2.119 Impact of temperature on molecular composition of secondary organic aerosols from anthropogenic and biogenic sources: from lab to field.

Early Career Scientist

Presenting Author:
Cheng Wu, Department of Environmental Science and Analytical Chemistry, University of Stockholm, Sweden, cheng.wu@aces.su.se

Co-Authors:
Wei Huang, Institute of Meteorology and Climate Research, Karlsruhe Institute of Technology, Germany
Yvette Gramlich, Institute of Meteorology and Climate Research, Karlsruhe Institute of Technology, Germany
Harald Saathoff, Institute of Meteorology and Climate Research, Karlsruhe Institute of Technology, Germany
Aki Pajunoja, Department of Applied Physics, University of Eastern Finland, Finland
Annele Virtanen, Department of Applied Physics, University of Eastern Finland, Finland
Federico Bianchi, Institute for Atmospheric and Earth System Research/Physics, Faculty of Science, University of Helsinki, Finland
Qiaozhi Zha, Institute for Atmospheric and Earth System Research/Physics, Faculty of Science, University of Helsinki, Finland
Diego Aliaga, Institute for Atmospheric and Earth System Research/Physics, Faculty of Science, University of Helsinki, Finland
Liine Heikkinen, Institute for Atmospheric and Earth System Research/Physics, Faculty of Science, University of Helsinki, Finland
Marcos Andrade, Laboratorio de Fisica de la Atmosfera, Universidad Mayor de San Andrés, Bolivia
Claudia Mohr, Department of Environmental Science and Analytical Chemistry, University of Stockholm, Sweden

Abstract:

Secondary organic aerosol (SOA) can be of natural or anthropogenic origin. Most often, precursors from biogenic and anthropogenic sources mix and interact with each other during atmospheric transport and chemical aging, and contribute together to SOA formation. During these processes, temperature plays an important role in changing the phase state, morphology and chemical composition of SOA.
We firstly present chamber studies of SOA formation from toluene and α-pinene in the AIDA chamber of the Karlsruhe Institute of Technology. The experiments were performed at temperatures between 293 and 243K, thus covering conditions from the Earth’s

surface to high altitudes. Organic compounds in both gas and particle phase were characterized on the molecular level with a chemical ionization mass spectrometer with filter inlet for gases and aerosols (FIGAERO-CIMS). Comparisons of SOA generated from individual precursor compounds and their mixtures for three different temperatures indicate that the temperature has a significant impact on the chemical composition. Overall, decreasing temperature leads to compounds with lower oxidation state, lower degree of oligomerization, but a higher gas-to-particle conversion. For mixed cases, the respective fingerprints of α-pinene and toluene enable us to distinguish between their contributions, while novel molecular tracers show potential interaction between these two sources.

The understanding obtained from the lab experiments is further used to interpret field observations. We show first results from a comprehensive field campaign (December 2017 – May 2018) conducted at the GAW station Chacaltaya in the Bolivian Andes, at 5240 m a. s. l.. This high-altitude site is influenced by the anthropogenic emissions from the nearby El Alto-La Paz metropolitan area, and the biogenic emissions from surrounding Eucalyptus forests as well as tropical rainforests through long-range transport. We focus on the results from the FIGAERO-CIMS and investigate relative importance of different sources contributing to new particle formation and growth processes.