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DEPARTMENT OF ENVIRONMENTAL SCIENCE

RC4:4.6 - Agricultural airborne N-pollution, particle pollution and public health effects

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1-Background

- Airborne particle pollution is thought to lead globally to 2 million premature deaths per year, with half of these due to outdoor exposure.
- Agricultural ammonia emissions contribute to the $PM_{2.5}$ and PM_{10} particle size fractions through the formation of secondary particles.
- A recent assessment indicated that agricultural emissions of ammonia make a significant negative contribution to the health of the Danish population, however this estimation is based on the assumption that all components of $PM_{2.5}$ are of equal importance. Soot, heavy metals and various organic substances are in fact thought be the main protagonists.
- The impact on human health of the reactive nitrogen component, which includes ammonia, is thus highly uncertain.
- Methods for isolating the effects of atmospheric reactive nitrogen from those of other compounds have not - to our knowledge - been developed.
- The aim of this post-doc is to address this by assessing the contribution from agricultural N-emissions to negative health effects in the Danish population.
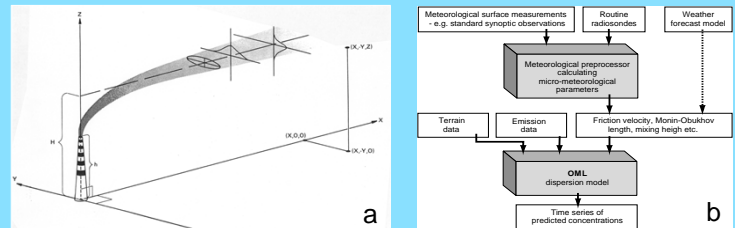

Figure 1: the Danish Gaussian dispersion model OML (Operationelle Meteorologiske Luftkvalitetsmodeller); conceptual drawing (a) and model schematic (b).

2-Methodology

An exposure assessment of the Danish population to the agricultural contribution to atmospheric N-compounds will be performed, and this, together with health data obtained from Centre for Integrated Register-based Research at Aarhus University (CIRRAU), will form the basis for an epidemiological study:

1. An initial exposure assessment will be performed using simple spatial proxies such as distance to pertinent agricultural activities, and this will be used in an initial epidemiological study.
2. A local scale atmospheric dispersion model such as the Gaussian model OML (Fig. 1) will be further developed. This will include incorporation of a novel climate-driven N-emission model recently developed Aarhus University. The model will be evaluated against historic experiments from Danish farm houses, and data from the Danish air quality monitoring program (Fig. 2).
3. Guided by the results of the initial epidemiological study, this model will then be used to perform a detailed exposure assessment, which will be used in a second epidemiological study.

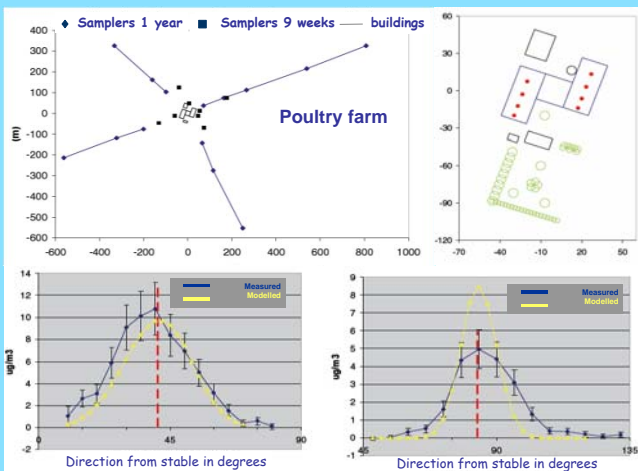It is anticipated that objectives 1, 2 and 3 will lead to three journal publications.

Figure 2: validating a model against ammonia concentration measurements collected at a poultry farm

3-Progress

An important step in this project is gaining access to Denmark's unique population and health registries, however this is a lengthy process involving several application rounds. An initial project ratification from Datatilsynet has been successfully completed, and an application to State Serum Institute for access to data is on-going. Access to the following registers has been requested:

- The CPR register (necessary for linking geocoded address data with health outcomes)
- The cancer register (information on conditions linked with exposure to pollution, e.g. lung cancer)
- The national patient register (information on diagnoses following hospitalisation)
- The cause of death register

Once access has been granted by State Serum Institute, registry data (except for the cancer register) will be obtained from the Familiedatabase, managed by CIRRAU. The following additional datasets necessary for the preliminary study have already been obtained:

- Annual geographical data on agricultural practice, including crop type (Fig. 3) and animal house location – these are compiled and maintained at the Department of Environmental Science, Aarhus University.
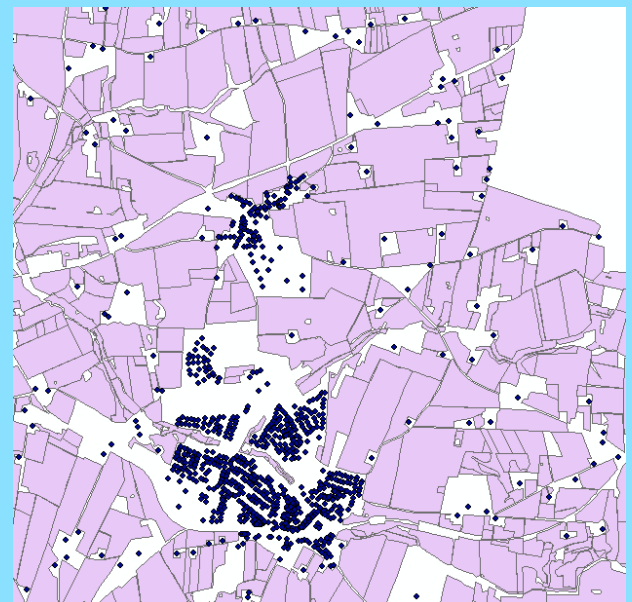

Figure 3: crop (area) and residence (point) data.