

Air Quality Science for Solutions
Cyber Space
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Winter Exhaust Measurements of Heavy-duty Vehicles to Characterize the Cold Temperature Performance of Selective Catalytic Reduction Catalysts in Controlling Oxide of Nitrogen Emissions

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Acknowledgments

Utah Department of Environmental Quality

Utah Department of Transportation

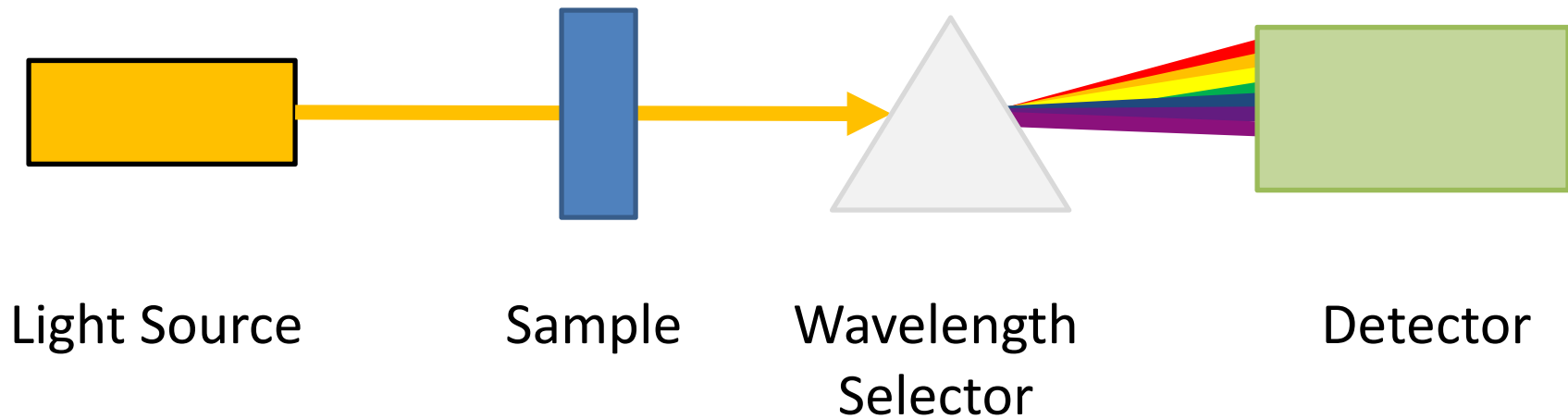
