Historic trends in N and S deposition in the UK 1800 to present

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LTLS CNP

macronutrient cycles programme C N P

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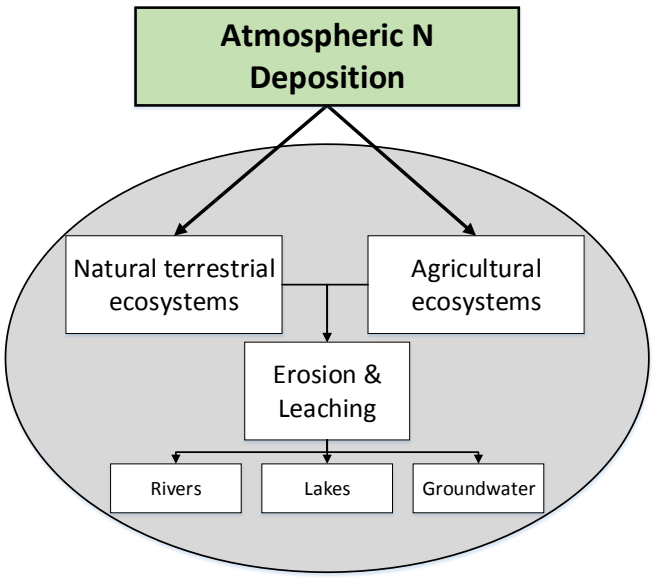
The Scottish Government

Introduction – Drivers of change in N & S

NERC Long-term large-scale (LTLS)



Key tasks

- Historic emissions – quantify sources, source data & model spatial distribution
- Model time series of emissions & deposition
- UK focus & European background
- Analyse & interpret data
- Publish results & collaborate on further work
- Publish data

1800
- First population census data
- Industrial Revolution

1900
- Domestic coal use peak
- Board of Agriculture established

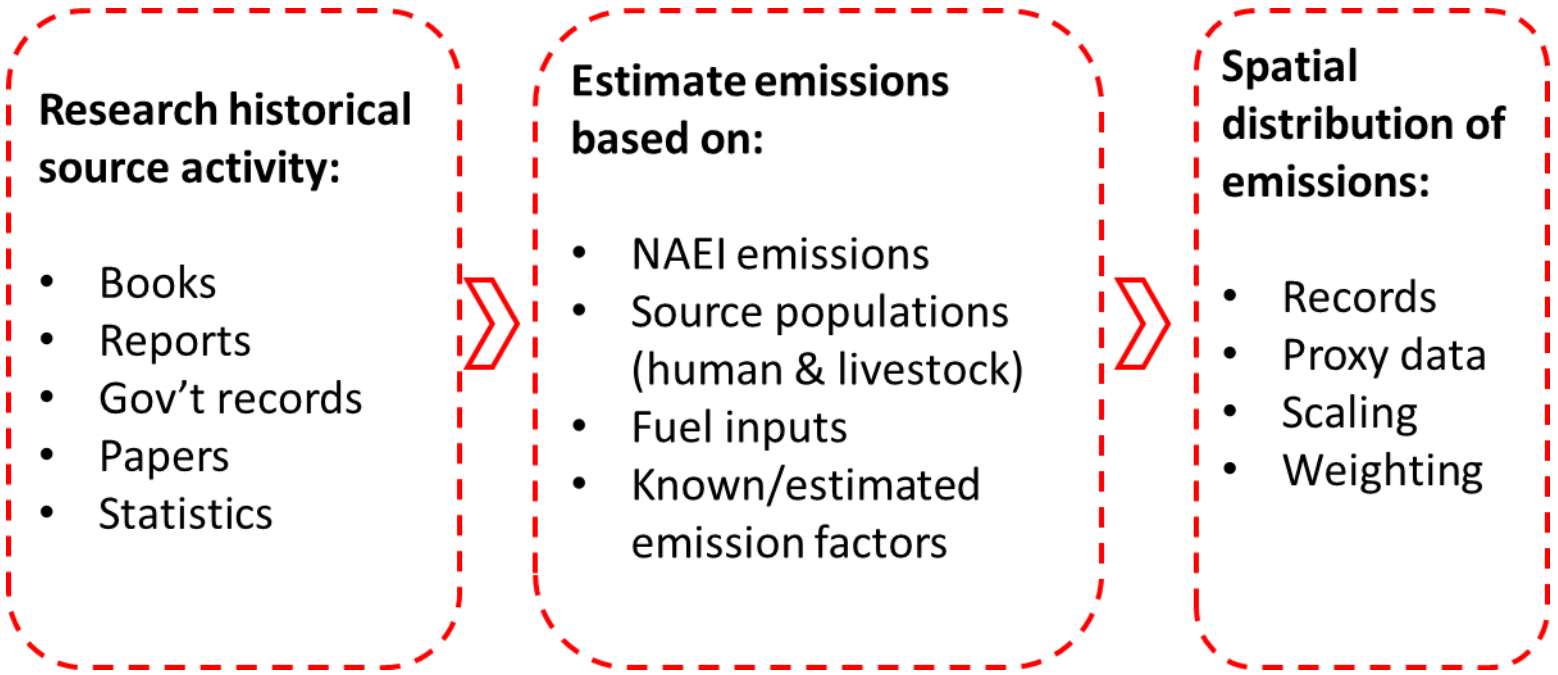
1950
- Large scale Haber-Bosch processing commences
- Increase in motor vehicles

