3.039 Wintertime NOx Chemistry in Power Plant Plumes.

Early Career Scientist

Presenting Author:
Dorothy Fibiger, NSF-AGS PostDoc, NOAA/CSD, Boulder, CO, USA, dorothy.fibiger@noaa.gov

Co-Authors:
Erin McDuffie, NOAA/CIRES/CU, Boulder, CO, USA
Bill Dube, NOAA/CIRES, Boulder, CO, USA
Patrick Veres, NOAA/CIRES, Boulder, CO, USA
Ben Lee, U of Washington, Atmospheric Sciences, Seattle, WA, USA
Felipe Lopez-Hilfiker, U of Washington, Atmospheric Sciences, Seattle, WA, USA
Marc Fiddler, North Carolina A&T, Greensboro, NC, USA
Jaime Green, North Carolina A&T, Greensboro, NC, USA
Carlena Ebben, UC Berkeley, Chemistry, Berkeley, CA, USA
Tamara Sparks, UC Berkeley, Chemistry, Berkeley, CA, USA
Andrew Weinheimer, NCAR, Boulder, CO, USA
Denise Montzka, NCAR, Boulder, CO, USA
Theresa Campos, NCAR, Boulder, CO, USA
Ronald Cohen, UC Berkeley, Chemistry, Berkeley, CA, USA
Solomon Bililign, North Carolina A&T, Greensboro, NC, USA
John Holloway, NOAA, Boulder, CO, USA
Joel Thornton, U of Washington, Atmospheric Sciences, Seattle, WA, USA
Steven Brown, NOAA/CU, Boulder, CO, USA

Abstract:

Nitrogen oxides (NO_x = NO + NO_2) play a key role in atmospheric chemistry and coal-fired power plants are a major source of NO_x to the atmosphere, making up approximately 30% of emissions in the US (epa.gov). NO_x emissions can vary seasonally, as well as plant-to-plant, with important impacts on the evolution of the plume chemistry. In particular, due to inefficient plume dispersion, nighttime NO_x emissions from power plants are held in concentrated plumes, where various reaction and mixing rates can have a strong influence on plume chemistry. During the day, NO_x catalyzes ozone (O_3) production, while at night it can react to form nitric acid (HNO_3) and nitryl chloride ($ClNO_2$) and remove O_3 from the atmosphere. These processes are well studied in the summer, but winter measurements are more limited.
We will show results from the aircraft-based WINTER campaign over the northeastern United States, where several nighttime intercepts of power plant plumes were made. The intercepts show variable rates of N_2O_5 conversion to HNO_3 and $ClNO_2$, which, in turn, alters the rate of removal of NO_x from the atmosphere. Additionally, if the N_2O_5 conversion is high, then the partitioning between $ClNO_2$ and HNO_3 formation plays a

significant role in NO_X removal. Finally, the rate of plume mixing and the background O_3 level also contribute to the rate of NO_X removal. Through modeling of plume chemistry and dispersion, we will show the relative importance of each of these influences on wintertime power plant plume chemistry and transport and how they influence removal of NO_X from the atmosphere.