Howard Trexler, Utah DOT

Donnetta Ford, Perry Port of Entry

Stacy Hammond, Brian Himes and Annette Bishop

<http://moini.net>

Absorption Spectroscopy

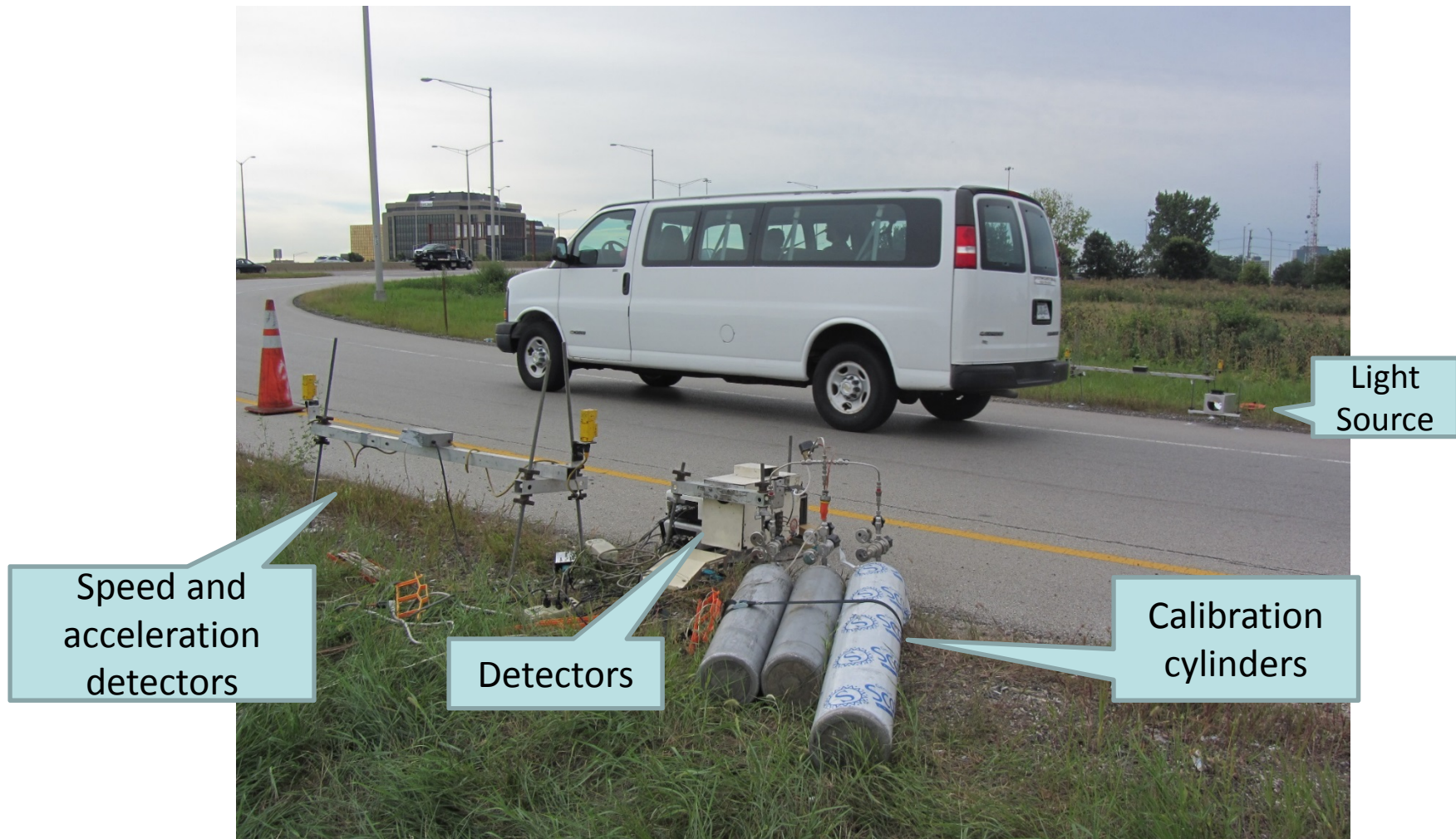


Absorbance Molar Absorptivity Path Length Concentration

$$A = \epsilon \times b \times c$$

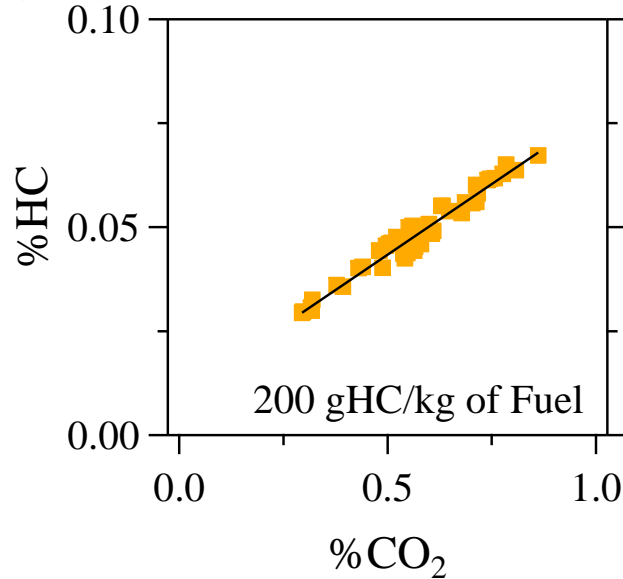
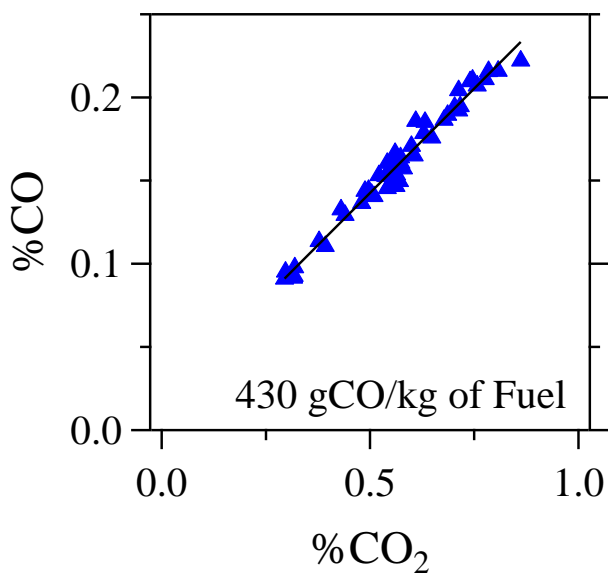
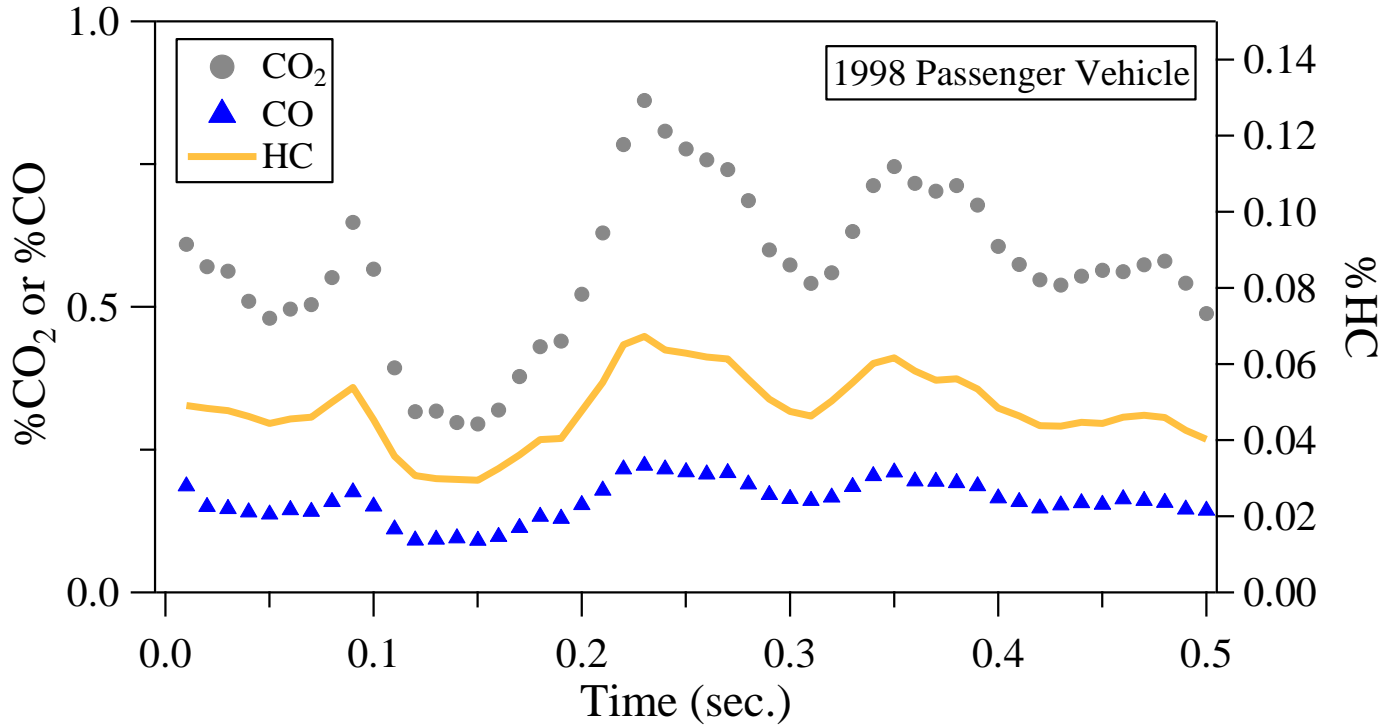
Beer-Lambert Equation

