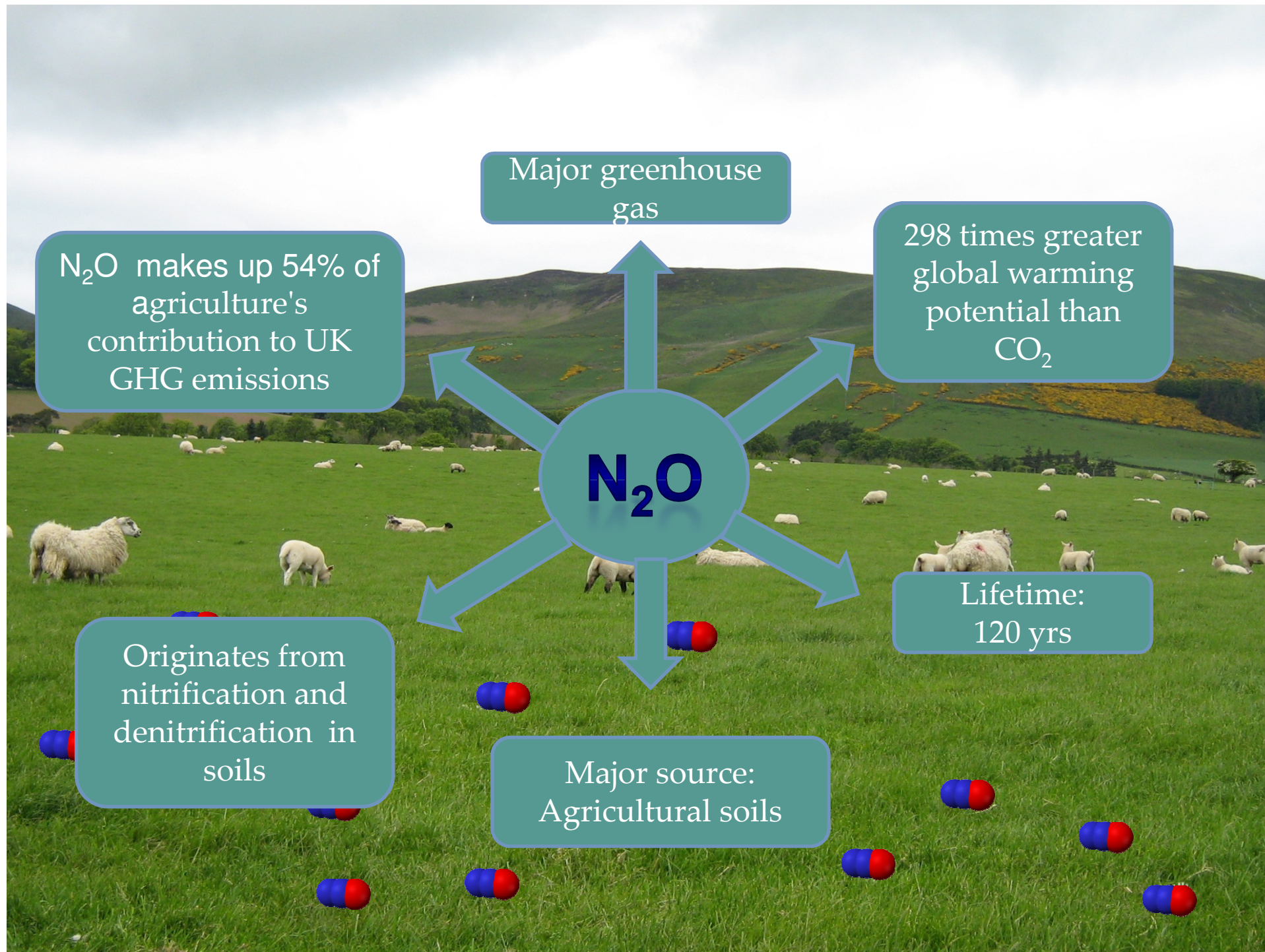


Measurement and modelling of greenhouse gas emissions in agricultural systems

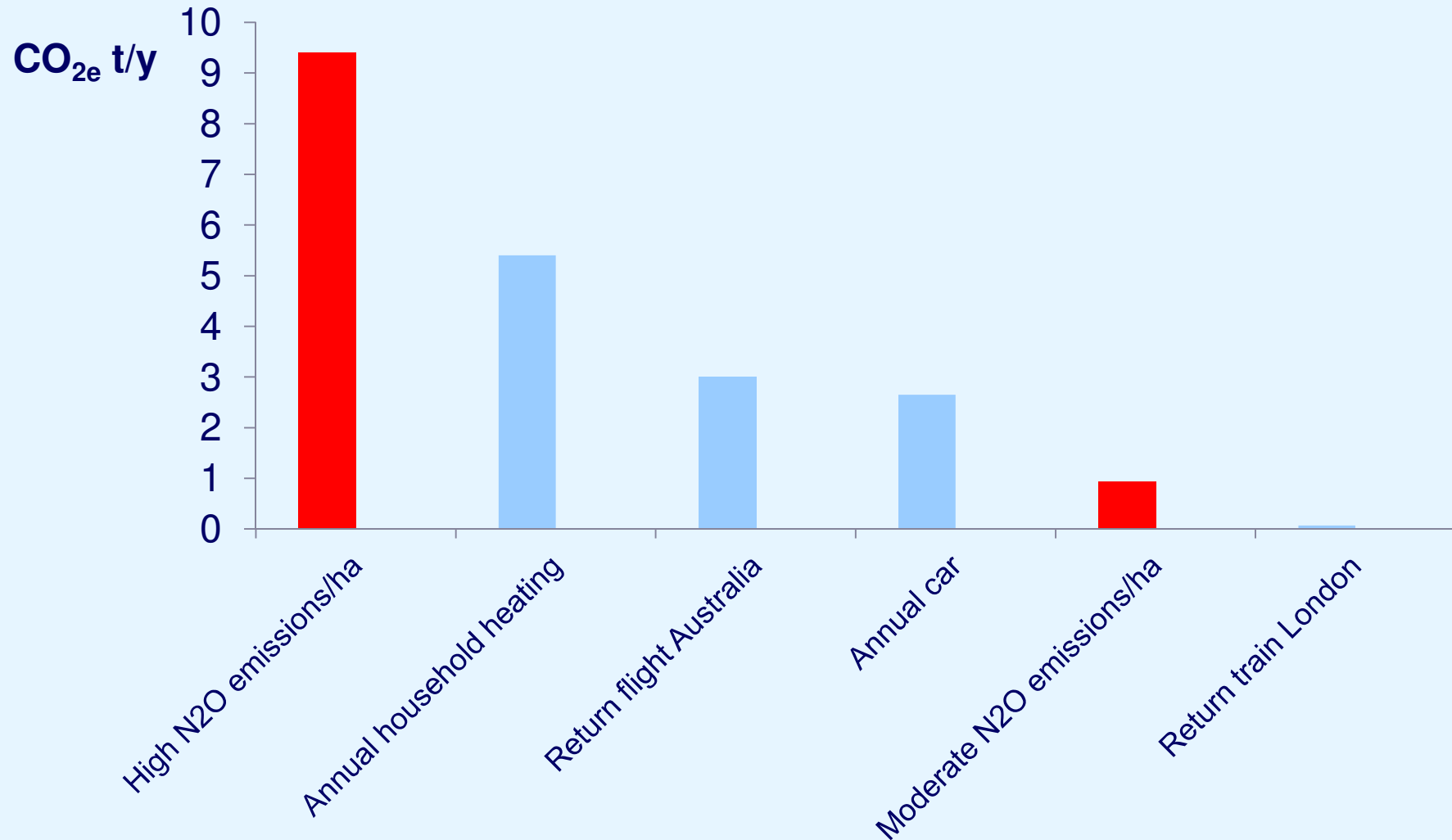
Bob Rees, Bruce Ball, Kairsty Topp,
Paul Hallett and Valentini Pappa

What are Scotland's nitrous oxide emissions?

How can they be reduced?



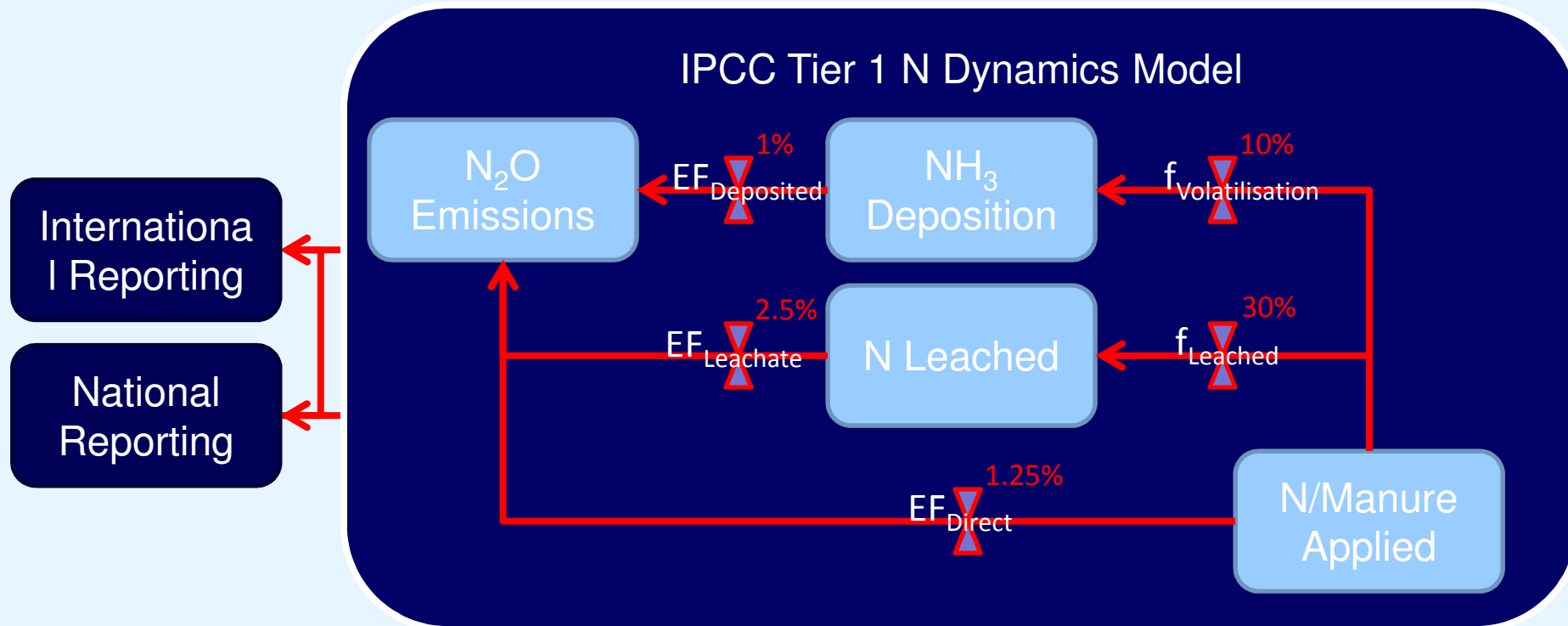
Comparing greenhouse gas emissions



Inventory reporting



The current inventory structure is 'bottom up'. Data from national surveys are multiplied by default IPCC emission factors based on international literature review



