



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

Concluding remarks

E Tipping *CEH*

JF Boyle *U Liverpool*

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*



POSTERS

Atmospheric modelling & measurements	Macronutrients in peat
<i>In situ</i> denitrification in soils	Erosion modelling
Terrestrial plant diversity	Groundwater
Riverine organic carbon (PO¹⁴C)	Wastewater
Lakes research and model	River biology
Net primary productivity	Scenarios

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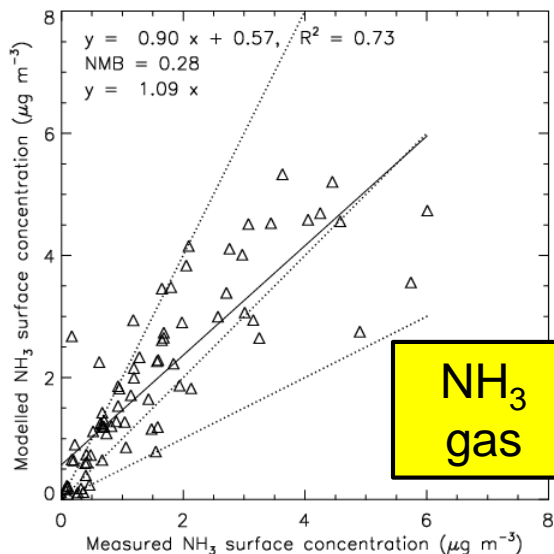
These and previous presentations

Stakeholder workshop reports

Posters for this meeting

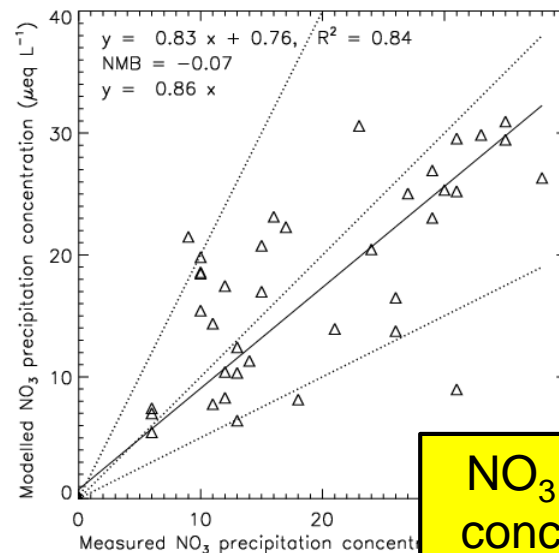
Published papers





NH₃
gas

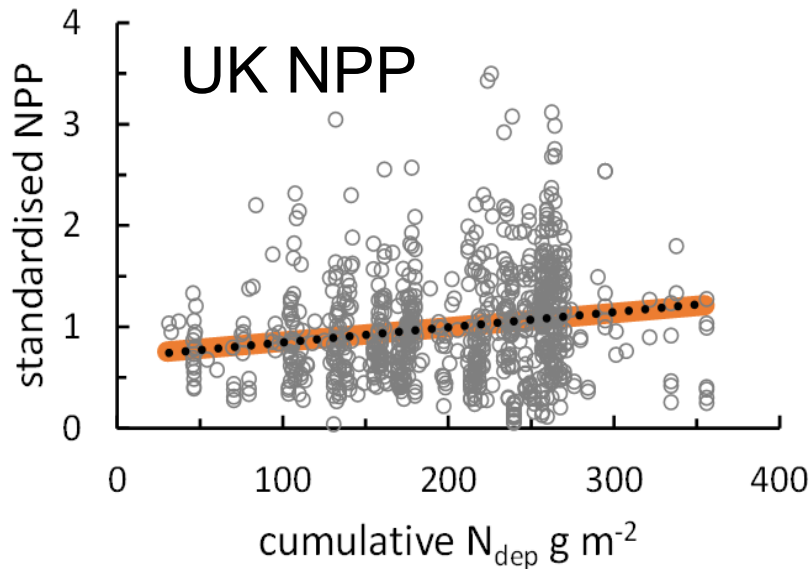
Modelled
vs
measured



NO₃
conc

Variable	Average ratio	r ²
NH ₃ gas	1.09	0.73
NO ₂ gas	0.79	0.94
NH ₄ conc	0.81	0.82
NO ₃ conc	0.86	0.84
NO ₃ particulates	0.77	0.88
HNO ₃ vapour	0.87	0.64