Fuel Efficiency Automobile Test (FEAT)



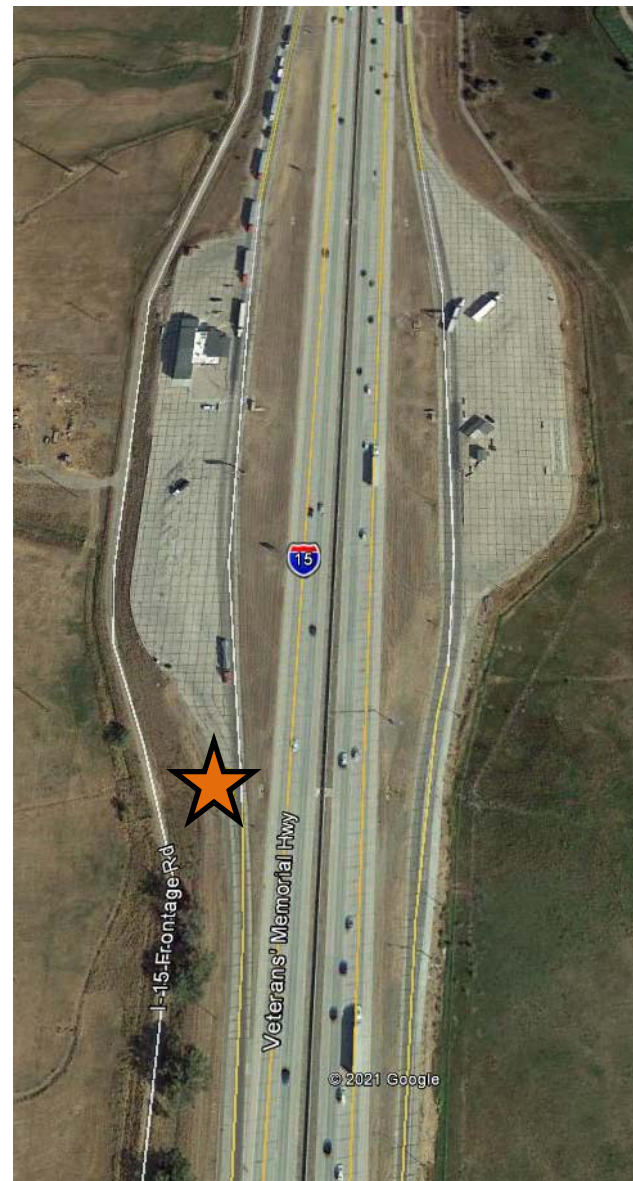
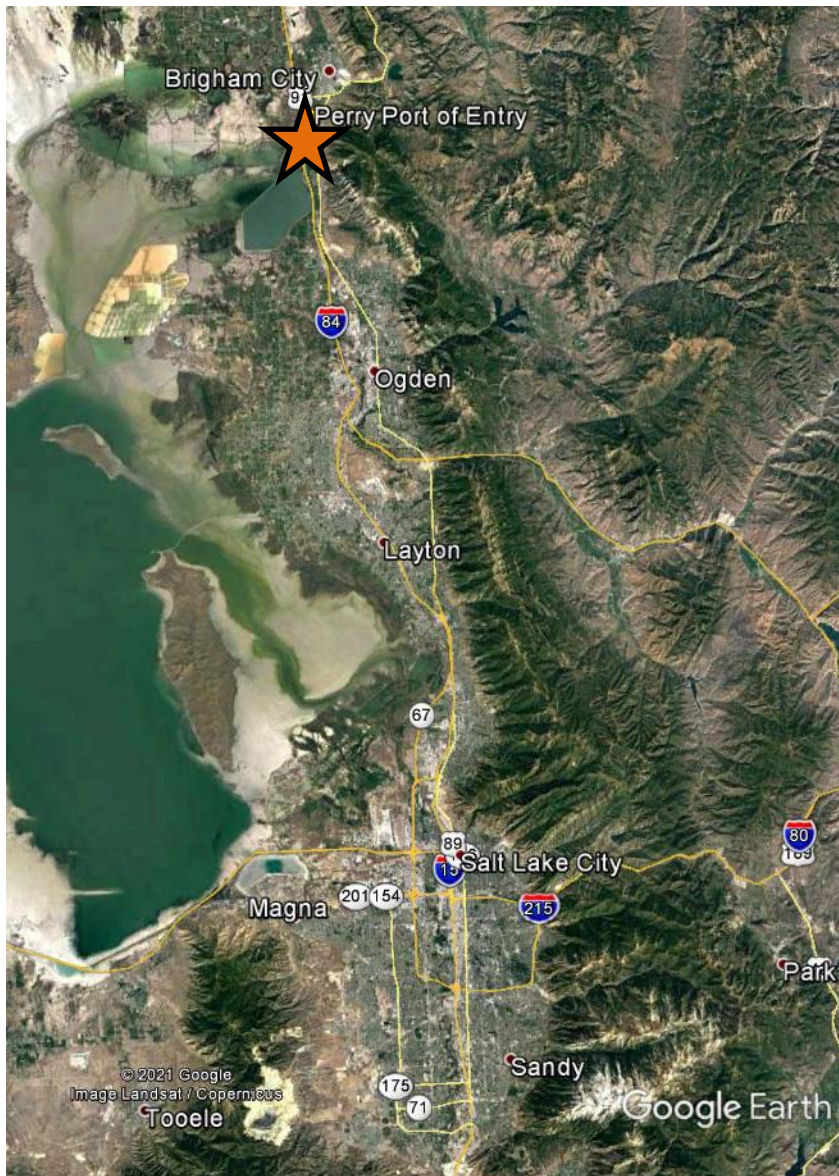
FEAT measures fuel specific (g/kg of fuel) emissions for CO (± 4 g/kg), HC (± 4 g/kg), NO (± 0.4 g/kg), NH₃ (± 0.05 g/kg) SO₂ and NO₂ (± 0.2 g/kg).

