Air Pollution from Agriculture
The Role of Ammonia

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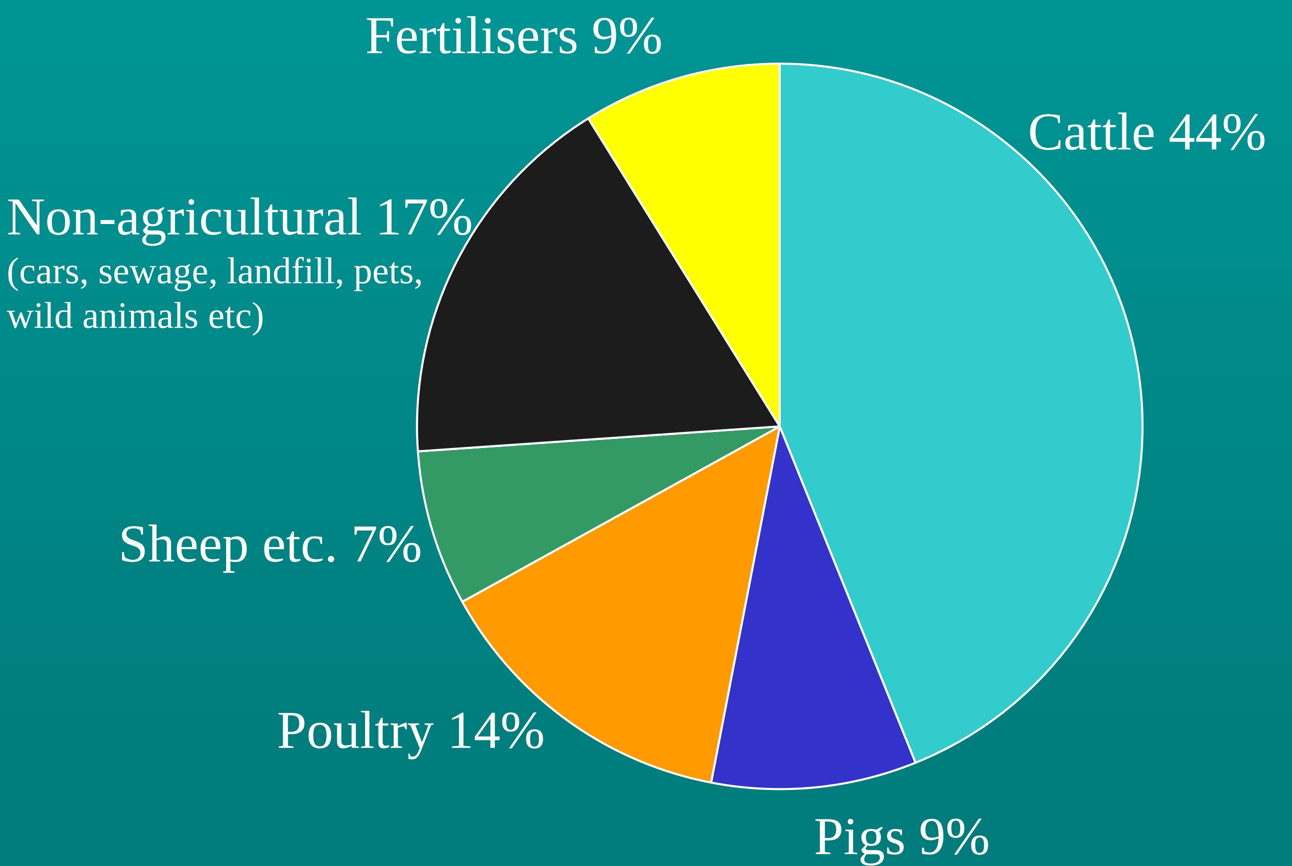
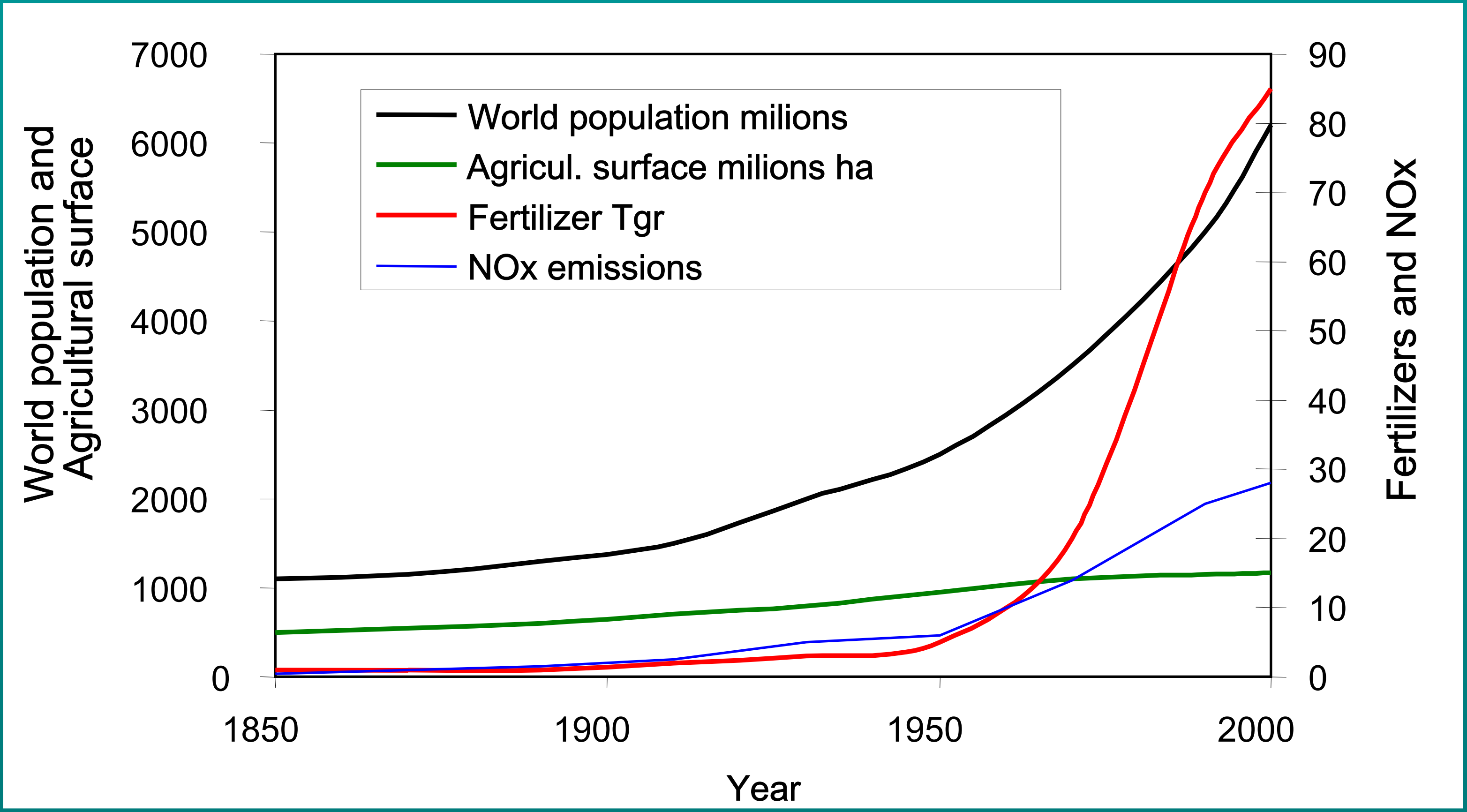
Presentation to the Air Pollution Hearing
European Parliament, Brussels, 11 May 2006.