1970
Peak in sulphur emissions

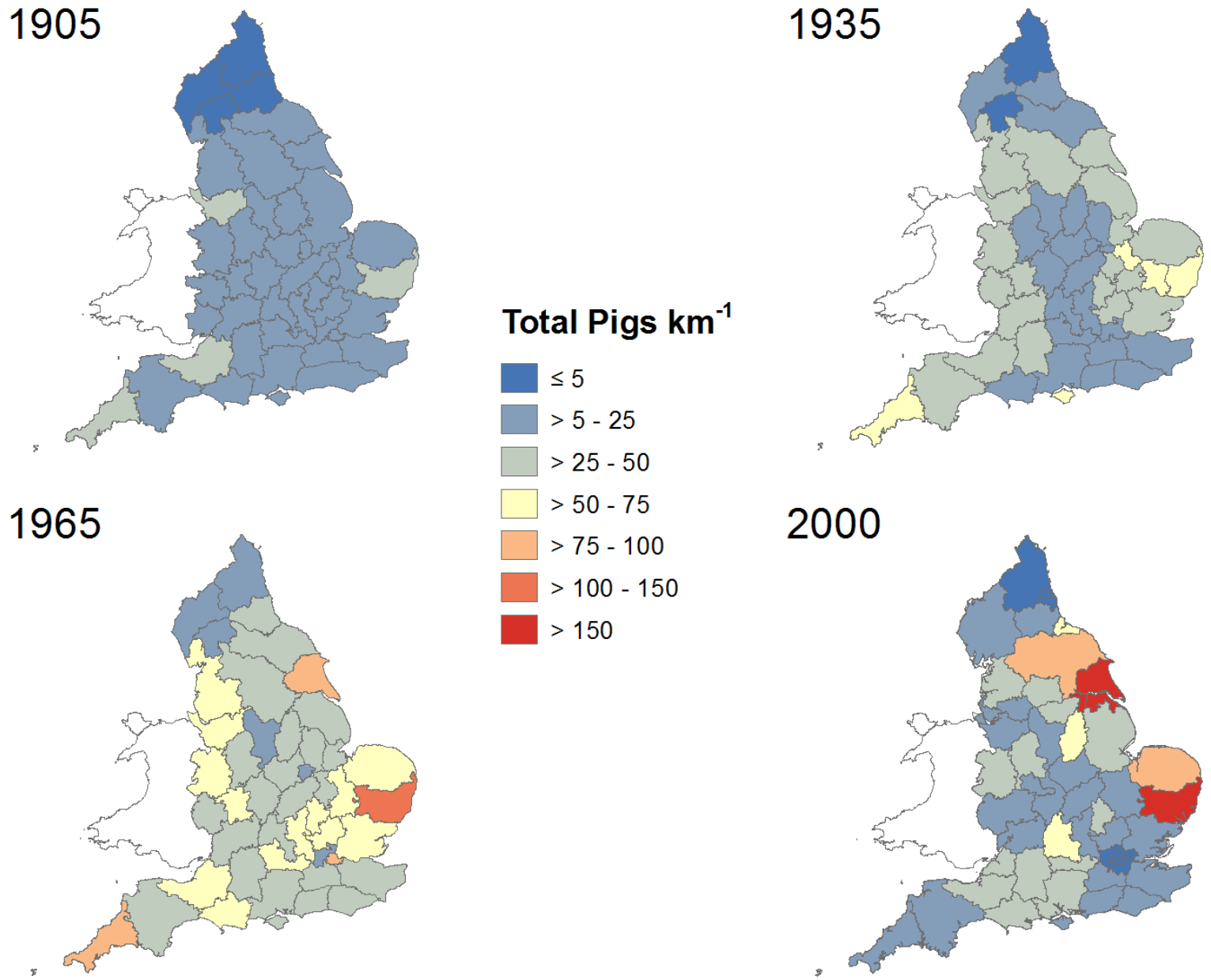
1990
- Peak NO_x & NH_3 emissions
- Sulphur reducing

2010
Present Day

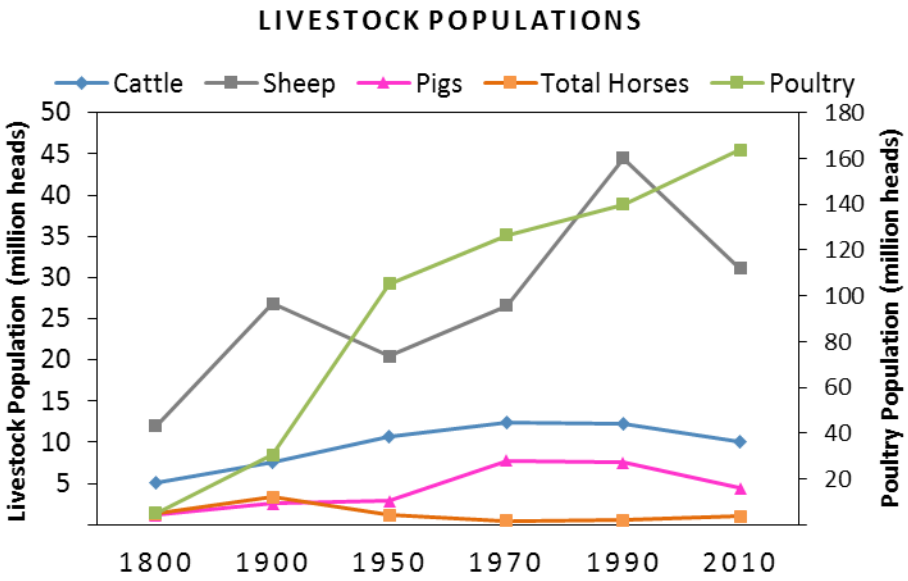
200+ years of history – emission sources

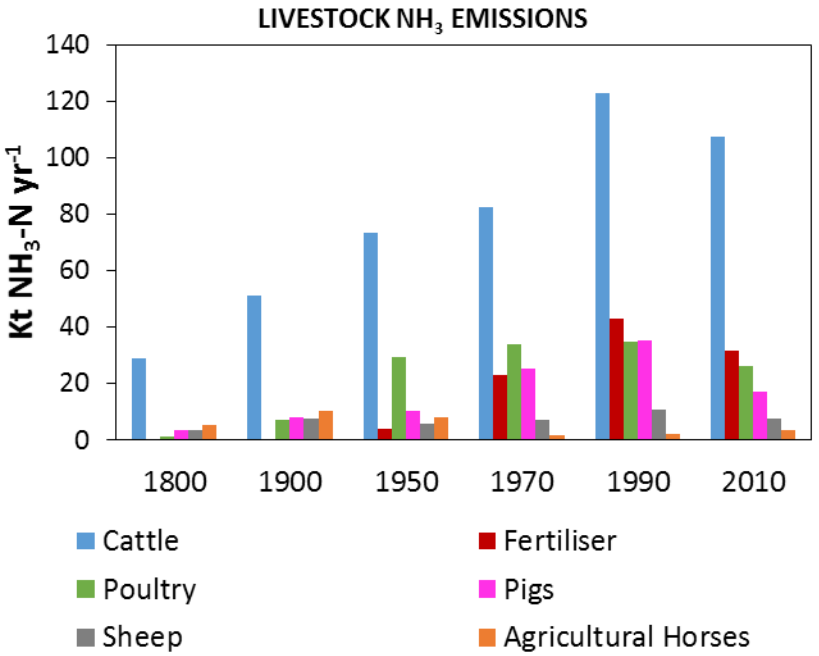


Pig density (county level)

