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**defra**  
Department for Environment  
Food and Rural Affairs

**SID 4**

## Annual/Interim Project Report for Period **Sep-Nov08**

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### Project details

1. Defra Project code	RMP 1906
2. Project title	UK National Ammonia Monitoring Network
3. Defra Project Manager	Paola Cassanelli
4. Name and address of contractor	Centre for Ecology & Hydrology (CEH) Edinburgh Research Station Bush Estate Penicuik Midlothian  Postcode EH26 0QB
5. Contractor's Project Manager	Sim Tang
6. Project: start date .....	01/05/03
end date .....	31/12/08

## Scientific objectives

7. Please list the scientific objectives as set out in the contract. If necessary these can be expressed in an abbreviated form. Indicate where amendments have been agreed with the Defra Project Manager, giving the date of amendment.

### **Operate and maintain network of ammonia concentrations across the UK**

The network will be continued on a monthly basis, maintaining the liaison with site operators and visiting sites for equipment servicing. The standard QA/QC procedures for the Ammonia Network developed by CEH would be followed. Analysis of air concentrations would be made at each site in a timely fashion to ensure early identification of problems.

### **Analysis of NH<sub>3</sub> and NH<sub>4</sub><sup>+</sup> concentration fields over the UK.**

The UK NH<sub>3</sub> and NH<sub>4</sub><sup>+</sup> concentration fields will be analysed at a resolution of 10 km x 10 km, with the data from local and mesoscale variability studies used to assess site representativity and sub-grid variability.

Results will be compared with the FRAME model (link to contract "Modelling the Deposition and Concentration of Long Range Air Pollutants" EPG 1/3/202). Seasonal variability will be examined in relation to the main source sectors in different regions, compensation points and inter-annual variability in relation to weather patterns.

### **Application of the results to provide maps of UK NH<sub>3</sub> concentration and dry deposition.**

The interpolated and modelled estimates incorporating measurement calibration will be applied at a 5 km resolution on an annual basis to investigate UK concentrations fields and dry deposition of NH<sub>3</sub>. Analysis of the results will provide recommendations on the suitability of the approaches for different purposes.

In addition to the objectives noted in the tender, the deposition models will be applied to estimate dry deposition of aerosol NH<sub>4</sub><sup>+</sup> in the UK. The analysis will provide an estimation of the effect of new data on total dry deposition budgets and NH<sub>3</sub> and NH<sub>4</sub><sup>+</sup> export from the UK. This will be considered in relation to ongoing work in other contracts ("Acid Deposition Processes" and "Modelling the Deposition and Concentration of Long Range Air Pollutants") on the overall budget of NH<sub>3</sub> for UK.

### **Reporting of monitoring results**

The results will be reported by a) oral and written reports to the Department, b) oral reporting to site operators at site operators meetings (approximately 35-50 people anticipated to attend each meeting, with their travel and subsistence paid by the contract), c) graphs and tables on the website of the NAMN ([www.uk-pollutantdeposition.ceh.ac.uk](http://www.uk-pollutantdeposition.ceh.ac.uk)) and d) publishing of papers in peer review and other international literature.

## Summary of Progress

8. Please summarise, in layperson's terms, scientific progress since the last report/start of the project and how this relates to the objectives. Please provide information on actual results where possible rather than merely a description of activities.

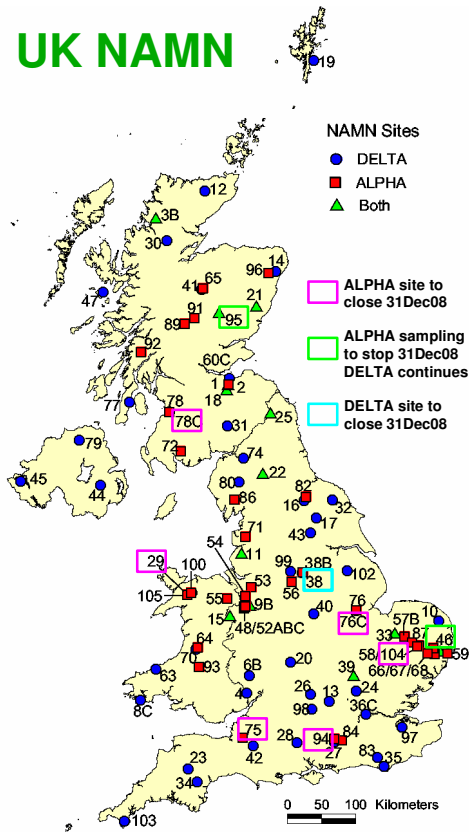
## UK National Ammonia Monitoring Network (NAMN)

