Abstract

**Investigating Sources of Ammonia Uncertainty in Modeling the Salt Lake City PM2.5 Nonattainment Area**

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During periodic winter stagnation episodes in the Salt Lake basin, fine particulate (PM2.5) concentrations can exceed the national air quality standard, primarily due to a buildup of ammonium nitrate. This study has investigated causes for an ammonia (NH3) emissions shortfall in the photochemical modeling system employed by the Utah Division of Air Quality (UDAQ) to support the recent Salt Lake City PM2.5 State Implementation Plan (SIP). During SIP development, UDAQ had little information on likely causes for the NH3 shortfall, whether by inventory inaccuracies or model deficiencies. UDAQ addressed the shortfall by adding additional NH3 emissions into the model inventory based on model-measurement differences by county, and then holding that additional quantity constant into the future year model projections. The need to supply the model with additional NH3 emissions from unknown sources presents a major model uncertainty that may affect the accuracy of projected future PM2.5 levels. Our project reviewed NH3 emission inventories and recently measured concentration patterns; investigated modeling uncertainties and deficiencies, updated the UDAQ modeling system and refined modeled NH3 emissions; and re-evaluated modeling results and PM2.5 sensitivity to NH3 and NOx emissions. We found that model-measurement comparisons benefitted from a reduction in vertical mixing and an increase in snow albedo that enhances photochemical production of nitrate. However, the model was insensitive to the introduction of bi-directional NH3 surface exchange and other chemical modifications such as increased chloride levels. We also achieved a major improvement in simulated NH3 and ammonium nitrate concentrations by scaling up NH3 emissions from gasoline vehicles by about a factor of two, a modification that is supported by evidence in the literature. Our modeling results indicate that with these changes, the inorganic PM2.5 chemical environment in the basin can spatially and temporally vary between ammonia-limited and nitrate-limited, which is consistent with past field studies. This chemical balance has major implications for accurately projecting future PM2.5 according to anticipated sector-specific emission inventory changes.