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Modelling the effects of N deposition on semi-natural ecosystems

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**Analysis and simulation of the
Long-Term / Large-Scale interactions
of C, N and P
in UK land, freshwater and atmosphere**

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J Quinton *Lancaster U*

ME Stuart *BGS*

AP Whitmore *Roth Res*

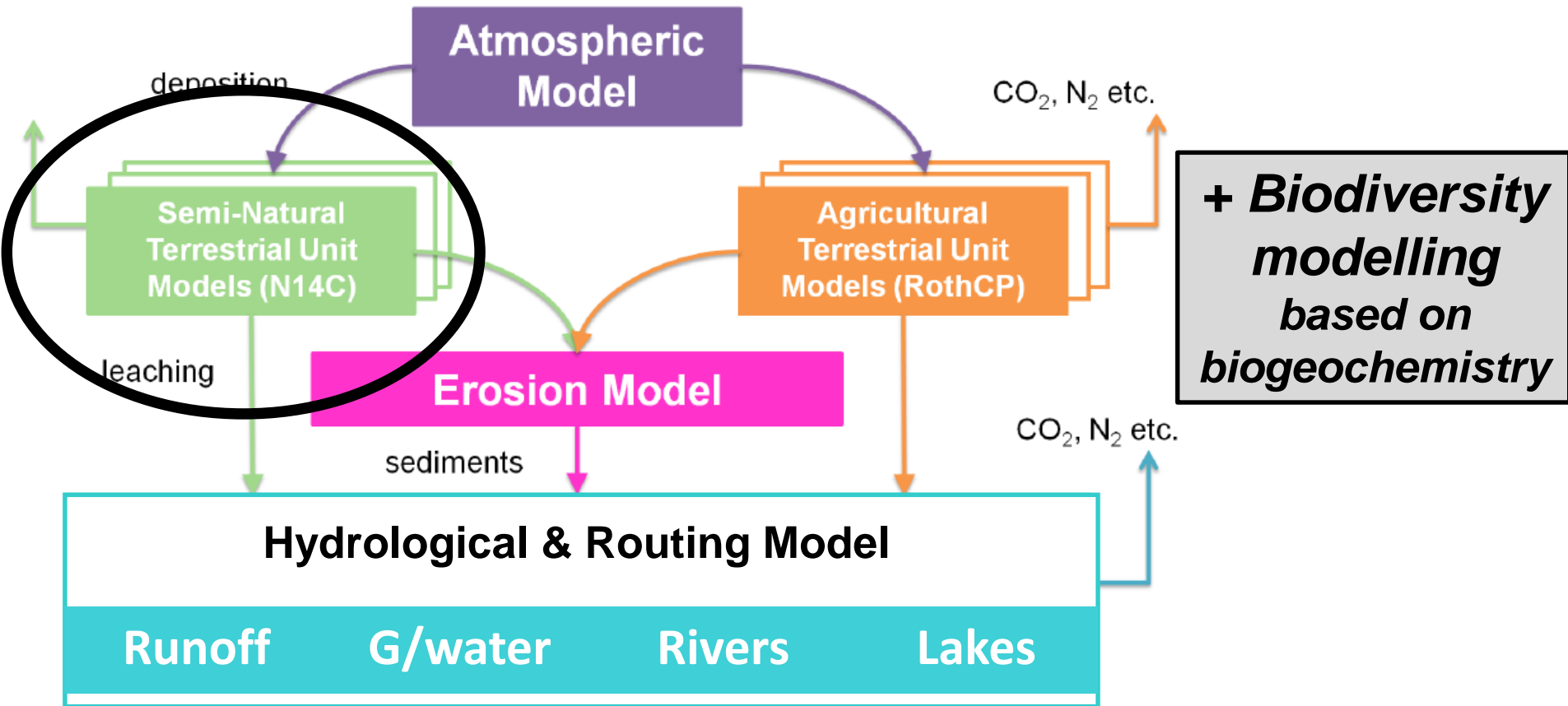
RC Helliwell *JHI**

NL Rose *UCL*

S Ullah *U Keele*

CL Bryant *NERC RCF*

LTLS activities

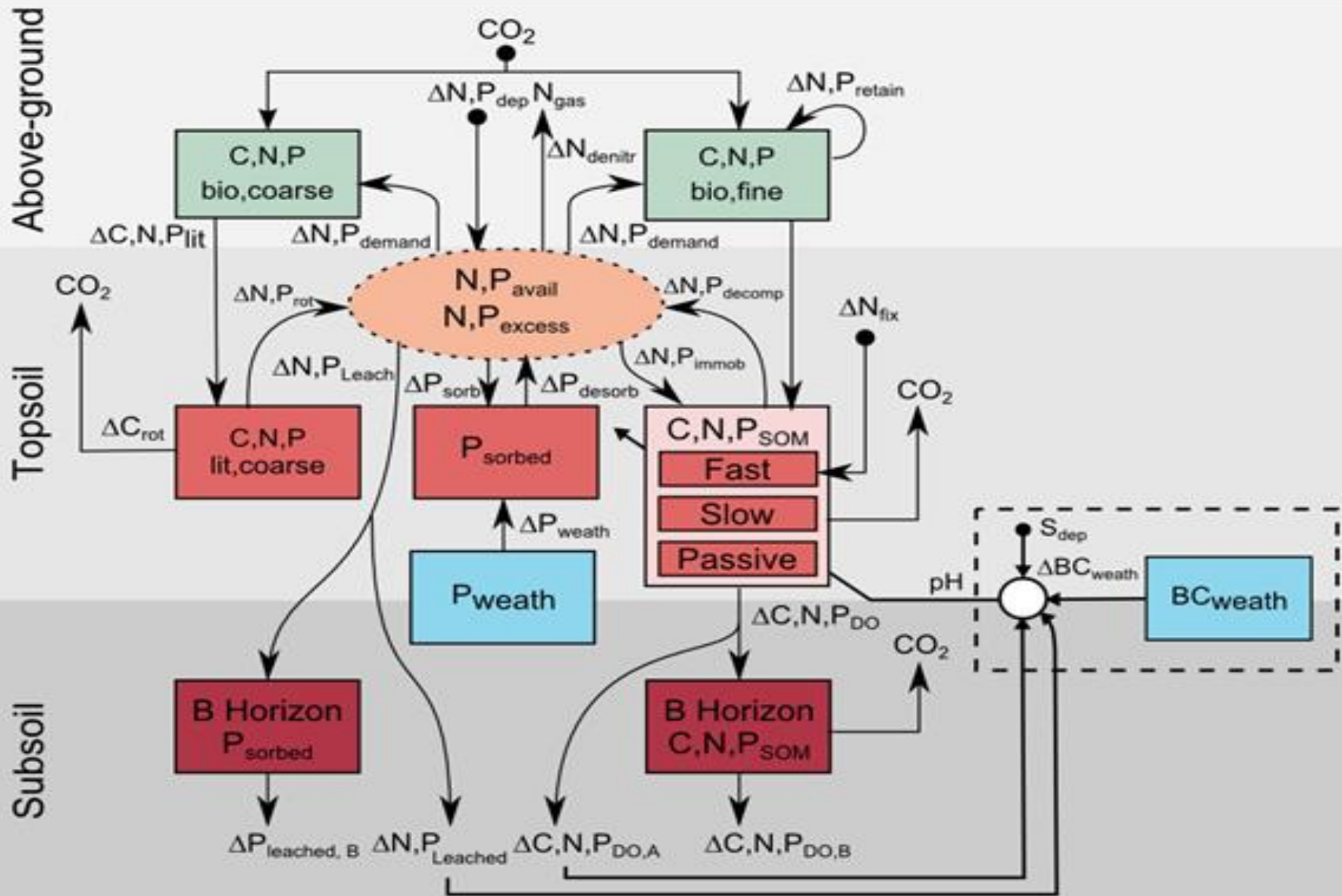


+ Measurements

soil denitrification
river transport (¹⁴C)
fuel experiments
NPP

soil survey (¹⁴C)
lakes
bracken survey

N14CP



N14CP - key points about P

- Acquisition of P
 1. weathering into soil
 2. (net) deposition to ombrotrophic peat