Contributing Authors: Y.S. Tang, N. van Dijk, I. Simmons, M. Anderson, R Storeton-West, Vogt, E. & M.A. Sutton

### Operation of Network

1. The current UK National Ammonia Monitoring Network (NAMN) contract expires at the end of December 2008, coinciding with contract end date for the UK National Nitric Acid Monitoring Network.
2. The Nitric Acid Network is conducted using an extension of the same DELTA system as employed in the NAMN, at a subset (30) of the NAMN sites. The site management, sample preparation, exposure, extraction and data analysis are fully integrated into the NAMN.
3. The Nitric Acid Network is operated and managed by CEH as a sub-contract to AEA Technology under the current UK Acid Deposition Monitoring Network (ADMN) contract which also expires at the end of December 2008.
4. A unified UK network for "UK assessment of Eutrophying and Acidifying air Pollutants" – UKEAP has been proposed which will bring together the monitoring of reduced nitrogen ( $\text{NH}_x$ ) in the NAMN with monitoring activities of the ADMN under one umbrella. The new UKEAP will be managed and operated in a joint collaboration between CEH and AEA Technology.
5. The existing network sampling will be maintained over the transition phase between contracts (Months 1-2). This will provide a smooth carry over into the next contract. In the case of any unforeseen delays in the contract start, CEH will undertake to cover the measurements for a reasonable period.
6. The transitional aspects between contracts will be maintained at an absolute minimum, since the measurements would continue to be made by the same sampling methods (uniquely available in the UK to CEH) and by the same staff.
7. Data from NAMN (and also from the Nitric Acid Network) will continue to be reported on the website <http://www.uk-pollutantdeposition.ceh.ac.uk/networks>
8. S15 Llyncllys Common: The property on which the monitoring equipment (DELTA and ALPHA) are located has been sold. The owners/LSOs, Mr David Pedlow and his wife (Mrs Jackie Pedlow) moved out on the 26<sup>th</sup> November 2008 and the new owner (Professor Anthony Freemont) has agreed to take over as the new LSO for the site. The Pedlows have shown Professor Freemont how to perform the monthly sample changes; measurement will therefore continue without interruption at this site. CEH personnel will pay a visit to the site (combined with other site servicing activities) in December to service the site and to meet Professor Anthony Freemont.
9. S25 Sourhope: this is a remote site with no mains power, and a wind/solar powered DELTA system has been operated at this site since April 1997. A visit to the site in November 2008 was made by two CEH personnel to replace the ageing (and malfunctioning system) with a new one. The equipment is currently working well.
10. S38 Sheffield: DELTA monitoring at this site will stop at the end of December 2008, due to closure of the site arising from the sale of Tipton Gardens by the University of Sheffield. Detail of an alternative site (new research field site) that was offered by the University has not been received yet. In the meantime, passive measurements of gaseous  $\text{NH}_3$  with ALPHA samplers will continue at the nearby S38B Weston Park site (Sheffield Museum met. enclosure; sk339873; ~0.5 km SE of Tipton Gardens). Measurement at this site has been made since May 2004, to compare with concentrations inside the walled gardens, and also in anticipation of the closure of the S38 site. There is a possibility to install a DELTA system at this site, which has the advantage of providing both  $\text{NH}_3$  and  $\text{NH}_4^+$  measurements, which is being looked into at the moment. However, aerosol  $\text{NH}_4^+$  data are available from the nearby S99 Ladybower site (grid ref: SK164892; 2007 annual mean  $\text{NH}_4^+ = 1.0 \mu\text{g NH}_4^+ \text{m}^{-3}$ , compared to S38 Sheffield, sk332870; 2007 annual mean =  $1.05 \mu\text{g NH}_4^+ \text{m}^{-3}$ ).
11. Review of monitoring sites in NAMN. The number of sites providing measurements has increased since the start of the current contract, from around 90 sites in 2006 to the present 96 sites. Additional measurements were made for a number of reasons, e.g. 1) investigate local variability in  $\text{NH}_3$  concentrations at DELTA monitoring sites, e.g. S76C, S78C, 2) setting up a second monitoring location close to an existing NAMN site, in anticipation of site closure, to provide a period of overlapping measurements to check for comparability in concentrations, e.g. S38B, and 3) Short-term measurements at nature reserves, on request from local site operator. e.g. S75, S104.