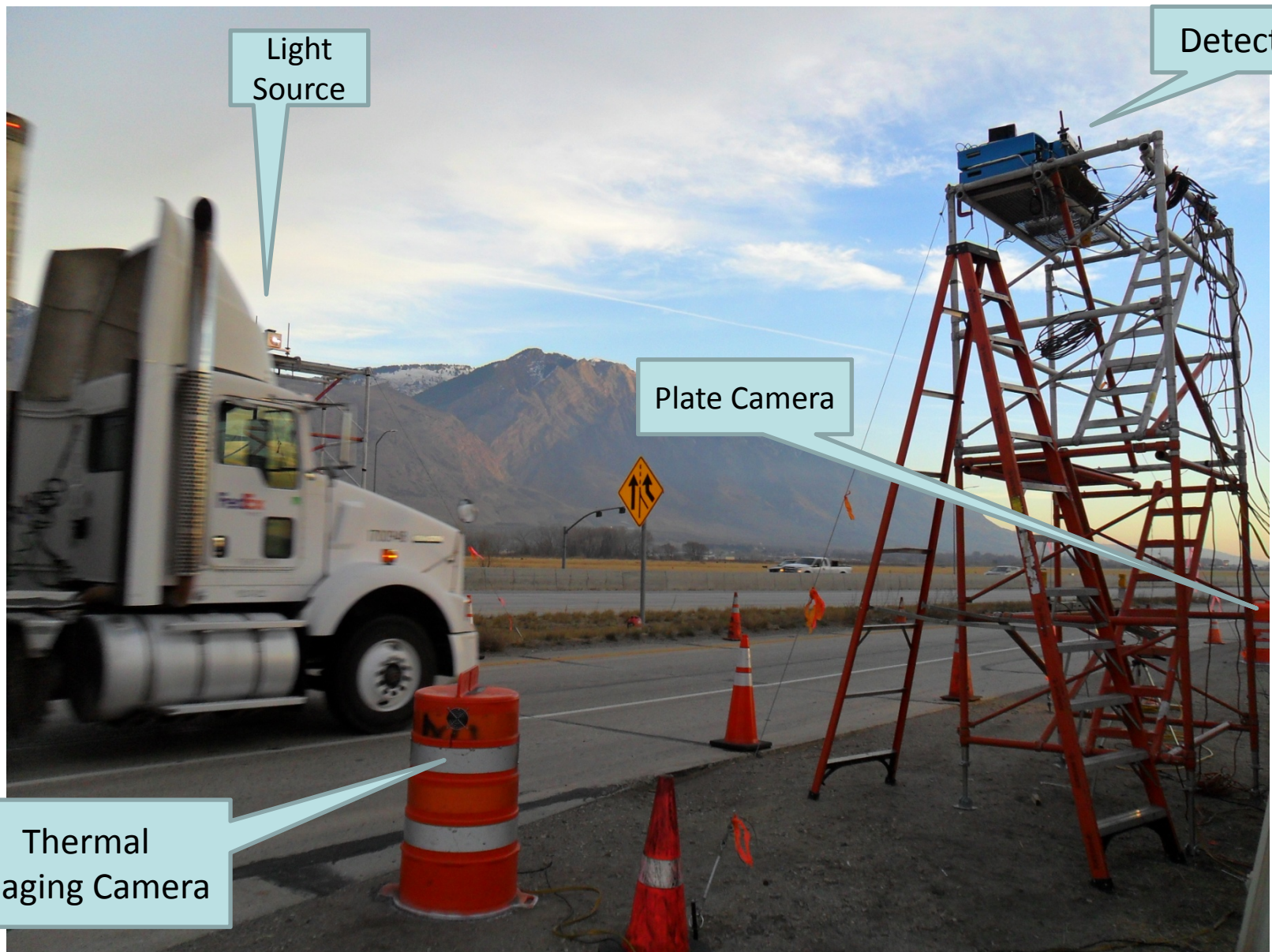
How FEAT Measures Tailpipe Emissions



Ratio graphs

Utah DOT Perry Port of Entry



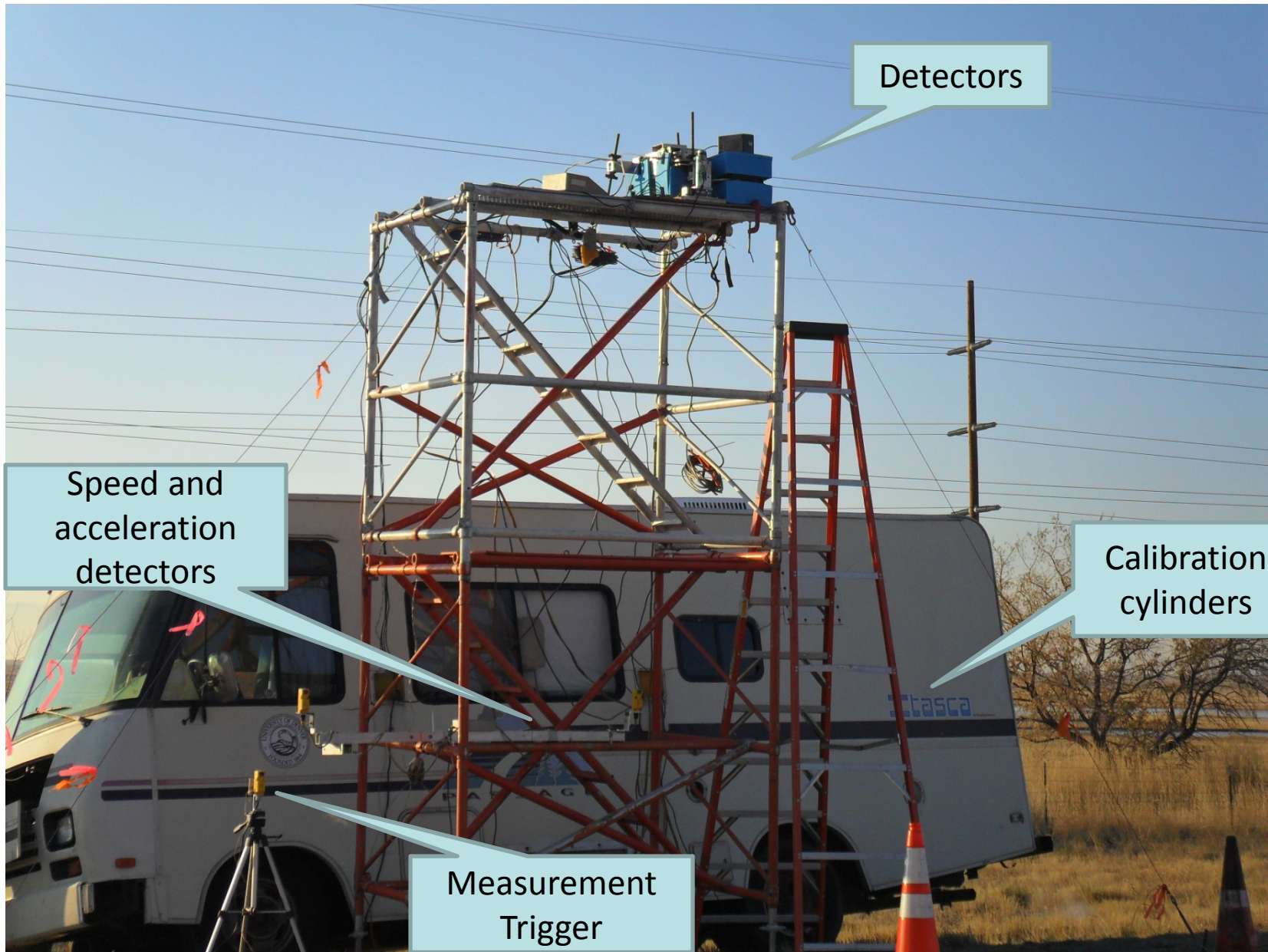


Light Source

Detectors

Plate Camera

Thermal Imaging Camera



Detectors