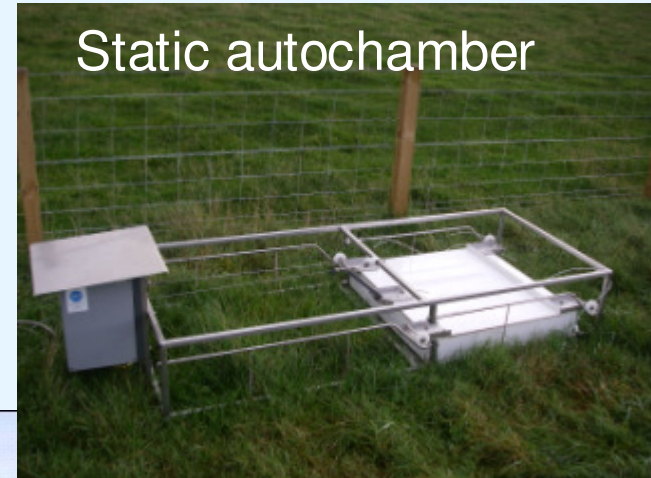
N₂O flux measurements



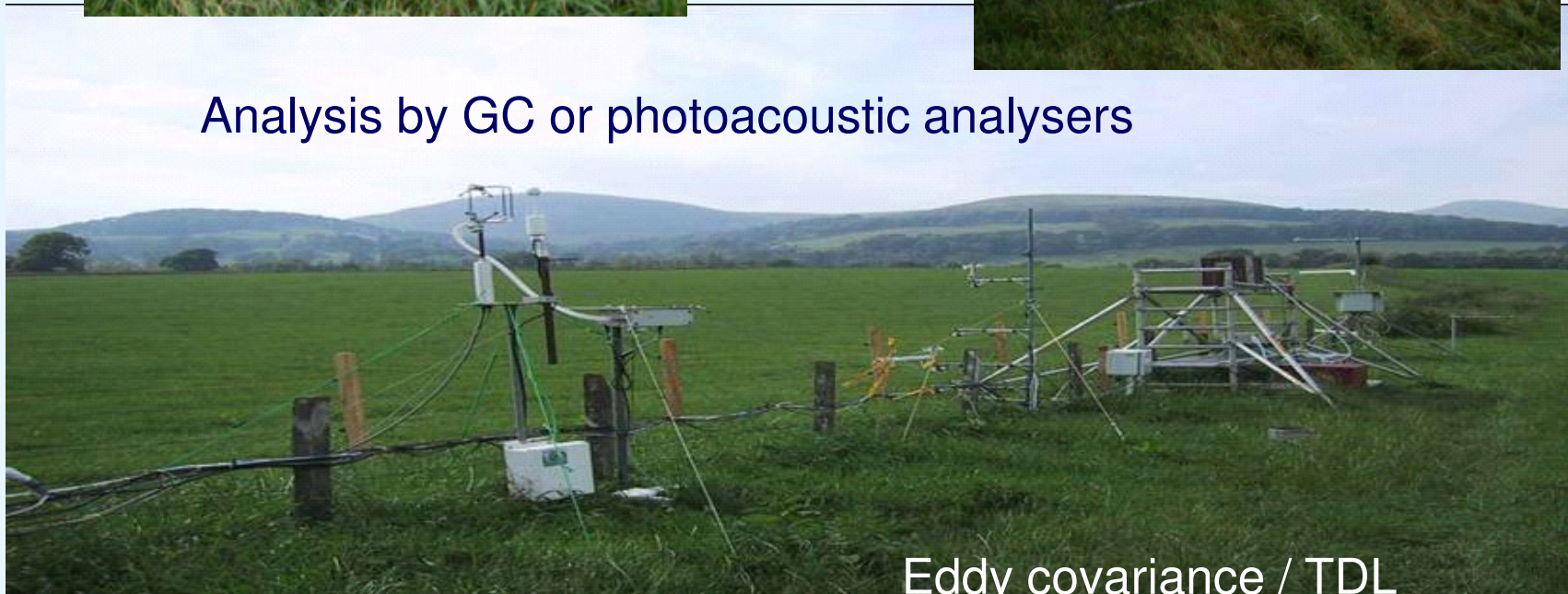
Static manual chamber



Static autochamber

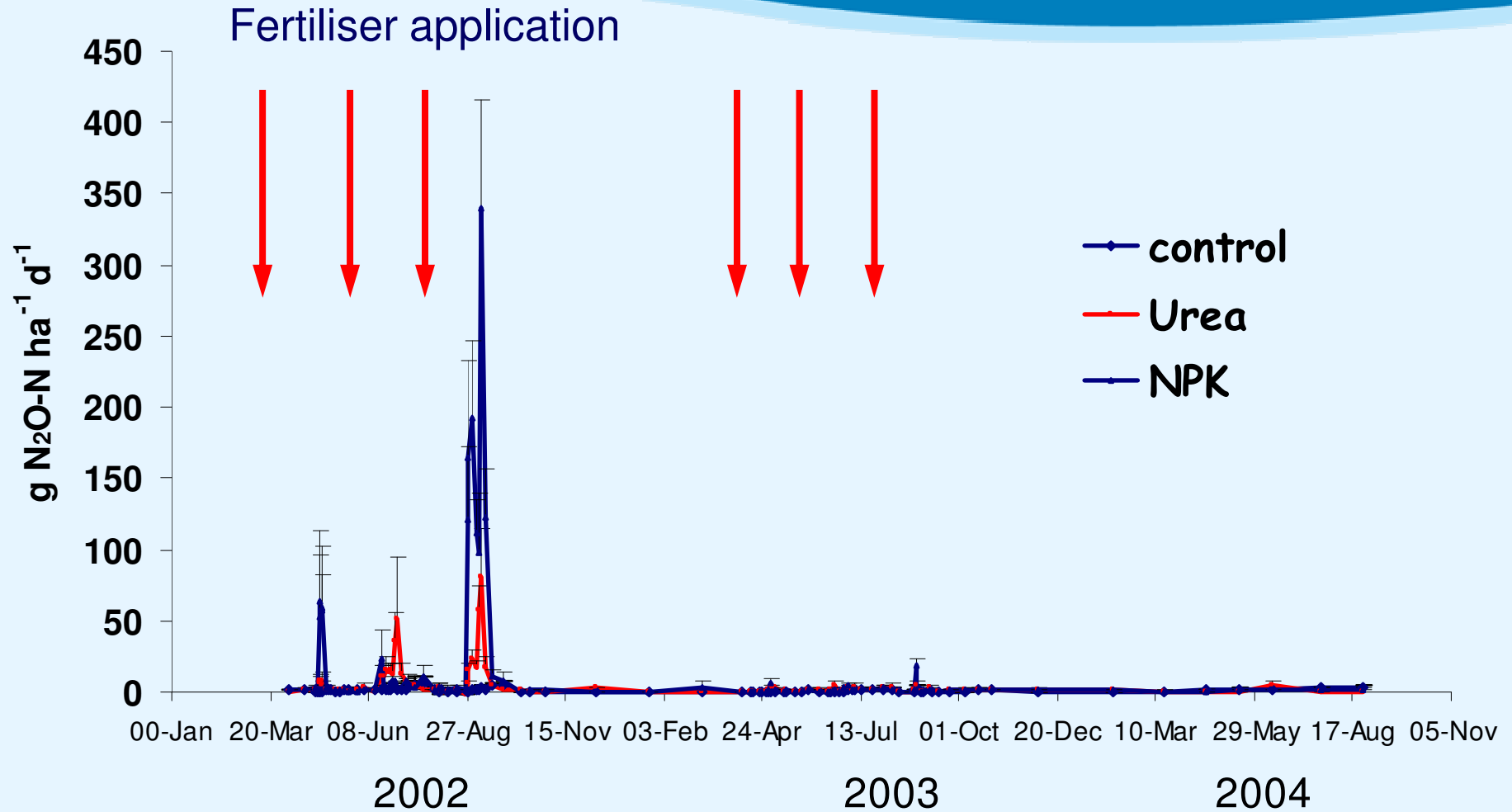


Analysis by GC or photoacoustic analysers

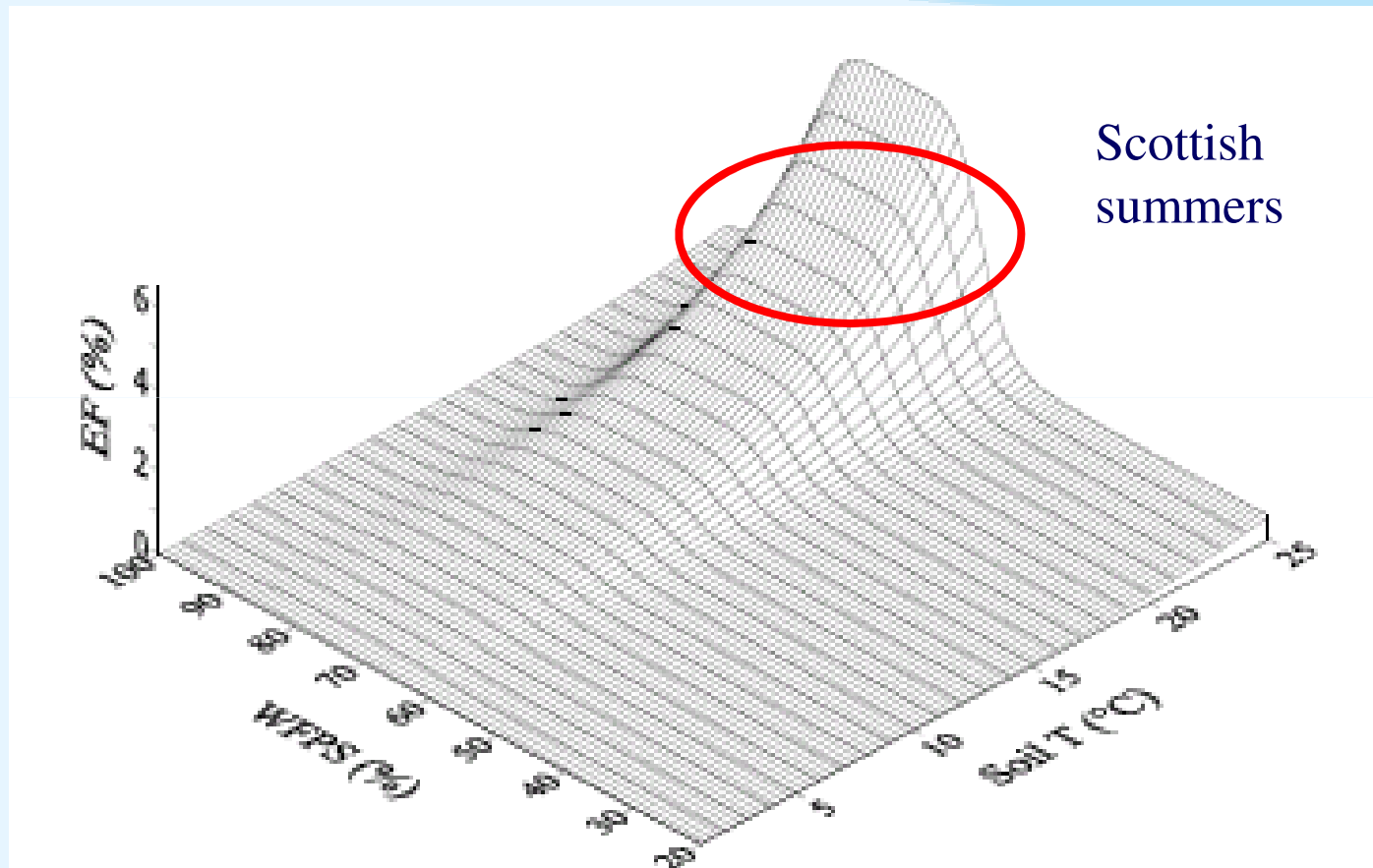


Eddy covariance / TDL

Fertilised grasslands