# UK NAMN



## Review of UK NAMN

- Proposed termination of NH<sub>3</sub> measurements with ALPHA samplers at 8 sites at end of Dec08:
  - S29 Dyffryn Mymbyr
  - S75 Westhay Moor
  - S76C Pointon 3
  - S78C Auchincruive 3
  - S94 Alice Holt 2
  - S95 Glenshee
  - S104 Hinderclay Fen
- Relocation of S38 Sheffield (Tpton Gardens – site closing at end of Dec08)
- Reduce number of sites measuring NH<sub>4</sub><sup>+</sup>. There are currently 46 sites providing NH<sub>4</sub><sup>+</sup> measurements, compared with the commitment of 35 sites in the present contract. The additional measurements are made outwith the contractual commitments, with supporting funds from CEH. The review of sites will take place during month 1- 3 of the new contract.

The UK NAMN, current status and after review (from Jan 2009):

	Current (Dec 08)	New (from Jan 09)
Total number of sites in UK NAMN	96	87
DELTA sites	59	58
ALPHA sites	50	42
Both (DELTA + ALPHA operated in parallel; intercomparison sites)	13	13
Of the DELTA sites:		
Sampling NH <sub>3</sub> only	13	13
Sampling NH <sub>3</sub> and particulate NH <sub>4</sub> <sup>+</sup>	46	45 (35)*
Sampling NH <sub>3</sub> / NH <sub>4</sub> <sup>+</sup> , as well as gaseous HNO <sub>3</sub> , SO <sub>2</sub> , HCl & particulate NO <sub>3</sub> <sup>-</sup> , SO <sub>4</sub> <sup>2-</sup> , Cl <sup>-</sup> , Na <sup>+</sup> , Ca <sup>2+</sup> , Mg <sup>2+</sup> ) as part of the UK Nitric Acid Monitoring Network	30	30

\* following review in months 1-3.

### S75 Westhay Moor NNR

This passive ALPHA site in the middle of Westhay Moor NNR (ST455440) was established in Feb 99 on behalf of David Reid (Somerset Wildlife Trust), the LSO for S42 Castle Cary. Ammonia concentrations at this site (2007 annual mean = 1.5 µg NH<sub>3</sub> m<sup>-3</sup>) is smaller than the FRAME estimated concentration of 5.6 µg NH<sub>3</sub> m<sup>-3</sup> for the 5 km grid square (v.4.7), probably due to the sheltered location of the reserve, away from sources. Ammonia concentrations at this site have not changed much over the past 9 years (annual means = 1.3 – 15 µg NH<sub>3</sub> m<sup>-3</sup>). Therefore it is proposed that ammonia monitoring will terminate at the end of December 2008.

