3.139 The atmospheric reactivity of the NO3 radical.

Early Career Scientist

Presenting Author:
Jonathan M. Liebmann, Atmospheric Chemistry Department, Max Planck Institut für Chemie, 55128, Mainz, Germany, jonathan.liebmann@mpic.de

Co-Authors:
Einar Karu, Atmospheric Chemistry Department, Max Planck Institut für Chemie, 55128, Mainz, Germany
Nicolas Sobanski, Atmospheric Chemistry Department, Max Planck Institut für Chemie, 55128, Mainz, Germany
Jan Schuladen, Atmospheric Chemistry Department, Max Planck Institut für Chemie, 55128, Mainz, Germany
Gerhard Schuster, Atmospheric Chemistry Department, Max Planck Institut für Chemie, 55128, Mainz, Germany
Anja Claude, Meteorologisches Observatorium Hohenpeissenberg, Deutscher Wetterdienst, 82383, Hohenpeissenberg, Germany
Jennifer B.A. Muller, Meteorologisches Observatorium Hohenpeissenberg, Deutscher Wetterdienst, 82383, Hohenpeissenberg, Germany
Dagmar Kubistin, Meteorologisches Observatorium Hohenpeissenberg, Deutscher Wetterdienst, 82383, Hohenpeissenberg, Germany
Robert Holla, Meteorologisches Observatorium Hohenpeissenberg, Deutscher Wetterdienst, 82383, Hohenpeissenberg, Germany
Heidi Hellen, Finnish Meteorological Institute, 00560, Helsinki, Finland
Hannele Hakola, Finnish Meteorological Institute, 00560, Helsinki, Finland
Lauriane Quéléver, Department of Physics, University of Helsinki, 00140, Helsinki, Finland
Simon Schallhardt, Department of Physics, University of Helsinki, 00140, Helsinki, Finland
Mikael Ehn, Department of Physics, University of Helsinki, 00140, Helsinki, Finland
Christian Plaß-Dülmer, Meteorologisches Observatorium Hohenpeissenberg, Deutscher Wetterdienst, 82383, Hohenpeissenberg, Germany
Horst Fischer, Atmospheric Chemistry Department, Max Planck Institut für Chemie, 55128, Mainz, Germany
Thorsten Hoffmann, Johannes Gutenberg University, 55128, Mainz, Germany
Jonathan Williams, Atmospheric Chemistry Department, Max Planck Institut für Chemie, 55128, Mainz, Germany
Jos Lelieveld, Atmospheric Chemistry Department, Max Planck Institut für Chemie, 55128, Mainz, Germany
Abstract:

We describe the first direct measurements of the total reactivity of NO$_3$ in ambient air, in which cavity-ring-down spectroscopy is used to monitor the loss synthetically generated NO$_3$ after reacting with ambient trace-gases in a flow-tube. The instrument can measure NO$_3$ loss rate constants between 0.005 s$^{-1}$ and 45 s$^{-1}$ with an uncertainty of 16 % in the center of its dynamic range. Results from the deployment of this instrument in a boreal forest in southern Finland and a rural mountain site in southern Germany are presented. In both cases, NO$_3$ reactivity was driven by local meteorology coupled with biogenic emissions and displayed a strong vertical gradient with the highest reactivity measured below canopy level in the boreal forest. Very low NO$_3$ reactivities were observed in the residual layer. Comparison of the measured NO$_3$ reactivity with measurements of Volatile Organic Compounds (VOCs) indicated that the reactivity is dominated by reaction with monoterpenes, though a significant fraction of reactivity remained unattributed. During daytime, at both sites, more than 25% of the NO$_3$ formed was removed via reaction with biogenic volatile organic compounds (BVOCs), implying a significant daytime loss of NOx and formation of organic nitrates and secondary organic aerosol via NO$_3$ chemistry even though the nitrate radical is generally considered to be of importance at night.