Performance evaluation and field deployment of a new ion source and drift-tube reactor for proton-transfer-reaction time-of-flight mass spectrometry

Jordan Krechmer (1), Felipe Lopez-Hilfiker (2), Manuel Hutterli (2), Abigail Koss (3), Rupert Holzinger (4), Katrin Fuhrer (2), Marc Gonin (2), John Jayne (1), Manjula Canagaratna (1), Douglas Worsnop (1), and Joost deGouw (1)

(1) Aerodyne Research, Inc., Center for Cloud and Aerosol Chemistry, Billerica, United States, (2) Tofwerk A.G., Thun, Switzerland, (3) Massachusetts Institute of Technology, Cambridge, MA, USA, (4) Universiteit Utrecht, Utrecht, The Netherlands

Volatile organic compounds (VOCs) have important implications for human health, aerosol formation, and air quality. We present the first laboratory and ambient measurements of VOCs from a novel drift tube proton transfer reaction source, the Vocus, coupled to a high-resolution time of flight mass analyzer (PTR-TOF). A quadrupole ion guide surrounding the drift tube uses a radio frequency (RF) voltage to effectively focus ions for transmission into the differential pumping stages and the mass analyzer. The new instrument achieves sensitivities for VOCs up to 25 000 counts per second per parts per billion volume (counts/ppb) with a mass resolving power R= M/ΔM > 12 000 Th/Th. The Vocus was deployed to the 2017 ACTRIS PTR-MS intercomparison campaign at Cabauw (PICAB), Netherlands with an automated calibration and background system. The high-resolution measurement allowed identification of additional elemental ion signals at many unit masses that would only be resolved with a resolving power > 8000 Th/Th. Several mass spectral factors were identified from ambient time series using a positive matrix factorization (PMF), indicating different anthropogenic, biogenic, and background emissions. We use the field data to evaluate the stability and precision of the calibration, background, and measurement.