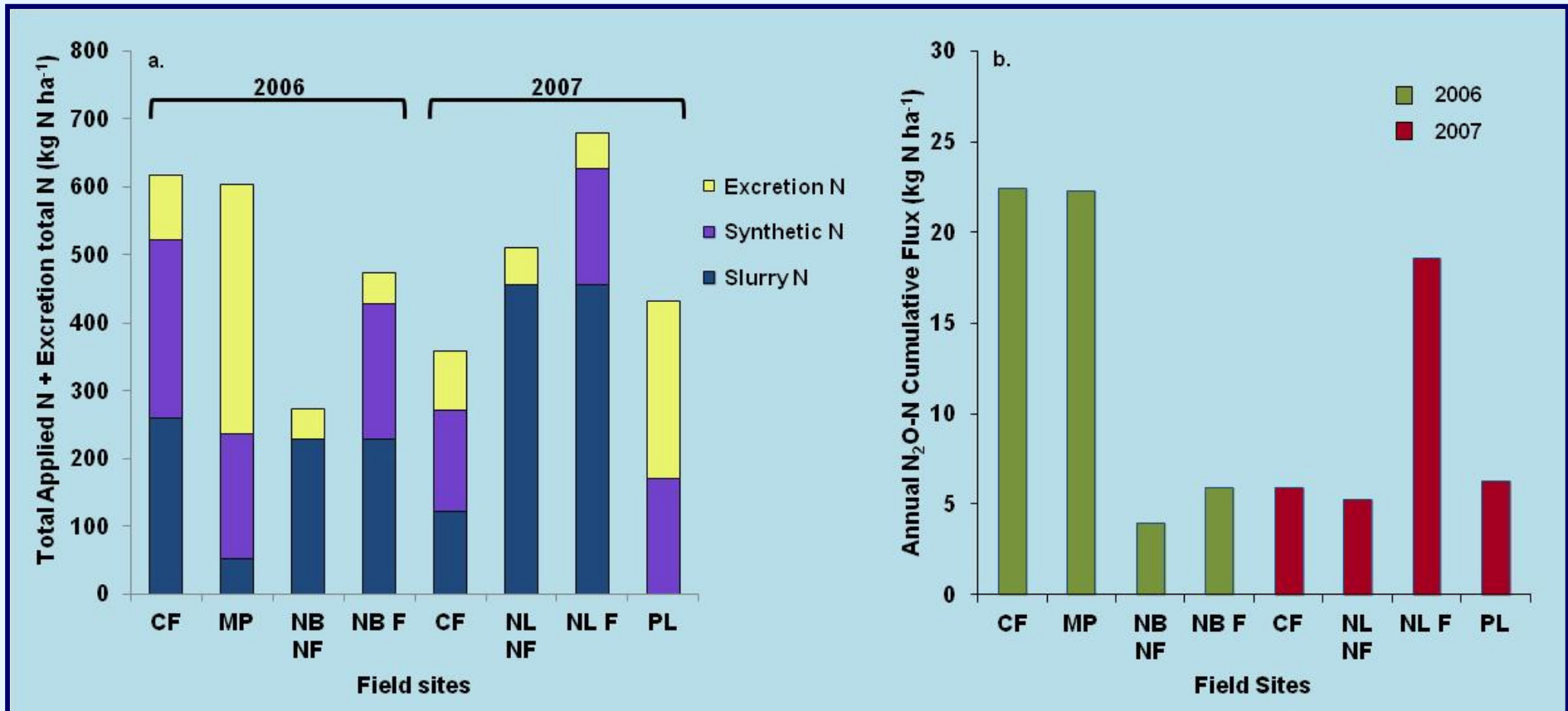
Controls of nitrous oxide emissions



Flechard et al, Agriculture, Ecosystems and Environment 121 (2007) 135–152

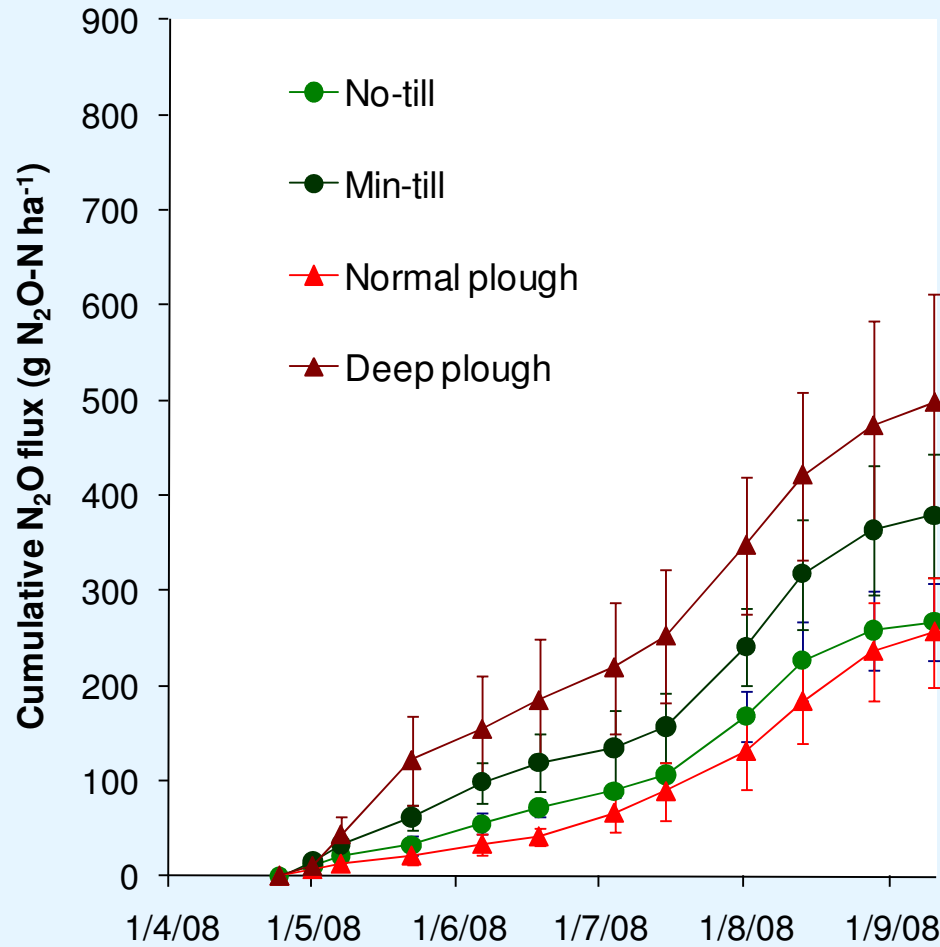
- Nitrogen input
 - Form/rate
 - Timing
 - Inhibitors
- Soil and water management
 - Tillage
 - Irrigation/drainage
- Crop rotation/agronomy
 - System changes