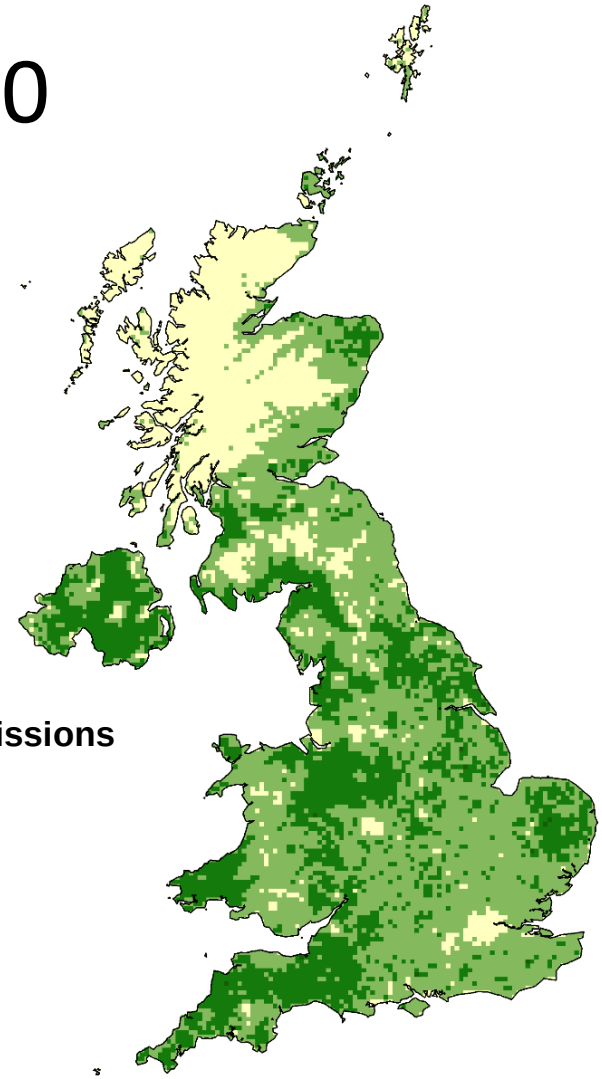


Agricultural ammonia emissions





2010



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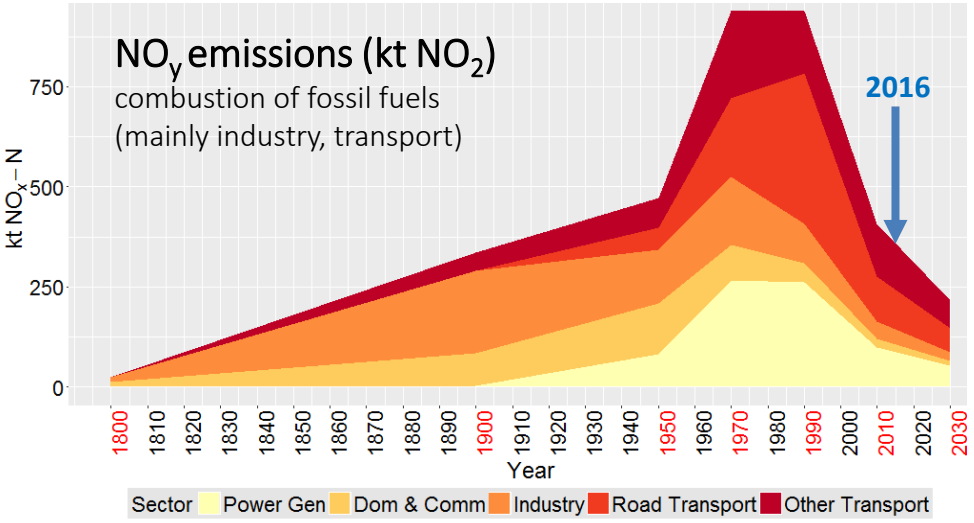
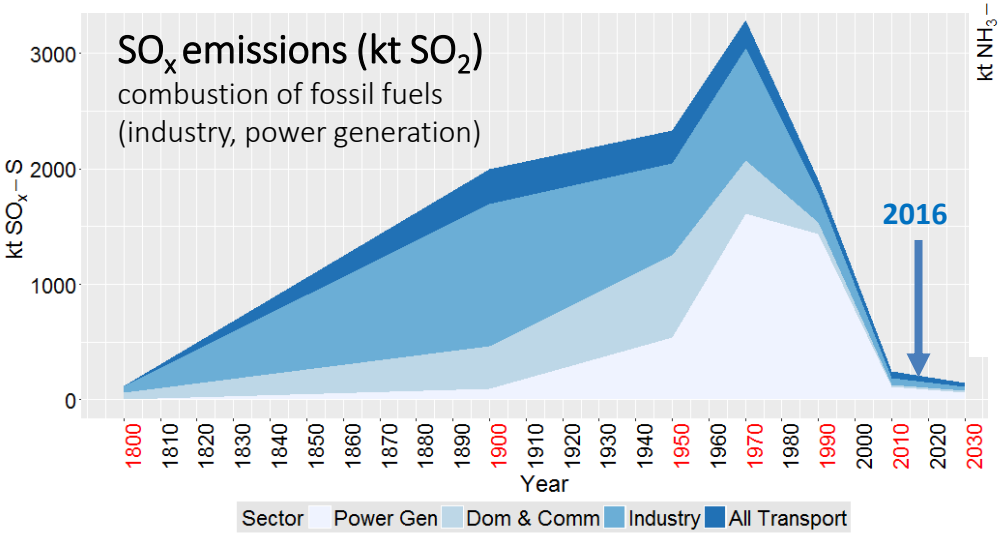
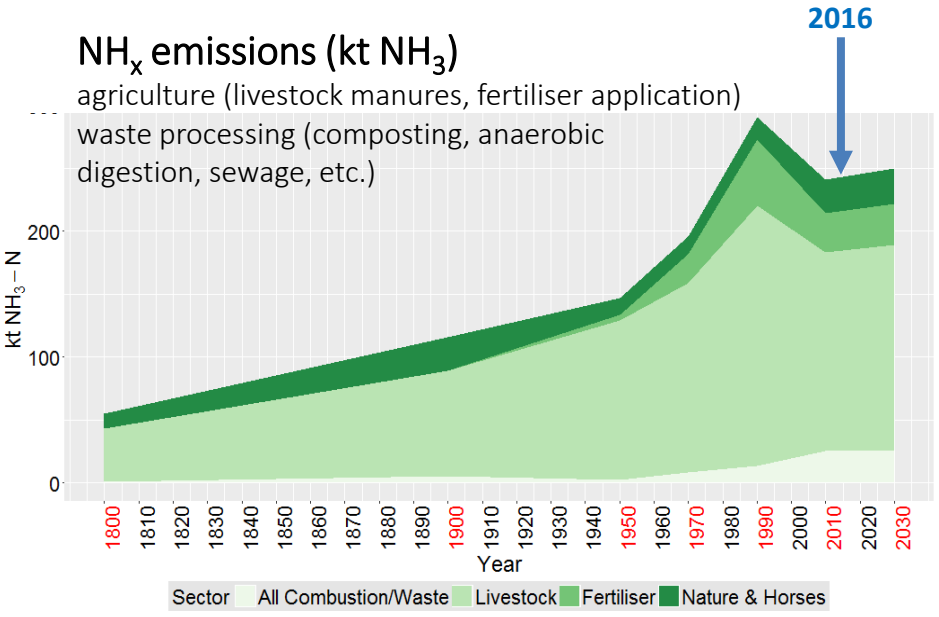
Historic emission trends 1800-2010