- Soil organic matter can immobilise & release P
- P is lost as DIP, DOP
- NPP depends on MAP, MAT, N, P, plant stoichiometry
- N fixation depends on P

N14CP - key points about C

- NPP depends on MAP, MAT, N, P, plant stoichiometry
- Soil organic matter comprises fast, slow & passive pools
- *model is constrained by radiocarbon*
- C is lost as CO₂ & DOC
- Soil organic matter can immobilise & release N & P

N14CP - key points about N

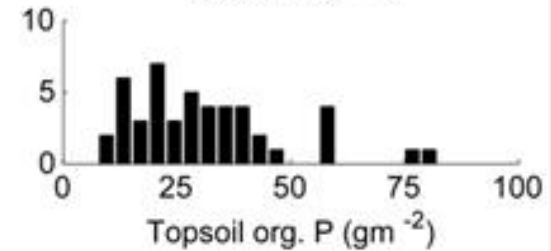
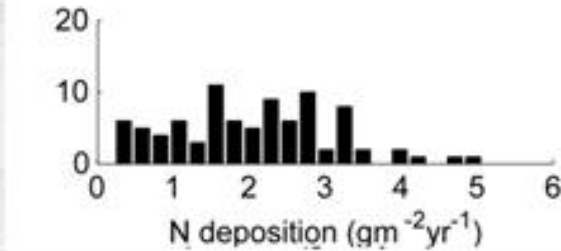
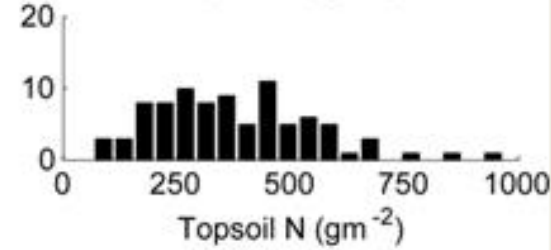
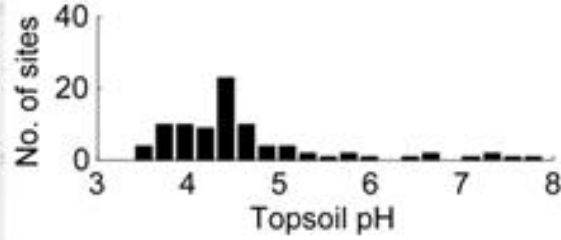
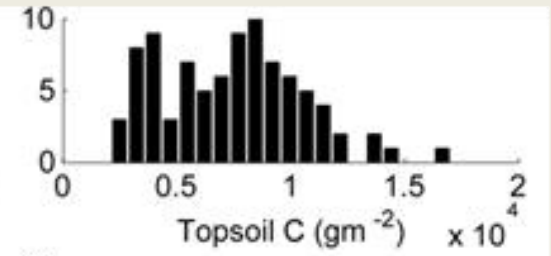
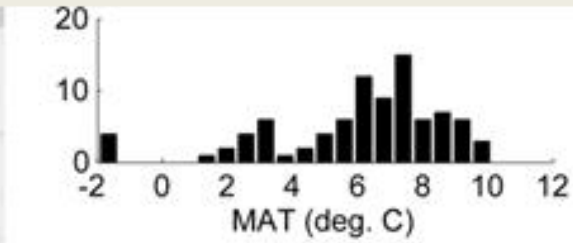
- Acquisition of N
 1. fixation, depends on P
 2. deposition
- Soil organic matter can immobilise & release N
- N is lost as gases, DIN, DON
- NPP depends on MAP, MAT, N, P, plant stoichiometry