The Polluters: Sources of ammonia

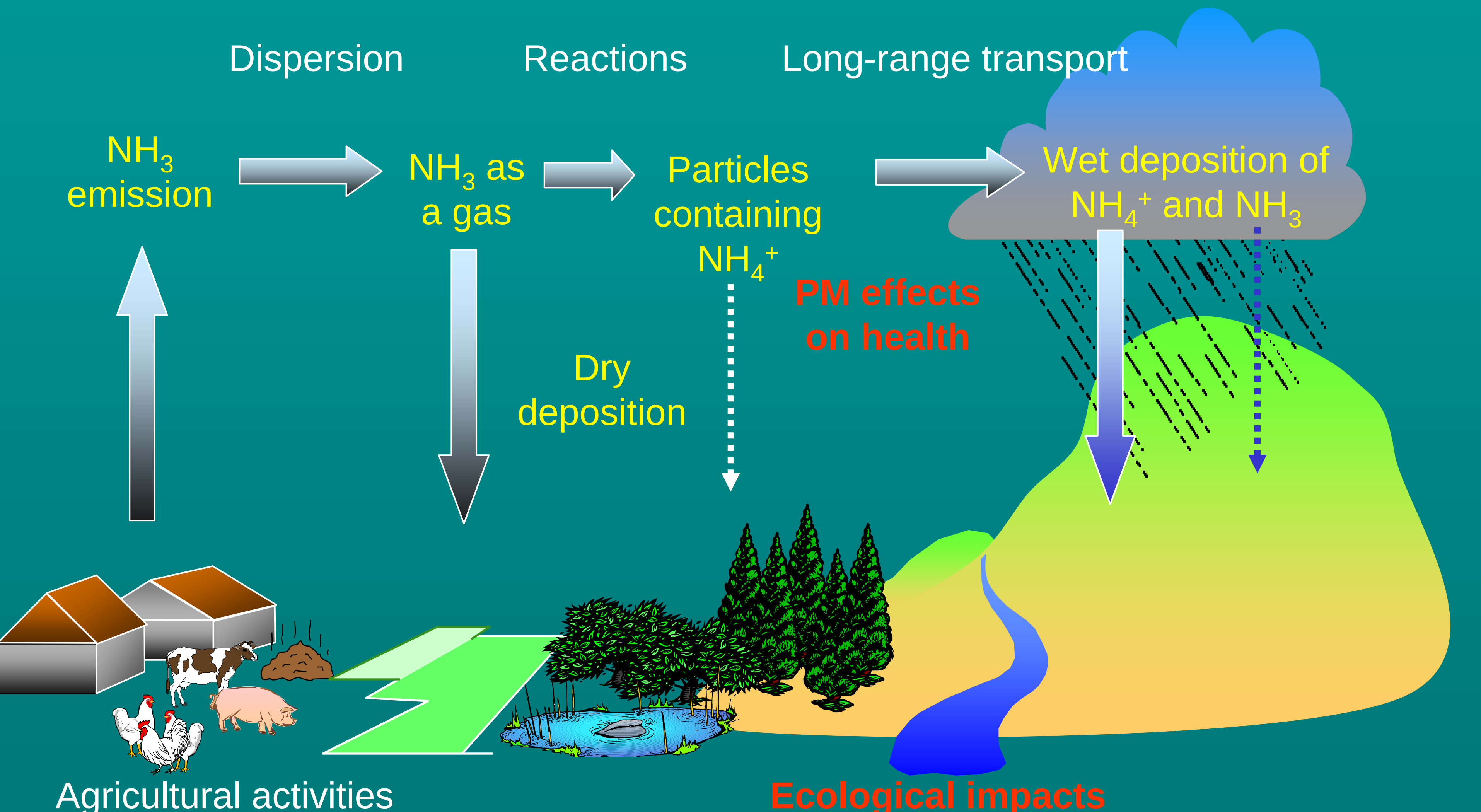


Values for the UK; proportions vary across Europe

Global increase in amounts of nitrogen



Ammonia in the atmosphere



Nitrogen reduces the abundance of woodland flowers

Wood sorrel (*Oxalis acetosella*)

Lost at the expense of:

Velvet grass (*Holcus lanatus*)

Effect of gaseous NH_3 on flowering of Cotton grass (*Eriorphorum vaginatum*)

Ambient NH_3

100 ug m^{-3} NH_3

CEH Edinburgh

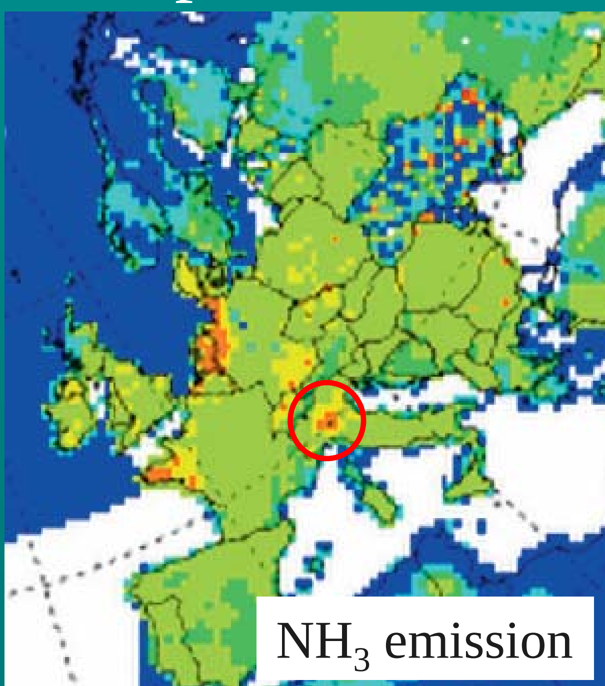
Effect of ammonia on the lichen *Ramalina farinacea*

Healthy lichen

Lichen "suffocated" by algae

Ammonia contributes substantially to particulate matter (PM) concentrations

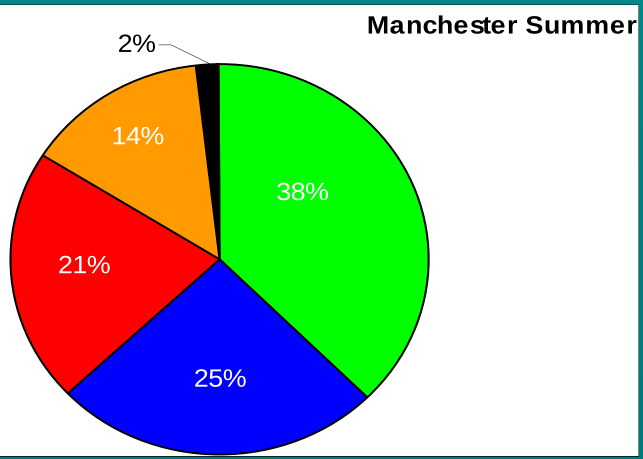
- Reduced visibility
- Human heath impacts

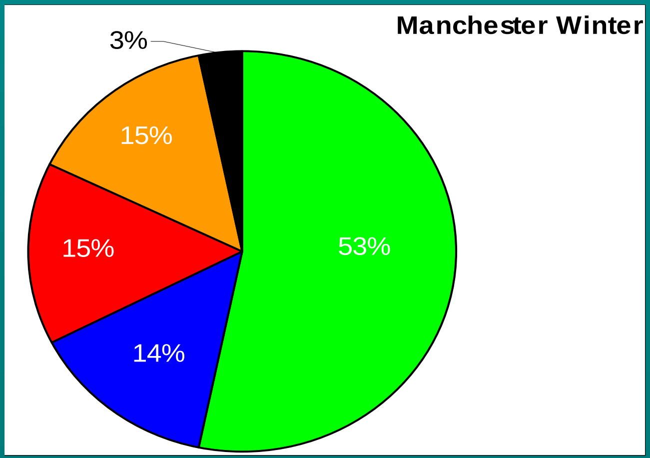


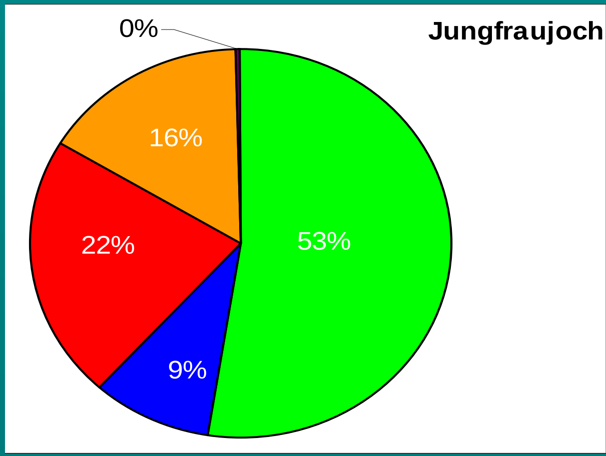
Parma, Emilia Romagna, Italy

Ammonium as a fraction of PM1.0

- Example data from Aerosol Mass Spectroscopy (AMS)
- Ammonium ~15% of total PM1.0
- Ammonium ~ 20-35% of the ionic fraction

