Comparison of time-resolved continuous measurements of ozone precursor VOCs in Borna, Saxony (Germany)

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Volatile organic compounds (VOCs) are important precursor substances from which ground-level ozone (O_3) can be formed through complex reaction chains involving NO_x and HO_x as well. As there are comparably low regulatory requirements for VOC measurements in the EU, VOCs are only sparsely recorded in the air quality monitoring networks in Germany and Europe, in contrast to ozone and nitrogen oxides (EU, 2008). However, in order to determine trends, check the effectiveness of emission reduction strategies and the correctness of emission inventories, be able to allocate emission sources and better understand ozone formation and the spread of its precursors, it is necessary to carry out long-term measurements of ozone precursors with a higher temporal resolution.

To check their suitability for continuous time-resolved VOC monitoring especially in measurement networks, two commercially available online-GC systems were tested over a time-period of about 1 1/2 years at a station of the air quality monitoring network in Saxony, Germany. Comparing the raw concentrations obtained from these two automated systems, the parameters of the regression range from a slope of 0.4 and an R^2 of 0.13 for ethene to a slope of 2 and a R^2 of 0.54 for toluene. Both instruments required significant maintenance efforts and due to a number of hardware and software issues, a data availability of 73-76 % was achieved. The biggest issue with the raw data quality arose from retention time shifts, especially for low boiling point compounds, leading to frequent misclassifications of chromatographic peaks. Time-consuming manual or semi-manual reprocessing of the raw data is mandatory to increase the data quality to a more acceptable level. With the reprocessed data, a slope of 1.6 and an R^2 of 0.59 can be achieved for ethene and thus a significant improvement. As a best-case example, propane achieves a slope of 1.3 and an R^2 of 0.85.

Approximately 20 of the 61 calibrated compounds could be measured on a regular basis including BTX aromatics and small chain alkanes and alkenes. Concentrations range from 0.03 ppb for most of the aromatics and longer chain alkanes and alkenes up to 2.2 ppb for C_2 and C_3 compounds. During the vegetation period, biogenic VOCs and especially isoprene show higher concentrations of up to 7.6 ppb. From the measured seasonal trends and diurnal and weekly patterns, influences from different emission sources such as local traffic, heating or vegetation can be obtained and first results will be presented. In addition, together with the respective photochemical ozone creation potential (POCP) (Derwent and Jenkin, 1991; Jenkin, 2017) of the measured VOCs, the influence of regional precursor emissions on the ozone concentration can be determined.

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