N inputs and cumulative fluxes

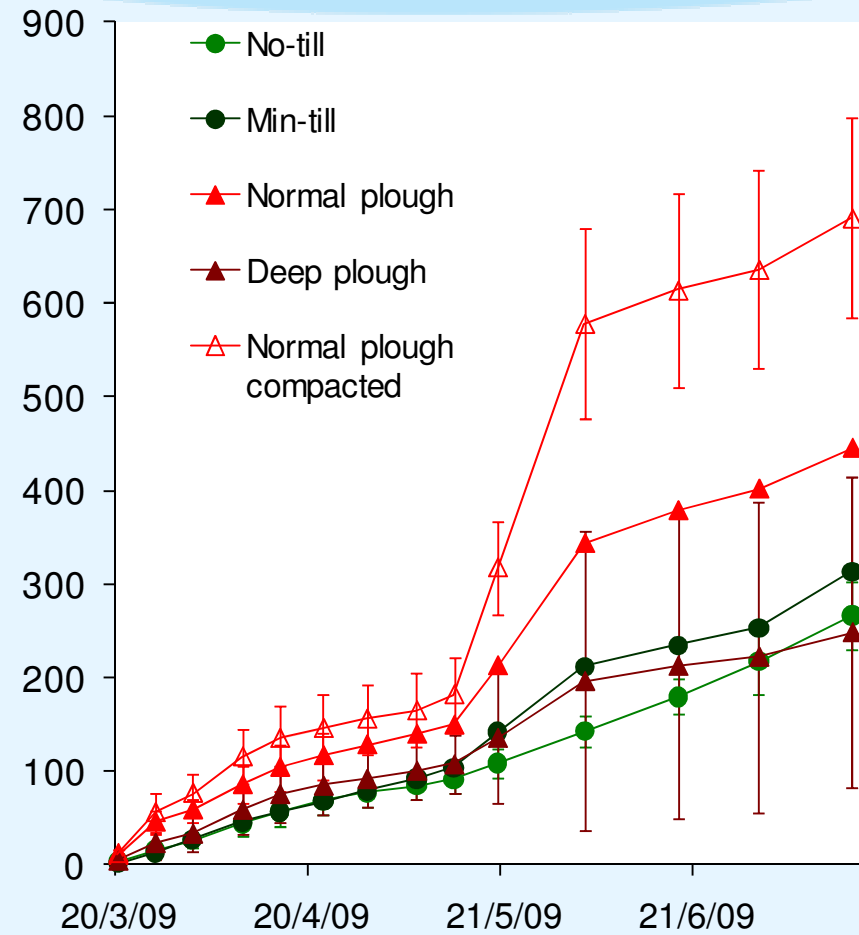


(a) Total applied N + excretion total N, and (b) annual cumulative N₂O fluxes for the sites for 2006-07.