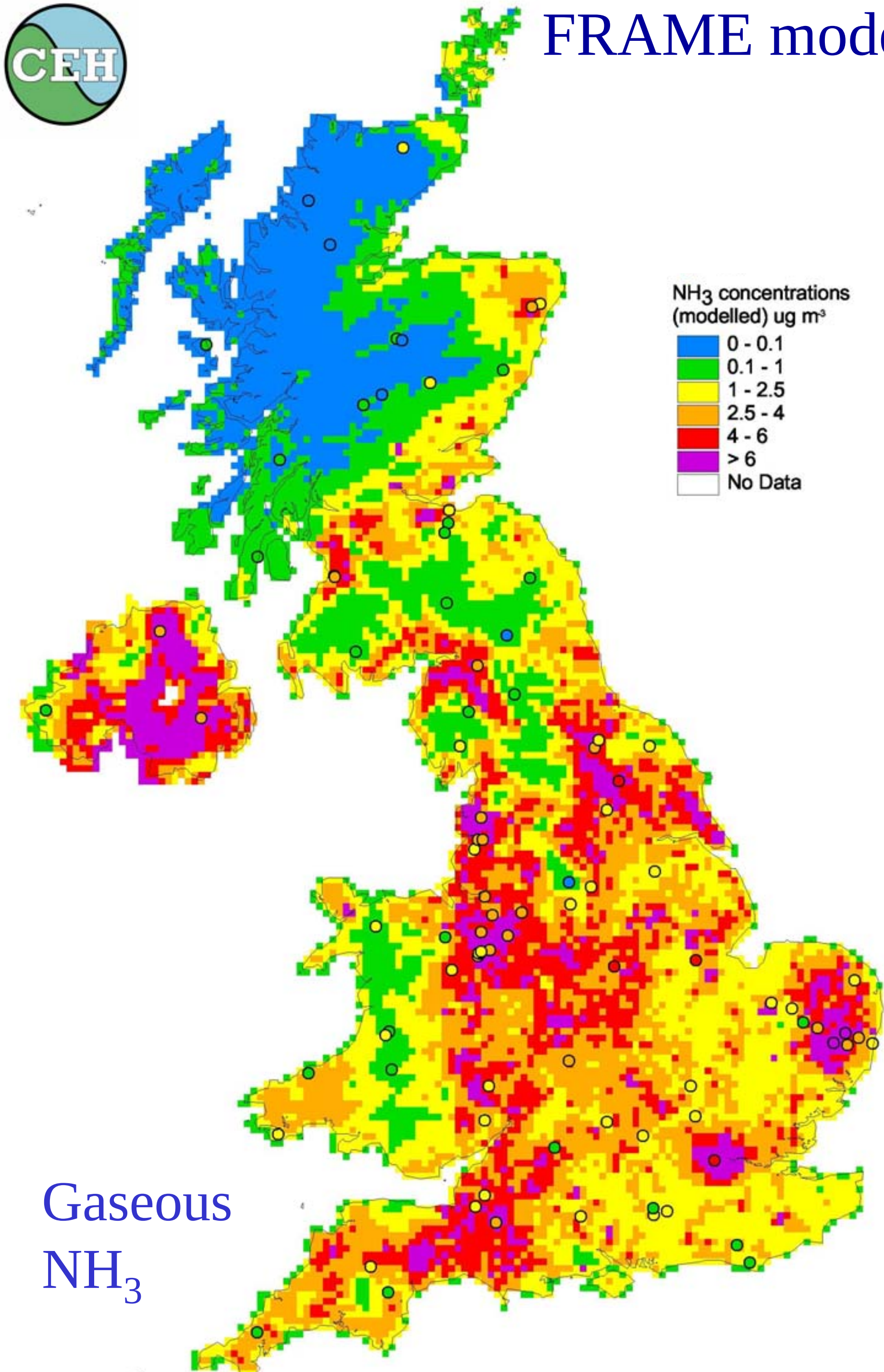




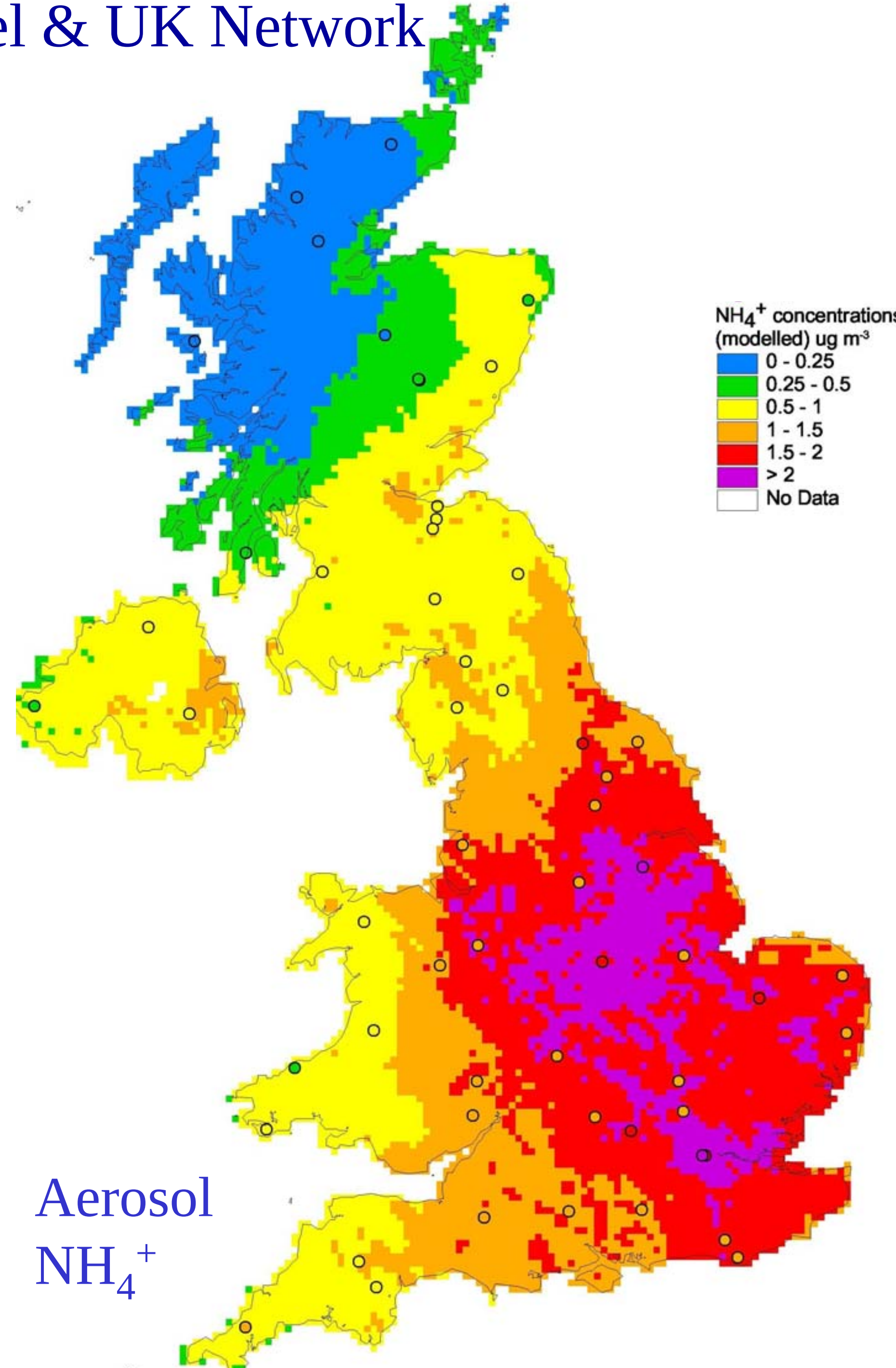


Ammonium Sulphate Nitrate Chloride Black carbon

FRAME model & UK Network

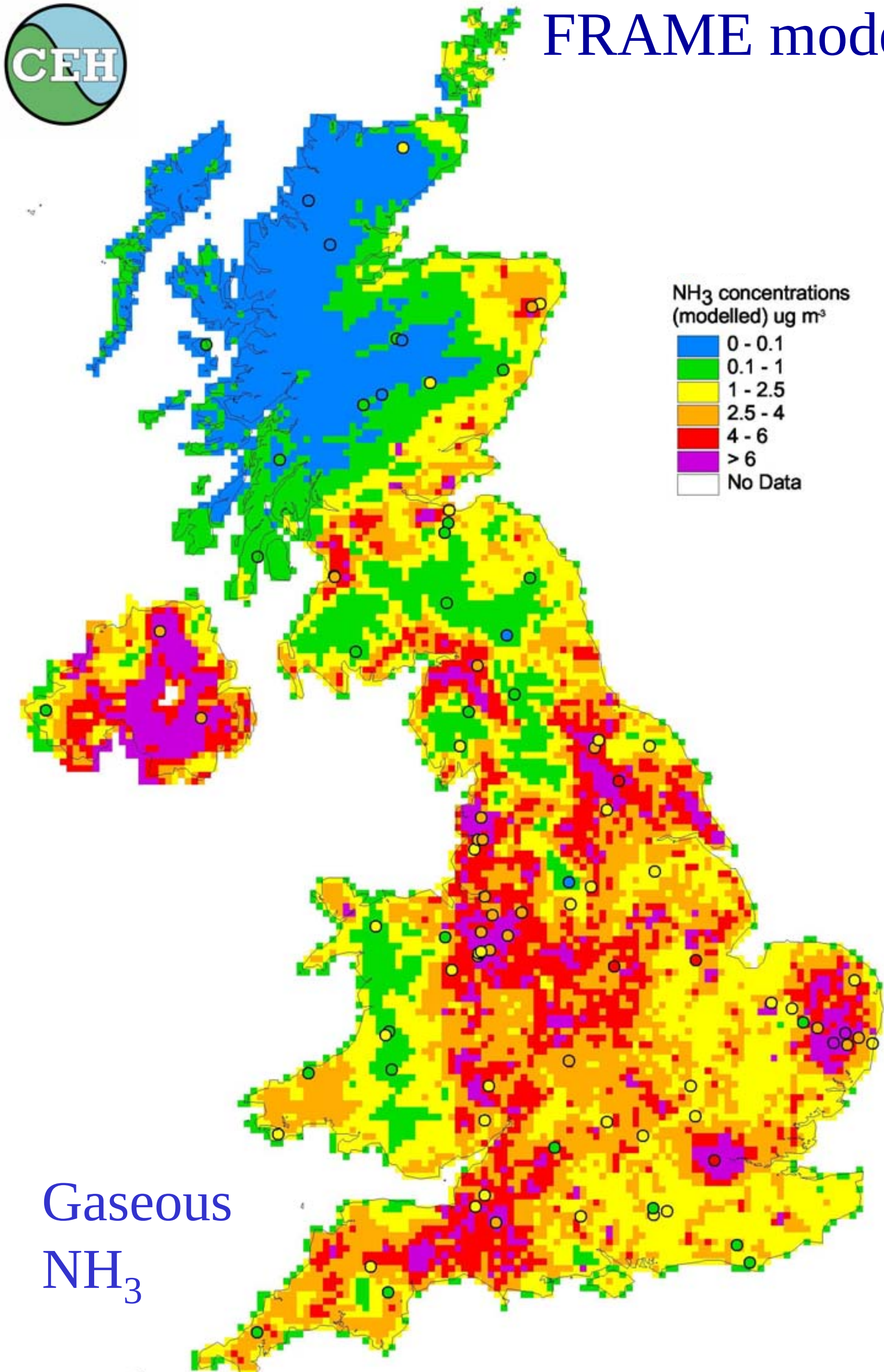


Gaseous NH_3



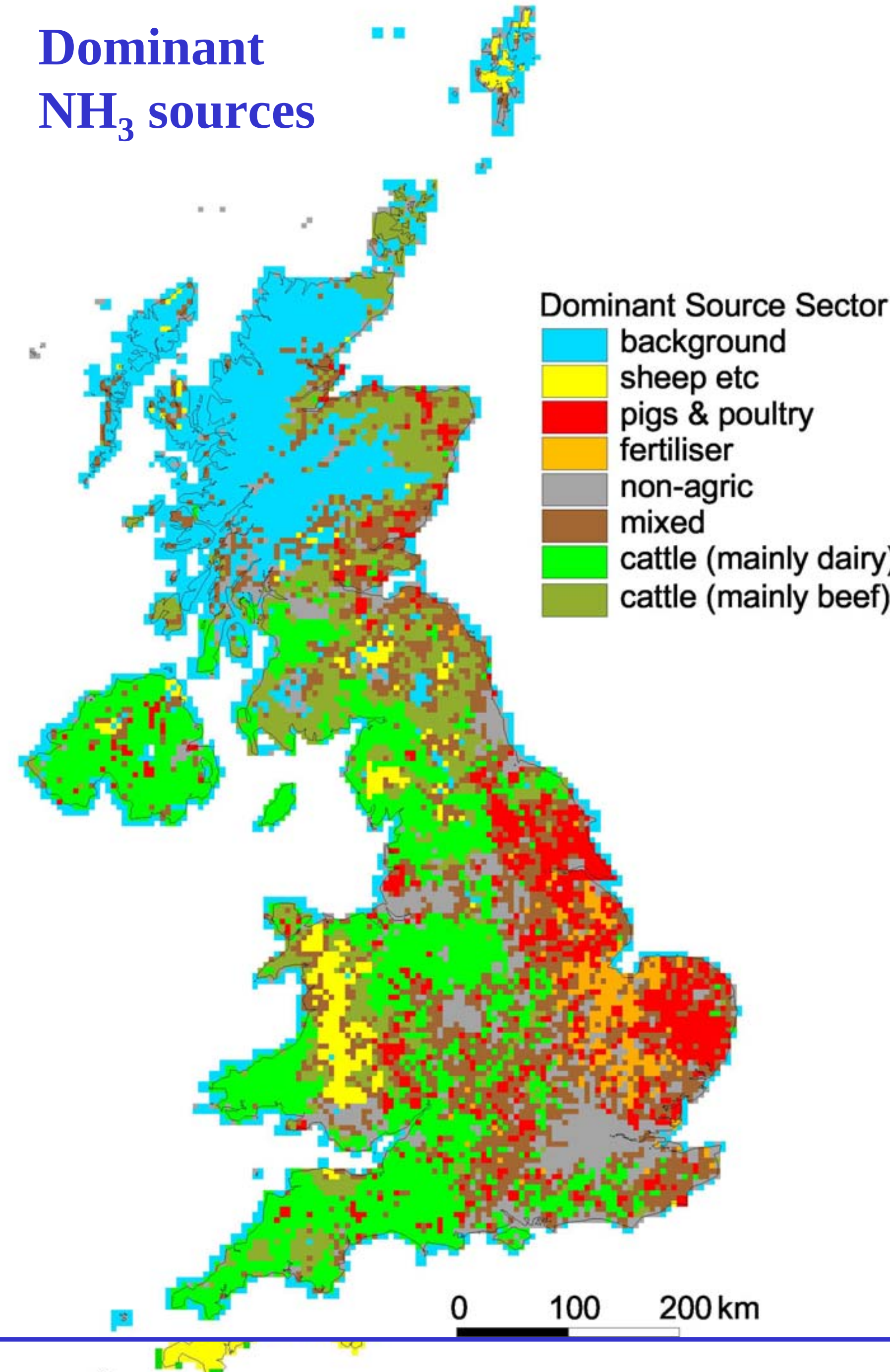
Aerosol NH_4^+

FRAME model & UK Network



