MODELLING and MEASUREMENTS of INORGANIC GAS AND AEROSOL CONCENTRATIONS AT A UK EMEP SUPER SITE

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Introduction

As part of the EMEP Monitoring Strategy[1] intensive measurements of inorganic gases and aerosols were carried out in June 2006 and January 2007 at several sites across Europe.
Hourly concentrations measured with a wet chemistry system (MARGA) during the intensive campaigns at the EMEP supersite Auchencorth Moss (Scotland, UK) (Fig.1) are presented here. A preliminary comparison of these measurements with the EMEP4UK model output data is also shown.

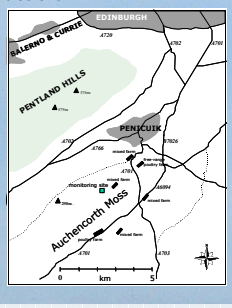


Figure 1. **Auchencorth Moss** super site: the field site is located ~20 km south-west of Edinburgh (Scotland, UK) on open moorland at 255 m asl, 3.2°E, 55.8°N. There are no major sources of pollution nearby although there are some large towns to the north-east and intensive farming to the south and south-east, as indicated on the map.

Methodology-measurements

A **MARGA 2S** (**M**onitoring instrument for inorganic **A**e**R**osol composition and acidifying **GA**ses)[2] (Fig.2) is a wet chemistry analyser that provides hourly gas concentration of NH_3, HCl, HNO_3, HONO, SO_2, and PM2.5 and PM10 concentration of Cl^-,NO_3^-,SO_4^{2-},NH_4^+,Na^+,K^+,Mg^{2+},Ca^{2+}.
Gases are sampled with the use of wet rotating denuders (Fig.3) and aerosols are sampled with a Steam-Jet-Aerosol-Collector (SJAC) (Fig.4). Concentrations are measured with online cation and anion chromatography.

Figure2. The MARGA2s is composed of 2 sampling boxes to collect PM2.5 and PM10 separately and an analyser box with online cation and anion chromatography to measure concentrations

Figure 3. a) Anular denuder scheme: ambient air is sampled through the anulus, gases are trapped in the absorption solution, which is then collected and analysed online for concentrations. **b)** photo of the denuder in the MARGA 2S.

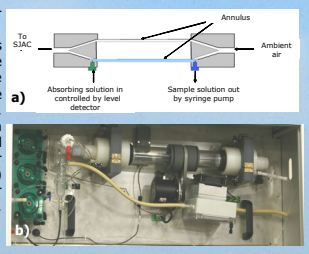
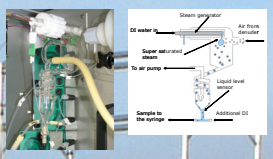
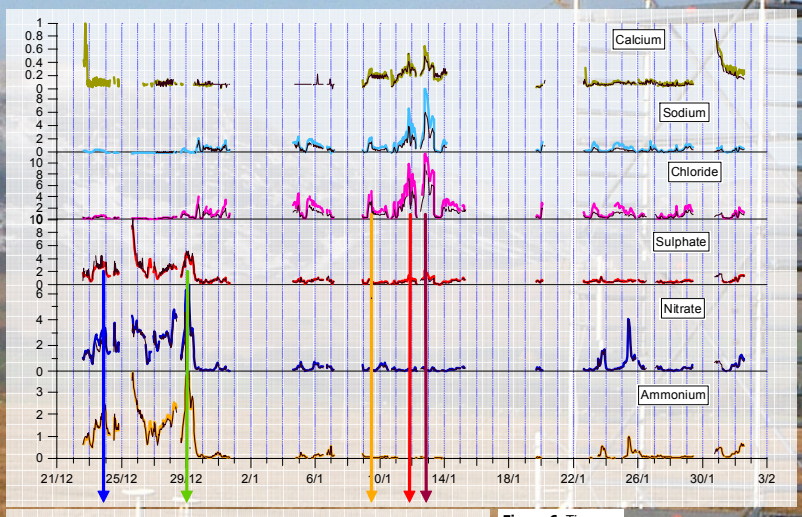


Figure 4. SJAC design: air particles enter the super saturated area to form drops that are then collected at the bottom and then analysed with an oline IC.



Results

- Measured aerosols concentrations for January 2007 provided a good ion balance for both PM2.5 and PM10 (Fig.5). Time series of the different compounds suggest that concentrations behaviour is related to long-range atmospheric transport events (Fig.6). Higher concentrations of NO_3^-,SO_4^{2-},NH_4^+ at the end of December 2006 were observed together with air masses moving over populated areas whereas clean air was observed during the episodes in the first half of January 2007.
- The chemical composition for PM2.5 and PM10 (Fig.7) show a high percentage of sea salt.
- Diurnal pattern of measured gases were more evident in June 2006 than in January 2007 (Fig.8)
- A preliminary comparison of observed and modelled (EMEP4UK) concentrations for sulphate, ammonium and ammonia is presented in Figure 9.
- A map of reduced Nitrogen modelled concentrations for 06 January 2007 is shown in Fig 10.



