Uncertainties in modelling the spatial distribution of agricultural ammonia emissions

SOFIE HELLSTEN[1,2,3], ULRIKE DRAGOSITS[2,3], CHRIS PLACE[3], MARK A. SUTTON[2]

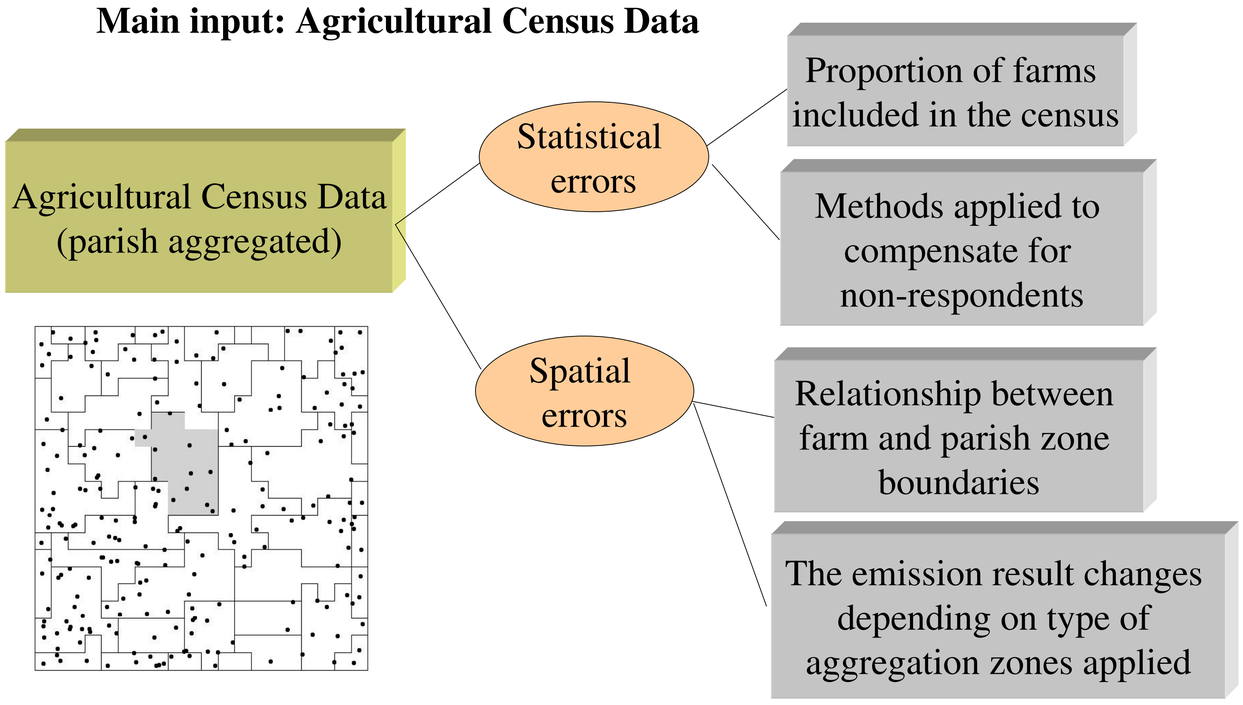
Background

In the UK, the AENEID model (Atmospheric Emissions for National Environmental Impacts Determination) has been developed to model the spatial distribution of ammonia (NH_3) emissions (Dragosits *et al.*, 1998). Firstly, the model spatially distributes the emission sources (livestock and crops/grassland from the Agricultural Census Data) in the landscape, linking it to land cover data, and secondly, the model calculates the emission map using emission factors.

Assessing the robustness of NH_3 emission inventories is important as the spatial outputs are used to estimate environmental impacts, e.g. through the assessment of critical loads. Incorrect mapping of emissions therefore leads to error in the assessment of potential environmental impacts.

1. Uncertainties in the data representing the sources

Main input: Agricultural Census Data

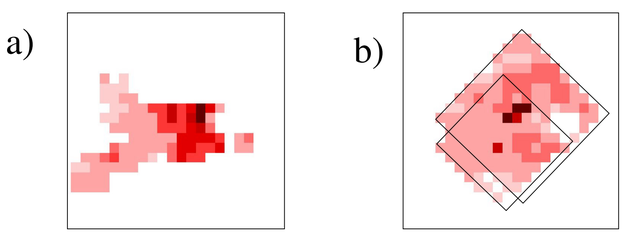


2. Uncertainties in the modelling methodology

Uncertainties in the assumptions applied to link emissions with landcover

I) Average farming practice applied, i.e. failure to incorporate regional variations

II) Uncertainties due to the assumption that all emissions occur within the parish of origin of farm census returns



a) Applying poultry emissions in the parish of origin

b) Applying poultry emissions from the same farms as in a) in a diamond-shaped zone around the farms

