AN INTERCOMPARISON OF MODELS USED TO SIMULATE THE ATMOSPHERIC DISPERSION AND DEPOSITION OF AGRICULTURAL AMMONIA EMISSIONS

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INTRODUCTION

Ammonia (NH_3) emitted into the atmosphere from agricultural sources can have an impact on nearby sensitive ecosystems either through elevated ambient concentrations or dry/wet deposition to vegetation and soil surfaces. Environmental impact assessments are often carried out using short-range atmospheric dispersion models to estimate mean annual atmospheric concentrations and total annual deposition of NH_3 at the ecosystem location. A range of different atmospheric dispersion models are used for these assessments depending on the location and experience of the assessors and have not, until now, been compared for these types of assessments. This poster compares and validates concentration predictions of four commonly used models (ADMS v4.1[1], AERMOD v07026[2], LADD[3] and OPS-st[4,5]) for dispersion from agricultural sources using hypothetical and real case studies.

MATERIALS & METHODS

Intercomparison for hypothetical scenarios

- **Modelling domain:** 2 x 2 km agricultural land cover, source in centre
- **Meteorological data:** Lyneham (UK), one year (1995)
- **Source description:** 10 000 kg NH_3 yr^{-1}. Four scenarios; see Figure 1
- **Receptor details:** Receptor grid (100 m spacing), 0.5 m above ground

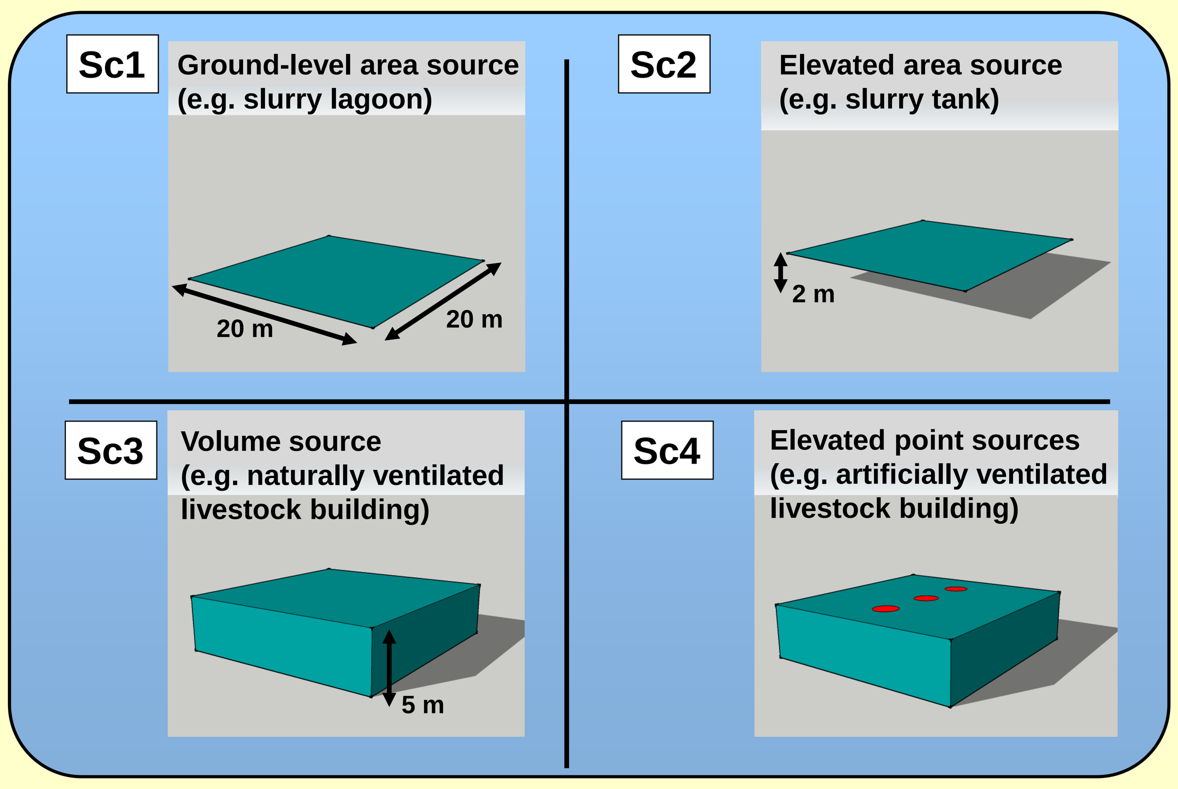

Figure 1: **Schematic representation of the agricultural source types used in the four scenarios**

Model validation using real case studies

Diffusion tube measurements of atmospheric NH_3 concentrations from two field experiments were used to validate the models (Figures 2a and 2b).