Speed and acceleration detectors

Calibration cylinders

Measurement Trigger

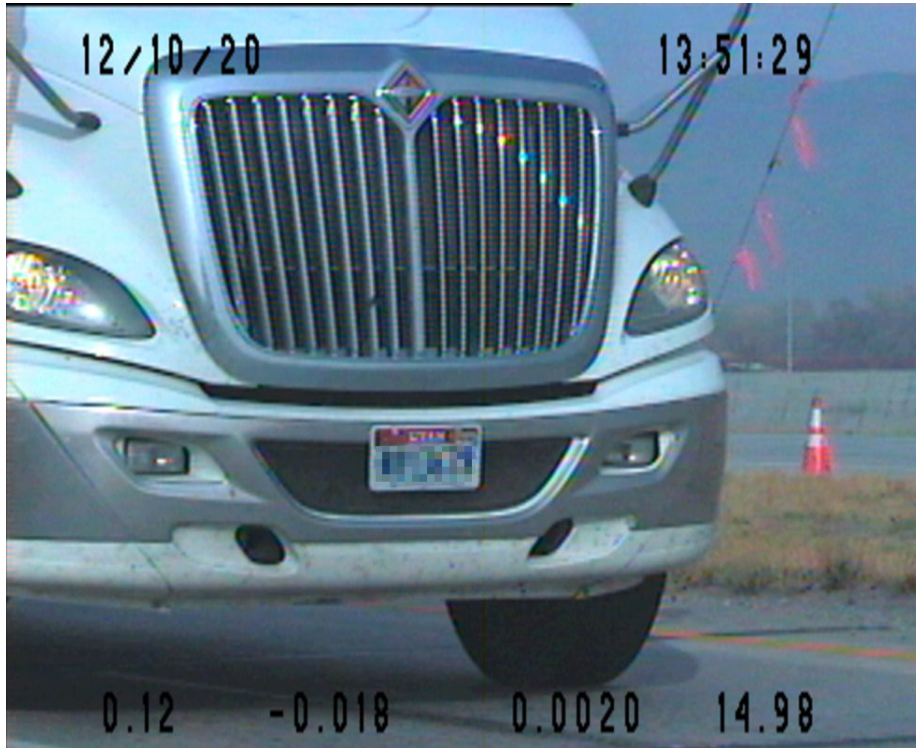
FEAT Setup for Elevated Exhaust Pipes



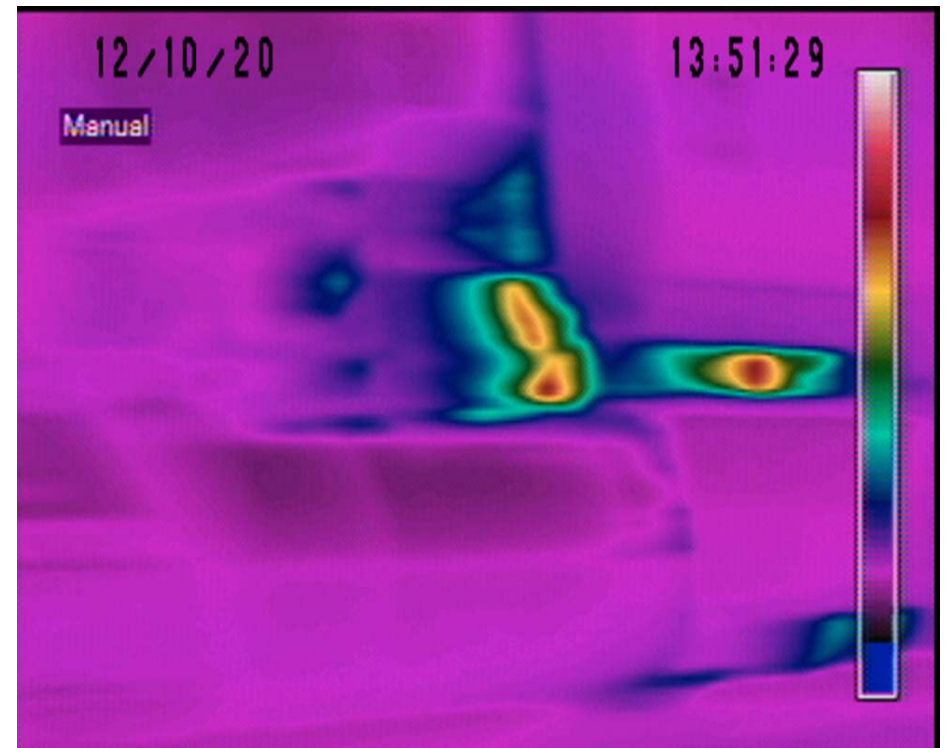
FEAT Setup for Ground Level Exhaust Pipes