Running N14CP

- MAP, MAT by site, with historical anomalies
- N & S deposition history by site
- Vegetation history: broadleaf / conifer / herbs / shrubs / peat
- Weathering: information, assumptions or calibration
- Soil formation starts at 10,000 BC

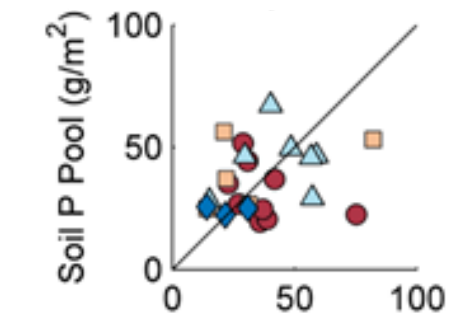
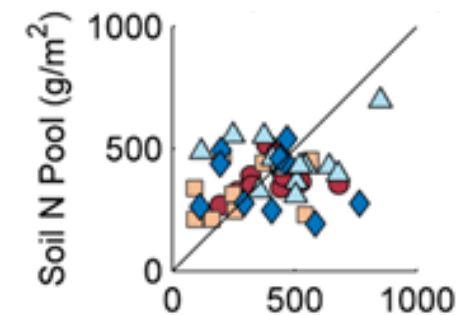
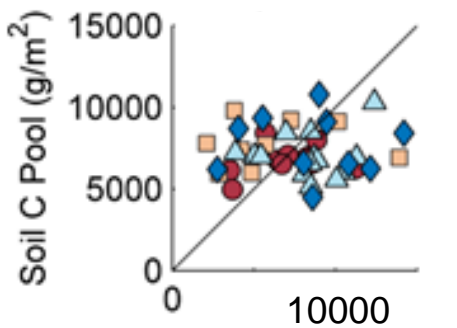
VERY SIMPLE!

Fitting N14CP: plot data

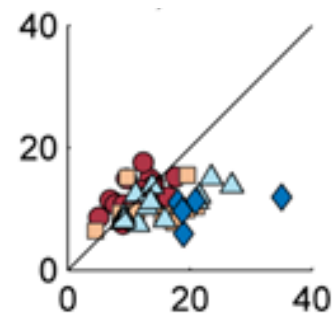
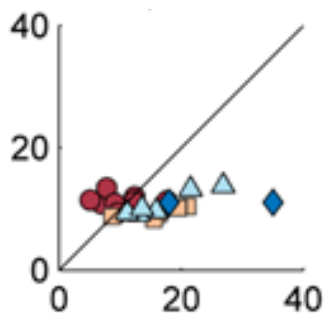
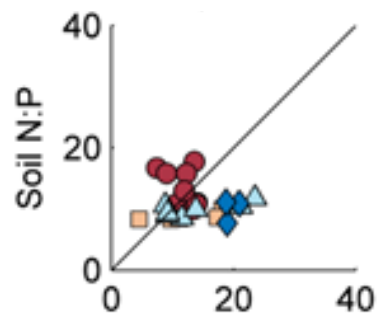
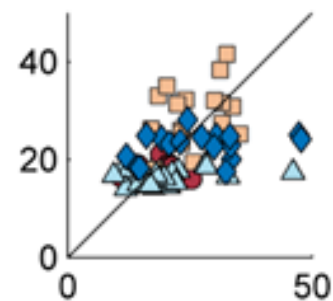
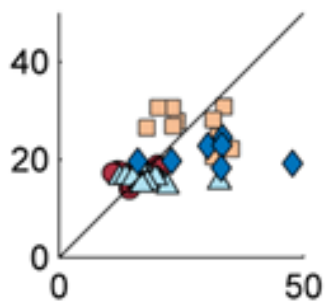
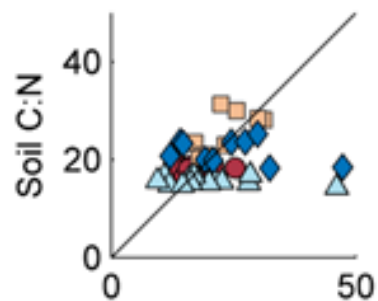
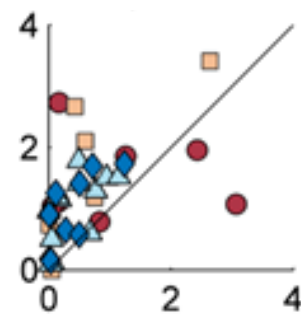
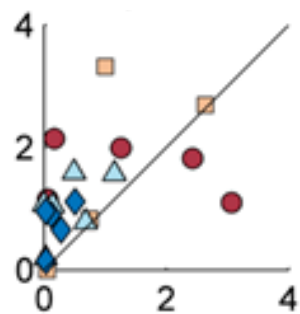
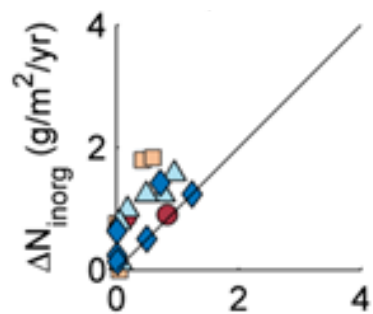


