Geophysical Research Abstracts
Vol. 21, EGU2019-10472, 2019
EGU General Assembly 2019
© Author(s) 2019. CC Attribution 4.0 license.

A novel facility to generate stable and reproducible aerosol mixtures that simulate the physicochemical properties of ambient air

Stefan Horender and Konstantina Vasilatou

Federal Institue of Metrology METAS, Analytische Chemie, Wabern, Switzerland (stefan.horender@metas.ch)

Particle mass concentration is the most important particle metric for air quality. Ambient threshold values for PM2.5 and PM10 have been established in Europe (EU Air Quality Directive 2008/50/EC) and worldwide. However, to date no reference aerosol exists for calibrating commercial PM-measuring instruments. As a result, comparisons with the reference gravimetric method need to take place in the field at least twice a year at 2 different sites. These procedures are time-consuming, expensive and suffer from high measurement uncertainties.

METAS is currently validating a novel facility to generate a homogeneous mixture of different aerosol types (salt, dust, soot and aged soot) in a downward pipe flow. The ultimate goal is to generate synthetic ambient aerosols in the laboratory for the calibration of PM measuring instruments. This facility consists of a 2.3-m-long pipe with inner diameter of 160 mm. The primary aerosols are injected in the center of the pipe and are subsequently mixed by three air jets arranged concentrically around the pipe. Details on the design of the facility will be presented in the talk. Isokinetic sampling can be achieved by using differently sized extraction cones that lead the aerosol to the reference gravimetric method and the different devices under test (oscillating microbalances, light scattering instruments etc.).

Measurements of the homogeneity of an aerosol consisting of 500 nm PSL particles showed that 2.3 m downstream of the aerosol injection the distribution was homogeneous within 5% and that the flow exhibited a turbulent "flat" velocity profile at the sampling location.

The flow field has been modeled by the COMSOL CFD module by taking advantage of the symmetry of the geometry so that only 1/3 of it had to be meshed. Since the Reynolds number of the flow is around 1800, turbulence had to be taken into account. Comparisons of the CFD results with measured velocity profiles using Laser Doppler velocimetry showed that a low-Reynolds number k-epsilon model that resolves the flow up to the wall (no wall functions) was appropriate to simulate the velocity characteristics of the pipe flow.

Currently, measurements are being performed by mixing salt and dust aerosols, whereas in a second step fresh and (photo-chemically) aged soot will be added in order to simulate better the physicochemical properties of atmospheric aerosols. Preliminary results of these investigations will be presented at the conference.