Perry Port of Entry Sampling Campaign Results



License Plate Picture

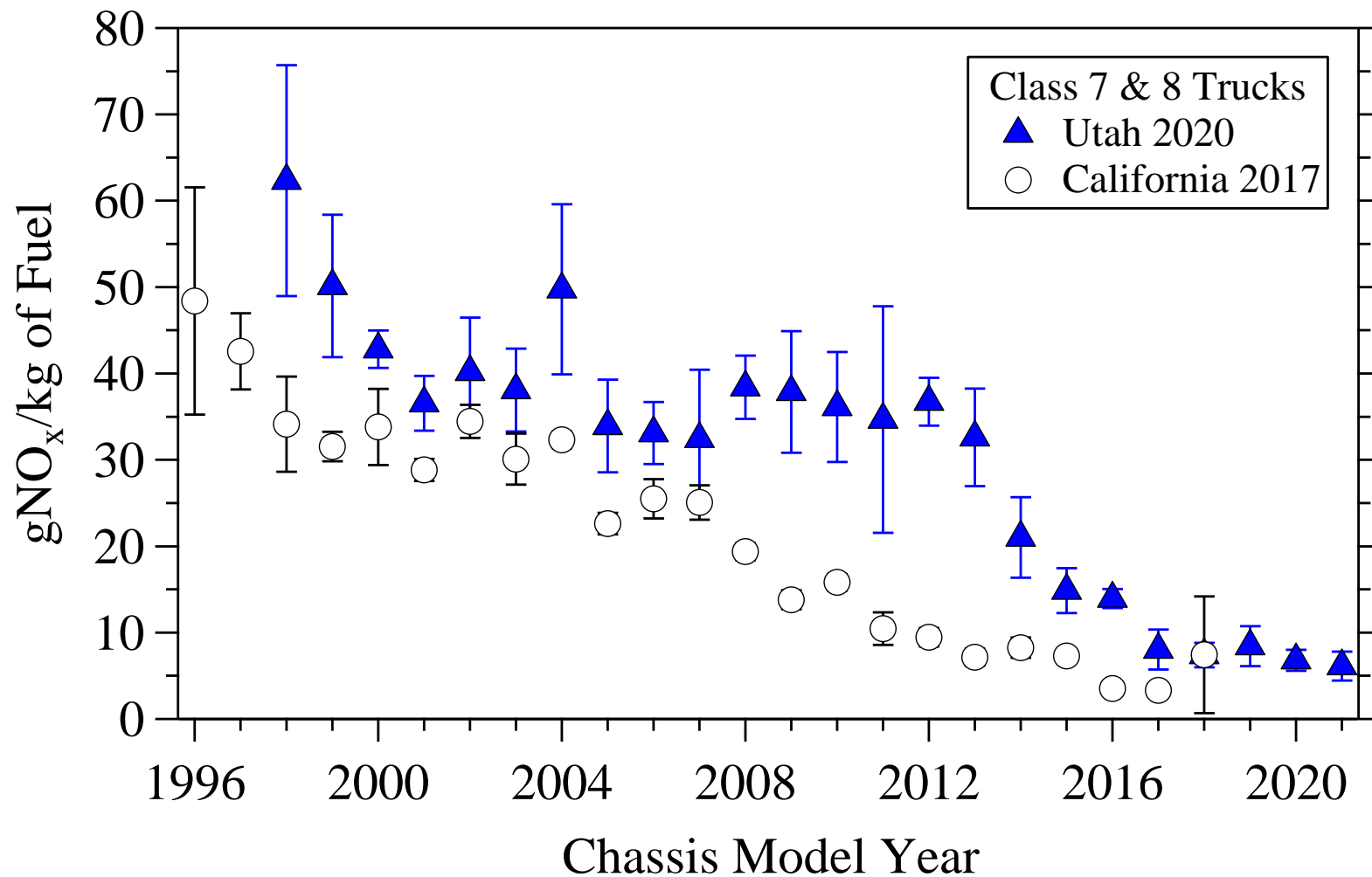


Thermal Image (Elevated pipes only)

Campaign Statistics (Dec. 7 – Dec. 11 2020)
2,266 Valid Emission Measurements
1,764 Readable License Plates
1,694 Matched Plates / 1,591 Class 7 & 8