N14CP fitting results: soil C N and P pools

Generalised Model
Param. Sites



N14CP fitting results: iN leaching, CN, soil NP



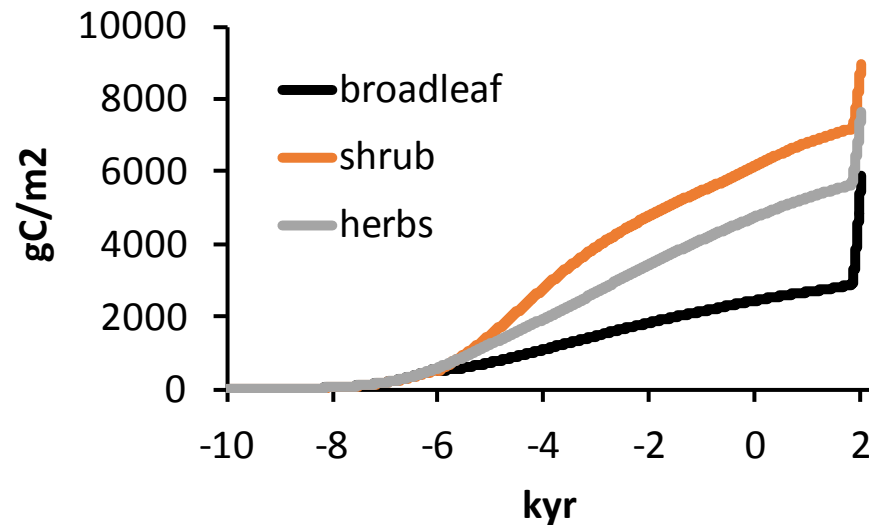
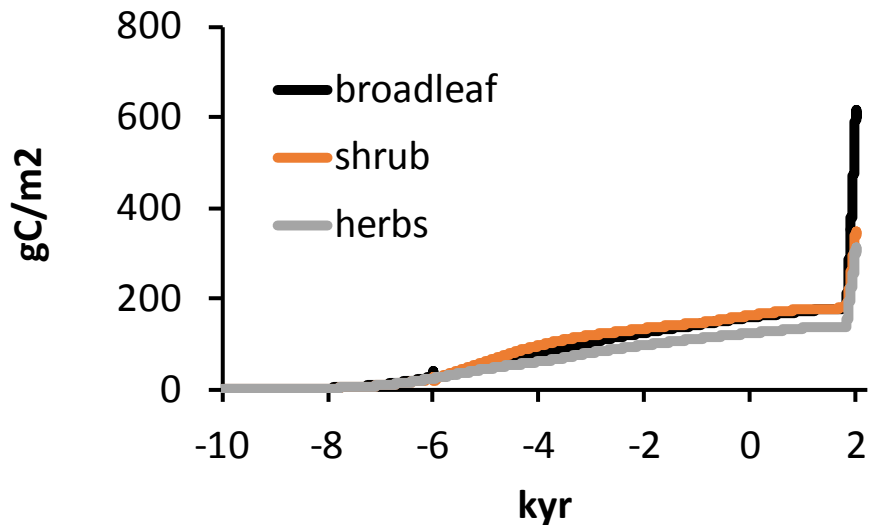
Limitations of the model

