Online Quantification of Oxidative Potential from Residential Wood Combustion (RWC) and Car Exhaust Aerosol

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Air pollution particles are the single highest environmental health risk and have adverse effects on human health with over 7 million premature deaths per year. Despite these negative effects, many physical and chemical properties of particulate matter (PM) and their effect on human health still remain unclear. The oxidative potential (OP) has widely been suggested as proxy to measure toxicity in PM. Different assays have been developed to quantify OP over the recent years. Most of them measure the OP offline from aerosol that is collected on a filter and analyzed with a time delay from days to month.

We could show for a biogenic secondary organic aerosol using α-pinene as precursor, that the OP-active compounds decay with a half-life from seconds to hours, leading to the assumption that the OP in filter samples, is potentially highly underestimated. Therefore, we built an online instrument that can quantify OP with a high time resolution using a physiological relevant assay. With this online instrument and the corresponding offline assay, we characterized several aerosol types, where we could show that there is not only an OP decay during the offline analysis, but that this decay is also highly variable for different aerosol systems.

With the online instrument we also measured primary (fresh) and secondary (aged) emissions from RWC and car exhaust to investigate the differences in aging times and compositional toxicity of the different aerosol systems. We could show a highly time resolved signal as well as that for RWC high photochemical ages lead to a lower mass-normalized OP, compared to car exhaust emissions where a higher aging leads to a slightly higher OP. Aged RWC gives, compared to aged car exhaust, an order of magnitude higher OP showing that aged RWC is potentially more toxic.