1,057 Elevated / 637 Ground Level
Temperature Range: -7° to 10°C Avg. 3.8°C

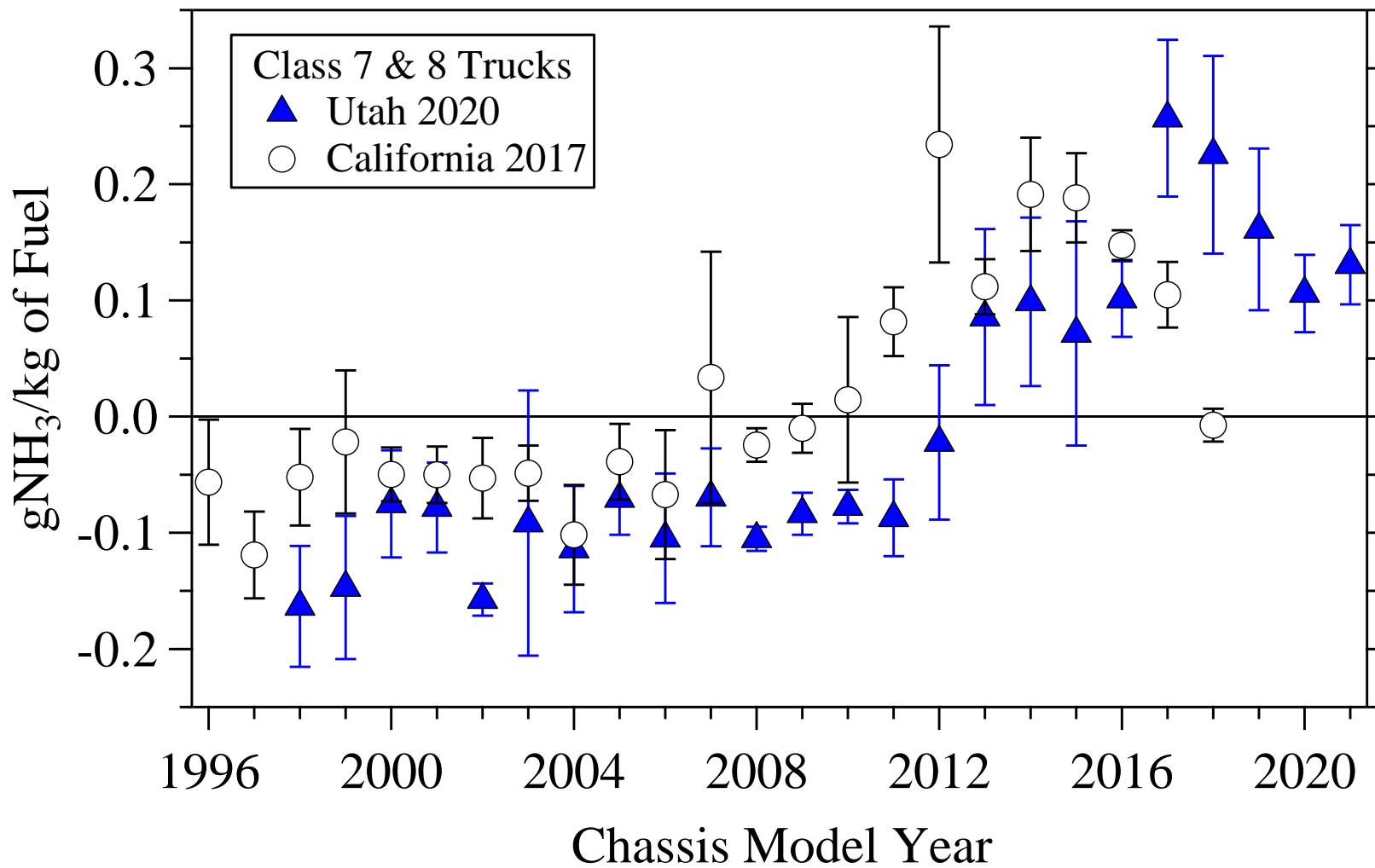
Class 7 & 8 only High / Low
Average MY – 2014.2 2012.6 / 2017.4
Average Speed – 28.9
Average Acceleration – 0.21
UT 40.5% / ID 13.6% / IN 10.2%
37 States and Canada 4.6%