#### S104 Hinderclay Fen

This passive ALPHA site is in the middle of Hinderclay Fen SSSI (TM025787) and was established in Jun 06 at the request of Andrew Excel (Shropshire wildlife Trust), LSO for S58 Swettenham Moss who was concerned about impacts of pig & poultry units close to the reserve. Ammonia concentrations at this site was high (2007 annual mean =  $6.2 \mu\text{g NH}_3 \text{ m}^{-3}$ ), that may be attributed to the proximity of farming emissions. Two years of measurements have been made, and it is proposed that ammonia monitoring will terminate at the end of December 2008.

#### S94 Alice Holt 2

The NAMN currently includes 7 forest sites providing  $\text{NH}_3$  measurements in support of the UNECE International Cooperative Programme (ICP) Forests (Level 2) programme. These are: S86 Lakes, S87 Thetford, S89 Rannoch, S91 Tummel, S92 Loch Awe, S93 Llyn Brianne, and S94 Alice Holt 2. Monitoring at 3 other ICP sites were terminated during 2006. S88 Sherwood passive site was replaced by S99 Ladybower in the new expanded  $\text{HNO}_3$  network from Jan 2006. Funding cuts for ICP level II Forest monitoring work led to closure of sites, and also termination of  $\text{NH}_3$  measurements at 2 other sites, S85 Savernake and S90 Coalburn (terminated end of Dec 06). These measurements provide important data on ammonia concentrations at the ICP Forest sites, extending the coverage of the UK network to areas well away from ammonia sources (most measurements are made in forest clearings). S94 Alice Holt 2 however, is actually on the grounds of the Alice Holt Forest Research station. S27 Alice Holt is a DELTA site in the nearby Alice Holt forest within the Forestry Commission research field site, which has been making measurements of  $\text{NH}_3$  since the site was established in Sep96. Since the monitored  $\text{NH}_3$  concentrations are very similar between the 2 sites, it is proposed therefore to terminate ALPHA sampling at S94 Alice Holt 2, and maintain DELTA measurements at S27 Alice Holt forest. The 2 sites are operated by the same LSO (Alice Holt Research station).

#### S29 Dyffryn Mymbyr

DELTA measurement at this site was replaced by ALPHA samplers in Feb 2005, due to the power being turned off for modernisation work by the National Trust. In January 2006, a new DELTA site was established at the nearby S100 Plas Y Brenin site (as part of the new expanded 30 site Nitric Acid monitoring network), to replace the S29 site (power still not back on, and building work still in progress). However, ALPHA measurements at S29 was continued to provide a period of parallel measurements to compare  $\text{NH}_3$  concentrations between the 2 sites. Annual mean concentrations at S29 was  $5.9 \text{ NH}_3 \text{ m}^{-3}$  for 2007, compared with a lower mean value of  $1.7 \mu\text{g NH}_3 \text{ m}^{-3}$  for 2006 ( $1.5 \mu\text{g NH}_3 \text{ m}^{-3}$  for 2005; 10 months measurements only), which suggests changes in ammonia emission sources during 2007. By contrast, the annual mean  $\text{NH}_3$  concentration at S100 was 0.51 and  $0.42 \mu\text{g NH}_3 \text{ m}^{-3}$  for 2006 and 2007 respectively. In June 2008, ALPHA measurement was started at S105 Llyn Llydaw (ECN site) on request from CCW and will continue for a year. Mean concentrations from 5 months of measurements is around  $0.4 \mu\text{g NH}_3 \text{ m}^{-3}$  so far at this site.

#### S95 Glenshee

A new DELTA system was installed in July 2006 at the S95 Glenshee Hotel passive sampling site, to replace the nearby S7 Gulabin Lodge DELTA site (non-operational due to unreliability of new site operators). The DELTA system at S95 provides both  $\text{NH}_3$  and aerosol  $\text{NH}_4^+$  measurements. Passive measurements at this site will now stop, since operation of the DELTA method at S95 is progressing well. Passive measurement at S95 Glenshee was made as an additional effort from CEH, outwith the contract commitment.