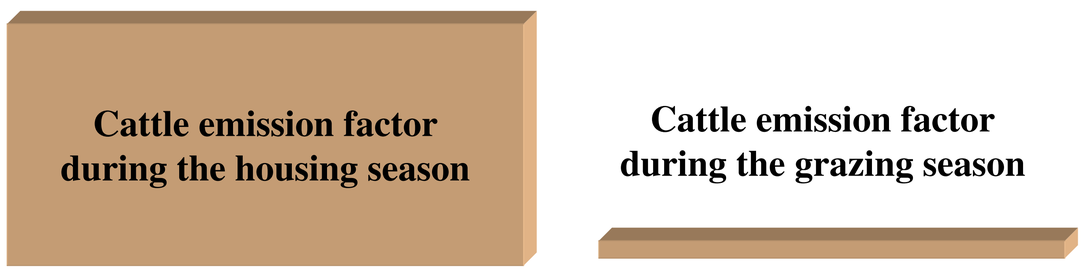
3. Uncertainties in the data sets used in the modelling process

Uncertainties in the land cover map and the parish dataset

4. Uncertainties in the emission factors applied

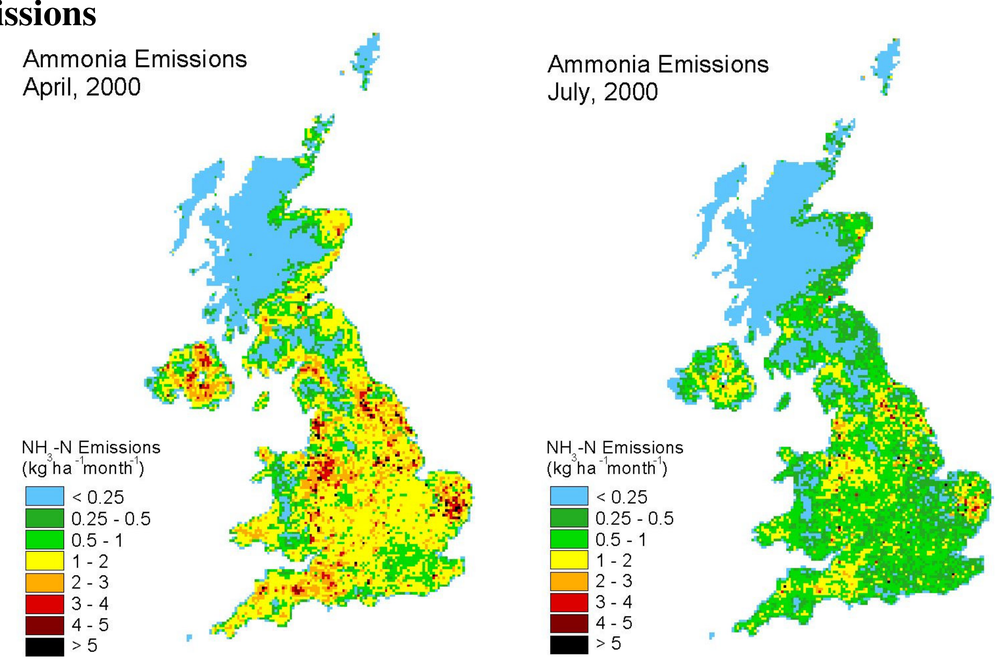
Average emission potentials fail to capture regional and temporal variations

Example: The cattle grazing season



5. Temporal uncertainties

Annual NH_3 emission inventories fail to capture seasonal trends in emissions



Conclusions

Modelling NH_3 emissions involves converting various input data into outputs of spatially distributed NH_3 emissions using mathematical expressions. Uncertainties in the modelling results are therefore associated with the quality of the input data and the datasets used in the modelling process, as well as the modelling methodology applied. These uncertainties may be of two different types; uncertainties in the magnitude of emissions (mainly associated with the emission factors applied), and uncertainties in the spatial location of emissions. Furthermore, annual NH_3 emission inventories are associated with temporal uncertainties due to the seasonal variability in environmental conditions and farming practice.

Reference: Dragosits, U., Sutton, M.A., Place, C.J., and Bayley, A.A. (1998): Modelling the spatial distribution of agricultural ammonia emissions in the UK. *Environmental Pollution* **102**, 195-203.

[1] IVL Swedish Environmental Research Institute, Box 5302, SE-400 14 Gothenburg, Sweden
[2] Centre for Ecology and Hydrology Edinburgh, Bush Estate, Penicuik, Midlothian EH26 0QB, UK
[3] Institute of Geography, The University of Edinburgh, Drummond Street, Edinburgh EH8 9XP, UK

sofie.hellsten@ivl.se