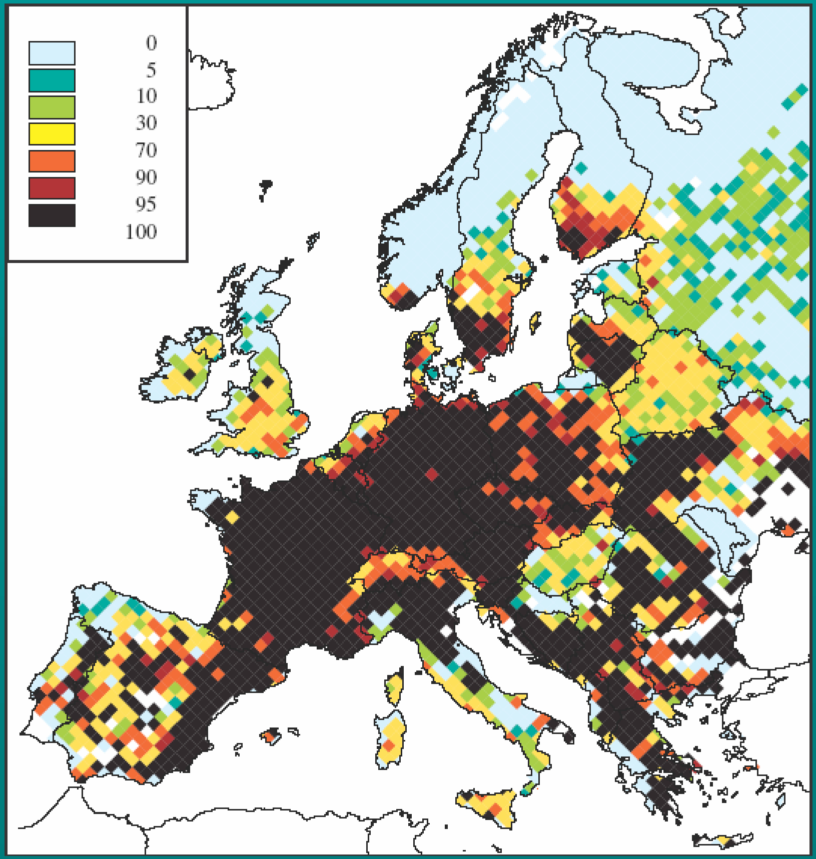
Gaseous
NH_3

Dominant
NH_3 sources



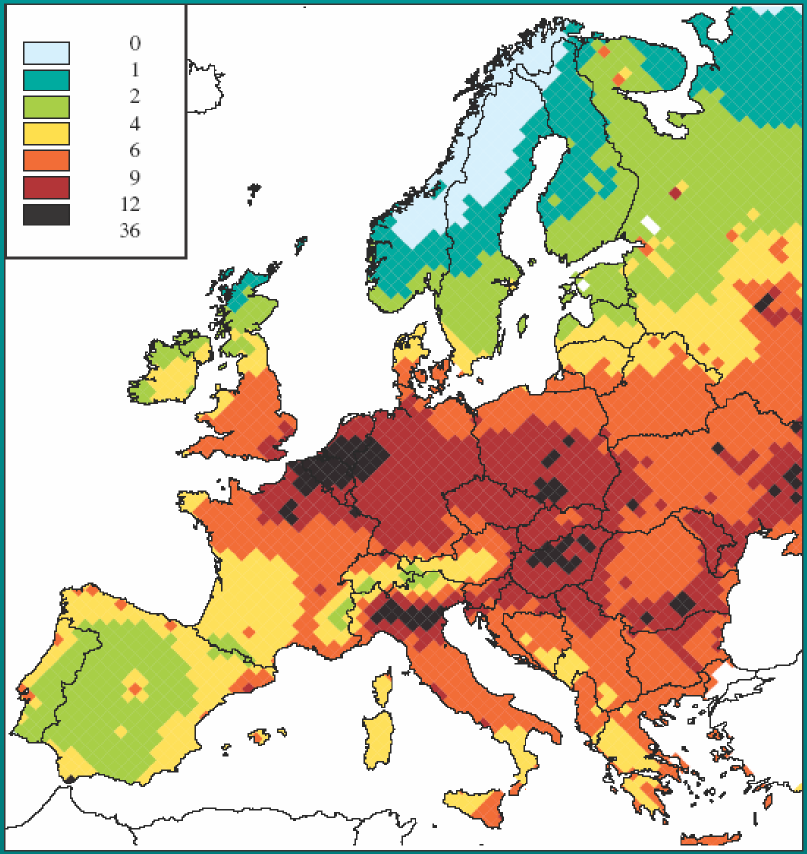
Predicted effects across Europe

Critical load exceedance
for N effects on ecosystems



% of ecosystems area with grid average N deposition > eutrophication critical loads (for 2000)

