Winter Exhaust Measurements of Heavy-duty Vehicles to Characterize the Cold Temperature Performance of Selective Catalytic Reductions Catalyst in Controlling Oxide of Nitrogen Emissions

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The Salt Lake City region in Utah experiences periods of high particulate levels in the winter months due to the combination of its topography, winter atmospheric inversions and local emissions. Secondary nitrite particles comprise the dominate fraction of the particles in these episodes and are the result of the reaction of oxides of nitrogen with ammonia. Recent research has shown that peak wintertime $PM_{2.5}$ concentration maxima have not been reduced along with the summertime maxima NO_x indicating a possible difference in the winter inventories. One possible explanation for these differences is that the NO_x emissions inventory is underestimated during the winter months. In addition recent work in Europe on light-duty diesel vehicles has shown significant temperature dependence in NO_x emissions with emissions increasing with decreasing temperature (Grange et al., Environ. Sci. Technol., 2019).

A significant fraction of NO_x emissions in the Salt Lake City area are produced by heavy-duty vehicles operating in or traveling through the area on the interstate highway system. New technology in the form of selective catalytic reduction catalysis to control NO_x tailpipe emissions have been entering the heavy-duty fleet since 2011 and winter-time performance of these systems has received little attention. Using the University of Denver's remote vehicle exhaust sensor we conducted a wintertime measurement campaign during the first full week of December 2020 and successfully measured more than 1700 heavy-duty vehicle tailpipe emission factors at the Perry Port of Entrance on I-15 near Brigham City, UT.

The measurement campaign sampled exhaust emissions from trucks with elevated and ground level exhaust pipes and collected emission factors for carbon monoxide, hydrocarbon, nitric oxide, nitrogen dioxide and ammonia. Temperatures during the measurement campaign ranged from -3° to 10° C. Previous University of Denver measurement campaigns have been exclusively conducted during warm spring, summer and fall time periods. These measurements will provide the opportunity for a direct comparison between the various emission factors with these warmer temperature measurements. This presentation will provide an overview of the measurement campaign and some of the preliminary results that we have obtained.