

Determination of partitioning of alpha-pinene ozonolysis products between gaseous and aerosol phases

INOMATA, Satoshi^{1*} ; TANIMOTO, Hiroshi¹ ; SATO, Kei¹ ; FUJITANI, Yuji¹ ; YAJIMA, Ryoji² ;
SAKAMOTO, Yosuke² ; HIROKAWA, Jun²

¹National Institute for Environmental Studies, ²Hokkaido University

Organic material accounts for a substantial fraction of atmospheric fine particulate matter, which directly and indirectly affects the global climate as well as human health. Many gas-phase organic compounds undergo oxidation in the gas phase to yield products, generally oxygenated, that have vapor pressures sufficiently low that they are partitioned between the gas and aerosol phases. Such compounds are often referred to as semi-volatile organic compounds (SVOCs) and, when present in the aerosol phase, as secondary organic aerosols (SOAs). Quantification of the impacts of SOAs requires understanding their chemical composition and processes of formation as well as mass yields. In particular, because a systematic underestimation of simulated SOA production increases with air mass ageing, speciation of the SVOCs produced by gaseous oxidation is essential. In addition, information about the partitioning of each SVOC between the gaseous and condensed phases as well as the reactions of the condensed SVOCs within the particulate phase is important for the description of SOA formation. We use chemical ionization-mass spectrometry to identify SVOCs in both the gaseous and the aerosol phases and to estimate the gas-aerosol partitioning of each SVOC. By using the same technique to measure SVOCs in both the gaseous and the aerosol phases, we were able to determine the partitioning of each SVOC between the gaseous and aerosol phases from the ratio of ion signals, without knowing the concentration of each SVOC. This ability to partition each SVOC between the gaseous and aerosol phases is a strong point of this approach, because most chemical species in SOAs are thought to be multifunctional, and determining their concentrations seems to be impossible. In the present study, we used two proton transfer reaction-mass spectrometers for real-time measurements of SVOCs produced in α -pinene ozonolysis in both the gaseous and the aerosol phases and determined the partitioning of each SVOC between the gaseous and aerosol phases. Time profiles of the SVOCs in both the gaseous and the aerosol phases were compared. This work was supported by the Environmental Research and Technology Development Fund (5-1408) of the Ministry of the Environment, Japan.

Keywords: Secondary organic aerosol, Gas-particle partitioning, Chemical ionization-mass spectrometry, Proton transfer reaction-mass spectrometry, alpha-Pinene, Ozonolysis