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Measurements of trace elements with Rotating Drum Impactors and subsequent X-ray fluorescence spectroscopy

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Samples of ambient aerosols often contain minuscule amounts of trace elements at or below the detection limit of the analysis method. Synchrotron x-ray fluorescence spectroscopy (SR-XRF) allows the detection of such small concentrations of elements without further treatment. This makes it possible to sample in the order of hours instead of days and thus to detect diurnal variations. Rotating Drum Impactors (RDIs) where employed to collect aerosols in three different size bins (PM10-PM2.5, PM2.5-PM1 and PM1) on a thin Mylar foil. These samples were analyzed subsequently with SR-XRF at the Swiss Synchrotron Light Source at PSI using monochromatic light of around 10-16 keV, and at Hasylab at DESY, Hamburg using a polychromatic beam.

Ambient samples had been collected in different settings (inter alia in an alpine valley, close to a freeway, in a city) and thus allow for a comparison of different emission scenarios (wood combustion, abrasion of vehicles, etc). Two of the field campaigns coincided with heavy pollution episodes in winter 2006, where the legal threshold of 50 μg/m^3 (daily average) was exceeded by up to a factor of 3. The elemental composition did not differ much between the sites in northern Switzerland. Heavier elements were found mainly in the largest size fraction, which is usually considered to originate from (mineral) dust re-suspended into the air or from mechanical abrasion. The smaller particle size fraction showed high amounts of carbonaceous material not detectable with the XRF setup and is more typical for combustion processes. K, Si, Fe,

Ca, Al, Na, Mg, Ba, Zn were identified as the important metallic contributors, while Ti, Cu and Cr were found only in traces. K is an indicator for wood combustion, but is also a component of mineral dust and de-icing salts applied to roads during wintertime. Additional measurements of different wood-burning stoves were performed at a test-bench. The results obtained with RDI samples were also compared to complementary measurements.

Results of this analysis will feed into source apportionment studies (applying positive matrix factorization, PMF) to get more insight into possible sources of emissions and therewith helping to formulate mitigation strategies.