Average behaviour is OK

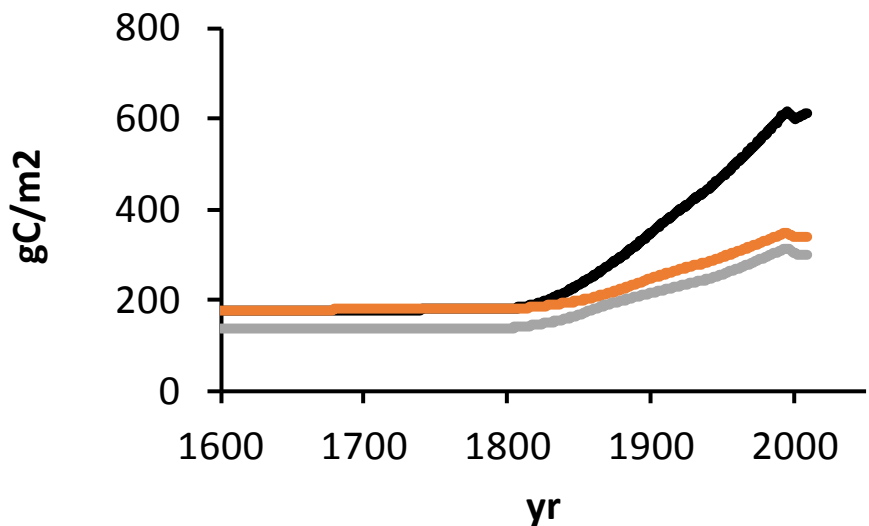
Inter-site variability poorly captured with available drivers

Possible improvement with a measure of (starting) P pool

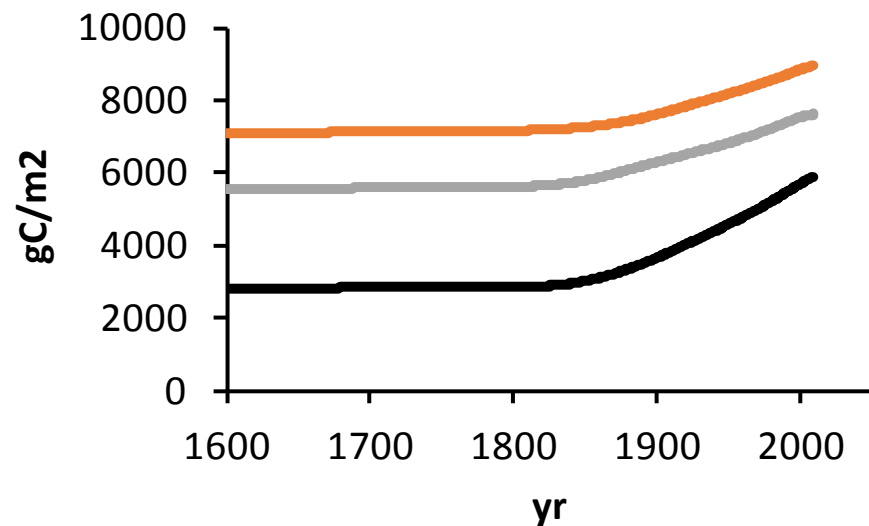
Semi-natural ecosystems / median climate and N deposition



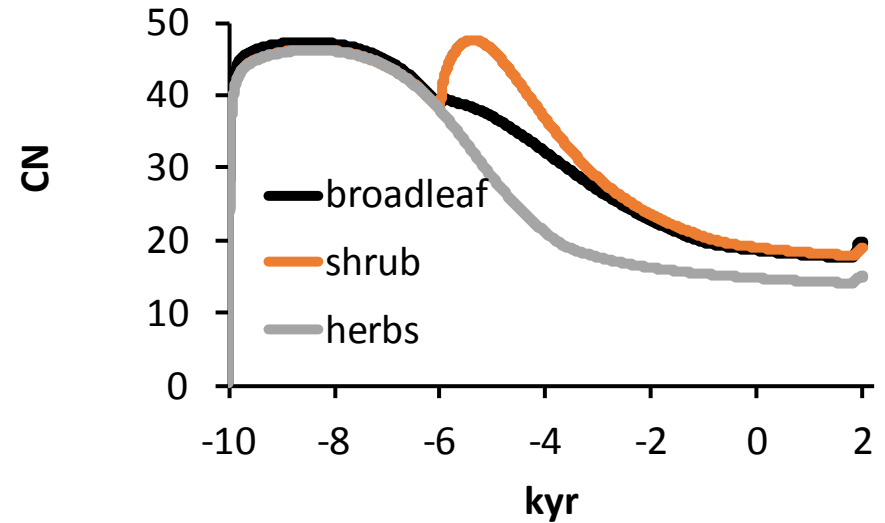
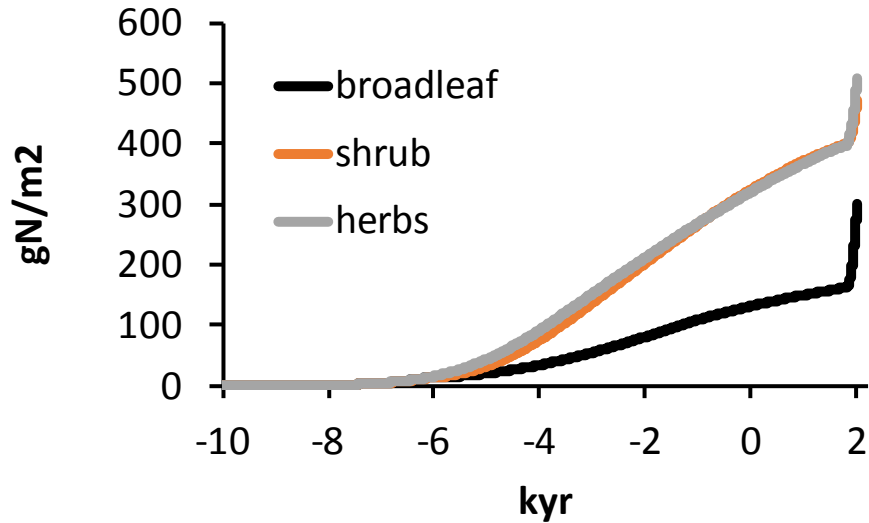
Net Primary Productivity



