Executive Summary

Mobile sources are one of the larger contributing factors that effect air quality issues in the State of California. As such, having direct knowledge of fleet averaged on-road emission levels is a critical input parameter for estimating inventories, evaluating emission control programs and planning future air improvement strategies. Toward that end the University of Denver has completed an on-road remote sensing study of motor vehicle emissions at sites in San Jose, Fresno and Los Angeles California. This is the first time that US light-duty fleets have been measured with our new multi-spectrometer instrument. A database for each site was compiled and contains 24,978 records in San Jose, 13,365 records in Fresno and 17,953 records in West Los Angeles for which the State of California provided registration information. All of the databases will be available for download from our website www.feat.biochem.du.edu.

Previous measurements existed at the San Jose site (1999) and the West Los Angeles site (1999, 2001, 2003 and 2005). The mean CO, HC and NO emissions for the fleet measured in San Jose experienced large reduction for all three species. At the West Los Angeles site previous reductions in CO and HC continued with this study, however, NO emissions increased from the 2005 measurements. Whether the increase in NO emissions is related to the change of season (fall to spring) that the measurements were collected is unclear and cannot be ruled out. Calculating emission reductions at the two sites between 1999 and 2008, finds that at the San Jose site CO, HC and NO emissions have decreased by 66%, 74% and 40% respectively despite an increase of 1.2 model years in the average age of the fleet. The West LA site has seen similar decreases of 70%, 74% and 43% for CO, HC and NO respectively while the fleet has only increased in age 0.2 model years over that period. The Fresno site had the oldest fleet at approximately 8.5 years old and is the only site where new car sales have never recovered after the 2001 downturn.

Ammonia emissions are influenced by driving mode and we observed differences between the three sites that were sampled. San Jose and Fresno had very similar fuel-based ammonia emissions with means of 0.48 ± 0.01 g/kg and 0.49 ± 0.01 g/kg while the data collected at the West Los Angeles site was higher with a mean of 0.79 ± 0.02 g/kg. The West Los Angeles site had significantly higher emissions for the newest model year vehicles and we believe that is a result of the more aggressive driving mode observed. We also observed that at all of the sites the emissions retreat with age at a similar rate. As catalyst age they begin to loose their reducing capabilities and driving mode becomes less important. This data shows that process to begin when vehicles are approximately fifteen years old. As NO_x emissions have decreased over the last twenty model years, the amount of the total fixed nitrogen emissions have also decreased. However, the fraction of these fixed nitrogen emissions contributed by ammonia have increased becoming a major component of the low fixed nitrogen emissions of the newest model years at all sites.

Light-duty measurements of NO_2 were generally expected to be rather uninteresting as gasoline powered vehicles emit little if any NO_2 and the fraction of the light-duty fleet in California that are diesels is small. However, beginning with the 2007 model year vehicles, diesel engine manufacturers were required to begin phasing in major reductions in particulate and NO_x

emissions with the full phase-in to be complete in 2010. These new regulations affect all diesel powered vehicles not just heavy-duty diesel vehicles. At the Fresno location a local ambulance company, which happened to use our ramp for their return trip from the downtown health center, provided us with measurements from new diesel particulate filter equipped vans. In total 30 2007 Dodge Sprinter vans (29 operating as ambulances) were measured 57 times over the seven days of measurements. These vans had gNO_2/kg emissions that were an order of magnitude larger than the other 865 2007 vehicles. These vehicles also had more than twice of their NO_x emissions emitted as NO_2 and while only counting for 0.4% of all the measurements they accounted for almost 15% of the sites total NO_2 emissions. While the number of light-duty diesel vehicles in Fresno is small the increased NO_2 emissions seen from these vehicles on-road might point to a future of increased on-road NO_2 emissions. This would have large ramifications for local ozone formation.

Sulfur dioxide emissions were also recorded with our new instrument and, despite changes to the analysis software; they still indicate a model year dependence that we do not fully understand. Sulfur dioxide emissions should be limited to the amount of sulfur in the fuel plus a small additional amount in older vehicles due to oil consumption. This should be reflected with most model years being at or below the fuel sulfur levels (15ppmw which translates into approximately 0.03 gSO_2/kg). We find only the newest eight to nine model years that meet these levels with older models (1999 models and older) rising to higher levels that are inconsistent with the known amounts of sulfur available for oxidation. The most logical explanation for these higher sulfur levels is some type of interference found in older vehicle exhaust that positively interferes with our SO_2 measurements. At this time we have been unable to identify this interference.