Using ADMS to model ammonia from intensive farms

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Environment Agency Ammonia Modelling Workshop
Intensive farming EPR Permitting
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Solihull

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Introduction
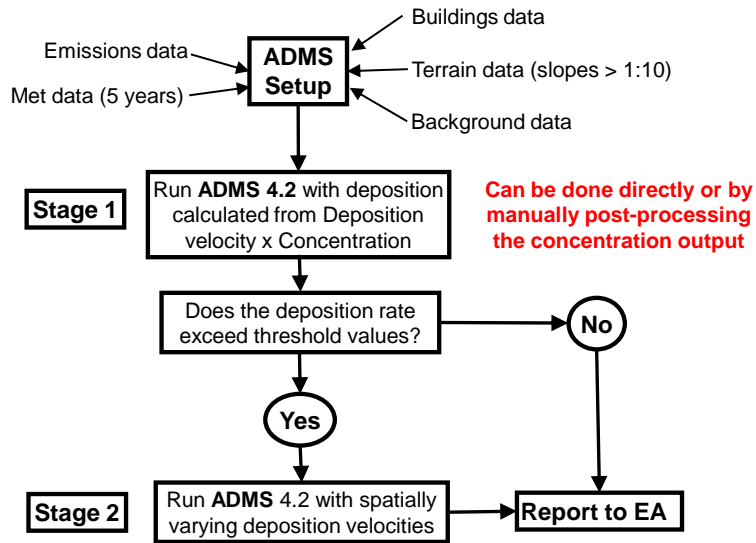
Aim:

To demonstrate how ADMS 4.2 can be used to model ammonia from intensive farms in line with the Environment Agency guidance

- Methodology
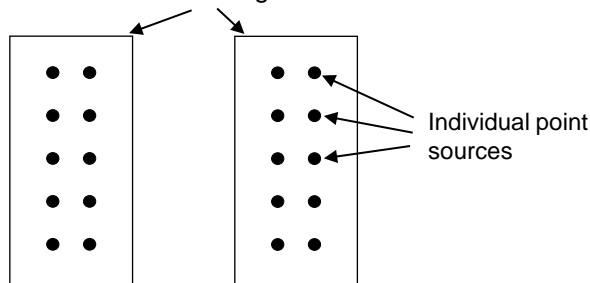- Case study
- Additional model options
- Summary

Methodology

Emissions data — Buildings data → **ADMS Setup** ← Terrain data (slopes > 1:10)

Met data (5 years) → **ADMS Setup** ← Background data

Stage 1 — Run **ADMS 4.2** with deposition calculated from Deposition velocity x Concentration

Can be done directly or by manually post-processing the concentration output

Does the deposition rate exceed threshold values? → **No**

Yes

Stage 2 — Run **ADMS** 4.2 with spatially varying deposition velocities → **Report to EA**

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Case study

- ADMS 4.2 model setup:
  - Series of low level point sources to represent roof vents
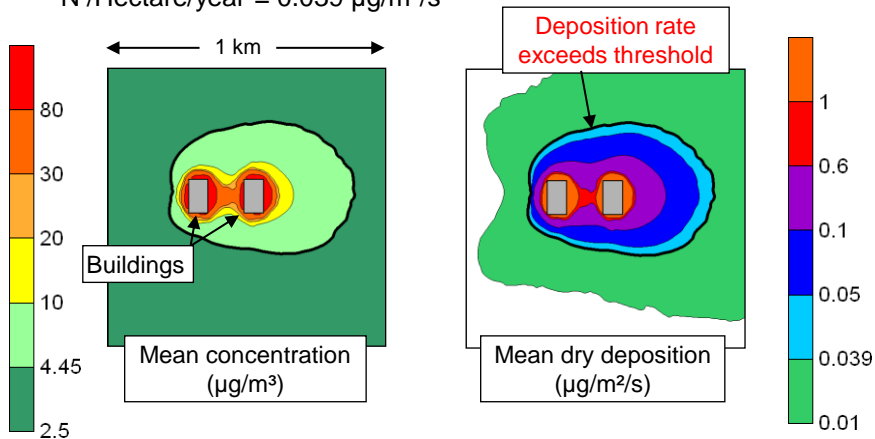 - Ambient release
  - 2 sheds modelled as buildings

Individual point sources

- Follow EA methodology using ADMS 4.2

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Case study

- Stage 1 results:
  – Consider results relative to a threshold deposition rate of 10 kg of N /Hectare/year = 0.039 µg/m²/s

Deposition rate exceeds threshold

1 km

80
30
20
10
4.45
2.5

Buildings

Mean concentration (µg/m³)

1
0.6
0.1
0.05
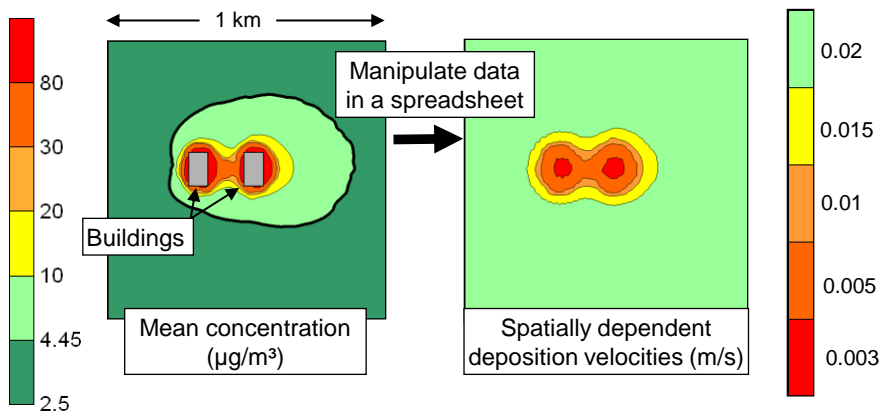0.039
0.01

Mean dry deposition (µg/m²/s)