Tillage under spring barley

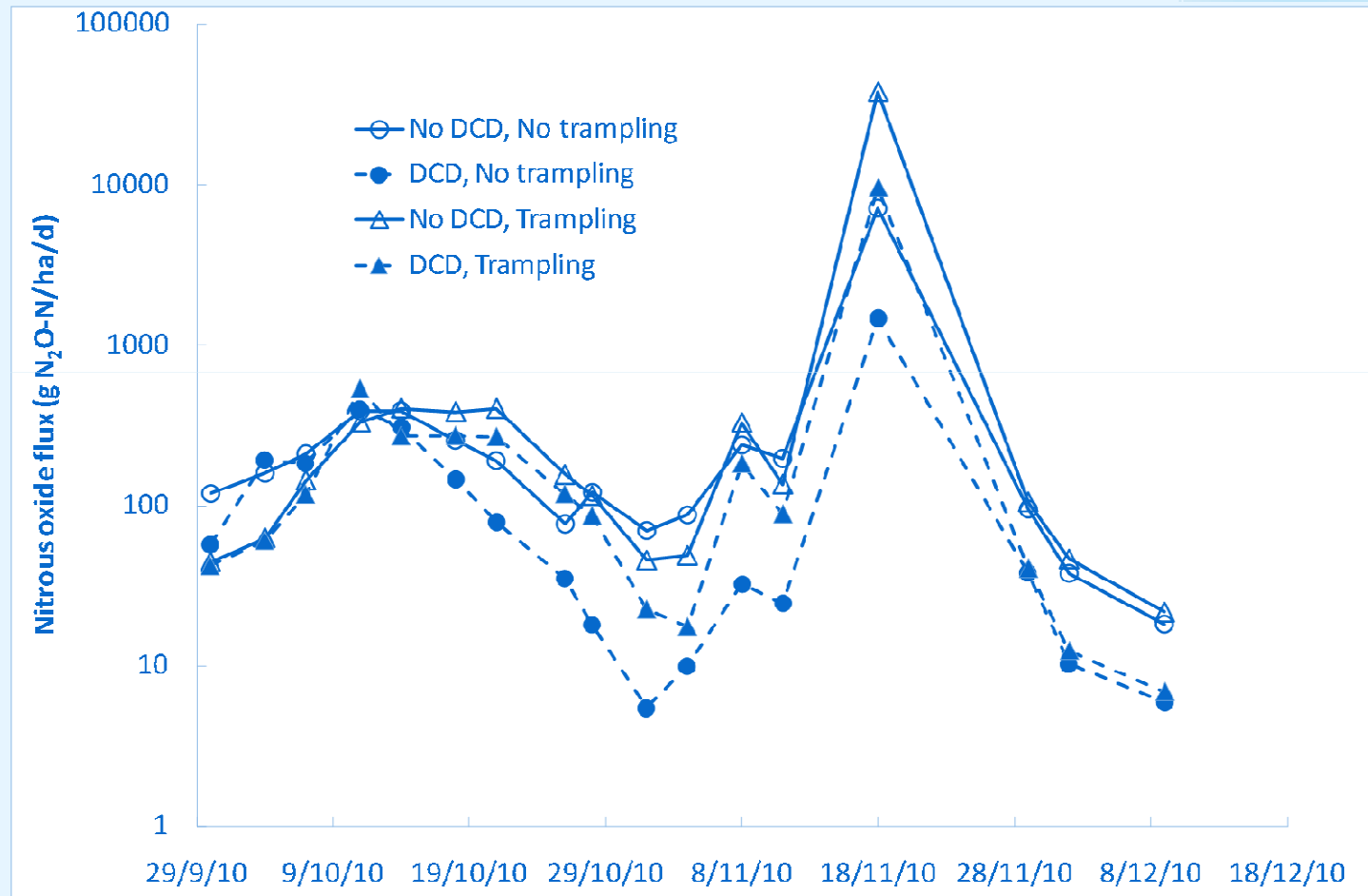


Rainfall: May-August 321 mm

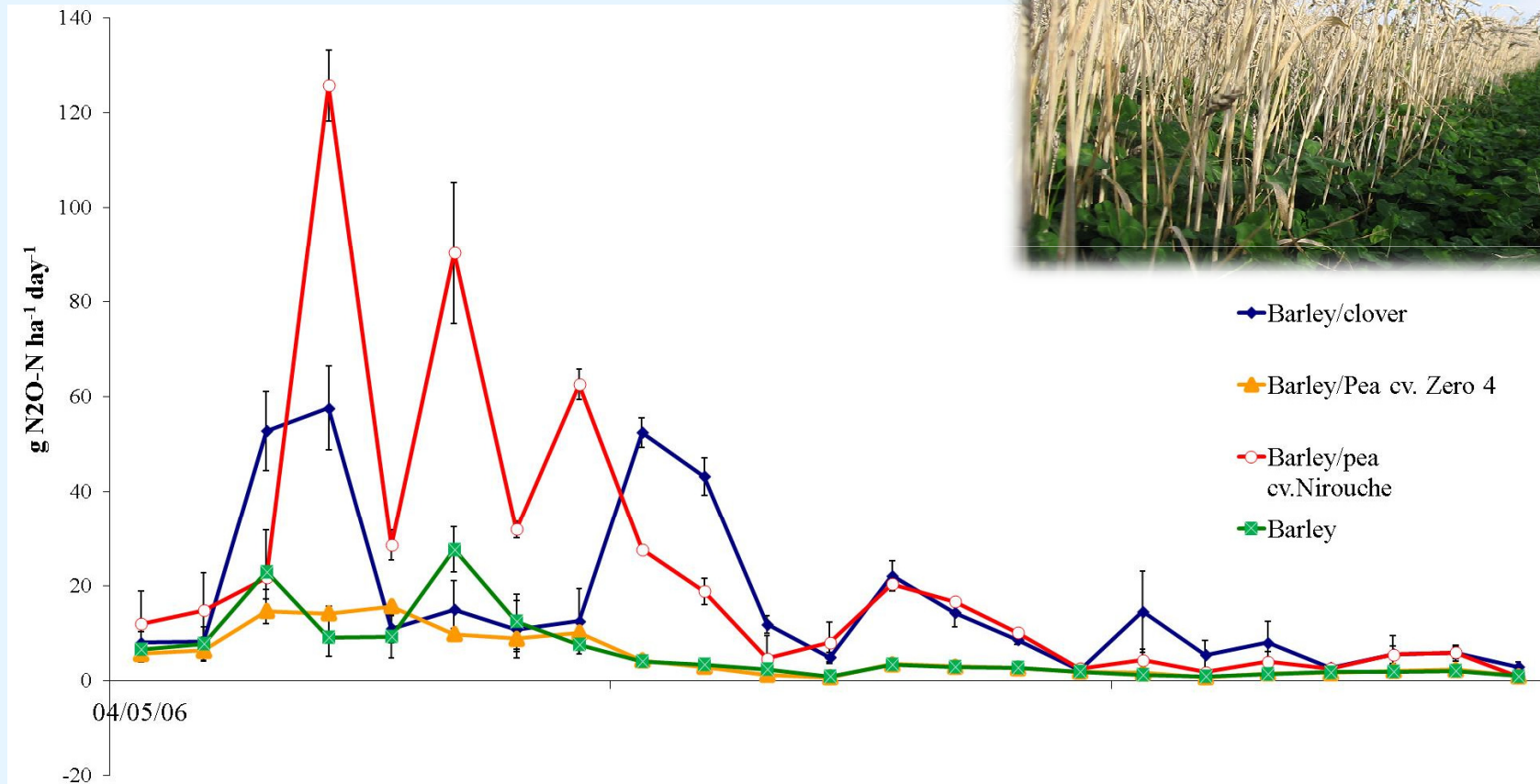


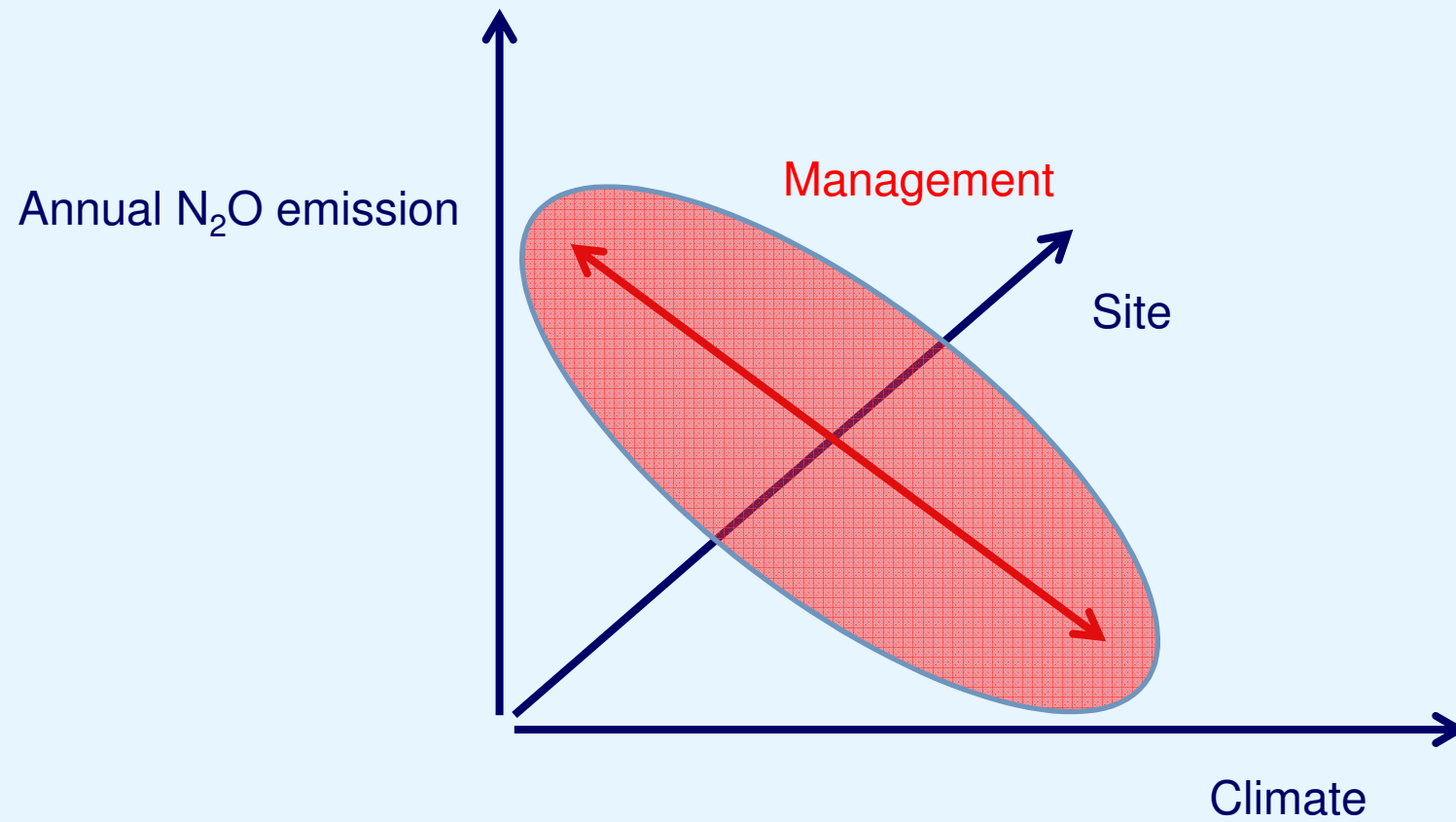
James Hutton Institute

Nitrous oxide emission and trampling and nitrification inhibitor



Nitrous oxide emissions from intercrops

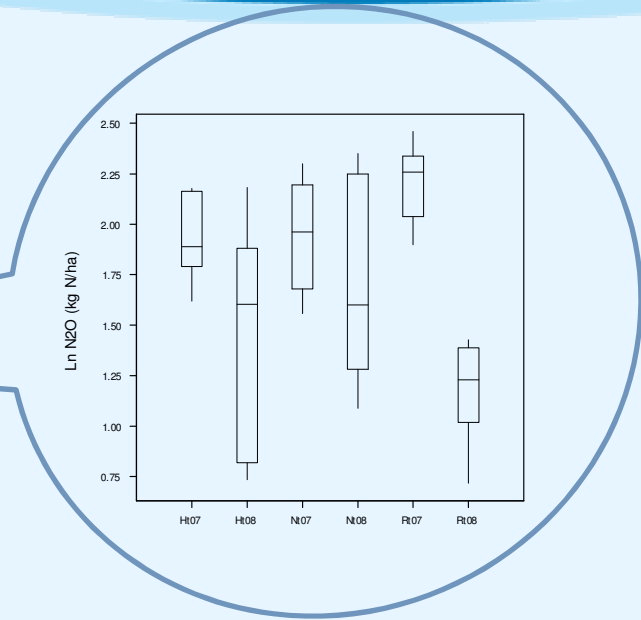
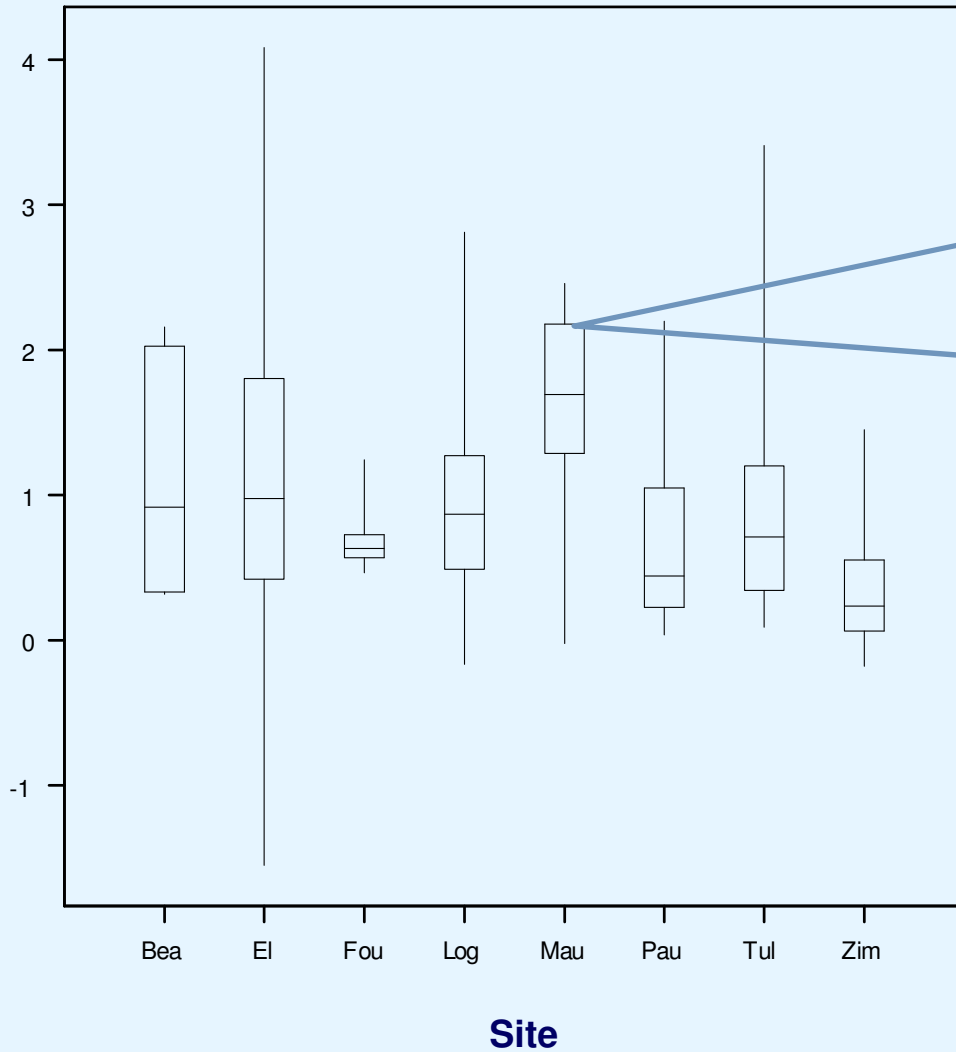