Loss in life expectancy
attributable to $PM_{2.5}$

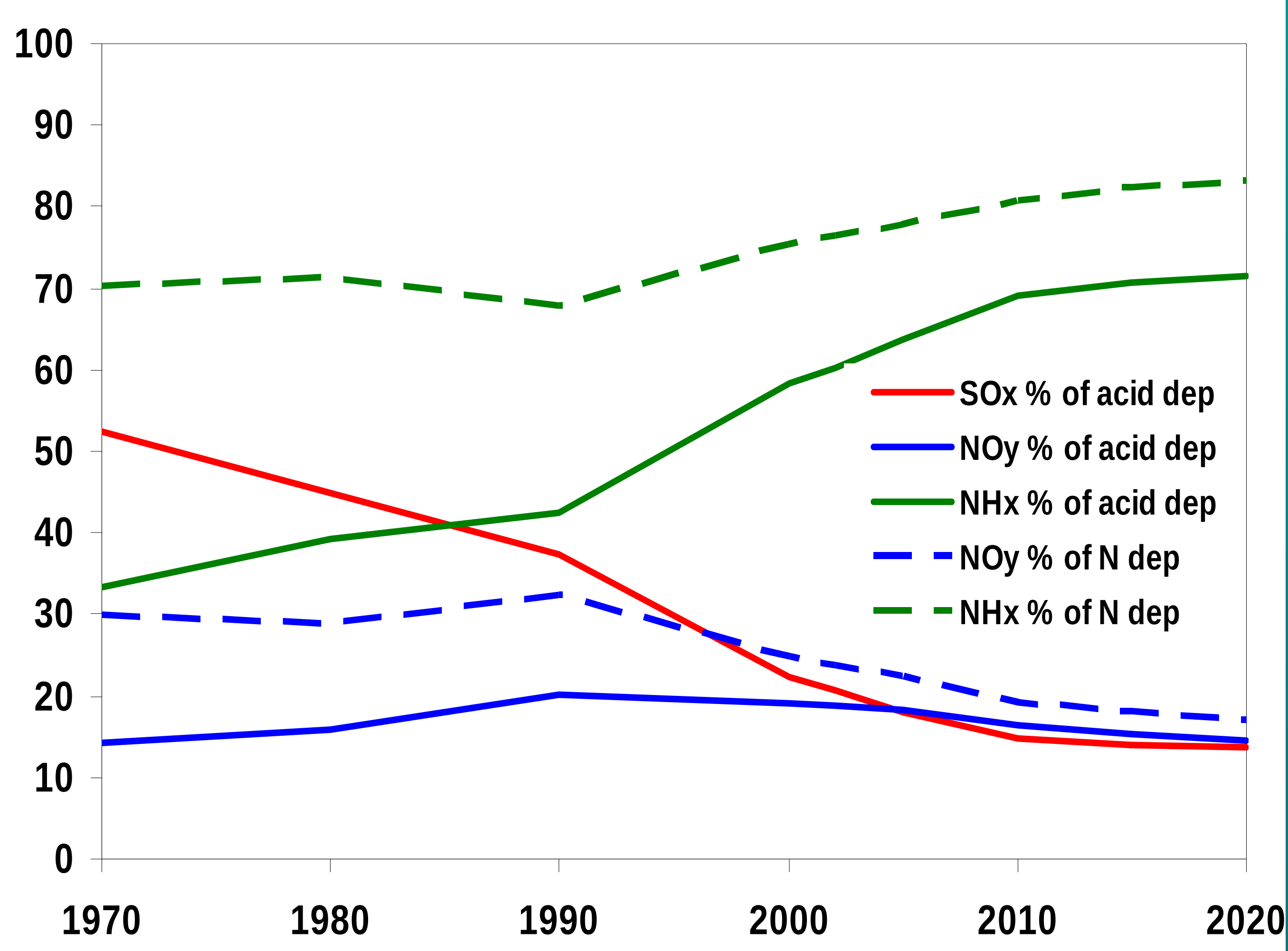


Loss in average life expectancy in months due to identified anthropogenic $PM_{2.5}$ (for 2000)

IIASA

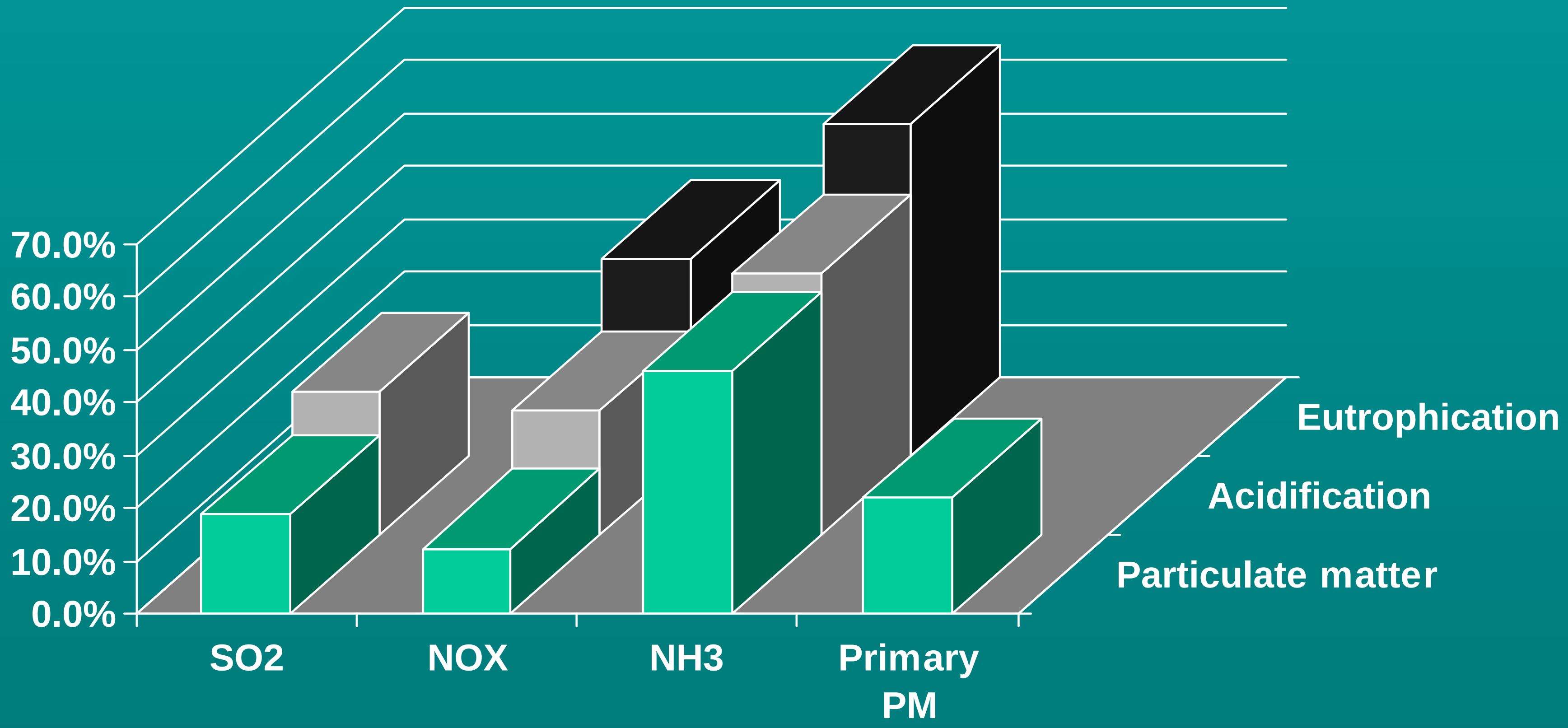
Effect of SO_2 and NO_x emission reductions on the NH_3 contribution to acid & N deposition