CEH
Edinburgh



Denitrification ($gN\ m^{-2}\ a^{-1}$)

New data ~ 1

Modelled ~ 0.3

Increase in woodland topsoil carbon

Topsoil resampling 1959-2010 (27 yrs)

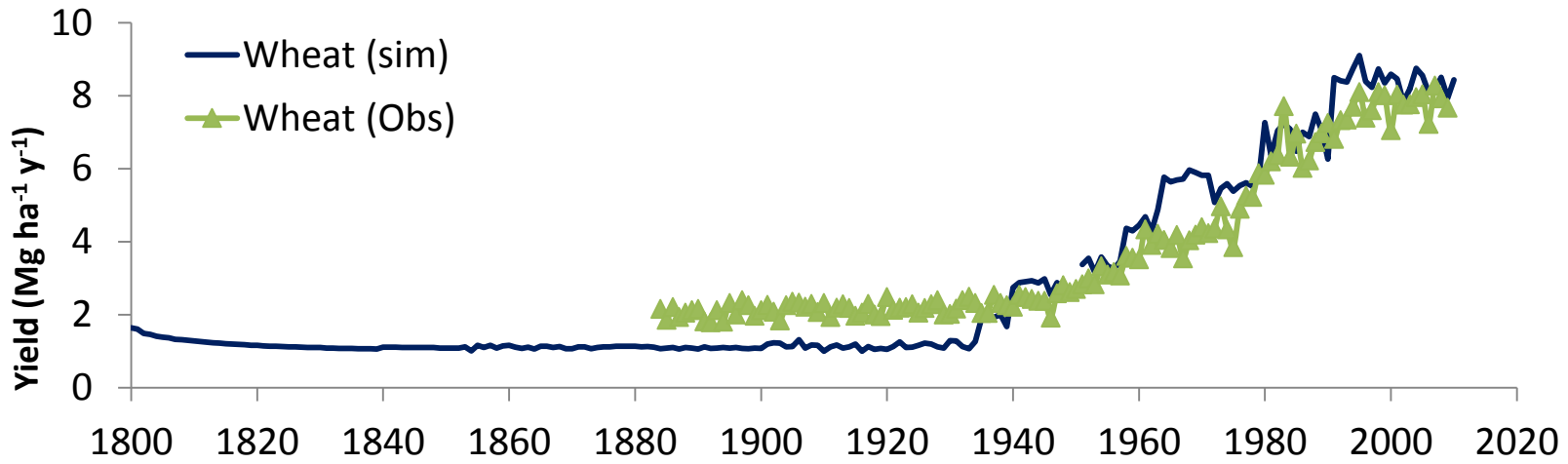
Average $[SOC]_2/[SOC]_1$

Model **1.05**

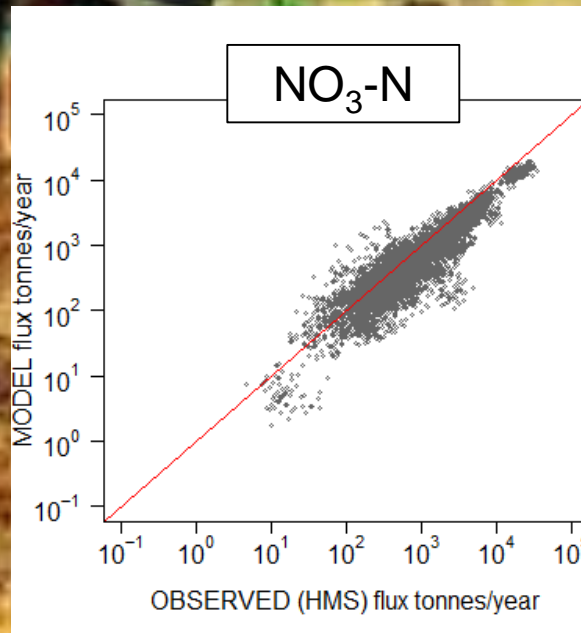
Obs **1.05** ($>1.00, p < 0.01$)