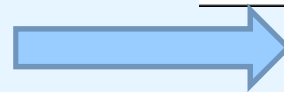
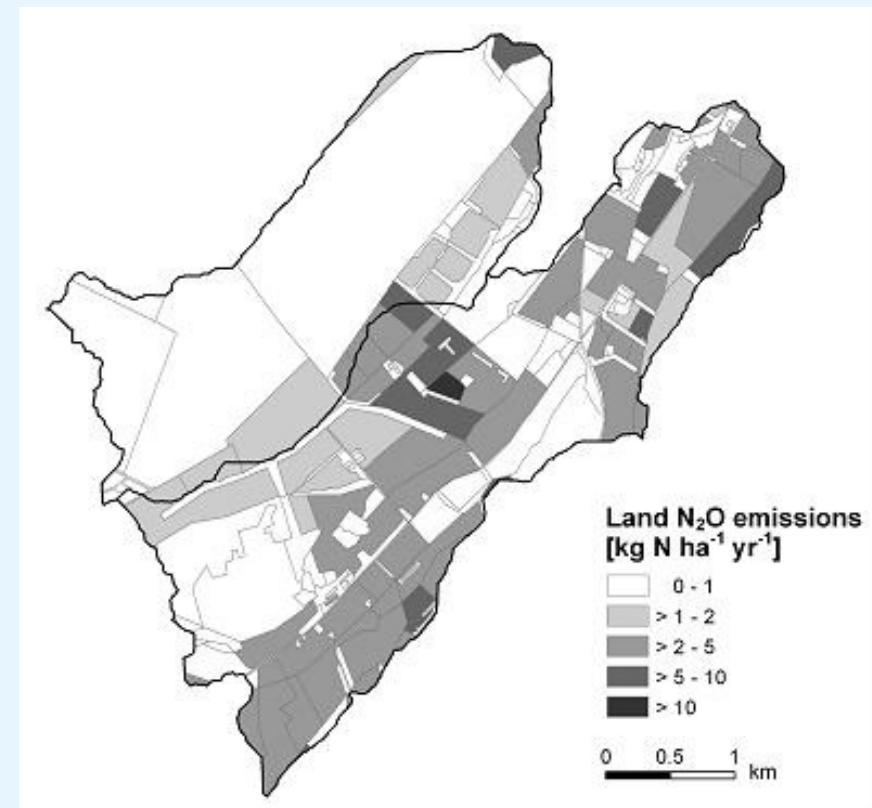
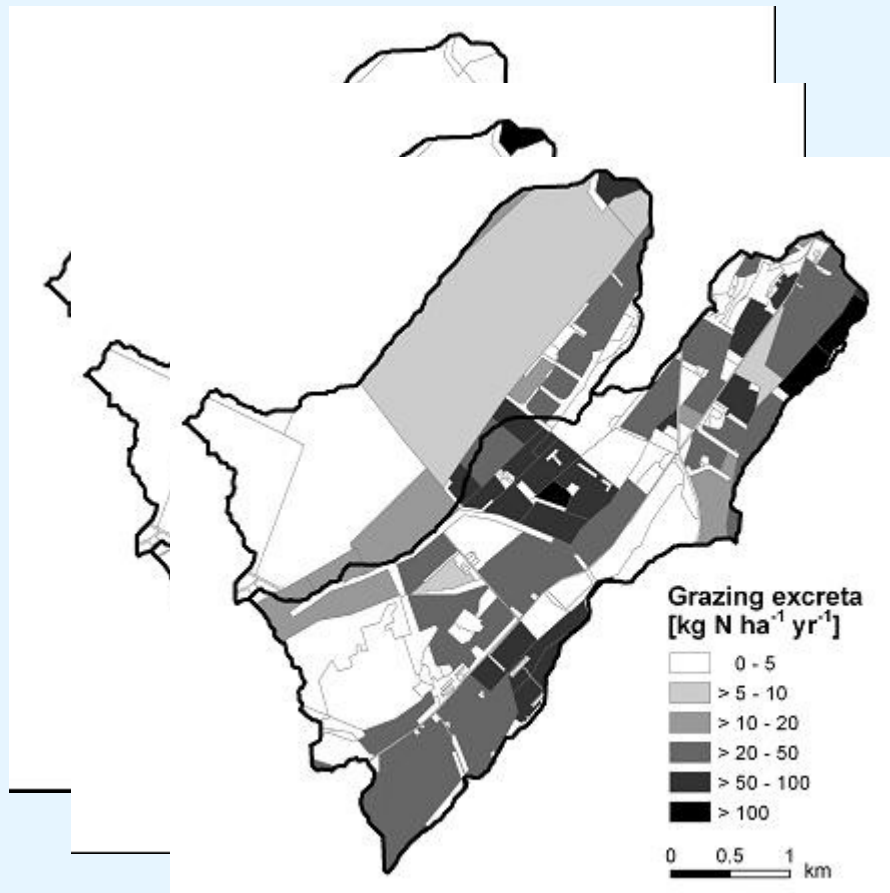
Variability in N₂O emissions between arable sites



Ln N₂O (kg N ha⁻¹ y⁻¹)



Understanding landscapes

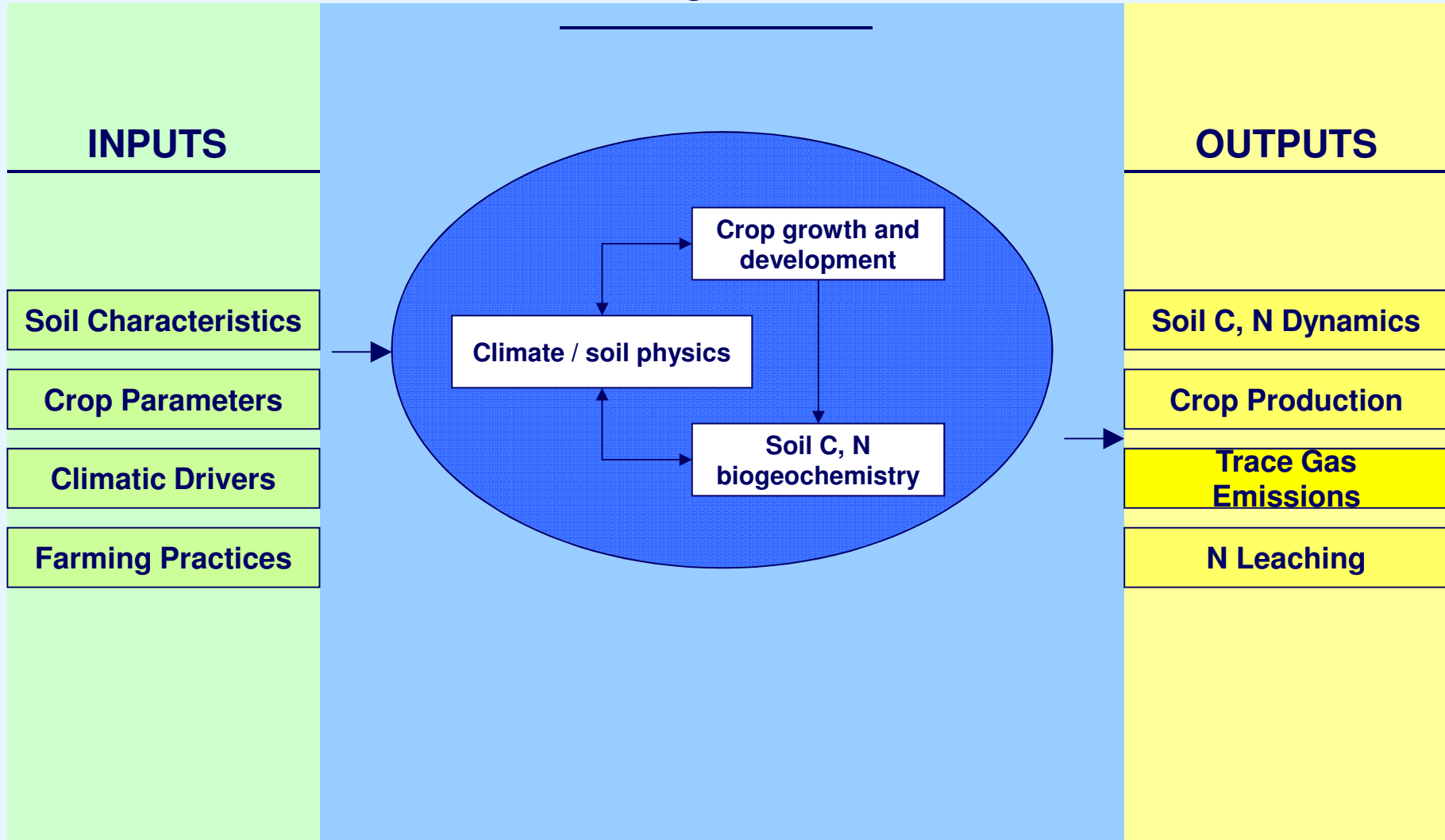


Mechanistic modelling:

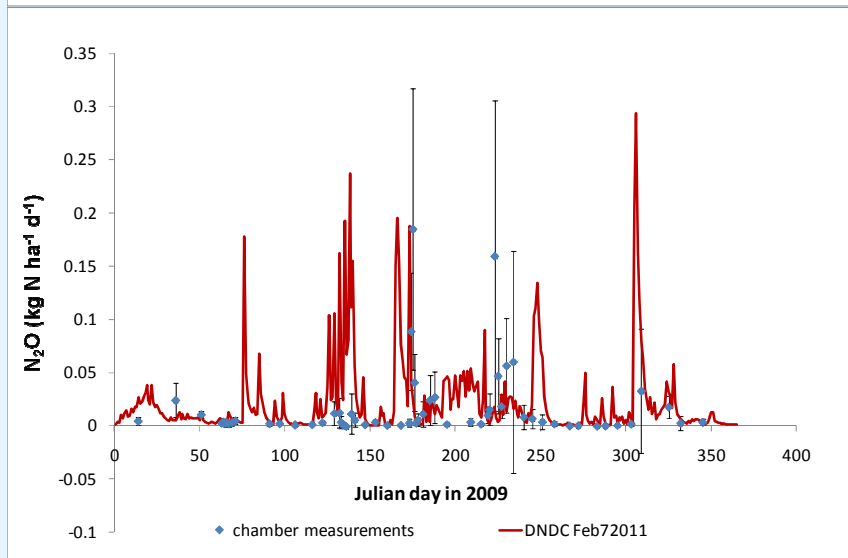
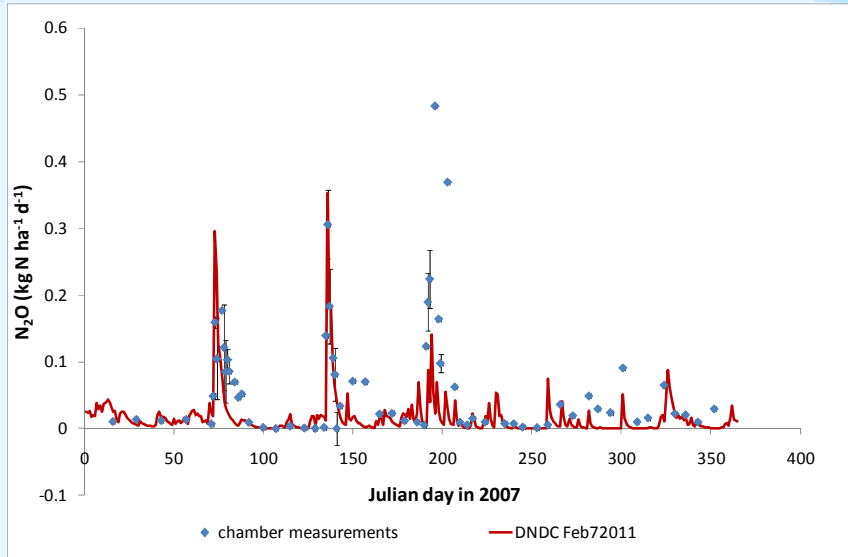
DNDC (DeNitrificationDeComposition)



