TEMPORAL AND SPATIAL VARIABILITY IN ATMOSPHERIC AMMONIA CONCENTRATIONS IN THE WESTERN UNITED STATES

J. L. Collett, Jr.[1*], Y. Li[1], T. Lee[1], D. Chen[1], K. Benedict[1], D. Day[4], S. Raja[1,2], F. M. Schwandner[1,3], C. M. Carrico[1], S. M. Kreidenweis[1], W. C. Malm[4], B. A. Schichtel[5], J. Ray[6], M. Tigges[7], S. Holcomb[7], C. Archuleta[7], L. Sherman[7], J. Molenar[7], H. J. Sewell[8], J. Mojica[9], and C. McDade[9]

In the western United States ammonia is a key ingredient in aerosol formation and is contributing to growing levels of nitrogen deposition in high elevation ecosystems. Despite its importance, ammonia concentrations are not regulated and seldom measured. Data from a series of ambient monitoring studies are examined here to explore the temporal and spatial variability of ammonia concentrations in the western U.S. Study sites were located in the states of California, Arizona, Texas, Colorado, Wyoming, Utah, and Nebraska. Measurement campaigns at individual sites ranged from one month to 4 years in duration. Ammonia was measured through a combination of URG annular denuders and Radiello passive samplers. The ammonia denuders were included in a denuder/filter-pack sampling system that also provided measurements of other key aerosol and gas phase nitrogen and sulfur species. Radiello passive samplers were found to provide excellent precision and good accuracy (vs. a denuder reference) for ammonia concentration measurements on timescales of one to three weeks. Network observations reveal strong spatial gradients in ammonia concentrations, with the highest concentrations in agriculture and livestock regions. Strong seasonal variability was observed in ammonia concentrations, consistent with higher emissions during warmer times of the year. Changes in gas-particle partitioning were observed, with a shift away from particulate ammonium toward increased gas phase ammonia during warmer and drier seasons. Observations from these studies will be reviewed and recent implementation of pilot NH_x (gaseous ammonia plus $PM_{2.5}$ ammonium) measurements into the U.S. Interagency Monitoring of PROtected Visual Environments (IMPROVE) network will be discussed.

* Presenting author (E-mail : collett@atmos.colostate.edu)

[1]Atmospheric Science Department, Colorado State University, Fort Collins, CO 80523 USA

[2]currently at Providence Engineering and Environmental Group, Irving, TX USA75063

[3]currently at Nanyang Tech. University, Earth Observing Laboratory, Singapore 639798

[4]Coop. Inst. for Res. in the Atmosphere, Colorado State Univ., Fort Collins, CO 80523 USA

[5]National Park Service/CIRA, Colorado State University, Fort Collins, CO 80523 USA

[6]National Park Service, Air Resources Division, Denver, CO 80225 USA

[7]Air Resource Specialists, Inc., Fort Collins, CO 80525 USA

[8] Shell Exploration and Production Company, Denver, CO 80237 USA

[9]University of California, Crocker Nuclear Laboratory, Davis, CA 95616 USA