#### S46 Sibton

DELTA and ALPHA samplers have been deployed at this site since the start of the network. ALPHA measurements at the edge of the water tower enclosure showed slightly higher concentrations compared with DELTA measurements at the centre of the enclosure. 2007 annual mean  $\text{NH}_3$  concentrations with ALPHA samplers was  $2.14 \mu\text{g NH}_3 \text{ m}^{-3}$ , compared with  $1.43 \mu\text{g NH}_3 \text{ m}^{-3}$  from DELTA. (FRAME estimate for 5 km grid square =  $3.9 \mu\text{g NH}_3 \text{ m}^{-3}$ ; v4.7). The monthly sample changes for both the DELTA and ALPHA measurements at Sibton is carried out by the same LSO (CG Images).

#### S76C Pointon 3

There is a goat shed across the road from the DELTA location (Environment Agency river gauge station), and there was some concern that the DELTA site may be affected by goat emissions. ALPHA measurements were made next to the housing during 2000 and 2001, which gave very large annual mean concentrations of 42 and  $91 \mu\text{g NH}_3 \text{ m}^{-3}$ , respectively. DELTA measurements at the river gauge station over the same period were 4.25 and  $6.13 \mu\text{g NH}_3 \text{ m}^{-3}$ , respectively. ALPHA measurements were moved to

a field behind the river gauge station in 2002. Annual mean concentrations for 2007 at this field location was  $1.96 \mu\text{g NH}_3 \text{ m}^{-3}$ , compared to  $7.0 \mu\text{g NH}_3 \text{ m}^{-3}$  at the river gauge station. The monthly sample changes for both the DELTA and ALPHA measurements at Pointon is carried out by the same LSO (Environment Agency).

### S78C Auchincruive 3

The site is in an agricultural area, with cattle passing within 10m of the DELTA equipment on a regular basis. Annual mean concentrations for 2007 at this site with DELTA measurements was  $9.3 \mu\text{g NH}_3 \text{ m}^{-3}$ , compared to  $4.8 \mu\text{g NH}_3 \text{ m}^{-3}$  with ALPHA samplers made 5m away (further away from passing cows). The monthly sample changes for both the DELTA and ALPHA measurements at Auchincruive is carried out by the same LSO (SAC Auchincruive).

### Other activities

- In 2007, a local scale (sub-5 km) variability assessment of ammonia, in conjunction with NitroEurope Landscape Analysis was initiated at a UK study landscape. The chosen study landscape is a 6 km x 6 km area in Southern Scotland, with emissions from poultry farms, sheep and cattle grazing, and some horses in close proximity to semi-natural areas (heathlands and forests). For reasons of confidentiality, the identity and location of the study landscape cannot at this time be disclosed. A total of 30 passive sampling sites (using the CEH ALPHA samplers) were established within the 36 km<sup>2</sup> grid area in mid-September 2006, and two intensive monitoring periods (monthly) were carried out from October to November 2006 to provide an initial assessment. Continuous measurement of monthly atmospheric NH<sub>3</sub> concentrations was then started in April 2007, and will finish at the end of December 2008, providing almost 2 years of measurement data. Results from the first year of measurements are summarised in Figure 2.
- Under UK NAMN, the objective of the local variability study is to provide additional information that is important for assessing representativity of existing monitoring sites and the spatial variability in local NH<sub>3</sub> impacts on semi-natural ecosystems. This follows on from previous sub-grid variability studies made at the Glenshee upland site and subsequently in East Anglia and Cheshire/Shropshire.
- Under NitroEurope (<http://www.nitroeuropa.eu/>), the wider remit is to assess how N management can modify reactive nitrogen (N<sub>r</sub>) fluxes at local and landscape scales, with particular emphasis on N<sub>r</sub> interactions with GHG fluxes. The project is carried out over six European study landscapes (Italy, Poland, France, The Netherlands, Denmark, and the UK). A PhD studentship appointed under NitroEurope is contributing to this assessment for the Scottish landscape. NitroEurope is therefore providing additional resources which are of added value and benefits for the UK NAMN.