MODEL



DNDC Modelling N₂O fluxes



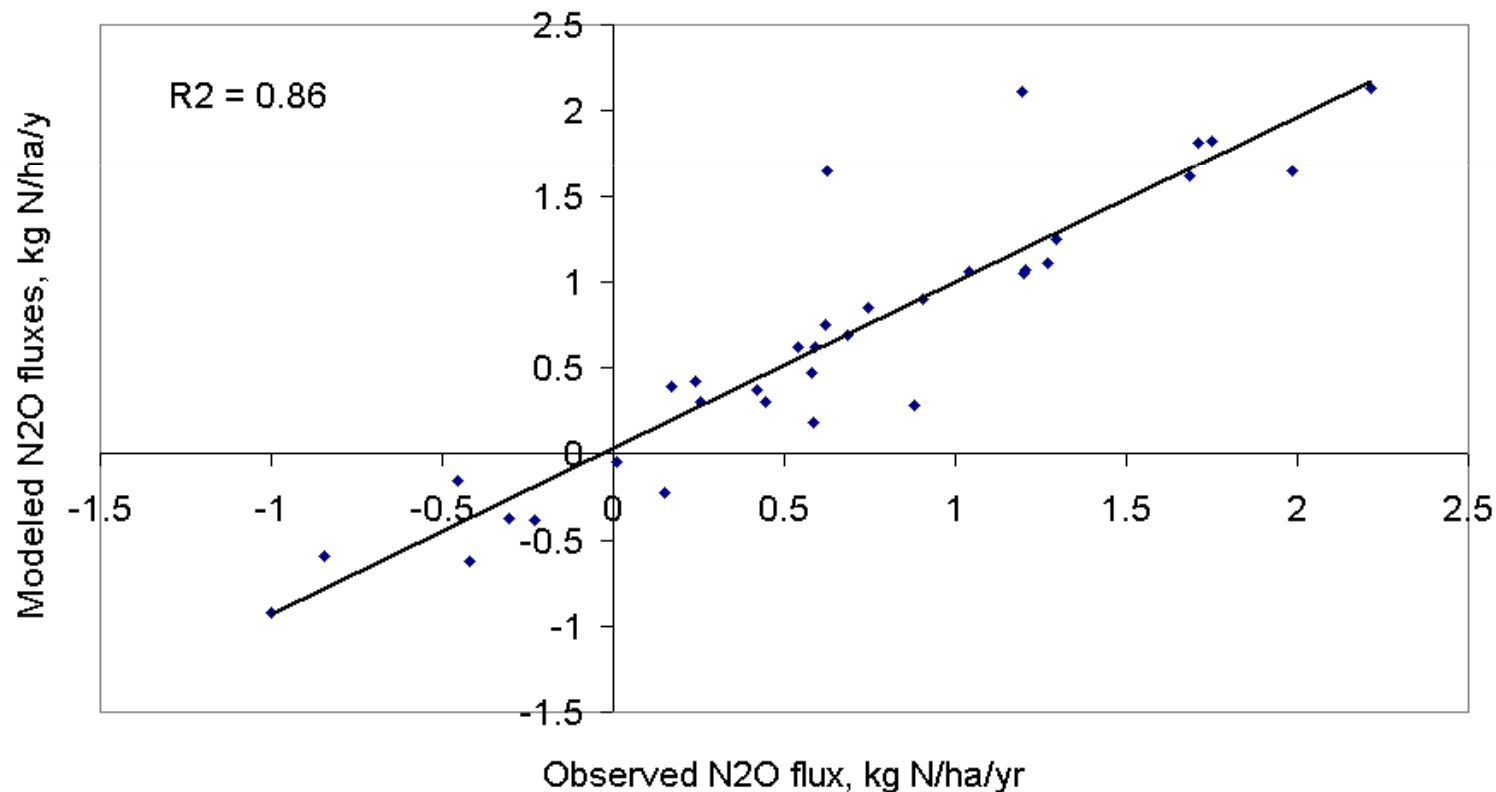
Field data is essential for model development and validation

K. Topp (SAC), S. Jones (SAC/CEH)

Validation of DNDC estimated annual N₂O fluxes



Observed vs. DNDC-Modeled N₂O Fluxes
(Field data from the U.S., Canada, the U.K., Germany, China, Japan, Costa Rica, New Zealand, and Zimbabwe)