% contributions to acid and N deposition for woodlands in UK



FRAME model

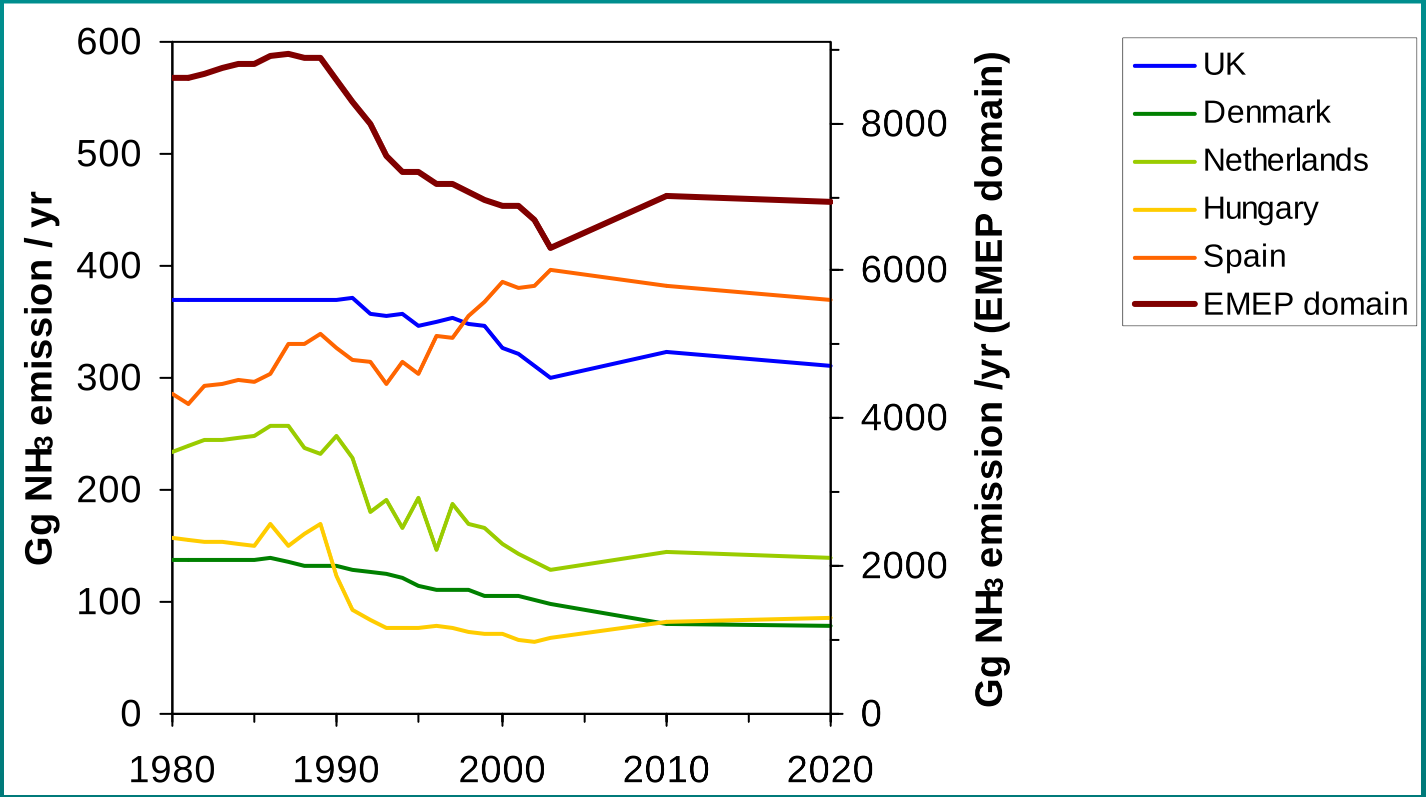
Percentage contribution of primary pollutants to the effects in 2020



Ammonia will become the main contributor to all three problems in 2020

What can be done for ammonia?

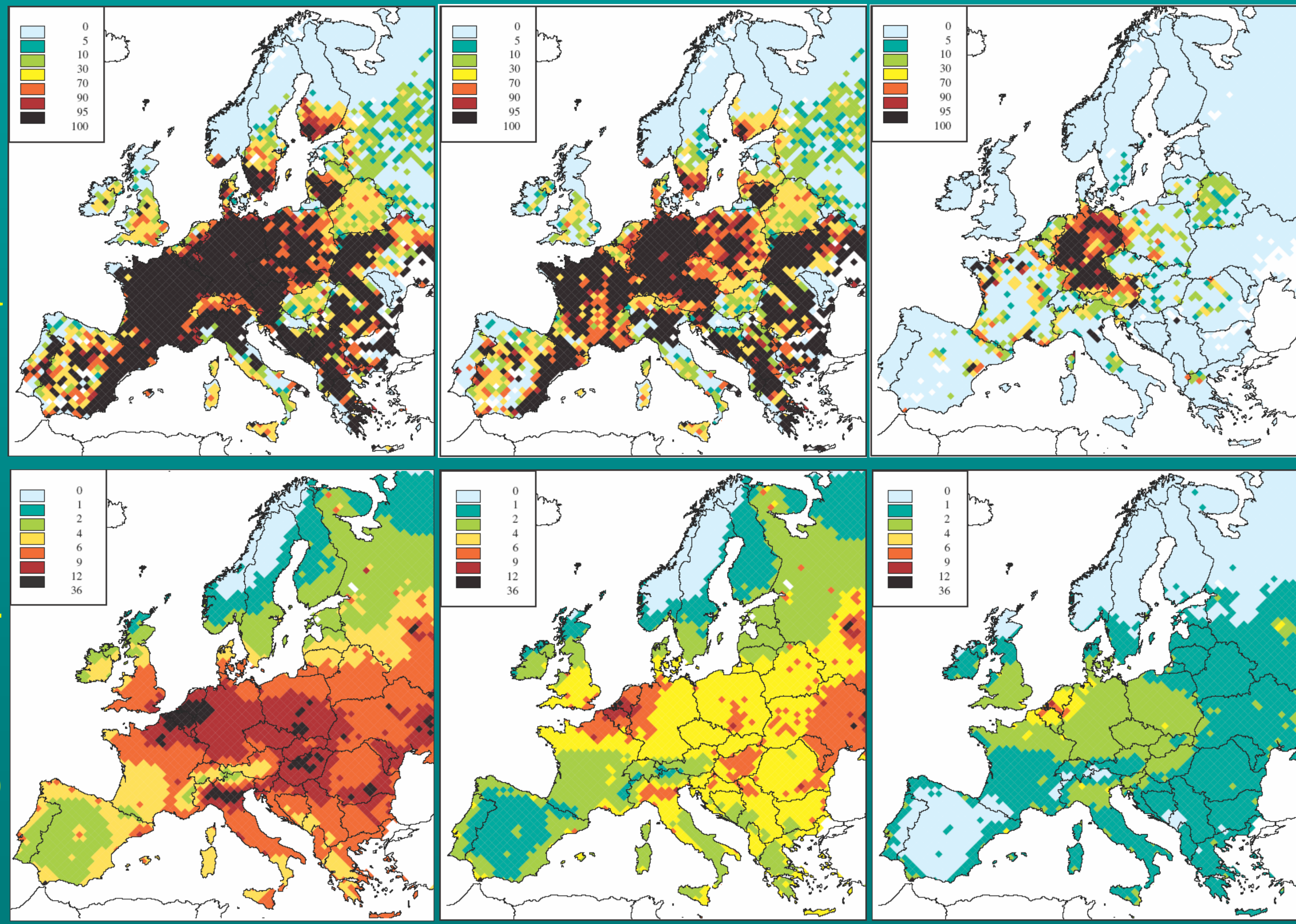
- Ambition for European livestock numbers needs to be agreed
- All EU Member States need to demonstrate commitment with measures to reduce ammonia emissions
- So far, the commitments have been very variable



Reducing in air pollution effects

Exceedance of N critical load by % ecosystem area

Loss in life-expectancy attributable to PM2.5 (months)