Lancaster University
Keele University
Cranfield University

CEH
James Hutton Institute



Riverine loads of $\text{NO}_3\text{-N}$, largely from agriculture



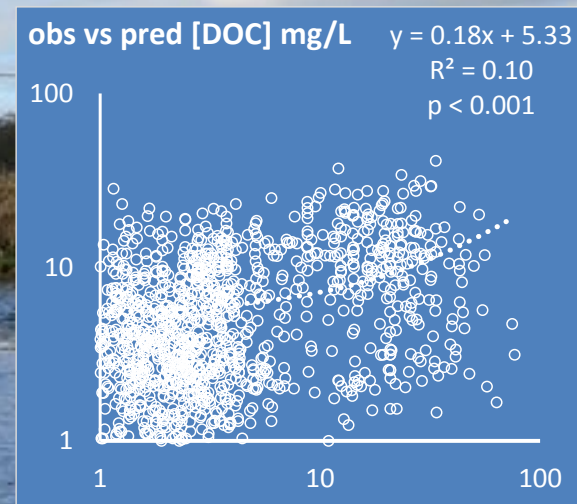
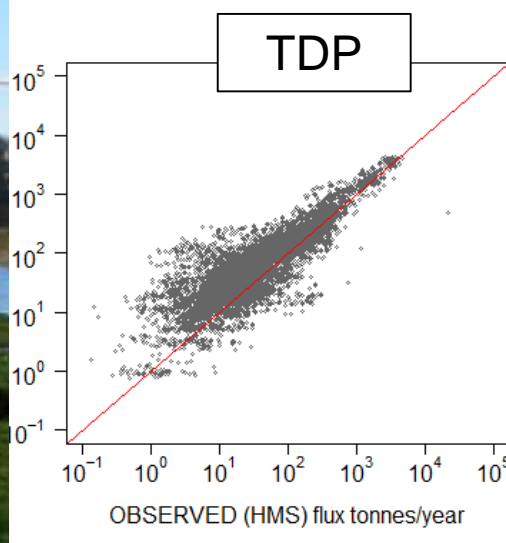
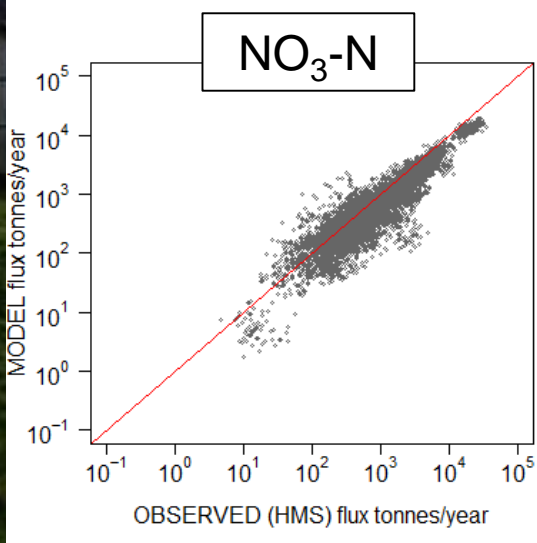
Rothamsted Research
CEH