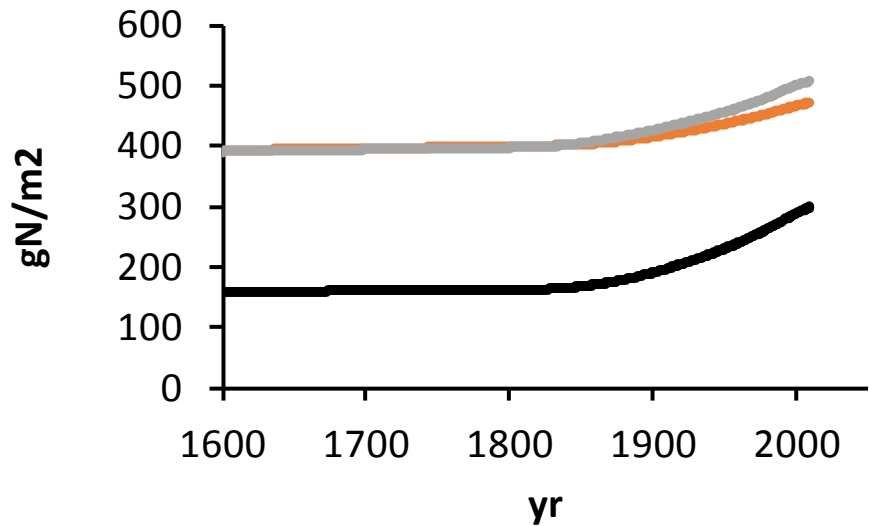
Soil organic C



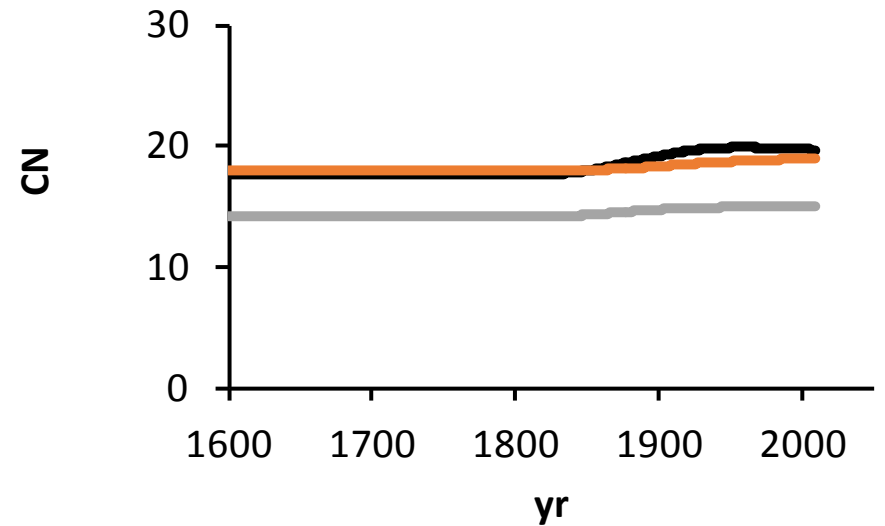
Semi-natural ecosystems / median climate and N deposition



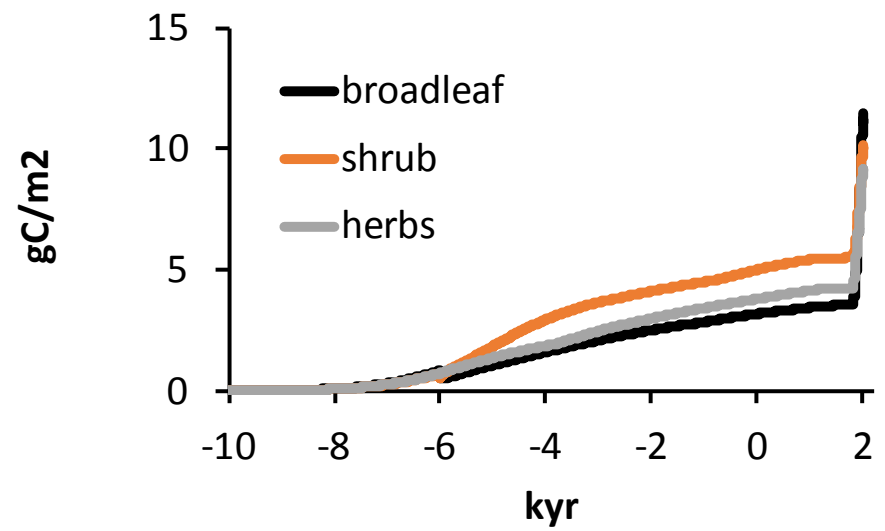
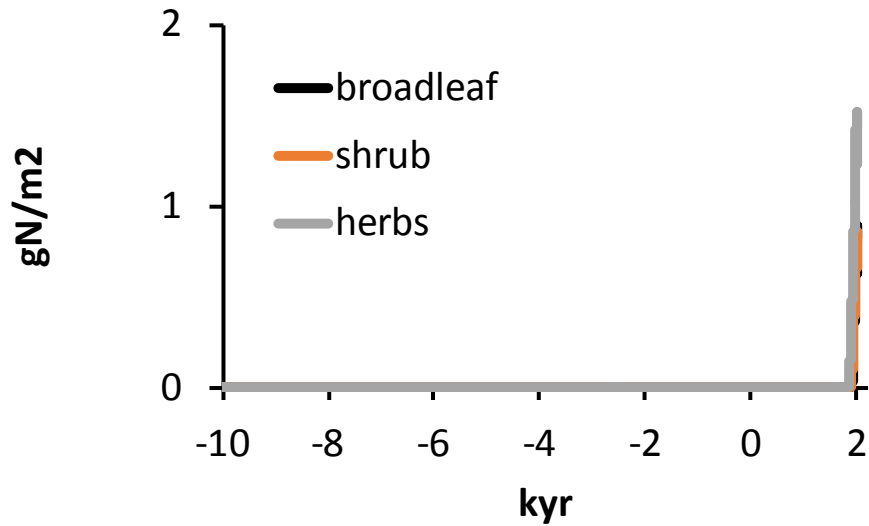
Soil organic N