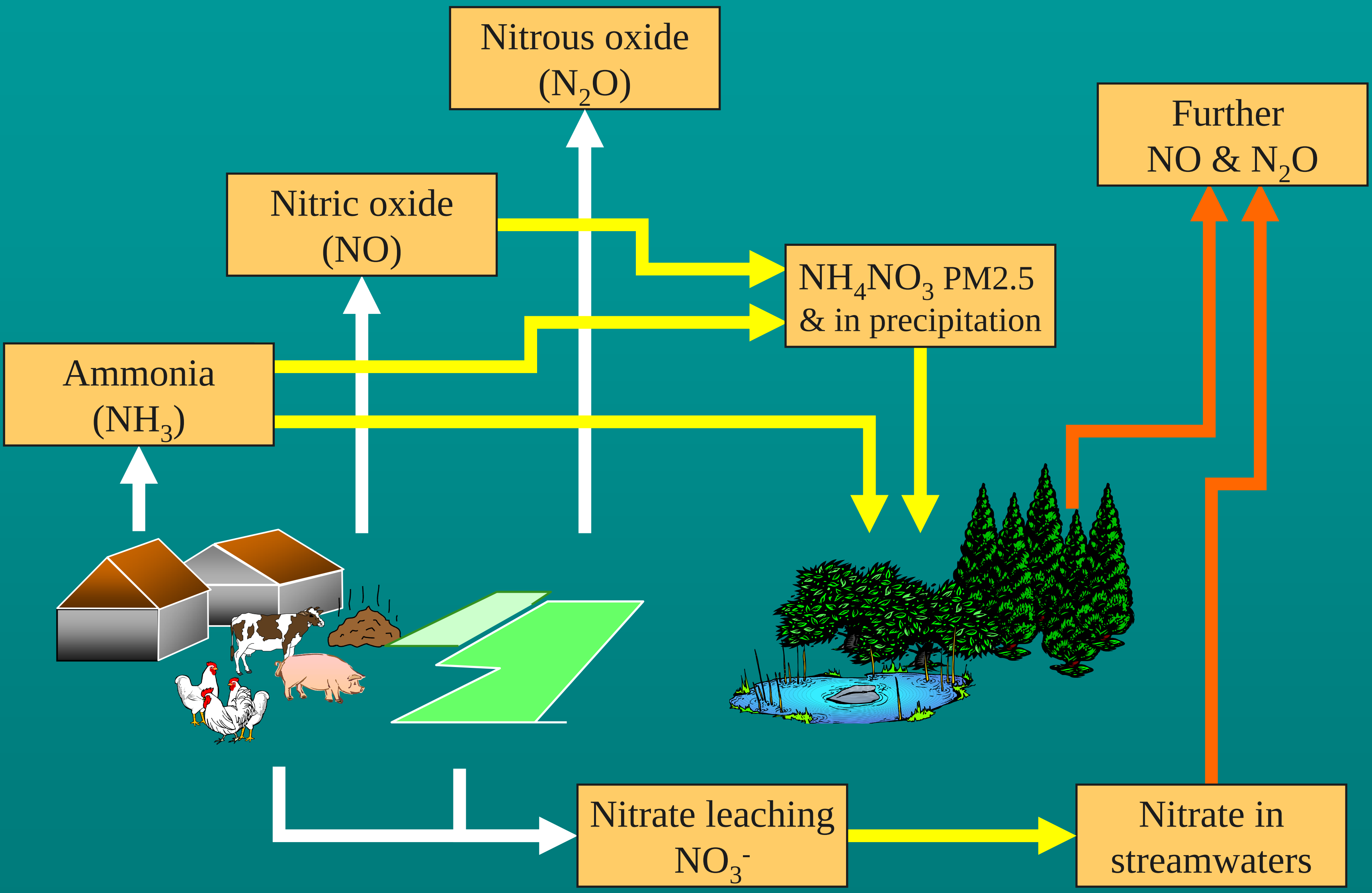


2000

2020
Current legislation

2020
Max. feas. reductions

Multi-pollutant interactions for nitrogen

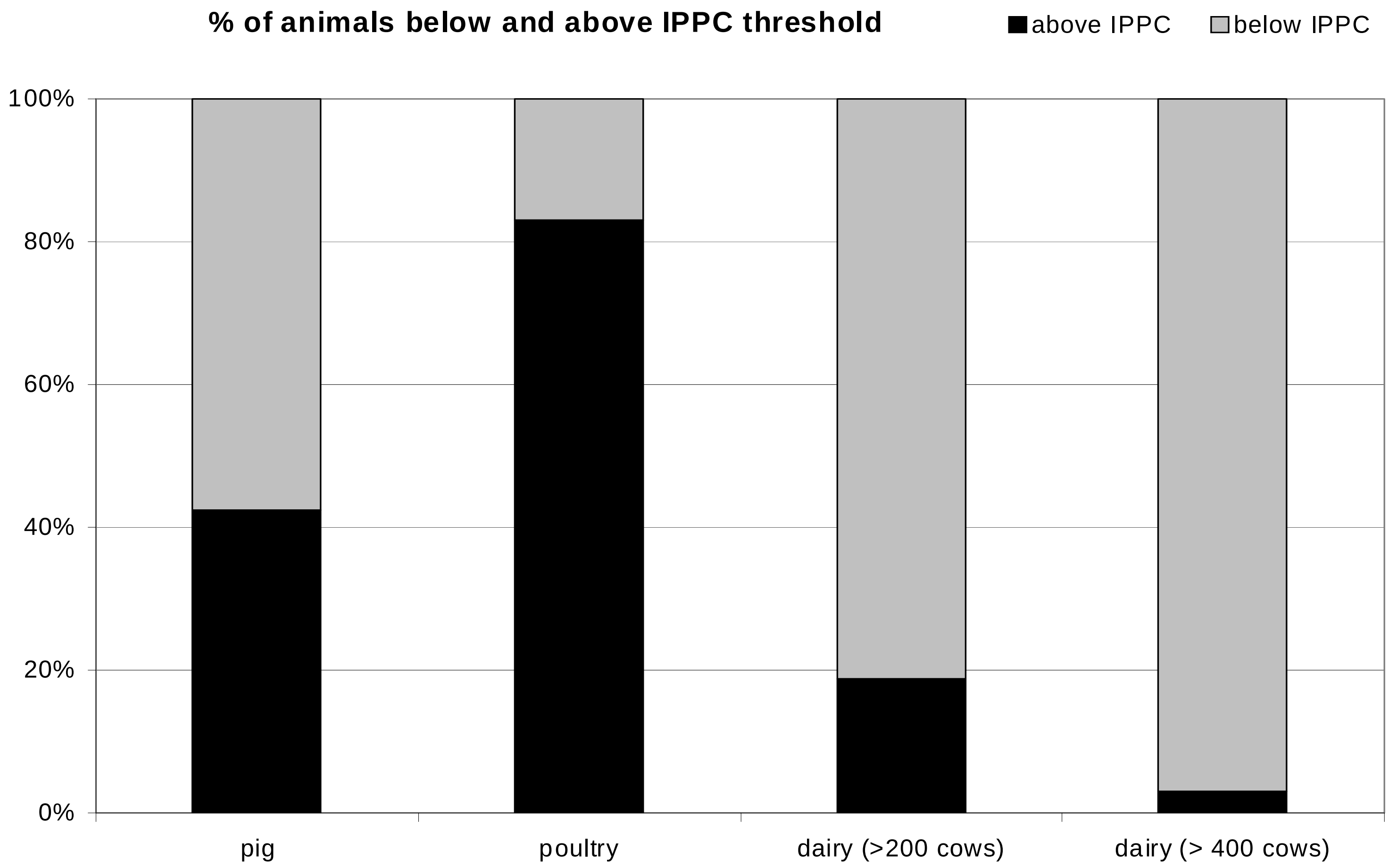


Abatement may swap one pollutant for another in the nitrogen cascade

Integrated Pollution Prevention and Control (IPPC) Directive

- Includes good practice for large pig and poultry farms (“installations”)
- Excludes small “family farms” (e.g. <40,000 bird places)
- Is it really integrated? It does not treat the fate of the manure if passed to a third party.
- Good case to extend IPPC to larger cattle farms:
  - The debate should centre on the farm-size limit
  - Existing IPPC farm sizes (as NH_3 emission) would equate to including farms with ~>200 cows

Integrated Pollution Prevention and Control (IPPC) Directive



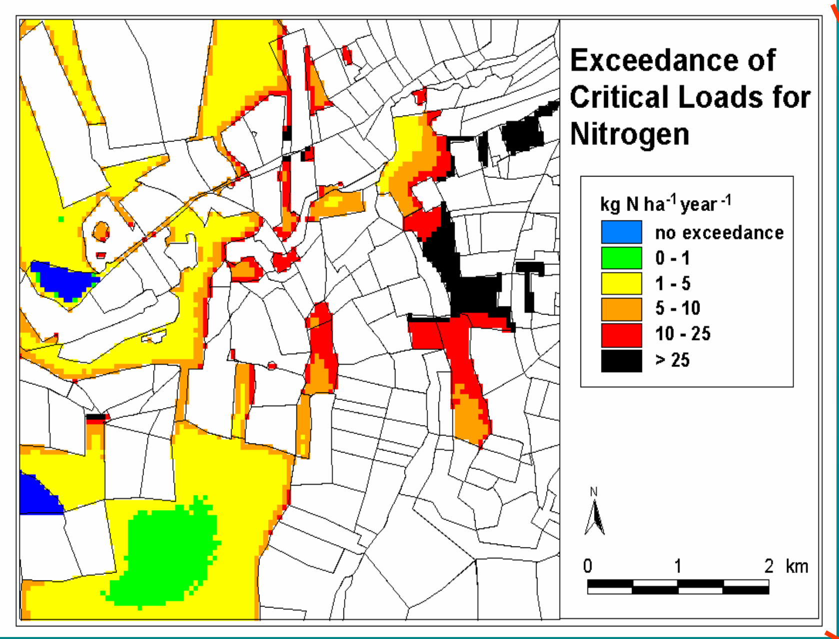
from farm statistics for England

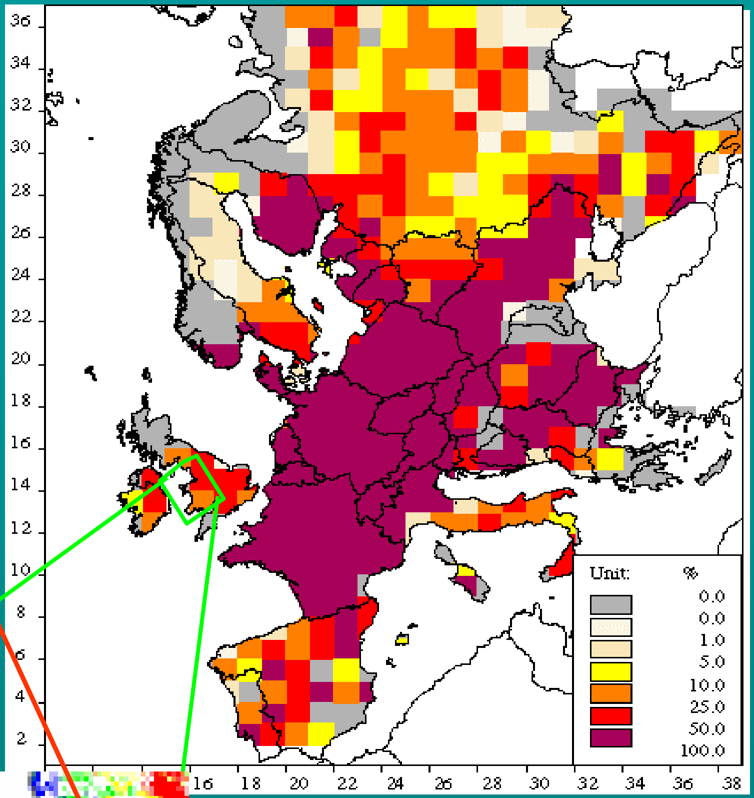
Examples of nitrogen pollutant swapping

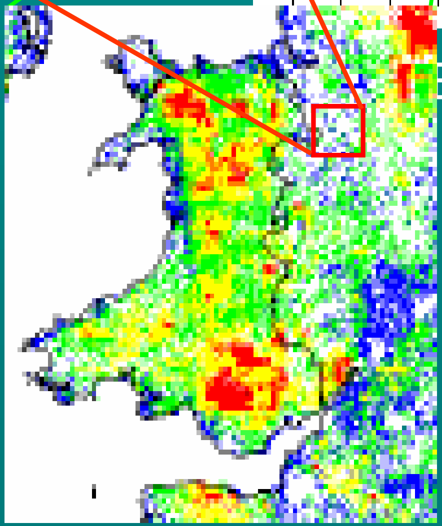
- Drying poultry litter
  - Decrease NH_3 (& NH_4^+ PM), but can increase dust emissions
- Incorporating manures in soils
  - Decrease NH_3, but can increase NO_3^- leaching
- Extending the cattle grazing season
  - Decrease NH_3, but can increase N_2O emissions