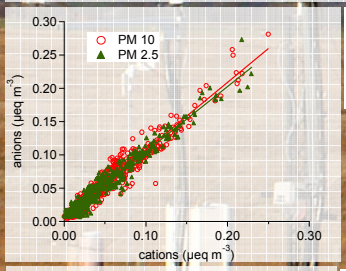


Figure 5. Ion balance for PM2.5 and PM 10 measured at Auchencorth Moss in January 2007.

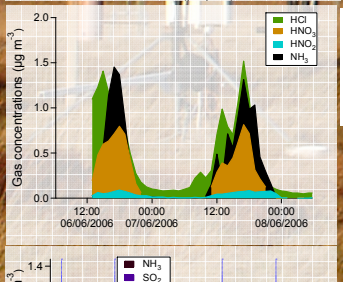
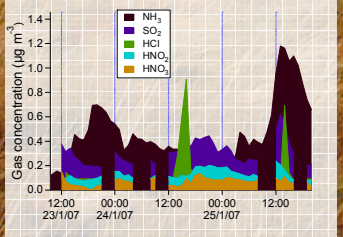


Figure 8. Examples of gas concentration diurnal patterns for June 2006(top) and January 2007(bottom).



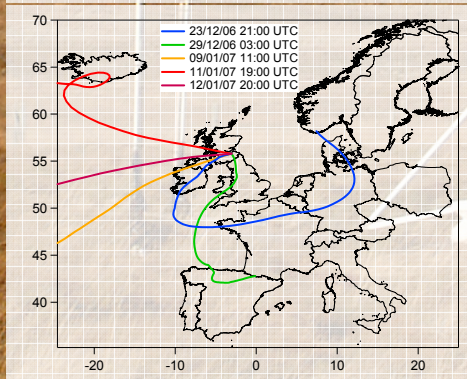
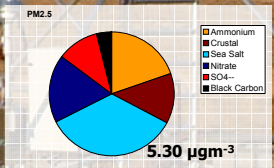


Figure 6. Time series of measured aerosol compounds (colourful lines indicate PM10 and thin black lines PM2.5) and 5-day back trajectories (arrival height 100 m AGL) for selected periods.



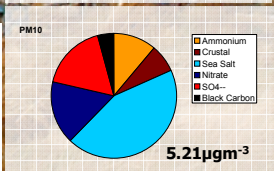
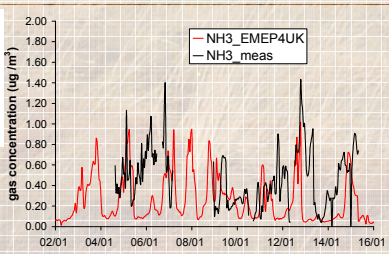
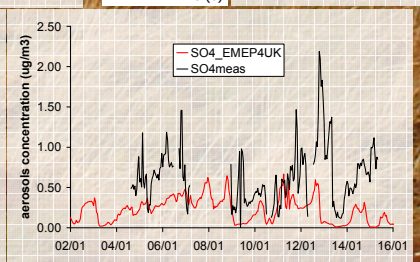
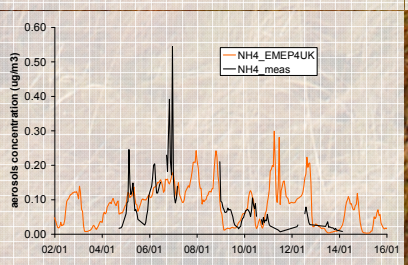


Figure 7. Pie charts show the average mass concentration for January 2007 and chemical composition for PM2.5 (a) and PM10 (b)

Figure 9. Comparison of EMEP4UK output data with measured concentrations of NH_3, SO_4^{2-},NH_4^+.







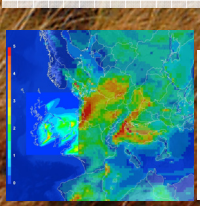


Figure 10. EMEP4UK 50 x 50 km2 Europe with nested UK domain at 5 x5 km2. units ug m-3 daily concentration of reduced Nitrogen for 06/01/2007.

Conclusions:

- The measurements presented provide a high temporal resolution picture of reactive gases and aerosols concentrations and an important database to evaluate the transport and chemical models.
- The model comparison for sulphate, ammonia and ammonium is promising however more work is needed to properly set up the fine resolution inputs such as emissions.

References

[1] EMEP Monitoring Strategy and Measurement Programme 2004-2009 http://www.nilu.no/projects/ccc/reports/Monitoring%20Strategy_full.pdf
[2] Trebs et al., 2004, Atmos. Chem. Phys., 4, 967–987

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