Model testing: waters

Upland surface waters

mg/L	<i>n</i>	obs	pred
DOC	1246	6.6	6.8
NO ₃ -N	1299	0.17	0.27

Riverine loads t/yr

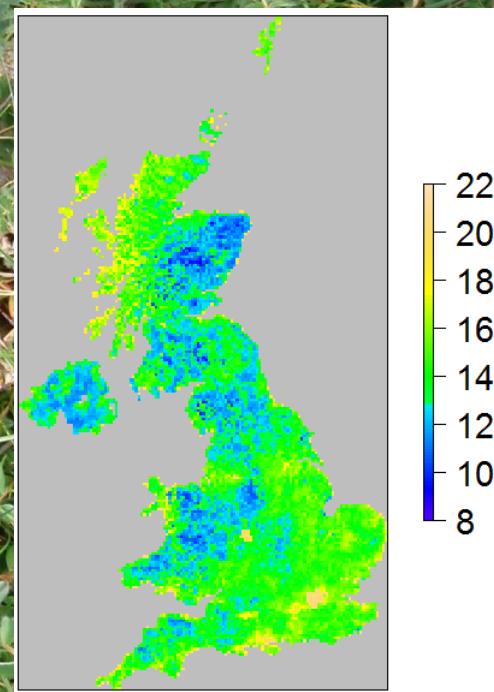
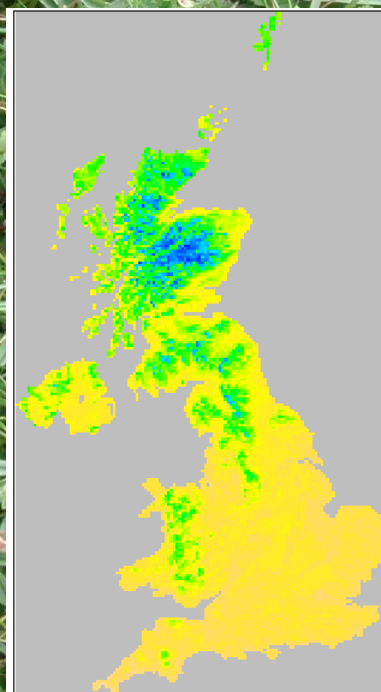
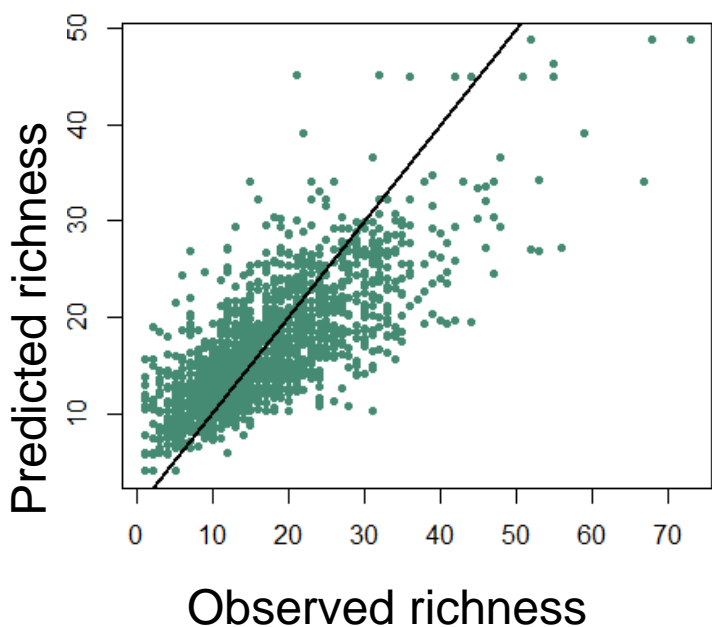


