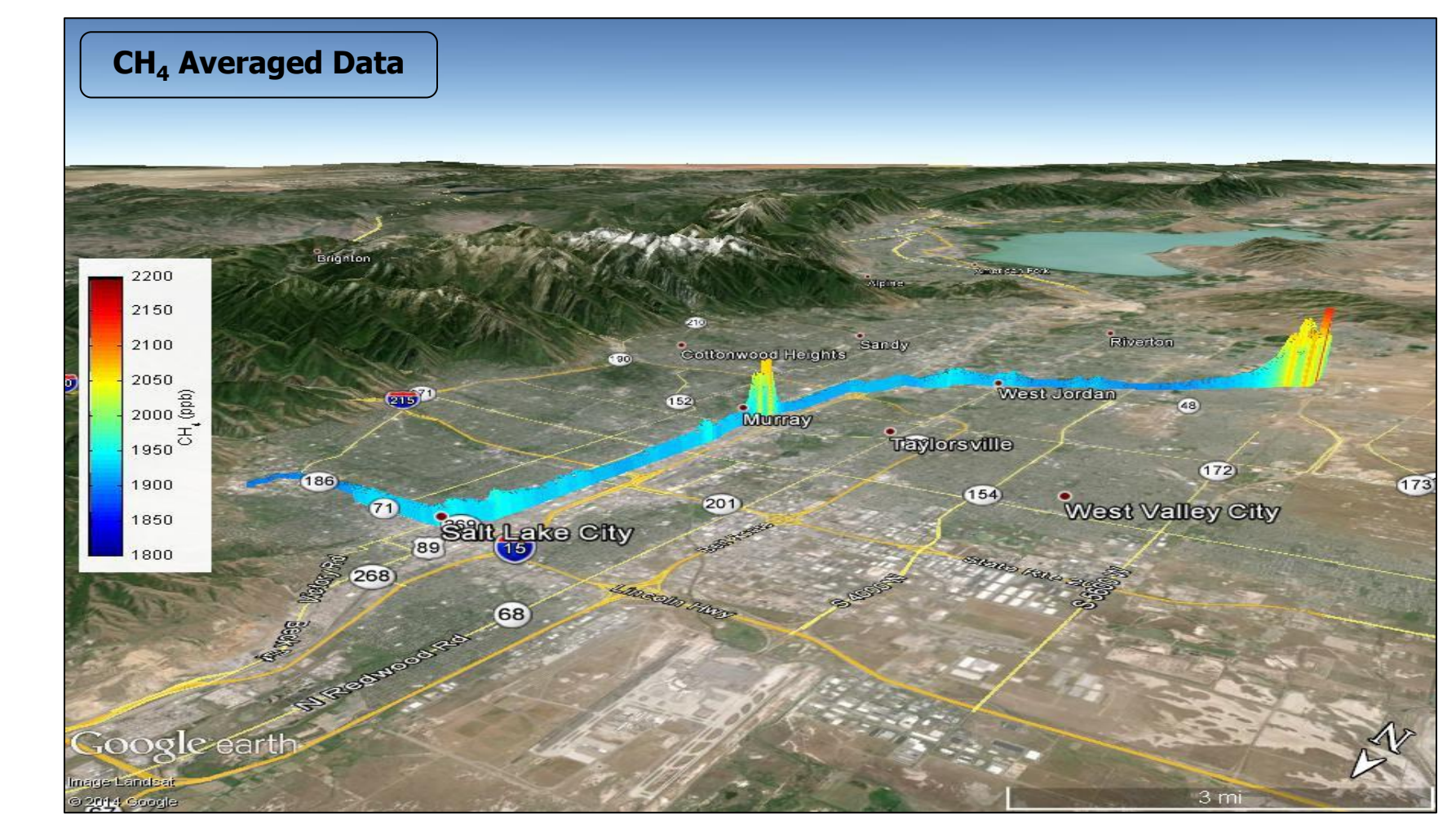
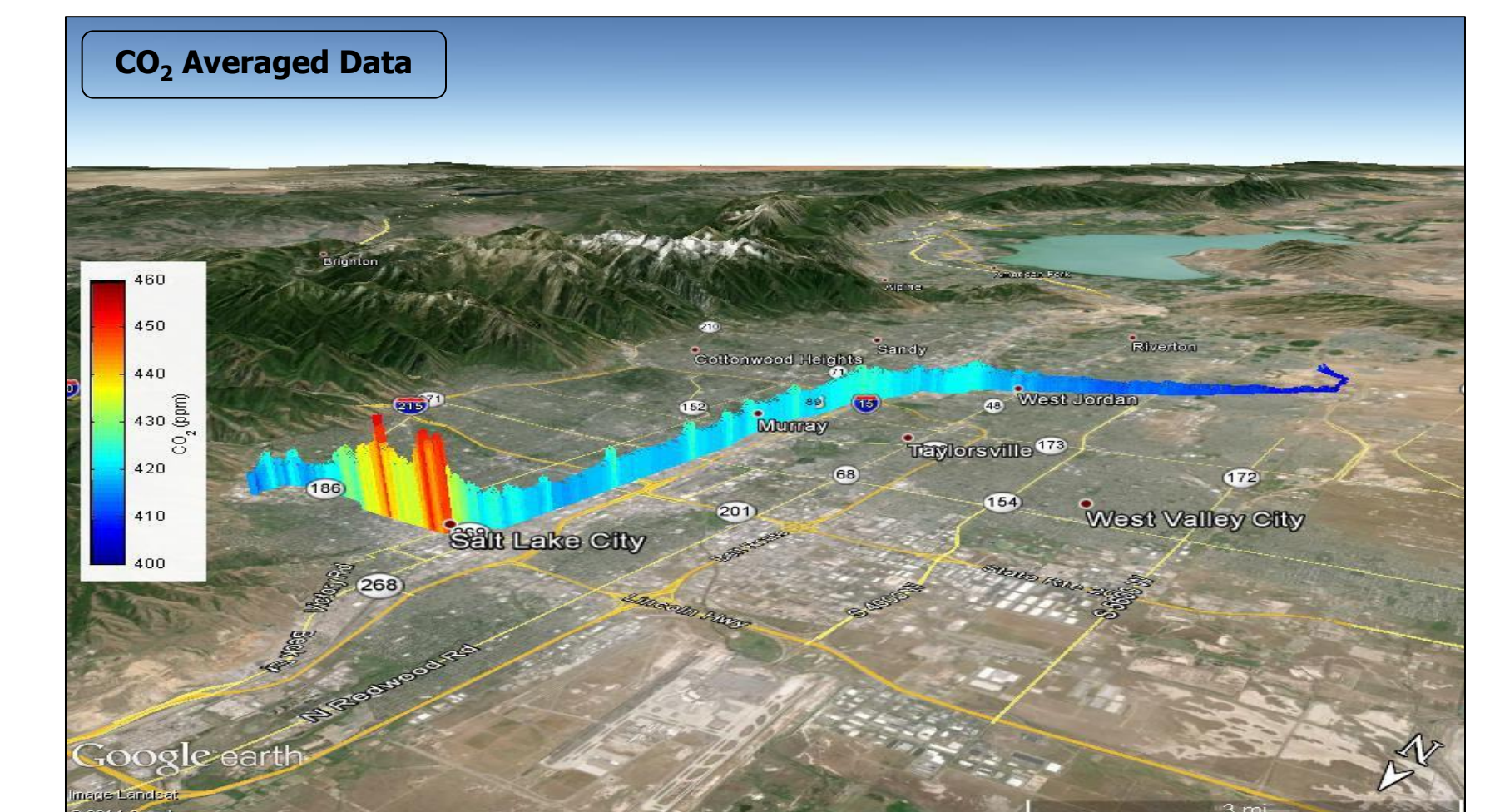
1800 UTC 11 Jan 2015 – 0600 UTC 12 Jan 2015

- Persistent stable layer in place with high PM_{2.5} observed by TRAX (circles) and fixed sites (squares)
- Noted decreases at times in concentrations at higher elevations (SW corner of valley) and near canyon openings (NE corner of valley) while lowest portion of valley retains high concentrations
- High concentrations return to SW corner of valley a few hours later



Aug-Sep 2014 Trace Gas Analysis Averages

- Noticeable regions of higher carbon dioxide and methane concentrations along rail line



Summary and Future Plans

- TRAX and helicopter have provided unique datasets to assess spatial distribution of pollutants across Salt Lake Valley
- Appears meteorological processes in complex terrain have impacts on distributions
- Potential expansion to additional TRAX cars and other public transit systems using microelectronics and Raspberry Pi logging systems
- Further deployments of equipment using helicopter are possible as well

Acknowledgements

- Helicopter Instrument Deployment: KSL Broadcasting and pilot Ben Tidswell
- Light Rail Instrument Deployment: Utah Transit Authority and Siemens USA for technical and logistical support
- Primary funding for summer ozone study: Utah Division of Air Quality
- Ozone study data collection and analysis: numerous undergraduate, graduate students, and staff at the University of Utah