

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

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1. INTRODUCTION

There are few speciated measurements of NH_3 and NH_4^+ 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 labour-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.cara.ceh.ac.uk) to provide long-term monthly data on both gaseous NH_3 and aerosol NH_4^+ [4].

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.nitroeuropa.eu). The species monitored are gaseous NH_3 and aerosol NH_4^+ , as well as other acid gases: HNO_3 , SO_2 , HCl , and aerosols: NO_3^- , SO_4^{2-} , Cl^- , Na^+ , Ca^{2+} , Mg^{2+} . 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.

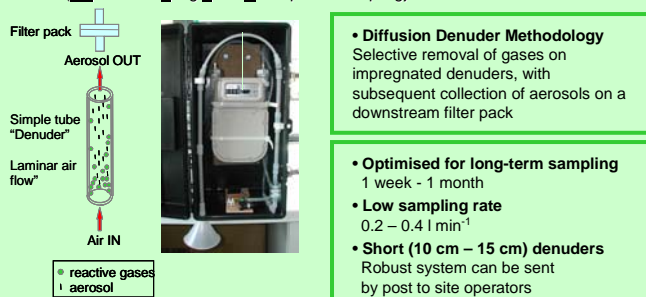
The 4 sites have different climates and ammonia concentrations:

- Montelibretti (Italy): Mediterranean
- Braunschweig (Germany), Temperate
- Valencia (Spain): Mediterranean
- Auchencorth (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.

DELTA (DEnuder for Long Term Atmospheric sampling)



5. DELTA INTERCOMPARISON RESULTS

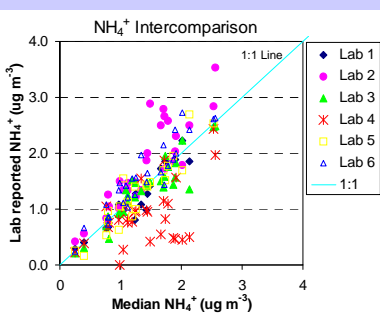
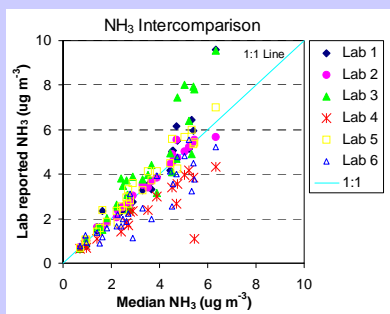


Figure 1: Preliminary results for gaseous NH_3 from the interlaboratory-inter-site intercomparison of DELTA measurements. Data points are two-weekly measurements from the 4 test sites.

Figure 2: Preliminary results for aerosol NH_4^+ from the interlaboratory-inter-site intercomparison of DELTA measurements. Data points are two-weekly measurements from the 4 test sites.

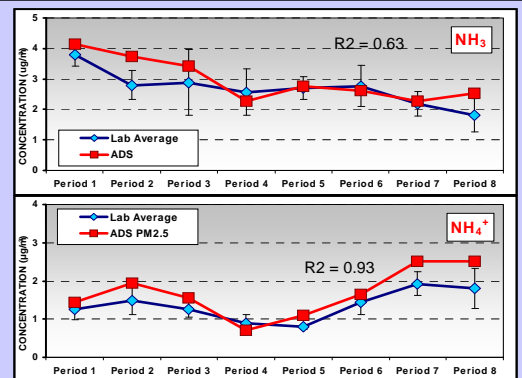


Figure 3: Preliminary results showing a comparison of the average NH_3 and NH_4^+ concentrations of all laboratories with measurements from a co-located daily annular denuder system (ADS) at Montelibretti, Italy. 2-weekly mean concentrations were derived from the average of hourly ADS data for the corresponding DELTA sampling periods.



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ACKNOWLEDGEMENT

This work was carried out with funding from the EU, and with supporting funds from NERC and the Department for Environment, Food and Rural Affairs (Defra). The assistance of colleagues from participating laboratories and field sites is also gratefully acknowledged.