Fuel Specific NO_x Emissions



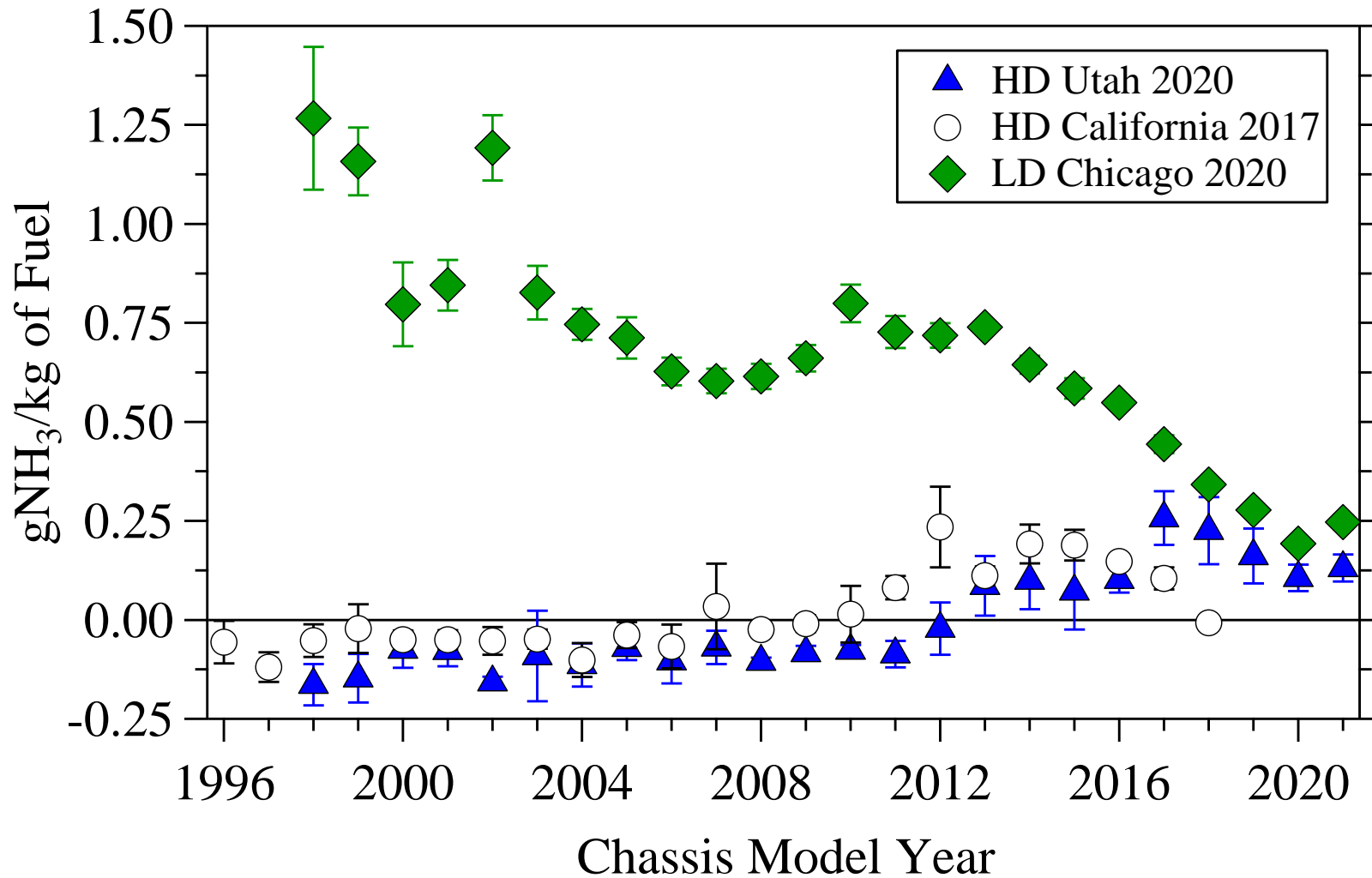
Preliminary – Do Not Cite or Quote

Fuel Specific NH₃ Emissions



Preliminary – Do Not Cite or Quote

Fuel Specific NH_3 Comparison



Preliminary – Do Not Cite or Quote

Conclusions

- A very successful winter measurement campaign was conducted at the Perry Utah Port of Entry
- Almost 1700 measurements with 94% from class 7 & 8 heavy-duty trucks
- Temperature during the measured ranged from -7° to 10° C with an average of 3.8° C
- Analysis has barely begun so further results will be forthcoming!