Development of a detailed measurement model for the assessment of atmospheric aerosols water soluble fraction by Ion Chromatography

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Introduction
Air composition is known to have a relevant impact on public health, on the environment and on meteorology and climate. The chemical characterization of gaseous and aerosol fraction is used to monitor risks from exposure to polluted air and to develop air transport and climate models. Air is appropriately sampled, and aerosols are collected in conveniently chosen filters, kept and treated according to the planned strategy. The ionic composition of the water soluble fraction of aerosols, assessed by Ion Chromatography, IC, is particularly useful to estimate the mineral composition of aerosols of both natural and anthropogenic origins.

The evaluation of the extraction step involved the estimation of the intermediate precision from duplicate analysis of pooled urban aerosol samples prepared from real samples to ensure homogeneity. The uncertainty budget is divided in the extraction, extract dilution and ionic analytical steps and effects has been identified. The uncertainty component is linear with measurement uncertainty.

In this work, a metrological model has been developed for the assessment of atmospheric aerosols water soluble fraction by Ion Chromatography, IC, is particularly useful to estimate the mineral composition of aerosols of both natural and anthropogenic origins.

The uncertainty associated with the preparation of duplicate filters was considered.

Identification and Quantification of uncertainty parameters

The extraction intermediate precision excluding uncertainty introduced by the validation procedure

Extraction volume

Dilution of extract

Stock Standard

Filter treatment (Whatman 41)

Sonication 450°C 60 mins

Ion Chromatography

Chromatogram

Standard Preparation

Stock Standard

Amount of water-soluble ion in the atmospheric aerosol collected on the filter

Extraction intermediate precision excluding uncertainty introduced by the validation procedure

Results

Variation of the relative expanded uncertainty with anion content

Variation of the percentage contribution of the uncertainty components with the sample content

For the determination of water extractable nitrate and sulphate, in defined conditions, from aerosol collected, in filters the contribution of the statistical interpolation of the sample signal in the calibration curve major at the lower fraction of the studied analytical range and minor for higher sample contents. The linear unweighted regression model was used after a detailed validation of models assumptions for calibration standards quality, and homosedasticity and linearity of the instrumental response. For higher samples contents or the all analytical range for chloride, the uncertainty associated with the intermediate precision of the extraction clearly dominates the uncertainty budget. The component was estimated after subtracting the uncertainty introduced by the validation procedure of the extraction precision. The other uncertainty components are minor ones and resources in managing these components can be saved with no relevant impact on measurements quality.