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Simultaneous Factor Analysis of Coupled Aerosol and VOC Mass Spectra in Regions of Biogenic Influence

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Recent studies suggest that the traditional binary treatments of atmospheric organics as either gases or particles may be inadequate, highlighting the need for analytical techniques capable of simultaneously considering particle and gas-phase species. Organic mass spectra of particles and volatile organic compounds (VOCs) were collected using an Aerodyne time-of-flight aerosol mass spectrometer (C-ToF-AMS), and a proton transfer reaction-mass spectrometer (PTR-MS), respectively. The particle and VOC mass spectra were combined into a single dataset, which was analyzed using the positive matrix factorization (PMF) receptor modeling technique. The relative weights of the AMS and PTR-MS data were balanced in the PMF analysis according to the criteria that the scaled residuals within a solution be independent of the measuring instrument. Instrument relative weight is controlled by the application of a scaling factor to the PTR-MS uncertainties. The AMS and PTR-MS instruments were deployed from mid-May to mid-June at two sites in Canada: (1) Egbert, ON (2007), a semirural site $\sim$70 km north of Toronto, and (2) Whistler, BC (2008), a remote site $\sim$120 km north of Vancouver. The Egbert site is influenced by anthropogenic emissions from Toronto and populated regions to the south, biogenic emissions from boreal forests to the north, and biomass burning emissions. The Whistler site is strongly influenced by boreal forest terpene emissions, with lesser contributions from long-range transport and anthropogenic emissions.