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Temporal variations and source apportionment of volatile organic compounds (VOCs) at an urban site in Zurich, Switzerland

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Volatile organic compounds (VOCs) originating from anthropogenic and natural sources play an important role in the formation of tropospheric ozone and secondary organic aerosols. Insight into emission and evolution of VOCs over time is essential to the understanding of diverse pollution episodes in urban areas.
In this study, we present seasonal variations and their associated emission sources of atmospheric VOCs in urban Zurich. Highly time-resolved volatile organic compounds measurements were performed using a proton-transfer-reaction time-of-flight mass spectrometer (PTR-TOF-MS) in summer and winter 2016. Distinct seasonal and diurnal patterns of several VOCs were observed indicating different origins and chemical reactions. Source apportionment was conducted for each season separately using positive matrix factor analysis based on 135 species measured.
In winter, substantial contributions from anthropogenic emissions were identified, including traffic emissions, biomass burning, and cooking. Traffic had the highest contribution, while the biomass burning factor was most influential during an episode probably related to wood burning activities.
The summer measurements revealed higher concentrations of oxidized VOCs (OVOCs) and relatively lower concentrations of aromatic compounds compared to those in winter. During the measurement periods, traffic emission was an important contributor, and two special events were identified, which were possibly related to biomass burning activities. Meanwhile, the OVOCs factor, which was probably related to photochemical oxidation of biogenic VOCs, contributed significantly. In general, VOCs in urban Zurich exhibited distinct variabilities in concentrations, emission sources and formations.