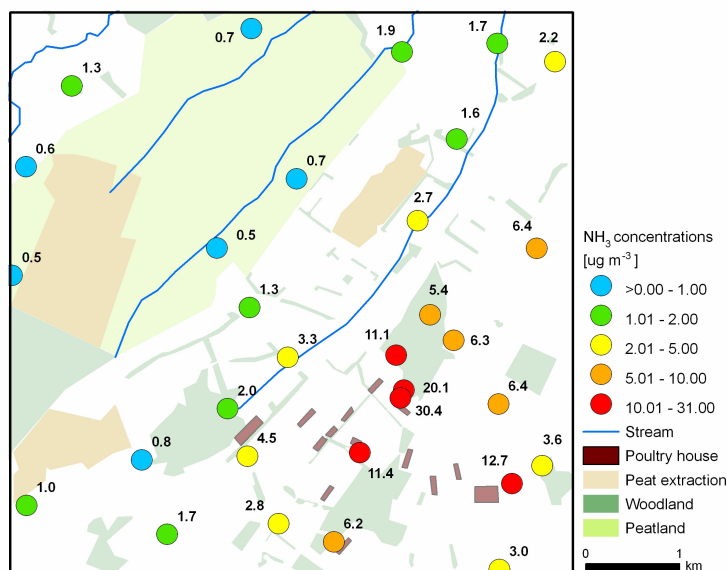


Figure 2: Monitored annual mean NH<sub>3</sub> concentrations (Apr07-Mar08) at the 30 sampling locations within the Southern Scottish study landscape (Vogt 2008)

Vogt E, Braban C, Dragosits U & Sutton M (2008). Assessing atmospheric ammonia dispersion at the landscape scale. Poster presented at IGAC 10th International Conference, Bridging the scales in Atmospheric Chemistry: Local to Global, 7 to 12 September 2008 in Annecy, France.

## Amendments to project

9. Are the current scientific objectives appropriate for the remainder of the project? ..... YES  NO
- If **NO**, explain the reasons for any change giving the financial, staff and time implications.

**Contractors cannot alter scientific objectives without the agreement of the Defra Project Manager.**

## Progress in relation to targets

10. (a) List the agreed milestones for the year/period under report as set out in the contract or any agreed contract variation.

It is the responsibility of the contractor to **check fully that all milestones have been met** and to provide a detailed explanation when they have not been achieved.

Milestone		Target date	Milestones met	
Number	Title		In full	On time
1	Annual report: Analysis of spatial and temporal patterns of NH <sub>3</sub> and NH <sub>4</sub> <sup>+</sup> over the UK, and reporting on other monitoring activities.	30/05/2008	Yes	No Delivered 21/08/08
2	Quarterly progress report: Continuation of NH <sub>3</sub> and NH <sub>4</sub> <sup>+</sup> monitoring in network between contracts, incorporating any agreed revisions.	31/08/2008	Yes	No Submitted 17/10/08. Resubmitted 24/10/08 on SID4 form
3	Quarterly progress report: Monitoring data, contributions to NitroEurope project, UNECE AEG and TFMM, and GEN TC264/WG11 on passive sampling with respect to NH <sub>3</sub> and initial results from local variability study at Auchincorth.	30/11/2008	Yes	Submitted 11/12/08.

4	Final report: Analysis of long-term trends in spatial and temporal patterns of NH <sub>3</sub> and NH <sub>4</sub> <sup>+</sup> over the UK, including results from local scale variability study.	28/02/2009		
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(b) Do the remaining milestones look realistic? ..... **YES**  **NO**   
 If you have answered **NO**, please provide an explanation.



## Publications and other outputs

11. (a) Please give details of any outputs, e.g. published papers/presentations, meetings attended during this reporting period.

