M.S. Defense Announcement
Evelyn Bangs
Monday, December 2 at 10:00 a.m.

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Defense
CIRA Director's Conference Room (135 CIRA)

Post Defense Meeting
Riehl Conference Room (211 ACRC)

Committee:
Jeffrey L. Collet (Advisor)
Sonia Kreidenweis
Katie Benedict
Ellison Carter (Civil and Environmental Engineering)

SPATIAL PATTERNS AND PARTICLE SIZE DISTRIBUTIONS OF ATMOSPHERIC AMINES IN NORTHERN COLORADO

Emissions of reactive nitrogen along the Front Range in Northern Colorado have implications for sensitive and protected environments such as those in Rocky Mountain National Park (RMNP). Nitrogen-containing pollutants exert a variety of adverse effects, ranging from visibility impairment to excessive nitrogen input to sensitive alpine ecosystems. Northern Colorado has many urban, agricultural, and oil and natural gas production that emit various forms of reactive nitrogen to the atmosphere. Model simulations and past measurements demonstrate that these emissions are capable of being transported long distances in gaseous and particulate forms. RMNP is particularly exposed to increased concentrations of reactive nitrogen pollutants during periods of easterly, upslope flow when emissions along the Front Range and sources farther are transported into the mountains. A detailed understanding of the composition of transported reactive nitrogen pollution is needed to predict impacts within RMNP. While emissions of ammonia and nitrogen oxides have received significant attention in precious studies, relatively little is known about organic nitrogen pollution, despite its ability to contribute to excess N deposition and to formation of particulate matter (PM). Amines are organic analogs of ammonia, where one or more hydrogen atoms are replaced by organic functional groups. The animal agriculture industry is known to be a major source of some amines, while the beer and wine industry, sugar beet industry, leather manufacturing, and chemical manufacturing are also potentially important sources. Many of these industries are located along Colorado's Front Range, providing a good opportunity to study amine atmospheric chemistry. While the chemical lifetime of many gas phase amines is relatively short (hours), they are strong bases that can compete with ammonia to form longer-lived particles that are transported over substantial distances. The work carried out in this study focused on assessing a spatial gradient of particulate amines between RMNP, Fort Collins, and Greeley. Greater concentrations of many amines were typically observed near source emissions in Greeley and/or Fort Collins, but significant concentrations of amines such as dimethylamine, were also observed in the more remote environment at RMNP. To better understand amines, their chemistry and their contribution to PM, size distributions of 16 different amines were analyzed from measurements with a Micro-Orifice Uniform Deposit Impactor (MOUDI). Of 16 analyzed amines, nine were found above the detection limits in summertime Fort Collins and five during the winter. Several organic acids and inorganic acid anions particle size distributions were also assessed to understand contributions from potential anion species involved in salt formation with amine cations. Organic acid particle size distributions, particularly oxalate, overlap with fine particle mode size distributions of both ammonia and amine cations. The size distribution measurements also reveal important reactions between gaseous nitric acid and coarse soil particles to generate coarse mode nitrate particles. Continued measurements of amines and other species size distributions and spatial gradients at more locations would help improve understanding of amine PM chemistry.