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Case study

- Stage 2 processing:
  – Calculate a concentration – dependent deposition velocity field
  – Use as input into ADMS 4.2

1 km

Manipulate data in a spreadsheet

80
30
20
10
4.45
2.5

Buildings

Mean concentration (µg/m³)

0.02
0.015
0.01
0.005
0.003

Spatially dependent deposition velocities (m/s)
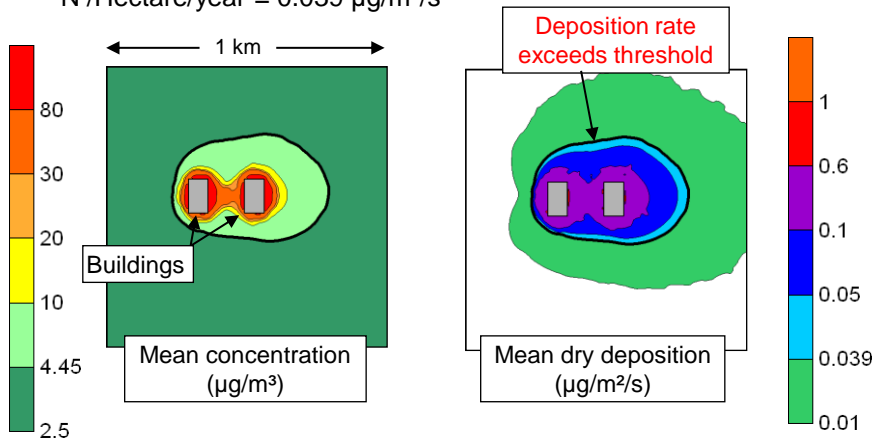
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Case study

- Stage 2 results:
  - Consider results relative to a threshold deposition rate of 10 kg of N /Hectare/year = 0.039 µg/m²/s

1 km

Deposition rate exceeds threshold

Buildings

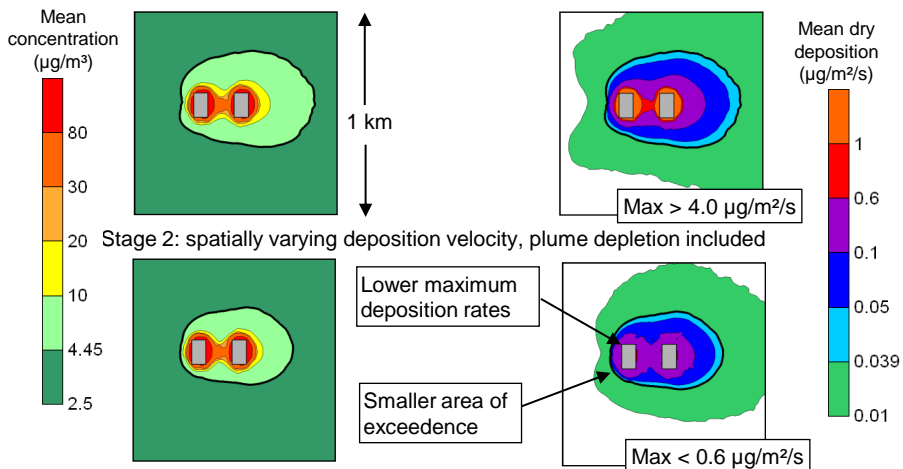Mean concentration (µg/m³)

Mean dry deposition (µg/m²/s)

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Case study

- Comparison of results from Stage 1 and Stage 2:
  - Stage 1: constant deposition velocity, no plume depletion:

Mean concentration (µg/m³)

1 km

Max > 4.0 µg/m²/s

Mean dry deposition (µg/m²/s)

Stage 2: spatially varying deposition velocity, plume depletion included

Lower maximum deposition rates
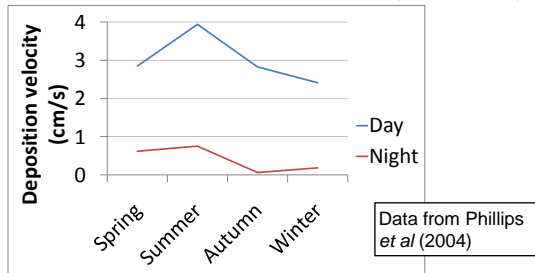
Smaller area of exceedence

Max < 0.6 µg/m²/s

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Additional model options

- It is well known that the deposition velocities also vary temporally, for example:

Data from Phillips *et al* (2004)

- ADMS 4.2 can model:
  - **Hourly varying** values of deposition velocity and surface resistance
  - **Seasonally varying** values of deposition velocity and surface resistance
  - **Spatially varying** values of deposition velocity (as demonstrated) and surface resistance
  - **Hourly and spatially varying** deposition velocities

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Summary of ADMS 4.2 capabilities

- In accordance with the Environment Agency guidance, ADMS 4.2 can model:
  - Ammonia deposition without plume depletion
  - Spatially varying deposition velocities
- Model features that enhance the model results include:
  - Buildings module
  - Complex terrain module
  - Background concentrations
- Additional ADMS 4.2 model options that may be of interest include:
  - **Hourly varying** values of deposition velocity and surface resistance
  - **Seasonally varying** values of deposition velocity and surface resistance
  - **Spatially varying** values of surface resistance
  - **Hourly and spatially varying** deposition velocities

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