- Contribution of Ammonia Monitoring Network to UNECE Task Forces (Mark Sutton)

Until 2007, the work of the NAMN was reported to the UNECE in the context of the Ammonia Expert Group (AEG) and the Task Force on Measurement and Modelling (TFMM). As of December 2007, it was agreed by the Executive Body of the Convention on Long Range Transboundary Air Pollution (CLRTAP) that the first group (AEG) would cease to exist, and be replaced by a new Task Force on Reactive Nitrogen (TFRN) and the Expert Panel on Mitigation of Agricultural Nitrogen (EPMAN) which is a subgroup of the TFRN. The TFRN has a much wider perspective in developing the technical basis for linking reactive nitrogen abatement strategies and under the co-chairmanship of Mark Sutton (CEH) and Oene Oenema (Alterra) held its first meeting in Wageningen (May 2008). With this change, the contribution of Mark Sutton to the TFRN is covered under a separate defra contract (Chairmanship of the TFRN).

In parallel, the TFMM has continued its work without substantial structural change, and the work of this was recently represented by Mark Sutton during its meeting 13-15 October 2008 at NILU in Oslo. The focus of this TFMM meeting was on developing the long term future monitoring and modelling strategy of EMEP. Mark reported on the success of the UK implementation of the existing EMEP monitoring strategy (2004-2009) showing how the combination of Level 1 monitoring activities (low cost per site, emphasis on long term temporal trends) was being complemented by the Level 2, Level 3 monitoring activities, including the EMEP 'intensive periods', with use of hourly gas/aerosol sampling. He reported encouraging agreement between the UK temporal trends in ammonia and ammonium during 2003 with those calculated by the EMEP4UK model, both of which showed peak concentrations during Feb-April, a period of substantial SE air flow.

- CEN TC264 WG11 (Sim Tang)

The 20<sup>th</sup> meeting of the CEN TC264 WG11 "Diffusive samplers" was held at the Joint Research Centre (JRC) Ispra, Italy, on 26<sup>th</sup> November 2008.

JRC was asked by the Directorate General Environment (DG-ENV) of the European Commission to conduct a pre-normative study to support the development of a CEN standard method for NO<sub>2</sub> monitoring in ambient air using diffusive samplers.

Agenda focussed on:

- Pre-normative study on NO<sub>2</sub> diffusive sampling
  - Results JRC workshop 2-3 October 2008 N 213
  - Program JRC workshop 27-28 November 2008
- Standard method for NO<sub>2</sub> diffusive sampling
  - Drafting of the standard N 214
- A request to add discussion of standardisation of NH<sub>3</sub> passive diffusion sampling to the agenda at the meeting by Sim Tang was accepted.

Resolutions from the meeting:

- CEN/TC 264/WG11 agreed that there is a potential need for NH<sub>3</sub> diffusive sampling.
- To explore the potential for standardization, Sim Tang will carry out a literature review and will give a presentation on NH<sub>3</sub> diffusive sampling at the next WG meeting (April 2009).
- WG 11 decided to send a proposal for a preliminary new work item on NH<sub>3</sub> diffusive sampling to CEN/TC 264. Theo Hafkenscheid (chair of WG11, and convener for TC264) will draft a NWI proposal and will send it to the WG members for comments before sending it to CEN/TC 264.
- All WG members agreed to explore the possibilities for funding for NH<sub>3</sub> diffusive sampling and report back to the secretary.

Development of a CEN standard method for NO<sub>2</sub> monitoring in ambient air using diffusive samplers.

Two meetings of experts (Sim Tang invited) were organised by JRC in order to review and discuss the draft method for monitoring NO<sub>2</sub> that will be prepared by the project coordinator (Michel Gerboles, JRC Ispra).

The first was held on 2-3 October 2008, and the 2<sup>nd</sup> meeting on 27-28<sup>th</sup> November (after the CEN TC264 WG11 meeting on 26<sup>th</sup> November 2008).

A pre-normative study was carried out on the following NO<sub>2</sub> passive samplers: the Radiello sampler, the Ogawa sampler, the Passam sampler and the Palmes tube.

A report on reviews of diffusive samplers and the draft method of NO<sub>2</sub> measurements with diffusive samplers is currently being circulated for comments within the expert group.

