

In-situ concentration of semi-volatile aerosol using water-condensation technology

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Introduction

- Versatile Aerosol Concentration Enrichment System (VACES) concentrates aerosol in the range of 0.01 - 10 μm by a factor of up to 40 using water condensation technology.
- Water condensation and changes in temperature inside VACES may affect partitioning of semi-volatile compounds.
- Are there significant artifacts?

Experimental setup

- Measurements were carried out on 10, 18, and 19 September 2002 at the central site of the Pittsburgh Air Quality Study.
- The output of the VACES was directed to the Aerodyne Mass Spectrometer (AMS).
- Concentrations of sulfate, nitrate, ammonium and organics as a function of size measured with and without the concentrator were compared.
- GFEMN thermodynamic model was used to model processes in the concentrator.

Results

- Concentrator does not change size distribution of sulfate at all conditions encountered during the study (Fig. 1).
- Size distributions of ammonium, organics and nitrate
 - are preserved at relatively clean conditions (Fig. 2)
 - exhibit an increase at small sizes during polluted episodes (Fig. 1)
 - increase at small sizes corresponds to the region of the maximum aerosol surface area
- Artifact is small, 1 $\mu\text{g}/\text{m}^3$ or less (0.3 - 2.7 % of the total aerosol mass).
- According to the model, nitrate artifact is most pronounced in ammonia-limited conditions, while in ammonia-rich environment it is negligible (Fig. 3)

Recommendations

- Operate VACES with a denuder and / or with its condenser temperature set to be equal the ambient temperature.
- If no denuder is used, concentration of individual compounds should be measured before and after concentrator, such that concentration factors for individual species are known.

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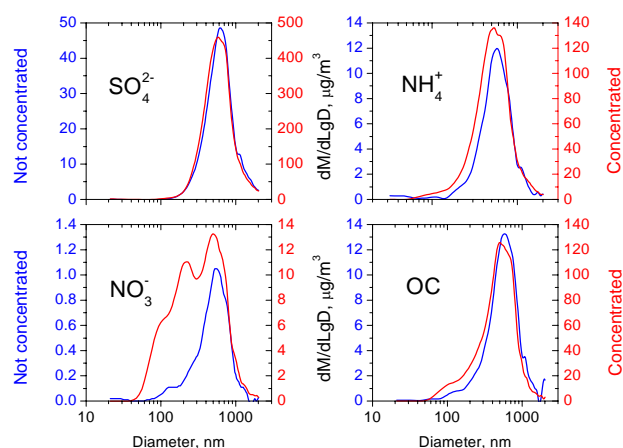


Figure 1. Aerosol size distributions measured with AMS on a polluted day with and without concentrator. Note low nitrate concentration.

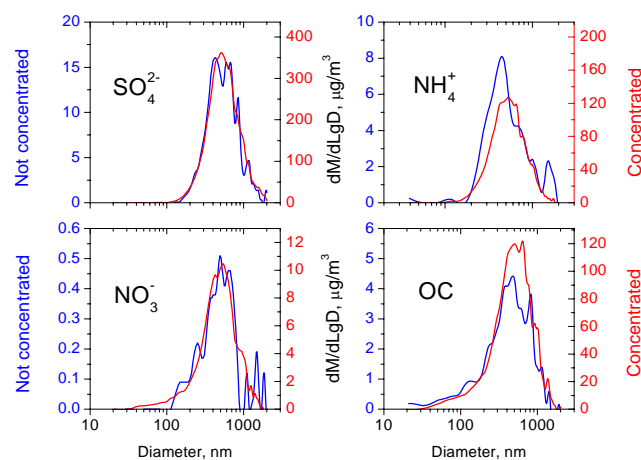


Figure 2. Aerosol size distributions measured with AMS on a clean day with and without concentrator. Note that nitrate distribution is preserved.

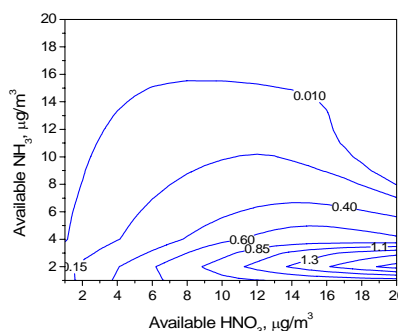


Figure 3. Predicted artifact formation as a function of ammonia and nitric acid concentrations. Note small values of artifact, especially at ammonia-rich conditions