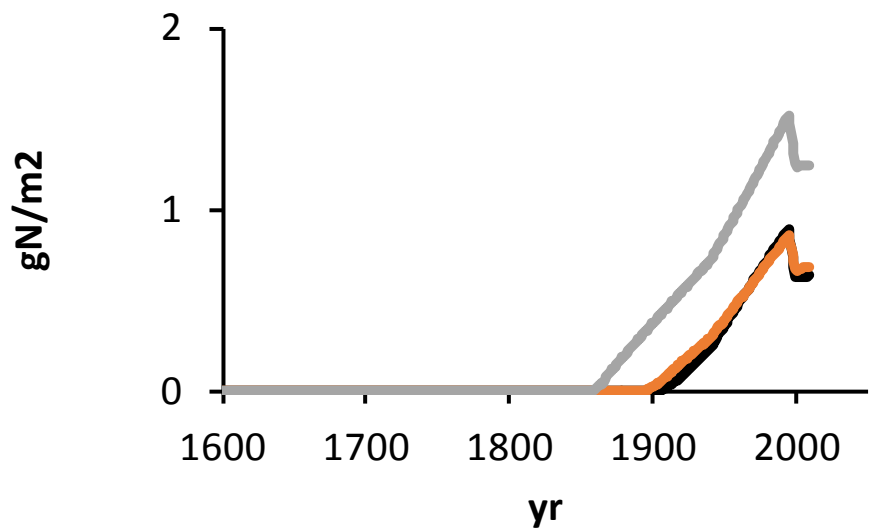
Soil CN ratio



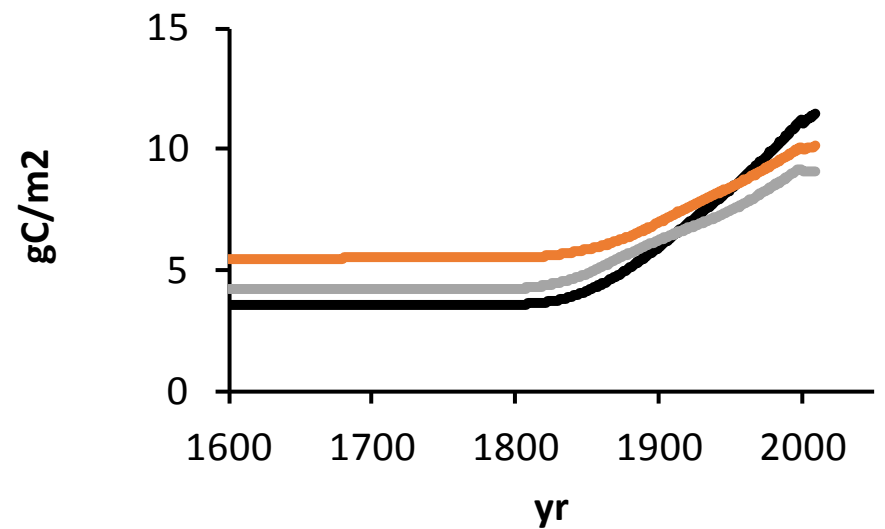
Semi-natural ecosystems / median climate and N deposition