- Prioritize measures with mutual benefits e.g. reduce N inputs in fertilizers and animal feed

Dealing with spatial scale







European exceedances of the critical load for nitrogen

Ecosystem protection

National targets and policy

Implications of fine spatial variability

- Nature areas near large farms are more at risk
- Woodland edges at high risk (the bits seen by the public)

- The exeedance is so massive that there is **no way that realistic national emission ceilings will avoid all impacts of NH_3 on biodiversity loss**

- Need to prioritize which ecosystems to protect and develop complementary spatial strategies
- Habitats Directive sites are the natural priority for biodiversity

Spatial planning for ammonia and the Habitats Directive

- Habitats Directive network of Special Areas of Conservation (SACs). Legal requirement to maintain "Site integrity"

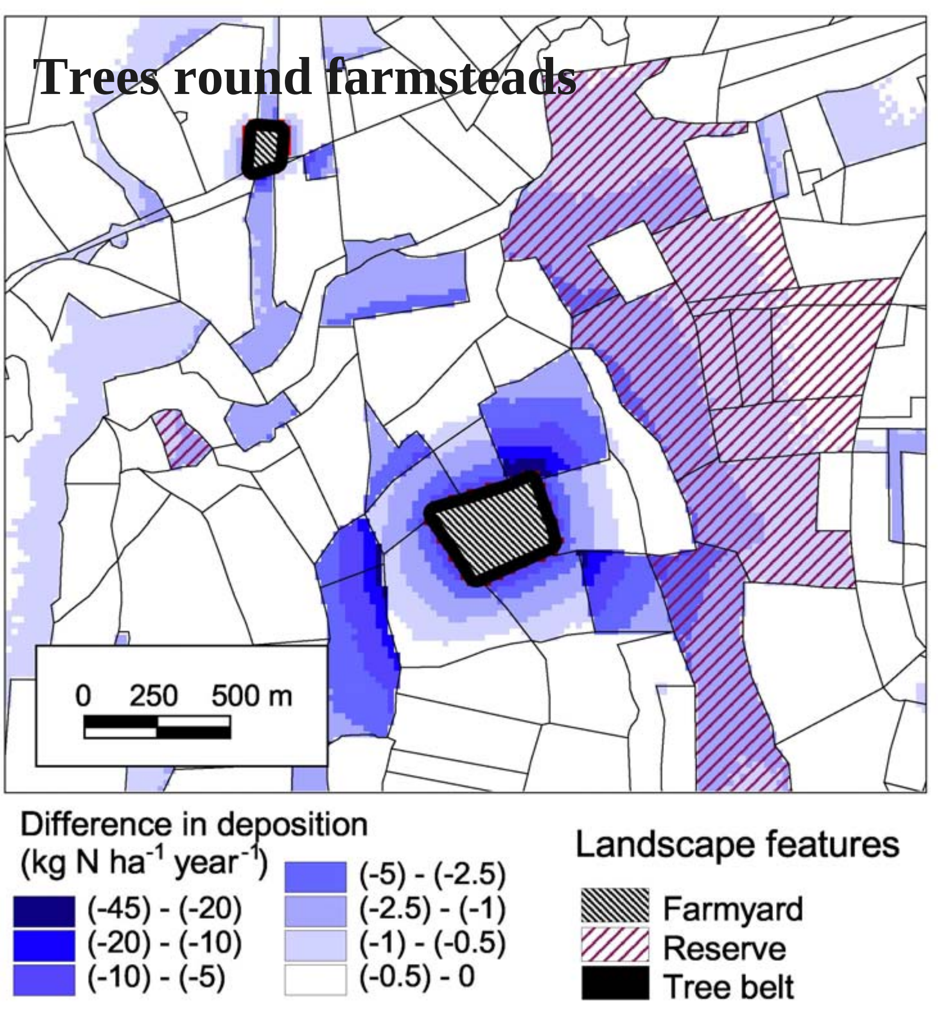
- Spatial approaches should be encouraged by setting an effect related objective:

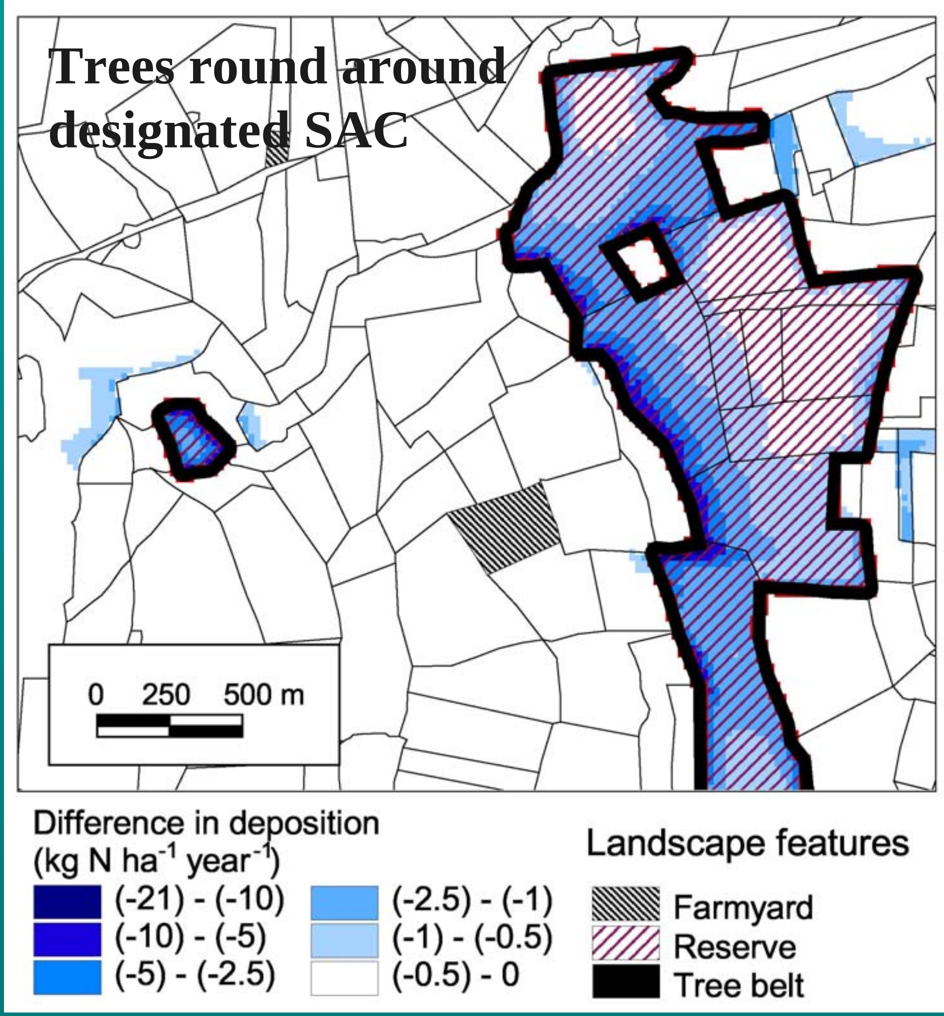
  "*Target to reduce the numbers of SACs where N critical loads are exceeded in each Member State by X%*"

- Regional and landscape spatial measures (inc. buffer zones) give larger benefits for the same total ammonia emissions.

Landscape planning scenarios: Effect of tree-belts on nitrogen deposition

Two farms, two hypothetical SACs; 50 m belts of trees





Conclusions: Ammonia problems

- In 2020 ammonia the largest contributor to acidification, eutrophication and particulate matter
- Current ammonia abatement is small compared with other sectors: more effort is required.
- Given costs and spatial variability, it is not feasible to protect all European ecosystems, while maintaining a viable livestock sector.

Conclusions: Ammonia and Strategies

- Need an integrated view of the N cycle, linking agricultural NH_3, N_2O and NO_3^- losses (inc. acidification, eutrophication & PM).
- Better coordination of NECD, Kyoto, Nitrates Directive/WFD and CBD
- Look for synergies and set different N priorities according to local sensitivity.
- Special Areas of Conservation (SACs) are the logical priority for biodiversity protection

Conclusions: Ammonia & Measures

A suite of measures is needed:

- Further reduce national ceilings (A+ is achievable for NH_3)
- Set an effects-based objective for SAC protection
- Set an air quality objective for annual mean ammonia
- Use national & landscape planning to help meet N objectives
- Extend IPPC to include cattle (with a realistic farm size limit)
- Incorporate eligible costs of mitigation measures and spatial strategies into agri-enviroment financing mechanisms