Vascular species per 4 m² : ↓NPP, ↑pH, ↑mean annual temp

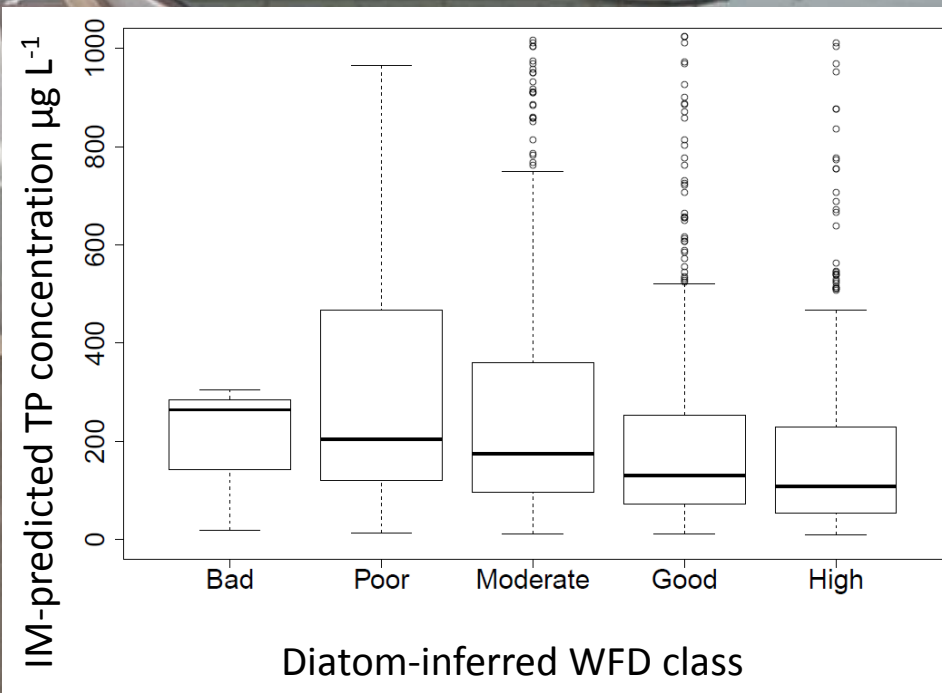
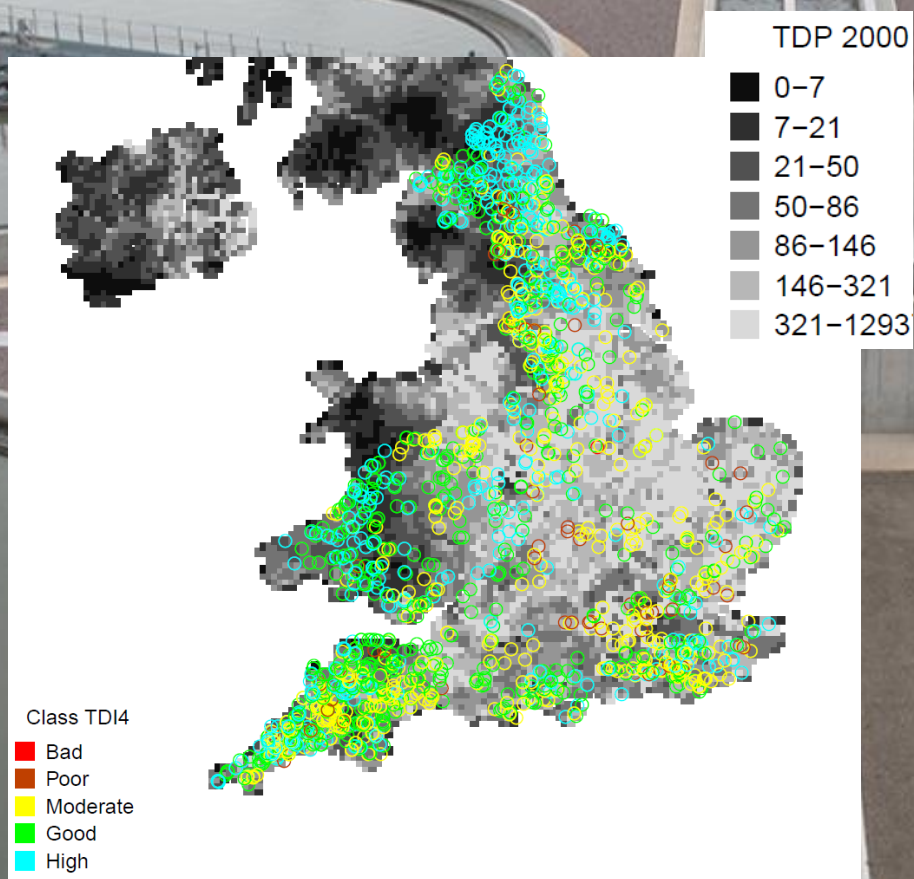
Preliminary model

1800

2000



River P concentrations: prediction with IM and links to ecological quality.



CEH, Bowburn Associates
Environment Agency

Summary

Semi-natural terrestrial ecosystems

Denitrification
Soil survey including ^{14}C
Macronutrients in peat
N14CP model
Underlying importance of P
Ndep effects on NPP, soil C, biodiversity
Erosion model

Atmosphere

Long-term deposition model
P deposition review

Agricultural ecosystems

Soil survey including ^{14}C
RothCNP model
Erosion model

Groundwater

P leakage from pipes
Aquifer delay model

Rivers

Wastewater analysis
POC age
Nutrient processing model

Lakes

New long-term data
Nutrient processing model

Integrated model

Source apportionment
Loads to the sea
P and WFD classes

Scenario analysis

Development of scenarios
Preliminary runs

Completion of the analysis: model testing
IM outputs
scenarios

New science National Capability projects
applications elsewhere
model improvements

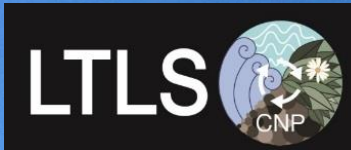
Working with stakeholders / scenarios

+ Measurements

soil denitrification
river transport (¹⁴C)
fuel experiments
NPP

soil survey (¹⁴C)
lakes
bracke
peat s





Thank you
for listening

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Radiocarbon Facility
(Environment)