SO_2 important for atmospheric chemistry/deposition processes

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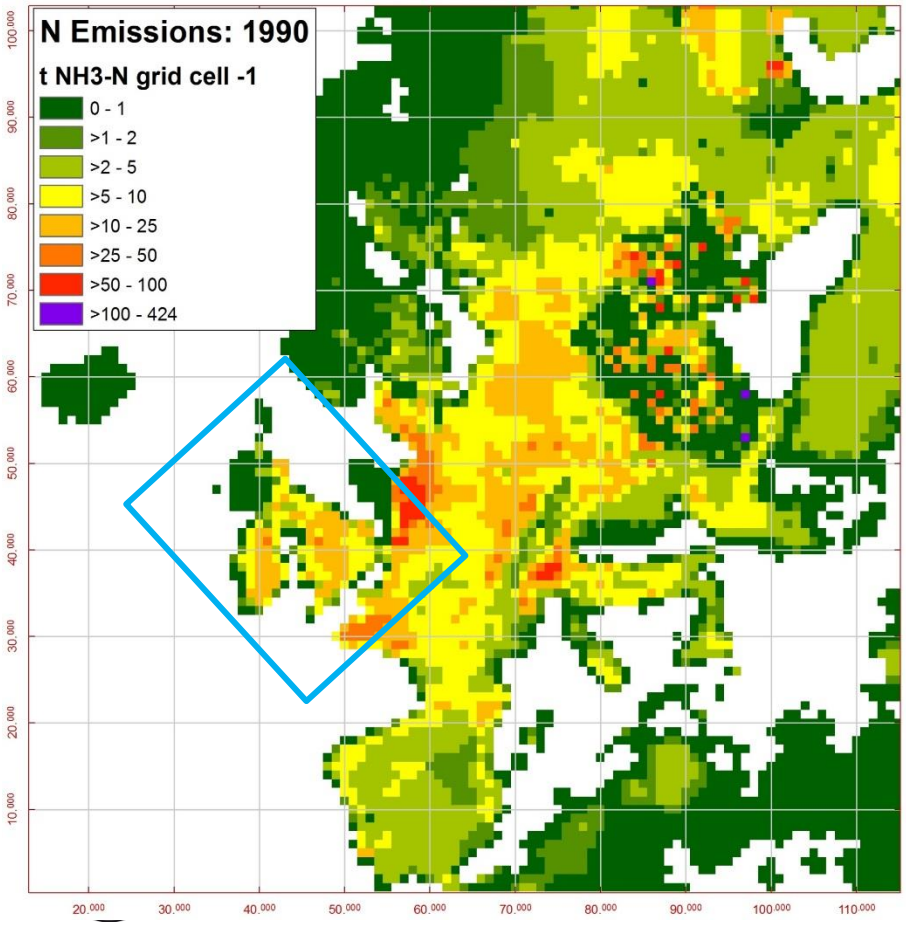
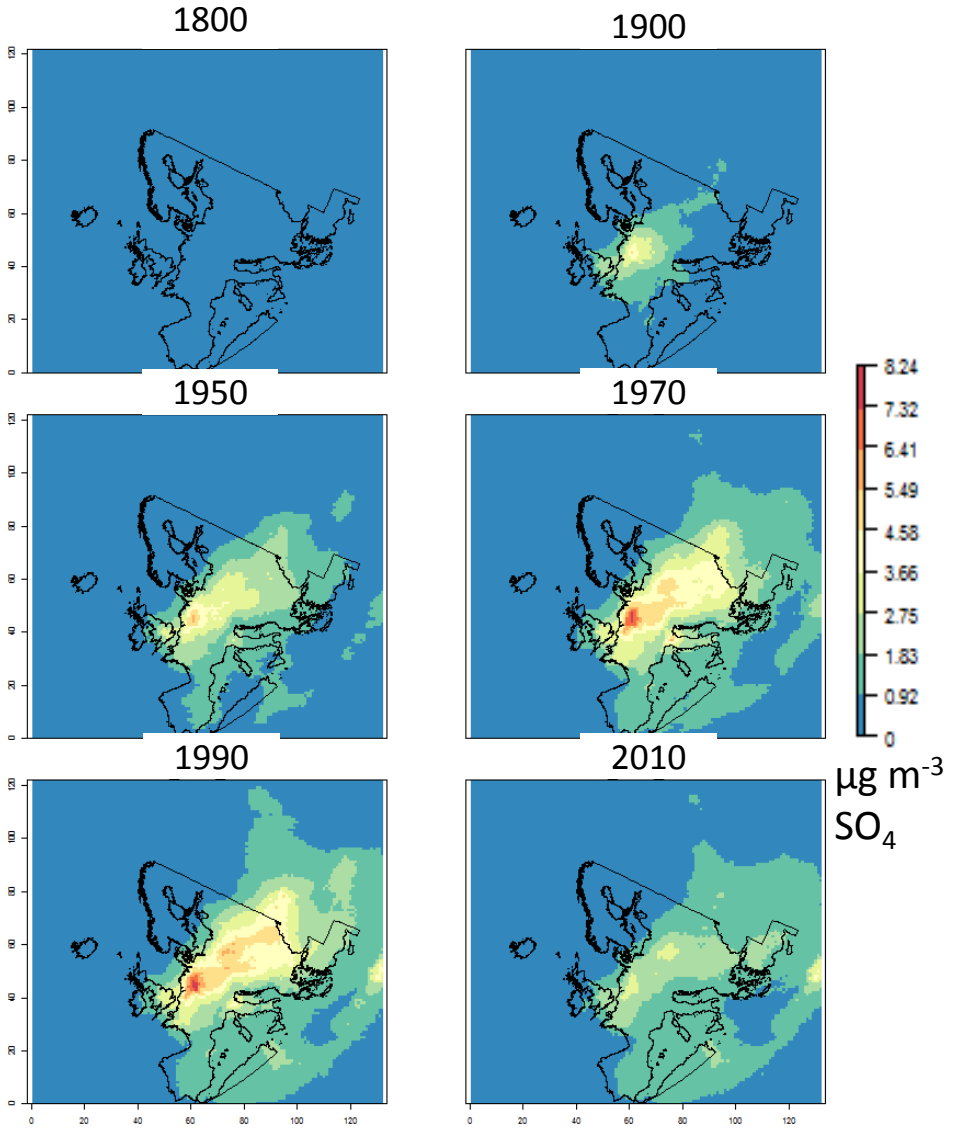
European background & deposition modelling