Figure 2a: Mean atmospheric ammonia concentrations measured in the vicinity of a pig farm in Falster, DK[6].

Figure 2b: Mean atmospheric ammonia concentrations measured in the vicinity of a pig farm in North Carolina, USA[7].

	Figure 2a	Figure 2b
Source:	2688 fattening pigs and piglets	4900 finishing pigs
Source type:	Artificially ventilated building	5 Naturally ventilated buildings and a slurry lagoon
Emission:	2400 kg NH_3 yr^{-1}	34300 kg NH_3 yr^{-1}
Meas. period:	12 x 1 week	46 x 1 week
Other meas.:	Meteorology, NH_3 and volume flow rate	Meteorology

RESULTS

Hypothetical Scenarios

Model agreement is good for the ground level area source (Sc1; Figure 3a), elevated area source and volume source scenarios (Sc2 and Sc3; not shown). However, model agreement is poorer for the elevated point source scenario (Sc4; Figure 3b), in which ADMS predicts the lowest concentrations and AERMOD the highest.

Sc1: ground level area source **Sc4: elevated point sources**

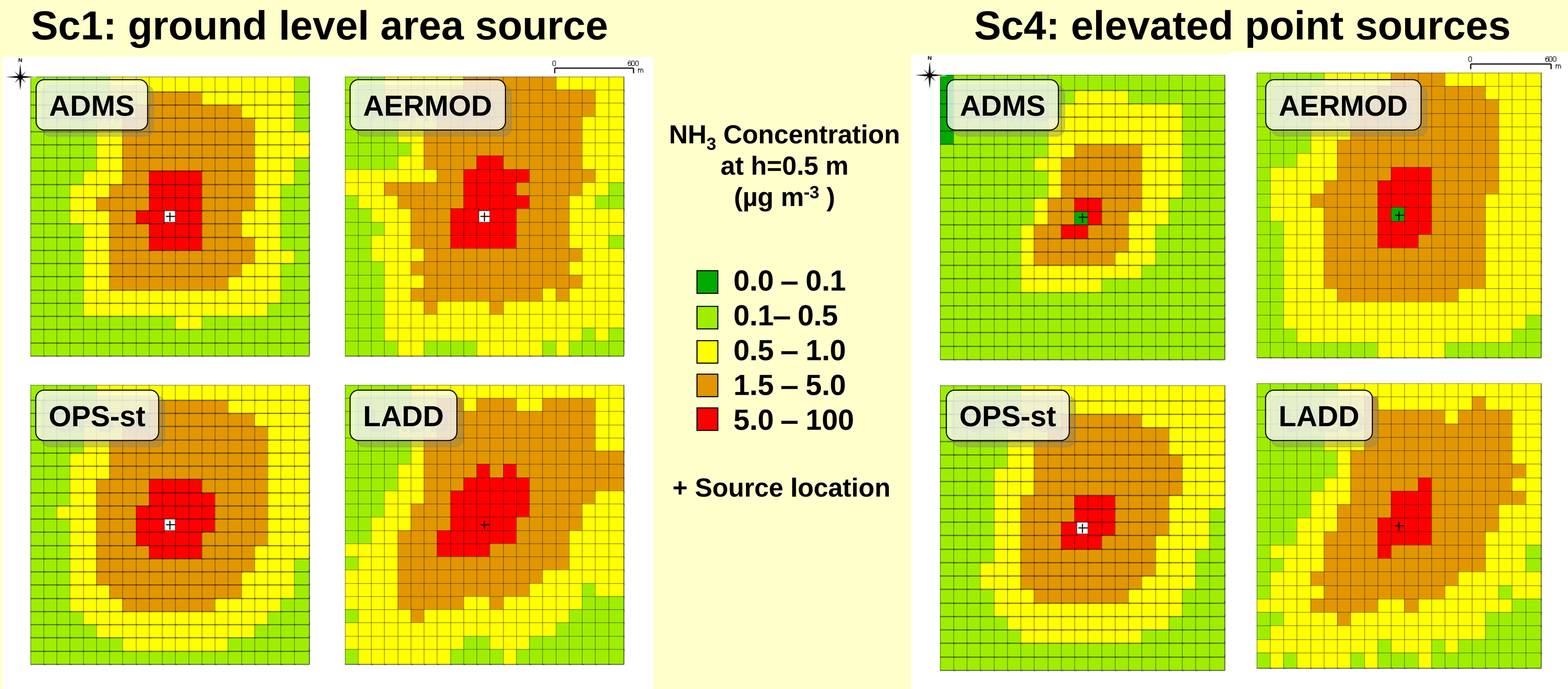

Figure 3a: Receptor NH_3 concentrations for scenario Sc1 (ground-level area source).

