Geophysical Research Abstracts
Vol. 14, EGU2012-1697, 2012
EGU General Assembly 2012

Quantification of the volatility of secondary organic compounds in ultrafine particles during nucleation events

J.R. Pierce (1), I. Riipinen (2), and the Additional authors Team

(1) Dalhousie University, Physics and Atmospheric Science, Halifax, Canada (jeffrey.robert.pierce@gmail.com), (2) Stockholm University

Condensation of secondary organic compounds onto ultrafine aerosols is important for growing these particles to sizes where they can act as cloud condensation nuclei. The organic flux to ultrafine particles depends strongly on the volatility of the condensing compounds. This paper presents quantitative estimates of the volatility of secondary organic aerosol (SOA) in freshly nucleated particles. We examine 13 nucleation/growth events in two remote continental locations, Hyytiälä, Finland and Egbert, ON, Canada. Two independent methods are used to quantify the volatility of the growing nucleation mode: (1) modelling of the growing nucleation mode to determine which volatilities allow the model to reproduce observed growth, and (2) modelling of the evaporation of heated aerosols in a Volatility Differential Mobility Particle Sizer to determine which volatilities allow the model to reproduce the observed evaporation. We find that the average saturation vapor concentration (C^*) in the freshly nucleated particles (once $D_p > 3$ nm) is likely less than 10^{-3}-10^{-2} μg m^{-3} (this corresponds to $3\cdot10^6$-$3\cdot10^7$ molecules cm^{-3} and a saturation vapor pressure of 10^{-8}-10^{-7} Pa). This maximum volatility depends somewhat on other uncertain factors that affect the size-dependent condensation of secondary organic compounds such as the surface tension, mass accommodation coefficient and the volatility of the pre-existing aerosols. However, our tests suggest that under no reasonable assumptions can the SOA in the ultrafine particles contain a majority of compounds with $C^* > 10^{-2}$ μg m^{-3}. We demonstrate that the growth could be driven by either gas-phase or particle-phase chemistry but cannot conclude which is responsible for the low-volatility SOA.