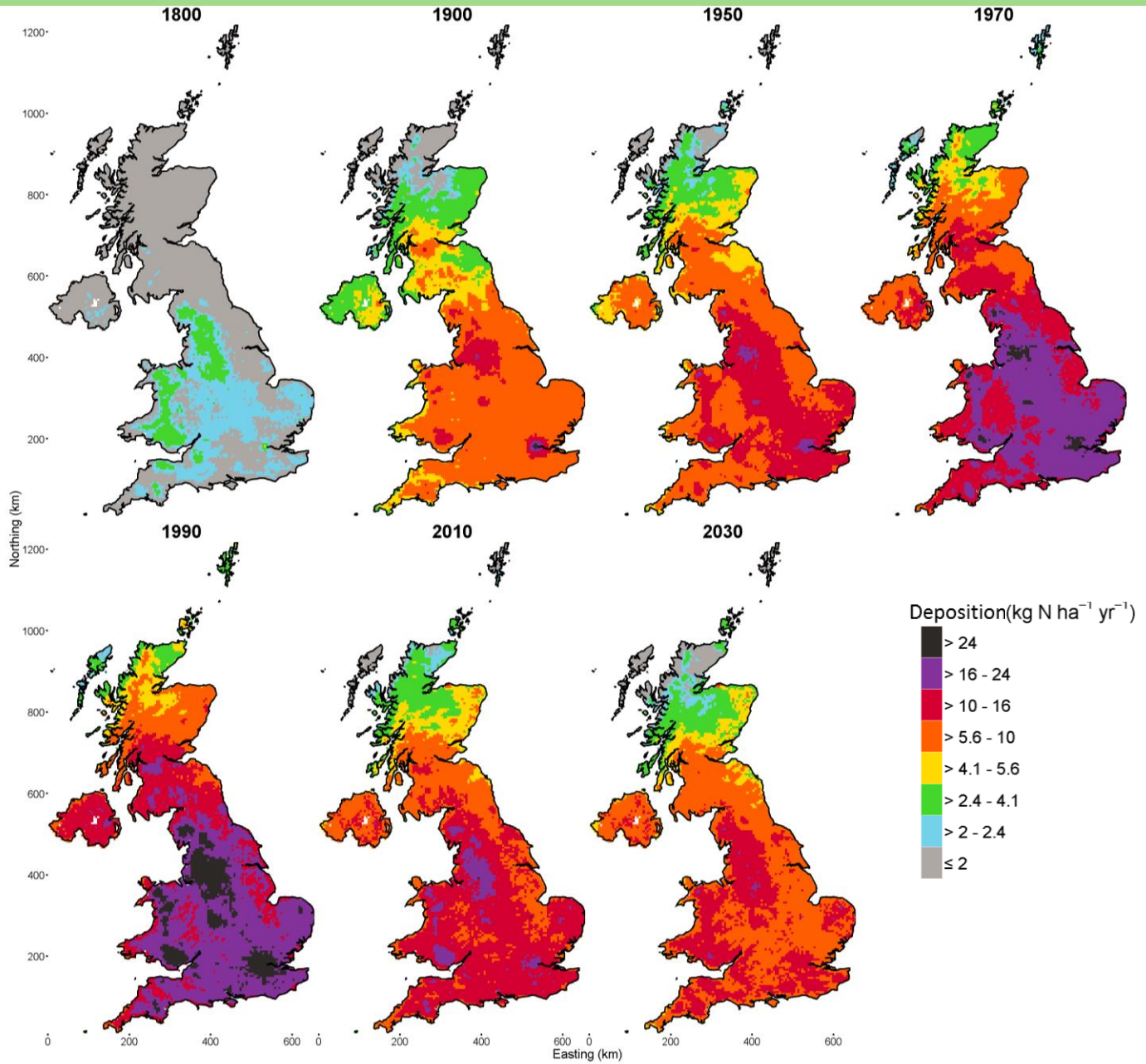
Fine Resolution Atmospheric Multi-pollutant Exchange (FRAME) model

Creating boundary conditions for a 5km FRAME-UK simulation





Total nitrogen deposition 1800-2030



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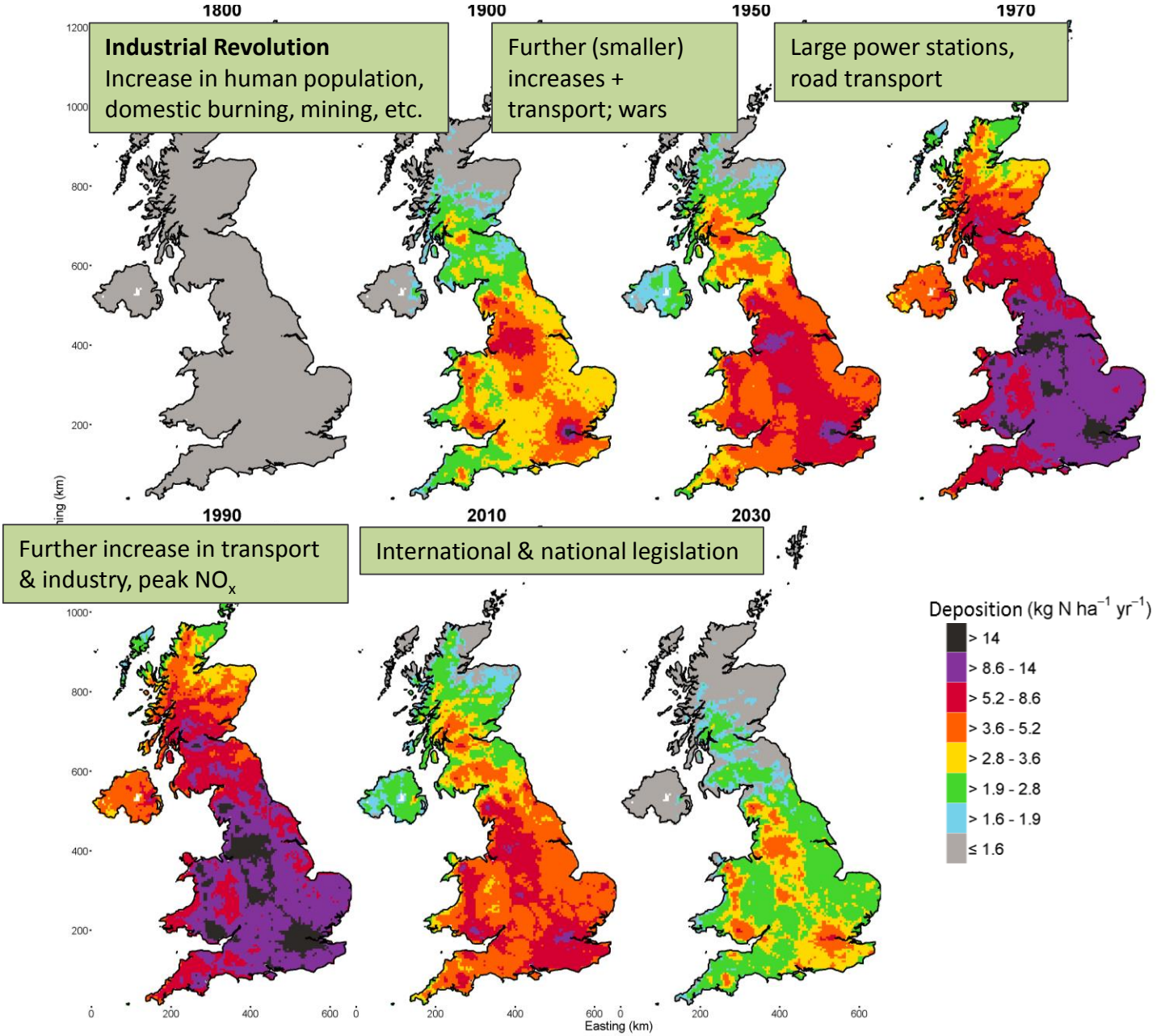
Grid square average deposition

Oxidised N deposition 1800-2030



Main sources:

- Combustion
- Motorised transport
- Industry

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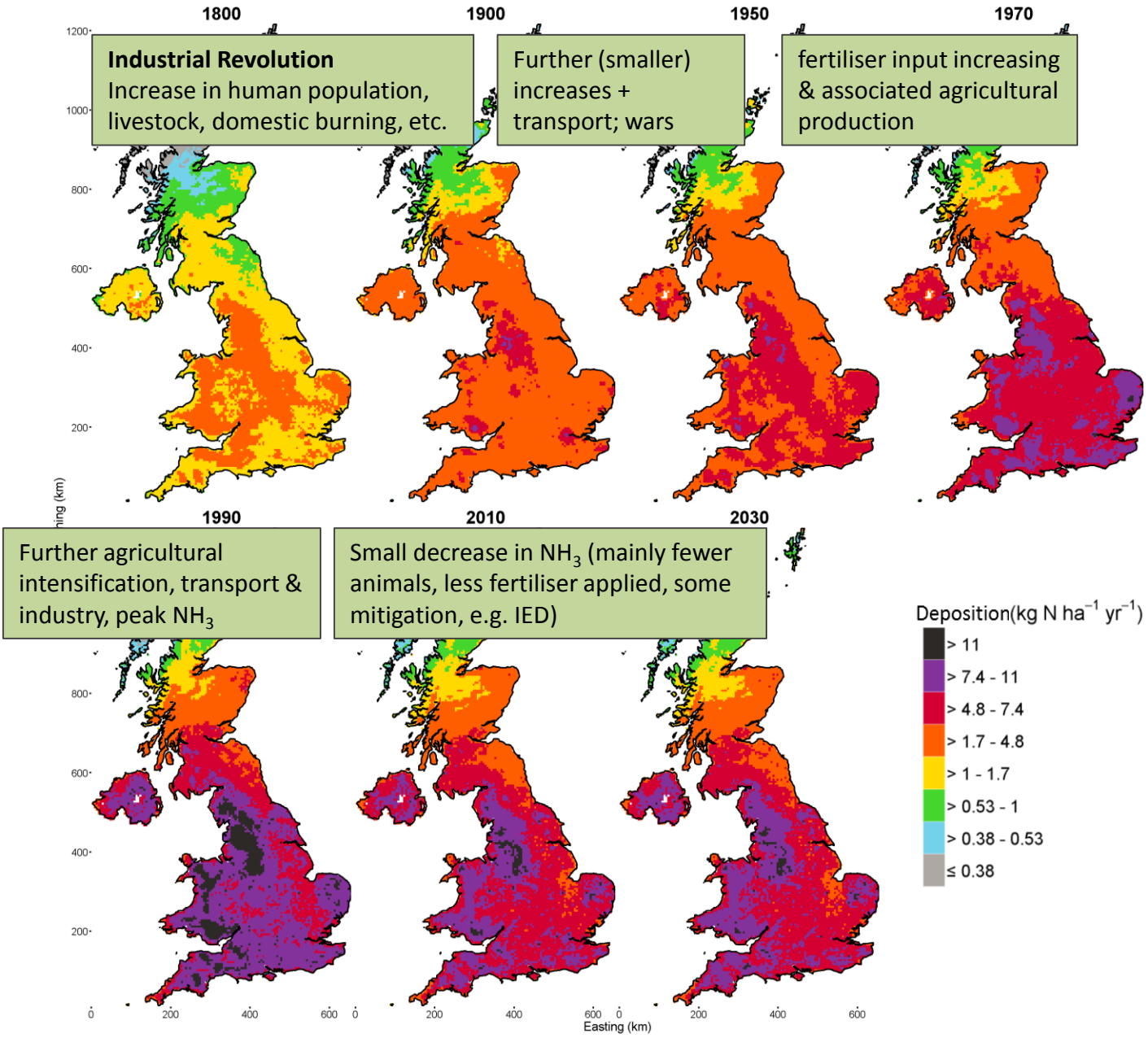
Grid square average deposition

Reduced N deposition 1800-2030



Main source:
Agriculture
(livestock & fertilisers)

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Grid square average deposition

Habitat-specific N deposition 1800-2030

You'll have to wait until this afternoon …

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Grid square average deposition

Components of N Deposition (1970)

Oxidised nitrogen

NO_y Wet Deposition

NO_y Dry Deposition

N Deposition
kg N ha^{-1} yr^{-1}

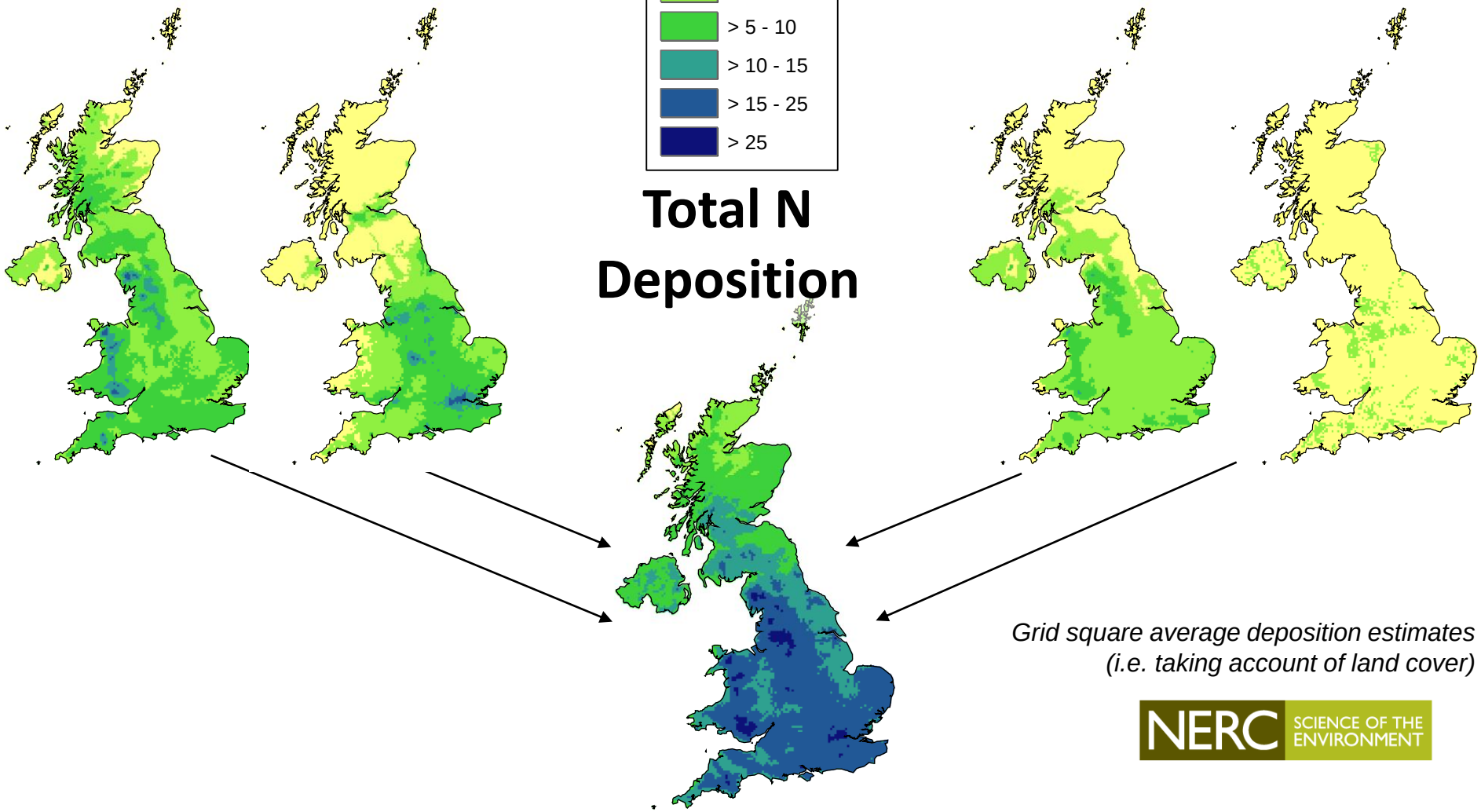
- ≤ 2.5
- > 2.5 - 5
- > 5 - 10
- > 10 - 15
- > 15 - 25
- > 25