Figure 3b: Receptor NH_3 concentrations for scenario Sc4 (elevated point sources).

Model Validation

Figures 4a and 4b show the comparison of the predicted concentrations with the measured data for the two pig farms. According to the model acceptability criteria of Chang and Hanna[8] all of the models performed acceptably for the Danish case study, except for the LADD model, which generally over-predicted concentrations. For the USA case study, all models performed acceptably.

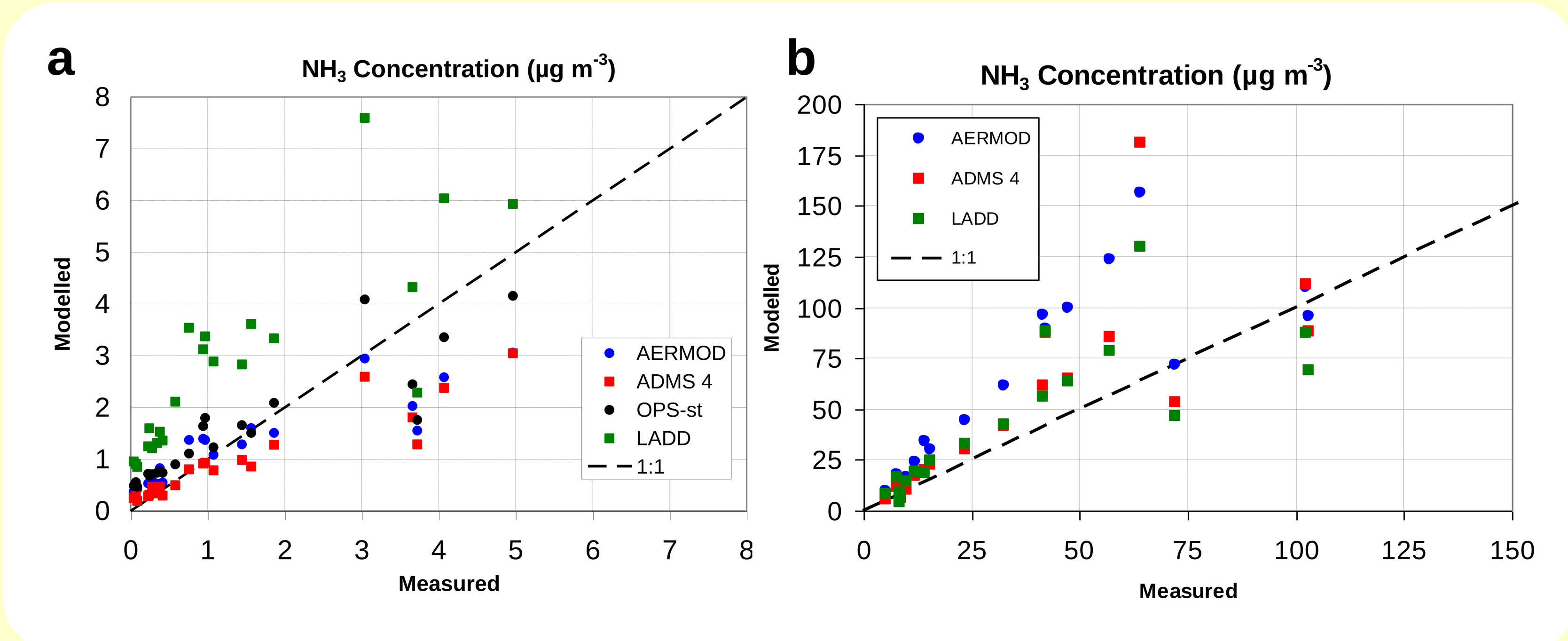

Figure 4: Modelled versus measured mean atmospheric ammonia concentrations for the pig farms in a) Denmark and b) USA.

CONCLUSIONS

The intercomparison of four short-range atmospheric dispersion models used for simulating local impacts of NH_3 has shown that there are significant differences between the concentration predictions of the models, especially for elevated point sources. However, in spite of these differences, the models generally perform acceptably, except for the LADD model when used to simulate elevated point sources.

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