1.053 On-line and off-line measurements of particle-bound reactive oxygen species (ROS) in Beijing.

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Abstract:

Reactive oxygen species (ROS), present in particles or generated by particle components upon deposition of particles in the human lung, are widely thought to be one of the main contributors to particle-related toxicity. However, there is so far only little data available on their concentrations in ambient air, making it difficult to gauge their impact on air quality. Recent studies have shown that a large fraction of particle-bound ROS in secondary organic aerosol is relatively short-lived, with lifetimes of several minutes. Traditional off-line sampling with high-volume samplers will therefore likely severely underestimate ROS concentrations, showing the need for on-line instrumentation.
We have recently developed a compact, high time-resolution, on-line instrument for the measurement of particle-bound ROS (OPROSI). To determine ROS concentrations, particles are continuously extracted and the extract is reacted with 2’7’-dichlorofluorescein (DCFH) in presence of horseradish peroxidase (HRP). This leads to formation of a fluorescent dye, which is detected spectroscopically. The instrument allows for up to 16 h of continuous measurement with a time resolution of around 10 min and a limit of detection of ca. 3 nmol [H_2O_2] equivalent per m^3 air.
We used the OPROSI to continuously measure the concentration of particle-bound ROS in Beijing air during the Air Pollution and Human Health in a Developing Megacity (APHH-Beijing) campaign in November-December 2016 and May-June 2017. We observed seasonal variations as well as pronounced diurnal cycles, with maxima developing in summer in later afternoon whereas winter daily maxima usually occur around midday or early afternoon. On-line ROS data are compared with off-line ROS data from aerosol collected in parallel on filters, with other gaseous and particulate air pollution parameters and with meteorological measurements. This study is the first long-term, online ROS data set, enabling us to gain a better understanding of the factors influencing ROS generation and distribution.