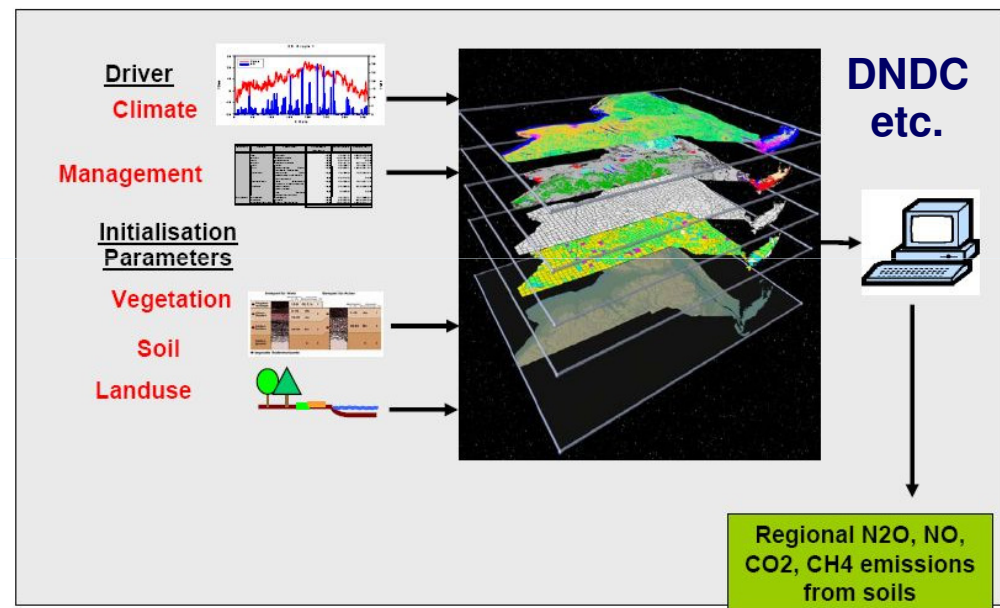
Regional modelling



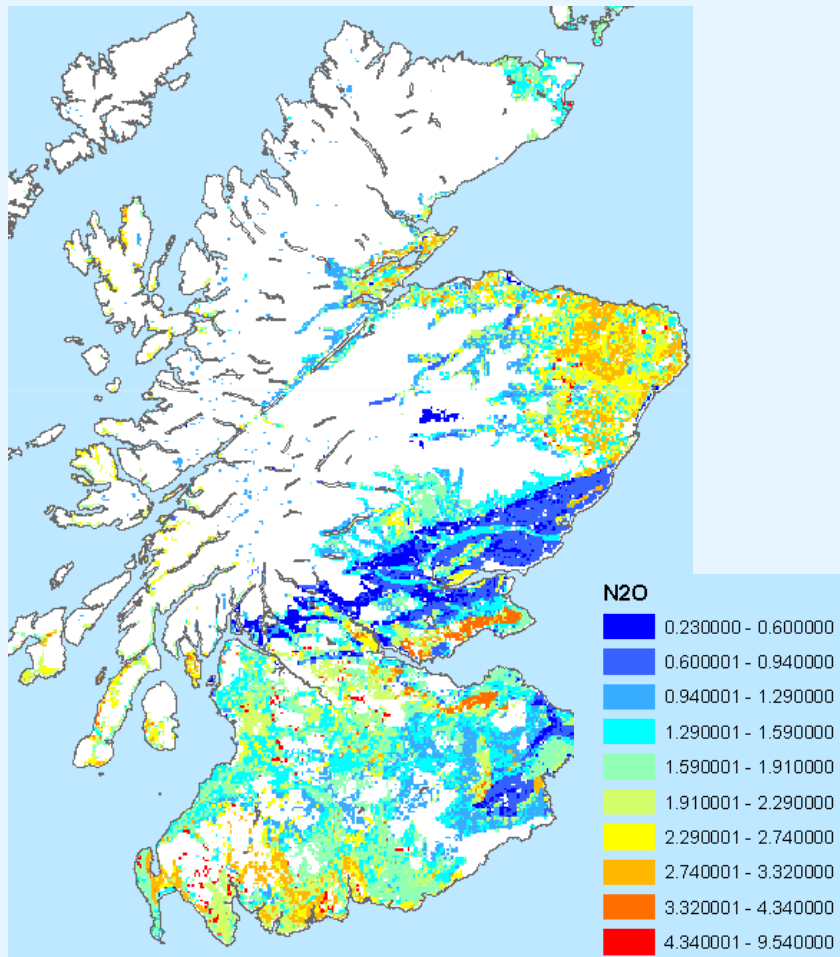
- Homogeneous Mapping Spatial Unit

- Soil type
- Slope
- Land cover
- Admin boundaries

- Agronomic practices
- Climate



Improving greenhouse gas accounting



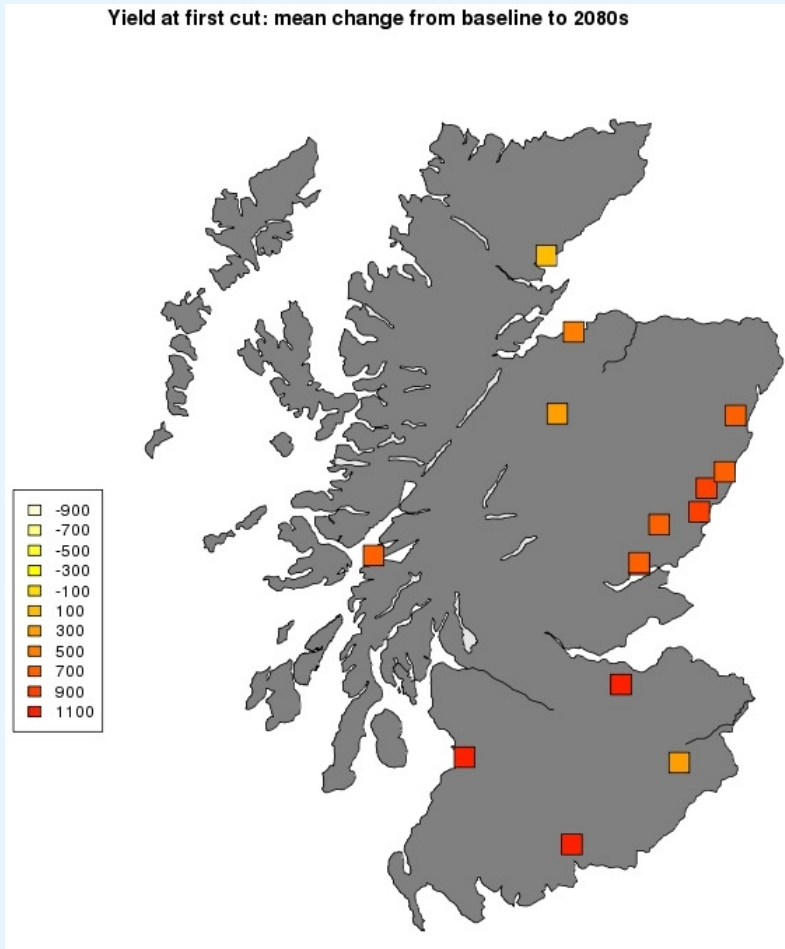
- Develop smart accounting systems that better reflect management interventions and climate

Topp *et al*, 2010

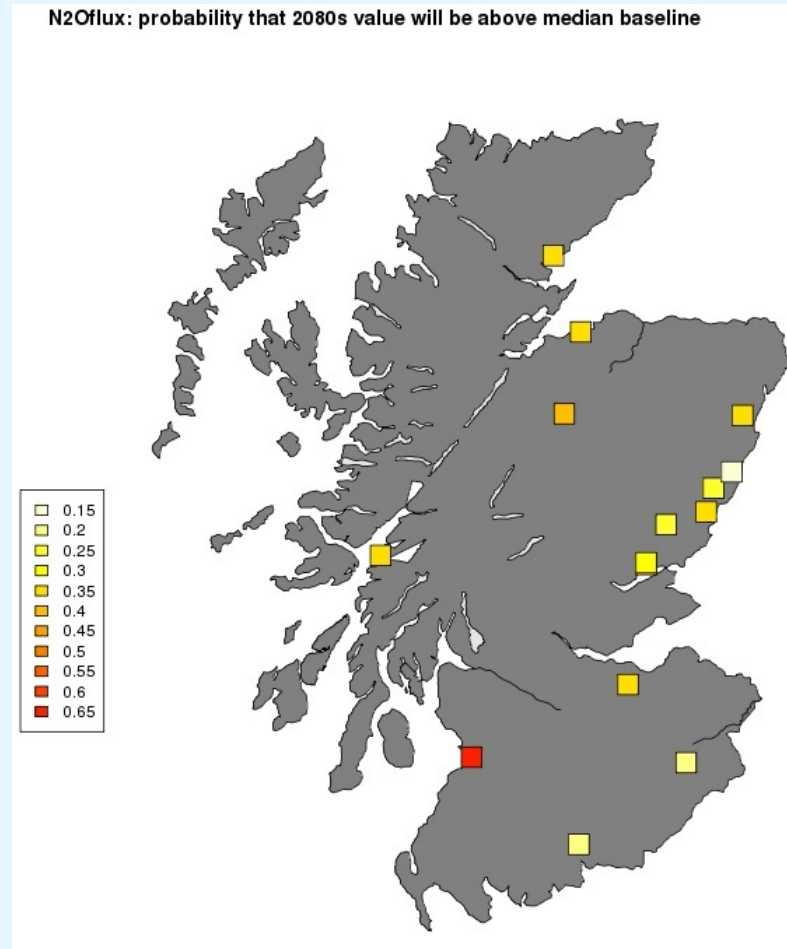
Responses to climate change



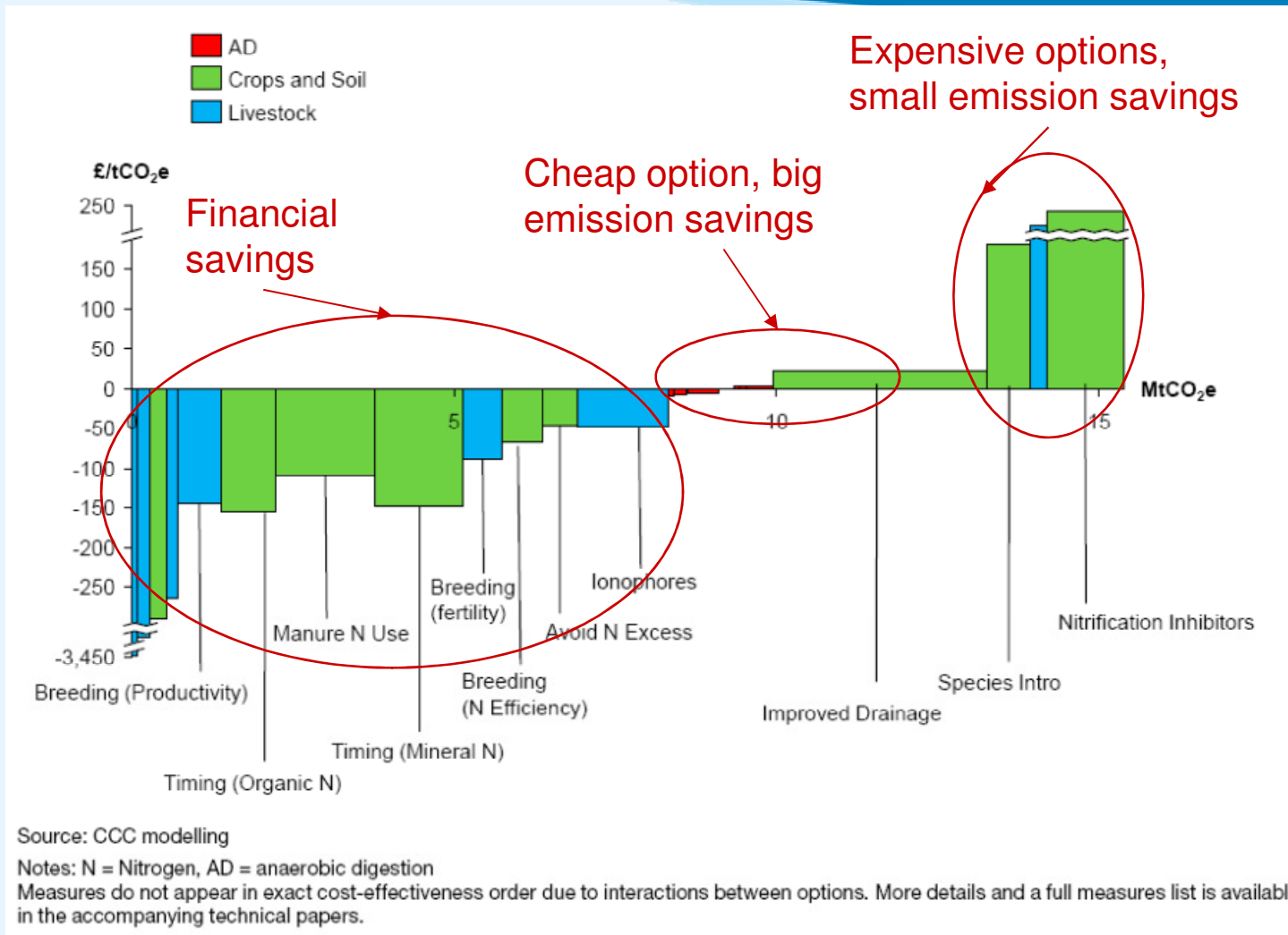
Yield at first cut: mean change from baseline to 2080s



N2Oflux: probability that 2080s value will be above median baseline



Mitigation Abatement Cost Curves



Building a low-carbon economy – The UK’s contribution to tackling climate change. 1st Report of the CCC, Dec, 2008

Carbon Management Centre



- To develop research education and advice on carbon management in the rural economy
- Contributing to SG policy led Centre of Expertise on Climate Change
- National research programme to improve inventory reporting and mitigation
- Farming for a Better Climate
- International cooperation



Good knowledge of

- Source processes
- Affects of individual driving variables
- Importance of climate and management
- The role of good management practice as a mitigation tool

Need more on

- Baseline emissions
- Interactions between management and climate
- Model validation and scaling
- Novel mitigation strategies: crop varieties and system design
- Farmer behaviour

Improving efficiency of resource use is central to reducing GHG emissions

Acknowledgements



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