Generation and physicochemical characterisation of ambient-like model aerosols in the laboratory: application in the intercomparison of automated PM monitors with the reference gravimetric method

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A new facility has been developed which allows for a stable and reproducible generation of ambient-like aerosols in the laboratory. The setup consists of multiple aerosol generators, a custom-made flow tube homogeniser, isokinetic sampling probes and a system to control aerosol temperature and humidity. Model aerosols containing elemental carbon, secondary organic matter from the photo-oxidation of α-pinene, inorganic salts such as ammonium sulphate and ammonium nitrate, mineral dust particles and water were generated at different environmental conditions and different number and mass concentrations. The aerosol physical and chemical properties were characterised with an array of experimental methods, including scanning mobility particle sizing, ion chromatography, total reflection X-ray fluorescence spectroscopy, and thermo-optical analysis. The facility is very versatile and can find applications in the calibration and performance characterisation of aerosol instruments monitoring ambient air. In this study, we performed, as proof of concept, an intercomparison of three different commercial PM (particulate matter) monitors (TEOM 1405, DustTrak DRX 8533 and Fidas Frog) with the gravimetric reference method under three simulated environmental scenarios. The results will be presented and compared to previous field studies. We believe that the laboratory-based method for simulating ambient aerosols presented here could provide a useful alternative to time-consuming and expensive field campaigns, which are often required for instrument certification and calibration.

Table: Chemical composition of the three model aerosols and environmental conditions during each experiment. EC, OC and OM stand for elemental carbon, organic carbon and organic matter, respectively.

Model aerosol	Sulphate (μg/m^3)	Nitrate (μg/m^3)	Ammonium (μg/m^3)	Mineral dust (μg/m^3)	Other (μg/m^3)	EC (μg/m^3)	OC (μg/m^3)	OM (μg/m^3)	T (°C)	% RH
1	3.06	3.17	0.80	8.6	5.5	4.8	14.9	20.9	21±1	50±2
2	2.03	4.53	0.73	3.0	6.0	3.8	8.8	12.3	12±1	70±3
3	3.07	1.75	0.55	3.5	4.7	1.3	5.1	7.1	21±1	70±3