Inorganic N leaching

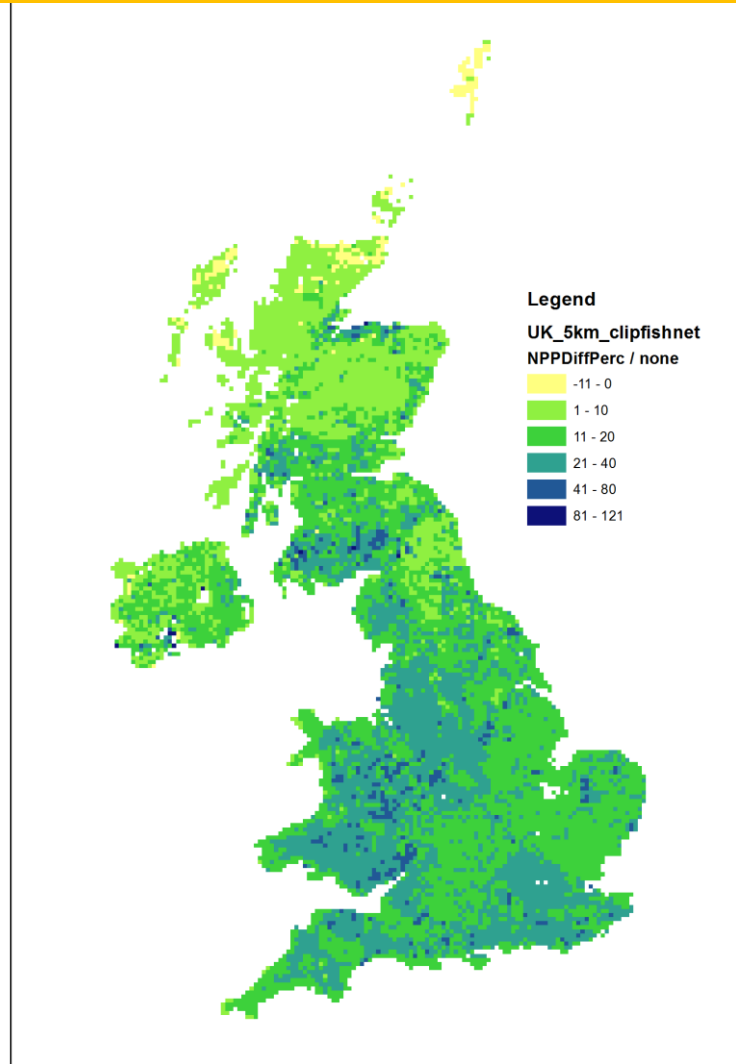


DOC leaching

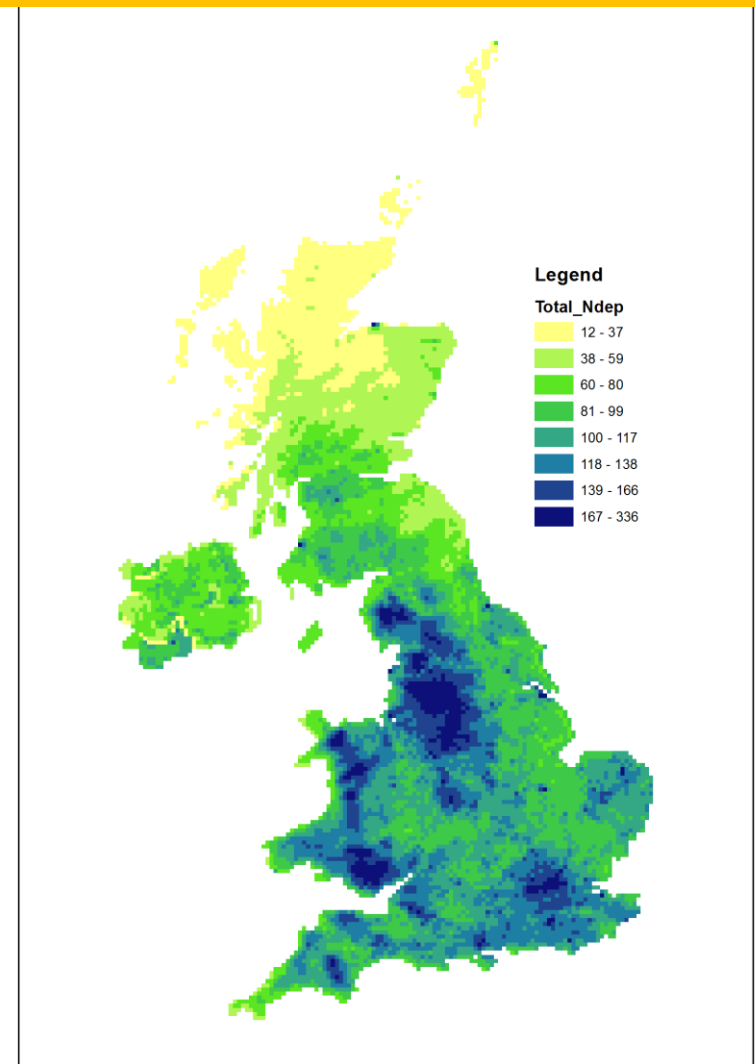


Net Primary Productivity & N deposition

Simulated % increase in NPP 1900-2000



Cumulative Ndep (g/m²) 1900-2000



Next steps

- **Linking biogeochemistry to terrestrial biodiversity**
S Jarvis, S Smart
- **Linking biogeochemistry to freshwater biodiversity**
G Simpson
- **Scenarios to 2100**
deposition modelling
semi-natural, agricultural, rivers, lakes
LTLS Modelling Team

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C Bryant (NERC Radiocarbon Facility)
AF Harrison (CEH)
R Tipping

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