Published papers / presentations

Sutton M.A., Eisman, J.E, Dentner F. & Moller D. (2008). Ammonia in the environment: From ancient times to the present. Environmental Pollution 156, 583-604.

Jan Willem Erisman, J.W, Sutton M.A, Galloway J. & Klimont X. & Wilfried Winiwarter (2008). How a century of ammonia synthesis changed the world. Nature geoscience, vol 1, 636-639.  
[www.nature.com/naturegeoscience](http://www.nature.com/naturegeoscience)

Published Book (2008)

Atmospheric Ammonia: Detecting emission changes and environmental impacts. Results of an Expert Workshop under the Convention on Long-range Transboundary Air Pollution. Springer.  
*Eds Sutton M.A., Reis S & Baker S.M.H.* ISBN 978-1-4020-9120-9

- (b) Have opportunities for exploiting Intellectual Property arising out of this work been identified? ..... YES  NO

If YES, please give details.

CEH has developed technology for the low-cost time-integrated passive diffusion sampling method for ammonia (ALPHA : "Adapted Low-cost Passive High Absorption"), and for the low-cost time-integrated active sampling using denuders and filters of a range of trace gases and particles (DELTA: "DEnuder for Long Term Atmospheric system"). Both these technologies have been deployed in the UK air quality monitoring networks under contract to Defra (Department for Environment, Food and Rural Affairs) for routine monitoring of ammonia (since 1996) and nitric acid and related species (since 1999) in air.

As part of the new UKEAP Project, CEH will transfer detailed knowledge of the operation and maintenance of ALPHA and DELTA technology to AEA staff. ALPHA and DELTA technologies are appropriate for air quality measurement in many situations beyond routine national monitoring, for example, in demonstrating compliance with air quality targets around point emission sources, or in demonstrating current air quality as part of Environmental Impact Assessments. As such, these are valuable technologies for consultancies or other bodies.

AEA and CEH are developing a Memorandum of Understanding to facilitate technology sharing.

(c) Has any other action been taken to initiate Knowledge Transfer?..... YES  NO

If YES, please give details.

Dissemination of DELTA and ALPHA sampling methodologies to improve Europe-wide monitoring of NH<sub>3</sub> and NH<sub>4</sub><sup>+</sup>, HNO<sub>3</sub> and related species.

- 1) Implementation of the DELTA system in a European Level 1 Inferential Flux Network (56 sites) under the NitroEurope IP project, Monitoring work commenced in January 2006, to provide monthly speciated measurements of atmospheric NH<sub>3</sub>, HNO<sub>3</sub>, SO<sub>2</sub>, HCl and gaseous NH<sub>4</sub><sup>+</sup>, NO<sub>3</sub><sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, Cl<sup>-</sup>, plus Na<sup>+</sup>, Ca<sup>2+</sup> and Mg<sup>2+</sup> (same as UK Nitric acid monitoring network)
- 2) Implementation of the CEH ALPHA samplers in NitroEurope Landscape studies in France, Poland, Denmark, as well as at the Scottish Southern Landscape study site.

Supply of CEH ALPHA samplers as implemented in the UK NAMN to USA (EPA, University of Illinois), Canada (Environment Canada) and for the NitroEurope IP European landscape studies (UK study as described in this report being one of 4 studies conducted across Europe).

## Future work

12. Please comment briefly on any new scientific opportunities which may arise from the project.

A unified UK network for “UK assessment of Acidifying and Eutrophying Air Pollutants” – UKEAP has been proposed which will bring together the monitoring of reduced nitrogen (NH<sub>x</sub>) in the NAMN with monitoring activities of the ADMN under one umbrella. The new UKEAP will be managed and operated in a joint collaboration between CEH and AEA Technology. CEH will continue with the operation and management of the UK NAMN and Nitric Acid Monitoring Network (re-named Acid Gas and Aerosol monitoring Network: AGANET, to reflect the range of species measured).

## Declaration

13. I declare that the information I have given is correct to the best of my knowledge and belief.

Name

Sim Tang

Date

11/12/08

Position held

Higher Scientific Officer