Reduced nitrogen

NH_x Wet Deposition

NH_x Dry Deposition

Total N Deposition



Grid square average deposition estimates (i.e. taking account of land cover)

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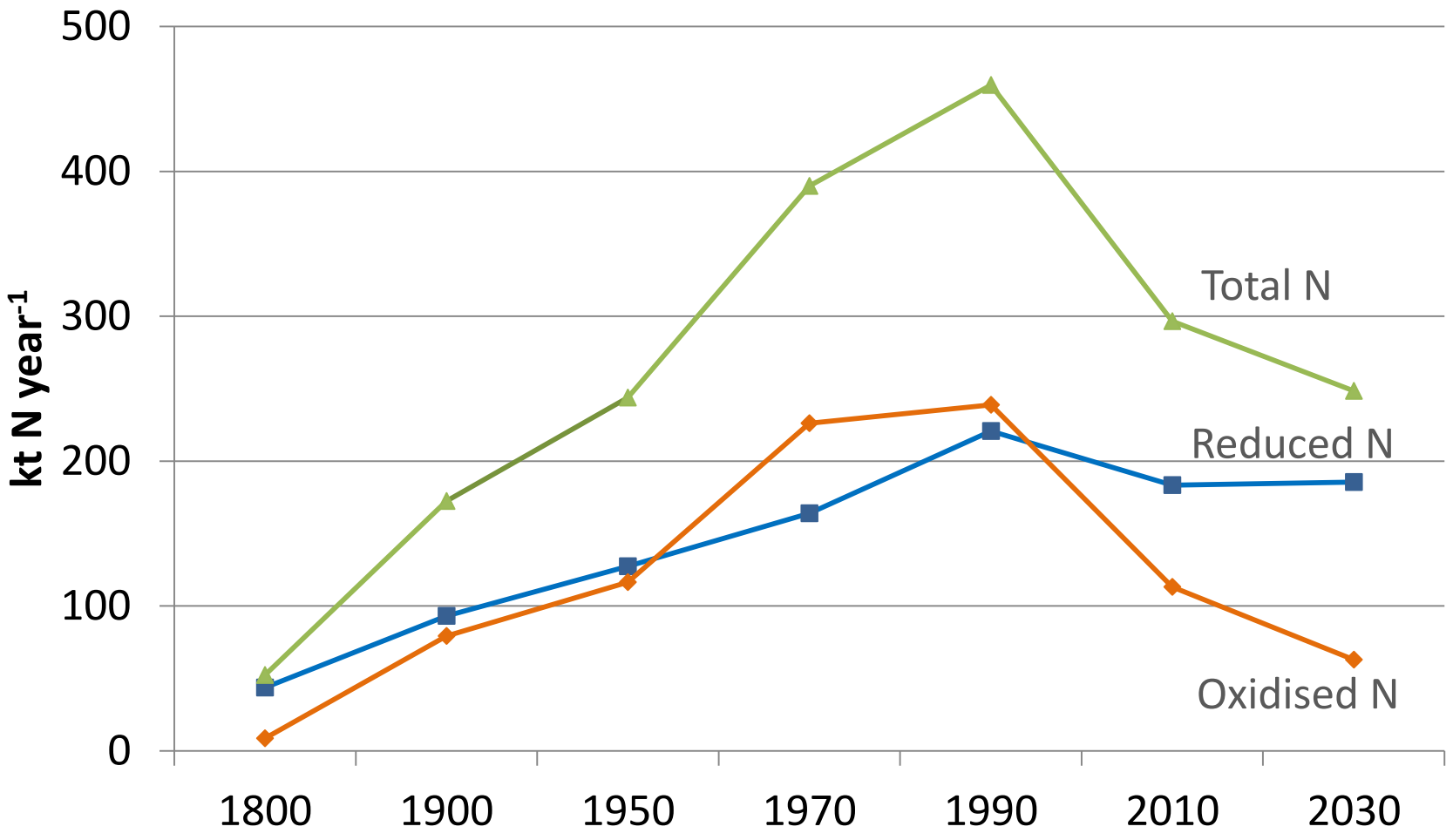
Temporal trends in N deposition 1800-2030



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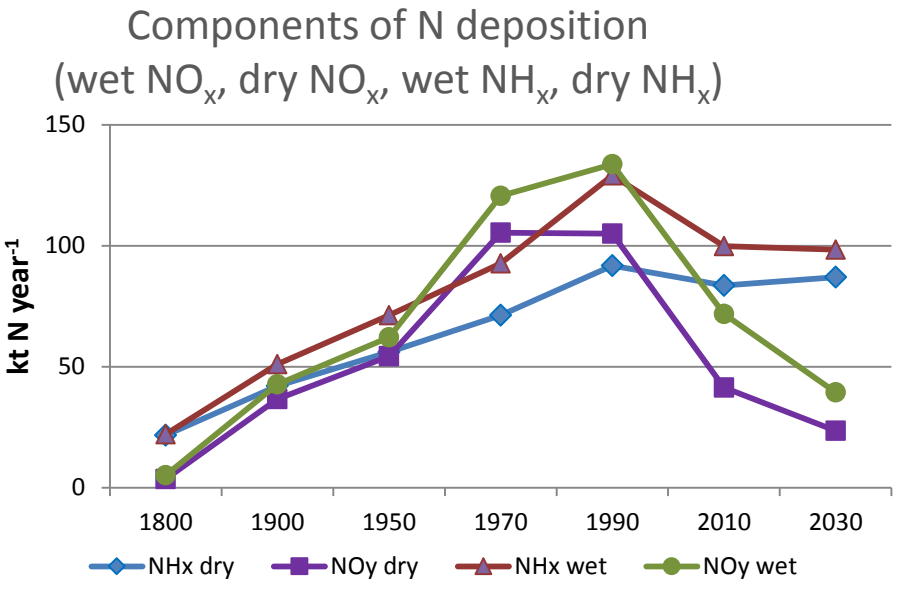
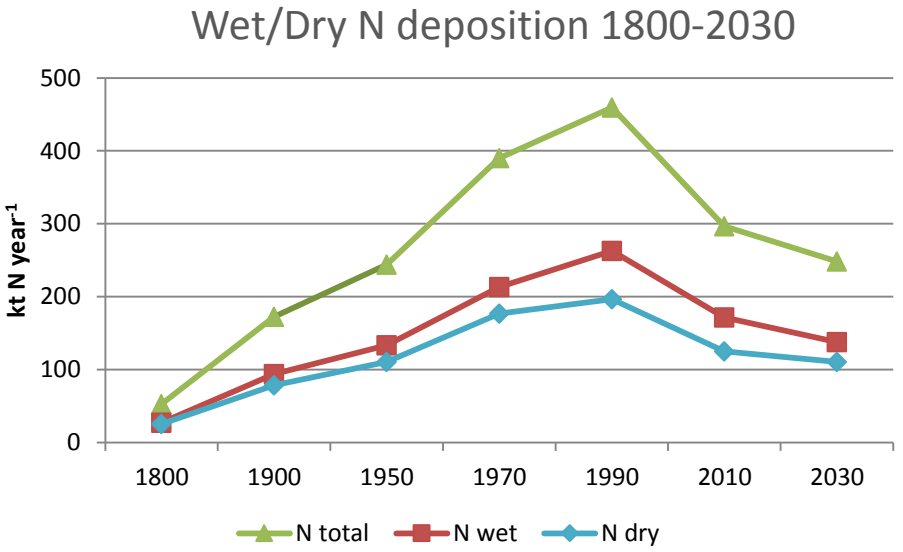
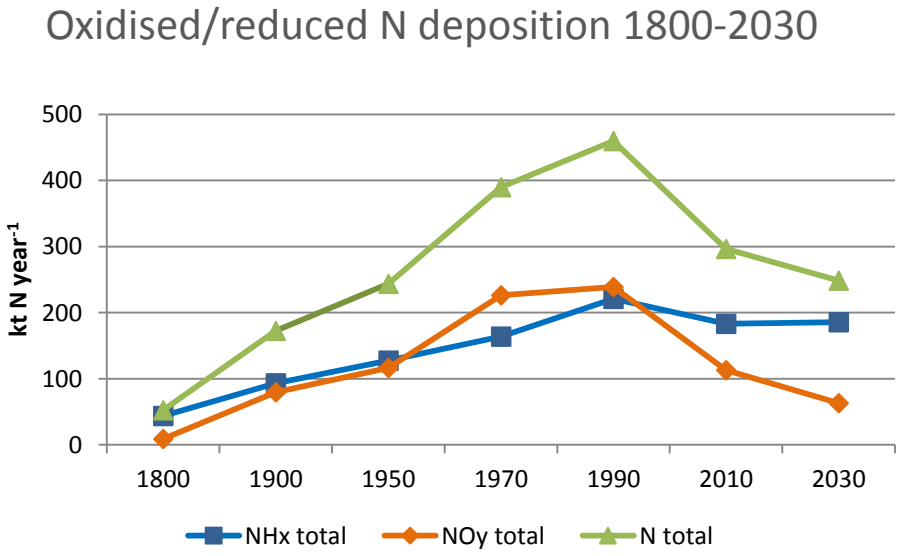
Analysis of N deposition components







