European intercomparison of low-cost denuder measurements for atmospheric ammonia and aerosol ammonium

There are few speciated measurements of NH₃ and NH₄⁺ in Europe. The usefulness of filter pack methods is limited by phase uncertainties [1], whilst daily measurements with annular diffusion denuder systems [2] are both costly and labor-intensive. In response to this challenge, the DELTA (Denuder for Long-Term Atmospheric) sampling system was developed [3] and since 1996 has been implemented in the UK National Ammonia Monitoring Network (NAMN: www.ceh.ac.uk) to provide long-term monthly data on both gaseous NH₃ and aerosol NH₄⁺ [4].

1. INTRODUCTION

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2. NitroEurope Inferential N Flux (Level 1) Network

Since November 2006, the DELTA methodology is also being implemented at 56 sites across Europe in the NitroEurope Inferential N flux (Level 1) network (www.nitroeurope.eu). The species monitored are gaseous NH₃ and aerosol NH₄⁺, as well as other acid gases: HNO₃, SO₂, HCl, and aerosols: NO₂⁻, SO₄²⁻, Cl⁻, Na⁺, Ca²⁺, Mg²⁺. Monitoring is on a monthly frequency that is optimal for estimating annual mean concentrations, whilst permitting characterisation of temporal trends.

3. Chemical Laboratories

Several laboratories share responsibility for sample preparation and analysis, whilst a network of local site operators at each site perform the monthly changeover of samples and subsequent exchange of samples by post.

4. DELTA Intercomparison

To ensure consistency in implementation of the DELTA protocol, an interlaboratory-intercomparison of DELTA measurements was conducted over 4-months between 6 laboratories at 4 test sites between July and early November 2006. The 4 sites have different climates and ammonia concentrations:
- Montebellratti (Italy): Mediterranean
- Braunschweig (Germany): Temperate
- Valencia (Spain): Mediterranean
- Aachen (UK): Temperate

6 x DELTA systems were set up at each site, and randomly assigned to each of six designated laboratories. A total of 8 measurement periods (2-weekly sampling) was carried out.

5. DELTA INTERCOMPARISON RESULTS

Figure 1: Preliminary results for gaseous NH₃ from the interlaboratory-intercomparison of DELTA measurements. Data points are two-weekly measurements from the 4 test sites.

Figure 2: Preliminary results for aerosol NH₄⁺ from the interlaboratory-intercomparison of DELTA measurements. Data points are two-weekly measurements from the 4 test sites.

Figure 3: Preliminary results showing a comparison of the average NH₃ and NH₄⁺ concentrations of all laboratories with measurements from a co-located daily annular denuder system (ADS) at Montebellratti, Italy. 2-weekly mean concentrations were derived from the average of hourly ADS data for the corresponding DELTA sampling periods.

REFERENCES


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