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Sulphur deposition maps 1800-2030

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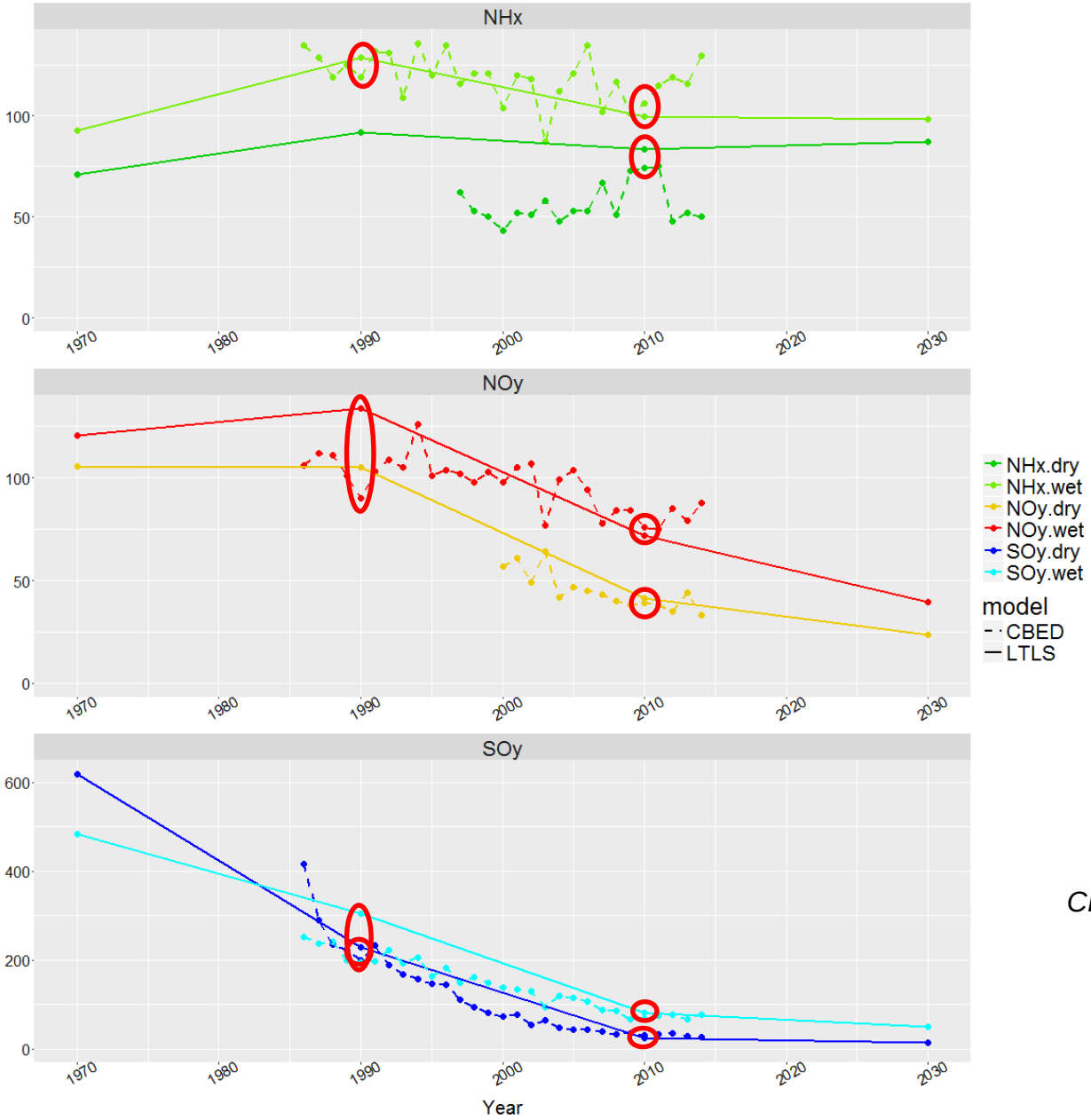
Grid square average deposition

Comparison with measurement-based data



CBED model, R. Smith et al., CEH Edinburgh

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Conclusions

- **N & S deposition** increased hugely during 19/20th centuries
- **S deposition** – emission reductions a big policy success!
- Recent considerable decreases (since ~1990) in total N deposition mainly due to **NO_x emission reductions** following international legislation (e.g. combustion plants, catalytic converters). Partial success story, in progress.
- **Reduced N (ammonia)** now largest source of N deposition, largely unchanged & predicted to remain stable
- Changing spatial patterns and composition of N deposition

Further work

Deposition & concentration data will enable a wealth of assessments of cumulative atmospheric N and S inputs and their impacts, on habitats and species as well as on human health.

Next steps:

- Continue analysis and interpretation
- Initial peer-review publications (in prep)
- Further collaborations on request
- Publication of datasets (2-yr grace period to Dec-2017)

Acknowledgements

Online datasets:

Vision of Britain, Edina Agricultural Census, Defra UK National Atmospheric Emissions Inventory

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Maciej Kryza (University of Wroclaw)